5th AeroSAT workshop

October 12 - 13, 2017, Helsinki, Finland

Minutes

Agenda

Posters

All presentation slides will become available at http://www.aero-sat.org/aero-sat-meeting-5.html

AEROCOM / AEROSAT 2017

AEROSAT minutes

SESSION 12 data and modeling
*chair: **M. Chin** / rapporteur: **T. Popp***

Use of satellite datasets and arising needs:

- aim: maps of common patterns from many satellites; complementarity of thermal IR and mid-visible datasets to constrain model
- aim: consistent trends across different satellite instruments (ESA, NASA)
- CCI: trends are likely more robust than AOD records (biases, but consistent); usefulness of satellite anomaly maps
- AEROCOM modelers wish for satellite median, but difficult to achieve

CCN from satellites

- (FM)AOD / AI not reliable at low values -> satellites miss lower part of CCN particle size
- instead of AOD: use cloud droplet concentration as proxy for CCN (Rosenfeld)
- needs high spatial resolution to resolve vertical cloud structure
- over land now available: VIIRS 375 m pixel in thermal
- first step: produce output for selected case studies

SEVIRI hourly AOD product joint with droplet number concentration offers

- animations of moving aerosol and clouds
- statistical 2D-histograms between FMAOD and CDNC

Ways to collaborate (model – satellite)

- model advancement closely tied to satellite observation capabilities
- some saturation of progress beyond AOD since ~2010s
- need breakthrough advancement of satellite retrievals to better constrain models; including (1) providing a long-term aerosol-amount-and-type product that might require some collaboration between the measurement and modeling communities, (2) providing pixel-level uncertainties with the data, (3) agreeing upon data formats, which also might require cross-community collaboration. Each of these is the focus of an AeroSat sub-group effort.

SESSION 13 AeroSAT challenges
chair: ***L. Sogacheva*** */ rapporteur:* ***T. Popp***

stimulating introductory talks by R. Kahn (remote sensing perspective) and M. Chin (modeling perspective)

Discussion sumamry - challenges

- mass – optical properties conversion
- how quantitatively constrain mass composition in models?
- how evaluate models in cloudy skies with optical satellite aerosol properties?
- vertical profiles of species, absorption, …
- AOD-PM2.5 relationship (profiles, composition, water amount)
- include also aircraft and ground-based data with model and satellite
- simulators to better evaluate parameterizations in models
- use more in-situ data to better understand where satellites observe well
- new: systematic in-situ observations beyond field campaigns (1 aircraft / 20 instruments)
- disentangle triangle mod - in-situ/airborne + sat to understand reliability (regions, seasons)
- obtain uncertainties on FMAOD, SSA, Reff, … - aerosol type probabilities
- possible link model – satellite: Optical depths at different wavelengths / of components WITH consistent definitions

Priority data needs to improve modelling

- profiles
- absorption
- reproduce cycles of variables

SESSION 14 working group on climate records
chair: ***G. De Leeuw*** */ rapporteur:* ***L. Sogacheva***

G. de Leeuw introduction
History: discussion at 4 AEROSAT meetings
Needs for CDRs

T.Eck: new AERONET version
AERONET L2 version3 will be released in Oct-Nov
Nick: need bias and uncertainties
Greg: Typical or maximum uncertainties? Typical
Validation of AERONET uncertainties? Consistent error estimate from several instruments
TOA radiance uncertainties are not considered
SKYNET comparison is suggested; they have different calibration
Uncertainties do not depend on AOD~, but max AOD is limited by 7

E. Wleton (given by T. Eck): MPLNET
MPLNET is a lidar network
New products: thin cloud COT, cloud phase, depolarization ratio
Europe: other locations in Spain soon (Potenza).
MPLNET (elastic lidars, daytime) working on vertical path, mirror AERONET, since used AERONET AOD (for comparison: Earlinet – day (research) and night)
High polarization – ice layer: Does it always exist over the dust layer? Under-estimation now.
Measurements exist in Canada, but not included? They are in GALION? Two networks should be integrated (also in Lat America)

G. Schuster: Lab evaluation of AERONET / GRASP
Validation of retrievals
Much less in validation than measurement instrument noise; residual is a criterion
Spherical / non-spherical: problem with humidification, dataset is not enough
No sea salt in components
Aeronet zero has to be >0 to be able to use logarithmic scale
Limit on absorption: Add another zero? Under computation now
Is there better agreement when residuals go down? Yes
Largest residuals are from nephelometer but not the algorithm.
Rsme may be same, but slope might be different.
Mix absorbin / nonabsorbin, fine/coarse mode: what happens with refractive indexes?
Random can't be averaged. Surface albedo brings bias to low AOD.
Why SSA saturates to 1 in GRASP?

