



23-25 June 2020

User Workshop on Satellite Atmospheric Composition

Raising awareness and expert consultation

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Introduction

The workshop brought together European service providers, e.g. weather offices and environmental agencies, and data providers to discuss atmospheric data as a whole, encompassing present and future data sources, from Copernicus (Sentinel, Atmospheric Monitoring Service) to supporting datasets (EUMETSAT Satellite Application Facilities, upcoming and contributing missions).

The aim of the thematic workshop was threefold:

1. Foster the engagement of existing and new users of atmospheric composition for applications and services;
2. Raise awareness on datasets, existing and emerging applications using existing and upcoming satellite datasets;
3. Verify user preparation elements and set up a series of needs and priorities.

The workshop was held virtually from 23-25 June 2020 and consisted of five sessions and had 12 webinars with 30 minutes of discussion on a specified theme with a moderator. The activities were over three days with 1.5 hours morning and afternoon sessions.

The report provides a synthesis of the presentations and discussions. The document is intentionally short and reports synthesis elements on:

- Existing and upcoming applications in the thematic areas
- User needs and preparation elements
- Outcomes and next actions


Full material is available as:


Program of the workshop in the [Appendix 1](#)
Presentation slides and recordings on the [workshop site](#)
Full debriefing and notes upon request to: training@eumetsat.int

Attendance and engagement

Throughout the three workshop days, 140 single people attended. Each session had 50 to 70 single attendees. A full list of the workshop attendees is available in the [Appendix](#).

The interactive user engagement platform [Sli.do](#) was used for the Q&A sessions. Workshop attendees could post questions on Sli.do, which were addressed during the Q&A sessions.

 Active users 45	
Engagement score	178
Engagement per user	4

 Questions 63	
Likes / dislikes	41 / 0
Anonymous rate	13%

Discussion on thematic areas

We group the highlights from presentations and the salient discussion elements extracted from the Q&A sessions along the thematic areas. This to identify and review existing and upcoming satellite applications as identified in the preliminary plan.

Data assimilation

Needs and perspectives in data assimilation have been touched. The Copernicus Atmosphere Monitoring Service (CAMS) has defined plans for data gathering and evolution (M. Parrington). The discussion highlighted that regional models, driven by local services, and inversion models are an emerging issue and that the ensemble of data assimilation users will be likely to increase. Simulated observations to perform experiments (OSSEs) will also be likely required. Concerning products, for chemistry most of them are of interest - and already in CAMS plans. Priority of aerosol data assimilation is on level 2 Aerosol Optical Depth and may include additional aerosol variables (type/class and height).

Composition-climate relationship monitoring

No specific discussion on climate datasets is included in specific presentations. However, the thematic is included as spot in several discussions. An emerging need is to integrate upcoming observations in longer data records, allowing climate analyses including trends. In general, the unique potential of the data to address key climate processes shall be best exploited. An example comes from 3MI aerosol data (and potential synergistic products) that may tackle needs of the cloud microphysics and modelling communities. The need to provide data for climate models has been mentioned and a more thorough involvement of the climate model community (MIPs) is needed here.

Support to Air Quality

Air Quality is a transversal theme and several presentations and discussions have addressed it. The role of satellite data on air quality applications is recognized and expected to grow further with the upcoming data available from Sentinel-4 and the availability of multiple data sources. Copernicus provides key elements through the CAMS service. The interoperability of service products and satellite data, or the use of observational data themselves, is a fundamental resource for a wide range of users (P. Stammes).

Much of the presentations and discussions show the use of satellite data (for chemicals) to assess the impact of lockdown during the COVID-19 crisis, showing that Earth Observations

bring relevant information for the science, stakeholders and public (C. Zehner, S. Hassinen, C. Clerbaux, P. Stammes).

A long-standing issue for air quality is to derive particulate matter products from satellite Aerosol Optical Depth. The new missions may provide a substantial step forward and a best integration with local and ground-based data.

