

# World Meteorological Organization

**WMO RA VI Hydrology Forum**  
**Koblenz, Germany, 8-10<sup>th</sup> May 2012**

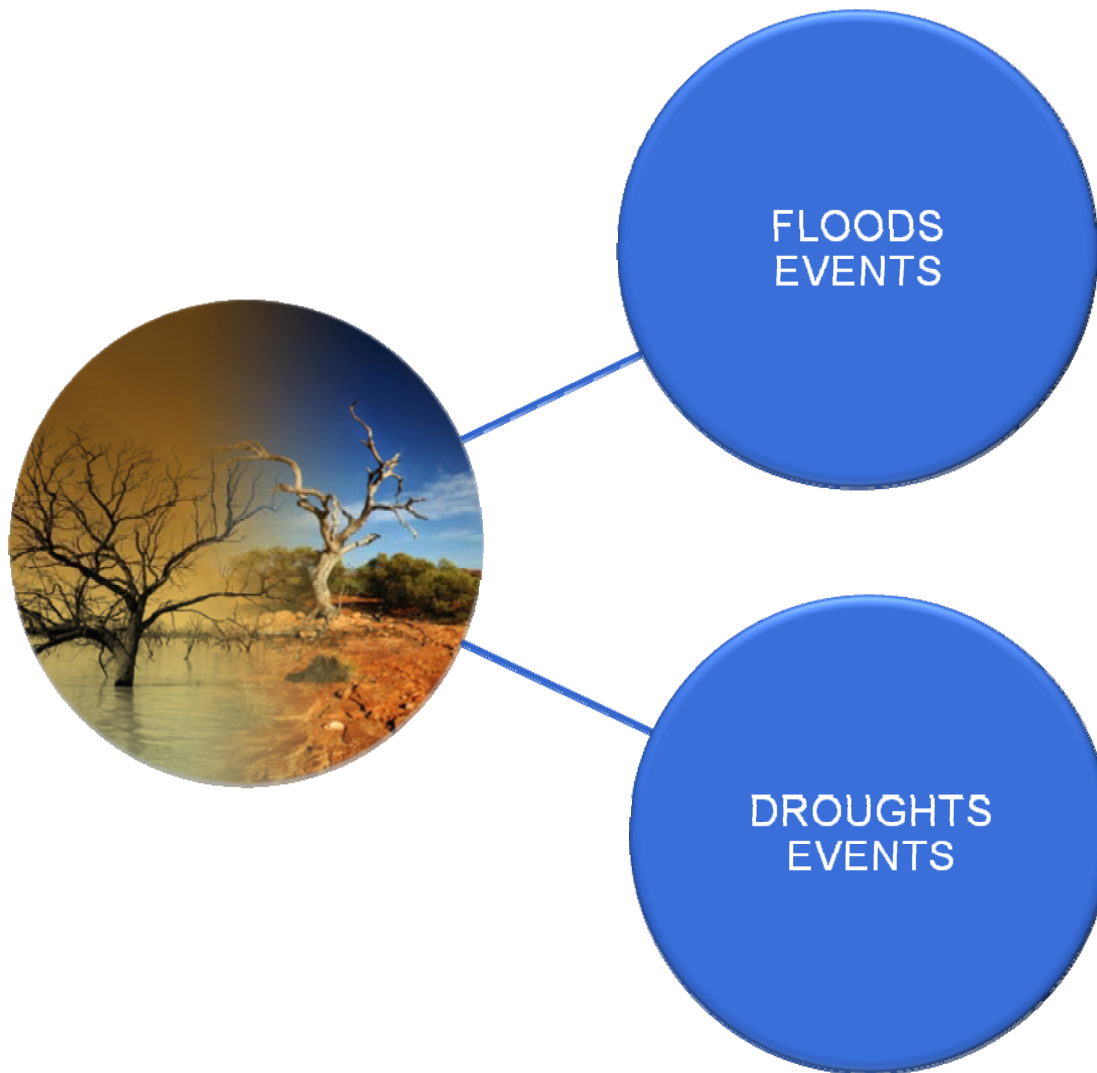
Spanish Automatic Hydrological Information System Program

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Fernando Pastor Argüello  
(General Water Directorate – SPAIN)

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- Spain in the Mediterranean Climate Context
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- Reporting Streams in EU: Spanish Water Information System

# Spain in the Mediterranean Climate Context



- The second most important natural disaster in Spain attending to the number of casualties, affected people and economic losses
- Direct impacts on human safety risks and urban floods (damages in infrastructures, urban furniture, private properties...)
- Result of climate risks (rainfall deficiencies) with hydrological consequences
- Direct impacts on water demands (ie. irrigation, water supply needs for domestic consumption), and indirect consequences on the resources as a result of their increased exploitation

