TECHNICAL REPORT

Ice Bulletins for the Antarctic Shipping Season 2019 – 2020

Prepared by Dr Jan L Lieser

Antarctic Meteorology Section — Bureau of Meteorology

Ice Bulletins for the Antarctic shipping season 2019–2020

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Executive summary

The Ice Bulletins compiled in this document are weekly reports on ice conditions for predominantly East Antarctica, including sub-weekly updates. They were prepared to support ship operations in East Antarctica during the 2019/2020 shipping season. These bulletins were primarily used to inform the Australian Antarctic program.

Throughout the shipping season, the focus of individual bulletins shifts with the main purpose of respective voyages of the Australian Antarctic research and supply vessel *Aurora Australis*. The Antarctic voyages of RSV *Aurora Australis* in the 2019/2020 season were (totalling more than 65 500 km, more than 35 300 nautical miles):

No.	Depart port	Main Purpose	Return to port
V1	25/10/2019	Davis Station resupply	27/11/2019
VMI	01/12/2019	Dumont D'Urville Station resupply; Macquarie Island personnel changeover	16/12/2019
V2	22/12/2019	Casey Station resupply	17/01/2020
V3	21/01/2020	Mawson Station resupply; Davis Station summer retrieval	06/03/2020

In 2019, total sea-ice cover around the Antarctic continent was mostly below the average of the 40-year satellite-based record. In October 2019, sea-ice concentration recovered to close-to average conditions for that time of the year before rapidly collapsing during November in the western part of the Australian Antarctic Territory (AAT) and to below average in the eastern part of the AAT. Further, the eastern Weddell Sea and the Ross Sea experienced a shortened sea-ice season (number of days with sea-ice cover in a given area). Only small regions of the offshore Bellingshausen Sea, eastern Amundsen Sea and the northern part of western Weddell Sea did show a slightly longer sea-ice season, which is in contrast to the previous trend.

The annual sea-ice extent minimum was 2.44×10^6 km^2 and observed on 28 February 2019, the seventh lowest on record. On the same day, the annual minimum sea-ice area was also measured at 1.62×10^6 km^2, the eleventh lowest on record. The annual sea-ice extent maximum was 18.46×10^6 km^2 and observed on 30 September 2019, the tenth lowest on record. However, the annual maximum sea-ice area was observed already on 03 September 2019 at 14.78×10^6 km^2, a value of the lower third of the 40-year record.

The sea-ice extent of the year 2019 in context: up until 2014, pan-Antarctic sea-ice extent was on a slightly upwards trend and reached its highest recorded extent on 20 September 2014. It has since then turned to record minimum conditions when it reached the lowest recorded extent on 01 March 2017. Since then, it appears to be recovering slightly even though it is still below the average of the 40-year observation period.

During 2019, notable new large tabular icebergs calved off the Ninnis Ice Shelf (C-36 in January), the Amery Ice Shelf (D-28 in September) and the Getz Ice Shelf (B-47 in October).

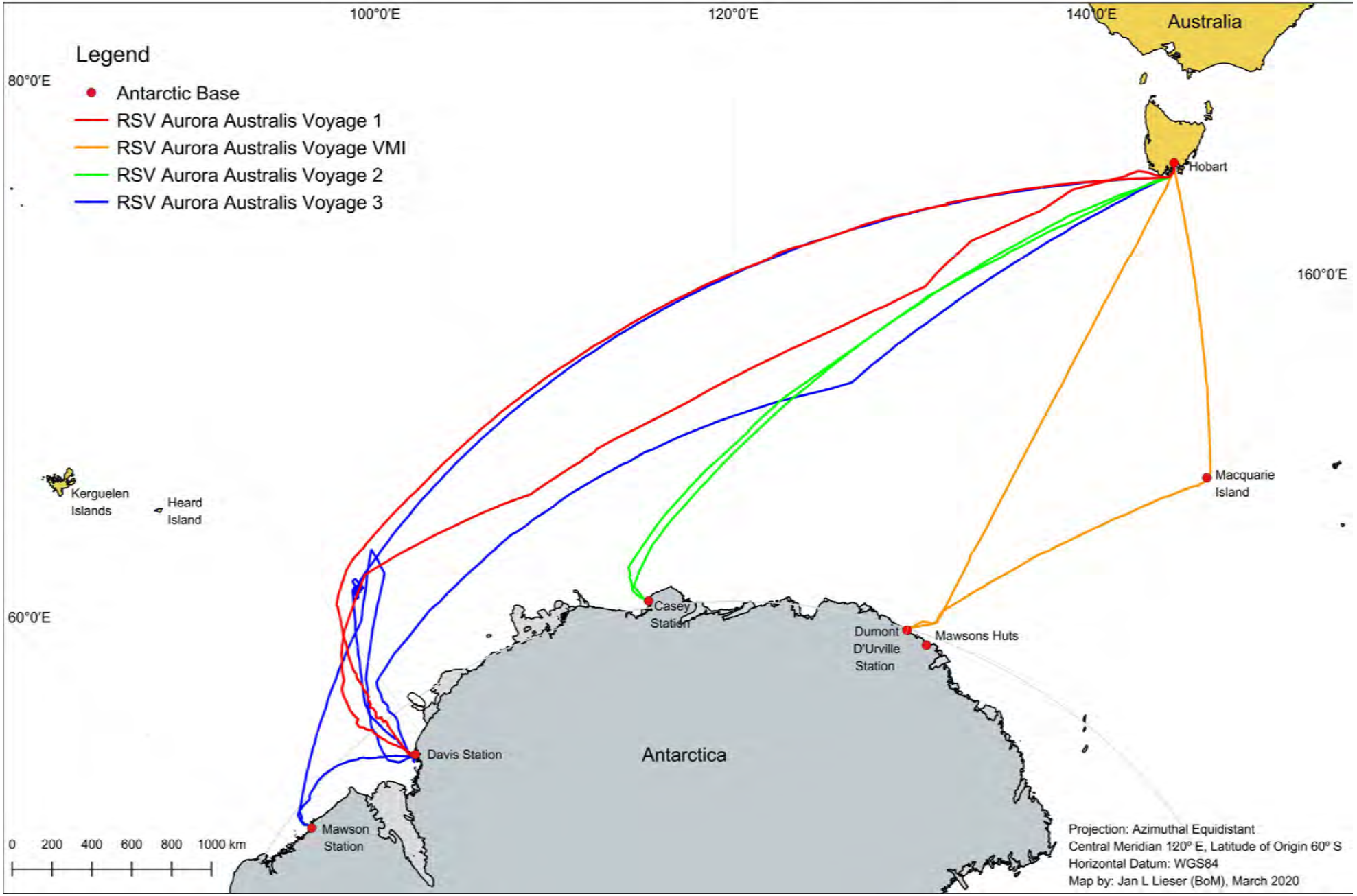
About this compendium

This compilation is the first volume of Ice Bulletins prepared by the Antarctic Meteorology Section's Ice Service at the Australian Bureau of Meteorology. They constitute a continuation of previous years' Sea Ice Reports that were provided by the Sea Ice Service of the Antarctic Climate & Ecosystems Cooperative Research Centre at the University of Tasmania.

The first bulletin of this compilation was issued on 04 September 2019, after the 2018/2019 Australian shipping season ended in March 2019 and a transition period during austral winter.

Previous annual summary volumes are available online (filed under 'Report') at: https://eprints.utas.edu.au/view/authors/Lieser=3AJL=3A=3A.html

ICE BULLETINS 2019/2020 VOYAGES



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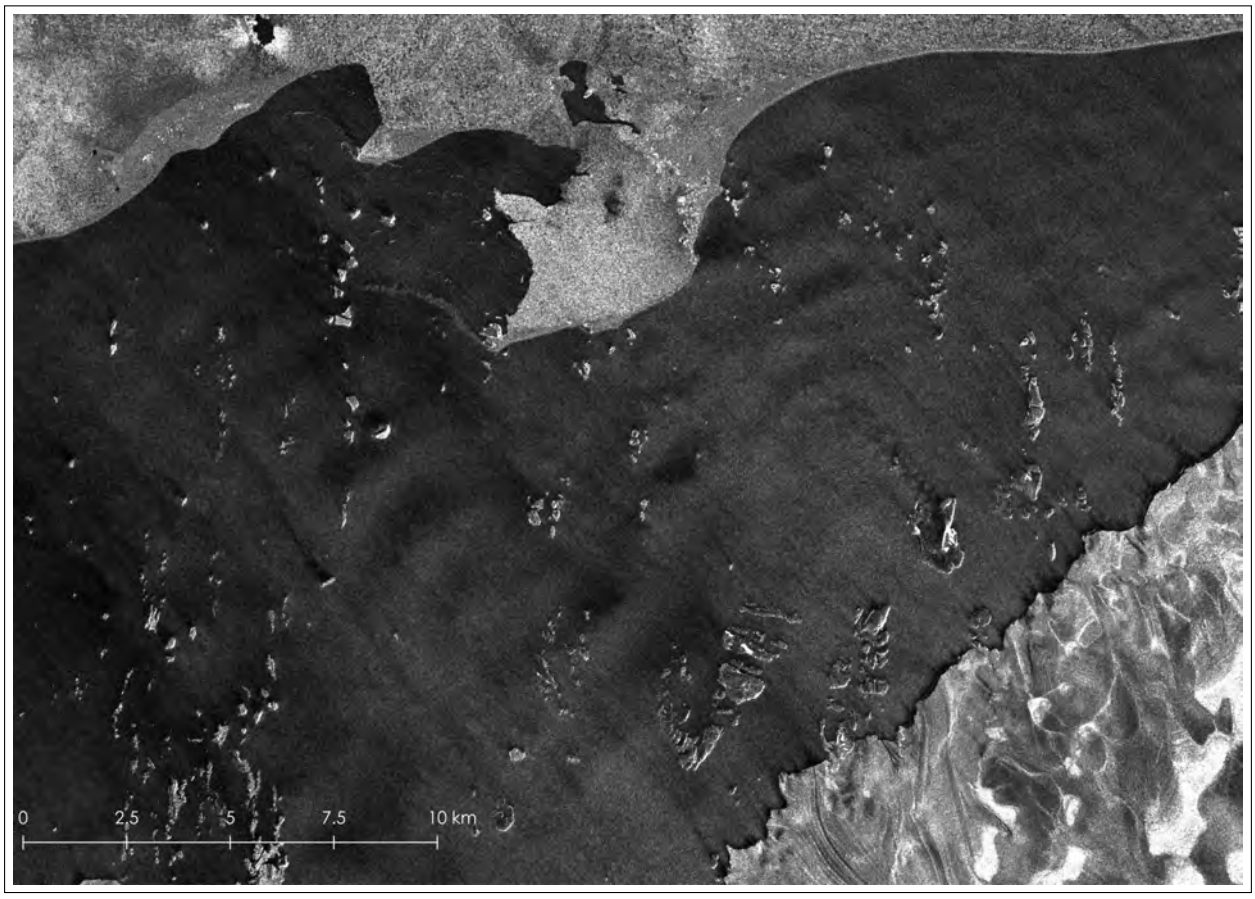
Frequently used acronyms

AMSR-2 [1]	Advanced Microwave Scanning Radiometer 2
BoM	Bureau of Meteorology (AUS)
ESA	European Space Agency
EW	Extra Wide swath (a SAR mode)
GMRT	Global Multi-Resolution Topography
IBCSO	International Bathymetric Chart of the Southern Ocean
ICDC	Integrated Climate Data Centre, University of Hamburg (GER)
IW	Interferometric Wide swath (a SAR mode)
JAXA	Japan Aerospace Exploration Agency
MODIS [2]	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration (USA)
SAR	Synthetic Aperture RADAR
TSX	TerraSAR-X satellite, operated by German Aerospace Center (DLR)
USGS	United States Geological Survey (USA)
VIS	Visible Spectrum
VNAA	Call sign: Research & Supply Vessel *Aurora Austalis* (AUS)



Katabatic wind bounces off Mawson Station roughening the ice-free ocean surface of the polynya offshore.

TerraSAR-X scene acquired 05/02/2020 at 23:56 UT and provided by KSAT/Astrium Infoterra.

[1] The AMSR-2 instrument is onboard the GCOM-W1 satellite, which is operated by JAXA.

[2] The MODIS instrument is operational on two satellites: AQUA and TERRA, both operated by NASA.

Ice Bulletin: Scullin Monolith & Murray Monolith

Issued: Wednesday 4th September 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Nearing the maximum annual sea-ice extent around Antarctica, this bulletin describes current conditions at two sites east of Mawson Station near Scullin Monolith and Murray Monolith.

Figure 1 shows a high-resolution overview SAR scene off Mawson Coast west of Cape Darnley. The approximate location of the scene of Figure 2 is indicated by the yellow/black frame.

The entire coastline is covered by fast ice, which is outlined by the red solid line. Polynyas are present off same parts of the fast-ice edge and new ice is forming in these regions of open water. The fast ice has formed at different times during the current sea-ice season, which results in different local properties reflected by different textures in the grey-scale representation of the SAR scene. Between many small to medium-sized icebergs grounded offshore, a larger one is at 67° 01’ E and 67° 08’ S.

Based on analysis from previous seasons, fast ice in the region tends to break out between late December and early January but has been also breaking out as early as mid-November.

Figure 2 shows a very high-resolution panchromatic image of the vicinity of the monoliths. In this figure, fast ice of different formation times (relative to each other) is marked by a dashed and a dotted red line. Different surface structures are clearly distinguishable. North of the monoliths, dark and fan-like patterns are most likely caused by dust that was blown off the exposed rock of the monoliths and has been partly covered by subsequent drifting snow. These patterns can also be identified in the SAR scene (Figure 1) by a brighter shading, which indicates higher surface roughness. When the snow cover of those patches remains thin, the darker dust will absorb sunlight at an increased rate locally, which will aid accelerated deterioration of the ice in those regions.

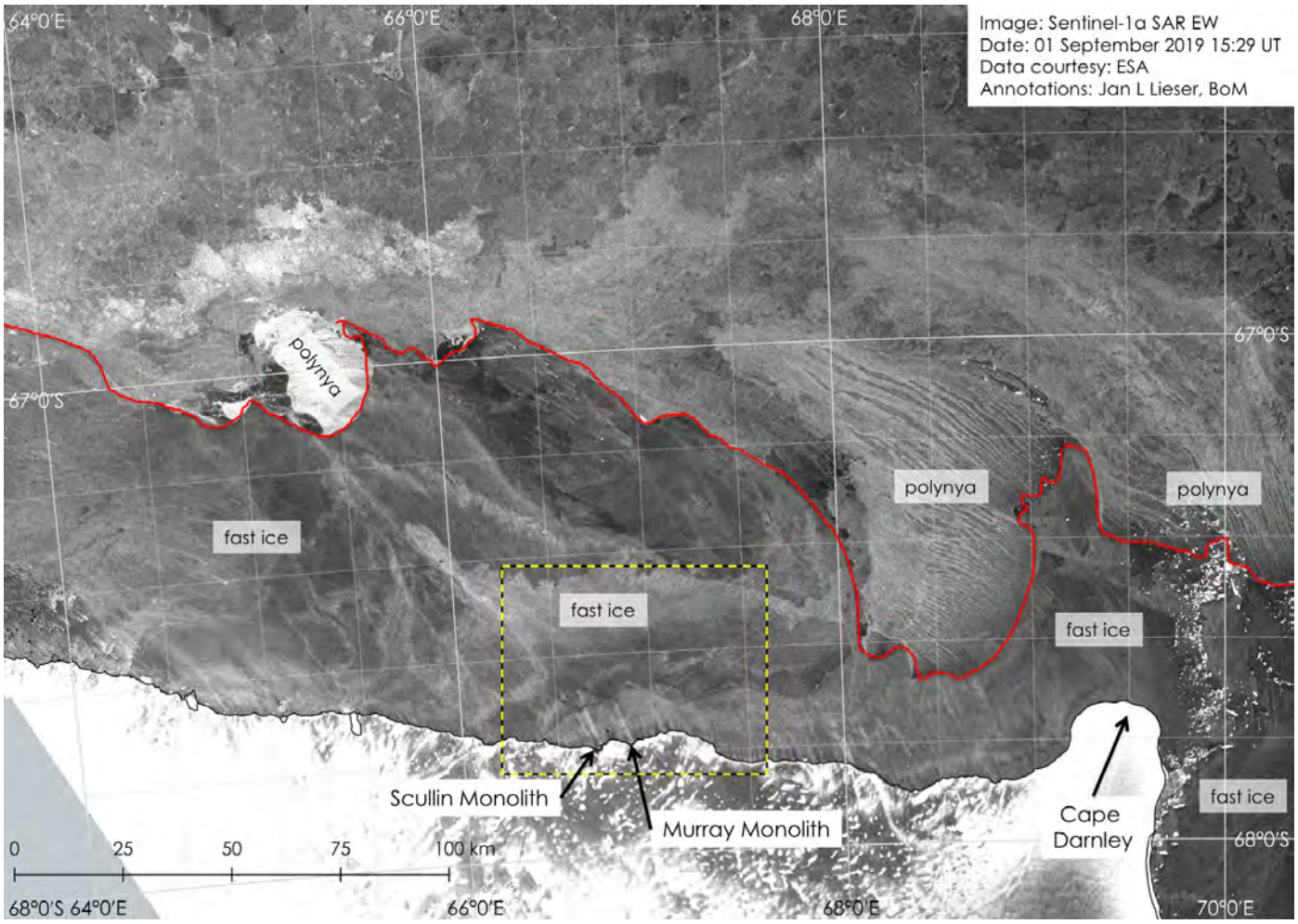


***Figure 1**: Sentinel-1a SAR EW scene acquired 01/09/2019 at 15:29 UT and provided by PolarView.*

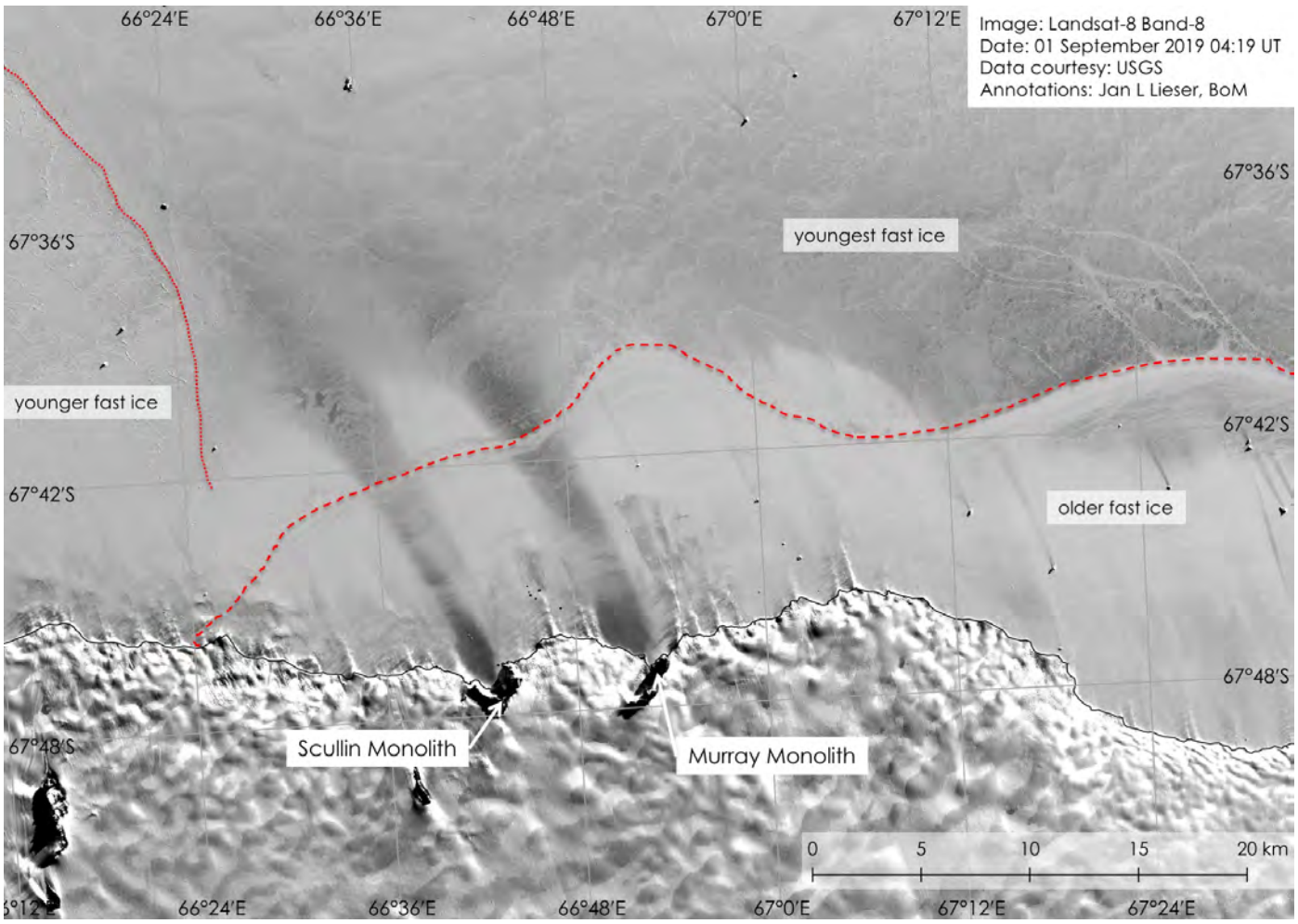


***Figure 2**: Landsat-8 Band-8 (panchromatic) scene acquired 01/09/2019 at 04:19 UT and provided by USGS.*

Ice Bulletin: Antarctica

Issued: Tuesday 10th September 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Close to the maximum annual sea-ice extent around Antarctica, this bulletin describes current sea-ice conditions around the continent in general.

Figure 1 shows the pan-Antarctic sea-ice concentration anomaly based on passive microwave remote sensing data.

After reaching the annual minimum sea-ice extent at the end of summer in late February, autumn and winter have shown consistently very low sea-ice extents. Monthly sea-ice extent values have been the third lowest on record (fourth lowest in February and June) and sea-ice advance has been lagging behind by several weeks compared to the long-term average throughout the growth season. In August, however, large scale environmental conditions have allowed for a recovery much closer to median conditions, but the overall extent remains still below average.

In August 2019, two large regions of particularly low extent and therefore a sea-ice edge further south than typical were in East Antarctica (between 50º E and 100º E) and in the Ross Sea and Amundsen Sea.

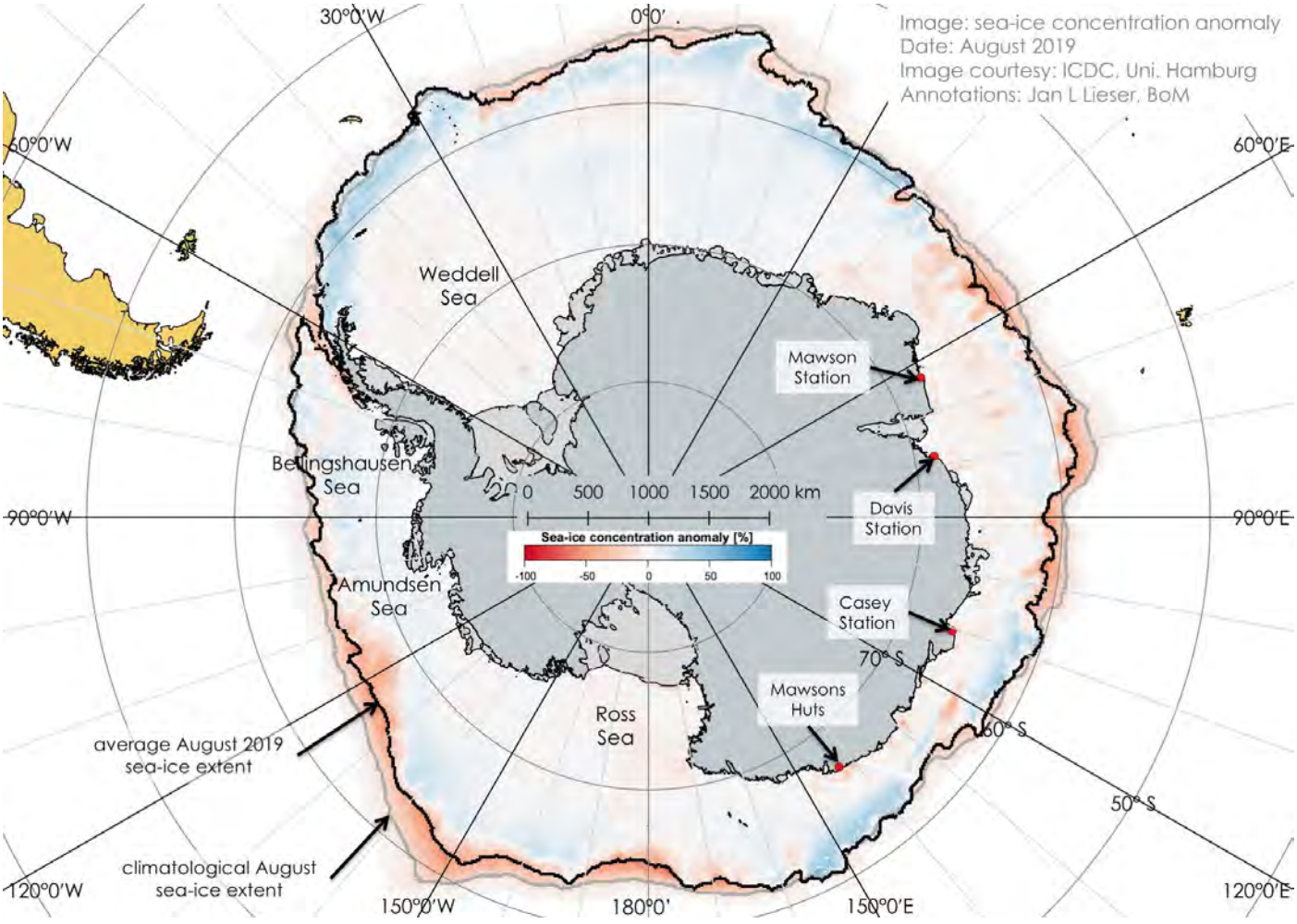


***Figure 1**: Sea-ice concentration anomaly for August 2019 provided by ICDC (Universität Hamburg).*

Ice Bulletin: Davis Station

Issued: Tuesday 8th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (15 m horizontal) panchromatic image of the Vestfold Hills, the home of Davis Station, and offshore.

Off Davis Station, the fast-ice edge shows a typical extent for the time of year. Many small to medium-sized icebergs that are grounded off the hills are providing anchor points for fast ice. West of the station, open water is a bit more than 4 nautical miles offshore.

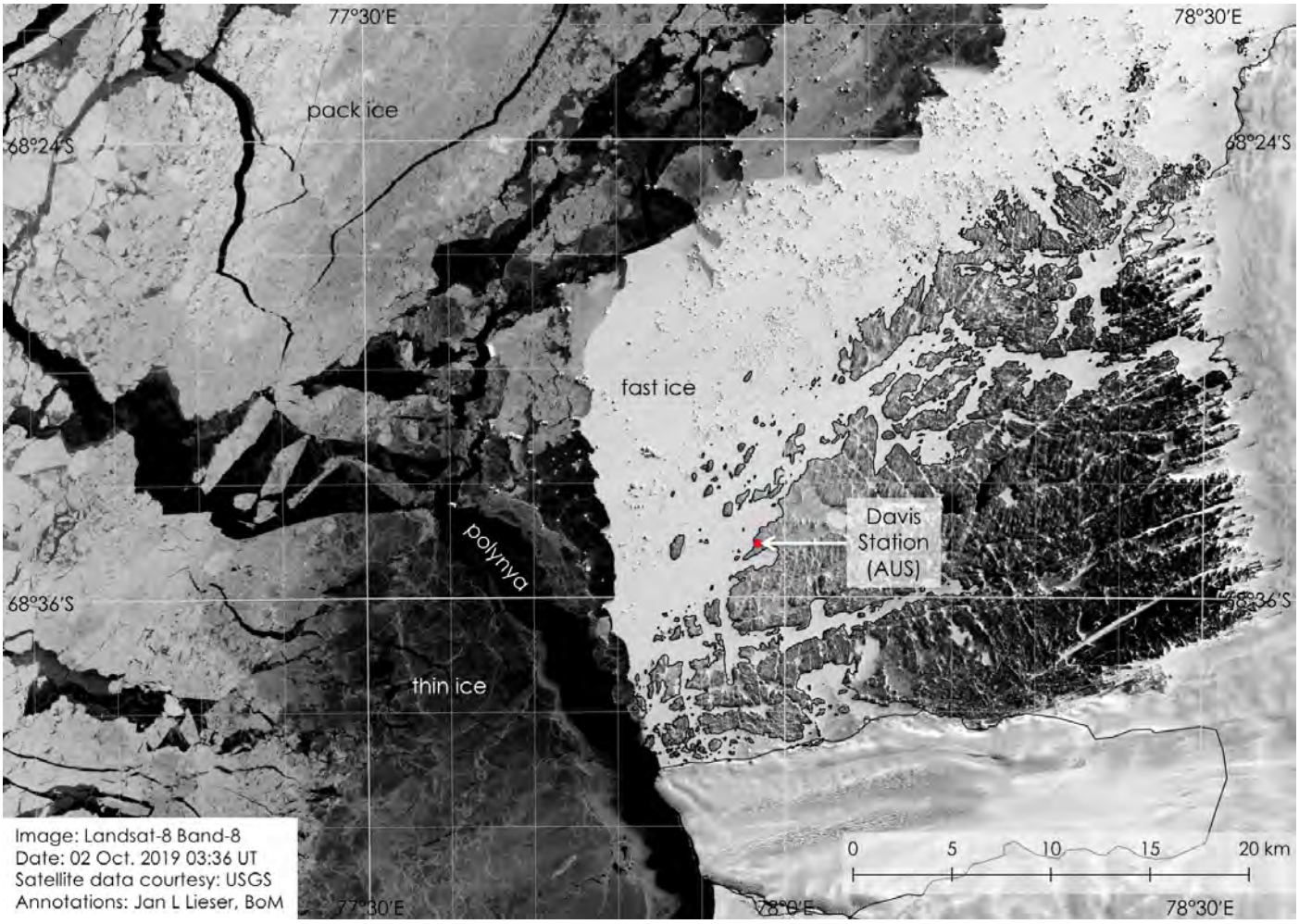


***Figure 1**: Panchromatic image of Davis Station and offshore acquired 02 October 2019 at 03:36 UT and provided by USGS.*

Ice Bulletin: Mawson Station

Issued: Tuesday 8th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (15 m horizontal) panchromatic image of Mawson Coast and offshore.

The northern edge of the fast ice shows a typical shape for the time of year. Northwest of the station, the persistent polynya is a little closer to the station than usual and the shortest distance between open water and the station is currently roughly 35.5 nautical miles. So-called 'Iceberg Alley' is a clearly distinguishable feature north of Mawson Station.

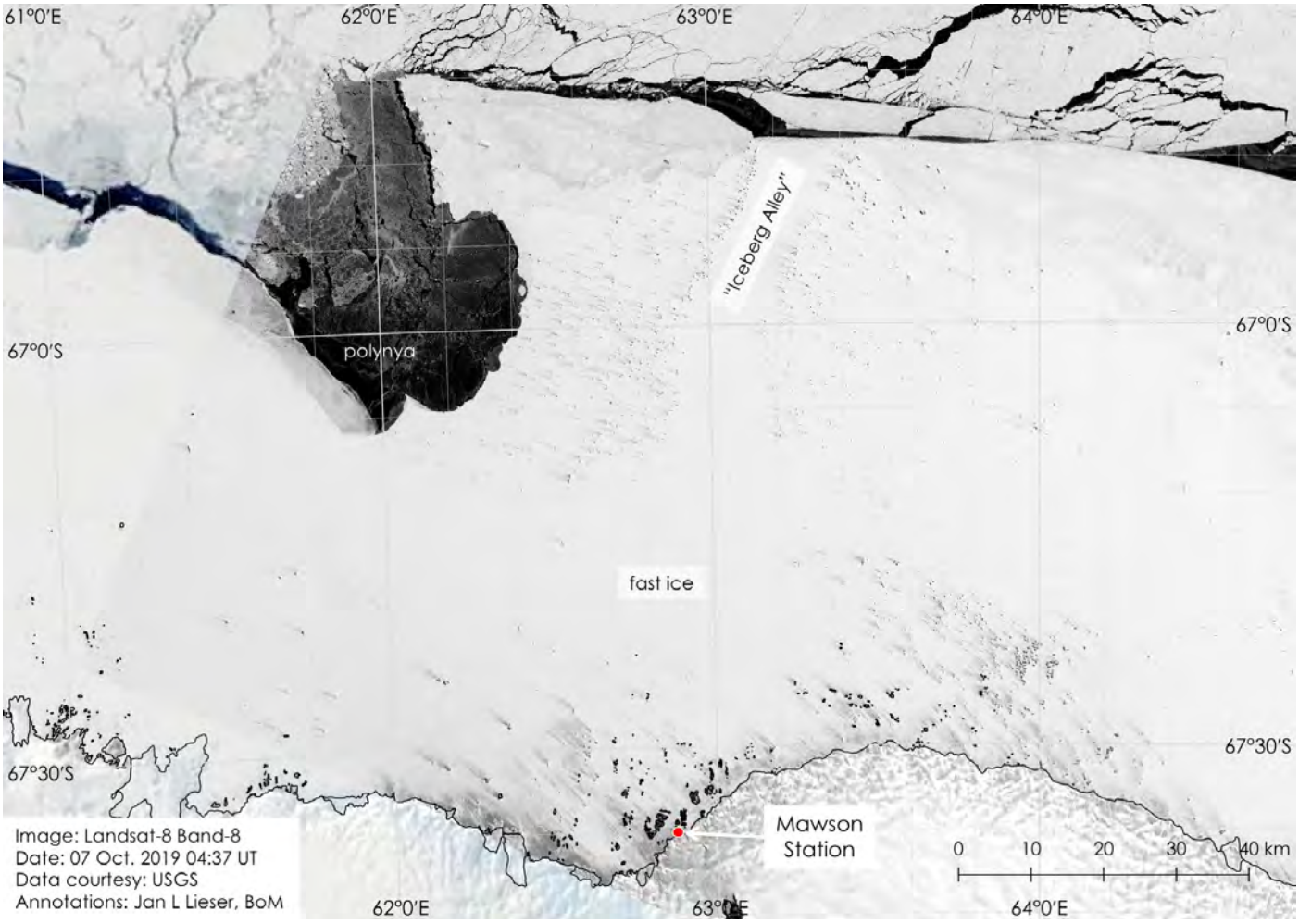


***Figure 1**: Panchromatic image of Mawson Station and offshore acquired 07 October 2019 at 04:37 UT and provided by USGS complemented by AQUA MODIS VIS data in the west provided by NASA.*

Ice Bulletin: Antarctica

Issued: Tuesday 10th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows the pan-Antarctic sea-ice concentration anomaly based on passive microwave remote sensing data.

On 30 Sept. 2019, sea-ice extent around Antarctica reached its maximum at 18.45 x 10^6 km^2, which is slightly below the long-term average. While the western Weddell Sea showed slightly above average sea-ice extent, the eastern Weddell Sea was below average conditions and East Antarctica presented varied extent above and below average, but above average sea-ice concentration within near-average extent between 115º E and 175º E.

The largest contribution to the overall below average sea-ice conditions comes from the Amundsen Sea and the surrounding Bellingshausen Sea and western Ross Sea. Amundsen Sea shows negative sea-ice concentration nearing 90% for the entire month of September 2019.

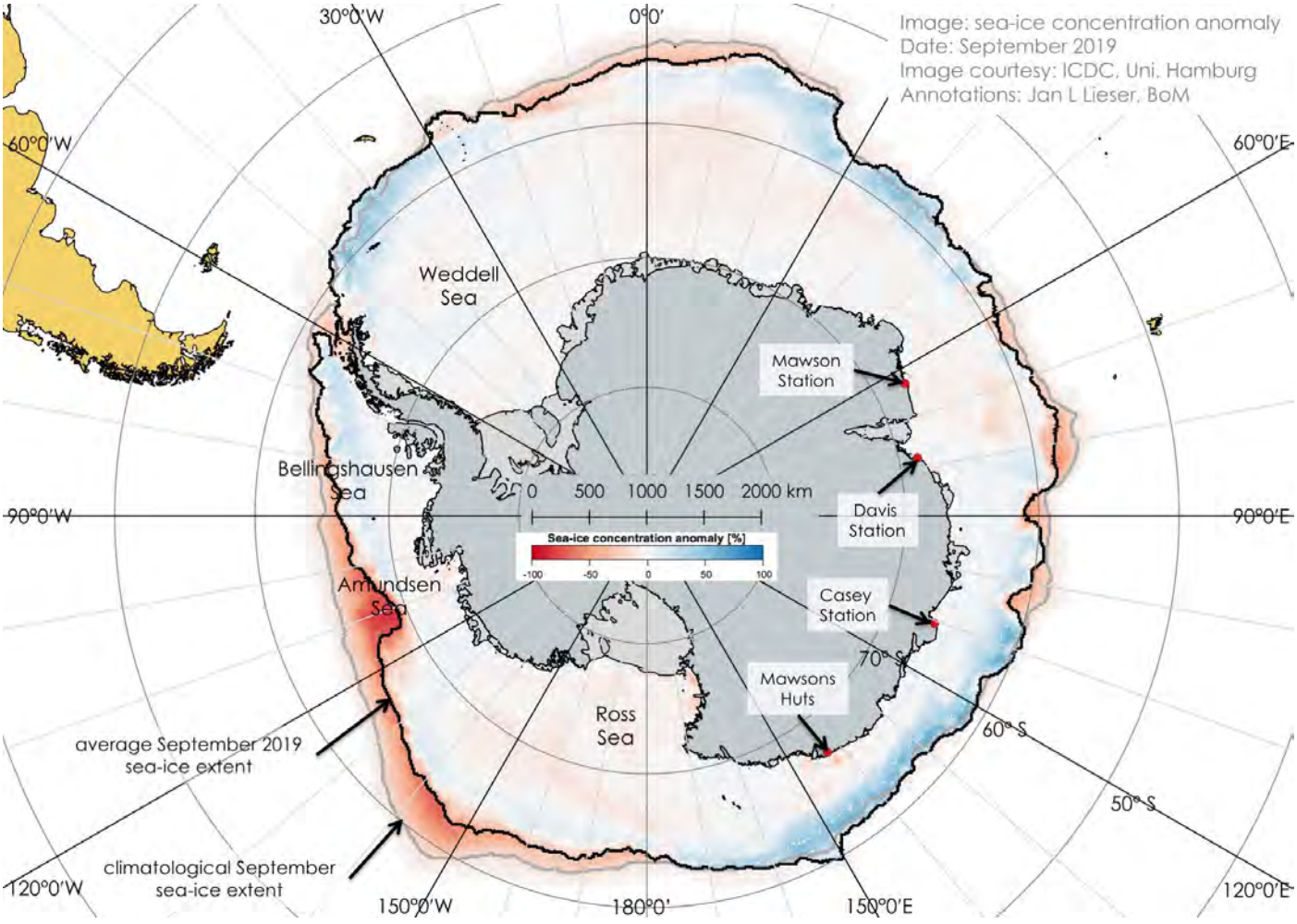


***Figure 1**: Sea-ice concentration anomaly for September 2019 provided by ICDC (Universität Hamburg).*

Ice Bulletin: Casey Station

Issued: Tuesday 10th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (30 m horizontal) Synthetic Aperture RADAR (SAR) scene of Casey Station and offshore.

The fast-ice edge is approximated by the red scribble line and shows a typical extent for the time of year. Many small to medium-sized icebergs that are grounded off the western flank of Law Dome are providing anchor points for fast ice and a few larger icebergs can be identified further offshore.

Vincennes Bay is largely filled with young and first-year sea ice but close to the fast-ice edge off Casey Station, mostly small floes of new, young and thin sea ice are found in the dynamical region adjacent to the fast-ice edge.

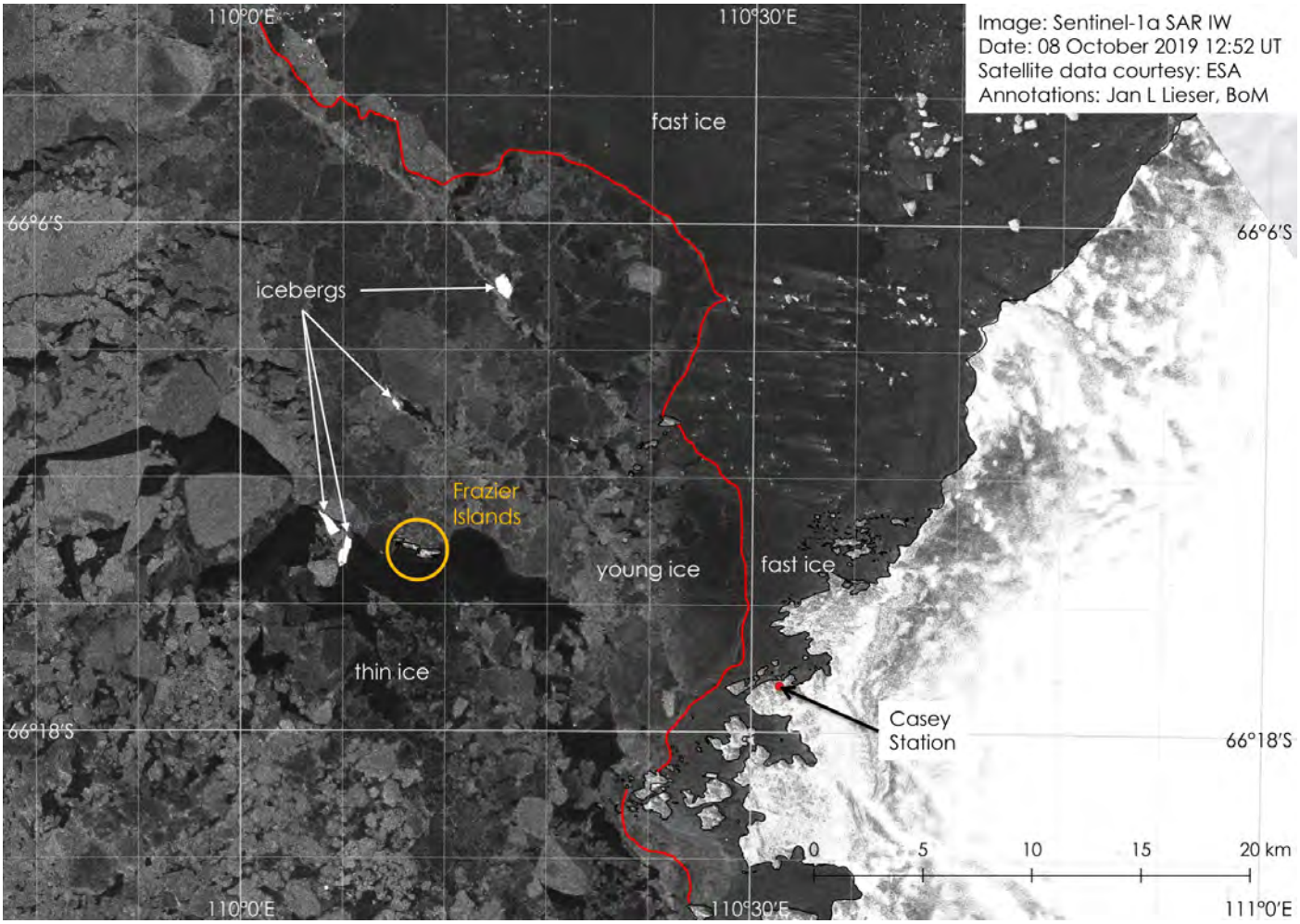


***Figure 1**: SAR scene of Casey Station and offshore acquired 08 October 2019 at 12:52 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Tuesday 14th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a sea-ice concentration chart derived from AMSR-2 data (greyscale) and two SAR swaths, as well as the median sea-ice extent for October as a green line.

Between Mawson Coast and the Shackleton Ice Shelf, sea ice is largely within the boundary (south) of the median extent. The marginal ice zone is relatively narrow along the northern edge of the sea ice and the pack ice consists of a large variety of ice types, ranging from new ice and thin and thick first-year ice to multi-year ice and old-ice inclusions.

The new iceberg D-28, which has recently broken off the Amery ice Shelf, is marked by a red shape just north of the shelf. Since the calving, the iceberg has rotated more than 90 degrees anti-clockwise but still remains very close to the ice-shelf front.

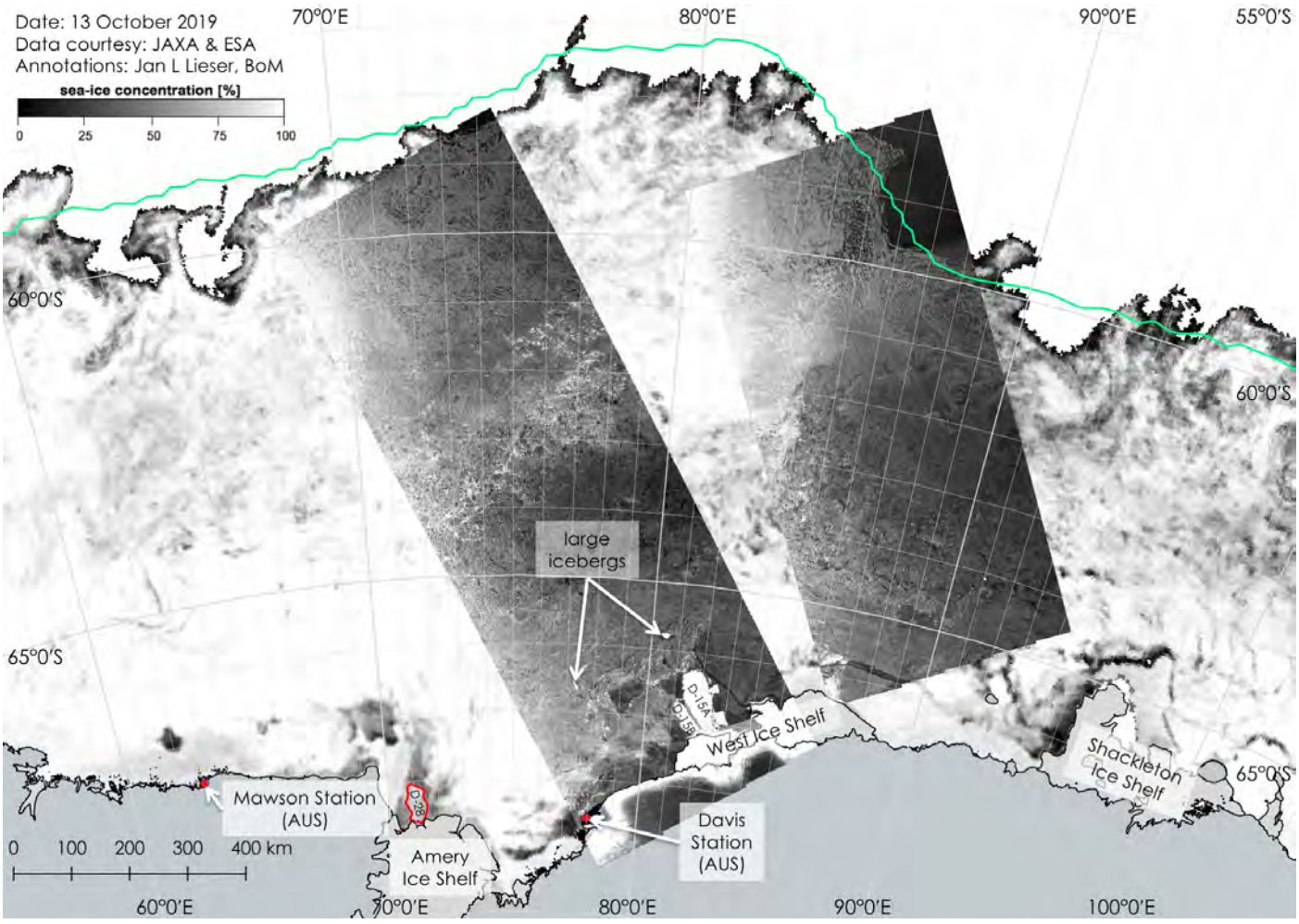


***Figure 1**: Composite of sea-ice concentration data (provided by ICDC, Uni. Hamburg) and two Sentinel-1 SAR swaths (provided by PolarView), all data acquired 13 October 2019.*

Ice Bulletin: Davis Station

Issued: Tuesday 16th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart derived from AMSR-2 data (greyscale) and a SAR scene, as well as the sea-ice edge derived from the sea-ice concentration data as a green line.

The region shown in the figure is located north of the West Ice Shelf and shows large-scale undulations of the sea-ice edge, where the sea ice is currently distributed largely by oceanic eddies and only to a lesser degree by wind and wave action. Along 87ºE and just south of 60ºS, one of such eddies becomes apparent in the pattern of sea ice of the marginal ice zone.

The combination of data shown in the figure also highlights the detection limits of the space-borne passive microwave data (AMSR-2), which is used to derive sea-ice concentration charts, when compared to the higher resolution of the SAR data. The connection between the marginal ice zone and the patch of sea ice at 89º30'E and 58ºS is not captured as the sea-ice edge.

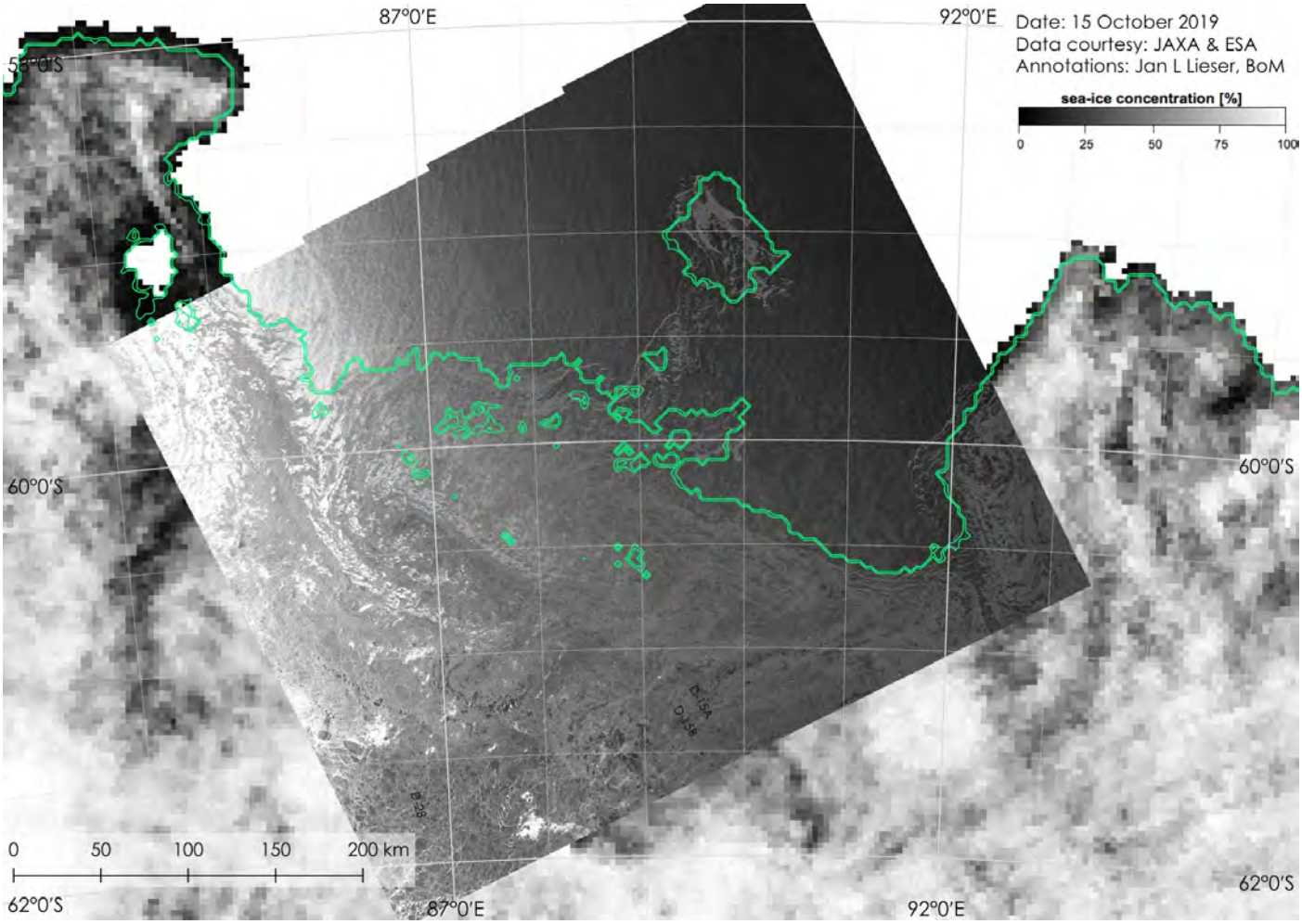


***Figure 1**: Composite of sea-ice concentration data acquired 15 October 2019 and provided by ICDC, Uni. Hamburg, and Sentinel-1b SAR EW scene acquired 15 October 2019 at 13:35 UT and provided by PolarView.*

Ice Bulletin: Casey Station

Issued: Tuesday 18th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (30 m horizontal) Synthetic Aperture RADAR (SAR) scene of Casey Station and offshore, including the Swain Group islands northeast of the station. Figure 2 shows a coarser resolution visible scene of the same geographical frame of Figure 1, but two days later.

The fast-ice edge on the day of data acquisition is approximated by the red scribble line in both figures. In the visible scene, the fast-ice edge from two days earlier (see Figure 1) is also included as a dashed line.

The region is experiencing a south-easterly wind regime currently, which has dislodged large parts of fast ice. Between the Donovan Islands and Casey Station, the fast-ice edge has retreated towards the coast and the outer part of the remaining fast ice is thinner than the near-shore part. The open water is wind roughened and streaks of newly forming grease ice clearly show in the visible scene.

Some of the marked icebergs in the figure are now free of fast ice.

The most recent imagery (Figure 2) does not allow for a judgment about the presence or condition of fast ice around Stonehocker Point.

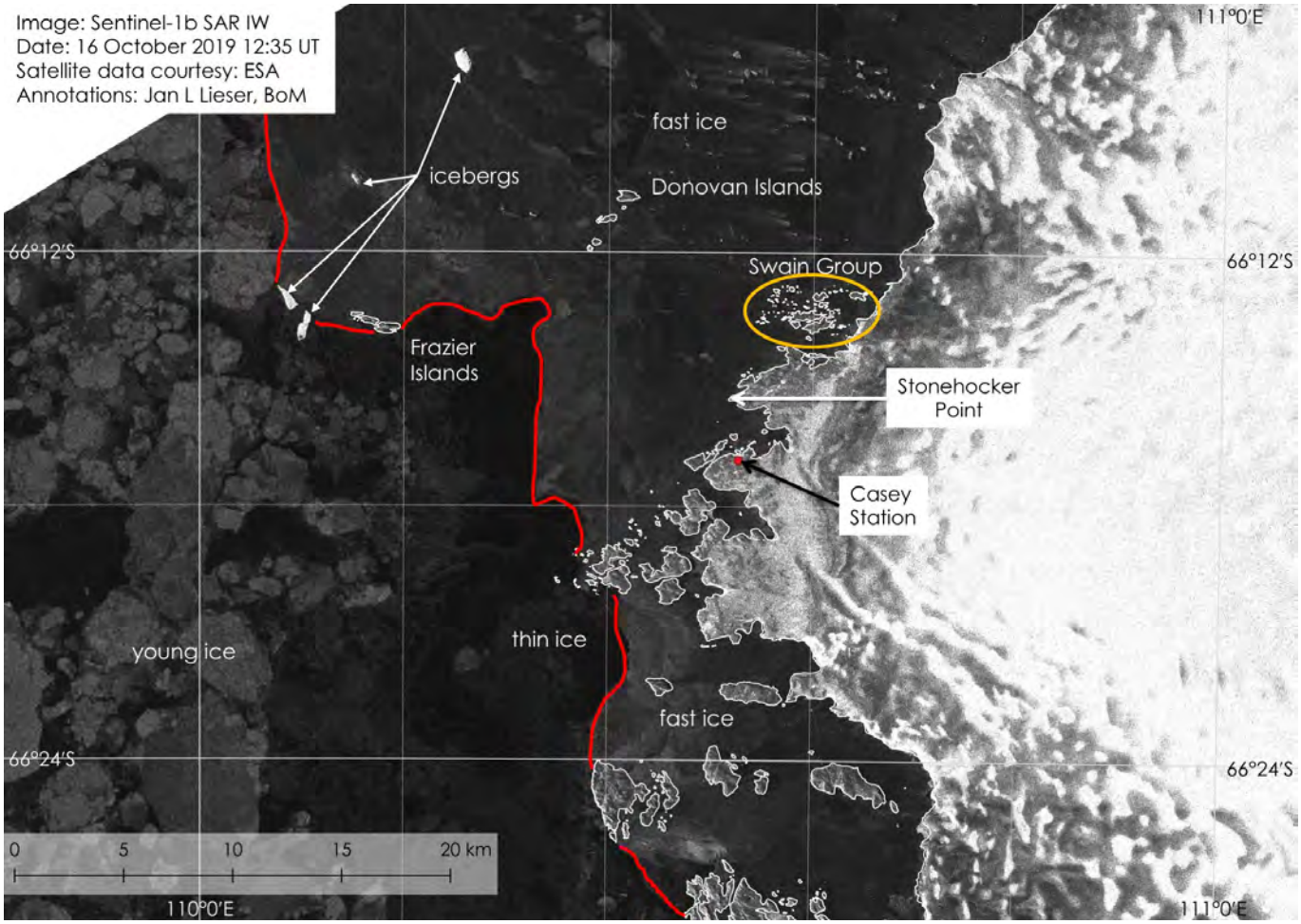


***Figure 1**: SAR scene of Casey Station and offshore acquired 16 October 2019 at 12:35 UT and provided by PolarView.*

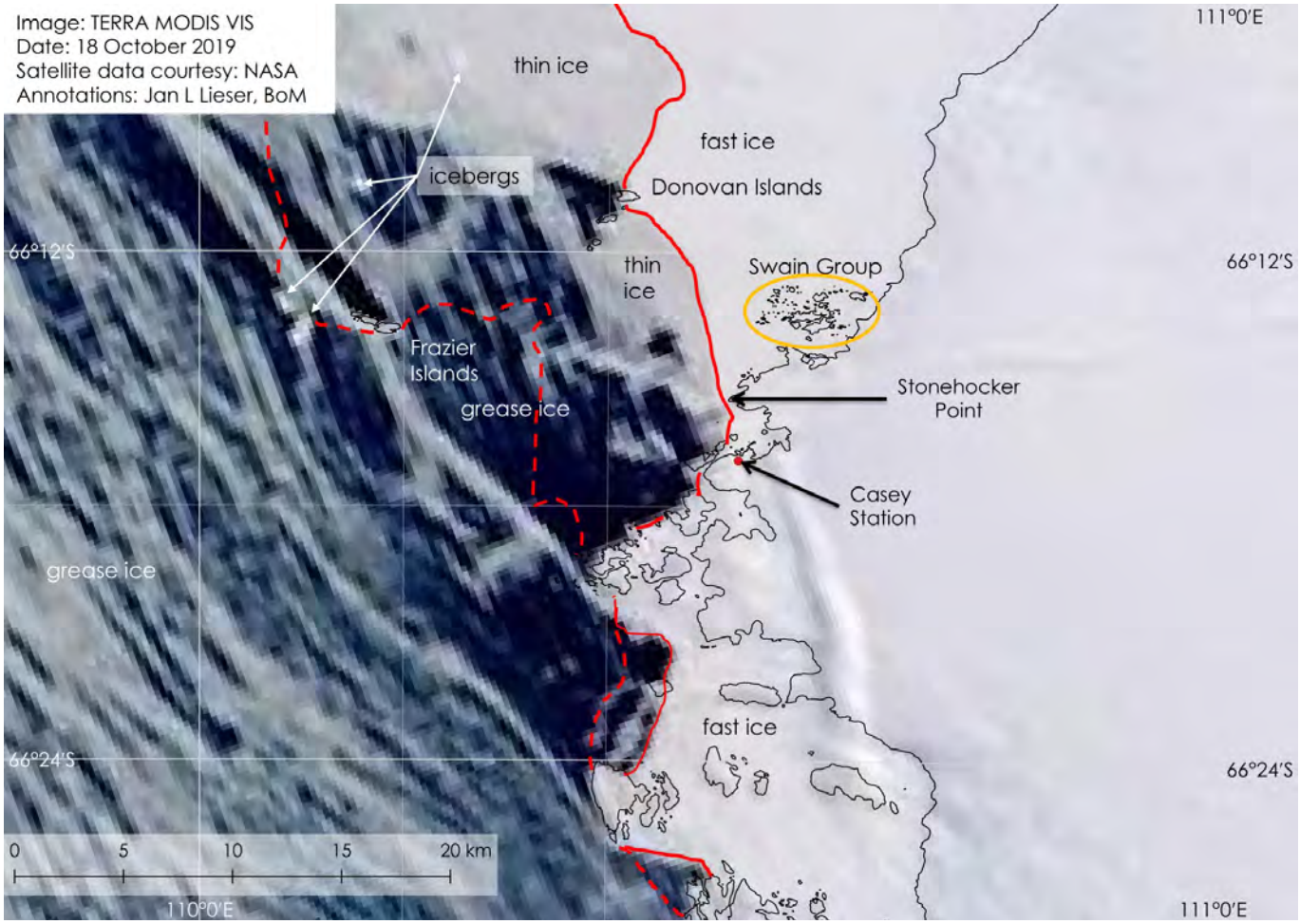


***Figure 2**: TERRA MODIS VIS scene of Casey Station and offshore acquired 18 October 2019 and provided by NASA.*

Ice Bulletin: Casey Station

Issued: Tuesday 19th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Casey Station and offshore, including the Swain Group islands northeast of the station.

The fast-ice edge is approximated by the red scribble line in the figure, yesterday's fast-ice edge is marked with a dashed red line. Additionally, the 'grease-ice edge' is marked with a yellow scribble line and yesterday's is marked as a dashed yellow line.

The continued south-easterly wind regime has pushed the grease ice further offshore and has dislodged more shore-fast sea ice. Between the Donovan Islands and Swain Group, the fast-ice edge has retreated eastward. The open water is wind roughened and streaks of newly forming grease ice clearly show in the visible data.

All of the marked icebergs in the figure are now free of fast ice.

This imagery indicates no more fast ice around Stonehocker Point.

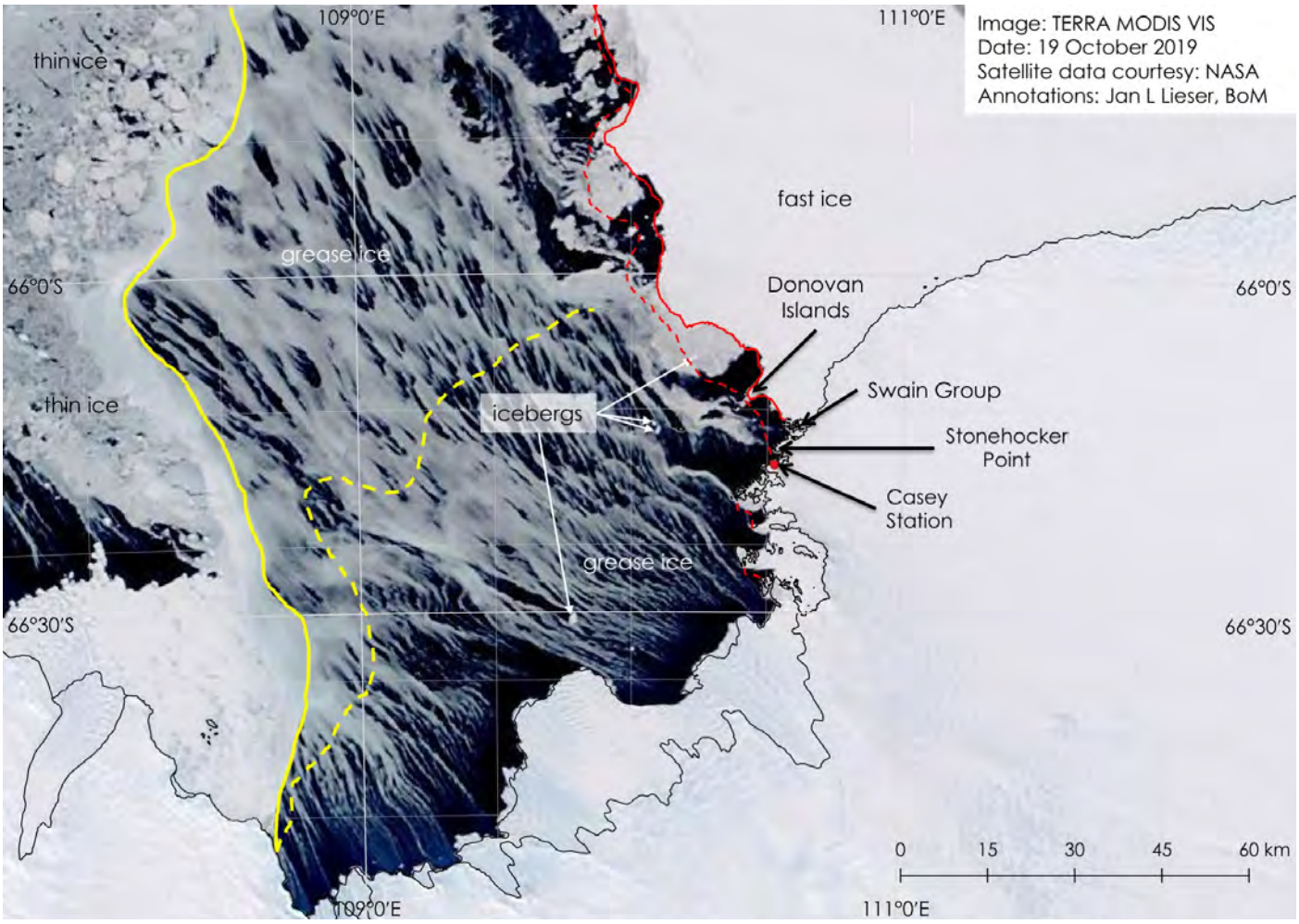


***Figure 1**: TERRA MODIS VIS scene of Casey Station and offshore acquired 19 October 2019 and provided by NASA.*

Ice Bulletin: Casey Station

Issued: Monday 21st October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (20 m horizontal) Synthetic Aperture RADAR (SAR) scene of Casey Station and offshore, including the Swain Group islands northeast of the station.

The fast-ice edge is approximated by the red scribble line. Most of the icebergs in the figure are marked by green dots.

The imagery confirms no fast ice around Stonehocker Point and a further retreating fast-ice edge north of Swan Group towards Donovan Islands.

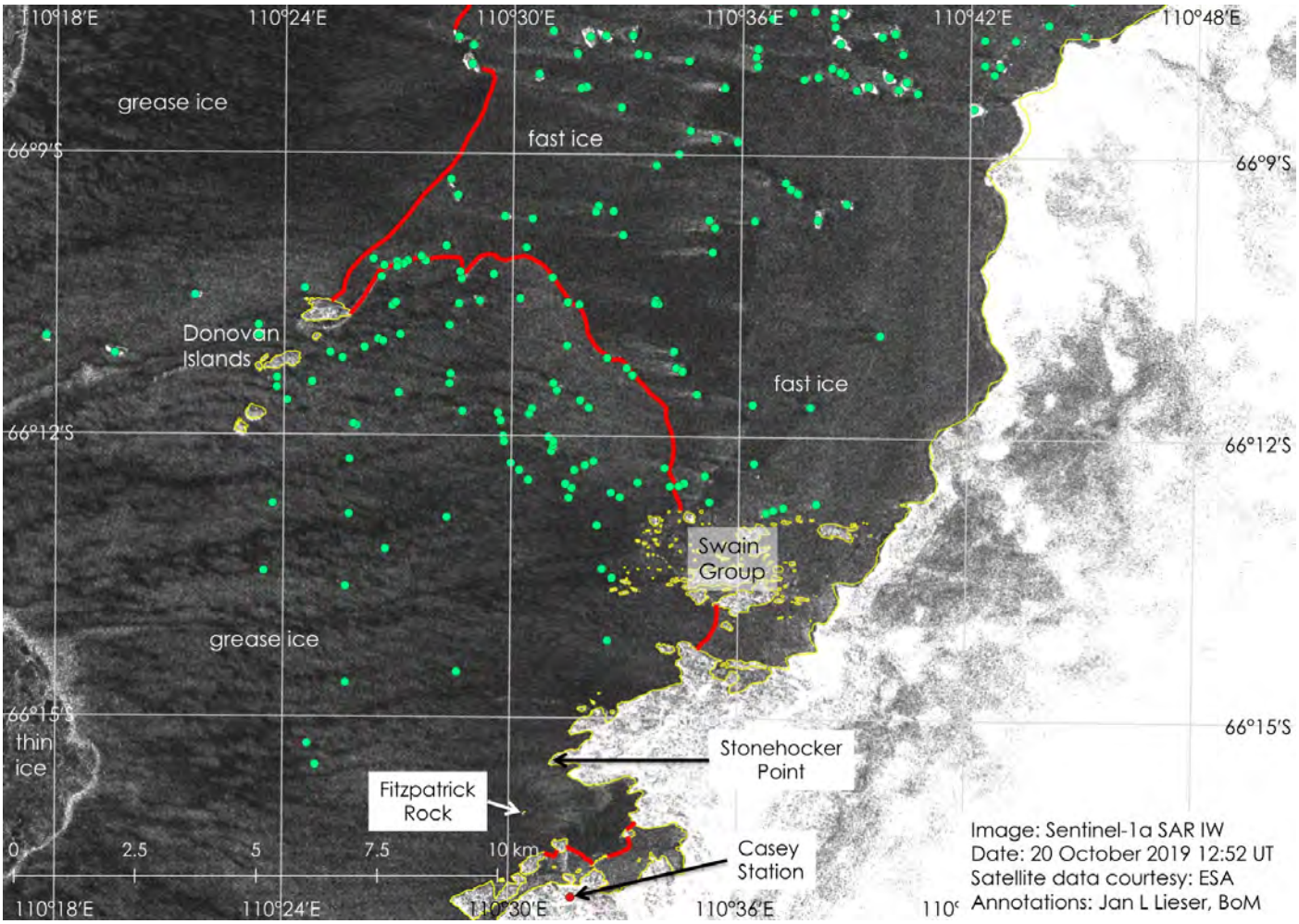


***Figure 1**: SAR scene of Casey Station and offshore acquired 20 October 2019 at 12:52 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Friday 25th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figures 1 and 2 show a composite of a medium-resolution (6.25 km horizontal) sea-ice concentration chart derived from AMSR-2 data (greyscale) and a SAR scene. Additionally, icebergs are identified in the SAR data and marked by red dots (1017 icebergs from SAR scene in Figure 1 and 2697 icebergs from SAR scene in Figure 2). The nature of icebergs and the SAR data means that not all icebergs of the scene may be identified.

The region shown in the Figure 1 is located north of the West Ice Shelf; the SAR scene of Figure 2 is located east of the SAR scene of Figure 1. The detection limit of the sea-ice concentration data is provided as 10%.

In Figure 1, the majority of icebergs has been detected east of 83ºE and only a few west of this longitude. This may partially be attributed to the viewing geometry of the SAR instrument, but it is also possible that there are momentarily less icebergs in the western part of the scene. The SAR scene of Figure 2 shows a more north-south oriented distribution of icebergs, which is to be expected.

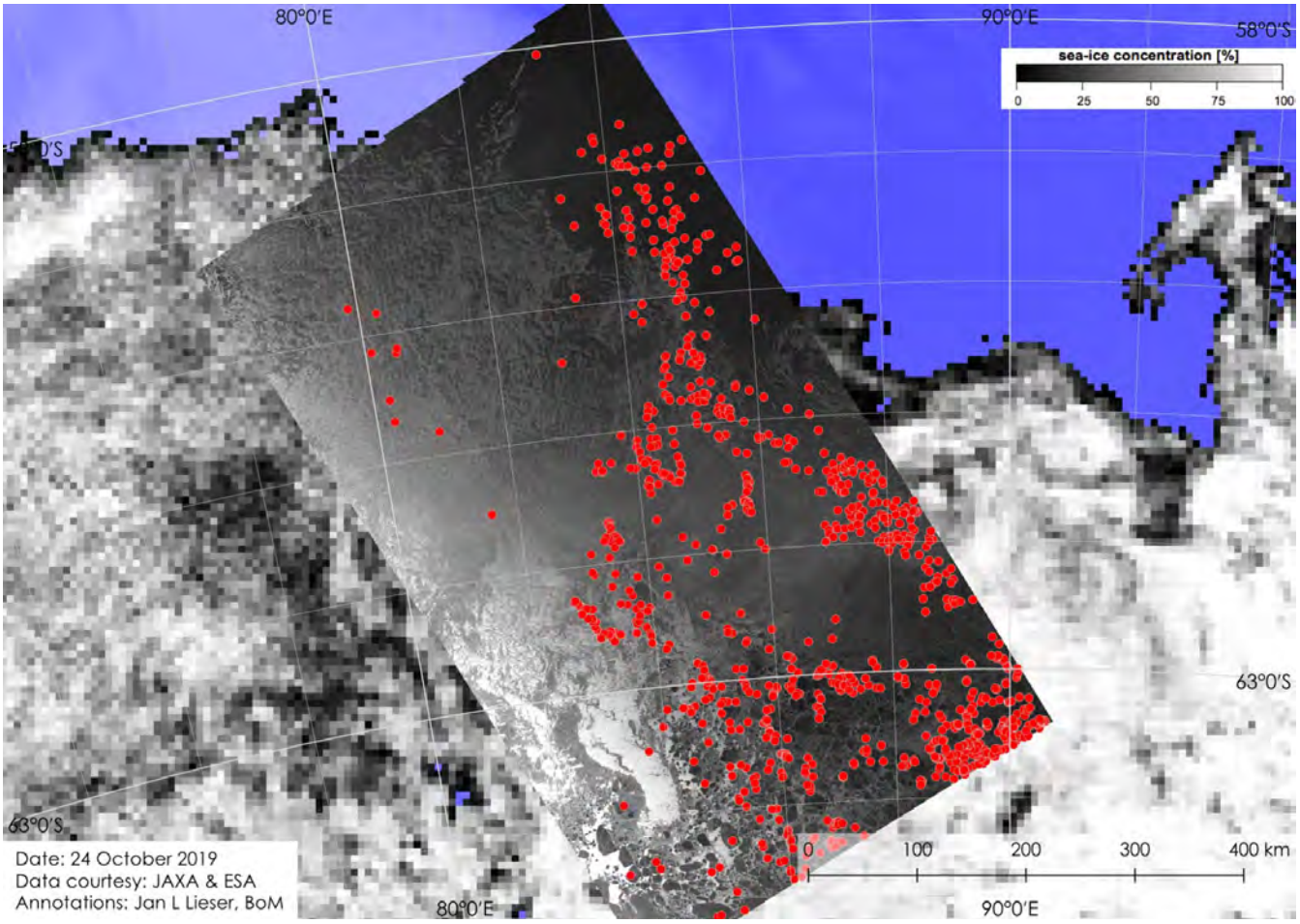


***Figure 1**: Composite of sea-ice concentration data acquired 24 October 2019 and provided by Uni.Bremen, and Sentinel-1a SAR EW scene acquired 24 October 2019 at 14:00 UT and provided by PolarView.*

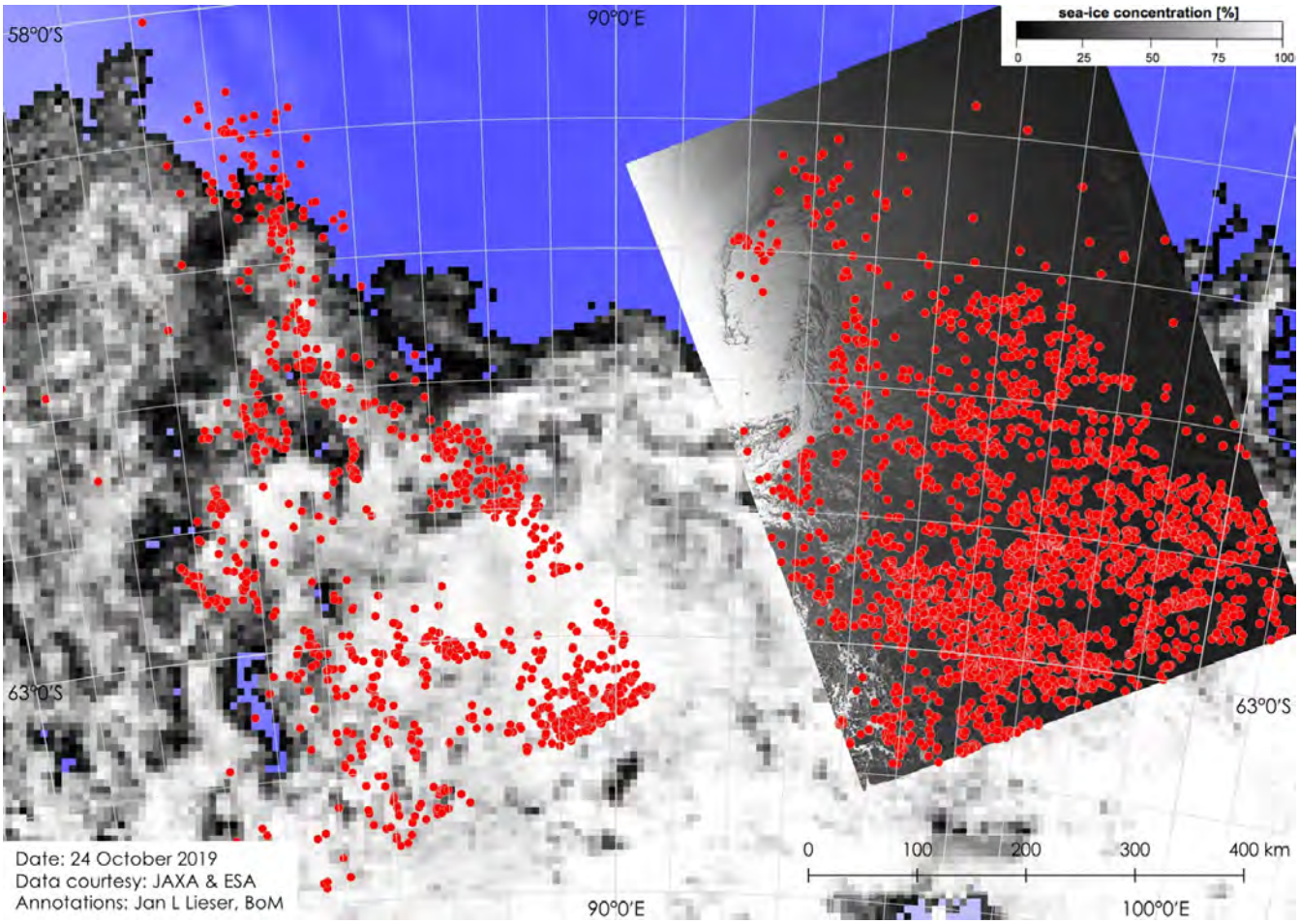


***Figure 2**: Composite as for Figure 1 with Sentinel-1b SAR EW scene acquired 24 October 2019 at 13:10 UT and provided by PolarView and western icebergs as detected from the SAR scene of Figure 1.*

Ice Bulletin: Brunt Ice Shelf

Issued: Saturday 26th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (20 m horizontal) SAR scene of the Brunt Ice Shelf, home of the British Halley VI Station. The western end of the shelf is expected to break away and produce a large iceberg of roughly 1750 km^2. As a precaution the station was re-located to a further eastern position during the 2016/17 austral summer.

The soon-to-be iceberg is attached to the rest of the Brunt Ice Shelf only around the McDonald Ice Rumples, where the so-called Chasm-1 (marked in yellow) and the Halloween Crack (marked in orange) converge. Chasm-1 has progressed northward by about 2 km since early September 2019. A couple of cracks are induced by the ice flow across the McDonald Ice Rumples and are marked by red scribble lines.

Currently, there are less than 8 km between the northern end of Chasm-1 and the smaller cracks west of the McDonald Ice Rumples.

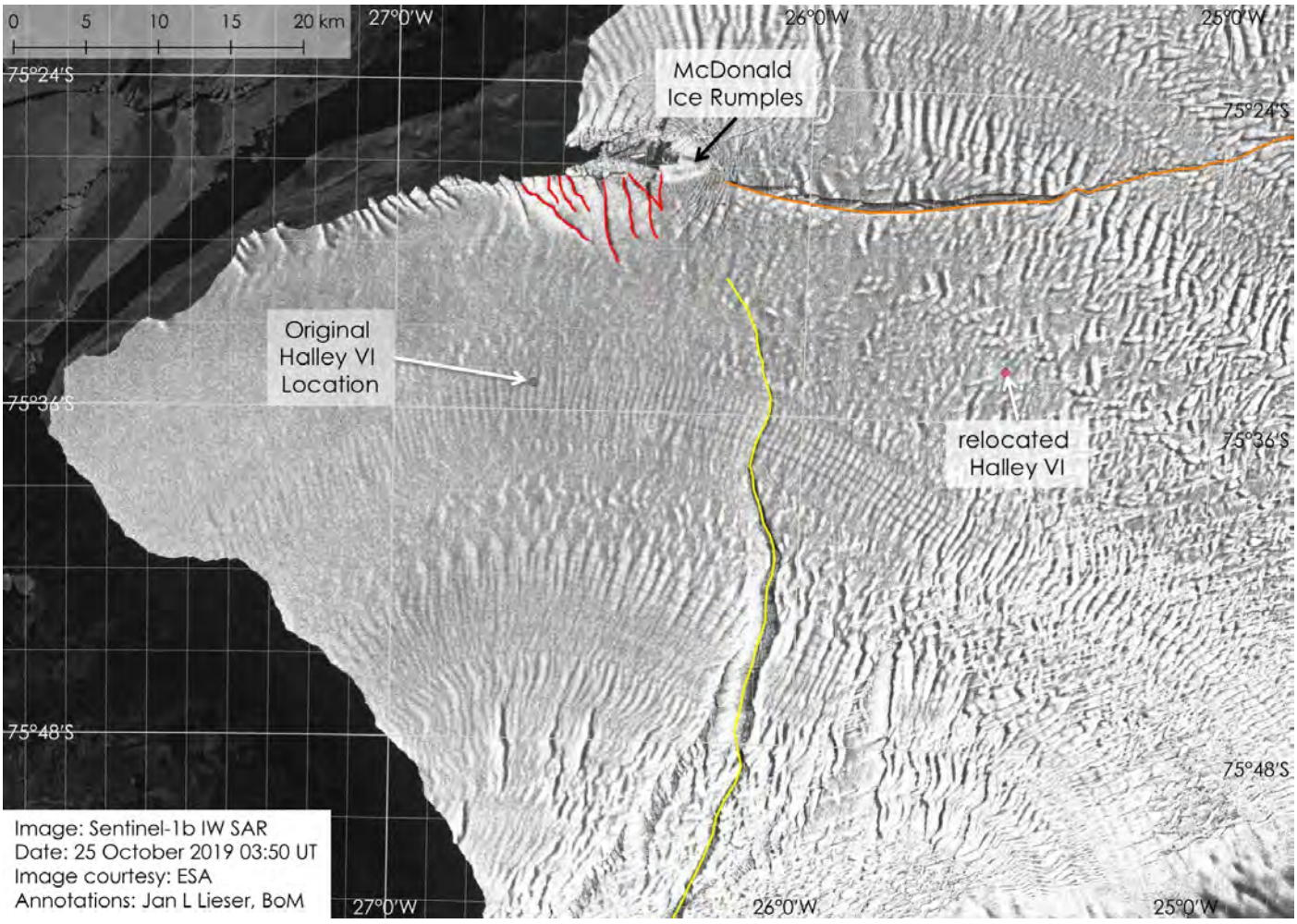


***Figure 1**: Sentinel-1a SAR IW scene acquired 25 October 2019 at 03:50 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Saturday 26th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart derived from AMSR-2 data (greyscale) and a SAR scene. Additionally, 2257 icebergs are identified in the SAR data and marked by red dots. The nature of icebergs and the SAR data means that not all icebergs of the scene may be identified.

The region shown in the Figure 1 is located north of the West Ice Shelf. The detection limit of the sea-ice concentration data is provided as 10%.

Immediately north of the West Ice Shelf, many grounded icebergs have been identified, but not many north of the grounded bergs towards 65ºS. North of 65ºS, icebergs are widely distributed within the sea ice, but again a notable reduction of detectable icebergs west of 83ºE and south of 60ºS.

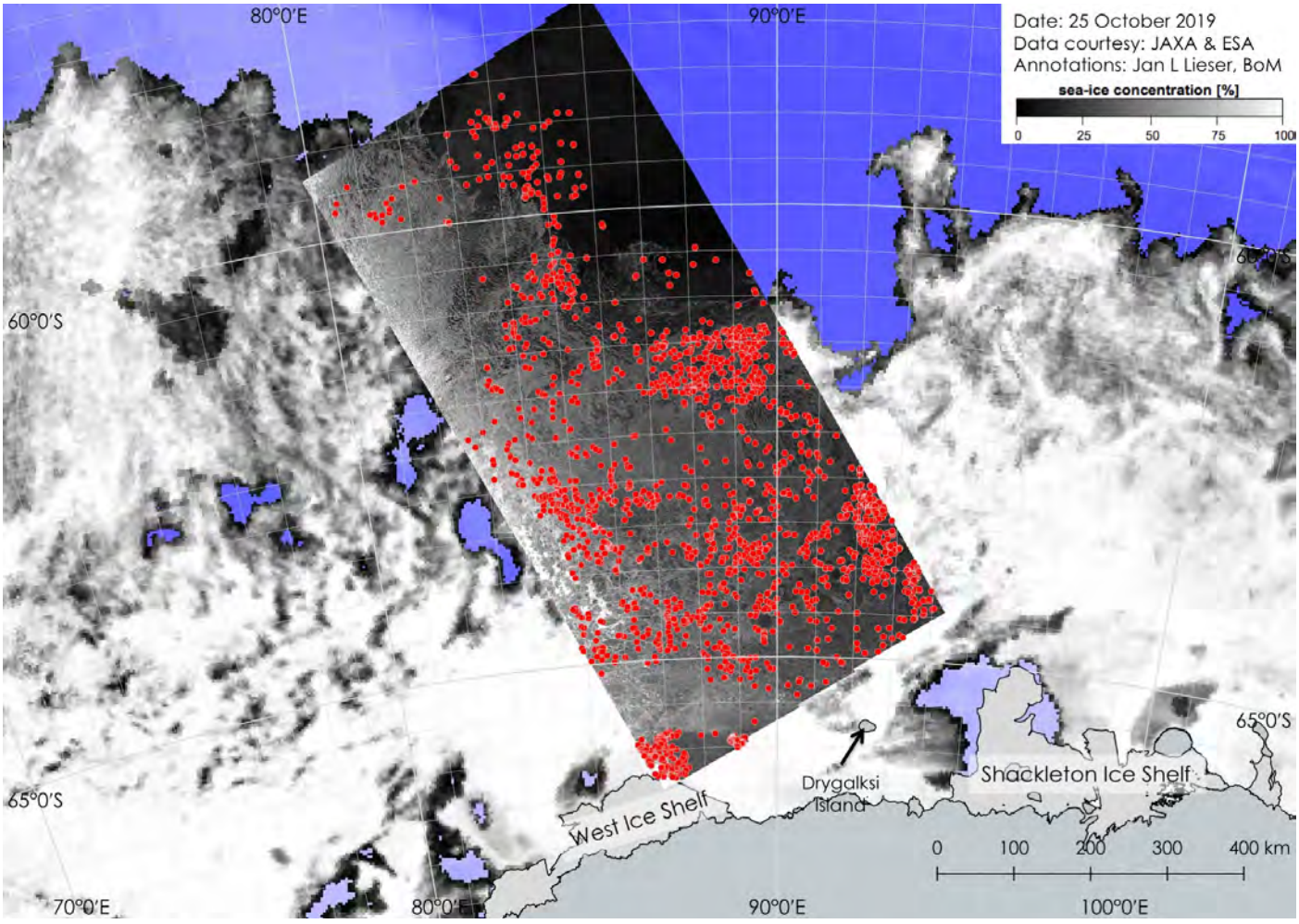


***Figure 1**: Composite of sea-ice concentration data acquired 25 October 2019 and provided by ICDC, Uni.Hamburg, and Sentinel-1b SAR EW scene acquired 25 October 2019 at 13:50 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Sunday 27th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart derived from AMSR-2 data (greyscale) and a SAR scene. Additionally, 3295 icebergs are identified in the SAR data and marked by red dots. The nature of icebergs and the SAR data means that not all icebergs of the scene may be identified.

The region shown in Figure 1 is located north of the West Ice Shelf. The detection limit of the sea-ice concentration data is provided as 10%.

Immediately north of the West Ice Shelf, many grounded icebergs have been identified. North from there, icebergs show the generally to be expected north-south distribution within the sea-ice zone. North of 60ºS, only a few icebergs are drifting freely surrounded by low concentration sea ice.

In the region, sea ice is predominantly first-year sea ice, but a band of old ice between roughly 64ºS and 66ºS is drifting southward and forms a major part of the high-concentration band of sea ice south of 65ºS.

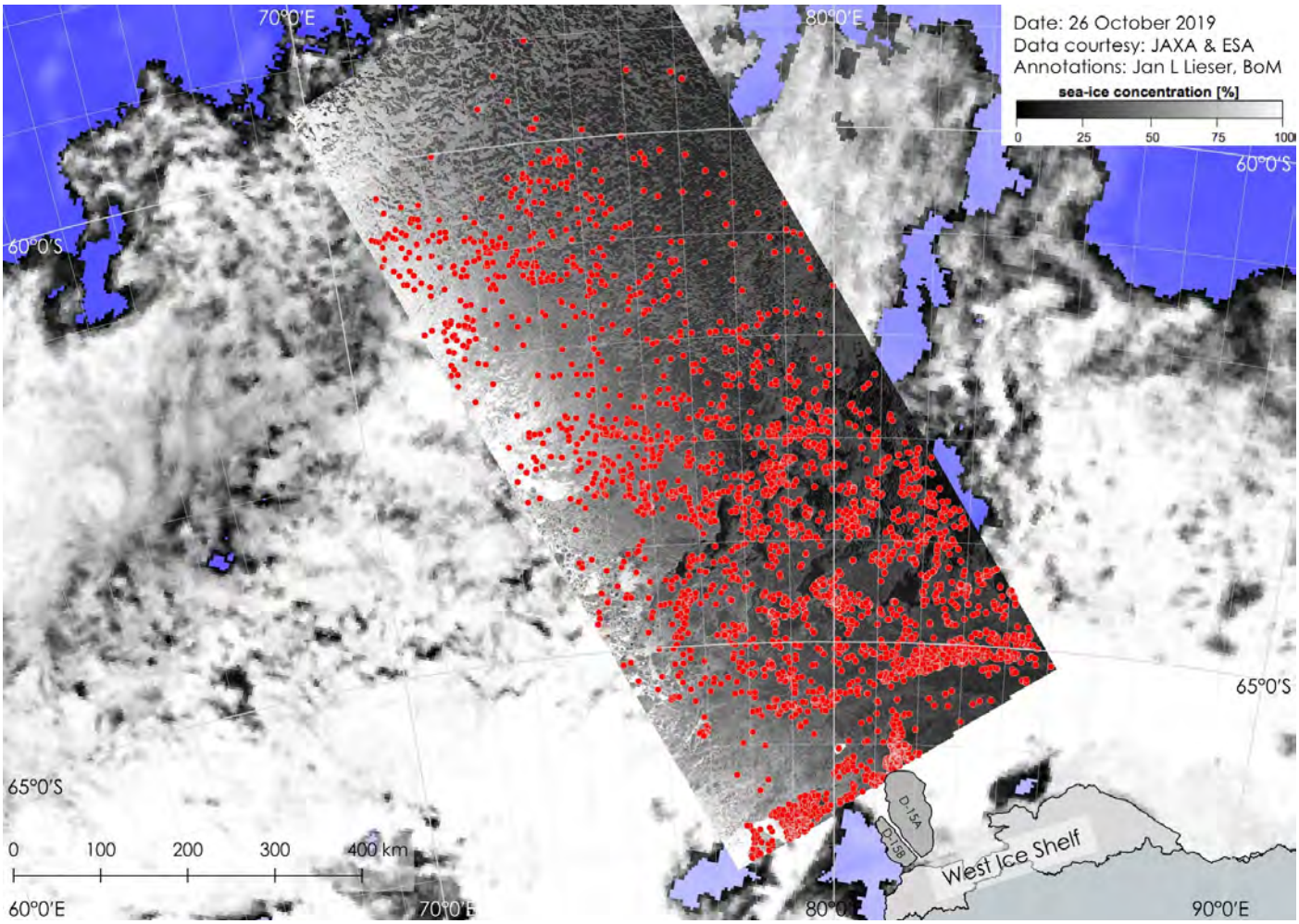


***Figure 1**: Composite of sea-ice concentration data acquired 26 October 2019 and provided by ICDC, Uni.Hamburg, and Sentinel-1b SAR EW scene acquired 26 October 2019 at 14:32 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Monday 28th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (15 m horizontal) panchromatic image of the Vestfold Hills, the home of Davis Station, and offshore.

Off Davis Station, the fast-ice edge shows a typical extent for the time of year. Many small to medium-sized icebergs that are grounded off the hills are providing anchor points for fast ice. West of the station, open water is a bit more than 4 nautical miles offshore.

The shape of the fast-ice edge has only changed slightly in the northern part of the frame, west of the station it remained largely unchanged but the outer edge is thinning due to the generally rising temperatures.

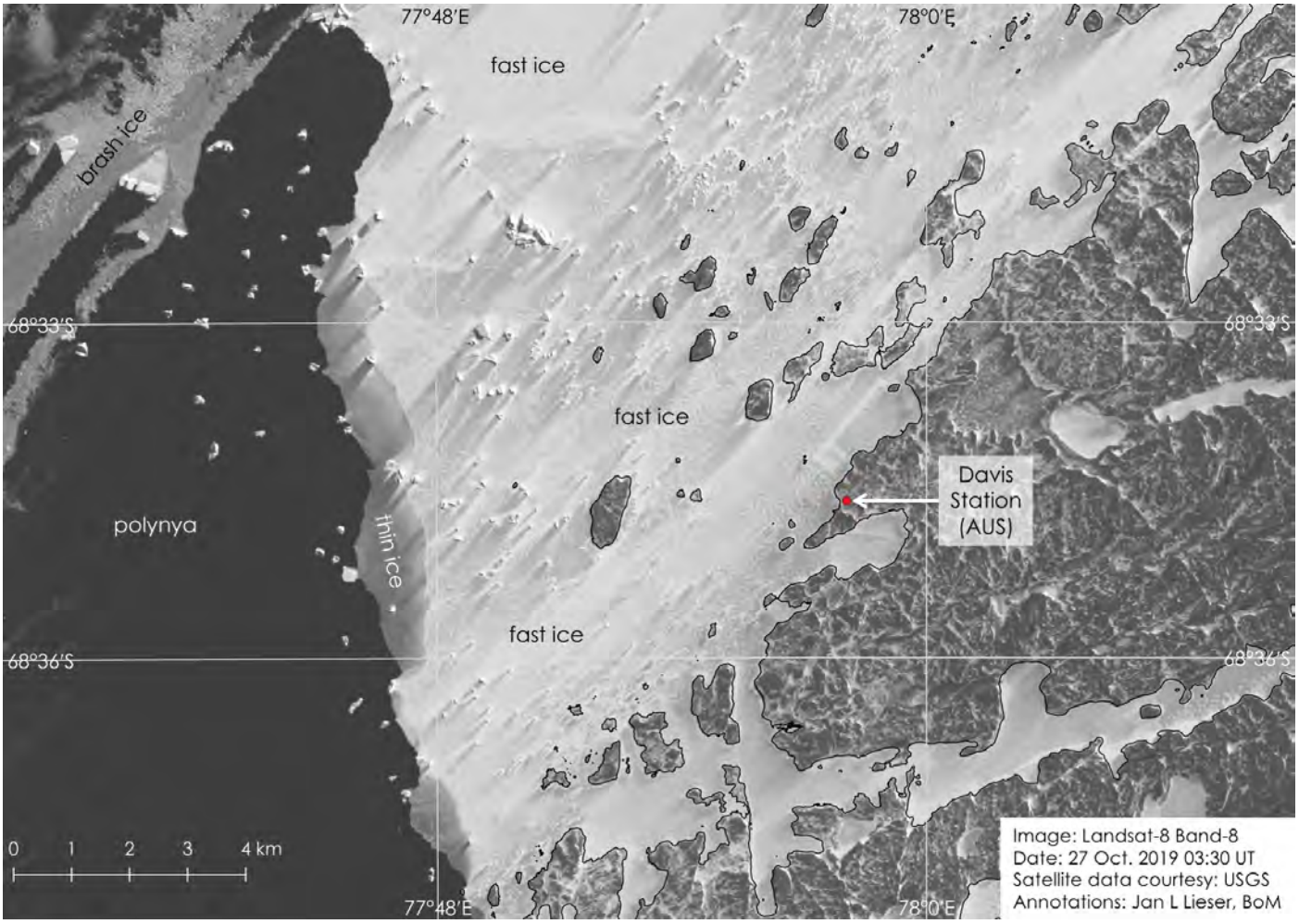


***Figure 1**: Panchromatic image of Davis Station and offshore acquired 27 October 2019 at 03:30 UT and provided by USGS.*

Ice Bulletin: Davis Station

Issued: Wednesday 30th October 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart combined with an iceberg analysis (red dots) based on Sentinel-1a SAR data (green frame; acquired on 29/10/2019 at 14:08 UT) north of the West Ice Shelf.

North of 62ºS and west of 83ºE, only a few icebergs have been identified, whereas the majority of the 3751 icebergs of the analysis are located in the southeast of the analysed area. Many clusters of icebergs may in-fact be regions of recently disintegrated icebergs, which have now resulted in fields of glacial debris that is interspersed within high-concentration sea ice.

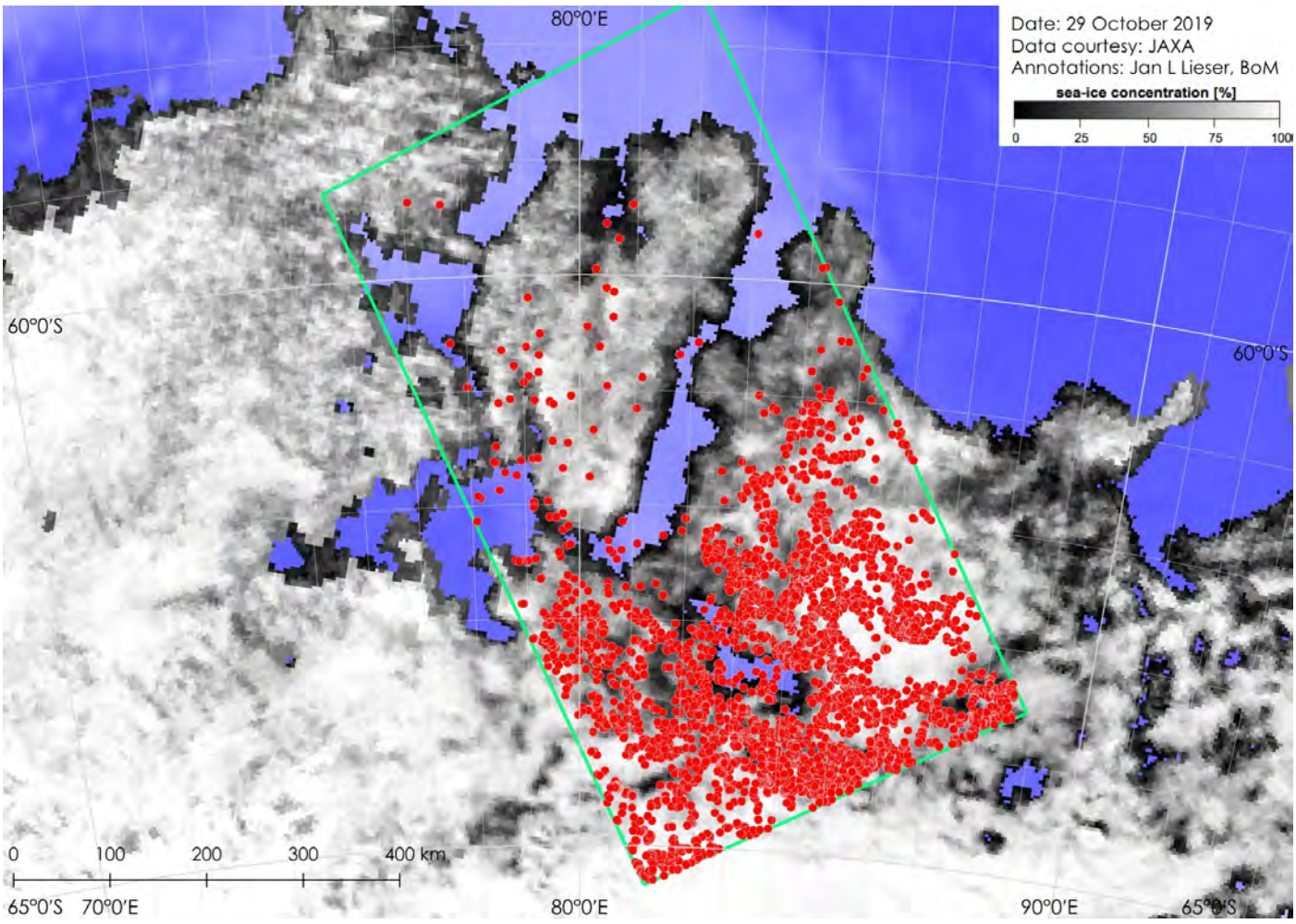


***Figure 1**: AMSR-2 sea-ice concentration data acquired 29 October 2019 and provided by ICDC, Universität Hamburg.*

Ice Bulletin: Davis Station

Issued: Friday 01st November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart combined with a Sentinel-1a SAR scene and iceberg analysis (red dots) based on the SAR data. The sea-ice edge based on sea-ice concentration data is also included as a yellow line. Icebergs larger than 20 square nautical miles (that is > 68.6 km^2) are marked by pink dots and labelled.

