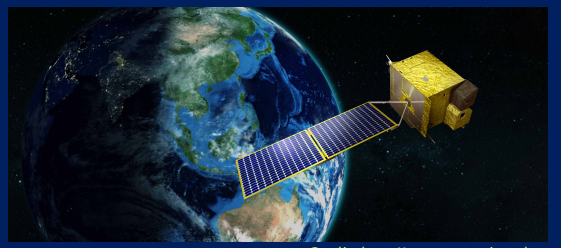
TEMPO Meeting
Poster No.: 8

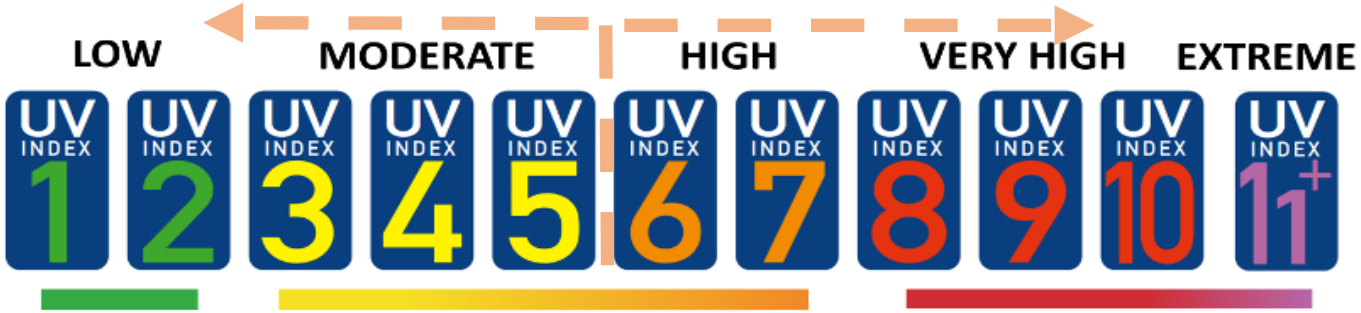
Preliminary results of UV index product in Asia using GEMS measurement



1. Introduction

- To raise public awareness of the risks of exposure to UV radiation UV index was adopted by WHO.
- The percentages of the low and high UV index using OMI satellite data. And yellow boxes show the observational data sites provided by WOUDC.
- Most of the observations were placed in relatively high latitudes and low risk UV index.

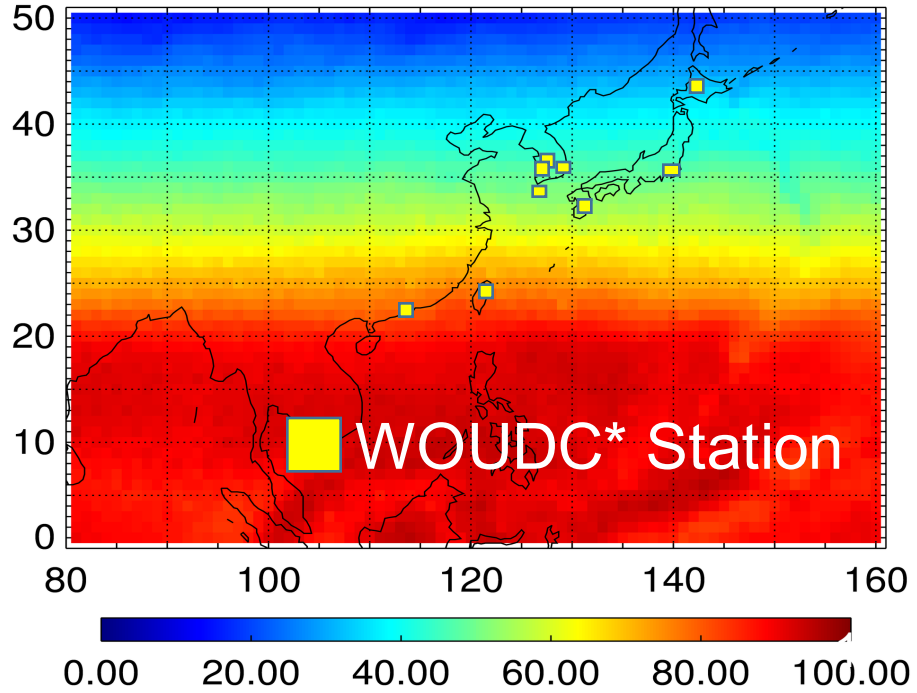
- GEMS would be possible to provide the spatial and diurnal variability of surface UV Index over East Asia.



