



MET
éireann

**Annual
Report
2006**



contents

Foreword	3
Mission Statement and Organisational Structure	4
Articles	
Web Site [www.met.ie] Renewal	5
Weather Review 2006 - Global	6
Weather Review 2006 - Ireland	11
Tom Keane Receives Bourke Silver Medal	12
Strategic Management	
- <i>Delivering Met Éireann's High-Level Goals</i>	13
Technical Developments	21
Appendices	
I. Forecast Accuracy	27
II. Publications	31
III. Met Éireann Finances	32
Corporate Information	33
Glossary	34
Acknowledgements	35

foreword



In the minds of most Irish people, mention of the year 2006 from a weather perspective will immediately call to mind the very fine summer with long spells of fine weather and temperatures surpassing 30°C on a few occasions. Like all years, of course, the weather brought us a mixture of almost everything, as the extensive report on the year's weather in this Report bears out.

One event upon which the weather might have exerted a major influence was the risk of flooding associated with the occurrence of high astronomical tides in the September to November period. If unfavourable weather had combined with the naturally occurring tides, serious flooding problems might have resulted in vulnerable areas of our coasts. Fortunately, the weather remained benign (as forecast!) and no harmful effects were experienced. However, the events intensified efforts to develop a national coastal flood forecasting capability, involving Met Éireann and the Department of Communications, Marine and Natural Resources (DCMNR). It transpired that the work of our Climate Prediction Project (C4I), involving some coupling with ocean models, had given Met Éireann a good basis upon which to approach the task, and model forecasts of sea level heights were provided to DCMNR in advance of each high tide event.

A development which did not impinge very much on the national consciousness in 2006 was the launch of the EUMETSAT's Metop-A weather satellite in October. However, this was a very significant event from the meteorological point of view as it is Europe's first meteorological polar-orbiting satellite and it complements the U.S NOAA series of polar-orbiting

satellites. Instruments such as the IASI (Infrared Atmospheric Sounding Interferometer, the most accurate sounding instrument ever flown on a satellite) promise to bring great benefit to Numerical Weather Prediction models upon which all forecasts are based.

One of the core activities of Met Éireann is the provision of services to aviation. The provisions of the Single European Sky directive are having a large impact on this sector. A requirement which Met Éireann had to meet in 2006 was certification as a Service Provider to aviation by demonstrating compliance with the EU Common Requirements. I am pleased to report that this was successfully accomplished by our Aviation Services Division in December, thus positioning Met Éireann to seek designation as the official Meteorological Service Provider in Ireland.

I would like to express my thanks to all the staff of Met Éireann for the great work done in 2006 and for the excellent results achieved in our mission to serve the public and to contribute to the success of the economy.

A handwritten signature in black ink, which appears to read 'Declan Murphy'. The signature is fluid and cursive.

Declan Murphy

Director



mission statement

“Our Mission is to monitor, analyse and predict Ireland's weather and climate, and to provide a range of high quality meteorological and related information to our customers.”

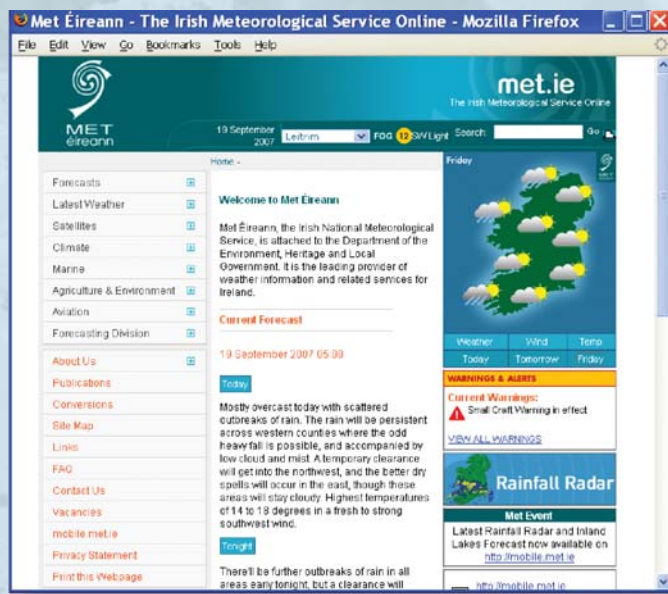
Organisational Structure of Met Éireann (December 2006)



website renewal

www.met.ie

May 2006 saw the launch of an enhanced version of Met Éireann's website. The site was initially launched in June 2001 and by May 2006 it had obviously grown very popular with up to 20,000 site visits per day. While the site was already rich in high-quality content it was decided to improve the service to customers by giving the site a makeover. The focus of the makeover was on renewing and updating existing content and enhancing the forecast pages. The specific aim was to freshen up the overall appearance, to improve the navigation, to make all code compliant with current accessibility standards



and to seed the capability for dual language access - both English and Irish. As an aid, the new TV weather graphics system in the General Forecasting Division was harnessed to automate routine production of products for the site.



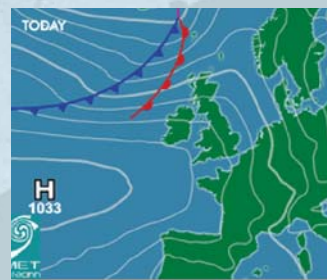
Site Enhancements

The site improvement highlights include:

- ▶ A new-look Home Page. The Home page on any web site is an important gateway to site content for customers and this is where the initial enhancements were made.
- ▶ Improved site navigation menu. The new site navigation makes it easier for site users.
- ▶ Improved presentation of Today, Tomorrow and Next day forecasts in both text and graphical form.
- ▶ Local (county) weather summary on the Home Page icon bar.
- ▶ A Warnings and Alerts box and all warnings on one page.
- ▶ A Contact Form to forward emails to important contact points.
- ▶ Improved presentation of Hourly Weather Reports from land stations and buoys.

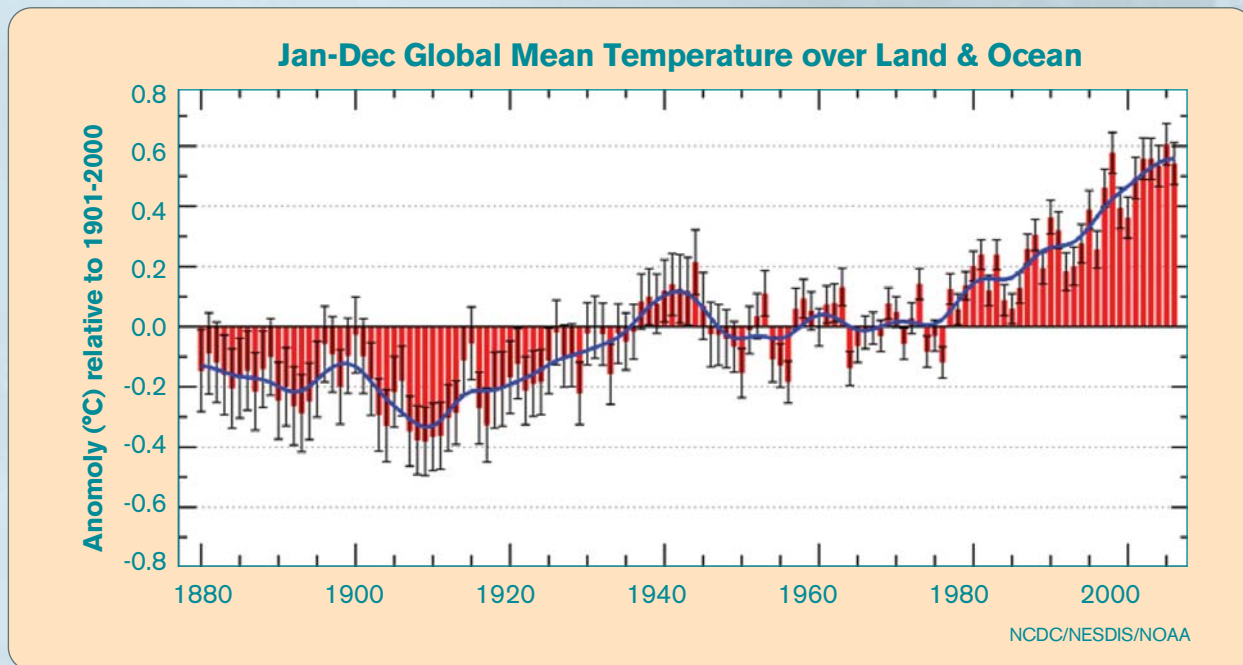
On-going Review

www.met.ie is the authoritative on-line source for Irish weather and climate information and Met Éireann constantly strives to improve its service to customers by keeping the site content always under review. The site information is made available as part of Met Éireann's public service role and site customers may reuse content such as forecasts as long as it is not for commercial gain and the information is credited to Met Éireann.



weather 2006 - A GLOBAL REVIEW

(Source : National Climatic Data Centre, US Department of Commerce)



Global Temperatures

The global annual temperature for combined land and ocean surfaces in 2006 was $+0.54^{\circ}\text{C}$ above average, ranking 5th warmest in the period of record. However, uncertainties in the global calculations due largely to gaps in data coverage make 2006 statistically indistinguishable from 2005 and several other recent warm years as shown by the error bars on the global time series graph shown above. Globally averaged land temperatures were $+0.78^{\circ}\text{C}$ and ocean temperatures $+0.45^{\circ}\text{C}$ above average, ranking 4th and 5th warmest, respectively. The land and ocean surface temperatures for the Northern and Southern Hemisphere ranked 2nd and 6th warmest, respectively.

