



EarthCARE Calibration and Validation Using an Airborne HSRL



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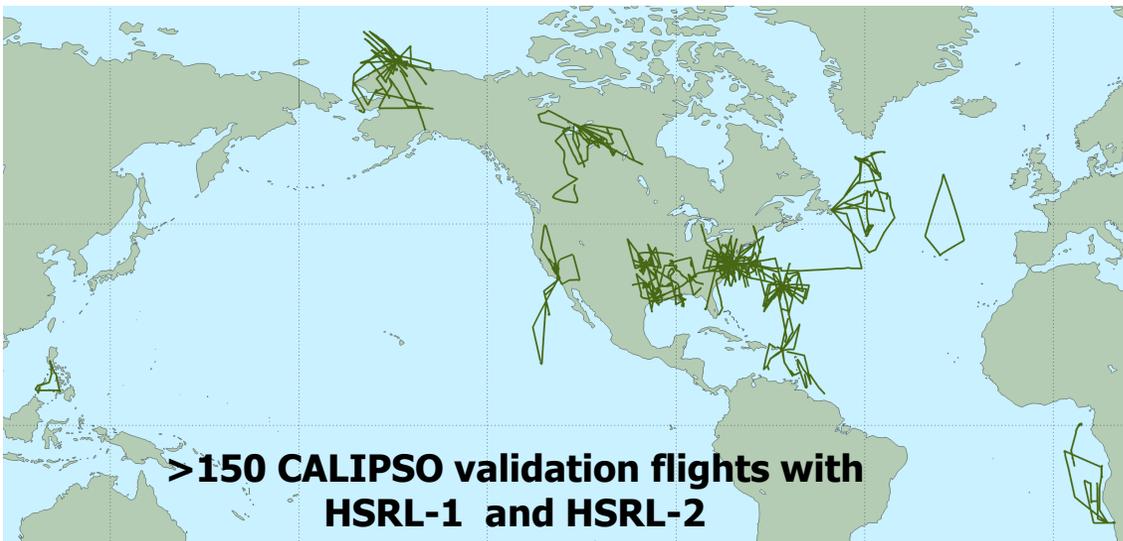
NASA Langley Research Center (LaRC)

