Report from

Intersessional Virtual Meeting of the International Cloud Working Group (ICWG)

29-30 September 2021 at 12:00-15:30 UTC

Hosted by EUMETSAT

Program Committee

Andrew Heidinger (co-chair, acting Rapporteur), Karl-Göran Karlsson (co-chair), and Bertrand Fougnie (local organizer)

CGMS Advisory Panel

Kerry Meyer (NASA, USA), Heikki Pohjola (WMO, Switzerland), Sung-Rae Chung (KMA Korea), Lu Feng (CMA, China), Andrew Heidinger (NOAA, USA), N. Puviarasan (IMD, India), Rob Roebeling (EUMETSAT, Germany), Alexei Rublev (Roshydromet, Russia), and Daisaku Uesawa (JMA, Japan)

Version: 22 November 2021

1. Introduction and background

The basis for the work of the International Clouds Working Group has historically been to arrange inter-comparisons of different cloud parameter retrievals and to discuss the achieved results and other relevant topics at regular ICWG workshops. A third workshop (ICWG-3) was planned in 2020 but had to be cancelled and postponed several times due to the Covid-19 pandemic. A new date for ICWG-3 is still not defined but we hope it can be arranged in 2022 (see concluding section).

This mini-workshop was arranged to basically restart the activities of ICWG after a period of reduced or even canceled activities due to the pandemic. The workshop was intended to mainly discuss the latest achievements, the foreseen near-future activities of ICWG and, in particular, prioritized activities in preparation of ICWG-3.

The workshop also addressed particular actions from CGMS, especially related to new activities to be dealt with by new topical sub-groups. For example, new topical groups on Lightning applications and ISCCP-NG were given extra space at the workshop for introducing the activities and plans in these fields.

This document shortly summarizes the main outcome of the workshop. The schedules for the two days are given below followed by short descriptions for each significant item in the schedule.

The workshop attendance was in total 55 registered participants with about 45 online participants in each of the two days. Participants from Europe and USA dominated but a fair number of Asian participants could also be noted. A full list of participants is given in Appendix B.

Day 1

Topic	Speaker	Time Start (UTC)	Time End (UTC)
Introduction and Plans for ICWG-3	Karlsson	12:00	12:15
Status of ICWG HLPP and Action Items	Heidinger	12:15	12:30
Lightning Topical Group	J. Grandell + S-E Enno: MTG Lightning imager: status, products, commissioning & cal/val planning Scott Rudlosky: Geostationary Lightning Mapper Observations and Applications	12:30	14:00
Break		14:00	14:15
Severe Weather Topical Group	Pavolonis	14:15	14:30
Height/Winds Topical Group	Heidinger/Wanzong	14:30	15:00
Microwave Topical Group	Dong	15:00	15:15
Intercomparisons Discussion	All	15:15	15:30

Day 2

Topic	Speaker	Time Start (UTC)	Time End (UTC)
Summary of Day 1 and Introduction	Karlsson	12:00	12:15
Modelling Topical Group Report	Watts	12:15	12:30
Cloud Mask Topical Group	Karlsson	12:30	13:00
Climate Topical Group Report	Stengel/Foster	13:00	13:30
Break		13:30	13:45
ISCCP-NG Discussion	Heidinger/Kahn	13:45	14:15
Intercomparisons Discussion (cont.)	All	14:15	14:45
Next Meeting Discussion	Fougnie	14:45	15:00
Wrap Up and Action Items + Co-chairmanship	Heidinger	15:00	15:30

2. Status of ICWG HLPP items and other actions and recommendations

ICWG is one of several scientific working groups organized under the framework of Working Group II (with topic “Satellite data and products”) of the CGMS. The activities in ICWG and the interaction with CGMS are regulated through actions and recommendations from the High-Level Priority Plan (HLPP) document and through specific actions and recommendations issued at the annual CGMS meetings. Below we list the current actions and recommendations from CGMS WG II to set the stage for the formal ICWG-CGMS interaction besides the more general role of ICWG of being an expert reference group for cloud-related science and operations.

HLPP actions relevant to ICWG:

4.2.5 Develop best practices for evaluation and validation of cloud properties.

This action shows the heritage to the former Cloud Retrieval Evaluation Workshops (CREW) with four workshops arranged in the period 2006-2014 before ICWG was formally declared as a scientific working group of CGMS WG II. The basis for CREW was inter-comparisons between algorithms developed by different institutes and agencies and this is still a core task for ICWG. This topic is relevant for all defined topical sub-groups. At this mini-workshop it was discussed as a general activity in Section 4.

4.3.4 ICWG to establish a liaison with EUMETSAT Convective Working Group or SCOPE Nowcasting.

This topic is relevant for Topical group on Severe Weather and is discussed in Section 3.2.

4.6.3 Through coordination between IPWG, ITWG and ICWG, continue to improve microwave radiative transfer models to include complex surfaces (e.g. snow, desert, etc.) and scattering atmospheres (e.g. frozen hydrometeors) to support improved algorithm development for current and future sensors.

This topic is relevant for Topical groups on Microwave applications and Cloud Modelling (see Sections 3.4 and 3.5).

General recommendations:

R47.04 ICWG and IWWG: ICWG to work with IWWG on the golden days observations to provide cloud height uncertainty for AMV applications

This topic is relevant for Topical group on Height/Winds (see Section 3.3) and also for the discussion on inter-comparisons in Section 4.

R47.05 ICWG: CGMS agencies to continue operating conically-scanning passive MW sensors in an early afternoon orbit as well as in a dusk/dawn orbit in order to maintain this unique long-term time series. Progress was made in the interaction of the ICWG

This topic is relevant for Topical group on Microwave applications (see Section 3.4).

R47.07 ICWG: CGMS members to budget a baseline funding for the intercomparison study, given its importance and impacts on global cloud products.

This recommendation was put from ICWG to CGMS and it is discussed briefly in Section 4.

R47.08 ICWG: CGMS members to consider introducing multi-sensor (satellite and ground-based measurements) applications for convective nowcasting when developing/updating product requirements.

