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Vertical profile of fog microphysics experiments

Frédéric Burnet (1), Thierry Bourrianne (1), Sébastien Barrau (1), Pauline Martinet (1), Gregoire Cayez (1), Maroua Fathalli (1), Christine Lac (1), Olivier Masson (2), Jackie Tav (2), Sébastien Conil (3), and the BURE team

(1) CNRM, Université de Toulouse, Météo-France, CNRS, Toulouse, France (frederic.burnet@meteo.fr), (2) IRSN, LEREN, Cadarache, Saint Paul Lez Durance, France, (3) ANDRA/ OPE, Centre de Meuse/Haute-Marne, Bure, France

Fog has a significant impact on human activities in particular with respect to air transport operations. To improve fog simulation and forecast the CNRM conducted two field campaigns during Fall 2015 and 2016 in collaboration with IRSN (Institut de Radioprotection et de Sûreté Nucléaire). Realized at the Observatoire Pérenne de l'Environnement (OPE) of ANDRA (Agence Nationale pour la gestion des Déchets Radioactifs) located in the East of France (250 km from Paris) in a deep rural area, an innovative instrumental set-up was deployed to gain insights on the following objectives :
- document typical features of the vertical profiles of fog microphysical properties (droplet size and number concentration, liquid water content (LWC) and visibility) in order to to constrain and validate numerical simulations ;
- asses the impact on fog forecast of the assimilation of humidity and temperature profiles retrieved from a ground-based microwave radiometer into the AROME numerical weather prediction model ;
- evaluate the amount of fog water deposition on plants by turbulent mixing which is a substantial sink of water at the surface.

Numerous instruments were installed on a mast at different altitude levels (2, 10, 50 et 120 m). During intensive observation periods in situ vertical profiles up to 500 m height above the ground were performed with a tethered balloon equipped with microphysics (modified DMT Cloud Droplet Probe) and turbulence (sonic and inertial sensors) measurements. Ultra-light (650 g) remotely piloted aircraft systems were also used to characterize the boundary layer properties evolution in complement to radiosonde measurements.

The instrumental set-up deployed during this campaign is presented and data collected during fog events are analysed to investigate the variability of the different parameters along the vertical. We show that LWC values are much higher that those usually measured at the ground during past experiments. We analyse a developed fog, a thin fog (< 50 m) and a stratus to fog transition that occurred successively during the nights from 27 to 30 October 2016. This study underlines the interest to document the time evolution at different altitude levels. We also investigate in details the fog formed due to stratus lowering that was sampled during the night of 1-2 December 2016. The vertical profiles of the droplet size distributions collected with the tethered balloon are investigated. They reveal noticeable differences between the stratus and the fog formed below.