**Introduction:** The NASA-Unified Weather Research and Forecasting Model (NU-WRF) was initialized using varying soil moisture conditions that were derived from uncoupled Land Information System (LIS) “spin-ups,” which varied in forcing quality and greenness fraction across the operational spectrum.

**Background:** It has been shown that land-atmosphere (L-A) interactions are governed by a series of positive and negative feedback loops that can be related using the Local L-A Coupling (LoCo) process chain, as follows:

\[
\Delta SM \rightarrow \Delta EF \rightarrow \Delta PBL \rightarrow \Delta ENT \rightarrow \Delta ED \rightarrow \Delta Precip/Clouds
\]

The current representation of soil moisture in operational numerical weather prediction models is inadequate for properly accounting for the effects of heterogeneity in soil moisture that can potentially impact the forecast. Therefore, we use uncoupled LIS runs to more accurately simulate the initial soil moisture field before the forecast begins.

**LIS Variations:**

- **Atmospheric Forcing:**
  - GDAS – coarse, global, 0.3-deg
  - NLDAS – best observed precip, 0.125-deg
- **Green Vegetation Fraction:**
  - Climatological: Monthly, satellite-based @ 3 km
  - Real-time: Daily, VIIRS-based @ 3 km

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**Model Configuration:**

- **Version:** NU-WRF version 8 patch: 4
- **Physics options:**
  - Microphysics: Goddard microphysics
  - PBL Scheme: MYNN 2.5
  - Radiation: RRTM
  - Land Surface Model: Noah
- **Domain Info:**
  - LIS SGP (TX/OK/KS/NE): 1 km grid spacing
  - 60 vertical levels – eta coordinate

**Initial Atmospheric Conditions:**

- NARR

**Why is this important?**

Weather events are strongly related to the surface conditions:
1. Surface conditions dictate energy fluxes.
2. Energy fluxes determine the strength of convective mixing, and, therefore, the height of the planetary boundary layer (PBL).
3. The height of the PBL influences the vertical positioning of the lifting condensation level (LCL), or the height at which a parcel lifted from the surface will achieve saturation while retaining its moisture content and potential temperature.

- In the upper layers of the boundary layer, air interacts with the free troposphere via entrainment.
- Once clouds are formed, the radiation budget is effected (shortwave and longwave), and microphysical processes introduce new sources of latent heat energy

**Therefore,**

The height of the LCL is a critical component in producing a realistic forecast. Moreover, if the LCL is directly related to surface temperature and moisture, these also become critically important.

**Model Forecast Difference Examples:**

**SOIL MOISTURE INITIALIZATION INTERCOMPARISON**

- GDAS
- VIIRS
- CLM
- NARR

**Future Work:**

- Continue investigation following LoCo Process Chain
- Develop further model approach to visualize both the impact from the surface and the impact from above the PBL
- Incorporate SMAP data via DA approaches
- Simulate additional case studies in more convectively active environments
- Simulate case studies with seasonal variations to highlight the impact of GVF

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