Program

EUMETSAT Cloud Workshop-2

3 - 5 February 2009 Locarno, Switzerland
Hosted by MeteoSwiss

Anke Thoss (SMHI),
Rob Roebeling (KNMI)
Igor Giunta (MeteoSwiss)

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Federal Office of Meteorology and Climatology
MeteoSwiss

Tuesday 3 February 2009

CLIMATOLOGIES

Chairperson: Rob Roebeling

09:00 Welcome
Igor Giunta and Anke Thoss

09:10 Keynote: Cloud Climatologies and results of GEWEX Cloud Assessment
Claudia Stubenrauch

09:40 Evaluation of the global cloud cover parameters obtained from geostationnary data in the frame of the MEGHA-Tropiques mission with CALIPSO lidar observations
G. Sèze, H. Legleau, M. Derrien , J. Pelon , S. Cloche

10:00 AVHRR Cloud Products NOAA/NESDIS Center for Satellite Applications and Research
Andrew Heidinger

10:20 Cloud Products CM-SAF
Rainer Hollmann and Maarit Lockhoff

10:40 COFFEE BREAK

RETRIEVAL ALGORITHMS

Chairperson: Juergen Fischer

11:00 Keynote: The MODIS Cloud Optical and Microphysical Product
Steve Platnick

11:30 SAFNWC / MSG cloud products
M.Derrien, H.Le Gléau and M.P. Raoul

11:50 Cloud detection using SEVIRI IR channels for the GERB processing
Alexandro Ipe

12:10 Recent improvements to the SEVIRI cloud processing methods used at the Met Office
James Hocking and Pete Francis

12:30 Simulated satellite radiances for the validation of cloud property retrievals
Luca Bugliaro

12:50 LUNCH BREAK

VALIDATION STUDIES AND APPLICATIONS

Chairperson: Bryan Baum

14:00 Keynote: Near-real time cloud products from operational and research meteorological satellites
Patrick Minnis, Louis Nguyen, William L. Smith, David R. Doelling

14:30 A Tool for Validating Cloud parameters from A-Train data
Phil Watts

14:50 Comparison of different inversion techniques for daytime cloud optical and microphysical parameters retrieval
Andi Walther

15:10 On the sensitivity of satellite-derived cloud climatologies to sensor resolution
H. Deneke, R. Roebeling, E. Wolters, C. Simmer, and A. Feijt

15:30 Comparison of cloud properties derived from SEVIRI and MODIS above the Southern Atlantic
Rene Preusker, Steffen Kothe, Anja Hünerbein, Jürgen Fischer

15:50 COFFEE BREAK

Chairperson: Pete Francis

16:20 Keynote: Improvements in MODIS Collection 6 Cloud-Top Properties and Ice Cloud Bulk Optical Models
Bryan Baum

16:50 Evaluation of CM-SAF cloud products in the Arctic region using CloudSat/CALIPSO measurements, synoptical observations and MODIS Level 3 products.
Karl-Göran Karlsson

17:10 Impact of Pixel Resolution and Cloud Horizontal Inhomogeneity on Satellite Cloud Phase Climatology Using Modis Data
E.L.A. Wolters, H.M. Deneke, J.F. Meirink, and R.A. Roebeling

17:30 Impact of the use of surface emissivity information on cloud detection and cloud analysis
Hans-Joachim Lutz

19:00 DINNER

Wednesday 4 February 2009

WORKSHOP INTERCOMPARISON

Chairperson: Claudia Stubenrauch

09:00 Intercomparison overview
Rob Roebeling

09:20 Validation of MSG and MetOp products from ship based measurements over the Atlantic Ocean
Andreas Macke, John Kalisch, Yann Zoll, Rainer Hollmann, Peter Schlüssel