The year began with ENSO [El Niño/Southern Oscillation] in a weak cold phase (La Niña) which had developed during late 2005, and the presence of these La Niña conditions in the equatorial Pacific contributed to the lower global average temperature this year. By April and May 2006, the near-equatorial SST anomalies had warmed to near-normal in the central Pacific region as the ENSO transitioned to a neutral phase. El Niño conditions developed in September, and by the end of December, sea surface temperatures in most of the central and eastern equatorial Pacific were more than 1.0°C above average.



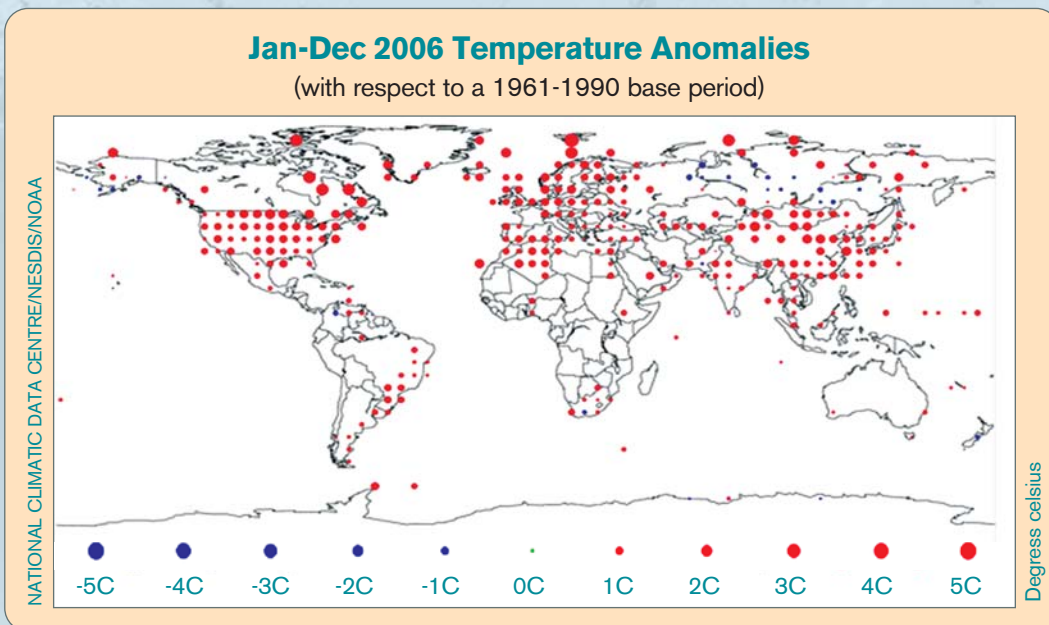
January-December	Anomaly	Rank	Warmest Year on Record
Global			
Land	+0.78°C	4th warmest	2005 (+0.97°C)
Ocean	+0.45°C	5th warmest	2003 (+0.48°C)
Land and Ocean	+0.54°C	5th warmest	2005 (+0.61°C)
Northern Hemisphere			
Land	+0.87°C	3rd warmest	2005 (+1.02°C)
Ocean	+0.49°C	4th warmest	2005 (+0.54°C)
Land and Ocean	+0.63°C	2nd warmest	2005 (+0.72°C)
Southern Hemisphere			
Land	+0.54°C	6th warmest	2005 (+0.83°C)
Ocean	+0.43°C	5th warmest	1998 (+0.50°C)
Land and Ocean	+0.44°C	6th warmest	1998 (+0.54°C)

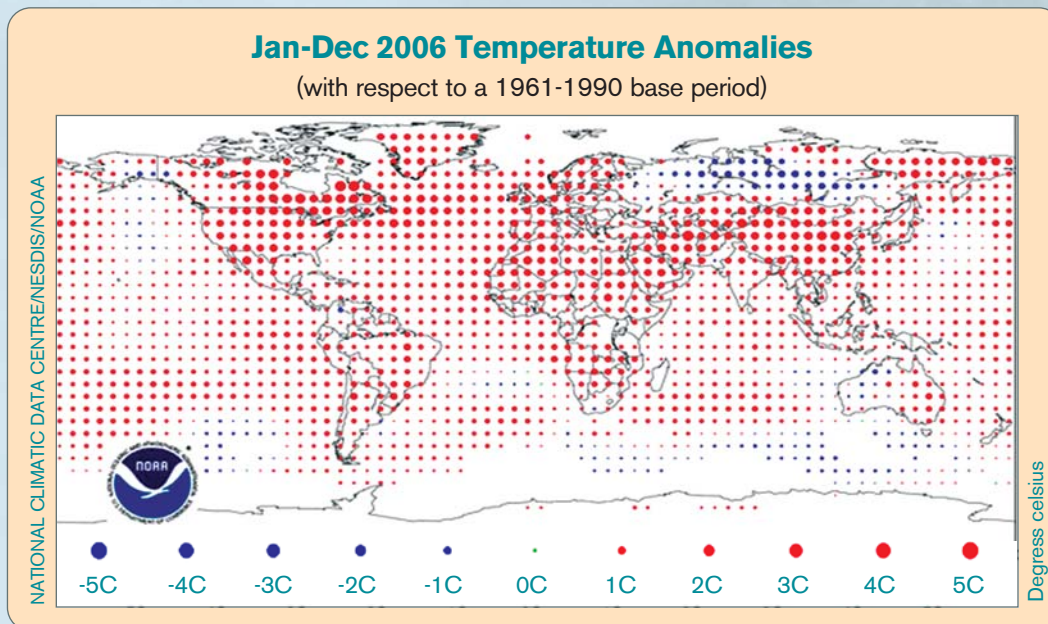
***The 1901-2000 average combined land and ocean annual temperature is 13.9°C, the annually averaged land temperature for the same period is 8.5°C, and the long-term annually averaged sea surface temperature is 16.1°C.*

Regional Temperatures

Warmer than average conditions occurred throughout most land areas of the world again in 2006. The largest anomalies were present throughout high latitude regions of the Northern Hemisphere including

much of North America, Scandinavia, China and Africa. Temperatures in these regions were 2-4°C above the 1961-1990 average. The only widespread area of negative anomalies occurred in central Russia.





The map, on page 7, is created using data from the Global Historical Climatology Network (GHCN), a network of more than 7,000 land surface observing stations. The map, above, is a product of a merged land surface and sea surface temperature anomaly analysis developed by Smith and Reynolds (2005). Temperature anomalies with respect to the 1961-1990 mean for land and ocean are analysed separately and then merged to form the global analysis.

Notable temperature extremes in 2006 included a heat wave that affected a large portion of the United States during July 16th - 25th. California was particularly affected, with 140 deaths attributed to high temperatures soaring past 40°C. Hot weather also enveloped much of Europe during mid-to-late July, with temperatures surpassing 32°C. In Britain, on the afternoon of July 19th, temperatures reached 36.5°C at Wisley, the hottest July temperature ever recorded in Britain. By late July across Europe, at least 50 deaths were blamed on the heat in Spain, France, Italy and the Netherlands.

In India, frost was observed in New Delhi for the first time in 70 years as cold air flowing from the Himalayas produced a low temperature of 0.2°C on January 9th.

The record low occurred on January 16, 1935, when -0.6°C was reported. In Russia, a severe cold wave, which arrived during January 17-18, brought some of the coldest temperatures to the region in decades. Moscow temperatures plummeted to -30°C, the coldest readings since the winter of 1978-1979, when temperatures dropped to -38°C. In June, unseasonably cold temperatures affected areas of Australia, with many locations breaking their all-time record minimum temperatures for the month. Averaged across Australia as a whole, it was the fourth coldest June in the post-1950 record.

