AIR QUALITY OVER CHINA

European Leader Investigator	***Chinese Leader Investigator***
Dr. Ronald van der A Royal Netherlands Meteorological Institute NETHERLANDS	Prof. Bai Jianhui Institute of Atmospheric Physiscs, Chinese Academy of Sciences, CHINA

List of Principal Investigators (PIs)

Topic Nr.	PIs	Title
32271_1	*Dr. Ronald van der A,* *Dr. Jianhui BAI*	***Air Quality Observations and Emission Estimates***
32271_2	*Prof. Gerrit de Leeuw,* *Prof. Yong Xue*	***AEROSOL: Satellite-derived aerosol properties over mainland China: application to air quality and trend analysis***
32271_3	*Dr. Nan Hao,* *Prof. Cheng Liu*	***Assessment of the characteristics, sources and impact of haze in China***

EXECUTIVE SUMMARY

Due to the strong economic growth in China in the past decade, air pollution is starting to become a serious issue in China with also global implications. Especially, the Beijing-Tianjin-Hebei region, the Yangtze River and the Pearl River deltas are three focal regions with serious air pollution and three key areas where air quality policies have gained a lot of attention in China. The main theme of this proposal is the study of air quality over China using satellite observations. The proposed project will focus on a better understanding of the sources and processes of air pollution.We propose the following focus areas of the research:- Satellite-derived aerosol properties over mainland China: application to air quality and trend analysis - Air Quality Observations and Emission Estimates: Emission will be derived from satellite observations to study the sources of air pollution and to improve the air quality modeling,- Assessment of the characteristics, sources and impact of haze in ChinaThe proposed work is often related to existing projects (eg. EU-project MarcoPolo), which can provide limited funding. Funding for the extra work can sometimes be found by combining this project with the educational activities (training of students) of the institutes.

ABSTRACT 32271_1: "Air Quality Observations and Emission Estimates"	
European Principal Investigator	***Chinese Principal Investigator***
Dr. Ronald van der A	Dr. Jianhui BAI
KNMI,	Institute of Atmospheric Physics, Chinese Academy of
Netherlands	Sciences, CHINA

The main theme of this proposal is the study of air pollution over China using satellite observations. The proposed project will focus on a better understanding of the sources of air pollution and their spatial and temporal variability.

To study the sources of air pollution we will derive emissions of volatile organic emissions (VOC), HCHO, SO2, NH3 and NO2 in East-China. We will combine (i) ground-based measurements of key compound species at and near Beijing region, (ii) satellite retrieved column abundances of HCHO, NO2 and SO2 from GOME-2 and OMI satellite sensors and (iii) regional models, in order to gain insight in anthropogenic and biogenic emissions. Satellite observations from GOME-2, OMI and TROPOMI will be used to study the temporal and spatial evolution of air pollutants in China. The satellite observations will be used in conjunction with chemical transport models to both access the satellite discerning capabilities over the regions but also to provide top-down constraints on the derived emissions. This effort can improve our understanding of the creation, the actual levels, the transport and the dispersion of air pollution.

In addition, emissions, derived from satellite observations, will be validated using ground observations in several cities and ground stations in China. The trend in emissions within will be derived. The validated emissions will be used in a regional chemical transport model. This model will calculate the forecast of the air quality for two days ahead.

Atmospheric pollution in China is still a severe problem, so, we will continue our study on monitoring and validation of trace gases, aerosols, BVOC emissions in China, especially at some typical sites. The main activities are ground observations, satellite data validation and applications. We will measure trace gases (NOx, SO2, O3), particulate matter (PM2.5), AOD, solar radiations (global radiation, direct radiation, diffuse radiation, UV, PAR), meteorological parameters (T, RH) at Xinglong and Xianghe stations. Similar measurements will be carried out at a tropical region (Danzhou, Hannan province) in China, which station is located at a rubber plantation ecosystem, and BVOC (biogenic volatile compounds) emission fluxes will be measured using a gradient method on an above-canopy tower. The observation data of BVOC emissions, O3, solar radiations and meteorological parameters at some typical ecosystems, i.e., temperate forest, subtropical bamboo forest, subtropical plantation (Qianyanzhou station, CAS) in China will be collected and analyzed. The time series of all above observations are from 2 or 3 years to more than 10 years, which are provided for validation and the improvement of air quality models and satellite data. BVOC emission data measured at some forests in China are also important input parameters and can be used for air quality and climate models, especially for estimating O3 and PM2.5 production through chemical and photochemical processes.

