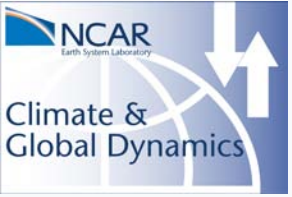


Sea Ice Results from CESM High Resolution Simulations

David Bailey and Frank Bryan

NCAR Earth System Laboratory

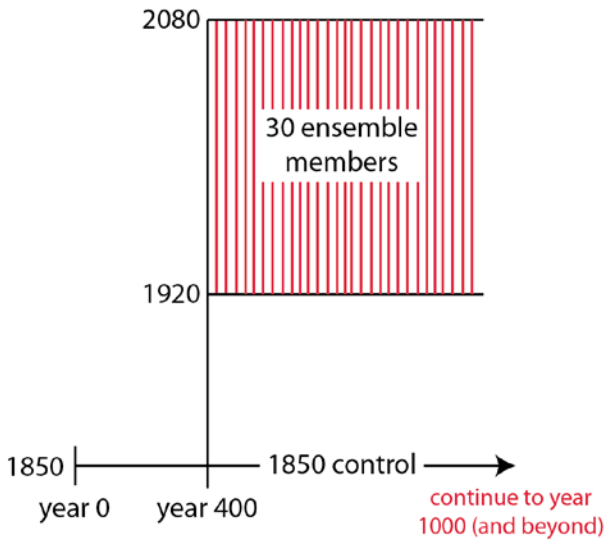
Thanks to Mat Maltrud, Julie McClean, Elizabeth Hunke, Marika Holland,

Jennifer Kay, Keith Lindsay, and Justin Small.

CESM-CAM5 Large Ensemble

Fun facts:

- Community project supported by CESM CSL resources
- 1 degree CESM-CAM5 (CESM1_1_1, CMIP5 physics)
- Historical and RCP8.5 forcing, 1920-2080
- WACCM ozone (not SPARC as used in CMIP5)
- Ensemble created with round-off error in air temp.
- 30 ensemble members stated minimum
- Continuous daily and monthly output
- 1990s, 2025-2034, 2070s 6-hourly output
- Archiving single variable time series only
- Each member will take ~2 weeks on Yellowstone
- Led by Jen Kay and Clara Deser (NCAR)



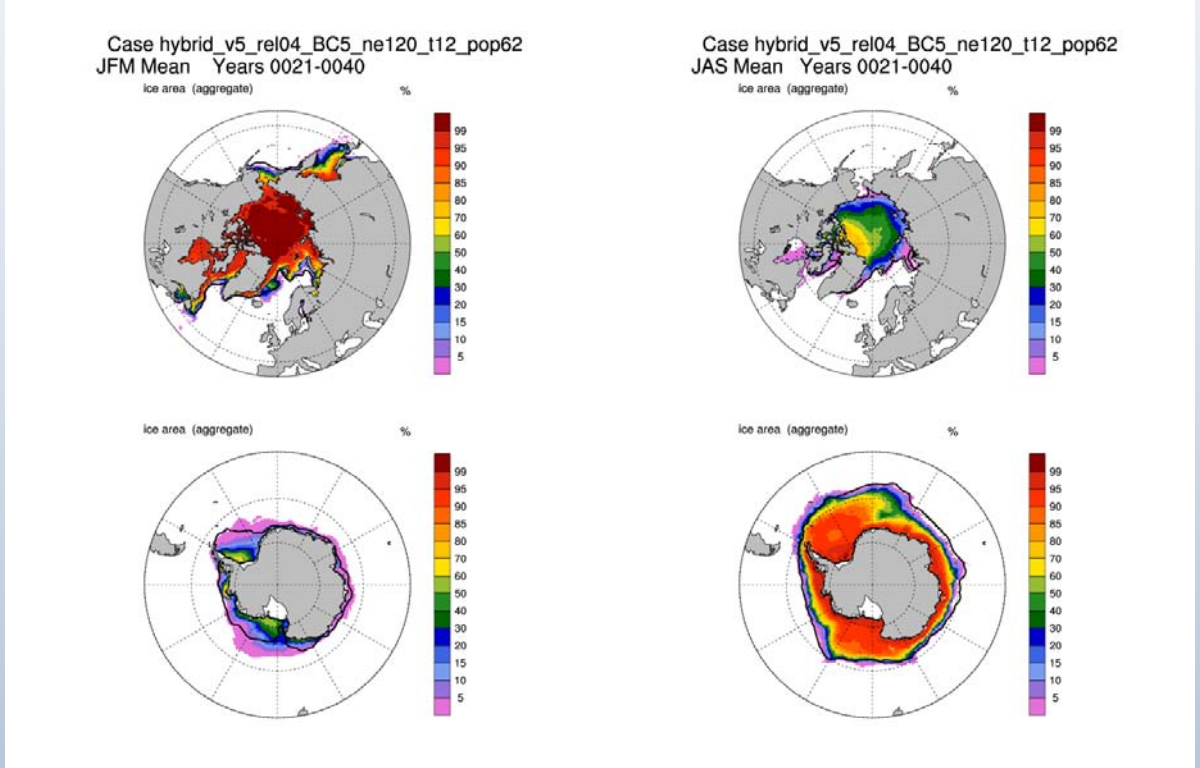
Status:

- 1850 control run at year 685
- First historical run complete (1850-2005)
- First RCP8.5 run started (2006-2080)

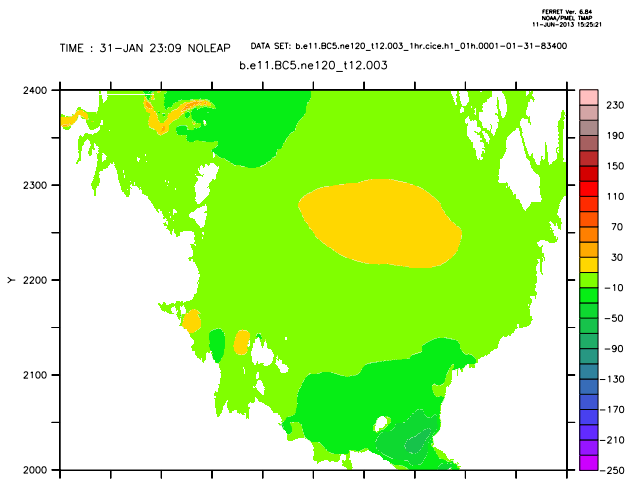
Planning Wiki:
https://wiki.ucar.edu/display/ccsm/CESM+Large+Ensemble+Planning+Page
E-mail list for updates:
http://mailman.cgd.ucar.edu/mailman/listinfo/cesmcam5_lrgens

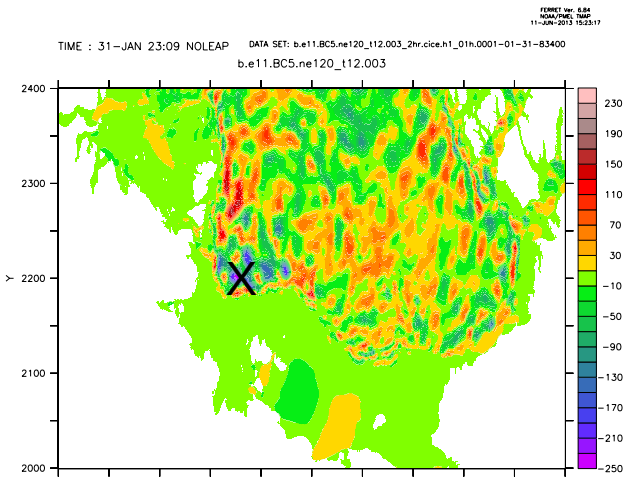
CESM (Accelerated Scientific Discovery)

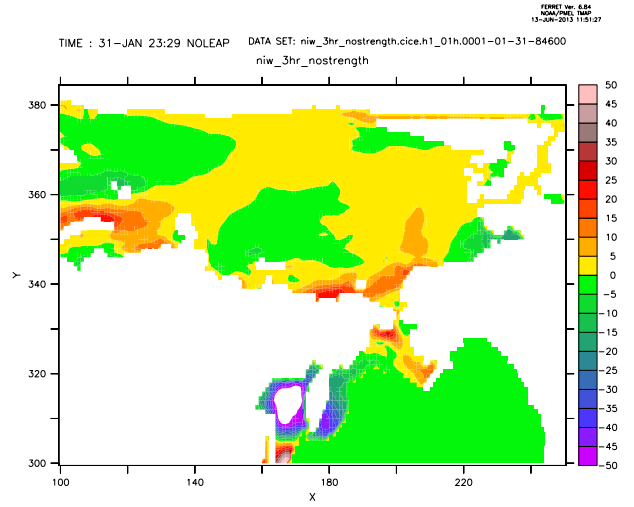
- CAM5 Spectral Element Dynamical Core and CLM at ne120 (approx 0.25 degree) resolution.
- Fully-coupled and CORE2 (T62) forced ice-ocean simulations.
- CICE/POP at 0.1-degree on tripole grid.
- All POP sub-gridscale parameterizations turned off with biharmonic viscosity on.
- Approximately 60 year run available on the ESG



