HSRL-2 Data Products

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LaRC Airborne High-Spectral-Resolution Lidar – Generation 2 ("HSRL-2")

Data Products

hdf5 data and png plot images

- Aerosol Extensive Measurements
  - Particulate backscatter profiles (355, 532, 1064 nm)
    - Δx ~ 1 km, Δz ~ 15 m
  - Aerosol extinction profiles and AOT (355 and 532 nm)
    - Δx ~ 6 km, Δz ~ 270 m
- Aerosol Intensive measurements
  - Particle depolarization profiles (355, 532, 1064 nm)
    - Δx ~ 1 km, Δz ~ 15 m
  - Extinction-to-backscatter ratio profiles (355 and 532 nm)
    - Δx ~ 6 km, Δz ~ 270 m
  - Angstrom exponent profiles
    - Extinction: 355-532 (Δx ~ 6 km, Δz ~ 315 m)
    - Backscatter 355-532, 532-1064 (Δx ~ 1 km, Δz ~ 15 m)
- Aerosol Type
- Aerosol Optical Thickness
- Cloud top heights
- Cloud top extinction and lidar ratios (future)

ICARTT format

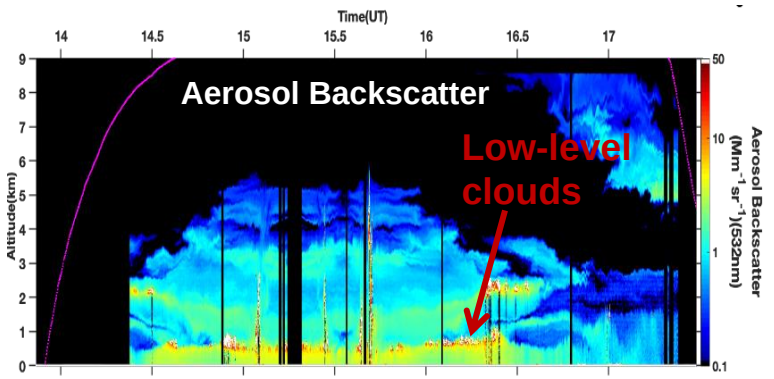
- Mixed Layer Heights
- Aerosol Optical Thickness

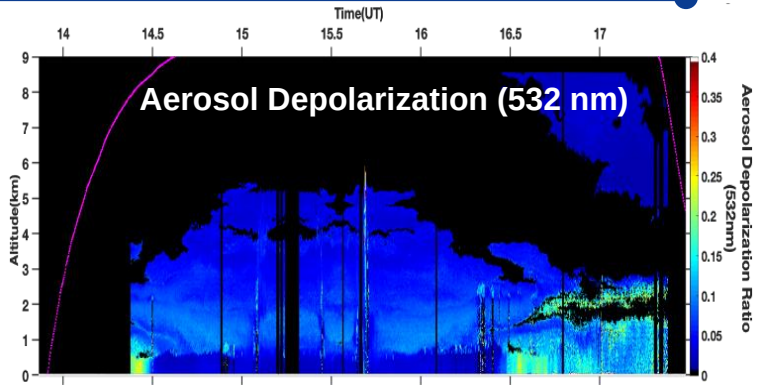
Data archived at https://www-air.larc.nasa.gov/cgi-bin/ArcView/activate.2019#HOSTETLER.CHRIS/

