Directions in Watershed modelling

Modelling of temporary streams in the Mediterranean

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2nd International SWAT Conference

Water Quality Protection and Management
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University of Hannover

Presentation overview

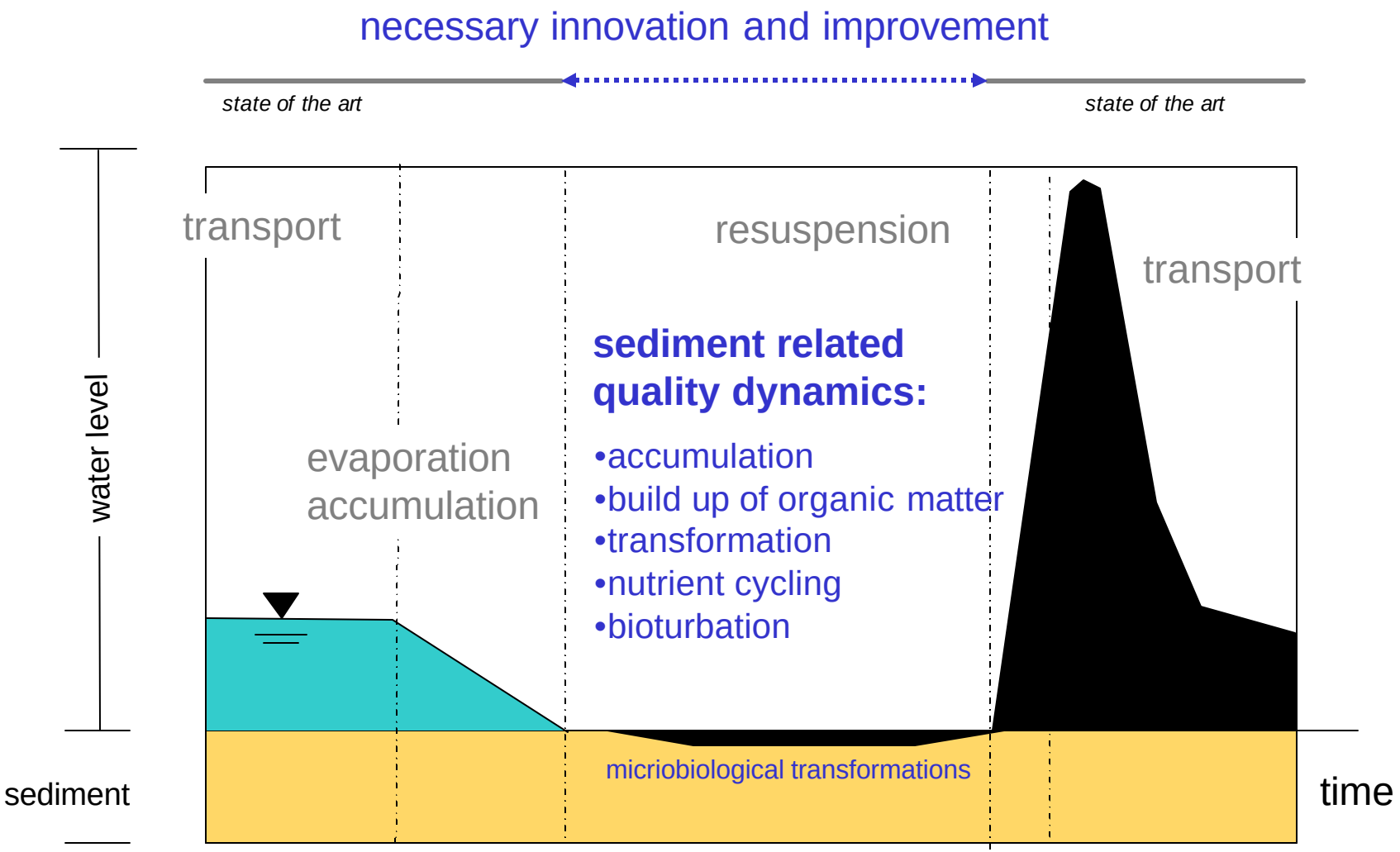
Introducing the problem

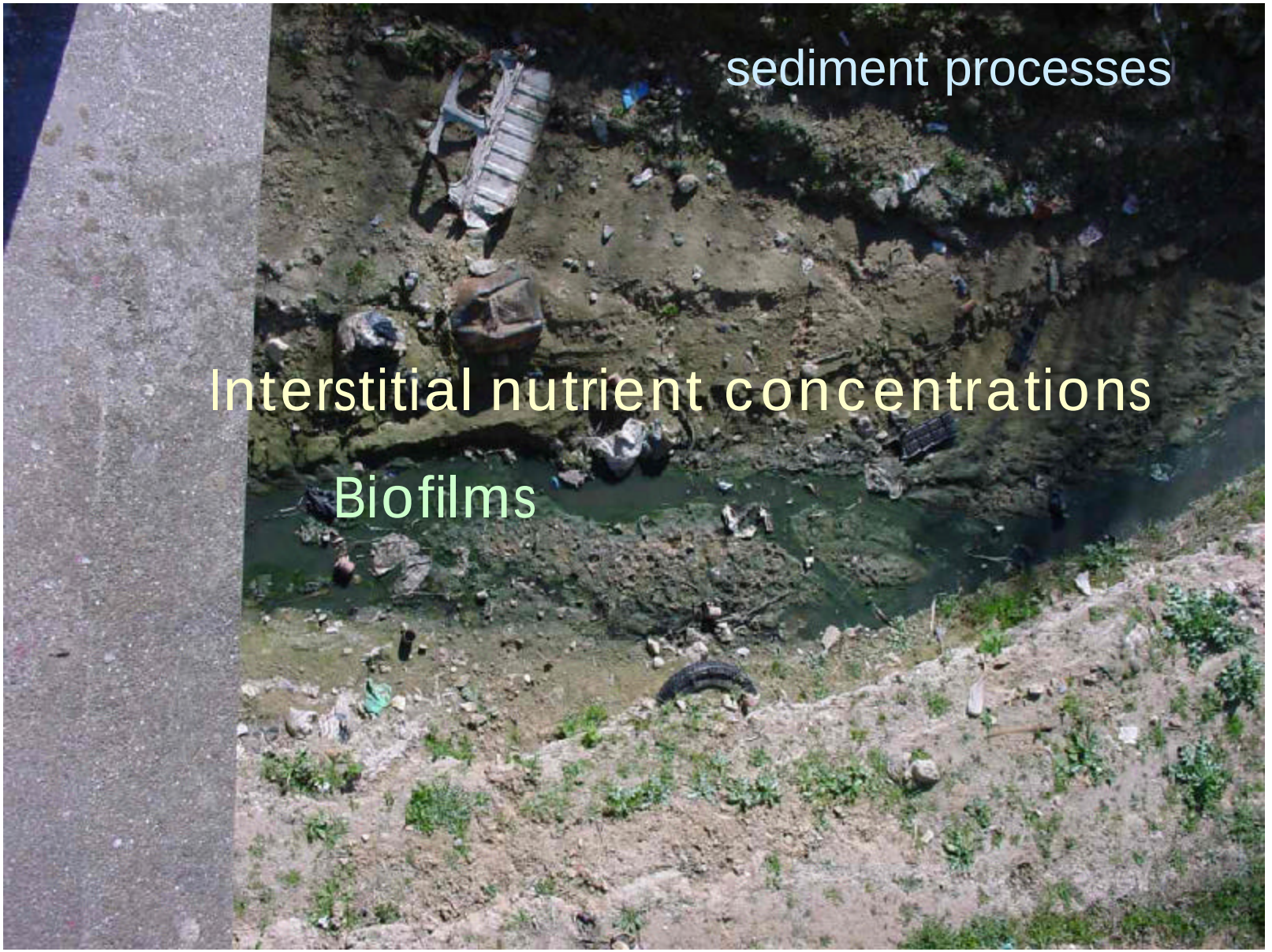
Introduction of the EU project tempQsim

- general aspects
- current activities
- SWAT related activities
- actual conclusions

Outline of future priorities

idealized seasonal sequence




sediment processes
Interstitial nutrient concentrations
Biofilms

tempQsim

Evaluation and improvement of water quality models
for application to temporary waters
in Southern European catchments

ENERGY, ENVIRONMENT
AND SUSTAINABLE DEVELOPMENT

EVK1-CT-2002-00112

Objectives tempQsim

- To define **requirements** to be met by water quality models
- To develop and test **hydrological modules**
- To develop and adjust **sediment modules**
  to assess accumulation, resuspension and transformation processes
- To modify and improve **water quality models**
- To apply and verify the modified models

Basic information tempQsim

- duration: Nov 2002 - Oct 2005

- 14 participants (9 countries)

Univ. Hannover	Germany	MSEM	France
CEH Wallingford	UK	UACEG Sofia	Bulgaria
TUC Crete	Greece	NCMR	Greece
EAWAG	Switzerland	Hydrocontrol	Italy
IMAR	Portugal	Univ. Essen	Germany
IRSA	Italy	Univ. Leeds	UK
CSIC	Spain	EC JRC-ISPRA	Italy

