AEOLUS Aerosol Assimilation in the DISC (A3D)

ATMOS 2021

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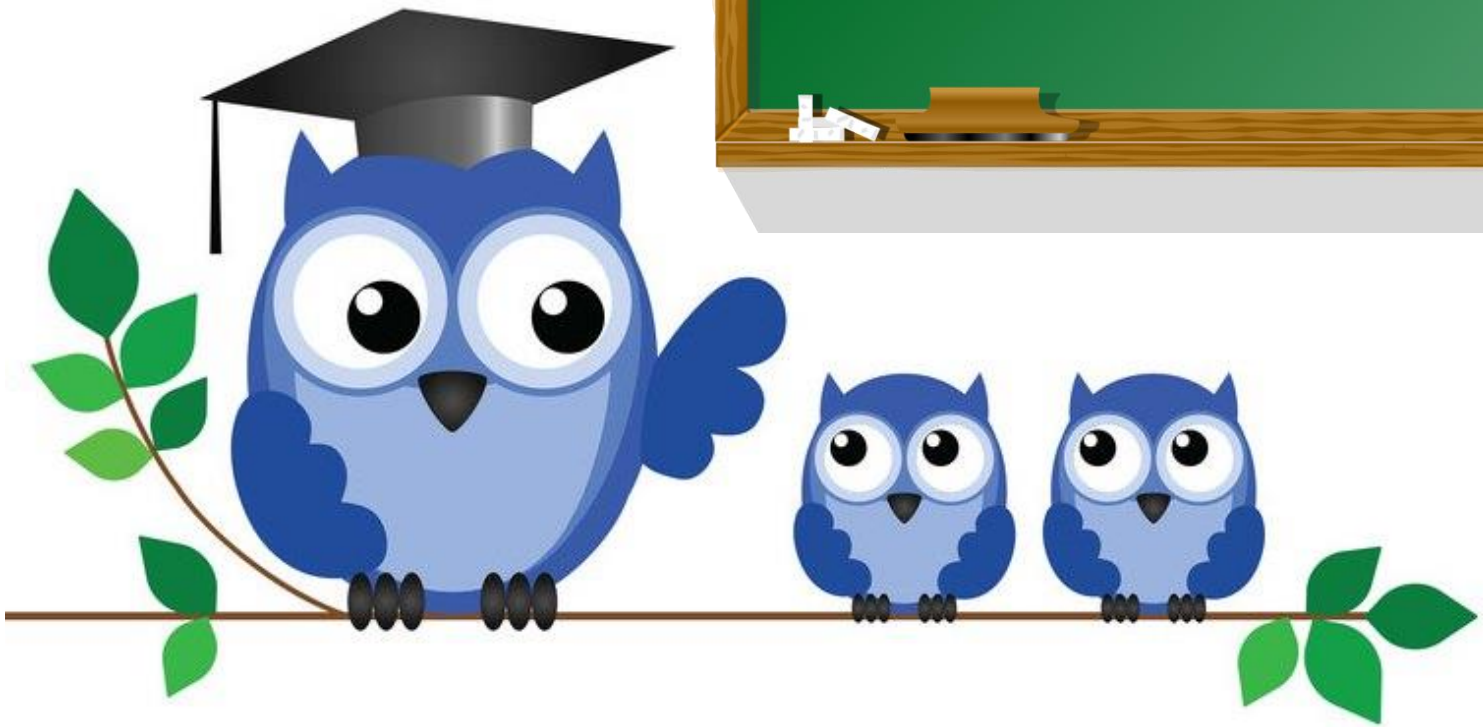
With the support of Melanie Ades, Zak Kipling, Tomas Kral, Gabor Radnoti, Roberto Ribas and many others

ECMWF

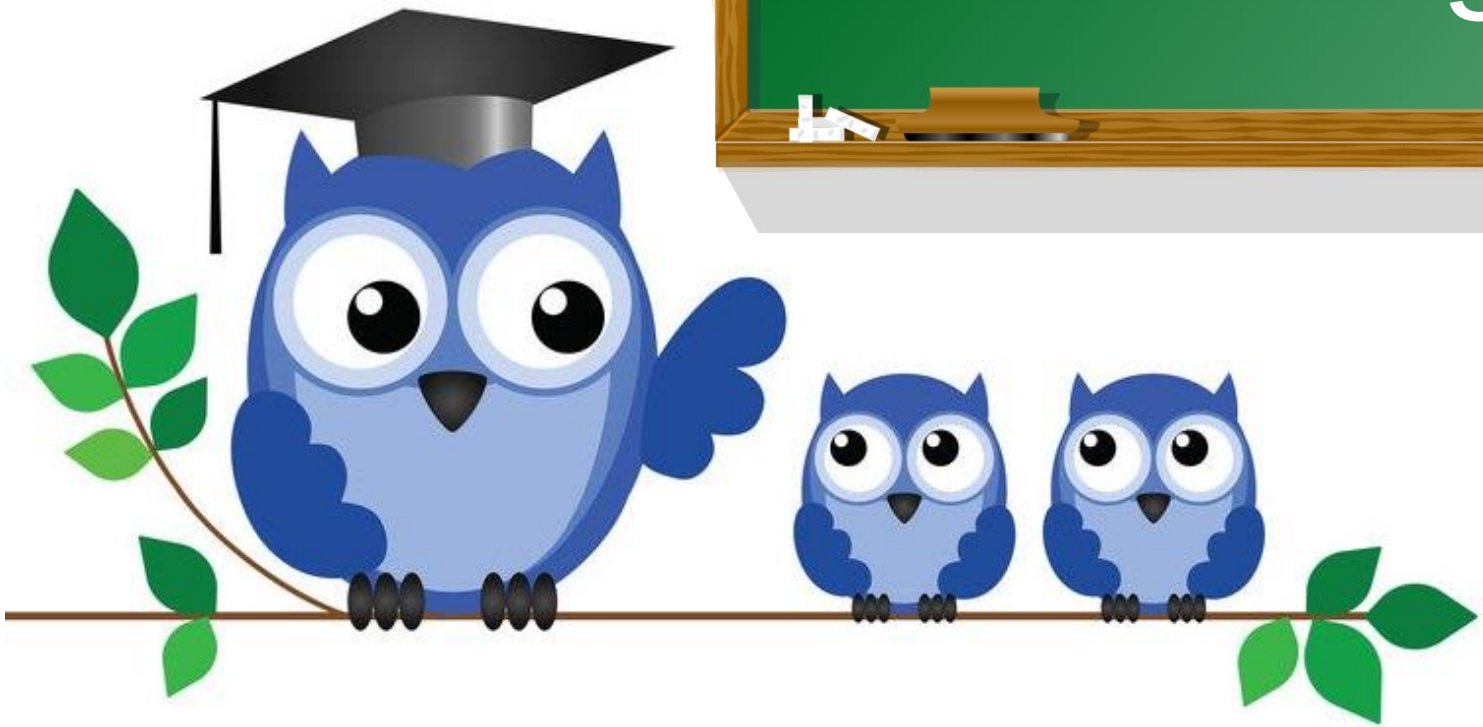
Objectives



Why do we want to assimilate lidar backscatter profile in COMPO-IFS?

COMPO-IFS is doing a good job already having a strong model for aerosol and a beneficial assimilation of AOD coming from MODIS (AQUA and TERRA) and PMAp.
The problem is the AOD is an column integrated data, no vertical distribution information is available.
Attributing the plume to an altitude can have a detrimental effect.
The backscatter profile is providing a key information that can only have positive effect in the system assimilation.

