# LoCo Updates and Progress

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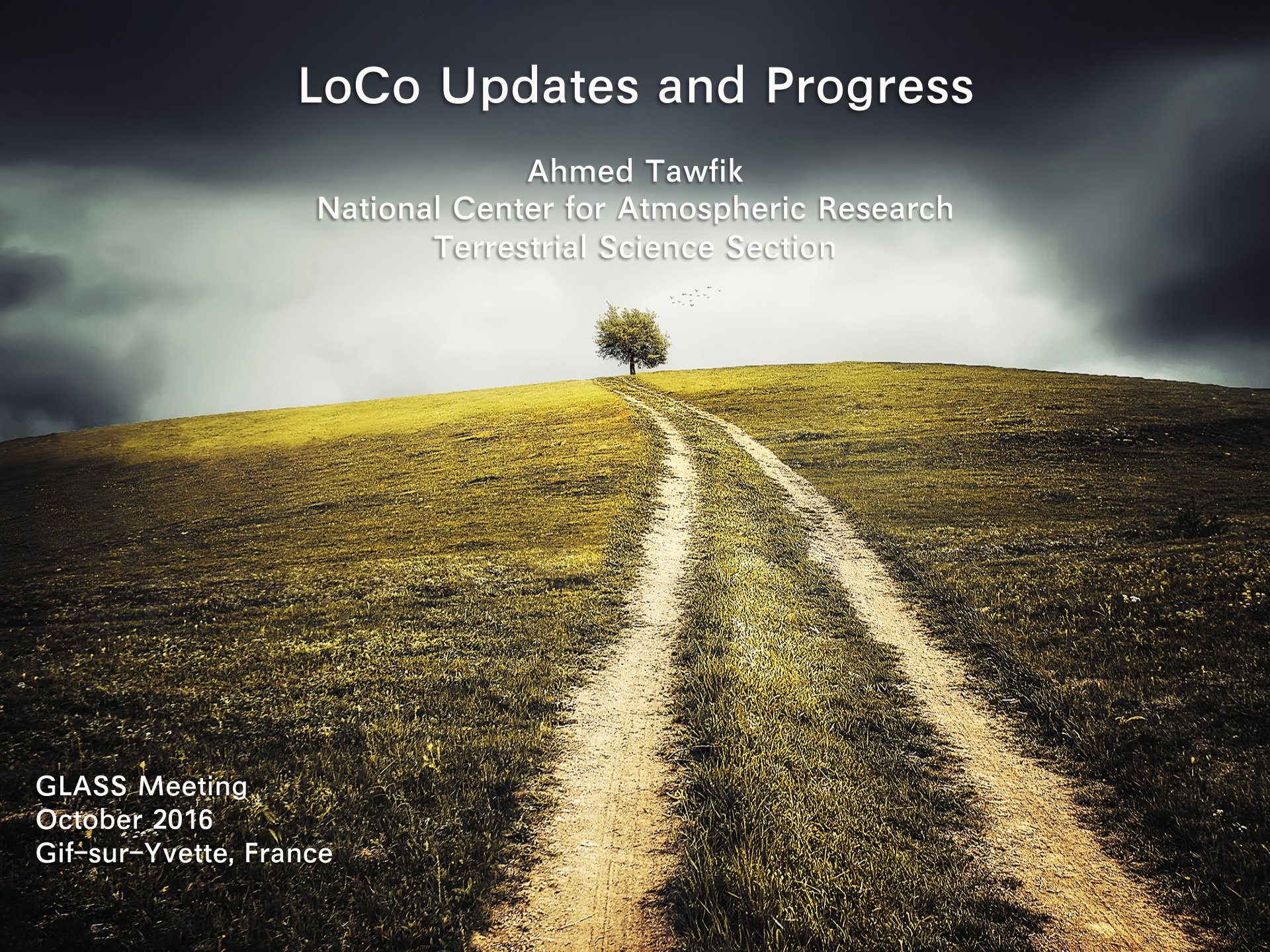


