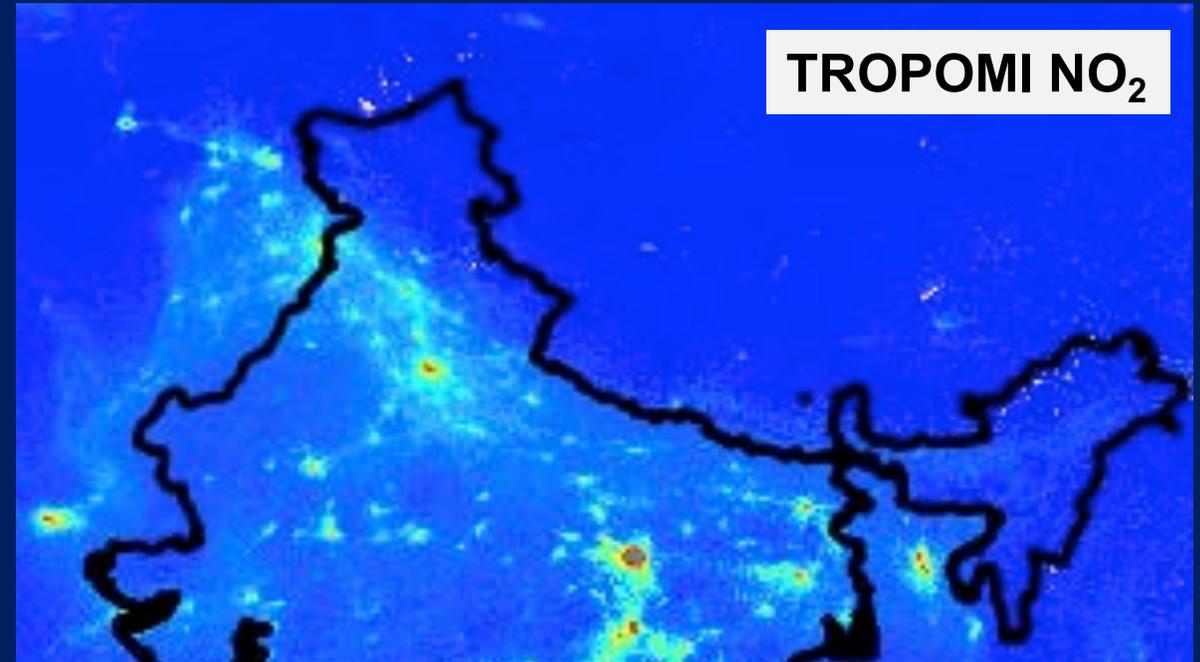
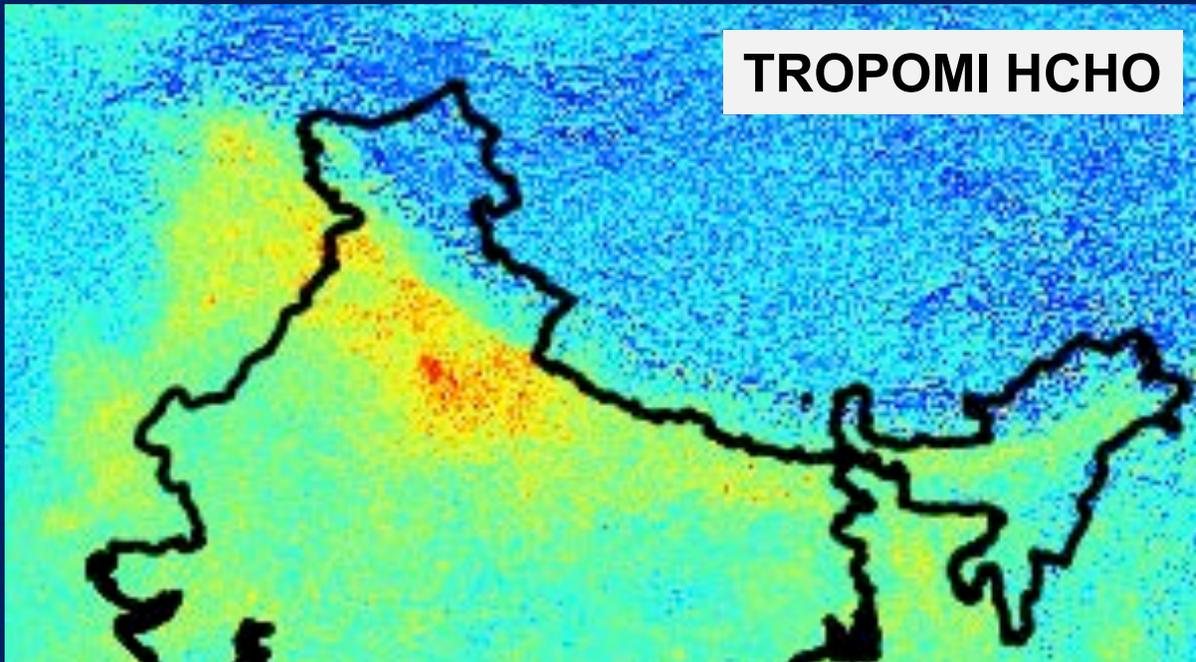
