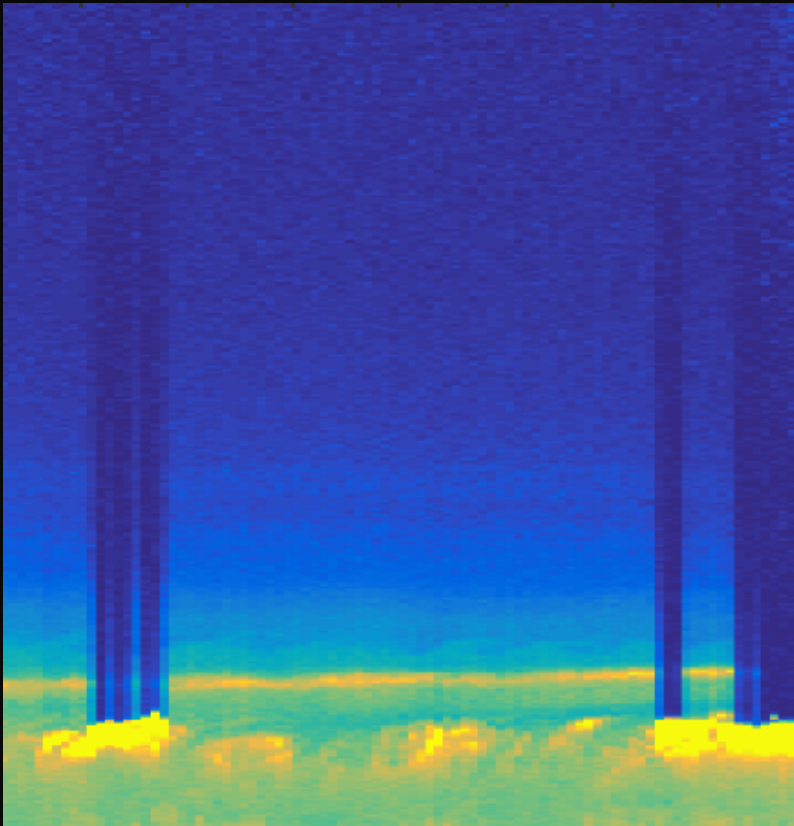


# Aerosol Vertical Structure: MPL Status and Preliminary results

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Rodrigo Delgado

LASIC | 2017 ARM/ASR Meeting | UM

# Lidar's purpose in LASIC



See the interactions between aerosols and clouds

**Focused on inverting extinction** from lidar signal to see smoke above the cloud layer.

# Lidar Retrieval Method

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Raw Signal (counts/ $\mu\text{s}$ ):

$$S_{raw} = \frac{1}{D(S_{raw})} \left( \frac{CEO\beta(z)}{z^2} e^{-2\tau(z)} + A(z, E) + B \right)$$

where:  $\beta(z) = \beta_M(z) + \beta_P(z)$

$$\tau(z) = \int_0^z \sigma_M(z) + \sigma_P(z) dz$$

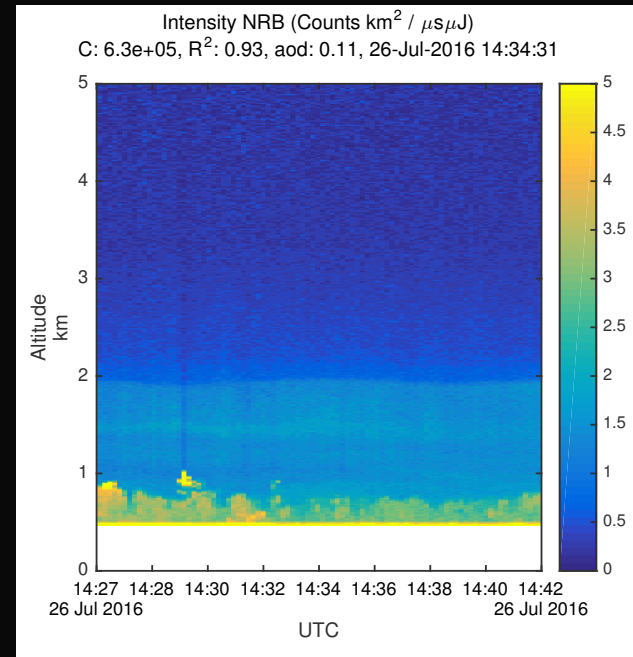
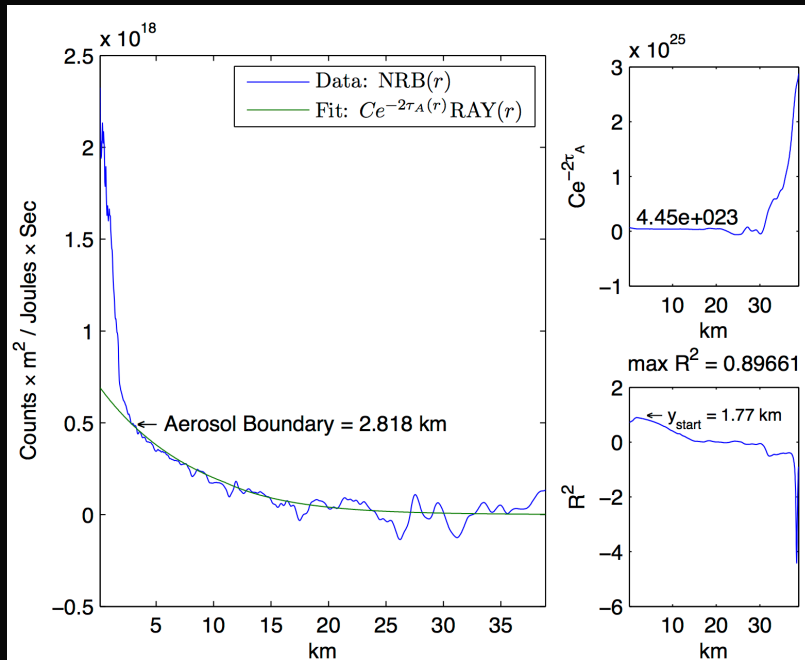
NRB Signal (counts  $\text{km}^2/\mu\text{s} \mu\text{J}$ ):