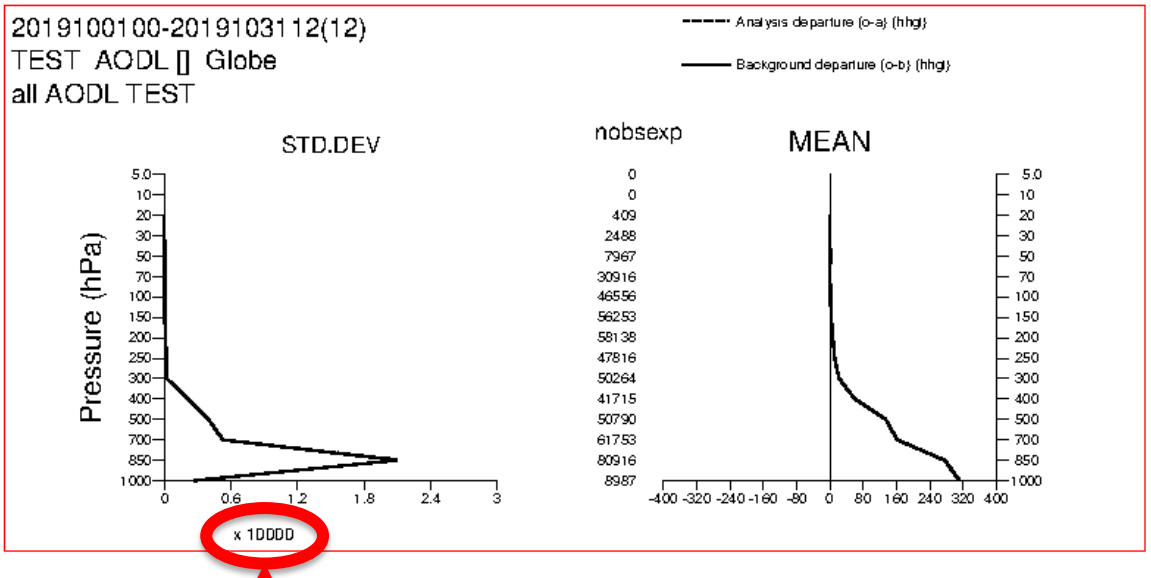
First step: Monitoring



Importance to monitor the instrument

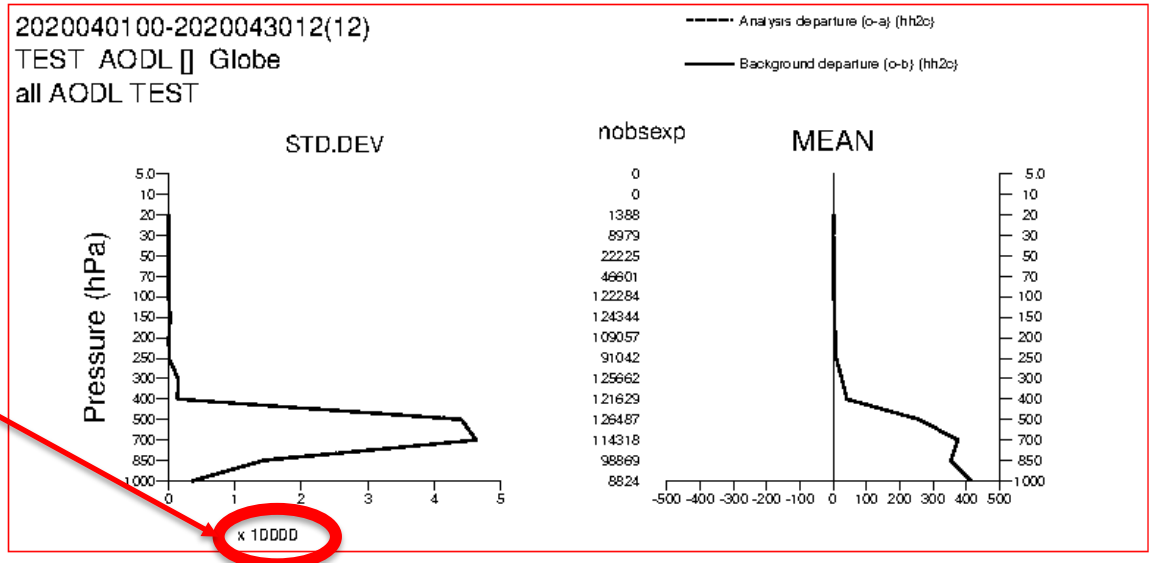
- The benefits to monitor an instrument are:
  - Observe any deviation of the instrument
  - Validate the quality of data
  - Notice any degradation
  - Recognise any artefacts introduce by the algorithm
  - ….

Monitoring of AEOLUS L2A for October 2019 and April 2020

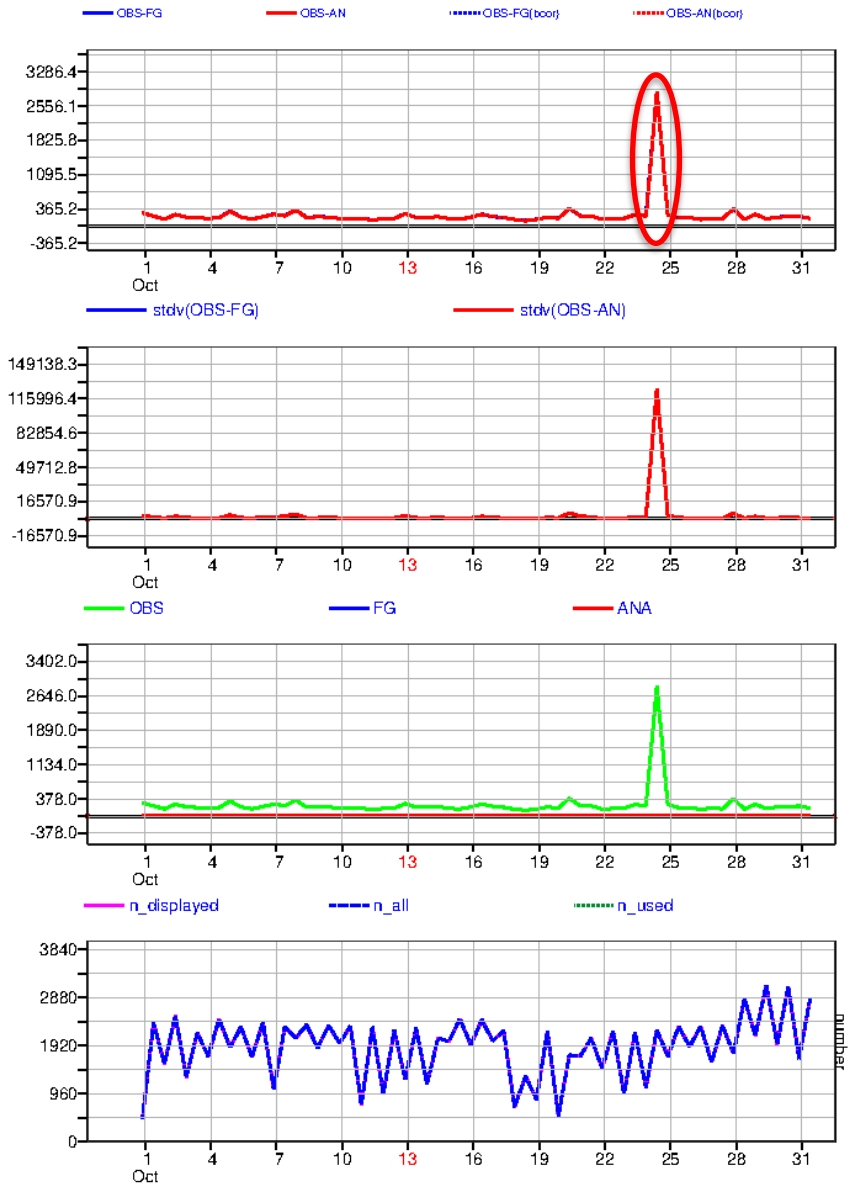


When looking at the first result comparing the observations with the first guess departure, it is clear that some artefact are left in the observations. It can be observed in both periods.

