Comparing national methane emission inventories with estimates by global high-resolution inverse model

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Introduction

Atmospheric methane (CH_4) plays a growing role in anthropogenic climate change. Reduce methane emissions have visible contributions to climate change mitigation in a shorter time scale. There is still a challenge to verify the accuracy of the amount of methane emission from different countries, which is essential to methane reduction policy and measures. We present the estimation of global and regional methane emissions with two sets of emission inventories including different anthropogenic emissions using global 0.1° × 0.1° high spatial resolution inverse model NIES-TM-FLEXPART-VAR (NTFVAR), one case with anthropogenic emissions from EDGARv4.3.2 emission inventory, the other with anthropogenic emissions from EDGARv4.3.2 scaled to the UNFCCC national reports matching country totals.

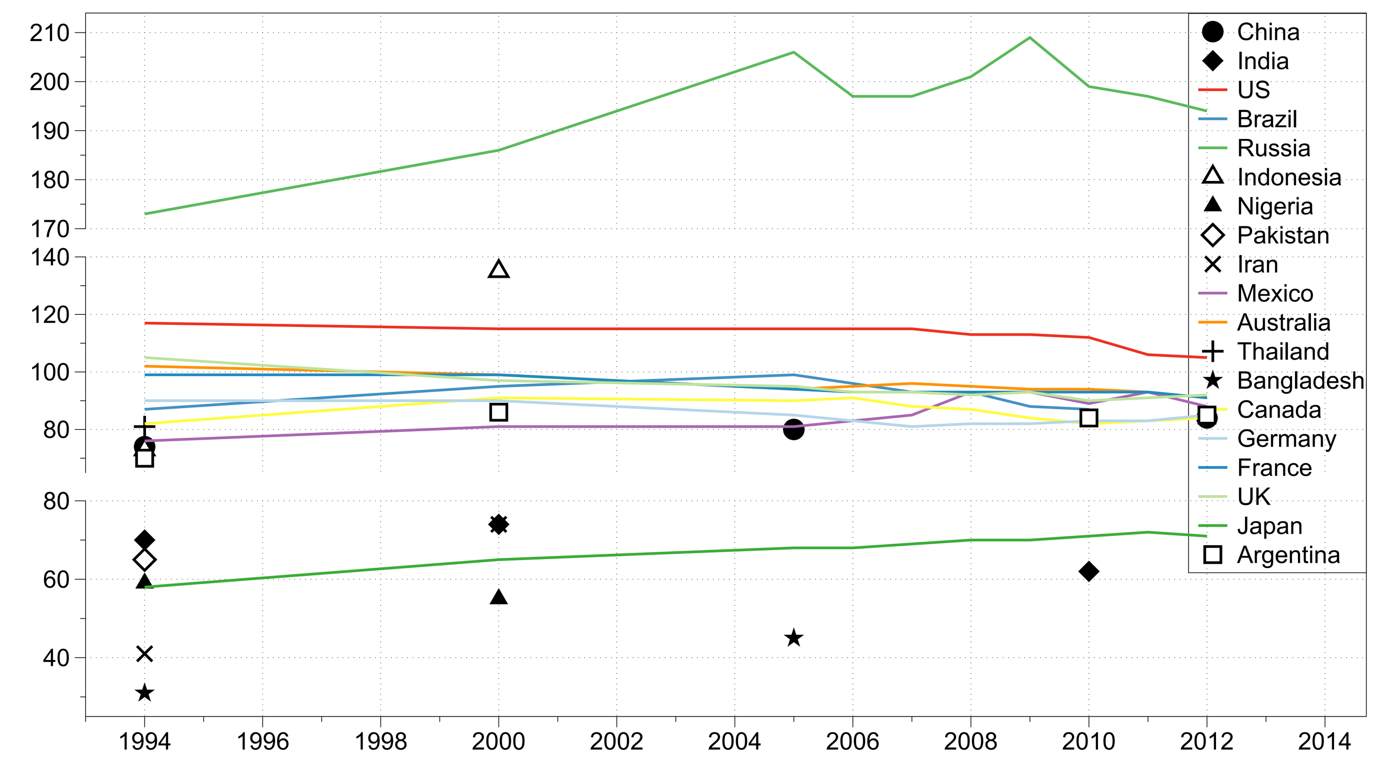

Figure 1 Anthropogenic methane emissions comparison between national reports to the UNFCCC and EDGARv4.3.2. The top 15 emitting countries (based on the amount of emissions in the year 2012) and big countries like Germany, France, UK and Japan are presented.