Monitoring Emissions for fast-reacting species

Presentations have shown multiple applications of satellite data to estimate (or correct) emissions of multiple species. A review of the current methods with limitations and advantages of satellite data shows that estimates of SO₂, NO_x reached a certain degree of maturity (D. Brunner). The presentation included the application of satellite data in transport models for long-lived species (e.g. CO₂ and CH₄). A substantial step ahead comes from Sentinel 5P with a clear capability in identifying spot and localized methane emissions and to exploit correlation of NO₂ and CO₂ to more clearly identify CO₂ sources (see also P. Stammes). Ammonia concentrations and emissions estimate is a specific topic (C. Clerbaux) with an overview on the monitoring and emission sources as identified from IASI data.

Natural Hazards Services: fire monitoring, volcanic ashes, dust

Examples mentioned the ability of existing aerosol products to detect fire plumes over land (Amazonia) and ocean (Australian fires 2019/2020) and the potential to support existing services as EFFIS (B. Fougne). Examples of support to services were provided for Dust monitoring Sand and Dust Storm Warning (SDS-WAS) and Support to Aviation Control Service (SACS) (S. Vandenbussche). SACS prototype included volcanic ashes monitoring from satellite (aerosol and SO₂ data). Real-time alerts for aerosol are under provision to SDS-WAS.

User preparation priorities and identified actions

We report the salient point of discussions and presentations related four user preparation priorities. Several presenters highlighted the different needs and requirements, some being both data users of scientific data and service providers (e.g. FMI and BIRA).

Identification of barriers of the data uptake and access to data from existing and upcoming operational missions

The item was addressed in several discussions and partly mentioned in presentations. Barriers can be due to physical access (e.g. data size, access) and knowledge (awareness, usability, accuracy). For the first, a series of advanced data access (cloud-based) points are under development / recently released as the EUMETSAT Data Tailor and Data Store (S. Wannop), the joint WEkEO and the ECMWF-Copernicus Atmosphere Data Store (M. Parrington). For example, there was interest in near-real-time access to Sentinel-3 aerosol products which will be disseminated via EUMETSAT data services such as EUMETCast. In any case it was highlighted that a proper support on both data access and use, tailored to the user type, should be a priority. Communication with users on the evolving data access services and training is essential to enhance the data uptake.

Availability of test data, format and tools

The availability of test data for the different sensors is a priority. EUMETSAT presentations provided first elements on the release of reference test datasets. Additional points touched the extent (time and spatial coverage) and the scientific coherence of the test datasets for assimilation experiments. This is formulated as a need without however a specific request. Discussion briefly addressed format guidance recognizing them as a clear need.

Guidance on fitness for purpose and Quality information on data

Several references were made that the performance, uncertainty and the associated limits on usage needs to be better understood and communicated to users. One example comes from the aerosol products that include quantitative variables with associated uncertainty (Aerosol optical depth), binary data (aerosol class/type and aerosol height). These data are priority parameters for the modelling and numerical weather prediction communities that require performance products and uncertainty characterisation. The error information may come with guidance on the usability of the data to fit with intended applications. The discussion provided as example the characterization of volcanic ashes that have no error (e.g. kept as binary information).

Training emerges as a key instrument for this purpose. A training plan addressing the atmospheric composition-related missions operated by EUMETSAT has started and activities have taken place. A specific question addressed the Sentinel-4 that represents a “game-changer” for composition. For this, the EUMETSAT aim is to have an approach in synergy with the overall Meteosat Third Generation preparation and training. The degree of in-depth training depends also on availability of test data (scientifically meaningful), tools and services.

Synergistic use of datasets and added value observational datasets

The point is a transversal object of discussion in most sessions and different concepts of synergies were evoked.

A first issue concerns the homogenization of the algorithms for the same type of instruments (e.g. UVNs, IASI). The need is clear and is partly addressed. The IASI products on METOP A-B-C are consistent, while for the sentinels (S4 and S5/S5P) it is clearly understood and planned.

The availability of synergy or multi-products (e.g. same variable with multi sensors) is a great potential and is an expected and priority need due to the amount of different data sources and products potentially composing multi-products - for instance the multi-sensor aerosol product is a synergetic (multi) product in itself.

At the actual stage, production of synergy products is not clearly identified as part of EUMETSAT remit, especially for “day1”.

