

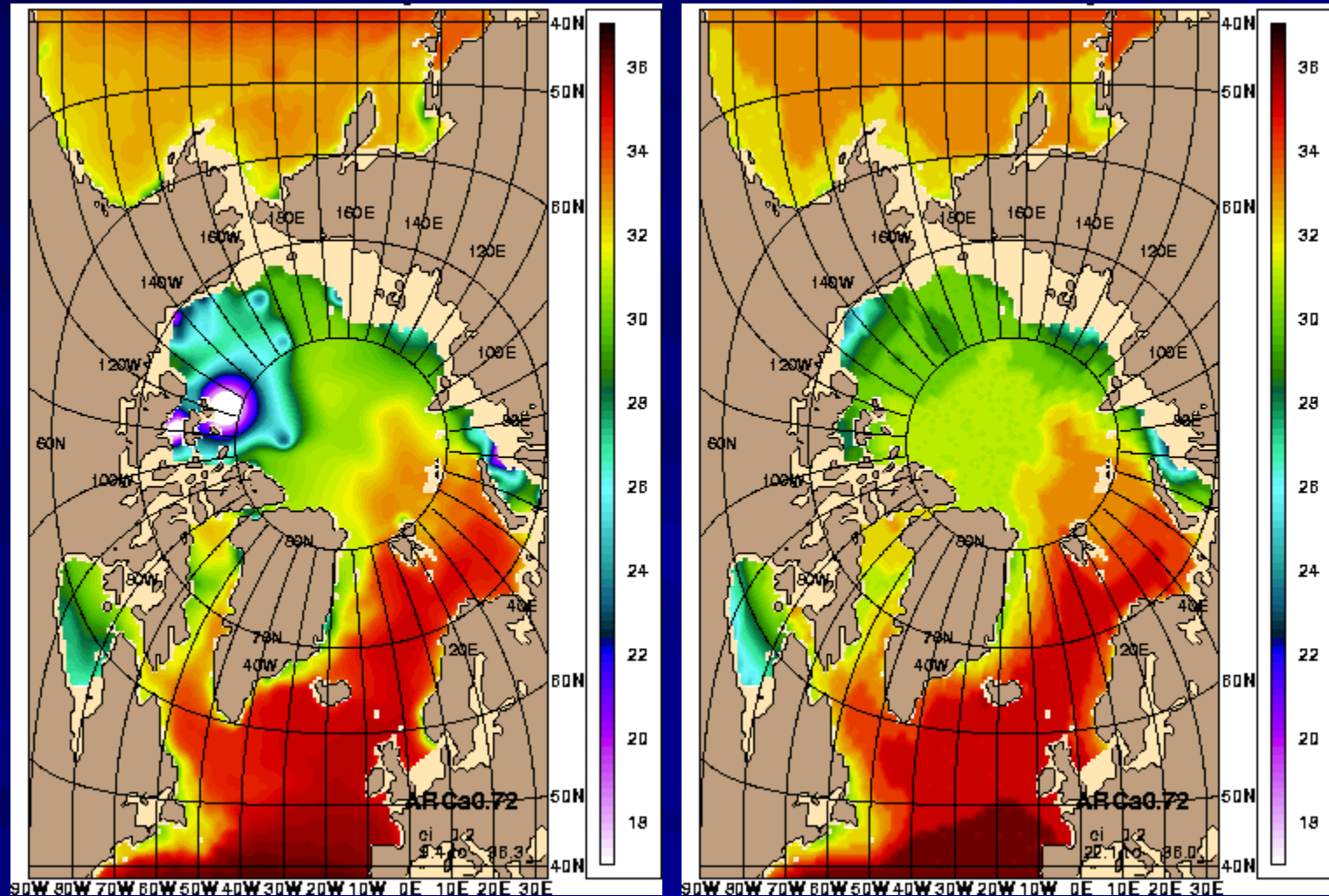
Sea Ice Modeling at NRL

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Pamela G. Posey and Lucy F. Smedstad

