An Ensemble Reanalysis with CAM6: Initial Conditions for Ensemble ESP & Realistic Forcing for CESM Models
Example: 500 hPa Heights, 00GMT 1 September 2010
Colored contours are 20 of 80 members from CAM
Black contour is from NCEP FNL, operational analysis
Yes, tropical heights are really that uncertain!!!

Remote sensing reduces SH uncertainty.

Agrees with NCEP where well-observed.
That’s hurricane Earl (2010).
Even at 1 degree, CAM6 provides good position.
Strength a bit low but still a hurricane.
DART/CAM 6 Reanalysis Timeline

CAM4 2 Deg

Completed 2012
CAM 4 2 Deg: Completed 2012

CAM 6 1 Deg: Expected Spring 2020

CAM 6 Phase 1 Supported by NCAR Strategic Capability (NSC)
DART/CAM 6 Reanalysis Timeline

- CAM4 2 Deg: Completed 2012
- CAM6 1 Deg: Expected Spring 2020
- CAM6 1 Deg: Expected Spring 2021

CAM 6 Phase 2 Contingent on Additional NSC Resources
Products You Can Use

Three output products available as they are completed:

1. 80-Member ensemble of CAM6 initial conditions.
2. 80-Member ensemble of forcing files for other CESM components.
3. Comparison of CAM6 6-hour forecasts to observations.
1. 80-Member ensemble of CAM6 initial conditions.

Available once per week.

High-quality, 1 degree initial conditions. Members sample initial condition uncertainty (not ad hoc perturbations). Consistent with CAM dynamics, minimize forecast spin-up. Only biases present are from CAM, not another model. Can be down/up-scaled for different resolutions.
2. 80-Member ensemble of forcing files for other CESM components.

Available at least every 6 hours.

Provide forcing for ensemble simulations or data assimilation.

Can be used directly with CESM coupler to force:
  - POP (MOM)
  - CLM/CTSM
  - CICE

Physically-consistent, realistic, balanced for CESM use.
Realistic ensemble uncertainty consistent with observing network.
CLM Ensemble Simulation and DA from Andy Fox.

- **Leaf Area Index (LAI):**
  - Free Run
  - Assim
  - Forecast

- **Ecosystem Carbon (gC m\(^{-2}\)):**
  - Result from CAM4 Reanalysis

- **Ecosystem Nitrogen (gN m\(^{-2}\)):**
  - Result from CAM4 Reanalysis

Graphs showing time series data from April to September 2004.
Products You Can Use

2. 80-Member ensemble of forcing files for other CESM components.

Can be used for many other things including:
• Forcing for off-line chemistry simulations/DA,
• Forcing for simulations/DA of models above troposphere,
• Boundary forcing for regional simulations/DA (WRF, MPAS...),
• Baseline for DA experiments with deeper atmosphere models.
3. Comparison of CAM6 6-hour forecasts to observations.

Available every 6 hours.

Reveal CAM6 model systematic differences from observations. Short-term systematic errors often related to longer-term. Can focus on specific regions and quantities. Helpful as baseline for new model development.
3. Comparison of CAM6 6-hour forecasts to observations.
Example: SH Temperature profiles, August 2010.
3. Comparison of CAM6 6-hour forecasts to observations. Example: SH Temperature profiles, August 2010.
Model: CAM 6, 1 degree in CMIP6 Configuration.

Assimilation: DART Manhattan, tuned parameters, updated inflation.
Reanalysis Quick Facts: Observations

Sample of observations used in 1 day.
Who’s doing the work?

Kevin Raeder: Overall project lead, keeps everything running (really hard).

Nancy Collins: Observations, software engineering.

Tim Hoar: Diagnostics, support for forcing other components.

Moha El Gharamti: Improved DART inflation, DART tuning.

Jeff Anderson: Organizational support.
TIME CRITICAL REQUEST

What other output would people like?

Periods with more frequent ensemble state output.
Other diagnostic output.
Ensemble means more frequently.

Contact us at dart@ucar.edu

The wheels are turning, don’t delay.
We would like to acknowledge high-performance computing support from Cheyenne (doi:10.5065/D6RX99HX) provided by NCAR’s Computational and Information Systems Laboratory, sponsored by the National Science Foundation.
DART Multiple Component Data Assimilation

Important! There are multiple instances of each model component.

DART assimilates observations into the components separately.

Started with CCSM4 20th Century 30-member ensemble for all model components.