North of 62ºS and west of 83ºE, only a few icebergs have been identified, whereas the majority of the 2491 icebergs of the analysis are located in the southeast of the analysed area. Many clusters of icebergs may in-fact be regions of recently disintegrated icebergs, which have now resulted in fields of glacial debris that is mostly interspersed within high-concentration sea ice.

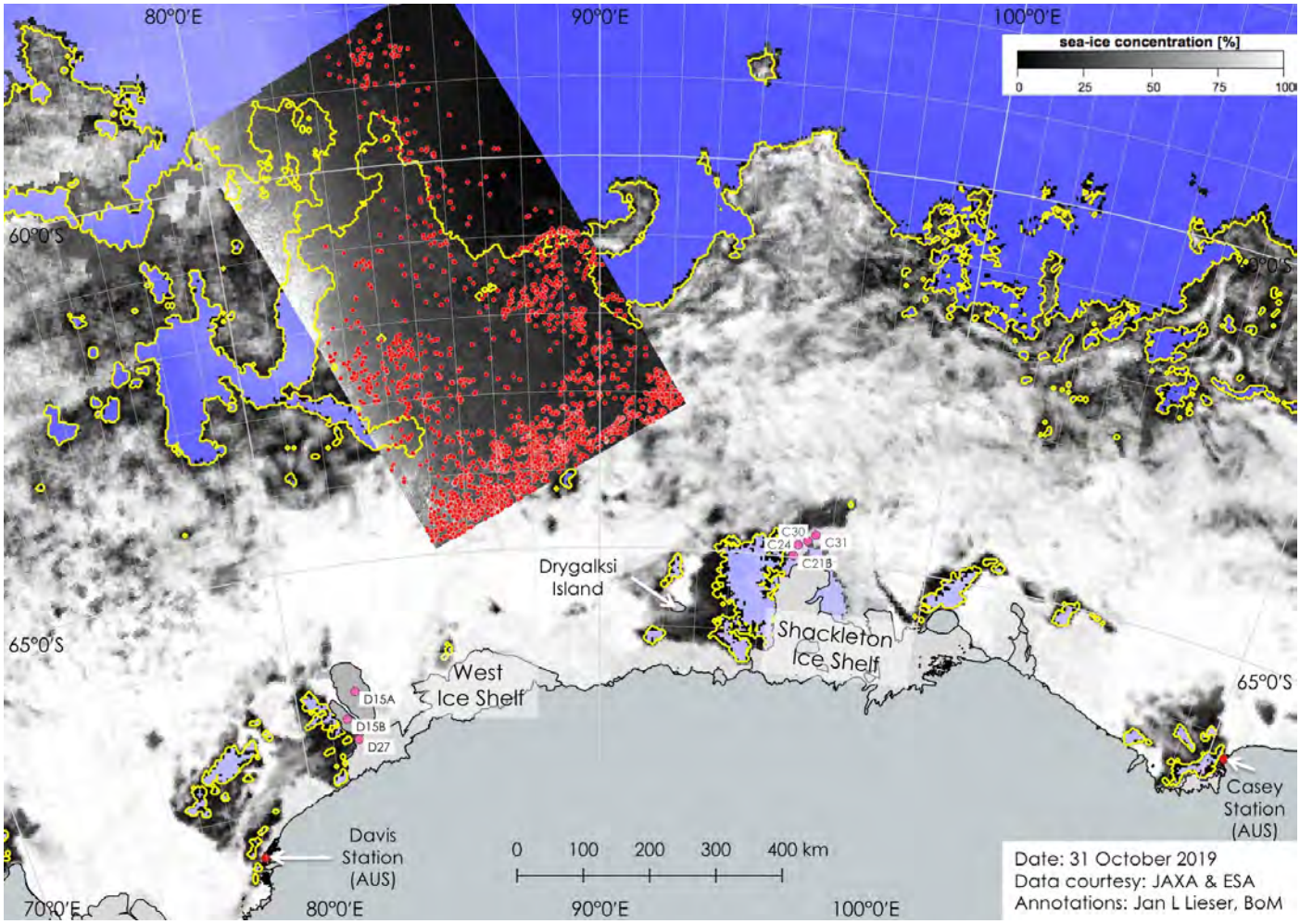


***Figure 1**: Composite of AMSR-2 sea-ice concentration data acquired 31 October 2019 and provided by ICDC, Universität Hamburg, and Sentinel-1a SAR EW scene acquired 31 October 2019 at 13:52 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Saturday 02nd November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of the Vestfold Hills and surrounds. The fast-ice edge based on high-resolution Landsat-8 data from 27 October 2019 (see Ice Bulletin from 28 October 2019) is indicated by the red line.

Recent wind and wave action have moved the fast-ice edge closer to shore. West of the station, fast ice has retreated roughly 1 km shoreward. Further north, larger pieces of fast ice have broken away and south of Sørsdal Ice Shelf fast ice is also starting to break up.

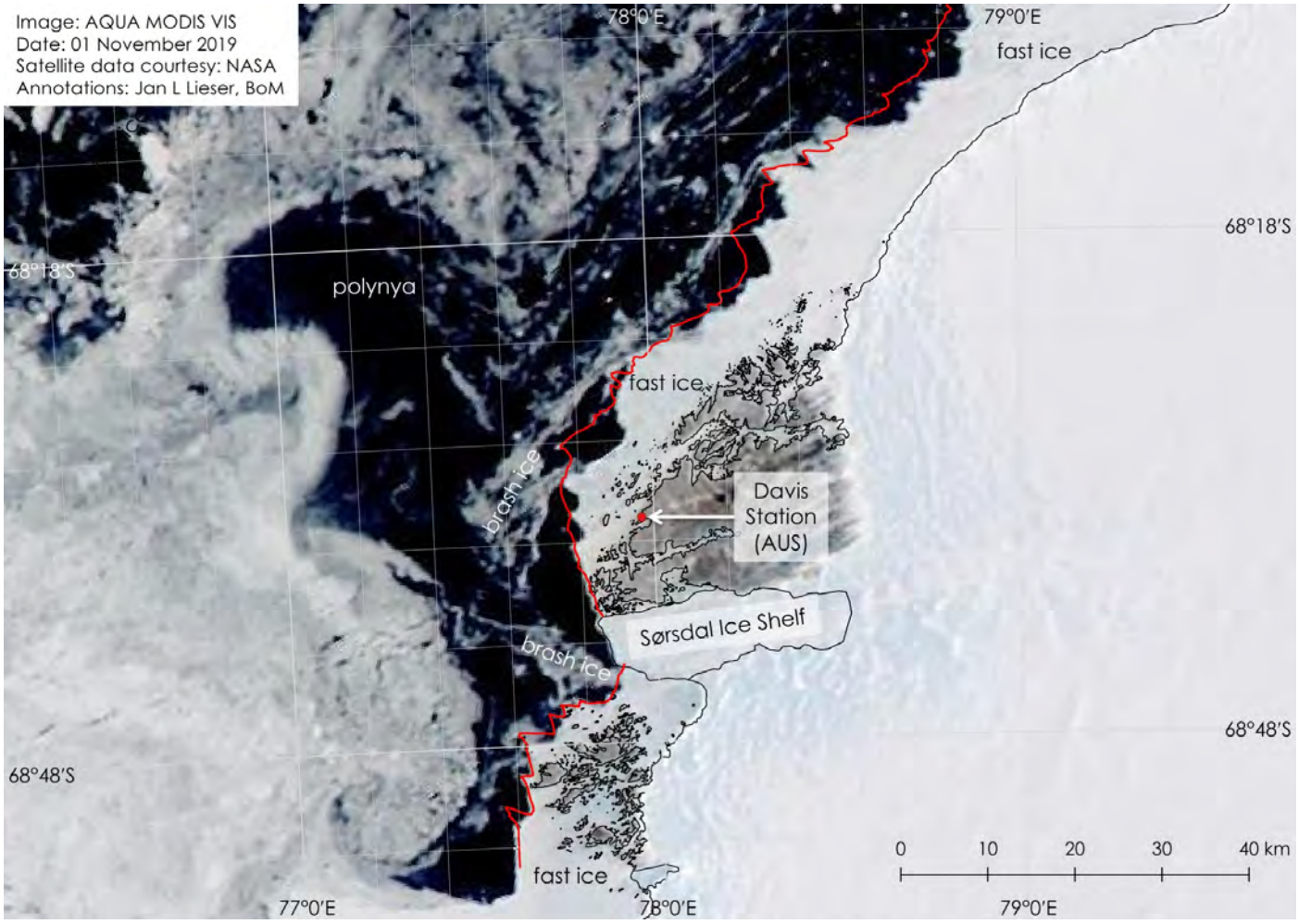


***Figure 1**: AQUA MODIS VIS scene acquired 01 November 2019 and provided by NASA.*

Ice Bulletin: Davis Station

Issued: Sunday 03rd November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of the Vestfold Hills and surrounds. The fast-ice edge based on high-resolution Landsat-8 data from 27 October 2019 (see Ice Bulletin from 28 October 2019) is indicated by the dashed orange line and the current fast-ice edge is approximated by the red line. Some larger icebergs are also marked.

Yesterday's observation of a retreating fast-ice edge is confirmed, and the current edge has moved roughly 2 km shoreward west of the station since 28 October. Further north, larger areas are now free of fast ice.

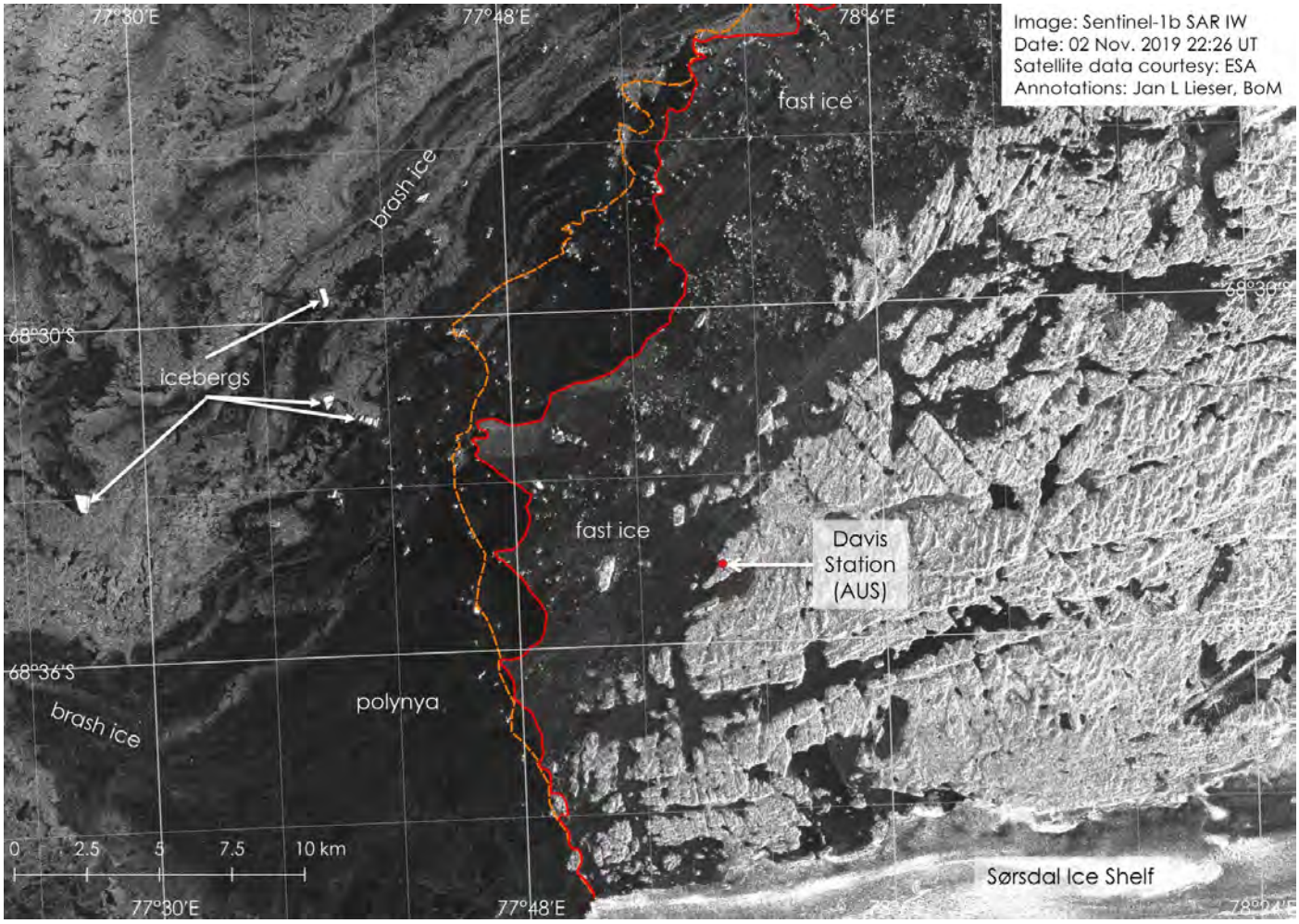


***Figure 1**: Sentinel-1b SAR IW scene acquired 02 November 2019 at 22:26 UT and provided by PolarView.*

Ice Bulletin: Casey Station

Issued: Monday 04th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (20 m horizontal) Synthetic Aperture RADAR (SAR) scene of Casey Station and offshore, including the Swain Group islands northeast of the station. The fast-ice edge is approximated by the red scribble line.

The imagery confirms a further retreating fast-ice edge north of Swan Group. The dashed orange line indicates a transition between temporarily fastened and very smooth (of almost black appearance) sea ice attached to older fast ice closer to the shore.

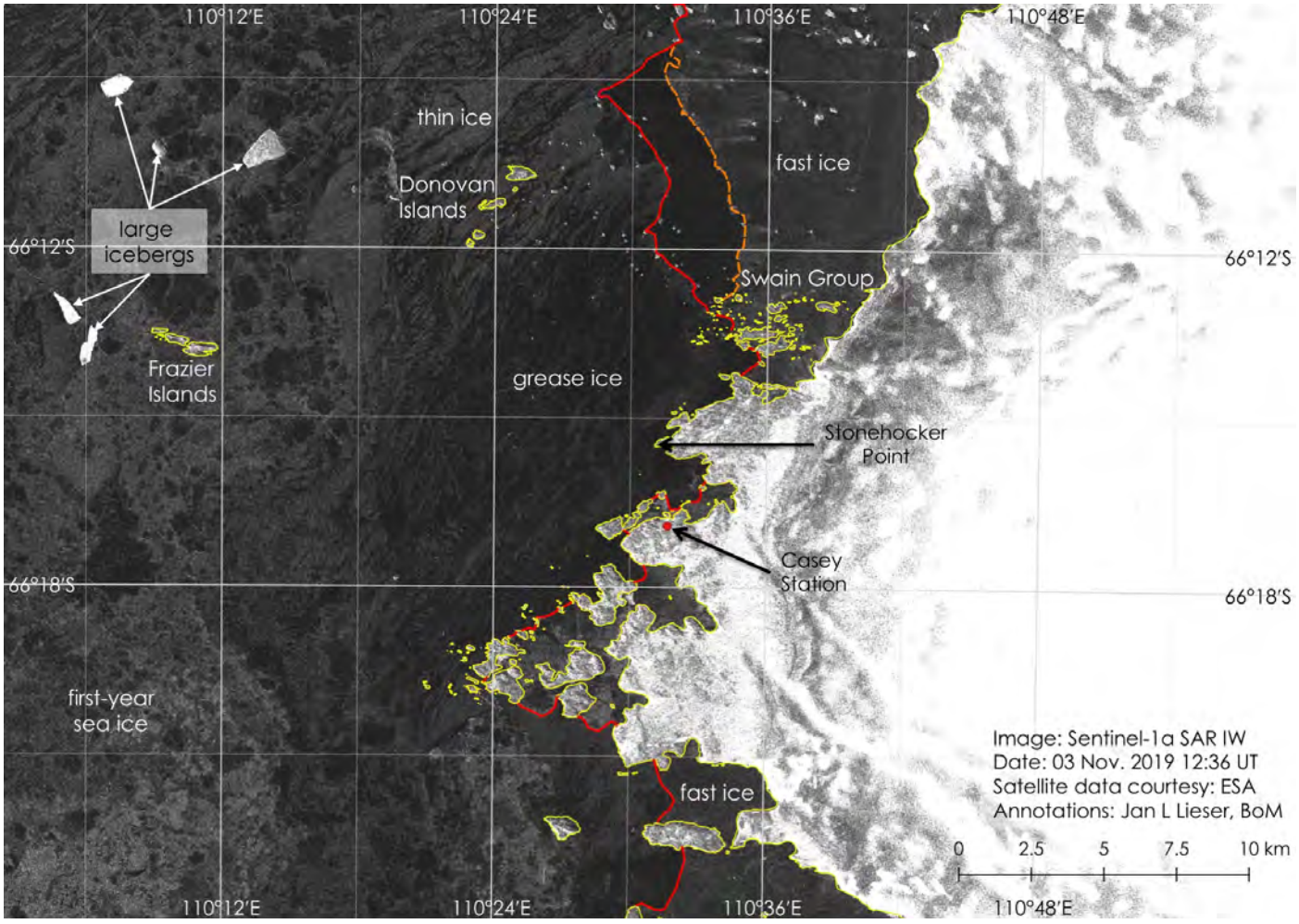


***Figure 1**: SAR scene of Casey Station and offshore acquired 03 November 2019 at 12:36 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Tuesday 05th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data. Additionally, the current cruise track of RSV *Aurora Australis* is marked by the orange line (up until 05 Nov. 2019 02:00 UT).

The vessel is currently operating in sea ice that is below the detection limit of the instrument/algorithm. Strips and patches of thin and decaying sea ice can be identified in SAR data (not shown).

There are many small to medium sized icebergs in the region, the very large icebergs that are present further south (south of 66ºS) are identified and marked.

West of iceberg D-15B, a patch of fast ice that is attached to the iceberg and wrongly classified as 'open water' by the algorithm. Another patch of fast ice is located directly south of iceberg B-39 and classified as very high (up to 100%) concentration of sea ice.

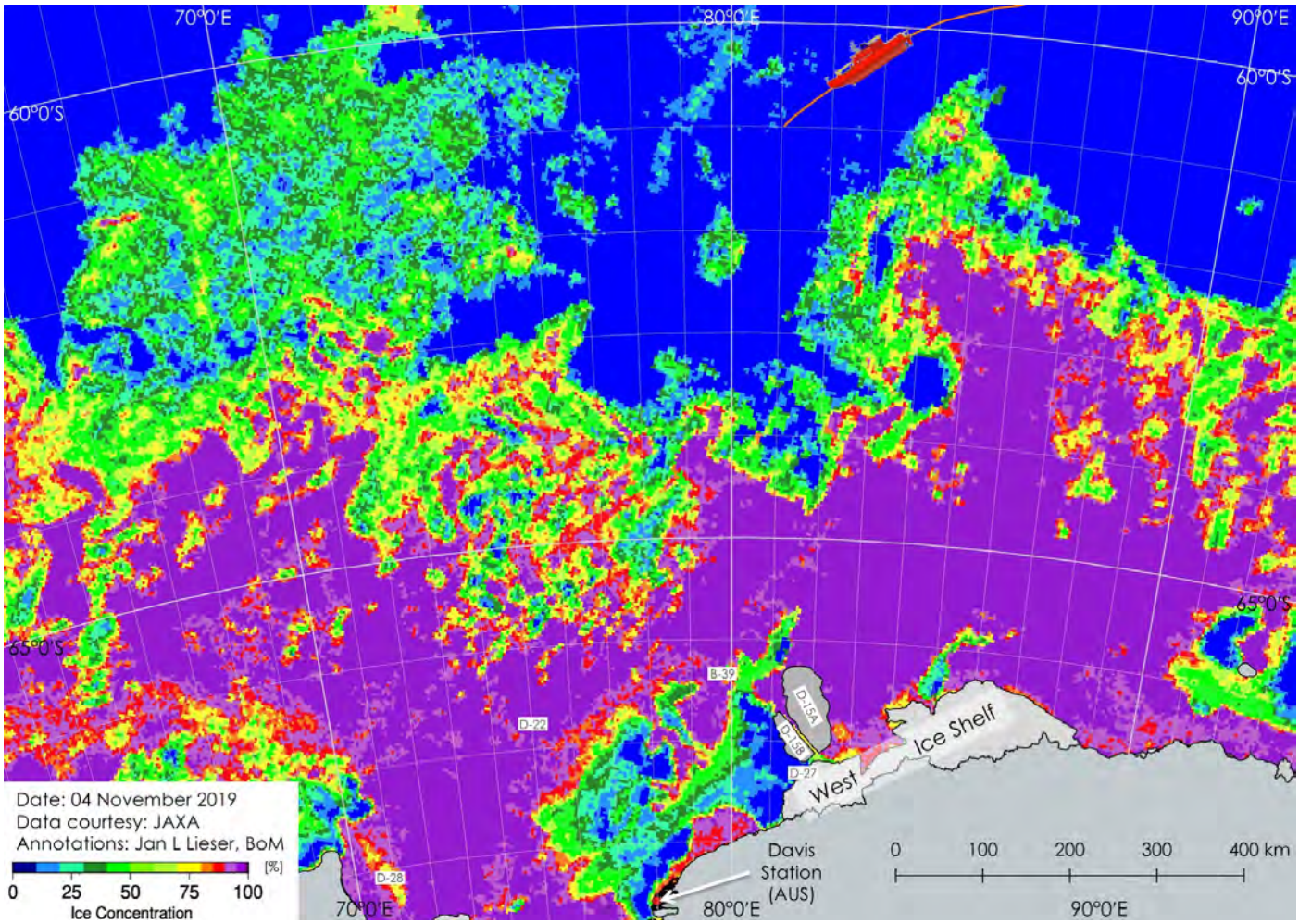


***Figure 1**: Sea-ice concentration chart acquired 04 November 2019 and provided by ICDC, Universität Hamburg.*

Ice Bulletin: Davis Station

Issued: Tuesday 05th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data and a SAR scene. The region is north of the West Ice Shelf. 327 small to medium sized icebergs are identified in the SAR scene marked with white dots. Additionally, the cruise track of RSV *Aurora Australis* is marked by the orange line (up until 05 Nov. 2019 06:20 UT).

The vessel is currently operating in sea ice that is below the detection limit of the AMSR-2 instrument/processing algorithm. Strips and patches of thin and decaying sea ice can be identified in SAR data.

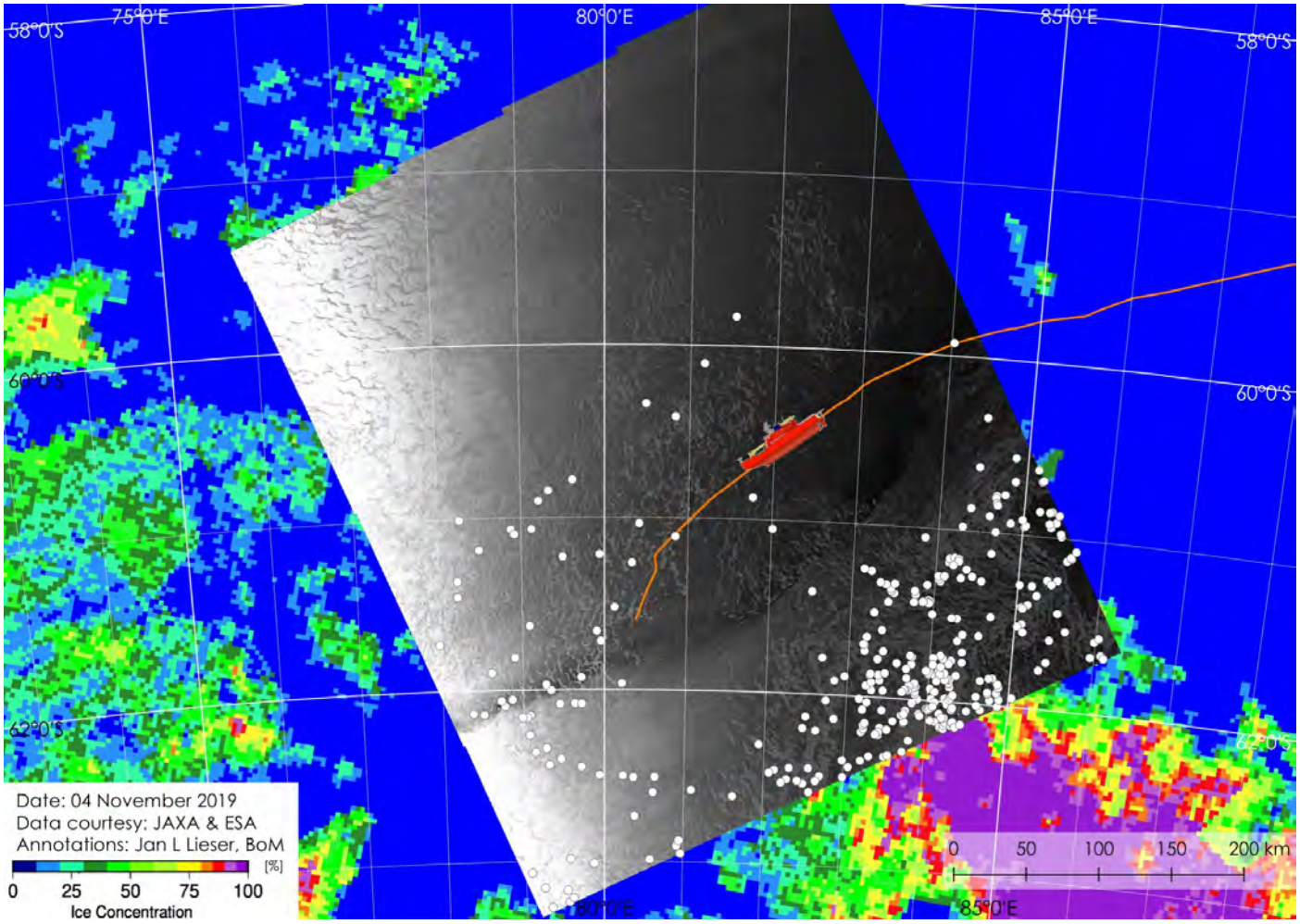


***Figure 1**: Composite of sea-ice concentration chart acquired 04 November 2019 and provided by ICDC, Universität Hamburg, and Sentinel-1b SAR EW scene acquired 04 November 2019 at 14:08 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Wednesday 06th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data. The current cruise track of RSV *Aurora Australis* is marked by the black line (up until 06 Nov. 2019 06:40 UT). Fast-ice areas marked with black-white outlines are based on SAR data acquired 04 Nov. 2019 (outline of the scene marked by the white rectangle).

West of iceberg D-15B, a patch of fast ice that is attached to the iceberg and wrongly classified as 'open water' by the algorithm. Another patch of fast ice is located directly south of iceberg B-39 and classified as very high (up to 100%) concentration of sea ice.

Between 65º30'S and 67ºS, a mixture of old ice and breaking first-year sea ice is to the south of the vessel and the polynya off Davis Station.

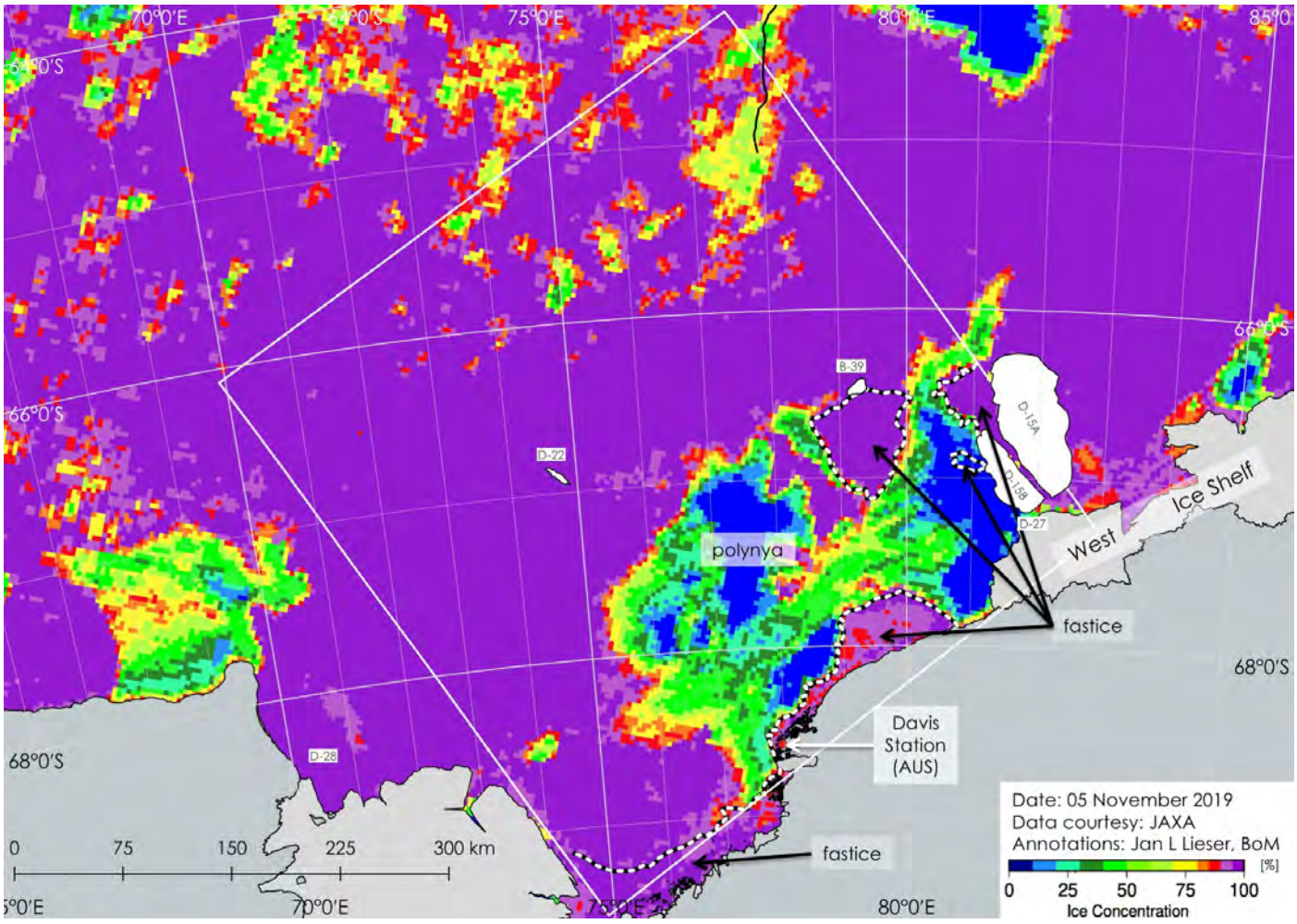


***Figure 1**: Sea-ice concentration chart acquired 05 November 2019 and provided by ICDC, Universität Hamburg.*

Disclaimer: *Every effort is made to ensure the data provided in this bulletin are accurate at the date of publication; however, the bulletin is provided without warranty of any kind. The figures and charts provided in this bulletin are intended only as a guide to ice conditions and are not suitable for navigation.*

Ice Bulletin: Davis Station

Issued: Thursday 07th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of the region northwest of the West Ice Shelf. The current cruise track of RSV *Aurora Australis* is marked by the orange line (up until 06 Nov. 2019 23:10 UT). Fast-ice areas are marked with red outlines. The position of iceberg B-39 on 04 Nov. 2019 is marked by a white outline; its position on 26 Oct. 2019 is marked by a dashed white outline.

Lines of grounded icebergs are marked in light blue. Those grounded icebergs trap drifting sea ice at their windward (eastern) side.

Vast floes or old sea ice (yellow outlines) have been tracked since 04 Nov. 2019 and moved south-westward at an average speed of 0.3 knots during those 48 hours of tracking.

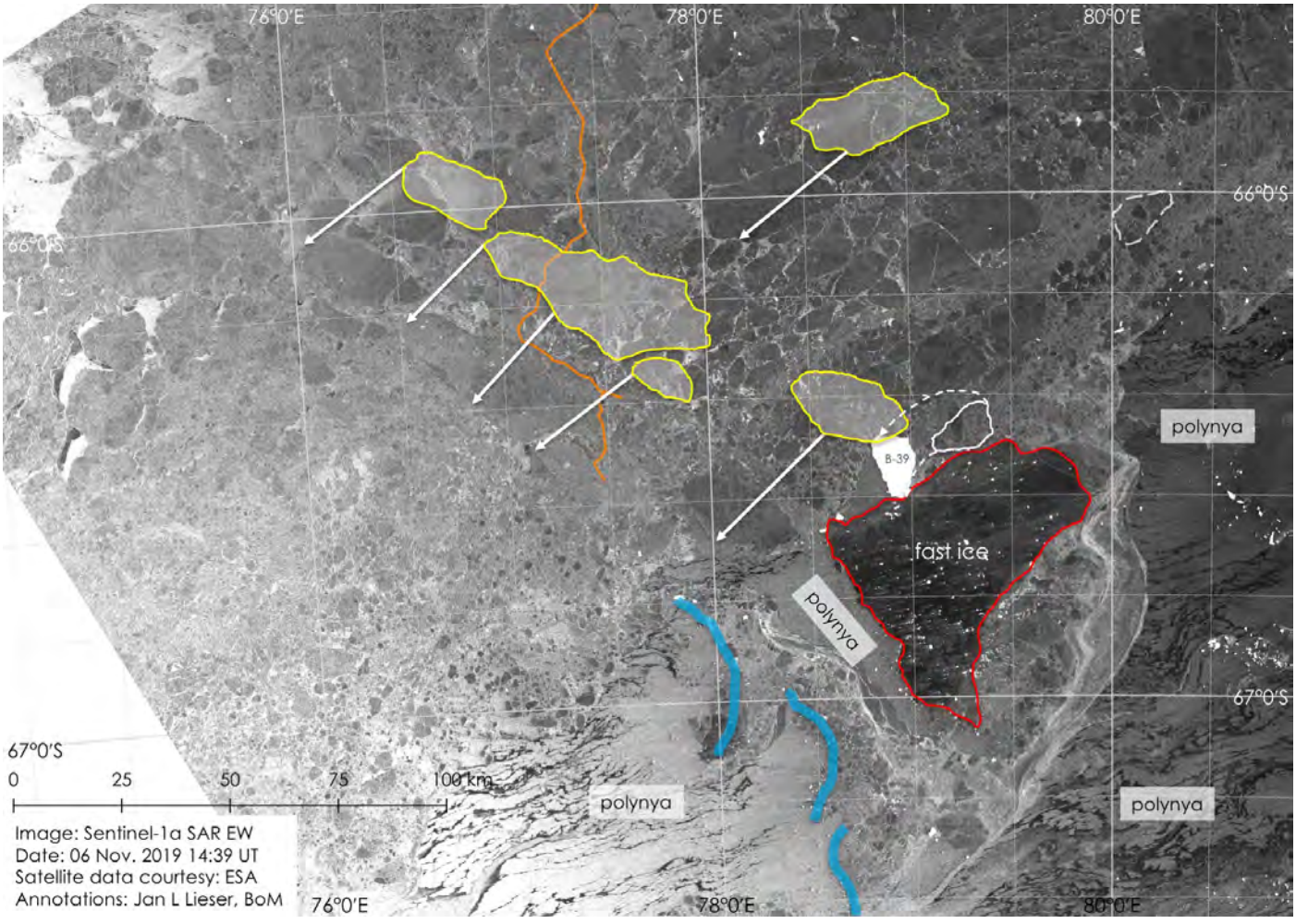


***Figure 1**: Sentinel-1a SAR EW scene acquired 06 November 2019 at 14:39 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Friday 08th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of the Vestfold Hills and offshore. The current cruise track of RSV *Aurora Australis* is marked by the orange line - up until 07 Nov. 2019 13:20 UT when the vessel arrived at the fast-ice edge. The fast-ice edge is marked by the red line.

The ship can be identified as a bright white spot just inside the fast ice at the time of satellite data acquisition. The white strip between the end of the orange track and the position of the ship is broken fast ice in the wake of the ship.

Many icebergs show as white patches and dots offshore. The majority is still trapped in shore-fast sea ice, but some are floating freely in the polynya off the fast-ice edge.

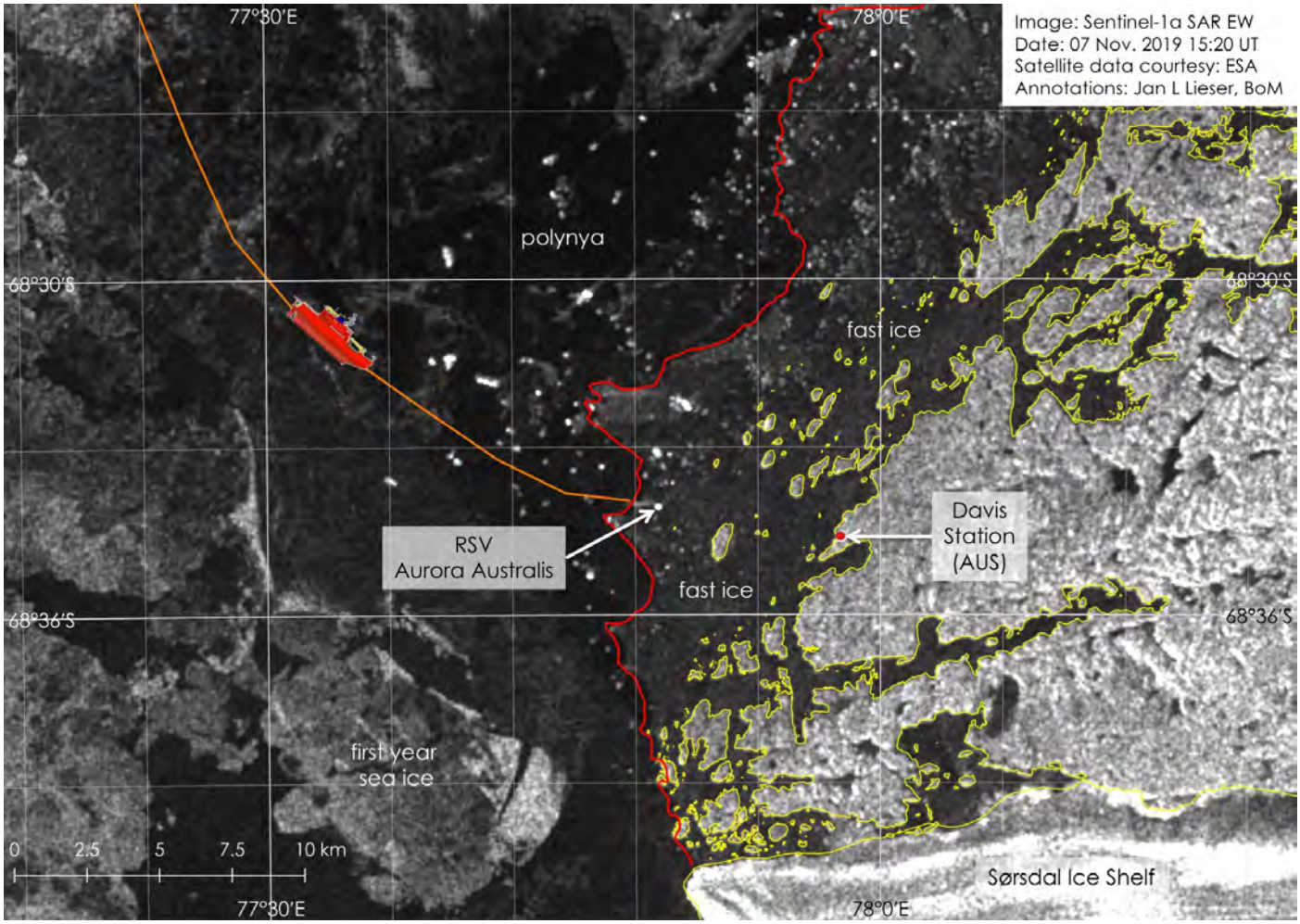


***Figure 1**: Sentinel-1a SAR EW scene acquired 07 November 2019 at 15:20 UT and provided by PolarView.*

Ice Bulletin: Mawson Station

Issued: Friday 08th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Coast and offshore. The fast-ice edge is marked by the red line. Rows of many icebergs north of the fast-ice edge are marked with blue brush lines. Those icebergs trap sea ice in its westward drift and create patchy open water in their lee.

Northwest of Mawson Station, fast ice starts to break up and the typical sawtooth pattern at the edge of the polynya is apparent. Some floes of ex-fast ice can be identified as dark patches in the western part of the polynya.

The shortest distance between the open water of the polynya and the station is roughly 33 nautical miles.

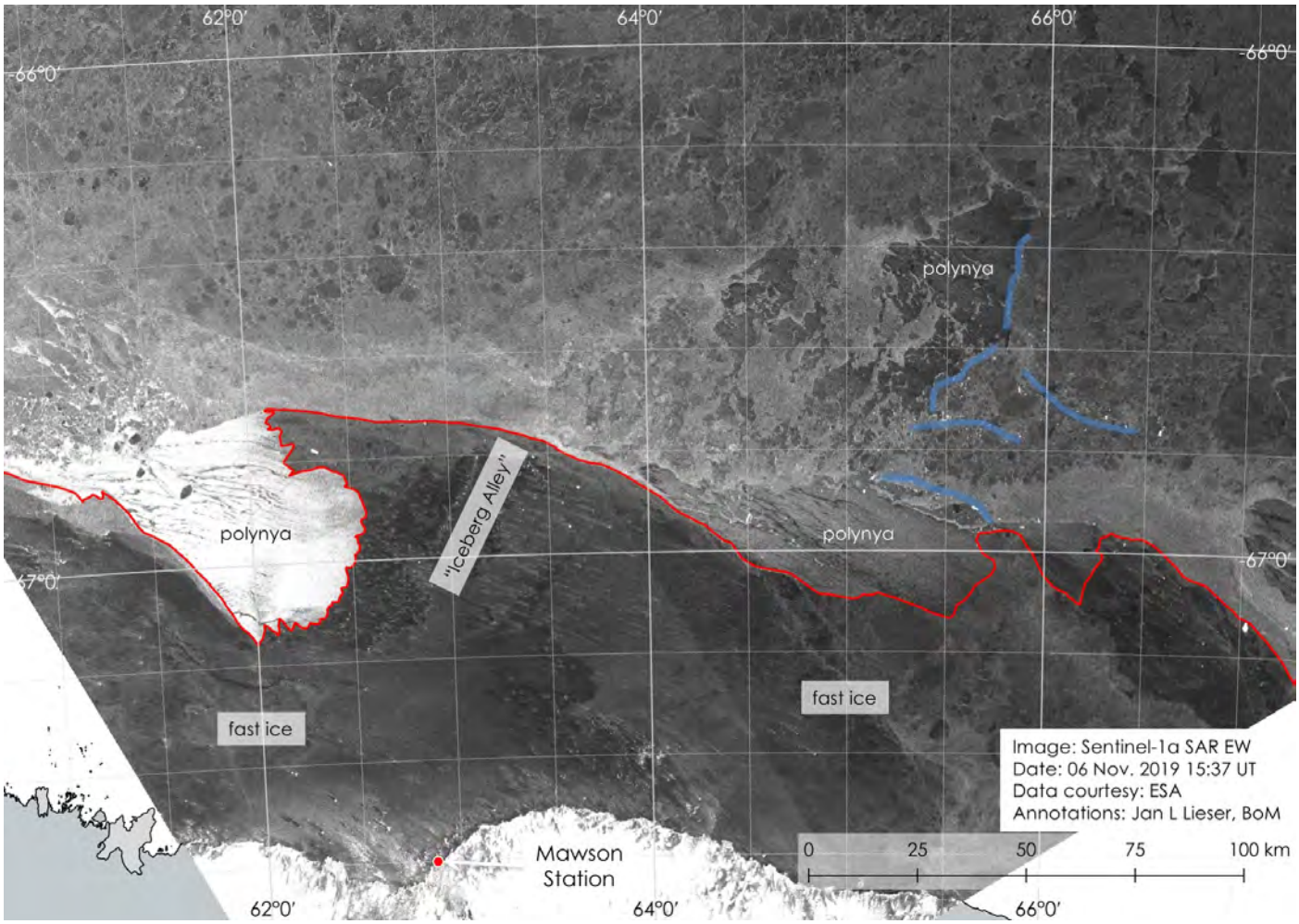


***Figure 1**: Sentinel-1a SAR EW scene acquired 06 November 2019 at 15:37 UT and provided by PolarView.*

Ice Bulletin: Casey Station

Issued: Friday 08th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Vincennes Bay/Casey Station and offshore. The fast-ice edge is marked by the red line. Wilkins Aerodrome can be seen in the southeast corner of the figure (marked by an orange ellipse).

North and south of Casey Station, the fast-ice edge continues to retreat towards the shore. Grease ice and thin sea ice can be identified in strips and patches offshore Vanderford Ice Shelf. Those patches are carried by small-scale oceanic eddies, which result in the typical swirl patterns.

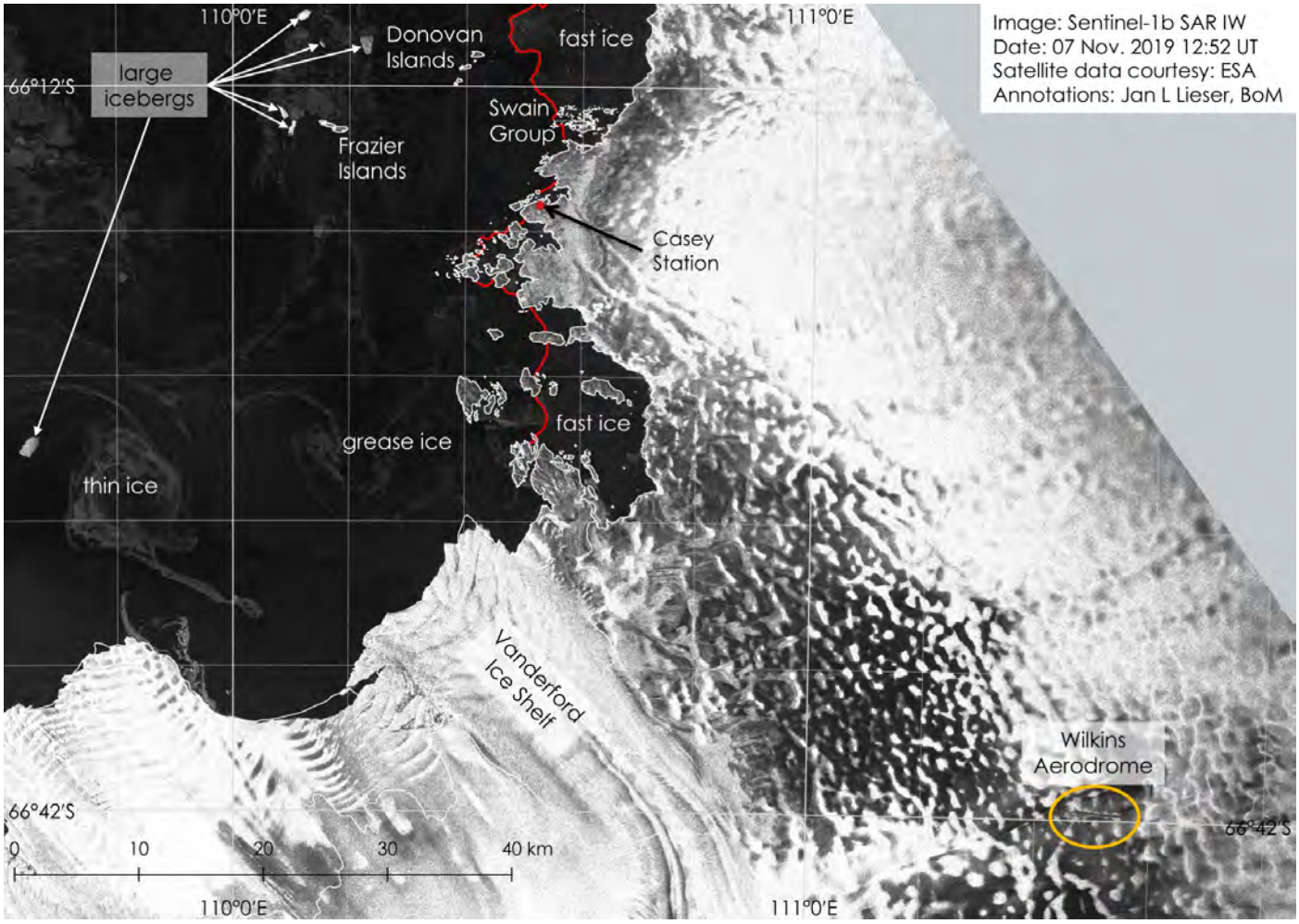


***Figure 1**: Sentinel-1b SAR IW scene acquired 07 November 2019 at 12:52 UT and provided by PolarView.*

Figure 2 shows a high-resolution sea-ice concentration chart of the wider area around Casey Station. The black frame indicates the position of the entire SAR scene, of which a part is shown in Figure 1.

The sea-ice edge is highly mobile, and patches of sea ice are carried by larger-scale oceanic currents as far north as 60ºS.

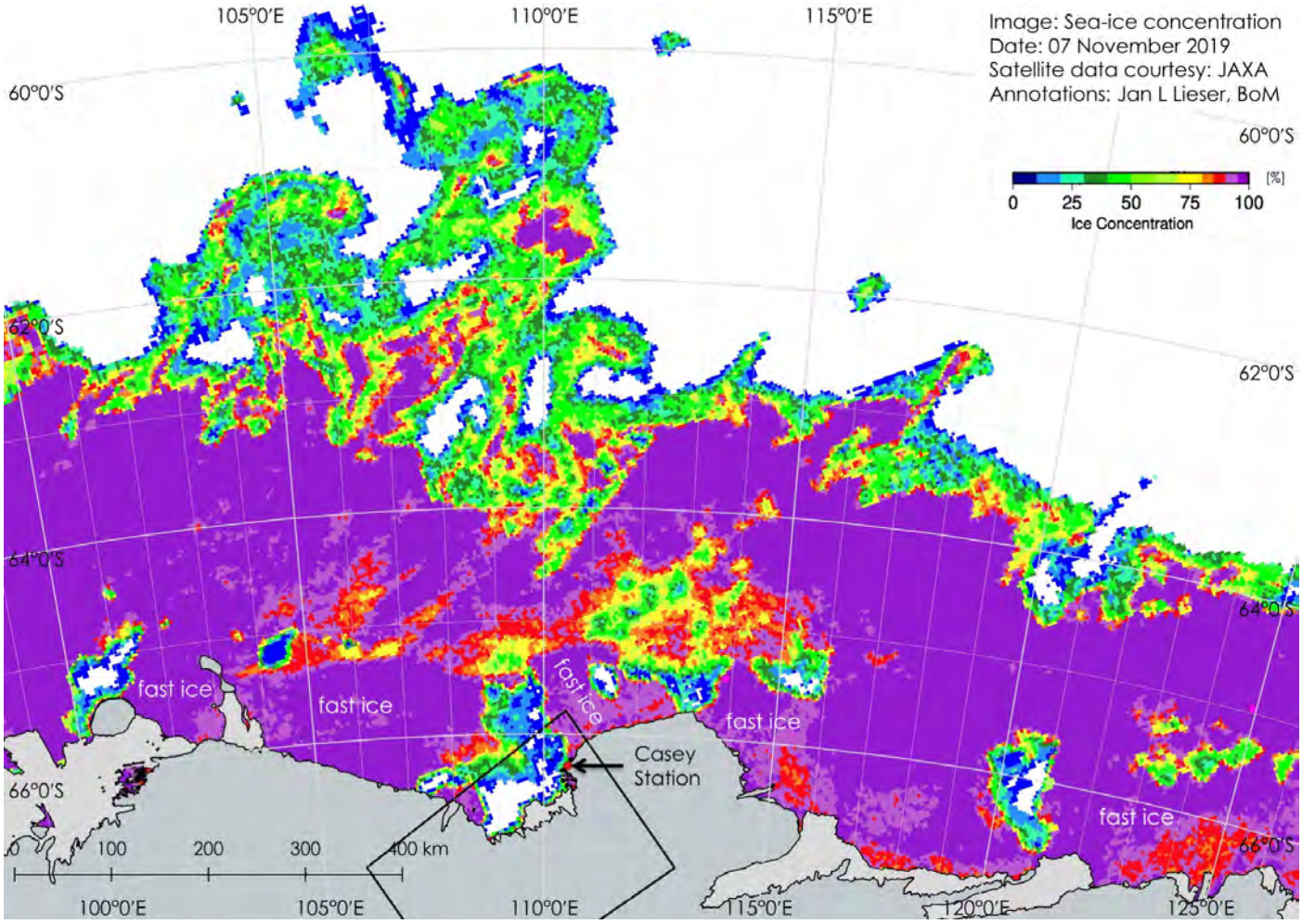


***Figure 2**: Sea-ice concentration chart acquired 07 November 2019 and provided by ICDC, Universität Hamburg.*

Ice Bulletin: D'Urville Sea

Issued: Friday 08th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of D'Urville Sea. The positions of four large tabular icebergs on 28 Feb. 2019 are marked by pink outlines. Iceberg C-34 has since left the area and iceberg C-33 has entered the region from the east.

During the winter season, icebergs B-9B and C-15 have gradually nudged their way north-westward, while still being trapped behind smaller but grounded icebergs to their north and west. Iceberg C-29 has not moved and a large fragment of iceberg C-29 is trapped between the three large tabular icebergs and smaller icebergs in the north.

The sea between Cape Denison and iceberg B-9B is covered with fast ice of different age (showing in shades of grey). A polynya west of the icebergs north of Cape Denison is currently covered by thin first-year sea ice.

North of Dumont D'Urville Station, icebergs can be seen grounded in a 12 km long row, with fast ice accreting to the east of those icebergs and a polynya north and west of the icebergs.

The sea-ice edge (not shown) is approximately 240 nautical miles north of the coast.

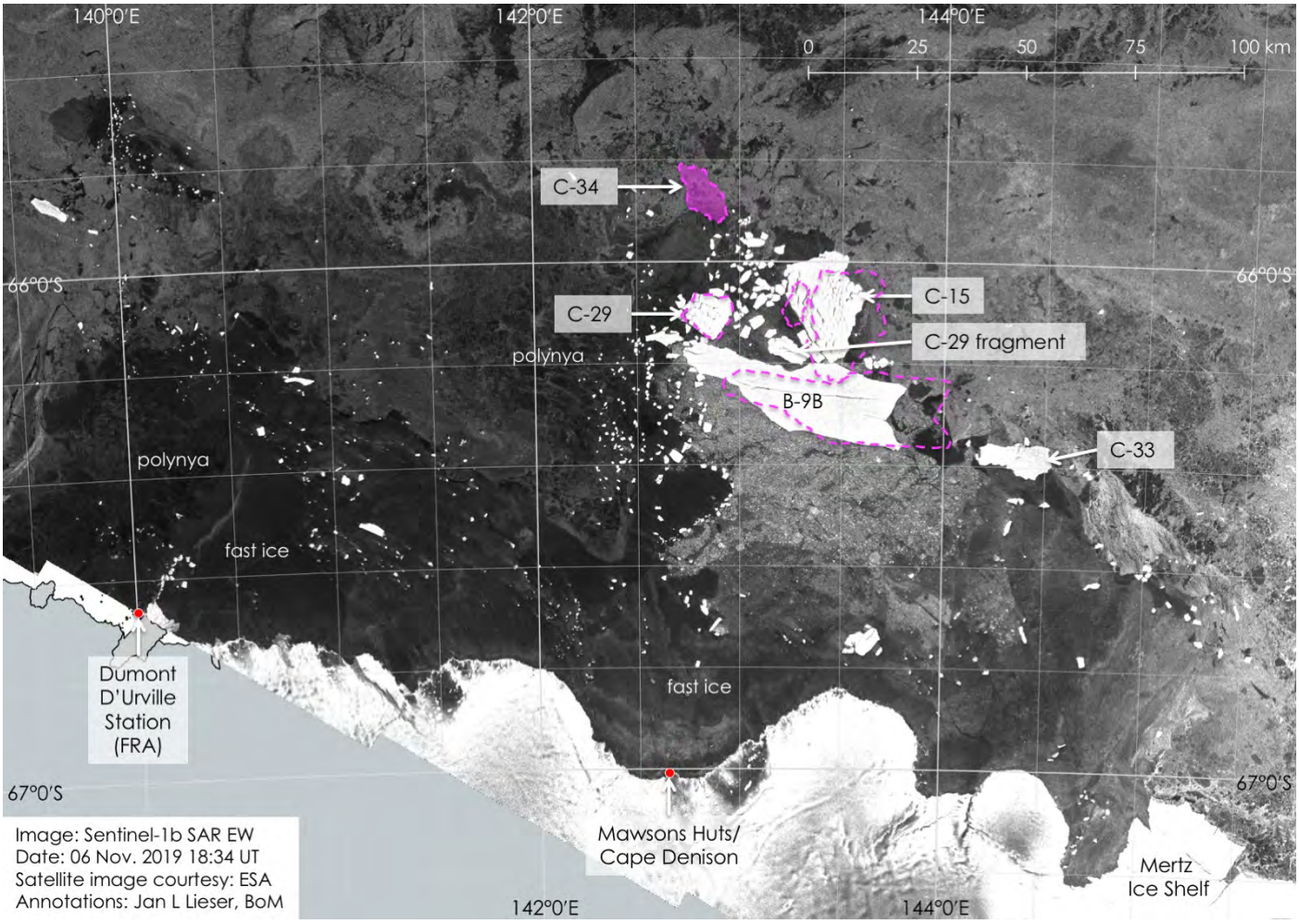


***Figure 1**: Sentinel-1b SAR EW scene acquired 06 November 2019 at 18:34 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Saturday 09th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Davis Station and offshore. The current cruise track of RSV *Aurora Australis* is marked by the orange line - up until 07 Nov. 2019 13:20 UT when the vessel arrived at the fast-ice edge at roughly 77°48'E longitude.

The ship can be seen as a bright white spot inside the fast ice at the time of satellite data acquisition. The white strip between the end of the orange track and the position of the ship is broken fast ice in the wake of the ship. The ice road and the Davis sea-ice Skiway are also marked in the imagery.

Many icebergs show as white patches and dots offshore. The majority is still trapped in shore-fast sea ice, but some are floating freely in the polynya off the fast-ice edge.

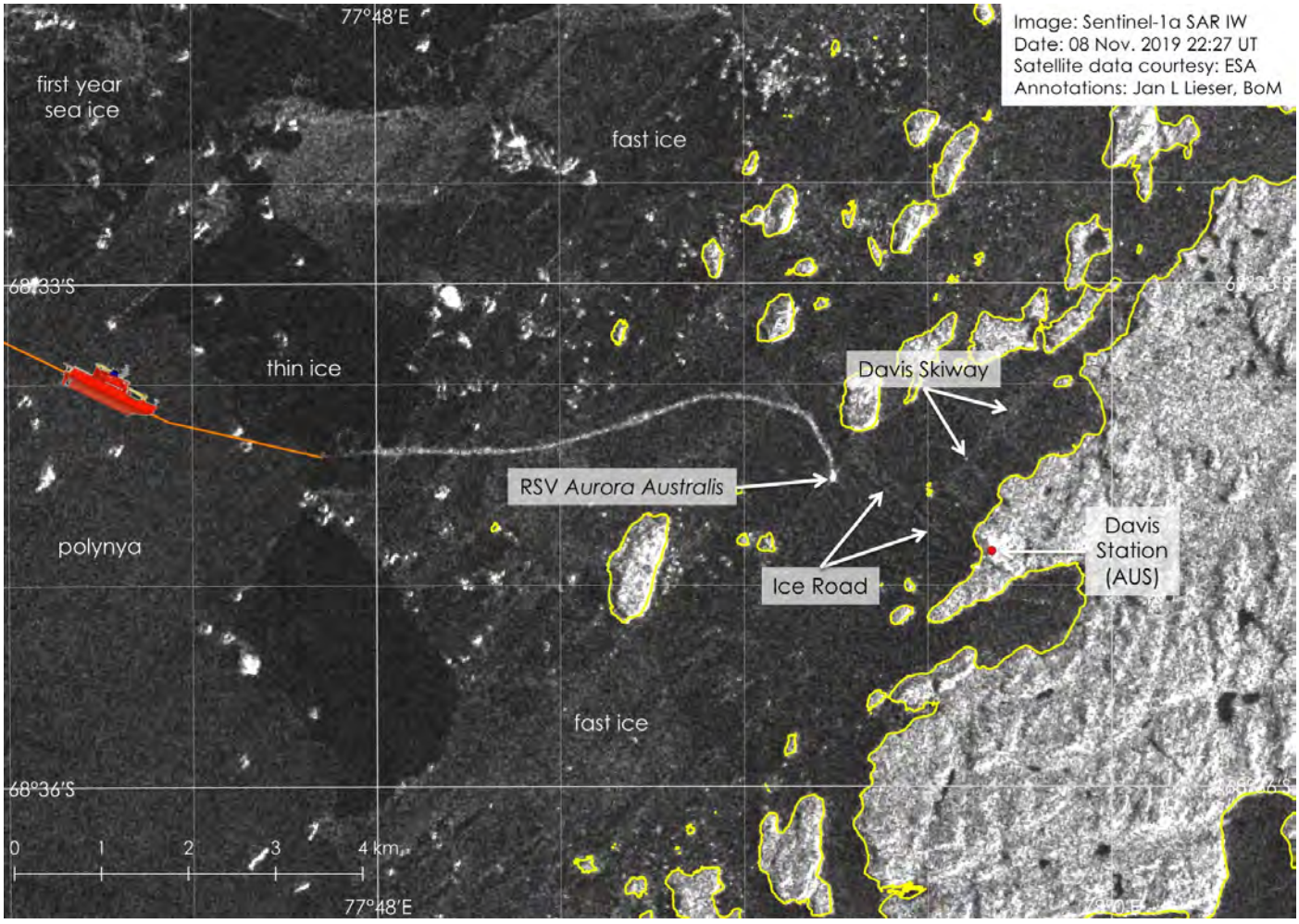


***Figure 1**: Sentinel-1a SAR IW scene acquired 08 November 2019 at 22:27 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Monday 11th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (15 m horizontal) panchromatic scene of Davis Station and offshore. The recent cruise track of RSV *Aurora Australis* is marked by the orange line - up until 07 Nov. 2019 13:20 UT when the vessel arrived at the fast-ice edge at roughly 77°48'E longitude. The scene is very slightly obscured by thin clouds.

The ship can be seen as a dark spot inside the fast ice at the time of satellite data acquisition. The dark strip between the end of the orange track and the position of the ship is broken fast ice. The ice road and the Davis sea-ice Skiway are also marked in the imagery.

Many icebergs can be identified offshore. The majority is still trapped in shore-fast sea ice, but some are floating freely in the polynya off the fast-ice edge. Snow accumulates at the windward side of those icebergs, whereas in the lee of the icebergs snow-free areas can be seen. White patchiness on the fast-ice areas is caused by smaller scale snow accumulations.

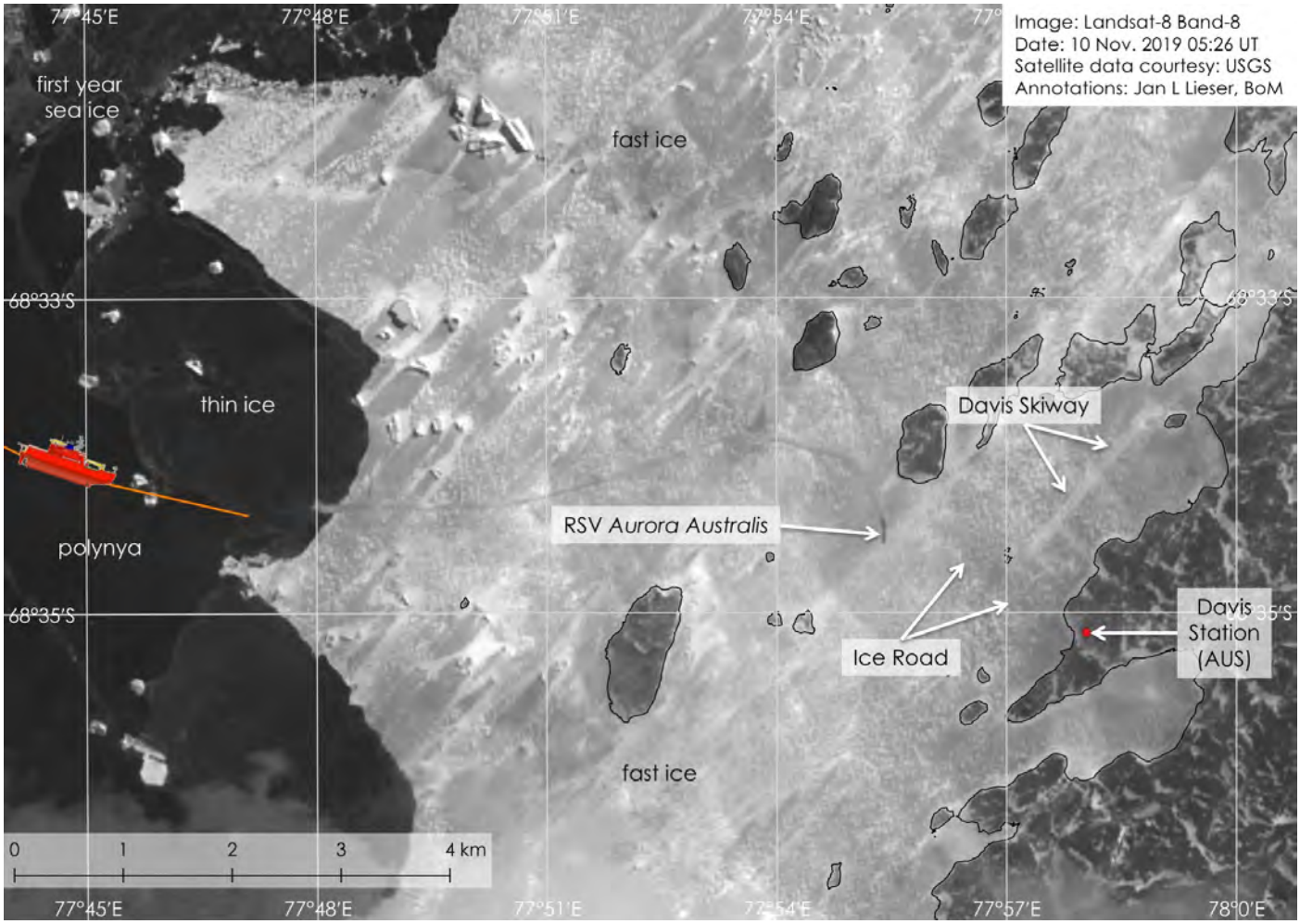


***Figure 1**: Landsat-8 Band-8 (panchromatic) scene acquired 10 November 2019 at 05:26 UT and provided by USGS.*

Ice Bulletin: Antarctica

Issued: Thursday 14th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows the pan-Antarctic sea-ice concentration anomaly based on passive microwave remote sensing data.

After reaching the annual sea-ice extent for 2019 at the end of September, the extent of sea ice reduced during October and fell to the third lowest extent on record by the end of the month. Below average conditions are found in the eastern Weddell Sea, parts of East Antarctica, western Ross Sea and the Amundsen Sea.

Between 110ºE and 180º and in the Bellingshausen Sea, the sea-ice extent was very close to the climatological average. Only in the western Weddell Sea, slightly above average sea-ice extent was observed.

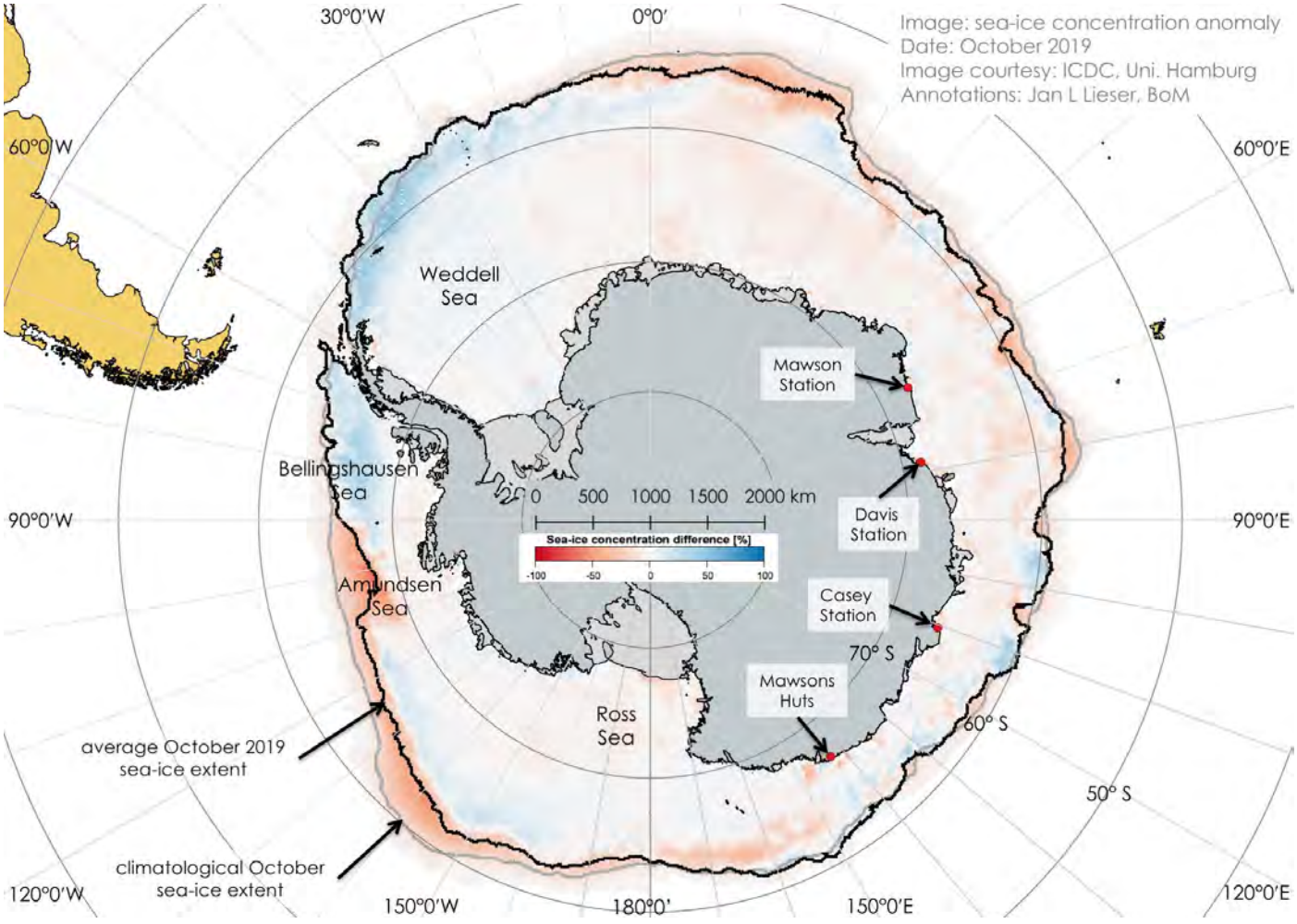


***Figure 1**: Sea-ice concentration anomaly for October 2019 provided by ICDC (Universität Hamburg).*

Ice Bulletin: Davis Station

Issued: Thursday 14th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data and a SAR scene. 2881 icebergs are marked by yellow dots based on the SAR data.

The SAR scene shows that sea ice extends farther north than the AMSR-2 data suggest (the black line continues the sea-ice edge through the SAR data). Even further north, icebergs are drifting freely as far north as 58º30'S.

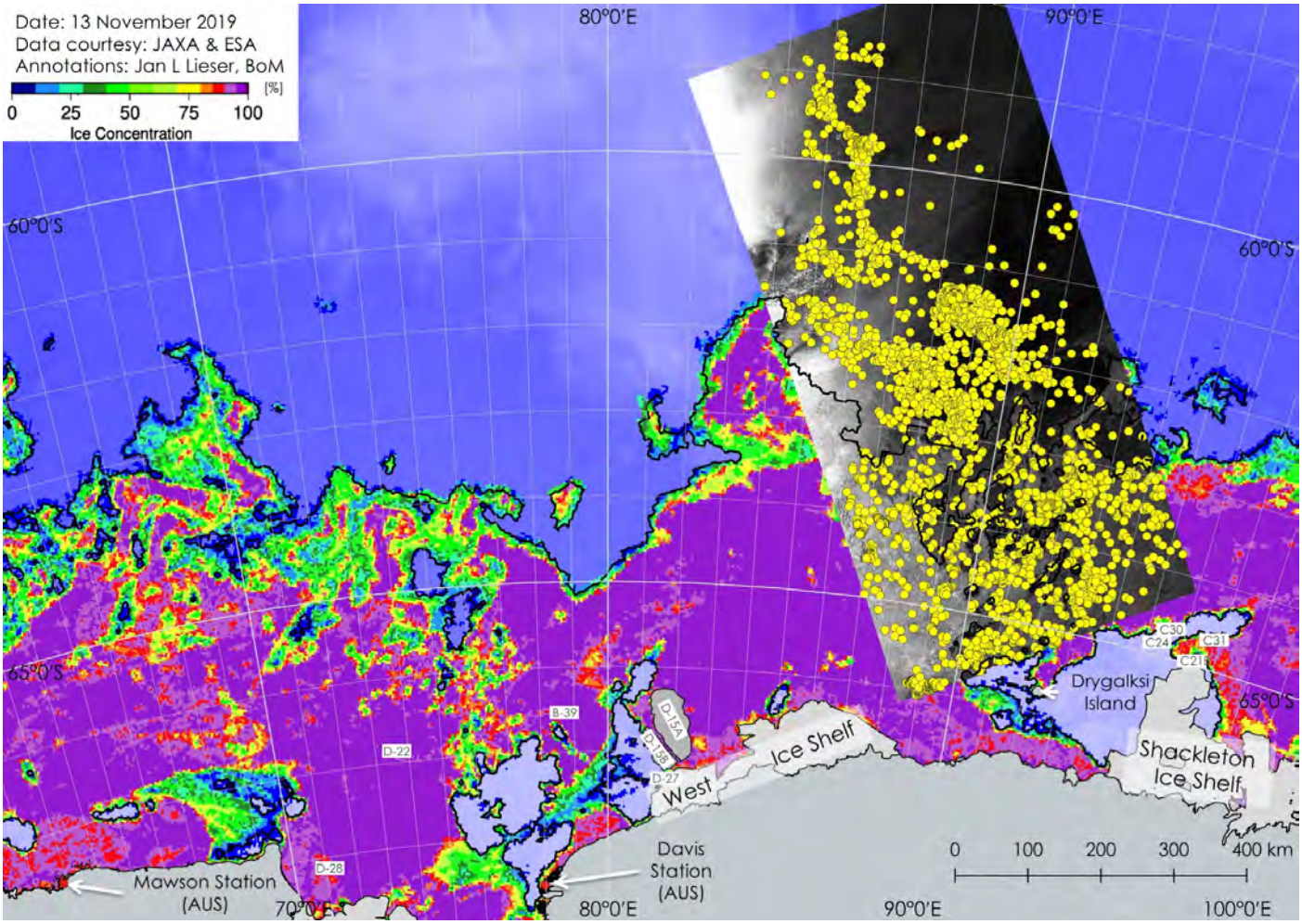


***Figure 1**: Sea-ice concentration chart acquired 13 November 2019 and provided by ICDC, Universität Hamburg.*

Figure 2 shows the same geographical frame as Figure 1, but a sea-ice concentration difference chart of high-resolution (3.125 km horizontal) sea-ice concentration data based on AMSR-2 data.

During the past week, sea ice has reduced in most areas (showing in green) with only smaller pockets of increased sea-ice concentration (showing in red) due to locally convergent drift.

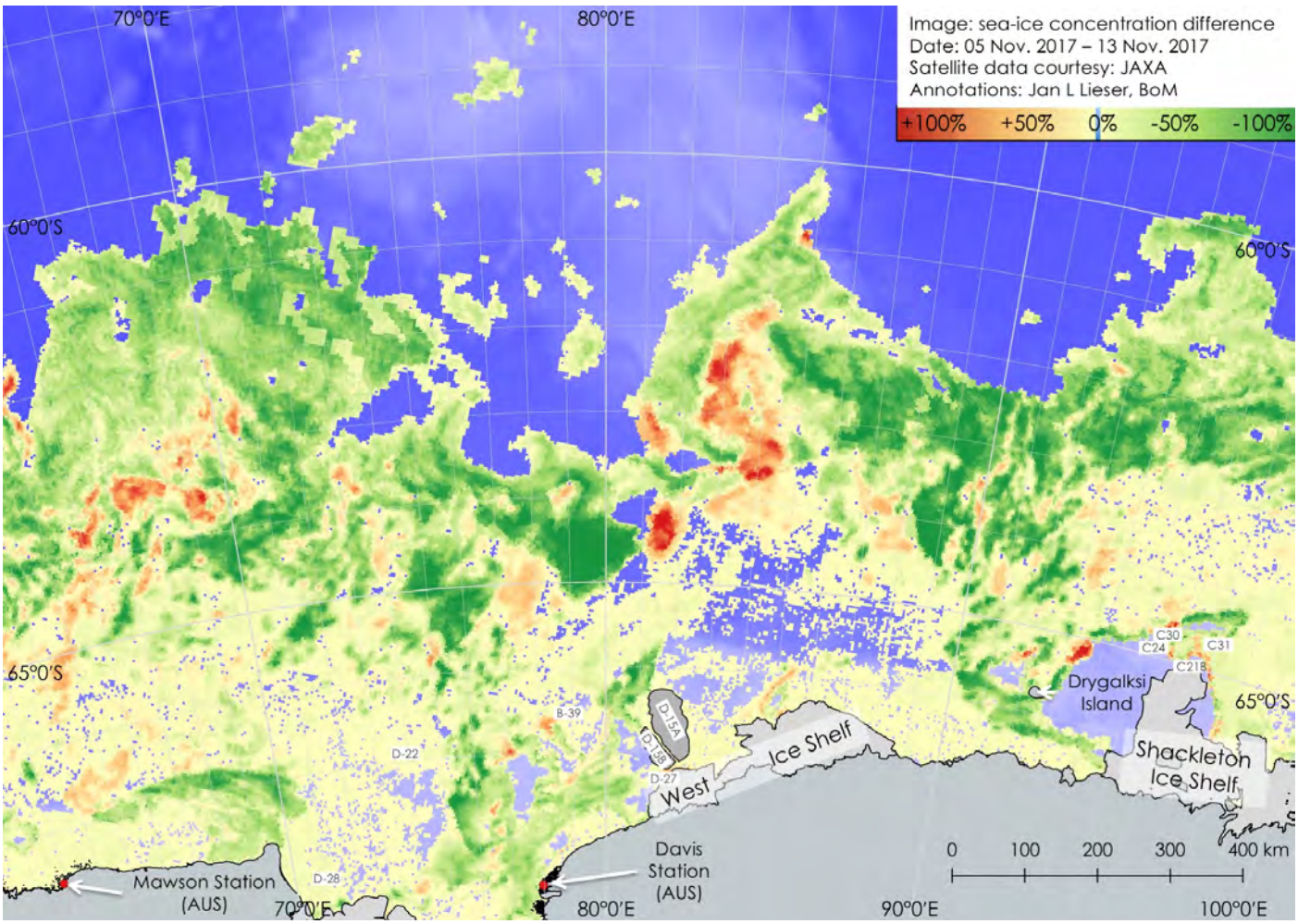


***Figure 2**: Sea-ice concentration difference chart for 05-13 November 2019 based in AMSR-2 data provided by ICDC, Universität Hamburg.*

Ice Bulletin: Dumont D'Urville Station

Issued: Tuesday 19th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data and a SAR scene.

The SAR scene shows the detection limits for thin and low concentration of sea ice in the AMSR-2 data (the white line continues the sea-ice edge through the SAR data). Further north, icebergs are drifting freely as far north as 61º30'S.

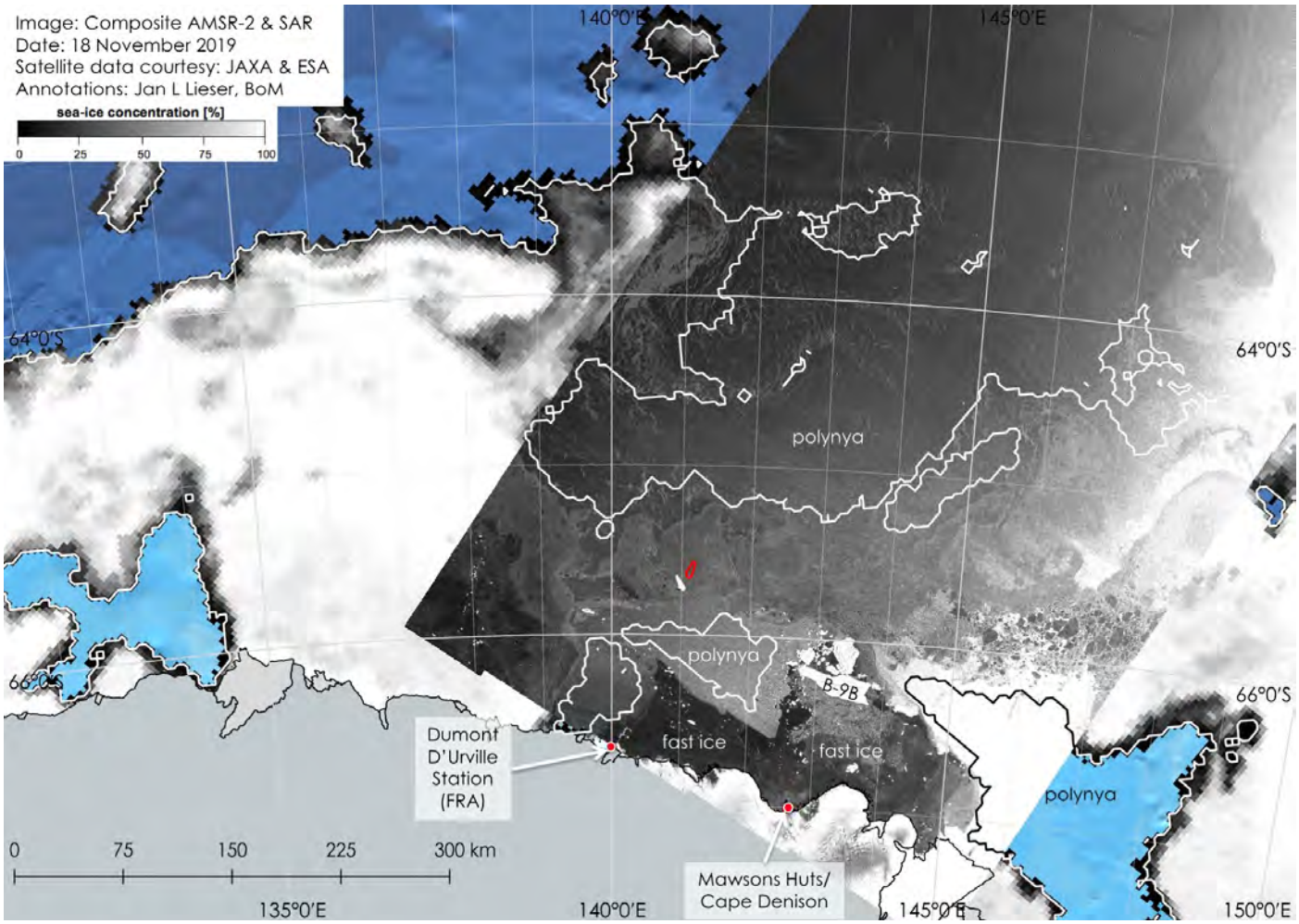


***Figure 1**: Composite of a sea-ice concentration chart acquired 18 November 2019 and provided by ICDC, Universität Hamburg and Sentinel-1b SAR EW data acquired 18 November 2019 at 18:34 UT and provided by PolarView.*

Figure 2 shows two panels of the same SAR scene at different scales. The fast-ice edge off Dumont D'Urville Station based on SAR data acquired roughly 24 hours earlier is marked by a red line. One free-drifting large iceberg is also marked by a red outline; it travelled roughly 11 km southward during the 24 hours.

The fast ice is breaking up at its edges but remains stabilised where grounded icebergs act as anchor points. The shortest distance between the fast-ice edge and the station is roughly 11 km.

North of the fast ice, sea ice is generally melting and drifting freely with only one band of high concentration between 65ºS and 66ºS. Along 140ºE and to the west of it, large patches of open water connect the two polynyas.

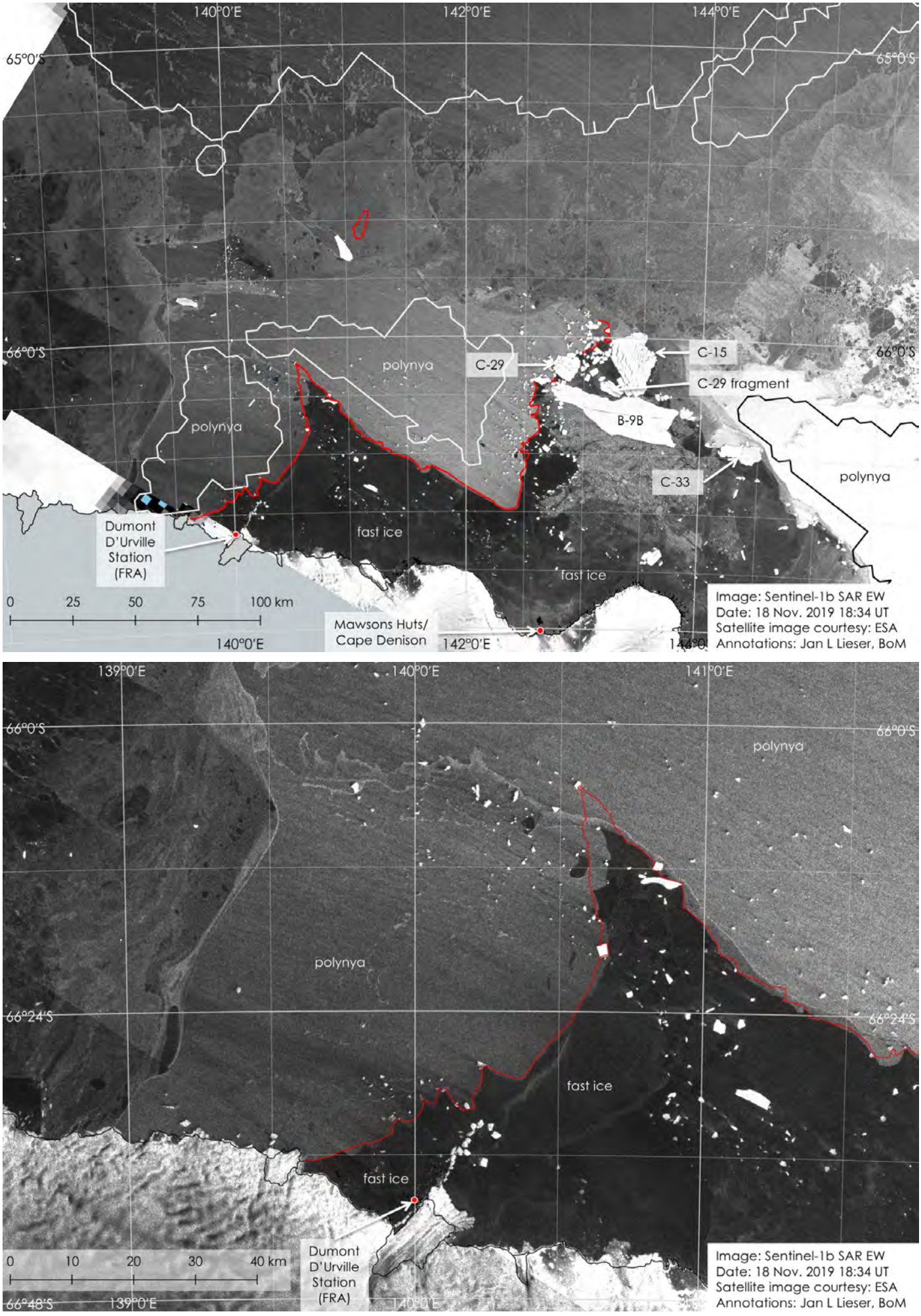


***Figure 2**: Sentinel-1b SAR EW acquired 18 November 2019 at 18:34 UT and provided by PolarView.*

Ice Bulletin: Dumont D'Urville Station

Issued: Tuesday 19th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data and locations of icebergs (marked by green dots) based on analysis of SAR data (acquired 18 November 2019; black frame).

1174 icebergs have been identified, the majority of which is confined to water depth of less than 350 m.

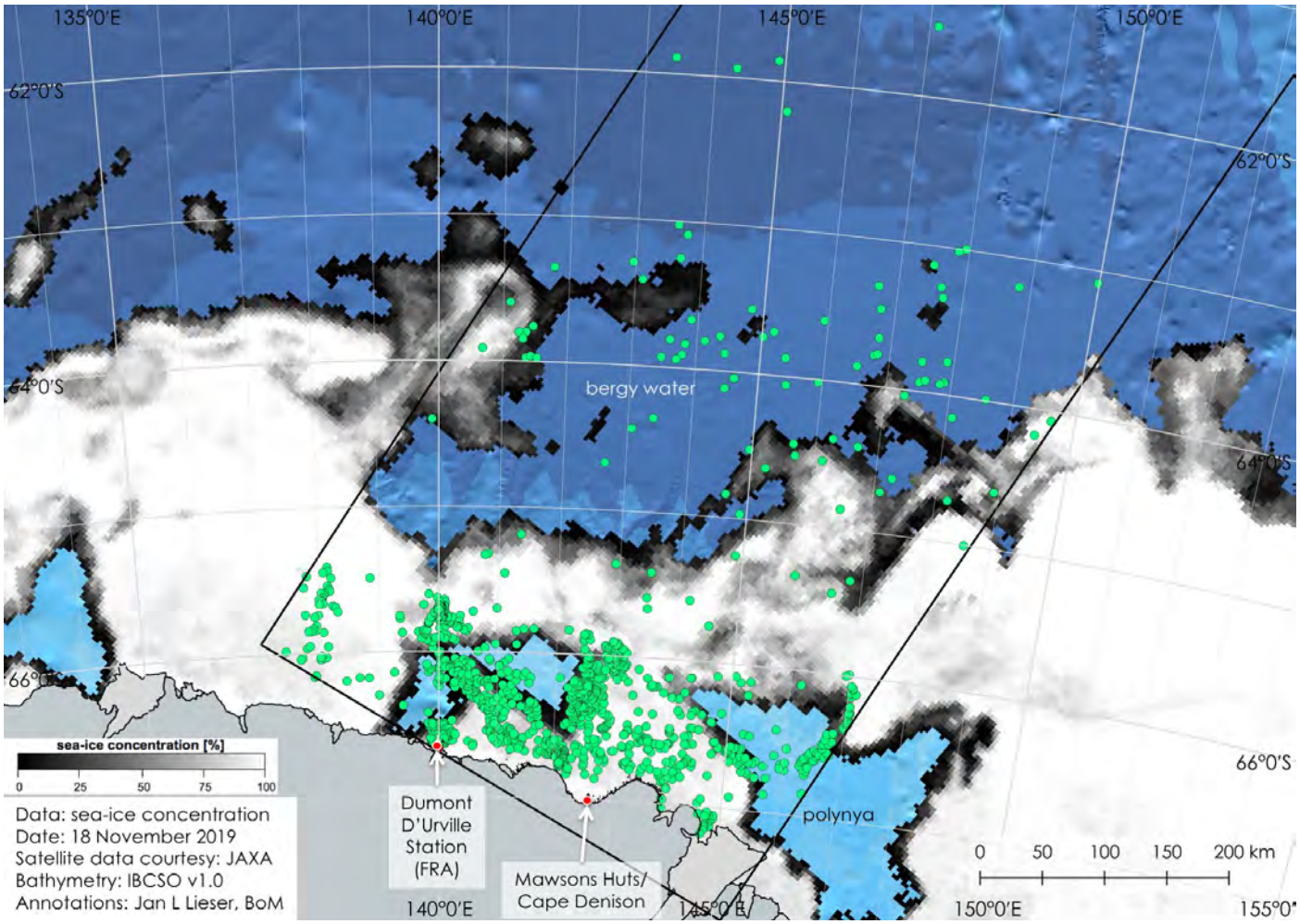


***Figure 1**: Sea-ice concentration chart acquired 18 November 2019 and provided by ICDC, Universität Hamburg.*

Ice Bulletin: Dumont D'Urville Station

Issued: Wednesday 20th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data and a SAR scene. Locations of icebergs are marked by blue dots based on analysis of the SAR data.

The SAR scene shows the detection limits for thin and low concentration of sea ice in the AMSR-2 data (the white line continues the sea-ice edge through the SAR data). North of the sea-ice zone, icebergs are drifting freely as far north as 61º20'S. 1168 icebergs have been identified, the majority of which is restricted to water depth of less than 350 m.

North of Dumont D'Urville Station, a band of higher concentration sea ice is confined between 65ºS and 66ºS. Along 140ºE and to the west of it, large patches of very low sea-ice concentration connect the polynya off station and the bergy water north of the sea-ice band.

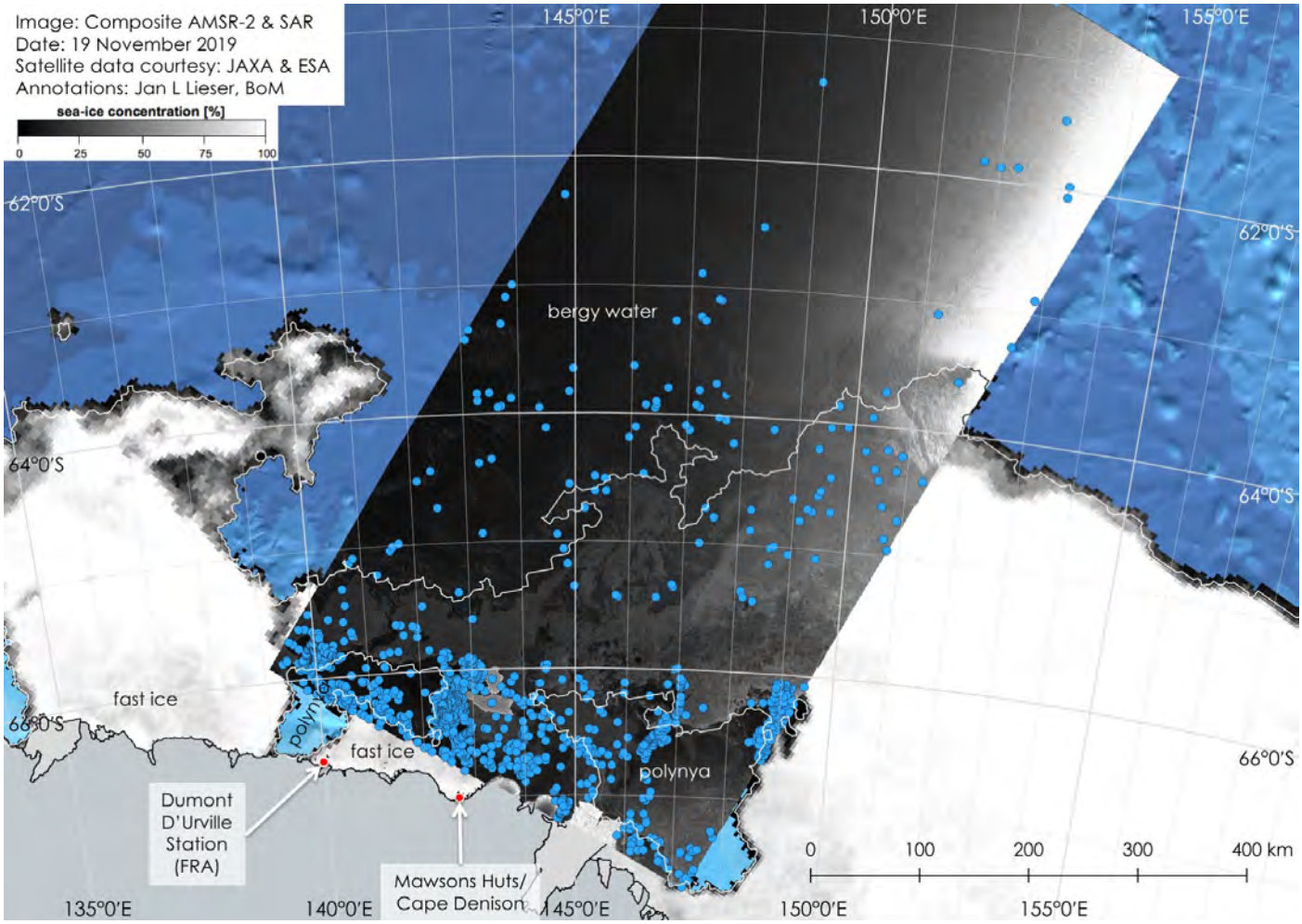


***Figure 1**: Composite of a sea-ice concentration chart acquired 19 November 2019 and provided by ICDC, Universität Hamburg and Sentinel-1a SAR EW data acquired 19 November 2019 at 18:25 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Wednesday 20th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data and a SAR scene. 290 icebergs are marked by blue dots based on SAR data analysis north of the Shackleton Ice Shelf. The cruise track of RSV *Aurora Australis* is shown as an orange line (up until 20 November 2019 10:20 UT).

The SAR scene shows that sea ice extends farther north than the AMSR-2 data suggest (the white line continues the sea-ice edge through the SAR data). Even further north, icebergs are drifting freely as far north as 59º30'S.

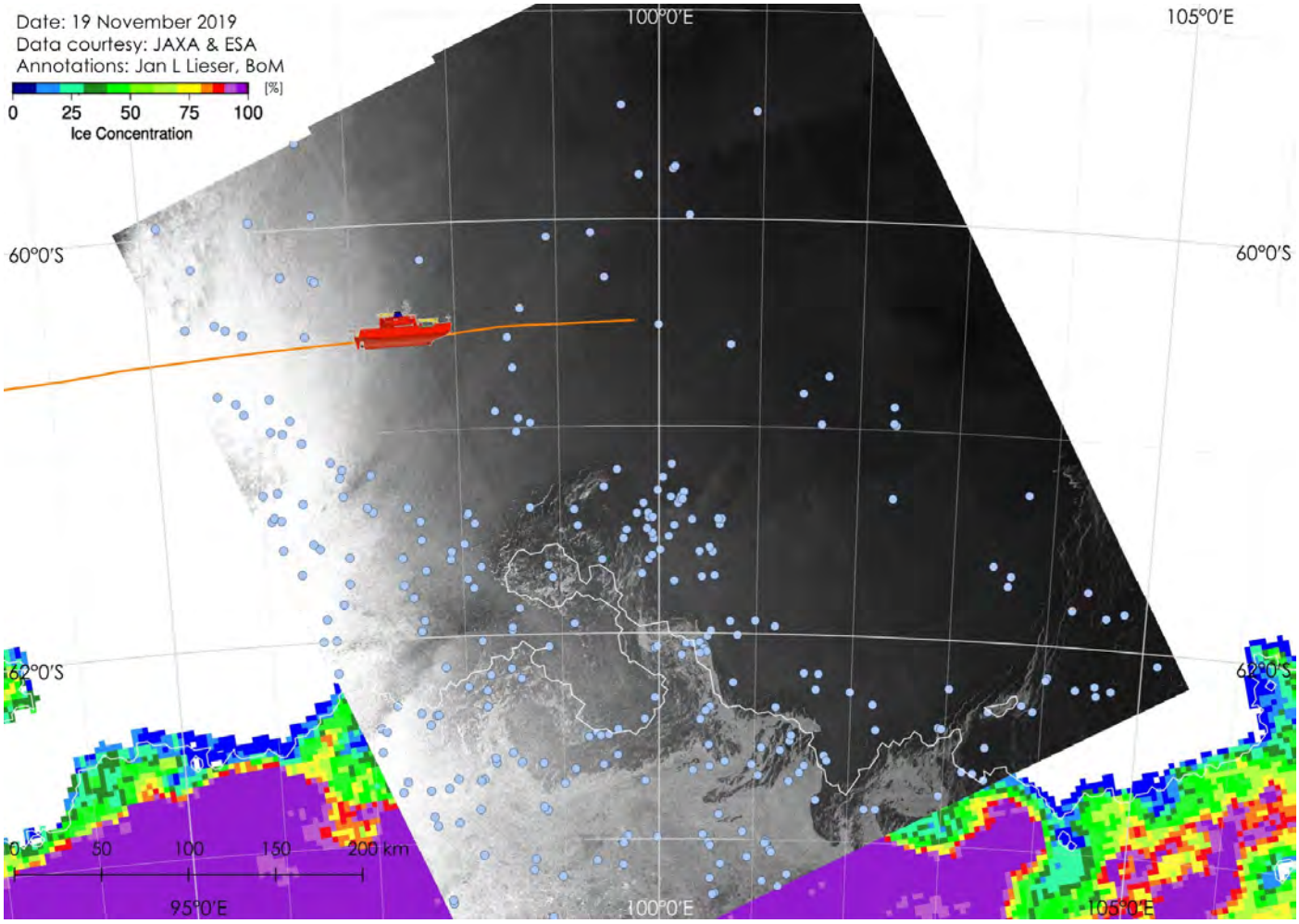


***Figure 1**: Composite of a sea-ice concentration chart acquired 19 November 2019 and provided by ICDC, Universität Hamburg and a Sentinel-1b SAR EW scene acquired 19 November 2019 at 12:53 UT and provided by PolarView.*

Ice Bulletin: Dumont D'Urville Station

Issued: Thursday 21st November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of visible scenes of the southern D'Urville Sea between Dumont D'Urville Station and the Mertz Ice Shelf. The sea-ice edge based on high-resolution sea-ice concentration data from AMSR-2 (not shown) is indicated by a black line. 1509 icebergs (pink dots) have been identified from SAR data (black frames; data acquired 20 November 2019 at 10:16 UT; data not shown) and the high-resolution panchromatic Landsat-8 data. The majority of the icebergs is restricted to water depth of less than 350 m.