GLASS Meeting
October 2016
Gif-sur-Yvette, France

# Some Thoughts and Opinions

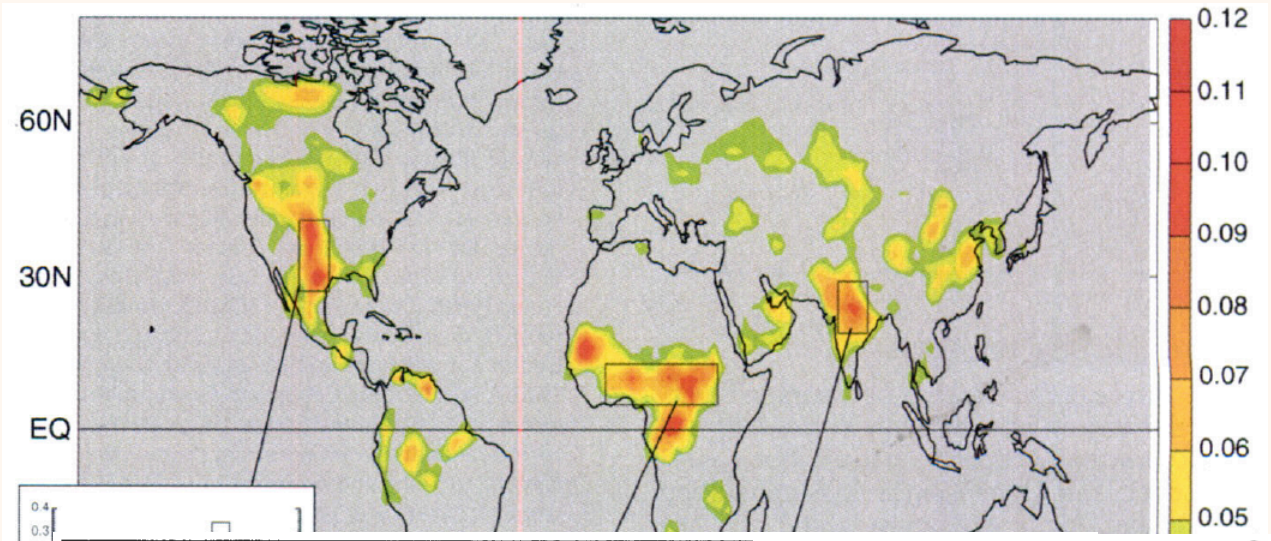
1. ***Column-based*** convective parameterizations don't/can't work for LoCo
    - LoCo approaches can inform the consistent model biases (too warm summer Plains, lack of MCSs, process of nocturnal convection)

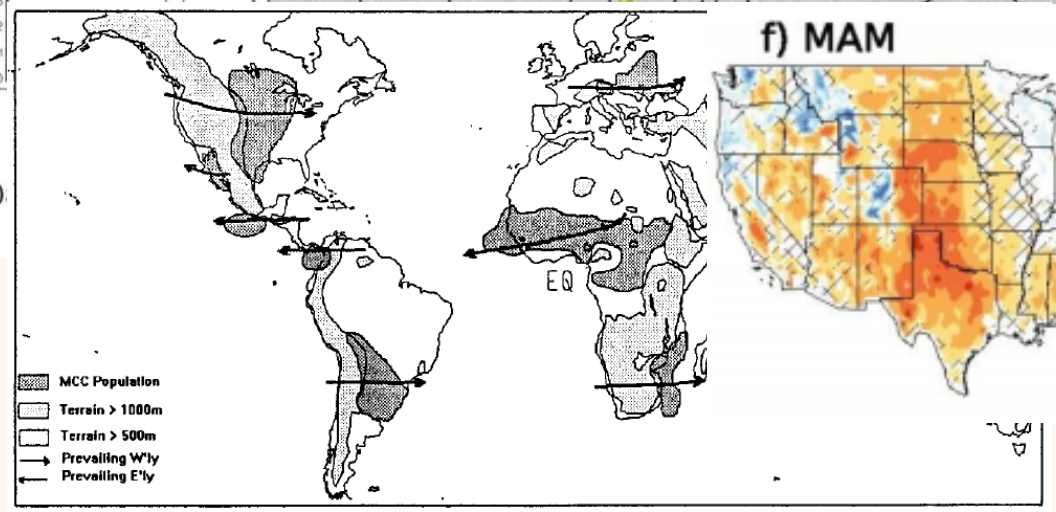
2. Process-based metrics are just new-born models that haven't grown-up yet
    - Updates on Coupling Metrics Toolkit (CoMeT)

