



The SMAP Level-4 ECO Project: Linking the terrestrial water and carbon cycles

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- (1) Global Modeling and Assimilation Office, NASA Goddard Spaceflight Center
- (2) Universities Space Research Association, GESTAR
- (3) Science Systems and Applications

Outline

1. The Level-4 ECO Project
2. Catchment vs. Catchment-CN
3. SMAP Level-2 Passive Assimilation
4. Modeled vs. Observed FPAR
5. Next Steps

The L4-ECO project

Objective: Develop a **fully coupled hydrology-vegetation data assimilation** algorithm to generate improved estimates of hydrological fields and carbon fluxes

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Assimilate SMAP observations into a land surface hydrology model to generate improved soil moisture estimates

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Use L4 SM estimates and MODIS fraction of absorbed photosynthetically active (FPAR) observations in carbon model to estimate carbon fluxes

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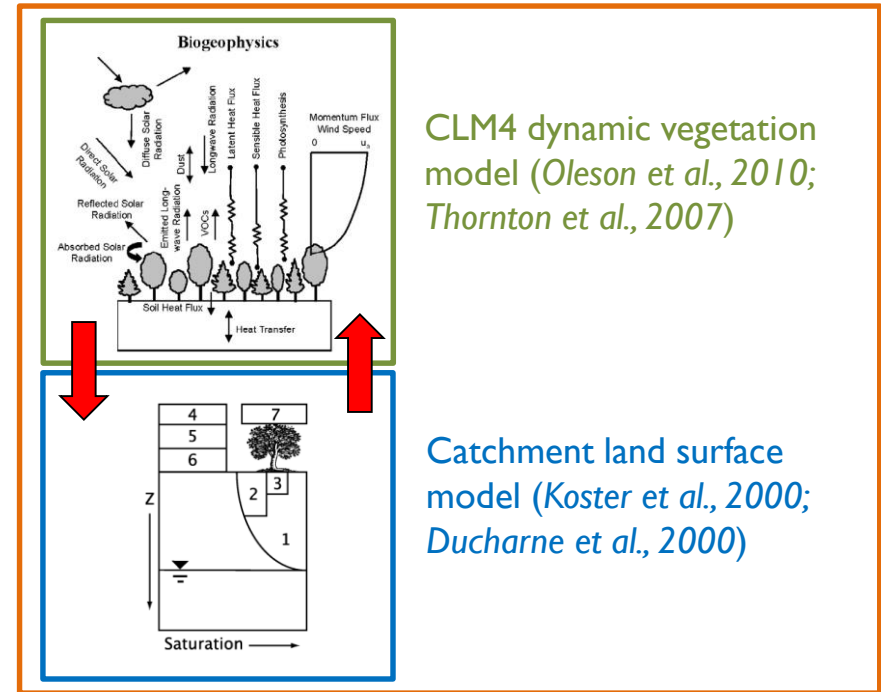
Land surface hydrology impacts biosphere (carbon fluxes), but not vice versa

The L4-ECO project

L4 ECO:

- Catchment-CN: Coupled land surface hydrology model (Catchment) and dynamic vegetation model (CLM4) to allow full feedback

Catchment-CN (Koster et al., 2014)