Single-scattering Albedo (SSA) difference between instruments (SP1: 0.88, SP2 0.94; SP2 is better. Can we trust PSAP? Can't get closure and go as low as 0.88
SSA uncertainty estimates: threshold should be set for AOD
Bring 2 instruments together to recognize the noise.
Atmospheric inhomogeneity is another source for uncertainties
Noise in AERONET discussed - what contributes most
UV-Index generic artifact is systematic
Particle sizes are smaller for lower AOD
Shape (size distribution) does not follow the distribution of lab experiments.
Humidity effects
Pre-AERONET instruments: how good are they?
Build climatology? There is seasonality (burning, dust mobility, biogenic particles)
If 10 sun photometers, can we get sufficient precision? Averaging is not good.
How good is good enough? (Depends on the question of interest.)
Decompose the error, is that possible?
Modelers need weekly/monthly uncertainties for 1 degree grid. Can the systematic error be recognized? Assimilation modeling requires pixel-level uncertainties.
Uncertainties and errors
Product can be used, but uncertainties should be enlarged
AAOD is more reasonable to use, because both measurement and modeling sensitivity to absorption increases with AOD. Bias is to absorption. But will be biased high (with SSA biased low)
Uncertainties also in nephelometer, absorption photometers. No better acoustic instruments.
AERONET does not have profile. Aircraft measurements needed. AERONET is always a bit lower than campaigns.

SESSION 15 Working group on experiments
chair: ***R. Kahn*** */ rapporteur:* ***M. Garay***

Objective: Identify Possible AeroSat Experiments

- Studies Among Aerosol Products
- Studies About Using Satellite Data to Constrain and/or Validate Models
- Studies About Using Models to Add Value to Satellite Data

Could be small (bilateral) or larger (multi-lateral) efforts

Discussion

Would like to see measurements that expand aerosol physical and optical properties to account for CCN

Co-locate aircraft campaigns around an aerosol “supersite,” which would have measurements of long-term aerosol characteristics and (diurnal and day-to-day) variability

Connecting retrieved optical constraints with inferred composition – UK funding (4 yrs), testing models and changes to optical properties and emission.
[Reddington et al., *BAMS*, September 2017]

Aerosol_cci did investigation of uncertainty in gridded / level3: 5 possible experimental approaches. Simplest approach seemed to work best. (Lesson learned: Pick some things and try them)

What are appropriate time and space scales for aerosol?

Level 3 data aggregation, recent 2017 paper (Nick Schutgens). New ideas could be tested by running through system.

Constrain aerosol type for all AODs (not just low and high). Model can give this to you very easily, but need to know exact definition. Types in model are strict. (Costas). Not enough just to have “this is the aerosol type,” but also need to know how “certain” this “type” is. Model could give this by running an ensemble. Will depend on emissions. Could start with a comparison?

Aerosol retrieval experiment in Aerosol_cci. Largest differences driven by differences in cloud masking, not aerosol types. Same conclusions as AVHRR, TOMS, MODIS, MISR product inter-comparison [Li et al., *Ann. Geohys. 27*, 2755-2770, 2009] Matters for averaging.

Pixel-level uncertainties are different for vertical (lidar) information, can be variable and more complex.

Set up a reference dataset for an “experiment” from a model for aerosol type.

What is the definition of aerosol type? Category of characteristics? Used as a term in satellite retrievals: size, shape, and absorption (and absorption spectral behavior). Bins determined by a cluster analysis of some sort. Qualitative, categorical constraint on some microphysical aspect of the particles. Does there need to be the same definition on the satellite and model side? What metric or metrics provide a mapping? Problem because different retrievals might have to use different definitions. (E.g., some schemes retrieve constraints on microphysical properties, others are interpretive and report a particle composition directly.) Modelers want a strict definition on how to sample model output. The satellite people need to provide this information (constraints) to the modelers. There should be some metrics appropriate for “most” satellite retrievals. Are radiative transfer inputs sufficient? Different information content for different instruments. MAIAC only has 3 types (background, dust, smoke). CALIPSO has 6. MISR produces qualitative constraints on size, shape, and SSA.

