



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Studying aerosol type selection and retrieved AOD estimates when applied to TROPOMI measurements

Anu Kauppi¹

joint work with Johanna Tamminen¹ & Marko Laine¹ (Methodology) and

Antti Kukkurainen¹ & Antti Lipponen¹ (radiative transfer and aerosol expertise)

¹Finnish Meteorological Institute, Finland

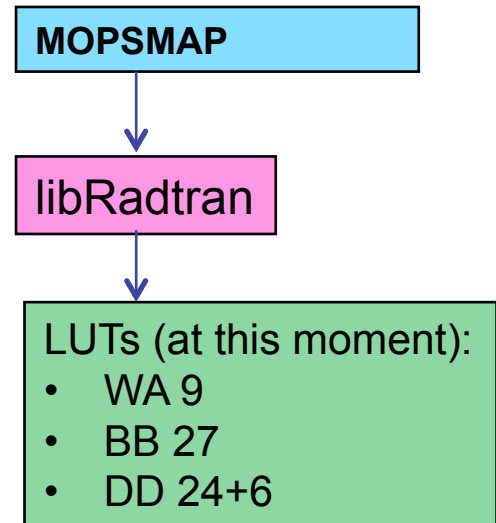
Motivation, Background and Data

- Heritage in work with OMI/Aura data and retrieval scheme similar to the OMI multi-wavelength OMAERO algorithm
 - References
 - Kauppi, A., Kolmonen, P., Laine, M., and Tamminen, J.: Aerosol-type retrieval and uncertainty quantification from OMI data, Atmos. Meas. Tech., 2017
 - Määttä, A., Laine, M., Tamminen, J., and Veefkind, J. P.: Quantification of uncertainty in aerosol optical thickness retrieval arising from aerosol microphysical model and other sources, applied to Ozone Monitoring Instrument (OMI) measurements, Atmos. Meas. Tech., 2014.
- Bayesian inference for LUT-model selection, AOD estimate and uncertainty
- Retrieving
 - AOD estimate at 500 nm based on MAP (maximum a posterior) estimate
 - Acknowledge uncertainty due to model selection and approximations in forward modeling
 - Uncertainty expressed as posterior density function

$$R_{\text{obs}}(\lambda) = R_{\text{mod}}(\tau, \lambda) + \underbrace{\eta(\lambda)}_{\text{Model discrepancy term}} + \epsilon_{\text{obs}}(\lambda)$$

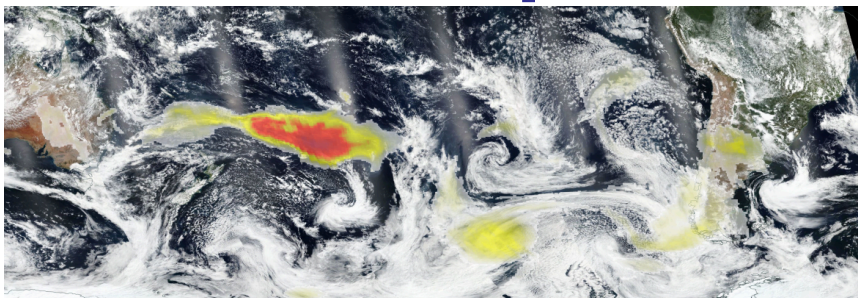
Data:

- TROPOMI/S5p L1b radiance and irradiance at wavelength bands:
Band3: 342.5, 354.0, 367.0, 376.5, 388.0, 399.5 nm
Band4: 406.0, 416.0, 425.5, 436.5, 440.0, 451.5, 463.0, 483.5, 494.5 nm
Band5: 675 nm
- Surface pressure from TROPOMI UV Aerosol Index product
- Surface reflectance from **ADAM** (A surface reflectance Database for ESA's earth observation Missions) database



Case 1. TROPOMI/S5p Orbit 11568 6-Jan-2020

Smoke drifted from Australian bushfires toward South America



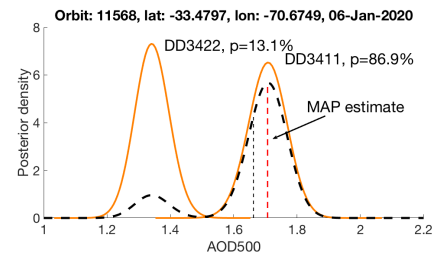
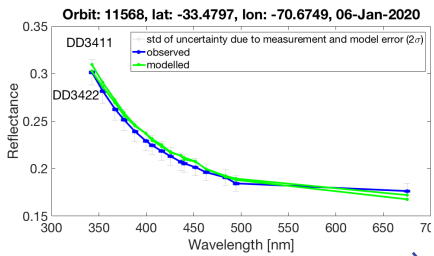
NASA Worldview: Suomi NPP/VIIRS (True color)

