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Seasonal Outlook
Western Ross Sea and McMurdo Sound
2008-2009

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Abstract

This National/Naval Ice Center Seasonal Outlook Western Ross Sea and McMurdo Sound 2008-2009 covers the upcoming melt period for the southern hemisphere's 2008 - 2009 spring and summer season. Conditions of first year ice and multiyear ice, in both open water and in vicinity of McMurdo Sound and Station, are provided. Data is compiled using various forecasting methods and numerous remote sensing tools. Forecast conditions are for the open water regions to melt with the typical hourglass pattern with a later than normal opening date. The Ross Sea ice band is projected to be 80nm to100 nm in width, requiring vessels to use ice breaker escorts until mid-January. Conditions in McMurdo Sound are forecast for the thicker first year fast ice to flush from the channel after icebreaker transit, with some multiyear ice remaining to the western regions, south of the Drygalski Ice Tongue to Cape Royds.

I. Introduction

This outlook presents the expected positions of the sea ice "edges" in the Western Ross Sea and the depiction of the mid-October fast ice boundary in McMurdo Sound. (See Figure 1 for a map of the Ross Sea). Ice edge positions at 15-day intervals, beginning 15 December, are forecast through the end of the shipping season in mid-February. The term "edge" is used to indicate the boundary between areas with sea ice and areas with no sea ice present. In the Ross Sea, the ice edge normally exhibits an "hourglass" melt pattern of the ice cover. This pattern of pinching off the pack ice occurs due to the concurrent ice melt along the northern ice edge and an enlarging polynya adjacent to the Ross Ice Shelf. The concentration and stage of development of ice remaining between these two edges are important factors in this outlook as a measure of predicted severity along the shipping route located between 175E-177W.

Additional factors evaluated for the forecast are atmospheric forecast model estimates, climate teleconnective patterns, ice thickness, and linear distance from Hut Point to the fast ice edge in McMurdo Sound. The linear distance is measured along a bearing of 330 degrees from Hut Point to the closest access point at the fast ice edge for incoming vessels.

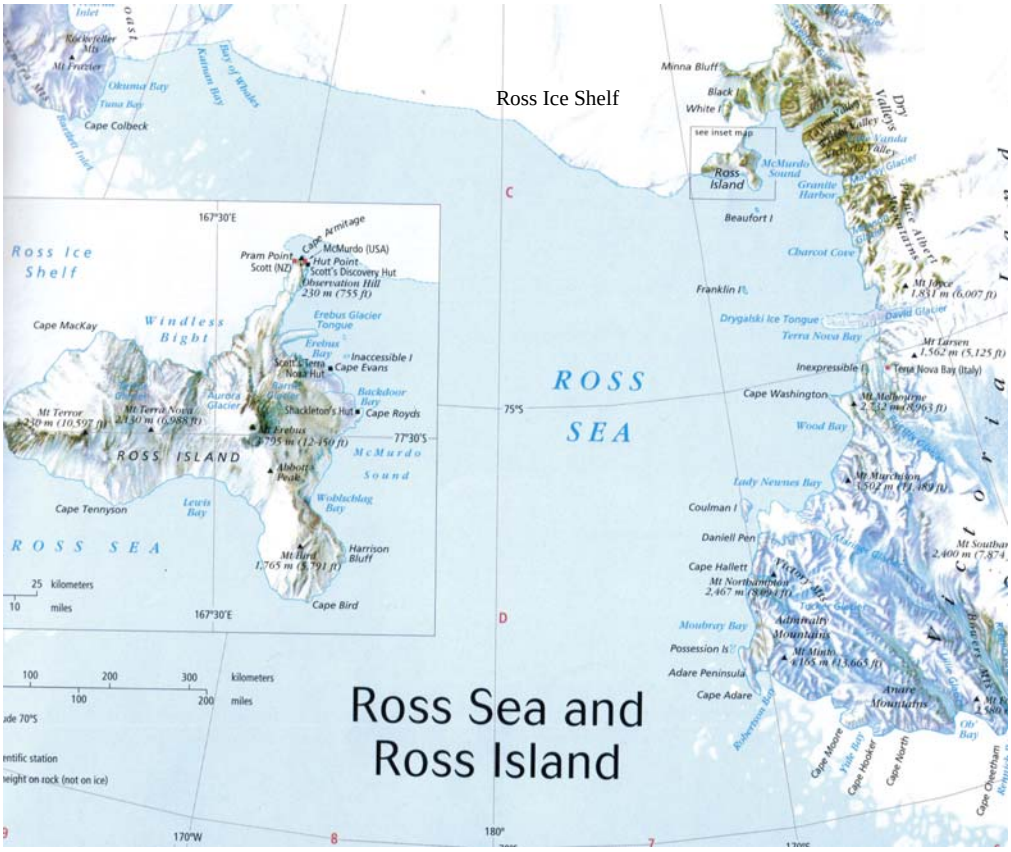


Figure 1. Map of Ross Sea and Ross Island

The categories of environmental data used to compile this outlook include:

