

CAM-SE coupled simulations at $\frac{1}{4}$ and $\frac{1}{8}$ degree resolutions

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AMWG

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CESM Configuration

- F1850 and B1850 compsets
- CESM1_2 release + CAM5_3_07
- 1/4 degree (ne120) and 1/8 degree (ne240) Atmosphere and CLM
- 1/10 degree (tx01) POP and CICE
- POP & CICE initial conditions:
 - From CAM4 T341 DOE high-res project
 - Atmospheric reanalysis forced CESM simulation using equivalently configured POP and CICE.

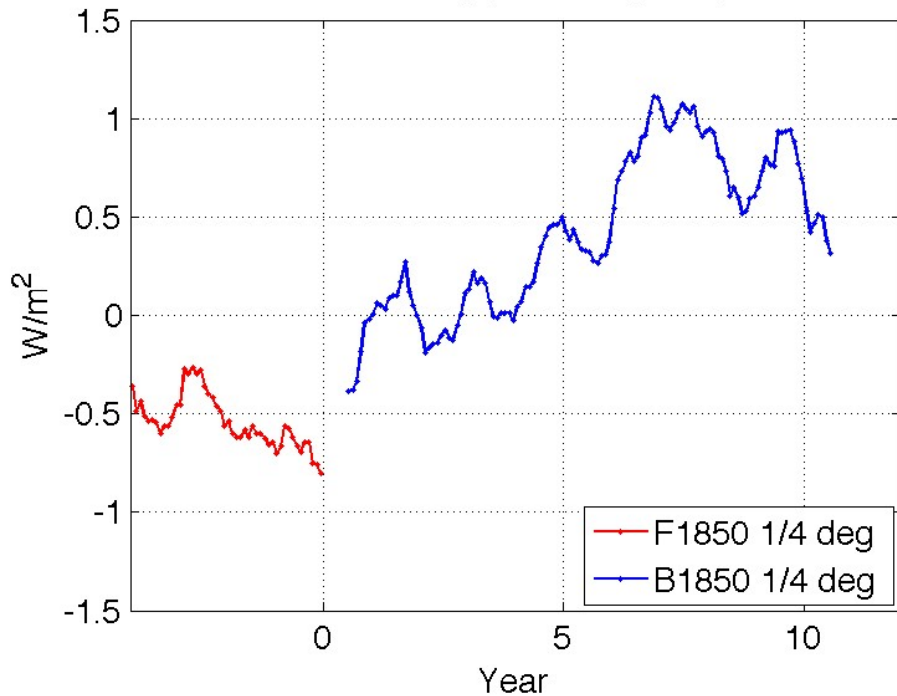
CAM5 Tuning

- Tuned using F1850 compset (pre-industrial)
- 1/4 degree (ne120)
- Adjusted dust_emis_fact and seasalt scale factor to tune global aerosol loading.
- “stock” settings have RESTOM $\sim -5.0 \text{ W/m}^2$
 - Increasing low cloud relative humidity threshold (rhminl) to 0.91
 - Used ZM cloud fraction (dp1) to tune for RESTOM ~ 0 (instead of c0)
 - Kept the ZM autoconversion coefficient (c0_ind,c0_ocn) low (0.0035)
- Ice autoconversion threshold (DCS) increased 50%. Improves LWCF with minimal impact on RESTOM
- ZM timescale (zmconv_tau) reduced slightly (to 3000s from 3600)

RESTOM (1 year running average)

