Dust model validation using CALIPSO

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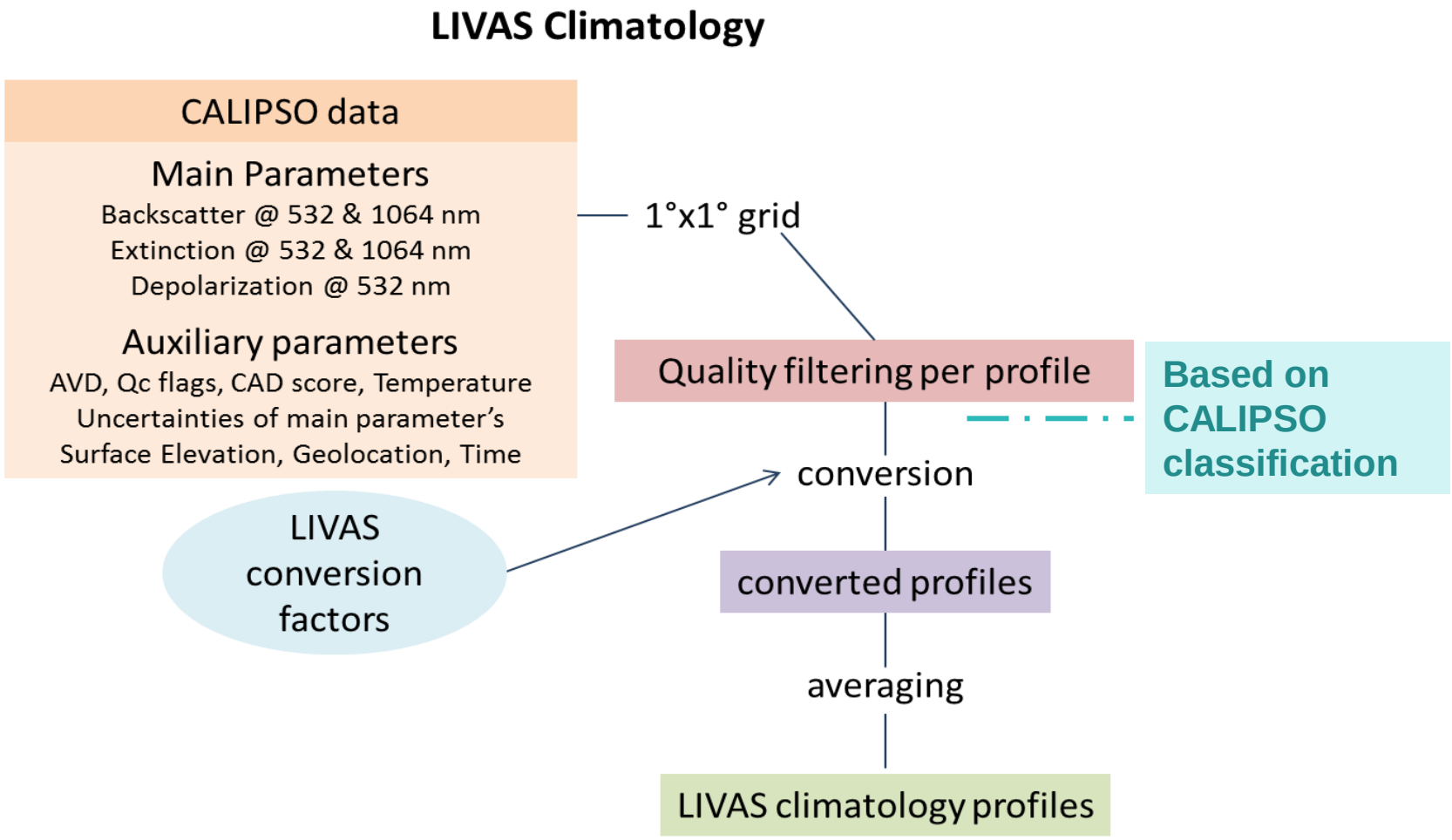
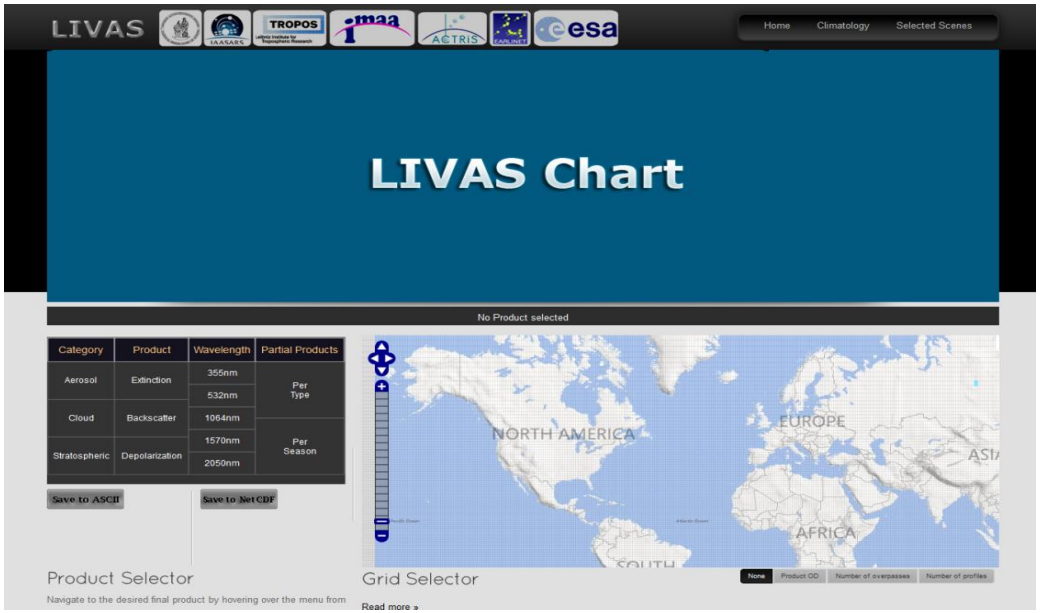
Points to be discussed

