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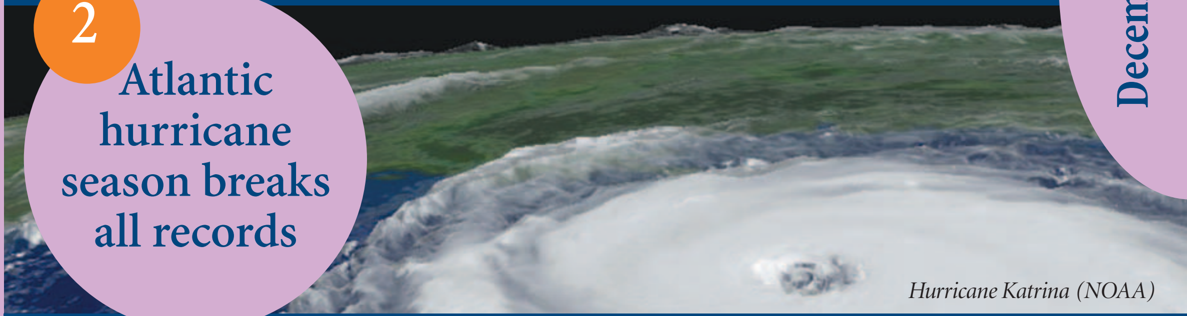


Hurricane Katrina (NOAA)

News in brief

Cooperation in satellite meteorology

Satellite meteorology made a step forward in November with the installation of the ground system for the JASON-2 Ocean Altimetry Programme. Partners in JASON-2 are the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Centre National d'Etudes Spatiales (France), the US National Oceanic and Atmospheric Administration and National Aeronautics and Space Administration.

EUMETSAT's satellites (METEOSAT-6, -7 and -8 over Europe and Africa and METEOSAT-5 over the Indian Ocean) make a significant contribution to weather forecasting and to the monitoring of the global climate.

Jason-2 will collect global ocean surface data to increase understanding of the forces behind global climate change and seasonal weather changes.

In October, WMO and the United Nations consortium for satellite imagery, UNOSAT, signed a Memorandum of Understanding (MoU) concerning the promotion of space science, meteorology, climatology and hydrology for the safety of human life and property, disaster reduction and mitigation and sustainable economic and social development, including education and training.

Foremost in the MoU is an exchange of information, representation and consultation. Meteorological information from WMO's Regional Specialized Meteorological

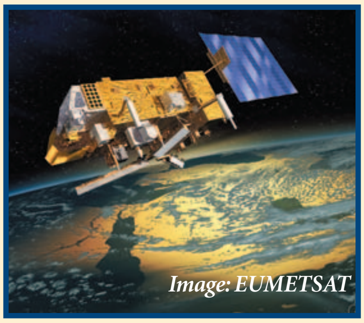


Image: EUMETSAT

Centres will be made available to UNOSAT, which, in turn, will provide high-resolution satellite imagery in support of a wide range of activities.

The information generated will be made available to National Meteorological and Hydrological Services. As the northern hemisphere winter approached, UNOSAT was already incorporating snow forecasts for the assistance of relief efforts in Pakistan after the October earthquake (see item on page 3).

Also in October, the Islamic Republic of Iran launched its first satellite. The data from SINA-1 will also be used for research and applications in meteorology, geology, agriculture, natural resources and natural disasters.

Training activities

Education and training in many aspects of meteorology, climatology, hydrology and related fields is essential if National Meteorological and Hydrological Services are to build up their capacity and respond to the requirements of users and to participate in a wide range of activities on the international level. A few examples of the training activities organized by WMO, sometimes in collaboration with Members or other organizations, are given below.

Satellite applications

In collaboration with EUMETSAT, WMO organized two training courses for the user community in Africa. The objectives were to optimize the use of data from meteorological satellites and the use of Meteosat Second Generation receiving stations; and to increase the knowledge and skills of meteorological trainers and potential trainers.

Statistics in applied climatology

Training in the use of statistics in applied climatology for African professionals working in meteorology, hydrology, agriculture, health, food security, construction, research and renewable energy was carried out.

Part of the training was done via e-learning prior to the course proper in order to secure direct involvement of more participants for a longer period at reduced cost. The e-module covered statistical software and topics such as data acquisition, handling and management. The workshop analysed statistical software and exchanged ideas on data acquisition and management.

Meteorological warning systems

Early warning systems are of paramount importance in preparing communities against the approach of a number of hydrometeorological hazards. WMO co-sponsored with Hong Kong, China,

News in brief

a training course on the design and operation of meteorological warning systems for developing countries. The course aimed to provide participants with a better understanding of the key underlying factors.

