E3SM
Energy Exascale
Earth System Model

Update on the low-res v1 water cycle model to be used for E3SM's DECK and CMIP submissions

2018-01-25

Chris Golaz
on behalf of the entire Water Cycle Coupled Simulation Task

LLNL-PRES-745340
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

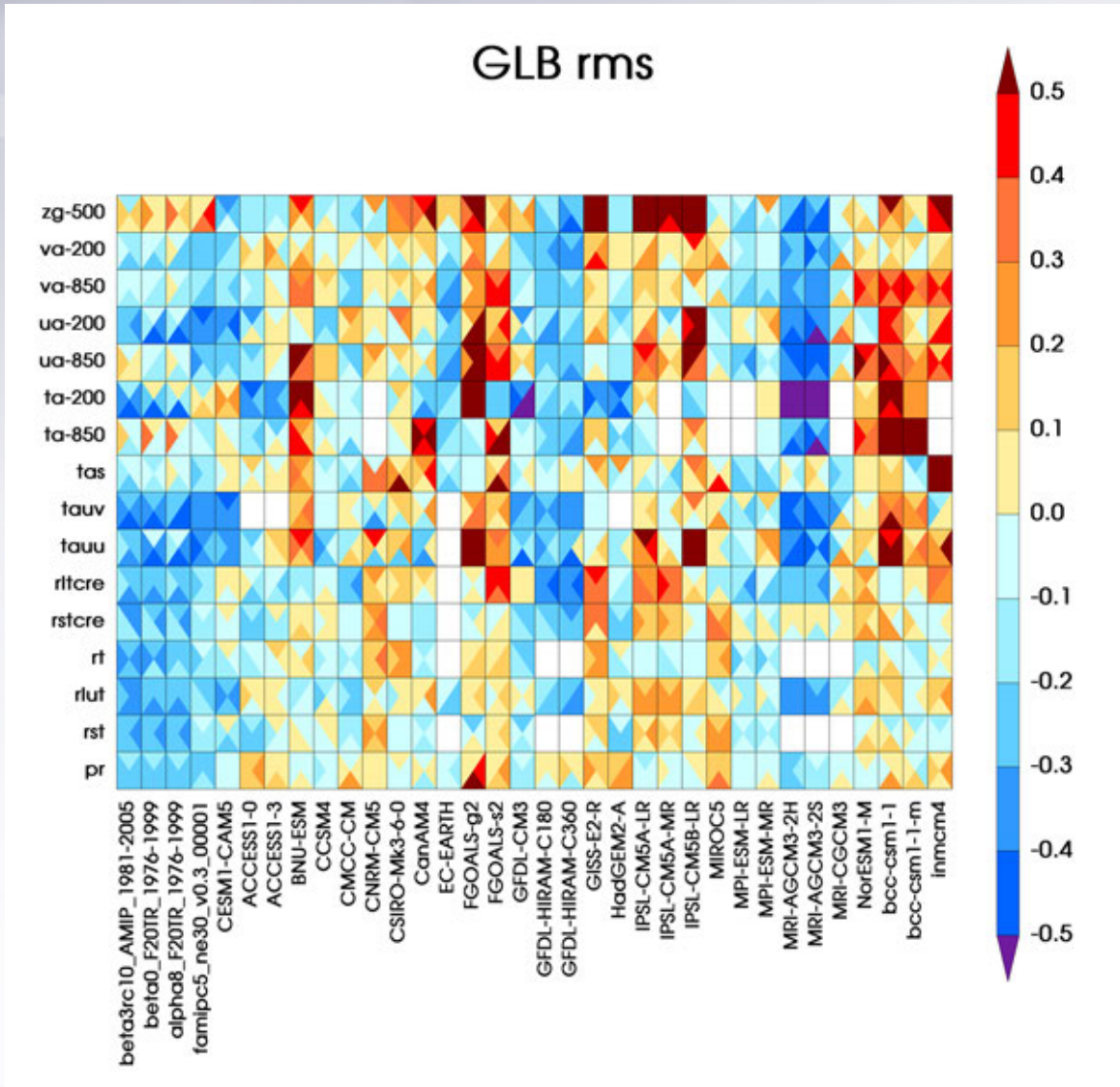
U.S. DEPARTMENT OF ENERGY

Status

- Latest version: **beta3rc10**
- Low-resolution configuration
  - 1 deg atmosphere/land ("ne30"), 72 layers
  - 30 to 60 km ocean/sea-ice ("oECv3"), 60 layers
- Recent key simulations
  - 1850 control simulation (260 years)
  - Test historical simulation (1850-2014)
    - Branched from control at 0090-01-01.
    - CMIP6 forcings
  - AMIP simulation (1978-2011)
    - CMIP6 forcings, except SSTs

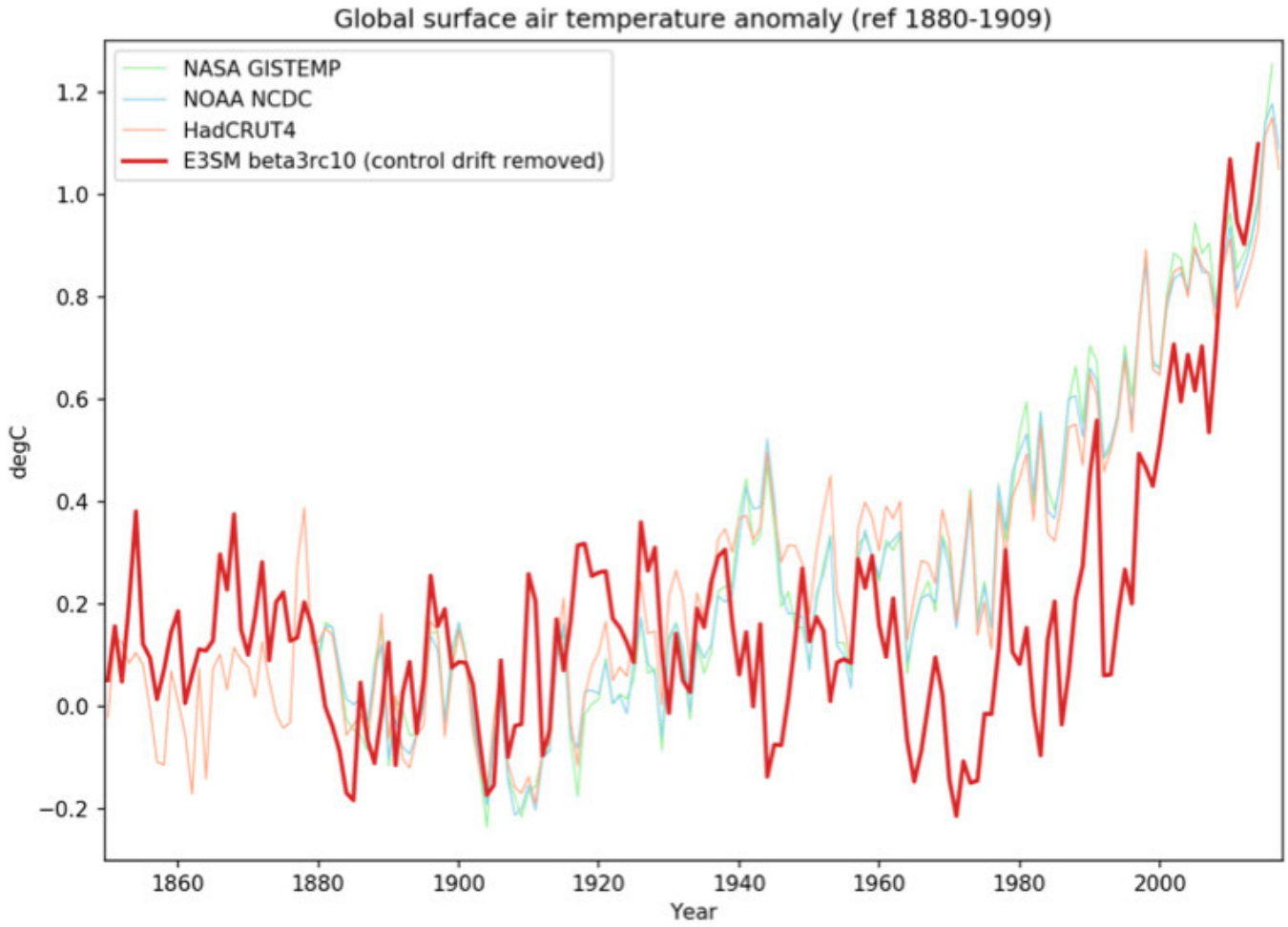
https://acme-climate.atlassian.net/wiki/spaces/SIM/pages/110788827/Coupled+-+Tune+and+Validate+Beta+simulations

