Assessing surface ozone sensitivity in major Indian cities to NO_X and VOCs using TROPOMI

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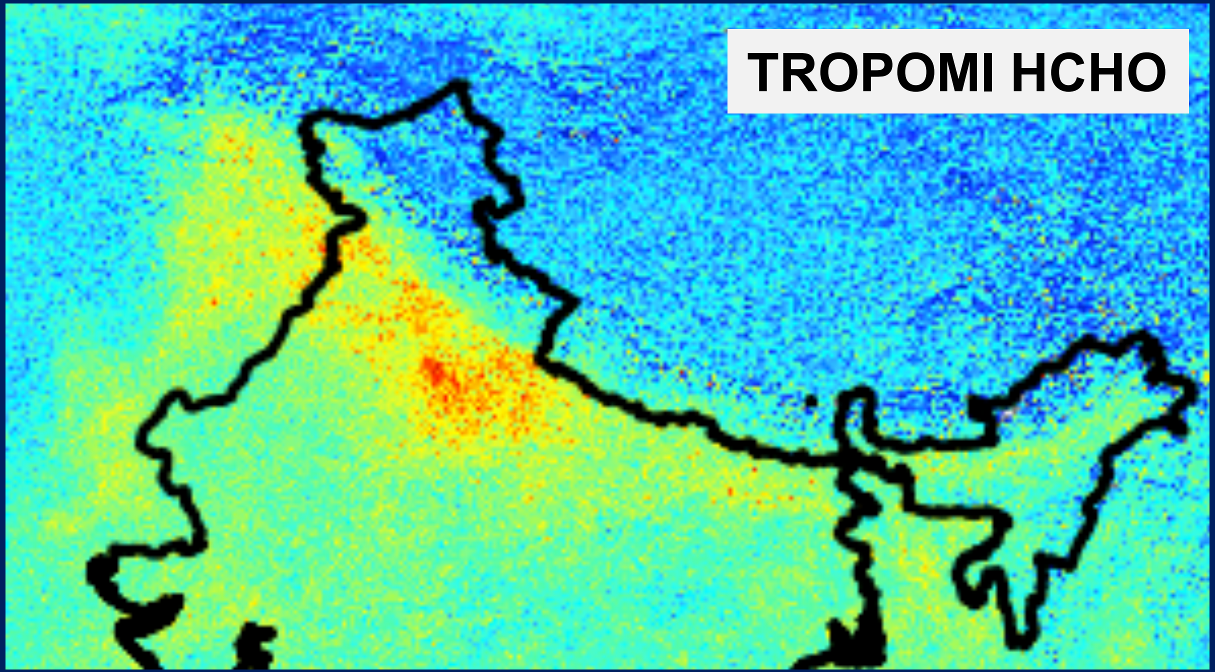

