Ensembles of satellite aerosol retrievals based on three AATSR algorithms within aerosol_cci

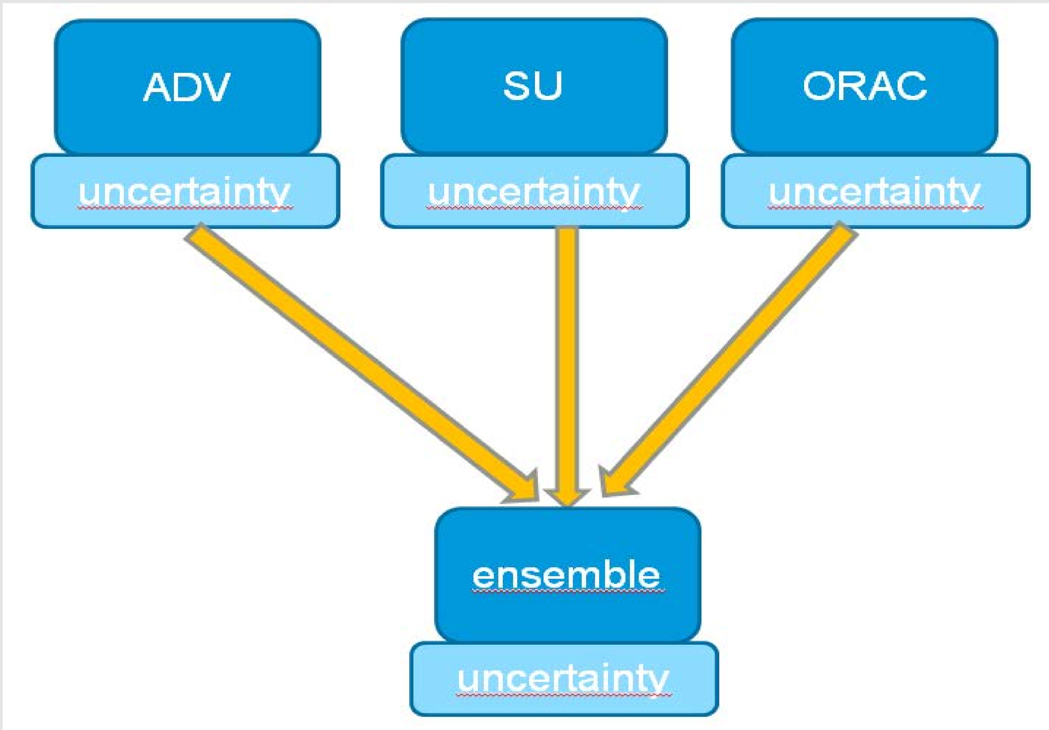
Miriam Kosmale[1], Thomas Popp [1]
[1]German Aerospace Center (DLR), German Remote Sensing Data Center (DFD)
contact: Miriam.Kosmale@dlr.de

Introduction

The Aerosol_cci project aims to provide an aerosol climate data record consisting of full mission aerosol data sets retrieved from European satellites. The aerosol data sets are retrieved from satellite data sets using algorithms which are specific for each instrument and for the retrieval approach and method chosen. From the ATSR-2/AATSR sensors Aerosol Optical depth (AOD) is retrieved (de Leeuw, 2015).
Within aerosol_cci three algorithms provide a long term dataset on AOD, which start with ATSR-2 on ERS-2 in 1995 and lasts with AATSR on ENVISAT until 2012.
The purpose of this work was to create a combined dataset out of the three Aerosol datasets. Based on the assumption that errors minimize by averaging, for normal distributed errors, the ensemble should have a better performance than the single datasets. Another advantage is a higher spatial distribution. Taking into account the uncertainties provided with the datasets the best combination of the ensemble can be performed.