# Spain in the Mediterranean Climate Context

## GENERAL FEATURES:

- High discharge variability

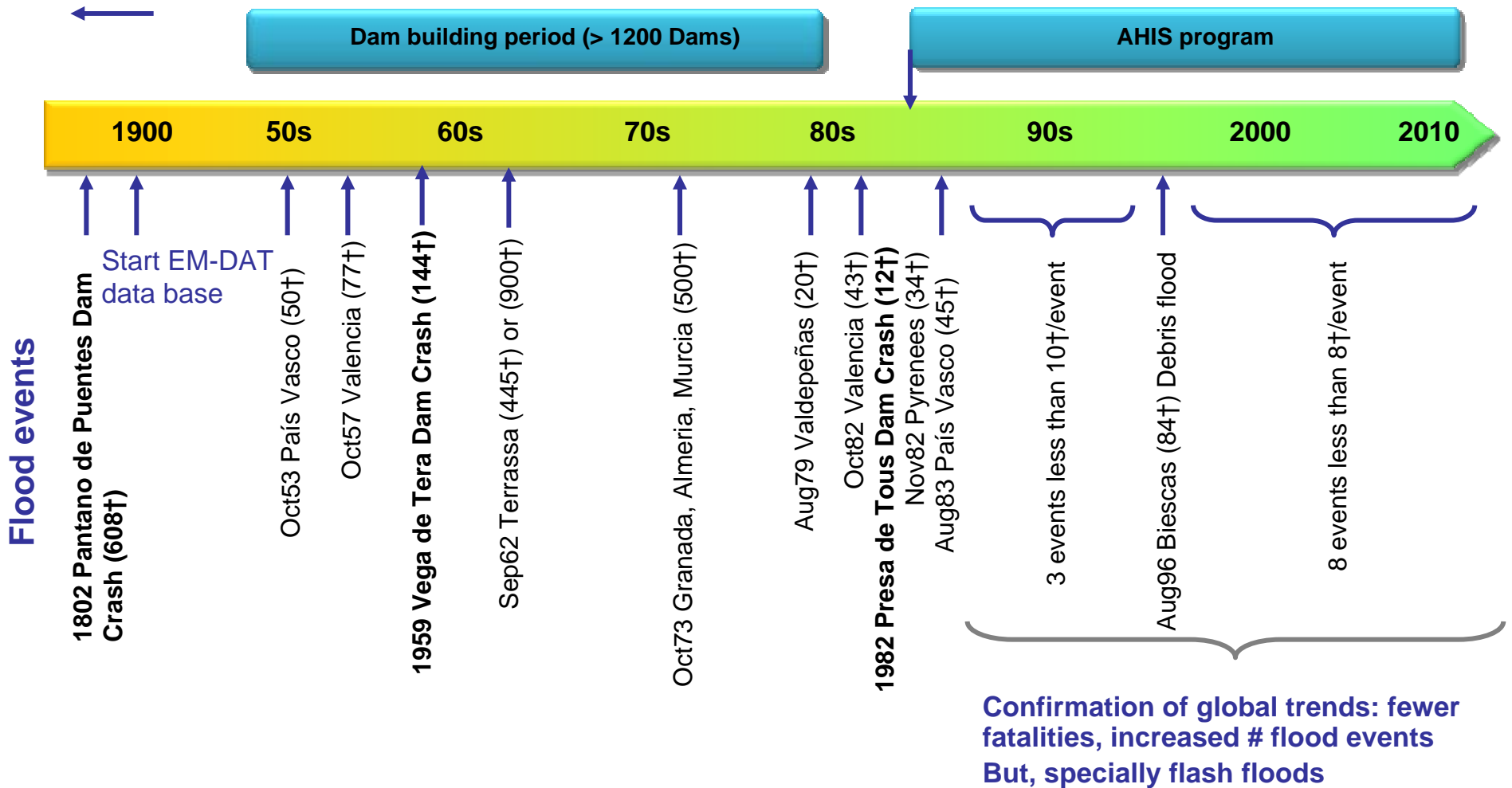


- High urban riverbank pressure



# Flood Events History in Spain

Historical reconstruction of past events belonging to non-instrumental period



Events Source: EM-DAT: The OFDA/CRED International Disaster Database

# Flood Events History in Spain

Flash Floods

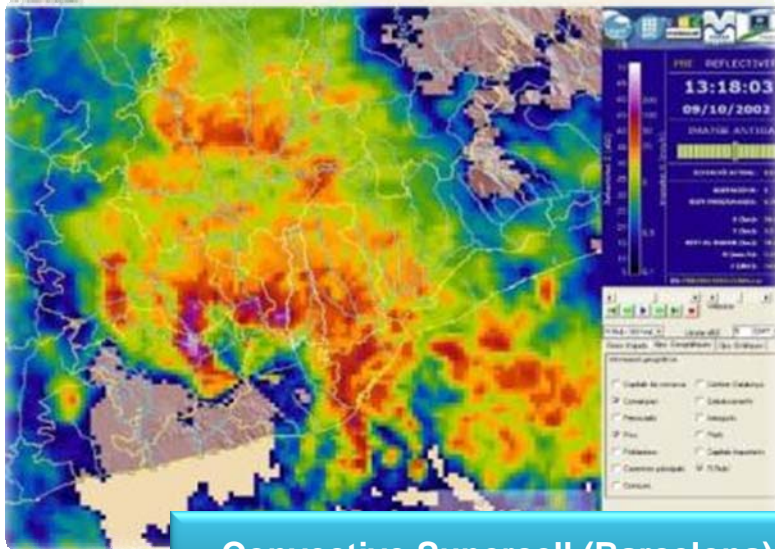


Maresme 2010



Terrassa 1962

General Flood of Duero River

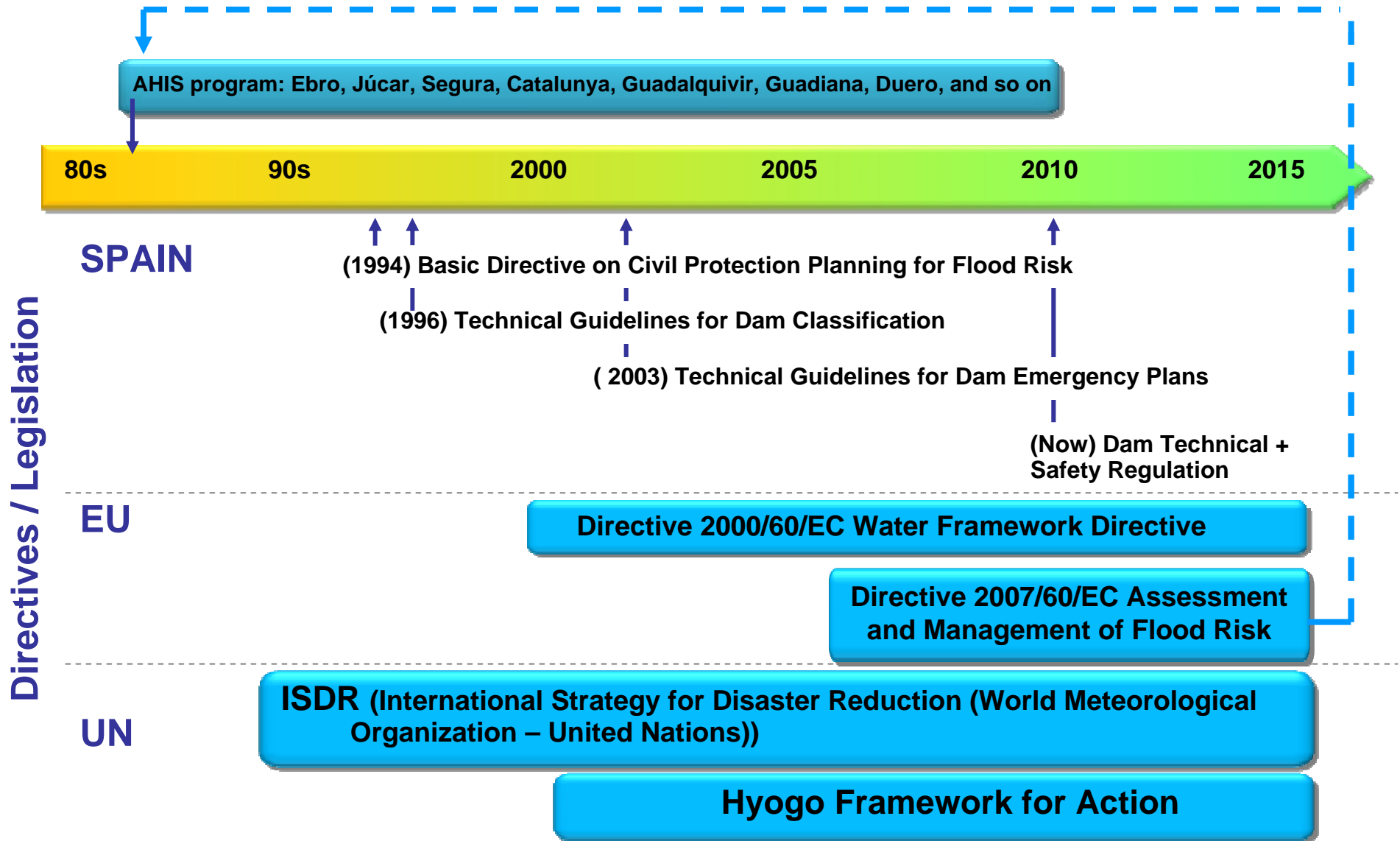


Convective Supercell (Barcelona)