- Opportunity to distinguish dust from space: CALIPSO depolarization capability
- Improve lidar ratio for Saharan dust in retrieval algorithms
- Develop a dust climatology including vertical information
- Examine the use of satellite data for assimilation and validation of dust models

LIVAS data processing chain



LIVAS web-portal - Climatology

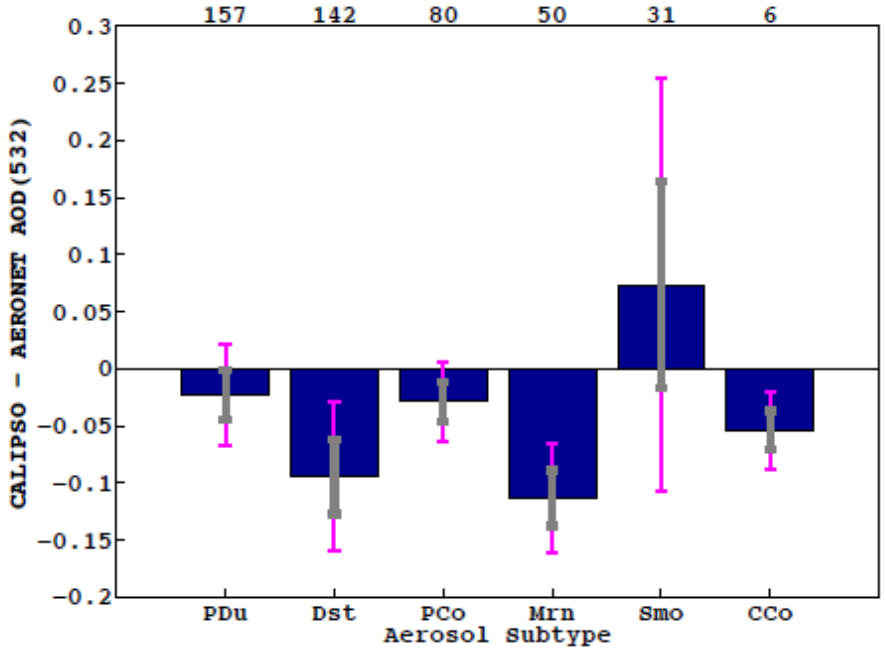


LIVAS FTP – Web portal
NetCDF files
For complete database

http://lidar.space.noa.gr:8080/livas/

ftp://lidar.space.noa.gr

Dust Lidar Ratio and its impact on LIVAS dust climatology



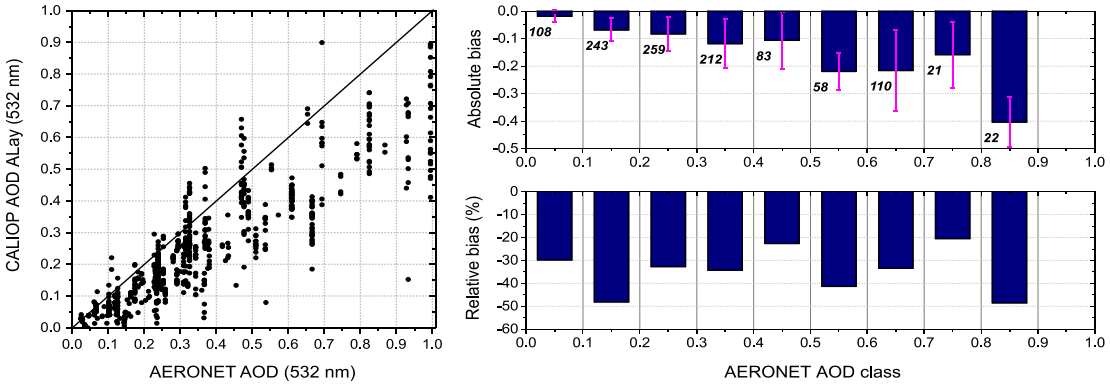
Relative bias of CALIPSO with respect to 147 sunphotometer stations in globe is −13% when dust is present and −3% when dust retrievals are not included in the analysis

