

Ultra High Resolution Global Climate Simulation to Explore and Quantify Predictive Skill for Climate Means, Variability and Extremes

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Atmosphere Model Working Group
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Project Goals

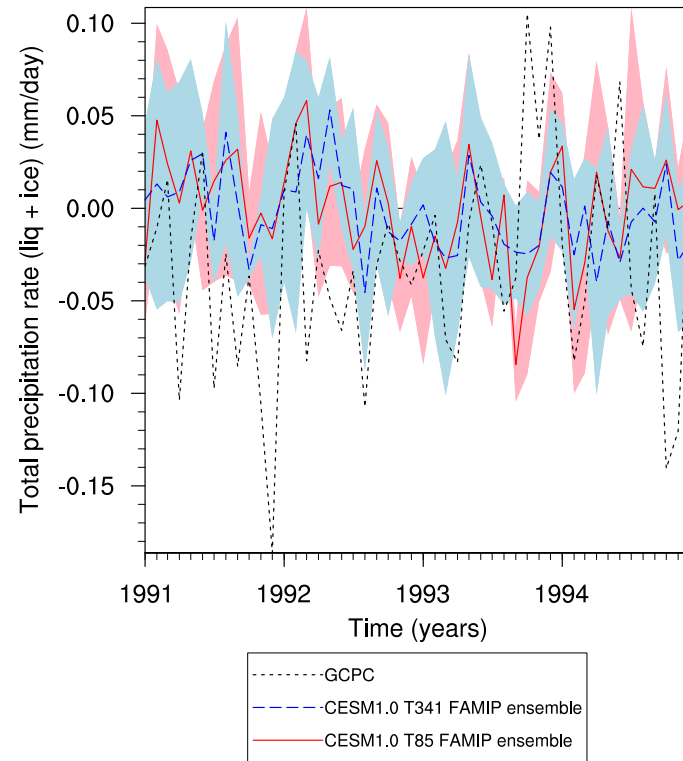
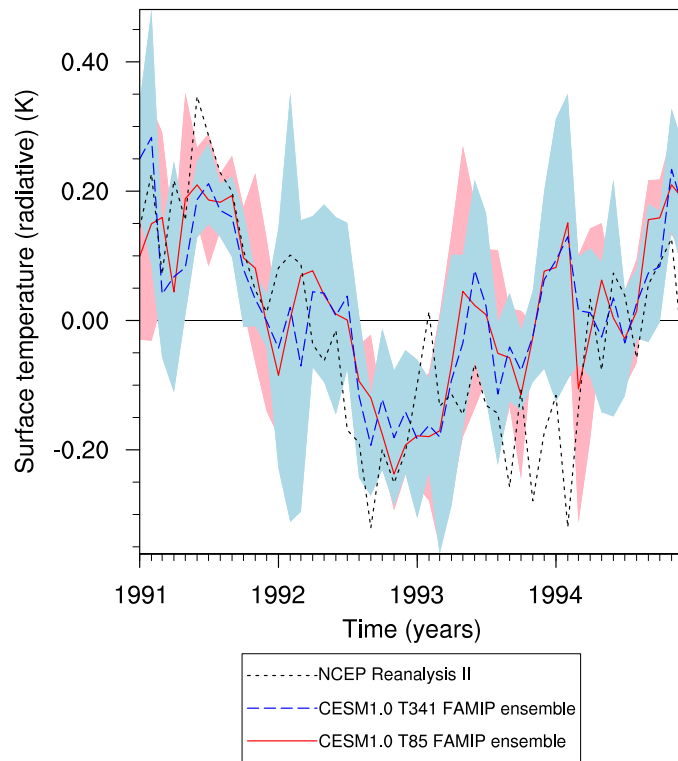
- Test hypothesis that higher resolution models are needed
 - To include explicit simulation of non-linear phenomena and interactions on the small scale that have feedbacks on large scale climate features
 - To provide accurate and explicit simulations of local to regional scale phenomena, including low-probability, high-impact hydrological events

Experimental Plan and Status

- T341 Experiments
 - T341/0.1 preindustrial (CAM4 phys): 43 years completed
 - T341 AMIP ensemble run completed
- CAM-SE Experiments
 - 0.25deg/0.1 preindustrial (CAM4 phys): evaluated against T341.
 - CAM-SE used for all future work, including ensemble of late 20th century/ early 21st century transients
- T85 Experiments for comparison
 - T85/x1 preindustrial for comparison to “standard” CCSM 4 release
 - Ensemble of late late 20th century/ early 21st century transients to test initialization strategy.
- Initial state exploration, sensitivity
 - Ocean/ice, 23 years completed. To be used for initialization of high resolution present day transients.

