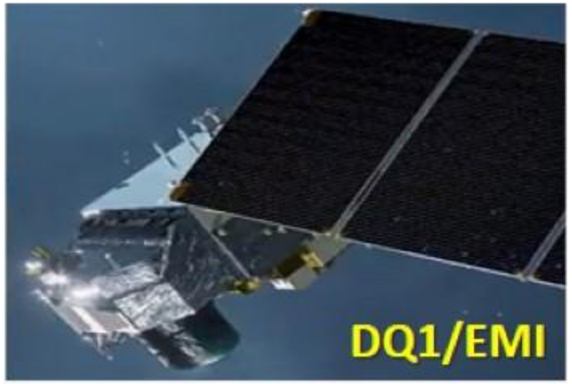
Remote sensing of trace gases from Chinese Environmental Satellite and MAX-DOAS network

Report: Cheng Liu

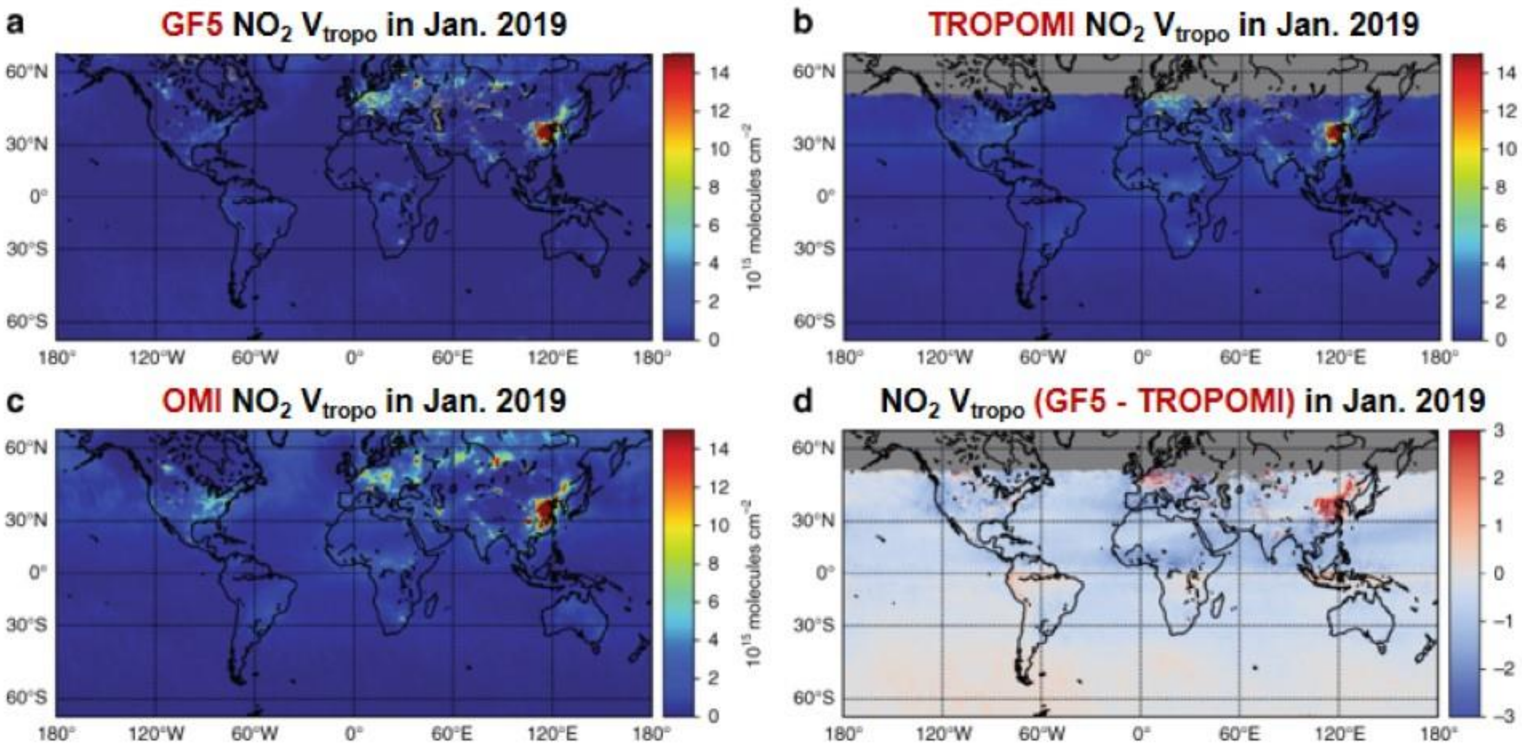
Chinese Environmental Satellite



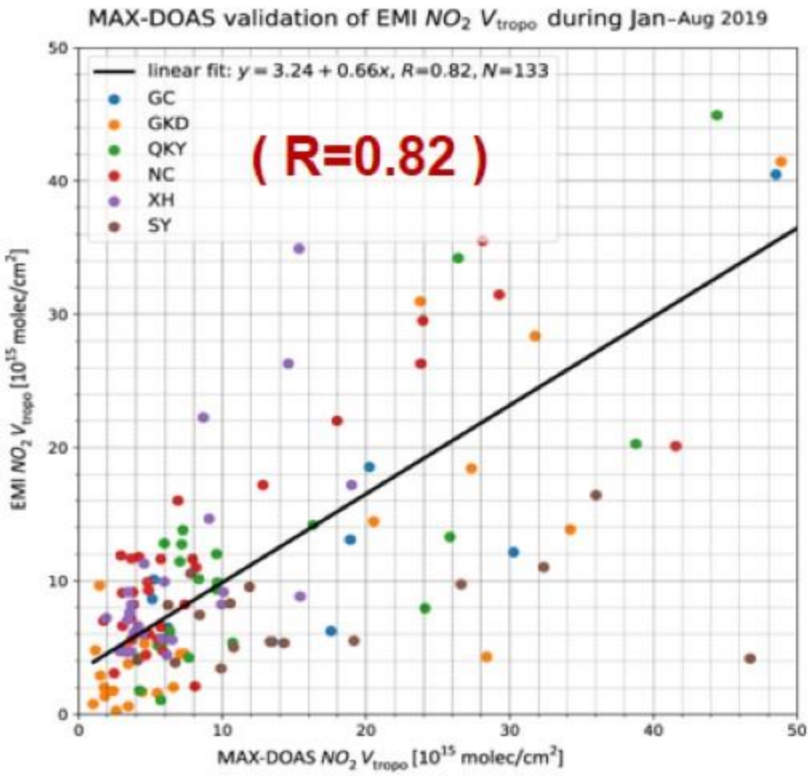
	GF5/EMI	GF5B/EMI	DQ1/EMI
launch time	2018.5.9	2021.9.7	2022.4.15
overpass time	13:30	10:30	13:30
angle of view	114°	114°	114°
spatial resolution	13km x 48km	13km x 24km	13km x 24km
spectral resolution	0.3-0.5nm	0.3-0.6nm	0.3-0.6nm
spectral range	240-710nm	240-710nm	240-710nm

