



Regional Arctic Sea Ice Forecasting in Support of the U.S. Coast Guard And ONR SeaState Operations

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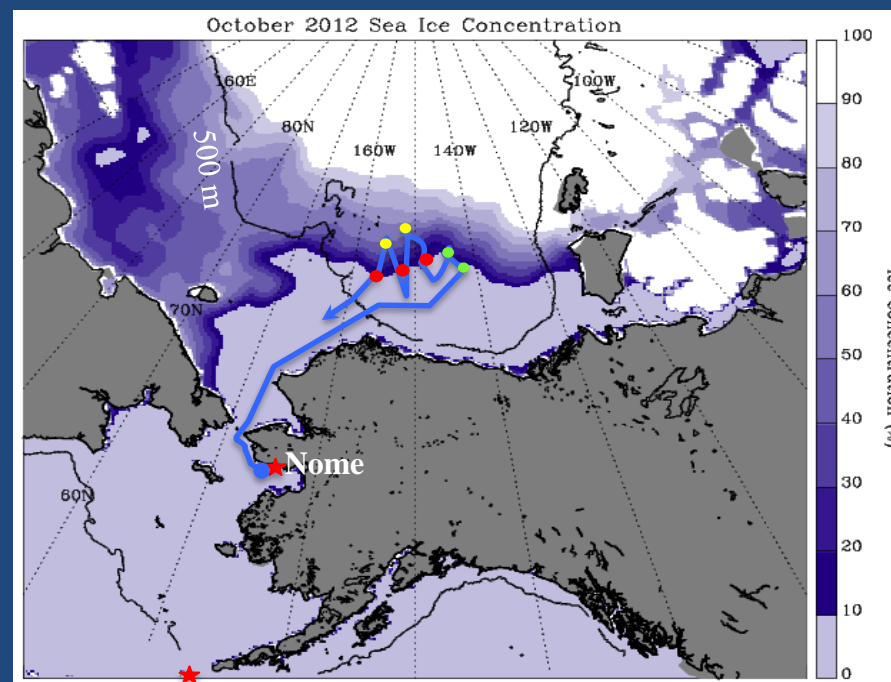
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⁴Jacobs Technology, Inc, Stennis Space Center, MS

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ONR Sea State DRI

- R/V Sikuliaq Ops in Beaufort and Chukchi
- Investigate:
 - Meteorology and fluxes
 - Ice thickness and snow depth
 - Waves – open ocean and in ice
 - Ocean salinity & temperature
- Sept - Nov 2015



