Dynamics of the planetary boundary layer height and lifting condensation level from aircraft observations

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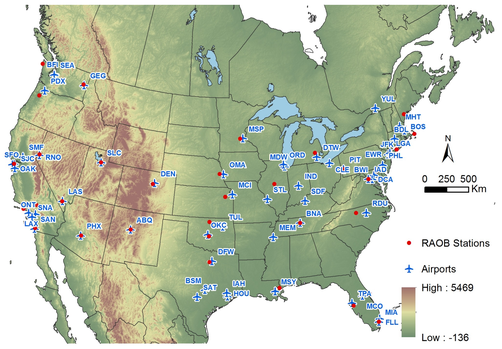
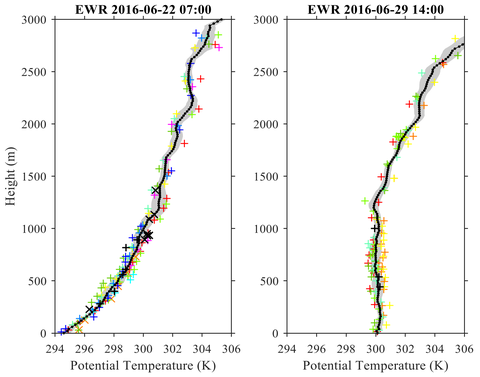
Research Goals

- Develop a consistent data record of planetary boundary layer (PBL) profiles that resolves the diurnal cycle;
- Compute and evaluate the planetary boundary layer height (PBLH);
- Examine the temporal dynamics of PBLH, lifting condensation level (LCL), and soil moisture (SM).