Global Precipitation

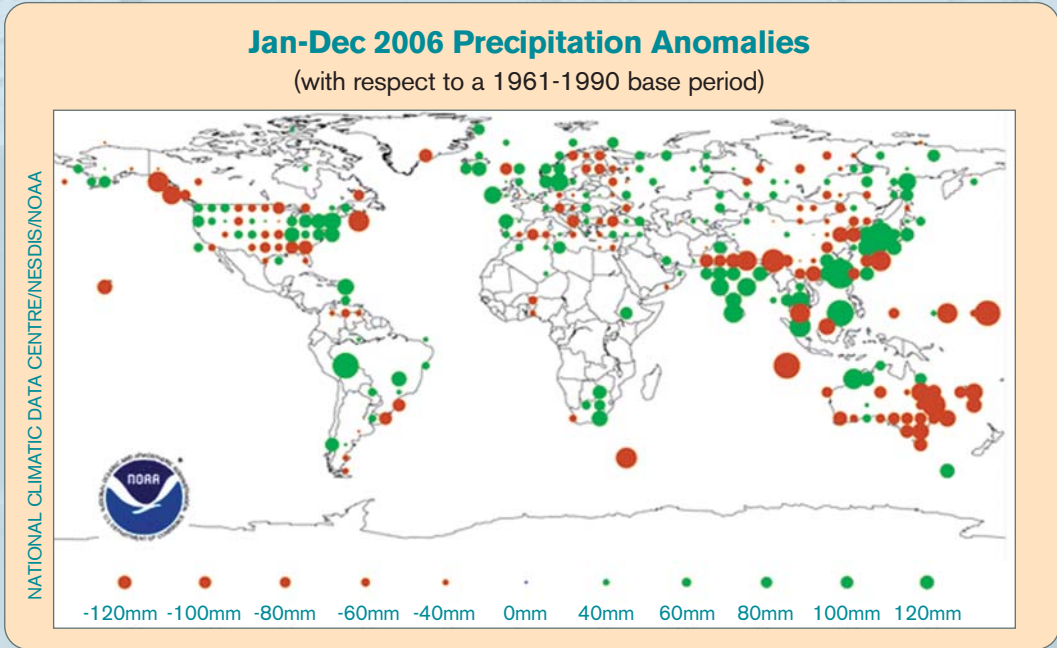
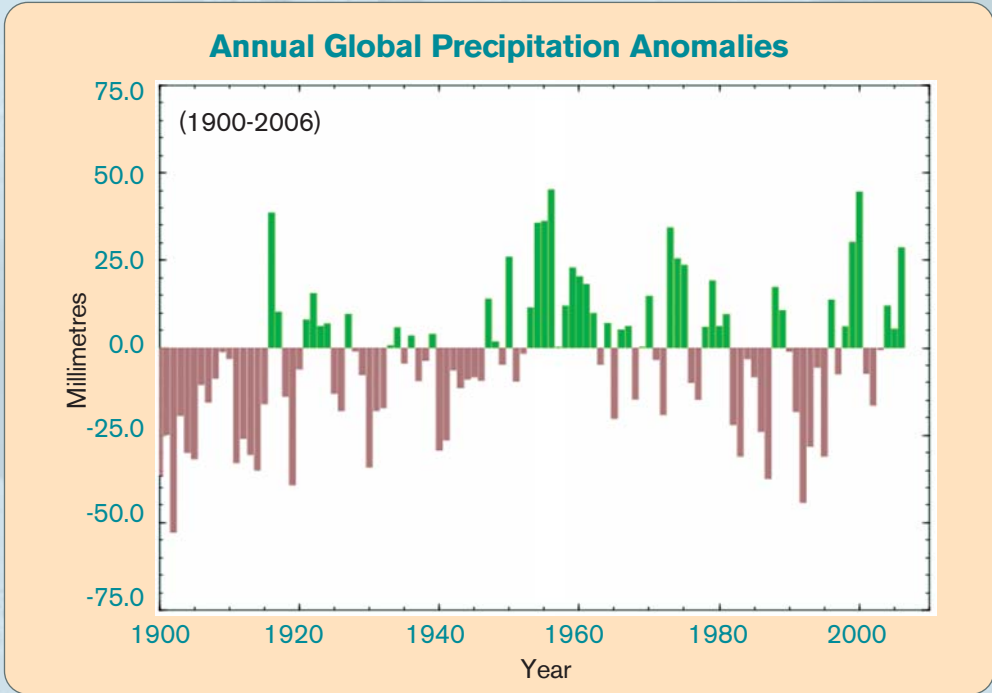
Global precipitation in 2006 was much above the 1961-1990 average, the largest value in five years. Regionally drier than average conditions were widespread across the U.S. Great Plains and Gulf Coast regions, the western coast of Canada and most of Australia. While the northeast U.S., Amazon Basin, India and Alaska all experienced wetter than average conditions.

A severe long-term drought continued throughout southern Ethiopia, southern Somalia, northeastern Kenya, as well as adjacent areas of eastern Uganda and Tanzania for most of the year. In February, drought



in Somalia was characterised as the worst in a decade. In all, an estimated 11 million people in East Africa and the Horn of Africa continued to face critical

food shortages brought about in part by the continuing drought despite the welcome rainfall that began in June.



In May, drought in China threatened the drinking water supply for nearly 14 million people in the northern part of the country. About 16.3 million hectares (40 million acres) of agriculture land, more than 12 percent of the nation's total, was affected by drought.

On Leyte Island, in the Philippines, approximately 20 inches (500mm) of rain fell during the first half of February, leading to more than 1000 lives lost when the village of Guinsaigon was buried by a landslide. The Philippines was also affected by five landfalling

typhoons in 2006, including Super Typhoon Dorian which hit the southeastern part of the island on November 30.

During June southern China received rainfall rates on the order of 99mm (3.5 inches) in two hours forcing the Bashili River out of its banks and flooding 11 villages in the Fujian province. The Chinese government characterised the summer flooding as the worst in 30 years in parts of the country, with 349 weather-related deaths in June.



weather 2006 - IRELAND REVIEW

Warmest on record in some places; mainly wet but sunny

Mean air temperatures for 2006 were over one degree above normal for the 1961-90 period in most places. At many stations it was the warmest year since 1997, while it was the warmest year on record at Casement Aerodrome, Kilkenny, Rosslare and also at Malin Head, where temperature records extend back to 1885. The mean annual temperature of 10.6°C at Dublin (Phoenix Park) was its highest value in a series that extends back to 1855; nine of the twelve warmest years at the station over this period have been recorded since 1995. Over the country as a whole during 2006, March was the only month where mean temperatures were near or a little below normal, while June, July, September and October were particularly warm months relative to normal. The hottest weather of the year was during mid-July, when the highest temperature, 32.3°C, was measured at Elphin, Co. Roscommon, on the 19th; this was the highest value recorded in Ireland since June 1976. For the second successive year, the lowest air and ground temperatures of the year at almost all stations were

recorded during exceptionally cold weather in early March.

Annual rainfall totals were above normal over most of the country, but they were a little below normal in parts of the east and south. Rainfall was very unevenly distributed throughout the year; January, February and June were drier than normal everywhere, while March, May and the autumn months were wet. Widespread heavy falls during the last three months of the year led to flooding in places, especially in midland and western areas. Most stations recorded their heaviest daily falls of the year on either October 25th or November 15th. The number of raindays (days with 0.2mm or more rainfall) measured during the year was close to normal in most places; there were fewer than 200 raindays in most eastern areas, with close to 250 wetdays in parts of Connacht. Annual sunshine totals were above normal everywhere. April, June and July were particularly sunny months relative to normal and only March was duller than normal at all stations. Shannon Airport had its sunniest year since 1968, while at Dublin Airport it was the sunniest since 1959.

