

# **ECMWF MACC-II/NRL OP NAAPS Performances evaluation on vertical dimension with MPLNET data: an overview**

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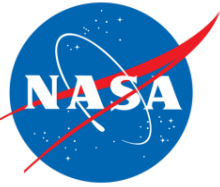
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<sup>3</sup> ECMWF, Shienfield Park, Reading, UK,

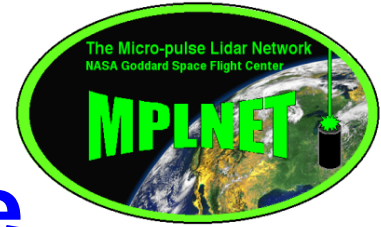
<sup>4</sup> National Central University, Taipei, Taiwan

<sup>5</sup> University of North Dakota, USA

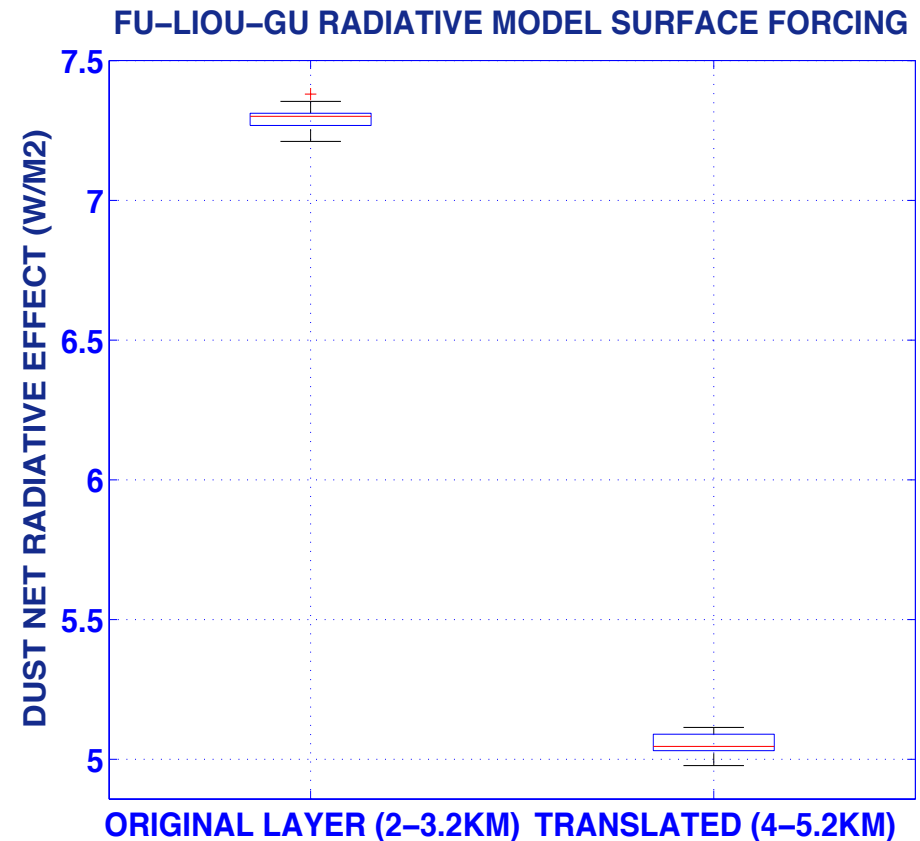
<sup>6</sup> Naval Research Laboratory, Monterey, CA, USA



# Lidar: essential to characterize model aerosol vertical structure

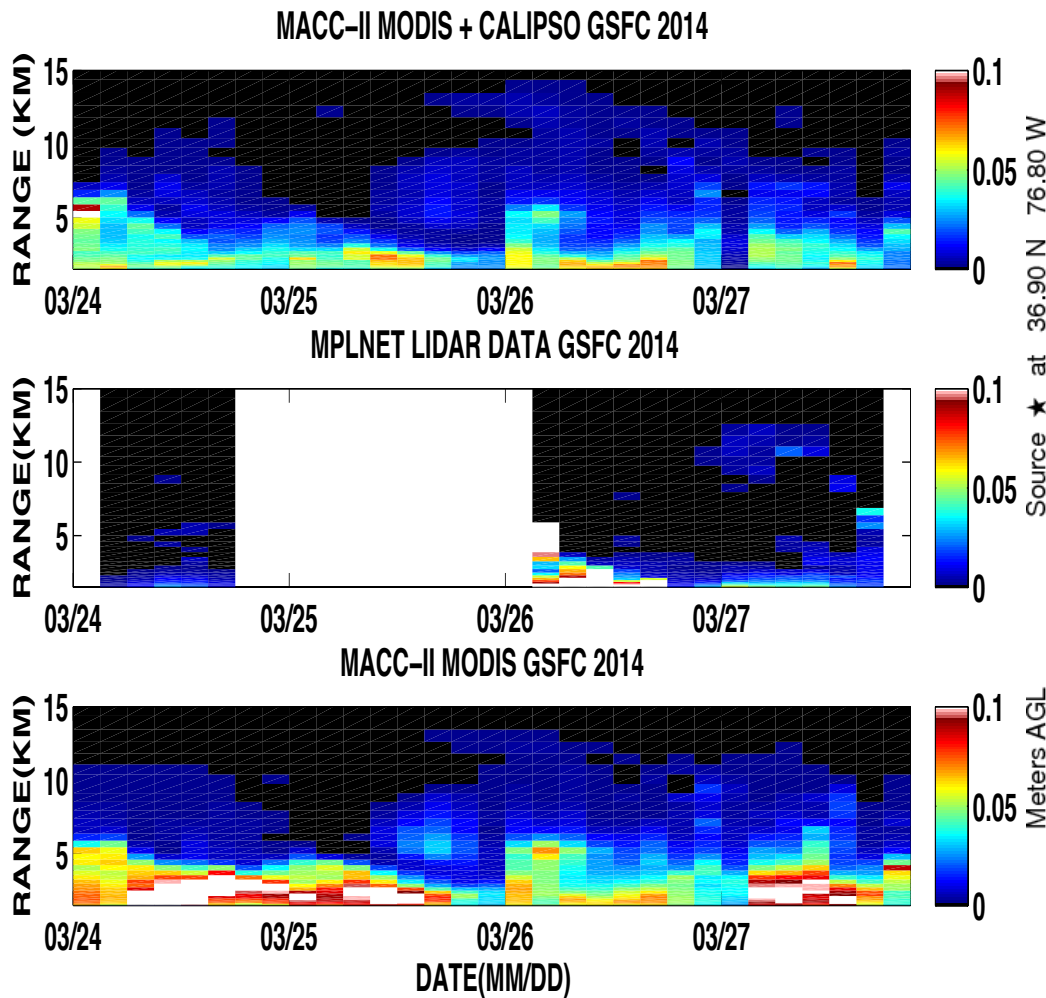
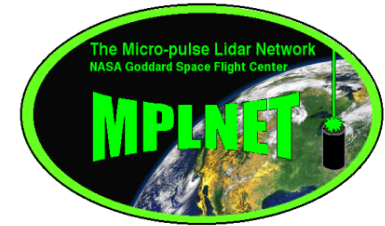


- Aerosol **vertical distribution is poorly quantified** due to the numerous uncertainties on direct emissions and secondary processes.
- Main source of uncertainty to study the impact of aerosols on global radiation balance.
- Lack of sufficient altitude-resolved information on aerosol abundance and properties.

