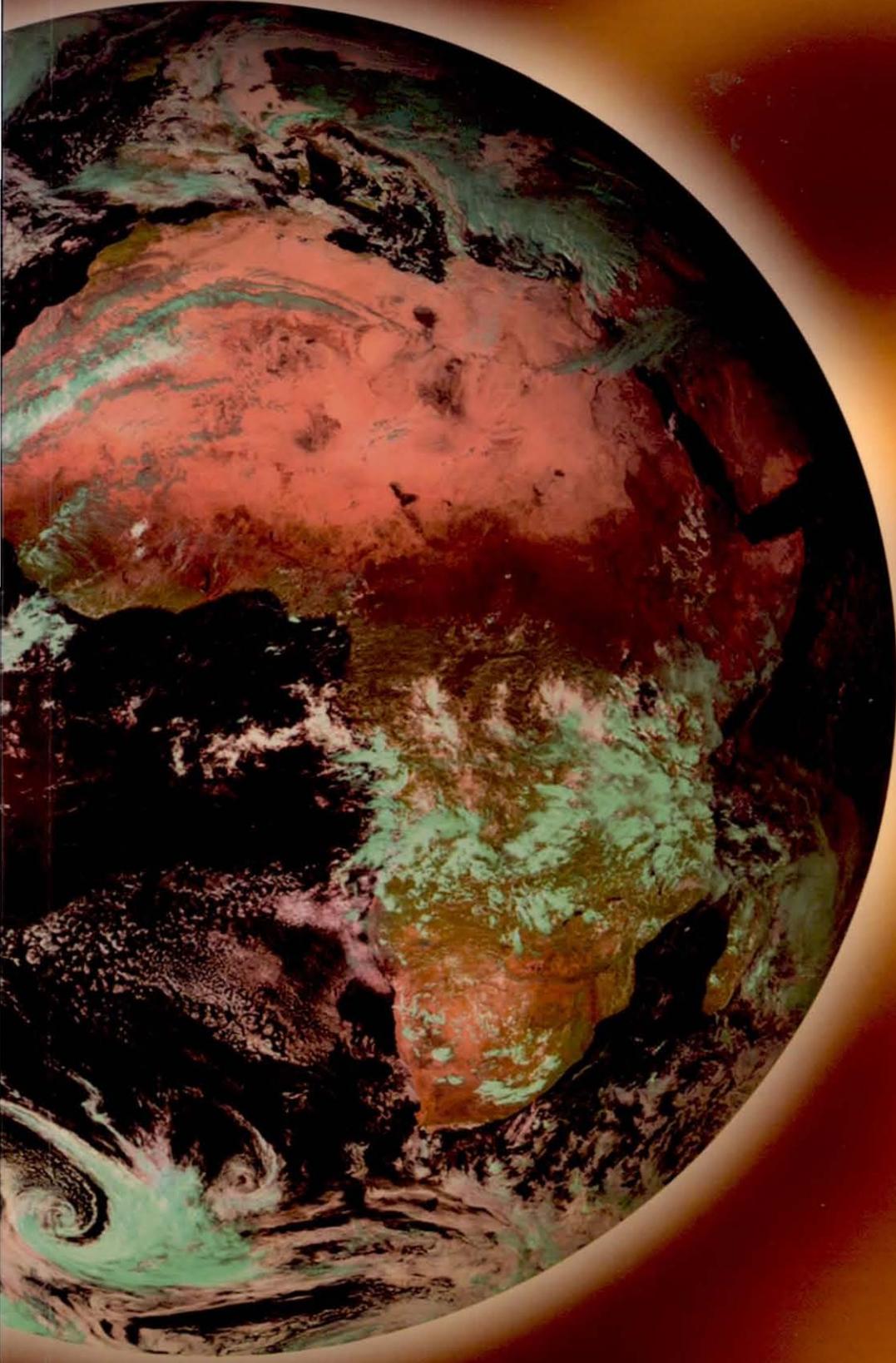


Annual Report 2002



Met Éireann



Contents

Foreword	2
Mission Statement and Organisational Structure	3
Articles	
EUMETSAT Conference and the Meteosat Second Generation Satellite System	4
Rainfall and Flooding in 2002	7
Programme News	
Forecasting Programme	9
Observing and Technical Support Programme	12
Climate Programme	15
Strategic Management	17
Other Activities	21
Appendices	
I. Staff Training and Development	23
II. Forecast Accuracy	24
III. Publications	27
IV. Met Éireann Finances	28
Corporate Information	29
Glossary	30

Foreword

Met Éireann has always considered that its meteorological activities contribute very significantly to the care and monitoring of Ireland's natural environment. On 6th June 2002 this conviction was underscored by the Taoiseach's announcement that, as part of a wider transfer of functions between Government Departments, henceforth Met Éireann was to be part of the Department of the Environment and Local Government. This move will provide us with an opportunity to forge closer links with the Department's environmental functions, and to locate our activities in a wider context. Met Éireann's Community Climate Change Consortium for Ireland (C4I) project, aimed at establishing a regional climate analysis and prediction centre for Ireland, is an example of the contribution we can make to the mission of the Department.

It is of course with some sadness that we part from our colleagues in the transport function, having been associated with that Department, and particularly the aviation section, since the establishment of the Meteorological Service in 1936. As it happens, 2002 was a year in which aviation issues were very topical. Recent pressures have focused attention on the costs of all services to aviation, not excepting those provided by Met Éireann. Following discussions with the Department of Transport, we are redoubling our efforts to make all our charges to the aviation sector as transparent as possible and in line with best practice. At European Union level too, the future provision of meteorological services to aviation is under review and the new Single European Sky initiative could have significant implications for Met Éireann.

The weather of 2002 was notable for above normal rainfall amounts which resulted in some serious flooding - notably during November, when both Cork and Dublin were badly



affected. Forecasts issued by Met Éireann helped the local authorities to cope with the disruption and underlined our vital role in dealing with severe weather events.

In line with the recommendations of the recent Value for Money study of Met Éireann, carried out by the Comptroller and Auditor-General, the on-going measurement of forecast accuracy remained high on our agenda during 2002.

I would like to record my thanks to all Met Éireann staff for the important work done in 2002, and for the excellent results achieved in our mission to help protect life and property, and contribute effectively to national prosperity.