AMIP atmosphere performance

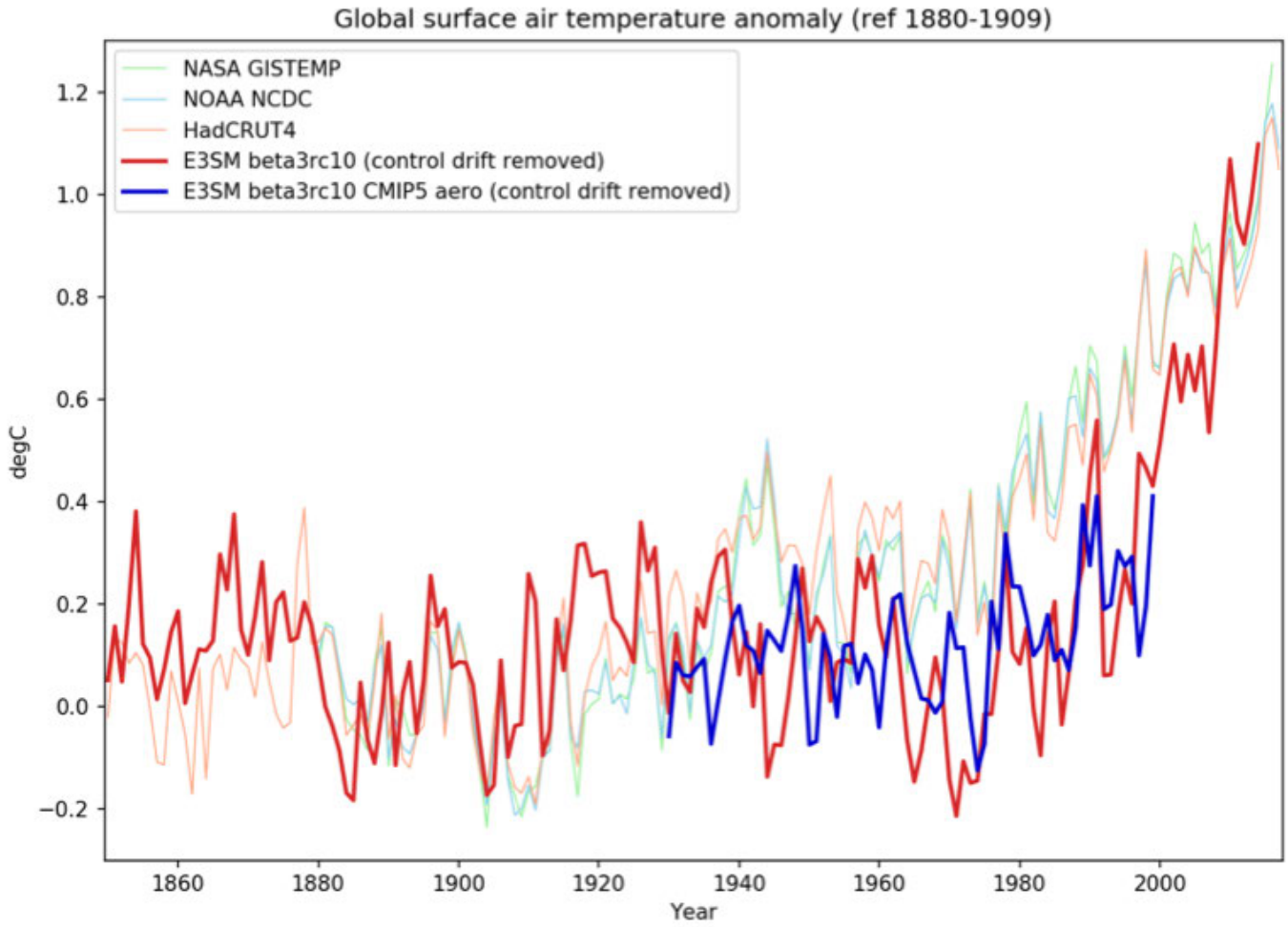


Qi Tang
PMP team

Historical simulation H1 (beta3rc10)



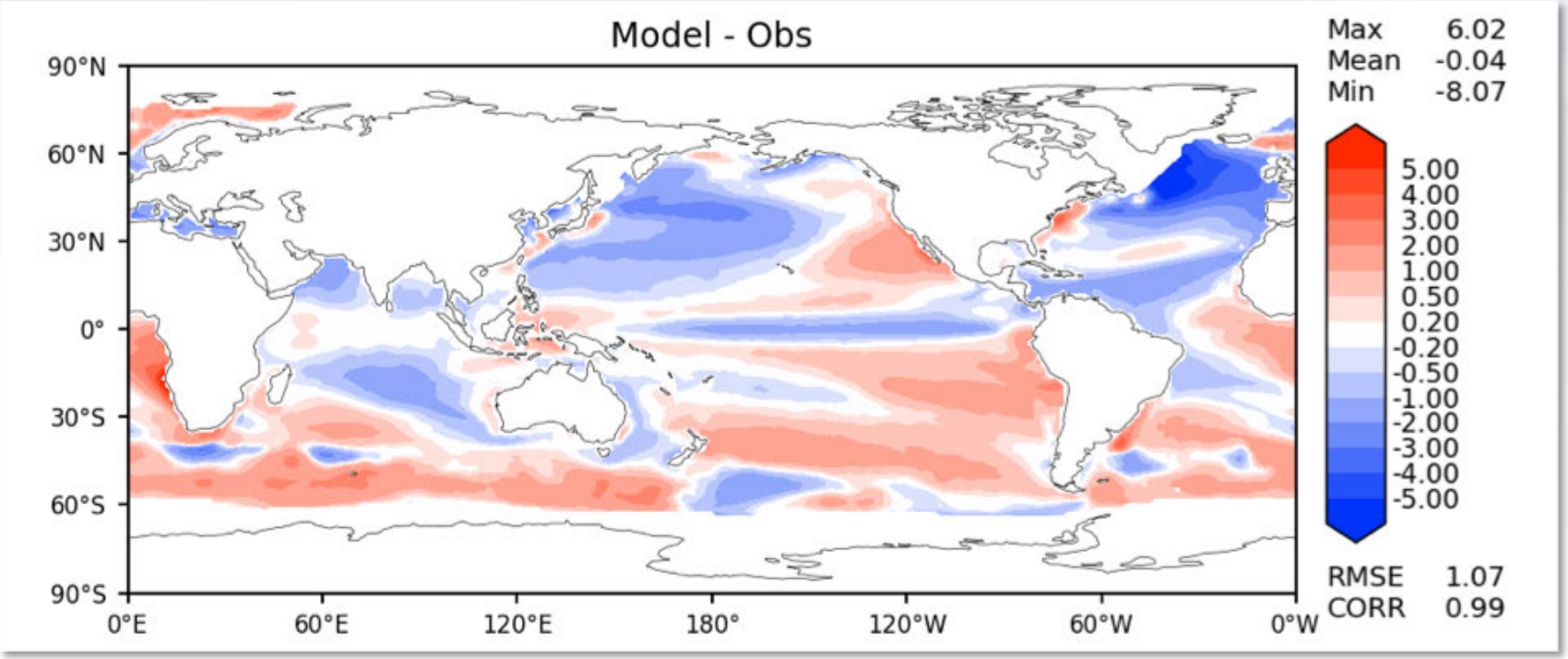
Impact of CMIP6 aerosol emissions



Sea Surface Temperature

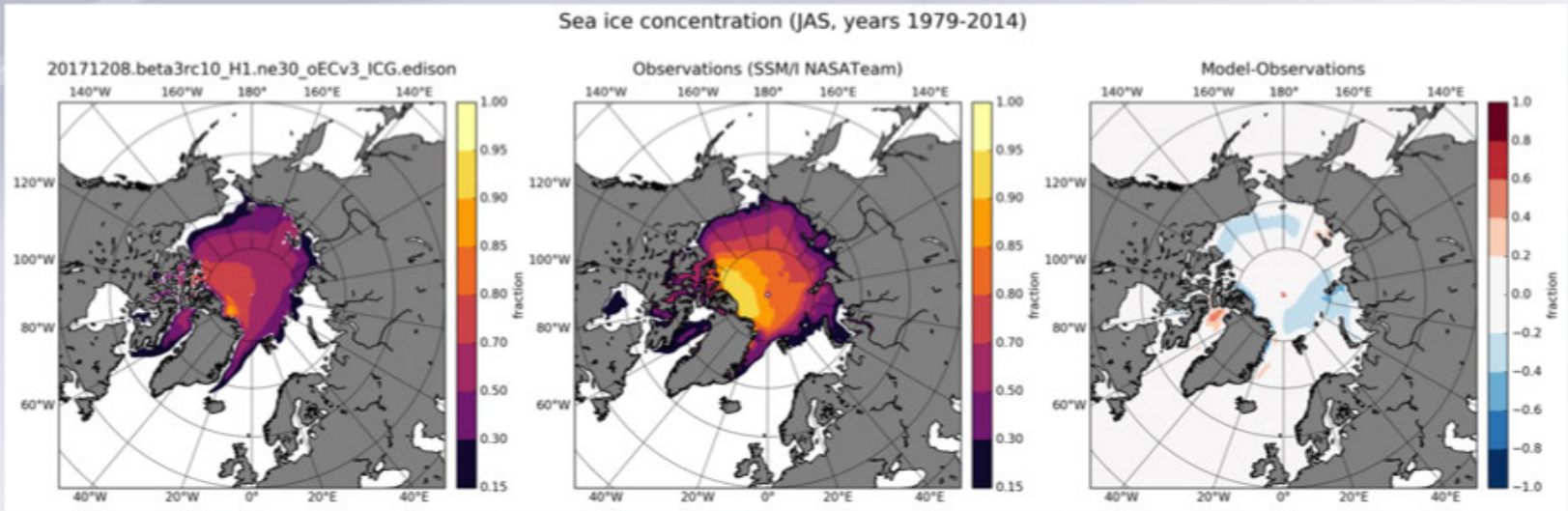
(Model 1979-2011;
Obs 1982-2001)

