1. Motivation

Eddies have characteristic life cycles:
- as tracer variance grows, eddy tracer fluxes are directed down gradient
- as variance decays, eddy tracer fluxes are directed up gradient

\[ \frac{\partial C}{\partial t} + \mathbf{u} \cdot \nabla C = F \]

\[ \frac{D}{Dt} \left( \frac{C^2}{2} \right) + \mathbf{u} \cdot \nabla C = F C \]

\[ \nabla \cdot \mathbf{u}' \nabla \cdot \mathbf{zeta}' > 0 \]

Southwest Indian Ocean

Eddies accelerate mean flow eastward, then westward linked to topography

Diagnostics of high-pass (<100 days) eddy relative vorticity convergence (10^{-12} s^{-2}) for 1992-2002 from era-40

Dashed lines denote regions of 90% significance (a Monte Carlo technique where the original data is Fourier transformed, random phase applied, then a new time series constructed, 800 times)

2. Atmospheric Storm tracks

- Eddies grow at the entrance of storm tracks, providing a down-gradient heat flux and an eastward acceleration
- Eddies decay at the exit and downstream of a storm track, providing a westward acceleration, sometimes leading to blocking

3. Eddy forcing in the Southern Ocean

- Eddies force in the Southern Ocean
- Drack Passage

4. Implications

- Eddies provide sequence of down-gradient and up-gradient tracer fluxes;
- Need to consider life cycle of eddies via evolution of tracer variance;
- Expect life cycles of ocean eddies to be reflected in coherent patterns, such as storm tracks.

References: