AEROSAT 2021 Summary

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AeroSat Goals (1)

- **Work with modelers to make satellite aerosol data as useful as possible for climate modeling (e.g., AeroCom)**
- **Achieve an open and active exchange of information**
  - Discuss retrieval advances, strengths and limitations
  - Negotiate matching user requirements with measurement capabilities
  - Share the latest technological advances
  - Work toward inter-operability (data formats & standards, terminology)
- **Forum for satellite aerosol retrieval experts**
  - Learn from each other, collaborate as appropriate
  - Initiate new developments, participate in ***AeroSat Experiments***
  - Work toward product improvement and harmonization

AeroSat Goals (2)

- **Promote the use of satellite data**
  - To support global measurements of aerosol amount, type and precursor gas 3-D distribution to the extent possible, with uncertainty estimates
  - As **complementary** to other sources of information
  - To better understand the role of aerosols in climate, climate change, air quality, and atmospheric processes
- **Forum includes satellite data users** (AeroCom / CCMI models, ICAP forecasts) **and data providers** (AERONET reference, space agencies)
  - Listen to each others' needs, any issues, and limitations
  - Discuss what is possible; Motivate new activities
  - Contribute to integration of satellite & suborbital observations
- AeroSat is an unfunded network (as is AeroCom)

AeroSat Group Dynamics

- Unlike most major meetings, AeroSat is organized as ***a meeting of experts*** on the topics covered, focused on ***DISCUSSION*** (*i.e., little-to-no time is spent on introductory material in the sessions*)
- Oral Presentations are held to a minimum (1 or 2/session @ 5-10 min each); leaving ***maximum time for group participation***
- Speakers are usually asked to ***briefly summarize the state of the entire field***, not just cover their own work
- In most cases, the ***work of individual groups is presented in posters***
- Each session has a moderator who presents 1-2 ***slides of key questions***, developed in collaboration with the speakers in the session
- The moderator also focuses the discussion on the key questions; ***calls in sequence on several people who raise hands to speak***, so the discussion keeps moving and everyone who wants gets the opportunity to participate
- Each session has a ***rapporteur to keep notes*** on emerging ideas; the chairs subsequently edit and archive the notes*
- When possible, the ***seating arrangement is in concentric circles***; 75 or more have participated this way*

* ***In the virtual space***, we instead supported an on-line bulletin board (*board.net*) hosting extensive, interactive discussions

AeroSat Study Topics

- **Comparing Satellite Aerosol Retrieval Algorithms**
- **Comparing Satellite AOD Products and Trends**
- **Aerosol Typing*; Particle Property Assumptions, Retrieval Constraints, and Comparison w/Models**
- **Characterizing Dust Aerosols**
- **Pixel-level Uncertainties**
- **Long-term Aerosol Data Records**
- **Constraining Wildfire Smoke Injection Height and Source Strength** (*joint with AeroCom*)

Additional AeroSat Discussion Topics

- Aerosol Vertical Distribution
- Aerosol-Cloud Interactions; CCN Retrieval
- Suborbital and Laboratory Aerosol Measurements
- Air Quality
- Climate Variables

***Related Activities**: *Commission on constraining Aerosol Properties* (*Y. Balkanski*); *Models, In situ, and Remote Sensing of Aerosols (MIRA)* (*G. Schuster*)

Perspectives on Collaboration with Modelers

- **Support model-satellite consistency**
  - Discuss + publish ***definition similarities & differences*** (Mod + Sat)
  - Provide ***aerosol typing information*** in a useful form
    -- Includes application of ***optical vs. compositional "types"***
  - Provide ***uncertainty characterization*** in a useful form

- **Guide the use of satellite datasets**
  - Provide a ***critical assessment*** of strengths and limitations
  - Provide harmonized ***quality statements***
  - Create ***data-record ensembles*** –> report the spread / confidence

- **Experiments**
  - Involve modelling to tie evaluations to critical variables
  - Develop smart ways to integrate complementary information content

