

# Summary Report on the International Clouds Working Group (ICWG)

Presented to CGMS-44 WGII/E.5.4

Rapporteur:

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# Outline

1. *Thanks to Bryan Baum and Rob Roebeling for their leadership and excellent cooperation*
2. Recalling actions and recommendations from CGMS-43
  1. Report from ICWG-1 (Thanks to the host, Prof. Jerome Riedi, for endurance in preparation)
  2. Topics for discussion =>

## Recalling Actions and Recommendations from CGMS-43 (May 2015)

CMA, EUM, JMA, NASA, NOAA, WMO	WGII/3	A42.02	The new task team on calibration events logging to identify a common set of parameters to be monitored as part of the calibration events logging and sensor performance monitoring.
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In Nov 2015 Co-chair R Roebling drafted white paper to be circulated within ICWG. The common cloud parameters discussed at ICWG-1 include: cloud mask (CM), cloud top temperature (CTT), cloud emissivity, effective radius (Re), and cloud optical thickness (COT).

ICWG	WGII/8	R43.14	ICWG should put focus on investigating data from the new-generations instruments on Himawari-8 and if available GOES-R for the retrieval of cloud parameters.
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In Nov 2015 ICWG established a TG titled “Assessment of level-2 Passive Imager Cloud Parameter Retrievals”, to assess the differences in Cloud Parameter Retrievals over the Asian region, applying existing retrieval algorithms to Himawari-8 measurements on 19 August 2015 (as the golden day for intercomparison).

ICWG, IWWG	WGII/6 and WGII/8	R43.11	ICWG and IWWG to liaise as appropriate on the provision of further information characterising the AMV derivation for enhanced QC and error characterisation.
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## ICWG-IWWG interactions:

Andy Heidinger from ICWG will be the liaison to IWWG. He and Dong Wu will participate in IWW-13 to be held in Monterey, CA, in June 2016. Regis Borde from IWWG attended ICWG-1 in Lille, France, in May 2016.

## ICWG-IPWG interactions:

Cloud-precipitation connection is also recognized in ICWG-1 and highlighted in a number of presentation papers. Rémy Roca and Ralf Bennartz, who plan to attend IPWG-8 meeting in October 2016 in Bologna, Italy, will help to facilitate further cooperation between the two groups.

## High-Level Priorities from CGMS-33

3.2.3	Develop best practices for retrieving cloud properties, using the converging capabilities of next-generation geostationary imagers	ICWG
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ICWG Topical Groups selected August 19, 2015 as the golden day for inter-comparison and evaluations of cloud products. The results are presented at ICWG-1. GOES-R ABI and polar orbiting data will be included for intercomparison before ICWG-2. ICWG attempts to establish references from these comparisons that can be used as benchmarks to track the cloud product accuracies from CGMS agencies.

3.2.4	Using current and future geostationary imagers and sounders, generate and disseminate consistent basic nowcasting products, initially in pilot areas, as identified in SCOPE-Nowcasting.	ICWG
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ICWG Severe Weather Topical Group had active discussions on nowcasting products as well as data collection and effective information generation. A scan strategy is recommended to include full disk imaging at least every 10 minutes when satellite and ground station capabilities allow. The group identified a need for intercomparison studies from various satellite derived thunderstorm properties over the life cycle of several thunderstorms.

## ICWG Biennial workshop

The 1<sup>st</sup> biennial workshop of the ICWG, or ICWG-1, was held in Lille, France from 17 to 20 May 2016, with ~85 attendees. The workshop covered a wide range of topics concerning cloud parameter retrievals, its applications and related issues.