$$S_{NRB} = C\beta(z)e^{-2\tau(z)}$$

# Lidar Constant: C

$$S_{fit} = C(\beta_M(z) + \beta_A(z))e^{-2(\tau_M(z) + \tau_A(z))}$$

At top of aerosol layer  $\beta_A(z) \rightarrow 0$



Reference  $\tau_A$  from Aeronet Cimel sunphotometer.  
C can then be used to find  $\tau_A$  for other times.

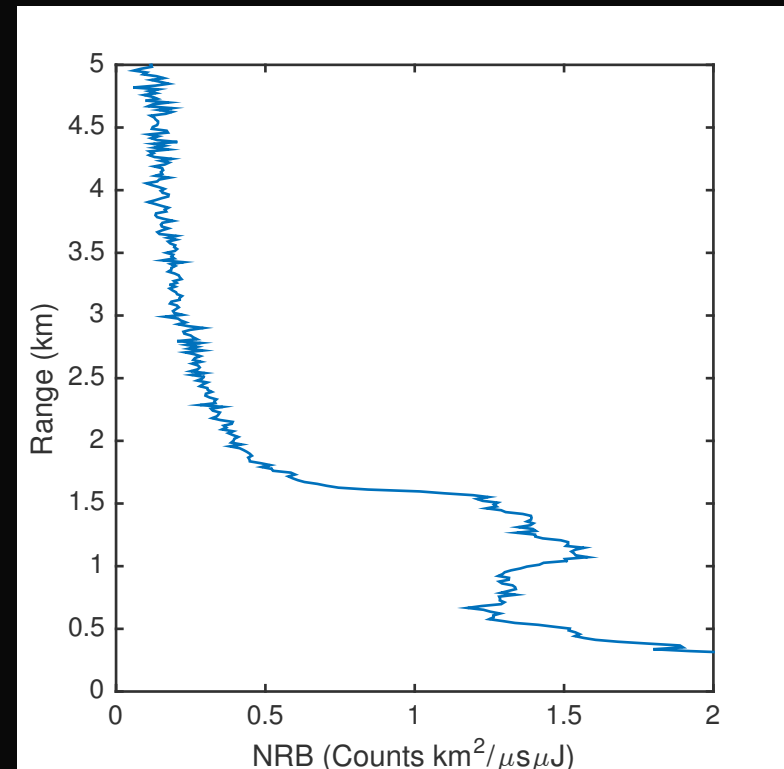
# Fernald Algorithm

$$\beta_P(n-1) = \frac{S_{NRB}(n-1)\Psi(n)}{\frac{S_{NRB}(n)}{\beta(n)} + \frac{\Delta r}{R_P} [S_{NRB}(n) + S_{NRB}(n-1)\Psi(n)]} - \beta_M(n-1)$$