Current AeroSat *(and joint AeroCom-AeroSat)* Experiment Efforts &Task groups

- ***Aerosol Retrieval Comparisons*** [*Kinne, Schuttgens, Sogacheva*]
- ***Characterizing Retrieval Uncertainties*** [*Sayer, Povey, Govaerts, Levy, Patadia, Witek, Kahn, Dubovik, Mei, Rozanov, Thomas, Kolmonen, Stebel, Limbacher, Lyapustin, Popp*]
- ***Consistent Multi-sensor Trends*** [*Sogacheva, Schulz, Popp*]
- Constraining ***Aerosol Type; also, Model – Satellite Synergy*** [*Mona, Kahn, Tsigaridis, Balkanski, Schuster*]
- Constraining ***Aerosol Injection Height*** [*Pan, Val Martin, Kahn, Chin, Nowotnick + AeroCom modelers*]
- Constraining ***Aerosol Source Strength*** [*Petrenko, Kahn, Chin + AeroCom modelers*]
- ***CCN New Approach*** [*Rosenfeld, Christensen, Bauer, Shanzuka, Stier*]

Day 2 **Tuesday, October 12, 2021**

UTC: 14:15-16:00 **AeroCom / AeroSAT**

EU:4:15–6:00pm/NY10:15am–noon/CA:7:15–9:00am/JP:11:15pm–1:00am/CN:15:00pm–midn.

Session O4 oral session **Dust** **Moderator: Yves Balkanski // Rapporteur: tbd**

1 14:15 Green, Robert *Earth surface mineral dust source investigations*

2 14:35 Levy, Rob *Comparing assumptions for dust optical properties in various Goddard-based retrieval*

3 14:50 Kok, Jasper *Contrib. of the world's main dust source regions to the global cycle of desert dust*

4 15:05 Colarco, Peter *A Review of the Treatment of Dust Optical Properties in Earth System Modeling*

- 15:20 Discussions

15 min break

- ISS/EMIT deployed
Hyper-spectral mineral dust source mapping

- Dust Size & Shape Distribution questions

- How common is **Large Dust** (>10 microns)?

Day 3 **Wednesday, October 13, 2021**

UTC: 11:00-12:30 **AeroCom / AeroSAT**

EU:1:00–2:30pm/NY:7:00–8:30am/CA:4:00–5:30am/JP:8:00pm–9:30pm/CN:7:00–8:30pm

Session O5 oral session	**Aerosol-Cloud Interactions**	Moderator: Michael Schulz // Rapporteur: tbd
1 11:00 Gryspeerdt, Edward	Sampling strategies for cloud droplet number concentration in satellite data	
2 11:15 Regayre, Leighton	Constraining aerosol forcing uncertainty using satellite data	
3 11:30 Sorooshian, Armin	ACTIVATE: Strategy and First Results	
4 11:45 Khlestova, Julia	Cloud condensation nuclei reduction impact over Moscow during spring 2020 lockdown on the cloud characteristics (simulations and measurements)	
5 12:00 Jia, Hailing	Significant underestimation of radiative forcing by aerosol–cloud interactions derived from satellite-based methods	

- ***12:15 Discussions*** (evidence by region and season of secondary effects of lifetime and precipitation)

15 min break

- Many challenges with ACI retrieval:
representative sampling
cloud filtering
how to acquire & use field measurements
how to apply reanalysis

UTC: 15:00-17:00 **AeroCom / AeroSAT**

EU:5:00–7:00pm/NY:11:00am–1:00pm/CA:8:00-10:00am/JP:midn.–2:00am/CN:11:00pm–1:00am

Session O6 oral session	**Processes**	Moderator: Mian Chin // Rapporteur: tbd
1 15:00 Bian, Huisheng	Obs. constrained analysis of sulfur species in the marine troposphere	
2 15:15 DeLessio, Meagan	Modeling atmospheric brown carbon in the GISS ModelE Earth system model	
3 15:30 Neubauer, David	Climate impacts of aviation aerosol emissions	
4 15:45 Torres, Omar	Temporal evolution of the stratospheric aerosol load from the Canadian 2017 and Australian 2020 pyroCb events	
5 16:00 Yu, Pengfei	Persistent stratospheric warming due to 2019-20 Australian wildfire smoke	
6 16:15 Zhang, Kai	The representation of natural aerosols and its impact on eff. aerosol forcing	

- ***16:30 Discussions*** (observational evidence/relationships to constrain processes in modeling)

- Critical Role for *In Situ* measurements
In characterizing processes (e.g., ATom)
- Need to add **Brown Carbon & PyroCBs**
into modeling