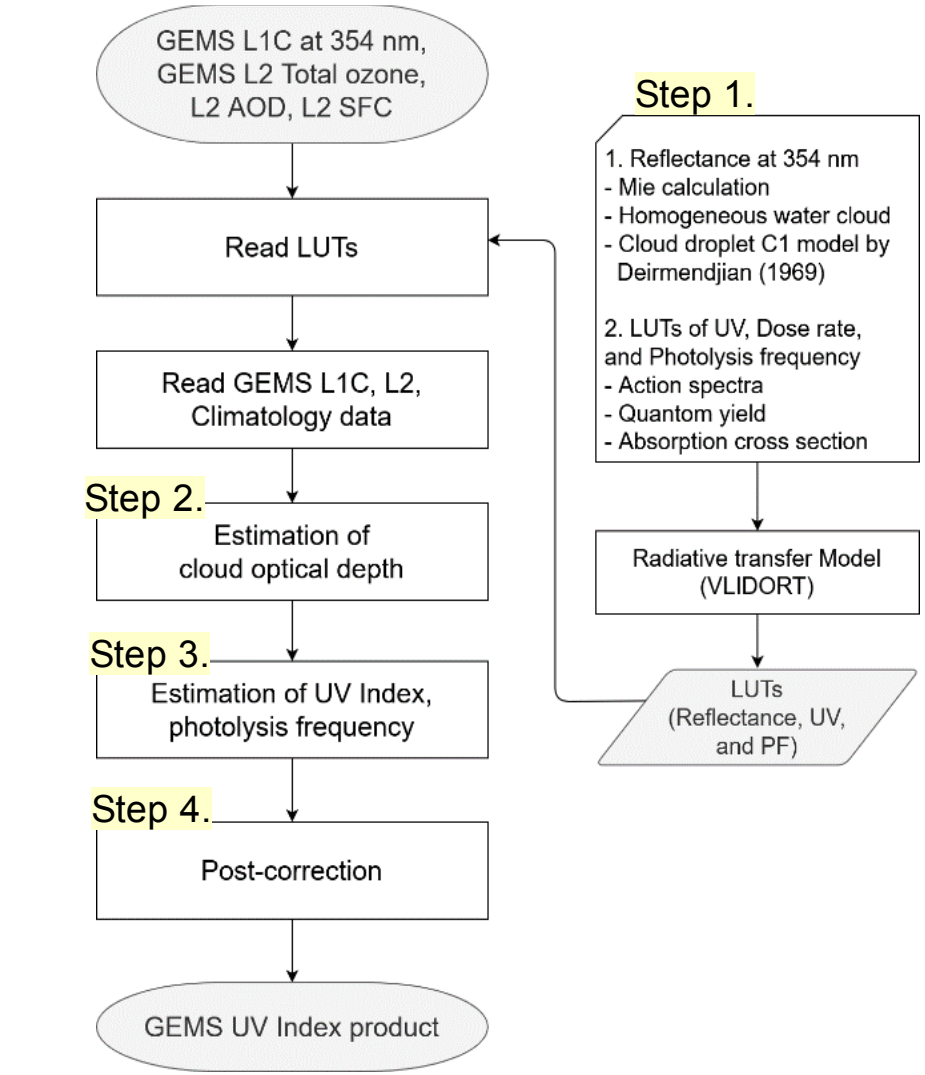
- Period: 2005-2009
- Data: OMI UVB Level3 (1˚x1˚)
- Solar zenith angle: 0˚