- part of the CATCHMOD cluster

Workpackages tempQsim

Assessment:
current and improved models

Process analysis:
Hydrology and water quality dynamics
at flow periods

Process analysis:
Channel bed processes

programming tempQsim modules and
model improvement

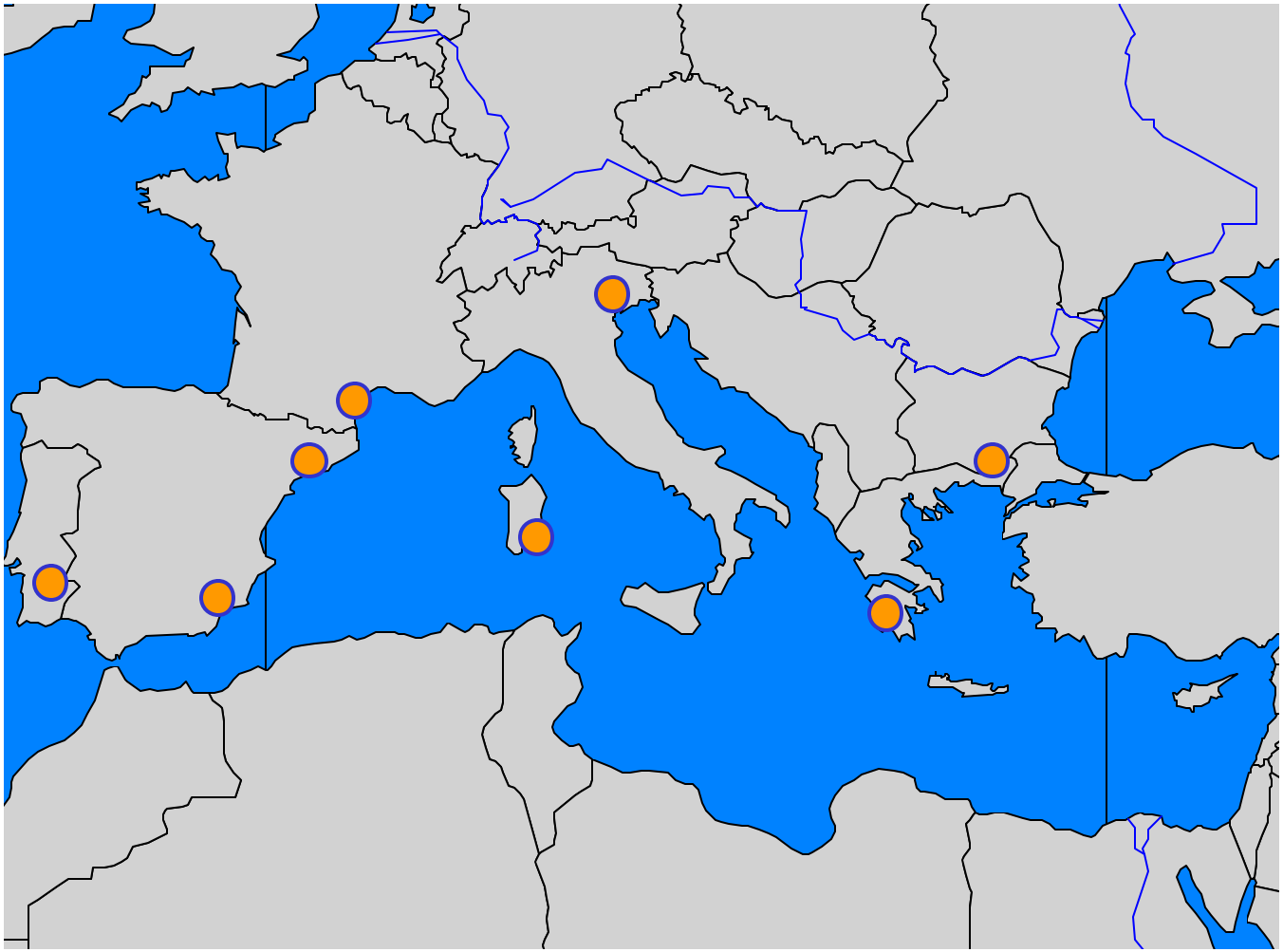
