Flood Risk Management in Spain:

flood control in transboundary rivers

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Tajo River Basin Authority - Spain
### TAGUS INTERNATIONAL RIVER BASIN

55.645 km² España  
+  
25.665 km² Portugal

<table>
<thead>
<tr>
<th>Dato</th>
<th>Unidades</th>
<th>Tajo en España</th>
<th>España</th>
<th>% Tajo/España</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficie</td>
<td>Km²</td>
<td>55.870</td>
<td>506.470</td>
<td>11.03 %</td>
</tr>
<tr>
<td>Población en habitantes</td>
<td>en miles</td>
<td>6.094</td>
<td>39.238</td>
<td>15.53 %</td>
</tr>
<tr>
<td>Precipitación media</td>
<td>mm</td>
<td>655</td>
<td>684</td>
<td>95.76 %</td>
</tr>
<tr>
<td>Recursos hidráulicos régimen natural</td>
<td>hm³</td>
<td>11.235</td>
<td>113.812</td>
<td>9.87 %</td>
</tr>
<tr>
<td>Aportación específica</td>
<td>hm³/km²</td>
<td>0.219</td>
<td>0.225</td>
<td>97.33 %</td>
</tr>
<tr>
<td>Capacidad de embalsas</td>
<td>hm³</td>
<td>12.000</td>
<td>56.043</td>
<td>21.40 %</td>
</tr>
<tr>
<td>Escorrentía subterránea</td>
<td>hm³</td>
<td>1.545</td>
<td>20.881</td>
<td>7.49 %</td>
</tr>
<tr>
<td>Reservas subterráneas</td>
<td>hm³</td>
<td>4.700</td>
<td>180.000</td>
<td>2.61 %</td>
</tr>
</tbody>
</table>

From “Tajo en cifras” (2000)
PUBLIC ADMINISTRATION OF WATER IN SPAIN

Basin Authorities

1. Attached to Ministry Of Environment
   CONFEDERACIONES HIDROGRÁFICAS:
   Northern Basin: Cantabrian and Miño-Sil
   Duero
   Tajo
   Guadiana
   Guadalquivir
   Segura
   Júcar
   Ebro
   Miño-Limia

2. Attached to Autonomous Regions
   Cuencas Internas de Cataluña
   Galicia Costa
   Cuencas Internas del País Vasco
   Cuencas Internas Andalucía
   Atlantics
   Mediterranea
   Baleares Islands
   Canary Islands
Keys for water management in Tagus basin

- Reservoirs eutrophication
- Water supply
- Water quality
- Water transfer to Spanish SE
- Transboundary issue
- MADRID
- 84% basin population
- Upper Tagus reservoirs

Cáceres
Toledo

240 km.
Contents

0. Foreword: driving forces affecting flooding damages

I. Flood prevention and risk management in Spain
   Dams coordinated management/Land use/Early Warning/Civil Protection Plans--->risk mapping/Early Warning

II. Transboundary rivers: Albufera agreements among Spain and Portugal

III. Directive 2007/60/EC on assessment and flood risk management

IV. Conclusions
Flood Risk Management in Spain:
flood control in transboundary rivers

0. Foreword: concept and definitions
0. Foreword: concept and definitions

Driving forces affecting floods

- Floods are a **natural phenomena**. But **risk** of flooding results from a combination of **natural** factors and **human** interferences.

- **Natural** factors are more related with meteorological, topographic, vegetation, soil conditions, specially rainfall.

- **Human** actions can influence flooding:
  - Affecting the run-off patterns (e.g. deforestation, urbanisation,). Modifying the natural conditions.
  - Increasing the possible impact of flooding (e.g. occupation of flood plains). Exposure to flooding.
Flooding damage process

Flood → Overflowing → Assets in Flooding zone → Damage

- Structures: dams, channels
- Land planning
- Building codes

Smoothing the Hydrogram: dams

Vulnerable assets

WORKSHOP ON FLOODS IN TRANSBOUNDARY CONTEXT Zagreb, November 2011
FLOOD RISK ASSESSMENT and FLOOD MANAGEMENT

Non structural measures

Prevention
- Land use, zoning and location
- Previous impact report of civil protection

Early Warning
- Meteorological
- Hydrological

Flood Emergency
- Action Plan
- Scenarios forecasting
- Tools and infrastructures support
- Coordination measures

FLOOD RISK MANAGEMENT

Resettlement and reconstruction work
- Building code
- Appropriate location
Flood Risk Management in Spain: flood control in transboundary rivers

