MINUTES OF FOURTH CLOUDNET WORKSHOP
(18 April 2005)

4-5 April, Observatoire de Paris, France.
Present: D Bouniol, A Protat, J Pelon, J Delanoe, P Flamant, Y. Morille, D. Josset. (IPSL); Martial Haeffelin, A Mathieu, (LMD); David Donovan, Henk Klein-Baltnink , Gerd-Jan van Zadelhoff (KNMI); Charles Wrench (RCRU); Oleg Krasnov, Herman Russchenberg, Y Dufournet (TUD); Robin Hogan, Ewan O'Connor, A Illingworth (co-ordinator.) U of R, N Gaussiat, , M Brooks, D Wilson (Met Office); Ulrika Willen (SMHI), A Seifert (DWD), L Schlosser (Gematronik), J-M Piriou (Meteo-France).

1. GENERAL REMARKS and PROGRESS ON DELIVERABLES.
1.0 Apologies for absence. A Tomkins (ECMWF), P Ravila (Vaisala).
1.1 Actions arising from the minutes not completed and not dealt under other headings.
Meeting: Actions from third progress meeting, Exeter UK, 5-6 April 2004.
6.1 – PR provide software for CT75 to record aerosols at high sensitivity – email from PR will complete by the end of the month. The new software has now been received.
ACTION 1.1 HKB will try it out when time permits.
Actions from third Cloudnet workshop, Delft 18-19 October 2004.
2.1 NG/DB to supply plot of decay of power output of the three 94GHz tubes.
ACTION: NG/DB supply this to AJI who would forward it G Stephens (completed).

1.1. Report on requested extension, deliverables, etc by Anthony Illingworth.
1.1.1 Requested six month no cost extension. Telephone confirmation that this is virtually certain had been received from Jean-Claude Lammens, who agreed that it was best not to submit cost statements in April but to wait to the end of the contract on 30 Sept. 2005.
ACTION 1.2 AJI – Contact Brussels stressing the importance of getting written confirmation of this extension.
1.1.2 BAMS Article. It was agreed that this was the best way forward.
ACTION 1.3 AJI to contact S Crewell for advice (completed) and then approach AMS.
1.1.3 Final workshop/symposium at Lindenberg. The ideal solution would be to have a one-day Cloudnet business meeting (Tuesday 11th Oct) and a half day of 'science results papers' close to the Lindenberg centenary science meeting on Friday 14 October, and if possible in combination with the GEWEX CAP meeting on Wed-Thurs 12-13 October.
ACTION 1.4 AJI to contact T Ackerman to coordinate these meetings.
1.1.4 Final Report.
ACTION 1.5 AJI to supply details of formats etc for those responsible for writing up the results of the four work packages for the final report.
1.1.4 Upcoming conferences.
EGS – Vienna – Apr 05 - DD will mention Cloudnet in his paper.
IAMAS – Beijing, Aug 05 – AJI will present Cloudnet paper. HM and HR will also present papers. These presentations need to be co-ordinated.
1.1.5 Publications.
The web site is being updated with the latest information on SIRTA and UR papers.
ACTION 1.6 All others to supply updated publication information.

1.2 Review of data base and new models joining Cloudnet (EOC).

This is progressing very well with many new models and sites. Some test Lindenberg observations are on the web site.
ACTION 1.6 AS to supply details of the Lokal Modell to EOC so that it can be put on the web site to complement the descriptions of the other models. Also a summary of major dates of model changes affecting clouds to be supplied.
ACTION 1.7 EOC to establish link with the MSG satellite products over the Cloudnet sites on Pat Minnis' web site and explore a link to the SYNERGEE GERB MSG data.
ACTION 1.8 MH to explore data availability from the SAF at Lannion.
ACTION 1.9 DD to explore the suitability of KNMI satellite data over Cloudnet sites.

2. DATA GATHERING AND PROCESSING.
2.1 Chilbolton – CLW reported that the 35GHz front end suffered some damage in November 2004 and had been operating with about 8dB reduced sensitivity. The repaired amplifier was reinstalled in March 05. (Coded pulse performance see 4.3).
CONTINUING ACTION 2.1 CLW to report on comparisons of profiles with the 78GHZ FM/CW and 35GHz pulsed radars to define the side-lobe limitations precisely.

