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Modelling mesoscale dynamics for ocean and climate prediction

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Mesoscale variability in the ocean (typical spatial scales of 100 km and time scales of a month) is the "oceanic weather", analogous to the synoptic disturbances which characterize the mid-latitudes atmospheric weather. This talk is a review of the progress made in the past decades in understanding and modelling key dynamical features of mesoscale eddies and jets. For ocean forecasts on weekly time scales, the geometry, amplitude and phase of mesoscale variability has to be captured by numerical ocean models. For climate prediction on longer time scales, the challenge for numerical models is to represent the integrated effect of mesoscale dynamics on the global ocean circulation and on the exchanges between ocean and atmosphere, cryosphere and biosphere. Firstly, we focus on aspects relevant for short-term ocean prediction, such as mesoscale instabilities, eddy propagation, frontogenesis, and interaction with the sub-mesoscale. Secondly, we discuss some important effect of eddies on large scale transports of heat and salt and more generally on the ocean climate. Ocean eddies are non-local in essence, and the zonal jets resulting from mesoscale turbulence drive large scale interactions and transports in ocean basins. The implications of this non-localness for eddy parametrisations have yet to be fully addressed. During the past decades, the progress in modelling and understanding eddies has been driven in part by Community Model Experiments. The DRAKKAR European consortium is an example of such CMEs, where researchers from different institutes and countries join forces to design and analyse ambitious simulations. We conclude by a discussion on the benefits of such strategies to face the future challenges in ocean and climate prediction.