Low-res v1 water cycle model Update

2017-10-12

Chris Golaz

on behalf of the entire Water Cycle Coupled Simulation Task

(Special thanks to Jon, Mark, Luke, Phillip for spending their summer in the trenches of model development)

Current status

- Latest version: **v1-beta2-FCT2**
- "20170926.FCT2.A_WCYCL1850S.ne30_oECv3.anvil"
- Low-resolution model
  - 1 deg atmosphere/land ("ne30")
  - 30 to 60 km ocean/sea-ice
- What's new in beta2-FCT2?
  - Lots of improvements in MPAS-Ocean
  - Misc bug fixes in the atmosphere (MG2 microphysics)
  - …
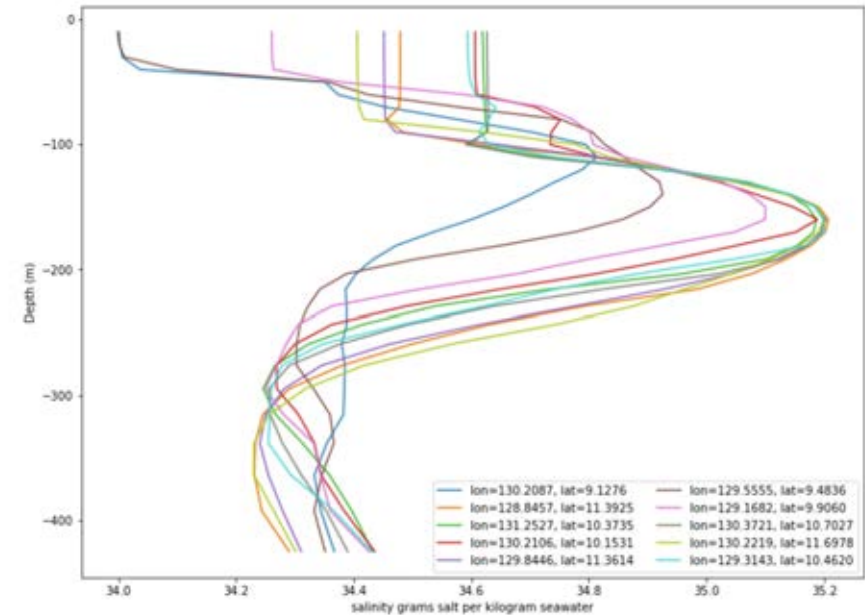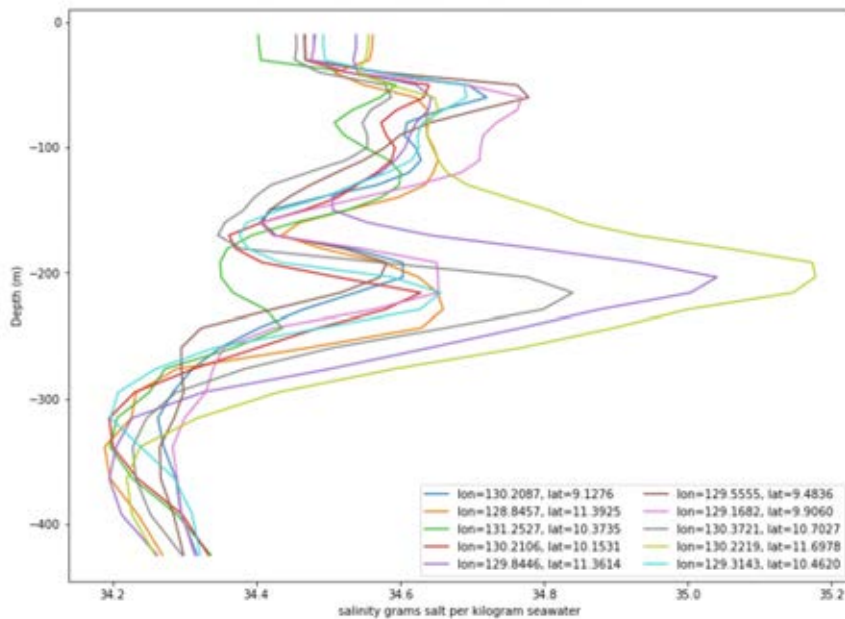- Currently running pre-industrial control simulation (1850).
- 50+ years

E³SM Energy Exascale Earth System Model

U.S. DEPARTMENT OF ENERGY

Ocean improvements
Vertical profiles
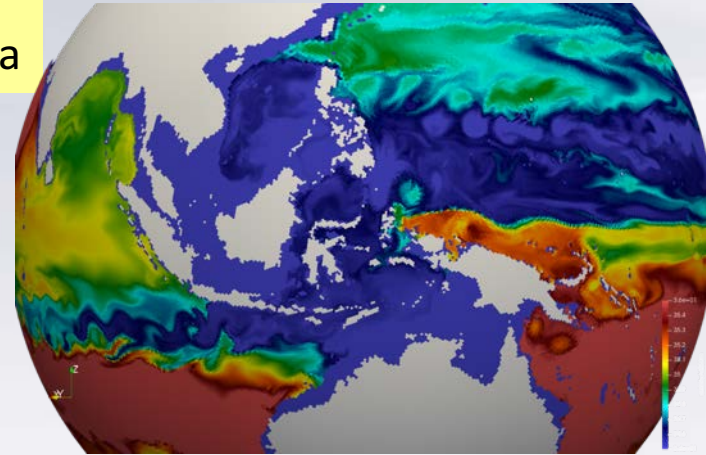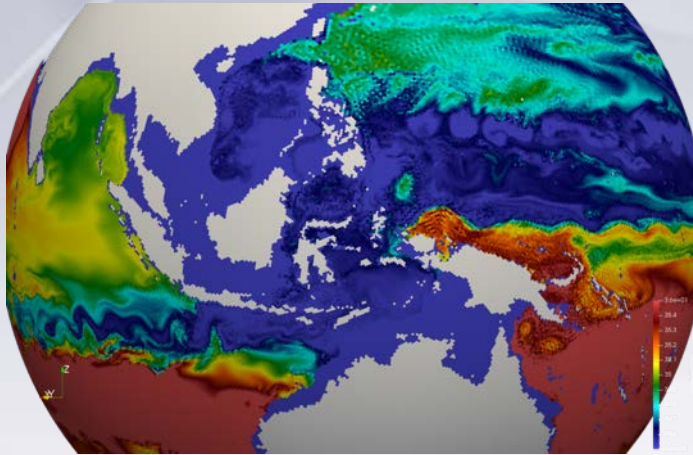
Before

