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A new assessment of land-atmosphere feedback strength

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Feedbacks between the land and the atmosphere are assessed through the development of a new physically-based feedback strength index. In broad terms, this index measures the sensitivity of afternoon rainfall to the land surface evaporative fraction (EF). More specifically, the index is a probabilistic assessment of the likelihood of afternoon rainfall, given a joint probability mass function that includes characterizations of land surface moisture conditions through the EF, and conditions in the low-level atmosphere through use of the Convective Triggering Potential (CTP) and a humidity deficit term (HI). The technique is applied to both the probability of rainfall occurrence and the expected value of rainfall depth, enabling us to determine where, for example, a high evaporative fraction might be strongly correlated with subsequent convection, and where a high evaporative fraction might be associated with high rainfall depths.

This analysis is applied to a 25-year long dataset from the North American Regional Reanalysis (NARR) project, and to multiple 50-year long simulations with the GFDL climate model, version AM2.1. From the NARR data, we are able to derive maps of the feedback strength for all months of the year in North America. We can compute similar maps for the entire globe with the modeling work and compare the results over North America. Additionally, different experimental designs and various analytical sampling tools enable us to assess the impact of factors such as El Nino/La Nina events on this feedback strength, and to assess how the feedback strength might change in the future. These maps reveal the distinct seasonality and regional structure of feedback strength around the globe.