Non-linear Dynamics of the Remotely Sensed Atmospheric Data and Modelling; Implications to Climate & Earth System Science; Case studies for Athens (Greece) and Beijing (China)

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The objective of the project is to explore the temporal and spatial variability of crucial atmospheric parameters for the dynamics of the climate and Earth system. In particular, the investigation of the spatio-temporal variability of the aerosol optical depth (AOD) and the atmospheric ozone content by utilizing modern tools of non-linear analysis is a principal component of the atmospheric and climate-dynamics modelling. The method is based on the exploitation of the available observations of the ESA and Chinese Earth Observation data (e.g. ERS-GOME, ENVISAT-MIPAS-GOMOS-SCIAMACHY), as well as the ground-based Dobson and Brewer stations and remote sensing networks (e.g. AERONET, WDCA, MODIS) performing the detrended fluctuation analysis. This technique eliminates the non-stationarities existing in the time-series and provides information about the intrinsic properties of the parameter under consideration, notably:

1) Does AOD and ozone exhibit long-range correlations? (i.e. some properties of the time series at different times are correlated and its correlation function decays much slower than exponential decay e.g. power-law decay).
2) Does AOD and ozone obey long memory? (i.e. if adjacent values are positively or inversely correlated exhibiting scaling effect). Is there a tendency for an increase / decrease in AOD and ozone to be followed by another increase/decrease in AOD and ozone at a different time?. The results obtained will be used to the validation of the basic climate models over normal and extreme (e.g. forest fires) conditions.
3) Quantification of the uptake of ozone into aerosol and water droplets as a function of height.

The deliverables of the project will be:

1) Climate characteristics of the non-linear dynamics of AOD and O_3 on a global scale. Impacts on the solar UV radiation and temperature fields. Case studies for Athens and Beijing at normal and extreme conditions.
2) Scaling properties of air pollution in Athens and Beijing to improve air-pollution forecast modelling.
3) The vertical profile of the uptake of ozone into atmospheric urban aerosol and cloud droplets.

For the Greek group the main funding source to run the project will be the Athens University. Other potential sources will be detected. For the Chinese group, the main funding is from The Multi-Scale Comprehensive Observation and Study of Spatial-Temporal Properties of Aerosol Project funded by the MOST Global Change Study Key Program of China between 2010 and 2015.

The accomplishment of the project is expected to train a number of young post graduate scientists during their Masters, Doctorate degrees or post doctorate research. In addition, the project supports the continuity of the ESA-MOST Dragon 2 relevant projects and themes.

非线性动力学的遥感大气数据和建模在气候变化与地球系统科学中的作用；雅典（希腊）和北京（中国）案例研究

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该项目的目的是探索气候和地球系统动态过程中至关重要的大气参数的时间和空间变异性。特别是，利用非线性分析工具调查气溶胶光学厚度（AOD）和大气臭氧含量的时空变异是大气和气候动态建模的一个主要组成部分。该方法是基于利用现有的欧空局和中国地球观测数据（例如ERS-GOME，ENVISAT-MIPAS-GOMOS-SCIAMACHY），以及地面Dobson and Brewer观测站和遥感观测网（如AERONET, WDCA,MODIS）进行趋势波动分析。这种技术消除了时间序列中存在的非平稳从而提供研究参数内在特性的信息，主要体现在：

1) AOD与臭氧是否表现出长范围的相关性？（即在不同的时间某些时间序列的特性相关性，其相关函数衰减比指数衰减如幂律衰减慢得多）。
2) AOD与臭氧是否遵守长期记忆？（即是否邻近值呈正或负相关尺度效应）。是否有一种趋势表示增加/减少气溶胶和臭氧将引发另一个在不同的时间的气溶胶和臭氧增加/减少？得到的结果将被用来验证在正常和极端条件（例如森林火灾）的基本气候模式。
3) 定量气溶胶和水液滴中的臭氧提高是否可以是高度的函数？

项目的可交付成果将包括：
1）在全球范围内气溶胶和臭氧的非线性动力学气候特征。对太阳紫外线辐射和温度的战场的影响。在正常和极端条件下雅典和北京的案例研究。
2）雅典和北京的空气污染尺度特性以及在空气污染预测模型的改善。
3）城市大气气溶胶和云滴中臭氧提高的垂直剖面。

希腊研究课题组的主要运行经费来源于雅典大学和其他可能的经费来源。中国科研课题组主要经费支持来自中国科技部《全球变化研究重大科学研究计划》项目（2010-2015）"多尺度气溶胶综合观测和时空分布规律研究"。项目的实施将培养一批年轻的硕士，博士研究生或博士后科学家。此外，该项目也是欧空局和科技部支持的龙计划二期项目的继续。