09:40 Results MSG intercomparison
Andi Walther

10:00 Results Polar Satellite intercomparison
Anke Thoss

10:20 Discussion

10:30 COFFEE BREAK

11:00 Comparison against Cloudsat/Calipso
Andi Walther

11:30 Discussion & Working group formation
Anke Thoss

11:50 Official Welcome
Dr Peter Binder, Head of Forecasting Division, MeteoSwiss

12:00 LUNCH BREAK

WORKING GROUPS

13:30 WG sessions 1

15:30 COFFEE BREAK

16:00 WG sessions 2

18:30 DINNER and SOCIAL EVENT

Thursday 5 February 2009

Chairperson: Andi Heidinger

09:00 Presentations of WG rapporteurs

10:30 COFFEE BREAK

11:00 Plans for joint paper

11:30 Recommendations and where do we go from here?

12:30 LUNCH BREAK and DEPARTURE

ANNEX 1: ABSTRACTS

Improvements in MODIS Collection 6 Cloud-Top Properties and Ice Cloud Bulk Optical Models

Bryan Baum
Space Science & Engineering Center
University of Wisconsin-Madison, Madison, USA

Later this year, members of the MODIS Atmospheres Team will be delivering software to NASA Goddard Space Flight Center for the upcoming Collection 6 processing effort. This collection will include a number of enhancements to MODIS radiometic calibration and cloud retrieval algorithms from what is available in the current collection. The anticipated improvements in cloud-top properties, such as the cloud mask and cloud-top height, are a result of ongoing efforts to compare MODIS cloud products to those from the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) on the Cloud-Aerosol Lidar Pathfinder Satellite Observations (CALIPSO) platform. The first part of this talk will focus on the enhancements to the MODIS cloud top properties anticipated for Collection 6. The second part will focus on recent work regarding the derivation of ice cloud bulk optical properties. The ice optical models include volume, projected area, asymmetry factor, scattering cross section, extinction cross section, and the scattering phase function. These properties are critical for building a static library of ice cloud reflection and transmission functions used in the operational retrieval of ice cloud optical thickness and effective particle size. A new scattering property database is, at the time of this writing, being derived for a set of discrete wavelengths between 0.4 and 100 μm. Scattering properties are being computed for particles spanning a maximum dimension range of 2 to 10,000 μm with a finer resolution in particle size than in the previous database. Our previous library of single-scattering properties at solar wavelengths included a parameter that accounted for the fraction of delta transmission energy, which is a contribution in the forward scattering direction due to the direct transmission of rays through two parallel particle-air interfaces. However, this parameter is an artifact of the geometric ray tracing method. A new treatment of ray spreading has been incorporated for forward scattering, replacing the delta-transmission term for photons that pass through two opposing (flat) facets of a hexagonal ice particle. Both ice particle surface roughening and polarization will be included.

Simulated satellite radiances for the validation of cloud property retrievals

L. Bugliaro, W. Thomas, T. Zinner, and B. Mayer
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The determination of cloud macrophysical (e.g. cloud top height), optical (e.g. cloud optical thickness) as well as microphysical (e.g. cloud effective particle radius) is essential for various applications and in general for a deep understanding of cloud processes. However, validation of retrieved cloud properties is complicated. Cloud classification algorithms are usually based on heuristic threshold tests. Independent objective methods to derive cloud properties are often not available, as satellite observations are the only means to observe clouds on a grand scale. Cloud observations from the surface are one possible data source for validation, but we know that systematic differences are to be expected, due to the different observation geometries from the surface and from the satellite. For cloud microphysical properties, the situation is even worse: Only few in-situ data, measured by aircraft, are available. To get reliable estimates of cloud microphysical properties from the ground, a complex combination of instruments is required to get quantitative results (e.g. microwave radiometry, radar, lidar). In addition, cloud inhomogeneity introduces some bias and considerable noise into the optical thickness and effective radius retrieved at the resolutions of the order 1-5 km. Although one could live with a small bias, noise hampers the validation by in-situ observations.

