Arctic Cap Nowcast/Forecast System

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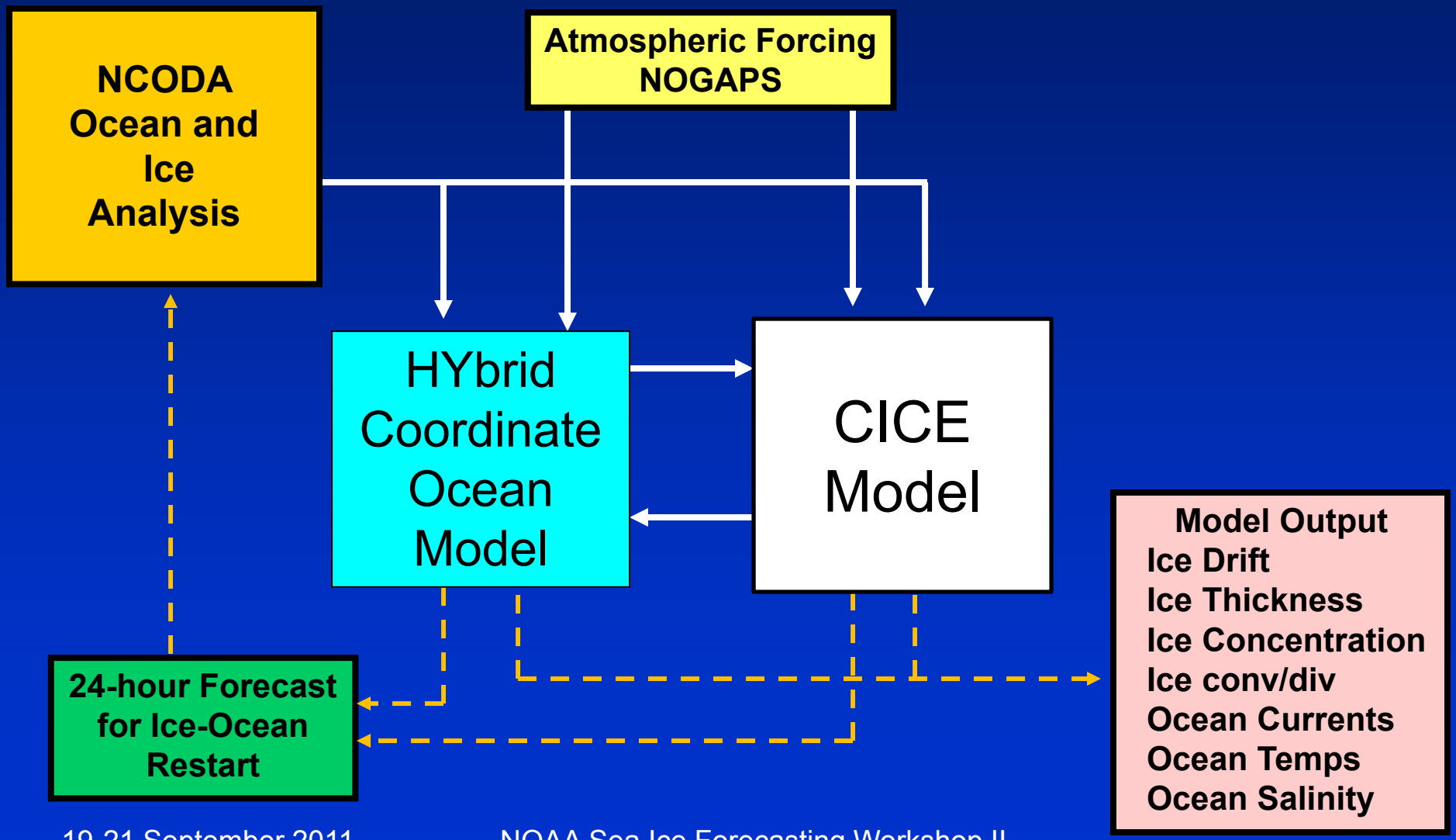
NRL Ice Forecasting Systems

