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Desert amplification and global warming

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Previous research found that the warming rate observed for the period 1979–2012 increases dramatically with decreasing vegetation greenness over land in mid- and low- latitudes, with the strongest warming rate seen over the driest eco regions such as the Sahara desert and the Arabian Peninsula, suggesting warming amplification over deserts. Here I analyze the observed and projected surface temperature anomalies over land between50°S-50°N for the period 1950–2099 by large-scale ecoregion and find strongest warming consistently and persistently seen over the driest eco regions during various 30-year periods, pointing to desert amplification in a warming climate (similar to polar amplification). This amplification enhances linearly with the global mean greenhouse gases (GHGs) radiative forcing. Possible mechanisms for this amplification are explored by analyzing changes in various variables related to atmospheric profiles, surface radiative forcing, land surface properties, and surface energy and radiation budget. My results show that desert amplification is likely attributable mostly to a stronger GHGs-enhanced downward long wave radiation forcing reaching the surface over drier eco regions as a consequence of a warmer and thus moister atmosphere in response to increasing GHGs. These results indicate that desert amplification may represent a fundamental pattern of global warming associated with water vapor feedbacks over land in low- and mid- latitudes where surface warming rates depend inversely on ecosystem dryness. It is possible that desert amplification might involve two types of water vapor feedbacks that maximize respectively in the tropical upper troposphere and near the surface over deserts, with both being very dry and thus extremely sensitive to changes of water vapor.

Biography

Liming Zhou has research interests in land-atmosphere/climate interaction, land-surface remote sensing, and remote sensing of vegetation dynamics, land-surface modeling, climate modeling, and applications of various remote sensed products in weather, climate, and environmental sciences. During the past decade, he has used satellite data, observations and climate models to understand physical processes/mechanisms and interactions of land-human-climate systems, and to improve model capability to predict climate change and assess its impacts and consequence on our climate and environment. Land surface processes related to vegetation dynamics, deforestation, afforestation, urbanization, desertification, and renewable wind energy are his emphases.

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