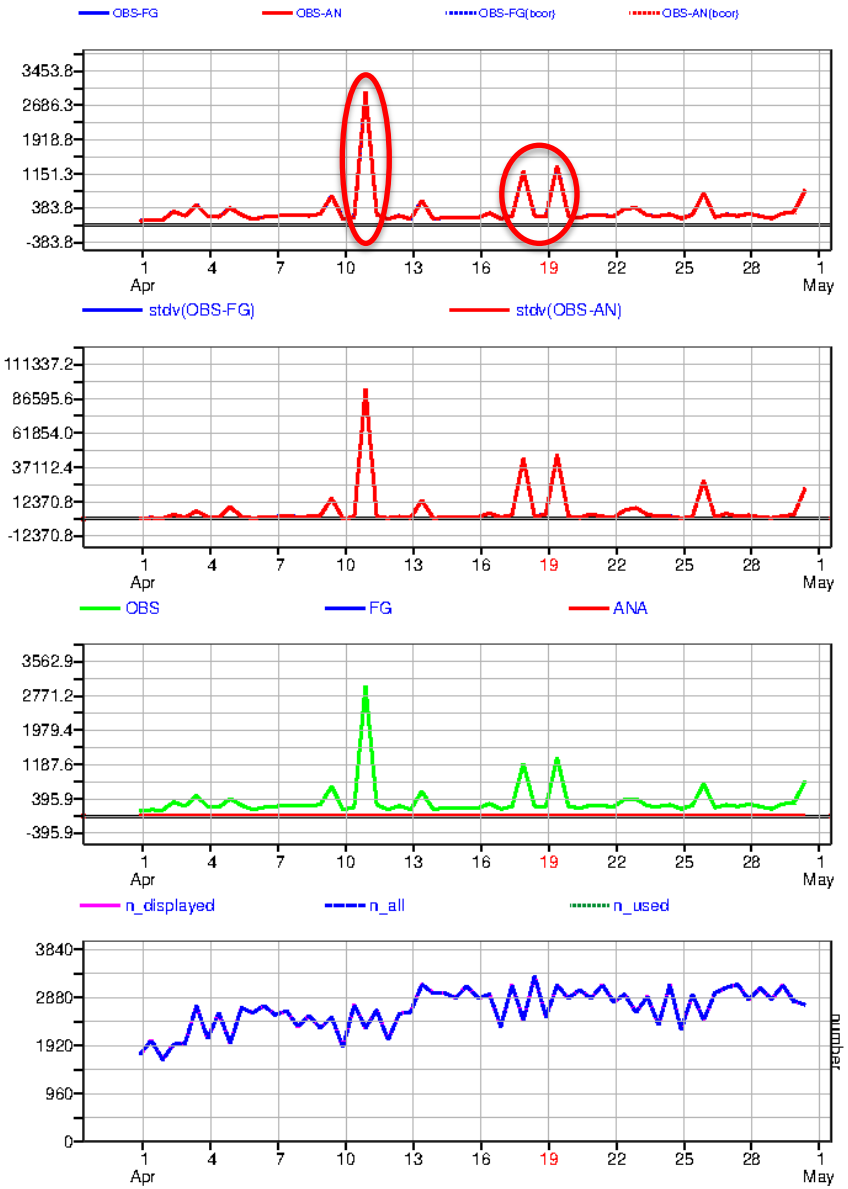
The standard deviation is out of range



AEOLUS LIDAR MONITORING
LEVEL =700.00 - 1013.25 HPA, ALL DATA [TIME STEP = 12 HOURS]
Area: lon_w= 180.0, lon_e= 180.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces)
EXP = HHGL



AEOLUS LIDAR MONITORING
LEVEL =700.00 - 1013.25 HPA, ALL DATA [TIME STEP = 12 HOURS]
Area: lon_w= 180.0, lon_e= 180.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces)
EXP = HH2C



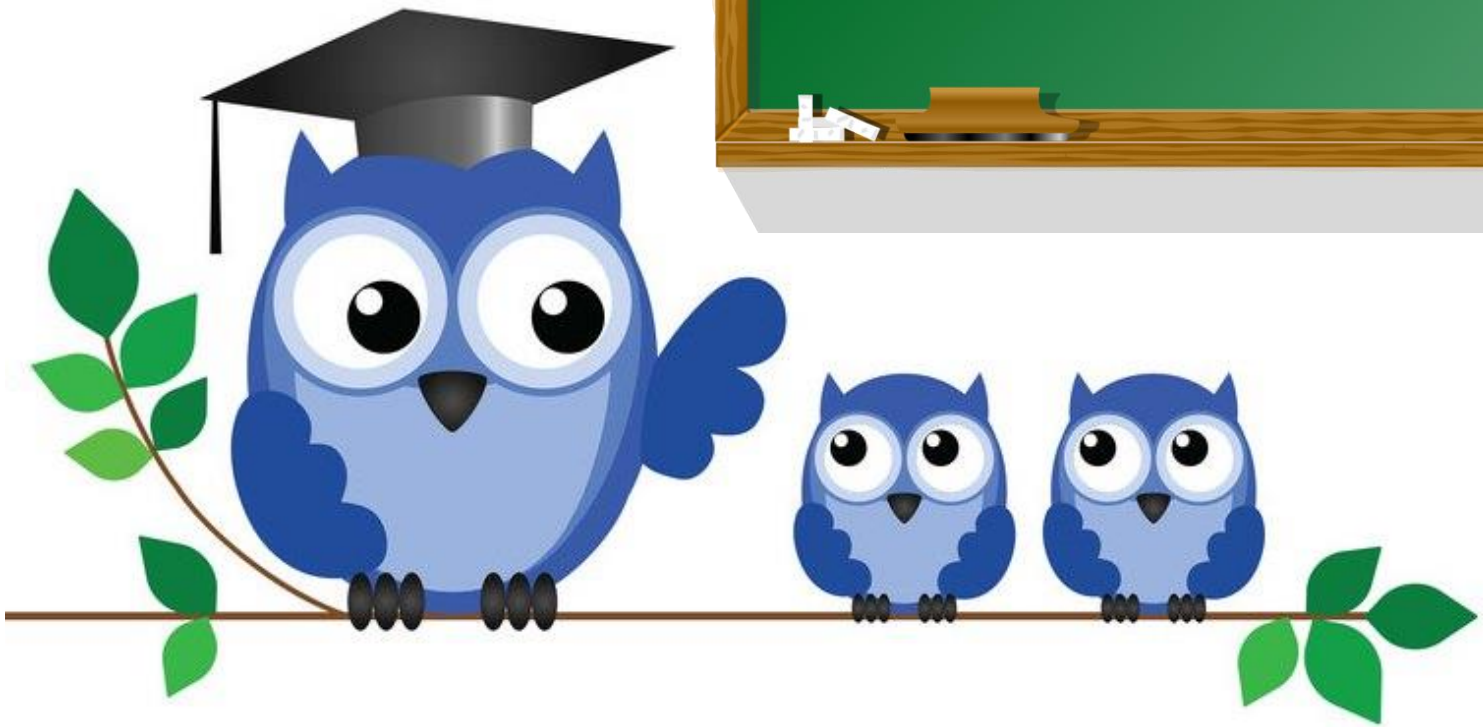
Monitoring of AEOLUS L2A

The monitoring shows:

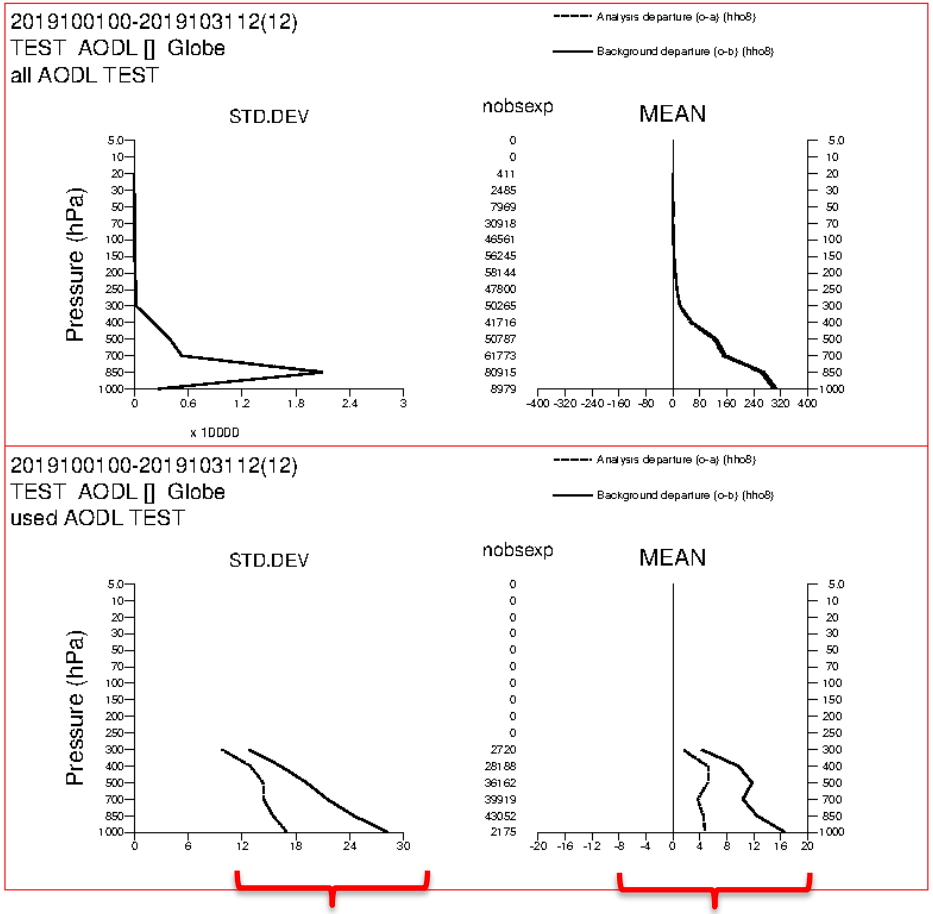
- Some artefacts are present for some days for AEOLUS.
- No link can be done with the AEOLUS time line status

Will the assimilation be able to remove these artefacts?