HYCOM Consortium Meeting
6-8 December 2005
RSMAS, Miami FL

Arctic Sea Surface Salinity – August

GDEM3 vs. PHC

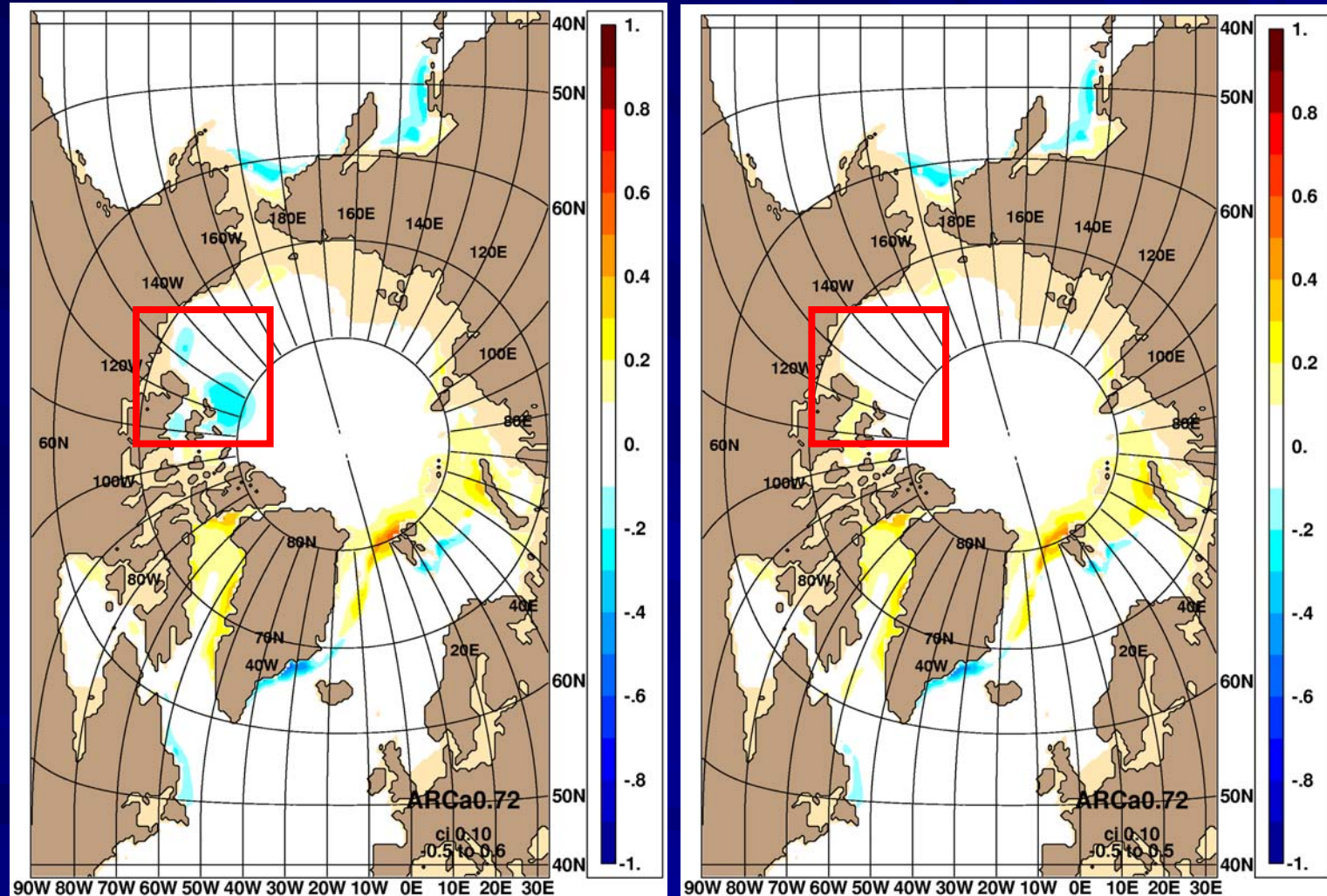


GDEM3 = Generalized Digital Environmental Model version 3.0

PHC = Polar science center Hydrographic Climatology

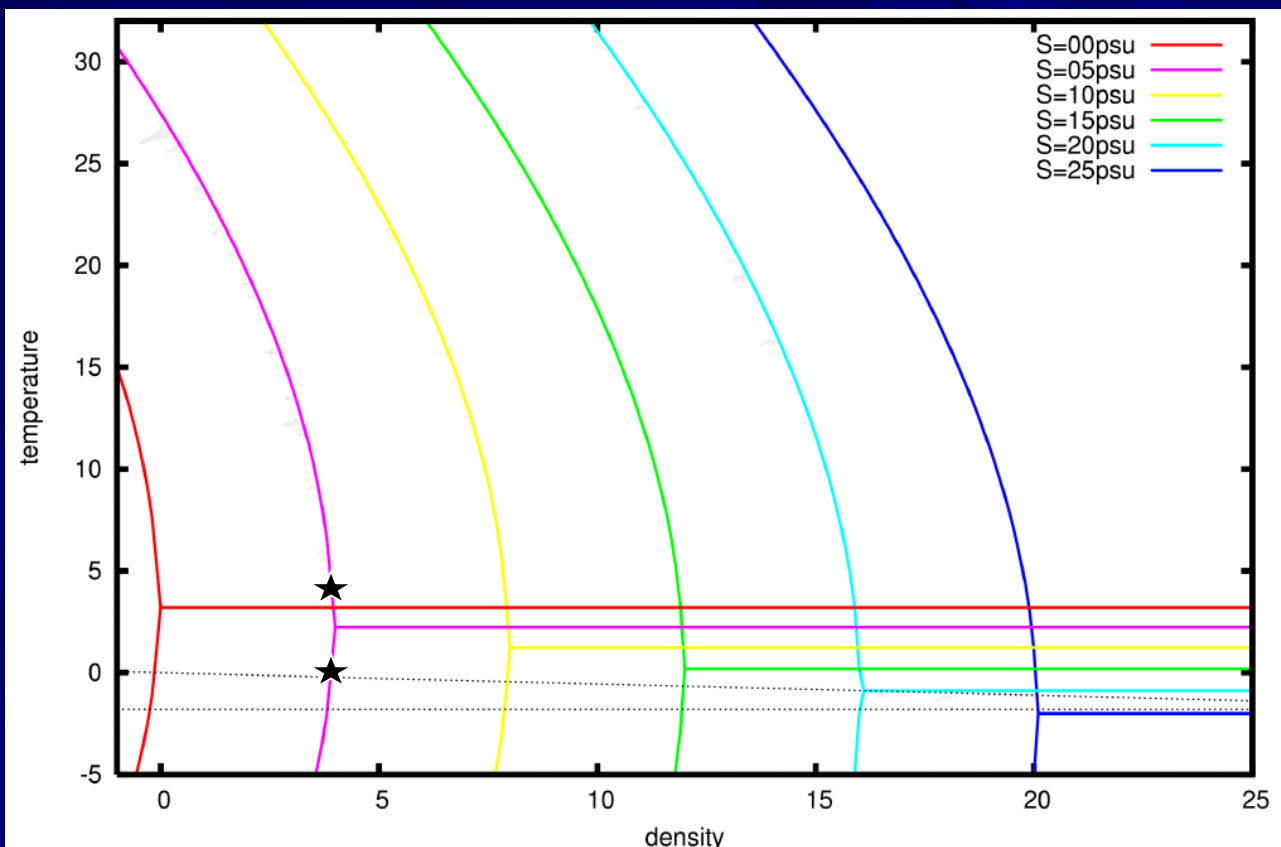
Mean Ice Concentration Error – ARCa0.72

GDEM3 vs. PHC SSS relaxation



σ_0 - Energy loan ice model - ERA40 wind and thermal forcing
SSS relaxation everywhere (even under ice)

