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# Temporal–spatial distribution of atmospheric predictability limit by local dynamical analogues

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To quantify the predictability limit of a chaotic system, the authors recently developed a method using the nonlinear local Lyapunov exponent (NLLE). The NLLE method provides a measure of local predictability limit of chaotic systems and is intended to supplement existing predictability methods. To apply the NLLE in studies of actual atmospheric predictability, an algorithm based on local dynamical analogues is devised to enable the estimation of the NLLE and its derivatives using experimental or observational data. Two examples are given to illustrate the effectiveness of the algorithm, involving the Lorenz63 3-variable model and the Lorenz96 40-variable model; they reveal that the algorithm is applicable in estimating the NLLE of a chaotic system from its experimental time series. On this basis, the NLLE method is used to investigate temporal–spatial distributions of predictability limits of the daily geopotential height and wind fields. The limit of atmospheric predictability varies widely with region, altitude and season. The predictability limits of the daily geopotential height and wind fields are generally less than three weeks in the troposphere, whereas they are approximately one month in the lower stratosphere, revealing a potential predictability source for forecasting weather from the stratosphere. Further work is required to examine broader applications of the NLLE method in predictability studies of the atmosphere, ocean, and other systems.