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A conceptual model for changes in land relative humidity

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Observations and climate models reveal a strong land-ocean contrast in the response of near-surface relative humidity to global warming: relative humidity tends to increase slightly over oceans but decrease substantially over land. Surface energy balance arguments have been used to understand the ocean response but these arguments are difficult to apply to more complex land surfaces.

Here we introduce a conceptual model, involving moisture transport between the land and ocean boundary layers and the free troposphere, to understand decreases in land relative humidity as the climate warms. The model suggests an oceanic control on land humidity changes, with local variations in evapotranspiration a second-order effect. The conceptual model is applied to both idealized and full-complexity general circulation model simulations and is found to perform well, capturing the simulated changes in land relative humidity. The link between these decreases in land relative humidity and the land-ocean warming contrast is discussed.