Thus, the following strategy is proposed and applied to our cloud property retrieval for MSG/SEVIRI: Starting from known cloud fields, the satellite observation has been simulated using a 1D and a 3D radiative transfer model to produce datasets where radiation as well as cloud properties are fully known, in contrast to using satellite observations alone where only the radiation field is available and the accuracy of the derived cloud information cannot be assessed because the ‘real’ cloud properties are not known. On this basis, retrieval algorithms can be tested and tuned, by comparing the retrieved properties with the initial cloud properties.

On the sensitivity of satellite-derived cloud climatologies to sensor resolution

H. Deneke[1,2], R. Roebeling[1], E. Wolters[1], C. Simmer[2], and A. Feijt[1]
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[2] Meteorological Institute of the University of Bonn (MIUB), Bonn, Germany

Current operational cloud property retrievals from meteorological satellite imagers assume the presence of a plane-parallel cloud covering individual satellite pixels. Thereby, all variability at spatial scales smaller than the sensor resolution is neglected. Due to the high spatial variability of clouds, and due to the non-linear relation of radiances to cloud properties, satellite-inferred cloud climatologies are known to be sensitive to the spatial resolution of the instrument.

We compare retrieval results obtained at typical nadir resolutions for polar-orbiting and geostationary satellite platforms of 1x1 and 3x3 km^2, respectively. The resulting distributions of cloud optical thickness, effective radius and water path exhibit significant random and systematic differences as a consequence of the differing sensor resolution.

To identify the mechanisms causing these differences, pixels are classified according to thermodynamic phase, sub-pixel cloud cover, and unresolved spatial variability. For these classes, the occurrence frequency and the resulting errors in cloud properties are quantified. In addition, the effects of mis-classifications by the cloud mask and thermodynamic phase determination are investigated.

Finally, the relevance of individual mechanisms for the overall accuracy of climatological cloud datasets are discussed, and possible strategies to correct for the resolution dependence for some of the mechanisms are presented.

SAFNWC / MSG cloud products

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Within the SAF in support to Nowcasting and Very Short Range Forecasting (SAF NWC), Météo-France has developed a software to extract cloud parameters (cloud mask and types, cloud top temperature and height) from MSG SEVIRI imagery. These modules are part of the SAFNWC/MSG software package whose first operational version (v1.0) has been available to users since June 2004. One year later, users could get an improved version (v1.2) tuned using SEVIRI images on a longer period. This latter version has been validated from one year of SEVIRI data by using collocated SYNOP observation, manual nephanalyst reports, radiosondes and lidar measurements and has been compared to other operational schemes during the first Eumetsat cloud workshop in 2006. Since then the cloud algorithms implemented in the SAFNWC/MSG software package have remained unchanged. A major improvement has been developed at Météo-France and will be available to the users through the version v2009 of the SAFNWC software package (available to users early 2009).

This paper summarizes the main features of the SAFNWC/MSG cloud algorithms that will be implemented in the version v2009 of the SAFNWC/MSG software package, presents extended validation results obtained from SYNOP observation and ground-based lidar/radar measurements and highlights the strength and weakness of the method, using the "satellite cloud parameter retrieval workshop" common test cases for illustration.

Recent improvements to the SEVIRI cloud processing methods used at the Met Office

James Hocking and Peter Francis
UK Met Office, Exiter, UK

Cloud products derived from radiances measured by geostationary satellites are required operationally in near-real time by the forecasting systems at the Met Office. They are used in the form of value-added imagery products to give visual aid to forecasters, and also provide important inputs to the Met Office's automated nowcasting systems, which provide short-range forecasts for the United Kingdom and north-west Europe.

The additional spectral channels available from SEVIRI, compared with previous Meteosat instruments, enable improvements to be made in the detection of cloud, and also in the determination of cloud-top pressure and temperature, cloud phase, optical thickness and effective radius.
The methods used by the Met Office for these retrievals will be summarised, some examples of these products will be shown, and improvements to the processing based on the results of the 2006 Cloud Workshop will be described.

