

Supplementary material for "Dynamics of the spread/error relationship in STEPS and in a generative AI precipitation nowcasting model"

Martin Bonte¹, Lesley De Cruz^{1, 2}, Fabian Debal¹, and Stéphane Vannitsem³

¹Royal Meteorological Institute of Belgium, Brussels, Belgium

²Vrije Universiteit Brussel, Brussels, Belgium

³School of Physical and Mathematical Sciences & The Asian School of the Environment, Nanyang Technological University, Singapore

1 Examples of nowcasts

This Section presents Figures of STEPS and LDCast nowcasts, as well as ensemble standard deviation as a function of space for one convective event (Fig. S1 and Fig. S2) and one stratiform event (Fig. S3 and Fig. S4).

In Figs. S2 and S4, the pixels in the ensemble mean error field with positive values are those for which the ensemble mean underestimated the rain, while the pixels with negative values are those for which the ensemble mean overestimated the rain. Because of the smoothing of the mean, pixels with underestimated values form sharp structures, while those with overestimated values form smoothed structures.

Here, in contrast with the rest of the work, pixels of STEPS nowcasts for which no value was available were not attributed the observed values. Missing values in STEPS nowcasts were ignored to compute the mean and the standard deviation. The white pixels at the bottom of the second column of Fig. S3 are pixels for which the displayed member was missing values.

2 $\cos \gamma(e, p)$ for SPEC ensembles

Figure S5 shows the time evolution of $\cos \gamma(e, p)$ for SPEC ensembles.