Model testing concept

tempQsim

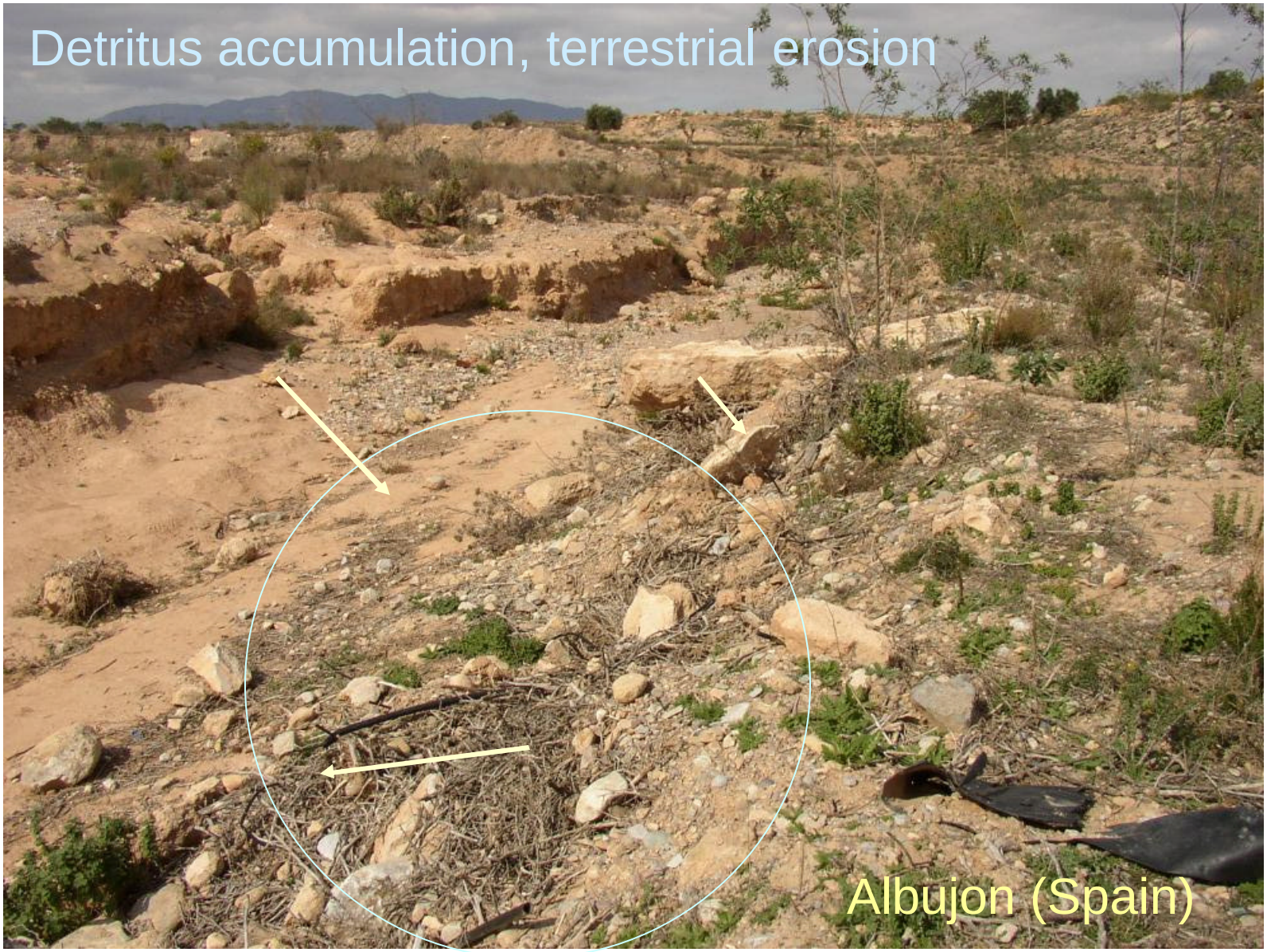
	SWAT	HSPF	CASCADE	ATHYS-POL	PESERA	EUROSEM
DEGEBE	PT		CEH		LEEDS	
ALBUJON		HE/HAN	CEH		LEEDS	
VENE	EAU			EAU	LEEDS	
VALLCEBRE				EAU/ES		ES
FLUMENDOSA	IRSA			EAU	LEEDS	
TAGLIAMENTO						
KRATHIS		HE			LEEDS	
ISKAR		BUL				