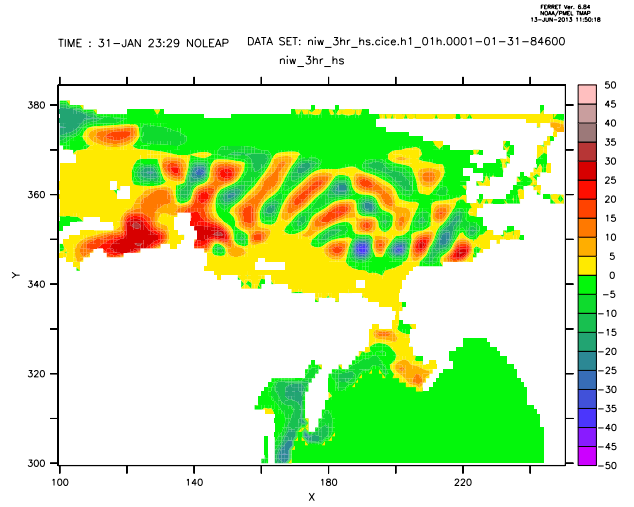
Inertial Oscillations







ice velocity (x) (cm/s)



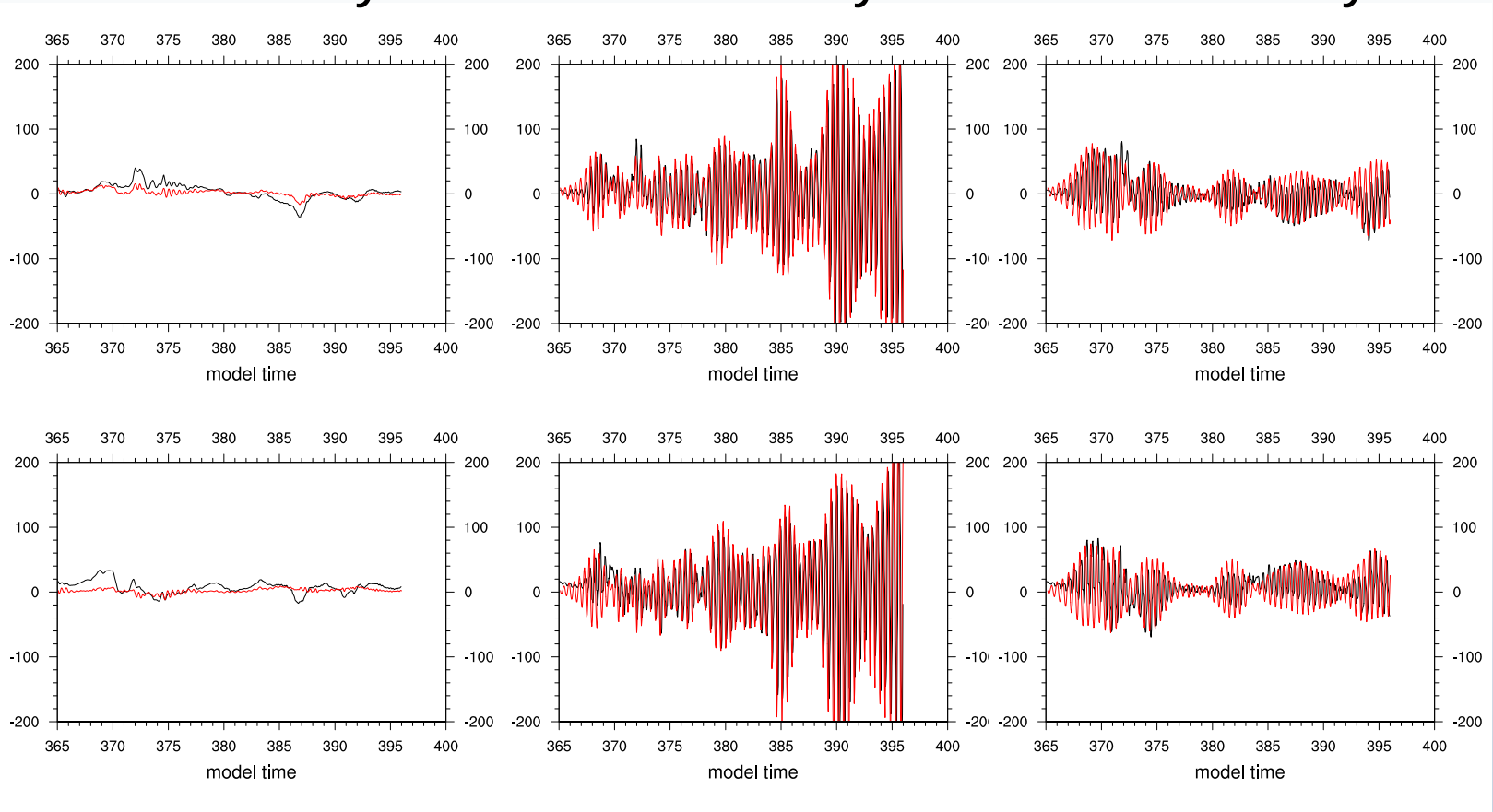
ice velocity (x) (cm/s)

