

CESM / DART: An ensemble data assimilation system for fully coupled models

Nancy Collins, Jeff Anderson, Tim Hoar, Kevin Raeder,
Mariana Vertenstein and entire CSEG group

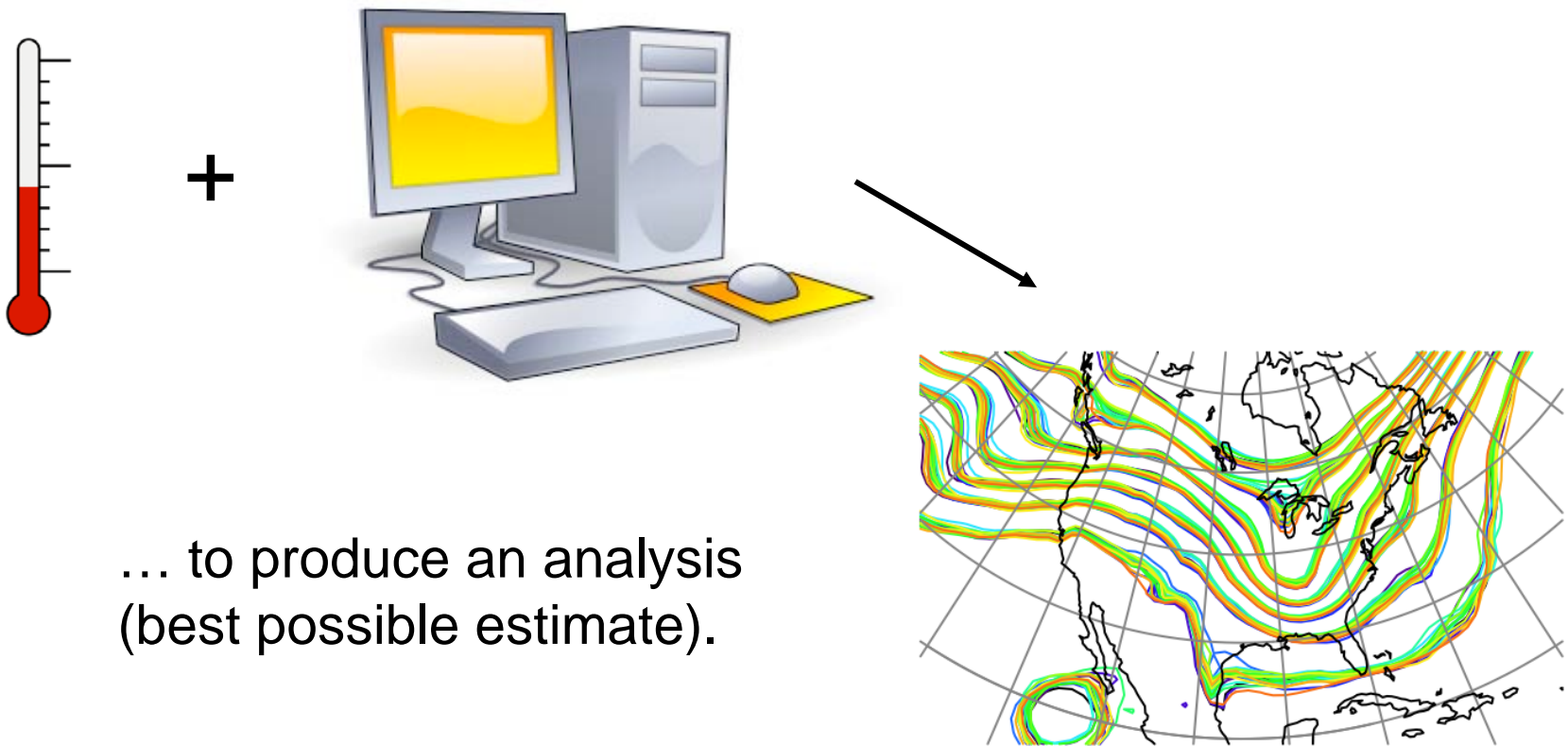
IMAGE and CGD

SEWG/CESM June 2013

nancy@ucar.edu

What is Data Assimilation?

Observations combined with a Model forecast...



