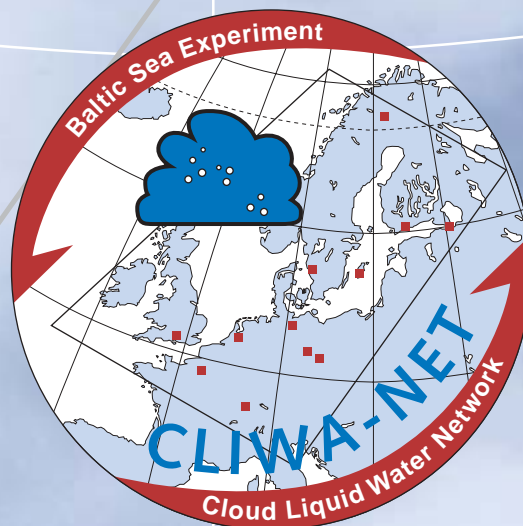


*Results from*

# CLIWA-NET

**Cloud Liquid Water Network**

2000-2003



## The CLIWA-NET project

On average, more than 60% of the Earth's surface is covered by clouds. Clouds strongly affect atmospheric radiative fluxes and heating rates. However, cloud processes are still not well understood and remain one of the greatest sources of uncertainty in present day climate models (IPCC'01 Third Assessment Report).



## CLIWA-NET Objectives

CLIWA-NET focuses on observations of cloud liquid water and vertical structures, and the evaluation and improvement of model parameterisations.

The specific CLIWA-NET objectives are:

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



The first radiometer based on the CLIWA-NET lowcost design has already been sold to customers.

## Highlights

### Ground based Network

A network of cloud-observing stations comprising microwave radiometers, infrared radiometers, lidar ceilometers and auxiliary measurements was successfully operated within two CLIWA-NET Network campaigns (CNN):

- CNN I: August – September 2000
- CNN II: April – May 2001

Both campaigns were part of the Baltex field experiment. Time series of liquid water path were derived from these measurements.

The combination of the different remote sensing instruments allowed for the identification of super-cooled liquid water layers, which prevailed more than 10% of the time.

### Satellite analysis

All AVHRR overpasses from the three observational periods were analyzed with respect to cloud cover fraction and cloud type classification.

A new microphysics analysis method was developed to discriminate water from ice clouds and to estimate cloud particle size.

A new retrieval algorithm for liquid water from AMSU was developed and evaluated.

Retrieval methods for cloud liquid water from passive imager were improved considerably. This resulted in optimized estimates of the spatial distribution of liquid cloud water.

### Atmospheric modelling

Leading European models (ECMWF, Rossby Center RCA, KNMI RACMO) have been found to represent the liquid water path reasonably well for non-precipitating periods, but considerably overestimate the frequency and duration of precipitation.

In the meso-scale range from 1 to 10 km, size distributions of model resolved convective cells are found to depend strongly on the employed horizontal resolution. At the smallest grid spacing a resolution independent distribution starts to develop, but even at 1 km some form of parameterized convection remains required.

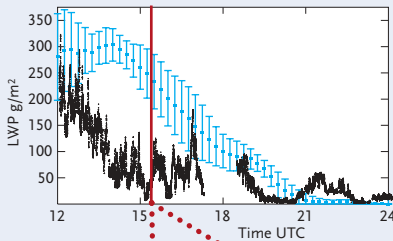
Based on CLIWA-NET observations derived from cloud penetrating radars, it is shown that increased vertical resolution greatly improves the vertical structure of model simulated clouds. This is crucially important for an accurate representation of cloud-radiation interaction.

## BBC

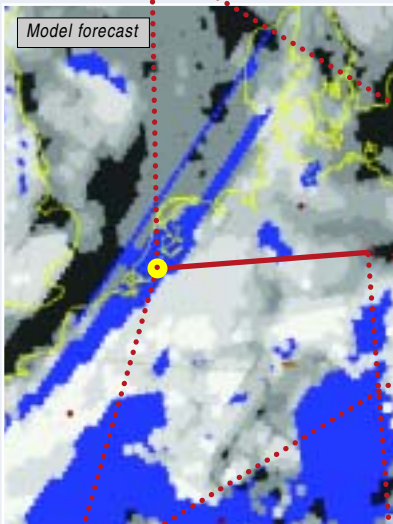
In August-September 2001 the Baltex Bridge Campaign (BBC) included intensive remote sensing observations at the Cabauw Experimental Site for Atmospheric research (CESAR) and within a regional network (100x100km). Initiated by **CLIWA-NET**, the campaign grew considerably by the inclusion of e.g. four aircraft and two tethered balloons by other European partners.