Coupled H1 - HadISST

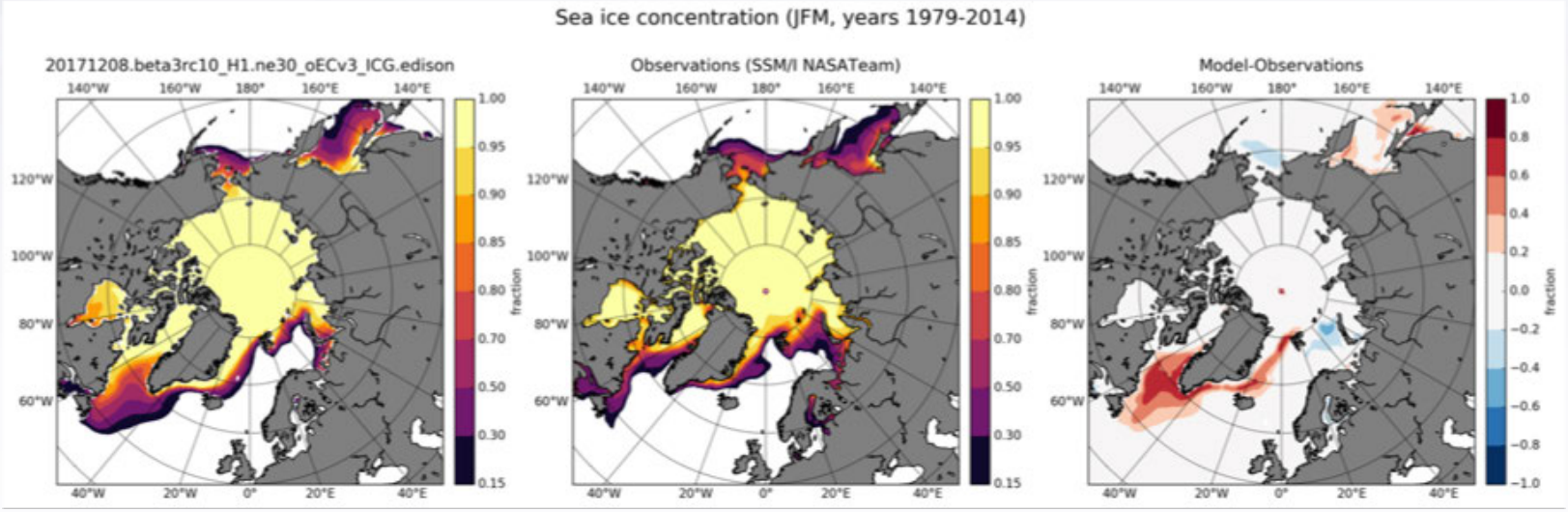


NH sea ice concentration

Summer

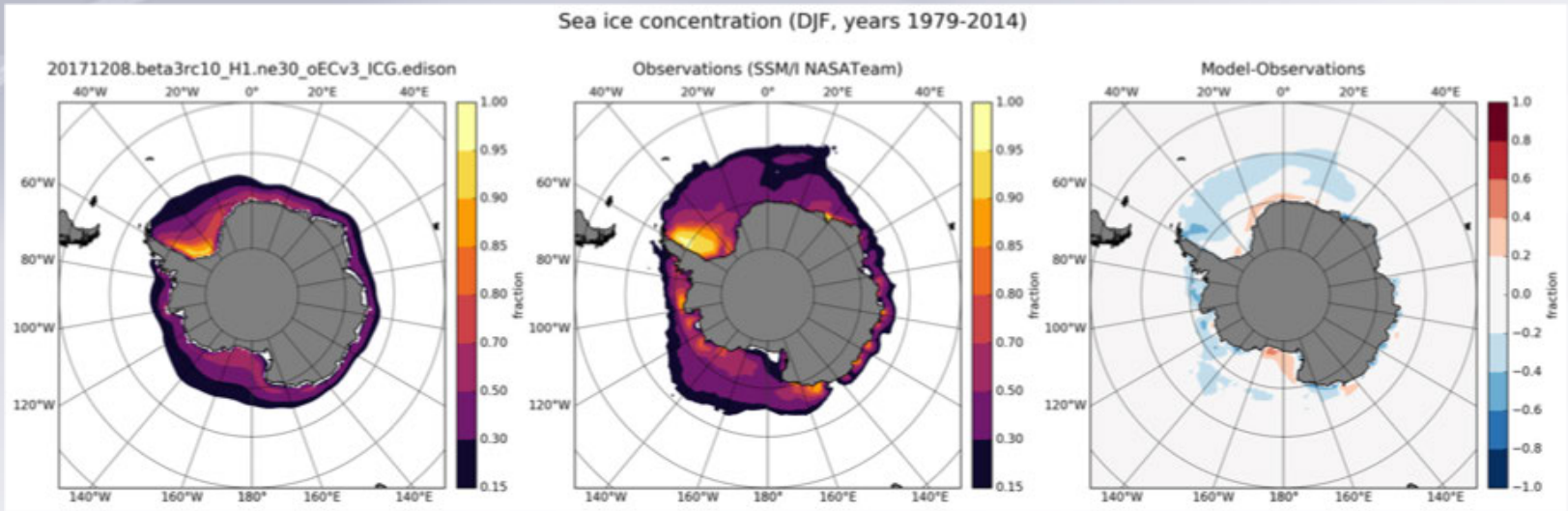


Winter

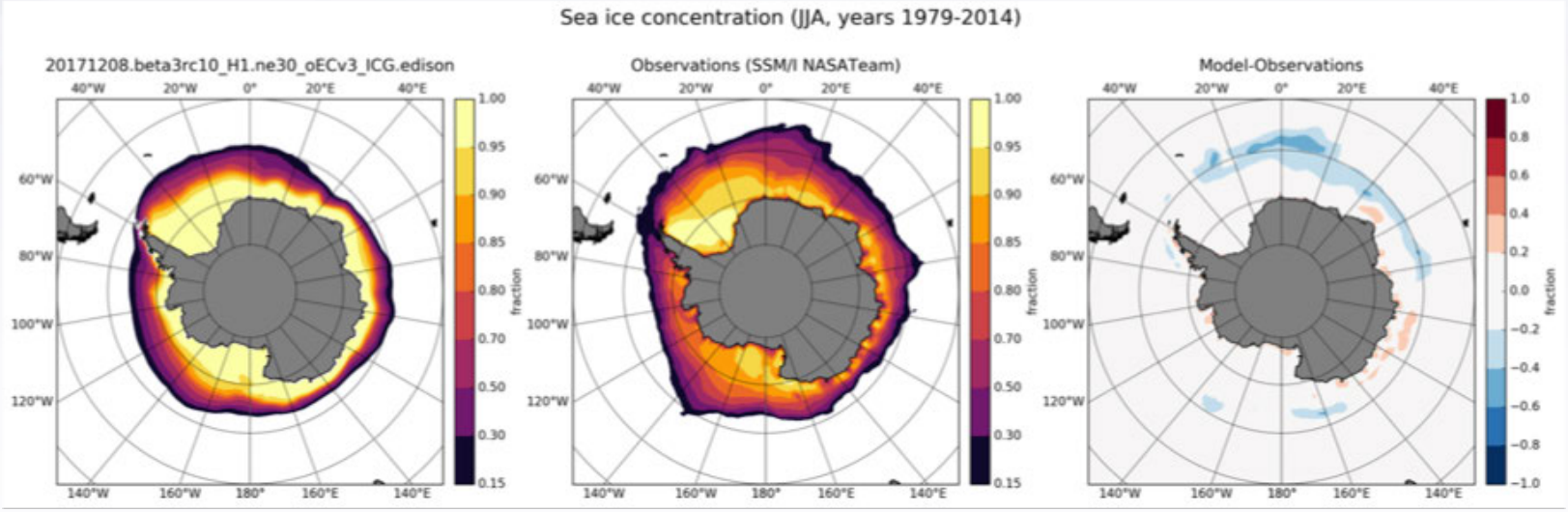


SH sea ice concentration

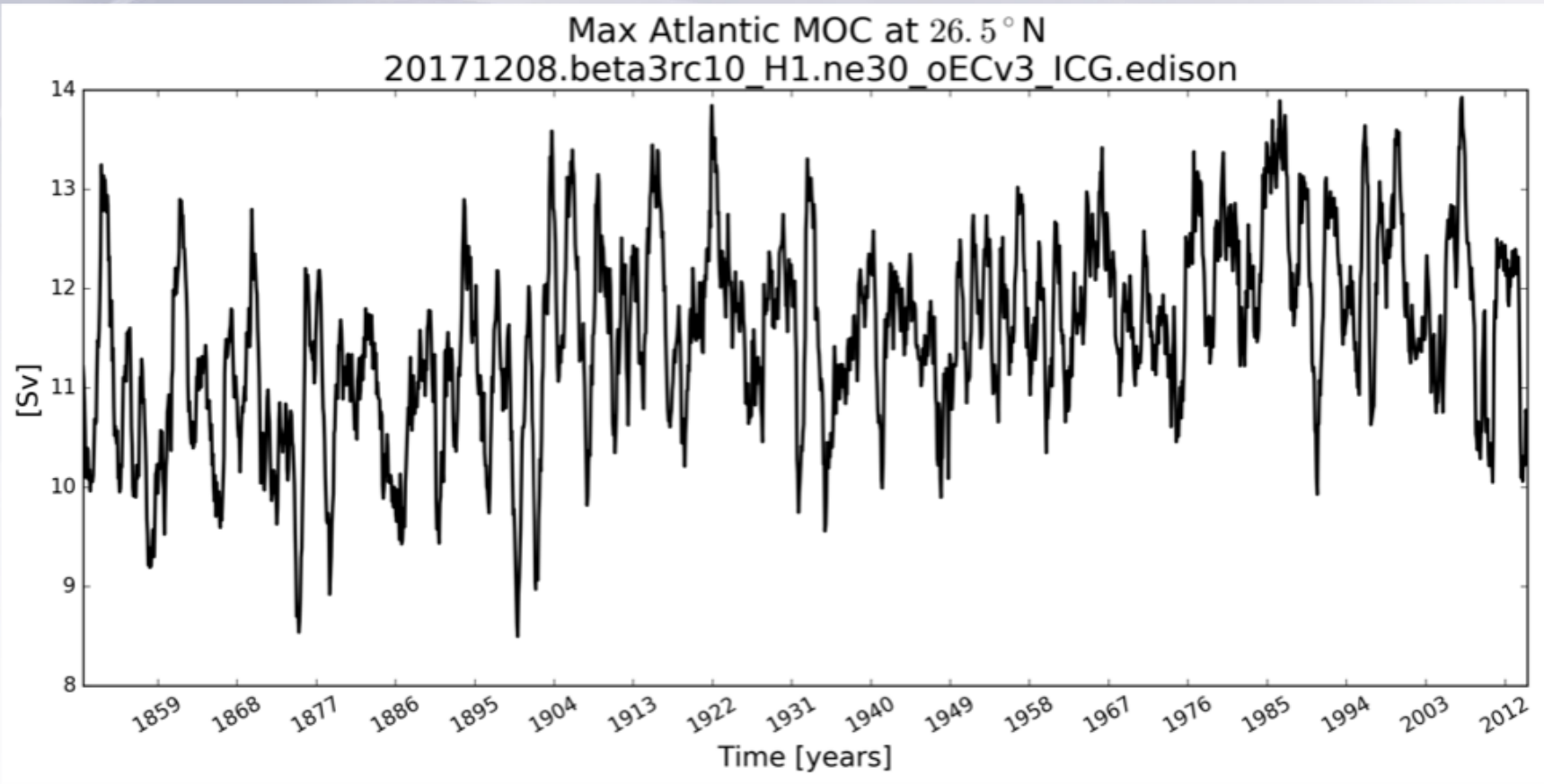
Summer



Winter



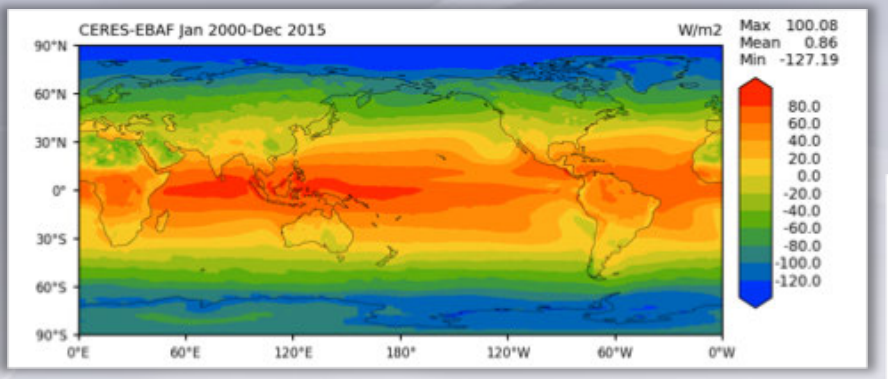
Coupled historical: AMOC

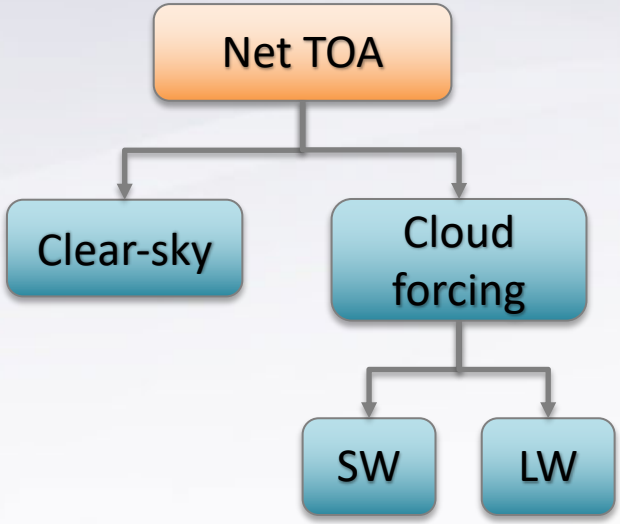