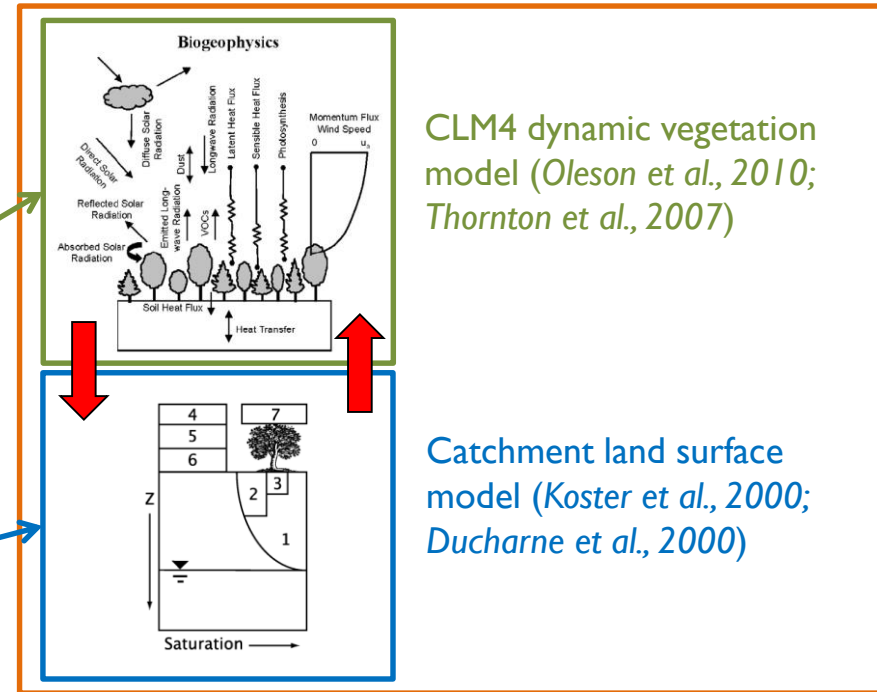


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- Assimilate:
 - MODIS FPAR
 - SMAP brightness temperatures (Tbs)

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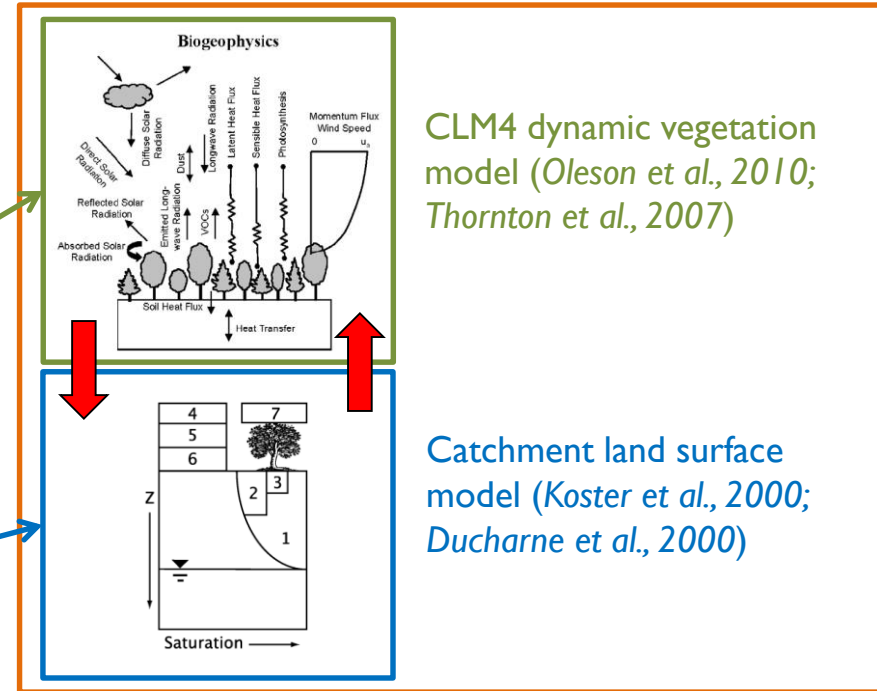
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Generate improved estimates of hydrological fields and carbon fluxes