Day 4 **Thursday, October 14, 2021**

UTC: 12:00-15:00 **AeroCom / AeroSAT**

EU:2:00–5:00pm/NY:8:00–11:00am/CA:5:00–8:00am/JP:9:00pm–midn./CN:8:00–11:00pm

Session O7 oral session **Constrain** Moderator: Thomas Popp // Rapporteur: Linlu Mei

1 12:00 Balkanski, Yves AeroCom-AeroSat Commission on Constraining Aerosol Properties

2 12:15 Schuster, Greg Tables of Aerosol Optics (TAO)

3 12:30 Kahn, Ralph Systematic sub-orbital aircraft measurements (SAM-CAAM)

- ***12:45 Discussions*** (priorities, add. needs)

15 min break

4 13:30 Schutgens, Nick Model evaluation with satellite data of AAOD and SSA

5 13:45 Sayer, Andrew All-sky vs. clear-sky AOD and the problem of partial cloudiness when comparing model and satellite aerosol fields

6 14:00 Tsikerdekis, Athanasios Aerosol data assimilation as a tool to detect model errors

- ***14:15 Discussions*** (integration of model and data, best practices)

- **Dust Retrieval Improved by combining measurements**
  e.g., VIS + TIR, IIR +Lidar

- **Several Efforts Underway**
  to collect particle microphysical & chemical properties
  in situ data are especially important here

UTC: 15:00-16:00 **AeroCom / AeroSAT**

EU:5:00–6:00pm/NY11:00am–noon/CA:8:00–9:00am/JP:12:00pm–1:00am/CN:11:00pm–midn.

Session O8 oral session **trends** Moderator: Andy Sayer // Rapporteur: tbd

1 15:00 Quaas, Johannes Aerosol trends since 2000 and aerosol ERF

2 15:15 Mielonen, Tero Comp. aerosol type time series in a climate model and a satellite retrieval

- ***15:30 Discussions*** (trends, Covid, natural events)

15 min break

- **accelerated anthropogenic climate forcing** since ~2000
- **aerosol type changes** are usually not included in retrievals, trends
  … an AOD bias?
- increased attention on **stratospheric aerosol trends** is encouraged, due to:
  increased **PyroCB** frequency
  increasing Indian monsoon injections
  volcanic contributions

Day5 **Friday, October 15, 2020**

UTC: 11:00-13:00 **AeroSAT**

EU:1:00–3:00pm/NY:7:00–9:00am/CA:4:00–6:00am/JP:8:00pm–10:00pm/CN:7:00–9:00pm

Session **O9 oral session** **Aerosat/Geo** **Moderator: Larisa Sogacheva // Rapporteur: Adam Povey**

1 11:00 Robbins, Daniel Improving Differentiation of Cloud and Extreme Smoke Plumes in Himawari-8 Scenes

2 11:15 Espinosa, Reed A synergistic multipixel retrieval of aerosol properties from geostat. satellite obs.

3 11:30 Mei, Linlu Above cloud aerosol properties retrieved from the XBAER algorithm

4 11:45 Winker, Dave Upcoming CALIOP Data Product Release

12:00 Discussions (added info from active, geo and passive combined sensors) **+ 15 min break**

- **synergy** offers added value
  - GEO + active sensor: better **NN training**
  - GEO angular sensing: **aerosol properties**
  - 2 GEO: **cross-calibration**, testing azimuthal symmetry assumption, stereo plume heights
  - passive + active: **vertical structure / typing**
  - satellite + model: constrain **aerosol type for low AOD**

Session **O10 oral session** **AerosatAQ** **Moderator: Ralph Kahn**

1 14:00 Martin, Randell Overview/ status of satellite based AQ

2 14:15 Garrigues, Sebastian Assimilation of multiple satellite aerosol optical depth (AOD) near real time (NRT) products in the Copernicus Atmospheric Monitoring Service (CAMS) data assimilation system

14:30 Discussions (Air Quality is the hot top for aerosol in the future, as radiative forcing has maxed)

- Air Quality **future aerosol hot topic**
- **Multiple challenges**
  - near-surface
  - space-time coverage
  - high spatial resolution / urban areas
  - speciation, ambient and dry aerosol
  - coastal areas, rugged terrain
- growing confidence, evidence short-term changes
- data assimilation of multiple NRT satellite AOD

AeroSat Web Site

https://aero-sat.org

- **Mission Statement**
- **Past Meeting Agendas w/slides & edited notes from discussion sessions**
- **Upcoming meeting information**
- **Publications**
- **Related web links**