MESOSCALE EDDIES

1. What are mesoscale eddies?

Generally speaking, eddies are fluid swirls and are common in both atmosphere and ocean.

Mesoscale eddies in the ocean have typical horizontal scales of 10-100 km.

They are also known as the "weather" of the ocean. They can be compared to highs and lows on weather maps, but are substantially smaller than their atmospheric counterparts.

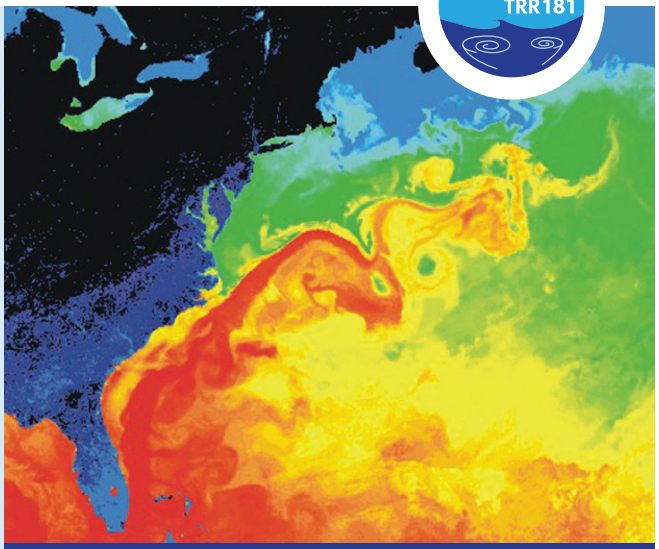
↑ *Atmospheric storm over Europe (Source: NERC, Dundee Satellite receiving station, www.sat.dundee.ac.uk)*

2. How are eddies generated?

Large scale circulations, such as the Gulf Stream, can become unstable. These instabilities can generate mesoscale eddies.

The eddies can be identified as highs and lows in maps of sea surface height. They also typically are made of water with warmer or colder temperatures than their surroundings.

The instability processes transfer energy from the large-scale currents to the eddies. In the atmosphere, enhanced eddy activity occurs along the "storm tracks" where weather systems grow.



↑ *Satellite picture of Gulf Stream and eddies (Red is warm and blue is cold, Source: NASA)*

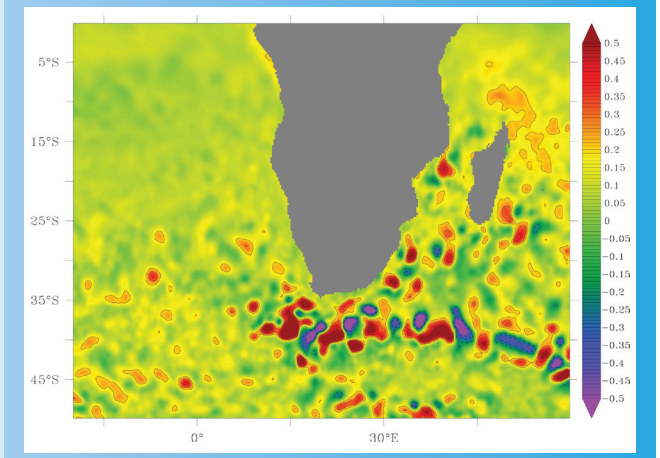
3. Why are eddies important?

Eddies transport heat, carbon and other climatically relevant tracers.

More than half of the kinetic energy in the ocean is in mesoscale eddies.

Eddies also exchange momentum with the large scale circulation. They can both accelerate and decellerate the large scale jet streams.

Eddies are an important player in the energy transfers between the large-scale flows and the smaller scale internal waves and mixing processes.



↑ *Warm (red) and cold (blue) eddies transporting their properties from the Agulhas region south of Africa into the South Atlantic (From: Aviso sea level anomaly, January 1st, 2016)*

4. What are the key research questions?

- How can the effects of eddies be considered in ocean models that cannot resolve them (this is called parameterization)?
- Where and how do the eddies lose their energy? This is important because this energy can be used to generate internal gravity waves that themselves are important for climate when they break and lead to mixing. On the other hand, eddies can also transfer energy back to the larger scales (this is called inverse cascade).
- How can the momentum transfer by eddies correctly be represented?

↑ *Signature of a small eddy and gravity waves seen in clouds in the atmosphere (Source: eoimages.gsfc.nasa.gov)*