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Investigating the hydrometeorological impacts of the 2013-2015 extreme drought in southeast Brazil by combining cluster analysis with land surface modeling

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The 2013-2015 drought in the southeast Brazil was considered the worst since 1930, affecting more than 21 million people in the Sao Paulo metropolitan region. Previous studies have focused on the meteorological mechanisms and their impact based on low-resolution remote sensing datasets. Here, we simulated this entire drought event at 1 km^2 resolution using the Joint UK Land Environment Simulator (JULES). The simulated domain covers large portions of the state of Sao Paulo and Minas Gerais with total area of about 200 thousand km^2 (458 km by 463 km). We first investigate the impact of using both global and local datasets (soil and vegetation cover maps) on model performance by comparing the simulated evapotranspiration against the Global Land Evaporation Amsterdam Model. We found that using additional local land cover information together with vegetation-specific leaf area index from remote sensing has significantly improved the model performance while the local soil information has limited influence. Preliminary results suggest a lag of about one month for the drought to propagate from rainfall decrease in December/2013 to soil moisture depletion in January/2014. In addition, we combined the predicted results from JULES with a cluster analysis within the region to further categorized the domain into five groups clusters based on climatic and soil properties. This was done to better understand and explain the key controlling factors associated with the drought over these groups. Overall, we found that clusters with larger soil water storage capacity and slower drainage present more resilience to the drought. This study presents a detailed analysis on the impact of the extreme drought based on a high-resolution land surface model for a large domain in southeastern Brazil, and reveal the specific characteristics of drought propagation processes throughout the 2013-2015 period, adding a more hydrologically-oriented view on the impacts of the 2013-2015 drought to the meteorological findings discussed previously.