Ocean Mesoscale Eddy Residence Time-scale and Its Control on the Global Overturning Circulation

Professor Julian MAK
（麥晉朗教授）

Department of Ocean Science

The Hong Kong University of Science and Technology

The ocean's global Meridional Overturning Circulation (MOC), sometimes known as the thermohaline circulation, plays a central role in the evolution of the Earth's climate via its role in the Earth system heat, oxygen and carbon cycles. While it is well-known that the MOC should depend on mechanical and thermodynamic forcing principally from the atmosphere, the ocean's internal dynamical processes (e.g., baroclinic instability, shallow and deep convection, wave turbulence, tidal dissipation) play a significant if not equivalent role in controlling the MOC under climate change scenarios in numerical models, via their respective roles in the ocean's energy and momentum pathways.

It is argued physically and quantified numerically here that the rate of dissipation of geostrophic mesoscale eddies in the ocean (cf. synoptic scale motion in the atmosphere), represented as an eddy residence time-scale, exerts a significant control on the MOC. The physical argument relies on the physically sound but somewhat counter-intuitive observation that dissipating the geostrophic mesoscale eddies actually drives a larger flow in the Southern Ocean, via changes to the momentum budget. Within an IPCC-class global ocean numerical model, the sensitivity of the MOC to the eddy residence time-scale is very significant: 50% change in the eddy residence time-scale roughly has the same effect as halving or doubling the Southern Ocean wind stress. While the projected changes in the Southern Ocean wind stress is suggested to be no more than around 10%, at present we have no strong constraints on the global distribution and magnitude of the eddy residence time-scale. Preliminary results on constraining the mesoscale eddy dissipation time-scale via an inverse method / parameter inference approach will be discussed.

17 September 2021

11:30 a.m.

Conference Room, 3/F,
Mong Man Wai Building

Zoom Link (Mixed-mode)

ID: 992 4969 9833 Passcode: 983837

EARTH SYSTEM
SCIENCE PROGRAMME

Enquires: 3943 9624 essc@cuhk.edu.hk