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

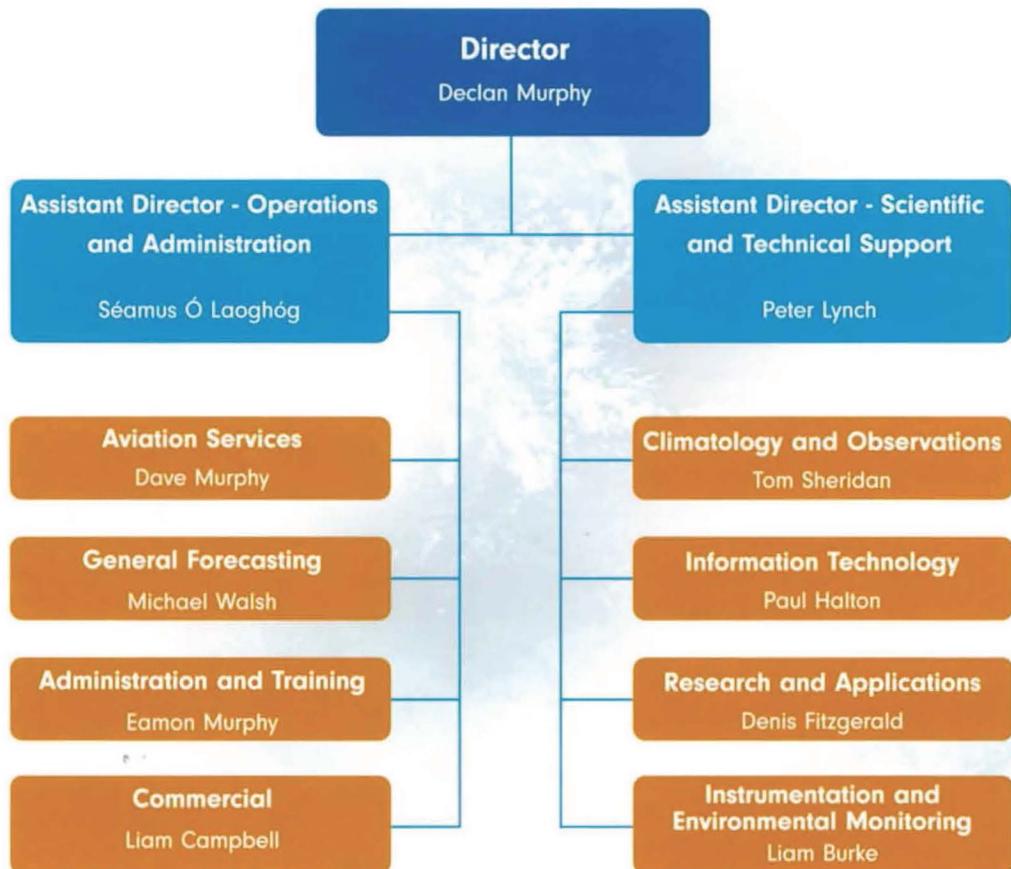
Declan Murphy
Director

August 2003

Mission Statement

Our Mission is to meet the national requirement for high-quality weather forecasts and associated services, with optimum efficiency and value for money.

Organisational Structure (December 2002)



EUMETSAT Conference and the Meteosat Second Generation Satellite System

Introduction

In September 2002 Met Éireann hosted the annual EUMETSAT Satellite Conference in Dublin Castle. EUMETSAT is the European Organisation for the Exploitation of Meteorological Satellites, and its primary objective is to establish, maintain and exploit European systems of operational meteorological satellites. The importance of satellites in modern weather forecasting, and the rapid pace of scientific development in this area, attracted almost 200 delegates to the Dublin Conference. Participants from as far afield as the USA, China, Russia, Japan and Africa attended more than 70 presentations on state-of-the-art satellite data applications.

The Background

Europe's weather satellite programme started in November 1977 with the launch of Meteosat-1 by the European Space Agency (ESA). In 1986 EUMETSAT was established as an international organisation with Headquarters at Darmstadt, a medium-sized town some 40 km south of Frankfurt in Germany. The new organisation took over the operation of the Meteosat programme from the ESA.

Meteosat-7, the current operational satellite, orbits 36,000 km above the Earth's equator at the same speed as the Earth itself rotates. It therefore appears to 'hover', or remain stationary, over the Gulf of Guinea on the west coast of Africa. In this configuration, known as a geostationary orbit, it can return regular images of the same area of the globe, allowing the development and progression of weather systems to be tracked.

Figure 1 shows an example of a Meteosat-7



Conference opening address by Mr. Pat the Cope Gallagher T.D., Minister of State at the Department of the Environment and Local Government.

image, taken at 14.00 UTC on 17th May 2002. It highlights a frontal trough moving north-eastwards over Ireland, which later in the day produced heavy rain over the east, north and northwest. The areas of heaviest rainfall can be seen as the yellow and red colours on the radar image taken at 20.30 UTC (Often the maximum usefulness is obtained from satellite imagery when it is interpreted in combination with other data).

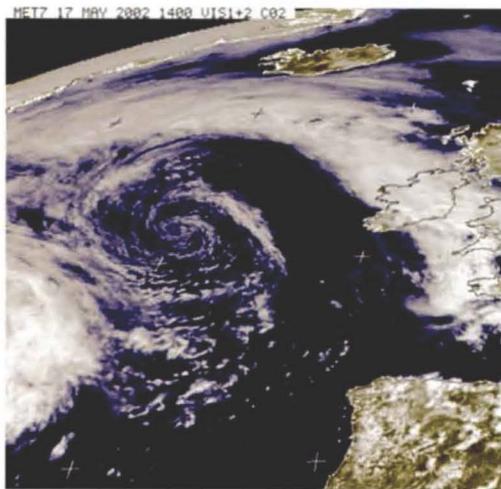
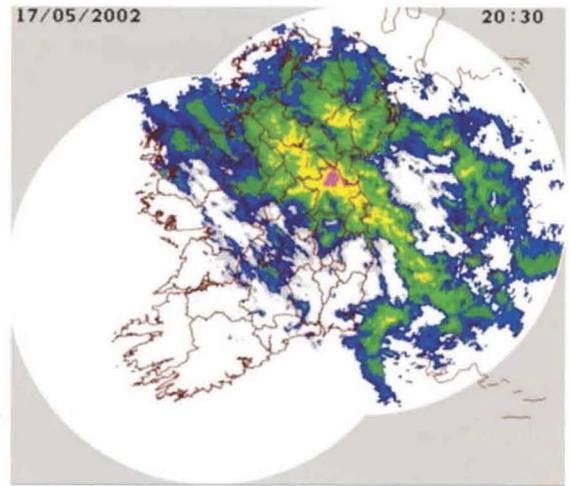


Figure 1: Meteosat-7 and radar images from 17th May 2002



The Second Generation

Scientific developments, and the increasing demands on weather forecasting systems, have created the need for more frequent and comprehensive observations from space. This has led to the Meteosat Second Generation (MSG) system, which will replace the Meteosat series.



Launch of MSG-1 Satellite aboard Ariane-5.

The first of the new satellites – MSG-1 – was sent into orbit aboard the European Ariane-5 launcher on 28th August 2002. MSG-2 will follow in 2005 and MSG-3 about five years later. The aim is to give a continuous MSG service for at least 12 years.

With the existing Meteosat system, an object such as a cloud has to cover at least 2.5 x 2.5 km to be seen in visible light, but with MSG, objects of 1 square km can be seen in the High Resolution Visible (HRV) channel. Also, while Meteosat-7 transmits images every 30 minutes, MSG will operate at twice this frequency. These improved spatial and temporal resolutions are important – for example in forecasting thunderstorms, which can grow rapidly to dangerous proportions. The new MSG imagery will also improve forecasts of hazards such as fog, snowfall, and rapidly deepening depressions that often bring gale force winds.

MSG will be capable of delivering about 20 times more information than the existing Meteosat system. To deal with the flood of new data, a completely new ground processing system is being developed. The central part of this system will be in the EUMETSAT Headquarters at Darmstadt. From there, the

MSG satellites will be monitored and controlled and data will be received, processed and retransmitted to end-users.

The Satellite Application Facilities (SAFs)

A novel feature of the MSG project is that sections of the satellite ground system will be distributed among several European meteorological services. These will host Satellite Application Facilities (SAFs), where specialised expertise will interpret MSG data to produce specific weather-related information. Different SAFs will focus their attention on topics such as ocean and sea ice, ozone concentrations and climate monitoring, to name just a few.

Among the SAFs of particular interest to Met Éireann is that dealing with Support to Nowcasting and Very Short Range Forecasting, based at the headquarters of the Instituto Nacional de Meteorología (INM) in Madrid. Output from this SAF is expected to improve Met Éireann's overall forecasting capability and in particular help with the identification, tracking and monitoring of rain-bearing cloud systems.

As an example of the SAF's work, Figure 2 shows a Meteosat image overlaid with computer-generated symbols representing typical weather types associated with particular cloud formations. These serve as a 'first-guess' to guide the forecaster's interpretation of the satellite images. The usefulness and reliability of this guidance will improve when the higher-resolution MSG images become available.

