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Comparison of GOSAT CO_2 to a multi-model CO_2 ensemble

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Global observations of total column CO_2 from space-based shortwave infrared measurements are well suited to improve our knowledge of the underlying surface fluxes. However, inferring these surface fluxes from total column data requires stringent levels of measurement precision and accuracy, representing a major challenge for the trace gas retrieval algorithms mainly due to spectral interference from atmospheric aerosols and clouds.

Although such satellite data can be well validated by the TCCON network of ground-based FTS instruments, this network is relatively sparse and lacks measurements in many of the more challenging geographical regions where the retrieval can be heavily influenced by aerosols. Global atmospheric chemistry transport model simulations (constrained by surface CO_2 measurements) can be used to assess the satellite data globally. This work uses an ensemble of models to determine in which regions the models typically agree with each other and can be considered our best estimate of the true state of the atmosphere and importantly in which regions the models differ considerably. It is in these regions where the models differ that the satellite data becomes more valuable.

In this work we compare the University of Leicester Full-Physics GOSAT CO_2 retrieval and the University of Bremen BESD SCIAMACHY algorithm to an ensemble of state of the art global atmospheric chemistry transport model simulations which have been constrained by surface CO_2 measurements.

We find that the models can consistently reproduce the majority of large-scale CO_2 variability observed by the satellite but there are key geographical regions where the models are unconstrained by surface measurements and specific events (such as biomass burning) where the models can differ by large amounts (+3 ppm).