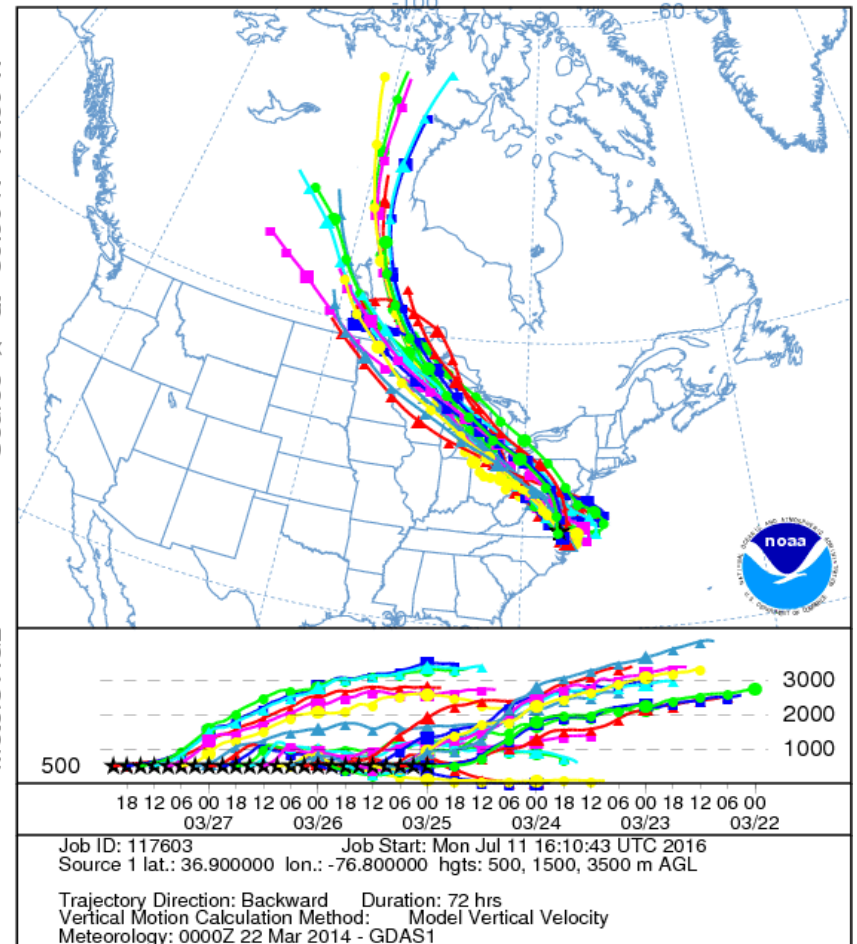


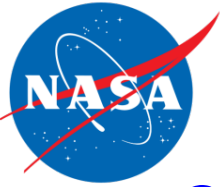


# GSFC MACC-II Extinction Coefficient 24-28 March 2014

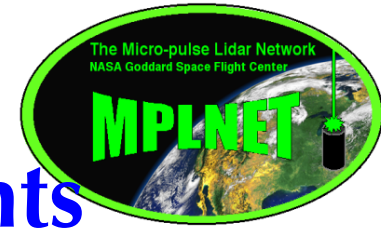


NOAA HYSPLIT MODEL  
Backward trajectories ending at 2100 UTC 27 Mar 14  
GDAS Meteorological Data





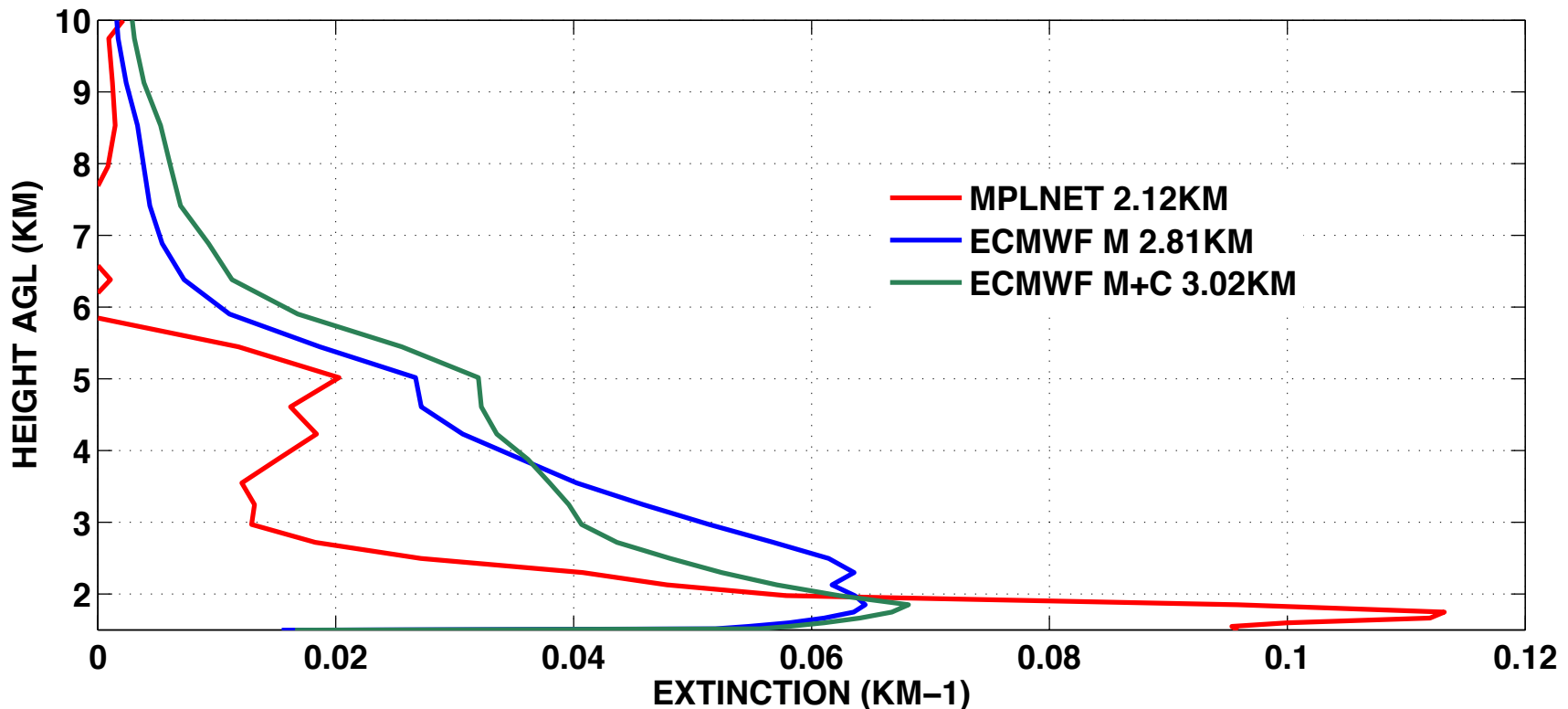
# Evaluation of the vertical model aerosol profiles vs. lidar measurements



Averaged extinction profiles are normalized to AOD=1(0-10KM)

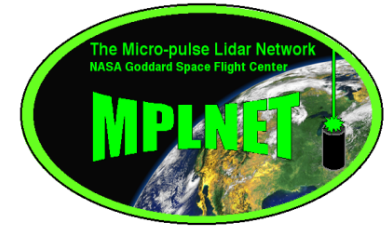
Mean extinction height diagnostic: 
$$Z_{\alpha} = \frac{\sum_i^n \alpha_{ext,i} * Z_i}{\sum_i^n \alpha_{ext,i}}$$

