Special Session: AMOC Stability Metrics
Multiple Equilibria in Box Models

$$m = k(\rho_2 - \rho_1) = k[\beta(S_2 - S_1) - \alpha(T_2 - T_1)]$$

$$m(S_2 - S_1) = -S_0 F_1$$

Rahmstorf (1996)
Multiple Equilibria in Box Models

AMOC exports freshwater: salt advection feedback is negative

AMOC imports freshwater: salt advection feedback is positive

Haline (reverse) circulation

Rahmstorf (1996)
Multiple Equilibria in Comprehensive Models

Multiple Equilibria in Comprehensive Models

Multiple Equilibria in Comprehensive Models

\[ \psi_{\text{atl}} \quad (\text{Sv}) \]

AMOC Recovery

Multiple Equilibria in Comprehensive Models

\[ \psi_{\text{atl}} \quad (\text{Sv}) \]


Hysteresis

\( L_1 \)

\( L_2 \)

\( \gamma_p \quad (\text{Sv}) \)
Multiple Equilibria in Comprehensive Models

Rahmstorf et al. (2005)
F_{ov} as AMOC Stability Metric

The Atlantic freshwater budget as a diagnostic for the existence of a stable shut down of the meridional overturning circulation

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“Pulse experiments strongly suggest that its sign determines the existence of a monostable or bistable regime in our model”
What is the sign of $F_{ov}$?

• Observations suggest $F_{ov} < 0$ (bistable regime)
  • E.g., Weijer et al. (1999), Huisman et al. (2010)

• Most coupled climate models $F_{ov} > 0$
  • E.g., Weaver et al. (2012)

• Are coupled climate models overestimating AMOC stability?
Special Session Presentations

• **Wei Liu**: Overlooked possibility of a collapsed Atlantic meridional overturning circulation in warming climate
• **Laura Jackson**: AMOC hysteresis in a state-of-the-art GCM
• **Aixue Hu**: Influence of the freshwater forcing pathway on the AMOC during 8.2k event in a high resolution coupled model
• **Wei Cheng**: Quantifying salt-advection feedback in GFDL and CESM pre-industrial control simulations