

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, March 2011

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

A. *Analysis of ice distribution and lead patterns*

Through GINA, we have recently acquired a complete set of clear- or partially clear-sky full resolution AVHRR images for the Beaufort study regions over the period 2004-2010. These will be used to bring our quantitative leads analysis from the previous project up to date. We will continue working with GINA to acquire the complete set of images for the Chukchi region from 1994-2010. Also, work is progressing on a detailed summary of repeatable lead patterns in the Chukchi Sea based on visual analysis of AVHRR data from 1994-2008. This will include the presence of open water around Wrangell Island as well as in the vicinity of Hanna and Herald Shoals.

B. *Analysis of landfast ice extent*

SAR data mining and processing

Five additional seasons of SAR imagery for the Chukchi were received, geocoded and mosaicked. The mosaics created from these data all had acceptable geocoding. Minor issues were concerning with file name date ranges have been addressed. Mosaics for the Chukchi 2004-05 season were reprocessed to include the extended study area for Kotzebue Sound. This necessitated mosaicking the frames in a specific order to ensure consistency with the previous mosaics, which were created before the Chukchi study area was extended to include Kotzebue Sound.

At this stage, there is only one season (2003-04 from the Chukchi study region) for which we have ordered data pending, though there are other individual frames pending for other seasons related to geocoding errors. Tables 1-4 below show the current status of SAR data mining and processing. Updates since the last report are highlighted in red.

Table 1: Data acquisition and processing status for the Chukchi study region. Lower case y's indicate issues that will require further work / reprocessing

Chukchi	Order Placed	Order Retrieved	Geocoded	Mosaicked	Uploaded to web site	Notes
1996-1997	Y	Y	Y	Y	N	20 km geocoding error on R97_186_189mos, R97_162_189gdif; leap year issue with fall frames dates
1997-1998	Y	Y	Y	Y	N	r98_191_193mos missing; replacement selected
1998-1999	Y	Y	Y	Y	N	Mosaics are good
1999-2000	Y	Y	Y	Y	N	Mosaics are good
2000-2001	Y	Y	Y	Y	N	Mosaics are good. Rename r00_365_366mos to r00_363_366mos
2001-2002	Y	Y	Y	Y	N	Mosaics are good. Rename r02_208_210mos to r02_208_211mos
2002-2003	Y	Y	Y	Y	N	Mosaics are good.
2003-2004	Y	?	N	N	N	Mosaics pending
2004-2005	Y	Y	Y	Y	N	Mosaics are good.
2005-2006	Y	Y	y	Y	N	Need to re-run mosaics giving preference to Chukchi swath; 8 mosaics with >1km geocoding errors
2006-2007	Y	Y	Y	Y	N	Mosaics are good.
2007-2008	Y	Y	N	N	N	Mosaics are good. (data only through April)

Table 2: Data acquisition and processing status for the Chukchi study region Lower case y's indicate issues that will require further work / reprocessing

Beaufort	Order Placed	Order Retrieved	Geocoded	Mosaicked	Uploaded to web site	Notes
1996-1997	Y	Y	Y	Y	Y	Complete (Previous study)
1997-1998	Y	Y	Y	Y	Y	Complete (Previous study)
1998-1999	Y	Y	Y	Y	Y	Complete (Previous study)
1999-2000	Y	Y	Y	Y	Y	Complete (Previous study)
2000-2001	Y	Y	Y	Y	Y	Complete (Previous study)
2001-2002	Y	Y	Y	Y	Y	Complete (Previous study)
2002-2003	Y	Y	Y	Y	Y	Complete (Previous study)
2003-2004	Y	Y	Y	Y	Y	Complete (Previous study)
2004-2005	Y	Y	Y	Y	N	Complete, but not on web
2005-2006	Y	Y	y	y	N	Geocoding errors on 7 mosaics; mosaics need to be reprocessed
2006-2007	Y	Y	Y	Y	N	Complete, but not on web
2007-2008	Y	Y	Y	Y	N	Complete, but not on web

Table 3: SLIE processing and database status for the Chukchi study region

	SLIE Delineations	Shapefiles	Grids	GeoDB	Uploaded to web site	Notes
Chukchi						
1996-1997	Y	Y	Y	Y	Y	Complete
1997-1998						
1998-1999	Y	Y	Y	Y	Y	Complete
1999-2000						
2000-2001						
2001-2002						
2002-2003						
2003-2004						
2004-2005						In progress; pending mosaic updates
2005-2006						Need updated mosaics (unresolved geocoding errors, etc.)
2006-2007	Y	Y	Y	Y	Y	Complete
2007-2008						Need mosaics

