Using EO to Monitor Air Quality and Address Uncertainties in Atmospheric Composition

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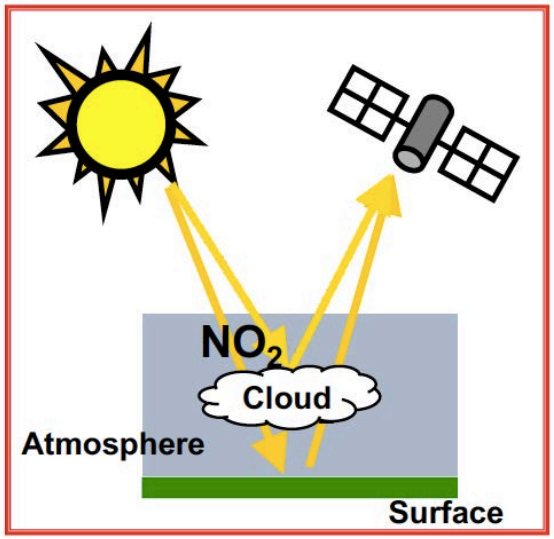
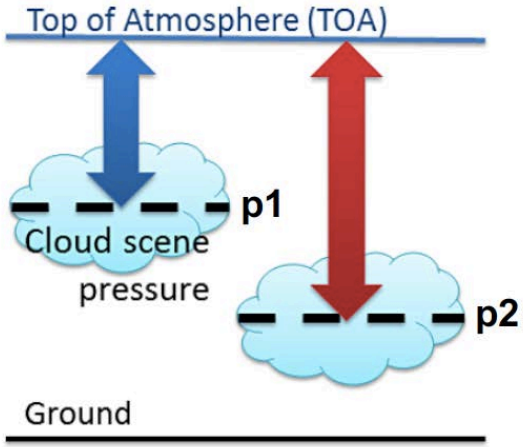
Upper troposphere NO_x

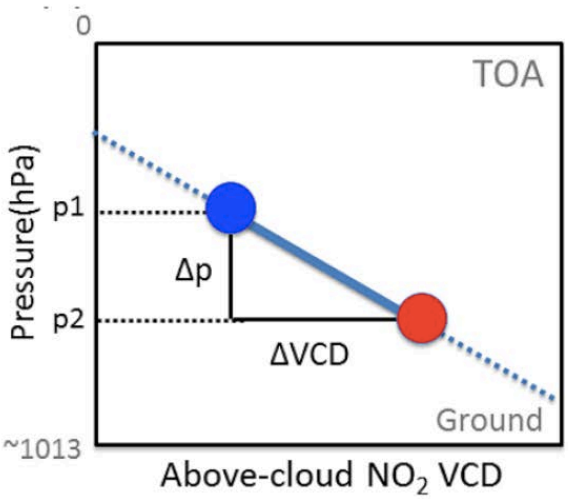
New satellite products of upper tropospheric NO_2