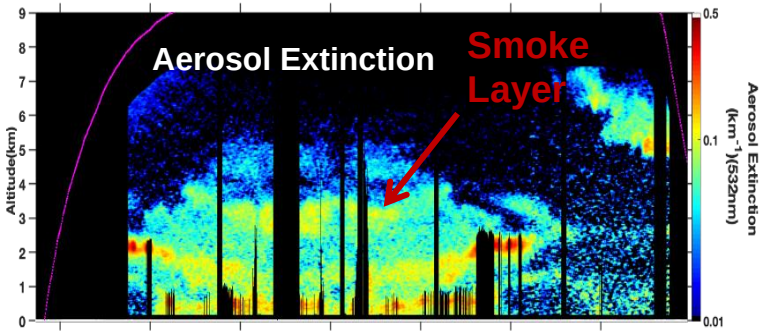
Look for

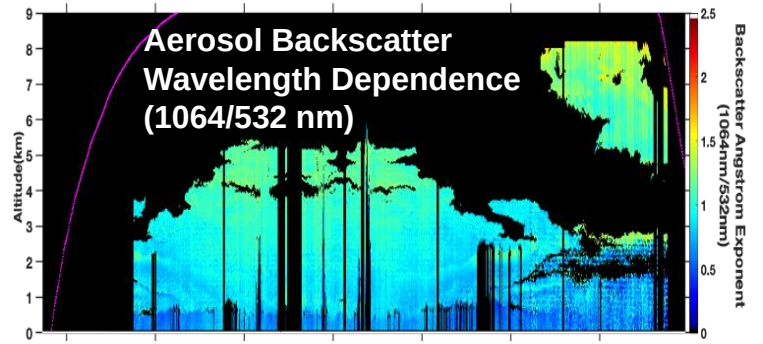
ACTIVATE-HSRL2_UC12_2020_R0_Read_Me_First.pdf

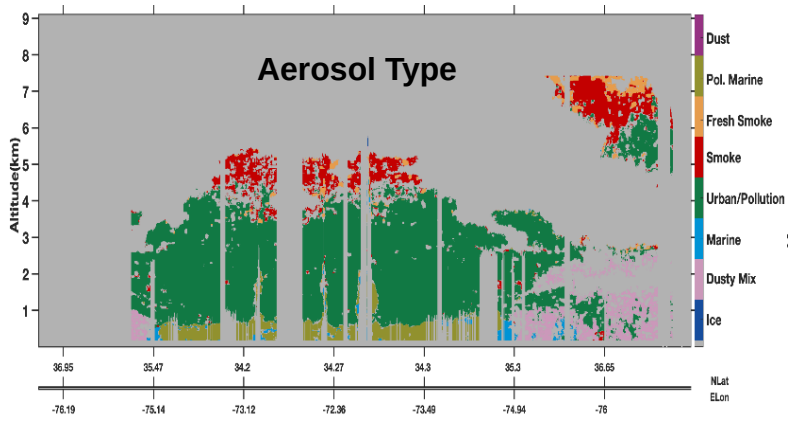
ACTIVATE-HSRL2_UC12_2020_R0_DataFileDescription.pdf

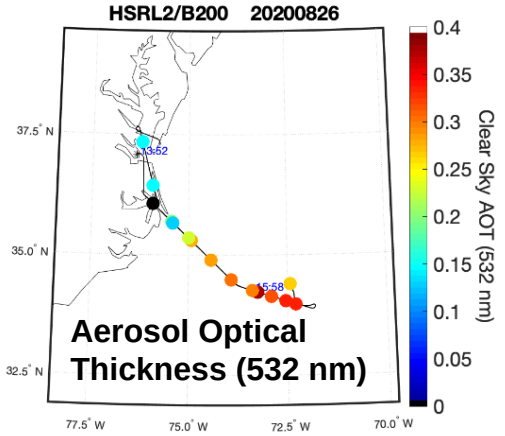












HSRL technique provides greater accuracy than the standard elastic backscatter lidar