case study sites

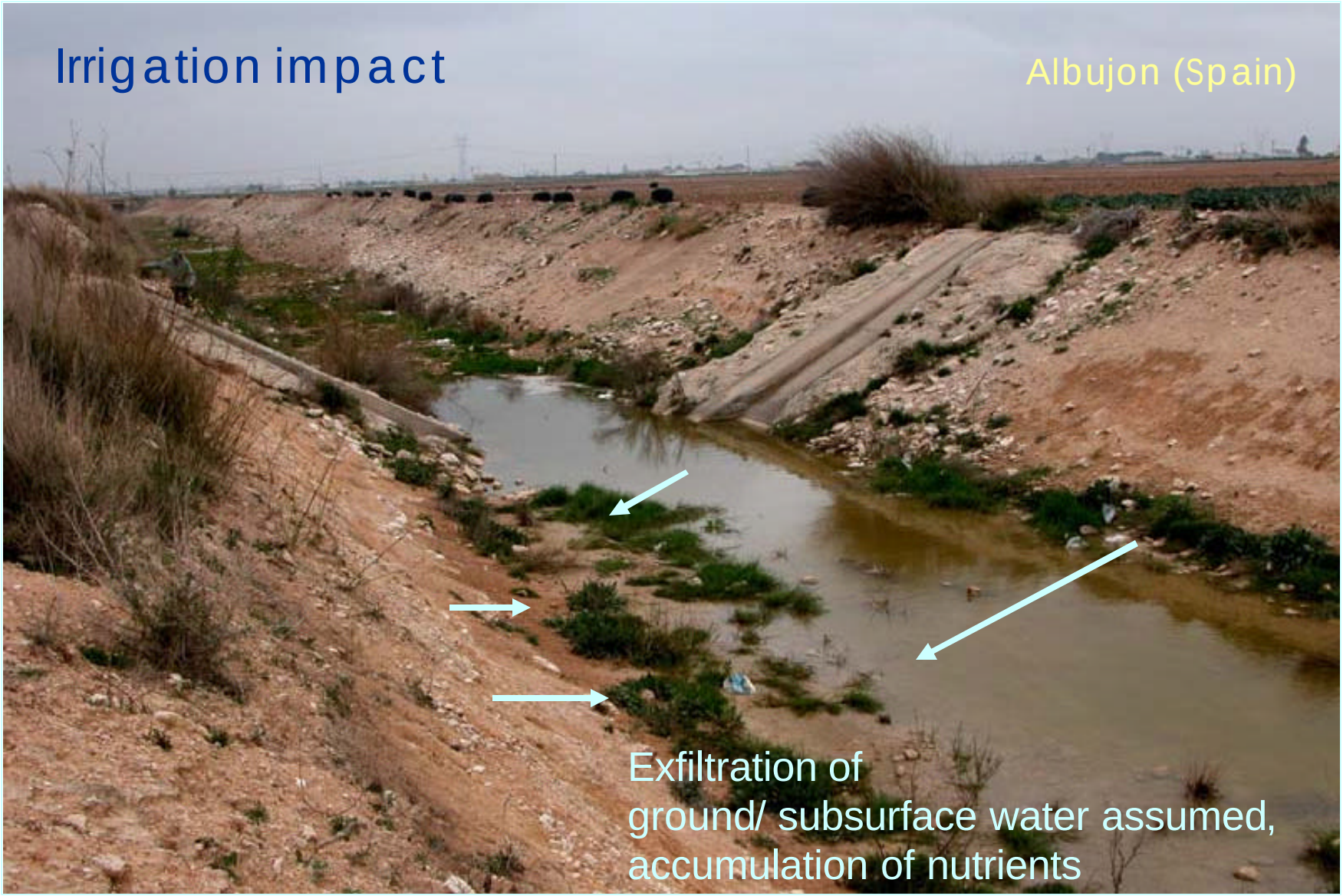
tempQsim




Hydrology
Extremly flushy behaviour
Krathis (Greece)


Detritus accumulation, terrestrial erosion
Albujon (Spain)

