CENTRE DE RECERCA MATEMÀTICA

EXCELENCIA MARÍA DE MAEZTU 2022 - 2025

PhD thesis defense

STATISTICAL ANALYSIS OF THE MADDEN-JULIAN OSCILLATION EVENTS

September 9th, 2025

12:00

CRM Auditorium

Supervisor: Álvaro Corral

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The Madden–Julian Oscillation (MJO) is the main mode of tropical intraseasonal variability, strongly influencing global weather. It modulates tropical convection, drives sub-seasonal variability, and interacts with El Niño–Southern Oscillation (ENSO). Yet, key aspects of its life cycle — initiation, duration, and termination — remain poorly understood.

This work shows that MJO event durations and sizes follow a double power-law distribution, suggesting a distinction between weak and extreme events but without a characteristic scale in these two categories. A critical duration near 27 days marks a sharp increase in extinction probability independent of initiation or ending phase, pointing to internal dynamics rather than external forcing.

Building on this framework, the thesis examines the evolution of extreme MJO events and their regional impacts over South America during austral summer. Results highlight stronger and more widespread convection anomalies, a significant influence on the South American Dipole (SAD), and clear modulation of extreme events by ENSO affecting their frequency, intensity, and subsequent impacts on South American weather patterns.