Datasets

ADV/ASV V2.30	**LUT approach** **land surface: spectral constant reflectance ratio** **ocean surface: modelled reflectance** **aerosol model: mixing Aerosol_cci common components** **cloud mask: combined thresholds, post-processing**
ORAC V3.02	Optimal estimation land surface: bi-directional reflectance model ocean surface: modelled reflectance aerosol model: mixing Aerosol_cci common components cloud mask: combined thresholds
SU V4.21	Iterative model inversion land surface: bi-directional reflectance model ocean surface: modelled reflectance aerosol model: mixing Aerosol_cci common components cloud mask: combined thresholds



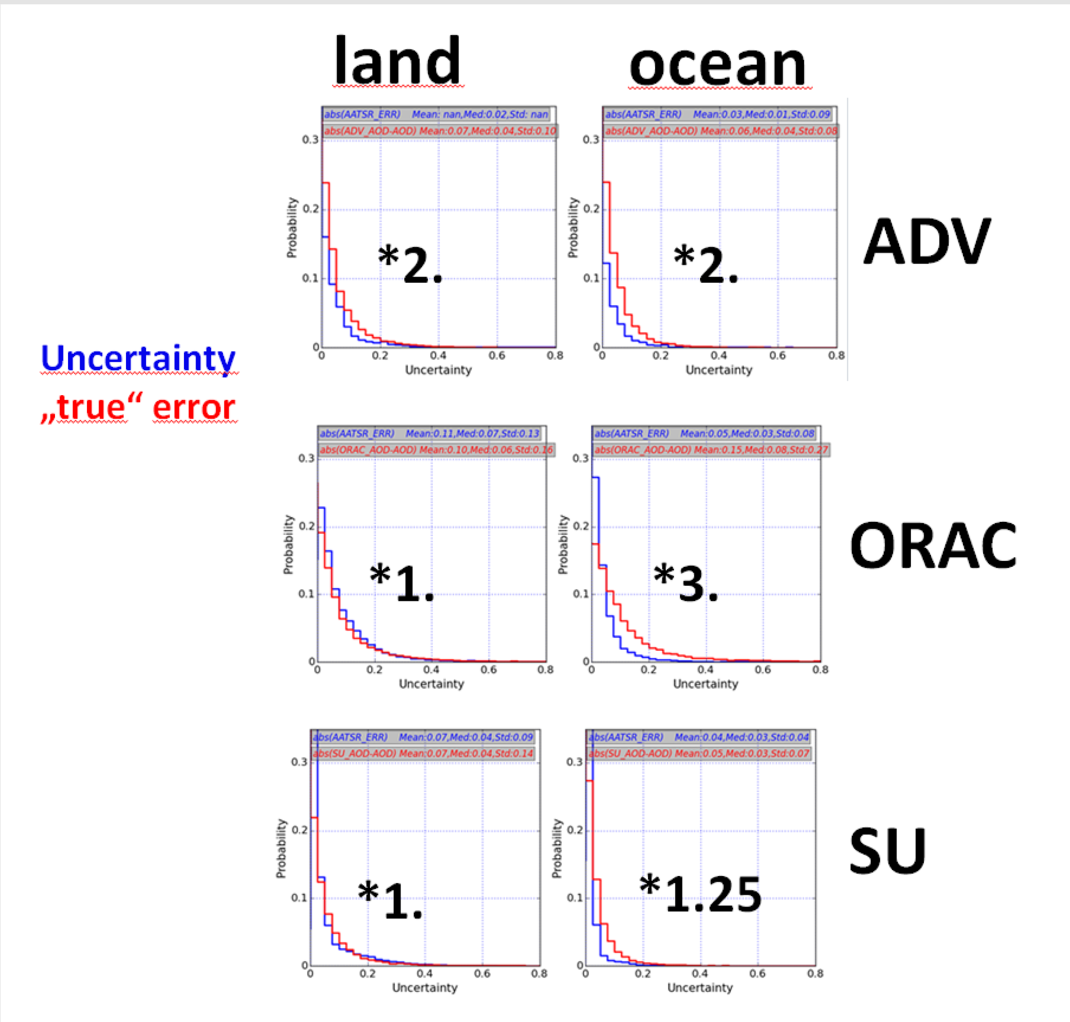


Fig. 1: Evaluation algorithm uncertainties distinguished between land and ocean. The factors show the mean difference to the true error

Methodology

In several steps different versions of ensembles were created from the three algorithms. All ensembles were made on level 2 and only afterward by creating a global 1° grid, or a regional 0.2° grid, switched to a level 3 product. On level 3 monthly and annual means can be calculated. All versions were validated against AERONET.