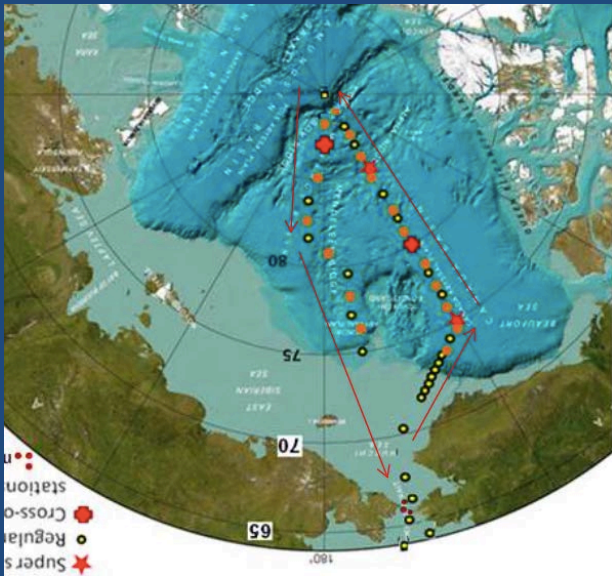
Dutch Harbor



Slide credit:
Martin Jeffries

U.S. Coast Guard Missions

- HLY1501
 - July 3 – July 26
 - Most ops in Beaufort and Chukchi

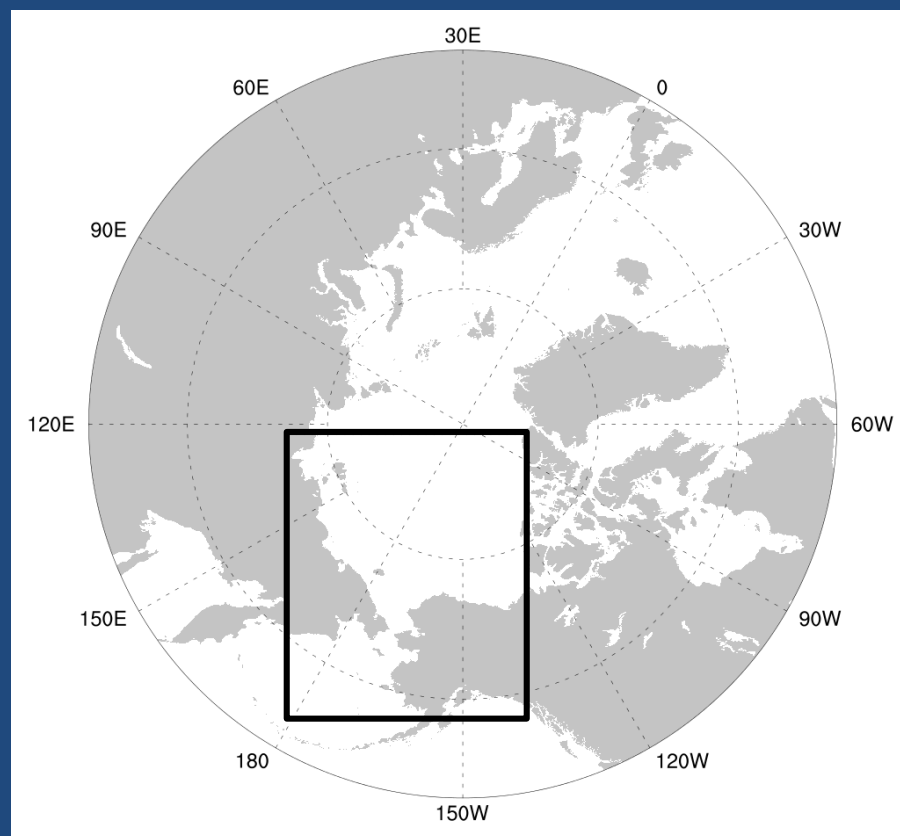


- HLY1502
 - Part of GeoTraces
 - Aug 09 Leave Dutch Harbor
 - Sept 8 reached Pole
 - Return Oct 12



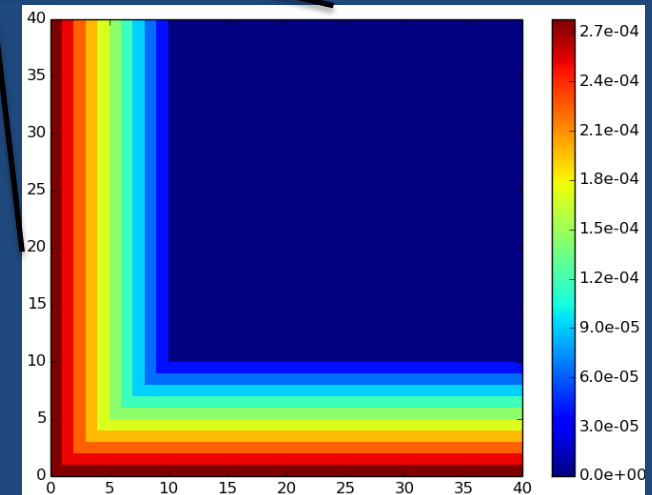
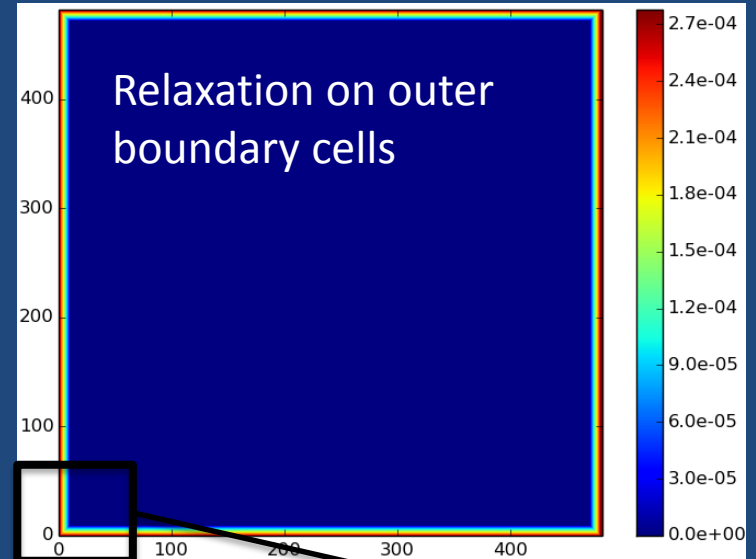
Model Setup

- CICE V5
- 2 km Grid Resolution
 - 1440x1728
 - Stereographic projection
- 384 processors at NAVY DSRC
 - Run once daily. 00Z run starts at 0845Z (after ATM Forcing COAMPS)
 - 4 days takes about one hour to run
 - 1 day hindcast, 3 day forecast
 - Time step 120 sec
- Initialized from Global Ocean Forecast System (GOFS) 3.1 on May 1, 2015
- Assimilates daily Ice Concentration masked with IMS



