

Using BEAR resources to interpret information from NASA satellite products

**Challenge:**

Use observations made on-board the NASA DC8 research aircraft and a chemical transport model to interpret information from new products of upper tropospheric nitrogen dioxide ( $\text{NO}_2$ ).

**Background:**

Nitrogen oxides ( $\text{NO}_x \equiv \text{NO} + \text{NO}_2$ ) in the upper troposphere (altitude: 8-12 km) have profound effects on the composition of the atmosphere and on climate, but the factors controlling their concentrations are poorly understood. We use two new satellite products of upper tropospheric  $\text{NO}_2$ , together with aircraft measurements and the GEOS-Chem chemical transport model, to assess current understanding of upper tropospheric  $\text{NO}_x$  sources. The satellite products are obtained by researchers at NASA and KNMI using observations from the Ozone Monitoring Instrument (OMI) onboard the NASA Aura satellite.

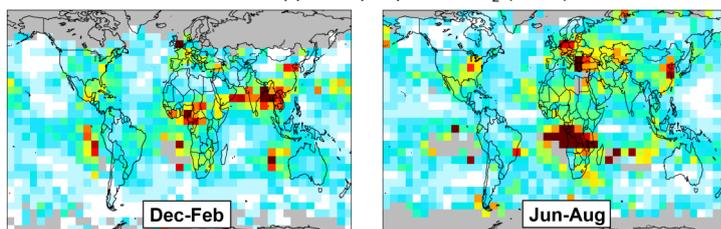
**Results and Implications:**

We find that the NASA product is more consistent with aircraft observations than the KNMI product and that the NASA product can only offer useful information at very coarse scales: seasonal averages at  $20^\circ \times 32^\circ$  ( $\sim 2000 \text{ km} \times 3200 \text{ km}$ ). Correlation with satellite observations of lightning flash frequencies shows that lightning is the dominant source of  $\text{NO}_x$  to the upper troposphere everywhere except the extratropical latitudes in winter. We infer a global lightning  $\text{NO}_x$  source of 5.6 Tg  $\text{NO}_x$  per year and show that the amount of  $\text{NO}_x$  generated per flash increases with the footprint (surface area) and energy of lightning flashes.

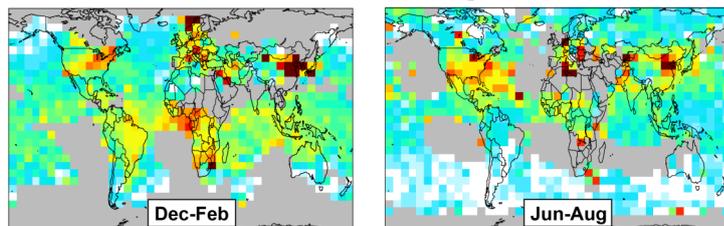
**Publication Details:**

E. A. Marais, D. J. Jacob, S. Choi, J. Joiner, M. Belmonte-Rivas, R. C. Cohen, S. Beirle, L. T. Murray, L. Schiferl, V. Shah, L. Jaeglé, Nitrogen oxides in the global upper troposphere: interpreting cloud-sliced  $\text{NO}_2$  observations from the OMI satellite instrument, Atmospheric Chemistry and Physics, doi:10.5194/acp-2018-556, in review, 2018.

KNMI OMI upper troposphere  $\text{NO}_2$  (2006)



NASA OMI upper troposphere  $\text{NO}_2$  (2005-2007)



Case study



**Client Profile**

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**Products Used:**

Fortran, Intel compiler, IDL, Slurm scheduler, Unix, Broadwell node, GEOS-Chem model

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Submitted: 25 July 2018