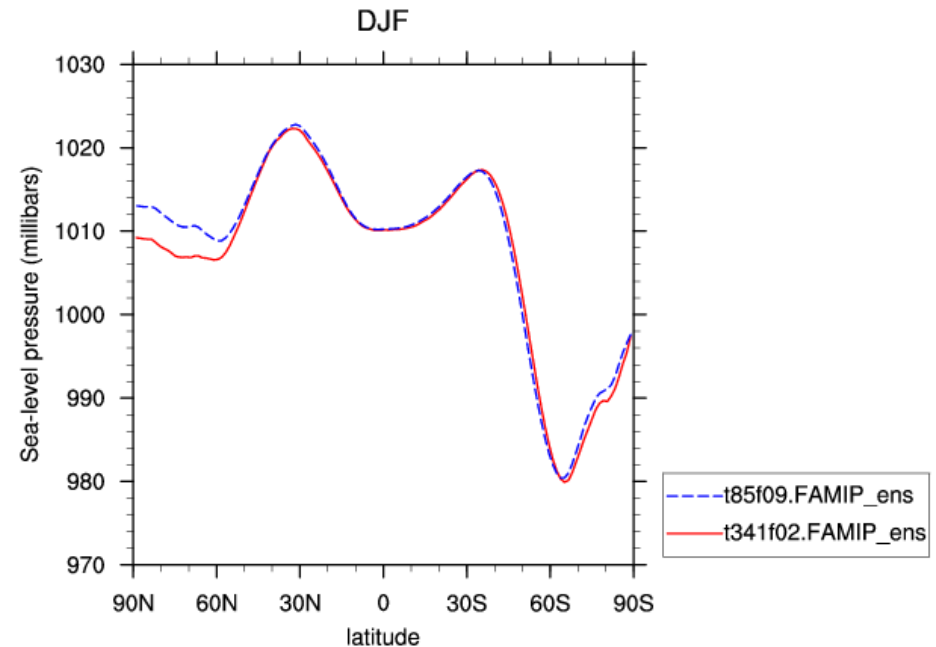
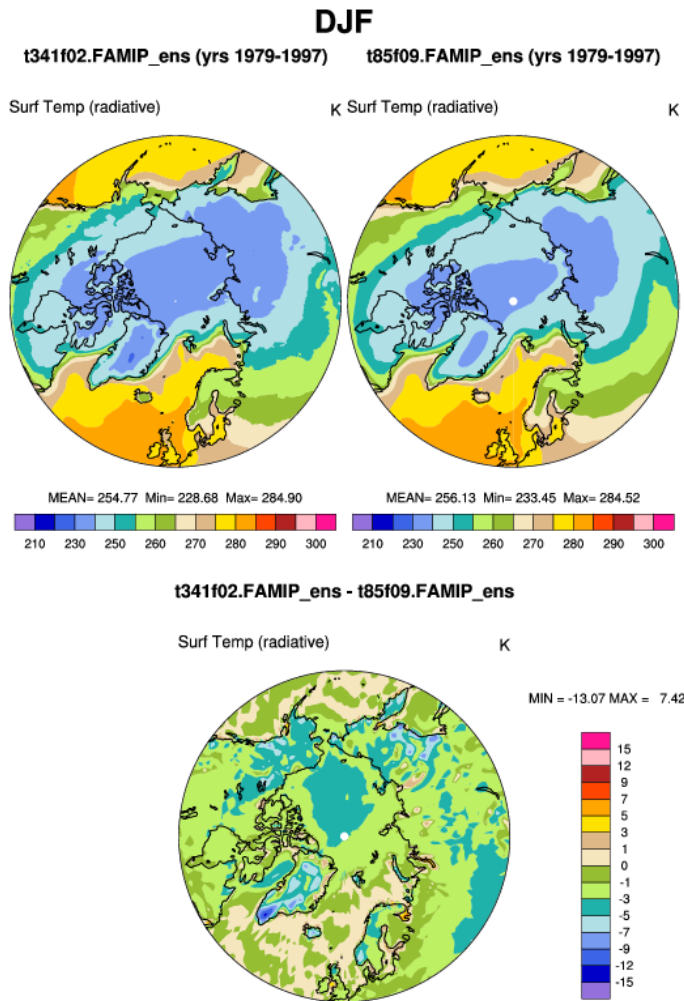
T341 AMIP ensemble just completed.