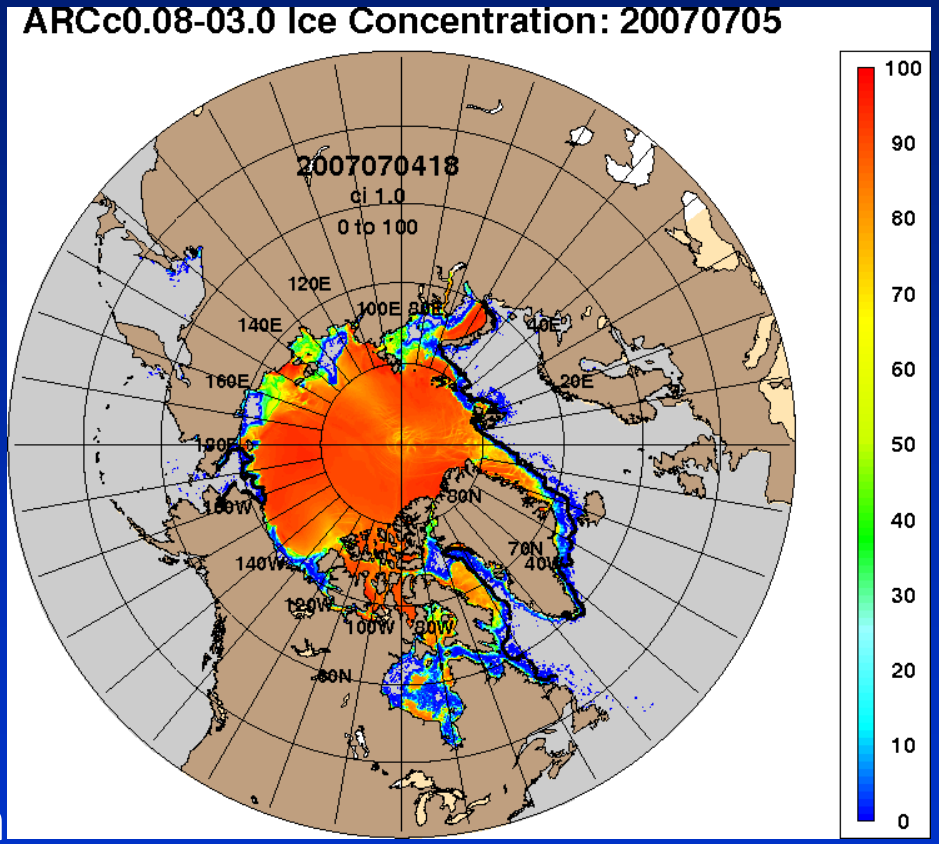
Arctic Cap Nowcast/Forecast System



Arctic Cap Nowcast/Forecast System (ACNFS)

- Improved Ice and Ocean Model
  - Replaces PIPS2.0
- Higher resolution – 3.5 km
- Improved data assimilation in the ocean and ice
- 5 day forecast daily
- ACNFS consists of :

  - Ice Model (CICE)
  - Ocean Model (HYCOM)
  - Data assimilation (NCODA)
- OPTEST scheduled for completion Dec 2011



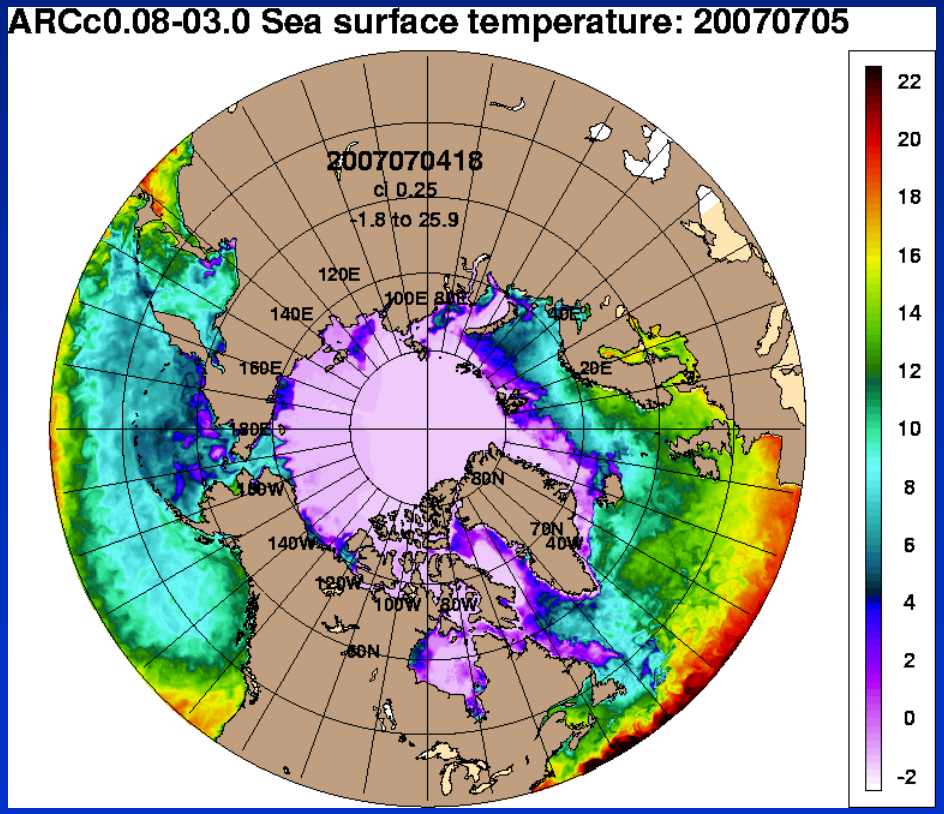
Black line denotes independent ice edge analysis from National Ice Center