APPROACH



Use cloud height variability to derive pseudoprofiles





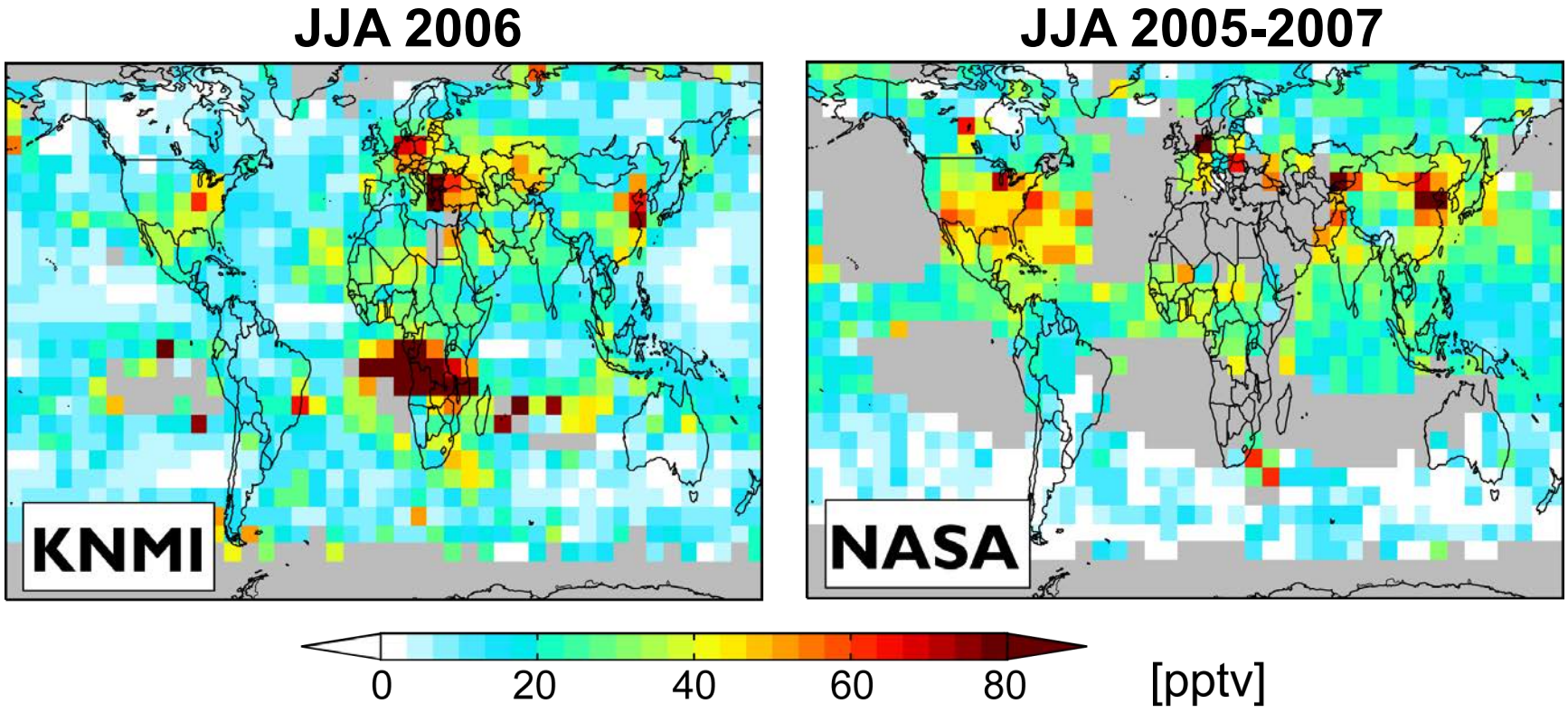
[Choi et al., 2014]

NO_2 volume mixing ratio (VMR) between clouds at p1 and p2