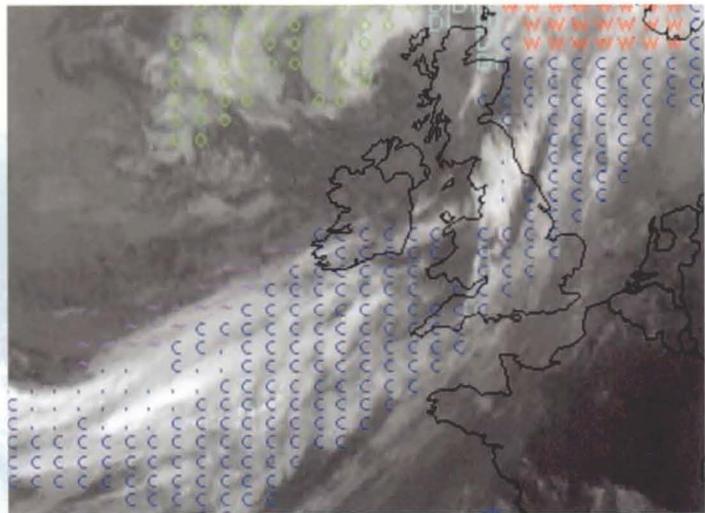


Figure 2:
Sample SAF Output

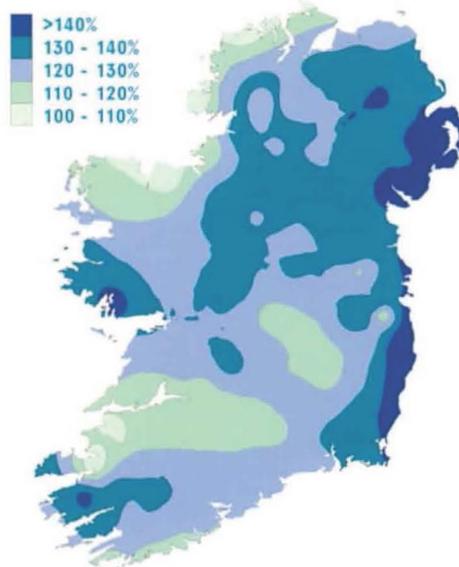
Some symbols:
 w Warm Front
 o Occlusion
 c Cold Front
 - Wave

The Future

The successful launch of MSG-1, just days before the opening of the Dublin Conference, represented a major milestone in Europe's weather satellite programme. Looking to the future, the Conference also considered plans for the EUMETSAT Polar System (EPS), a series of polar orbiting satellites the first of which is due for launch in 2005. Polar orbiting satellites circle the Earth in an almost north-south orbit, passing close to both poles, at an altitude (approx. 800 km) which is much lower than the geostationary satellites. The geostationary and polar systems will together provide complementary data of immense usefulness in operational weather forecasting.

Rainfall and Flooding in 2002

Rainfall amounts in 2002 were above normal throughout most of Ireland, and set new records in many parts of Leinster and Munster. Particularly heavy falls occurred during the months of February, May, October and November. At Valentia Observatory the rainfall in 2002 amounted to 1923mm, the highest annual total since records began in the area in 1892.



Annual Percentage of Normal Rainfall for 2002.

Such exceptional rainfall resulted in several serious flooding incidents during the year, at times exacerbated by a combination of strong winds and high tides.

Following several days of stormy weather in late January, a deep depression of 930 hPa passed to the northwest of Ireland on 1st February. Bands of heavy thundery rain, accompanied by south-westerly gales, affected most parts of the country throughout the day. Most disruption, however, was caused by the exceptionally high tides recorded around many coasts, especially in the Irish Sea. The worst affected area was Dublin; severe flooding occurred after the highest tide measured for

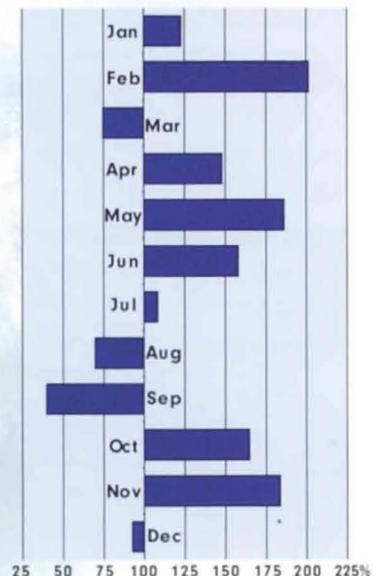
Monthly Percentages of Normal Rainfall in 2002.

over eighty years caused rivers and canals to overflow in parts of the city.

The east, north and northwest of the country experienced heavy rainfall in mid-May. Falls of more than 25mm were recorded on the 17th as a band of thunderstorms merged over much of Leinster and Ulster, and daily totals exceeded 50mm in some places.

Both October and November were among the wettest months on record in the south and east. A band of heavy rain brought falls of over 25mm to many southern counties on 25th October. At Rosslare, rain commenced in the early afternoon and by midnight measured 80mm, over half of which fell in a 2-hour period between 15.00 and 17.00 UTC, including a 1-hour fall of 31.5mm. This represented the highest midnight-to-midnight fall at Rosslare since the station opened in 1956.

On 13th November an area of heavy rain moved into eastern regions, associated with a deep depression of 966 hPa which became slow-moving over the Irish Sea. Rain continued for over 30 hours in the Dublin area and



caused severe flooding along the valley of the River Tolka. The river level rose to 2.42m at Glasnevin (Botanic Gardens) in the early morning of the 15th, corresponding to a flow rate of 97 m³/s – the highest recorded in over 50 years of measurements, including a major flooding event in December 1954. Dublin Airport’s daily rainfall total up to midnight on the 14th was 75mm, the highest since records began there in 1941.

Heavy rainfall later in November also brought flooding to the south and southwest, causing particular disruption in Cork city. Cork Airport



Record high tides following a week of stormy weather caused severe flooding in the Ringsend area of Dublin on 1st February.



Rainfall amounts of over 50mm on 14th November resulted in widespread flooding along the valley of the River Tolka in Dublin.

and Valentia Observatory measured over 120mm of rain in the eight-day period between 20th – 27th November, or the equivalent of the normal total for the entire month.



The question inevitably arises, whether the heavy rainfall of 2002 represents nothing more than the normal variability of Irish weather from one year to the next, or could perhaps be a manifestation of a definite change in climate. In 2001, studies by the United Nation’s Intergovernmental Panel on Climate Change (IPCC) anticipated that global winter rainfall would increase in future years. The studies also indicated that precipitation extremes would probably increase to a greater degree than mean precipitation. However much research remains to be done, and at the moment it is not possible to say if any individual precipitation event in Ireland is directly related to global climate change.

Severe flooding in Blackpool, Cork on 27th November.



Aircraft taxiing for take-off at Dublin Airport.

Local Area Forecasts (LAFs) were provided for the airports at Donegal, Sligo, Galway, Kerry and Waterford. The Division also provided telephone briefings for private pilots and support for Search and Rescue operations.

Aviation Services Division is the focal point for liaison between Met Éireann and the various international agencies involved in the regulation of aviation meteorology. Staff from the Division participated in meetings of the Meteorology Group of ICAO's European Air Navigation Planning Group (EANPG), and of the Commission on Aeronautical Meteorology

(CAeM) of the World Meteorological Organisation (WMO).

A major refurbishment of the Aviation Services Division's offices in Shannon began in May and was completed later in the year.

Research and Applications

Numerical Weather Prediction

Theoretical work on the development of the HIRLAM Numerical Weather Prediction (NWP) model continued during 2002. Progress was

Summary of services provided by the Aviation Services Division in 2002

Number of SIGMET Warnings for Shannon FIR	112
Number of Flight Folders provided	16140
Number of aerodrome and wind shear warnings	763
Number of telephone aviation briefings	9215
Number of Terminal Aerodrome Forecasts issued	16032
Number of Local Area Forecasts issued	5262
Number of Search and Rescue forecasts issued	184

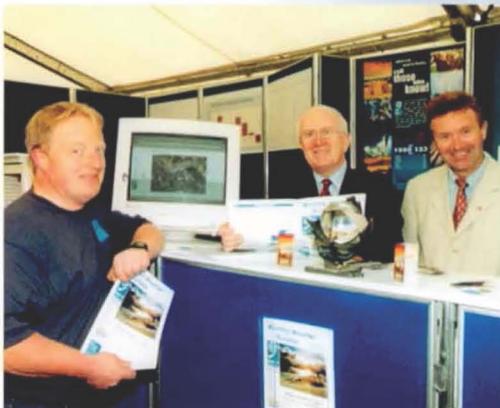
made on implementing a new finer-mesh model designed to run at hourly intervals (the finer-mesh model has a horizontal resolution of 12 km and 40 vertical levels, compared to a resolution of 15 km and 31 vertical levels in the main HIRLAM model). Particular attention was paid to improving the accuracy of precipitation and near-surface temperature forecasts.