1) Remotely sensed imagery: visible satellite imagery from NASA's Moderate Resolution Imaging Spectroradiometer (MODIS), the Defense Meteorological Satellite Program (DMSP) Operational Line-Scan System (OLS), NOAA's Advanced Very High Resolution Radiometer (AVHRR), DMSP Special Sensor Microwave Imager (SSMI), QUIKSCAT, EnviSat Global Monitoring Mode (GMM), and Advanced Microwave Scanning Radiometer for EOS (AMSR-E),

2) Drilled ice thickness measurements in McMurdo Sound,

3) Archived meteorological data received from McMurdo Station for 2008,

4) National Centers for Environmental Prediction (NCEP) / National Center for Environmental Research (NCAR) Reanalysis Data through September 2008, and

5) Sea ice climatology for the Ross Sea.

The rates of recession for the Ross Sea ice edge and the McMurdo Sound fast ice edge are derived using an analogue forecasting technique that relates historical observations of pre-season ice extent and thickness to the predicted severity of austral summer ice conditions. This relationship is based upon the premise that ice conditions of similar areal extent and thickness will follow the same historical progression of decay. This "persistence" of antecedent ice conditions and recession rates has been well documented during the many years of Operation DEEP FREEZE.

(Operation DEEP FREEZE is the unclassified code name given to the operations previously conducted by the U.S. Navy to provide operational and logistic support to the United States Antarctic Program [USAP]).

The estimated position of the ice edge and the "opening date" are based on the collection of evidence from analogue years, adjusted to reflect alterations of current conditions from past conditions, forecast atmospheric models, oceanic models, and cryospheric models.

II. Initial Ice Conditions and Ice Climatology

The National Ice Center (NIC) ice analysis from 29 September - 03 October 2008 (**Figures 2a-2c**) reveal that the position of the northern ice edge is between a climatological minimum and mean across the majority of the Ross Sea.

During the 2007-2008 austral summer, the normal "hourglass" breakup of the ice pack in the Ross Sea failed to occur, resulting in a band of first year ice that normally comprises the iceedge not completely melting, leaving a large swath of second year ice between 150°0E and 165°W and 63°S and 70°S. Multi-year pack ice is found to the west of 176E in the southern Ross Sea, continuing northwestward around Cape Adare and into the western Ross Sea, south and west of the Bellany Islands.

The majority of the fast ice is now first and second year ice with the exception of McMurdo Sound, which is still a majority of old ice, with a reported average ice thickness of 81" (205cm) as measured by Jeffery Scanniello of the US Antarctic Program for their annual sea ice shipping report . Total concentration and stage of development of sea ice and icebergs is labeled using World Meteorological Organization (WMO) international system of sea ice symbols, also known as "Egg Code" (see **Figure 3** for an explanation).

As of 29 September 2008, there are only two icebergs of significance remaining in the Ross Sea. B-15A is north of the iceedge, centered near 57°33'S/170°49'E, with an estimated size of 61nm x11nm. The second iceberg of interest is B15J which is located off the coast of Cape Kinsey at 68°53'S/158°57'E is estimated at 27nm x15nm in size. **Figure 5** shows the relative position of these icebergs.

There are numerous smaller icebergs throughout the Ross Sea which could pose a hazard to shipping between 178E and 170W during Operation DEEP FREEZE 2008-2009.