I. Floods in Mediterranean basins: the case of Spain
Flood prevention and risk management guidelines

Structural

• Hydraulic infrastructure dam

No Structural

• Early Warning System

• International bodies Sp&Pr
Flood Risk Management in Spain: Flood Risk Management in Spain: flood control in transboundary rivers

I. a. Dams

It is an important issue in Spain (more than 1,200 large dams)
Hydraulic Infrastructures: dams

<table>
<thead>
<tr>
<th>Natural resources</th>
<th>Available without regulation</th>
<th>Available with regulation</th>
<th>Water Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>112 km³</td>
<td>9.19 km³</td>
<td>46 km³</td>
<td>40 km³</td>
</tr>
</tbody>
</table>
**HIDRAULIC INFRASTRUCTURES**

*Data of the operating reservoir and in construction*

**Reservoirs with storage capacity >10 hm³**

<table>
<thead>
<tr>
<th>Plan</th>
<th>Número de embalses en explotación</th>
<th>Capacidad de los embalses en explotación (hm³)</th>
<th>Superficie inundada (ha)</th>
<th>Capacidad de los embalses en ejecución (hm³)</th>
<th>Capacidad total (explotación y ejecución) (hm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norte I</td>
<td>53</td>
<td>3.040</td>
<td>11.771</td>
<td>0</td>
<td>3.040</td>
</tr>
<tr>
<td>Norte II</td>
<td>27</td>
<td>559</td>
<td>2.913</td>
<td>0</td>
<td>559</td>
</tr>
<tr>
<td>Norte III</td>
<td>32</td>
<td>122</td>
<td>712</td>
<td>0</td>
<td>122</td>
</tr>
<tr>
<td>Duero</td>
<td>67</td>
<td>7.654</td>
<td>35.417</td>
<td>13</td>
<td>7.667</td>
</tr>
<tr>
<td>Tajo</td>
<td>198</td>
<td>11.131</td>
<td>58.806</td>
<td>4</td>
<td>11.135</td>
</tr>
<tr>
<td>Guadiana I</td>
<td>90</td>
<td>8.508</td>
<td>48.039</td>
<td>335</td>
<td>8.843</td>
</tr>
<tr>
<td>Guadiana II</td>
<td>36</td>
<td>684</td>
<td>4.654</td>
<td>92</td>
<td>776</td>
</tr>
<tr>
<td>Guadalquivir</td>
<td>107</td>
<td>8.208</td>
<td>43.293</td>
<td>659</td>
<td>8.867</td>
</tr>
<tr>
<td>Sur</td>
<td>37</td>
<td>1.160</td>
<td>5.212</td>
<td>159</td>
<td>1.319</td>
</tr>
<tr>
<td>Segura</td>
<td>27</td>
<td>1.144</td>
<td>6.580</td>
<td>79</td>
<td>1.223</td>
</tr>
<tr>
<td>Júcar</td>
<td>47</td>
<td>3.343</td>
<td>17.263</td>
<td>6</td>
<td>3.349</td>
</tr>
<tr>
<td>Ebro</td>
<td>151</td>
<td>6.761</td>
<td>40.294</td>
<td>941</td>
<td>7.702</td>
</tr>
<tr>
<td>C. I. Cataluña</td>
<td>14</td>
<td>692</td>
<td>2.450</td>
<td>80</td>
<td>772</td>
</tr>
<tr>
<td>Galicia Costa</td>
<td>22</td>
<td>688</td>
<td>4.446</td>
<td>0</td>
<td>688</td>
</tr>
<tr>
<td>Total península</td>
<td>908</td>
<td>53.694</td>
<td>281.850</td>
<td>2.368</td>
<td>56.062</td>
</tr>
<tr>
<td>Baleares</td>
<td>2</td>
<td>11</td>
<td>119</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Canarias</td>
<td>114</td>
<td>101</td>
<td>477</td>
<td>0</td>
<td>101</td>
</tr>
<tr>
<td><strong>Total España</strong></td>
<td><strong>1.024</strong></td>
<td><strong>53.806</strong></td>
<td><strong>282.445</strong></td>
<td><strong>2.368</strong></td>
<td><strong>56.174</strong></td>
</tr>
</tbody>
</table>
Dam Safety Management

What require it?

✓ Dam Classification
✓ Operation and Maintenance Rules (approved for Water Directorate)
✓ Emergency Action Plan
✓ Implementation of Operating Procedures
✓ Inspection and Annual Reports
✓ Periodical Complete Safety Review

Who is responsible?

