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Comparison of Modeled and Observed Regional Precipitation Trends: Detection, Attribution, and Consistency Tests

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Precipitation trends over the period 1901-2010, assessed over relatively well-observed global land regions, show areas with significant increases and decreases in previous studies. Here we assess these trends for detectable anthropogenic influences and for consistency with Coupled Model Intercomparison Project 5 (CMIP5) historical simulations. We find a tendency for stronger increases in observations than in models, although observed and modeled trends are statistically consistent over 59% of the analyzed area. Trends were detectable–compared to natural variability–over 37% of the area. Over 19% (8%) of the area, increased (decreased) precipitation was partly attributable to anthropogenic forcing, including increases over parts of the northern extratropics and southern South America. Observations, but not the model ensemble, showed a tendency for decreased spatial coverage of dry extreme months. Both observations and models showed some increased coverage of wet extreme months. The results suggest that future precipitation projections within these regions/models could lead to an overestimate of future drought risk, but an underestimate of future flooding risk. Alternative shorter trend periods (1951-2010 and 1981-2010) are also assessed, and do not indicate a prominent negative trend bias of the models, as was found for the 1901-2010 trends. Also an atmosphere-only model, forced with observed sea surface temperatures and other climate forcing agents, does not reproduce as large a precipitation increase in the northern hemisphere extratropics as observed since 1901. Further study is needed to assess the reliability of the apparent negative trend bias (1901-2010) of the CMIP5 models, and the underlying physical mechanisms.