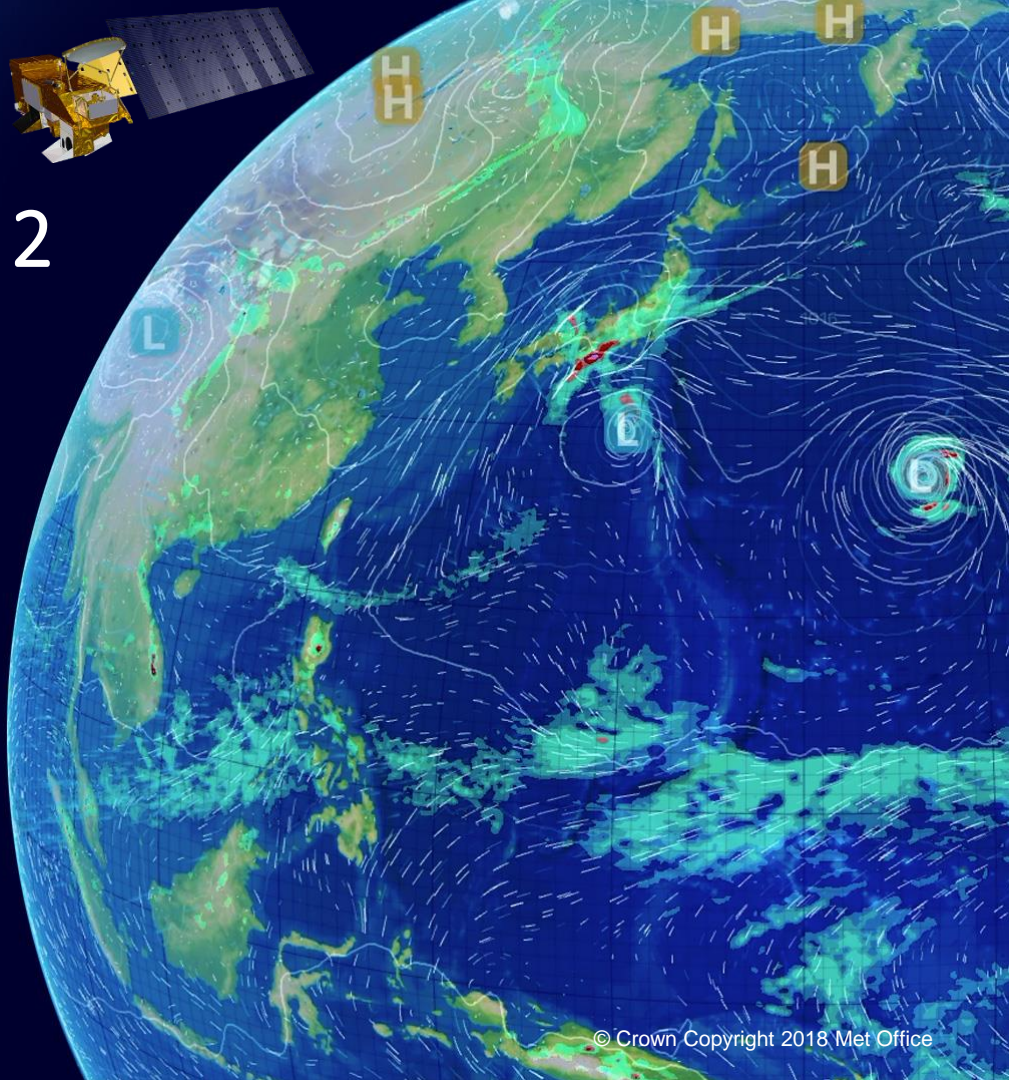


Met Office update – Part 2

Satellite observations

10th ICAP Working Group Meeting
Met Office, Exeter. 6-8 June 2018

Yaswant Pradhan and Malcolm Brooks

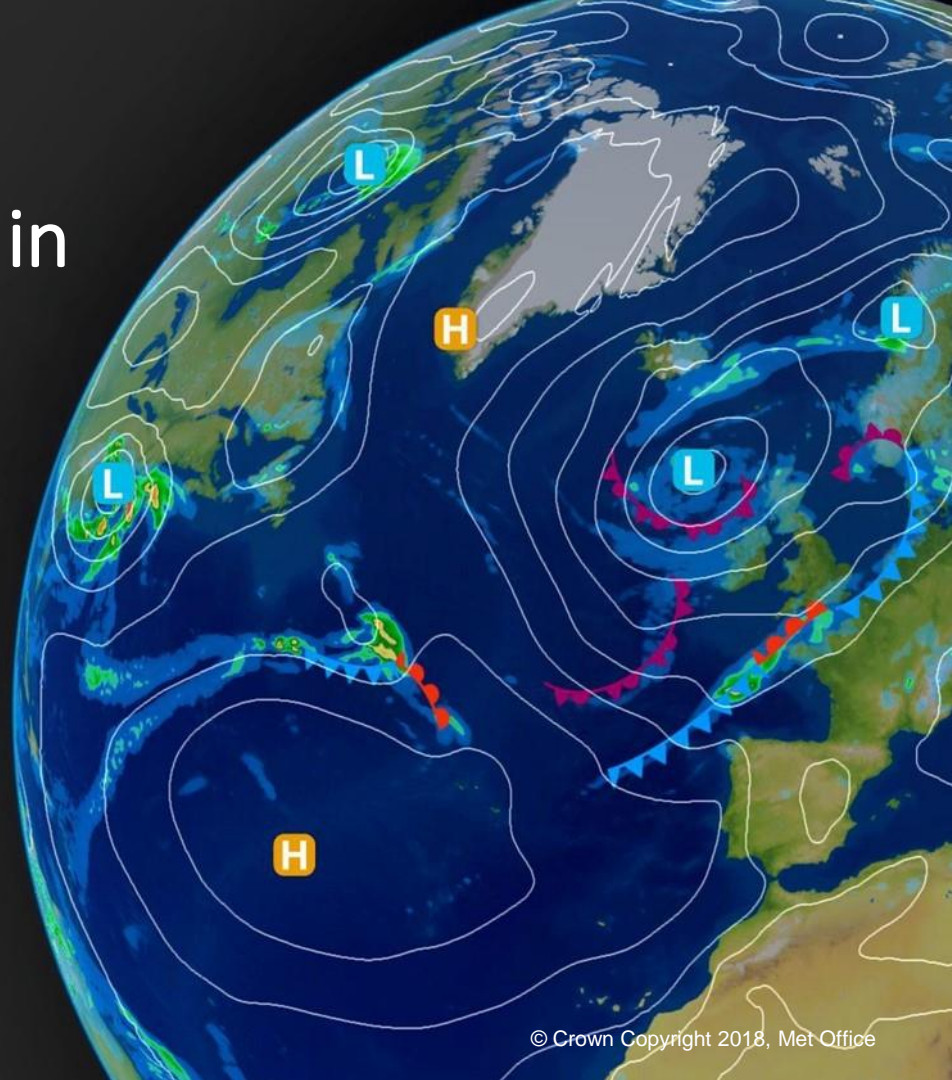


Content

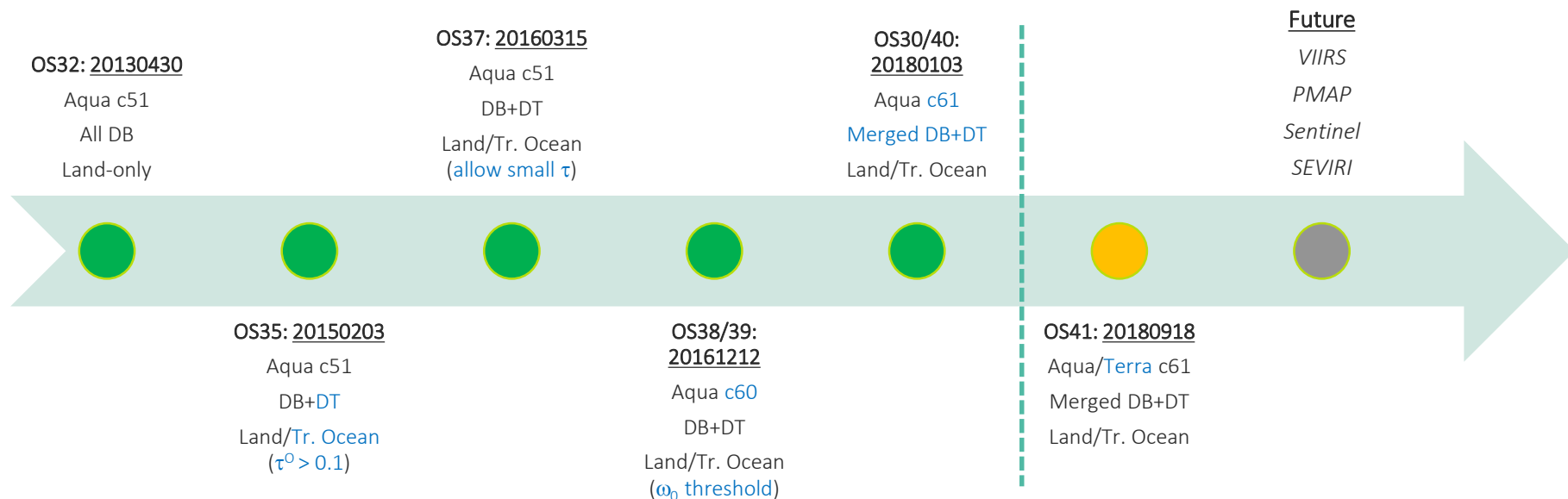