Sea Ice Simulation in HYCOM

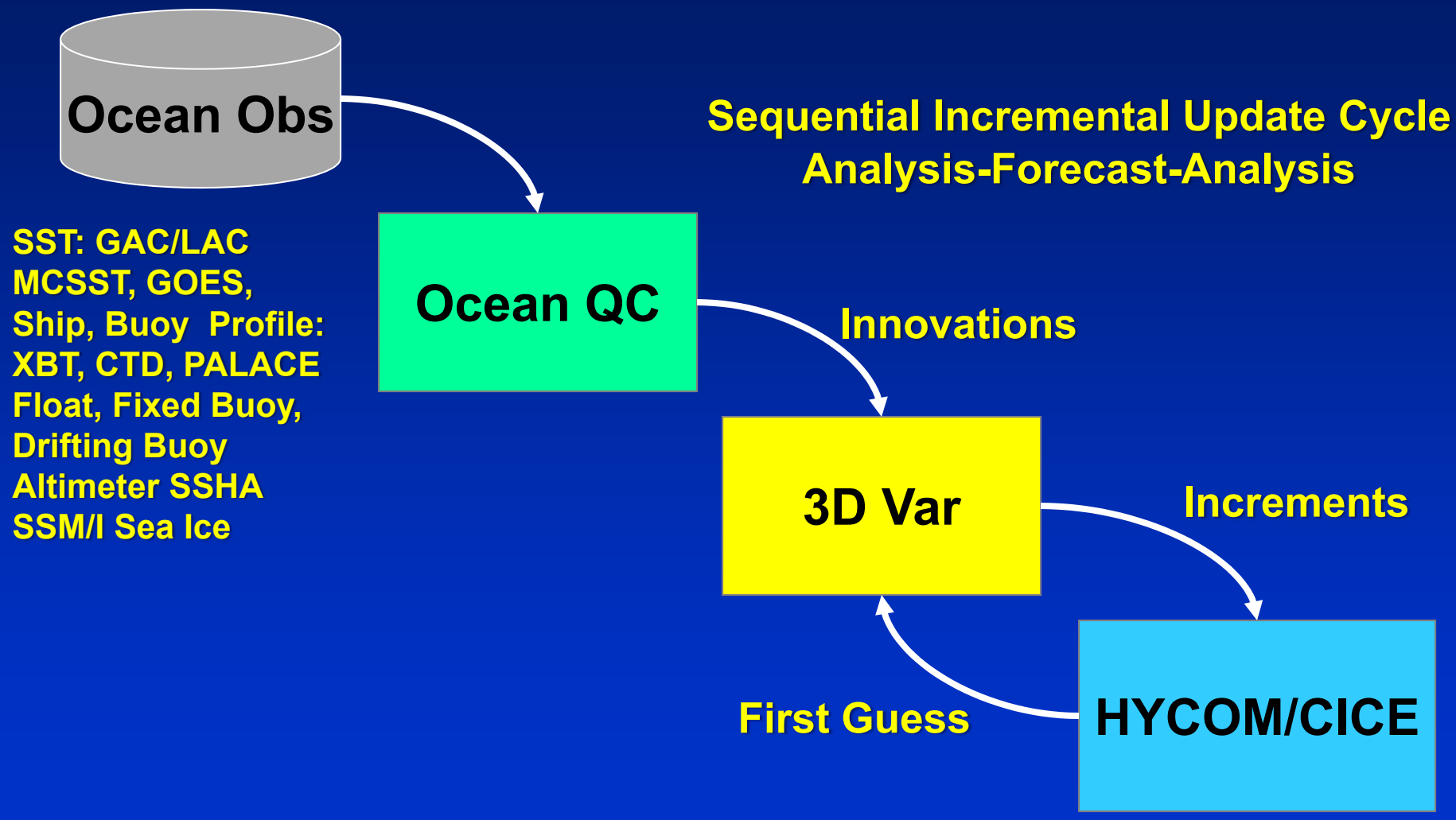
- Couple HYCOM with a sea ice (CICE v 4.0) model developed by Los Alamos National Laboratory
  - Next generation, advanced system
  - Additional ice physics
    - Energy-based ice ridging scheme
    - Energy-conserving thermodynamics
    - Multi-category, linearly remapped ice thickness
  - New capability to predict areas of lead opening and closing
  - Coupling between ocean and ice via the Earth System Modeling Framework (ESMF)

