Geophysical Research Abstracts
Vol. 19, EGU2017-8822, 2017
EGU General Assembly 2017

Wind-driven variations in an overturning circulation

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The Atlantic overturning circulation and poleward heat transport is balanced by northern heat loss to the atmosphere and corresponding water mass transformation. The structure of this circulation and transformation is particularly manifested – and observed – at the Greenland-Scotland ridge.

There is however a rich variability in the exchanges across the ridge on seasonal and yearly time scales. This variability has been almost perfectly captured in atmospherically forced ocean GCMs (e.g. Olsen et al 2008, Sandø et al 2012), suggesting that on shorter time scales the variability of the exchanges are connected to sea level pressure and corresponding wind stress forcing.

Focusing on seasonal and yearly time scales, we accordingly propose that the connection between the exchanges of overturning waters across the Greenland-Scotland ridge and the sea level pressure must be direct and simple, and we use idealized simulations to support this hypothesis. The mechanisms underlying the connection are formulated through conceptual models. Although the models and simulations are simplified with respect to bathymetry and hydrography, they can reproduce the main features of the overturning circulation in the Nordic seas.

In the observations, the variable exchanges can largely be related to sea level pressure variations and large scale wind patterns, and the idealized simulations and accompanying conceptual models show how these impacts can manifest via coastal downwelling and gyre circulation.

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