This topic is relevant for the Topical group on Severe Weather and is discussed in Section 3.2.

New actions and recommendations from the latest CGMS meeting in May 2021 (CGMS-49) and from the latest CGMS Intersessional meeting on 27th of September 2021):

(Notice that the action numbers for the last two actions are still not known and we therefore use some preliminary notations as place holders)

A47.16: ICWG to organize a dedicated session (0.5-1 day) on lightning observations from space (calval, algos, applications and products)

This ICWG intersessional meeting is a first step taken here by allowing two longer introduction presentations on this topic (see Section 3.1). It is also intended to allow further space for this new Topical group at the next ICWG-3 meeting.

AXX.X1: CGMS members to provide feedback of ISCCP-NG L1g by End of 2021.

All participants in the CGMS Intersessional meeting were asked to respond to this action (if applicable). See also Section 3.8.

AXX.X2: ICWG hold a discussion on FY3E MERSI cloud products. (mentioned at CGMS Intersessional)

This will be a new topic for ICWG-3.

3. Status reports from Topical groups

3.1. Topical Group on Lightning applications

The meeting included a longer presentation and introduction to Lightning applications (partly in response to action A47.16 in Section 2).

Scott Rudlosky from NOAA started by presenting the experiences of Geostationary Lightning Mapper (GLM) data at NOAA. There are now more than four years of data since the launch of GOES-16 but despite this Scott emphasized the pioneering status

of the work where the community discover new things daily. He presented examples of flash climatologies (see Figure 1 below) and other statistics. An interesting observation is that despite much higher lightning frequencies over land, the strongest and longest strikes occur over oceans.

Scott discussed also product quality and error sources where a lot of focus is given to the overlapping area of GOES-16 and GOES-17. Problems to deal with are, for example, sunglint effects, solar intrusion and large viewing angles.

GLM data has been well received by forecasters providing useful additional information. Examples of GLM products can be found at the GLM NWS Virtual Lab Webpage (https://vlab.ncep.noaa.gov/web/geostationary-lightning-mapper).

Work has started with an overall GLM Value Assessment Overview which addresses many different aspects and applications. It is clear that the access of GLM data improves Severe Thunderstorm and Tornado warnings. A large improvement of forecasts has been noted during weather radar outage events and in areas with poor radar coverage.

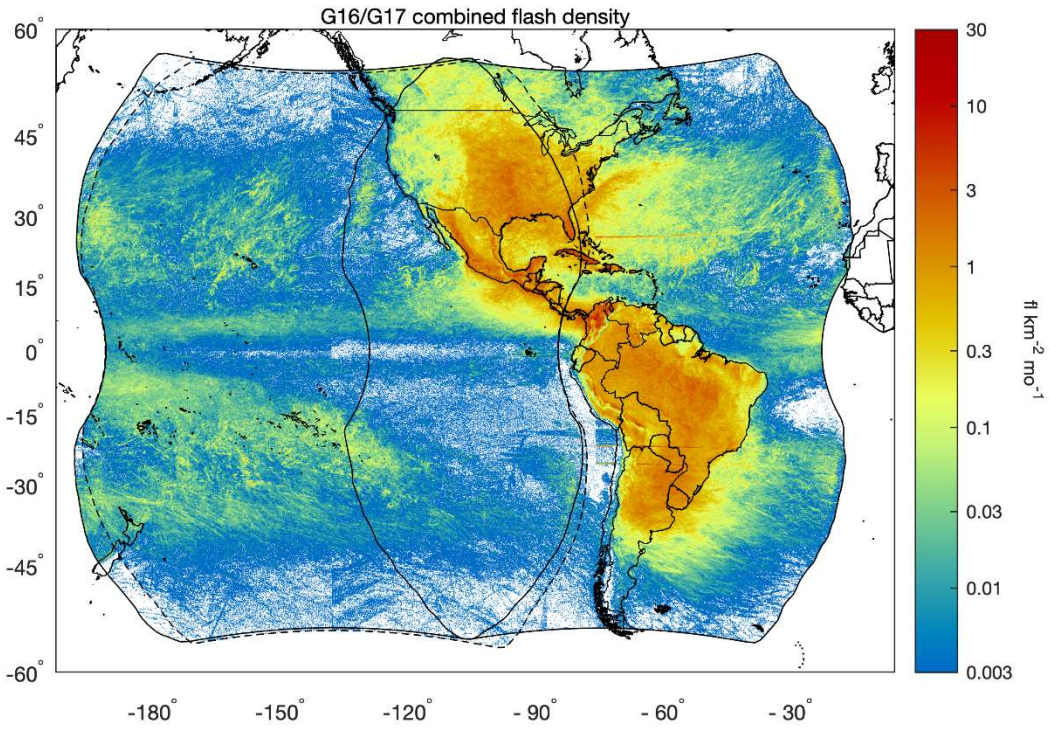

Figure 1 Accumulated flash densities (flashes per month) from combined GLM data of the GOES-16 and GOES-17 satellites (from Rudlosky and Virts, 2021).

Jochen Grandell and Sven-Erik Enno from EUMETSAT then introduced the status and the technical details of the MTG Lightning Imager (Figure 2). The design is quite different from the GLM instrument. Most noteworthy is that measurements will be made in four different fields of views sub-dividing the MSG disk into four sectors.

Jochen demonstrated aspects of how to filter the signal to get useful results. He also briefly introduced to the envisaged products to be defined. After that Sven-Erik presented the tools planned for commissioning and Cal/Val.

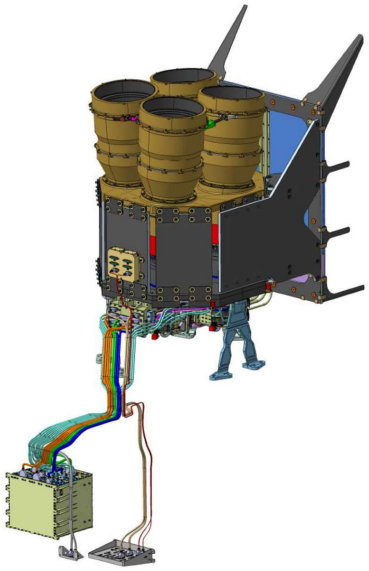

Figure 2 The MTG Lightning imager (LI).