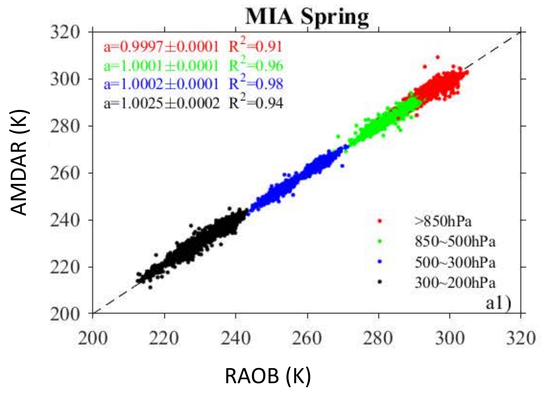
AMDAR/ACARS data



Data processing

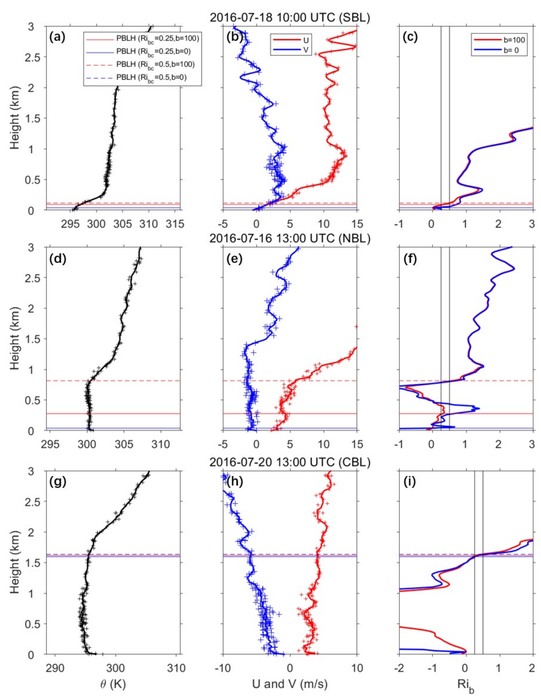


Comparison to radiosonde data

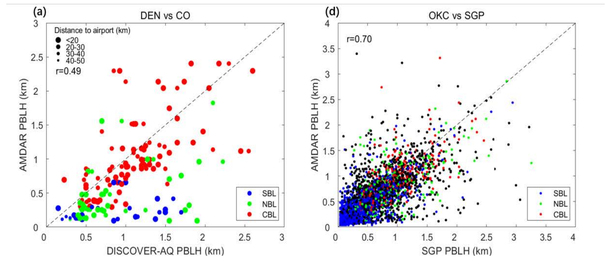


PBLH

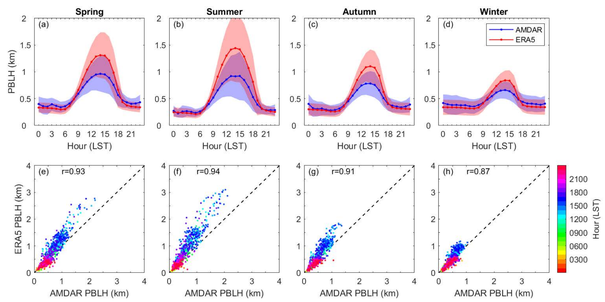
The bulk Richardson number method



Evaluation

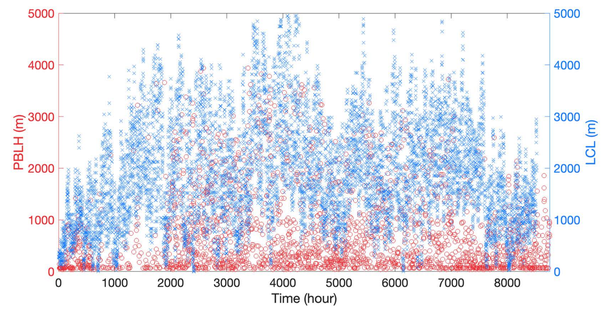


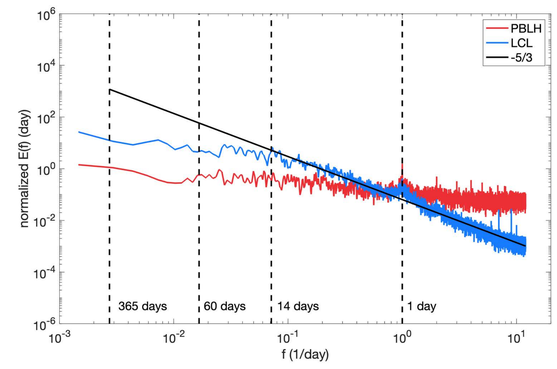
Diurnal variations and comparison to ERA5



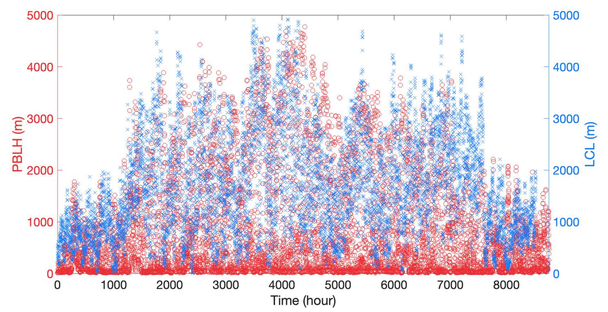
PBLH vs LCL

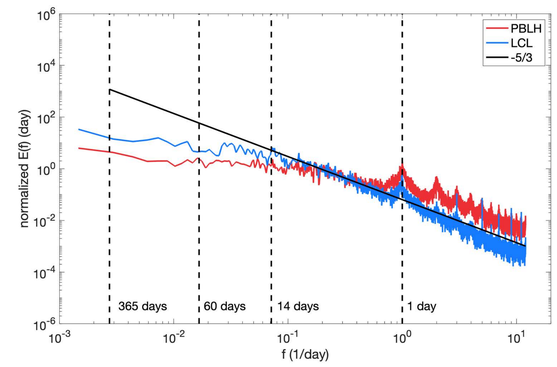
AMDAR





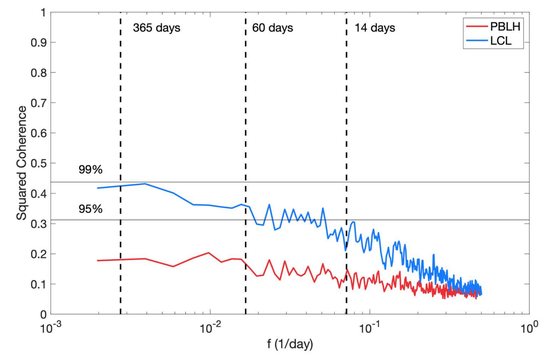
ERA5



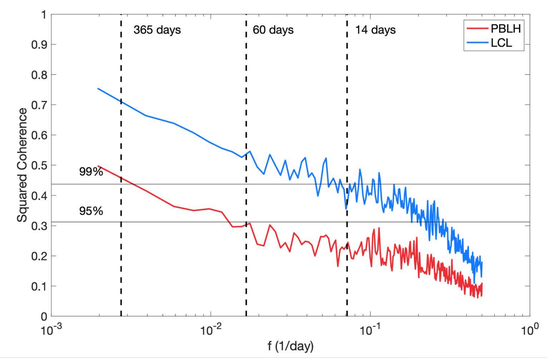


Coherence with Soil Moisture (SM)

AMDAR



ERA5



Conclusions

- A data-record of PBL profiles and PBLH is developed based on AMDAR/ACARS data. The data quality is assessed using independent datasets.
- The temporal dynamics of PBLH, as well as those of LCL, are investigated using spectral analysis. The PBLH spectrum shows a near white noise behavior while the LCL spectrum exhibits stronger reddening at the weather scales. As a result, there is less coherence between PBLH and soil moisture compared to the coherence between LCL and soil moisture.
- The ERA5 reanalysis product not only overestimates the magnitude of PBLH, but also misrepresents the temporal dynamics of PBLH. The ERA5 PBLH shows too much persistence and too strong coherence with its soil moisture.

References:

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