

Structure Paper

Research Question

How can we build a simplified dynamic model of the AMOC and the GIS tipping cascade behaviour integrated into a simple climate model than can be calibrated on complex hysteresis ?

Challenge and research gap

The methodology of Martinez Monteiro et al.(2022) used in SURFER v3.1 have a single forcing parameter, a new calibration module is necessary.

Rationale behind the approach

- Recent approach in the tipping element literature **use simple non linear dynamic model because complex model alone are not sufficient to understand tipping elements projections.** They are computational constraints and they have a large uncertainty.
- Recent literature using **conceptual models found that interactions tend to destabilize the entire system**, increasing the risk of observing tipping events and cascades, even for a warming below 2°C. They also show that the **ice sheets often initiate tipping cascades, while AMOC rather acts as a mediator.** (Couplet 2024a)
- The studies using conceptual models often use very simplistic forcing scenarios**, placing a strong emphasis on the critical temperatures at which TE tip but overlooking the time scale of their internal dynamics. (Couplet 2024a)
 - Importance in the case of non-stationary forcing such as the global warming because overshoot without tipping can be produce.
- Existing studies often address different aspects of tipping dynamics, but none have fully incorporated interactions between elements and their feedbacks on global temperature in a single framework, while performing multi-millennial simulations under realistic emission scenarios.** (Couplet 2024a)

Key Messages

The AGTCCM is an AMOC-GIS tipping element emulator capable of fitting hysteresis based on complex models such as EMICs that helps to better constrain and study possible future climates and tipping elements evolutions.

- It is possible to create a tipping element emulator of the AMOC and GIS based on simple nonlinear dynamics capable of fitting hysteresis based on complex models.**
- That tool helps to better constrain possible future climates and tipping elements evolutions.**
- **This methodology paves the way for applying this method to other tipping elements and other models.**

Cited literature

- Couplet (2024a) - Tipping interactions and cascades on multimillennial time scales in a model of reduced complexity