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Decomposing the time-mean Atlantic Meridional Overturning Circulation and its variability with latitude.

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The Atlantic Meridional Overturning Circulations (AMOC) is crucial to our global climate, transporting heat and nutrients around the globe. Detecting potential climate change signals first requires a careful characterisation of inherent natural AMOC variability. Using a hierarchy of global coupled model control runs (HadGEM-GC3.1, HighResMIP) we decompose the overturning circulation as the sum of (near surface) Ekman, (depth-dependent) bottom velocity, eastern and western boundary density components, as a function of latitude. This decomposition proves a useful low-dimensional characterisation of the full 3-D overturning circulation. In particular, the decomposition provides a means to investigate and quantify the constraints which boundary information imposes on the overturning, and the relative role of eastern versus western contributions on different timescales.

The basin-wide time-mean contribution of each boundary component to the expected streamfunction is investigated as a function of depth, latitude and spatial resolution. Regression modelling supplemented by Correlation Adjusted coRrelation (CAR) score diagnostics provide a natural ranking of the contributions of the various components in explaining the variability of the total streamfunction. Results reveal the dominant role of the bottom component, western boundary and Ekman components at short time-scales, and of boundary density components at decadal and longer timescales.