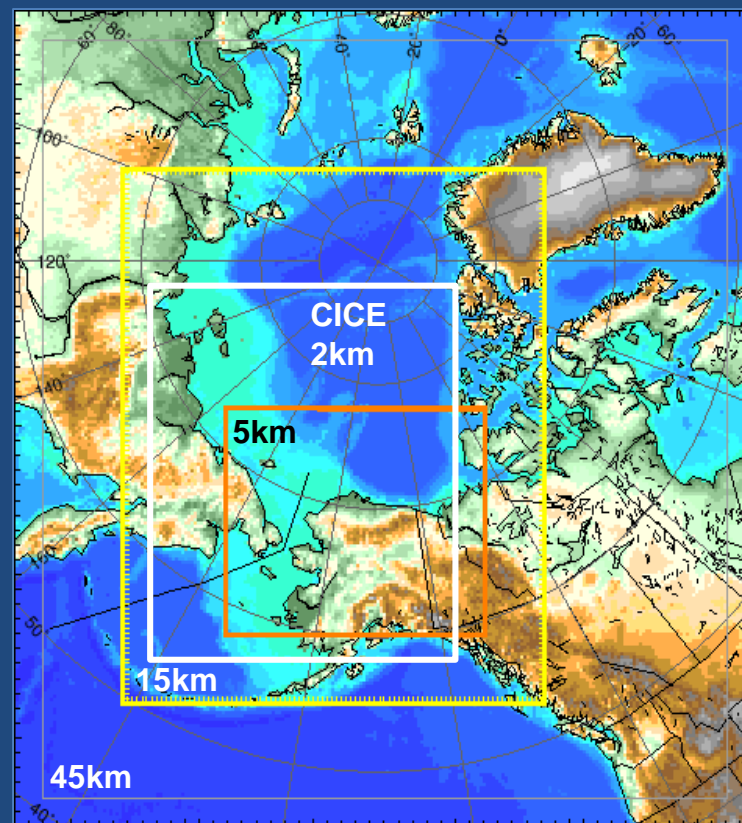
Boundary Conditions

- CICE values are relaxed to conditions obtained from GOFs/ACNFS (Arctic Cap Nowcast/Forecast System) at the domain boundaries.
 - Ice concentration, ice/snow volumes, ice velocity, ice surface temp
 - Ice/snow internal energy reinitialized
- Relaxation on outer 20 grid cells.
- Relaxation timescale increases from 1/300s on the outer most cells to 1/86400s at the inner most boundary cells.
- GOFs/ACNFS data interpolated to regional CICE and converted to CICE V5 format.



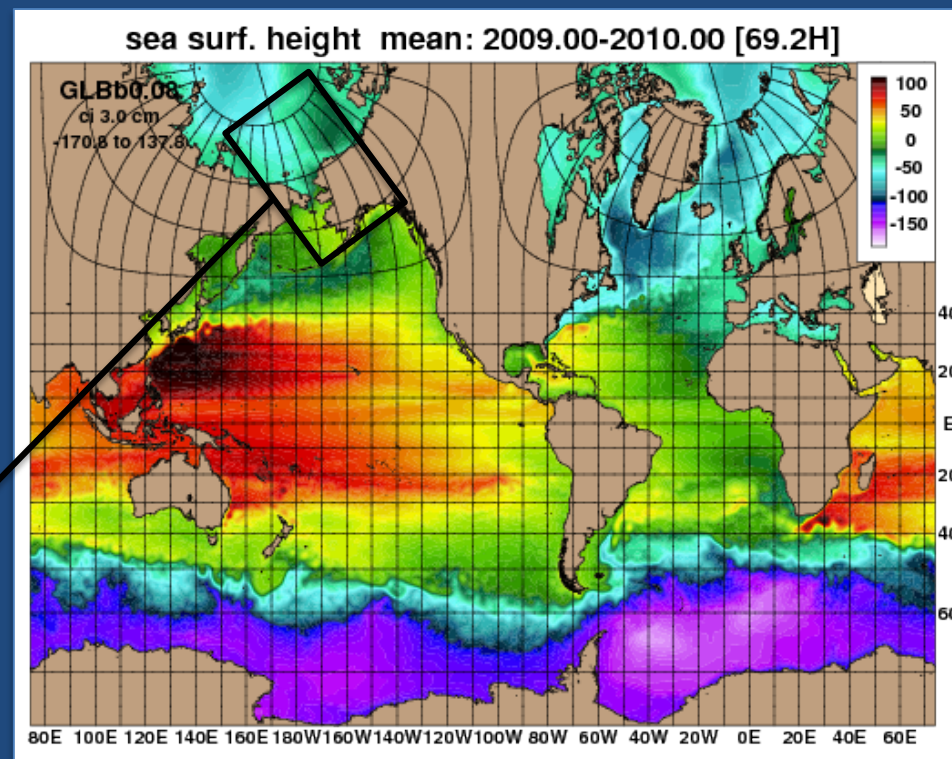
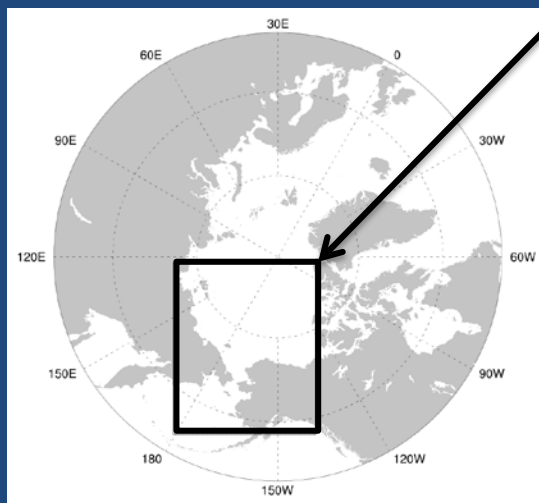
Atmospheric Forcing

- Downward shortwave and longwave radiation, 10 meter winds, air temp, specific humidity
- COAMPS (Coupled Ocean Atmosphere Mesoscale Prediction System)
 - not coupled with CICE
 - Run by NRL-MRY twice/daily
 - 3 Nests: 45 km, 15 km, 5 km
 - Created COAMPS setup routines to generate CICE forcing from model output
 - CICE updated to read COAMPS NetCDF
- NAVGEM
 - NAVy Global Environmental Model
 - ½ degree global operational output
 - External FORTRAN code to interpolate to CICE grid
- Check first for COAMPS. If no COAMPS, use NAVGEM