1. Satellite AOD observation in the MetUM-NWP
2. Recent observation changes (since last ICAP)
3. Satellite dust/AOD R&D
4. Future plans

Satellite dust observations in MetUM-NWP

History and motivation

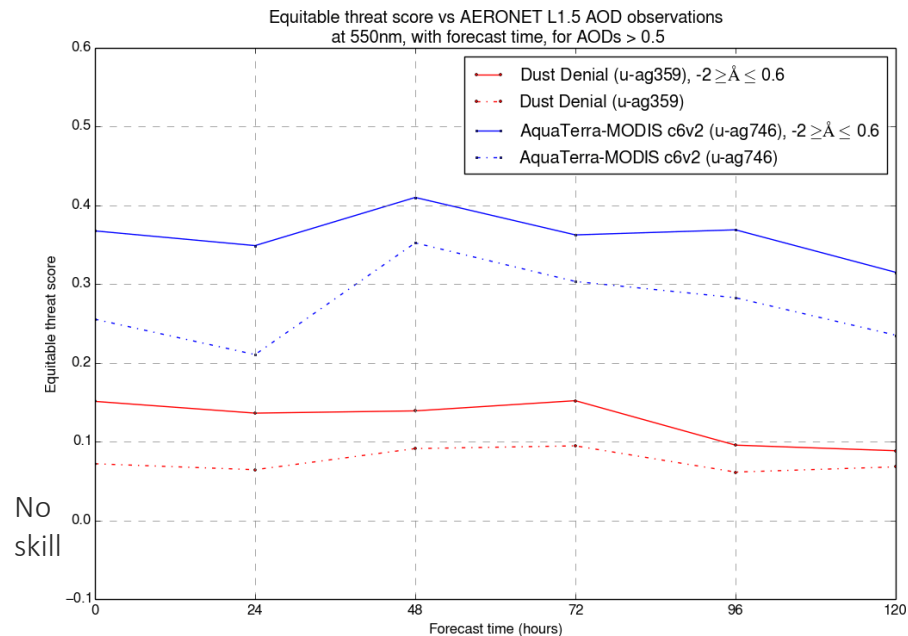
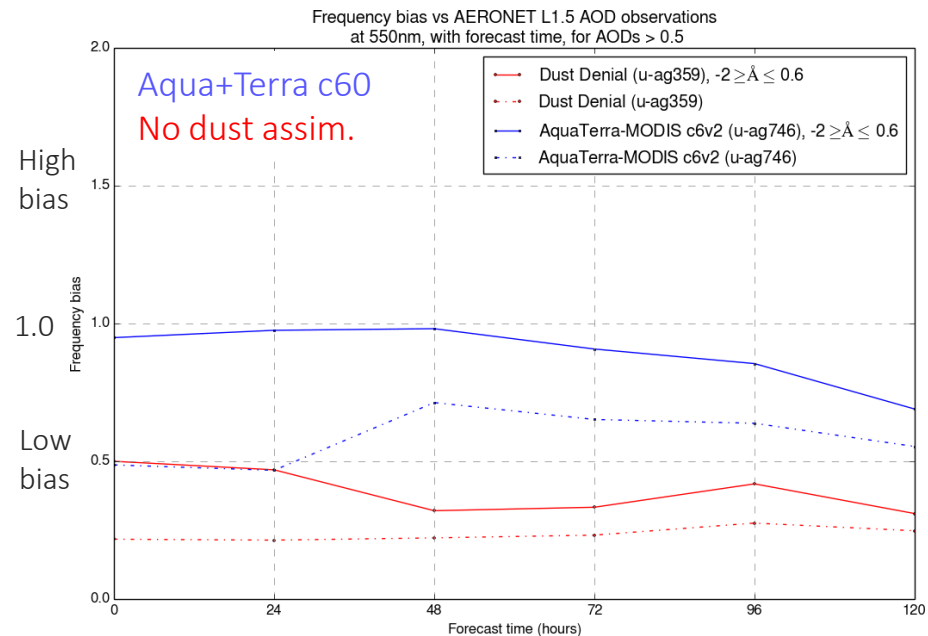