Density vs. Temperature

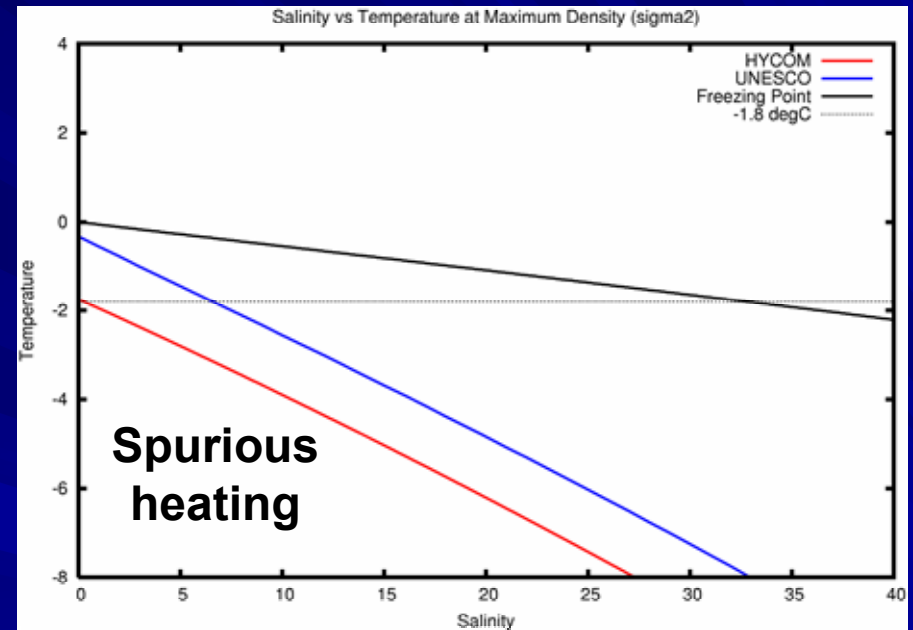
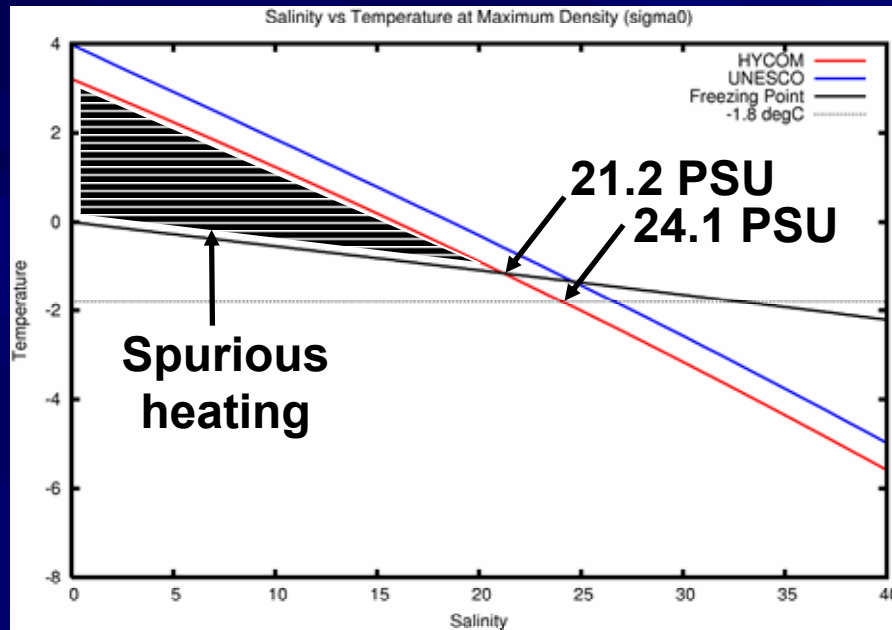


There exist two temperatures at the same salinity for a given density.
HYCOM always chooses the warmer temperature.

Density = sig(T,S), Temperature = tofsig(ρ ,S)
sig(0.0, 5.0) = 3.9 sig(4.5, 5.0) = 3.9
tofsig(3.9,5.0) = 4.5°C

Salinity vs. Temperature at Max. Density

σ_0 vs. σ_2

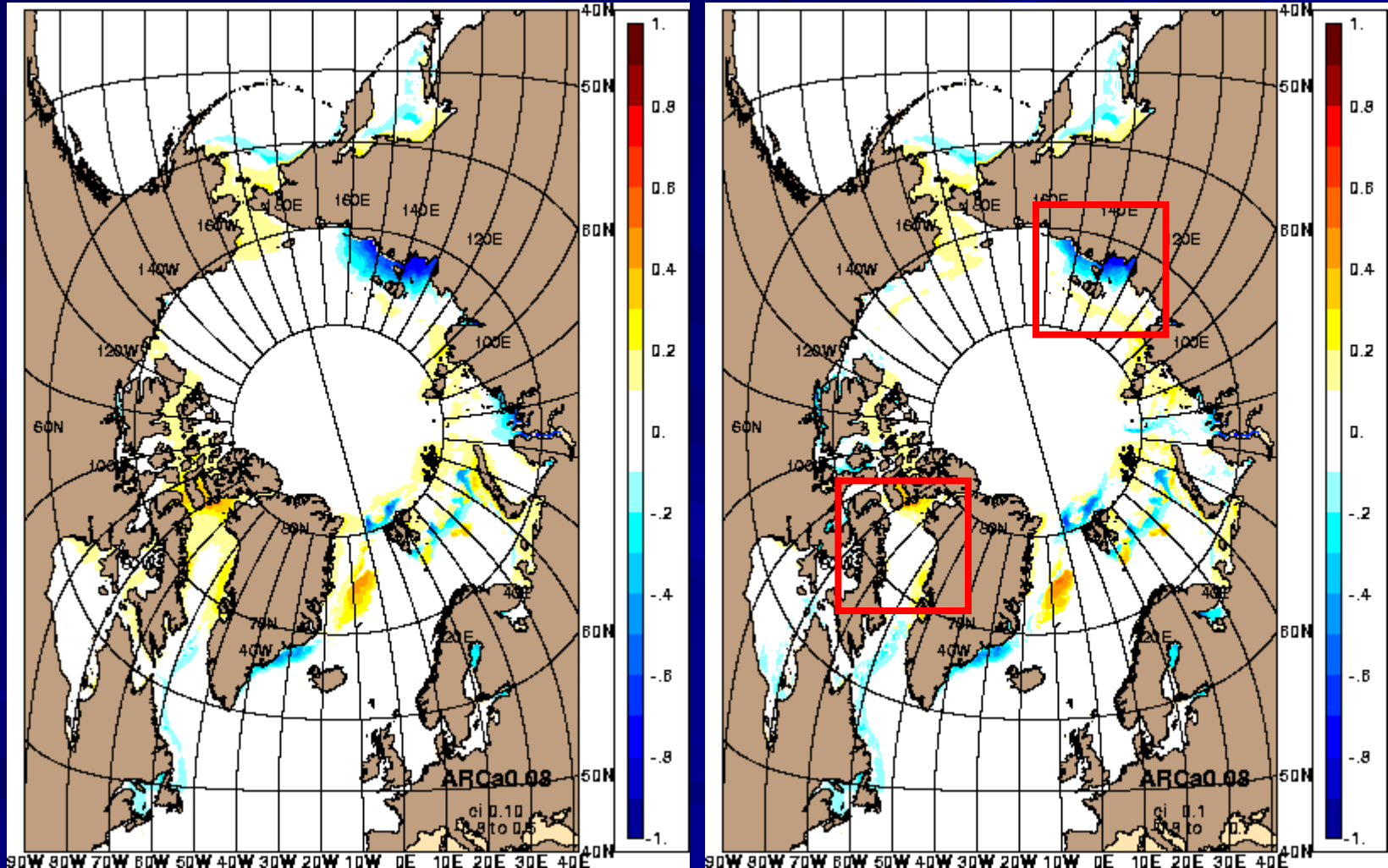


This is not a problem for σ_2

Spurious heating : Above the freezing point in σ_0 ,
Below the freezing point in σ_2

