

Surface Relative Humidity Changes in Reanalysis and Observations

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Abstract

According to the Clausius-Clapeyron relation, the total amount of atmospheric water vapor should go up in a warmer climate under the assumption of approximately fixed relative humidity, at an increase of $\sim 7\%$ per degree Celsius warming. However, many studies shown that fairly widespread decreases in relative humidity (RH) near the surface are observed over the land in recent years. In this study, we compare the latest observational land surface humidity dataset, HadISDH, and the homogenized dataset around 2000 stations from China, with the latest generation reanalysis (including the ERA- Interim, ERA-20C, NOAA/ESRL PSD 20CR version C) from 1960s to present. The globally averaged behaviour of HadISDH and most reanalysis are very similar in surface relative humidity measures on climatological mean, decadal and interannual timescales. However, both the HadISDH and reanalysis products can not capture the observed long-term RH changes derived from the homogenized dataset over China, primarily because the HadISDH and reanalysis products still contain spurious wet biases before about 2005. This deficiency results mainly from the discontinuities contained both in the HadISDH and the reanalysis relative humidity fields that are mainly induced by the instrument changes.