Annual net TOA radiation

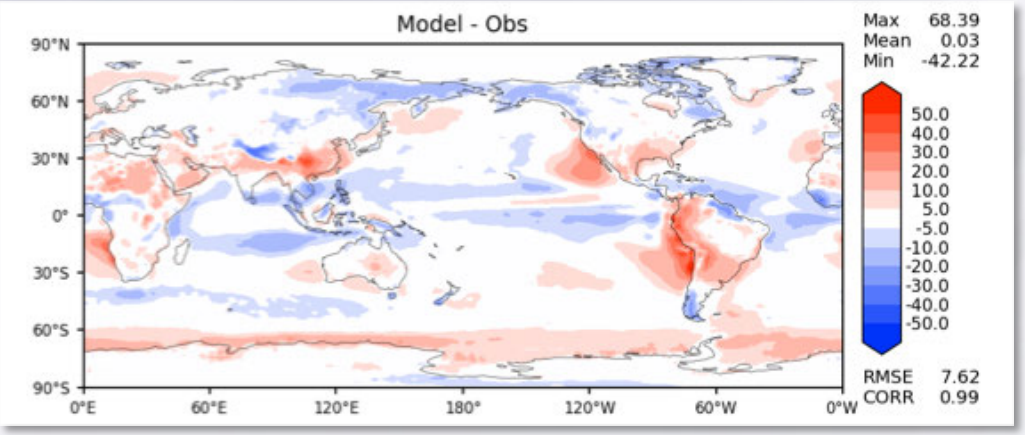
(1979-2011)

CERES-EBAF Ed 4.0

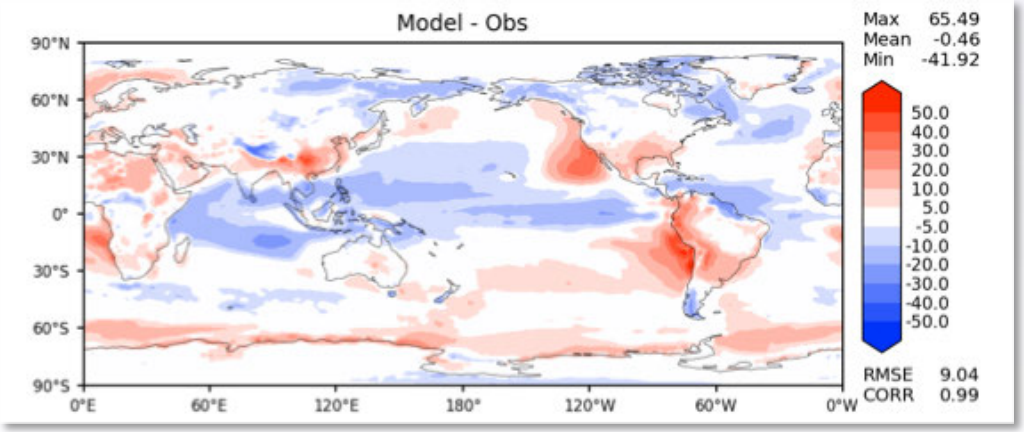




AMIP - observations



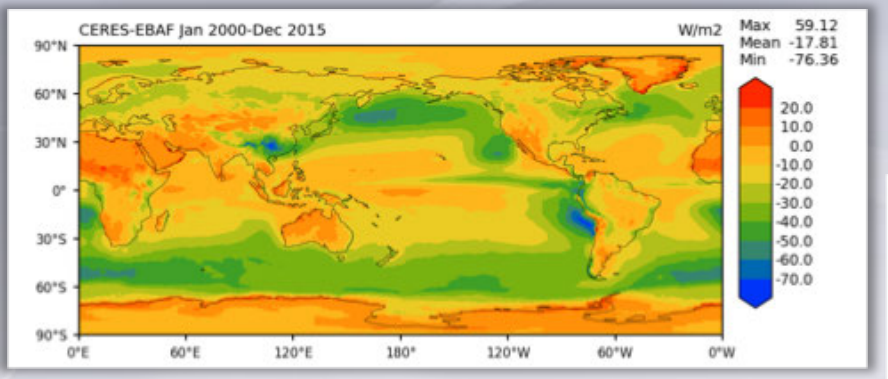
Coupled H1 - observations

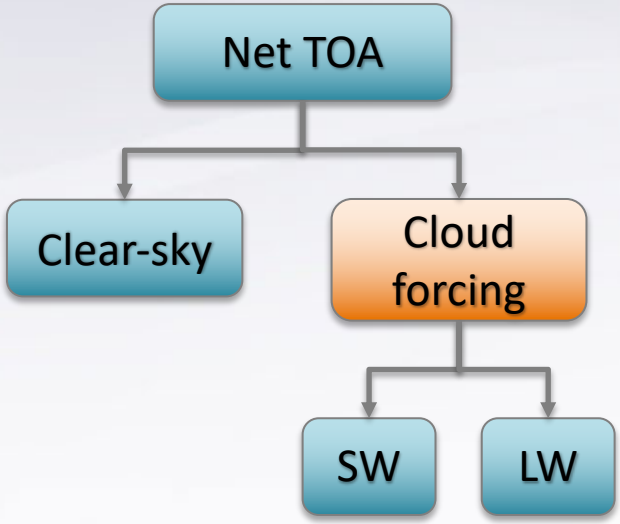


Annual net TOA cloud forcing

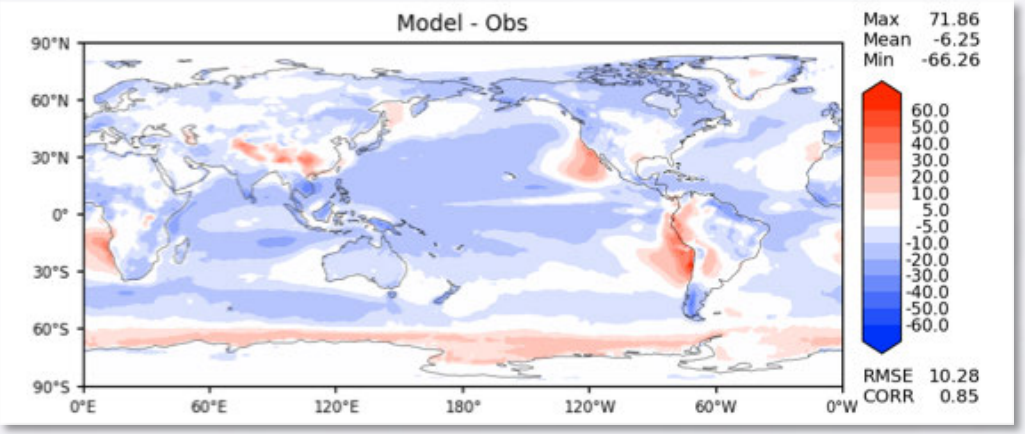
(1979-2011)