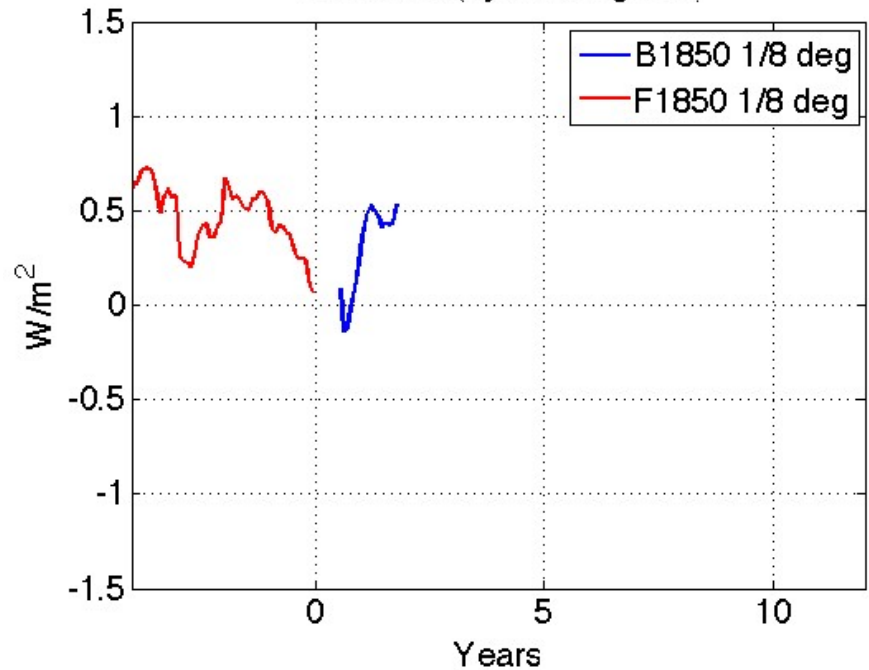
¼ degree

RESTOM (1yr running ave)



1/8 degree

RESTOM (1yr running ave)

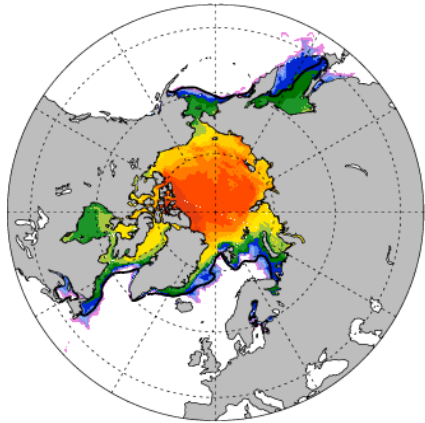


- F1850 ¼ degree: run for 5 years with final tunings
- B1850 ¼ degree: run 11 years so far (ongoing)
- F1850 1/8 degree: ran 5 years with ¼ degree tunings
- B1850 1/8 degree: ran 2 years

B1850 1/4 degree sea ice (year 6)