More information and more details in the planning process will be presented at ICWG-3. Unfortunately, real measurements are not expected until after ICWG-3 in 2023.

3.2. Topical Group on Severe Weather

Mike Pavolonis at NOAA/NESDIS presented the status of activities in this topical group.

He first presented some results of a recent meeting of the EUMETSAT Convective Working Group (CWG) which was held 6-8 April 2021. It means that we already have a link to CWG (thus, Action 4.3.4 in section 2 could potentially be closed).

He stressed that while traditional cloud products and imagery are still valued, there is a trend towards automated image interpretation and extraction of higher-level information (e.g. turbulence detection, convective initiation, lightning nowcasting, severe weather predictions, convective precipitation rates, aircraft icing, small ice crystal detection, etc.). Much of these developments are enabled through Machine Learning (ML) methods.

All CGMS agencies produce convective Nowcasting products but definitions and specifications vary.

He concluded that there is a lot of synergy (or overlap) with other CGMS activities (e.g., ICWG Lightning, IPWG, ISCCP-NG, etc.). The overlap is so large that it could be questioned if we should keep this particular topical group in the future or whether it should be merged with the Lightning topical group. This question will be addressed more specifically at ICWG-3.

Other general questions to discuss at ICWG-3 are whether we should generate various long-term data records from the mentioned higher-level information and how ML methods will impact future products.

3.3. Topical Group on Cloud Top Heights (and winds)

A cooperation between the ICWG topical group on cloud top height products and the International Winds Working Group (IWWG) has been established. Steve Wanzong from NOAA (active in IWWG) presented the status of these interactions.

Steve recalled the history of AMV inter-comparisons and the planned next inter-comparison. Altogether, three inter-comparisons have been carried out since 2010. He then presented some results from the earlier inter-comparison followed by a description of ongoing preparations for a 4th inter-comparison to be reported in 2023. This will be based on data from the Golden day of October 20, 2019, thus addressing recommendation R47.04 in section 2.

He then addressed the most recent updates of operational wind products. Interestingly, it could be noted that cloud height updates/improvements do not always lead to improved AMVs.

It can be recalled (with some relevance for recommendation R47.07 in section 2) that a large part of the funding of the inter-comparison work in IWWG is provided by the EUMETSAT NWC SAF project.

3.4. Topical Group on Microwave cloud applications

Dong Wu from the NASA Goddard Space Flight Center presented the status in this topical group.

He emphasized global microwave cloud sounding to be a critical link between the VIS/IR-observed cloud information at cloud top and precipitation (rainfall and snowfall) recorded at the surface (see Figure 3).

There are large needs for this information in NWP data assimilation, for the creation of new cloud products and for defining and extending climate data records.
Dong listed the latest developments and progress in this field. There are many small satellite constellations with MW instruments already existing and many more are planned for use in the near future, for example the NASA EVI/TROPICS mission with 9 cubesats and the ESA/(OHB Sweden) AWS mission with four smallsats. New MW sensors are also soon available from major operational weather satellites (e.g. EUMETATs EPS-SG satellites) and more long-term plans include ambitious attempts to monitor full vertical resolution of water and ice particle distributions and particle motion (NASA’s AOS/ACCP mission).

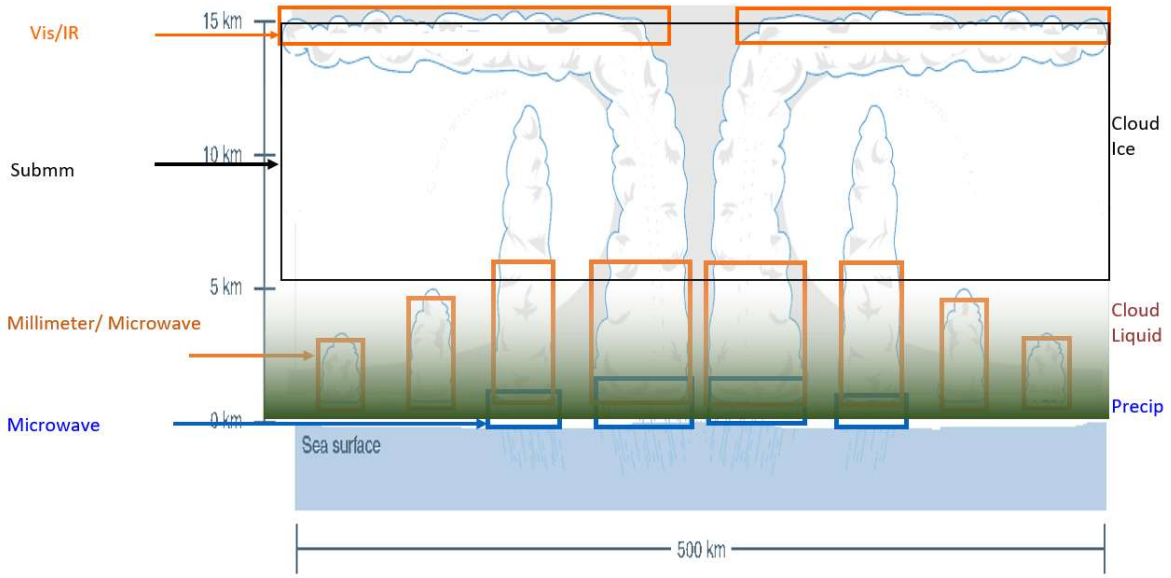

Figure 3 Schematic description of vertical measurement domains probing clouds by use of sensors in different spectra regions. (from ICWG inter-sessional presentation by Dong Wu, 2021).

It was concluded that the continuation of this topical group is needed to follow the extensive plans and the progress in this field.

3.5. Topical Group on Cloud Modelling

Phil Watts from EUMETSAT reported the status of work in this topical group.