Inertial Oscillations

One-hourly Two-hourly Three-hourly

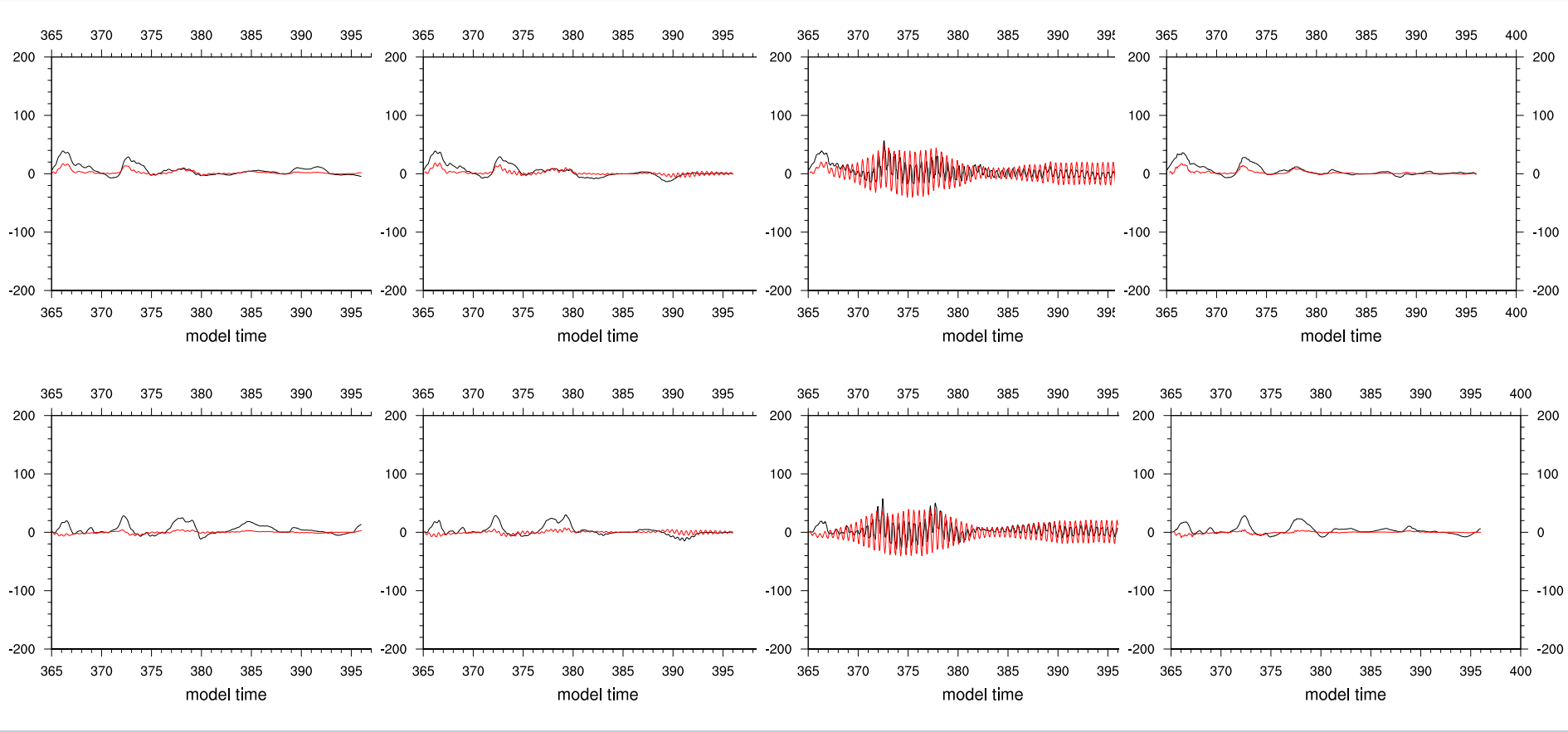
Ui
Uo

Vi
Vo



Low Resolution (1.9x2.5_gx1v6)