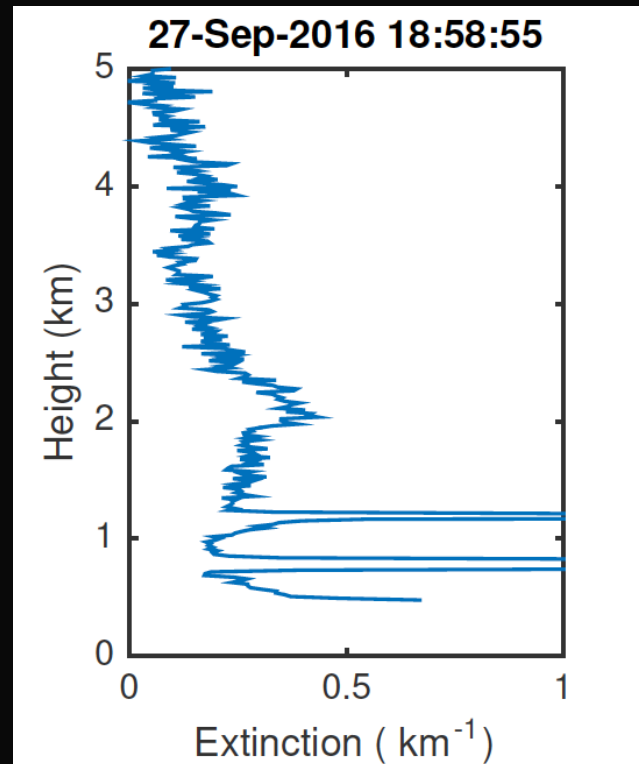
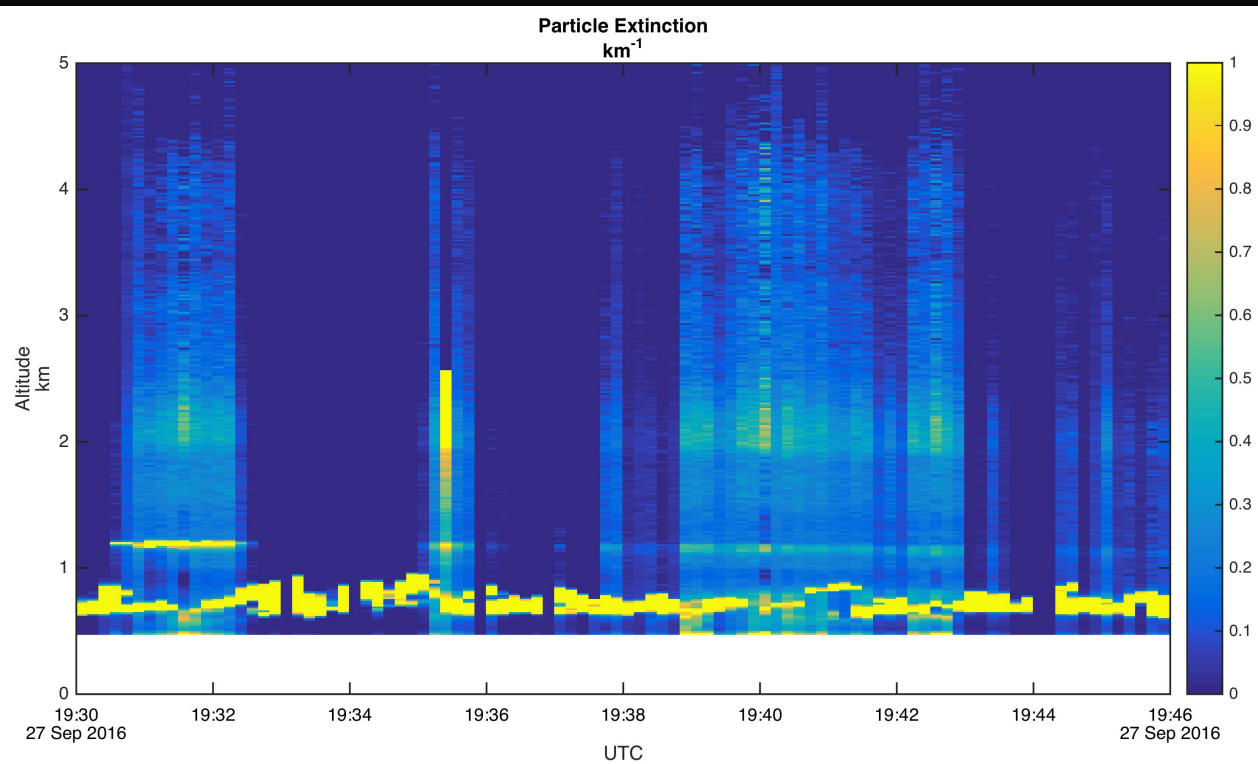
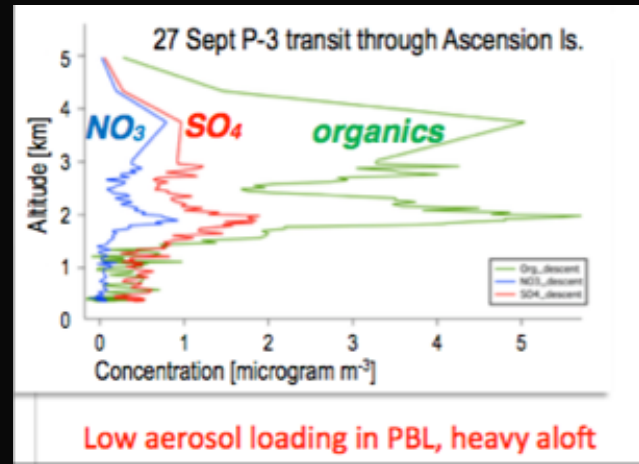
Recursive: from top to bottom

Needs  $\tau_A$  and aerosol top height.

Finds particle extinction,  
backscatter coefficient, and  
backscatter-extinction ratio.