NORMALIZED EXTINCTION COEFFICIENT GSFC 22-27 MARCH 2014

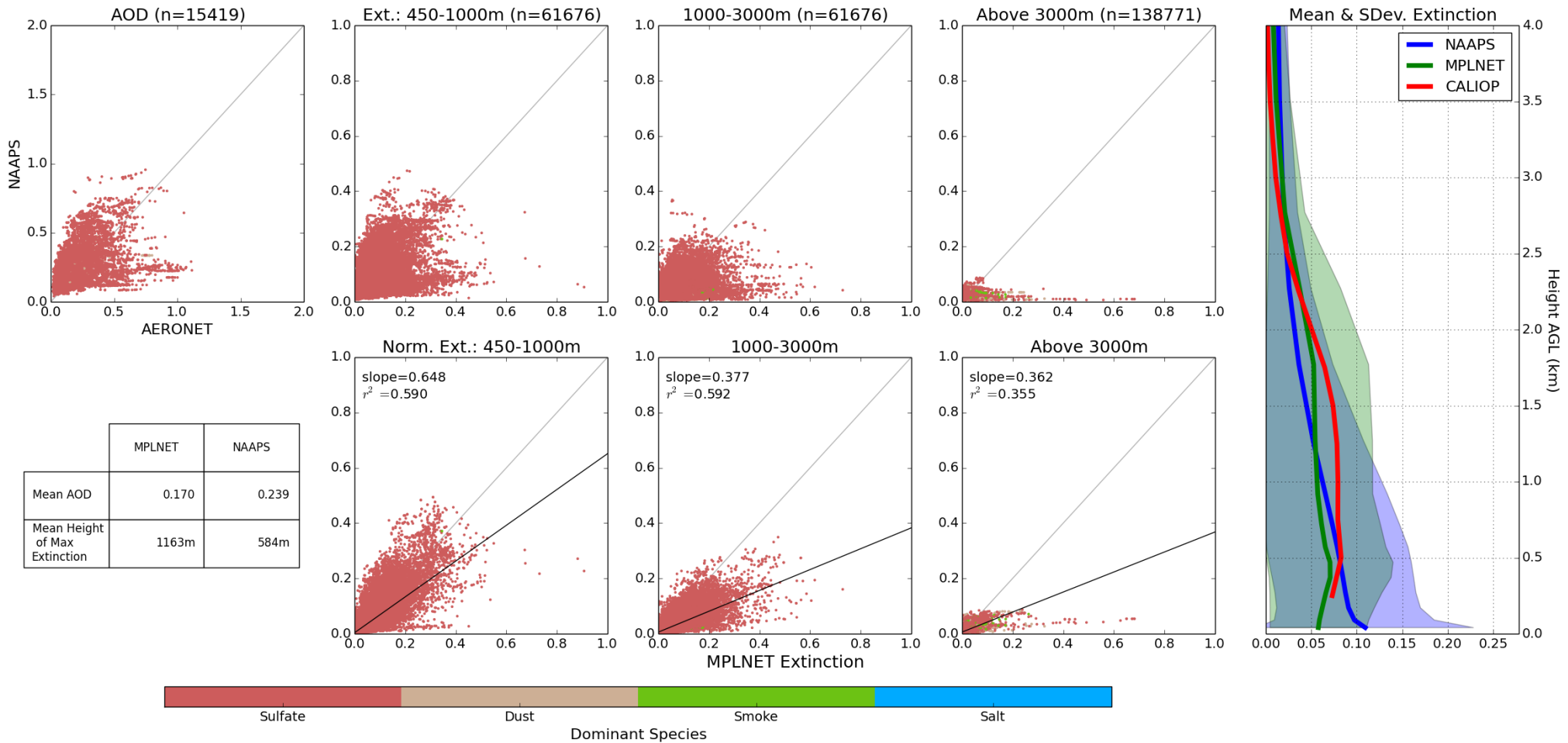


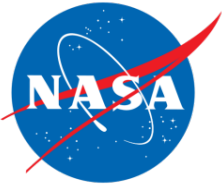


# Operational NAAPS 2007-2011 GSFC

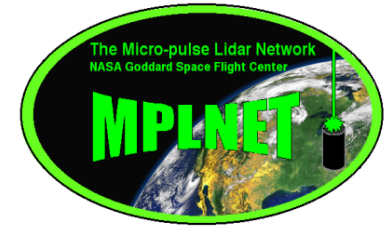


NAAPS v MPLNET at GSFC (2007-2011)

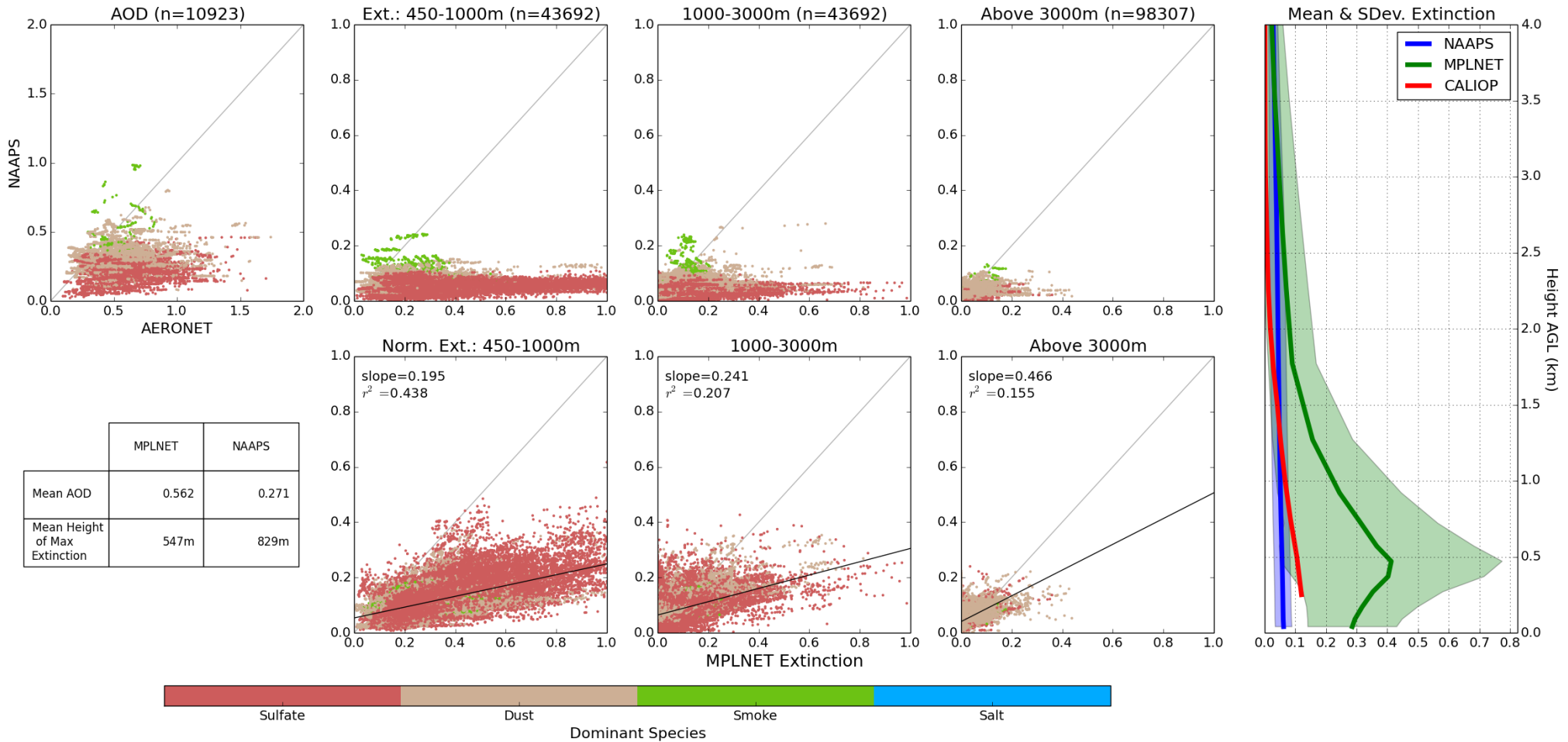




# Operational NAAPS 2007-2011 KANPUR

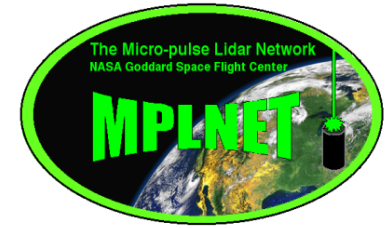


NAAPS v MPLNET at Kanpur (2007-2011)