*World Ozone and Ultraviolet Radiation Data Centre (WOUDC)

Percentage of UV index (6 < UVI)



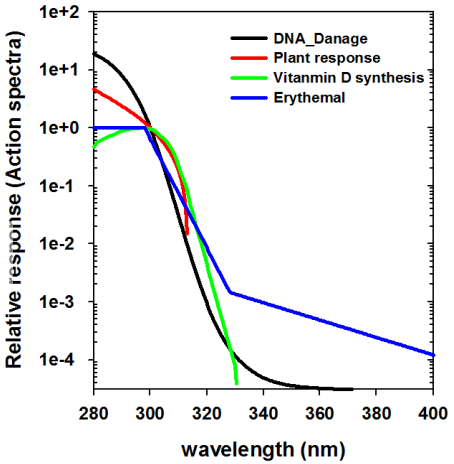
2. Overview of GEMS UV index algorithm



- **UV Index**
- **Damage of DNA, plant response, vit. D synthesis indices, photolysis frequency of Ozone**

Step 1. Calculation of Look-up tables

1) TOA Reflectance at 354 nm
2) Surface UV Dose rate
3) Photolysis frequency of O_3



Step 2. Estimation of Cloud optical depth (COD)

LUT of R_{354} =f(COD, ~~Geometry~~, ~~TH~~, ~~SA~~, ~~TO3~~)

Measured TOA reflectance ⟷ Calculated TOA reflectance

*Here τ_c is an effective optical depth that it corresponds to the cloud optical depth of a homogeneous water cloud.

Step 3. Estimation of UV Index

- GEMS L2 Total ozone, GEMS L2 SFC, Estimation COD
- LUT of UVDR

Step 4. Post correction

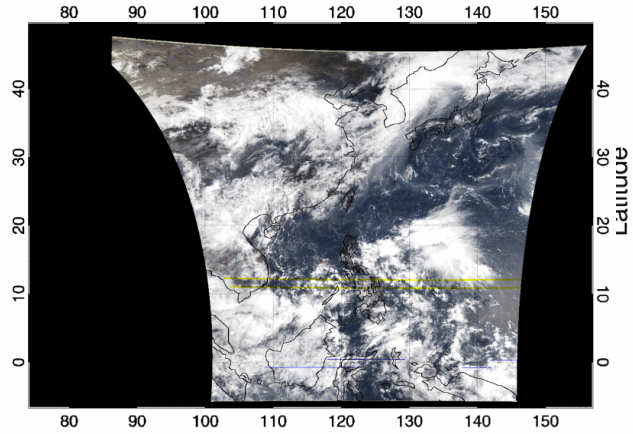
- Absorbing aerosol (Aroal et al., 2009)
- GEMS L2 AOD
  MAC V1 (Kinne et al., 2013)

$$Ca = \frac{1}{1 + K * \tau_{abs}}$$

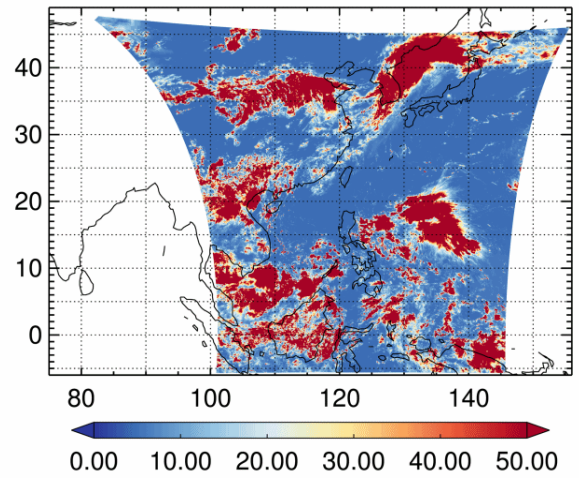
[K: 3; average coefficient]

