



Development of the Best Estimate Planetary Boundary Layer Height Value-added Product

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Introduction

- ❖ The planetary boundary layer height (PBLHT) has been widely determined using *in situ* radiosonde data. However, radiosonde data has poor temporal resolution and is subject to sampling error
- ❖ Lidar remote sensing provides high-temporal and continuous observations. PBLHT can be determined from several methods including methods using gradients of aerosol backscatter intensity from lidar measurements, methods using variance of vertical air motion from Doppler lidar measurements, and methods using temperature and humidity profiles from Raman lidar measurements
- ❖ Recommendation for a PBLHT-BE and/or PBLHT-QC that applies QC to each technique and creates QC Flags in a merged product

Different Methods to Derived PBLHT

- **PBLHT-Sonde:**

- Heffter method (Heffter 1980)
- Liu-Liang method: convective, neutral, and stable regimes (Liu and Liang 2010)
- Bulk Richardson Number method (Sorensen 1998)

- **PBLHT-MPL**

- Wavelet Covariance of lidar backscatter (Sawyer and Li 2013)

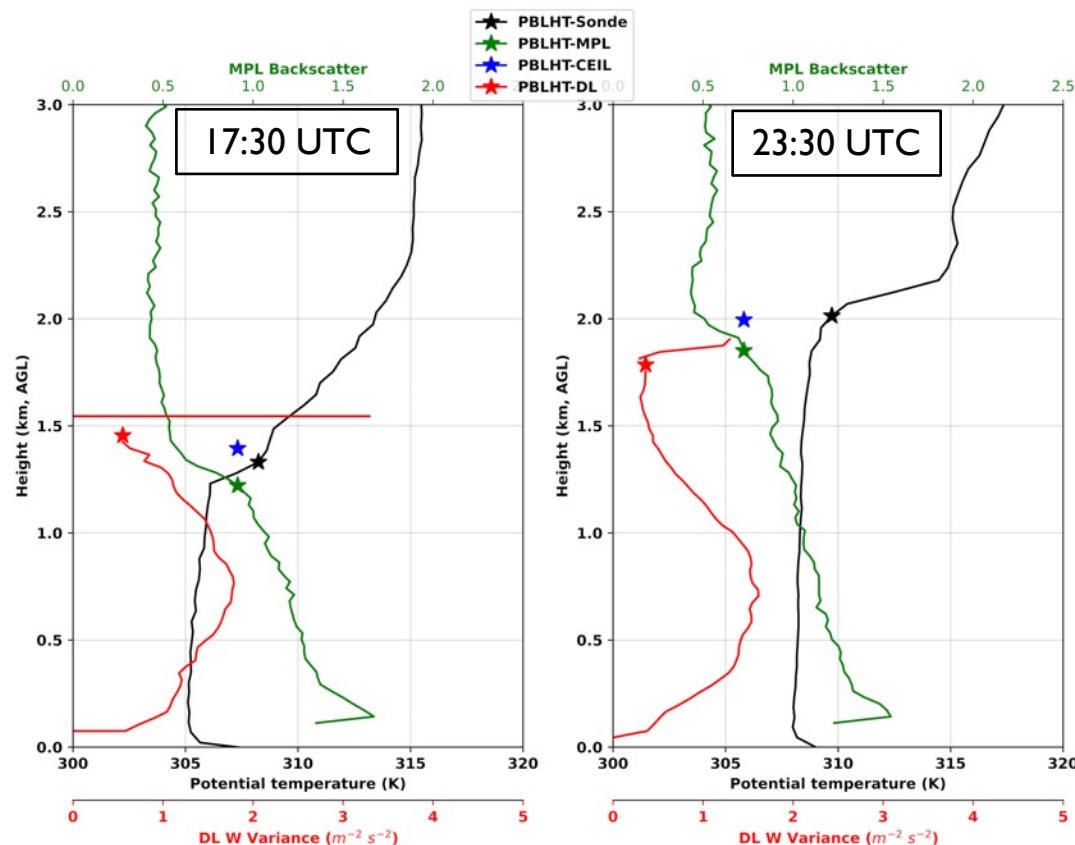
- **PBLHT-CEIL**

- CL31 built-in software using an enhanced gradient method

- **PBLHT-DL**

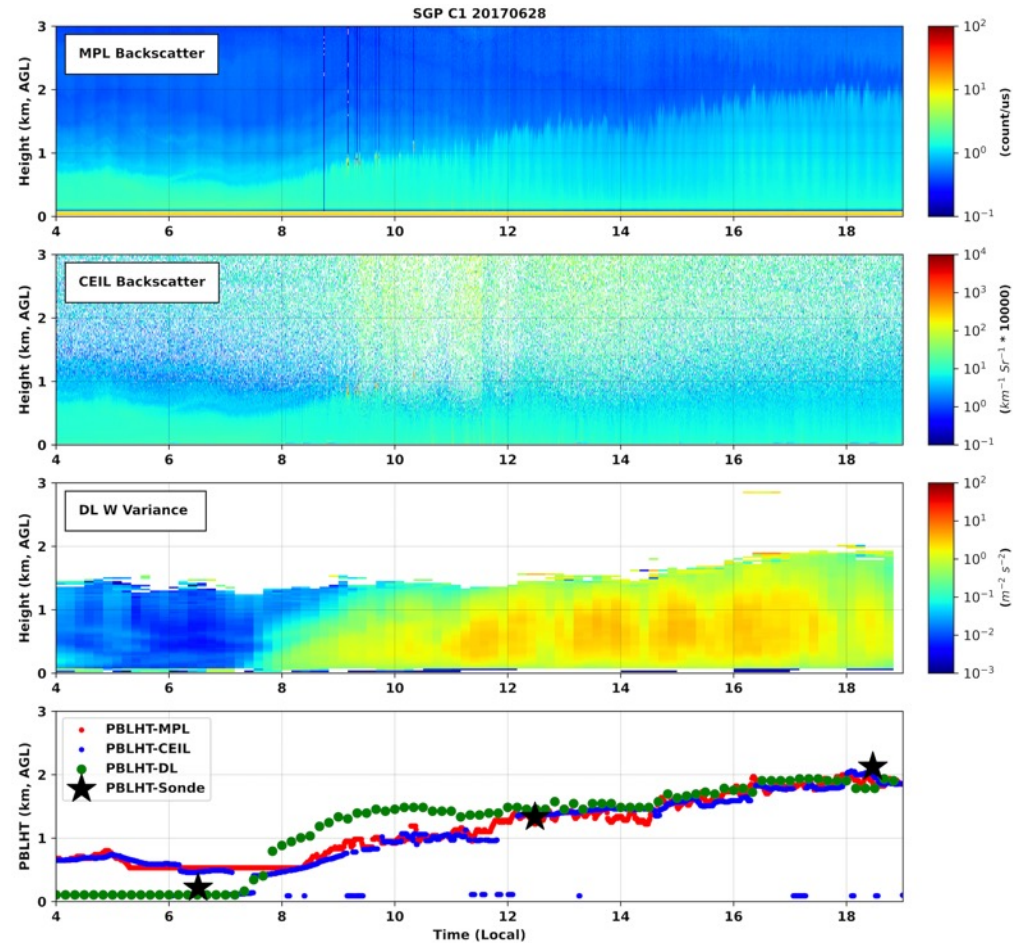
- WVariance threshold of $0.04 \text{ m}^{-2}\text{s}^{-2}$ (Berg et al., 2017)

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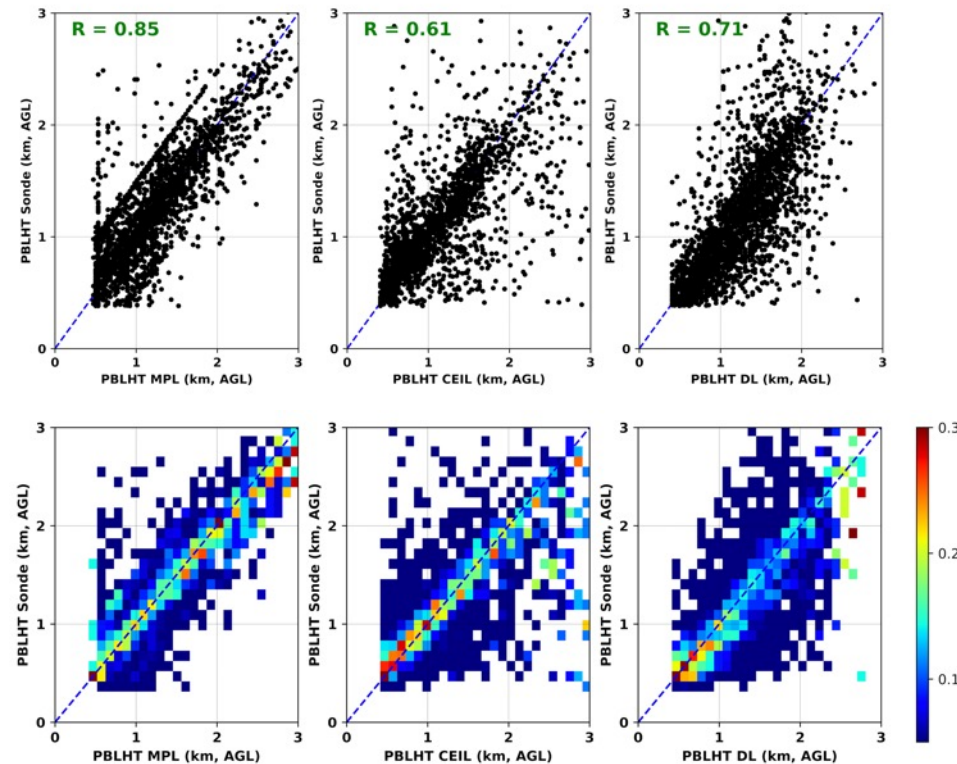
Different Methods to Derived PBLHT