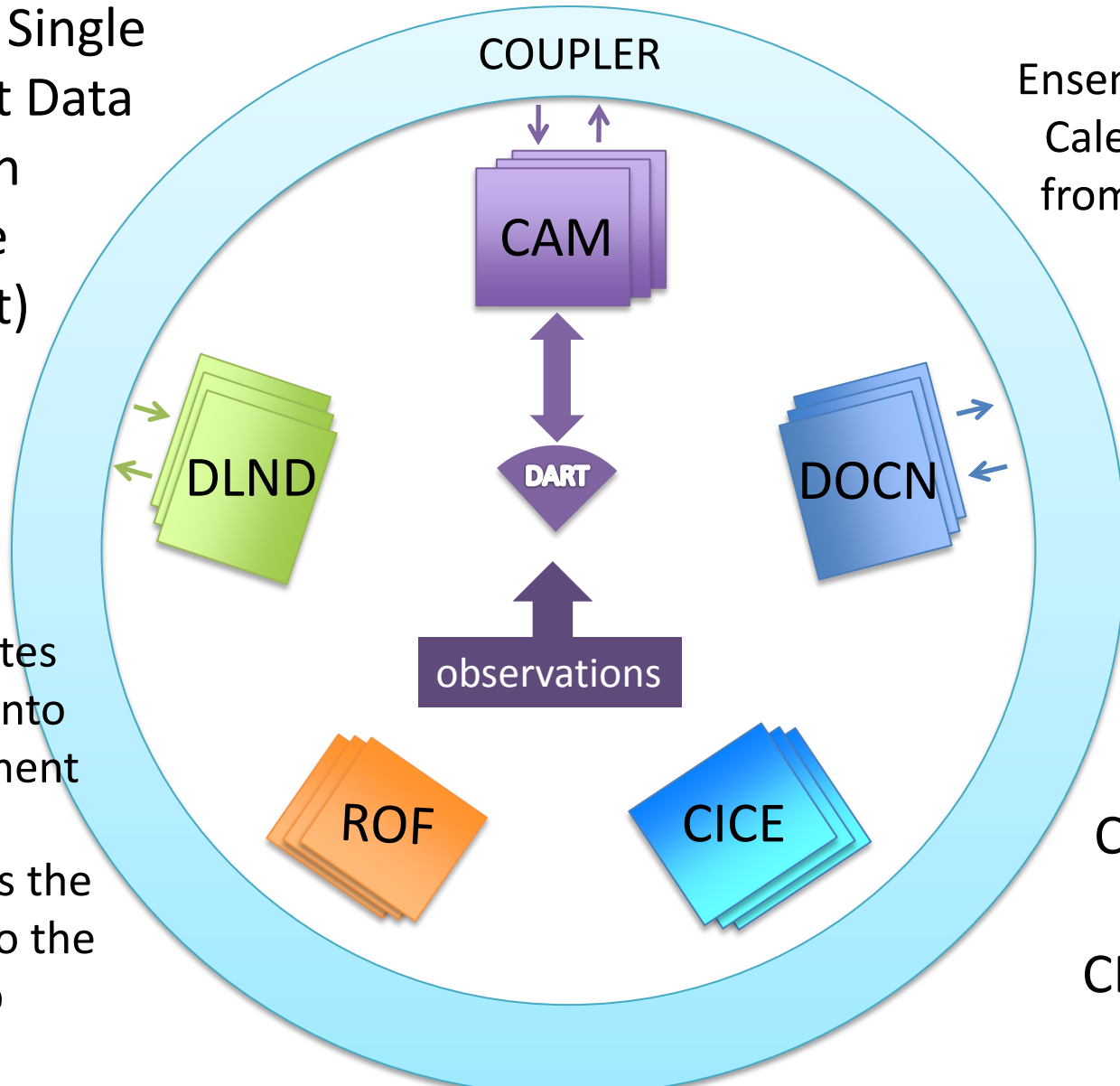
... to produce an analysis
(best possible estimate).

What is DART?

- DART = Data Assimilation Research Testbed
- NCAR software written and supported by the DAREs group in IMAGE
 - Freely distributed via anonymous SVN
 - Supports DA in dozens of models, obs types
 - Extensible to new models and new observations
- Implements Ensemble Data Assimilation Techniques
 - Leverages CESM multi-instance capability

DART-CAM Single Component Data Assimilation (One Active Component)

Started CAM Ensemble with Same Calendar Date Data from Multiple Years



DART assimilates observations into active component

Coupler moves the components to the next time step

CAM4, CAM5, in CCSM, CESM 1.0 Beta

Examples of Observations Assimilated into CESM

- Atmosphere

- Radiosonde T,U,V,Ps,Q
- Satellite Winds U,V
- Aircraft/ACARS U,V,T,Q
- GPS Refractivity
- Many other satellite products available
- Regional NWP uses:
 - Land Sfc T,U,V,Ps,Q
 - Marine Sfc T,U,V,Ps,Q