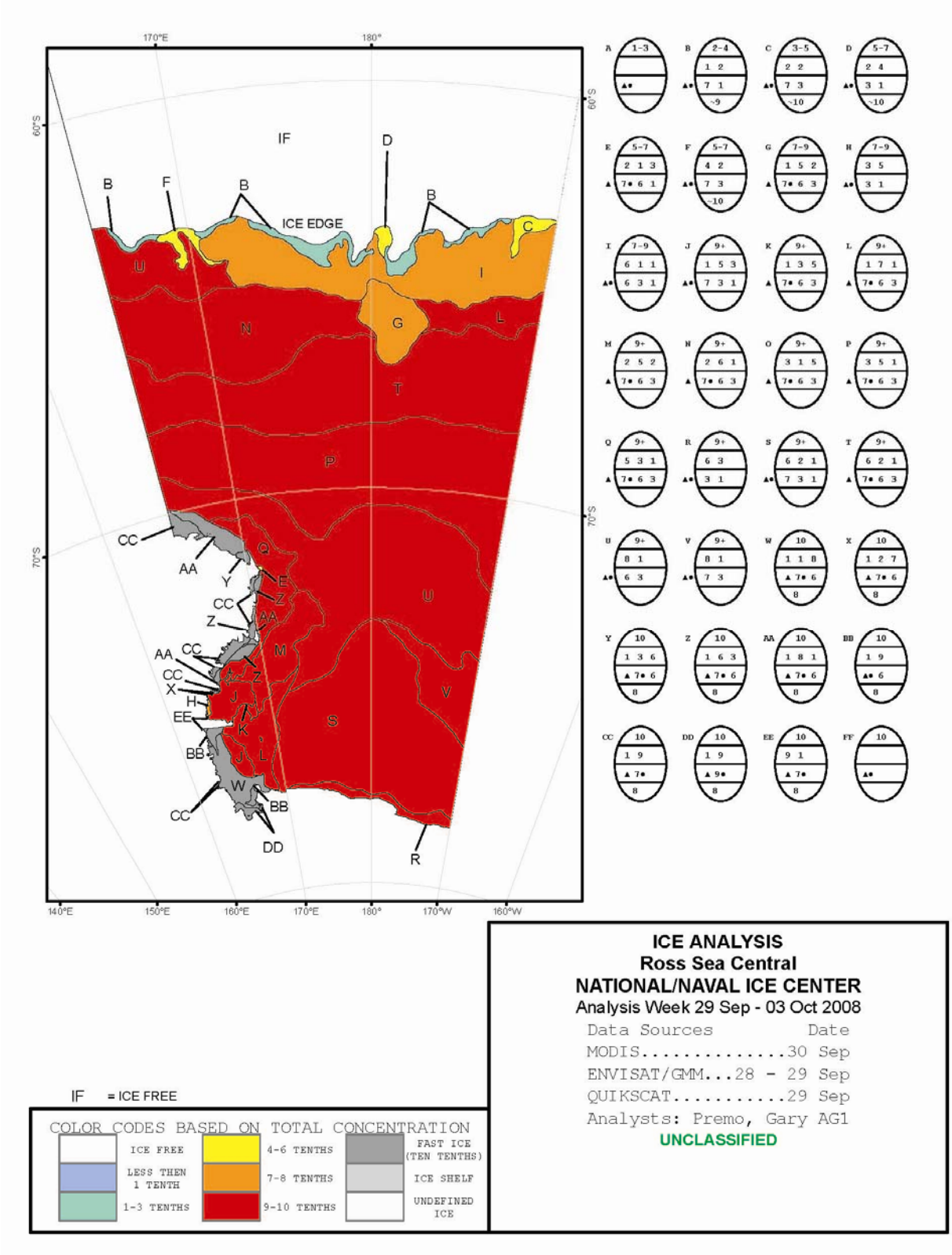


Figure 2a. 29 September - 03 October 2008 Ross Sea Central Ice Conditions

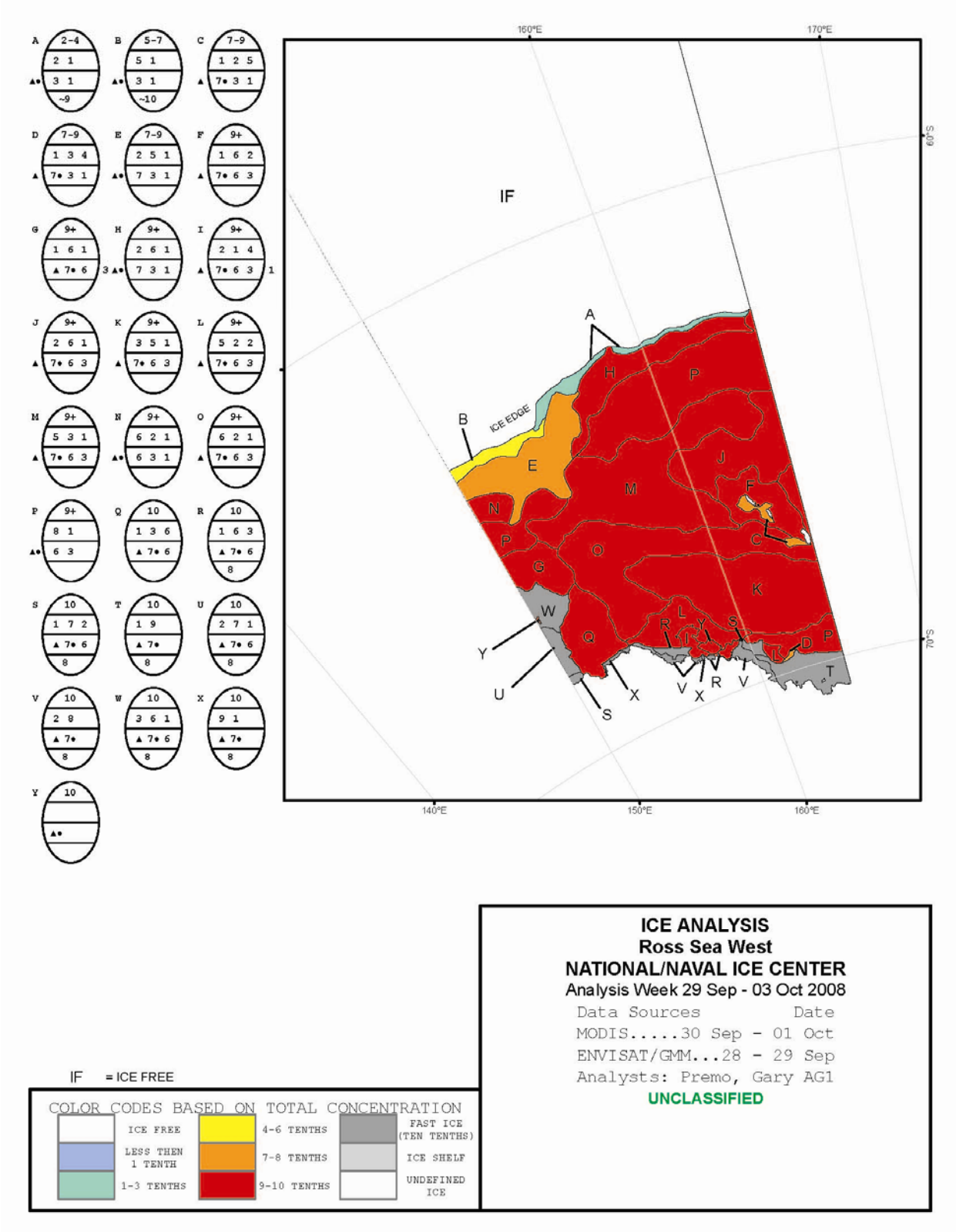


Figure 2b. 29 September – 03 October 2008 Ross Sea West Ice Conditions