County/ Station	Rainfall (mm)			Temperature (°C)				Sunshine (Hours)			No. of days with					
	Total	% of average	Most in a day Amount date(s)	Mean	different from average	Extremes highest lowest	Total	% of average	Most in a day Amount date(s)	Rain	Snow	Air frost	Hail	Thunder	Fog	Gale gusts
Co. Clare Shannon Airport	968.5	105	47.8 21 Sep	11.1	+1.0	30.2 -5.8	4.08	112	15.3 6 Jun	211	3	23	10	15	23	68
Co. Cork Cork Airport	1198.3	98	42.2 25 Oct	10.4	+1.0	25.4 -4.0	4.29	109	15.4 2 Jun	202	6	7	5	4	89	80
Co. Donegal Malin Head	1156.9	111	34.3 23 Nov	10.6	+1.3	25.9 -1.5	3.92	111	15.8 25 Jun	231	8	6	35	5	11	171
Co. Dublin Dublin Airport Casement Aerodrome	740.0 676.5	 93	29.7 15 Nov 37.6 15 Nov	10.3 10.6	 +1.3	26.5 -5.8 31.0 -7.5	4.51 4.24	112 111	15.6 2 Jun 15.0 17 Jul	192 177	8 5	32 39	7 11	6 9	24 15	75 82
Co. Kerry Valentia Observatory	1760.7	126	55.3 25 Oct	11.5	+1.1	26.8 -2.8	3.89	109	15.6 2 Jun	240	3	5	17	7	8	76
Co. Kilkenny Kilkenny	895.2	108	40.6 15 Nov	10.6	+1.3	30.2 -6.4	4.29	117	15.4 2 Jun	194		43				33
Co. Mayo Belmullet Knock Airport	1399.2 1205.6	127	50.5 21 Sep 39.2 25 May	11.1 9.1	+1.5	29.9 -4.6 25.9 -3.4	3.96 3.10	106	15.0 27 Jun 14.5 14 May	245 249	8 9	11 28	36 10	16 1	125 123	68
Co. Monaghan Clones	1054.1	115	26.7 25 Oct	10.1	+1.3	28.9 -6.6	3.75	102	15.2 15 Jul	222		32				42
Co. Offaly Birr	911.3	112	26.7 25 Oct	10.4	+1.1	30.1 -7.8	3.87	109	14.8 15 Jul	203		32				34
Co. Westmeath Mullingar II	1004.5	109	31.8 3 Dec	10.0	+1.2	29.4 -7.2	4.12	114	15.3 1 Jun	226		39				16
Co. Wexford Rosslare	904.5	102	32.3 15 Nov	11.4	+1.3	23.3 -2.3	4.85	108	15.5 2 Jun	168	3	5	6	7	25	113



award...

Tom Keane Receives Austin Bourke Silver Medal

Tom Keane, retired Head of R&A Division, was the first recipient of the Austin Bourke Silver Medal for his extensive work in the science and discipline of Agricultural Meteorology in Ireland and elsewhere during the course of his career. The presentation and reception took place in the Royal Irish Academy (RIA), Dublin on March 2nd 2006.

The medal is awarded by the Joint Working Group on Applied Meteorology (AgMet) in recognition of outstanding contribution to agrometeorology, applied environmental meteorology or biometeorology as evidenced by a documented record of achievement and the high opinion of peers or end-users over an extended period.



Tom Keane pictured with members of the AgMet Group when he received his award



strategic management

Delivering Met Éireann's High-Level Goals

Progress in Achieving High-Level Goals

Met Éireann's Strategy Statement lists ten High-Level Goals which together describe the organisation's key objectives and strategies. Progress in achieving these Goals during 2006 is detailed below.

High-Level Goal 1: To make available to the general public of Ireland an excellent service of high quality general weather forecasts, warnings of hazardous weather and other information helpful in the prevention or mitigation of environmental disasters.

The General Forecasting Division (GFD) supplies a wide range of forecast services and weather warnings through the Central Analysis and Forecast Office (CAFO) and the RTÉ Weather Office. Customers include the general public, Government and semi-state bodies, local authorities, the media and a range of business and commercial interests.

Specific Warnings	Number of days
Frost / Low Temperature	51
Rain	20
Snow	8
Thunder	119
Wind	96
Blight Conditions	62

During 2006 the volume of routine forecasts issued by the Division was similar to previous years. A total of 491 Gale Warnings and 597 Small Craft Warnings

were issued, along with additional specific warnings of particular weather conditions (see Table).

From April 1st the Small Craft Warning became a year-round-service following representations from the Marine Safety Working Group.

Customised weather services were delivered to energy utilities, the building industry, local authorities and several other business and commercial interests. In collaboration with the National Roads Authority, winter road maintenance forecasts for over 50 sites were provided to local authorities nationwide.

The Telephone Consultancy Service (which provides direct customer access to the operational weather forecasters) continued to prove popular with many industrial and commercial clients. Strong demand continued for Weatherdial, Met Éireann's premium-rate telephone weather service, particularly from the agricultural sector.

Throughout 2006 the Division provided updates for Met Éireann's web site several times daily using new style graphics that were introduced during the year. Forecasts of pollen count and sunburn index continued to be issued during the spring and summer months.

Numerical Weather Prediction (NWP)

Collaboration with the HIRLAM (High-Resolution Limited Area Model) community in NWP research continues. The main focus for Met Éireann has been on the treatment of the lateral boundary conditions

used in the NWP model. In the current system the flow of information through the boundaries that mark out the geographical and vertical extent of the model domain is distorted; the goal of the research is to formulate, in a mathematical sense, transparent boundaries that will improve the accuracy of the forecasts. Good progress has been made and a prototype system tested.

Throughout 2006 the HIRLAM model ran 4 times daily on Met Éireann's computer systems and the output formed the principal basis for short-range forecasting (up to 48 hrs ahead). The Wave Prediction Model (WAM), which forecasts sea conditions such as wave and swell height, ran twice daily in tandem with the HIRLAM model.

In 2006 work began on upgrading and rationalising the operational NWP systems in Met Éireann. Talks were held with the Irish Centre for High-End Computing (ICHEC) with a view to scientific collaboration and the operational running of Met Éireann's NWP system on the ICHEC supercomputers. A feasibility study, involving the running of the NWP system at ICHEC and the delivery of data to/from Met Éireann, was completed at the end of the year.

For forecasts in the range 3 to 7 days ahead, Met Éireann continues to rely primarily on guidance provided by the European Centre for Medium-Range Weather Forecasts (ECMWF). In early 2006 ECMWF upgraded the global model, enhancing both the horizontal and vertical resolution of the forecasts.

High-Level Goal 2: To fulfil the State's obligations to provide meteorological services to aviation and to influence future developments in this area in order to achieve the best long-term result for the State and for the aviation sector.

The Aviation Services Division (ASD) provides services to civil, military and general aviation, in accordance with ICAO standards and recommendations and national procedures. It comprises the Central Aviation Office at Shannon Airport, where the Head of the Division is based, together with the Meteorological Offices at Dublin, Cork airports, Ireland West Airport Knock and at Casement Aerodrome. Aviation Services Division is the focal point for liaison between Met Éireann and the Irish Aviation Authority, the airport authorities and the International Civil Aviation organisation and the Commission for Aeronautical Meteorology of the World Meteorological Organisation. ASD staff also actively contribute to the work of cooperative organisations to ensure the best and most efficient service to users.

The ASD provides forecast services for the regional airport of Donegal, Sligo, Galway, Kerry and Waterford.

All routine operations continued as normal throughout the year. Terminal Aerodrome Forecasts (TAFs) were issued for Shannon, Dublin, Cork and Knock Airports and for Casement Aerodrome. Local Aerodrome Warnings were provided for these sites and also for a number of regional airports. A total of 121 SIGMET





warnings were issued for the Shannon Flight Information Region, while 234 forecasts were provided to assist Search-and-Rescue operations. Self-briefing facilities were made available to pilots at Dublin, Cork and Shannon Airports.



Cumulonimbus over Sherkin Island in March

The European Union's Single European Sky (SES) policy aims to make air transport within Europe safer, more efficient and more cost effective. SES seeks to rationalise the organisation of European airspace, reducing the present multiplicity of Flight Information Regions (FIRs) and ultimately creating a single unified airspace in Europe. SES also regulates the provision of services to aviation, including meteorological services.

The impact of SES on Met Éireann, which is currently the ICAO authority for meteorological services to civil aviation in Ireland, will be significant. In order to obtain a license to continue providing such services Met Éireann is required to comply with strenuous conditions. These are specified in the so-called Common Requirements Directive of the SES with

direct applicability in EU States. As the certificate so obtained will be valid in member States, the EU ensures a level playing field through these common requirements. Each organisation must be certified by its own National Supervisory Authority as being compliant with the common requirements prior to the issue of a certificate. ASD received its certificate for meteorological service provision under SES in December 2006.

High-Level Goal 3: To provide a comprehensive range of climate services to all sectors based on a high quality, up-to-date national climate archive, and, in collaboration with other centres of expertise, provide an authoritative voice on future climate trends in Ireland.

Throughout 2006 the Climatology and Observations Division continued its main tasks of maintaining the National Climate Database, managing the observational station networks and operating the Climate Enquiries Office.

The Climate Enquiries Office received approximately 4,500 telephone enquiries and 2,350 requests by email/fax/letter for climatological information or reports. More than 300 meteorologist reports were provided for legal/insurance cases and expert witnesses attended in court as required.

