NATIONAL INSTITUTE OF METEOROLOGY AND HYDROLOGY

FINAL REPORT

7th SALGEE (Virtual) Workshop

Drought & Vegetation Monitoring: Energy–Water Cycle

24 November 08:00 UTC – 26 November 14:30 UTC 2021

January 2022

Prepared by Prof. Dr. Julia Stoyanova and Dr. Christine Träger-Chatterjee

1) Introduction

The 7th SALGEE2021 Workshop "Drought & Vegetation Monitoring: Energy–Water Cycle" was held in virtual format, on 24-26 November 2021. The Workshop is supported by EUMETSAT in the frame of SALGEE (**S**atellite **A**pplications for **L**and surface analyses **G**roup for **E**astern **E**urope) Project. This is an advanced thematic Workshop, providing a forum and framework to develop strategic objectives and collaborations to increase the benefit accrued from EUMETSAT Satellite Missions (geostationary and low Earth orbit satellites) in land surface analyses for the long term to be prepared for the MTG mission, as well as go deeper in collaborative work with CM SAF and H-SAF and to supports the implementation of EUMETSAT SAF Strategy related to climate monitoring and applications and the use of satellite products for Terrestrial-Essential Climate Variables (T-ECV).

Vegetation is the main indicator of climate and plays a functional role in energy balance and the water cycle. Plants reduce the effects of burning fossil fuels by absorbing carbon dioxide.

Land-ecosystems have increasingly been subject to heavy drought. The role of land-ecosystems in weather and climate associated with extreme events and their prediction are more and more realized. Thus, quantitatively evaluating drought impacts on ecosystems is an important task of present research. To facilitate the use of satellite data in this research, EUMETSAT has developed a Prototype Data Cube for Drought & Vegetation Monitoring (D&V Cube), which is a new approach of providing multi-dimensional data from different providers to users. The D&V Cube contains satellite based data records from the LSA, CM and H SAF; ERA-5 land re-analysis provided by ECMWF as well as interpolated station measurements from the GPCC (Global Precipitation Climatology Project).

2) 7th SALGEE Workshop objectives

The 7th SALGEE2021 Workshop aimed at identification of research and operational opportunities in using SAFs products, to reflect current needs in research and applications, and to review capabilities of satellite technology using multiple products for monitoring and forecasting land surface state and processes as related to drought. The topics of the workshop were:

- Using satellite information to characterize droughts on vegetated land surfaces, related processes and consequences, using Climate Data Records (CDRs).
- Discussing the different aspects of droughts – meteorological, hydrological, agricultural and ecological - and the potential of satellite data with invited representatives from the SAFs to share experiences.
- Fire activity in relation to land surface state and on biomass burning effects.
- Perspectives and improvements of SAF products by using MTG data and development of new EUMETSAT services.
- First experiences on using the D&V Cube to access long (Climate) Data Records, analyses and visualization of the results
    - illustrate the usage of the D&V Cube in different applications
    - illustrate the applicability of the D&V Cube for regional applications
- Workshop discussion and feedback on D&V Cube utilization for potential applications.

3) Summary of the main aspects of the 7th SALGEE Workshop

During the workshop participants discussed and identified

- new ideas for collaboration between SAFs and the EUMETSAT secretariat for further evolution of D&V Cube and tools facilitating the development of applications using CDRs.
- possible joint activities among SAFs in the area of drought, vegetation and wildfire monitoring.
- the use of satellite database on a **Prototype Data Cube for Drought & Vegetation Monitoring (D&V Cube)** as a new approach of providing multi-dimensional data from different providers to users.
- up to date knowledge, methods, concepts, and available satellite information related to atmosphere-biosphere connections.
- Recorded presentations are available here: https://www.youtube.com/playlist?list=PLOQg9n6Apif3QepRETtCNPdEL14xY0DFg
- Slides of all presentations are shared here: https://training.eumetsat.int/mod/folder/view.php?id=14866

4) Administrative organization of the 7th SALGEE

- The Workshop preparation was initiated in line with the proposal of *Christine Traeger-Chatterjee,* EUMETSAT that SALGEE to be involved in the implementation of the D&V Cube initiative and to give feedback on its utility on this topic.
- As preparatory work, NIMH team participated in the EUMETSAT webinars devoted on training about the Cube implementation.
- For workshop preparatory work four Zoom meetings were organised between EUMETSAT and the Secretary of SALGEE Steering Group.