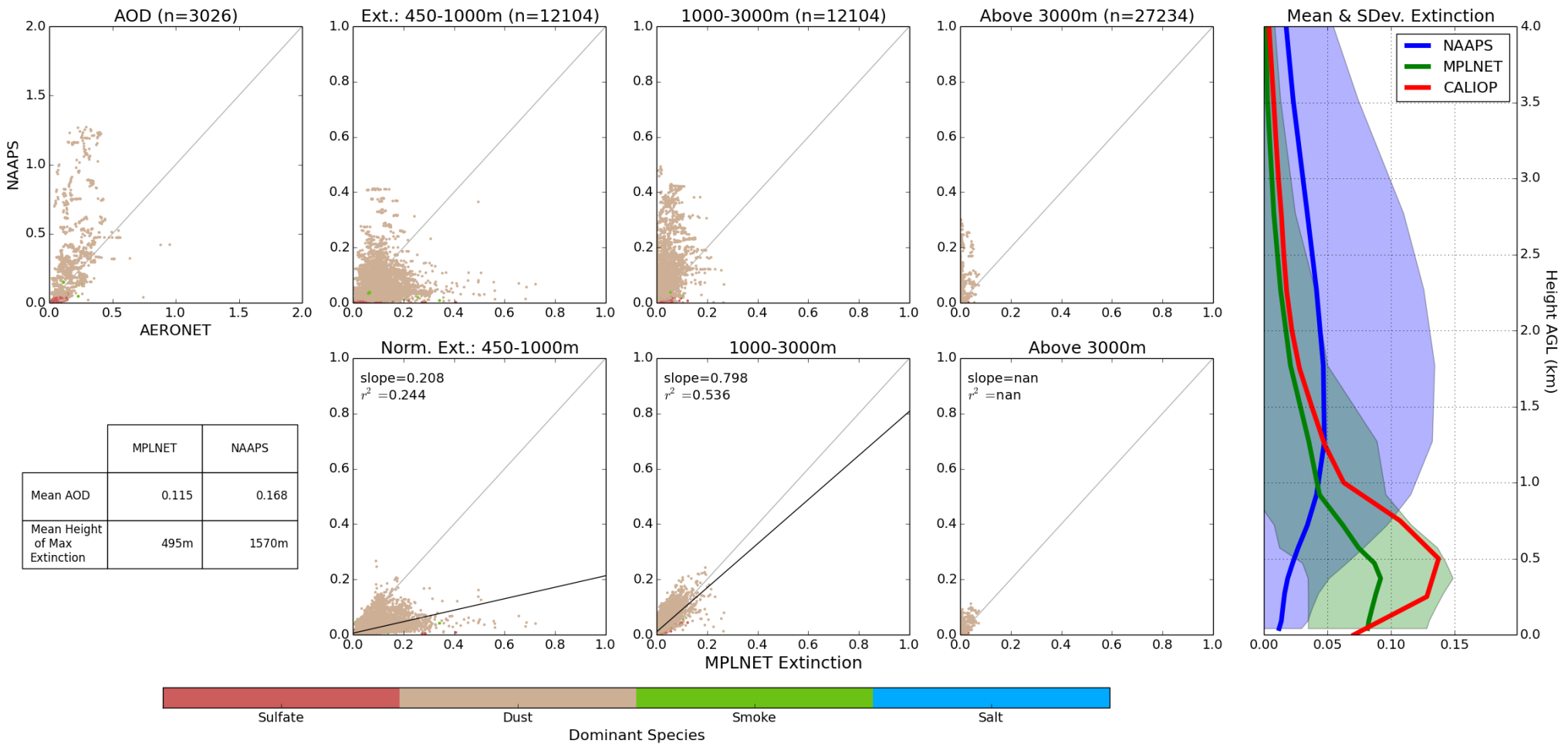


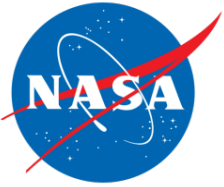


# Operational NAAPS 2007-2011 RAGGED POINT

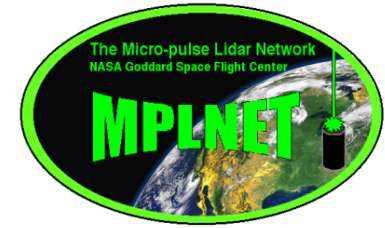


NAAPS v MPLNET at Ragged Point (2007-2011)

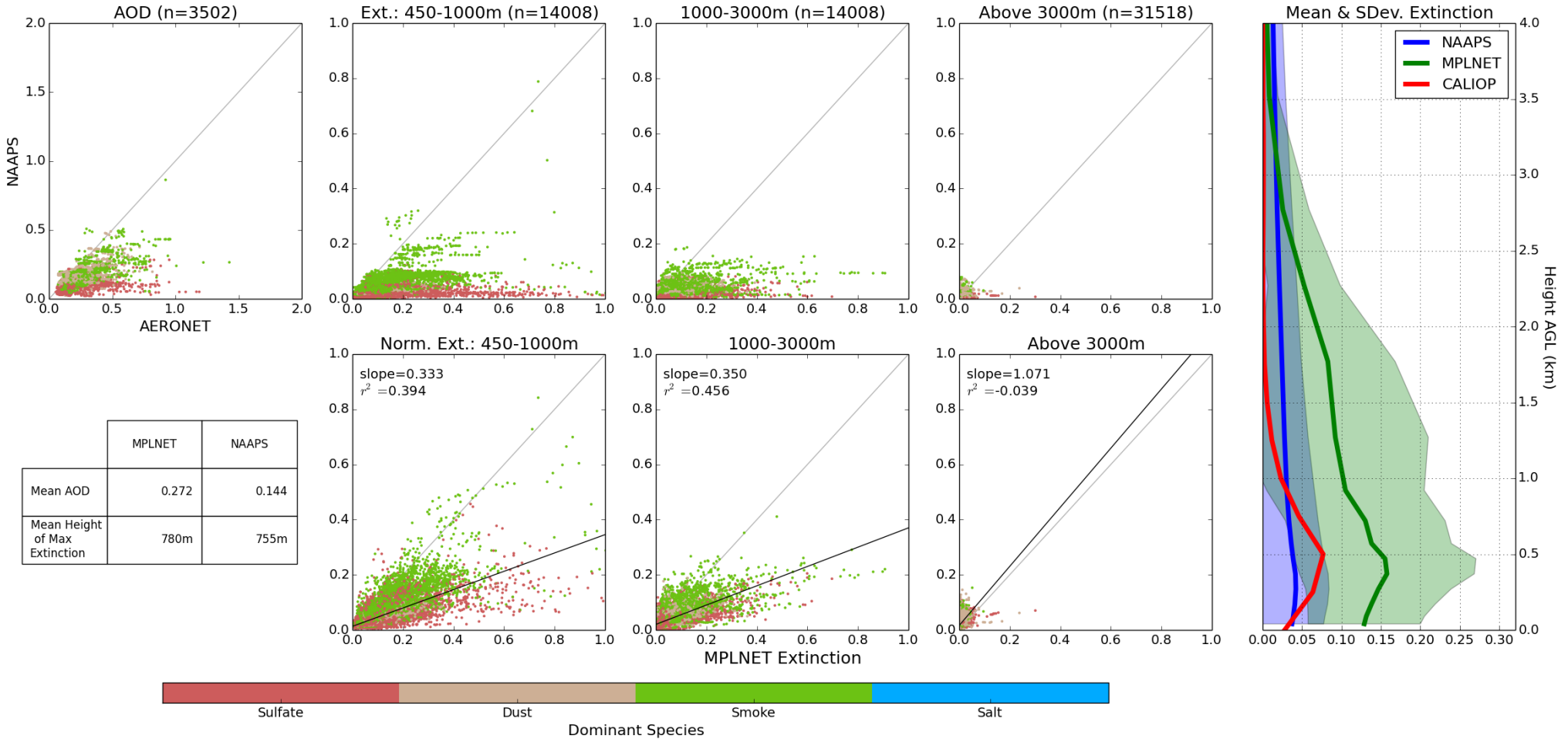




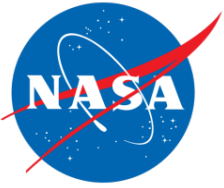
# Operational NAAPS 2007-2011 SINGAPORE



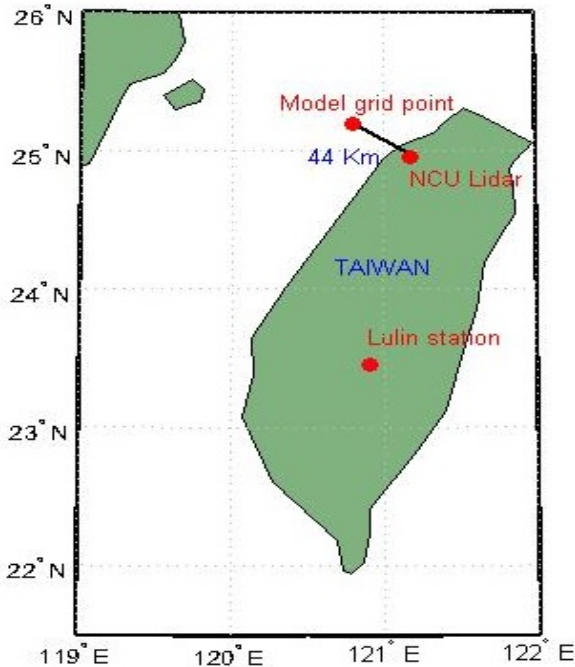
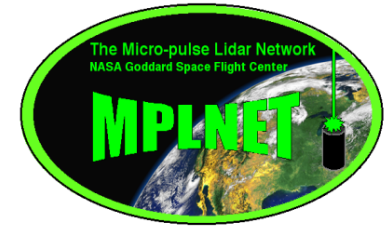
NAAPS v MPLNET at Singapore (2007-2011)



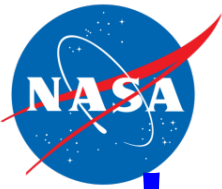




# Assessing MACC-II performances at NCU

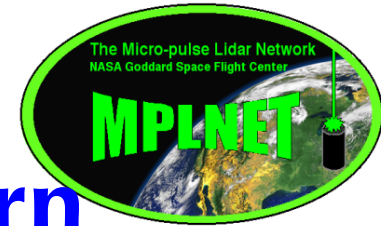


- MACC-II: extinction profiles from 0000UTC 22 March 2014 to 0000UTC 27 March 2014 each 3 hours
- Lidar Data: gridded extinction profiles
- *In-situ* pm<sub>2.5</sub> and pm<sub>10</sub> measurements at NCU and Lulin stations