CERES-EBAF Ed 4.0

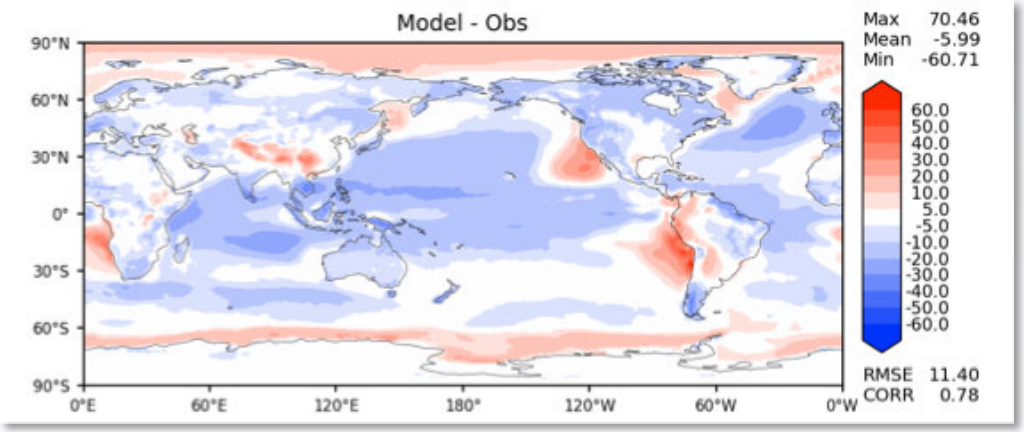




AMIP - observations



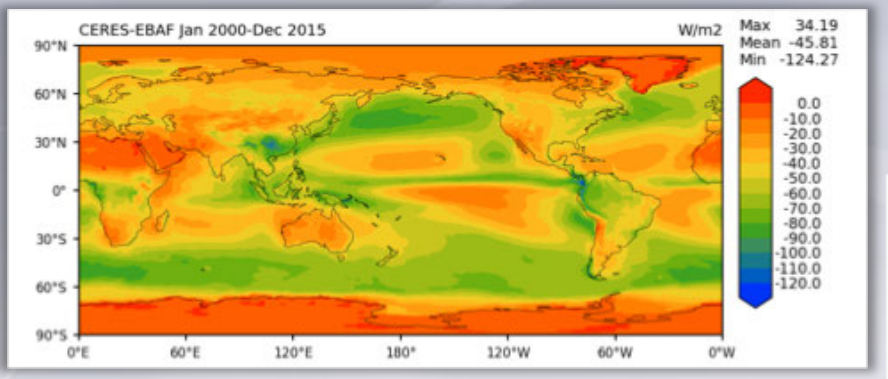
Coupled H1 - observations

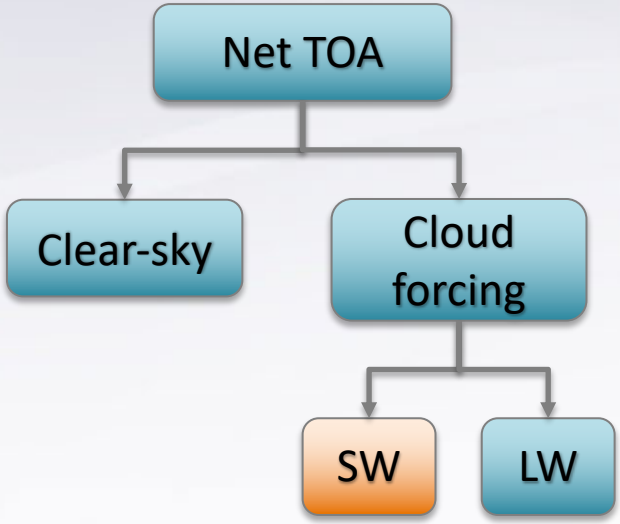


Annual SW TOA cloud forcing

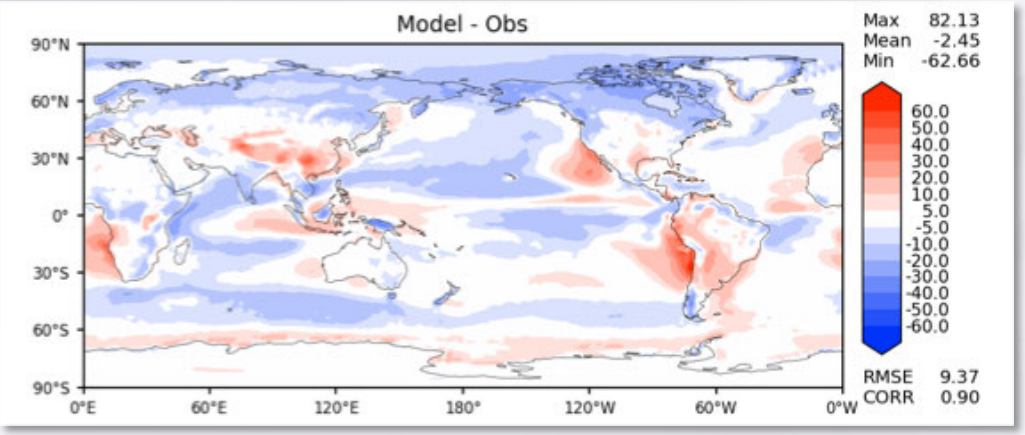
(1979-2011)

