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Rhythm and theoretical perception of climate change during the 21^{st} century using CMIP5 simulations

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In most studies, climate change is approached by focusing on the evolution between a fixed current baseline and future, emphasizing stronger warming as we move further from the current climate. This long-term vision is used in order to characterize quantitatively the magnitude and expected effects of mitigation policies across the globe. In this study, an alternative approach more focused on adaptation is envisaged. It considers the rhythm of climate change by following it up with a running baseline over periods of 20 years, defining the time evolution of the speed at which climate changes. Comparing this speed with the variability of the previous 20 years, our work also aims to give an idea on how fast the climate changes from the recent year-to-year variability. This represents a theoretical approach of perception of climate change, as a 20-year period can illustrate the memory of a generation. In this way, we also evaluate how much adapting to the recent past 20 years is sufficient to cope with the expected changes of the coming ones. As a result, we estimate the stress on adaptation needs over the 21^{st} century.

Here we are mainly interested on mean and variability of surface air temperature and precipitations. A multi-model study based on CMIP5 RCP8.5 scenario is conducted.

Over the 21^{st} century, important changes occur in terms of surface air temperature. These are mainly characterized by an increase of warming speed resulting in its doubling at the end of the century (2071-2090) compared to the IPCC current baseline (1986-2005), although models exhibit a different climate sensitivity. Despite an unanimous stronger speed in high latitudes of the Northern Hemisphere than anywhere else, the speed can increase more rapidly in some other regions.

When comparing the warming speed with year-to-year variability, the change of surface air temperature appears to be perceived stronger and sooner in tropical areas than in any other regions, especially in South-East Asia. By the end of the century, 50 to 70 percents of these areas have a mean temperature out of the 2σ-limit given by the distribution of the previous 20 years.

Consistently with temperature, regions which are drying (moistening) tend to experience an increase in drying (moistening) speed. Drying regions being fewer than moistening ones and drying speed being weaker than moistening one, a continuous intensification of the hydrological cycle is confirmed. Besides, their spatial fraction over the globe appears to remain unchanged (about 65% of regions are moistening), and also stabilizes in the second half of the century in their geographical distribution.