Think of a study that is useful – start simple (smoke, dust, background). What is missing from the data that Nick Schutgens put together? Experiment already begun for 2006 and 2010. Modelers don’t see a need to compare model to aerosol type – this is for the remote sensing people. However, it might be useful to compare the spatial distributions of aerosol air masses, differentiated by aerosol type, between satellite maps and models samples at the satellite snapshots.

PARASOL retrieval (GRASP) doesn’t use models (like a LUT), but types can be determined afterwards by empirical rules. Alternatively, try to retrieve size distribution based on chemical composition.

Model generates 100% dust, 100% biomass burning, etc. Then you can combine how you want. Would this be useful?

Activity needs to start small – multi-angle retrieval vs. nadir-only. How to we translate from model (with simple types)?

Aerosol_cci already has AEROCOM median aerosol mixtures (4 particles / components). Using fine mode fraction, dust fraction, and fraction of strongly absorbing fine mode. How important is this when AOD is low?

Aerosol type feeds into pixel level uncertainty – models can convert to column-effective SSA, etc. This can be used to assess the uncertainty in aerosol properties.

ORAC plans to use Stefan's (AEROCOM median) climatology and provides pixel-level uncertainty. Will climatology improve retrieval in situations when there is not enough information?

Suppose experiment is done on aerosol type, what are we trying to learn? Will help communication between satellites and models. Satellites have some information to contribute to models, but not sure how to use this. In principle, could also use models to improve satellite retrievals in situations with limited information. Would like to do something like MERRA2 reanalysis that blends models and observations? Can map out air masses. How is this different from an aerosol reanalysis? First goal is to create a common language. Next, try to use model data in a satellite retrieval in a well-defined framework. Can make the information we already have (from satellites) to constrain the models. Can take advantage from the model, which is complete. Reanalysis isn't really using all the information from the satellites (e.g., spatial information, which is probably the most important satellite contribution regarding aerosol type).

Models can also be used to constrain the locations of particular types of retrievals in the satellites.

(Mian Chin): More and more confused on who needs who. Type is helpful to models, but not needed. Can compare spatial distributions of air masses from satellites to models, and they are not the same. Another opinion: It is a symbiosis. Satellites can help by mapping the spatial distributions of AOD and aerosol air masses to validate models; models can associate aerosol air masses with sources, helping to constrain aerosol type in the satellite retrievals, especially where AOD is low and satellites cannot retrieve type.

Small plumes are not necessarily detected, but may be retrieved at high resolution. This could feed back to the model. In low AOD situations, the model might provide information to the retrievals.

If you cannot phrase clearly and simply what the higher goal is, that is not a good sign. Different people are after different things.

Goal is to lower uncertainties of the parameters that are reported by the satellite retrievals?

Goal is to achieve consistency between modeling and retrievals. Some information from satellites that is not yet used can be of a benefit to the models and the overall understanding of aerosol (type) distributions.

Goal is to enable the information on what aerosol is where back and forth between models and retrievals.

Modelers want to see CCN. Are willing to accept AOD, but did not think you could get it from retrievals. Now it may be possible to provide CCN. Would like to see an experiment devoted to CCN. Add a CCN counter to MPLNet sites?

Can someone take the lead to answering the questions as to what we are doing, why, and who benefits who? (Ralph, Lucia, Costas)

Ralph: I think the ***AeroSat Experiments***, discussed later in this year's meeting, will go a long way toward answering this question. They will determine what AeroSat members are interested in doing, convolved with what they actually have time to do. I'm hoping that we take advantage of the unique relationship between AeroSat and AeroCom to pursue experiments that involve ***measurement-modeling collaborations***. Other efforts, such as CCI, are focused, e.g., on satellite-product-inter-comparisons.

What about simulators? Do the models have enough information. Are there limitations in the radiative transfer (e.g., bands, surface reflectance)? Is there an intermediate way to do this (e.g., take model types and try retrievals)? Could this help the models do a better job with the assimilations?

On aerosol vertical distribution, it would be helpful for CALIPSO and MISR teams to get together. Would like to include a modeling component as well. Use CALIPSO to initialize HYSPLIT and trace observations back to sources. Would not require a full model for comparison.

Aerosol retrieval comparison should also involve interpretation. 19 different datasets calls out for evaluation of strengths and limitations of aerosol retrievals. Try to explain reasons for differences so the community can make sense of all the different retrievals. Not just comparisons over AERONET. Need to ensure retrievals are independent from AERONET. Can provide guidance where retrievals provide useful information. Need to deal with cloud screening. AERONET classified as surface type and aerosol type in comparisons in Aerosol_cci.