HYbrid Coordinate Ocean Model (HYCOM)

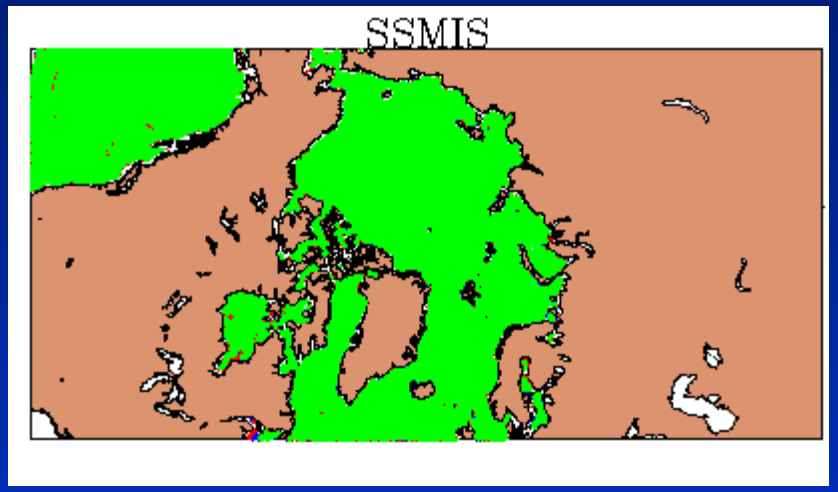
- Developed by a Consortium (Los Alamos National Laboratory (LANL), NRL, U. Miami)
- Hybrid coordinates
  - Isopycnal in open, stratified ocean
  - Terrain-following in shallow coastal seas
  - Z-level in mixed-layer and/or in unstratified seas
- Tripole grid – pole moved over land to eliminate singularly of North Pole
- Climatological monthly varying rivers
- Tides being added/tested
- Global HYCOM provides boundary conditions for “Arctic Cap” model



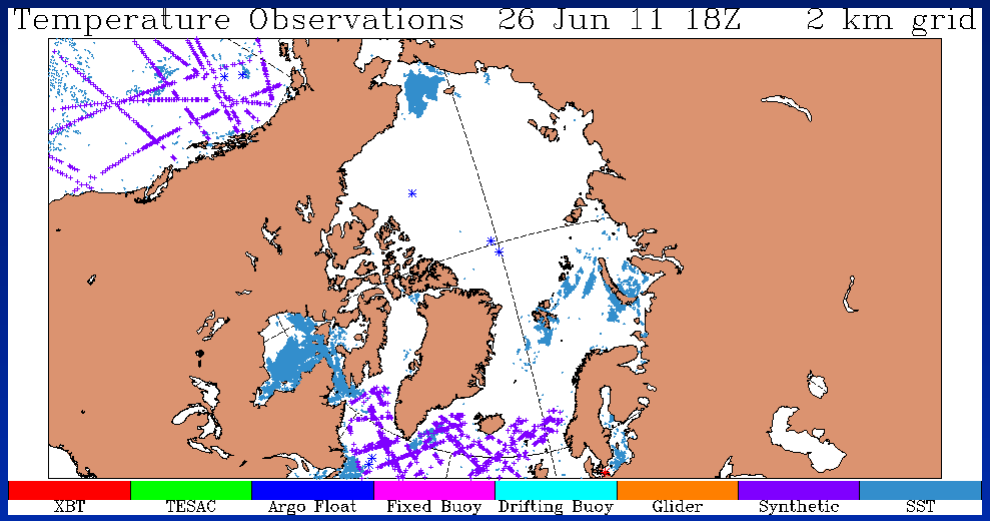
Navy Coupled Ocean Data Assimilation (NCODA)