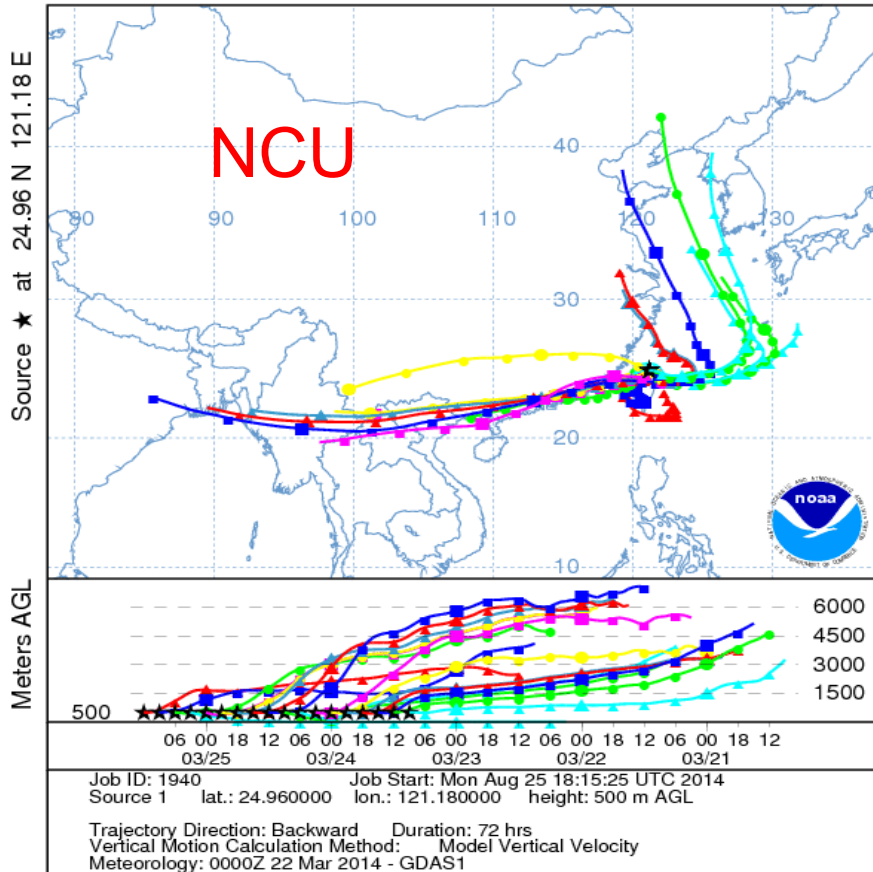


# NCU: two different patterns

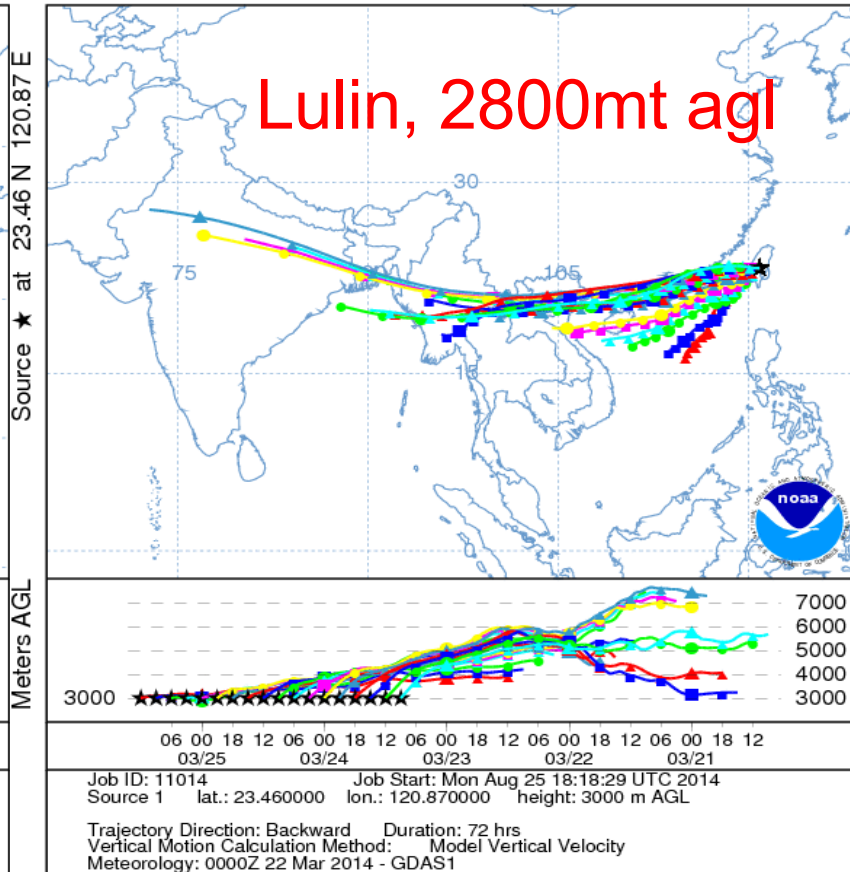
## Lulin: Mostly constant wind pattern

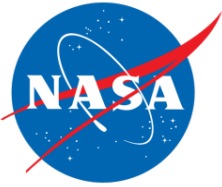


NOAA HYSPLIT MODEL  
Backward trajectories ending at 1200 UTC 25 Mar 14  
GDAS Meteorological Data

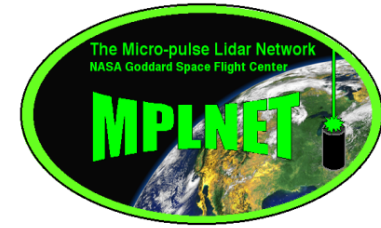


NOAA HYSPLIT MODEL  
Backward trajectories ending at 1200 UTC 25 Mar 14  
GDAS Meteorological Data