$$NO_2\ VMR = \frac{\Delta VCD}{\Delta p} \times \frac{k_B g}{R_{air}}$$

Upper troposphere NO_x

New satellite products of upper tropospheric NO_2



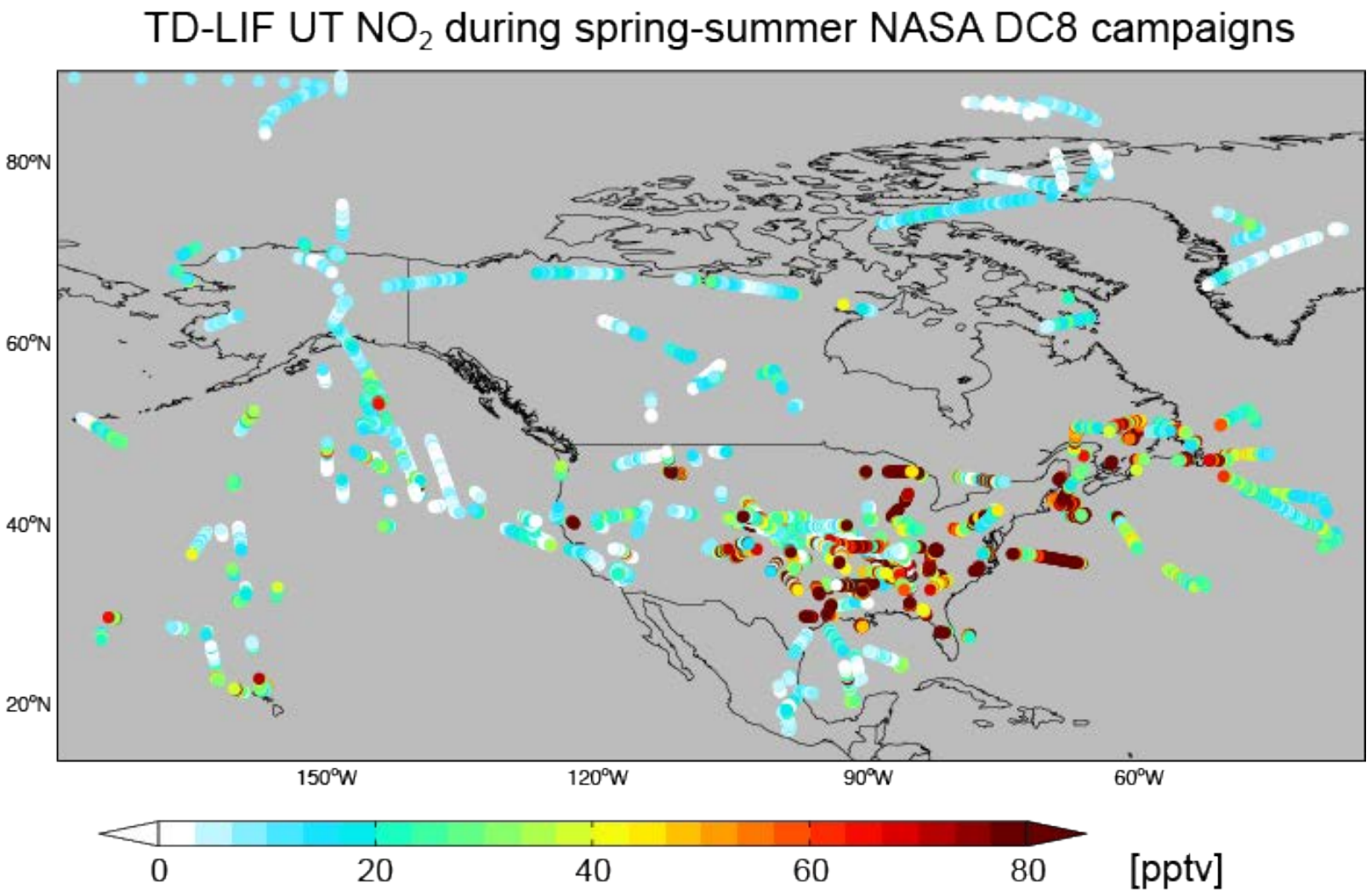
Which is correct?