Methods

Variational inverse modeling system NTFVAR is based on NIES-TM transport model (resolution 2.5° × 2.5°) and FLEXPART model (resolution 0.1° × 0.1°). Model model details are presented in Belikov et al. (2016) and Shirai et al. (2017). Prior emissions include anthropogenic emissions (case S0: EDGARv4.3.2, case S1: EDGARv4.3.2 scaled to the UNFCCC reports), Biospheric emissions (VISIT), Biomass burning (GFASv1.2). Ground CH_4 observations from WDGCC and NIES. The new gridded emission inventory based on the UNFCCC reports is estimated using the scaling of country annual total to EDGAR inventory by equation (1).

$$E_{UNFCCC}(t) = E_{EDGARv4.3.2}(t)\times\frac{1}{n}\sum_{k=1}^{n}\left(\frac{E_{UNFCCC}(i)}{E_{EDGARv4.3.2}(i)}\right) \qquad (1)$$

The scale of anthropogenic corrections ($CORR_{an}$) to multi-annual average EDGAR priors and natural corrections ($CORR_{vcw}$) to multi-annual average VISIT priors are defined by (2), (3).

$$scale = CORR_{an}/EDGAR_{2008-2012} \qquad (2)$$

$$scale = CORR_{vcw}/VISIT_{2008-2013} \qquad (3)$$

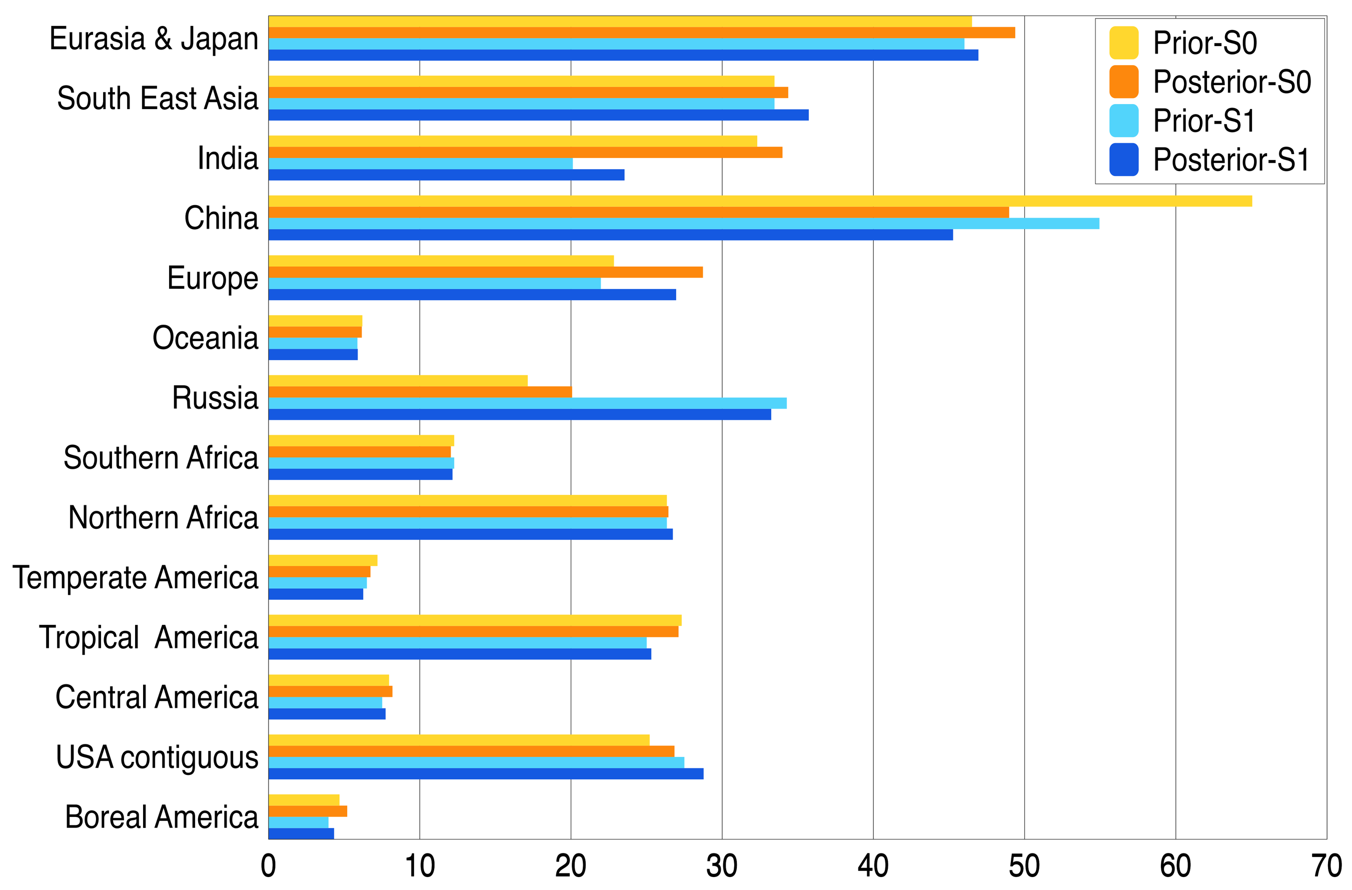

Figure 2 Regional anthropogenic methane emissions.

