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Overview of the TRO-pico campaign aiming at studying of the impact of convective overshooting on the stratospheric water budget: first highlights

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Two processes are competing in the control of water vapor concentration in the tropical stratosphere: i) The so-called cold trap that is the slow ascent of water vapour in the TTL followed by ice crystal freezing and sedimentation leading to the drying of air entering the stratosphere and ii) convective overshooting that injects ice crystals sublimating in the stratosphere, eventually followed by further condensation and sedimentation. In contrast with the large-scale cold trap mechanism, overshooting towers are small size, fast but relatively frequent processes. Even if the first is frequently thought to be the main process controlling the amount of water in the stratosphere, the importance of overshooting, highly dependent on the frequency of the events, is still unknown. The aim of the TRO-pico project, supported by the French ANR, is to characterize the variability and frequency of convective water injections, its contribution at the regional wet season timescale, and to improve the understanding of their role with respect to the cold trap at a wider scale. The project is based on a small balloon campaign that took place in Bauru (22.3°S) in S-E Brazil, in March 2012 and from November 2012 to March 2013 (most of the wet season) with a peak phase in January-February 2013 (during the most active convective season). The campaign involved a series of light weight payloads, including Pico-SDLA laser spectrometers (H_2O, CO_2 or CH4), a FLASH Lyman alpha hygrometer, a mini-SOAZ spectrometer for O_3, NO_2, H_2O, COBALD and LOAC aerosol instruments, combined with ground based S-Band radar and an optical depth sensor so-called ODS, satellite observations from CALIPSO, MLS, and adequate modelling tools that is of all parameters sensitive to convective intensity. TRO-pico included a two time-scale campaign with a total of 37 balloon flights including 34 flights using H_2O sensors in the flight train: i) a Six Month Observation Period (SMOP) covering to the full wet season during which water vapour profiles were measured regularly for studying its variability and seasonal change, and ii) an intensive observation period (IOP) during the most convectively intense period when all above-mentioned parameters were measured next or above thunderstorms. More than one year after the end of the campaign, here we give the first conclusions from this large campaign, such as the variability of water vapour in the TTL, the influence of the overshooting convection within the profiles gathered, new insights from modelling of deep convection, as well as statistics from cirrus observations and modelling.