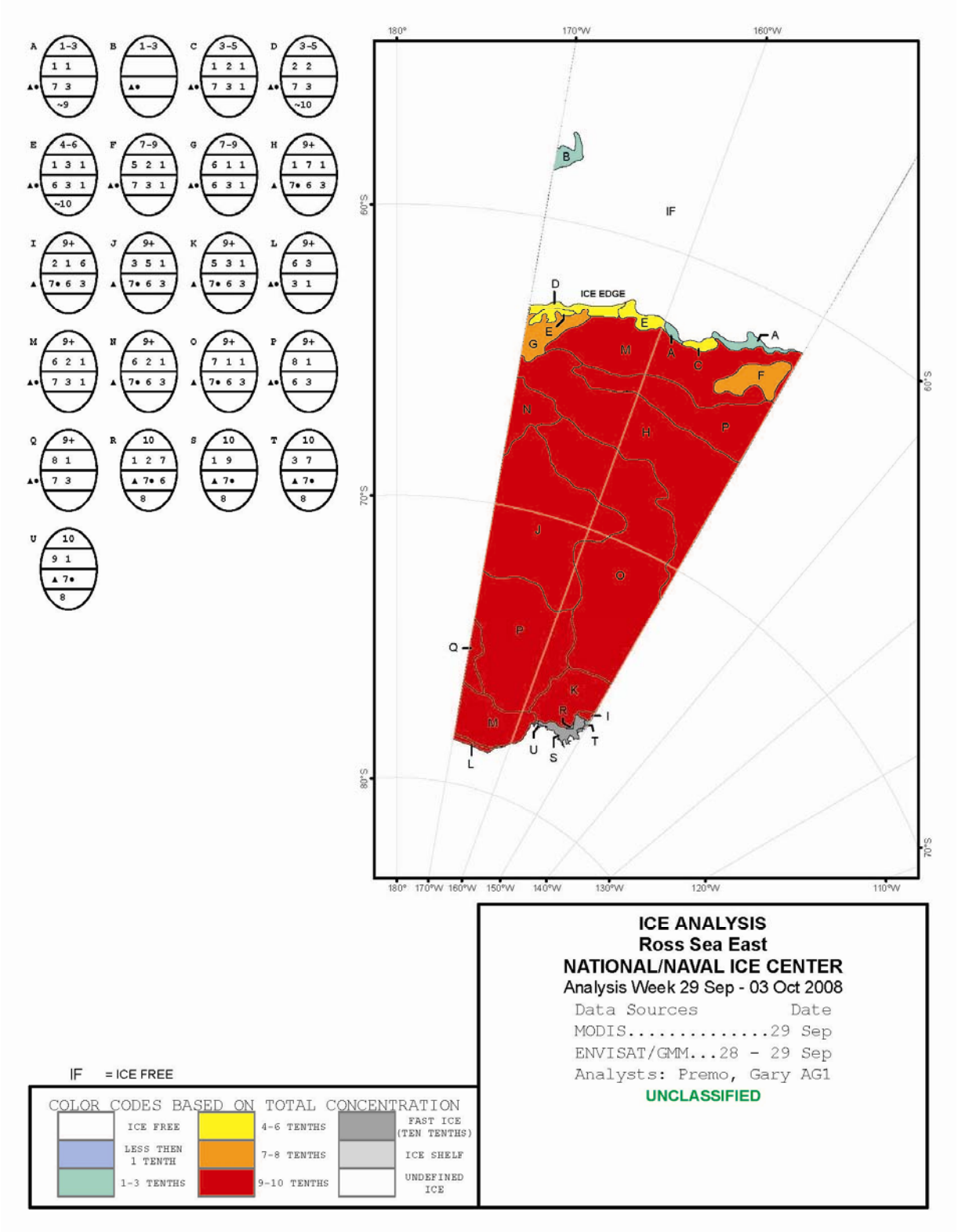
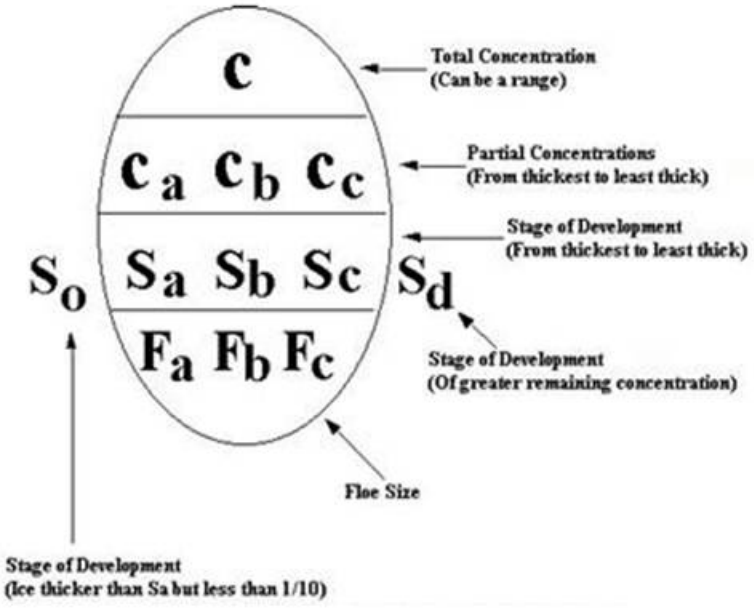


Figure 2c. 29 September - 03 October 2008 Ross Sea East Ice Conditions



STAGES OF DEVELOPMENT

1 = New ice (0-10cm)
3 = Young ice (10-30)
6 = First year (30-200cm)
7 = First year thin (30-70cm)
1. = First year medium (70-120cm)
4. = First year thick (120-200cm)
7. = Old Ice (survived at least one summers melt)
8. = Second year ice (survived one summer melt
9. = Multi-year ice (survived at least two summer melts)

