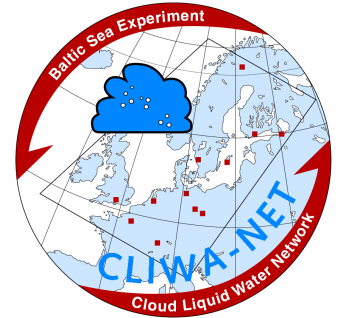


# BALTEX Cloud Liquid Water Network: CLIWA-NET

## Ninth quarterly report



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### Overview

All CLIWA-NET measurement campaigns have been successfully finished. The results of the last measurement campaign – the BALTEX BRIDGE Campaign (BBC) – were the focus of the BBC-workshop held from 13-16 May in Leipzig. Due to the large interest from outside the CLIWA-NET community the BBC campaign became a major European cloud observation campaign. Therefore the first two days of the BBC-workshop were devoted to the larger BBC community while the second two days concentrated on CLIWA-NET related topics. The highlights achieved within the different CLIWA-NET workpackages will be presented below. Interfacing between the workpackages and the definition of further research activities different covered a significant part of the workshop. Additionally, a representative (Anke Thoss) from the EU-project CLOUDMAP participated and a cooperation between both projects including data exchange was agreed upon.

### Highlights of the quarter

#### *Progress Report WP2000: Ground-based network*

After the end of the BBC campaign previews of all data can be viewed via the CLIWA-NET homepage and assessed from the BBC ftp server. Level2 data, which combines microwave-radiometer-derived liquid water path (LWP) and integrated water vapor (IWV), infrared radiometer temperature, ceilometer derived cloud base height and diverse rainflags are available for both CNN campaigns. For BBC a level2 product combining cloud radar (MIRACLE, GKSS), multi-spectral microwave radiometer (MICCY, University of Bonn), ceilometer and meteorological measurements was derived using an optimal estimation technique. It consists of the vertical profiles of temperature, humidity and cloud liquid water (LWC) profile as an additional level2 product.

An interfacing meeting between WP2000 and WP3000 (satellites) took place on April 25, 2002 in the Congress Center in Nice (Room Gallieni 4). The discussions focused on the accuracy of ground-based microwave derived LWP values with special focus on the treatment of negative values. Additionally, case studies for merging ground-based and satellite measurements were discussed. The meeting took place in Nice in conjunction with the XXVII European Geophysical Symposium where a number of CLIWA-NET related talks were presented.

Analysis of the data from the Microwave Intercomparison campaign continued. One focus is here on the theoretical description of the gaseous absorption in the microwave region because of the strong influence on the accuracy of microwave radiometer derived LWP. We are cooperating with several other research groups to solve that issue

Within WP2500 (Cloud Products) a statistical analysis of cloud radar measurements (MIRACLE) during the BBC campaign has been performed. Data coverage in standard vertical looking mode was about 70% during daytime hours under non-precipitating conditions. Using a cloud mask shows a total cloud cover of 70% during the whole measurement time. About 70% of all cloudy radar profiles are

identified to represent single layer clouds, only 7% show three or more cloud layers. Overlap of two neighboring cloudy radar range gates show large discrepancies from the usual assumption of random overlap. The observation made in earlier publications that cloud layer overlap converges around random overlap for growing level separation could not be confirmed here. Reducing the data set to the cases where both the radar and ceilometer algorithms detect clouds, more than 50% of all cloudy radar profiles show drizzle events. One third of the cloudy radar profiles are not detected as cloudy by the ceilometer CT75 operated by KNMI. Part of the difference might be attributed to insects.

WP2600 (Design of a *low-cost* microwave radiometer) has already achieved more than originally planned. Due to internal funding of Radiometer Physics GmbH a first demonstration model will be available at the end of the project. Present work focusses on a flexible, user-friendly software.

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

KNMI and IfM continued processing of satellite derived LWP for all observational periods (CNN1, CNN2, BBC). The LWP retrieval is focused on the AVHRR data on board the noon-orbiting NOAA16 satellite because of its better calibration and the higher solar insolation conditions of the observed cloud fields. The processing is hampered by the need for a manual identification of clear sky conditions. SMHI started a comparison between cloud cover from satellite and from the SMHI atmospheric circulation model. Significant differences were found especially for ice clouds over ocean areas.