- Ocean

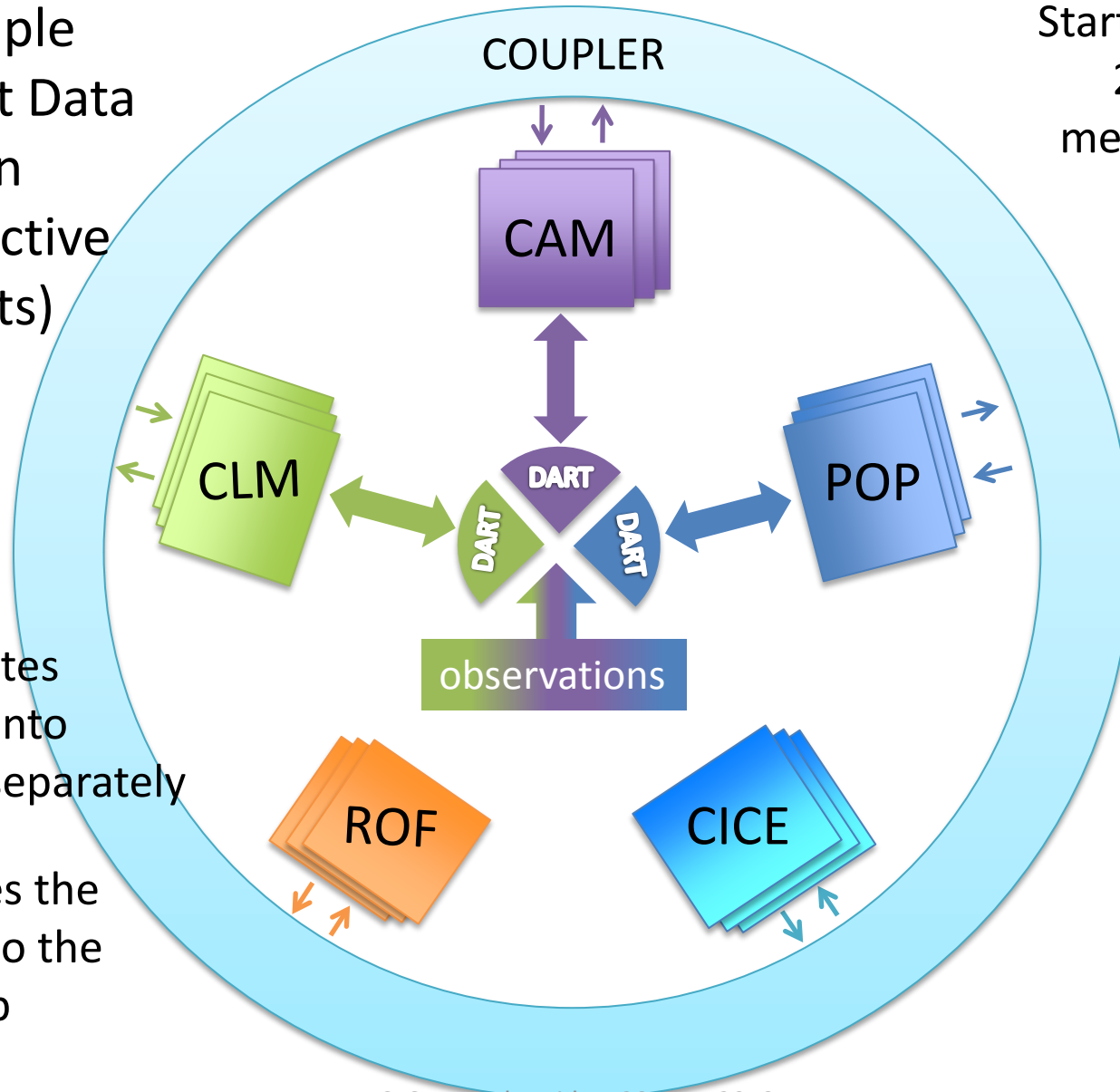
- XBTs, CTDs, XCTDs
- Floats, Drifters, Moorings
- Satellite products for SST, SSH, surface winds etc available

- Land

- Tower Fluxes,T,U,V
- Satellite Snow Fraction, Thickness, Water Content
- Soil Moisture, T

DART Multiple Component Data Assimilation (Multiple Active Components)