Operational resilience was enhanced through the provision of a new backup computer, on which a coarse-grid version of the HIRLAM weather prediction model was installed.

An internal web site was developed to deliver new model guidance material to the operational meteorologists - including forecasts of vertical stability and cross-sections of temperature, wind and humidity.

Agricultural and Environmental Unit

Output from the Numerical Weather Prediction models was incorporated directly into the warning system for the occurrence of spells of weather conducive to the spread of potato blight. Blight warnings now include an indication of the duration of humid conditions, and updates are issued as required while these conditions persist. Generally 2002 was a bad year for potato blight - in all, a total of 11 blight warnings were issued.



Mr. Pat the Cope Gallagher T.D., Minister of State at the Department of the Environment and Local Government (centre) visited the Met Éireann stand at the National Ploughing Championships in Ballacolla.

Mr. Denis Fitzgerald, Head of the Research and Applications Division, continued as co-ordinator of AGMET, the Joint Working Group on Applied Agricultural Meteorology. On 14th November AGMET launched the 'Agrometeorological Needs Review and Analysis for Ireland' to an invited audience from Government, the Universities and Research Institutes. The launch was followed by a discussion on how the various agencies might best meet the identified needs for more observations, more localised weatherforecasts, and improved modelling of agricultural and environmental systems.

Marine Unit

In July the third in a planned network of five weather buoys was deployed off the southwest coast, as part of a joint Marine Institute / UK Met Office / Department of the Marine and Natural Resources / Met Éireann initiative.

Met Éireann's numerical wave prediction model (WAM) was installed on a new server. Good progress was made on a project to automate readings of sea temperatures at Malin Head Pier. Training was provided to Irish Navy personnel in weather observations at sea.

In collaboration with General Forecasting Division, the Marine Unit initiated a project to monitor sea heights in Irish waters as an aid to forecasting coastal flooding.

Library & Information Services

Work continued on the implementation of the Library's new automated cataloguing system. Two issues of Met Éireann's staff magazine *Splanc* were produced during the year. The librarian continued to serve as content manager for Met Éireann's web site, and coordinated the implementation of routine changes and upgrades. Work was completed on an internal web site to provide staff with electronic access to subscription journals.

Observing and Technical Support Programme

Synoptic Network

Met Éireann's network of synoptic weather stations, at which hourly observations of weather conditions are made, comprises a mix of manned and automatic sites. A full programme of 24-hour observations was maintained throughout the year at all stations.

The existing Automatic Weather Stations (AWSs) do not provide adequate information on some weather parameters - e.g., visibility and cloud conditions. Sets of intelligent sensors capable of monitoring these parameters are deployed at the synoptic stations in Clones, Kilkenny and Mullingar, for real-time assessment by meteorologists in the Central Aviation Office.

The first operational unit of the new TUCSON Automatic Weather Station was deployed in late 2002 at Mace Head (Co. Galway), a Global Atmospheric Watch observatory operated by the National University of Ireland, Galway.

Airports

A new anemometer and wind display system was installed at Shannon Airport.

Meteorological Radar and Satellite Receiving Systems

Met Éireann operates two networked weather surveillance radars, located at Dublin and Shannon Airports, and also maintains ground station facilities for the reception of data from meteorological satellites.

Both radar and satellite data continued to play a central role in Met Éireann's forecasting activities during 2002.

Valentia Observatory

Valentia Observatory continued its programme of routine upper-air soundings, entailing four radiosonde ascents daily. Ozone and ultra-violet levels were also measured at the station, and



Staff at Met Éireann's synoptic station at Malin Head.

during the winter special ascents to monitor the vertical profile of ozone were carried out. The Observatory participated in international and national atmospheric chemistry and geomagnetic monitoring programmes.

Monitoring of worldwide seismic activity, carried out with the cooperation of the Dublin Institute for Advanced Studies, continued during 2002. The Observatory now has an uninterrupted sequence of 40 years recording of seismic events.

At year's end, work was well underway on Phase 1 of a major refurbishment programme at the Observatory.

Laboratory

The chemical composition of air and precipitation samples at selected synoptic stations was analysed as part of on-going national and international programmes. Some sampling systems and analysis procedures were changed, necessitating intercomparison of datasets.



IT Operations

Information Technology

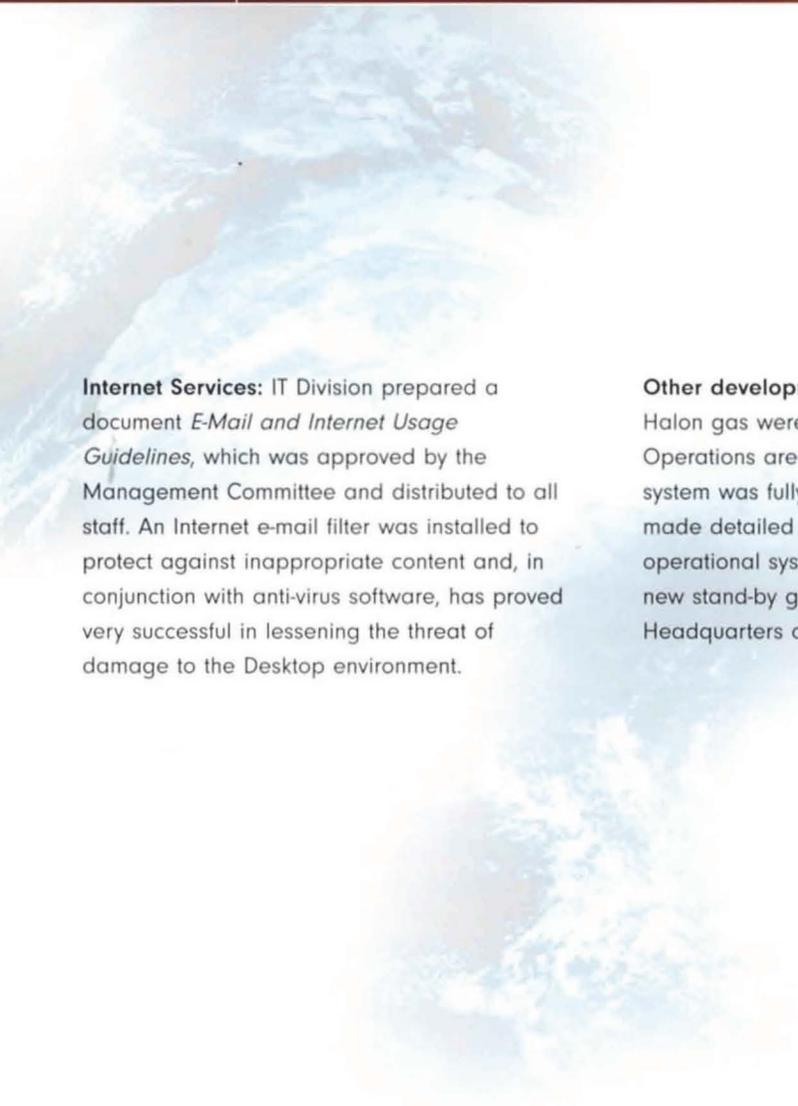
In addition to the major task of providing routine support and maintenance for existing computer systems, the IT Division made good progress during 2002 on several high-priority projects. Many of these involved a significant level of cross-Divisional collaboration.

Among the Division's most significant areas of work were:

Numerical Weather Prediction: The main Numerical Weather Prediction server proved generally reliable, although on three occasions during the year hardware failures resulted in processor replacements being required. A number of outstanding installation tasks were completed, and a range of software patches installed. New hardware and software maintenance contracts were agreed.

Telecommunications: Following problems with network packet losses, several server systems were removed from the Thick-Wire Ethernet and connected instead with UTP (unshielded twisted pair) cabling. Work on the installation of a new LAN at Valentia Observatory, and a new WAN link to Cork Airport, was completed. In December a Martis Node was purchased for installation in Met Éireann HQ – this will facilitate the management of existing and future telecommunications circuits.