Some coming events

6-10 February 2006: CBS Expert Team on Ensemble Prediction Systems, Exeter, United Kingdom

6-10 February 2006: CIMO Expert Team on Meteorological Radiation and Atmospheric Composition Measurements, Davos, Switzerland

13-15 February 2006: Technical Conference "Improving Predictability of High Impact Weather with Emphasis on Southern Hemisphere", Cape Town, South Africa

16-24 February 2006: Commission for Atmospheric Sciences—14th session, Cape Town, South Africa

13-17 March 2006: International Conference on Flood Forecasting, San José, Costa Rica (co-sponsored by WMO)

12-16 June 2006: Sixth International Conference on Urban Climate, Göteborg, Sweden (co-sponsored by WMO)

17-21 July 2006: WMO Conference on Living with Climate Variability and Change: Understanding the Uncertainties and Managing the Risks, Espoo (Helsinki), Finland

Aeronautical meteorology

Aviation is one of the foremost users of meteorological information. WMO and the China Meteorological Administration co-sponsored a training course for 15 aeronautical forecasters from developing countries. Aviation weather hazards were the main focus, covering turbulence, icing, thunderstorms, low cloud and poor visibility and their effect on aircraft operations, hazard detection methods (including aerological diagrams), satellite imagery, Doppler radar, empirical forecasting techniques and the use of numerical weather prediction for nowcasting.

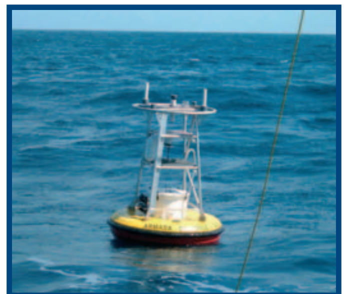
Vital data from drifting buoys

WMO and its partners are responding to an increasing demand for marine observations in support of a wide range of applications. Some of these are weather forecasting, tsunami monitoring, coastal area management, fishing, ship routeing, marine pollution prevention and clean up and climate modelling and prediction.

Vital ocean surface and subsurface observations are provided by an international array of drifting buoys, which now consists of 1 250 operational units in all the world's oceans.

Representatives of meteorological and oceanographic services, buoy manufacturers and satellite data telecommunication providers met in October to discuss a wide range of relevant issues concerning drifting buoys. These included technical developments, instrument evaluation, network performance, operational enhancements, data telecommunication and assimilation and research and operational applications.

A major aim identified by the meeting is increased deployments in data-sparse areas, notably in the southern hemisphere. Another is to equip half the drifting buoys with barometers, including some 300 in the Southern Ocean.



Drifting buoys provide data for weather forecasting, tsunami monitoring, coastal area management, fishing, ship routeing, marine pollution prevention and clean up and climate modelling and prediction.

Longer-term objectives are to establish a better dialogue with users; to design drifting buoys that last longer; and to reduce data availability delays.

Record Atlantic hurricane season

Early indications of a very active Atlantic hurricane season proved accurate. The season's storms caused a vast amount of damage, death and destruction. Damage estimates have already been put at more than US$ 100 billion (mostly from Hurricane *Katrina*) and over 2 800 deaths (mostly from *Katrina* and *Stan*).

Thanks to accurate hurricane forecasts provided by WMO RSMC Miami-Hurricane Center and the national warning centres in the region, many lives were saved.

The season saw 26 tropical storms, making it the most active season on record. Thirteen became hurricanes—the most to form in a single season. Of these, seven were major hurricanes, one short of the 1950 record. Fifteen systems made landfall—another record. It is the first hurricane season, Atlantic or Pacific, to exhaust the list of names and resort to Greek letters for naming.

Wilma was the most powerful hurricane, in terms of both wind speed and air pressure, ever measured in the Atlantic basin. *Wilma* also broke records for fastest development, going from tropical storm status to Category 5 hurricane in less than 24 hours.

Late-season Tropical Storm *Gamma* became almost stationary when it reached Honduras. It brought heavy rain, causing disastrous landslides and flooding.

Flying into the storm

Small, robotic aircraft can venture into areas which are too hazardous for manned craft.

Hurricane hunters

Hurricane reconnaissance aircraft—"hurricane hunters"—of the US Air Force and National Oceanic and Atmospheric Administration (NOAA) fly into hurricanes in order to make precise, real-time observations. The accurate tracking of these extreme weather events, followed by timely early warnings, has contributed to saving lives and reducing damage.

Dropsondes—sensors attached to a parachute—are released by the aircraft inside the hurricane. The sondes record measurements of wind speed and direction, air pressure and temperature as they fall, which takes about 15 minutes.

The data gathered are translated into a standard WMO format and are on the Miami National Hurricane Center's Website within 20 minutes.

The pilots require a minimum 3 000 hours flight experience and at least three tropical cyclone seasons before they are permitted to take charge of a Hurricane Hunter. Once inside a hurricane, periods of zero visibility force them to rely on their instruments to navigate in winds of sometimes more than 200 km/h.