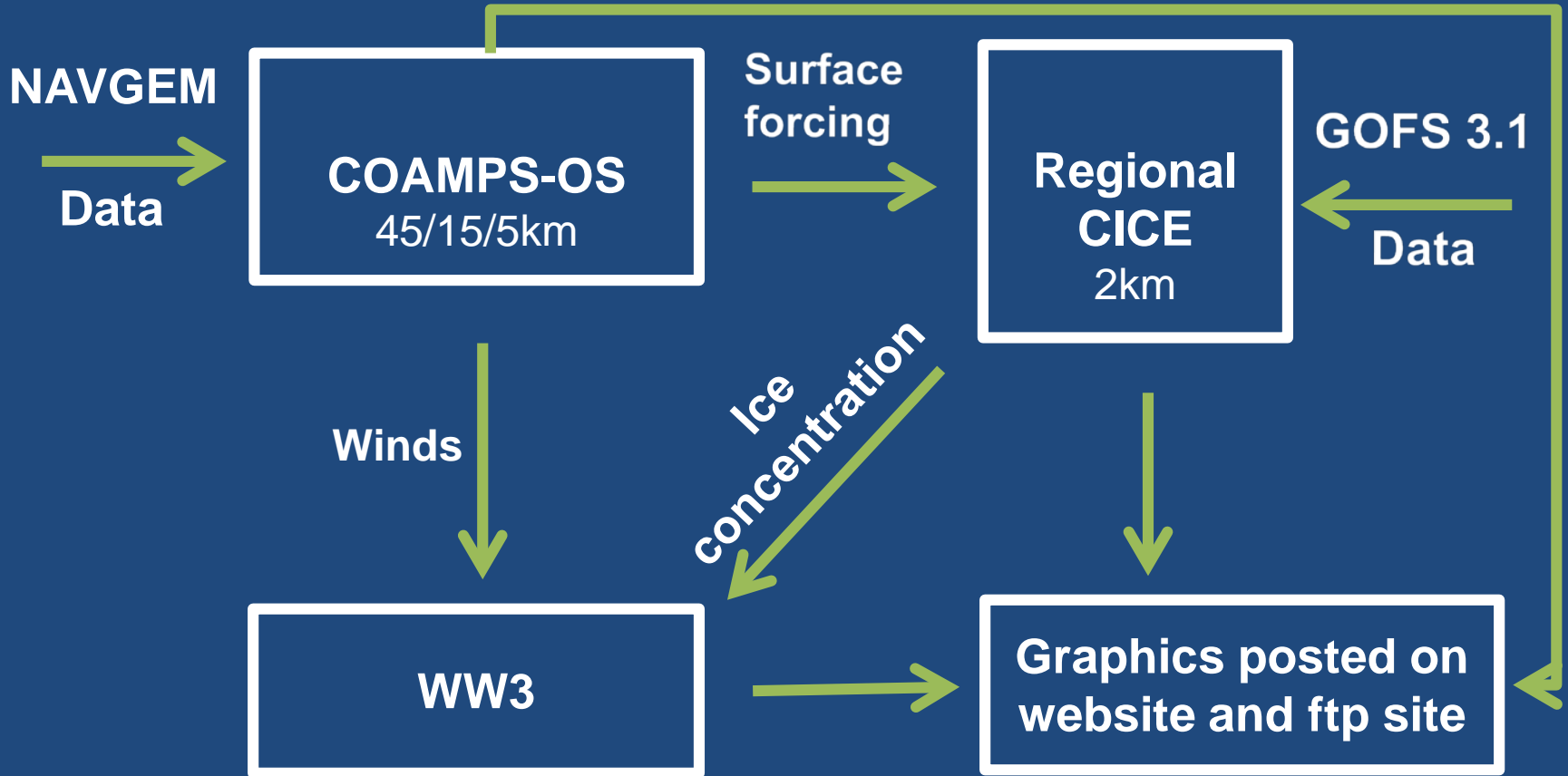
Ocean Forcing

- SST, SSS, Surface Currents from GOFS 3.1
 - 3.5 – 4 km near pole
- Interpolated to 2 km Regional Grid





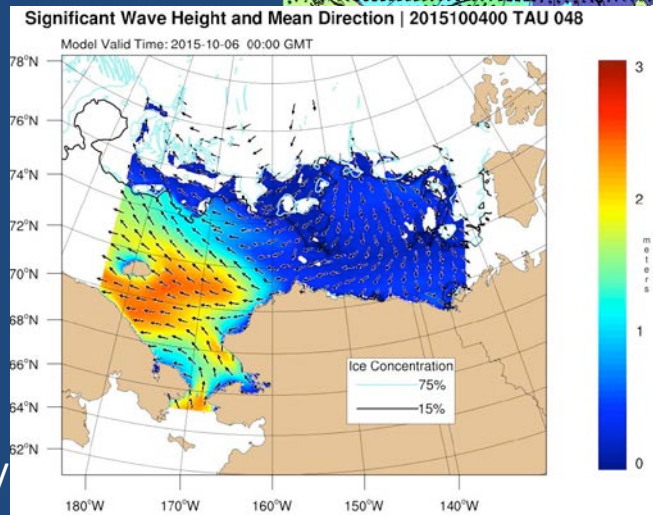
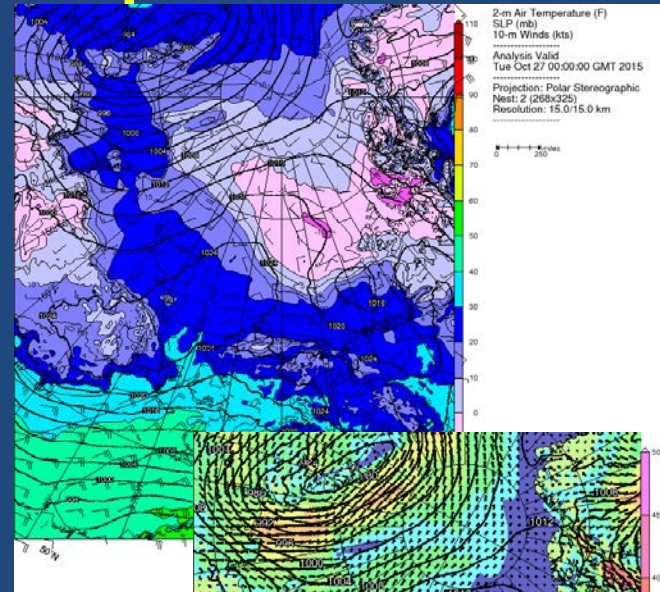
COAMPS-CICE-WW3 Healy Real-Time Forecast



