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Observed fingerprint of a weakening Atlantic Ocean overturning circulation

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The evolution of the Atlantic meridional overturning circulation (AMOC) over the past hundred years or so is poorly known for lack of direct measurements. Building on previous work (Rahmstorf et al., 2015) we use a high-resolution global climate model (Saba et al., 2016) to derive a characteristic spatial and seasonal sea-surface temperature (SST) fingerprint of an AMOC slowdown consisting of a cooling in the subpolar gyre region (most pronounced during November-May) and a warming in the Gulf Stream region and explain the mechanisms (Zhang and Vallis, 2007) that link the pattern to an AMOC slowdown.
This fingerprint is found in the observed long-term temperature trends, indicating a pronounced weakening of the AMOC since the mid-20th Century. We define an improved SST-based AMOC index, which is optimized in its regional and seasonal coverage to reconstruct AMOC changes. Analysis of an ensemble of CMIP5 model simulations confirms that this index has high skill in reconstructing the long-term trend of the AMOC. The CMIP5 simulations are used to calibrate the observed decline (3 ± 1 Sv since the mid-20th Century) and reconstruct the evolution of the AMOC for the period 1870-2016. For recent decades, our reconstruction of the AMOC evolution agrees with the results of several earlier studies using different methods, e.g. (Robson et al., 2014), (Kanzow et al., 2010) and (Latif et al., 2006), suggesting that our AMOC index also has skill in reproducing interdecadal variations.

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