Comparison of Mixed Layer Heights from Airborne High Spectral Resolution Lidar, Ground-based Measurements, and the WRF-Chem Model during CalNex and CARES

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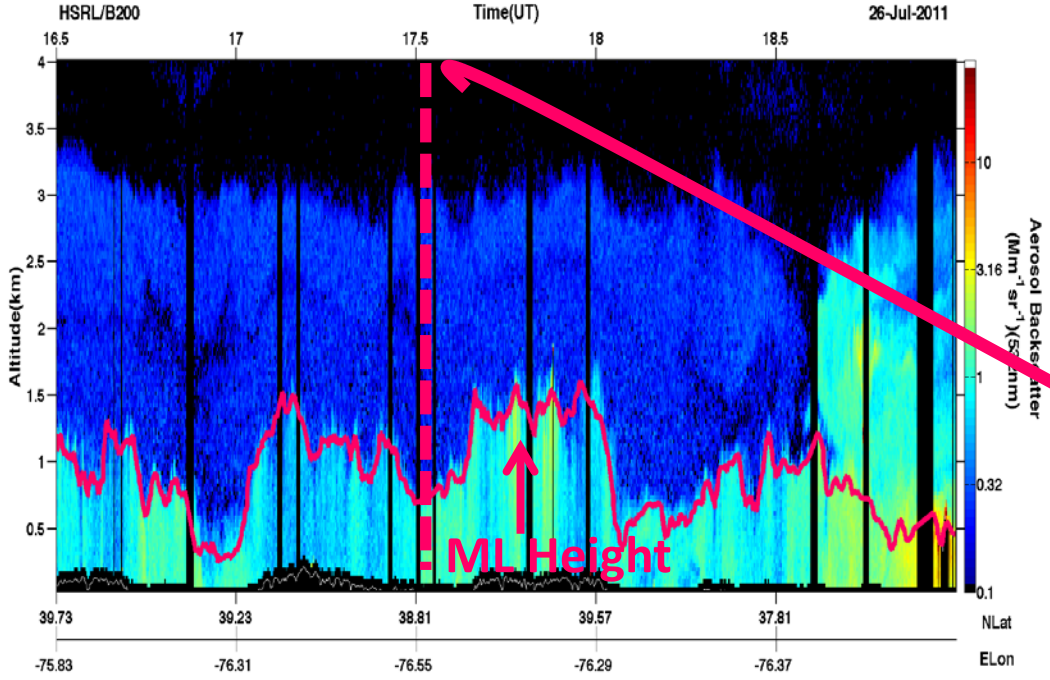
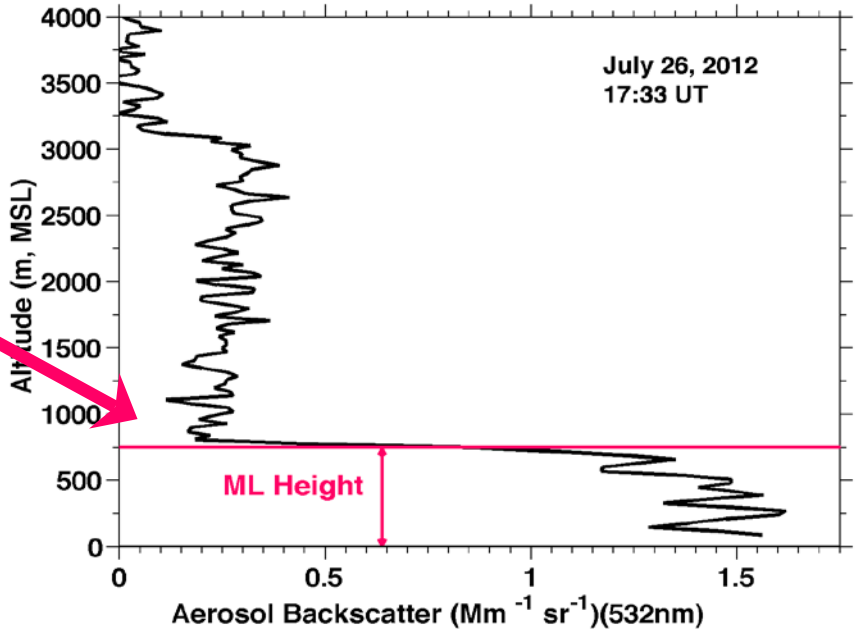
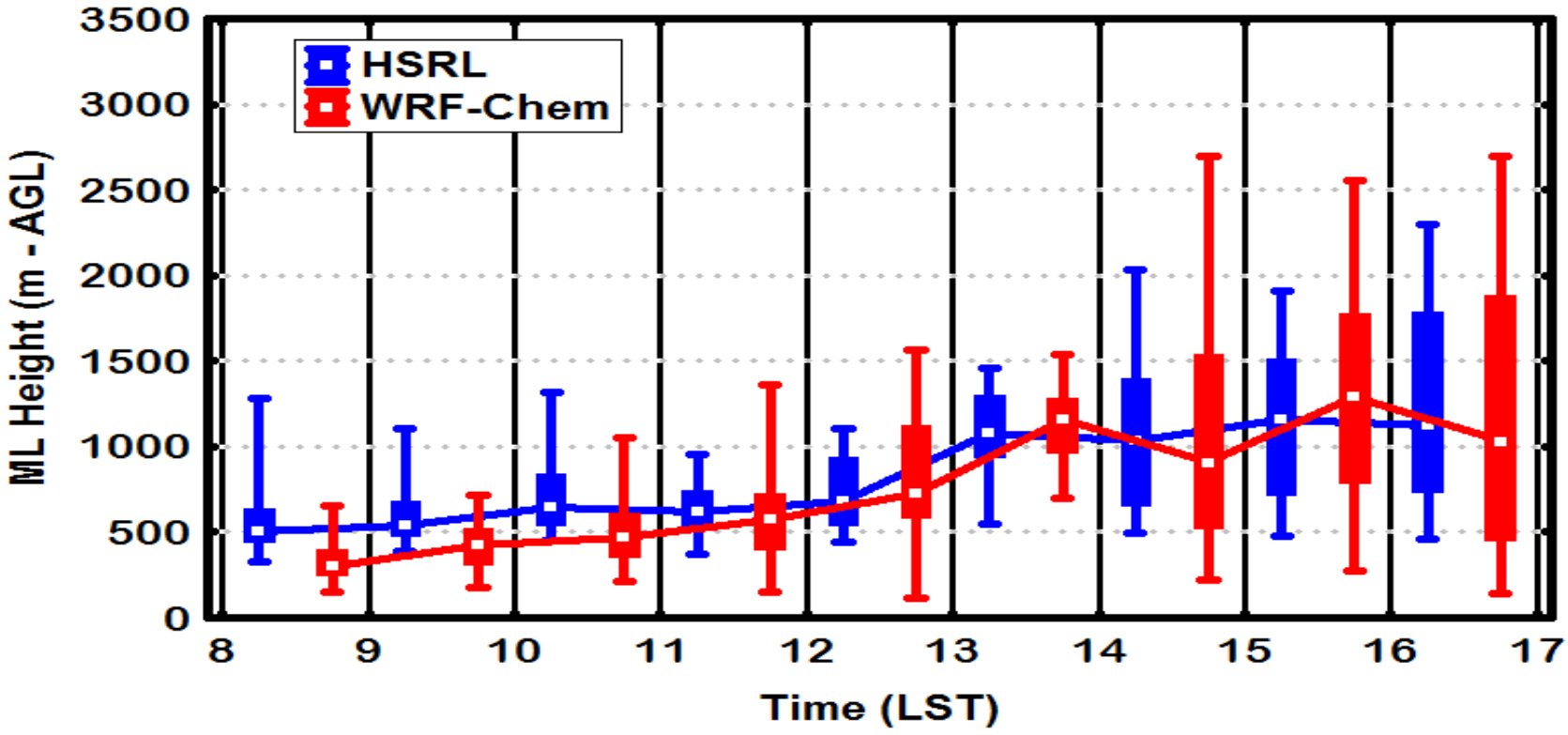
HSRL data used to find height of Mixed Layer

