# GEMS ozone product evaluation using ozonesonde measurements during the ACCLIP campaign

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Averaged O3 profile

UTLS ozone: GEMS is better than Clim

Trop ozone: GEMS V3 is better than V2

a priori

**2** GEMS V3 has improved trop O3

ERA5 Potential Vorticity (100 hPa)











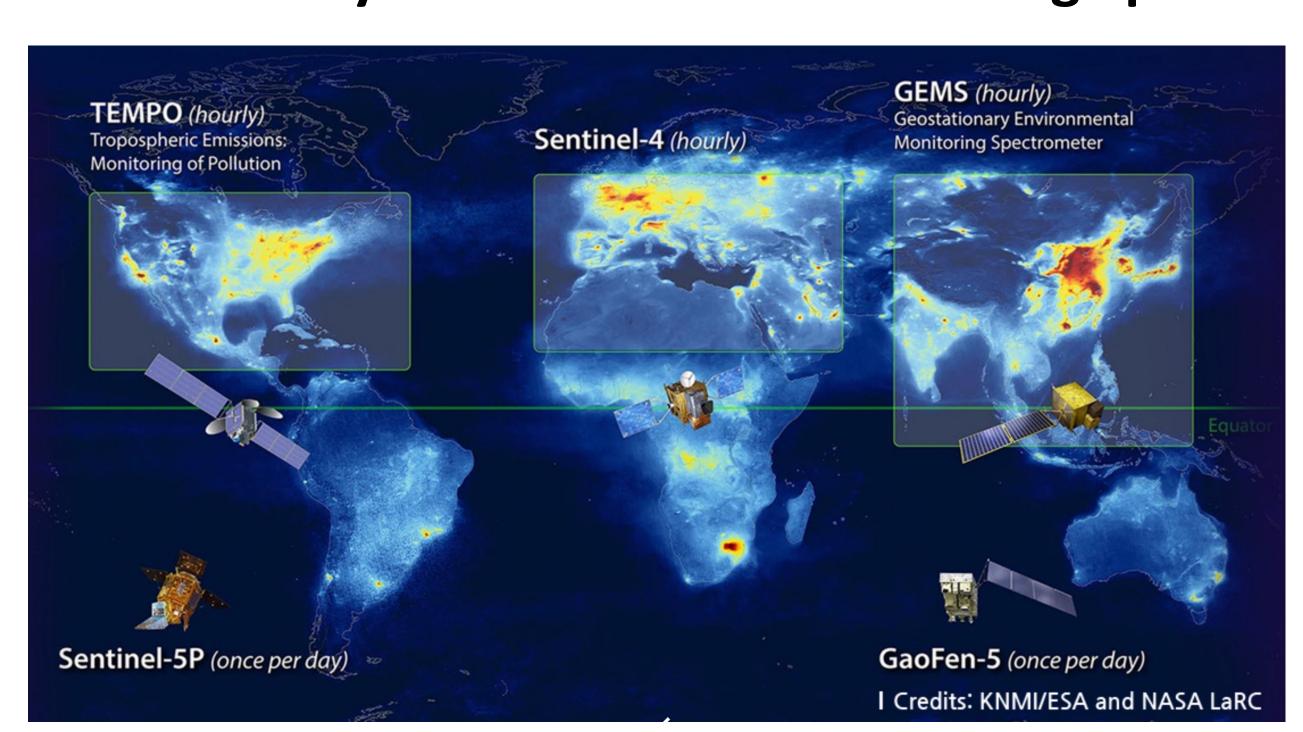


Fig.1 Spatial coverage of GEMS and companion GEO environmental statellites (Image from GEMS official site (http://gems1.yonsei.ac.kr/)

The GEO-KOMPSAT 2B satellite with Geostationary Environment Monitoring Spectrometer (GEMS) was launched in February 2020 for conitunuous monitoring of air quality (AQ) with unprecedented spatial (3.5~7 km) and temporal (~1 hour) resolutions using a geostationary Earth orbit for the first time. Advanced of UV-visible spectrometer provides subnanometer spectrum within 300-500 nm, produces hourly column information of O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, HCHO, CHOCHO aerosols distribution over Asia (Fig.1)

#### Ozone profile

Comparison

ASM activity and anticyclone

were "significantly stronger"

than normal, it covers the

leading to low ozone (and

low potential vorticity) in

\* Small value means strong Anticyclone

the UTLS

whole Korean Peninsula

Ozone profile information is also produced using optimal estimation method, and ozone spectral line fitting in UV window (Huggins Bands; 300-340 nm; Rodgers 2000; Liu et al. 2010; Bak et al. 2013). (\* Chappuis band information is not used)

