Seasonal Outlook for Ross Sea and McMurdo Sound 2021-2022

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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, the term "ice edge" is used to delineate the boundary between areas with greater than or equal to 4/10ths sea ice and areas with less than 4/10ths sea ice.

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 2021 (Figure 1), the position of the northern ice edge was very close to the climatological maximum extent for this time of year except for the western Ross Sea where there was significantly less ice. The spring melt has already begun in that area and the edge has been pushed south by northerly winds. As is typical, the Ross Sea is primarily covered with first year thick 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 there is a narrow east-west bridge of old ice across the Ross Sea near 65°S, but the bulk of the old ice is concentrated far to the east, near 65°S, 150°W and the far west 65°S, 150°E. The concentration of old ice in the bridge is relatively low and should have minimal influence on the melt-out.

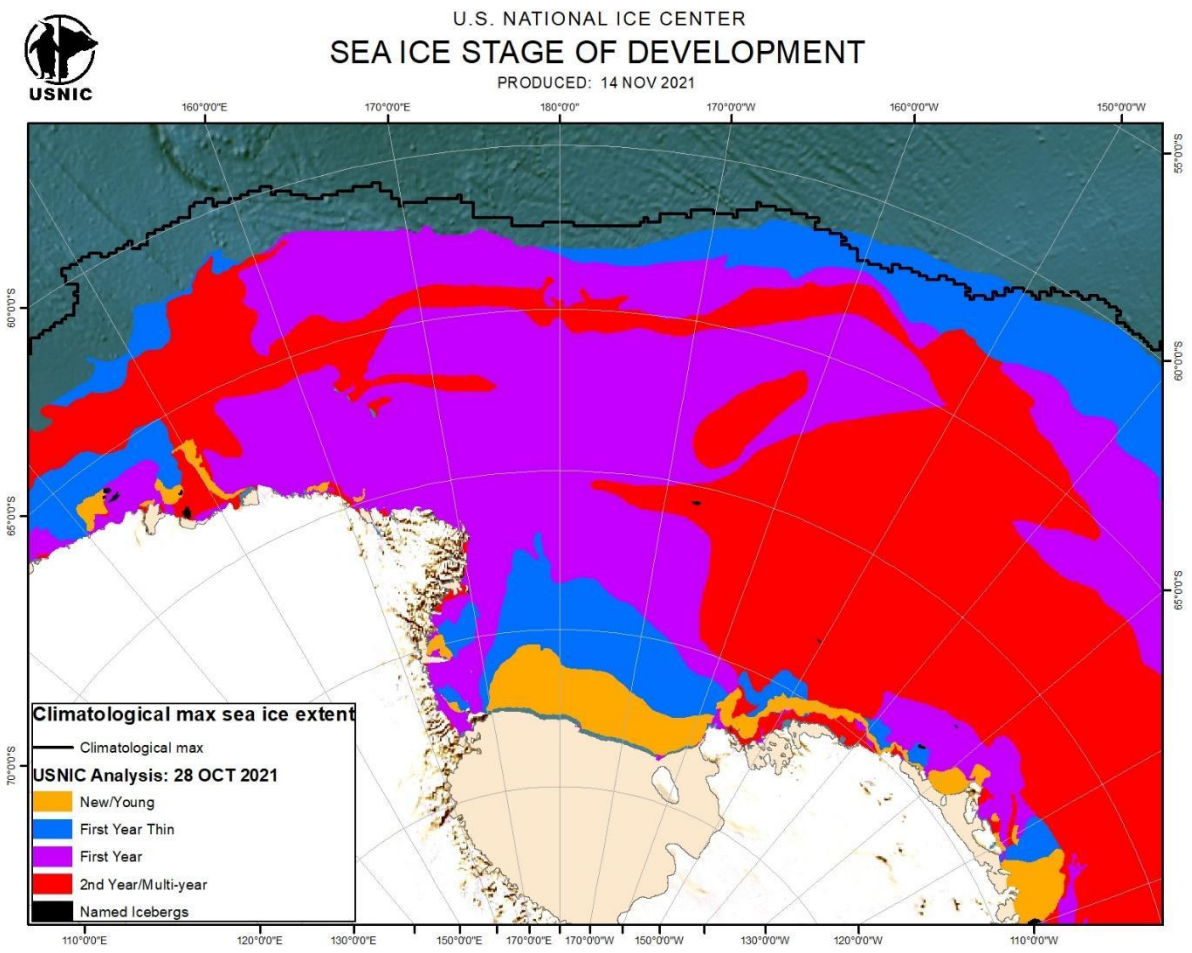

Figure 1. USNIC Weekly Analysis, Stage of Development valid: 28 October 2021.