- PBL can be divided into discreet layers. For example, the daytime mixed layer (ML), also known as the convective boundary layer (CBL), is a subset of the PBL in which convectively driven eddies mix thermodynamic conditions, resulting in roughly uniform vertical profiles of moisture and potential temperature within that layer (Stull, 1988)
- ML heights derived from daytime-only cloud-screened aerosol backscatter profiles measured by the airborne HSRL; ML heights are a good proxy for PBL heights during the daytime
- Automated technique uses a Haar wavelet covariance transform with multiple wavelet dilations to identify sharp gradients in aerosol backscatter at the top of the ML (adapted from Brooks, JAOT, 2003)
- HSRL ML heights combine results from automated algorithm and manual inspection of HSRL backscatter profiles



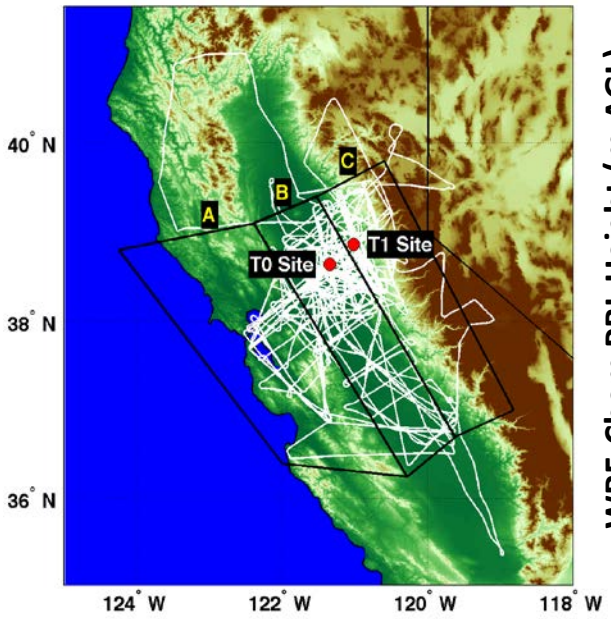


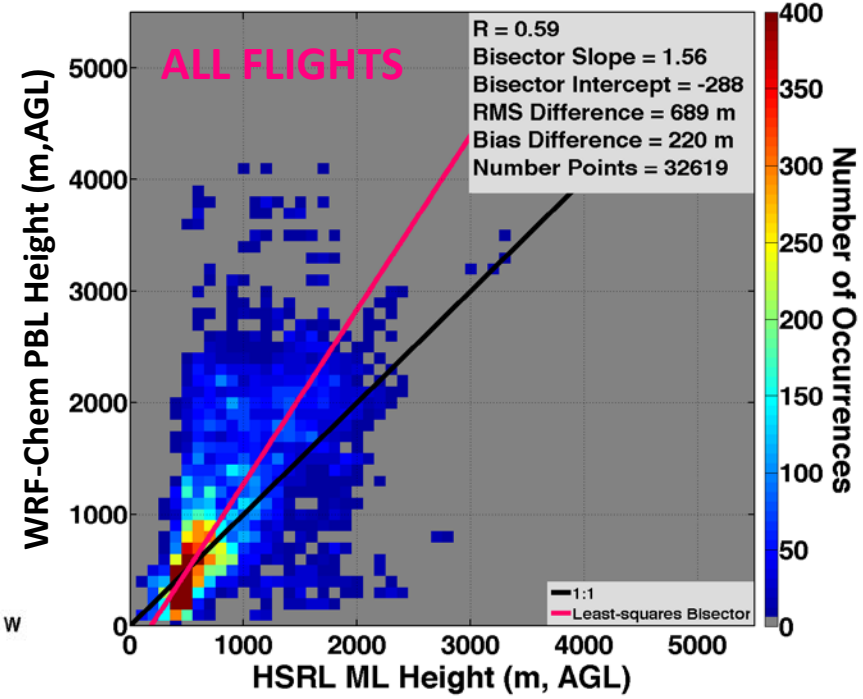
HSRL ML and WRF-Chem PBL Comparisons



- Diurnal variation for HSRL ML heights and WRF-Chem PBL heights
- Lines connecting the white dots denote median height for each hour
- Largest difference is ~200 m during the early morning hours and could be attributed to a residual layer

