

Assessment of Land-Atmosphere Coupling in CAM-CLM

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– Use a Suite of LA Coupling Metrics –



Quantifying the L-A Coupling Processes

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Soil moisture Memory (Delworth and Manabe 1988)

Terrestrial Coupling (Dirmeyer 2011)

Mixing Diagram Approach (Santanello et al. 2009, 2011)

Relative Humidity Tendency (Ek and Holtslag 2009)

Heated Condensation Framework (Tawfik et al. 2015a,b)



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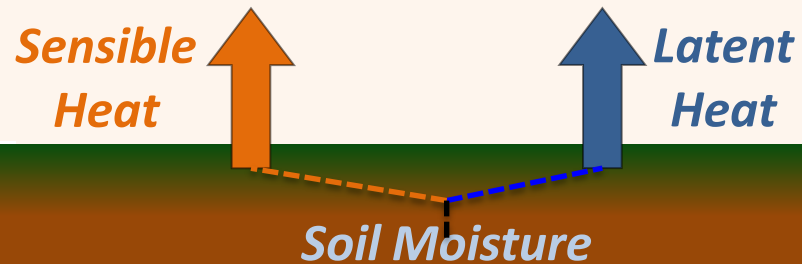


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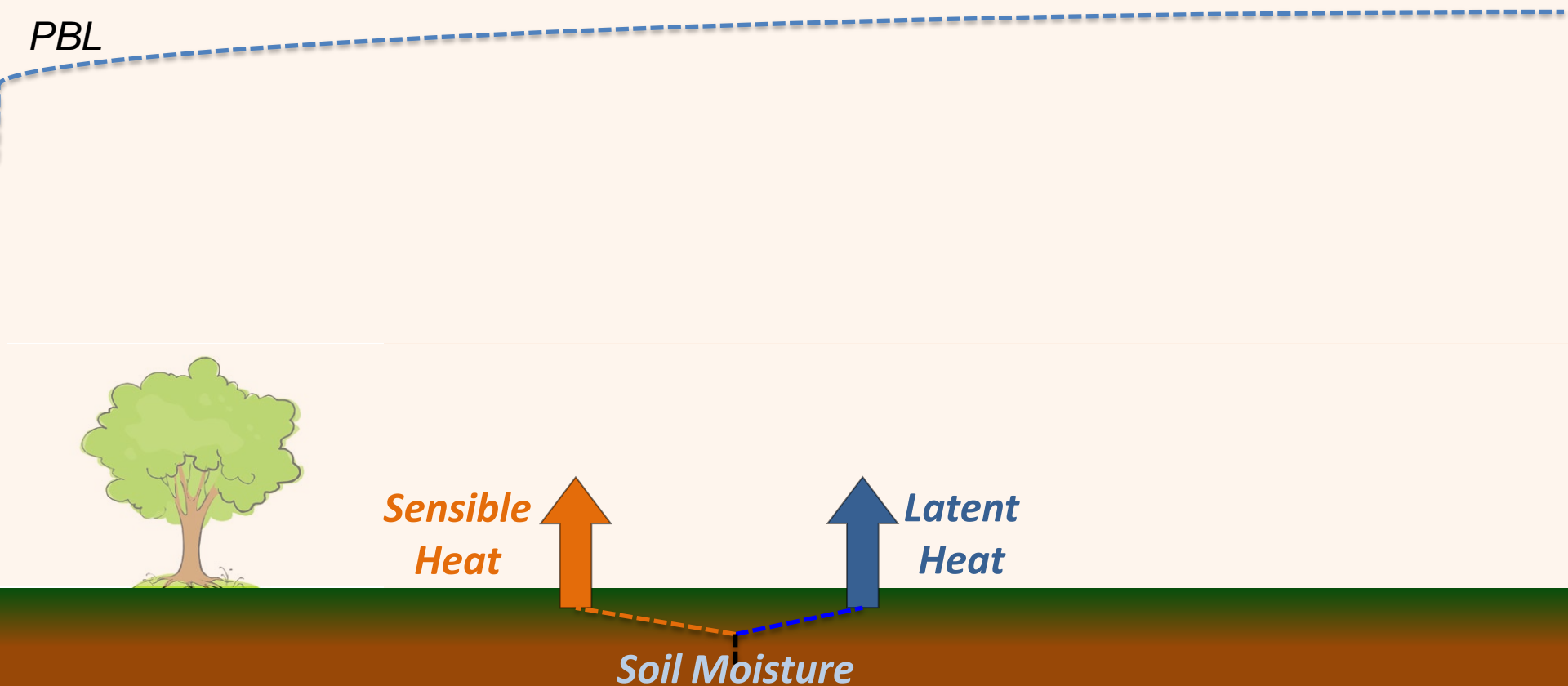