Mean Ice Concentration Error – ARCa0.08

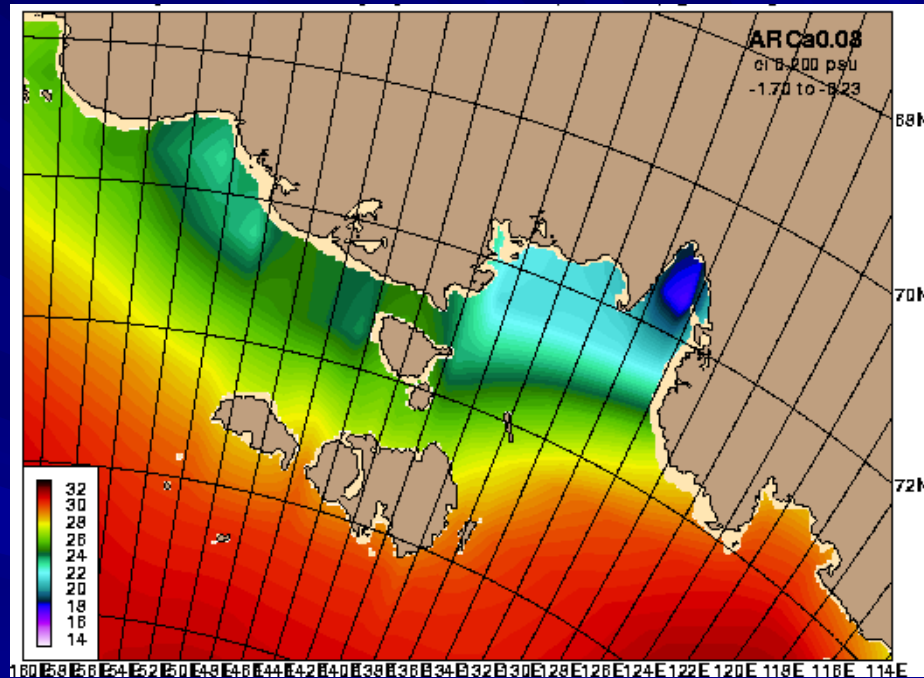
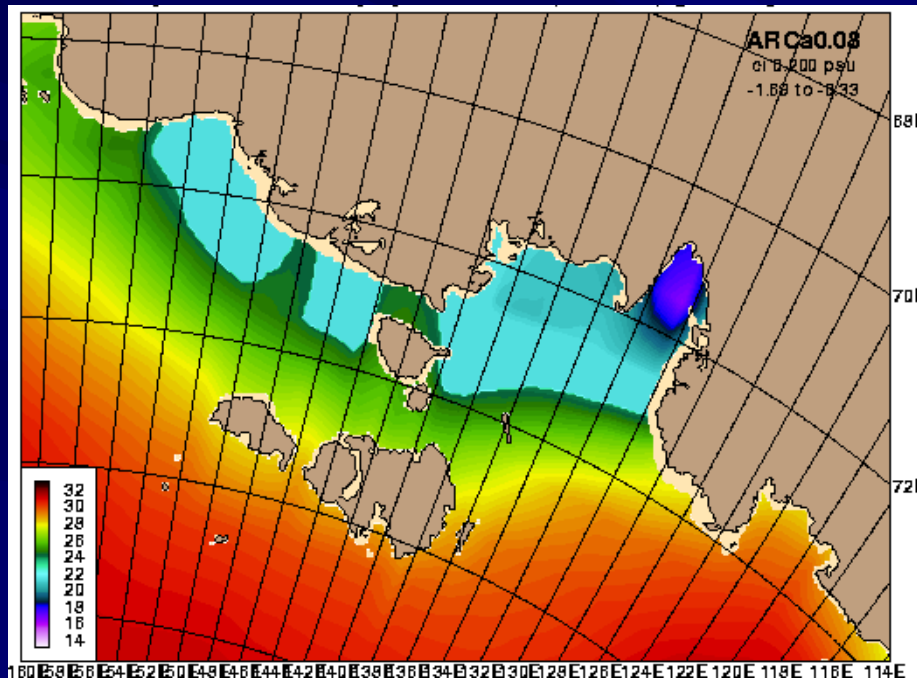
Old vs. new ice freezing point formulation