■ GF5 NO_2 retrieval and validation

- **GF5 NO_2 comparison with TROPOMI and OMI**



- **GF5 NO_2 validation with MAX-DOAS**

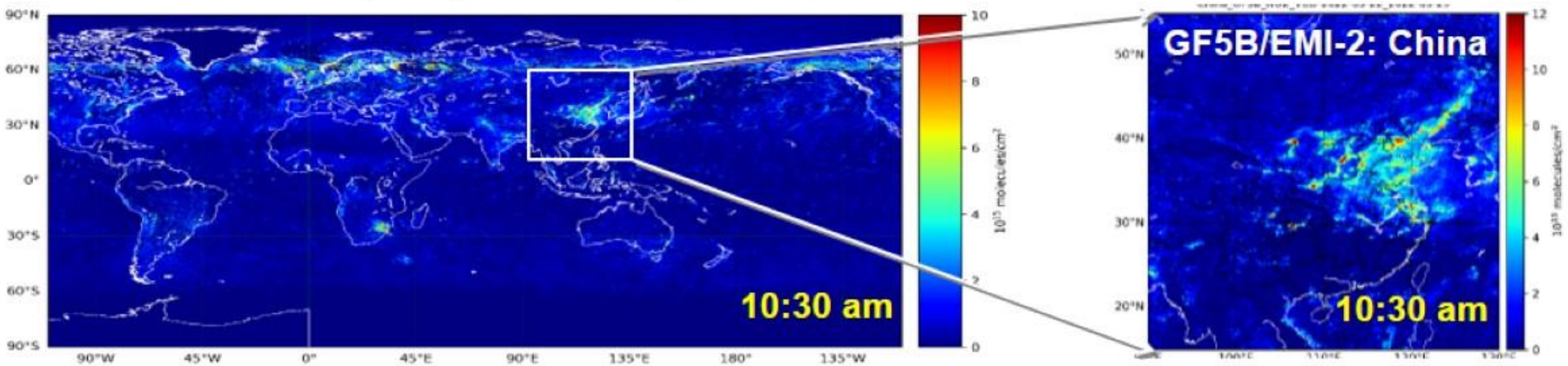


Zhang, Liu et al., Light: Science & Applications, 2020

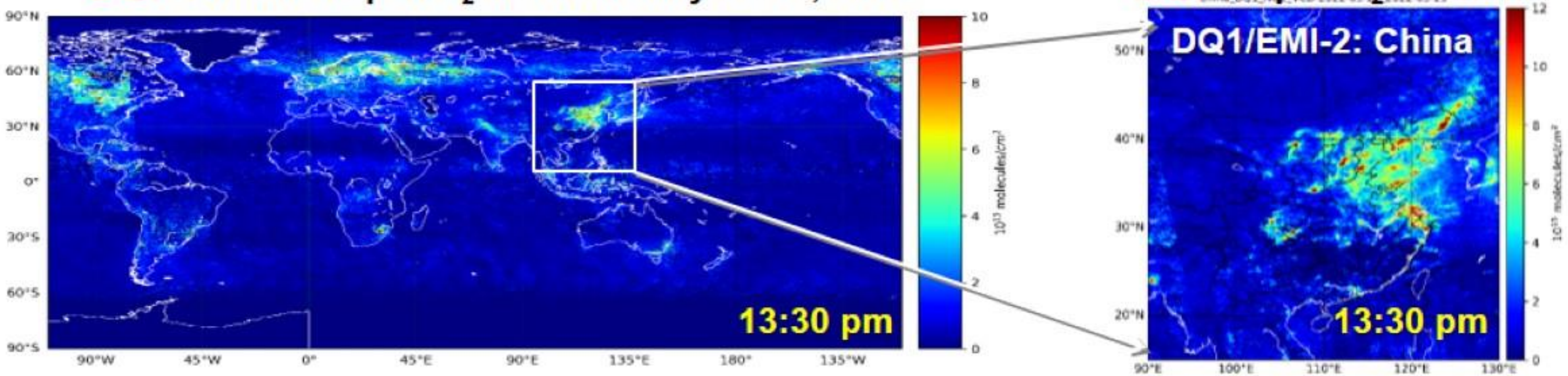
- □ GF5 NO_2 VCDs generally show good spatiotemporal agreement with the OMI and TROPOMI (R of ~0.9, bias < 50%).
- □ The validation with ground-based MAX-DOAS observations also shows good correlation with R of 0.82.

■ EMI NO_2 onboard DQ1 and GF5B

GF5B: Global Trop. NO_2 between May 22-29, 2022 | **GF5B Trop. NO_2 in China**



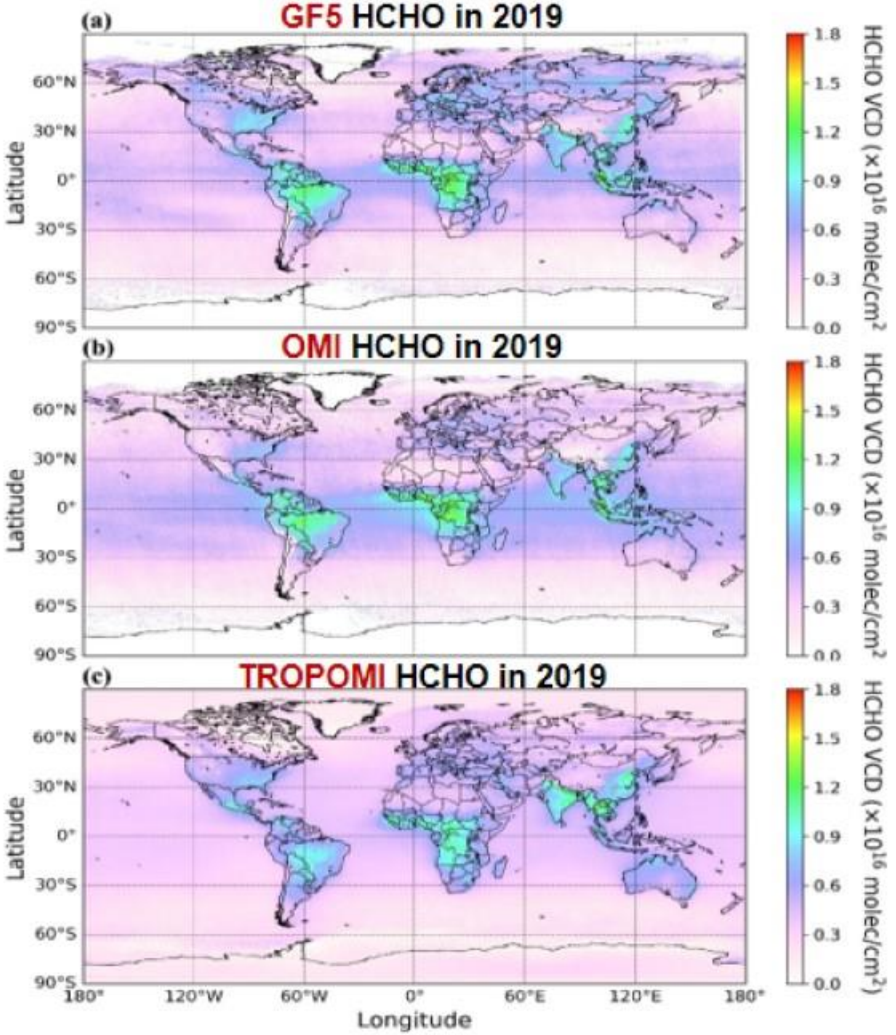
DQ1: Global Trop. NO_2 between May 22-29, 2022 | **DQ1 Trop. NO_2 in China**



