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Effects of a subgrid-scale topography and land use simulation for the Alps region. Part I: Validation of reproduction experiment

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We apply a mosaic-type parameterization of subgrid-scale topography and land use scheme (Sub-BATS) for the regional climate simulation to produce the fine-scale surface climate information and to investigate the effect of SUB-BATS over the Alps region. Two simulations are performed without and with implementation of Sub-BATS scheme, all other conditions being identical using the NCEP/NCAR reanalysis data as the initial and boundary condition (1982-1992:10yr). The coarse grid cell of the control simulation is 15km X 15 km (CONT) while subgrid cell is 3km X 3km (SUB). Hence, each coarse grid cell is divided into 25 subgrid cells. The meteorological variables from original coarse grid are directly disaggregated to subgrid for calculation of land surface process. Then, surface fluxes calculated from subgrid are reaggregated onto the coarse grid for input to the atmospheric model. First, the performance of control simulation without Sub-BATS is evaluated. Since the Sub-BATS simulation depends on the quality of the original coarse grid, the performance of coarse grid could be critical standard to estimate our modeling system. The CONT simulation is able to reproduce the most prominent patterns of the spatial distribution and seasonal dependence, even though underestimation of summer temperature and overestimation of winter precipitation are evident along the mountain region. We then assess the detailed structure of subgrid topography and land-use effects from the Sub-BATS simulation. The seasonal and regional patterns of the SUB simulation are in line with those found in the CONT simulation. However, the SUB simulation shows pronounced spatial variability over the Alps region, which is maximized by topography complexity with a wide range of altitude and a highly contrasting relief. In particular, the SUB simulation clearly describes the formation and melting of snow in response to the topographic correction of the temperature applied to the disaggregation scheme. Two sensitivity experiments are also included, one for lapse rate effects and one for convective precipitation disaggregation.