



On the derivation of macrophysics and microphysics cloud parameters from combination of passive and active radiation measurements : airborne FRENCH campaign case studies

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The airborne FRENCH (Field Radiation Experiment on Natural Cirrus and High-level clouds) campaign has taken place over the Atlantic Ocean and the Mediterranean Sea off the coasts of southern France from the end of September to mid-October in 2001. The flights plans were high enough to acquire measurements above high-level clouds such as cirrus. During the experiment, measurements were acquired simultaneously by various remote sensing instruments (passive and active).

Thanks to the diversity of the instruments available during the FRENCH campaign, we compare and combine the different measurements using various methods to describe optical and radiative cloud properties and their link to microphysical properties. As a first step of our analysis, cloud altitude is derived from different techniques. The LEANDRE lidar allows for detecting the bottom and the top of the cloud. The multi-angular radiometer POLDER offers the possibility to use a stereoscopic approach. With two measurements in the oxygen A-band at 765nm, we can apply a differential absorption method to retrieve the pressure of the observed scene. Then we investigate a methodology based on the capability of each instrument to determine the cloud optical thickness as well as to describe the cloud microphysics. In a first step, we show that these parameters have to be retrieved together. that's the reason why we use an optimal estimation method to find the best agreement between our different kinds of measurement and simulations. Simulations are performed with the adding-doubling method and the microphysical model is chosen from analysis of polarized radiance measurements. In the case of ice cloud particles, we use an inhomogeneous hexagonal

monocrystal.

The FRENCH campaign was also an opportunity to analyze combination of radiation instruments before it is exploited in the frame of future space missions such as the Aqua-Train. Some of the instruments on board the aircraft had characteristics similar to those of spaceborne instruments of the Train. The airPOLDER (POLarization and Directionality of the Earth's Reflectances) is similar to PARASOL and measures multidirectional and polarized reflected light in the visible and the near-infrared. The MiniMIR (Middle InfraRed) instrument has spectral channels similar to some of MODIS. Leandre (lidar with polarization capabilities) is very similar to the CALIOP lidar on board the CALIPSO platform and finally, the multichannel thermal infrared radiometer CLIMAT has spectral channels close to those of the IIR radiometer on board CALIPSO.