✓ Dam Owners → Hydropower’s Company, Municipalities, Water Users, Estate...
✓ Under inspection of Water Directorate and Basin Authorities
Reservoir Committee: in case of flood the PERMANENT COMMITTEE coordinate the operation at basin level, providing information to Civil Protection.
Flood Risk Management in Spain:

flood control in transboundary rivers

I. e. Early Warning System
SAIH – Sistema Automático Información Hidrológica

Automatic Hydrological Information System (SAIH) main objectives:

- **Supply** of information automatically in real time
- **Forecasting** in short term the evolution of levels and flows
- **Management** of the exploitation of the reservoirs and canals

SAIH NETWORK  at 2008 (currently Guadiana and Duero’s SAIH is working too)

- **1,775 Control Points**
  - Reservoirs
  - Flow gauges rivers
  - Flow gauges in channels
  - Rain gauges
  - Booster station

- **Investment updated (2006): 374 M€**
- **Operational cost updated: 18 M€/year**

Recently going on:
- Guadiana
- Duero
AHIS – Authomatic Hydrological Information System

- Data Acquisition: TRANSDUCERS
- Data Communication: NETWORKS
- Data Processing: CONTROL CENTRE
- Aided Models for DECISION MAKING

Communication Main Types

Radio: main and secondary net

Satellite HISPASAT
SAIH provide hydrological data to Civil Protection when a Flood Warning or Emergency has been declared.

Flood Risk Management Plan includes:
- Hazard maps
- Risk maps
- Contingency plans
Confederación Hidrográfica del Tajo
TOPOLOGICAL AND TYPOLOGICAL FEATURES OF THE NETWORK

In total there are 202 control points located throughout the basin. The control points planned are listed in the following table.

<table>
<thead>
<tr>
<th>CONTROL POINTS</th>
<th>COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rainfall control</td>
<td>43</td>
</tr>
<tr>
<td>2. Rainfall/level control</td>
<td>18</td>
</tr>
<tr>
<td>3. Reservoir control</td>
<td>47</td>
</tr>
<tr>
<td>4. River flow-gauging</td>
<td>53</td>
</tr>
<tr>
<td>5. Water levels evolution control</td>
<td>7</td>
</tr>
<tr>
<td>6. Channel measurement point</td>
<td>22</td>
</tr>
<tr>
<td>7. Pumping control</td>
<td>12</td>
</tr>
</tbody>
</table>
SAIH system has proved to be a successful tool providing flow and precipitation data in real time (every 10 minutes) and allowing for accurate hydrological forecast.
Foreseen of land’ owners affected (in certain sub basins)
Flood Risk Management in Spain:
- Flood control in transboundary rivers

II. Albufeira agreements among Spain and Portugal
THE ALBUFEIRA AGREEMENT

AGREEMENT ON COOPERATION FOR THE PROTECTION AND SUSTAINABLE EXPLOITATION OF THE WATERS FROM THE SPANISH-PORTUGUESE HYDROGRAPHIC BASINS
International bodies: Albufeira Convention

Cooperation Agreement for protection and sustainable use of international basins between Spain and Portugal (Albufeira 11/30/98).

Rivers included:
- Miño y Limia
- Duero
- Tajo
- Guadiana

In case of flood a continuous data interchange is produced between INAG (Portugal) and Spanish River Basin Authorities (Miño – Limia, Duero, Tajo and Guadiana)
<table>
<thead>
<tr>
<th>Cuenca Hidrográfica</th>
<th>Total Area (km²)</th>
<th>Portugal Area (km²)</th>
<th>%</th>
<th>España Area (km²)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miño</td>
<td>17.080</td>
<td>850</td>
<td>5</td>
<td>16.230</td>
<td>95</td>
</tr>
<tr>
<td>Limia</td>
<td>2.480</td>
<td>1.180</td>
<td>48</td>
<td>1.300</td>
<td>52</td>
</tr>
<tr>
<td>Duero</td>
<td>97.600</td>
<td>18.600</td>
<td>19</td>
<td>79.000</td>
<td>81</td>
</tr>
<tr>
<td>Tajo</td>
<td>80.600</td>
<td>24.800</td>
<td>31</td>
<td>55.800</td>
<td>69</td>
</tr>
<tr>
<td>Guadiana</td>
<td>66.800</td>
<td>11.500</td>
<td>17</td>
<td>55.300</td>
<td>83</td>
</tr>
<tr>
<td><strong>TOTAL cuencas</strong></td>
<td><strong>264.560</strong></td>
<td><strong>56.930</strong></td>
<td><strong>22</strong></td>
<td><strong>207.630</strong></td>
<td><strong>78</strong></td>
</tr>
<tr>
<td><strong>TOTAL países</strong></td>
<td><strong>581.000</strong></td>
<td><strong>89.000</strong></td>
<td><strong>64</strong></td>
<td><strong>492.000</strong></td>
<td><strong>42</strong></td>
</tr>
</tbody>
</table>

Áreas em km²
TREATIES EVOLUTION

- LIMIT TREATY OF 1864: it shows that the water resources existing in the border stretches have to be used for mutual benefit without damage to the other part.