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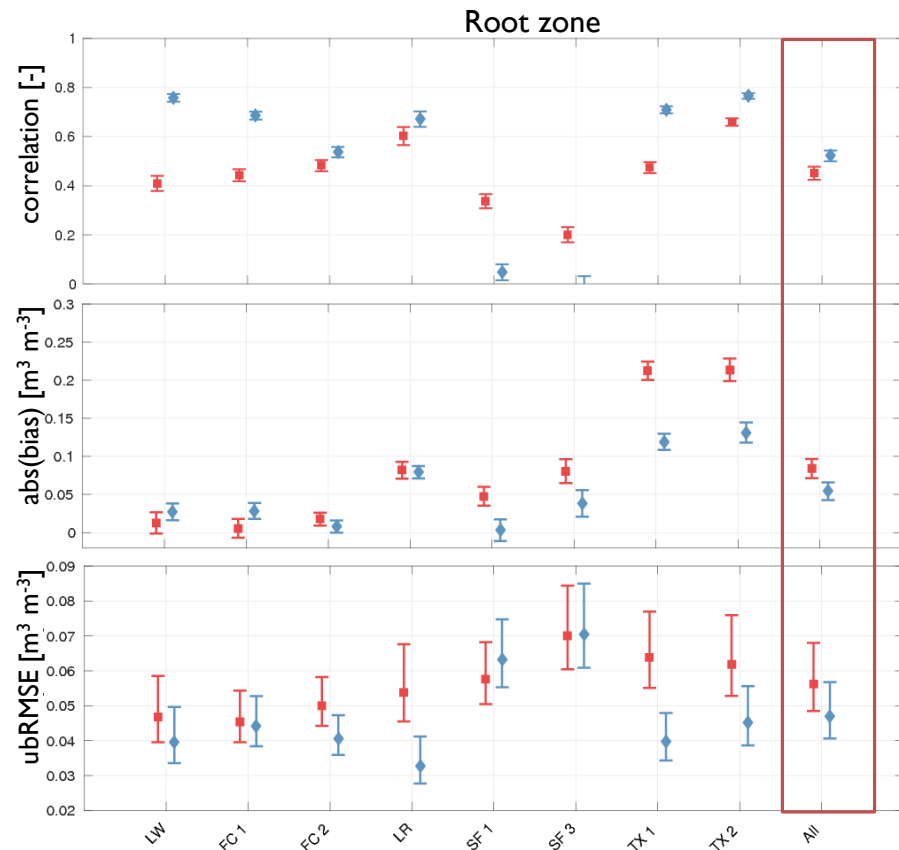
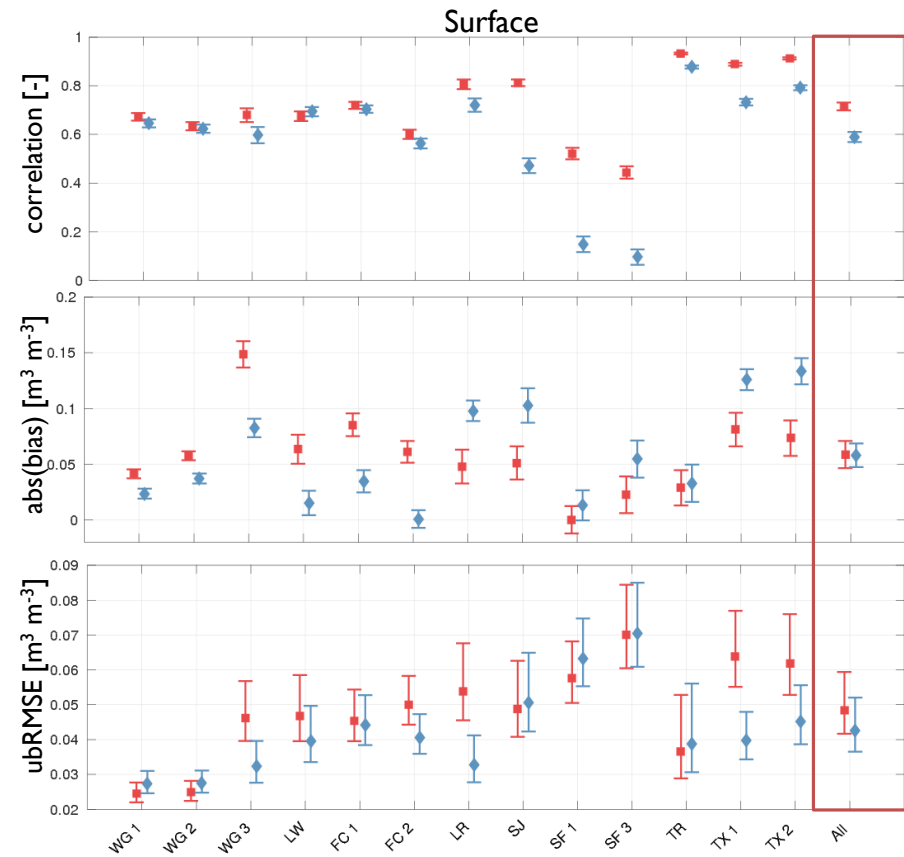
CLM4 dynamic vegetation model (Oleson et al., 2010; Thornton et al., 2007)

Catchment land surface model (Koster et al., 2000; Ducharne et al., 2000)

