Applying Ensemble Data Assimilation to CLM

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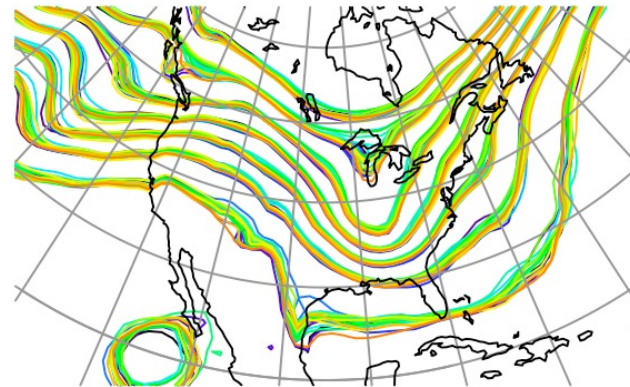
Community Land Model (4.5, 5.0)

CLM5.0

- Carbon, Nitrogen, Water, Energy, Cycling

Biogeochemical cycles
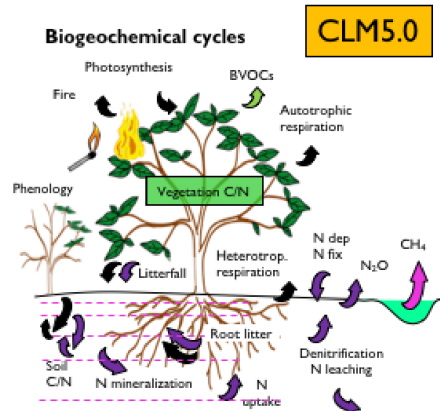
Data Assimilation Research Testbed

- Ensemble Kalman Filter (Deterministic)
- 40-80 ensemble members
- Temporal and Spatially Varying Adaptive Inflation
- Localization (Horizontal, Vertical, State)

Observation Space

③ Update (posterior)

② Obtain obs. estimates

④ Apply update to model state (posterior)

CAM   CLM

① Forecast (t_k) (prior)

⑤ Forecast (t_{k+1})

Model Space

CLM-DART Applications

Carbon Exchange (Western U.S)

CLM   CLM-DART

GPP (gC m⁻² month⁻¹)

ER (gC m⁻² month⁻¹)
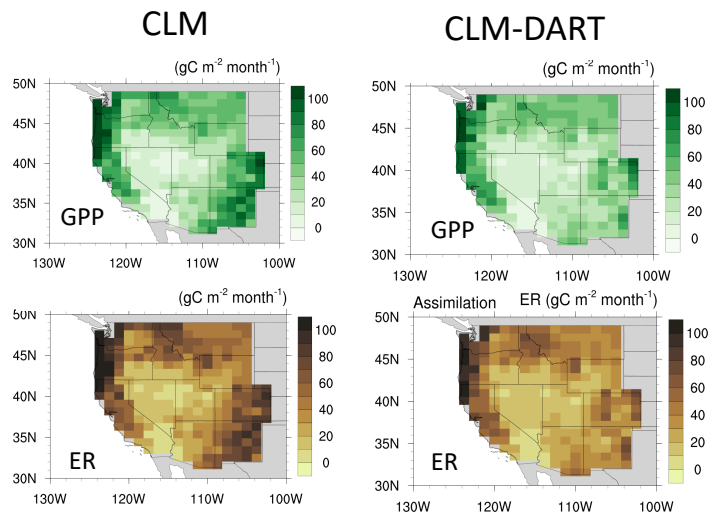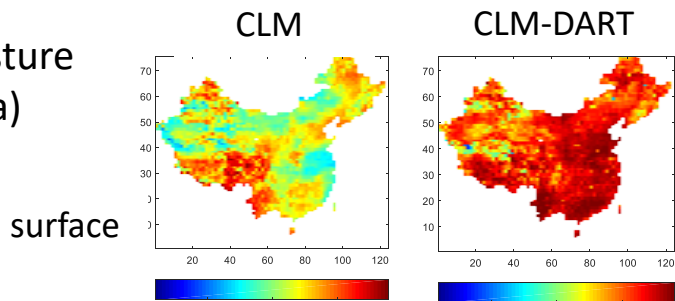
Raczka et al, (2021)

Leaf Area, Biomass (Arctic)

CLM
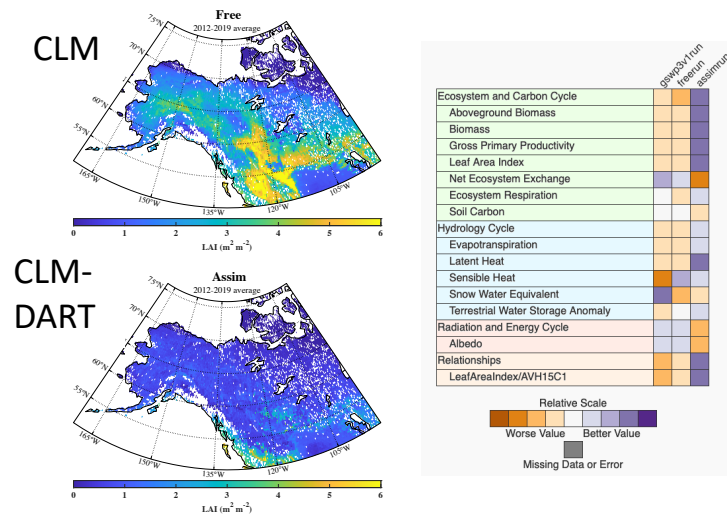
CLM-DART

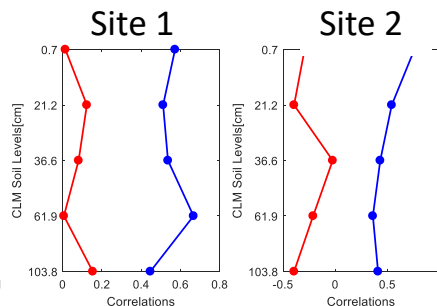X. Huo et al, (in prep), See Poster Session, June 13th