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Science and Validation Workshop
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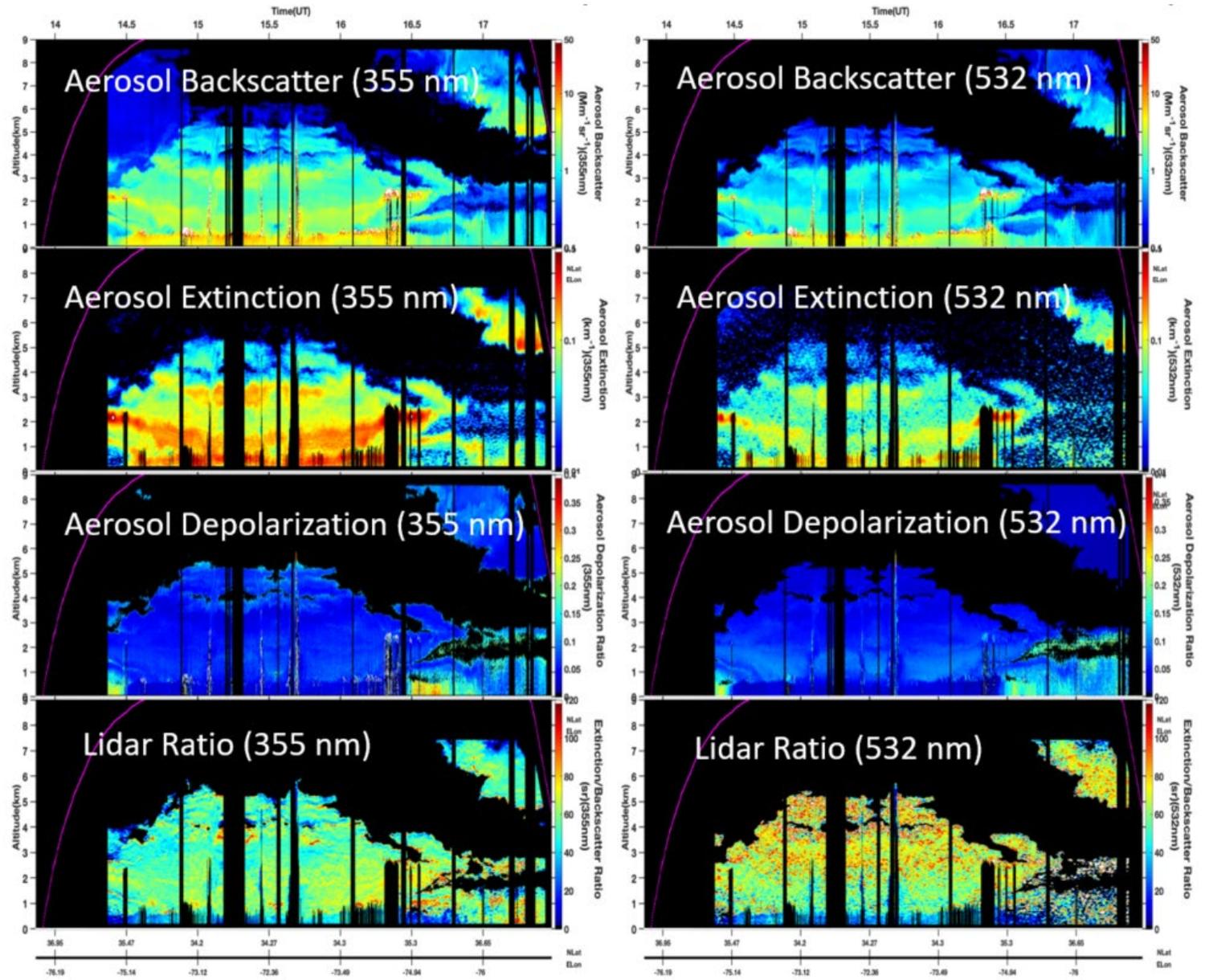
NASA Langley (LaRC) HSRL team participation in ATLID validation focuses on the use of HSRL-2 measurements



- HSRL-2 is LaRC's second-generation airborne HSRL
 - $3\beta + 2\alpha + 3\delta$ aerosol/cloud lidar
 - HSRL capability at 355 and 532 nm
 - Elastic backscatter lidar capability at 1064 nm
 - Polarization sensitive at 355, 532, and 1064 nm
 - Ozone DIAL capability
 - Ocean profiling capability (1-m depth resolution)
 - Particulate backscatter (355 and 532 nm)
 - Diffuse attenuation coefficient (355 and 532 nm)
 - CDOM fluorescence
 - Chlorophyll fluorescence
- Flown on 16 field deployments starting in 2012
- Aircraft: King Air, G-III, G-V, P3, ER-2
- Often deploys with one or more passive remote sensors, especially polarimeters and spectroradiometers