- The Workshop was performed in virtual format using Zoom, organised by EUMETSAT. The opening was at 09:00 UTC on Wednesday, 24 November 2021. The closure was at 14:30 UTC on Friday, 26 November 2021.
- *Christine Traeger-Chatterjee,* responsible to manage land, climate and marine training activities was the responsible officer from EUMETSAT for this Salgee Workshop.
- For administrative aspects of Workshop organization the responsible person from EUMETSAT was Ms. Regina Hoefenmayer. Madalina Ungur supported the workshop design and facilitation.

5) Scientific program of the 7th SALGEE

- The scientific program of the Workshop was developed in the frame of WP 4 ('*SALGEE virtual workshop preparatory work'*) of the implementation of the SALGEE Project 2021 in accordance to EUMETSAT PO Number/Date 4500021883/4 October-2021.

- Dr. Julia Stoyanova, NIMH Bulgaria and Secretary of SALGEE Steering Group has proposed the topic of the workshop '*Drought & Vegetation Monitoring: Energy–Water Cycles'*. She invited lecturers, selected according to the scope of the meeting and developed the scientific agenda of the workshop.

- Presenters from CM SAF (DWD), H SAF (ECMWF and TU Vienna) and MeteoSwiss were invited by Dr. Christine Traeger-Chatterjee, EUMETSAT. This allowed to discuss the work of three invited SAFs in the context of SAGLEE, with a special focus on the Drought & Vegetation applications.

The work for the 7th SALGEE workshop was framed in 4 Work Packages, aimed at contributing to the development of the workshop agenda, and to illustrate the practical use of LSA SAF products in solving practical problems related to drought by relevant studies:

Work Package 1: Vegetation drought assessment

Work Package 2: Disturbances in energy-water cycles and Forest health.

Work Package 3: Climatic analyses of fire activity and land surface dry anomalies.

Work Package 4: SALGEE virtual workshop preparatory work.

6) Workshop attendance

Thirty participants have attended the 7th SALGEE workshop, 15 of them lecturers representing EUMETSAT, LSA SAF, CM SAF, H-SAF, ECMWF, NIMH Bulgaria, Estellus Laboratory Paris, and Universities in Basilicata, Lancaster, Valencia, and Vienna Univ. of Technology gave high-level lecture support to the Workshop. These are remote sensing specialists and product developers, modellers, researchers, and teachers, gathered in the frame of 7th SALGEE meeting to review the progress and exchange experience on latest developments in land surface analyses techniques, as well as to combine efforts between different SAFs on application of products in monitoring and analyses of drought, fires and related problems.

Seven participants from Armenia, Greece, and 5 from Bulgaria user communities were attending as trainees. Invitation letters by EUMETSAT were sent to all participants; the five Bulgarian participants were invited by Julia Stoyanova.

It is noted that the last several SALGEE Workshops only saw very few participants representing entities from the Balkan and Middle East regions. In the 7th SALGEE, Slovenia, two institutions from Greece (Univ. Thessaloniki and National Observatory of Athens), two institutions from Cyprus, Armenia, Georgia, Jordan, I.R. of Iran representatives were invited. Among them only Armenia (giving talk) and Greece (National Observatory of Athens) accepted the invitation. For future SALGEE workshops the goal is to have again a stronger active participation of entities from the Balkan and Middle East as well as maintaining and increasing participation from all EUMETSAT member states and other partners.

