Seasonal Outlook for Ross Sea and McMurdo Sound 2019-2020

Christopher Readinger
U.S. National Ice Center
4231 Suitland Rd.
Suitland, MD 20746
E-mail to: nic_analyst@noaa.gov

INTRODUCTION

The US 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 tanker and ice-strengthened cargo ships to the pier at McMurdo Station, located at 77°51'S, 166°40'E [4].

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 predominately 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 ice analysis for 31 October 2019, the position of the northern ice edge was near the median between the climatological max and mins. This is less than last year when the edge was near the climatological max across the majority of the Ross Sea. The Ross Sea is primarily covered with first year thick sea ice (>47" or >120cm), but the extent of old ice is significantly more than last year. The old ice is concentrated east of 180 longitude and north-northwest of Cape Adare. The old ice distribution can be seen as the dark red shape in the Outlook graphic (Figure 2). Average surface air temperatures for the Austral autumn and winter are similar to last year averaging 2-3^{o}C above normal [2]. Katabatic winds from the south off the Ross Ice Shelf help to produce prodigious amounts of sea ice during the winter and variations in this wind could influence sea ice extent and potentially thickness. To investigate this potential driver we look at meridional wind anomalies for the autumn-winter season. Generally the anomalies were very small for most of the Ross Sea, however there was a narrow band showing strongly negative values extending N-S along the 165^{o}W longitude from Ross Island to the Balleny Islands. This could have had an influence on sea ice production but given the position along the coast it may not play a role in the meltout of the central Ross Sea.

In addition to sea ice, another potential hazard to navigation this season could come from Iceberg B43, which is currently in the middle of the Ross Sea (172°50'W 72°37'S), drifting slowly to the WNW. B43 measures 10NM x 5NM and will calve thousands of smaller icebergs when it eventually breaks up.

As of November 11th the sea ice survey by McMurdo Station ice experts[4] found the fast ice in McMurdo Sound averages 59.3" (151cm), equating to first-year thick stage of development. As shown in Figure 1, the fast ice extends 17.5 nautical miles from the edge to the turning basin. The fast ice got a late start during the freeze-up this year and thus is significantly thinner than average. Additionally, unlike last year there is no second year ice in the typical resupply channel.

