Aerosol information provided by ESA EO missions

CGMS is informed about the capabilities of actual and future ESA EO satellites for aerosol sensing.

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1.- INTRODUCTION

Atmospheric aerosols, although minor component in mass, are critical in terms of impacts on climate and especially climate change. Aerosols influence the global radiation balance directly by scattering and absorption of solar radiation, and indirectly through influencing could reflectivity, cloud cover and cloud lifetime. Further, the IPCC has identified anthropogenic aerosols as the most uncertain climate forcing constituent.

2.- ESA PRESENT MISSIONS CONTRIBUTION

- ERS-2 polar satellite, flying since 1995, provides aerosol information thanks to the ATSR-2 (Along Track Scanning Radiometer) instrument. The ATSR-2 is an evolution of the ATSR on board ERS-1, mainly dedicated to SST retrieval (thermal Infrared) , with the additional visible channels at 0.55, 0.67 and 0.87 μm for vegetation remote sensing.

  GOME (Global Ozone Monitoring Experiment), embarked on ERS-2, is an across track scanning optical spectrometer, covering the wavelength range of 250-790 nm, splitted in four channels. It has also capabilities to detect aerosols, and such capability will be continued operationally thanks to the embarking of GOME-2 in the MetOp series, flying from 2006 until at least 2019.

- The Envisat polar satellite, launched in March 2002, provides in turn aerosol information thanks to the improved ATSR(AATSR), MERIS (Medium Resolution Infrared Spectrometer) and SCIAMACHY.

  The Advanced AATSR, is functionally the same instrument as ATSR-2..

  MERIS is a programmable, medium-spectral resolution, imaging spectrometer operating in the solar reflective spectral range. Fifteen spectral bands can be selected by ground command, each of which has a programmable width and a programmable location in the 390 nm to 1040 nm spectral range. Although aerosols can be detected, there is no specific product.

  SCIAMACHY is an imaging spectrometer whose primary mission objective is to perform global measurements of trace gases in the troposphere and in the stratosphere. The solar radiation transmitted, backscattered and reflected from the atmosphere is recorded at relatively high resolution (0.2 μm to 0.5 μm) over the range 240 nm to 1700 nm, and in selected regions between 2.0 μm and 2.4 μm (UV-SWIR: 240-314, 309-3405, 394-620, 604-805, 785-1050, 1000-1750, 1940-2040 and 2265-2380nm). The high resolution and the wide wavelength range make it possible to detect many different trace gases despite low concentrations (The mixing ratios of most constituents are of the order of 10-6 or less). The large wavelength range is also ideally suited for the detection of clouds and aerosols. SCIAMACHY has three different viewing geometries: nadir, limb, and sun/moon occultations which yield total column values as well as distribution profiles in the stratosphere and (in some cases) the troposphere for trace gases and aerosols.

3.- ESA FUTURE MISSIONS CONTRIBUTION

- The first future Explorer Mission to provide information about aerosols is the ADM-Aeolus, to be launched in 2007. The main aim of the mission is to demonstrate the

possibility of providing winds at altitudes between the surface and about 30 Km. The main element is the ALADIN instrument i.e. Doppler wind Lidar intended to provide profiles of the horizontal wind in the troposphere and lower stratosphere above or in absence of thick clouds. ADM-Aeolus will also deliver profiles of backscatter and extinction coefficients, which will allow to retrieve cloud and aerosol information.

- EarthCARE is the ESA Explorer mission, to be launched in 2012, dedicated to Earth Clouds, Aerosols and Radiation. It will be implemented in co-operation with JAXA. It is aimed to overcome the fact that the present observations of global aerosol properties are limited to optical depth and crude estimates of particle size. It addresses the need to know aerosols chemical composition, whether they scatter or absorb and their vertical and geographical distribution.

  The mission goal is to deliver observations of vertical profiles on a global scale of aerosol properties such as extinction coefficient and an estimate of the size and chemical composition of the aerosol particles, differentiating between absorbing and n0n-abosirbing aerosols. The basic parameter is the aerosol optical thickness profile, which needs to be converted into aerosol mass and size. The requirement is for a detectability threshold of 0.05 with an accuracy of 10-15%.

  The profile information can only be provided by active instruments i.e. a backscatter Lidar for aerosols. This, together with a high frequency Doppler radar for clouds, will allow discrimination between absorbing/non-absorbing aerosols. A multi-spectral imager is required to provide additional geographical coverage of aerosol retrievals. A broad band radiometer is also required for the mission to provide radiances and to derive fluxes.

4.- FURTHER INFORMATION

www.esa.int/eo
www.envisat.esa.int