The environment where the atmosphere meets the sea is critically important in hurricanes as it is where the ocean's warm water energy is directly transferred to the atmosphere just above. It is also where the strongest winds in a hurricane are found. Observing and ultimately better understanding this region of the storm is crucial if forecasts of hurricane intensity and structure are to be improved. Manned flights in this zone, however, are highly dangerous.

Aerosondes

Thus arose the idea of using a small, robust, unmanned craft. In September 2005, the first unmanned aircraft, known as an Aerosonde, successfully completed a 10-hour mission into Tropical Storm *Ophelia*. Flying at altitudes as low as 125 m, it provided the first ever detailed observations of the near-surface, high-wind hurricane environment.

The Aerosonde was fitted with traditional hurricane observation instruments and a satellite communications system to relay information on temperature, pressure, humidity and wind speed every half second in real-time. It also carried an infrared sensor to estimate the underlying sea-surface temperature. All available data were transmitted in near-real time to NOAA's National Hurricane Center and Hurricane Research Division.

Comparisons between *in situ* and satellite-derived observations will also be possible. The resulting data will help initialize and verify operational and research-oriented numerical simulations.

The predictive capability of the Aerosonde holds enormous potential for enhanced disaster prevention and mitigation.

Harsh winter predicted for Pakistan

A seasonal weather report released by the Pakistan Meteorological Department at the end of October warned that areas affected by the massive earthquake which struck the country earlier in the month could expect a more severe winter than usual. This would affect the estimated 3 million people who survived the disaster, as well as humanitarian and relief organizations working throughout the region.

Snowfall has already been reported from isolated places in the earthquake region over the latter part of October. The overview of regional and global parameters indicates that another harsh winter is approaching the earthquake-stricken areas. Snowfall is expected to exceed the normal range both in terms of frequency and quantity.

Temperatures are likely to range well below normal. In December, January and February, even daytime temperatures are likely to remain several degrees below freezing, especially in mountainous areas, where at night they can sometimes reach a January low of -20°C. Landslides and foggy weather are other factors which could influence human survival.

It has been estimated that some 73 000 people have died from the earthquake, 70 000 were injured and 3 million left homeless.

A harsh winter would have have devastating effects on the survivors of the October earthquake in Pakistan.

Climate, weather and infectious diseases

WMO is encouraging further studies into the impact of climate in the propagation of infectious diseases, including the emerging threats of avian influenza (bird flu) and Severe Acute Respiratory Syndrome (SARS).

The role of climate in the initiation and spread of certain diseases is one aspect of research aiming to save lives through effective early warning systems. Such systems are developed by weather and climate experts in partnership with health and social services. WMO and the World Health Organization are working on guidelines to be used by meteorological and health agencies.

Climate change and biodiversity

WMO is participating in studies of the linkages between biodiversity and climate change.

The areas covered are identification of the major properties that contribute to ecosystem resilience; integration of biodiversity considerations in the implementation of adaptation activities to climate change; and approaches, methods and tools for planning, designing, and implementing adaptation activities.

Current focus is on adding case-studies and on developing synergies between the United Nations Conventions on Biodiversity and Desertification for the exchange of experience and information.

Adaptation to climate change for the conservation and sustainable use of biodiversity is a rapidly developing area. One project being formulated is the preparation of new National Adaptation Plans of Action by national Governments in the context of the United Nations Framework Convention on Climate Change.

Adaptation to the effects of climate change due to both natural and human factors is a high priority for all nations. WMO assists developing countries to improve their resilience and integrate adaptation goals into their sustainable development strategies.

Climate and land degradation

More than 250 million people are directly affected by desertification. In addition, another one billion in at least 100 countries are at risk. They include the world's poorest and most fragile citizens. Combating desertification is essential to secure their food and livelihoods.

Sustainable development efforts for dryland countries must be based on a sound understanding of the different factors that contribute to land degradation. The United Nations Convention to Combat Desertification (UNCCD) has recognized the important role of climate and its variations. Land-management practices can combat land degradation. To accurately assess them, however, the climate resources and the risk of climate-related or induced natural disasters in a region must be known.

WMO and other relevant organizations will be working with the UNCCD's Committee on Science and Technology to address the interactions of climate, land degradation and livelihood security.

- *The Aral Sea: Water, Climate and Environmental Change in Central Asia*. (WMO-No. 982) Flip book.
- *Climate and Land Degradation*. (WMO-No. 989), Brochure, 32 pp.

