



Complementarity among climate related energy sources: Sensitivity study to climate characteristics across Europe

Baptiste Francois (1,2), Benoit Hingray (1,2), Jean-Dominique Creutin (1,2), Damien Raynaud (1,2), Marco Borga (3), and Robert Vautard (4)

(1) LTHE – Université de Grenoble 1/CNRS, 38041 Grenoble, France, (2) LTHE - Université de Grenoble 2/G-INP, 38041 Grenoble, France, (3) University of Padova, Dept. Land, Environment, Agriculture and Forestry, Padova, Italy, (4) LSCE/IPSL, laboratoire CEA-CNRS-UVSQ Orme des Merisiers, 91191 Gif sur Yvette Cedex, France

Climate related energy sources like solar-power, wind-power and hydro-power are important contributors to the transitions to a low-carbon economy. Past studies, mainly based on solar and wind powers, showed that the power from such energy sources fluctuates in time and space following their driving climatic variables. However, when combining different energy sources together, their intermittent feature is smoothed, resulting to lower time variability of the produced power and to lower storage capacity required for balancing.

In this study, we consider solar, wind and hydro energy sources in a 100% renewable Europe using a set of 12 regions following two climate transects, the first one going from the Northern regions (Norway, Finland) to the Southern ones (Greece, Andalucía, Tunisia) and the second one going from the oceanic climate (West of France, Galicia) to the continental one (Romania, Belorussia). For each of those regions, we combine wind and solar irradiance data from the Weather Research and Forecasting Model (Vautard et al., 2014), temperature data from the European Climate Assessment & Dataset (Haylock et al., 2008) and runoff from the Global Runoff Data Center (GRDC, 1999) for estimating solar-power, wind-power, run-of-the-river hydro-power and the electricity demand over a time period of 30 years.

The use of this set of 12 regions across Europe allows integrating knowledge about time and space variability for each different energy sources. We then assess the optimal share of each energy sources, aiming to decrease the time variability of the regional energy balance at different time scales as well as the energy storage required for balancing within each region. We also evaluate how energy transport among regions contributes for smoothing out both the energy balance and the storage requirement.

The strengths of this study are i) to handle with run-of-the-river hydro power in addition to wind and solar energy sources and ii) to carry out this analysis over a long time period while past studies, to our knowledge, have used less than 10 year time period.

References:

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