A long term comparison of cloud properties observed by vertically pointing radar and lidar with their representation in operational NWP models

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1. INTRODUCTION

The representation of clouds is one of the major uncertainties in the predictions of future climate change (Mitchell 2000, Stocker, 2001), due to the complex effects of clouds on the earths radiative and hydrological balances. Much of this uncertainty stems from the lack of adequate and objective observations.

The CLOUDNET project aims to use data obtained from near-continuously operating cloud observing sites for the development and implementation of cloud remote sensing synergy algorithms. The data is obtained from a network of three cloud remote sensing stations, Chilbolton (UK,) Cabauw (Netherlands), and Paris (France). The data presented in this abstract used appromximately 8 months of data, but data collection is ongoing and should last for 2 years.

The use of active instruments (lidar and radar) results in detailed vertical profiles of important cloud parameters which cannot be derived from current satellite sensing techniques. These can be compared with the cloud parameters produced from a range of Numerical Weather Prediction (NWP) models which are outputting profiles of cloud and other parameters over the cloud remote sensing stations from the operational forecast runs. At present outputs are archived from the the ECMWF, Meteo France, the Met Office (Mesoscale and Global models) and the KNMI RACMO model.

2. METHOD

The data used in this paper are primarily the cloud radar and lidar. The exact configuration of each of these instruments varies from site to site, but generally speaking the cloud radars are able to detect most cloud, except thin Cirrus and thin StratoCumulus (which has yet to develop drizzle droplets), although the cloud radar cannot meaningfully distinguish the cloud base when precipitation is falling from the clouds, however the lidar is ideally suited to this task .The presence of cloud is determined (as Hogan 2000), where there is a radar return. For ice cloud, this is unambiguous in that falling ice is treated as cloud in most NWP models. Cloud warmer than the wet-bulb 0^oC (as determined from the model profiles) isotherm is considered to be cloud if it is above a cloud base detected the lidar. This results in a time-height section through the clouds, at the radars high temporal and vertical resolution. This is then averaged onto the same grid as the model outputs to be compared with the model profiles of cloud parameters. The model clouds are filtered to remove cloud which have Ice Water Contents (*IWC*) lower than the sensitivity of the radar would be able to predict. In the ECMWF output cloud is added below clouds precipitating significant amounts of ice, as at present this is not included in the ECMWF model as cloud.

3. RESULTS

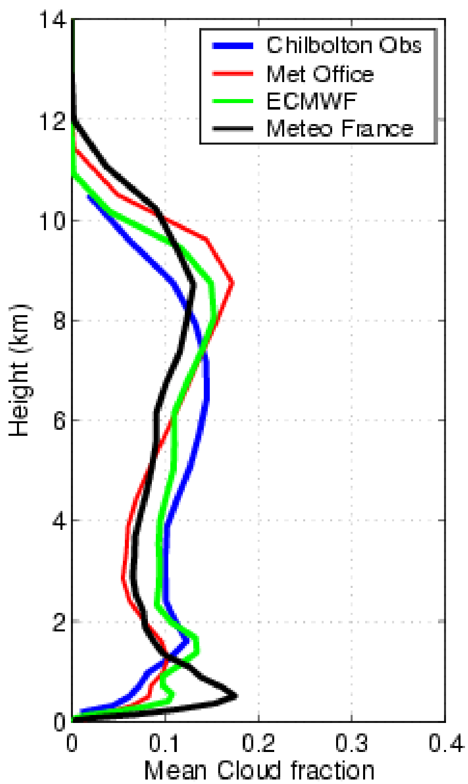

Figure 1. Mean cloud fraction over the Chilbolton site for the Met Office (Mesoscale), ECMWF and MeteoFrance models, for the period April-September 2003.

Figure 1. shows a a general underestimate of cloud fraction below 8 km, by all three of the models shown,

although the ECMWF appears to have a mean cloud fraction closest to the observations at all heights. In the full poster, these results will be expanded, and displayed for more models, and more sites.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

Hogan, R.J. and Illingworth, A.J. (2000): Deriving Cloud Overlap Statistics from Radar Observations. Quart. J. Roy. Meteor. Soc. **126**, 1-7.

Mitchell, J.F.B. (2000): Modelling Cloud-Climate Feedbacks in the Predixction of Human induced Climate Change. World Climate Research Program Workshop on Cloud Processes and Cloud Feebacks in Large-Scale models. WCRP-110.

Stocker, T.F. 2001: Physical Climate Processes and Feedbacks, in IPCC, Climate Change 2001: The Scientific Basis.