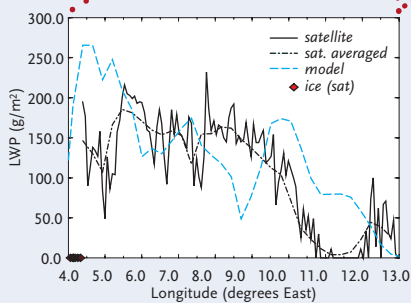
## One day during CNN II



The time series of LWP measurements from the ground-based network station Cabauw (solid line) and the model forecast (bars indicate spatial variation) reveals large discrepancies at the time of satellite overpass.



LWP distribution over Western Europe on 4 May 2001 at 15:15UTC derived from AVHRR (right) and forecasted by the RACMO model (left). Ice clouds are indicated in blue color.

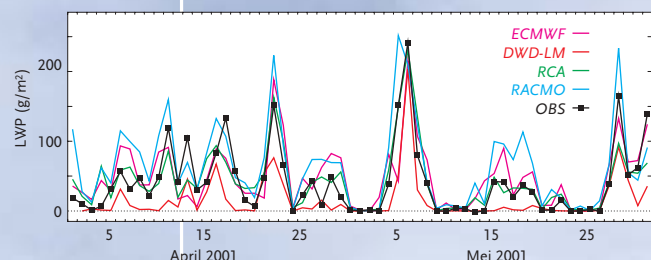


The LWP along the transect connecting the CLIWA-NET stations Cabauw (west) and Potsdam (east) show that the model and satellite measurements indicate similar gradients. The 1.2km resolution of the satellite shows spatial variations in LWP that cannot be resolved by the model.

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.

## Daily values for CNN II

The time series of daily averaged liquid water path for Lindenberg during CNN II. As reliable observations can not be made during precipitation events the model output needs to be filtered in order to enable useful comparison between model and measurements.



## Participating **CLIWA-NET** key-persons and institutes:

### **Dr. Arnout Feijt**

Royal Netherlands Meteorological Institute,  
The Netherlands

### **Dr. Susanne Crewell**

Meteorologisches Institut Universität Bonn, Germany

### **Dr. Cecile Mallet**

CETP/UVSQ/IPSL, France

### **Prof. Martti Hallikainen**

Helsinki University of Technology, Laboratory of Space  
Technology, Finland

### **Dr. Thomas Rose**

Radiometer Physics GmbH, Germany

### **Dr. Jürgen Güldner**

Deutscher Wetterdienst, Germany

### **Prof. Gunnar Elgered**

Chalmers University of Technology, Onsala Space  
Observatory, Sweden

### **Prof. Christian Mätzler**

University of Bern, Switzerland

### **Dr. Colin Jones**

Rosby Centre, Swedish Meteorological and  
Hydrological Institute, Sweden

### **Dr. Andreas Macke**

Institute for Marine Research Kiel, Germany

### **Dr. Markus Quante**

GKSS Research Center Geesthacht, Germany

### **Dr. Charles L. Wrench**

CLRC – Rutherford Appleton Laboratory, United  
Kingdom

### **Dr. Anton Beljaars**

European Centre for Medium-Range Weather Forecast,  
United Kingdom

### **User Advisory Group**

Wim Monna (GCOS), Harald Neumann (Lufthansa),  
Bertram Arbesser-Rastburg (ESTEC), Pekka Ravila  
(Vaisala), Frank Wouters (Ecofys).



## Points of contact

### **Ground Based Network**

**Dr. Susanne Crewell**  
Meteorologisches Institut  
Universität Bonn  
Auf dem Hugel 20  
5312 Bonn  
Germany  
Tel: +49 228735779  
E-mail: [screwell@uni-bonn.de](mailto:screwell@uni-bonn.de)

### **Satellite Analysis**

**Dr. Arnout Feijt**  
Royal Netherlands Meteorological Institute, KNMI  
Postbus 201  
3730 AE De Bilt  
The Netherlands  
Tel: +31 30 2206495  
E-mail: [feijt@knmi.nl](mailto:feijt@knmi.nl)

### **Atmospheric Modeling**

**Dr. Erik van Meijgaard**  
Royal Netherlands Meteorological Institute, KNMI  
Postbus 201  
3730 AE De Bilt  
The Netherlands  
Tel: +31 30 2206480  
E-mail: [vanmeijg@knmi.nl](mailto:vanmeijg@knmi.nl)

A full description of the **CLIWA-NET** project and latest results can be found at the **CLIWA-NET** web site:

[www.knmi.nl/samenw/cliwa-net](http://www.knmi.nl/samenw/cliwa-net)

### **EU**

This project is supported by the European Commission's RTD programme on Energy, Environment and Sustainable Development within the research area "Better exploitation of existing data and adaptation of existing observing systems". The project has started on March 1, 2000 and has a duration of three years.

Scientific officer:  
Mr. Ricardo Casale  
EC, DG-XII  
Wetstraat 200, B-1049 Brussels, Belgium  
Email: [Ricardo.Casale@cec.eu.int](mailto:Ricardo.Casale@cec.eu.int)