McMurdo Sound: As of November 7th the most recent sea ice survey by the McMurdo Station fast ice survey team[1] found the fast ice in McMurdo Sound averages 84.5” (215cm) and was still thickening due to continued cold conditions. The fast ice edge currently extends out to Cape Bird which is ~38 NM from the typical ship turning basin (Figure 2). At this time it is unknown whether the fast ice will remain at this further extent or if it will break off as the melt ramps up. The more typical scenario leaves around 14–16 NM of fast ice for the USCGC Polar Star to cut in the channel.

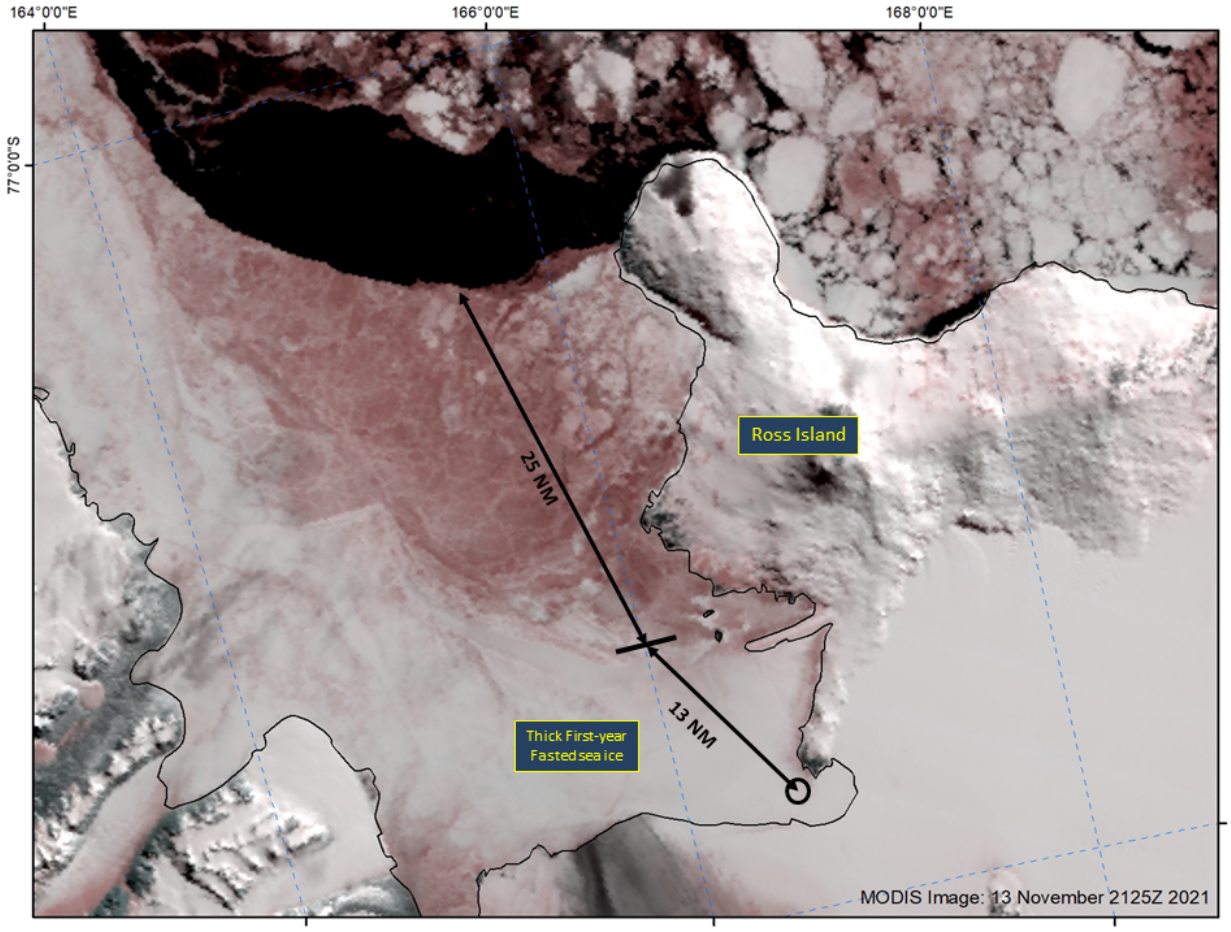

Figure 2. Fast Ice situation in McMurdo Sound as of 13 November 2021. MODIS Image.

Average surface air temperatures[2] for the Austral autumn and winter averaged −20°C or colder for most of the Ross Sea basin, but overall temperatures were 0.5–2°C above normal for the majority of the Ross Sea basin, (Figure 3). This pattern of temperatures and temperature anomalies was very similar to last year, in both location and magnitude.