Pixel selection is important to help with cloud screening. In a simulator, information about surface could help models that do not have explicit models for the surface.

An experiment to integrate trends in aerosols from retrievals over the past 10-20 years.

What's planned for assembling satellite data (Schutgens)? Has already assembled model simulations.

Aerosol retrieval comparison: Responsibility (Kinne, Schutgens)?

Aerosol vertical distribution: Responsibility (Winker)

Trend exercise: Responsibility (Michael, Larissa, Thomas)

SESSION 16 working group on aerosol typing
chair: ***L. Mona*** */ rapporteur:* ***F. Patadia***

L. Mona

An overview of the effort towards creating a reference database for aerosol typing [REDAT] was presented. This work is in being conducted in 3 phases. As part of the first phase, aerosol model information from different groups has been collected.

Why do we need aerosol typing?
Remote sensing can provide optical constraints on size, shape and ssa but further interpretation is required with additional information to associate this information with source type, to identify the anthropogenic component, etc.

Results
This group in particular uses HSRL classification method on EARLINET/ACTRIS to come up with aerosol types.
From 712 cases they came up with 10 classes that were clustered based on lidar vs Beta_AE and grouped them into 4 classes
Nomenclature : 6 main classes / aerosol types were identified

Plans

- Create a REference Database for Aerosol Typing (REDAT)
  CNR-IMAA is putting together this collocated (all sources of aerosol type information) database [Hispectral Lidar ; EARLINET]
- It can be used for comparing typing procedures
- And can be a reference database for linking with modeling community
- It will help to overcome small dataset limitation and in translation of requirements

GRASP : Strength and Weakness : Oleg Dubovik

[Generalized Retrieval of Aerosol and Surface Properties (GRASP) algorithm]

- POLDER & MERIS results were presented in this talk

- Underlying retrieval technique is:

- Numerical inversion is implemented as a statistically optimized fitting of observations following the multi-term least squares method (LSM) strategy, which combines the advantages of a variety of approaches and provides transparency and flexibility in developing algorithms that invert passive and/or active observations and derive several groups of otherwise unknown parameters. Different smoothness constraints are simultaneously applied on aerosol size distributions and spectral dependencies of the aerosol refractive index and surface reflectance parameters [Schutcher et a, 2005] to retrieve information on aerosol size and chemical composition [BC, Dust etc].

- Parasol with more information [wavelength, polarization, angles (144 inputs)] matches AERONET AOD better than MERIS retrievals ; AE is much better correlated from PARASOL compared to MERIS, which gave a false large particle class

- GRASP now has also PM2.5 maps

- Limitations
  - Slow / Speed
  - Requires a priori constraints for scales in smoothing of horizontal pixel-to-pixel variations of aerosols and day-to-day variations of surface reflectance

SESSION 17 evolving AEROSAT, collaboration
chair: ***N. Schutgens*** */ rapporteur:* ***T. Popp***

CEOS-AC-VE (virtual constellation atmospheric composition / aerosol component of air quality)

- virtual constellation is complementary to AEROSAT (data collection + delivery <-> discussion on algorithms and use)
- other related communities: SPARTAN (in situ PM), ICAP (models)
- inter-comparison of GEO satellites / model community interest
- share results of GEO inter-comparison with AEROCOM/AEROSAT (presentation next meeting)
- role of polar sensors / AOD: transfer standard between GEO sensors (radiation, level2) / consistency of GEO – LEO
- involvement of models in interpreting aerosol properties
- need side meeting of representatives / long-term collaboration plan

ICAP

- focus on operational forecasts / NRT
- ICAP provides multi-model ensemble
- bias correction (departures from model) -> important input to retrievals
- help with error characterization from retrieval providers
- ICAP needs:
    - multiple datasets, guidance (complementary information content / coverage)
    - bias-free datasets – correct known biases, quantified random error (can be large, „RMSE as f(AOD)") – and validated
    - auxiliary variables (cloud fraction, snow, reflectances)
    - easy data access, few major upgrades, specific added value
    - variables needed: AOD (bias-corrected, error-characterization), FMAOD / CMAOD, AAOD / SSA (UV-AAI), lidar / vertical, mass concentration; reflectance assimilation; aerosol type categories are difficult
    - climatologies / reanalysis
    - verify biases (globally rather homogeneous) to AERONET -> dialogue, OSSEs to prioritize variables

SESSION 18 working group on pixel uncertainties
*chair: **T. Popp** / rapporteur: **G. Thomas***