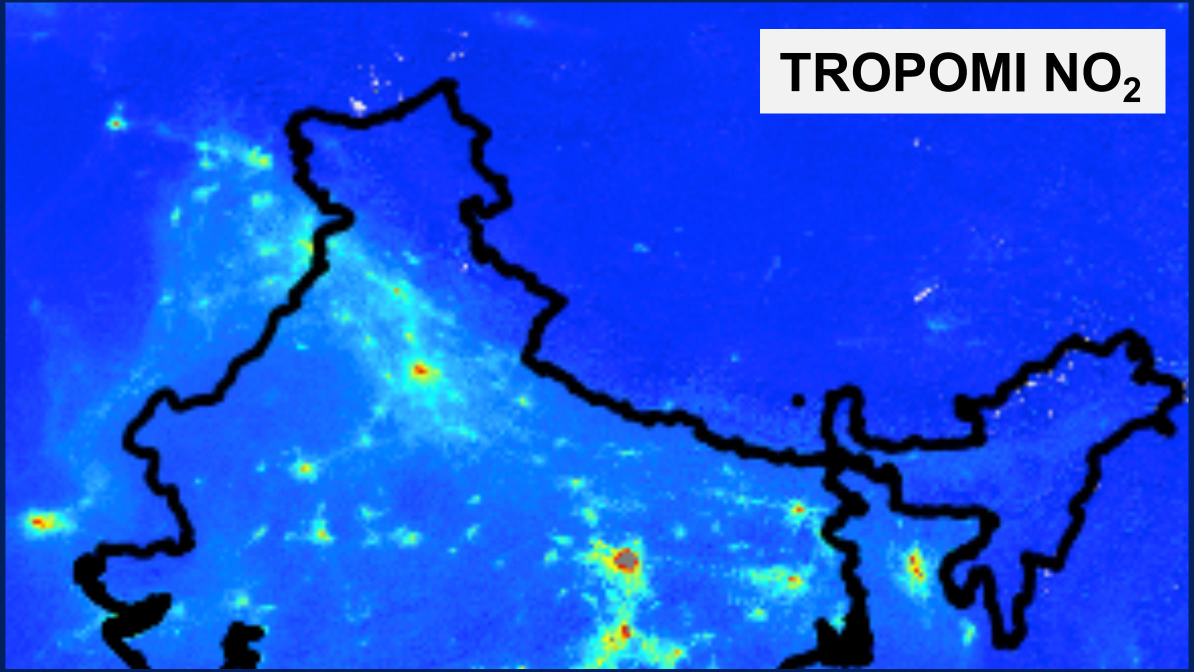

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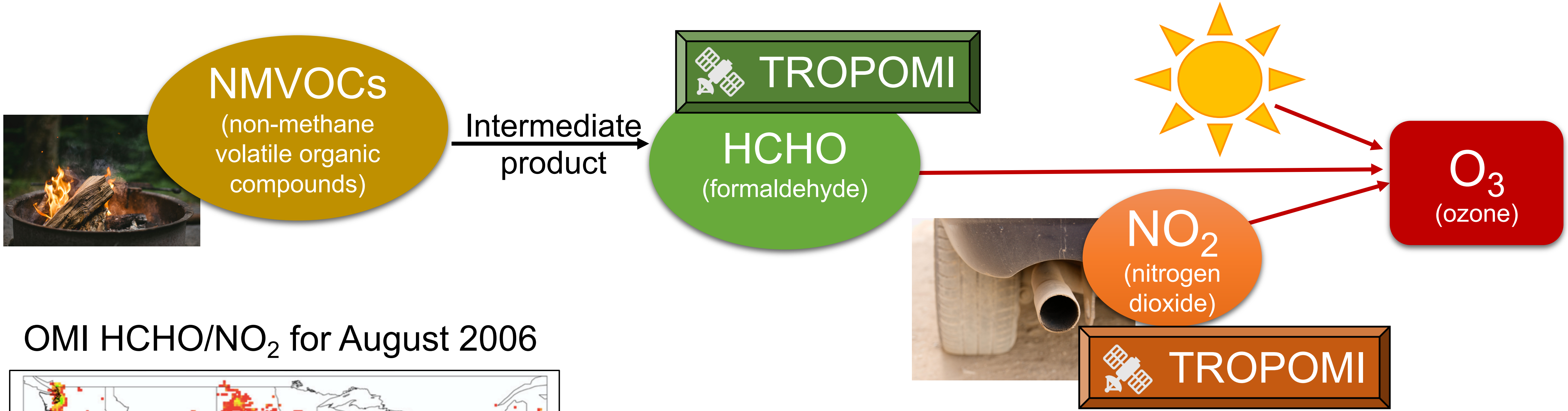
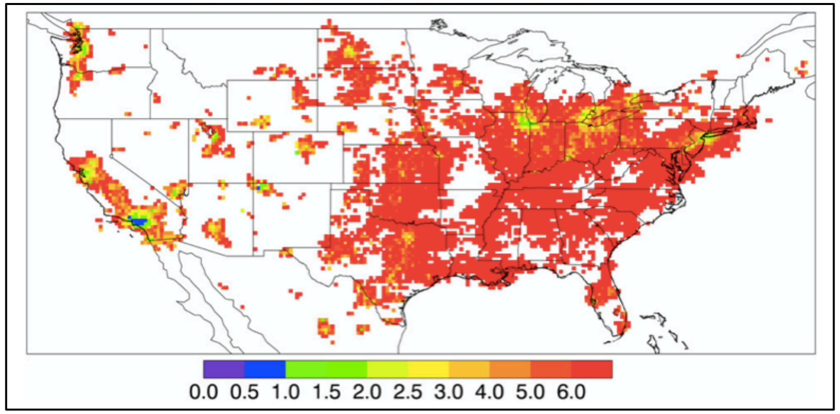
$HCHO/NO_2$ as indicator of O_3 production sensitivity