3. Case study (August 6, 2020)

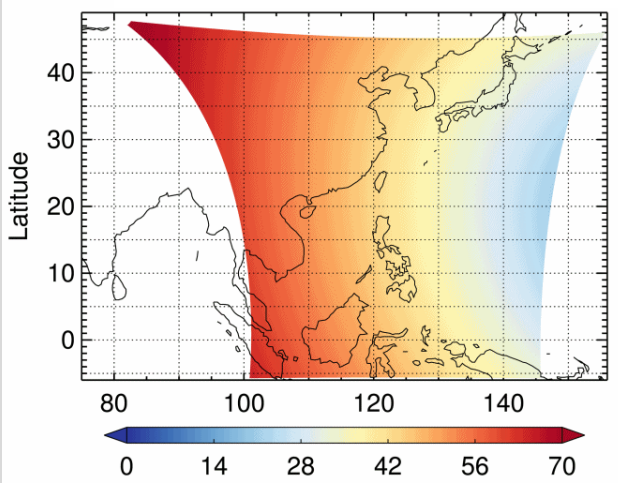
[GEMS False RGB]



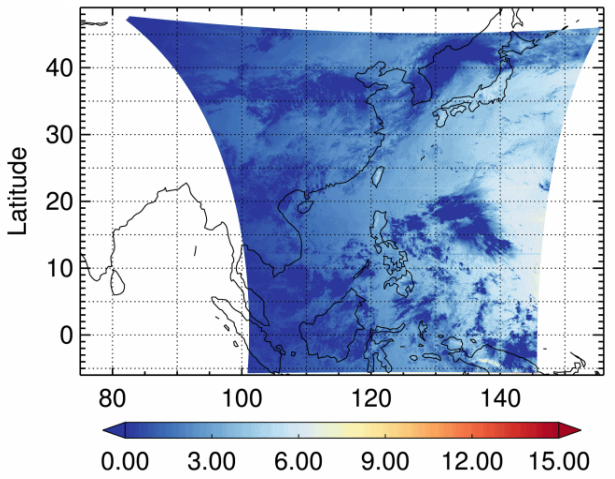
[Cloud optical depth]



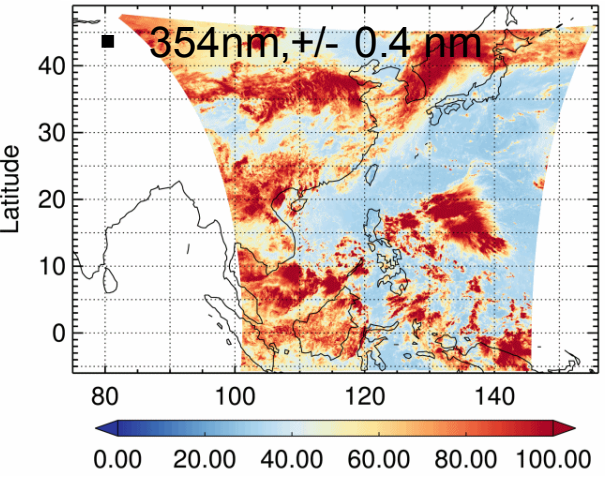
[Solar zenith angle]



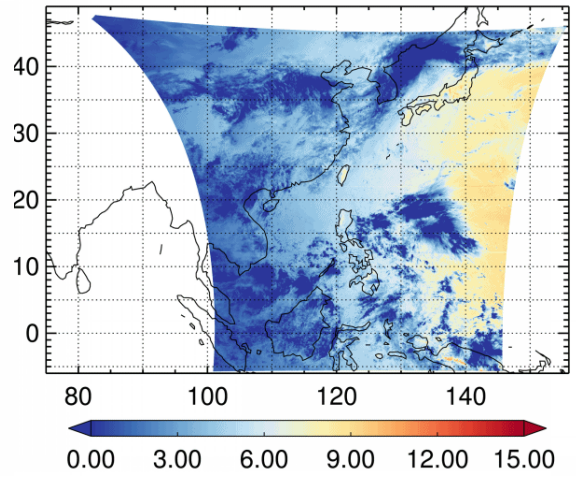
[Damage of DNA Index]



