Instituto de Ingeniería del Agua y Medio Ambiente

UNIVERSIDAD POLITECNICA DE VALENCIA

# Riparian vegetation modelling for the assessment of environmental flow regimes and climate change impacts within the WFD (RIPFLOW)

**By: Prof. Félix Francés**

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**Project Coordinator**
**http://lluvia.dihma.upv.es**

Regional and national research programmes network on iwrm-net Integrated Water Resource Management

# The Consortium & key personnel

- **Technical University of Valencia (Spain)**
  - Research Institute of Water Engineering and Environment: **Félix Francés** (coordinator)
  - Research Institute for Integrated Management of Coastal Zones: **Francisco Martínez-Capel**

- **Technical University of Lisbon (Portugal)**
  - Instituto Superior de Agronomia: **Teresa Ferreira**
  - Instituto Superior Técnico: **António Pinheiro**

- **Umweltbüro Klagenfurt (Austria): Gregory Egger**

# Background

- Riparian ecosystems are important by their self and for their ecological services.

- They are connected with rivers ➔ be taken into account in the rivers ecological status evaluation, in a wide sense or from the WFD point of view.

- To accomplish this evaluation in the long-term, it is necessary to have a tool capable to predict the riparian vegetation response to its driving forces, as far as these drivers will or can change in the future.

# Project objectives

- Scientific objective: to develop a flexible dynamic model of riparian habitats and vegetation to be easily applied in a wide range of conditions across Europe.

- Application to some case studies of the countries involved in this project (Austria, Portugal and Spain):
  - Validate the model (present conditions)
  - Practical objective: assess the impact of future scenarios:
    - Climate change
    - Water management decisions

# Contribution to ERA-NET IWRM Call

- Focused project
- Three research bids in the topic: “Hydrological and morphological pressures and impacts on ecological status”
  - Deliver techniques to understand and manage the impacts of altered hydrology
  - Development of tools/methodologies to asses the “ecological flow regime” of rivers
  - Deliver tools that support decision-making and policy development in extreme events

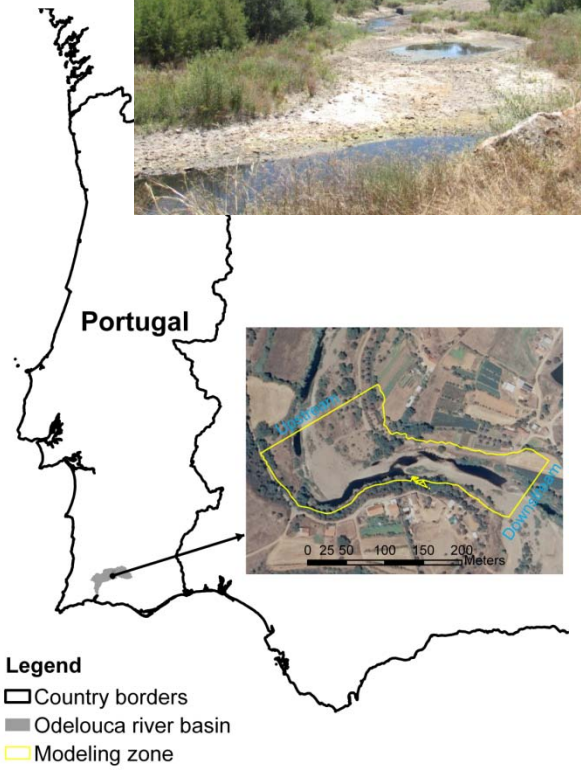
# Work packages

- WP 1: Project coordination
- WP 2: Generating scenarios
- WP 3: Development of RIPFLOW model
- WP 4: Field data acquisition and processing
- WP 5: Model application to case studies

# Case studies: Portugal

- Odelouca River:

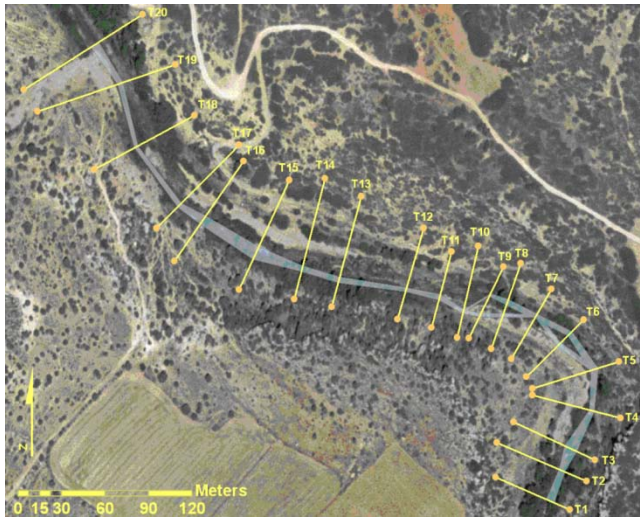
- Typical Mediterranean river
- **Non-permanent** flow regime
- **No flow regulation** upstream
- Near natural conditions (human pressure and riparian vegetation)



# Case studies: Spain

- Terde reach at the Mijares River:

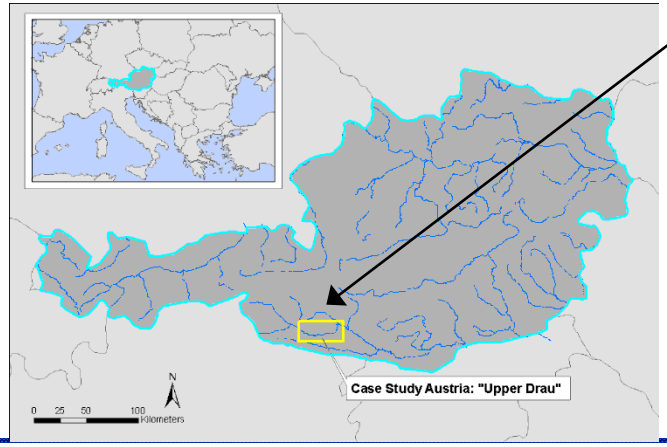
  - **Permanent** flow regime
  - **No flow regulation** upstream
  - Near natural conditions



# Case study: Austria

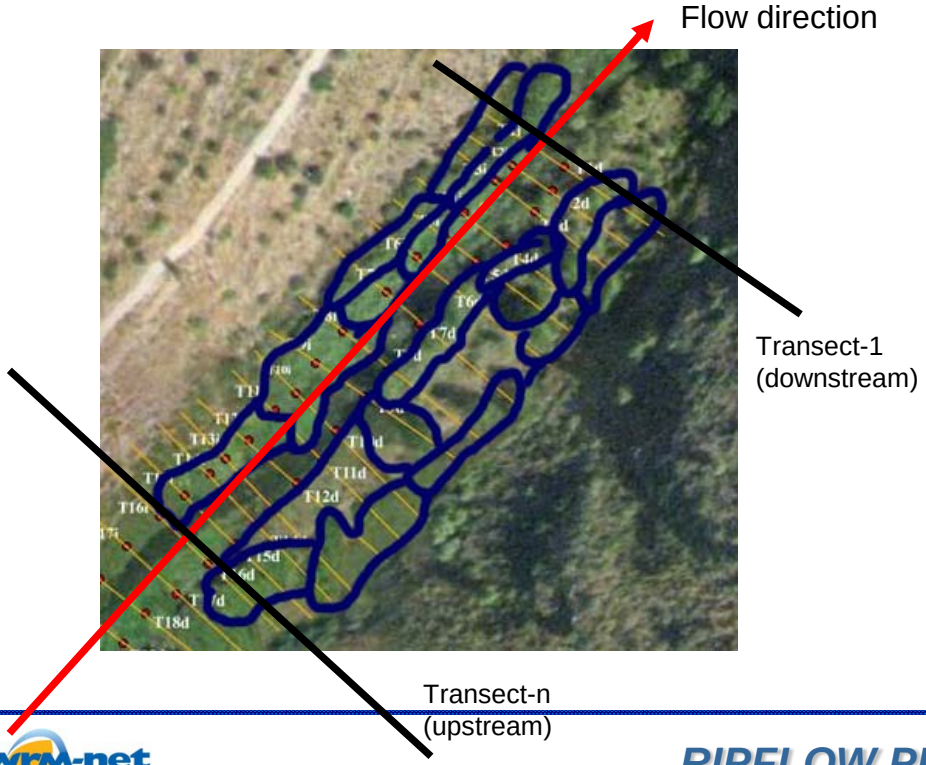
- Upper Drau River:

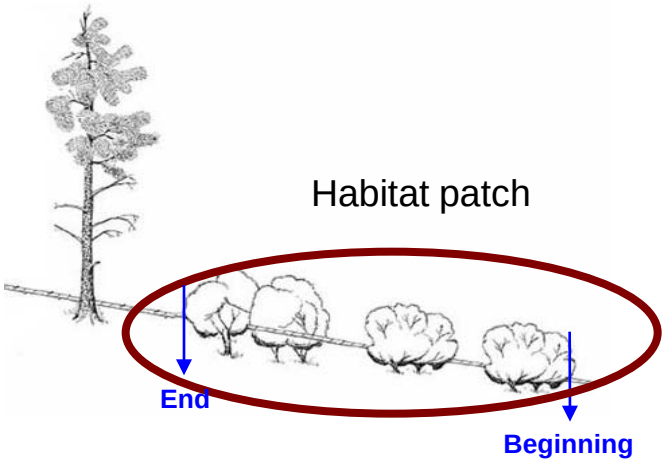
  - Typical **alpine river**
  - **Permanent** flow regime
  - No flow regulation upstream
  - **Channelized** in the1970s, **restored** in 2002



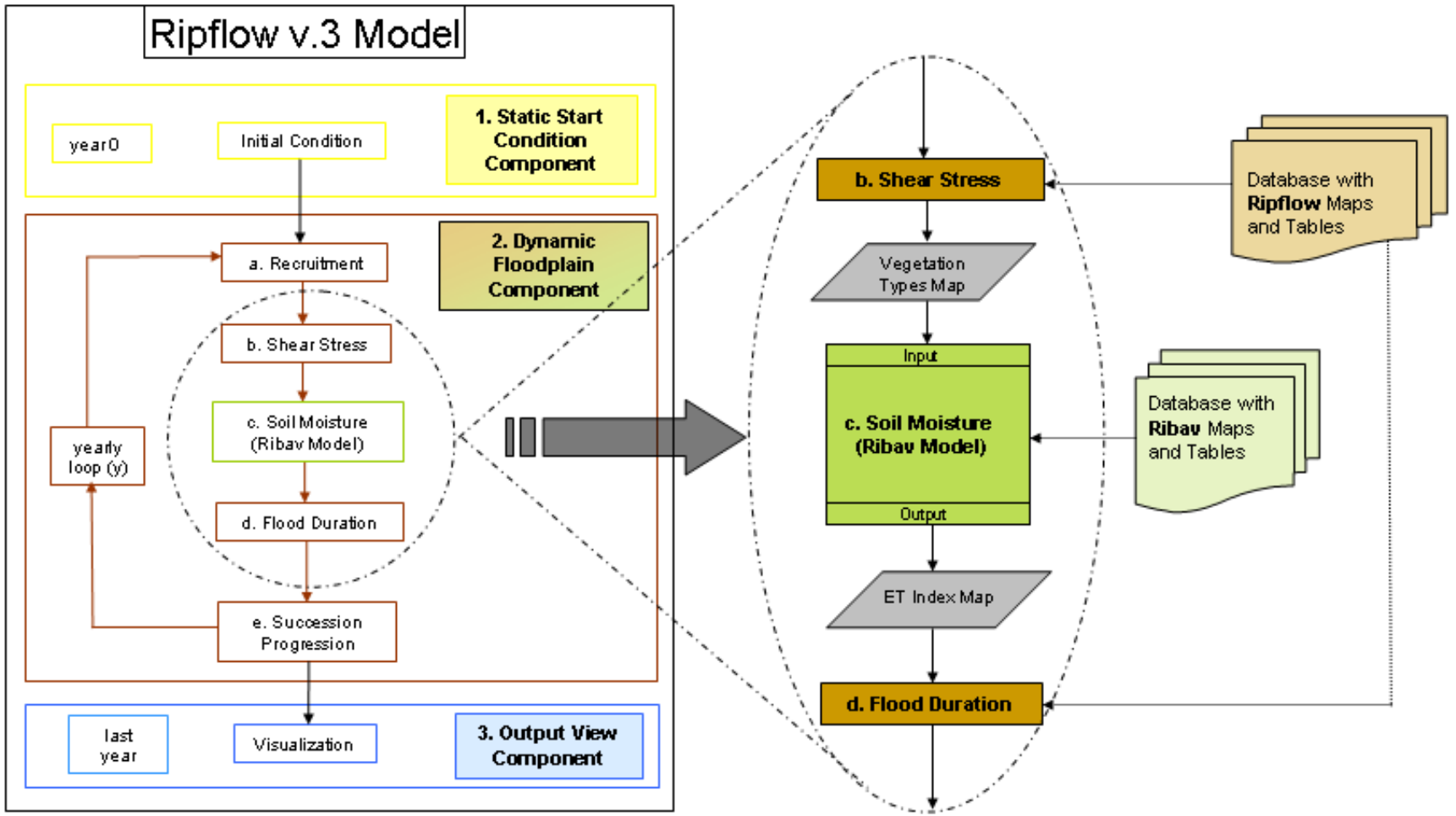
# Field data acquisition

- Topography survey
- Hydrometry for calibrating Hydraulic Model – 2D
- Vegetation survey by **habitat patches**
- Soils Sampling → Texture and O.M.