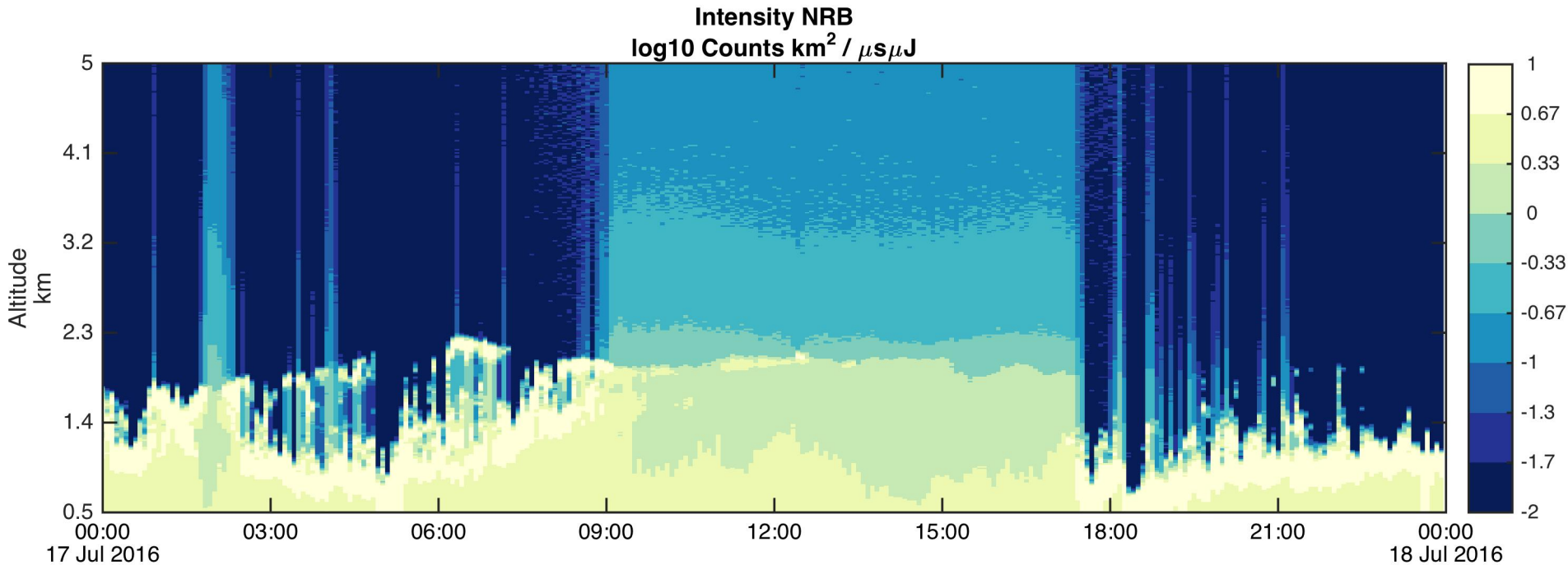


# Particle Extinction



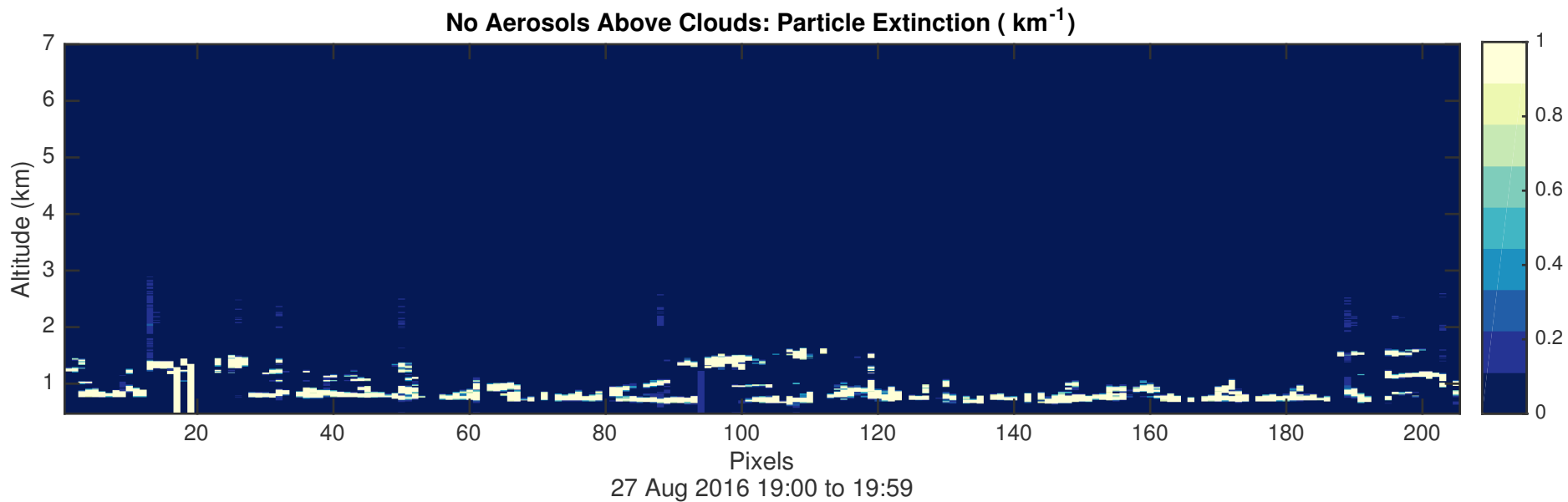
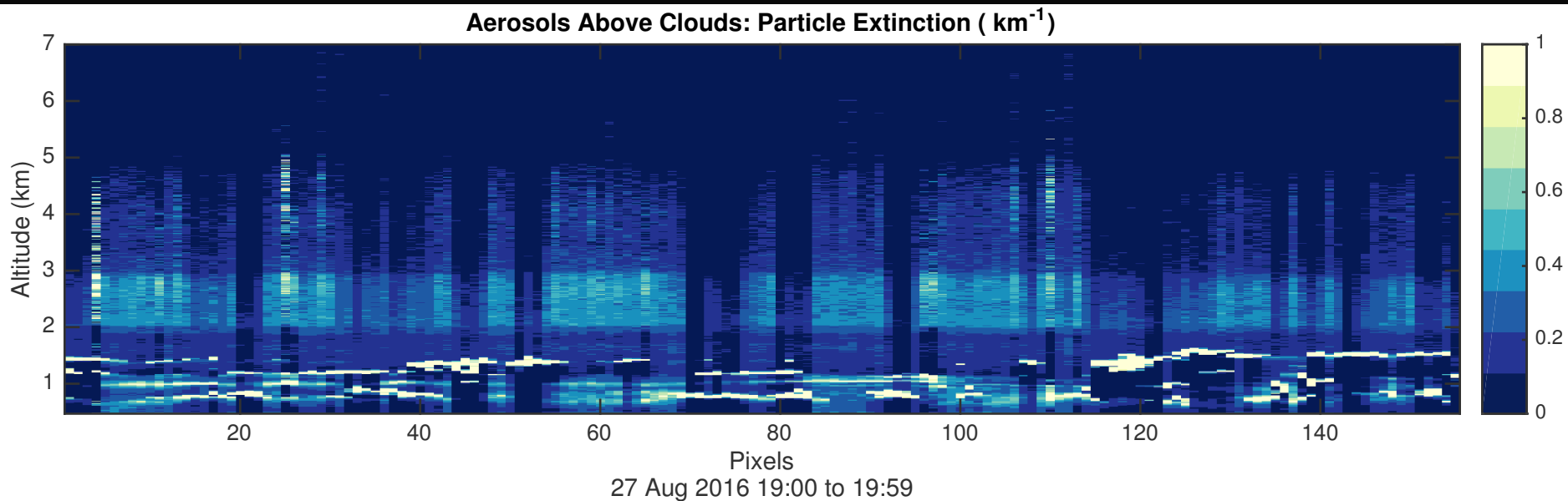
# Quality Issue