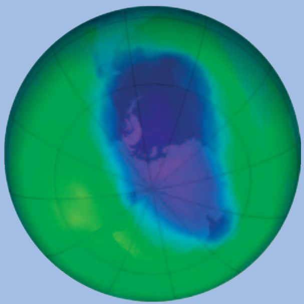
A core contribution to polar science

The Arctic climate exhibits the fastest pace of warming on

World Meteorological Organization

World Meteorological Organization
7 *bis*, avenue de la Paix, P.O. Box 2300
CH-1211 Geneva 2 Switzerland
Tel: +41 (0) 22 730 83 14/83 15
Fax: +41 (0) 22 730 80 27
Internet: http://www.wmo.int

We welcome your comments about *MeteoWorld* and look forward to hearing from you: jtorres@wmo.int



Ozone watch

The phase-out of ozone-depleting substances is seen in the slow decline in the so-called Equivalent Effective Stratospheric Chlorine (EESC). This parameter includes all the chlorine- and bromine-containing substances. The EESC peaked around 1997 and is expected to return to pre-1980 levels around the middle of this century. This means that the Antarctic ozone hole will recur every year for some 50 years.

Signs of the first phase of recovery have been detected in middle latitudes but not in the polar regions.

The 2005 Antarctic ozone hole attained its maximum size of 27 million km^2 in mid-September. This is significantly larger than the maximum reached in 2004 (23 million km^2) but is still smaller than the ozone holes of 2000 and 2003, which peaked at 28.5 and 29 million km^2, respectively.

Interannual dynamical variability makes it difficult to detect ozone recovery in the polar regions. Many more years of observations will probably be needed before a trend can be detected.

- *Protecting the ozone layer—A priority for WMO* is a four-page booklet.

the planet and 2005 brought another record: the area of Arctic Ocean sea ice in September was the smallest since satellite observations began.

The year 2005 was also one of intense debate on the future of polar research. The Second International Conference on Arctic Research Planning (Copenhagen, Denmark, November) identified five major research challenges for polar science: climate and environmental regimes of the Arctic region; Arctic societies and change; Arctic cryo-hydrological systems and global interactions; Arctic terrestrial and marine life and systems; and adapting and coping with change in the Arctic.

WMO participates with international partner organizations and programmes in the Climate and Cryosphere project, which addresses several of these challenges. It seeks to enhance and coordinate efforts to monitor the cryosphere, to study climate-related processes involving the cryosphere, to model and understand the cryosphere's role in the climate system, and to develop cryosphere-based indicators of the global change.

A recent finding obtained from an ice core at the Station Dome Concordia in the Antarctic is that the current levels of the greenhouse gases carbon dioxide and methane in the atmosphere are higher than at any time in the past 650 000 years.

The importance of this finding is that it spans two different regimes of climate variations, namely the modern regime, which dates back to approximately 420 000 years, and a somewhat different regime before it. An intensive array of ice-coring activities is envisaged both in the Antarctic and in Greenland for the International Polar Year 2007-2008.

The core drilled at Dome Concordia has air samples dating back 650 000 years. (Photo: A. Lori/Italian National Agency for New Technologies)

Water-resources assessment

Knowledge of a country's water resources availability and distribution is a prerequisite for their sustainable management. Such knowledge can be acquired through regular and long-term monitoring, and the capacity to perform an adequate assessment of the resource. To assist countries, WMO and UNESCO prepared a handbook on water-resources assessment for the evaluation of national capacities.

WMO also organizes workshops to present this methodology to experts from National Hydrological Services (NHSs). The last one was for western and central African countries.

It emerged that hydrological monitoring and water-resources assessment capabilities in these countries are affected not only by the obsolescence of observing networks but also a reduction in the staffing of NHSs.

Evaluation of capabilities will be useful when preparing proposals for international cooperation projects in the area of water resources.

The various factors that concur to create national capacity to perform water-resources assessment include an institutional and legal framework, data-collection and management systems, education, training and staff management.

Improved hydrological data

The hydrological observations and products that are required and available for scientific applications such as global water-cycle experiments, the initiation and validation of climate models and hydrological process studies, are generally inadequate.

WMO is collaborating in an initiative to identify, define and facilitate a global "network of networks" of hydrological parameters. Eight projects aim at reducing the shortcomings for 11 hydrological parameters, including river discharge, lake levels and soil moisture.

One global terrestrial network for the measurement of river runoff has been defined, based on 380 existing river gauge stations in 82 countries. Time-series of discharge data that used to reside in national archives are now available at the Global Runoff Data Centre (Koblenz, Germany)—and the flow of data is continuing.

A similar initiative is underway for information on lake levels and area; proposals for a world data centre for lakes are being evaluated.

The use of globally measured hydrological information has been limited by a lack of common data standards and operating procedures. A hydrological metadata standard has now been completed. Entirely based on existing ISO standards for geoscientific information, it is well embedded in the WMO Core Metadata Standard.

An inventory of global networks and data centres in the hydrological domain has been completed. This is an essential element for the distribution of global responsibility for all parameters.