Presentation – Thomas Popp – Introduction and overview
TOA measurements' sensitivity to AOD varies greatly with pixel conditions:

- AOD
- Aerosol and surface properties
- Viewing geometry and cloud proximity

Define pixel uncertainty as an estimate of the standard deviation of a Gaussian (1-sigma error) describing a combination of these (and other) factors:

- Showed simple linear error combination of different uncertainties (i.e. squared addition of variances)

Discussed uncertainty validation, with emphasis on the approach used in Aerosol_cci for AOD uncertainty; compare true error (in this case, difference from AERONET AOD) to estimated uncertainty:

- If uncertainties are correct and normally distributed, would expect the actual error to be less than the uncertainty value 67% of the time.
- Noted that not all error sources are included in the standard uncertainty (for example cloud masking errors have such a non-linear impact on retrieved AOD the Gaussian error approximation is clearly not appropriate)

Need for pixel-level uncertainty?

- Highly desirable if products are to be used in assimilation systems
- Consistent data integration (when producing ensemble products for instance)
- Allows for quantitative data filtering by users (compare with qualitative quality flags)

Questions and topics for discussion:

1. Can we achieve consistency between validation (against AERONET) and error propagation?
2. How can we better treat non-Gaussian error distributions?
3. How best to validate uncertainty?
4. How do we treat propagation from L2 to L3?
5. How can we provide uncertainty for derived properties (which aren't directly retrieved)?

Proposed a deliverable for AeroSAT 2018: Overview / recommendations paper (lead by Andy Sayer)

Questions and discussion
It was noted (by Yves Govaerts) that in propagation from L2 to L3, it is important to separate random and systematic error sources.

- The point that known systematic errors should be removed from products entirely was made.
    - Nick Schutgens enquired if any work had been done on investigating the limits of using the Gaussian distribution for uncertainty propagation (answer was no).

Presentation – Kerstin Stebel – Aerosol_cci uncertainty validation

Basic premise of the Aerosol_cci uncertainty validation is that distribution of AOD differences between the satellite product and AERONET should match a Gaussian described by the per-pixel uncertainty estimates

- Assume that AERONET uncertainty can be neglected
- AERONET match-up criteria was 50 km / 30 mins
- Presented results for the final Aerosol_cci ATSR products.

Results have been plotted as time series, both per site and global, and also as scatter plots and histograms, with sites grouped by surface type:

- The results are consistent within missions, but changes seen between ATSR-2 and AATSR data records.
- See that uncertainties tend to be under-estimated for high AOD, while they are over-estimated at low AOD.
- As might be expected, brighter surface types tend to correspond to larger AOD uncertainty.

Seasonality has also been investigated through producing multi-annual averages, and there is some seasonality in the retrieved uncertainty.

Questions and discussion

There was a question about the validation of L3 uncertainty. Adam Povey described the work done by the uncertainty working group within Aerosol_cci, looking at different experimental methods of calculating a L3 uncertainty value. Basic answer was that the worst-case-scenario (double of averaging the uncertainty values of the L2 pixels in the L3-grid box) worked best.

Oleg Dubovik made the point that, because AOD is strictly a positive value, with a concentration towards low values, we should be looking at log-normal distributions. The Gaussian uncertainty approximation will probably be more appropriate for log-AOD.

Andy Sayer pointed out that the central-limit theorem suggests that for a given observation, a Gaussian error should be reasonable.

Gareth Thomas noted that ORAC does, in fact, retrieve log-AOD (along with its uncertainty).

Linlu Mei asked if any examination of the dependence of the AOD uncertainty on derived parameters like fine-mode AOD had been done. No, was the answer.

There was also some discussion of the match-up criteria. It was suggested that a nearest-pixel (i.e. no averaging) would produce the best results. Both Ralph Kahn and Alexei Lyapustin suggested that distance criteria for AERONET match-ups should be site specific.

Presentation – Andy Sayer – Pixel level uncertainty techniques

Presented some basic definitions:

- Error: retrieval - truth (don't always know the truth, of course)
- Uncertainty: distribution of errors (how confident are we in the retrieved value)
- Prognostic estimate: I have a cow. I think it weighs X, but it could be X +/- dX.
- Diagnostic estimate: The cow actually weighs X; how close was I?

Example diagnostic uncertainty: MODIS Dark-Target validation. Box-and-whisker plots of AERONET vs MODIS scatter plots used to produce an uncertainty envelope.