Figure 3. WMO Egg Code

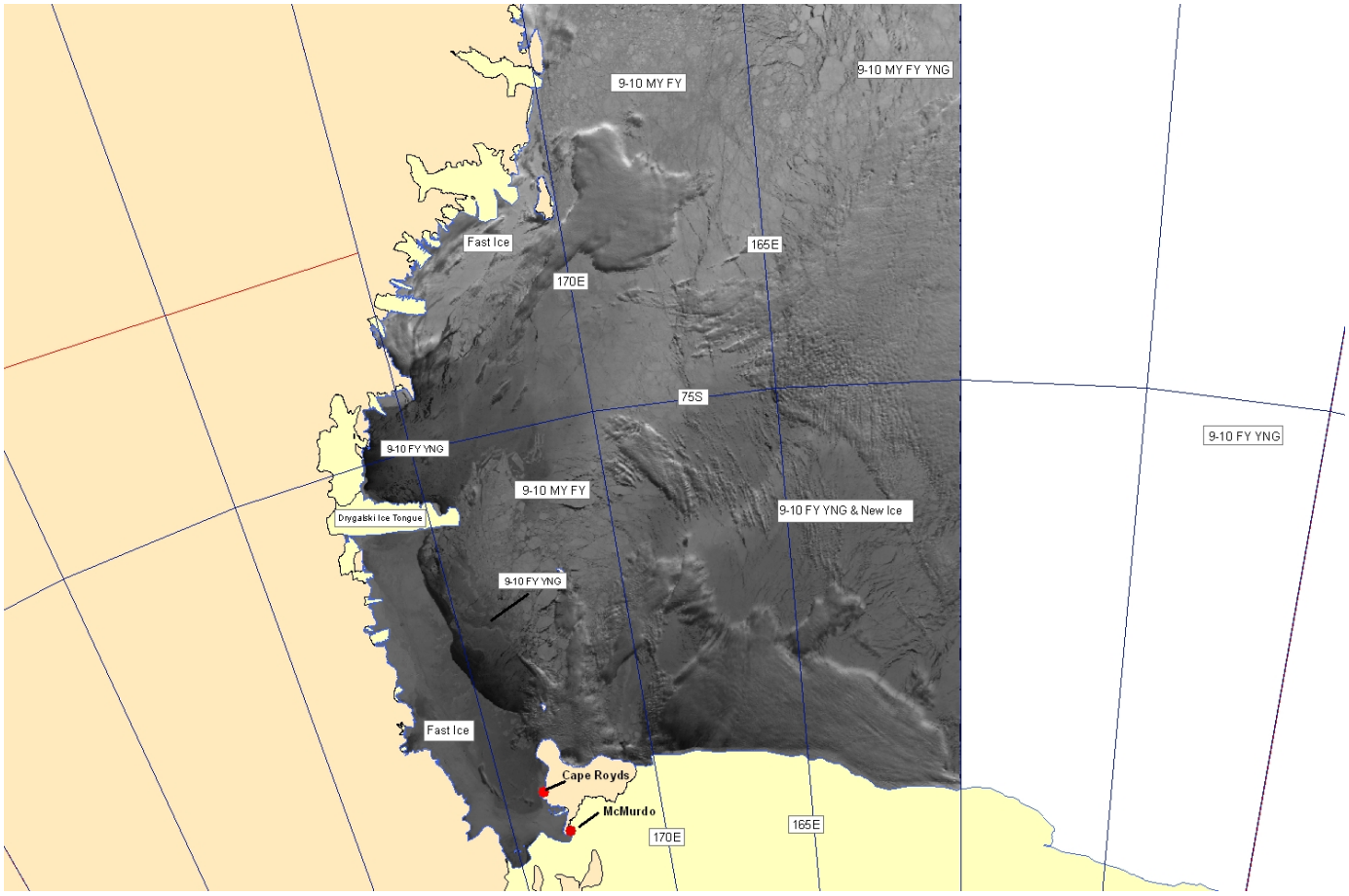


Figure 4. 02 October 2008 – MODIS – Aqua

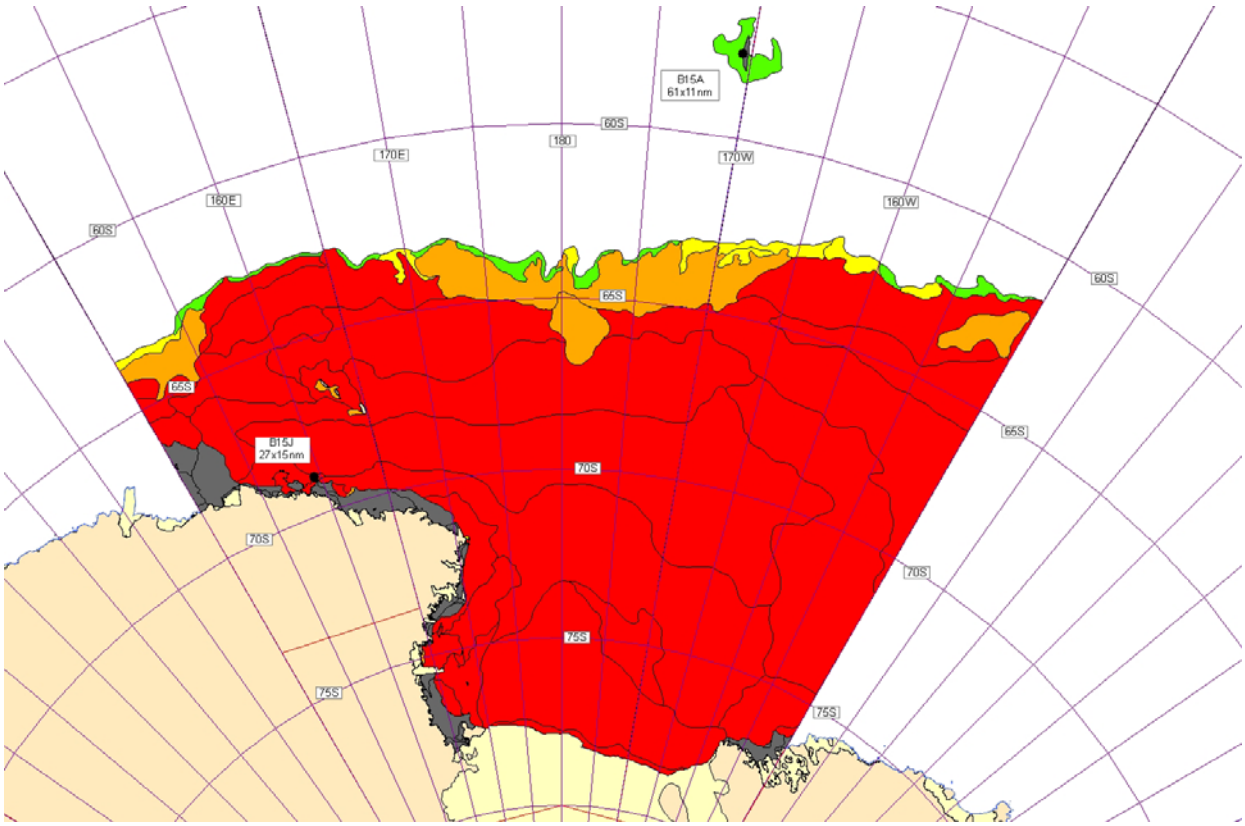


Figure 5. 01 October 2008 Ross Sea Ice Conditions & Icebergs

Icebergs and Shelf Ice

After a period of years with significant calving of the Ross ice shelf, the last two years have seen very little production of large icebergs in the Ross Sea. There are still numerous smaller icebergs scattered throughout the Ross Sea which can pose a hazard to navigation.

The only major iceberg of interest in the vicinity of the Ross Sea shipping route is iceberg B15A which is located well north of the ice edge near 57°33'S/170°49'W and is caught in the West Wind Drift current, slowly drifting eastward.

For regular updates on the location of these and other Antarctic icebergs, visit the National/Naval Ice Center's Iceberg Database at:

http://www.natice.noaa.gov/products/iceberg/index.htm

III. Outlook

Ross Sea

The average opening date for the icebreaker led convoys to transit the western Ross Sea shipping lane is historically 7-10 January. Typical conditions of the opening include a 20 nm-50 nm wide band of lesser (≤4/10 tenths) ice concentration. However, with a higher amount of second year ice remaining between 63°S and 70°S, **A slightly later than normal opening date of 20 January 2009 is forecast this year.** This forecast is based on:

a) *Surface Air Temperatures*. The NCEP reanalysis model suggests that surface air temperatures over the Ross Sea were slightly above normal during the austral winter. Air temperatures at McMurdo Station suggest a mild winter as well, with temperatures above normal during the freeze-up in March and remaining above normal throughout the spring and early summer. Air temperatures returned to closer to normal in July and went below normal in August. The mild winter should act to lessen both the ice thickness and the subsequent time required to melt the first/multi-year sea ice. Additionally, global climate models (GCMs), like the Scripps' Global Spectral Model, indicate slightly warmer than normal conditions are expected for the summer in the Ross Sea. This will aid the melt of sea ice along the Ross Ice Shelf.

b) *Near Normal Sea Surface Temperatures along Ice Edge*. Near normal sea surface temperatures have been measured along the western Ross Sea ice edge from March-September 2008. The current outlook from NOAA's Climate Prediction Center suggests near normal conditions will persist until early 2009.

c) *Fast Ice Extent in McMurdo Sound.* The fast ice extent in McMurdo Sound in October 2008 is near it's normal extent for this time of year. The majority of this fast ice has survived through 2 years, but is likely to fracture and flush from the sound. Isolated areas of fast ice with large multi-year content located along the shoreline from Drygalski Ice Tongue south to Cape Royds (see **Figure 4**) are likely to remain late into the Antarctic summer melt.