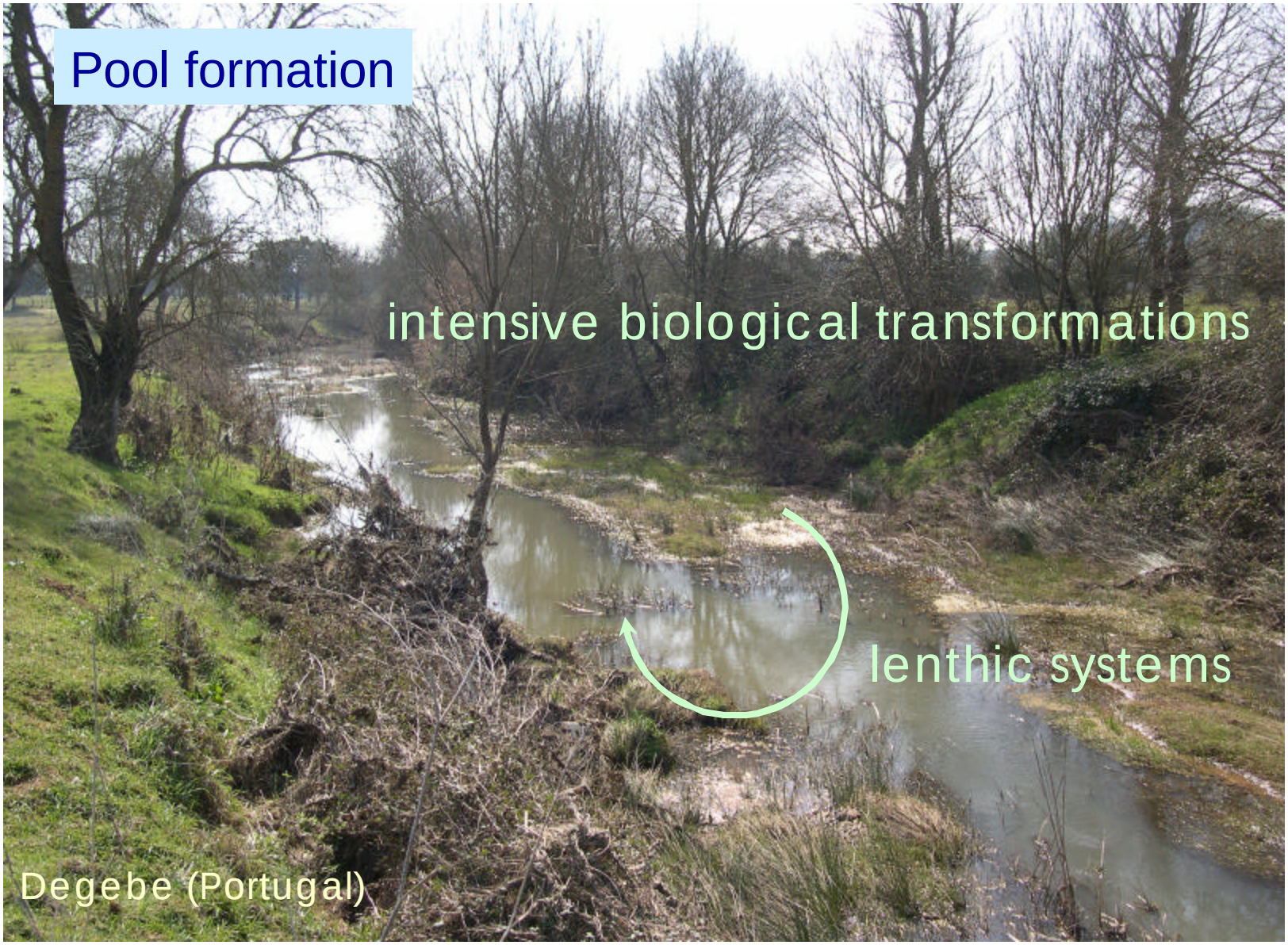
Irrigation impact

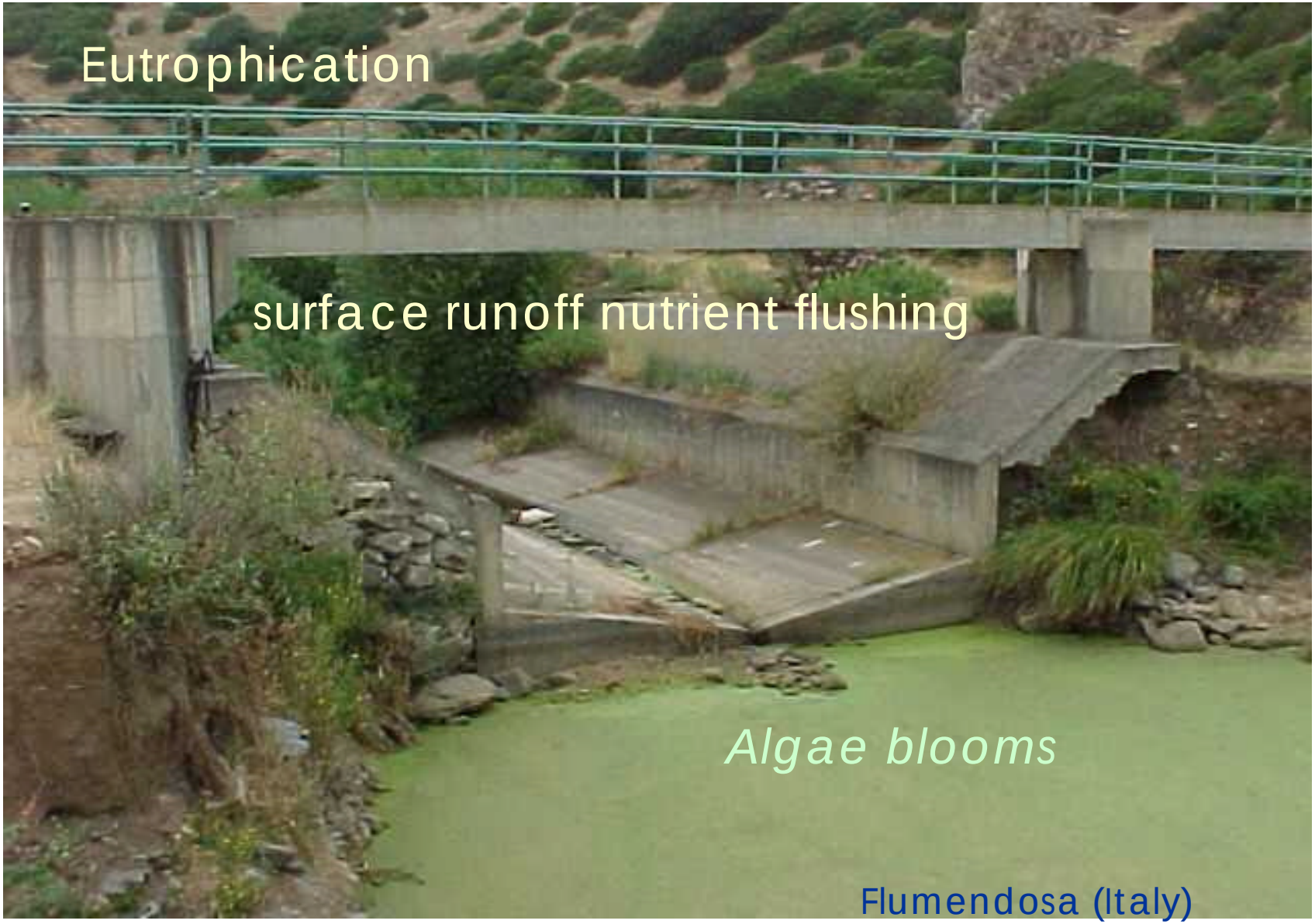


Long term accumulation of nutrients

Albujon (Spain)

Pool formation