- Has the advantage that it is easy to understand, and provides an uncertainty against a widely accepted reference.
- Disadvantages: It's not prognostic (doesn't provide any per pixel information), so is of limited use for assimilation etc. It is dependent on the sampling provided by AERONET and hides regional variability. It is also dependent on the accuracy of the external data source (AERONET).

Example prognostic uncertainty: Optimal estimation

- Advantages are that it is truly prognostic and pixel-specific, and can be validated using the Aerosol_cci type analysis.
- Disadvantages are that it requires accurate input covariances (measurement, forward model and a priori uncertainties), it is difficult to give an overall uncertainty estimate (like the Dark Target approach provides). It also will only produce an accurate uncertainty if the forward model is appropriate and behaving linearly near the solution.

Example prognostic uncertainty: MODIS Deep Blue

Come up with a (linear) function which describes the expected uncertainty as a function of retrieved AOD and viewing geometry (or whatever you believe to be important in determining error in your retrieval). This function can then be used to provide an error estimate for each retrieval pixel.

- Advantages: fairly easy to understand and communicate. Provided uncertainties are more useful than a (purely) diagnostic error estimate. Coefficients can be derived through validation (although this will require a reprocessing of the data).
- Disadvantages: It is still over-simplistic (is really just an advanced diagnostic error estimate) and relies on sampling and breadth of the validation data.

The above information is the basic skeleton of the proposed AeroSAT uncertainty paper. Paper Outline:

- Definition of terms
- Examples (perhaps the above three)
- Validation of uncertainties
- Recommendations

Finally provided a few talking points and questions:

- Can we agree on a common definition of uncertainty (1-sigma)?
- What is the right balance of specificity and ease of use?
- Should, and how should, those using only diagnostic approaches move towards prognostic uncertainties?
- When assessing data quality, is there a common metric we can use? (GCOS compliance fraction?)
- Can we improve and standardise uncertainty validation?
- Is the Gaussian assumption valid (what about outliers)?

- What about the uncertainties in, or introduced by, the validation data (sampling and radiometric errors)?
- How do we validate uncertainties in derived products (like Angstrom, SSA, fine-mode fraction etc)?
- L3 uncertainties…?

The questions and discussion on Andy's presentation morphed into a general discussion on the overall uncertainty topic.

Discussion

Members of the MISR team noted that the MISR v23 processing was starting on the day of this discussion, and that it utilised a LUT based scheme for providing pixel-level uncertainties.

Adam Povey made the point that how uncertainty is described and derived is dependent on retrieval approach and what the data is to be used for: we can all be correct in our approach, without being consistent.

Michael Schulz said that more attention needed to be paid to propagating uncertainty from L2 to L3, as this is what the modellers tended to use. This led to a long discussion on the purpose and merits of L3 data:

The question of why L3 is produced was asked – do we actually think it is physically descriptive and valid?

- User demand (ease of use, L3 is on spatial scales which better match GCM grids)
- Not all L3 data is created equal. Nick Schutgen's AeroCom L3U product held up as an example of better L3 product approach.

There was also some discussion of how to better represent the variability within a single L3 grid cell. The idea of L3 using PDFs of data (rather than averages and spread – like mean and standard deviation) was put forward (again) by Falguni Patadia. Adam Povey suggested a variation on this idea:

- Fit the PDF of data to an expected functional form (Gaussian, log-normal, etc.) and store coefficients (lower data volumes)
- Include a goodness-of-fit parameter as a form of uncertainty estimate.

Jim Limbacher noted that one problem with L3 data is that it is often used to derive other quantities (e.g. Mass extinction), which are not mathematically correct with averaged values.

Presentation – Alexei Lyapustin – A different L2 uncertainty approach

This talk presented an approach applied to the MAIAC MODIS aerosol product by some statisticians interested in using the data for Air Quality purposes. The approach uses machine learning to determine the importance of a list of factors in predicting the error in the retrieved AOD verses AERONET. In the MAIAC example only four parameters were found to be of statistical importance over the 16-year dataset:

1. The diagnostic error estimate (like the Dark-Target one). i.e. AOD value is the primary determinant of its own accuracy.
2. Relative azimuth
3. Aerosol variability (spatial/temporal?)
4. A very slight trend in the retrieved AOD, which was invisible in the reflectance and raw AOD record.

Thomas Popp asked Alexei to share details of an upcoming paper describing this work.