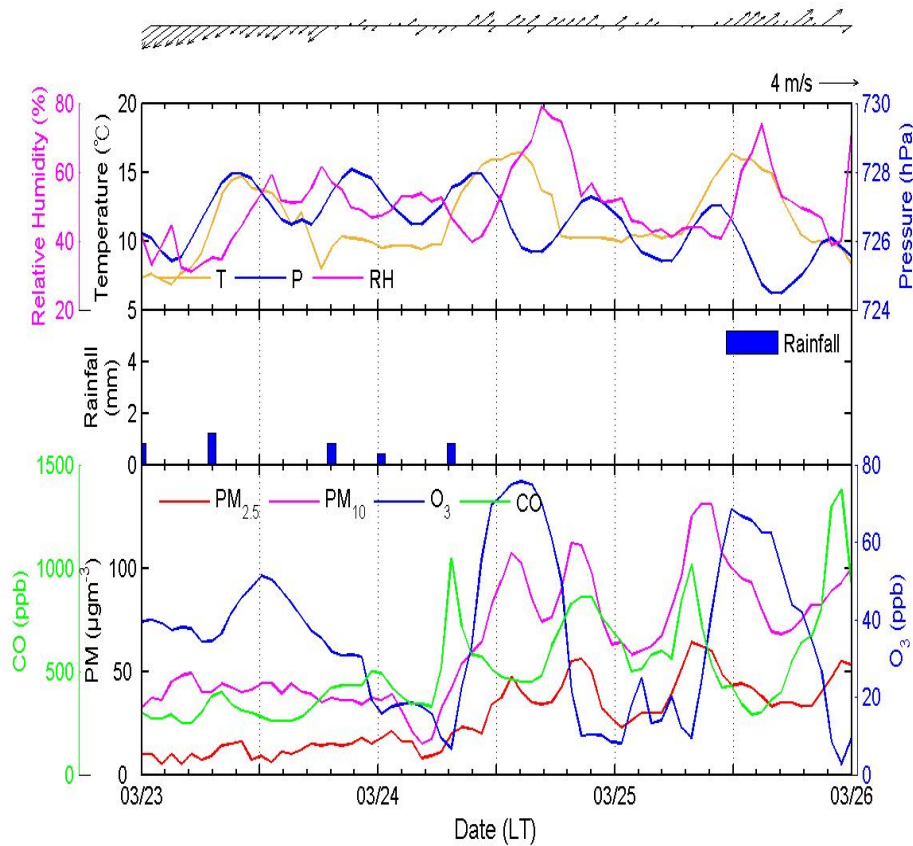




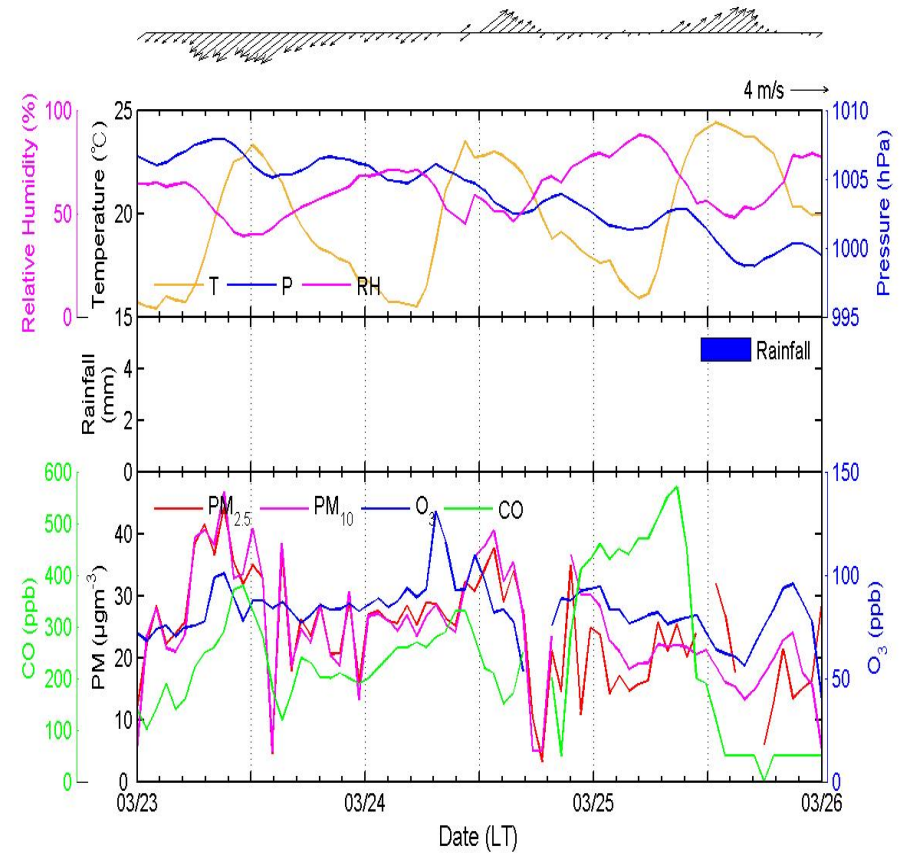
# In-situ PM<sub>2.5</sub> and PM<sub>10</sub>



EPA Pingzhen Air Quality Data and NCU Meteorology Data  
20140323~20140325

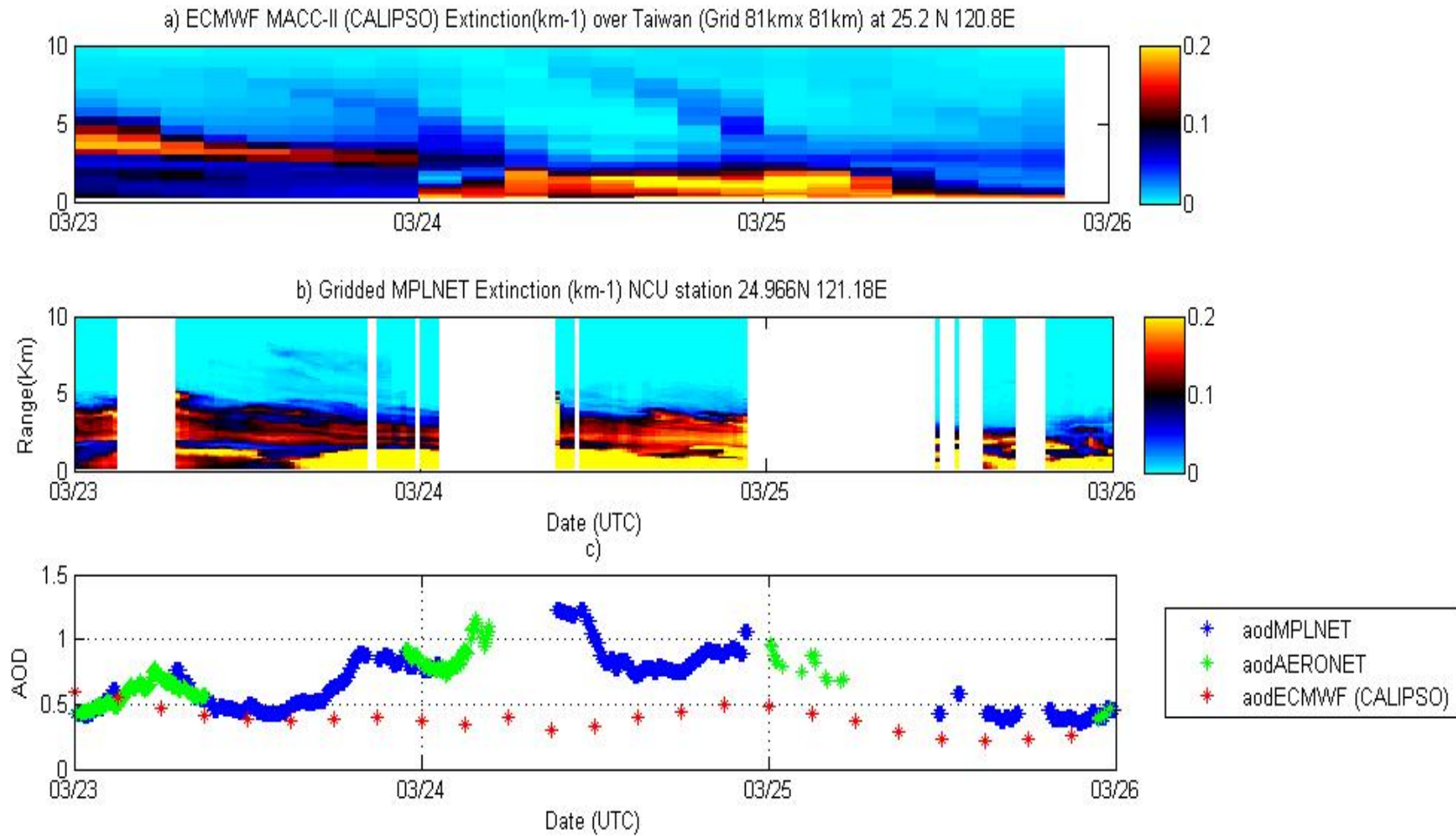
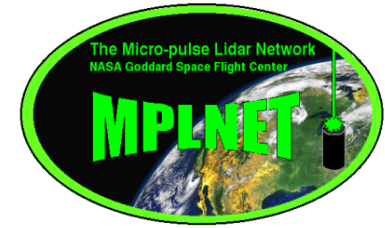