Second step: Assimilation

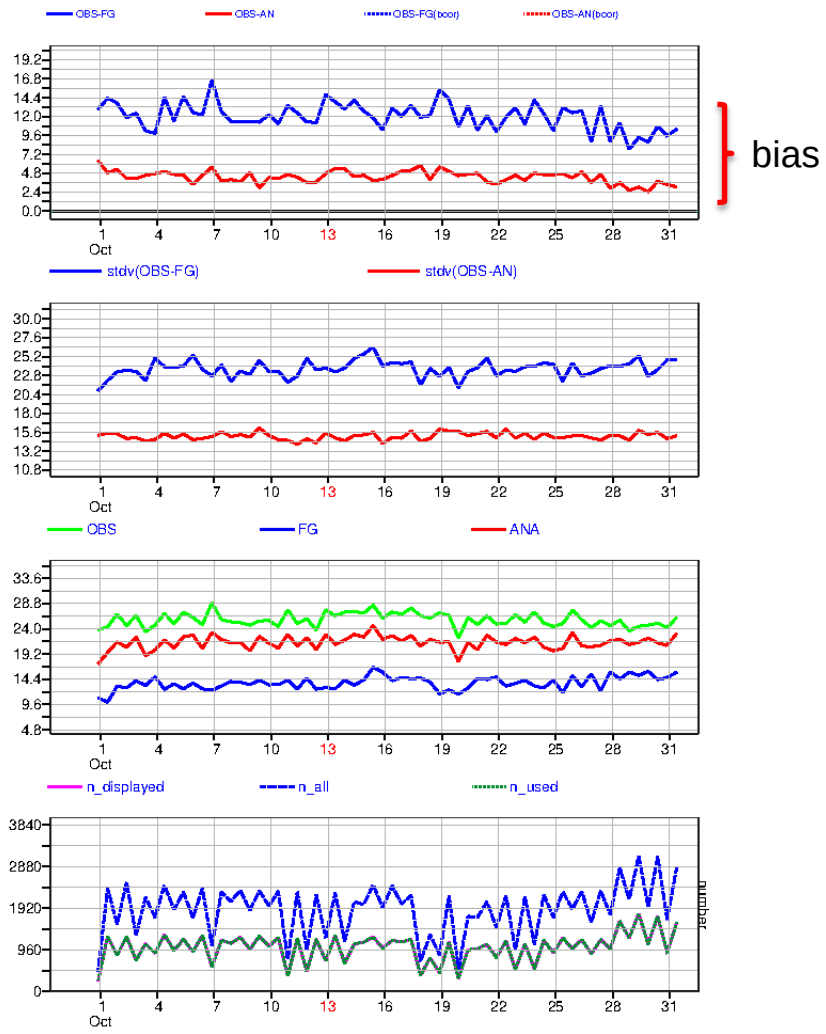


Assimilation of AEOLUS L2A for October 2019

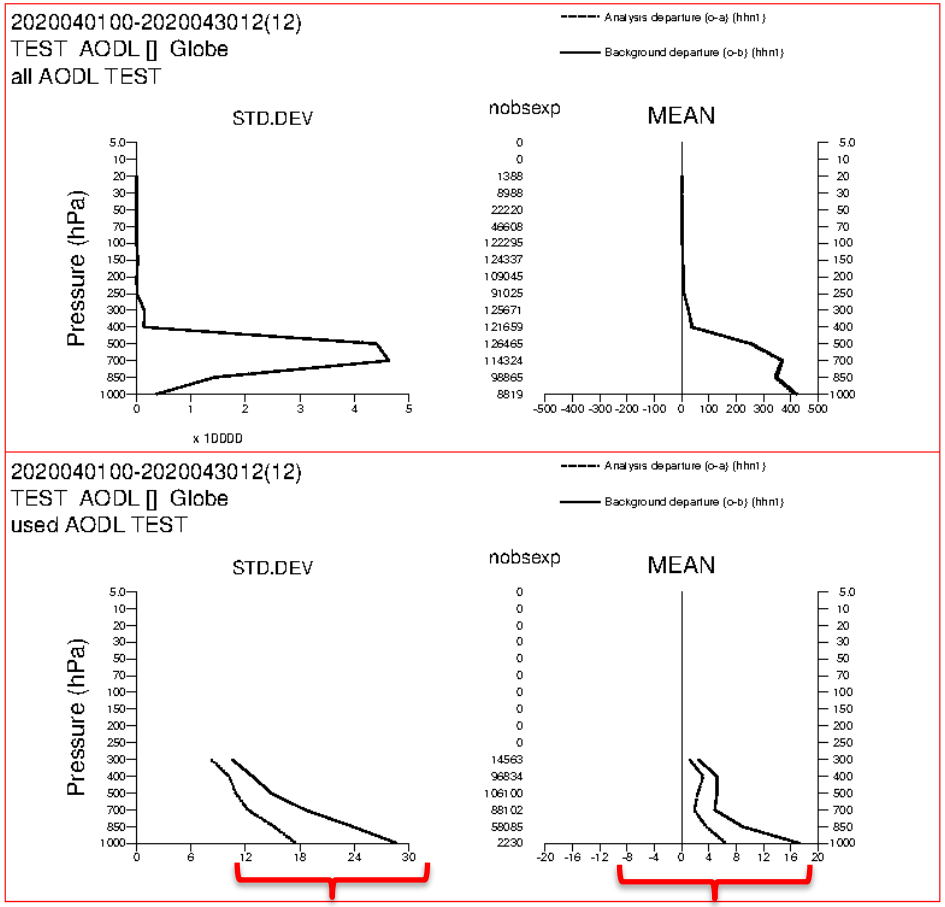


Large reduction of the range of data

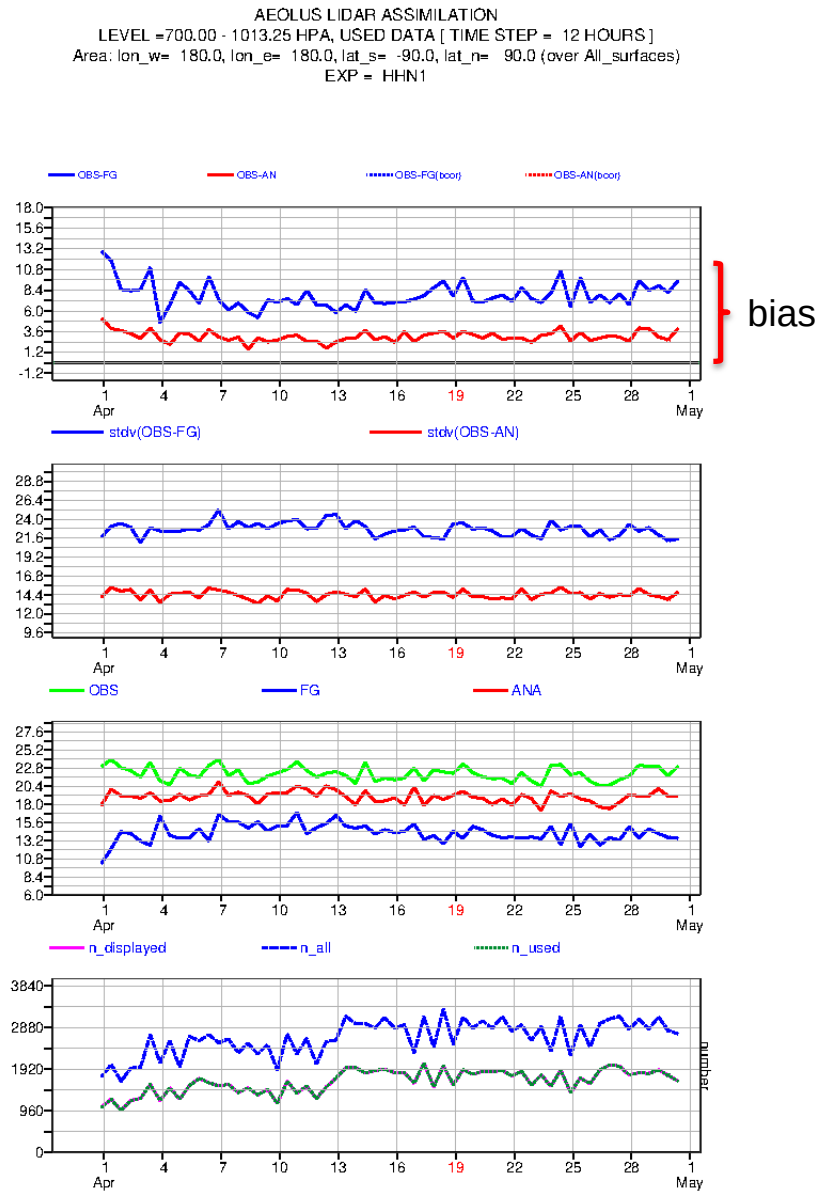
AODL FROM OZONE
LEVEL =700.00 - 1013.25 HPA, USED DATA [TIME STEP = 12 HOURS]
Area: lon_w= 180.0, lon_e= 180.0, lat_s= -90.0, lat_n= 90.0 (over All_surfaces)
EXP = HHO8



