BALTEX Cloud Liquid Water Network

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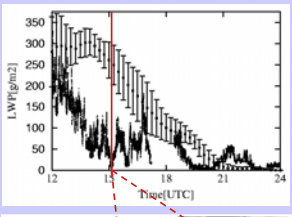
▶CLIWA-NET Objectives

The EU-project **CLIWA-NET** focuses on observations of cloud liquid water and its vertical structure, and the evaluation and improvement of model parameterizations. The specific **CLIWA-NET** objectives are:

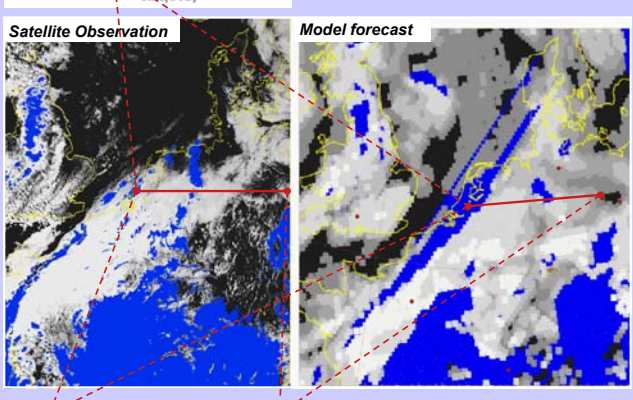
- Contribute to the development and implementation of the Global Observing System with a focus on cloud observations.
- Implementation of a prototype of a European Cloud Observation Network.
- Objective evaluation and improvement of state-of-the-art cloud parameterzations for climate and weather forecast models, with a focus on integrated cloud liquid water and vertical structure of clouds
- Development of an adequate observing system for the detection of icing conditions for aircraft.
- Contribution to BALTEX/BRIDGE
- Design of a "low cost" microwave radiometer in co-operation with industry

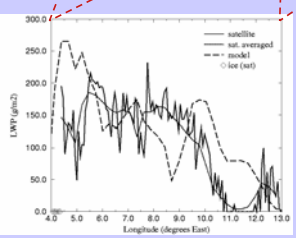
▶One day during CNN II

For 4 May 2001 the liquid water path measurements from the ground-based network (time series) and the NOAA16 satellite field are compared with the forecast of the RACMO model inintialised at 12 UTC on May 3, 2001. The time series at Cabauw (below) reveals large discrepancies at the time of the satellite overpass (15:15 UTC).



The LWP distribution over North Western Europe derived from AVHRR-measurements (left) and the RACMO forecast (right) show no (black) or little (dark grey) liquid water clouds over the North Sea. Both, model and satellite show cirrus clouds (indicated by the blue color) in the South and over England.





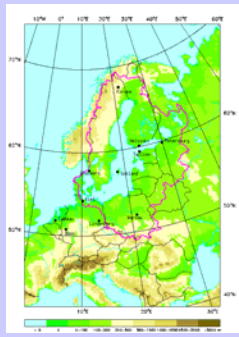
The LWP along the transect connecting the **CLIWA-NET** stations Cabauw and Potsdam (right) shows that model and satellite measurements indicate similar gradients. The 1.2 km resolution of the satellite shows spatial variations in LWP that can not be resolved by the model (Δx = 18 km).

The high LWP variability in time and space complicates the evaluation of model forecasts and shows the need for a combination of ground-based and satellite measurements.

▶ Measurement Campaigns

The prototype of a European cloud observing system was successfully operated during three measurement ampaigns. It encompassed measurements within a ground-based network of cloud observing stations comprising microwave radiometers to derive liquid water path (LWP) and auxiliary measurements like lidar ceilometers to investigate the vertical cloud structure. All AVHRR overpasses were analyzed with respect to cloud cover and cloud type classification. LWP was derived using an optimized procedure for NOAA-16 overpasses. Two **CLIWA-NET** Network (CNN) campaigns covered North Central Europe while the BALTEX BRIDGE Campaign (BBC) took place in the Netherlands:

- **CNN I**: August-September 2000
- **CNN II**: April-May 2001
- **BBC**: August-September 2001

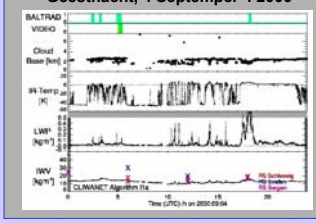


The BBC campaign included intensive remote sensing observations at the Cabauw site including three cloud radars. Within a regional network (100 x 100 km) microwave radiometer, lidar ceilometer, infrared radiometer and pyranometer were operated at six stations. During the first two weeks a microwave intercomparison campaign (MICAM) with eight radiometers was carried out. Initiated by CLIWA-NET, the campaign grew considerably larger by the inclusion of e.g. four aircraft and two tethered balloons by European partners.

Time Series

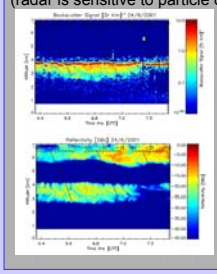
For every day and every station overview graphs can be viewed at the CLIWA-NET web site.Liquid water path and integrated water vapor are derived from microwave radiometer measurements. Infrared temperature indicate the cloud base temperature while the cloud base height is derived from lidar ceilometer measurements.

Geesthacht, 4 Septemper 4 2000



Process Study

Simulataneous measurement of the radar reflectivity and the lidar backscatter on 24 September 2001 reveal a cloud layer between 3 and 4 km which consists of a thin layer of supercooled water (strong lidar reflection) with larger ice particles below (radar is sensitive to particle diameter[6]).

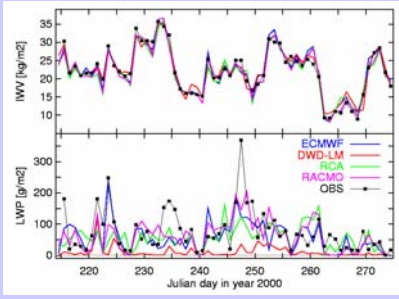


At Cabauw super-cooled layers were found to occur more than 10% of the time.

▶Atmospheric modelling

The short-term (up to 36 h) forecasts of four European models (ECMWF, Rossby Center RCA, KNMI RACMO and DWD Lokalmodell LM) for all campaigns were evaluated.

As an example time series of daily averaged integrated water vapor (IWV) and liquid water path (LWP) at Lindenberg during CNN I are shown. As no reasonable observtions can be carried out during precipitation events the model output needs to be filtered in order to enable useful comparison between model and measurement. After filtering, most models represent LWP reasonably well for non-precipitating cases, but considerably overestimate the frequency and duration of precipitation. Further results are:



In the meso-scale range from 1 to 10 km model resolved convective cells are found to depend strongly on the employed **horizontal resolution**.

Based on ground-based observations it has been shown that increased **vertical resolution** greatly improves the vertical structure of model simulated clouds.

The CLIWA-NET project was funded by the European Commision's RTD programme on Energy, Environment and Sustainable Development within the research area „Better exploitation of existing data and adaption of existing observing systems" under EVK2CT-1999-00007 from March 1, 2000 for the duration of three years. Web site: **http://www.knmi.nl/samenw/cliwa-net/**