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Strongly attenuating **cloud** doesn't allow perception of smoke in free troposphere in many cases

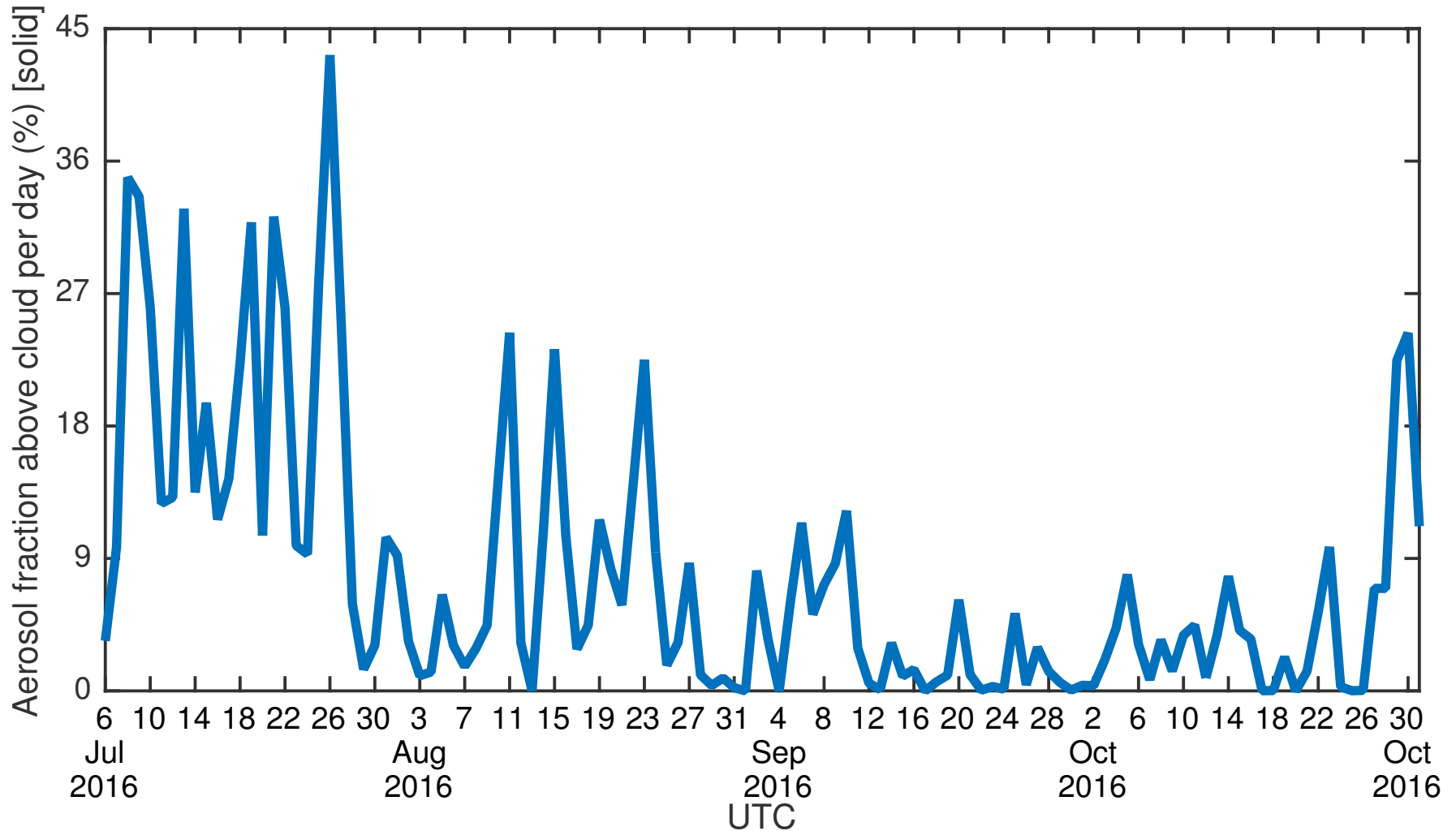
# Machine Learning: Search for **Aerosols Above Clouds**