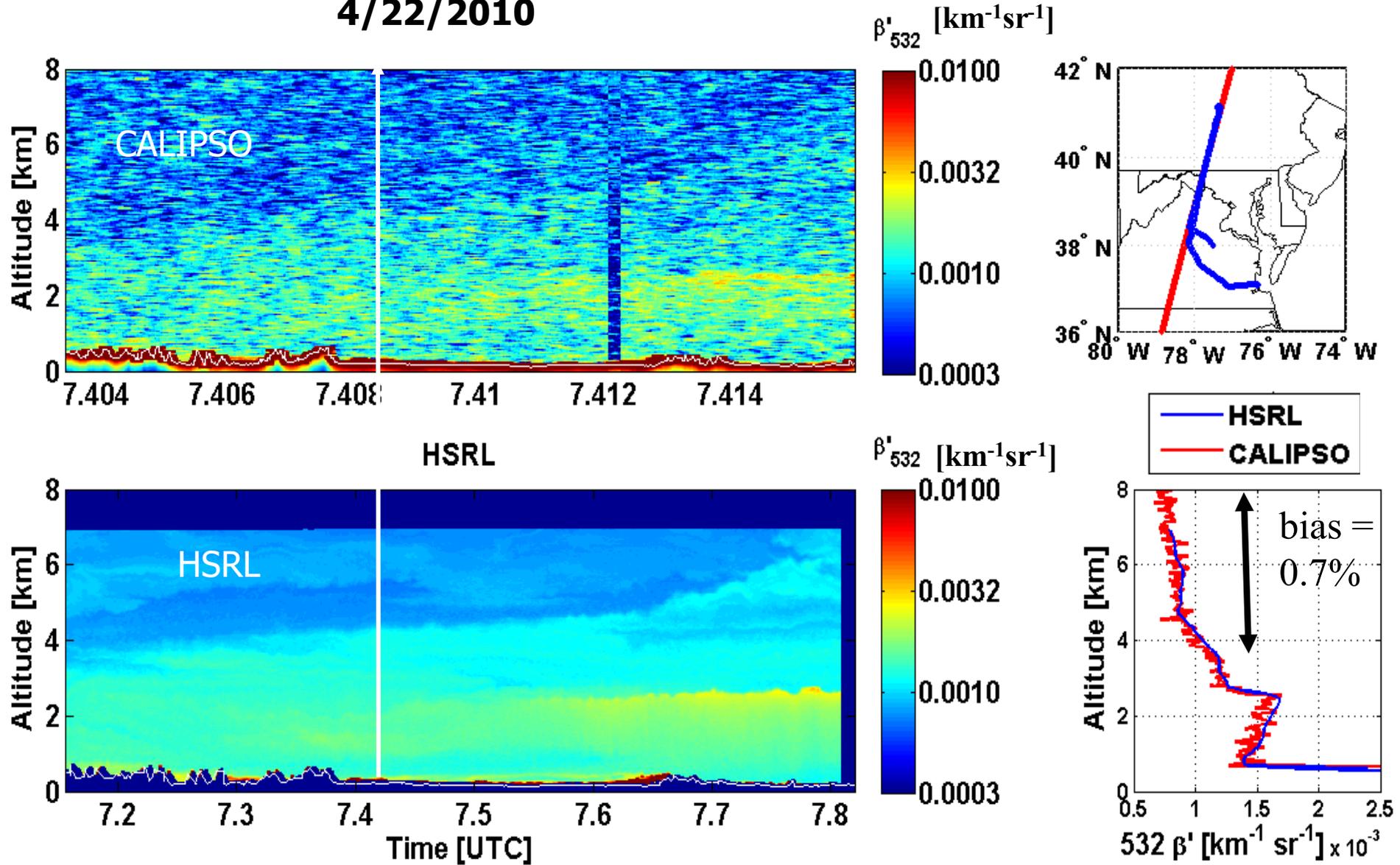
HSRL-2 measurements are relevant to ATLID validation in several ways