Table 4: SLIE processing and database status for the Chukchi study region

	SLIE Delineations	Shapefiles	Grids	GeoDB	Uploaded to web site	Notes
Beaufort						
1996-1997	Y	Y	Y	Y	Y	Complete (Previous study)
1997-1998	Y	Y	Y	Y	Y	Complete (Previous study)
1998-1999	Y	Y	Y	Y	Y	Complete (Previous study)
1999-2000	Y	Y	Y	Y	Y	Complete (Previous study)
2000-2001	Y	Y	Y	Y	Y	Complete (Previous study)
2001-2002	Y	Y	Y	Y	Y	Complete (Previous study)
2002-2003	Y	Y	Y	Y	Y	Complete (Previous study)
2003-2004	Y	Y	Y	Y	Y	Complete (Previous study)
2004-2005	Y	Y	Y	Y	Y	Complete
2005-2006						In progress; need mosaics (unresolved geocoding errors)
2006-2007	Y	Y	Y	Y	Y	Complete
2007-2008	Y	Y	Y	Y	Y	Complete

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

N/A

D. Miscellaneous activities

During late March, two members of the project team (Eicken and Mahoney) were in Barrow for a large aerial and field campaign as part of the NSF-funded Seasonal Ice Zone Observing Network (SIZONet; <http://www.sizonet.org>) project. As part of SIZONet, we have been carrying out end-of-season airborne sea ice thickness survey since 2007 using electromagnetic (EM) induction techniques, which involve towing an EM-bird beneath an aircraft. This year, we collaborated with colleagues from the Alfred Wegener Institute, who are conducting a more extensive international aerial campaign called the Polar Airborne Measurements and Arctic Regional Climate Model Simulation Project (PAM-ARCMIP; http://www.awi.de/en/research/research_divisions/climate_science/sea_ice_physics/expeditions/pamarc mip_2011/). Both Shell and Conoco Philips have indicated their willingness to contribute to the generation of data products resulting from this activity.

By bringing SIZONet and PAM-ARCMIP together in Barrow this year, we were able to use a DC-3 aircraft for the aerial surveys, which offers a much greater range than the helicopters we have been using in the past. This afforded us the unique opportunity on March 30 to fly over grounded sea ice at Hanna Shoal, almost 200 km from Barrow. Careful examination SAR data from March 22 and 25 indicated a region of stationary ice at -161.90° W, 72.00° N, in a location consistent with earlier analyses. This is shown by the blue regions in Figure 1a,b.

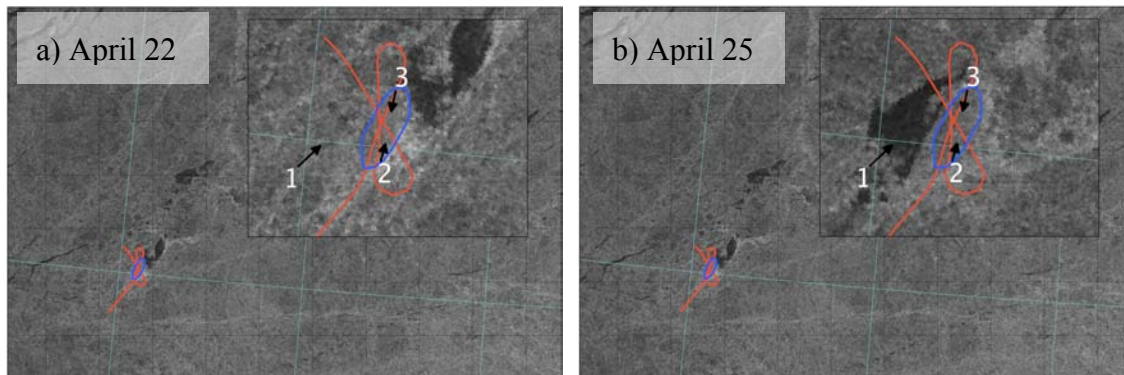


Figure 1: ENVISAT SAR images over Hanna Shoal. For scale, the black grid lines are 10 km apart. The blue outline shows a region of stationary (and therefore presumably grounded) ice. The red lines indicate the low-altitude flight path of the thickness measurements that were carried out. Arrows 1,2 and 3 indicate the locations and approximate orientations of photos 1-3 taken at higher altitude shown in Figure 22.

