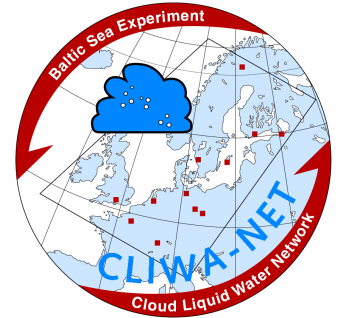


BALTEX Cloud Liquid Water Network: CLIWA-NET

Eleventh quarterly report



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Overview

Towards the end of the CLIWA-NET project an overview about the results achieved so far was given to the User Advisory Group during a meeting at De Bilt on October 23, 2002. The lively discussions were fruitful and showed that the project is on the right track. After discussions with several scientists it was decided to combine the final workshop of CLIWA-NET with the final workshop of the EU-project EUROCS, which will also end in spring 2003. As EUROCS and CLIWA-NET both aim at the improvement of cloud parameterizations, however, with different approaches (case studies within EUROCS; long term time series within CLIWA-NET), this combination is expected to be quite fruitful. The local organizer (INM Madrid) has agreed to additionally host the CLIWA-NET community. The programme of the meeting including joint and parallel sessions is currently prepared in coordination with the EUROCS coordinator (Jean-Luc Redelsberger) and the local organizer (Javier Calvo).

Highlights of the quarter

Progress Report WP2000: Ground-based network

Model Evaluation (WP2100-2400):

All raw data, level 1 and level 2 data from the Extensive Observation Periods (EOP) CNN I, CNN II and BBC are now in their final and complete form and can be accessed through the ftp servers <ftp://cliwaftp.uni-bonn.de> and <ftp://bbc.knmi.nl>. Additionally the LWP level 2c *added value* product was derived after intensive discussion with WP-3000 and WP-4000 at the BBC workshops. This product consists of refined LWP data, where negative LWP values are corrected for long-term cloud-free LWP drifts (~1 day), and discontinuous LWP jumps. The method considers mean LWP-offsets during each EOP and applies a correction scheme using Gaussian weighting of cloud-free determined cases in a given time window. It was derived for all radiometers during all EOPs and can be accessed at the above cited ftp sites.

Cloud Processes (WP2500):

Two additional *added value* products were derived: 1.) A cloud classification scheme to distinguish between cloud-free, ice cloud, mixed-phase cloud, liquid water cloud, drizzle, significant precipitation, and ambiguous cases was developed for the BBC campaign at the Cabauw site. This scheme uses cloud radar, lidar-ceilometer, microwave radiometer, and interpolated radiosonde measurements and gives a classification for each radar pixel on a 82.5 m height and 5 s time resolution. Such classification data is of extreme importance considering the applicability of specific micro-physical algorithms, which are commonly derived for certain phases or regimes. 2.) High resolution LWC profile data were derived using a new method which allows the determination of cloud liquid water density profiles on a vertical resolution corresponding to the radar resolution during the BBC campaign. Up to now this product was only available on a 250 m resolution and can now be obtained on a 37.5 – 82.5 m resolution. The method now also takes microwave absorption model errors into account, which leads to a more realistic error determination.

Furthermore, the cloud process studies included an analysis of the diurnal cycle of LWP and integrated water vapor (IWV). The mean values of IWV and LWP did not show any significant cycle for the

EOPs, however the differential IWV cycle shows a strong increase of IWV with height in the morning hours. Cloud layer overlap studies have been conducted for the BBC campaign using the 94-GHz cloud radar data.

Design of a lowcost microwave radiometer (WP2500):

Manufacturing of the first prototypes ordered by Japanese Instituts is ongoing. The radiometer will already be used for an AMSR validation in January 2003 in Japan. Discussions within the User Advisory group led to the incorporation of an additional *wet delay* product.

Progress Report WP 3000: Satellite remote sensing and integration of observations

Macroscopic cloud parameters (WP3100):

After all satellite data was acquired, geo-located and archived, the group of scientists working in this WP have started finalizing their work: writing parts of the final reports, writing reviewed publications, cleaning up data bases, identifying shortcomings. The access to the results through the web-sites and ftp has been improved. Special sets of results were created for the scientists of WP4000, modeling, who use the satellite data to do model evaluation.

Statistical analysis of monthly mean values of high-level clouds from model and satellite has revealed spurious values around land-sea boundaries. This artifact is being looked into. Also the diurnal cycle of cloud types does not seem correct completely. This requires special attention.

Vertically integrated liquid water (WP3200):

During this 11th quarter of the project the analysis of AVHRR data focused on BBC. It turns out that the calibration of AVHRR on board of NOAA-16 is much better than from earlier instruments. This has a large positive impact on the quality of the retrieved values for optical thickness and liquid water path. Unfortunately statistical analysis proves that the NOAA-14 calibration is significantly off and it is not feasible to recalibrate NOAA-14. Currently, the research focuses on the analysis of all daytime NOAA-16 passes and quantifying the retrieval accuracy.