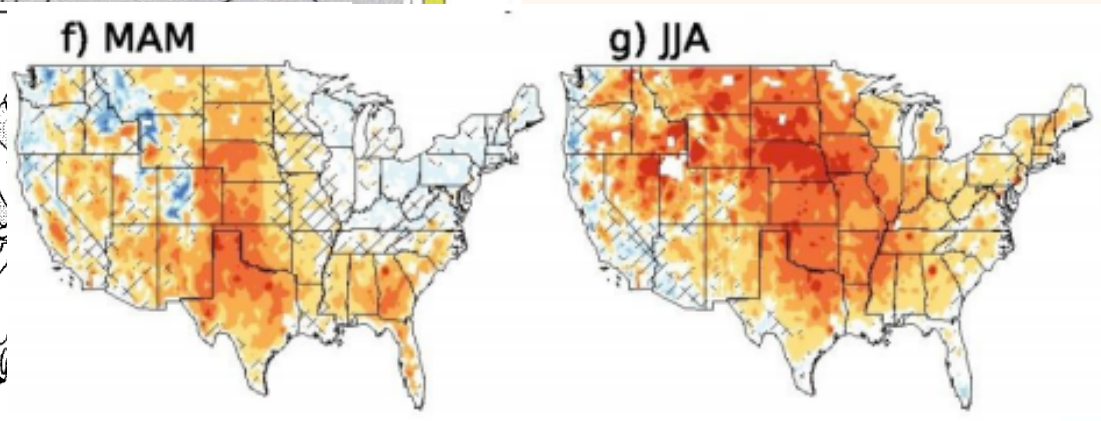
3. LoCo metrics can be unified → "LoCo equations"