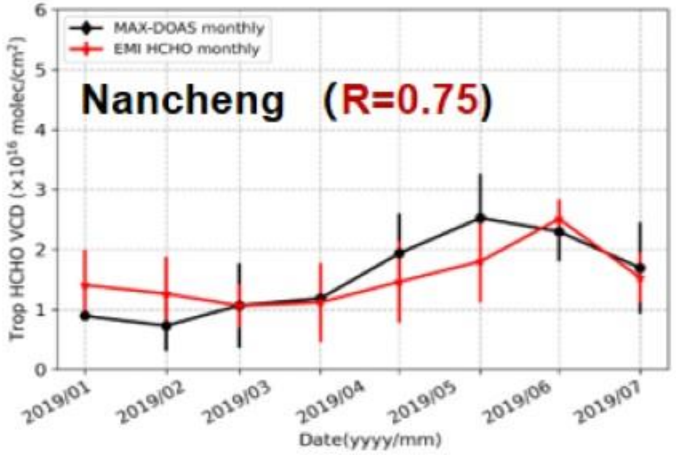
- ☐ **Similar distribution of tropospheric NO_2 are observed by EMI onboard DQ1 and GF5B.**
- ☐ **NO_2 pollution level at the near-noon time was significantly higher than morning.**

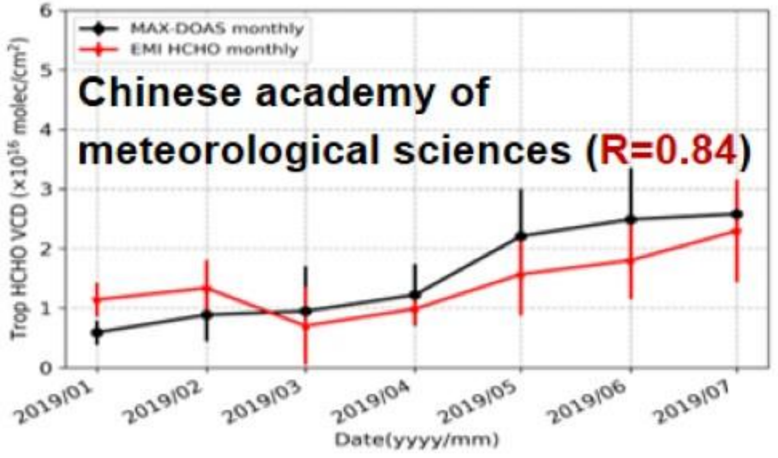
■ GF5 HCHO retrieval and validation

● GF5 HCHO comparison with TROPOMI and OMI

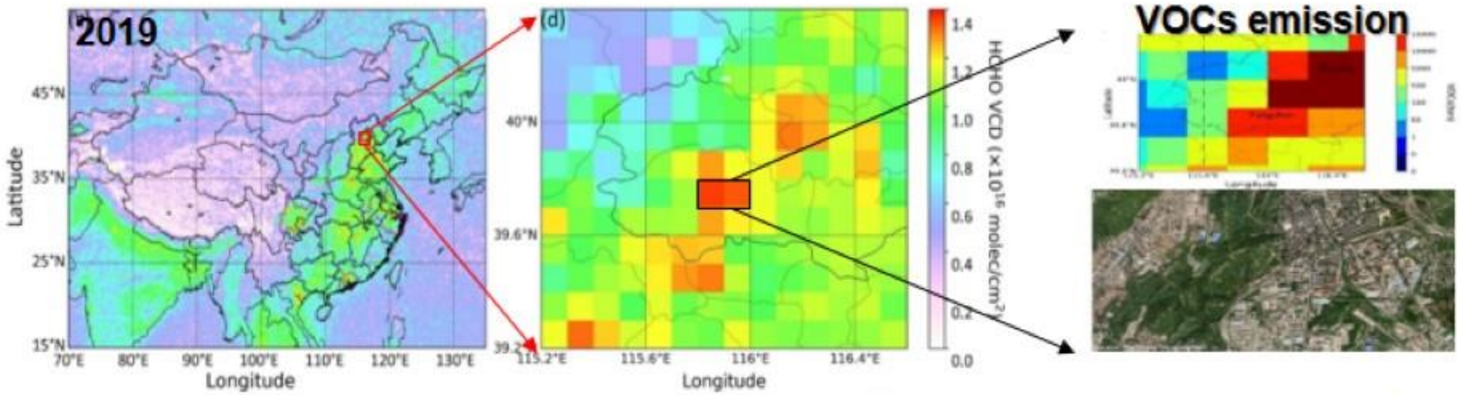


● GF5 HCHO validation with MAX-DOAS





● GF5 HCHO: Locating VOCs emission sources

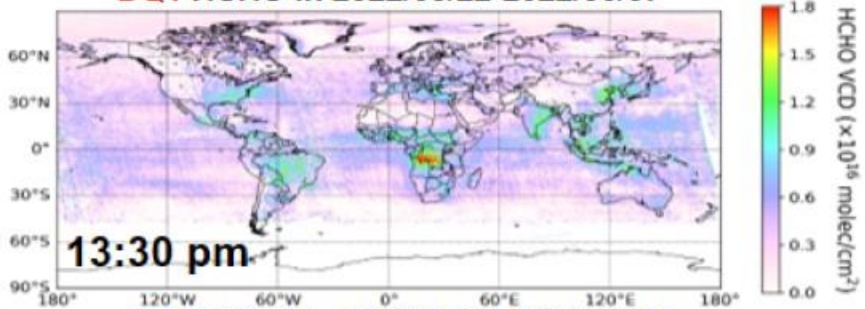


Wenjing Su, Cheng Liu et al., ENVIRONMENTAL POLLUTION, 2022

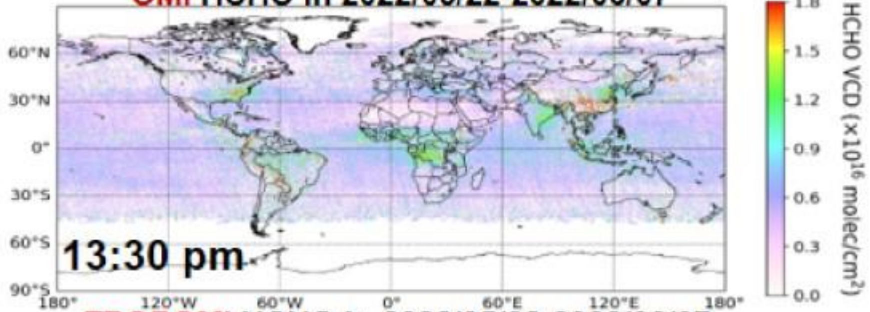