Lulin EPA Air Quality Data and Meteorology Data  
20140323~20140325



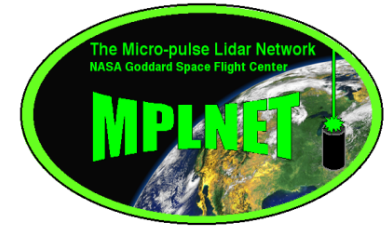


# 23-26 March 2014 NCU

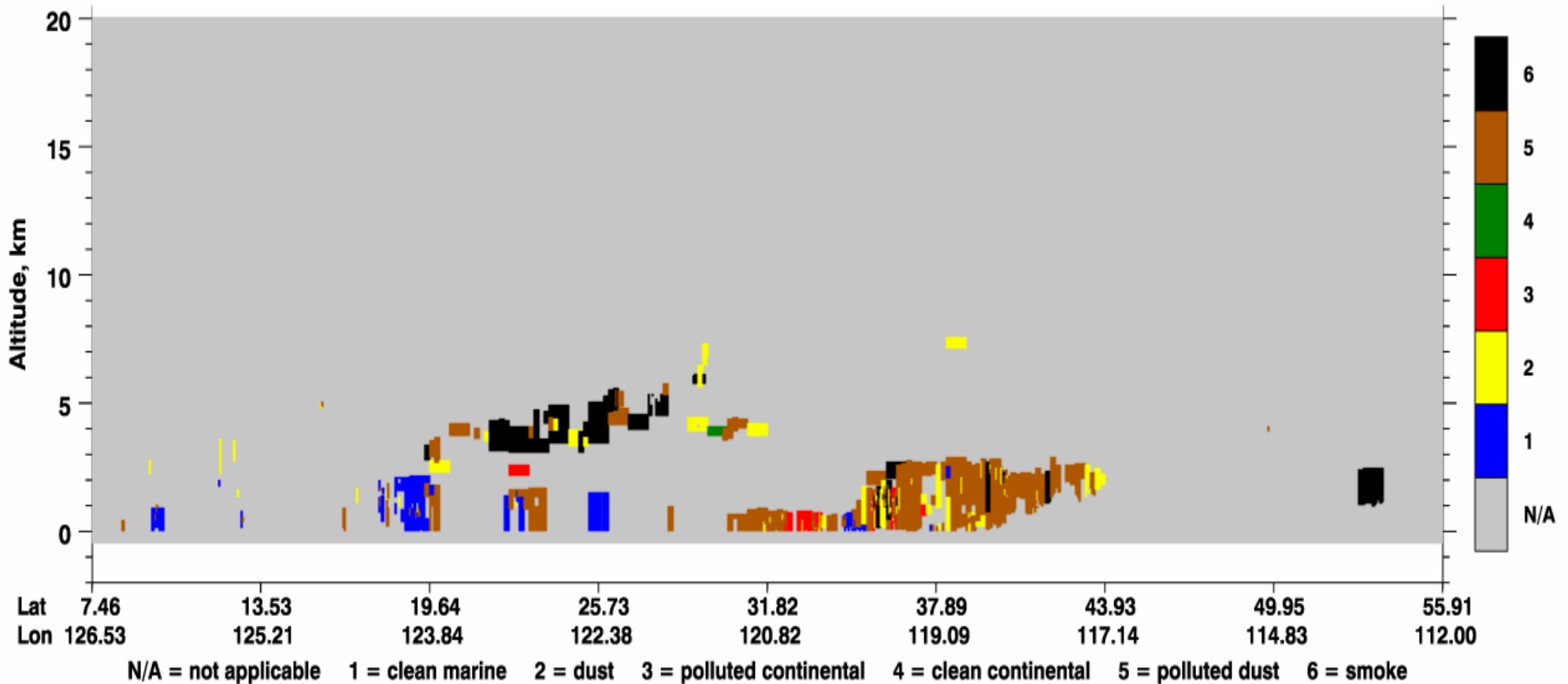


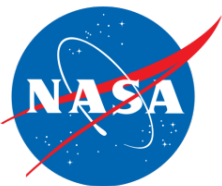


# CALIPSO on 23 March 2014

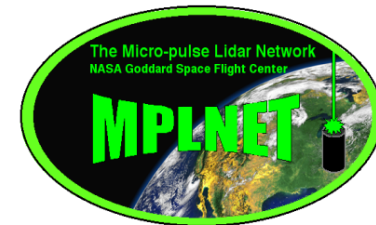


Aerosol Subtype UTC: 2014-03-23 05:14:44.7 to 2014-03-23 05:28:13.4 Version: 3.30 Standard Daytime





# Evaluate model performances vs. observations:



- Mean Fractional Error (**MFE**)

$$MFE = \frac{2}{N} \sum_{i=1}^N \frac{|\alpha_{mod,i} - \alpha_{obs,i}|}{(\alpha_{mod,i} + \alpha_{obs,i})}$$

- Mean Fractional Bias (**MFB**)

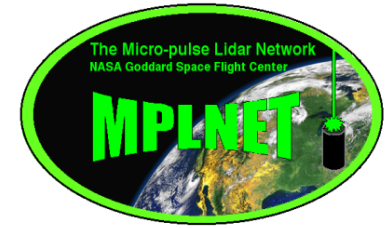
$$MFB = \frac{2}{N} \sum_{i=1}^N \frac{(\alpha_{obs,i} - \alpha_{mod,i})}{(\alpha_{mod,i} + \alpha_{obs,i})}$$

- Performance Goal:  $MFE < 0.5$  and  $-0.3 < MFB < 0.3$
- Performance Criteria:  $MFE < 0.75$  and  $-0.6 < MFB < 0.6$