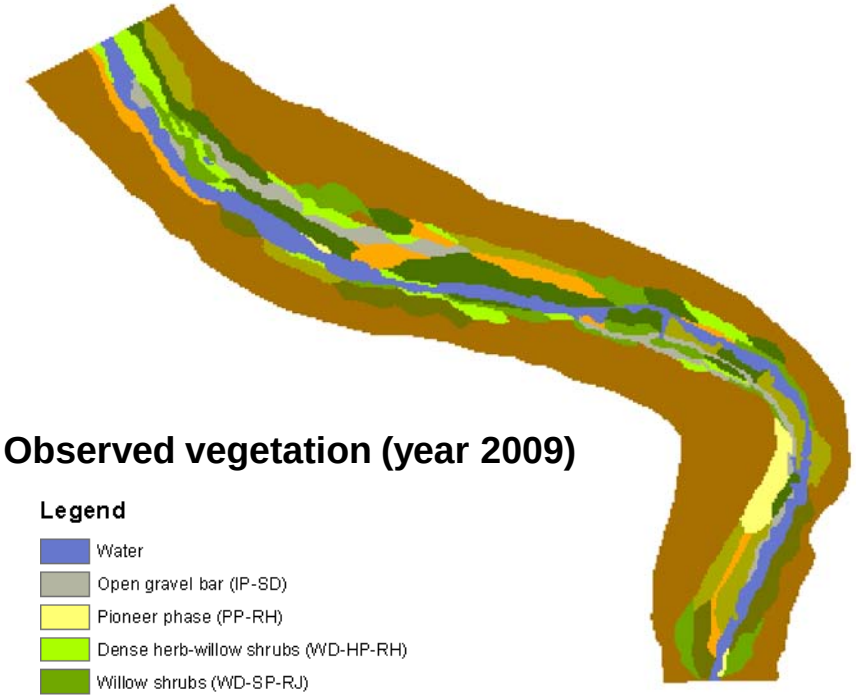


# Develop. of RIPFLOW v3 model



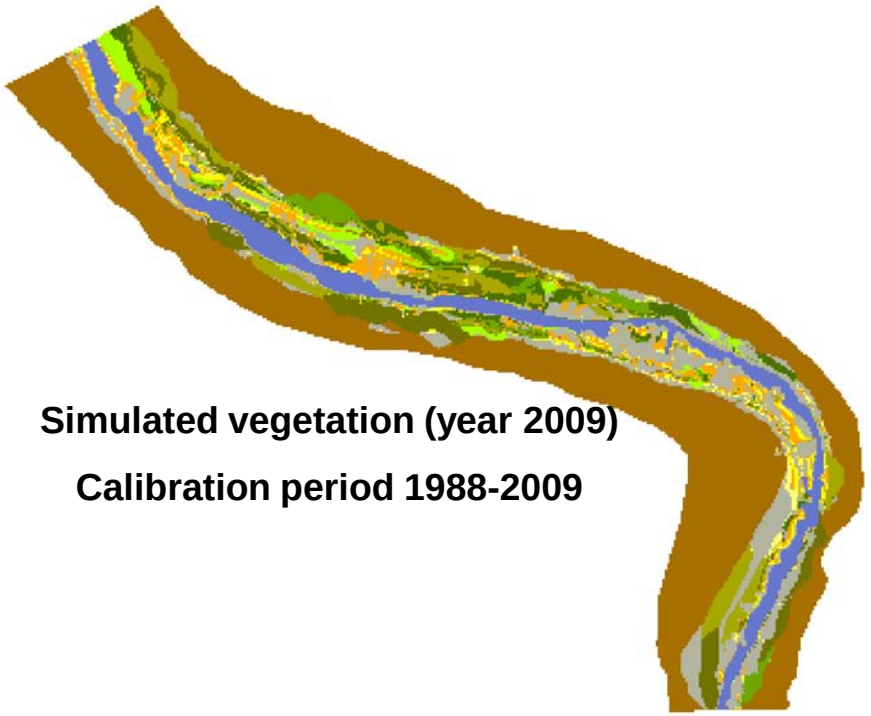
# Model calibration: Terde



**Observed vegetation (year 2009)**

Legend

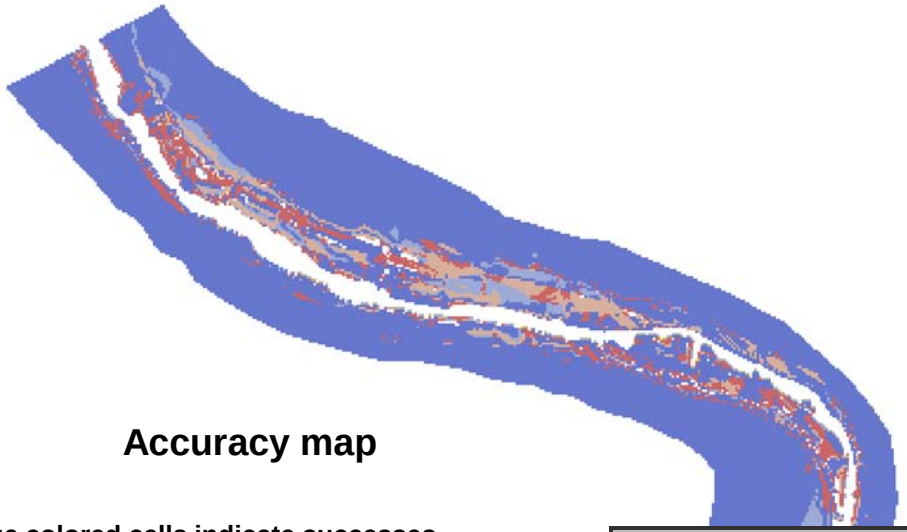
- Water
- Open gravel bar (IP-SD)
- Pioneer phase (PP-RH)
- Dense herb-willow shrubs (WD-HP-RH)
- Willow shrubs (WD-SP-RJ)
- Young willow and poplar forest (WD-ES-RA)
- Old willow and poplar forest (WD-EF-RA)
- Trees Caducifolius - Coniferous (WD-MS-RA)
- Oak forest (WD-UF-TV)
- Herbs-Reed (RE-HP-RH)
- Reed-Willow shrubs (RE-SP-RH)