DQ1 HCHO retrieval and validation

- **DQ1 HCHO comparison with TROPOMI and OMI**

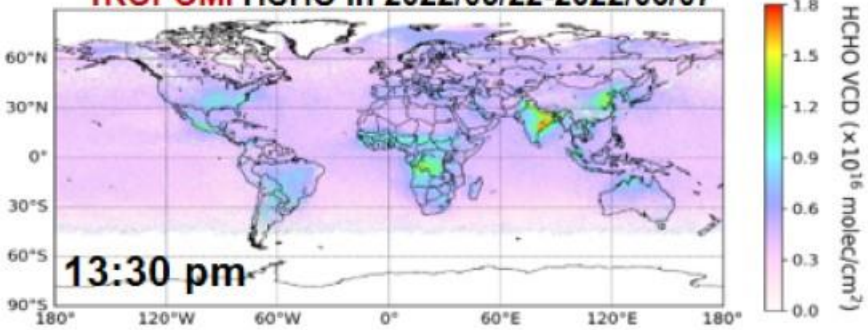
DQ1 HCHO in 2022/05/22-2022/06/07



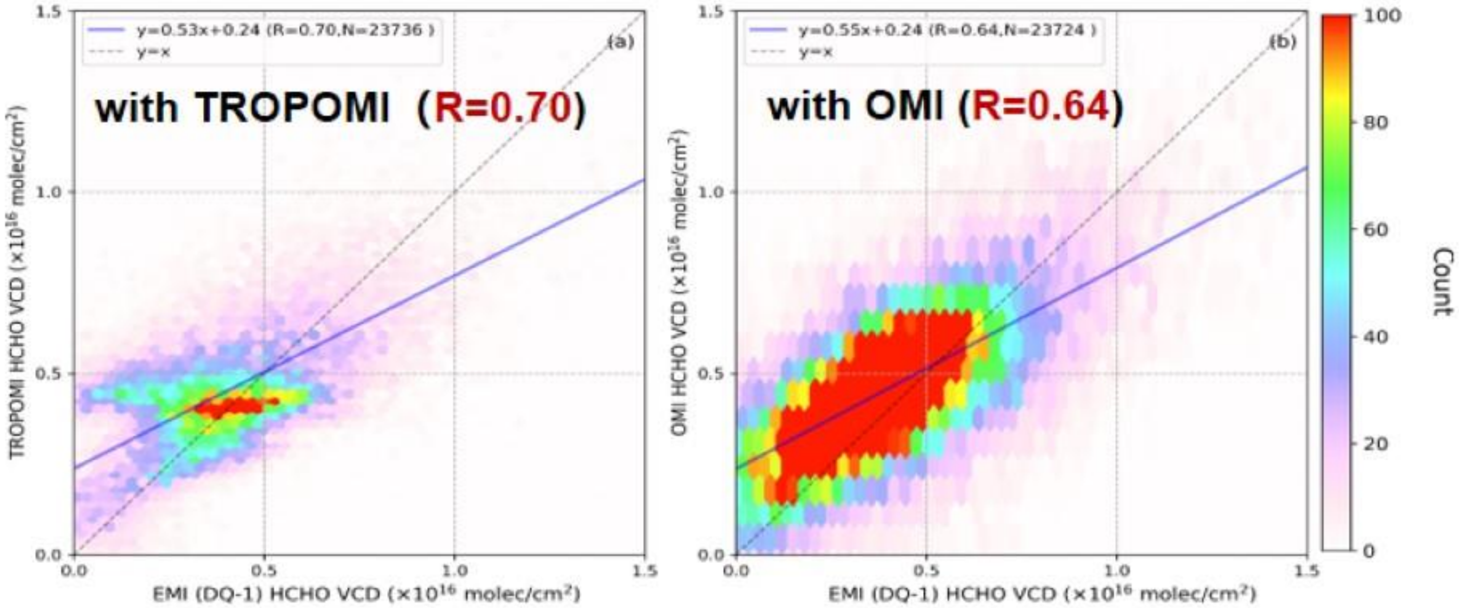
OMI HCHO in 2022/05/22-2022/06/07



TROPOMI HCHO in 2022/05/22-2022/06/07

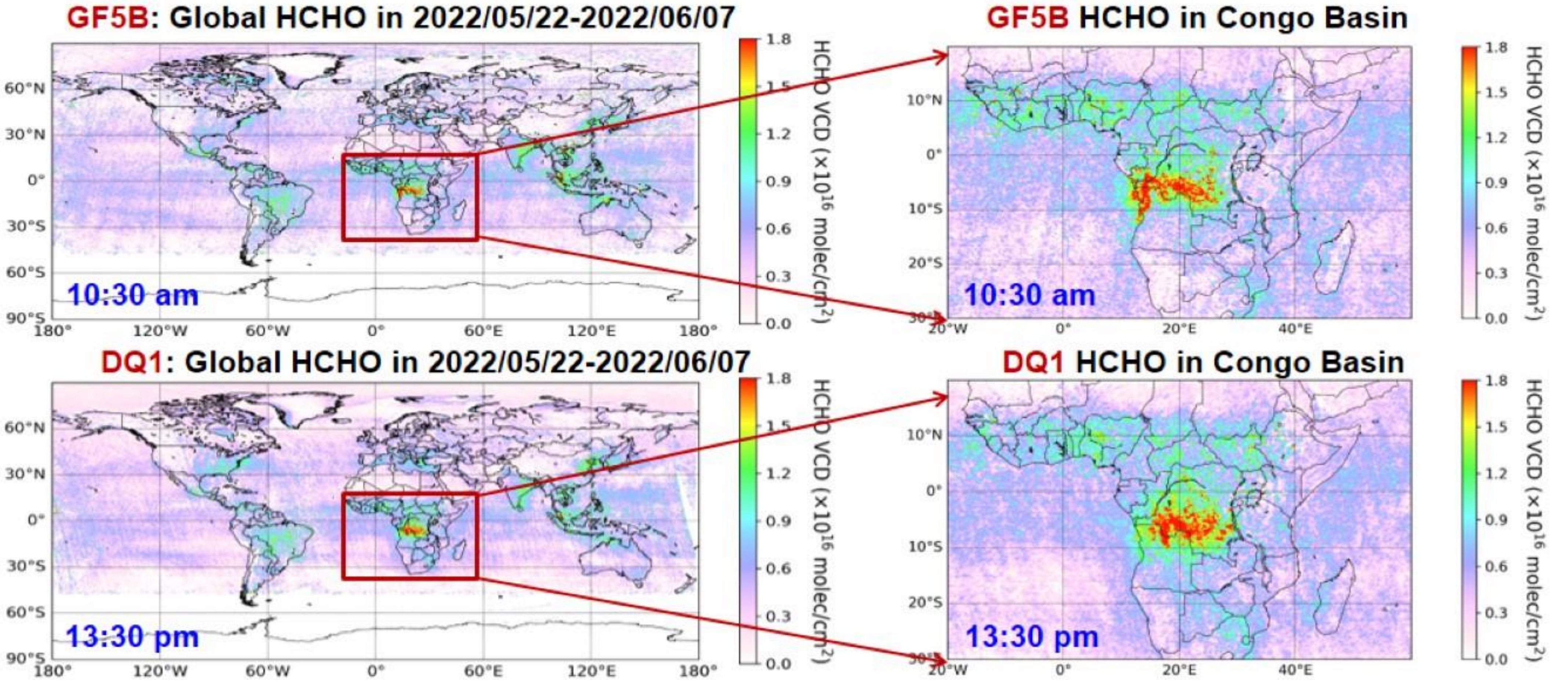


- **DQ1 HCHO validation with with TROPOMI and OMI**



- **We compare HCHO VCDs from DQ1 with OMI and TROPOMI, because they have similar local overpass times.**
- **HCHO VCDs by DQ1 on show similar spatiotemporal trends with TROPOMI(R=0.7) and OMI (R=0.64) HCHO VCDs.**