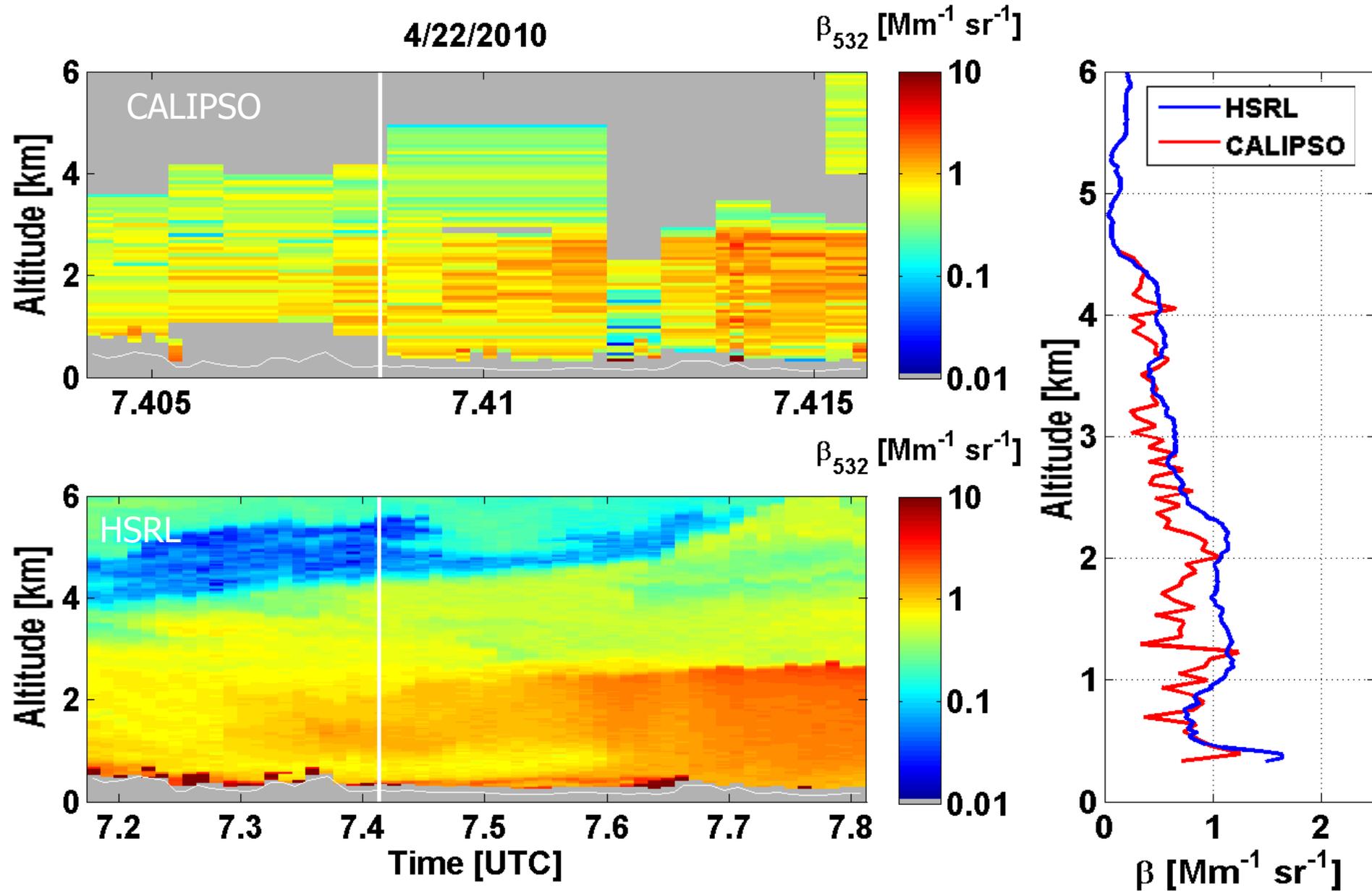
- 355-nm measurements provide direct validation of ATLID Level-2 products
- Coincident 532- and 1064-nm measurements provide a bridge data set for interpretation of validation measurements made from instruments without 355-nm capability
 - Ground-based and airborne
 - Statistical comparisons with CALIPSO
- Higher information content provides means to assess ATLID aerosol typing