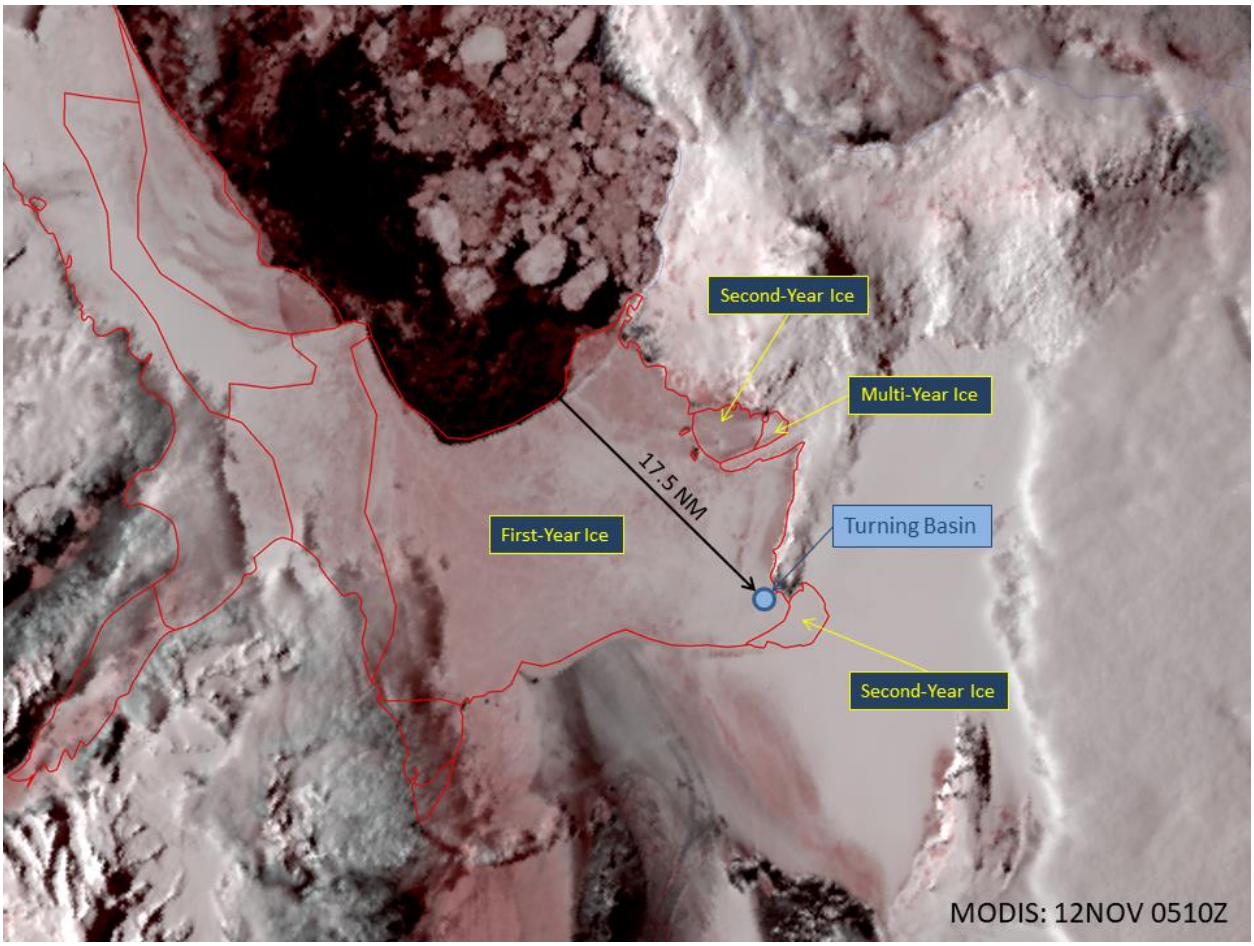

Figure 1. Fast Ice situation in McMurdo Sound as of 12 November 2019. MODIS Image.

Atmospheric Circulation: The extreme southern high latitudes are dominated by a westerly circumpolar vortex that extends from the surface to the stratosphere. The long-term variability in this vortex is called the Antarctic Oscillation (AAO) [5] or Southern Annular Mode (SAM). The AAO has been negative for the past 2 months with the trend forecast to continue for at least the next 2 weeks into December. Negative AAO means there should be weaker westerly winds which inhibit the northward Ekman transport and

upwelling of warmer subsurface water. On the other hand, the weaker westerly winds could allow the intrusion of warmer mid-latitude air further south.
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/aao/aao.shtml

Input considered for this outlook includes:

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

OUTLOOK

As of late October 2019, the distribution of old ice in the Ross Sea resembles the distribution of old ice from 2018. Other years had similar distributions but we chose to use a year since the dramatic loss of sea ice from 2014-2016. Last year the unescorted date was extremely early (31 December), 3 weeks earlier than forecast and the first time in December since the mid-1990s. This dramatic shift in ice loss was unexpected and we haven't quite determined whether this was an outlier event or a new normal.

The meltout in 2018 began earlier than usual, but proceeded extremely fast through December. So far, the melt is behind the 2018 pace. Many of the other parameters from 2018 are also present this year with one big exception being the AAO index, which is currently negative. This may slow the extremely fast paced melting. On the other hand, the sea ice edge is already approximately 100NM south of where it was last year. Lastly, the Navy ESPC [3] long range model which eventually did pick up on the extremely fast melt last year is not showing any deviations from a more typical meltout through December for the run initialized 19 November.

Given all of these factors and the uncertainty of extreme conditions we are projecting that vessels in the Ross Sea will require icebreaker escort until approximately 07 January 2020 and navigable ice conditions for unescorted vessels (≤4/10) are expected after this date.

As with recent years, USNIC will publish bi-weekly updates to this outlook beginning 15 December comparing how the meltout corrresponds to our recession dates shown in Figure 2 below. In addition we will use the Navy ESPC model to look ahead at how the meltout may progress.

