ENERGIES
THE TOTAL GROUP'S EXTERNAL MAGAZINE No.14

KEEPING WATCH ON PLANET EARTH

At the 2003 Earth Observation Summit in Washington, around thirty governments adopted the G8 Evian proposal to bring all Earth observation systems under one umbrella to create a permanent and global set of indicators and monitor the Planet's condition, natural phenomena and the changes caused by humans. This cooperative system for observation, measurement and forecasting, called the Global Earth Observation System of Systems (GEOSS), is now becoming a reality, bringing together different countries as well as disciplines and pooling already-existing observation infrastructure on all continents. A new tool to preserve Planet Earth?

With the Industrial Revolution, the Earth entered a new era that Paul Crutzen – winner of the 1995 Nobel Prize for Chemistry for his research on the ozone layer – named the Anthropocene era. This period is characterised by the significant, indeed preponderant, influence of human activity on the major physical, chemical and biological balances of our planet. Since the middle of the 20th century, humankind has considerably modified the planet's hydrology by storing or diverting huge amounts of water. We have upset the processes of erosion and sedimentation. And we have changed the chemical composition of the atmosphere, thus also modifying some of its physical properties. Today, even the ongoing evolution of the other living beings mainly depends on human impact. This situation is a cause for concern, all the more so because we all have a claim to the benefits of progress and because the world population, already huge, is expected to grow by a further 50% in the coming decades, generating ever-higher demand for resources, energy and space.

Our ability to understand and, above all, predict the changes that are now under way requires multiple and coordinated observation programmes, and in many cases constant monitoring. We also need the means to analyse, interpret and model the data we gather, so as to be able to predict and manage the changes that are now occurring. The scope of the current debate on the future of our planet is constantly changing too, as new observations allow scientists to fine-tune their predictions. In this respect, the controversy in the scientific community over the predicted change in sea level provides an excellent example of the multiple factors that come into play – atmosphere, oceans, polar ice-caps, rivers, mountain glaciers and even volcanoes – and the complexity involved in analysing all the data. The sea-level debate shows just how indispensable computer modelling is to our understanding of how all these parameters interact. And above all, it shows just how worthless computer models are without the measurements that are the only means of confirming their hypotheses.

Governing means planning ahead

The best measure of any country's will to act on environmental issues, energy supply and security is the forward-planning resources it devotes to them. The ability to predict future trends has never been as vital as it is today, especially regarding natural resources and climate. A few years ago, the political leaders of about a hundred different countries (with the United States and Europe in the lead) decided to pool their Earth-observation capabilities in order to combat the new threats that affect all the Earth's peoples. If we want to avoid crises and grasp opportunities, we must make the effort to manage human development. And effective management supposes that decision-makers have access to a planetary set of indicators showing data about current conditions, resources, trends, threats and fragile areas – in more or less real time – so that they can make the best possible decisions.

This planetary set of indicators, a yardstick of natural services if you like, is now under construction. It is called the Global Earth Observation System of Systems (GEOSS) and is the result of a proposal made by the G8 countries at the 2003 Earth Observation Summit in Washington. Within just 15 months, the international community at the highest levels signed up to the initiative and in April 2005 a Group on Earth Observation (GEO) was set up to coordinate the new system. The Geneva-based group is a voluntary partnership between more than 70 governments and should complete its main mission by 2015, ten years after it was set up.

The GEOSS system, which benefits from worldwide coordination, includes both satellites and observation infrastructure on the ground, at sea and in the air. It provides a guarantee of long-term measurements and will maximise synergies at national and regional level. At this stage, the system is being based on an extraordinary variety of data from existing observation systems. At the same time, GEOSS is helping to coordinate and harmonise those systems and, where necessary, to complement them by identifying new needs. Lastly – and importantly – the system will mean that all stakeholders have better access to information in a spirit of international cooperation that will reduce costs and boost the effectiveness of investments.

Nine priority applications

One key characteristic of GEOSS is that it is closely focused on a multitude of potential users: weather forecasting services, disaster-warning bodies, public health services, agricultural and forestry agencies, municipal and regional authorities, agencies managing nature reserves, renewable energy companies, international organisations involved in negotiating environmental conventions (on ozone, carbon, biodiversity, water, etc.) and even NGOs. In other words, GEOSS will be user-oriented. One of its achievements so far has been to set up a sort of "one-stop shop": this GEOPortal (already on line) will give access to a wide variety of completely reliable information customised to the needs of all its users.

Nine societal applications have been given priority by the system's builders, areas where cross-discipline data on the state of Planet Earth are indispensable. Examples here are: how to reduce the loss of human life due to natural disasters; how to optimise energy resources; and how best to manage water use. Themes like these are the framework around which GEOSS is built.

Naturally, building such an ambitious system involves overcoming a number of technical, human and commercial obstacles. At the technical level, the main challenge is to coordinate a number of observation systems that are very different in both nature and origin. The solution here is to adopt common standards wherever possible for parameters such as observation satellite spectrum bands, image resolution and data transmission and storage modes. This is the only way to ensure interoperability and simplify the comparison of different sets of data. The "whole" represented by GEOSS is greatly superior to the sum of its parts, because it gives users access to all the information provided by the different existing and future observation systems.

Pooling different sets of data can also come up against purely human obstacles. For example, GEOSS involves information that some countries consider to be strategic, particularly data on water resources, and this information may not be made available, even in regions where the water situation is of particular concern.