North of Dumont D'Urville Station and the Mertz Ice Shelf, highly dynamic thin sea ice is seen through thin clouds. The western part of the scene is a bit more obscured by clouds.

North of the station, a band of higher concentration sea ice remains confined between 65ºS and 66ºS.

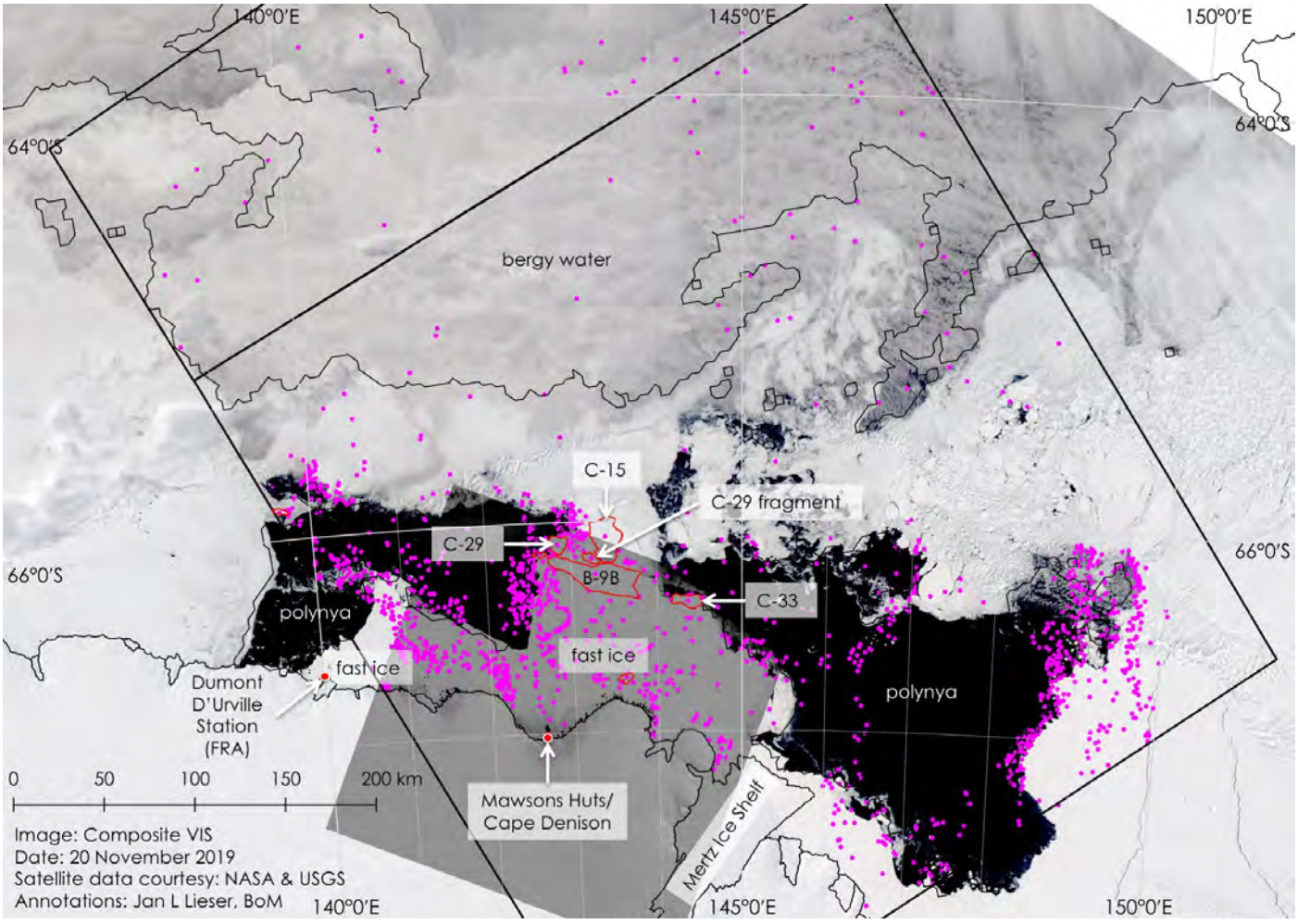


***Figure 1**: Composite of an AQUA MODIS visible scene acquired 20 November 2019 and provided by NASA and a Landsat-8 Band-8 scene (grey square) acquired 19 November 2019 at 23:22 UT and provided by USGS.*

Ice Bulletin: Dumont D'Urville Station

Issued: Friday 22nd November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of the southern D'Urville Sea. The red line indicates the fast-ice edge on 17 November 2019. Large tabular icebergs are marked by pink outlines. The shaded pink outline marks a drifting iceberg that travelled roughly 16.5 km westward since 18 November 2019.

North of Dumont D'Urville Station, fast ice is breaking up and the ex-fast ice is drifting westward. The break-up also releases icebergs that were trapped within the fast ice. Of those, non-grounded icebergs are now drifting westward.

North of the fast ice, a band of higher concentration sea ice remains confined between 65ºS and 66ºS. This band consists mostly of decaying small floes of first-year and old sea ice, interspersed with many icebergs of various sizes.

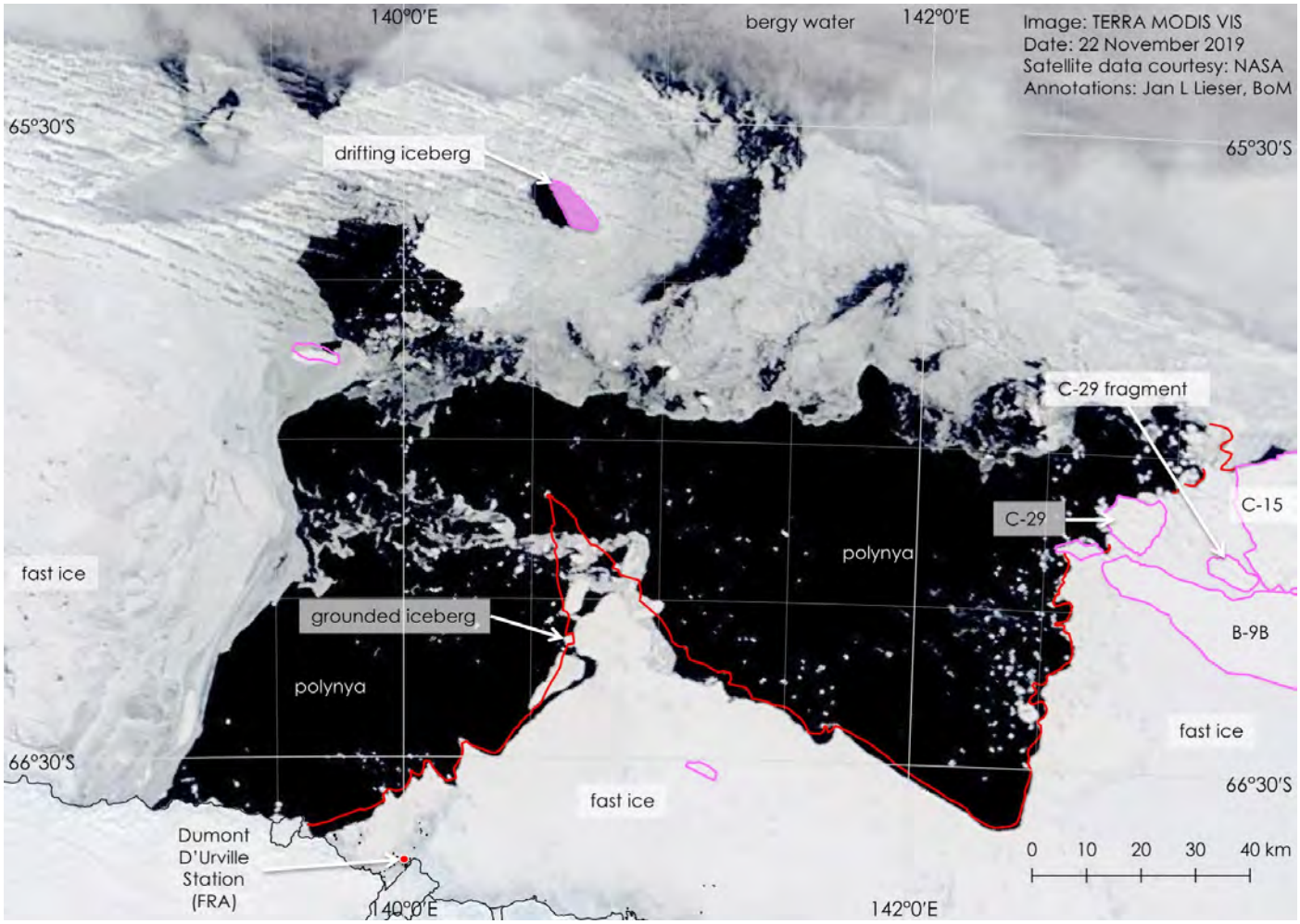


***Figure 1**: TERRA MODIS visible scene acquired 22 November 2019 and provided by NASA.*

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Disclaimer: *Every effort is made to ensure the data provided in this bulletin are accurate at the date of publication; however, the bulletin is provided without warranty of any kind. The figures and charts provided in this bulletin are intended only as a guide to ice conditions and are not suitable for navigation.*

Ice Bulletin: Dumont D'Urville Station

Issued: Tuesday 26th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data (background) and SAR scenes. Locations of icebergs are marked by pink dots based on analysis of the SAR data (dark pink for 24 November 2019; bright pink for 25 November 2019).

The SAR scene shows the detection limits for thin and low concentration of sea ice in the AMSR-2 data (the blue line continues the AMSR-2 sea-ice edge through the SAR data). Strips and patches of decaying sea ice can be seen north of 64ºS and east of 140ºE.

North of the sea-ice zone, icebergs are drifting freely as far north as 60º30'S (not shown in the figure). From SAR data acquired on 25 Nov. 2019, 1397 icebergs have been identified, of which the majority is restricted to water depth of less than 350 m.

North of Dumont D'Urville Station, a band of higher concentration sea ice is confined between 65ºS and 66ºS. Fast ice off the station continues to break up (see Figure 2).

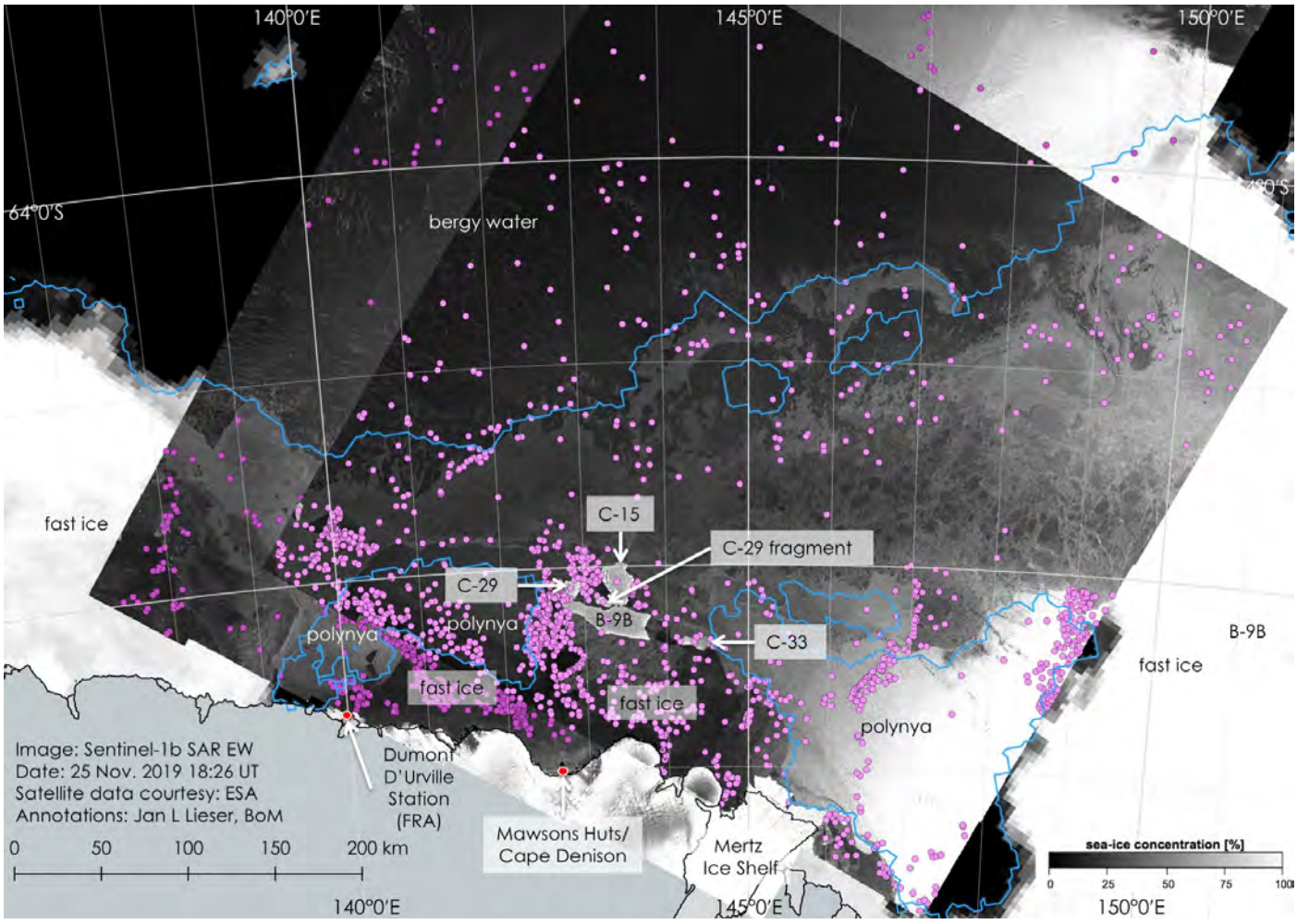

***Figure 1**: Composite of a sea-ice concentration chart acquired 25 November 2019 and provided by ICDC, Universität Hamburg (background) and Sentinel-1b SAR EW data acquired 25 November 2019 at 18:26 UT and Sentinel-1a SAR EW data acquired 24 November 2019 at 18:35 UT (underlying the scene from 25 November 2019); both SAR data sets are provided by PolarView.*

Figure 2 shows a SAR scene off Dumont D'Urville Station. The fast-ice edge is indicated by the red line. The dashed yellow line marks the fast-ice edge on 17 November 2019. Fast ice is retreating towards the coast.

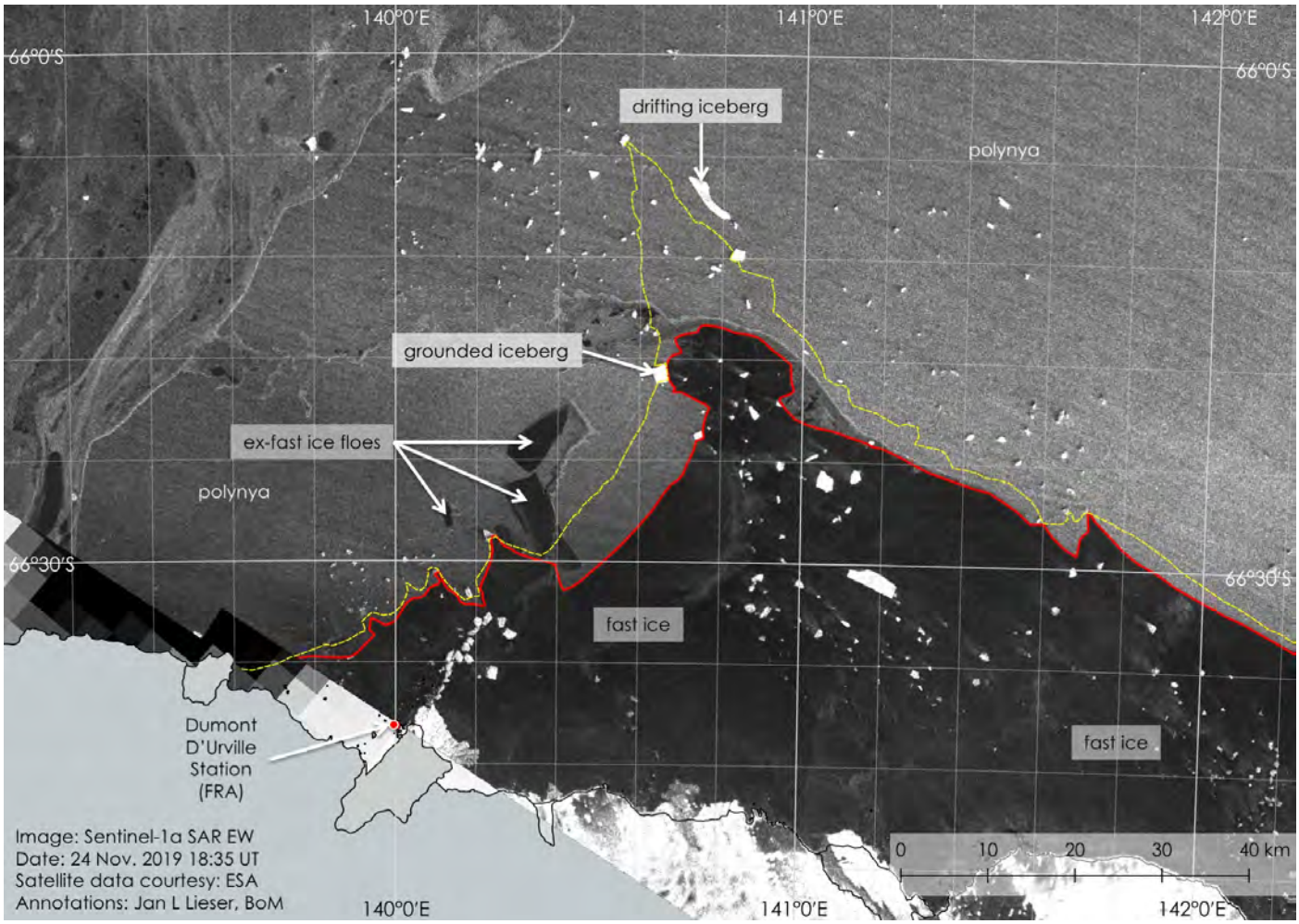

***Figure 2**: Sentinel-1a SAR EW data acquired 24 November 2019 at 18:35 UT and provided by PolarView.*

Ice Bulletin: Dumont D'Urville Station

Issued: Friday 29th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a visible scene (eastern part) and a SAR scene (western part). Large tabular grounded icebergs are marked by pink outlines. Between Dumont D'Urville Station and iceberg B-9B, the fast-ice edge is marked by an orange line and by a green line for 24 Nov. 2019. A red dotted line marks the most recent fast-ice break-up over night (at about 141°30'E).

On 28 Nov. 2019, a brief change in wind direction resulted in an eastward redistribution of sea ice in the region and break up of fast ice west of 139ºE.

Off the station, the shortest distance between the polynya and the station is roughly 5 nautical miles.

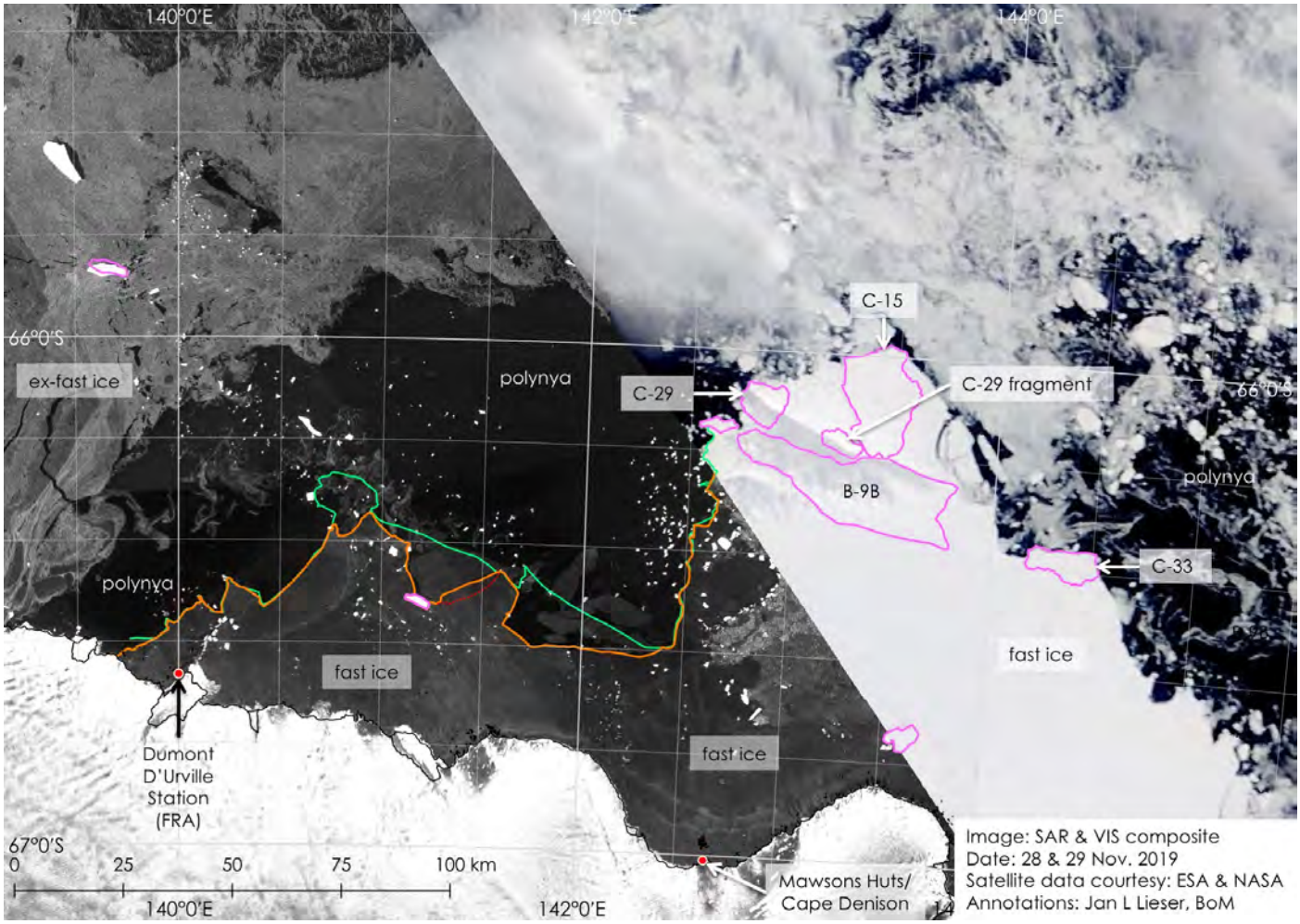

***Figure 1**: Composite of a Sentinel-1b SAR EW scene (western part) acquired 28 November 2019 at 10:48 UT and provided by PolarView and a TERRA MODIS VIS scene (eastern part) acquired 29 November 2019 and provided by NASA.*

Ice Bulletin: Dumont D'Urville Station

Issued: Saturday 30th November 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data (background) and a SAR swath. Locations of 1903 icebergs are marked by pink dots based on analysis of the SAR data.

The SAR scene shows the detection limits for thin and low concentration of sea ice in the AMSR-2 data (the cyan line continues the AMSR-2 sea-ice edge through the SAR data). Strips and patches of decaying sea ice can be seen south of 63ºS and east of 140ºE.

North of the sea-ice zone, icebergs are drifting freely as far north as 61º30'S, but the majority of the icebergs is restricted to water depth of less than 350 m and of those the majority is enclosed by fast ice.

North of Dumont D'Urville Station, a band of higher concentration sea ice is confined between 65ºS and 66ºS. Fast ice east of the station continues to break up.

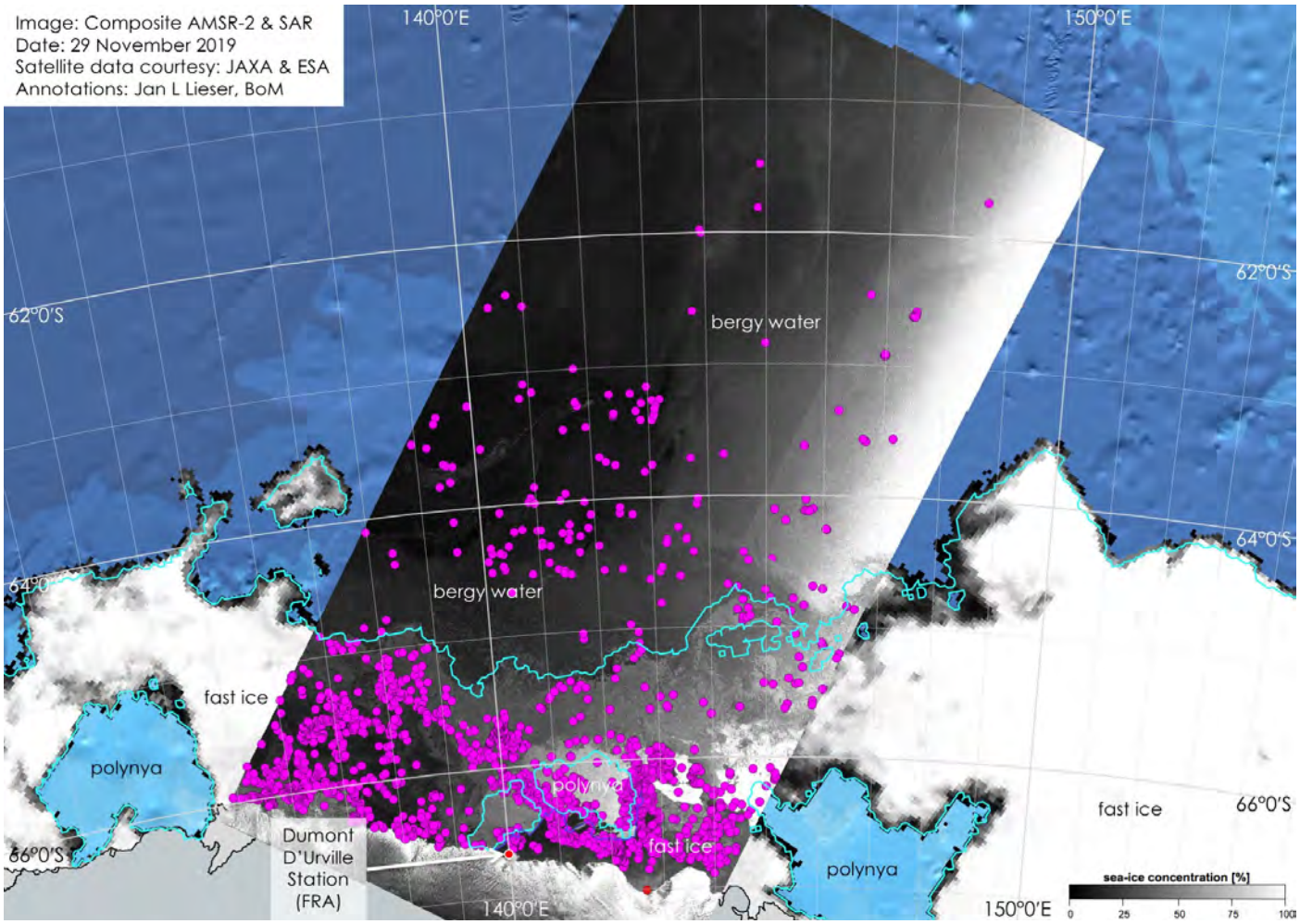

***Figure 1**: Composite of a sea-ice concentration chart acquired 29 November 2019 and provided by ICDC, Universität Hamburg (background) and Sentinel-1a SAR EW data acquired 29 November 2019 at 18:43 UT and provided by PolarView.*

Ice Bulletin: Dumont D'Urville Station

Issued: Sunday 1st December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of southern D'Urville Sea between Dumont D'Urville Station and Cape Denison. The fast-ice edge is marked by a red line.

The fast-ice edge on 28 November 2019 is indicated by a green line. It is evident that fast ice continues to break up east of the station. Broken ex-fast ice can be seen drifting westward in the polynya between the remaining fast ice and the pack ice.

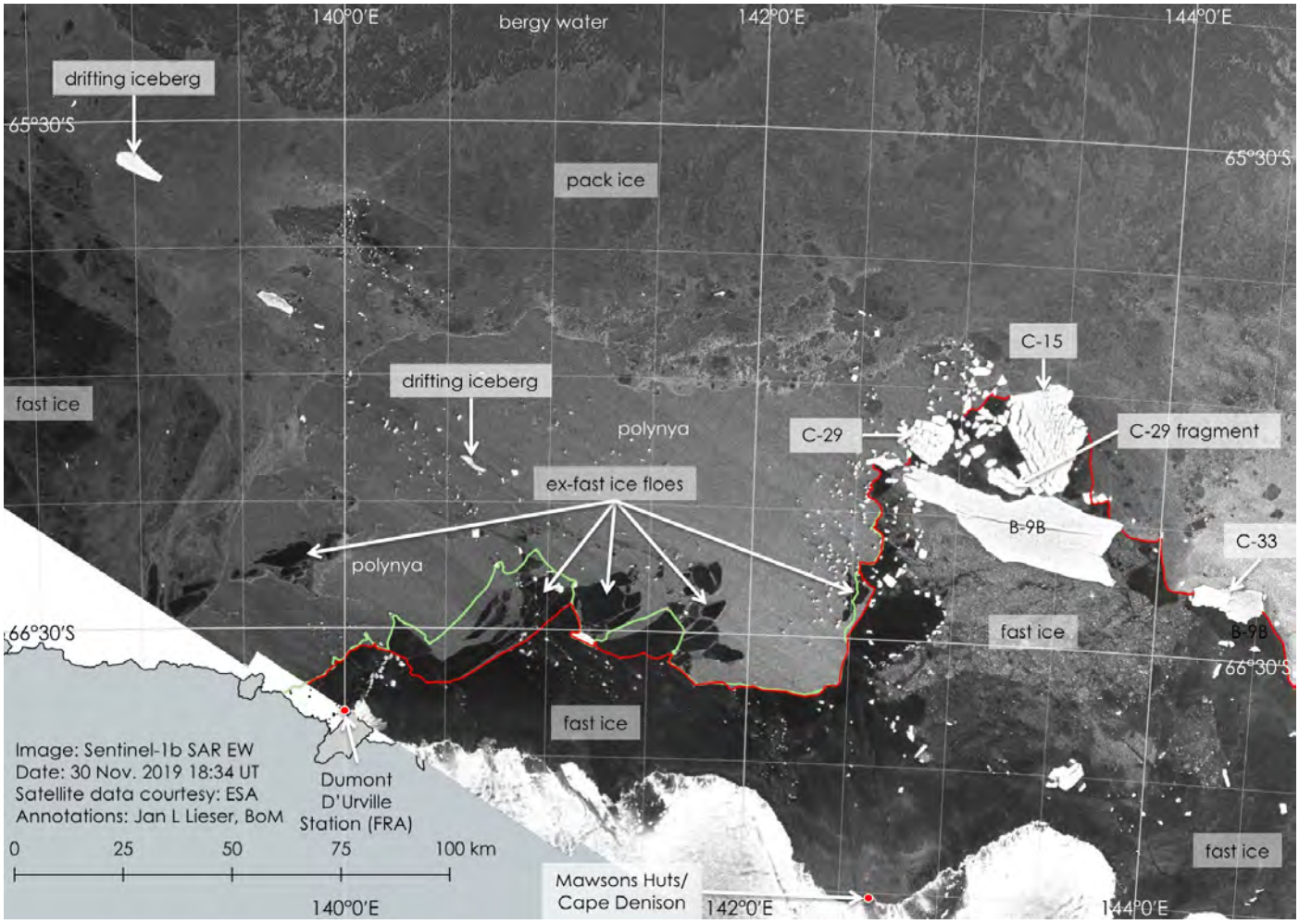

***Figure 1**: Sentinel-1b SAR EW data acquired 30 November 2019 at 18:34 UT and provided by PolarView.*

Ice Bulletin: Dumont D'Urville Station

Issued: Monday 2nd December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data (background) and a SAR scene (southwest to northeast banding is the result of processing artefact).

The cross-polarised SAR scene shows icebergs more clearly in open water regions and the general detection limits for thin and low concentration of sea ice in the AMSR-2 data (the cyan line continues the AMSR-2 sea-ice edge through the SAR data). Strips and patches of decaying sea ice can be seen south of 64°30'S between of 141°E and 144°E.

North of the sea-ice zone, icebergs are drifting freely as far north as 61°30'S (not shown), but the majority of the icebergs is restricted to water depth of less than 350 m and of those the majority is enclosed by fast ice.

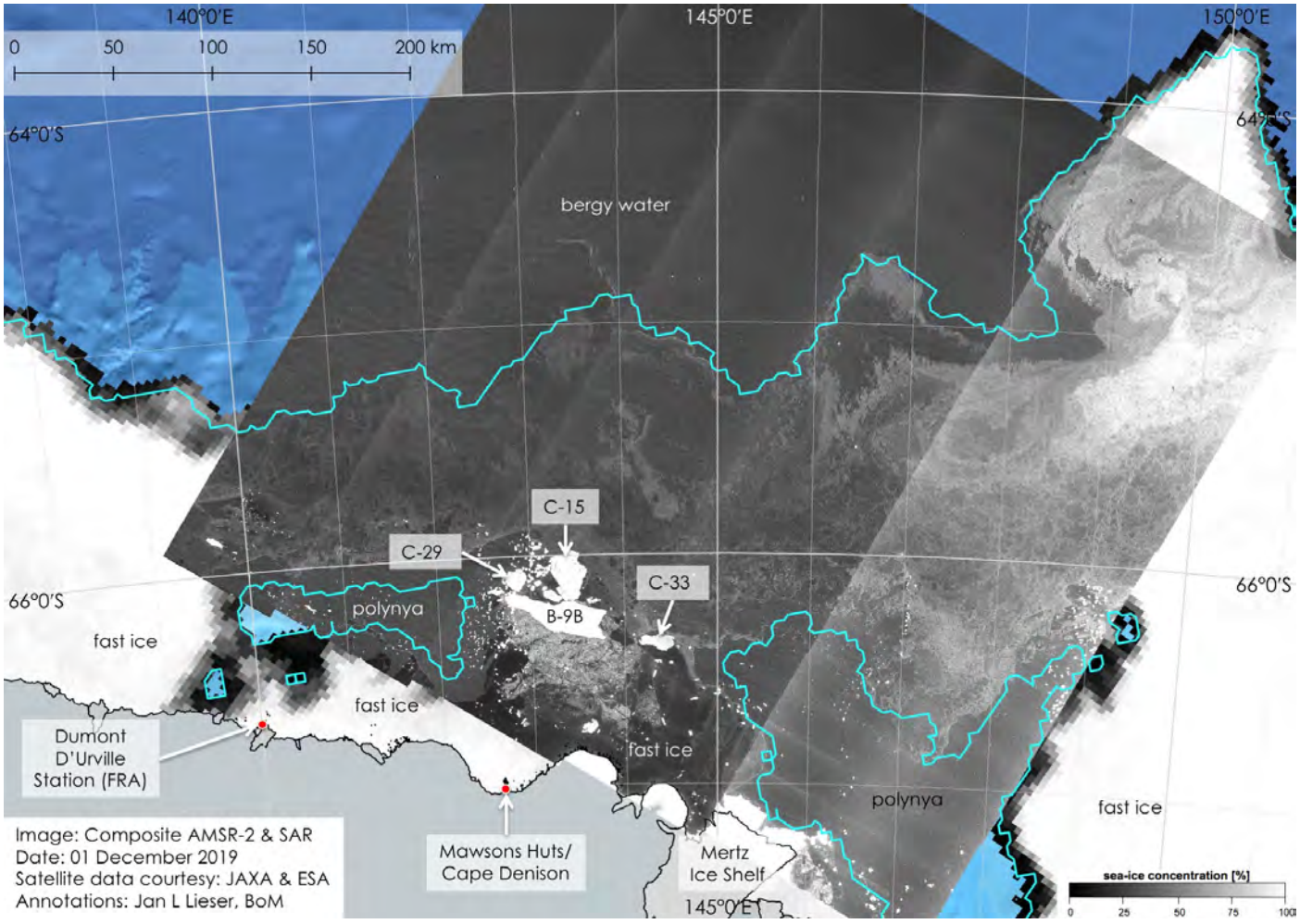

***Figure 1**: Composite of a sea-ice concentration chart acquired 01 December 2019 and provided by ICDC, Universität Hamburg (background) and Sentinel-1a SAR EW hv data acquired 01 November 2019 at 18:26 UT and provided by PolarView.*

Figure 2 shows the same high-resolution (3.125 km horizontal) sea-ice concentration chart based on AMSR-2 data as in Figure 1 but without the SAR overlay.

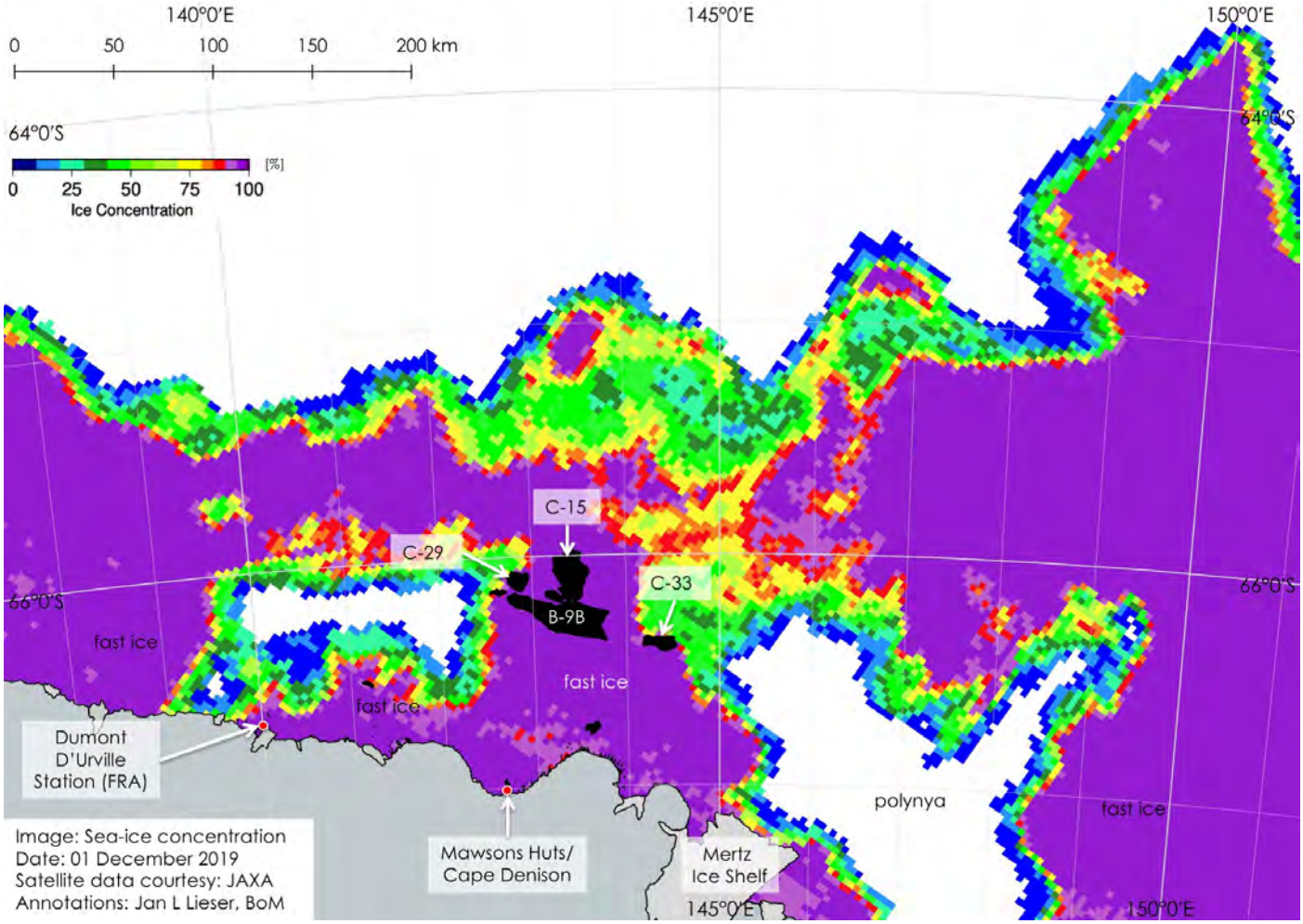

***Figure 2**: Sea-ice concentration chart acquired 01 December 2019 and provided by ICDC, Universität Hamburg.*

Ice Bulletin: Mawson Station

Issued: Tuesday 3rd December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Coast and offshore complemented by visible data in the east. The fast-ice edge on 19 Nov. 2019 is marked by a yellow line, the current fast-ice edge is marked by the blue line.

The fast ice has been retreating roughly 80 km towards the station from the east and also a little bit from the northern edge. Northwest of the station, the persistent polynya is currently roughly 31.5 nautical miles away. The so-called 'Iceberg Alley' is a clearly distinguishable feature north of Mawson Station.

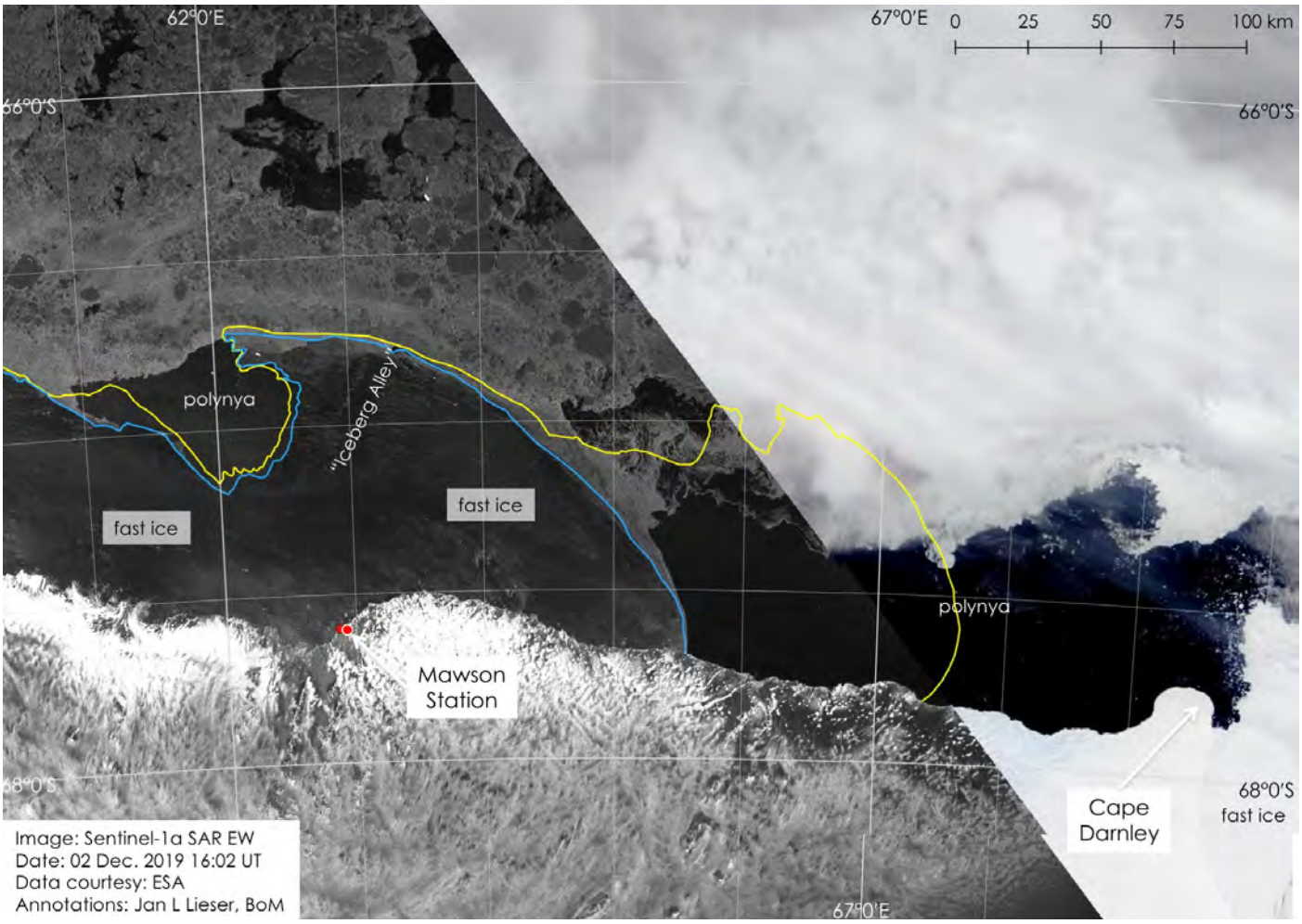

***Figure 1**: Sentinel-1a SAR EW scene acquired 02 December 2019 at 16:02 UT and provided by PolarView complemented by TERRA MODIS VIS data in the west provided by NASA.*

Ice Bulletin: Dumont D'Urville Station

Issued: Wednesday 4th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution SAR scene (southwest) and visible data (northeast). The fast-ice edge is marked by a yellow line; the fast-ice edge on 30 November 2019 is marked by a blue line.

North of Dumont D'Urville Station, the fast-ice edge has shifted roughly 5 km southward. Although the view of the ocean/ice surface is obscured by clouds in the visible data, the continuation of the new fast-ice edge can be estimated at around 141º0'E. Strips and patches of decaying ex-fast ice can be seen drifting westward in the polynya.

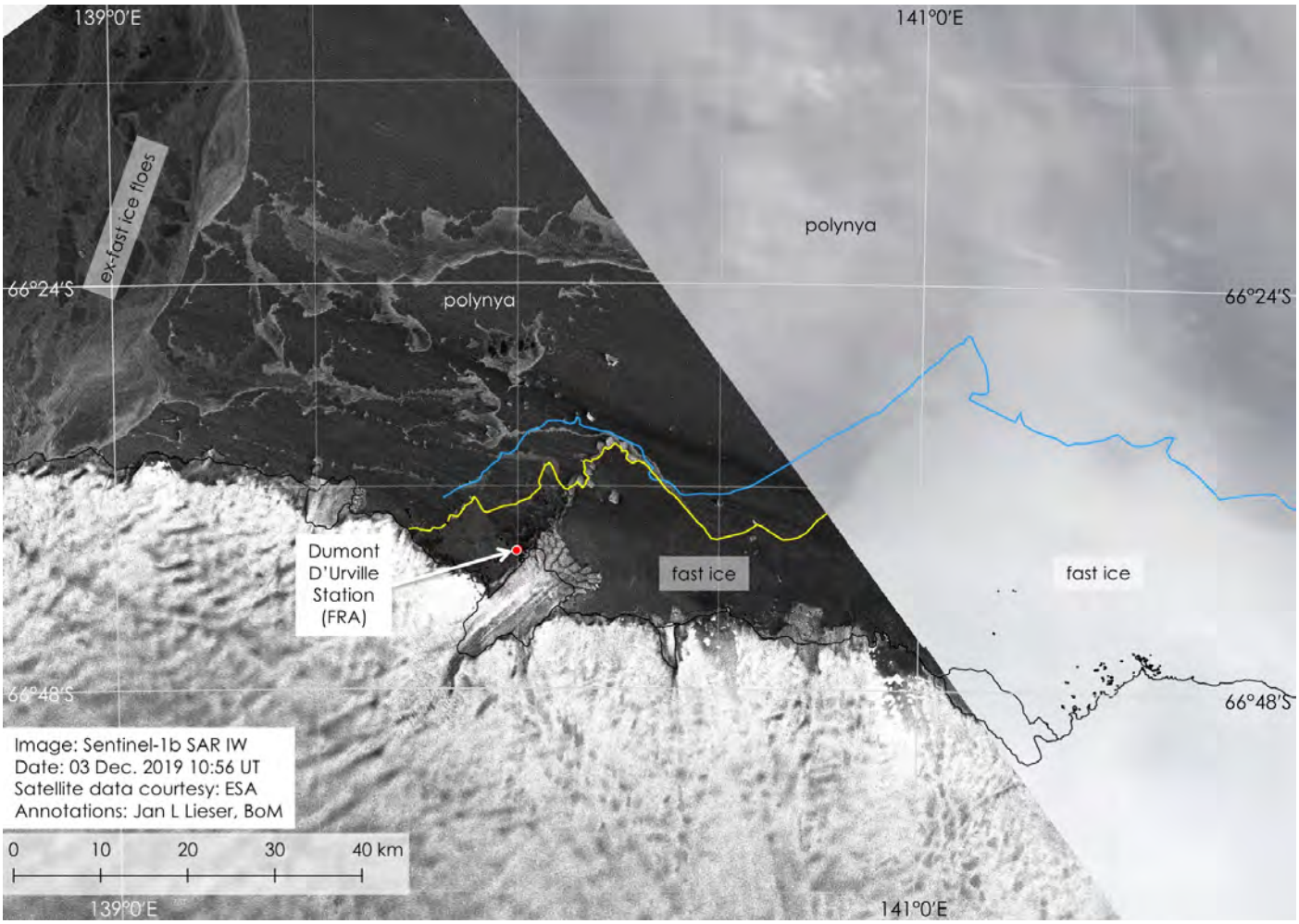

***Figure 1**: Sentinel-1b SAR IW scene acquired 03 December 2019 at 10:56 UT and provided by PolarView; complemented by TERRA MODIS VIS data acquired 04 December 2019 and provided by NASA.*

Ice Bulletin: Dumont D'Urville Station

Issued: Thursday 5th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Dumont D'Urville Station and offshore. Yesterday's fast-ice edge is marked by a yellow line. Very large icebergs are marked by pink outlines.

Off Dumont D'Urville Station, more fast-ice broken away and the fast-ice edge is now roughly 1 km north of the station. Many icebergs are drifting in the polynya while others remain grounded. Strips and patches of decaying ex-fast ice can be seen drifting westward in the polynya.

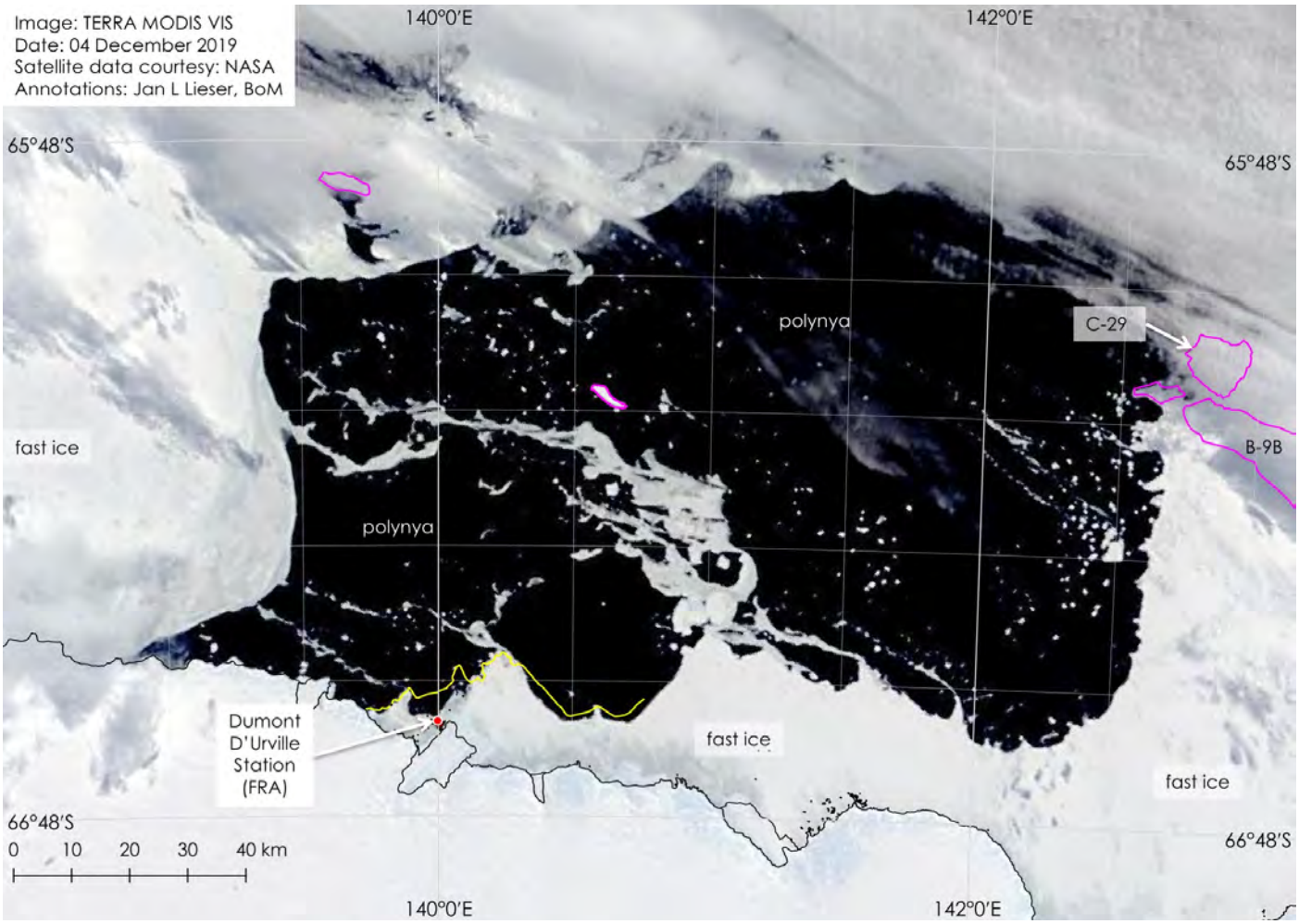

***Figure 1**: TERRA MODIS VIS data acquired 04 December 2019 and provided by NASA.*

Ice Bulletin: Dumont D'Urville Station

Issued: Friday 6th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Dumont D'Urville Station and offshore. The fast-ice edge is marked by a blue line. The cruise track of RSV *Aurora Australis* is marked by the orange line (up until 05 Dec. 2019 21:40 UT).

Off Dumont D'Urville Station, the fast-ice edge is about 1.5 km north of the station. Many icebergs are drifting in the polynya while others remain grounded. Strips and patches of decaying ex-fast ice can be seen drifting westward in the polynya.

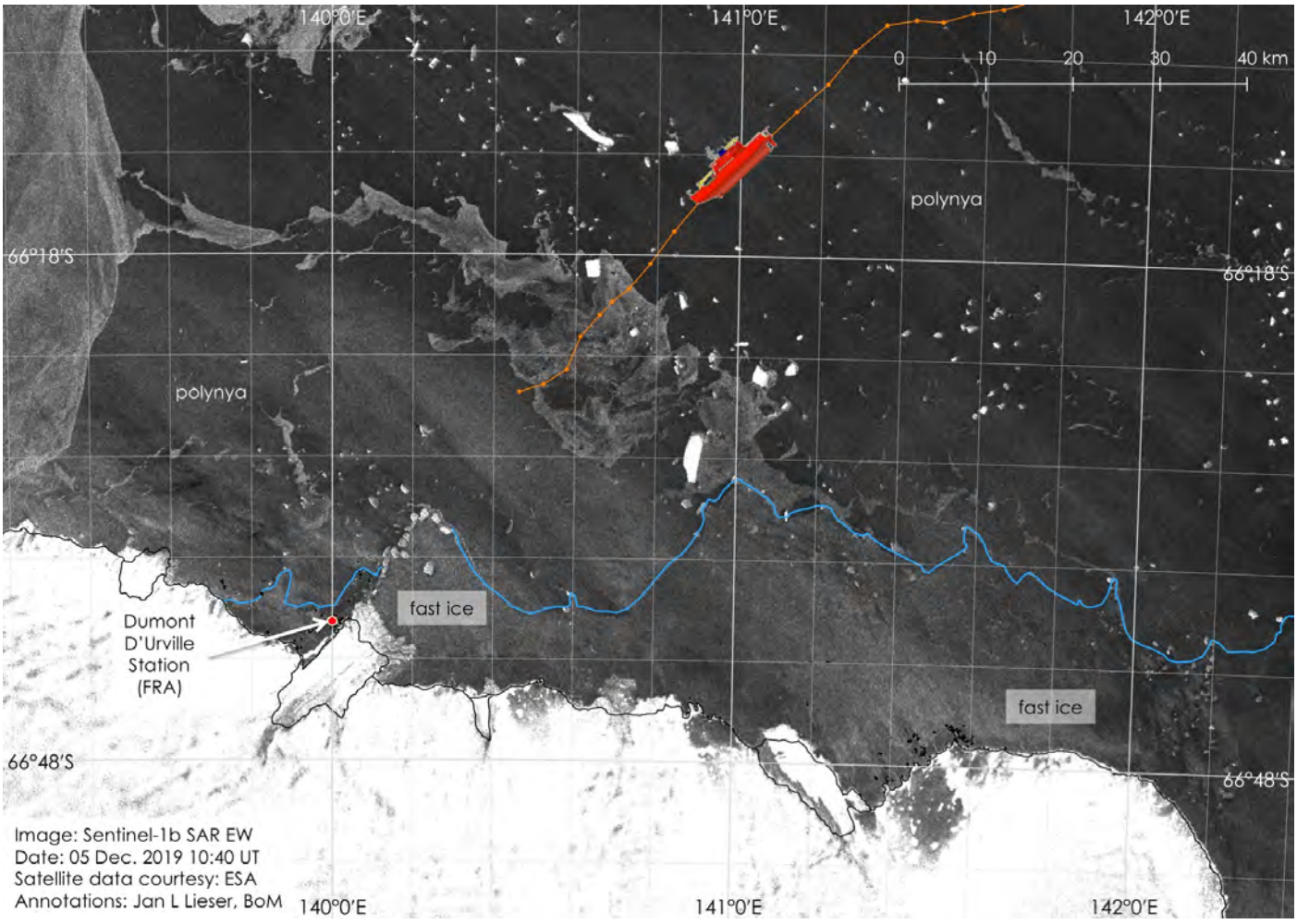

***Figure 1**: Sentinel-1b SAR EW data acquired 05 December 2019 at 10:40 UT and provided by PolarView.*

Ice Bulletin: Dumont D'Urville Station

Issued: Friday 6th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Dumont D'Urville Station and offshore. The fast-ice edge is marked by a blue line. The cruise track of RSV *Aurora Australis* is marked by the orange line (up until 05 Dec. 2019 22:20 UT).

Off Dumont D'Urville Station, the fast-ice edge is about 1.5 km north of the station. Many icebergs are drifting in the polynya while others remain grounded. Strips and patches of decaying ex-fast ice can be seen drifting westward in the polynya.

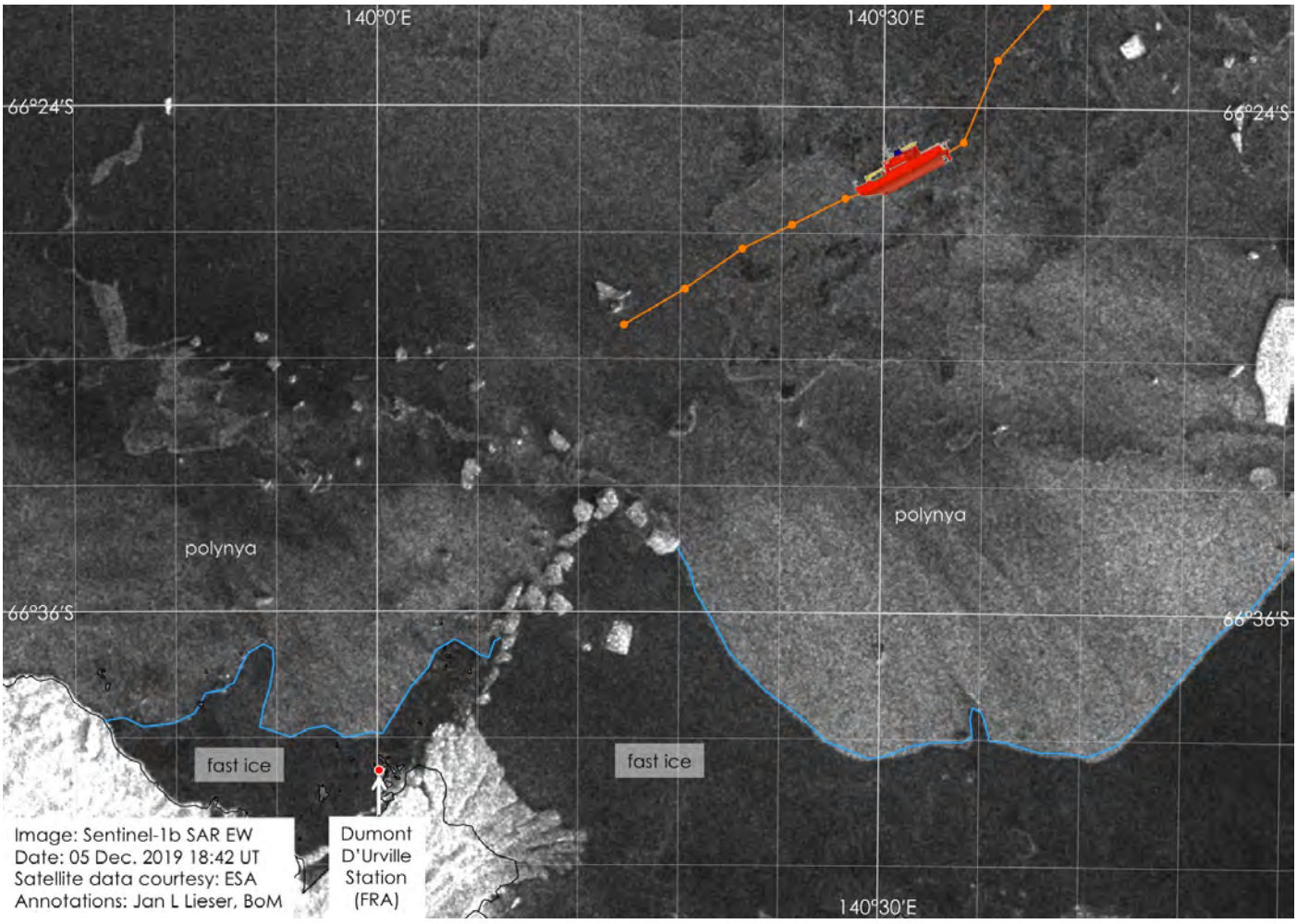

***Figure 1**: Sentinel-1b SAR EW data acquired 05 December 2019 at 18:42 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Friday 06th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Davis Station and offshore.

The movements of icebergs B-39 and D-22 have been marked by colour-coded shapes. During the previous month, iceberg B-39 has drifted westward along a patch of fast ice (note: not land-fast sea ice but fastened between grounded icebergs) and is currently tumbling in south-easterly direction towards the coast. Iceberg D-22 has travelled westward and is currently located at roughly 67º10'E and 67º05'S (not shown).

Iceberg D-28, which broke off the Amery Ice Shelf in late September, has rotated 90 degrees anti-clockwise and is scraping northward along fast ice that is attached to the eastern side of Cape Darnley.

North and south of Davis Station, fast ice continues to break up and patches of ex-fast ice are drifting south-westward.

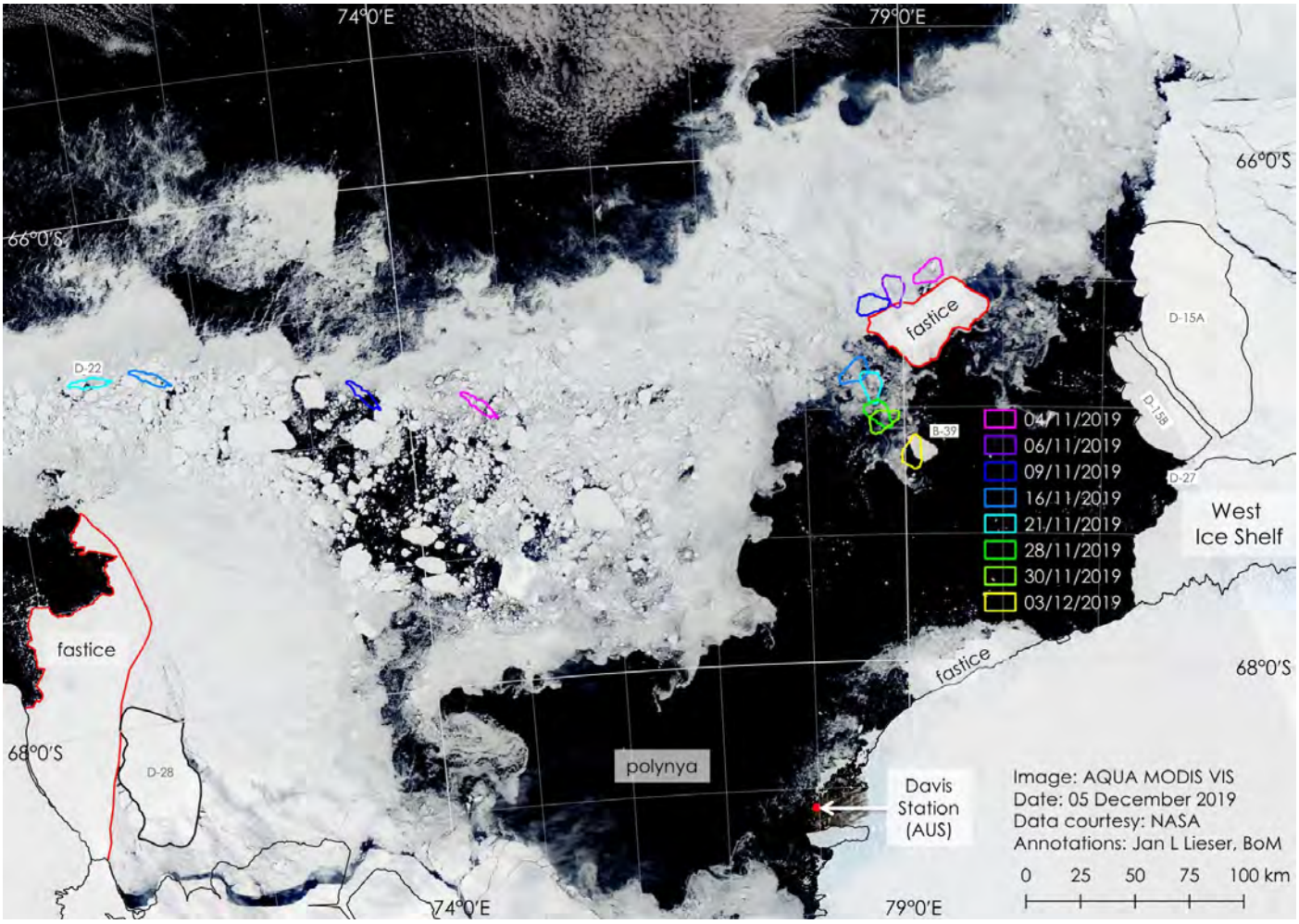

***Figure 1**: AQUA MODIS VIS scene acquired 05 December 2019 and provided by NASA.*

Ice Bulletin: Brunt Ice Shelf

Issued: Tuesday 10th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (20 m horizontal) SAR scene of the Brunt Ice Shelf, home of the British Halley VI Station. The western end of the shelf is expected to break away and produce a large iceberg of roughly 1750 km^2. As a precaution the station was re-located to a further eastern position during the 2016/17 austral summer.

The soon-to-be iceberg is attached to the rest of the Brunt Ice Shelf only around the McDonald Ice Rumples, where the so-called Chasm-1 (marked in yellow) and the Halloween Crack (marked in orange) converge. Chasm-1 has progressed northward by about 1.5 km since end of October 2019. Since 25 October 2019, the shelf has moved roughly 110m westward. New cracks and extensions of existing cracks are marked by blues lines.

Currently, there are roughly 3 km between the new northern end of Chasm-1 and the new, smaller cracks south of the McDonald Ice Rumples.

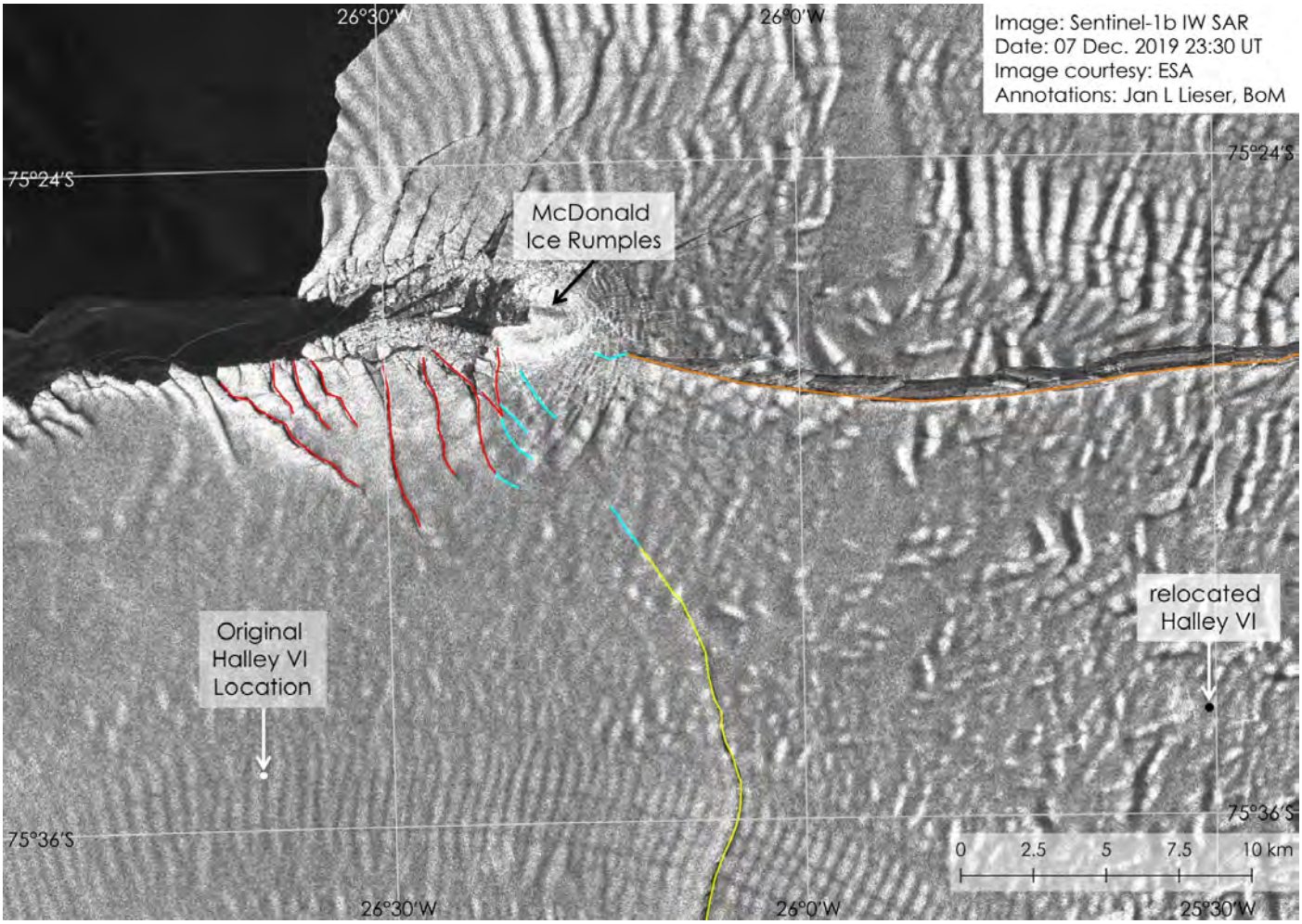

***Figure 1**: Sentinel-1a SAR IW scene acquired 07 December 2019 at 23:30 UT and provided by PolarView.*

Ice Bulletin: Casey Station

Issued: Wednesday 11th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a high-resolution sea-ice concentration chart of the wider area around Casey Station and a SAR scene of the sea north of the sea-ice edge. 877 icebergs have been identified in the SAR data and are marked by pink dots. The blue line marks the December median sea-ice extent.

The current sea-ice cover is largely confined south of the median extent, but strips and patches of sea ice are still drifting well north of the sea-ice edge (for example between 109ºE and 110ºE south of 63ºS).

North of the sea-ice zone, many icebergs are drifting freely as far north of 59º30'S (the extent of the SAR scene) and potentially even further.

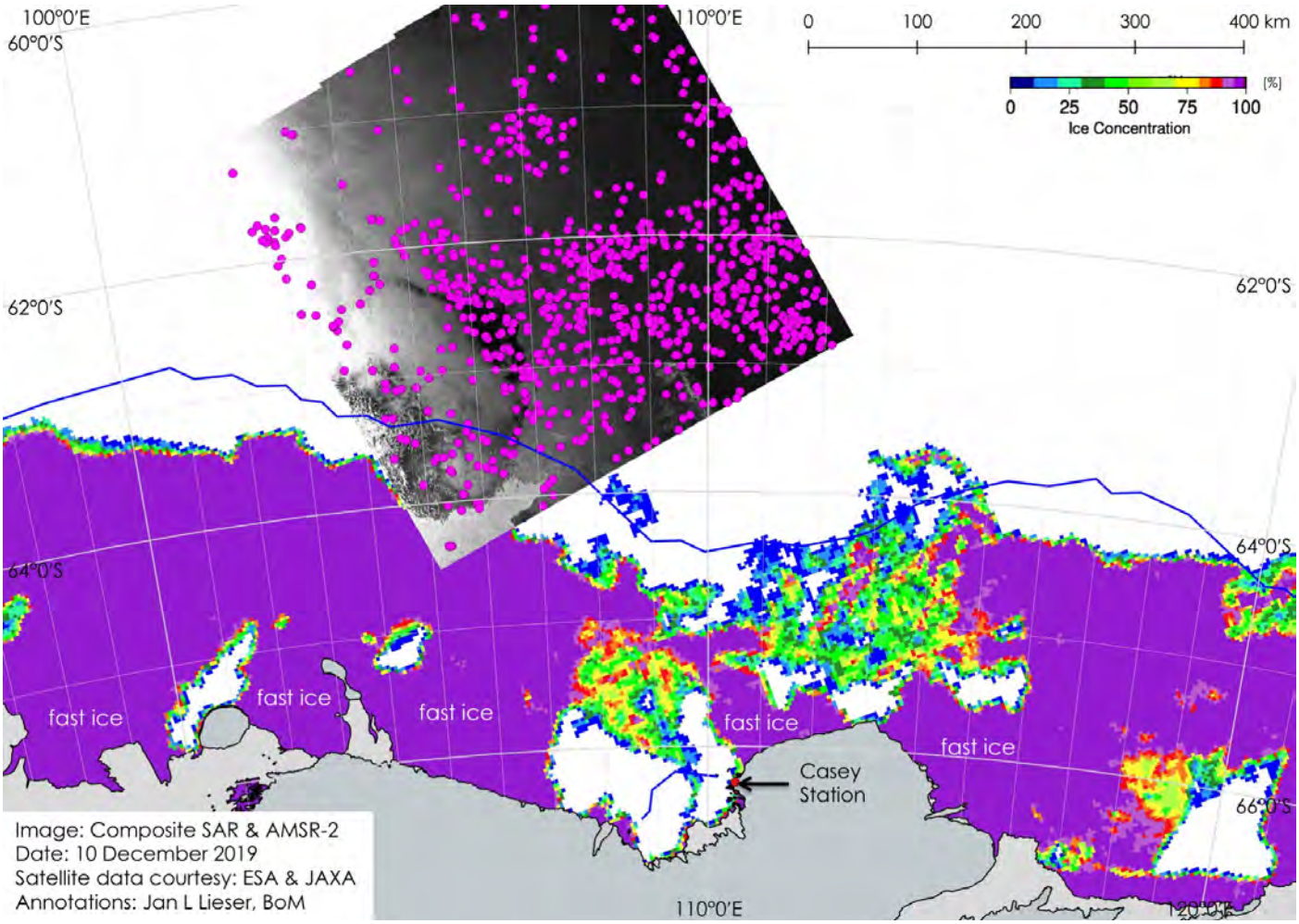

***Figure 1**: Composite of AMSR-2 sea-ice concentration chart acquired 10 December 2019 and provided by ICDC, Universität Hamburg and Sentinel-1b SAR EW scene acquired 10 December 2019 at 12:28 UT and provided by ESA.*

Ice Bulletin: Casey Station

Issued: Tuesday 17th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart of the wider area around Casey Station. The location of a whale-recorder mooring is marked by a green dot (north of the sea-ice zone).

North of the station, the sea-ice cover is largely confined to south of 65ºS, but strips and patches of sea ice are still drifting further north (for example along 111ºE up to 64º30'S).

North of the sea-ice zone, hundreds of icebergs are drifting freely as far north as 59º30'S and potentially even further.

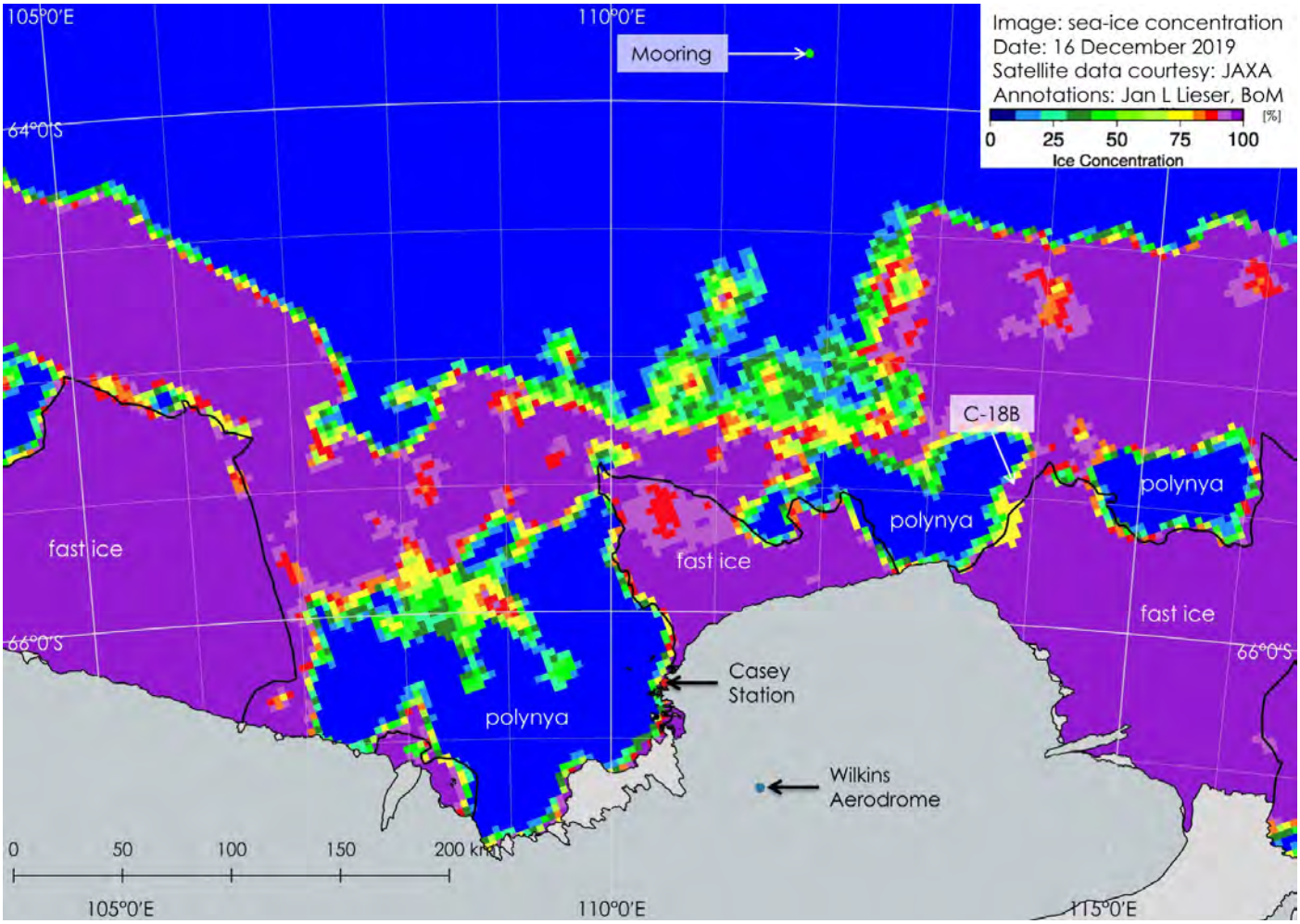

***Figure 1**: AMSR-2 sea-ice concentration chart acquired 16 December 2019 and provided by ICDC, Universität Hamburg.*

Figure 2 shows a very high-resolution (10 m horizontal) optical scene of Casey Station and to the north of it on top of a SAR scene (30 m horizontal resolution). The black/yellow frame indicates the location of the data shown in Figure 3.

The detail offered by the optical data allows for an appreciation of conditions at the floe scale. The sea ice of the area is rapidly decaying and consists of small to medium-sized first-year floes. Some large icebergs can be clearly identified in the sea-ice zone and many more, smaller ones are also present.

Figure 4 shows a close-up of the station and surrounds, where only minimal fast ice remains nearshore.

Figure 5 provides a clear view of Wilkins Aerodrome in the Casey Station hinterland.

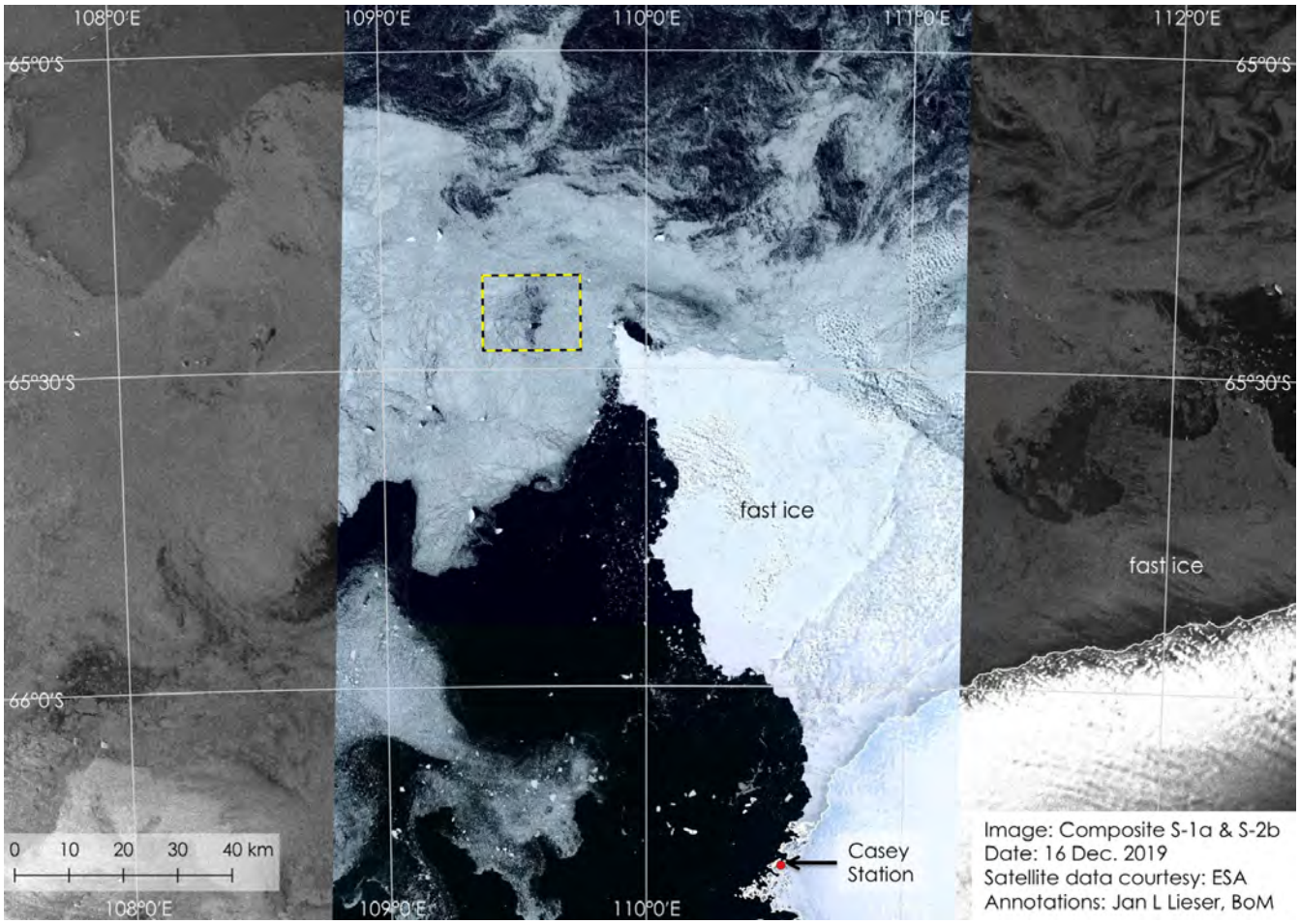

***Figure 2**: Composite of Sentinel-1a SAR EW data acquired 16 December 2019 at 12:29 UT and provided by PolarView and Sentinel-2b VIS data acquired 16 December 2019 at 01:55 UT and provided by ESA.*

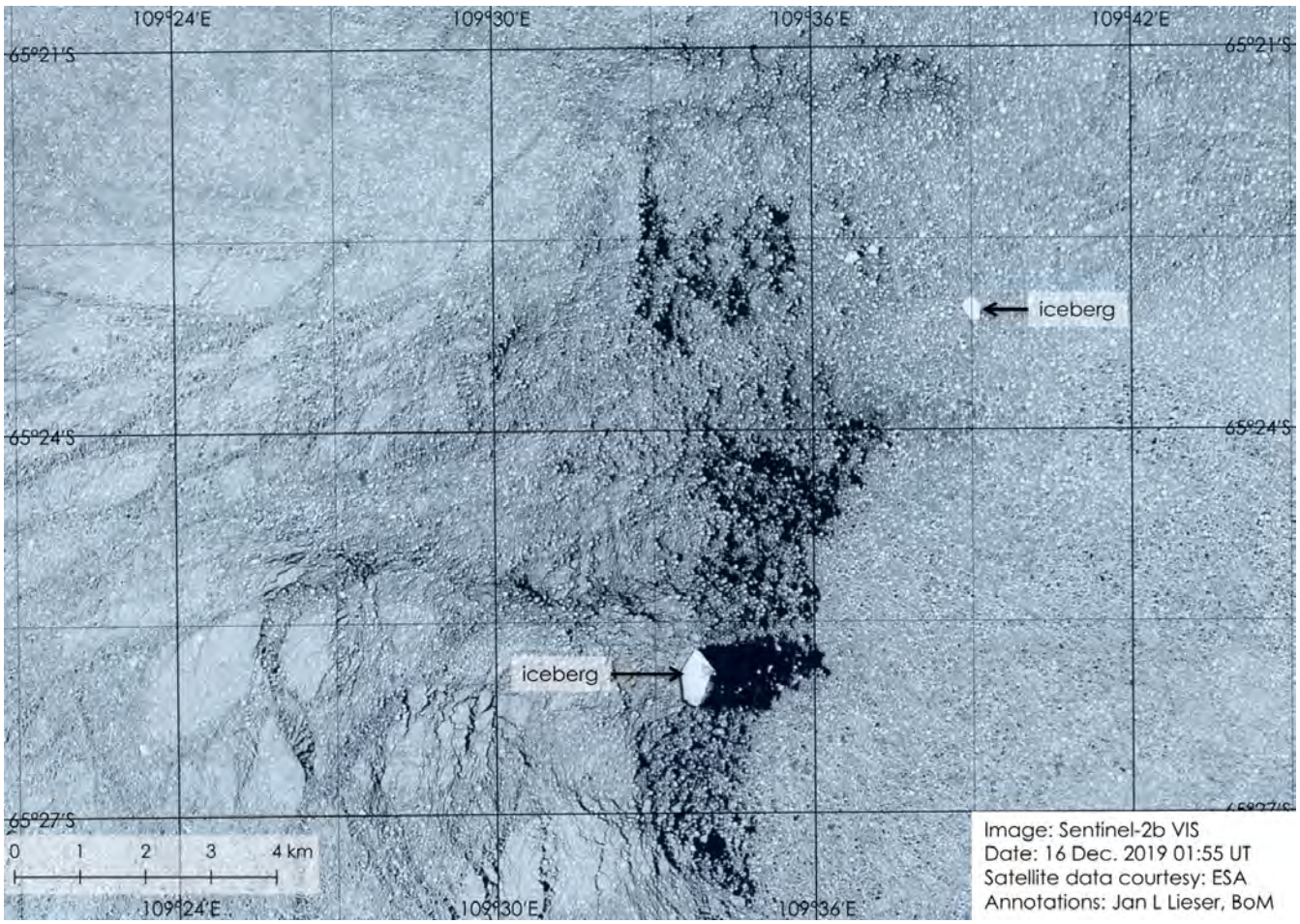

***Figure 3**: Sentinel-2b VIS data acquired 16 December 2019 at 01:55 UT and provided by ESA.*

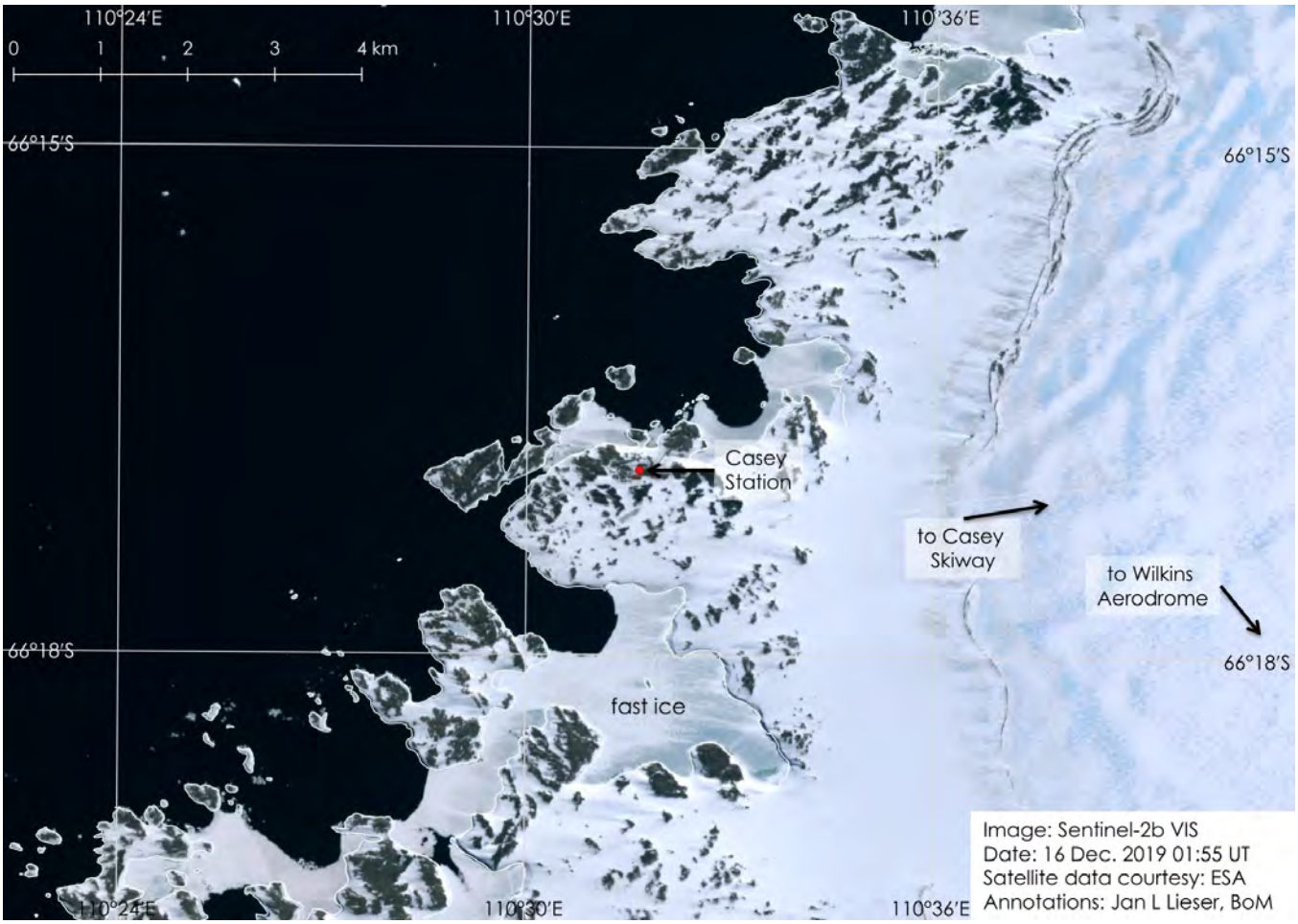

***Figure 4**: Sentinel-2b VIS data acquired 16 December 2019 at 01:55 UT and provided by ESA.*

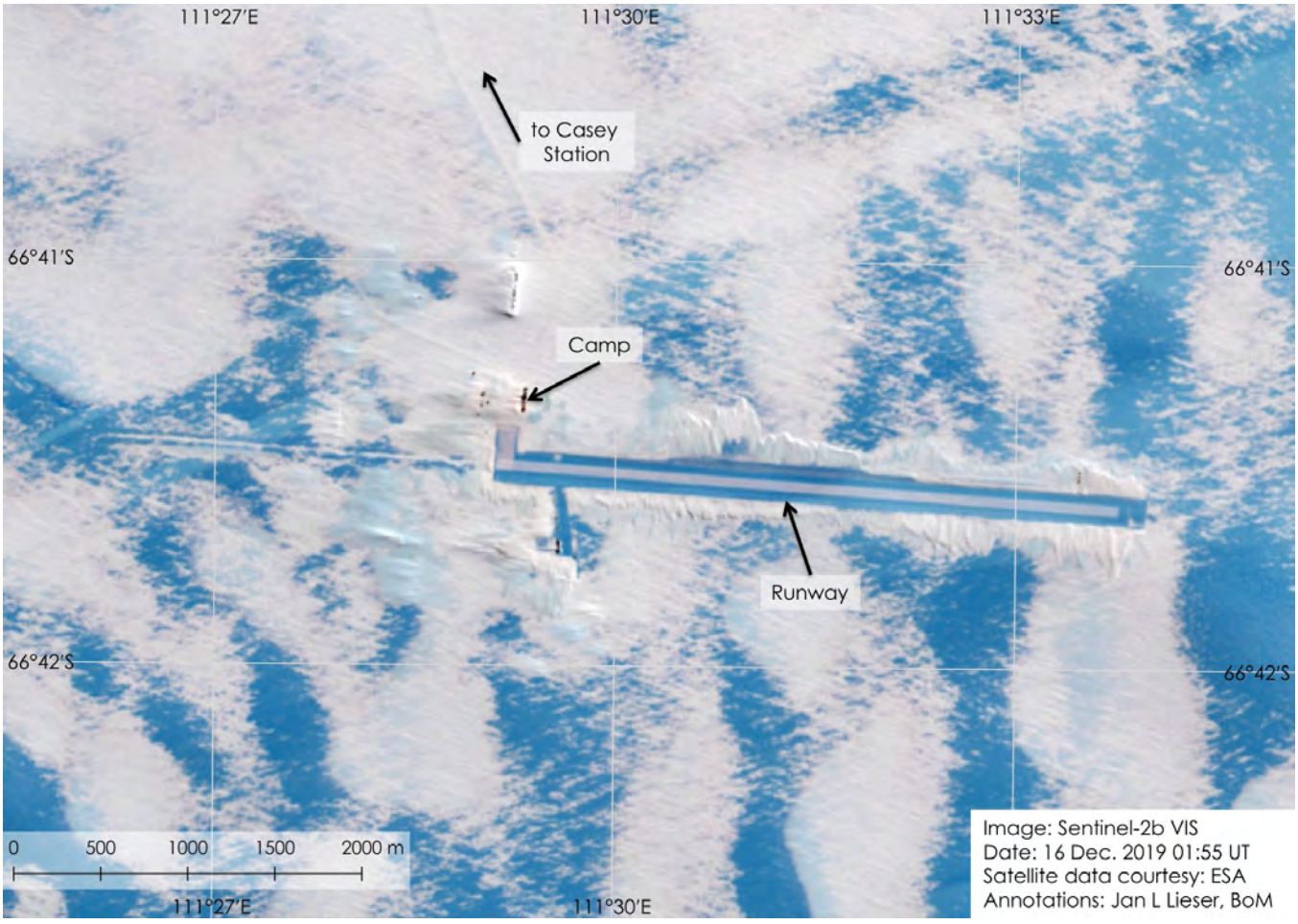

***Figure 5**: Sentinel-2b VIS data acquired 16 December 2019 at 01:55 UT and provided by ESA.*

Ice Bulletin: Casey Station

Issued: Thursday 19th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of high-resolution (3.125 km horizontal) sea-ice concentration data of the wider area around Casey Station and a SAR swath. The sea-ice edge based on the sea-ice concentration data is marked by a cyan line. East and west of Casey Station, fast ice is marked by a black outline.

The location of a whale-recorder mooring is marked by a green dot (north of the sea-ice zone).

1637 icebergs have been identified in the SAR data and are marked by magenta dots. Additionally, icebergs as identified in SAR data from 17 December 2019 (white frames) are marked by pink dots. East of Law Dome, hundreds of icebergs off the Williamson Glacier have not been marked individually.

North of Vincennes Bay (off Casey Station), the sea-ice cover is largely confined to south of 65ºS, but strips and patches of sea ice are still drifting further north (for example along 111ºE up to 64º30'S).

North of the sea-ice zone, hundreds of icebergs are drifting freely as far north as 59º30'S and potentially even further.

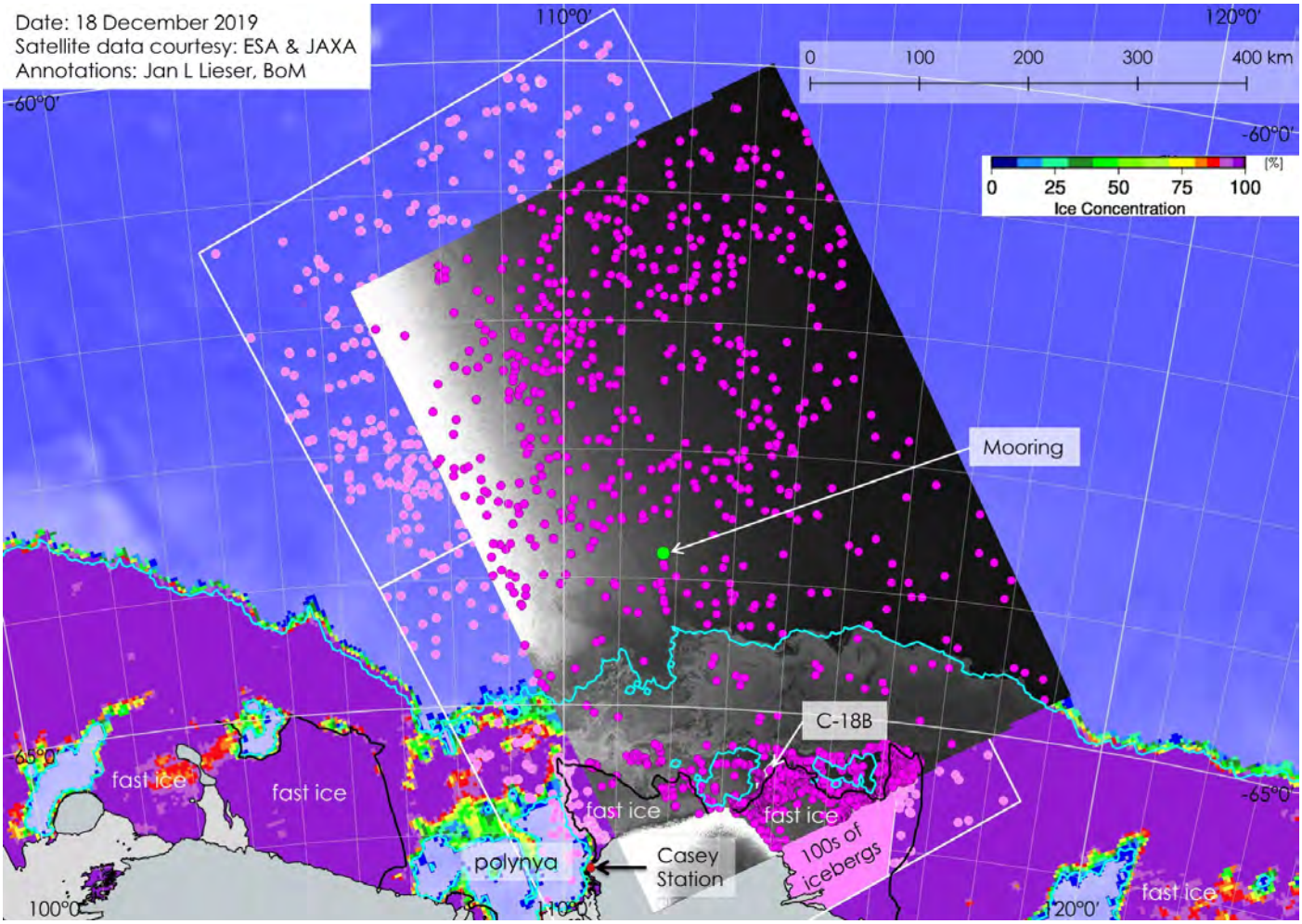

***Figure 1**: Composite of AMSR-2 sea-ice concentration data acquired 18 December 2019 and provided by ICDC, Universität Hamburg and Sentinel-1a SAR EW swath acquired 18 December 2019 at 12:13 UT and provided by ESA. Bathymetry provided by SCAR.*

Ice Bulletin: Davis Station

Issued: Friday 20th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high resolution (10 m horizontal) visible scene of Davis Station and the Vestfold Hills.

Offshore, fast ice continues to break up and small floes of ex-fast ice are drifting south-westward interspersed with icebergs.