CERES-EBAF Ed 4.0

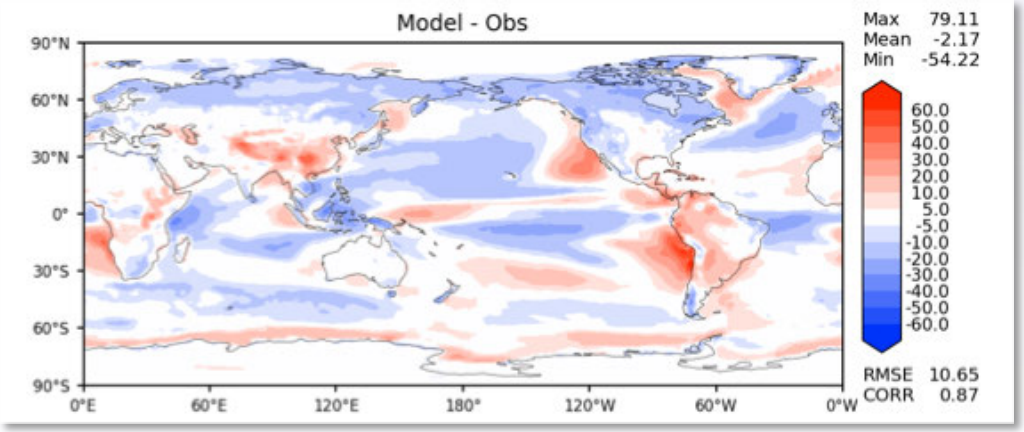




AMIP - observations



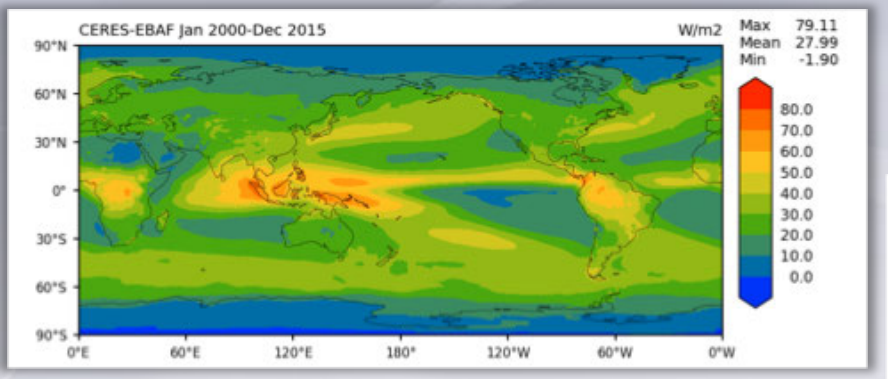
Coupled H1 - observations

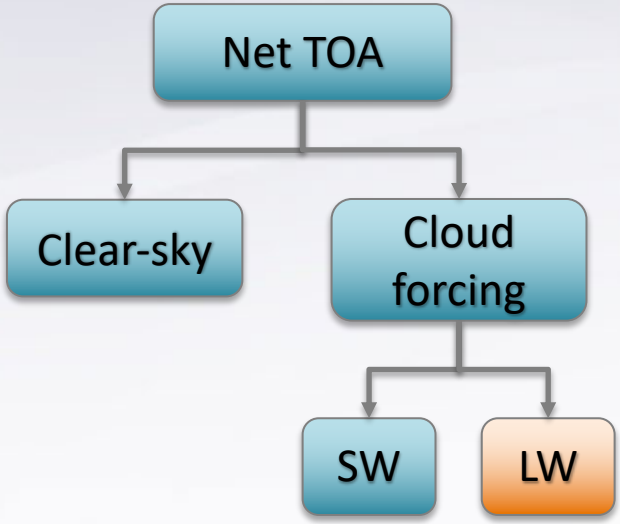


Annual LW TOA cloud forcing

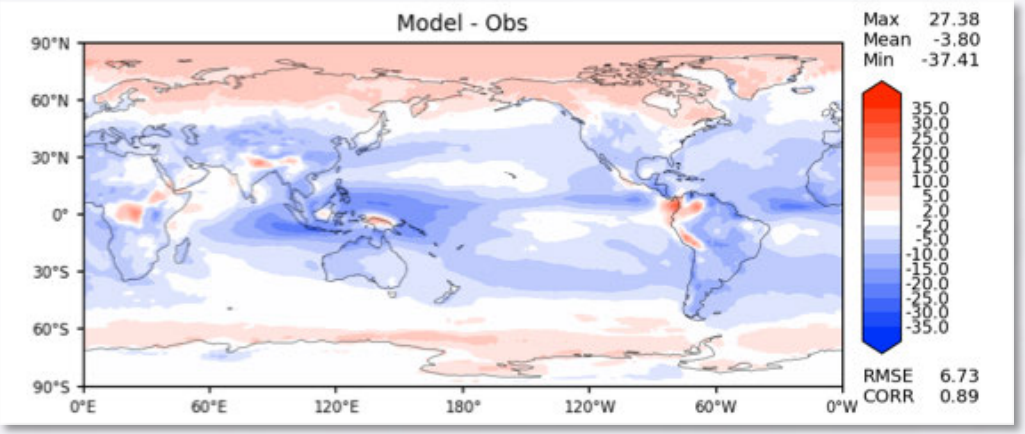
(1979-2011)

CERES-EBAF Ed 4.0

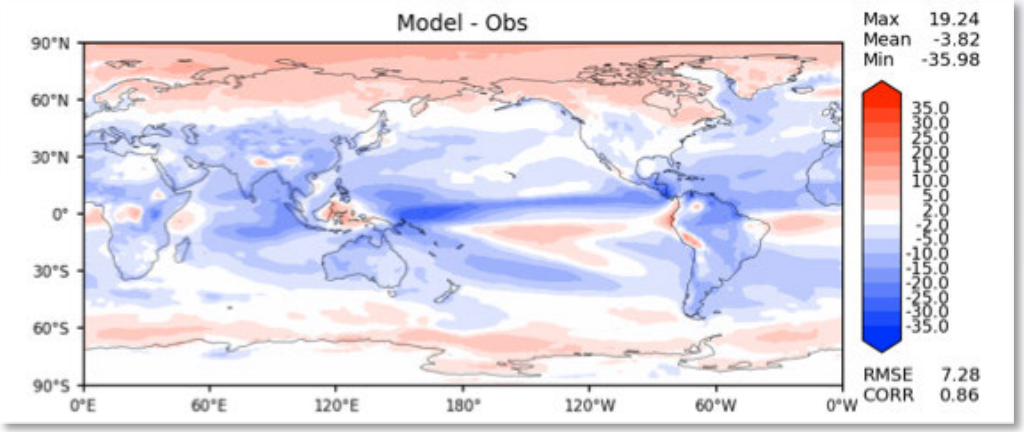




AMIP - observations

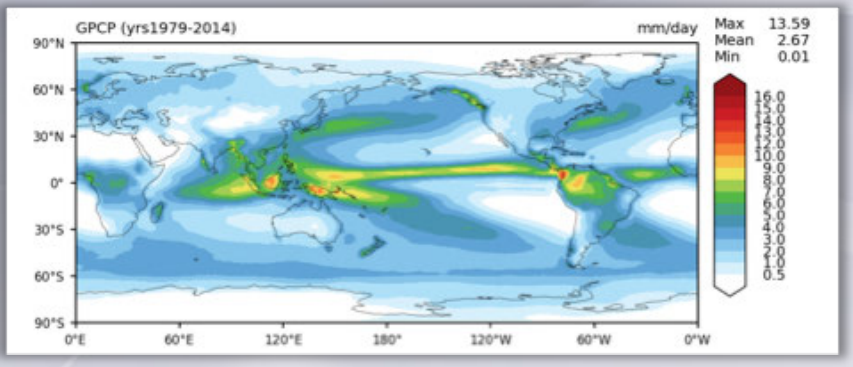


Coupled H1 - observations

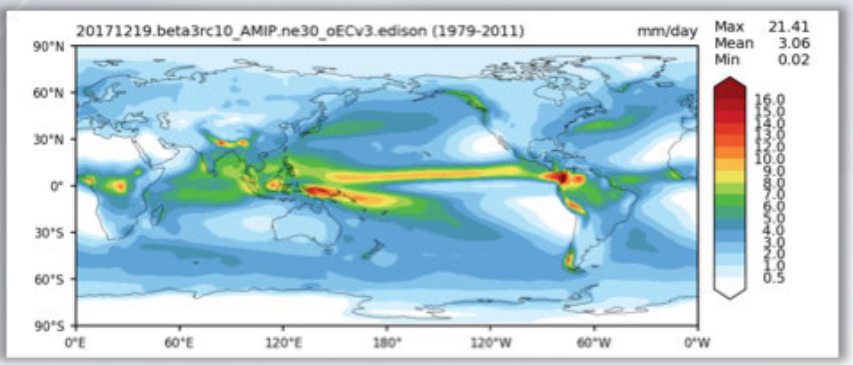


Annual precipitation
(1979-2011)