**Simulated vegetation (year 2009)**

**Calibration period 1988-2009**

# Model calibration: Terde



**Accuracy map**

**-Blue colored cells indicate successes between observed and simulated vegetation**

**-Red colored cells indicate high differences between observed and simulated vegetation**

## Calibration results:

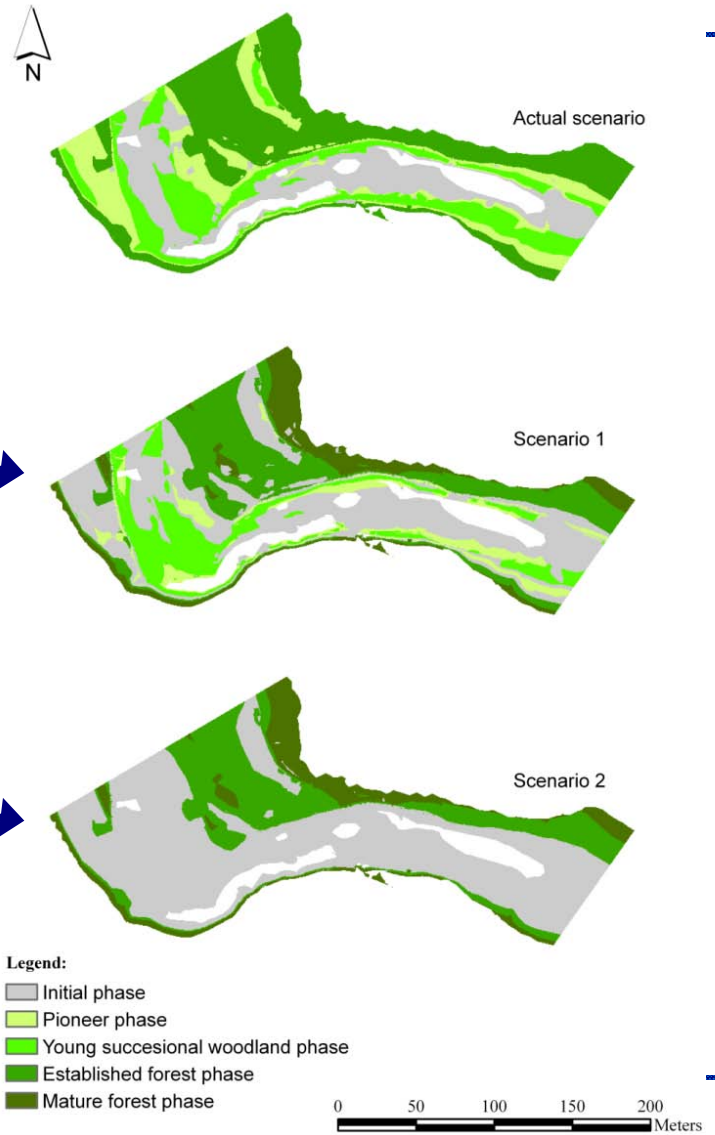
**Kappa coefficient = 0.7127 ± 0.00675 (95% confidence limit)**

| Confusion Matrix | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | IP-SD | PP-RH | WD-HP-RH | WD-SP-RJ | WD-ES-RA | WD-EF-RA | WD-MS-RA | WD-UF-TV | RE-HP-RH | RE-SP-RH |
| IP-SD | 2952 | 230 | 190 | 104 | 98 | 62 | 0 | 0 | 338 | 958 |
| PP-RH | 426 | 93 | 0 | 0 | 0 | 0 | 0 | 0 | 151 | 56 |
| WD-HP-RH | 107 | 25 | 520 | 57 | 18 | 47 | 6 | 0 | 50 | 79 |
| WD-SP-RJ | 241 | 1 | 0 | 631 | 33 | 65 | 66 | 0 | 15 | 59 |
| WD-ES-RA | 80 | 1 | 5 | 1 | 752 | 568 | 336 | 0 | 31 | 67 |
| WD-EF-RA | 23 | 10 | 0 | 0 | 0 | 1240 | 226 | 0 | 14 | 11 |
| WD-MS-RA | 14 | 2 | 0 | 0 | 0 | 0 | 1119 | 0 | 2 | 0 |
| WD-UF-TV | 187 | 0 | 0 | 0 | 0 | 0 | 0 | 17882 | 0 | 0 |
| RE-HP-RH | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 8 |
| RE-SP-RH | 279 | 44 | 43 | 69 | 153 | 6 | 0 | 0 | 23 | 286 |

# Climate change scenarios: Odelouca

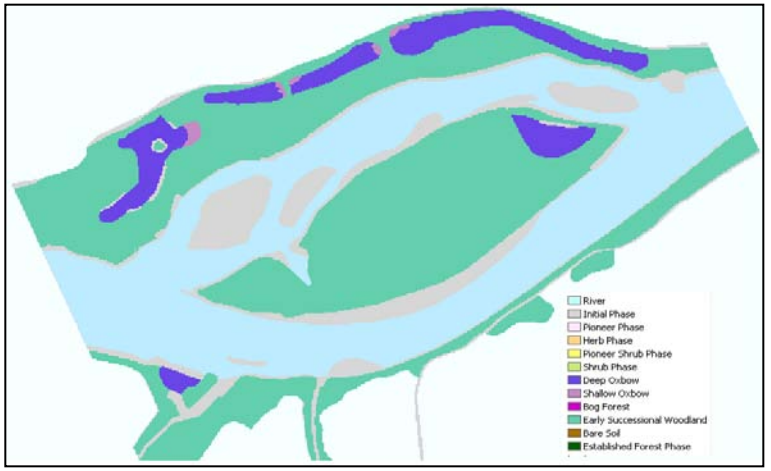
**Scenario 1**: 50% increase in winter floods intensity with a reduction of 1m in the water table)