Results

The ratio of the global anthropogenic methane emission of case S0 to that of case S1 is 98%, varying by regions, from 200% in Russia to 84% in China and 62% in India. The optimized global total methane emissions are similar but various in regions. The most distinct changes are in Russia, as shown in Figure 2, the anthropogenic prior doubled from 17 to 33 Tg CH_4 yr^{-1}, the posteriors increase from 20 to 32.8 Tg CH_4 yr^{-1}, and the correction rate changes from 19% to -2%, which might imply more accurate estimation by national report compared to the underestimated EDGARv4.3.2 emissions.

Case S0 obtains obvious increase of anthropogenic emissions in central Europe, Russia and the contiguous USA, larger area of decrease in east China (Figure 3(b)) compared to case S1 (Figure 4(b)). Natural emissions of case S1 (Figure 4(d)) show more increase in the Amazon area, more decrease in the Siberia area and boreal America compared to that of S0 (Figure 3(d)).

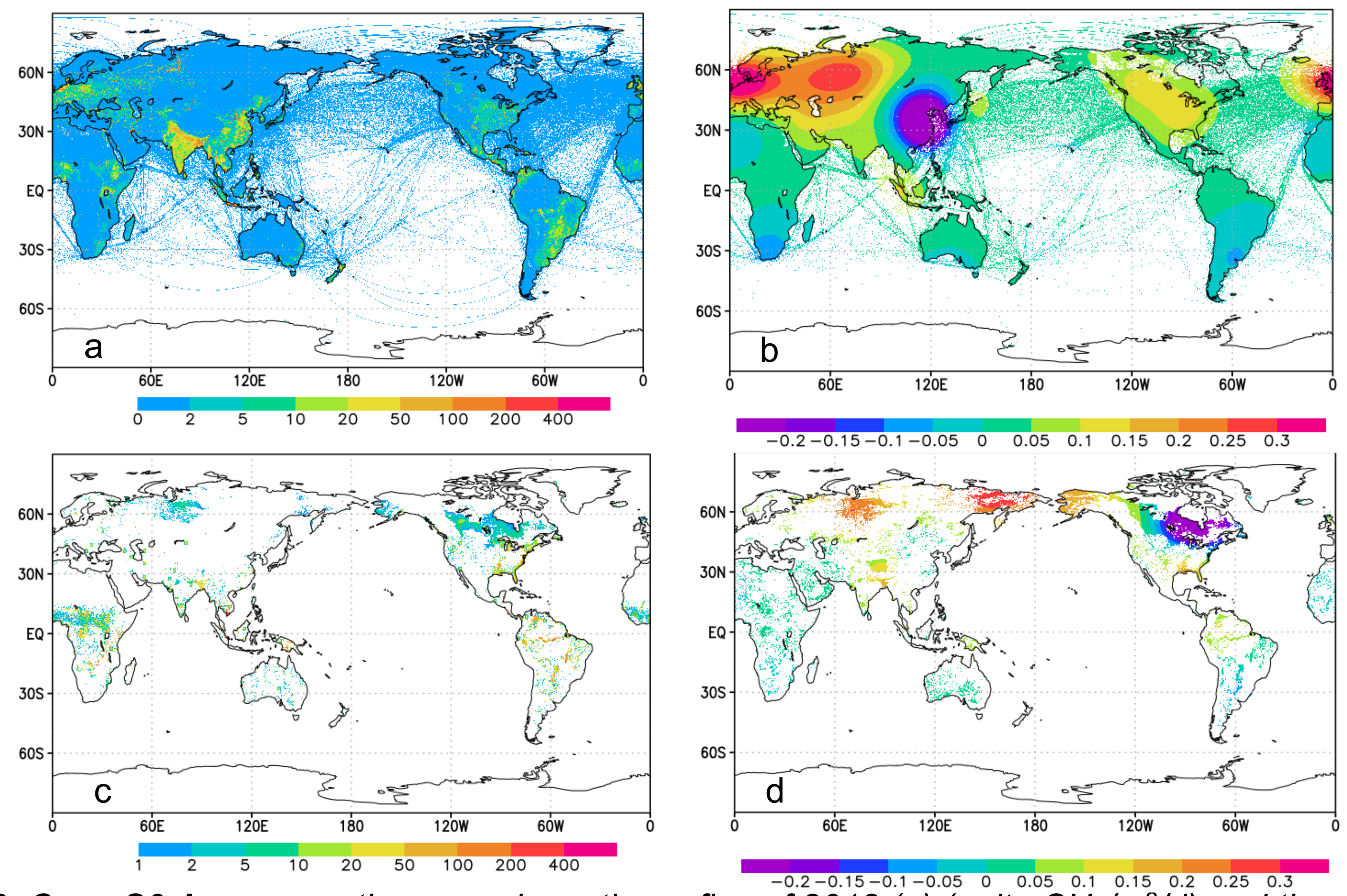

*Figure 3 **Case S0** Average anthropogenic methane flux of 2012 (a) (unit $gCH_4/m^2/d$) and the scale (b), average natural CH_4 flux of 2012 (c) (unit $gCH_4/m^2/d$) and the scale (d).*