He recapitulated the goals of this group:

- To document methods used to model clouds in cloud parameter retrieval schemes, e.g. in high level shared documents.
- To report on success (or not) of approaches
- To establish good communications on the subject

The main modelling issues are

- Multi-Layer Clouds
- Horizontal Inhomogeneity
- Vertical Inhomogeneity
- Ice scattering parameters
- Aerosol (with cloud; over, in or below)
- Fractional Cover (n<1)

Some of these issues are illustrated in Figure 4.

For this particular workshop, only a few progress reports from group members had been received. Phil also noted that the current draft documentation of methods (in response of the first goal above) is about to be outdated.
He showed some results from his own group at EUMETSAT regarding the OCA model and how to tackle multi-layer clouds and vertical cloud inhomogeneities in OCA. Also, some preparatory work for new sensors (e.g. 3MI) on EPS-SG was briefly mentioned.

There is a lot of activity but also uncertainty on how best treat cloud vertical distributions. This becomes even more important with new channels (e.g., O2 A-band from OLCI) and new sensors with multi-view capabilities (e.g., 3MI).

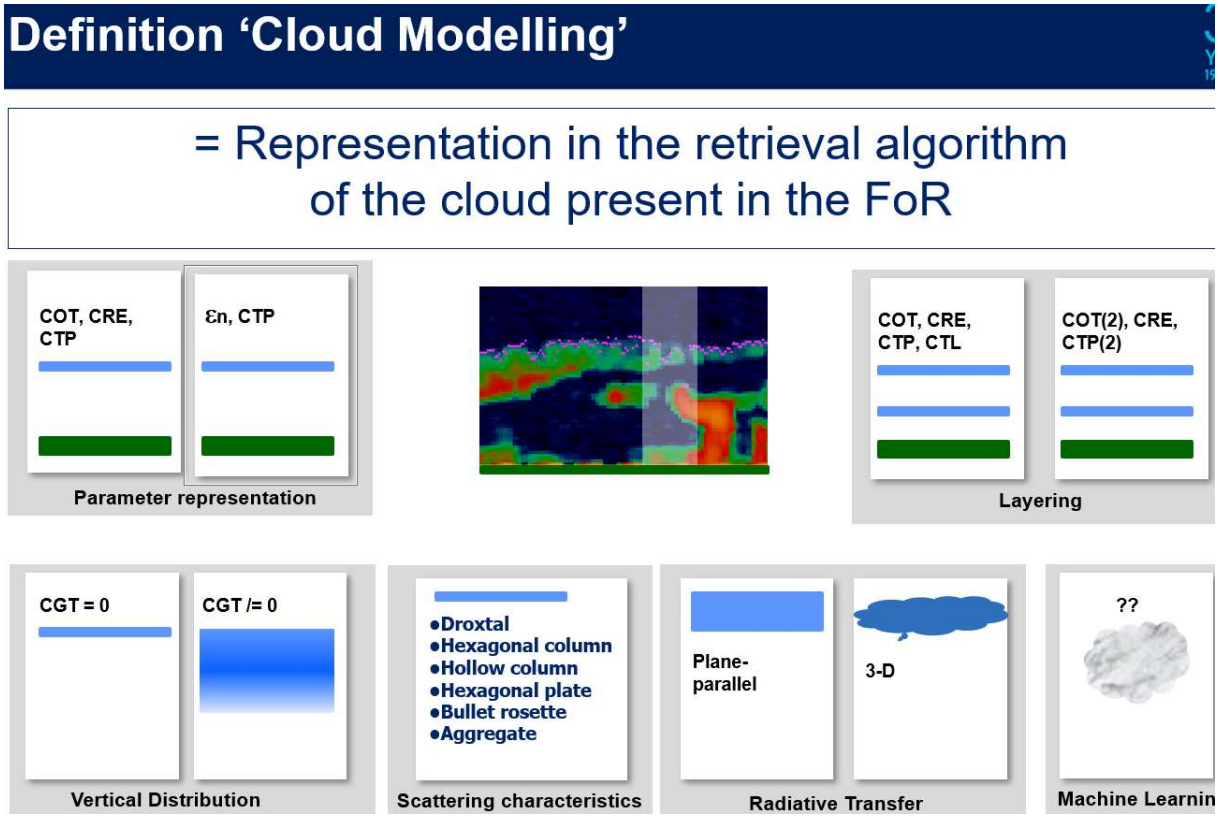

Figure 4 Various aspects of cloud modelling (from ICWG inter-sessional presentation by Watts, 2021).

Despite the seemingly limited progress in the work of this group its justification is still high considering the challenges which still exist and which become even more important with the introduction of new sensors ahead in time. The importance of this work also for several other topical groups was emphasized. It concerns in particular the cloud height retrievals for the Height/Winds group but there are also important links to the topical groups of Climate and ISCCP-NG.

3.6. Topical Group on Cloud Masking

Karl-Göran Karlsson reported the status and progress for this topical group.

He claimed that the motivation for having this group, focusing on the cloud detection problem, is still high since a substantial part of the uncertainties of downstream

products is clearly linked to uncertainties in cloud screening. Another aspect is the importance of cloud masking for climate studies of radiative feedback effects from clouds.

Current operational cloud screening is still dominated by the use of fuzzy multispectral thresholding methods or by Bayesian methods. However, AI/ML-based methods are under rapid development. It is clear that CALIPSO/CALIOP still remains a gold-mine for Cloud Masking development.

The recommendations from ICWG-2 are still valid, i.e., to add more comparisons over the polar regions and to start interaction with users of Clear Sky Radiances.

Historically, inter-comparisons of various cloud masks have been a cornerstone in previous ICWG and CREW workshops. However, the strategy for inter-comparisons and the way forward is currently unknown (discussed later in Section 4).

Upcoming global climate data sets (e.g., those from the ISCCP-NG project and climate data sets based on VGAC data = reduced resolution VIIRS data) offer more opportunities for cloud detection collaboration.

Karl-Göran proposed that ICWG-3 should highlight new ML/AI methods for cloud masking as a consequence of the large efforts in the development of such methods recently.