What can we learn?

With D. J. Jacob, S. Choi, J. Joiner, M. Belmonte-Rivas, R. C. Cohen, S. Beirle, L. T. Murray, L. Schiferl, V. Shah, L. Jaeglé

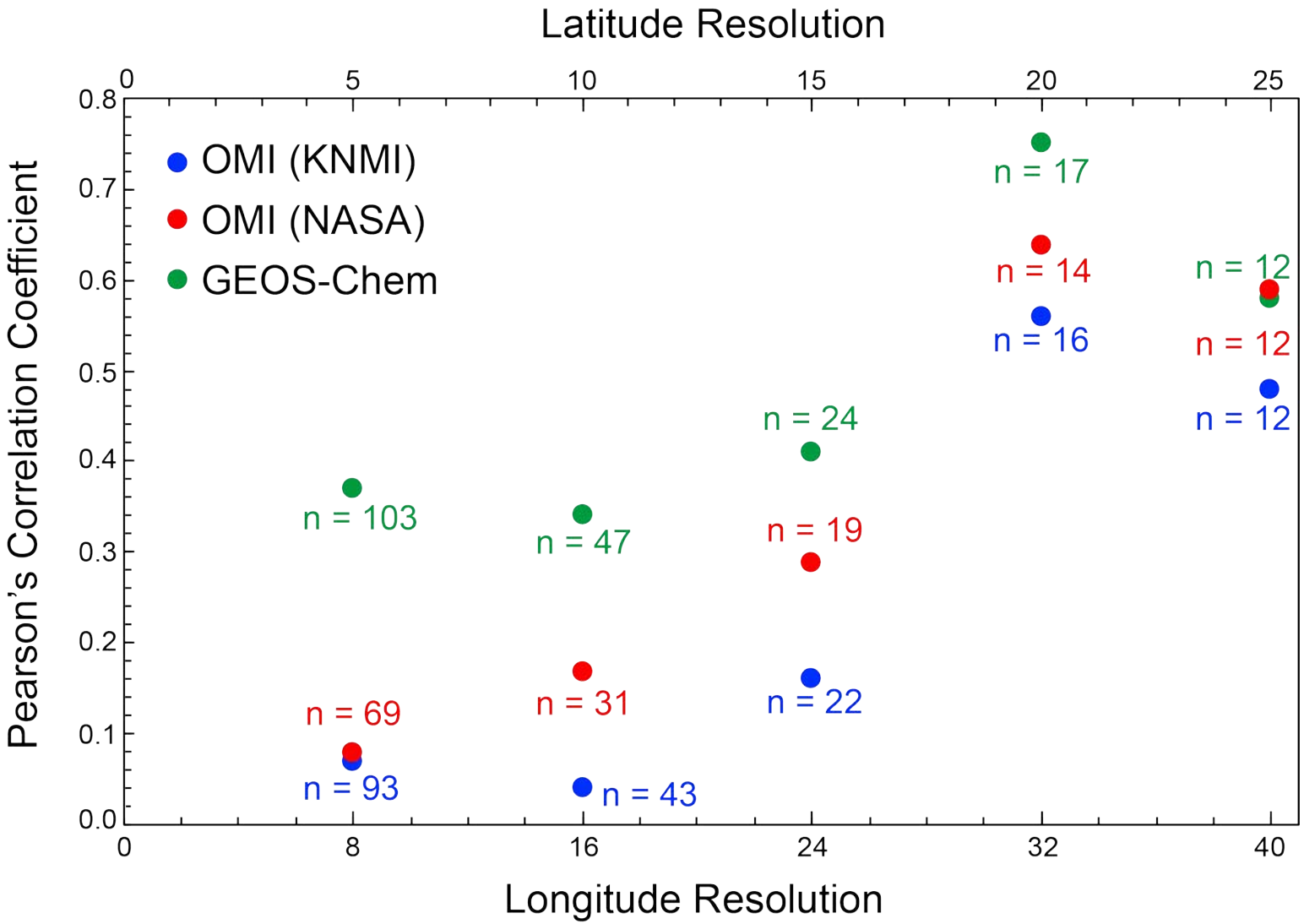
Upper troposphere NO_x

Use aircraft observations to arbitrate



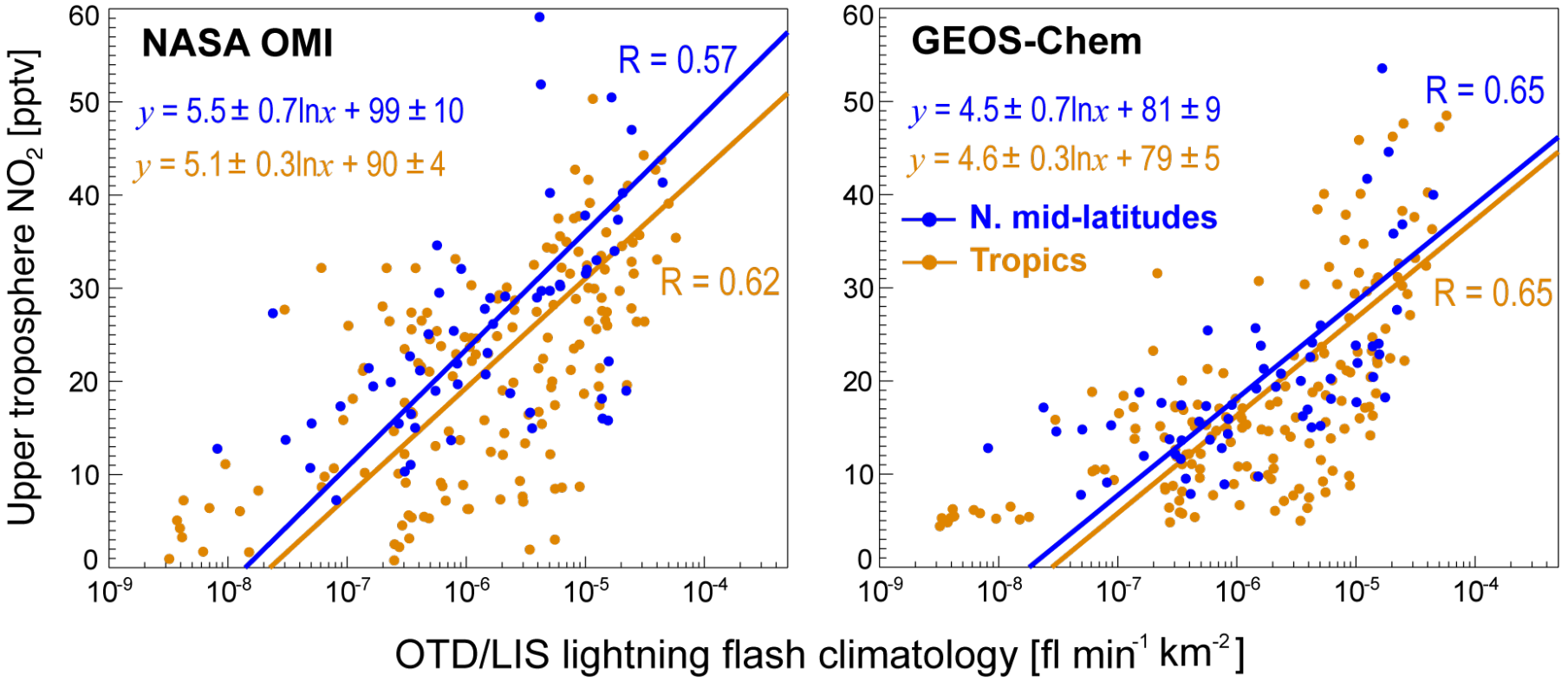
Arbitration with Aircraft Observations

New satellite products of upper tropospheric NO_2



Upper troposphere NO_x sources

New satellite products of upper tropospheric NO_2