First, single means on all common pixels are creating the ensemble. The disadvantage is, that no profit of the maximum spatial distribution of the ensemble can be made. The pearson correlation was 0.83.
In a second step also means were taken if more than one algorithm pixel werde available. But addionally also single pixel were added, were only one algorithm retrieved values for AOD. But it showed that the validation against AERONET perfomed worse with a pearson correlation of 0.80.

Since within aerosol_cci also the error quantification within the algorithms were taken into account, all products provide uncertainty information on pixel level. So in a final step the contributions of the algorithms werde weighted with their unvertainty. The uncertainties itself were adopted to each other, as the uncertainty validation showed small differences (fig 1) to the true error with AERONET.

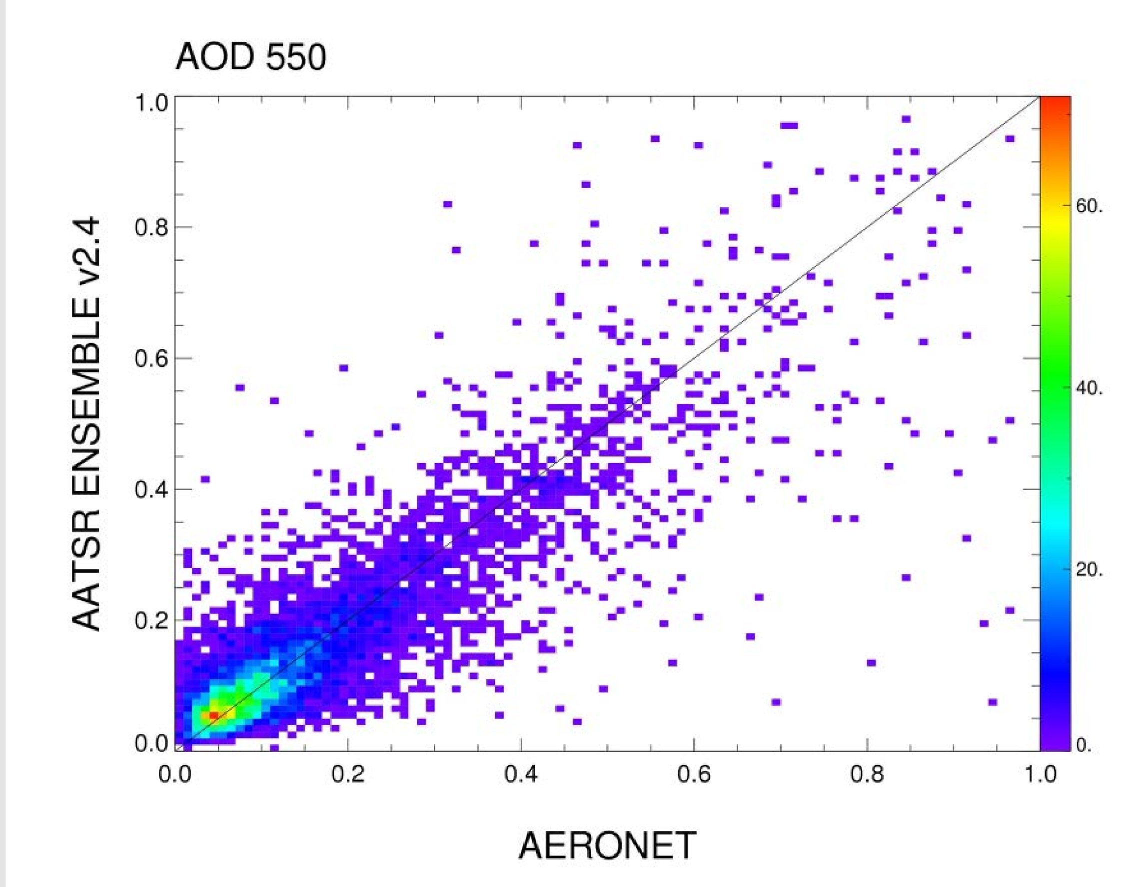


Fig. 2: Validation of the uncertainty weighted ensemble for 2011

Validation with AERONET for 2011	ADV 2.30	SU 4.21	ORAC 3.02	Ensemble 2.4
N	6557	6324	8532	6614
BIAS	-0.02	0.00	0.07	0.00
RMSE	0.10	0.11	0.20	0.09
CRMSE	0.10	0.11	0.18	0.09
PEARSON	0.82	0.82	0.59	0.87
fit m	0.76	0.75	0.74	0.85
fit offset	0.02	0.05	0.12	0.03

Conclusions

An ensemble out of three AATSR Aerosol retrieval schemes were created (fig 3).

