5.3 The Environmental Satellite (Envisat)

Envisat is an advanced Earth observing satellite, due for launch in 1999, designed to provide measurements of the atmosphere, ocean, land and ice over a 5-year period. As the successor to the highly successful ERS-1 and ERS-2 satellites, it will ensure direct continuity of data from most of the ERS instruments, thereby extending to more than 10 years the long-term data sets crucial for environmental monitoring and furthering many operational and commercial applications.

The payload includes three new high-resolution spectrometers for atmospheric sounding:

— GOMOS, a stellar occultation instrument operating in the UV-visible and near-IR, is primarily designed for accurate monitoring of stratospheric ozone;
— MIPAS is an IR limb emission sounder, mainly for investigating chemical and dynamical processes and climatology in the stratosphere;
— SCIAMACHY observes nadir, limb and occultation radiation between UV and short-wavelength IR for studies of tropospheric and stratospheric chemistry.

Envisat also carries an advanced synthetic aperture radar (ASAR) that can collect high-resolution images with variable viewing geometry, together with new wide-swath and selectable dual polarisation capabilities. A new imaging spectrometer (MERIS) is included for ocean colour and vegetation monitoring, and there are improved versions of the ERS radar altimeter (RA-2), the microwave radiometer (MWR) and visible/near-IR radiometers (AATSR), together with a new high-precision orbit measurement system (DORIS).

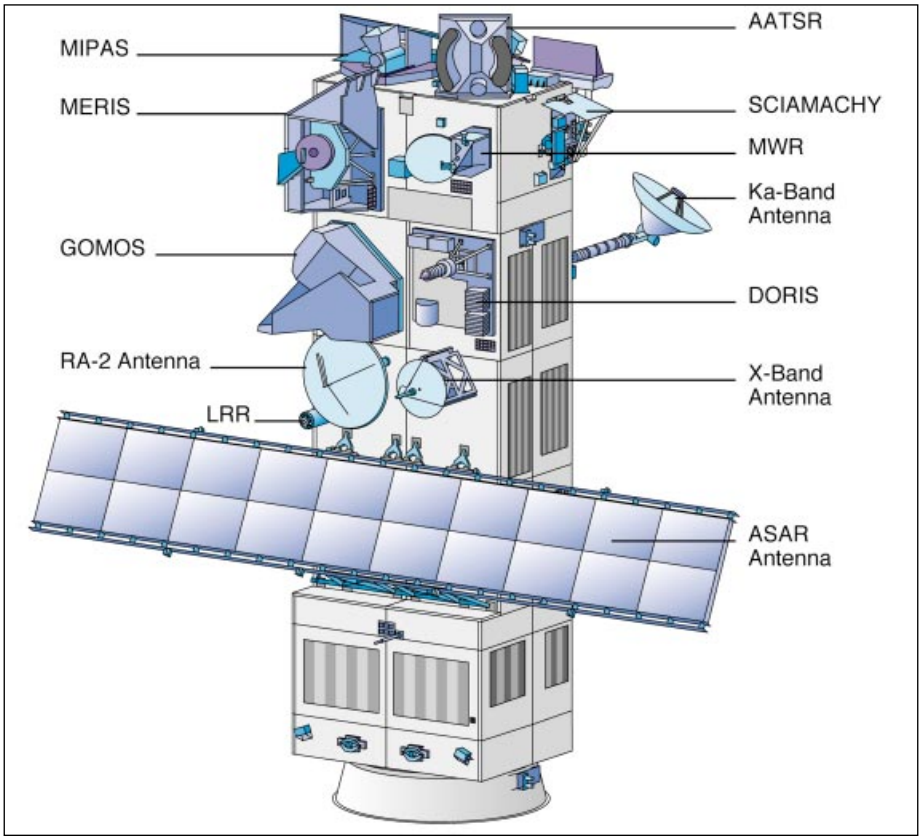
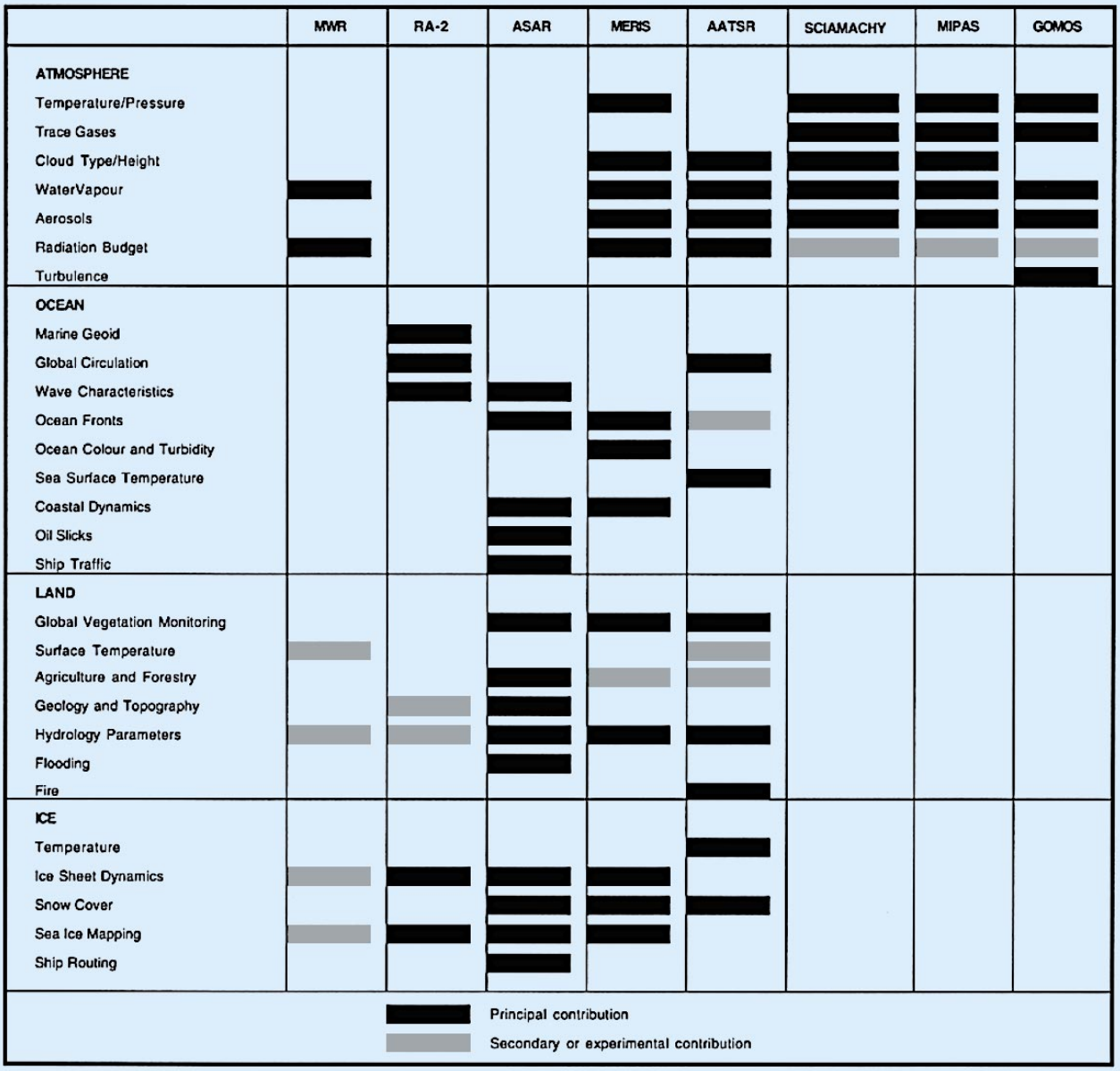


