

Systematic Differences in Global CO₂ Inverse Model Results

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We compared a suite of state-of-the-art global carbon dioxide (CO₂) inverse models to observations to assess the dependence on differences in northern extratropical vertical transport and to identify other drivers of the modelled spread. The posterior CO₂ concentration profiles have been evaluated against the High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER) Pole-to-Pole Observations (HIPPO) aircraft campaign over the mid pacific in 2009-2011. The modelled CO₂ fields agree reasonably well with the HIPPO observations, in particular for the annual mean vertical gradients in the northern hemisphere. The latitudinal distributions of land fluxes have converged significantly since the Atmospheric Carbon Cycle Inversion Intercomparison (TransCom3) and the Regional Carbon Cycle Assessment and Processes (RECCAP) and they are now in close agreement. The results from these models for other time periods (2004-2014, 2001-2004, 1992-1996) confirm that the tropics have been almost neutral for several decades. However, models do still disagree on the ocean-land partitioning, and this is driven by differences in fossil fuel emissions associated with differences in retrieved atmospheric growth rates. The uncertainty on prescribed fossil fuel emissions is large relative to the natural fluxes of interest; the model range is 0.94 PgC/yr in global fossil fuel emissions. The models also retrieve surprisingly different three-year atmospheric growth rates, the model range is 0.65 ppm, or 1.38 PgC over 3 years.

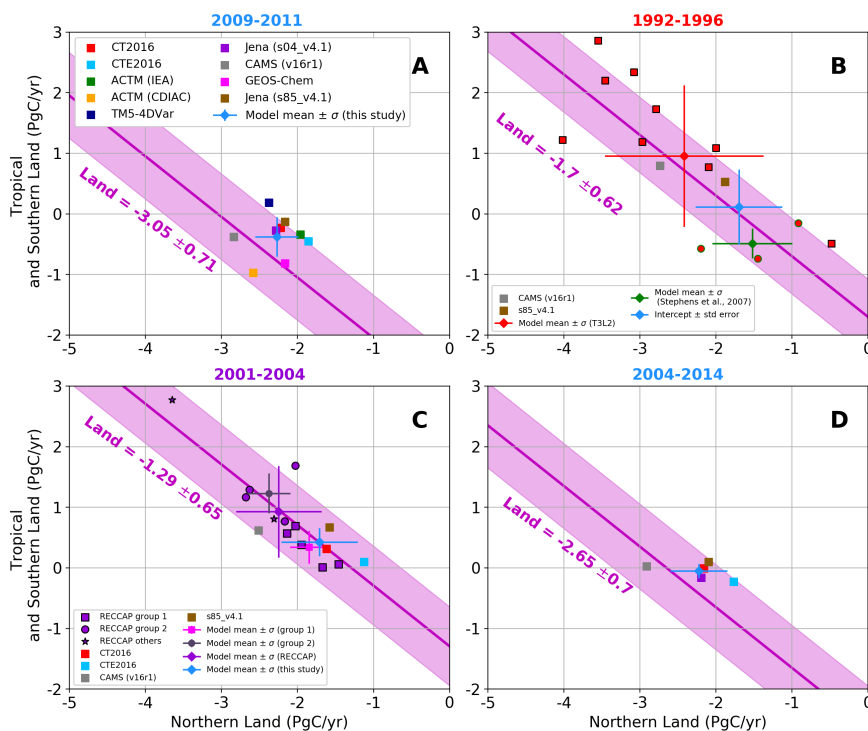


Figure 1. Tropical and Southern versus Northern Extratropical land fluxes for the periods **A)** 1992-1996, **B)** 2001-2004, **C)** 2009-2011 and **D)** 2004-2014. The average of the available simulation with uncertainty (1 standard deviation) is shown in blue with associated error bars. The TransCom Level 3 outputs (Gurney et al. 2004) are shown in red and transport corrected models from (Stephens et al., 2007) in green on panel B (1992-1996). Inversions from the RECCAP period (2001-2004) are also shown on panel C.