2.176 First observations of the aerosol vertical profiles in the Himalayan foothill region using an ultralight aircraft platform.

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Abstract:

Limited observational knowledge (especially from airborne measurements) on vertical properties of atmospheric aerosols in the Himalayan region prevents us from quantitatively assessing aerosol impacts in the sensitive Himalayan-Tibetan Plateau region. To quantify the vertical and horizontal variations of aerosol properties in this region, an airborne campaign with a single-engine, two-seater ultralight aircraft (IKARUS C 42) was carried out from the Pokhara Valley, Nepal (83.97°E, 28.19°N, 815 masl) in two phases: test flights in May 2016 (pre-monsoon) and intensive sampling flights in December-January 2017 (winter). The sampling flight plan included vertical profiling (between 1000- 4200 masl) at multiple points in mountain valleys and a horizontal south-north transect (>3000 mals) through the Pokhara Valley. A suite of aerosol instruments was deployed onboard which included a GRIMM OPC 1.108 (D_p: 300- 20000 nm), TSI SMPS (11-400 nm), TSI CPC 3375 and 3007 for the particle count, and two Magee Scientific Aethalometers (AE42 and AE 51) for BC and light absorption measurements. Sharp morning and afternoon gradients were observed in the vertical profile of aerosol number and size, mostly dominated by <400 nm particles. The gradient was much steeper in the winter than the pre-monsoon season. The elevated polluted layer was observed during the pre-monsoon season, associated with strong synoptic transport from the Indo-Gangetic Plain. The elevated layer was also observed in the winter season, only during the presence of high-pressure systems. Using the libRadtran model v2.02, the relationship of the radiative forcing (at 800 masl and 4000 masl) with the measured vertical profiles of aerosol size distribution and multi-wavelength aerosols absorption is explored. The diurnal and seasonal forcing variations, as well as the geographical variations (across different mountain valleys) are also evaluated. The aerosol radiative forcing estimates from aerial measurements are also compared with the columnar ground-based (AERONET) and satellite-based (CALIPSO) forcings.