First looks: Time series of monthly climatology



From A. Gaddis, UT

First looks: many mean climate states are not improved with finer resolution

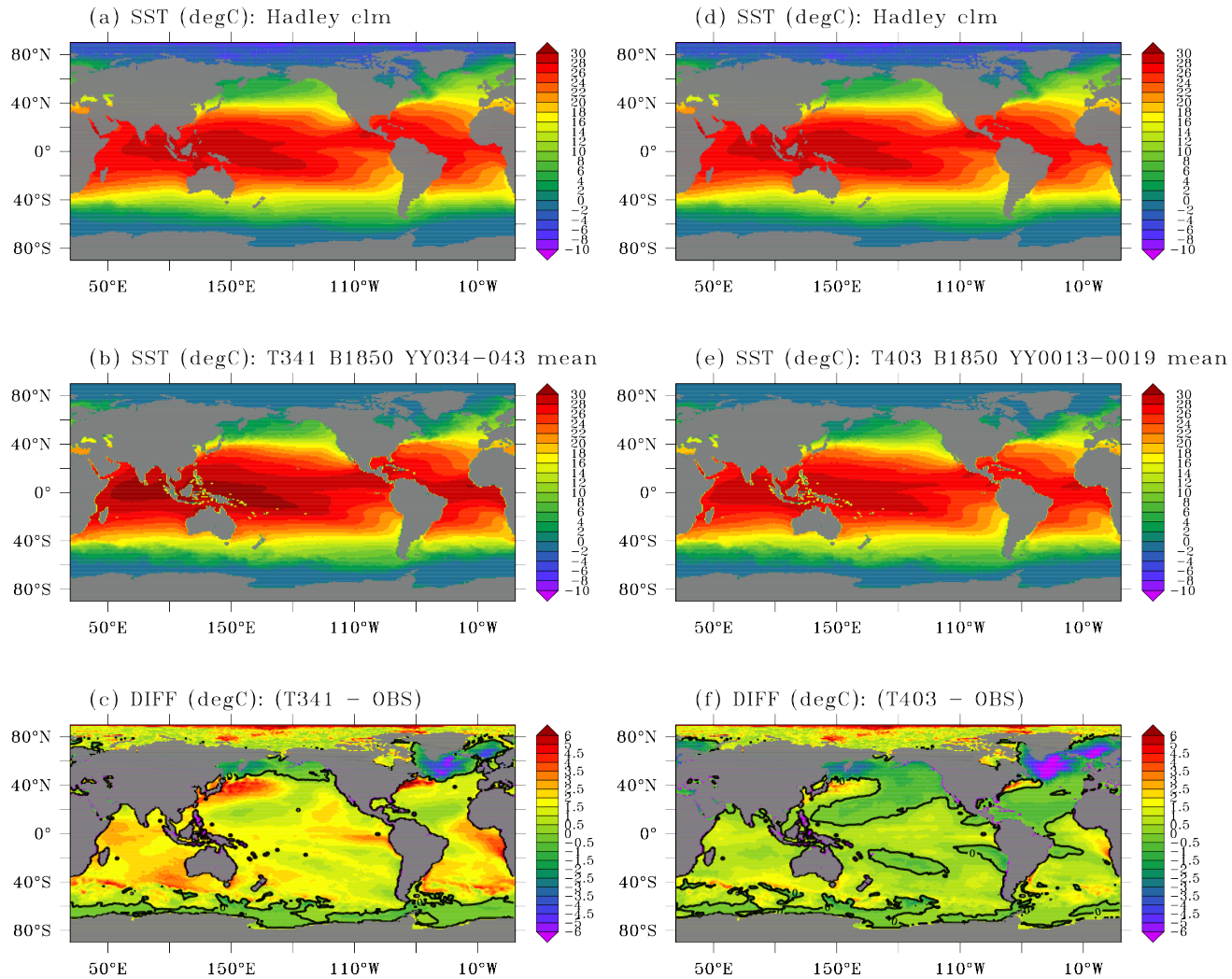


T341 Arctic regions is too cold and has a SLP low bias (T85 does as well)