The Monthly Weather Summary was produced promptly after the end of each month, giving a preliminary assessment of the month's weather. The Monthly Weather Bulletin subsequently provided a more comprehensive description of weather

conditions with commentary on significant events, both in Ireland and worldwide.

The Division continued to maintain and collect data from almost 600 climatological and rainfall stations, assisted by co-operating agencies and private individuals. These data, along with data from Met Éireann's own stations, were quality-controlled and made available in the climatological database. Almost half of the stations in the observing networks were visited by Met Éireann inspectors during 2006. Alternative sites were sought for some stations where nearby building activity was considered a threat to the validity and representativeness of the measurements.

Migration to a new computer system for climatological data processing and quality control was completed early in the year.

High-Level Goal 4: To maintain a high level of expertise and involvement in specialised areas such as agricultural, environmental and marine meteorology and to use this expertise to provide forecast guidance and decision support.

Agricultural and Environmental Unit

During 2006 the Agmet Unit continued its close working relationship with agricultural and environmental groups. In collaboration with Teagasc and University College Dublin, a prototype decision support system for nitrogen/slurry spreading was produced, based on ECMWF ensemble forecast fields. A workshop was organised for early 2007, to showcase the system to farmers, agricultural advisers and educational institutes.

A new Soil Moisture Deficit model, developed in partnership with Teagasc and University College Dublin was implemented in Met Éireann. Output from the model can be used to forecast suitable weather conditions for slurry spreading; it plays an important role in supporting the recent EU Nitrates Directive. This work was carried out by an INTRA student supervised by Met Éireann.

The AGMET Unit again supported Met Éireann's attendance at the National Ploughing Championship in Grangeford, Tullow, Co. Carlow, in September. This provided an excellent opportunity for Met Éireann to highlight its services and to obtain feedback from customers.

Contrasts in Irish Weather



i) On the beach at Curracloe, Wexford in July



ii) Rime, or ice accretion, growing on an Ordnance Survey pillar on Slieve Donard





Marine Unit

During 2006 the Marine Unit handled routine sea and shipping-related meteorological enquiries. The Unit continues to oversee the operational running of a numerical wave model (WAM) which is used to provide forecast guidance on the sea state around Irish coastal areas and the Irish Sea. In September, coinciding with a period of exceptionally high tides, the ROMS ocean model was run operationally in collaboration with the Department of Communications, Marine and Natural Resources, to produce forecasts of sea surge heights around Irish coastlines.

The M1 moored buoy, part funded by the EUMETNET Composite Observing System (EUCOS) and the Surface Marine Observation Programme (E-SURFMAR) was moved from its position west of the Aran Islands further west. The Marine Unit continues to monitor the quality of the data from the fixed buoy network, ensuring that problems are identified and resolved as quickly as possible; the data are an important input for the numerical and general forecasts covering Europe and the Atlantic.

Met Éireann continued its involvement in the EU-funded PRISM project, established to develop predictive models of the Irish Sea with supporting web-based tools suitable for use in planning and management decisions. A range of output data from the Met Éireann numerical forecast model are used to support PRISM.

Community Climate Change Consortium for Ireland (C4I) Project

Two lengthy climate simulations were completed for

the ENSEMBLES project in 2006: a 110-year (1951-2060) simulation of the European climate on a 25km horizontal grid; and a reference simulation on the same grid, based on historical data, for the period 1961-1990. The output datasets, post-processed to a common format, were sent to the Danish Meteorological Institute for archival and access by ENSEMBLE partners for further research. The data extends the range of regional climate simulations carried out by C4I and provides a measure of the uncertainty in predictions of the future Irish climate.

The ROMS ocean model, driven with atmospheric data, was used to investigate the impact of climate change on coastal flooding around Irish coastal areas. Initially, a 10-year (1993-2002) validation simulation was performed using re-analysis data and the outputs verified against satellite-based altimeter data and tidal gauge observations. This work has been followed up by using downscaled ECHAM5/OM1 GCM data to drive the ROMS model to assess the impact of climate change on future storm surges. Simulations were launched at the end of 2006.

Climate simulations were also carried out to investigate the influence of sea surface temperatures on Atlantic storms.

Work on river catchment flooding continues: the influence of rainfall, temperature and evaporation on the Boyne, Foyle, Barrow, Feale, Blackwater, Slaney, Suck and Moy river catchment areas were examined. Work has focused on developing a suitable measure to define the performance of the hydrological model and its ability to capture extreme events rather than the mean state i.e. peak flows rather than the mean flows.

A high-resolution climate model is currently being used to produce a wind atlas for Ireland to support the wind energy community.

High-Level Goal 5: To undertake commercial meteorological activity in a way that is consistent with competition law and with Met Éireann's other mandates so as to reduce overall costs to the exchequer.

Met Éireann's principal revenue-earning activities continued to include premium-rate weather forecasts, services to TV and other media, provision of climatological data and reports, and supply of severe weather forecasts (including winter road maintenance) to the National Roads Authority and to local authorities. Contract with RTÉ was extended for a further 2 years up to 2008. Revenues from these activities showed a slight decline from the 2005 peak.

Customer service continued to benefit from the Customer Relationship Management (CRM) software system which provides instant access to key customer information, prioritises activities and tracks all customer-related communications. Operating in tandem with enhancements to Met Éireann's

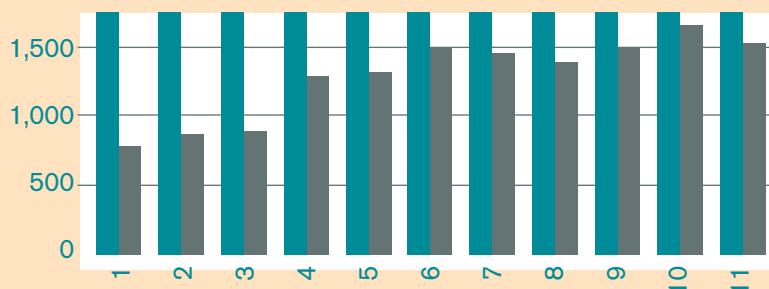
accounting procedures, the CRM system enables customer requirements to be managed with improved timeliness and efficiency.

Throughout 2006 the Commercial Division maintained on-going liaison with all major customer groups and business partners. Marketing and promotional activities included attendance at a number of shows and exhibitions, most notably the National Ploughing Championships in September.

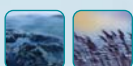


Met Éireann staff helping a visitor to the stand at the National Ploughing Championship

Annual Revenue 1996 -2006



Year	Amount (€1,000)
1995	719
1996	766
1997	876
1998	883
1999	1,277
2000	1,312
2001	1,463
2002	1,444
2003	1,398
2004	1,501
2005	1,651
2006	1,517



High-Level Goal 6: In association with Met Éireann's overall meteorological functions, carry out an appropriate and relevant set of environmental monitoring and geophysical programmes.

Valentia Observatory

Four upper air radiosonde ascents per day to measure the vertical profile of meteorological elements were carried out at the Observatory, along with hourly surface weather reports. Measurements of ultraviolet (UV) radiation and surface and total column ozone levels were performed, supplemented during the winter months by ozonesonde ascents.

The Observatory participated in national and international monitoring programmes in atmospheric chemistry, geomagnetics, seismology, and phenology. The upgrade of the geomagnetic facilities continued. MOUs were signed with the Dublin Institute of Advanced Studies (DIAS) for a major upgrade of the seismological facilities and with the UK Met. Office for the installation of a lightning detection unit in the Met Office global network.

Cooperation continued with NUI, Galway, in the area of atmospheric physics and chemistry, following up on the 2005 Global Atmospheric Watch (GAW) review.

Laboratory

Analysis of the chemical composition of air and precipitation samples from selected synoptic stations, primarily Valentia Observatory, continued. In association with the Environmental Protection Agency (EPA), samples were also analysed from five new

locations in an ERTDI project to monitor air quality and acidification linked to transboundary pollution. Plans for a further extension of the range of the atmospheric chemistry programme, in accordance with the requirements of EMEP, GAW were completed.

High-Level Goal 7: Maintain and enhance a technical infrastructure for Met Éireann that supports the production of its outputs.

Instrumentation

Synoptic Network

The longstanding Met Éireann network of synoptic stations, which produce hourly reports of local weather conditions, comprises a mix of manned and automatic stations. A full programme of observations, 24 hours a day, was maintained throughout the year.

One additional automatic weather station (AWS) was installed in 2006 in the unified climatological and synoptic observations network (TUCSON). It was located at a Teagasc site at Grange, Co. Meath. This brings the number of AWSs in this new automated network to 13.

