AGU-Ocean Science Meeting での「海洋混合学」の国際研究動向調査

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１．要旨

隔年で世界中の海洋研究者が一堂に会する最も大きな海洋科学の国際会議の一つである米国地球物理学連合（AGU）主催の海洋科学会議（Ocean Science Meeting）が 2018 年 2 月 11-18 日に米国ポートランドにおいて行われた。この会議では、混合過程の基礎研究から、海洋大循環に与える鉛直混合の影響、海洋長周期変動に関するセッションが多くたてられ、海洋混合学に関する国際的な研究動向を調査するのに、非常に適した会議であった。この会議において、研究動向を把握するとともに、本新学術を宣伝し、国際共同研究の構築に関わる活動を実施した。

２．OMIX 関連セッション(要旨は別紙参照)

2018/2/12 Monday

PL11A The Driving Forces of the Ocean’s General Circulation I-IV

海洋循環の駆動源についてのセッション。海洋混合と循環についての興味深い講演多数あり。MIT の Ferrari のグループなどが提唱している斜面上の海底境界層での等密度面を横切る湧昇と潮汐混合による海底向きの下降流がバランスして深層の循環が作られるという仮説についての諸要素の数値実験などの研究が急速に進んでいる。

The focus of this session is on the processes that facilitate the closure of the ocean's general circulation. The processes driving the upper and lower branches of circulation, and interconnecting them are of interest. In particular, the impact of changes in these driving processes on the circulation, thereby on the climate system, on a wide range of time scales will be part of our focus. Example topics of interest include: high latitude coupled dynamics, interior and deep ocean turbulence and mixing, boundary processes and global scale energetics and/or water mass analyses. We encourage contributions that not only focus on physics of processes, but also on their role and interconnections in the large-scale circulation.

Primary Chair

Ali Mashayek*Scripps Institution of Oceanography*

Co-Chairs

Lynne D Talley*University of California San Diego*
Sheldon Bacon*University of Southampton*
Colm-cille Patrick Caulfield*University of Cambridge*

2018/2/12

PS11A: Interaction Between Internal Waves and Multiple-Scale Dynamics

Internal waves in the ocean, including inertial internal waves, internal tides and nonlinear internal waves, co-exist with other oceanic phenomena with multiple-scales, such as general circulations, fronts, mesoscale and sub-mesoscale eddies. Since such phenomena have different temporal and spatial scales from internal waves, their dynamics have usually been studied separately. However, more and more evidences reveal apparent interactions between them. Background currents and tilted thermocline associated with geostrophic circulation or mesoscale eddies affect the generation and propagation of internal waves, including reflection, refraction, formation of higher modes and non-linear evolution. As a feedback, internal wave breaking or scattering changes local mixing, thus influencing the genesis and

evolution of general circulation and mesoscale eddies. This feedback may be especially important for long-term variations of ocean circulation and climate change, and also provides a roadmap to understand and estimate appropriate dissipation rates for numerical models. This session invites presentations that report recent progress on interactions between internal waves and other dynamical phenomena in the ocean, so as to clarify the energy and momentum route between these processes in different scales. Observational, theoretical and numerical investigations are all welcome.

Primary Chair

Qiang Li *Tsinghua University*

Co-Chairs

Xueen Chen *Ocean University of China*

John Huthnance *National Oceanography Center*

180213 Tuesday PS21A

PS21A Recent Advancements in Stratified Turbulent Mixing I

This session will explore recent developments in understanding mixing in stratified turbulent shear flows and its role in ocean circulation. The significance of mixing to the ocean energy cycle has long been recognized. While pioneering work developed a basic understanding of turbulence generated by shear instabilities and its efficiency in overcoming stable stratification, significant advancements have been made in recent years. A new framework based on the concept of Available Potential Energy has shed light on the role of mixing in the ocean energy cycle and its efficiency in flows driven either by shear or convective overturning, both characteristic of intermittent ocean turbulence. Meanwhile, new mechanisms for the development of shear instabilities are being discovered through numerical modeling and observations. In addition, meta-analyses of increasingly resolved DNS and ocean microstructure are leading to improved mixing parameterizations for use in ocean models and interpreting observational data. The talks in this session will span theory, experiments, modeling, and observational approaches to discuss recent advancements, new techniques and outstanding questions in turbulent mixing. We encourage submissions focusing on mixing across a range of ocean scales and settings, including global, coastal and estuarine, and its influence on biogeochemical processes.

