



## The Ocean-Atmosphere Hydrothermohaline Conveyor Belt

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The ocean thermohaline circulation is linked to the hydrothermal circulation of the atmosphere. The ocean thermohaline circulation is expressed in potential temperature-salinity space and comprises a tropical upper-ocean circulation, a global conveyor belt cell and an Antarctic Bottom Water cell. The atmospheric hydrothermal circulation in a potential temperature-specific humidity space unifies the tropical Hadley and Walker cells as well as the midlatitude eddies into a single, global circulation. Superimposed, these thermohaline and hydrothermal stream functions reveal the possibility of a close connection between some parts of the water and air mass conversions. The exchange of heat and fresh water through the sea surface (precipitation-evaporation) and incoming solar radiation act to make near-surface air warm and moist while making surface water warmer and saltier as both air and water travel towards the Equator. In the tropics, air masses can undergo moist convection releasing latent heat by forming precipitation, thus acting to make warm surface water fresher.

We propose that the Clausius-Clapeyron relationship for moist near-surface air acts like a lower bound for the atmospheric hydrothermal cell and an upper bound for the ocean thermohaline Conveyor-Belt cell. The analysis is made by combining and merging the overturning circulation of the ocean and atmosphere by relating the salinity of the ocean to the humidity of the atmosphere, where we set the heat and freshwater transports equal in the two stream functions

By using simulations integrated with our Climate-Earth system model EC-Earth, we intend to produce the "hydrothermohaline" stream function of the coupled ocean-atmosphere overturning circulation in one single picture. We explore how the oceanic thermohaline Conveyor Belt can be linked to the global atmospheric hydrothermal circulation and if the water and air mass conversions in humidity-temperature-salinity space can be related and linked to each other along a "line" corresponding to the Clausius-Clapeyron relationship. A geographical description of how and where this occurs together with this new hydrothermohaline stream function will be searched for.

The net heat and freshwater transport of the ocean and atmosphere can also be calculated from the thermohaline and hydrothermal stream functions. The heat transport across isohumes in the atmosphere and isohalines in the ocean as well as the freshwater transport across isotherms in both the atmosphere and ocean are computed. The maximum heat transport is about 16 PW in the atmosphere, while that of the ocean is just about 1 PW. The freshwater transport across isotherms in the atmosphere and ocean are shown to be tightly connected with a net maximum freshwater transport of 4 SV in the atmosphere and 2 Sv in the ocean.