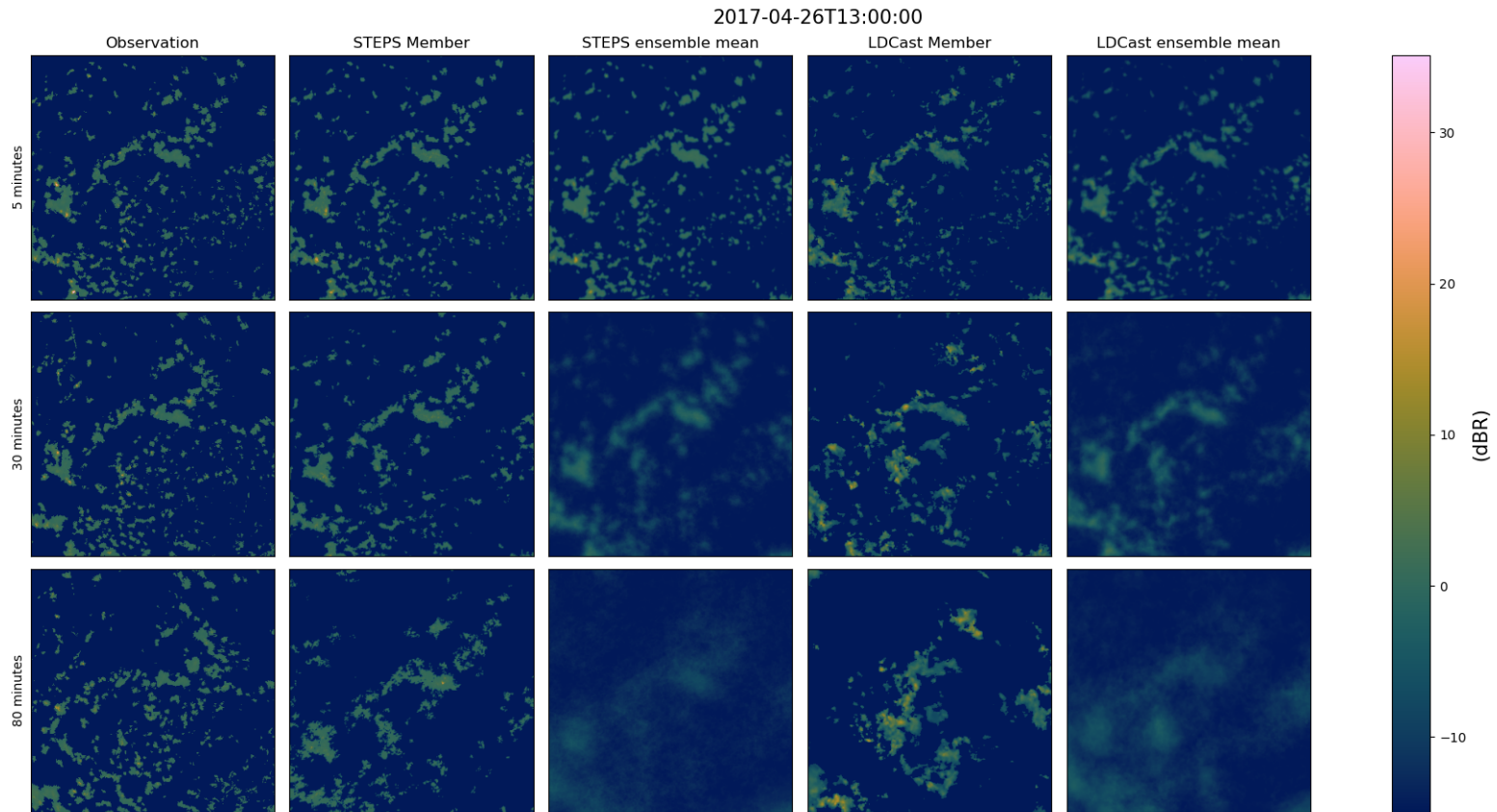


Figure S1: Examples of nowcasts in the convective case: observations in the first column, an example of a STEPS ensemble member in the second column, the STEPS ensemble mean in the third column, an example of a LDCast ensemble member in the fourth column and the LDCast ensemble mean in the fifth column.

