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The CHE global nature run: A high-resolution simulation providing realistic global carbon weather for the year of the Paris Agreement

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High resolution simulations of carbon dioxide, methane and carbon monoxide (CO_2, CH_4 and CO) have been produced as part of the CO_2 Human Emissions (CHE) project in order to assist carbon-cycle research and applications, such as the design of a CO2 Monitoring Verification Support (CO2MVS) capacity in support of the Paris Agreement. This dataset provides realistic variability of the carbon tracers in the atmosphere modulated by the weather and the underlying surface fluxes as shown by comparison with independent observations. It can therefore provide a reference for atmospheric inversion systems that use atmospheric observations from satellites and in situ networks to derive natural surface fluxes and anthropogenic emissions of CO_2, CH_4 and CO. Additional tagged tracers are used to identify the atmospheric enhancements associated with the different surface fluxes. These flux enhancements can shed light into the potential of new satellites to detect the emission signals in the atmosphere. As satellites observe the mean concentration of carbon tracers over a partial/total atmospheric column, the CHE nature run is also used here to assess the contribution of total column variability from different layers in the atmosphere. We find that the variability in the free troposphere is often dominating the variability of the total column for CO2, CH4 and CO, highlighting the role of long-range transport to represent variability of carbon tracers in the atmosphere, as well as the importance of assessing the accuracy of long-range transport in chemical transport models used in atmospheric inversions.

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