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A unified approach to the dynamics of model errors

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One of the principal causes limiting the skill of a forecasting model are the errors arising from uncertainties in the parameters or in the way processes not expressible directly in terms of the model variables are accounted for. There is currently a vivid discussion in the literature on the extent to which such model "errors " can be counteracted by augmenting the model equations by forcing terms, usually assimilated to Gaussian Markov noises. In this presentation some generic features of model errors in both the short time and the asymptotic regimes, are identified (Nicolis 2003, 2004). Emphasis is placed on their connection to the dynamical and statistical properties of the underlying reference (error free) system such as the Lyapunov exponents and the invariant probability distribution on the attractor. It is shown that error sources are generally coupled to the model variables in a highly intricate manner. This tends to render problematic their modeling by Gaussian white noises. In particular, it turns out to be very difficult to improve by such a modeling simultaneously the average properties and the variability around the mean (Nicolis, 2005).