5.079 An optimal specification of a micro-satellite for detection of NO2 hotspots with a km-order resolution.

Early Career Scientist

Presenting Author:
Tamaki Fujinawa, Environmental Chemistry and Engineering, Tokyo Institute of Technology, Tokyo, Japan, fujinawa.t.aa@m.titech.ac.jp

Co-Authors:
Katsuyuki Noguchi, Information and Computer Sciences, Nara Women's University, Nara, Japan
Andreas Richter, Institute of Environmental Physics, University of Bremen, Bremen, Germany
John Burrows, Institute of Environmental Physics, University of Bremen, Bremen, Germany
Naohiro Yoshida, Environmental Chemistry and Engineering, Tokyo Institute of Technology, Tokyo, Japan
Yasuko Kasai, National Institute of Information and Communications Technology, Tokyo, Japan

Abstract:

We have investigated a concept of a micro-satellite for the observation of tropospheric NO_2 with a spatial resolution of 1x1 km^2 using the UV/visible wavelength range. Our aim is to find an optimal specification for the sensor concept. SCIAMACHY, GOME-2 and OMI have successfully provided the global distributions of tropospheric NO_2 (Hilboll et al., 2013; Duncan et al., 2016) with a horizontal resolution of 13-80 km, and satellite instruments having a resolution of 3-8 km (e.x. GEMS, TEMPO, Sentinel-4 and Sentinel-5P) are now being developed or have been launched. Here, we assumed an instrument with a 2D-CMOS array sensor and a compact optical system dedicated to the detection of NO_2 hotspots. The scientific requirement used in this study is to observe the tropospheric NO_2 column with a measurement error of less than 10%. The SCIATRAN was used for radiative transfer calculations. Considered areas were Beijing in China as a strongly polluted region and Hokkaido in Japan as a clean region. Calculated seasons were winter (January) and summer (July) on 2010 and 2012. The vertical profiles of NO_2, SO_2, O_3, BrO and HCHO for the troposphere and the upper atmosphere (up to 100 km) were taken from monthly mean values from the CHASER model, and annual mean values from the SOCRATES model, respectively. A Lambertian surface was assumed and a variability of albedo (0.05-1.0) was taken into account. The synthetic spectra were convolved with a Gaussian slit function with a FWHM of 0.4 nm and random noise was added corresponding to the signal-to-noise ratio (SNR) derived from the defined SNR equation using a given sensor specification. One thousand spectra were analyzed by the DOAS method for each of the different geometries and fitting windows. Finally, we statistically evaluated the measurement errors as the 1-sigma standard deviation of the 1000 retrieved SCDs.