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



B compset
CESM 1.1.1

DART assimilates observations into components separately

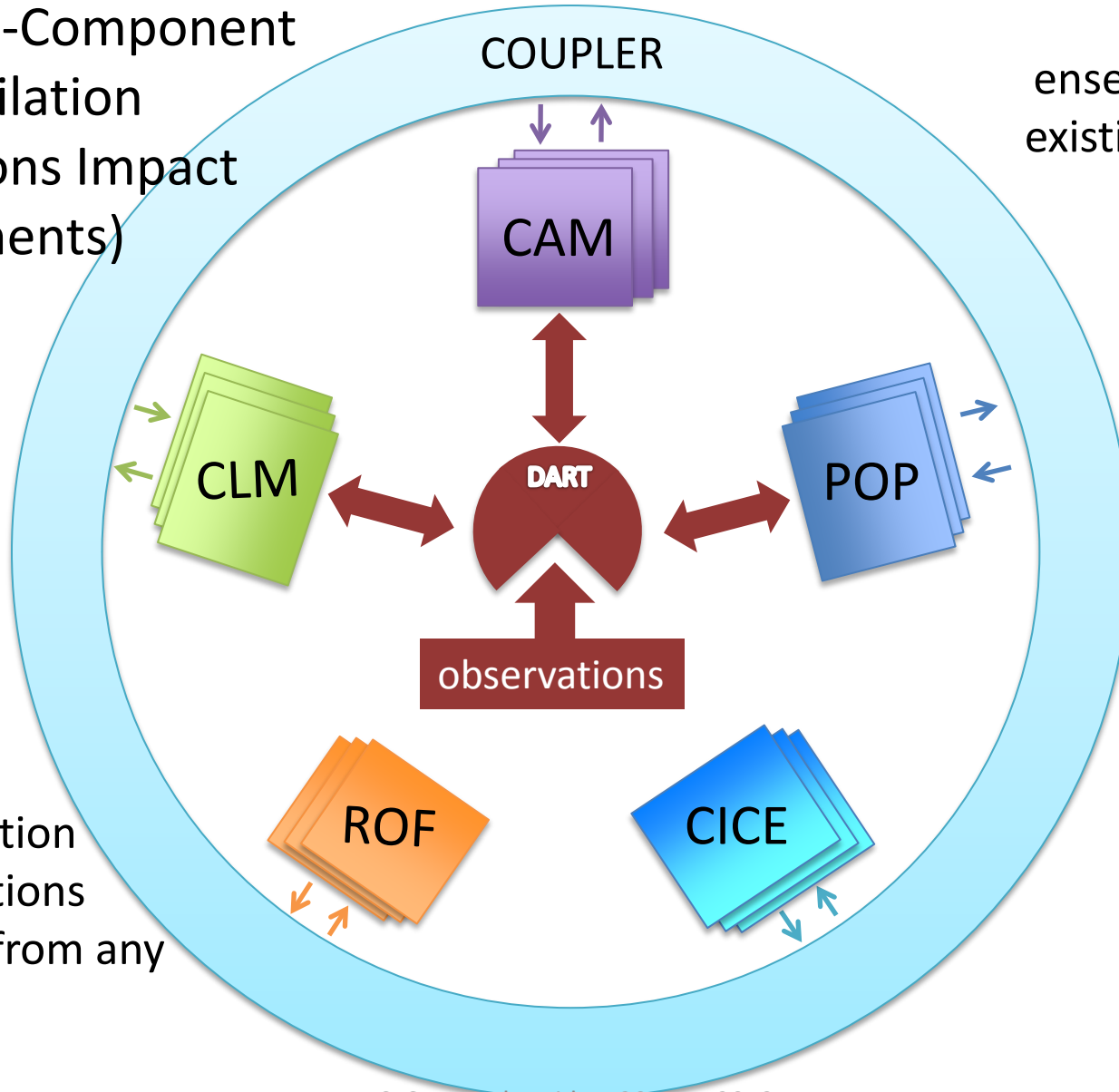
Coupler moves the components to the next time step

Current Status and Ongoing Work

- For the first time we have successfully assimilated observations into multiple components in a fully-coupled CESM system
 - Mechanism is working
 - Run a month of CESM with assimilation, coupling every 6 hours
 - Results don't look unreasonable
 - Science evaluation beginning
- Next step: Enable cross-component assimilation in a fully-coupled CESM system
 - Serious science questions remain once this is running

DART Cross-Component
Data Assimilation
(Observations Impact
All Components)

Can start with
ensemble data from
existing experiments



B compset
CESM 1.2

DART assimilation
of all observations
impacts data from any
component

Thanks.

For more information:

<http://www.image.ucar.edu/DARes/DART>

dart@ucar.edu