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Dynamic Mode Decomposition Uncovers Hidden Oceanographic Features Around the Strait of Gibraltar SUDAM SURASINGHE, SATHSARA DIAS, KANATHTHA PRIYANKARA, ERIK BOLLT, MARKO BUDISIC, Clarkson University, LARRY PRATT, Woods Hole Oceanographic Institution, JOSE SANCHEZ-GARRIDO, University of Malaga — Oceanic flow around the Strait of Gibraltar comprises dynamic sub-mesoscale features arising due to topographic and tidal forcing, instabilities, and strongly nonlinear hydraulic processes, all governed by nonlinear equations of fluid motion. The purpose of this study is to isolate dominant features from 3D MIT general circulation model simulations and to investigate their physics. To this end, we use the Dynamic Mode Decomposition (DMD) that decomposes the sequence of simulation snapshots into a sum of Koopman modes: spatial profiles with well-defined exponential growth/decay rates and oscillation frequencies. To identify known features, we correlate identified DMD modes with the tidal forcing and demonstrate that DMD is able to non-parametrically detect the prominent waves known to occur in the western Mediterranean. Additionally, the analysis reveals previously undocumented Kelvin waves and demonstrates that meandering motions in the Atlantic Jet entering the Mediterranean Sea are associated with the diurnal tidal forcing. The DMD thus recovers the results obtained by classical harmonic analysis of tidal constituents, and also highlights features that have eluded attention so far, suggesting that DMD could be a useful part of an oceanographer's toolbox.

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