Measurements	Characteristics
Sonde	Reliable Poor temporal resolution
Micropulse Lidar	Strong aerosol signal Overlap correction issues below 400m; elevated aerosol layers
Ceilometer	Real-time display and monitoring Elevated aerosol layers
Doppler Lidar	Good for PBL development state Low SNR > 2km



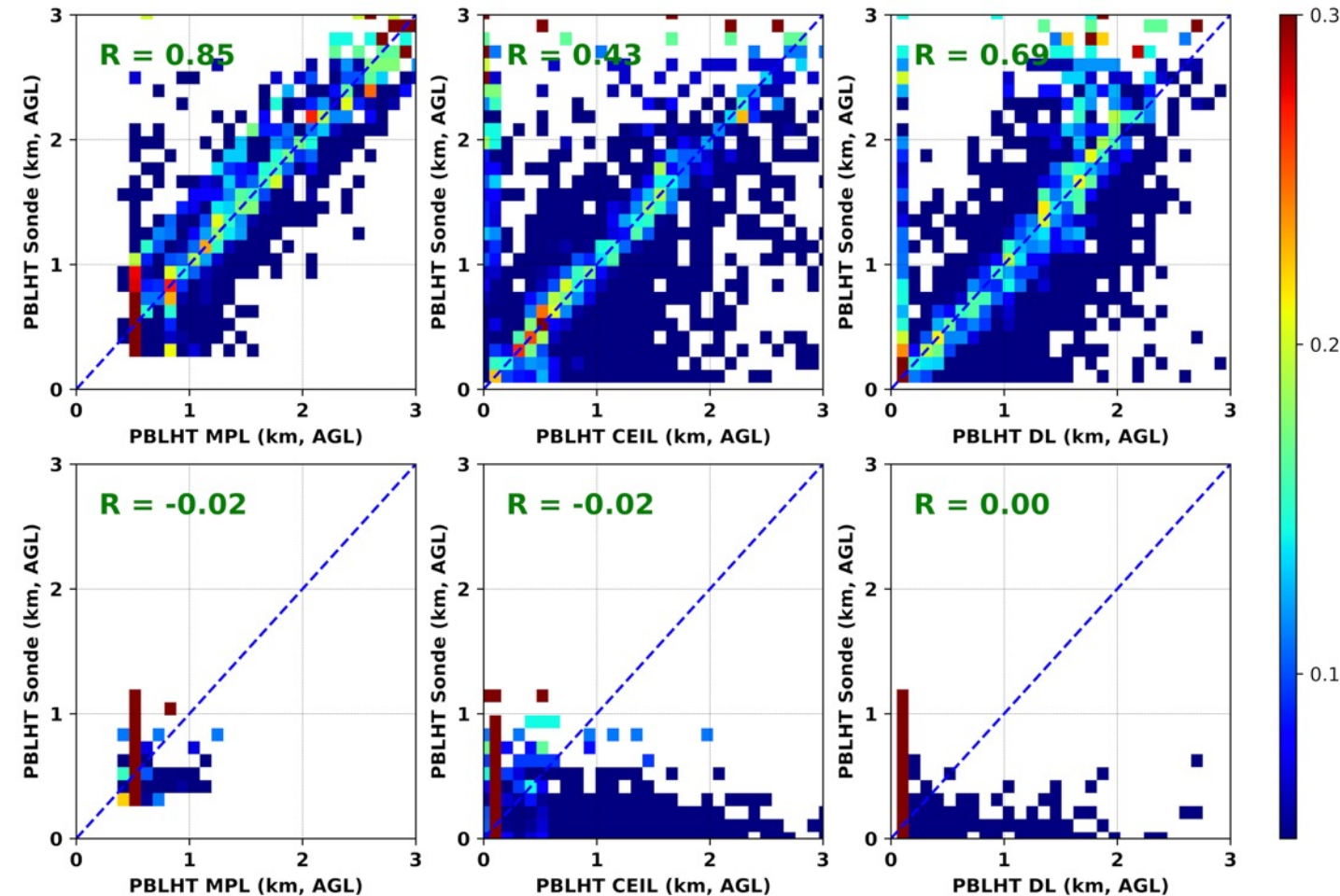
Different Methods to Derived PBLHT

VAPs	ARM sites
PBLHT-Sonde	SGP(2001-2021), ENA(2013-2021), NSA(2002-2021), AMF field campaigns
