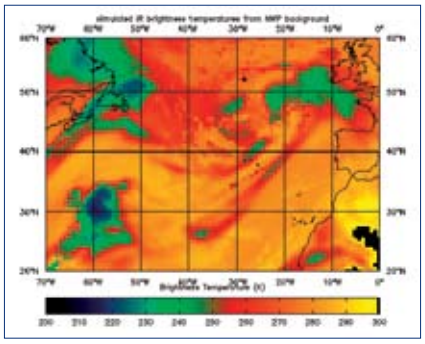
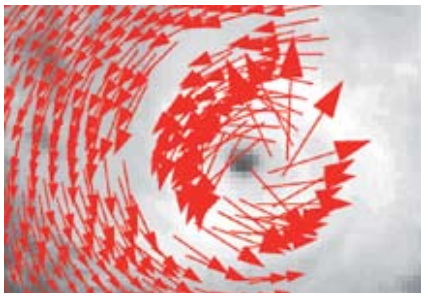
Numerical Weather Prediction (NWP) is the basis of all modern global and regional weather forecasting. Its capabilities are being expanded by the NWP Satellite Application Facility (SAF), which is developing techniques and tools for the effective use of data and products generated by EUMETSAT and other satellite operators.

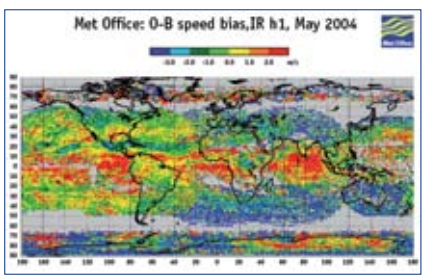
The Numerical Weather Prediction SAF



Simulated Meteosat water vapour image using the RTTOV radiative transfer model and NWP fields



25 km resolution winds from tropical cyclone Rita measured by the SeaWinds scatterometer. Cloud background is GOES infrared



Map showing geographical comparison of winds versus the Met Office NWP background field

The improvement in the quality and quantity of satellite data over the last decade, and in the ability of meteorologists to process and assimilate the information into Numerical Weather Prediction (NWP) models, has made space-observed data the most important ingredient in NWP, which uses powerful computers to model the atmosphere and compute forecasts ranging from a few hours up to 10 days ahead. NWP underpins the forecasts of all the National Meteorological Services, and is a core activity of many of them.

Measurements from infrared and microwave radiometers, or sounders, on board polar-orbiting satellites provide NWP models with global information on temperature and humidity throughout the depth of the atmosphere. Wind speed and direction are deduced by tracking and measuring the movement of clouds, water vapour and other tracers with visible or infrared imagers. Meteorologists rely mainly on Meteosat and other geostationary satellites to provide this information because of the short time between successive images. However, over the ocean, data on winds near the water's surface can be obtained by measurements from scatterometers on polar-orbiting satellites.

Using these various observations to their best advantage in NWP is complicated and difficult. Not only is a detailed knowledge required of the many physical processes contributing to the measurements, but failure to take proper account of the often subtle error characteristics of the data can easily result in the observations damaging rather than enhancing the forecast.

The NWP SAF is helping significantly to improve NWP accuracy and the benefits derived from NWP by developing techniques and tools for the more effective use of satellite-generated data and products. The NWP SAF began developments in 1999 under the leadership of the UK Met Office in partnership with the European Centre for Medium-Range Weather Forecasts (ECMWF), the Dutch Meteorological Institute (KNMI) and Météo-France. Its core users are NWP centres in EUMETSAT's Member and Cooperating States, EUMETSAT's central processing facilities, licensed users and other SAFs.

NWP SAF users receive software packages for incorporation within their own systems, for example:

- **The ATOVS and AVHRR Pre-processing Package (AAPP)**, which processes data from sounders on board the US's polar-orbiting NOAA satellites. AAPP is also the processor used by receiving stations serving the EUMETSAT Advanced

Jason-2 securing ocean altimetry

All lights are green for the planned launch of Jason-2 in 2008. Meeting this launch date has become imperative, owing to the demise of the TOPEX/Poseidon mission, which has finally been retired after 13 years of service. However, the newer generation of satellites is unlikely to match the record set by TOPEX/Poseidon because of their much shorter life expectancy of five years - the result of using off-the-shelf components in their construction (for cost reasons) which are less radiation resistant than the ones used for TOPEX/Poseidon - and also to a lower level of redundancy.

The race is now on and all the international partners involved - EUMETSAT, CNES, NASA and NOAA - are poised to meet the challenge.

- The system preliminary design review took place in Toulouse on 13 December, with all four agencies carefully checking system documentation, launch and early orbit phase requirements, system requirements and service specifications. In the ensuing review, no major issues were identified.
- The earth terminal infrastructure in Usingen was accepted and CNES has almost completed the integration of its equipment into the station. The complete earth terminal was accepted on 9 March 2006.
- The development of the HQ-based real-time processing system began immediately afterwards and is expected to be completed in 2007.
- The cooperative agreement to secure the Jason-2 programme was signed by the four partners on 11 April 2006.

The development of Jason-2's infrastructure may still be ongoing, but we are already looking to the future. Given Jason-2's five-year life expectancy and the lengthy period involved in developing a new satellite, it is of utmost importance that its replacement is ready to take over from 2013. First discussions to develop the baseline and the requirements for a new satellite will be taking place during the course of 2006.

Retransmission Service (EARS), which enables NWP centres to receive sounding data from large areas of the northern hemisphere within 30 minutes of observation time – vital for regional NWP.

- **The Radiative Transfer for TOVS (RTTOV) model**, which is able to accurately predict the radiances observed by a wide range of satellite infrared and microwave sensors, given atmospheric temperature and humidity profiles and surface characteristics, and which is fast enough for operational data assimilation.
- **Scatterometer processors**, which use radar backscatter from the ocean surface to provide information on low level winds and are used operationally by the OSI SAF. The NWP SAF is developing a generic scatterometer processor capable of interfacing with various instruments, including SeaWinds.

The value of observations is critically dependent on their quality, so as part of its remit the NWP SAF monitors the quality of many types of satellite observations and makes the results freely available via its website. The NWP SAF is continually working to improve its products and to meet evolving user requirements, which in turn are often driven by the advent of new satellites and instruments. Hence it is well prepared for the imminent EUMETSAT Polar System, in anticipation of which significant enhancements have been made to AAPP, RTTOV and scatterometer processing in order to exploit challenging new instruments such as the Infrared Atmospheric Sounding Inferometer (IASI) and the Advanced Scatterometer (ASCAT). Planning is already underway for the US's National Polar Orbiting Environmental Satellite System (NPOESS) and the NPOESS Preparatory Programme.

For further information about the NWP SAF please visit: www.metoffice.gov.uk/research/interproj/nwpsaf

About SAFs

SAFs are dedicated centres of excellence for processing satellite data and form an integral component of EUMETSAT's distributed applications ground segment. Located at National Meteorological Services in Member States, they use the expertise of the EUMETSAT community to process application-specific data from geostationary and polar-orbiting satellites for the generation of new products and tools for the meteorological and climate data user communities.