Synergy with ground-based and in-situ data, such as inter-comparison or validation campaigns, for better understanding the differences among the various products are recognized an important factor that will need a specific strategy.

Synergy products and derivation of other parameters should be then further investigated with these scenarios in mind.

First lessons learnt along the workshop objectives

Raise awareness on existing and emerging missions and potential applications

Awareness of existing and upcoming products and existing applications was raised with high-level presentations. Presentations and discussion also included the prospective for improvements and potential gaps for the data. Several representative examples were provided (e.g. the synergy with the Sentinels, the combined products for aerosol). A series of applications were presented, ranging from air quality to services (e.g. fire detection, dust, volcanic ashes). The climate component has been frequently evoked. Moreover, several presentations gave the status of the pollution changes due to the COVID-19 lockdown. Feedback on awareness procedure was positive, with the suggestion to diffuse more the information, together with a focus on the objective of the upcoming events as informative / discussion / consultation to clarify with participant's expectations.

Foster the engagement of existing and new users

Workshop participation was satisfactory with a good geographical coverage (almost all EU countries) with representatives from main institutions and weather services. Expert participants came from the different sectors (data provider, scientist, service provider) and the need to act as data provider and expert user at the same time was often outlined in presentations. Concerning the engagement of new users, workshop discussion highlighted a series of points / recommendations.

- (1) As expected, Users belong and are structured in different communities, since atmospheric composition is a different field than meteorology, with different players. A clear example are environmental agencies, that often operate outside the weather services and act at regional / town level. The network shall be then expanded to best include this diversity.
- (2) Exploit the potential added value of working with such different User communities (e.g. cloud and modelling communities, air quality) to better understand their needs and possible joint applications.
- (3) A good understanding of the data value chain is important¹. Missing elements of the chain are a proper estimate of uptake and value of application of current and upcoming missions. Such analysis may be beneficial for both service targeting and to focus users and stakeholders and their needs.
- (4) Awareness and information are a powerful leverage for engagement. The potential might be better exploited with a more wide advertisement and abatement of barriers (e.g. connection / registration) for attendees.

Start a user preparation and identify a series of needs and priorities

The workshop served as kick-off for the user preparation process for the next-generation atmospheric composition satellite data generated by EUMETSAT-operated missions. In line with the workshop concept, the audience consisted mainly of expert users (140 individual

¹ For a specific Data value Chain analysis for the Copernicus Space program see IEEE Geoscience and Remote Sensing Magazine, Vol. 5, Issue 3, 2017, doi: 10.1109/MGRS.2017.2720263.

participants in total, and at least 70 in each session). Presenters and moderators provided most of the discussions in the sessions, probably due to the online format imposed on the event by COVID-19. We need then successive actions to identify needs and priorities of the various, broader user communities.

We have identified a pool of expert users grouped by the application areas including part of workshop invited. We have also updated the distribution list of the workshop, based also on the attendance and the need to cover the missing areas.

A proper survey on the specific lines of preparation and a series of regular awareness short events were then planned downstream of the workshop.

The structure and methods of the survey is under implementation and will gather from the workshop. Given the importance of the expert view, it is anticipated that the survey may see both be structured an “expert assessment” with a high-level evaluation of status and priorities for each application domain by a recognized experts and a quantitative pool from a larger User pool on the elements of preparation (barriers / test data / guidance / data access / synergy). Representatives of the communities (e.g. the Model Inter-comparison Programmes MIPs that are built within the Climate models community) together with the presenters and moderators will be consulted to provide both a specific view per each theme and to diffuse the information and the request to fill the survey within their User communities. The survey shall also reflect the elements of the data value chain. Downstream application providers may be asked on existing and/or intended applications with estimates of the actual/expected impact and overall volume. Methods, identification of User groups and outcomes will be shared with the preparations programs for the EUMETSAT missions (MTG and EPS-SG).