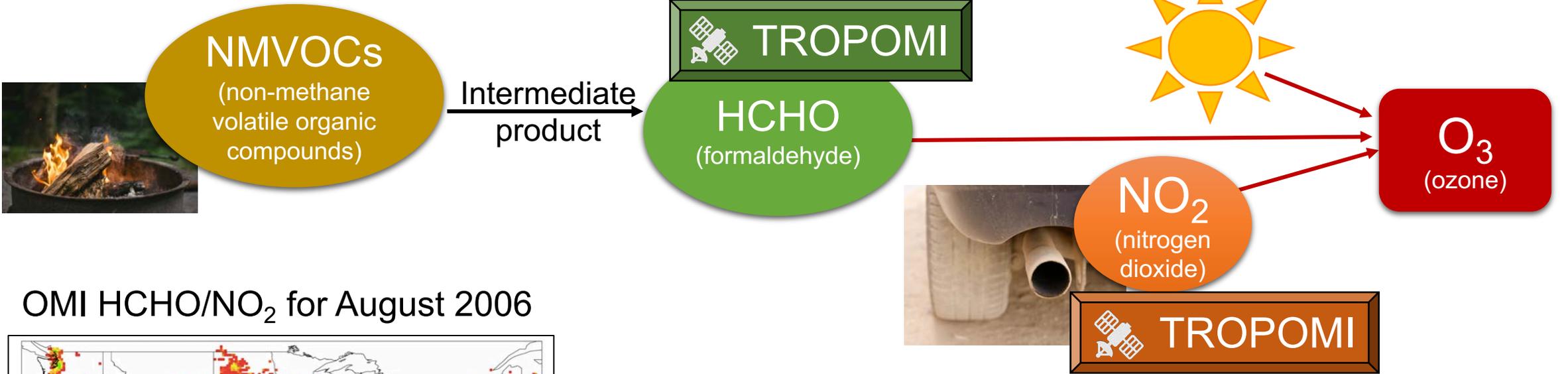