d) *Icebergs*. Icebergs scattered in the western Ross Sea continue to drift with the ocean currents throughout the region. These numerous smaller icebergs throughout the Ross Sea could pose a hazard to shipping between 178E and 170W.

e) *Analog Years*. Due to the amount of first year ice that survived the summer melt, 1994 was the only year that had any similarities to ice conditions found in early October of 2008. During this analog year, the unescorted date (≤ 4/10 ice coverage) was 16 January.

f) *Helfrich Statistical Ross Sea Opening Model Results*: Multiple linear regression model results for determining ice recession predicted Jan 19th as a navigable date. Since this tool is still under evaluation and has not undergone peer review, it is treated as only one tool within the overall assessment. The revised objective formula appears better capable of predicting delayed opening dates. Model variables include September Antarctic Oscillation values, vernal winds velocities off the Ross Ice Shelf, cumulative air temperatures, strength of the vernal Ross Sea Low, and the mean amplitude of ice extent latitude in October.

Taking into consideration the inputs mentioned above, **it is projected that the Ross Sea ice band will be 80nm-100nm in width and vessels will require icebreaker escort until approximately 19 January 2009 (Figure 6**). Navigable ice conditions for unescorted vessels ($\leq$ 4/10 tenths) are expected after 20 January 2009.

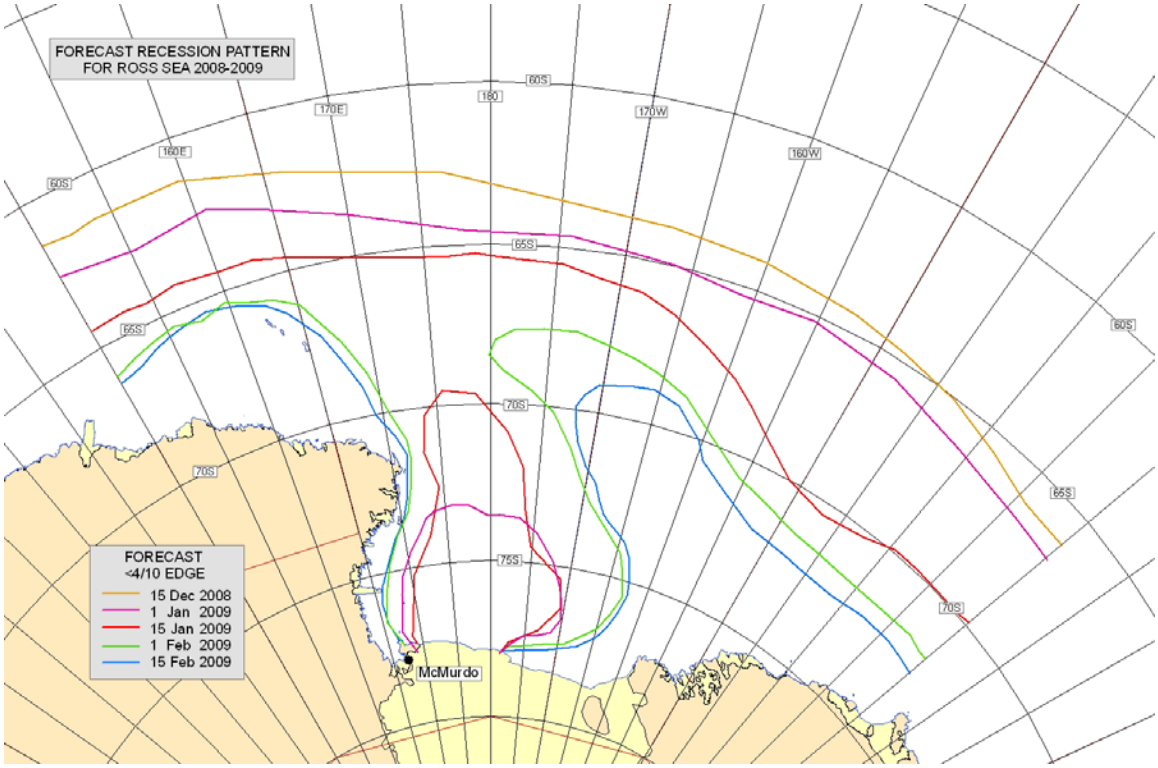


Figure 6. Forecast Recession Pattern for Ross Sea (2008-2009) Season (≤4/10 edge)