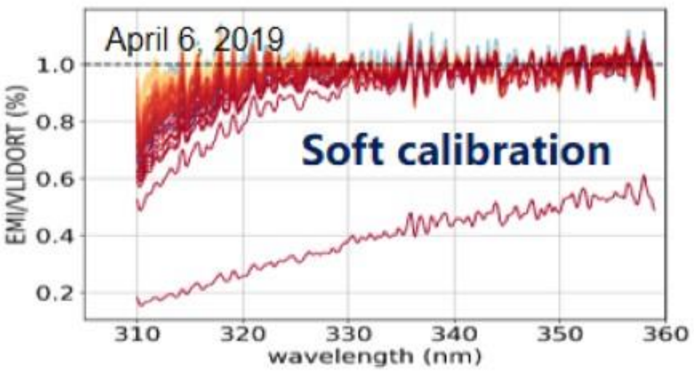
■ EMI HCHO onboard DQ1 and GF5B

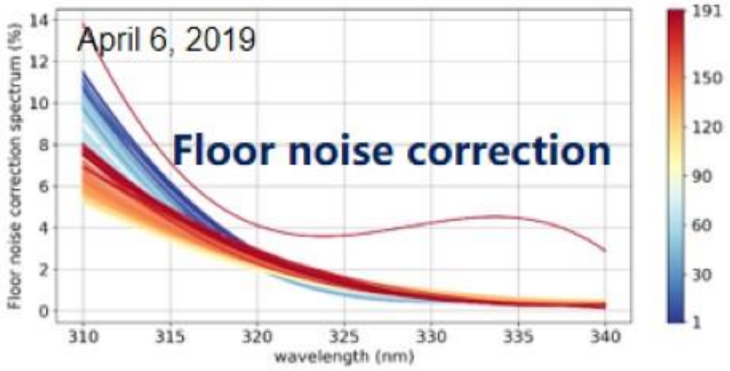


- ☐ We compare morning and afternoon HCHO VCDs from China's GaoFen-5B and DQ-1 satellites trying to study the diurnal variation of global HCHO concentration.
- ☐ Afternoon HCHO VCDs are higher than morning HCHO VCDs in Congo Basin

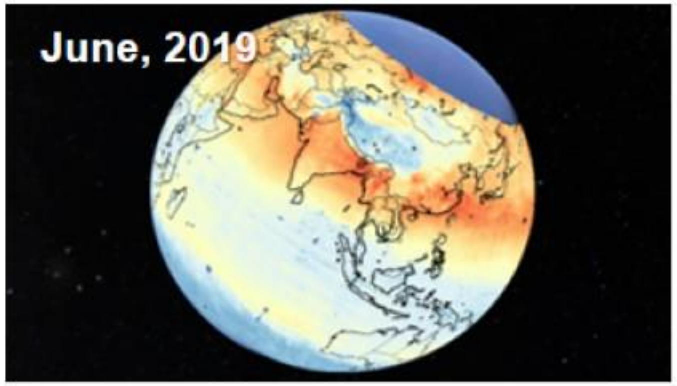
GF5 ozone profiles retrieval

- **GF5 ozone profiles retrieval**

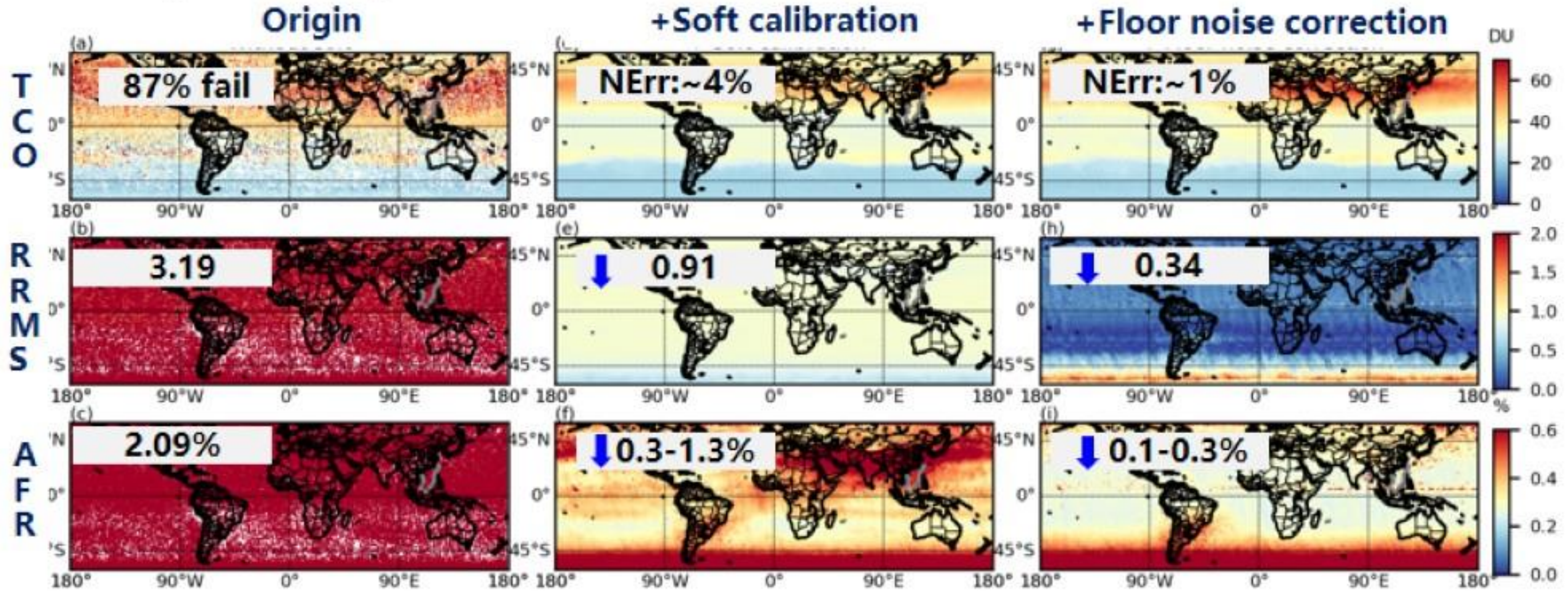




- **GF5 TCO: monthly mean**



Monthly mean ozone profiles retrieval: June 2019



$$\mathrm{RRMS} = ABS\left(\sqrt{\frac{1}{N}\sum_{1}^{N}\left(\frac{\Delta Y}{S_y^{1/2}}\right)^2} - 1\right)$$

- N: Number of wavelengths
- S_y: Covariance matrix of measurement uncertainty
- ΔY: Fitting residual

$$\mathrm{NErr} = (\mathrm{AK} - I)X_{ae}$$

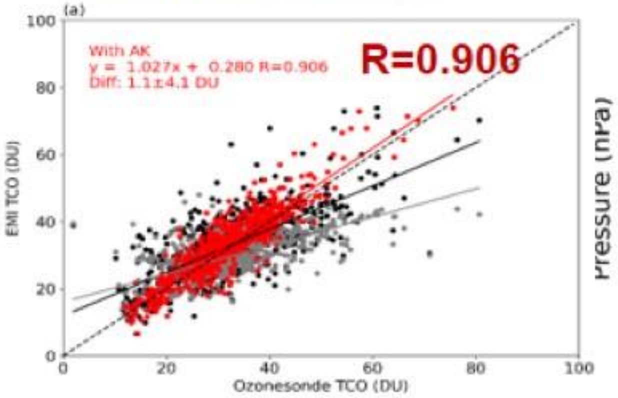
- AK: Averaging kernel
- X_{ae}: A priori error
- I: Unity matrix
- AFR: Averaging fitting residual

GF5 ozone profiles validation and application

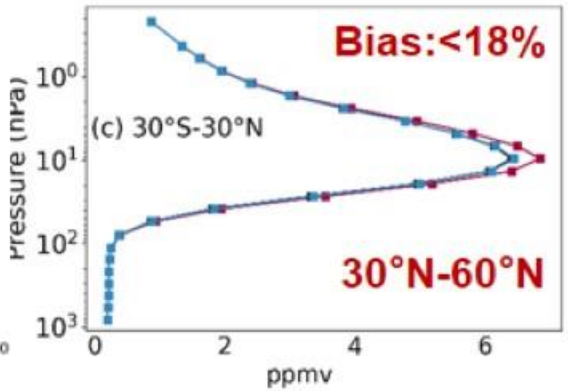
- **GF5 ozone profiles validation with ozonesonde and CNEMC**

