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Resilience of the combined wind-plus-solar power production in Europe to climate change: a focus on the supply intermittence

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A high penetration of the wind and solar photovoltaic (PV) power in the electricity grid, as proposed for the future energy mix scenarios in Europe, increases the dependence of the power supply on weather and climate conditions. This dependence induces intermittency and vulnerability to long-term changes in climate. In Europe, previous works (Jerez et al 2015; Tobin et al 2016) have shown that the climate change impact on the mean production of PV and wind power is limited but overall negative. Also, the climate change signals for the temporal variability of PV and wind power production, individually, are essentially small. However, the behavior of the PV-plus-wind power generation in terms of their temporal variability under climate change conditions still remains unveiled. Here we present the first assessment on the resilience of the combined PV-plus-wind power production to climate change with a focus on the supply intermittence. We adopted regional and continental perspectives to evaluate actual and potential climate change impacts at several temporal scales (from daily to interannual), using state-of-the-art climate projections together with a climate-production model and considering a future massive deployment of wind and PV installations. Results support that the spatio-temporal complementarity between the wind and solar resources (which outstands the most as regard their annual cycles) help to minimize the risk of having an undesirable higher variability of the combined production under future climate conditions, even if such complementarity is not exploited in current development plans. That's particularly the case at the continental scale, with the projected change in the temporal variability of the joint production of PV and wind energy being totally negligible, which holds also in most of the regional behaviors. However, better expectations could be ideally drawn. If the deployment plans were able to reach a perfect temporal anticorrelation between the wind and the PV power production series, a significant increase in the stability of the joint production would be reached, ranging from 5 to 25% across regions (15% at the continental scale). Interestingly, the highest benefits would be achieved at the daily time-scale in central and southern Europe, where the amplitude of the day-to-day jumps of PV-plus-wind power production would be reduced by 5-10%. These results may drive stakeholders to take holistic and optimized decisions.

References:

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Tobin et al. (2016). Climate change impacts on the power generation potential of a European mid-century wind farms scenario. Environmental Research Letters, 11(3), 034013.

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