Soil Moisture

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Drier

PBL

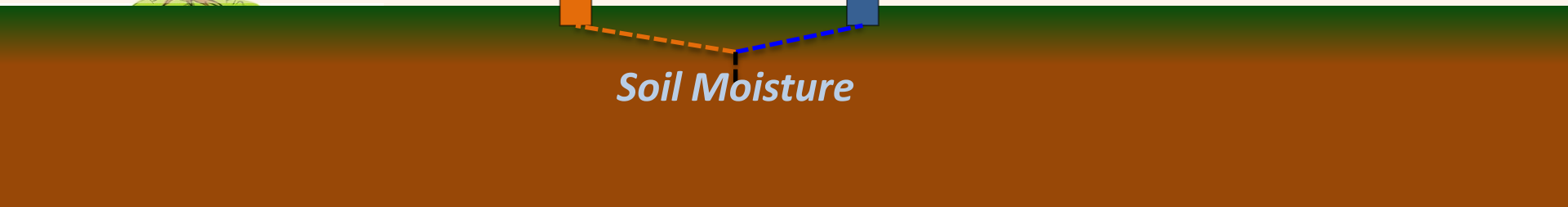


*Sensible
Heat*

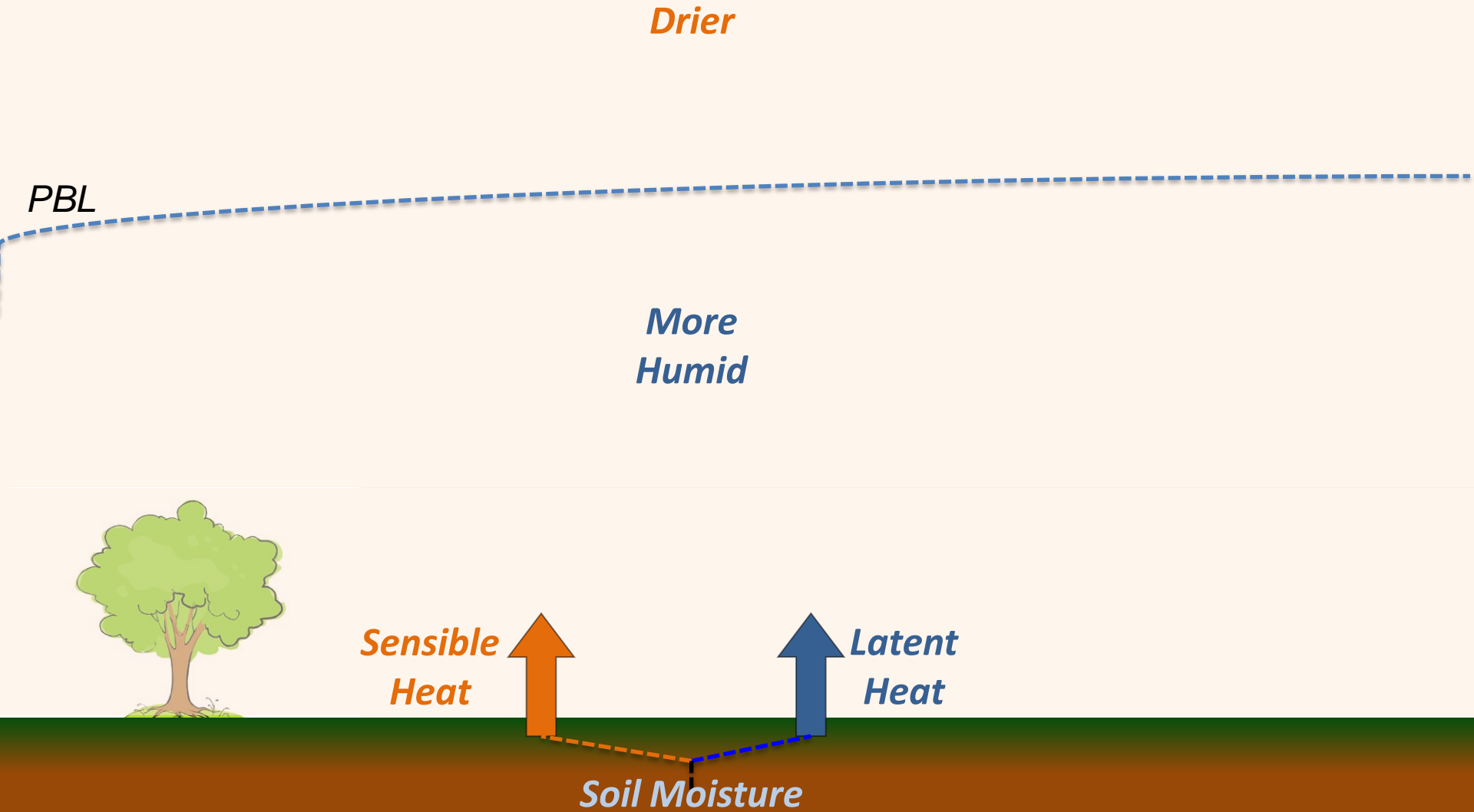


*Latent
Heat*

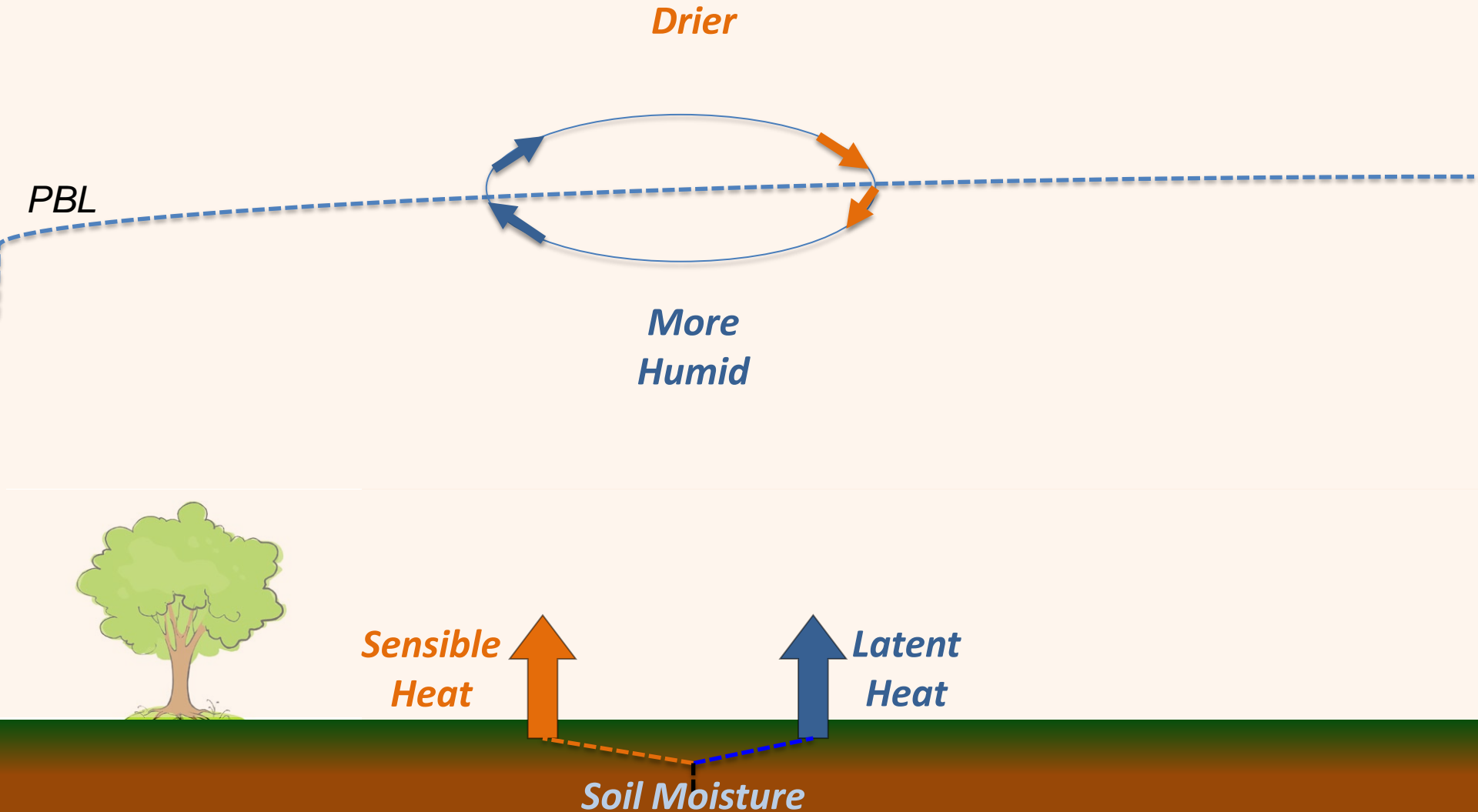
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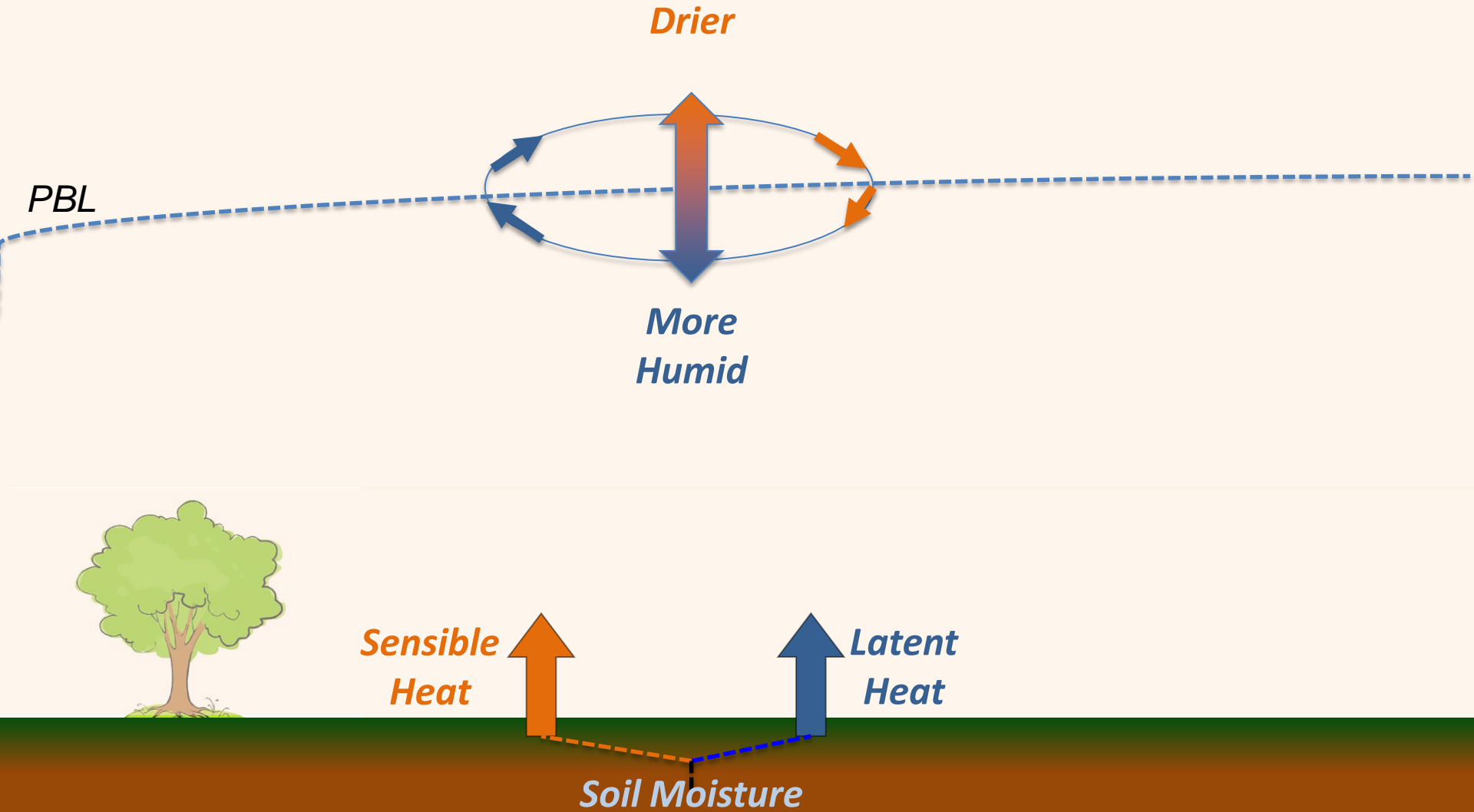
