Climate change impacts on wind power density over southeastern Mediterranean

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Energy production from the utilization of wind energy potential depends on the variability of the wind field as determined by the interaction of natural processes on different scales. Global climate change can cause alterations in the surface wind and thus it may affect the geographical distribution and the wind energy potential variability. Wind energy production is sensitive to wind speed changes, especially in the upper percentile of the wind speed distributions, where energy production is more effective. The importance of wind energy production changes is enhanced by the fact that wind energy investments are long-term and are characterized by high initial costs and low operating costs. In the present study, these changes are examined for the southeastern Mediterranean region, based on simulations of the Regional Climate Model ALADIN 5.2 extracted from the Med-CORDEX database for the climatic scenarios RCP4.5 and RCP8.5. The results indicate a wind power density increase over the Aegean Sea, the Ionian Sea, the Dardanelles and the Black Sea, with similar levels of increase for both climatic scenarios. In contrast, during the winter period there is a decline across the southeastern Mediterranean, which is more significant in the case of the RCP8.5 scenario. Finally, for most areas of eastern Greece, there is a reduction in the number of wind speed cases for both below and above cut-in and cut-out wind speeds, while there is an increase in the number of wind speed cases that wind turbines operate at their maximum power. The results are expected to reduce the uncertainty associated with the impact of climate change on wind energy production.