Timeline



Motivation

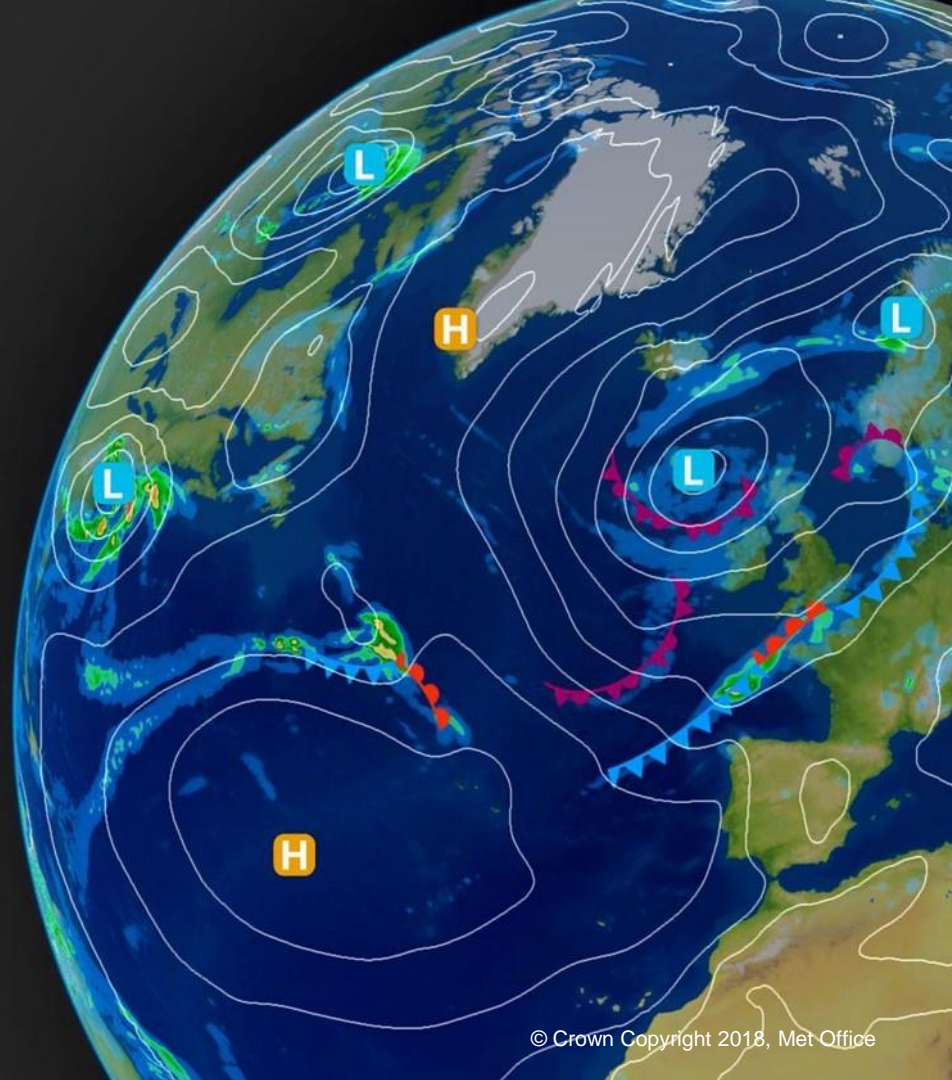
Impact of MODIS DA in Global NWP dust forecast



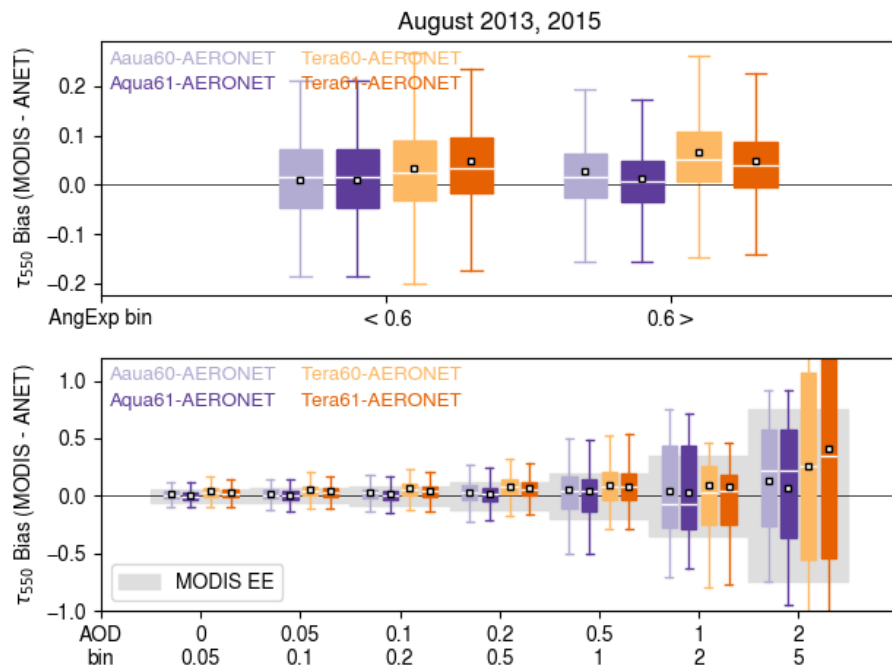
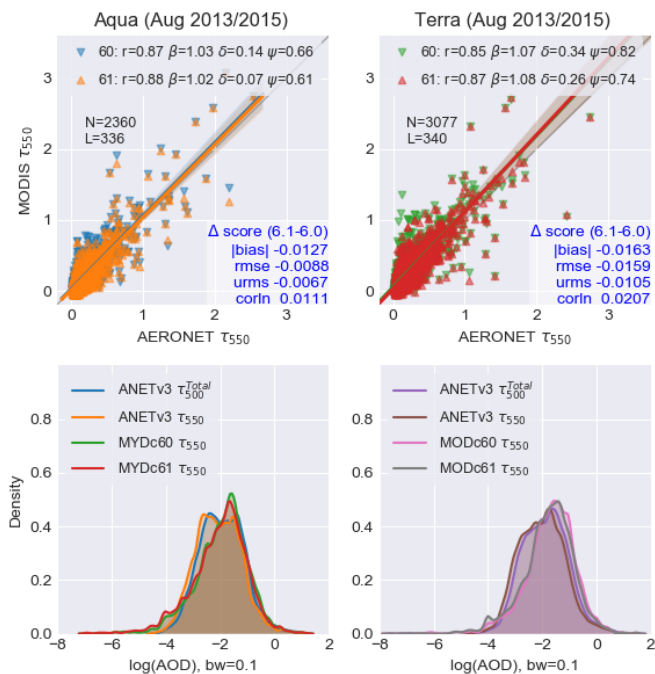
Recent obs. changes

