Validation of the Arctic Cap Nowcast/Forecast System (ACNFS) Against Satellite and Observational Data

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Introduction

Validation of a new operational Arctic Cap Nowcast/Forecast system (ACNFS) has been completed. Results of validation test include:

- Ice Thickness
- Ice Extent
- Ice Draft
- Assimilating Ice Concentration

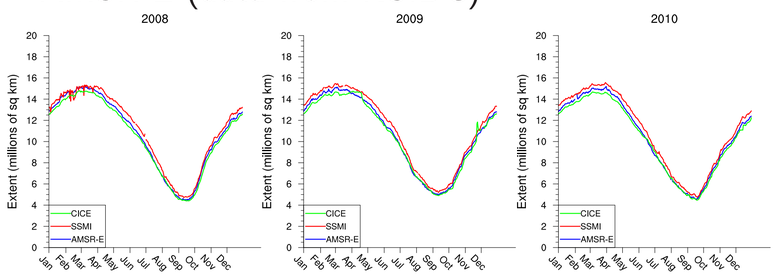
Comparisons made with current operational Polar Ice Prediction System (PIPS2.0) where appropriate.

ACNFS Model Overview

- ACNFS couples HYbrid Coordinate Ocean Model (HYCOM) with Community Ice CodE (CICE)
- ∼4km resolution (c.f. ∼25km PIPS2.0 resolution)
- Domain 45-90°N
- Ocean/Ice data assimliated via Navy Coupled Ocean Data Assimilation (NCODA)
- Ice concentration at ice edge is assimilated
- Data exchanged between HYCOM and CICE hourly
- ACNFS model run from July 2007-present

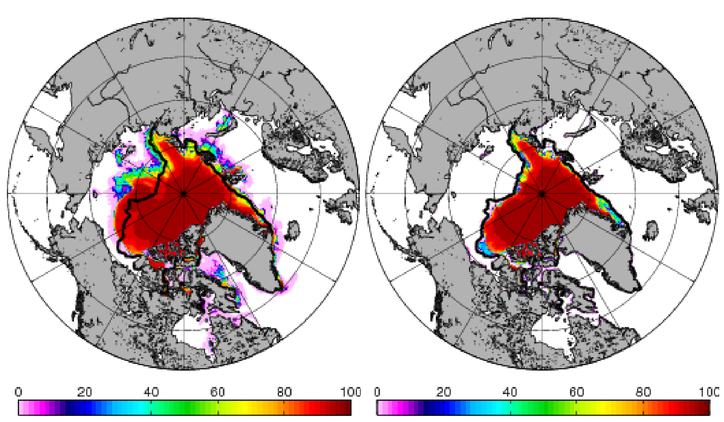
Ice Extent

- Identify area where ice concentration $> 15\%$
- Compare with extent observed by SSM/I and AMSR-E (data from NSIDC)



- ACNFS compares well with satellite

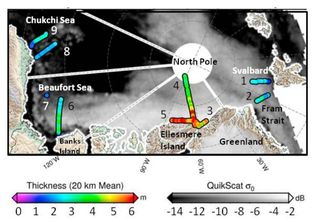
Ice Concentration Assimilation



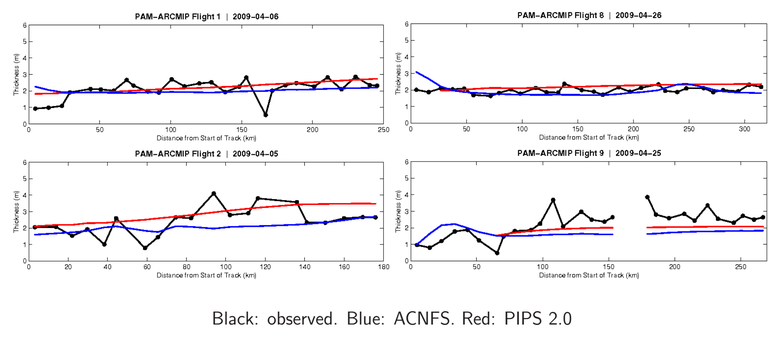
Ice Concentration (%) (Left) without and (Right) with assimilation. Black line is ice edge obtained independently from National Ice Center.