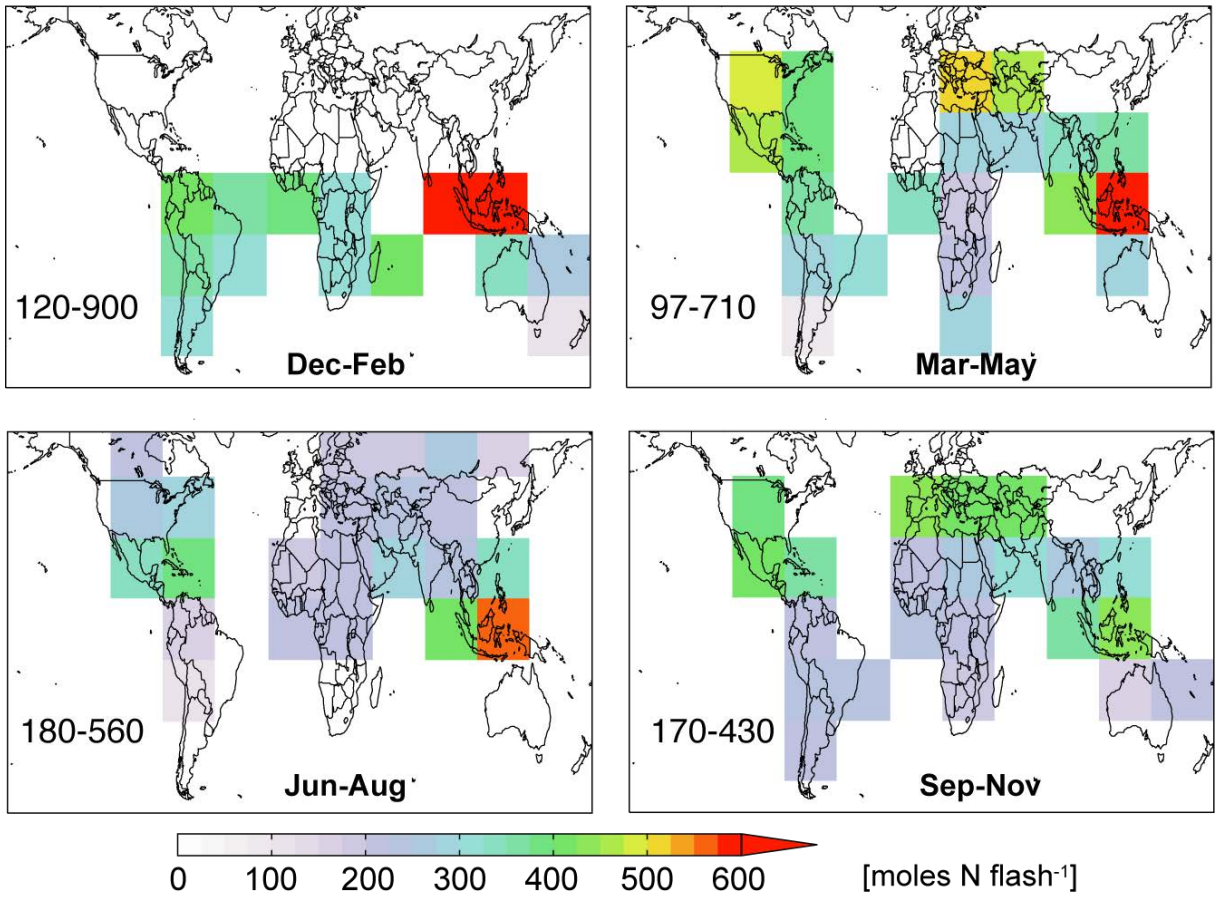


Variability in upper troposphere NO_2 dominated by lightning

OMI-derived lightning NO_x production rates

Improved constraints on lightning NO_x

OMI-derived seasonal mean lightning NO_x production rates



Global mean lightning NO_x production rate: **280 mol N per flash**

Global lightning NO_x emissions: **5.6 Tg N a^{-1} (2006)**

Air Pollution and Green Space Monitoring in Cities

