Session: C4 Poster: TH246B

Observed and projected future shifts of climatic zones in Europe

Kirsti Jylha[†]; Pauli Jokinen; Kimmo Ruosteenoja
[†] Finnish Meteorological Institute, Finland
Leading author: kirsti.jylha@fmi.fi

Maps illustrating projected shifts of climatic zones are an effective visualization tool for disseminating climate change information. Based on seasonal cycles of monthly mean temperature and precipitation, Europe can be divided into seven main climate zones (in the order of current area coverage): boreal rainy, temperate rainy, temperate dry-summer, dry semiarid, tundra, boreal dry-summer and dry arid. Although the basic features of the European climate have remained unaltered during the last six decades, the observational gridded data set E-OBS for temperature and precipitation reveals noticeable shifts in climatic zone borders. Between two recent periods of about 30 years, 12% of the land areas (analogous to an area twice as large as the French mainland) was affected by shifts towards warmer or drier climate types. These shifts were more than five times more widespread than changes towards cooler or wetter climate types. Dry and tundra climates indicated the largest percentage changes, the former extending and the latter retreating. In absolute terms, the widest extension in area coverage took place for temperate rainy class (Jylh et al., 2010). Two likely contributors to the detected shifts of the climate zones in Europe are human-induced warming and fluctuations of the North Atlantic Oscillation (NAO), the latter possibly also having an anthropogenic component. The NAO index was considerably higher during the latter period than during the former period. On the other hand, the observed changes, in terms of relocation and coverage, are in accord with projected human-induced future trends during the current century. The projections are founded on simulations performed with two suites of climate models, one consisting of 19 global climate models (GCMs) and the other of an ensemble of regional climate models (RCMs). Based on multi-model means, the former set (CMIP3 GCMs) was used to study the influence of alternative radiative forcings (SRES A2, A1B and B1) on the migration of climatic zones. The latter set (the ENSEMBLES project RCM simulations under the A1B forcing) were applied to examine the model performance and the scatter in the projections due to differences in model formulation. In most of northern Europe, the current climatic zones were represented rather realistically by the RCMs. However, the model performance appeared to be rather poor in south-eastern Europe. Accordingly, it was decided to not to use the direct model output but to apply the so-called delta change method for the two sets of model data, together with the E-OBS observed data set for the reference period 1971-2000. The results suggest major changes in the climatic zones in Europe in the future. The large patterns are quite similar across and between the two sets of climate simulations, although there are differences in the speed of the shifts. Altogether, around 45-70% of the study domain will be affected by shifts towards a warmer or drier climate type, the A2 scenario producing the fastest and most significant alterations. Within the next few decades, regions assigned to either tundra or boreal climates are projected to shrink at a rate of about 180·10≥ km≤ (roughly corresponding to an area half that of Germany) per decade, while the temperate and dry climate zones expand at rates of about 140·10≥ km≤ and 40·10≥ km≤ per decade, respectively.