Based on ground observation data, the concentrations of trace gases and aerosols, BVOC emissions will be obtained, their daily, seasonal and annual variations can be recognized. Empirical models of BVOC emissions, O3, UV, PAR will be developed, then, the response of O3 to isoprene and monoterpene emissions, the relationship between BVOC emissions and HCHO column density will be studied at some ecosystems, in order to better understanding the mechanism of O3 formation associated with BVOCs and wider applying the satellite data. Suggestions for air pollution control policy in some regions in China will be defined.

ABSTRACT 32271_2: "AEROSOL: Satellite-derived aerosol properties over mainland China: application to air quality and trend analysis"

European Principal Investigator	***Chinese Principal Investigator***
Prof. Gerrit de Leeuw Finnish Meteorological Institute (FMI), Finland	Prof. Yong Xue Institute of Remote Sensing and Digital Earth, CAS, CHINA

A high-quality satellite-derived aerosol data set will be provided for air quality studies over mainland China. The instruments used will be ATSR-2 (ERS-2), AATSR (ENVISAT), SLSTR (Sentinel-3) and MERSI (FY satellites). Together these instruments will provide a consistent aerosol data set starting in 1995. The primary product is the spectral aerosol optical depth (AOD). The satellite products will be validated using Chinese Sun Photometer networks available to the consortium (AERONET, CARSNET and the RADI network). The long time series allows for trend analysis and evaluation of changes in emissions across China such as the consequences of urbanization, industrial changes and changes in life style. The AOD data will further be used together with ground-based PM2.5 data available to the Chinese partners to develop an robust AOD/PM2.5 relationship following methods described in, e.g., Xu et al. (2015). In this study the FMI air quality model SILAM will be used. PM2.5 is important for air quality, with a strong effect on human health. Part of this PM2.5 data set will be set aside as an independent data set for validation. The PM2.5 data will further be used to develop the appropriate tools and techniques, which can be used for the estimation of deterioration rates (corrosion or soiling) of specific materials.

ABSTRACT 32271_3: "Assessment of the characteristics, sources and impact of haze in China"

European Principal Investigator	***Chinese Principal Investigator***
Dr. Nan Hao	Prof. Cheng Liu
German Aerospace Center, Germany	University of Science and Technology of China,CHINA

Executive Summary of activity:
Air pollution is one of the most important environmental issues in developing Asian countries like China. In recent years, haze frequently occurred in China due to rapid economic development, urbanization and motorization. For instance, there about half a year was haze days with poor visibility in Beijingin 2014. Haze is closely related to the large emissions of SO2, NOx, volatile organic compounds (VOCs), and particulate matter (PM) especially PM2.5 from anthropogenic activities. Publicly available in situ observations can not provide sufficient spatial coverage and high consistence in data quality for a long-term period. Therefore, knowledge gaps still exist in the understanding of the characteristics, sources and regional impact of haze in China under the background of global climate change. Satellite retrievals with high spatial coverage and high consistence for a long period can improve our understanding on haze pollution over China. In this project, we attempt to combine satellite observations throughout the troposphere with ground-based and aircraft measurements to provide a holistic view of characteristics and sources of haze pollutions over strongly affected regions of China. We apply multi-platform satellite observations by the GOME, SCIAMACHY, GOME-2, IASI, OMI, Sentinel 5 precursor (TROPOMI), MOPITT, MODIS, MISR, Suomi-NPP VIIRS and CALIPSO instruments to analyze NO2, SO2, VOCs like HCHO and CHOCHO and other related trace gases, aerosol parameters like aerosol optical thickness (AOT) and absorbing aerosols index (AAI) in this region.We will show the potential of using the current generation of satellite instruments to monitor haze pollution. Global and regional chemical transport model (MOZART and WRF-CHEM) will be used to simulate the impact of regional transport of air pollutants on haze and compared with the satellite measurements. The potential impact of haze over China on a regional climate change will be also investigated by combining satellite, in situ and aircraft measurements with modeling calculations.

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- DLR:
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