### Key issues of the ICWG-1 are:

- *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*



## ICWG-1

**17-20 May 2016, Lille, France, Europe**

*Organized by Université de Lille 1 - Sciences & Technologies, France*

*Financially supported by EUMETSAT*

[Website:](#)

[http://www.icare.univ-lille1.fr/crew/index.php/Welcome\\_ICWG](http://www.icare.univ-lille1.fr/crew/index.php/Welcome_ICWG)



# ICWG Topical Groups (Lead)

- **Cloud masks (Karl-Göran Karlsson)**
- Calibration of passive imagers (Dave Doelling)
- Use of combined sensors for cloud retrievals (Bryan Baum)
- **Cloud modelling for remote sensing (Phil Watts)**
- Cloud height for wind applications (Andy Heidinger)
- Cloud retrievals over snow and ice surfaces (Andi Walther and Adam Dybbroe)
- **Severe weather applications (Mike Pavolonis)**
- Validation sources and strategies (Pat Minnis)
- **Assessment of level-2 passive imager cloud parameter retrievals (Yong-Sang Choi)**
- **Assessment of retrieval uncertainties (Caroline Poulsen )**
- Aggregation methods for climate applications (Nadia Smith)
- **Assessment of cloud parameter data records for climate studies (Martin Stengel, Mike Foster)**

## R43.14: ICWG investigations on new-generation instruments (e.g., Himawari-8, GOES-R) for cloud parameters

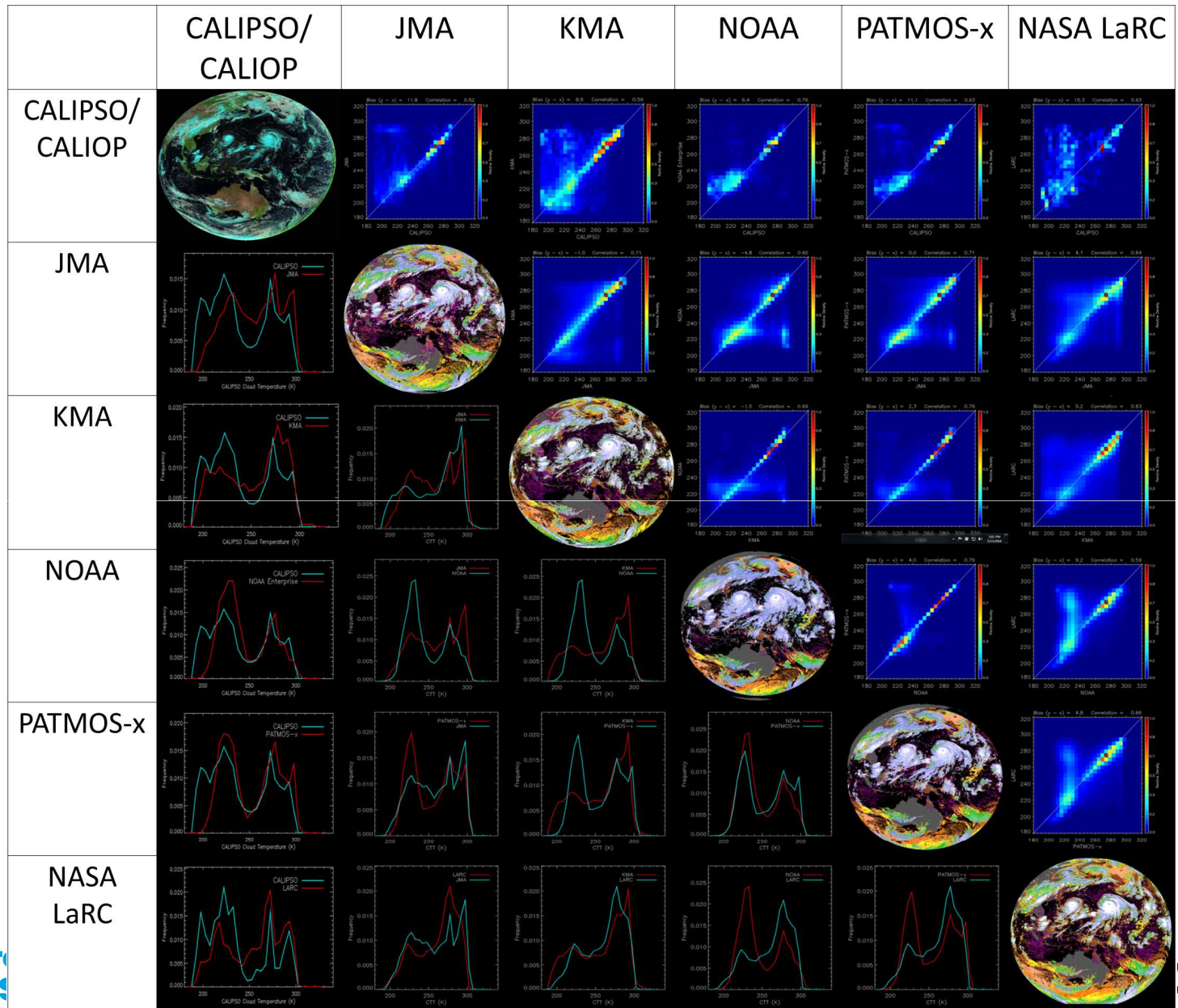
- August 19, 2015 was selected as the golden day for inter-comparison and evaluations of cloud products.
- Participants included CMA, EUMETSAT, JMA, KMA, NASA-GSFC, NASA-LaRC and NOAA at the ICWG-1 meeting.
- ICARE has been hosting and will continue to host the inter-comparison data sets.
- Data will be made available to other groups interested in testing operational cloud products for specific applications.
- GOES-R ABI inter-comparison will also be considered before ICWG-2 meeting. Polar orbiting data will be collected for this golden day for future analysis.
- Will consider a polar orbiting inter-comparison for the same golden day used for AHI.
- Will attempt to establish references from these comparisons that can be used as benchmarks to track the cloud product accuracies from CGMS agencies. For example, Taylor Plots using CALIPSO as the reference will be used as one benchmark result for cloud height comparisons.
- Should expand to include basic measures of uncertainty for each product as recommended by the ICWG Uncertainty Group. For example, inclusion of cloud-top pressure errors would foster collaboration with the IWWG.