More recently, further improvements have been made to the cloud mask, by making use of: (i) temporal differencing techniques to improve detection around dawn and dusk, (ii) EUMETSAT's Clear-sky Reflectance Map product to improve detection over land, and (iii) an additional spatial coherence test using data from the High Resolution Visible channel. In addition, we have also recently introduced RTTOV-9 as our fast radiative transfer model, which has improved the performance of our cloud-top pressure scheme, especially for low clouds. These improvements will be described, and examples will be shown.d by geostationary

AVHRR Cloud Products NOAA/NESDIS Center for Satellite Applications and Research

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NOAA/NESDIS currently generates cloud products from imagers flown on the POES, METOP and GOES platforms. In addition, it has embarked in collaboration with other agencies on an effort to develop cloud algorithms for the future GOES-R series of geostationary satellites. This talk provides an overview of the NESDIS imager cloud product suite, its history and its plans for the future. In addition to being an important source of real-time cloud product information, the AVHRR is also gaining importance in area of multi-decadal climate research because its data record spans over three decades (1979-2009+). The second half of this talk will compare the NESDIS AVHRR cloud products to those from the SMHI Polar Platform System (PPS) and to co-located and nearly simultaneous products from MODIS.

Cloud Products CM-SAF

Rainer Hollmann and Maarit Lockhoff
DWD, Offenbach, Germany

The Satellite Application Facility on Climate Monitoring (CM-SAF; http://www.cmsaf.eu) as part of EUMETSAT's SAF network provides satellite-derived products suitable for climate monitoring. Available cloud parameters include cloud fraction; cloud type and cloud top height/temperature/pressure as well as the microphysical properties cloud optical thickness, cloud water path and cloud phase. Presently, cloud products are derived using data from the METEOSAT-8 and 9 satellites and the polar orbiting NOAA and MetOp satellites. The implemented operational near real-time (NRT) system generates daily and monthly mean products with a spatial resolution of 15km*15km. To generate these products the SAF-NWC cloud software is used.

The presentation will summarize the results of a recently performed validation study accessing the quality of the monthly mean cloud cover, cloud top pressure and cloud type products using observations from synoptic stations and MODIS satellite data products. The time period studied covers the years 2006 to 2008.

Cloud detection using SEVIRI IR channels for the GERB processing

Alessandro Ipe
Royal Meteorological Institute of Belgium (RMI), Brussels, Belgium

The first Geostationary Earth Radiation Budget (GERB) instrument was launched during the summer 2002 together with the Spinning Enhanced Visible and InfraRed Imager (SEVIRI) on board of the Meteosat-8 satellite. This broadband radiometer aims to deliver near real-time estimates of the top of the atmosphere (TOA) solar and thermal radiative fluxes at high temporal resolution thanks to the geostationary orbit. Such goal is performed at the Royal Meteorological Institute of Belgium by running the L20 GERB processing which generates these fluxes at several spatial resolutions from the directional filtered radiance measurements of the instrument. This processing consists of successive components, one of them being a radiance-to-flux conversion. Such conversion is carried out in the solar region by using information from a scene identification of SEVIRI data. This scheme estimates the cloud mask over the whole SEVIRI/GERB field-of-view with solely visible SEVIRI channels. While this method gives good results during daytime, it cannot be applied during nighttime. Nevertheless, cloud mask information is valuable to study clouds and aerosols thermal radiative forcing. Thus, a nighttime cloud mask would benefit the GERB flux products in the thermal region.

In this paper, we present a simple cloud detection method based on infrared (IR) SEVIRI channels. Our strategy relies on multispectral threshold tests applied on brightness temperatures (BT) associated to the 8.7, 10.8 and 12 μm bands. Such thresholds are commonly estimated using skin surface temperatures (SST) output from numerical weather prediction (NWP) models. However, for the sake of simplicity of the GERB operational processing, TOA clearsky BTs are computed using solely SEVIRI data. Thus it allows to preserve the native SEVIRI spatial and temporal samplings. Our main assumption is that clearsky surfaces are associated with highest IR radiances while clouds, usually colder, exhibit a drastic drop of their IR signature. Moreover, cloud occurrences are a transient phenomenon compared to the slowly varying surface IR state. Then, it is possible to compute threshold values for these multispectral tests according to the surface type which limit their sensitivity to the uncertainties of the clearsky BT estimations. To avoid any bias in the IR cloud mask, its consistency is checked with respect to its visible counterpart. Discrepancies between these two products are quantified using daytime data and possible improvements such as thresholds tuning are suggested to achieve satisfactory agreement.