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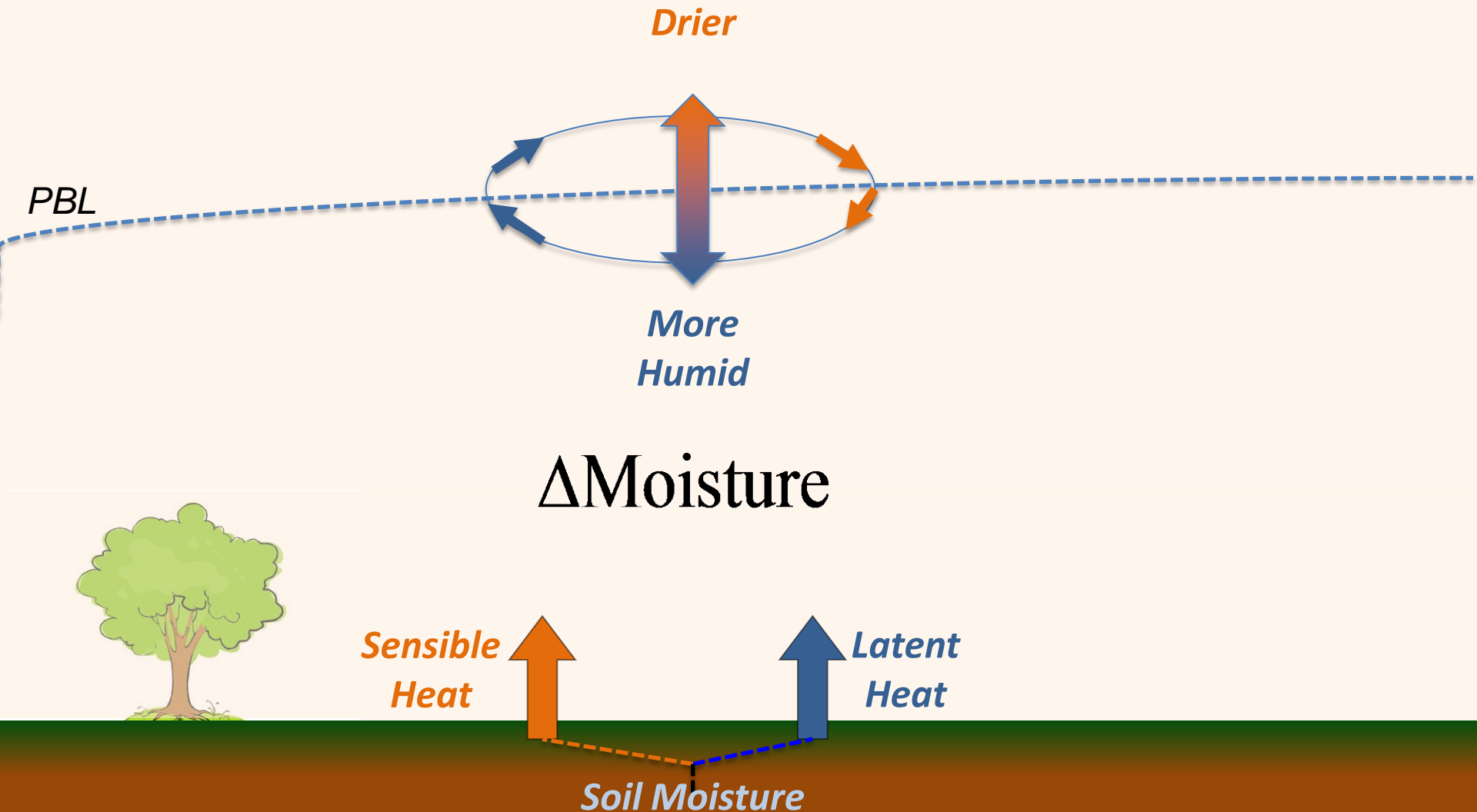
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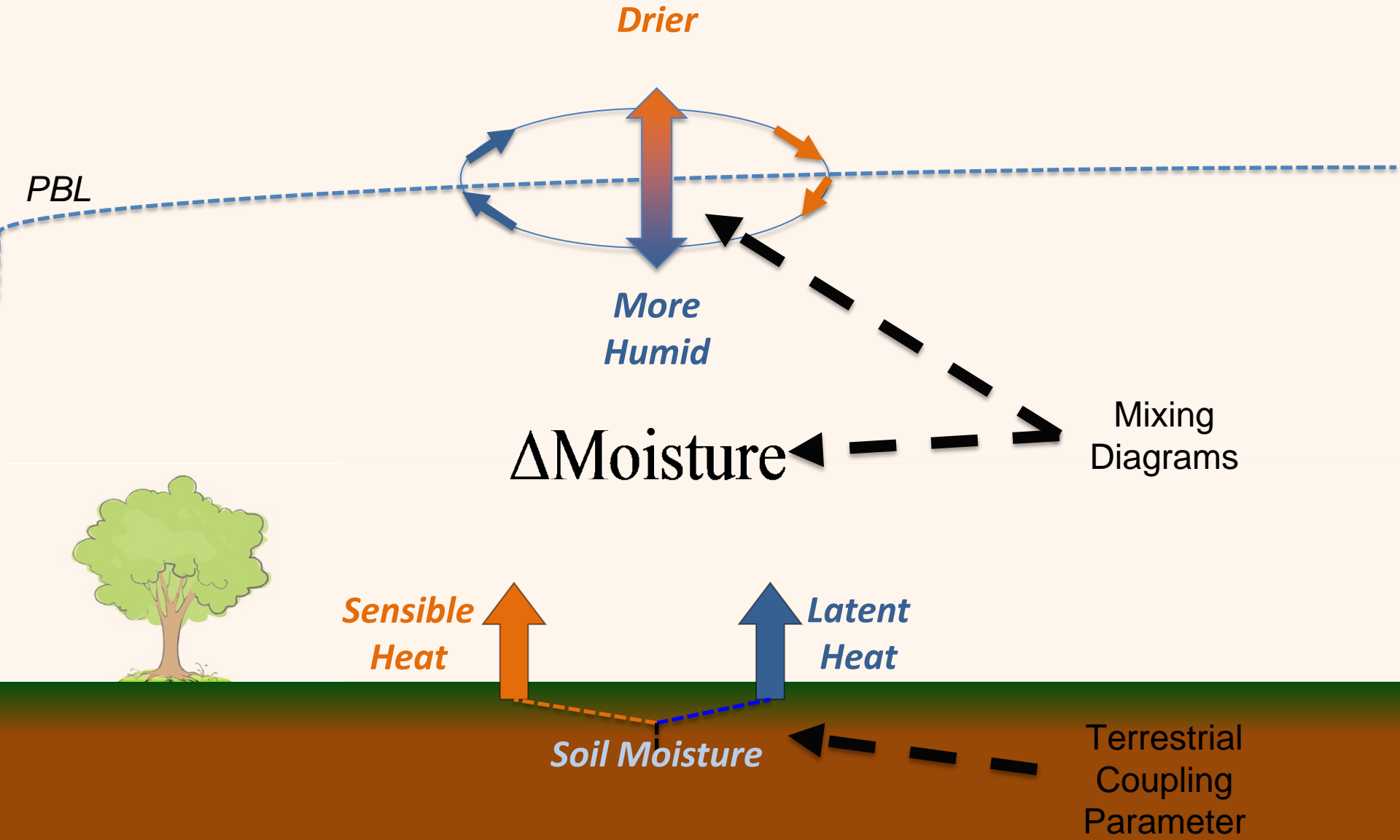
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Simulation Setup

