

*Mapping and Characterization of Recurring Spring Leads and Landfast Ice in the Chukchi and Beaufort Seas, Coastal Marine Institute Project (NOFA MMS09HQPA0004T)*

**Monthly progress report, May 2010**

1) Summary of work performed and progress made during preceding month

A. *Analysis of ice distribution and lead patterns*

We have decided on a simple conceptual model that can be used to describe repeatable patterns of pack ice movement and the resulting lead patterns in the Chukchi Sea pack ice. Several patterns have been described, but the list certainly is not complete. We expect some additional patterns to be added as the study progresses to look at imagery from 2004 to the present. Study of that imagery will begin in July after the investigator returns from vacation.

B. *Analysis of landfast ice extent*

We are continuing to order SAR data for the Chukchi study region. An initial examination of SAR data for the 2006-07 season showed significant sea ice variability within Kotzebue Sound justifying our decision to expand the study region to include this area (see monthly report April, 2010). Tables 1 and 2 show the current status of data acquisition and processing for SAR imagery in the Chukchi and Beaufort study regions, while Tables 3 and 4 show the status of SLIE processing for both study regions.

Having finalized the Chukchi study region, we have now completed the high-resolution coastline that we will use to mask the land regions in the imagery and from which we will measure the landfast sea ice width. To complete the landfast sea ice analysis, we will use tools developed during the previous MMS study (AK-03-06, MMS-71707). Some work is still required to adapt these tools, which in many cases were “hard-wired” for the specific requirements of the previous study. Now that we are analyzing two study regions of different sizes some of the code will have to be rewritten to generalize it for the new requirements. This work is already underway and should be completed in time to analyze the first complete seasons of SLIE delineations.

**Table 1: Data acquisition status for the Chukchi study region**

<b>Chukchi</b>	<b>Data Mining</b>	<b>Order Placed</b>	<b>Order Received</b>	<b>Geo-coded</b>	<b>Gradient Diff</b>	<b>Notes</b>
1996-1997	Y	N	N	N		Only 2 mosaics for Oct
1997-1998	Y	N	N	N		No data for Oct
1998-1999	Y	Y	Y	Y	Y	3 new frames 4 Kotz processed
1999-2000	Y	N	N	N		
2000-2001	Y	N	N	N		
2001-2002	Y	N	N	N		
2002-2003	Y	N	N	N		Only 2 mosaics in December
2003-2004	Y	N	N	N		
2004-2005	Y	Y	Y	Y	Y	4 new frames 4 Kotz processed
2005-2006	Y	Y	Y	Y	Y	11 new frames 4 Kotz processed
2006-2007	Y	Y	Y	Y	Y	Will include Kotzebue
2007-2008	Y	N	N	N		Data through April

**Table 2: Data acquisition status for the Beaufort study region**

<b>Beaufort</b>	<b>Data Mining</b>	<b>Order Placed</b>	<b>Order Received</b>	<b>Geocoded</b>	<b>Gradient Diff</b>	<b>Notes</b>
1996-1997	Y	Y	Y	Y	Y	Previous study
1997-1998	Y	Y	Y	Y	Y	Previous study
1998-1999	Y	Y	Y	Y	Y	Previous study
1999-2000	Y	Y	Y	Y	Y	Previous study
2000-2001	Y	Y	Y	Y	Y	Previous study
2001-2002	Y	Y	Y	Y	Y	Previous study
2002-2003	Y	Y	Y	Y	Y	Previous study
2003-2004	Y	Y	Y	Y	Y	Previous study
2004-2005	Y	Y	Y	Y	Y	
2005-2006	Y	Y	Y	Y*	Y*	*Geocoding errors on 7 mosaics
2006-2007	Y	Y	Y	Y	Y	1 frame not recovered; replaced
2007-2008	Y					Only through April

**Table 3: SLIE processing status for the Chukchi study region**

<b>Chukchi</b>	<b>SLIE Delineations</b>	<b>Shape-files</b>	<b>Grids</b>	<b>GeoDB</b>	<b>Uploaded to web site</b>	<b>Notes</b>
1996-1997						
1997-1998						
1998-1999	In progress					Extend to include Kotzebue?
1999-2000						
2000-2001						
2001-2002						
2002-2003						
2003-2004						
2004-2005	In progress					Extend to include Kotzebue?
2005-2006						
2006-2007						
2007-2008						

**Table 4: SLIE processing status for the Beaufort study region**

<b>Beaufort</b>	<b>SLIE Delineations</b>	<b>Shape-files</b>	<b>Grids</b>	<b>GeoDB</b>	<b>Uploaded to web site</b>	<b>Notes</b>
1996-1997	Y	Y	Y	Y	Y	Previous study
1997-1998	Y	Y	Y	Y	Y	Previous study
1998-1999	Y	Y	Y	Y	Y	Previous study
1999-2000	Y	Y	Y	Y	Y	Previous study
2000-2001	Y	Y	Y	Y	Y	Previous study
2001-2002	Y	Y	Y	Y	Y	Previous study
2002-2003	Y	Y	Y	Y	Y	Previous study
2003-2004	Y	Y	Y	Y	Y	Previous study
2004-2005	In progress					
2005-2006	In progress					
2006-2007						
2007-2008						1 frame not recovered; replaced