2.2 Cabauw - CloudNET data gathering was continuing but the 35GHz power had fallen to 9W so the sensitivity was now rather poor. A new tube delivering 250W should be installed this spring. Some of the four receivers of the CT75 ceilometer had also failed and were scheduled for replacement. Approval had been received to buy a new lidar and funds are being sought for a profiling radiometer. It is also hoped to have a continuous RAMAN lidar operating next year.

2.2.1 OK reported that TARA has been operating well since 18 Aug 04 supplying 30sec Z, mean Doppler and Doppler width. This is data is on the KNMI web-site in netCDF.
ACTION 2.1 OK to supply a link for this data to the Cloudnet web site.
OK presented retrievals of LWC and LWP from TARA using the Z/alpha and Z technique. Comparisons with a radiometer suggested a bias of 20g/m^2 and a standard deviation of 80g/m^2. By next week this would have been completed for all sites.
ACTION 2.2 HR/ OK and EOC to compare these radar/lidar products with the Cloudnet radiometer and report in time for a June meeting in Warsaw. (see 3.1 as well).

2.3 Palaiseau
MH CloudNET RASTA Radar observations ceased at SIRTA October 2004.
Calibration flights with RASTA on an aircraft below CloudSat are planned later this year.
RASTA Radar measurement to resume at SIRTA Nov 05 to Feb 06, beyond which RASTA should be operating in AMMA in W. Africa. Cloudnet LNA Lidar measurement continue as before (5days/week). It is hoped to have a new FM/CW 94GHz radar and a new 355nm lidar with depolarisation operating continuously at SIRTA from 2006 onwards together with a 1238MHz wind profiler.

3. RETRIEVAL ALGORITHMS
3.1 N Gaussiat provided an update on the retrieval of LWP from dual frequency radiometers using the ceilometer to define periods of no liquid water to optimally adjust the radiometer calibration. These retrievals are included in the Chilbolton, SIRTA and Cabauw data categorisation on the web site. Statistics were presented suggesting that the technique can tolerate offsets of 5K in the radiometers, and that cloudy periods of up to 10 hours introduce only small errors in derived lwp.

ACTION 3.1 OK/HR/EOC to compare these LWP values with those from the Z-alpha, Z technique. (see action 2.1 as well).

3.2 Lidar only STRAT algorithm was described by YM. Target categorisation uses the cross polar data. The CAPRO (Cloud Aerosol Properties) algorithm retrieves cloud thermodynamic phase and optical depth (works well for optical depths from 0 to 1.)
ACTION 3.2 YM et al to produce cloud phase product for about 2000 hours of SIRTA data by June so that EOC can place it on the CloudNET web so that it can be compared (e.g.) with the UKMO model. Cloud optical depth will also become available (date TBD).

3.3 Comparing lidar/radar extinction inversions using Raman lidar. DD described how the radar/lidar product can be blended for periods with/without Rayleigh scattering above clouds using RAMAN as an independent check of optical depth and errors derived.
ACTION 3.3 DD to implement this with the SIRTA data.

3.4 G-J Z described the lidar ice extinction versus iwc technique using crystal face data.
ACTION 3.4 G-J Z to compare extinction from this lidar only technique with those from the KNMI radar-lidar technique for the cloudnet data set.

3.5 RADON technique. (JD). Uses the mean Doppler velocity over (say) 20mins to derive profiles of Do, which are combined with Z to produce an extinction coefficient.
ACTION 3.6 JD to compare optical depths obtained from RADON with those directly obtained from the lidar using Rayleigh scattering above cloud. Estimates of extinction and optical depth (with errors) to then be released to EOC to put on the web site.
JD to compare this product with those from the other four ice retrieval techniques.

3.6 Z-IWC-T. AP described data fits for a large aircraft data set which suggested that, in contrast to the present Cloudnet product, the use of temperature led to little improvement in IWC. A vigorous discussion ensued concerning the use of log and linear fits.
ACTION 3.7 RJH/AJI/AP to resolve this inconsistency. (Completed).

