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Prediction-skill variability in atmospheric and oceanic models

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Various numerical atmospheric and oceanic models have been developed in the past several decades. A fundamental question arises: Can we determine which model provides "the best prediction"? To answer this question, full knowledge of the prediction error statistics of each model is needed. Due to high structural complexity and high dimensionality of the error phase space, establishment of such statistics is difficult. Usually the Gaussian distribution is assumed for the error statistics for simplicity. However, it might not be true for regional ocean models.

A new scalar with the dimension of time, the irreversible-skill time (IT), is defined as the time period when the prediction error first exceeds a pre-determined criterion (i.e., the tolerance level) [originally defined as valid prediction period by Chu et al. (2002b, c)], is introduced to estimate the model predictability for linear and nonlinear stages in the prediction error evolution. The probability density function (PDF) of IT satisfies the backward Fokker-Planck equation (or called Pontryagin-Kolmogorov equation in the Russian literature).

Great advantages of IT for model evaluation are: (1) establishing the analytical framework for estimating the local prediction-skill of regional ocean models, (2) understanding the temporal intermittency of prediction-skill, and (3) searching physical mechanisms causing extremely successful prediction (ESP). Application to ocean (atmospheric) model evaluation is demonstrated.

References

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