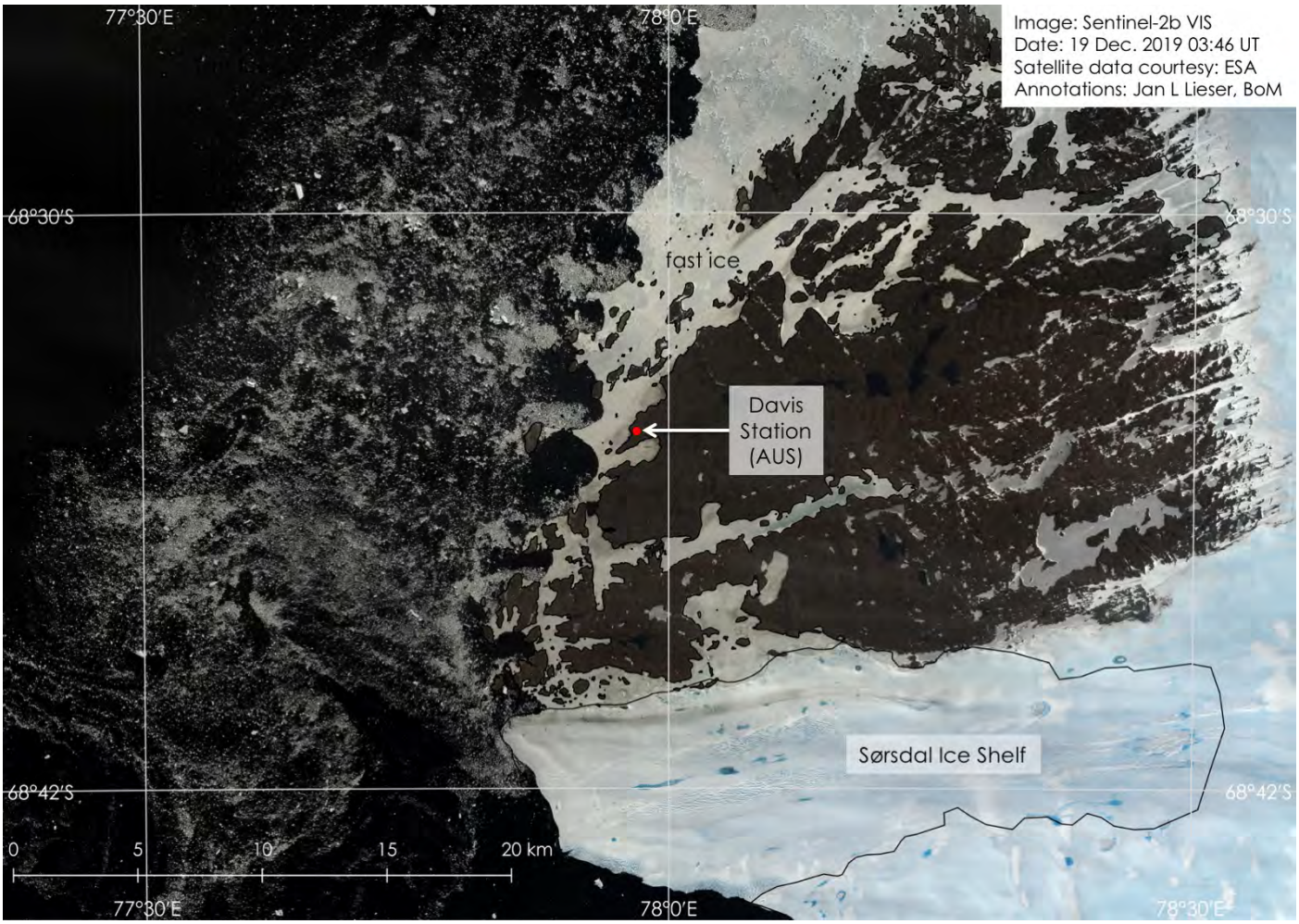

***Figure 1**: Sentinel-2b VIS scene acquired 19 December 2019 at 03:46 UT and provided by ESA.*

Figure 2 provides a close-up zoom of Davis Station, where individual buildings can be seen and identified by their colour. Also, the road used during resupply operations and the Davis Skiway can be seen as surface features.

Figure 3 shows a very high resolution (10 m horizontal) visible scene of the Larsemann Hills south of the Vestfold Hills. Offshore, grounded icebergs are enclosed by fast ice.

The clearly visible ship tracks cutting through the fast ice were created by the Chinese vessels XueLong and XueLong-2 during their recently completed resupply operations. Mostly east-west oriented cracks in the fast ice are new stress features that are typically radiating around anchor points, here icebergs.

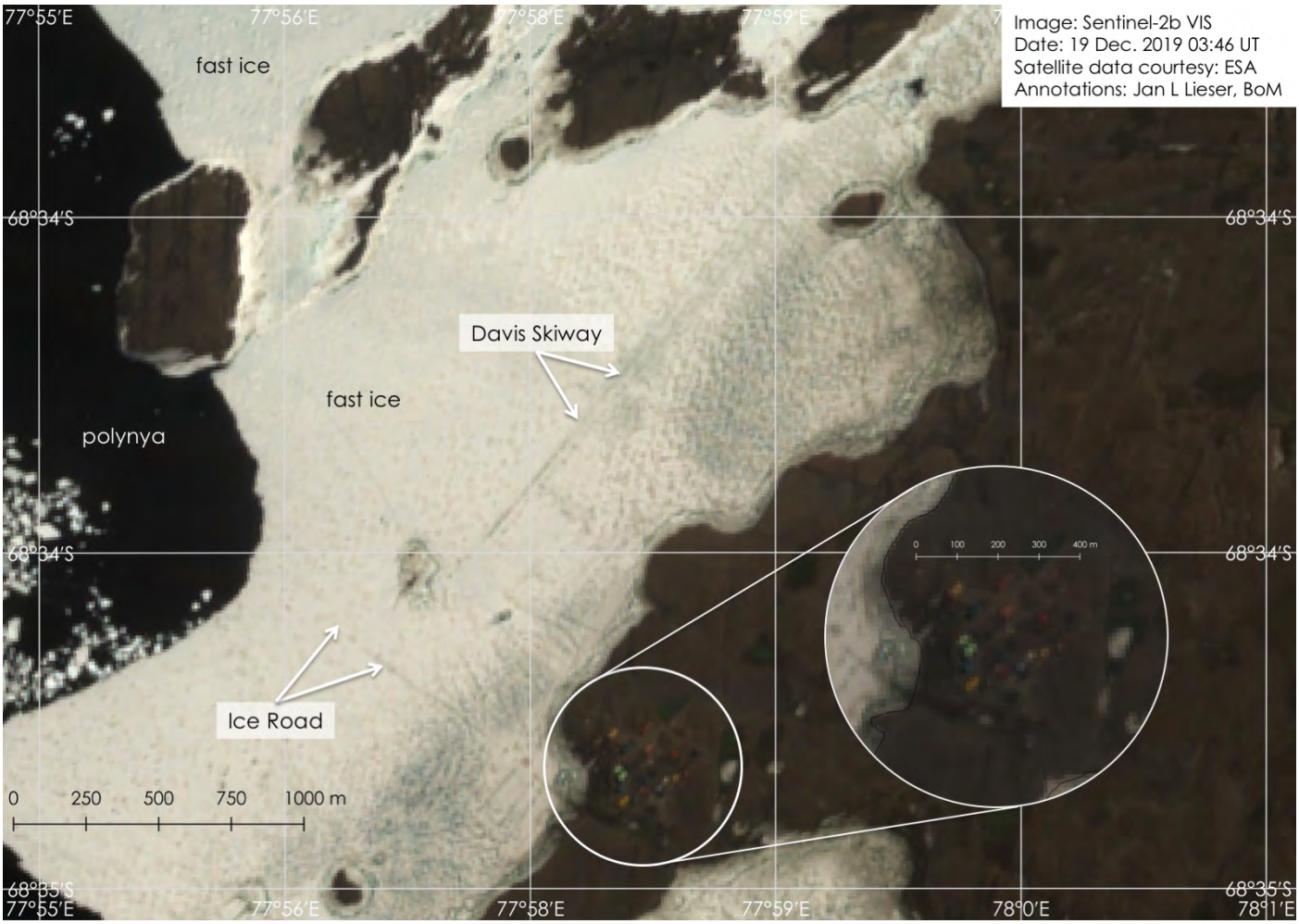

***Figure 2**: Close-up of Figure1.*

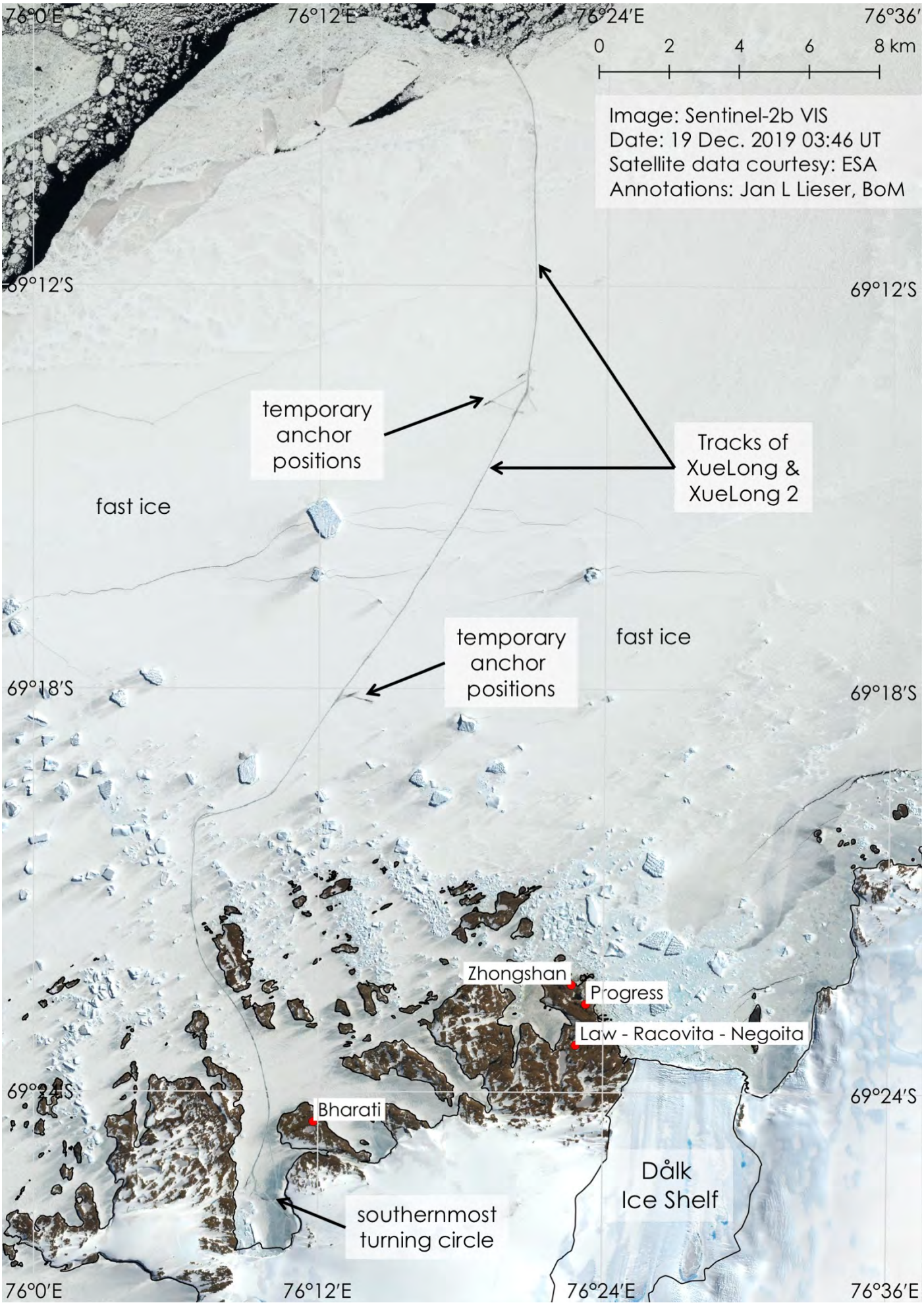

***Figure 3**: Sentinel-2b VIS scene acquired 19 December 2019 at 03:46 UT and provided by ESA.*

Ice Bulletin: Casey Station

Issued: Monday 23th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows SAR swath of the area north of Casey Station.

The location of a whale-recorder mooring is marked by a green dot (north of the sea-ice zone).

In the northern scene (north of the white line), 626 icebergs have been identified and are marked by magenta dots. In the southern scene, 1684 icebergs are marked by pink dots, but east of Law Dome, hundreds of icebergs off the Williamson Glacier have not been marked individually.

North of the sea-ice zone, hundreds of icebergs are drifting freely as far north as 59º30'S and potentially even further.

North of Vincennes Bay (off Casey Station), the sea-ice cover is largely confined to south of 65ºS, but strips and patches of sea ice are still drifting further north (for example along 111ºE up to 64º30'S).

Fast ice remains attached to the north-western and north-eastern flank of Law Dome where it is stabilised by grounded icebergs, but only minimal fast ice is found off Casey Station.

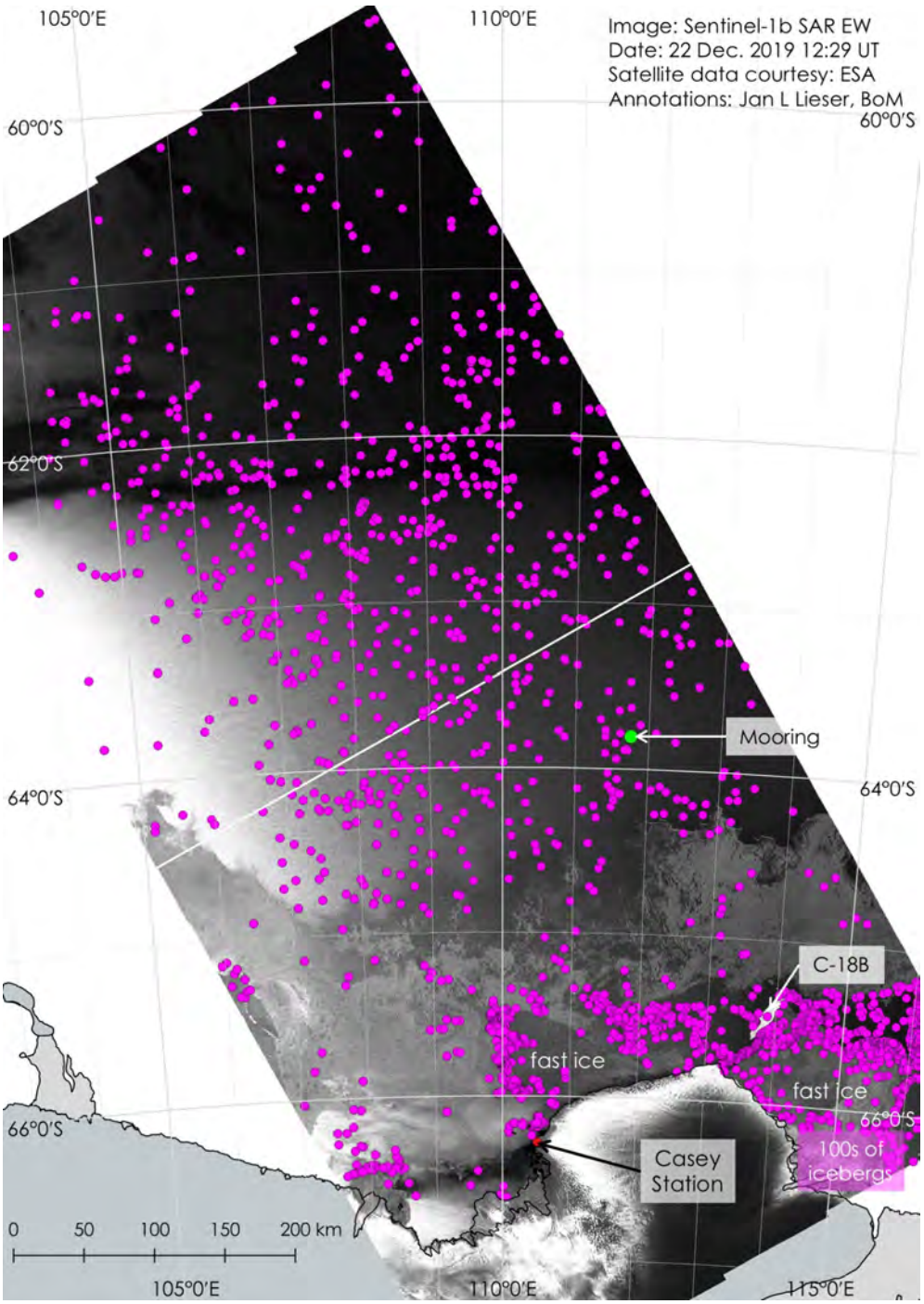

***Figure 1**: Sentinel-1b SAR EW swath acquired 22 Dec. 2019 at 12:29 UT and provided by ESA.*

Ice Bulletin: Davis Station

Issued: Tuesday 24th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high resolution (10 m horizontal) panchromatic scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by red letters.

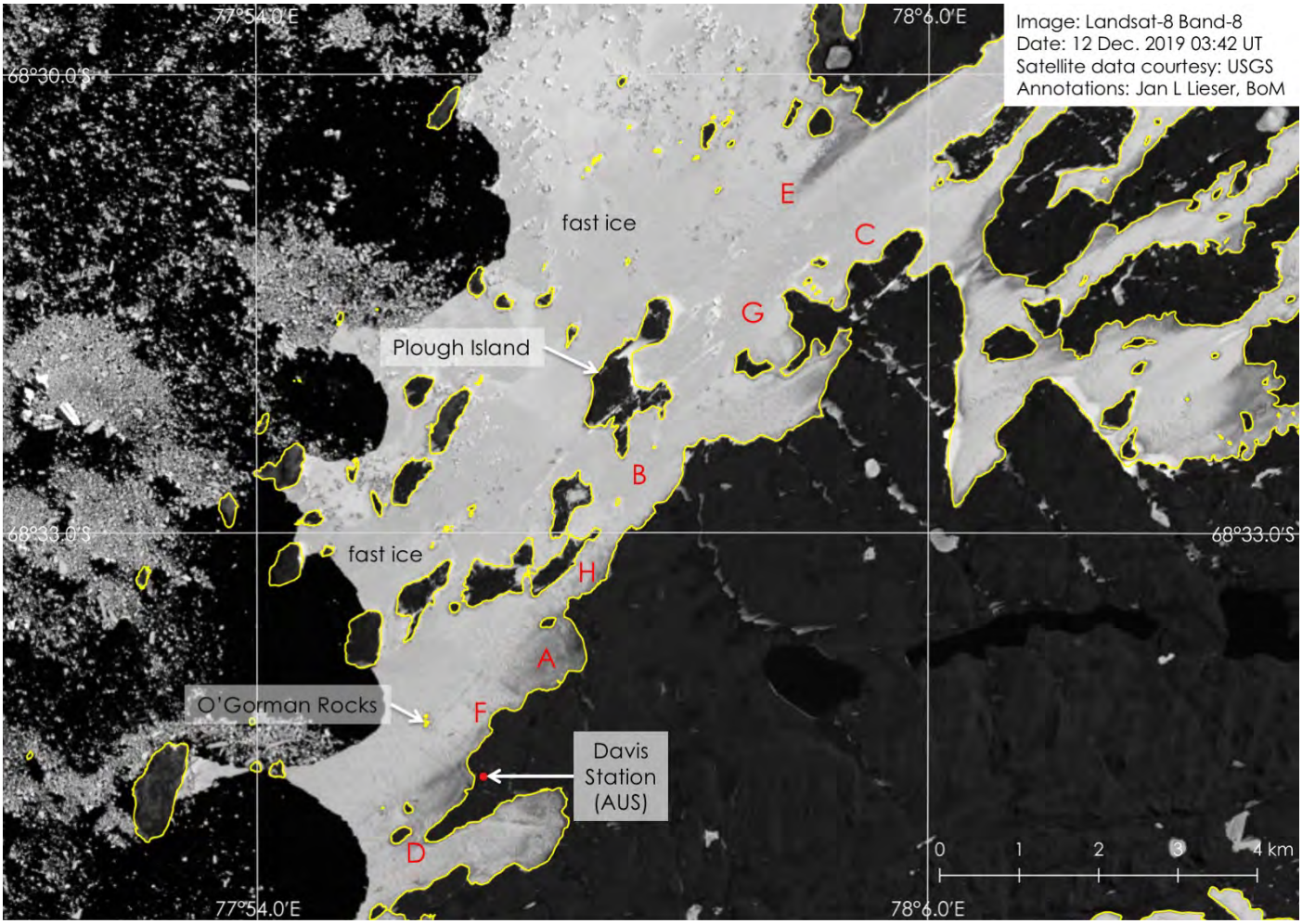

***Figure 1**: Landsat-8 Band-8 scene acquired 12 December 2019 at 03:42 UT and provided by USGS.*

All areas of proposed hydrographic surveying are covered by fast ice. While broken ex-fast ice and icebergs are drifting south-westward off the fast-ice edge, the fast-ice edge itself has been largely stable during the past two weeks (since the data shown in Figure 1 were acquired).

Ice Bulletin: Casey Station

Issued: Friday 27th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a SAR scene north of Law Dome and optical data in the background. A mooring a marked by a green dot; the current cruise track of RSV *Aurora Australis* is marked by the orange line (up to 26 Dec. 2019 22:50 UT).

192 icebergs have been identified in the SAR data and are marked by magenta dots.

The location of the mooring is free of sea ice, but icebergs are expected to be in the vicinity. Sea ice is only south of 64ºS and can be seen through the cloud cover and only in the southernmost corner of the SAR scene.

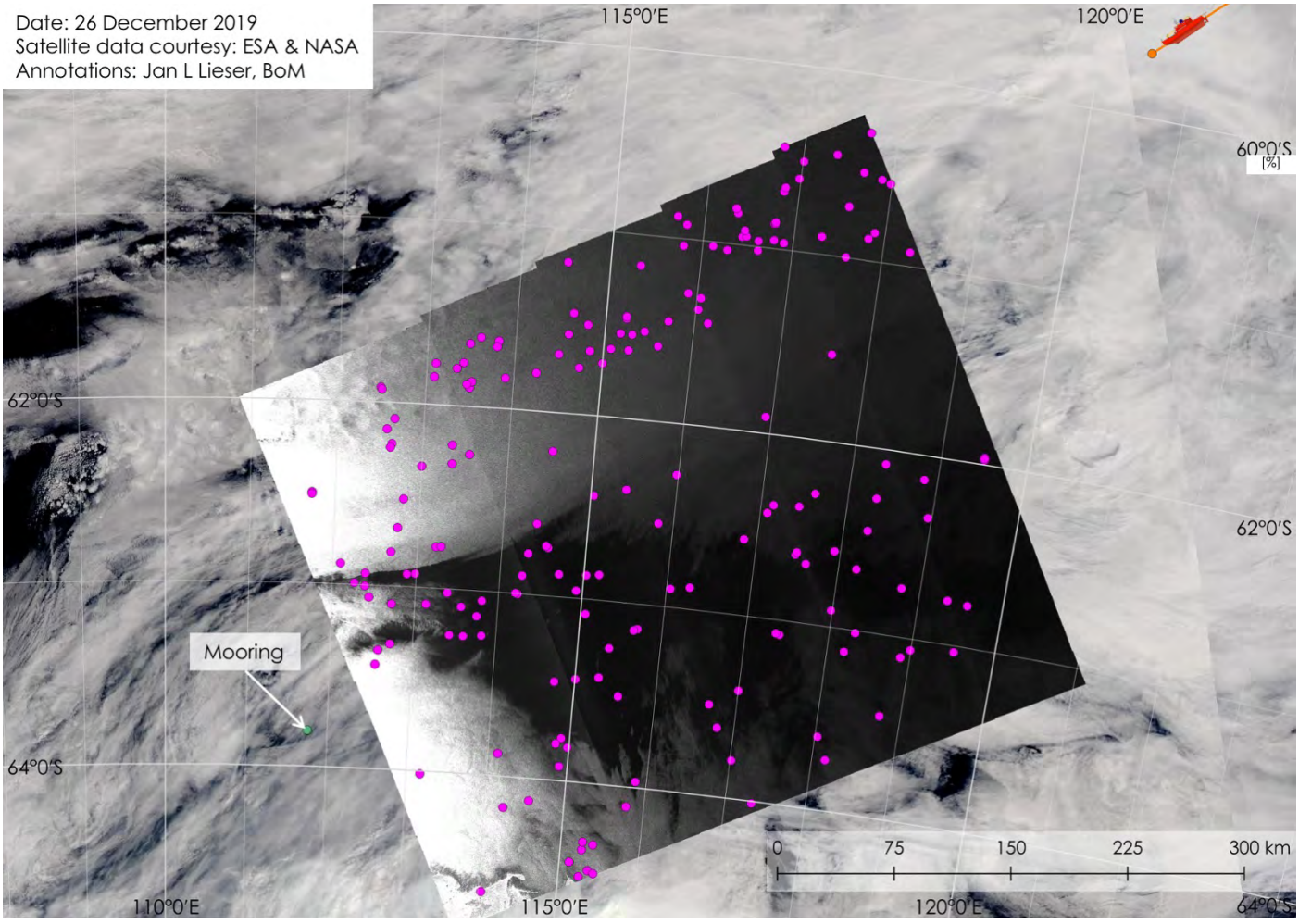

***Figure 1**: Composite of Sentinel-1b SAR EW swath acquired 26 December 2019 at 11:55 UT and provided by ESA and AQUA MODIS VIS data acquired 26 December 2019.*

Figure 2 shows a high-resolution SAR scene of Casey Station and offshore. Fast ice is marked by red lines. Only minimal fast ice remains in sheltered bays around the station. A few icebergs are drifting offshore.

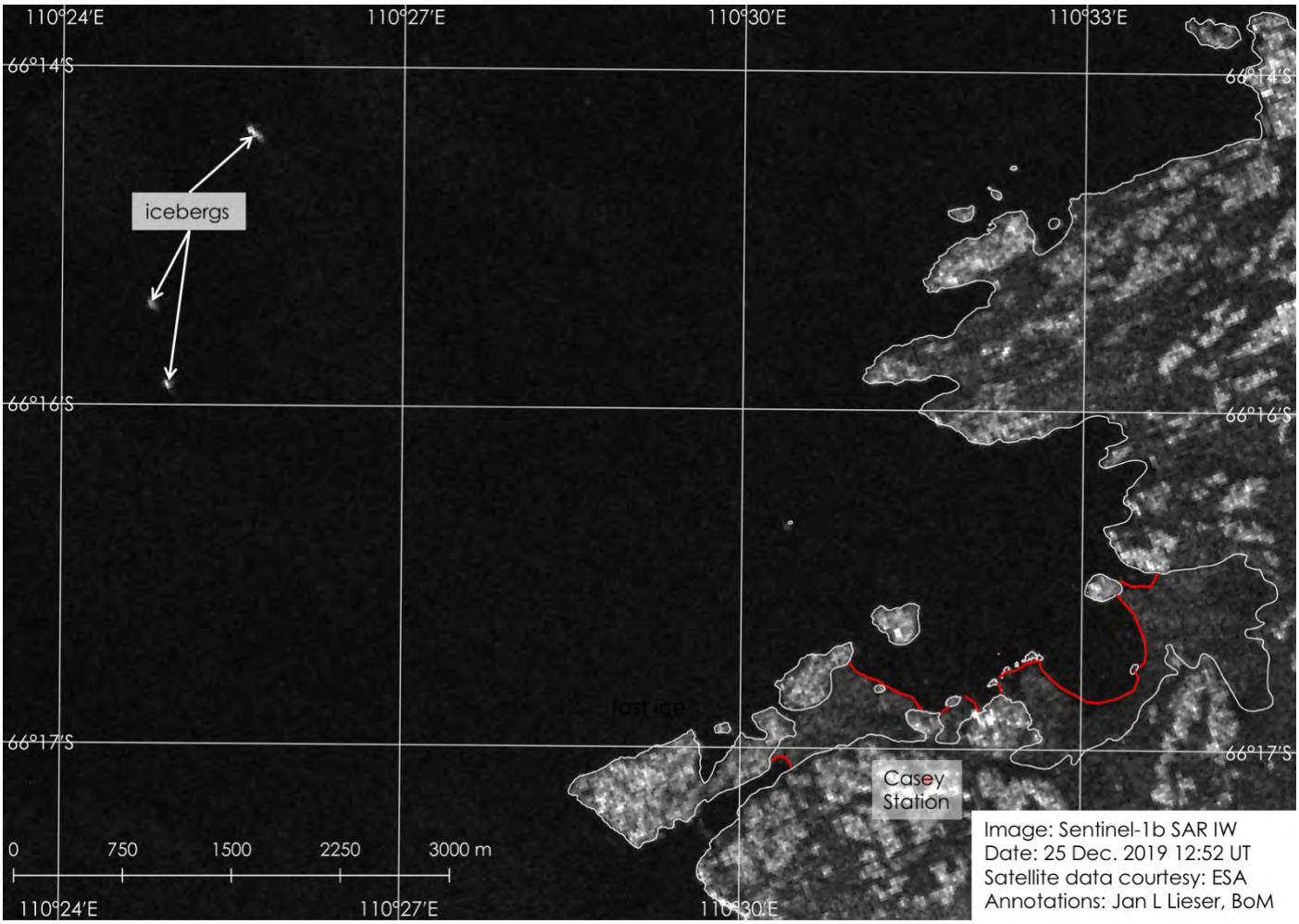

***Figure 1**: Sentinel-1b SAR IW swath acquired 25 December 2019 at 12:52 UT and provided by ESA.*

Ice Bulletin: Casey Station

Issued: Saturday 28th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows SAR data of the area north of Law Dome. The location of a whale-recorder mooring is marked by a green dot (north of the sea-ice zone). The current cruise track of RSV *Aurora Australis* is marked by the orange line (up until 28 Dec. 2019 00:10 UT)

Icebergs have been identified in the SAR data and are marked by magenta dots.

The location of the mooring is currently not occupied by an iceberg but is within a region where icebergs drift freely.

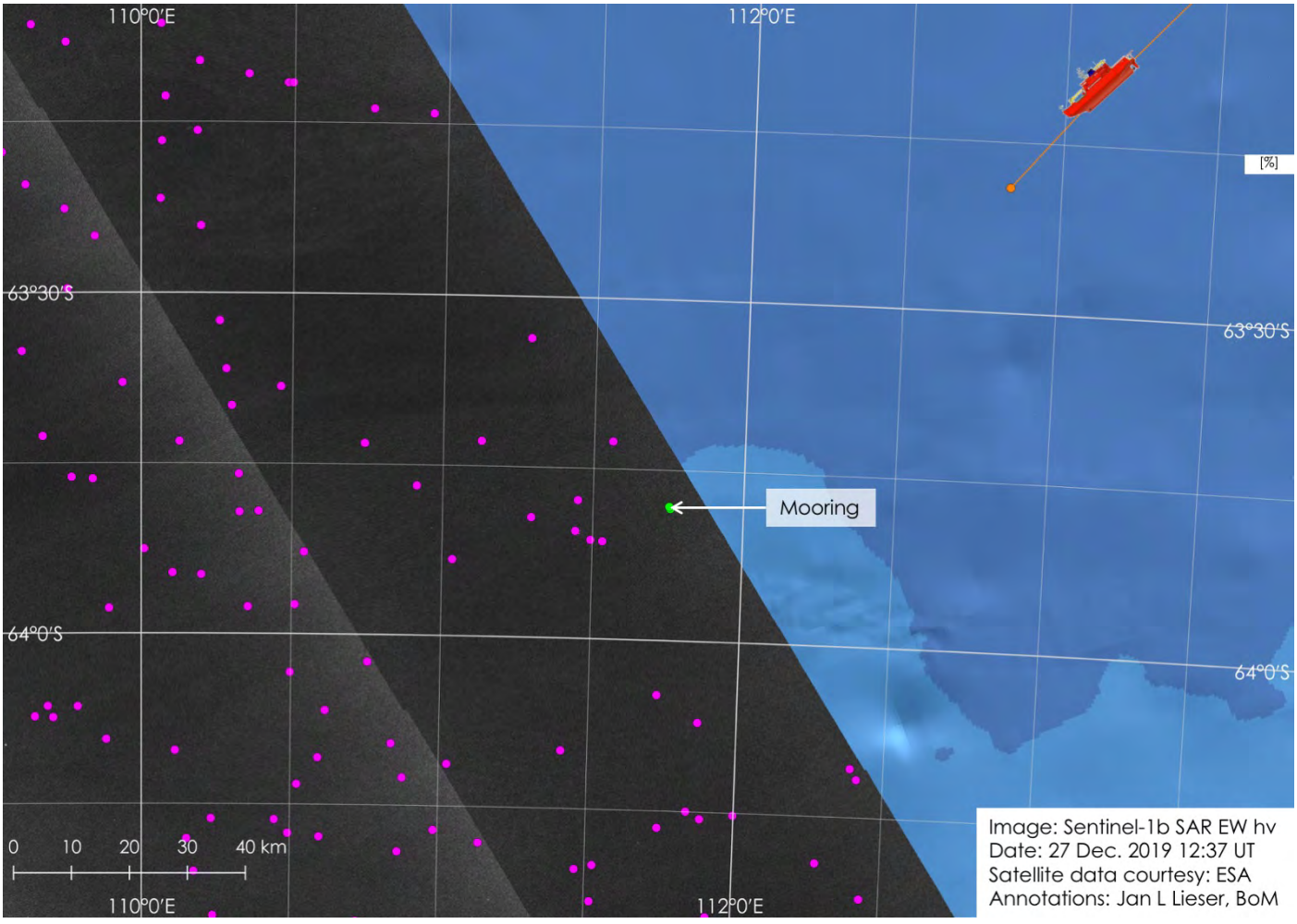

***Figure 1**: Sentinel-1b SAR EW (hv-polarised) data acquired 27 December 2019 at 12:37 UT and provided by ESA. Bathymetry provided by IBCSO.*

Ice Bulletin: Casey Station

Issued: Saturday 28th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of high-resolution (3.125 km horizontal) sea-ice concentration data of the wider area around Casey Station and a SAR scene. The sea-ice edge based on the sea-ice concentration data is marked by a cyan line. The location of a whale-recorder mooring is marked by a green dot (north of the sea-ice zone). The current cruise track of RSV *Aurora Australis* is marked by an orange line (up until 28 Dec. 2019 06:50 UT).

1299 icebergs have been identified in the SAR data and are marked by magenta dots.

North of Vincennes Bay (off Casey Station), the sea-ice cover is largely confined to south of 65ºS and appears with a fuzzy sea-ice edge east of 107º30'E, which indicates that the sea-ice zone is not under big pressure there. West of 107ºE, the sea-ice edge is more confined to a straight line, which indicates compression from the north.

A yellow arrow (between 110º30'E and 107ºE) shows the general drift direction of sea ice in the region: westward around the fast ice off the north-western flank of Law Dome, turning south into Vincennes Bay before heading north again along the fast-ice edge west of the polynya.

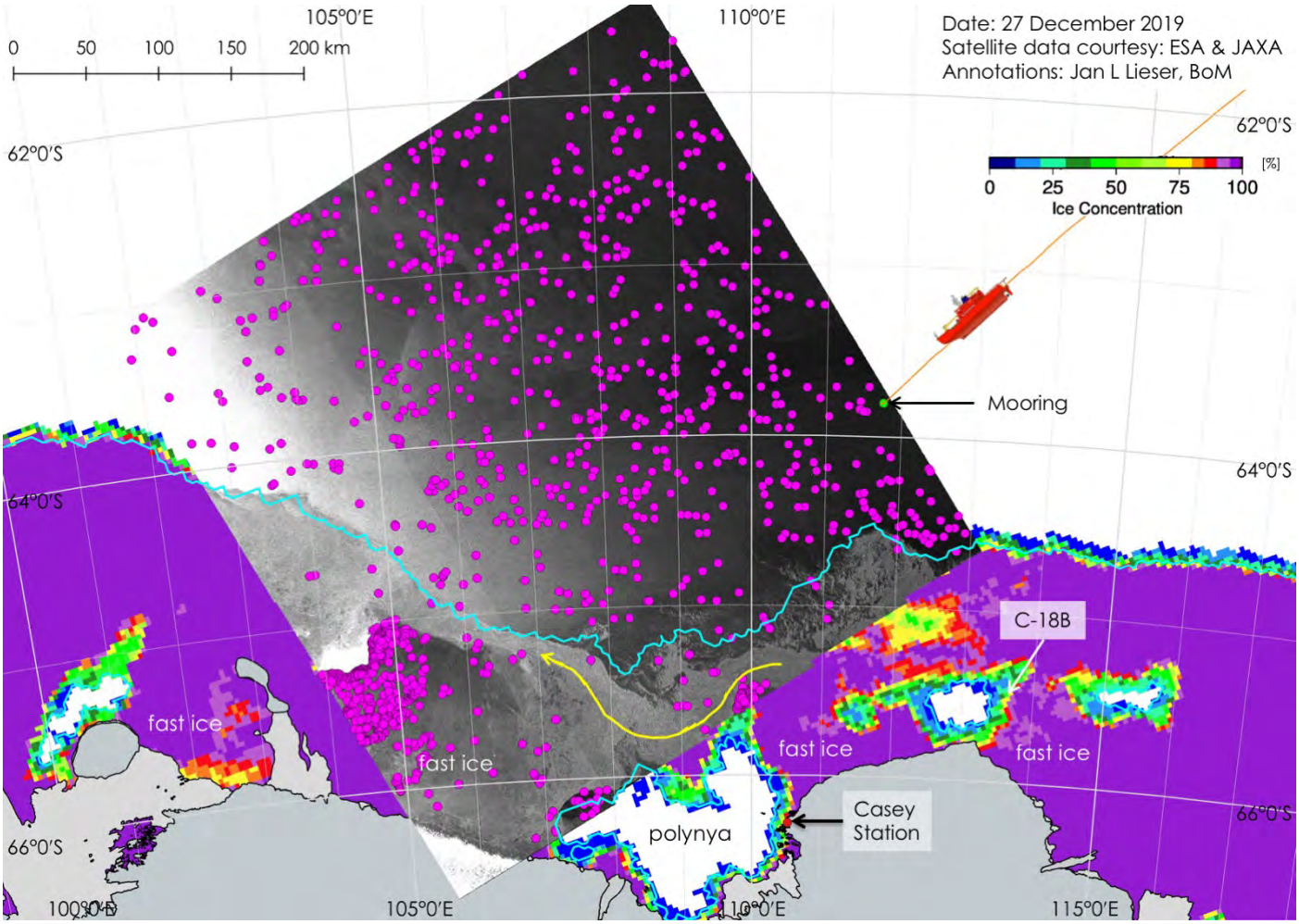

***Figure 1**: Composite of AMSR-2 sea-ice concentration data acquired 27 December 2019 and provided by ICDC, Universität Hamburg and Sentinel-1b SAR EW swath acquired 27 December 2019 at 12:37 UT and provided by ESA.*

Ice Bulletin: Davis Station

Issued: Monday 30th December 2019

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high resolution (10 m horizontal) optical scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by red letters. The fast-ice edge on 19 Dec. 2019 is marked by the red line.

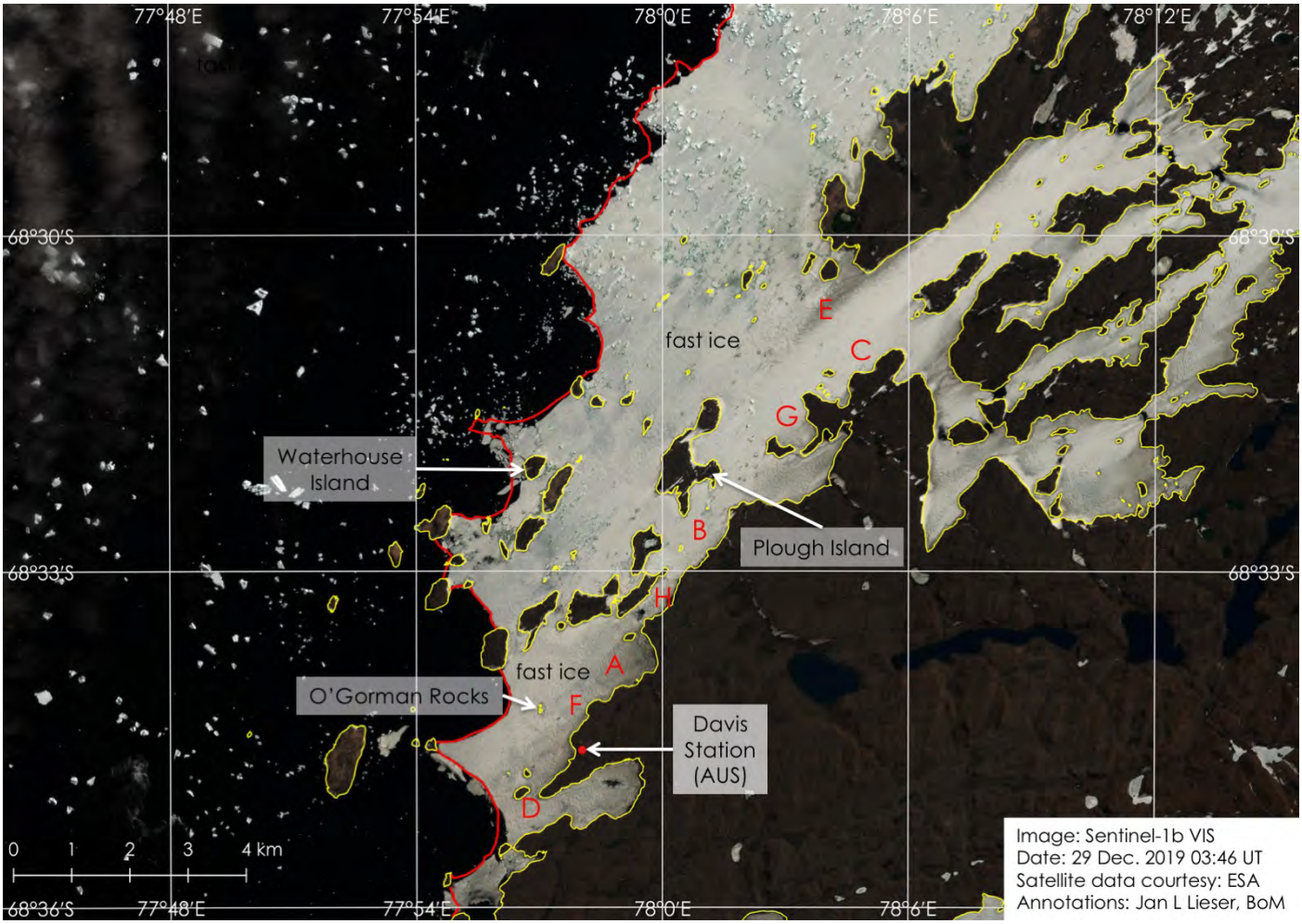

***Figure 1**: Sentinel-2b visible composite (band 2, band 3 and band 4) acquired 29 December 2019 at 03:46 UT and provided by ESA.*

All areas of proposed hydrographic surveying are covered by fast ice. Broken ex-fast ice and icebergs are drifting south-westward off the fast-ice edge.

Since 19 Dec. 2019, the most notable fast-ice breakup can be seen off Waterhouse Island. Further north and south, the fast-ice edge retreated only minimal towards the coast in isolated places.

Ice Bulletin: Casey Station

Issued: Friday 03rd January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows SAR data off Casey Station. The position of RSV *Aurora Australis* (call sign VNAA) at the time of data acquisition can be seen as a bright spot.

A patch of ex-fast ice is drifting in the bay northeast of the station (marked by a blue arrow).

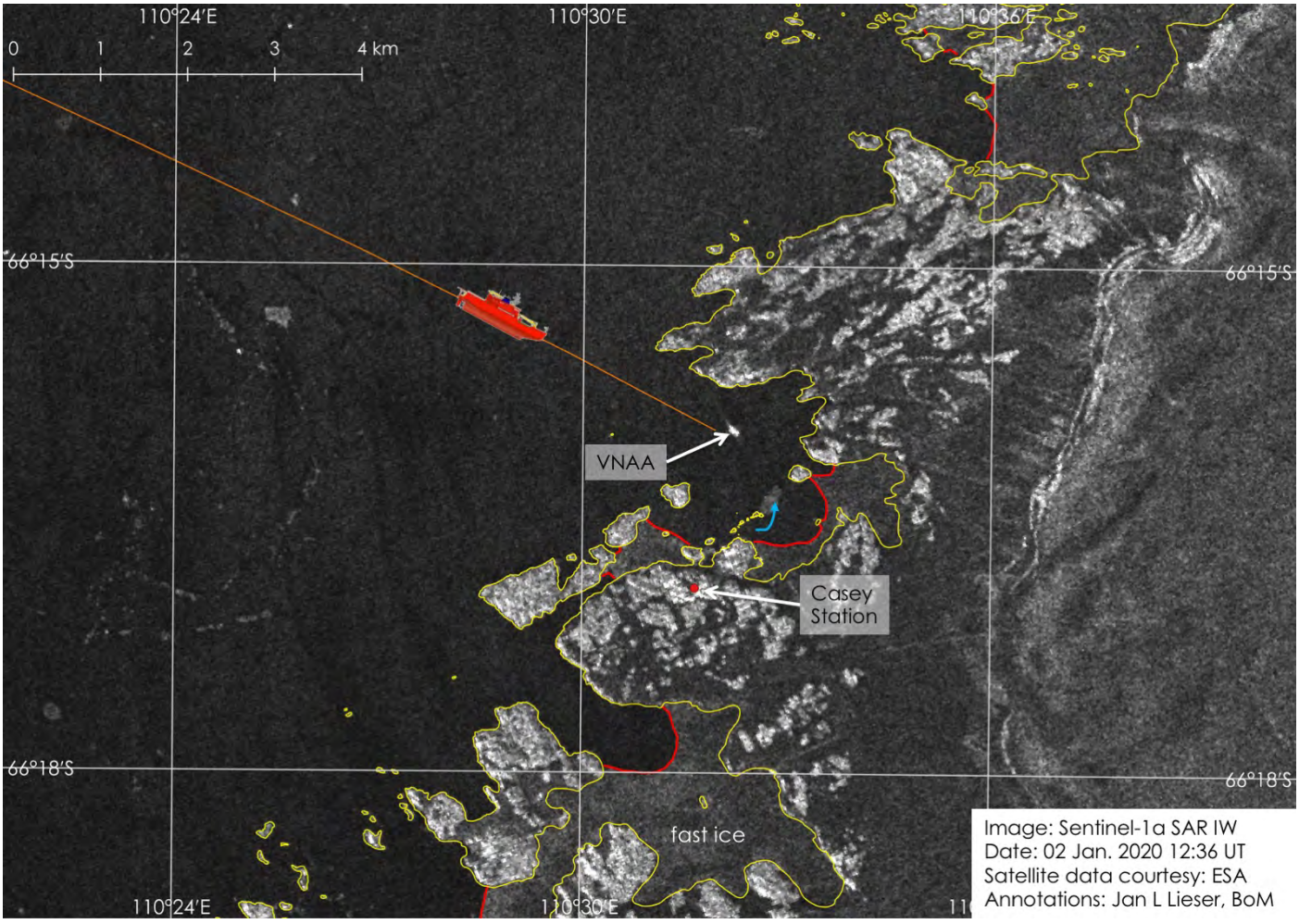

***Figure 1**: Sentinel-1a SAR IW data acquired 02 January 2020 at 12:36 UT and provided by PolarView.*

In the north of Vincennes Bay (not shown in the Figure), sea ice is drifting freely between 108º30'E and 109º50'E and predominantly distributed by oceanic eddies currently. Those ocean-surface features have carried some sea ice as far south as 66º30'S into the bay.

Ice Bulletin: Mawson Station

Issued: Friday 03rd January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (10 m horizontal) visible composite of Mawson Coast and offshore.

Nearshore, fast ice deteriorates, and a large patch of open water can be seen roughly 17 km west of the station. Further signs of cracking and deterioration are visible north of this patch.

North of Mawson Station, fast ice continues to break away from the northern edge of the fast ice (not shown in the figure), but the shortest distance between the open water of the so-called 'northwest polynya' and the station is still more than 30 nautical miles.

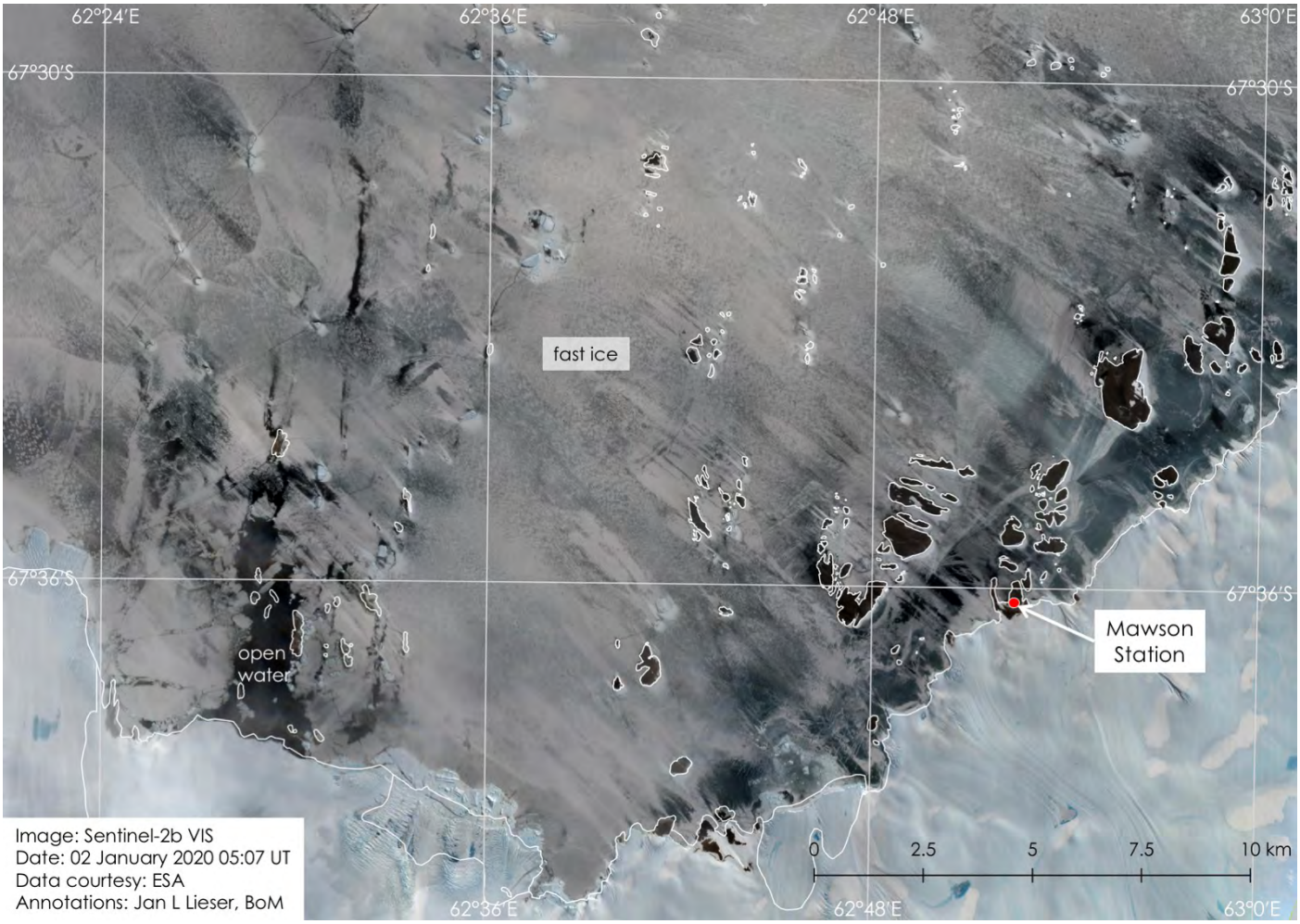

***Figure 1**: Sentinel-2b VIS composite acquired 02 January 2020 at 05:07 UT and provided by ESA.*

Ice Bulletin: Casey Station

Issued: Saturday 04th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows an optical scene of Vincennes Bay off Casey Station and to the north. The recent cruise track of RSV *Aurora Australis* is marked by the orange line and her position off station is marked (VNAA) by an orange dot.

1379 icebergs are identified in a SAR scene (black frame, acquired 03 Jan. 2020 at 12:27 UT) and fast ice is marked by a red outline. Many more icebergs are enclosed within the fast ice areas. Two large named tabular icebergs are also in the region.

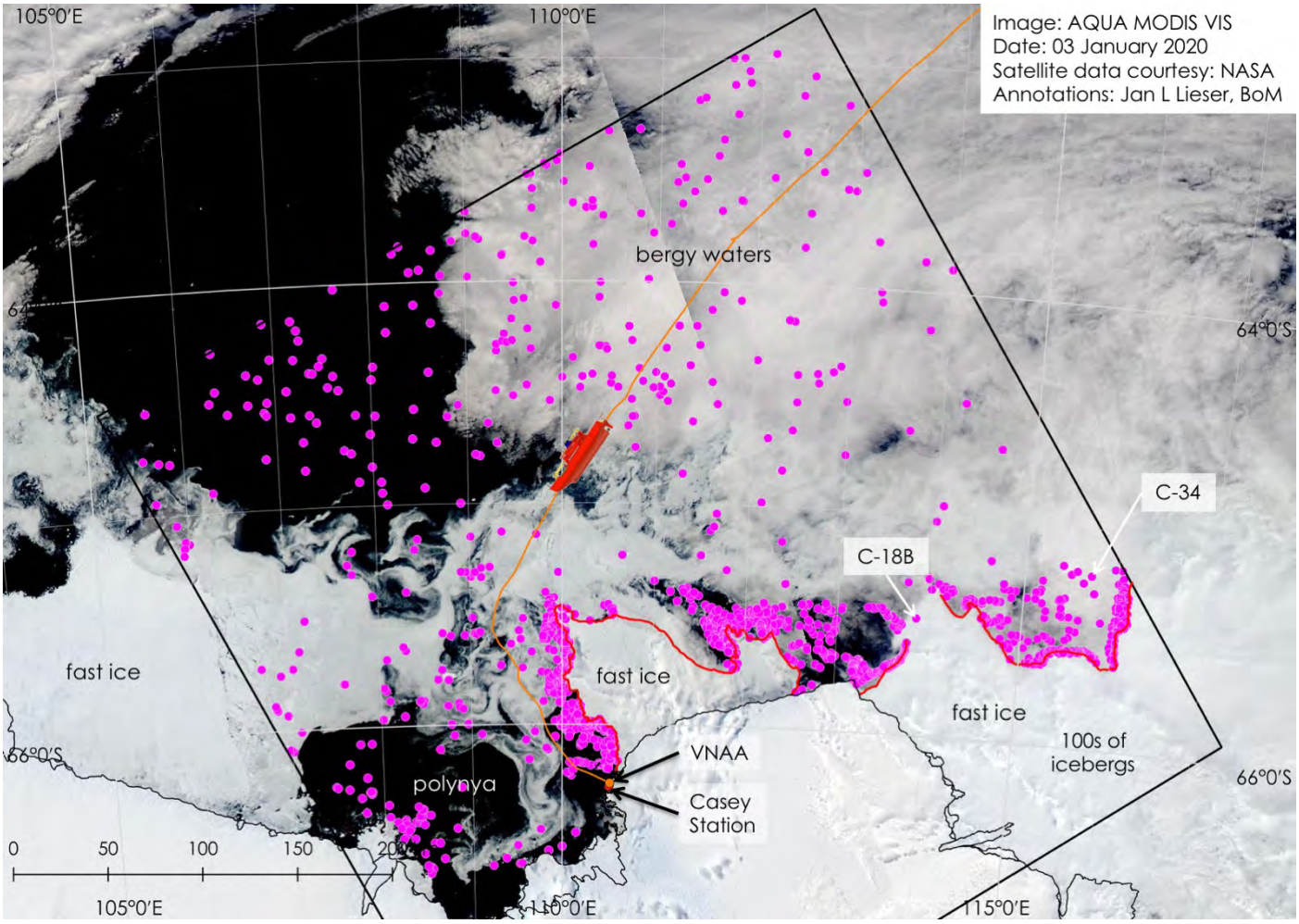

***Figure 1**: AQUA MODIS VIS acquired 03 January 2020 and provided by NASA.*

In the north of Vincennes Bay, sea ice is drifting freely between 108ºE and west of 110ºE. It is predominantly distributed by oceanic eddies. Those ocean-surface features have carried some sea ice as far south as 66º45'S into the bay.

Ice Bulletin: Davis Station

Issued: Monday 06th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene northwest of the West Ice Shelf, north of Davis Station.

The drift of iceberg B-39 has been marked by colour-coded shapes. During the previous two months, the iceberg has drifted westward along a patch of fast ice (note: this patch has in the meantime shrunk and is now shattered ex-fast ice), turned south and eastward, then north and further east and is now off the northwest corner of Iceberg D-15B. It is expected that this drift is predominantly forced by ocean currents.

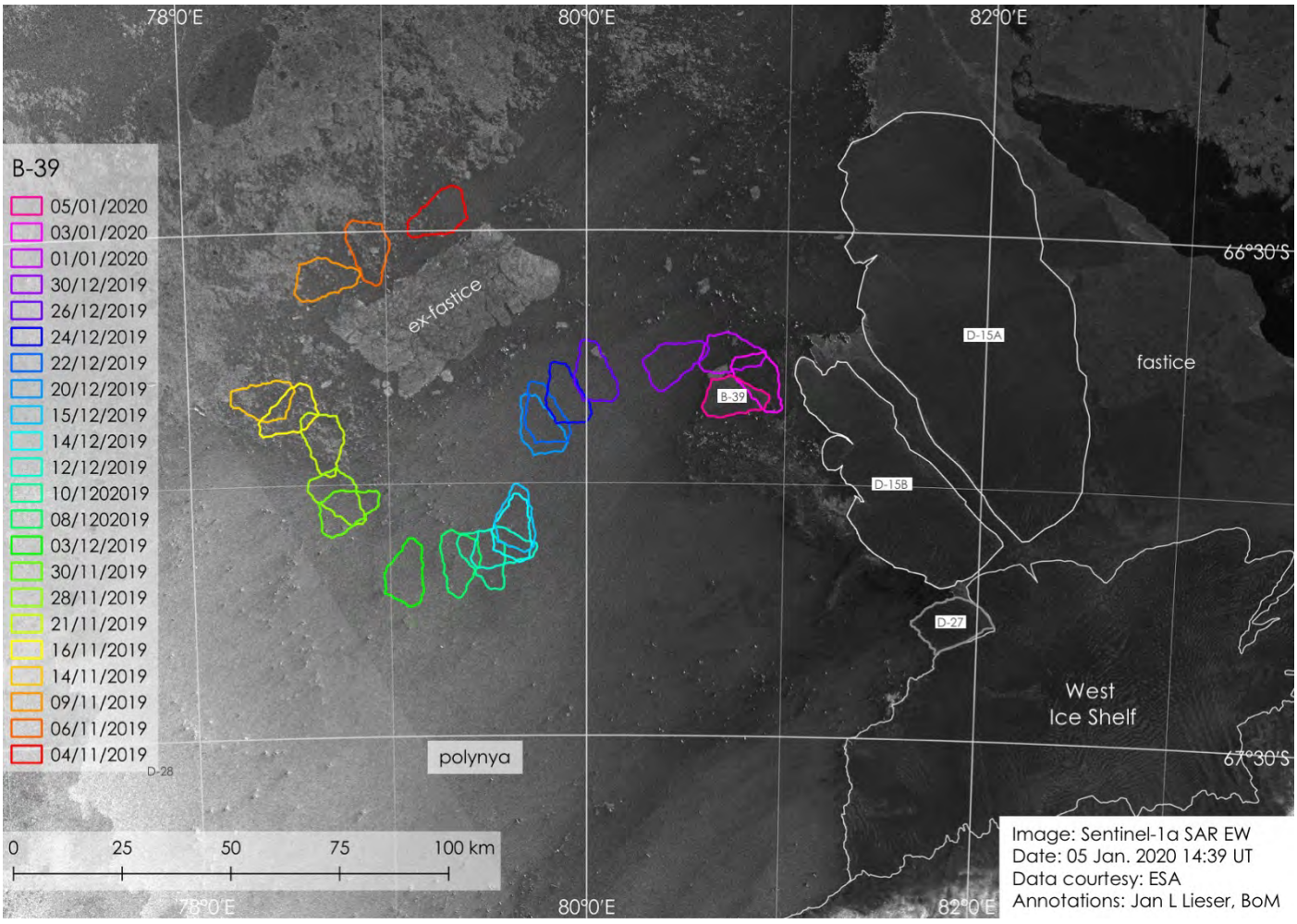

***Figure 1**: Sentinel-1a SAR EW scene acquired 05 January 2020 at 14:39 UT and provided by PolarView.*

Ice Bulletin: Casey Station

Issued: Tuesday 07th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of SAR and optical data of Vincennes Bay off Casey Station and to the north. The recent cruise track of RSV *Aurora Australis* is marked by the orange line and her position off station is marked 'VNAA'.

201 icebergs are identified in the eastern SAR scene and more than 900 in the western SAR scene. Many more icebergs are enclosed within the fast ice areas. Two large named tabular icebergs are also in the region.

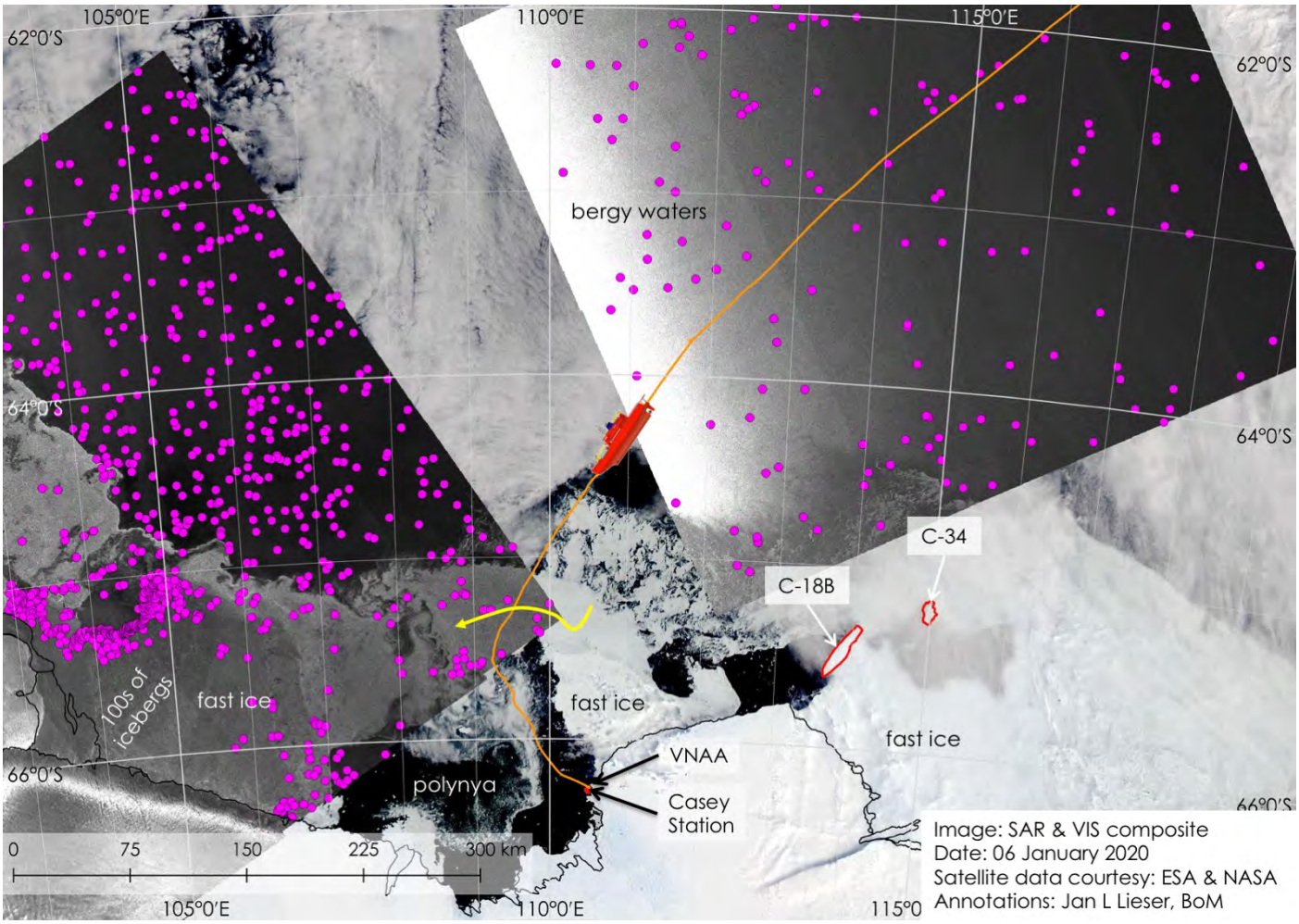

***Figure 1**: Composite of SAR and optical data comprised of Sentinel-1b SAR EW acquired 06/01/2020 at 12:52 UT (western scene) and Sentinel-1a SAR EW acquired 06/01/2020 at 12:04 UT(eastern scene), both SAR scenes provided by PolarView, on a backdrop of AQUA MODIS VIS data acquired 06 January 2020 and provided by NASA.*

The passage of a low-pressure system north of the sea-ice zone recently, has re-distributed the pack ice south of the sea-ice edge. A yellow arrow indicates the principal drift of sea ice north of Casey Station caused by that passage. This area shows very high (up to 100%) concentration of sea ice, even though it consists mostly of small to medium size floes with a few icebergs in mix.

A region of lower concentration sea ice has been narrowed in this process and is now between 108ºE and of 108º30'E north of 65º30'S.

Ice Bulletin: D'Urville Sea

Issued: Wednesday 08th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of D'Urville Sea. 1056 icebergs have been identified in the entire scene (only the south-western part is shown) and are marked by pink dots. A few of the larger icebergs are marked by yellow outlines. Fast ice is outlined by a red line.

Between Dumont D'Urville Station and Cape Denison, fast ice is breaking up and some open water of the polynya is already nearing Commonwealth Bay. The sea-ice edge runs just north of 66ºS between 140ºE and 146ºE.

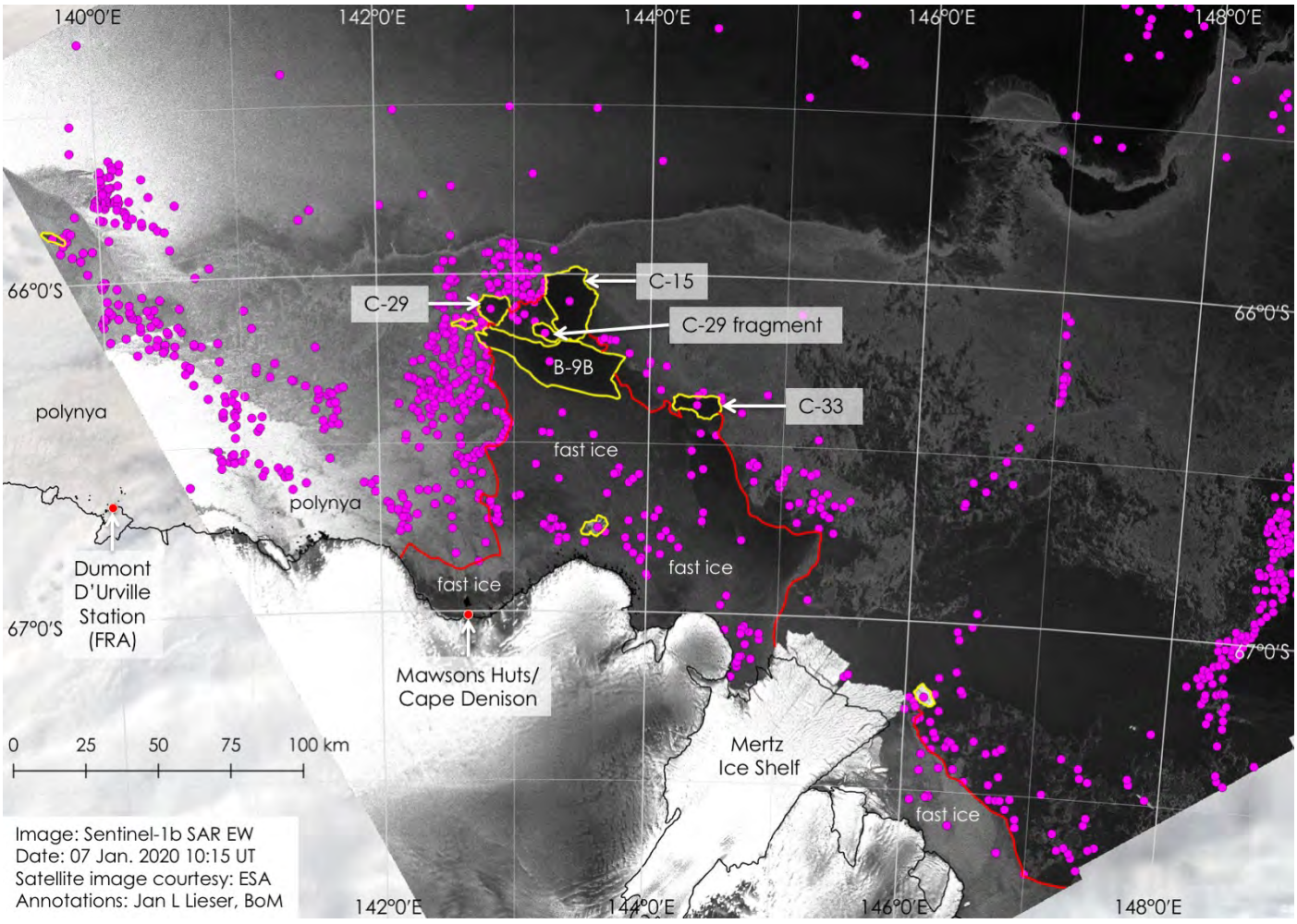

***Figure 1**: Sentinel-1b SAR EW scene acquired 07 January 2020 at 10:15 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 07 January 2020 and provided by NASA*

Ice Bulletin: Casey Station

Issued: Wednesday 08th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data of Vincennes Bay off Casey Station and to the north. The position of RSV *Aurora Australis* is marked by an orange dot off station ('VNAA').

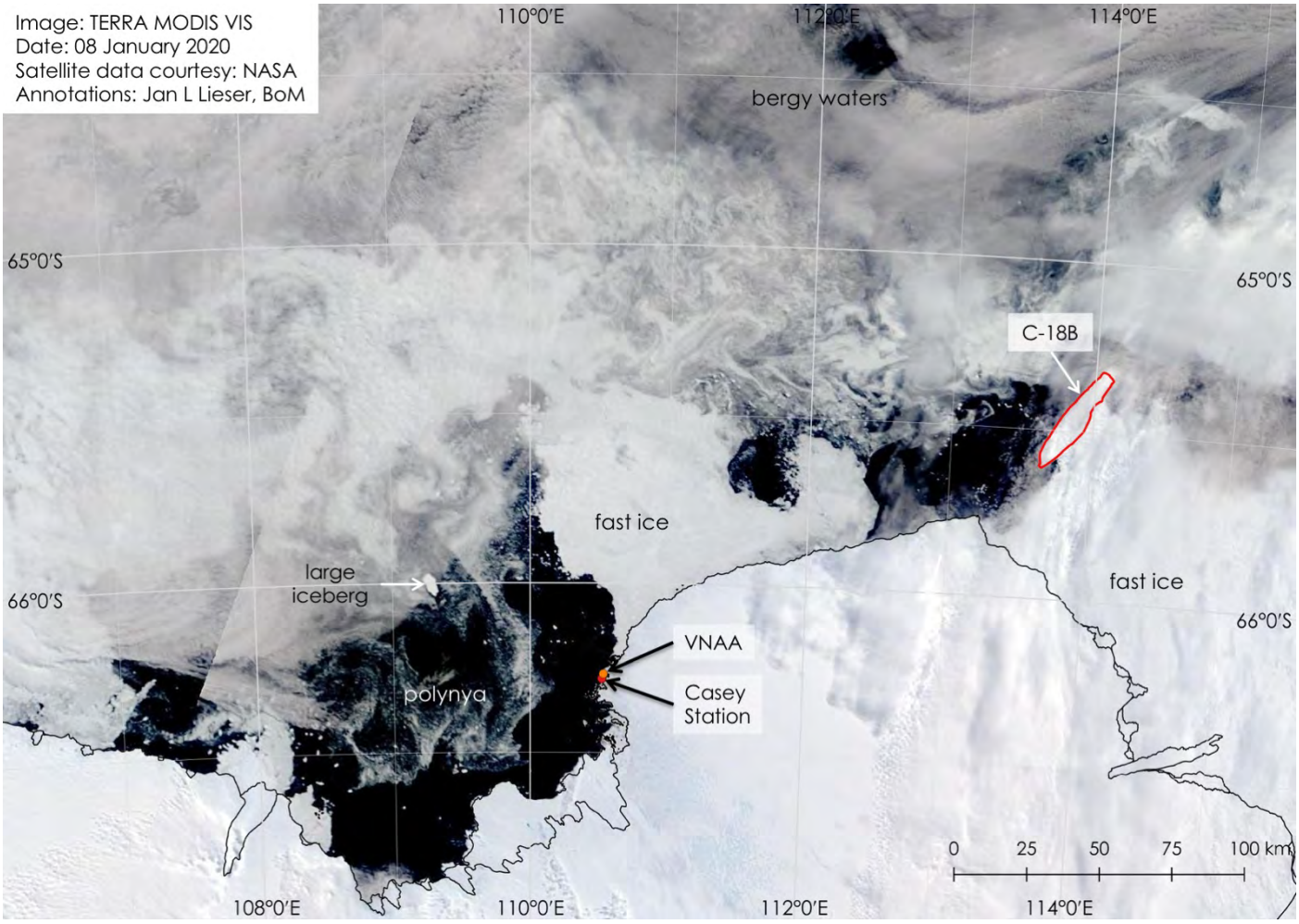

***Figure 1**: TERRA MODIS VIS data acquired 08 January 2020 and provided by NASA.*

After the passage of a low-pressure system north of the sea-ice zone recently, the sea-ice zone north of the polynya off Casey Station shows now the typical eddy patterns of oceanic surface features again. This indicates a generally relaxed region under little pressure from ocean swell or wind stress.

Lower sea-ice concentration remains however narrowed to a region between 108ºE and of 109ºE north of 66ºS.

One very large iceberg has drifted roughly 55 km south-eastward since the start of the year and is currently centred at 109º15'E and 66º0'S. This iceberg's area is 6.4 square nautical miles (almost 22 km^2) and therefore not big enough to be officially named and tracked (the threshold for which is 20 square nautical miles).

Ice Bulletin: Casey Station

Issued: Wednesday 08th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data of Vincennes Bay off Casey Station and to the north. The position of RSV *Aurora Australis* is marked by an orange dot off station ('VNAA').

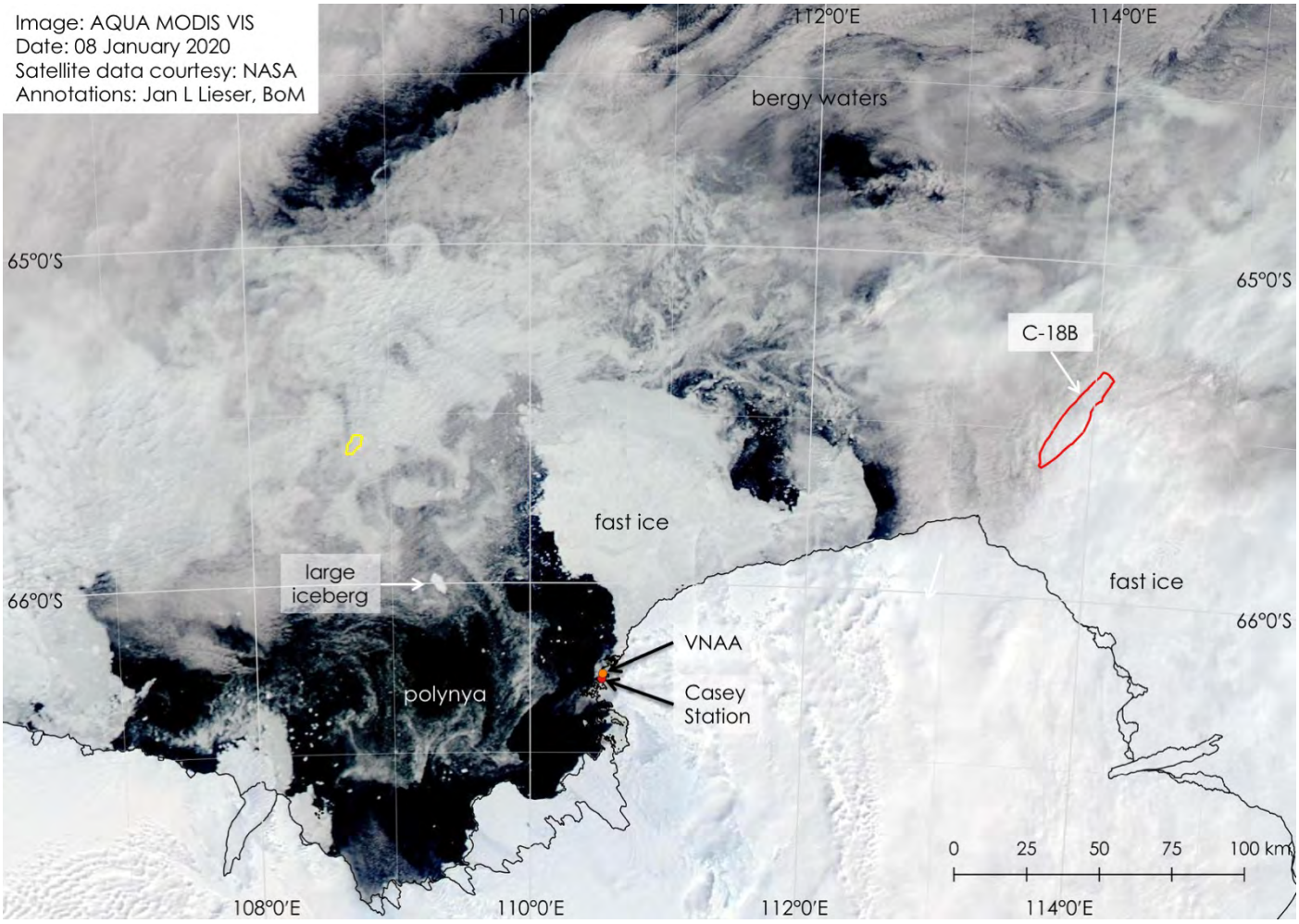

***Figure 1**: AQUA MODIS VIS data acquired 08 January 2020 and provided by NASA.*

Further to the preceding Bulletin, the pack ice region north of Vincennes Bay shows further signs of relaxing. Lower sea-ice concentration remains however narrowed to a region between 108ºE and of 109ºE north of 66ºS.

The very large iceberg drifting south-eastward since the start of the year (the yellow shape marks its location on 01/01/2020) has drifted another 2.8 km between the acquisitions of the two MODIS images by the TERRA and AQUA satellites. The white arrow marks the position of the iceberg in the previous scene that was showing the data from TERRA.

Ice Bulletin: Casey Station

Issued: Thursday 09th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart of the wider area around Casey Station. The fast-ice edge is approximated by a black line. The current position of RSV *Aurora Australis* is marked by an orange dot ('VNAA').

Two large icebergs have been identified and are marked by magenta shapes.

North of Vincennes Bay (off Casey Station), the sea-ice cover is expanding northward beyond 64º30'S. An area of lower sea-ice concentration remains east of 108ºE.

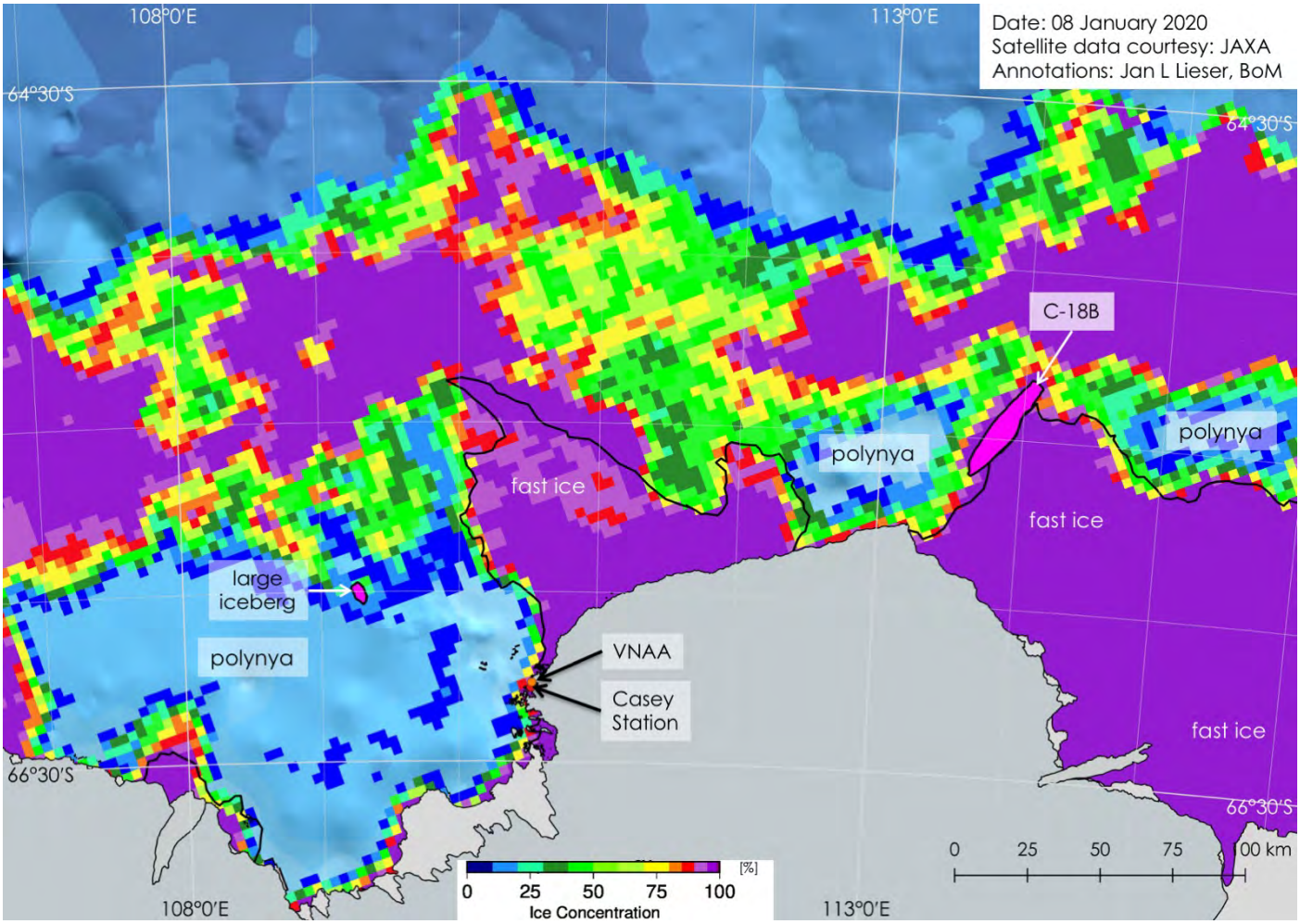

***Figure 1**: AMSR-2 sea-ice concentration data acquired 08 January 2020 and provided by ICDC, Universität Hamburg; background: IBCSO v1.0.*

Ice Bulletin: Casey Station

Issued: Friday 10th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (40 m horizontal) SAR of the wider area around Casey Station. The sea-ice edge based on passive microwave data (see Figure 2) is marked by the green line. The cruise track of RSV *Aurora Australis* since leaving the station is marked by an orange line.

Figure 2 shows a high-resolution (3.125 km horizontal) sea-ice concentration chart of the same geographical region as Figure 1.

Two large drifting icebergs have been marked by yellow shapes, a large grounded berg by a red shape.

North of Vincennes Bay (off Casey Station), the sea-ice cover is expanding northward beyond 64º30'S. An area of lower sea-ice concentration (see Figure 2) remains just east of 108ºE.

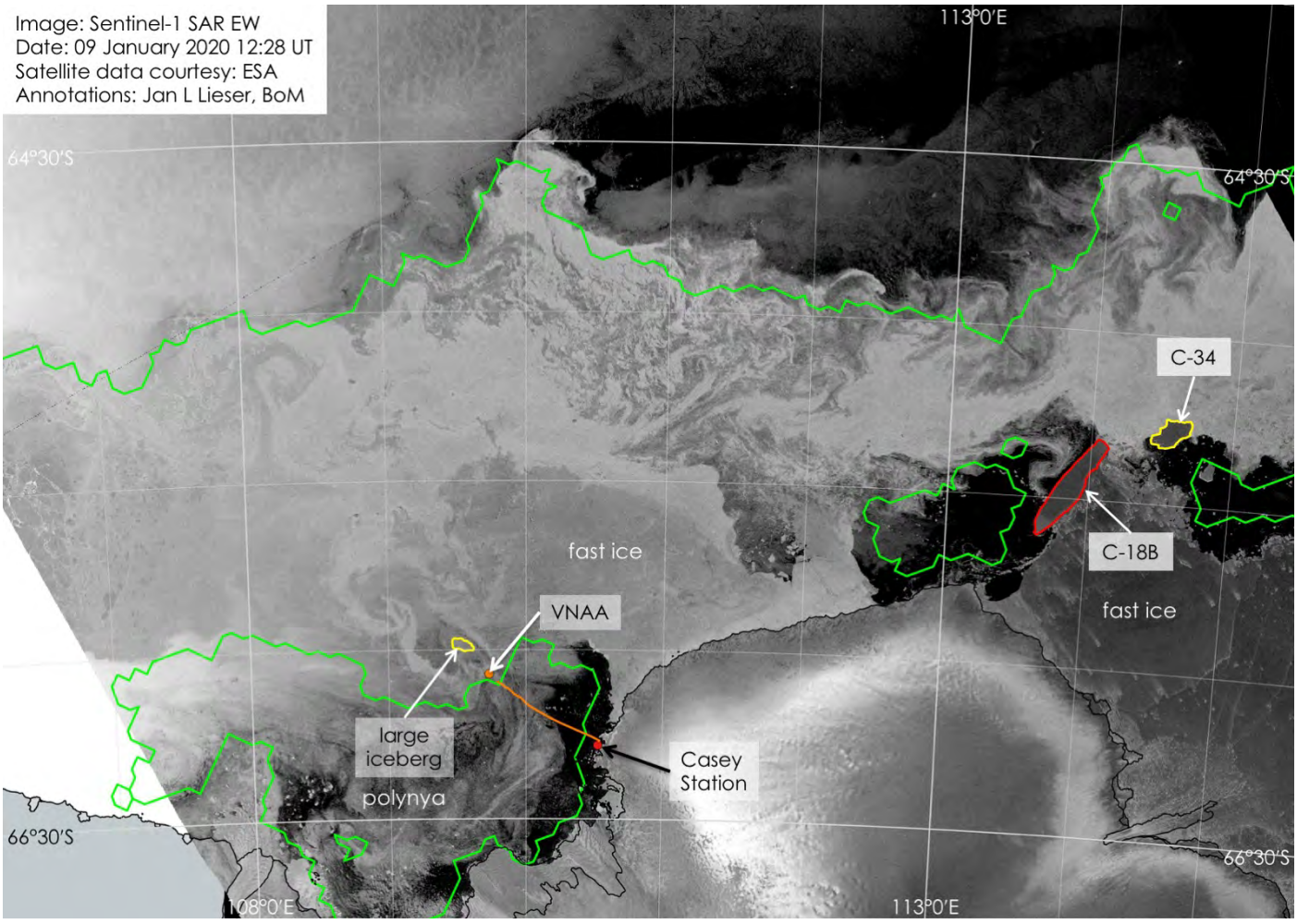

***Figure 1**: Sentinel-1 SAR EW data acquired 09 January 2020 at 12:28 UT and provided by Drift+Noise Polar Services.*

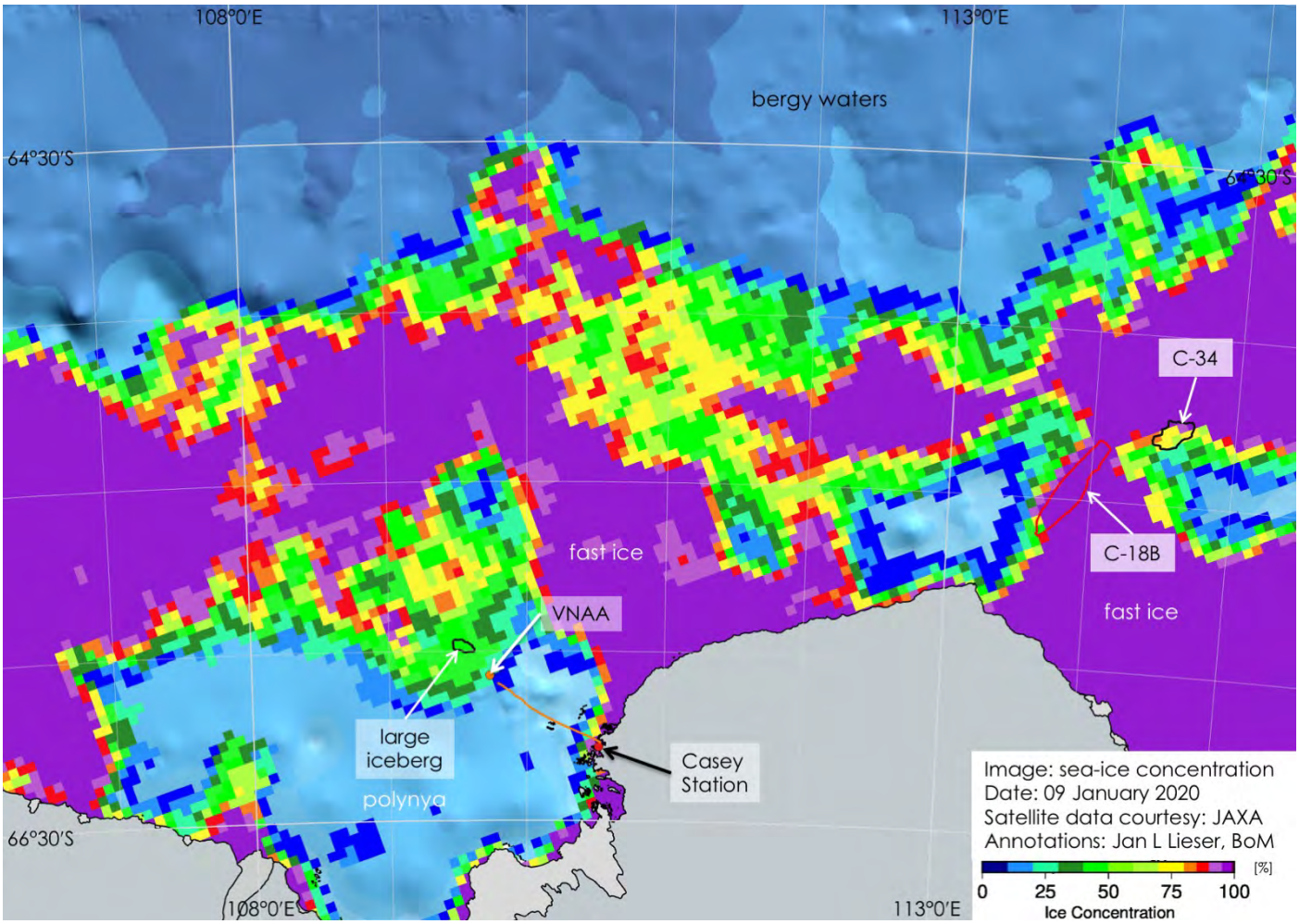

***Figure 2**: AMSR-2 sea-ice concentration data acquired 09 January 2020 and provided by ICDC, Universität Hamburg; background: IBCSO v1.0.*

Ice Bulletin: Casey Station

Issued: Saturday 11th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR of the wider area around Casey Station. The cruise track of RSV *Aurora Australis* since leaving the station is marked by an orange line (up until 10 Jan. 2020 21:10 UT, the orange dot). The location of the vessel at the time of data acquisition is marked by a white dot.

Two large drifting icebergs have been marked by yellow shapes, one large grounded berg by a red shape.

The ship has just left the sea-ice zone northward and entered an area of freely navigable water in which ice of land origin is present in concentrations less than 1/10. There may be sea ice present, although the total concentration of all ice should not exceed 1/10. Such areas are referred to as 'bergy waters'.

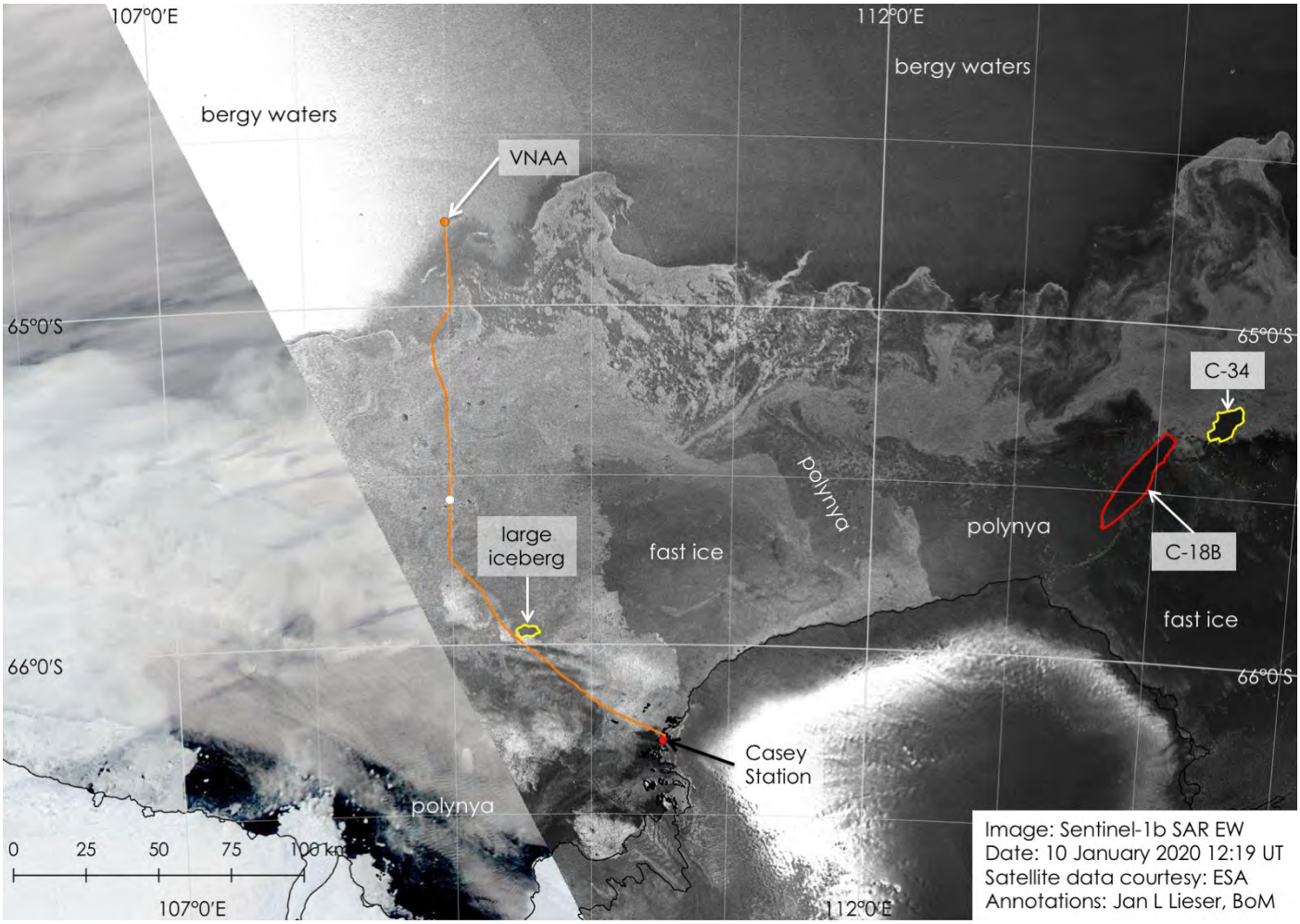

***Figure 1**: Sentinel-1b SAR EW data acquired 10 January 2020 at 12:19 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 10 January 2020 and provided NASA.*

Ice Bulletin: Mawson Station

Issued: Monday 13rd January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (30 m horizontal) SAR scene of Mawson Coast and offshore.

Nearshore, fast ice continues to deteriorate, and patches of open water are outlined in yellow. More signs of cracking and deterioration are visible further along the coast.

The sea-ice edge in the north is currently a well-defined line after the passage of weather systems, which compacted the pack ice between the open water (bergy waters) and the fast-ice edge. A kinematic shear zone is approximated by a cyan dashed line where pack ice north of the line moves faster westward than the pack ice south of this line, which is pressed against the fast-ice edge.

North of Mawson Station, the shortest distance between the open water of the so-called ‘northwest polynya’ and the station remains still more than 30 nautical miles.

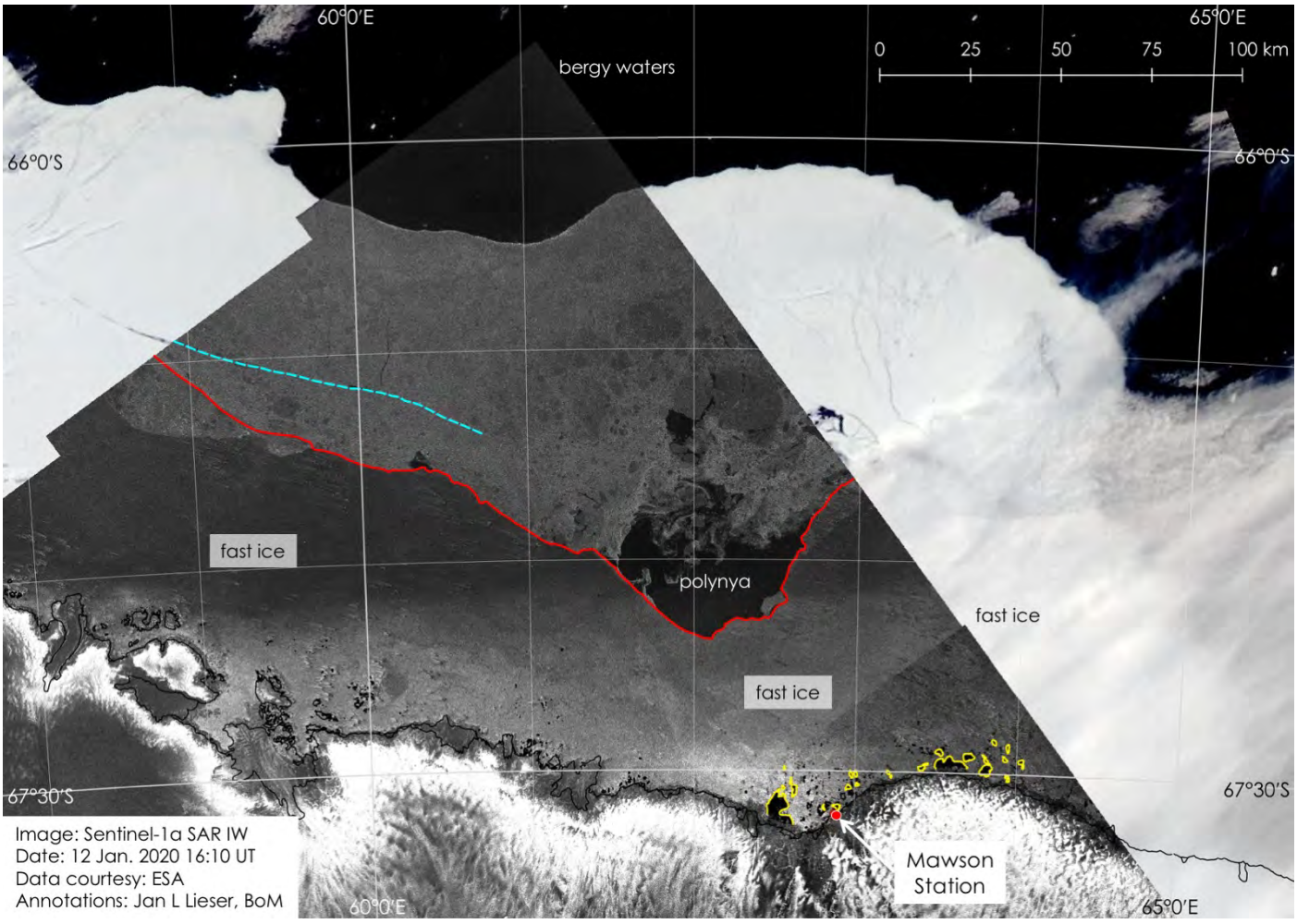

***Figure 1**: Sentinel-1a SAR scene acquired 12 January 2020 at 16:10 UT and provided by ESA; complemented by AQUA MODIS VIS data acquired 12 January 2020 and provided by NASA.*

Ice Bulletin: Davis Station

Issued: Tuesday 14th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by white letters. The fast-ice edge on 01 January 2020 is marked by the red line.