OMI $HCHO/NO_2$ for August 2006



[Duncan et al., 2010]

$HCHO/NO_2$

$< 1 \Rightarrow NO_X$-saturated
$> 1 \Rightarrow NO_X$-sensitive

[Martin et al., 2004]

Limitation

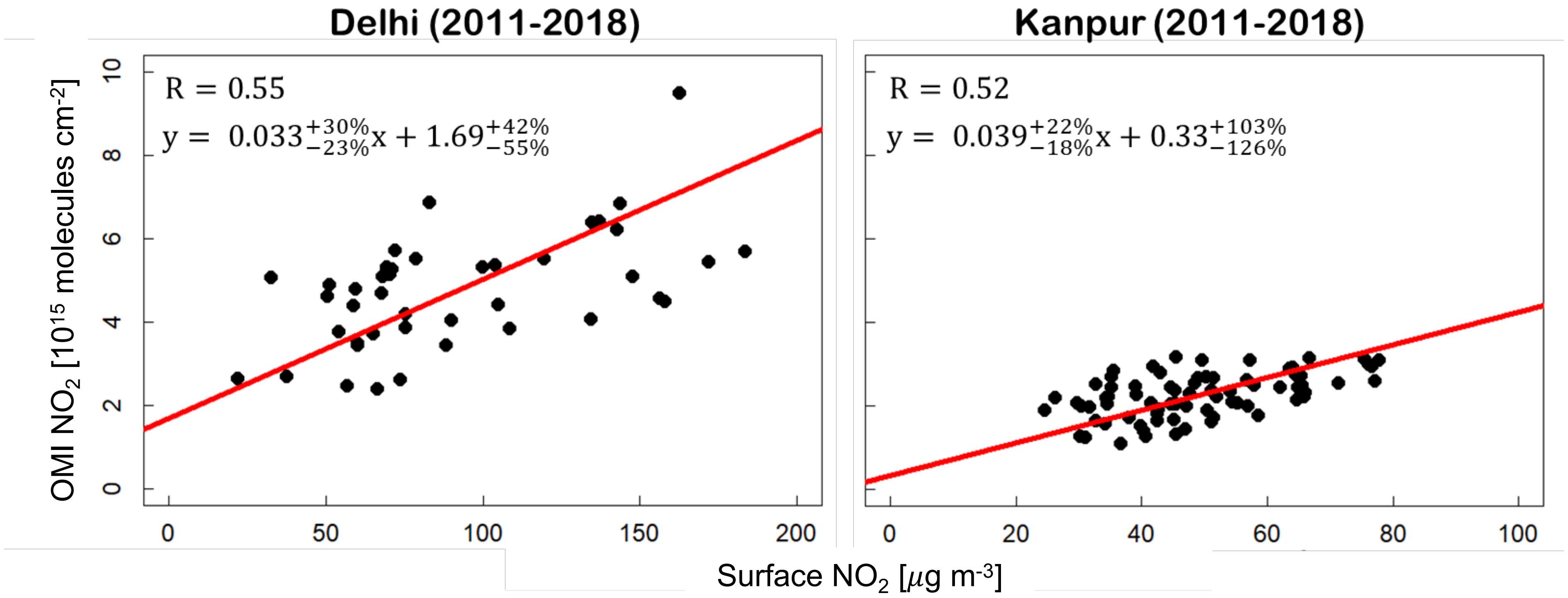
Depends on local oxidation regime and thus the transition across regimes varies with space & time

