Proceedings for the 13th International Winds Workshop
27 June - 1 July 2016, Monterey, California, USA

REPORT FROM THE INTERNATIONAL CLOUDS WORKING GROUP (ICWG)

Dong Wu[1], Bryan Baum[2], Andrew Heidinger[3], Rob Roebeling[4]

[1] CRL, NASA Goddard Space Flight Center, Greenbelt, MD, USA

[2] SSEC, University of Wisconsin, Madison, WI, USA

[3] Center for Satellite Applications and Research, NESDIS, NOAA, Madison, WI, USA

[4] EUMETSAT, Darmstadt, Germany

Abstract

The 1st meeting of the International Cloud Working Group (ICWG) was held in May 2016 at the University of Lille, France. The workshop covered a wide range of topics concerning the remote sensing of cloud parameters, related applications and issues, specifically in cloud detection, cloud modeling for remote sensing, severe weather applications, level–2 retrievals and uncertainties, and establishment of decadal cloud record for climate research with well-defined uncertainties. As part of formal ICWG activities, it was recognized that closer links should be built with the users of the cloud products. With the ever-increasing reliance of AMV products on cloud-heights from cloud product retrieval algorithms, the ICWG seeks a stronger relationship with the IWWG. This paper highlights some of the activities undertaken in this direction.

INTRODUCTION

The 1st ICWG workshop, or ICWG-1, was held in University of Lille, France on 17-20 May 2016 and drew ~85 attendees. The workshop covered a wide range of topics concerning the remote sensing of cloud parameters, related applications and issues, specifically in cloud detection, cloud modeling for remote sensing, severe weather applications, level 2 retrievals and uncertainties, and establishment of decadal cloud record for climate research with well-defined uncertainties. These activities were coordinated through several Topical Groups.

The ICWG grew out of the Cloud Retrieval and Evaluation Workshops (CREW). The CREW met previously in 2007, 2009, 2011 and 2014 (Roebeling et al., 2013 and Roebeling et al., 2015). The CREW meetings were funded by EUMETSAT. Anke Thoss (Swedish Meteorological and Hydrological Institute; SMHI), Igor Giunta (Meteo Swiss) and Bryan Baum (SSEC: Space Science and Engineering Center, University of Wisconsin-Madison) served as the leaders of the CREW meetings. The initial focus of CREW was on the inter-comparison of cloud products for the Meteosat Second Generation SEVIRI Instrument. EUMETSAT funded visiting scientist positions, held by Andi Walther and Ulrich Hamman, to conduct a standard analysis on the data submitted by each group for a set of chosen “golden” days. Later meetings of CREW expanded the focus to include comparisons of polar orbiting cloud products (AVHRR and VIIRS). In 2014, Rob Roebeling successfully led the effort to evolve the CREW into the ICWG when the CGMS agreed to the Terms of Reference to define the scope of the ICWG. The web site for both ICWG and CREW is http://www.icare.univ-lille1.fr/crew .

With the ever-increasing reliance of AMV products on cloud-heights from cloud product retrieval algorithms, the need for collaboration between the IWWG and ICWG becomes more important. In recognition of this, the ICWG has included a cloud height analysis in its inter-comparison activities and a topical group on retrieval uncertainties. Before the next meeting, the ICWG intends to have a Topical Group that is focused solely on supporting the AMV applications.

ICWG ACTIVITIES AND TOPICAL GROUPS

Based on the Terms of Reference agreed to by the CGMS, the initial activities of the ICWG were as follows.

- Inter-comparison of cloud products from CGMS agencies and other providers
- Cloud Modelling
- Cloud Parameter Retrievals from Combined Sensors
- Aggregation Methods for Climate Applications
- Assessment of Cloud Parameter Retrievals and their Uncertainty Estimates
- Cloud Parameters in Weather and Climate Applications

The Topical Groups of ICWG were formed to support these activities (*for details see http://www.icare.univ-lille1.fr/crew/index.php/Topical_Groups*). These groups will evolve as interest and priorities change but the basic set of activities listed above will not change. In recognition of the importance of cloud height retrievals on AMV products, the ICWG has included cloud height products in its inter-comparison activities and a topical group on retrieval uncertainties. The IWWG presentation by Steve Wanzong titled "Comparison of OCA and ACHA Cloud Pressures for AMVs" is a first step in defining a process that is relevant to both the ICWG and IWWG. We anticipate that the number of participants will increase, with results that can be discussed at the next ICWG.

