Data-Driven Seasonal Prediction Model using Isentropic Potential Vorticity

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Abstract

The large-scale atmospheric circulation can be depicted by conserved isentropic potential vorticity (IPV) process. The single isentropic layer potential vorticity provides an explanation of the 3D atmospheric motion, because the isentropic layer is not parallel to a constant altitude or an isobaric layer but varies from low latitude at low altitude to high latitude at high altitude. Based on these two IPV features, the 340K isentropic layer IPV can be the prediction variable of the long-term excess 6-month data-driven prediction model. This data-driven model is efficient to generate the ensemble prediction results for fulfilling the uncertainty of the seasonal forecasts. The IPV was separated into time series parts, the principal components, and the spatial parts, the empirical orthogonal functions by isometric feature mapping (ISOMAP). The time series parts were trained and predicted by data-driven neural network model. The predicted time series parts and the spatial parts were composed to reconstruct the future IPV. The 340K IPV patterns had the obvious differences in summer and winter. When proceeding the pentad 5-day seasonal data-driven prediction, the prediction models could be divided into summer and winter kinds with individual training/testing data. When proceeding the monthly prediction, they were not so sensitive to use summer or winter seasonal training models.

等熵位渦資料驅動季節預報模式

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摘要

大尺度大氣環流可以透過守恆等熵位渦（IPV）過程來描述。單等熵層位渦提供了 3D 大氣運動的解釋，因為等熵層不與恆定高度或等壓層平行，而是從低海拔的低緯度到高海拔的高緯度變化。基於這兩個 IPV 特徵，340K 等熵層 IPV 可以作為長期超額 6 個月資料驅動預測模型的預測變數。這種資料驅動模型可以有效地產生集合預測結果，以滿足季節性預測的不確定性。透過等距特徵映射（ISOMAP）將 IPV 分為時間序列部分、主成分和空間部分、經驗正交函數。時間序列部分透過資料驅動的神經網路模型進行訓練和預測。將預測的時間序列部分和空間部分組合起來以重構未來的 IPV。 340K IPV 模式在夏季和冬季有明顯差異。在進行五天季節性資料驅動預測時，預測模型可以分為夏季和冬季兩種，並具有單獨的訓練/測試資料。在進行每月預測時，他們對使用夏季或冬季季節性訓練模式較不敏感。