Current status of the operational EUMETSAT coud mask algorithm

Sauli Joro
EUMETSAT, Darmstadt, Germany

In August 2007 the operational EUMETSAT cloud mask algorithm was updated in order to improve the cloud detection especially over sea. Also, the logic, determining whether a pixel is cloudy, was re-designed offering better quality information about the cloud mask. The presentation introduces the changes done to the cloud mask algorithm together with some examples of the improved cloud detection.

Impact of the use of surface emissivity information on cloud detection and cloud analysis

Hans-Joachim Lutz
EUMETSAT, Darmstadt, Germany

The knowledge of the surface emissivity is an important condition for all IR radiative transfer (RT) calculations and thus important for all satellite products that are based on RT calculations. A variety of the Meteosat Second Generation (MSG) algorithms use techniques which are based on the RT results, e.g. the cloud and dust storm detection, and the cloud top height derivation.

The Emissivity information has been derived from the University of Wisconsin - CIMSS global infrared land surface emissivity database with its high spectral and high spatial resolution. This data has been re-mapped in space and spectra to the Meteosat-8/9 SEVIRI channel definition.

This presentation demonstrates the inclusion of the emissivity information in the product generation process, and its impact on the cloud products.

Evaluation of CM-SAF cloud products in the Arctic region using CloudSat/CALIPSO measurements, synoptical observations and MODIS Level 3 products.

Karl-Göran Karlsson
SMHI, Norrkoping, Sweden

A thorough investigation of CM-SAF cloud products over the Arctic region has been carried out using various reference observations. The most important component in this evaluation has been the comparison to cloud information provided by CALIPSO-CALIOP measurements. Also MODIS cloud mask information along the CALIPSO track, MODIS Level 3 products (Collection 5) and synoptical cloud observations from ground stations was utilised in the study.

The study focused on four selected months in 2007: June, July, August and December. 142 CALIPSO matchup cases for individual NOAA-17, NOAA-18 and Metop-2 satellite overpasses over the Arctic area resulted in an overall matchup dataset of almost 400 000 individual pixel matchups almost evenly distributed over the four selected months.
Studied products were cloud amount (i.e., accuracy in cloud detection), cloud type and cloud top height. A very useful feature was the access to the CALIOP Vertical Feature Mask product which enabled (probably for the first time) a thorough evaluation of AVHRR cloud type information. In addition, it enabled a deeper study of the quality of cloud top height retrievals for different cloud type categories.

The study revealed very encouraging results for the polar summer months, especially for cloud amount estimations. On the other hand, it is clear the cloud retrievals from AVHRR imagery are still very challenging in polar winter conditions. Concerning the latter, a systematic underestimation of cloud amounts was revealed indicating that predominantly thin clouds regardless of cloud altitudes were missed. MODIS results were significantly better but high RMS differences revealed that there should still be scope for improvements in the precision of MODIS retrievals. AVHRR cloud top retrievals showed a general underestimation of cloud tops for high-level clouds but this feature seems to be common to also other methods (e.g. especially MODIS retrievals). However, a specific feature was a substantial overestimation of cloud tops for fog or near-surface stratus clouds. The reason for this has to be studied closer in the near future.