RESULTS FROM ICWG CLOUD VERTICAL EXTENT INTERCOMPARISONS

As mentioned before, the inter-comparison of cloud products has been a focus of the CREW meetings and continues with the ICWG. With the launch of Himawari-8 Advanced Himawari Imager (AHI), the ICWG chose to focus the inter-comparisons of products based on these measurements. The comparison effort was led by Prof. Yonsang Choi of the Ewha Women's University of Seoul, Korea. Based on his suggestions, August 19, 2015 was chosen as the Golden Day. This particular day was chosen since it included two major typhoons that impacted several Asian countries. This effort compared a set of cloud products provided by the 6 participating groups. Included in this analysis were products relevant to the IWWG, including the cloud-top vertical extent. Figure 1 shows a sample analysis of the cloud-top temperature products from JMA, KMA, NOAA, NASA-LaRC and the CIMSS/PATMOS-x groups. These data were compared to each other and to the results from the NASA CALIPSO/CALIOP sensor, which is considered as truth in these comparisons. The images on the diagonal show the satellite retrievals for 03:30Z. The images above the diagonal are the scatterplots and images below the diagonal show the distributions. All data are for 0330 UTC except for the CALIPSO comparisons that include all AHI-CALIPSO colocations for August 19, 2015. The results show that the differences are caused primarily by each product's ability to correctly (a) detect thin cirrus and (b) place low-level cloud heights in the presence of marine inversions.