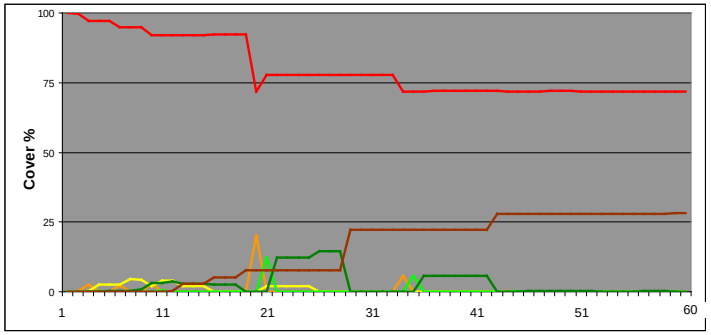
**Scenario 2**: 130% winter flood intensity increase with the lowering of about 4 meter of the water table



# Management scenarios: Upper Drau

Two scenarios have been performed to find out the effect of channel geometry on habitats for riparian vegetation.




Scenario 1: “Small In-Stream Bars”: narrow and deep side channel and small in-stream bars:

- Little succession phases turnover
- Prevailing of recycling processes

# Management scenarios: Upper Drau

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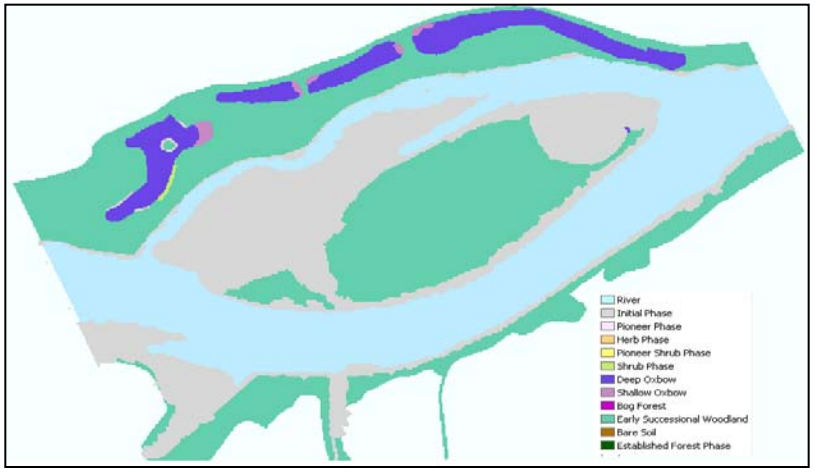
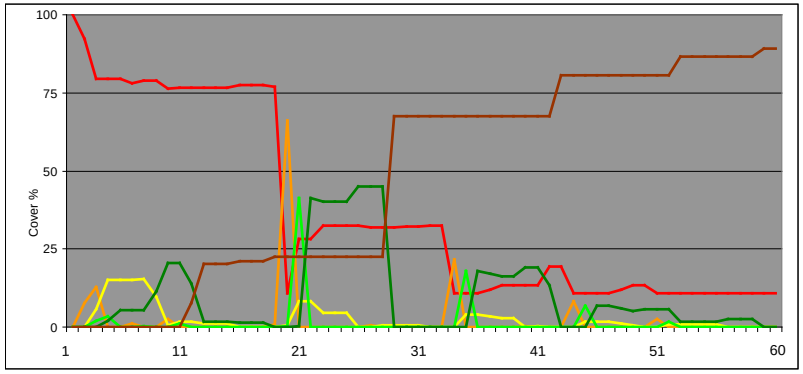



Scenario 2: “Large In-Stream Bars”: wide and less deep side channel and large in-stream bars:

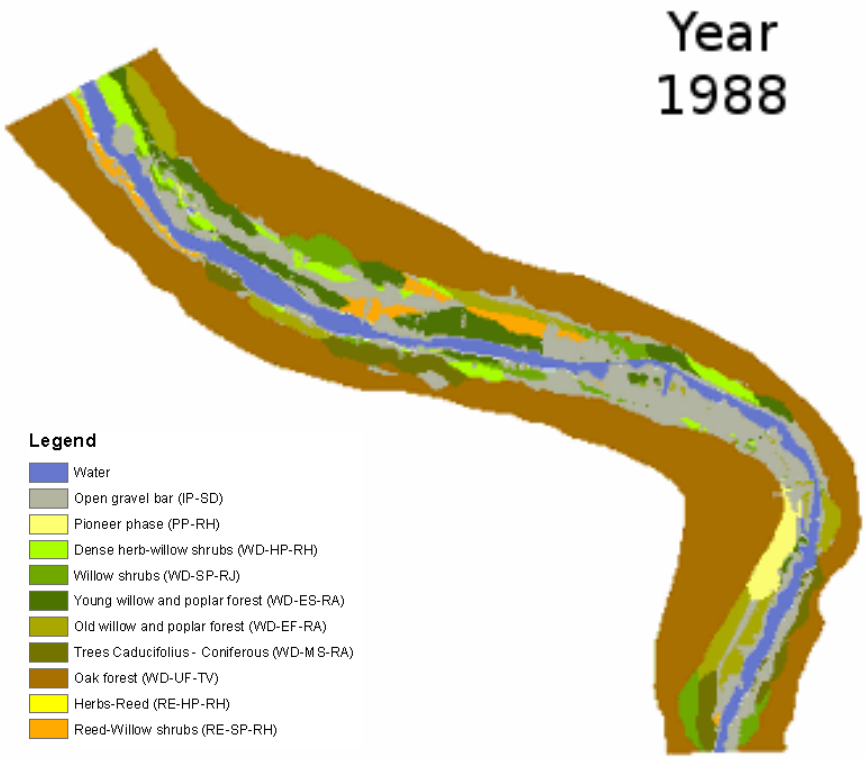
- Succession phases turnover limited in time
- Prevailing of succession processes

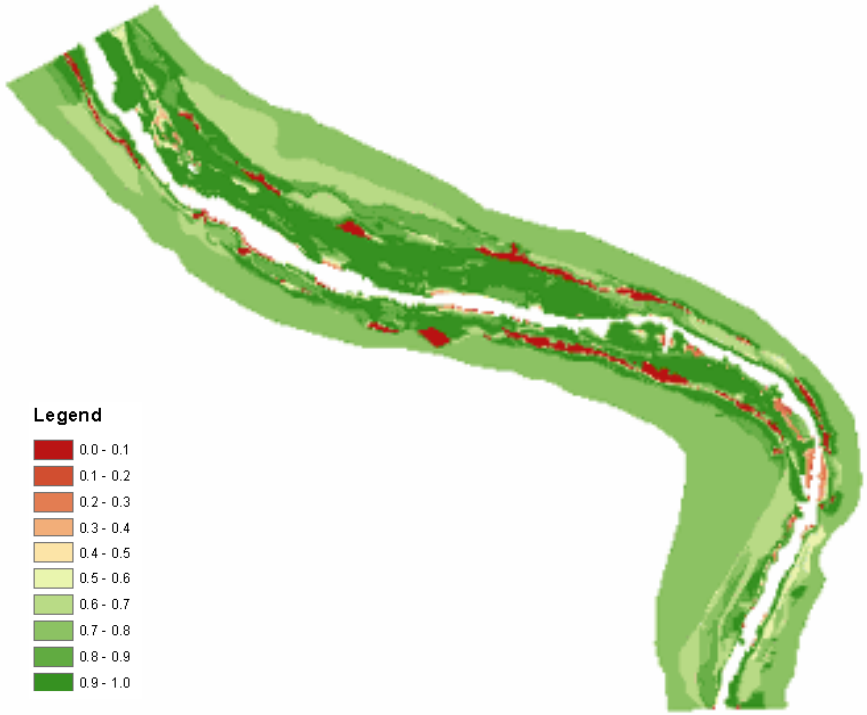
# Transferring results

- RIPFLOW program and the Final Report (project web: *http://www.iiama.upv.es/RipFlow/index.htm*
- Local seminars oriented to end-users
  - II Seminar in River Restoration, Portugal, March 2011
  - To be organized in Spain
- Congress presentations and Scientific publications
- Organization of congress Special Sessions
  - EGU General Assembly in Vienna, April 2011 "**An overview of present riparian vegetation modelling: different approaches for different problems?"**
  - IAHR Congress, June 2011, Brisbane
  - EcoHydraulics 2012, Vienna

# Dynamic vegetation simulation

## 1988 – 2009 inTerde (Mijares River, Spain)




**Succession Phases**

**ETidx**