# Coordination Group for Meteorological Satellites - CGMS

ICWG inter-comparisons of cloud fraction for Golden Day August 19, 2015

(Heidinger et al.)



# Suggested Action Items to GCMS

(From Cloud Inter-Comparison Group)

- CGMS members to submit their data to the ICWG intercomparison. Full-disk data at 10 minute temporal resolution, 2 km spatial resolution in the native AHI projection is preferred. The data should be submitted by September 1, 2016.

## Recommendation to CGMS

- CGMS members to budget a baseline funding for the intercomparison study, given its importance and impacts on global cloud products. Currently, ICWG helps to facilitate to collect the data (e.g., level-3 climate data record in TG Climate Product, level-2 retrieval assessment in TG Intercomparison), but many teams carried out the efforts on a volunteer basis. Lack of funding limited the scope and prohibited a definitive analysis of the new HIMAWARI-8 data set.

# Severe Weather Topical Discussion

- Summary of European CWG activities
- Satellite data collection recommendations for CGMS agencies
- Recommended steps towards global harmonization of derived products for severe weather applications
- Coordination with other ICWG topical groups (e.g. cloud property needs for severe weather applications)
- Outside CGMS coordination

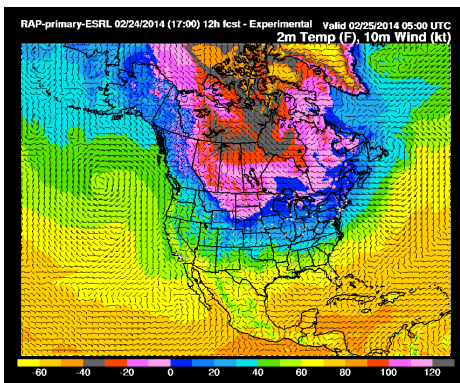
**Initial primary focus is mid-latitude convective nowcasting applications over land**

# Summary for CGMS

(From Severe Weather Topical Group)

- **Recommendation to CGMS:** To ensure that rapidly evolving weather outside of rapid scan areas is sufficiently sampled, CGMS geostationary satellite operators should adopt a scan strategy that includes full disk imaging at least every 10 minutes when satellite and ground station capabilities allow.
- **Recommendation to CGMS:** Since satellite products that directly address severe weather nowcasting applications (0 to 6 hour forecasts) have not been standardized, it is recommended that CGMS agencies provide a list of operational Level-2 products that utilize meteorological satellites for severe weather (thunderstorm) applications.
- **ICWG Action:** Inter-compare various satellite derived thunderstorm properties over the life cycle of several thunderstorms identified as worthy of study by the European Convective Working Group. This activity is a natural extension of the satellite-derived cloud property inter-comparisons performed by the members of the ICWG over the last 10 years, but endorsement by CGMS agencies is critical to ensure that the work is prioritized and completed.