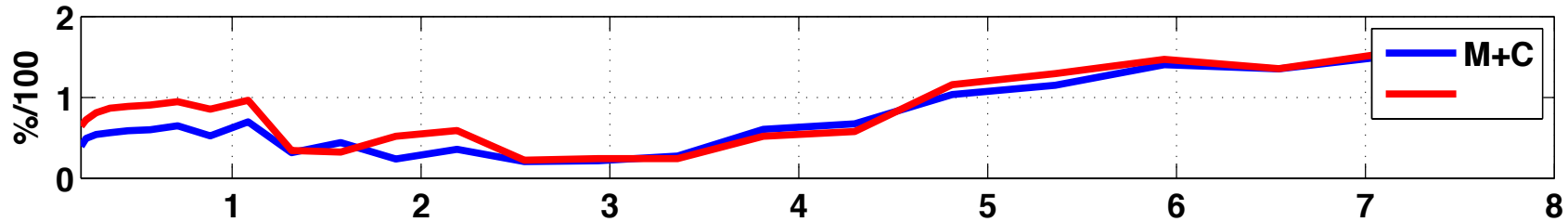


# Performances Evaluation

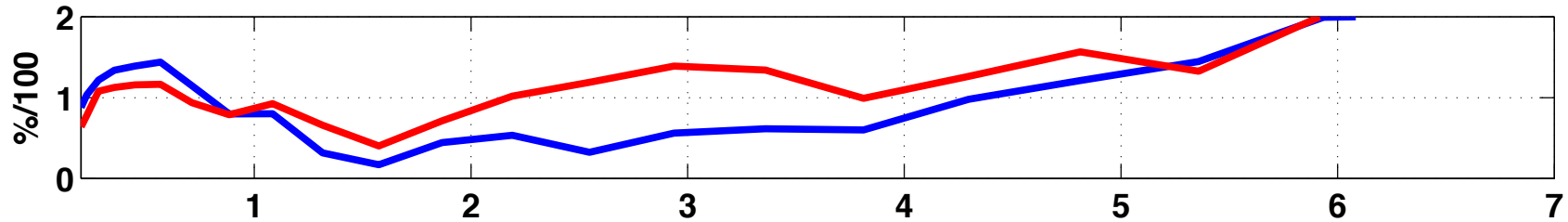
## MFE



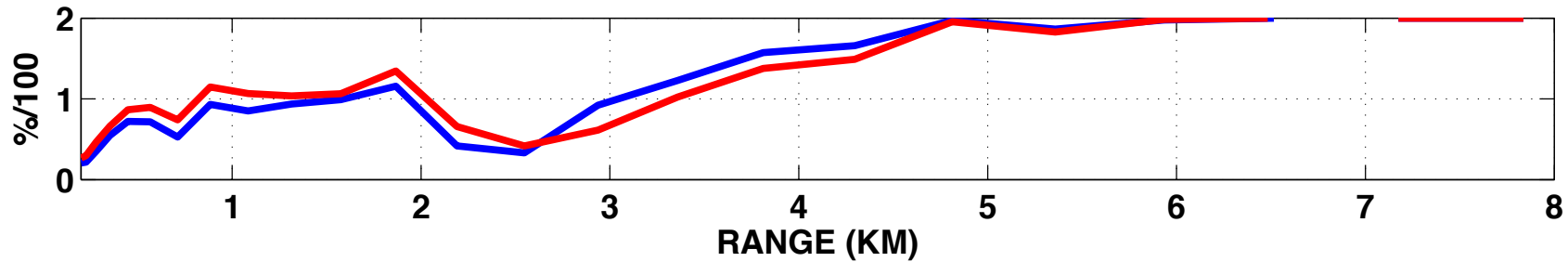
MFE 23 MARCH 2014



MFE 24 MARCH 2014

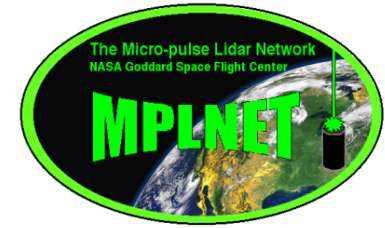


MFE 25 MARCH 2014

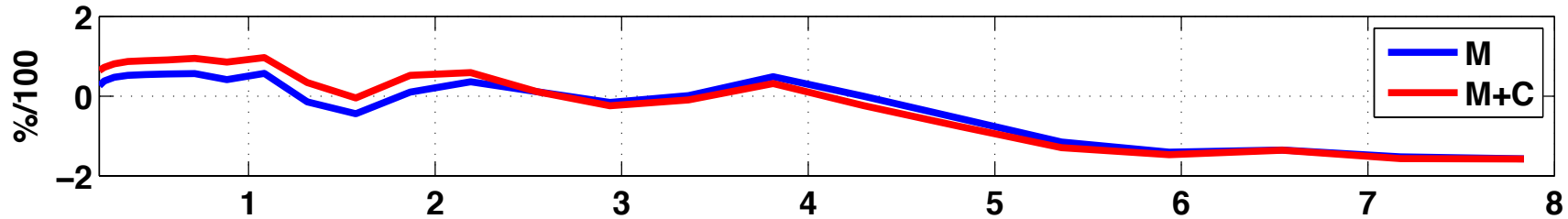




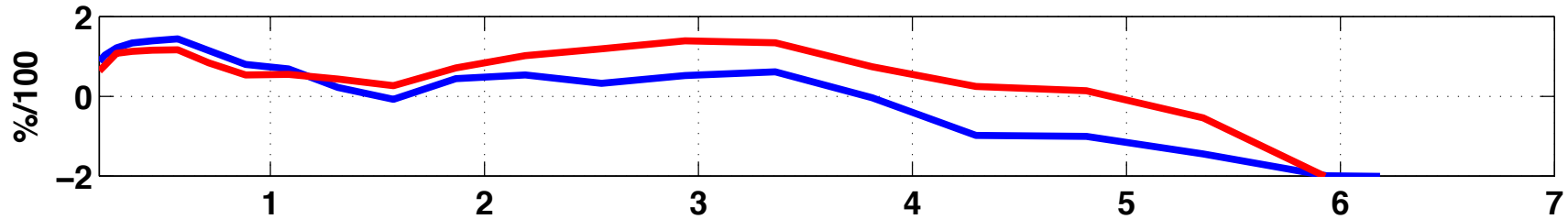
# Performances Evaluation MFB



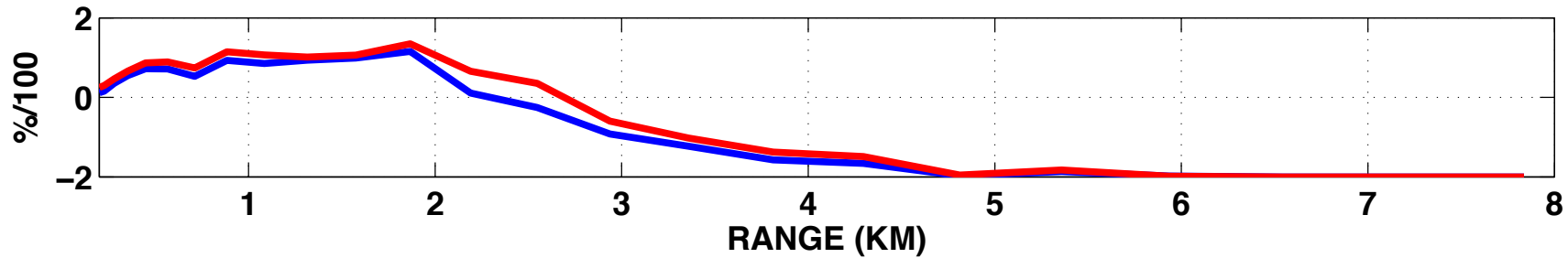
MFB 23 MARCH 2014



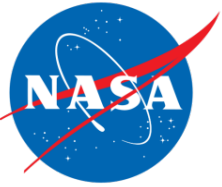
MFB 24 MARCH 2014



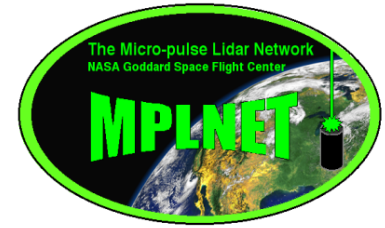
MFB 25 MARCH 2014



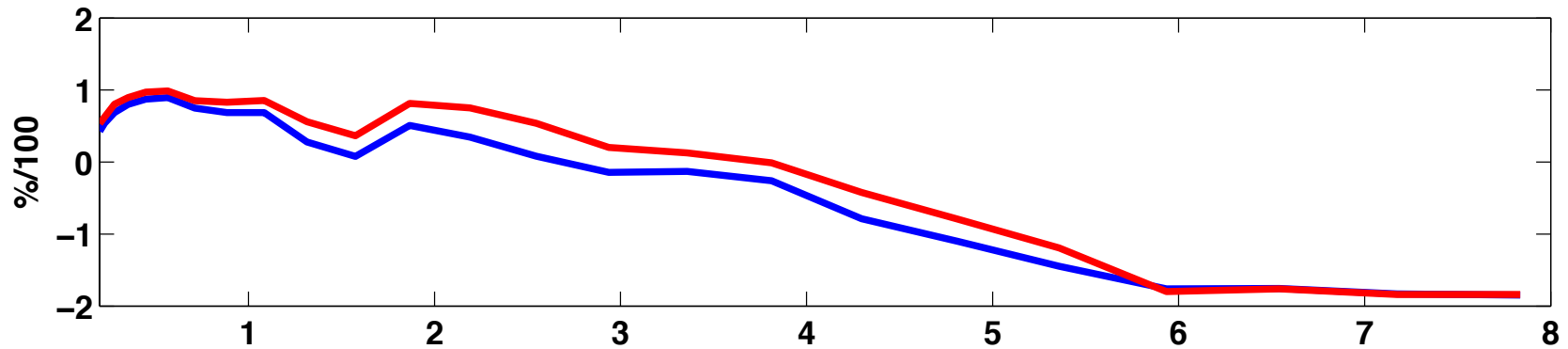




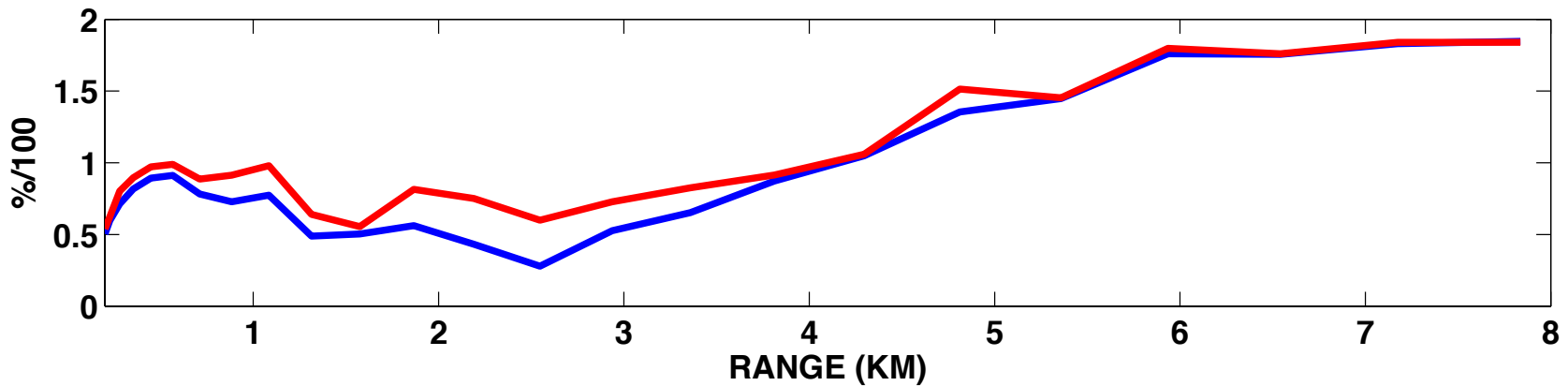
# Global MFE-MFB 23-25 March

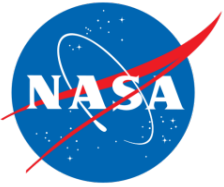


MFB 23-25 MARCH 2014

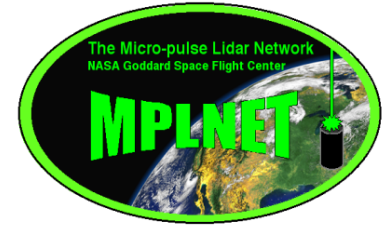


MFE 23-25 MARCH 2014

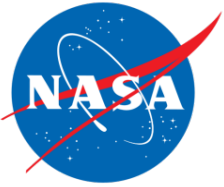




# Conclusions and Future Perspectives

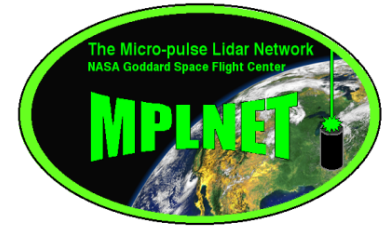


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- Some results show that MACC-II and OP NAAPS tend to underestimate the aerosol load in the boundary layer and overestimate in the upper troposphere
  - MPLNET lidar are a useful tool to evaluate how DA from CALIPSO works.
  - MACC-II: ad-hoc study is needed (and hopefully performed), where the assimilated profile is known and the model behavior evaluated.
  - Soon (hopefully) a paper from these studies.



# Thank you

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## MPLNET STAFF

- *PI: Judd Welton/612*
- *James Campbell/NRL, CA*
- *Jasper Lewis/JCET-UMBC/612*
- *Simone Lolli/JCET-UMBC/612*
- *Larry Belcher/SSAI/612*
- *Sebastian Stewart/SSAI/612*
- *Phillip Haftings/SSAI/612*