General Flood of Guadiana River



# Directive / Legislation Status in Spain



# Spanish Automatic Hydrological Information System (AHIS) Program

- Spanish AHIS program started in 1983, after the dramatic flood events of Valencia, País Vasco and Pyrenees.
- Currently almost all river basins are equipped with gauging stations, telemetry systems and control centres. Some of the AHIS have more than 20 years of real experience.

## Mission

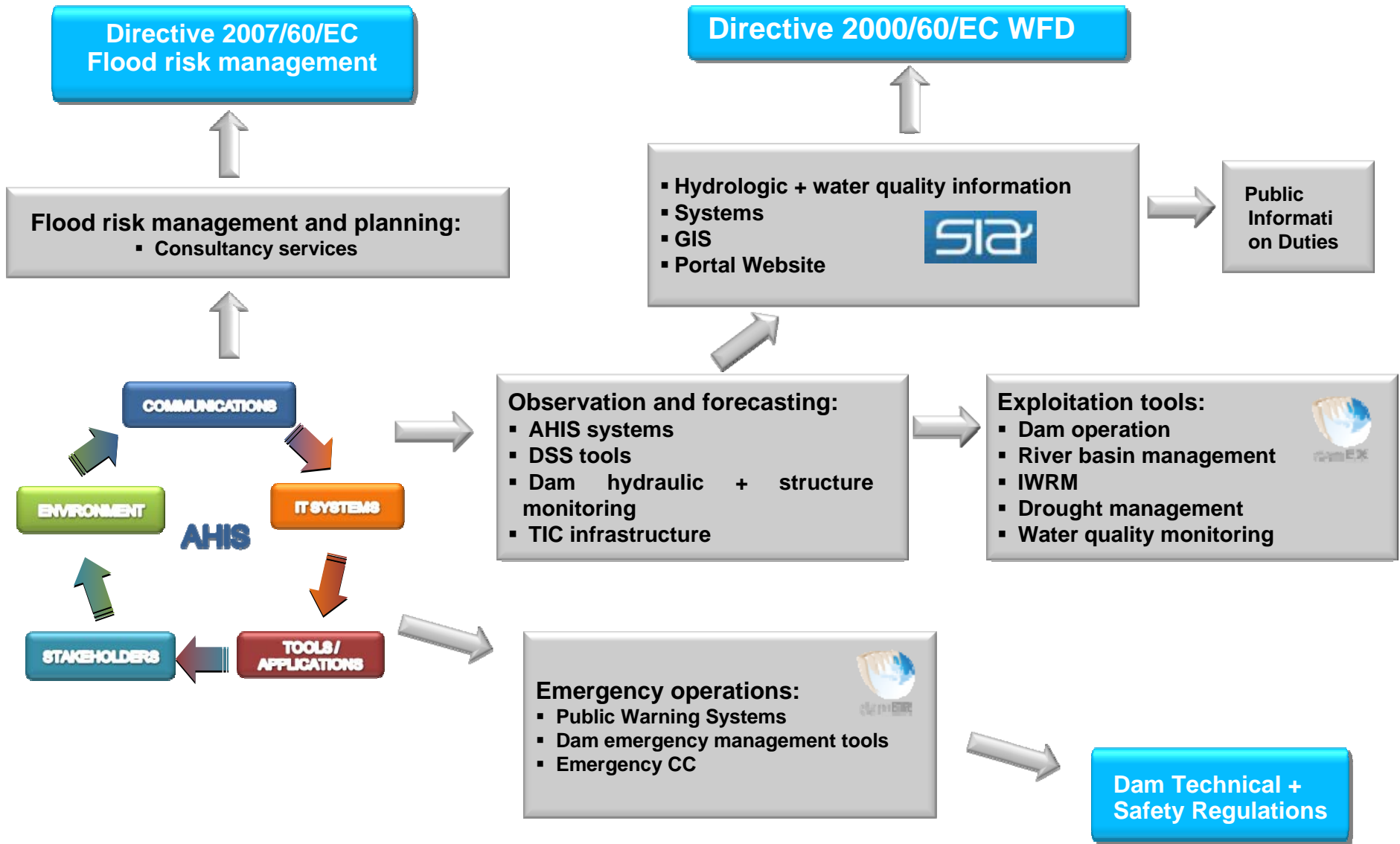
- Prevent damage of floods and droughts
- Improve management of water resources