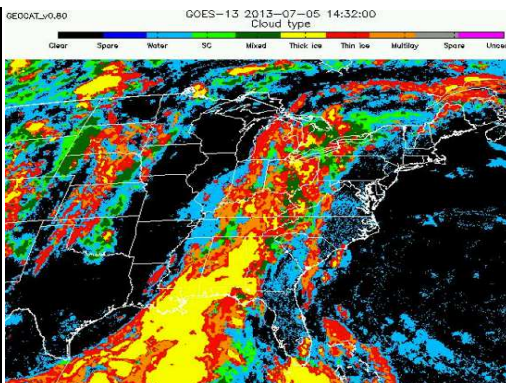
# Best Scientific Practice for Severe WX



High-resolution NWP  
Data



Storm Environment



Geostationary  
Satellite Data



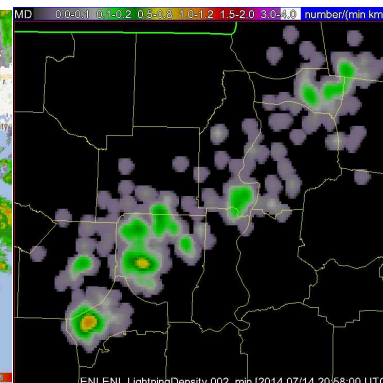
Evolution of Cumulus  
to Cumulonimbus



Precipitation Radar  
Data



Storm Tracking and  
Hydrometeor  
Properties



Lightning Data



Storm  
Electrification

Encourage algorithm developers to utilize satellite data, in tandem with non-satellite data, to develop improved applications for short-term severe weather forecasting

# Recommendations to CGMS

(From Severe Weather Topical Group)

- Ensure that convective weather outside of rapid scan areas is sufficiently sampled, geostationary satellite operators from CGMS members should adopt a scan strategy that includes full disk imaging at least every 10 minutes when satellite and ground station capabilities allow.
- When only a subset of spectral channels on a geostationary sensor can be disseminated during rapid scan operations, the channel selection should include at least two infrared window channels (3 where possible) in addition to standard visible (0.65  $\mu\text{m}$ ) and near-infrared (3.9  $\mu\text{m}$ ) measurements to allow convective cloud properties to be estimated for nowcasting applications regardless of solar zenith angle.
- In coordination with users, CGMS members to work towards standardizing satellite products (requirements and terminology) that identify rapid developing cumulus clouds and mature cumulonimbus with strong updrafts.
- Initiate coordination with IWWG, ITWG, and IPWG on convective weather.
- Use satellite cloud products in tandem with non-satellite data, specifically ground-based radar and lightning products.

# Cloud Models (CMo) for Remote Sensing

**Aim:** Obtain a collective view on current cloud modelling issues and solutions (both employed and proposed), document to provide a group resource and an encouragement for collaborative endeavour.

## Baseline to define a modelling issue:

Single layer, plane parallel, homogeneous microphysics and temperature

ICWG CMo Issue 1 – Multi-Layer Cloud

ICWG CMo Issue 2 – Horizontal Inhomogeneity

ICWG CMo Issue 3 – Vertical Inhomogeneity

ICWG CMo Issue 4 – Ice scattering parameters

ICWG CMo Issue 5 – Aerosol (with cloud, over, in or below)

ICWG CMo Issue 6 – Fractional Cover ( $n < 1$ )