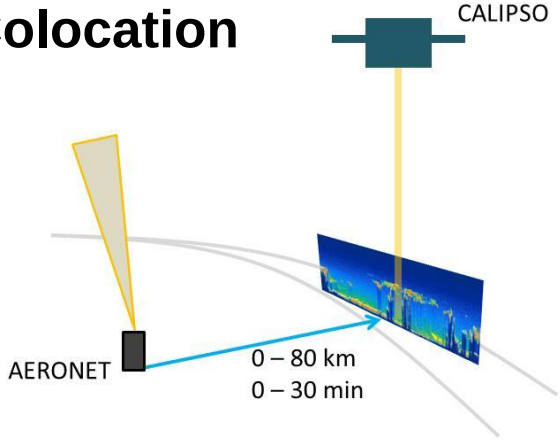
Schuster et al., 2012

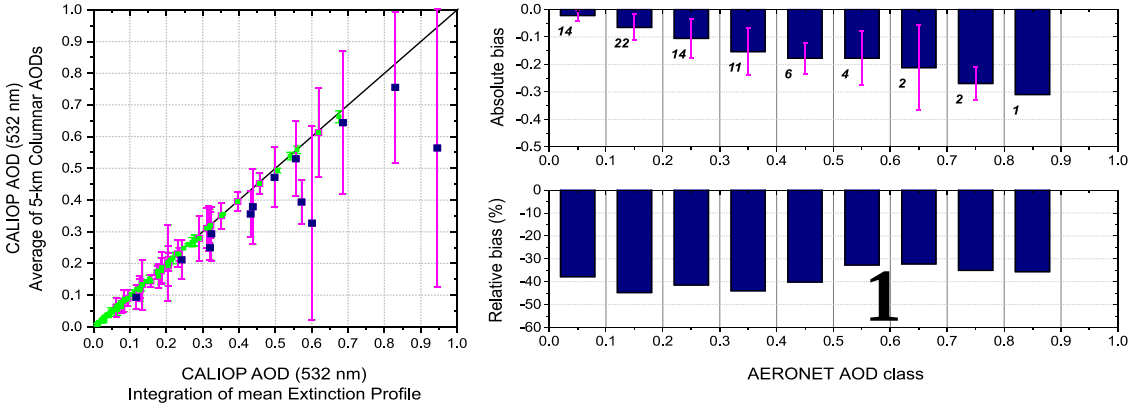
Saharan Dust Lidar Ratio

AERONET / CALIPSO Colocation

LR=40sr

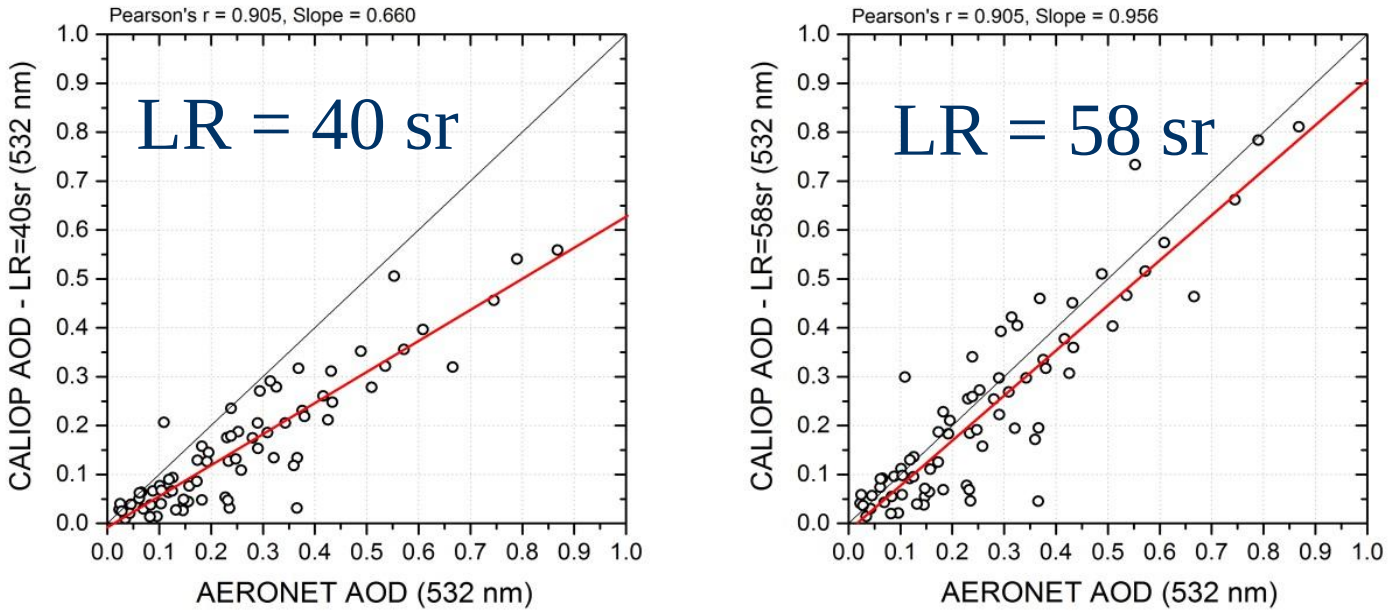






Pure Dust cases from CALIPSO typing

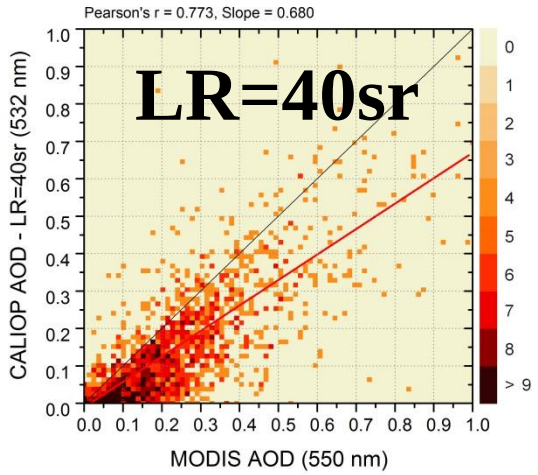