The Met Éireann observational networks are supported by calibration, maintenance and repair programmes. A new facility for calibrating humidity sensors over their full operational range will be delivered early in the New Year.

The same new type of ceilometer was selected for deployment at both airports and synoptic stations. Five units were purchased in late 2006 for deployment at airports.



Instruments Unit staff working on installation of new TUCSON station at Grange during a snow shower [February 3rd]



TUCSON station at Grange nearing completion of installation in April

Meteorological Radar and Satellite Receiving Systems

Met Éireann operates two networked weather surveillance radars, located at Dublin and Shannon Airports. A significant retrofit was carried out on the former in 2006.

Ground station facilities for the reception of data from meteorological satellites are also maintained. These continue to be upgraded to handle the additional types of information becoming available from the new geostationary and polar orbiting satellites.

Information and Communications Technology

IT Vote Control in Dept Finance granted a delegation certificate for 2006 for IT-related expenditure to DEHLG, including Met Éireann. A detailed annual report on IT expenditure for 2005 and estimates for 2006 were compiled and sent to IT Vote Control at the end of April 2006.

Met Éireann ICT-related expenditure for 2006 amounted to an overall total of €736K.

Working Arrangements / Staffing Resources

The on-going support and maintenance of the ICT infrastructure at Met Éireann continues to require a substantial amount of staffing resources not just in the IT Division but also in other Divisions such as GFD, R&A, C&O, I&E and ASD. However, over this reporting period large gaps have emerged in the capacity of the IT Division to provide full cover for some mission critical systems and this is a major cause for concern as our resources to sustain progress have become less predictable.

In March, a Temp. Programmer/Analyst, was employed on a 1-year contract to continue the in-house development of the new web based self briefing unit [wSBU] for airline pilots.

2006 - TECHNICAL DEVELOPMENTS

Technical Developments in 2006

UPS Replacement

During the latter half of 2005 a detailed implementation plan was prepared for the replacement of the UPS that serves the operational areas of HQ. The task was successfully completed in January 2006.

The efforts of all the staff involved ensured that there was a minimum of down time for all essential services delivered to Met Éireann's internal and external customers.

MSG satellite

IT Division continued to support the reception and processing of data from the MSG satellites. Additional memory capacity was installed to meet the increasing data requirements.

The old EUMETSAT data reception system, PDUS, was decommissioned in June

Equipment was purchased in readiness for the reception, processing and display of additional satellite data, particularly data for the new European METOP polar orbiting satellite that was successfully launched by EUMETSAT on 19 October.

Radar

A major upgrade and refurbishment of the Dublin Airport weather radar system was undertaken in the course of the year.

It is expected that the old Microwave link from Dublin Airport (via Howth) to Met Éireann in Glasnevin will be decommissioned early in 2007.

Sferic Data

Following the signing of a new agreement between UKMO and Met Éireann to install a new Lightning Detection System at Valentia Observatory, new software was acquired to decode the larger Sferic bulletins which are expected to report much more lightning fixes from early in 2007.

Government VPN

By the end of 2006 all our Wide Area Links are routed through the Government Virtual Private Network (GVPN). Enhancements during 2006 included the following:

- ▶ Shannon link upgrade
- ▶ Internet link upgrade
- ▶ Casement link upgrade
- ▶ Valentia connection to GVPN completed
- ▶ Department of Environment, Heritage & Local Government link transferred from Wireless to the GVPN in September

Backup and Disaster Recovery

Initial stage of Development of a new strategy for the backup and restoration of Linux / UNIX systems was prepared.

RMDCN (Regional Meteorological Data Communications Network)

Preparations for the upgrade of our link to the RMDCN network from Frame Relay protocol to MPLS were made. The upgrade of the RMDCN link from 384kbps to 1Mbps is scheduled for completion by end Q1 2007.

Marine Observations

Marathon Gas Platform

During August the AWS on the Marathon Gas



Platform was upgraded. This resulted in a new report format and delivery method. Existing reception and processing software at Met Éireann was updated accordingly.

New M6 buoy

Software for producing Coastal reports was updated to include observation data from the M6 Buoy.

Observations reports were received from the Celtic Explorer in September.

NWP data from ECMWF

In February the introduction of a new High Resolution Forecasting system at ECMWF necessitated the reorganisation of the routine dissemination of the Boundary Condition suite of data required to run the HIRLAM model. Two additional servers [dry/wet] were installed. The dissemination schedule was also modified to include additional EPS data that include Probability and Plume plots.

Job submission scripts on the ECACCESS server were also updated.

High-Level Goal 8: To position Met Éireann so as to make the most effective contribution to the achievement of Government objectives in the general environmental area.

Automation of Observing Network

Work continued on this project throughout 2006. By the end of the year, work was well advanced on the TUCSON stations at Johnstown Castle, Oakpark and Ballyhaise. It is planned that these will replace the

present manned stations at Rosslare, Kilkenny and Clones - this process is likely to commence in 2007. The requirement to provide coastal reports in the southeast area was also being addressed.

Work on identifying a suitable replacement site at Birr was well advanced while the process in relation to Belmullet was still at an early stage. A TUCSON station will be installed on the existing site at Malin Head.

Work also continued on proposals to address the HR issues arising on foot of these changes.

Flood Studies Update Project

Ireland has suffered a number of major flood events during the last decade, and current climate change research indicates that this problem is likely to worsen in the future. Met Éireann is involved in a number of initiatives to help minimise the risk to life and property.

Flood estimation has generally been undertaken using the methodologies and data provided in the Flood Studies Report, the outcome of an extensive UK/Irish research programme dating from the early 1970s. For some years past, Met Éireann has participated in the Flood Studies Update project to revise the Report. The main focus in 2006 has been in the analysis of extreme rainfall events in Ireland. This work involves the quality control of the short-duration rainfall and the development of a depth-duration-frequency model for periods from 1 to 25 days, later extended to short-duration data, with durations ranging from less than 24-hours down to 15 minutes.



High-Level Goal 9: Actively seek collaboration with UK and other European meteorological services in order to improve the effectiveness of Met Éireann and to pursue Government objectives in relation to the British-Irish Agreement.

Throughout 2006 Met Éireann maintained its active involvement in the work of several international organisations including the World Meteorological Organisation, the International Civil Aviation Organisation, the European Centre for Medium-Range Weather Forecasts, the European Organisation for the Exploitation of Meteorological Satellites, the European Co-operation in Meteorology grouping and the European Meteorological Network. Met Éireann also continued its participation in HIRLAM, a co-operative project in Numerical Weather Prediction between the Nordic countries, Spain, the Netherlands and Ireland.

The European Co-Operation in Meteorology grouping (ECOMET) was established in 1995 in response to the development of commercial meteorological activities in Europe. Its primary objectives are to preserve the free and unrestricted exchange of meteorological information between the European National Meteorological Services, and to ensure the widest availability of basic meteorological data and products for commercial applications.

High-Level Goal 10: To utilise the Civil Service modernisation programme in all its aspects to improve the efficiency of Met Éireann and to develop the potential of its staff.

Administration

Budgetary outturns for 2006 were broadly in line with estimates, with a small overspend on the capital budget being balanced by a corresponding underspend on the non-capital side. Subscriptions to Meteorological international Organisations were slightly ahead of estimates.

During the year there was one resignation and seven retirements. There were two appointments to the Meteorologist grade and eight to the Meteorological Officer grade. Four staff were serving in temporary contract posts and three were on career breaks at various stages during the year. At the end of 2006 there were the equivalent of 222 staff posts filled in Met Éireann (taking into account work sharing etc.).

In May, a special meeting of the Management Committee was convened to consider the future organisation of weather forecasting operations in Met Éireann. This strategically-focused session was guided by the work of the Group on the Future of Forecasting, which had for some time been investigating Met Éireann's forecasting needs and how they should be addressed. There was particular emphasis on the appropriate role of automation in operational forecasting, and the meeting included demonstrations of two meteorological workstation systems. Further assessment of workstations and their suitability for Met Éireann's requirements continued throughout the remainder of the year.

As part of the continuing implementation of the Management Information Framework (MIF) system, a number of Met Éireann staff participated in a trial of the Oracle I-Expenses (Internet Expenses) system. This is an on-line Web-based module of the Oracle Financial

System which enables staff to enter their own expenses claims. I-Expenses calculates entitlements using built-in rules and rates, and all claims are automatically routed for review and approval.

Other notable developments in 2006 included the launch of an improved Met Éireann web site (www.met.ie), publication of a new Statement of Strategy, significant progress in planning for automation of the observing network and detailed preparations for refurbishment of Met Éireann's Headquarters offices in Glasnevin, Dublin.

