

Ocean meridional overturning circulation (MOC)/ thermohaline circulation (THC)

Motivation:

Temperature, salinity, and THC slides from EPS131 first lecture
from EPS131/Sources/07-THC:

- 1a-THC-belt.jpeg
- 1c-THC-cfc-animation-horizontal.gif
- 1d-THC-cfc-animation-vertical.mpg
- 1e-YouTube - The Day After Tomorrow.webloc
- 1g-Surface_air-T_deviations-from-zonal-mean-Rahmstrof.jpg

Stommel 1961 model, bifurcations, multiple equilibria, hysteresis

(from EPS131: 3-notes-THC-Stommel-model.pdf
1h-vellinga-wood-THC-collapse-Hadley-model.pdf
4b-Rahmstorf-et-al-2005-Stommel-bifurcation-GCM-intercomparison.pdf
6c-THC-in-global-warming-Bryden_et al_2005.pdf)
saddle-node bifurcation and hysteresis

THC variability

Motivation:

present day and past climate variability
(from EPS131: 2a-rapid_transports2.png
little ice age and abrupt climate change slides from
EPS-131-lecture-01-intro-2-phys-oceanogr.pptx)

Excitation of an oscillatory mode:

Figs 3,4 from Tziperman-Toggweiler-Feliks-Bryan-1994.pdf
and Hopf bifurcation notes

Non-normal transient growth,

introduction, writing PDE in matrix form, optimal i.c.
non normal excitation of THC variability
(slides #2,3,5,6,7,9 from nonnormal_THC_short.pdf)

Time permitting: stochastic optimals (Tziperman-Ioannou
2002, section 4, eqns 11-14)