Desktop Services: The workload associated with Desktop support and maintenance continued to increase throughout the year. Roll-out of PCs bought in 2001 was completed, while a further batch of 51 desktop PCs and 4 laptops was delivered in December. Particularly noteworthy was the installation of general-purpose PCs in many of Met Éireann's outstations, so enabling staff at these locations to link to e-mail services, access the Internet etc.



Internet Services: IT Division prepared a document *E-Mail and Internet Usage Guidelines*, which was approved by the Management Committee and distributed to all staff. An Internet e-mail filter was installed to protect against inappropriate content and, in conjunction with anti-virus software, has proved very successful in lessening the threat of damage to the Desktop environment.

Other developments: The last containers of Halon gas were removed from the IT Operations area and the new fire protection system was fully commissioned. IT Division staff made detailed preparations to manage all operational systems during the installation of a new stand-by generator at Met Éireann's Headquarters offices in Glasnevin.

Climate Programme

The Climatology & Observations Division continued its main tasks of (1) maintaining the National Climate Database, (2) management / quality-control of the observational station networks and (3) operating the Climate Enquiries Office, which delivers climatological data to customers and produces the Monthly Weather Bulletin.



The new Climate Database Server.

During 2002 a selection of historical weather station reports was made available on Met Éireann's web site (www.met.ie), to facilitate clients who required access to these data. Despite this the Climate Enquiries Office handled over two thousand client queries, an increase of 14% over 2001. Subscription numbers for the Monthly Weather Bulletin showed a modest increase.

The routine inspection of rainfall and climate stations, which had been seriously curtailed in 2001 due to the Foot & Mouth crisis, resumed in 2002. A total of 210 rainfall stations and 40 climate stations were visited. Throughout the year, good quality data was received from, on average, 550 stations. 13 new stations were opened and only 2 closed.

A new database server (Sun Fire V880) was installed to host the Climate Database.

Under the auspices of the British-Irish Council work commenced on producing a gridded baseline climatology for the island of Ireland as part of the UK Climate Impacts Programme (UKCIP) project.

The Weather of 2002

Rainfall totals for 2002 were above normal almost everywhere, and were the highest on record at most stations in Leinster and Munster. The wettest months relative to normal were February, May, October and November, when some serious flooding occurred in both rural and urban areas.

Annual mean temperatures were above the 1961-1990 normal for the ninth successive year. June, July and October were a little cooler than average over most of the country, but mean temperatures for January, February and November were more than two degrees above normal in places. Almost all stations recorded their highest temperatures during late July or early August, when values of around 25°C were measured. In most parts of the country the lowest temperature of the year occurred on 1st January, when ground temperatures fell below -10°C at some inland locations.

Sunshine totals for the year were close to normal almost everywhere. September and October were the sunniest months relative to

normal, while the months of May, June and July were dull except in the north. Daily sunshine durations of 15 hours or more were measured at a few stations during early June.

Mean windspeeds for the year were below normal everywhere; they ranged 7 - 11 knots (8 - 13 m.p.h.) at most stations, but reached 13 - 15 knots (15 - 17 m.p.h.) at coastal stations in the north and northwest. The strongest winds of the year were measured during late January and late October. Malin Head recorded the highest gust of the year, 86 knots (99 m.p.h.), on 28th January.

The Weather of 2002

County/ Station	Rainfall (mm)			Temperature (°C)			Sunshine (hours)			No. of days with:						
	Total	% of average	Most in a day amount date(s)	Mean	diff. from average	Extremes Highest Lowest	Daily mean	% of average	Most in a day amount date(s)	Rain	Snow	Air frost	Hail	Thunder	Fog	Gale
CO. CLARE																
SHANNON AIRPORT	1068.9	115	35.6 21 Oct	11.2	+1.0	24.0 -3.8	3.47	100	13.8 4 May	238	3	6	14	7	23	65
CO. CORK																
CORK AIRPORT	1538.1	127	34.6 21 Nov	10.3	+0.8	23.2 -0.9	3.73	98	13.9 4 May	258	6	1	9	4	110	89
CO. DONEGAL																
MALIN HEAD	1062.5	100	20.2 19 Feb	10.2	+0.8	22.2 -0.1	3.68	110	15.0 5 Jun	251	9	1	36	5	9	180
CO. DUBLIN																
DUBLIN AIRPORT	1095.6	n/a	74.6 14 Nov	10.1	n/a	23.7 -6.6	3.64	93	12.7 5 Jun	247	5	18	8	4	36	83
CASEMENT AERODROME	1014.8	143	52.5 14 Nov	10.3	+1.0	23.2 -5.5	3.54	96	12.5 26 Aug	216	3	17	9	10	17	80
CO. KERRY																
VALENTIA OBSERVATORY	1922.7	134	41.3 20 Nov	11.1	+0.6	22.4 -1.4	3.39	101	15.4 6 Jun	269	3	3	15	9	9	92
CO. KILKENNY																
KILKENNY	1046.7	129	30.1 8 Oct	10.3	+0.9	24.9 -7.5	3.51	101	12.2 7 Apr	246	n/a	27	---	n/a	---	50
CO. MAYO																
BELMULLET	1318.3	115	33.8 20 Oct	10.6	+0.9	23.1 -3.1	3.67	105	13.4 2 Aug	277	8	3	39	6	19	144
CONNAUGHT AIRPORT	1463.8	n/a	33.6 20 Oct	9.0	n/a	23.4 -4.6	3.27	n/a	13.2 5 Jul	273	12	14	16	4	168	81
CO. MONAGHAN																
CLONES	1243.1	134	41.6 17 May	9.8	+0.5	25.6 -5.7	3.40	116	12.6 11 May	225	n/a	21	---	n/a	---	47
CO. OFFALY																
BIRR	1029.9	128	26.0 23 Jan	10.2	+0.8	24.9 -7.0	3.19	96	11.9 4 May	247	n/a	22	---	n/a	---	45
CO. WESTMEATH																
MULLINGAR II	1212.6	131	36.0 20 Oct	9.9	+0.9	25.0 -8.0	3.51	101	12.8 21 Aug	260	n/a	24	---	n/a	---	39
CO. WEXFORD																
ROSSLARE	1241.1	142	80.0 24 Oct	11.3	+1.2	22.9 0.4	4.37	101	15.2 5 Jun	215	0	0	4	3	39	116

Strategic Management

High-Level Objectives

Met Éireann's High-Level Objectives, as identified in the Strategy Statement 1999-2001, are

- To provide a comprehensive range of high-quality meteorological services to the Irish people and to all sectors of the Irish economy.
- To ensure the long-term sustainability of meteorological services in Ireland through adequate infrastructural investment.
- To help reduce public exchequer costs by engaging in profitable commercial activities, while maintaining a constructive relationship with the private sector and always conforming fully with competition law.
- To obtain optimum benefit from developments in meteorological science by prudent utilisation of modern technology, by a well-focused research programme and by collaboration with relevant bodies.
- To utilise fully the talents and potential of all staff by pursuing a humane and effective human resource policy, and by according high priority to training, communications and participation.
- To examine the current clerical, technical and professional grade structures with a view to matching individual skills to work requirements, and to promoting overall staffing flexibility.

Significant progress was made in achieving these objectives during 2002.

Meteorological Services

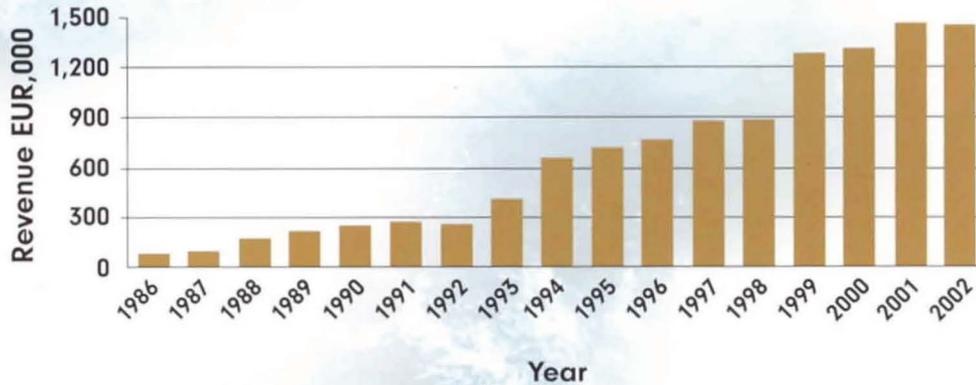
Met Éireann continued to fulfil its primary role as Ireland's National Meteorological Service, delivering a wide range of weather forecast products to its principal user groups – the general public, civil and private aviation, Government Departments and Agencies and many business and commercial customers. Requests for climatological information, which have grown significantly in recent years, were addressed with increased efficiency by means of improved data-handling and delivery systems.