Saharan dust LR (CALIOP vs AERONET)

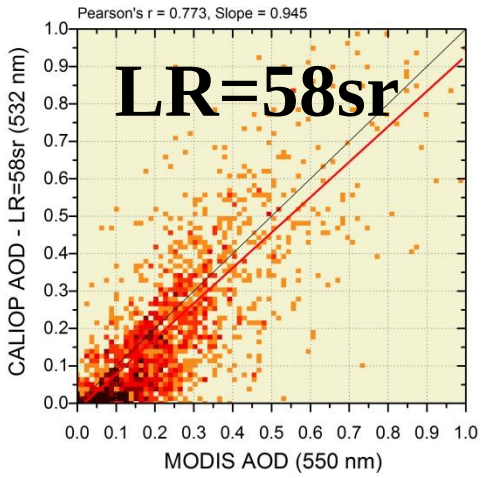


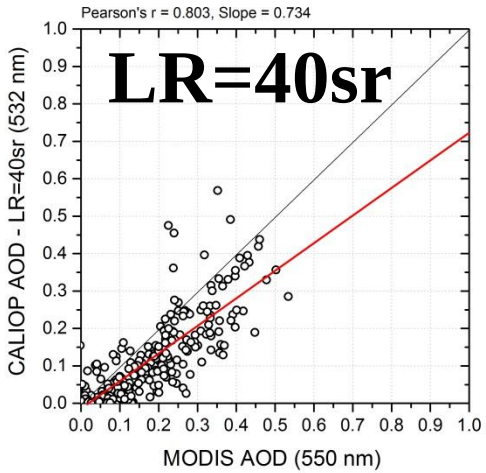
Comparison of CALIPSO AOD versus collocated AERONET measurements when LR is equal to 40 sr (left) and when LR is equal to 58 sr (right).