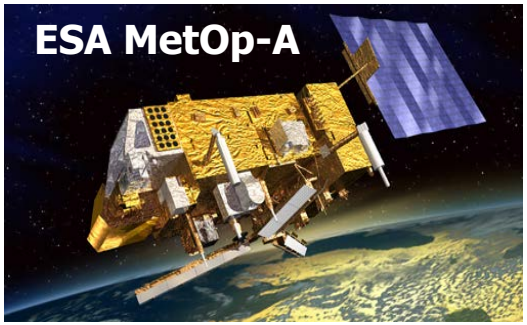
TRACE

Tool for Recording and Assessing the City Environment

With **K.Vohra** (**PhD student**), P. Porter, W. J. Bloss, Defra, Ricardo

Long record of diverse observations

12+ years of air pollutants and vegetation dynamics from NASA and ESA satellites



HCHO NO_2 SO_2 | NH_3 | CO AOD LAI EVI

○ Air pollutants regulated by EU

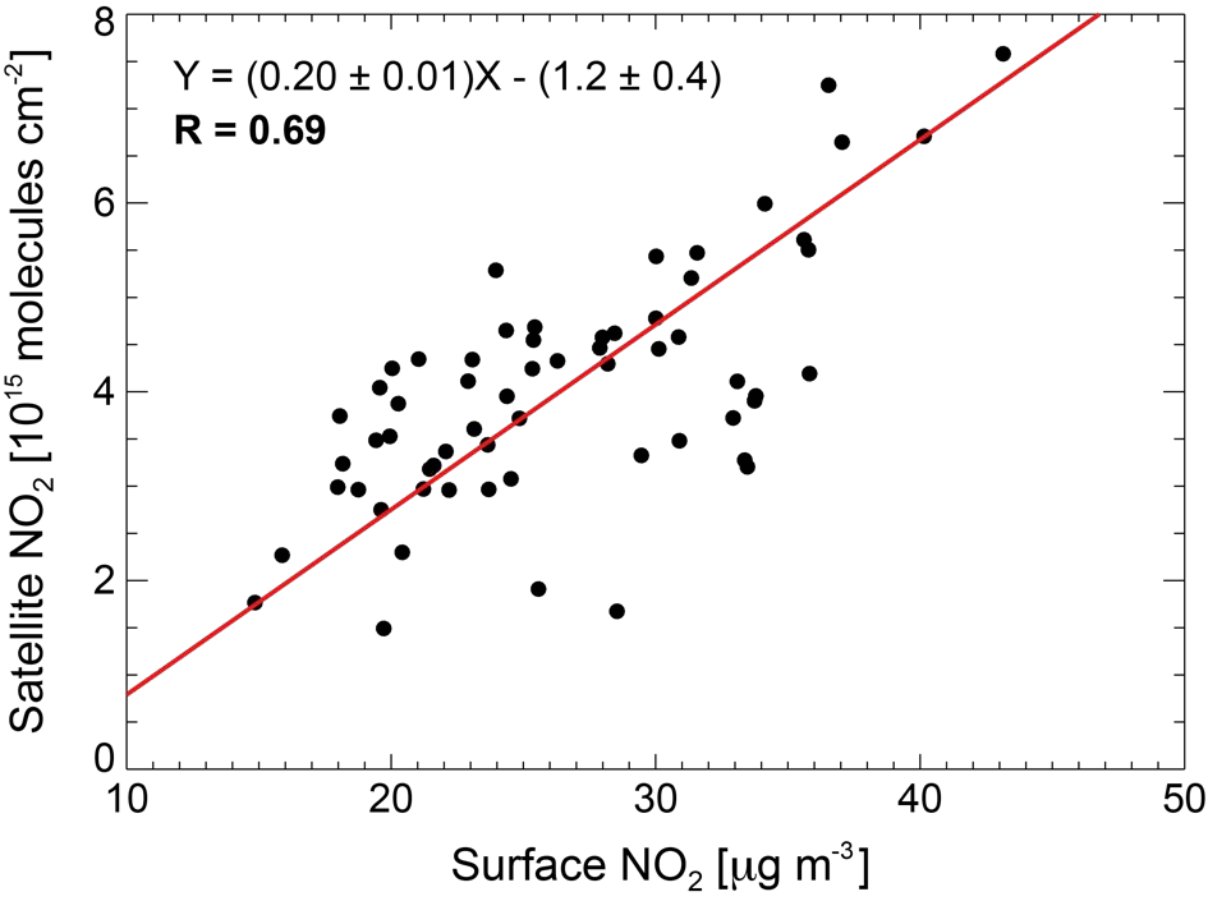
○ Constraints on regulated air pollutants

