Geophysical Research Abstracts, Vol. 7, 02947, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02947

Irreversible Predictability Time – A Quantitative Measure of Model Predictability

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Analysis of model predictability needs full knowledge of prediction error statistics. 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 ocean models.

A new scalar with the dimension of time, the irreversible-predictability time (IPT), is defined as the time period when the prediction error first exceeds a pre-determined criterion (i.e., the tolerance level), is introduced to estimate the model predictability for linear and nonlinear stages in the prediction error evolution. IPT is in fact the well-known first passage time. The probability density function of IPT satisfies the backward Fokker-Planck equation (or called Pontryagin-Kolmogorov equation in the Russian literature).

Great advantages of IPT are illustrated using low-dimensional models such as Lorenz system (1984) to high-dimensional ocean/atmospheric models such as Princeton Ocean Model: (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. Application to ocean (atmospheric) model evaluation is demonstrated.

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Oral presentation is requested.