Geophysical Research Abstracts
Vol. 19, EGU2017-14641, 2017
EGU General Assembly 2017

Impact of Climate Change on the Climatology of Vb Cyclones

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Extra-tropical cyclones of type Vb develop over the western Mediterranean and move northeastward, leading to heavy precipitation over Central Europe and posing a major natural hazard. Since such cyclones are high-impact events that lead to important economical and personal damage, in Central Europe, and especially in the Alpine region, understanding their sensitivity to climate change is important to provide suitable adaptation measures. This communication aims at investigating the impact of climate change in Vb cyclones through a climate simulation covering the whole 21st century performed with the Community Earth System Model (CESM1). Further, some selected Vb episodes within the simulation are downscaled with the Weather Research and Forecasting Model (WRF). The analysis focuses on two different time periods. The reference period spans the ERA-Interim period 1979 to 2013, whereas the other one covers the last 30 years of the 21st century 2070-2099. The simulation uses the emissions from the business as usual scenario (RCP8.5).

For both periods, the Vb cyclones were identified using a tracking tool and their main properties were characterized. During the reference period 86 Vb cyclones can be identified overall, which corresponds to approximately 2.5 Vb cyclones per year. This number corresponds very well to the 82 Vb cyclones found in the ERA-Interim reanalysis dataset in the same period of time. This number is reduced under future climate conditions, leading to 48 Vb cyclones in total, or to 1.6 Vb cyclones per year on average. Despite the reduction in their number, results indicate that there is a tendency for intensification in precipitation for high-impact Vb events of around 10% over the Alpine region in the future compared to the ones between 1979 and 2013. Interestingly, while the summer months are most prone for the occurrence of the 10 heaviest precipitation Vb events in the current conditions, the 10 heaviest precipitation Vb events in the future become shifted towards spring and also fall months, implicating an important change in the seasonality of the phenomenon.

In order to gain more insight on the changes in the processes responsible for such changes in precipitation and occurrence of Vb events, we downscaled the 10 most precipitation intense Vb events of each of the two periods. Preliminary results indicate that future Vb events tend to affect more strongly the eastern costs of the Mediterranean Sea, while the impact in the Alpine region becomes slightly ameliorated compared to current situations. This result is in agreement with results previously obtained through the analysis of a set of highly idealized sensitivity experiments, and can be related to an increasing instability at the eastern coast of the Mediterranean Sea induced by a stronger latent heating over the sea under future conditions.