Preliminary results

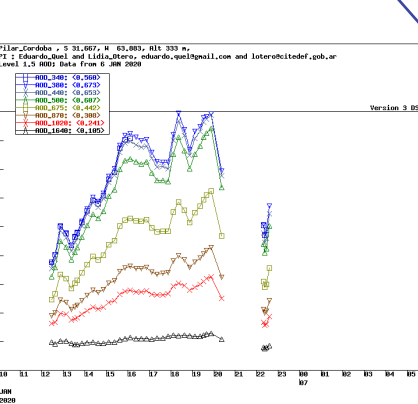
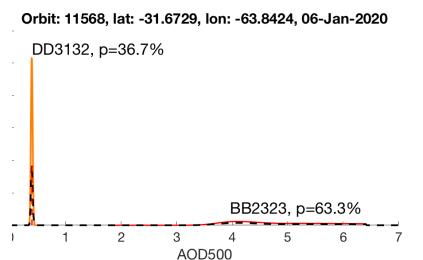
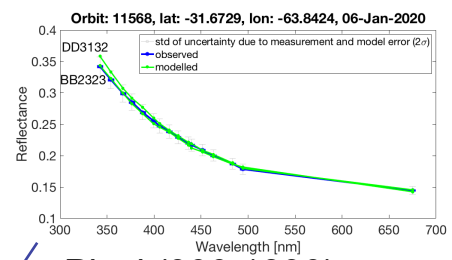
Data:

- TROPOMI/S5p L1b data
- Surface pressure: from TROPOMI/S5p UVAI product
- Surface reflectance: ADAM database

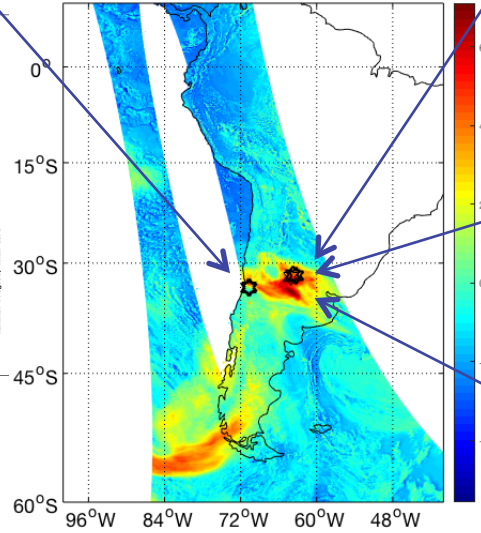
Pixel (262,1822)



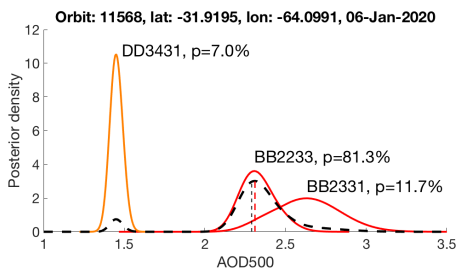
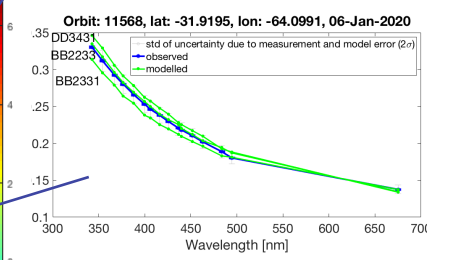
Pixel (394,1834)



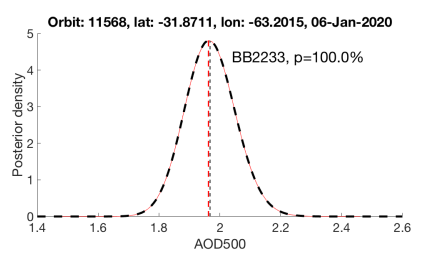
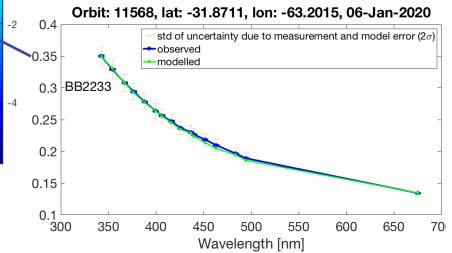
TROPOMI UVAI 340/380 o11568 06-Jan-2020



Pixel (390,1830)



Pixel (400,1828)

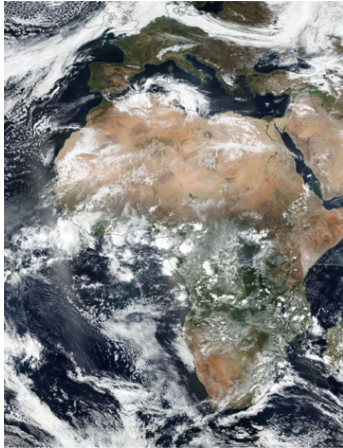


AERONET Pilar_Cordoba
 (31.667S, 63.883W)
 V3 Level 1.5 AOD



Case 2. TROPOMI/S5p Orbit 07450 22-Mar-2019

Preliminary results



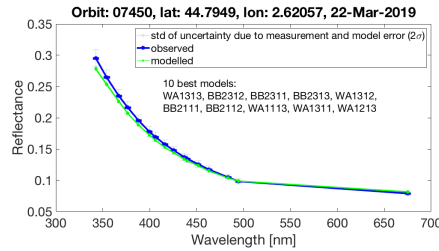
NASA Worldview:
Suomi NPP/VIIRS (True color)