Scatter plots of GF5 and ozonesonde:

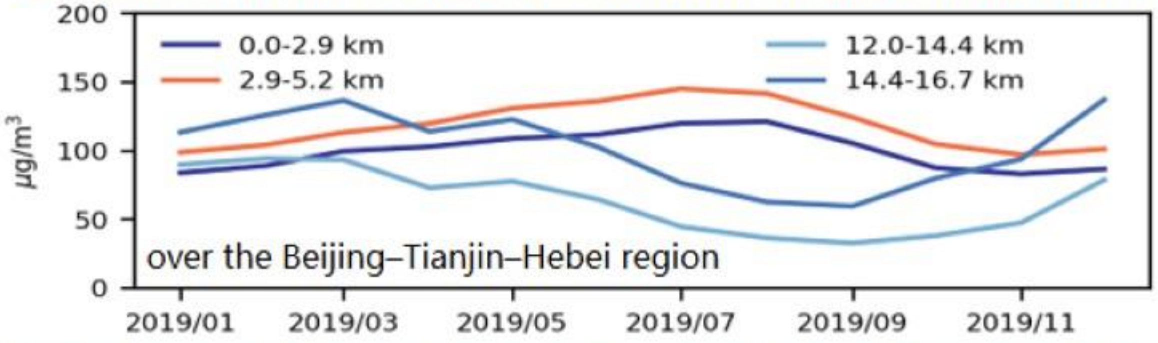
TCO: 2018/11-2020/04



Ozone profile: 2018/11-2020/04



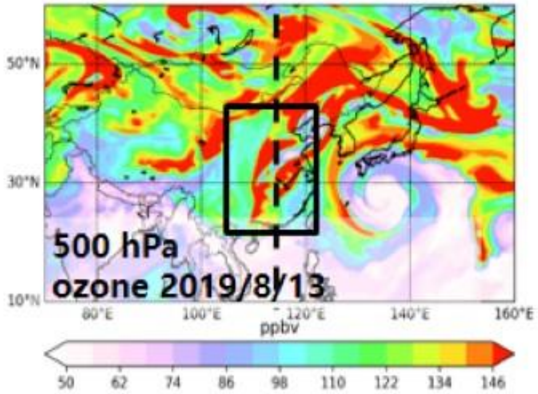
Time series of ozone concentration at different altitudes:

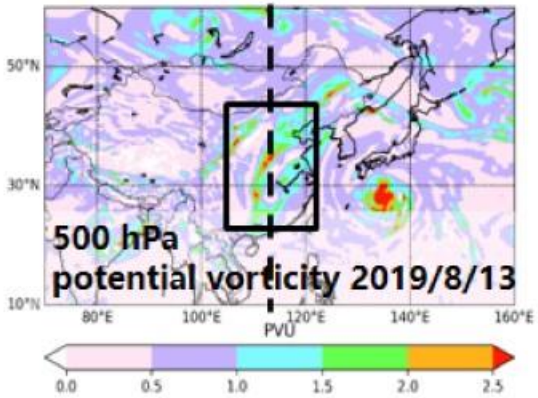


- **The peaks of ground-level ozone and upper tropospheric ozone occur in different seasons**

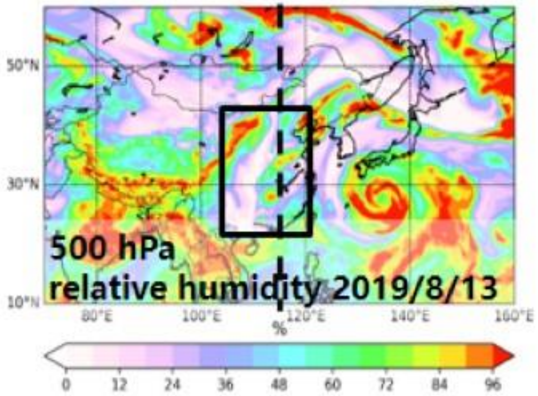
- **stratospheric ozone intrusion**

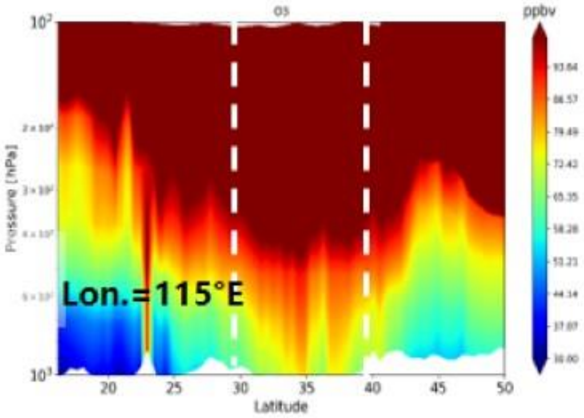
High ozone and potential vorticity





Low relative humidity

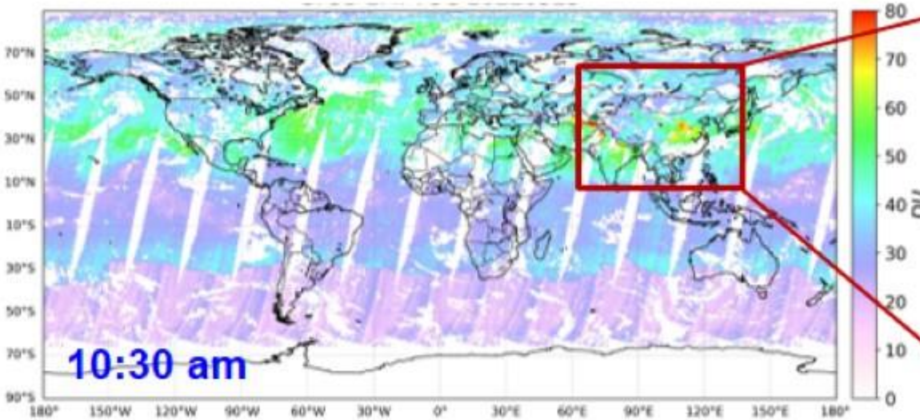




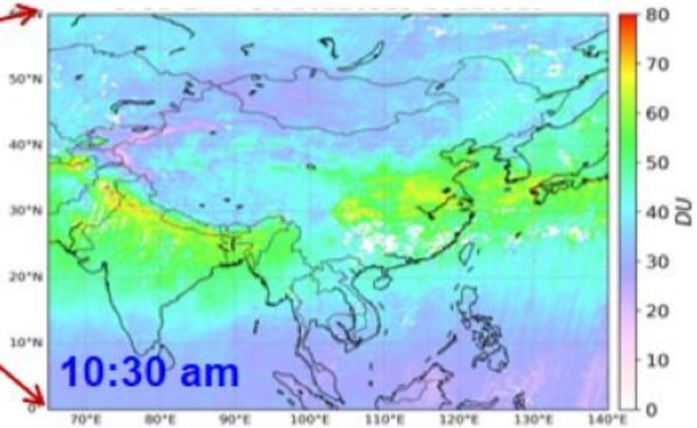
Fei Zhao,Cheng Liu et al. Environmental Research Letters, under review