[Jin et al., 2017; Souri et al., 2020]

In this study, we use TROPOMI observations to assess surface O_3 sensitivity to NO_X and VOCs

Assessment of Earth observations

Satellite vs surface NO_2 in Indian cities



Points are monthly average

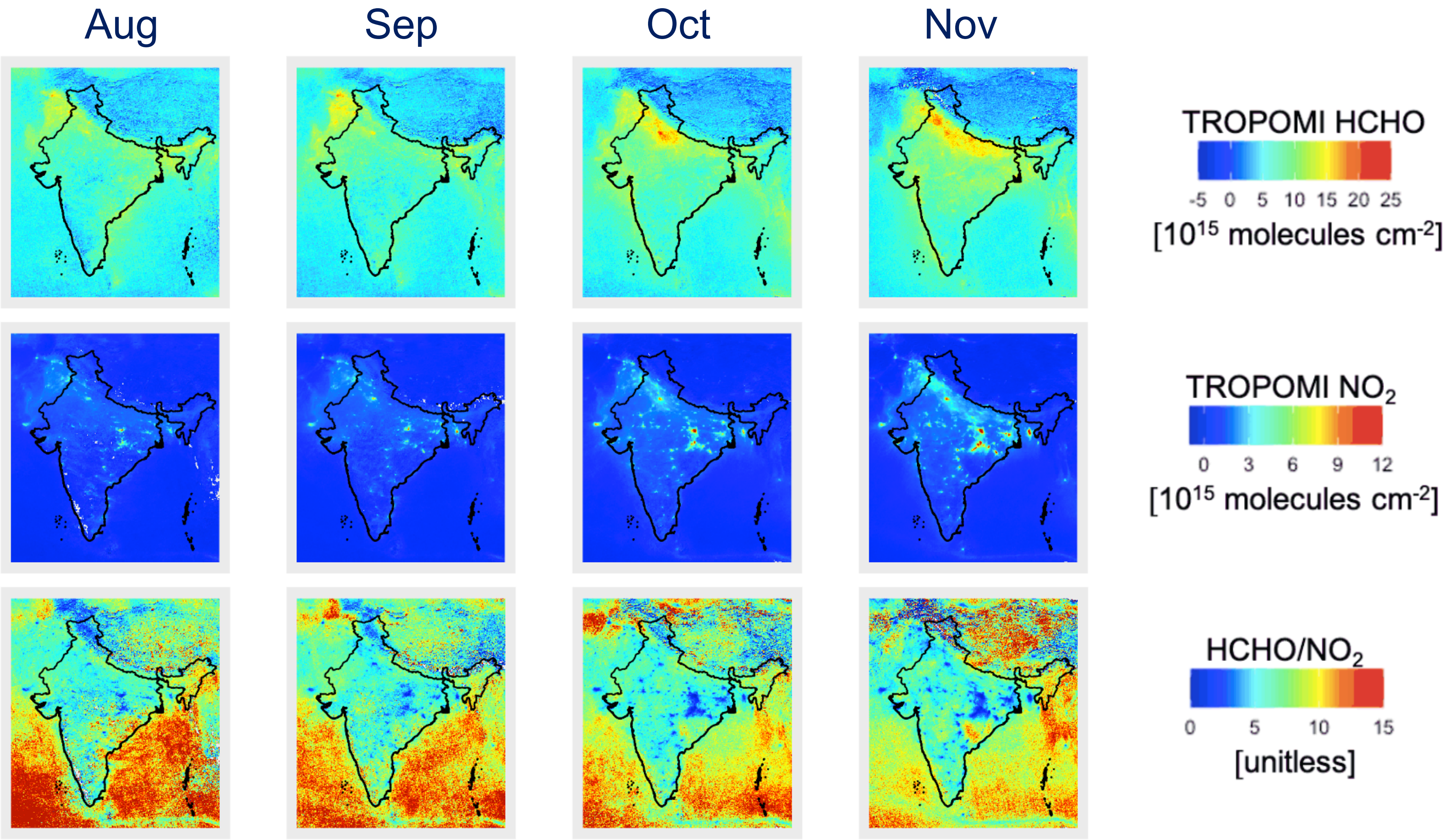
Earth observations can reproduce variability in surface air pollution