Validation against AERONET showed a quite good performance (fig 2), which is as good as the best algorithm included (pearson correlation 0.87).

The ensemble was calculated on level 2, but also gridded level 3 products can be provided.
Annual mean maps of Aerosol optical depth (see fig 4) present the aerosol distribution of this merged product.
The spatial availability of values per each gridcell is higher, than for one single algorithm. This is the great strength of the new product. Together with the good correlation results it could act as an aditional new merged dataset for aerosol_cci.

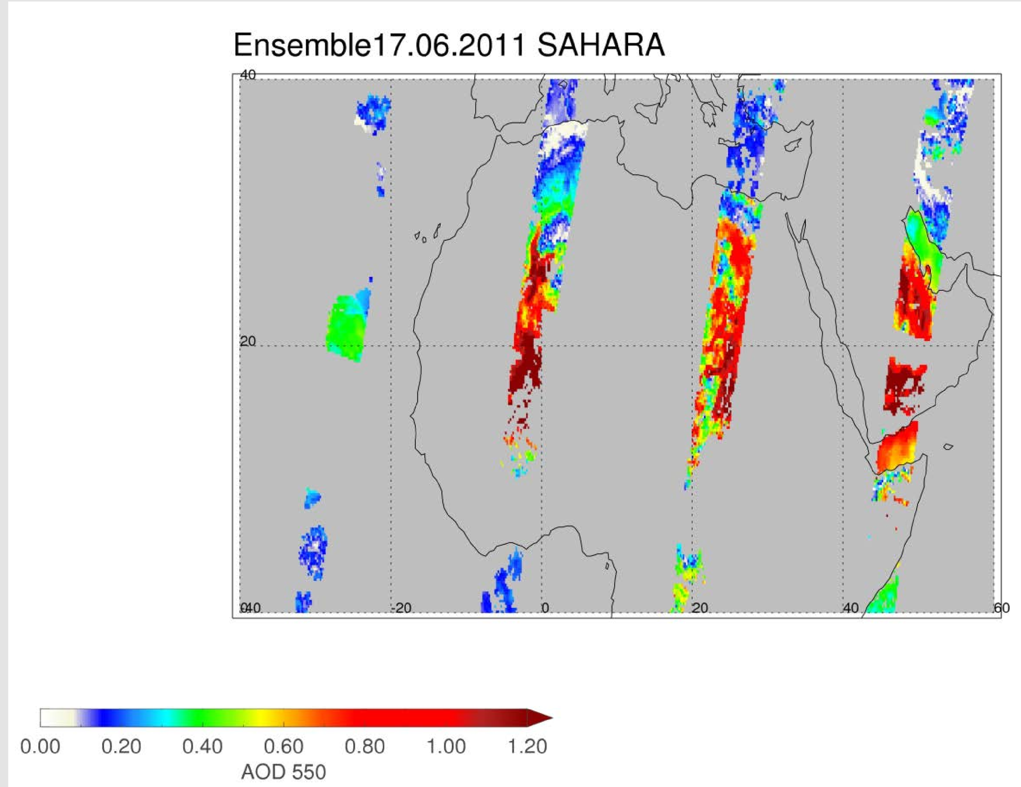


Fig. 3: Ensemble, uncertainty weighted, for one single day over Sahara