# Assessing surface ozone sensitivity in major Indian cities to $\text{NO}_x$ and VOCs using TROPOMI

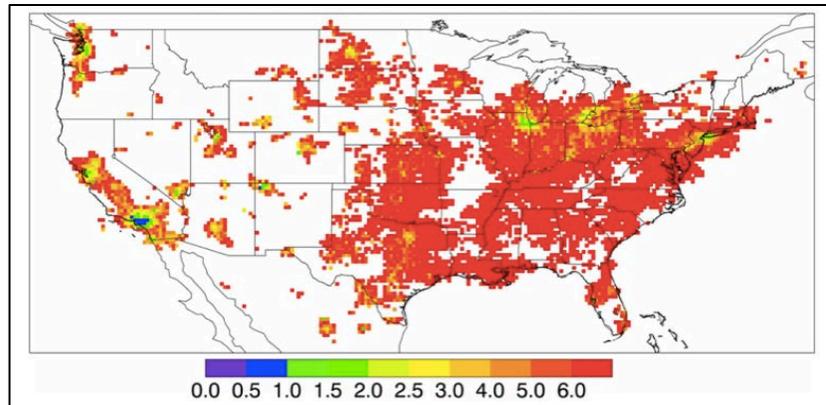
Karn Vohra (kxv745@bham.ac.uk), Eloise A. Marais, Gongda Lu, William Bloss, Lei Zhu, Henk Eskes, Isabelle De Smedt



# HCHO/NO<sub>2</sub> as indicator of O<sub>3</sub> production sensitivity



OMI HCHO/NO<sub>2</sub> for August 2006



[Duncan et al., 2010]

HCHO/NO<sub>2</sub>

< 1 ⇒ NO<sub>x</sub>-saturated  
> 1 ⇒ NO<sub>x</sub>-sensitive

[Martin et al., 2004]

Limitation

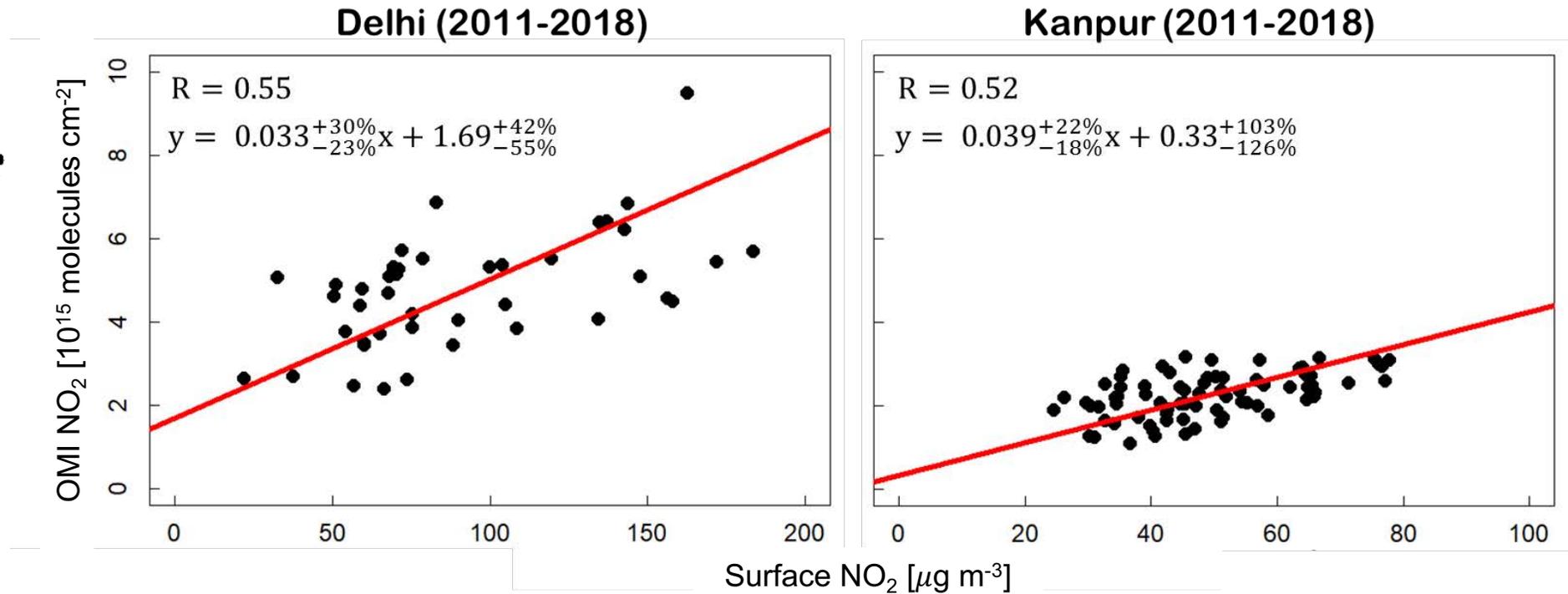
Depends on local oxidation regime and thus the transition across regimes varies with space & time