Migration to MODIS collection 6.1 (c61)

Special thanks to Andy Sayer for MODIS c61 test data

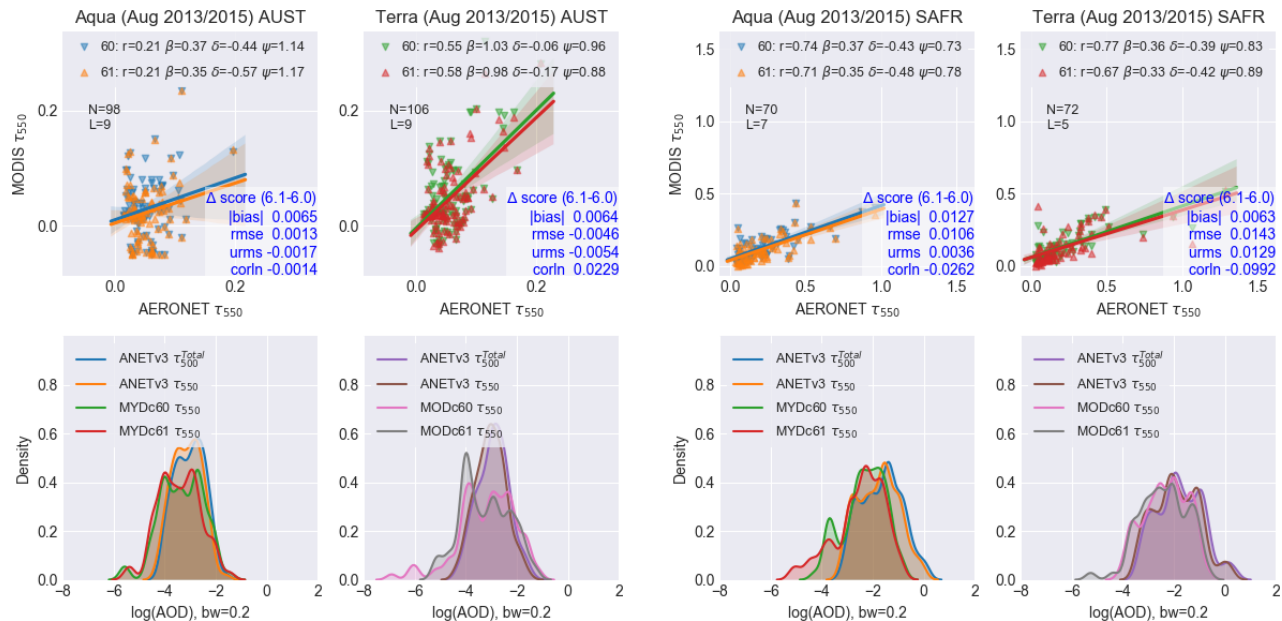


MODIS c60 → c61: merged DB+DT v AERONET v3



MODIS c60 → c61

- On a global scale c61 compares better with AERONET
- c61 marginally worse over Australia and S. Africa.
- c61 AOD > c60 AOD over the Arabian peninsula (no AERONET during test period)



Our dust selection criteria

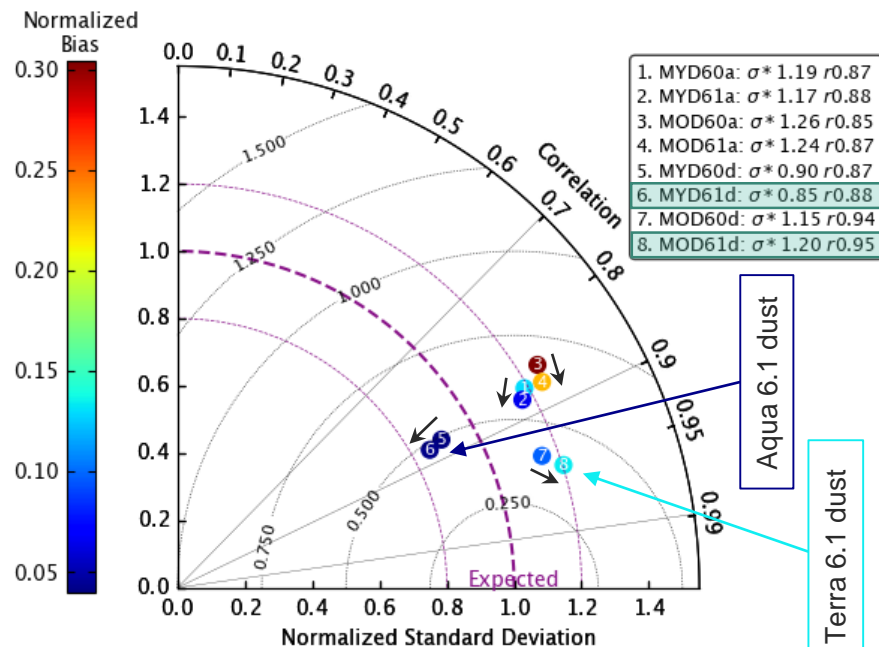
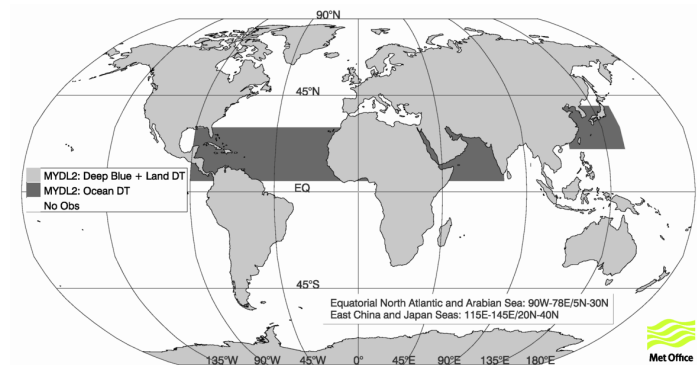
FineMode Fraction ≤ 0.4