C. *Assessing potential alternative approaches at deriving landfast ice edge locations and landfast ice stability*

Having demonstrated the technical feasibility of using an interferometric SAR (InSAR) approach to identifying landfast sea ice, we have been also be working on a technique to automatically extract the SLIE from the InSAR results. We are developing a work flow consisting of four steps to delineate the landfast sea ice extent from an interferometric SAR image. These steps are illustrated in Figure 1 and listed below.

Step 1: **Simple thresholding** based on a cut-off coherence value

Step 2: **Morphological filtering** to fill in small holes of low coherence and exclude small patches of high coherence

Step 3: **Patch size analysis** to identify individual connected patches and reject small ones

Step 4: **Outline closing** through the identification of edge segments and rejection of closed loops

It may also be possible to apply these steps to the gradient difference imagery to automate the SLIE delineation process, but for the moment we are still proceeding with this manually.

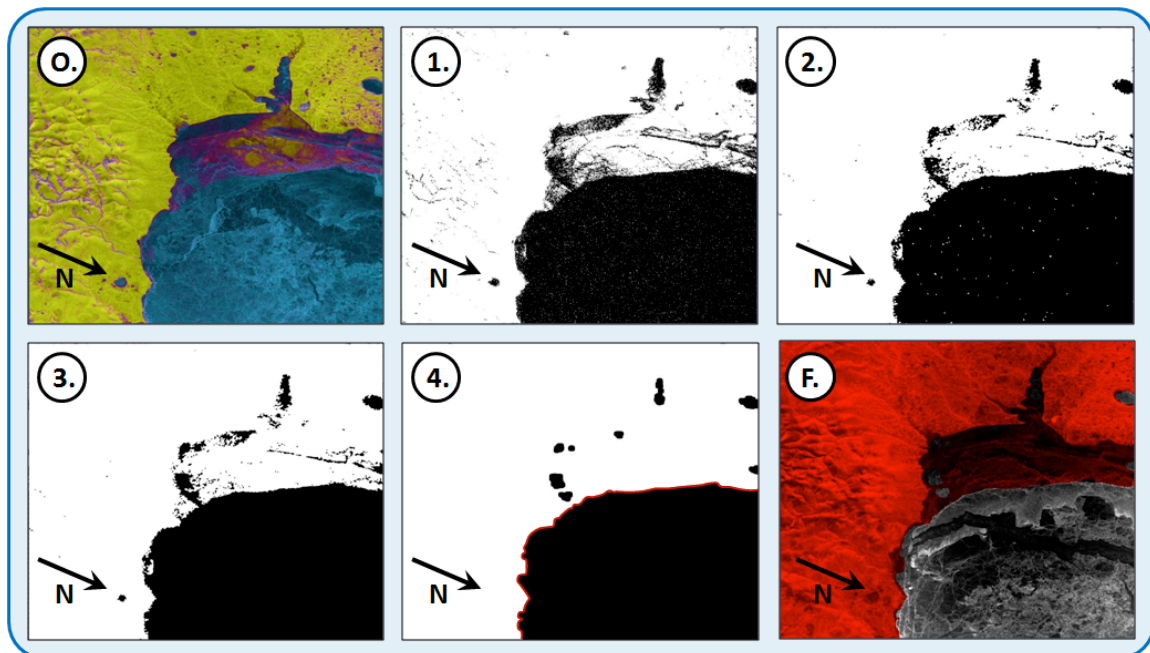


Figure 1: Work flow steps involved in automatically delineating SLIE based on an interferometric coherence image (O). Panels 1-4 illustrate the steps described in the text. Panel F shows a masked SAR image with the land and landfast sea ice in red with non-landfast ice in grey.

*D. Miscellaneous activities*

In response to a request from Warren Horowitz, we prepared a brief initial assessment of the work that would be required to review existing literature regarding the impact of ice breaker activity on the physical characteristics of the sea ice cover and assess whether this literature is sufficient and relevant for current sea ice conditions. We estimate that it would take a month of A. Mahoney's time to review and assess the existing literature and, if necessary, prepare a proposal for additional work in this field.

2) Summary of significant technical, schedule or cost problems encountered during preceding month

n/a

3) Summary of resolutions agreed to between Contractor and MMS re item (2)

n/a

4) Significant meetings held or other contacts made in connection with project during preceding month

n/a

5) Action items, open questions etc.

n/a