Seasonal Outlook for Ross Sea and McMurdo Sound 2022-2023

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INTRODUCTION

The U.S. National Ice Center (USNIC) provides planning and real time operational support for the efforts of the United States Antarctic Program (USAP) through collaboration with National Science Foundation (NSF) and the U.S. Coast Guard (USCG). Specifically, this outlook is provided as environmental awareness to safely plan icebreaker operations in the McMurdo/Ross Sea channel and escort ice-strengthened resupply ships to the pier at McMurdo Station, located at 77°51'S, 166°40'E.

In this specific outlook, navigable sea ice is considered to be less than or equal to 4/10ths sea ice cover.

METHODOLOGY

Climatology: The rates of recession for the Ross Sea ice edge are predominantly derived using an analog forecasting technique that relates historical observations of pre-season ice extent and thickness to the predicted severity of austral summer ice conditions. This analog data from climatological conditions is adjusted to reflect the expected impact of current meteorological and oceanographic conditions in the Ross Sea.

Current Conditions: Based on the USNIC sea ice analysis for 28 October 2022 (Figure 1), the position of the maximum sea ice extent exceeded the climatological maximum over the eastern Ross Sea, and was below the climatological maximum in the western Ross Sea. In recent weeks strong winds and currents have pushed the existing sea ice toward the east, but weather conditions were not conducive to filling in the gaps left by the drifting ice in the western Ross with new ice growth. As is typical, the Ross Sea is primarily covered with first year sea ice (purple; >47" or >120cm), but it is the extent and distribution of old ice (red; second year/multi-year ice) that is of greater interest. This season the old ice is limited to areas in the eastern and western Ross Sea, with no band of old ice extending across the central region. The lack of old ice in the central basin could indicate a slightly earlier melt-out.