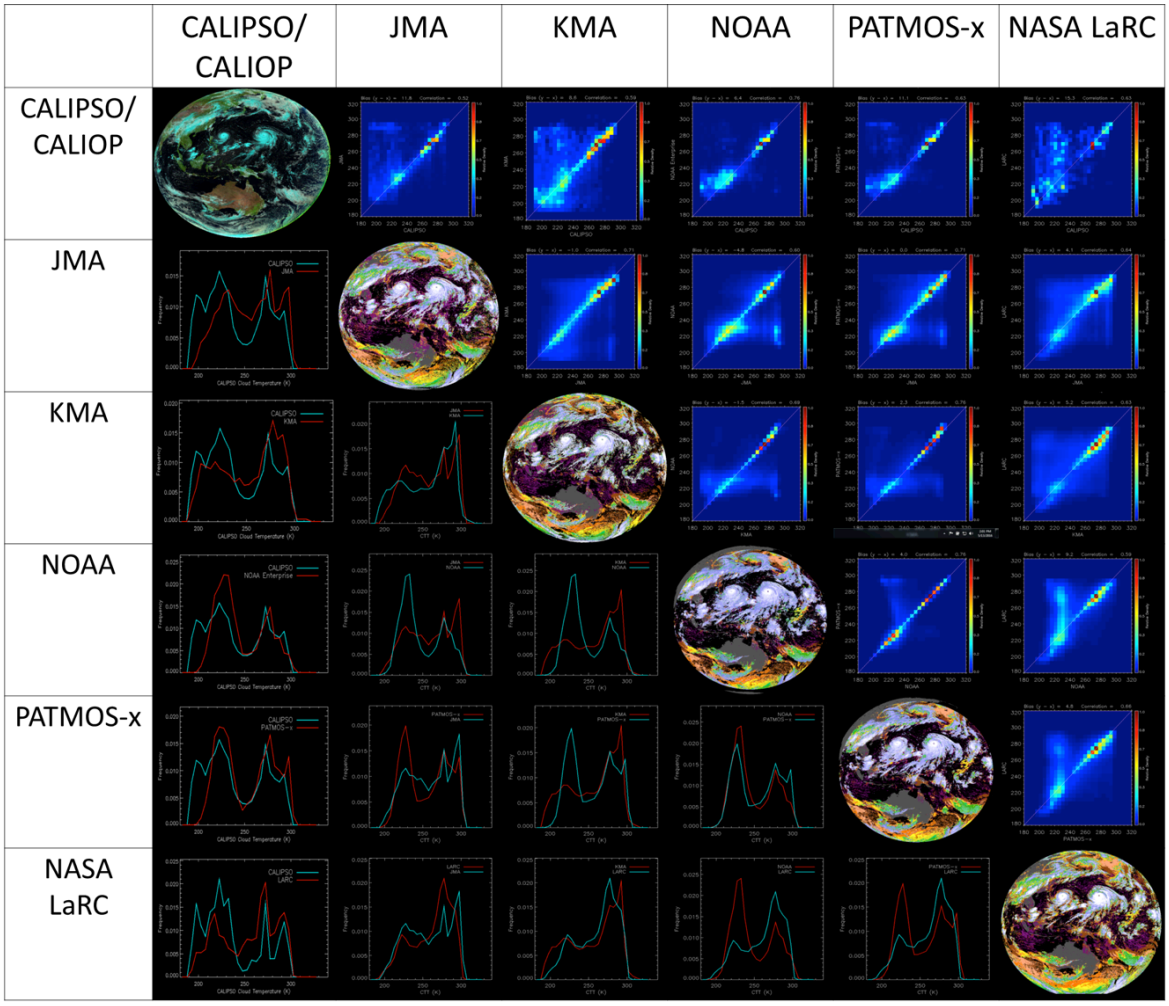

Figure 1: Analysis of the 5 cloud-top temperature products generated from AHI data products submitted to ICWG. Images on diagonal are the product images except for the upper left corner which is a false color image. Images above the diagonal are the scatterplots and images below the diagonal are the distributions. All data are at 0330 UTC except for the CALIPSO data, which include all AHI-CALIPSO co-locations for August 19, 2015.

PLANS FOR FUTURE IWWG COLLABORATION

In addition to product inter-comparisons, the ICWG formed a topical group on "*Assessment of Retrieval Uncertainties*". This group was led by Caroline Paulsen and Phil Watts. The discussions within this group dealt mainly with setting up the framework for properly computing and comparing uncertainties. It is hoped that the ICWG can work with the IWWG and develop standard metrics of quality and uncertainty that are optimal for the AMV application. As mentioned earlier, Steve Wanzong's presentation at this IWWG meeting titled "Comparison of OCA and ACHA Cloud Pressures for AMVs" was a first attempt to provide an ICWG analysis that is relevant for AMV analysis. Figure 2 shows a figure from Steve's presentation that compares cloud-top pressure (top) and cloud-top pressure uncertainty (bottom). The Optimal Cloud Analysis (OCA) (Watts et al., 2011) is a EUMETSAT cloud algorithm and the AWG Cloud Height Algorithm (ACHA) (Heidinger and Pavolonis, 2009) is an analogous algorithm from NOAA. Both OCA and ACHA are Optimal Estimation (OE) approaches that automatically provide uncertainty estimates. Figure 2 shows that the two uncertainty estimates display similar results, with the largest errors coming from cloud edges and the lowest errors from opaque clouds. The results from Figure 2 are from nighttime observations where OCA and ACHA use a similar channel set. For daytime hours, OCA uses solar reflectance channels while ACHA does not. The difference in the channel sets during the day result in larger differences in uncertainty. Differences

in uncertainty are also apparent in multi-layer scenes. Other ICWG cloud height providers do not use OE algorithms and therefore, the estimation of uncertainties is different. However, further comparison of uncertainties with these algorithms will also be considered. These issues will be addressed as preparation for ICWG-2.

