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VERTICAL PROFILE OF BLACK CARBON POLLUTION

APPLICATION NOTE

MOTIVATION

Detailed vertical profiles of aerosol parameters are needed to quantify the effects of aerosols on radiative forcing and clouds and how these in turn influence climate and the hydrological cycle. Since recent studies have demonstrated the inability to compute these profiles from surface aerosol measurements alone, vertical profiles of aerosol optical properties must be acquired to compute aerosol and cloud radiative effects throughout the entire atmospheric column. The location of aerosols within the vertical column, such as above or below the clouds, can have a significant effect on the sign of the forcing.

BC profiles are globally scarce compared to ground level data. Thus, there is a clear need to improve the knowledge about aerosol vertical profiles. This is true especially over mountainous regions.

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METHODOLOGY

Vertical BC profiles are measured to determine their direct radiative effect.
The results indicate that surface measurements do not represent the aerosol properties within the elevated layers, especially if these layers are influenced by long range transport.
BC gradient can be used to determine planetary boundary layer.
At PBL also a decrease in Rh was observed.

BALOON MEASUREMENTS

Measurement in three Italian basin valleys.
Maximum height 600 m.
Ascent/descent rate was set at 30 m/min.
The BC concentrations were constrained close to ground (within 200 m).
Direct radiative effect was up to 100 mW/m3 for the atmospheric layer closest to the ground.

UNMANNED AERIAL VEHICLE MEASUREMENTS

Measurements over the Indian Ocean up to 3000 m.
A relatively constant aerosol concentration was observed on most days from the ground up to an altitude of approximately 500 m a.s.l., which corresponded to the typical cloud base.
Vertical profiles are significantly different and depend on the meteorology.
Concentrations can be higher above the PBL due to long range transport.
Using wind back trajectories it was confirmed that the plumes originated over land.

Related aticles

L. Ferrero et. al., „Impact of black carbon aerosol over Italian basin valleys: high-resolution measurements along vertical profiles, radiative forcing and heating rate“, Atmos. Chem. Phys., 14, 9641–9664, (2014).
C. E. Corrigan et. al., „Capturing vertical profiles of aerosols and black carbon over the Indian Ocean using autonomous unmanned aerial vehicles “, Atmos. Chem. Phys., 8, 737–747, (2008).

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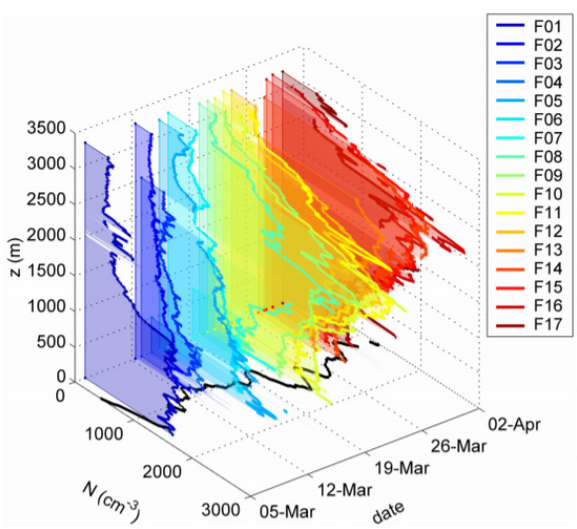

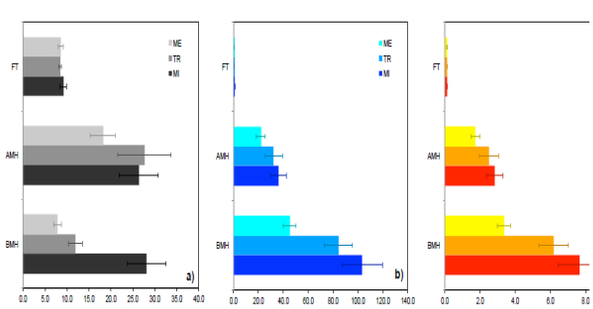

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Keeping an Eye on the Air