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Atmospheric rivers identification and tracking in global and regional datasets: a novel approach

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Atmospheric rivers (ARs) are important phenomena delivering ∼90% of poleward water vapor transport to midlatitudes and associated with hydrological extremes being dense distributed spatially. They are associated with strong precipitations along western mid-latitude continental coastlines and can cause flooding events or droughts relief. Understanding ARs role in the global hydrological cycle is critically important for assessment and prediction of regional precipitation extremes.
Modern reanalyses, climate models outputs and regional downscaling products are a very good source of data for development numerical tools for ARs identification, tracking, and analysis of atmospheric rivers.
A number of atmospheric rivers identification tools have been developed to date, the ARTMIP (Atmospheric River Tracking Method Intercomparison Project) has been started a few years ago. However, the main problem of the ARs tracking methods so far is to subset spatial grid points which are associated with ARs. Most of the developed algorithms rely on sets of conditional rules filtering grid points and resulting in a set of nonconvex regions that are AR-candidates. These regions are then filtered with a set of rules. Most of existing global AR detection schemes differ in spatial grid points subsetting and AR-candidates filtering algorithms.
We present the novel combination of algorithms that allow detecting ARs accurately. The gridpoints subsetting algorithm allows selecting AR-candidates taking into account multidecadal integrated vapor transport statistical characteristics. We also present the novel AR-candidates filtering algorithm based on the accurate estimation of the geometric characteristics of AR-candidate regions. One of our most novel approaches is the usage of neural networks methods for tracking of the ARs through the lifecycle. With this set of algorithms, we have detected and made an attempt to track ARs in MERRA2 and ERA-Interim reanalyses, CMIP5 high-resolution model experiments and some regional downscaling products. We present preliminary global climatologies of ARs based on these data. We also demonstrate the comparison of reanalyses and CMIP5 model experiments in the scope of ARs activity and water transport induced by them.

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