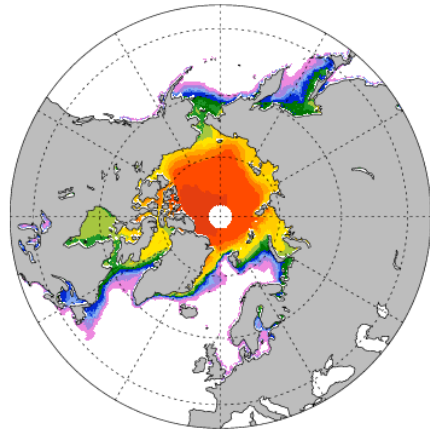
Year 6

ice area (aggregate) %



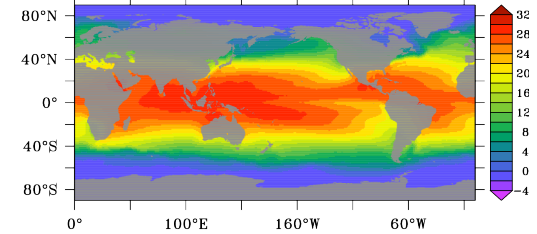
SSM/I obs

ice area (aggregated) %



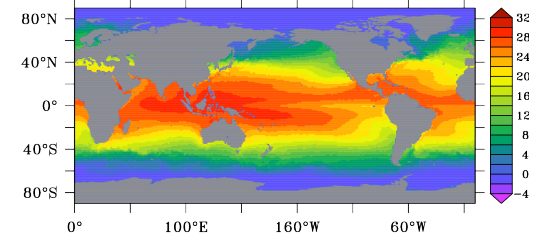
SST Hadley

(a) SST (degC): Hadley c1m 1870-1899



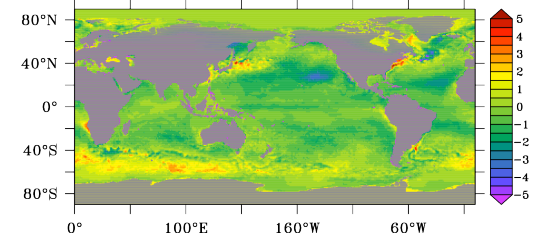
SST Year 6

(b) SST (degC): B1850c5 m2 YR 0006

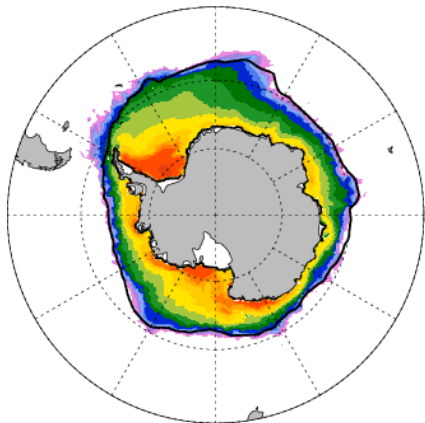


DIFF

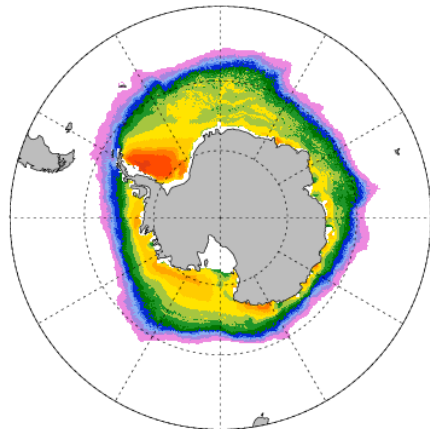
(c) DIFF (degC): (B1850c5 YR 0006 - OBS)



ice area (aggregate) %



ice area (aggregated) %



ANN average ice edge is reasonably realistic in the Northern Hemisphere. The ice edge in the Southern Hemisphere is also reasonable, except for being too far south in the Indian Ocean section of the Southern Ocean – probably due to the warm biased SSTs.

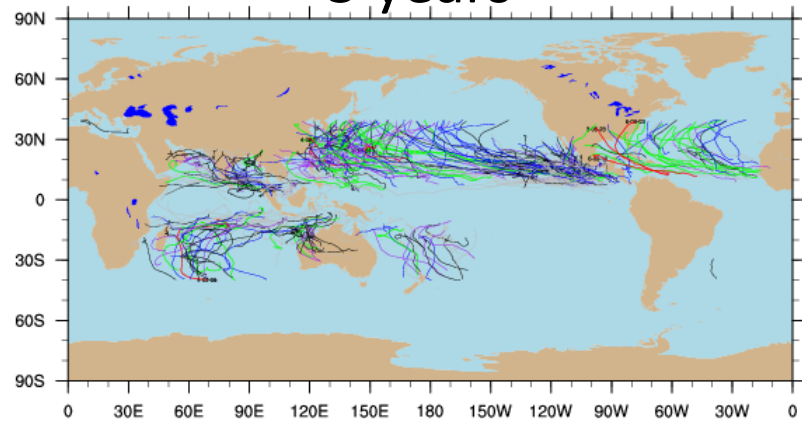
Tropical Cyclones

- Tropical cyclones tracked using the Knutson et al. BAMS 2007 algorithm in the TECA code (Prabhat et al. ICCS 2012).
- “stock” tunings give ~ 150 cat0-5 TC per year
- Decreasing dp1 for RESTOM=0 reduces TC count from 150 to 100 per year
- Increasing c0_ocn for RESTOM=0 reduces TC count from 150 to 116 per year
- zmconv_tau: ranging from 900s to 3600s gives TC counts from 37-150
- Wanted to reduce zmconv_tau to 1800 for timescale reasons, but ended up using 3000. (default 3600s)