Pooling data and prediction models

However, attitudes are changing, and governments are realising that no individual country can set up an observation network comprehensive enough to cope with today's planet-wide challenges. So a consensus is now emerging that the best approach is indeed the Data Sharing Principles laid down by GEO. For a single isolated set of data, no matter how accurate, is of limited interest unless the data can be assimilated and interpreted, and this in turn supposes dynamic computer models that can be used to make predictions. Naturally, countries that wish to preserve their prerogatives can simply pool the relevant data and build their prediction models independently. This is already how the world of weather forecasting operates: observations are shared in real time but network partners such as Europe, the United States, Japan and China elect to have their own modelling centre and issue forecasts for their own territory.

The main commercial obstacle to GEOSS concerns the business models adopted for data and other information. Some countries have adopted a commercial approach to data such as satellite imagery and meteorological data. National services such as Météo France and the UK Met Office, for example, provide a basic service for free but charge for specialised services such as local forecasts or details for specific sporting events. But in the United States the business model stresses free access: data that has been obtained using public funds is public property, so the National Weather Service delivers forecasts and observations free of charge. Subsequently, private businesses can process the data further and sell targeted forecasts to their own customers. From a government's point of view, these two models are in fact economically equivalent and GEO is now looking at ways to reconcile the two approaches. In the case of satellite imagery from sources such as Spot or Landsat, the problem is slowly solving itself, via "free-access creep": low-resolution images are now almost always free. This trend owes a lot to a joint initiative by Brazil and China, which offered, within the GEO framework, to provide data from CBERS (China-Brazil Earth Resources Satellites) free of charge to countries in Africa and Central America. Furthermore, Brazil has announced that its own archives of Landsat data can now be accessed free of charge by all users. The United States Geological Survey (USGS), which operates Landsat and keeps full archives, has rapidly followed suit. With the result that only very-high-resolution images are now provided on a commercial basis, and these are not particularly necessary for environmental purposes.

Despite the difficulties outlined above, which are quite natural given the ambitious nature of the project, GEOSS is experiencing rapid and diversified development. Two years after GEO was set up, more than a hundred related projects were presented at the 2007 ministerial summit in Cape Town. They ranged from a planetary "fleet" of nearly 3,000 ocean-observation (ARGO) buoys and cooperation →

→ programmes between observation satellite operators to early-warning systems for natural disasters. It is encouraging to note that no new observation systems are being designed today without provision for their integration into the others GEOSS.

And what about the future? High on the GEO agenda are coordination of all satellite imagery data, further oceanic observations using spatial altimetry and ARGO buoys, and the setting up of a global system for observation of continental watercourses. Given the importance of the water resources issue, there is an urgent need to upgrade the systems used to measure the flow at the mouths of the world's rivers and to gather the piezometric data needed for monitoring water tables. Other priorities are to develop the skills and means necessary to asses water quality (bacteriology and contamination) and to improve monitoring of atmospheric aerosols – solid or liquid particles in suspension, whether natural (desert or marine sources) or caused by human activity (pollution, fires). Aerosol particles can have an impact on the weather, the climate and human health. Dust particles from deserts have caused meningitis epidemics in the Sahel region, and oceanic aerosols have been linked to surges of cholera in countries such as Bangladesh. One last priority is to undertake satellite observations of carbon flows, which is currently impossible; this will be one of the keys to accurate modelling of climatic phenomena as well as to monitoring compliance with any post-Kyoto conventions.

It is encouraging to note that no new observation systems are being designed today without provision for there integration in the others.

Permanent biodiversity monitoring

The task facing GEO is vast. One of the key issues it must address – one that is causing great concern worldwide but which is one of the most difficult to quantify – is the decline in biodiversity. Biological diversity is wealth which, among other virtues, has an impact on an ecosystem's ability to resist environmental changes. Biodiversity is also a resource for the chemicals and pharmaceuticals industries and can be a key asset in limiting epidemics. Any threat to biodiversity integrity, however insignificant it may seem, can have quite unexpected consequences. One example here is Lyme's disease, an infection that is spread via tick bites. For several years now, increasing numbers of cases of Lyme's have been reported in certain forest zones of northern Europe and the United States. But what caused this "epidemic"? In these zones, deforestation and the clearing of hedgerows has destroyed the habitat of the predators that controlled the population of white-footed mice, which are the favourite host animal of ticks. As these mice multiplied, so did ticks, and so did cases of Lyme's disease…

It is essential to regularly "take the pulse" of biodiversity, along with all other vital life signs of our planet. To do this, GEO has set up a data gathering system called the GEO Biodiversity Observation Network (GEOBON), whose mission is to facilitate all necessary action to monitor biodiversity and to standardise observation methods, in particular by setting up a battery of indicators that will allow a certain number of indirect indicators to be monitored by satellite. So we are seeing the emergence of a comprehensive observation and information system that can keep scientists informed in real time about the physiological condition of the Earth. A network of sensors stretching from the poles to the Equator, from the seabed to the upper reaches of the atmosphere, and including everything from water tables and continental surface to wells deep underground, volcanoes and forests. A system that is increasingly accurate and able to decipher the different "time spans" of our planet, from the very short (natural disaster warnings and occurrences) to the very long (changes in agricultural land or climate).

We must admit that there is something very comforting in seeing a cooperative initiative of this scope successfully developing today, when recent years have been marked by all-out competition between the superpowers for access to space and control of information. GEOSS is an initiative that has got different governments, disciplines and observation networks all working together. The all-too-recent awareness of the fragility of both our home planet and our civilisation – and of the need to preserve them – has finally begun to be translated into action. Collective action. ■

José Achache
Geophysicist, GEO Director, Group on Earth Observations.

For further information, please consult *Energies No.14 - Geosciences for development - Summer 2008*, soon accessible via www.total.com