Forecast quality was enhanced through on-going development of Met Éireann's numerical weather prediction and wave prediction models. Efforts continued to further improve procedures for the verification of public weather forecasts.



The TUCSON installation at Mullingar, Co. Westmeath..

Annual Revenue 1986 - 2002



Meteorological Infrastructure

During 2002 good progress was made on The Unified Climate and Synoptic Observation Network (TUCSON) programme, a project to design, develop, build and deploy a network of logger-based Automatic Weather Stations (AWSs). By the end of the year TUCSON AWSs were installed at two locations – Mullingar, Co. Westmeath and Mace Head, Co. Galway.

Testing of a new Vaisala WD50 anemometer and wind display system for airports was completed in 2002. The new system was subsequently installed at Shannon Airport, as part of the Irish Aviation Authority's CAIRDE programme.

A new weather buoy (M3) was deployed approximately 30 nautical miles off Mizen Head, the third in a planned network of five fixed buoys around the Irish coast.

Commercial Activities

As in previous years Met Éireann's principal commercial activities included services to TV and other media, the provision of premium-rate

weather forecasts and supplying forecasts of severe weather (including winter road ice) to the National Roads Authority and Local Authorities. Miscellaneous forecast services were also provided to a wide range of commercial and industrial interests (construction, marine, agriculture, energy utilities etc).

For the first time in several years overall revenues declined in 2002. While the reduction was small, it highlights the increasingly competitive environment within which Met Éireann pursues its commercial activities.

The Commercial Division co-ordinated Met Éireann's participation in a number of Shows and Exhibitions throughout the year. Especially noteworthy was attendance at the National Ploughing Championships in Ballacolla, Co. Laois, in late September. This 3-day event was blessed throughout with glorious autumn sunshine, and as in previous years provided an invaluable opportunity to promote Met Éireann's services and meet with one of our most important user groups.

Zeiss non-magnetic theodolite used at Valentia Observatory for making geomagnetic field measurements.



Science and Technology

During the year theoretical work focused on further development of the HIRLAM Numerical Weather Prediction model. Work on a finer-mesh version of HIRLAM, intended to run at hourly intervals, continued with the testing of new condensation and surface schemes aimed at improving the accuracy of precipitation and near-surface temperature forecasts.

The Marine Unit, in collaboration with Forbairt, the Marine Institute, the Department of the Marine, NUI Galway and the University of Bangor (Wales) submitted an application to the European Union's INTERREG Programme for funding to develop and run an ocean model in Ireland.

Work proceeded on establishing the Community Climate Change Consortium for Ireland (C4I), a collaborative research project based around a Regional Climate Analysis, Modelling and Prediction Centre in Met Éireann.

At Valentia Observatory, a regional geomagnetic field model called SCHA2002 was

developed in association with the Hermanus Magnetic Observatory, South Africa. The model is based on surface and satellite data - surface data from Belgium, Britain, France and Ireland, and magnetic field measurements taken by the Danish-owned Ørsted satellite, which is located in a low Earth Orbit of between 638 km and 849 km. SCHA2002 utilises the Spherical Cap Harmonic Analysis (SCHA) technique and gives a regional representation of the geomagnetic field over an extensive area surrounding the island of Ireland.

In the climatology area, work was initiated to identify and correct any inhomogeneities in Met Éireann's rainfall data records. Long-term series of weather data may sometimes be affected by a number of non-climatic factors, for example weather station relocation or changes in instrumentation. Such factors may (though not always) cause data to be unrepresentative of the true climatic variation.

Met Éireann supported a one-day Symposium entitled 'Climate Change - Challenges for Ireland', which was organised by the Royal Irish Academy at the National Botanic Gardens, Glasnevin, in June.

Staff and Human Resource Management

While staff numbers were close to full complement during most of 2002, pressure of work was such that Met Éireann continued to engage some contract staff to help maintain essential services.

The Partnership Council held eight meetings during the year, including one at Valentia Observatory. The Council also attended a meeting with Aer Rianta staff in April, to discuss their experience of, and approach to,



Members of the Partnership Council joined Departmental colleagues at the Partnership review meeting in September.

partnership issues. In September, representatives from the Partnership Council attended a meeting organised by the Department of the Environment and Local Government (DoELG) to review overall Partnership arrangements.

Among the principal topics addressed by the Partnership Council in 2002 were Met Éireann's move to DoELG, equality issues, the Staff Input Scheme and cleaning/maintenance of office accommodation. The Council also monitored the progress of the Performance Management and Development System (PMDS). In October, the members of the PMDS Implementation Group, Management Committee and Partnership Council attended a 1-day seminar to consider the findings of a PMDS attitudinal survey which had been conducted during the summer by Precept Consulting. Towards the end

of the year, a new Project Team to manage all aspects of PMDS implementation was established.

The Merit Awards Group approved awards for 5 individual staff members and 4 staff teams – in all, 22 staff benefited from the scheme in 2002.

North – South Co-operation

Established cooperative arrangements between Met Éireann and the Northern Ireland branch of the UK Met Office continued in 2002. A planned programme of exchange visits involving staff from the two organisations was launched in May, when a Met Éireann meteorologist spent a very enjoyable and informative week in Belfast.

Other Activities

Change of Department

The Taoiseach's speech to the Dáil on 6th June signalled a momentous change for Met Éireann - having been attached to the Transport function since its foundation in 1936, Met Éireann would in future be part of the Department of the Environment and Local Government (DoELG).



Shortly after the announcement, Mr. Niall Callan (Secretary General, DoELG) and Ms. Geraldine Tallon (Assistant Secretary, DoELG) visited Met Éireann and met with the Director and the Management Committee. Further meetings ensued between personnel from Met Éireann and their counterparts in the new parent Department. All these encounters were very positive - a high level of goodwill was evident on all sides, along with a determination to implement the transition as smoothly as possible. Most members of Met Éireann's Management Committee attended the Department's Senior Managers Conference in September.

The move to DoELG opens new opportunities and challenges for Met Éireann - particularly in such areas as air quality and environmental monitoring, which are likely to grow in importance in the coming years.

Administration

The Euro conversion was achieved without any major difficulties and was adjudged to have been very successful.

Total expenditure in 2002 was within the approved allocation.

A new 3-year Administrative Budget agreement for 2002-2004 was concluded between Met Éireann and the Department of Public Enterprise. The status of this agreement was somewhat uncertain following the transfer of responsibility for Met Éireann to DoELG. Invoice payments and Met Éireann salary cheques continued to issue from the former parent Department, renamed the Department of Transport, until late in the year when the DoELG financial management system absorbed these tasks.

Staff recruitment was at a considerably lower level than in 2001; only three new Meteorological Officers were employed. However during the year there were two resignations, two transfers to other Departments, three personnel commencing career breaks and seven retirements. By the year's end plans for a new recruitment competition were well advanced.

A Steering Group was established to oversee preparation of a new Met Éireann Strategy Statement, which is expected to be ready by mid-2003.

International Affairs

Met Éireann maintained its active involvement in the work of several international organisations, including the World Meteorological Organisation (WMO), the International Civil Aviation Organisation (ICAO),

the European Centre for Medium-Range Weather Forecasts (ECMWF), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Co-operation in Meteorology grouping (ECOMET) and the European Meteorological Network (EUMETNET). 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.

Met Éireann hosted the 2002 EUMETSAT Satellite Conference in Dublin Castle in September. This prestigious event was attended by almost 200 delegates from 31 countries and proved a major success, helped by the flawless launch of EUMETSAT's MSG-1 satellite just days before the Conference opened.

