Flow asymmetry over topography: Implications for large-scale circulation

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Flow asymmetry

Flow over topography is different depending on direction.





Idealized flow simulations Shallow-water model.

Re-entrant channel mimicking slope around a closed basin.

Oscillating winds back and forth along the slope.

We run idealized experiments to test whether flow asymmetry affects the largescale circulation.

Will we see the positive bias and the flow suppression in idealized simulations?



Simulation results





Anna Lina P. Sjur, https://doi.org/10.5194/egusphere-egu25-10178

What enhances positive flow? On depth contours, the main suspect is flux of vorticity

Vorticity flux matters because of Stokes' theorem.





Evolution of vorticity fluxes with changing forcing

Increasing vorticity flux with increasing negative forcing.

After saturation, energy goes mainly into turbulence.

Flow memory gives a vorticity flux contribution also during positive phase.



Implications

Cyclonic and anti-cyclonic atmospheric forcing can give different ocean circulation.

High resolution needed to capture the effects of flow asymmetry.

→ The positive bias we observe is not captured by today's climate models.