3.7. Topical Group on Climate Applications

Activities in the Climate topical group were covered by Martin Stengel, Mike Foster and Claudia Stubenrauch.

Martin started by suggesting that there might be a need for collecting condensed information about released and planned new (versions of) cloud climate data records and their key features. This is not meant to be superseding existing inventories, e.g. the ECV Inventory compiled by the Joint CEOS/CGMS Working Group on Climate, but rather facilitate a quick and effective exchange of information primarily within ICWG. He exemplified that with fact sheet examples for the ESA-CLOUD-CCI, CLARA-A3, CLAAS-3, EUMETSAT OCA and PATMOS-x data records.

Mike continued by presenting the current status of PATMOS-x Version 6.0. The most important new feature compared to previous versions is the use of a few HIRS channels (i.e, water vapour and carbon dioxide bands at 7.0 and 13.3 microns) through fusion interpolation techniques. This also led to the decision to only use those AVHRR channels which are available throughout the entire record (which means that the 12 micron AVHRR channel is not used). An example of the achieved results regarding global cloud amounts can be seen in Figure 5. The negative trend in global cloudiness is still there but the results in the beginning of the series are now less fluctuating than before. Also cloud top height retrievals look more reasonable now, e.g. agreeing better with corresponding MODIS-based results.

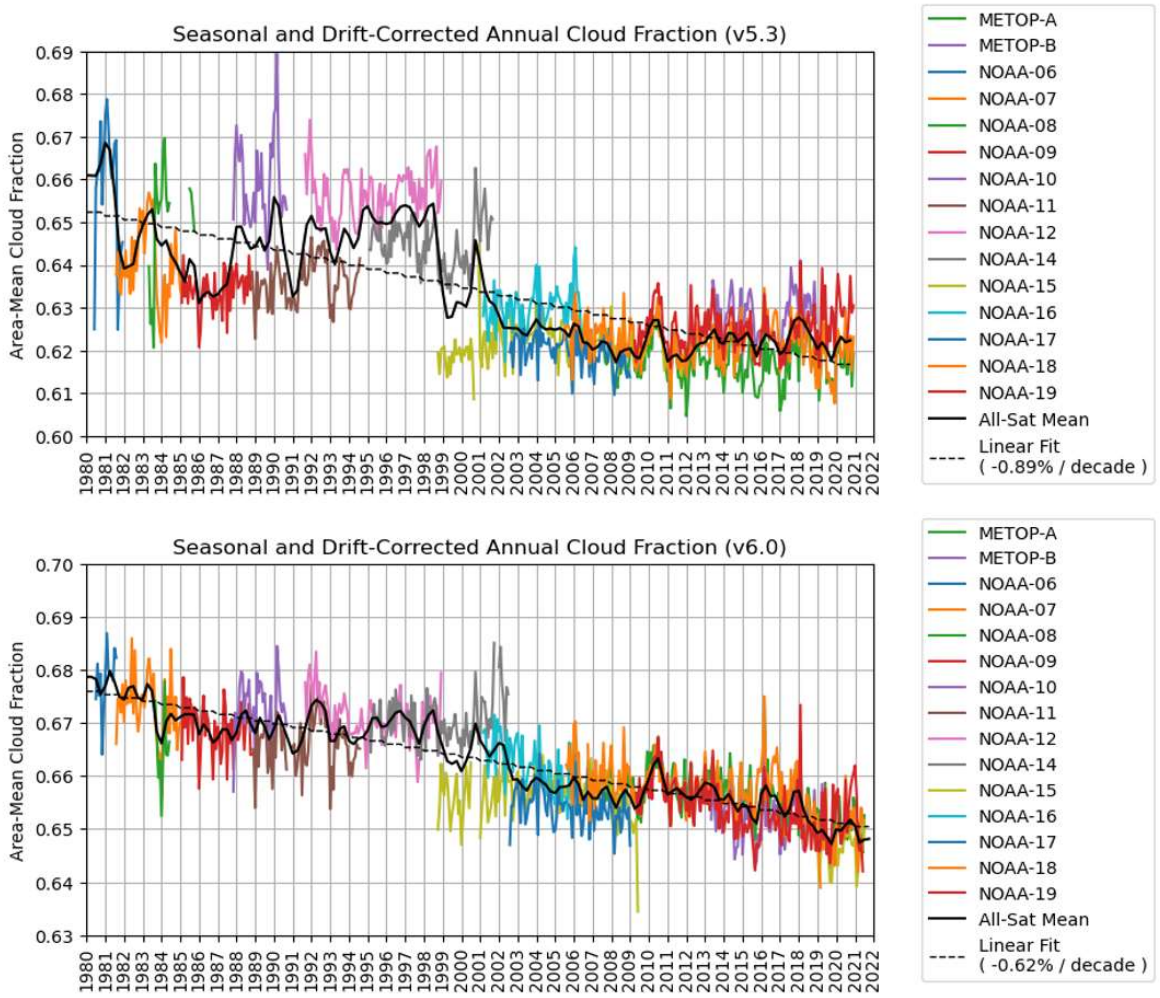

Figure 5 Comparison of global cloud fraction from the new PATMOS-x version 6.0 (bottom) with the previous version (top). (from ICWG inter-sessional presentation by Mike Foster, 2021).

Claudia Stubenrauch gave an update on the GEWEX Cloud Assessment Dataset. A new assessment has now (2021) been done with 11 different cloud climatologies. New submissions have been received from Cloud CCI and CM SAF CLARA-A2 (both AVHRR-based), CLDPROP (extending MODIS with VIIRS data) and MISR. Also upgraded data sets from sounders and from CALIPSO have been introduced compared to the 2012 assessment. First impression is that things are generally similar to the previous 2012 assessment, although the most recent addition from MISR deviates significantly (much lower cloud amounts) from previous data.
A scientific article is currently in preparation.

Martin then showed an analysis of Arctic cloud climate data sets and highlighted some areas of difference in time-series and trends. However, agreement among involved data sets were found for a decreasing cloudiness in summer months and an increasing trend in autumn months.