Partnership

The Partnership Council held six meetings during 2006, one of which was arranged in conjunction with a visit by the Council to Met Éireann's synoptic station at Belmullet.

Dr. Damian Thomas from the National Council for Partnership and Performance [NCPPI] addressed the March meeting of the group as part of its review of the Partnership process in Met Éireann.

A sub-committee was set up to review and advance proposals for the future membership and structure of the Council. This group presented its report to the October meeting. Following discussion, a revised membership framework and operating procedures were adopted and these will be introduced in early 2007.

At the May meeting in Belmullet, the Director made a presentation on the status of plans for the automation of the synoptic network.

The Partnership Council contributed to Met Éireann's

input for the Department's Action Plan and Context Statement for the new 'Towards 2016' National Agreement.

The Council continued to monitor developments in regard to the planned refurbishment of the HQ Building - at the end of the year, proposals in this regard were well advanced.

The Partnership Council also monitored the operation of the Performance Management and Development System (PMDS) and Health and Safety issues throughout the Service.

Partnership Council considered and had an input into the revised Training and Development Strategy for Met Éireann prior to its adoption by Management.



Met Éireann Partnership Council meeting local staff prior to their meeting in Belmullet.

Staff Training and Development

- ▶ 298 Course/Training events, of which 30 were training courses abroad, were delivered to staff during 2006. While some staff, because of their particular requirements, attended multiple courses, 162 staff attended at least one training event.

- ▶ 13 staff availed of the Refund of Fees scheme, and this year all the fees were paid up front before the courses started.
- ▶ Meteorologist recruits (2) received their Induction Training at UCD on the Masters in Meteorology Course and 1 staff member enrolled on the course part-time.



Meteorological Officers who completed basic training at Baldonnel



- ▶ Induction Training for Meteorological Officers was provided in-house for 7 staff.
- ▶ There were 36 PMDS-related training Courses conducted.
- ▶ 3 Staff attended Irish Language Courses with Gaeleagras and 1 staff attended a sign language course with the CS Language Centre.
- ▶ A revised Training and Development Strategy for Met Éireann prepared and adopted early in the year.

Library & Information Services

One issue of Met Éireann's staff magazine Splanc was produced during the year. Met Éireann's Librarian resigned from the Service in January and a replacement had not been appointed at the end of the year.

The main areas of the Librarian's work were redistributed among other staff pending the appointment of a replacement which it is hoped will take place early in 2007.

Young Scientist and Technology Exhibition

In 2006 Met Éireann sponsored a Special Award at the Esat BT Young Scientist and Technology Exhibition for the best project with Irish weather or climate as its central theme. Students, Richeal Ní Thighearnaigh & Etáin Nic an Aoire, from Coláiste Íosagáin, Dublin won the award for their project "The Sunny Southeast" - Is It True?

The project involved monitoring and comparing the weather in Wexford and West Cork during July and August 2004 to see in which location the best summer weather occurs.



Winning students being presented with their award by Joan Blackburn.



Appendices

Appendix I - Forecast Accuracy

Verification of Public Weather Forecasts

During 2006 Met Éireann continued the routine verification of predicted daily maximum temperature, minimum temperature and rainfall at four sites (Dublin, Cork, Birr and Belmullet), based on the RTÉ 1 radio forecasts at 7.55 am.

Figures 1 and 2 show the mean annual Root Mean Square (RMS) errors for the maximum and minimum temperature forecasts for the years 2001 - 2006 (the smaller the RMS error, the better the forecast). Figure 3 shows the mean annual verification of rainfall amount by means of Hanssen and Kuipers' Score - this has a value of 1 for a perfect forecast, and zero for a random forecast, i.e. one lacking any skill. The Figures also show corresponding mean annual scores for persistence.

For 2006, the mean Root Mean Square (RMS) error for the maximum temperature forecast is about 1.5°C, and about 2.0°C for the minimum temperature. For rainfall, the average value of the Hanssen and Kuipers' Score is 0.48. All these scores are in line with the corresponding values for 2001-2005.

An indication of the quality of the forecasts can be got by comparing the forecast scores with the values that would be obtained for a 'standard' forecast. Persistence is a commonly-used standard for verification purposes - i.e., a forecast that assumes that tomorrow's weather will be the same as today's. Figures 1 - 3 show that, as would be expected, the annual forecast scores for the years 2001-2006 are in all cases much better than the persistence scores.

Figure 1.

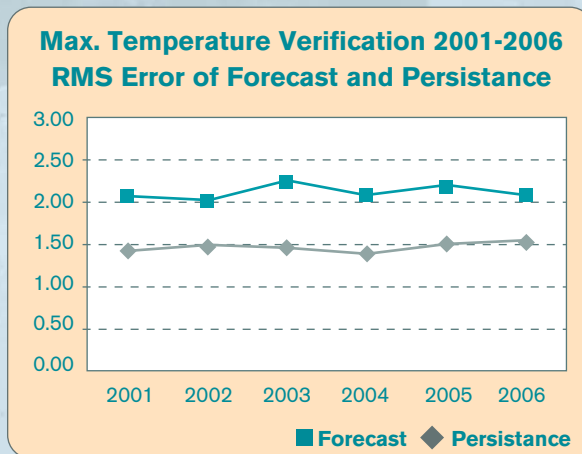


Figure 2.

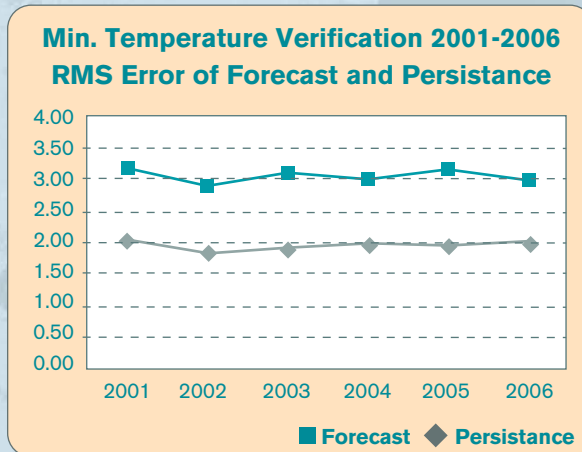
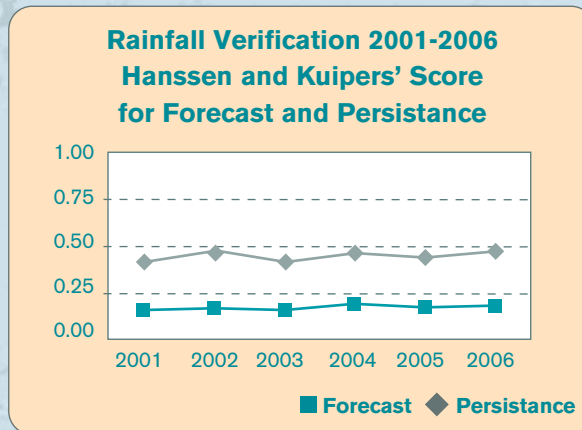


Figure 3.



Numerical Weather Prediction

The evolution of the annual verification scores for the HIRLAM forecasts of 2-Metre Temperature and 10-Metre Wind Speed, from 2001 to 2006, is shown in Figures 4 and 5.

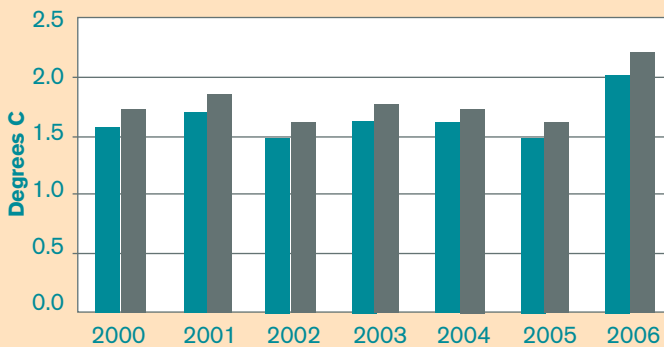
Figure 4 gives the Root Mean Square error scores of forecast 2-Metre Temperature for 24 hrs and 48 hrs, verified against actual temperature reports from the network of Irish observing stations. Both scores show

a disimprovement in the 2006 RMS error compared with corresponding values for 2005. The reasons for this are to be investigated.

Figure 5 shows the Root Mean Square error scores of forecast 10-Metre Wind Speed for 24 hrs and 48 hrs. For the 24 hrs forecast the 2005 RMS error is the same as in 2006, while for the 48 hrs forecast the 2005 RMS error is slightly lower.