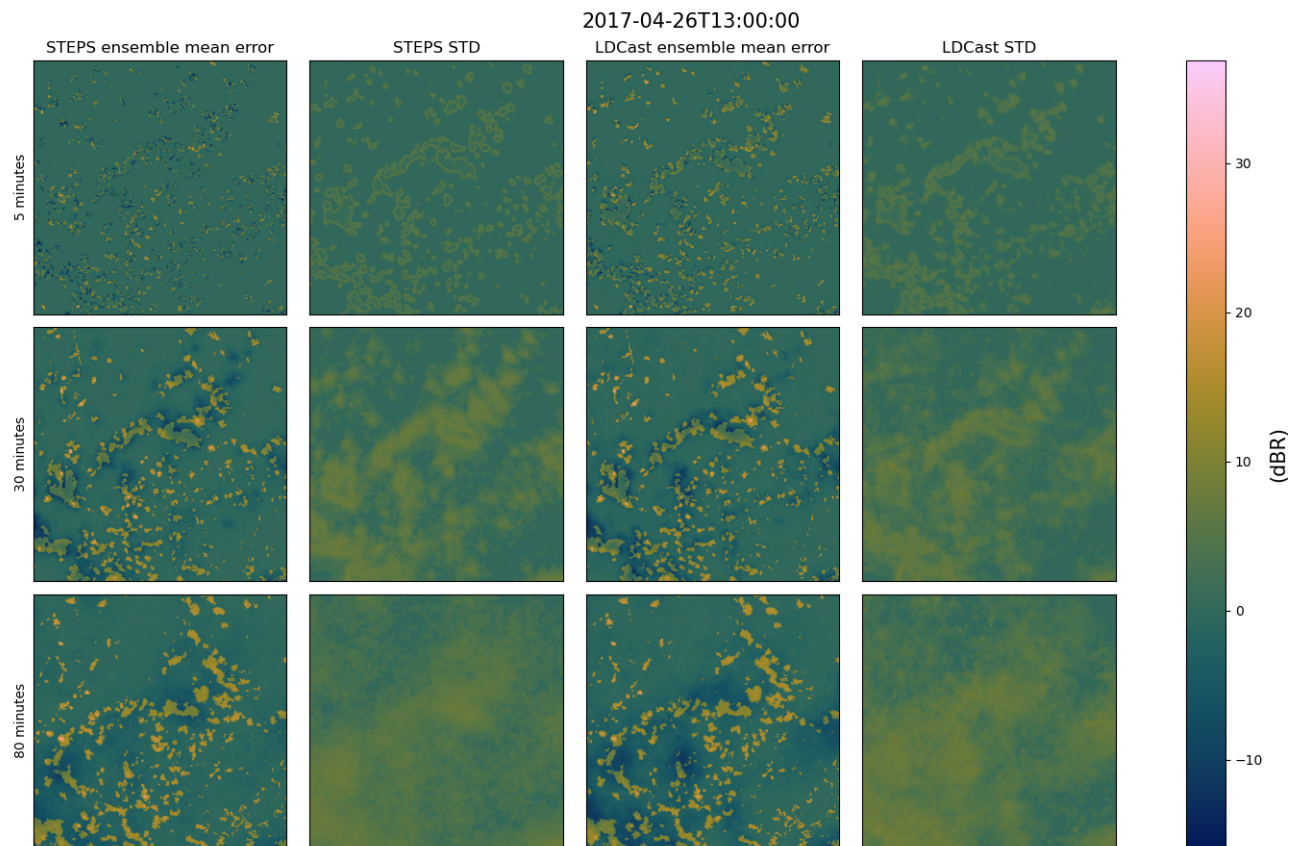


Figure S2: For the convective case: standard deviation in the STEPS ensemble (second column) and the LDCast ensemble (fourth column) as a function of space, compared with the pixel-wise error $e = y - \bar{x}$ for STEPS (first column) and for LDCast (third column).