Various inter-comparisons have been performed for LWP from ground based microwave radiometer data obtained during BBC and from collocated satellite based LWP. Auxiliary data (lidar, radar, wind profiler) have also been taken into account. Direct inter-comparisons have been performed for LWP retrieved for an area of 25 pixels around the measurements station and for an integration time of 30 minutes around the overpass time. Cloud classifications for the 25 pixel areas have been produced by SMHI. The frequently observed large discrepancies are currently analyzed. First results indicate that differences between satellite and ground based derived LWP are mainly found for highly variable cloud fields (broken cumulus clouds) and for multilayer clouds. Also the risk of ice contamination in mixed phase clouds needs to be taken into account.

The problem of comparing temporal (microwave radiometer) and spatial (satellite) data has been further addressed by searching for those scales with similar temporal and spatial statistical properties (mean and standard deviation). Three satellite scenes [case 1: 6.4 2001, 11:20 UTC: stratiform thin cloud deck with occasional convective spots; case 2: 6.4 2001, 14:00 UTC cumulus convection developing from the stratiform deck; case 3: 21.04.01 12 UTC: broken cumulus cloud field with clear sky gaps] have been analyzed so far. It is found that mean and standard deviation only agree for thin and homogeneous clouds. No characteristic scales could be obtained for which spatial and temporal averaging yields comparable statistical properties. Further satellite scenes will be looked at to classify the quality of the LWP intercomparison as a function of cloudtype.

#### *Progress Report WP4000: Model evaluation/Improvement*

##### **Model Evaluation (WP4100):**

The model evaluation based on validated data (level 1b and 2 for LWP-product) is continuing. In the future brightness temperatures computed from the model forecasts using different gas absorption models to eliminate potential.

##### **Horizontal resolution (WP4200):**

MIUB performed simulations using the Lokal-Modell for some cases during CNN1 with different horizontal grid spacings ranging from 7 down to 1km. A new developed and more efficient nesting scheme enabled us to use exactly the same model domain for all resolutions. A comparison with previous results using varying domains indicated that only the new approach is reasonable because

effects caused by different boundaries have the same magnitude as refinement effects. The new simulations show hardly any changes due to refinement in terms of mean quantities (slightly increasing LWP and rain rates as grid spacing becomes smaller). An analysis of field structures revealed that the size of resolved convective cells is nearly constant as number of grid points but not in physical space. This shrinking process does not converge on investigated scales from 7 down to 1km.

**Parametric issues (WP4300):**

At the Rossby Center work continued in various areas of cloud-linked parametric issues in relation to observations inferred within CLIWA-Net:

- i ) the diurnal cycles of clouds and cloud radiative forcing,
  - ii a) cloud amount and cloud content in shallow convection
  - b) the sensitivity of cloud liquid water to microphysical parameterisation assumptions
  - iii a) the vertical structure of clouds in numerical models
  - b) cloud overlap assumptions
  - c) the effect of increased resolution on the representation of clouds
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**Conferences and Workshops:**

MICAM meeting, University of Bonn, 28 February – 1 March, 2002

**Highlights of the quarter:**

Two papers submitted to Special BALTEX Issue for BER (Boreal Environmental Research)

Cloud Observations and Modeling within the European BALTEX Cloud Liquid Water Network, Susanne Crewell, Matthias Drusch, Erik van Meijgaard and André van Lammeren<sup>2</sup>

Retrieval of the spatial distribution of Liquid Water Path from combined ground based and satellite observations for atmospheric model evaluation, Arnout Feijt, Dominique Jolivet and Erik van Meijgaard

**Problems encountered:**

WP2000: Breakdown of the CLIWA-NET ftp server at University of Bonn due to severe power failure, data could be restored within 2 weeks.

**Significant departures from Description of Work:**

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

**Upcoming Meetings:**

European Geophysical Society, XXVII General Assembly, Nice, France, 21-26 April 2002; including Meeting on interfacing between WP2000 und WP3000 in preparation of BBC meeting

BBC-workshop, Leipzig, 13-14 May 2002

CLIWA-Net workshop, Leipzig, 15-16 May 2001