EMI O_3 onboard DQ1 and GF5B

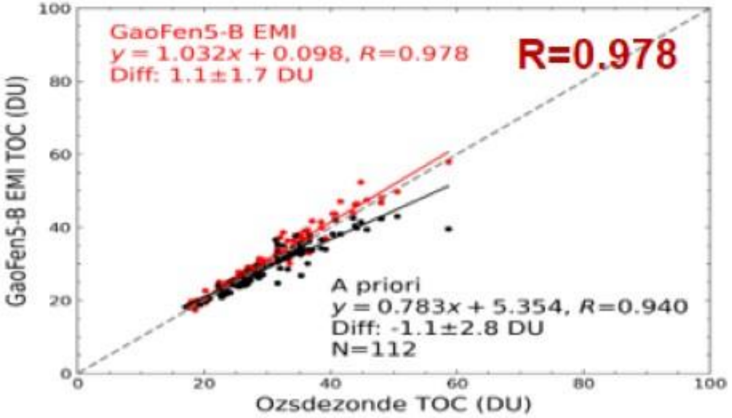
GF5B: Global O_3 in 2022/05/23



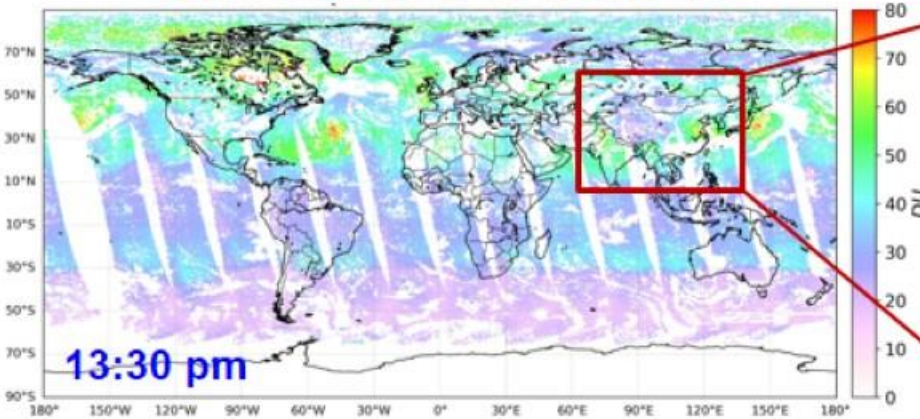
GF5B O_3 in China



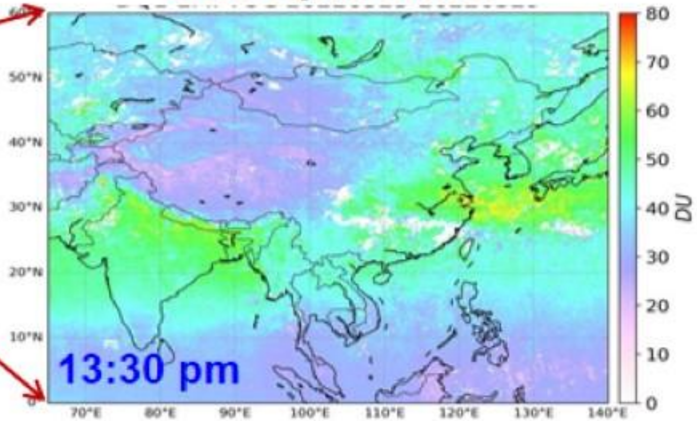
- **GF5B** O_3 validation with ozonesonde



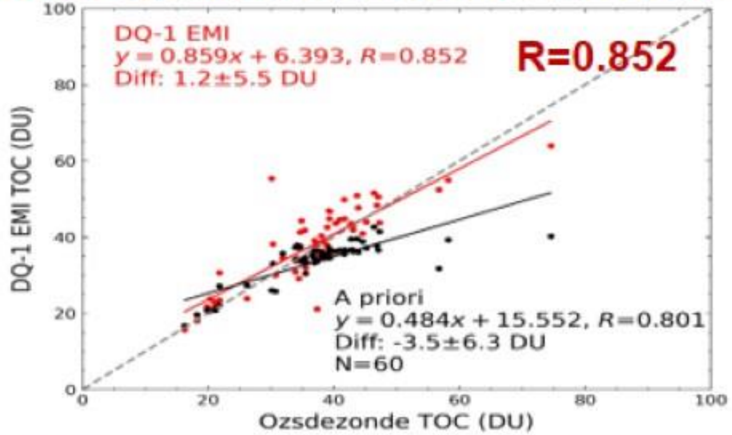
DQ1: Global O_3 in 2022/05/23



DQ1 O_3 in China



- **DQ1** O_3 validation with ozonesonde

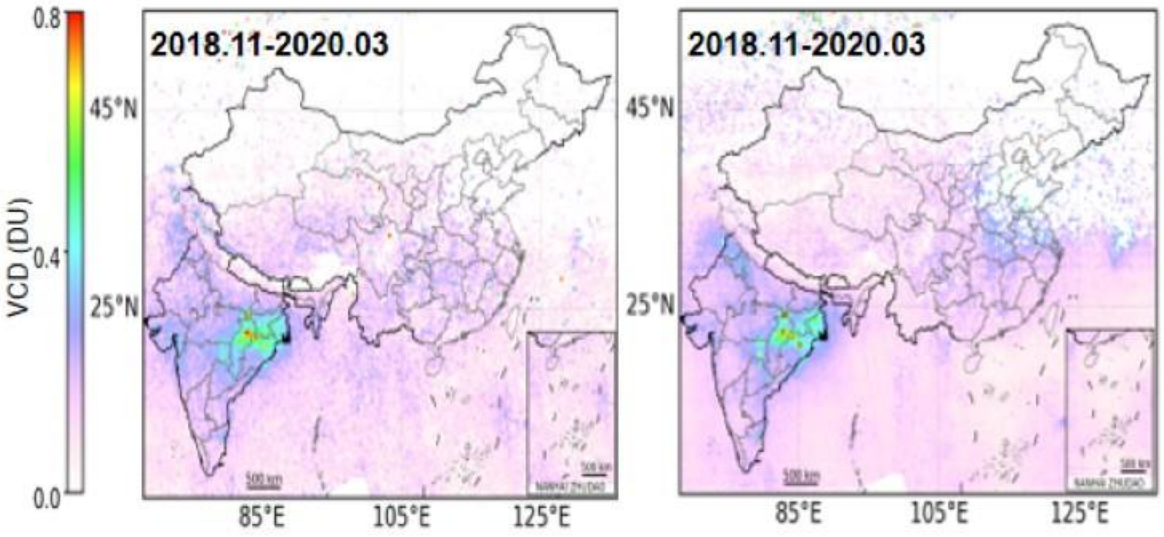


- To study diurnal variation, we compare morning and afternoon global tropospheric O_3 from GF5B and DQ-1 satellites.
- We find that tropospheric O_3 in the morning is higher than in the afternoon in the mid-latitude (30°N-40°N) region but opposite at higher latitudes.