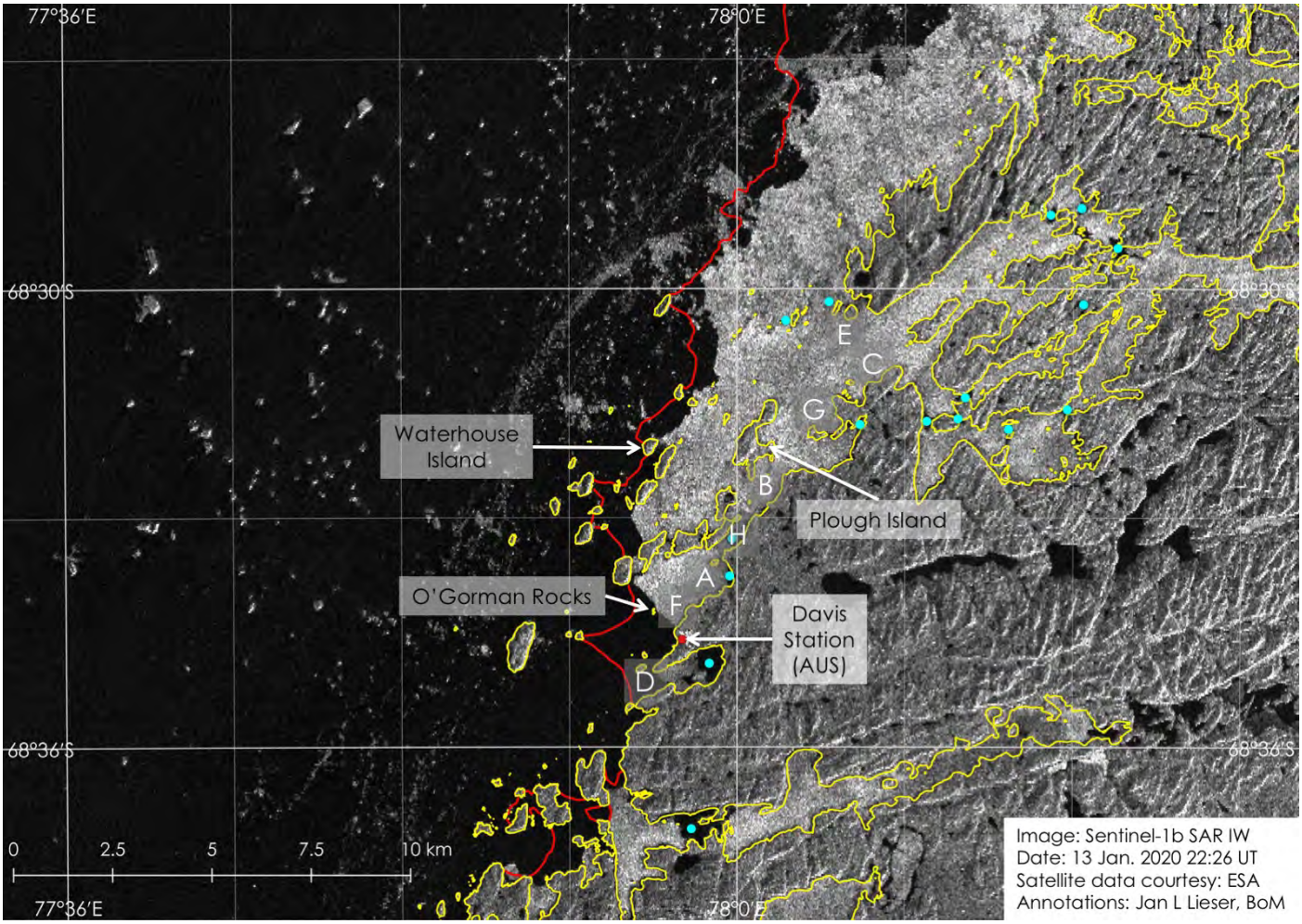

***Figure 1**: Sentinel-1b SAR IW scene acquired 13 January 2020 at 22:26 UT and provided by PolarView.*

Most of the areas of proposed hydrographic surveying are still covered by fast ice, but the sea-ward fast-ice edge is slowly retreating towards the coast and nearshore fast ice is rotting as well. Those nearshore locations are marked with cyan dots, for example at location 'A' and 'H'. Inshore from location 'D', there appears to be broken ex-fast ice, which is still occupying Heidemann Bay.

Broken ex-fast ice and icebergs are drifting south-westward off the fast-ice edge.

Ice Bulletin: Davis Station

Issued: Wednesday 15th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (6.125 km horizontal) sea-ice concentration chart of Cooperation Sea between Mawson Station and Davis Station. Large named tabular icebergs are marked. The general drift direction of pack ice is indicated by yellow arrows.

The location of an acoustic whale mooring is marked by a green dot (north of the West Ice Shelf) and the proposed deployment locations of autonomous drifters are marked by white dots (northeast of the Amery Ice Shelf).

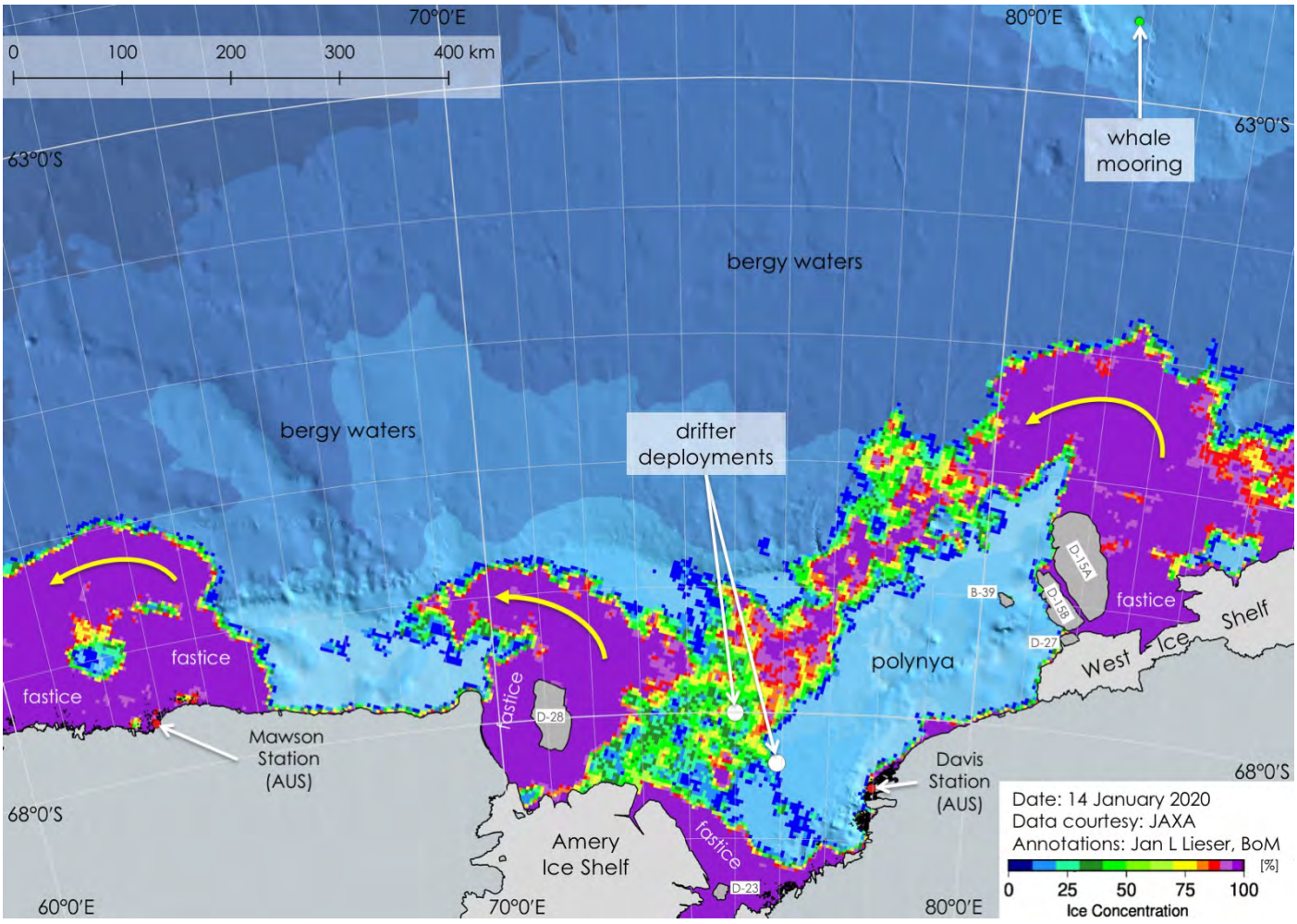

***Figure 1**: Sea-ice concentration chart acquired 14 January 2020 and provided by ICDC, Universität Hamburg; Bathymetry: IBCSO v1.0.*

The whale mooring is roughly 160 nautical miles north of the sea-ice edge, but is expected to be still in bergy waters, which indicates possible presence of icebergs in the vicinity.

North of the polynya off Davis Station, the sea ice is highly mobile. The two proposed drifter-deployment locations are currently in a region of roughly 50% sea-ice concentration or less. This can change quickly with locally changing atmospheric and oceanic conditions, but the trend is still expected towards lower sea-ice concentration in February.

Off Mawson Station, fast ice remains local, but east and west of the station signs of break-up are noticed nearshore. However, the northern fast-ice edge is still fairly stable, which results in the shortest distance between the polynya northwest of the station and the station being still close to 30 nautical miles.

Ice Bulletin: D'Urville Sea

Issued: Friday 17th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of southern D'Urville Sea. The positions of some of the larger icebergs on 07 January 2020 are marked by yellow outlines.

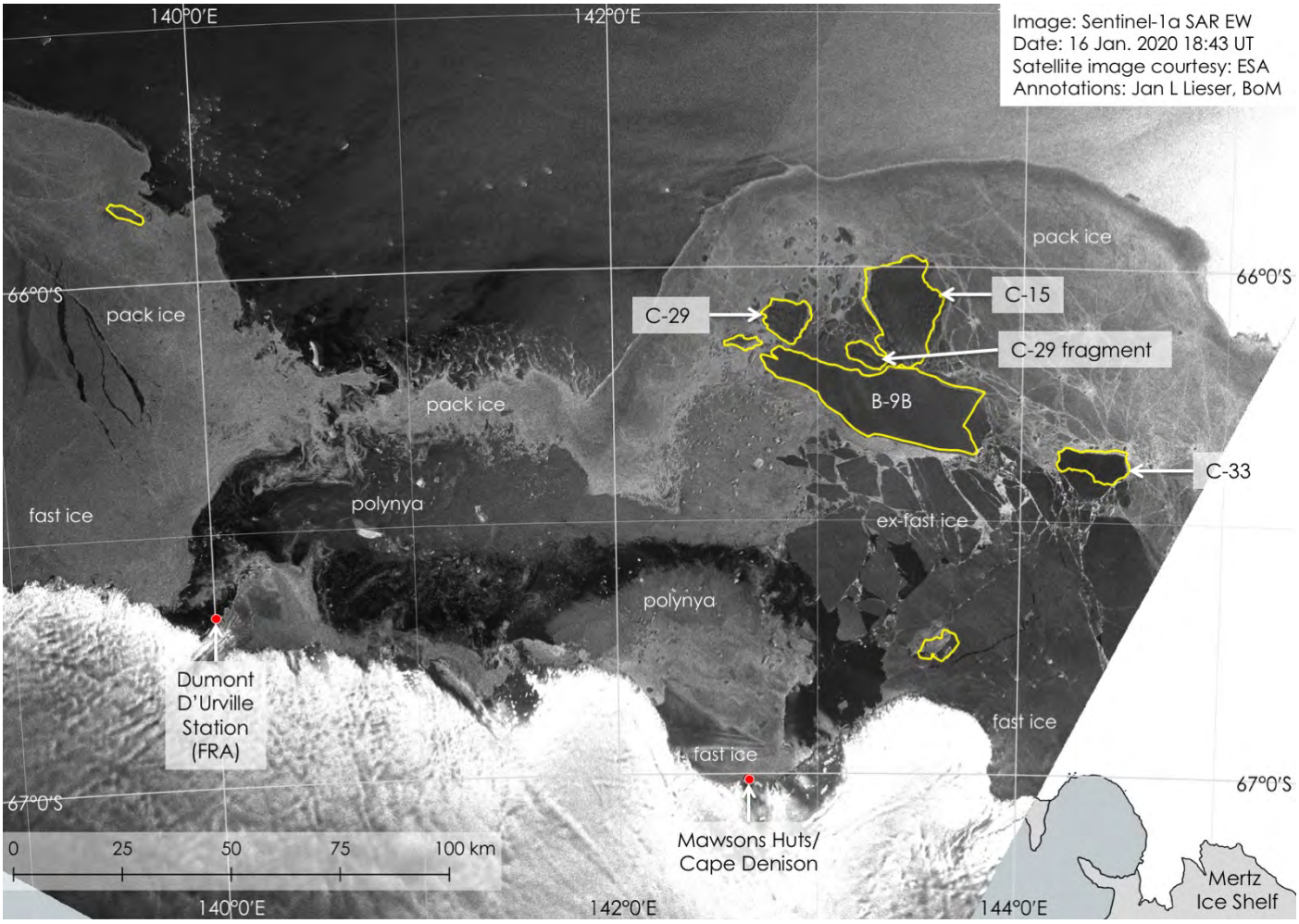

***Figure 1**: Sentinel-1a SAR EW scene acquired 16 January 2020 at 18:43 UT and provided by PolarView.*

Between Dumont D'Urville Station and Cape Denison, fast ice continues to break up and a large part of Commonwealth Bay is now free of fast ice. Only west of Cape Denison, some fast ice remains nearshore. Between the cape and iceberg B-9B, fast ice has shattered into large sheets of now ex-fast ice, which will continue to break up.

Most of the marked large tabular icebergs have started to wiggle again, now that the fast ice enclosure has broken up. Icebergs B-9B and the C-29 fragment are not moving yet.

Ice Bulletin: Mawson Station

Issued: Friday 17th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Coast and offshore.

Nearshore, fast ice continues to deteriorate, and recently growing patches of nearshore open water are marked ‘OW’. More signs of cracking and deterioration are visible further along the coast.

After the recent compaction of the pack-ice zone, the sea ice shows now a few more signs or released pressure. Northwest of ‘Iceberg Alley’, some large sheets of ex-fast ice, which had recently broken off, are floating freely within the pack ice.

North of Mawson Station, the shortest distance between the open water of the so-called ‘northwest polynya’ and the station remains more than 30 nautical miles.

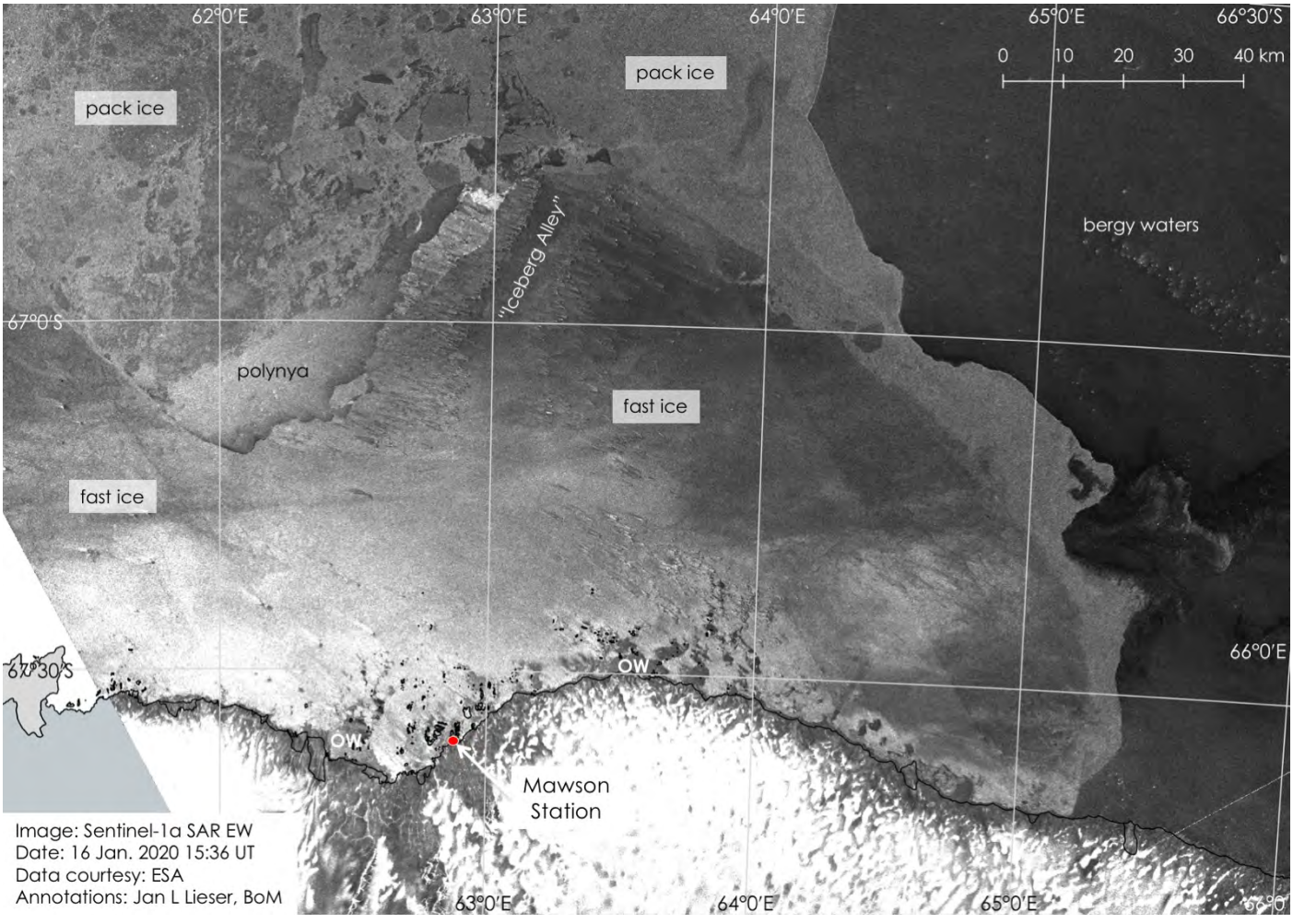

***Figure 1**: Sentinel-1a SAR scene acquired 16 January 2020 at 15:36 UT and provided by PolarView.*

Ice Bulletin: Mawson Station

Issued: Thursday 23rd January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore.

Nearshore, fast ice continues to deteriorate and recently growing patches of nearshore open water are marked ‘OW’. More signs of cracking and deterioration are visible further along the coast.

North of the fast-ice edge, pack ice shows a few more signs or released pressure and lower compaction. However, ‘Iceberg Alley’ is still completely covered by fast ice and the shortest distance between the open water of the so-called ‘northwest polynya’ and Mawson Station remains more than 30 nautical miles.

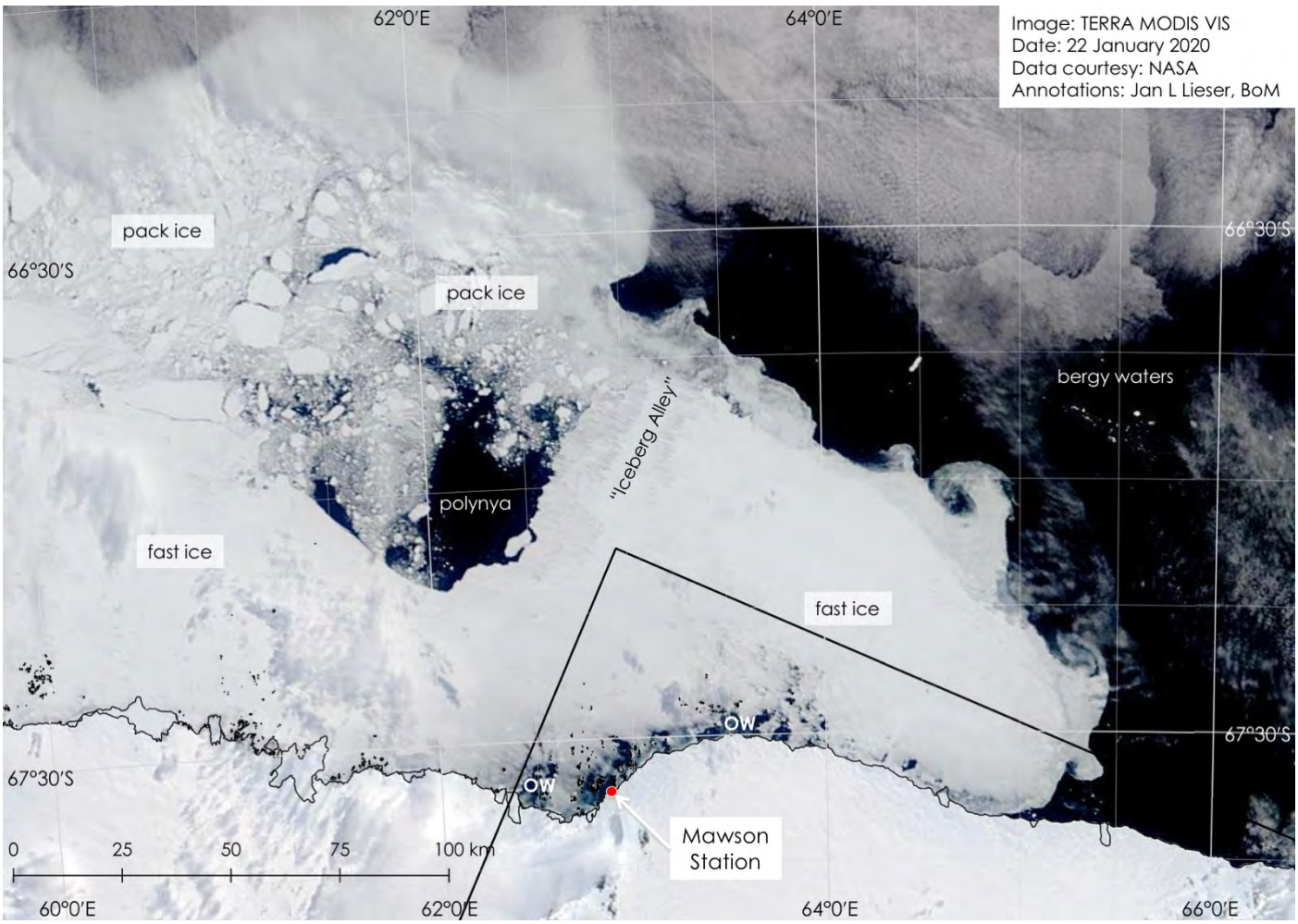

***Figure 1**: TERRA MODIS VIS scene acquired 22 January 2020 and provided by NASA.*
The black frame indicates the position of the Landsat-8 image shown in Figure 2

Figure 2 shows a very high-resolution (15 m horizontal) panchromatic scene of Mawson Station and the east of it. The station and the southwestern corner of the figure are slightly obscured by clouds.

The extent of the above mentioned near-shore open water is clear by the dark patches north of the ice cap.

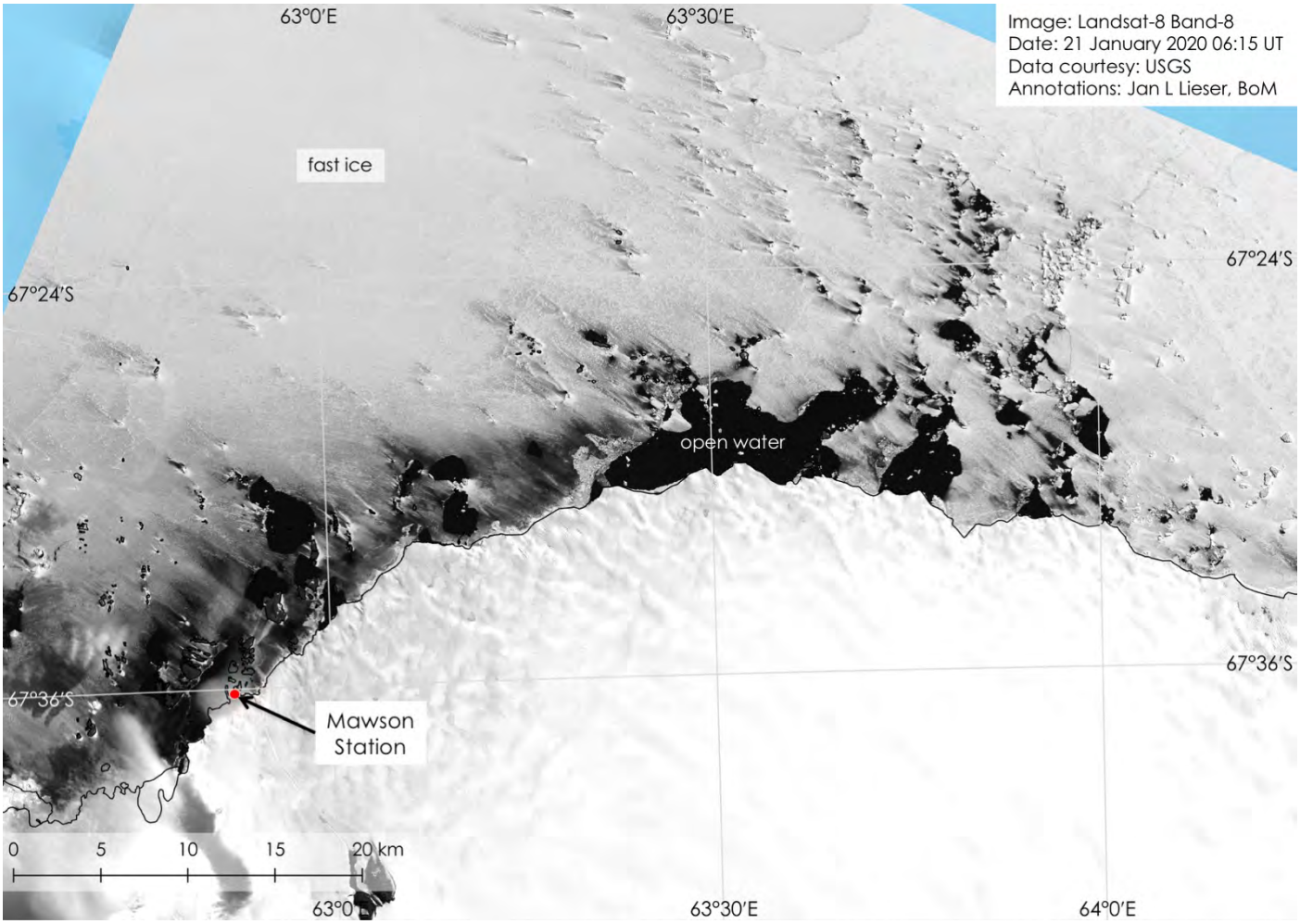

***Figure 1**: Landsat-8 Band-8 scene acquired 21 January 2020 at 06:15 UT and provided by USGS.*

Ice Bulletin: D'Urville Sea

Issued: Thursday 23rd January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of southern D'Urville Sea. The positions of some of the larger icebergs on 07 January 2020 are marked by yellow outlines.

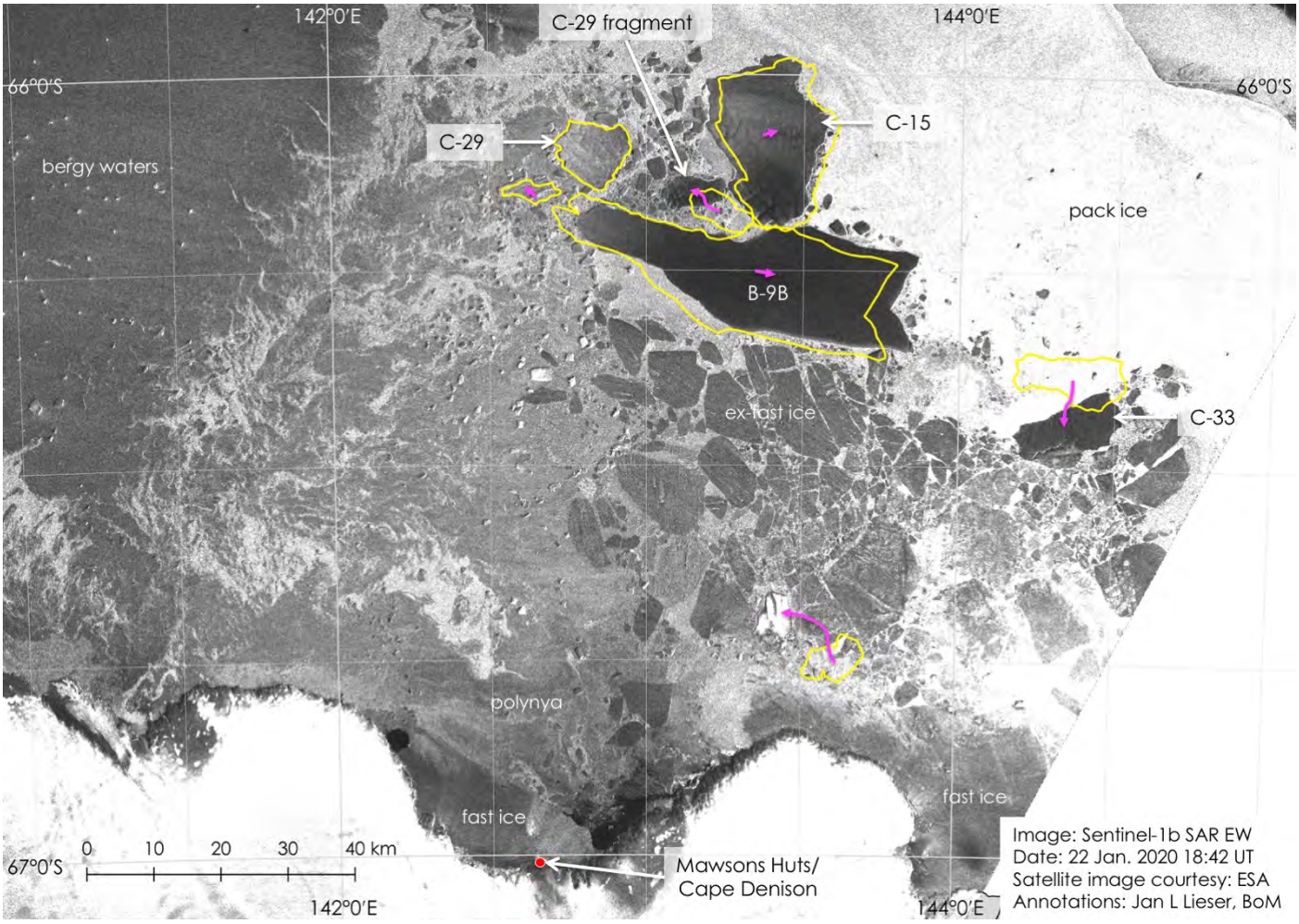

***Figure 1**: Sentinel-1a SAR EW scene acquired 16 January 2020 at 18:43 UT and provided by PolarView.*

Between Mawsons Huts/Cape Denison and the large icebergs north of it, fast ice has mostly shattered and only west of Cape Denison some fast ice remains nearshore.

All of the marked large tabular icebergs (except iceberg C-29) have started to move in different directions, which are indicated by pink arrows. With its eastward movement, iceberg B-9B appears to have dislodged iceberg C-15.

Ice Bulletin: Mawson Station

Issued: Friday 24th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Station and offshore.

Nearshore, fast ice continues to deteriorate, and growing patches of nearshore open water are clearly visible as dark patches and marked ‘OW’. More signs of cracking and deterioration are visible further along the coast.

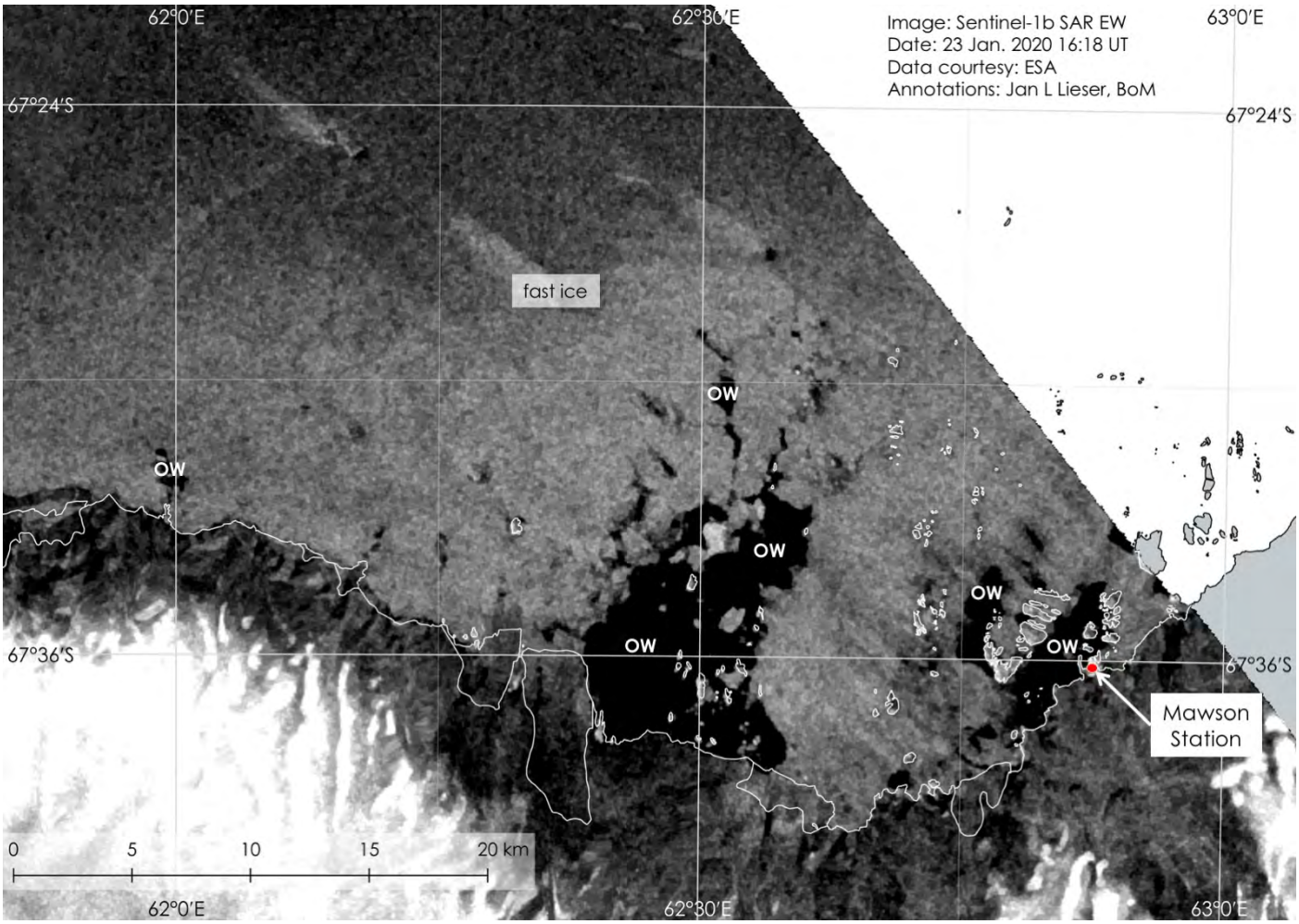

***Figure 1**: Sentinel-1b SAR scene acquired 23 January 2020 at 16:18 UT and provided by Drift+Noise Polar Services.*

Ice Bulletin: Davis Station

Issued: Friday 24th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Cooperation Sea between Cape Darnley and West Ice Shelf. Large named tabular icebergs are marked. The general drift direction of high-concentration pack ice is indicated by yellow arrows.

Northwest of the West Ice Shelf, the drift of iceberg B-39 since the start of the year is marked by coloured shapes. The position of iceberg D-28 on 15 January 2020 north of the Amery Ice Shelf is indicated by a grey dashed shape.

The locations of proposed deployment of autonomous drifters are marked by white dots (northeast of the Amery Ice Shelf).

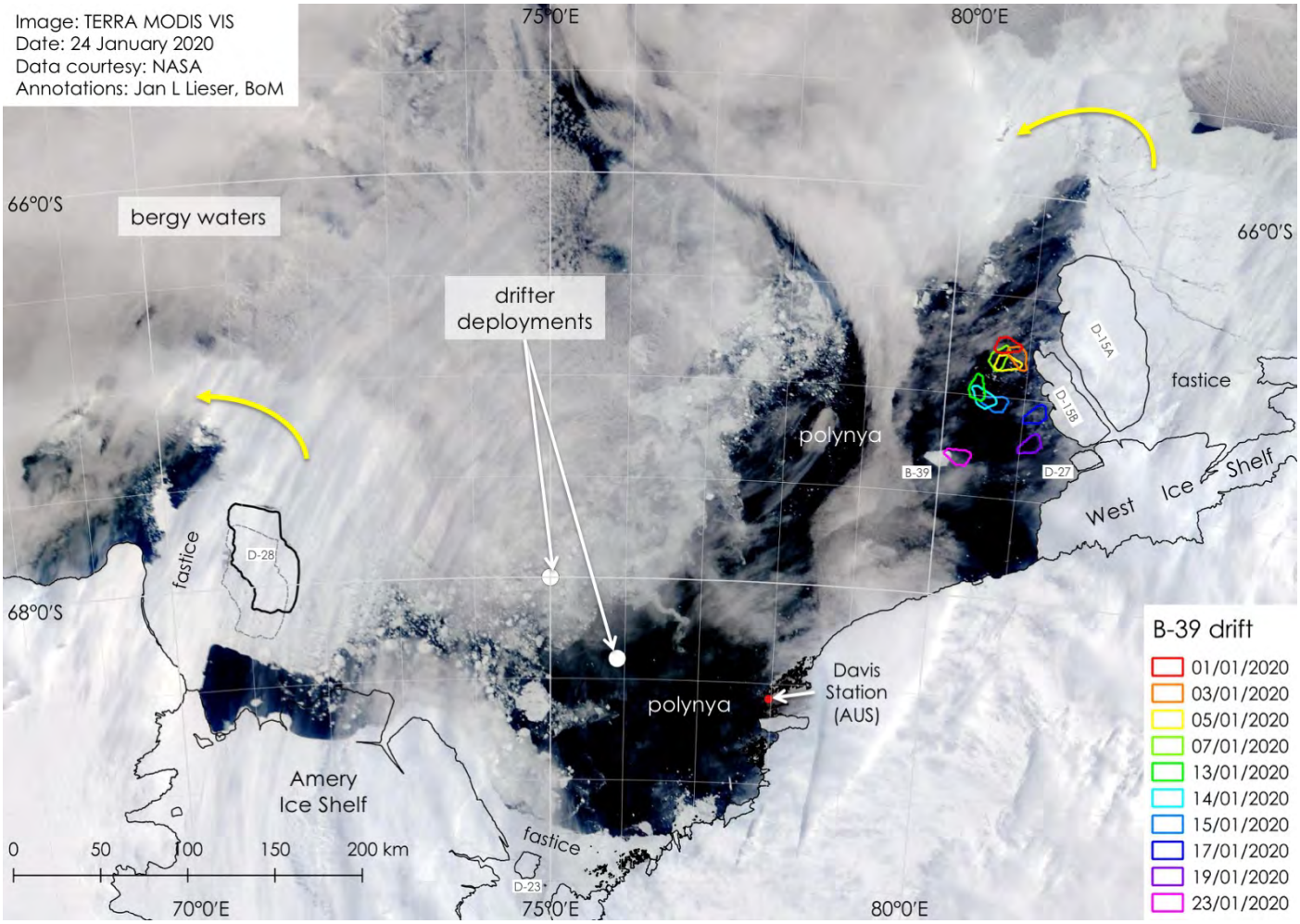

***Figure 1**: TERRA MODIS VIS scene acquired 24 January 2020 and provided by NASA.*

North of the polynya off Davis Station, the sea ice is highly mobile. The proposed north-western drifter-deployment location is currently in a region of roughly 50% sea-ice concentration, the south-eastern location in less concentration. This can change quickly with locally changing atmospheric and oceanic conditions, but the trend towards lower sea-ice concentration is still expected in February.

During the last week, iceberg D-28 appears to have gained a bit more momentum in its northward drift.

Ice Bulletin: Davis Station

Issued: Sunday 26th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by white letters.

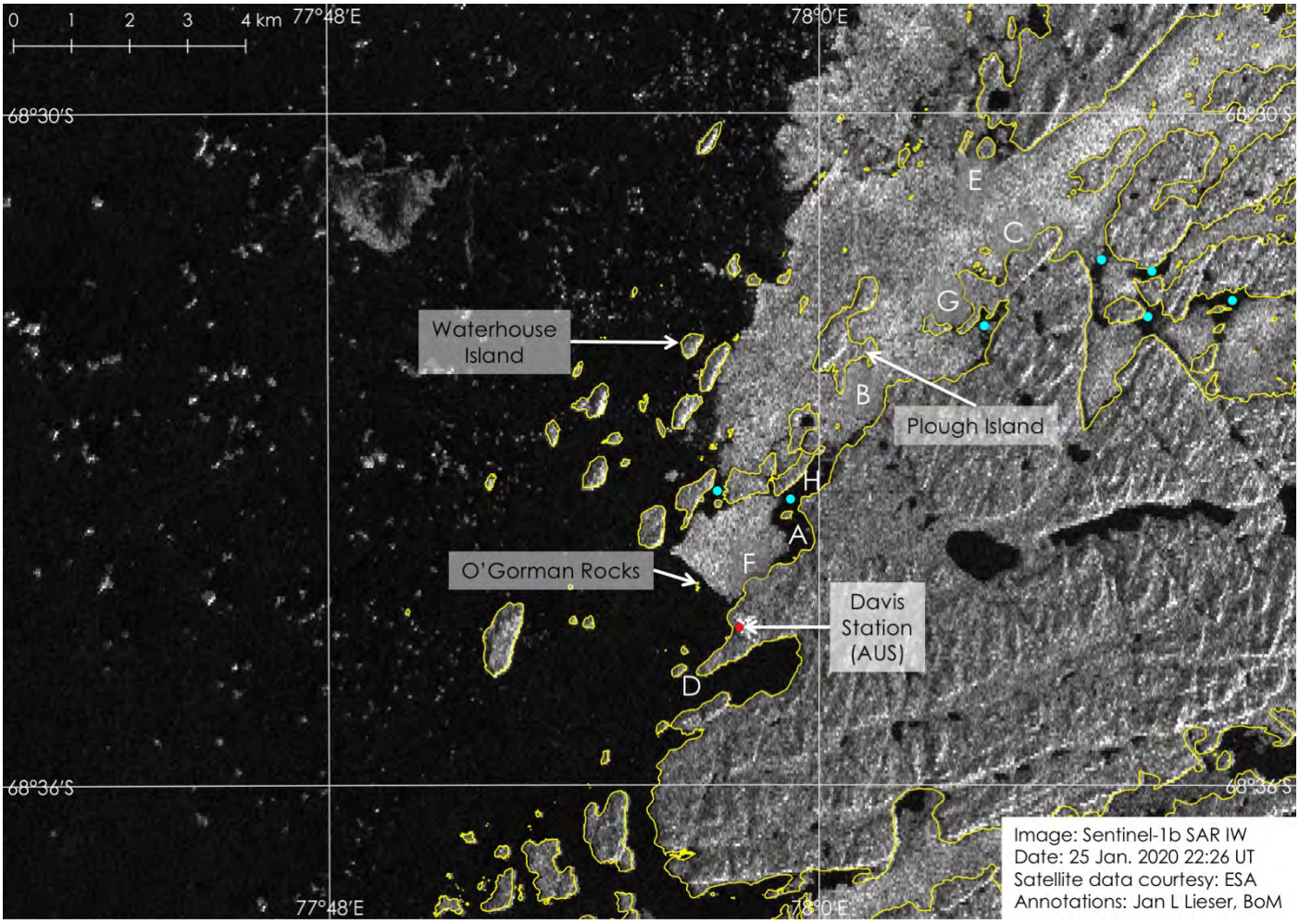

***Figure 1**: Sentinel-1b SAR IW scene acquired 25 January 2020 at 22:26 UT and provided by PolarView.*

Most of the areas of proposed hydrographic surveying are still covered by fast ice, but the sea-ward fast-ice edge continues to retreat slowly towards the coast and nearshore fast ice is rotting as well. Those nearshore locations are marked with cyan dots, for example at locations 'A' and 'H' and between the two. Location 'D' is now free of any ex-fast ice, including Heidemann Bay.

Broken ex-fast ice and icebergs are drifting generally south-westward offshore.

Ice Bulletin: Mawson Station

Issued: Monday 27th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of visible data offshore Mawson Station. The open-water boundary based on SAR data from 23 January 2020 is marked by the cyan line (the straight cyan line indicates the edge of the SAR data).

Along 62º30'E, the continued deterioration of fast ice is clear from the comparison of the cyan line with the current ice edge. Further east, growing patches of nearshore open water are clearly visible as dark patches and marked 'OW'. More signs of cracking and deterioration are visible further along the coast.

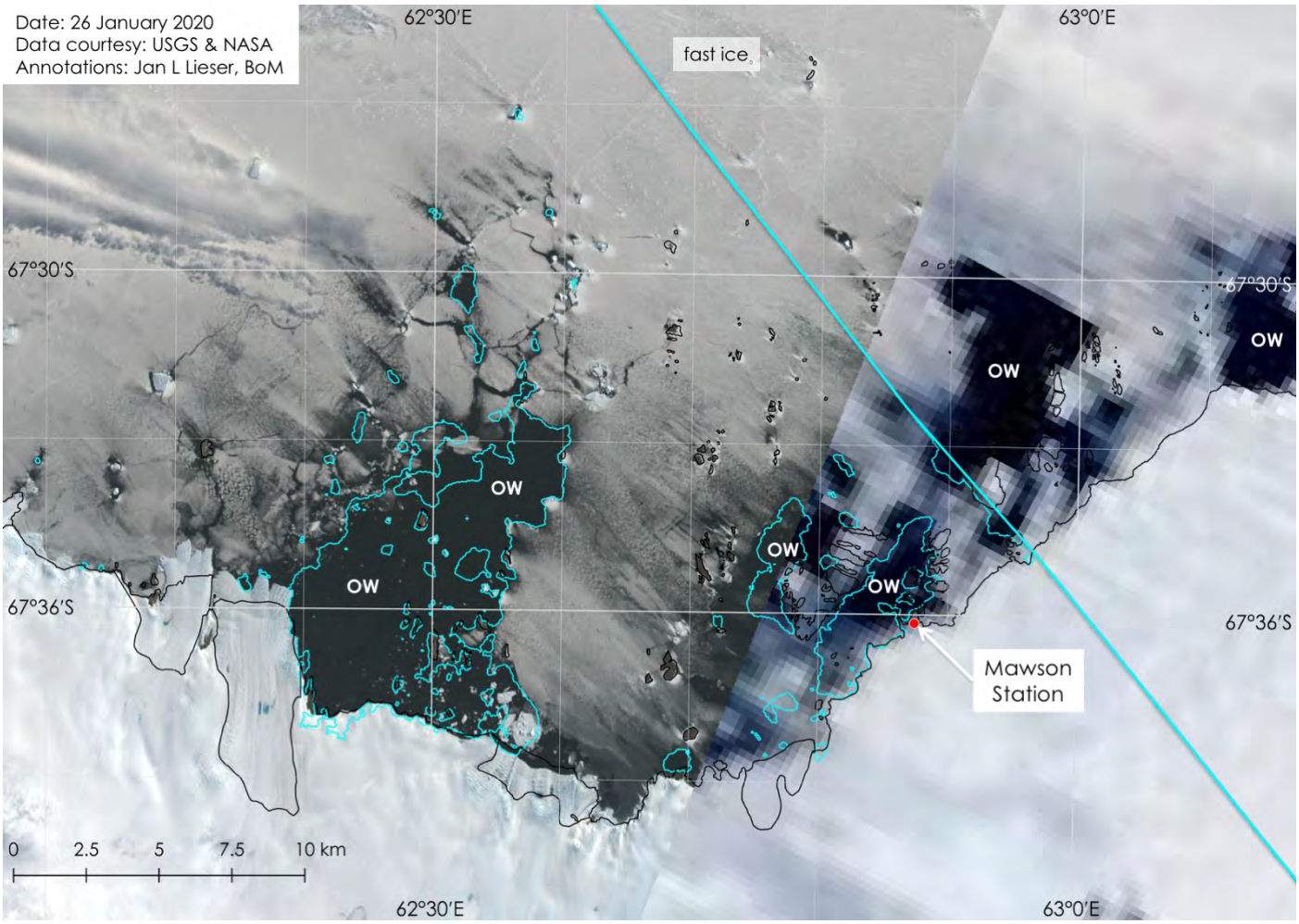

***Figure 1**: Composite of Landsat-8 visible data (west) acquired 26 January 2020 at 04:50 UT and provided by USGS and TERRA MODIS VIS data (east) acquired 26 January 2020 and provided by NASA.*

Ice Bulletin: Sabrina Coast

Issued: Monday 27th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data offshore Sabrina Coast, between the Totten Ice Shelf and the Moscow University Ice Shelf.

During the past 24 hours, fast ice that had grown between the icebergs that comprise the Dalton Iceberg Tongue (pink shape) has broken into multiple sheets. The icebergs originate typically from the Moscow University Ice Shelf and ground in shallow bathymetry offshore. In between those icebergs, fast ice usually grows for more than one winter season to become multi-year fast ice. Some seasonal pack ice gets also incorporated at the eastern edge of the tongue, when it accumulates behind the grounded icebergs in its westward drift.

At the western edge of the ice tongue, a few large open water patches developed since the beginning of summer behind the row of icebergs that mark the western boundary of the tongue. This process is normally purely thermodynamically driven. It appears now that the fast ice in general was weakened enough for wind and waves to break it up even in between the grounded icebergs. This is evident from the large cracks that have developed throughout the iceberg tongue.

Similar features can be observed east of iceberg C-18B.

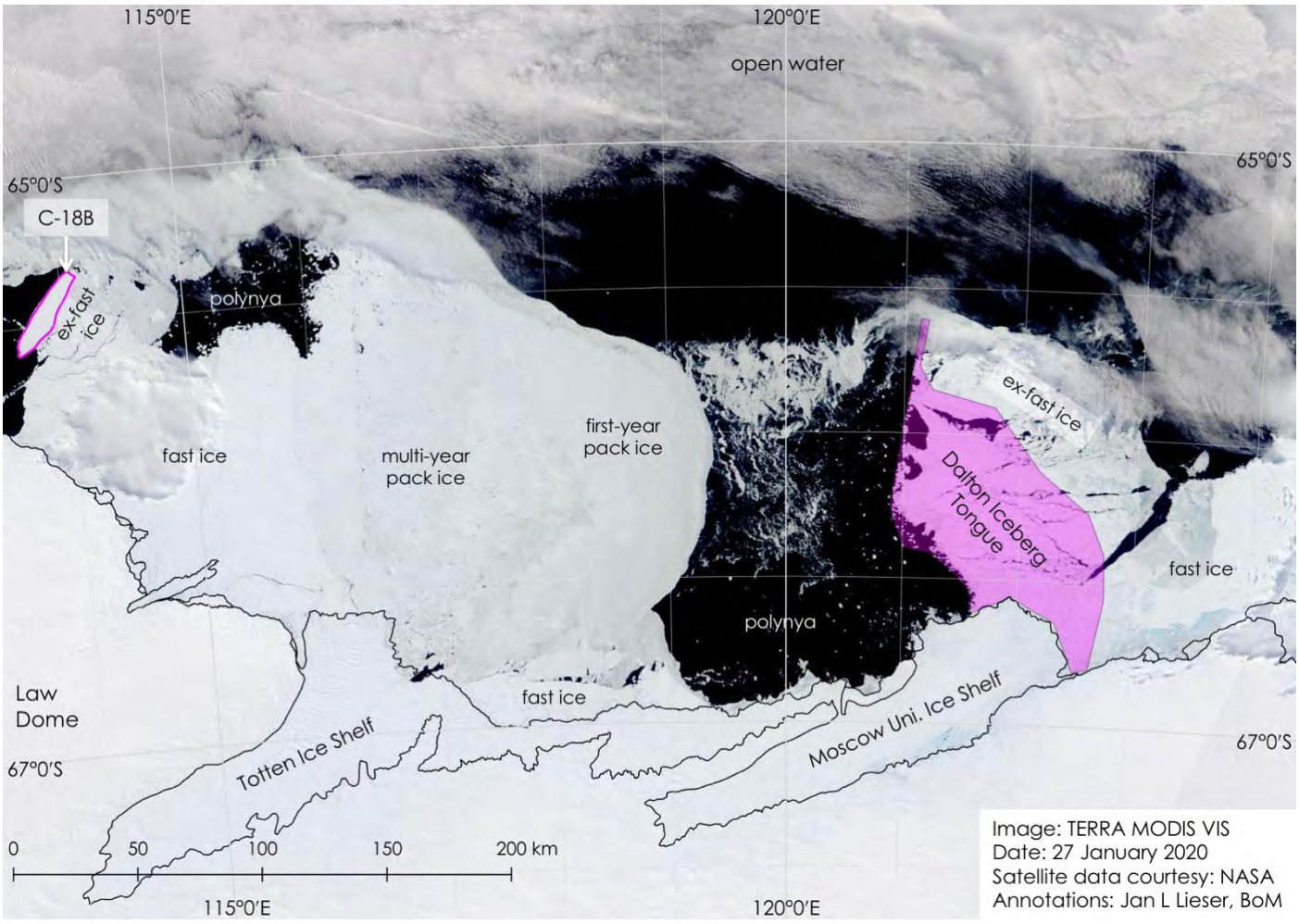

***Figure 1**: TERRA MODIS VIS data acquired 27 January 2020 and provided by NASA.*

Ice Bulletin: Davis Station

Issued: Tuesday 28th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of East Antarctic waters between 75ºE and 97ºE. Large named tabular icebergs are marked. The general drift direction of high-concentration pack ice is indicated by yellow arrows. The current cruise track of RSV *Aurora Australis* is given by the orange line (up until 28 Jan. 2020 02:50 UT).

West of the West Ice Shelf, the drift of iceberg B-39 since the start of the year is marked by coloured shapes.

The locations of proposed deployment of autonomous drifters (west of Davis Station) and the location of a whale mooring (north of the West Ice Shelf) are marked by yellow dots.

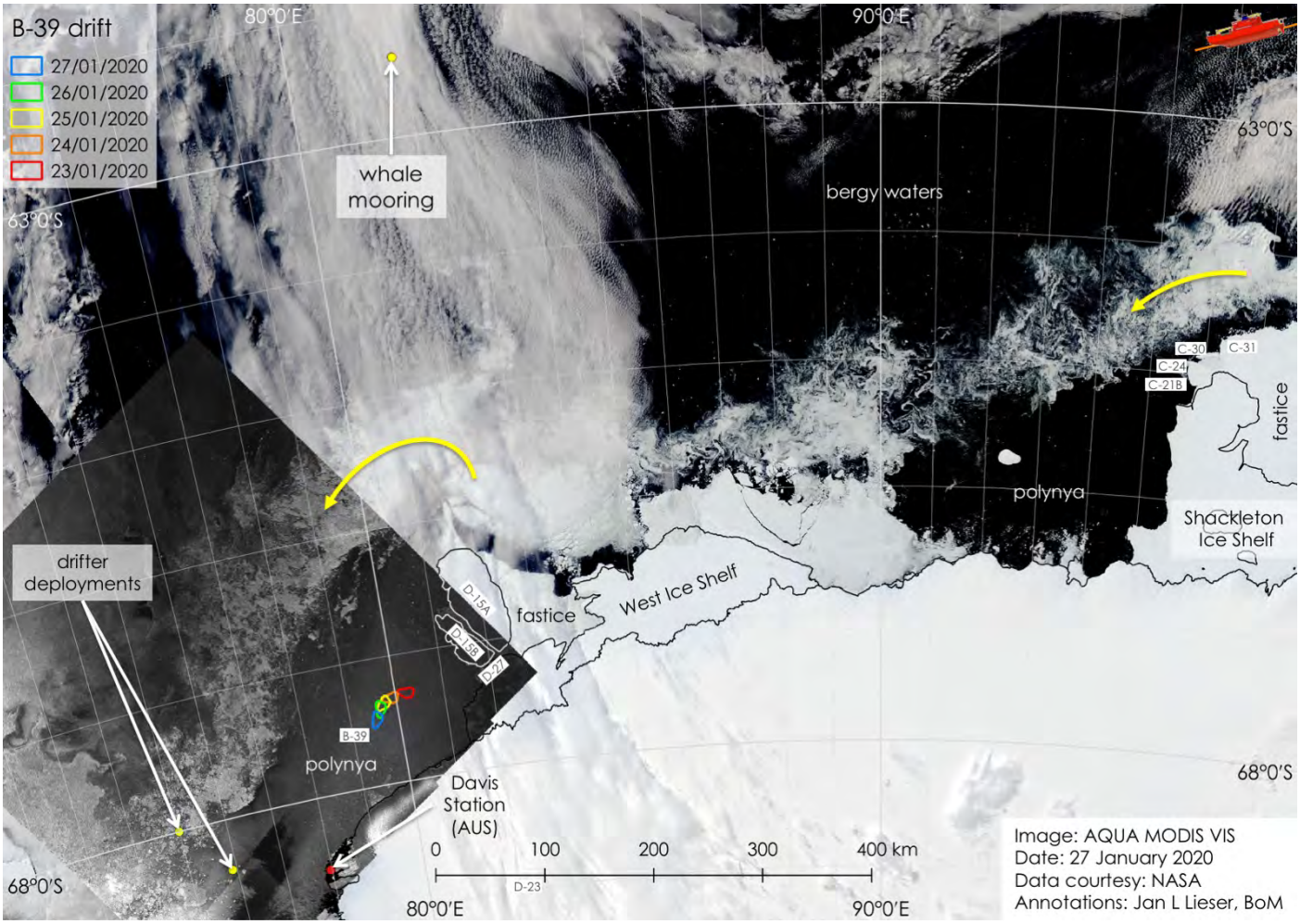

***Figure 1**: AQUA MODIS VIS scene acquired 27 January 2020 and provided by NASA with an overlay of Sentinel-1a SAR EW data in the southwest (acquired 27 January 2020 at 14:56 UT and provided by PolarView).*

The location of the whale mooring is unaffected by sea ice, but recent wind and oceanic conditions have combined to carry some sea ice up to 64ºS between 82ºE and 83ºE.

North of the polynya off Davis Station, the sea ice remains highly mobile. The proposed drifter-deployment locations are in a region of roughly 50% sea-ice concentration or less. This may change quickly with locally changing atmospheric and oceanic conditions, but the trend towards lower sea-ice concentration is still expected in February.

Ice Bulletin: Mawson Station

Issued: Tuesday 28th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Coast and offshore. One large (but unnamed) tabular iceberg drifting in the northwest is outlined with a pink shape. Nearshore, open water patches are marked 'OW' as well as one area east of 'Iceberg Alley'.

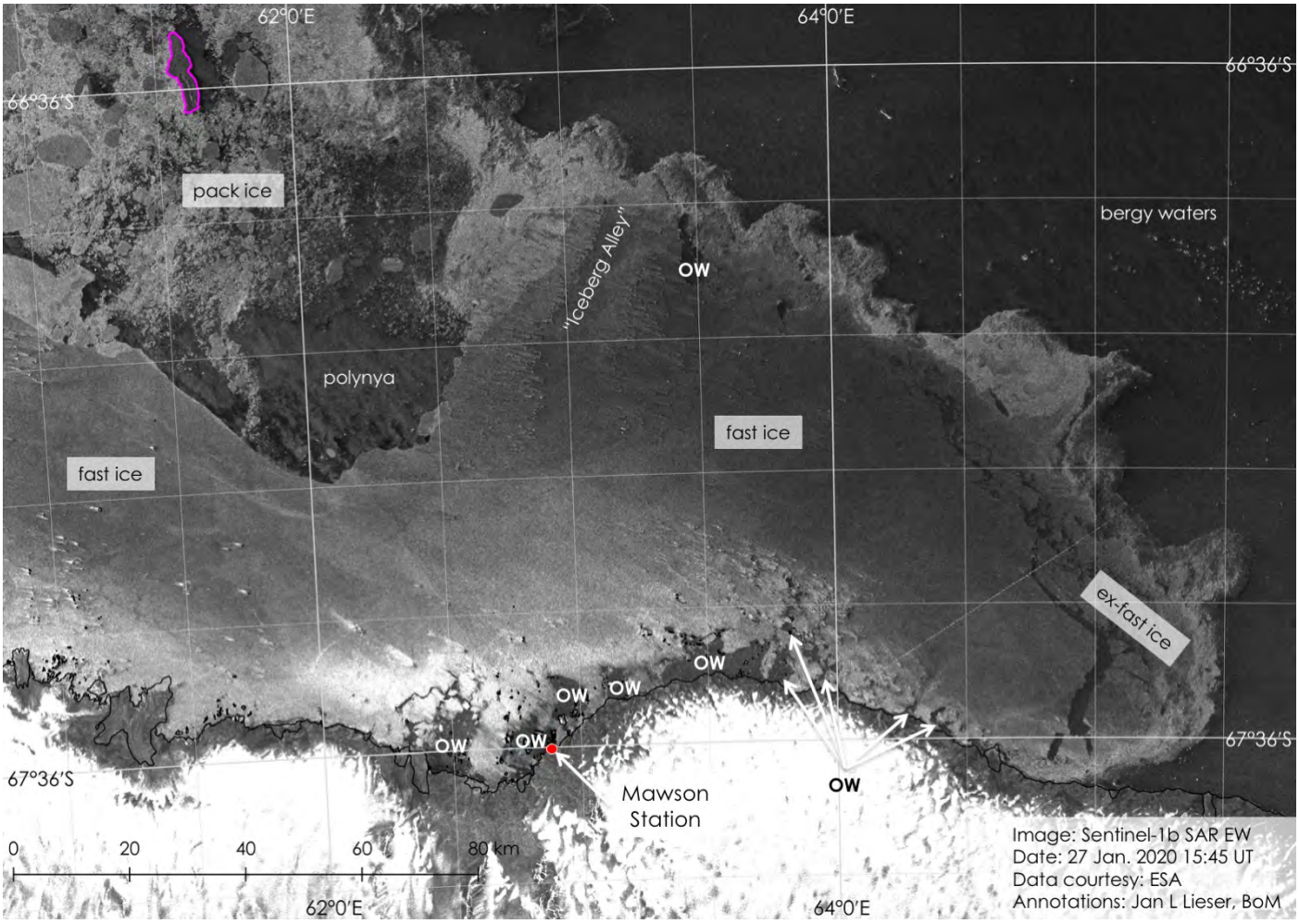

***Figure 1**: Sentinel-1b SAR EW data acquired 27 January 2020 at 15:45 UT and provided by PolarView.*

East and west of Mawson Station, fast ice continues to deteriorate in slowly growing open-water patches. At the eastern side of the fast ice (between 65ºE and 67ºE), fast ice has broken off from the edge in large sheets. Two smaller patches of open water are also west of 63ºE at the northern edge of the fast ice (annotated 'OW' east of 'Iceberg Alley') and a little further east at 63º48'E and 66º57'S.

The so-called northwest polynya remains a little more than 31 nautical miles away from the station.

Ice Bulletin: D'Urville Sea

Issued: Tuesday 28rd January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of southern D'Urville Sea. The positions of some of the larger icebergs are marked by pink outlines; however, the four largest icebergs in the area are obscured by clouds/not covered by the SAR.

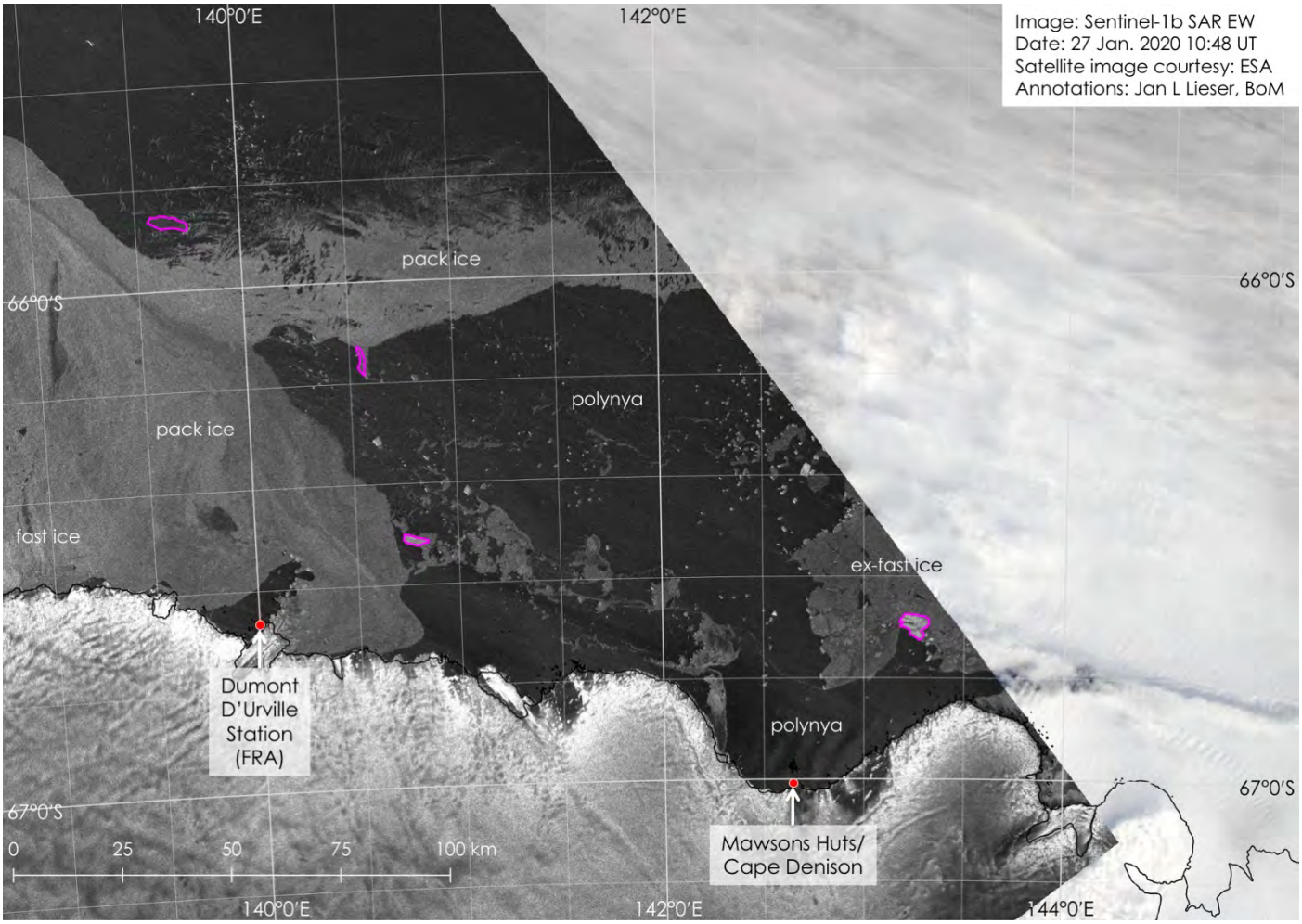

***Figure 1**: Sentinel-1b SAR EW scene acquired 27 January 2020 at 10:48 UT and provided by PolarView.*

Cape Denison is now mostly free of any sea ice, only along the western edge of Commonwealth Bay (off Cape Denison) little fast ice remains nearshore.

Off Dumont D'Urville Station, open water forms a polynya that is surrounded by broken floes of pack ice predominantly comprising of ex-fast ice and old sea ice.

Ice Bulletin: Davis Station

Issued: Thursday 30th January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of a SAR scene and high-resolution (3.125 km horizontal) sea-ice concentration data of Davis Station and offshore. The sea-ice edge based on the sea-ice concentration data shown is indicated by the white line. Large named tabular icebergs are marked. North of the West Ice Shelf, the general drift direction of pack ice is indicated by a yellow arrow. The current cruise track of RSV *Aurora Australis* is given by the orange line (up until 30 Jan. 2020 03:30 UT). The white 'x' marks the ship's position at the time of SAR data acquisition.

West of the West Ice Shelf, the recent drift of iceberg B-39 is marked by coloured shapes.

The locations of proposed deployment of autonomous drifters (west of Davis Station) are marked by white dots.

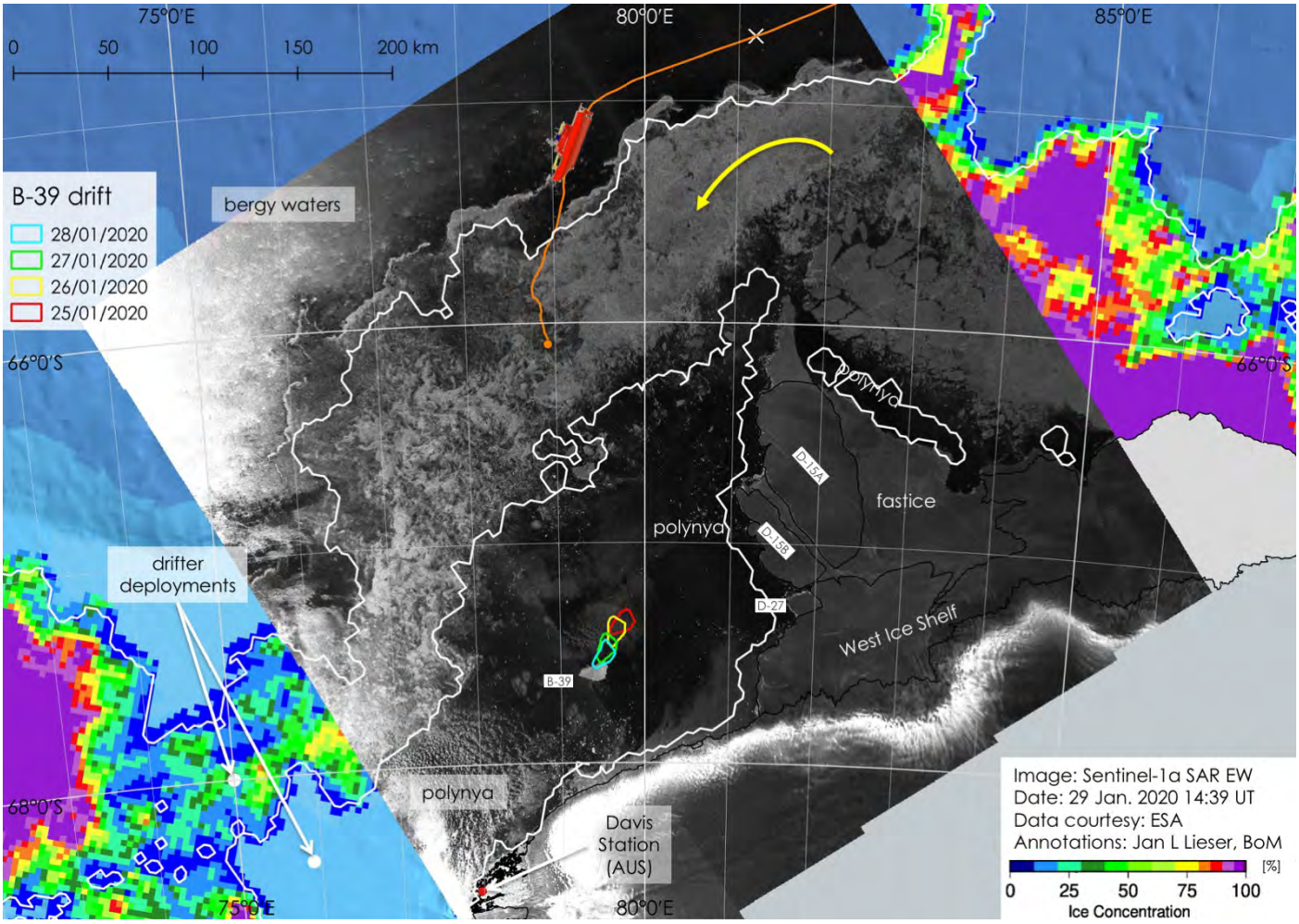

***Figure 1**: Composite of Sentinel-1a SAR EW data acquired 29 January 2020 at 14:39 UT and provided by PolarView and AMSR-2 sea-ice concentration data acquired 29 January 2020 and provided by ICDC, Universität Hamburg; Bathymetry: IBCSO v1.0.*

North of the polynya off Davis Station, the sea ice remains highly mobile. The proposed drifter-deployment locations are in a region of roughly 50% sea-ice concentration or less. This may change quickly with locally changing atmospheric and oceanic conditions, but the trend towards lower sea-ice concentration is still expected in February.

Ice Bulletin: Iceberg A-68A

Issued: Friday 31st January 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR swath east of northern Antarctic Peninsula. The drift of iceberg A-68A since late January 2019 is shown by colour-coded shapes.

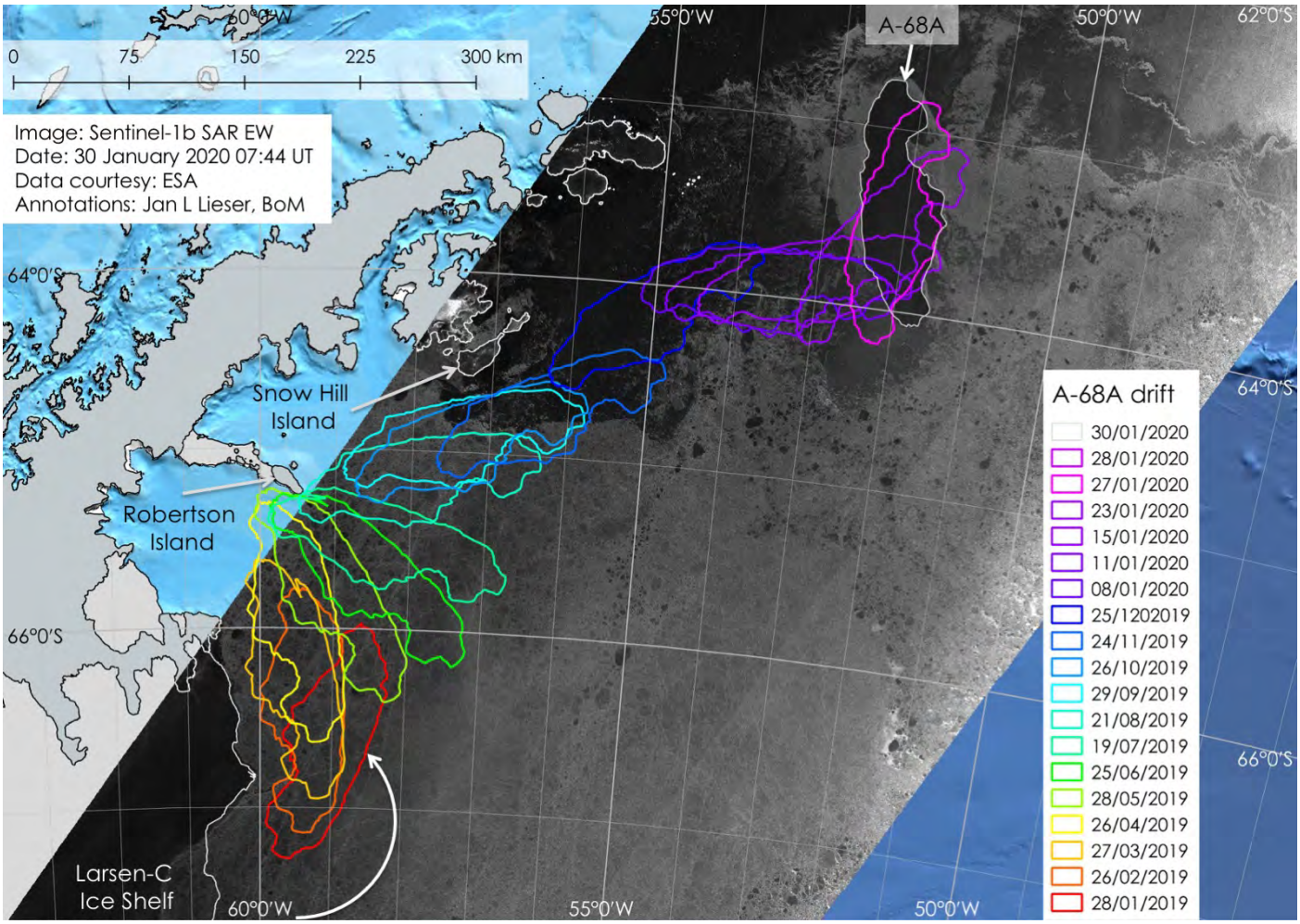

***Figure 1**: Sentinel-1b SAR EW data acquired 30 January 2020 at 07:44 UT and provided by PolarView; Bathymetry: IBCSO v1.0.*

Since calving off the Larsen-C Ice Shelf in July 2017, the iceberg has performed an anti-clockwise turn out of its original position. A 180º turn was completed in February 2019. Since then it has drifted northward and swung anti-clockwise again around Robertson Island, before drifting in north-easterly direction east of Snow Hill Island. Off Snow Hill Island, the iceberg has drifted in roughly 300 m of water depth but is now heading into deeper water and currently in about 900 m water depth.

Recently, the iceberg appears to have gained more momentum in its drift (note: purple shades represent January 2020 drift only) and is now oriented north-south.

Ice Bulletin: Mawson Station

Issued: Saturday 01st February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore.

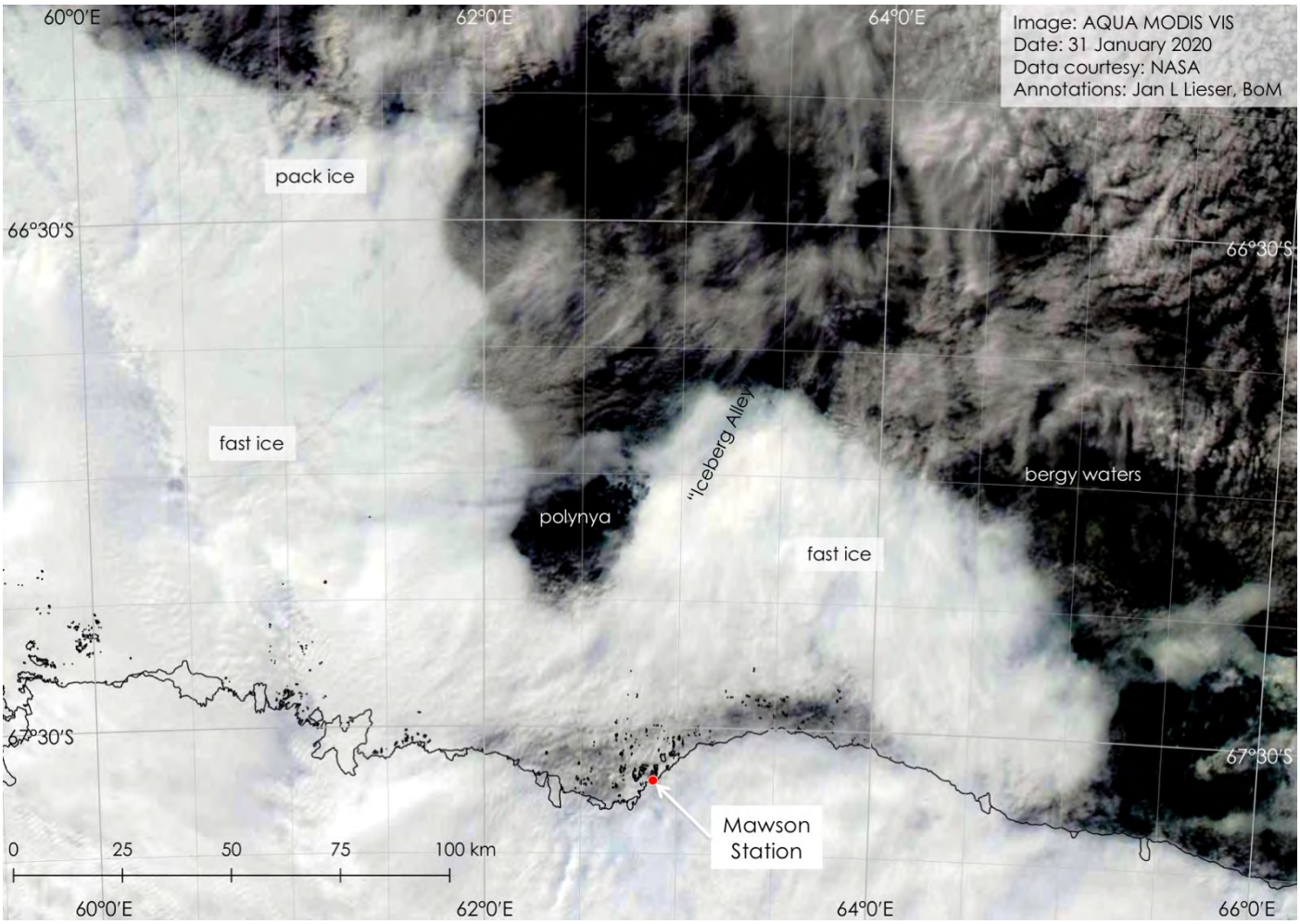

***Figure 1**: AQUA MODIS VIS data acquired 31 January 2020 and provided by NASA.*

While the entire scene is obscured by clouds, it appears the southern edge of the so-called 'Northwest Polynya' has progressed southward in recent days. At the same time, Iceberg Alley appears still largely covered by fast ice.

The true extent of nearshore open water patches cannot be determined from this imagery.

Figure 2 shows the same geographical frame as Figure 1 but visible data for 01 February 2020. The increased cloud does not allow for an assessment of sea-ice conditions off Mawson Station.

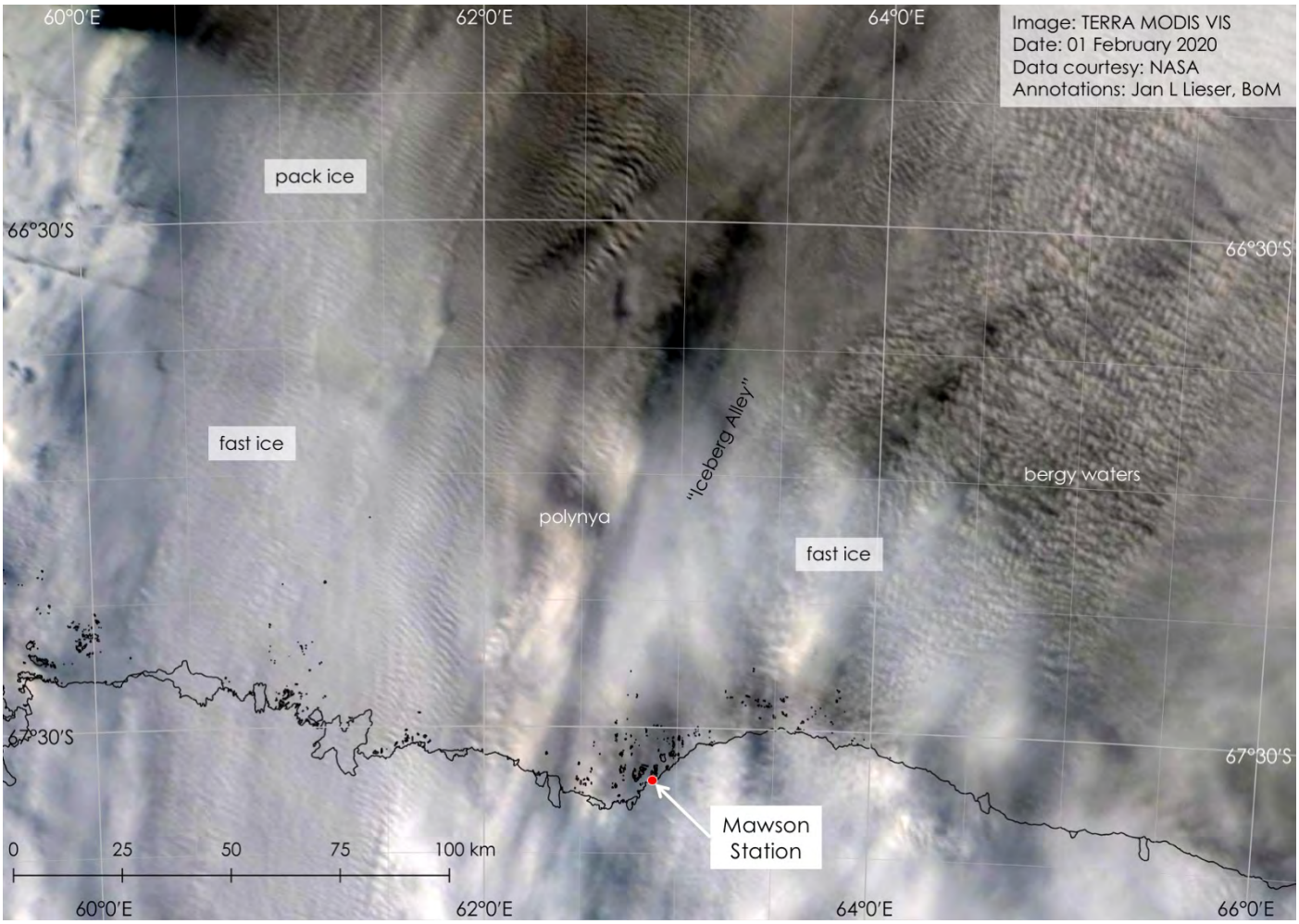

***Figure 2**: TERRA MODIS VIS data acquired 01 February 2020 and provided by NASA.*

Ice Bulletin: Mawson Station

Issued: Sunday 02nd February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore.

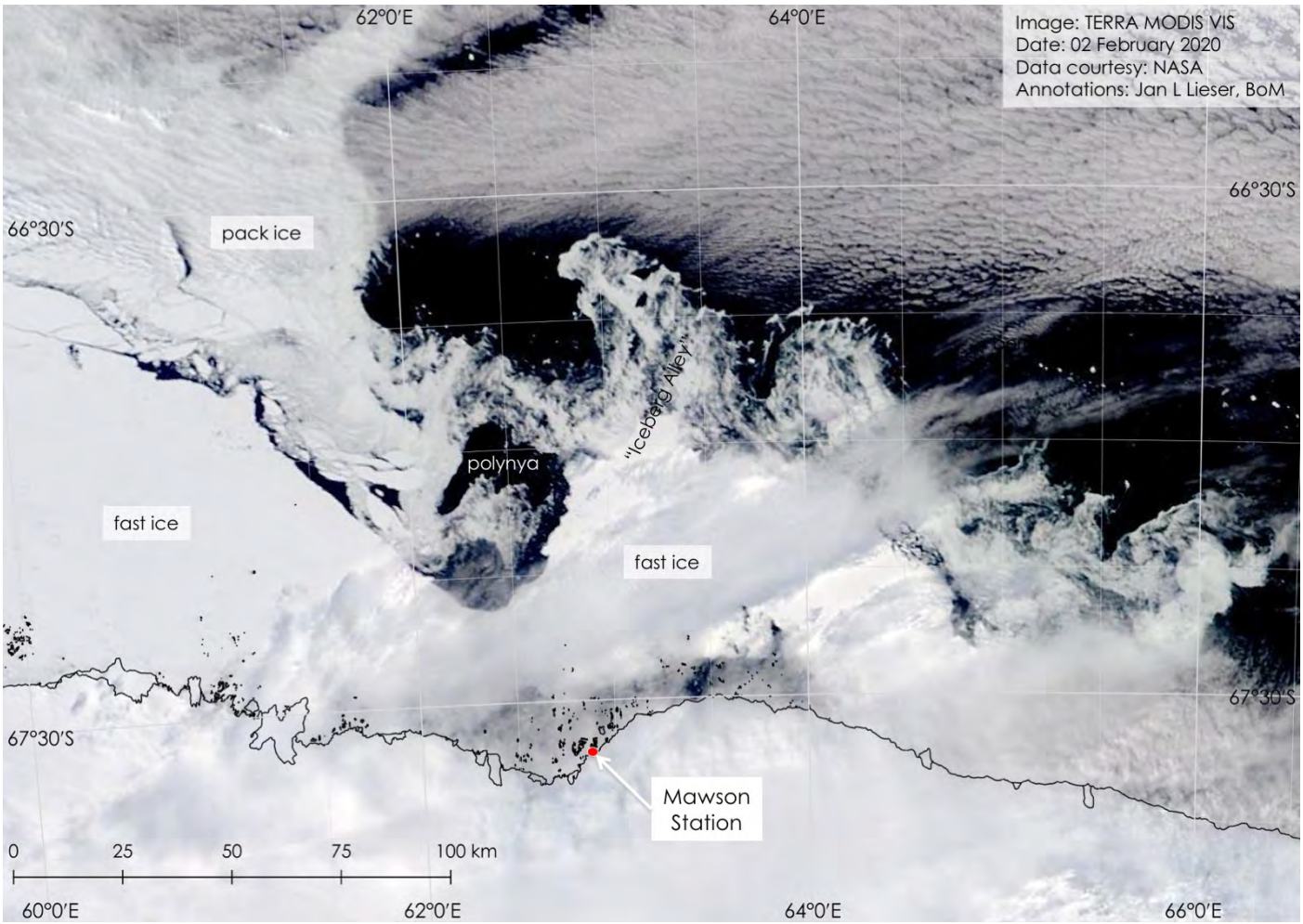

***Figure 1**: TERRA MODIS VIS data acquired 02 February 2020 and provided by NASA.*

While the coast and the fast ice north of Mawson Station are still obscured by clouds, the grown extent of nearshore open-water patches and the polynya northwest of the station is apparent. The southern edge of the polynya has progressed southward and the northern edge of nearshore open water has moved northward.

The shortest distance between the station and the polynya is now roughly 21 nautical miles.

The fast ice of the northern part of so-called ‘Iceberg Alley’ has also broken up and an increased amount of ex-fast ice is off the northern edge of the fast-ice body.

Ice Bulletin: Davis Station

Issued: Monday 03rd February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (6.125 km horizontal) sea-ice concentration chart of Cooperation Sea between Mawson Station and Davis Station. Large named tabular icebergs are marked. The general drift direction of pack ice is indicated by yellow arrows. The cruise track of RSV *Aurora Australis* is given by the orange line (up until 03/02/2020 06:10 UT; the orange dot).

The location of an acoustic whale mooring (north of the West Ice Shelf) and the proposed deployment locations of autonomous drifters (northeast of the Amery Ice Shelf) are marked by white dots.

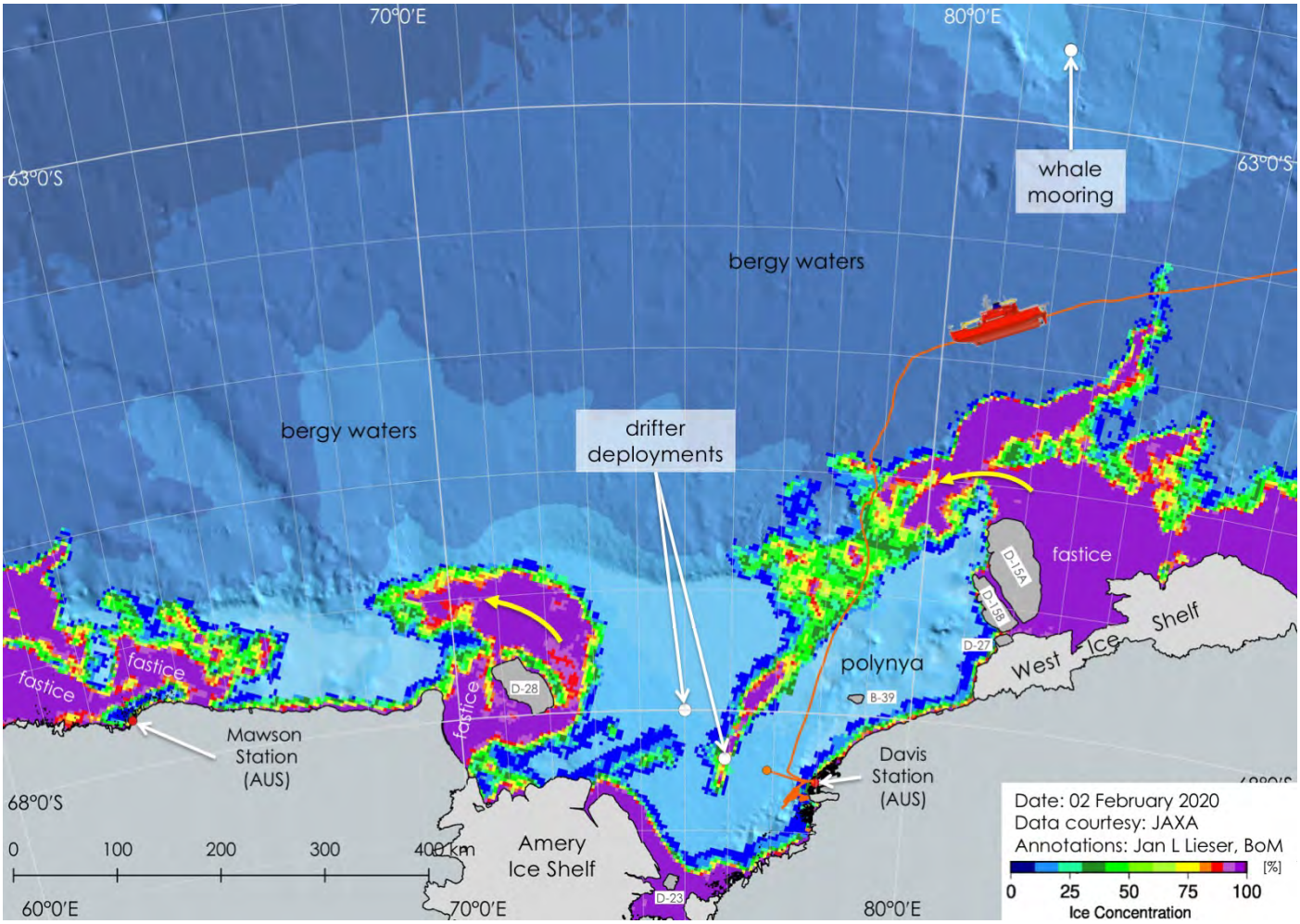

***Figure 1**: Sea-ice concentration chart acquired 02 February 2020 and provided by ICDC, Universität Hamburg; Bathymetry: IBCSO v1.0.*

The whale mooring is roughly 180 nautical miles north of the sea-ice edge, but is expected to be still in bergy waters, which means presence of icebergs possible in the vicinity.

North of the polynya off Davis Station, the sea ice is highly mobile. The two proposed drifter-deployment locations are currently in a region of less than 50% sea-ice concentration. It is expected to decrease further until the end of the summer but can change temporarily with locally changing atmospheric and oceanic conditions.

Ice Bulletin: Mawson Station

Issued: Monday 03rd February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene (TerraSAR-X ScanSAR at 16 m horizontal resolution) of Mawson Coast and offshore.

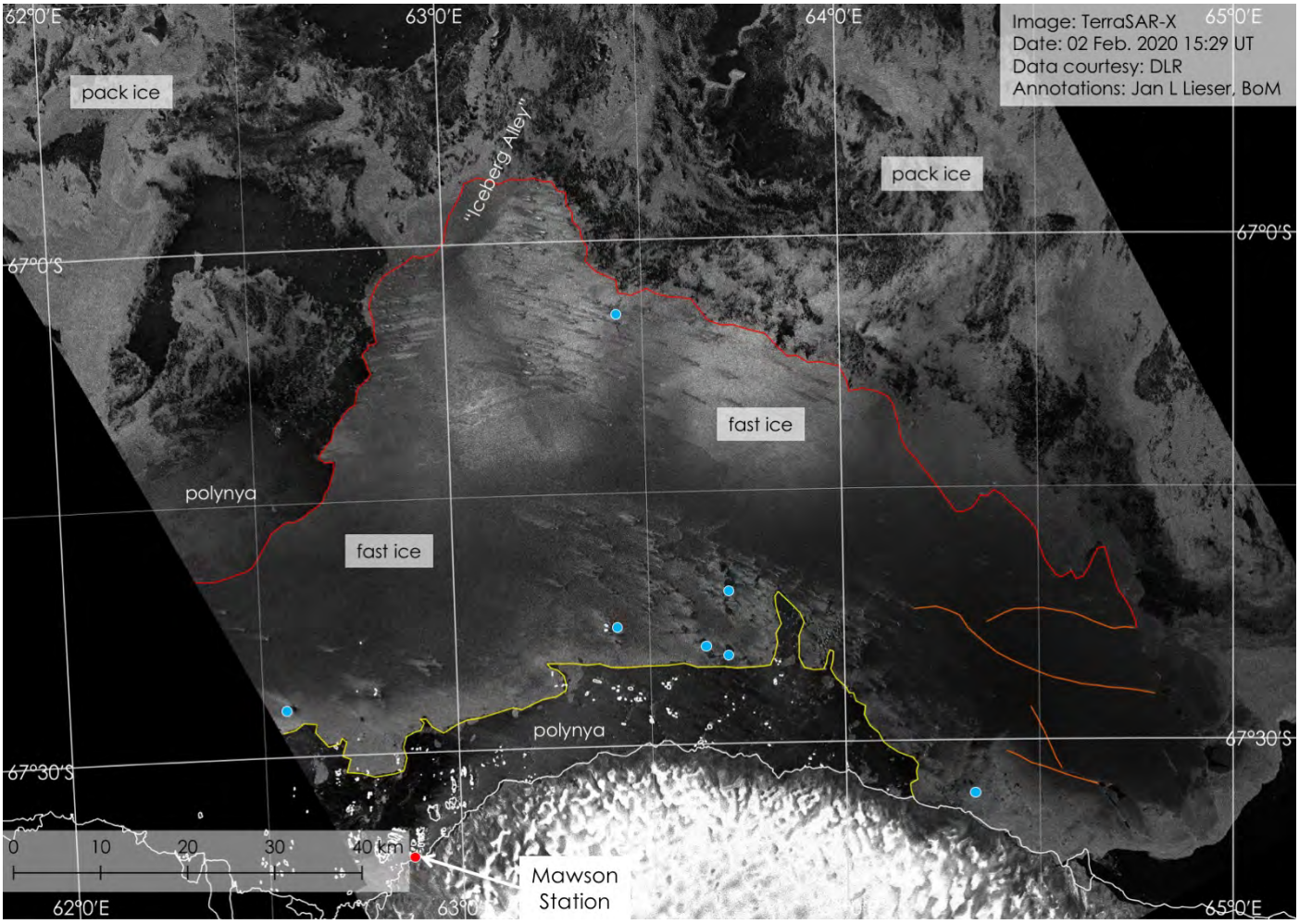

***Figure 1**: TerraSAR-X data acquired 02 February 2020 at 15:29 UT and provided by KSAT.*

Off Mawson Station and along the coast towards the east, the polynya has grown substantially. The northern edge of the polynya is approximated by the yellow line. The southern edge of the polynya northwest of the station has progressed southward as well as the northern fast-ice edge in general. This northern edge is indicated by the red line.

At the eastern edge of the fast-ice body, very large sheets of fast ice have broken and created major cracks, which are shown as orange lines. The eastern fast-ice edge, as well as parts of the northern edge, are fuzzy and not strictly determined due to the presence of loosened ex-fast ice that is now drifting freely as pack ice.

The fast ice of 'Iceberg Alley' has also started to break up.

Between the station and the polynya in the northwest, the fast ice appears homogenously smooth with only a few incorporated icebergs (that show as brighter grey spots at the eastern ends of snow trails between 67º15'S and 67º30'S). East of 63ºE, many more icebergs are enclosed by fast ice, which shows signs of further deterioration (blue dots).

Ice Bulletin: Mawson Station

Issued: Monday 03rd February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of visible and SAR data between Mawson Station and Cape Darnley.

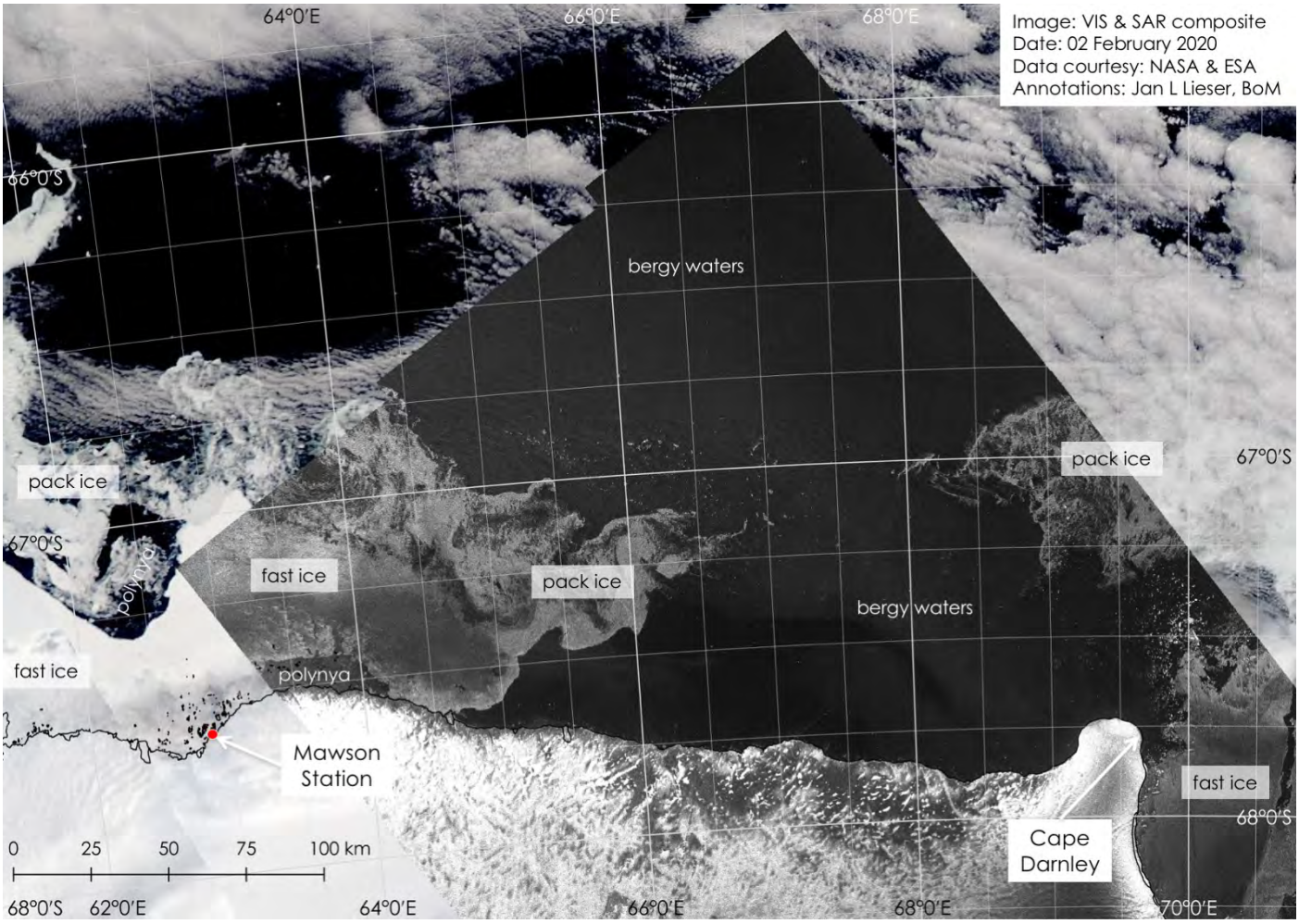

***Figure 1**: AQUA MODIS VIS data acquired 02 February 2020 and provided by NASA; overlay of Sentinel-1a SAR IW data acquired 02/02/2020 at 15:45 UT and provided by PolarView.*

East of Cape Darnley, fast ice remains shorefast and the large iceberg D-28 continues to rotate anti-clockwise (just outside the frame of the figure).

