# SEVENTH FRAMEWORK PROGRAMME
# THEME – ICT
# [Information and Communication Technologies]

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## Executive Summary

**The following report presents the State of the Art related to Meteorological Forecasting Models applied to Meteorology, the products of the Spanish Government's State Meteorological Agency and, finally, practical applications in the Hydraulics and Hydrology fields.**

**The application of Numerical Forecasting Models to the fields of Hydraulics and Hydrology incorporates a high added value for applications intended for making forecasts for the management of water resources, as it increases the time scope for the hydraulic and hydrological models forecasting by increasing the time scope for both these inputs and for rainfall.**

# 1 Introduction

The following report presents the State of the Art related to Meteorological Forecasting Models applied to Meteorology, the products of the Spanish Government’s State Meteorological Agency and, finally, practical applications in the Hydraulics and Hydrology fields.

## *1.1 A Little Bit of History*

Gathering weather observations, explaining the atmosphere's behaviour and forecasting wind and rain are very old practices. Already the book of Genesis tells of a meteorological event that became the most famous in western culture: the Genesis Flood.

Up until the 20th century people with a scientific interest in atmospheric weather carried out three activities: an empirical activity consisting of gathering observation data and trying to infer something from these, a theoretical activity dedicated to explaining atmospheric phenomena on the basis of general laws and a practical activity consisting of weather forecasting. Naturally, these activities have always been inter-related and the term meteorology has been used for the three.

In the 19th century, as the number of persons dedicated to meteorology grew, the empirical, theoretical and forecasting activities became differentiated. Many of those working in the empirical tradition made weather averaging their main concern and this gave rise around the middle of the century to a descriptive science, climatology. Many of those working in the theoretical tradition took the laws of physics as their starting point, giving rise to the branch of science called dynamic meteorology. Finally, with the start of daily forecasts from meteorological services in the 1870s, weather forecasting became a profession.

These three traditions continued on their differentiated paths until the middle of the 20th century, a period in which the connections between them became closer and more numerous and with meteorologists beginning to talk of unifying meteorology. These unification, which peaked in the 50s and 60s of last century, was closely linked with the development of electronic computing.

# 2 Meteorological Forecasting Models

From time immemorial man has tried to forecast the weather, in order to try and be free of its pernicious effects or to take advantage of its benefits.

Meteorological forecasting is the application of science and technology to predicting the state of the atmosphere for a given time and location. Meteorological forecasts are made by gathering quantitative data on the current state of the atmosphere and the use of scientific understanding of the atmospheric processes that describe the atmosphere’s evolution.

Meteorological forecasting is based mainly on changes in barometric pressure, the current meteorological conditions, even though the human factor continues to be necessary for establishing the best possible forecasts for the model that is the basis of the forecast, which implies recognising patterns, knowledge of performance models and knowledge of bias models.

The chaotic nature of the atmosphere, the enormous calculating power necessary for solving the equations that describe the atmosphere, the error in measuring initial conditions and an incomplete comprehension of atmospheric processes mean that forecasts are less precise as the range of the forecasts is increased. The use of sets of forecasting models can help to reduce error, achieving a result in probability terms.

## *2.1 Numerical Forecasting Models*

Numerical weather forecasting is carried out using a mathematical model formulated by partial derivatives equations that translate the general laws of physics that govern the earth's atmosphere.

The atmosphere is a fluid, which is why the equations used are the general equations of fluid mechanics, but for the case of an isolated layer of air (dry or containing water vapour) the movement of which is observed from a non-inertial system, like all those that rotate with the earth.

An analysis of the order of magnitude for the different terms of these first equations makes it possible to simplify these in line with the space and time scales for the meteorological phenomena being considered. As regards classic meteorological forecasting, the horizontal spatial scales go from 10,000 km to 10 km (planetary, synoptic and mesoscale scales) and the temporal scales from various days to a few hours.

The mathematical equations obtained are not linear and, in general, they cannot be solved analytically. Solving them requires calling on numerical calculation, which provides an approximate solution. "Digitisation” consists basically of replacing the equations in continuous variables by equations in which the variables are discreet, for which the solutions are obtained using an appropriate alogorithm.

There is a large variety of models, each one with its advantages and disadvantages. Generally, the more precise the calculation method the more calculations that are required and, therefore, the longer the time needed to perform these. Evidently, for a given precision, fast methods are selected, as for a forecast to make sense it needs to be made in a relatively short time. One should point out that a meteorological forecast is really a race against time, as it is no use forecasting tomorrow's weather if it takes more than twenty-four hours to calculate this. That is why one always needs to compromise between a calculation's precision and the time it takes to perform it.