PBLHT-MPL	SGP (2014-2021), CACTI
PBLHT-CEIL	SGP (2012-2021), ENA (2013-2021), NSA (2013- 2021), AMF field campaigns
PBLHT-DL	SGP (2010-2021)
PBLHT-RL	Under development



Comparisons of PBLHT-MPL, PBLHT-CEIL, PBLHT-DL with PBLHT-sonde at the SGP site under neutral or convective PBL regimes. Daytime data between 8:00-19:00 local time from 2015 -2020 are used

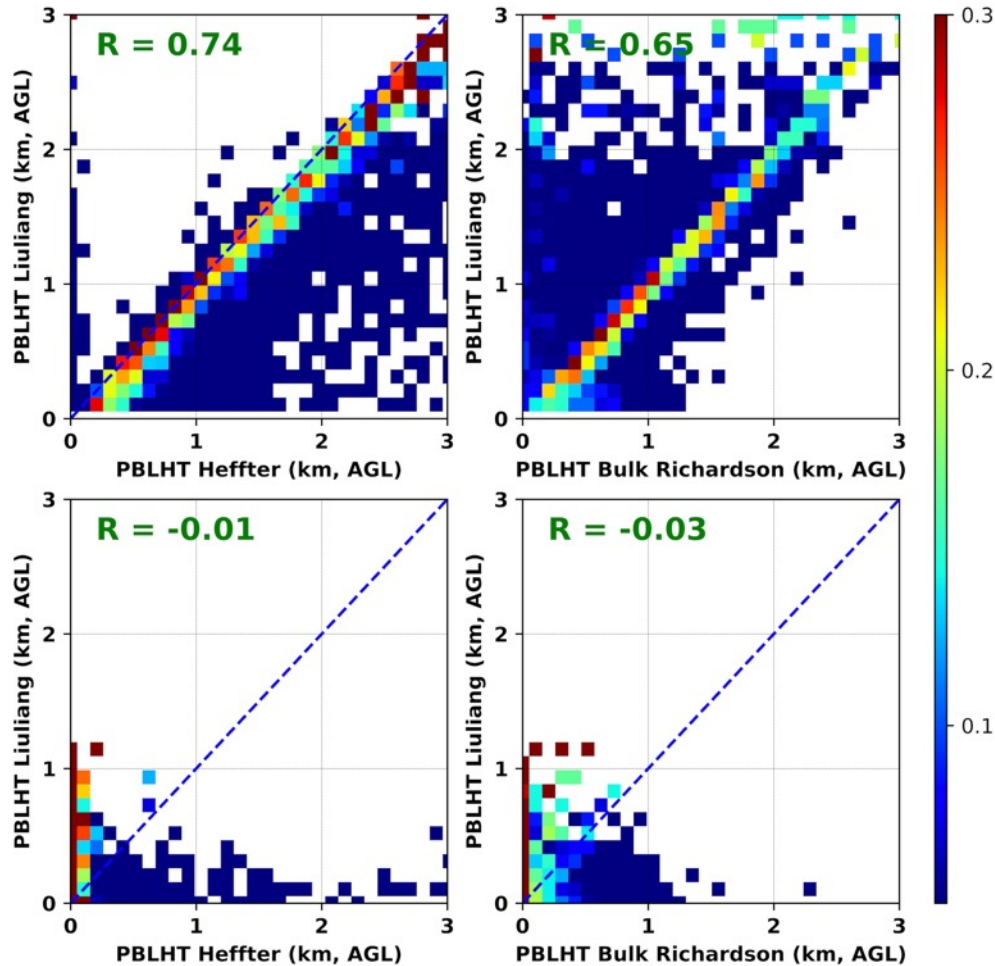
Convective and Neutral vs. Stable PBL Regimes