Soil Moisture (China)

CLM   CLM-DART

surface

Correlations (R) w/ ERA5 reanalysis

Sub-surface

Site 1   Site 2

CLM

CLM-DART

D. Hagan et al, (in prep)

Snow (Global)

Snow Cover Fraction
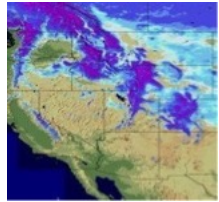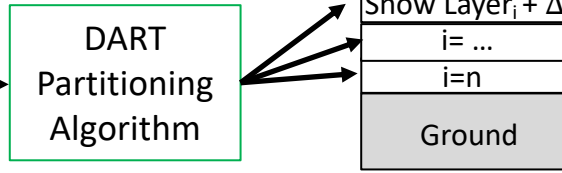
Snow Water Equivalent

CLM minus (CLM-DART)

Zhang et al., 2014

3
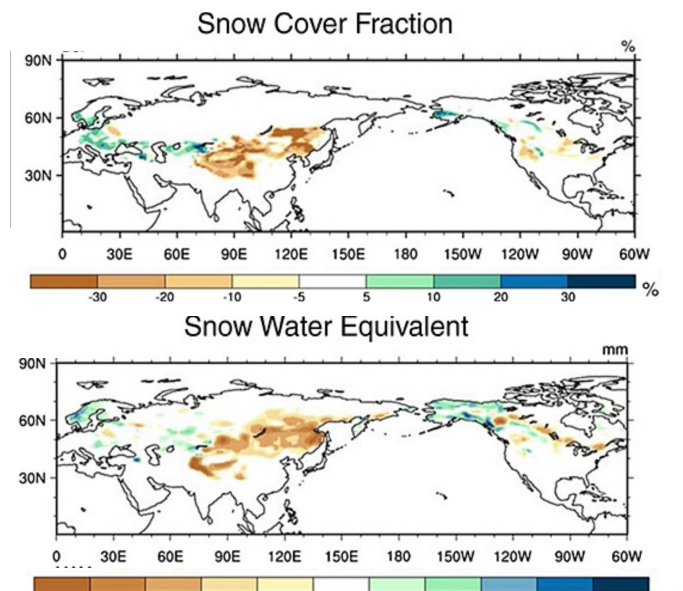
New/Future Developments

Snow Water Equivalent (SWE)

Observed SWE

Δ Total SWE $= \Sigma(\Delta$Layers$)$
Δ Total Ice $= \Sigma(\Delta$Layers$)$
Δ Total Liquid $= \Sigma(\Delta$Layers$)$
Δ Total Depth $= \Sigma(\Delta$Layers$)$
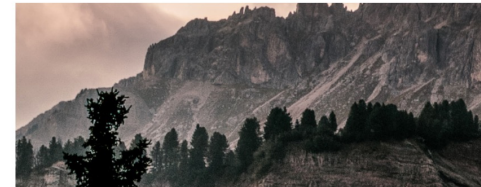
Solar-Induced Fluorescence (SIF)
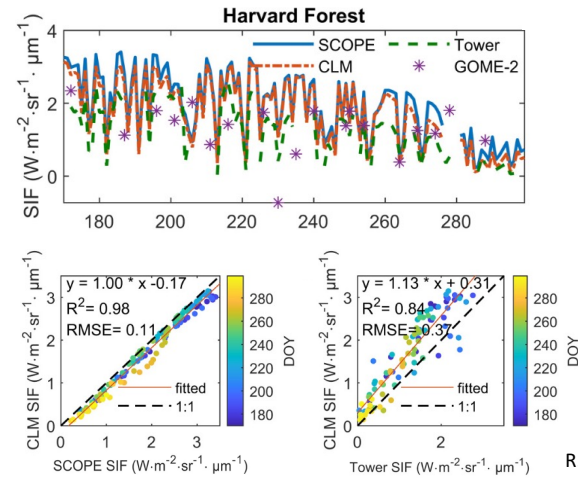
R. Li et al., (2022)

Filter w/ Bounded Quantity Capabilities
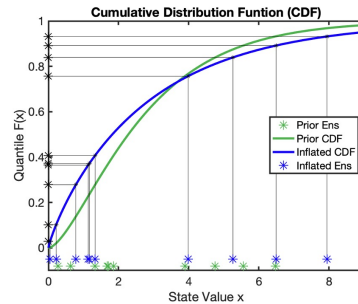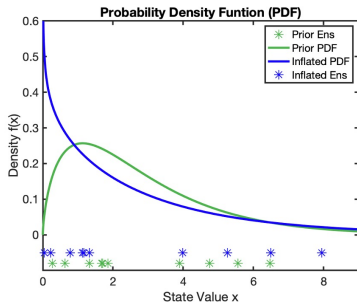
- Leveraging quantile information

CLM5-DART Tutorial

The CLM5-DART tutorial provides a detailed description of the download, setup, execution and diagnostic steps required for a simple global assimilation run using CLM5. It is intended to be performed after the completion of the more general DART tutorial which covers the fundamental concepts of the Ensemble Kalman Filter used within DART.
...

https://dart.ucar.edu/tutorials/

For more information:

CAM GCOM CAM-Chem FESOM ROMS WRF

GITM CABLE WRF-Hydro WACCM

CLM

AM2

POP

BGRID

SQG

https://dart.ucar.edu

https://docs.dart.ucar.edu

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MPAS_OCN

WACCM-X PBL_1d NOAH-MP

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