Two spectrally resolved channels → two equations to solve for 2 unknowns

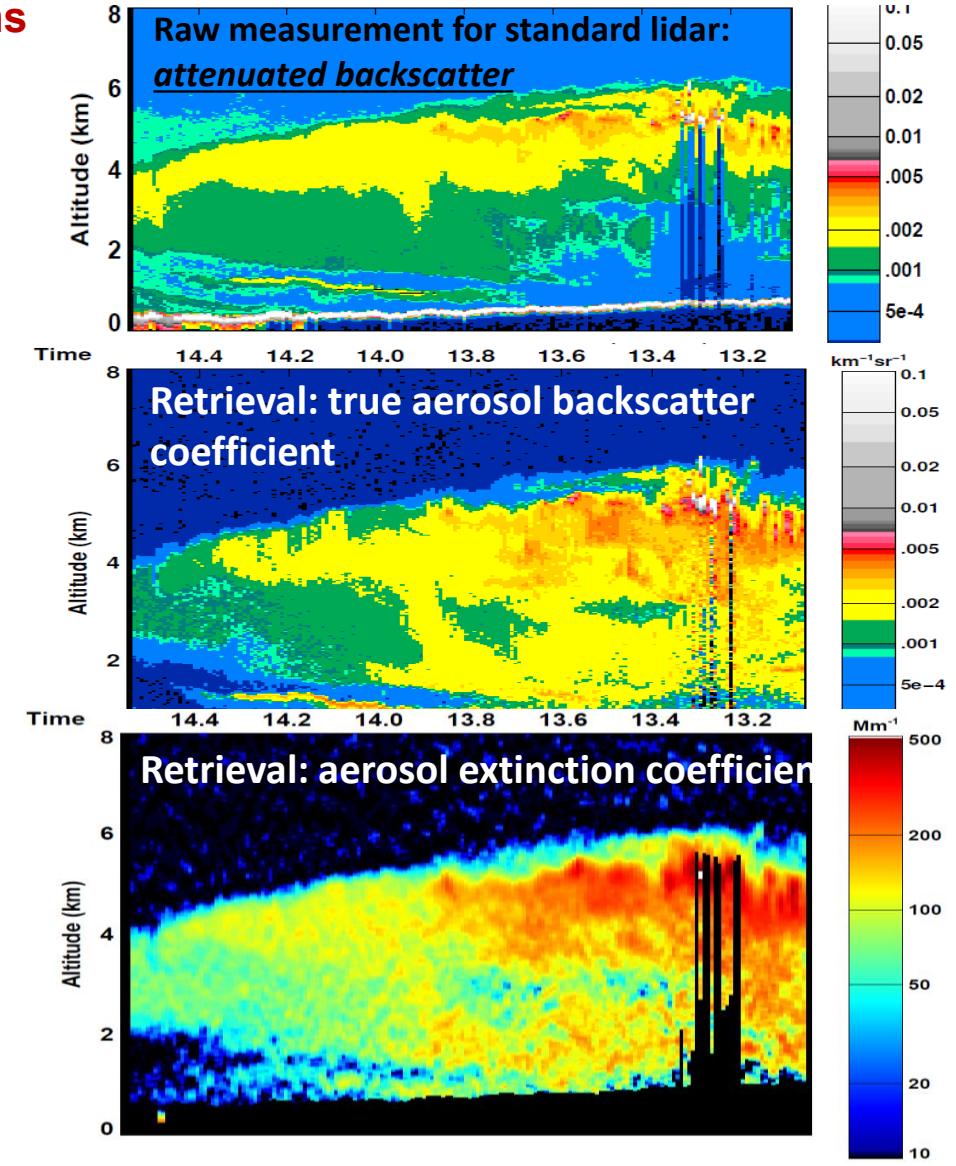
2 unknowns

$$P_a(r) = \frac{C}{r^2}[\beta_m(r) + \beta_a(r)]\exp\left\{-2\int_0^x [\alpha_m(r') + \alpha_a(r')]dr'\right\}$$

$$P_m(r) = \frac{C}{r^2}[\beta_m(r)]\exp\left\{-2\int_0^x [\alpha_m(r') + \alpha_a(r')]dr'\right\}$$

Advantages

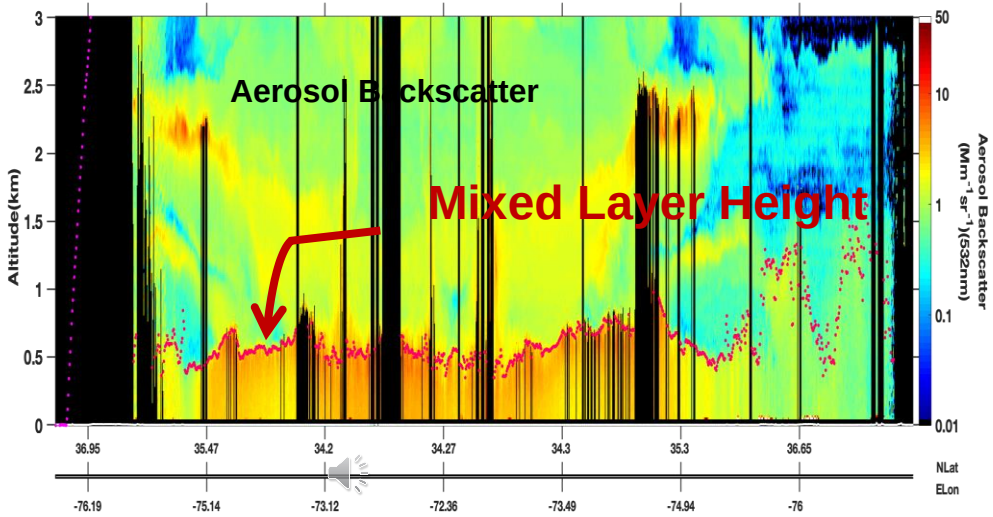
- **Backscatter coefficient**
  - Direct measure of backscatter, rather than attenuated
  - Accurate at all altitudes; errors do not accumulate with range
- **Independent measure of extinction**
  - No need for assumed lidar ratio or external constraint
  - Molecular channel also provides direct measure of AOT
- **Highly accurate particulate depolarization**
  - Separating particulate and molecular parts requires accurate backscatter
- **Vertically resolved aerosol type information**
  - Lidar ratio gives the most information about aerosol composition for non-dust aerosol
- **Ocean retrieval**
  - HSRL technique allows vertically resolved ocean retrieval