Catchment vs. Catchment-CN

Evaluation against CVS data

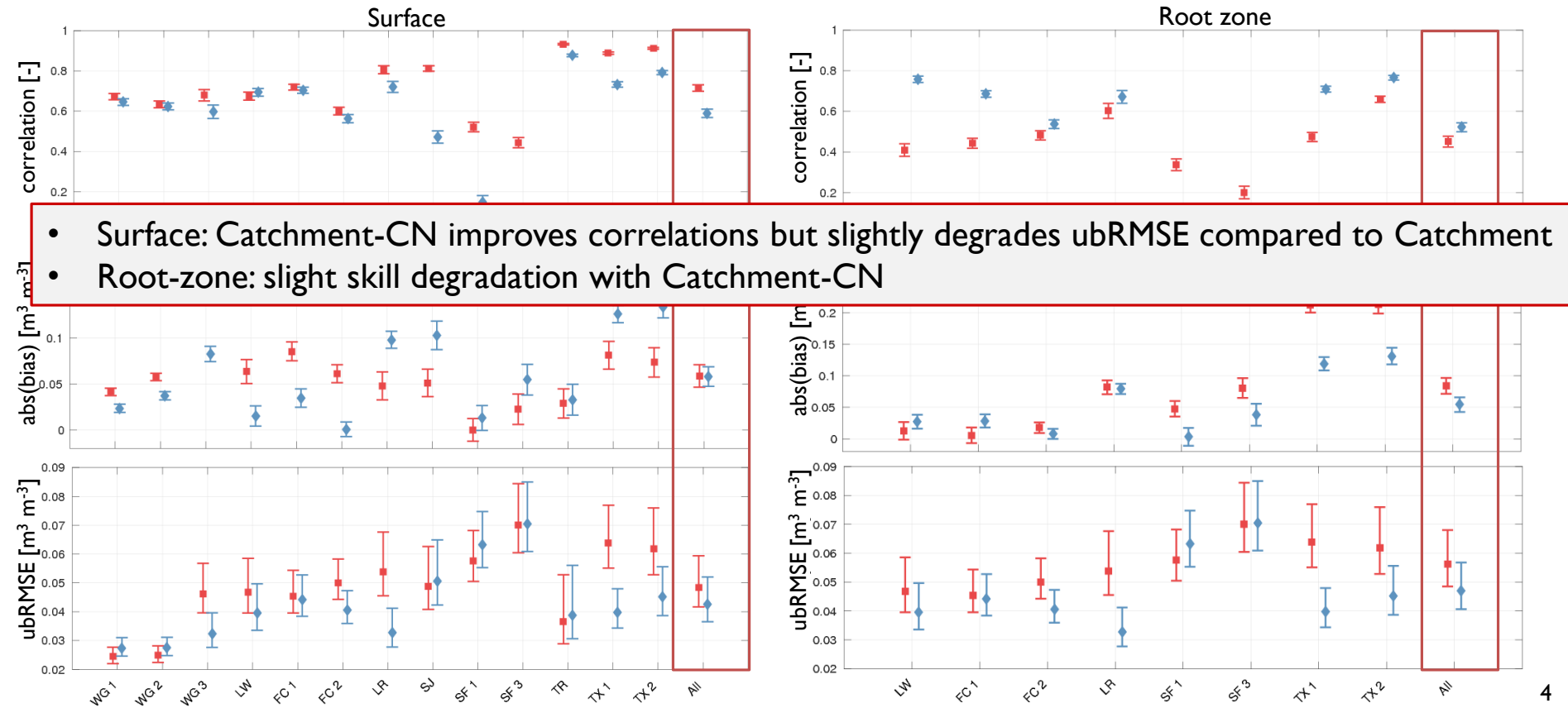
■ Catchment-CN
◆ Catchment



Catchment vs. Catchment-CN

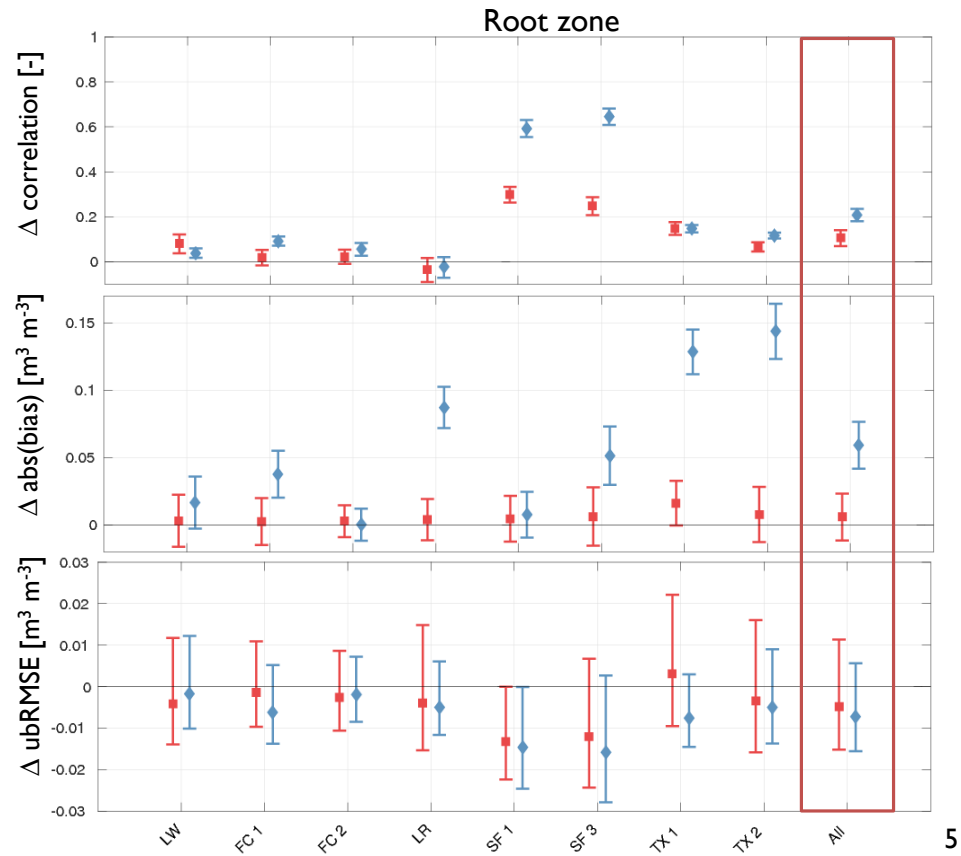