East of Mawson Station, fast ice remains attached to the coast only between 64°10'E and 64°33'E. Ex-fast ice is drifting freely as pack ice north of the fast-ice edges.

The shortest distance between Mawson Station and the polynya in the northwest is roughly 21 nautical miles.

Ice Bulletin: D'Urville Sea

Issued: Tuesday 04th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of southern D'Urville Sea. The positions of some of the larger icebergs are marked by pink outlines and dashed yellow shapes indicate their respective position on 07 January 2020.

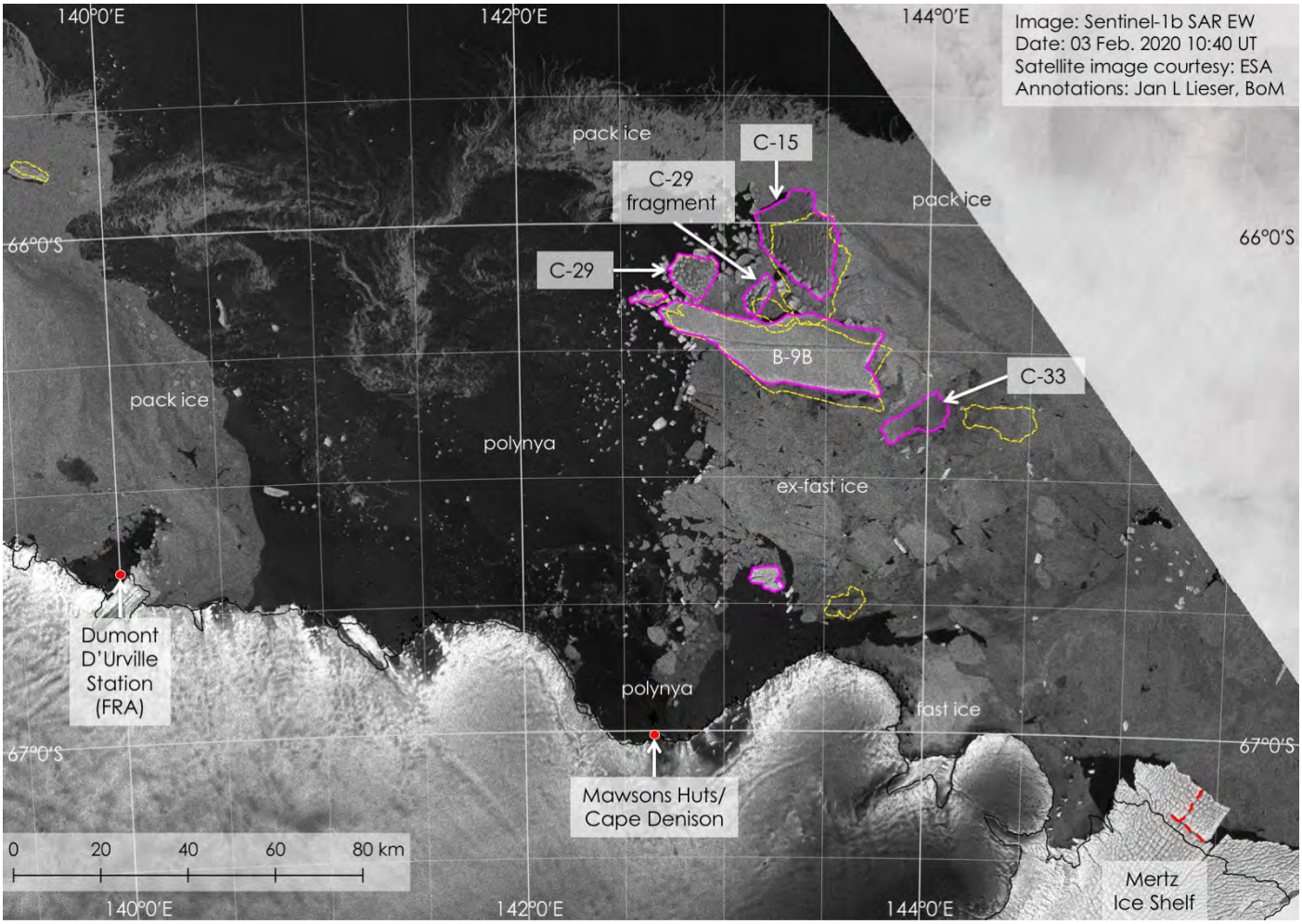

***Figure 1**: Sentinel-1b SAR EW scene acquired 27 January 2020 at 10:48 UT and provided by PolarView.*

Along the western edge of Commonwealth Bay (off Cape Denison), the last remaining fast ice has broken up.

Since the breaking up of the large body fast ice between Cape Denison and the group of icebergs north of it, some of the very large icebergs have moved in various directions. Iceberg B-9B has moved slightly northward and dislodged iceberg C-15, which has shed three smaller icebergs that are now between those two icebergs. The C-29 fragment rotated anti-clockwise but remains trapped in the vicinity. Iceberg C-29 has not moved at all. Iceberg C-33 has moved westward.

The Mertz Ice Shelf appears to be readying a new iceberg (approximated by the red dashed lines), where two major rifts are joining.

Off Dumont D'Urville Station, open water forms a polynya that is surrounded by broken floes of pack ice predominantly comprising of ex-fast ice and old sea ice.

Ice Bulletin: Mawson Station

Issued: Wednesday 05th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of visible and SAR data between Mawson Station and Cape Darnley. The general drift direction of pack ice north of fast ice patches is indicated by yellow arrows.

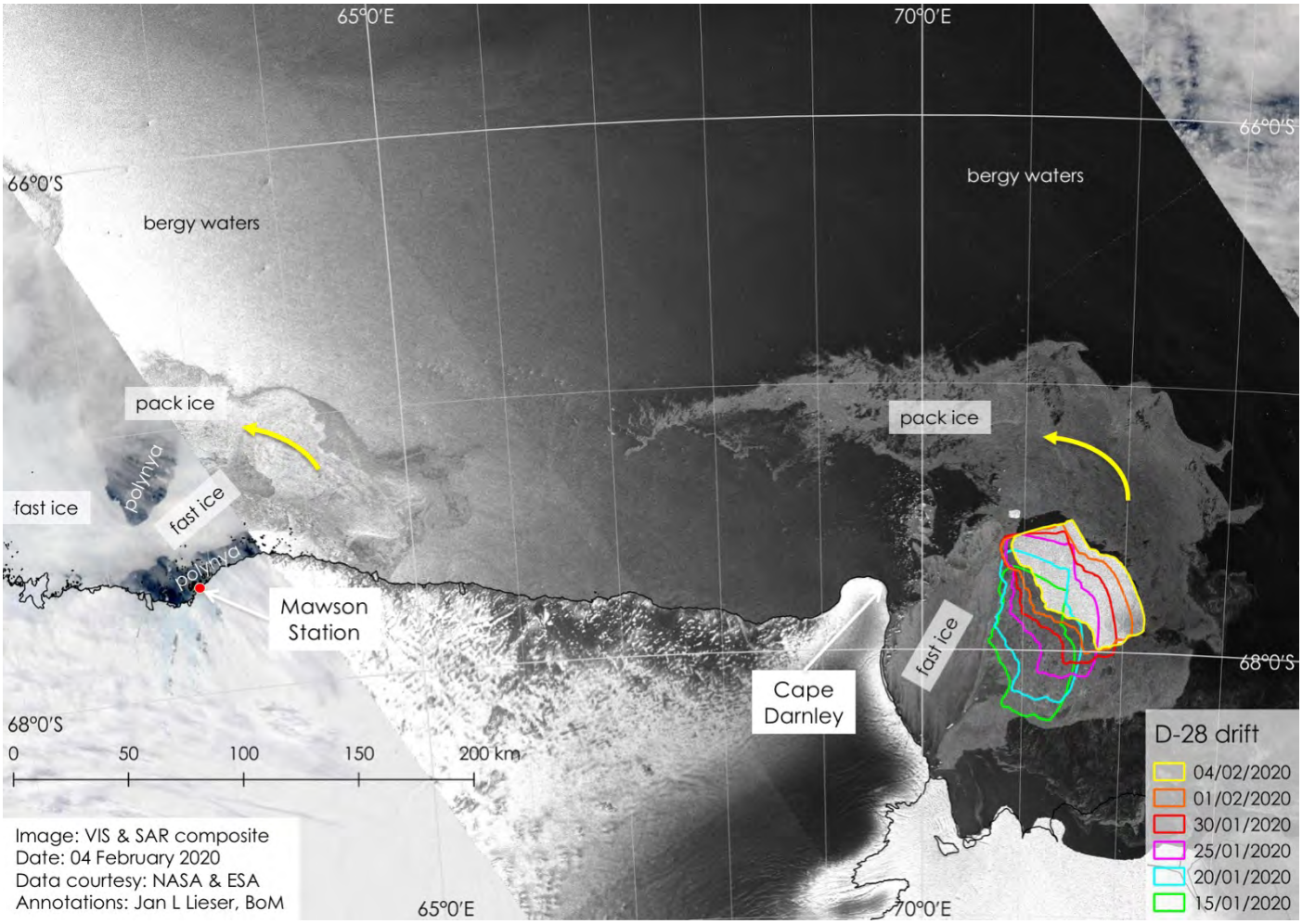

***Figure 1**: Sentinel-1a SAR EW data acquired 04/02/2020 at 15:29 UT and provided by PolarView; background AQUA MODIS VIS data acquired 04 February 2020 and provided by NASA.*

East of Cape Darnley, fast ice remains shorefast but is breaking up from the north. The large iceberg D-28 continues its anti-clockwise rotation (illustrated by coloured shapes).

East of Mawson Station, fast ice remains attached to the coast only between 64°10'E and 64°43'E. Ex-fast ice is drifting freely as pack ice north of the fast-ice edges.

Off Mawson Station, the polynya is growing and the shortest distance between the station and the polynya in the northwest beyond the remaining fast ice is a little more than 20 nautical miles.

Ice Bulletin: Mawson Station

Issued: Wednesday 05th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (17 m horizontal) SAR scene of Mawson Station and offshore.

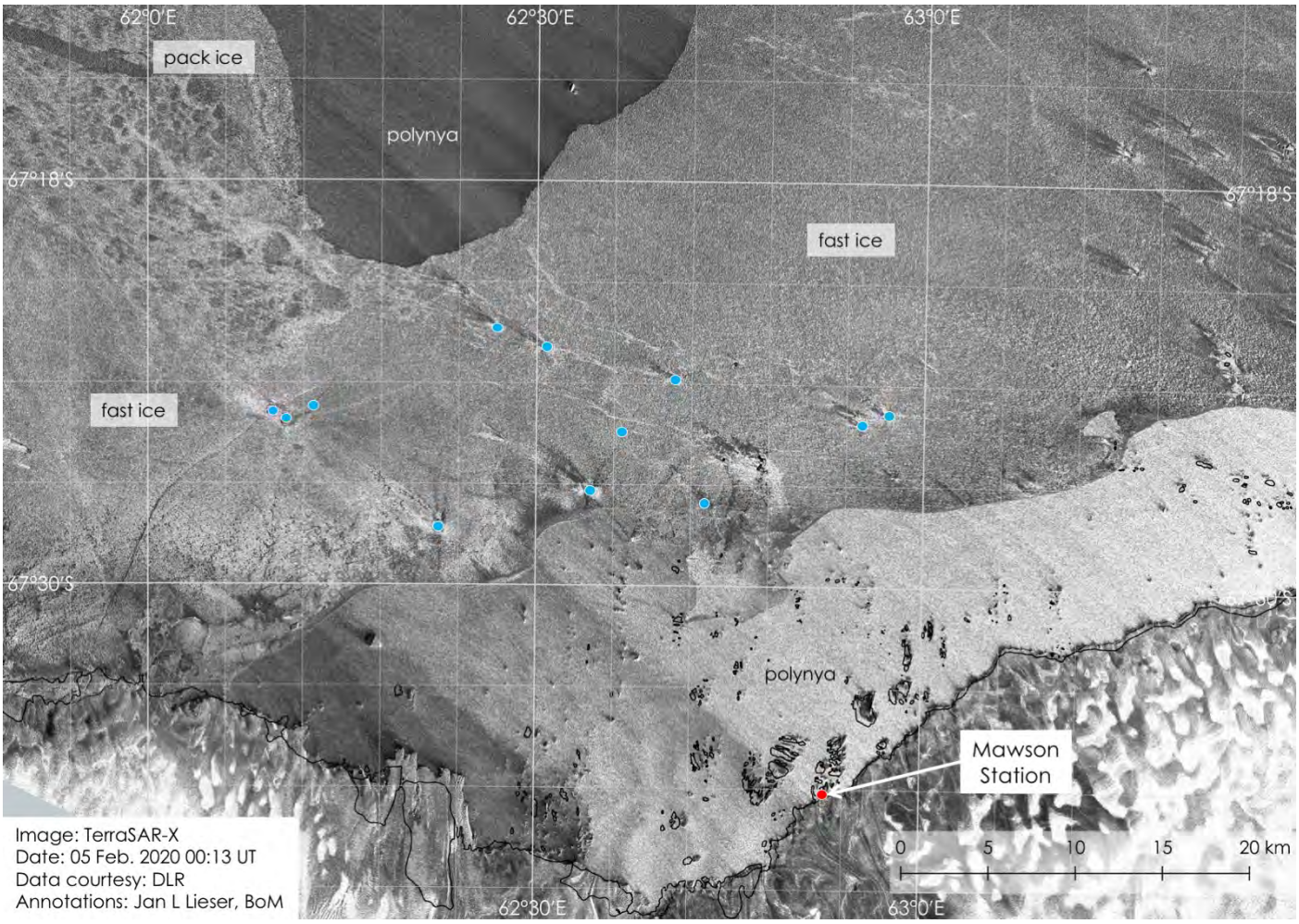

***Figure 1**: TerraSAR-X SAR data acquired 05/02/2020 at 00:13 UT and provided by KSAT;*

Off Mawson Station, the polynya is clearly detectable. North of the polynya, fast ice remains local and some of the larger icebergs that are enclosed within the fast ice are marked by blue dots. Tide cracks between icebergs and partly islands can be seen, and wind-blown snow dunes are predominantly east-west orientated.

Figure 2 provides the northern continuation of Figure 1 (the same data set). The extent of 'Iceberg Alley' is highlighted in yellow. A transition between ex-fast ice in the northern part and still fastened sea ice in the southern part is indicated by and orange line (around 67ºS).

West of the northern part of the alley, ex-fast ice can be identified drifting between many icebergs that are partly grounded and partly free drifting. South of 67ºS, very little drifting sea ice is in that part of the polynya, because upstream of that part (east of it) fast ice is still intact and held back behind the rows of icebergs that make the southern part of the alley.

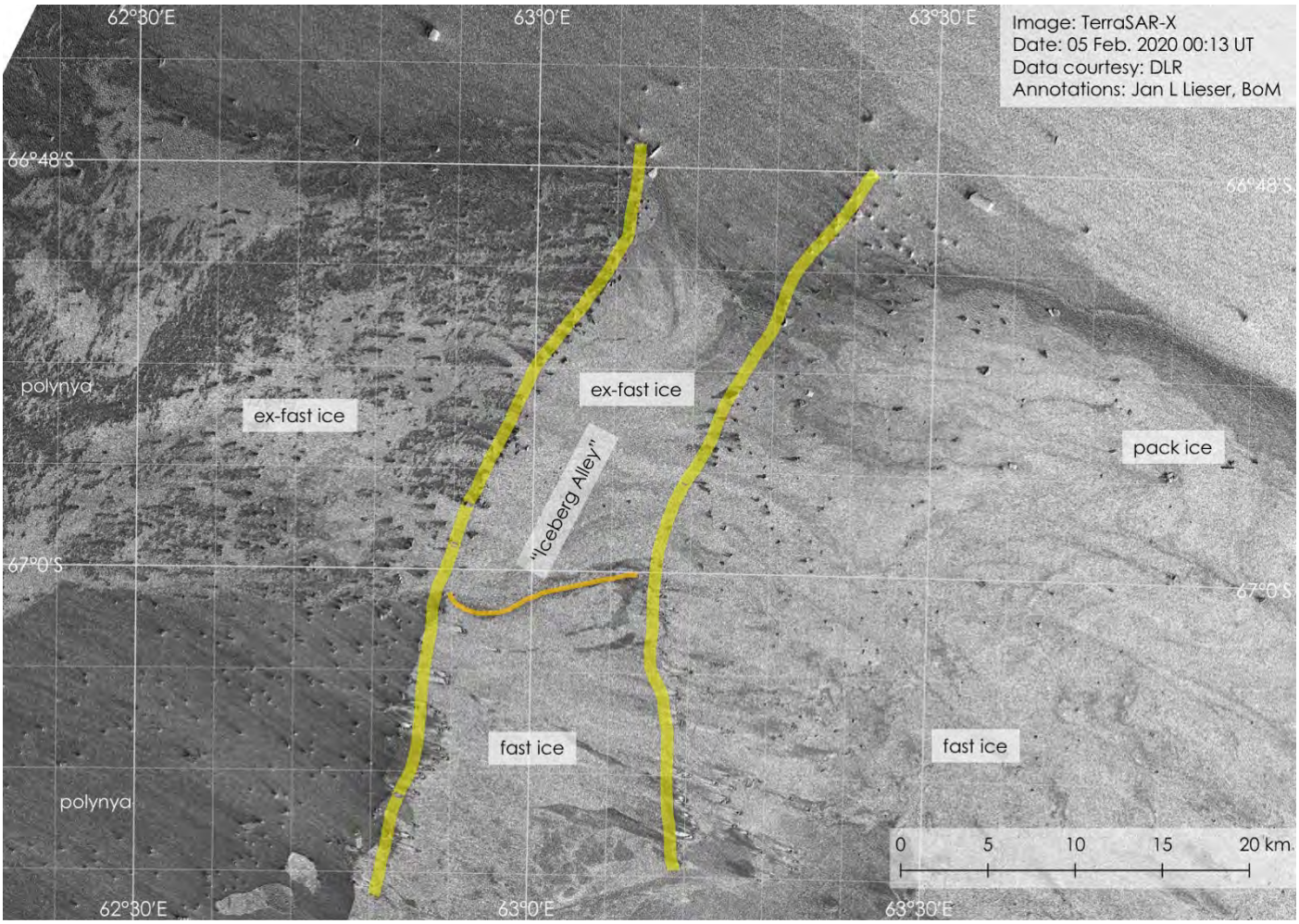

***Figure 2**: TerraSAR-X SAR data acquired 05/02/2020 at 00:13 UT and provided by KSAT;*

Ice Bulletin: Mawson Station

Issued: Thursday 06th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene off Mawson Station complemented by visible data in the northeast.

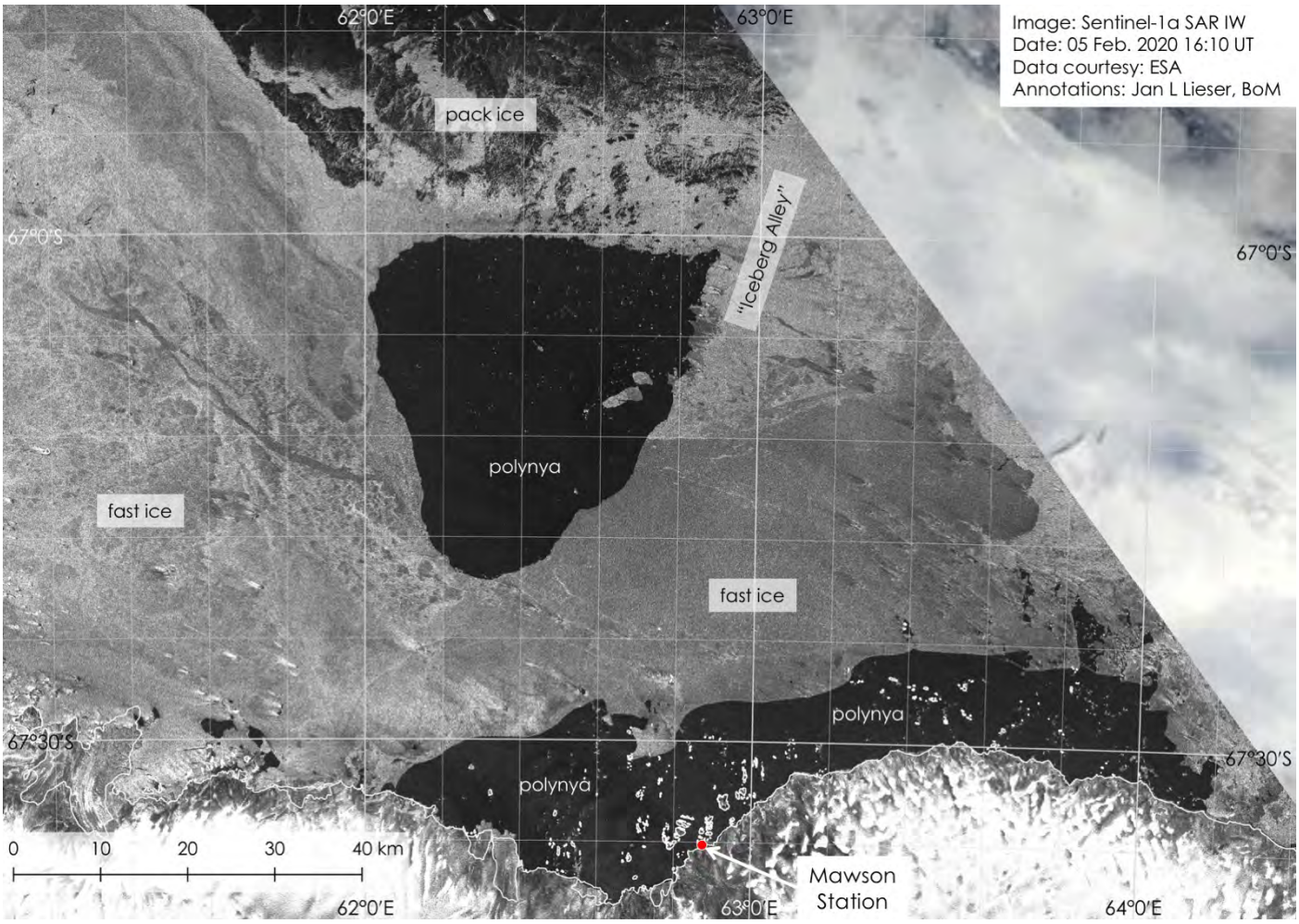

***Figure 1**: Sentinel-1a SAR IW data acquired 05/02/2020 at 16:10 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 05 February 2020 and provided by NASA.*

Off Mawson Station, the polynya is growing eastward and westward but the shortest distance between the station and the polynya in the northwest beyond the fast ice remains a little more than 20 nautical miles.

The northern part of iceberg alley is filled with broken ex-fast ice while the southern part appears to be still covered by fast ice. The ex-fast ice of the northern part is spilling out westward through the western row of icebergs that make Iceberg Alley.

After the recent southerly winds, the polynyas (the one off station and the one beyond the fast ice) have a rather defined northern edge.

Ice Bulletin: Mawson Station

Issued: Thursday 06th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (8 m horizontal) SAR scene of Mawson Station and offshore.

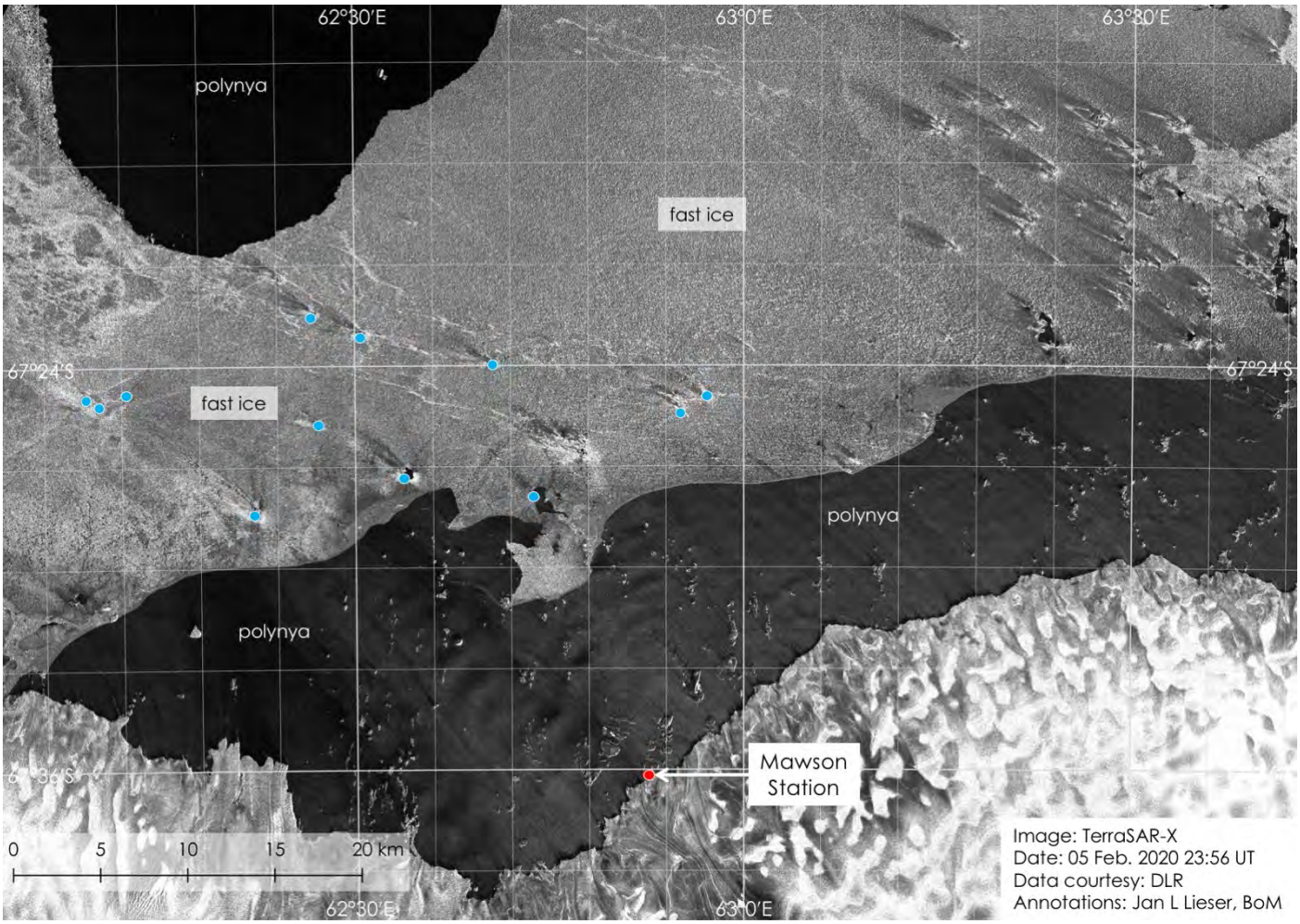

***Figure 1**: TerraSAR-X SAR data acquired 05/02/2020 at 23:56 UT and provided by KSAT;*

The overall sea-ice situation off Mawson Station has not changed significantly between the two TerraSAR-X acquisitions on 05 February 2020. Offshore, the polynya is clearly identifiable. In this polynya, ocean surface waves are seen as darker and lighter grey arches (appearing to originate around the Mawson Station area), which are induced by katabatic surface wind that is 'bouncing' on the ocean surface offshore.

North of the polynya, fast ice remains local and some of the larger icebergs that are enclosed within the fast ice are marked by blue dots. Tide cracks between icebergs and some of the islands can be seen, and wind-blown snow dunes are predominantly east-west orientated.

Figure 2 provides the northern continuation of Figure 1 (the same data set). The extent of 'Iceberg Alley' is highlighted in yellow. A transition between ex-fast ice in the northern part and still fastened sea ice in the southern part is indicated by and orange line (around 67ºS).

A notable difference to the previous TerraSAR-X acquisition is a new crack southeast of Iceberg Alley (marked by a blue line).

West of the northern part of the alley, ex-fast ice is drifting between many icebergs that are partly grounded and partly free drifting. South of 67ºS, very little drifting sea ice is in that part of the polynya, because upstream of that part (east of it) fast ice is still intact and held back behind the rows of icebergs that make the southern part of the alley.

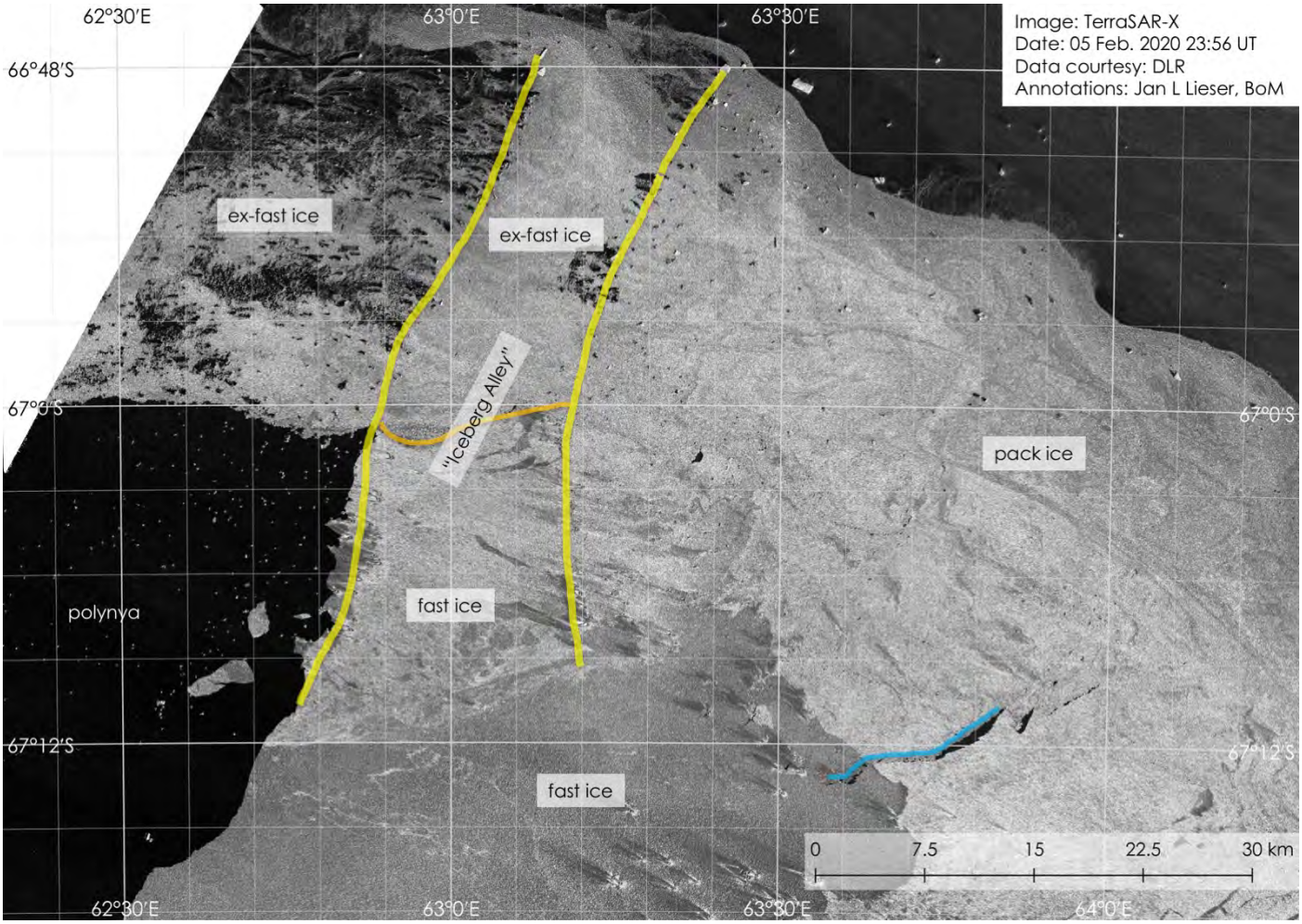

***Figure 2**: TerraSAR-X SAR data acquired 05/02/2020 at 23:56 UT and provided by KSAT;*

Ice Bulletin: Davis Station

Issued: Friday 07th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by white letters.

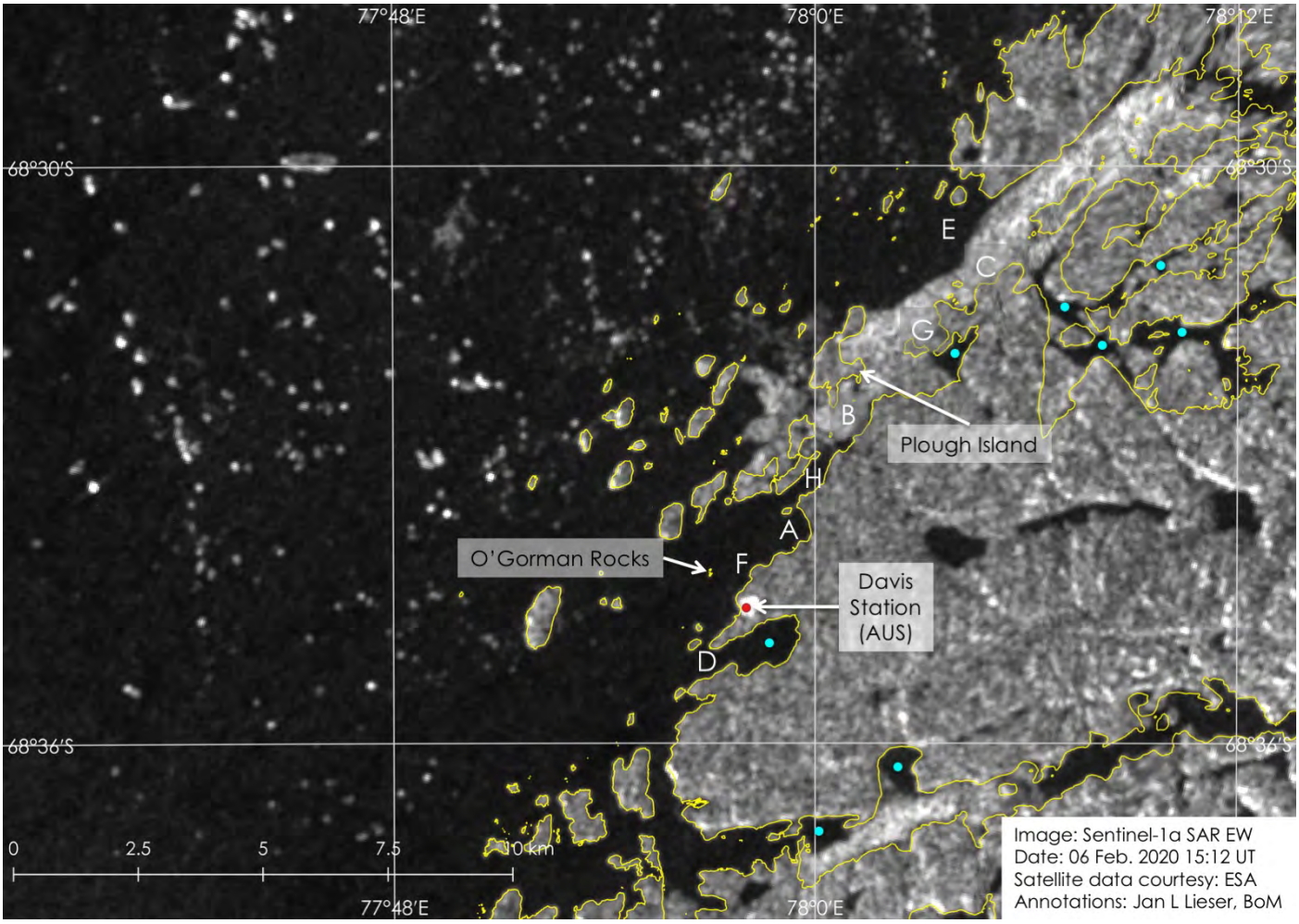

***Figure 1**: Sentinel-1a SAR EW scene acquired 06 February 2020 at 15:12 UT and provided by PolarView.*

Some of the areas of proposed hydrographic surveying start to be clear of fast ice, for example the southern locations of 'D' to 'H'. Further north, the fast-ice edge continues to retreat slowly towards the coast and nearshore fast ice is rotting as well. Those nearshore locations are marked with cyan dots, for example inshore of locations 'G' and 'C'.

Broken ex-fast ice and icebergs are drifting generally south-westward offshore.

Figure 2 shows a larger overview of the same data as Figure 1. The recent drift of large tabular iceberg B-39 is indicated by colour-coded shapes. The iceberg is roughly 97.0 km^2 (or 9,700 ha) and is travelling approximately 20 km per day south-westward.

Offshore, strips and patches of decaying first-year sea ice can be seen in filament-like structures mirroring local ocean surface eddies.

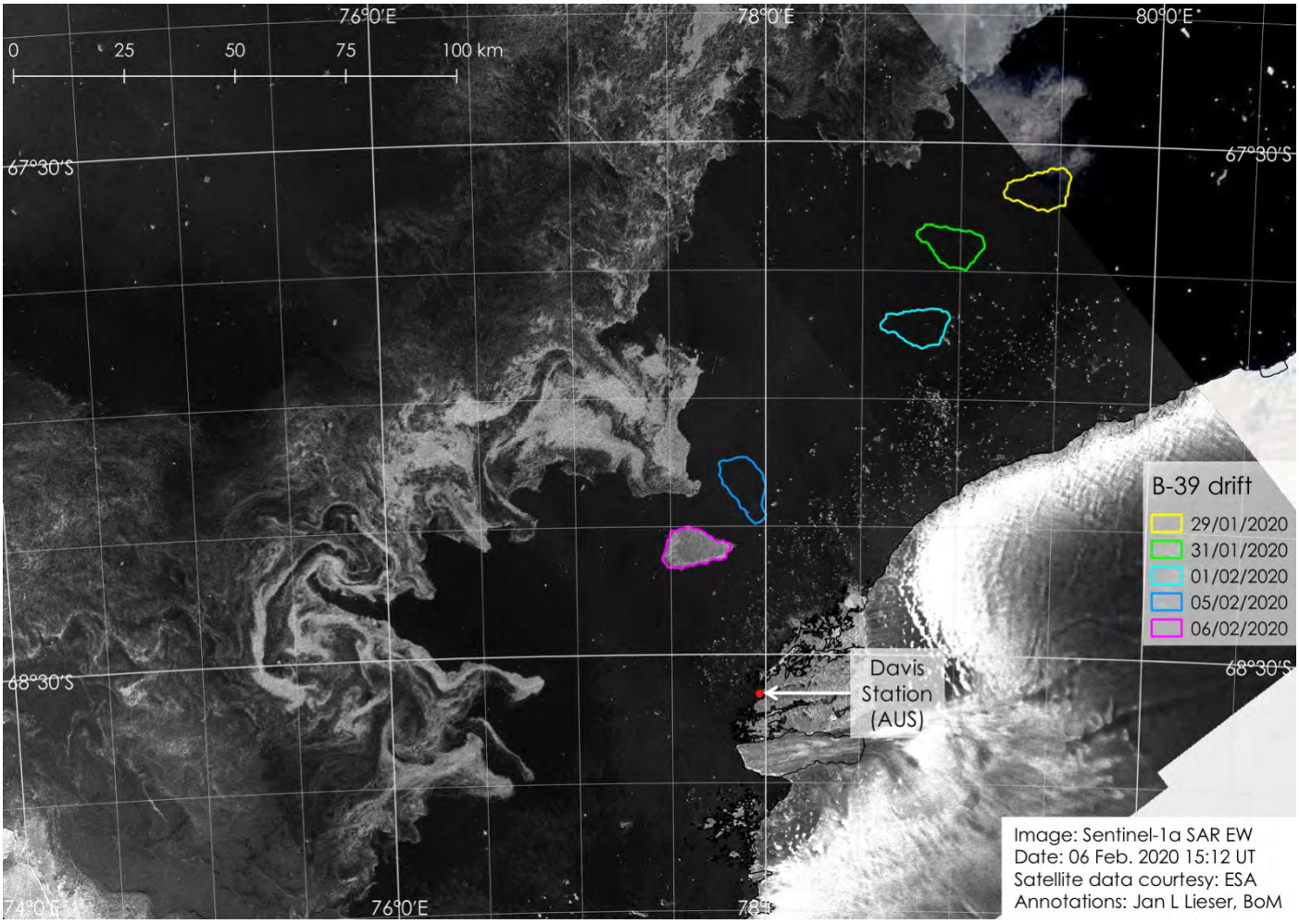

***Figure 2**: Sentinel-1a SAR EW scene acquired 06 February 2020 at 15:12 UT and provided by PolarView.*

Ice Bulletin: Davis Station

Issued: Friday 07th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by white letters.

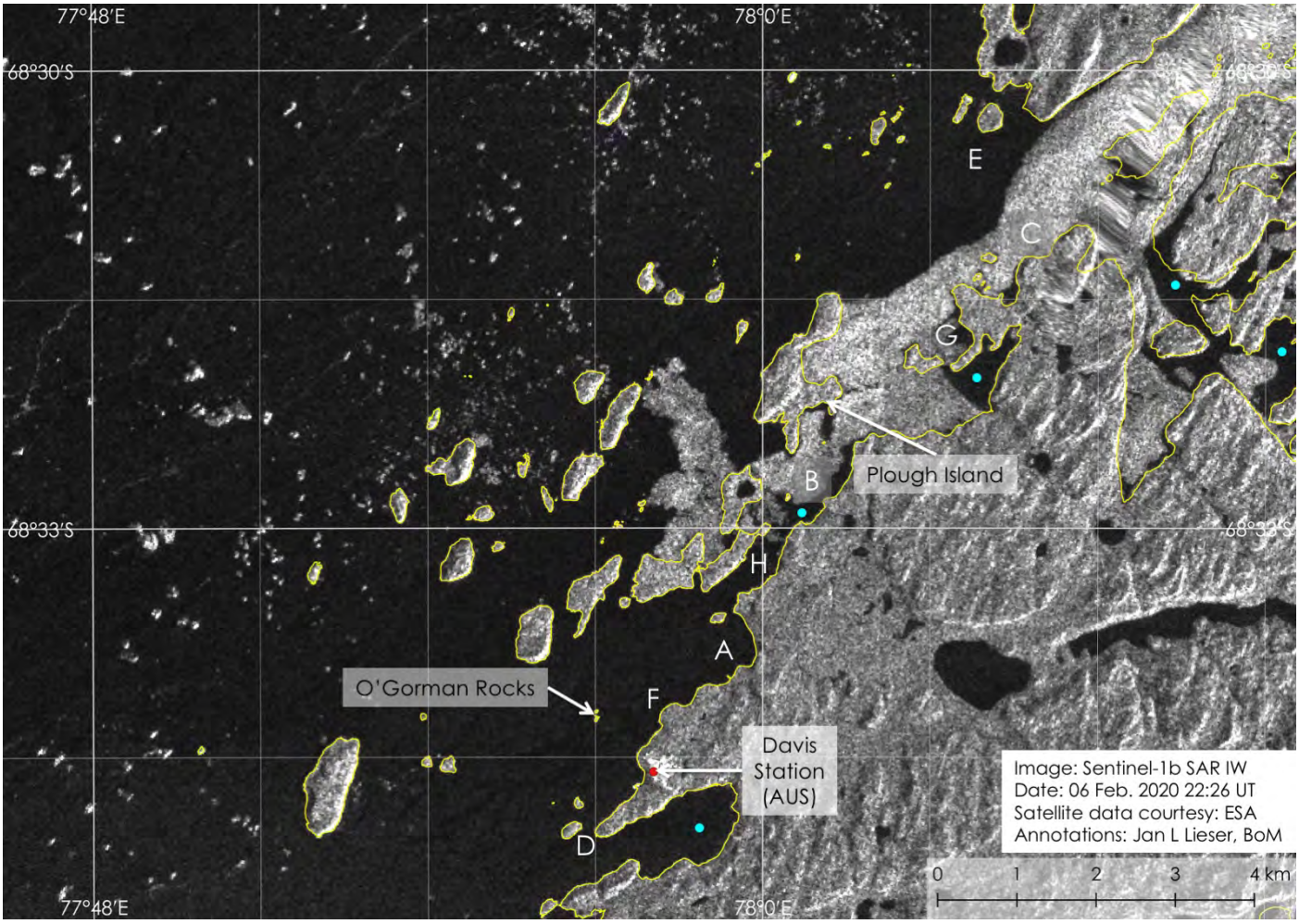

***Figure 1**: Sentinel-1b SAR IW scene acquired 06 February 2020 at 22:26 UT and provided by PolarView.*

The extent of the areas of proposed hydrographic surveying that start to be clear of fast ice is clearer from the high-resolution data (see previous bulletin). The southern locations of 'D' to 'H' are free of sea ice and 'B' is showing signs of breaking up fast ice too. Further north, location 'E' appears largely free of sea ice. At locations 'G' and 'C', the fast-ice edge continues to retreat slowly towards the coast and nearshore fast ice is rotting as well (marked by cyan dots).

Broken ex-fast ice and icebergs are drifting generally south-westward offshore.

Figure 2 shows a larger overview of the same data as Figure 1. The drift of the large tabular iceberg B-39 can be seen by the displacement from the magenta shape, which shows the iceberg's position roughly seven hours earlier (06 Feb. 2020 at 15:12 UT; see previous bulletin). The iceberg has drifted approximately 4.5 km per during this time.

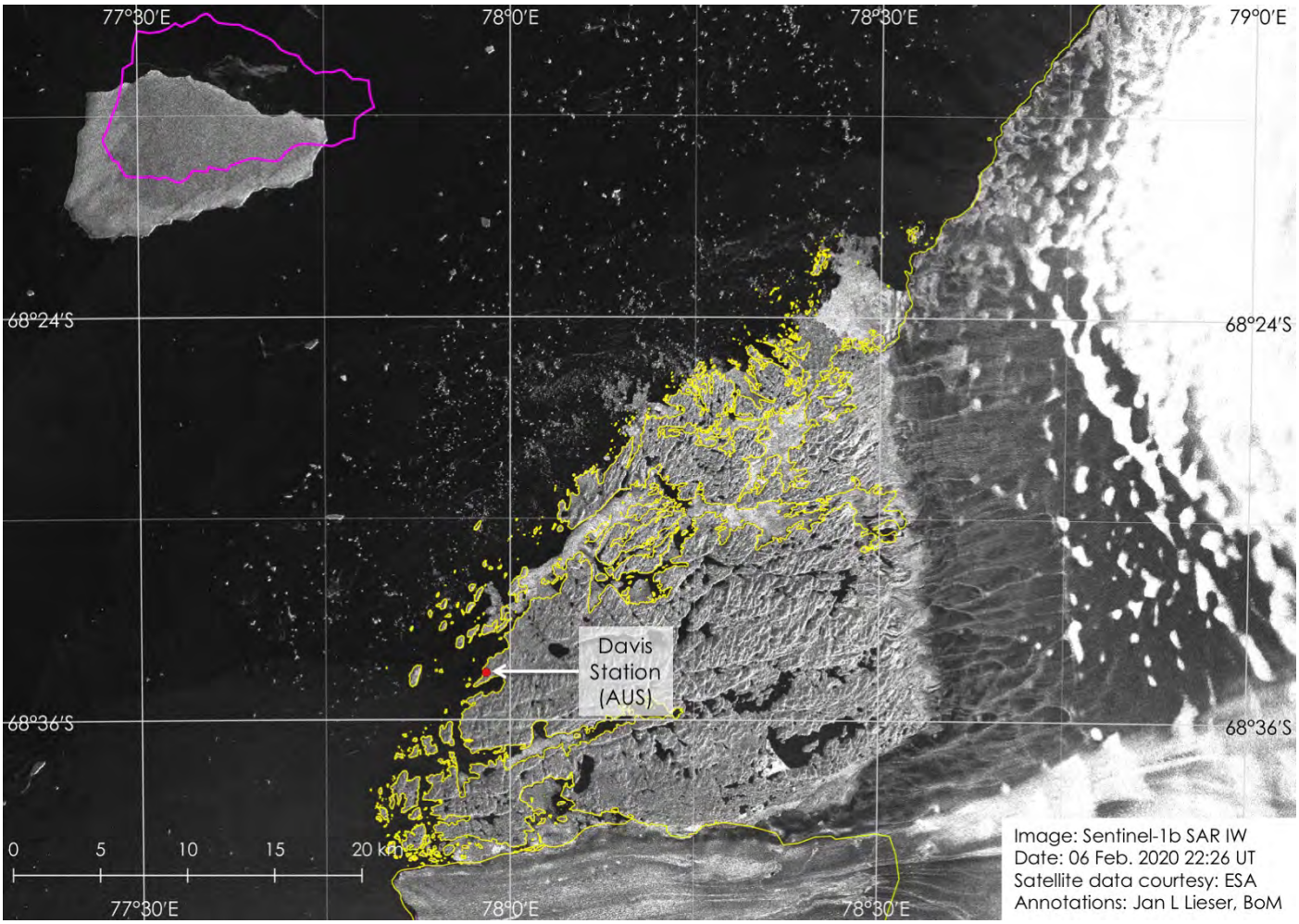

***Figure 2**: Sentinel-1b SAR IW scene acquired 06 February 2020 at 22:26 UT and provided by PolarView.*

Ice Bulletin: Mawson Station

Issued: Friday 07th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore.

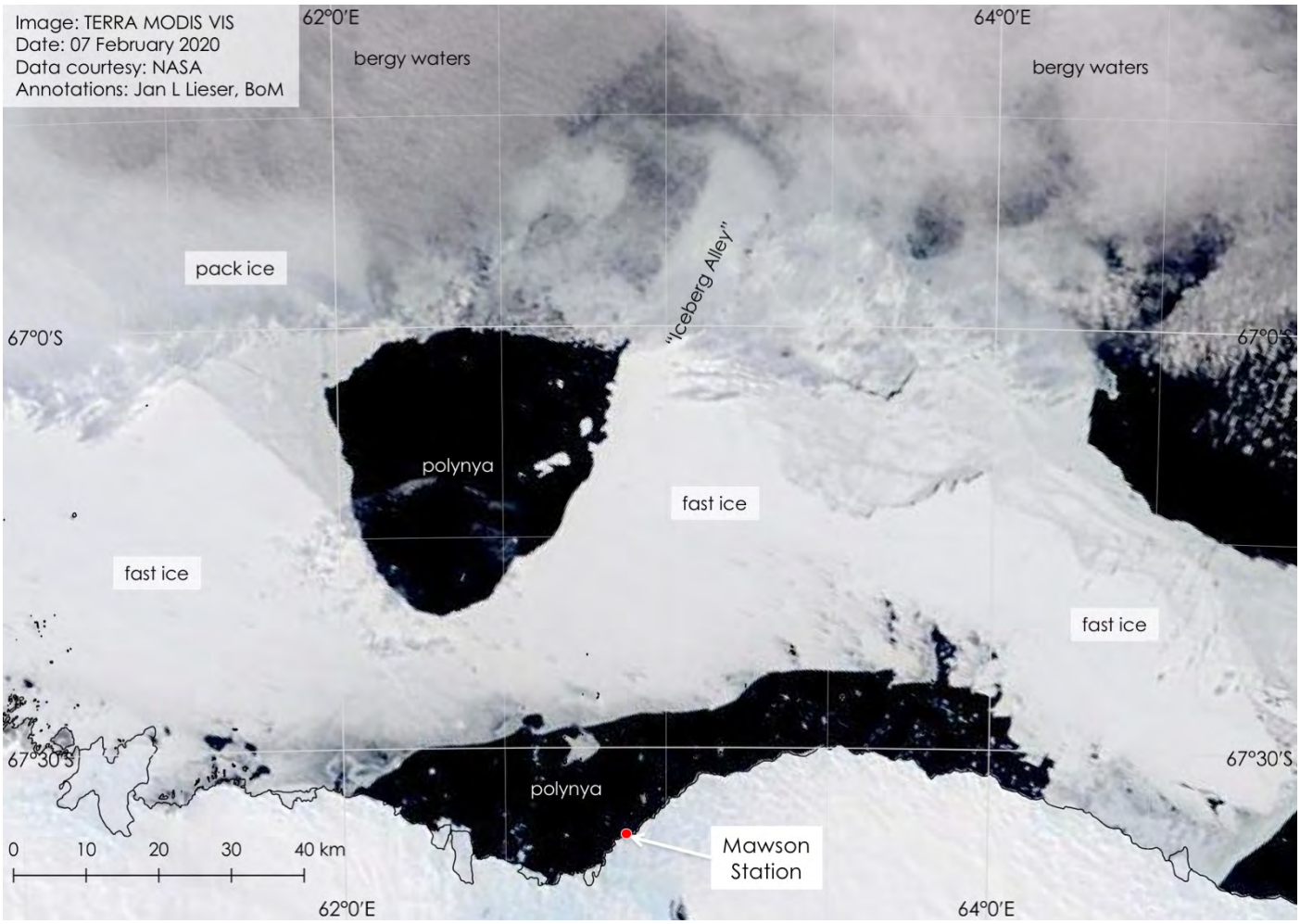

***Figure 1**: TERRA MODIS VIS data acquired 07 February 2020 and provided by NASA.*

The northern and southern edges of the fast ice that separates the coastal polynya and the polynya northwest of Mawson Station remain largely unchanged. Iceberg Alley appears to be still filled with ex-fast ice in the north and unbroken fast ice in the south. Even though broken sea ice is drifting westward through the gaps between the grounded icebergs of the western edge of the alley, the alley itself is still largely filled with sea ice.

East of Mawson Station, fast ice continues to break around the edges. That is particularly evident at 63º50'E and 67º20'S and further along the coastline, where fast ice appears to be thinning and partially breaking.

Ice Bulletin: Mawson Station

Issued: Saturday 08th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution SAR scene of Mawson Station and offshore. The apparent banding is a SAR processing artefact. The georeferencing of the image is slightly out by roughly 600 m in a northeast-southwest direction.

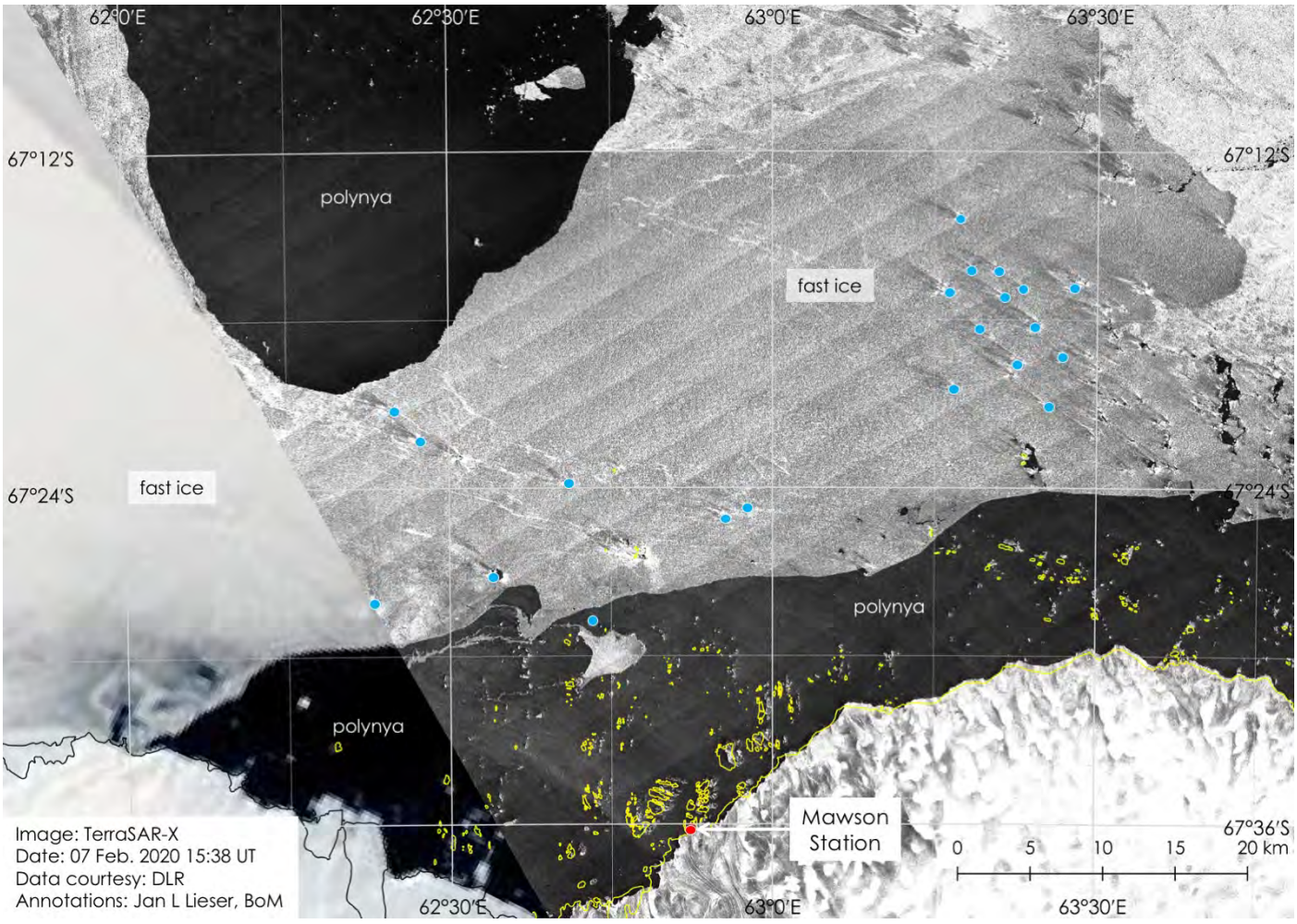

***Figure 1**: TerraSAR-X SAR data acquired 07/02/2020 at 15:38 UT and provided by KSAT; complemented by AQUA MODIS VIS data (in the southwest) acquired 07/02/2020 and provided by NASA.*

The overall sea-ice situation off Mawson Station has not changed significantly since 05 February 2020.

North of the polynya, fast ice remains local and some of the larger icebergs that are enclosed within the fast ice are marked by blue dots. Tide cracks between icebergs and some of the islands can be seen, and wind-blown snow dunes are predominantly east-west orientated.

Figure 2 provides the northern continuation of Figure 1 (the same data set). The extent of 'Iceberg Alley' is highlighted in yellow. A transition between ex-fast ice in the northern part and still fastened sea ice in the southern part is indicated by and orange line (around 67ºS).

West of the northern part of the alley, ex-fast ice is drifting between many icebergs that are partly grounded and partly free drifting. South of 67ºS, very little drifting sea ice is in that part of the polynya, because upstream of that part (east of it) fast ice is still intact and held back behind the rows of icebergs that make the southern part of the alley.

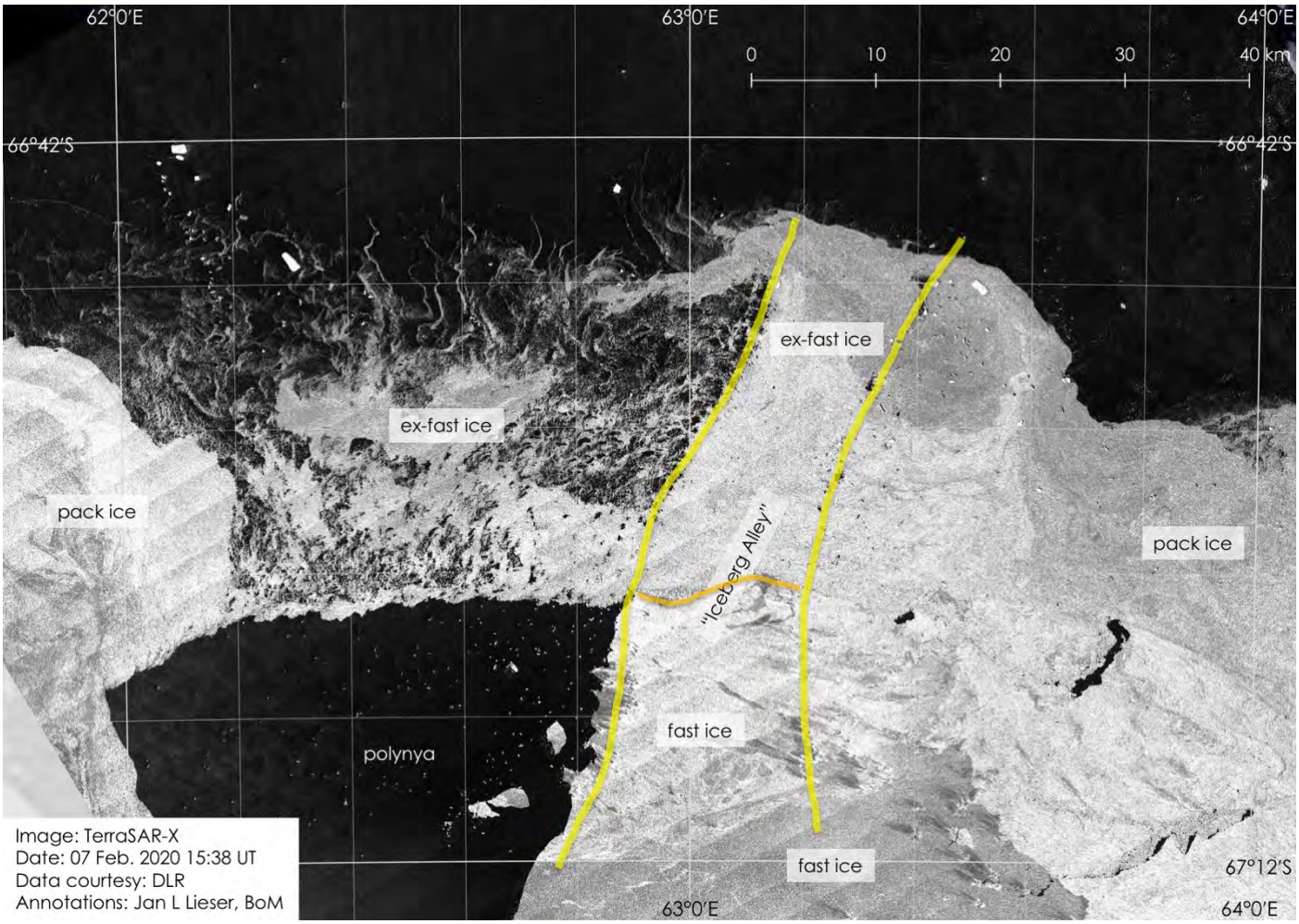

***Figure 2**: TerraSAR-X SAR data acquired 07/02/2020 at 15:38 UT and provided by KSAT.*

Ice Bulletin: Mawson Station

Issued: Saturday 08th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 08 Feb. 2020 08:40 UT, the orange dot).

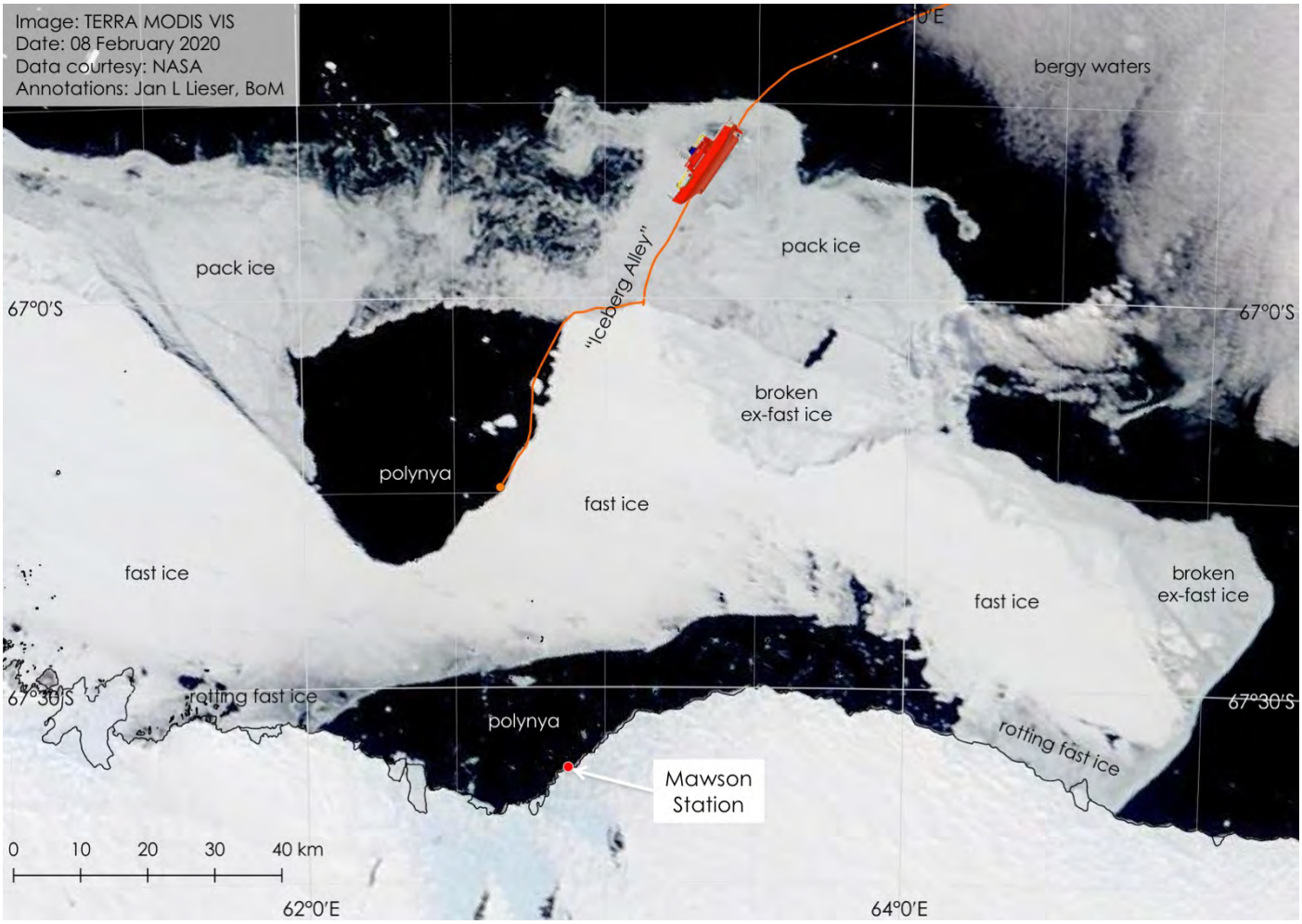

***Figure 1**: TERRA MODIS VIS data acquired 08 February 2020 and provided by NASA.*

The fast-ice situation north of Mawson Station remains generally unchanged. East and west of the station, fast ice is deteriorating nearshore and in the eastern part of the fast-ice body broken ex-fast ice remains local.

Ice Bulletin: Mawson Station

Issued: Sunday 09th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Mawson Station and offshore. The cruise track of RSV *Aurora Australis* is shown as an orange line (up until 08 February 2020 22:30 UT, the orange dot). The position of the vessel at the time of satellite data acquisition is marked by a white dot.

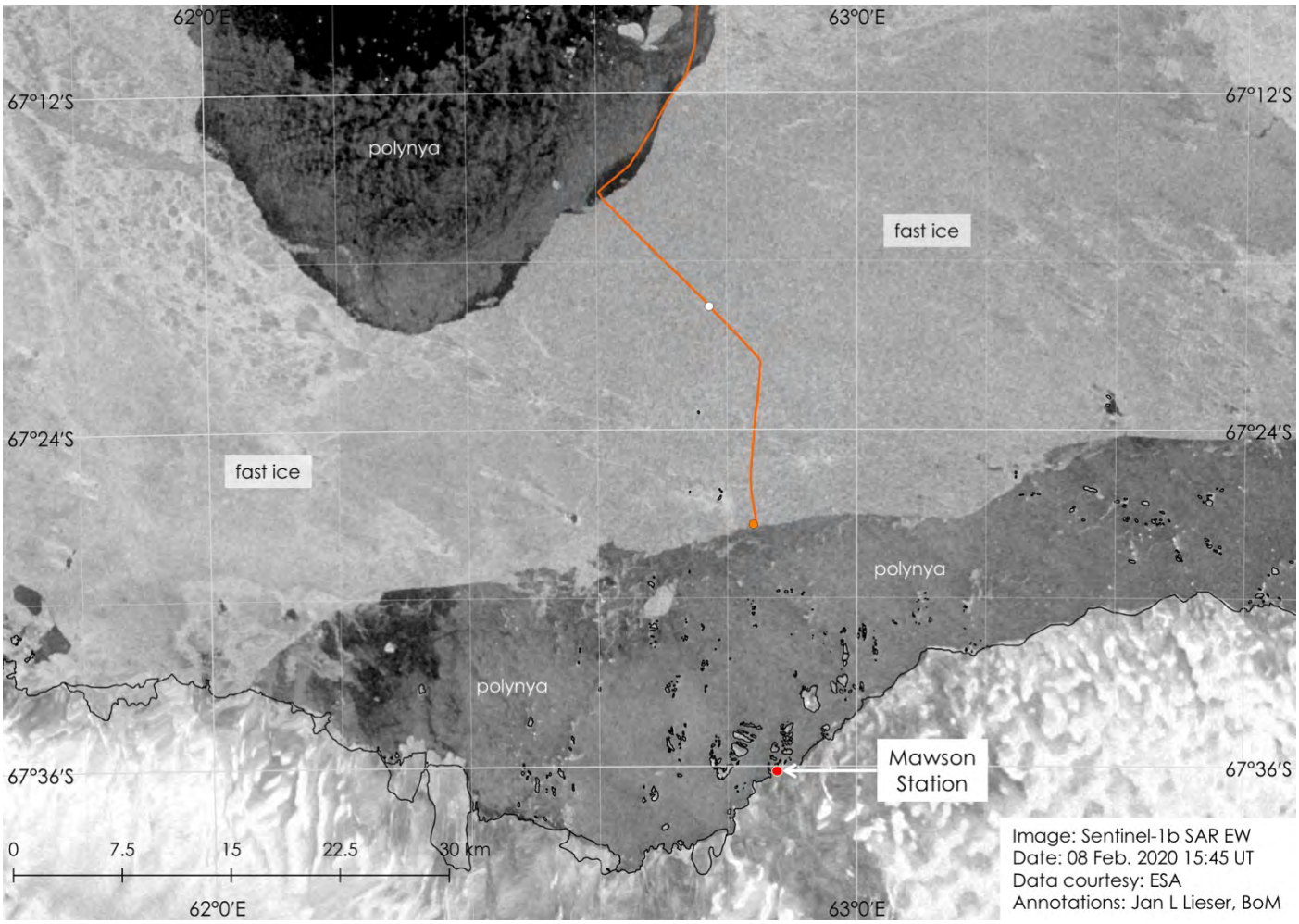

***Figure 1**: Sentinel-1b SAR EW data acquired 08/02/2020 at 15:45 UT and provided by Drift+Noise Polar Services.*

The overall sea-ice situation off Mawson Coast has not changed significantly since 05 February 2020.

Off Mawson Station, the polynya is largely free of drifting sea ice (ex-fast ice). Only at the northern edge of the polynya (towards the still fastened sea ice), some sea ice accumulates wind driven.

Ice Bulletin: Mawson Station

Issued: Sunday 09th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 09 Feb. 2020 08:30 UT, the orange dot). Yesterday's northern fast-ice edge is indicated by the cyan line.

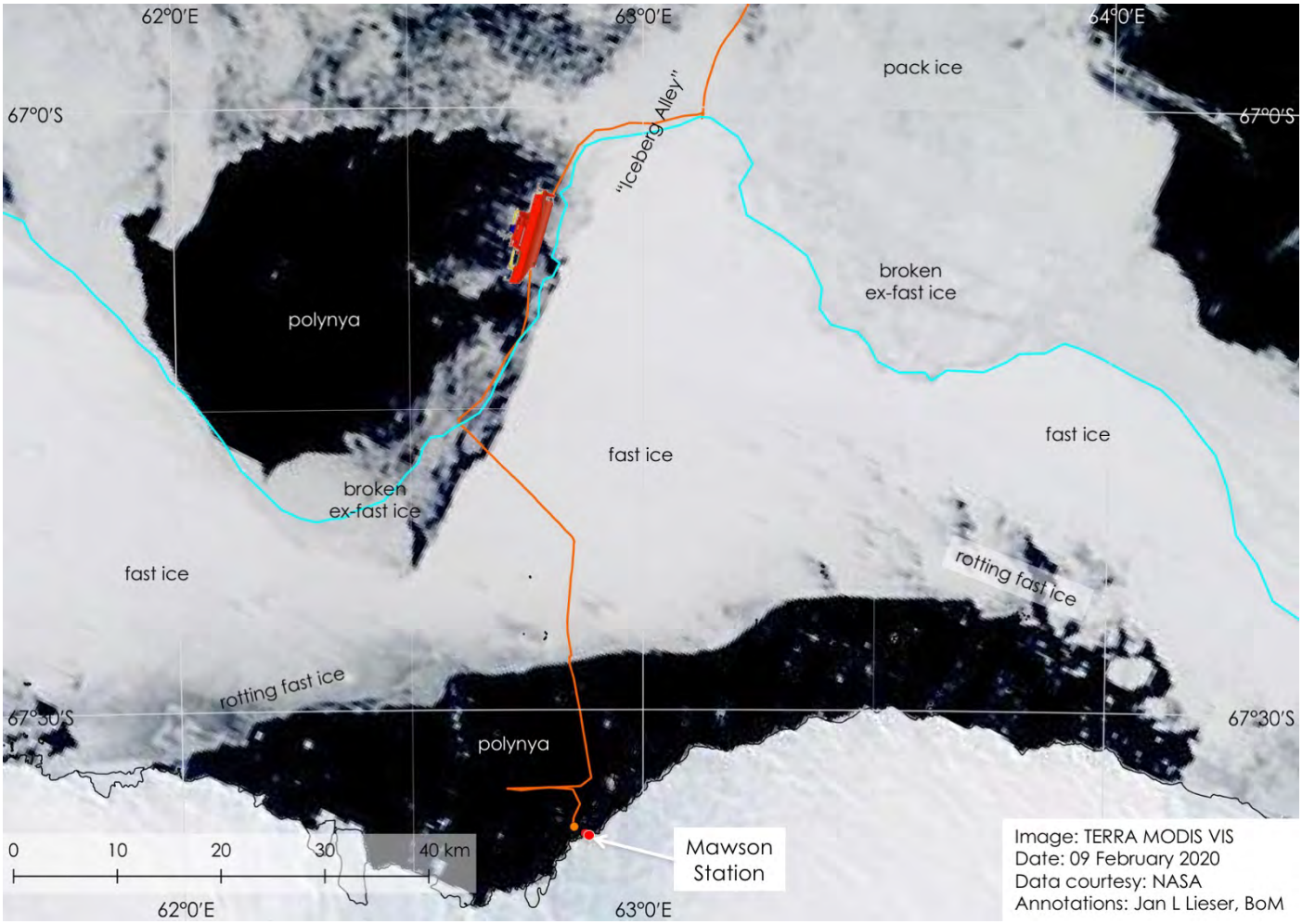

***Figure 1**: TERRA MODIS VIS data acquired 09 February 2020 and provided by NASA.*

Since the vessel transited through the fast ice south of 67°15'S, roughly 2.5 nautical miles of fast ice along the track have broken away from the northern end of the fast-ice passage and large parts north and south of the entry point as well.

Along the coast, fast ice continues to deteriorate east and west of the station.

Ice Bulletin: Davis Station

Issued: Tuesday 11th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Davis Station and the Vestfold Hills. The recent drift of iceberg B-39 is given by colour-coded shapes. Isobaths of the upper 600 m of the ocean are provided in shades of blue.

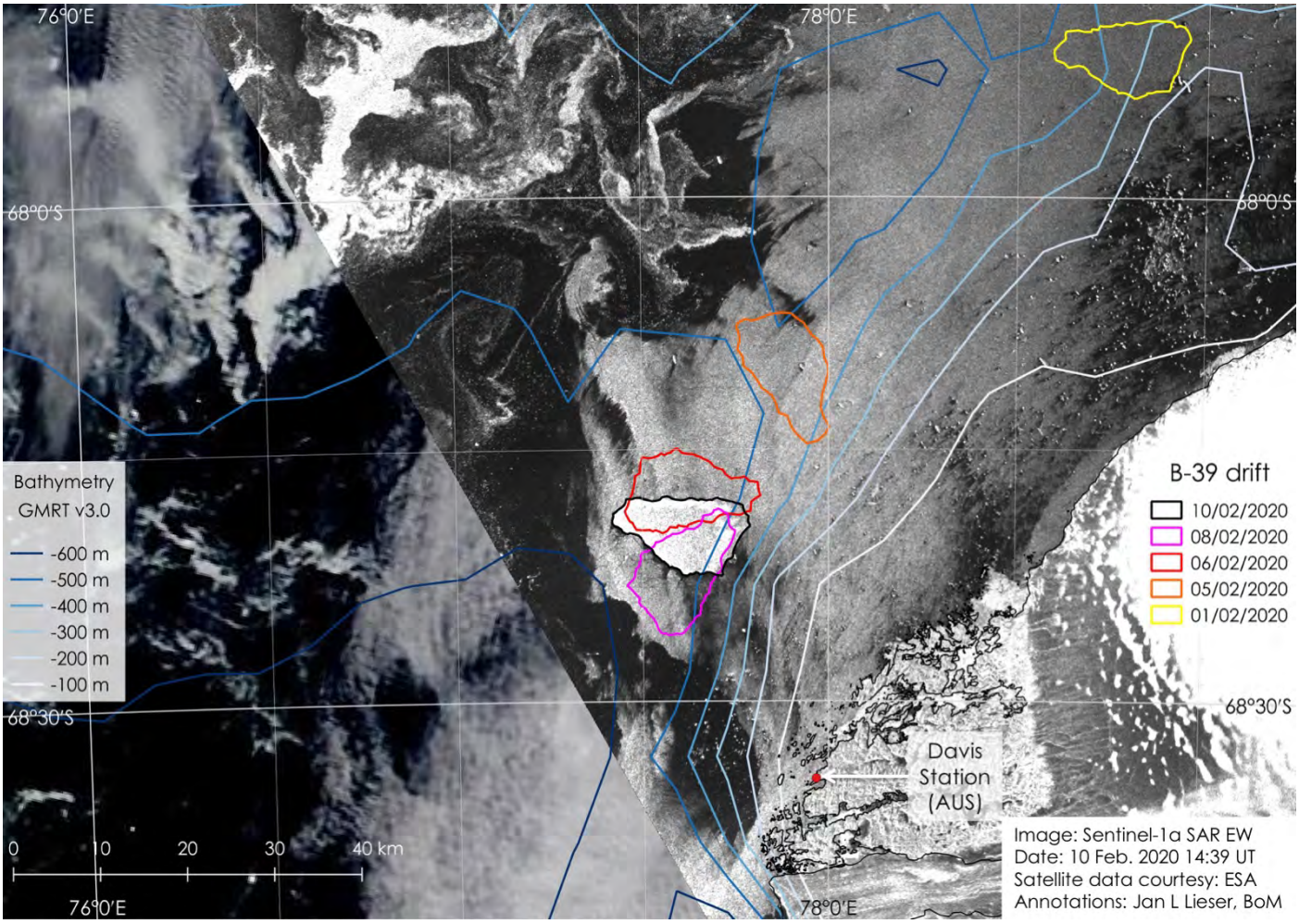

***Figure 1**: Sentinel-1a SAR EW scene acquired 10 February 2020 at 14:39 UT and provided by PolarView; complemented by TERRA MODIS VIS data in the southwest acquired 10 February 2020 and provided by NASA.*

North of Davis Station, many icebergs are grounded in water of less than 200m. However, west of the station some icebergs are grounded in waters of 300 m to 400 m. Iceberg B-39, which was off the Dalton Iceberg Tongue (east of Casey Station) a year ago, was travelling along the 300 m to 400 m bathymetry north of Davis Station but is currently rotating in slightly deeper waters northwest of Davis Station.

Farther offshore, strips and patches of sea ice can be seen in swirling patterns that are predominantly redistributed but ocean surface eddies.

Ice Bulletin: Antarctica

Issued: Wednesday 12th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows the pan-Antarctic sea-ice concentration anomaly based on passive microwave remote sensing data.

At the height of summer, sea-ice concentration around Antarctica displays a mixed pattern of above and below average conditions. Below average conditions are found in the central and eastern Weddell Sea and parts of the eastern Ross Sea. In East Antarctica and the Bellingshausen Sea and Amundsen Sea, conditions are close to average for the time of year.

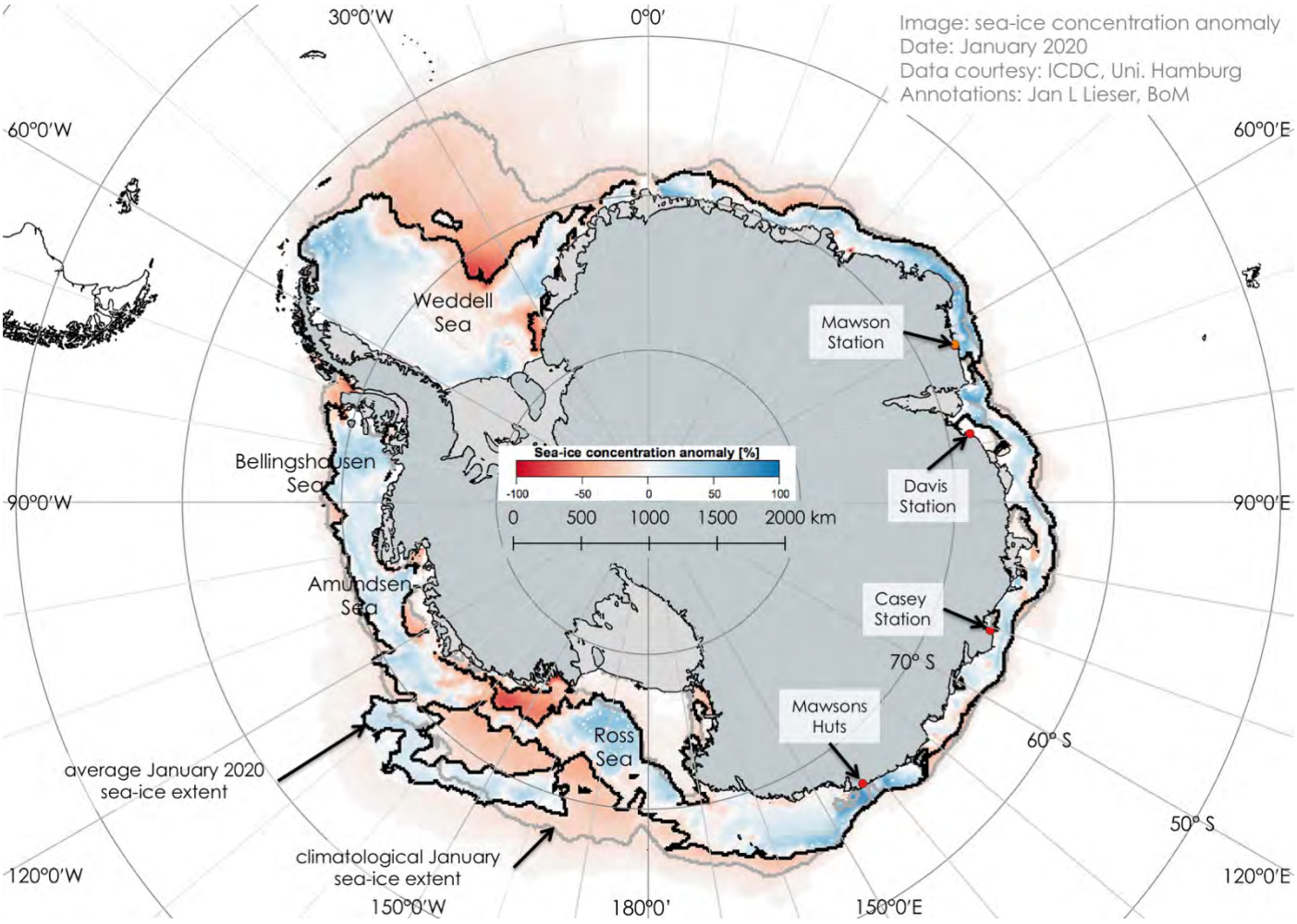

***Figure 1**: Sea-ice concentration anomaly for January 2020 provided by ICDC (Universität Hamburg).*

Ice Bulletin: Mawson Station

Issued: Wednesday 12th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Station and to the east of it. The cruise track of RSV *Aurora Australis* is shown as an orange line (up until 12 February 2020 00:00 UT, the orange dot). The recent rotational drift of iceberg D-28 is marked with colour-coded shapes.

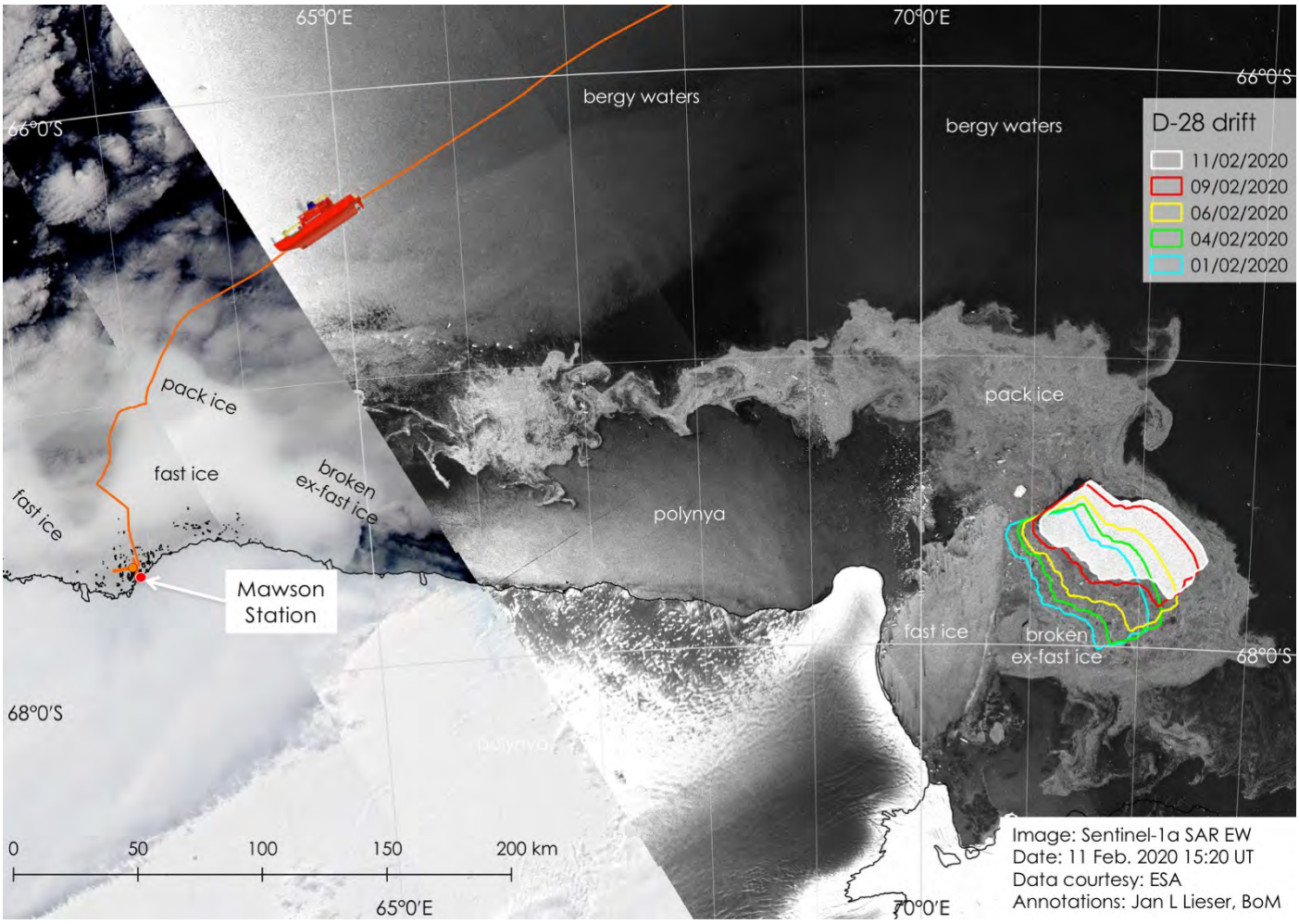

***Figure 1**: Sentinel-1a SAR EW data acquired 11/02/2020 at 15:20 UT and provided by PolarView; complemented by AUQA MODIS VIS data acquired 11/02/2020 and provided by NASA.*

Off Mawson Station, the polynya appears to be progressing southward slightly. In the vicinity of iceberg D-28, ex-fast ice and pack ice remains local and continues to drift westward north of 67°30'S.

A large number of icebergs is drifting within the mix of different sea-ice types and north of the ice edge.

Ice Bulletin: Pine Island Bay

Issued: Wednesday 12th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows high-resolution SAR scene of Pine Island Bay, the polynya off the Pine Island Ice Shelf.

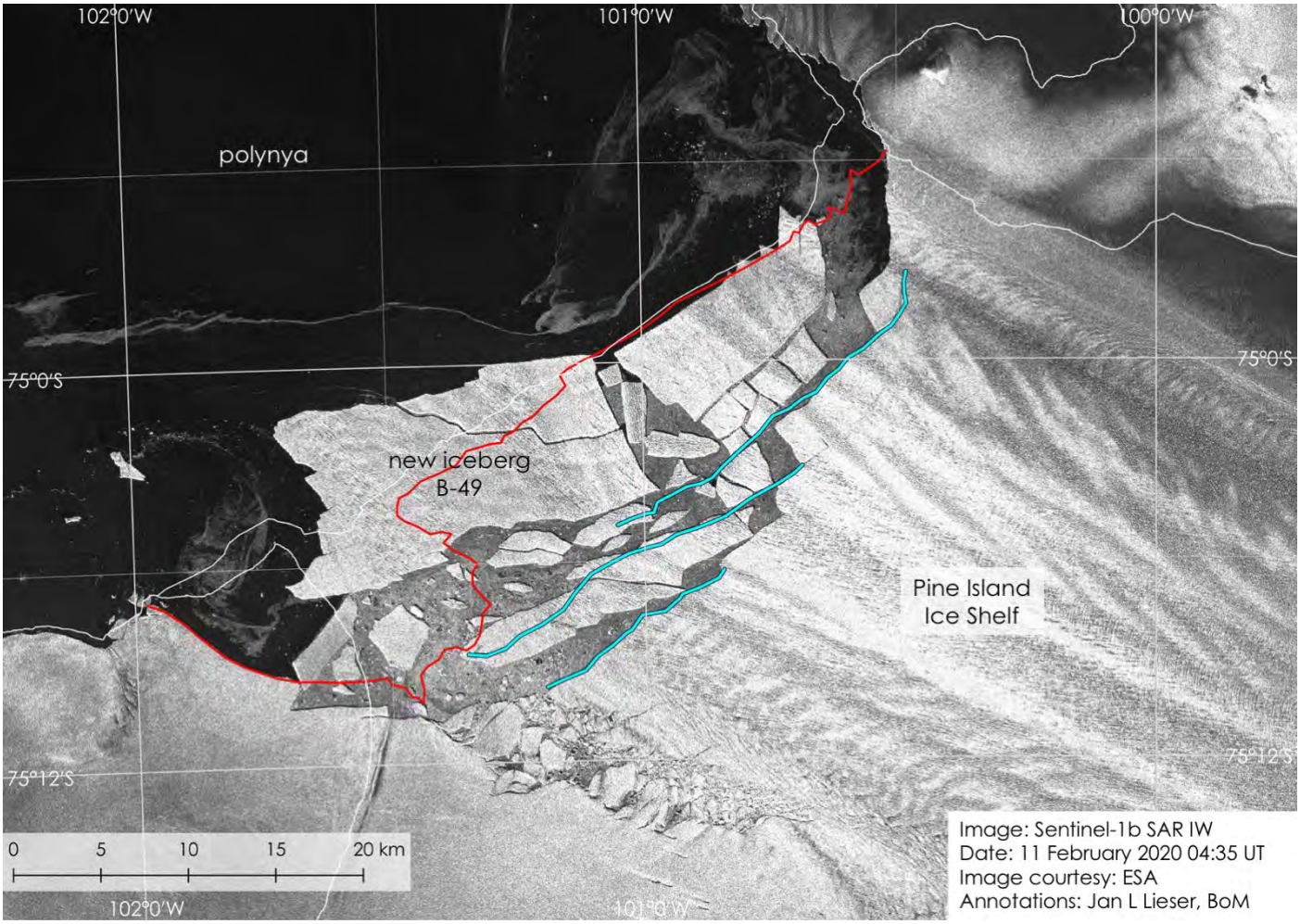

***Figure 1**: Sentinel-1b SAR IW scene acquired 11 February 2020 at 04:35 UT and provided by PolarView.*

Since late 2019, three significant rifts (marked in cyan) were developing at the calving front (marked in red) of the Pine Island Ice Shelf, the floating end of Pine Island Glacier (also referred to as PIG).

On 09 February 2020, these rifts created a large number (more than 30) of new icebergs (which may be affectionately called 'piglets' here, even though the process is scientifically known as calving). The largest iceberg qualifies for a name and will be called B-49, the 49th iceberg from the 'B' sector of Antarctica (the quadrant between 90ºW and 180º) that is being tracked by the US National Ice Center. This iceberg, however, shows already a significant zig-zag rift, which indicates that it will soon split into at least two icebergs.

Ice Bulletin: Davis Station

Issued: Thursday 13th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by white letters.

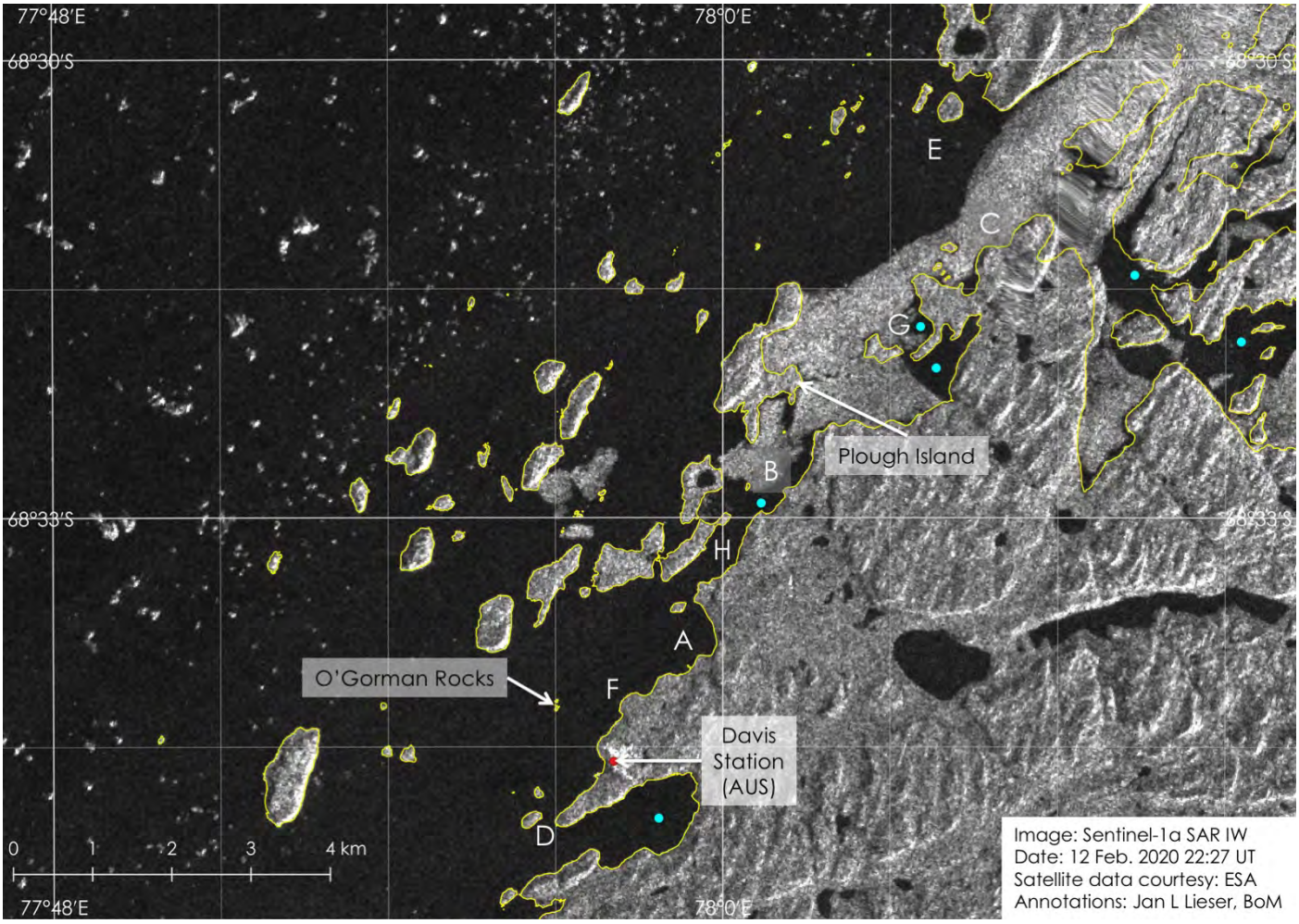

***Figure 1**: Sentinel-1a SAR IW scene acquired 12 February 2020 at 22:27 UT and provided by PolarView.*

The extent of the areas of proposed hydrographic surveying is slightly growing. The southern locations of 'D' to 'H' are free of sea ice and locations 'B' and 'G' are showing more signs of breaking up fast ice. Further north, location 'E' appears largely free of sea ice. At location 'C', the fast-ice edge continues to retreat slowly towards the coast. Nearshore fast ice is rotting as well (marked by cyan dots).

Broken ex-fast ice and icebergs are drifting generally south-westward offshore.

Figure 2 shows a larger overview of the same data as Figure 1. The drift of the large tabular iceberg B-39 can be seen by the colour-coded shapes. Since the beginning of February, the iceberg has drifted southward along the coast and has now completed a 180º turn off the Vestfold Hills before heading a bit northward again.

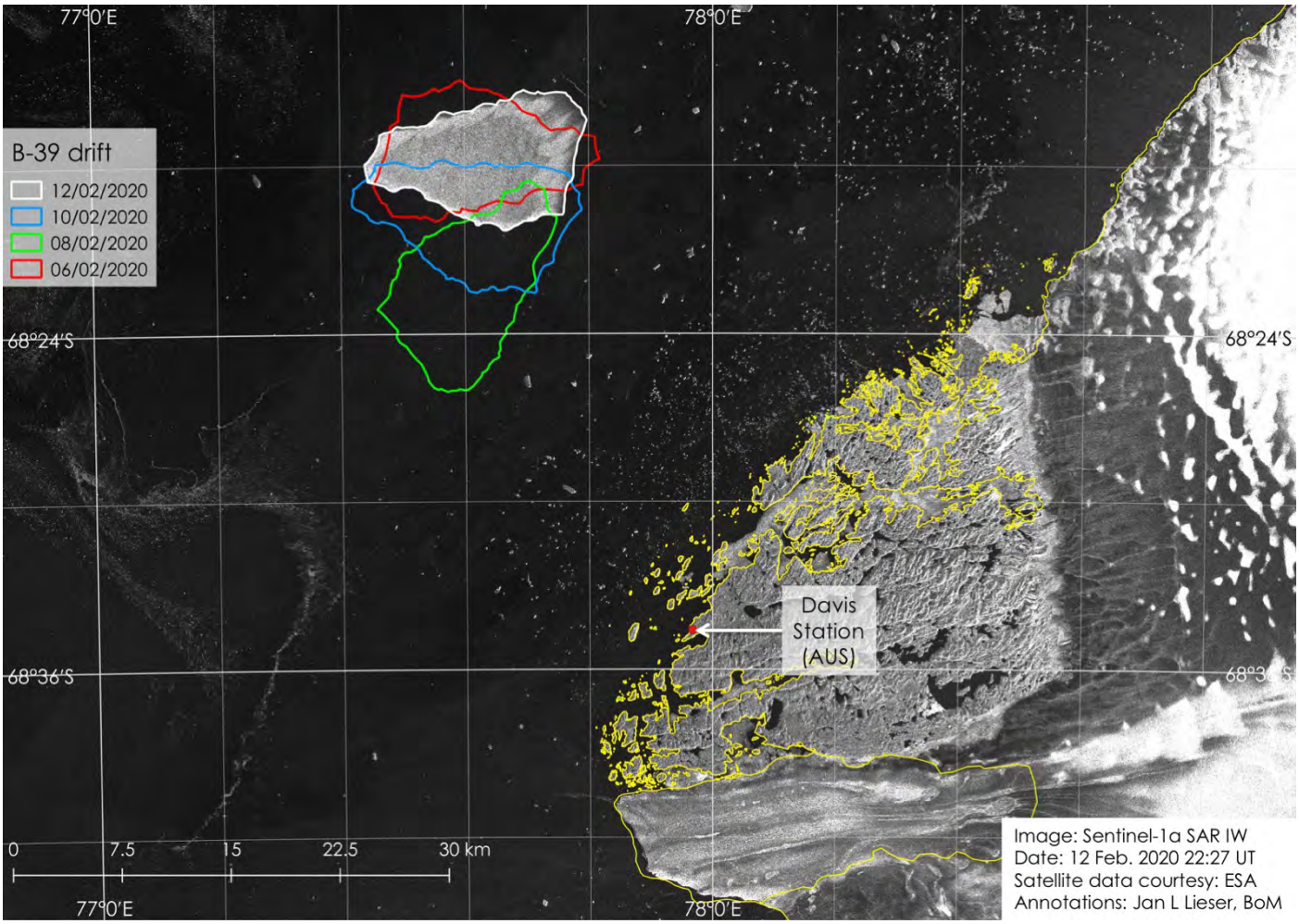

***Figure 2**: Sentinel-1a SAR IW scene acquired 12 February 2020 at 22:27 UT and provided by PolarView.*

Ice Bulletin: Mawson Station

Issued: Thursday 13th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Mawson Coast. The cruise track of RSV *Aurora Australis* is shown as an orange line (up until 13 February 2020 05:40 UT, the orange dot).