[Vohra et al., in review, *ACPD*]

Assessing ozone production regime over India

TROPOMI observations for Aug-Nov 2019 $(0.1° \times 0.1°)$

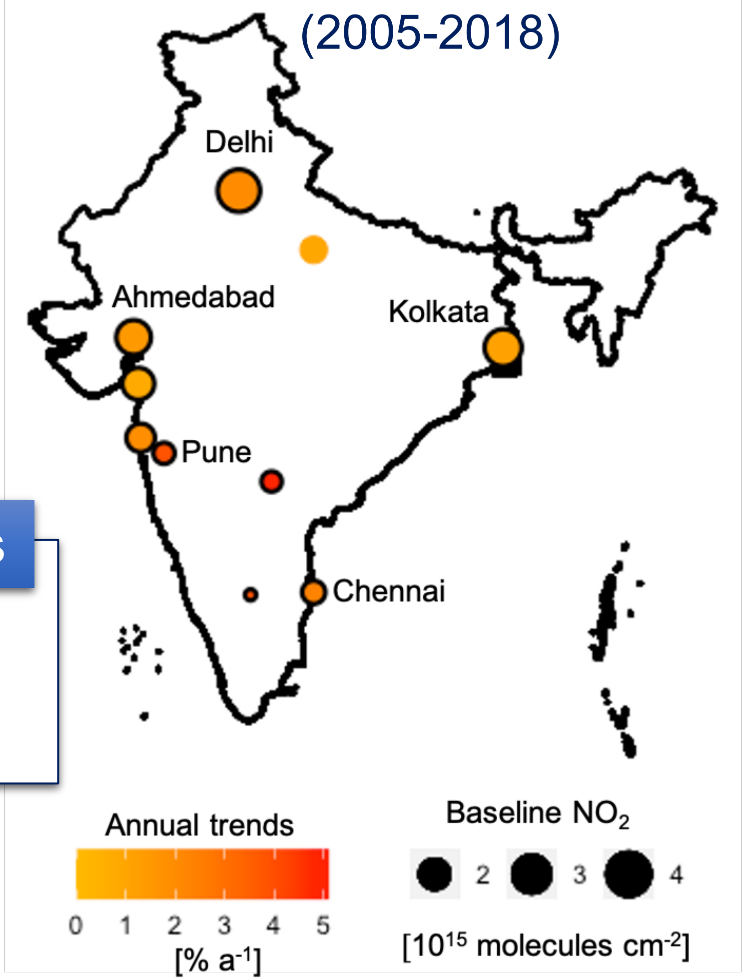
Monsoon (Aug/Sep)
Biomass burning (Oct/Nov)



Most of India is in NO_X-sensitive regime except for Delhi and coal-mining regions