Salinity profiles near the equator

After

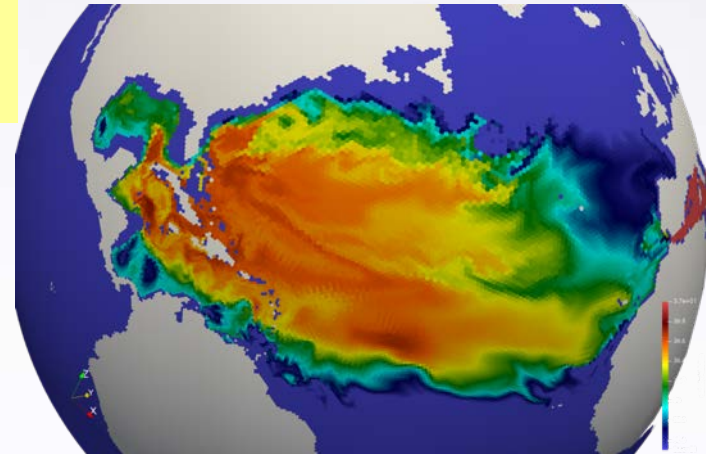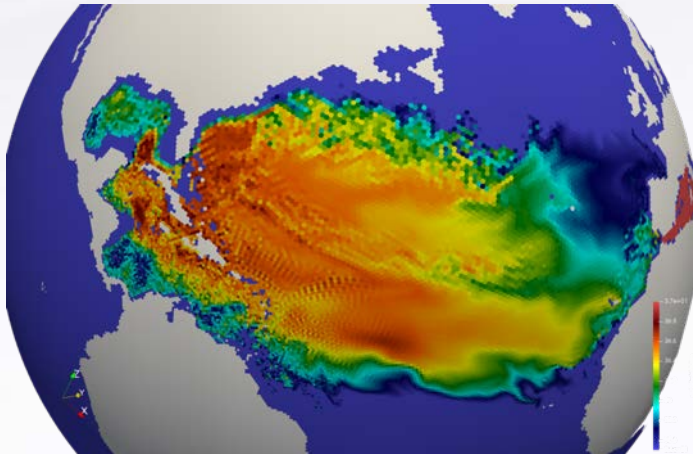# Ocean improvements Reduction is horizontal noise

Before

Salinity Indonesia

After

Salinity Gulf of Mexico

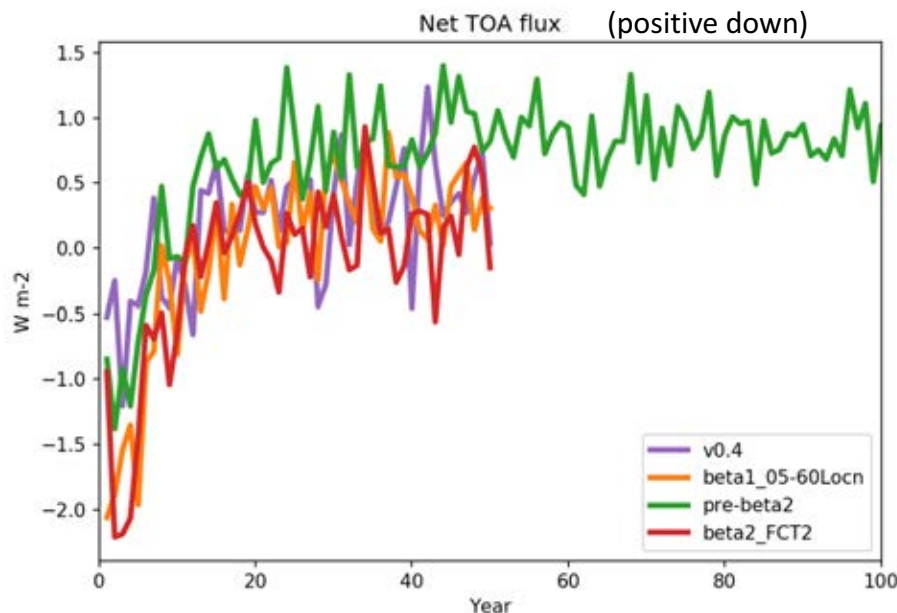Mark Petersen

U.S. DEPARTMENT OF **ENERGY**
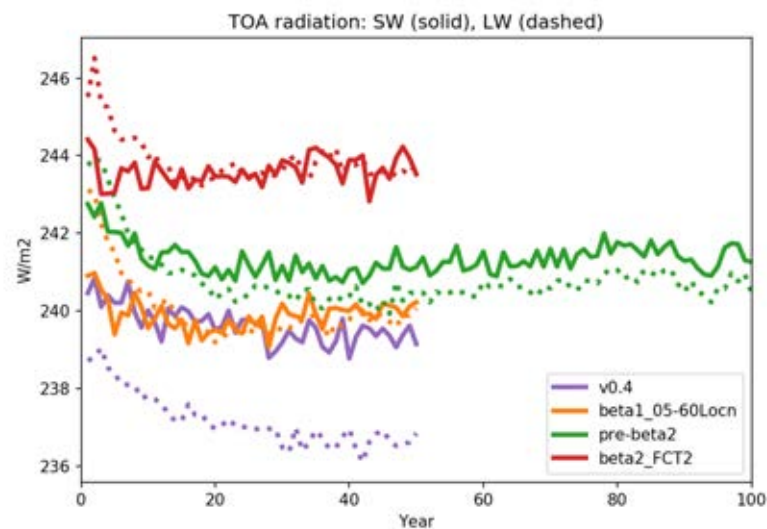
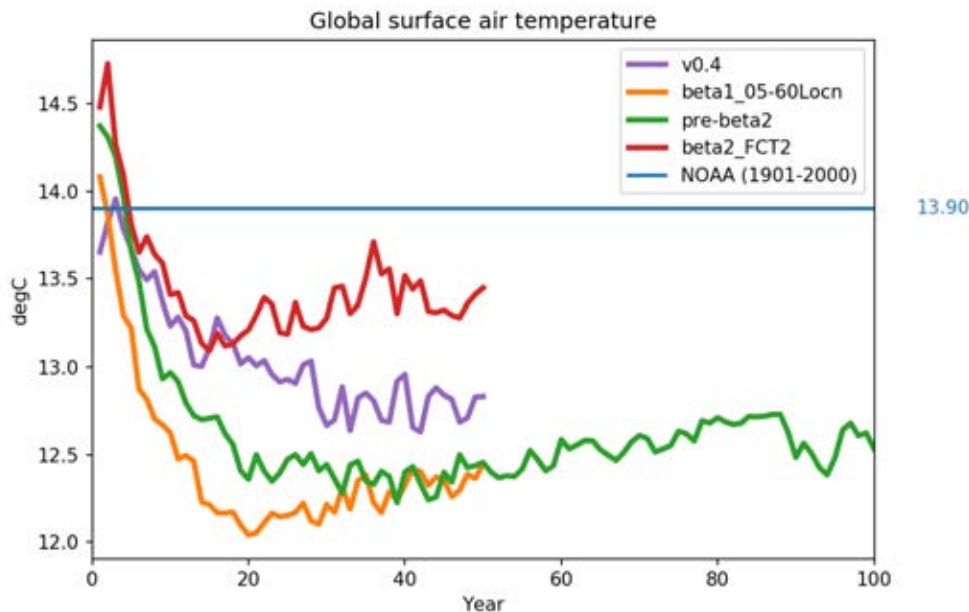E³SM Energy Exascale Earth System Model

Pre-industrial control

Very close to zero after initial adjustment…

SW and LW could benefit from small retuning
(impact of MG2 bugs)