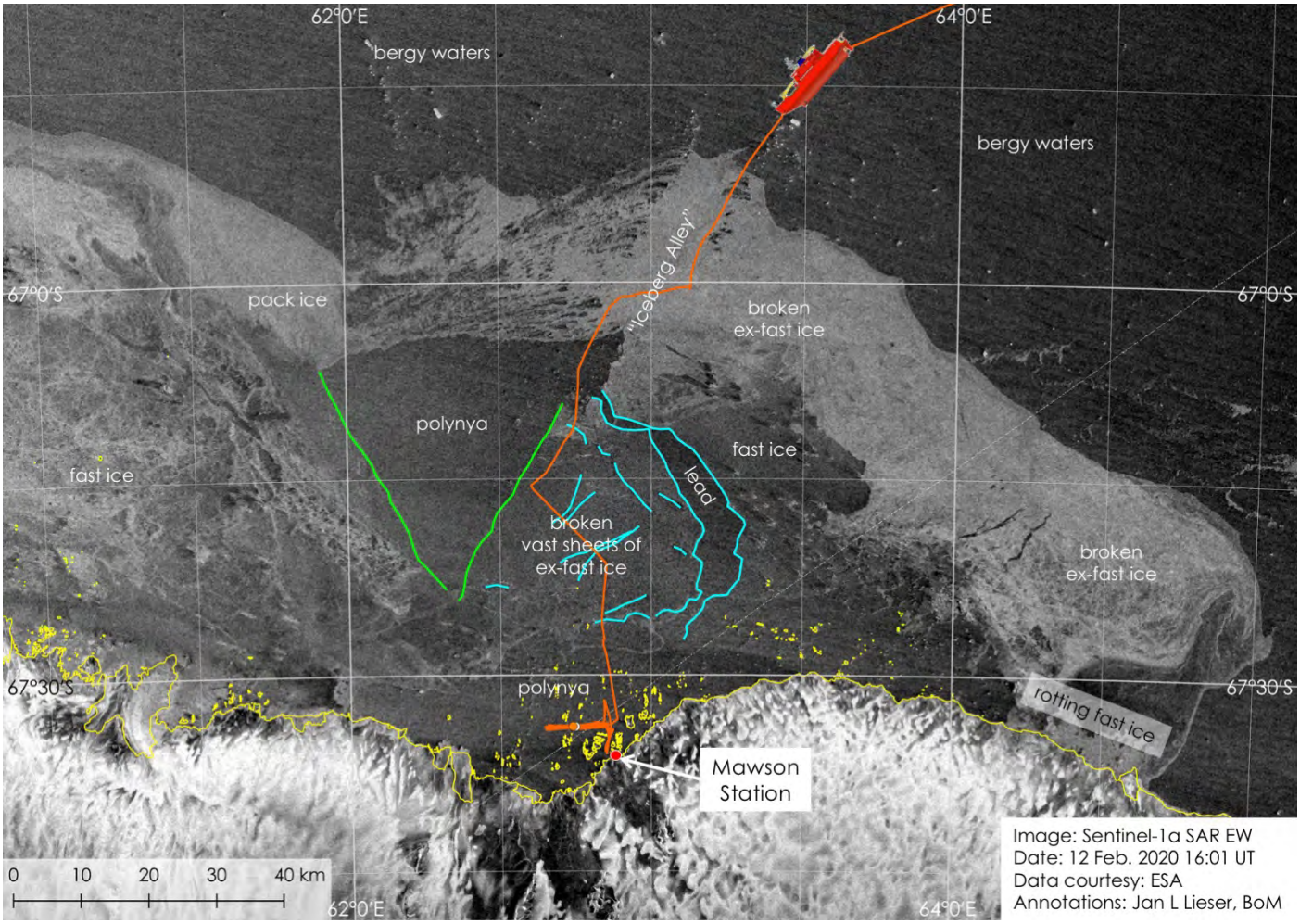

***Figure 1**: Sentinel-1a SAR EW data acquired 12/02/2020 at 16:01 UT and provided by Drift+Noise Polar Services.*

North of Mawson Station, fast ice is breaking into vast sheets of now ex-fast ice south of Iceberg Alley. A large lead has opened between 63ºE and 63º30'E and is outlined by cyan lines. More cyan lines to the west of this lead mark major cracks and smaller openings in the part of fast ice that has separated. With this process, the shape and size of the polynya northwest of the station has shifted as well (green lines). South of 67º10'S, the eastern edge of the polynya is now roughly 3 nautical miles further west.

East of the station, the fast ice continues to break into pieces and a wide band of broken ex-fast ice is showing in bright grey shades off the fast-ice edge. West of the station, fast ice is also breaking up.

The general drift direction of the mixture of broken ex-fast ice and old pack ice is north-westward.

Ice Bulletin: Mawson Station

Issued: Friday 14th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Coast and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 14 Feb. 2020 03:30 UT, the orange dot). The northern fast-ice edge on 08 Feb. 2020 (when the ship sailed southward along the then fast-ice edge) is indicated by the cyan line.

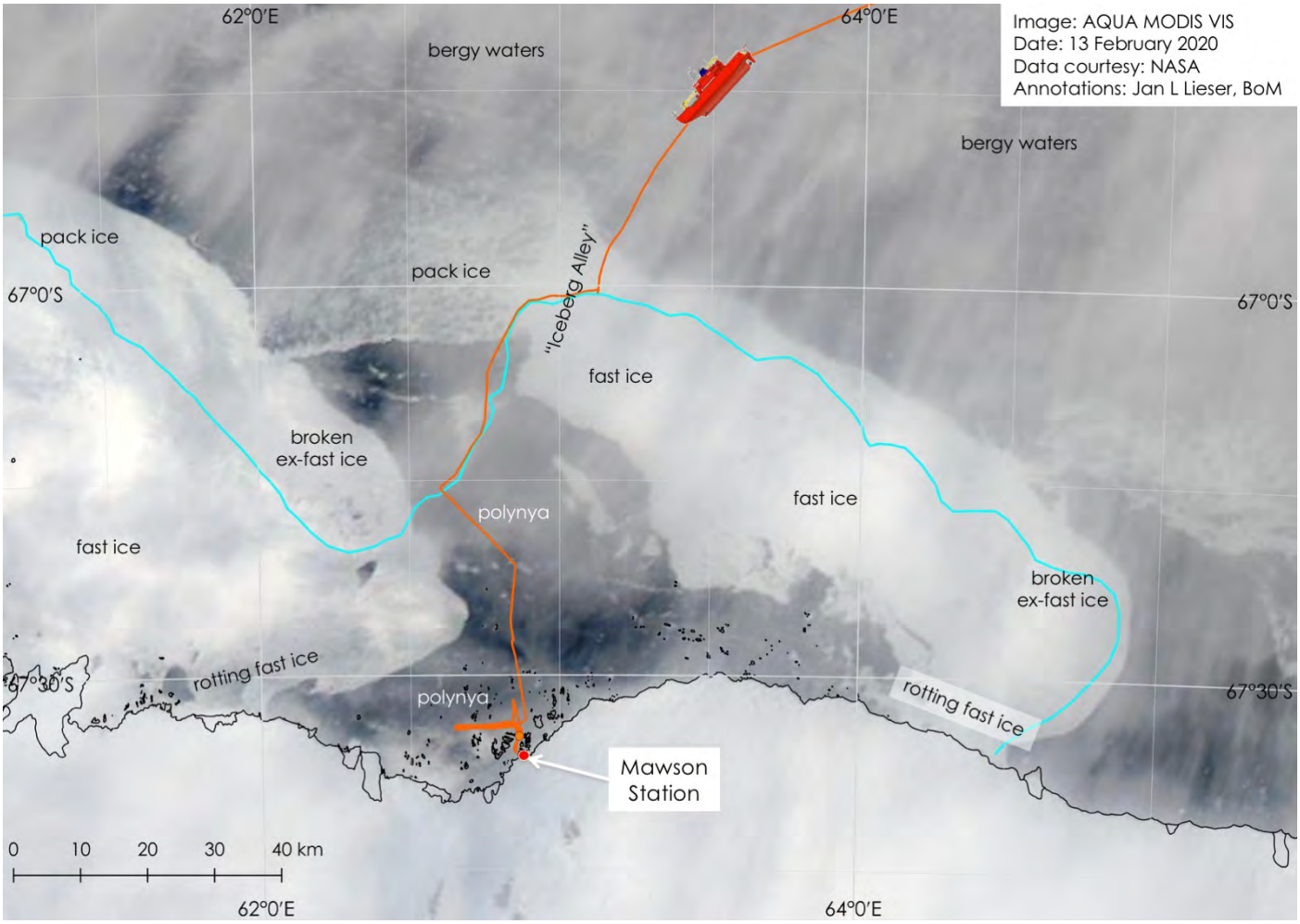

***Figure 1**: TERRA MODIS VIS data acquired 13 February 2020 and provided by NASA.*

Since 12 Feb. 2020, a substantial proportion of the fast ice between Iceberg Alley and the station has disintegrated and has been pushed westward. It is now broken ex-fast ice that is accumulating along the eastern edge of the fast ice west of the station (west of 62°30'E).

However, the southern part of Iceberg Alley appears to be still covered by fast ice that is locked between icebergs of the alley as there is no broken sea ice or ex-fast ice streaming westward like it is in the northern part of the alley.

East and west of the station, fast ice continues to deteriorate along the coast.

Ice Bulletin: D'Urville Sea

Issued: Friday 14th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of southern D'Urville Sea. Pink shapes mark the positions of some of the larger icebergs in their respective position on 07 February 2020.

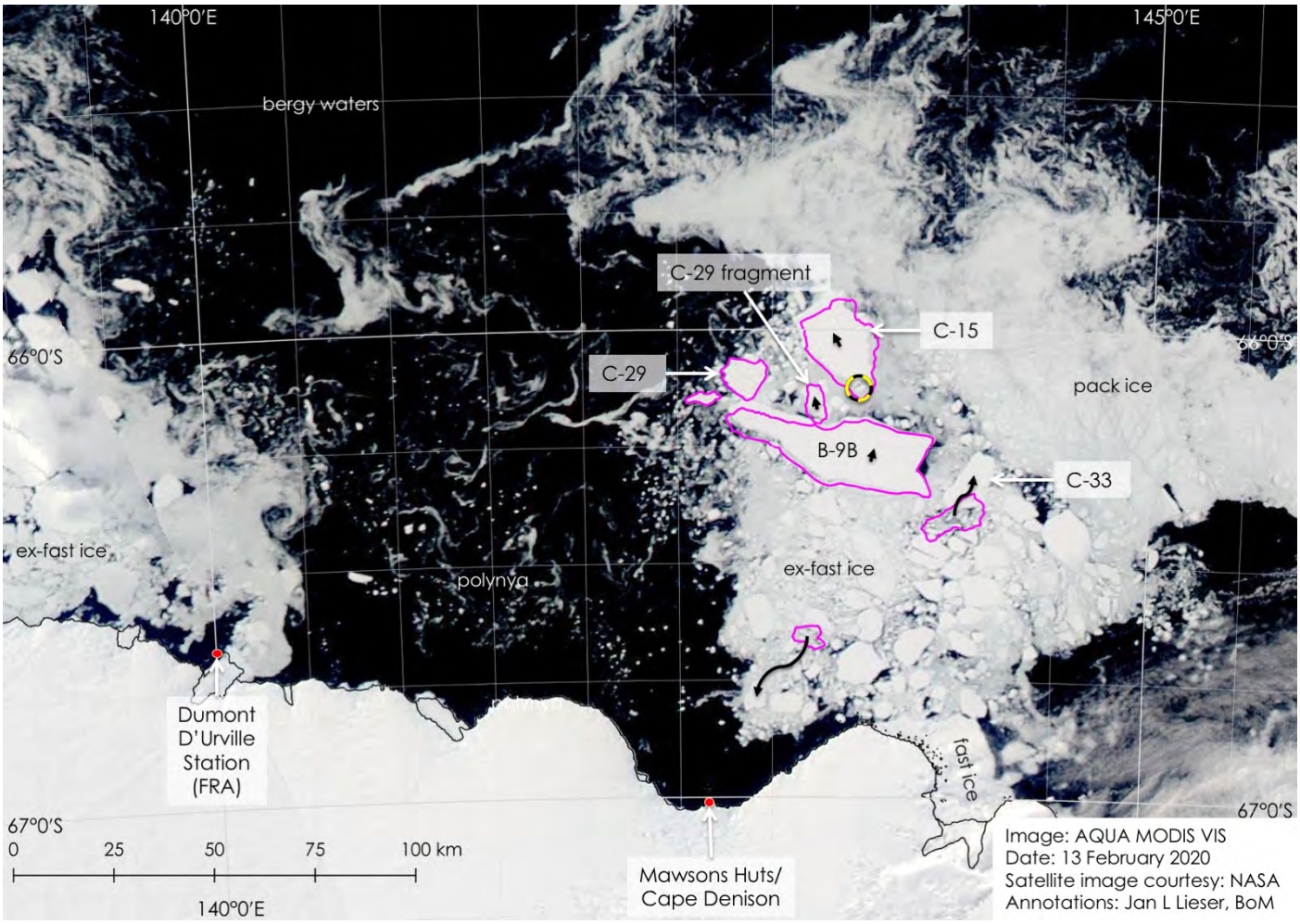

***Figure 1**: AQUA MODIS VIS scene acquired 13 February 2020 and provided by NASA.*

Commonwealth Bay (off Cape Denison) is free of fast ice.

Since the breaking up of the large body fast ice between Cape Denison and the group of icebergs north of it, some of the very large icebergs have moved in various directions. Iceberg B-9B appears unsettled but trapped between smaller bergs. Iceberg C-15 has shed another smaller iceberg (yellow/black circle). The C-29 fragment wiggles but remains also trapped in the vicinity. Iceberg C-29 has not moved at all. Iceberg C-33 has moved northward.

Off Dumont D'Urville Station, open water forms a polynya that is surrounded by broken floes of pack ice predominantly comprising of ex-fast ice and old sea ice.

Ice Bulletin: Iceberg A-68A

Issued: Friday 14th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene east of northern Antarctic Peninsula. The drift of iceberg A-68A in February 2020 is shown by coloured shapes (pink: 01/02/2020; purple: 07/02/2020).

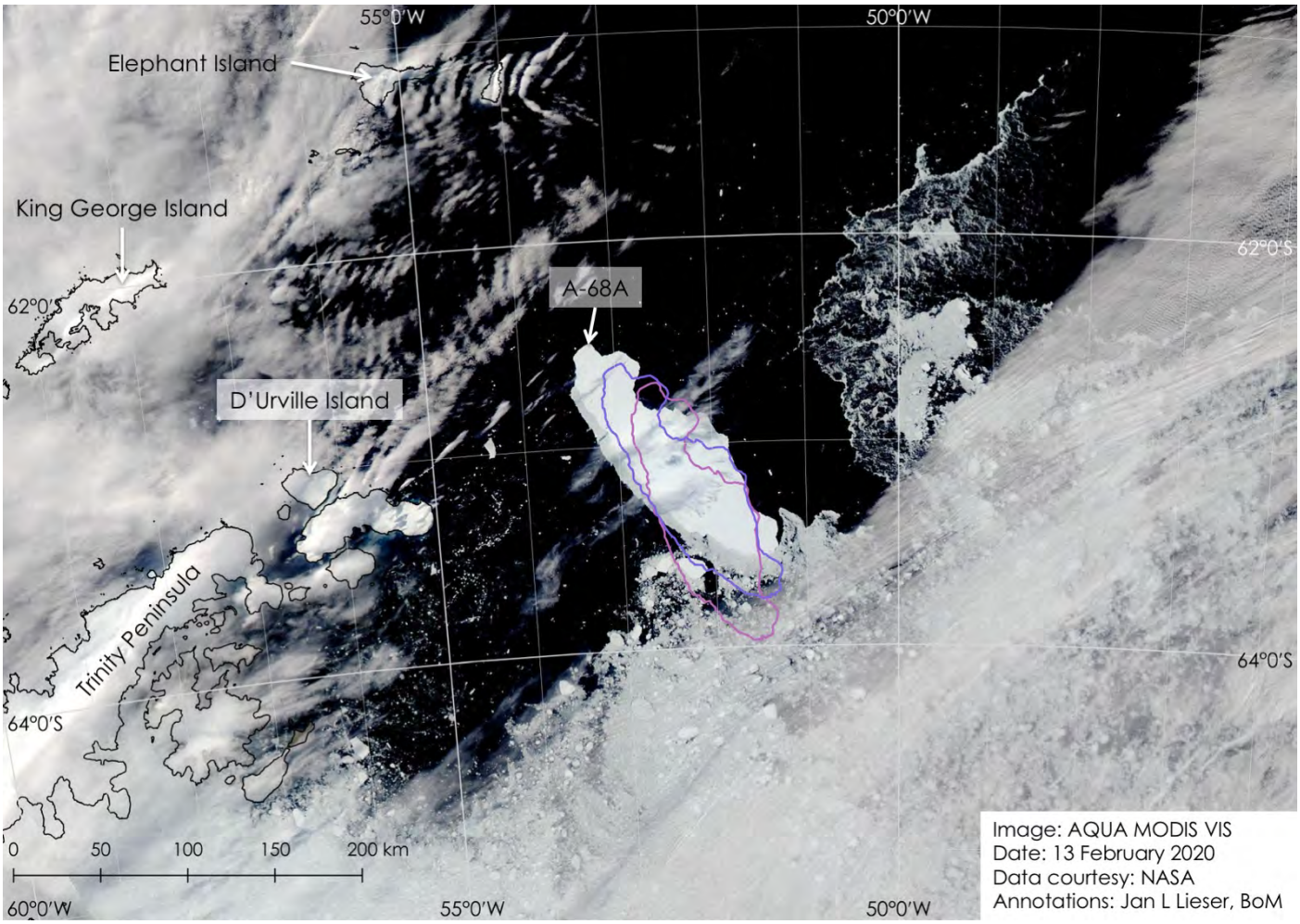

***Figure 1**: AQUA MODIS VIS data acquired 13 February 2020 and provided by NASA.*

In February 2020, the iceberg has turned further anti-clockwise from its north-south orientation at the end of January. Currently, it's drifting in approximately 1000 m to 1500 m water depth and appears to be following the western edge of the Powell Basin, which is centred roughly at 50ºW and 62ºS and about 3300 m deep.

A-68A has also left behind the sea-ice zone of the Weddell Sea now (seen south of it under thin clouds), which exposes it to the waves and swell of the southern South Atlantic unprotected by pack ice. It is expected that the integrity of the iceberg may soon be compromised in the rougher ocean state due to its size (length to width ratio) and that it will break into smaller pieces.

Ice Bulletin: Mawson Station

Issued: Saturday 15th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of visible and SAR of Mawson Coast and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 15 Feb. 2020 01:00 UT, the orange dot). The sea-ice edge as deduced from medium-resolution (6.25 km horizontal) sea-ice concentration data is indicated by the cyan line.

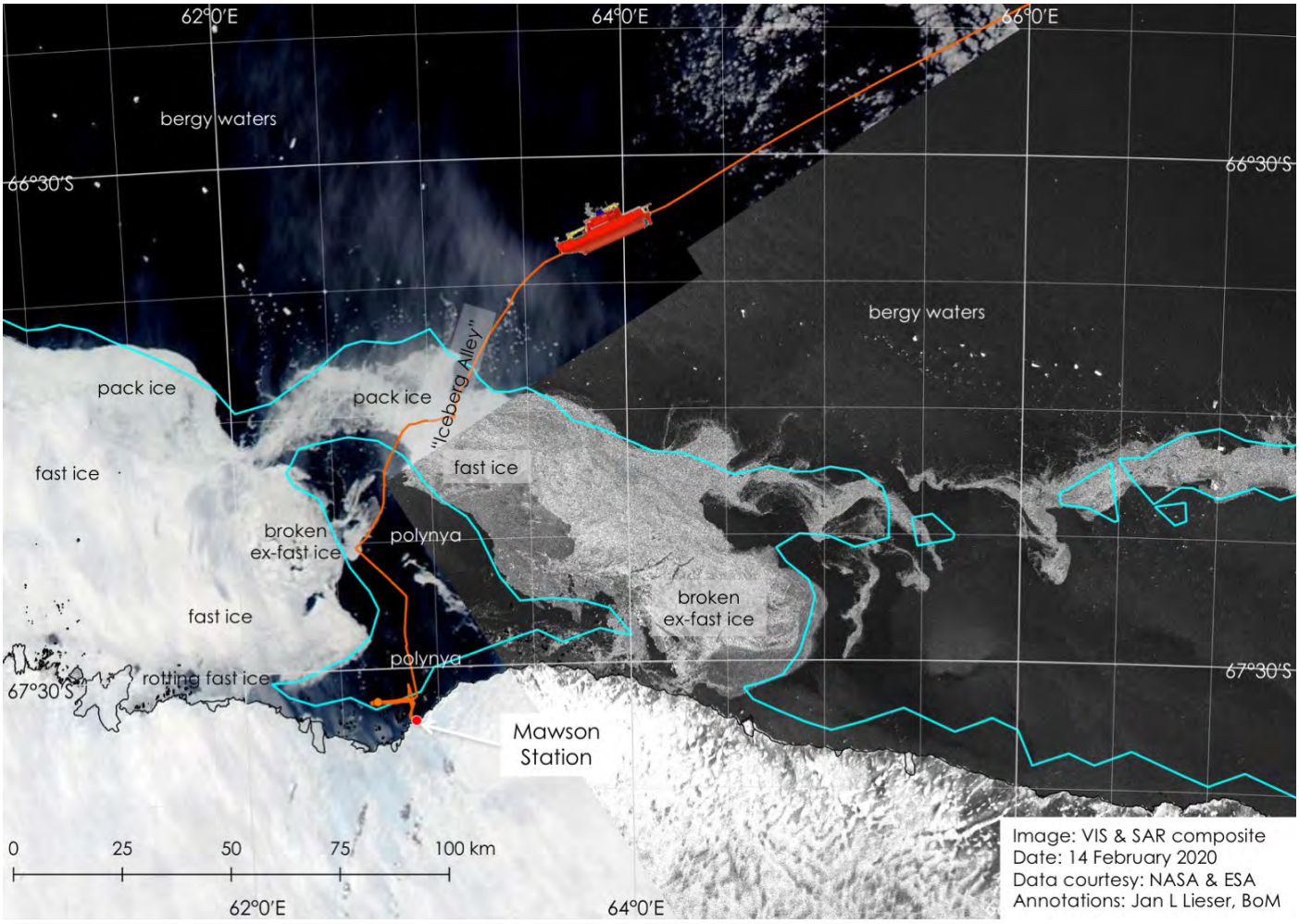

***Figure 1**: Composite of AQUA MODIS VIS data (western part) acquired 14 February 2020 and provided by NASA and Sentinel-1a SAR IW data (eastern part) acquired 14 February 2020 at 15:45 UT and provided by PolarView.*

East of Mawson Station, fast ice has detached from the coast and is further disintegrating. However, some fast ice remains fastened between grounded icebergs, including in the southern part of Iceberg Alley.

The mixture of broken ex-fast ice and old pack ice shows in brighter shades of grey in the SAR part of the figure.

North of the sea-ice edge, many icebergs and some still solid sheets of ex-fast ice can be identified in both, the visible and SAR data. This means that the 'limit of all know ice' (also referred to as LAKI) is much further north than the sea-ice edge based on sea-ice concentration data might suggest. (The coastal spill-over effect of the sea-ice concentration data is also clear where the open-water edge is a few kilometres north of the coastline.)

Ice Bulletin: Davis Station

Issued: Monday 17th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Davis Station, the Amery Ice Shelf and Prydz Bay.

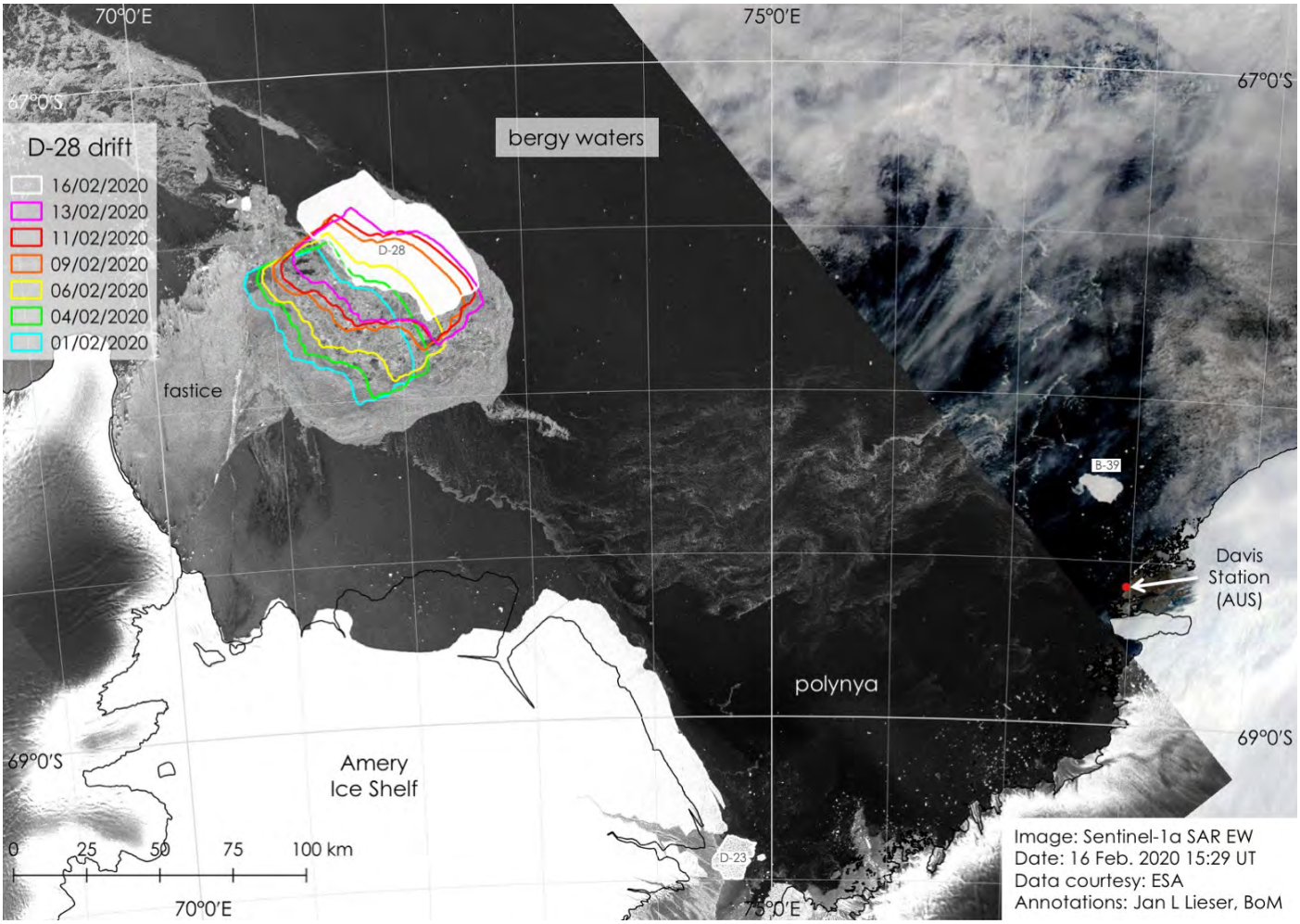

***Figure 1**: Sentinel-1a SAR EW scene acquired 16 February 2020 at 15:29 UT and provided by PolarView; complemented by AQUA MODIS VIS data (northeast) acquired 16 February 2020 and provided by NASA.*

Very little sea ice is off Davis Station. North of the station, iceberg B-39 remains local but appears to be not grounded at this stage.

Strips and patches of broken sea ice are drifting westward in front of the Amery Ice Shelf.

Iceberg D-28 appears to have turned a corner now around the shore-fast sea ice off Cape Darnley (northwest of the Amery Ice Shelf). This iceberg of roughly 1600 km^2 and a perimeter of about 175 km is drifting northward since 13/02/2020 in approximately 500 m of water depth.

South of the iceberg, a mix of old sea ice, ex-fast ice and broken brash ice has been accumulating. It is expected to follow the iceberg and enter the generally north-westward drift when north of 67°30'S.

Ice Bulletin: Mawson Station

Issued: Monday 17th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of visible and SAR of Mawson Coast and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 18 Feb. 2020 04:20 UT, the orange dot).

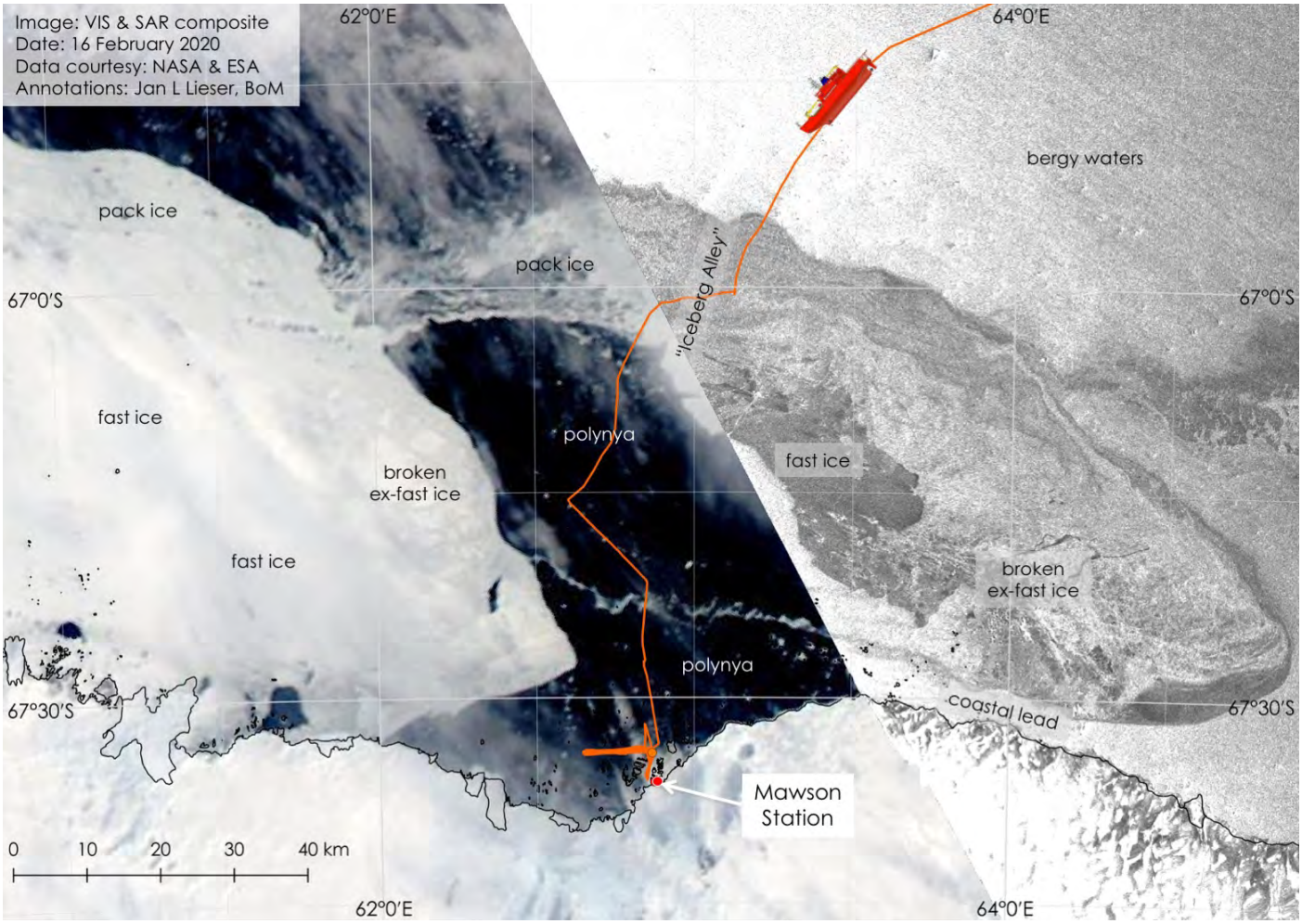

***Figure 1**: Composite of AQUA MODIS VIS data (western part) acquired 16 February 2020 and provided by NASA and Sentinel-1a SAR EW data (eastern part) acquired 16 February 2020 at 15:28 UT and provided by PolarView.*

East of Mawson Station, a wide lead has formed off the coast. Some fast ice still remains fastened between grounded icebergs, but the southern part of Iceberg Alley is showing increased signs of fast-ice break up now.

The mixture of broken ex-fast ice and old pack ice shows in brighter shades of grey in the SAR part of the figure.

North of the sea-ice edge, many icebergs and some still solid sheets of ex-fast ice can be identified in both, the visible and SAR data. This means the 'limit of all know ice' is much further north than the sea-ice edge based on sea-ice concentration data might suggest.

West of Mawson Station, two large areas of open water can be identified nearshore. Those are centred at 61º02'E and 67º24S and at 61º42'E and 67º30'S.

Ice Bulletin: Mawson Station

Issued: Tuesday 18th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Mawson Station and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 18 Feb. 2020 00:00 UT).

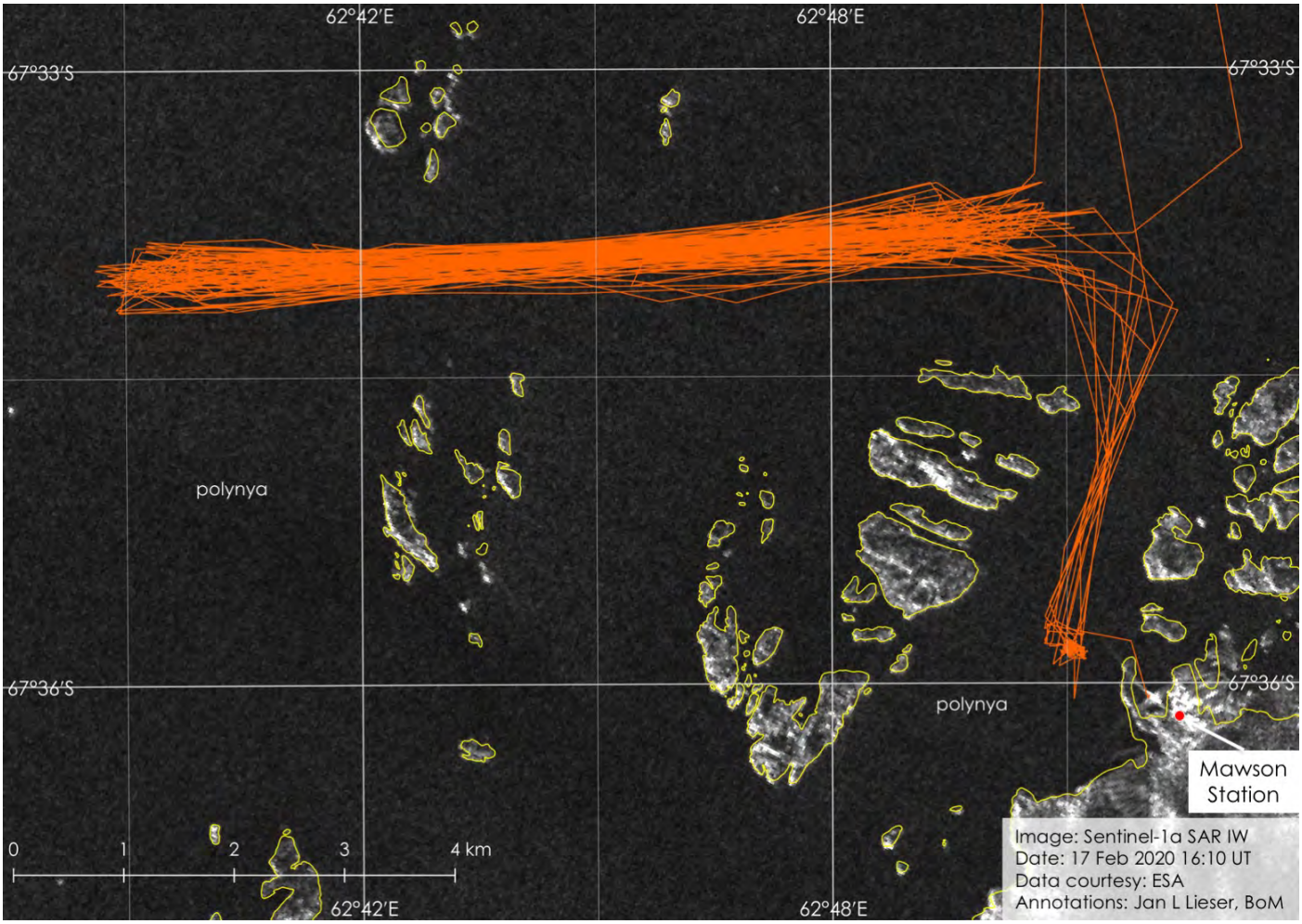

***Figure 1**: Sentinel-1a SAR IW data acquired 17 February 2020 at 16:10 UT and provided by PolarView.*

The ship can be seen as a bright star (near-perfect reflector of the SAR pulse) inside Horseshoe Harbour off Mawson Station. The 'stooging ground' is east-west oriented along roughly 67°34'S.

Figure 2 shows visible data of Mawson Coast between Mawson Station and Cape Darnley. The recent cruise track of RSV *Aurora Australis* is also included. The grey frame (in the western part) outlines the region covered by the full Sentinel-1a SAR scene of which a part features in Figure 1.

Off Cape Darnley, iceberg D-28 has travelled approximately 5 km northward during the past 24 hours. The dashed pink shape indicates its location yesterday.

Northwest and southeast of the fast ice off Cape Darnley, some discoloured sea ice can be identified. The tint of this sea ice is likely to be caused by algae taking advantage of favourable growing conditions.

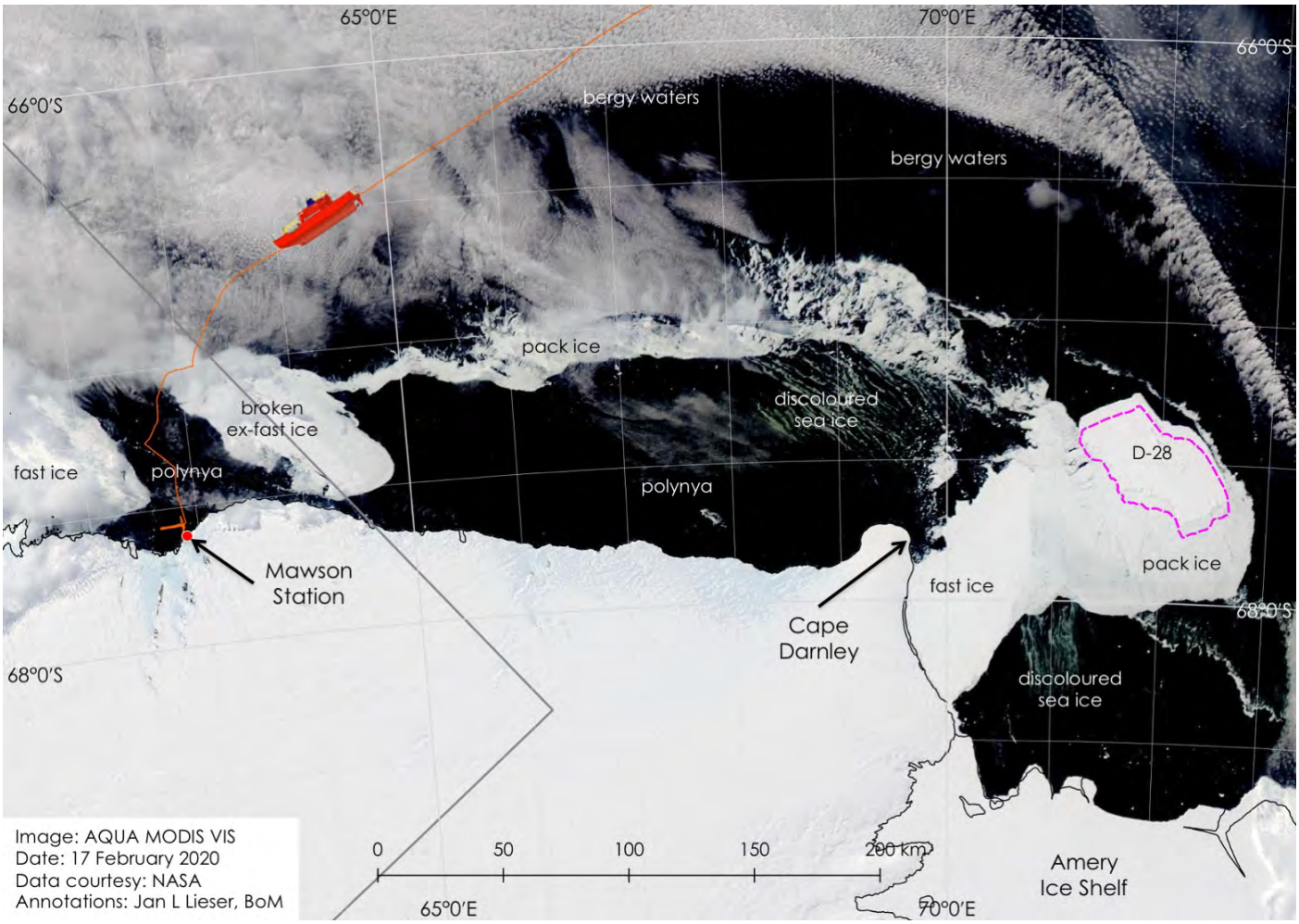

***Figure 2**: AQUA MODIS VIS data acquired 17 February 2020 and provided by NASA.*

Ice Bulletin: Davis Station

Issued: Wednesday 19th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of Davis Station and the Vestfold Hills. Areas of proposed hydrographic survey operations between O'Gorman Rocks and Plough Island (and further north) are marked by white letters.

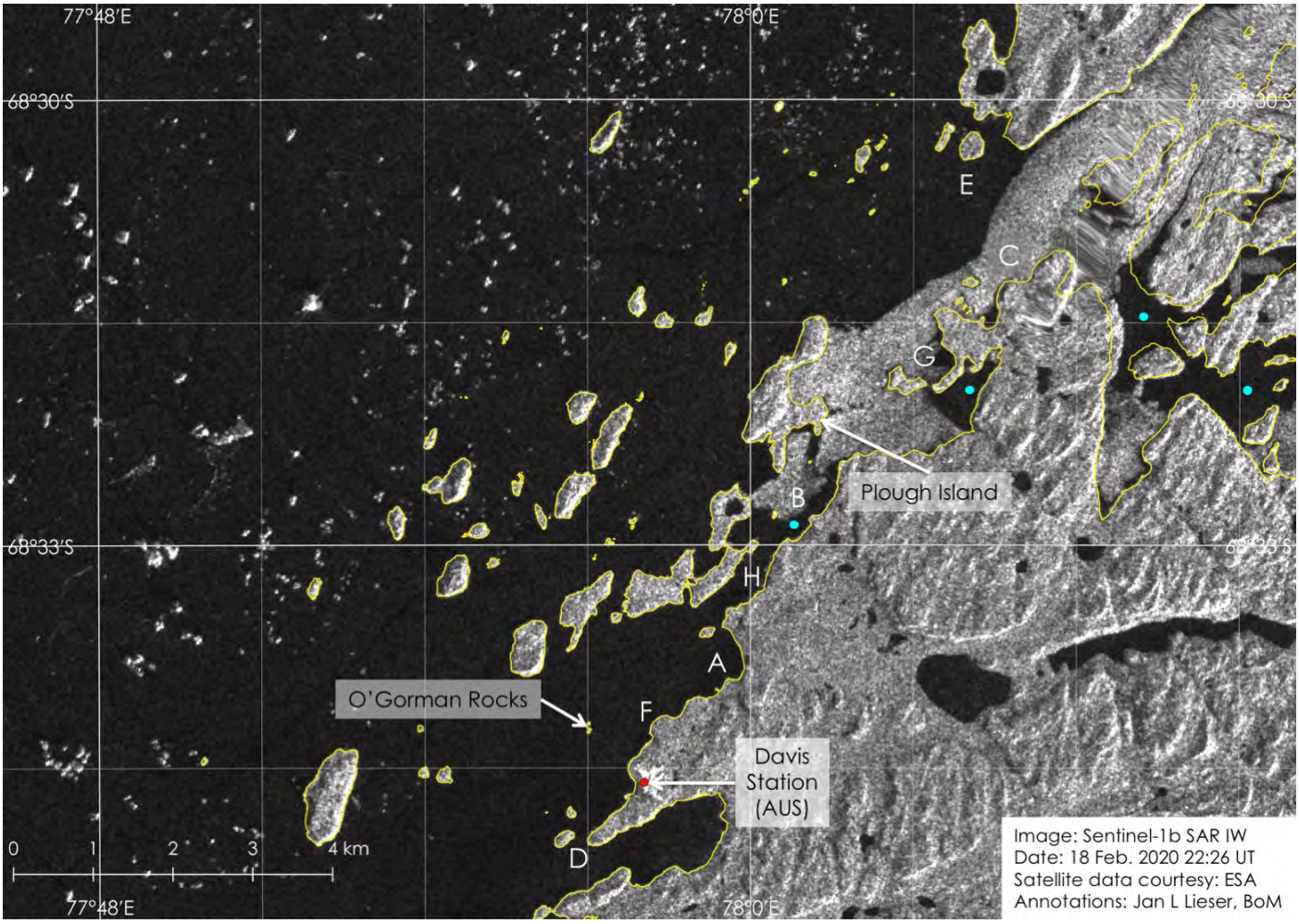

***Figure 1**: Sentinel-1a SAR IW scene acquired 18 February 2020 at 22:26 UT and provided by PolarView.*

The extent of the areas of proposed hydrographic surveying continues to grow. The southern locations of 'D' to 'H' are free of sea ice and locations 'B' and 'G' are showing more signs of breaking up fast ice. Further north, location 'E' appears largely free of sea ice. At location 'C', the fast-ice edge continues to retreat slowly towards the coast. Nearshore fast ice is rotting as well (marked by cyan dots).

Broken ex-fast ice and icebergs are drifting generally south-westward offshore.

Ice Bulletin: Mawson Station

Issued: Wednesday 19th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a visible scene of Mawson Station and offshore. The recent cruise track of RSV *Aurora Australis* is provided as an orange line (up until 19 Feb. 2020 09:00 UT).

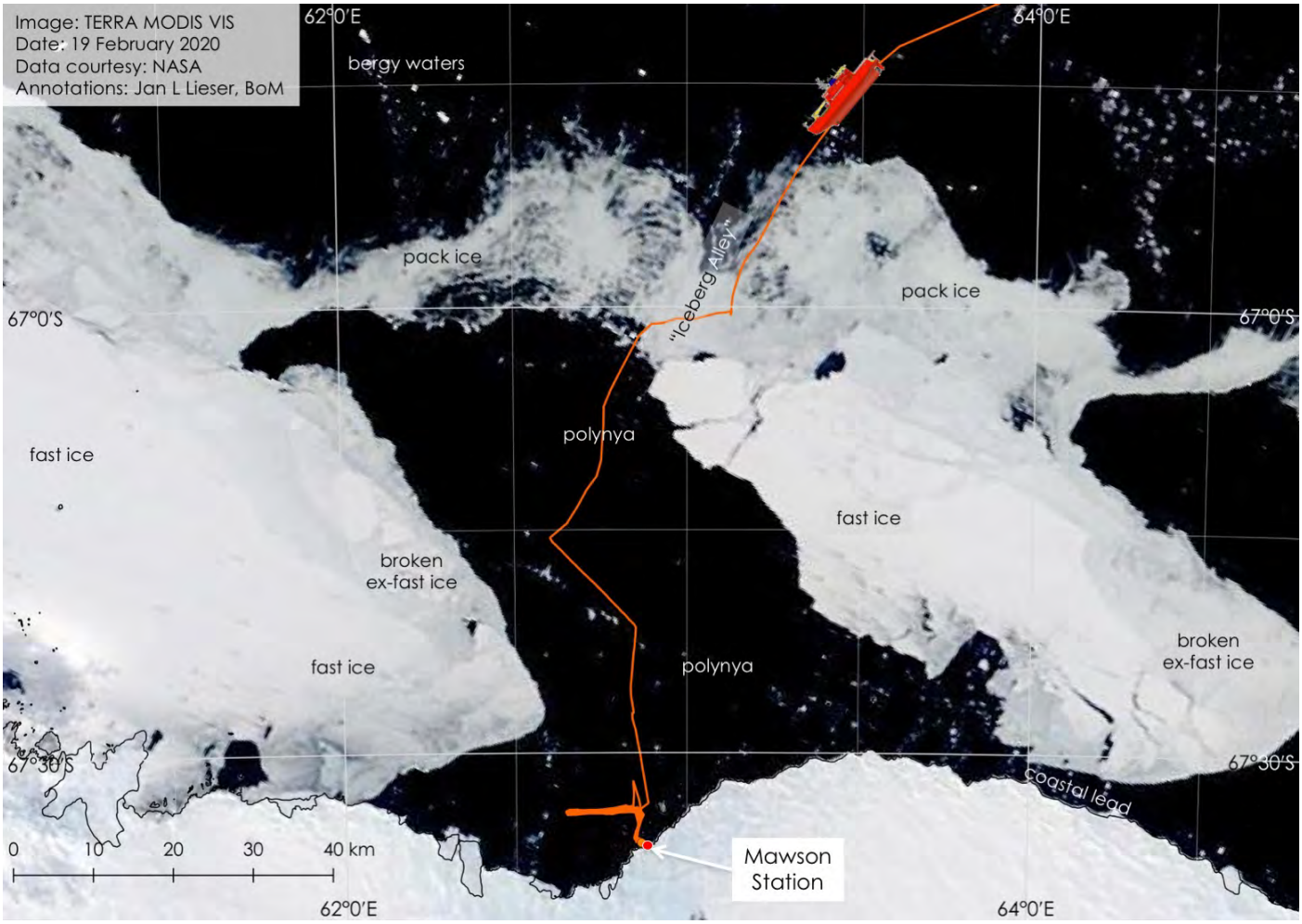

***Figure 1**: TERRA MODIS VIS data acquired 19 February 2020 and provided by NASA.*

Sea-ice conditions appear to have stabilised temporarily. Two very large floes of ex-fast ice are still present in the southern part of Iceberg Alley but the general trend of sea ice and fast ice breaking up continues.

Figure 2 shows very high-resolution SAR data of Iceberg Alley north of Mawson Station. The apparent banding of the sea ice is a data-processing artefact.

Three different sea-ice types can be distinguished by their texture and appearance. Still intact fast ice is found southeast of Iceberg Alley. This fast ice is only locked between grounded icebergs and not landfast. North of this patch is breaking and broken ex-fast ice. Drifting pack ice forms the northernmost part of the sea-ice zone.

North of the sea-ice edge, many icebergs are drifting in so-called bergy waters.

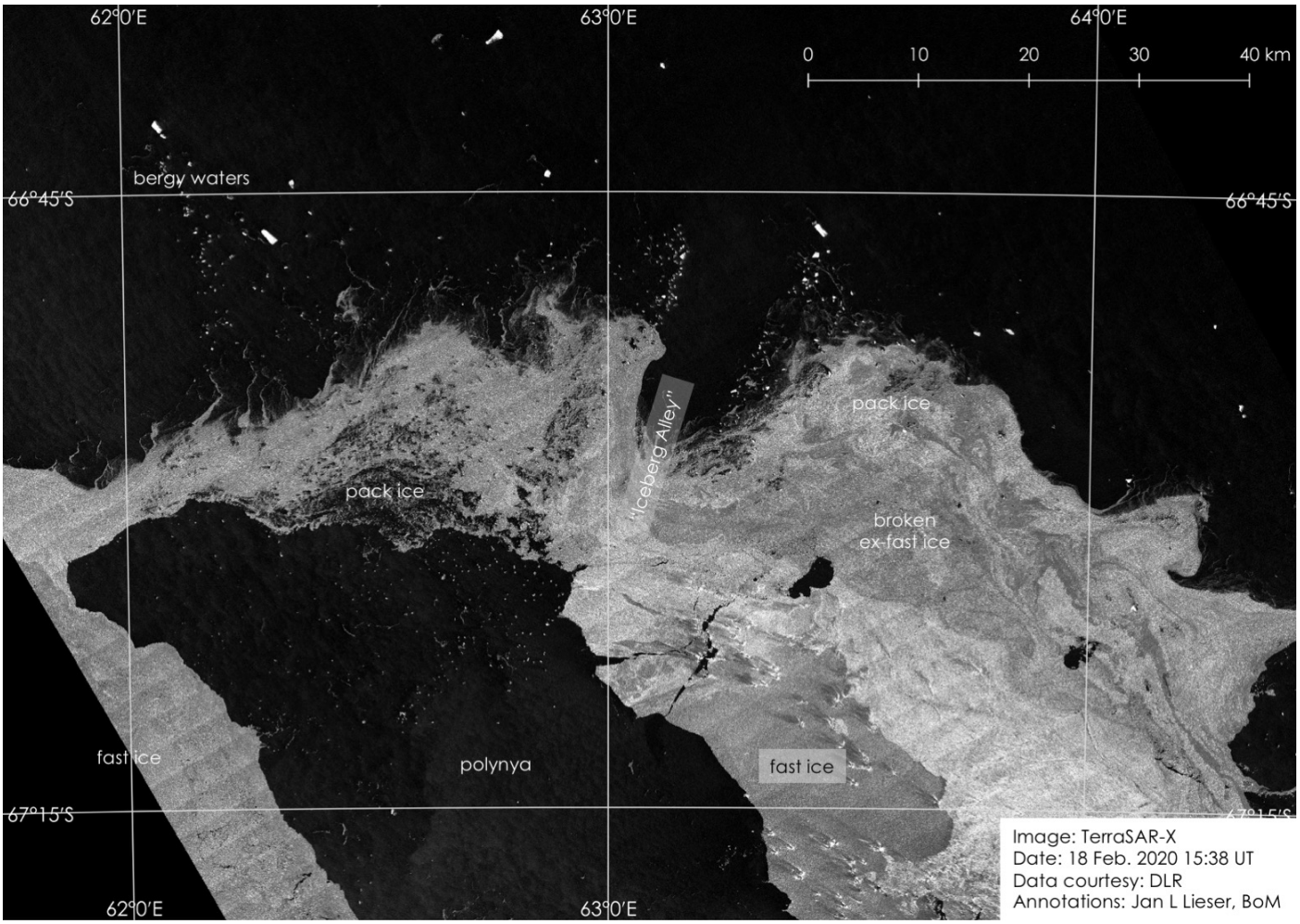

***Figure 2**: TerraSAR-X scene acquired 18 February 2020 at 15:38 UT and provided by KSAT.*

Ice Bulletin: Davis Station

Issued: Friday 21st February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene of Davis Station and the Vestfold Hills. The past two weeks of drift of the large iceberg B-39 offshore the Vestfold Hills is indicated by the colour-coded shapes.

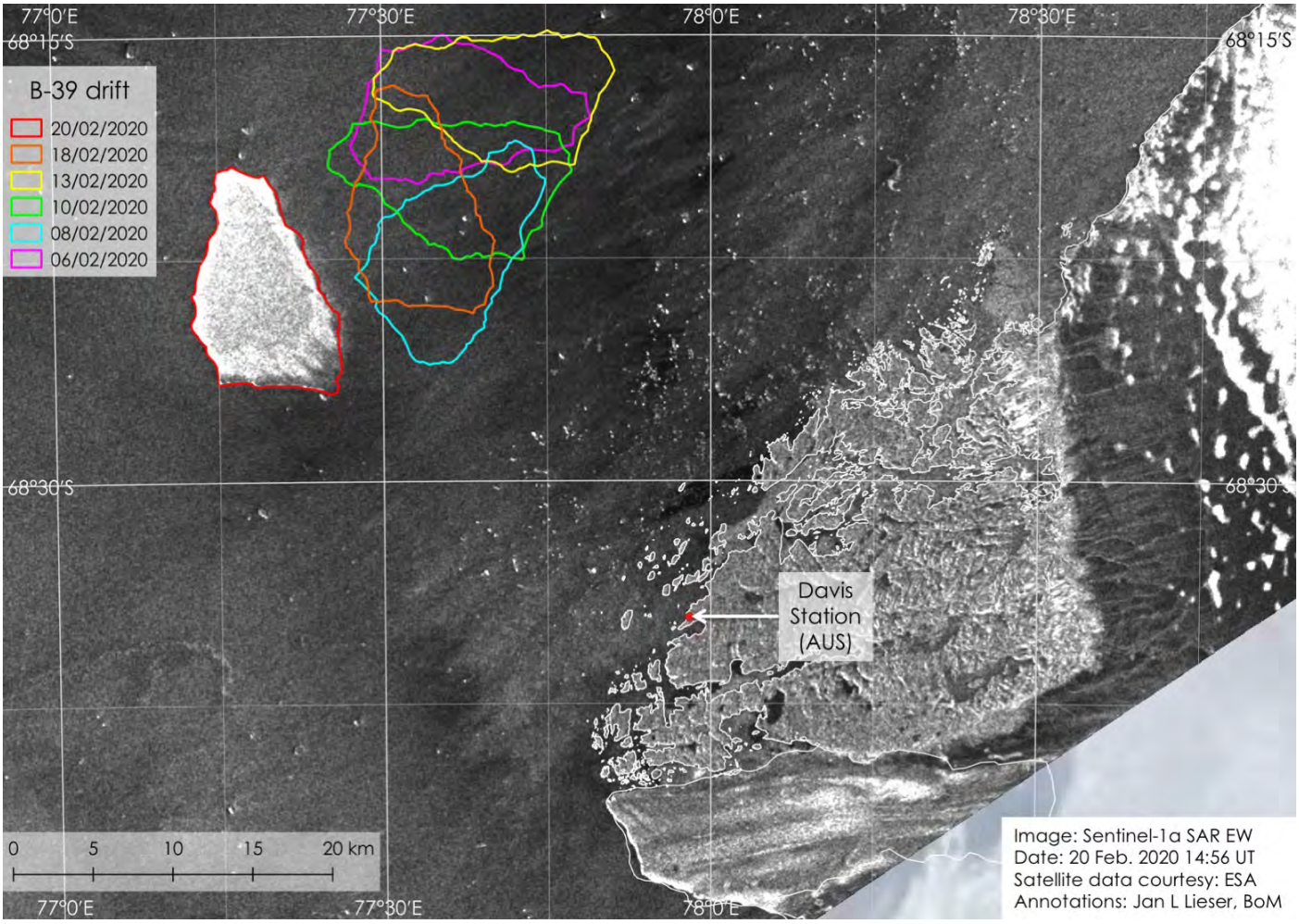

***Figure 1**: Sentinel-1a SAR EW scene acquired 20 February 2020 at 14:56 UT and provided by PolarView.*

After it's initially south-westward drift along the coast north of the hills, the iceberg has now performed a 'loop-de-loop'-like pattern off the northern part of the Vestfold hills and is now on a south-westerly trajectory again. For the last two days, the iceberg has travelled roughly three nautical miles per day and not changed orientation significantly.

Broken ex-fast ice and more smaller icebergs are drifting generally south-westward offshore.

At the end of February, some new sea ice may be starting to form under favourable conditions. While the overall sea-ice extent minimum for the season appears not to have been reached yet, locally the formation of brash ice and new ice may be encountered.

Ice Bulletin: Cooperation Sea

Issued: Friday 21st February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of SAR scenes and visible data of the western Cooperation Sea and Cape Darnley. The recent cruise track of RSV *Aurora Australis* is given by the orange track (up until 21 Feb. 2020 03:30 UT, the orange dot).

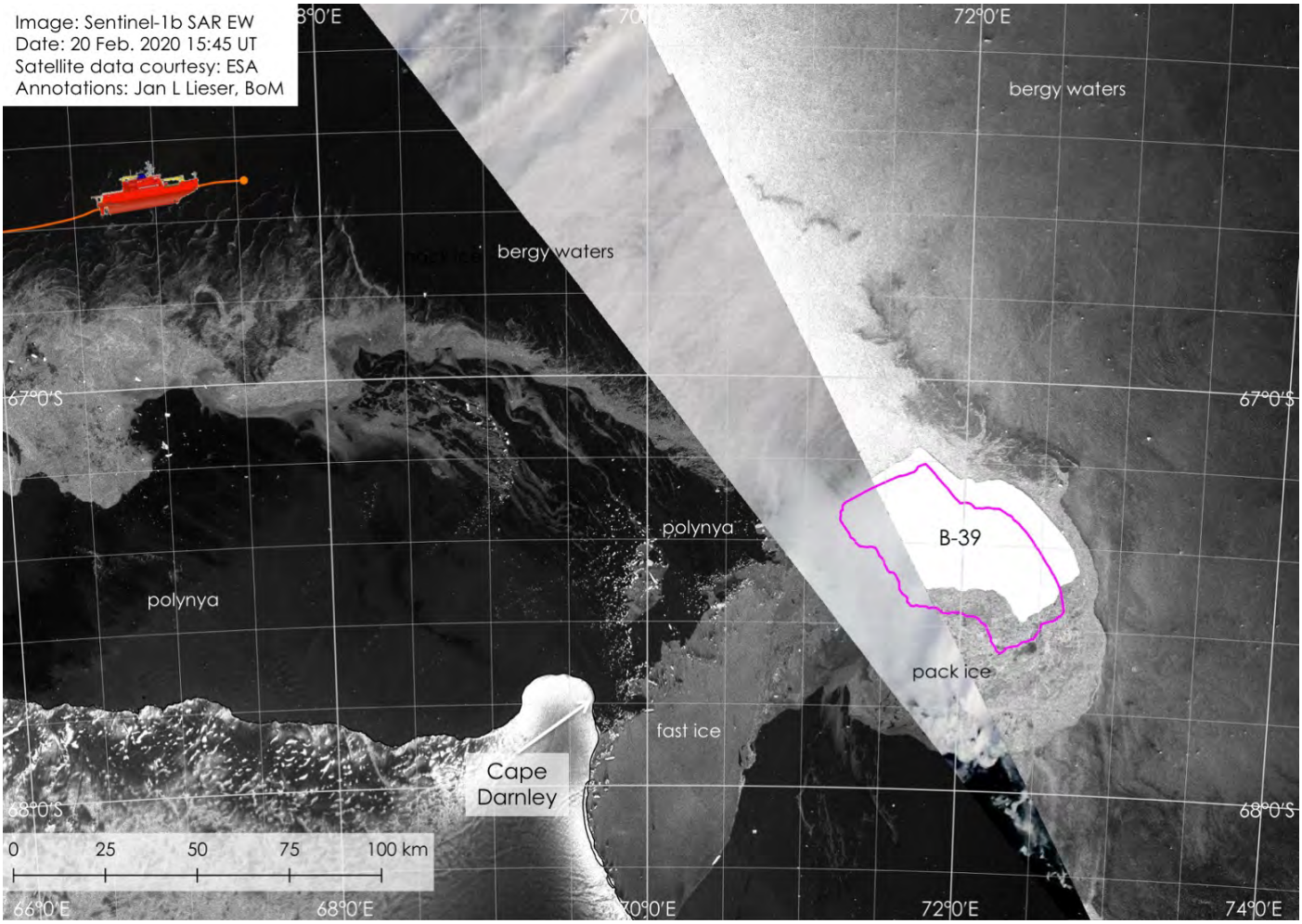

***Figure 1**: Composite of Sentinel-1b SAR EW scene acquired 20 February 2020 at 15:45 UT (western part) and Sentinel-1a SAR EW scene acquired 20 February 2020 at 14:56 UT (eastern part), both provided by PolarView; complemented by AQUA MODIS VIS data acquired 20 February 2020 and provided by NASA.*

Off Cape Darnley, the fast ice continues to break up and drift north-westward with the general surface currents.

East of 68ºE, strips and patches of thin sea ice are streaming northward. Further east, such strips and patches are also drifting as far north as 66º20'S at 70º40'E. Those strips originate from sea ice surrounding iceberg B-39, which is itself drifting northward with a slight rotation. Since 18 Feb. 2020 (the pink shape), the southern corner of the iceberg has moved roughly 5.5 nautical miles north-eastward due to the rotational momentum.

North of the sea-ice edge, bergy waters extend throughout the entire Figure 1 and even further north.

Ice Bulletin: Cooperation Sea

Issued: Friday 21st February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data of Cooperation Sea. The recent cruise track of RSV *Aurora Australis* in the area is marked by an orange line (up until 21 Feb. 2020 06:00 UT, the orange dot). The respective positions of two large icebergs on 18 Feb. 2020 are indicated by the pink shapes.

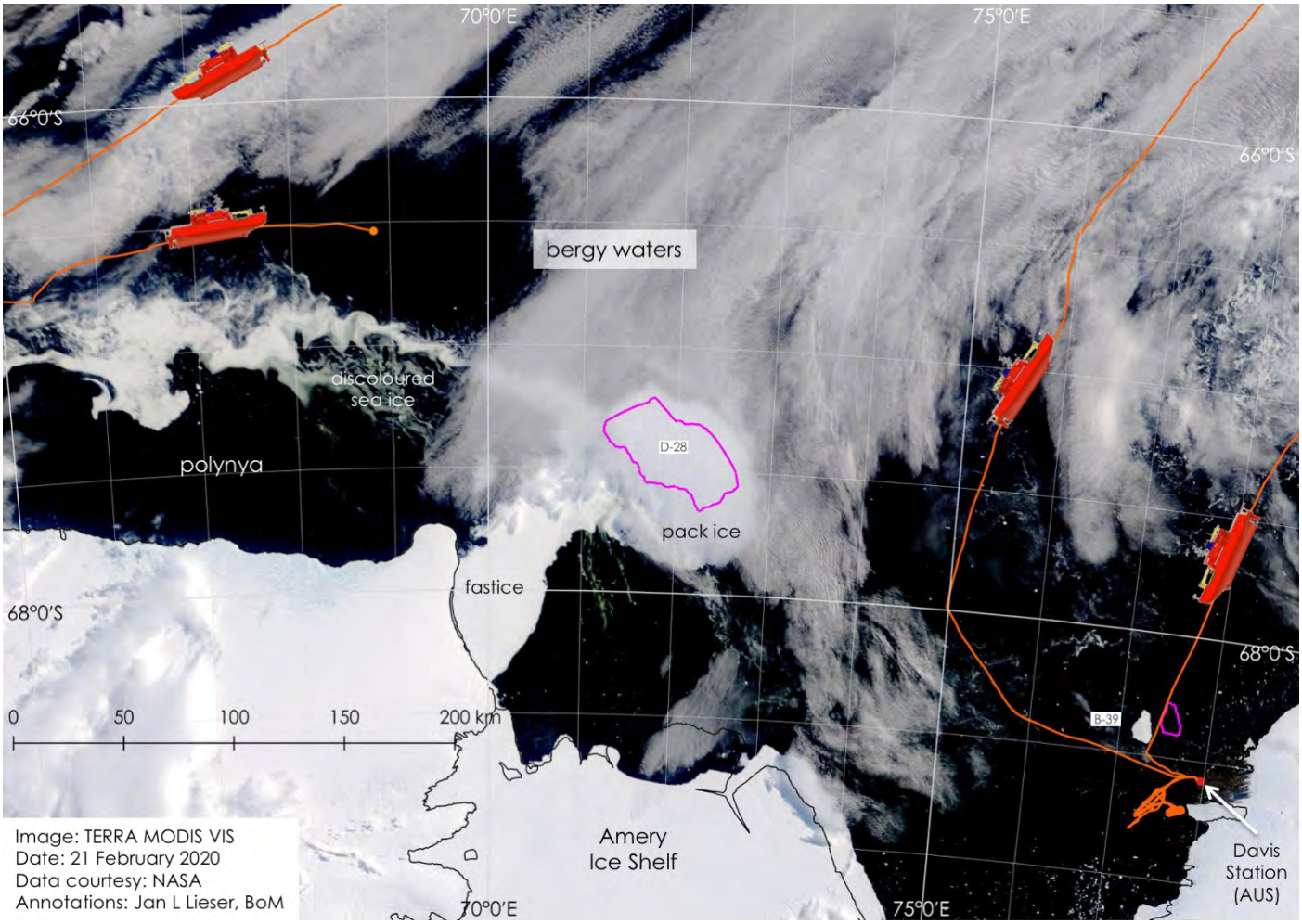

***Figure 1**: TERRA MODIS VIS scene acquired 21 February 2020 and provided by NASA.*

The previously noted discolouration of some sea ice west and south of iceberg D-28 appears to continue. This is also an indication that some new sea ice starts to form as the process of discolouration is thought to be linked not only to algal growth, but also to the formation of frazil ice and therefore new sea ice.

The extent of northward-reaching strips and patches of sea ice cannot clearly be established due to the presence of clouds. Passive microwave sea-ice concentration data is expected to miss the true sea-ice extent as well, as it will be below the detection limit of the instrument and processing algorithm.

Ice Bulletin: Wilkins Aerodrome

Issued: Saturday 22nd February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (30 m horizontal) visible scene of Wilkins Aerodrome. The southern end of the road from Casey Station to the aerodrome is marked by a black line.

The blue-ice runway can be seen as the rectangular feature. Snow dunes and shifted snow either side of the runway are visible as shades of lighter blue.

Figure 2 shows a higher-resolution (15 m horizontal) panchromatic scene of the same area as Figure 1. Here, blue-ice areas appear in darker grey and snow features almost white.

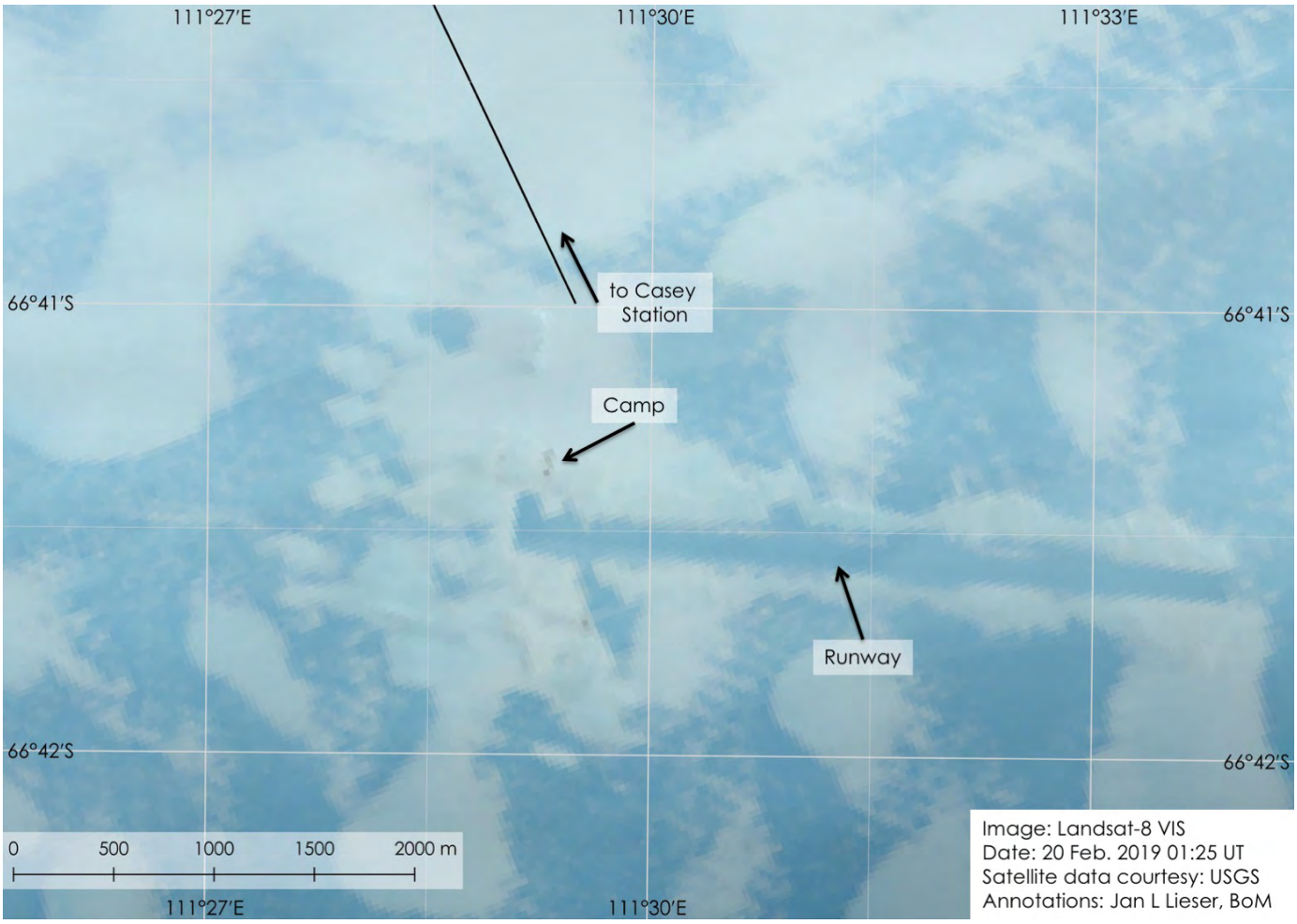

***Figure 1**: Landsat-8 visible scene acquired 20 February 2020 at 01:25 UT and provided by USGS.*

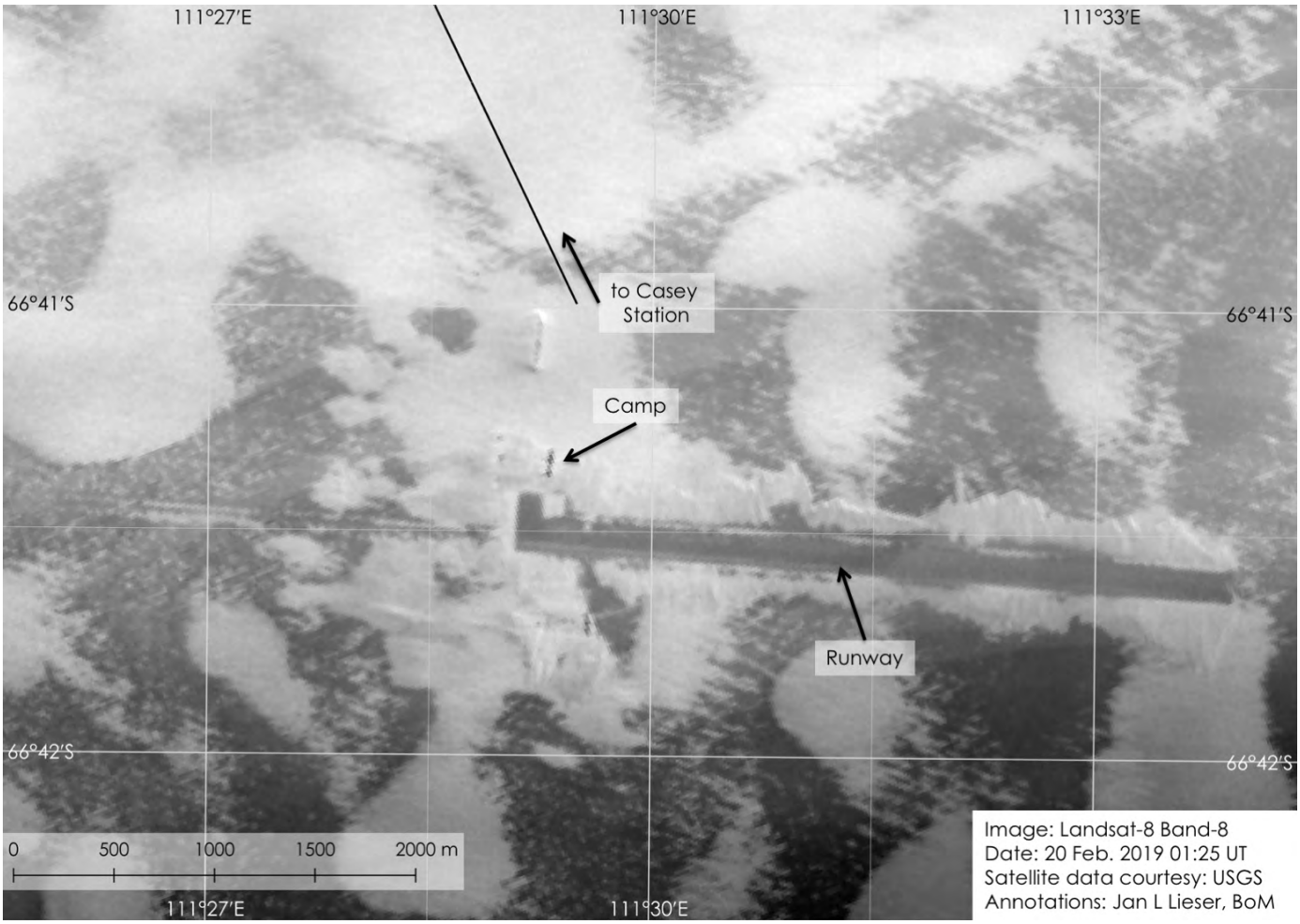

***Figure 2**: Landsat-8 Band-8 scene acquired 20 February 2020 at 01:25 UT and provided by USGS.*

Ice Bulletin: Davis Station

Issued: Sunday 23rd February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a composite of SAR and visible data off Davis Station and the eastern Cooperation Sea. The recent cruise track of RSV *Aurora Australis* is included as an orange line (up until 23 Feb. 2020 09:30 UT, the orange dot). Additionally, the sea-ice edge based on passive microwave sea-ice concentration data is given as a white line.

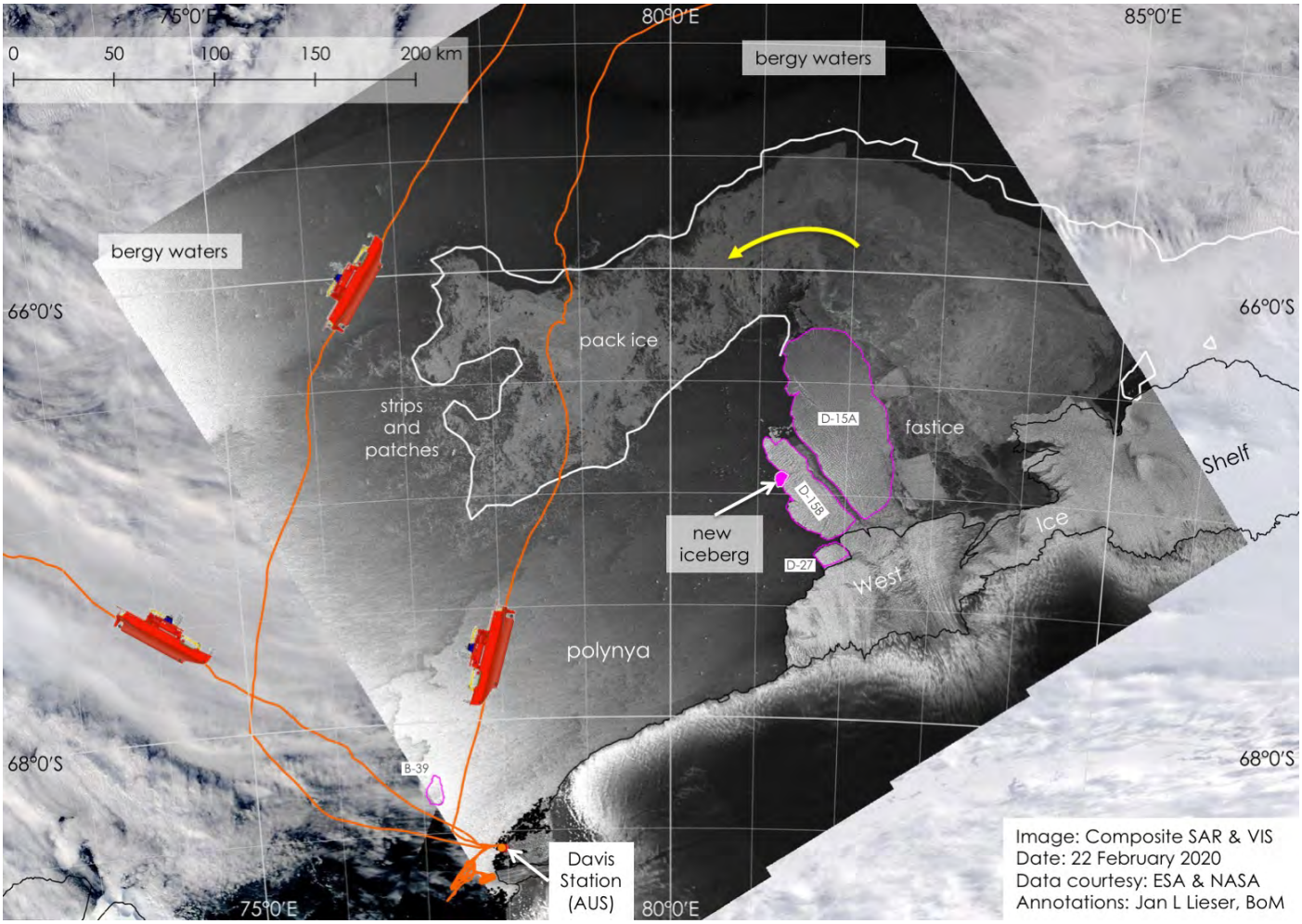

***Figure 1**: Sentinel-1a SAR EW scene acquired 22 February 2020 at 14:39 UT and provided by PolarView; complemented by TERRA MODIS VIS data acquired 23 February 2020 and provided by NASA.*

Sea ice extends further west than the sea-ice edge might suggest, as strips and patches of sea ice drifting westward are below the detection limit of the passive microwave instrument.

Northwest of Davis Station, iceberg B-39 is drifting north-westward during the past few days. Off iceberg D-15B, a new larger iceberg (roughly 35.5 km^2) has broken off at a corner of iceberg D-15B, which has lost numerous smaller icebergs during the past months already.

Northeast of iceberg D-15A, a reservoir of old sea ice feeds a westward stream of pack ice drifting into Cooperation Sea (as indicated by the yellow arrow).

Ice Bulletin: Davis Station

Issued: Monday 24th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a sea-ice concentration chart for a part of the southern Indian Ocean. Large tabular icebergs are identified with annotated pink shapes. A swath of SAR data (Sentinel-1a SAR EW from 23 Feb. 2020 13:44 UT; extent given by the grey frame) has been analysed for small to medium sized icebergs.

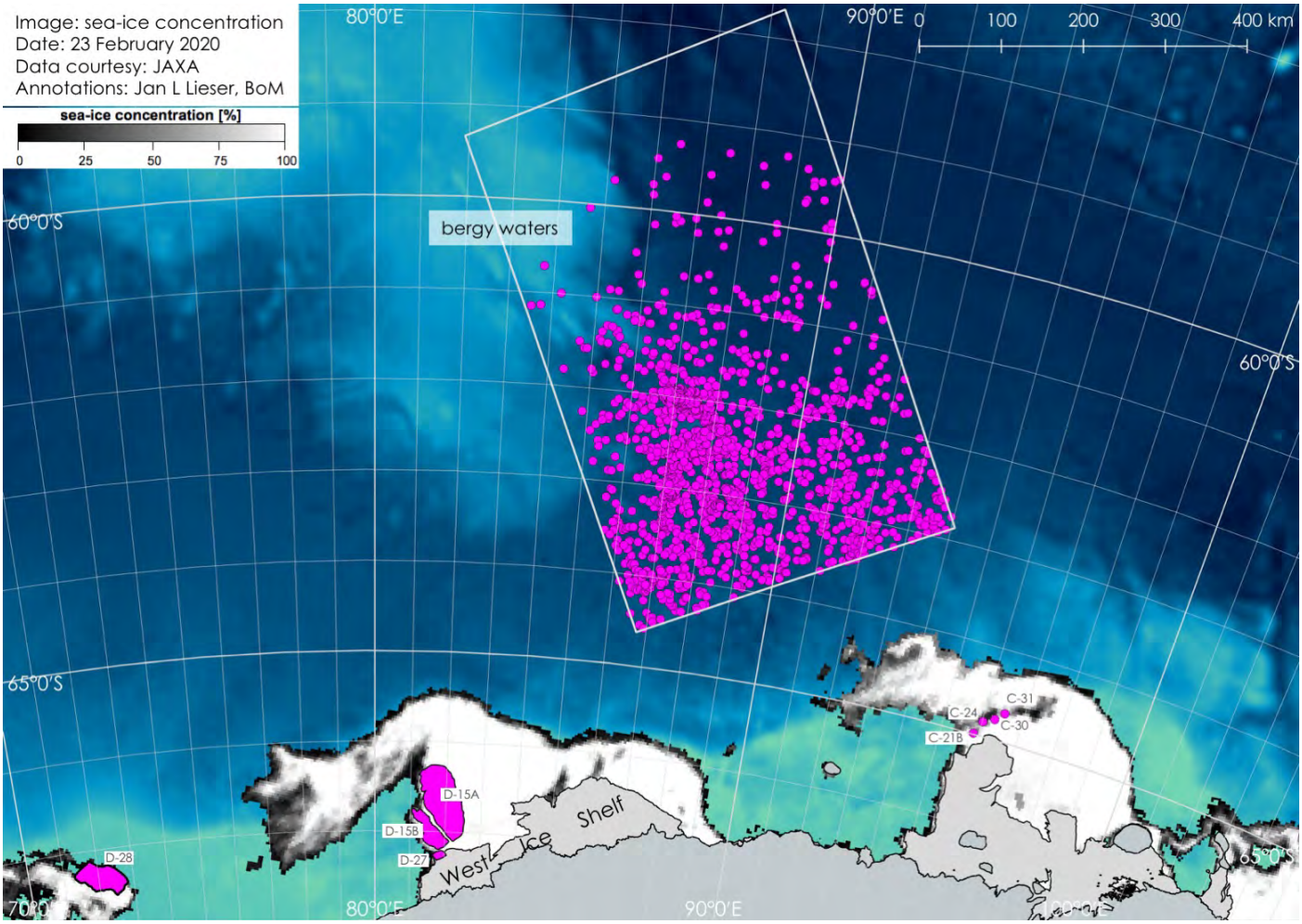

***Figure 1**: Sea-ice concentration data acquired 23 February 2020 and provided by ICDC, Universität Hamburg; Bathymetry provided by SCAR.*

Sea ice extent is currently close to its annual minimum.

From the SAR data (not shown in the figure) 1578 small to medium icebergs have been identified and marked with pink dots. The distribution of those icebergs highlights that bergy waters still reach to latitudes north of 60ºS and therefore up to 360 nautical miles further north than the sea-ice edge.

Ice Bulletin: Wilkins Aerodrome

Issued: Friday 28th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (15 m horizontal) panchromatic scene of Wilkins Aerodrome.

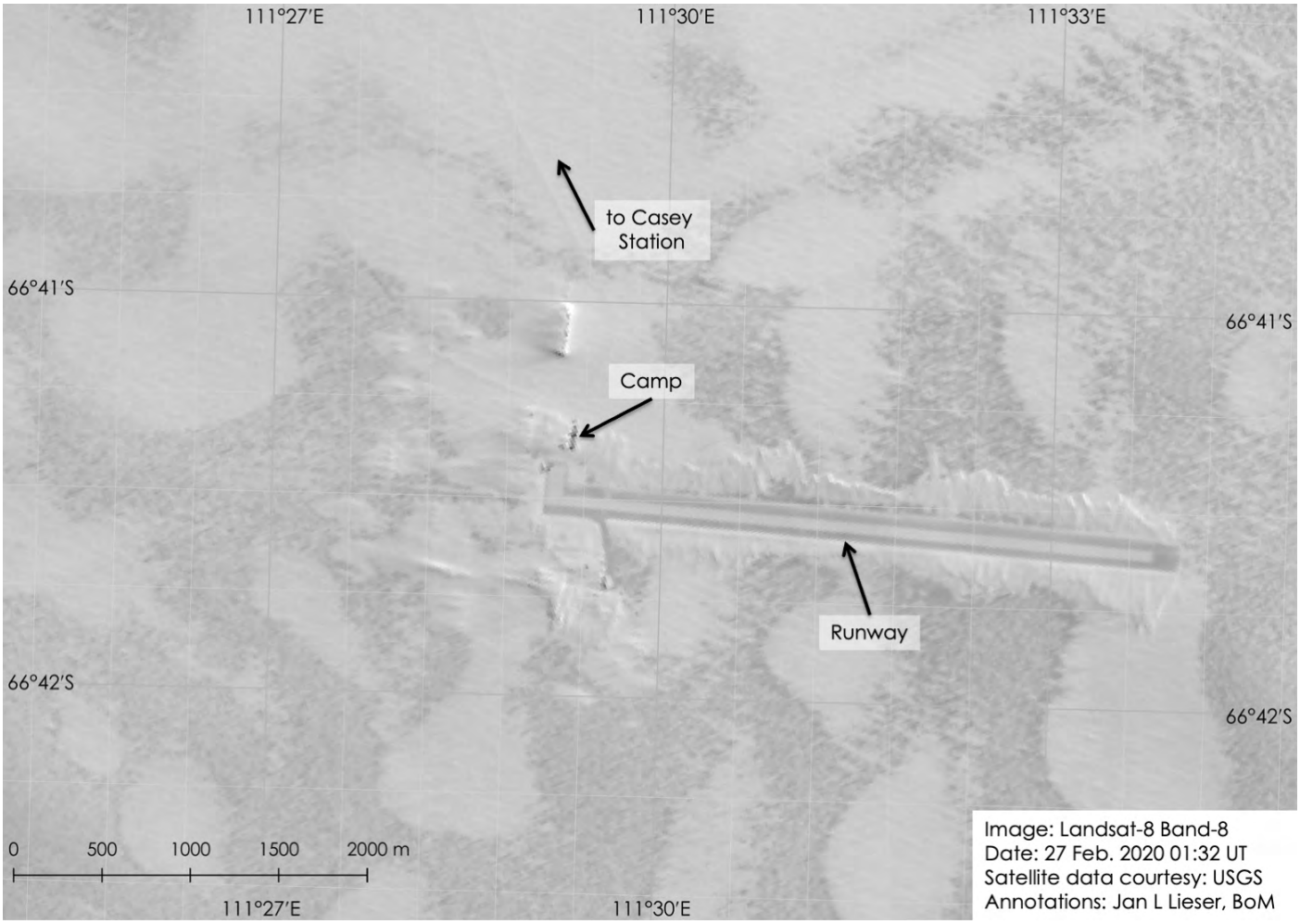

***Figure 1**: Landsat-8 Band-8 scene acquired 27 February 2020 at 01:32 UT and provided by USGS.*

The blue-ice runway is clearly visible in the cloud-free scene. The route to Casey Station and the camp are also clearly visible. North and south of the runway, snow dunes are left from clearing the runway.

Ice Bulletin: Bunger Hills

Issued: Friday 28th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR scene of the Bunger Hills.

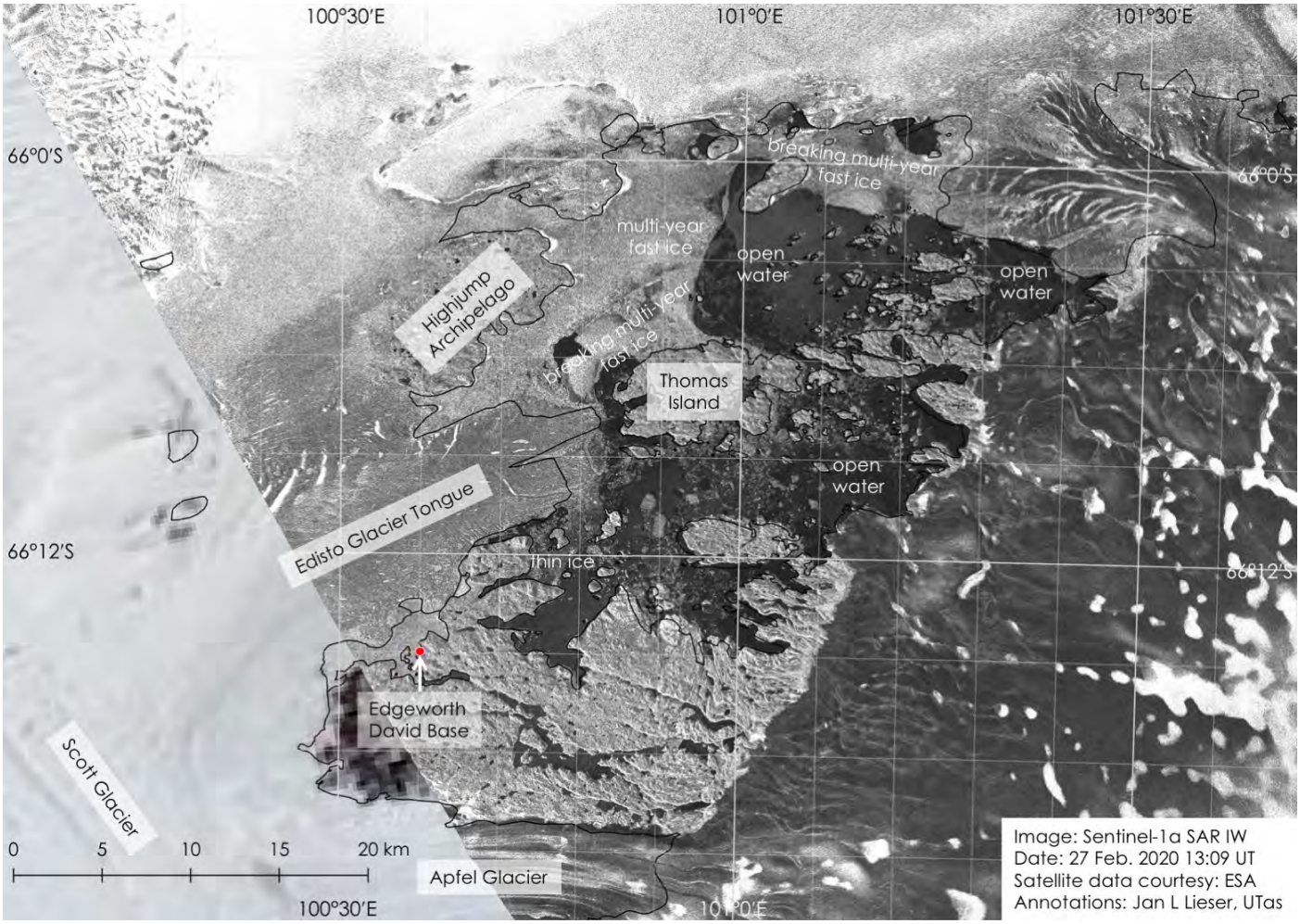

***Figure 1**: Sentinel-1a SAR IW scene acquired 27 February 2020 at 13:09 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 27 February 2020 and provided by NASA.*

The rock outcrop east and south of Highjump Archipelago is known as the Bunger Hills. As the areas between the hills are freshwater and saltwater lakes, the region is also referred to as Bunger Islands or Bunger Oasis.

Typically, these lakes are covered by lake ice or fast ice that can last through summer seasons and is therefore also considered multi-year fast ice. In recent years, some of the areas experienced sufficient melt during summer so that the lakes have open water surfaces.

Currently, of the roughly 550 km^2 of total lake surface between the islands only about 90 km^2 remain covered by multi-year fast ice in the north-western part of the area immediately east of Highjump Archipelago. A further 100 km^2 can be considered breaking, which means that 2/3 of the entire lake area is either open water or has some broken ice floes.

Only the lake south of the Edisto Glacier Tongue (near Edgeworth David Base) remains so far apparently unaffected by the changing conditions.

Ice Bulletin: Davis Station

Issued: Friday 28th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data for Cooperation Sea between Cape Darnley and the West Ice Shelf. The drift of two large tabular icebergs is marked by colour-coded shapes, respectively.

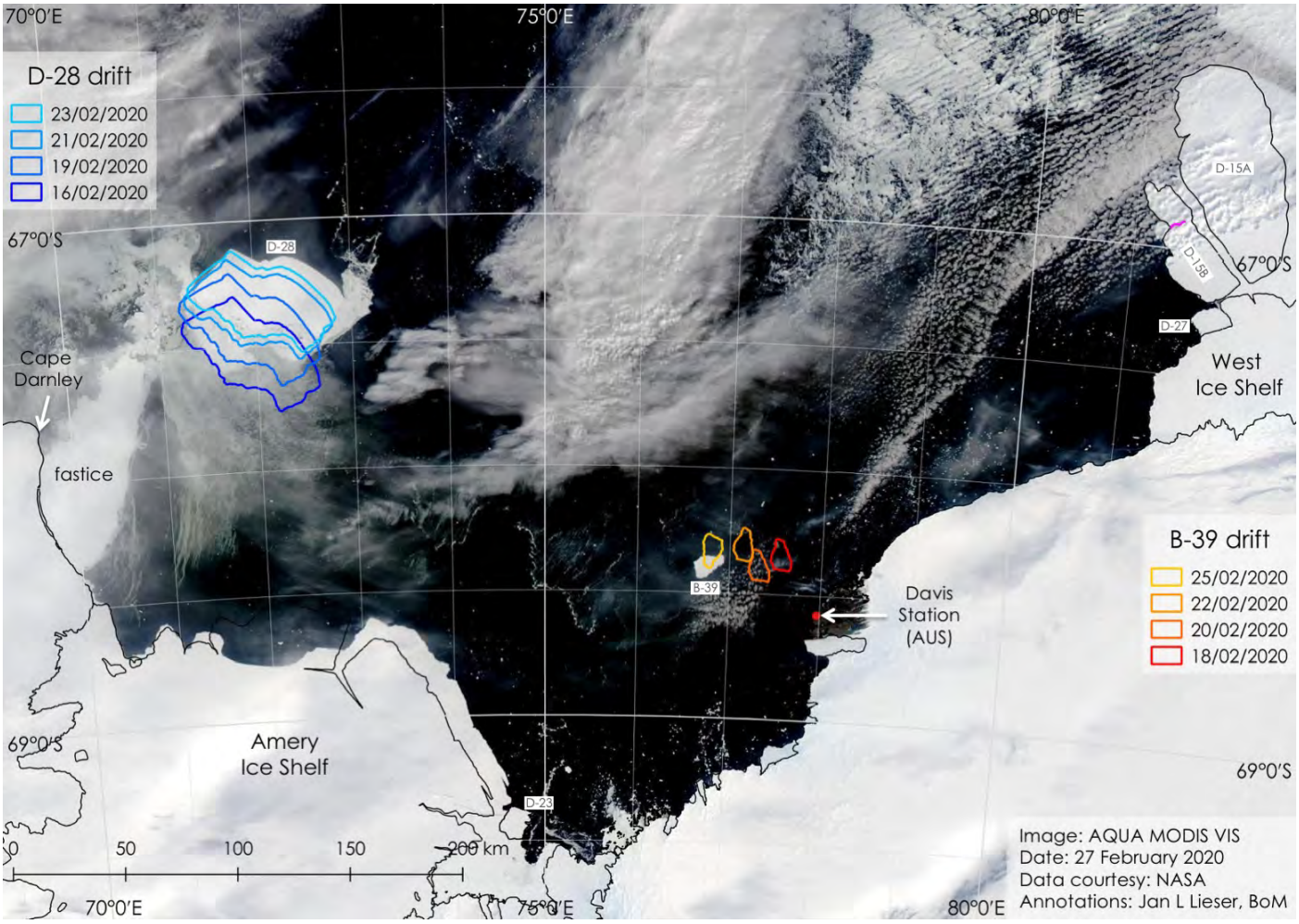

***Figure 1**: AQUA MODIS VIS data acquired 27 February 2020 and provided by NASA.*

Off Davis Station, iceberg B-39 has gradually drifted further offshore and recently started to turn again. Between 22/02/2020 and 25/02/2020, the berg has performed a 180º turn anti-clockwise and has since continued the rotation for another 90º.

The new iceberg that separated from D-15B recently is too small for an official name but the northern part of D-15B is preparing to break away and that part of approximately 240 km^2 will then become D-15C.

East of Cape Darnley, iceberg D-28 appears to have hit an undersea obstacle around which it is now turning anti-clockwise, while the northern tip of the fast ice that is attached to the eastern side of the cape is crumbling and drifting westward.

Some ongoing discolouration of newly forming sea ice south of iceberg D-28 can still be identified through the thin clouds. Similar features are found west of the iceberg (outside the frame of Figure 1).

Ice Bulletin: D'Urville Sea

Issued: Friday 28th February 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows SAR data for southern D'Urville Sea between Dumont D'Urville Station and the Mertz Ice Shelf. The drift of iceberg C-33 is marked by colour-coded shapes.

