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Increase of Southern European cold spell intensity under climate change?

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Extreme weather and climate events, like cold spells, have often significant impacts on nature and society. A cold spell is a marked and unusual cold weather characterized by a sharp and significant drop of air temperatures leading to extremely low values, possibly associated to heavy snowfalls. It is unclear whether anthropogenic forcing would increase or decrease their occurrence and change their dynamics. Due to the scarcity of these events, climate simulations are required to answer this research question.
We investigate winter cold spells in the Southern European region. Using documentary sources, we have selected 32 cold spell events over the past decades and we use data from the NCEP reanalysis to identify these cold spells on a reference period over 1948-2018.
We find that during the cold spells the dynamical characteristics of the atmospheric circulation exhibit similar features that can be detected by the analysis of sea level pressure, geopotential high, temperature and snow cover fields.
In a long (500 years) reference simulation performed with a general circulation model (Planet Simulator - PlaSim) we have verified that the cold spell average dynamics detected in observations is well reproduced. To select cold spells in PlaSim simulation we have used atmospheric circulation analogues of the averaged cold spells found in the NCEP reanalysis. In order to determine the effect of anthropogenic forcing on the characteristics of cold spells, we used PlaSim to perform long control simulations under different emission scenarios. We find that anthropogenic emissions enhance some features linked to the intensity of simulated cold spells. Our results suggest that the response of extreme cold weather events to climate change is not purely thermodynamics nor linked to the global average temperature increase, but crucially depends on the modification of atmospheric circulation at mid-latitudes.