The results of a numerical forecast depend on the simplifications made to obtain the system of mathematical equations for the model and the effects of the digitisation used. That is why it is important to make an analytical study of the different numerical outlines and to have a precise knowledge of the errors inevitably committed when using one or the other.

When one says numerical calculation one means computer, as this is the tool required to make the calculations. This introduces a new degradation, as the calculations are not made on an exact basis but approximately and, as one is working with a limited number of decimal points (8 to 16), a rounding error is committed. However, this rounding error introduced by the computer is mostly lower than that committed by solving this mathematical model using numerical methods.

Once the model’s mathematical equations have been formulated, their solution requires starting with the initial state of the atmosphere at the time $t = 0$. This means that one should know for this time the value of all the variables that characterise the state of the atmosphere. This is possible thanks to the creation and functioning of the worldwide meteorological observation service which, using conventional methods both on the surface and at altitude and with the aid of man-made satellites, obtains an acceptable description of the atmosphere at an initial given moment. However, the initial data should not be introduced brusquely into the model (this was the Richardson error), as at a set moment the atmospheric variables are interrelated as, at least theoretically, they are also a result of the evolution in the equations.

Consequently, in order to avoid engendering heavy oscillations because of the propagation of unrealistically wide gravitational waves, the initial values collected from the variables have to be ajusted, such that pressure and wind verify a certain equilibrium named the mass-wind equilibrium. A technique called *non linear initialisation by normal modes* is used for this.

The precise determination of an initial atmosphere condition based on available meteorological observations, called objective analysis, was carried out at first using geometric interpolation methods. By the middle of the 80s a proposal was made for the very general variational formulation (search for the minimum for a functional), which can be solved using optimum control methods. In this case one talks of variational assimilation of the observation data.

This last approximation makes it possible to take into account the information supplied by a wide variety of observation systems, in particular data sensed remotely by satellite systems, which are linked to the models' variables by non-linear relationships.

Likewise, the minimisation can easily be extended to data distributed in space and time: This is then referred to as four-dimensional variational assimilation (abbreviated as 4D-VAR).

The design of more precise and faster numerical frameworks and the increase in computing power have meant that errors due to numerical techniques and electronic calculation tend to diminsh. There remains a fundamental error that results from the fact that the readings taken from the observation network do not make it possible to determine the exact value of the variables that define the initial status of the model. Thus, when defining this there will always be a certain degree of inaccuracy.

Because of the non-linearity of the evolution equations, the inevitable introduction of a slight deviation in the initial status is amplified as the model evolves, leading after a time to a solution that is totally distanced from the reference solution.

This poses the following question: At what point does the solution obtained cease to have value? or, what is the same, what is the limit for the atmosphere's predictability. An attempt has been made to determine this limit in two ways: using turbulence studies and by carrying out parallel numerical experiments. The unanimous opinion today is that the atmosphere predictability limit for the problems of initial values is between 10 and 15 days.

In order for the mathematical problem to be well proposed, one needs the surroundings conditions as well as the evolution equations and initial conditions; i.e. it is necessary to know the values of the atmospheric variables over the boundary of the atmospheric domain *D* considered. Should *D* be the whole of the terrestrial atmosphere one has only to take its lower and upper limits into account. Should it be limited by a lateral boundary then one will also have to make suppositions that are more or less justified on the evolution of the variables on this boundary. For example, in large domains one can impose the same conditions on their lateral edges, which is equivalent to a spatial recurrence.

Naturally, the quality of the forecast inside the domain will depend on the accuracy of the estimate of the evolution of the variables on its lateral boundary. Also, the larger the domain the more the forecast will last for its inferior, being affected by the errors committed on the boundary.

Progress in the numerical forecasting of the weather has been highly favoured by the development of increasingly powerful computers. Thus, the power of computers used in meteorology has risen from 3 thousand operations/second (IBM 701 installed in 1955) to 2.5 million operations/second (CDC 6600 in 1966) to 7 thousand million operations/second (Cray C98 in 1991), to 100 thousand million operations/second (Fujitsu VPP 5000 installed with Météo-France at the end of 1999). This growing calculating power has essentially been used for increasing the models' horizontal and vertical resolution. Neither should one forget that this progress is also due to the efforts of mathematicians, who are increasingly proposing more accurate and faster outlines and of physicists, who are improving the methods for describing the complexity of the atmospheric physical processes.

The process for forecasting the weather does not end with the numerical result. Computers are not the answer to everything! In particular, for shorter periods (from some hours to one or two days) the skill of the weatherman in charge of the forecast is essential as he is the one who knows best the regional climate and the limits of the models, who adjusts and even modifies the results of the simulation and translates these into observable weather terms: rainfall intensity, the day’s maximum and minimum temperatures, the possible appearance of fog, storms, gusts of wind, etc.

