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Water vapor tracers in a regional climate model: what they are and how we validate the method

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Moisture tagging or water vapor tracers are becoming a powerful tool for investigations on the water cycle at a regional and even global scale. It enables climate models for precise studies on atmospheric moisture sources and pathways. We describe here the fundamentals of this online Eulerian method, that we implemented into the Weather Research and Forecasting (WRF) regional meteorological model. We perform an in-depth validation with monthly long simulations over North America at 20 km resolution following a strategy that consists in tagging all possible moisture sources: lateral boundaries, continental, maritime or lake surfaces and initial atmospheric conditions. We estimate errors as the moisture or precipitation amounts that cannot be traced back to any source. Validation results indicate that the method exhibits high precision, with errors considerably lower than 1% during the entire simulation period, for both precipitation and total precipitable water. Errors in conclusions from this method are therefore almost entirely linked to the regional model performance and not to the water tracers technique itself.