Validation of MSG and MetOp products from ship based measurements over the Atlantic Ocean

Andreas Macke[1], John Kalisch[1], Yann Zoll[1], Rainer Hollmann[2], and Peter Schlüssel[3]
[1]IFM-GEOMAR, Kiel, Germany
[2]DWD, Offenbach, Germany
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The Atlantic transects of the Research Vessel Polarstern are used to perform continuous observations of the surface radiation budget from pyranometer and pyrgeometer measurements, cloud cover and cloud type from full sky imager observations, humidity and temperature profiles as well as liquid water path and precipitable water path from a multichannel microwave radiometer for tropocal, subtropical and mid-latitude climatic conditions. Comparison with the CM-SAF surface radiation budget products show a very good agreement. The same is true for temperature profiles from MetOp-IASI for clear sky conditions. Agreements and disagreements for specific synoptical and climatological situations will be discussed.

Near-real time cloud products from operational and research meteorological satellites

Patrick Minnis[1], Louis Nguyen[1], William L. Smith[1], David R. Doelling[1], Rabindra Palikonda[2], Douglas A. Spangenberg[2], Christopher R. Yost[2], Mandana M. Khaier[2], Qing. Z. Trepte[2], and Fu-Lung Chang[3]

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A set of algorithms developed for the Clouds and Earth's Radiant Energy System (CERES) Project have been adapted for application to all satellite imagers having at least 3 channels at wavelengths near 0.65, 11, and 3.8 µm. Additional spectral radiances are used if available, especially at 12 and/or 13.3 µm. These algorithms are now being applied operationally to generate cloud products in near-real time over the globe and at high temporal and spatial resolutions in certain areas using data from GOES, Meteosat, MTSAT, FY-2C, MODIS, and AVHRR (http://www-angler.larc.nasa.gov/satimage/products.html). The analyses begin with calibration of all satellites to the Terra MODIS visible channel and to each other at other wavelengths to achieve as much consistency as possible. The algorithms first determine clear and cloudy pixels, then they classify clear pixels as the nominal surface or snow-covered. For cloudy pixels, the cloud effective temperature and height are estimated, followed by cloud base and top altitudes. Cloud phase, optical depth, and effective particle size are derived and cloud ice or liquid water path are computed from the results. A multilayer detection scheme using the 13.3-µm channel has been developed and is being applied to satellites having the appropriate channel. The properties for the upper and lower layers are derived for those pixels identified as multilayered. The satellite imagery and cloud products are provided online both digitally and as loopable images. The products are also matched to instrumented ground sites and to ICESat GLAS and CALIPSO/CloudSat for easy comparison with active sensor retrievals. Validation studies performed to date indicate very good agreement for most parameters except thin cirrus cloud heights, possibly as a result of using models with asymmetry factors that are too large, even though their values are some of the smallest in use today. The algorithms and applications are continuously evolving. A brief outline of the algorithms, examples of products, and validation results will be presented.

The MODIS Cloud Optical and Microphysical Product

Steve Platnick, Steve Ackerman
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The Moderate Resolution Imaging Spectroradiometer (MODIS) was developed by NASA and launched onboard the Terra spacecraft on December 18, 1999 and the Aqua spacecraft on May 4, 2002. Earth observations began on February 24, 2000 for Terra and June 24, 2002 for Aqua. A comprehensive set of remote sensing algorithms for cloud masking and the retrieval of cloud physical and optical properties has been developed by members of the MODIS Atmosphere Team. In addition to an extensive cloud mask, pixel-level products include cloud-top properties (temperature, pressure, effective emissivity), cloud thermodynamic phase, cloud optical and microphysical parameters (optical thickness, effective particle radius, water path), as well as derived gridded statistics.

We will discuss algorithms and show examples from the Collection 5 processing stream, including Level-2 (pixel level) cloud retrievals for selected 5 minute (2000x2330 km) data granules, as well as Level-3 1° gridded daily and monthly maps and zonal means. In addition to scalar statistics, the Level-3 MODIS atmosphere product includes marginal and joint histograms of many cloud properties. The joint histograms provide a means for examining correlations and relations between cloud optical thickness and effective radius, cloud-top pressure, and cloud-top temperature, as well as between cloud effective radius and cloud-top pressure and cloud-top temperature. The statistics and histograms are produced separately for liquid water and ice clouds. Validation efforts and lessons-learned will be also be discussed.