- **Atmospheric Model:** CAM5-SE
- **Land Model:** CLM4.5-SP
- **Ocean:** Observed Data Ocean
- **Resolution:** ne30np4 (~ 1 by 1 degree)
- **Simulation years:** 1979-2006

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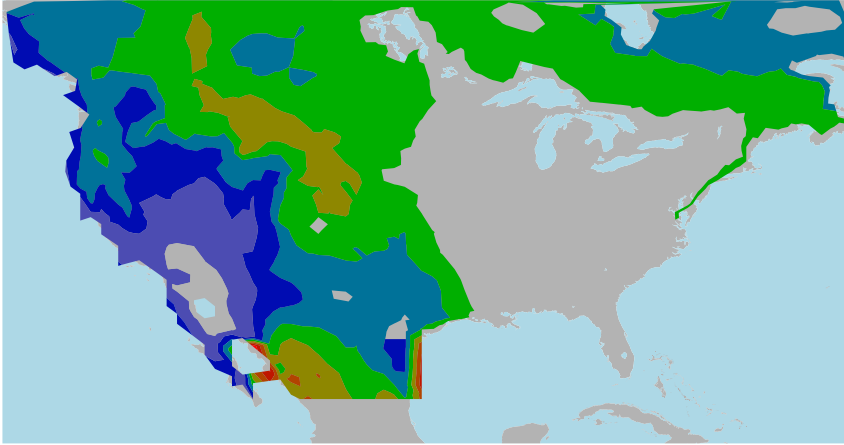
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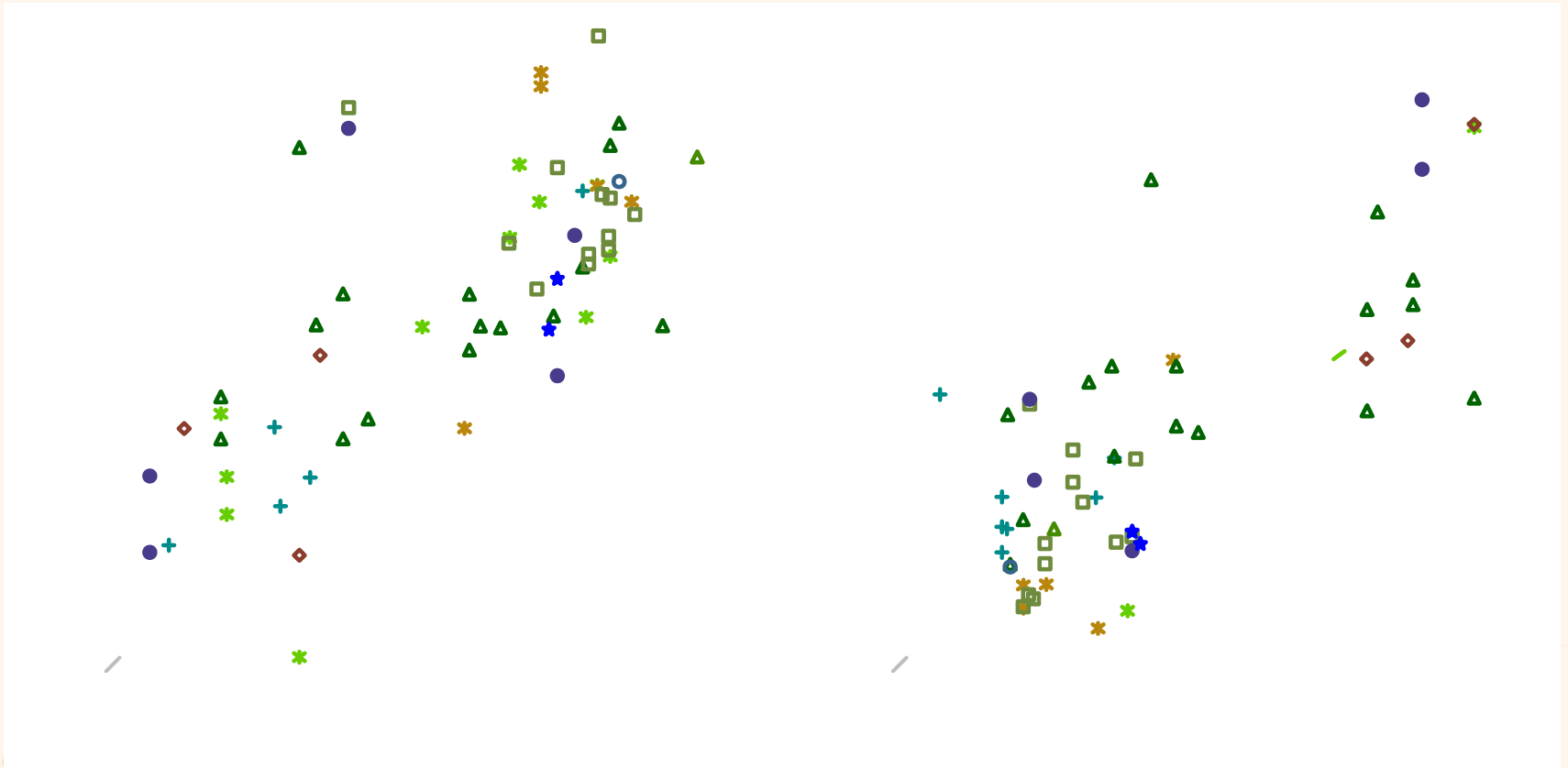
**** Results will focus on July only**