**AHIS, an open platform  
towards an operational  
Integrated Water Resources  
Management**





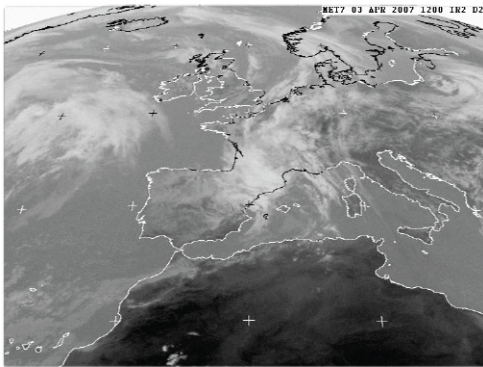
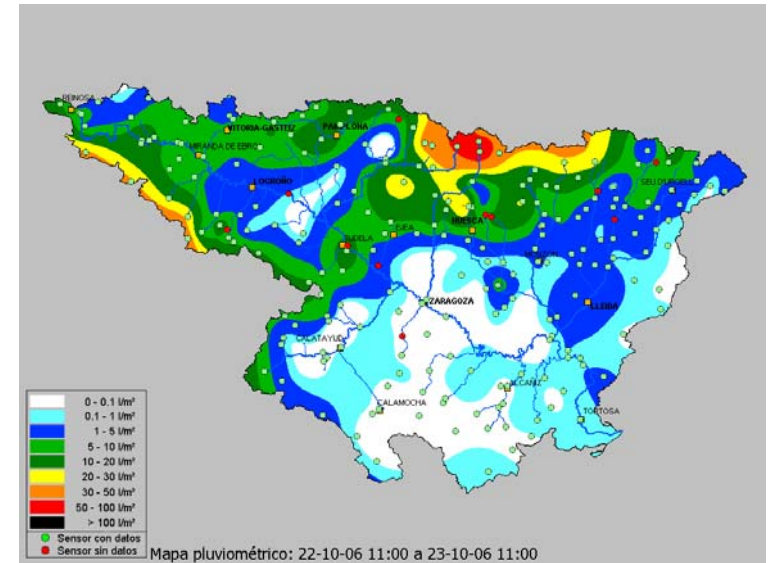
# Regulations and Solutions





# CONCLUSIONS ON SAIH

- Huge handy apply in Flood Emergencies
- Investment quickly recover
- Economically viable System
- Essential tool for optimizing the management and allocation of water resources
- Factor in the modernization of Basin Authorities.



# CONCLUSIONS ON SAIH

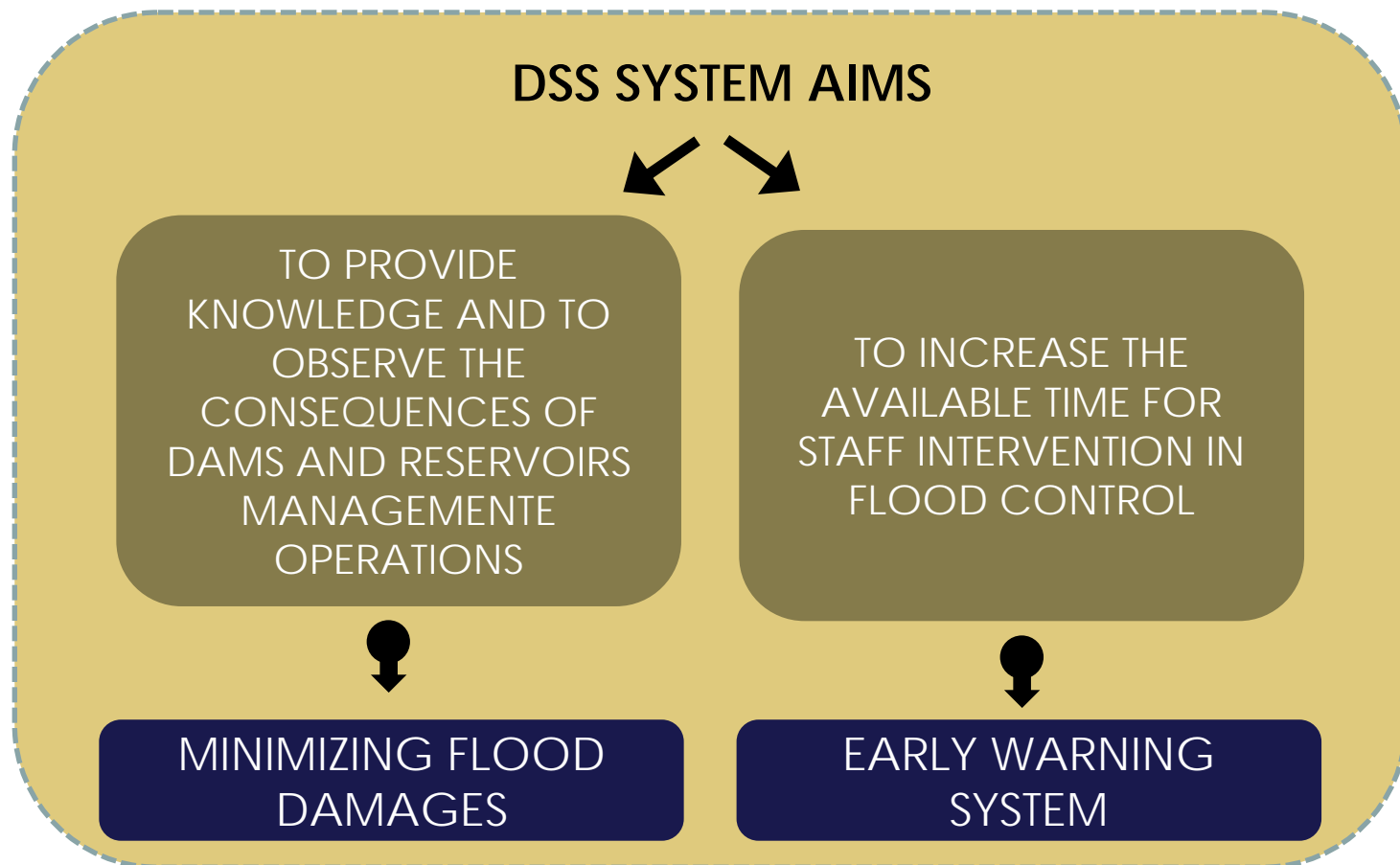
**SAIH** Systems provide **Real-Time** Hydro-Meteorological Information but **No Forecast** Information