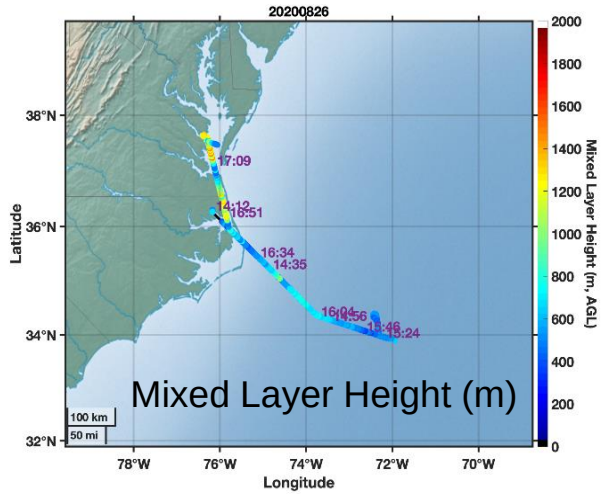


HSRL-2 Derived Data Products

Mixed Layer Heights

- Mixed Layer (ML) heights derived from cloud-screened aerosol backscatter profiles
- Technique uses a Haar wavelet covariance transform with multiple wavelet dilations to identify sharp gradients in aerosol backscatter (adapted from Brooks, JAOT, 2003)
- Automated HSRL algorithm chooses ML from among aerosol gradients with input from manual inspection where necessary (Scarino et al., 2014, ACP)

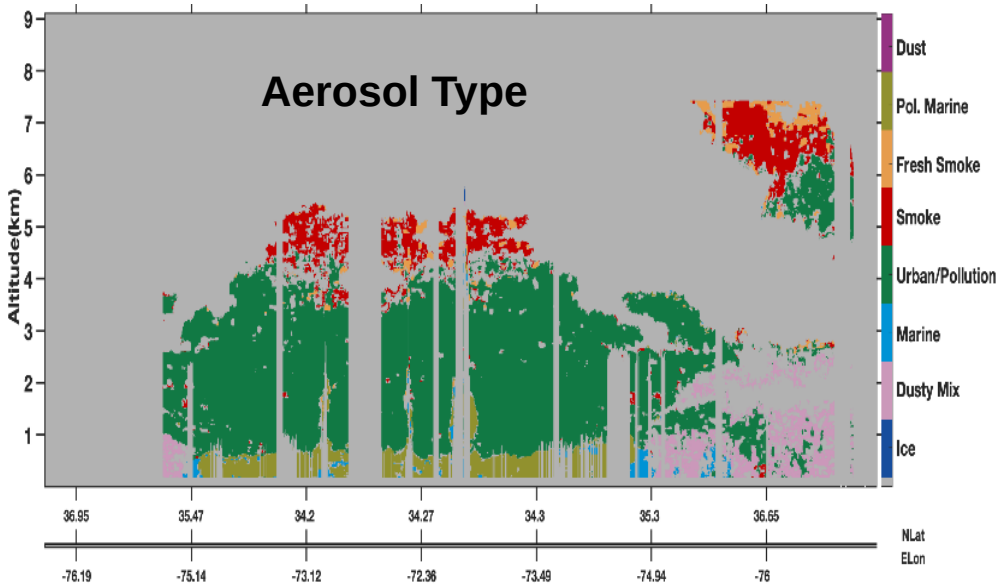




Scarino et al., 2014, ACP

Aerosol Type

- Multiwavelength HSRL measurements provide aerosol intensive parameters for classifying aerosols and apportioning AOT to type
- Suite of aerosol intensive parameters (extinction-to-backscatter ratio, backscatter color ratios, depolarization ratio, spectral dependence of depolarization) provide more robust aerosol classification
- Reveals significant vertical variability of aerosol types not apparent in passive retrievals



Burton et al., 2012, AMT