Figure 4

HIRLAM Verification RMS Error of 2-Metre Temperature



2m Temp

	24	48
1996	1.63	1.69
1997	1.70	1.94
1998	1.64	2.07
1999	1.59	1.70
2000	1.57	1.71
2001	1.69	1.84
2002	1.47	1.60
2003	1.62	1.75
2004	1.59	1.71
2005	1.47	1.60
2006	2.01	2.19

Figure 5

HIRLAM Verification RMS Error of 10-Metre Wind Speed



10m Wind

	24	48
1996	2.62	2.75
1997	2.47	2.69
1998	2.36	2.51
1999	2.18	2.40
2000	2.10	2.36
2001	2.08	2.34
2002	2.16	2.41
2003	2.14	2.36
2004	2.14	2.34
2005	2.16	2.41
2006	2.16	2.40

■ 24hr Forecast ■ 48hr Forecast





Road Surface Temperature

Forecasts of road conditions are provided under contract to the National Roads Authority. Verification of the Road Surface Temperature (RST) minimum forecasts was carried out during the winter 2005/2006 season for the so-called critical nights (nights on which RSTs less than 5°C were observed) for all available sites. Table 1 shows the Hanssen and Kuipers' Score and the RMS Error for the 2005/2006 forecasts, along with the corresponding values for the winter seasons 2004/2005, 2003/2004 and 2002/2003.

Table 1.

	Hanssen and Kuipers' Score	RMS Error
2005-2006	0.68	1.7°C
2004-2005	0.66	1.6°C
2003-2004	0.70	1.5°C

For 2005/2006 both the Hanssen and Kuipers' Score and the RMS Error show small variations compared to the 2004/2005 values. However both scores have been quite stable over the past three winter seasons.

Air Temperature Forecasts

Early morning forecasts of maximum and minimum temperatures for Dublin and Cork, for the current day and the subsequent two days, are issued by General Forecasting Division. These forecasts are subsequently verified against observations at Dublin and Cork Airports.

Figure 6

Max and Min Temperature Verification, 2001-2005
RMS Error of Forecasts for Dublin

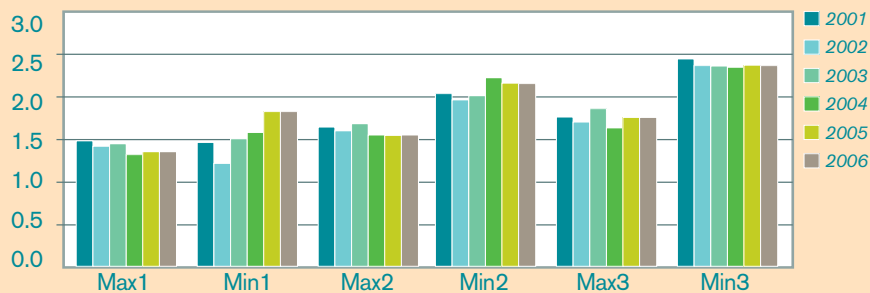


Figure 7

Max and Min Temperature Verification, 2001-2005
RMS Error of Forecasts for Cork

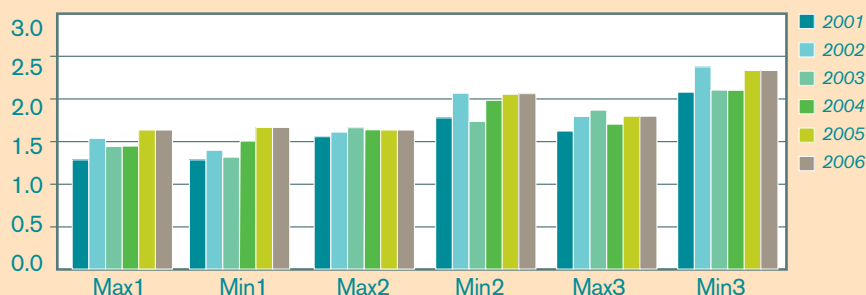


Figure 6 shows the annual RMS error scores for Dublin for the period 2001-2006 (Max1 = max temperature on current day, Max2 = max temperature on following day etc). Figure 7 shows the corresponding RMS error scores for Cork.

Generally speaking the 2006 RMS scores are all comparable with those of 2005.

(It should be noted that in previous years, the comparison were based on the 24hrs, 21z to 21z, whereas in this report the comparison are based upon the exact day in question, i.e., 00z to 24z.)





Appendix 2 - Publications

McDonald, A., 2005: Progress report on transparent lateral boundary conditions. HIRLAM newsletter 49, 124-128.

McDonald, A., 2006: Transparent lateral boundary conditions for baroclinic waves II: introducing potential vorticity waves. *Tellus* 58A, 210-220.

McDonald, A., 2006: The 'Lorenz' grid computational mode: implications for transparent boundary conditions and vertical two grid noise. HIRLAM technical report 67 27pp.

C4I: Preliminary comparison between statistical downscaling and very high resolution dynamical downscaling. ENSEMBLES Report, 2006.

McGrath R, Semmler T, Sweeney C, Wang S (2006): Impact of Balloon Drift Errors in Radiosonde Data on Climate Statistics. *Journal of Climate* 19(14): 3430.

Wang S, Mcgrath R, Semmler T, Sweeney C (2006): Validation of simulated precipitation patterns over Ireland for the period 1961-2000. *International Journal of Climatology* 26(2): 251-266.

S. Wang, R. McGrath, T. Semmler, C. Sweeney, P. Nolan (2006): The impact of the climate change on discharge of Suir River Catchment (Ireland) under different climate scenarios. *Natural Hazards and Earth System Sciences*, 6:387-395.

Appendix 3 - Met Éireann Finances

Income and Expenditure 2005/2006	2006	2005	2006	2005
	€ ,000	€ ,000	€ ,000	€ ,000
Salaries and Related Expenses (A1)			14,954	14,387
Other Operating Expenses			2,756	2,705
Capital Expenditure			735	602
Contributions to International Organisations			3,235	2,945
Total			21,680	20,639
Receipts from Eurocontrol (Route Charges)	7,841	7,833		
Receipts from Commercial & Cost Recovery Activities	1,517	1,651		
Total Receipts	9,358	9,484		
Net Cost of Operations			12,322	11,155
Some details of above				
A1				
Salaries			14,042	13,533
Overtime			668	568
Payment to Observers			119	114
Other Allowances			125	
				172
A2 (Travel & Subsistence)			223	
A3 (Training/Merit Awards/Cleaning etc.)			502	238
A4 (Communications & Post)			263	506
A5 (Computing Capital)			224	265
A5 (Computing Non-Capital)			531	250
A5 (Instrumentation Capital)			511	564
A5 (Instrumentation Non-Capital)			608	352
A6 (Maintenance/Energy)			626	588
A7 (Consultancy)			3	525
				19
			18,445	17,694
Some details of commercial/cost recovery receipts				
Aviation			6	
Climatological Information	198	181		
General Forecasting	1,287	1,440		
Miscellaneous	32	24		
	1,517	1,651		

The figures presented above are approximate and for information only. They do not form part of the official annual accounts of Met Éireann.





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Glossary

ALADIN	Limited-area Numerical Weather Prediction model of Météo-France
AWS	Automatic Weather Station
C4I	Community Climate Change Consortium for Ireland
CAFO	Central Analysis and Forecast Office
CRM	Customer Relationship Management
ECMWF	European Centre for Medium-Range Weather Forecasts
ECOMET	European Co-operation in Meteorology
ECPDS ECMWF	Product Distribution System
EUCOS EUMETNET	Composite Observing System
EUMETCast	EUMETSAT data dissemination system
EUMETNET	Network of European Meteorological Services
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FIR	Flight Information Region
GAW	Global Atmosphere Watch
HIRLAM	High-Resolution Limited Area Model
ICAO	International Civil Aviation Organisation
INTRA	Integrated Training (3rd-level work experience programme)
ISO	International Organization for Standardization
MSG	Meteosat Second Generation
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OPW	Office of Public Works
PRISM	Predictive Irish Sea Models
PMDS	Performance Management and Development System
QMS	Quality Management System
RMS Error	Root Mean Square Error
RST	Road Surface Temperature
SAF	Satellite Application Facility
SES	Single European Sky
SIGMET	Information on occurrence of specified aviation weather phenomena
SMS	Short Message Service
SYNOP WMO	Code for Surface Synoptic Observations
TAF	Terminal Aerodrome Forecast
TUCSON	The Unified Climate and Synoptic Observation Network
WAFS	World Area Forecast System
WAM	Wave Forecast Model
WAN	Wide Area Network
WMO	World Meteorological Organisation





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- ▶ Henry Skeath (Slieve Donard)
- ▶ Ayolt Kloosterboer (Curracloe Beach)





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