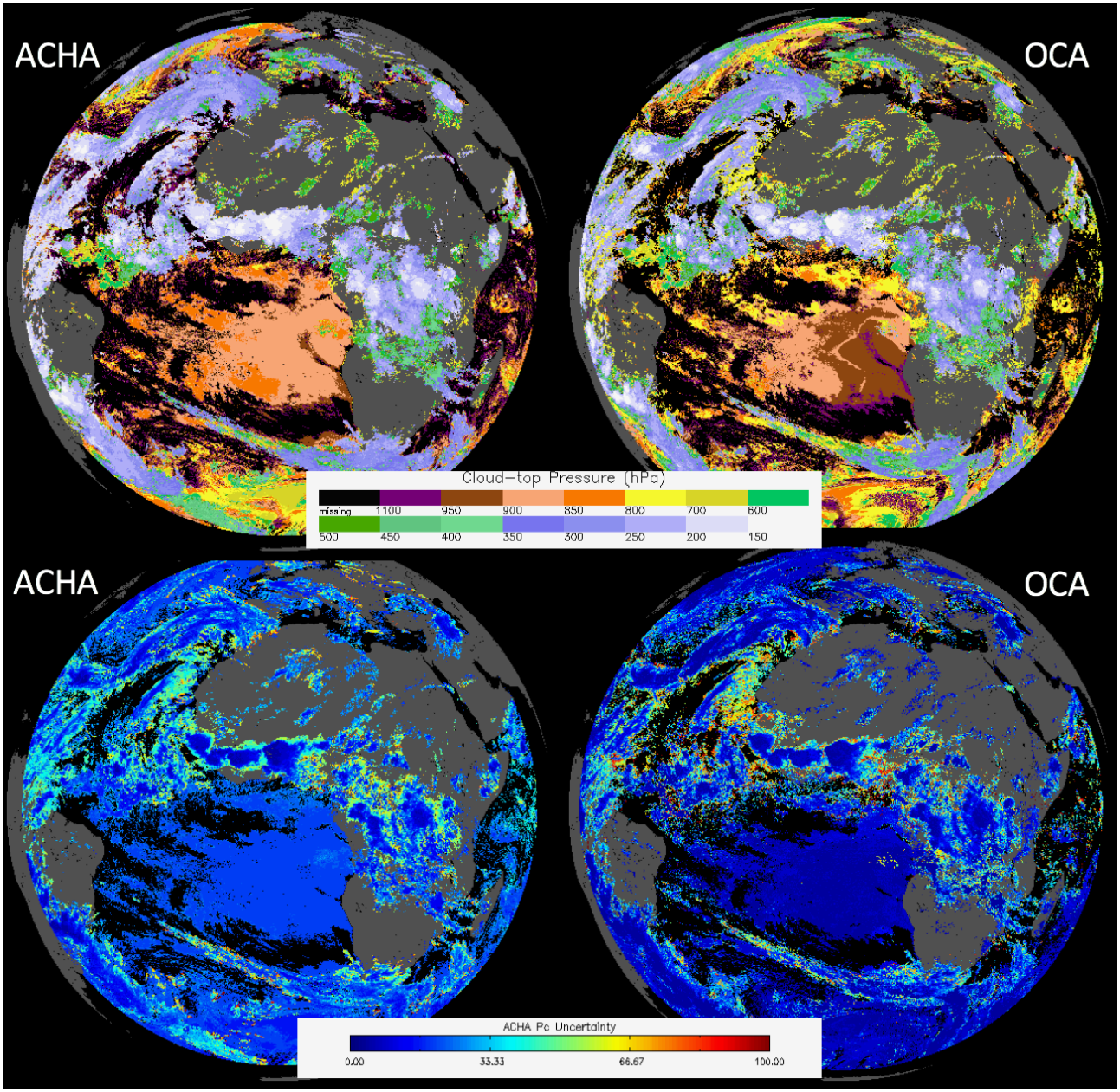

Figure 2: Comparison of the OCA(EUMETSAT) and ACHA(NOAA) cloud-top pressures (top) and cloud-top pressure uncertainties (bottom). Units of cloud-top uncertainty are hPa.

CONCLUSIONS

The ICWG is the newest CGMS working group. As the use of cloud products by AMV applications becomes more and more common, the need for cooperation between the ICWG and IWWG becomes critical. The goal of the ICWG is form a sub-group with focus of optimizing the cloud height products and their uncertainties for the AMV applications. During this IWWG, Steve Wanzong showed the comparison of the

heights from OCA and ACHA as used by a common AMV algorithm. A goal for the next meeting is to extend this analysis to all of the ICWG cloud-height providers and present at the next ICWG meeting.

REFERENCES

Heidinger, A. K., and M. J. Pavolonis, 2009: Gazing at Cirrus Clouds for 25 Years through a Split Window. Part I: Methodology. *J. Appl. Meteor. Climatol.,* **48**,1100–1116, doi: 10.1175/2008JAMC1882.1.

Roebeling R., B. Baum, R. Bennartz, U. Hamann, A. Heidinger, A. Thoss, and A. Walther, 2012: Third Cloud Retrieval Evaluation Workshop (CREW-3) GEWEX newsletter 2012, February 2012

Rob Roebeling, Bryan Baum, Ralf Bennartz, Ulrich Hamann, Andy Heidinger, Anke Thoss, and Andi Walther, 2013: Evaluating and Improving Cloud Parameter Retrievals. *Bull. Amer. Meteor. Soc.,* **94**, ES41–ES44. doi: http://dx.doi.org/10.1175/BAMS-D-12-00041.1

Rob Roebeling, Bryan Baum, Ralf Bennartz, Ulrich Hamann, Andrew Heidinger, Jan Fokke Meirink, Martin Stengel, Anke Thoss, Andi Walther, and Phil Watts, 2015: Summary of the Fourth Cloud Retrieval Evaluation Workshop. *Bull. Amer. Meteor. Soc.,* **96**, ES71–ES74. doi: http://dx.doi.org/10.1175/BAMS-D-14-00184.1

Watts, P., R. Bennartz, and F. Fell (2011a): Retrieval of two-layer cloud properties from multispectral observation using optimal estimation, Journal of Geophysical Research, Vol. 116, D16203, doi:10.1029/2011JD015883