Proposals emerging from the European Commission, regarding the provision of meteorological services to aviation, could have significant implications for Met Éireann. The Commission's proposal for a Single European Sky (SES) is an attempt to reform the architecture of European air traffic control, and has been prompted mainly by the steady rise in delays to air traffic over recent years. The SES initiative also addresses issues of cost-effectiveness, efficiency and reliability in the

provision of air navigation services – these include meteorological information, communications, navigation and surveillance etc. Met Éireann's Aviation Services Division is continuing to monitor the evolving situation.

Ms. Evelyn Murphy, Head of Marine Meteorology in Met Éireann, was elected Chairman of the European Group on Ocean Stations (EGOS) at their December meeting in Geneva.

Brigadier General (ret.) John J. Kelly, Jr., Director of the National Weather Service, U.S.A., paid a courtesy visit to Met Éireann in November.

Young Scientist and Technology Exhibition

Met Éireann sponsored a Special Award at the Esat Young Scientist and Technology Exhibition, held at the Royal Dublin Society in January. The Award was for the best project with Irish weather or climate as its central theme. Declan Murphy (Director, Met Éireann), presented the prize to the winners - a group from St. Gerard's School, Bray, Co. Wicklow, for their project on the relationship between air quality and lichen growth in the South Dublin - Bray region.

Appendix I - Staff Training and Development

General

During 2002, Met Éireann staff attended general training courses totalling 173 training days. Three newly-appointed Meteorological Officers completed their initial training at Casement Aerodrome. A total of ten staff availed of the Refund of 3rd Level Fees scheme.

At the end of the year there were the equivalent of 230 staff posts filled in Met Éireann (taking into account work sharing etc).

Performance Management and Development System

As in 2001, preparations for the introduction of the Performance Management and Development System (PMDS) were an important focus of Met Éireann's training activities. Phase 2 training was completed by mid-February, and Phase 3 (the final 1-day module) was presented to most staff during April and May. In all, a total of 423 PMDS training days were delivered at venues in Dublin, Killarney and Carrick-on-Shannon.

Learning Resource Centre (LRC)

Operating under the day-to-day management of the librarian, the Learning Resource Centre continued to prove popular with staff. The range of learning/training materials was enhanced, and the LRC maintained its registration as a Testcentre for the European Computer Driving Licence (ECDL).

ECDL training in Met Éireann operates largely on a self-learning basis - the ECDL course material is made available on a self-study CD, accompanied by a course manual. In 2002 several staff were engaged in mastering the seven modules required for the award of the ECDL qualification. During the year Met Éireann's Testcentre implemented a new Autotest feature, which considerably reduces the time spent administering ECDL tests. Candidates can now complete each test interactively and obtain the results immediately afterwards.

Met Éireann continued its involvement in EUMETCAL, a EUMETNET project designed to promote the joint development of computer assisted learning (CAL) materials for meteorology.



Appendix II - Forecast Accuracy

Verification of Public Weather Forecasts

During 2002, 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 07.55. Figures 1 and 2 show the monthly variation of the Root Mean Square (RMS) error for the maximum and minimum temperature forecasts (the smaller the RMS error, the better the forecast). Figure 3 shows the 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. Averaged over the year, the results show a Root Mean Square (RMS) error of about 1.5°C in the maximum temperature, and about 1.8°C in the minimum temperature. For rainfall, the average value of the Hanssen and Kuipers' Score is 0.46.

Figure 1

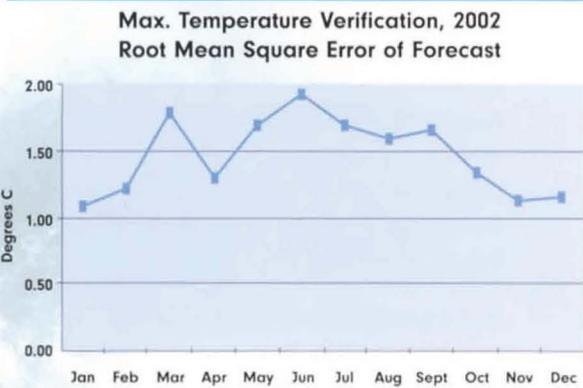


Figure 2

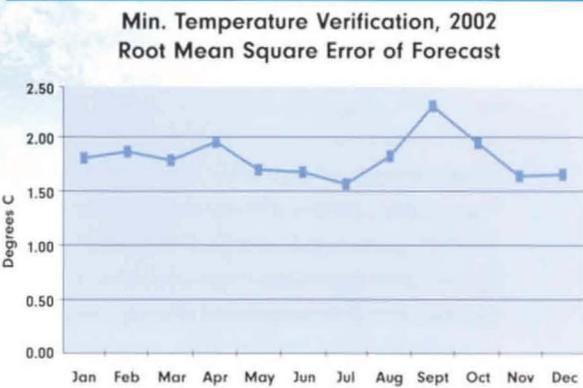
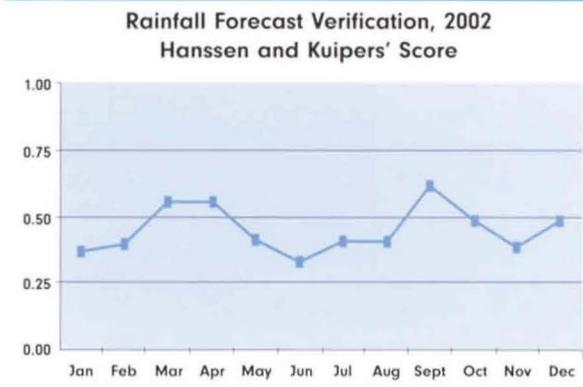


Figure 3



An indication of the quality of the forecasts can be got by comparing these scores with the values that would be obtained for a 'standard' forecast. In this case, we use persistence as a standard – i.e., a forecast that assumes that tomorrow's weather will be the same as today's.

The comparative scores, averaged over the year, are shown in Table 1.

Table 1	Max. Temperature (RMS Error)	Min. Temperature (RMS Error)	Rainfall (Hanssen and Kuipers' Score)
Forecast	1.48°C	1.81°C	0.46
Persistence	2.01°C	2.88°C	0.17

As would be expected, in all cases the forecast scores are very substantially better than those for persistence.

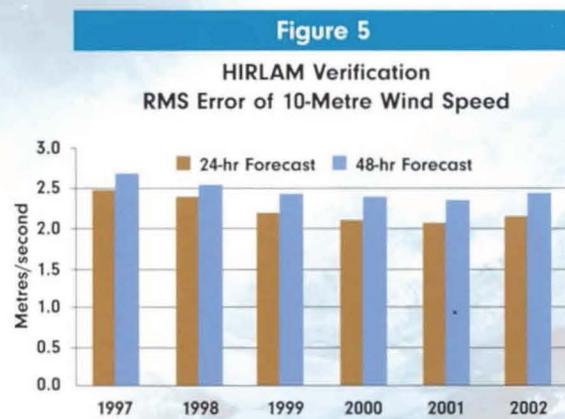
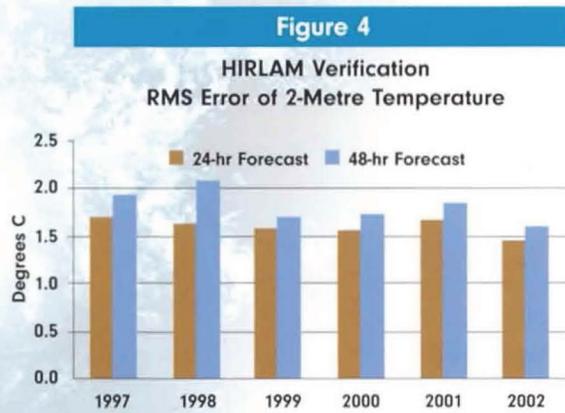
The RMS forecast error for maximum temperature, and the Hanssen and Kuipers' score for rainfall, are almost unchanged from the 2001 values. The RMS forecast error for minimum temperature shows a small improvement on 2001.

Numerical Weather Prediction

The evolution of the verification scores for the HIRLAM forecasts of 2-Metre Temperature and 10-Metre Wind Speed, from 1997 to 2002, 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 small improvement in RMS error compared with corresponding values for 2001.