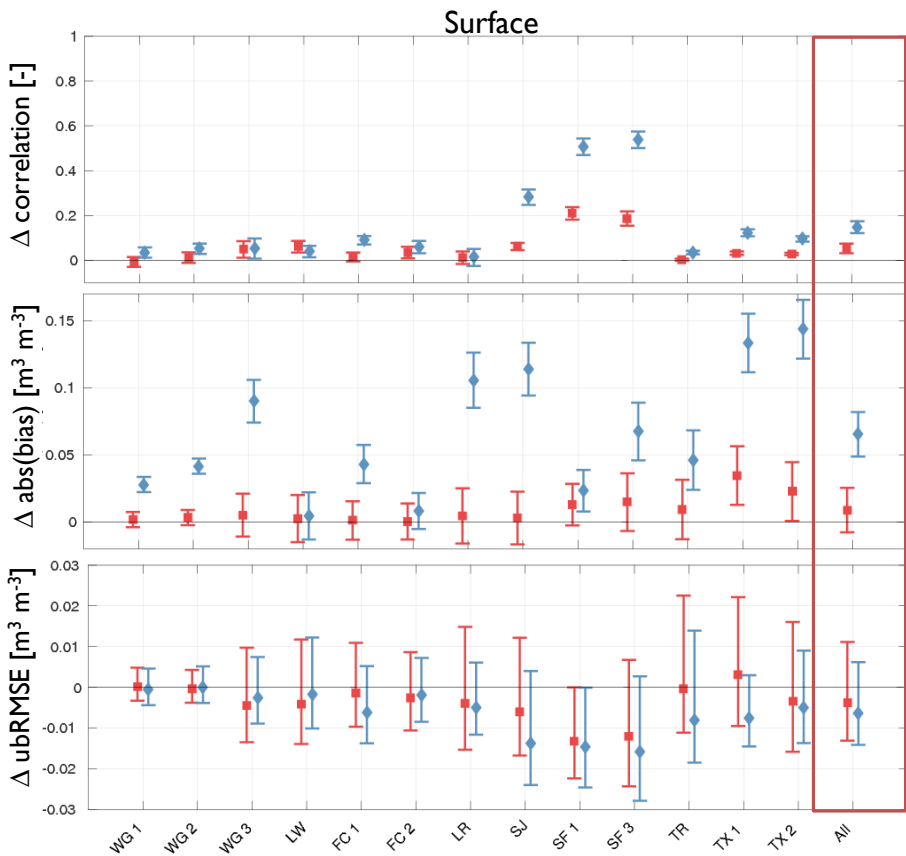
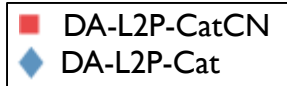
Evaluation against CVS data

■ Catchment-CN
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Assimilation of SMAP L2SMP