σ_0 - Energy loan ice model - ERA40 wind and thermal forcing

SSS – Laptev Sea – February

Old vs. new salinity climatology generation

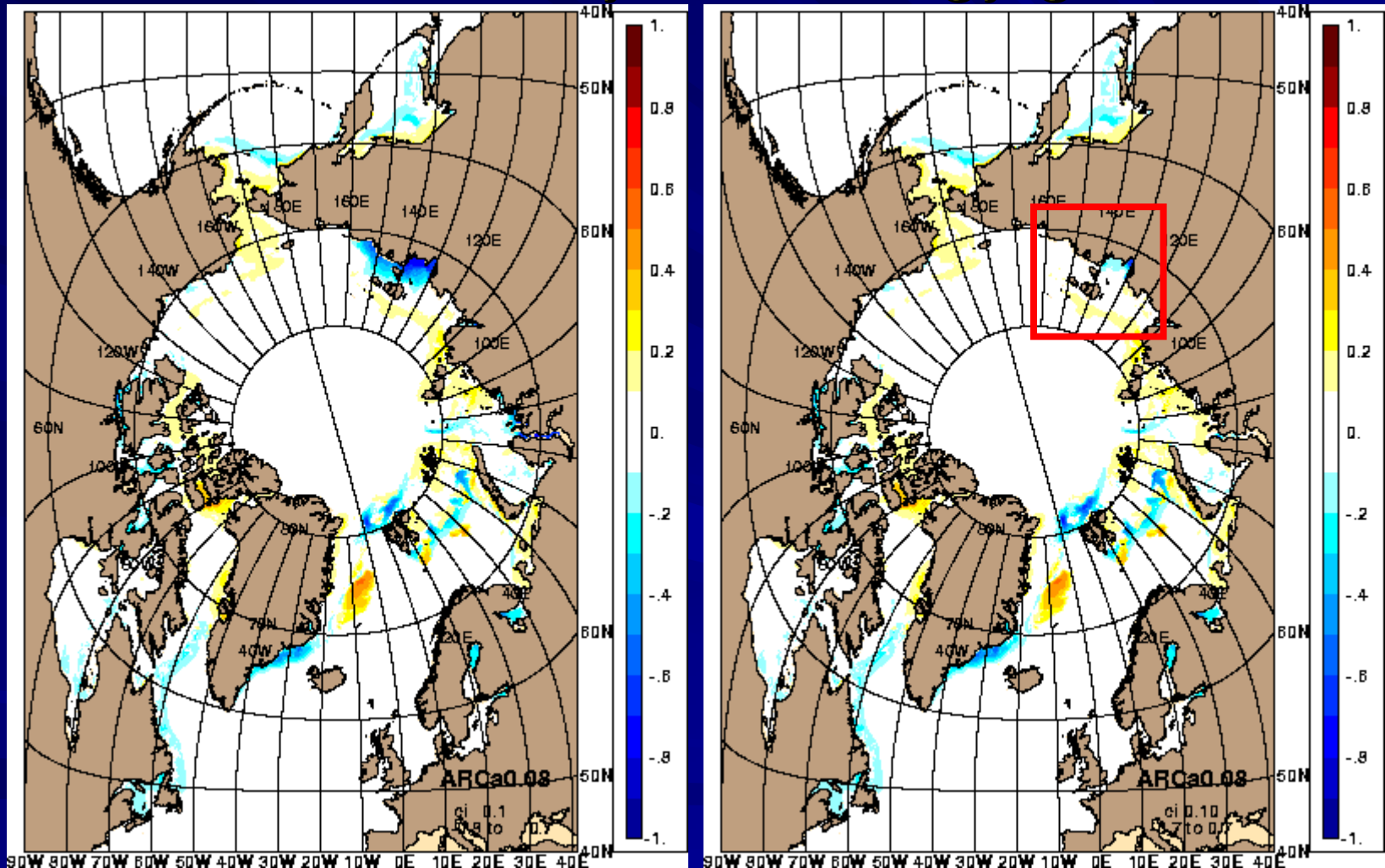


PHC 3.0 climatology

Going into density space and back to temperature space when mapping to model layers

Mean Ice Concentration Error – ARCa0.08

Old vs. new salinity climatology generation

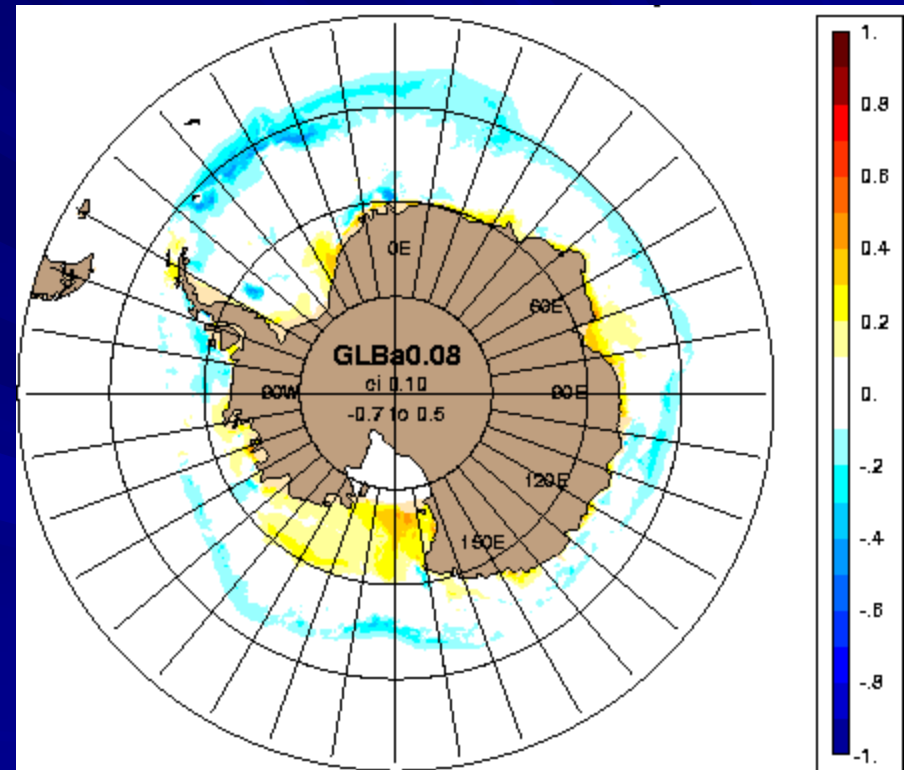
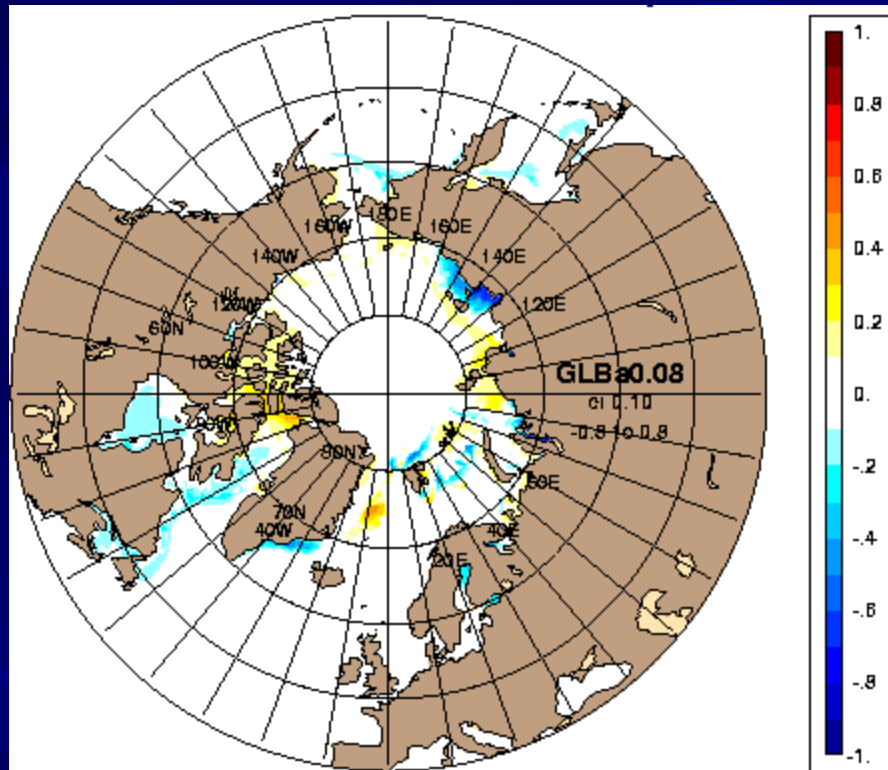