The full participants list is provided in **Appendix 2.**

7) 7th SALGEE Workshop structure

The agenda of the 7th SALGEE Workshop covers a broad range of LSA SAF, CM SAF, H SAF product applications related to variety of drought aspects in presence of vegetation, and characterising energy and water cycles on a climatic scale. The satellite products applications are illustrated in the scope of energetic loading (global radiation, sunshine duration, LST), precipitation, root zone soil moisture and their anomalies and combined use over Europe in different studies. The agenda (see **Appendix 1**) includes a 'Welcome & Introduction' session, five General Sessions, and finalizing the work with a 'Final Discussion'. Two sessions to informally meet your colleague were organised on "Wonder-me". These joint sessions were not well attended by the people, some technical problems have occurred.

Each of the talks during the separate sessions was followed by discussions. People were very active and open for collaboration. Suggestions, new ideas and possibilities for common work between LSA SAF, CM SAF, and H SAF were raised and should be further discussed. See section 10 (Recommendations).

Each working day 24-26 November concluded with a 30 minutes 'Wrap up of the Day' report prepared by Julia Stoyanova. These reports gave the essence/questions/discussed issues from each talk and accent on the main questions to be posed during the Final Discussion. This summary is provided further below in this section.

Welcome & Introduction part: The Workshop was opened by the SALGEE Steering Group secretary Dr. Julia Stoyanova with a short overview of the SALGEE Project (*aims, traditions, and perspectives*), a reminder of drought spectrum and related indexes for its characterization, the topics of the Workshop are presented. Welcome address was given by Joachim Saalmueller, Head of User Support and Climate Services Division at EUMETSAT who pointed out the importance of organising these regular meetings. SALGEE is continuing to adapt to the needs of the community in the area of application on drought and fires. The three SAFs were in invited because the combination of their products are crucial to make good use of analytical capabilities provided by satellite data for several sectors: Agriculture and Forestry as central ones and also Water management, Energy, Health, Tourism. He encouraged to strengthen and build the partnership through SALGEE, which is a very strong regional platform and it would be good if a wider community of EUMETSAT Member States would be involved.

Dr. Christine Traeger-Chatterjee from EUMETSAT gave a brief introduction to the 7th SALGEE meeting organization and details on how to communicate during the Workshop.

Session 1: Satellite data in support to Land Surface Analyses (*moderated by Christine Traeger-Chatterjee*)

The Session included following talks:

- An overview of the development of LSA SAF from its beginning to nowadays – how it serves and responds to user needs with accent on the big data services development, in parallel to increased spatial resolution and time frequency from FCI, Flexible Combined Imager, carried on the MTG-Imager satellites, including the perspective of LSASAF products development and improvement.
- A recorded talk was given about the all-weather type land surface temperature product, based on geostationary and MW satellites observations aimed to provide an accurate view of temperatures across land surfaces globally over the past 20-25 years (developed in the frame of ESA-CCI Project).
- A Prototype Data Cube for Drought & Vegetation Monitoring (D&V Cube) developed by EUMETSAT as a new approach of providing multi-dimensional data from different providers to users aimed to facilitate the use of satellite data has been presented.

Session 2: Energetic loading and land fluxes (*moderated by Christine Traeger-Chatterjee*) talks

- Accent is given on the incoming surface solar radiation, defined as an Essential Climate Variable by GCOS. CM SAF developed regional and global climate data records (CDRs) of surface solar radiation from geostationary and polar-orbiting satellite instruments, accompanied by operational data at a short time latency to be used for climate monitoring, and accessibility via the D&V Cube are presented.
- Accounting that evapotranspiration is dependent mainly on the solar energy available to vaporize the water and on water content in the soil layers, an overview of operational ET products generated by LSA SAF, also generation of ET and surface fluxes (LE and H) data record (CDR) from 2004 to 2020 are presented with emphasizing on their potential use for monitoring the water stress on vegetation.

