Air Quality Monitoring and Forecasting in China

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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 on the effect of aerosols on the climate. To study the sources of air pollution we will derive emissions of volatile organic emissions (VOC), HCHO, SO_2 and NO_2 in the East-China and Beijing in particular.

We will combine (i) ground-based measurements of key compound species at and near Beijing region, (ii) satellite retrieved column abundances of HCHO, NO_2 and SO_2 from GOME-2 and OMI satellite sensors and (iii) global/regional models, in order to gain insight in anthropogenic and biogenic emissions in the Beijing area.

Satellite observations from SCIAMACHY and OMI will be used to study the temporal and spatial evolution of sulphur dioxide over Europe and 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 SO_2 emissions provided by current inventories and air quality simulations. This effort can improve our understanding of the creation, the actual levels, the transport and the dispersion of SO_2 and channel future scientific efforts in novel ways.

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

NO_2 is an important precursor of aerosols. To study the relation between aerosols and NO_2 we will use the data sets of the Absorbing Aerosol Index (AAI) and NO_2 retrieved from GOME, SCIAMACHY, OMI and GOME-2, which comprises a long time series of more than 15 year. In addition ground measurements will be used.

To study the effect of aerosols on the climate, several studies will be conducted to gain understanding of the distribution of aerosols in time and space, including the temporal variability and the vertical distribution. Aerosol data retrieved from satellites, e.g. MODIS, will be validated with the Chinese AERONETlike aerosol network. Specific knowledge on aerosols in China from ground-based in situ and remote sensing measurements will be used together with radiative transfer models and global circulation models to determine aerosol effects on climate in China, including contributions from natural and anthropogenic origin.

Common aerosol and cloud spatial Day-Of-the-Week patterns in the Aerosol Optical Depth of MODIS will be studied to reveal an impact of the anthropogenic working cycle on regional meteorological and climatic parameters due to the aerosol indirect effects. From CALIPSO and AERONET data a climatology (4-year, 1x1 degree) will be derived focused on Asian dust aerosol type.

The proposed work is often related to existing projects, which has the advantage that the expertise is already available. Funding for the extra work can sometimes be found by combining this project with the educational activities (training of students) of the institutes

中国的空气质量监测和预测

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本项目的主要目标是利用卫星观测来开展中国的空气污染研究。项目的研究工作主要集中于更好地认识空气污染物的各种来源以及大气中气溶胶对气候变化的影响等方面，其中包括中国东部和北京地区挥发性有机物（VOC），HCHO，SO2和NO2的排放。

本项目的实施拟采用多种技术手段相结合的方案，即

1. 以北京及周边地区为基地开展对主要污染物的地基监测；
2. 利用GOME-2和OMI等卫星监测资料开展HCHO，NO2和SO2柱总量的卫星反演；
3. 发展和完善全球和区域模型，强化对京津冀地区人为源和生物源排放的认识。

利用SCIAMACHY和OMI卫星观测资料开展欧洲和中国上空大气中SO2的污染状况及其时空演变特征的研究，将卫星观测与污染物输送模式相结合来评价卫星观测的分辨能力并对现有排放源清单和空气质量模拟提供的SO2排放进行评估。这一研究会为认识SO2的实际污染水平、输送和扩散等特征提供一个新的途径。

此外，将在中国的几个城市中通过地基观测对卫星观测的NO2排放进行验证，并且获得NO2排放的短期变化趋势特征，验证后的NO2排放将用于区域化学输送模型中，用这种模型可以提前两天进行空气质量预报。

NO2是大气中气溶胶的重要前体物，为研究气溶胶与NO2的关系，将使用吸收气溶胶指数（AAI）和NO2资料。这些资料是从GOME，SCIAMACHY，OMI和GOME-2等卫星观测资料反演得到的，已有长达15年的时间序列。同时也会用到地面的相应观测资料。

为研究气溶胶的气候效应，将开展关于气溶胶时空分布及变化特征的研究，其中包括气溶胶的垂直分布特征。为此，将使用中国气溶胶观测网的资料来验证卫星反演（如MODIS）得到的气溶胶观测结果。结合对气溶胶的地基和卫星观测结果，使用辐射传输模型和全球环流模型对气溶胶的气候效应进行模拟研究，包括对自然和人为气溶胶气候效应的研究。

同时，将对MODIS的AOD中气溶胶和云的每周一天图像进行研究，以便认识人类活动周期是如何通过气溶胶的间接效应对气象和气候参数产生影响的。

此外，利用CALIPSO和AERONET资料，可获得一些气候变化（4年，1?×1?）特征（主要集中于亚洲沙尘气溶胶方面）。

本项目与目前实施的其它有关项目中的部分内容有关，因此已有一定的研究工作积累，本项目可与研究所的一些教育培训活动相结合，获得一些经费支持。