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Disentangling the intrinsic and forced oceanic variability through different ensemble simulation strategies

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The global pullback attractor (GPBA, e.g., Ghil et al., 2008) of a chaotic dissipative dynamical system subjected to time-dependent forcing implies full statistical knowledge of the system, as it tells which states can be assumed at any time instant, and with what probability. In this context, the GPBA of a four-variable quasigeostrophic ocean model (Pierini, 2011) forced by a schematic, time-dependent North Pacific double-gyre wind field is derived through an ensemble of many thousands of simulations. The knowledge of the system's GPBA is then exploited to disentangle the intrinsic oceanic variability from the atmospherically forced variability.

In realistic global high-resolution ocean modelling, determining the system's GPBA is computationally prohibitive, but ensemble simulations with a limited but significant number (50) of members have nonetheless been carried out (e.g., Bessières et al., 2017). The same approach, including also stochastic forcing, has been adopted with the low-order ocean model. Knowledge of the GPBA -available in this case- allows one to assess the statistical significance of the small ensemble simulation approach and, at the same time, suggests new strategies that could improve the identification of the low-frequency oceanic variability of intrinsic origin.

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Pierini S., 2011: J. Phys. Oceanogr., 41, 1585-1604.