



The rising greenhouse effect: experiments and observations in and around the Alps

R. Philipona

MeteoSwiss, Station aerologique, Payerne, Switzerland (rolf.philipona@meteoswiss.ch, 41 26 6626212)

The rapid temperature increase of more than 1°C in central Europe over the last three decades is larger than expected from anthropogenic greenhouse warming. Surface radiation flux measurements in and around the Alps in fact confirm that not only thermal longwave radiation but also solar shortwave radiation increased since the 1980s. Surface energy budget analyses reveal the rising surface temperature to be well correlated with the radiative forcing, and also show an increase of the kinetic energy fluxes explaining the rise of atmospheric water vapor. Solar radiation mainly increased due to a strong decline of anthropogenic aerosols since mid of the 1980s. While anthropogenic aerosols were mainly accumulated in the boundary layer, this reduction let solar radiation to recover (solar brightening after several decades of solar dimming) mainly at low altitudes around the Alps. At high elevations in the Alps, solar forcing is much smaller and the respective temperature rise is also found to be smaller than in the lowlands. The fact that temperature increases less in the Alps than at low elevations is unexpected in the concept of greenhouse warming, but the radiation budget analyses clearly shows that in the plains solar forcing due to declining aerosols additionally increased surface temperature, whereas in the Alps temperature increased primarily due to greenhouse warming that is particularly manifested by a strong water vapor feedback.