Assimilation of AEOLUS L2A for April 2020



Large reduction of the range of data



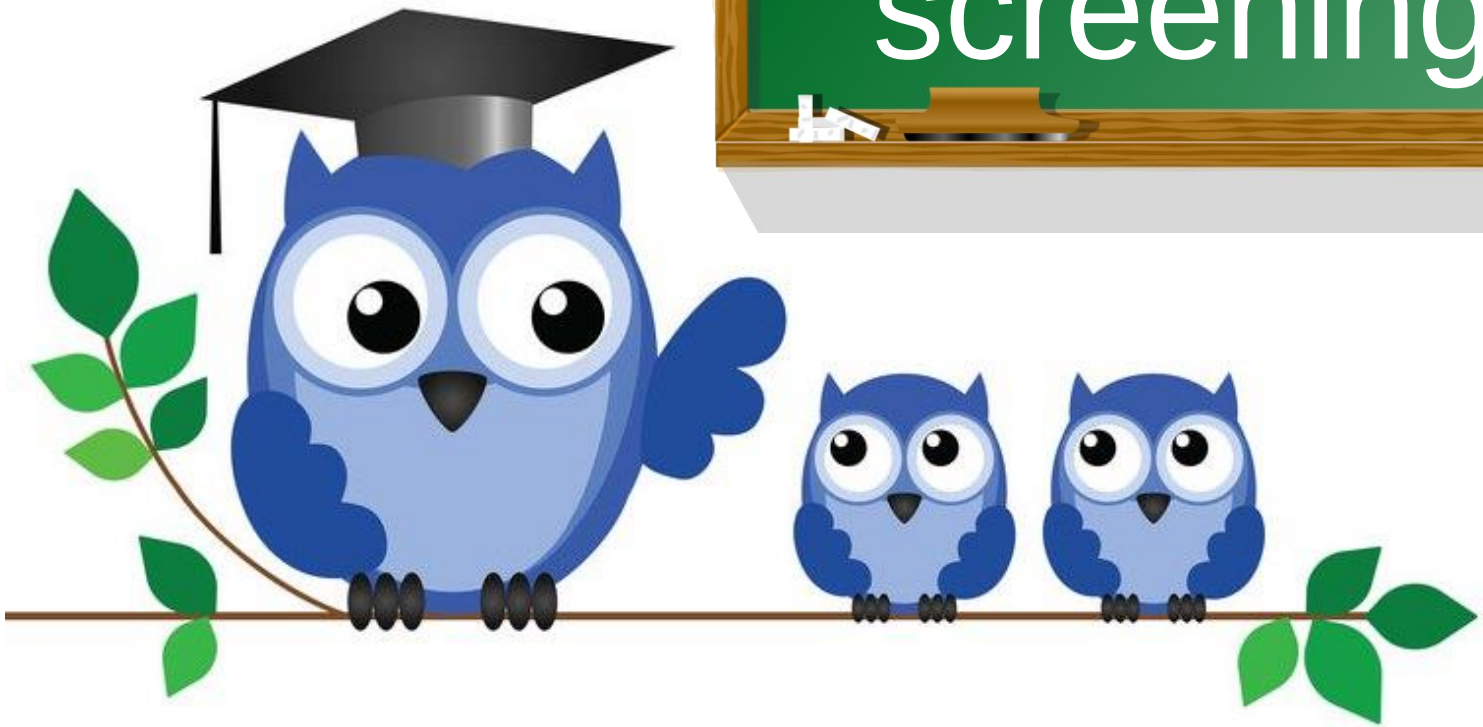
Assimilation results

The assimilation shows:

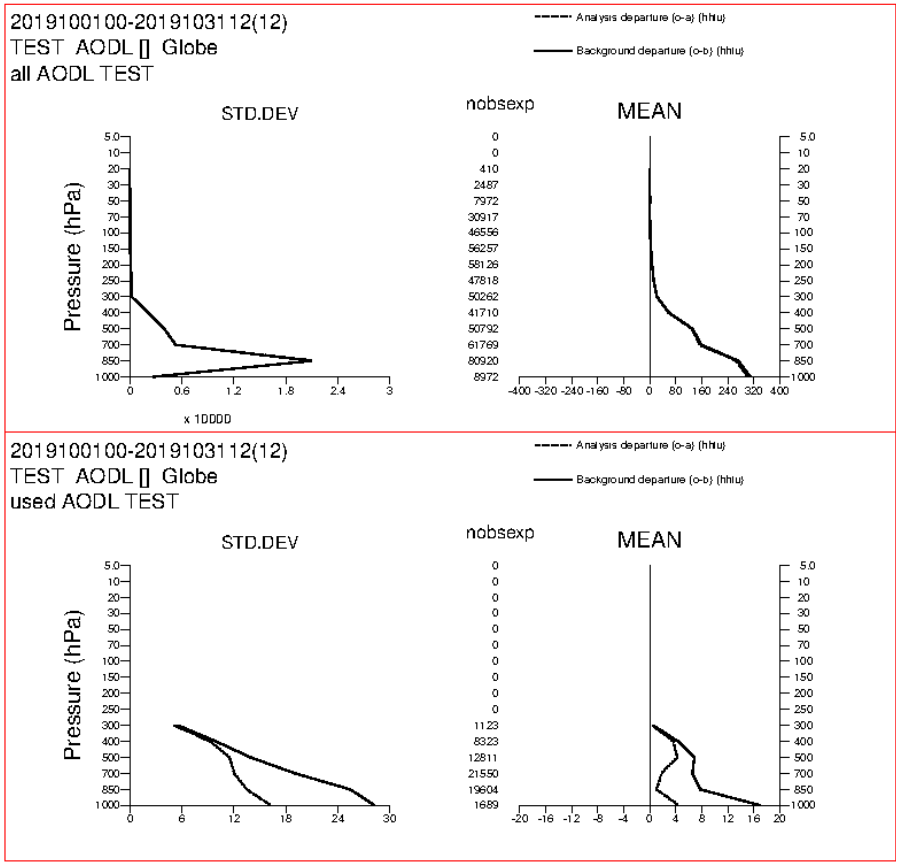
- Elimination of major artefact for AEOLUS L2A
- Decrease of 50% of data for AEOLUS L2A
- Decrease of the bias between the observation and the model but still a bias left after assimilation.
- Positive impact of the assimilation as it is bringing the model closer to the observation

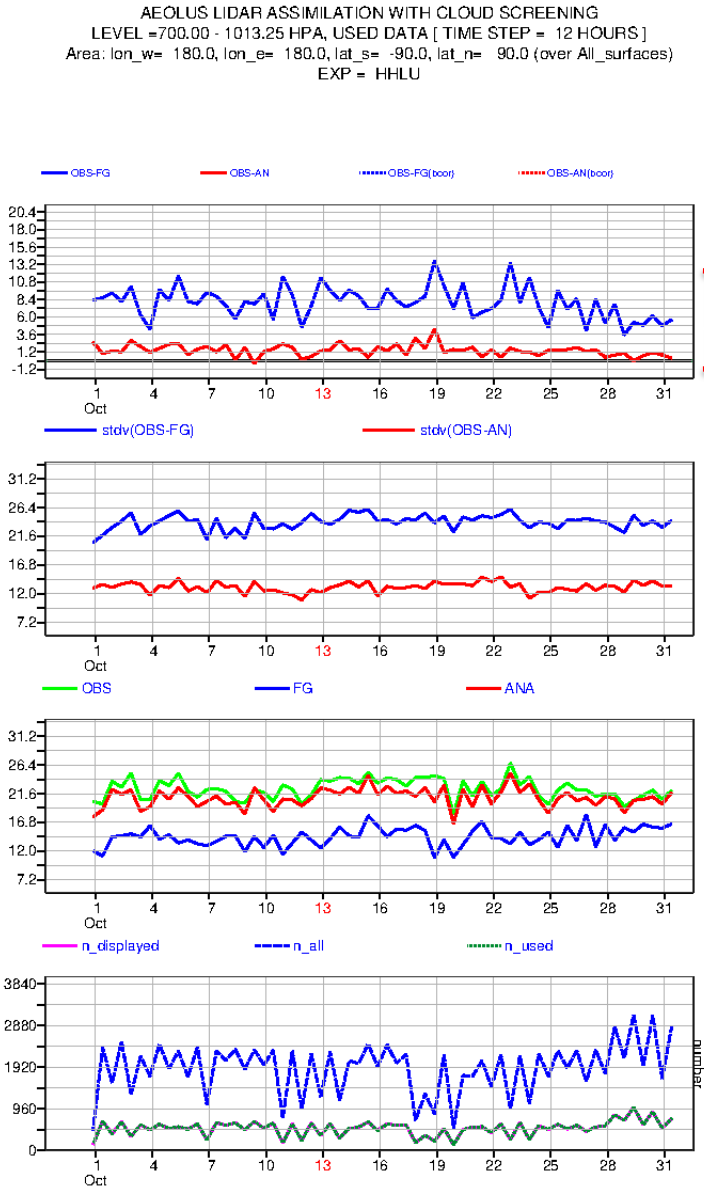
Will a cloud screening based on the model be able to remove the residual bias for AEOLUS L2A?