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

In this study, we use TROPOMI observations to assess surface O<sub>3</sub> sensitivity to NO<sub>x</sub> and VOCs

# Assessment of Earth observations

## Satellite vs surface NO<sub>2</sub> in Indian cities



Points are monthly average

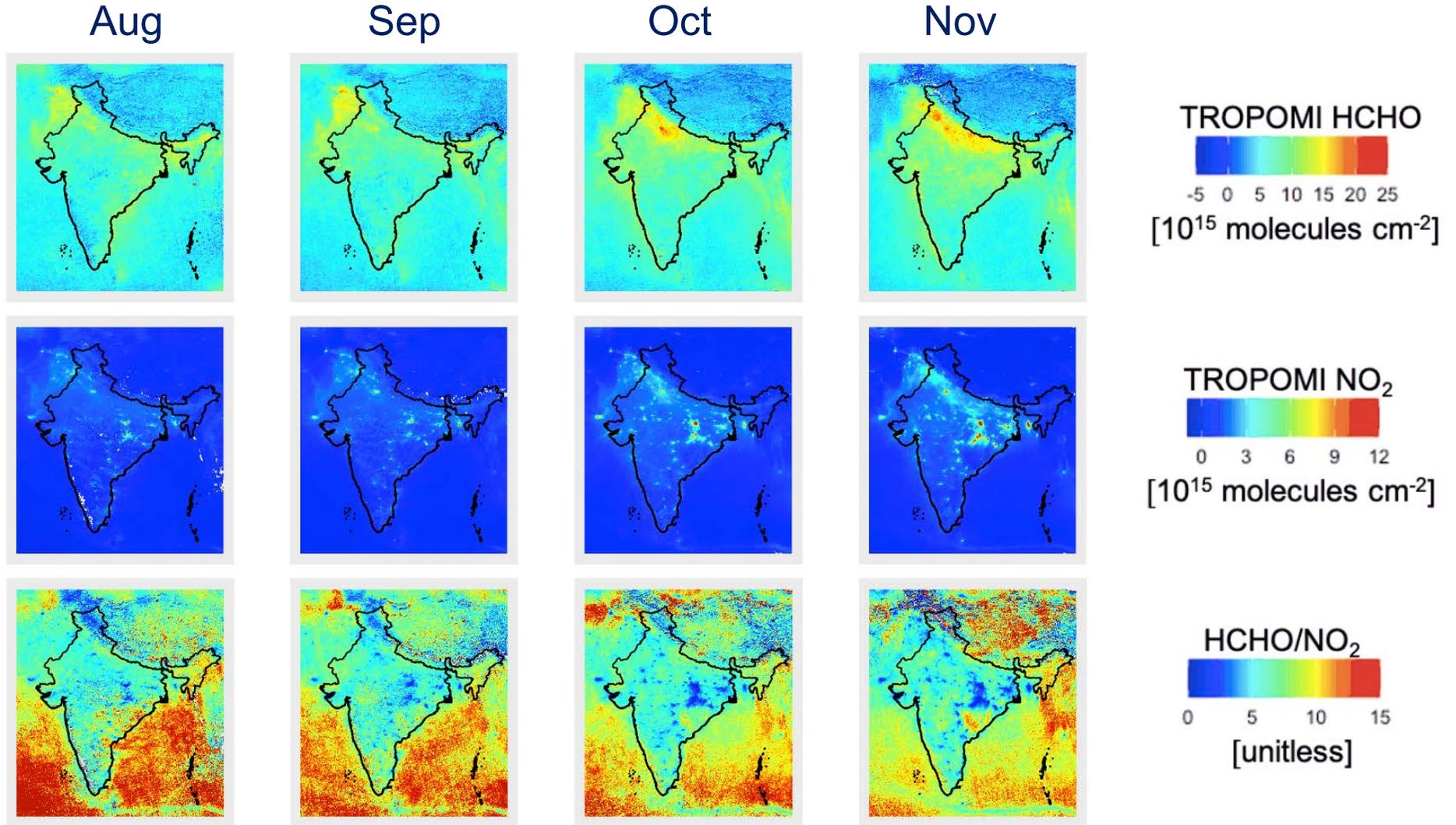
Earth observations can reproduce variability in surface air pollution

