Screening the coupled atmosphere-ocean system based on Covariant Lyapunov Vectors

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We analyze linear perturbations of a coupled quasi-geostrophic atmosphere-ocean model based on Covariant Lyapunov Vectors (CLVs). CLVs reveal the local geometrical structure of the attractor, and point into the direction of linear perturbations applied to the trajectory. Thus they represent a link between the geometry of the attractor and basic dynamical properties of the system, and they are physically meaningful. We compute the CLVs based on the so-called Ginelli method using the tangent linear version of the quasi-geostrophic atmosphere-ocean model MAOOAM (Modular Arbitrary-Order Ocean-Atmosphere Model). Based on the CLVs, we can quantify the contribution of each model variable on each scale to the development of linear instabilities. We also study the changes in the structure of the attractor - and, consequently, in the basic dynamical properties of our system - as an effect of the ocean-atmosphere coupling strength and the model resolution.