- CHANGE OF NOTES OF 1912: gives a set of simple rules for the industrial use of the water in the border stretches, assigning each country with half of the running flow and establishing that a technical project for the water use had to be presented.


- AGREEMENT OF 1964: equal distribution of the hydropower potential of the international stretch of the Douro River. The additional protocol describes the cases of lateral reservoirs and pumps.

- AGREEMENT OF 1968: extends the previous agreement to the others transboundary rivers, studies the possibilities for using lateral reservoirs and contemplates other uses.
RESERVOIR STATUS FROM DUERO R. B.

Portugal

Spain
NEED OF A NEW CO-OPERATION FRAMEWORK

• STRUCTURAL REASONS
  – POLITICAL, SOCIAL AND ECONOMICAL CHANGES
  – NEW FEELINGS ABOUT WATER PROBLEMS

• TECNICAL REASONS
  – CONVENTIONAL FRAMEWORK IS WORN-OUT

• INMEDIATE CAUSES
  – SPAIN ISSUES THE PRELIMINARY DRAFT OF ITS NATIONAL HYDROLOGICAL PLAN
  – INSUFFICIENT THAKE ACCOUNT OF PORTUGAL
  – WATER DEMANDS INCREASING : CLIMATE CHANGE
  – WATER FRAMEWORK DIRECTIVE (DRAFTING)
THE PRINCIPLES OF THE ALBUFEIRA CONVENTION

• Coordination of managing plans and measures programs.- Respect the principles of the Water Framework Directive, coordinating the goals to meet between the two Basin Authorities. There is national liberty to establish and to realize a measures-programme that allows achieving the goals.

• Development of the contents.- Handles about each activity related to the water exploitation including protection of water quality.

• Cooperation.- Is based on four principal elements:
  – Regular and systematic exchange of information
  – Consultations via specific organs
  – Adoption of measures which make possible the homologation of administrative and juridical systems of both countries
  – Flow regime
PRINCIPAL CONTENTS

• Institutional Regime (Articles 20 and 23)
• Exchange of Information (Articles 5, 6 and 7 and Annex I)
• Transborder Impacts (Articles 8 and 9 and Annex II)
• Quality and Pollution (Articles 13 y 14)
• Water uses (Article 15)
• Exceptional Situations (Articles 17, 18 y 19)
• Flow Regime (Article 16, Additional Protocol and Annex)
• Guaranties Regime
MANAGEMENT ORGANS

• In the case of the Albufeira Agreement two organs (Cooperation Organs) were formed with parity compositions and therefore strictly bilateral
  • The Conference of the Parts, with a high political level
  • The Commission for the Development and Application of the Agreement (CADC), with a more technical content

• The fundamental element on which the Commission’s action is based is formed by the Work Groups.

• The participation of civil society in the Commission’s work must be extensive.
FLOW REGIME ANUAL VALUES

<table>
<thead>
<tr>
<th></th>
<th>Miño</th>
<th>3.700 hm³ en FRIEIRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duero</td>
<td>3.500 hm³ en MIRANDA // 3.800 hm³ en SAUCELLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.000 hm³ en CRESTUMA</td>
<td></td>
</tr>
<tr>
<td>Taio</td>
<td>2.700 hm³ en CEDILLO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.000 hm³ en PONTE MUGE</td>
<td></td>
</tr>
<tr>
<td>Guadiana</td>
<td>Valores entre 600 y 300 hm³ en el AZUD DE BADAJOZ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(de acuerdo con la precipitación y situación de embalses)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Además, 2 m³/s continuos en BADAJOZ y en POMARAO</td>
<td></td>
</tr>
</tbody>
</table>

Crestuma: 5.000 hm³
Saucelle: 3.800 hm³
Ponte Muge: 4.000 hm³
Cedillo: 2.700 hm³
Badajoz: 2m³/s
Pomarao: 2m³/s
EXCEPTIONAL CONDITIONS

