

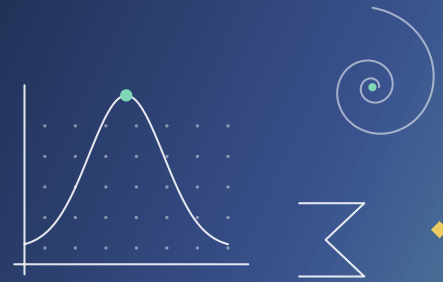
Module code

SPM-3421

Type of module

Undergraduate: Mathematical Sciences – Elective

Introduction to Geophysical Fluid Dynamics



Modular credits

4

Total student
engagement

56 hours

Prerequisite

SPM-2205 Ordinary
Differential Equations
SPM-2206
Multivariate Calculus

Anti-requisite

None

Aims

To develop students' ability to analyse and apply mathematical models of geophysical fluid dynamics to investigate large-scale atmospheric and oceanic processes, and to evaluate their relevance to climate variability and climate change.

Module learning outcomes (MLO)

On successful completion of this module, a student will be expected to be able to:

MLO 1

Analyse the characteristic spatial and temporal scales of geophysical flows to distinguish dominant dynamical balances in large-scale atmospheric and oceanic systems.

MLO 2

Apply governing equations and modelling assumptions to derive simplified mathematical models for rotating, stratified geophysical fluids.

MLO 3

Evaluate geostrophic and quasi-geostrophic theories, including potential vorticity conservation, to explain balanced flows, wave dynamics, and adjustment processes.

MLO 4

Implement analytical and computational techniques to solve and visualise boundary-layer flows, wave motions, and linear instabilities in idealised geophysical fluid models.

MLO 5

Justify the use of idealised geophysical fluid dynamics models when interpreting climate variability and climate change, recognising both their explanatory power and limitations.

Module contents

Introduction and scales of geophysical flows	Governing equations and modelling assumptions	Geostrophic dynamics and balanced flows
Quasi-geostrophic theory and potential vorticity	Boundary layers and Ekman dynamics	Wave dynamics in rotating fluids (Rossby and inertia-gravity waves)
Linear instabilities and adjustment processes	Applications to climate variability and climate change using idealised GFD models	

Assessment

60% **40%**
Examination Coursework



■ Examination — 60% ■ Class tests — 30% ■ Computational assignment — 10%

Formative assessment

Weekly discussion and feedback

Summative assessment

COMPONENT	WEIGHTING
Examination	60%
Coursework	40%
Individual	40%
Class tests	30%
Computational assignment	10%

Graduate attributes and skills

Programme learning objectives (PLO) addressed

1	PLO 1 (Core Mathematical Knowledge)	2	PLO2 (Analytical Problem-Solving)
3	PLO 3 (Computational And Digital Tools)	4	PLO 4 (Mathematical Communication)
6	PLO 6 (Adaptability And Lifelong Learning)		

Sustainability concept addressed

4	SDG 4 Quality Education
13	SDG 13 Climate Action

Digital skills/software used (not limited to)

- Learning management and collaboration platforms (e.g. Canvas)
- Mathematical and scientific programming software (e.g. MATLAB, Python)
- Mathematical document preparation software (e.g. LaTeX)
- Version control systems (e.g. Git/GitHub)

Micro-credentialling option

No

Stackable towards GenBESTARI Undergraduate Degree Programme or other relevant Lifelong Learning Programmes

No

Document details

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