Session 3: Soil Moisture (*moderated by Christine Traeger-Chatterjee*)

Accounting the benefit from spatially and temporally detailed information on soil moisture having numerous applications (water resource management, drought monitoring, rainfall-runoff response, and others), the three presentations focused on:

- ECMWF ASCAT root zone SM produced for H SAF and related applications for hot, dry/ rainy environment
- A brief introduction to the 25 km H SAF ASCAT surface soil moisture retrieval and estimating root zone soil moisture from surface time series methods are briefly introduced. ASCAT soil moisture data services and a lot of applications on: drought monitoring with satellite soil moisture data; comparison between soil moisture & precipitation radar data for risk insurance; ASCAT soil moisture and vegetation anomalies via NDVI and others are presented.
- A global Sentinel-1 data cube (based on information from the first multi-satellite Synthetic Aperture Radar (SAR) mission) for land monitoring applications that permit fast access to multi-year time series and image stacks is also presented.

Session 4: Wildfires (*moderated by Carla Barroso*)

Three talks that cover different aspects of fire phenomena are presented:

- Accounting that biomass burning emissions may much contribute to increase atmospheric concentrations of carbon dioxide (CO2), and thereby raises temperatures at

the Earth's surface, the new biomass burning according "fire emissions" product from King's College based on geostationary fire radiative power (FRP), which includes the ability to estimate carbon emissions and fuel consumption directly from the FRP data, close to finalizing is presented, and later to be extended to Europe.

- Synoptic and climatic aspects of fire activity, and emission effects are presented in two parts talk: The first one, characterizing fire activity in Eastern Mediterranean by linking to biophysical indexes identifying land surface state; the second part concerns the IASI measurements from Metop for identifying ozone production in the fire plumes through photochemical transformations of the primary pollution as well as transport of O3 to the Earth surface due to stratospheric intrusions.
- Talk on new generation satellites (Copernicus Sentinel-3, MTG, EPS-SG) and related possibilities for better detection of wildfire and studying the related environmental effects as well as the user support provided by EUMETSAT for wildfire monitoring within Copernicus and User Preparation Programs on MTG- and EPS-SG are presented.

Session 5: Drought & Vegetation Monitoring (*moderated by Carla Barroso*)

This Session covers seven talks that accent on main aspects of terrestrial drought influences on vegetation response: land surface state dry anomalies characterized via soil moisture deficit, atmosphere dryness, vegetation distribution, gross primary productivity, and relevant satellite products

- It is suggested drought monitoring with vegetation to be characterized using CDRs of satellite products on the basis of constructing complex physically motivated indexes in combination with SVAT model outputs and NWPs. Regional applications over Eastern Mediterranean (Bulgaria) reflecting: agricultural drought quantification; drought & natural crop production estimates; drought & forest health disturbances evaluation are proposed. Suggestions for inclusion of relevant indexes in the D&V Cube are posed.
- Vegetation Health Index (VHI) is widely used for monitoring and characterizing droughts. Correlation analyses are performed to study the relationship between VHI and drought indicator SPEI (Standardized Precipitation-Evapotranspiration Index) with the aim of assessing the effect of drought on each contribution- NDVI and LST). It is shown that the relative contributions of NDVI (Vegetation Condition Index, VCI) and of LST (Thermal Condition Index, TCI) to vegetation health depend on vegetation cover (on a global scale).
- Based on a case study of the heat wave in 2017 over Europe and related vegetation stress in South Italy, it is shown that satellite data from Metop can be useful for assessment of vegetation dryness indices. IASI data are used in order to introduce parameters depending also on atmospheric humidity. D&V Cube inferred parameters are used to evaluate any correlation with thermodynamic parameters from IASI.
- The use of satellite data to quantify the effect of O3 exposure on GPP is reported. O3-induced GPP reductions were estimated to vary between 0.36-9.55 percent across Europe forests along a North-South transect between 2003-2015. Soil moisture is a significant variable governing GPP reduction over Mediterranean.