REFERENCE PRECIPITATION: under threshold levels → special flow regime in this year

<table>
<thead>
<tr>
<th>RIO</th>
<th>PRECIPITACIÓN DE REFERENCIA</th>
<th>FECHA</th>
<th>OBSERVACIONES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIÑO</td>
<td>70 %</td>
<td>1 de july</td>
<td></td>
</tr>
<tr>
<td>DUERO</td>
<td>65 %</td>
<td>1 de junio</td>
<td></td>
</tr>
<tr>
<td>TAJO</td>
<td>60 %</td>
<td>1 de abril</td>
<td>Especial dos años secos</td>
</tr>
<tr>
<td>GUADIANA</td>
<td>variable</td>
<td>1 de marzo</td>
<td>Lluvia y situación de embalses</td>
</tr>
</tbody>
</table>
**ALBUFEIRA CONVENTION: new flow regime (Addenda)**

### SPANISH CONTROL POINT

<table>
<thead>
<tr>
<th>Caudales en la Sección de Aguas Abajo de Cedillo</th>
<th>$hm^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUDAL INTEGRAL ANUAL</td>
<td>2.700</td>
</tr>
<tr>
<td>CAUDAL INTEGRAL TRIMESTRAL</td>
<td></td>
</tr>
<tr>
<td>1 de octubre al 31 de diciembre</td>
<td>295</td>
</tr>
<tr>
<td>1 de enero al 31 de marzo</td>
<td>350</td>
</tr>
<tr>
<td>1 de abril al 30 de junio</td>
<td>220</td>
</tr>
<tr>
<td>1 de julio al 30 de septiembre</td>
<td>130</td>
</tr>
<tr>
<td>CAUDAL INTEGRAL SEMANAL</td>
<td>7</td>
</tr>
</tbody>
</table>

### PORTUGUESE CONTROL POINT

<table>
<thead>
<tr>
<th>Caudales de la Subcuenca Portuguesa entre Cedillo y Pontemuge</th>
<th>$hm^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUDAL INTEGRAL ANUAL</td>
<td>1.300</td>
</tr>
<tr>
<td>CAUDAL INTEGRAL TRIMESTRAL</td>
<td></td>
</tr>
<tr>
<td>1 de octubre al 31 de diciembre</td>
<td>150</td>
</tr>
<tr>
<td>1 de enero al 31 de marzo</td>
<td>180</td>
</tr>
<tr>
<td>1 de abril al 30 de junio</td>
<td>110</td>
</tr>
<tr>
<td>1 de julio al 30 de septiembre</td>
<td>60</td>
</tr>
<tr>
<td>CAUDAL INTEGRAL SEMANAL</td>
<td>3</td>
</tr>
</tbody>
</table>
CUENCA DEL TAJO INTERNACIONAL

RÉGIMEN DE CAUDALES ANUALES DEL CONVENIO DE ALBUFEIRA EN CEDILLO

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Apantallaje mínimo CA (hm³)</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
<td>2700</td>
</tr>
<tr>
<td>Embalse de Cedillo</td>
<td>17532</td>
<td>3565</td>
<td>9890</td>
<td>8467</td>
<td>2710</td>
<td>2779</td>
<td>8101</td>
<td>3701</td>
<td>2295</td>
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ALBUFEIRA CONVENTION

CUENCA DEL TAJO INTERNACIONAL

RÉGIMEN DE CAUDALES ANUALES DEL CONVENIO DE ALBUFEIRA EN CEDILLO

SITUACIÓN: 31/01/2011

<table>
<thead>
<tr>
<th>SEMANA</th>
<th>D.E.</th>
<th>VOLUMEN SEMANAL (hm³)</th>
<th>CÓMPROMISO SEMANAL (hm³)</th>
<th>VOLUMEN TRIMESTRAL ACUMULADO</th>
<th>APORTACIONES ACUMULADAS</th>
<th>PRECIPITACIÓN</th>
<th>% DE LA PRECIP. ACUMULADA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27-sep</td>
<td>0,3</td>
<td>0,3</td>
<td>0,3</td>
<td>0,3</td>
<td>0,3</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>28-sep</td>
<td>0,3</td>
<td>0,3</td>
<td>0,3</td>
<td>0,3</td>
<td>0,3</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>04-oct</td>
<td>0,3</td>
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VOLUMEN ANUAL COMPRIMETRICO: 2,700 hm³
ALBUFEIRA CONVENTION: Article 18 Floods (I)

1. The Parties shall co-ordinate their actions and create exceptional mechanisms to minimise the effects of floods.

2. Flood warning situations shall be declared upon request of the affected Party and shall be maintained as long as necessary. Whenever one Party ascertains the existence of a situation which may cause flooding in the other Party's territory, it shall immediately convey this information to the previously determined competent authorities in accordance with the procedures agreed upon.