Aug 2021 vs Aug 2022

## Asian Summer Monsoon Chemical and Climate Impact Project (ACCLIP)

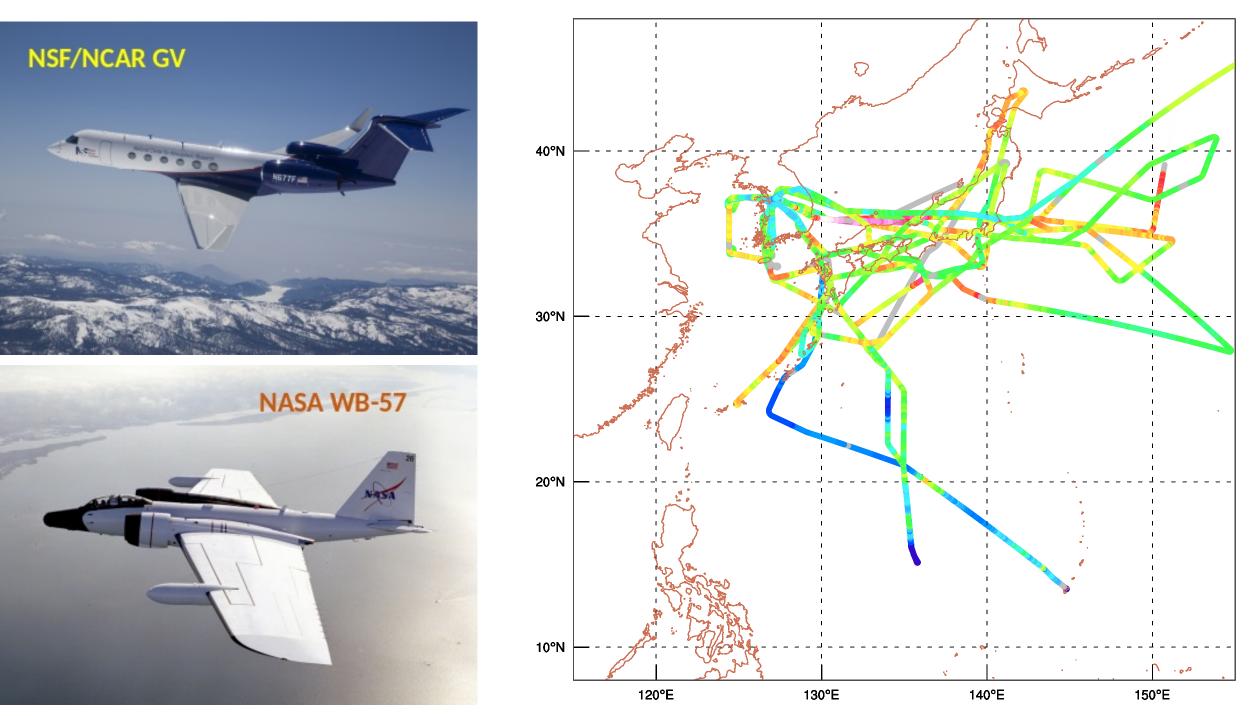


Fig.2 Two aircrafts used in ACCLIP and filght track of GV (upper one) during ACCLIP (Images from ACOM NCAR, https://www2.acom.ucar.edu/acclip)

O3 variability during ACCLIP

To understand Asian gas and aerosol emissions and impact on global chemistry through Asian Summer Monsoon (ASM) convectio & circulation, airbourne upper troposphere and lower stratosphere (UTLS) chemistry meaturements were made over Korea and Northwestern Pacific in August 2022. Comprehensive data on trace gases, aerosols, clouds, and radiation were obtained through 31 research flights (GV: 14 RFs + WB: 17 RFs)

#### **Ground measurements**

Balloon-based ground measurements of O3, aerosols, and LS water vapor were also conducted over S. Korea, Taiwan, Palau. This study uses daily 38 ozonesonde measurement data from S. Korea (Anmyeon site, 36.54°N 126.33°E).