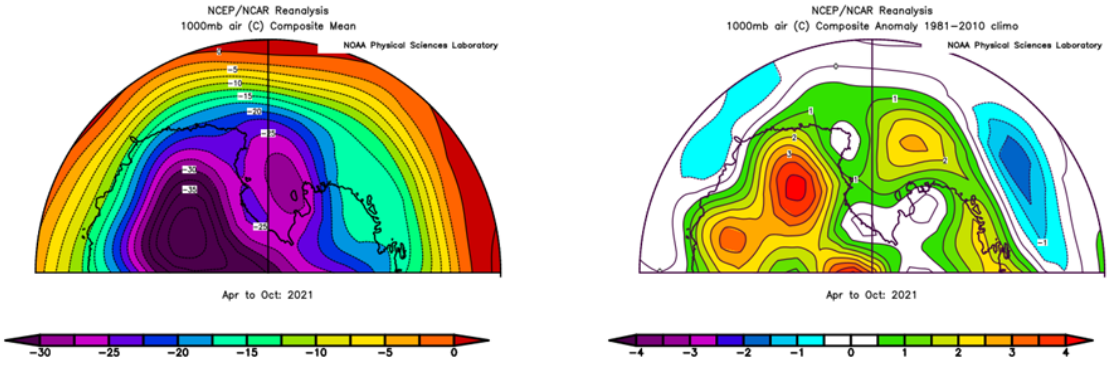

Figure 3. NCEP/NCAR Reanalysis of mean 1000mb air temperatures (left) and 1000mb temperature anomaly (right) from Apr-Oct 2021.

Katabatic winds off the Ross Ice Shelf help to produce prodigious amounts of sea ice during the winter. Variations in the wind could 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 autumn-winter season[2]. Stronger than average southerly winds can create prodigious amounts of new and young ice, but may not allow enough time for it to grow in thickness 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 2021, the strongest southerly winds were centered over East Antarctica with decreasing values over the Ross Sea, switching to a peak in northerly winds in the far western Amundsen Sea. The anomaly shows a strong decrease in southerly winds over the west side of the Ross Ice Shelf near McMurdo Sound up to 3 m/s weaker than normal (Figure 4) as well as stronger than normal northerly winds to the east. Similar to the reanalyzed temperatures above, the reanalyzed wind pattern and anomalies were also very similar to 2020.

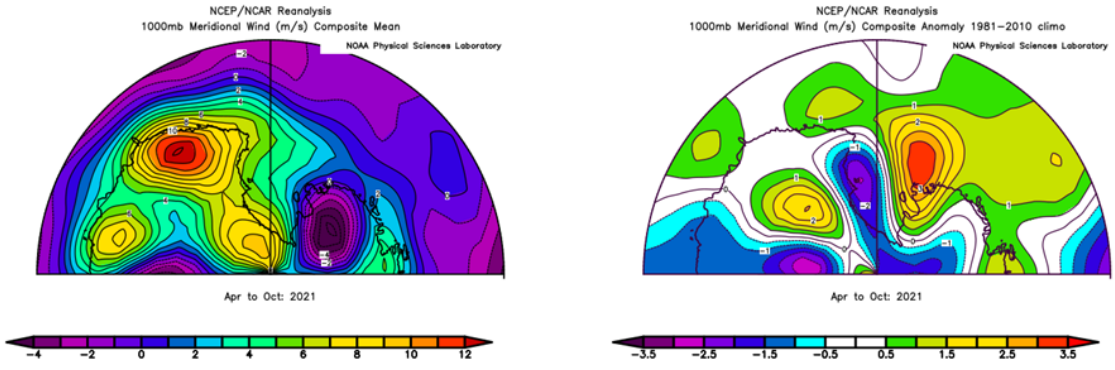

Figure 4. NCEP/NCAR Reanalysis of mean meridional winds (left) and meridional wind anomaly (right) from Apr-Oct 2021.

Input considered for this outlook includes:

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

OUTLOOK

Given all of the similarities described above between the 2020 and 2021 seasons from the overall extent of sea ice, the extent and distribution of old ice, the similar temperature and wind patterns during freeze-up and winter, 2020 will be used as the analog year for the Ross Sea recession pattern this year (Figure 5).

In 2020 the melt-out was well underway at the end of November with the Ross Sea polynya extending 150 NM northward from the shelf. The polynya began opening in the 3rd week of November, which occurred this year as well. In 2020, the Ross Sea became navigable (<40% sea ice concentration) in the 3rd week of January. Thus, our projection says a similar situation will occur this year as well; by January 17th, 2022 to be specific.

As always, there are numerous small icebergs scattered throughout the Ross Sea which can pose a hazard to navigation. Currently, iceberg B-50 is drifting northward east of 170°W, and does not pose a hazard to the central Ross Sea at this time.