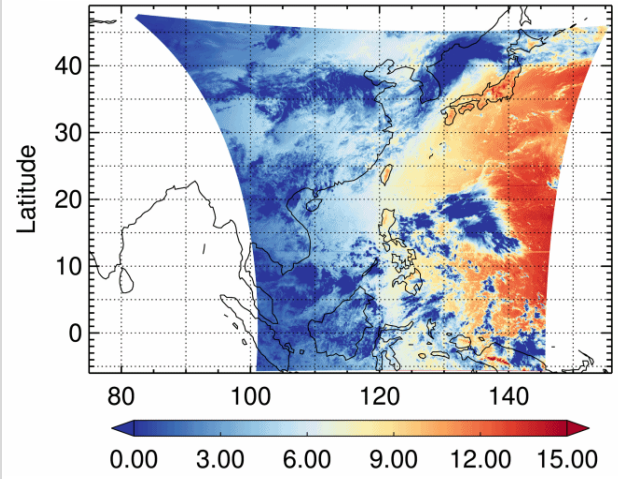
[TOA Reflectance]



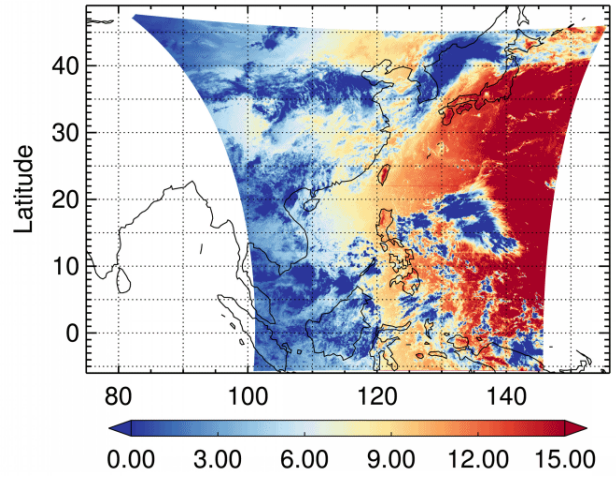
[UV Index]



[Plant response Index]

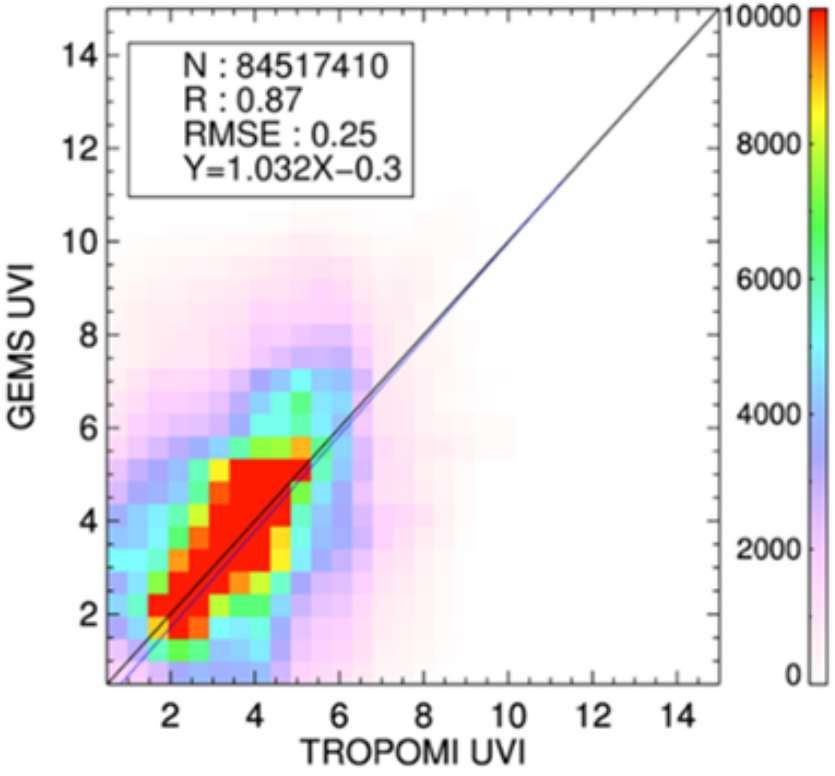


[Production of Vitamin D Index]



