

Specific Knowledge Course

Advanced Ocean Modelling

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[TRR 181 "Energy Transfers in Atmosphere and Ocean"](#)

8 – 11 February 2021

10.00 – 13.00

Objectives

This course will give an overview over the principles of mathematical and numerical modelling of geophysical flows. We will discuss the underlying system of differential equations, classical approximation, and models from first analytical models of the North Atlantic gyre to general circulation models and the corresponding solution methods. The focus will be on ocean models.

Topics

- Stommel gyre model
- Navier-Stokes Equations in a rotating frame of reference
- Material time derivative and Eulerian/Lagrangian coordinate systems
- Classical approximations (hydrostatic, Boussinesq, thin-shell, quasi-geostrophic)
- Reynolds Averaging, simple models of turbulence
- General Circulation Models with "physics" packages
- Large scale waves and their solution in GCMs: Rossby waves, Kelvin waves, Poincaré waves
- Solution methods (only as an overview), discretization in space and time

Methods

Mainly lecturing; if possible, we will try to work on hands-on tutorials with the MITgcm and Python

Prerequisites

- Basic calculus: partial differential equations, differential operators (e.g., gradient, divergence in \mathbb{R}_3), integrals
- Fundamental conservation laws of physics (momentum, energy, angular momentum, etc.)
- Prior knowledge in fluid dynamics would be helpful

Software used in the course

MITgcm (<https://mitgcm.org>) , requires a unix-like environment (Unix, Linux, MacOS X) and functional fortran compiler, e.g. gfortran

Python for visualisation of MITgcm output (latest version 3.8; can be downloaded from <https://www.anaconda.com/download/>)

It will be possible to use Matlab but the online tutorials will be prepared in Python only

Format

The course will be given online via Webex meetings. Participants need a laptop or desktop computer incl. video conferencing tools (webcam, speaker/headphone) and a good internet connection. Access to the online learning platform will be provided before the start of the course. **Participants are expected to turn on their cameras for the full duration of the course.** Please sign up only, if you agree to show yourself to the others. If you encounter technical problems, please contact us.

Schedule

Four online live sessions from 10.00 to 13.00 on each of the four days (with short breaks in between)

Registration

To register for this course, please visit the course web page:
<https://www.marum.de/en/education-career/2021-02-08.html>

Please note that your registration will be binding.

The registration deadline for this course is **2 February 2021**.

Any enquiries regarding the course should be addressed to early-career@marum.de.