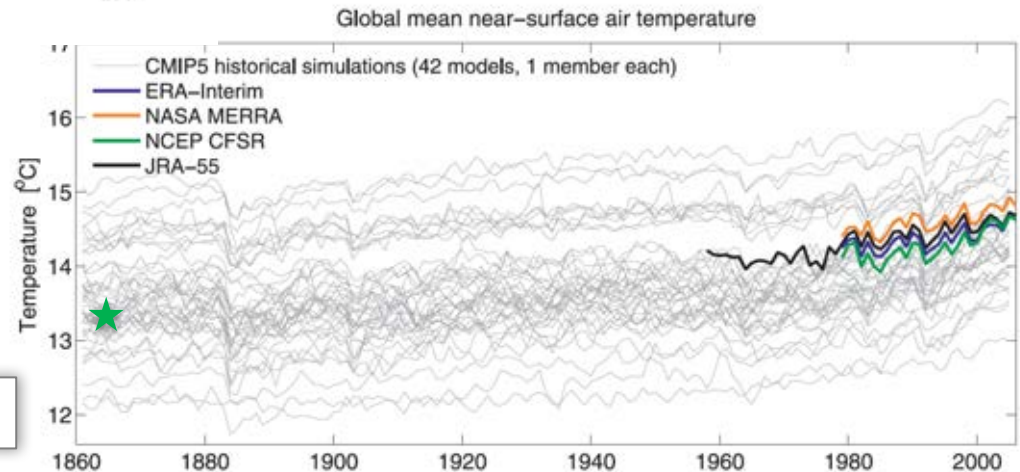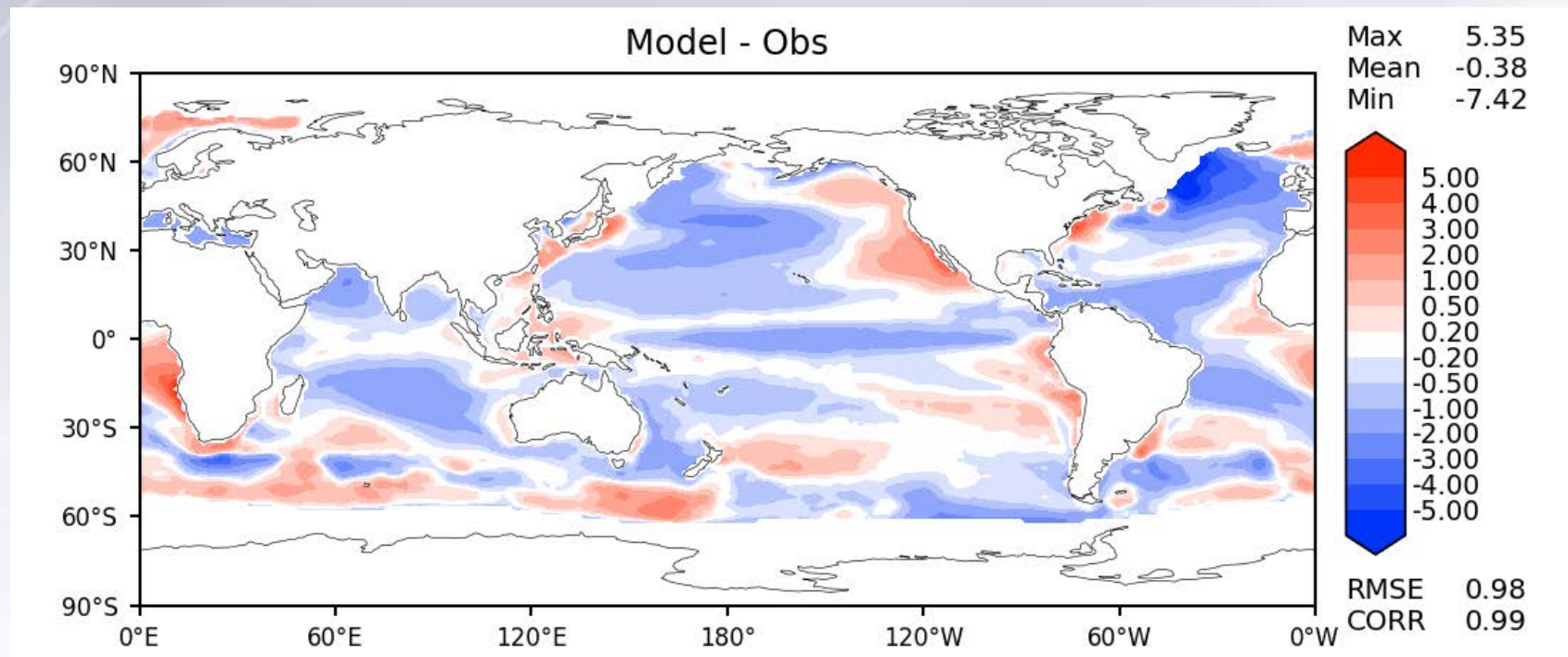# Pre-industrial control

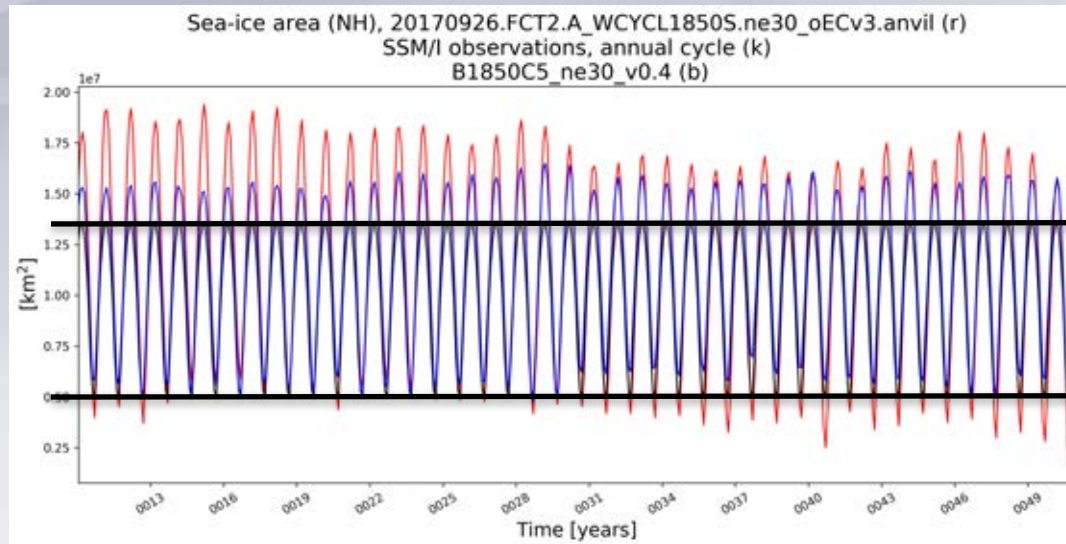…where no E3SM prototype v1 has gone before

Hawkins and Sutton (2015)
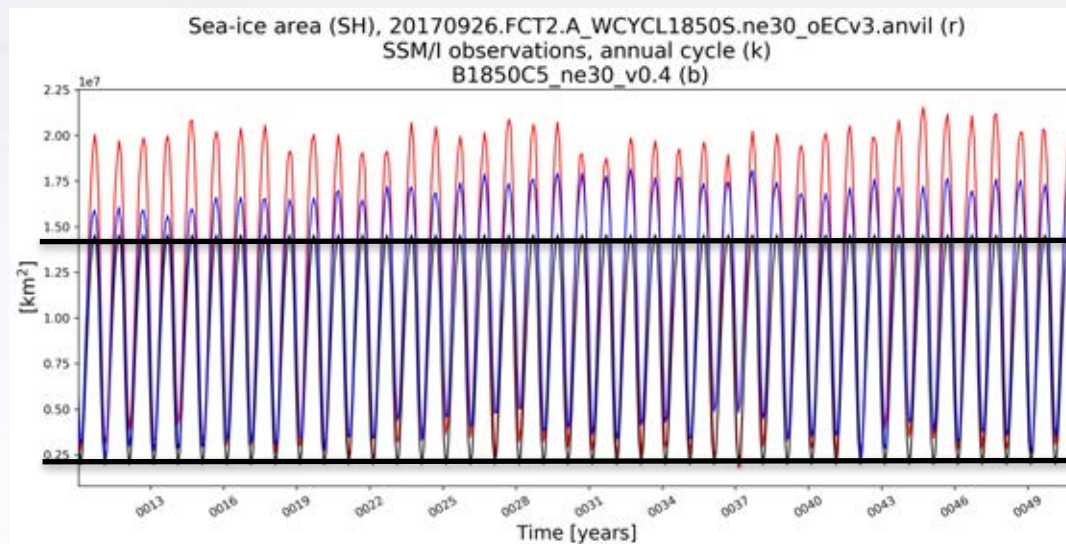
Pre-industrial control: SST