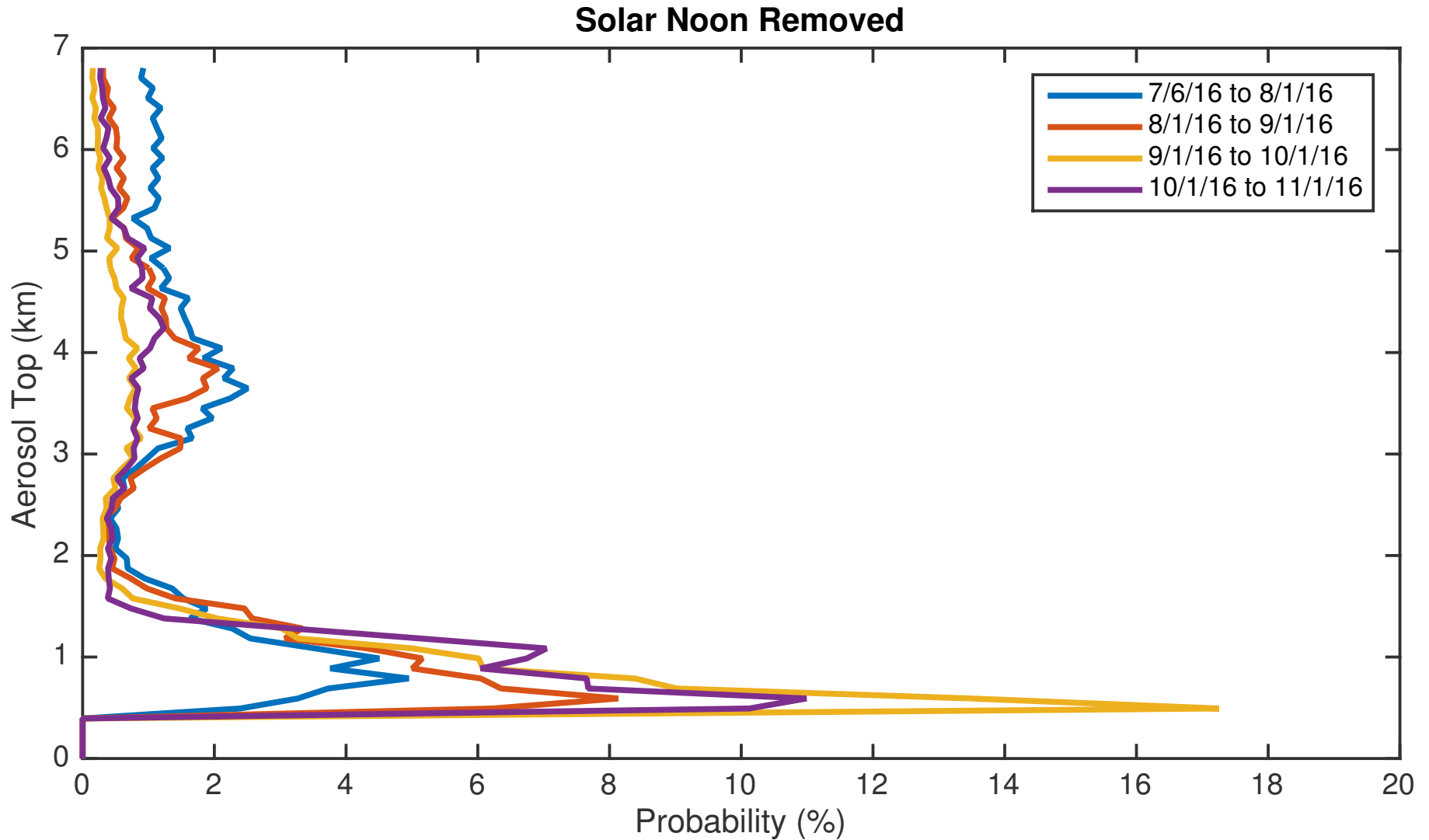


# Aerosol Fraction Above Cloud per day

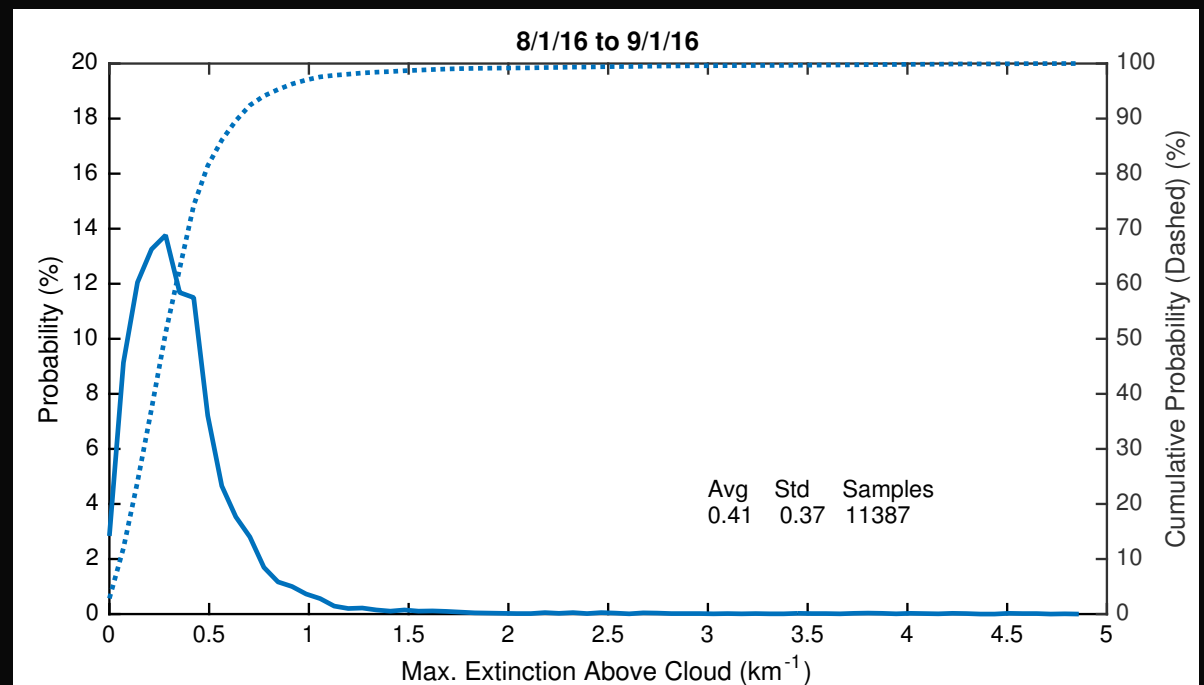
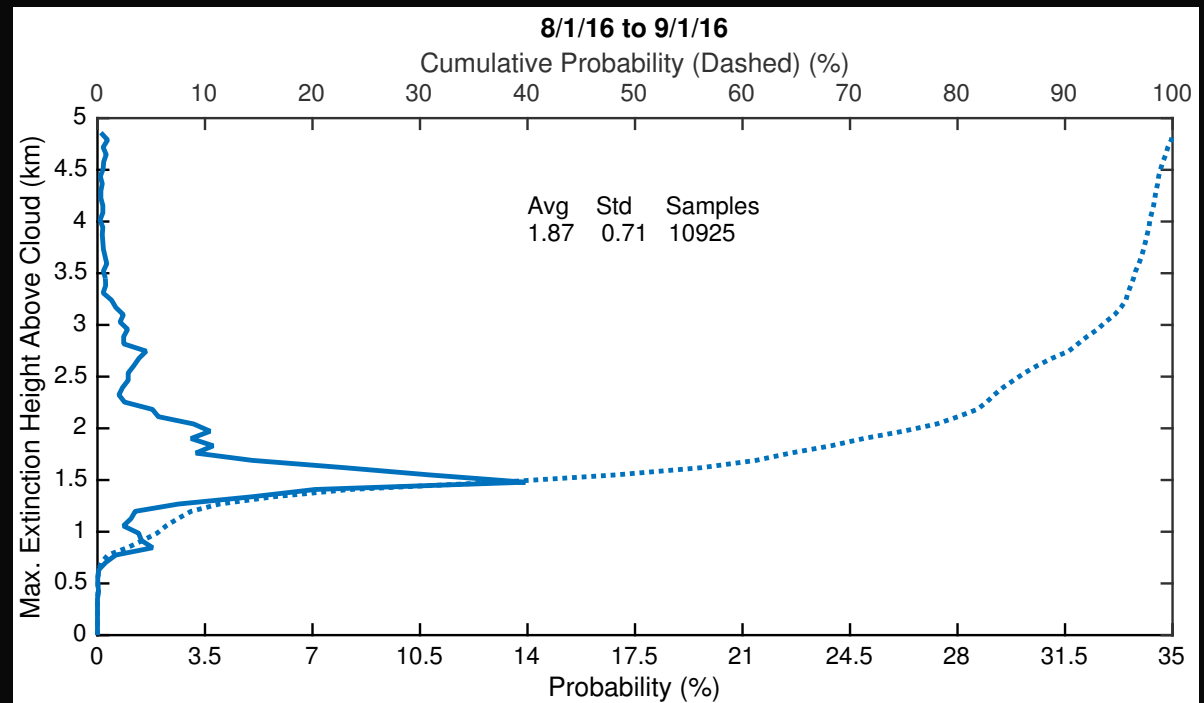