# Column Convection Does not work

"**Hotspots**", **MCSs**, and **warm biases** tend to appear in the same area



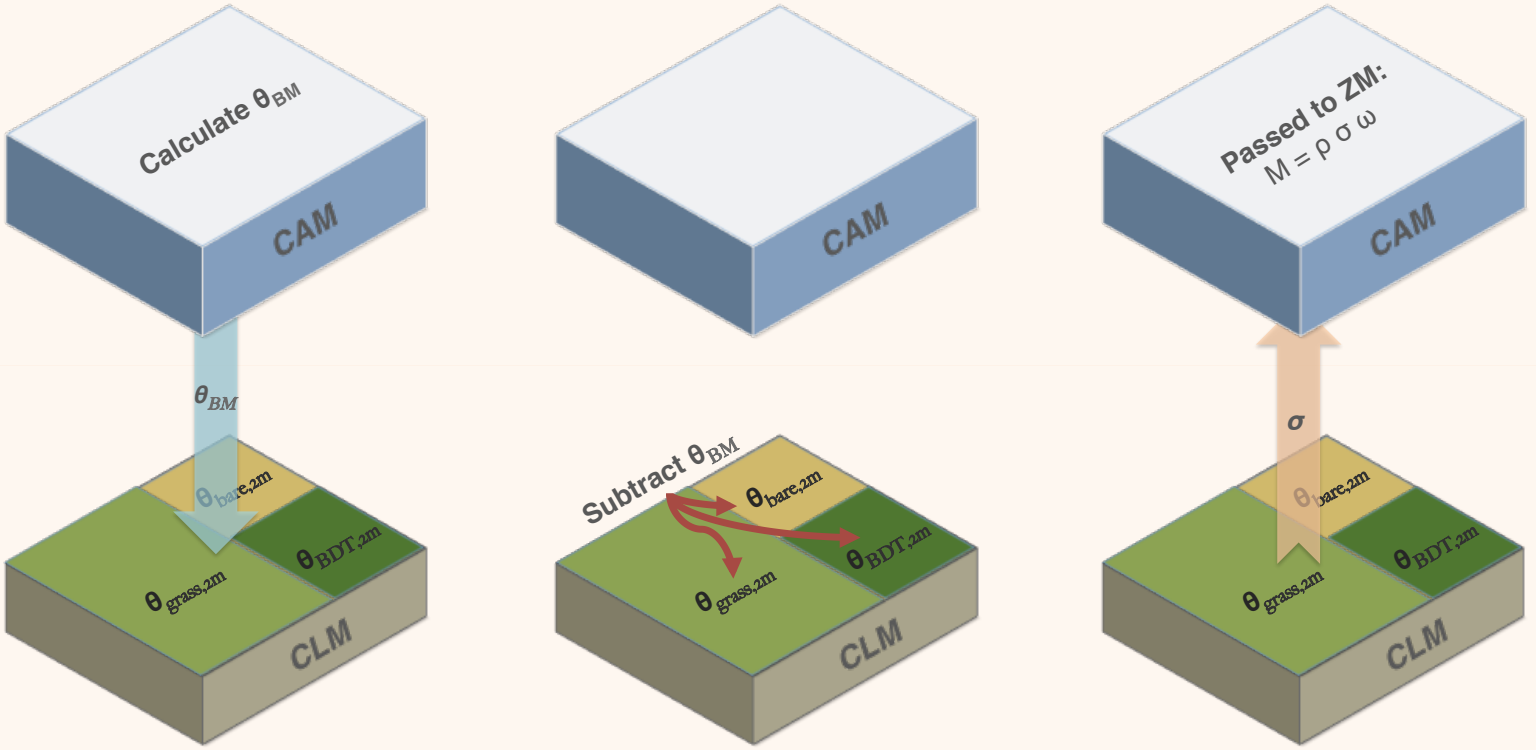

(Courtesy of Andreas Prein)

# Column Convection Does not work

If convection schemes are constrained to be sub-grid

$$M = \rho * \boldsymbol{\sigma} * w$$

$$\boldsymbol{\sigma} \ll 1$$




1. Calculate the convective threshold, $\theta_{BM}$
2. Subtract $\theta_{2m}$ from $\theta_{BM}$ for each PFT tile
3. Pass convective fraction, $\sigma$, to CAM

(https://github.com/abtawfik/CESM_1.2.2_Subgrid_Triggering)

(Tawfik et al. In-prep)

# Column Convection Does not work

Fundamentally the role of surface-convection interactions are being neglected when thinking about convection. I think we can have something to say about:

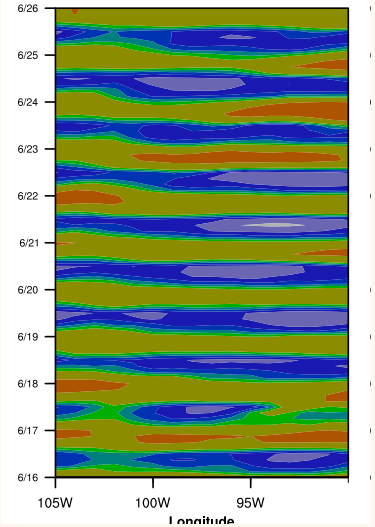
1. Warm bias over the Plains
2. Process producing nocturnal convection
3. Developing more adequately “coupled” convective schemes

Example of constraining convective parameterizations by the asymptotic assumption:

- More propagation
- No more diurnal phase locking
- But precipitation statistics fail

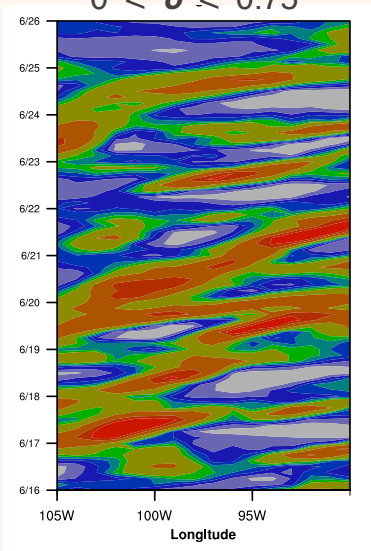
Need to move away from column-based convective parameterization to get coupling/feedbacks right in GCMs.