Angstrom Exponent ≤ 0.6

Effective Radius $> 1\mu\text{m}$

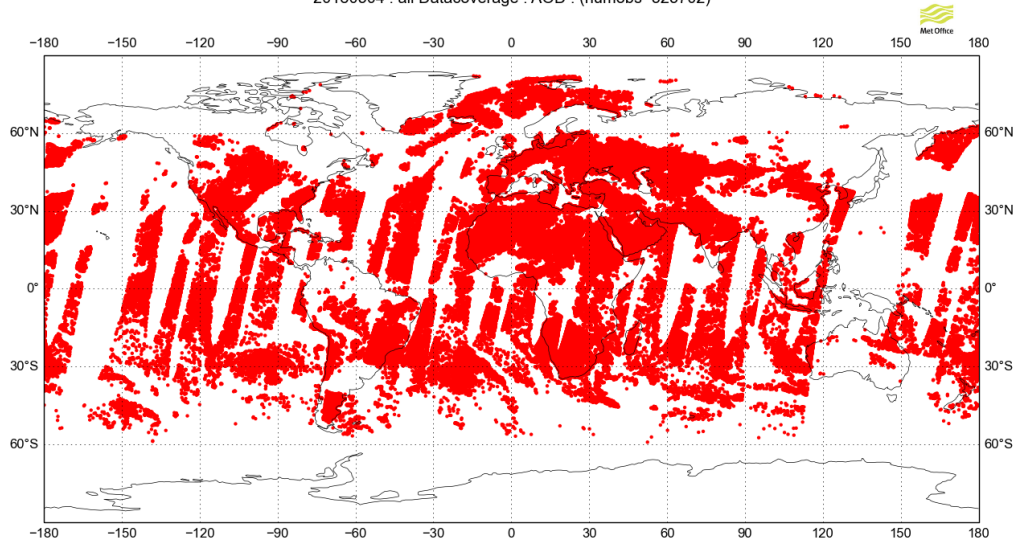
Single Scattering Albedo at 470nm: (0.878, 0.995)

AODthreshold: $\begin{cases} \tau_{550}^{OB} < 0.1 & \text{if } \tau_{550}^{BG} > 0.1, \\ \tau_{550}^{OB} \geq 0.1 & \text{otherwise} \end{cases}$

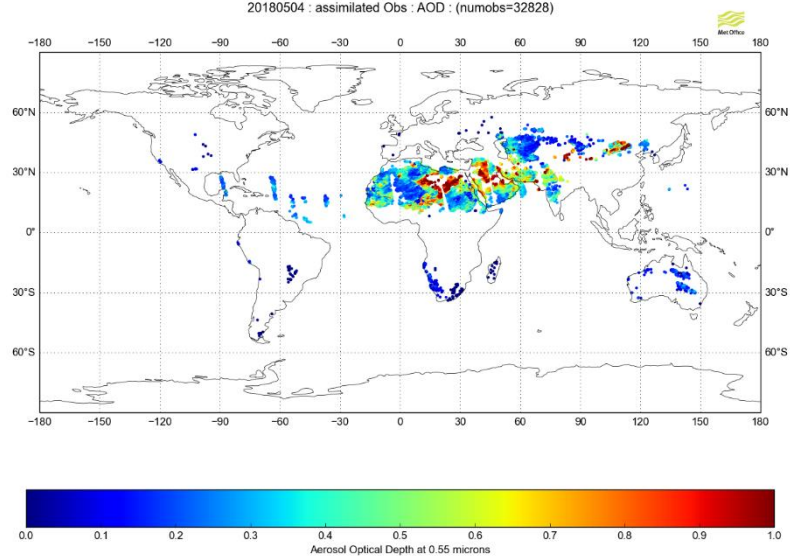


Used ~10% of best obs.

20180504 : all Datacoverage : AOD : (numobs=325702)

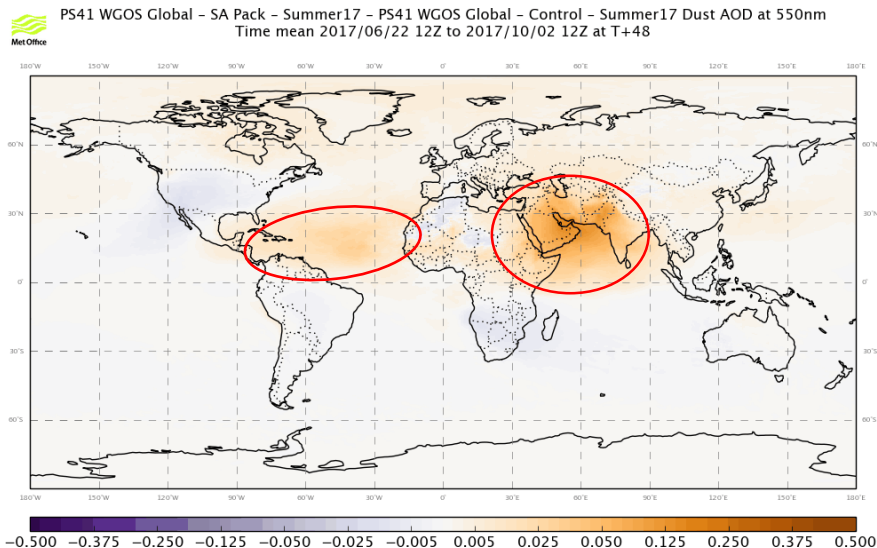


20180504 : assimilated Obs : AOD : (numobs=32828)

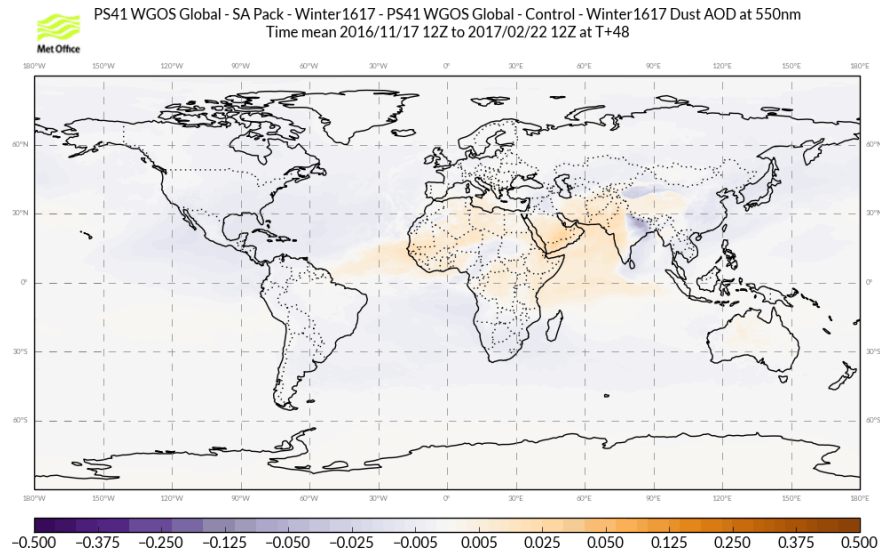


MODIS c61 impact: T+48 diff

Summer: Ctrl (Aqua c60) · Expt (Aqua+Terra c61)