Mean State of Surface Energy Flux and Partitioning

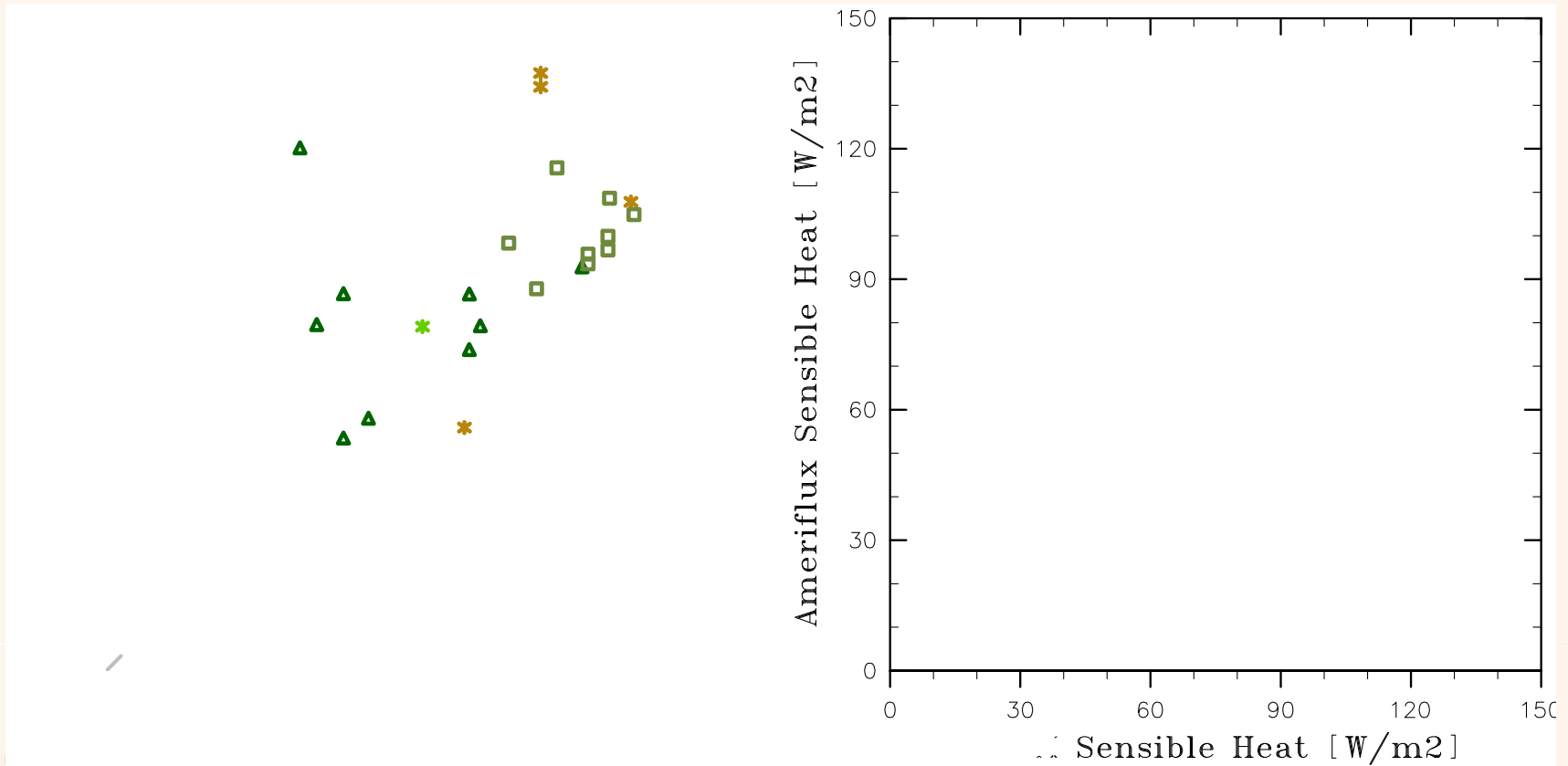


$$EF = \frac{LH}{SH + LH}$$

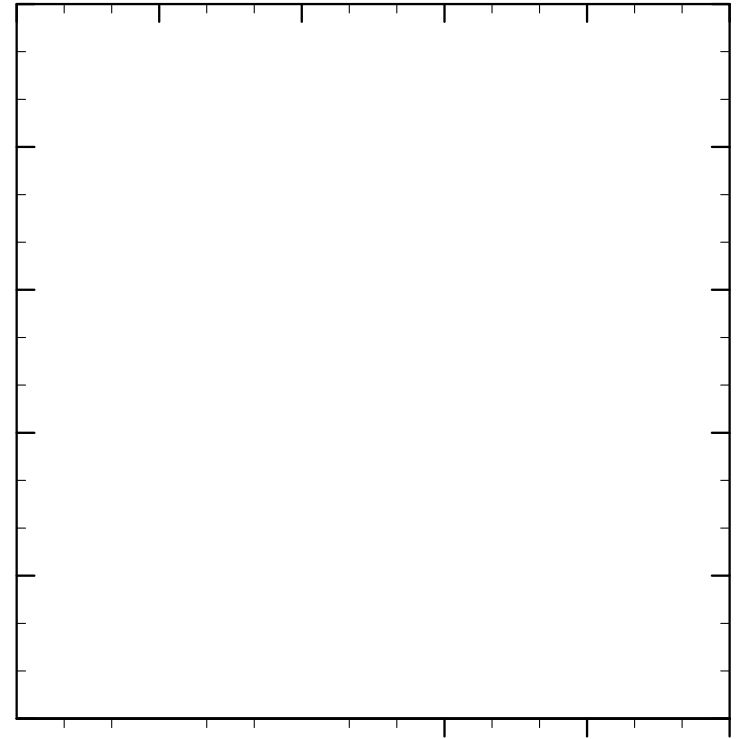
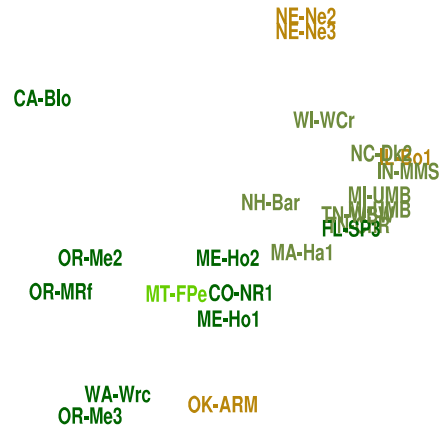
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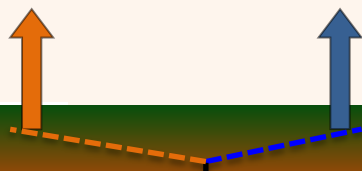
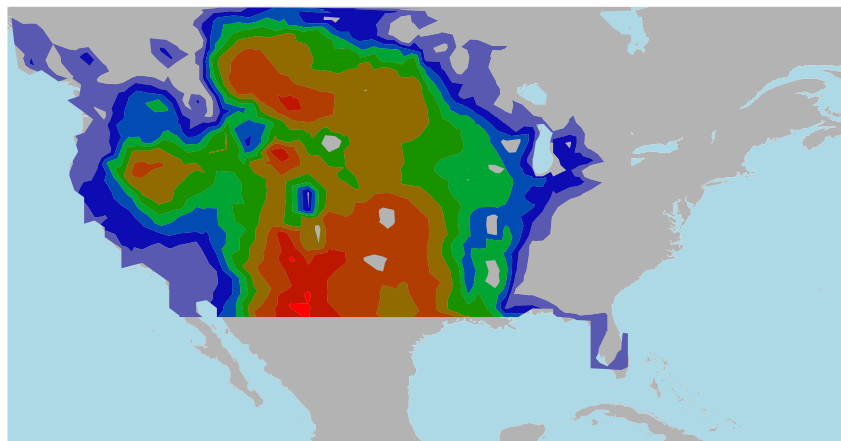
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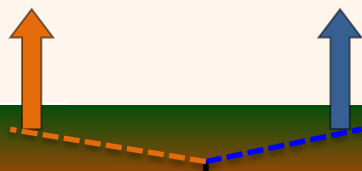
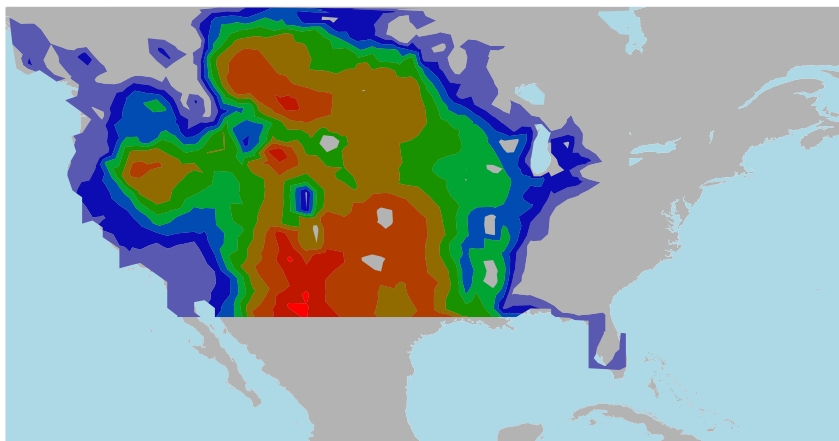


Where do changes in soil moisture influence surface latent heat flux?