Climatology years 31-50

Pre-industrial control: sea ice area

NH

SH

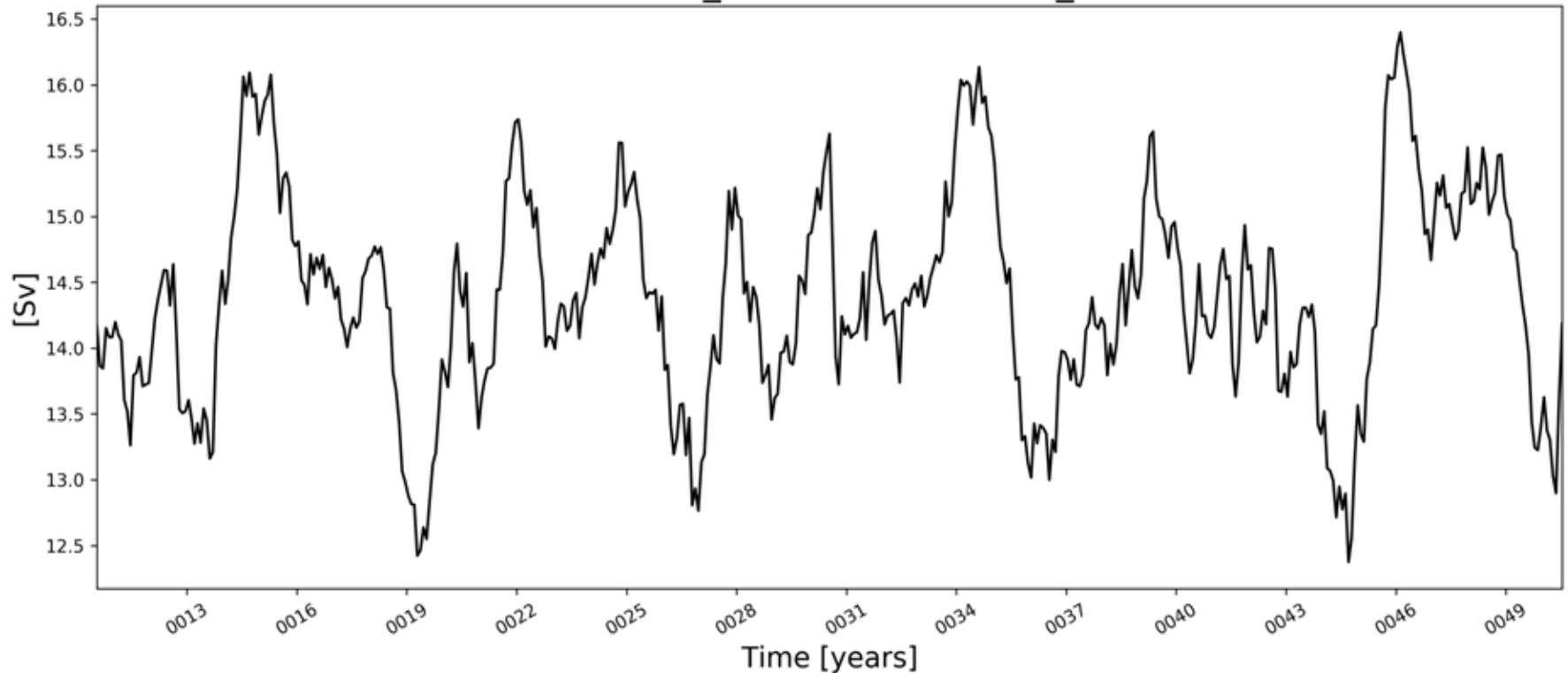PD obs seasonal cycle

PD obs seasonal cycle

beta2
v0.4
obs (PD)
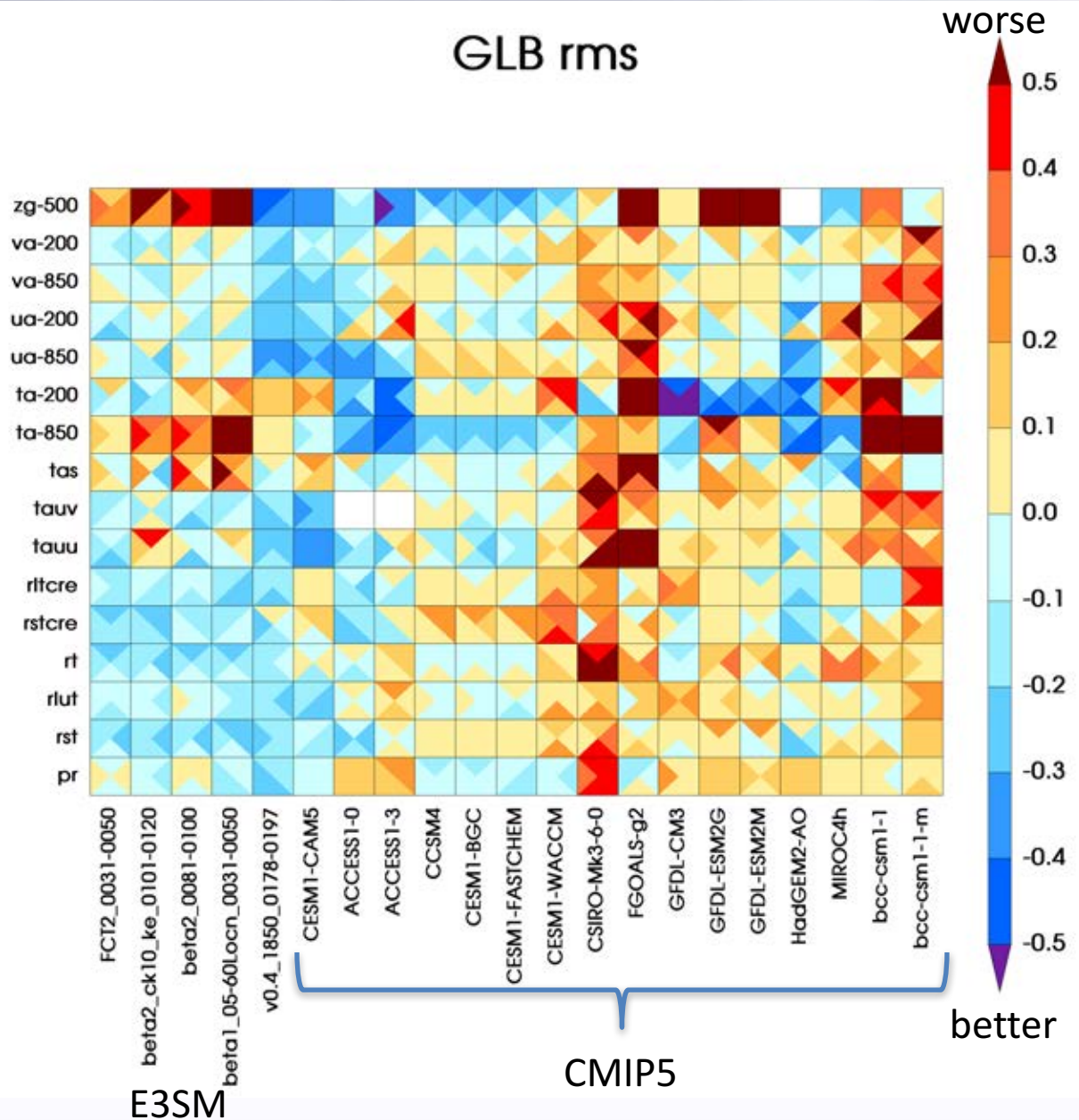
Pre-industrial control: AMOC

