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The role of internal climate variability for interpreting climate change scenarios

Douglas Maraun

GEOMAR Helmholtz Centre for Ocean Research, Ocean Circulation and Climate Dynamics, Kiel, Germany
(dmaraun@geomar.de, +49-(0)431-6004052)

When communicating information on climate change, the use of multi-model ensembles has been advocated to sample uncertainties over a range as wide as possible. To meet the demand for easily accessible results, the ensemble is often summarised by its multi-model mean signal. In rare cases, additional uncertainty measures are given to avoid loosing all information on the ensemble spread, e.g., the highest and lowest projected values. Such approaches, however, disregard the fundamentally different nature of the different types of uncertainties and might cause wrong interpretations and subsequently wrong decisions for adaptation. Whereas scenario and climate model uncertainties are of epistemic nature, i.e. caused by an in principle reducible lack of knowledge, uncertainties due to internal climate variability are aleatory, i.e. inherently stochastic and irreducible. As wisely stated in the proverb "climate is what you expect, weather is what you get", a specific region will experience one stochastic realisation of the climate system, but never exactly the expected climate change signal as given by a multi model mean. Depending on the meteorological variable, region and lead time, the signal might be strong or weak compared to the stochastic component. In cases of a low signal-to-noise ratio, even if the climate change signal is a well defined trend, no trends or even opposite trends might be experienced. Here I propose to use the time of emergence (TOE) to quantify and communicate when climate change trends will exceed the internal variability. The TOE provides a useful measure for end users to assess the time horizon for implementing adaptation measures. Furthermore, internal variability is scale dependent - the more local the scale, the stronger the influence of internal climate variability. Thus investigating the TOE as a function of spatial scale could help to assess the required spatial scale for implementing adaptation measures. I exemplify this proposal with a recently published study on the TOE for mean and heavy precipitation trends in Europe. In some regions trends emerge only late in the 21st century or even later, suggesting that in these regions adaptation to internal variability rather than to climate change is required. Yet in other regions the climate change signal is strong, urging for timely adaptation.

Douglas Maraun, When at what scale will trends in European mean and heavy precipitation emerge? Env. Res. Lett., in press, 2013.