Inventory of Goals, needs and instrumentation BBC2

With this document, we want to make an inventory of the goals and the needs of the BBC2 participants. Furthermore, for the experimental planning we need to know which instruments will be brought to Cabauw.
It is hopped that this document will stimulate the cooperation between the participants. People may find that the additional instrumentation they need is also needed by other or that they have instruments that others need, which they had not planned to bring to Cabauw up to now.

Measured three dimensional LWC fields for radiative transfer calculations

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Goals. Improvement of the radiative transfer calculations in NWP and climate models through inhomogeneous clouds. To achieve this 4D-clouds goal we need measurements of the cloud structure, cloud cover, LWP power spectrum, cloud boundaries, cloud layers, etc. These measurements will be used to generate 3D-cloud fields with a search algorithm for the radiative transfer calculations.
Measurement scales. The largest scale is determined by the grid box of a GCM, say 100 km, the smallest by what resolution a radiative transfer model can handle for a NWP simulation 10km/256cell ? 30 m.
Preferred meteorological conditions. Water clouds, homogeneous single layer clouds and ones that are more complex, without other clouds above to have a homogeneous radiation field above.
Own instrumentation. (Scanning) microwave radiometer MICCY, including a (scanning) IR radiometer.
Required other instrumentation. LWC-probe (flying ramps up and down for vertical LWC profiles) and lidar. Radiometers below the clouds (on the ground) in the visible and infrared regime for validation.
Dream instrumentation. Every instrument that can describe cloud structure: non-scanning microwave radiometer (for long time series and easy combination with other instruments), (scanning) lidar, IR radiometer, CASI cloud mask, nadir lidar/radar on aircraft for the cloud top structure. For radiative transfer calculations in the infrared, it would be interesting to have humidity and temperature measurements. For validation, spectrally resolved and broadband radiative fluxes would be good.

Error quantification of in-situ validation measurements for cloud retrievals with ground based remote sensing

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Goals. This project has two goals, firstly, to quantify the error made in validation studies of cloud retrievals of LWC profiles with ground based remote sensing due to the 3D-structure of clouds. Based on this quantification method, one can, secondly, investigate which validation method performs best. Therefore, we need measurements of cloud structure (we can easily combine data

from various instruments with our evolutionary search algorithm thus the more the better) and simultaneously in-situ measurements of LWC profiles. For this project, we got funding from the CAATER-program.
Measurement scales. The smallest interesting scale is determined by the remote sensing scale (10 m). The largest scale by the horizontal distance the aircraft needs to get an entire profile (10 km).
Preferred meteorological conditions. Water clouds, homogeneous single layer clouds and ones that are more complex.
Own instrumentation. Scanning microwave radiometer MICCY, Scanning cloud radar MIRACLE, IR radiometer. In situ cloud microphysics measurements (flying ramps up and down for vertical LWC profiles) via a CAATER-proposal.
Required other instrumentation. Lidar.
Dream instrumentation. Every instrument that can describe cloud structure and in-situ probes for LWC and droplet size: (scanning) lidar, IR radiometer, CASI, nadir lidar/radar on aircraft for the cloud top structure, and PVM and FSSP (etc., flying ramps up and down for vertical LWC profiles).

Scattering of radar waves by small scale cloud structures

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Goals. Investigate if the radar reflections in stratocumulus and cumulus are dominated by scattering due to Poisson distributed cloud droplets, spatial humidity structures (usually called Bragg scattering), or due to spatially correlated droplets (coherent particle scattering). This project is just a hobby of mine.
Measurement scales. The scattering is produced by structures of half the size of the radar waves. Therefore, scales down to one mm are interesting. As this is probably not reachable, one will have to extrapolate (hopefully as little as possible). The largest interesting scale is a few orders of magnitude larger than the smallest scale.
Preferred meteorological conditions. Stratocumulus clouds and especially cumulus clouds.
Own instrumentation. None
Required other instrumentation. PVM, two radars at different frequencies (the coherent particle scattering is strongest at large wavelengths).
Dream instrumentation. Fast FSSP (drop distance distribution), and PVM, fast humidity, temperature in-situ measurements close together (to be able to calculate cross-correlations).

Microphysical cloud properties for correction algorithms of remote sensing data

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Goals. The main goal of this project is the validation of ground-based and remote sensing data (ENVISAT) for the development of correction algorithms due to the influence of clouds, their optical and microphysical properties on satellite data. The second aim of the project is the measurement of microphysical aerosol properties in the PBL and the investigation of aerosol-cloud interaction. For that, profiles and horizontal legs below, inside and above the clods should be flown with as many overpasses over the remote sensing side as possible. A co-ordination with satellite overpasses is desirable but not urgent. For this project, we got funding from the EU by CAATER.
Measurement scales. The smallest interesting scale is determined by the in-situ measurement probes and is of 1 km. For good statistics horizontal legs should be of a length of about 50 km.

Preferred meteorological conditions. Water clouds and mixed phase clouds, single-layer and multi-layer systems ones during a build up phase of a cloud system.
Own instrumentation. In-situ measurement probes for microphysical cloud and aerosol parameters (PMS probes) and for the direct measurement of LWC/TWC (Nevzorov probe).
Required other instrumentation. 95 GHz cloud radar of GKSS and in the aircraft measurement devices for long- and short-wave radiation measurements.
Dream instrumentation. Any other ground-based instrument that provides additional information about cloud height, thickness and structure (cilometer, lidar, microwave radiometer).

Combining balloon-borne drop microphysical with aircraft and ground-based radiation measurements

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Goals. As a result of our discussion at the Leipzig BBC workshop and in Toulouse we propose a somewhat different approach for tackling the cloud enhanced absorption problem during BBC-2. It is based on the combination of balloon, aircraft and ground-based measurements. The balloon shell be used to characterize the microphysical properties of the cloud field, whereas the aircraft is concentrating on the radiation measurements above the cloud. Below- and in-cloud measurements with the aircraft are not attempted, instead at the surface a spectrometer, similar to that installed on the aircraft will be deployed. Additionally pyranometer measurements at the surface will be included. The balloon will perform continuous vertical profiling of the cloud layer and thus the microphysical measurements with the balloon will characterize the temporal and spatial cloud inhomogeneity in detail. The advantage of using two instrumental platforms (balloon and aircraft) for the airborne measurements is that the aircraft may sample and average a larger area above the cloud, which yields measurements that are more representative. With this approach, the airborne and ground-based radiation measurements are performed simultaneously with the balloon microphysical sampling.
Measurement scales. Balloon: The high-frequency data from the balloon cover a wide range of spatial scales, which is mainly restricted by the sampling statistics. The aircraft will fly above the cloud up to 4 km altitude.
Preferred meteorological conditions. Extended stratiform cloud sheet above the ground based measurement site, Cloud top less than 1.3 km.
Own instrumentation. The same as during BBC-1, additionally actinic flux densities will be measured (aircraft only).
Required other instrumentation. Heidelberg O_2-A spectrometer.
Dream instrumentation. Duplicate the albedometer and install it on a second aircraft

Title

Name
Institute
Goals.
Measurement scales.
Preferred meteorological conditions.
Own instrumentation.
Required other instrumentation.
Dream instrumentation.