Third step: Cloud screening



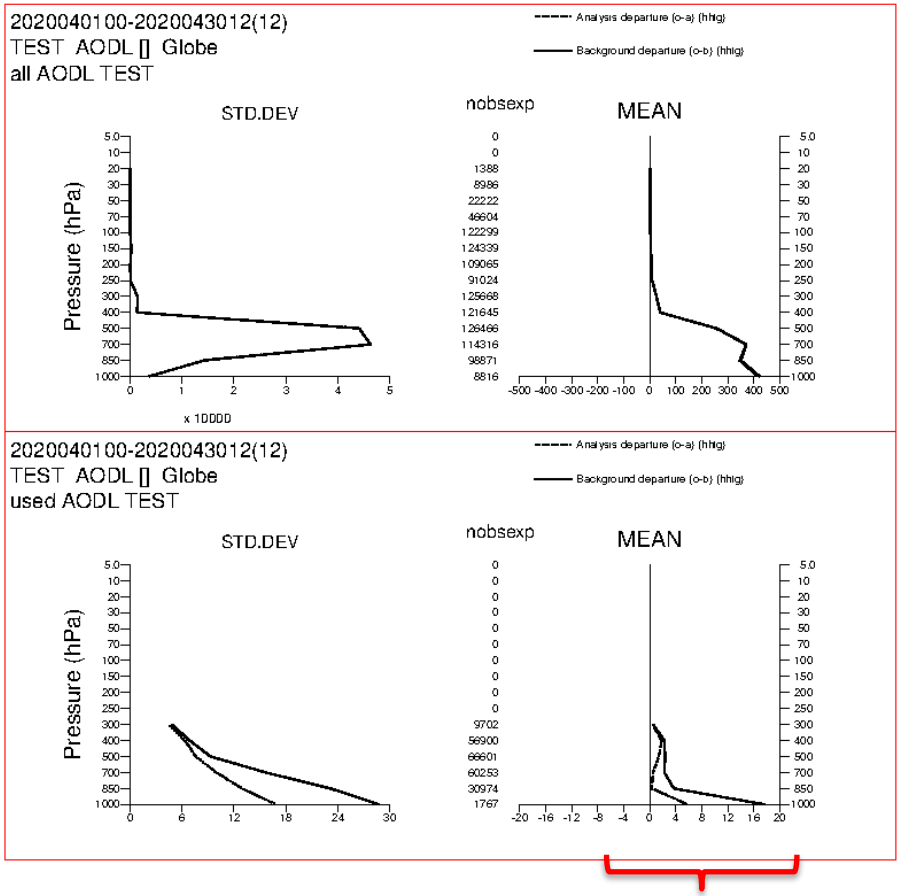
Assimilation with cloud screening for October 2019

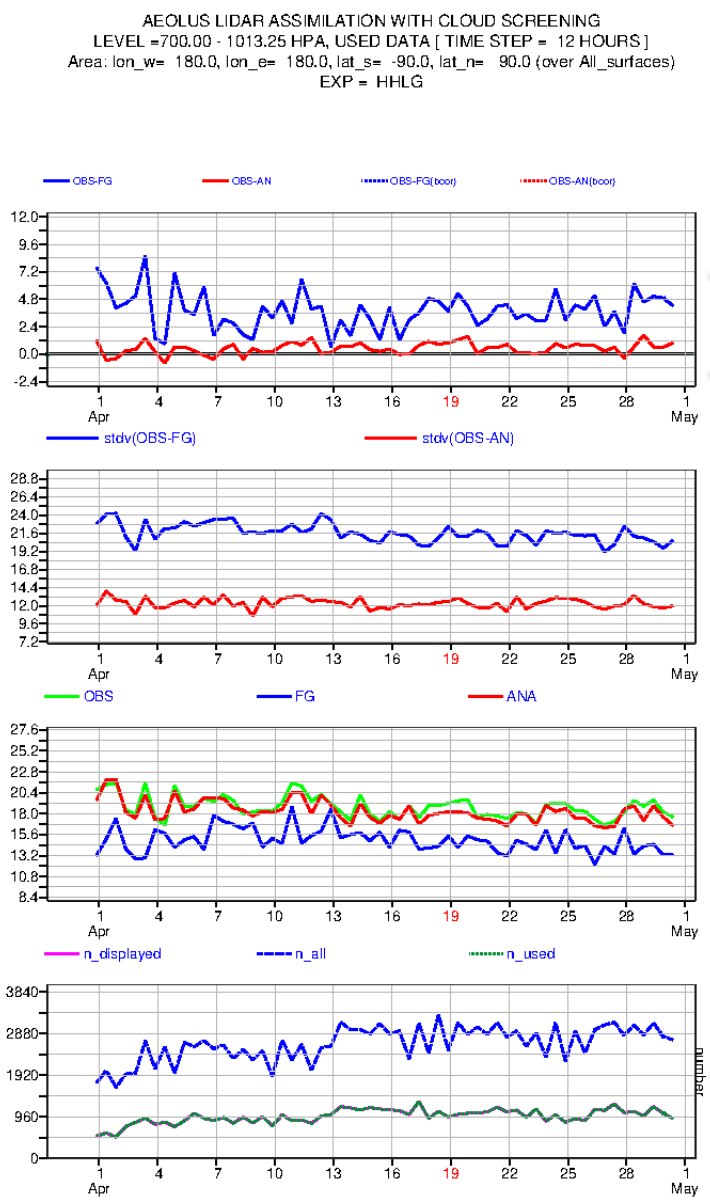




Bias reduction

Assimilation with cloud screening for April 2020





Bias reduction

The assimilation is reaching the no bias

Assimilation with cloud screening results

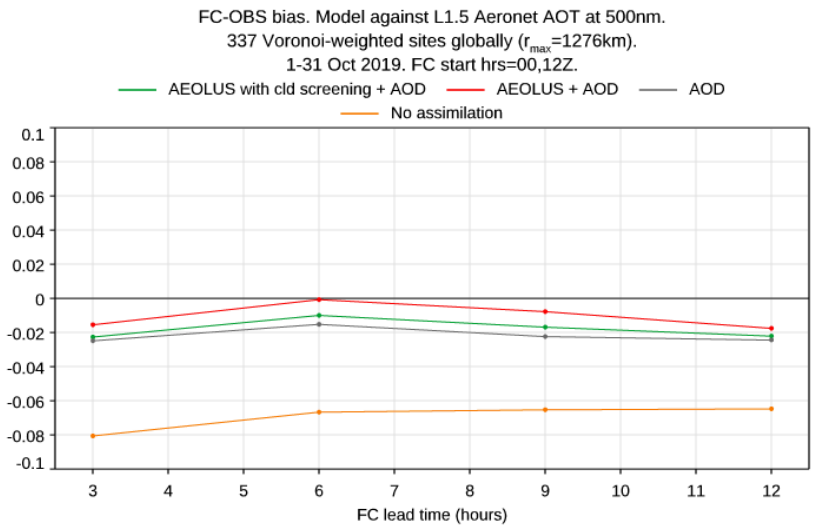
The cloud screening shows:

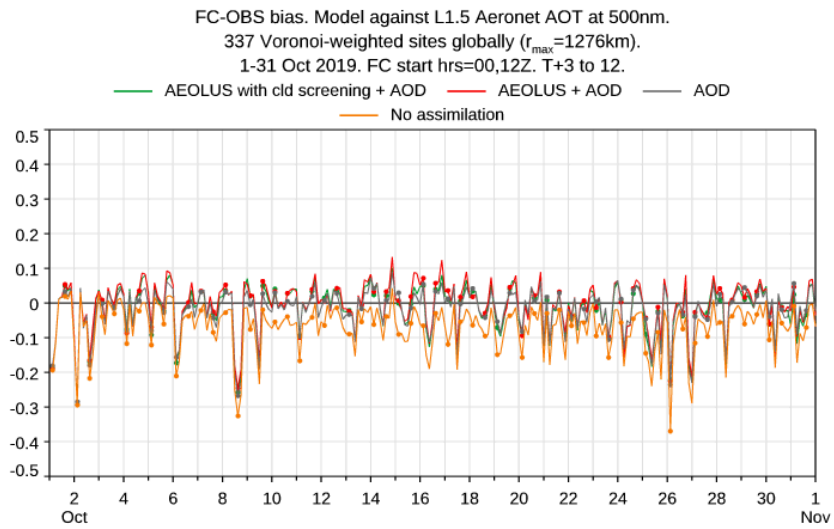
- Elimination of the residual bias
- Decrease of 75% of data
- Positive impact of the assimilation as it is bringing the model even closer to the observation

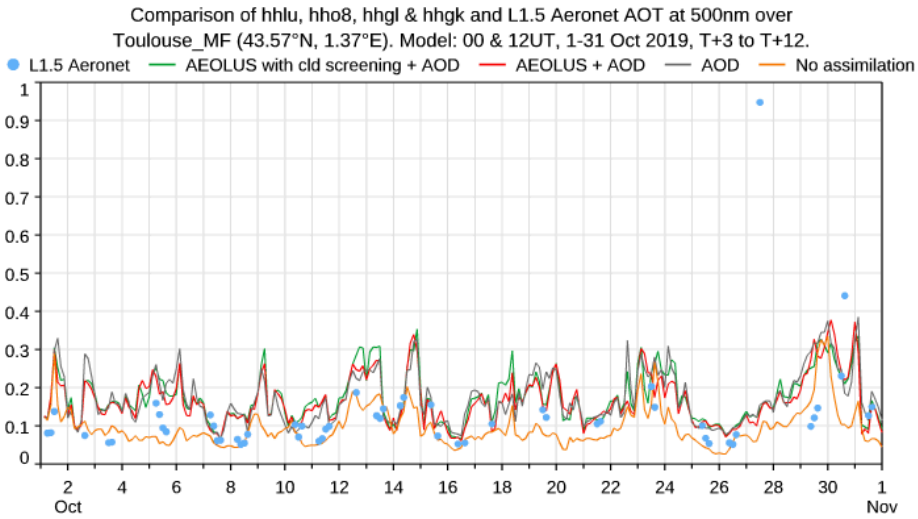
Will the comparison with independent data be improved by the backscatter profile assimilation?