A multi-parametric System built to characterize the land surface state, based on operational satellite information, ground observations and some indexes, using a lot of LSA SAF, CM

SAF, H SAF products (actual values and anomalies vs. multiannual mean) and its application on a regional scale (Poland) is presented. The System is developed on a research internal level.

- The development of an improved version of the LSA SAF EPS global FVC, LAI and FAPAR products, including a new variable, the Canopy Water Content is presented. Refining the operational algorithm and improving the realism of the time profiles (better identification of snow) are performed. A new algorithm is delivered and used to generate a CDR of global EPS products. Some drought illustrative examples are also included.

- The experience of Armenia for drought assessment introducing LST as a parameter is presented. It is underlined that Armenia is one of the most disaster-prone countries in southern Caucasus, a short climatic overview of 2021 and the application of Copernicus open access data of LST from MODIS and NDVI from MODIS on a monthly basis for selected regions and for whole territory are presented.

Session 6: Applications using D&V Cube (*moderated by Christine Traeger-Chatterjee*)

Two presentations related to D&V Cube are given:

- A work now under development is focused to merge the ESA CCI SM and a subset of the EUMETSAT DC variables by means of machine learning in order to estimate soil moisture at 0.05°, hence improving the soil moisture spatial resolution 5 times. Preliminary results of the downscaled SM are presented and the major obstacles in the development of a higher resolution (~1 km) soil moisture product are discussed.

- First experience from using D&V Cube as a new tool to extend the studies on drought monitoring, illustrated by application examples focused on drought & disease effects on ecosystem resilience; drought & crop productivity are presented. D&V Cube milestones, some difficulties, shortcomings, and utilities are discussed. Feedback and suggestions regarding fore D&V Cube improvements to meet the user needs are presented, e.g. inclusion of new parameters; a procedure for constructing own indexes based on existing parameters in the Cube to be introduced in R-Toolbox; Improve the spatial/temporal resolution (e.g. precipitations); improvement of the graphical configurations in the CM SAF R-Toolbox.

8) Summary of the discussion & suggestions during the Sessions

Summary of the 'Wrap up Day 1, 2, 3' is presented in the Power Point Presentation *Wrap up Days & Final Discussion 26Nov2021.pptx*. The document summarises the main problems discussed and put questions/suggestions for the Final Discussion on 26 November 2021.

9) Recommendations:

Data Cube:

- The D&V Cube is recognized as useful way for providing data from different SAFs and other providers to users. It is recommended that EUMETSAT add further products to the Cube,

especially for fire monitoring, fire emissions, as well as information on atmospheric moisture patterns and others. Would suggest we to work together on the prioritized list and the way to do it, my suggestion would be to provide another shared document with the list of some parameters that would be available from our side. Others could add other parameters that may be available from other data provider.

- Consider to include NRT data (up to 24 h) in the Cube or to provide them in the same format in the cube. In this case the cubes needs to become dynamic (vs. static at the moment). This list should then be prioritized in collaboration with team SALGEE. Consider the different temporal resolution of products, including historic data, such CDR, via ICDR, to NRT. 'Cube on demand'. API access is important
- Recommendation to EUMETSAT: data cube on demand (dynamic cube) would be appreciated, which would also allow retrieve NRT from our archive (*In this way the user can configure his own cube with parameters that you want to have. You can go to the archive at any time and extract the most recent data in the same format*).
- EUMETSAT to provide training on the data cube, including online material for self-study and user support specific to the data cube.

Other topics:

- Interest in fire topics and products is expressed. Participants asked to be informed about user information and support events on the fire products, as well as about innovations that become available with the new satellite programs. Users are encouraged to please check the EUMETSAT webpage and training page and other channels (e.g. twitter, linked-in) regularly for new announcements.
- Product user guide for the applications in Drought, Vegetation, Fire related issues in the frame of SALGEE: Such a guide that includes concepts, approaches, and product applications t would also serve as a material to increase the use of related SAF products. SALGEE Steering Group and EUMETSAT to discuss this option and to see what would be possible and how.
  The user guide, which could be distributed among the colleagues and Met services in EUMETSAT member states to show the benefit from using the satellite products, the concepts, the approaches in Land Surface Analyses.