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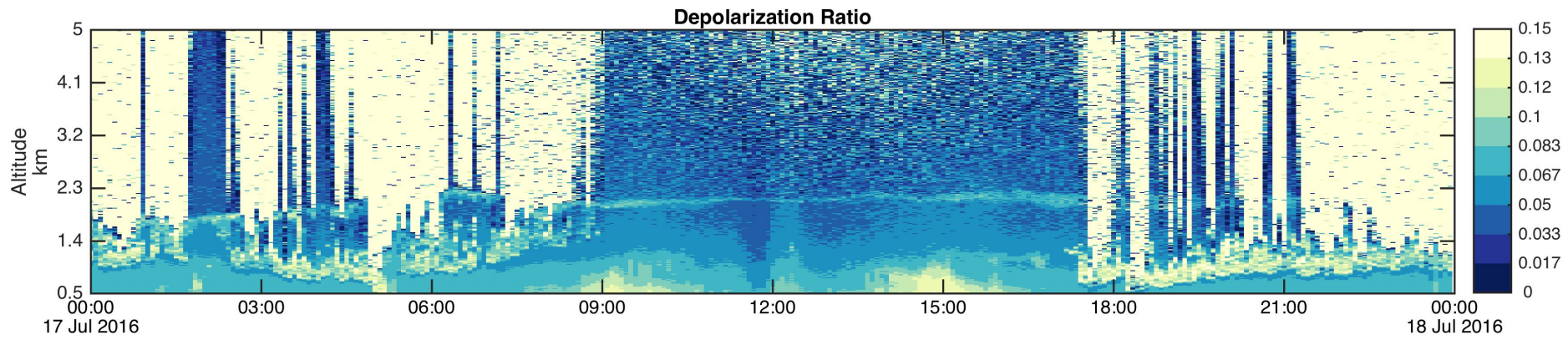
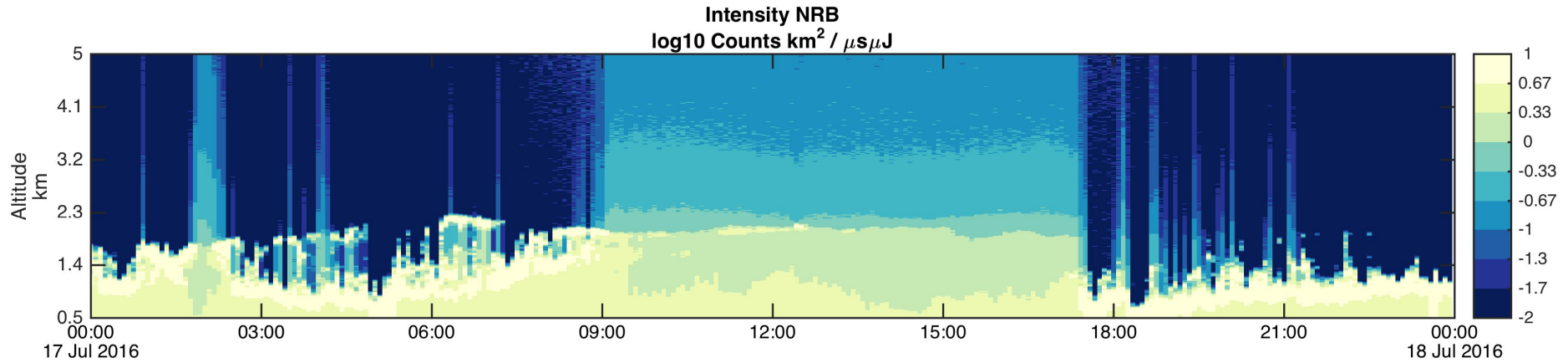
# Aerosol Top