One-hourly Two-hourly Three-hourly Six-hourly

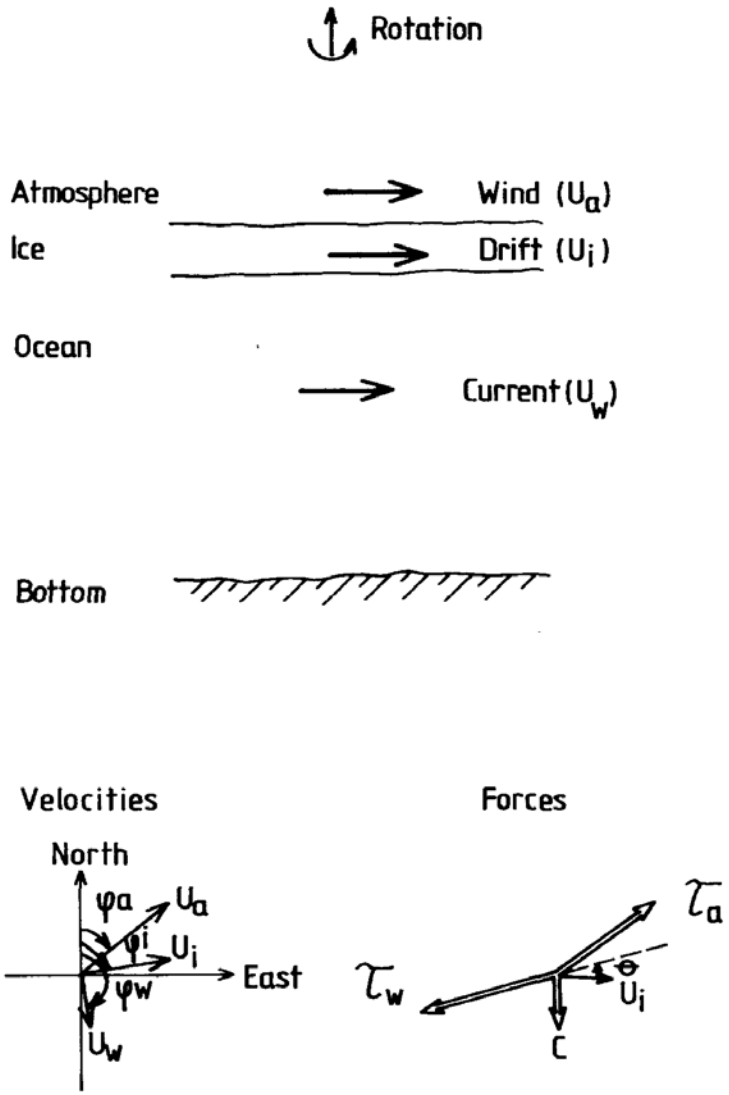


Omstedt, Nyberg, and Leppäranta 1996

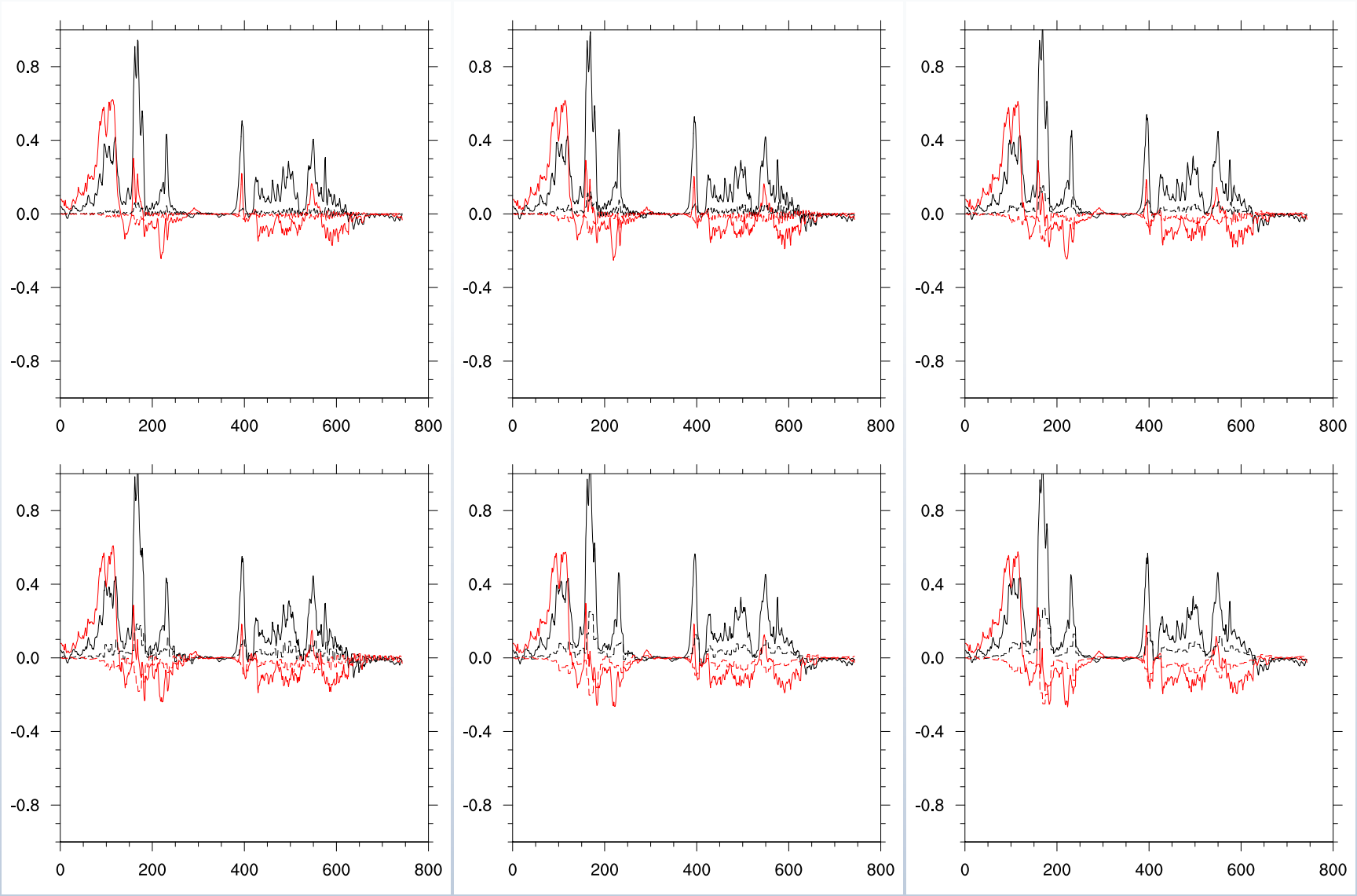
$$\frac{\partial}{\partial t}(\rho_i U_i) + if\rho_i U_i = \frac{\partial \tau_i}{\partial z},$$

$$\frac{\partial}{\partial t}(\rho_w U_w) + if\rho_w U_w = \frac{\partial \tau_w}{\partial z},$$