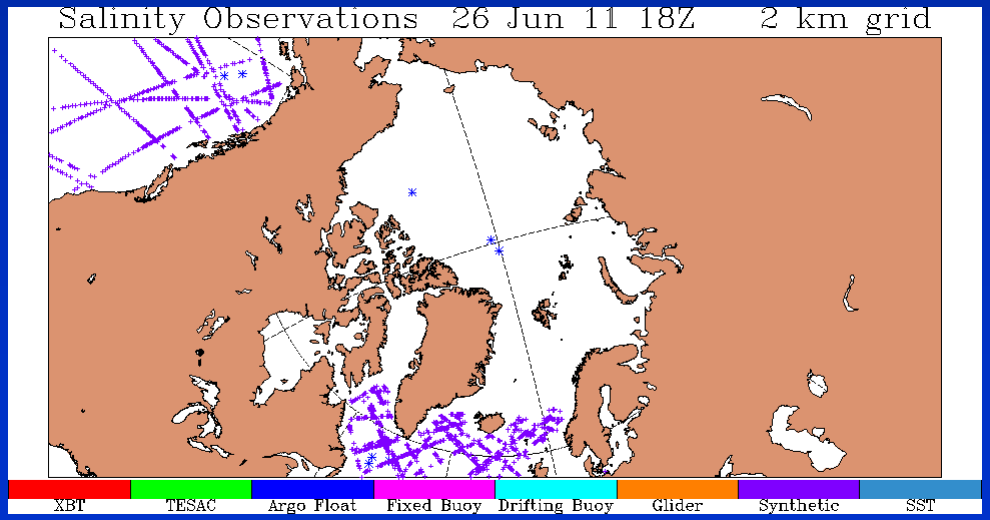


Current Arctic data types that are assimilated into the ACNFS model



Limited coverage; only ice concentration data provide almost full coverage.





Assimilates both surface and 3D observations

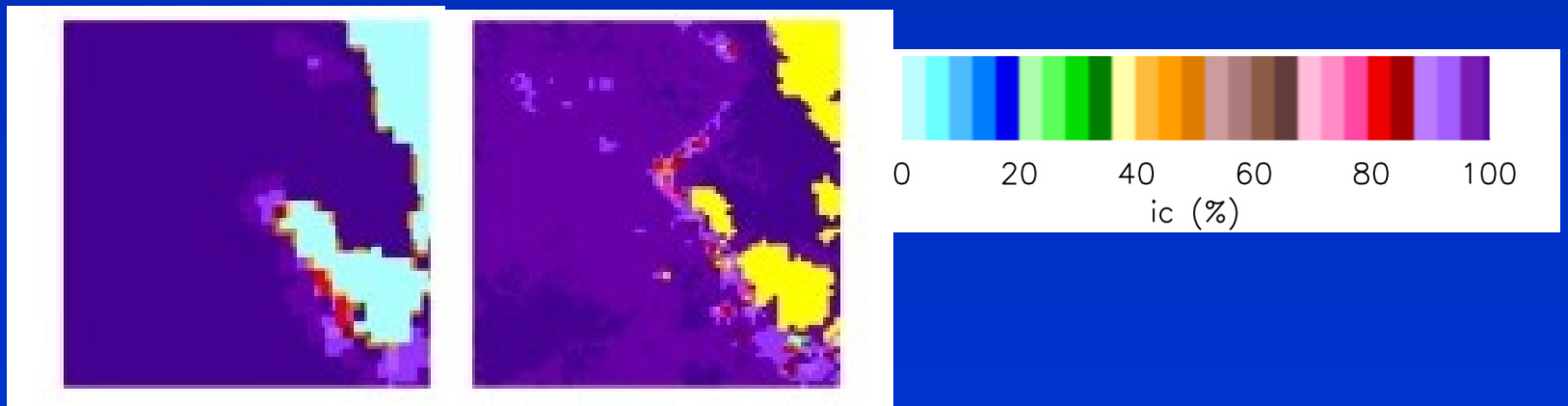
Ice Modeling Assimilation from Satellites

- Currently, DMSP SSM/I ice concentration (25 km) is the only ice field assimilated in the Arctic Cap Nowcast/Forecast System (ACNFS). ACNFS grid resolution is ~3.5 km. Mismatch in resolution between data and model.

- Since June 2010, AMSR-E ice concentration (12.5 km) has been available in real-time from NASA LANCE website.

