Using CarbonTracker-CH_4 to Understand the Recent Methane Budget

L. Bruhwiler, E. Dlugokencky and K. Masarie

NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305; 303-497-6921, E-mail: lori.bruhwiler@noaa.gov

Anthropogenic sources are thought to account for roughly 60% of the global atmospheric methane budget, with natural sources making up about 40%. Emissions from wetlands are the largest contribution from natural sources, while agriculture (rice and ruminants) and waste dominate anthropogenic emissions. Fugitive emissions from fossil fuel extraction are thought to make up about 20% of the global atmospheric methane budget. After declining over the past decades, the global growth rate of methane has started to increase again, and the cause of this trend is not currently understood. Climate-driven increases in wetland emissions likely played a role, especially in the tropics and the Arctic. Anthropogenic emissions as estimated from economic data have also been increasing, especially due to rapidly expanding Asian economies. In this paper we use a state-of-the-art ensemble data assimilation system (CarbonTracker-CH_4) to attribute methane variability and trends to anthropogenic and natural source processes. We pay particular attention to the Arctic, where some recent years have been the warmest on record, and to the tropics and the potential role of ENSO in driving variability of wetland emissions. Finally, we explore whether a signal in anthropogenic emissions is present in the atmospheric network observation, and whether it is present in flux estimates from the methane assimilation. We find that high latitude and tropical wetland emission anomalies are readily identified by the assimilation, however, changes in Asian anthropogenic emissions are still difficult to estimate using the assimilation because of the sparseness of the global network. This highlights the importance of increased surface observations as well as the possible use of space-based observations.

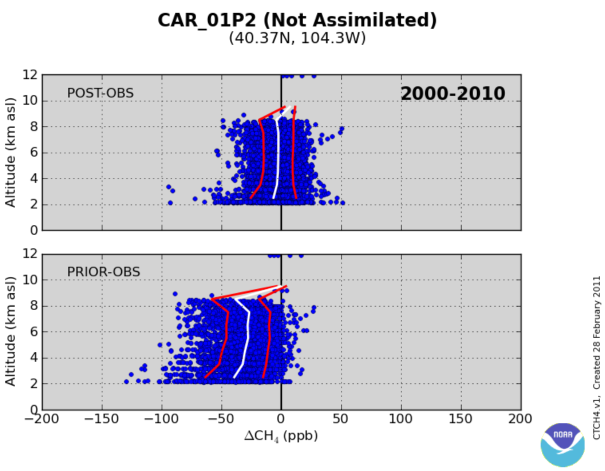

Figure 1. Difference between modeled and measured methane for profiles measured at Carr, CO for the prior (bottom) and posterior (top) flux estimates. The white line shows the average difference for each altitude and the red lines show the 1-sigma confidence bounds.

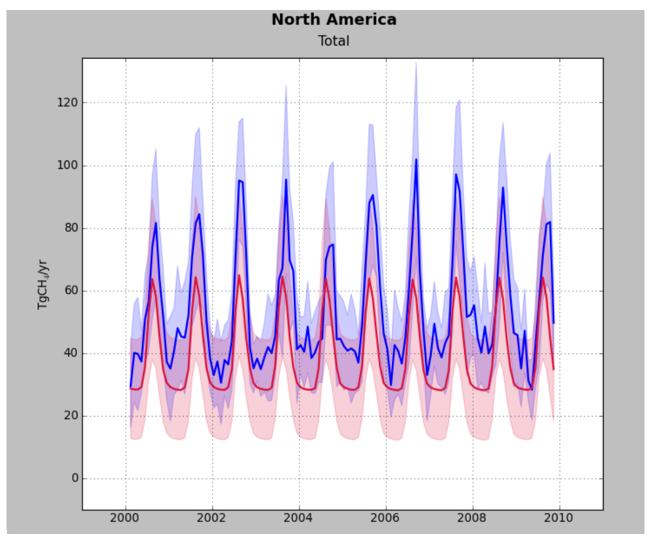

Figure 2. The estimated total methane flux for North America. The dark blue line shows the posterior flux estimates with 1-sigma confidence bounds in light blue. The dark red line is the prior flux estimate and the light red area is the 1-sigma error bounds of the prior flux uncertainty.