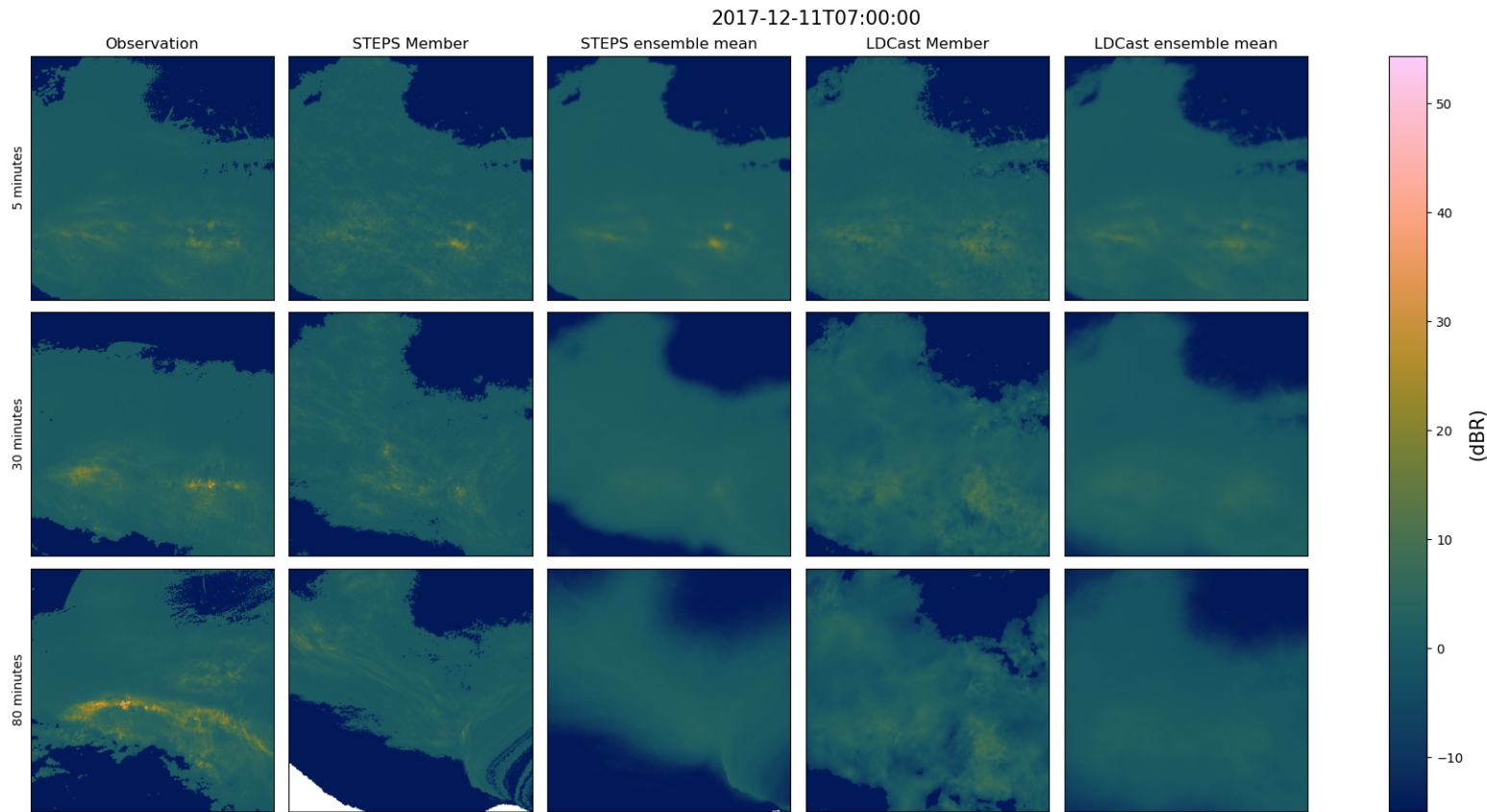


Figure S3: Examples of nowcasts in the stratiform case: observations in the first column, an example of a STEPS ensemble member in the second column, the STEPS ensemble mean in the third column, an example of a LDCast ensemble member in the fourth column and the LDCast ensemble mean in the fifth column. The represented STEPS member lacks values for some pixels.

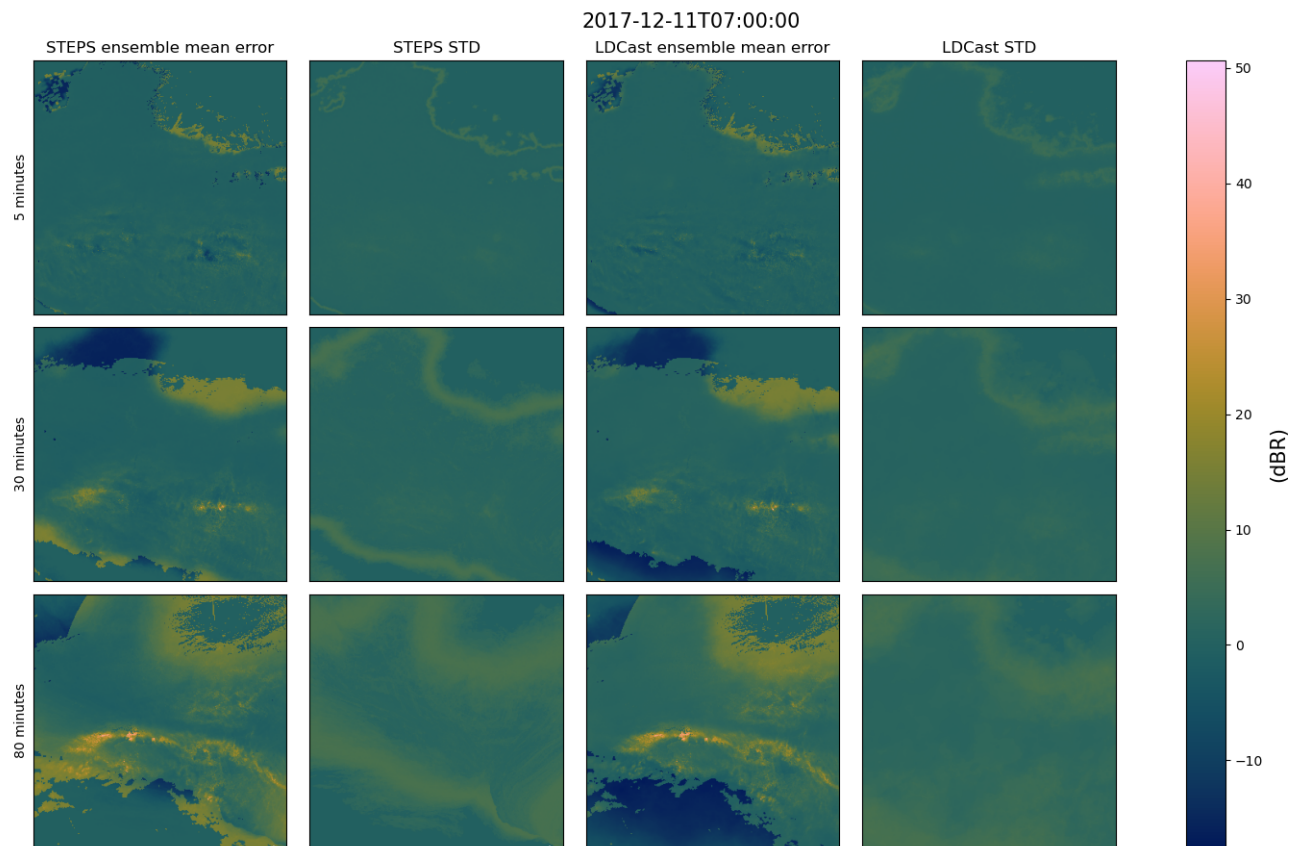


Figure S4: For the stratiform case: standard deviation in the STEPS ensemble (second column) and the LDCast ensemble (fourth column) as a function of space, compared with the pixel-wise error $e = y - \bar{x}$ for STEPS (first column) and for LDCast (third column).