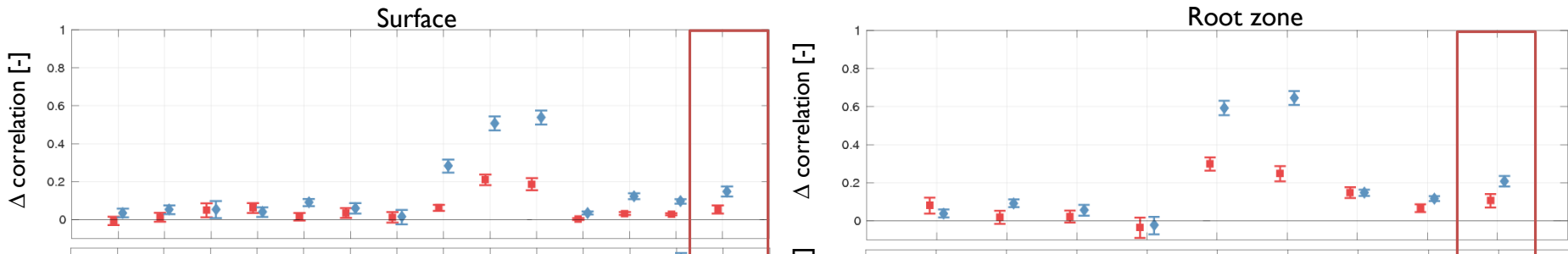
Evaluation against CVS data



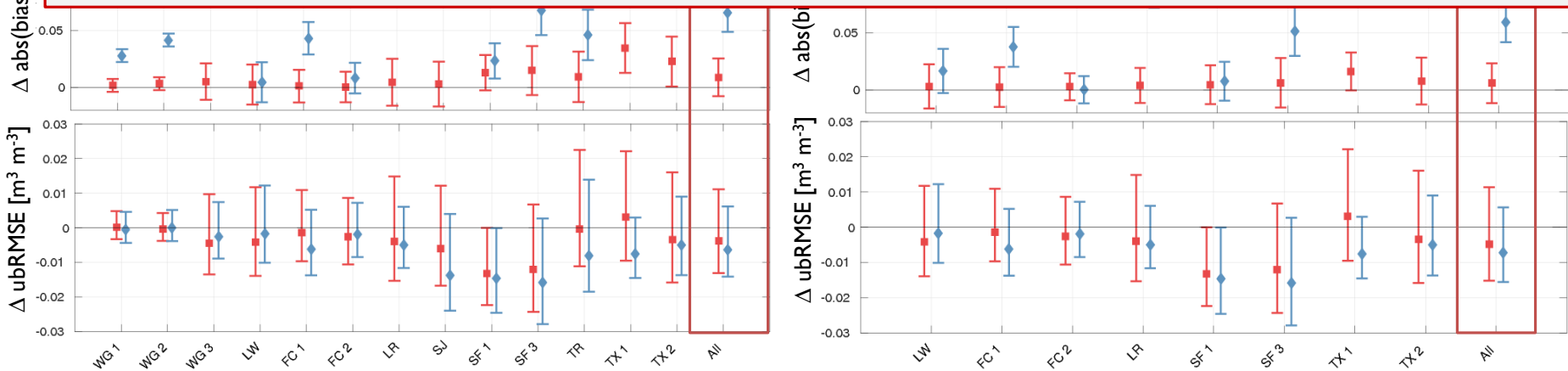
Assimilation of SMAP L2SMP

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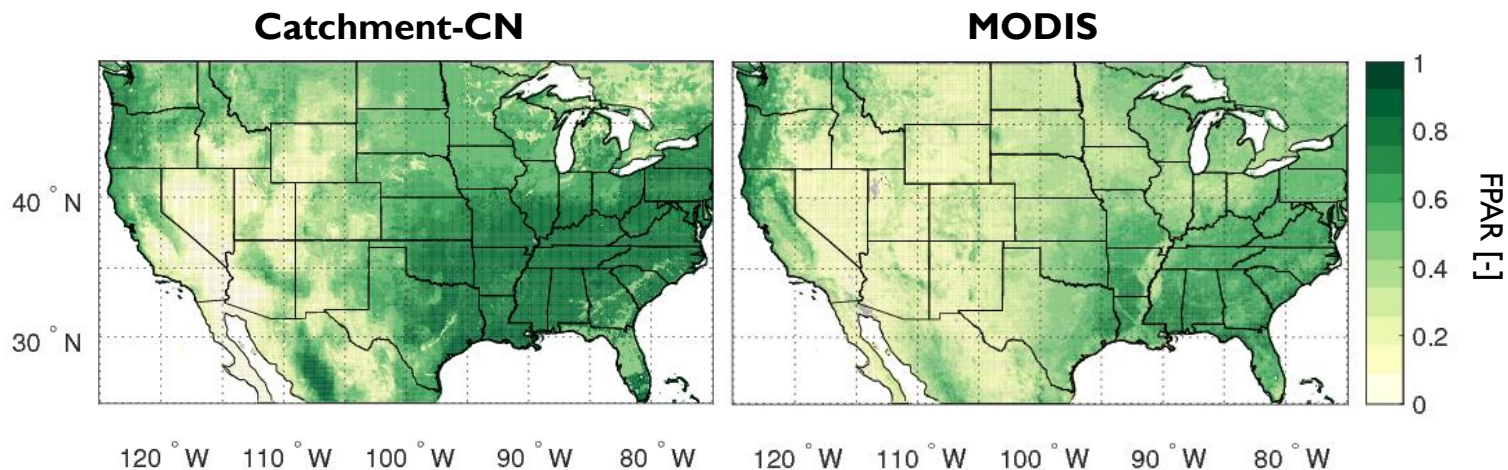
■ DA-L2P-CatCN
◆ DA-L2P-Cat



- Assimilation of SMAP L2P retrievals yields correlation and ubRMSE skill improvements in both cases
- Slightly smaller surface skill improvements for Catchment-CN, because of improved model skill