Example Level 1 validation

4/22/2010

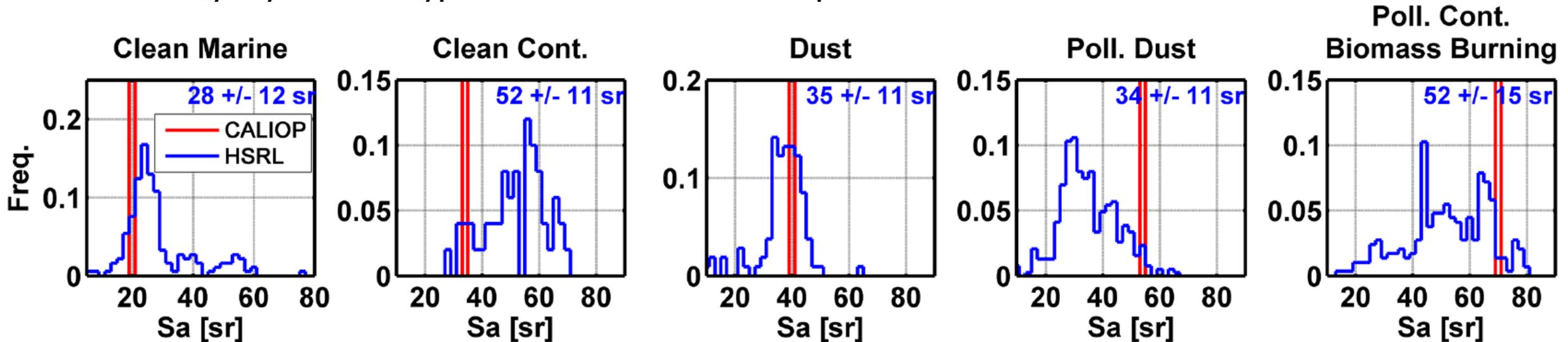
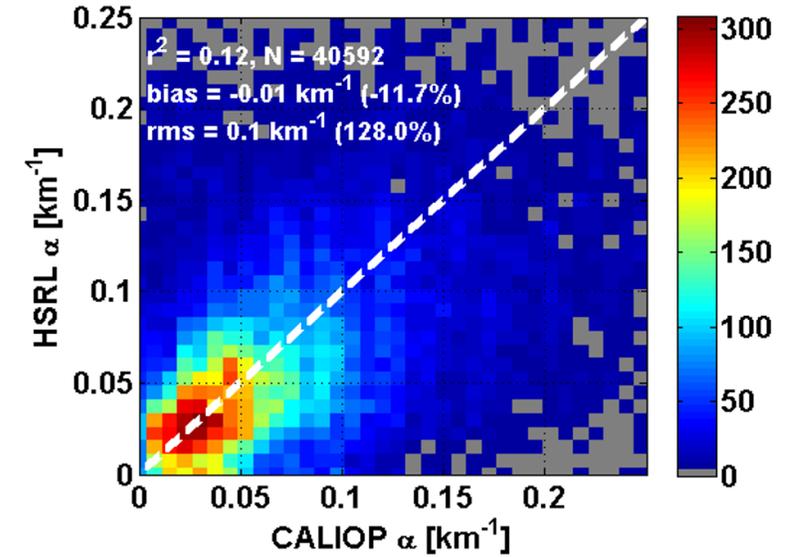


Example Level 2 aerosol profile validation (v3.01)