TC tracks

1/4 degree

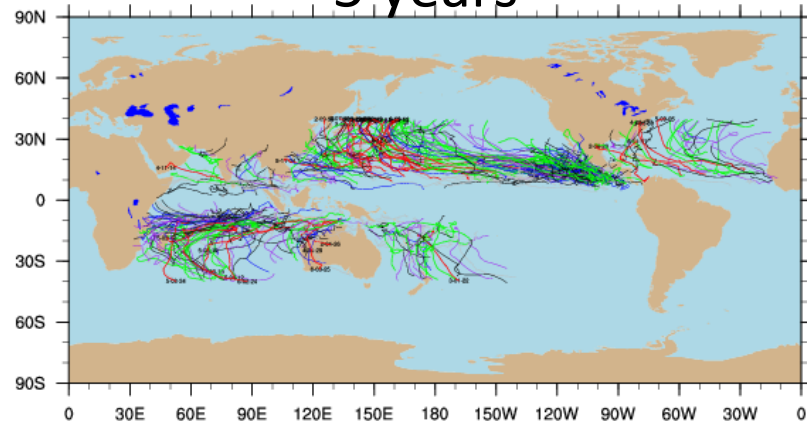
5 years



TC# per year: 34/24/10/11/8/1

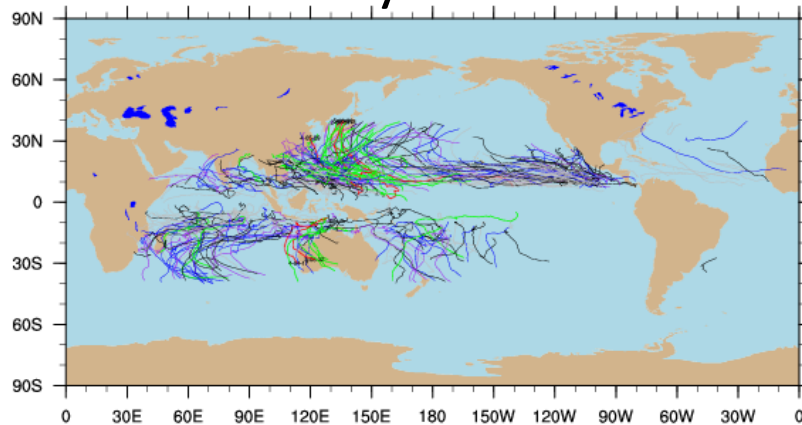
1/8 degree

5 years



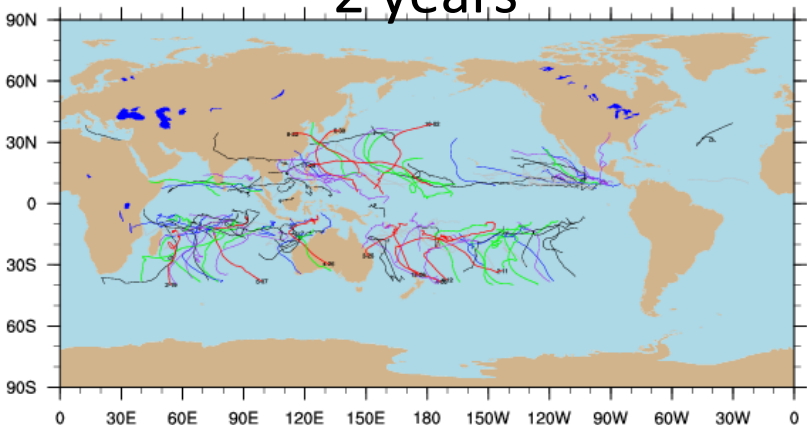
30/26/10/14/18/7

5 years



36/20/11/9/7/1

2 years



18/18/9/12/9/6

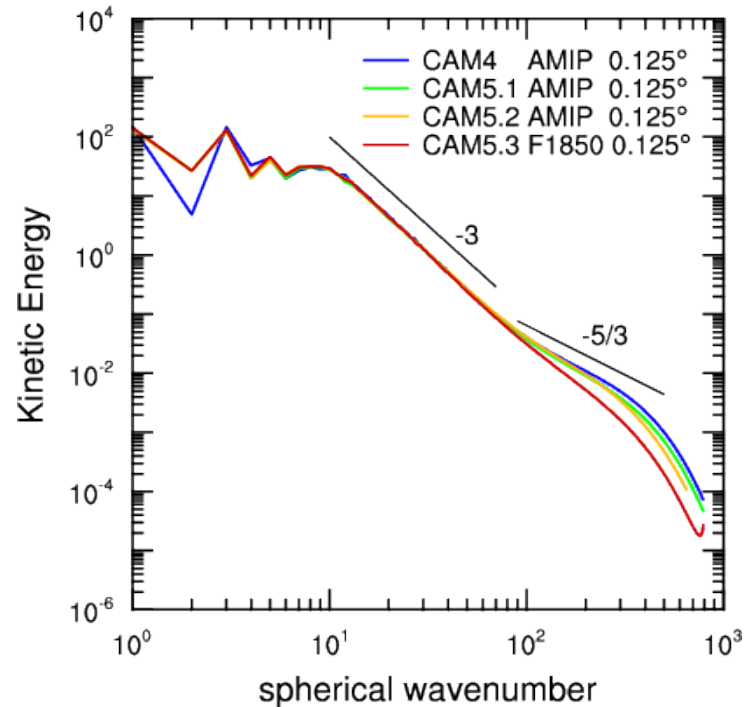
F1850

B1850

KE Spectra (1/8 degree)

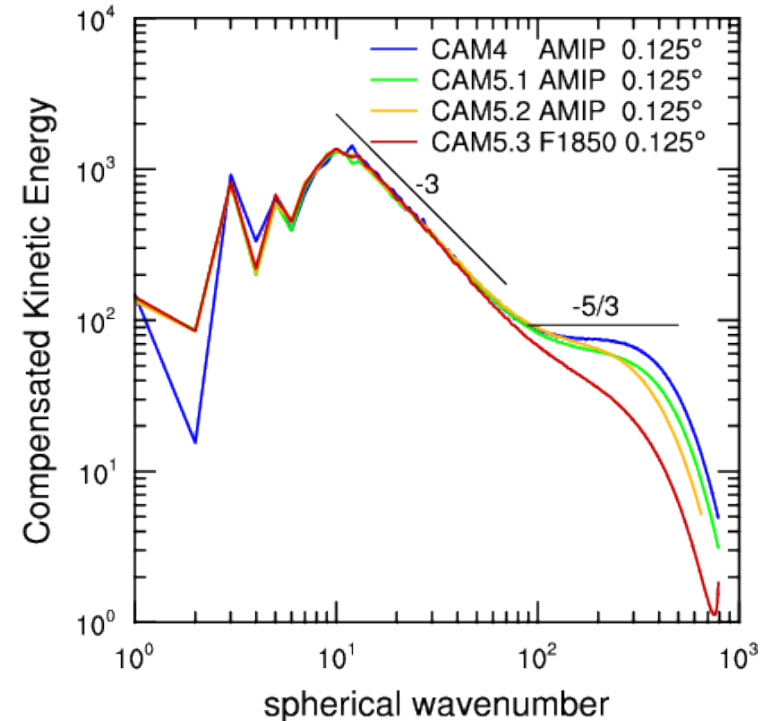
KE

CLIMATOLOGY 250mb



KE * k^{5/3}

CLIMATOLOGY 250mb



- CAM4 has well resolved mesoscale shallowing (transition to -5/3, matching obs)
- CAM5.1 weaker transition – due to CAM Version 5 physics
- CAM5.2 additional dissipation (increased dissipation for rougher topography)
- CAM5.3 much weaker. Dynamics: vertically lagrangian. Physics?

Conclusion

- Tuned version of CAM5 at $\frac{1}{4}$ degree for use by the DOE High-Resolution Project as it transitions from CAM4/T341
- Tuned aerosol scalings, dp1 (for RESTOM), DCS (for LWCF). Did not significantly change zmconv_tau (due to tropical cyclone count)
- Reasonable behavior so far (10 years). Run ongoing.
- Coupled system also runs with $\frac{1}{8}$ degree atmosphere, with same tunings and no code changes. Runs on Mira with O(500K) threads (32K MPI tasks, each with 16 threads)

Global Means

1/4 degree

(5 years)

RESTOM=-0.56

LWCF= 22.8

SWCF=-48.7

1/8 degree

(5 years)

RESTOM= 0.45

LWCF= 21.7

SWCF=-46.1

F1850

(5 years)

RESTOM= .75

LWCF= 23.1

SWCF=-48.5

(2 years)

RESTOM= .26

LWCF= 21.5

SWCF=-46.0

B1850