Eutrophication
surface runoff nutrient flushing
Algae blooms
Flumendosa (Italy)

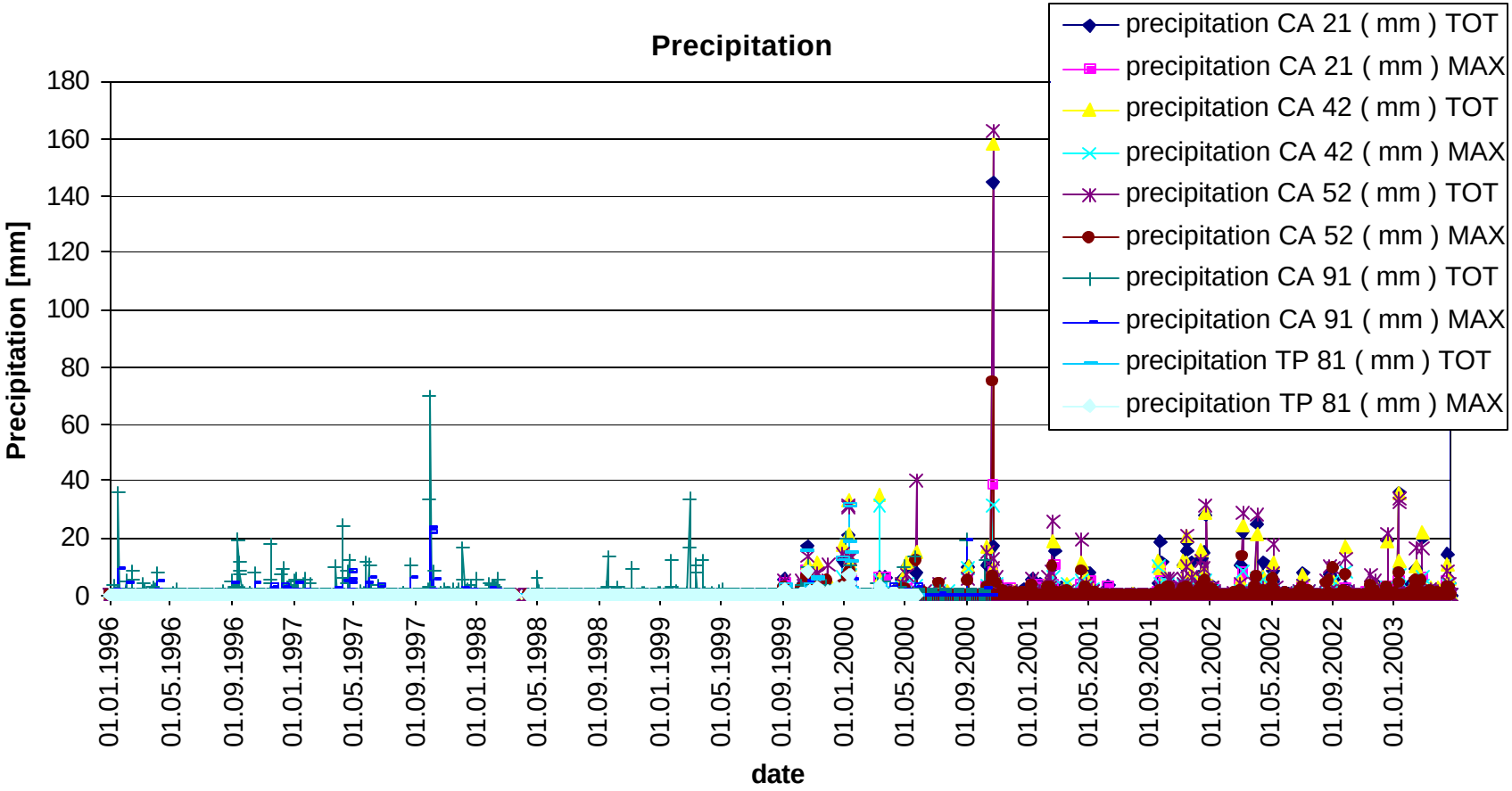
Providing hydrological basic information