**Neutral and
Convective
PBL Regimes**

**Stable PBL
Regime**

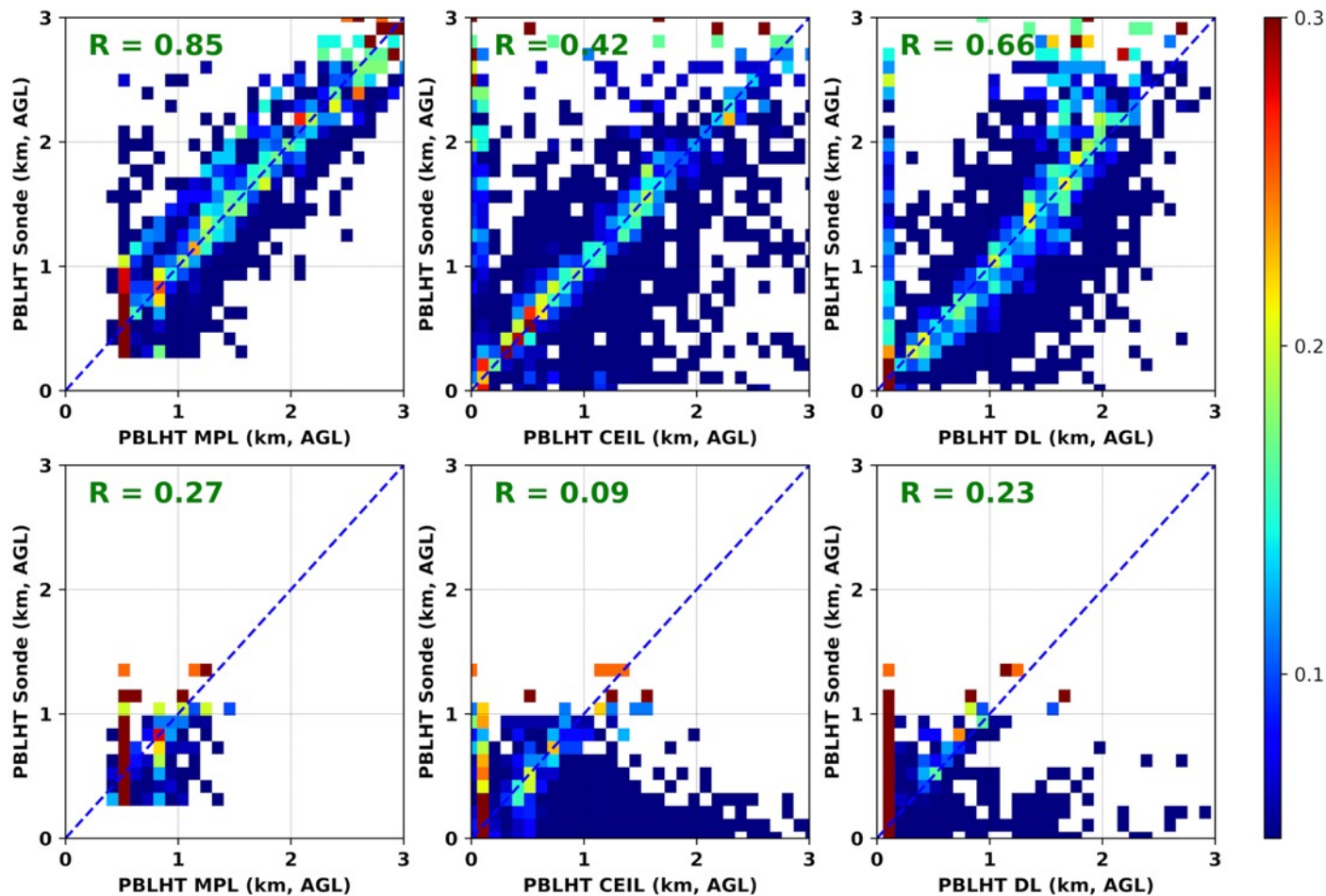
Convective and Neutral vs. Stable PBL Regimes



