Geophysical Research Abstracts
Vol. 21, EGU2019-17201, 2019
EGU General Assembly 2019

Atmosphere response to heat waves hitting wet and dry soils in the Mediterranean region

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The land and atmosphere are interlocked by coupled hydrologic and energy cycles that are a major part of the Earth's climate system, but the feedback from soil moisture to precipitation via the return path through evapotranspiration (latent heat flux) is weak. Nevertheless, a few studies have addressed the crucial role of soil moisture feedbacks in European droughts, while others assessed the effect of dry soils in amplifying and prolong hot temperatures associated with heat waves in Europe. Surface moisture deficits are a relevant factor for the occurrence of hot extremes in many areas of the world, then the effects of soil moisture-temperature coupling are geographically more widespread than commonly assumed. This suggests that hot day predictions could be substantially improved in operational forecasts with the aid of soil moisture initialization.
In this work, several sensitivity experiments were performed to assess the role of key climate components on Mediterranean weather at the seasonal time-scale. Specifically, six experiments have been designed to evaluate the impact of soil moisture on the summer season. In a region often hit by summer heat waves, the main goal is the assessment of the land-atmosphere response to heat waves hitting a pre-existing a) dry soil or b) wet soil. To do that, land and atmosphere have alternatively been coupled and uncoupled.
When hot air advections hit a wet soil, shorter and less intense (i.e. characterized by lower temperatures) heat waves are recorded only if land and atmosphere are uncoupled. Otherwise, hot air rapidly dries the terrain off, inhibiting the mitigation effect of the pre-existing wetness, and heat waves are more severe. Instead, enhanced and prolonged suppression of precipitation, recursively triggering new heat waves, is remarkable when hot air encounters a pre-existing dry soil, majorly when land and atmosphere are coupled.