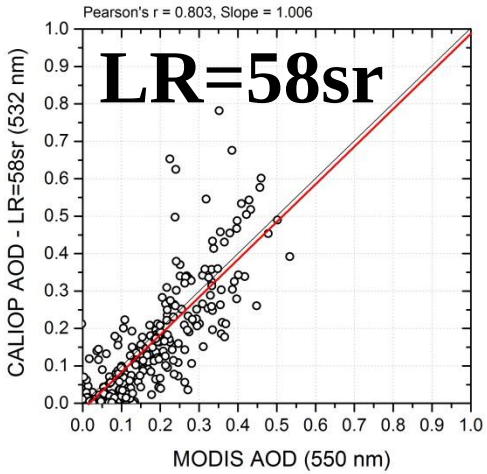
Amiridis et al. ACP 2013

Saharan Dust LR (CALIPSO vs MODIS)









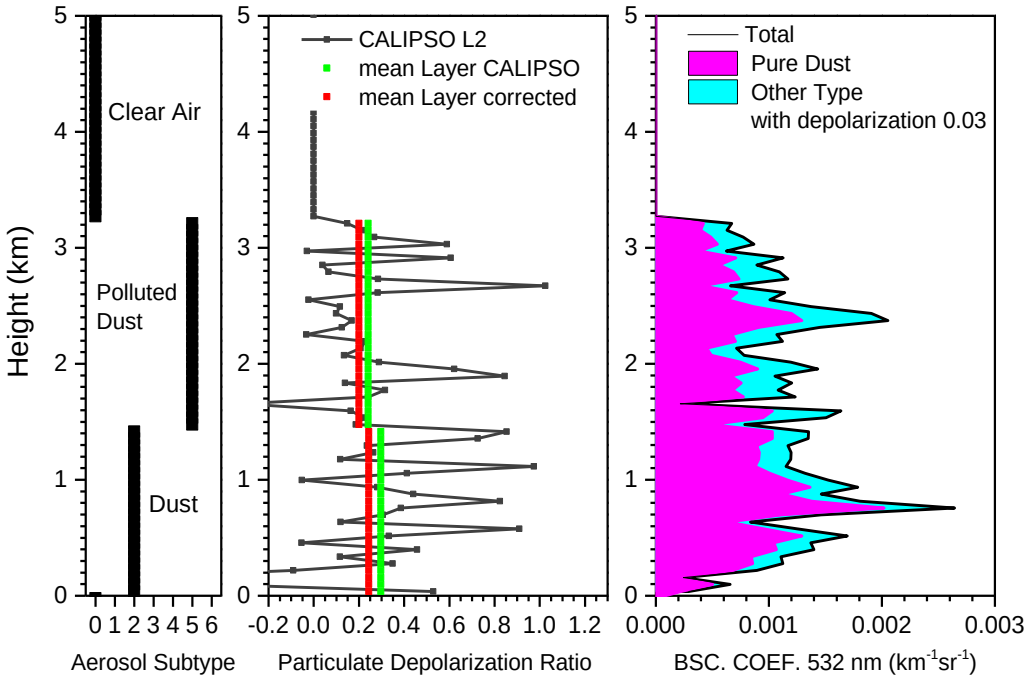
CALIPSO AODs (1^0x1^0) versus collocated MODIS-Aqua Level 3 product using LR equal to 40 sr (left) and LR equal to 58 sr (right).

Upper: 2D histograms representing the number of cases found for each CALIPSO/MODIS AOD bin between 0 and 1.0 (bin step equal to 0.0125).

Lower: Data are screened to ensure horizontal homogeneity in the cell cloud-free conditions for the MODIS cell.

Saharan Dust
LR = 58 sr

Separation of pure dust from dust mixtures



mean depolarization for the OTHER aerosol type, equal to 0.03

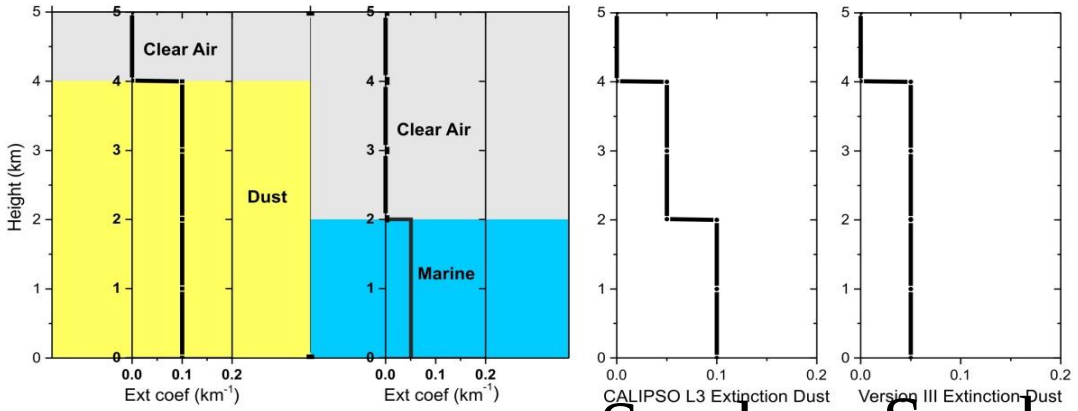
- **Left**: Aerosol type.
- **Middle**: Particle depolarization ratio (black line), mean layer depolarization reported by CALIPSO (green line) and re-calculated mean particle depolarization ratio (red line).
- **Right**: Backscatter coefficient separation for pure dust (in magenta color) and “other” aerosol type (in cyan color).