Max Atlantic MOC at 26.5°N
20170926.FCT2.A_WCYCL1850S.ne30_oECv3.anvil

"Gleckler" PMP plot

Qi Tang / PMP team
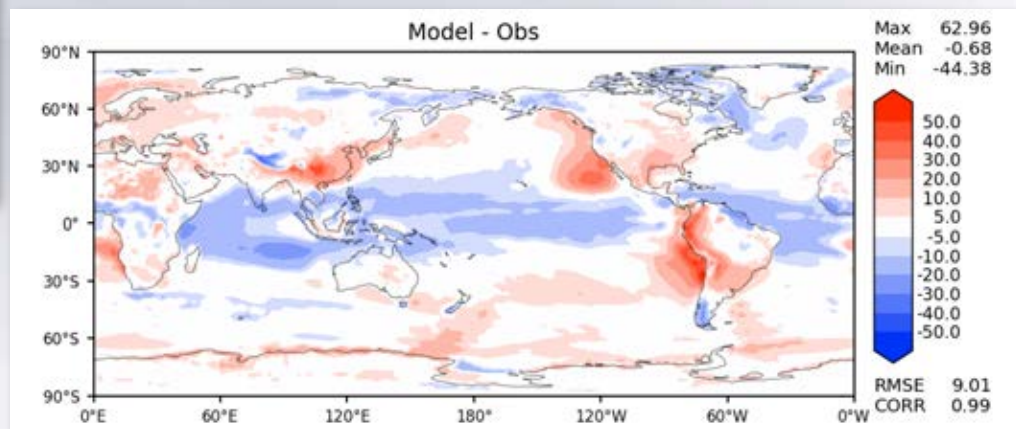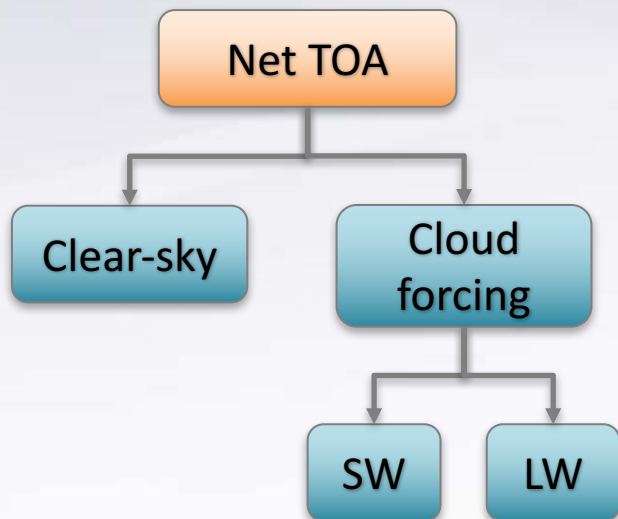
Annual net TOA radiation
(Years 31-50; 81-100)