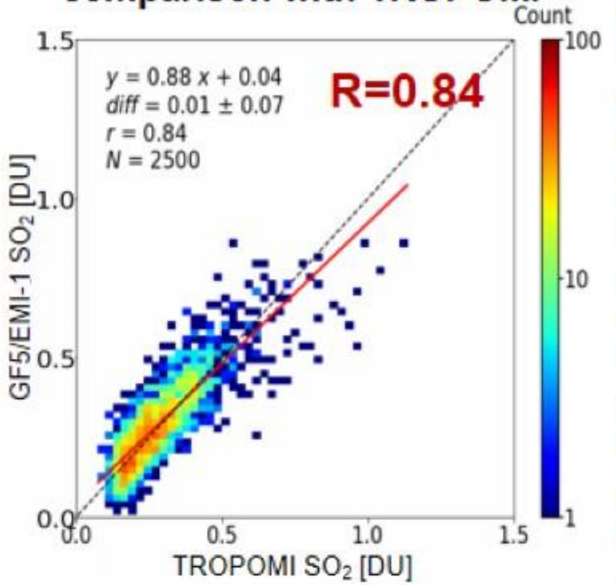
■ GF5 SO_2 retrieval and validation

- **GF5 SO_2 comparison with TROPOMI**
- **GF5 SO_2 validation with in-situ site**

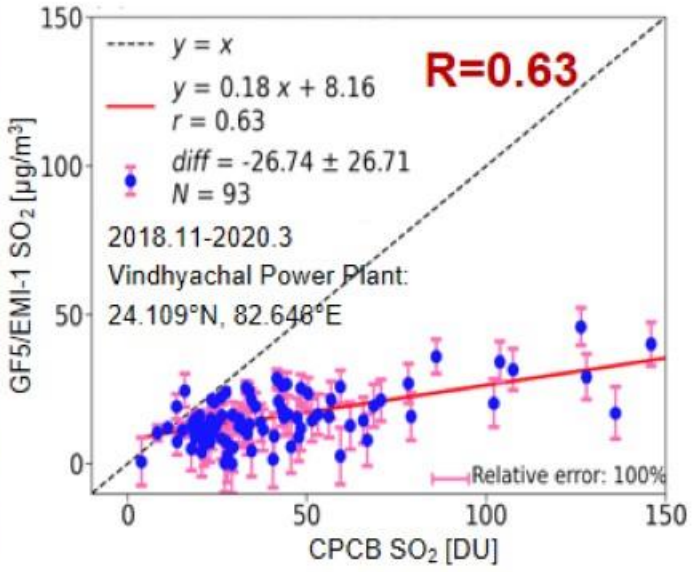
GF5 SO_2 Product **TROPOMI OE SO_2 Product**



comparison with TROPOMI



validation with CPCB (in-situ site)



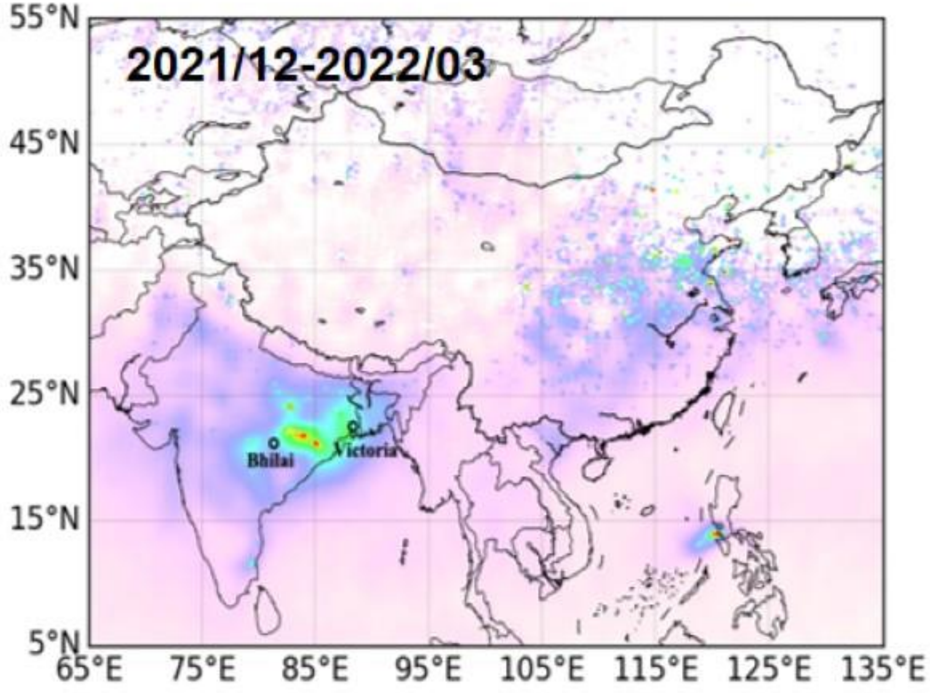
Congzi Xia, Cheng Liu et al., Science Bulletin. 2021

- ☐ **GF5 SO_2 is consistent with the TROPOMI product, with a spatial R of 0.84 and a mean bias of 0.08 DU.**
- ☐ **The SO_2 surface concentration from GF5 correlates well with in-situ measurements in India (R=0.63).**

GF5B SO_2 retrieval and validation

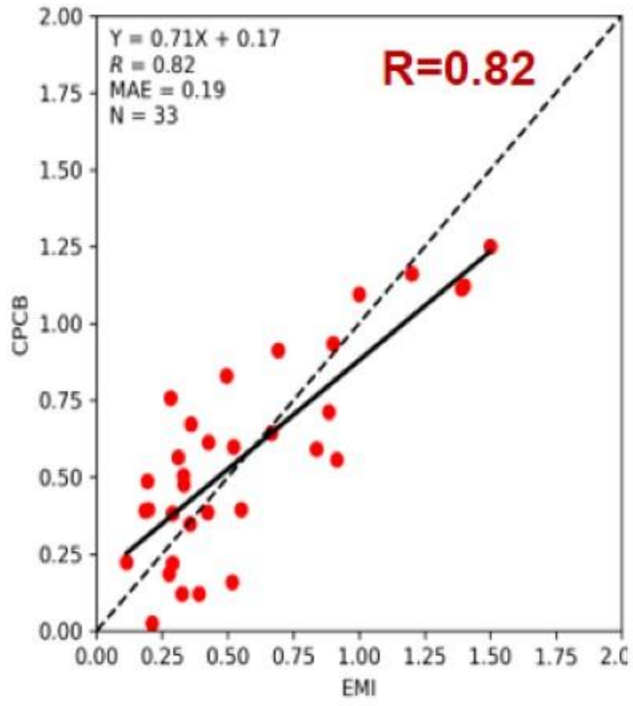
- **GF5B SO_2 result**

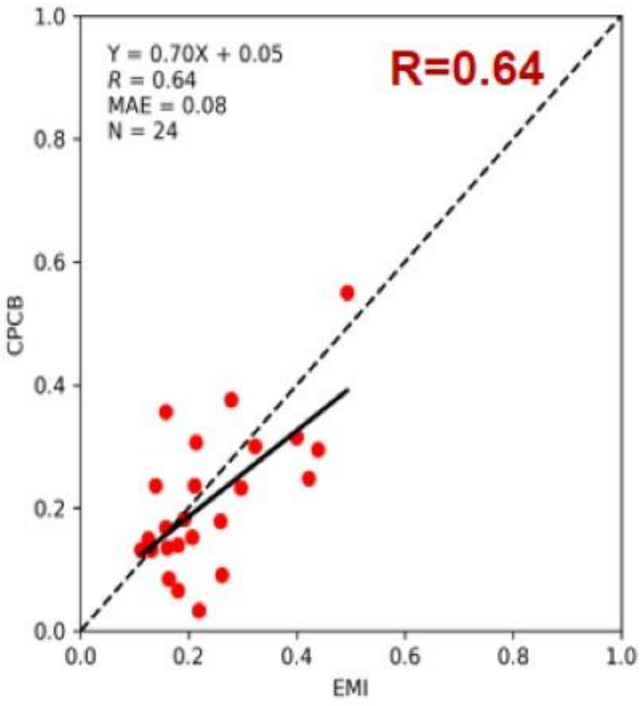
  - monthly mean GF5B SO_2



- **GF5B SO_2 validation with Indian CPCB (in-situ site)**

  - Bhilai (21.19°N, 81.34°E)
  - Victoria (22.54°N, 88.34°E)





Thanks for your attentions