The Parties shall agree to transmit promptly, during flood warnings situations, the available data on precipitation, river flows and water levels, and with regards to reservoir storages and their operational conditions, in order to support the adoption of the most adequate management strategies and the co-ordination of these strategies. During flood warning situations, the affected Party may require the other Party to adopt the foreseen measures or any other measures deemed necessary to prevent, eliminate, mitigate, or control the effects of the flood.
ALBUFEIRA CONVENTION: Article 18 Floods (II)

6. The Parties shall provide the Commission with information on the actions requested and undertaken so that it may assess the results obtained and propose any corrections deemed appropriate.

7. The Parties within the Commission shall undertake joint studies on floods to establish the measures required to mitigate their effects, particularly the rules for operating the relevant hydraulic infrastructures in flood situations. These rules shall be drafted within a period of two years, which may be extended by special agreement between the Parties.
JOINT STUDIES on FLOODS

Joint study in order common implementation of new shared control points
DATA EXCHANGE COMUNICATION PROTOCOL (April 2003)

Data exchange every 15 min. via FTP through the internet

INAG Portugal

SAIH Tajo Spain

Global Water Partnership

WORKSHOP ON FLOODS IN TRANSBOUNDARY CONTEXT Zagreb, November 2011
DATA EXCHANGE

**SPAIN (CHT) → PORTUGAL (INAG)**

- Los datos que se transmitirán de CHT a INAG serán:
  - Reservoirs data:
    - B → Hydropower flow (m3/s)
    - S → Total outflow (m3/s)
    - U → Inflow (m3/s)
    - Y → Reservoir volume (Hm3)
  - From reservoirs:
    - E_30 VALDECAÑAS
    - E_31 TORREJON-TAJO
    - E_31 TORREJON-
    - E_36 GABRIEL Y GALAN
    - E_39 VALDEOBISPO
    - E_45 ALCANTARA
    - E_47 CEDILLO
  - Flows
    - A005 VALENCIA ALCANTARA
  - Raingages:
    - P_58 ARROYO DEL ARQUIJO
    - P_60 SIERRA DEL SALIO
    - P_61 ALTO DEL REY
    - E_43 RIVERA DE GATA
    - E_45 ALCANTARA
    - E_47 CEDILLO
DATA EXCHANGE

PORTUGAL (INAG) → SPAIN (CHT)

• Los datos que se transmitirán de INAG a CHT serán:
• Reservoirs data:
  – Storage volume.
  – Inflow
  – Hydropower
  – Outflow
• From reservoirs:
  • EP01 FRATEL
  • EP02 PRACANA
  • EP03 CASTELO DE BODE
  • EP04 BOUCA
  • EP05 CABRIL
• Flows (flow gages or calculated) and water levels:
  • AP01 SEGURA
  • AP02 BEIRA
  • AP03 ABRANTES
  • AP04 TRAMAGAL
  • AP05 ALMOUROL
  • AP06 OMNIAS
• Raingages:
  • PP01 PINHEL
  • PP02 PEGA
  • PP03 COVILHA
  • PP04 REGO DA MURTA
  • PP05 VILA VELHA DE RODAO
  • PP06 CASTELO DE VIDE
  • PP07 MONFORTE
Main measures deemed necessary control the effects of the flood.
CHT (Spain) → Civil Protection Sp

INAG (Portugal) → Civil Protection Pr

If necessary according with theirs respective regulations

National Civil Protection

Government Sp

Government Pr

INSTITUTIONAL PROTOCOL

NATIONAL EMERGENCY
Floods event 19 February 1 March 2010

AGREEMENT ON COOPERATION FOR THE PROTECTION AND SUSTAINABLE EXPLOITATION OF THE WATERS FROM THE SPANISH-PORTUGUESE HYDROGRAPHIC BASINS
Predicción de precipitación, del domingo 21 de febrero al martes 2 de marzo

Titular: Confederación Hidrográfica del Tajo. Prohibida la distribución a terceros.

