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High resolution numerical investigation of the indirect effects of aerosols on orographic precipitation

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Mountains play a key role for humanity providing freshwater for the areas downstream. The amount of precipitation at a given location is significantly affected by orography. Since changes of rainfall are expected in the changing climate, understanding how orographic precipitation responds to global warming and to anthropogenic forcing is becoming particularly pressing. To better understand the physical processes at play, in this study we investigate the indirect effects of aerosols on precipitation using the Weather Research Forecasting (WRF) Model: sensitivity experiments are run with different numbers of water-friendly and ice-friendly aerosols in the atmospheric boundary layer. 5-years long simulations at high spatial resolution (4Km) have been run in the Great Alpine Region, where orographic lifting plays an important role and precipitation has a large spatial variability due to the complex orography. Results indicate that the indirect effects of aerosols modify cloudiness and precipitation in different ways among the flatlands (Po Valley) and the mountain areas. Physical mechanism at the base of those differences are discussed.