ICWG CMo Issue 7 – index of refraction

ICWG CMo Issue 8 – Effective variance

# GEWEX Cloud Assessment

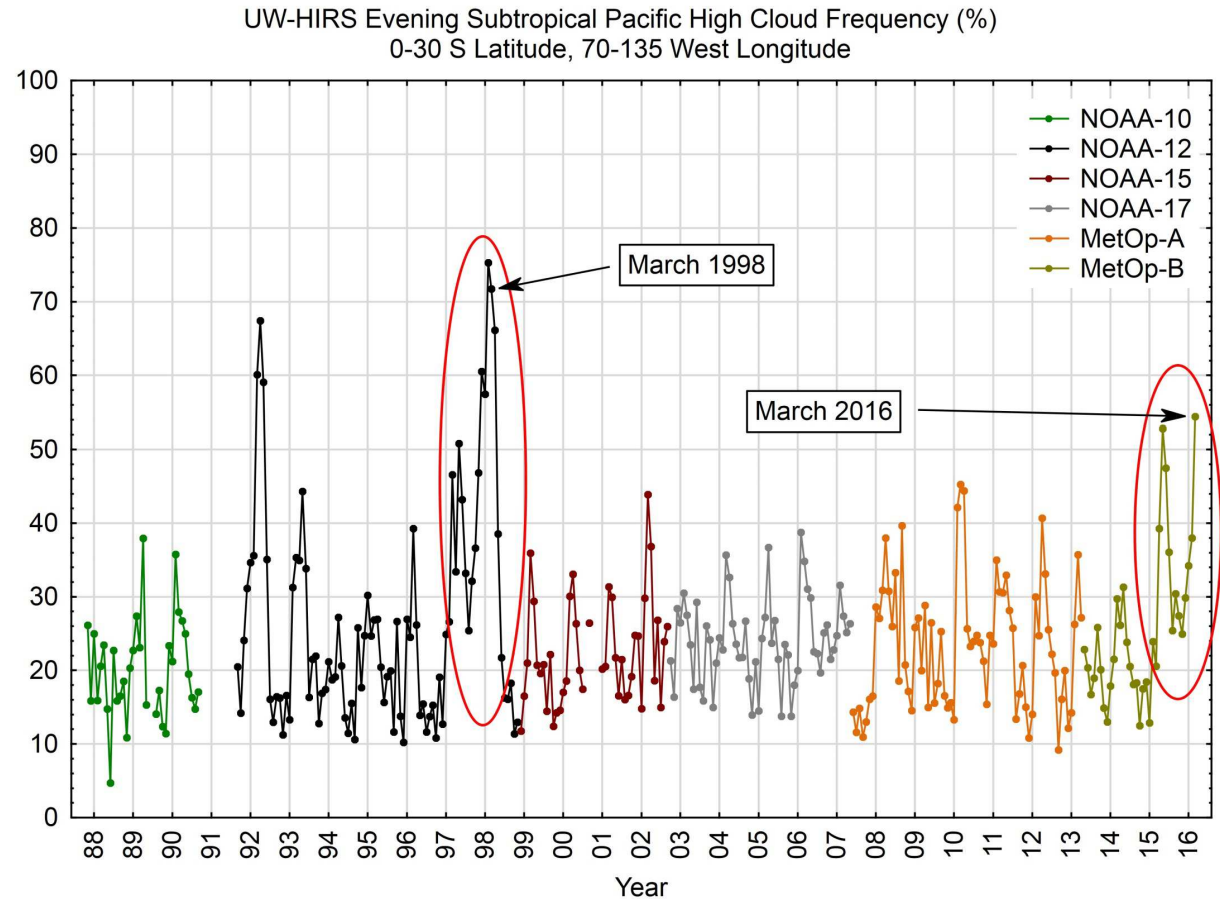
(From Climate Product Topical Group)

- The Climate Product Topical Group discussed the value of the GEWEX Cloud Assessment as an archive for level3 cloud climatologies in a shared format. To this end six of the participants present agreed to either add or extend their data holdings in the GEWEX archive ([climserv.ipsl.polytechnique.fr/gewexca/](http://climserv.ipsl.polytechnique.fr/gewexca/)):
  - SATCorps, PATMOS-x, CLARA-A2, HIRS CMSAT, Cloud\_CCI, CALIPSO
- Questions raised regarding the current GEWEX format included whether:
  - The current level3 spatial resolution ( $1^{\circ} \times 1^{\circ}$ ) would be sufficient for current and future model needs (perhaps add  $0.5^{\circ} \times 0.5^{\circ}$  when possible)
  - We need to add or change included variables (CDNC, radiative properties)
  - Given the increase in AVHRR- and HIRS-derived records a method to address satellite drift should be included;
  - Averaging standards should be developed to account for visible saturation for optical retrievals
  - Uncertainty estimates should be integrated into the averaging process.
- Recommendation to ICWG and GEWEX DAP
  - The Climate Product Topical Group expressed interest in extending and expanding GEWEX Cloud Assessment activities in the ICWG framework.