From a practical point of view, forecasting using mathematical models covers a period that goes from 8 or 10 hours up to, in the best of cases, the following nine or ten following days, and that with serious limitations dependent on the specific atmospheric situation and the period of the year. It is not rare to find situations for which it is very difficult to go beyond 60 or 72 hours. For periods below six or eight hours today's mathematical models are not adequate and one needs to use other techniques called immediate forecasting or very short term prediction. These are developed from more or less complex extrapolations of the meteorological data obtained from automatic surface and remote sensing stations (radar, satellites, lightning detection networks...) with high spatial and temporal resolution. This requires continuous monitoring of the atmosphere's evolution and rapid decision-taking for possible sending of warnings to rectify the predictions.

## *2.2 Operational forecasting models*

The growing complexity of numerical forecasting models and the difficulties of perfecting really effective programmes in scientific super-computers have favoured a move to an individual craftsman’s form of working for a large scientific project. In fact, whilst the first numerical forecasting models could be conceived, developed and tested by one person, perfecting the current models implies the cooperation from numerous teams that surpass the capacities of one national service. Accordingly, and above all in Europe, one has seen the development of "community models" or "unified models", aimed at various categories of users of different meteorological services.

Among the models created that are common to different meteorological services we can refer to:

- The HIRLAM (High Resolution Limited Area Model) model, the result of work in common carried out since 1985 by the Scandinavian countries, Ireland, the Netherlands and Spain.

- The ARPEGE-IFS (Integrated Forecast System) model, developed by Météo-France and the ECMWF (European Centre for Medium-Range Weather Forecast) since 1987.
- The ALADIN (Aire Limitée, Adaptation Dynamique, Développement InterNational) model, developed since 1992 by Météo-France in collaboration with researchers from Central Europe. This model is operated by Austria, Belgium, Bulgaria, Croatia, the Czech Republic, France, Hungary, Romania, Slovakia and Slovenia.

There are two commonly operated metorological centres in Europe.

- The ECMWF, created in 1974 and located in Reading (United Kingdom). This groups together eighteen Western European countries and provides daily medium term forecasts (up to ten days).
- The RCLACE (Regional Centre for Limited Area Modelling in Central Europe), created in Prague in 1994. This groups six Central and Eastern European countries (Austria, Croatia, the Czech Republic, Slovake and Slovenia) and operates twice daily a limited domain fine scale model that provides forecasts for up to two days.

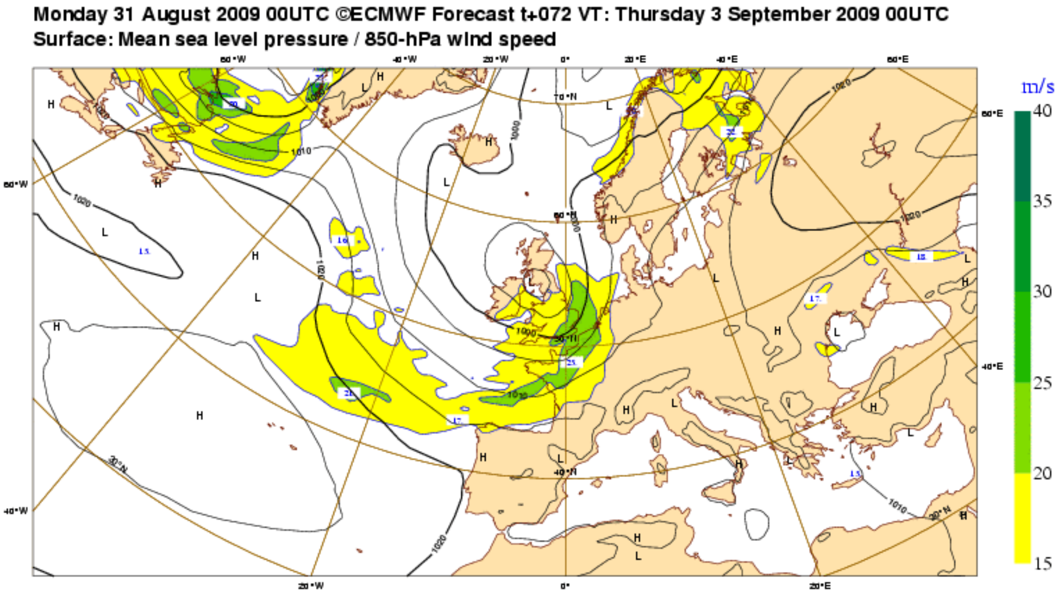
There are only around a dozen national meteorological services in the world that make operational numerical forecasts for the planet as a whole. In Europe, in addition to the ECMWF these are done by Météo-France in Toulouse, the British Meteorological Office in Bracknell and the Deutscher Wetterdienst in Offenbach.