Figure 5.3.1. The Envisat satellite.

Table 5.3.1. The measurement capabilities of Envisat's instruments.



In the atmosphere, Envisat will observe many of the factors affecting the environment that are related to changes in atmospheric composition. The results of these changes include the enhanced greenhouse effect, increases in levels of 'UV-B' radiation reaching the ground and changes in atmospheric composition. Understanding the processes involved and the ability to observe the key parameters are both currently lacking. The observations made by Envisat are intended to help redress the balance by not only extending the range of variables observed from space, but also the range of altitude covered, i.e troposphere as well as stratosphere.

The oceans exert a major influence on the Earth's meteorology and climate through their interaction with the atmosphere. Understanding the transfer of moisture and energy between ocean and atmosphere, as well as the transfers of energy by the oceans themselves, are matters of scientific priority. Envisat is intended to contribute to work in this area by providing information on ocean topography and circulation, winds and waves, ocean waves and internal waves, atmospheric effects on the sea surface, sea surface temperatures, coastal bathymetry and sediment movements, as well as the bio-physical properties of oceans – both coastal waters and open ocean.

The Earth's land surface is a critical component of the Earth system becasue it carries more than 90% of the biosphere. It is the location of most human activity and it is therefore on land that human impact on the Earth is most visible. Within the biosphere, vegetation is of fundamental importance because it supports the bulk of human and animal life and largely controls the exchanges of water and carbon between the land and atmosphere. Yet knowledge and understanding of the many processes involved is actually quite limited. Observations of the land surface by Envisat will allow the characterisation and measurement of vegetation parameters, surface water and soil wetness, surface temperature, elevation and topography. These are critical data sets required for the improvement of climate models, in particular the estimates of albedo, vegetation productivity and land surface fluxes.

Last, but not least, the cryosphere is a key component of the climate system. It includes the ice sheets as well as sea-ice and snow cover. Here, the all-weather capabilities of Envisat will be exploited to the full as the hostility, remoteness, winter darkness, inclement weather conditions and frequent cloud cover of high latitude ice/snow-covered regions make the use of remote sensing mandatory. Envisat will provide important information on seasonal (and long-term) variations in sea-ice extent and thickness, evolutions in the ice sheets and snow cover. All impact the climate system; several are very sensitive indicators of climate change. Here again, the knowledge of many of the processes involved is lacking.

As a total package, Envisat’s capabilities exceed those of any previous or planned Earth observation satellite. Its measurement capabilities are summarised in Table 5.3.1, indicating the overall capabilities of the Envisat instruments. Some have been designed to work closely together. Thus, for example, the RA-2 requires input from both the MWR and DORIS instruments even for the derivation of some of its basic geophysical products. Other Envisat instruments provide synergetic opportunities simply because several different types of observation are available for the same place and time. A good example of this is provided by the combination of the three atmospheric chemistry instruments (GOMOS, MIPAS and SCIAMACHY), which are functionally quite different but observe different sets of chemical species in partially overlapping profiles.