CERES-EBAF Ed 4.0

beta2-FCT2 - observations
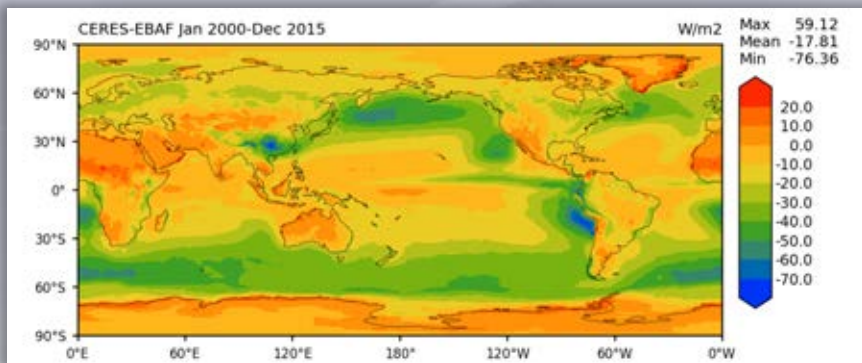

v0.4 - observations

Net TOA

Clear-sky
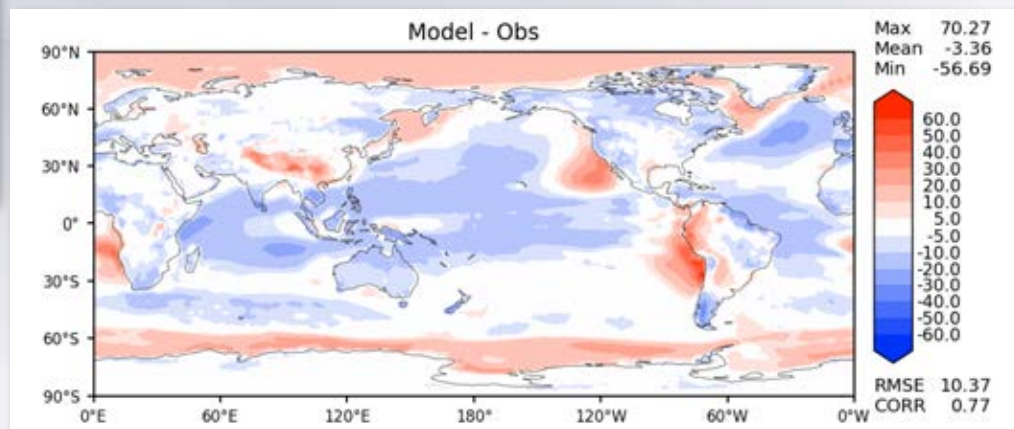
Cloud forcing

SW

LW
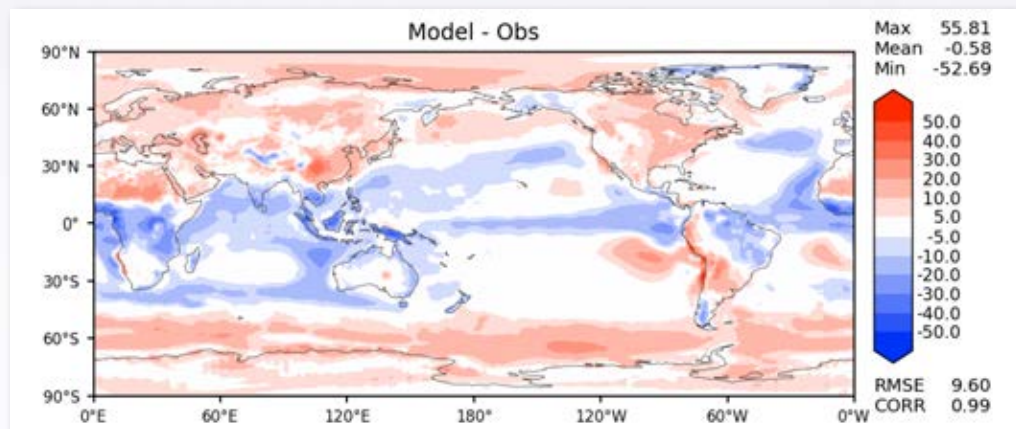
CERES-EBAF Ed 4.0
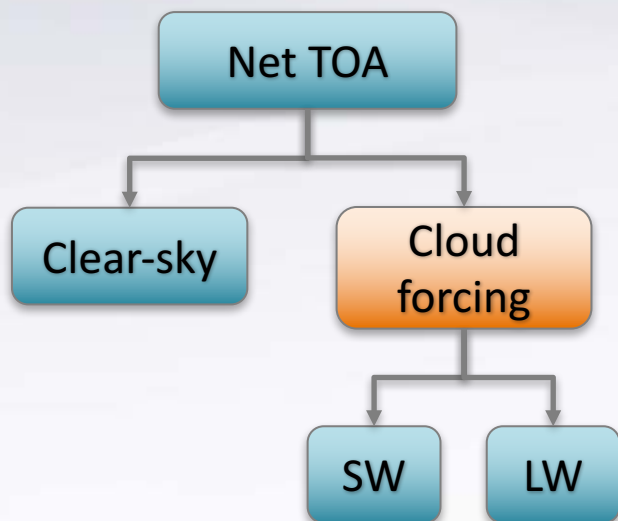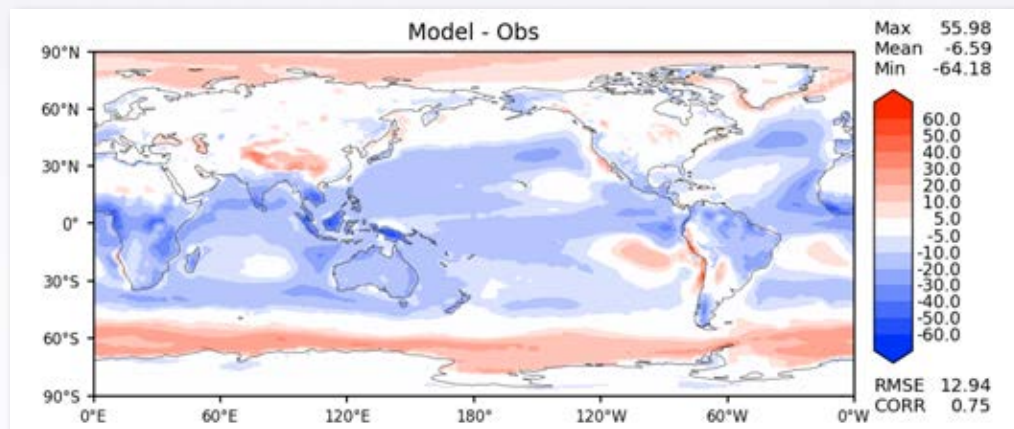
Annual net TOA cloud forcing
(Years 31-50; 81-100)

beta2-FCT2 - observations

v0.4 - observations

Net TOA

Clear-sky

Cloud forcing

SW

LW

ACME Diags

CERES-EBAF Ed 4.0

Annual SW TOA cloud forcing
(Years 31-50; 81-100)

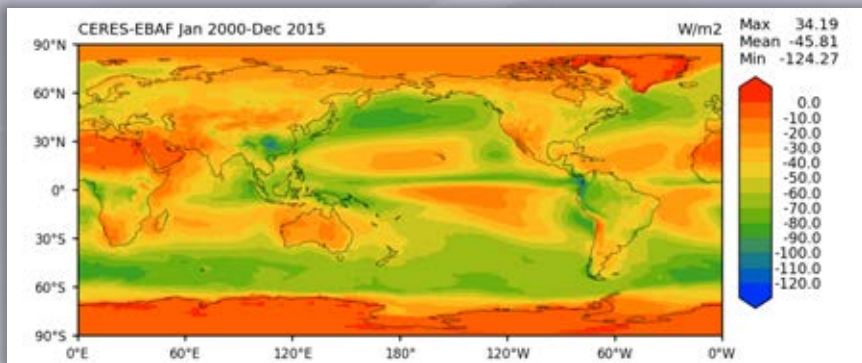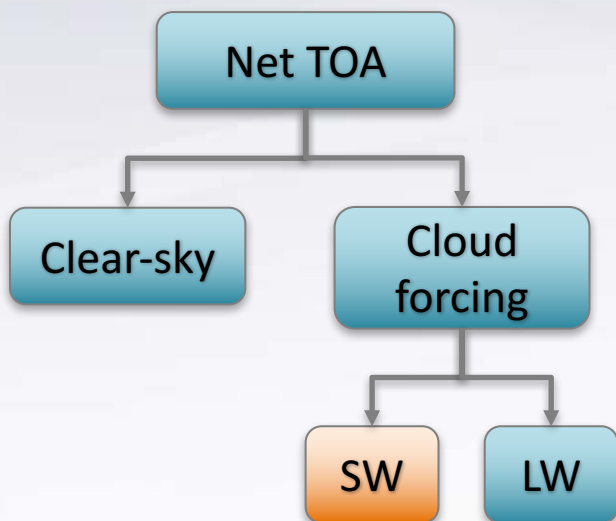beta2-FCT2 - observations

v0.4 - observations

Net TOA

Clear-sky

Cloud forcing

SW   LW

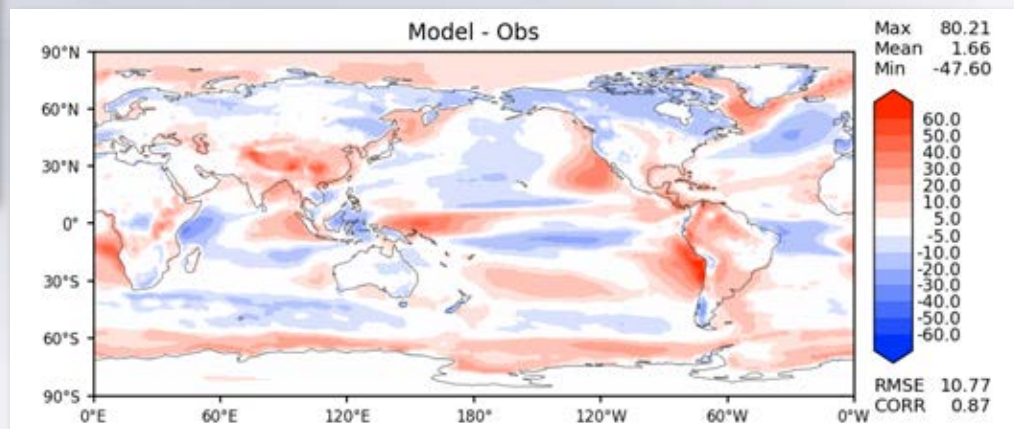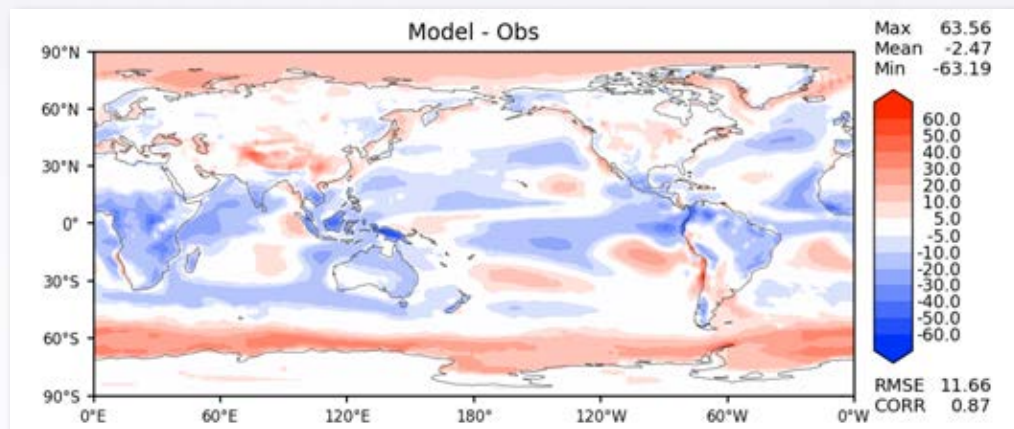CERES-EBAF Ed 4.0
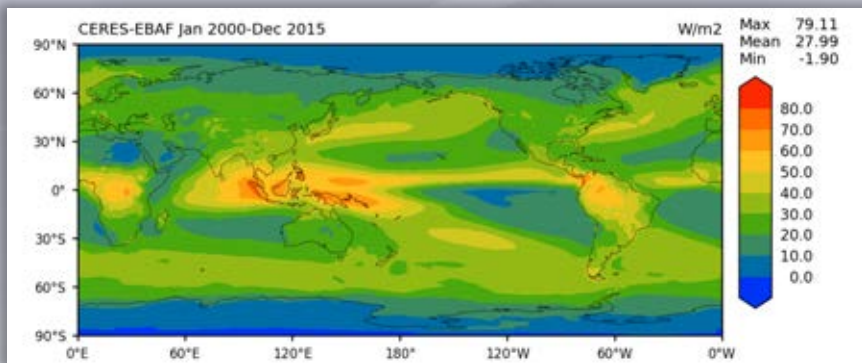
Annual LW TOA cloud forcing
(Years 31-50; 81-100)

