ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών
ΙΔΡΥΘΕΝ ΤΟ 1837

Τμήμα Φυσικής
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Αθήνα, 18 Σεπτεμβρίου 2025

ΥΠΟΣΤΗΡΙΞΗ ΔΙΔΑΚΤΟΡΙΚΗΣ ΔΙΑΤΡΙΒΗΣ

Σας γνωρίζουμε ότι την **Παρασκευή 3 Οκτωβρίου 2025** και ώρα **13:00**, ο **κ. Ιωάννης Καραγιώργος** θα υποστηρίξει τη διδακτορική του διατριβή στην αίθουσα Α18 του Τομέα και διαδικτυακά. Το θέμα της διατριβής είναι:

«The interactions of the coupled ocean-atmosphere system in the Mediterranean region, under the influence of the optical characteristics of the upper ocean layer»

«Οι αλληλεπιδράσεις του συζευγμένου συστήματος θάλασσας-ατμόσφαιρας στην περιοχή της Μεσογείου, υπό την επίδραση των οπτικών χαρακτηριστικών του ανώτερου στρώματος του ωκεανού»

Abstract
This thesis investigates how variations in ocean optical properties shape the upper-ocean thermal structure and dynamics, and in turn, modulate air–sea interactions in the Mediterranean region. To this end, we developed MedX-CM (extended Mediterranean coupled model), a fully coupled, high-resolution modeling framework for the Mediterranean and Black Seas that integrates atmosphere (WRF), ocean (NEMO), surface waves (WaveWatch III), and marine biogeochemistry (PISCES) through the OASIS coupler. The system explicitly resolves cross-component feedbacks, enabling a reliable representation of processes driving both climate variability and extreme weather events in the Mediterranean.

We first assessed the role of coupling complexity within MedX-CM using Medicane Ianos (2020) case study, showing that while track errors depend mainly on initialization, oceanic and wave feedbacks strongly regulate storm intensity through SST cooling and altered air-sea heat and momentum fluxes. We then investigated the influence of ocean optical properties at seasonal to

decadal scales through twin simulations (2011–2021), demonstrating that chlorophyll-driven radiative heating amplifies the seasonal cycle of upper-ocean temperature, enhances summer warming and winter cooling, and cools subsurface layers year-round. These responses are governed by mixed-layer depth and the balance between near-surface absorption and vertical mixing, with atmospheric feedbacks further modulating SST anomalies via latent heat flux. The role of bio-optical forcing was further confirmed with Cyclone Daniel (2023) case study, where wavelength- and chlorophyll-sensitive radiation schemes produced warmer pre-storm SSTs and stronger storms, but also more pronounced post-storm cold wakes. Finally, two-way physical–biogeochemical coupling was shown to reproduce key ecosystem features in the region and link vertical chlorophyll variability to regionally distinct upper ocean thermal responses.

Together, these results demonstrate the importance of coupling complexity and bio-optical processes across timescales in the Mediterranean region, underscoring the need for their explicit inclusion to advance coupled forecasting and improve regional climate projections.

Η Τριμελής Συμβουλευτική Επιτροπή:

Σ. Σοφιανός, Καθηγητής, Τμήμα Φυσικής, ΕΚΠΑ (επιβλέπων)
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