Primary Chair

Brian L White

University of North Carolina at Chapel Hill

Co-Chairs

Stephen G Monismith *Stanford University*

Jeffrey R Koseff *Stanford University*

180213PC31A

- **PC31A** Meridional Overturning Circulation Dynamics in Past Warm and Cold Climates I

The meridional overturning circulation (MOC) is a key component of the global climate system, as it modulates the transport and storage of both heat and carbon. Changes in deep-ocean circulation are thought to have played a key role in past climatic transitions, such as between glacial and interglacial periods. However, reaching a quantitative understanding of the dynamics that contributed to these changes, remains a major challenge in climate research. The MOC's response to current climate trends is also an unknown when assessing future global ocean-climate-carbon cycle interactions. Investigating how the MOC varied in the past can provide crucial information on the mechanisms and drivers of its variability, as well as on the

possible impacts of future circulation changes. This multidisciplinary session will facilitate discussions between the modeling and data communities, with the aim to explore both the transient and equilibrium response of the MOC to different forcing scenarios. We welcome contributions from both proxy-based studies to reconstruct past changes, and those exploring these dynamics from a mechanistic perspective, spanning from theoretical approaches to fully-coupled numerical modeling efforts. We especially encourage combined model-data analyses, as well as studies investigating past periods that could be viewed as analogues for future climates.

Primary Chair

Alice Marzocchi *University of Chicago*

Co-Chairs

Benoit Thibodeau *The University of Hong Kong*
Juan Muglia *Oregon State University*
Andrea Burke *University of St Andrews*

PL52A: From WOCE Through CLIVAR to GO-SHIP: Results from Global Repeat Hydrographic Surveys II

As part of the global repeat hydrography effort, researchers from around the world have worked to measure vertical profiles of seawater properties with high spatial resolution, precision, and accuracy approximately once per decade. These measurements are made along pre-defined sections that cross the major ocean basins. The first detailed surveys were conducted by the 1990s World Ocean Circulation Experiment (WOCE). Major sections were repeated in the 2000s as part of the Climate Variability and predictability program (CLIVAR). Now, the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP) is carrying this observation strategy into a third decade. Repeat hydrographic measurements have proven critical for revealing variability and long term trends in ocean heat content, freshwater cycling, anthropogenic and natural carbon storage, circulation patterns, acidification, nutrient distributions, and other natural and anthropogenic tracers. These cruises have also provided support for ancillary measurements and other observation programs (e.g. Argo and remote sensing).

In this session, we invite contributions from those who are interpreting these physical, chemical, and biological observations, or using them to construct or validate ocean circulation models or property estimation algorithms. Submissions from researchers who rely on repeat hydrography cruises for in situ sensor deployments or remote sensor calibration/validation are also invited.

Friday, February 16, 2018

Primary Chair

Richard A Feely *NOAA Pacific Marine Environmental Laboratory*

Co-Chairs

Alison M Macdonald *Woods Hole Oceanographic Institution*
Leticia Barbero *University of Miami*
Toste S Tanhua *GEOMAR Helmholtz Centre for Ocean Research Kiel*

PS52A: How Do Submesoscale and Internal Wave Driven Mixing Matter on Global and Regional Scales? II

Ocean mixing processes driven by submesoscale dynamics (e.g. mixed layer instabilities, shear instability, etc), internal waves (e.g. nonlinear wave interactions, lee waves, etc), and the interaction between the two are known to have

a significant local impact. However, less is known about the importance of these mechanisms on larger scales, including the effect on the water-mass transformation, buoyancy budgets, energy pathways, and subsequent biogeochemistry. This is due to the challenges of observing and modeling these processes accurately with regional and global coverage. This session welcomes abstracts that help investigate the influence of these small-scale processes (occurring at time scales of inertial periods and spatial scales below 10km) on the large-scale by use of observations, modeling, or parameterizations. We hope to initiate discussions that relate to the regional, basin, and global scale effects of submesoscales and internal waves on the physics and biogeochemistry of the ocean.

Friday, February 16, 2018

Primary Chair

Mariona Claret*JISAO/University of Washington*

Co-Chairs

Caitlin Whalen*Applied Physics Laboratory*
University of Washington
Tyler Hennon*Scripps Institution of Oceanography*
Cimarron Wortham*NorthWest Research Associates*