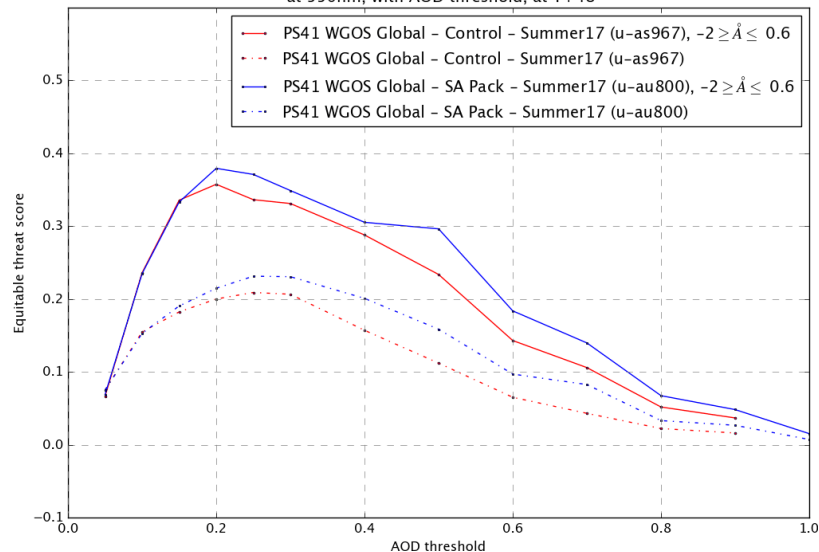
Winter: Ctrl (Aqua c51/c60) · Expt (Aqua+Terra c61)



MODIS c61 impact: T+48 skill

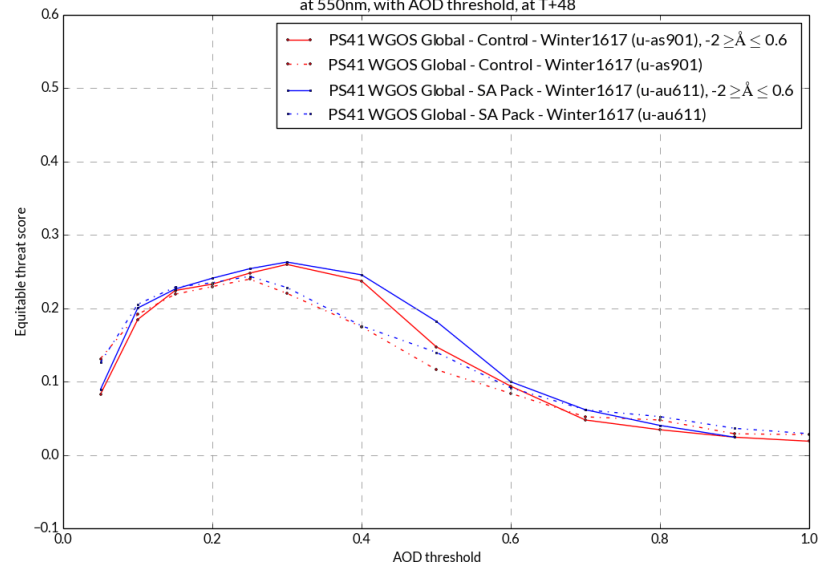
Summer: Ctrl (Aqua c60) · Expt (Aqua+Terra c61)

Equitable threat score vs AERONET L1.5 AOD observations
at 550nm, with AOD threshold, at T+48



Winter: Ctrl (Aqua c51/c60) · Expt (Aqua+Terra c61)

Equitable threat score vs AERONET L1.5 AOD observations
at 550nm, with AOD threshold, at T+48

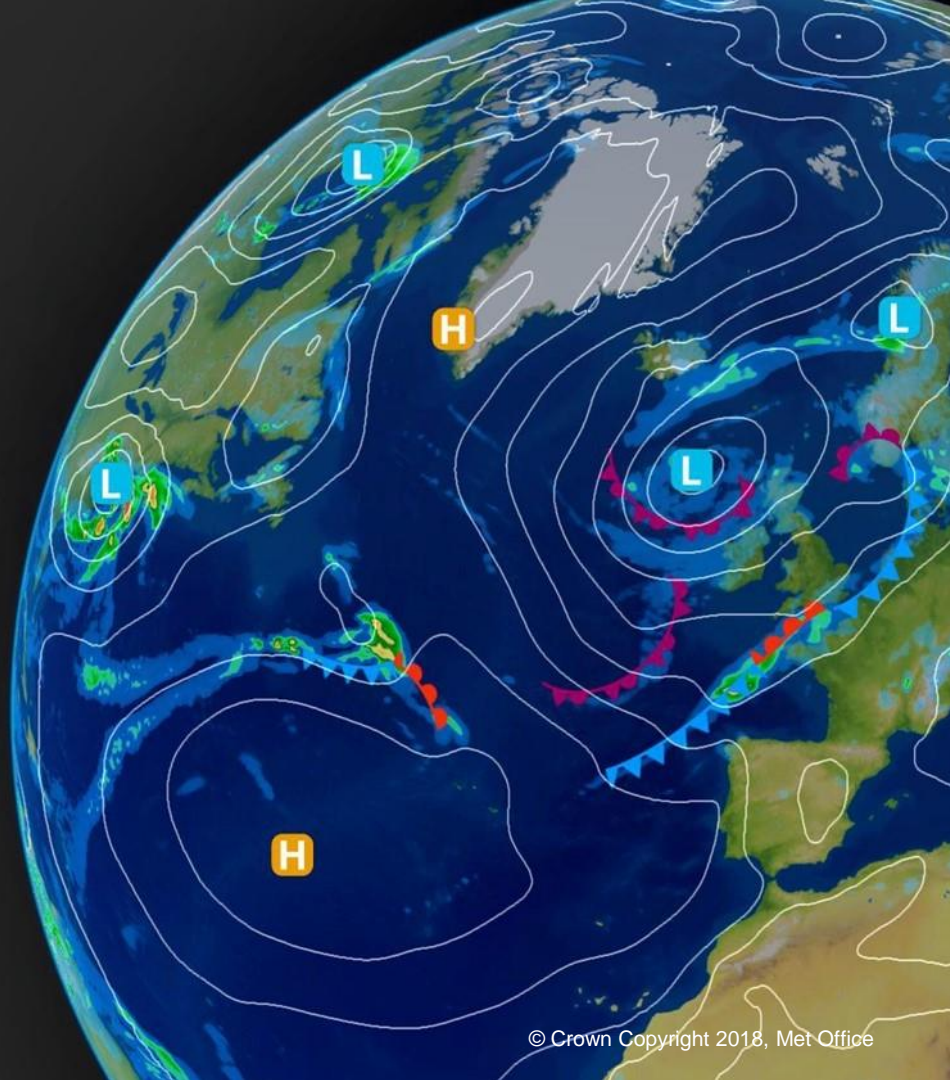


Summary

- In Summer:
 - Adds slightly more dust over the Arabia and tropical Atlantic
 - Marginally better forecast skills for moderate-high AOD loading
- In Winter:
 - Reduced model drift over India, Saudi Arabia and Western USA (not shown)
 - Neutral impact on dust forecast skills
- Overall impact: neutral/slightly positive (reminder: these are low-res runs)