# 3 Products of the AEMet (State Meteorological Agency of Spain)

## 3.1 Numerical forecasting models

ECMWF: Medium-term forecasts (more than 5 days): general circulation models for the atmosphere (GCM)

- Global domain. Global general circulation model.
- Operational since 1979 with daily forecasts for up to 10 days.
- T799 spectral model with 91 levels on the vertical scale.
- Suitable for medium-term, seasonal and climatic forecasts.
- No need for lateral environment conditions.
- They need a large operational infrastructure in order to be maintained.
- Also used for monthly (following month), seasonal (4 months) and, shortly, annual forecasts.
- Reference: http://www.ecmwf.int

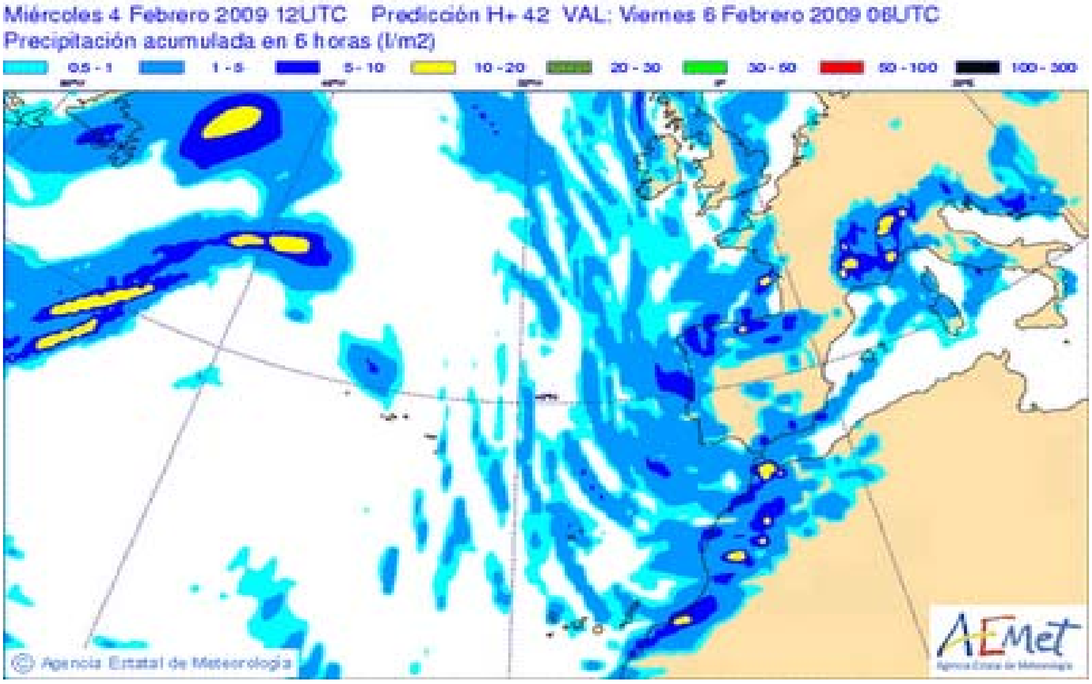


Monday 31 August 2009 00UTC ©ECMWF Forecast t+072 VT: Thursday 3 September 2009 00UTC
Surface: Mean sea level pressure / 850-hPa wind speed

ECMWF FORECAST

HIRLAM: Short-term forecast (less than 3 days): limited area models (LAM).

- This is a limited area model developed by 8 European countries.
- This has been the AEMet's operative model since 1996 with four forecasts per day for up to 48 hours.
- Model in finite differences and grid points.
- "Leapfrog" schema for temporal derivatives.
- Includes the schemas for typical parametrisations.
- Reference: http://hirlam.org
- Operative integrations for the Hirlam system (v 6.1.2) are made for different extents and resolutions.



Miércoles 4 Febrero 2009 12UTC Predicción H+ 42 VAL: Viernes 6 Febrero 2009 06UTC
Precipitación acumulada en 6 horas (l/m2)

HIRLAM FORECAST

## *3.2 Others*

### 3.2.1 AEMet’s Water Balance

The purpose of this product is to facilitate monitoring at national level and daily time scale for the various components of the water balance: Rainfall, potential and real evapotranspiration and soil humidity reserve and percentage over the land's capacity, all with HIRLAM model resolution.

The inputs for the model are synoptic data from AEMet's automatic weather stations for rainfall and sunshine and values in grid for the analyses of the AEMet numerical weather forecasting operative model (HIRLAM) for temperature, relative humidity, wind and atmospheric pressure, as well as invariant soil and physiographical information.