Comparison of cloud properties derived from SEVIRI and MODIS above the Southern Atlantic

Rene Preusker, Steffen Kothe, Anja Hünerbein, Jürgen Fischer
Free University of Berlin, Berlin, Germany

TBD Rene Preusker

Evaluation of the global cloud cover parameters obtained from geostationary data in the frame of the MEGHA-Tropiques mission with CALIPSO lidar observations

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For the need of the MEGHA-Tropique space mission, a coherent cloud mask and cloud type classification is required in the latidudinal band between 40°N and 40°S with a good spatial and temporal sampling. The data from the five geostionnary satellites (MSG, GOES-E, GOES-W, MTSAT, FY-2C) allowing such an approach will be analysed using the retrieval method developed by the SAFNWC. The same set of channel will be used for all the geostationary in order to obtain the best as possible global coherence of the retrieved cloud type and cloud top pressure field. Cloud and aerosol layer structure observed with CALIPSO (CALIOP Lidar) will be used to evaluate and intercompare these fields.

In this talk, first monthly mean charts of spatial cloud distribution obtained over the globe from the different geostationary satellites will be compared to CALIPSO data, in terms of cloud type frequency. Then, collocated cloud top pressure distributions derived from CALIPSO and geostationary satellite data will be shown. Differences will be analyzed as a function of Lidar cloud type, geostationary SAFNWC cloud type and climate regimes. Day and night data will be examined separately. First conclusions on the quality of cloud type and cloud top pressure field build from the geostationnary will be given. Finally, using MSG data, the effect on the SAFNWC retrieval of using a reduced set of channels will be analysed.

Cloud Climatologies and results of GEWEX Cloud Assessment

Claudia Stubenrauch
CNRS/IPSL Laboratoire de Météorologie Dynamique, Ecole Polytechnique, Palaiseau, France

Satellite observations provide a continuous survey of the state of the atmosphere over the whole globe. One GEWEX activity is to assess the quality and reliability of available global cloud data sets for climate studies (http://climserv.ipsl.polytechnique.fr/gewexca). GEWEX cloud products are provided by the International Satellite Cloud Climatology Project (ISCCP), using data from a combination of polar orbiting and geostationary imagers. There are two cloud analyses (HIRS-NOAA and TOVS Path-B) using TIROS-N Operational Vertical Sounder Operational (TOVS) observations onboard the NOAA polar orbiting satellites. The relatively high spectral resolution of these instruments provides reliable cirrus identification, day and night. Recently, the NOAA PATMOS-x project has reanalyzed the Advanced Very High Resolution Radiometer (AVHRR) data onboard the same satellites. Cloud occurrence climatologies using sun occultation measurements from the Stratospheric Aerosol and Gas Experiment (SAGE) and from surface observations also participate in the assessment, as well as analyses using the second generation instruments MODIS (Moderate Resolution Imaging Spectroradiometer) and AIRS (Atmospheric Infrared Sounder) aboard the NASA the Earth Observing System (EOS). Since summer 2006 data are available from two active instruments aboard the A-Train: the lidar of the CALIPSO mission and the CloudSat radar, giving for the first time a global insight on cloud layering. Climatological averages of cloud properties, their regional, seasonal and diurnal variations as well as time series of these climatologies are presented.

Comparison of different inversion techniques for daytime cloud optical and microphysical parameters retrieval

Andi Walther
Space Science & Engineering Center
University of Wisconsin-Madison, Madison, USA

The results of the inter-comparison study of first EUMETSAT cloud workshop in 2006 and also the most recent results for this workshop have shown that cloud optical parameter products from several algorithms exhibit considerable differences even the approach is similar.