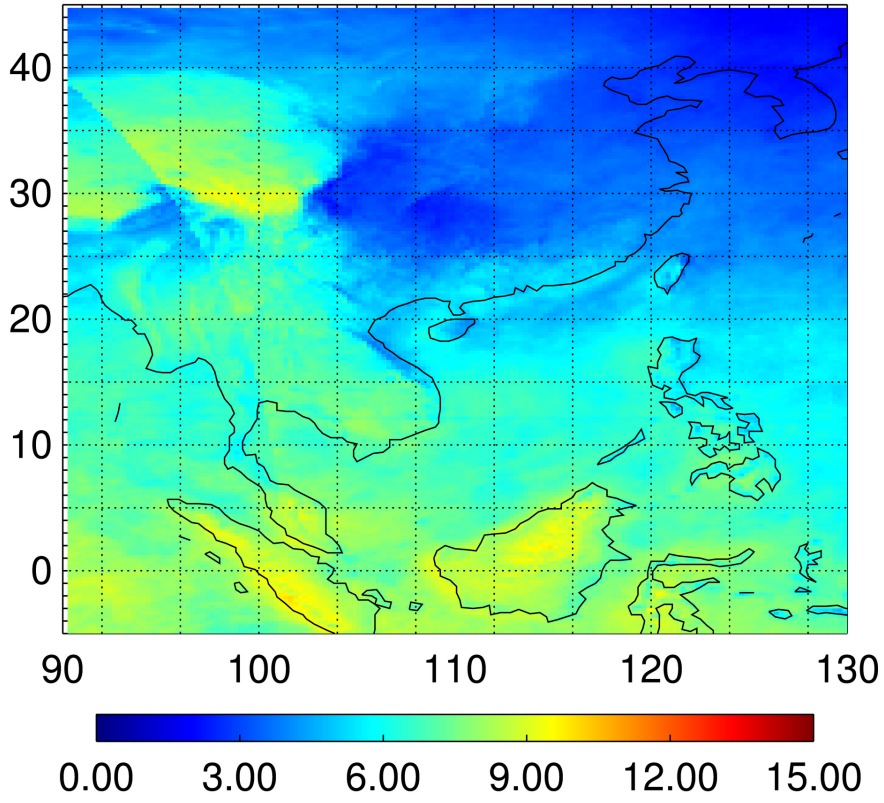
4. Results

[Validation (2020/08~2020/12)
Distance <10 km, Time <30 min]



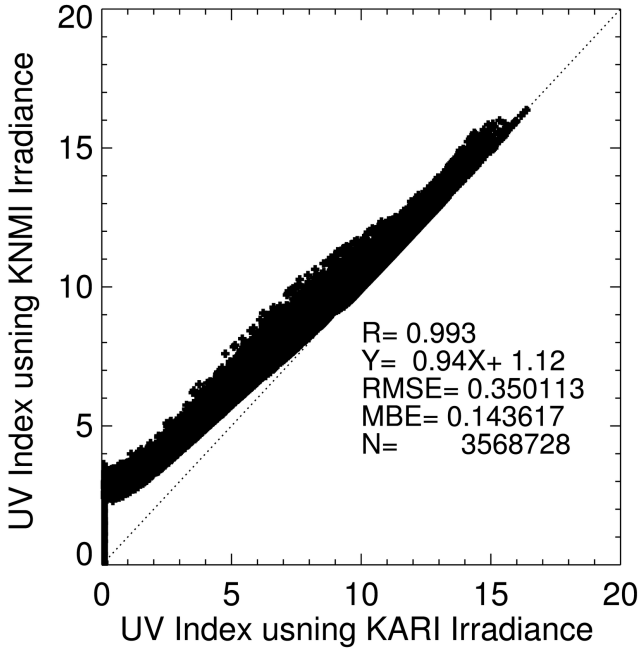
- Absorbing aerosol correction
  GEMS: L2 AOD Product
  TROPOMI: L3 MAC Climatology

[Climatology of UV Index from
2020/08 to 2020/12 04 UTC
0.25degx0.25deg]



- Data: August-December

[Changes in UV index due
to differences in irradiance]



- KNMI irradiance,
  KARI irradiance

5. Application using GEMS UV radiation product

1) Provide health information

- GEMS UV Product provide UV index information in better spatial and time resolution.

