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Exploring drivers of evapotranspiration in CMIP6: A Multivariate Perspective

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To detect, quantify and attribute the effects of climate change in the context of rising carbon emissions, analyses often pinpoint individual variables. The aim is to find a signal of the externally forced response amidst internal climate variability. This becomes more challenging when examining regional shifts or variables with high internal variability like evapotranspiration, which in addition is affected by observational and modeling uncertainty. However, the interconnection of climate variables provides an advantage in considering them together, allowing us to explore how their relationships evolve over time and a better understanding of the underlying drivers.

Here, we investigate the combined effects of energy and water availability on evapotranspiration in climate models. Using a simple linear model, we quantify the contributions of these variables, which vary regionally. Water availability is more important in dry regions, whereas in wetter regions energy is the more dominant constraint on evapotranspiration. Moreover, we also find regions in which water availability dominates inter-annual variability, while evapotranspiration trends are better predicted by energy availability. This suggests that different causal factors may drive variations in the short and long term, which bears implications for the interpretation and potential constraint of projected future trends. In such a case, a signal of climate change is much more easily detected in a multi variate space, as the signal emerges in a direction where there is little internal variability. Finally, this approach provides insights into the complex influences shaping evapotranspiration and opens the door to possible constraints on future changes.