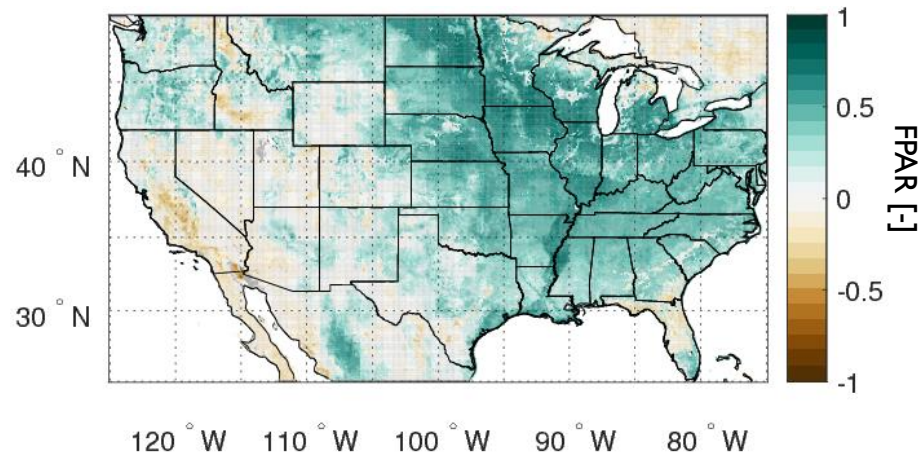
Catchment-CN FPAR vs. MODIS FPAR



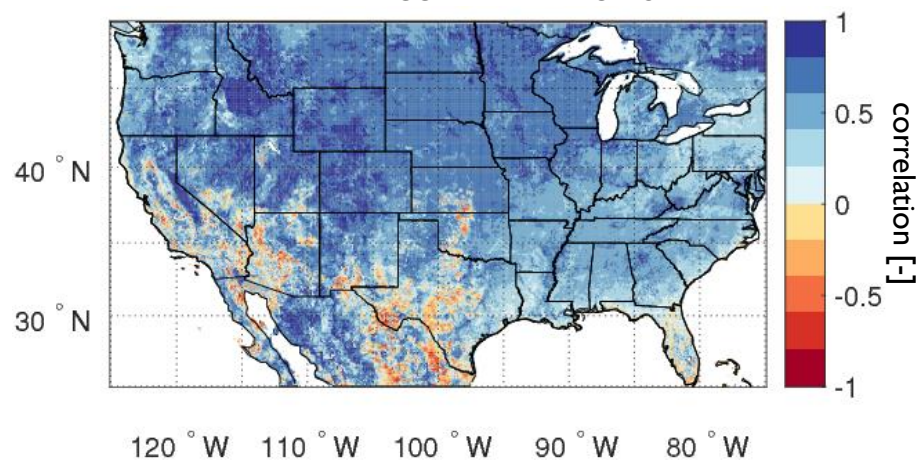
Mean FPAR Apr 2015 - Mar 2017

Catchment-CN FPAR vs. MODIS FPAR

$\text{FPAR}_{\text{CCN}} - \text{FPAR}_{\text{MODIS}}$



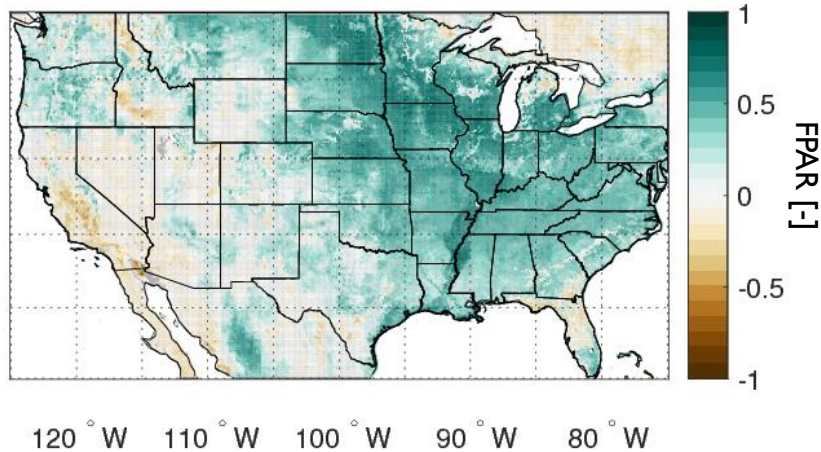
$R(\text{FPAR}_{\text{CCN}}, \text{FPAR}_{\text{MODIS}})$



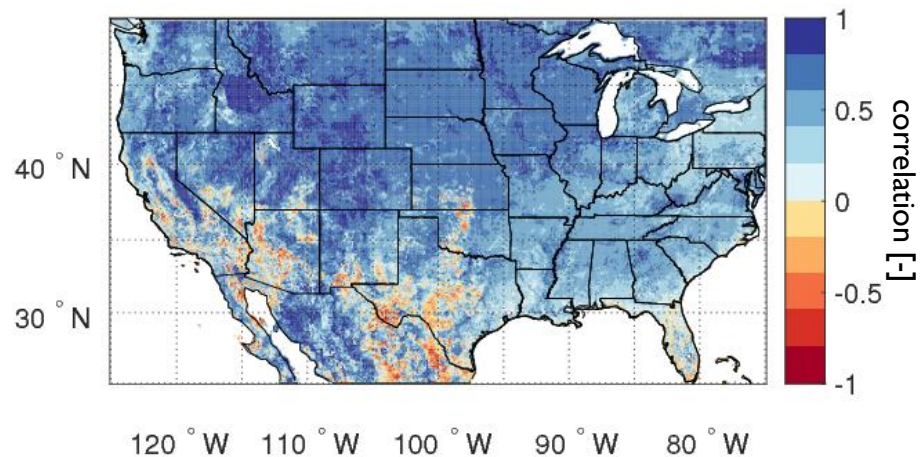
- Model and observations show strong discrepancies in absolute values and dynamics
- Differences may be too large to correct through assimilation alone

Catchment-CN FPAR vs. MODIS FPAR

$\text{FPAR}_{\text{CCN}} - \text{FPAR}_{\text{MODIS}}$



$R(\text{FPAR}_{\text{CCN}}, \text{FPAR}_{\text{MODIS}})$



- Model and observations show strong discrepancies in absolute values and dynamics
 - Differences may be too large to correct through assimilation alone
- calibrate Catchment-CN to obtain more realistic model simulations

Next steps...

(I) Calibrate Catchment -CN

- Use MODIS FPAR observations to estimate optimal vegetation parameters for Catchment-CN
- Obtain more realistic FPAR simulations

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(2) SM and FPAR assimilation

- Jointly assimilate SMAP Tbs and MODIS FPAR observations into *calibrated* Catchment-CN
- Test OCO-2 SIF assimilation

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(3) Data generation

- Use fully coupled data assimilation system to generate improved estimates of hydrological fields and carbon fluxes

Thank you!

References

Reichle, R.H., Koster, R., Collatz, G.J. (NASA ROSES 2015 - SUSMAP), The SMAP Level 4 Eco-Hydrology Product: Linking the terrestrial water and carbon cycles through the joint assimilation of SMAP data and MODIS and OCO-2 vegetation observations

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EXTRA SLIDES

Assimilating SMAP L2P SM into Catchment-CN

Evaluation against CVS data