Typically the Nakajima & King approach with simultaneous measurements in a visible conservative scattering channel (SEVRIR: 0.6 µm or 0.8 µm) and an absorption channel in the NIR range (either 1.6, 2.2 or 3.9 µm) is used. The algorithms differ basically in the RTM, inversion method, ice particle scattering property models, and the use of ancillary data sets. The algorithms typically use pre-calculated look-up-tables (LUT) to speed up the forward calculations.

During the work on the optimal estimation inversion technique I noticed the high sensitivity of the results on the a-priori assumption of the effective radius. The frequency distribution of long-term observations, such as monthly mean, has shown significant typically a-priori peaks for effective radius. For this reason it was worth to have a more thoroughly look into the inversion technique.

The goal of this study is to compare different inversion techniques and to evaluate them for a few case studies. I applied MSG scenes to 1D-var optimal estimation techniques with different a-priori assumptions and interior parameters (step size and convergence criteria), to a genetic algorithm code as well to a more direct iterative search. The evaluation includes accuracy as well as computational cost.

A Tool for Validating Cloud parameters from A-Train data

Phil Watts
EUMETSAT, Darmstadt, Germany

A software tool for the validation of cloud products derived from SEVIRI observations using various A-Train instruments has been developed by Informus under contract to Eumetsat.
The cloud products optical thickness, effective radius, height/pressure, phase have been considered. It addresses the co-location of SEVIRI and A-Train data accounting for different observation geometries and makes use of sub-scale information where available. It enables flexible generation of validation datasets for multiple purposes.
The A-train sensors included are CPR, CALIOP, MODIS, AMSR-E and ECMWF environmental information is additionally included. The main focus has been made on the active instruments in order to remain as independent of the SEVIRI products as possible. CPR or CALIOP can serve as reference instrument for calculating parallax shifts of up to 40 km depending on SEVIRI view zenith angle. Spatial resolution, which varies with SEVIRI zenith angle is accounted for when collocating with A-Train data.

A brief description of the tool will be given with some examples of its use. However the main emphasis will be to establish whether such a tool is of interest to groups taking part in the Workshop and, if so, to stimulate discussion. If there is interest beyond distribution in its current state, then issues on its future development and/or maintenance might include:

- Inclusion of further instruments, e.g. POLDER.
- Inclusion of further product groups, e.g. aerosol.
- Upgrading to future A-Train level-2 products and / or
- addition of third-party enhanced A-Train products.
- Collection mechanisms for A-Train source data and / or
- development of a community repository, e.g. of one year duration, of baseline orbits.
- Maintenance / development mechanisms, e.g. ‘open-source’

IMPACT OF PIXEL RESOLUTION AND CLOUD HORIZONTAL INHOMOGENEITY ON SATELLITE CLOUD PHASE CLIMATOLOGY USING MODIS DATA

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The effect of clouds on the Earth's radiation budget is partly determined by their thermodynamic phase. Therefore accurate and spatially continuous information on cloud phase is of key importance for climate monitoring. The accuracy of cloud phase retrievals from satellite is reduced if clouds are broken or horizontally inhomogeneous. This presentation quantifies the effect of pixel resolution and cloud horizontal inhomogeneity on cloud phase climatology using retrievals from the Moderate Resolution Imaging Spectroradiometer (MODIS) data onboard the EOS-Terra satellite.

Visible and near-infrared (0.6 μm and 1.6 μm) spectral channel reflectances from MODIS are used to prepare a cloud phase climatology over the eastern Atlantic ocean, central Europe, and central Africa applying an updated version of the Cloud Physical Properties algorithm (CPP) for four months in 2007.

This presentation addresses three research questions. First, we discriminate between homogeneous and inhomogeneous clouds using semi-variance analysis. Subsequently, the cloud phase climatology for the different areas is derived for overcast homogeneous cloud fields only. In addition, a similar investigation is done for overcast cloud fields with an increasing degree of inhomogeneity. Finally, the impact of an increasing broken cloud amount on the derived cloud phase climatologies is scrutinized.