**Decision Support System** as a tool that collects and analyzes in Real-Time, SAIH data and generates **Forecasts** about the Basins **Future Response**



# DECISION SUPPORT SYSTEM

Flood Forecasting Decision Support System makes possible to know the basin response 72h in advance to the emergency

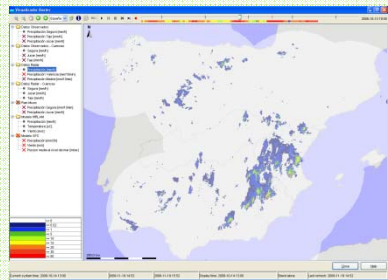


# DECISION SUPPORT SYSTEM

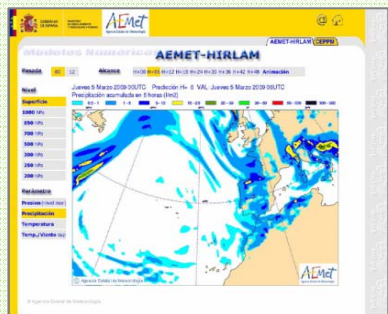
## DATA FEEDS



SAIH data



Radar data

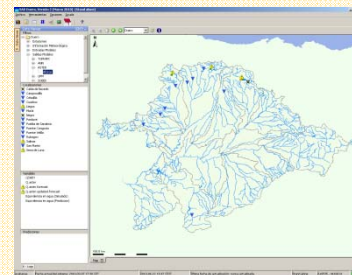


HIRLAM forecast data

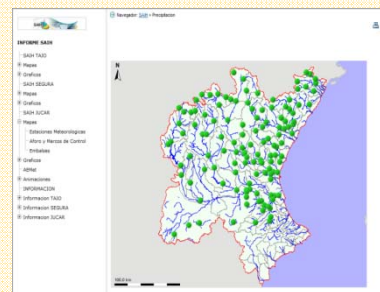
## DSS



SAIH data

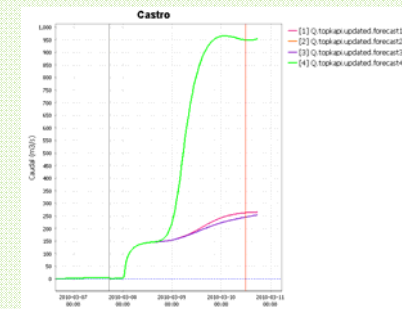


Radar data



HIRLAM forecast data

## FORECASTS



Forecast discharge  
adjusted  
observed values





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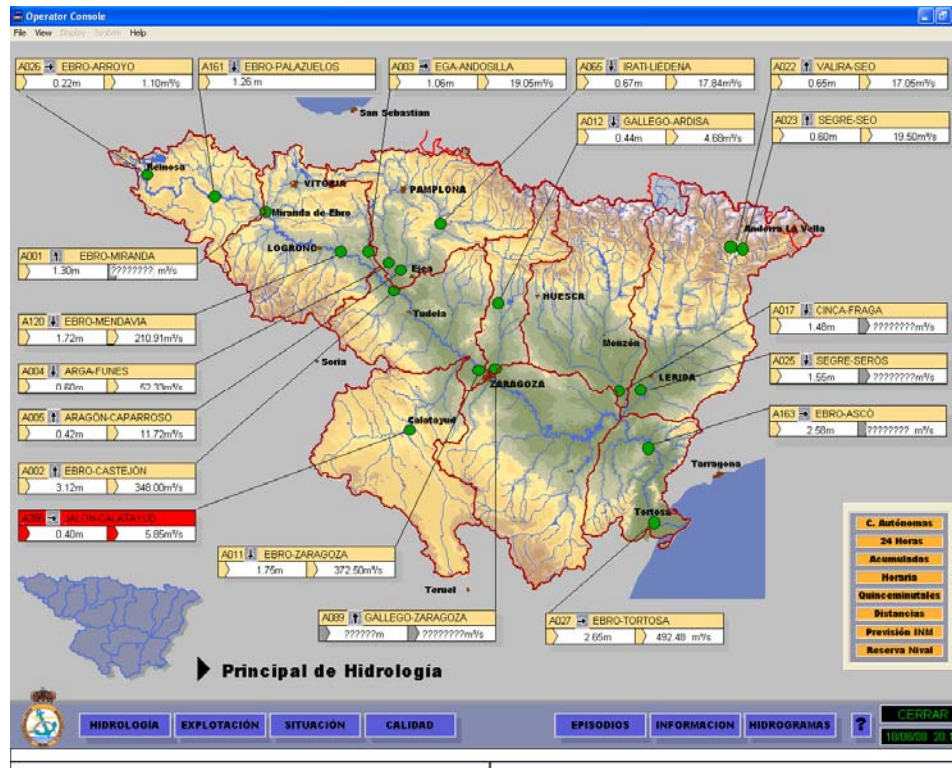
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CONFEDERACIÓN HIDROGRÁFICA DEL EBRO

SAIH Ebro

## 2. Automatic Hydrologic Information System

The Automatic Hydrological Information System is a set of informatic and communication tools which collect hydrological and meteorological data from a sensor network every 15 min.



SAIH Ebro implementation:  
Works began in 1988  
Service started in 1996  
Starting investment: 75 M€  
Annual maintenance: 5 M€/year





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SAIH  
Ebro

## CONTROL POINT OR REMOTE STATIONS

**SAIH Ebro is composed of several types of control stations and sensors:**

- 70 Stations in dams
- 200 River gauge stations
- 200 Stations in irrigation canals
- 325 Rainfall measurements
- 175 Temperature sensors
- 13 Snow accumulation sensors



**And 100 radio repeater stations**



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## S.A.I.H Ebro Primary Communication Network (Radio)

- 100 radio repeater which build a WAN network and give coverage to the stations by a TETRA system
- alternative connections via satellite & GPRS

The communication network structure was conditioned by a series of design specifications:

- Volume of information transmitted.
- Hierarchical network structure in three levels (Control points, Concentration points and Basin Processing Center)
- Transmission of information via terrestrial radio, since then, was the most reliable in situations with adverse weather conditions, ensuring safe operation of the network 24 hours a day.