SSM/I
25.0 km

AMSR-E
12.5 km

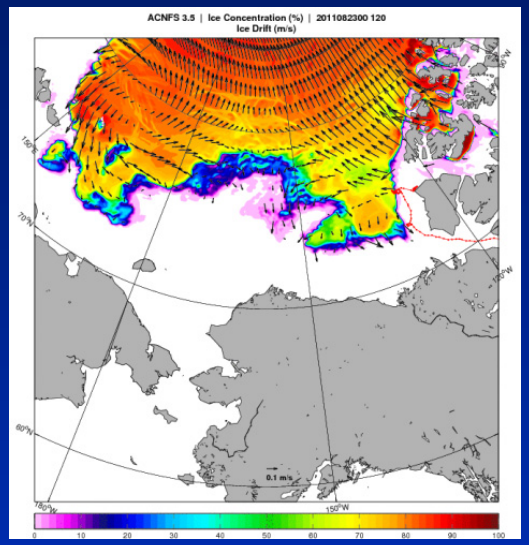


Mean distances (km) between the independent NIC ice edge and the ACNFS assimilating AMSR-E or SSMI. 01 July 2009 – 30 June 2010

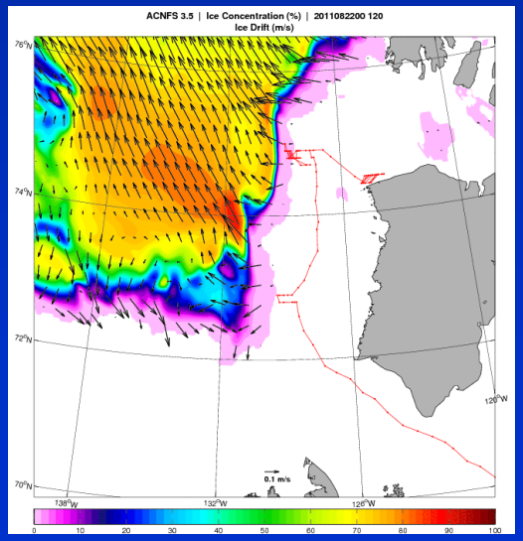
Region	ACNFS assimilating AMSR-E	ACNFS assimilating SSM/I	% Improvement
Full Arctic	**18.1**	21.6	16%
Greenland	39.6	**35.7**	-9%
Barents	**34.9**	39.4	11%
Laptev	64.7	64.4	0%
Sea of O	**48.2**	62.8	23%
Bering/Chukchi /Beaufort	**46.5**	58.7	21%
Canadian Archipelago	53.8	**48.3**	-11%
Average	**43.7**	47.2	7%