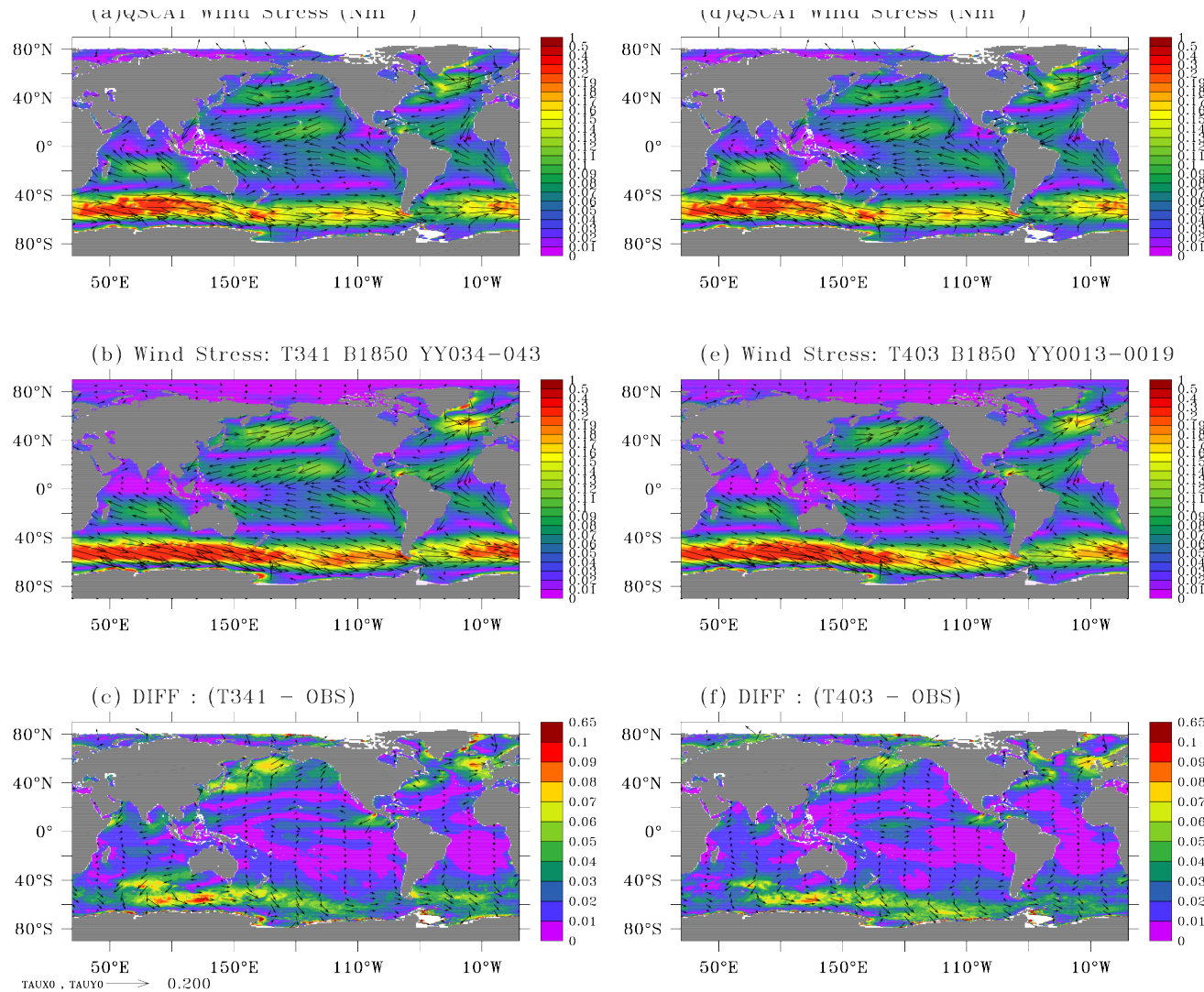
T341 B1850 43 year run

- Atmosphere is energy balanced
- As with the forced SST runs, moisture and cloud levels are low
- Ocean and ice initial state used CORE forcing run output
- Uses “delta Eddington,” parameterization which has produced more realistic sea ice thickness and extent
- Some improvements in the ocean/ice relative to previous hi-res coupled run (McClellan et al. 2011)

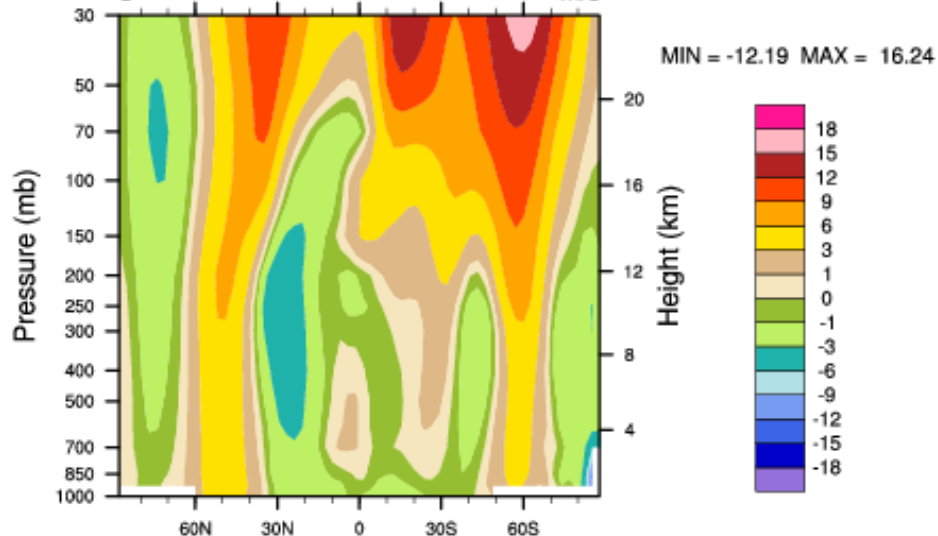
SST from Hadley PI climatology, T341 for years 34-43 (LHS), and Atlas for years 13-19 (RHS)



Annual Wind Stresses Vectors and Their Magnitudes from QuikSCAT and T341 for Years 34-43 (LHS) and Atlas years 13-19 (RHS)

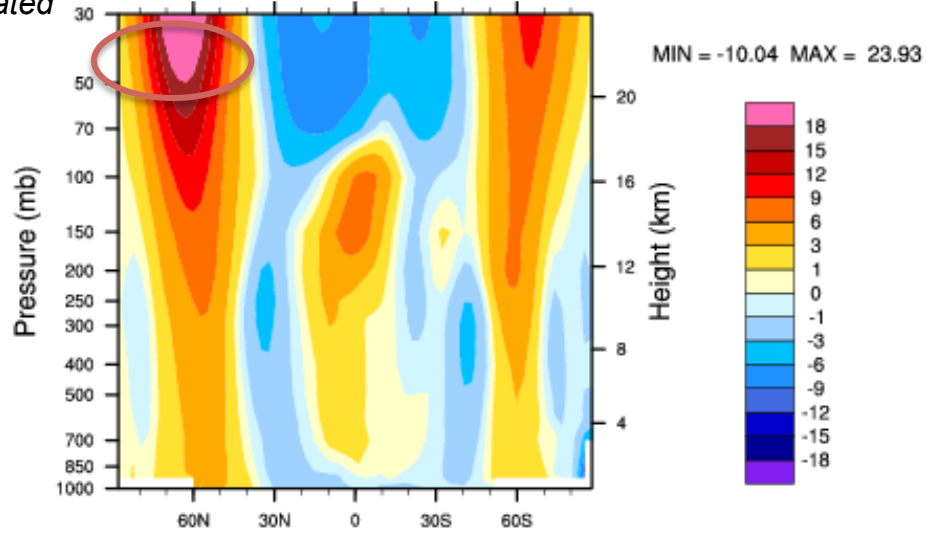


DJF Zonal Wind (m/s)