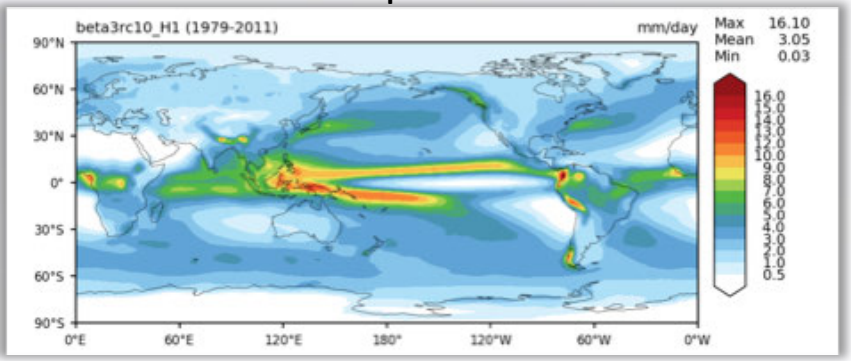
GPCP v2.2



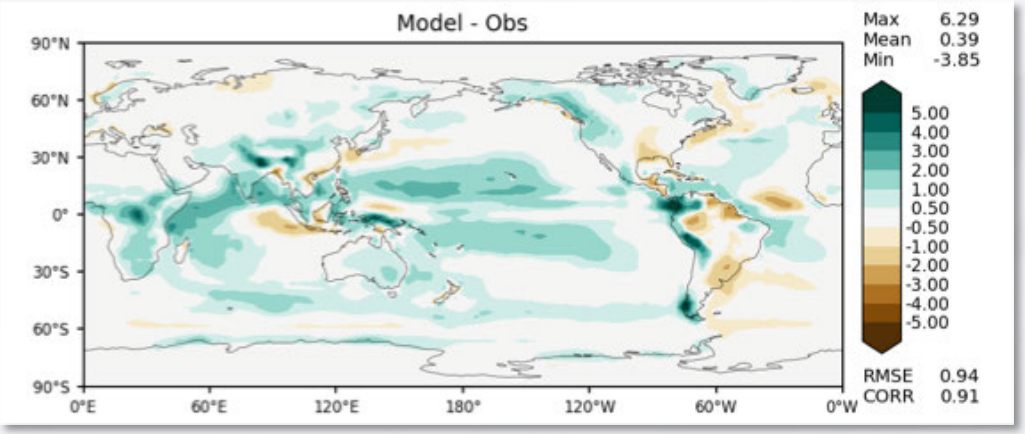
AMIP



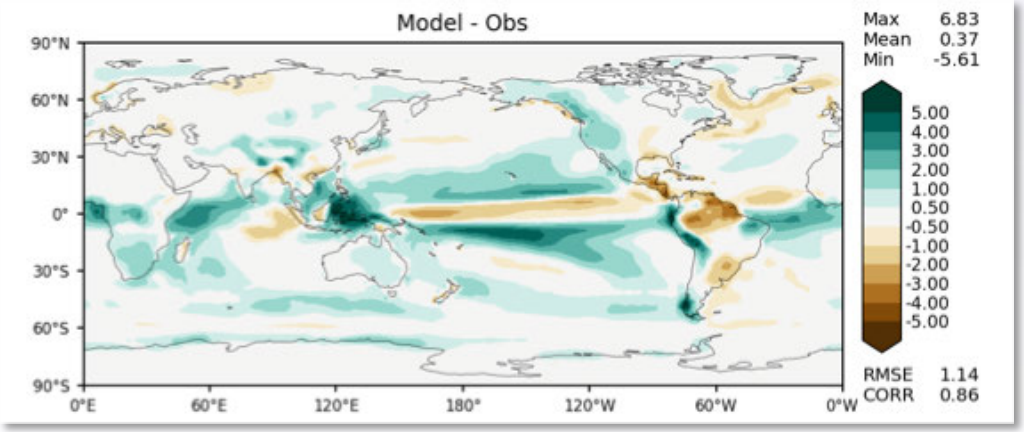
Coupled H1



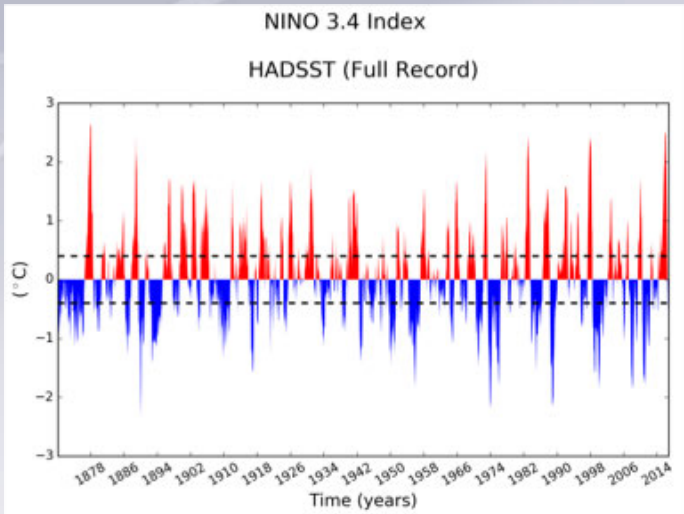
AMIP - observations

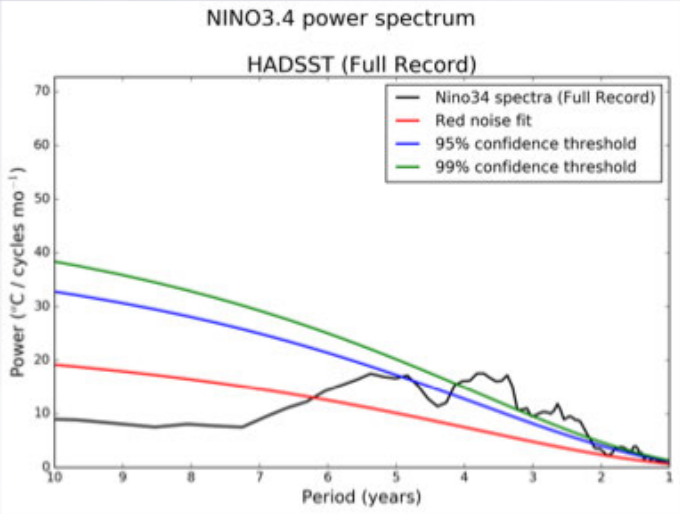


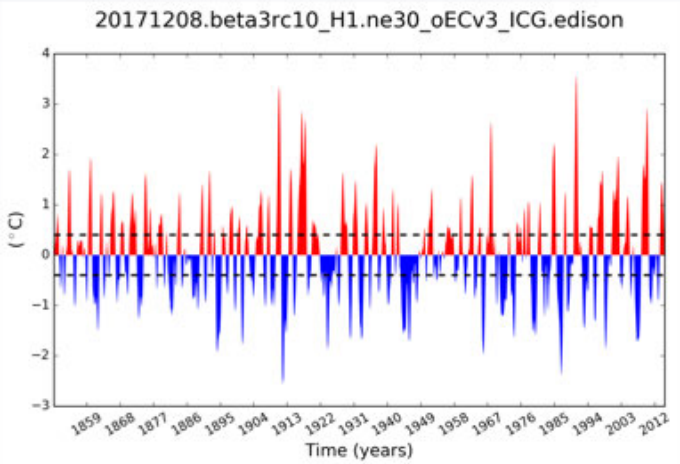
Coupled H1 - observations

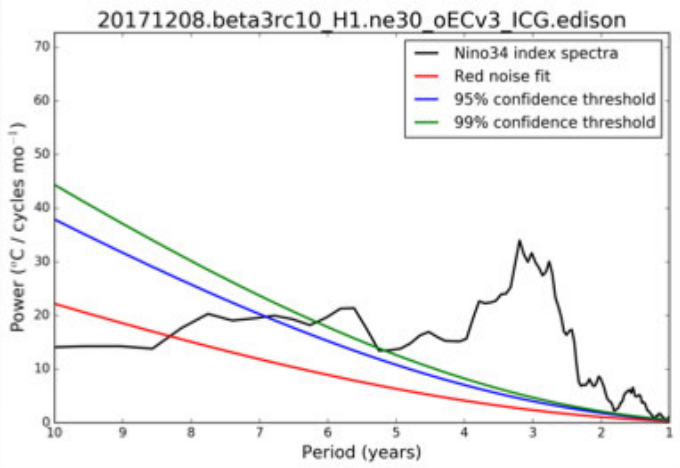


ENSO (Nino3.4)

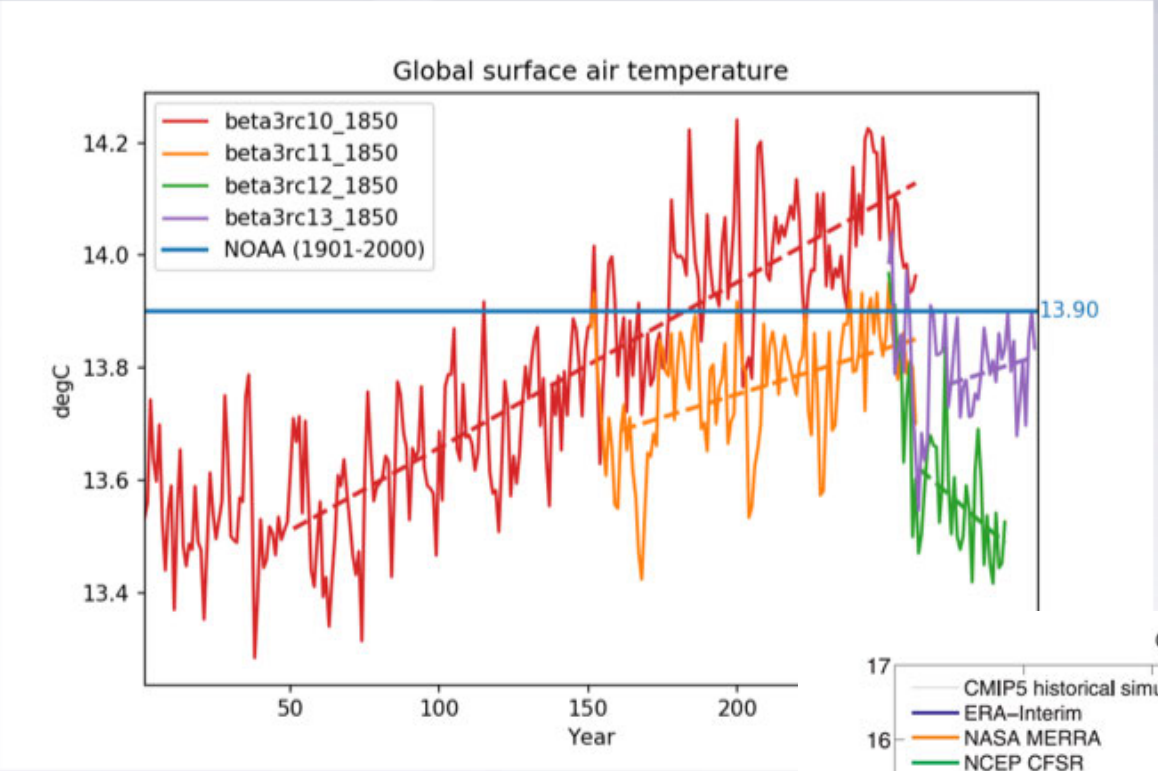

NINO 3.4 Index
HADSST (Full Record)
(°C)
Time (years)


NINO3.4 power spectrum
HADSST (Full Record)
Nino34 spectra (Full Record)
Red noise fit
95% confidence threshold
99% confidence threshold
Power (°C / cycles mo⁻¹)
Period (years)

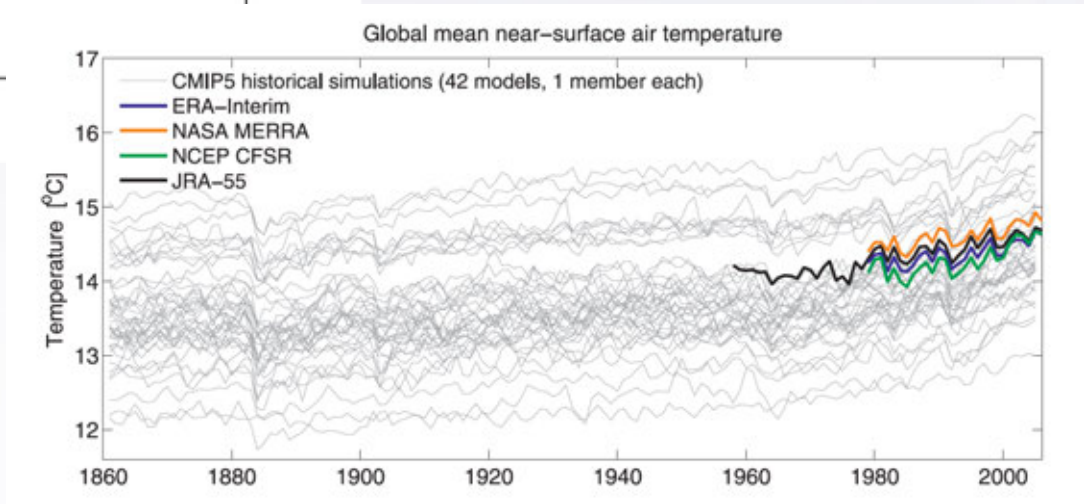

20171208.beta3rc10_H1.ne30_oECv3_ICG.edison
(°C)
Time (years)


