Highlights of CREW and Plans for ICWG

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Abstract
The Cloud Retrieval and Evaluation Workshop (CREW) has met 4 times. CREW initially focused on comparisons of cloud retrievals for a set of images from the MSG/SEVIRI sensor. CREW has expanded its scope to include most current sensors that generate operational cloud products. In addition, CREW also grown to include discussions on optimal Level-2 and Level-3 data for cloud product users including weather and climate modellers. With the approval of CGMS, CREW is transforming into the International Cloud Retrieval Working Group (ICWG). The ICWG welcomes continued collaboration with the IWWG. The first ICWG meeting will be held in 2016 in Lille, France.

CREW INTRODUCTION

The Cloud Retrieval Workshops (CREW) started in 2006 with support from EUMETSAT and with the aim of bringing cloud retrieval experts together to evaluate the retrieval of cloud products from the recently launched Meteosat Second Generation (MSG) SEVIRI instrument. Three additional CREWs has been held since 2006. The first workshop was held in Norrköping Sweden, the second in Locarno, Switzerland, the third in Madison, USA and the fourth in Grainau, Germany. As Figure 1 shows, the numbers of participants has grown steadily from 25 at the first meeting to roughly 70 at the fourth meeting. In addition, while the first CREW contained mainly Europeans, the CREW participant list now includes scientists from Europe, North America and Asia.

The goals of the CREWs are to enhance our knowledge on state-of-art cloud parameter retrievals from passive imager observations and move towards optimising these retrievals for now-casting, weather forecasting, climate monitoring, as well for the analysis of weather and climate models. Level-2 and Level-3 cloud parameter assessment studies are facilitated by a common database of passive imager retrievals (from geostationary and polar satellites) and reference observations from active instruments (e.g. from the A-Train). Roebeling et al. (2013) provides more information on the goals and history of CREW.

Figure 1: Growth in participant numbers in CREW meetings. Colors indicate regional participation.
CREW ANALYSIS

One successful feature of the CREW workshops was the notion to request participants to submit retrieval results for pre-selected SEVIRI scenes. A EUMETSAT-funded visiting scientist (A. Walther) and later a EUMETSAT funded research fellow (U. Hamann) manipulated the data submissions into a common format and applied a standard analysis to them before the CREW meeting began. The standard analysis was made available to the participants before or early in the workshop and this facilitated detailed and fruitful discussion among the participants. These analyses included inter-comparisons of the results for SEVIRI and comparison to CLOUDSAT and CALIPSO data in the EOS A-Train using the AVACS software suite. The data submitted to the CREW common data base, the CREW inter-comparison and validation packages, as well as the A-Train Validation of Aerosol and Cloud properties from SEVIRI (AVACS) software are available at the website of the ICWG (http://www.icare.univ-lille1.fr/crew/). The goal of these packages is to allow new data providers to replicate the CREW analysis at their home institutions between the CREW meetings. For any particular cloud product (cloud mask, height, phase, optical depth and particle size), there were roughly 10 providers. The analysis shown here is focused on the SEVIRI cloud height comparisons because these are likely the most relevant to the IWWG. Table 1 shows the providers and some algorithm information for the cloud height products from SEVIRI for the first CREW Workshop.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Method</th>
<th>Channels (µm)</th>
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Table 1: List of SEVIRI cloud height providers to CREW and some information on the cloud height algorithm.

Figure 2 shows a typical CREW analysis of cloud height for a single SEVIRI scene. Each image shows the results for one SEVIRI image from the providers listed in Table 1. Each image also shows the mean values computed for all cloudy pixels over the disk. The range in mean values is 440 to 593 hPa. Some of the differences observed in these comparisons are due to differences in the cloud mask. Because of this, part of the standard CREW analysis is to compare products using a common cloud mask and quantify the cloud mask impacts.

Figure 3 shows a more quantitative analysis of the cloud heights based on comparisons to the Cloud Profiling Radar (CPR) on the NASA CloudSat platform that was part of the EOS A-Train (Hamann et al., 2014). Figure 3 shows a Taylor plot that compares the bias and correlation of the SEVIRI cloud height against the standard CPR product. The results are separated for optically thin, optically thick, and multi-layered clouds. Perfect results would show values with a correlation of 1.0 and a normalized standard deviation of 1.0. The distance from the point of perfect agreement is a measure of product quality relative to the truth data (i.e., the CPR product). Figure 3 shows that the 10 data sets agree best for thick clouds and least for multilayered clouds. CREW reports used the AVACS tool to probe more deeply into regions of high amounts of disagreement.
Figure 2: Comparison of MSG/SEVIRI cloud heights from the CREW data providers for 13 June 2008 at 12:00 UTC. Mean values are listed next to the provider names. Bottom right image shows a false color image for reference.
Figure 3: Taylor plot of the SEVIRI cloud heights from each of the CREW participants. Truth data is from the NASA CloudSat CPR. X-axis and Y-axis are the normalized standard deviation. Correlation values are shown on outer axis.

**EVOLUTION OF CREW INTO ICWG**

In 2013, CREW co-chair Rob Roebeling sought and achieved permission at the 42nd meeting of Coordination Group on Meteorological Satellites (CGMS) in Guangzhou, China to form the International Clouds Working Group (ICWG). The ICWG will build upon the CREW activities and expand to formerly include representation from all operational meteorological centers. The overarching objectives for the establishment of the ICWG are to:

1. foster commonality for level-2 and level-3 operational cloud parameter retrievals and/or products;
2. contribute to the assessment of differences between level-2 cloud parameter retrievals;
3. contribute to the validation of both level-2 cloud parameter retrievals and their error estimates;
4. identify and address research questions on level-2 cloud parameter retrieval algorithms and level-3 aggregation methods;
5. contribute to process studies of clouds and/or convection;
6. contribute to the definition of new space borne observation capabilities for cloud parameter retrievals and validation;
7. support and stimulate training of the operational and scientific community;
8. enhance the communication in this field and develop international partnerships.

The list of potential topics and leads for the sub-working groups, as identified at the 4th CREW meeting, is presented in Table 2. The first meeting of the ICWG is planned for Lille, France in 2016.

The ICWG will maintain close relationships with other CGMS working groups serving the meteorological community, among others the IWWG. The communication with the IWWG is established through Andrew Heidinger, who is the nominated focal point currently.
Table 2: List of proposed topics and leads of the sub-working groups.

CONCLUSIONS

The CREW meetings have greatly expanded the collaboration with the satellite cloud retrieval community. This work will expand and continue under the newly formed International Cloud Working Group (ICWG). The ICWG looks forward to continuing to grow its relationship with the IWWG. With the growing reliance of AMV providers on the cloud heights generated by cloud retrieval algorithms, the ICWG expects the initial collaboration between the two groups to be focused on the cloud top height products and their error characterization. The IWWG has a strong collaboration with NWP and the ICWG also looks forward to the opportunity to collaborate with NWP more closely through its involvement in the IWWG. The ICWG is grateful for the invitation to attend the IWWG-12 and looks forward to future chances to work with the IWWG.

REFERENCES