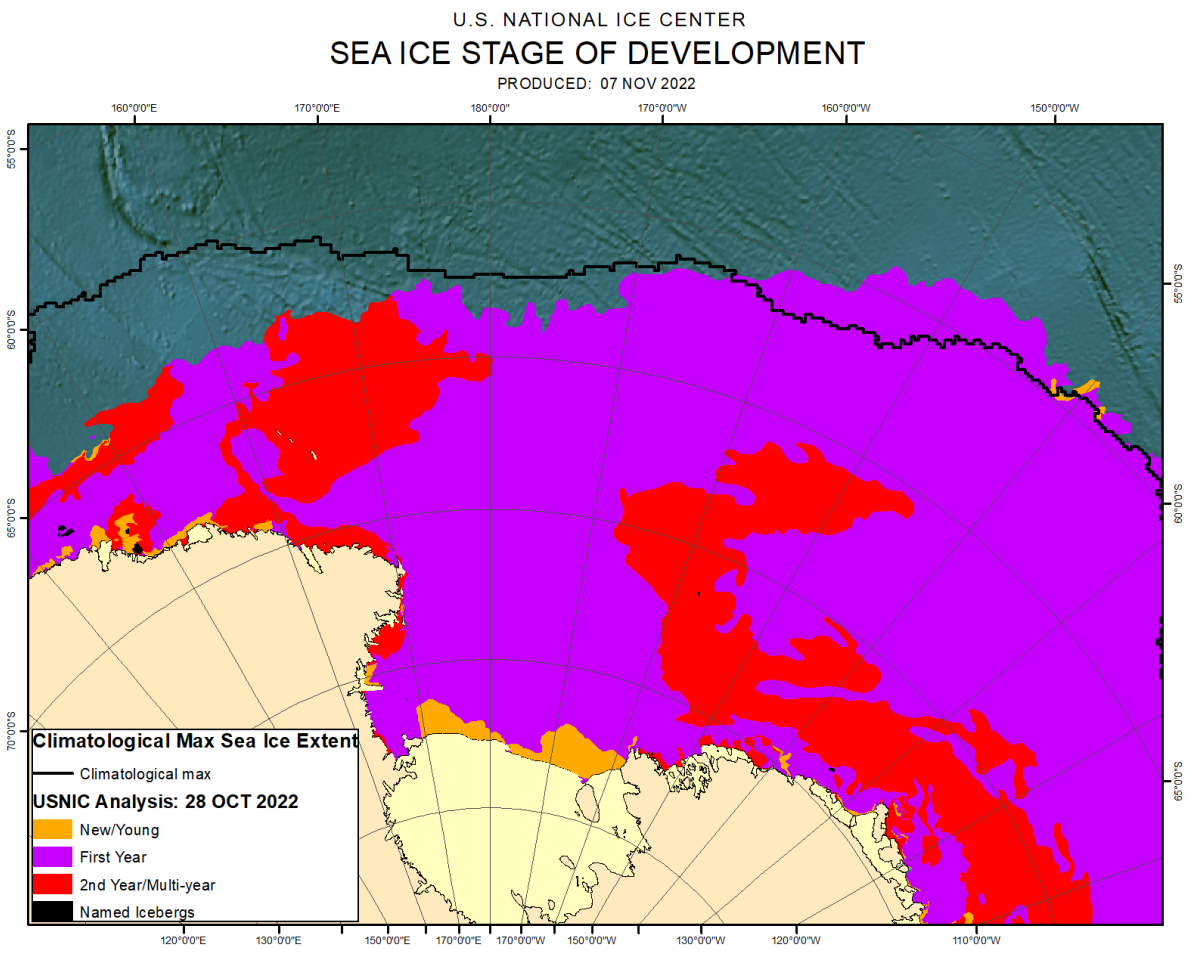

Figure 1. USNIC Weekly Analysis, Stage of Development valid: 28 October 2022.

McMurdo Sound: As of 13 November, the last survey by the McMurdo Station fast ice survey team[1] found the fast ice in McMurdo Sound ranges from averages 40” (102 cm) to 50” (150 cm) and continued to slowly thicken over the previous months due to continued cold conditions. This fast ice is thinner than average and very similar to 2019 thicknesses[1]. The fast ice edge currently extends about 15 NM out from the approximate location of the ship turning basin adjacent to the McMurdo pier (Figure 2). At this time the fast ice is typically about twice this extent if not more, which combined with the lack of thickness makes for a very below average year for McMurdo Sound fast ice. It is unknown what effect it may have had, but the 4km long iceberg situated East-West across the western portion of the Sound appears to have finally broken free of its grounding location and drifted north. Judging by VIIRS IR and Day-Night band imagery the iceberg seems to have drifted out of the area in May 2022. We believe that the iceberg acted as a buttress to northward drifting sea ice, which more easily allowed fast ice to form and grow in extent and thickness.