○ Vegetation extent/cover

○ Vegetation greenness

Product Validation

EO versus surface NO_2 observations

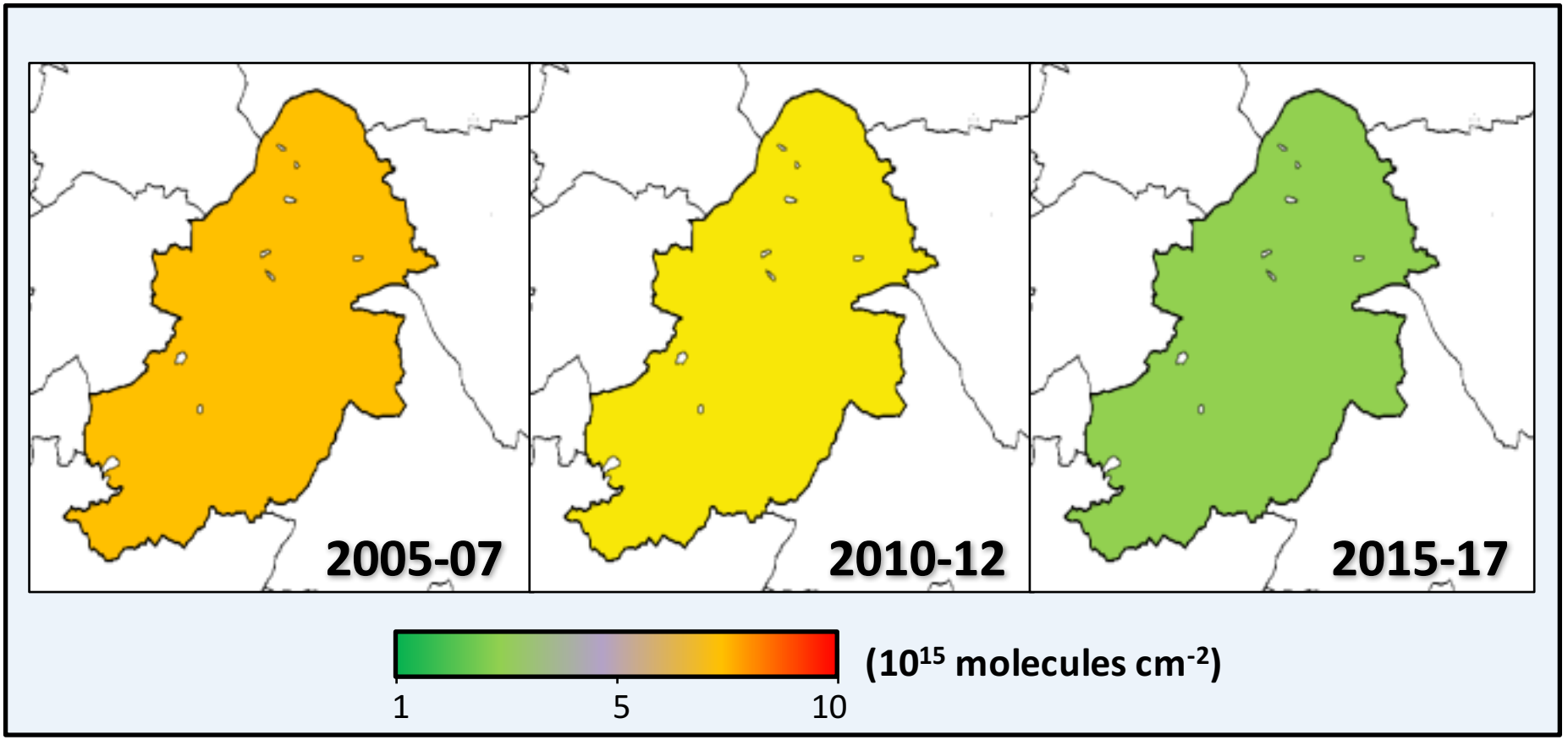


Consistent month-to-month variability

Data analysis by **Karn Vohra**, PhD student at UoB

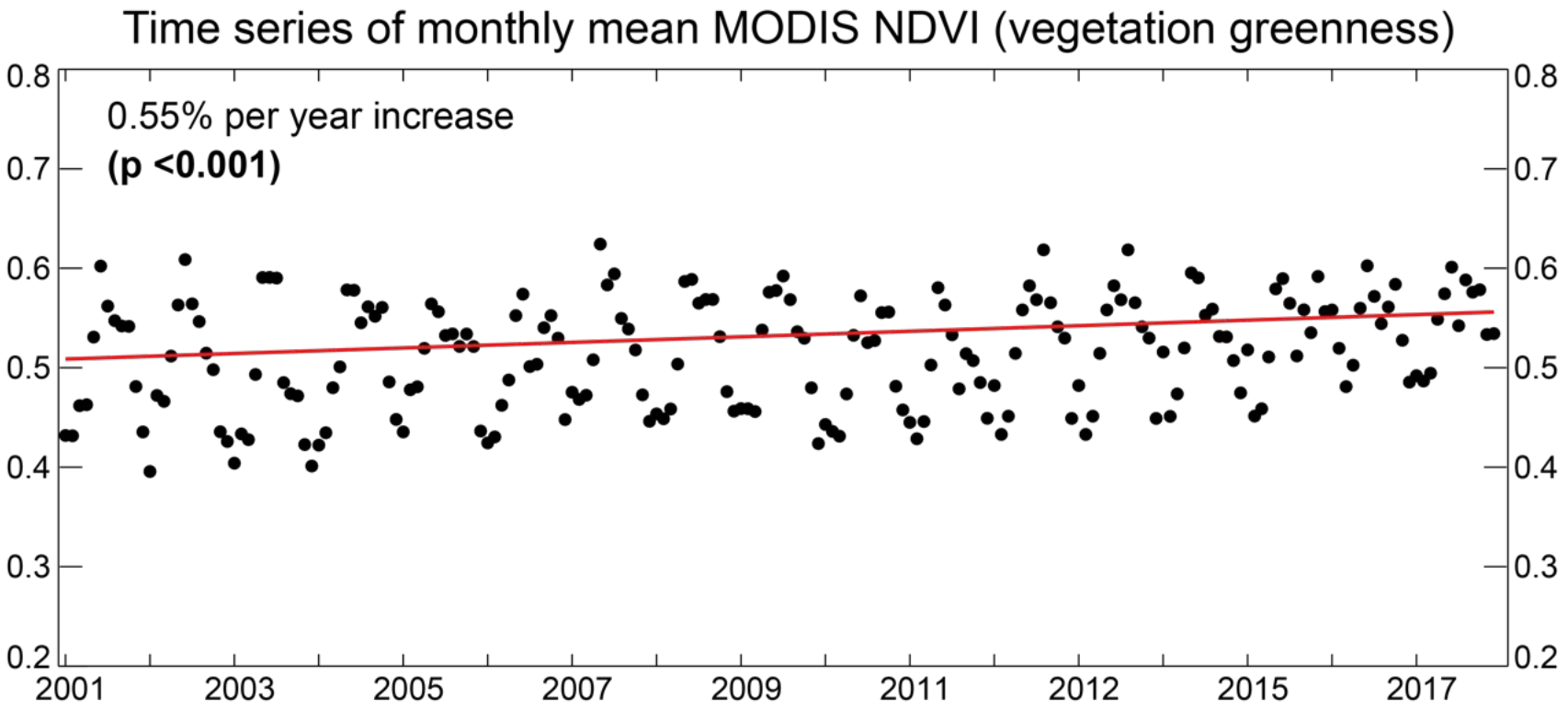
City-Wide Air Pollution Trends

City-wide decrease in NO_2 of 39%



EU annual mean NO_2 standard
40 μg m^{-3} ≡ 6 × 10^{15} molecules cm^{-2}

City-Wide vegetation greenness trends



Significant seasonal trends: **1.1%** per year (**winter**), **0.61%** per year (**autumn**)

Implications for health of green spaces and ability to sequester carbon (climate change)

Shameless Plug(s)

NCEO Conference, Birmingham 2018. Chairing a session on EO Application to City Sustainability **(abstract deadline: 8 June)**

AGU meeting, Washington DC. Chairing a session on Emerging Air Quality Issues in Africa (co-chairs: Guy Brasseur, Christine Wiedinmyer)