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

# Assessing ozone production regime over India

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

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

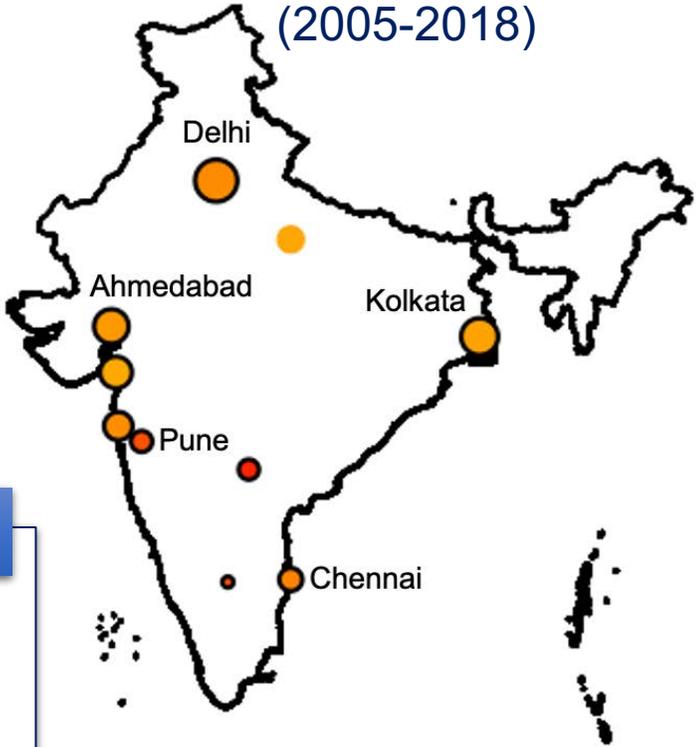


Most of India is in NO<sub>x</sub>-sensitive regime except for Delhi and coal-mining regions

# Long-term trends in O<sub>3</sub> precursor sources of NO<sub>x</sub> and VOCs

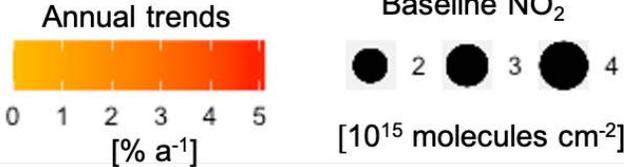
### Trends in OMI NO<sub>2</sub>

(2005-2018)