Appendix 1 - Agenda

Tuesday, 23 June 2020		
Session I - Status and evolution of new EUMETSAT missions and instrumental synergies		
Time	Title	Presenter / Moderator
9:10 - 9:35 UTC	The Sentinels on the new generations of EUMETSAT satellites	R. Munro
9:35 - 10:00 UTC	IASI Next Generation and Meteosat Third Generation Infrared Sound	D. Coppens
10:00 - 10:30 UTC	Q&A - focus on gas observation synergies	D. Loyola
13:00 - 13:30 UTC	Aerosol products on the EUMETSAT Meteosat Third Generation and Polar Mission	B. Fougne

13:30 - 14:00 UTC	Q&A - focus on aerosol observation synergies	S. Bojinski
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Wednesday, 24 June 2020

Session II - Synergies and experiences with existing missions and programs

Time	Title	Presenter / Moderator
9:10 - 9:20 UTC	Air pollution mapping with TROPOMI on S5P – high-resolution discoveries	P. Stammes
9:20 - 09:40 UTC	IASI products and applications	C. Clerbaux
09:40 - 10:00 UTC	Two hats: Experience with the roles as data provider in AC SAF and as heavy data user at FMI	S. Hassinen
10:00 - 10:30 UTC	Q&A, focus on experience gained to bring on new missions	F. Fierli

Session III - Present and Future Utilization of Atmospheric Composition Satellite Data in Copernicus Service

Time	Title	Presenter / Moderator
13:00 - 13:30 UTC	The role of satellite data in the Copernicus Atmosphere Monitoring Service	Mark Parrington
13:30 - 14:00 UTC	Q&A, focus on perspectives on use of satellite and upcoming applications of CAMS	Mark Parrington, Stijn Vermoote

Thursday, 25 June 2020

Session IV - Examples on services and applications with existing (and upcoming) atmospheric composition data

Time	Title	Presenter / Moderator
9:10 - 9:20 UTC	Quantifying emission from satellite data	D. Brunner
9:20 - 09:40 UTC	Aerosols and methane products from IASI and IASI-NG and applicability in services	S. Vandenbussche

09:40 - 10:00 UTC	New products and applications from Sentinel-5p	C. Zehner
10:00 - 10:30 UTC	Q&A - focus on new and emerging thematics and services	C. Clerbaux
Session V - Data Access and Handling		
Time	Title	Presenter / Moderator
13:00 - 13:20 UTC	The evolution of data access in EUMETSAT	Sally Wannop
13:20 - 13:30 UTC	The CAMS Atmosphere Data Store: data availability and access	Mark Parrington
13:30 - 14:00 UTC	Q&A - focus on access to data from existing and upcoming operational missions	S. Thonipparambil, Julia Wagemann

Appendix 2 - List of attendees

Name	Organisation / Agency	Country
Monika Hajto	IMGW-PIB	Poland
Dario Stelitano	INGV,Italy	Italy
Natalia Prats	AEMET	Spain
Cathy Clerbaux	LATMOS	France
Claudia Cesarini	MEE0	Italy
Rosemary Munro	EUMETSAT	
Manish Soni	Birla Institute of Technology	India

Wuh Feng	University of Leeds	UK
Piet Stammes	KNMI	The Netherlands
Sandip Dhomse	University of Leeds	UK
Chris Wilson	University of Leeds	UK
Sreerekha Thonipparambil	EUMETSAT	
Ana Carvalho	SMHI	Sweden
Cameron Saint	Metoffice	UK
Zainab Hakim	Satavia	UK
Ben Veihelmann	ESA	
Simone Mantovani	MEE0	Italy
Michel Van Roozendaal	BIRA-IASB	Belgium
Julia Wagemann	MEE0	Italy
Emiel van der Plas	KNMI	Netherlands
Oana Nicola	Meteoromania	Romania
Franco Marengo	MetOffice	UK
Efthymia Pavlidou	NEA	Greece
Mateja Irsic Zibert	ARSO	
Christian Borger	Max Planck Institute for Chemistry	Germany
Jose Prieto	EUMETSAT	

