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Comprehensive assessment of projected changes in water availability and aridity

Peter Greve (1,2) and Sonia I. Seneviratne (1)

(1) ETH Zürich, Institute for Atmospheric and Climate Science, Zürich, Switzerland (peter.greve@env.ethz.ch), (2) Center for Climate Systems Modeling (C2SM), ETH Zürich, Zürich, Switzerland

Substantial changes in the hydrological cycle are projected for the 21st century, with potential major impacts, particularly at regional scale. However, the projections are subject to major uncertainties and the metrics generally used to assess such changes do not fully account for the hydroclimatological characteristics of the land surface. In this context, the 'dry gets drier, wet gets wetter' paradigm is often used as a simplifying summary. However, recent studies have challenged the validity of the paradigm both for observations (Greve et al., 2014) and projections (Roderick et al., 2014), especially casting doubt on applying the widely used P-E (precipitation - evapotranspiration) metric over global land surfaces. Here we show in a comprehensive assessment that projected changes in mean annual P-E are generally not significant in most land areas, with the exception of the northern high latitudes where significant changes towards wetter conditions are found. We further show that the combination of decreasing P and increasing atmospheric demand (potential evapotranspiration, Ep) leads to a significant increase in aridity in many subtropical and neighbouring regions, thus confirming the paradigm for some dry regions, but invalidating it for the relative large fraction of the affected area which is currently in a humid or transitional climate regime. Combining both metrics (P-E and P-E_p) we conclude that the 'dry gets drier, wet gets wetter' paradigm is generally not confirmed for projected changes in most land areas (despite notable exceptions in the high latitudes and subtropics), because of a lack of robustness of the projected changes in some regions (tropics) and because humid to transitional regions are shifting to drier conditions, i.e. not following the paradigm.

References

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