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## BASIN PROCESSING CENTER (CPC)



In the Basin Processing Center, a powerful SCADA system collects, processes, stores and displays the information.

**BPC is working 365 days a year, 24 hours a day.**

It is monitored:

- Alerts generated by the S.A.I.H. network itself.
- Alerts related to “Confederación Hidrográfica del Ebro (CHE)” operations.



**DSS is defined as a set of operational tools and models specially designed for real time flood forecasting in Ebro basin**

## DSS TARGETS

**Provide support for  
dam operation**



**MINIMIZE FLOOD  
DAMAGES**

**Increase the available  
time for the  
intervention personnel  
in flood defense**



**EARLY FLOOD  
WARNING**



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SAIH<sub>Ebro</sub>

## DSS MODEL INPUTS

**1.- Real time collected data from SAIH remote stations every 15 min:**

- Rainfall & snowfall
- Temperature
- River flows
- Reservoir levels
- Reservoir outflows





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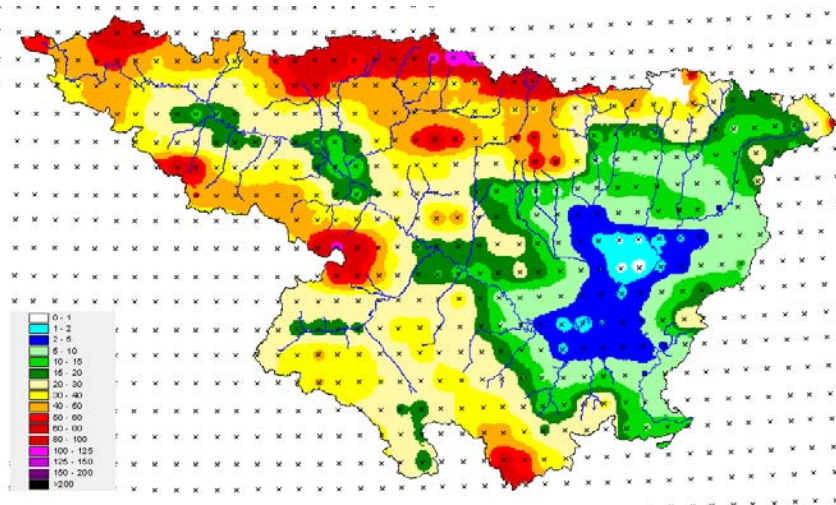
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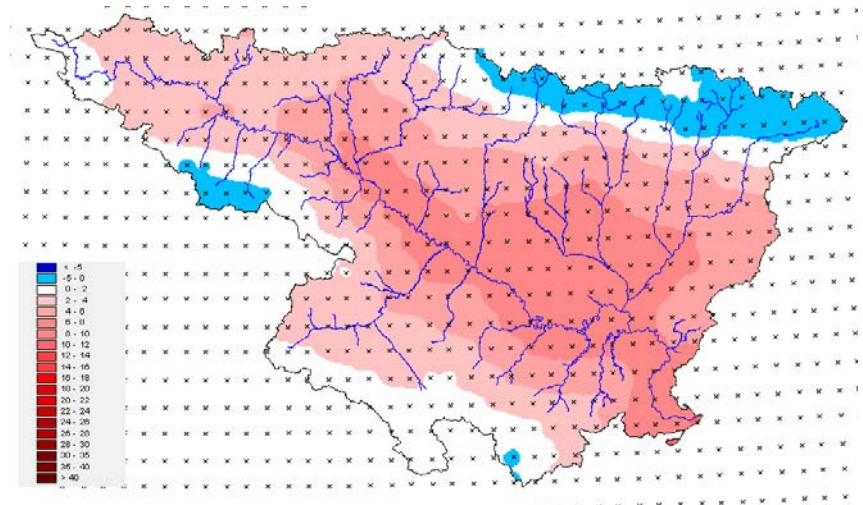
## DSS MODEL INPUTS

### 2.- Meteorological forecasts for the next 72 hours

- AEMet (Meteorological State Agency) - **HIRLAM** (0,16°)
- NWS (American Aviation National Weather Service) - **GFS** (0,5°)
- ULE (Leon University) - **WRF** (0,03°)



72-hour **rainfall** forecast map for  
the 26-03-2007 14h



72-hour **temperature** forecast map for  
the 26-03-2007 14h



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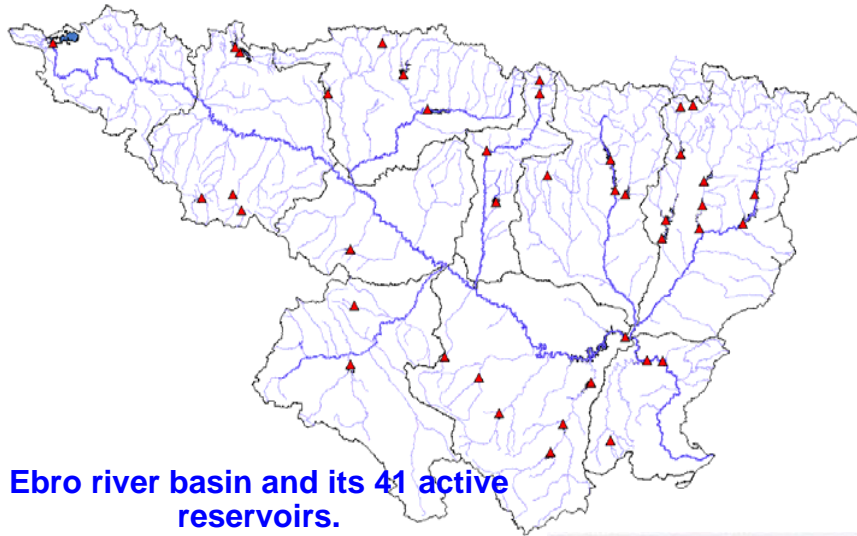
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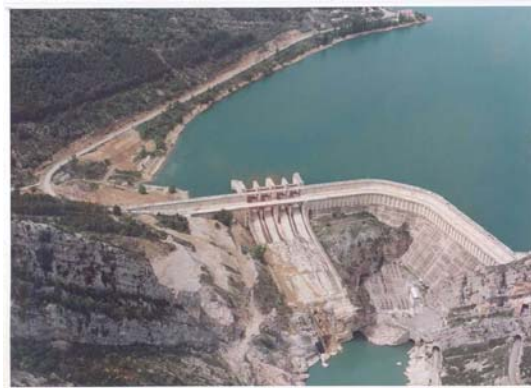
## DSS MODEL INPUTS