**Default CESM**




**Require no more than 75% of to be active (the necessary convective param. constraint)**

$0 < \sigma < 0.75$



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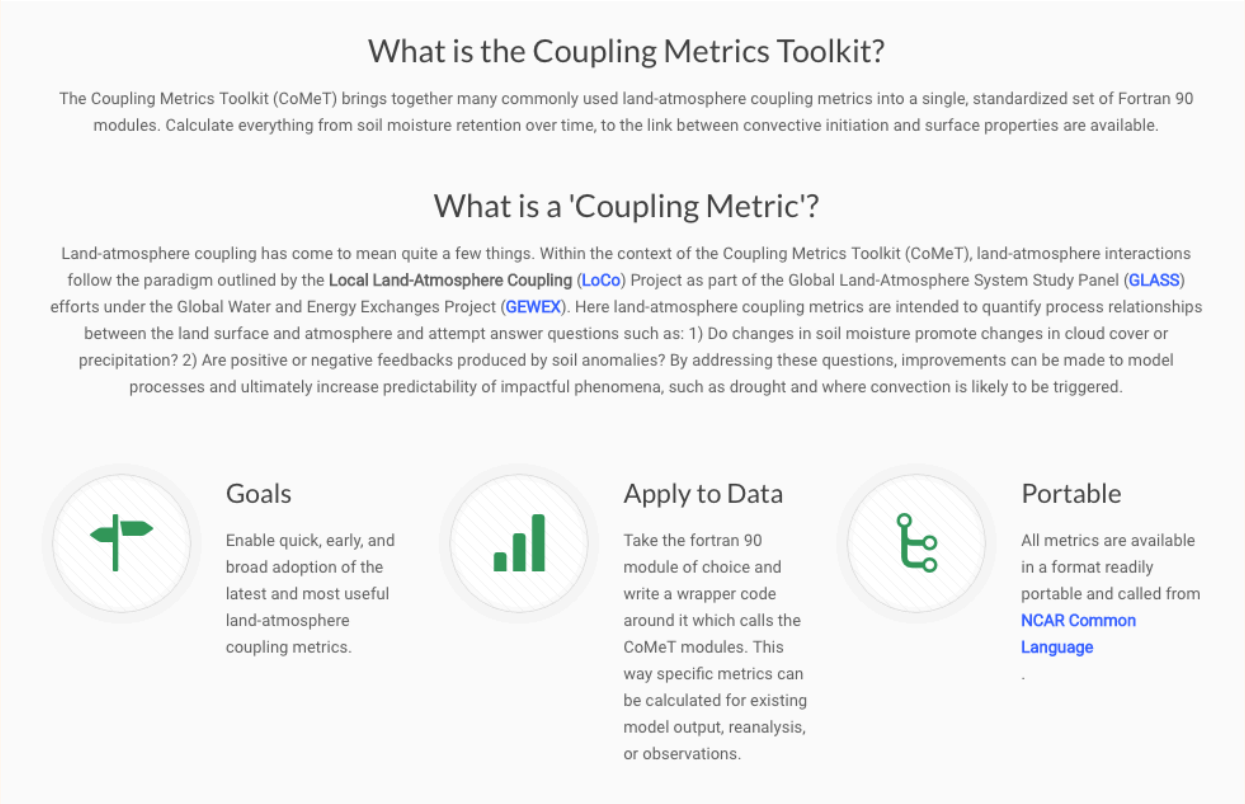
# Updates and Plans for CoMeT

- Instructions and examples for porting to python and NCL
- Rewrite in a non-machine dependent language (potentially…)
- Provide some guidance on the website that is uses questions to guide to the most appropriate metric?
- When I have time, add other metrics:  Next up is the TFS/AFS because it is most asked about



## What is the Coupling Metrics Toolkit?

The Coupling Metrics Toolkit (CoMeT) brings together many commonly used land-atmosphere coupling metrics into a single, standardized set of Fortran 90 modules. Calculate everything from soil moisture retention over time, to the link between convective initiation and surface properties are available.

## What is a 'Coupling Metric'?

Land-atmosphere coupling has come to mean quite a few things. Within the context of the Coupling Metrics Toolkit (CoMeT), land-atmosphere interactions follow the paradigm outlined by the **Local Land-Atmosphere Coupling** (LoCo) Project as part of the Global Land-Atmosphere System Study Panel (GLASS) efforts under the Global Water and Energy Exchanges Project (GEWEX). Here land-atmosphere coupling metrics are intended to quantify process relationships between the land surface and atmosphere and attempt answer questions such as: 1) Do changes in soil moisture promote changes in cloud cover or precipitation? 2) Are positive or negative feedbacks produced by soil anomalies? By addressing these questions, improvements can be made to model processes and ultimately increase predictability of impactful phenomena, such as drought and where convection is likely to be triggered.

### Goals

Enable quick, early, and broad adoption of the latest and most useful land-atmosphere coupling metrics.

### Apply to Data

Take the fortran 90 module of choice and write a wrapper code around it which calls the CoMeT modules. This way specific metrics can be calculated for existing model output, reanalysis, or observations.

### Portable

All metrics are available in a format readily portable and called from NCAR Common Language
.