Figure 5 shows the Root Mean Square error scores of forecast 10-Metre Wind Speed for 24 hrs and 48 hrs. For both timesteps the RMS errors show a marginal increase as compared to the 2001 values.



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 2001/2002 season for the so-called critical nights (nights on which RSTs less than 5°C were observed) for all available sites. Table 2 shows the Hanssen and Kuipers' Score and the RMS error for the 2001/2002 forecasts, along with the corresponding values for the winter seasons 2000/2001 and 1999/2000.

Table 2	Hanssen and Kuipers' Score	RMS Error
2001-2002	0.62	1.7°C
2000-2001	0.70	1.7°C
1999-2000	0.58	1.7°C

The Hanssen and Kuipers' score for 2001/2002 is slightly less than the 2000/2001 value. The RMS errors have remained almost unchanged over the three-year period.

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 shows the annual RMS error scores for Dublin for the period 1998-2002 (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 RMS errors for Dublin are slightly better than in 2001, while for Cork the opposite is true - the scores show a small disimprovement compared to 2001.

Figure 6

Max. and Min. Temperature Verification, 1998 - 2002
RMS Error of Forecasts for Dublin

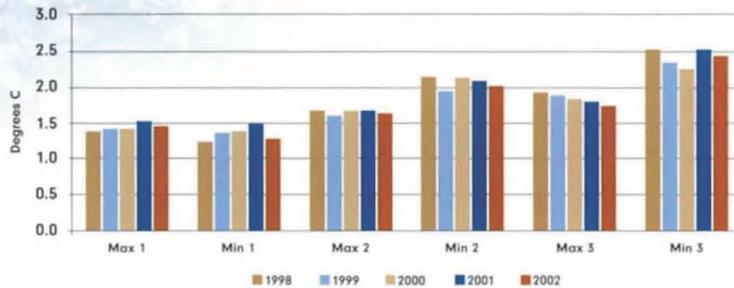
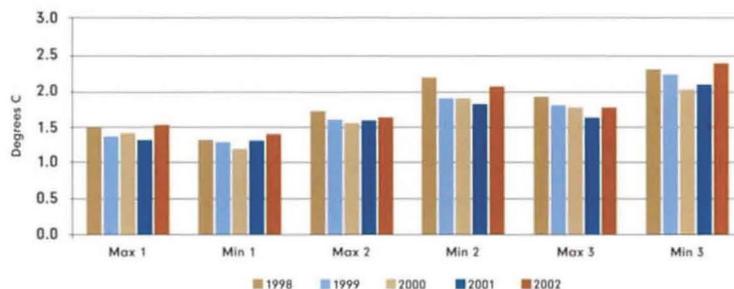


Figure 7

Max. and Min. Temperature Verification, 1998 - 2002
RMS Error of Forecasts for Cork



Appendix III - Publications

Fitzgerald, D. L. 2002: Tricomi and Kummer functions in occurrence, waiting time and exceedance statistics. *SERRA*, 16, 3, 207-224, Springer.

Fleming, G. *et al* 2001: Weather on the Internet and other New Technologies. WMO/TD No 1084, Geneva.

Holm, D. D. and Lynch, P. 2002: Stepwise Precession of the Resonant Swinging Spring. *SIAM Journal on Applied Dynamical Systems*, 1, 44 - 64.

Klein Tank, A.M.G., Wijngaard, J.B., Fitzgerald, D. *et al* 2002: Daily Dataset of 20th-Century Surface Air Temperature and Precipitation Series for the European Climate Assessment. *Int. J. Climatol.* 22, 1441-1453.

Lynch, P. 2002: Resonant motions of the three-dimensional elastic pendulum. *Intl. J. Nonlin. Mech.*, 37, 345-367.

Lynch, P. 2002: The Swinging Spring: a Simple Model for Atmospheric Balance. Pp. 64-108 in *Large-Scale Atmosphere-Ocean Dynamics. Vol II: Geometric Methods and Models*. Ed. J. Norbury and I. Roulstone. Cambridge University Press.

McDonald, A. 2002: A step toward transparent boundary conditions for meteorological models. *Monthly Weather Review* 130, 140-151.

McDonald, A. 2002: Well-posed boundaries; progress report. *HIRLAM newsletter* 41, 109-113.

McDonald, A. 2002: Changes to the HIRLAM needed for finer grids. *HIRLAM newsletter* 42, 9-17.

McDonald, A. 2002: Testing transparent boundary conditions for the shallow water equations in a nested environment. *HIRLAM technical report* 54, 31pp.

Murphy, G. and Holden, N.M. 2001: Agrometeorological Needs Review and Analysis for Ireland. *AGMET Group Report*.

Undén, P., Lynch, P., McDonald, A., McGrath, R., *et al* 2002: HIRLAM-5 scientific documentation, 144pp.

Appendix IV - Met Éireann Finances

The figures presented below are approximate and for information only. They do not form part of the official annual accounts of Met Éireann. All amounts are in Euro.

Income and Expenditure 2002/2001

	2002 €,000	2001 €,000	2002 €,000	2001 €,000
Salaries and Related Expenses (A1)			12,323	11,302
Other Operating Expenses			2,614	2,058
Capital Expenditure			930	1,101
Contributions to International Organisations			2,286	2,810
Total			18,153	17,271
Receipts from Eurocontrol (Route Charges)	6,984	6,487		
Receipts from Commercial & Cost Recovery Activities	1,444	1,463		
Total Receipts	8,428	7,950		
Net Cost of Operations			9,725	9,321
Some details of above				
A1				
Salaries			11,660	10,433
Overtime			518	747
Payment to Observers			97	88
Other Allowances			48	34
A2 (Travel & Subsistence)			243	146
A3 (Training/Library/Printing etc)			404	442
A4 (Communications & Post)			241	216
A5 (Computing - Capital)			423	818
A5 (Computing - Non-Capital)			572	394
A6 (Maintenance/Energy)			553	287
A7 (Consultancy)			70	36
A8 (Instrumentation - Capital)			507	283
A8 (Instrumentation - Non-Capital)			531	537
			15,867	14,461
Some details of commercial / cost recovery receipts				
Aviation	27	22		
Climatological Information	171	126		
General Forecasting	1,219	1,293		
Miscellaneous	27	22		
	1,444	1,463		

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Glossary

AGMET	Joint Working Group on Applied Agricultural Meteorology
AWS	Automatic Weather Station
C4I	Community Climate Change Consortium for Ireland
CAeM	Commission for Aeronautical Meteorology
CAFO	Central Analysis and Forecast Office
CAIRDE	Computerised Air Traffic Integrated Radar Display Equipment
CAL	Computer Assisted Learning
CAO	Central Aviation Office
EANPG	European Air Navigation Planning Group
ECDL	European Computer Driving Licence
ECMWF	European Centre for Medium-Range Weather Forecasts
ECOMET	European Co-operation in Meteorology
EGOS	European Group on Ocean Stations
ESA	European Space Agency
EUMETCAL	European Meteorological Computer Assisted Learning
EUMETNET	Network of European Meteorological Services
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FIR	Flight Information Region
HIRLAM	High-Resolution Limited Area Model
HRV	High Resolution Visible
ICAO	International Civil Aviation Organisation
INTERREG	European Union programme to encourage cross-border partnerships and stimulate regional development
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
LAF	Local Area Forecast
LAN	Local Area Network
LRC	Learning Resource Centre
MSG	Meteosat Second Generation
NWP	Numerical Weather Prediction
PMDS	Performance Management and Development System
RMS Error	Root Mean Square Error
RST	Road Surface Temperature
SAF	Satellite Application Facility
SCHA	Spherical Cap Harmonic Analysis
SES	Single European Sky
SIGMET	Information on occurrence of specified aviation weather phenomena
TAF	Terminal Aerodrome Forecast
TUCSON	The Unified Climate and Synoptic Observation Network
UKCIP	United Kingdom Climate Impacts Programme
UTP	Unshielded Twisted Pair
WAM	Wave Forecast Model
WAN	Wide Area Network
WMO	World Meteorological Organisation

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Irish Times
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