Validation assessment of CALIPSO extinction and lidar ratio assumption

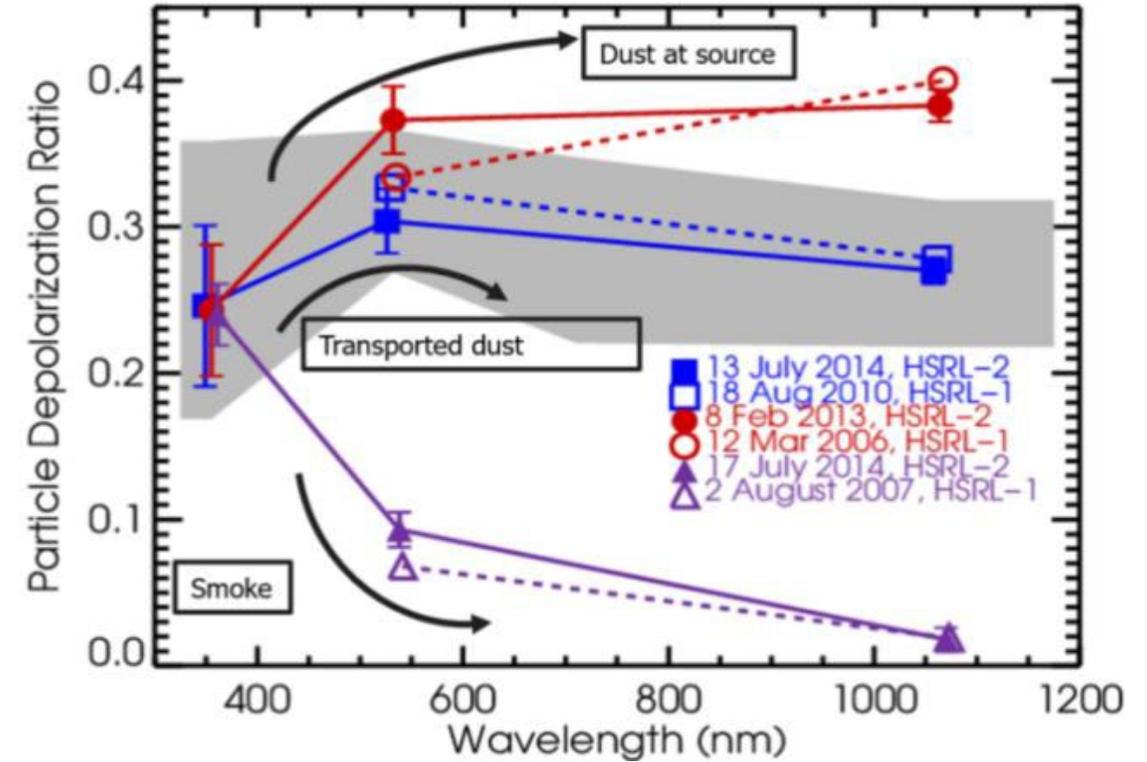
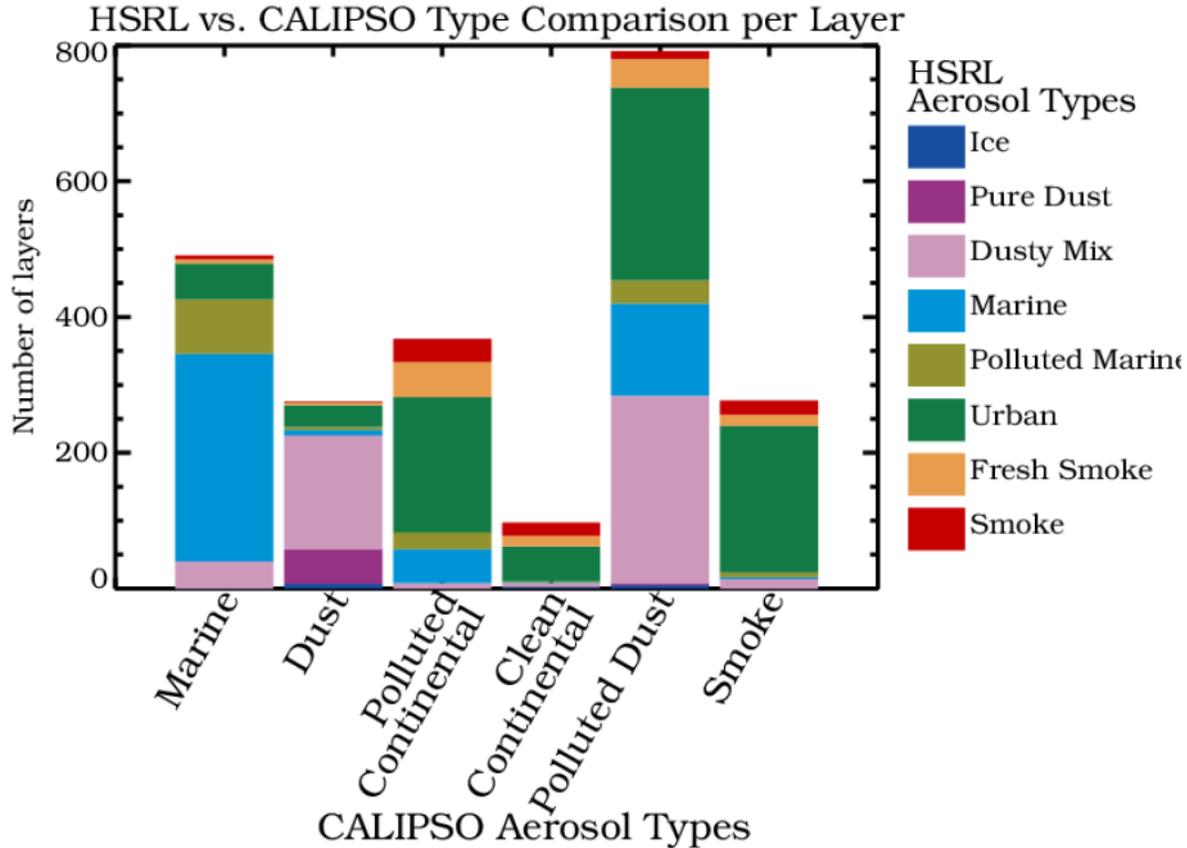
- CALIPSO extinction retrieval relies on an assumption of lidar ratio
- Lidar ratio assumption is based on CALIPSO inference of aerosol type
- CALIPSO uses a discrete set of lidar ratios
- Airborne HSRL used to assess extinction value as well as underlying aerosol type and lidar ratio assumption



