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Chaotic behaviour via Lyapunov exponent of a three-layer quasigeostrophic model

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While contemporary general circulation models represent a primary tool for study of the climate system in its full complexity, lower-dimensional simulations can also provide valuable information about the specific features of the atmosphere. Here, we use a long stream function time series from a three-layer quasigeostrophic model on the sphere over the Northern hemisphere to investigate its chaotic behaviour. We reconstruct the phase space in two different ways to estimate the maximal Lyapunov exponent. The first method is based on using delay coordinate of a single time series (at a given grid point). The second method is based on multivariate phase space reconstruction (at many grid points) using the leading principal component time series (without time delay). For both reconstructions we apply the Rosenstein method to estimate the maximal exponent. Additionally, we estimate the rate of trajectory divergence using the autocovariance function. An attempt to interpret the results in terms of geographical links is then discussed.