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Unprecedented salinity fluctuation indicates that we are getting close to a tipping point

Yechul Shin¹, Ji-Hoon Oh¹, Niklas Boers^{2,3}, Marius Årthun⁴, Huiji Lee¹, and Jong-Seong Kug¹

¹School of Earth and Environmental Sciences, Seoul National University ²School of Engineering and Design, Technical University Munich ³Potsdam Institute for Climate Impact Research ⁴Geophysical Institute, University of Bergen

Recently, the North Atlantic has experienced a freshening event of unprecedented magnitude, the largest in the last 120 years. This event has attracted considerable attention for its potential impact on the Atlantic Meridional Overturning Circulation (AMOC), a key component of the global climate system responsible for regulating climate patterns and distributing heat across the Northern Hemisphere. However, there is no clear reason to explain the magnitude; NAO, proposed as a main reason, is comparable with other periods.

In this study, we compare recent observations and GCM projections to explore the implications of salinity variability for AMOC stability. We suggests that the enlarged flucutation could imply the loss of AMOC resilience. The observations show an increase in autocorrelation in the eastern SPNA, a region critical for AMOC dynamics, suggesting critical slowing. We find a very similar feature in the GCM: critical slowdown in the eastern SPNA with a similar spatial pattern. Both critical slowdowns are strongly related to the basin–scale salt advection feedback, measured by the baroclinic freshwater convergence into the Atlantic Ocean (Mov). Although observations and models share the same stability autocorrelation space, their time frame is different. The GCMs and observation has different level of the Mov, which results in the observations show earlier signs of instability. Although the IPCC report suggests that the AMOC will not collapse before 2100 with medium confidence, an increasing number of studies point to the possibility of collapse in recent years. Our results also warn against the optimistic view of the tipping point by integrating observations with model projections.

- Key words: Tipping Point, Abrupt Climate Change, Critical Slowing Down, Atlantic Meridional Overturning Circulation, Resilience
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