Las predicciones de cada día corresponden a la precipitación acumulada entre las 07 UTC de ese día y las 07 UTC del día siguiente. (Hora Peninsular: Invierno UTC+01; Verano UTC+02)
Set off

• As early as possible

• Information exchange Instituto Nacional D’Agua de Portugal → maximum flows in the border

• Set up of Basin Reservoir Committee
  → warning to dams operators
  → releasing water in advance
Large dam in Spanish Low Tagus basin
Transboundary flow control: main dams

- Alcántara: 924hm³
- Gabriel y Galán: 3,162hm³
- Cedillo: 260hm³
- Rosarito: 85hm³
- Borbollón: 85hm³
- Valdecañas: 1,446hm³
- Torrejón: 196hm³
Meteorological monitoring
Areal rain calculated from data in real time (SAIH)
Areal rain calculated from data in real time (SAIH) Event Summary
Inflow expected and dams management

MANAGEMENT RESERVOIR CONDITIONS
- No exceed dam’s safety level
- No damages downstream (maximum outflows)

Flows upstream controlled
Left side tributaries

Gabriel y Galán
924hm³

Alcántara
3,162hm³

Cedillo
260hm³

Borbollón
85hm³

Torrejón
196hm³

Rosarito
85hm³

Valdecañas
1,446hm³
Hydrological modeling forecast
Floods event 19 February 1March 2010
Final results in trans boundary body
EMBAL SE DE ALCANTARA

CAUDAL TOTAL DE ENTRADA
CAUDAL TOTAL DE SALIDA

chart by amCharts.com
### Storage evolution of main reservoirs in Spanish low Tagus

#### Table 1: Volumen Último de Cada Día (Hm³) and % Llenado

<table>
<thead>
<tr>
<th>Date</th>
<th>Cedillo</th>
<th>% Llenado</th>
<th>Alcántara</th>
<th>% Llenado</th>
<th>Valdecanas</th>
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<td>19/02/2009</td>
<td>213.044</td>
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<td>2693.850</td>
<td>85%</td>
<td>1151.820</td>
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<td>1147.410</td>
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<td>2776.260</td>
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<td>23/02/2009</td>
<td>227.240</td>
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<tr>
<td>01/03/2009</td>
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<td>2783.340</td>
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#### Table 2: Volumen Último de Cada Día (Hm³) and Diferencia

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En el Tajo Bajo e Internacional, además de las intensas precipitaciones de su propia cuenca, confluyen los caudales desagados del resto de sistemas antes indicados, con la condición de contorno de limitar los caudales desagados hacia Portugal en evitación de daños en dicho país.

en trimestre diciembre-febrero:
o Aportación a Alcántara: 4.226 hm³
o Incremento de Vol. Almacenado en Valdecañas: 633 hm³
o Volumen desagado en Alcántara: 2.739 hm³
o Aportación a Cedillo: 4.064 hm³
o Volumen desagado en Cedillo a Portugal: 4.064 hm³
o Caudal máximo desagado en Cedillo: 3.000 m³/s

Flood smooth
La regulación española del Tajo ha reducido de 6.000 m³/s a 3.000 m³/s el caudal que hubiera tenido el Tajo en su entrada a Portugal.
FLOOD MANAGEMENT PHASES

Meteorological forecast → warning
Reservoir Committee set up → dams management in advance → operational level establishment
Continuous information interchange INAG CHT → references flows to Portugal (damages)
INAG → Civil Protection (Santarem city)
Meteorological forecast and monitoring in real time (SAIH)
Hydrological simulation → coordinated dam’s management
End of event. Analysis Reporting
Arguments?

• Hydropower complaints (both in Sp and Pr)
  – Reduction of potential production and cost of the energy of replacement (central power station)

• Discussion: safety levels in dams (Sp) versus damage mitigation downstream (Pr)

• Discussion: economic contribution downstream to the maintenance (Pr) of regulation's infrastructures (Sp) (It does not exist at the present)

• Bad management of reservoirs (rarely)
Flood Risk Management in Spain:

flood control in transboundary rivers

III. Directive 2007/60/EC on assessment and risk flood management
In Europe 40 of the 110 River Basin Districts are International River Basin Districts.