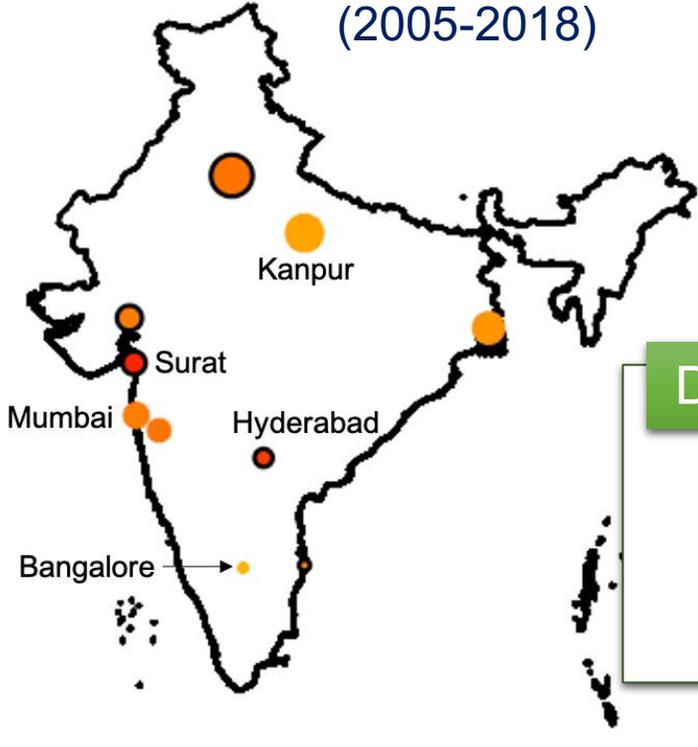
Dominant sources

- Industrial
- Transportation
- Biomass burning



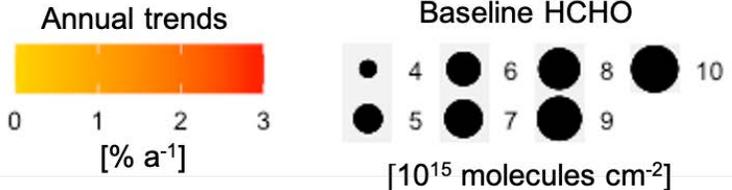
### Trends in OMI HCHO

(2005-2018)



Dominant sources

- Biogenic
- Biomass burning
- Combustion
- Transportation



Significant trends are outlined

Increase in NO<sub>2</sub> is larger and more significant compared to HCHO increase; suggesting increase in O<sub>3</sub> production in NO<sub>x</sub>-sensitive areas