Other activities

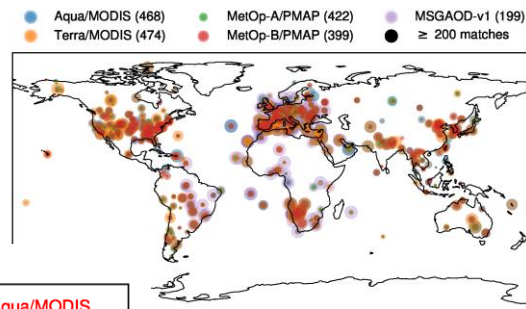
- Assessment of PMAP v2.0, and MSGAOD v1.0 alongside MODIS c6.0
- New! SEVIRI 1DVar dust



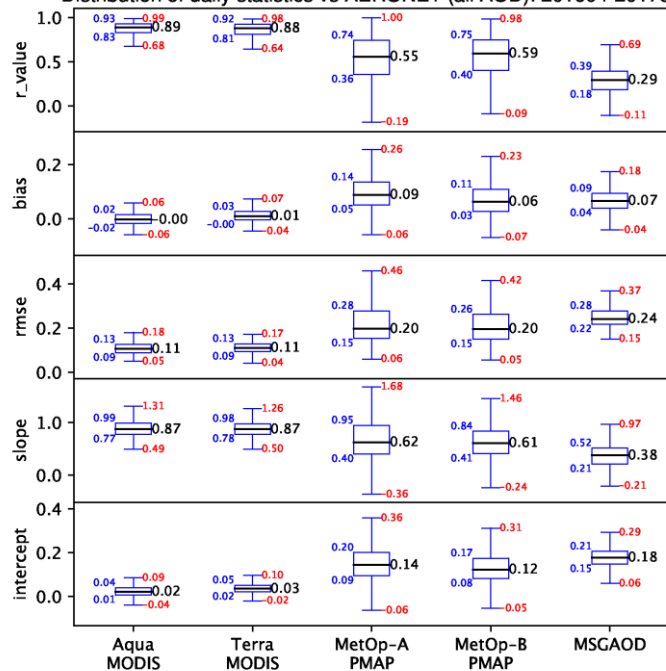
AOD verification: 2016-2017

- MODIS c6.0 (Science)
 - Combined DB+DT
- PMAP v2.0 & 2.1 (NRT)
 - Polar Multi-sensor Aerosol Product is a combined aerosol product based on measurements by the GOME-2, AVHRR and IASI instruments on MetOp satellite series.
 - AOD over ocean already used in CAMS experiment → **minimal impact on the analysis and subsequent forecast.**
- MSGAOD v1.0 (Met Office)
 - Dust optical thickness retrieved from empirical relationship between SEVIRI infrared (10.8 μm) radiance and aerosol optical depth at 550nm. (see <https://sds-was.aemet.es/forecast-products/dust-observations/msg-2013-u.k.-met-office>)

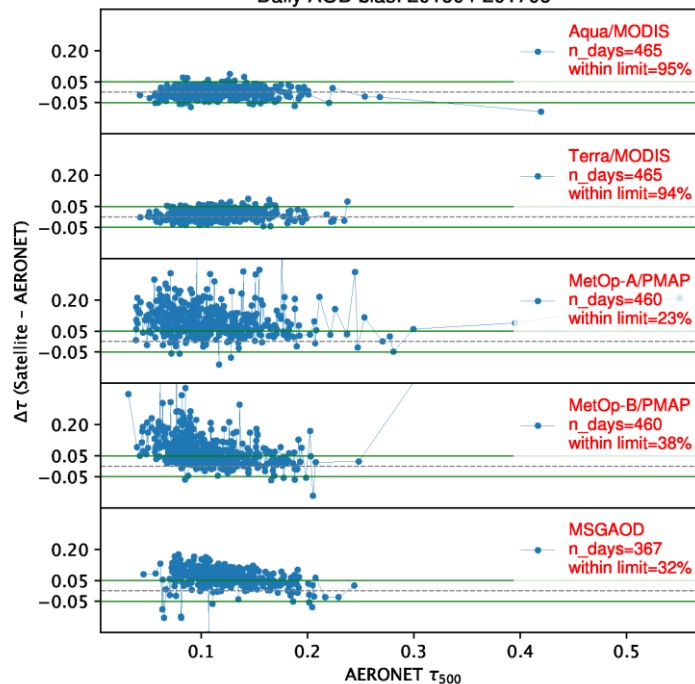
AOD verification: 2016-2017



Distribution of daily statistics vs AERONET (all AOD): 201604-201706



Daily AOD bias: 201604-201706



Daily median

Summary

- Neither PMAP nor MSGAOD is close enough to MODIS AOD retrieval accuracy
- PMAP data are but they being monitored to assess readiness for operational implementation
- By design MSGAOD should perform better over arid regions when dust not too close to the ground – currently being used for event monitoring
- What was overlooked at this point – VIIRS