COAMPS and WW3 72 hour forecasts: twice daily at 00Z and 12Z
CICE 72 hour forecast: 00Z

Model Output

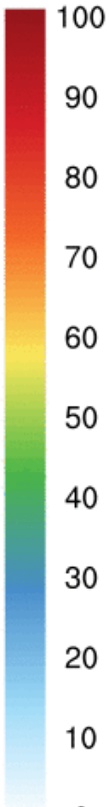
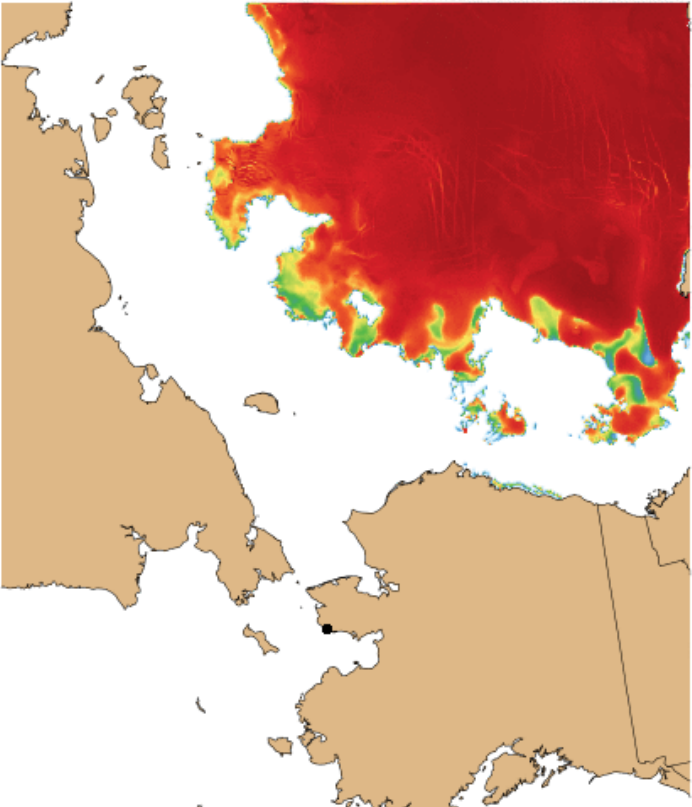
- Ice concentration, thickness, drift, surface temp, strength, opening rate
- Wave height, period
- COAMPS-OS webpage
 - <https://cavu.nrlmry.navy.mil/COAMPSOS/>
- Model Output pushed to NIC
- Plots pushed to U.S.C.G. and U. Victoria



