Isoprene emissions over Australia

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Abstract.

1 Introduction

Emissions of isoprene may be overestimated in Australia. One of the most popular emissions inventories for biogenic isoprene, the Model of Emissions of Gases and Aerosols from Nature (MEGAN) is poorly calibrated for Australian conditions. **?** compared MEGANv2 against emissions calculated using top down estimates from the GOME2 satellite measurements of formaldehyde. **?** showed that this overestimate may be a factor of 2-3 in January. **?** show how 50% of the isoprene emissions could be reduced by accounting for lower soil moisture. **?** discuss the suitability of MEGAN's isoprene and monoterpene emission factors over southeast Australia, and suggest ...TODO:

2 Data and Model

3 Methods

3.1 GEOS-Chem simulation

The GEOS-Chem global atmospheric chemistry model (V10.01) simulates and records up to 66 chemical species (tracers) in the standard run, at 2 by 2.5° horizontal resolution, with 47 levels up to the top of the atmosphere (TOA at 0.01 hPa). Output for an area averaged over 1200 - 1400 local time can be saved for comparison and recalculation with satellite overpass records. GEOS-5 meteorological fields from NASA's ...(TODO: ref and note) are used to drive transport and coupled with the chemical module of GEOS-Chem.

3.2 Recalculation of OMI HCHO

3.3 Calculation of Emissions

As is done in **???**, we assume that HCHO, and Isoprene columns are in a steady state, with no horizontal transport. In these circumstances the emissions of precursors are easy to calculate as long as we know the molar HCHO yields (Y_i) and effective

chemical loss rates (k_i):

$$\Omega_{HCHO} = \frac{1}{k_{HCHO}} \Sigma_i k_i Y_i \Omega_i = \frac{1}{k_{HCHO}} \Sigma_i Y_i E_i \quad (1)$$

We can infer the local (grid space) isoprene emissions (E_{isop}) using effective formaldehyde yield from isoprene (Y_{isop}).

$$\Omega_{HCHO} = S \times E_{isop} + B \quad (2)$$

Where B is the background HCHO, and $S = Y_{isop}/k_{HCHO}$ is determined monthly as the regression between Ω_{HCHO} and E_{isop} on daily saved outputs from GEOS-Chem over Australia using 2 by 2.5° horizontal resolution.

This gives us a monthly value for Y_i resolved to our 2° by 2.5° horizontal resolution, which is entirely based on the model. Using our measurements of the biogenic HCHO column ($\hat{\Omega}_{HCHO}$) recalculated from the OMI satellite product, we use this derived yield and the same formula to determine our new top-down emissions estimates. Figure 1 shows the modelled isoprene emissions and column HCHO concentrations along with the RMA regression line, sampled from grid boxes over Australia for January 2005. Some affects from the low emissions in grid boxes which are largely oceanic can be seen and are handled by TODO: handle these and document here.

Modeled background emissions are ignored as they do not affect the calculation of the modeled slope. The OMI background is calculated from the averaged column amounts over the remote pacific (15° S to 15° N, 175 to 120° W) However, when calculating the E_{isop} from our modeled slope with OMI HCHO and background, we end up with negative emissions wherever the OMI HCHO column is less than the OMI background (as $E_{isop} = \frac{\Omega_{HCHO} - B}{S}$).

Using this modelled slope at 2° by 2.5° and applying it to equation 2 with B and Ω_{HCHO} calculated using OMI satellite measurements provides a new estimate of isoprene emissions. Figure TODO: **??** shows the emissions calculated this way along with the Emissions output by GEOS-Chem averaged over January, 2005.

4 Results

5 Conclusions

Author contributions.

Competing interests. The authors declare that they have no conflict of interest.

Data availability. All GEOS-Chem model output is available from the authors upon request.

