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Vegetation zones in changing climate

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Climate patterns analysis can be performed for individual climate variables separately or the data can be aggregated using e.g. some kind of climate classification. These classifications usually correspond to vegetation distribution in the sense that each climate type is dominated by one vegetation zone or eco-region. Thus, the Köppen-Trewartha classification provides integrated assessment of temperature and precipitation together with their annual cycle as well. This way climate classifications also can be used as a convenient tool for the assessment and validation of climate models and for the analysis of simulated future climate changes.

The Köppen-Trewartha classification is applied on full CMIP5 family of more than 40 GCM simulations and CRU dataset for comparison. This evaluation provides insight on the GCM performance and errors for simulations of the 20th century climate. Common regions are identified, such as Australia or Amazonia, where many state-of-the-art models perform inadequately. Moreover, the analysis of the CMIP5 ensemble for future under RCP 4.5 and RCP 8.5 is performed to assess the climate change for future. There are significant changes for some types in most models e.g. increase of savanna and decrease of tundra for the future climate. For some types significant shifts in latitude can be seen when studying their geographical location in selected continental areas, e.g. toward higher latitudes for boreal climate. Quite significant uncertainty can be seen for some types.

For Europe, EuroCORDEX results for both 0.11 and 0.44 degree resolution are validated using Köppen-Trewartha types in comparison to E-OBS based classification. ERA-Interim driven simulations are compared to both present conditions of CMIP5 models as well as their downscaling by EuroCORDEX RCMs. Finally, the climate change signal assessment is provided using the individual climate types. In addition to the changes assessed similarly as for GCMs analysis in terms of the area of individual types, in the continental scale some shifts of boundaries between the selected types can be studied as well providing the information on climate change signal. The shift of the boundary between the boreal zone and continental temperate zone to the north is clearly seen in most simulations as well as eastern move of the boundary of the maritime and continental type of temperate zone. However, there can be quite clear problem with model biases in climate types association.

When analysing climate types in Europe and their shifts under climate change using Köppen-Trewartha classification (KTC), for the temperate climate type there are subtypes defined following the continentality patterns, and we can see their generally meridionally located divide across Europe shifted to the east. There is a question whether this is realistic or rather due to the simplistic condition in KTC following the winter minimum temperature, while other continentality indices consider rather the amplitude of temperature during the year. This leads us to connect our analysis of climate change effects using climate classification to the more detailed analysis of continentality patterns development in Europe to provide better insight on the climate regimes and to verify the continentality conditions, their definitions and climate change effects on them. The comparison of several selected continentality indices is shown.