More than 60% of the EU territory is located in international River Basin Districts.
Water Framework Directive 2000/60/EC

- Prevents further deterioration
- Protects aquatic ecosystems
- Enhanced protection of aquatic environment
- To promote a sustainable use of water
- Improve water quality: reduction of discharges
- Improve of water bodies status

Mitigation of effects of drought and floods

Good Status Water Bodies → 2015
Directive on Flood Risk Management

• Mitigation of consequences of floods is a objective of 2000/60/EC known as WFD - Art. 1(e)- but the directive doesn't develop this issue. A specific directive could fill up this lack

• Should bring a common understanding of this phenomenon (taking into account particularities of countries or sub-regions)

• Elaboration of risk maps with common criteria that facilitate their interpretation

• Greater transparency on land management

• Under the perspective of a better knowledge of risks for the location of different land uses

• The Directive shall be carried out in coordination with the Water Framework Directive, through coordination of the public participation procedures in the preparation of the RBMP.
Directive 2007/60/EC on assessment and risk flood management

FLOOD RISK MANAGEMENT DIRECTIVE
- Risk preliminary assessment
- Hazard maps
- Risk maps
  - Inhabitants affected
  - Economic damages
- Flood Risk Management Plans
Flood Risk Management Plans

- Inspired by principles of prevention, protection, preparedness, early warning systems

- Where an international river basin district, or unit of management referred to in Article 3(2)(b), falls entirely within the Community, Member States shall ensure coordination with the aim of producing one single international flood risk management plan, or a set of flood risk management plans coordinated at the level of the international river basin district. Where such plans are not produced, Member States shall produce flood risk management plans covering at least the parts of the international river basin district falling within their territory, as far as possible coordinated at the level of the international river basin district.

- Where an international river basin district, or unit of management referred to in Article 3(2)(b), extends beyond the boundaries of the Community, Member States shall endeavour to produce one single international flood risk management plan or a set of flood risk management plans coordinated at the level of the international river basin district; where this is not possible, paragraph 2 shall apply for the parts of the international river basin district falling within their territory.
Directive 2007/60/EC on assessment and risk flood management

To be taken into account in FRM Plans:

- Costs and benefits
- Flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains,
- Environmental objectives,
- Soil and water management,
- Spatial planning, land use, nature conservation
- Navigation and port infrastructure.
**Directive 2007/60/EC on assessment and risk flood management**

Implementation schedule

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<thead>
<tr>
<th>Activity</th>
<th>Completed at Date</th>
<th>Update * at Date</th>
<th>Review * at Date</th>
</tr>
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<tbody>
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<td>Preliminary Assessment / Identification of risk areas</td>
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<td>22/12/21</td>
<td>Every six years</td>
</tr>
<tr>
<td>Potential and risk maps</td>
<td>22/12/13</td>
<td>22/12/21</td>
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<tr>
<td>Risk Management Plan</td>
<td>22/12/15</td>
<td>22/12/21</td>
<td>Every six years</td>
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*The review of these plans can be integrated into the revision of the River Basin Management Plans*
95/308/EC: about Helsinki Convention

- **COUNCIL DECISION** of 24 July 1995 on the conclusion, on behalf of the Community, of the Convention on the protection and use of transboundary watercourses and international lakes (95/308/EC):

  - Article 1: The Convention on the protection and use of transboundary watercourses and international lakes is hereby approved on behalf of the European Community.

- The Directive 2007/60/EC should contribute to put into practice the communitarian obligations, particularly on the protection and use of transboundary watercourses and international lakes.
Flood Risk Management in Spain: Flood Risk Management in Spain: Flood control in transboundary rivers

IV. Conclusions
Conclusions (1/2)

- It is necessary to develop a **long-term strategy** in order to reduce territory vulnerability. Keys:
  - Preparedness. Prevention and mitigation measures
  - Early warning systems
  - Civil protection plans

- At long time preventive measures are economic and ecological more efficient. But some times structural solutions could be required.
  - Dams play a important role dealing with flood management in Spain. Must be operated in a adequate way for a successful flood management

- **Land use allocation** should be treated with a proper approach, according to **risk criteria**. Coordination among different authorities (territory management, municipalities, civil protection, water authorities...) is required

- **Flood risk maps** could provide a important information for a appropriate **land planning**
  - Greater transparency on land management under the perspective of a better knowledge of risks for the location of different activities
Conclusions (2/2)

- **International rivers** Flood Risk Management Plans should be **coordinated** at basin level
- **International river basin district** shall ensure coordination producing one **single international flood risk management plan**, or a set of flood risk management **plans coordinated** at the level of the international river basin district.

- To be taken into account in FRM Plans:
  - Flood extent and flood conveyance routes and areas which have the potential to retain flood water, such as natural floodplains,
  - Environmental objectives,
  - Soil and water management, spatial planning, land use, nature conservation
  - Appropriate coordination in management of hydraulic infrastructures in order to mitigate the effects of the floods
Thank you for your attention!

Eng. Justo MORA MUÑOYERRO
Technical Director
Tajo River Basin Authority – Spain
justo.mora@chtajo.es