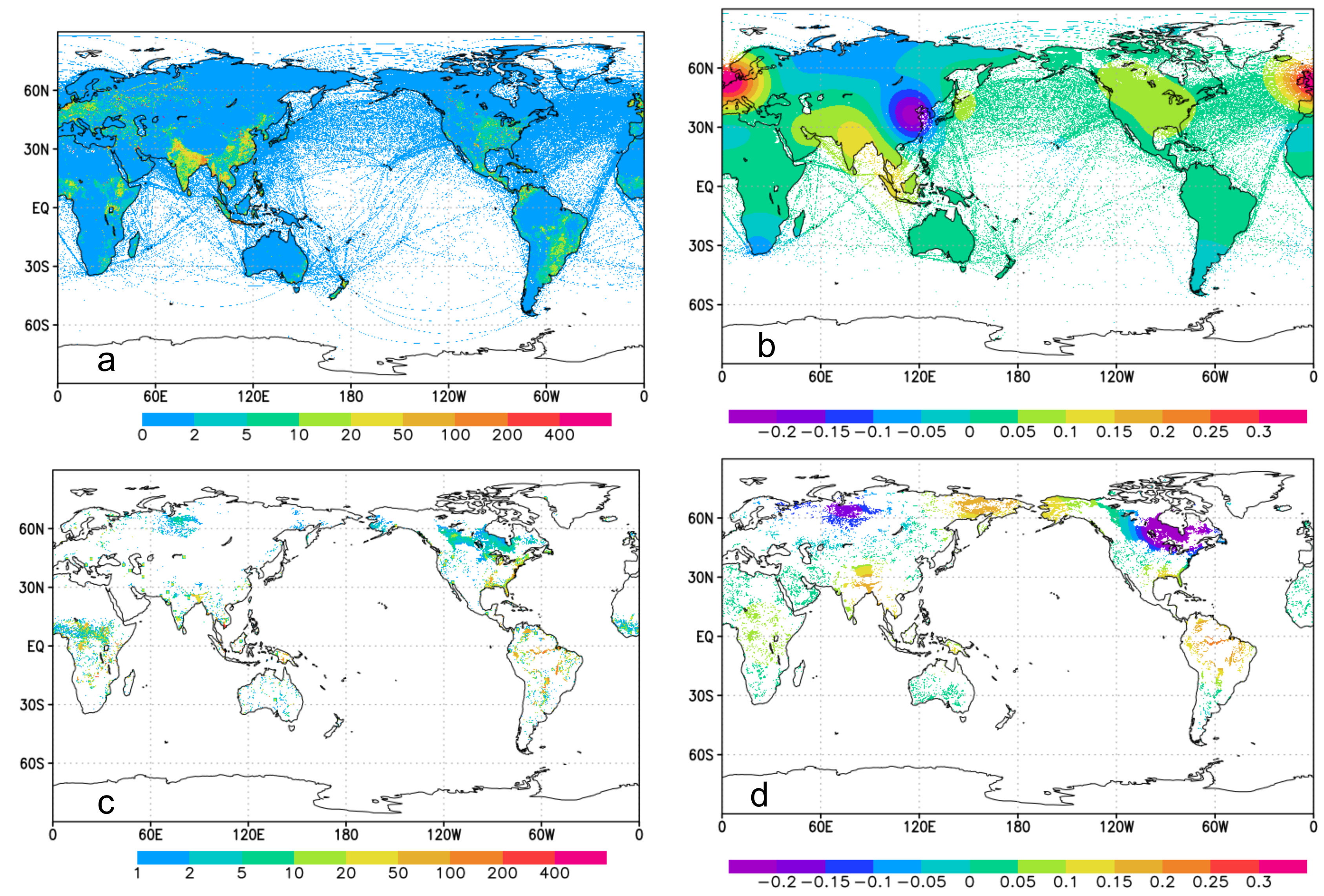

*Figure 4 **Case S1** Average anthropogenic methane flux of 2012 (a) (unit $gCH_4/m^2/d$) and the scale (b), average natural CH_4 flux of 2012 (c) (unit $gCH_4/m^2/d$) and the scale (d).*

References

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