## **GEMS Ozone profile product (O3P)**

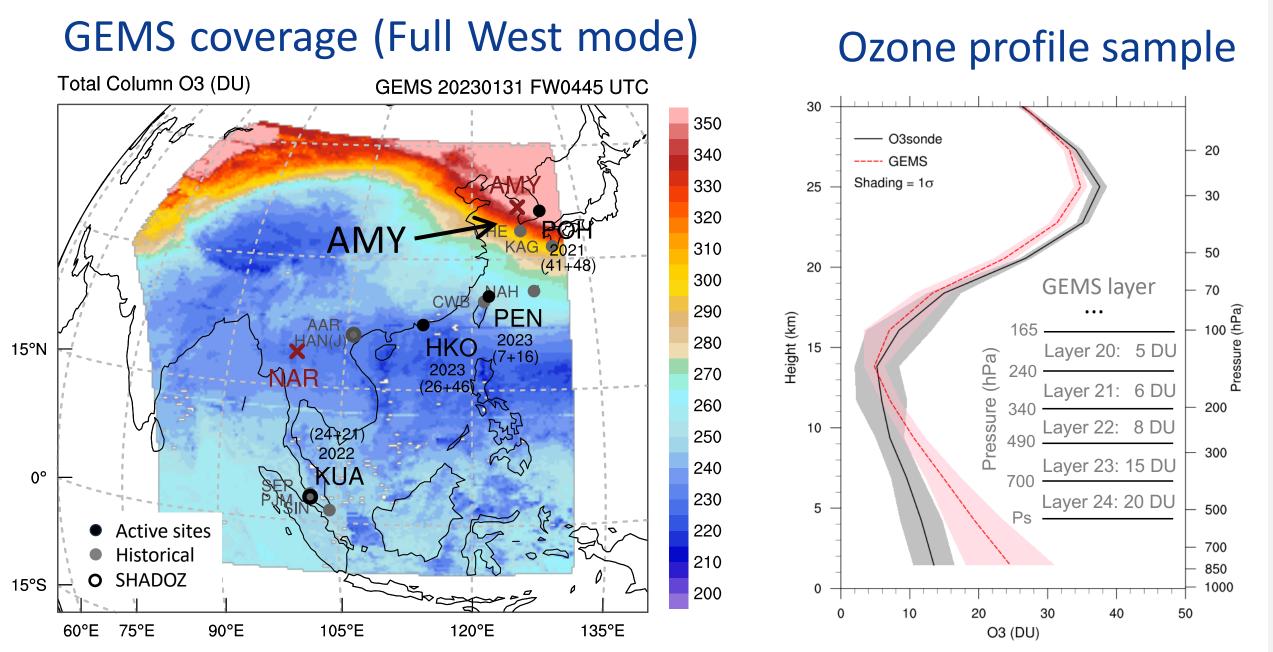


Fig.3 [Left] Total column ozone from GEMS with historical Ozoneosonde sites (only black markers are active. [Right] GEMS ozone profiles in 24 layers

### GEMS Averaging kernel (GEMS O3P only use Huggins bands)

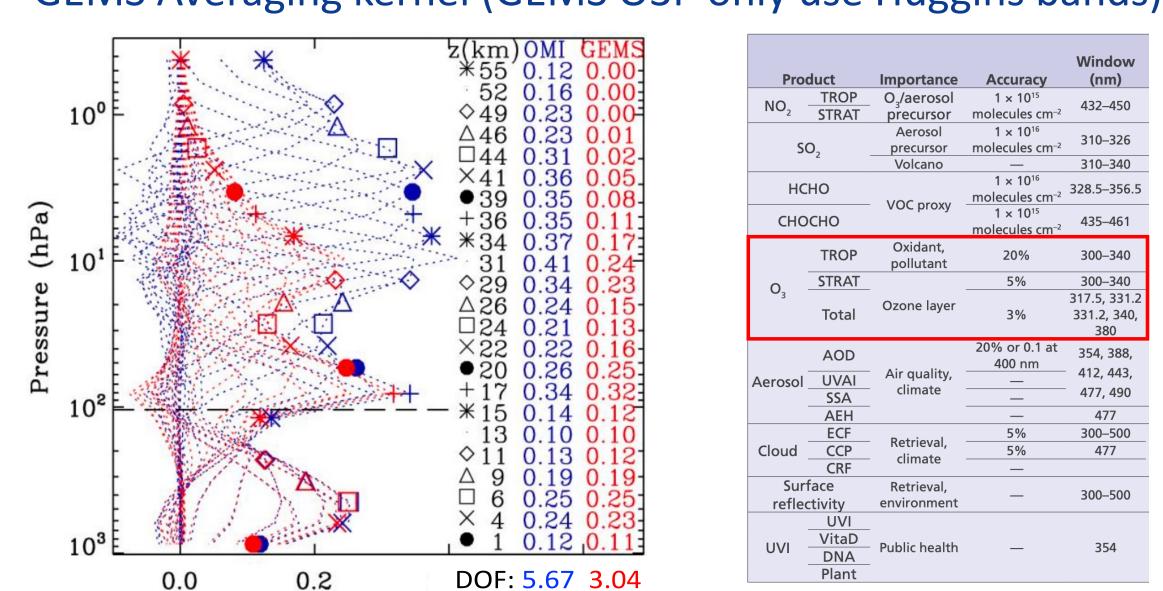


Fig.4 GEMS averaging kernel (2020 NIER), channel information (Kim et al. 2020)

## Ozonesonde meaturements

Number of ozonesonde profiles at each site in S. Korea



### Acknowledgments

This research was supported by National Institute of Environmental Research of Ministry of Environment in South Korea

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Summary

- 1. New version of GEMS  $O_3$  product (O3P Ver.3) shows improved ozone variability in the troposphere.
- 2. GEMS O3P (Ver.3) shows good potential of capturing daily O3 variability (STE, convective influence) in the troposphere.
- 3. Year-to-year changes of  $O_3$  in the troposphere and lower stratosphere are reasonably captured, but need further evaluations.
- 4. ACCLIP Ozonesonde measurements significantly contributed to the improvement of the GEMS O3 product (O3P Ver.3).

## Further study

- Evaluation of the seasonal evolution of the Trop. and Strato. ozone
- 2. Continued measurement of ozonesonde for interannual evaluation
- 3. Adding more O3 profile measurements over Asia
- 4. Cross-valiadation with chemical reanalyses and modeling products