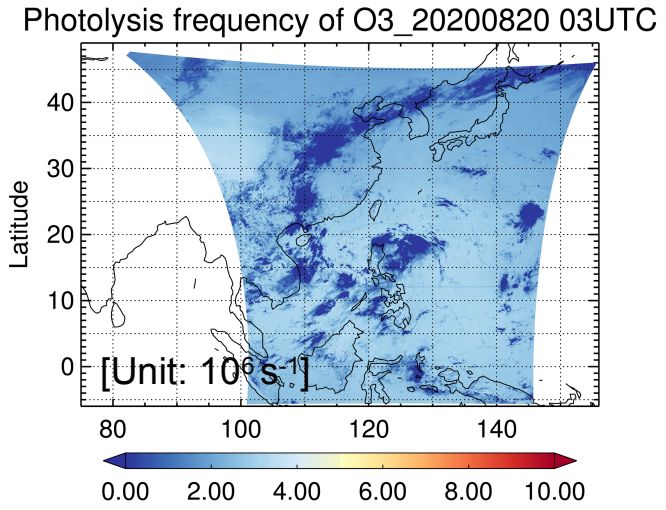
2) Photolysis frequency of surface Ozone and NO_2

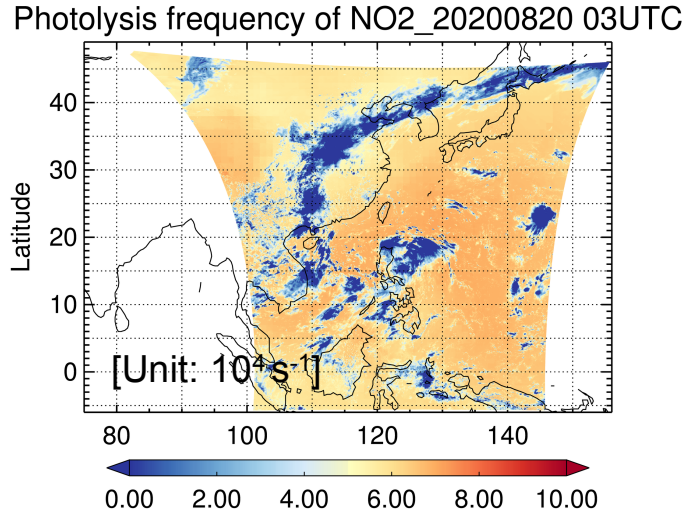
$O_3 + h\nu \rightarrow O_2 + O(^1D)$ (λ < 320 nm)

$NO_2 + h\nu \rightarrow NO + O$ (λ < 420 nm)

- $E_A(\lambda,\tau,t) = \int_0^{2\pi} d\phi \int_0^{\pi} E(\lambda,\theta,\phi,t) sin\theta d\theta.$
- $J_A(t) = \int_\lambda \sigma_A(\lambda,T)\ \phi_A(\lambda,T)\ E_A(\lambda,\tau,t) d\lambda,$