SESSION 19 ***wrap-up and outlook***

AEROSAT experiments initiated this year:

- *Aerosol Retrieval Comparison [Kinne, Schuttgens]*
- *Characterizing Retrieval Uncertainties [Sayer, Povey, Govaerts, Levy, Patadia, Witek, Kahn, Dubovik, Mei, Rozanov, Thomas, Kolmonen, Stebel, Limbacher, Lyapustin, Popp]*
- *Joint Remote-Sensing AOD and Type [Kinne, others]*
- *Connecting model – satellite aerosol type [Mona, Kahn, Tsigaridis]*
- *Constraining Aerosol Vertical Distribution [Winker, Kahn, Nowotnick, Colarco…]*
- *Consistent multi-sensor trends* [*Sogacheva, Schulz, Popp*]
- *CCN new approach [Rosenfeld, Christensen, Bauer, Shanzuka, Stier]*

Task groups should

- invite others interested
- define the experiment
- start test the core of an experiment with few participants
- involve more participants when basic concept is mature
- report at AEROSAT 2018

wrap-up AEROSAT 2017

- 45 - 80 participants (varying over sessions)
- Very good representation of modelling teams
- First step towards defining concrete activities (experiments)
- Suggestions for next year AEROSAT: Specific session on aerosol cloud interaction with cloud retrieval experts

Thanks to

Hannele Korhonnen, Edith Rodriguez, Gerrit de Leeuw, and colleagues

Chairs (Mian, Larisa, Gerrit, Nick, Lucia)

Rapporteurs (Larisa, Mike, Falguni, Matt)

AERO-SAT

AeroCom

AEROSAT program

Thursday, October 12, 2017

AeroCom / AeroSAT

chair: ***M. Chin***

	SESSION 11	**AeroCom challenges**
8:30 – 8:45	**M. Schulz**	*AeroCom wrap-up and outlook*
	SESSION 12	**data and modeling**
9:00 – 9:15	**M. Schulz**	*lessons learned using satellite data, future needs and recommendations*
9:15 – 9.30	**N. Schutgens**	*Aerosol optics comparisons between remote sensing and modeling*
9:30 – 9:45	**S. Kinne**	*User case studies of Aerosol_cci – an overview*
9:45 – 10:00	**D. Rosenfeld**	*CCN data from satellite retrievals and what can we do with them?*
10:00 – 10:15	**Y. Govaerts**	*Aerosol_cci attempts on a joint aerosol-cloud products from SEVIRI*
10:15 – 10:45	coffee-break	

chair: ***L. Sogacheva***

	SESSION 13	**AeroSAT challenges**
10:45 –11:00	**R. Kahn**	*new challenges for AeroSAT – remote sensing perspective*
11:00 –11:15	**M. Chin**	*new challenges for AeroSAT – global modeling perspective*
11:15 –11:45	**all**	*progress, needs, recommendations*

11:45 – 12:00 **poster introductions (part 2)**

max 1 ppt slides / 1 minute poster introduction *in alphabetic order (of those not present on Monday)*

12:30 – 13:30 lunch

chair: ***G. De Leeuw***

	SESSION 14	**working group on climate records** (high-quality, long-term, consistent)
13:30 – 13:45	**G. DeLeeuw**	*Introduction*
13:45 – 14:00	**T. Eck**	*AERONET v3 update and including AERONET inversion uncertainties*
14:00 – 14:15	**E. Welton**	*MPL data and uncertainties*
14:15 – 14:30	**G. Schuster**	*Laboratory Evaluation of AERONET and GRASP Retrieval Algorithms*
14:30 – 15:00	**all**	*experience with ground remote sensing references*
15:00 – 15:15	**all**	*Other records (AVHRR, TOMS/OMI,) and next year's progress*
15:15 – 16:30	coffee break + poster viewing	

chair: ***R. Kahn***

	SESSION 15	**Working group on inter-comparisons**
16:15 – 16:30	**R. Kahn**	*overview & suggestions of AeroSAT experiments / inter-comparisons*
16:30 – 18:00	**all**	discussion:

- *What can be done best through AEROSAT experiments?*
- *What are the goals, concepts, rules for such experiments?*
- *Collecting ideas for experiments*
- *What experiment results could be delivered by AeroSat 2018?*

