Supplementary Information: FuXi: A cascade machine learning forecasting system for 15-day global weather forecast

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Supplementary Notes

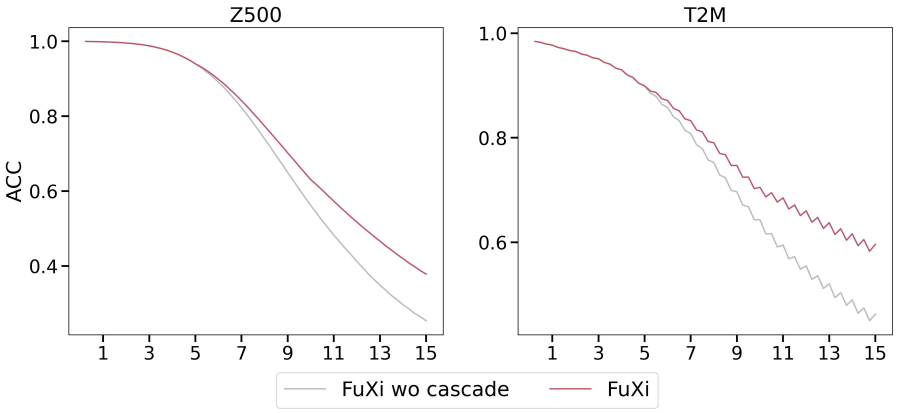
1 Effectiveness of the cascade model architecture

This section discusses the effect of using the cascade ML model architecture to reduce accumulation errors in weather forecasting. We use a single FuXi base model (FuXi-short) without the cascade, to generate 15-day forecasts. Then we evaluate its performance in comparison with the original FuXi model. Supplementary Figure 1 shows the comparable performance for forecasts of Z500 and T2M between the single base FuXi model and FuXi over lead times ranging from 0 to 7 days. However, the performance of the single FuXi base model deteriorates significantly as lead times increase, primarily due to accumulation error.

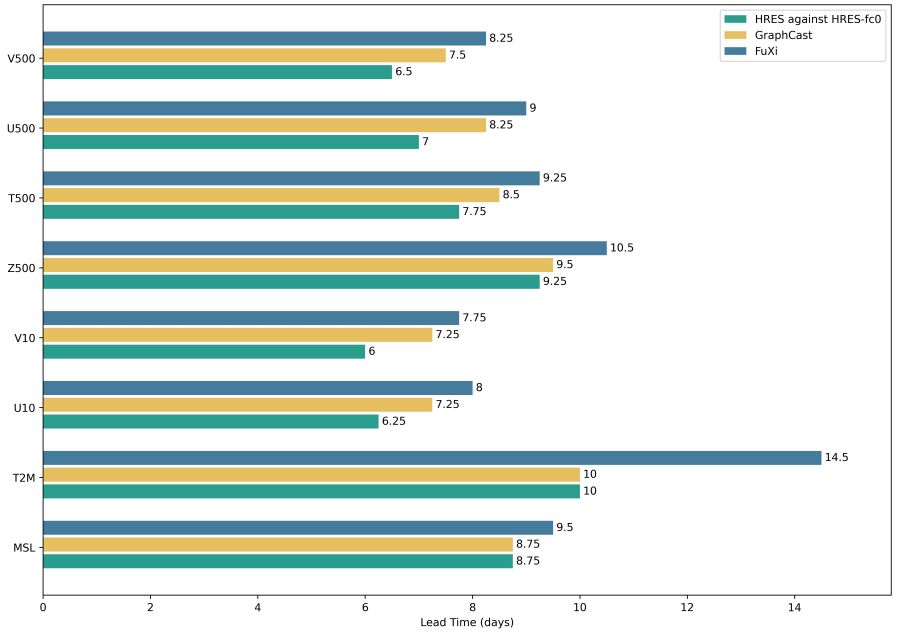
2 Skillful forecast lead time comparison

Supplementary Figure 2 compares the skillful forecast lead time of ECMWF HRES, Graphcast, and FuXi for 4 surface variables: MSL, T2M, U10, and V10, as well as 4 upper-air variables at 500 hPa pressure level: (Z500, T500, U500, and V500. FuXi improves the skillful lead time of all 8 variables show in the figure. The most significant improvement is for T2M, where FuXi increases the skilful lead time from 10 days by ECMWF HRES and Graphcast to 14.5 days for T2M. For Z500, the improvement is seen from 9.25 days by ECMWF HRES and 9.5 days by Graphcast to 10.5 days by FuXi.

Supplementary Figures



Supplementary Figure 1: Comparison of the globally-averaged latitude-weighted ACC of the FuXi system (red lines) and FuXi without cascade (gray lines) using testing data from 2018.



Supplementary Figure 2: Skillful forecast lead times (ACC >0.6) of ECMWF HRES, Graphcast, and FuXi for 4 surface variables (MSL, T2M, U10, and V10) and 4 upper-air variables (Z500, T500, U500, and V500) at 500 hPa pressure level.