σ_0 - Energy loan ice model - ERA40 wind and thermal forcing

Lessons Learned Using Arctic Cap HYCOM and Energy Loan Ice Model

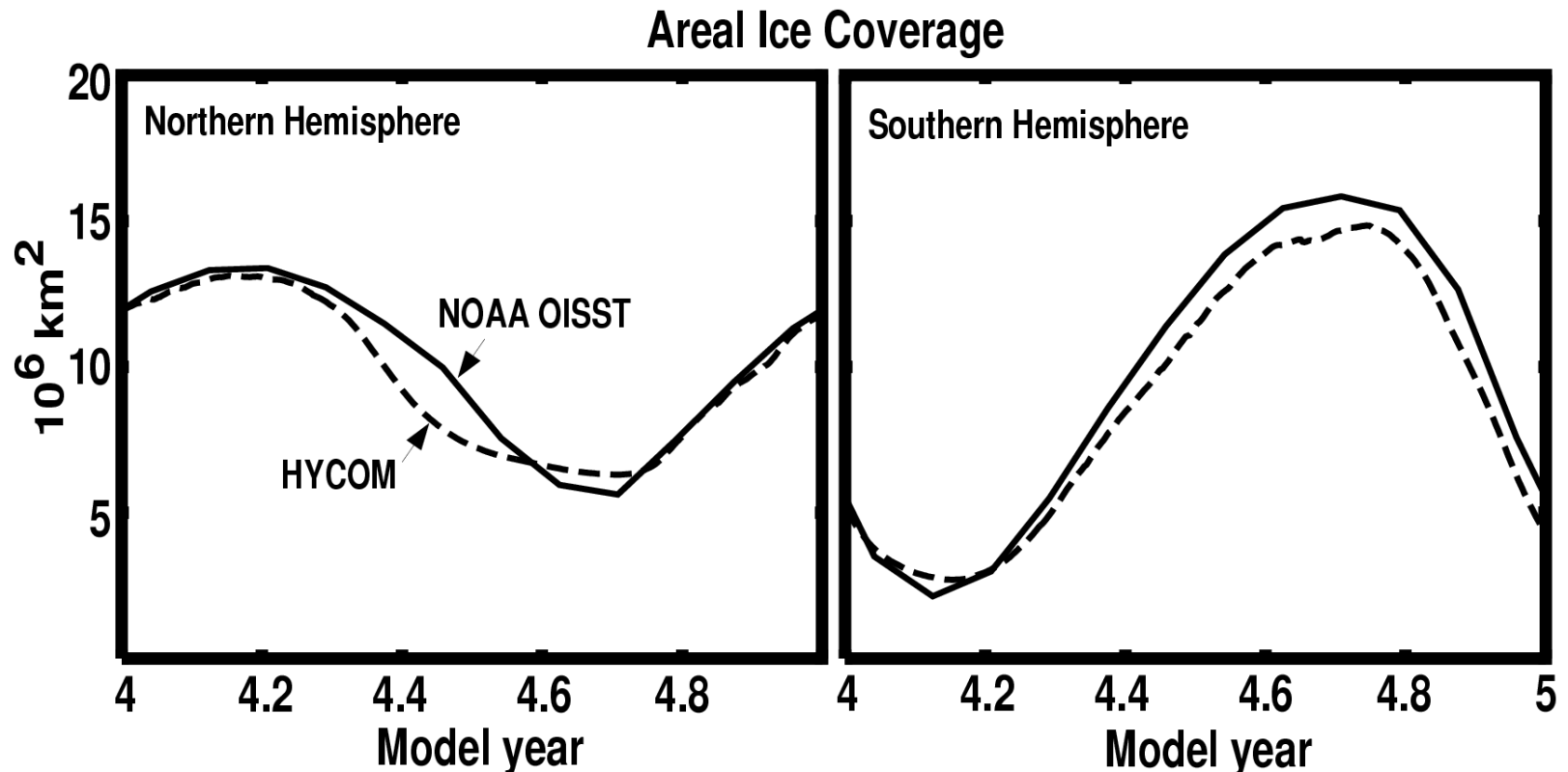
- GDEM3 is not usable in the Arctic Ocean because of bad summertime SSS
- Fine tuning of ice freezing point reduced ice concentration error
- Update to software that generates relaxation climatology improved salinity fields and reduced ice concentration error in low salinity regions
- Use σ_2 to avoid ice melt problems associated with low salinities

1/12° Global HYCOM Mean Sea Ice Concentration Error vs. NOAA Olv2



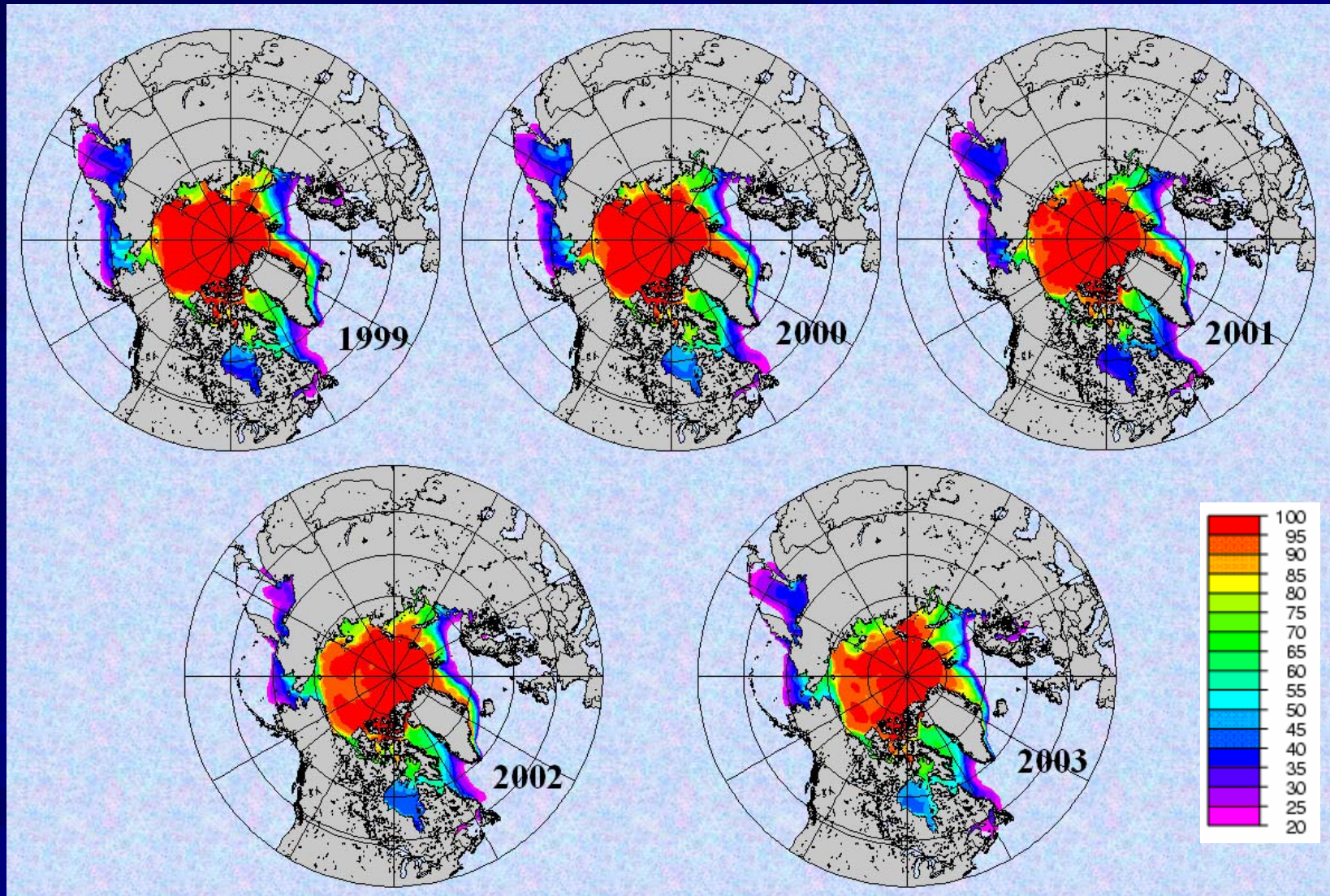
Best σ_0 result – Energy loan ice model – ERA15 wind and thermal forcing