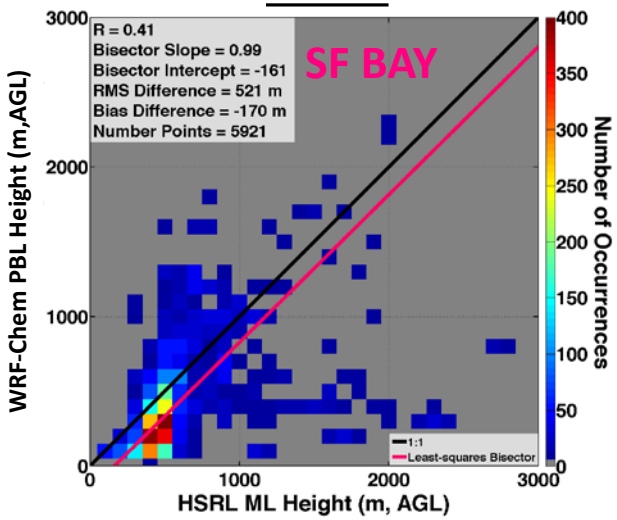
HSRL ML and WRF-Chem PBL Comparisons



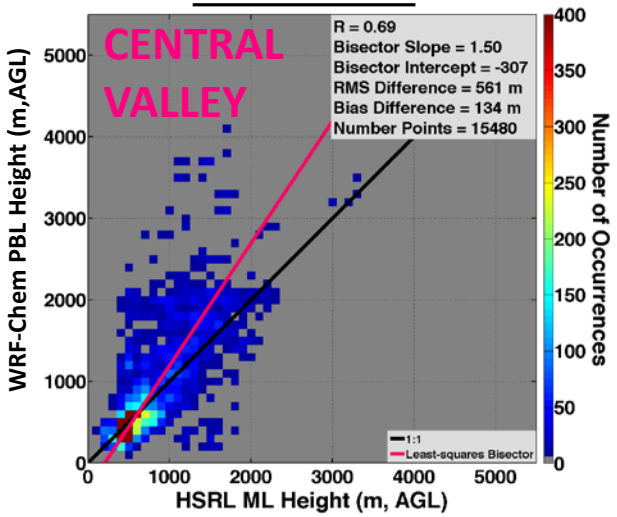


- Comparisons over the Central Valley performed best, whereas the complex terrain and water affected comparison results over Sierra Nevada and SF Bay