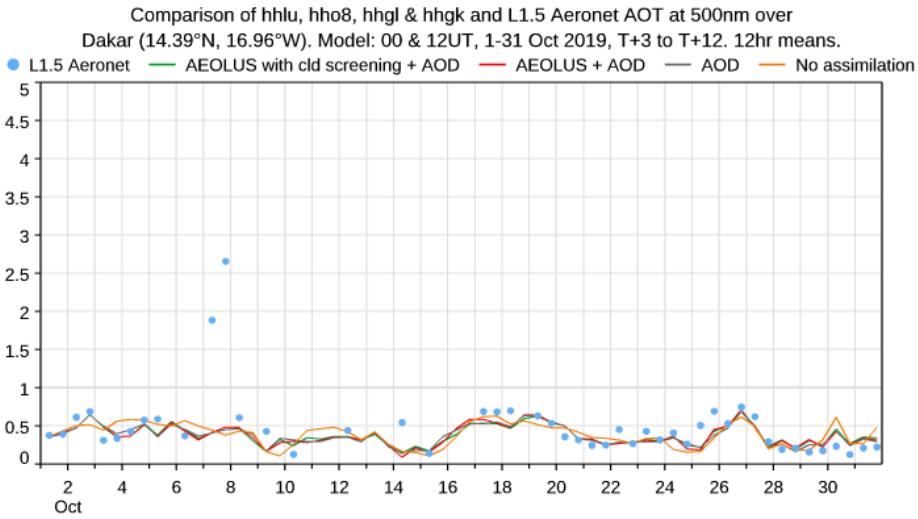
Forth step: Comparison with AERONET

October 2019 AEOLUS

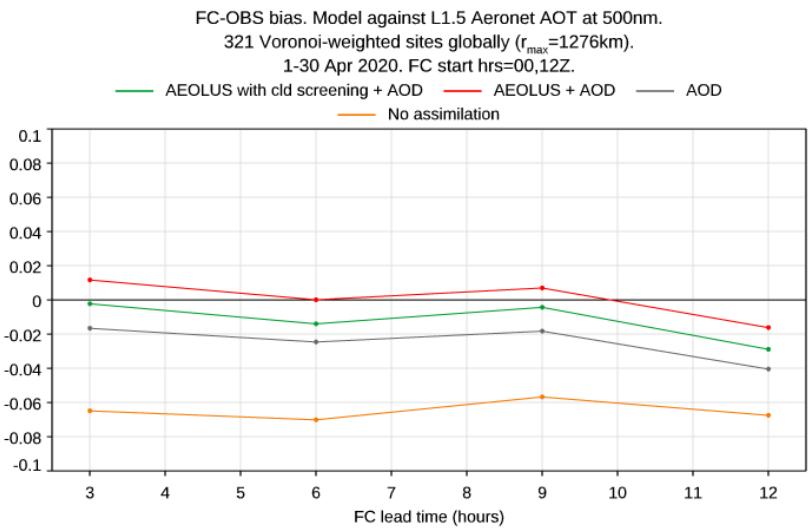


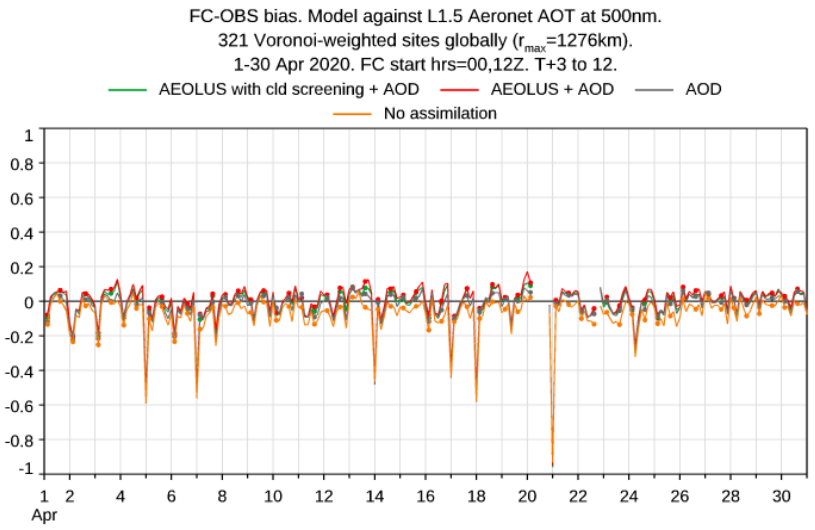


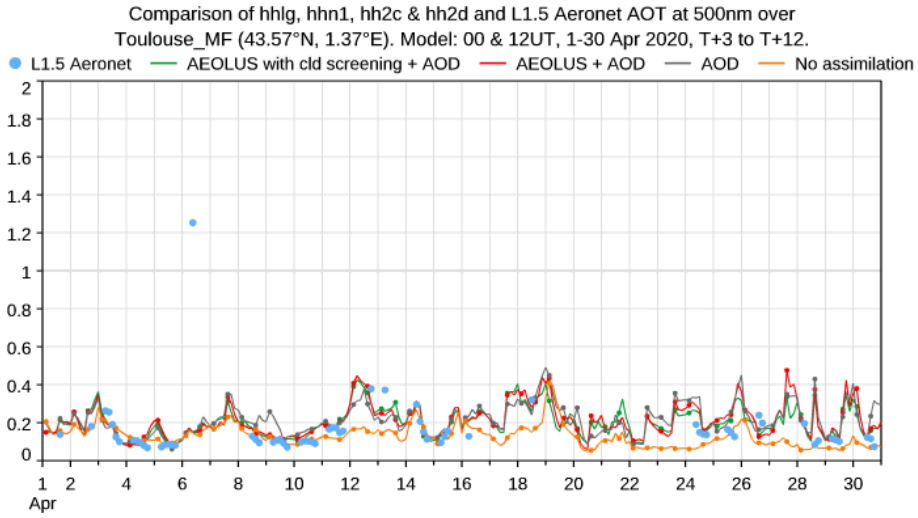


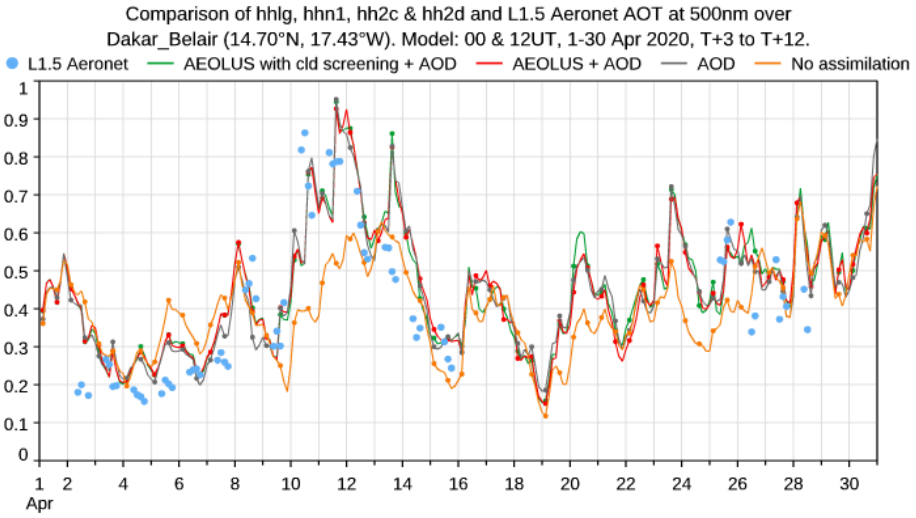


April 2020 AEOLUS

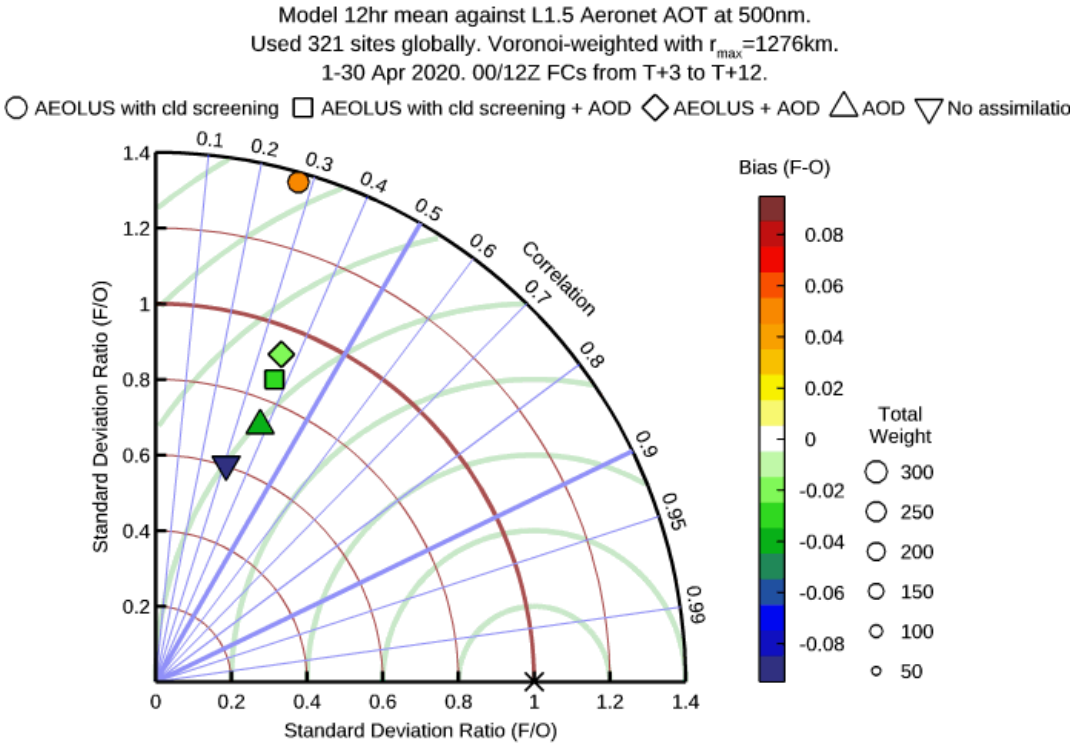








Taylor diagrams AEOLUS



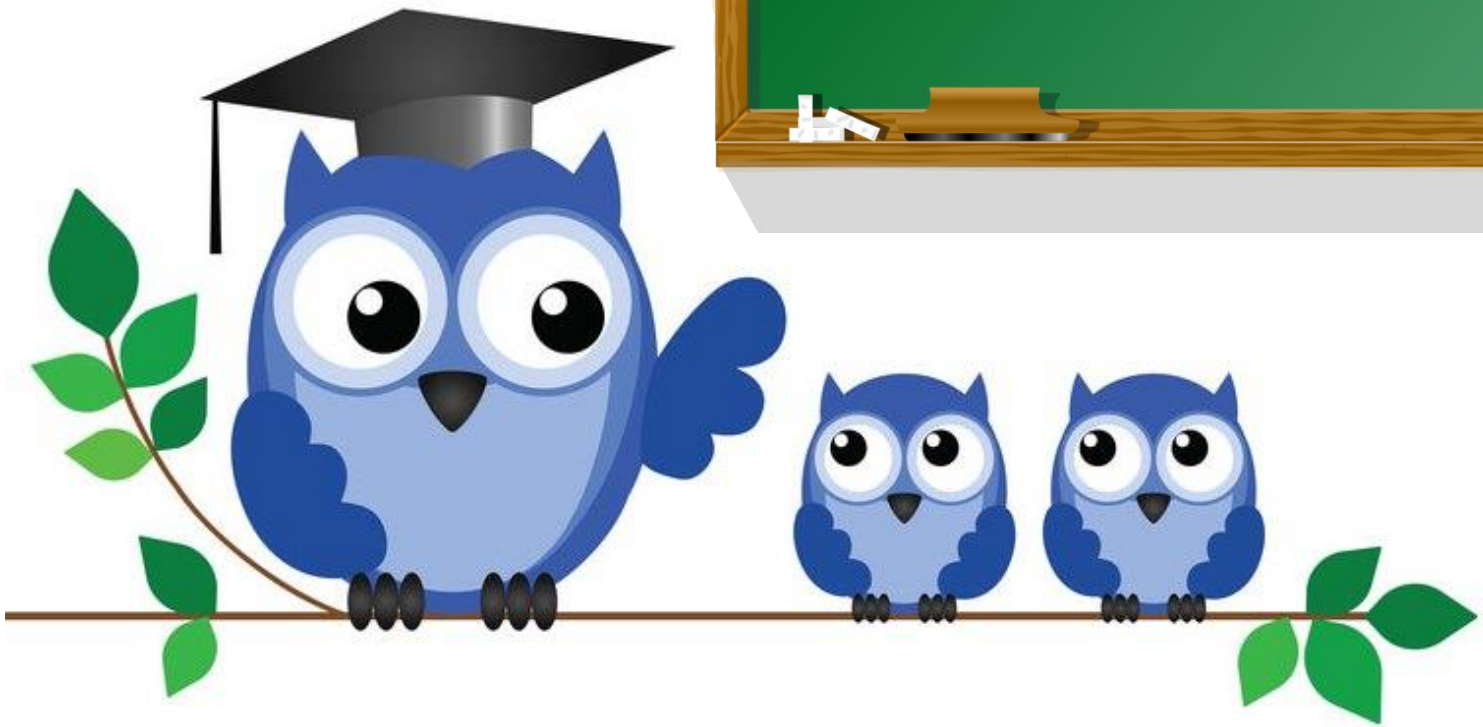
The best results are given by the assimilation of AOD and AEOLUS.
The assimilation of AEOLUS only shows a positive bias

Assimilation with cloud screening results

The comparison with AERONET shows that the assimilation of AEOLUS on top of the AOD is improving the AOD estimate by the model.

The improvement done by the cloud screening on the observation assimilation is not perceptible here.

Conclusion



Conclusion

During the first part of the project, Aeolus L2A data have been used to demonstrate the positive impact that the assimilation of aerosol backscatter can have on COMPO-IFS.

The impact and necessity of monitoring has also been demonstrated.

A cloud screening based on the model using internal or AUX files can improve the quality of data.

AEOLUS was not dedicated to aerosol but the scientific teams have managed to extract a product of good quality from the data.