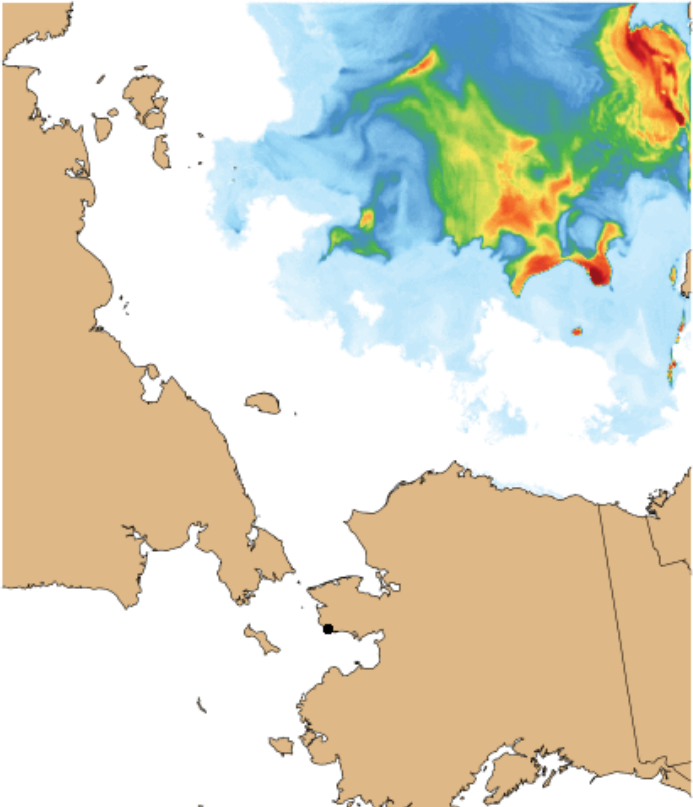
Model Output

2015-09-30

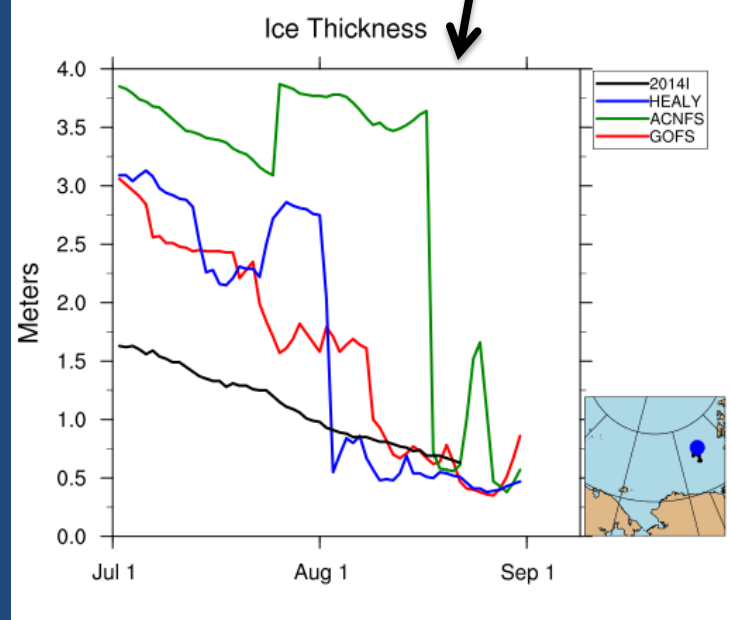
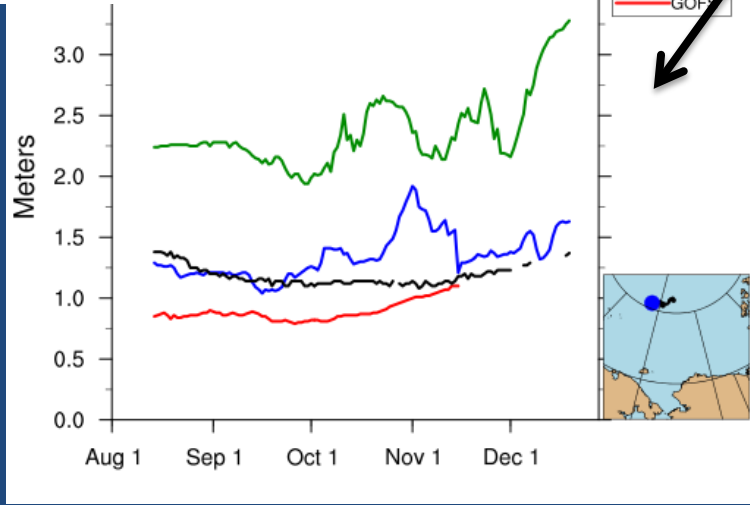
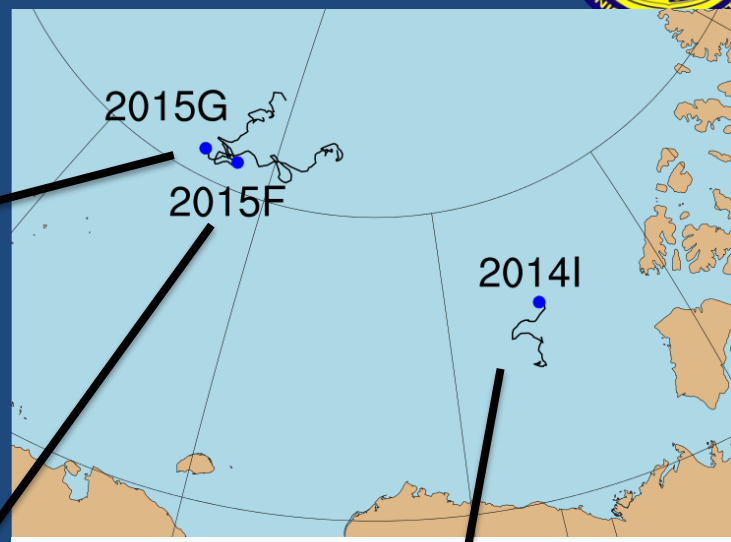
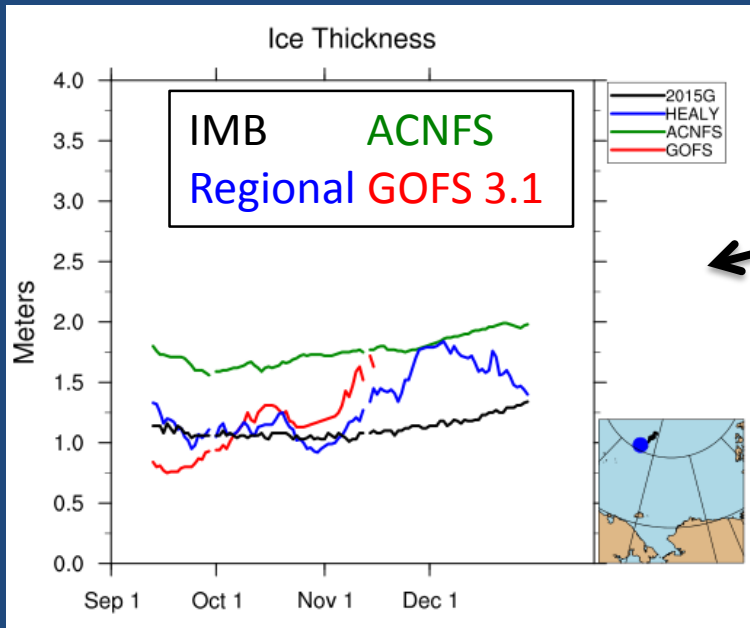
Ice Concentration