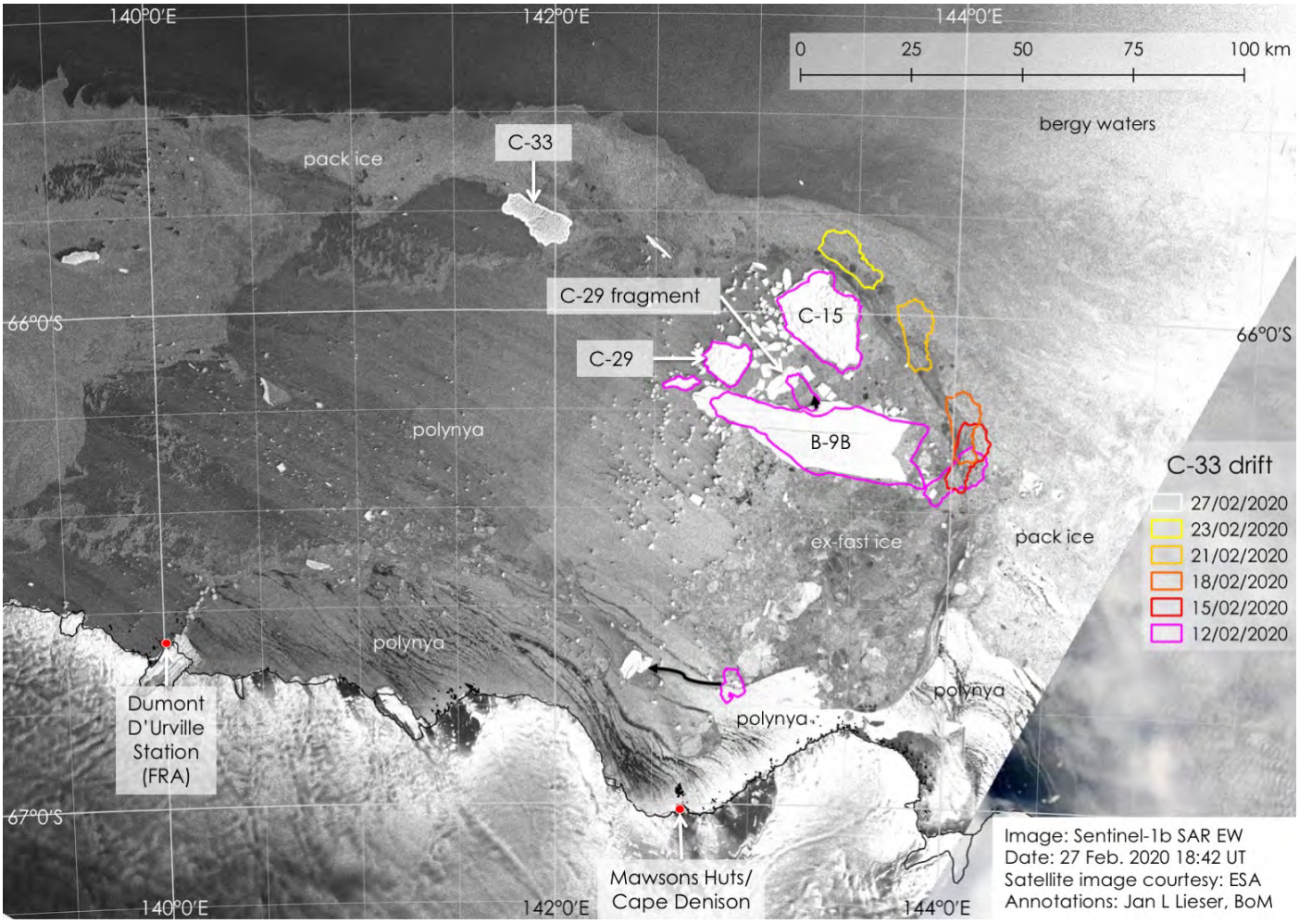

***Figure 1**: Sentinel-1b SAR EW data acquired 27 February 2020 at 18:42 UT and provided by PolarView.*

North of Cape Denison, most of the icebergs have not moved far since 12/02/2020. Iceberg B-9B is slowly drifting back and forth in east-west direction and iceberg C-15 appears to be stuck behind smaller icebergs that are grounded west of it. Iceberg C-29 is not moving at all.

The notable exception is iceberg C-33, which appears to have accelerated since it drifted past iceberg C-15 on 23/02/2020. Since then, it has also performed a 180º rotation.

Closer to Mawsons Huts, one large iceberg has also drifted westward while rotating anti-clockwise.

Off Dumont D'Urville Station, fast ice has completely broken out and only a row of grounded icebergs remains off l'Astrolabe Ice Shelf (immediately east of the station).

Between Cape Denison and iceberg B-9B, a melange of old sea ice, ex-fast ice and newly forming sea ice originating in the polynya conglomerates.

Ice Bulletin: Bunger Hills

Issued: Tuesday 03rd March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (30 m horizontal) visible scene of the Bunger Hills.

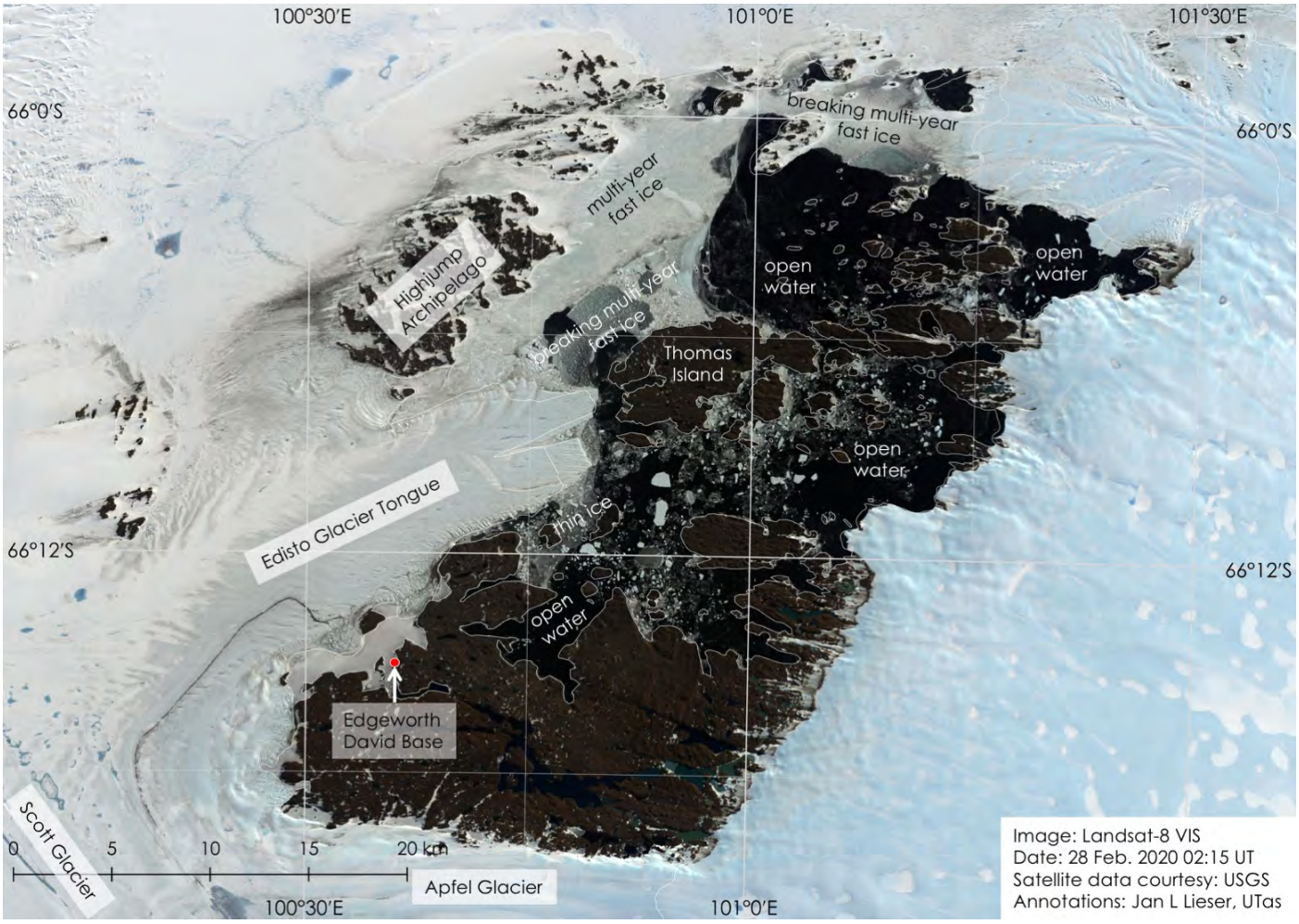

***Figure 1**: Landsat-8 VIS composite scene acquired 28 February 2020 at 02:15 UT and provided by USGS.*

The extent of open water in amongst islands of the Bunger Oasis is clear from the visible composite.

The lake south of the Edisto Glacier Tongue (near Edgeworth David Base) remains so far apparently unaffected by the changing conditions, however, a small region of open water can be identified in the north-eastern corner of the lake area and the fjord southeast of the base is also free of ice. This is marked ‘o.w.’ in Figure 2, which is a very high-resolution (15 m horizontal) panchromatic scene capture simultaneously with the data of Figure 1.

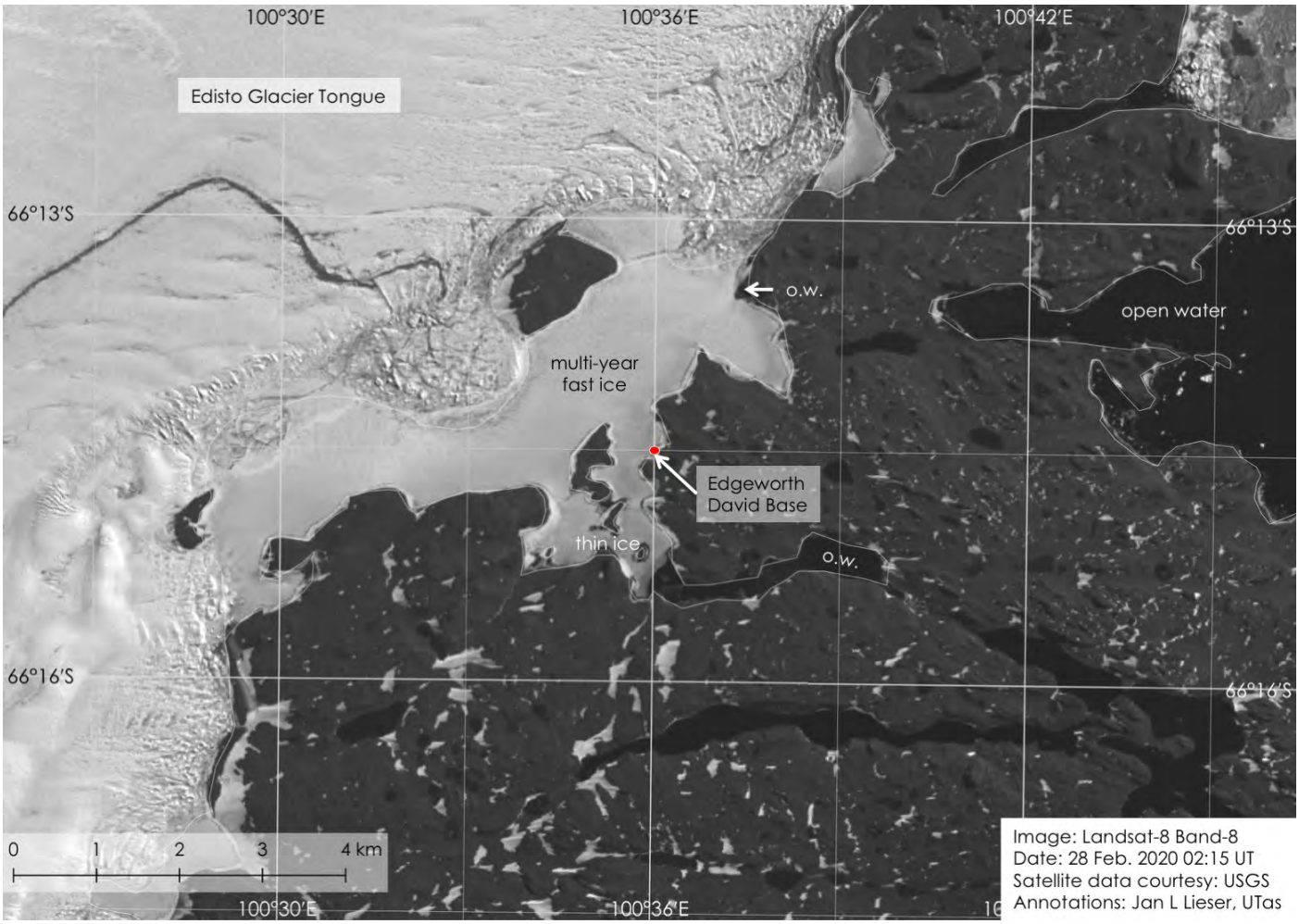

***Figure 2**: Landsat-8 Band-8 scene acquired 28 February 2020 at 02:15 UT and provided by USGS.*

Ice Bulletin: Iceberg A-68A

Issued: Tuesday 03rd March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene east of northern Antarctic Peninsula. The drift of iceberg A-68A since late February 2020 is shown by colour-coded shapes.

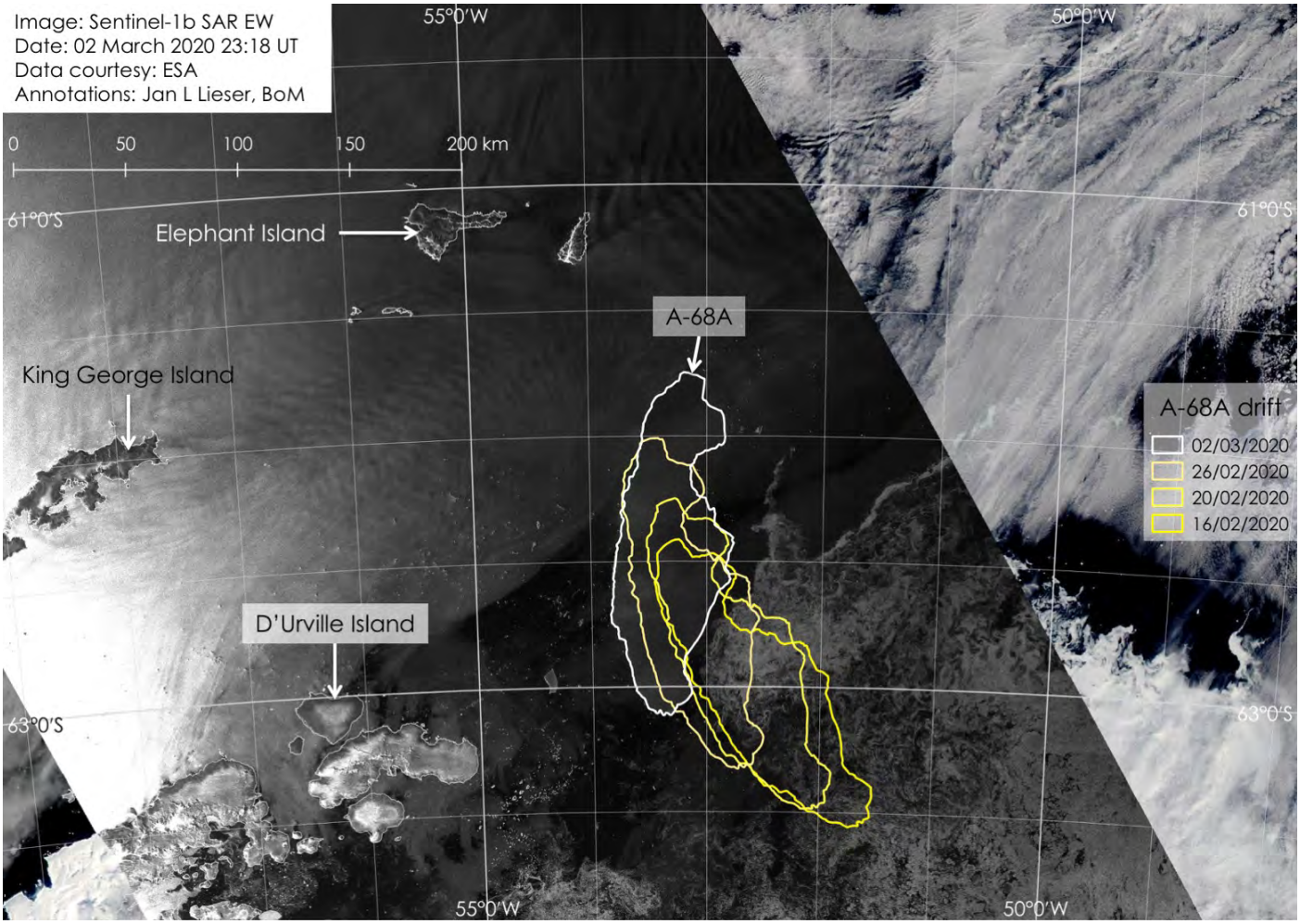

***Figure 1**: Sentinel-1b SAR EW data acquired 02 March 2020 at 23:18 and provided by ESA; complemented by AQUA MODIS VIS data acquired 02 March 2020 and provided by NASA.*

Since late February 2020, the iceberg has switched rotation and is now turning clockwise while continuing its generally northward course. It is currently following the western edge of the Powell Basin, which is centred roughly at 50ºW and 62ºS and about 3300 m deep (Figure 2).

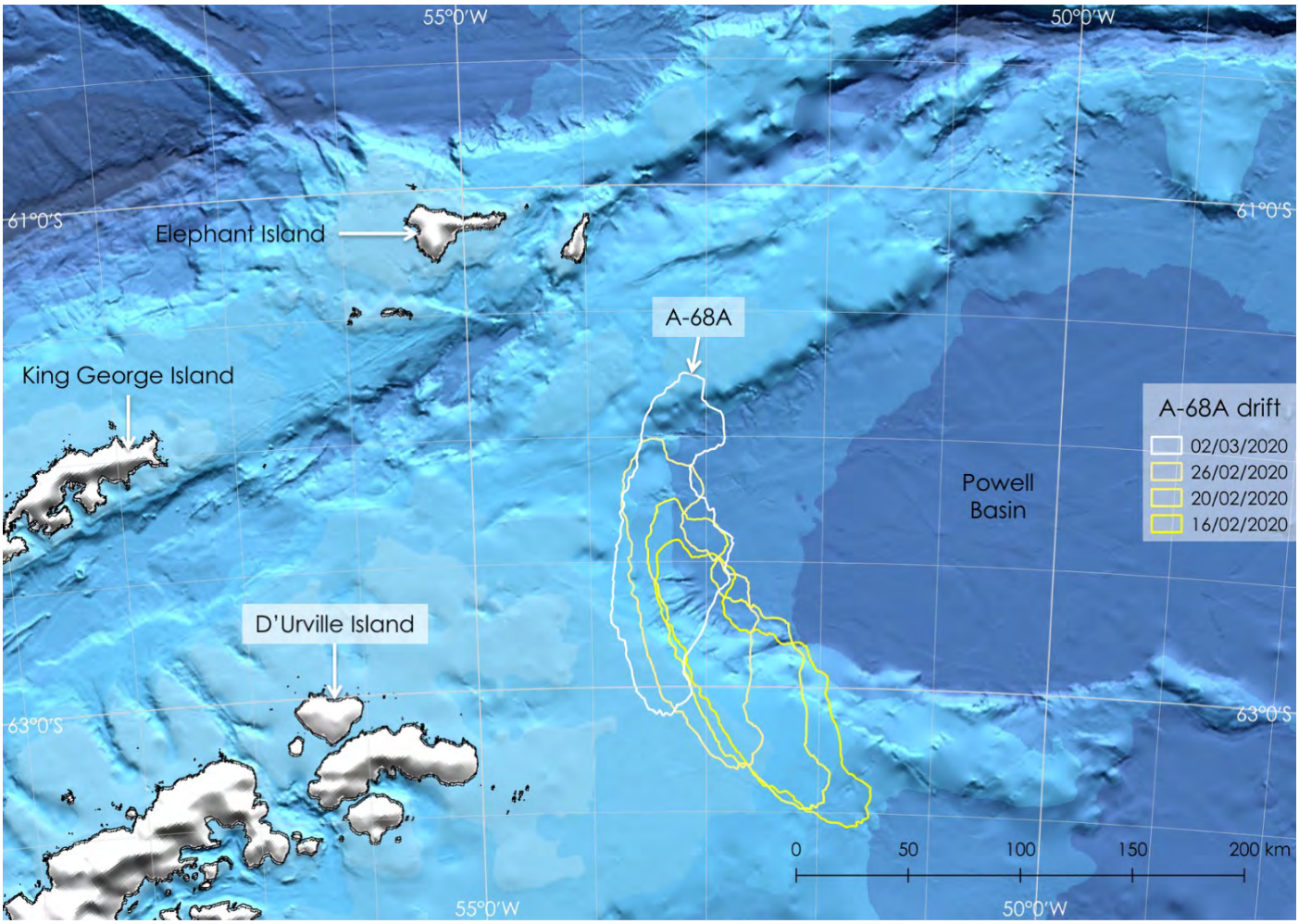

***Figure 1**: Iceberg A-68A drift with respect to the bathymetry (IBCSO v. 1.0; Arndt et al., 2013).*

Ice Bulletin: Sabrina Coast

Issued: Wednesday 04th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data offshore Sabrina Coast, between the Law Dome and the Moscow University Ice Shelf. The fast-ice edge in the region is marked by a red line.

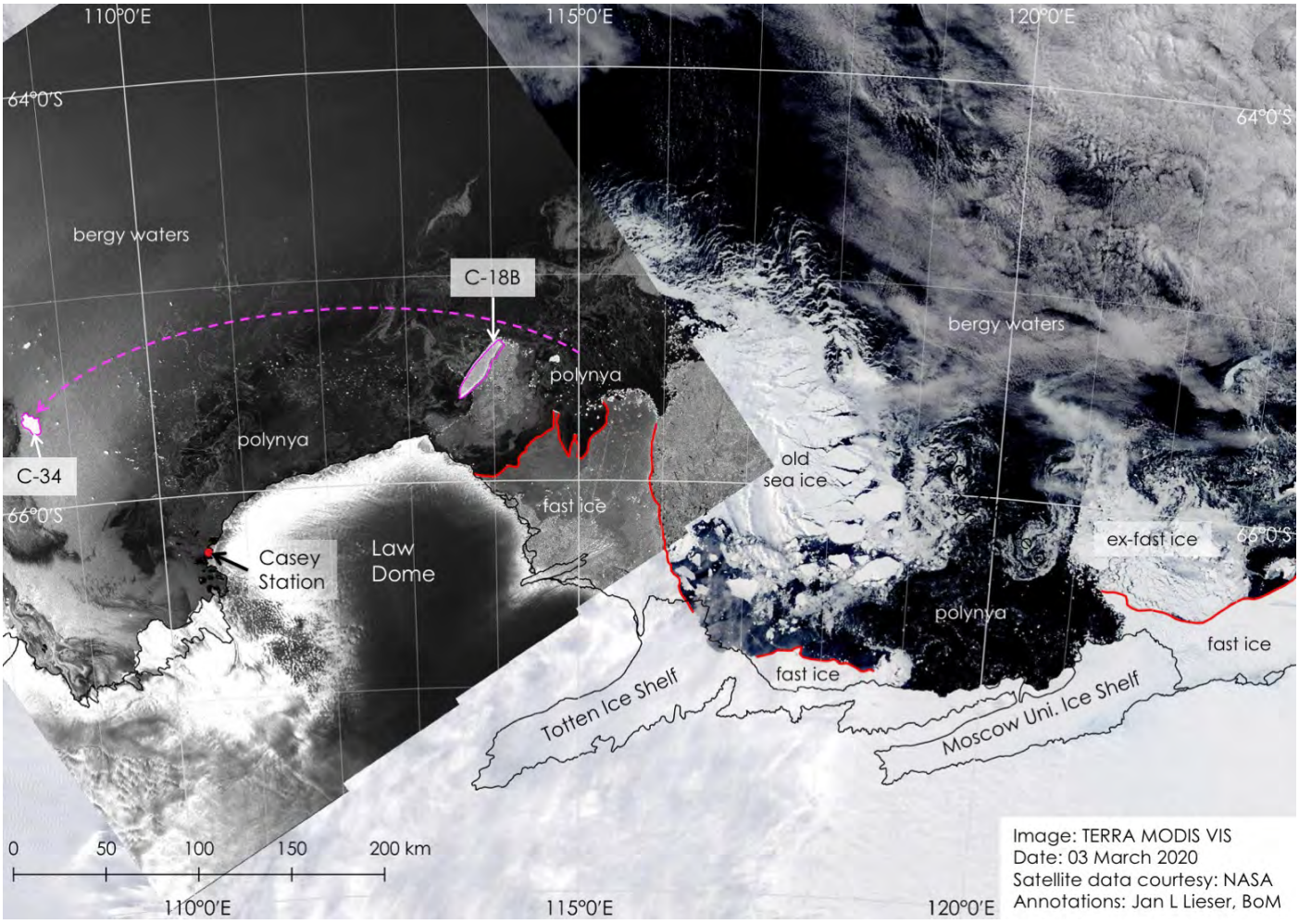

***Figure 1**: TERRA MODIS VIS data acquired 03 March 2020 and provided by NASA;*
Sentinel-1b SAR EW data (overlayed in the west) acquired 03 March 2020 at 12:27 UT and provided by PolarView.

North of Casey Station, fast ice that typically forms between icebergs grounded on Petersen Bank (northwest of Law Dome) has disappeared entirely.

Since late January, fast ice off Sabrina Coast (between the Totten Ice Shelf and the Moscow University Ice Shelf) continued to break up and disintegrate. Southeast of iceberg C-18B, a large polynya has formed that is partly still covered by broken ex-fast ice, as it is held against the iceberg with the westward ocean surface current.

Within the Dalton Iceberg Tongue (north of the Moscow University Ice Shelf), fast ice has largely broken into floes that are trapped between the icebergs of the tongue. Smaller pieces of ex-fast ice escape northward around the row of icebergs that form the western edge of the iceberg tongue.

During February, iceberg C-34 has travelled roughly 170 nautical miles westward.

Ice Bulletin: Davis Station

Issued: Tuesday 10th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data for Cooperation Sea between Cape Darnley and the West Ice Shelf. The drift of two large tabular icebergs is marked by colour-coded shapes.

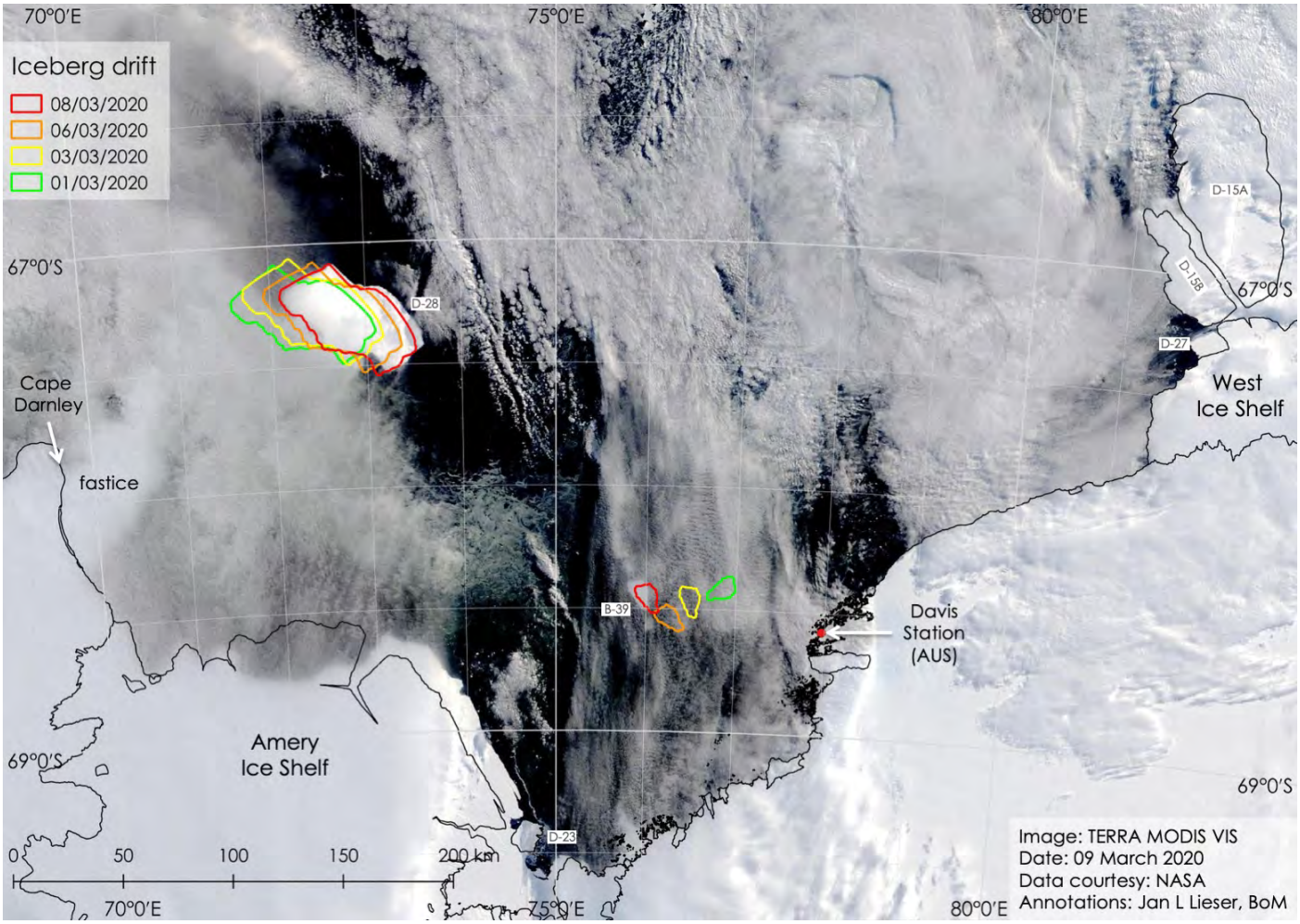

***Figure 1**: TERRA MODIS VIS data acquired 09 March 2020 and provided by NASA.*

Off Davis Station, iceberg B-39 is drifting further offshore. Since the beginning of March, the berg has continued to rotate and travelled more than 20 nautical miles westward.

Meanwhile east of Cape Darnley, iceberg D-28 has drifted more than 12 nautical miles eastward away from the cape and the fast ice that is still crumbling there.

North of the Amery Ice Shelf, some ongoing discolouration of newly forming sea ice can still be identified in the gap between the clouds.

On 19 February 2020, the pan-Antarctic sea-ice extent reached its annual minimum at 2.66 x 10^6 km^2 and the annual sea-ice area minimum was recorded at 1.65 x 10^6 km^2 on the same day.

Ice Bulletin: Iceberg A-68A

Issued: Tuesday 10th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene east of northern Antarctic Peninsula. The drift of iceberg A-68A since late February 2020 is shown by colour-coded shapes.

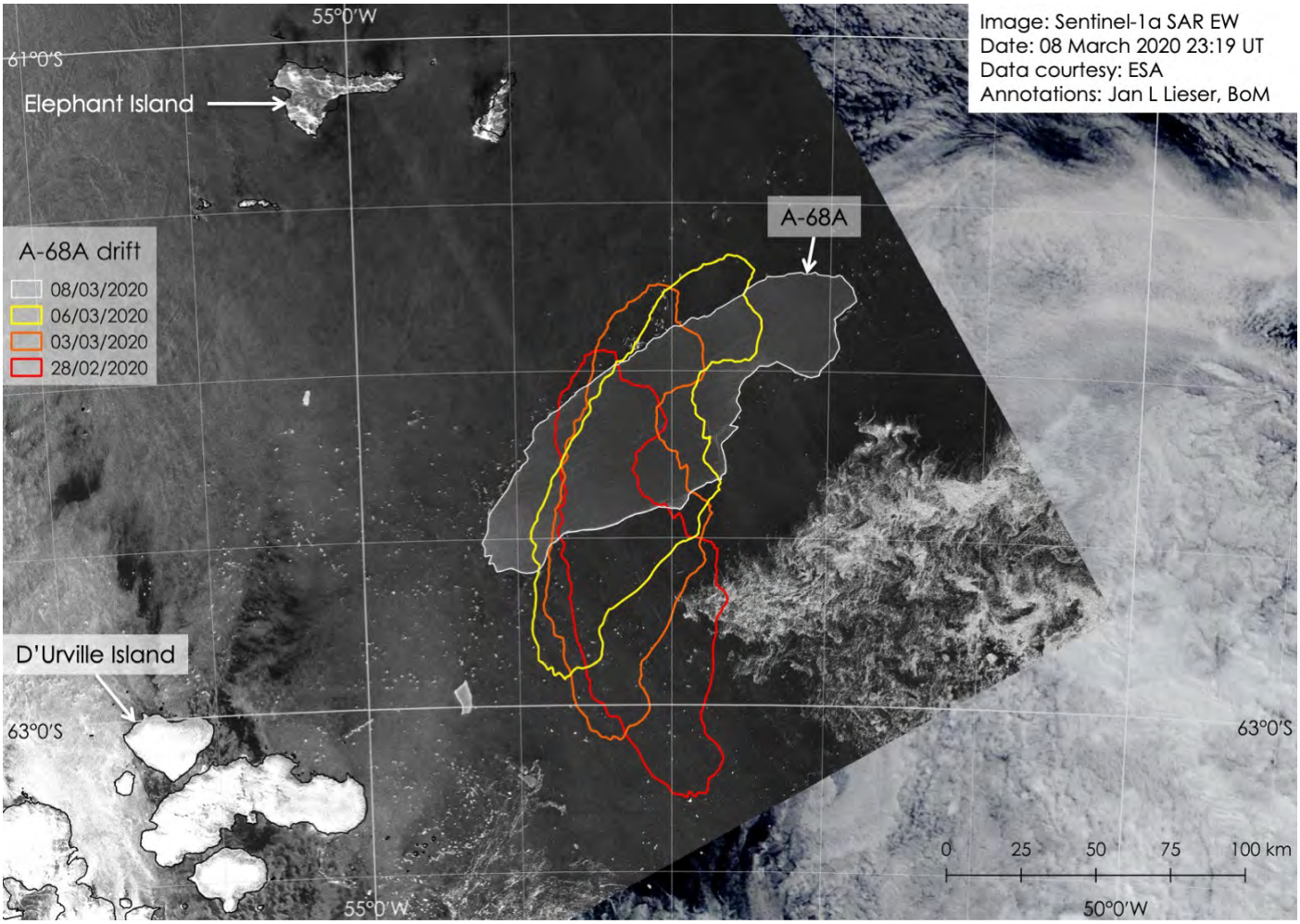

***Figure 1**: Sentinel-1a SAR EW data acquired 08 March 2020 at 23:19 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 08 March 2020 and provided by NASA.*

In late February 2020, the iceberg has switched rotation and is continuing to turn clockwise on its generally northward course in March. Currently, it is closely following the 2000 m contour of the western edge of the Powell Basin, which is centred roughly at 50ºW and 62ºS.

Southwest of iceberg A-68A, many small icebergs (and one medium sized) can be seen drifting freely. At the northern edge of the iceberg, icebergs appear to the spawning off the edge of the berg particularly west of 53ºE.

Southeast of the iceberg, strips and patches of sea ice is seen in the SAR data and through the thin clouds of the visible data.

Ice Bulletin: Antarctica

Issued: Friday 13th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows the pan-Antarctic sea-ice concentration anomaly based on passive microwave remote sensing data.

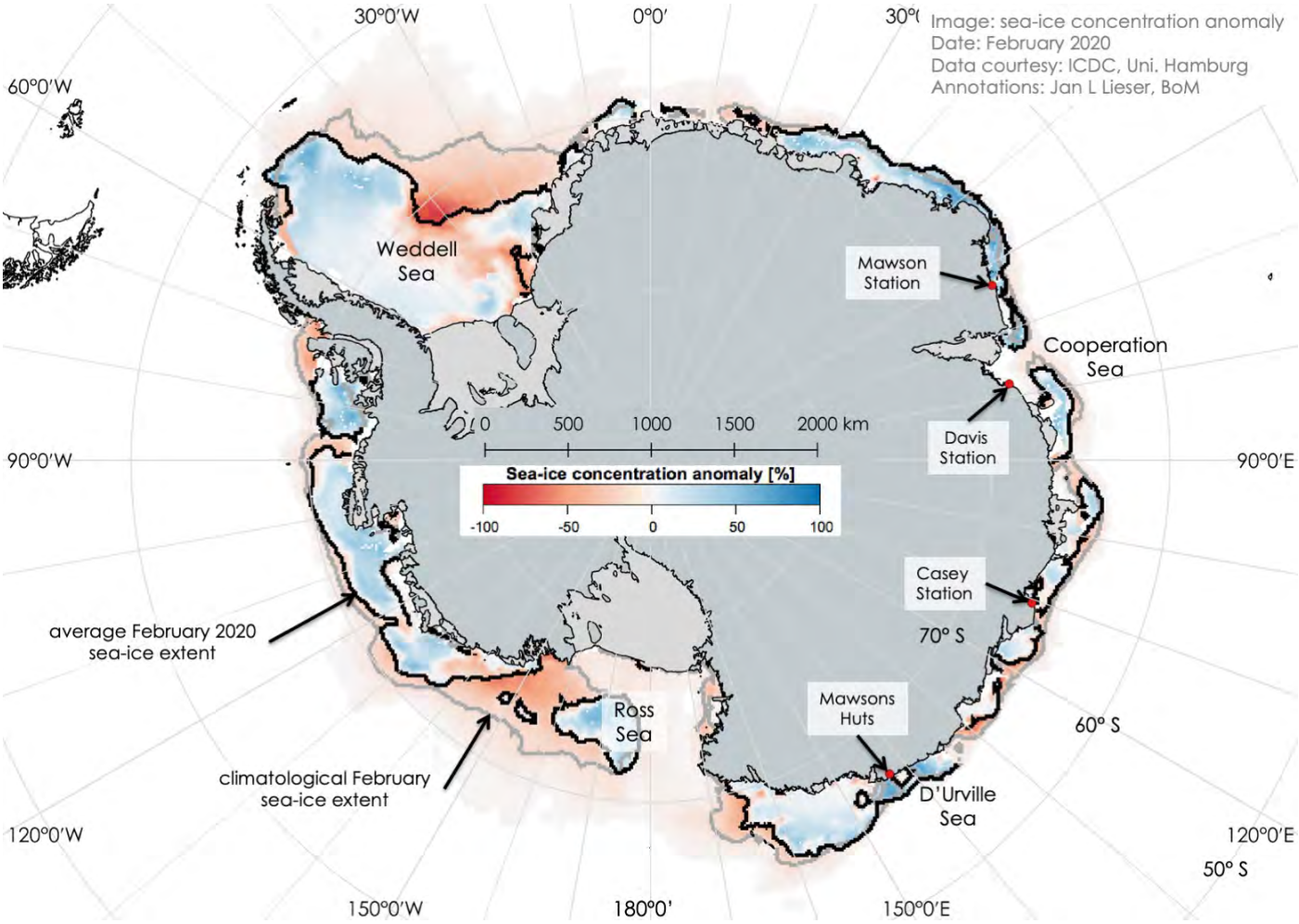

***Figure 1**: Sea-ice concentration anomaly for February 2020 provided by ICDC (Universität Hamburg).*

During February 2020, sea-ice concentration around Antarctica displayed a mixed pattern of above and below average conditions regionally. The most pronounced below average conditions were found in the central and eastern Weddell Sea but also in parts of the eastern Ross Sea. In East Antarctica, conditions were slightly below average for the time of year except for Mawson Coast (off Mawson Station) and D'Urville Sea, where average conditions prevailed.

On 19 February 2020, the pan-Antarctic sea-ice extent reached its annual minimum at 2.66 x 10^6 km^2 and the annual sea-ice area minimum was recorded at 1.65 x 10^6 km^2 on the same day.

Ice Bulletin: South Sandwich Islands

Issued: Monday 16th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figures 1 and 2 show the same geographical frame of the northern Traversay Islands, a group of three islands that make up the northern end of the South Sandwich Islands. The western-most Leskov Island is outside of the frame of the figures.

While there are only a few icebergs identified in the SAR data (pink dots in Figure 1), the notable striking feature in both data sets is the clearly visible Kármán vortex street, a repeating pattern of swirling vortices. Here, these swirls are caused by the highest elevation on Visokoi Island (Mount Hodson: 1005 m), which acts as an isolated obstacle to the laminar air flow over the ocean. Interestingly, the atmospheric vortices appear to be causing a pattern of similarly sized ocean surface roughness, which can be seen in the SAR data. Zavodovski Island's highest elevation of Mount Asphyxia (551 m) shows no interaction with the vortices or the cloud formation.

At the time of observation, the islands were in between two large low-pressure systems, one southwest of the islands and centred roughly at 64º10'S and 37º50'W and one northeast of the islands roughly at 50º00'S and 20º00'W. A third large low-pressure system in the northwest a bit further away centred at roughly 44º10'S and 44º20'W may have also played a role in the overall atmospheric regime that influenced the local conditions. At the Traversay Islands/South Sandwich Islands, a south-southeasterly flow in the early morning (UT) shifted south by the time of the SAR overpass to southwesterly by the time of the TERRA MODIS overpass. This explains the changed angle of the vortex street, which was roughly 30 degrees at 06:30 UT and about 15 degrees five hours later.

Another six hours later, by the time of the AQUA MODIS overpass (at 15:35 UT, not shown), the flow was not disturbed by Mount Hodson anymore and did not produce a vortex-street pattern.

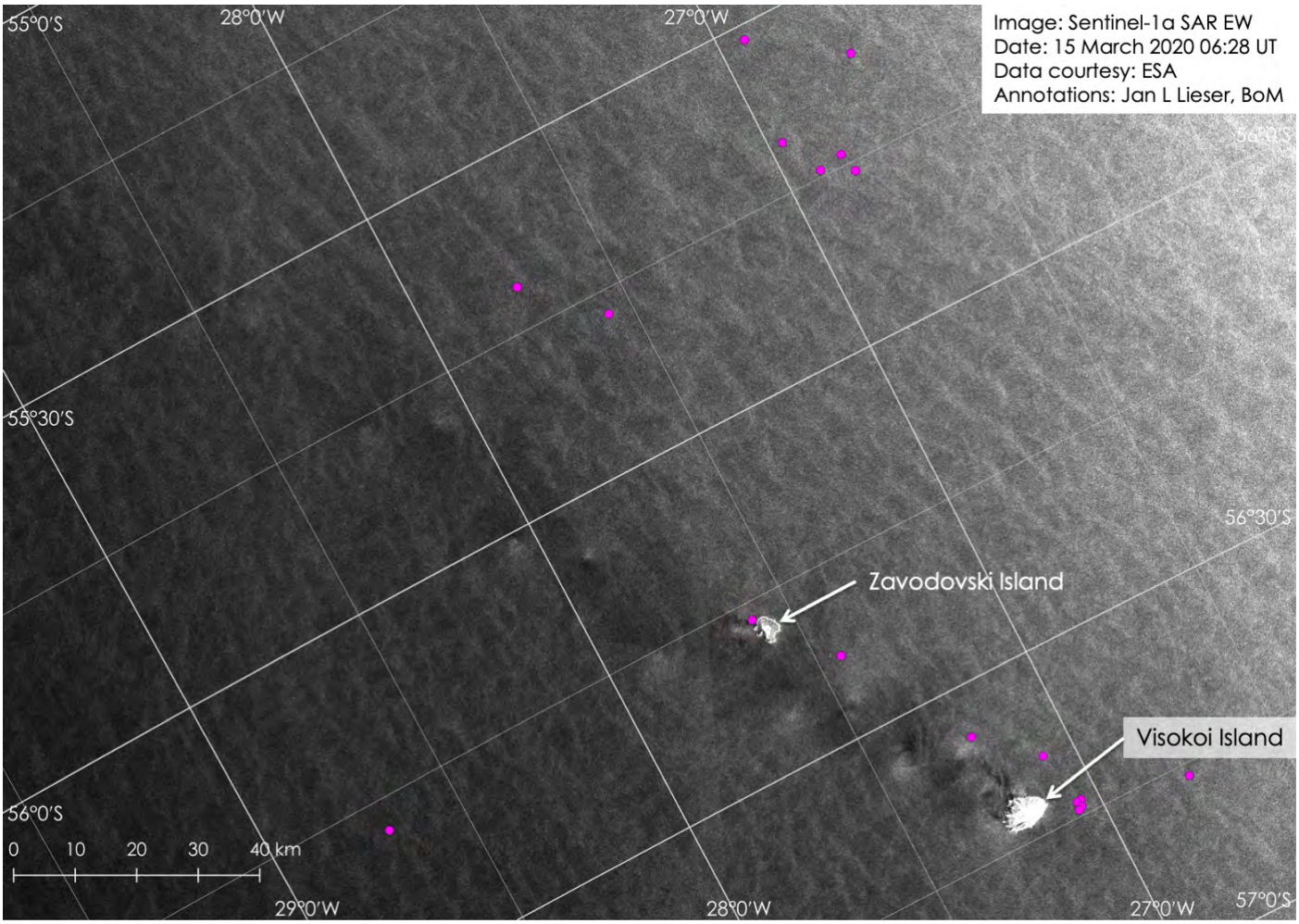

***Figure 1**: Sentinel-1a SAR EW scene acquired 15 March 2020 at 06:28 UT provided by PolarView.*

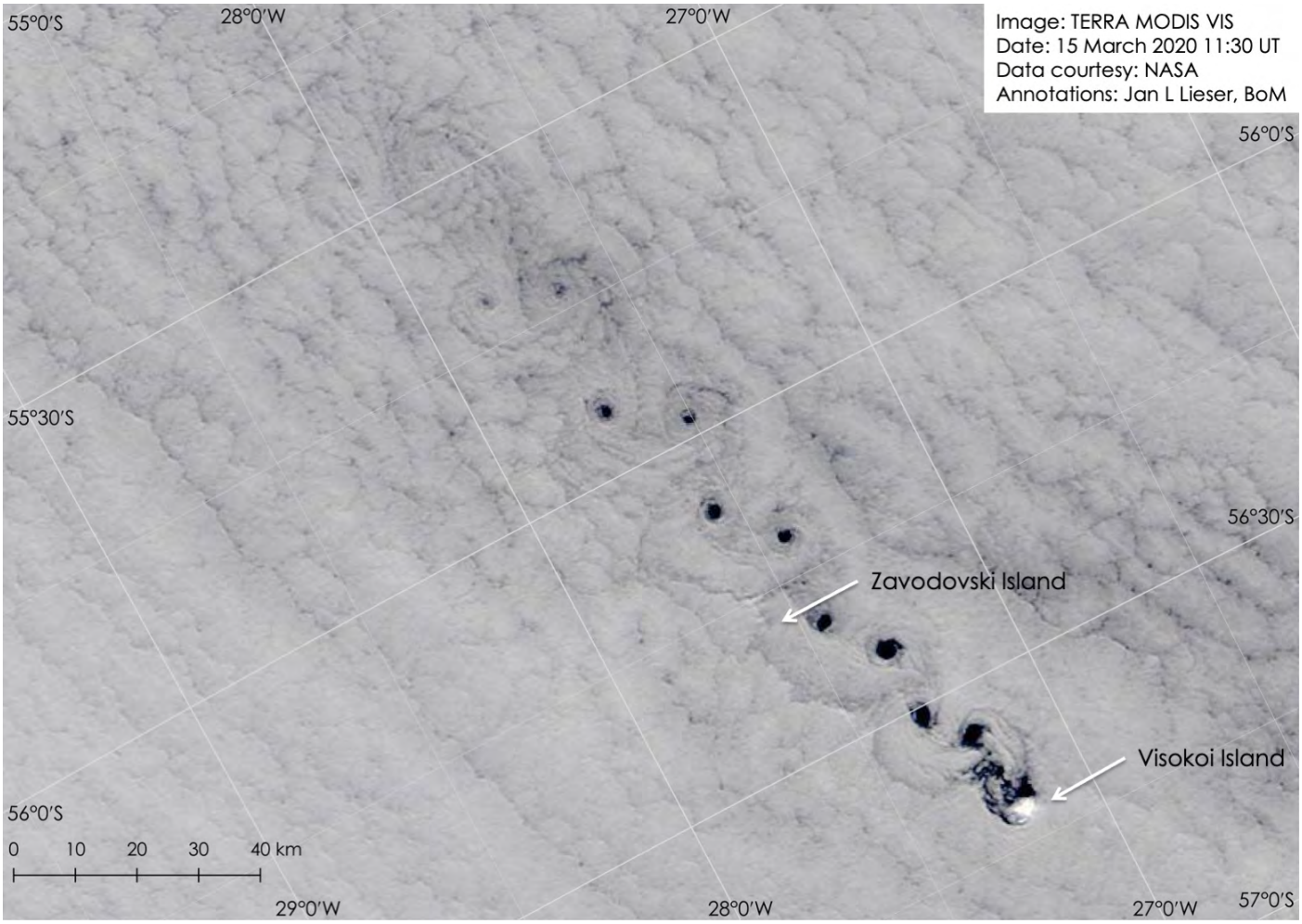

***Figure 2**: TERRA MODIS VIS scene acquired 15 March 2020 at 11:30 UT provided by NASA.*

Ice Bulletin: Cooperation Sea

Issued: Thursday 19th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows SAR data for southern Cooperation Sea between Cape Darnley and the Vestfold Hills/Davis Station. The drift of two large tabular icebergs is marked by colour-coded shapes.

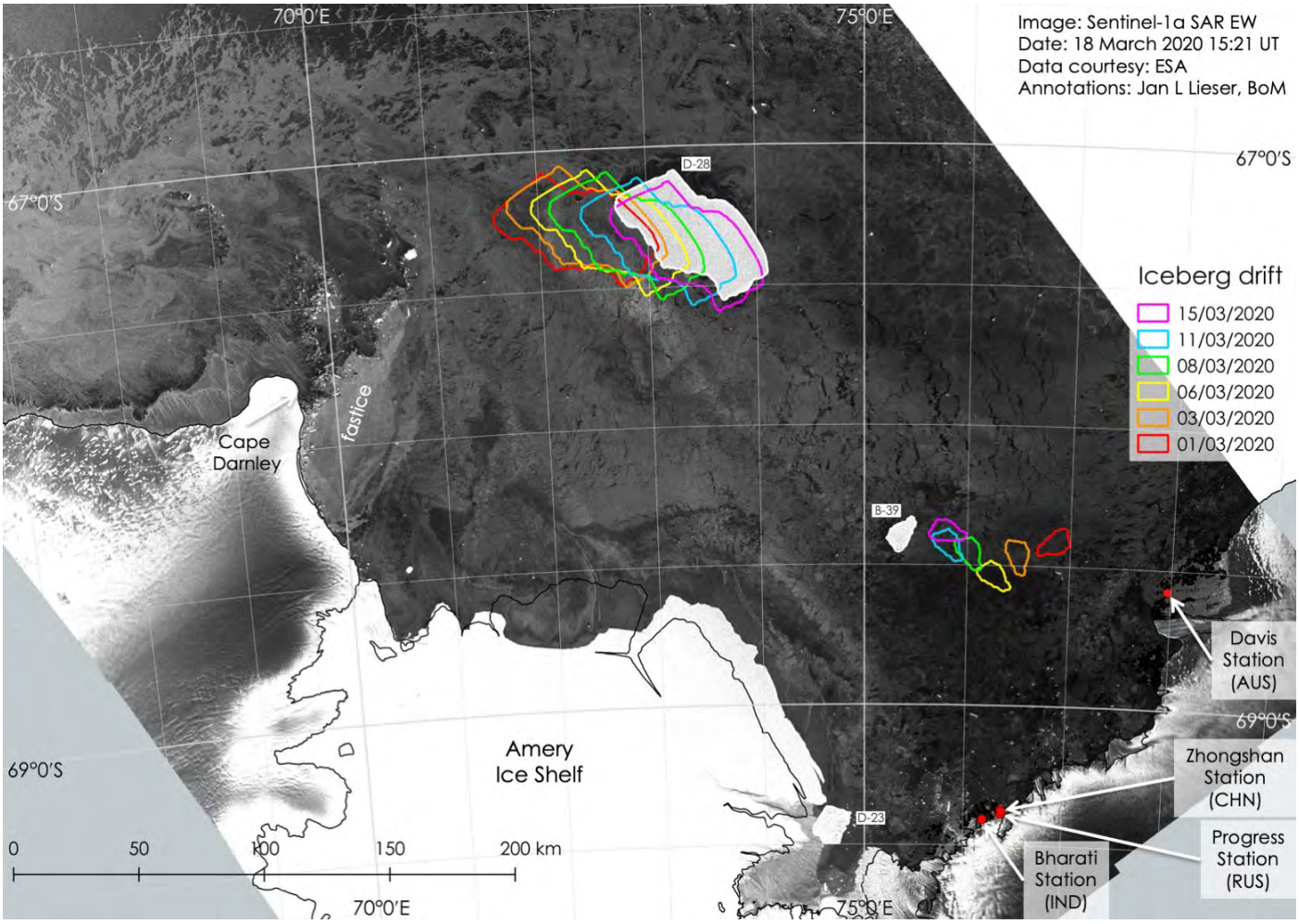

***Figure 1**: Sentinel-1a SAR EW data acquired 18 March 2020 at 15:21 UT and provided by PolarView.*

West of Davis Station, iceberg B-39 is drifting further offshore. Since the beginning of March, the berg has continued to rotate and travelled more than 33 nautical miles westward.

Meanwhile east of Cape Darnley, iceberg D-28 has drifted more than 45 nautical miles eastward away from the cape and the fast ice that has survived the summer season and is now growing again. This eastward drift was against the general north-westward drift of sea ice, which was drifting around the iceberg. Only since 15 March 2020, the iceberg has now a slight northward drift again.

In the entire region shown in the figure, new ice formation has set in and only between the ice shelf and iceberg D-28 some pack ice that survived the summer melt season is now being considered second-year sea ice.

Ice Bulletin: Sabrina Coast

Issued: Thursday 19th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows SAR data offshore Sabrina Coast, between the Law Dome and the Moscow University Ice Shelf.

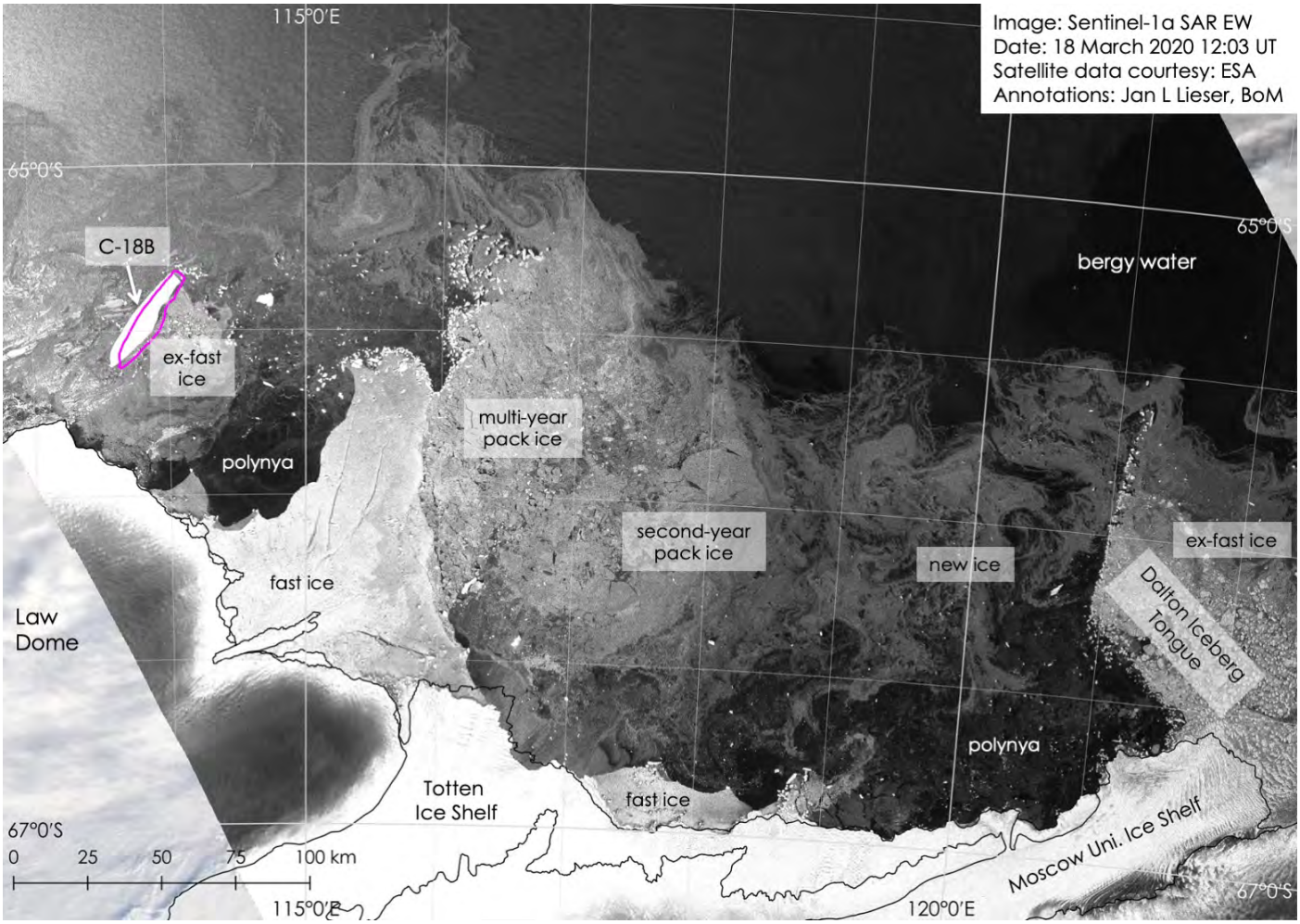

***Figure 1**: Sentinel-1a SAR EW data acquired 18 March 2020 at 12:03 UT and provided by PolarView; complemented with AQUA MODIS VIS data acquired 18 March 2020 and provided by NASA*

Off Sabrina Coast, some pack ice has survived the summer melt season and new ice is forming towards the sea-ice edge and in the polynya west of the Dalton Iceberg Tongue. Broken fast ice in between the icebergs of the iceberg tongue is now consolidating again but still shows signs of the summer break up.

Since early January 2020, iceberg C-18B has shifted slightly westward from a position that it had held for many years (pink shape). Southeast of the iceberg, a large polynya has grown since February 2020 and is partly still covered by broken ex-fast ice that is held against the iceberg with the westward ocean surface current.

Ice Bulletin: Iceberg A-68A

Issued: Thursday 19th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a SAR scene east of northern Antarctic Peninsula. The drift of iceberg A-68A since early March 2020 is shown by colour-coded shapes.

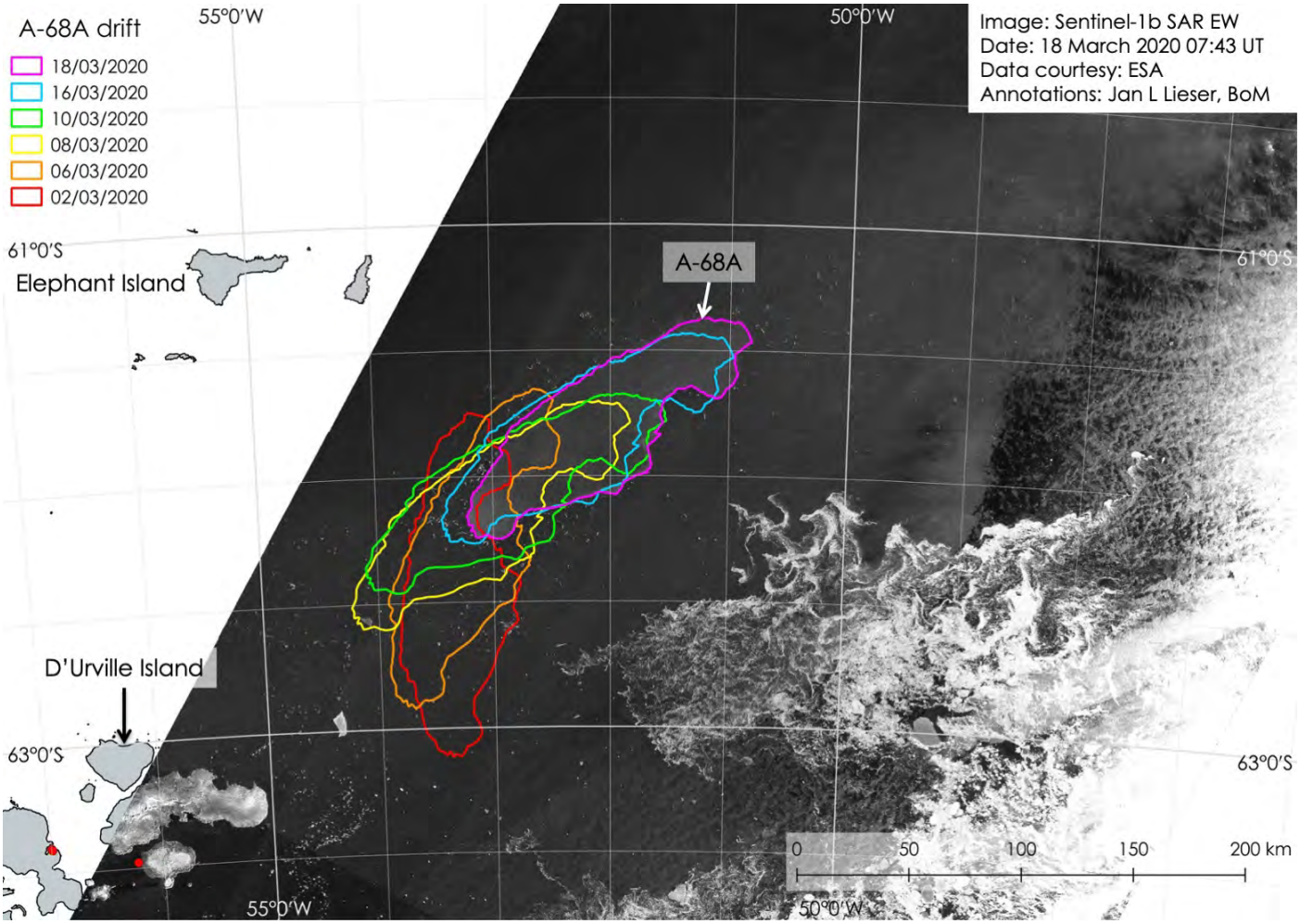

***Figure 1**: Sentinel-1b SAR EW data acquired 18 March 2020 at 07:43 UT and provided by PolarView.*

Since late February 2020, the iceberg had switched rotation and was continuing to turn clockwise on its generally northward course during March. Currently, it is closely following the 1000 m contour of the northwestern edge of the Powell Basin, which is centred roughly at 50ºW and 62ºS (see Figure 2).

Southwest of iceberg A-68A, many small icebergs (and one medium sized) can be seen drifting freely. At the northern edge of the iceberg, icebergs appear to the spawning off the edge of the berg.

Southeast of the iceberg, strips and patches of newly growing sea ice is seen in the SAR data.

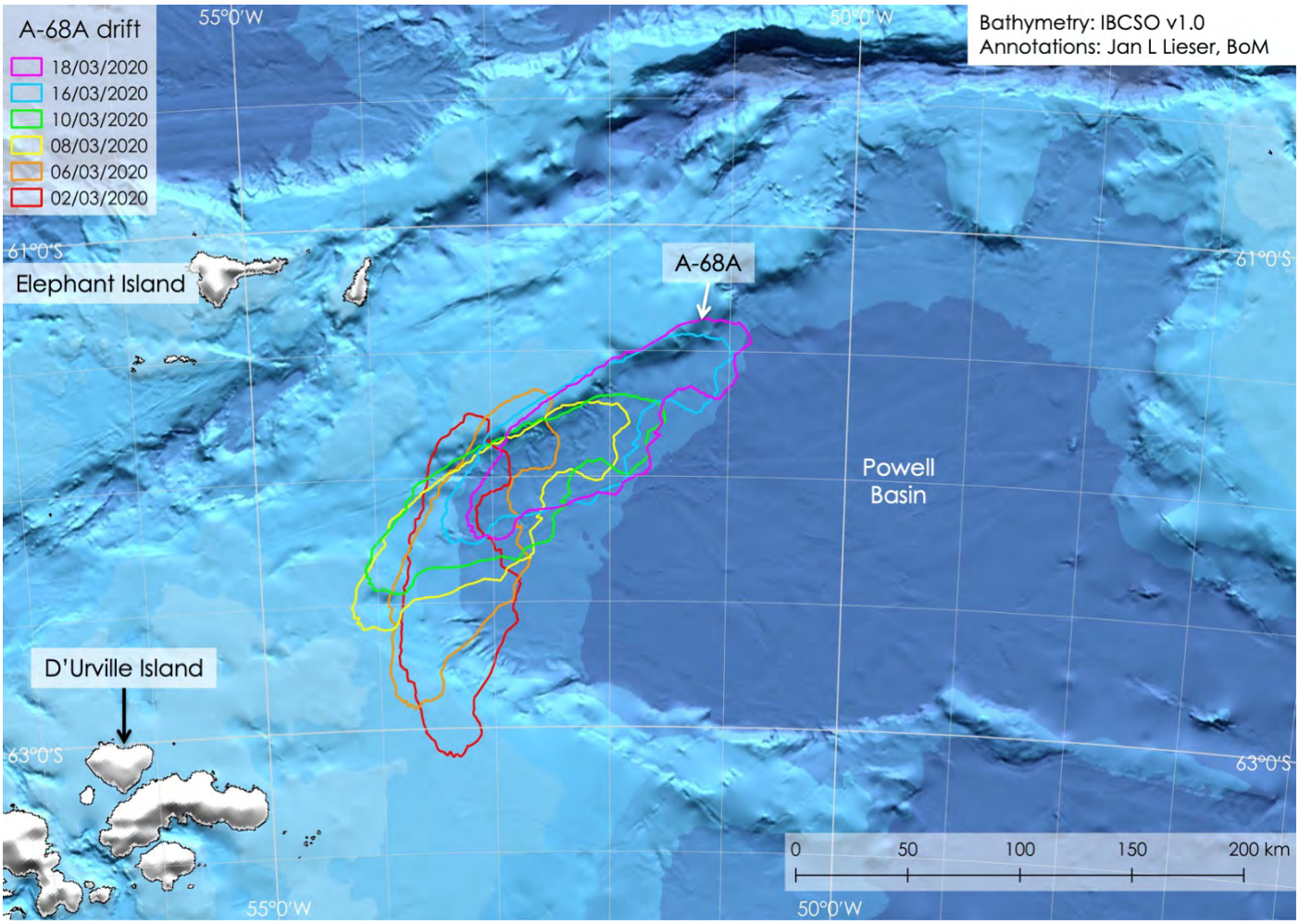

***Figure 2**: The drift of iceberg A-68A with respect to the bathymetry of the Powell Basin; bathymetry provided by IBCSO.*

Ice Bulletin: Casey Station/Wilkins Aerodrome

Issued: Friday 20th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution (30 m horizontal) visible scene of Casey Station and offshore.

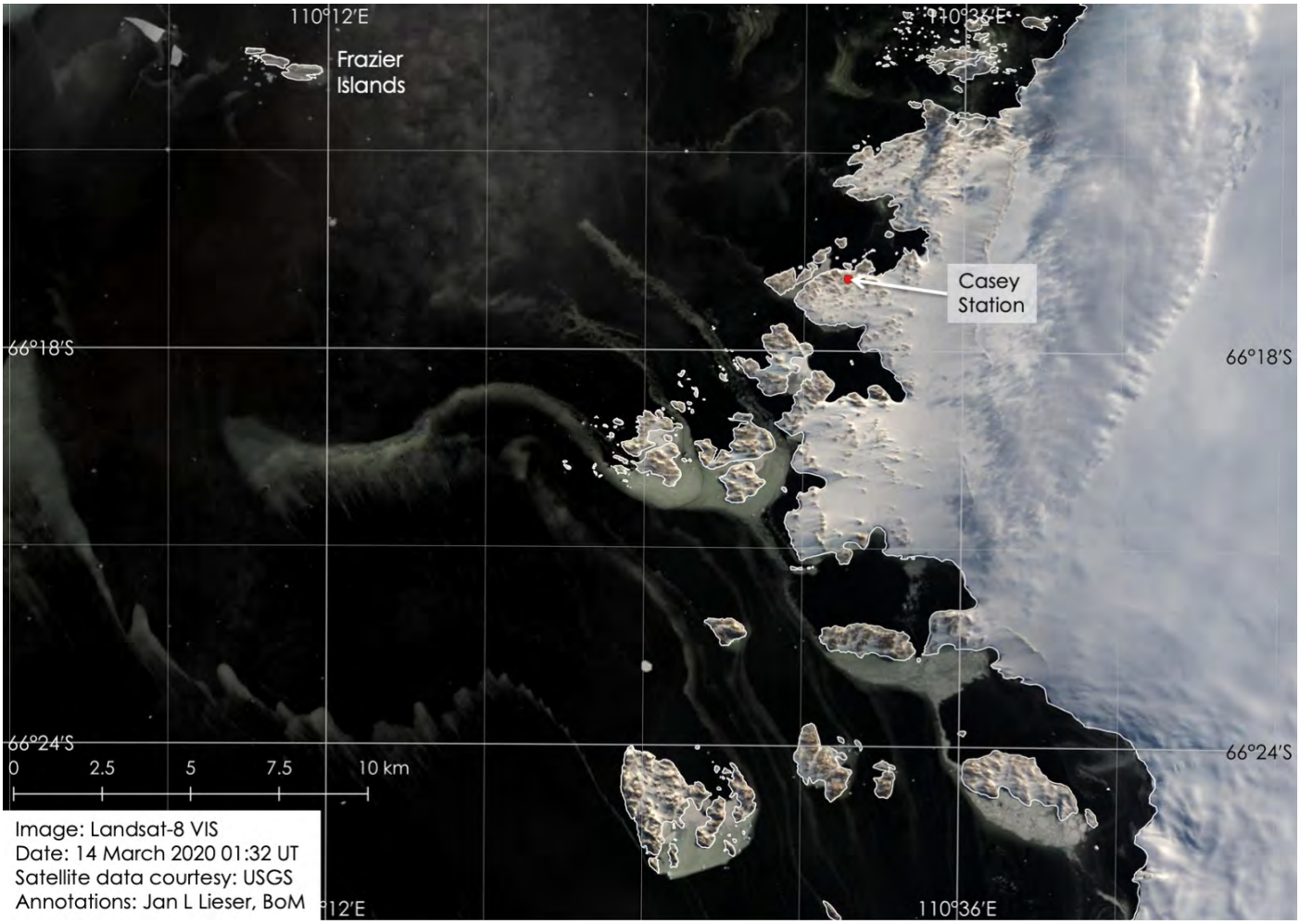

***Figure 1**: Landsat-8 visible composite acquired 14 March 2020 at 01:32 UT and provided by USGS.*

New ice formation is seen with strips and patches of grease ice drifting generally north-westward. I few isolated icebergs are also found in the scene.

Figure 2 shows a very high-resolution (15 m horizontal) panchromatic scene of Wilkins Aerodrome.

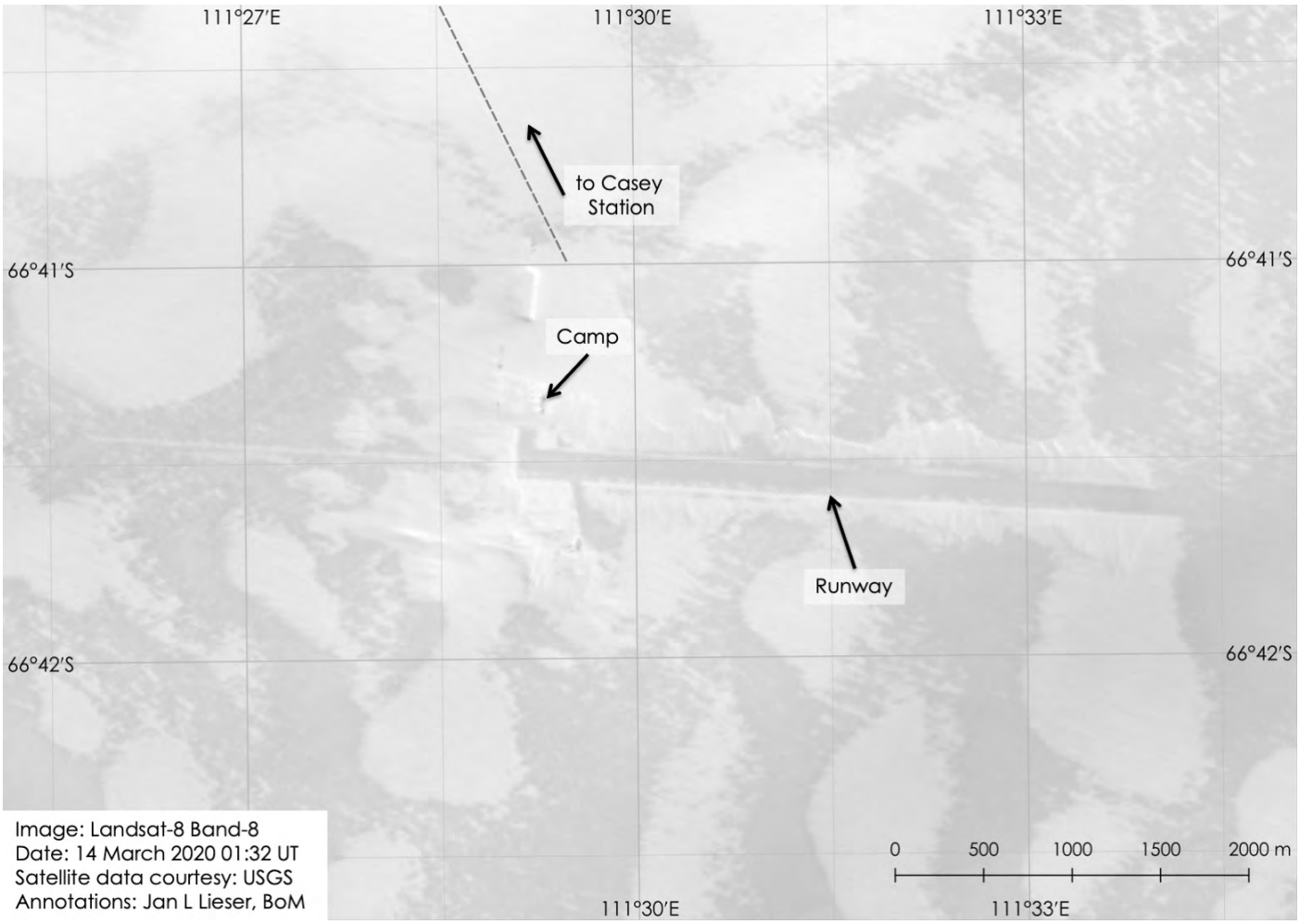

***Figure 2**: Landsat-8 Band-8 (panchromatic) scene acquired 14 March 2020 at 01:32 UT and provided by USGS.*

The blue-ice runway is clearly visible in the cloud-free scene. The route to Casey Station and the camp are also clearly visible. North and south of the runway, snow dunes are left from clearing the runway.

Ice Bulletin: D'Urville Sea

Issued: Tuesday 24th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a high-resolution SAR swath for southern D'Urville Sea between Cape Denison and the Ninnis Ice Shelf.

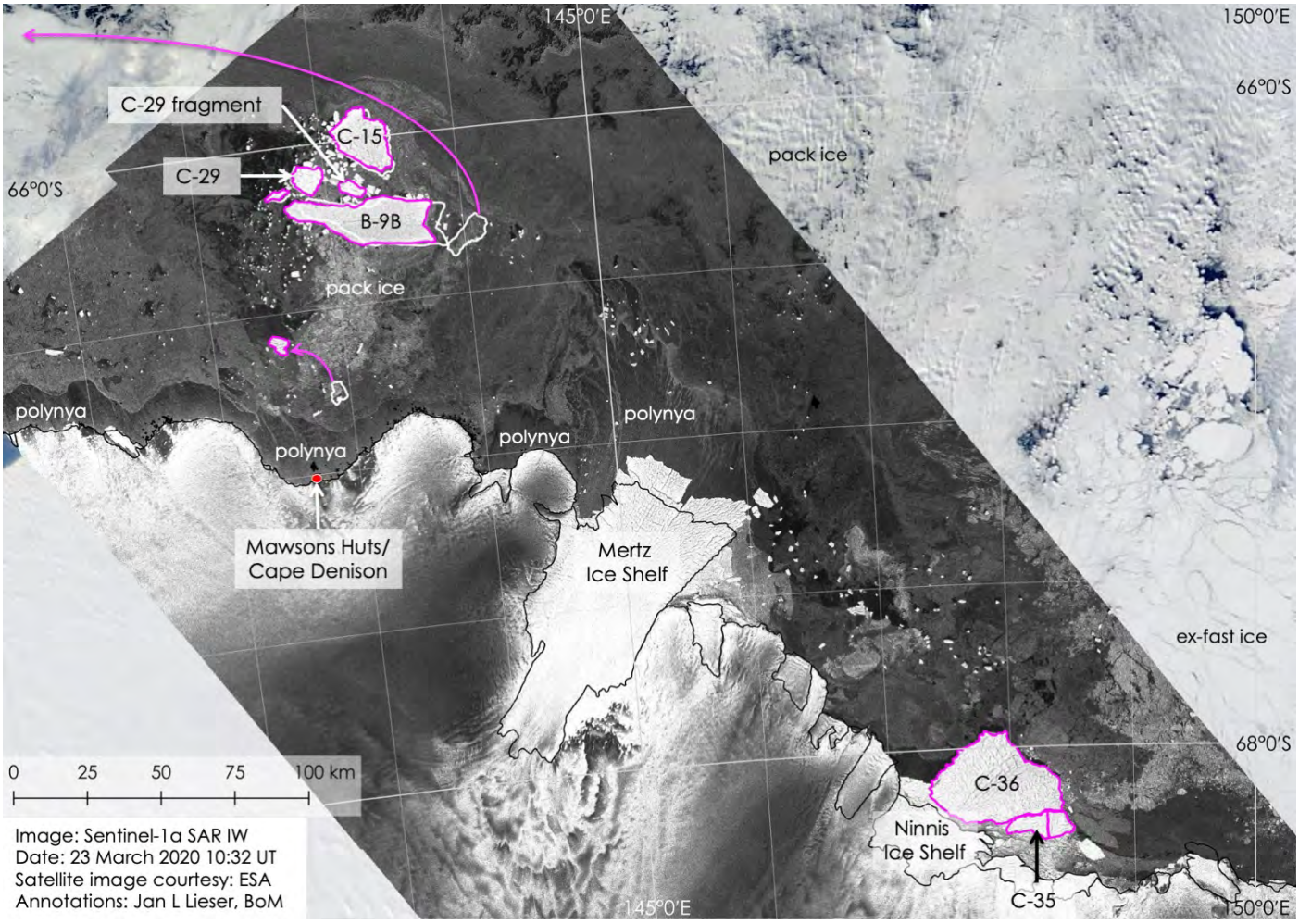

***Figure 1**: Sentinel-1a SAR IW data acquired 23 March 2020 at 10:32 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 23 March 2020 and provided by NASA.*

Sea ice is growing and consolidating in the area. West of the Mertz Ice Shelf, a near-shore polynya is maintained by offshore winds. Between Cape Denison and iceberg B-9B, a melange of old sea ice, ex-fast ice and newly forming sea ice originating in the polynya conglomerates. The entire offshore region of Figure 1 is covered by some form of sea ice or icebergs.

North of Cape Denison, most of the large icebergs have not moved far since 12/02/2020 (white shapes), except for iceberg C-33 that departed the region since late February 2020.

Off the Ninnis Ice Shelf, iceberg C-35 has split in two, where the larger western part (78 km^2 or 23 nautical miles^2) will retain the name and the smaller eastern part (59 km^2 or 17 nautical miles^2) is too small to be tracked. The cut-off for iceberg tracking by the NSIDC is 20 nautical miles^2 and/or 10 nautical miles across.

Ice Bulletin: Mawson Station

Issued: Wednesday 25th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows a very high-resolution (15 m horizontal) panchromatic scene of Mawson Station and offshore.

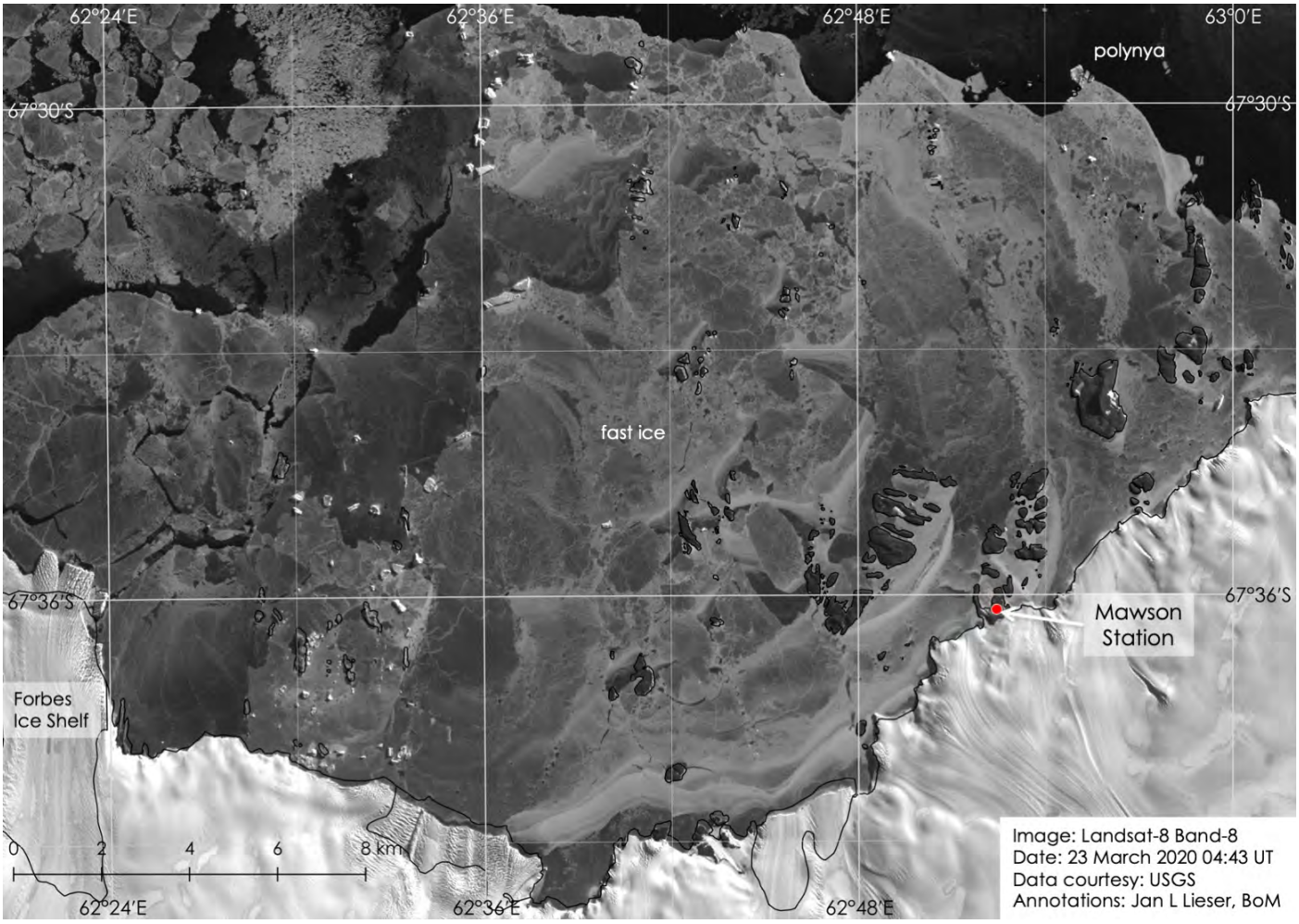

***Figure 1**: Landsat-8 Band-8 (panchromatic) data acquired 23 March 2020 at 04:43 UT and provided by USGS.*

Patchy fast ice is growing offshore the station and between the islands. Grounded icebergs act as pinpoints for the ice to stabilise but particularly near-shore mostly new and young ice is present.

Figure 2 provides a larger scale view (almost the entire acquisition frame) of the same data of which Figure 1 shows the close-up around Mawson Station.

Many different forms of sea ice are distributed across the full offshore region of the figure. Nearshore, fast ice is starting to grow east of the station, whereas west of the station some fast ice has survived the summer season. Where grounded icebergs hinder sea-ice drift with the westward ocean surface current, polynyas appear in the lee of the icebergs. These polynyas are covered by a transient cover of new and very thin ice. East of Iceberg Alley, the pack ice consists of a melange of old sea ice, ex-fast ice and new ice forming in-situ. North of the pack-ice edge, the marginal ice zone is covered by grease ice, which presents the initial stages of new sea-ice floes. North of the high-concentration soupy grease ice, strips and patches of grease ice is carried and distributed by small-scale ocean-surface eddies under calm atmospheric conditions.

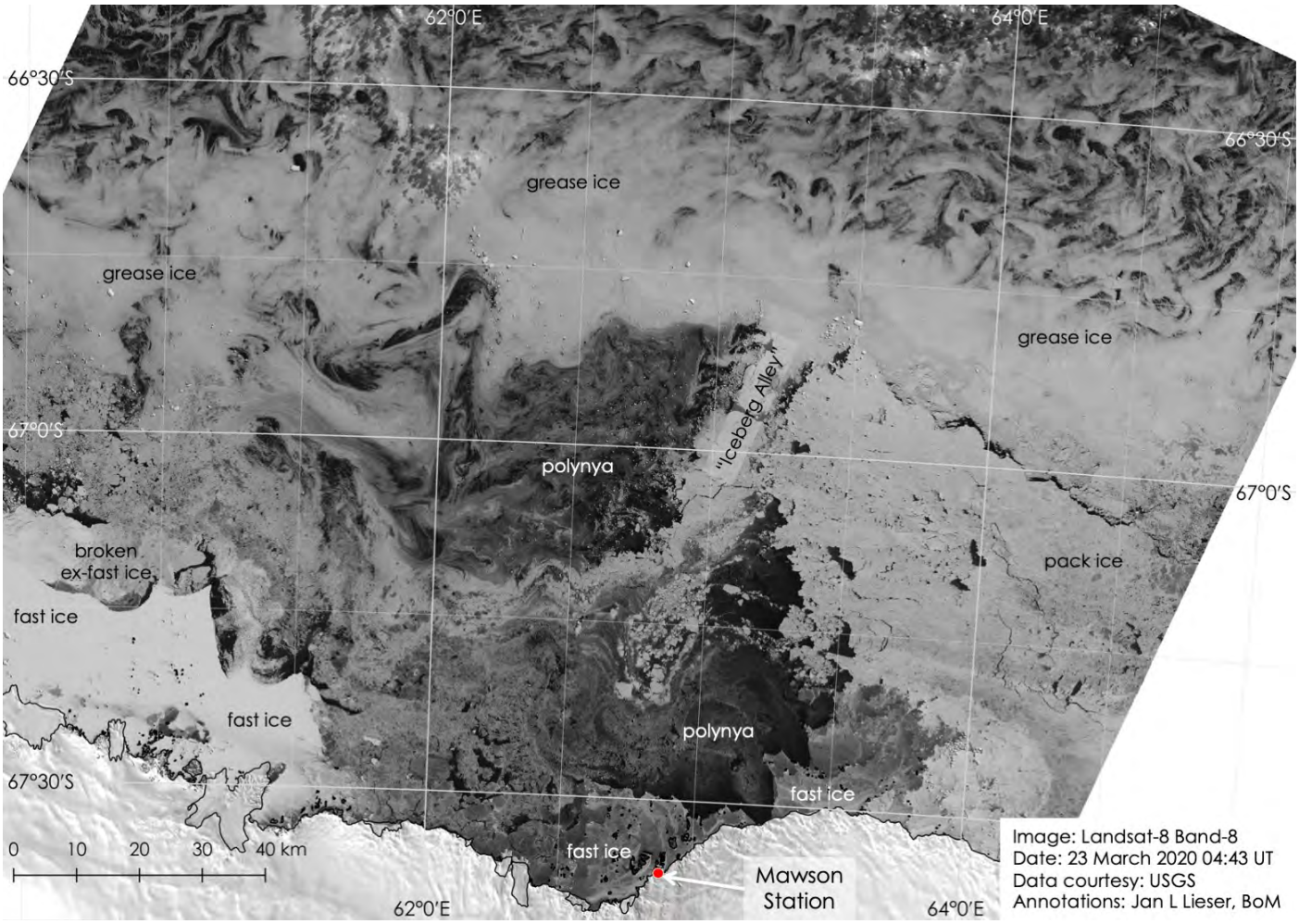

***Figure 2**: Landsat-8 Band-8 (panchromatic) data acquired 23 March 2020 at 04:43 UT and provided by USGS.*

Ice Bulletin: Davis Station

Issued: Thursday 26th March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows high-resolution SAR data of the Vestfold Hills and off Davis Station.

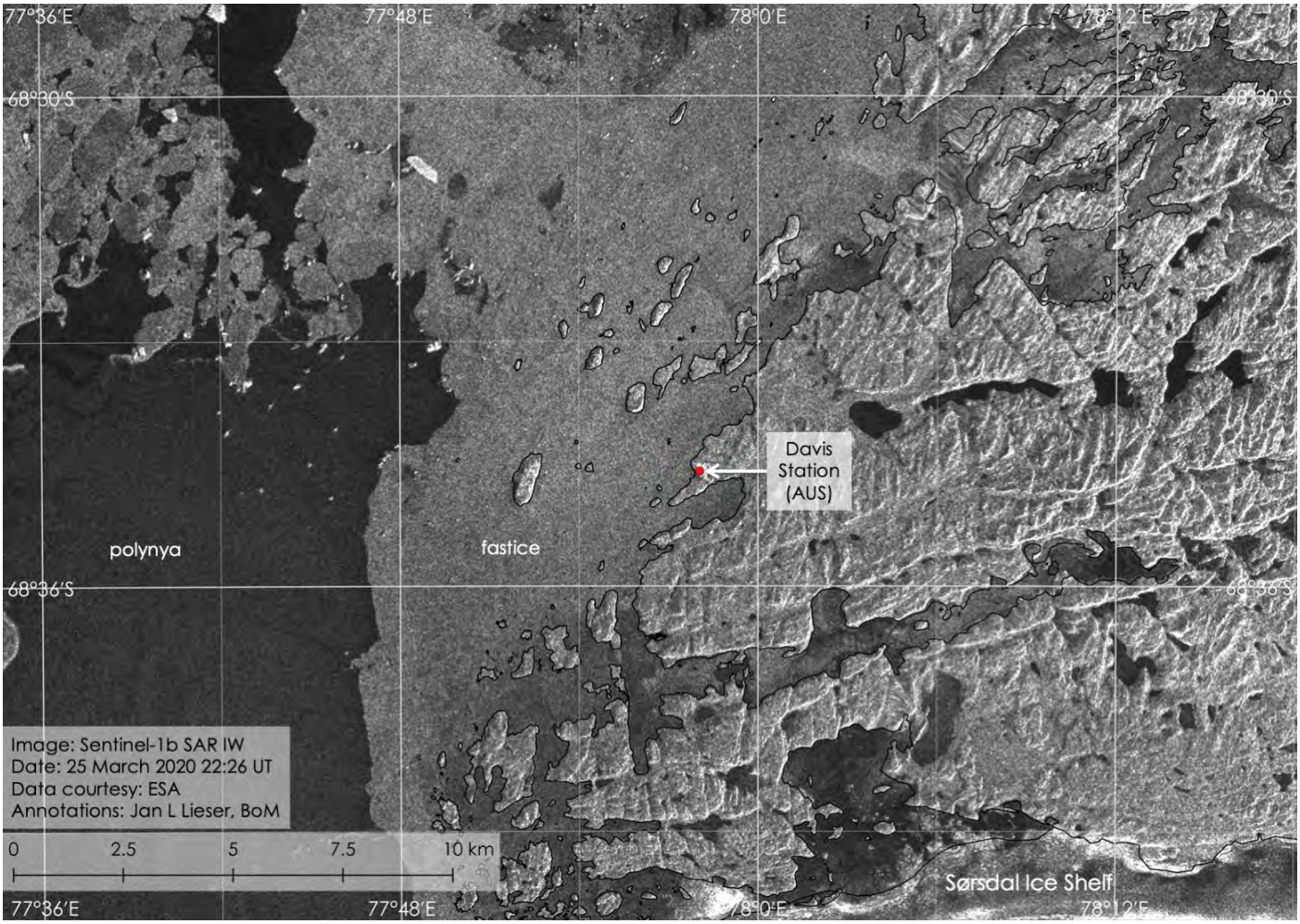

***Figure 1**: Sentinel-1b SAR IW data acquired 25 March 2020 at 22:26 UT and provided by PolarView.*

Off Davis Station, fast ice is growing westward that is partly stabilised by grounded icebergs but west of 77º48'E a small polynya is active.

Figure 2 shows the larger overview of which Figure 1 shows the small region around Davis Station. The entire area shown in Figure 2 is covered by some form of ice including comparatively small polynyas, one southwest of the Vestfold Hills (see also Figure 1), another one off the Publications Ice Shelf and a smaller one halfway between the aforementioned two. There is also a broken polynya north of the Vestfold Hills and a productive polynya west of the West Ice Shelf and north of it.

The position of iceberg B-39 is outlined based on SAR data acquired seven hours earlier. This iceberg is freely drifting within the pack ice.

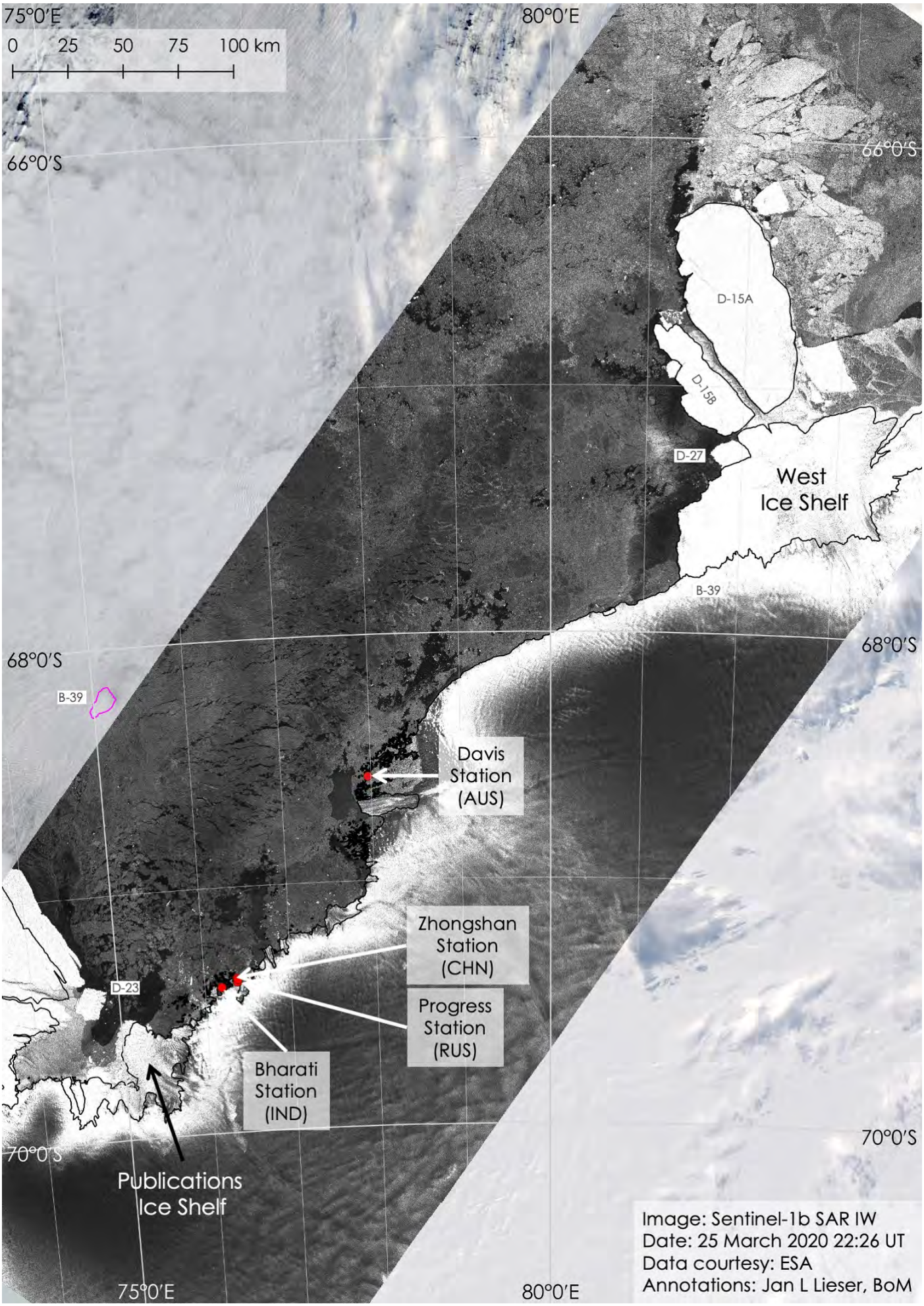

***Figure 2**: Sentinel-1b SAR IW data acquired 25 March 2020 at 22:26 UT and provided by PolarView; complemented by AQUA MODIS VIS data acquired 25 March 2020 and provided by NASA.*

Ice Bulletin: Cooperation Sea

Issued: Tuesday 31st March 2020

Analyst: Jan L. Lieser

Australian Government
Bureau of Meteorology

Ice Situation:

Figure 1 shows visible data for southern Cooperation Sea between Cape Darnley and the West Ice Shelf. The drift of two large tabular icebergs is marked by colour-coded shapes.

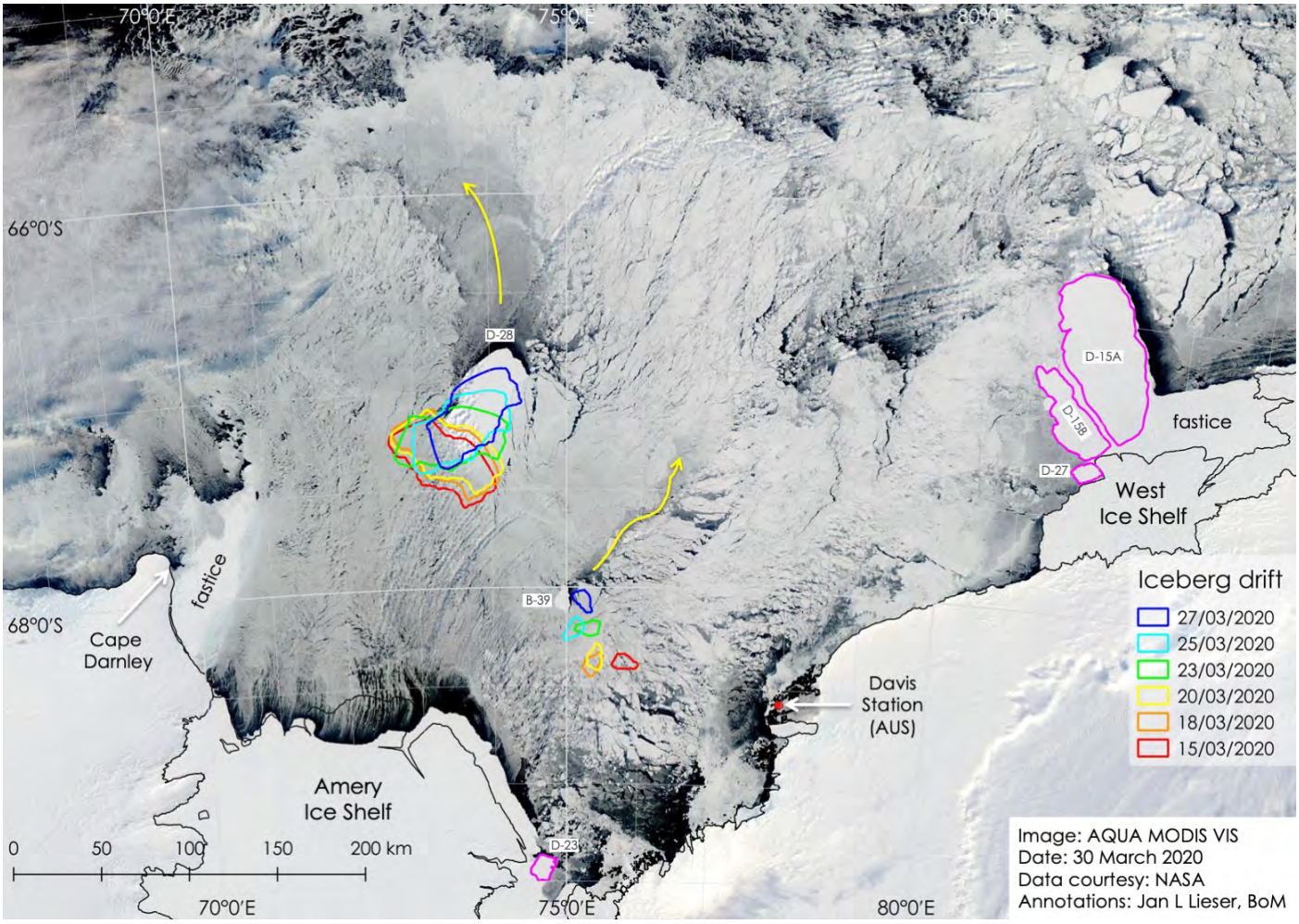

***Figure 1**: AQUA MODIS VIS data acquired 30 March 2020 and provided by NASA.*

The figure shows a largely cloud-free scene of the region. Only in the southeast (over the continent) and northwest (over the marginal ice zone), some thin clouds obscure the surface. A few streaks of sea smoke can also be seen between the Amery Ice Shelf and iceberg D-28 and in isolated places elsewhere.

West of Davis Station, iceberg B-39 is drifting further offshore. Since mid-March, the berg has continued to rotate and travelled more than 40 nautical miles westward in a zig-zag way.

Meanwhile north of the Amery Ice Shelf, iceberg D-28 has turned almost 90 degrees anti-clockwise and has now a more northward drift aligned with the sea ice. In the lee of both large icebergs, thin sea ice is newly forming in the wake of the icebergs (yellow arrows).

In the entire region shown in the figure, new ice formation has set in and nearshore as well as behind obstacles (that is large icebergs or fast ice) polynyas of varying form and duration are present.

About the author:

Jan L Lieser

Dr Jan L Lieser is a meteorologist and marine glaciologist with the Antarctic Meteorology Section at the Australian Bureau of Meteorology.

Jan is the leader of the Ice Service that is provided by the Bureau of Meteorology. Besides his operational duties he maintains a research interest is polar remote sensing. He has also collected on-site polar meteorological observations and sea-ice geophysical measurements, and has researched numerical modelling of Arctic sea ice and Antarctic subglacial Lake Vostok. He was a wintering scientist at the German Neumayer Station and has participated in several field research programs in both Antarctica and the Arctic Ocean, conducted by the Australian Antarctic Division and the German Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research. Jan has spent more than 450 days at sea, on-board icebreakers.

The sea-ice edge off Knox Coast (centre roughly at 104° *E and* 61° *S).*

Sentinel-1b SAR EW scene acquired 28/10/2019 at 12:37 UT and provided by PolarView.