Ice Thickness: Airborne Observations

- Synoptic Airborne Observations measure snow + ice along a track (Haas et al. 2010)
- Model data interpolated to track locations



Tracks from Haas et al. 2010

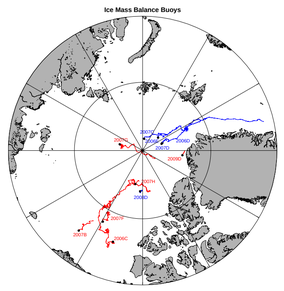


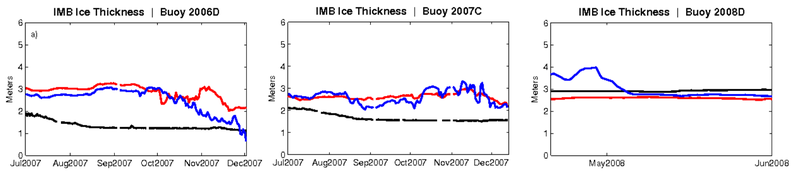
Black: observed. Blue: ACNFS. Red: PIPS 2.0

- On average ACNFS within 0.5m of observations

Ice Thickness: Ice Mass Balance Buoys

- Ice Mass Balance Buoys (IMB) deployed 2006-2009 (Perovich et al. 2009)
- Drift time 1-6 months
- Mean model ice thickness difference from IMB ∼1.2m





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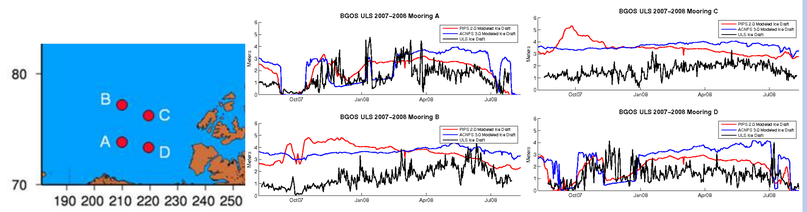
Ice Draft

WHOI deployed 4 moored upward looking sonar (ULS) in Beaufort Gyre (Proshutinski 2009).

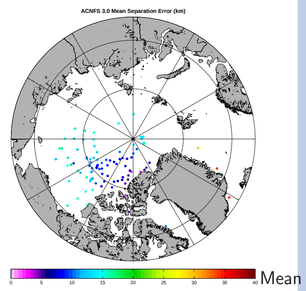
- ULS determines distance to bottom of ice.
- Pressure sensor determines distance to sea surface.
- Pressure - ULS = Ice Draft
- 89% ice thickness is underwater and seen as draft (Rothrock et al. 2003)



- Mean ACNFS difference ∼1.5m

Ice Drifter Location

- 102 ARGOS drift buoys deployed in 2008
- University of Washington International Arctic Buoy Program (IABP, Dr. Rigor)
- Passive tracer put in model at buoy location each day
- Difference in buoy location and tracer after 24hrs
- Mean error ∼10km
- Largest error in areas of thin ice (east of Greenland) that tends to move faster than thick ice (north of Canadian Archipelago)



separation error (km) plotted at start of each ARGO buoy

Ice Drifter Velocity

- Passive tracer inserted into model at each IABP location.
- Velocity components of IABP drift buoys compared to ACNFS tracer velocity.
- Result: Mean model velocity error 1.1cm/s
- As with drifter location, largest errors in areas of thin ice that tend to move faster.

Summary

- Overall, ACNFS compares well with observations:
  - Thickness within $\pm$ 1.0m on average
  - Ice extent close to that obtained from satellite
  - Draft difference ∼1.5m
  - Mean 24hr ice drift error ∼10km
  - Mean 24hr ice drift velocity error ∼1cm/s
  - Assimilating ice concentration improves ice edge location
- ACNFS is running in real-time at NAVO and producing a daily 5-day forecast of ice drift, ice concentration, ice thickness, ocean currents, ocean temperature and salinity.
- NIC is currently evaluating ice products from ACNFS, while NAVO is evaluating the ACNFS ocean products.
- Operational Testing (OPTEST) is scheduled to be complete by end of 2011.

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