Ice Thickness

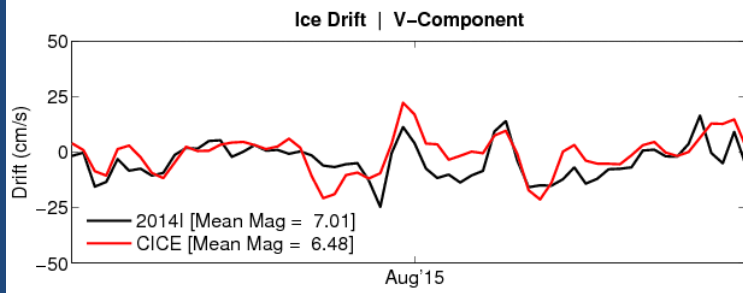
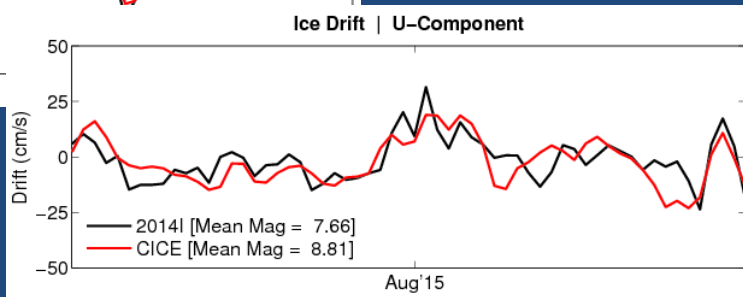
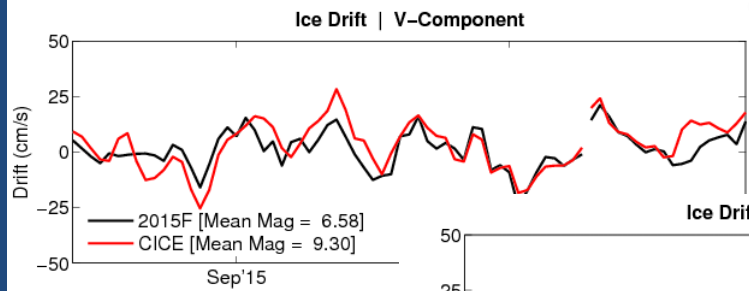
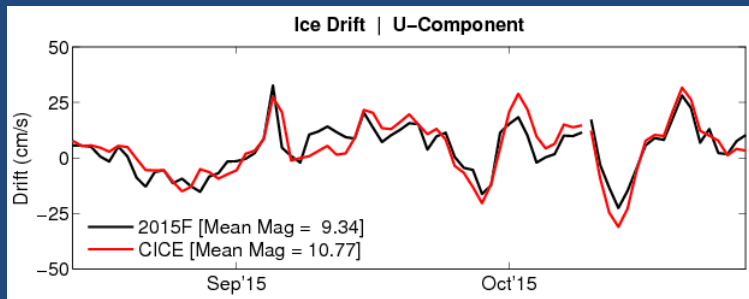


