

# Einladung zum Mathematischen Kolloquium

Am Donnerstag, **dem 16. Juli 2026**, spricht

— Herr Prof. Dr. Gary Froyland von der University of New South Wales (Sydney),

Gast am Lehrstuhl Dynamical Systems and Data bei Herrn Prof. Dr. Péter Koltai,

über das Thema

## Spectral Approaches to Complex Dynamics

### Abstract

The weather and the climate, along with social processes, biological processes, and engineering processes, are all dynamical systems because they are governed by a set of micro-rules at the level of individual states that describe how processes evolve over time. Complex dynamical systems incorporate elements of unpredictability (nearby initial states quickly diverge from one another) and emergence (macroscopic system behaviour is not apparent from the set of micro-rules due to many interacting components).

Emergent behaviour in complex dynamical systems is typically connected with the appearance of macro-structures that persist for a certain amount of time. Examples of such macro-structures include eddies in the ocean, cyclonic storms or heatwaves in the atmosphere, and the coalescing of societal opinion around a particular issue. It is these macro-phenomena that impact our daily world, but it remains challenging to identify key organising emergent phenomena from micro-rules or spatiotemporal observations. Part of the difficulty arises from the usually complicated nonlinear dynamics of the micro-rules. To access these macro-phenomena, we use a linear operator induced by the micro-dynamics. This linear operator – the transfer operator – acts on ensembles of individual states, and its linearity enables one to access a large toolbox from linear analysis.

In this talk, I will gently introduce the transfer operator and its associated spectral theory. We also make connections to a dynamic spectral geometry of evolving manifolds, centred on the dynamic Laplace operator. Several example analyses are presented, ranging across problems in climate, physical oceanography, and atmospheric science.

Beginn: 16.30 Uhr (Kaffee/Tee ab 16 Uhr im S 748)

Ort: Hörsaal H 19, Gebäude Naturwissenschaften II, Universitätsgelände