### 3.- Scheduled or hypothetical reservoir releases



Itoiz reservoir in April 2008

Mediano reservoir in April 2008





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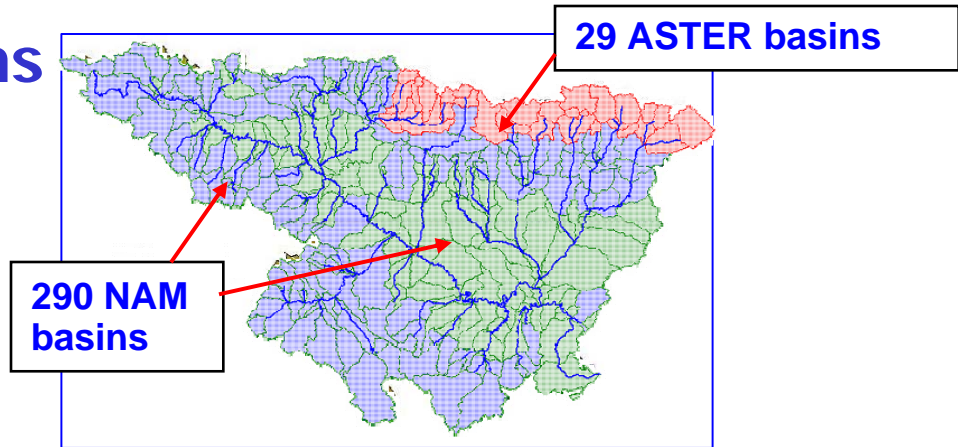
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## SIMULATION contains

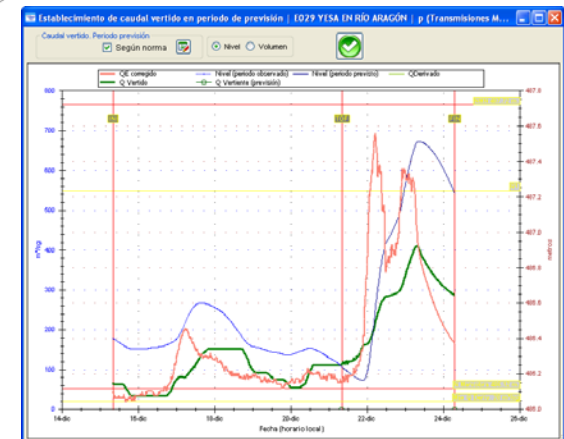
- 2 HYDROLOGIC MODELS that allow to simulate the hydrological cycle in order to estimate flows in basins. The **ASTER** model is used for the Pyreneen basins and the **NAM** model for the rest of basins.



- HYDRAULIC MODEL (MIKE 11, Muskingum) for the flood wave propagation in rivers and reservoirs.



- DAM OPERATION MODULE serves as a support for the decision-making process.







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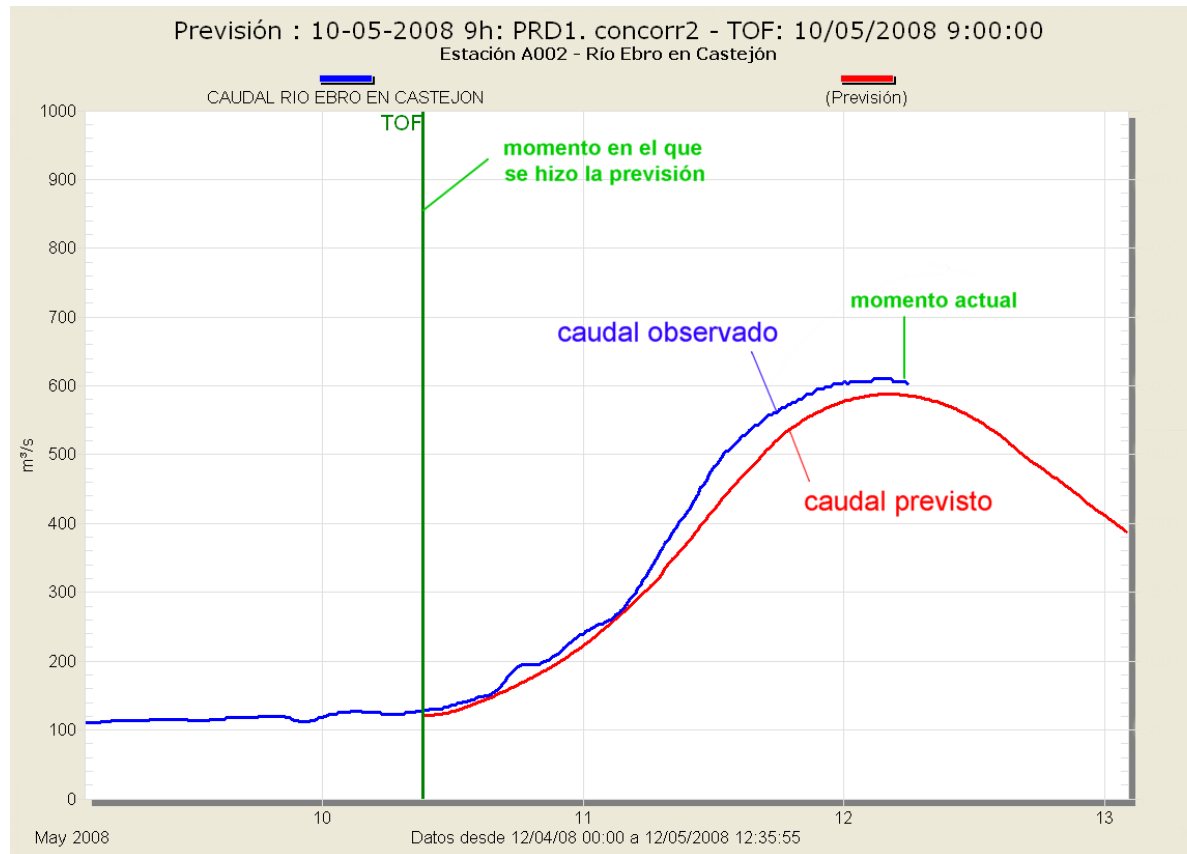
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## DSS MODEL OUTPUTS:

### 1- Flood forecasts at the river gauge stations (200) or at different computing cross-sections (800)





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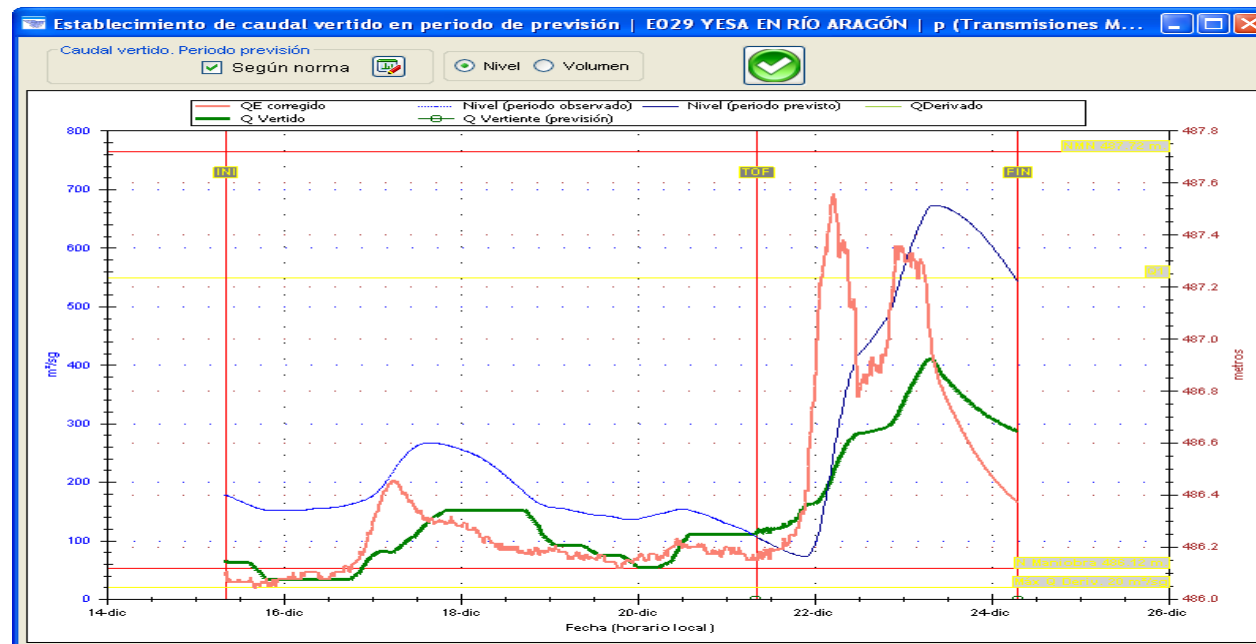
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## DSS MODEL OUTPUTS:

2- The optimal operation (outflows) for every reservoir in order to:

- guarantee dam's safety
- minimize maximum discharge





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# DSS WEBSITE : [www.saihebro.com](http://www.saihebro.com)

SAIH Ebro Confederación Hidrográfica del Ebro

SAIH Ebro Real time data **Forecasts** Reports News Historic data Contact Users

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Automatic Hydrologic Information System of the Ebro river basin

Programa AGUA

**WARNING**  
The data are provisional and subject to review.

AENOR R Empresa Registrada UNEN EN ISO 9001 EIC-1375-1999

CERTIFIED MANAGEMENT SYSTEM Net

CAUDAL RIO EBRO EN ZARAGOZA

Date	Discharge (m³/s)
18 Jun 06:00	422.88
18 Jun 12:00	380.99
18 Jun 18:00	338.30
19 Jun 06:00	296.02
19 Jun 12:00	253.73
19 Jun 18:00	211.44
20 Jun 06:00	169.15
20 Jun 12:00	126.86
20 Jun 18:00	84.58
21 Jun 06:00	42.29
21 Jun 12:00	0.00
21 Jun 18:00	0.00
22 Jun 06:00	0.00
22 Jun 12:00	0.00
22 Jun 18:00	0.00

FORECAST MADE ON: 18/06/2008 08:00 VALID TO: 21/06/2008 02:00  
CHARACTERISTIC DISCHARGES IN PHASE OF DEFINITION

# Spanish Water Information System

## ▪ Multiplicity of topics

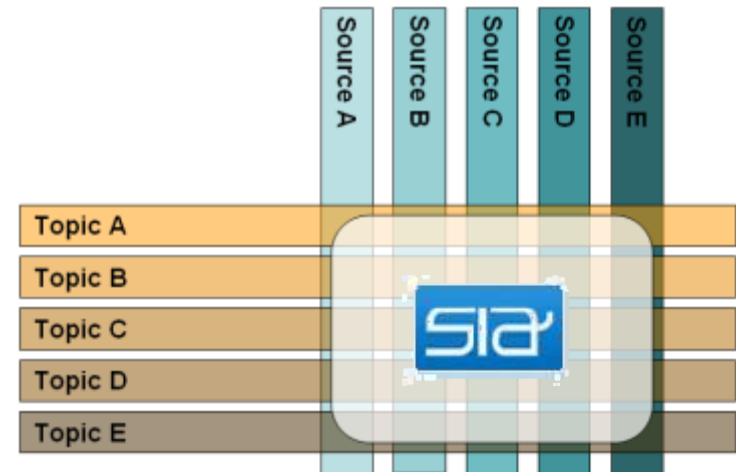
- Water description and water status: surface water, ground water, quantity, quality, rainfall
- Water uses and impacts: industrial, agriculture, urban
- Water infrastructure
- Water management: laws, institutions, investments, monitoring actions

## ▪ Multiplicity of information types

- Documents
- Real time data
- Validated data
- Aggregated data / indicators
- Geographic information

## ▪ Multiplicity of focus levels

- Local
- National
- International / regional





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**THANK YOU FOR YOUR ATTENTION**