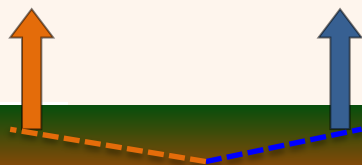
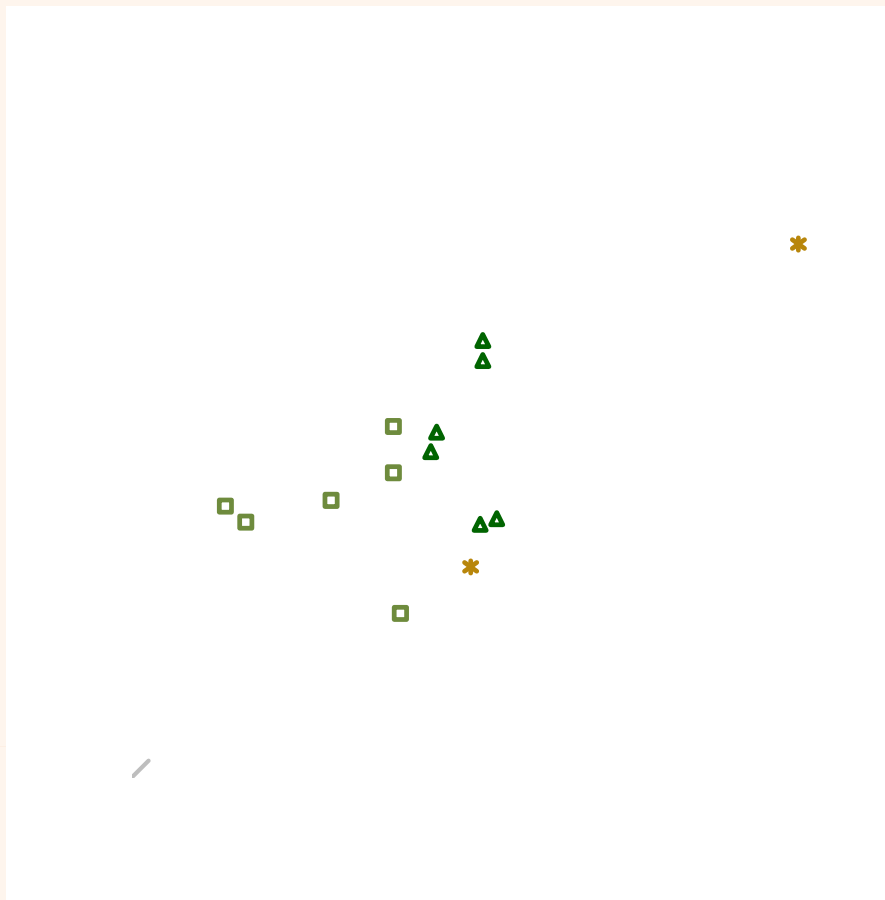
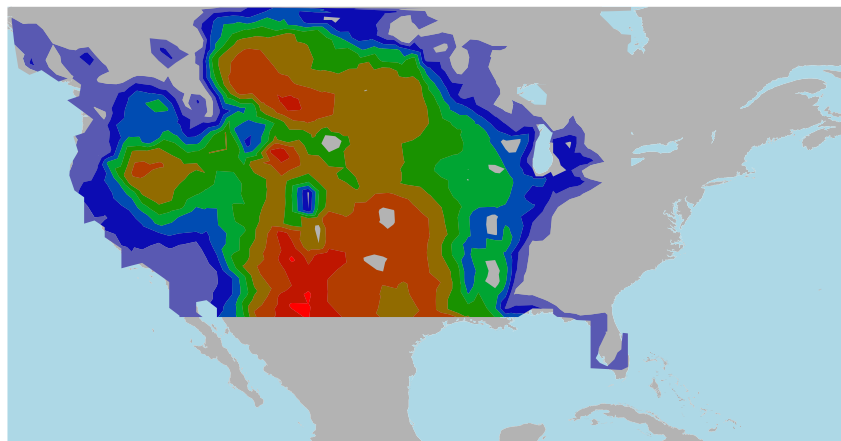
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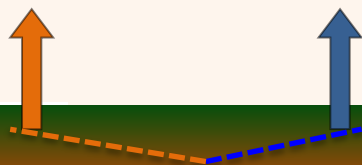
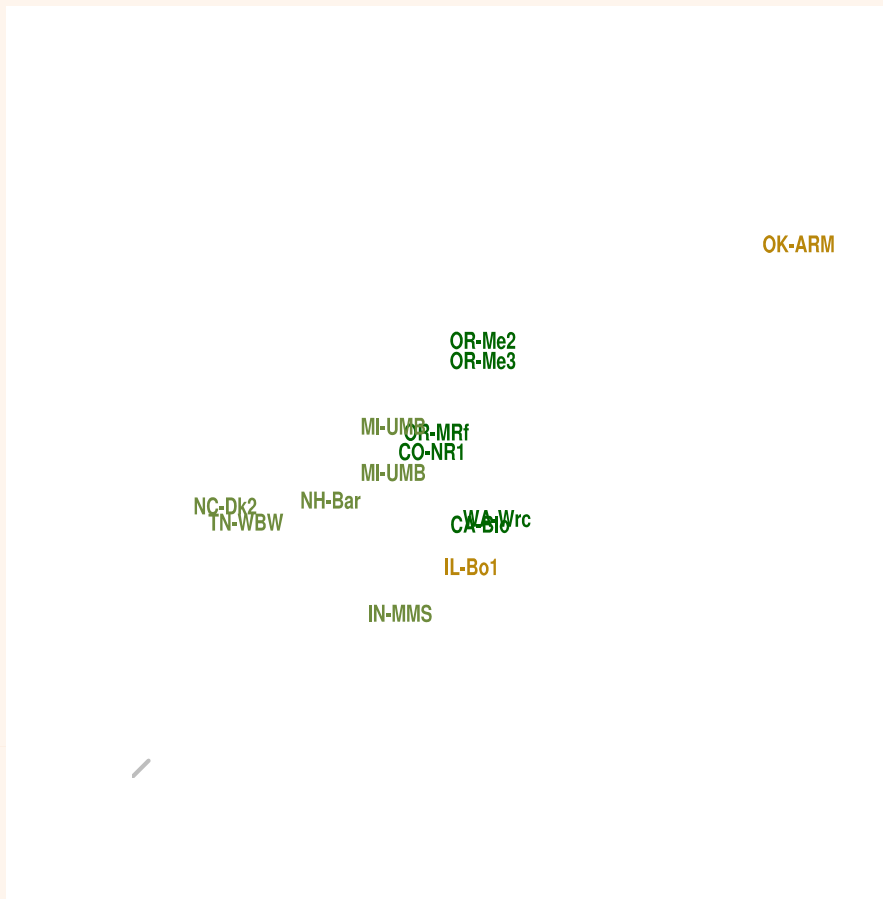
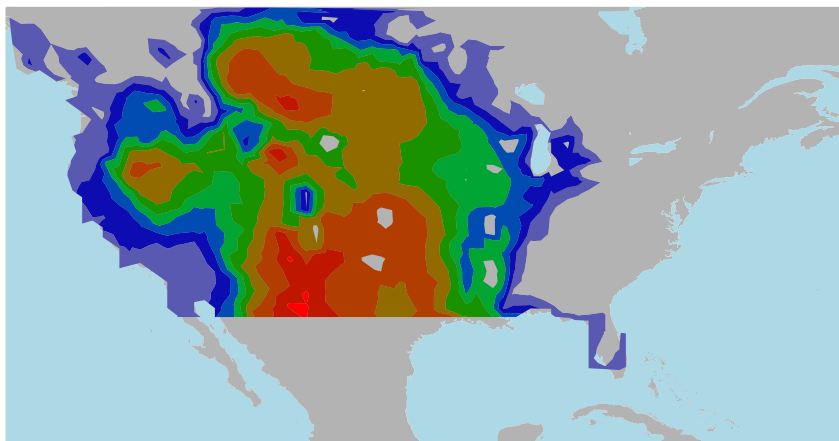
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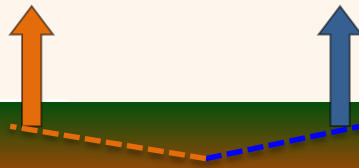
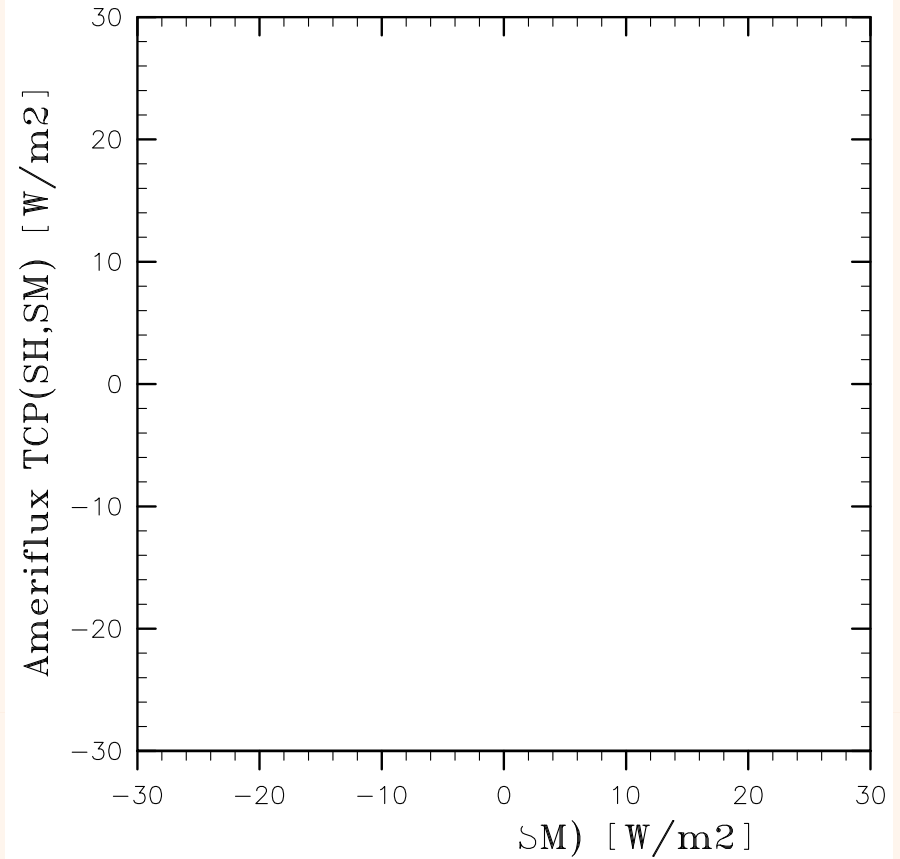
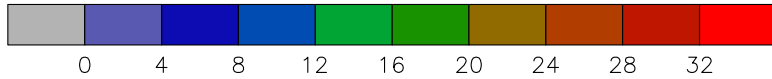
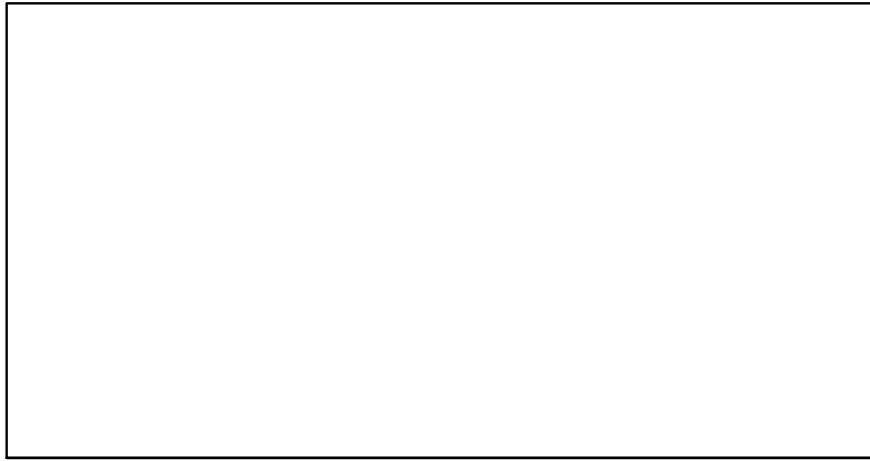
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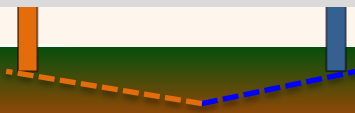
Where do changes in soil moisture influence surface **sensible** heat flux?

