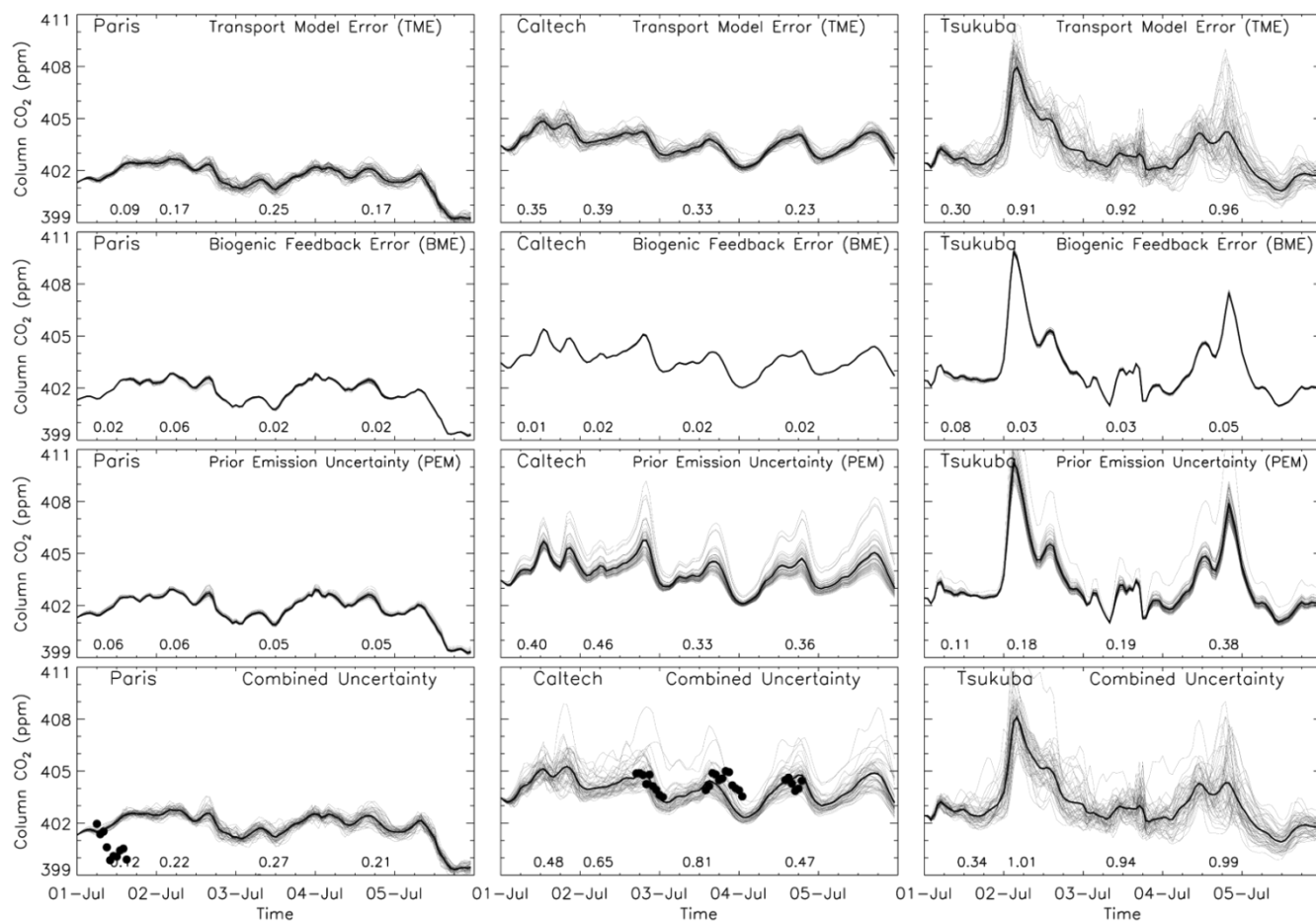Geoscientific
Model Development

Supplement of

Representing model uncertainty for global atmospheric CO_2 flux inversions using ECMWF-IFS-46R1

Joe R. McNorton et al.