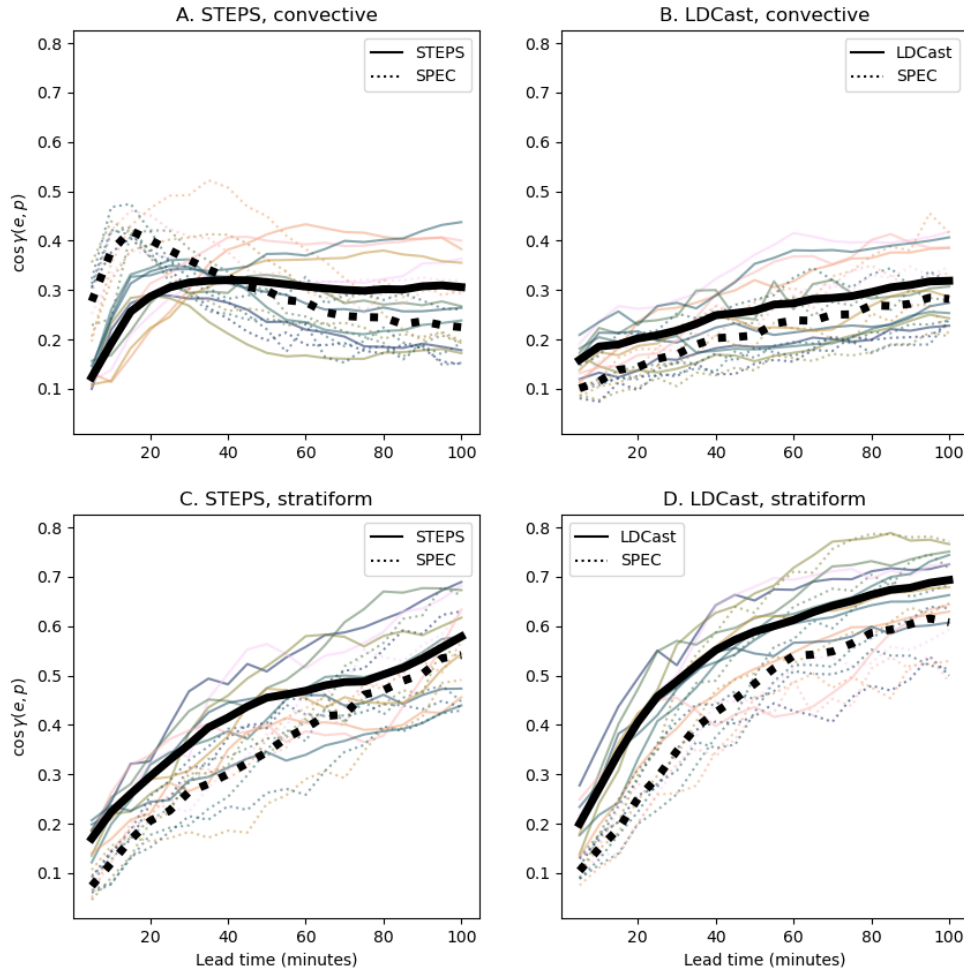


Figure S5: Same as Fig. 6 but with SPEC ensembles instead of MAAFT ensembles. Comparison of $\cos \gamma(e, p)$ of the error and its the projection on STEPS/LDCast ensembles (solid lines) with the $\cos \gamma(e, p)$ for the corresponding SPEC ensembles (dotted lines), for all lead times. Thin lines depict $\cos \gamma(e, p)$ for each event and thick lines represent the event average. The SPEC ensembles whose scores are presented in panels A. and C. are built from the corresponding STEPS ensembles, while those whose scores in presented in panels B. and D. are built from the corresponding LDCast ensembles.