The time series of LWP retrieved from AVHRR and the microwave radiometer MICCY during BBC serve as reference. For this purpose spatial (AVHRR) and temporal (MICCY) averaging, removal of precipitation and ice cloud and assumptions about assuming an effective radius of 10 μ m need to be made. The representativeness issue that was described before hampers the comparison between ground and satellite. It reduces the correlation between ground based and satellite based retrievals considerably. Differences between both instruments (AVHRR and microwave radiometers) tends to be strongly dispersed but on average are not very high (linear regression gives a slope of around 0.8 for all cases) with a correlation coefficient of about 0.8. The differences depend on viewing geometry, surface property, solar angle, cloud variability and optical thickness. It is very tricky to underline main trends, especially with statistical analysis, due to the poor number of data used for the analysis each case so far. This preliminary statistic analysis must be completed using more cases, which is possible analyzing the two NOAA-16 overpasses during day-time and adding results from northern stations. The AMSU retrieval has been improved further. Still the AMSU does not really do better than the AVHRR from NOAA-16. This is probably mainly caused by the so called beam-filling problem. In the next and last quarter this beam-filling issue and its consequences will be addressed in more detail.

Progress Report WP4000: Model evaluation/Improvement

Model Evaluation (WP4100):

The model evaluation continued on the basis of the level 2c added value product data. Simultaneously to the evaluation of model predicted IWV and LWP with observed values retrieved from microwave radiometer (MRAD) measurements work was started to compare model simulated brightness temperatures with the MRAD measured brightness temperatures. The approach is based on the Liebe 1993 absorption model. The latter method has the advantage that it avoids the need to deal with negative LWP values generated by the retrieval algorithm. It is expected that comparing the outcome of both methods will facilitate the interpretation of the results, in particular the events of small LWP. Work was started to compare model predicted vertical profiles of liquid water content with vertical distributions inferred during the BBC-campaign from microwave radiometer, cloud radar and ceilometer (input from WP2400). Preliminary results show substantial differences among the models and with the observations. Like in the evaluation of LWP, the occurrence of precipitation in the models plays a critical role.

Horizontal resolution (WP4200):

Simulations with the Lokal-Modell of DWD at different horizontal resolutions were performed for one case during CNN2 and two cases during the BCC campaign at a new model domain of 400x400km centered over Cabauw. Focusing on area mean quantities and mean fluxes, a first analysis indicated that only liquid water content, ice water content and rain rate are affected by refinement, whereas other quantities like cloud cover or surface fluxes show no sensitivity. Simulations with explicitly parameterized convection are less sensitive to increased resolution and contain very little liquid water (as already mentioned by WP4100) which can be traced back to a poor representation of sub-grid scale condensation processes.

Parametric issues (WP4300):

In collaboration with the satellite group at SMHI, new cloud climatologies (cloud mask & cloud types) have been developed from the AVHRR satellite retrievals for the CNN2 & BBC periods. These cloud climatologies are more internally consistent and have been evaluated where possible against surface observations. The total cloud amount and high and low level clouds, simulated in a suite of Rossby Centre integrations, have been compared to this new data set. The mean diurnal cycle of the 3 cloud classes has also been evaluated. Some preliminary work has begun to compare the diurnal cycle of cloud related variables in the participating models directly with surface based observations at the CLIWA-NET CNN stations.

The evaluation of cloud vertical structure and cloud overlap using cloud radar has been continued. The observations show more binary clouds, either overcast or cloud free, while all the models have clouds more frequently but of lesser amount. Different cloud parameterizations have been considered. A semi-empirical cloud fraction scheme, using both relative humidity and cloud water as predictants, appears better than a pure relative humidity based scheme. The semi-empirical scheme might be further improved for mid latitudes by tuning with WP2000 data, since it was originally developed for tropical convection.

Conferences and Workshops:

Workshop of the EU-Project, De Bilt, 21 October 2002: presentation of main CLIWA-Net objectives and results (Erik van Meijgaard)

Crewell, S. and U. Löhnert, 2002: [Ground-based remote sensing of cloud liquid water - A case study](#), *XXVIIth General Assembly of the International Union of Radio Science*, Proceedings, 3 pages. (invited talk)

Appearance of three CLIWA-NET related contributions in *Boreal Environment Research*, 7, 2002: Crewell et al., Doescher et al., Feijt et al.

Highlights of the quarter:

Meeting with the User Advisory Group, De Bilt, 23 October 2002

Problems encountered:

none

Significant departures from Description of Work:

DWD is still lagging in the delivery of LM-model data

Upcoming Meetings:

5th and Final CLIWA-NET workshop at INM, Madrid, 16 to 19 December 2002 in conjunction with the final workshop of the EU-Project EUROCS