Martin finally proposed that this topical group should try to concentrate on defining, studying and publishing results from one particular climate application for every single

ICWG workshop event. This could contribute to a frequent and fruitful interaction within this group.

3.8. Topical Group on ISCCP-NG

Brian Kahn and Martin Stengel presented the activities in this topical group.

Brian recapitulated what has happened recently in the discussions and definitions of the ISCCP Next Generation project. A small ISCCP L1g group has been formed for prototyping a first version of a georing radiance data product. ICWG arranged a separate virtual workshop in June 2021 to discuss this L1g product. Based on the feedback from that meeting some issues have been fixed. He reminded about the action for CGMS and ICWG members to test L1g data and provide feedback until the end of the year (see CGMS action AXX.X1 in Section 2).
NOAA is committed to supporting ISCCP-NG L1g and GSICS, and NASA is considering using ISCCP-NG L1g to support its A-CCP initiative. Europe (EUMETSAT and ESA) has made some commitments to start using ISCCP-NG L1g for the generation of cloud products.
L2/L3 work is beginning and Martin Stengel showed some examples from first attempts of applying ANN-based methods developed in the ESA-CLOUD-CCI+ project to ISCCP-NG L1g data. An interesting feature here was the successful application of spectral band adjustments to all included sensors to emulate SEVIRI Met-11 data. He also presented the plans from the ESA-Cloud_cci+ and CM SAF projects to further contribute to ISCCP-NG.

It has been expressed that ICWG through this topical group should guide the work through a close coordination of inter-comparison activities. The upcoming ISCCP-NG cloud data sets (all of them using ISCCP-NG L1g as input) should compile an L2/L3 ensemble evaluated in the GEWEX Cloud Assessment (if being continued). Further decision on the actual ISCCP-NG L2 methods and data records to be used on a longer term should be based on the GEWEX CA outcome incorporating potential recommendations from ICWG.

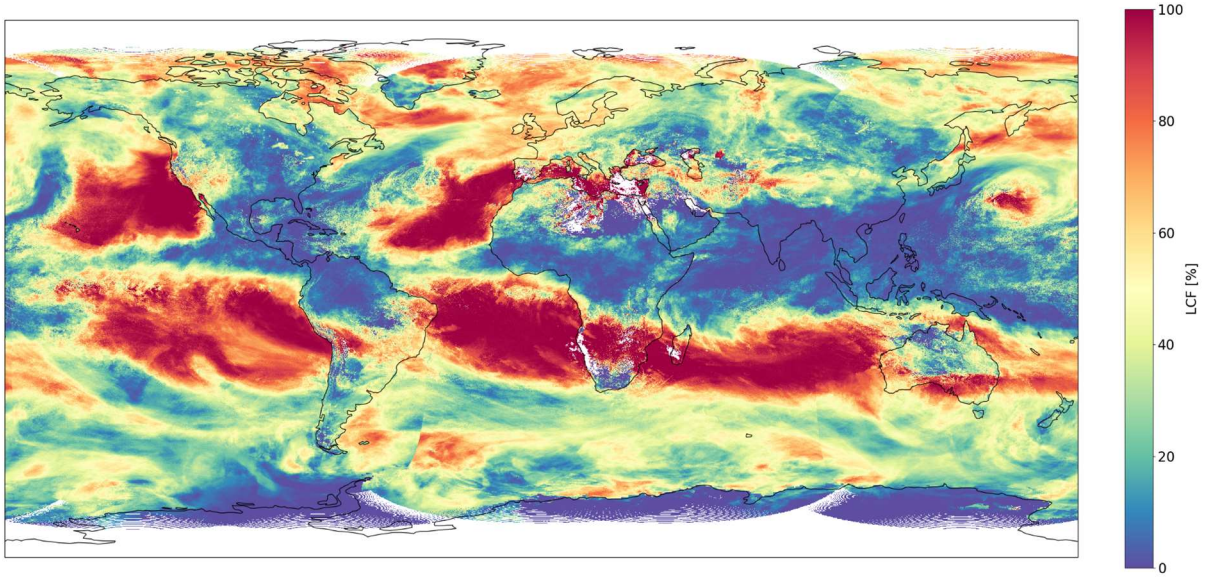

Figure 6 Example of a 6-day average Liquid Cloud Fraction product based on applying Cloud_cci+ ANN to ISCCP-NG L1g data. (from ICWG inter-sessional presentation by Martin Stengel, 2021).

The next major international ISCCP-NG workshop will take place in 2022 or 2023.

4. Discussion on inter-comparison studies

Due to the historical importance of inter-comparison studies in previous ICWG and CREW workshops, a short discussion on this topic was carried out.

The basic motivation for inter-comparisons is to allow each agency or institute to get a sense of how their product compares to that of others (in a standard objective way). This is also directly linked to action 4.2.5 in the HLPP document (see Section 2).

Previous CREW and ICWG workshops were centered around inter-comparisons of Golden day data. Some results were published in workshop reports and in peer-reviewed papers. This was based on the work of dedicated and specifically funded scientists analyzing the results for ICWG.

The question is: How shall we proceed here? What's the way forward? There are at least three possible ways:
1. Going back to original methods/data.
2. To make smaller inter-comparisons linked to topical groups.
3. Just provide library of tools and data for everyone to use.

The discussion did not result in any conclusion but maybe a common effort centered around the Height/Winds Golden day of October 20, 2019, could be envisaged. If this could be realized, the Topical group of cloud modelling should then partner with the Heights/Wind Inter-comparison activities and help diagnose the behavior in multi-layer situations. Other Topical Groups are also encouraged to think about what they want from inter-comparisons or how they can add to the Height/Wind Inter-comparison. Nina Håkansson (SMHI) suggested that the Height/Wind inter-comparison should be extended with data from polar satellite data and, in particular, data from the VIIRS sensor.

However, it is uncertain what can be achieved in the current situation with no scientists specifically tied to and funded for the inter-comparison task. A really efficient coordinated effort which could produce extensive and useful validation results requires dedicated scientists. We will continue to ask for such support from CGMS WG II.