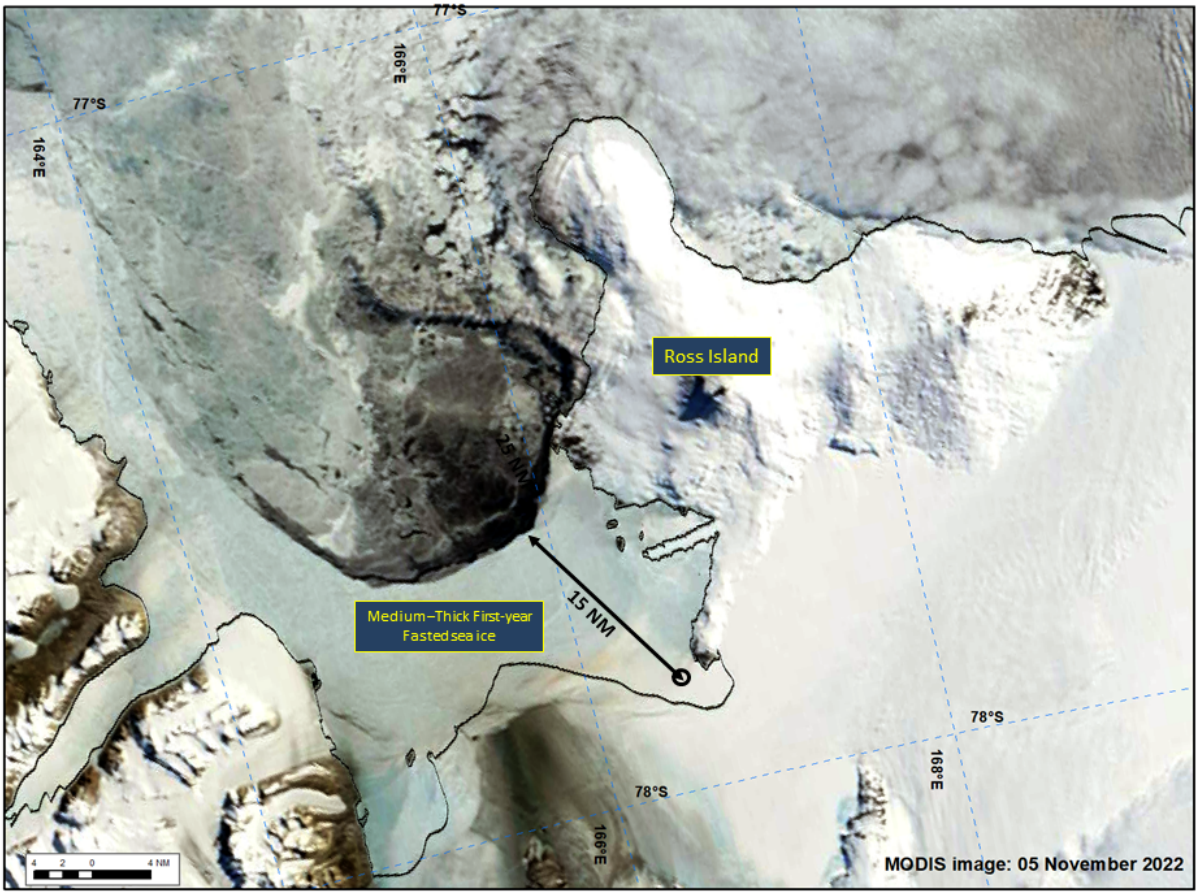

Figure 2. Fast Ice situation in McMurdo Sound as of 5 November 2022. MODIS Image.

Seasonal Weather: Average surface air temperatures[2] for the austral sea ice growth season (April – October) were -20°C or colder for the Ross Sea basin, with a narrow band of warmer temperatures that settled over the western edge of the Ross Sea. Compared to the climatological average, temperatures were 0.5-3°C above normal for the majority of the Ross Sea basin with the greatest anomaly occurring along the western side near Ross Island and Terra Nova Bay (Figure 3). This season's temperature anomaly was warmer than last year and centered more over the western Ross Sea than last year.

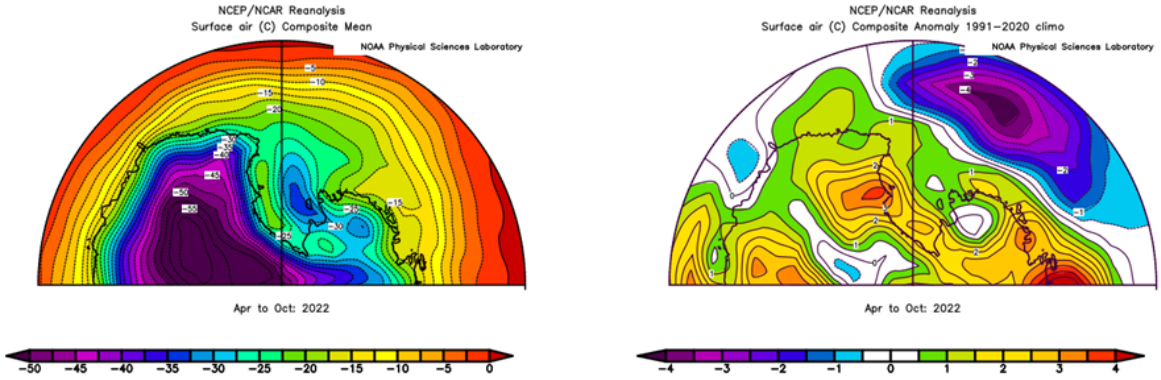

Figure 3. NCEP/NCAR Reanalysis of mean Surface Air Temperature (left) and Surface Temperature Anomaly (right) from Apr-Oct 2022

Katabatic winds off the Ross Ice Shelf help to produce prodigious amounts of sea ice during the winter. Variations in the wind can influence sea ice extent and potentially thickness. To investigate this potential driver we look at the mean meridional wind and meridional wind anomaly for the sea ice growth season (April to October)[2]. Excessive southerly winds can create prodigious amounts of new and young ice, but may not allow enough time for it to thicken before being pushed north into a warmer environment. Weak winds could result in less overall ice extent, but coupled with cold temperatures the ice could be thicker than average. For 2022, the strongest southerly winds were centered over western side of the Ross Sea turning to northerly winds over the eastern Ross Sea near Edward VII Peninsula (Figure 4, left). This pattern is very similar to last year. The anomaly shows a strong decrease in southerly winds over the west side of the Ross Ice Shelf east of Terra Nova Bay up to 2m/s weaker than normal as the rest of the region was near normal compared to climatology. Compared to previous years, this wind pattern and anomaly are not significantly different to recent years.