Tesche et al., 2012

Decomposition of dust from other aerosols

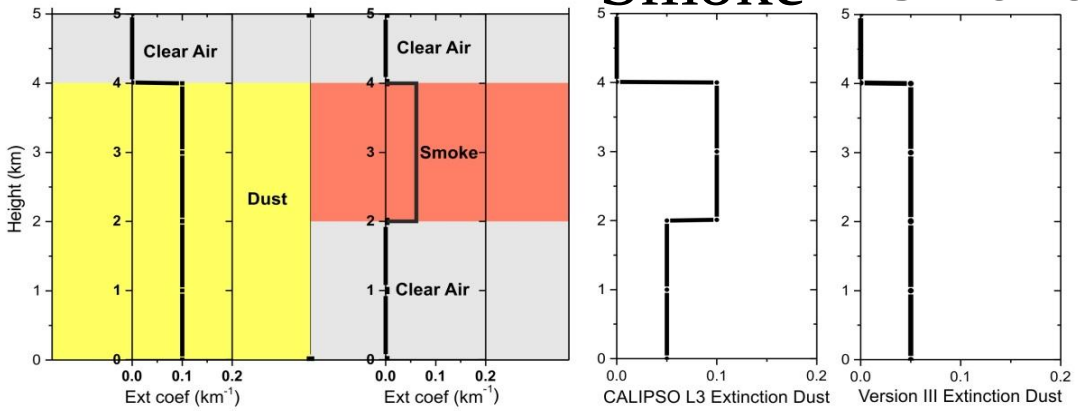
Marine Marine=0

Case 1



Smoke Smoke=0

Case 2

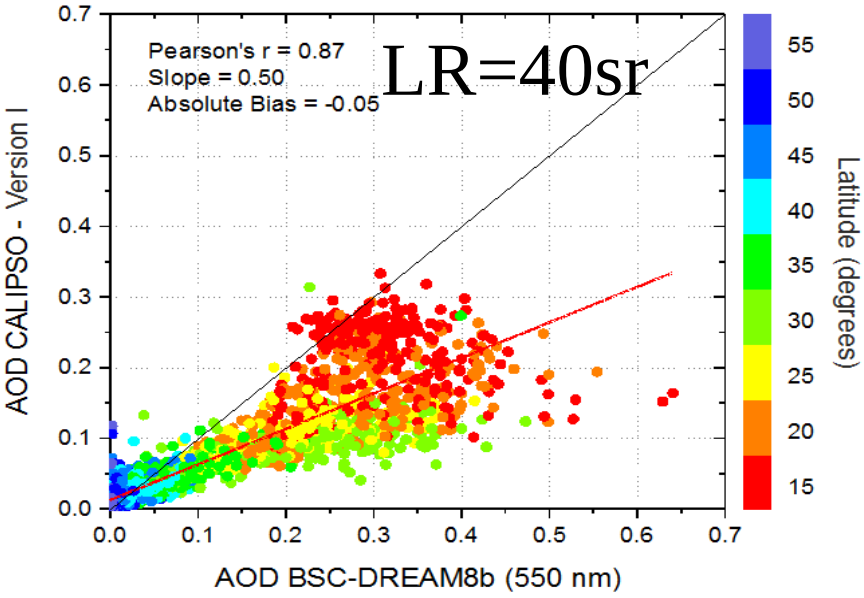


Same Dust Load

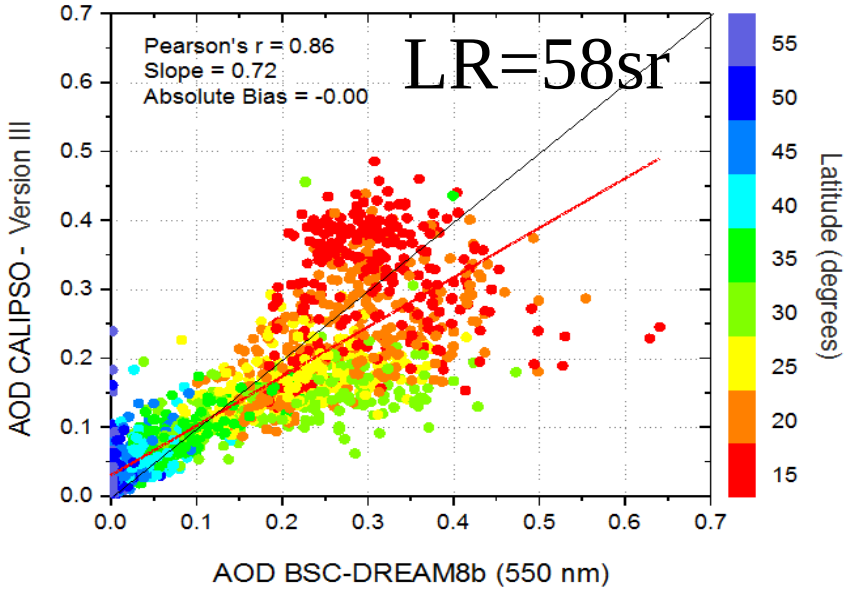
Different mean profile

Same mean profile

Comparison of CALIPSO product with DREAM



Original Version I CALIPSO AOD

