



The atmospheric water circulation is an extension of the oceanic overturning!

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The large-scale ocean-atmosphere circulation redistributes heat and fresh water over the entire Earth. The winds are constituted by air mass transports in the atmosphere and the currents are water-mass transports in the ocean. The momentum equations are therefore integrated in order to compute these velocities of the atmospheric air masses and oceanic water masses. Yet it is the associated heat and fresh-water transports that matter for the redistribution of these characteristics within the two separate systems as well as the exchange through the sea surface. We have therefore, in this study, traced the fresh-water not only through the ocean but also through the atmosphere. In the atmosphere this was achieved by taking the advection of a mass based on the specific humidity instead of the air mass when calculating the overturning stream functions. The water mass overturning is hence computed for the entire ocean-atmosphere system, with stream lines crossing the surface. The data used come from the Earth system model EC-Earth for past, present and possible future climates. The water-mass overturning of the atmosphere shows a completely new image of the circulation with cells even going in the opposite direction and at different altitudes compared to the air-mass stream functions. These overturning "water cells" of the atmosphere connect directly to the ones of the ocean even though they are one order of magnitude weaker. This new and original way of dealing with the hydrological cycle of the entire ocean-atmosphere system has just commenced and will be extended to other ways, such as Lagrangian trajectories, of tracing the water.