The following have been used as input data for generating the invariant fields:

- Files on soil uses by geographical coordinates (47 classes; 0.0058º resolution) from the MAPA.
- Texture file by geographical coordinates (5 classes plus 5 combinations; 0.0058ºresolution) from the CORINE project database.
- Terrain Digital Model by geographic coordinates with 15" resolution.

The meteorological variables used for calculating the different terms for the water balance equation come from two sources:

- Accurate rainfall and sunshine hours from the manual and automatic meteorological stations in Spain, as well as some from Portugal and France, up to a total of 350 stations.
- Analysis data from the HIRLAM 0.2º meteorological model. Use is made of the wind variables at 10m, temperature at 2m, specific humidity at 2m and surface pressure, taken daily at 00, 06, 12 and 18 hours.

The outputs from the water balance are grid values of 0.2º resolution covering the whole of Spanish territory.

The rate of humidity extraction in function of atmospheric conditions is not considered as a direct process but is dependent on the soil's prior humidity content.

### 3.2.2 SPI Index.

Drought is a complex climate phenomenon: Its temporal and spatial environments are frequently diffuse, its effects accumulate through a gradual process that is dilated in time, not being able to inform until much later than the finalisation of the meteorological drought event that caused them. The level of severity of a meteorological drought is defined not just by the intensity of the lack of rain but also by its temporal structure and spatial extension.

Among the numerous drought indexes that have been defined, there has been growing use throughout the world of the Standardised Precipitation Index (SPI) developed by McKee in 1993. The main advantages of the SPI are: Its operating simplicity, permitting the quantification and comparison for the intensities of lack of precipitation between zones with very varied climates and, above all, the fact that it can be integrated over a broad range of time scales, which makes it useful as an indicator of different types of drought, both those that are of short duration and which produce effects mainly for the agricultural, forestry and livestock sectors, and for characterising long duration climatic droughts that are conducive to hydrological droughts.

The calculation of the SPI for a determined location starts with the long series of precipitation corresponding to the desired period. This historical data record is adjusted to a probability distribution, which is then transformed into a normal distribution such that the average SPI value for this location and the selected period is zero (Edwards and McKee, 1997). Positive SPI values indicate precipitation above the average, with negative values indicating precipitation below the average. As the SPI is standardised, both wet and dry period can be represented in the same way and one can monitor any period by using the index.

**SPI VALUES**

| | |
|---|---|
| **2.0 or more** | **Extremely wet** |
| **1.5 to 1.99** | **Very wet** |
| **1.0 to 1.49** | **Moderately wet** |
| **-.99 to .99** | **Near normal** |
| **-1.0 to -1.49** | **Moderately dry** |
| **-1.5 to -1.99** | **Severely dry** |
| **-2.0 or less** | **Extremely dry** |

A dry period is produced whenever the SPI is continuously negative and reaches a value of -1.0 or less. The drought ends when the SPI becomes positive.

Each episode of drought has, therefore, duration, defined as being between its commencement and its end, and an intensity for each month in which it is maintained. The sum of the SPI values for all of the months included in the episode is called the "magnitude" of the drought.

Using the precipitation input data for the balance, an independent analysis and monitoring module has been developed for drought, this being updated monthly, although it is open to more refreshing in the future. The application that has been developed makes it possible to generate and update on a monthly basis a set of graphic and tabular products referring to the SPI for accumulated periods from 1 month to 3 years, using local data from a set of AEMET synoptic stations and estimated data for precipitation over the large River Basins, as well as climate data.

# 4 HIRLAM

The HIRLAM system in the AEMet:

- Operative integrations for the Hirlam system (v 6.1.2) for different extents and resolutions.
- Particularities of the Hirlam system in accordance with the AEMet's forecasting priorities.
- Characteristics of the past operations in accordance with the AEMet's calculating capacity (currently CRAY X1).

Operational configurations:

ONR:

- 0.16 degress latxlon horizontal resolution.
- 40 hybrid levels vertical resolution.
- ECMWF environment conditions from six hours earlier.
- Integrations of up to 72 hours forecast at 00, 06, 12 and 18 UTC.
- Very large integration area so as to avoid problems in environments.

HNR and CNN:

- 0.05 degress latxlon horizontal resolution.
- 40 hybrid levels verticla resolution (the same as for ONR).
- ONR environment conditions for the same time.
- Integrations of up to 36 hours forecast at 00, 06, 12 and 18 UTC.
- Small integration area as the BC's model is also Hirlam.

Verification of the numerical models:

- Comparison of the model's variables with observed, analysed or diagnosed values for the same variables or another type of meteorological parameters.
- Fundamental tool for knowing the numerical model.
- Types of verification:
- Subjective valuation (conceptual models).
- Objective valuation.