5. Outcome and conclusions

This inter-sessional ICWG mini-workshop was considered quite successful in summarizing the status in different fields of cloud retrieval developments since the last ICWG workshop (ICWG-2 in Madison, USA, in November 2018). It also provided ideas and recommendations for what to discuss and present at the next physical workshop, ICWG-3. Besides general status reports from topical groups at ICWG-3, we can anticipate further focus on activities in the new topical groups of Lightning applications and ISCCP-NG. An increased attention to Machine Learning processes in various

retrievals is also foreseen at ICWG-3. Finally, results from retrieval inter-comparisons are likely to be presented based on the Golden day of October 20, 2019.

The following actions were suggested as additional results of this mini-workshop:

ICWG-2.5_1: The topical group on Cloud Masking to establish a connection to the users of Clear-Sky Radiance Products (GEO and LEO satellites) and possibly in coordination with ITWG.
(Ben Johnson from ITWG already volunteered to assist here during the workshop).

ICWG-2.5_2: The topical group on Cloud Modelling should offer its services to the Height/Winds Inter-comparison activity, especially regarding the multi-layer scene performance.

ICWG-2.5_3: Climate Data producers should adopt a uniform data description (e.g., in the form of standardized fact sheets) to create a better overview of existing cloud climate data records. It was also recommended for this topical group to focus on one common study area in advance of each individual ICWG event.

ICWG-2.5_4: Stereo cloud height producers should be invited to contribute to the activities of the topical group of Height/Winds.

Presentations from the mini-workshop can be made available by the co-chairs upon request.

6. ICWG management and plans for ICWG-3

The next official ICWG workshop, ICWG-3, should take place next year (2022). Although it would be theoretically possible to hold the workshop already in spring 2022, it was claimed that too much of schedule conflicts with other meetings and events would be likely in the first half of 2022. A safer approach (also from the covid-19 pandemic perspective), which also would allow for completion of new inter-comparison studies, would be to hold the workshop in autumn 2022. A suggestion from Bertrand Fougnie, representing the host of this mini-workshop (EUMETSAT- also accepting to be the host of ICWG-3), was to schedule ICWG-3 in Darmstadt, Germany, to the week 26-30 September 2022 with backup dates 3-7 October. ICWG-3 is envisaged to be a 4-day meeting and it would be possible to combine it with the EUMETSAT Meteorological Satellite conference which occurs in Brussels the week before (19-23 September).

(After the mini-workshop, a short enquiry about the availability of participants for the suggested dates 26-30 September 2022, was carried out. No particular problems were noted and these dates have consequently now been blocked and booked for the available meeting rooms at EUMETSAT.)

There is also a need to install new co-chairs of ICWG at ICWG-3. Both current co-chairs will resign at that time. No new candidates have so far been suggested by CGMS. However, two internal (to ICWG) candidates have expressed their interest

(Martin Stengel from DWD, Germany, and Kerry Meyer from NASA, USA) and they will be suggested for acceptance by CGMS WG II. Andrew Heidinger is also volunteering to become the new ICWG rapporteur to CGMS WG II.

7. References

Rudlosky, S.C. and Virts, K. S., 2021: Dual Geostationary Lightning Mapper Observations, *Mon. Wea. Rev.,* **149**, 979-998, https://doi.org/10.1175/MWR-D-20-0242.1

Appendix A – Acronyms

Acronym	Definition
3MI	EPS-SG Multi-Viewing Multi-Channel Multi-Polarisation Imaging instrument, EUMETSAT
AI	Artificial Intelligence
ANN	Artificial Neural Networks
AOS/ACCP	Atmosphere Observing System / Aerosol, Cloud, Convection and Precipitation, NASA
AMV	Atmospheric Motion Vector
AVHRR	Advanced Very High Resolution Radiometer
AWS	Arctic Weather Satellite, ESA
CALIOP	Cloud-Aerosol Lidar with Orthogonal Polarization, CALIPSO satellite
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite, NASA
CCI	Climate Change Initiative, ESA
CCI+	Follow-on project of ESA's Climate Change Initiative
CDR	Climate Data Record
CGMS	Coordination Group for Meteorological Satellites
CLAAS-3	CLoud property dAtAset using SEVIRI, Edition 3, CMSAF
CLARA-A3	The CM SAF Cloud, Albedo And Surface Radiation dataset from AVHRR data (Edition 3)
CLOUD-CCI	ESA's Climate Change Initiative on Clouds
CM SAF	Satellite Application Facility on Climate Monitoring, EUMETSAT
CREW	Cloud Retrieval Evaluation Workshop
CSR	Clear Sky Radiance
CWG	Convective Working Group, EUMETSAT
DWD	Deutscher Wetterdienst (Germany's National Meteorological Service)
ECV	Essential Climate Variable
EPS-SG	EUMETSAT Polar System Second Generation
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites

Acronym	Definition
EVI/TROPICS	Earth Venture Instrument, Time-Resolved Observations of Precipitation structure and storm Intensity, NASA
FY-3E	Fengyun, Chinese satellite
GAC	Global Area Coverage (AVHRR)
GCOS	Global Climate Observing System
GEO	Geostationary orbit
GEWEX	Global Energy and Water cycle Experiment, WCRP
GLM	Geostationary Lightning Mapper, NOAA
GOES	Geostationary Operational Environmental Satellite, USA
GSICS	Global Space-based Inter-Calibration System, WMO/CGMS
HIRS	High resolution Infrared Radiation Sounder, NOAA
HLPP	High Level Priority Plan
ICWG	International Cloud Working Group
IMD	India Meteorological Department
IPWG	International Precipitation Working Group
ISCCP-NG	International Satellite Cloud Climatology Project – Next Generation
ITWG	International TOVS Working Grouop
IWWG	International Winds Working Group
JMA	Japan Meteorological Agency
KMA	Korean Meteorological Agency
LEO	Low Earth Orbit
LI	Lightning Imager, MTG
MERSI	Medium Resolution Spectral Imager, China
MetOp	Meteorological Operational Satellite EUMETSAT
MISR	Multi-angle Imaging Spectroradiometer, NASA
ML	Machine Learning
MODIS	Moderate Resolution Imaging Spectroradiometer, NASA
MSG	Meteosat Second Generation
MTG	Meteosat Third Generation