3.7 YD described initial work on dual wavelength techniques for IWC and LWC.

3.8 Radar-lidar algorithms. DB provided an update, suggesting a coding error in C Tinel formulations lead to, in one blind-test example, an 85% error if multiple scattering was ignored, but in fact this was only 35% and with MS included fell to 14%..
ACTION 3.7 DB to complete implementation of this technique and then compare the products with those from the KNMI technique currently on the web site. The two products can then be placed on the internal cloudnet site for detailed comparison.

4. SPECIFICATIONS AND INSTRUMETNS FOR THE RECOMMENDED CLOUD OBERVING STATION.

4.1 CW presented a cost estimate for an FM/CW system at 35 or 94GHz.
4.2 AP presented a similar estimate for a 94GHz FM/CW system.
4.3 AJI (EP) presented an analysis of the Chilbolton 35GHZ data in which alternate pulses are coded and non-coded showing that Z range side lobe errors introduced by the 8bit complementary codes now used by the 35GHz at Cabauw and Chilbolton were only

significant when the Doppler velocity was high and precipitation was present. For clouds the range side lobes were negligible.
ACTION 4.1 AJI to contact EP regarding the effect of the coding on the folding velocity.

4.4 Lidar systems.
PF presented the 'TRESS' system which is being built for AMMA which contains mini-lidar 532, 355 and cross polar) , Raman (607m,) , a sun photometer and an IR radiometer. Some examples of data were shown. The device is not available commercially.
JP presented a survey of commercial lidar systems available now and those which should appear shortly.

4.5 Radiometers.
AJI presented some information supplied by Susanne Crewell of CLIWANET.

4.6 Instrument Discussion.
DD will be editing the WP report that deals with this. This will have to reflect various combinations and possibilities but the following points were made:

a) A cloud radar operating with FM/CW should have the required sensitivity. None is presently commercially available but there are plans to construct such radars. The choice between 35 and 94GHz is difficult, but 35GHz has the advantage of less attenuation by water vapour, oxygen and liquid water. It may need a larger antenna than the 94GHz fro the same sensitivity.
b) Lidar. The talks indicated several developments are imminent which should result in a lidar of sufficient sensitivity which can be operated unmanned.
c) Radiometer. The Cliwanet document provided a specification and price. The new technique suggests that a radiometer drift of 5K can be tolerated. This relaxation may lead to a reduction in price.

5. COMPARISONS WITH MODELS..

5.1 Lidar cloud statistics. AP used the model output to predict if the obscuration of the lidar signal by low clouds would bias the statistics of the high clouds. Indications are that this does not occur, at least at SIRTA.
ACTION 5.1 AP to finish this study and to consider thresholding the high cloud statistics by optical depth of the high clouds.

5.2 . Lidar cloud statistics. MH presented statistics on the number of high clouds observed by the LNA and the significant increase in the amount of high cloud detected.
ACTION 52 MH to continue this and to use the Rayleigh signal to estimate the optical depth of these high clouds and collaborate with EOC to compare with models.

5.3 DB Sampling of the RALI radar/lidar algorithm. DB found that at SIRTA there were 233 days/1337 hours of lidar and radar data but only 223 hours which had simultaneous radar/lidar signals. In other words only 5% of the clouds could be amenable to the radar/lidar algorithm. Statistics at Cabauw and Chilbolton were similar. Statistics were presented to see if the 5% was a good sample of the full cloud data set. It seems that the RALI IWC is constant with altitude whereas the model IWC falls with height.

ACTION 5.3 DB to continue this work, and check if RALI radar/lidar algorithm produced a similar IWC to the Z-IWC-T and RADON algorithm applied to the same sub-set of clouds.
ACTION 5.4 G-J Z suggests that during one period the Chilbolton data below -20dBZ was unreliable; this should be checked with NG to see if the data on the web was now OK.