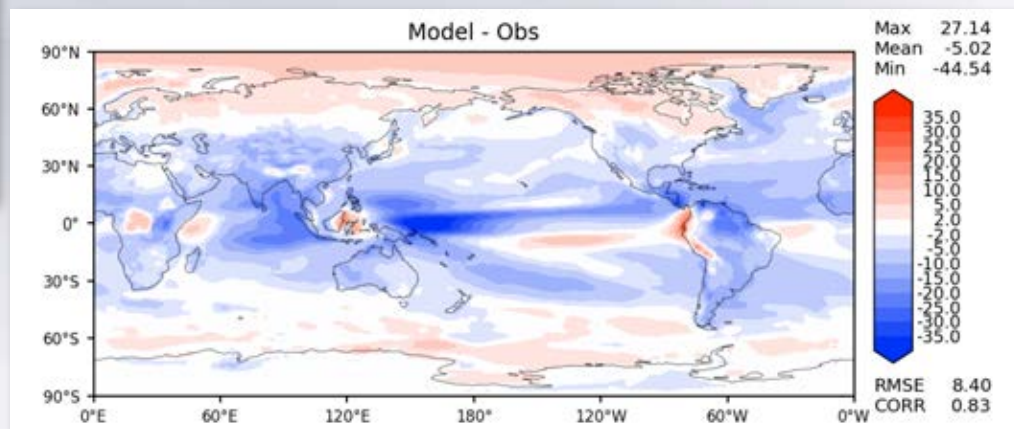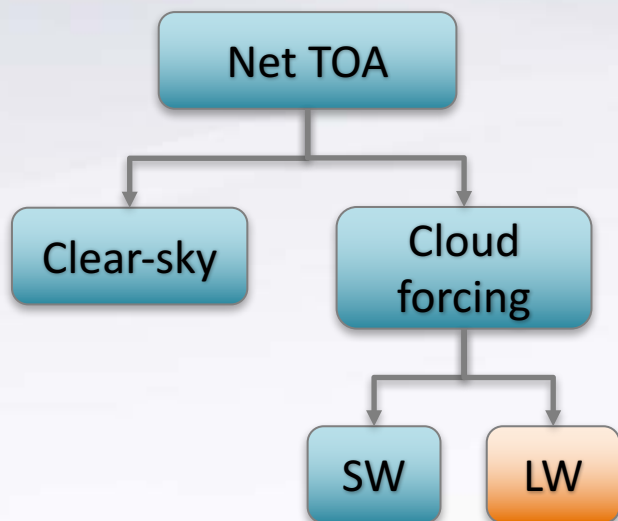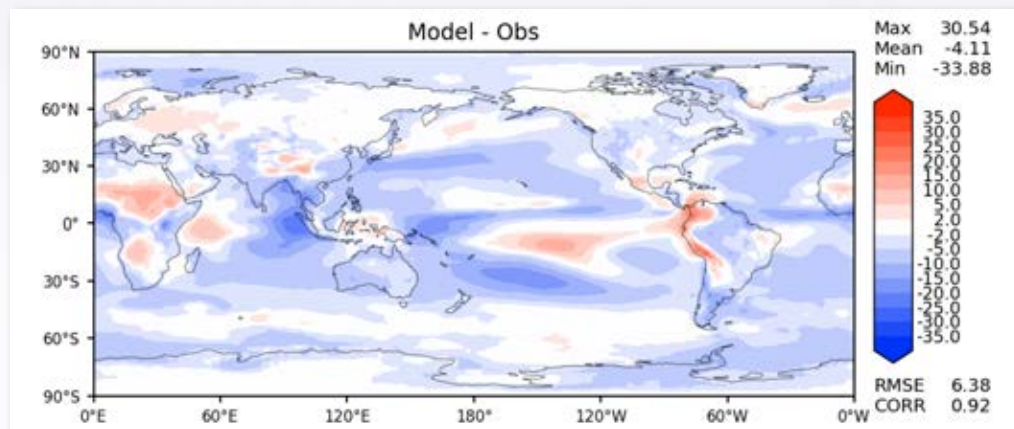beta2-FCT2 - observations

v0.4 - observations

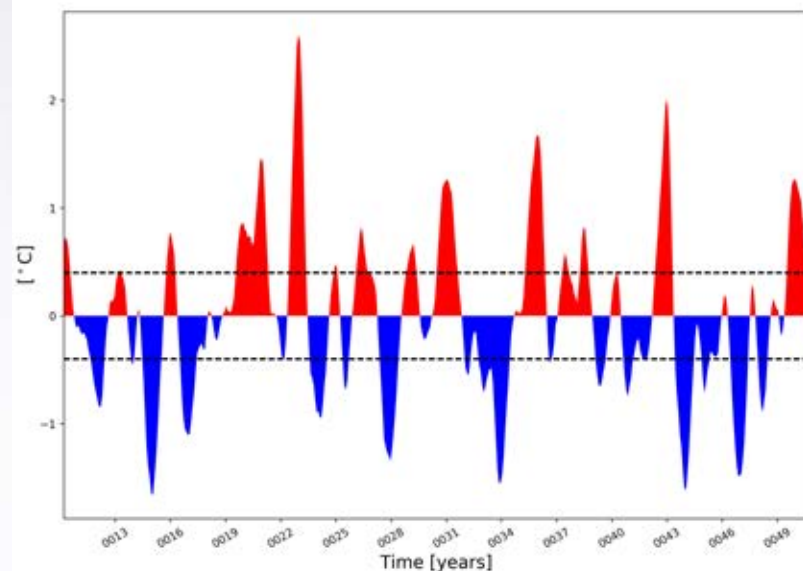Net TOA

Clear-sky

Cloud forcing

SW

LW

ACME Diags

GPCP v2.2

Annual precipitation
(Years 31-50; 81-100)