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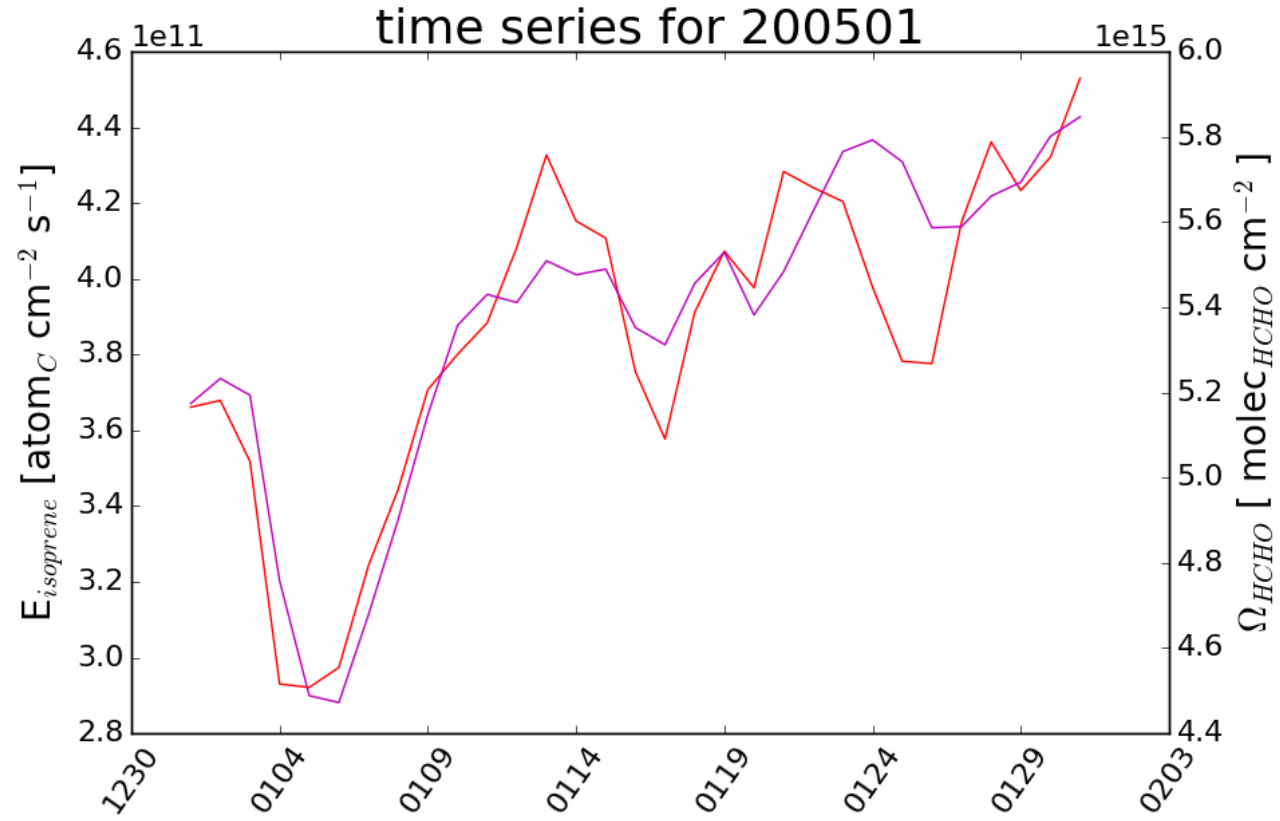
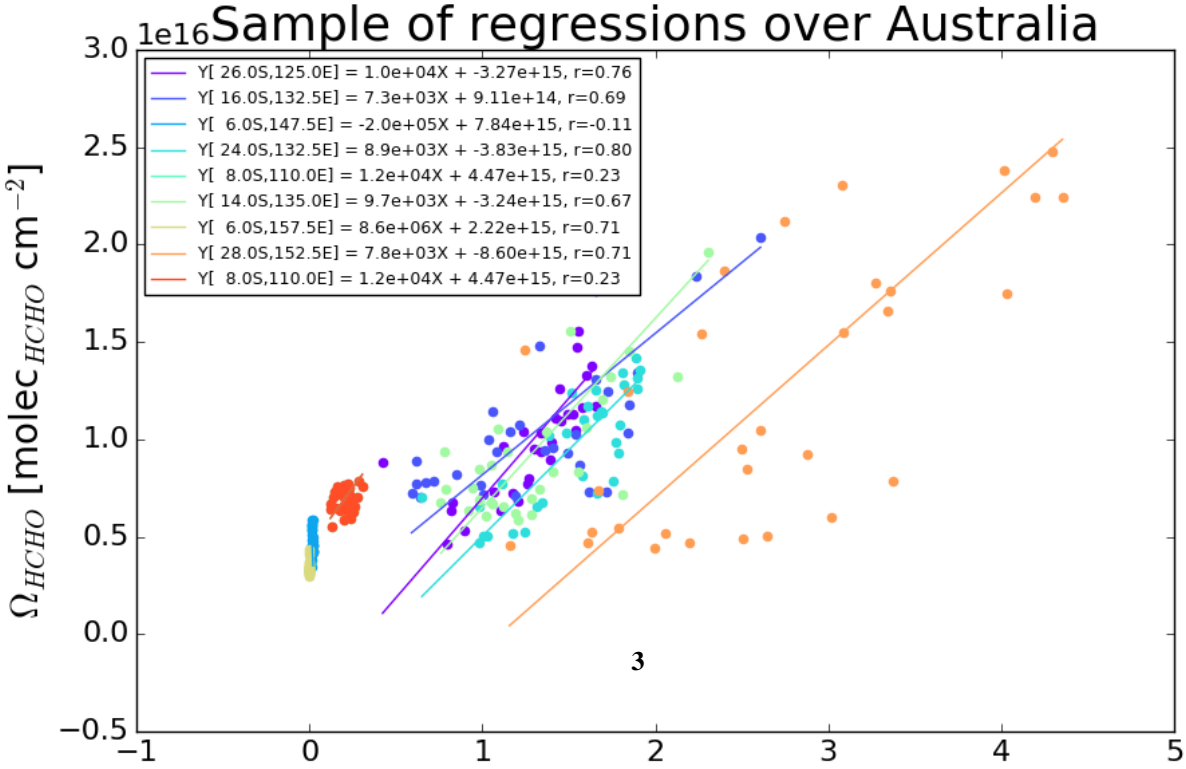

time series for 200501
1e11
1e15
$E_{isoprene}$ [atom$_C$ cm^{-2} s^{-1}]
Ω_{HCHO} [molec$_{HCHO}$ cm^{-2}]
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
1230
0104
0109
0114
0119
0124
0129
0203


Sample of regressions over Australia
1e16
Ω_{HCHO} [molec$_{HCHO}$ cm^{-2}]
Y[26.0S,125.0E] = 1.0e+04X + -3.27e+15, r=0.76
Y[16.0S,132.5E] = 7.3e+03X + 9.11e+14, r=0.69
Y[6.0S,147.5E] = -2.0e+05X + 7.84e+15, r=-0.11
Y[24.0S,132.5E] = 8.9e+03X + -3.83e+15, r=0.80
Y[8.0S,110.0E] = 1.2e+04X + 4.47e+15, r=0.23
Y[14.0S,135.0E] = 9.7e+03X + -3.24e+15, r=0.67
Y[6.0S,157.5E] = 8.6e+06X + 2.22e+15, r=0.71
Y[28.0S,152.5E] = 7.8e+03X + -8.60e+15, r=0.71
Y[8.0S,110.0E] = 1.2e+04X + 4.47e+15, r=0.23
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1
0
1
2
3
4
5

References