**Neutral and
Convective
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**Stable PBL
Regime**

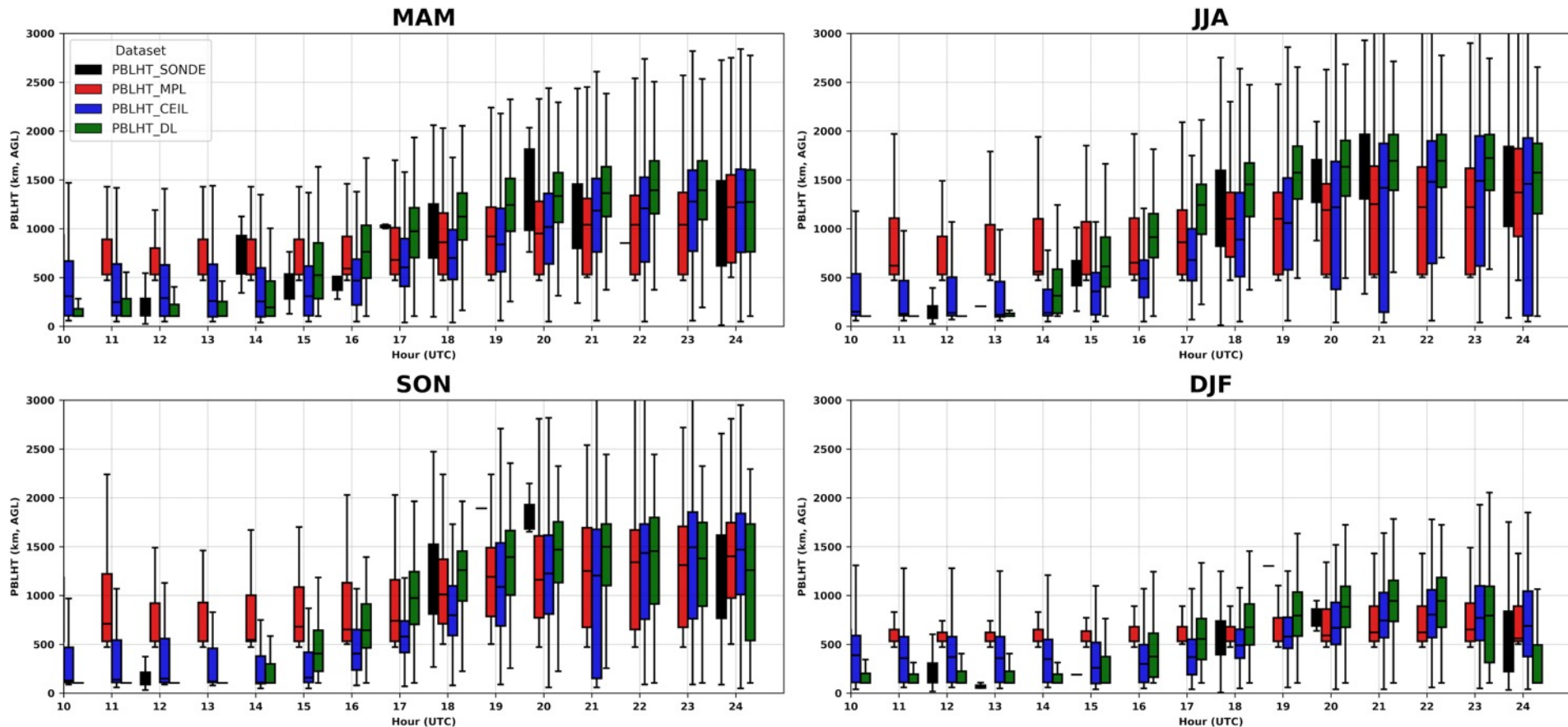
Daytime and Nighttime



Daytime

Nighttime

Diurnal Cycles of PBLHTs at SGP



- PBLHTs from lidar measurements show similar diurnal cycles and seasonal variations as PBLHT SONDE
- During daytime, generally $\text{PBLHT_DL} > \text{PBLHT_CEIL} > \text{PBLHT_MPL}$

Summary

- PBLHT_MPL and PBLHT_DL VAPs were developed and are available at the ARM SGP central facility site and for the CACTI field campaign. PBLHT_RL is under development
- PBLHT from different lidar measurements compare well with PBLHT_SONDE under neutral and convective PBL regimes but has no correlation with PBLHT_SONDE under the stable PBL regime.
- In general PBLHTs from lidar measurements show similar diurnal cycles and seasonal variations as PBLHT SONDE

References and Acknowledgement

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