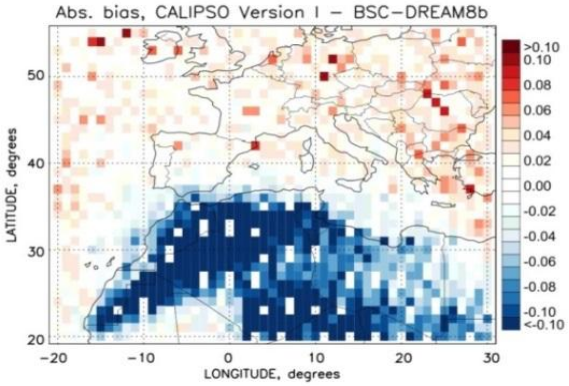


Updated Version III CALIPSO AOD (LR equal to 58 sr , non-dust aerosol types, pure dust component)

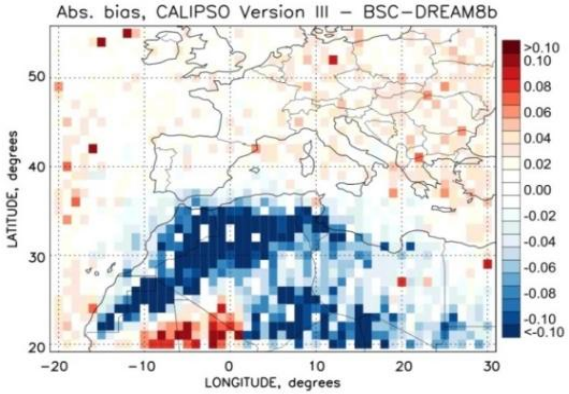
Color bar represents the latitudinal zone of the comparison, in 5 degree bins

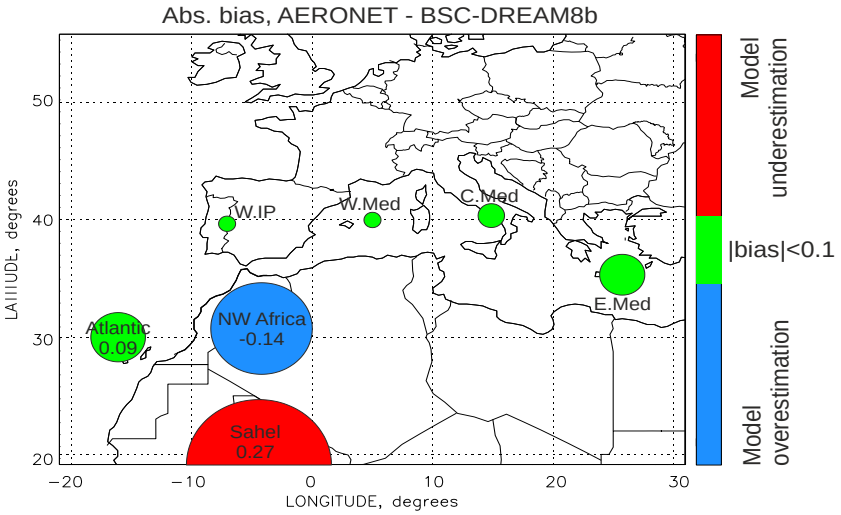
Comparison of CALIPSO product with DREAM