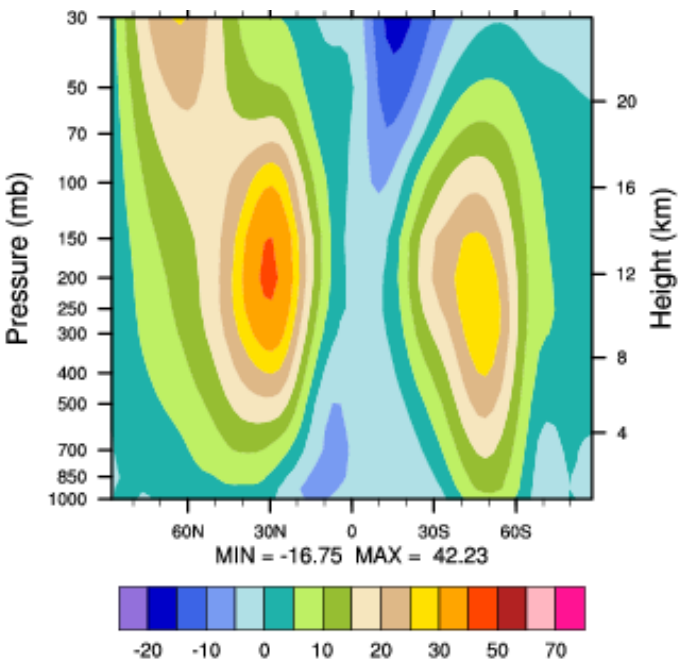


T341-NCEP

Overly strong polar night jet eliminated



Atlas-NCEP



NCEP Reanalysis

CAM-SE B1850 sister run to T341

- Tuned with forced SST simulations
- 10 years completed, uses same ocean ice settings and initial conditions
- Seasonal Arctic SLP and TS are improved relative to T341
- Improvements do not translate into improved ice/ocean states.