Friday, October 13, 2017

AeroSAT

chair: ***L. Mona***

	SESSION 16	**working group on aerosol typing**
8:30 – 8:45	**L. Mona**	*Overview of contributions by AeroSAT participants: definitions, inventory*
8:45 – 9:00	**O. Dubovik**	*GRASP multi-purpose retrieval concept: strengths and limitations*
9:15 – 09:45	**all**	*What progress in aerosol typing products and intra-product coordination can we expect by AeroSat 2018?*
9:45 – 10:15	coffee-break	
10:15 – 10:45	discussion continued	

chair: ***N. Schutgens***

	SESSION 17	**evolving AEROSAT, collaboration with other initiatives**
10:45 – 11:00	**O. Torres**	*Short report on air quality session at CEOS-AC-VE meeting 6/2017* (**remote**)
11:00 – 11:30	**all**	*What specific AeroSat working group results and/or products should we aim to deliver to outside groups and initiatives?*
11:30 – 11:45	**A. Benedetti**	*Short report on ICAP progress and possible data collaboration* ***(remote)***
11:45 – 12:00	discussion continued	
12:00 – 13:00	lunch	

chair: ***T. Popp***

	SESSION 18	**working group on pixel uncertainties**
13:00 – 13:15	**T. Popp**	*Overview with contributions collected from AEROSAT participants*
13:15 – 13:30	**K. Stebel**	*What we have learned in validating Aerosol_cci pixel-level uncertainties?*
13:30 – 13:45	**A. Sayer**	*Plan to outline a paper summarizing technique options and applicability*
13:45 – 15:00	all	*What progress on defining and reporting AOD and aerosol-type pixel-level uncertainties can we expect by AeroSat 2018?*
15:00 – 15:30	coffee break	
	SESSION 19	
15:30 – 16:00	**T. Popp / R. Kahn**	*AeroSAT wrap-up and outlook*

AERO-SAT

AeroCom

Posters (alphabetical order; with satellite focus or high relevance for retrievals)

P-66
Brühl, Christoph
Stratospheric and tropospheric aerosol 2002 to 2012, EMAC chemistry climate model simulations and GOMOS, IASI and ATSR satellite observations

P-57
Che, Yahui
Aerosol properties retrieved over land with AVHRR sensor data

P-58
Clarisse, Lieven
Measuring dust optical depth with IASI

P-50
Di Noia, Antonio
Unsupervised aerosol classification from POLDER data using self-organizing maps

P-53
Garay, Mike
The MISR 4.4 km Aerosol Product: Development and Uses

P-04
Guang, Jie
Retrieval of atmospheric particulate matter using satellite data

P-46
Henrikson, Swante
Degrees of freedom and model-satellite comparisons

P-05
Kalashnikova, Olga
Size and type characterization of particulate matter (PM) with MISR multiangle and AirMSPI polarimetric imagery

P-09
Kinne, Stefan
Aerosol climatology – MACv2

P-48
Kukkurainen, Antti
LibRadtran based tool for computing lookup-tables for satellite aerosol retrievals

P-36
Lee, Huikyo
Characterization of wildfire-induced aerosol emissions from the Maritime Continent peatland and Central African dry savannah with MISR and CALIPSO aerosol products

P-54
Limbacher, James
A MISR Pixel-Level Aerosol Retrieval Algorithm for Turbid, Coastal, and Eutrophic Waters

P-60
Lipponen, Antti
Bayesian Dark Target Algorithm for MODIS AOD retrieval and uncertainy quantification over land

P-55
Lyapustin, Alexei
Aerosol Product from Algorithm MAIAC and its Comparison with DT and DB

P-62
Mei, Linlu
Recent progress of aerosol remote sensing over the Arctic in the AC3 project

P-59
Patadia, Falguni
What is the uncertainty in MODIS aerosol optical depth in the vicinity of clouds?

P-56
Sayer, Virginia
Dark Target Aerosol Retrieval for VIIRS with MODIS Continuity

P-44
Shinozuka, Yohei
An uncertainty analysis for satellite-based estimates of cloud condensation nuclei

P-64
Sogacheva, Larisa
Long-time series (1995-2015) of satellite observations of AOD over China combined from ATSR and MODIS.

P-49
Thomas, Gareth
Recent developments in the ORAC aerosol processor

P-61
Virtanen, TImo
Collocation mismatch uncertainty in validation of satellite AOD retrievals

P-52
Witek, Marcin
New approach to the retrieval of AOD and its uncertainty from MISR observations over dark water

P-37
Witek, Marcin
Satellite assessment of sea spray aerosol productivity: Southern Ocean case study

P-51
Yoshida, Mayumi
Common Retrieval of Aerosol Optical Properties Using Satellite Imaging Sensors for JAXA Earth Observation Products