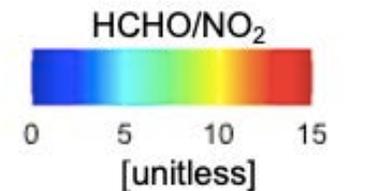
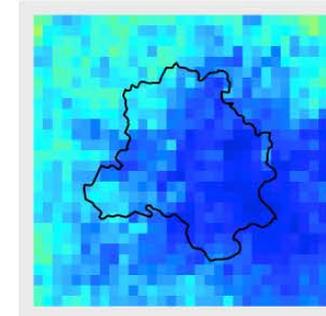
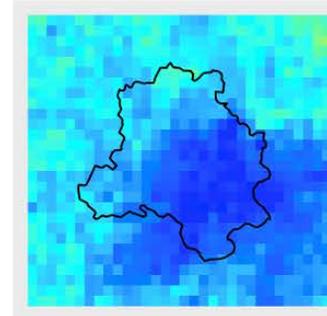
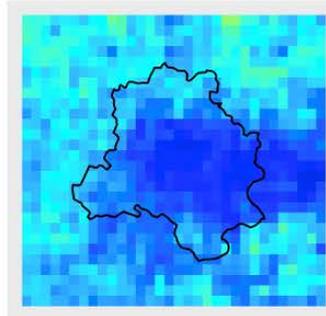
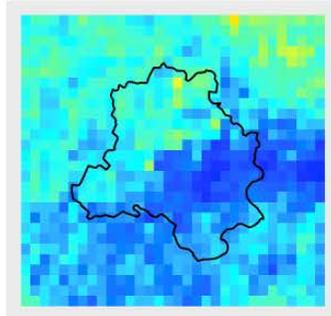
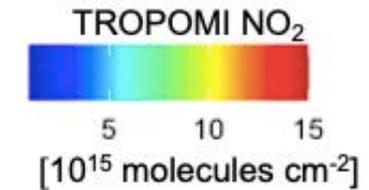
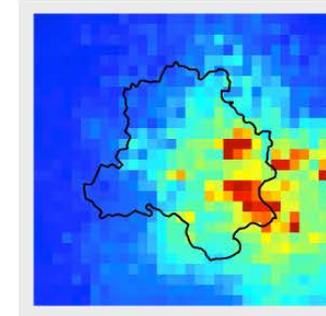
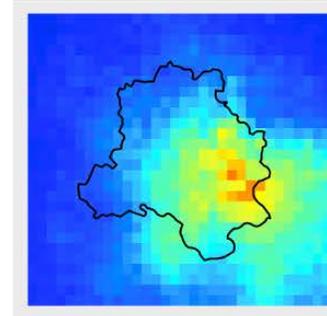
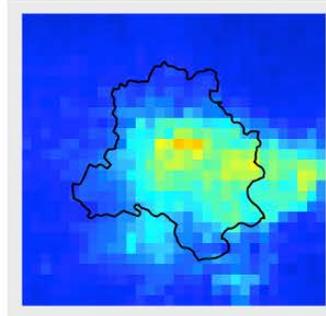
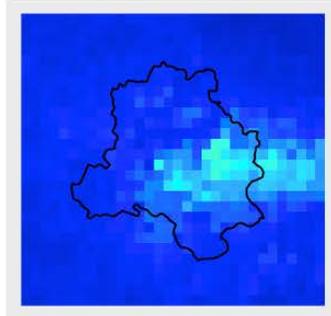
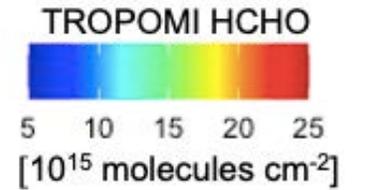
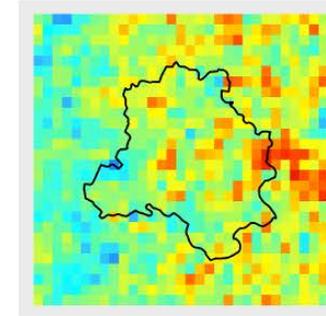
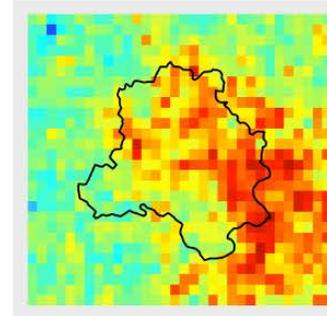
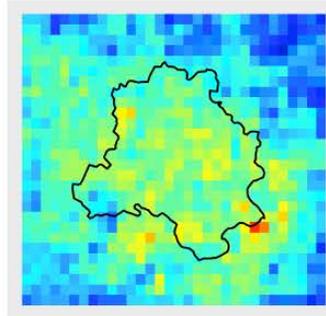
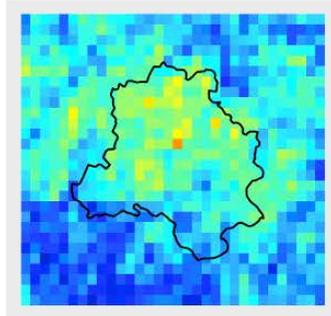
# Assessing ozone production regime in Delhi

Aug

Sep

Oct

Nov



Oversampled  
TROPOMI  
observations  
for Aug-Nov 2019  
( $0.025^\circ \times 0.025^\circ$ )

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

High HCHO across Delhi during biomass burning but NO<sub>2</sub> 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<sub>x</sub> on ozone production in India and Delhi
- ✓ TROPOMI observations over India are used to derive HCHO/NO<sub>2</sub> at regional (~10 km) and local (2.5 km) resolutions
- ✓ Preliminary results show most of India in NO<sub>x</sub>-sensitive regime and Delhi in NO<sub>x</sub>-saturated regime during August-November 2019
- ✓ Long-term increasing NO<sub>2</sub> trends suggest increase in O<sub>3</sub> 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](mailto:kxv745@bham.ac.uk)

 @kohra\_thefog