Relief shapes and precipitation on the south side of the Alps – Part I: Relief characteristics and dry sensitivity simulations

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Abstract
There are two distinct climatological precipitation maxima at the south side of the Alps and an area of reduced precipitation between them. The westernmost maximum was explained by deflection of the large-scale southern rotational flow towards the west leading to a convergence in this barrier jet. The explanation for the lack in precipitation in between must consider smaller scale relief characteristics. Thus relief shapes are examined at the meso-beta scale with special emphasis on slope and concavity/convexity. Dry simulations are performed in a 10-km resolution using a fully compressible nonhydrostatic numerical model, with three values of nondimensional mountain height \( Nh/U = 0.5, 1.25, 2.5 \), two flow directions (from S and SW) and three different idealized topographies. The results suggest a correlation between regions of uplift on the windward side and concavity for a moderately blocked flow \( Nh/U = 1.25 \). Two uplift regions, corresponding to the climatological precipitation maxima occur on both sides of idealized Trentino Mts. only for the southerly flow. Adding idealized Dinarides enhances the eastern area of uplift, both in magnitude and spatial extent.

1 Introduction
There are two precipitation maxima in climatological sense on the southern side of the Alps (FREI and SCHÄR, 1998, SCHWARB et al., 2001). The first is located to the SE of the Alps in the Julian and the Karnic Alps connected with another area of strong precipitation to the SE in Croatia in the Dinaric Alps north of Gulf of Kvarner. The second maximum is in Ticino and the Lago Maggiore area – the MAP Target area (LMTA). The two maxima are not connected: there is a gap in climatological precipitation field in Trentino – Alto Adige/Südtirol, extending partly also to the north in Austrian Tyrol (Figure 1).

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The western maximum precipitation area has suffered several heavy flood events (e.g. Brig, Piedmont), and has been extensively studied by many authors (e.g. the HERA, 2000; the MAP, 2003), while severe floods in Julian and Karnic Alps have received less scientific and public attention – also due to the fact that this area is less densely populated and urbanized. Nevertheless, in a massive landslide during the night of November 16–17, 2000, the village of Log pod Mangartom, Slovenia, located in the Julian Alps, was hit by a debris flow of about one million cubic meters of morainic material and slope gravel resulting in seven casualties (i.e. BRILLY et al., 2002). The landslide seems to have been caused by accumulation of precipitation in slope material during the wet summer and autumn 2000 and finally triggered by an intense rainfall on the 15th of November. A similar event happened in the village Ugovizza/Ukve near...