Long-term trends in O_3 precursor sources of NO_X and VOCs

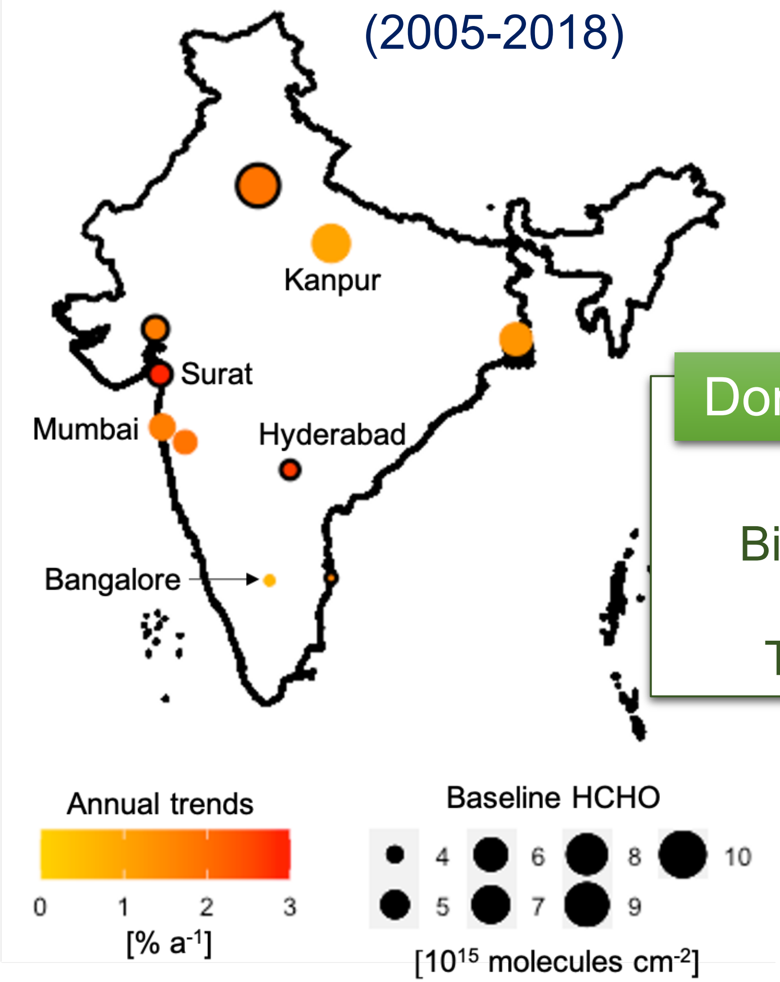
Trends in OMI NO_2



Dominant sources

Industrial
Transportation
Biomass burning

Trends in OMI HCHO



Significant trends are outlined

Dominant sources

Biogenic
Biomass burning
Combustion
Transportation

Increase in NO_2 is larger and more significant compared to HCHO increase; suggesting increase in O_3 production in NO_X-sensitive areas