Old version
LR: 40sr



New versio
LR: 58sr



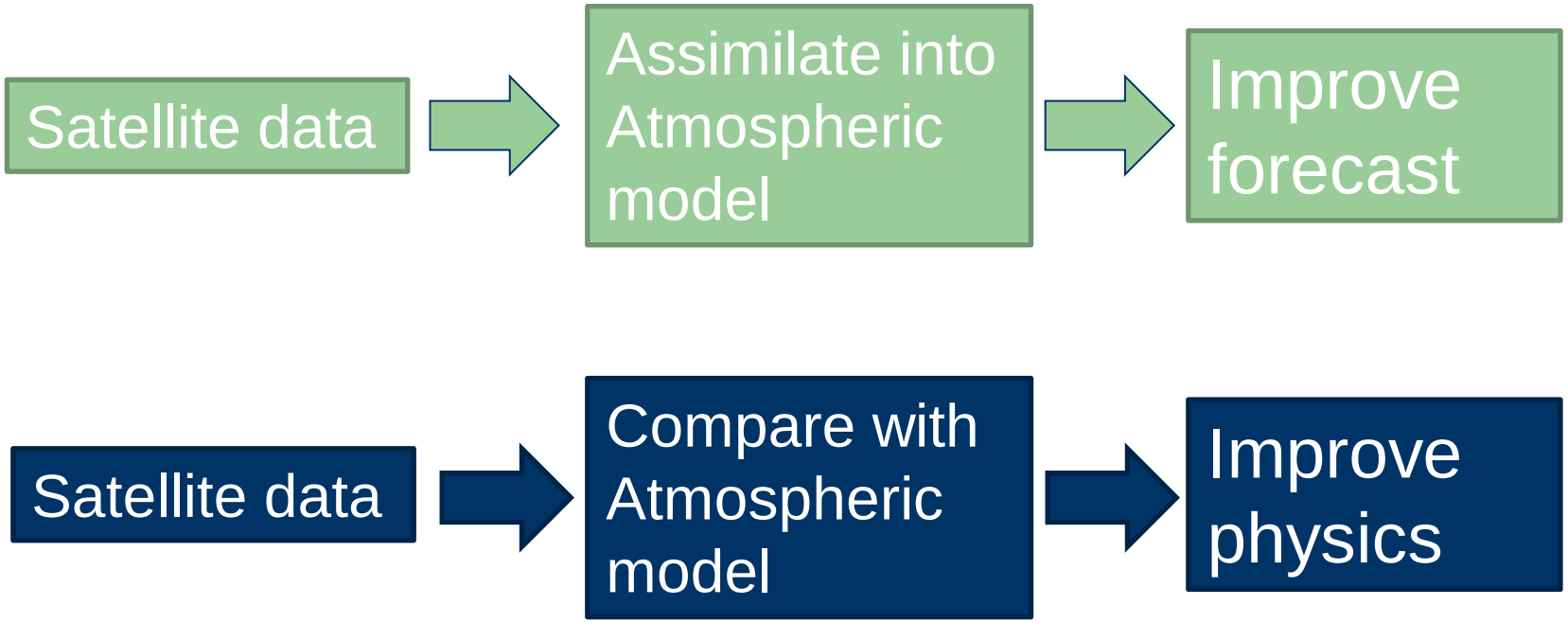


Observed biases follow model known biases

Spatial distribution of 5-year AOD absolute biases for CALIPSO climatological product and the BSC-DREAM8b dust model outputs.

(Basart et al., 2012)

Use satellite data in dust models



Sentinel Mirror Site at the National Observatory of Athens

- **Disseminate Sentinel data and higher level Copernicus products** to the End User & Scientific communities mainly at national level, but also to neighbouring South Eastern Mediterranean and Balkan countries on the basis of the existing and/or future transnational needs and co-operations.

- The whole project is in line with the on-going initiatives and strategic objectives for building at NOA a **Center of Excellence for EO based monitoring of the Environment and Natural Disasters (BEYOND)** and processing of Space Data.

Conclusions

- Using a lidar ratio of 58 sr instead of 40 improved CALIPSO retrievals for Saharan dust
- Decomposition of pure dust from other pollutants improves also the vertical representation of dust
- Assimilating this information in dust models can improve our understanding and forecasting of dust processes in the atmosphere
- The lidar ratio seems to vary significantly for different dust areas (e.g. Atlantic, Middle East, China)
- This may also imply the need for a different dust modeling approach for different areas

Thank you for your attention!

Acknowledgements