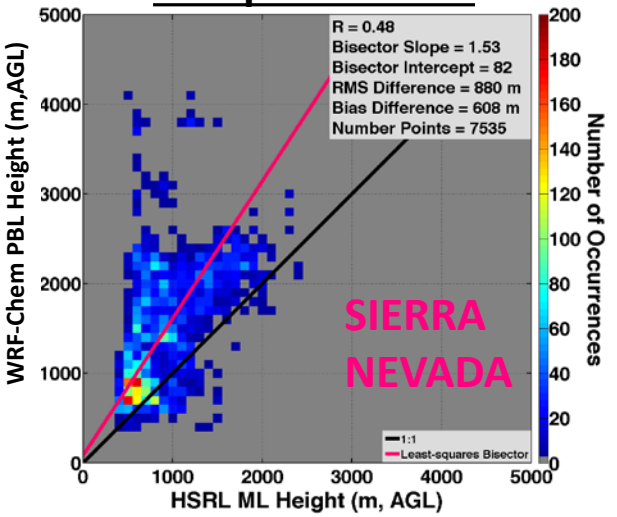
Water



Flat Terrain

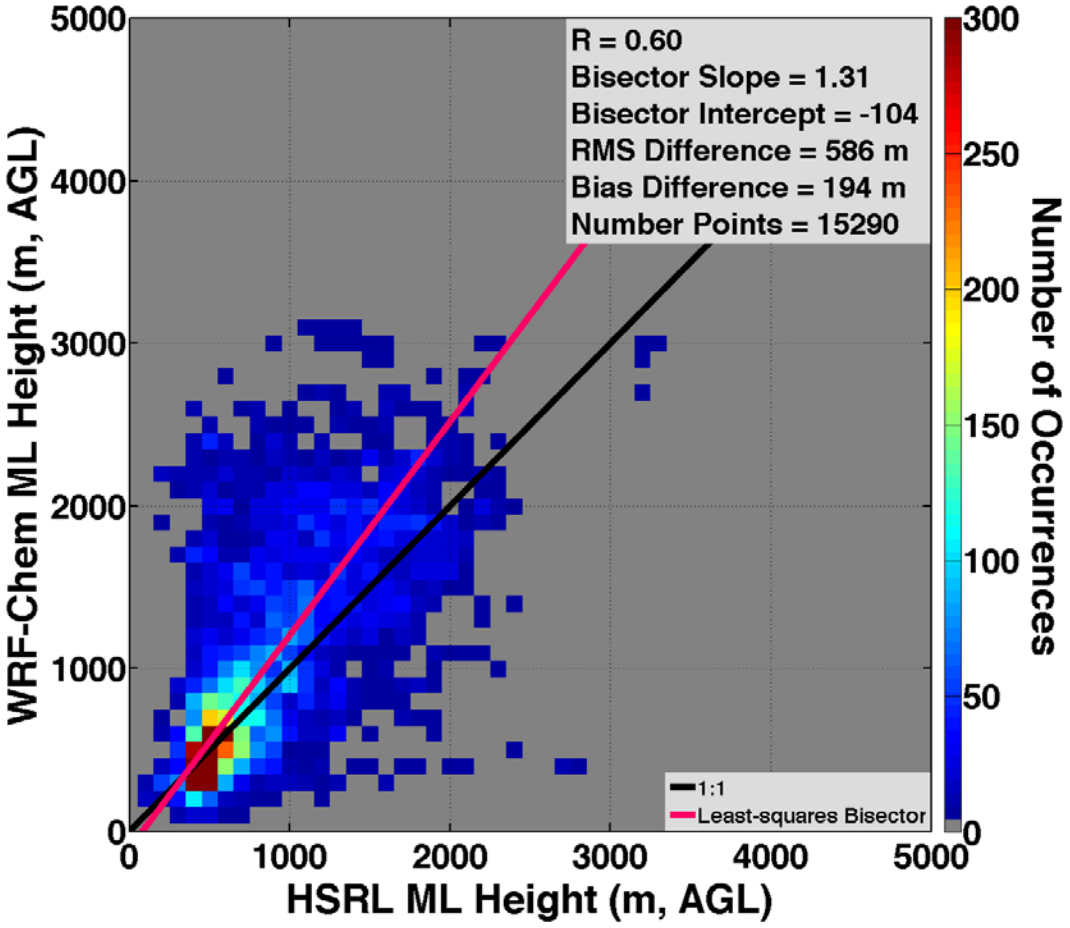


Complex Terrain



ML Heights: HSRL compared to WRF-Chem

- Simulated aerosol backscatter from the WRF-Chem along the HSRL flight tracks was processed through the wavelet covariance transform algorithm to produce ML heights using the same methodology as used for the HSRL-1 ML heights



Summary

- PBL height is a key parameter for simulating climate processes and assessing model simulation of aerosol pollutant concentrations and transport
- HSRL ML heights were important for assessing the WRF-Chem model and gave insight into the differences in PBL heights produced by different techniques (aerosol gradients vs. potential temperature)
- The small difference between the techniques supports the use of the ML computed from aerosol backscatter gradients as a good proxy for the PBL
- Suggests that other factors in the modeling and/or HSRL ML height retrievals were responsible for differences between the HSRL and WRF-Chem PBL heights

Additional Studies

- Currently analyzing the marine boundary layer for TCAP (2012), as well as data from other field campaigns that HSRL-1 and 2 have participated in
- Comparisons of HSRL ML heights to PBL heights from GEOS-5 and ECMWF-MACC