Thanks to all who contributed to making SALGEE a successful in the past and to all who made this 7th SALGEE meeting successful.

21 December 2021 SALGEE Secretary

Sofia

/Assoc. Prof. Dr. Julia Stoyanova/
NIMH-Bulgaria

Appendix 1

SALGEE

7th SALGEE Meeting 24 – 26 Nov 2021

''Drought & Vegetation Monitoring: Energy–Water Cycle'' Workshop Agenda

Day 1: Wednesday, 24 November 2021

08:00 UTC Welcome and Introduction

- Julia Stoyanova (NIMH Bulgaria)
- Joachim Saalmueller (EUMETSAT, Head of User Support and Climate Services)
- Christine Träger-Chatterjee (EUMETSAT)

Session 1: Satellite data in support to Land Surface Analyses

08:30 - 09:00 UTC LSA SAF past, present and future, Luis Pessanha, IPMA

09:00 - 09:30 UTC About land surface temperature (LST) All-weather type, Carlos Jimenez, Estellus (recorded)

09:30 – 10:00 UTC *Coffee break*

10:00 - 10:30 UTC Gridded Data for Drought and Vegetation Monitoring – EUMESAT's first prototype data cube, Christine Träger-Chatterjee, EUMETSAT

Session 2: Energetic loading and land fluxes

10:30 - 11:00 UTC Global and Regional Satellite-based Surface Solar Radiation data sets provided by the CM SAF, Joerg Trentmann, DWD/ CM SAF

11:00 - 11:30 UTC Operational and reprocessed LSA SAF ET and surface energy fluxes products: examples of potential applications, Alirio Arboleda, RMI

11:30 - 13:00 UTC *Lunch break*

Session 3: Soil Moisture

13:00 - 13:30 UTC Trends and case studies for the H SAF ASCAT root-zone soil moisture data records, David Fairbairn, ECMWF

13:30 - 14:00 UTC Applications of H SAF Soil Moisture Data, Wolfgang Wagner, TU Vienna

14:00 - 14:30 UTC A global Sentinel-1 data cube for land monitoring applications. Wolfgang Wagner, TU Vienna

14:30 - 15:00 UTC Wrap up of Day 1

15:00 UTC End of Day 1

Day 2: Thursday, 25 November 2021

Session 4: Wildfires

08:00 - 08:30 UTC Biomass burning emissions products from geostationary fire radiative power (FRP), MODIS aerosol optical depth (AOD) and Sentinal-5P carbon monoxide (CO) data, Hannah Nguyen, King's College, UK

08:30 - 09:00 UTC Meet your colleague and have a chat on ''Wonder-me'', join here: https://www.wonder.me/r?id=03213c41-066b-4905-8e2f-72cacca2b0c7

09:00 - 09:30 UTC Synoptic and climatic aspects of fire activity, and emission effects, Part I and Part II, Christo Georgiev, NIMH

09:30 - 10:00 UTC *Coffee break*

10:00 - 10:30 UTC Copernicus (incl. supporting missions) data and services for wildfires monitoring and management, Federico Fierli, EUMETSAT

Session 5: Drought & Vegetation Monitoring

10:30 - 11:00 UTC Drought and vegetation monitoring using satellite derived climate data records, Julia Stoyanova, NIMH

11:00 - 11:30 UTC A climatological assessment of drought impact on vegetation health index, Celia Gouveia, IPMA

11:30 - 13:00 UTC *Lunch break*

13:00 - 13:30 UTC The IASI dryness vegetation index (IASIDVI) and its application to the 2017 heat-wave in Southern Italy, Carmine Cerio, Univ. Basilicata, Italy

13:30 - 14:00 UTC Estimating the effect of tropospheric O3 on Gross primary productivity over European forests using satellite data, Jasdeep Anand, Univ. Lancaster

14:00 - 14:30 UTC Wrap up of Day 2.