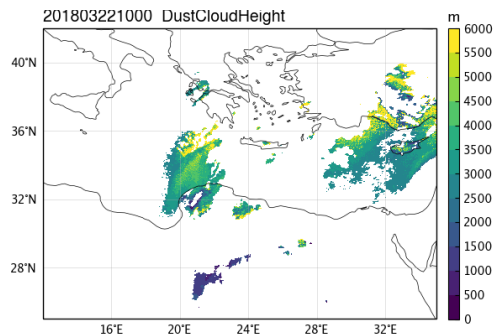
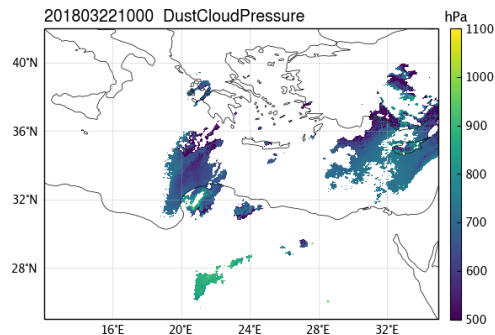
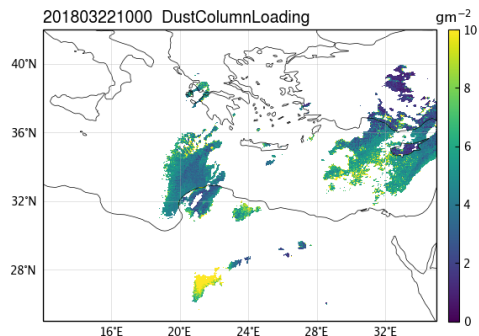
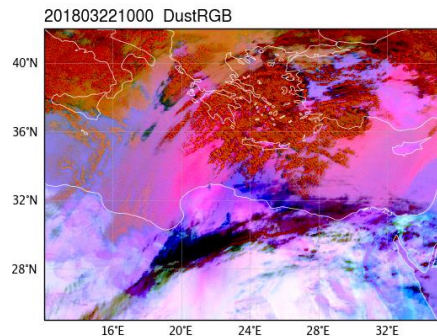
Dust properties from SEVIRI: 1D-Var retrieval

- State vector: dust column loading, dust layer pressure, dust effective radius
- Retrieval scheme mainly based on: Francis *et al* (2012) for volcanic ash, with few adjustments for dust such as:
 - Dust refractive index: Volz (1972), number of IR channels selection, dust detection and first guesses

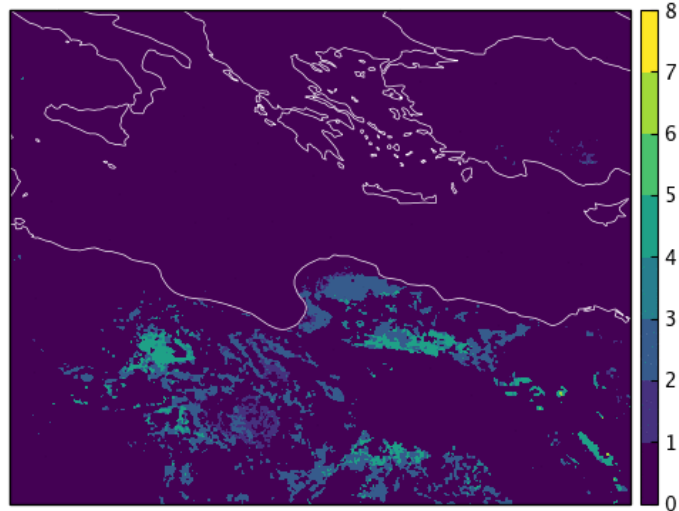
As of now:

- Both column loading and height retrievals compares reasonably with aircraft data (although height retrieval seems sensitive to dust pressure first guess)
- Extending AOD at visible is challenging – too sensitive to retrieved size

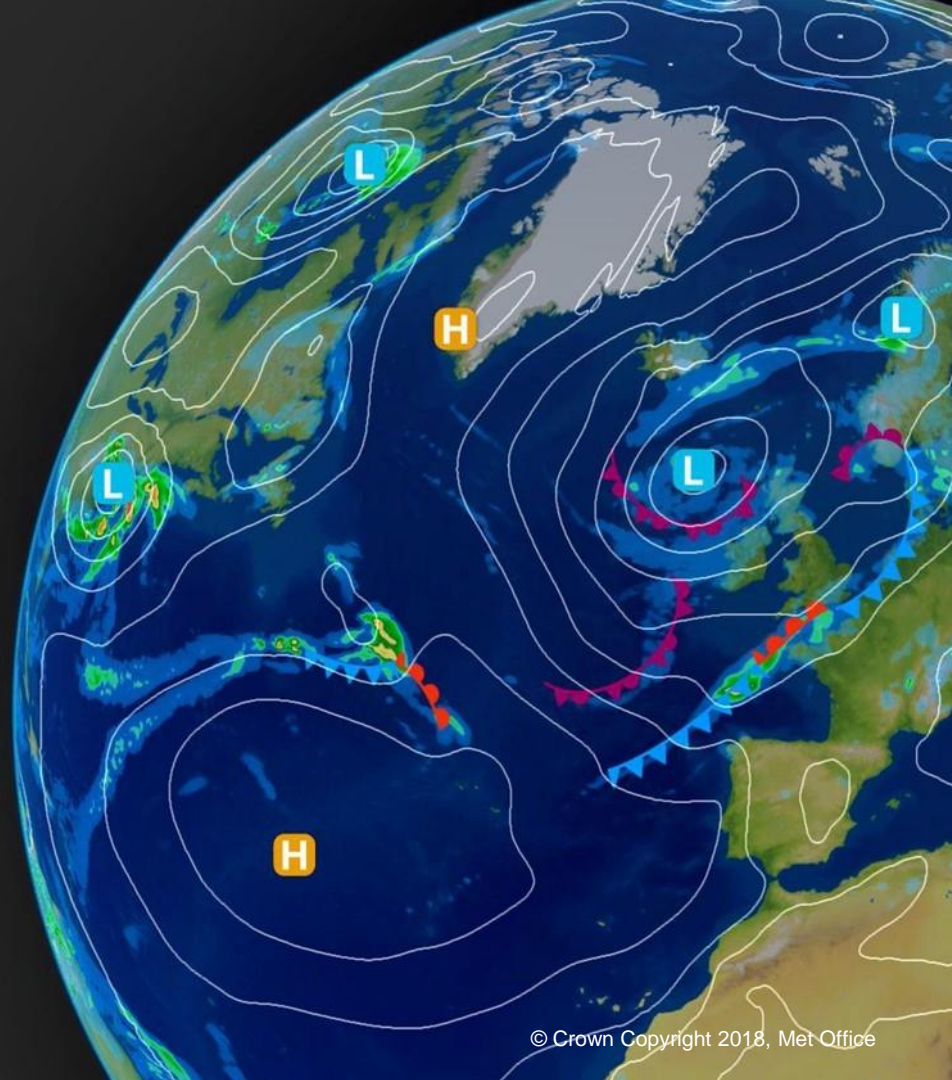
SEVIRI 1D-Var retrieval example: Crete dust



201803210000 DustConfidence



Future plans



Things under the radar

- Continue assessment of PMAP and include VIIRS?, Sentinel (future)
- Improve SEVIRI Dust 1D-Var product?
- Test ORAC retrieval scheme using SEVIRI
- ...and perform more experiments...

Thanks for your attention!

For more information, please contact



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