Rogers et al. (2014), Looking through the haze: evaluating the CALIPSO level 2 aerosol optical depth using airborne high spectral resolution lidar data. *AMT*



HSRL-2 high information content ($3\beta + 2\alpha + 3\delta$) useful for assessing HETEAC aerosol typing and wavelength dependencies to connect 355-nm ATLID measurements to 532/1064-nm data sets



Burton et al. (2013), Aerosol classification from airborne HSRL and comparisons with the CALIPSO vertical feature mask, AMT

Burton, S. P., et al. (2015), Observations of the spectral dependence of linear particle depolarization ratio of aerosols using NASA Langley airborne High Spectral Resolution Lidar, ACP



LaRC HSRL team proposal objectives

1. Participate in EarthCare Cal/Val Team planning efforts and development of the ACPV best practices document
2. Work with the EarthCare Team in the use of existing airborne HSRL-2 data in the development and assessment of ATLID retrieval algorithms
3. Develop and implement a methodology for assessing ATLID Level-1b data products
 - HSRL-2 operational processing includes no Level-1b step. This will require development of a new product and associated uncertainties
4. Use the extensive set of airborne HSRL-2 measurements to develop a “translation database” for
 - Relating ATLID measurements at 355 nm to CALIOP and other lidar measurements acquired at 532 nm and 1064 nm
 - Assessing ATLID’s HETEAC aerosol typing skill and comparing to aerosol typing using other wavelengths
5. Use HSRL-2 data to evaluate selected ATLID L1 and L2 aerosol and cloud products from future airborne underflights



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Validation-relevant data sets

- First validation underflight opportunity will be during the PACE-PAX campaign (Sept 2024).
 - Focus is validation of the aerosol/cloud products from the PACE mission
 - Deploy on the NASA ER-2; flight level \sim 19 km
 - See Kirk Knobespiesse's presentation for details

- Anticipate that NASA will fund more validation underflights in the future. We are eager to work with ESA and NASA HQ to define future underflight opportunities.

- Past data sets may be used by members of the EarthCARE validation community to
 - Explore translation of 532-nm airborne and ground-based validation data to ATLID's 355-nm products
 - Assess HETEAC aerosol typing
 - Explore active-passive synergy retrievals
 - ...



**We look forward to working with the EarthCARE
validation team!**