Beaufort Sea Expedition

Area 1

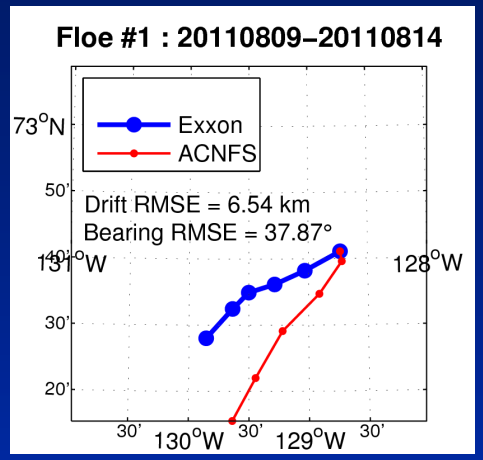


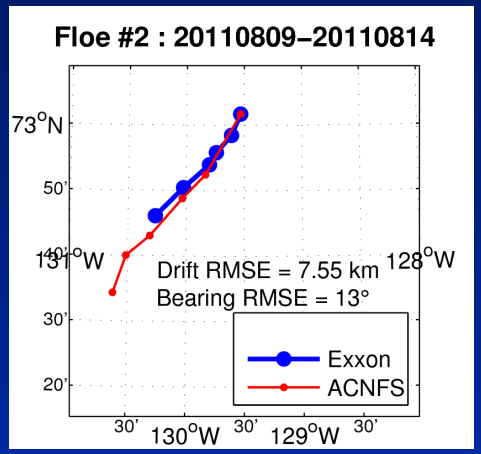
Area 2

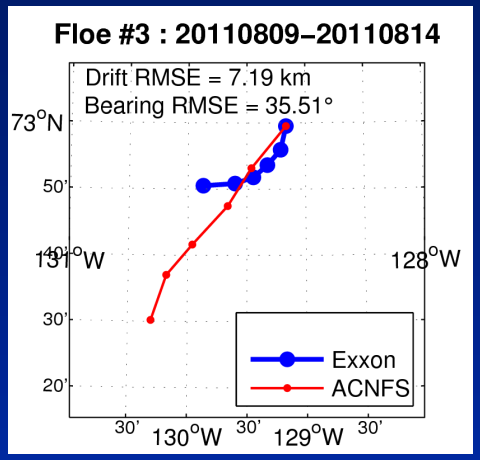


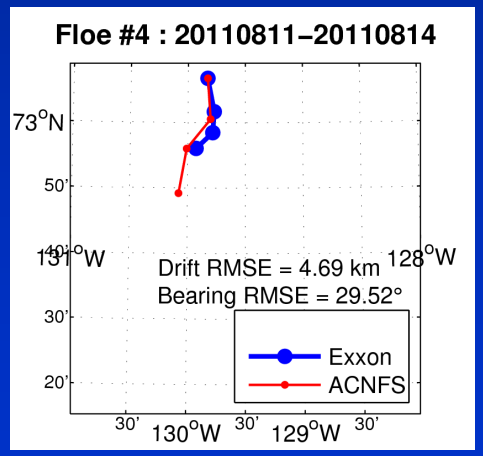
- Support to ExxonMobil
  - August 13-25, 2011
  - Ice breaker Amundsen
  - ACNFS 120 hour forecasts provided via ftp for 2 zoomed areas in Beaufort Sea
  - Ice drift beacon data, floe data provided to NRL for model validation
  - POC's: Dmitri G. Matskevitch (ExxonMobil)
  - David Barber (U Manitoba)

