

Atmosphere-surface interactions: high-resolution atmospheric simulation coupled with a Surface Data Assimilation Scheme

Recent research results suggest that soil conditions (turbulent fluxes, temperature, moisture) have a driving role for a proper modeling of the spatio-temporal evolution of land-atmosphere interactions over complex orography (Chow et al., 2005, Campo et al. 2009).

Chow et al. (2005) showed a methodological approach necessary to achieve accurate numerical simulations of flow over steep and mountainous terrain, by using as prototype case the Riviera Valley in the southern Swiss Alps (MAP-Riviera project field campaign 1999). Their main finding is that a proper agreement between simulations and observations can be obtained, but only when high-resolution surface datasets are used and the nested grid configurations are carefully chosen. This means that simply increasing spatial resolution without incorporating improved surface data gives unsatisfactory results, since the onset and magnitude of the winds over complex orography are highly sensitive to initial soil moisture conditions.

Campo et al. (2009) studied the land-atmosphere interactions in an high resolution atmospheric simulation coupled with a surface data assimilation scheme and demonstrate that results of the coupling experiment showed improvements in the reconstruction of the surface states by the atmospheric model and considerable influence on the atmospheric dynamics.

In this framework, this research project will be devoted to explore the effects of assimilating the surface turbulent fluxes, temperature and humidity states, provided by satellite-derived observations, into high-resolution numerical simulations of deep moist convective events over complex orography areas, performed with WRF model.

The study will be based on the comparisons between meteorological model results with and without coupling with the assimilation scheme in terms of surface dynamics and the evolution of the boundary layer, and with special focus on the effects on the predictive ability of the model with regard to amount and spatio-temporal distribution of rainfall. A catalogue of extreme precipitation events observed during last few years and representative of flash flood-producing storms in small-to-medium size Italian catchments will be modeled at very fine resolution with the WRF model coupled and uncoupled.