Model Comparison – CRREL IMB

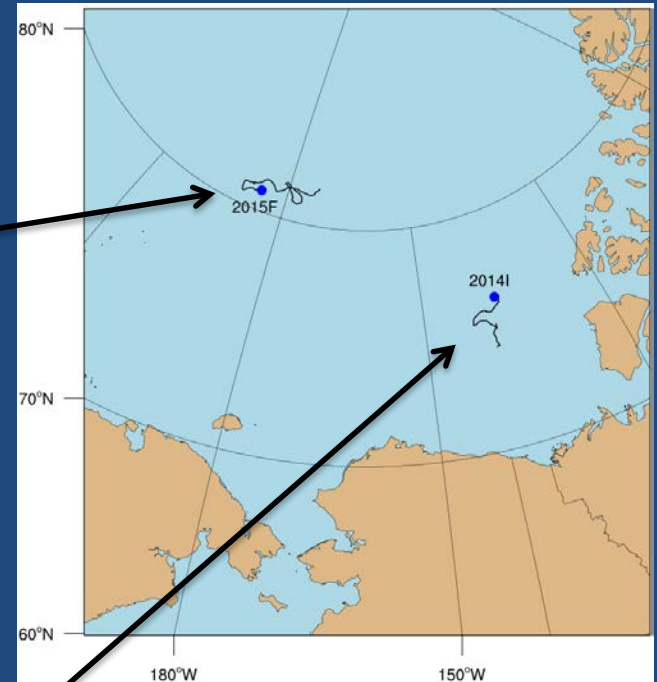




Model Comparison – CRREL IMB Drift

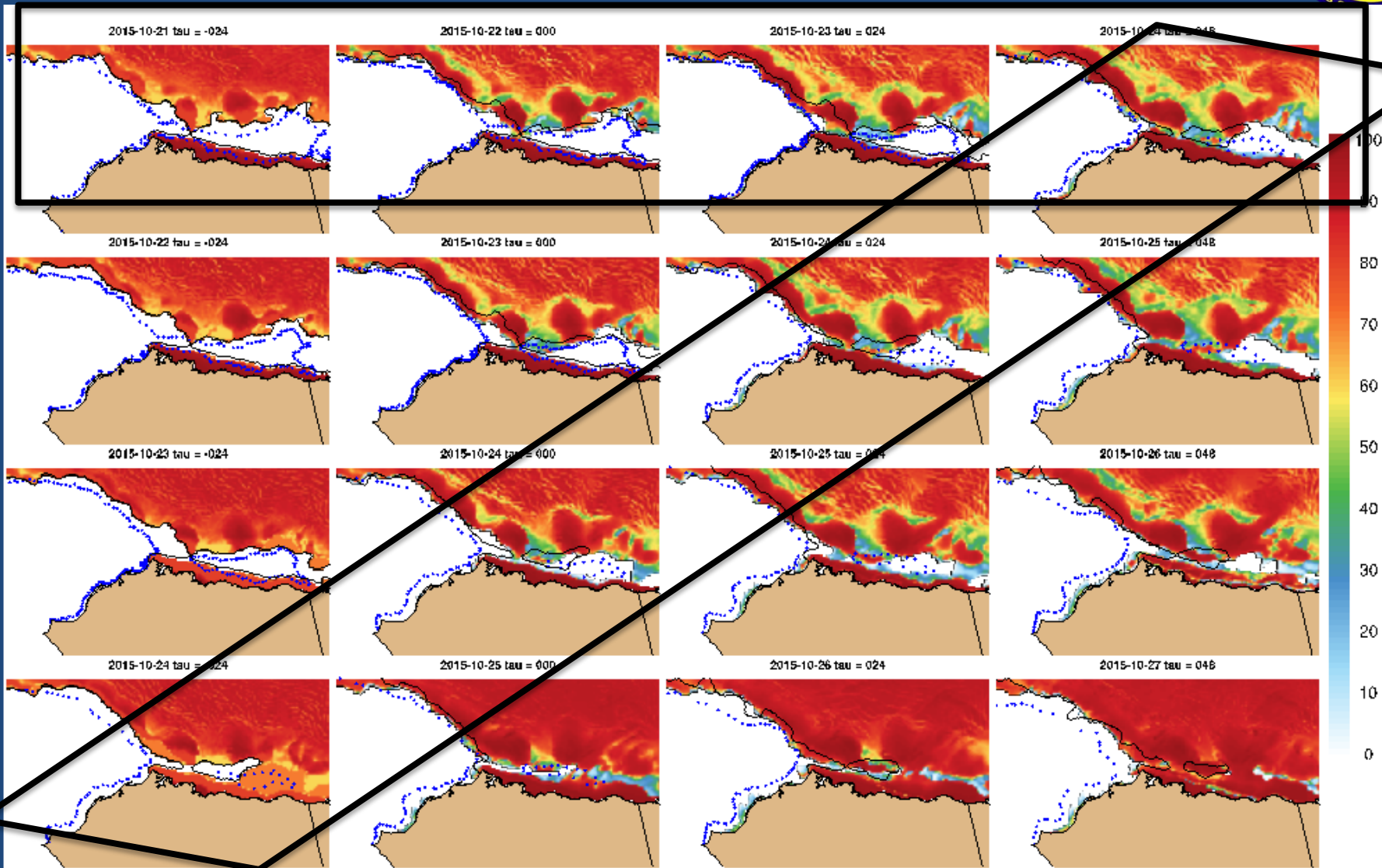


2015F



2014I

Ice Growth 2015-10-24



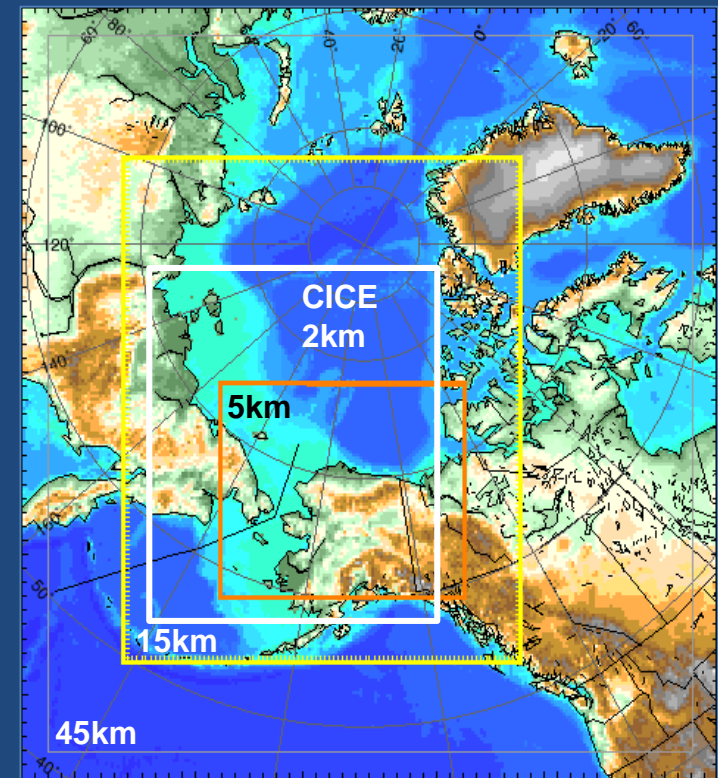


Summary

- High resolution, regional Arctic model setup to support U.S.C.G. and ONR Sea State DRI OPS
 - Model output pushed to NIC for daily analysis and UVIC
- Regional CICE model forced with Arctic COAMPS and GOFS 3.1
- Relaxation boundary conditions for CICE
- Model Drifts close to CRREL IMB drift
- Regional Model Ice Thickness sharp change in Beaufort (likely due to advection of ice), too thin in Chukchi

Future work

- Continue to run through March 2016
 - Support ICEX 2016
- Re-initialize ice thickness field from blended SMOS/Cryosat data
 - Li Li, NRL-DC
 - (Early results shown at AGU)
- Hindcast with higher resolution COAMPS
 - COAMPS has different representation of cloud and precipitation physics below 10 km resolution
 - Run fully coupled
- Wave effects on ice floe size distribution





Backup slides