## High-Level Cloudiness During El Nino: 1997-98 vs. 2015-16

- HIRS observations since 1979 for cloudiness over ocean (0-30S and 70W-135W)
- Three El Nino events: 1982-83, 1997-98, and 2015-16
- Occurrence of monthly high clouds: 75% in 1982-83 (not shown here) and 1997-98
- The 2015-16 event: high-level cloudiness lower by ~30% in general. The 2016 March spike is still 15% lower than March 1998.



Credit: R. Frey and P. Menzel (U Wisc)

# Uncertainty of Climate Data Records

(From Climate Product Topical Group)

- Discussed prominent issues facing those groups developing climate data records (CDRs) from heritage sensors like HIRS and AVHRR, as the number of cloud climate records developed from these sensors has steadily grown in recent years. Issues identified as being priorities include:
  - Calibration
  - Reliance on reanalysis products as ancillary data
  - Aliasing effects caused by orbital drift

These are issues that specifically affect stability of these records over time, limiting their usefulness for certain climate applications such as trend detection.

- **Recommendation to CGMS CDR developers**
  - We recommend CDR development groups that use heritage sensors collaborate to better characterize error associated with calibration, dependence on ancillary data, and satellite drift, with the goal of developing robust methods for minimizing uncertainty paying specific attention to improving the long-term stability of the record via addressing biases on season, annual and multi-decadal timescales.

# Reprocessing

(From Climate Product Topical Group)

- The Climate Product Topical Group discussed the challenges of re-processing modern satellites for CDR purposes as the amount of data produced by these satellites rapidly increases. The amount of data produced by Suomi NPP, Himawari and others and future launches (e.g. GOES-R series) is large enough to make it difficult to re-process.
- **Recommendation to Satellite Data Processors**
  - We recommend Satellite data processors develop sub-sampled versions (perhaps ~5km) of level1b files including statistical information (i.e standard deviation) to reduce the size of satellite data and facilitate re-processing for CDR development.

# Suggested Action items to CGMS

(From Climate Product Topical Group)

- CDR developers submit their records to the GEWEX Cloud Assessment archive
- CDR developers produce diurnally corrected products based on intended local overpass time of the satellite series at launch (e.g. afternoon or morning).

## Recommendations to CGMS

- Satellite Data Providers generate subsampled versions of level1B products for recent and future launches to facilitate CDR reprocessing, for example, MODIS MYD02SSH data.

# Active Cloud Sensors

- ICWG TGs recognize importance of CALIPSO, ISS/CATS, and the upcoming EarthCARE mission for validation of the cloud properties retrieved from passive sensors. The absence of space cloud lidars will severely impact our ability to evaluate cloud products from new sensors, and product uncertainty from advanced cloud retrievals.
- The availability of future spaceborne lidar cloud measurements is essential for validation of long-term cloud records. Lack of plans for space cloud lidars beyond EarthCARE has raised ICWG's concern.
- **Recommendation to Space Lidar Providers**
  - Long-term lidar measurements from space are important for validation of atmospheric retrievals from passive sensors. The Climate Product Topical Group encourages satellite providers to provide sufficient funding for future lidar missions.

## ICWG Changes and Updates

- Andy Heidinger (NOAA/NESDIS) to replace Bryan Baum as ICWG Co-Chair

## Information Exchange

The ICWG members are encouraged to exchange data and code with the aim to foster development of cloud retrieval algorithms and the generation data records for meteorological and climatologic applications.

- ICWG-1 discussion to consider open source community validation software
  - Suitable for GEO and Polar orbiters (even high resolution )
  - Python based library -> Pytroll (<http://www.pytroll.org>)
  - Cost sharing and possible partial funding?

## Website

The ICWG website hosts information on the workshops, access to common data records and tools, and information on the Topical Groups. Please visit:

[http://www.icare.univ-lille1.fr/crew/index.php/Welcome\\_ICWG](http://www.icare.univ-lille1.fr/crew/index.php/Welcome_ICWG)

*Thanks to ICARE, Université de Lille 1 - Sciences & Technologies*