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Attractor dimension of time-averaged climate observables: insights from a low-order ocean-atmosphere model

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The ocean and atmosphere have very different characteristic timescales and display a rich range of interactions. Here, we investigate the sensitivity of the dynamical properties of the coupled atmosphere-ocean system when time-averaging of the trajectories of the original system is performed. We base our analysis on a conceptual model of the atmosphere-ocean dynamics which allows us to compute the attractor properties for different coupling coefficients and averaging periods. When the averaging period is increased, the attractor dimension initially shows a non-monotonic behaviour, but ultimately decreases for windows longer than 1 year. The analysis of daily, monthly and annual instrumental and reconstructed indices of oceanic and atmospheric circulation supports our results. This has important implications for the analysis and interpretation of long climate timeseries with a low temporal resolution, but also for the possible convergence of climate observables subjected to long time-averages towards attractors close to hyperbolicity.