As with recent years, USNIC will publish bi-weekly updates to this outlook beginning around 15 December comparing how the USNIC weekly analyses correspond to the recession dates. In addition we will use the ESPC 45-day model[3] to look ahead at how the melt-out progresses. Last year the ESPC model forecasts showed much faster than realistic melt, but the distribution of sea ice was much closer to reality than the Outlook suggested. So far this season, the model forecast follows the 15 December ice edge recession line fairly well, but the Ross Sea polynya is quite different (not pictured).

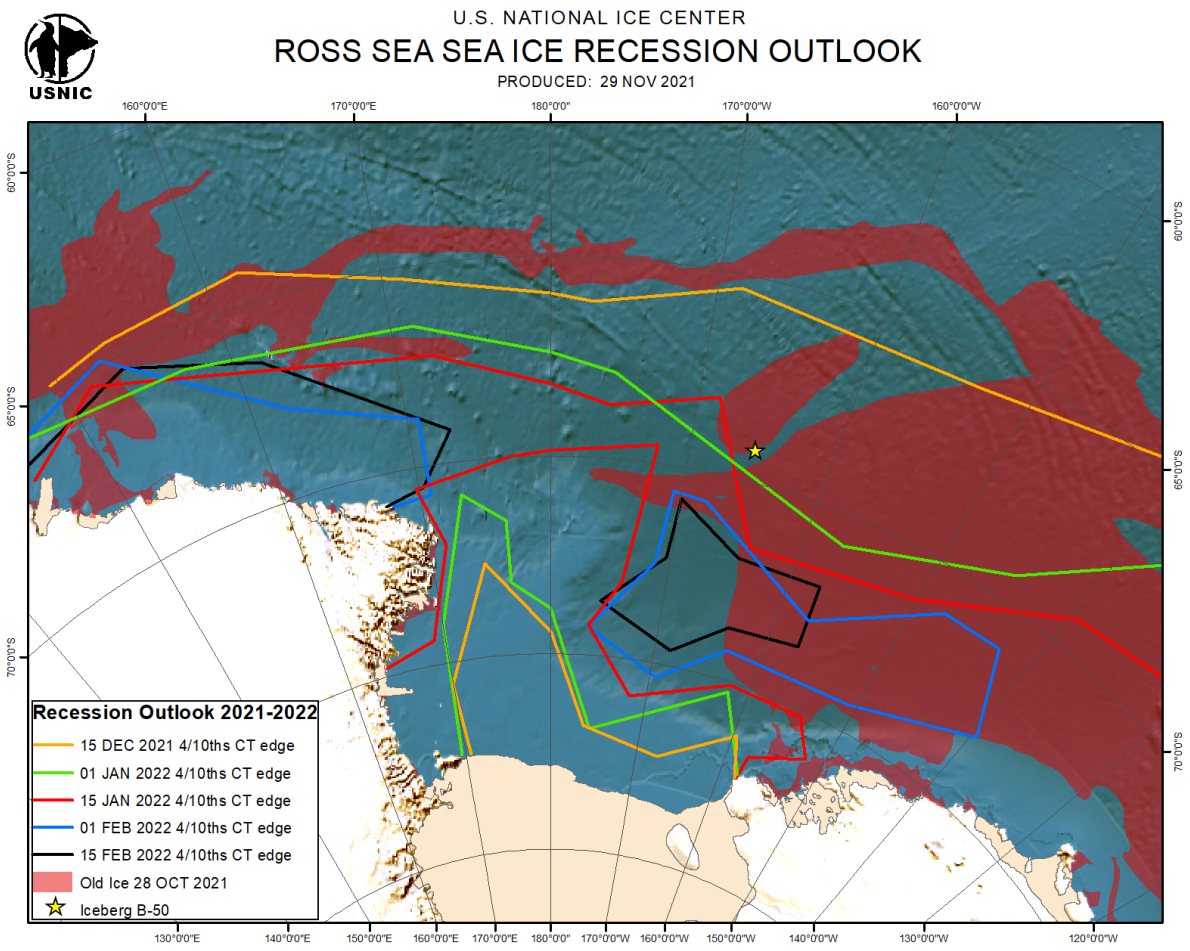

Figure 5. 2021-2022 Ross Sea Ice Edge Recession Outlook (lines indicate 4/10 sea ice concentration).

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

REFERENCES

[1] Brechtel, N. (2021), McMurdo Sea Ice Report November 8, 2021.

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

[3] Metzger, E. J. et al., (2014), Operational Implementation Design for the Earth System Prediction Capability (ESPC): A First Look, Naval Research Laboratory, NRL/MR/7320—14-9498