The red lines in Figure 1 indicate the flight paths of three overpasses that were made at low-altitude (with the aircraft at ~ 200 feet and the EM-bird at ~ 50 feet) for ice thickness and surface elevation measurements. The data have yet to undergo final analysis, but preliminary results indicate significant amounts of ice exceeding 15 m thickness. Due to the 40 m sampling footprint of the EM-bird, it is likely that individual ridge keels will be thicker. Analysis of the data is complicated by potential grounding of ridges, which will require consideration of model results for comparable geometries. The numbered arrows in Figure 1 indicate the location and approximate orientation of photos 1-3 in Figure 22. Photo 1 in Figure 2 shows the extent of the floe identified in Figure 1. Within this floe, we identified another elliptical feature that we believe contains at least two grounded ridges.

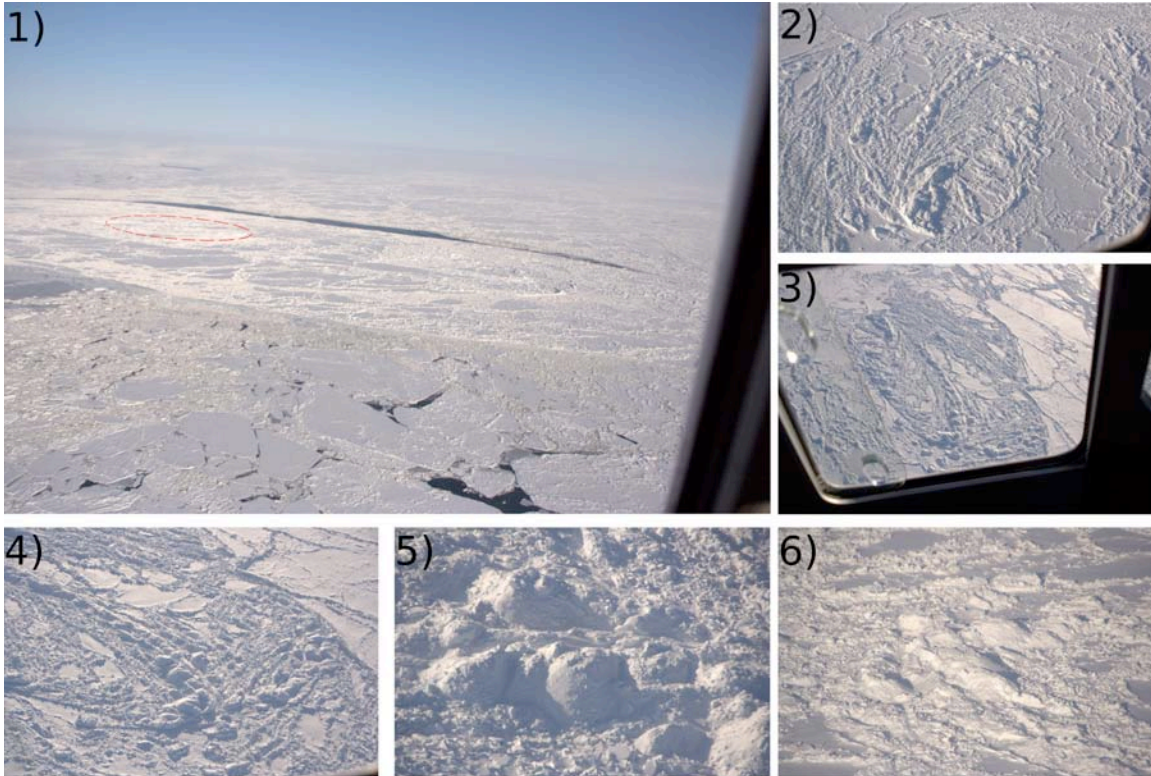


Figure 2: Photographs of the sea ice in the region of Hanna Shoal taken on March 30, 2011. The red dashed ellipse in photo 1 indicates the location of the elliptical feature photographed in photos 2 & 3. Photos 4-6 are show details of the grounded ridge we believe are pinning this floe.

Other activities

In addition, we have received reviews back on the two papers we recently submitted for publication. In both cases, the reviews were largely positive. We have revised and resubmitted the manuscript discussing operational monitoring of sea ice and anticipate publication in *Journal of the Marine Technological Society* soon. Revisions to the manuscript on our InSAR approach to landfast ice mapping (submitted to *Remote Sensing of the Environment*) will take more time though we anticipate acceptance after resubmission.

The landfast ice/leads bibliography has now been updated and includes literature up to 2010, including the peer-reviewed papers that resulted from the previous project. This will be available through the project website shortly and we include it as an appendix to this report. The EndNote bibliography file is also available upon request.

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

5) Action items, open questions etc.

n/a

APPENDIX: Updated bibliography of leads and landfast sea ice literature

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