

### Response by the authors to referee number 3

Dear Reviewer,

We are thankful for Your comments.

#### **Specific comments on manuscript # amt-2010-70**

Abstract. Line 1-5: This is misleading. Authors apply SYNAER technique on synthetic spectral reflectance (also mentioned between line 10-15) and do not use actual measurements made by the two sensors. However, authors mention on line 15 of section:

Introduction that SYNAER is already in operation at DFD and derived AOD along with the type of aerosol over both land and ocean based on OPAC model.

The synthetic spectral reflectances in the form of the look-up tables are used only in the second part of the retrieval algorithm in order to determine aerosol type. SYNAER retrieval is applied for real measurements from combination of two satellite instruments (AATSR and SCIAMACHY) and is operational at DFD.

Introduction Line 5: "The characterization of aerosols using satellite observations is challenging...". The characterization of aerosol type depends on surface type (ocean or land, dark or bright surface) and 'non-uniqueness' of inversion. Many combination of aerosol types would produce similar spectral signature in reflectance measured by the satellite sensor.

We completely agree with this statement according to 'non-uniqueness' of inversion. In SYNAER a look-up table (LUT) approach has been used. The main shortcomings of this pseudoinversion method are (1) the database has to be very large for simulating all the possible conditions and (2) it is difficult to estimate the sensitivity of the aerosol inversion to the input parameters. An additional problem is the lack of uniqueness in the solutions, but this is the problem with all inversions. In the present study we used a classical tool from statistic (PCA) to remove intercorrelated observations and to extract uncorrelated and independent variables. Such an approach is very useful since, in addition, it will give us in an unbiased way the number and interpretation of parameters that can be retrieved and thus will overcome the second shortcoming of the LUT approach.

Line 25: I have some doubts with Table 1. Why there is repeatation in the aerosol model composition, for instance, with model no. 15-16-17 (also with model 5-6 and 7-8? Do authors change hematite content with water soluble and mineral component?

Table 1 shows the definition of the 40 mixtures used in the SYNAER retrieval method. The set of 40 mixtures is meant to model all principally existing aerosol types and allow for some variability in the composition of each type. Two groups of 20 mixtures, each are applied where either relative humidity or the absorption of the mineral component are altered. There is also height variation, for example in definition of 15-17 mixtures.

We will add more detailed description for the table.

Section 3.3: Distinction between aerosol type Page 2590, line 9-10: "Domains of different aerosol models are well distinguished." Not true completely. Its valid only for dust. There is a considerable overlap over the lower part of the domains. Please clarify this.

The overlap over the lower part of the domain is due to not complete distinction between biomass burning and polluted water soluble aerosol. Similar as it was indicated on Fig. 5a where small overlap can be also observed. On Page 2590, line 9-10, Figure 6c is discussed. The retrieval still has problems with aerosol type identification in lower part of the domain, despite favourable surface type: meadow. This feature confirms once more the necessity for the reduction of the 40 predefined aerosol mixtures to the smaller number of aerosol type definitions. In ideal retrieval case we are trying to have the uniform distribution of aerosol types in PCA weighting domain. (Fig. 1) As we see, also in meadow surface case, we still need to optimize the number of aerosol mixtures in the retrieval.

Page 2590, line 11-14: Not clear.

Changed: The differences between absolute values and starting point value for the solid lines on these figures (6a, b and c) are caused by the differences between **AOD** measurement values which form the structure of analysing matrices for each surface type case.

Section 4: Discussion and conclusions: Page 2591: Repeatative content (on separating biomass burning and pollution aerosols) in paragraph 1 and 2

p. 2591 Lines 9-10 reworded: However, when two DFS are available, sometimes there is a problem to discern anthropogenic polluted aerosol.

Figures Fig. 6c: replace 'wies' with 'meadow'

OK