sible Heat and Soil Moisture Coupling



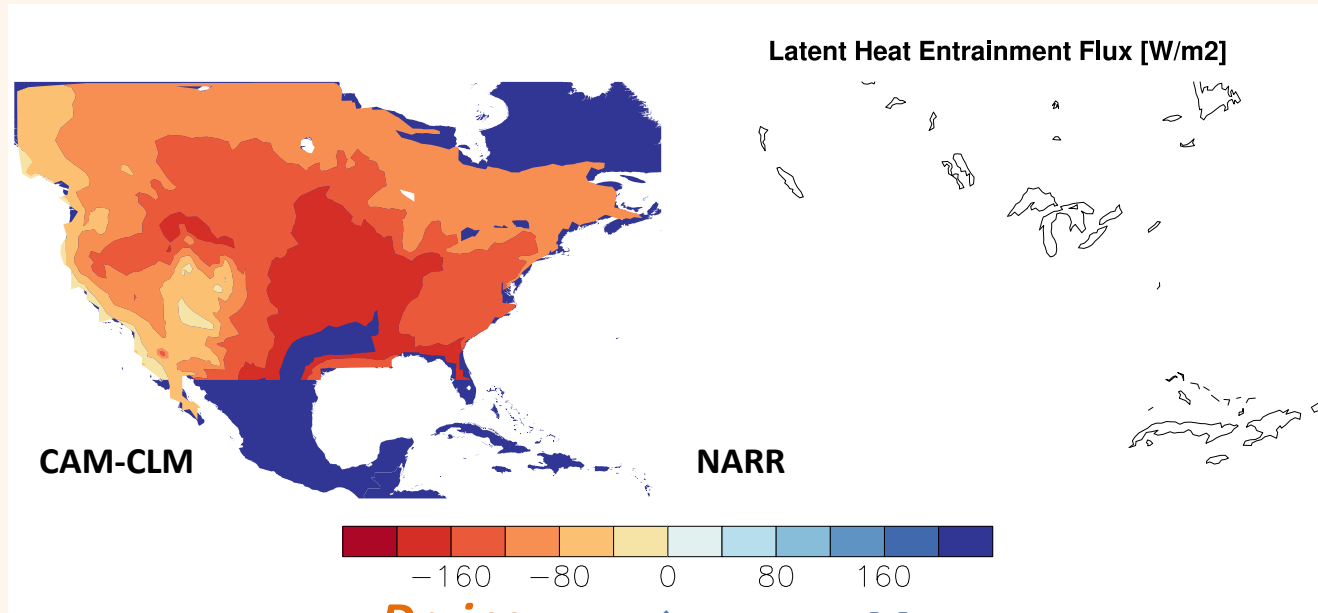
Soil Moisture

How does CAM respond?