14:30 UTC End of Day 2

Day 3: Friday, 26 November 2021

Session 5: Drought & Vegetation Monitoring (Continue)

08:00 - 08:30 UTC Multiparametric monitoring of land surface state and anomalies in regional scale, with use of operational satellite products and ground observations, Piotr Struzik, Institute of Meteorology and Water Management

08:30 – 09:00 UTC The LSA SAF vegetation products: status, new developments and potential applications, Javier Garcia Haro, Univ. Valencia

09:00 UTC - 09:30 UTC Using Land Surface Temperature and Vegetation Indices for Monitoring Drought in Armenia., Zara Petrosyan, Hydromet, Armenia

09:30 UTC - 10:00 UTC *Coffee break*

Session 6: Applications using D&V Cube

1) Towards a long-term (> 15 years) and medium resolution (0.05°) soil moisture dataset over Europe by merging ESA CCI SM and EUMETSAT products, Luca Zappa, TU Vienna
2) First Experience on D&V Cube applications, Julia Stoyanova, NIMH

11:00 – 11:30 UTC Discussing Workshop Contributions with colleagues (Wonder me), join here: https://www.wonder.me/r?id=03213c41-066b-4905-8e2f-72cacca2b0c7

11:30 – 13:00 UTC Lunch break

13:00 - 14:00 UTC Final discussion

14:00 - 14:30 UTC Recommendations and wrap up

14:30 UTC End of Workshop

Appendix 2

List of lecturers & participants in the virtual 7th SALGEE Workshop 2021

"Drought & Vegetation Monitoring: Energy –Water Cycle"

24-26 November 2021

Invited by EUMETSAT

1. Julia Stoyanova, LSASAF NIMH Bulgaria, SALGEE Steering Group
2. Luis Pessanha, IPMA, Portugal, SALGEE Steering Group
3. Christine Traeger Chatterjee, EUMETSAT
4. Joachim Saalmueller, EUMETSAT
5. Christo Georgiev, NIMH Bulgaria
6. Celia Gouveia, LSASAF IPMA, Portugal
7. Javier Garcia Haro, LSASAF Univ. of Valencia, Spain
8. Hannah Nguyen, LSASAF, King's College, UK
9. Alirio Arboleda, LSASAF RMI, Belgium
10. Carlos Jimenes, Estellus Laboratory, Paris (*recorded participation*), France
11. Wolfgang Wagner, Vienna University of Technology
12. Piotr Struzik, HSAF, Institute of Meteorology and Water Management, Poland
13. Guido Masiello, Univ. Basilicata, Italy
14. Jasdeep Anand, Univ. Lancaster, UK
15. David Fairbairn, ECMWF
16. Jörg Trentmann, CM SAF DWD, Germany
17. Federico Fierli, EUMETSAT
18. Zara Petrosyan, Service of the Hydrometeorology and Active Influence on Atmosphere Phenomena, Armenia
19. Andrey Kulishev, NIMH Bulgaria
20. Athanasios Karagiannidis, National Observatory of Athens, Greece
21. Carla Barroso, EUMETSAT

Invited by NIMH

22 Kiril Slavov, Kiril.Slavov, NIMH Bulgaria
23 Hristo Chervenkov, NIMH Bulgaria
24 Irina Angelova, NIMH Bulgaria
25 Valeriya Yordanova, NIMH Bulgaria
26 Georgy Koshinchanov, NIMH Bulgaria

Partially attending

27. Sara Venafra, Univ. Basilicata, Italy
28. Carmine Cerio, Univ. Basilicata, Italy
29. Erdem Erdy, EUMETSAT
30. Hasmik Panyan, Service of the Hydrometeorology and Active Influence on Atmosphere Phenomena, Armenia