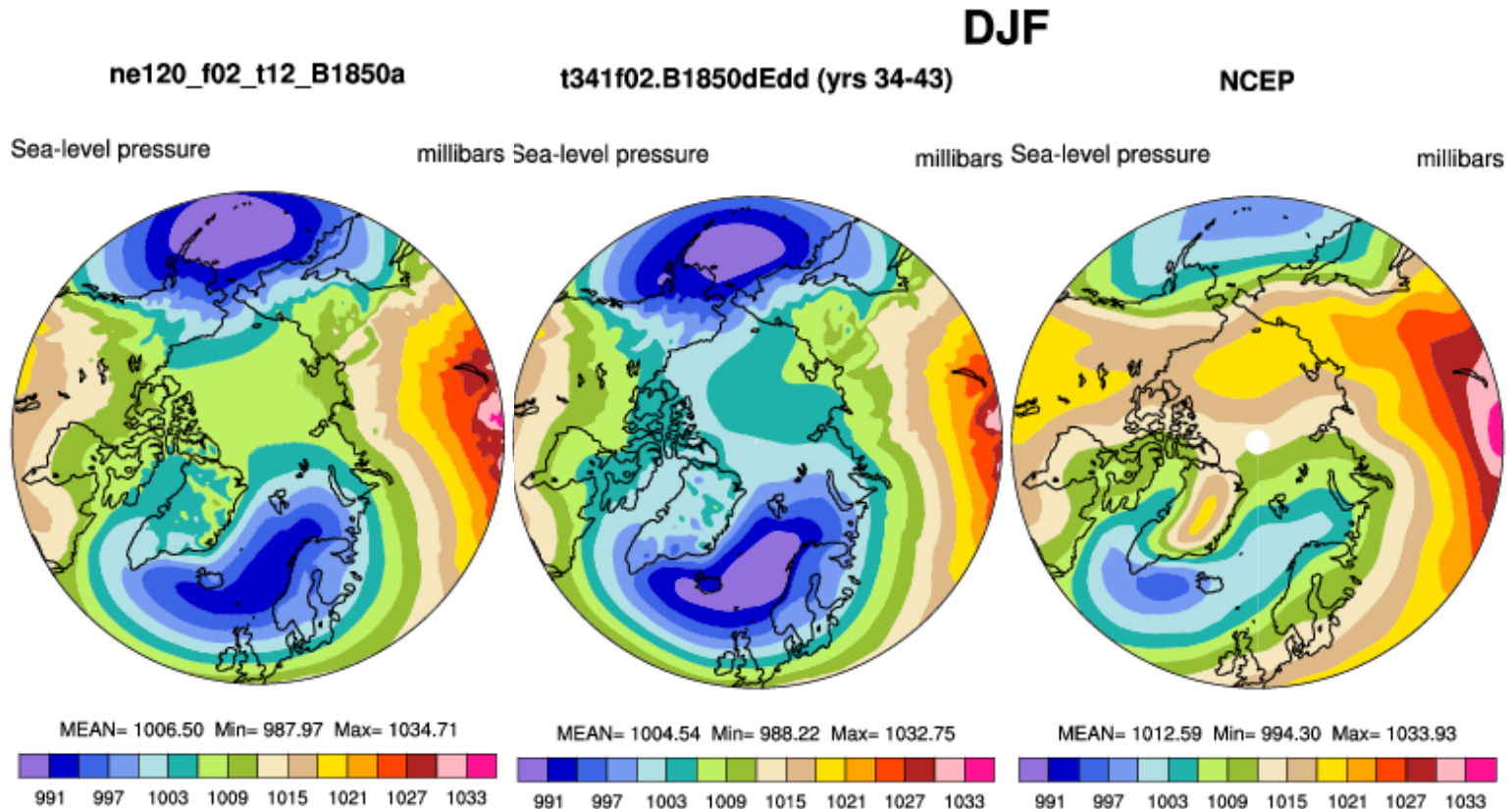


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CAM-SE B1850 versus T341

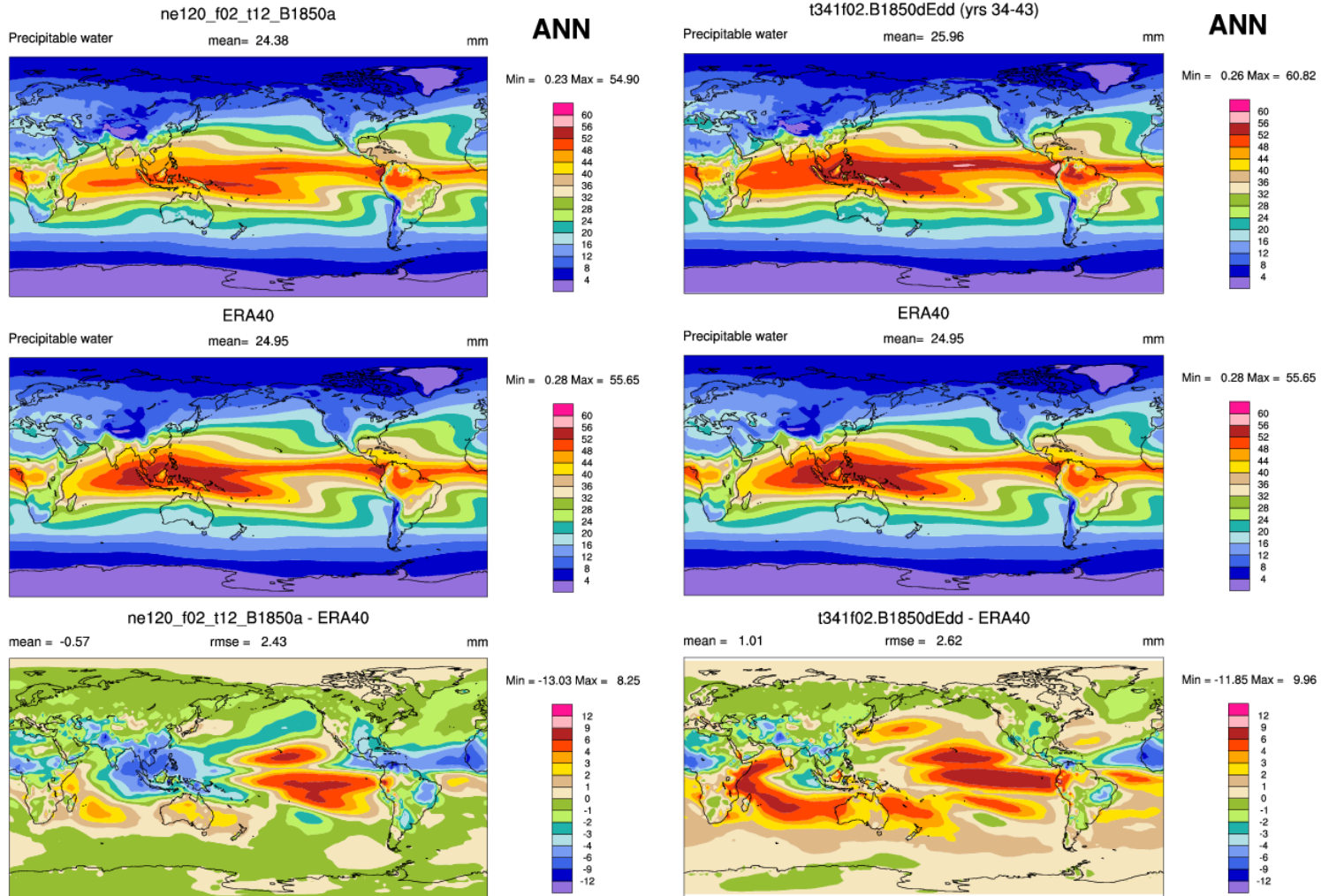


DJF SLP compared to NCEP reanalyses

CAM-SE Years 5-9, T341 Years 34-43, NCEP 1979-98

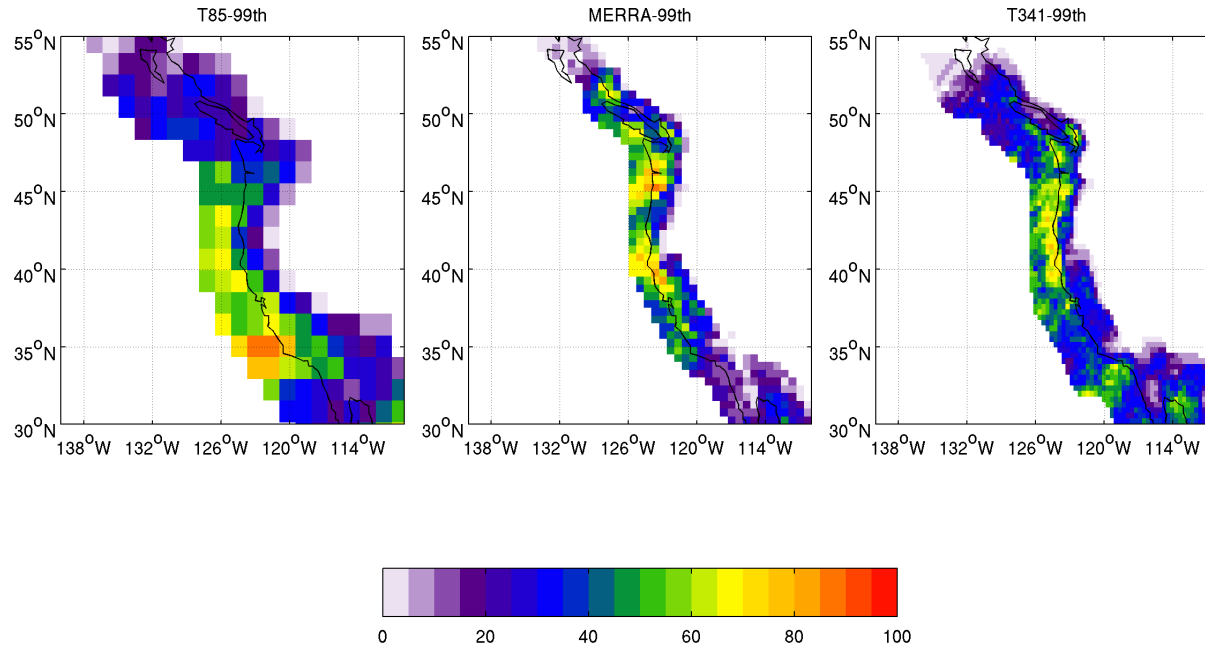


CAM-SE B1850 versus T341



Annual Precipitable Water compared to ERA interim

High resolution enables analysis of links of climate extremes across multiple scales: EACS and atmospheric rivers