20171208.beta3rc10_H1.ne30_oECv3_ICG.edison
Nino34 index spectra
Red noise fit
95% confidence threshold
99% confidence threshold
Power (°C / cycles mo⁻¹)
Period (years)

Control simulation drift

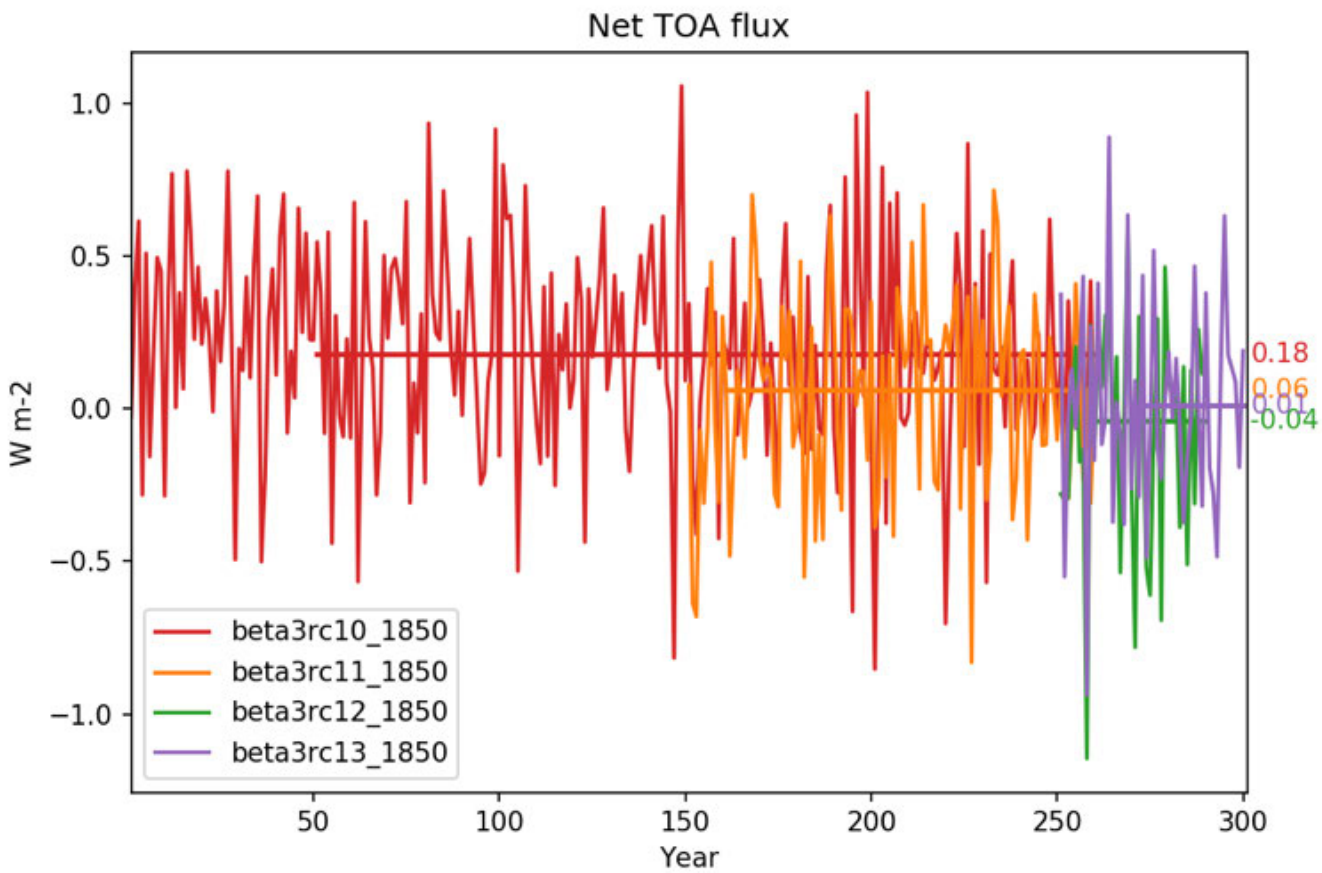


Hawkins and Sutton (2015)



Retuning using clubb_c14

Impact on net TOA flux



Retuning using clubb_c14

DECK simulation plans

DECK simulations before release

- Over 1300 years in a few months…
  - piControl (500+ years)
  - Abrupt 4xCO2 (150 years)
  - 1% per year CO2 increase (150 years)
  - Historical (165 years x n_ensemble_members)
  - AMIP
- Publish data…
- Write paper…
- Release model…

- Possible, but very little room for problems
- Cannot afford "clean" initialization

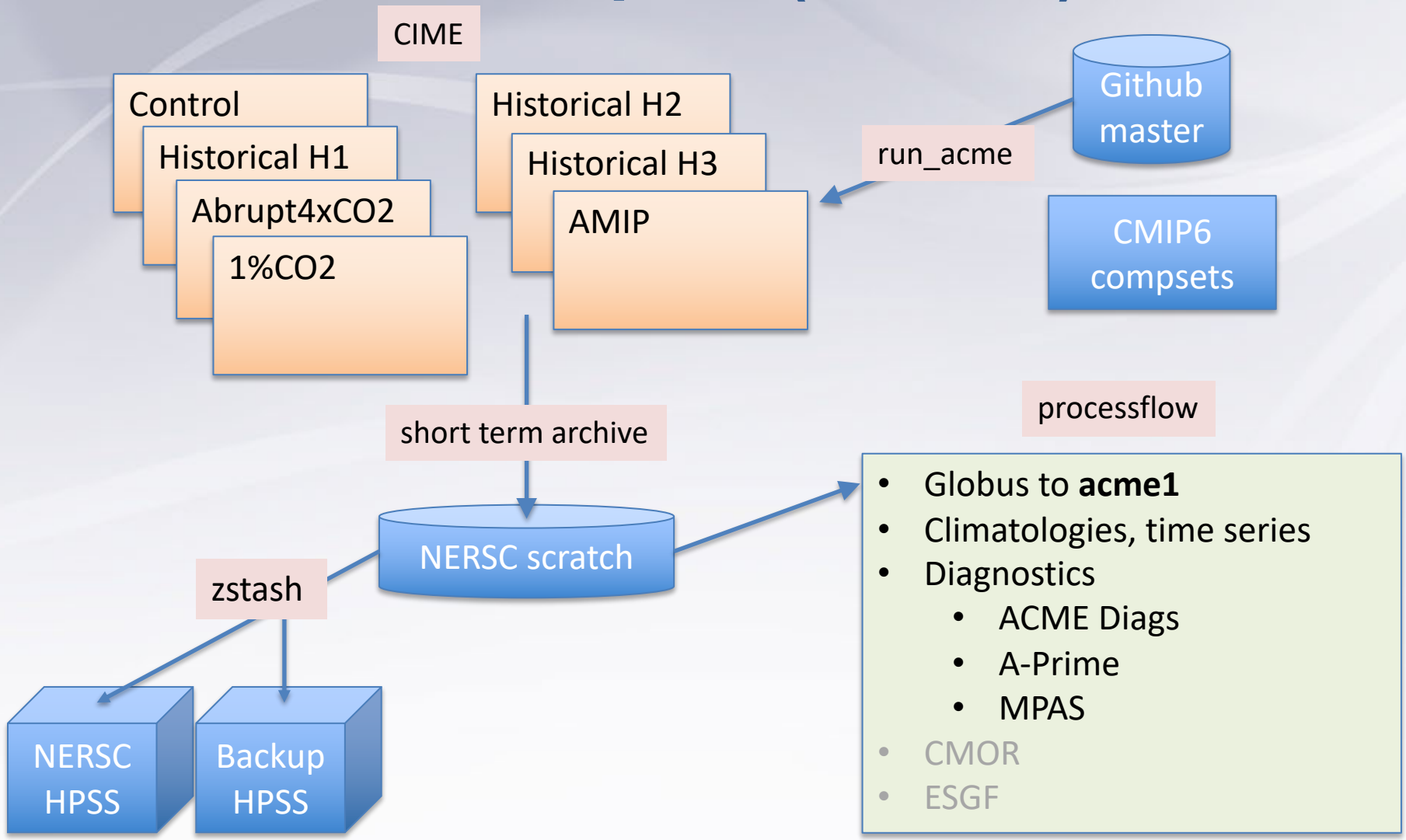
DECK simulation: initialization

- No time for a new complete spin-up.
- Will need to initialize from previous control simulations.
- Most likely:
  - A few months (?) of stand-alone MPAS-O…
  - …10 years of G-case (20170814.FCTfix-del4.GMPAS-IAF.T62+oECv3.anvil)
  - …50 years coupled (20170926.FCT2.A_WCYCL1850S.ne30_oECv3.anvil)
  - …250 years of coupled beta3rc10
  - …50+ years of coupled beta3rc13
  - ➢ Initial conditions for CMIP DECK control simulation.

Next few days…

- Make ‘master’ BFB reproduce ‘beta3rc10’
- Create ‘beta3’ tag
- Add necessary bug fixes (Intel17 bug workaround)
- Finalize tuning (likely beta3rc13).
- Soft code freeze
  - be nice to Rob, no more BFB changes afterward.
- New tag.
- Start DECK Control simulation.

DECK execution plan (Edison)



Questions?