OPERATIONAL DATABASE SYSTEMS
AT THE UNITED KINGDOM METEOROLOGICAL OFFICE

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1. Introduction

From the title of this part of the workshop "Operational Database Systems" I have taken a fairly liberal meaning to the words operational and database. Operational has a different meaning when used in the context of producing real-time forecasts as opposed to the person wanting an immediate answer to "What has been the hottest recorded temperature in London over the last 50 years?".

The UK Meteorological Office has some 14 differently managed systems that have been developed independently and for different reasons.

For ease of classification one can group the systems into three main areas depending on the type of data stored. These areas are observational or real time data, climate or archive data and numerical model data fields.

2. Observational (real time) data

There are three databases in this area - Synoptic Data Bank (SDB), Meteorological Database (MDB) and Satellite and Radar image database (IMAGE)

The SDB was first developed in 1971 when the UK Met Office acquired an IBM 360/195 mainframe computer. At the time there were no machineable databases available and the software was written in machine code for efficiency. The amount of data taken off the Global Trunk Circuit (GTS) was about 8 megabytes and this was fed into the system via 5 hole paper tape at regular intervals.

In 1975 the SDB became permanently resident and received data off the GTS via the Telecommunication computer system in real time. The system has evolved over the last 20 years and currently stores approximately 14 megabytes of data in a 24 hour period. However most data are still stored in the character format of the orginal code.

Obviously a lot has changed since 1971 and in 1989 it was decided to conduct a user survey with a view to replacing the SDB. The main reasons for this were:
- a larger proportion of data were becoming asynoptic,
- new computer orientated codes were being developed such as GRID, GRIB and BUFR,
- because software is developed much slower than hardware it is important that it is machine independent,
- but most important of all, the data was being used for an increasing diversity of purposes and users requirements were expanding. For example typical requests of yesterday are -
    all surface observations for Germany at 12z today

or upper air (TEMP) report from Paris for 00z.
  but the user now and in the future wants answers to -
        all surface wind speeds over Europe for 06z,
        or global 500mb temperatures at 12z,
        or all stations reporting fog at 03z.

Out of these changing requirements emerged the Meteorological Data Base (MDB) which started by storing the ERS-1 satellite data in BUFR in August 1991. Since then all new data types have been put into the MDB in BUFR (i.e. AMDAR, DRIFTER, satellite data), and currently injests in excess of 30 megabytes daily. It has been designed to hold BUFR, GRIB or character format and all data currently in the SDB will be moved into the MDB.

3. Climate or long term (archival) data

The SDB when it was originally created did not serve the requirements of those who want data over a long period, such as the temperatures for LONDON for the last 50 years. This was never the aim of the SDB, so systems were set up to handle the data in climate order. There are many systems today because users build systems to satisfy a particular need and because of the hardware technology restrictions.

The climate systems in place at present are :
The Synoptic Machineable Records(SMR) which gets its data from the SDB and stores it in periodic order. The data are retained for 25 years, whereas the SDB only goes back 5 years. All other climate databases came after the SMR and most take their data from the SMR.

The Global Climatological/Synoptic databases (GCD/GSD) hold a subset of the SMR data but in an annual climatological order. The main use for this data is for aviation and defence enquiries.

The Climate Database (CDB) is the main UK Climatological data store. Again the majority of the data is from the SMR, but some data are received on paper forms and magnetic tape. These data are annually reformatted into a climatological order and kept indefinitely.

The Marine Database holds global marine data since 1854. The data comes from the SMR, hand-written logs and magnetic tape.

The Climat Database (CLIMAT) contains monthly mean values of certain meteorological elements and is mainly used for monitoring climate trends and verifying climate models.

The Met Office Historic Sea Surface (MOHSST) and Marine Air Temperatures (MOHMAT) systems hold sea surface temperatures and marine air temperatures for the last 140 years. Climatological research is the main purpose for these two systems.

The Radar Rainfall Data (PARAGON) holds hourly radar data accumulated into daily totals which are then adjusted by rainfall data from rain gauges. It is used to answer enquires and assess performance of the radar network.

Many of these systems are 20 years old and are now in need of replacement. A feasibility study was set up to look at the database systems of the office. This has produced a project called MIDAS(C) - (Meteorological Information Database Access System(Climate)) which will replace the Climate, Marine and CLIMAT databases.

4. Numerical model data

The main repository in this area are the Fields Files. It holds the operational forecasts for a 24 hour period. The format of the data base is an in-house format but is moving towards the use of GRIB. Here ease of use has a very low priority when compared with the high requirement for speed and efficiency when extracting information.

The Products database is one of forecast fields in graphical format. It was set up originally to overcome the limited speed available from graphical hardware. With the arrival of powerful graphical workstations and their increasing use this database will most probably cease to be required.

Another important database that uses model data is the Model Output Statistics (MOS) database. This contains and is used to produce probabilistic forecasts of surface maximum and minimum temperatures, cloud and visibility for specific positions around the world..

The Observation Processing Database (OPD) holds statistics comparing observed synoptic data with analysis and background model values. The data are used to monitor quality, coverage and timeliness of receipt of observational data, systematic errors in the model, the quality control schemes in SDB and MDB, and model data acceptance. In the future it is hoped to include the OPD functions within the MDB.

5. The future

Databases and the way data are stored in the future at the UK Meteorological Office is an exciting challenge. Work has already started on making the MDB portable across various hardware platforms. The requirements for merging the OPD into the MDB are being drawn up and the possibilities of storing more numerical model results within the MDB are being investigated. As the new system for climate data (MIDAS(C)) is being developed close co-operation in being maintained with developers of the MDB so that the two systems can eventually provide a common interface to the user.

The Office will also continue to review and investigate commercial database systems with a view to obtaining one that meets ALL our needs. Unfortunately present commercial systems do not meet the Office's requirements.