Free flying cluster of miniaturized radiosondes for multi-parameter atmospheric fluctuation observations

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We present a newly developed methodology to track Lagrangian fluctuations of physical and chemical quantities in the atmosphere. The measurements are carried out by using a freely floating cluster of mini, innovative radiosondes. The radiosonde are light (∼20 gr) and are carried out by biodegradable small balloons. The primary aim of this method is to obtain Lagrangian statistics of the turbulence fluctuations inside warm clouds, their boundaries and the surrounding sub-saturated environmental air. This is important information, difficult to find at the state of the art and very useful for modeling cloud formations which are still a primary source of uncertainty in the numerical simulation of climatic and meteorological information[1]. The method was developed within the H2020 COMPLETE network, www.complete-h2020network.eu (2016-2021). Each radiosonde in the cluster is made of a radioprobe[2] which is mounted on a biodegradable balloon[3] filled with a mixture of helium and air. The system is able to float inside and around clouds for a time span of a few hours and measure fluctuations of air temperature, pressure, humidity, position, velocity, acceleration and Earth magnetic field along each single probe trajectory. By following in a passive way the multi-phase cloud parcels, the system can provide a multi-point endoscopic view of clouds and the surrounding clear-air. Preliminary in-field experiments were carried out with tethered and freely floating radiosonde network in different sites in collaboration with CNR-INRIM, ARPA Piemonte and OAvdA[4]. The recent experiments at OAVdA, on Nov 3, 2022, addressed the possibility to implement a **distance neighbor graph algorithm**[5] for turbulent dispersion analysis in the atmosphere. Measurements that have not yet been implemented in field atmospheric observations.

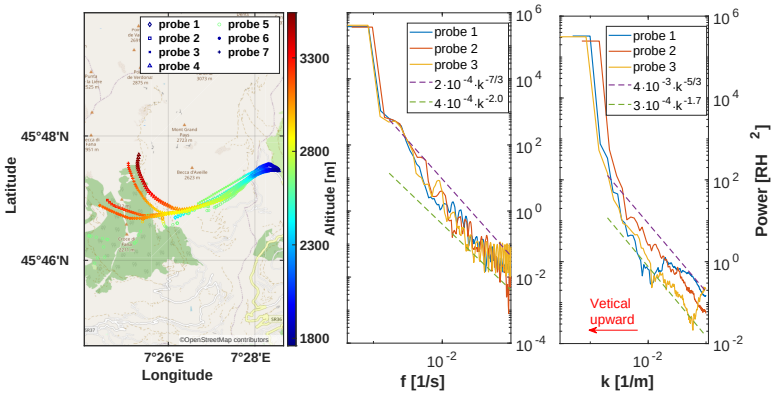

Figure 1: Trajectory of the radiosondes during the free launch period, Nov. 3rd, 2022, OAVdA. Marker colors indicate the reached altitude by the sondes. Middle and right hand side panels: frequency and wave number spectra of the humidity fluctuation during the flight.

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