Soil Moisture

Latent Heat Entering from aloft into the boundary Layer



Drying

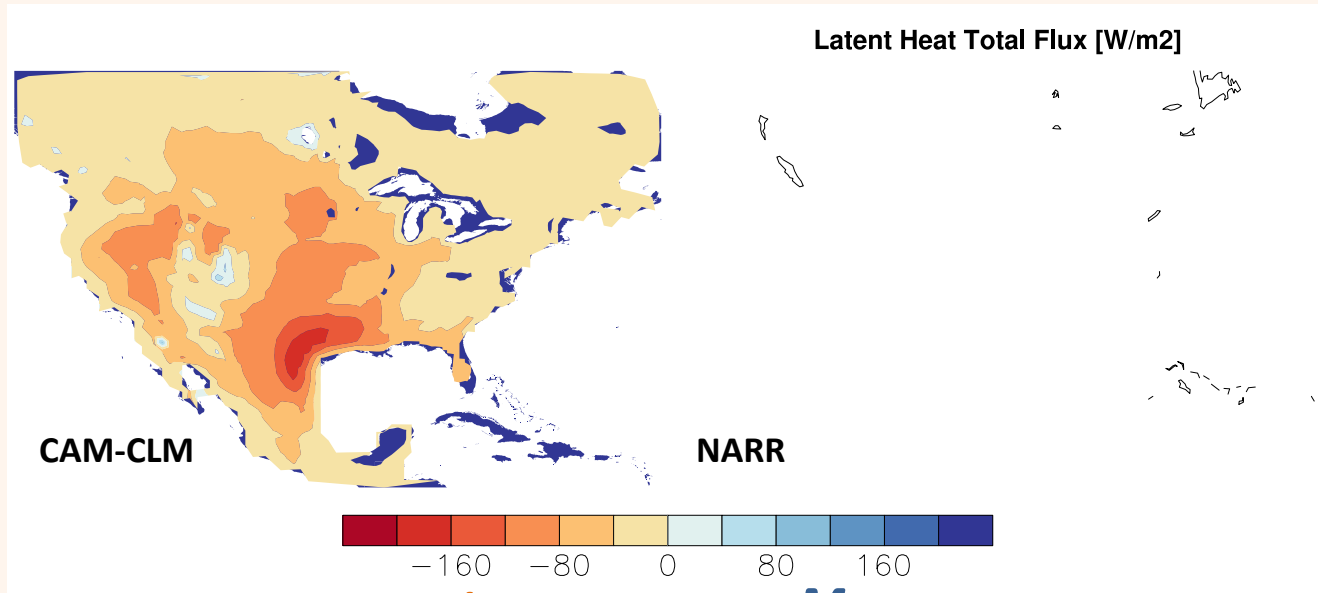
More Humid



PBL



Latent Heat Entering from aloft into the boundary Layer



Drying

More

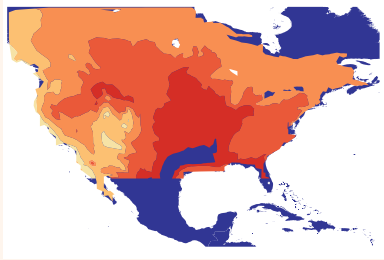
Humid

PBL

Δ Moisture



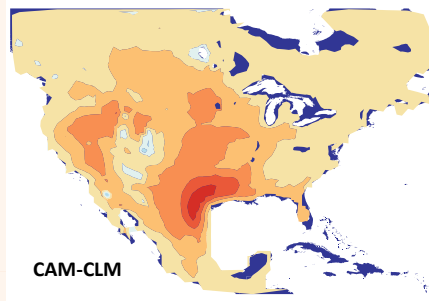
Summary of Behavior



- ✓ CAM responds with **greater drier air** entrainment

PBL

Δ Moisture



- ✓ Results in **net drying** of PBL, but mitigated by LH surface flux

- ✓ Soil moisture **strongly** controls surface sensible heat flux variability in the Southern Plains

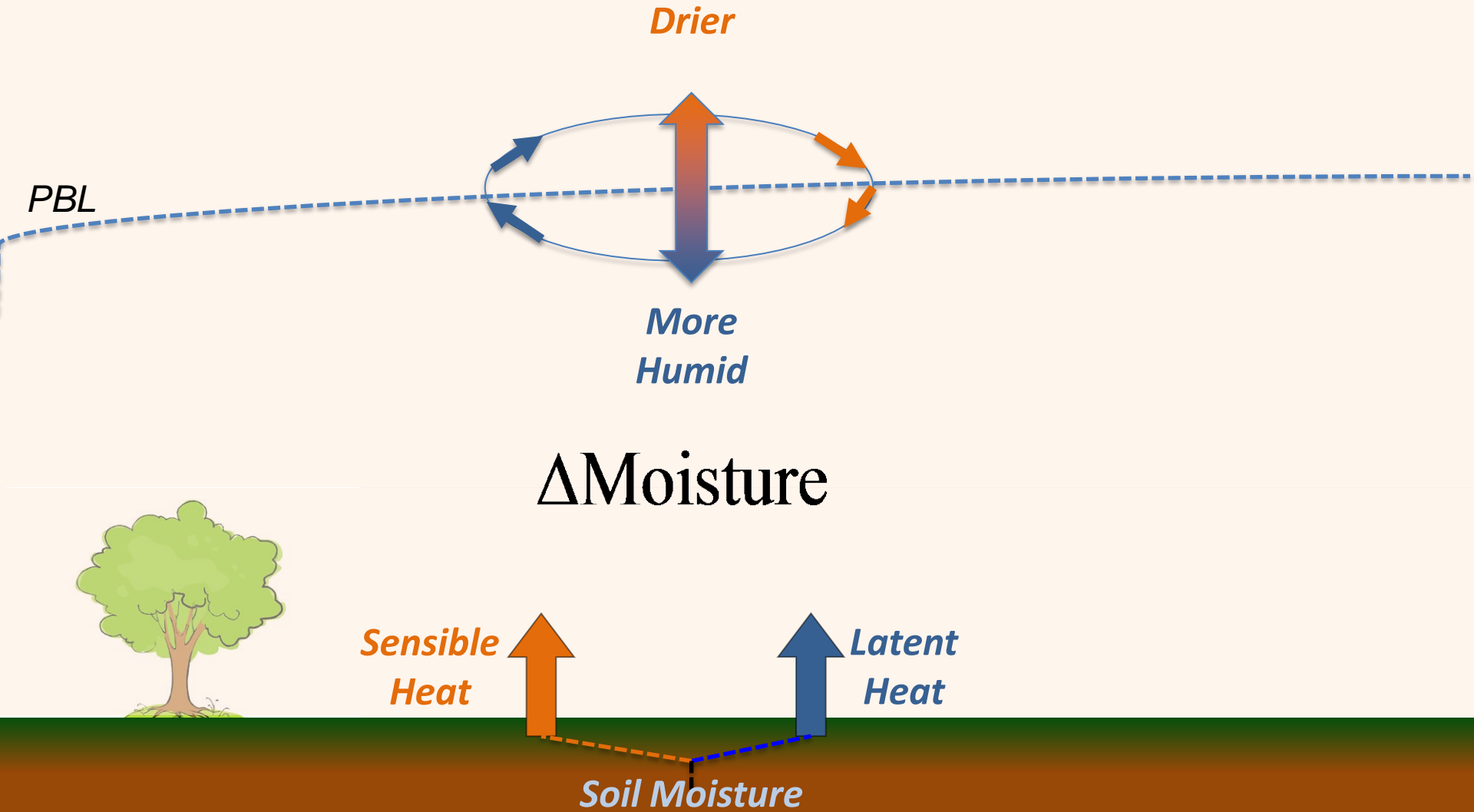
Mean SH

SH-SM
Coupling

Model Performance

- CLM captures the mean LH and SH across the various landcover types
- Coupling between soil moisture and surface fluxes is also well represented including land cover type distinctions
 - Deciduous broadleaf forests had weaker LH-SM coupling than needleleaf evergreen forests in both models and observations
- Unclear if the entrainment side (CAM response) of the equation is correct?

Next Step: Closing the feedback by understanding clouds and precipitation?



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