Rosa Ullucci	EUMETSAT	
Yalda Fatahi	FMI	Finland
Matthieu Pommier	Ricardo Energy and Environment	France
Klaus-Peter Heue	DLR	Germany
Ahmad Pezeshk	Ferdowsi University	Hungary
Anu-Maija Sundström	FMI	Finland
Vincent Guidard	Meteo France	France
Karen De Causmaecker	KMI	Netherlands
Mahnaz Khazaie	IRIMO	Iran
Henk Eskes	KNMI	Netherlands
Laaziz El Amraoui	Meteo France	France
Brigitte Language	North-West University, South Africa	South-Africa
Dorothee Coppens	EUMETSAT	
Stephan Bojinski	EUMETSAT	
Hans Mathias Mamen Vege	Science[&]Technology AS	Netherlands
Kunal Bali	IIT Delhi, India	India
ilse aben	SRON	Netherlands
Federico Fierli	EUMETSAT	

Zoi Bekiari	Aristotle University of Thessaloniki	Greece
Olaf Tuinder	KNMI	Netherlands
Laurence ROUIL	INERIS	France
Janne Kotro	FMI	Finland
Songhan Wong	Meteorological Service Singapore	Singapore
Diego Loyola	DLR	Germany
Seppo Hassinen	FMI	Finland
Fernando Gonzalez	OHB	
Mark Parrington	ECMWF	
Katerina Garane	LAP/AUTH, Greece	Greece
Alessandra Moneris	Bureau of Meteorology, AU	Australia
Lorenzo Labrador	WMO	
Miriam Latsch	Institute of Environmental Physics (IUP), University of Bremen	Germany
Ping Wang	KNMI	Netherlands
Martin de Graaf	KNMI	Netherlands
Sophie Vandenbussche	BIRA-IASB	Belgium
Bing Gong	Forschungszentrum Jülich GmbH	Germany

Sebastien Garrigues	ECMWF	
Daniel Bannister	SATAVIA	UK
Mickael Bacles	Meteo France	France
Steffen Beirle	Max Planck Institute for Chemistry	Germany
Sarah Safieddine	LATMOS	France
Cathy Li	Max Planck Institute for Meteorology	Germany
Bertrand Fougne	EUMETSAT	
Ummugulsum Alyuz	ITU	UK
M Chipperfield	University of Leeds	UK
Hector Barboza	BSC	Spain
Huang Rui		
Christine Träger-Chatterjee	EUMETSAT	
Stelios Kazadzis		
Julien Chimot	EUMETSAT	
Mario Echeverri Bautista	KNMI	Netherlands
Kyriaki Papachristopoulou		
Stefano Decesari	IFAC-CNR	Italy

Thomas Popp	DLR	Germany
Claudia Volosciuk	WMO	
Omaira Garcia	AEMET	Spain
XL zhang		
Dominik Brunner	EMPA	Swiss
Rimal Abeed	LATMOS	France
Gabriele Stiller	Karlsruhe Institute of Technology	Germany
Antonio Vecoli	MEE0	Italy
Lothar Schüller	EUMETSAT	
Stijn Vermoote	ECMWF	
Song Liu	DLR	Germany
Leonardo Alvarado Bonilla	University of Bremen	Germany
Adrien VUVAN	LATMOS	France
Ugo Cortesi	IFAC-CNR	Italy
Bert Van den Oord	KNMI	Netherlands
Mengyao Liu	KNMI	Netherlands
Pieter Valks	DLR	Germany
Konstantinos Michailidis	Aristotle University of Thessaloniki	Greece
Gerrit Kuhlmann	EMPA	Swiss

Najmeh Kaffashzadeh

Marc Schwaerzel	EMPA	Swiss
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Andreas Vogel	KIT	Germany
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Virginie MARECAL	METEO France	France
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Rui Huang

hervé petetin	BSC	Spain
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Claus Zehner	ESA	
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Andreas Thorvaldsen	stcorp.no	Norway
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Carlos Morillas	alumnos.upm.es	Spain
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Mohammad Saifur Rahman

Pierre Coheur	Free Univ Brussels	Belgium
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Sander Niemeijer	sstcorp	Netherlands
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Pugazenthi Kannan

Hayley Evers-King	EUMETSAT	
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Shikhar Goenka

Francesco Fusto	ARPACAL	Italy
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MAGLOIRE TEGUIA

Carlo Lacagnina BSC Spain

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Esther Mbog

Alberto Berjón ragsa Spain