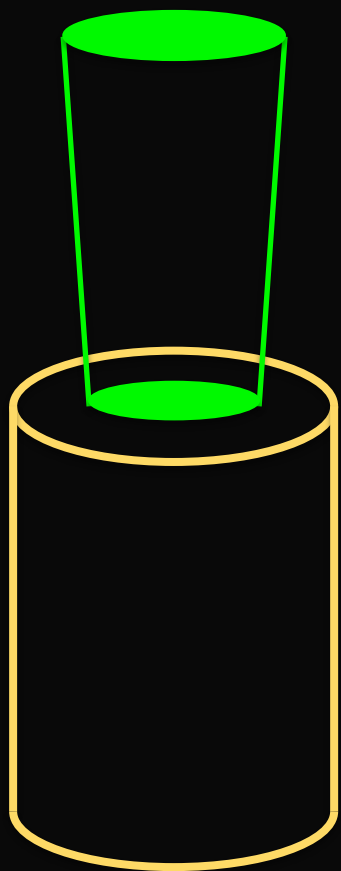


# Max Extinction Height

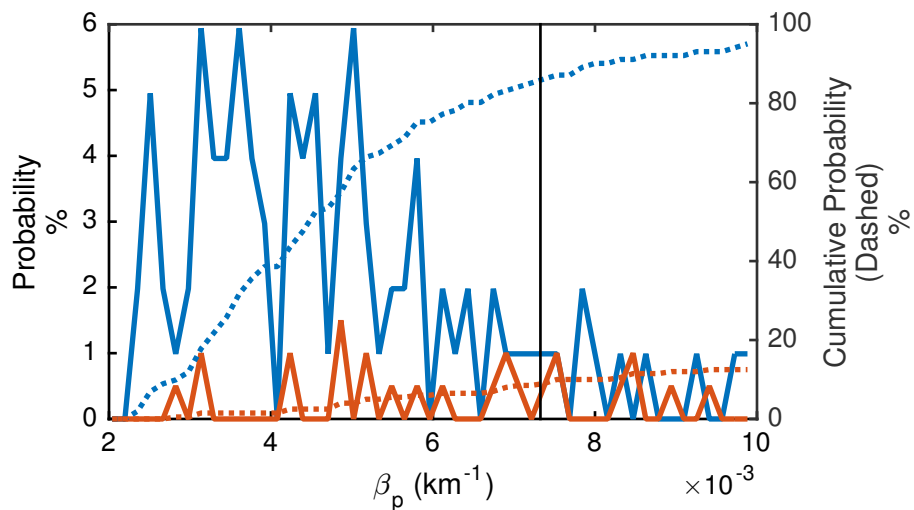


# Questions





# Cloud Mask



$\beta_p$	Avg	Std	Samples
Cloud-free	5.06e-03	2.26e-03	102
Cloud-present	6.34e-01	1.45e+00	201