Subjective valuation:

Comparison of structures deduced from the model with values diagnosed from conceptual models.

Advantages:
- Comparison of structures on which the subjective forecasts are based.
- Clearer messages for the forecasters.

Disadvantages:

- Lack of objective quality criteria.
- Lack of systematic data.
- Difficulty in relating the results with the parts of the model on which one has to work.

Objective verification:

Comparison of observed or analysed values for the model variables with the model's forecasts.

Advantages:

- Standard methodology.
- Objective methods without human intervention.
- Statistical results from systematic procedures.

Disadvantages:

- Problem of lags in point to point comparisons.
- Little utility for forecasters.

Precipitation forecast:

Determinist approximation:

- High resolution numerical models (less than 10 Km).
- Sophisticated outlines for data assimilatiopn (radar, GPS, satellite).
- Appropriate physical parameterisations for high resolution.
- Databases for verification with high spatial and temporal resolution.

Probabilistic approximation:

- Forecasting by sets for the short term.
- Numerical models with resolution around 25 Km.
- Appropriate schemas for the generation of disruptions for limited area models.
- Databases for verification with high spatial and temporal resolution.

Precipitation verification:

- Data from 1996-2002 from the INM's climatology network stations.
- 24 hour accumulations.
- Monthly and seasonal variations.
- Contingency tables.

Deep convection:

- Study cases with detailed information.

- Sparse obesrvation frequency.
- Very high preciptation amounts in few hours.
- Difficulties with the models for reaching the observed quantities.

# 5 Practical Applications of Interest in Hydrology and Hydraulics

## *5.1 ECMWF*

It is used for monthly (following month), seasonal (4 months) and, shortly, annual forecasts.

Its outputs are used for generating precipitation maps with the analogies method.

It is used for calculating maximum and minimum temperature forecasts.

## *5.2 HIRLAM*

Institutional users of this system are:

Ministry of Defence:

- Support for routine operations (naval manoeuvres and exercises).
- Support for external operations (Bosnia).
- Support for low level flights.

Ministry of Public Works and Transport:

- AENA – Data for aeronautical self-service.
- DGT (General Traffic Directorate) – Temperature forecasts for highways.
- ADIF (Railways Infrastructure Agency) – Wind on High Speed lines.
- PPE – Waves model.

Ministry of the Environment and Rural and Marine Environs:

- River Basin Districts.
- Nuclear Safety Council.

Private users of this system are:

- Wind farm management companies (CENER).
- Electricity utility companies (Iberdrola).
- City Councils (Zaragoza, Huelva).
- The America's Cup in Valencia.
- Private meteorological consultancy firms (Meteologica, Meteotem).

Other uses:

- Use of direct outputs from Hirlam-AEMet as input for specific models.

## 5.3 *Water Balance*

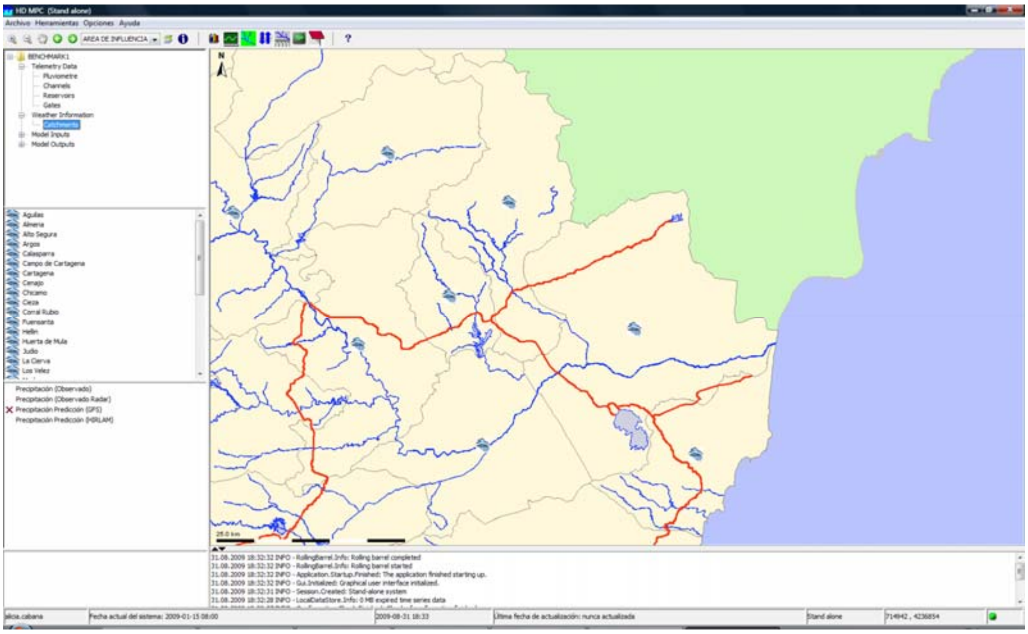
Having a daily estimate of soil humidity can be useful for certain matters:

- Supporting the fight against fires by collaborating in a better evaluation of the water state of live and dead vegetation and a more accurate determination of the risk indices.
- Support for decision-taking in the field of authorising controlled burning.
- With regard to agriculture: estimating the needs for irrigation, soil workability, advance evaluation of the possibility of drought and quantitative monitoring of the same.
- In the hydrology field: Support for resources management and better evaluation of the initial response for a river basin with episodes of intense rainfall.
- In meteorology, having data fields with a reasonable estimate of soil humidity makes it possible to incorporate these data in initialising the models and improving the predictions for some parameters. Also, in the reverse sense one can couple the balance model to the outputs from a numerical model and predict the soil humidity values for the coming days.
- It can be useful in climate and CC studies for the purposes of analysing scenarios and impacts.

# 6 Integration in a platform for water management

WL Delft Hydraulics' Flood Early Warning System (DelftFEWS) provides a state of the art of water forecasting and warning system. The system is a sophisticated collection of modules designed for building a water forecasting system. The philosophy of the system is to provide an open shell system for managing the forecasting process. This shell incorporates a comprehensive library of general data handling utilities, allowing a wide range of forecasting models to be integrated in the system through a published open interface. The modular and highly configurable nature of the system allows it to be customized to the specific requirements of an individual water forecasting.

The system applies the latest software standards. It has been developed in using JavaTM technology, and is fully configurable through open XML formatted configuration files.

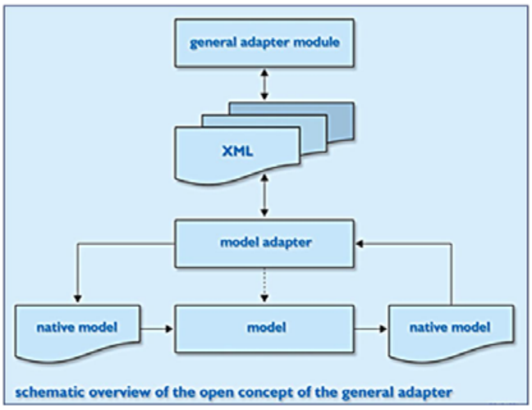


```
31.08.2009 18:32:32 INFO - RollingBarrel.Info: Rolling barrel completed
31.08.2009 18:32:32 INFO - RollingBarrel.Info: Rolling barrel started
31.08.2009 18:32:32 INFO - Application.Startup.Finished: The application finished starting up.
31.08.2009 18:32:32 INFO - Gui.Initialized: Graphical user interface initialized.
31.08.2009 18:32:31 INFO - Session.Created: Stand-alone system
31.08.2009 18:32:28 INFO - LocalDataStore.Info: 0 MB expired time series data
```

alicia.cabana | Fecha actual del sistema: 2009-01-15 08:00 | 2009-08-31 18:33 | Última fecha de actualización: nunca actualizada | Stand alone | 714942 , 4236854

PLATFORM IMPLEMENTED FOR HD-MPC WITH FEWS TECNOLOGY

Of paramount importance in an operational water forecasting system is an efficient connection to external data sources. DelftFEWS provides an import module that allows importing of on-line meteorological and hydrological data from external databases. These data include for example time series obtained from telemetry systems like observed water levels, observed precipitation, but also meteorological forecast data, radar data and numerical weather predictions. Data are imported using standard interchange formats, such as XML, GRIB and ASCII. The import of external data also supports ensemble weather predictions, such as those provided by the European Centre for Medium Range Weather Forecasts (ECMWF) or, in Spanish case, the QPF obtained for HIRLAM (NWP model) that run at Agencia Estatal de Meteorología (AEMet).



schematic overview of the open concept of the general adapter

The philosophy of DelftFEWS is to provide an open system that allows a wide range of existing forecasting models to be used. This concept is supported by the general adapter module, which communicates to external modules through an open XML based published interface, effectively allowing “plugging-in” of practically any forecasting model.