(coupling-metrics.com)

# Unifying LoCo Concepts?

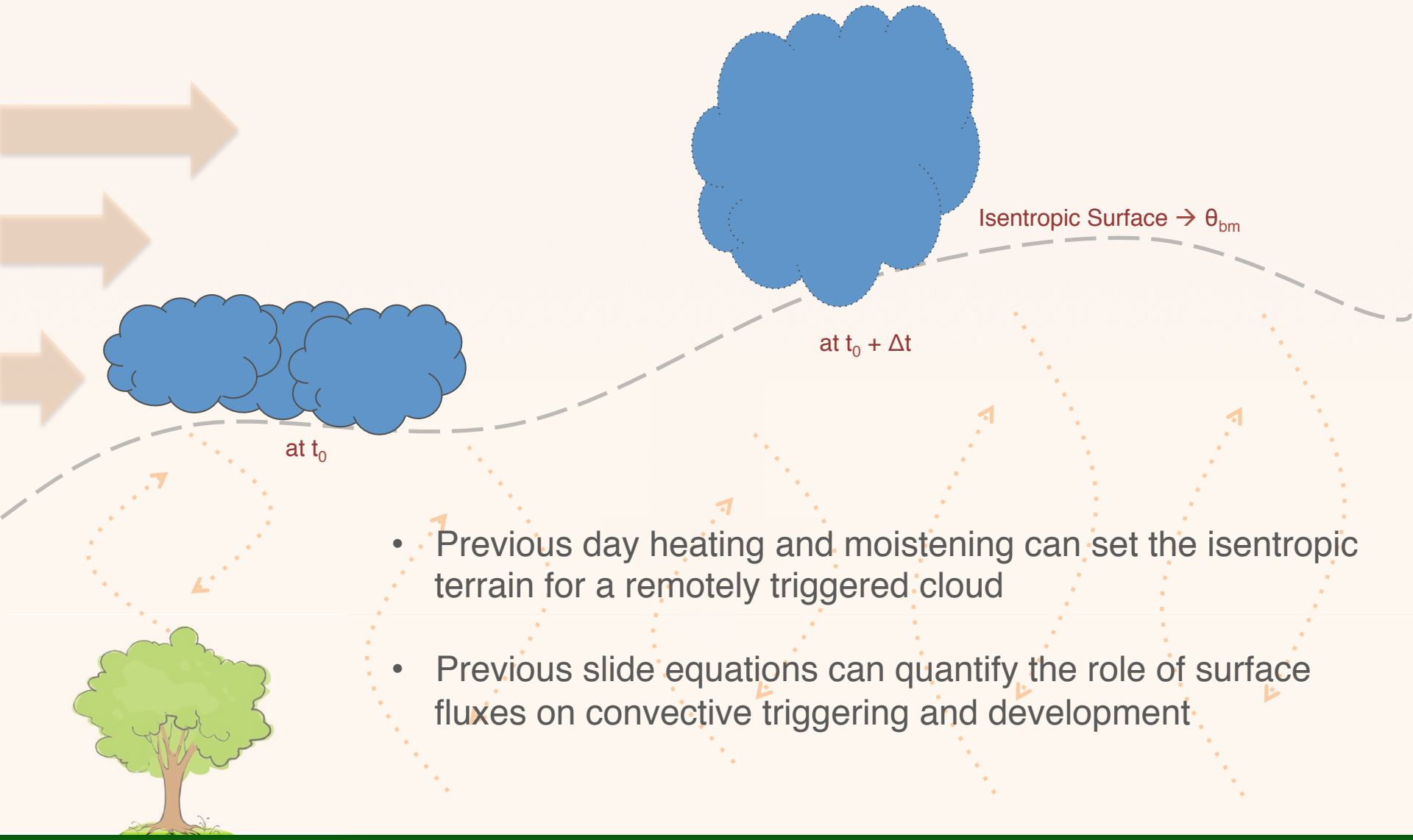
How did you get to **Triggering** (an event)

$$\frac{\partial \theta_{def}}{\partial t} = \left.\frac{\partial \theta_{BM}}{\partial t}\right|_{evap} - \frac{H_{sfc}}{\rho c_p dz} + \frac{H_{ent}}{\rho c_p dz} + \left.\frac{\partial \theta_{def}}{\partial t}\right|_{adv} + \left.\frac{\partial \theta_{def}}{\partial t}\right|_{diab}$$

What produced **Intensification** (a process)

$$\omega_{\theta_{BM}} = \left(\frac{\partial p}{\partial t}\right)_{\theta_{BM}} + V \cdot \nabla_{\theta_{BM}} p + \frac{\partial p}{\partial \theta}\frac{d\theta}{dt}$$

Merges concepts from RH-tendency, mixing diagrams, TFS/AFS, and HCF




- Previous day heating and moistening can set the isentropic terrain for a remotely triggered cloud
- Previous slide equations can quantify the role of surface fluxes on convective triggering and development