5.5 LWC observed variability. EOC presented statistics of pdfs of lwc and dilution of water clouds derived from using cloud base and top from the radar and lidar and the lwp from the radiometer and compared them with model representation. This product will shortly be on the web.

5.6 LWC variability. DW analysed whether the variability of LWP within the model grid box from the radiometer data would have an effect on radiative transfer because the IR transmissivity is not linearly related to the lwp. He concluded that the 0.7 factor often used to correct for this should be closer to 0.35, but that it was probably more important at this stage to get the model lwp right in the first place.

5.7 Regime analysis. MB showed that the observed LWC was typically twice that of the model, but this could be affected because the data was confined to cases of no precipitation. Statistics of IWC of the observations and the models with various rain filters applied were presented.
ACTION 5.5. Extend to SMHI model data when available.

5.8 DW compared two cloud schemes in MO model (present and PC2) and suggested that the climate models produced too much cloud in a stable boundary layer.
ACTION 5.6 EOC to consider producing statistics on the big boxes used for climate runs.

5.9 New parameterisation scheme in RACMO based on ice particle size profiles variation normalised with respect to cloud top and base. A one year trial showed changes in cloud forcing of up to 25W/m^2. At this stage only the changes in radiation are modelled, there are no changes in the dynamics and (e.g.) no change is made in ice terminal velocities.

5.10. Observed profiles and radiative effects. UW presented early results of changes in SW radiation for modelled clouds and the observed real structure.
ACTION Continue this work.

5.11 RJH introduced the level three statistics to provide model skill scores now available on the web and described the analysis planned for the next few months.

ACTION ALL. By early June it is important that as many data sets as possible with the new algorithms are on the web so that the statistical analysis can be extended to these results. The algorithms which need to be ready for analysis by June are:

LWP from Z/alpha - action 3.1 OK
STRAT/CAPRO - action 3.2 YM
Blended radar/lidar Rayleigh - action 3.3 DD
RADON - action 3.5 JD
LNA lidar opt depth - action 5.2 MH
RALI - action 3.7, 5.3 DB

6. UPDATE ON MODELS.
Ecmwf: 29r1 very soon – new moist bl scheme should improve stratocumulus.
29r3 – sep 05 – better cloud numerics – vert levels increase from 60 to 91. horiz res up to T799. Testing new scheme to allow ice supersaturation.
Long term plans – statistical approach for cloud cover + multiphase ice microphysics.

Met office: Mesoscale unchanged. Global: 18 Jan 05 microphsyics and boundary layer improbed – may affect clouds. 8 Feb 05 – new data assimilation.
Plans: May 04 Mesoscale over UK 4km and 12km over all Europe. PC2 should be introduced at the end of the year.

MeteoFrance: Arome will be 2.5km in 2008 with explicit convection. The Cloudnet data is proving more useful for cloud evaluation than synoptic observations.

SMHI: ACTION 7.1 UW will supply TKE from the SMHI model to the data set.

DWD: The 7km grid region is being extended.

8. WRAP UP SESSION.
8.1 Breakthroughs were reviewed and the following candidates identified:
WP2 – operation of stations – i) extra models; ii) ARM sites; iii) Lindenberg (EOC).
WP3 – retrieval algorithms – iv) use of lidar for lwp (NG);
v) lwc profiles and statistics (EOC).
vi) STRAT/CAPRO technique (YM)
vii) particle size density (AP)
viii) RADON (JD)
ix) Raman merge check with lidar and lidar/radar.
WP4 - compare with models
x) LWC Bl cloud dilution statistics (EOC)
xi) LWC times two in models (MB)
xii) New RACMO parameterisation (J-G Z)
xiii) Level 3 analysis (RJH)
xiv) Cloudnet better than synoptic for model evaluation (J-P M)
xv) Better ice cloud retrieval with good lidar. (MH)
xvi) Regime analysis (MB).
ACTION 8.1 All to supply text half a page of text and diagram for final report. (For style see last year's report).

8.2 Final report. AJI will supply precise details to those responsible for writing the text for WP1, 2, 3, 4, and 5.

8. Date of final meeting. Week of 10-14 October at Lindenberg.