*Correspondence to:* Joe R. McNorton (joe.mcnorton@ecmwf.int)

Here we provide an overview of results from July simulations, with equivalent plots to those in the main paper for January.

Supplementary Figure 1. IFS model XCO$_2$ (ppm) spread over three TCCON sites for 50-member ensemble for 1-5th July 2015 for uncertainties in model transport (first row), biogenic feedback from meteorological uncertainty (second row), monthly uncertainties in anthropogenic emissions (third row) and a combination of all uncertainties (fourth row). Individual ensemble members are shown with grey lines and the ensemble mean is the black line. TCCON observations, when available, are shown for the 5 days (black circles). Values denote standard error after 12, 24, 48 and 96 hours.
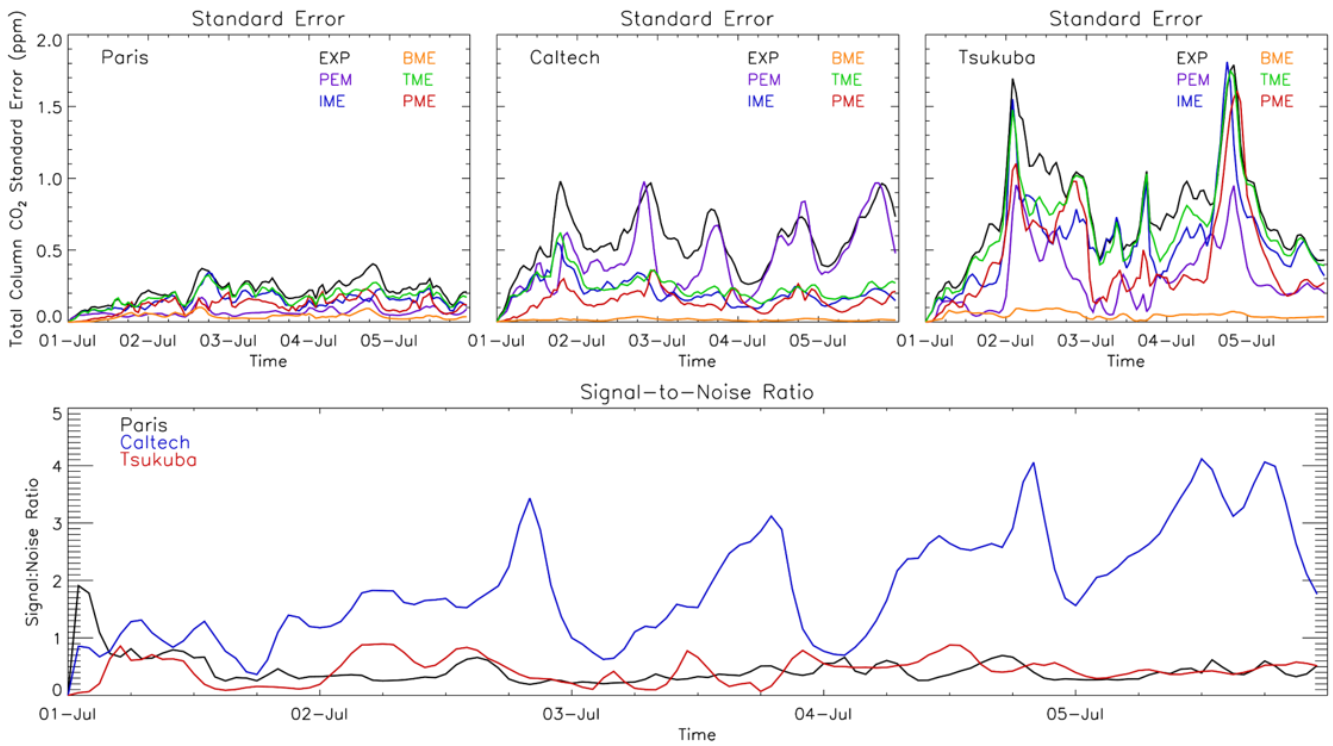
Supplementary Figure 2. IFS model XCO₂ (ppm) standard error across 50-member ensemble over three TCCON sites for 7 different model configurations for July 2015 (top row). The