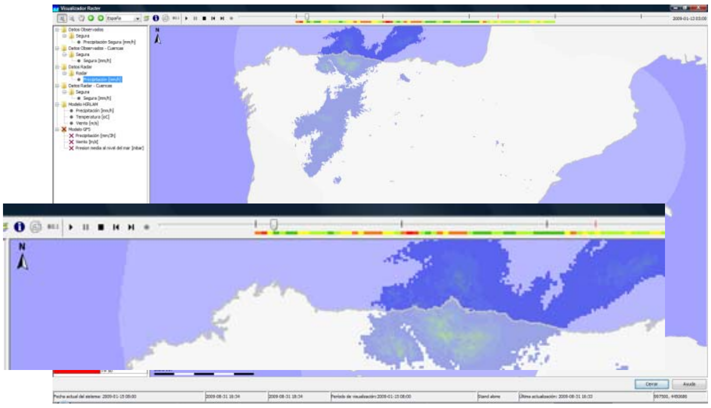
An adapter between the native module data formats and the open XML interface is typically required, and such adapters are already available to support a wide range of hydraulic and hydrological models.

The great advantage of this open interface is that existing hydrological and hydraulic models and modelling capabilities can easily be integrated in the forecasting system, without the need for expensive re-modelling using a specific model.

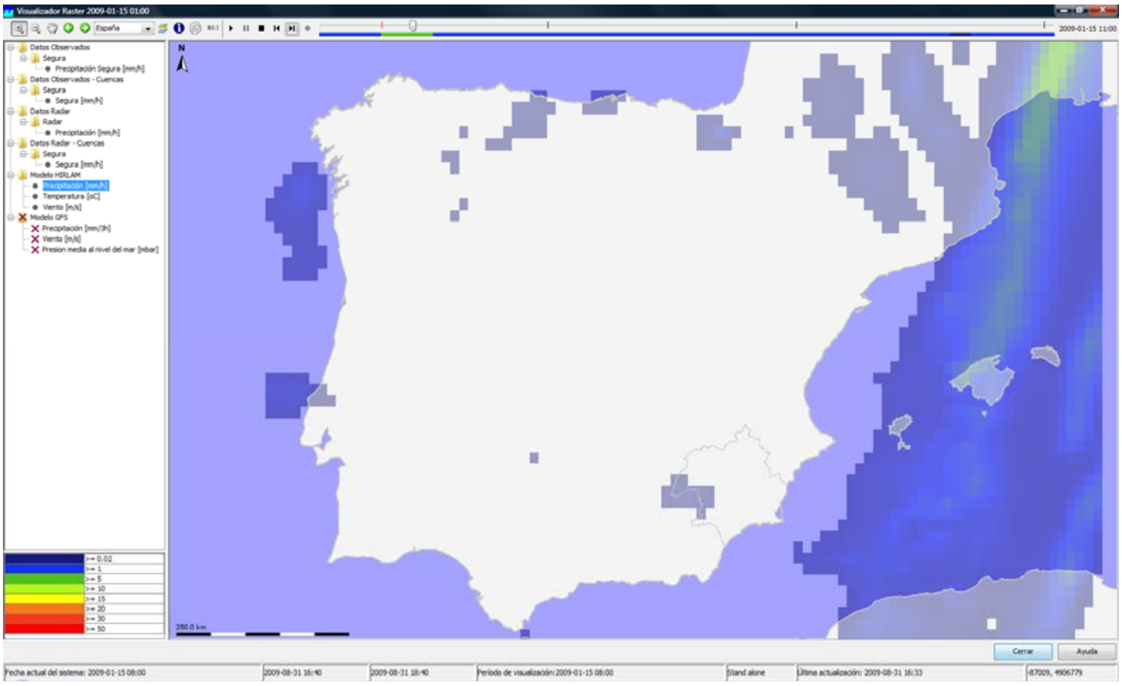
In this project Inocsa is planning to implement in this platform:

- Model Predictive Control
- Simulation Hydraulic Software (HEC-RAS)
- Modules for importing data:
  - Telemetry Data: SAIH
  - Metrological Data: AEMet
    - ✓ RADAR
    - ✓ HIRLAM

In this phase a Module for the importing data is already implemented.



RADAR



Fecha actual del sistema: 2009-01-15 08:00 | 2009-08-31 16:40 | 2009-08-31 18:40 | Periodo de visualización:2009-01-15 08:00 | Stand alone | Última actualización: 2009-08-31 16:33 | -87009, 4906779

HIRLAM

# 7 Conclusions and Recommendations

Inocsa has made an approach to meteorological forecasting models from a user point of view in the fields of Hydraulics and Hydrology.

The application of Numerical Forecasting Models to the fields of Hydraulics and Hydrology incorporates a high added value for applications intended for making forecasts for the management of water resources, as it increases the time scope for the hydraulic and hydrological models forecasting by increasing the time scope for both these inputs and for rainfall.

Inocsa pretends to use the platform FEWS for managing all the information of the project: inputs, outputs, model predictive control, simulation models. This Platform provides Inocsa with an operative and friendly management of all the information over only one interface which facilitates research, test and application. In this phase Inocsa has already implemented a module for the importation of data, included the meteorological information: HIRLAM.