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Integrated water vapor trends and variability in GPS, ERA-Interim and climate model simulations

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A GPS Integrated water vapour (IWV) dataset based on the IGS repro1 ZTD solution is used to assess ERA-Interim reanalysis (ERA-I) and four different configurations of IPSL's LMDZ climate model simulations (two different physics and both free runs and nudged simulations).

Temporal and spatial variabilities in the datasets were compared using global monthly means for the period between 1995 and 2010. Means, standard deviations and linear trends were assessed.

A good agreement was found in the means and variabilities between GPS and ERA-I, even in regions with large gradients. In terms of trends, large coherent spatial patterns of moistening and drying are also evidenced in both datasets. Moistening is mainly seen in Northern South America, Central Africa and Western Pacific; and drying in Northern Africa and Australia. In most regions with significant trends, GPS data could validate the ERAI trends except over North Africa where no long term GPS data were available. Comparison with other reanalyses shows contrasting results over this region.

The climate model simulations reproduce satisfactorily the annual means and inter-annual variability. Regarding the trends, a significant improvement is observed in the nudged simulations, reflecting a significant annual to decadal change in moisture transport at global scale. The new LMDZ physics is able to represent the moistening and drying trends in most regions consistently with GPS and ERA-I, including a drying trend over North Africa.

This study concludes that not only does GPS IWV data prove to be useful in global climate model validation, but the comparison between different model physics and nudging may also help interpret the origin of the observed trends in IWV.