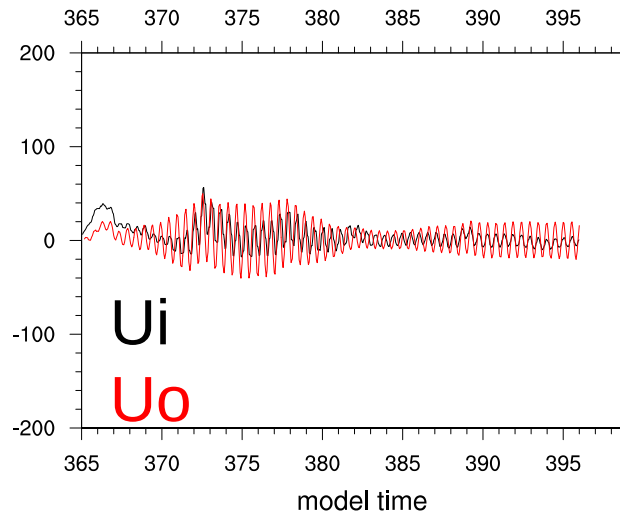
$U_i = u_i + i*v_i$
$U_w = u_w + i*v_w$

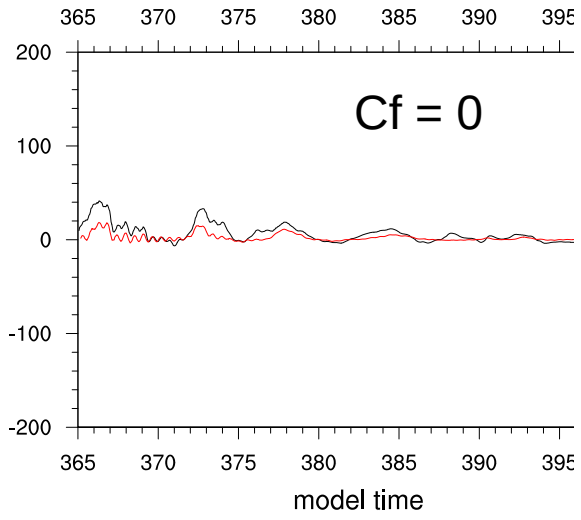


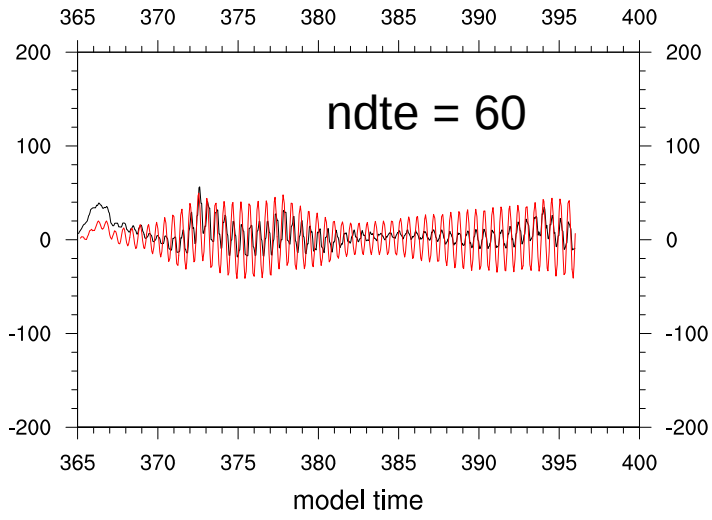
Simple Model

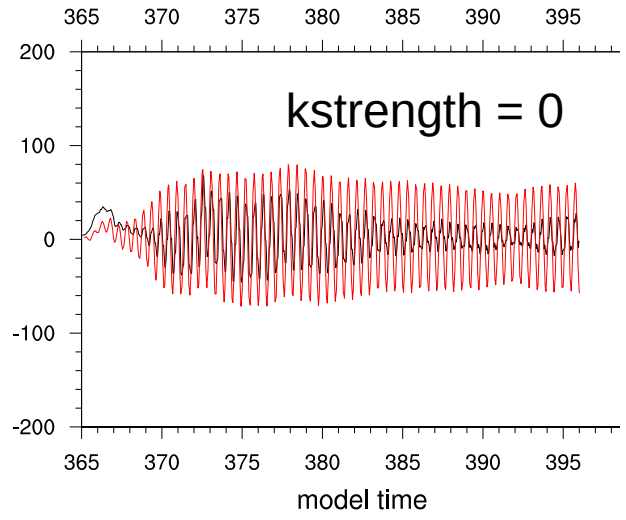


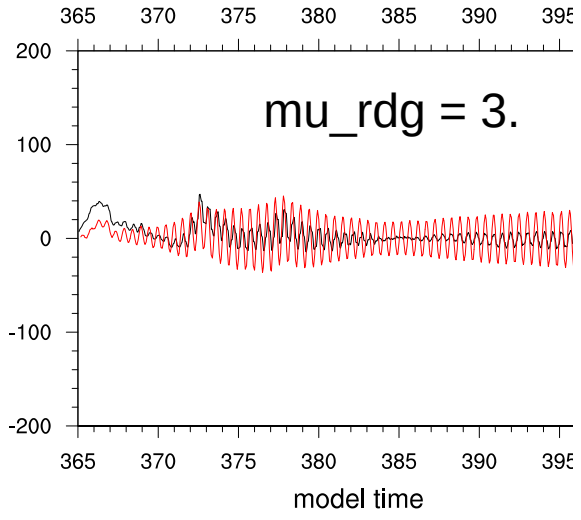
Sea Ice Dynamics Changes
(All with 3-hourly ocean coupling)