1/12° Global HYCOM Sea Ice Area vs. NOAA Olv2



Best σ_0 result – Energy loan ice model – ERA15 wind and thermal forcing

CICE (PIPS 3.0) Annual Ice Concentration



Stand-alone CICE – 1999-2003 NOGAPS 3-hourly wind and thermal forcing

Global HYCOM Coupling with CICE

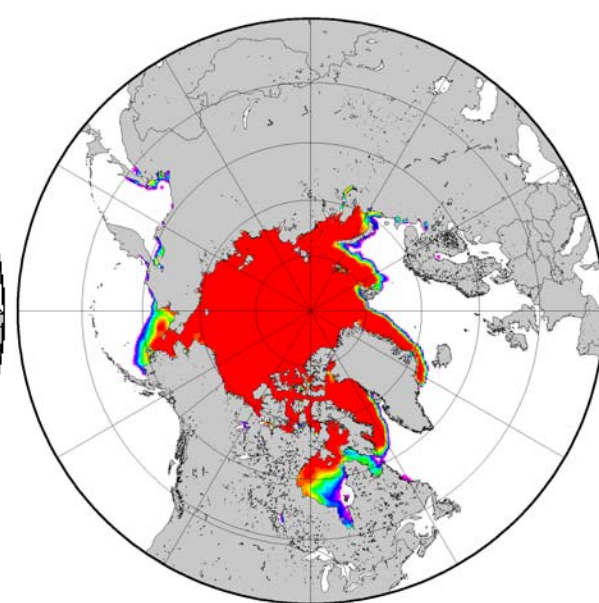
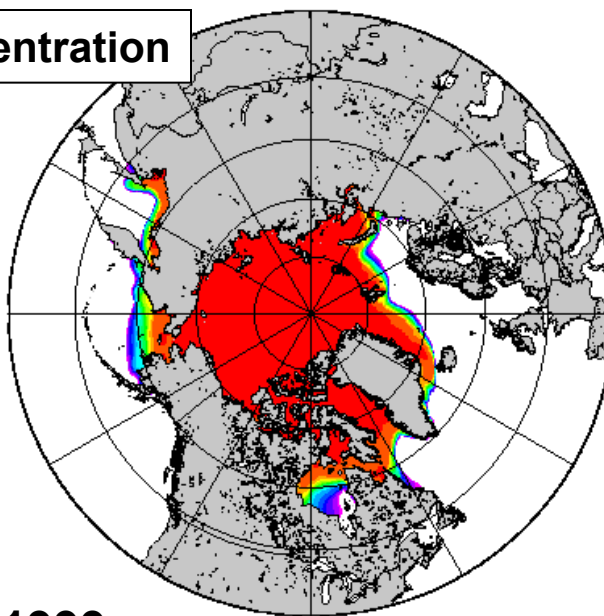
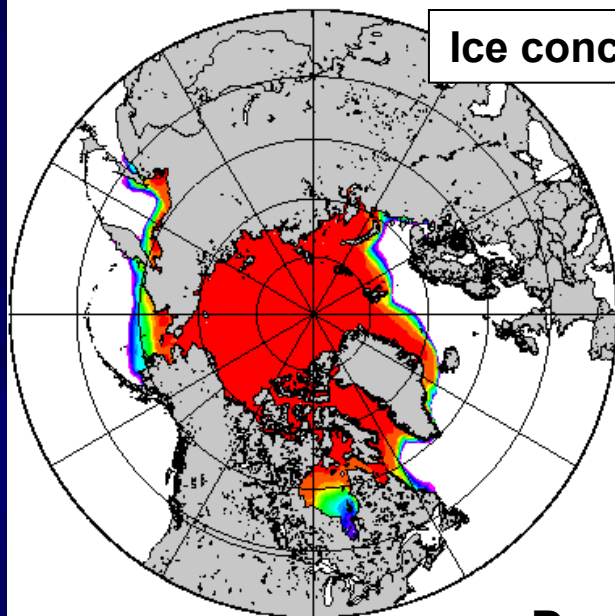
- Stand-alone CICE sensitivity runs are currently underway for $.72^\circ$ (~ 35 km) and $.08^\circ$ (~ 3.5 km)
- Coupling between HYCOM and CICE via the Earth System Modeling Framework (ESMF)
- Expect to have HYCOM + CICE next calendar year
- CICE will be the ice component of the $.08^\circ$ global HYCOM system delivered to NAVO near the end of FY07