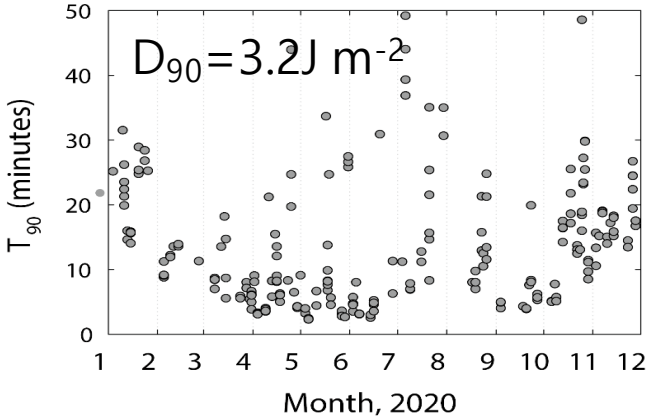
where $\sigma_A(\lambda, T)$ is the absorption cross-section (m^2 $molec^{-1}$), and $\phi_A(\lambda, T)$ is the photolysis quantum yield (molecule $photon^{-1}$) for species O_3 depending on the temperature (T).





3) Inactivation times of SARS Coronavirus COV and COV2

- Reference paper: Herman et al. (2020)
- VLIDORT Version 2.6: 250-320nm, 0.5nm, Online calculation



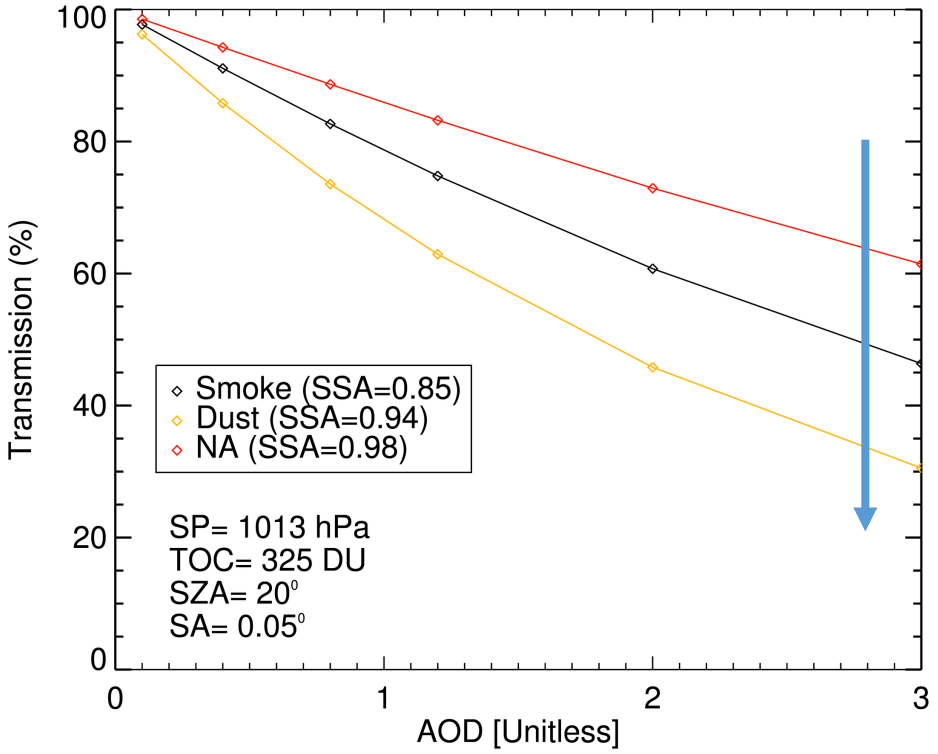
* Inactivation times in 2020 at Yonsei University

Post correction for Absorbing AOD

- Aerosol optical properties (AOP): Kim et al. (2018)

Type	r_{m1}	r_{m2}	σ_{m1}	σ_{m2}	M1 Fraction	Re(RI) (440 nm)	SSA (440 nm)	AAE 440–675 nm	AE 440–675 nm
HAF	0.0854	1.4115	1.5421	1.7630	0.99994	1.46	0.88	1.34	1.49
Dust	0.0644	1.0392	1.4420	1.6436	0.99823	1.48	0.91	2.11	0.25
NA	0.1013	0.8176	1.5870	1.9371	0.99980	1.41	0.97	1.17	1.53

- Transmission= (UVI_{AODi}/ UVI_{AOD0})



- Summary of available measurements of aerosol single scattering albedo