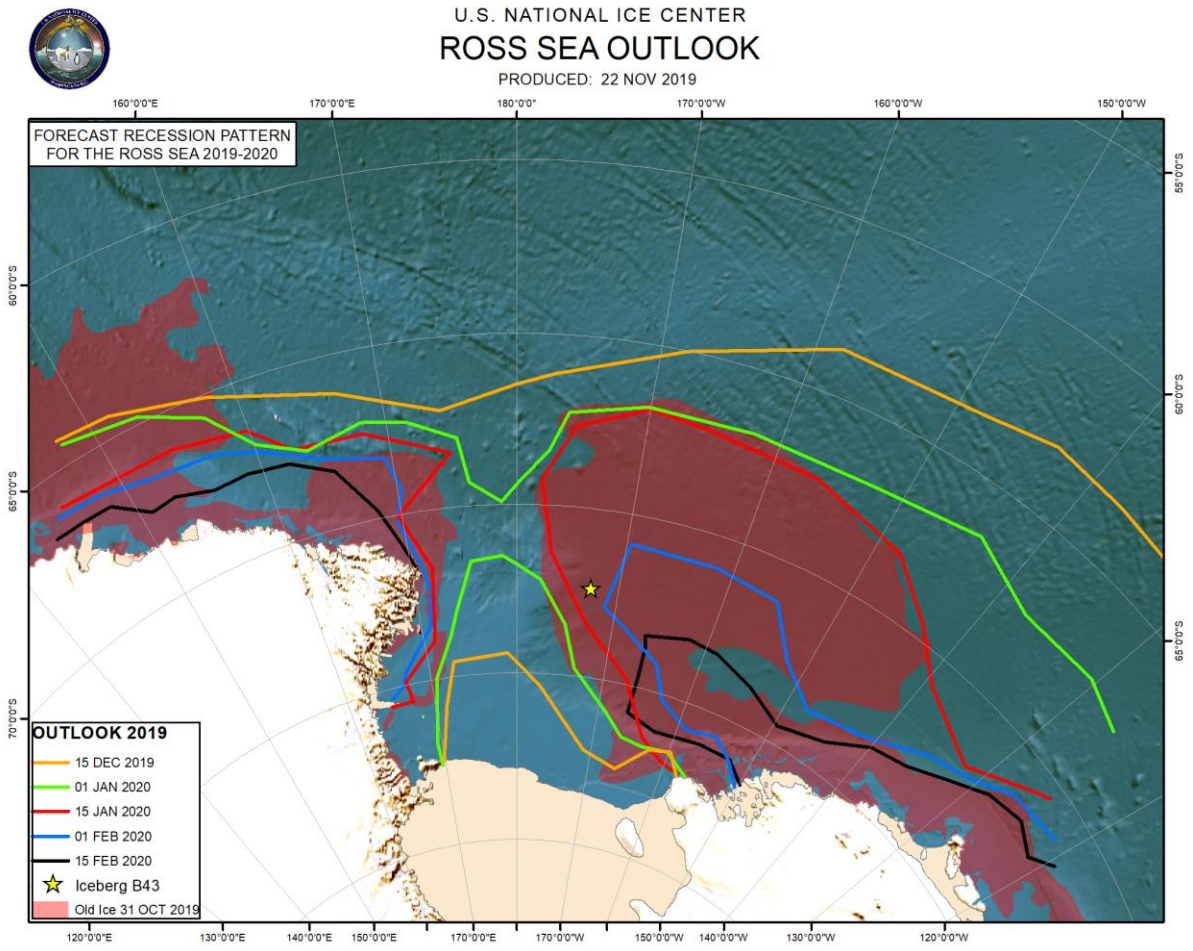

Figure 2. 2019-2020 Ross Sea Ice Edge Recession Outlook (<4/10 ice edge).

As always, there are numerous small icebergs scattered throughout the Ross Sea which can pose a hazard to navigation. Sea ice analyses for the Ross Sea can be obtained via the NIC website at: https://www.natice.noaa.gov/products/weekly_products.html

REFERENCES

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[4] McMurdo Sound Sea ice Report

[5] Thompson, D. W., and J. M. Wallace (2000), Annular modes in extratropical circulation, Part II: Trends, J. Clim., 13, 1018– 1036.