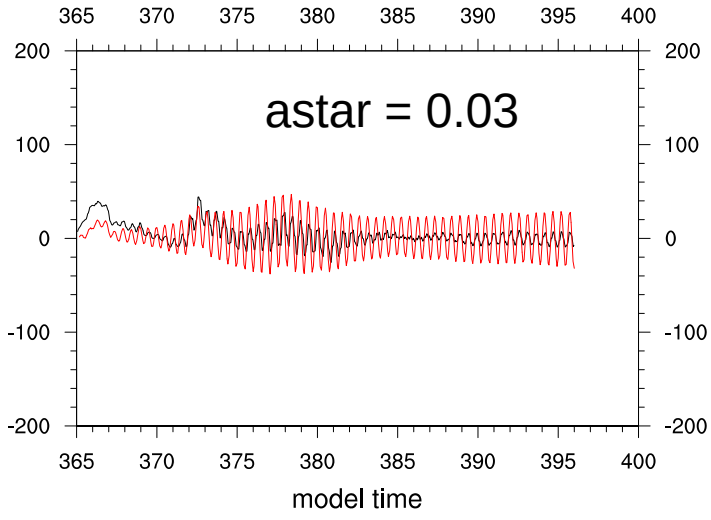










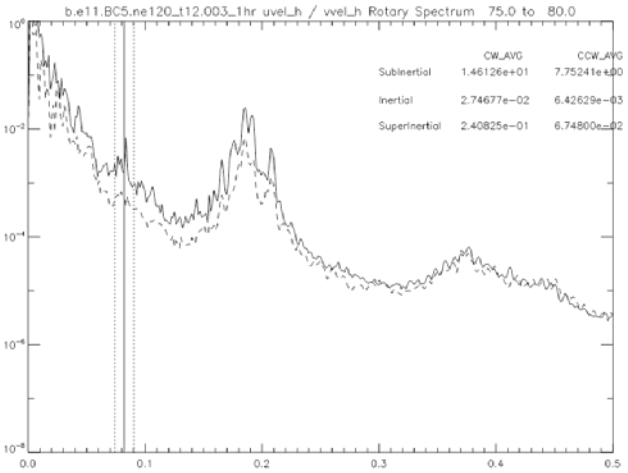


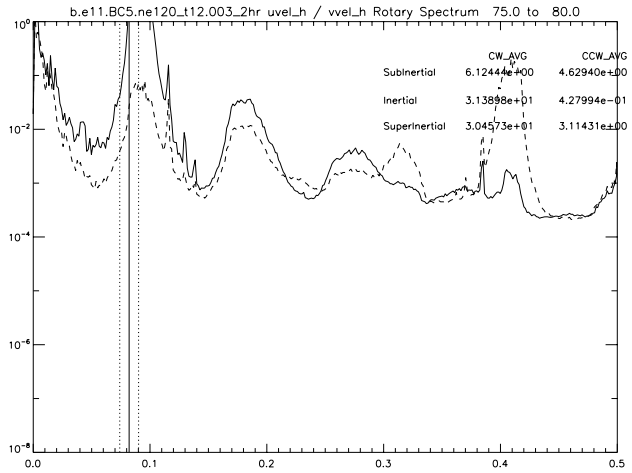
Summary

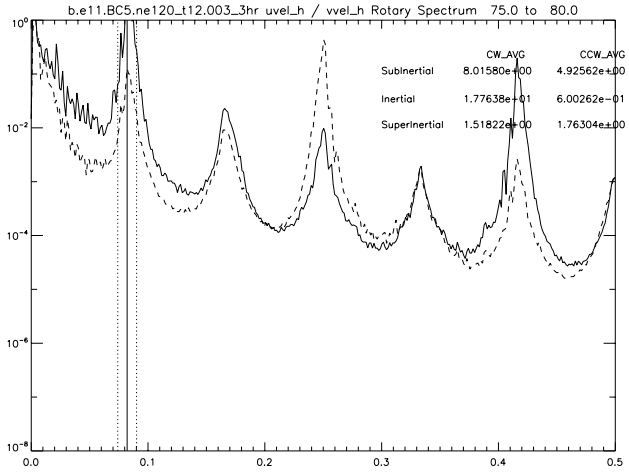
- ASD run and Large Ensemble
- Instability related to ocean coupling frequency, inertial period and sea ice dynamics (likely evp/strength relationship)
- Can simulate stable inertial oscillations with 1-hourly coupling and appropriate time-step in sea ice.
- Note that the new runoff component (as of CESM 1.1.1) needs to be coupled at least as frequently as the ocean component.
- Southern hemisphere appears to be unaffected due to free drift or smaller internal stress?
- Work in progress to determine origin of instability and resonant frequency.

NCAR is sponsored by the National Science Foundation.
Funding from NSF OPP for D. Bailey is gratefully acknowledged.

Frequency Analysis







Strength versus Amplitude