**Motivation**

- Process-level understanding of L-A Coupling is critical to model evaluation and development.
- The convective PBL serves as a key component and modulator of L-A interactions, such that PBL structure and evolution are key observables of Earth's coupled system.
- In-situ (e.g. radiosonde) and ground based approaches to PBL remote sensing are limited and discontinuous in nature.

Here we assess the capabilities and limitations of routine PBL retrieval from satellite in terms of resolution and accuracy needed to be useful for L-A, hydrology, cloud/convection, pollution, or model development applications.

**Satellite Instruments**

**IR Sounding/AIRS:** Atmospheric Infrared Sounder aboard NASA's Aqua satellite. AIRS uses a hyperspectral infrared spectrometer with over 2300 channels to retrieve vertical profiles of temperature and humidity. Two recent algorithm versions (V6 and 6.28) are compared in this study.

**IR Sounding/GOES:** GOES/GOES-R retrieves thermodynamic soundings using 19-channels in the IR with high temporal (hourly+) and spatial (<10km) resolution, but with broad weighting functions and coarse vertical resolution.

**Lidar/CALIPSO:** Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations. Composed of Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP), Infrared Imaging Radiometer (IIR), and Wide Field Camera (WFC). CALIOP (used here) uses a laser to measure backscatter from aerosols (Hostetler et al. 2006) at 532 nm.

**Lidar/CATS:** Cloud-Aerosol Transport System aboard the International Space Station (ISS). CATS uses high repetition rate lasers to measure backscatter from aerosols (Yorks et al. 2015) at 1064 nm.

**GPS/COSMIC:** GPS Radio Occultation (RO) measures atmospheric refractivity (N) profiles that can be used to infer temperature and humidity.

**Conclusion:**

- The PBL remains a major gap in our observational suite, as today’s spaceborne instruments cannot reach the required targets in terms of accuracy or resolution.
- There is a lack of focused effort or planning (short or long-term) in place for improving lower tropospheric retrievals over land.
- Other components of WEC cycle monitoring (e.g. GPM, SMAP, GRACE, SWOT) are now in place, and thus the importance of PBL information will continue to rise.

**Summary of Current Capabilities**

Today’s spaceborne instruments have limited PBL sensitivity:

- Hyperspectral Sounders (e.g. AIRS/AMSU) are the most capable in terms of spectral resolution but have not been tailored for PBL sounding and are confounded by surface emissivity.
- Lidar (e.g. CALIPSO) can obtain high vertical resolution, but is limited in return time and spatial sampling and does not provide thermodynamic state information.
- Geostatistical (e.g. GOES-R) have frequent temporal sampling, coarse spectral bands and PBL resolution.
- GPS-RO (e.g. COSMIC) retrieves profiles, but is limited in PBL by sampling and confounding issues related to humidity/temperature.

Thus, each of these sensors has some advantages, but also considerable limitations that make them impractical for PBL studies.

**Future Initiatives**

- 2017 NRC Decadal Survey: 2 white papers submitted.
  - Scientific and societal importance of PBL
  - Measurement requirements and potential instrument/mission approaches
- LoCo Working Group (GEWEX): Stressing importance of PBL metrics and variables for model development (CMIP6)
- NASA-GSFC Science Task Group: Challenged with assessing current status and short-term plan for PBL monitoring from space