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Attribution of European Heatwaves to Global Warming Using Spectrally Nudged Storylines

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This study employs Spectrally Nudged Storylines to attribute heatwaves to anthropogenic global warming. Utilizing high-resolution global (ECHAM) and regional (CCLM) climate models, we aim to discern the influence of anthropogenic climate change on the characteristics of European heatwaves observed in the last decade. Differently to the statistical approach that uses large ensembles/datasets to study large amount of similar events and attribute their occurrence to climate change, the storylines simulate a specific extreme event under different thermodynamical conditions by constraining the large scale dynamics of the system. Thus, directly attributing the change in characteristics of the extreme event to the changes in the thermodynamics, based on the prescribed sea surface temperature and greenhouse gases emission levels. In such way, three storylines are built: a Factual storyline that resembles the climate state as we know it, a Counter Factual storyline that is fixed to the past century representing a world without climate change, and a Plus 2°C storyline that shows how these extreme events change in a world where the global mean temperature is 2°C higher than in pre-industrial times. By the use of these three storylines, we can tell to what extent global warming has provoked heatwaves to be as extreme in a world as we know it, and what can we expect them to be in a warmer future climate.