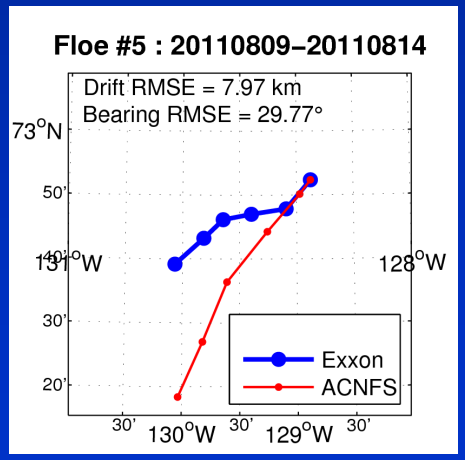
24-hr Floe Comparisons

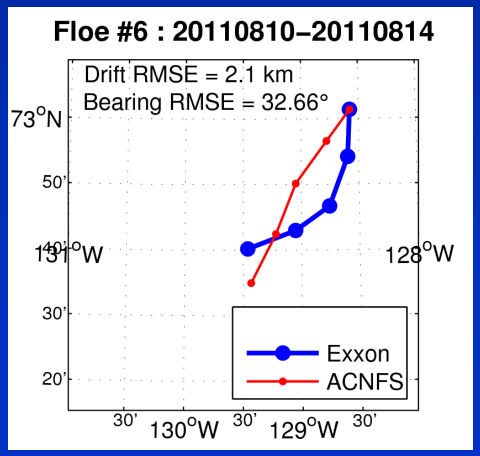






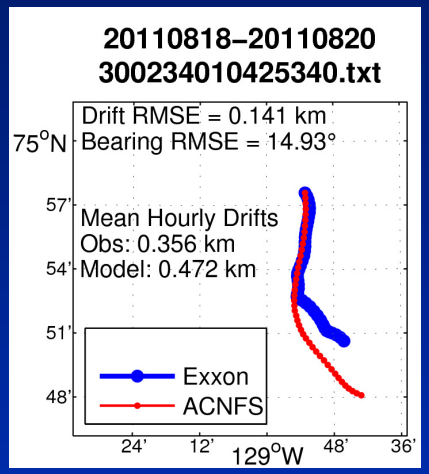


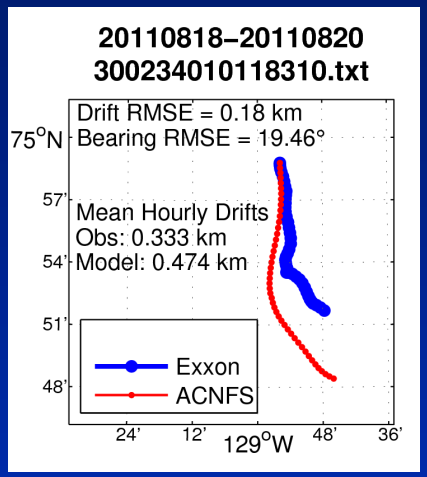


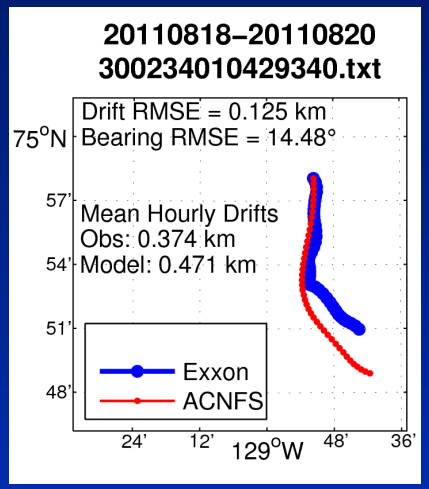


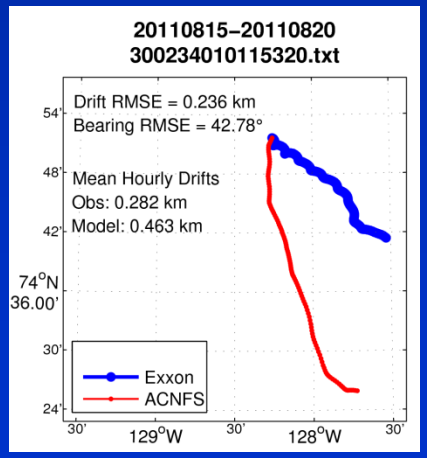
Based on 27 observations: 24-hr drift RMSE 6.5 km, bearing RMSE 31°

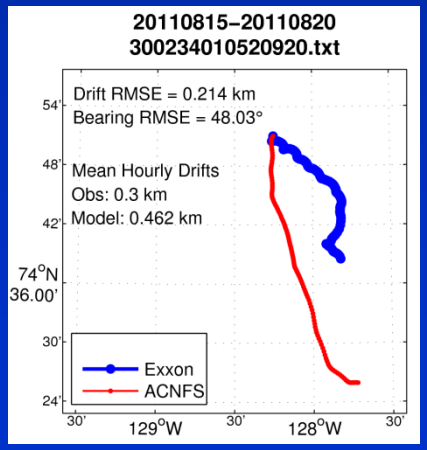
Preliminary Analysis with Hourly Beacon Data











Determining the Impact of Sea Ice Thickness on the Arctic's Naturally Changing Environment (DISTANCE)

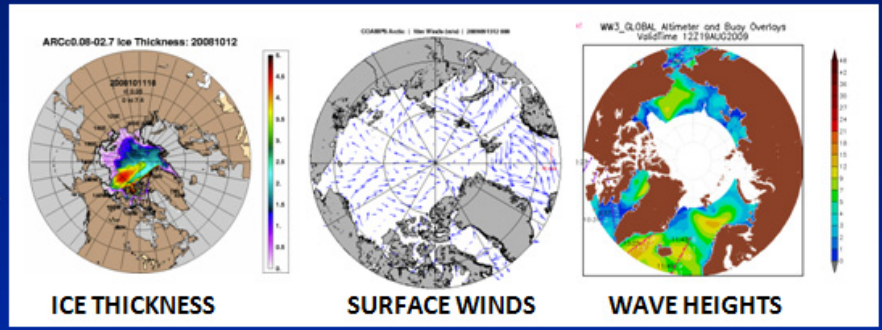
Code 7220
Satellite Algorithms

Code 7320
Arctic Modeling

FY12 START

NRL

Code 7420
Airborne Campaign



boreholes

NRL, CRREL
In situ

Strategy

Remote Sensing Synergism

- Collect in situ data (ice/snow thickness)
- Develop airborne algorithm from in situ data
- Utilize airborne data to derive satellite algorithm

Ice-Ocean Modeling Scheme

- Validate model ice thickness against new satellite/airborne data
- Simulate snow forcing on ice distribution

Leverage existing Arctic programs

Future plans

- Delivered 1/12 Arctic Cap to NAVOCEANO. OPTEST is underway (NIC/NAVO). Scheduled completion date Dec 2011. http://www7320.nrlssc.navy.mil/hycomARC

- Assimilate AMSR-E higher resolution ice concentration fields and MODIS surface ice temperatures (collaboration with Jenny Hutchings) in ACNFS – Scheduled delivery Sept 2012.

- NAVGEMS (NOGAPS upgrade): target resolution ~1/4°testing with ACNFS to begin in FY12

- CICE (v4.1) is scheduled to be implemented into the global 1/12° HYCOM/NCODA system. New capability to forecast ice conditions for both northern and southern hemisphere.

- Proposed FY13 6.2 Newstart: A Coupled Relocatable High-Resolution Arctic Modeling System (atmosphere-ice-ocean)

Questions?

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