East Asian Cold Air Surges (EACS) → extreme precipitation: Atmospheric Rivers
AR are narrow moisture conveyor belts that account for over 90% of the cross-latitude water vapor transport in the midlatitudes.

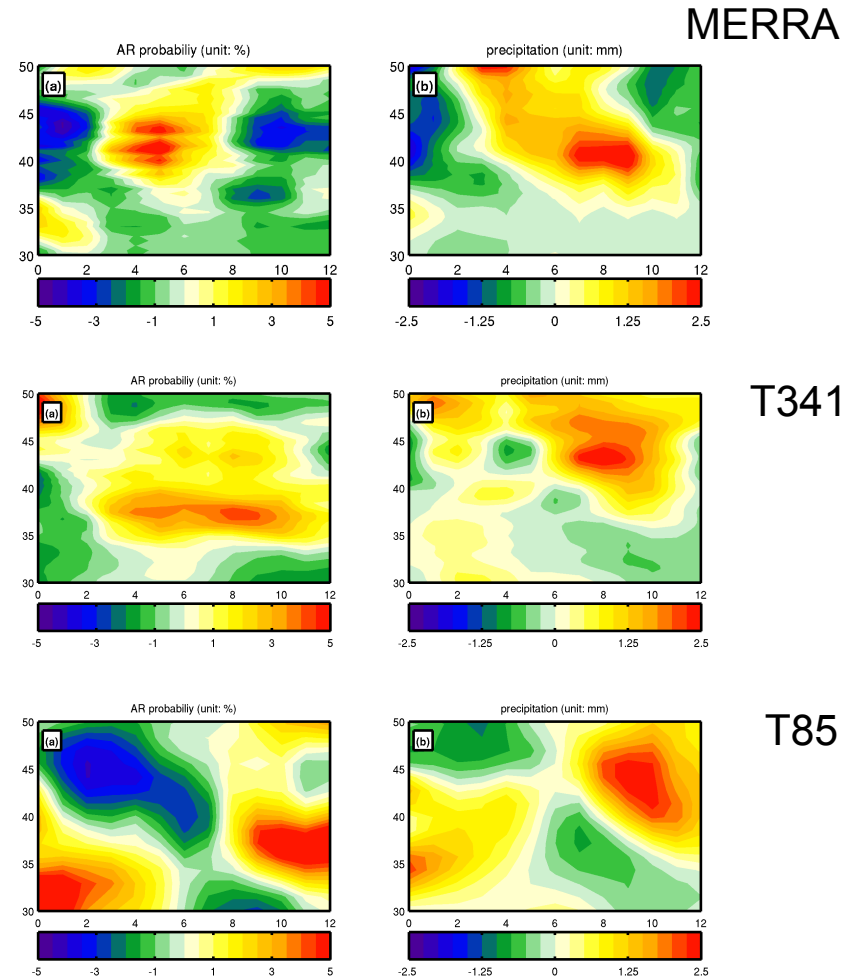
The high-resolution T341 spectral model is able to resolve coastal precipitation associated with Atmospheric Rivers (AR) more accurately than T85, compared to NASA MERRA data.