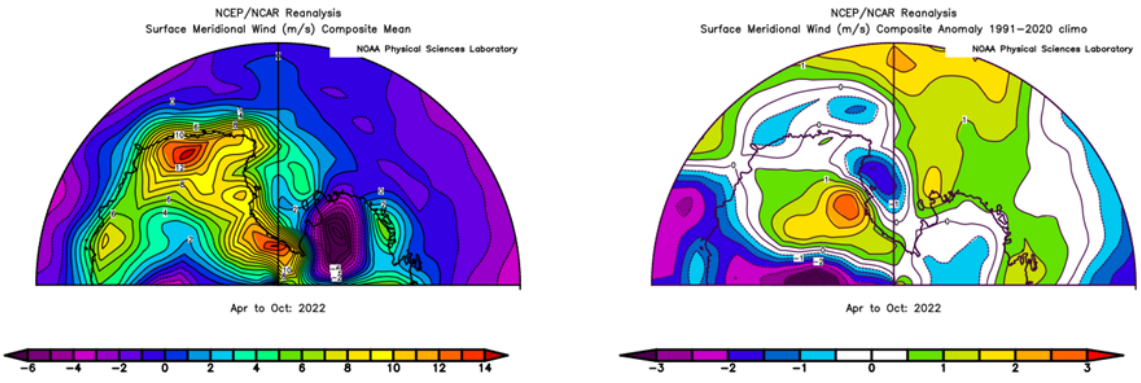

Figure 4. NCEP/NCAR Reanalysis of mean meridional surface winds (left) and meridional surface wind anomaly (right) from Apr-Oct 2022

Input considered for this outlook includes:

(a) Surface air temperature and temperature anomaly for the winter season April-October
(c) Fast ice extent in McMurdo Sound
(d) Current location of ice edge compared to previous years and climatological maximum
(e) Location and concentration of first-year and multi-year ice
(f) Meridional wind and wind anomaly in the Ross Sea
(g) Navy ESPC 45 day model sea ice thickness and concentration forecast

OUTLOOK

After careful consideration of all of the above parameters, we will use the 2018-2019 season as the analog for the Ross Sea recession pattern this season (Figure 5).

In 2018 the melt-out was well underway at the end of November with the Ross Sea polynya extending 200 NM northward from the Ross Ice Shelf. This year the edge has already significantly receded in the past month, but the polynya has not begun to open yet. This seems mostly due to a lack of southerly winds blowing off the Ross Ice Shelf creating the opening. On the west side of the basin, north of the Drygalski ice tongue winds have continued to blow off the coast and a polynya has opened there. It's unknown whether this wind anomaly will persist but we forecast the polynya to be smaller than usual by mid-December with the melt primarily pushing south from the northern ice edge. By the 3rd week of December 2018, the polynya extended northward to 72^{o}S, leaving only 200 NM of pack ice left to melt along the 175^{o}E meridian. In 2018, the Ross Sea became navigable (<40% sea ice concentration) on or around 31 December 2018, which was the first time in recent memory this occurred in December. In February 2022, sea ice cover reached a record low in the satellite era(3), and has not yet rebounded to normal levels. The below average ice cover plus warmer than average temperatures, our projection says a similar situation should occur this year as well. We conservatively expect the central Ross Sea to be navigable by the first week of January; 3 January 2023 to be specific. Due to westerly winds and currents pushing the pack ice in a lopsided shape, we expect it could open east of 180 longitude again.

As always, there are numerous small icebergs scattered throughout the Ross Sea which can pose a hazard to navigation. Currently, iceberg B-46 is near 160^{o}W drifting north-east and does not pose a hazard to the central Ross Sea.