beta2-FCT2 - observations

beta2-FCT2

v0.4

v0.4 - observations

ACME Diags

Nino3.4 index time series
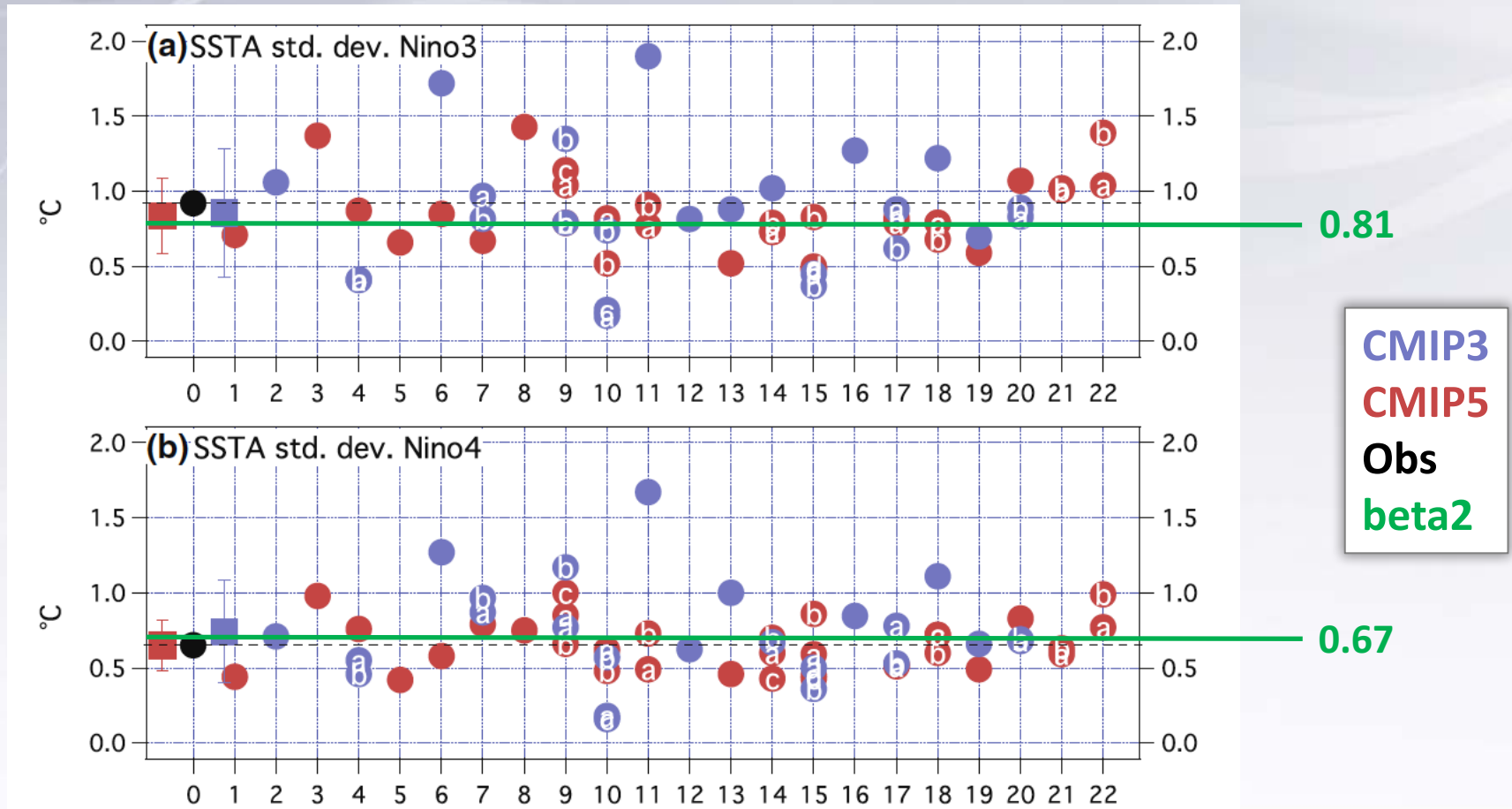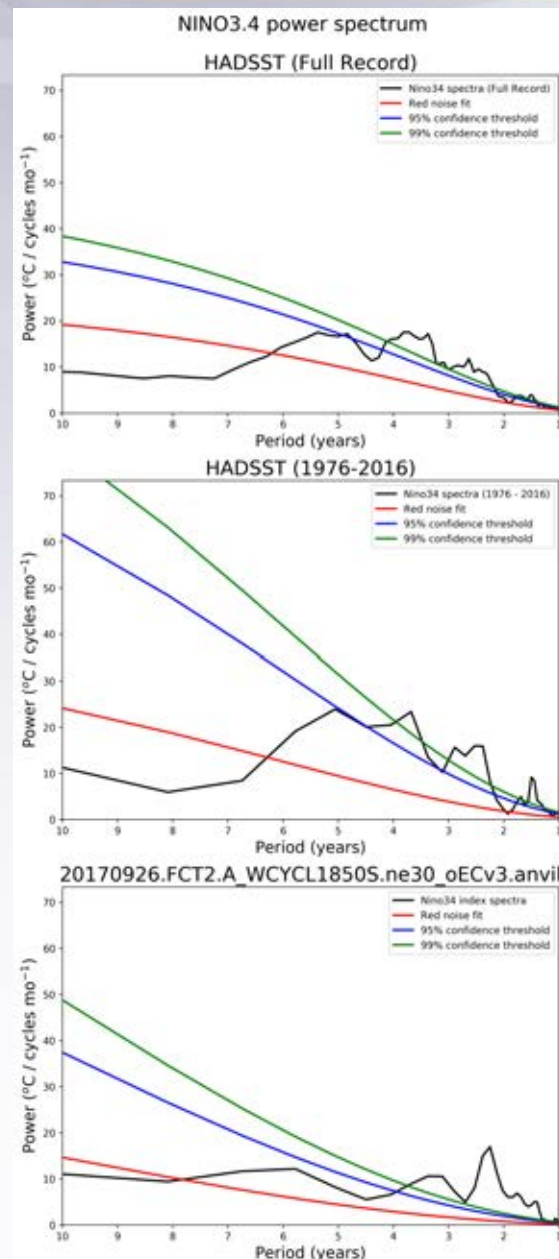
HadSST

beta2-FCT2

A-Prime / MPAS-Analysis
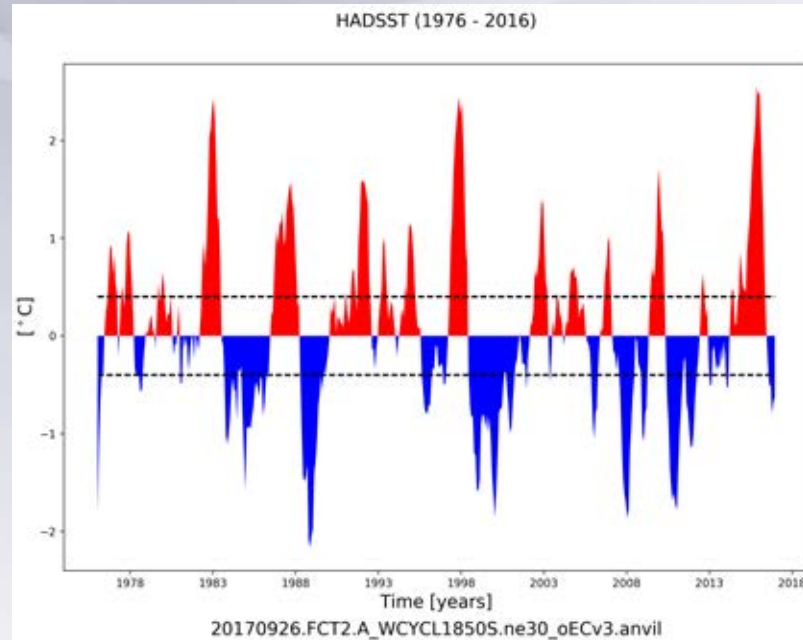
Nino3 and Nino4 standard deviation

Bellenger et al. (2014)

Nino3.4 spectrum

The road ahead…

- Analyze beta2-FCT2…
- Attempt minor improvements upon beta2-FCT2…
- Test historical simulation…
- DECK+ simulations:
  - PI control
  - AMIP
  - 1 %/year CO2
  - 4xCO2
  - Historical (multiple members)

What could possibly go wrong?