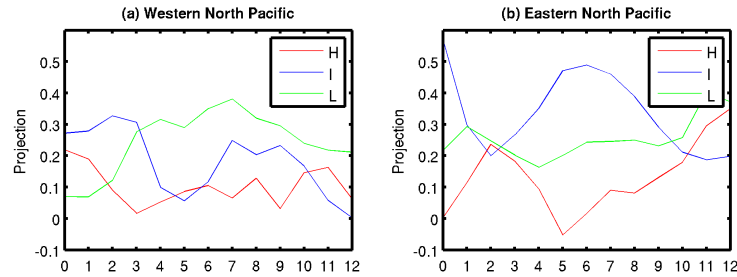
Links of large scale East Asian cold air outbreaks to smaller scale AR within T341

Composite anomalies of
(left) daily occurrence probability
of ARs along the West Coast (%)
(right) composite anomalies of
the precipitation rate along the
West Coast (mm/day)

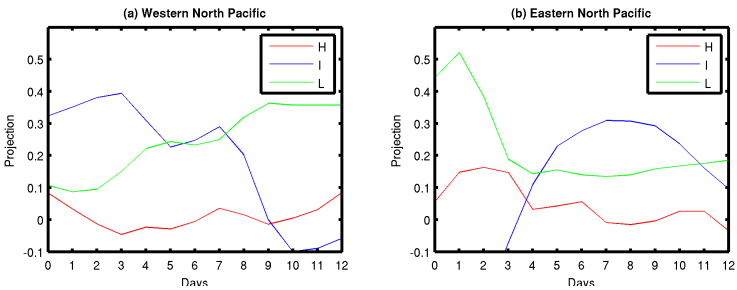
Downstream modulation for
MERRA, T341, and T85 precip rate
show that the coastal anomaly
has very clear southward
propagation in both MERRA and
T341 simulation (right).



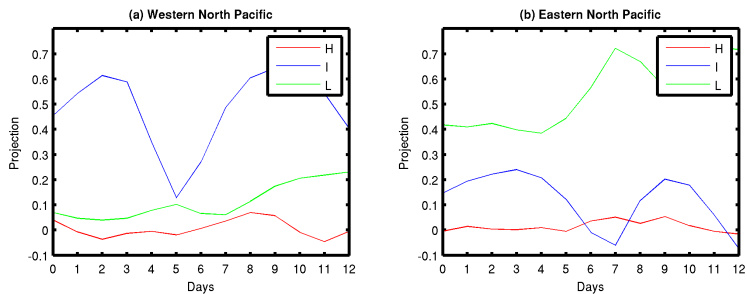
Degree of contribution to height tendency of East Asian Cold Surges due to **high**, **intermediate** and **low** frequency eddies



MERRA



T341



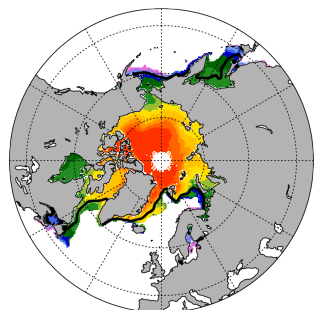
T85

Over the Eastern Pacific, the prominent signal of AR is due to intermediate scale eddies, which organize the water vapor primarily through advection transport. The T341 simulation is better able to capture the primary role of IF eddies.

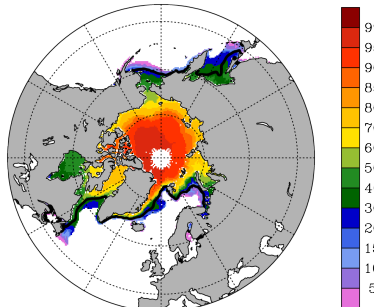
From Tianyu Jiang, GT

Annual Ice concentration (%) from Atlas (LHS) and T341 (RHS) and SSM/I

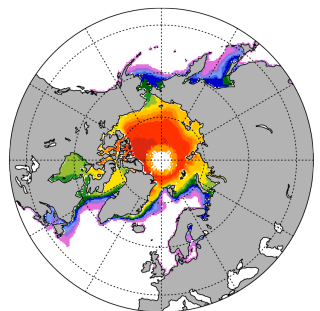
T403 B1850 ice area (aggregated) %



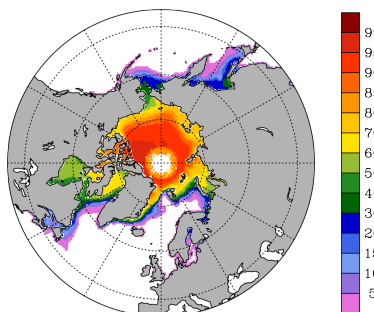
T341 B1850 ice area (aggregated) %



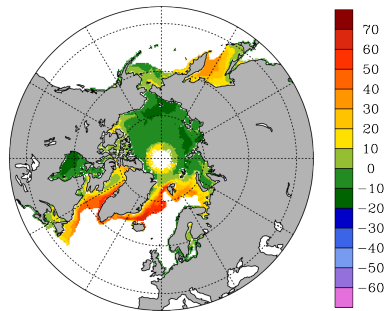
SSM/I ice area (aggregated) %



SSM/I ice area (aggregated) %



T403 B1850 - SSM/I ice area %



T341 B1850 - SSM/I ice area %