CICE/HYCOM grid
~3.5 km

CICE/PIPS3 grid
~9 km

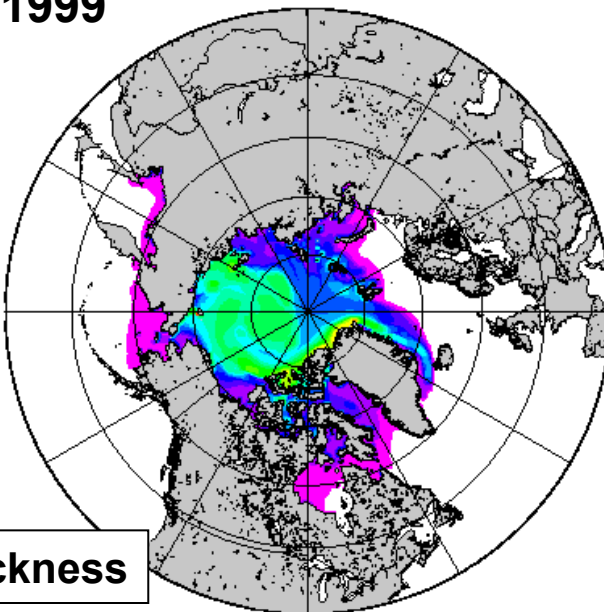
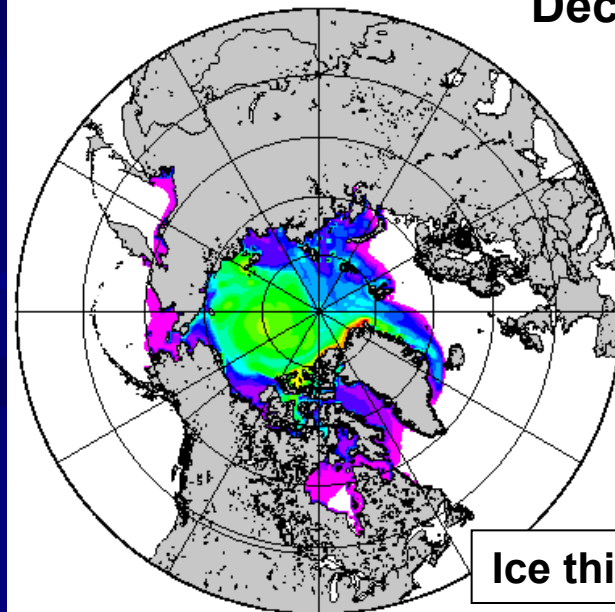
SSMI

Ice concentration

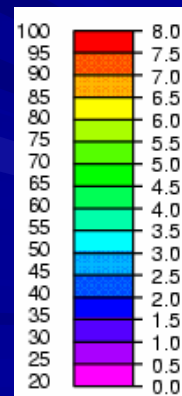


Dec 1999

Ice thickness



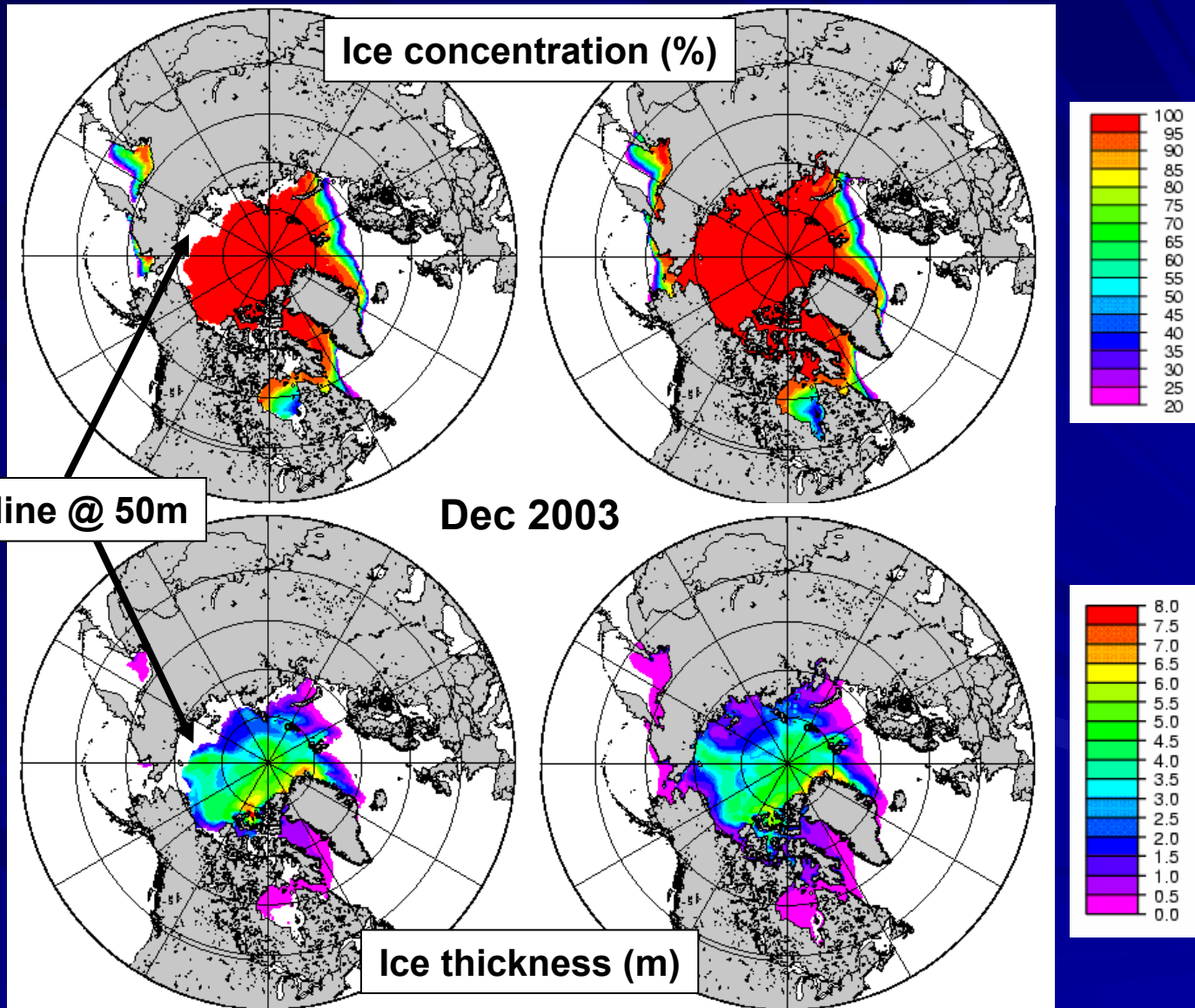
Concentration (%)



Thickness (m)

CICE/HYCOM grid
~35 km

CICE/PIPS3 grid
~9 km



Global NCOM Coupling with CICE

- CICE will run on PIPS (9 km) grid
- Coupling will be done as separate runs with coupling at the file level possibly with CICE running at the 12Z watch
- Scheduled for transition to NAVOCEANO in early FY06