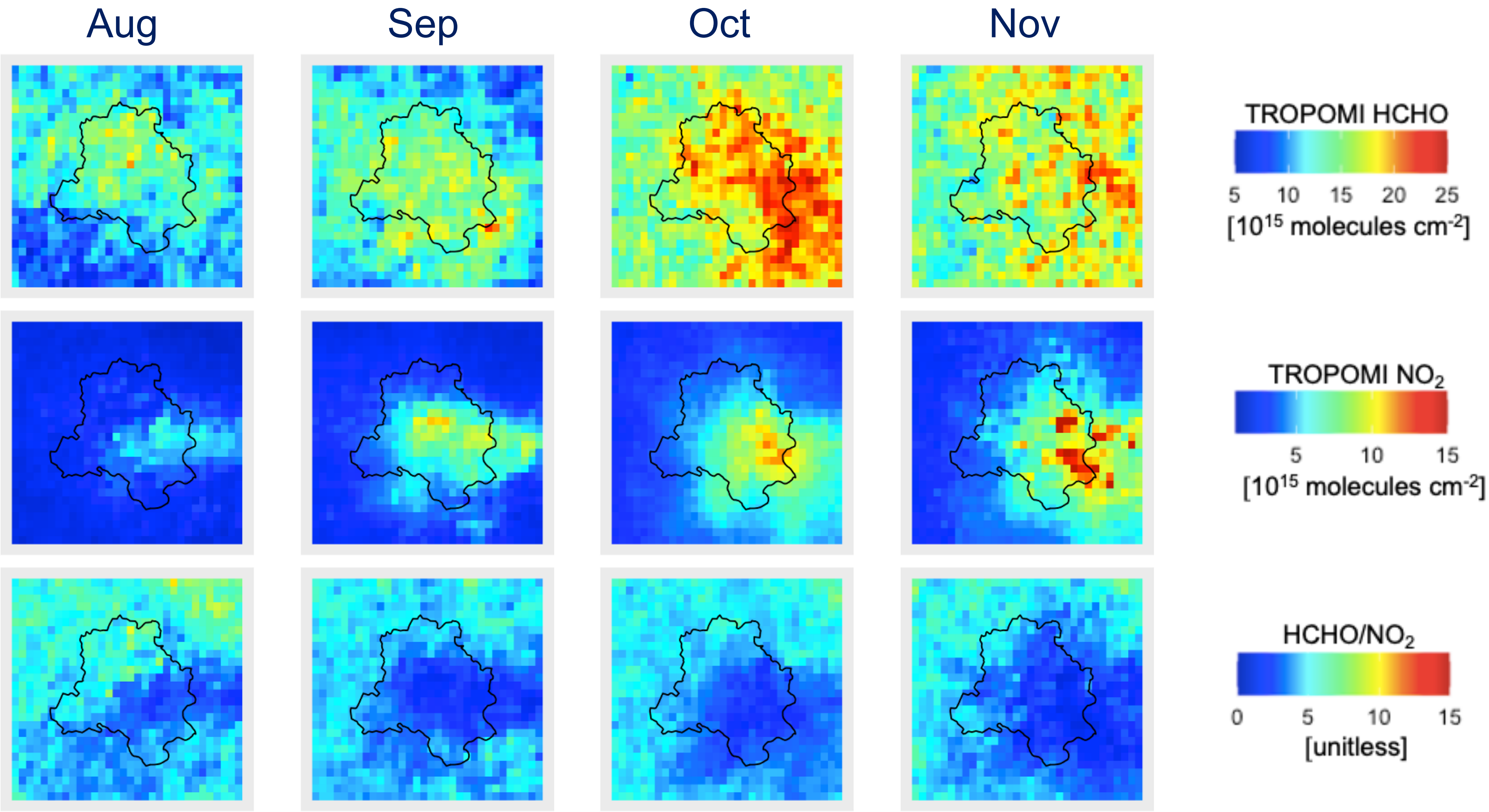
Assessing ozone production regime in Delhi

Oversampled TROPOMI observations for Aug-Nov 2019

$(0.025° \times 0.025°)$

Monsoon (Aug/Sep)

Biomass burning (Oct/Nov)



High HCHO across Delhi during biomass burning but NO_2 elevated only in eastern Delhi leading to two distinct ozone production regimes

Conclusions and next steps

- ✓ We have an initial look at the influence of VOCs and NO_X on ozone production in India and Delhi
- ✓ TROPOMI observations over India are used to derive $HCHO/NO_2$ at regional (~10 km) and local (2.5 km) resolutions
- ✓ Preliminary results show most of India in NO_X-sensitive regime and Delhi in NO_X-saturated regime during August-November 2019
- ✓ Long-term increasing NO_2 trends suggest increase in O_3 formation for most of India (no evidence of improvements due to recent air quality policies)
- ❑ We intend to develop an updated approach aided by interpretation with a chemical transport model to identify the most effective strategies for regulating ozone

Any questions? kxv745@bham.ac.uk @kohra_thefog