Acronym	Definition
MW	Microwave part of spectrum
NASA	National Aeronautics and Space Administration, USA
NOAA	National Oceanic and Atmospheric Administration, USA
NWC SAF	Nowcasting Satellite Application Facility, EUMETSAT
NWP	Numerical Weather Prediction
NWS	National Weather Service, USA
OCA	Optimal Cloud Analysis, EUMETSAT
OLCI	Ocean and Land Colour Instrument, Sentinel-3, ESA
PATMOS-x	Pathfinder Atmospheres – Extended, NOAA
SCOPE	Sustainable Coordinated Processing of Environmental Satellite data
SEVIRI	Spinning Enhanced Visible InfraRed Imager, EUMETSAT
SMHI	Swedish Meteorological and Hydrological Institute
TCDR	Thematic Climate Data Record
TOVS	Tiros-N Operational Vertical Sounder
VIIRS	Visible Infrared Imaging Radiometer Suite, NASA/NOAA
VIS	Visible part of spectrum
VGAC	VIIRS Global Area Coverage
WCRP	World Climate Research Programme, WMO
WMO	World Meteorological Organization, United Nations

Appendix B – Participant list

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Caroline Poulsen	Australian Bureau of Meteorology
Claudia Stubenrauch	LMD/CNRS/Sorbonne University, France
David Doelling	NASA, USA
Dong Wu	NASA, USA
Emmanuel Fontaine	Meteo France
Gaelle Kerdraon	Meteo France
Hancheol Lim	NMSC, Korea
Heikki Pohjola	WMO, Switzerland
Jaime Daniels	NOAA, USA
Jan Fokke Meirink	KNMI, the Netherlands
Jerome Vidot	Meteo France
Jochen Grandell	EUMETSAT, Germany
John Jackson	EUMETSAT, Germany
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Karl-Göran Karlsson	SMHI, Sweden
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Loredana Spezzi	EUMETSAT, Germany
Luca Bugliaro	DLR, Germany
Luca Lelli	University of Bremen, Germany
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Mikael Rattenborg	EUMETSAT, Germany
Mike Foster	University of Wisconsin, SSEC, USA
Mike Pavolonis	NOAA, USA
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Steve Wanzong	University of Wisconsin, SSEC, USA
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Thomas Fiolleau	LEGOS, France
William Smith	NASA, USA
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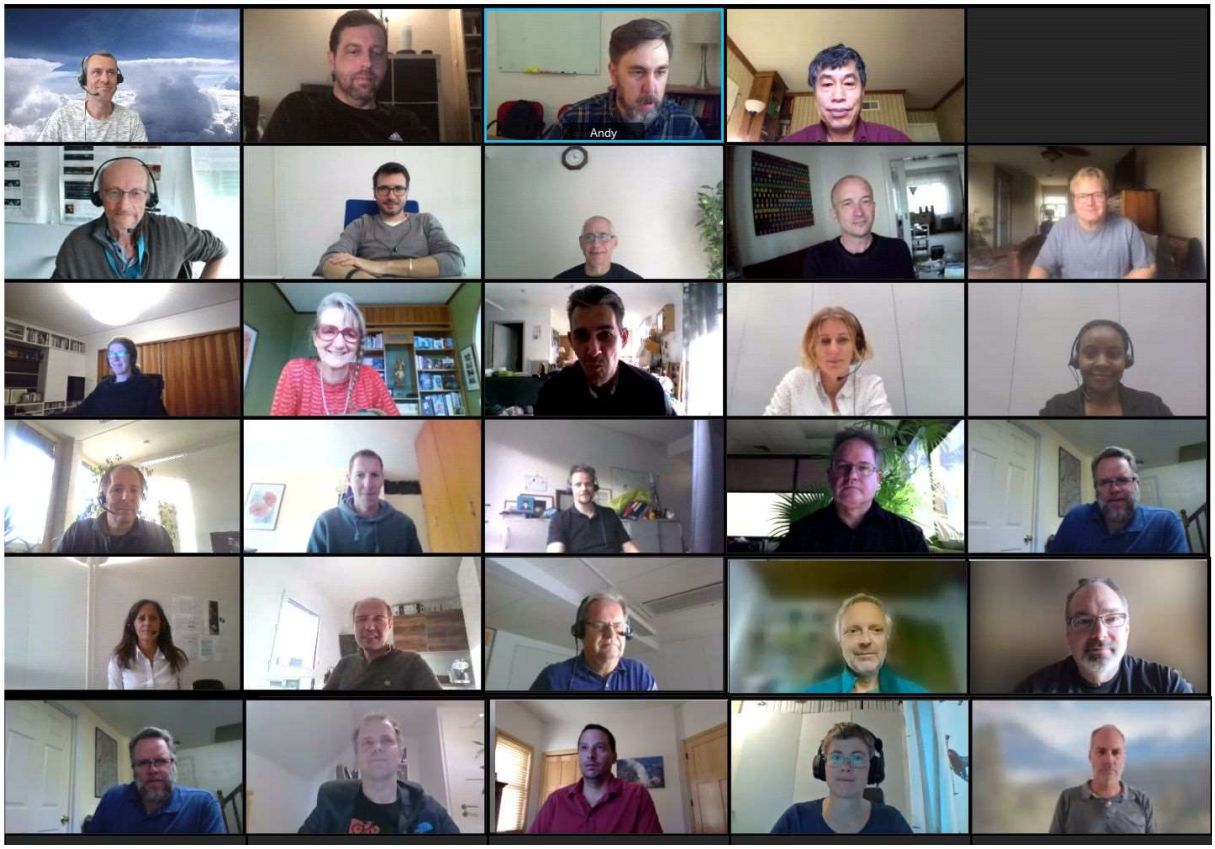

Some of the participants caught on pictures.