The importance of transport model uncertainties for the estimation of CO2 sources and sinks using satellite measurements

http://www.firstlight.cn 2010-10-22

This study presents a synthetic model intercomparison to investigate the importance of transport model errors for estimating the sources and sinks of CO_2 using satellite measurements. The experiments were designed for testing the potential performance of the proposed CO_2 lidar A-SCOPE, but also apply to other space borne missions that monitor total column CO_2. The participating transport models IFS, LMDZ, TM3, and TM5 were run in forward and inverse mode using common a priori CO_2 fluxes and initial concentrations. Forward simulations of column averaged CO_2 (xCO_2) mixing ratios vary between the models by σ=0.5 ppm over the continents and σ=0.27 ppm over the oceans. Despite the fact that the models agree on average on the sub-ppm level, these modest differences nevertheless lead to significant discrepancies in the inverted fluxes of 0.1 PgC/yr per 10^6 km^2 over land and 0.03 PgC/yr per 10^6 km^2 over the ocean. These transport model induced flux uncertainties exceed the target requirement that was formulated for the A-SCOPE mission of 0.02 PgC/yr per 10^6 km^2, and could also limit the overall performance of other CO_2 missions such as GOSAT. A variable, but overall encouraging agreement is found in comparison with FTS measurements at Park Falls, Darwin, Spitsbergen, and Bremen, although systematic differences are found exceeding the 0.5 ppm level. Because of this, our estimate of the impact of transport model uncerainty is likely to be conservative. It is concluded that to make use of the remote sensing technique for quantifying the sources and sinks of CO_2 not only requires highly accurate satellite instruments, but also puts stringent requirements on the performance of atmospheric transport models. Improving the accuracy of these models should receive high priority, which calls for a closer collaboration between experts in atmospheric dynamics and tracer transport.

存档文本