XCO₂ signal generated by uncertainties in anthropogenic emissions divided by the noise from remaining model error over the same TCCON sites (bottom row).
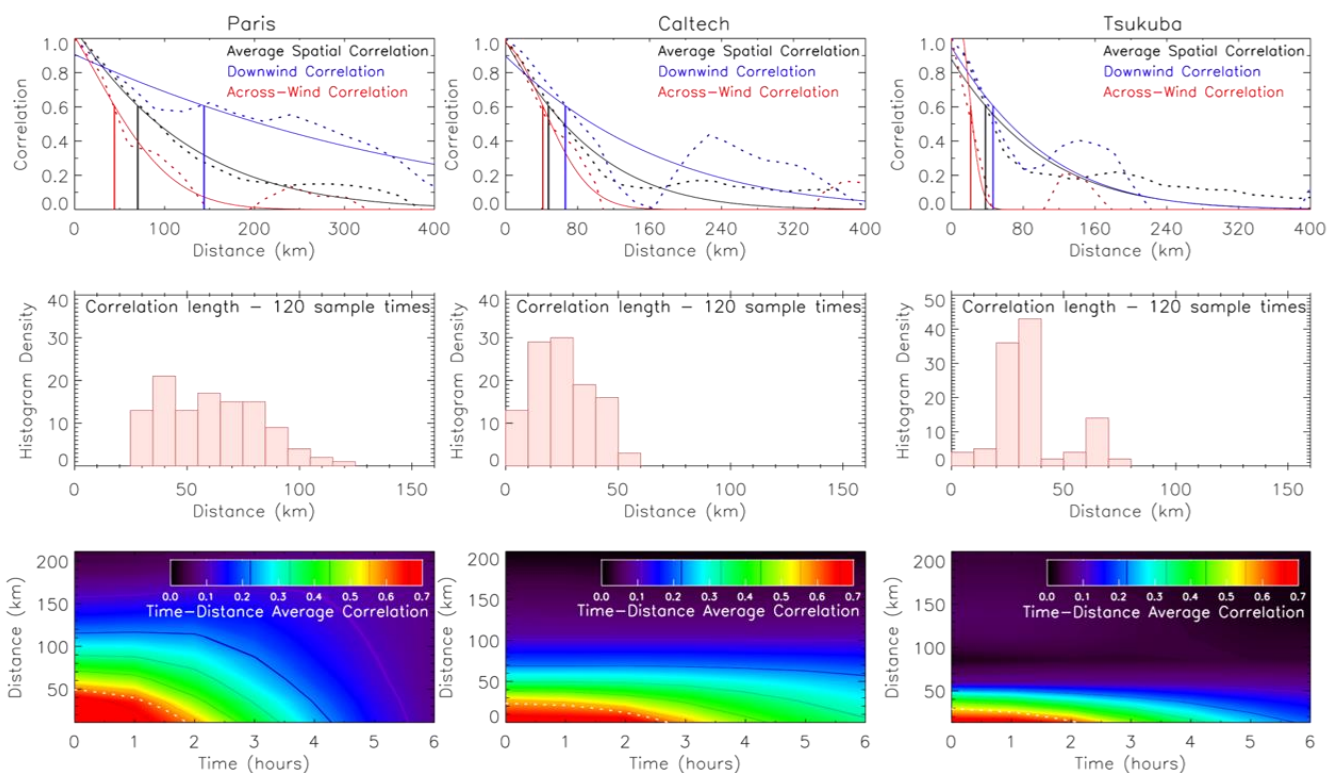
Supplementary Figure 3. A snapshot of XCO2 error correlation with respect to Paris (left), Caltech (middle) and Tsukuba (right) as a function of distance for a 50-member IFS model ensemble after 4 days (top row). These panels show the directionally averaged (black dashed line), downwind (blue dashed line) and across-wind (red dashed line) correlation values are shown with a gaussian fit (solid lines) in addition to the derived correlation length where $R = e^{-0.5}$ (vertical solid lines). The directionally averaged derived correlation lengths for 120 sample times for July 2015 are placed in 10km bins for all three sites (middle row). The directionally and time averaged error correlation values for the same 120 sample sizes as a function of both time and distance (bottom row).