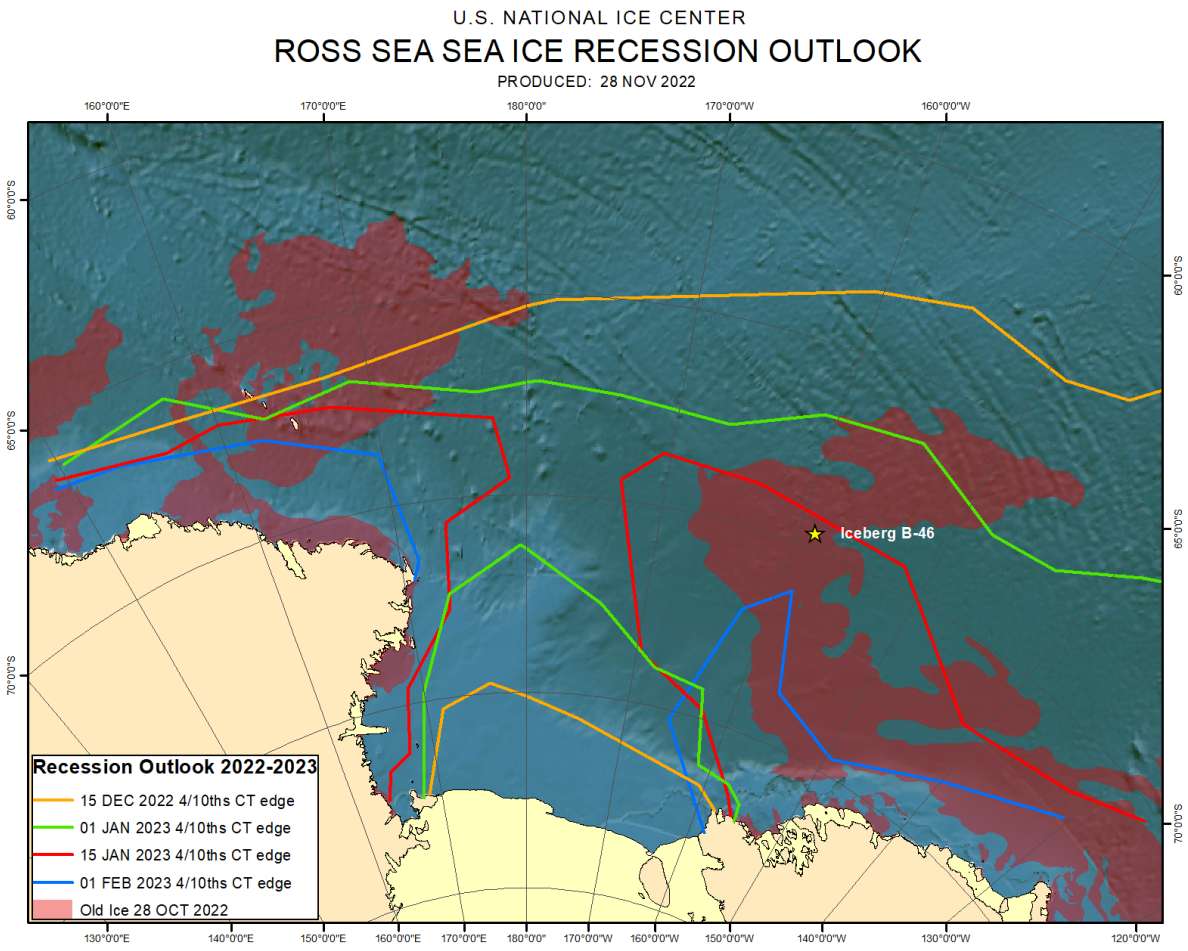

Figure 5. 2022-2023 Ross Sea Ice Edge Recession Outlook (lines indicate 4/10 sea ice concentration).

Sea ice analyses for the Ross Sea can be obtained via the USNIC website at: https://usicecenter.gov/Products/AntarcHome

REFERENCES

[1] McMurdo FS&T. (2022), McMurdo Sea Ice Report November 13, 2022.

[2] Kalnay, E. and Coauthors, (1996), The NCEP/NCAR Reanalysis 40-year Project. Bull. Amer. Meteor. Soc., 77, 437-471.

[3] Turner, J. et al. (2022), Record Low Antarctic Sea Ice cover in February 2022. *Geophysical Research Letters, 49*, e2022GL098904. https://doi.org/10.1029/2022GL098904