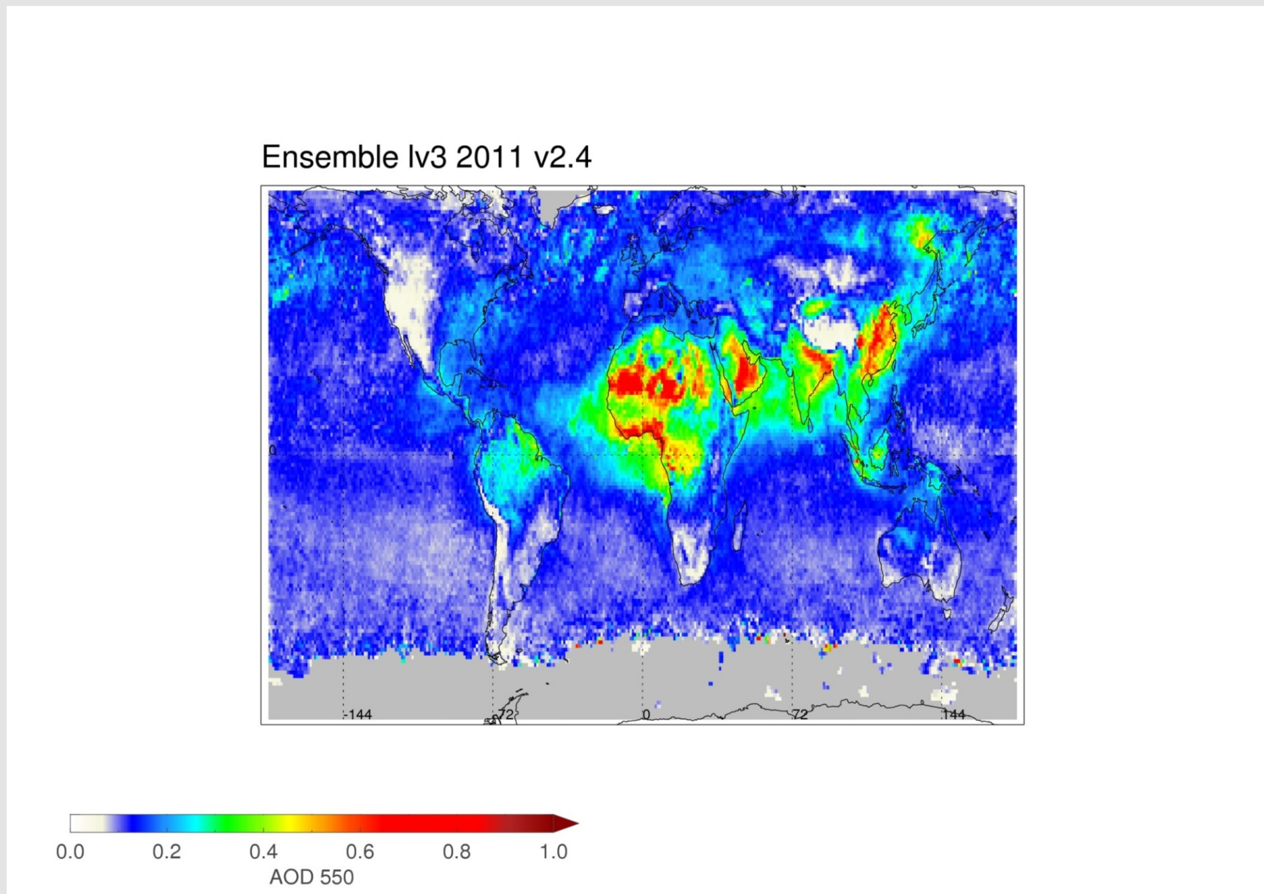


Fig. 4: Aerosol Optical depth AOD 550nm for 2011 of the uncertainty weighted ensemble, gridded on 1° , annual mean

literature:

de Leeuw, G.; Holzer-Popp, T.; Bevan, S.; Davies, W. H.; Descloitres, J.; Grainger, R. G.; Griesfeller, J.; Heckel, A.; Kinne, S.; Klüser, L.; Kolmonen, P.; Litvinov, P.; Martynenko, D.; North, P.; Ovigneur, B.; Pascal, N.; Poulsen, C.; Ramon, D.; Schulz, M.; Siddans, R.; Sogacheva, L.; Tanre, D.; Thomas, G. E.; Virtanen, T. H.; von Hoyningen Huene, W.; Vountas, M. & Pinnock, S. Evaluation of seven European aerosol optical depth retrieval algorithms for climate analysis *Remote Sensing of Environment*, 2015, *162*, 295 - 315

DLR
Deutsches Zentrum
für Luft- und Raumfahrt