Data:

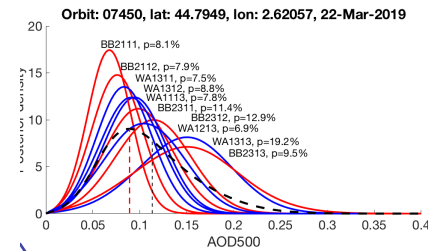
- TROPOMI/S5p L1b data
- Surface pressure: from TROPOMI/S5p UVAI product
- Surface reflectance: ADAM database

Model number xxxx: 1.) main type, 2.) imag. refractive index, 3.) vertical distr., 4.) size distr.

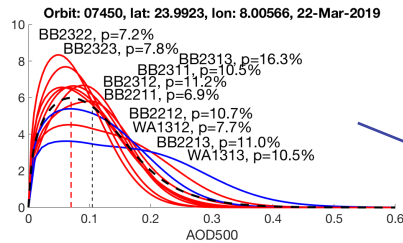
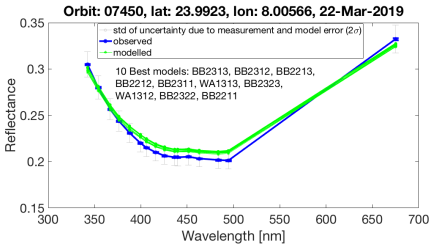
Pixel (285,2264)



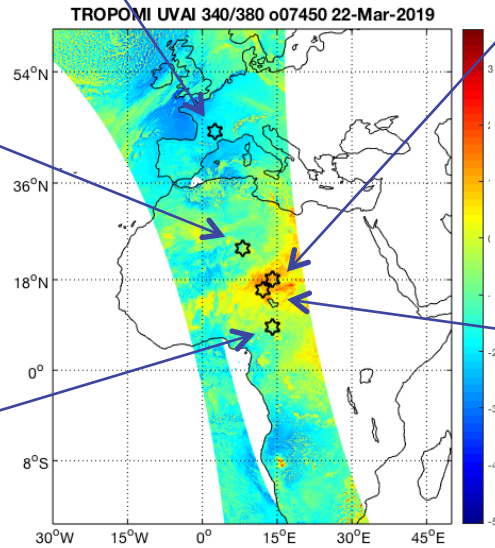
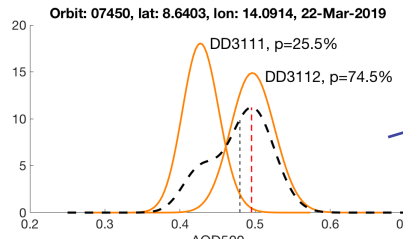
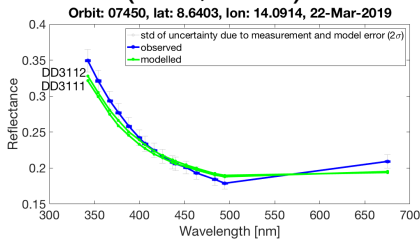
Pixel (376,1832)



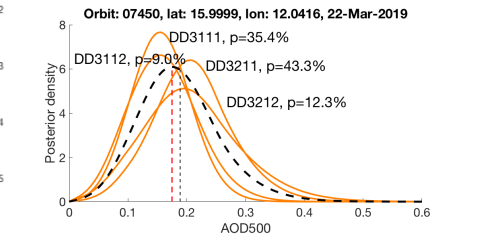
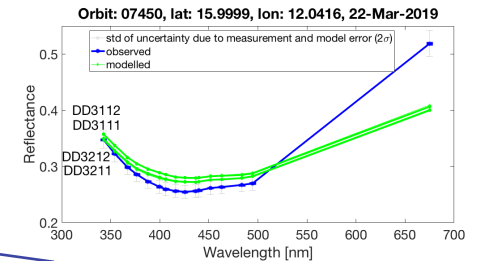
Pixel (278,1935)



Pixel (342,1687)



Pixel (332,1804)



Next steps

Please note, these are preliminary results and under verification

- This work is going on, including
 - check the measurement error
 - Here was used the model discrepancy term (i.e. model error) estimate from the previous studies with OMI data. The model discrepancy term will be estimated for this study.
 - check LUTs functioning
 - examine the retrieved results and compare to e.g. AERONET data
- A lot more study cases are needed
- Paper in preparation

Acknowledgements: Academy of Finland CoEinv for funding and scientific support, we thank the AERONET PIs and site managers for providing the data, the ADAM products have been collected from the ADAM database (adam.noveltis.com) and were produced by the ADAM team under the European Space Agency (ESA) study contract Nr C4000102979.

Thank you!