flow period: water quantity and water quality

- acquisition of rainfall, runoff data
- providing basis information for catchment models
- characterisation of dry and wet periods
- specific contraction and expansion studies at Tagliamento (Tockner at al.)

Processing of available data

Precipitation variability Albujon, SE Spain



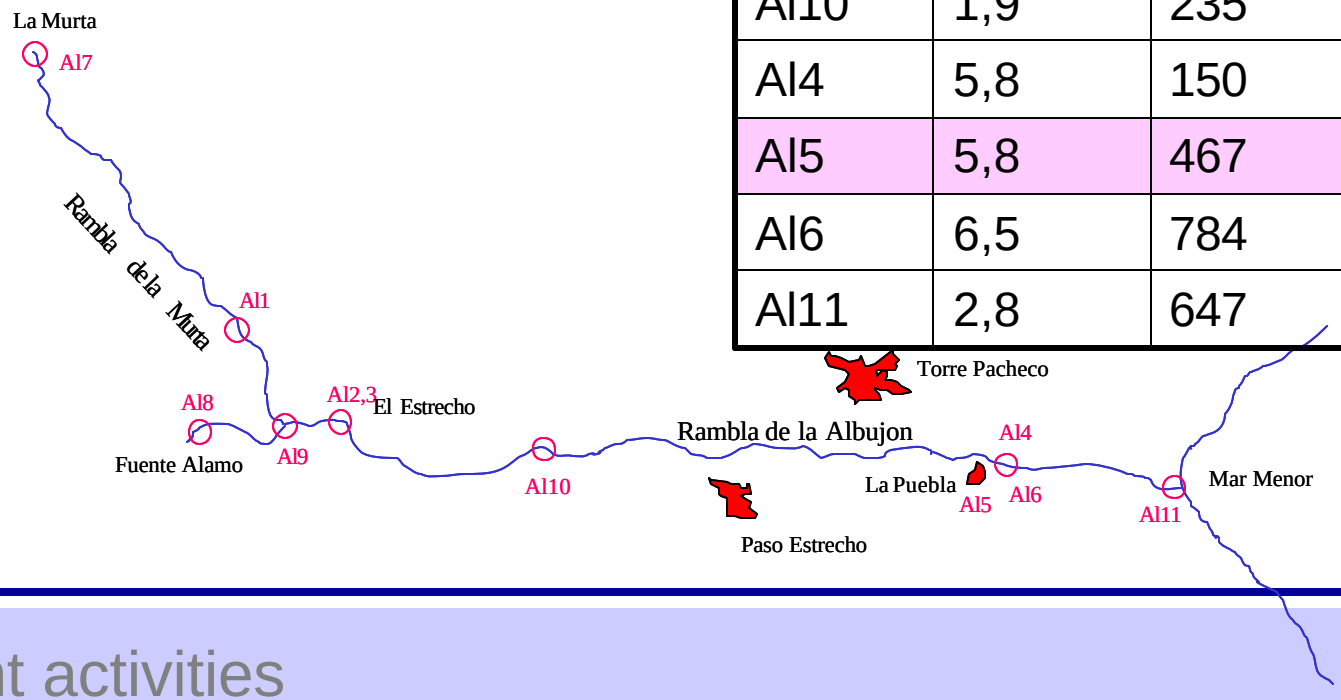
(Data source: Instituto Murciano de Investigacion y Desarrollo Agrario y Alimentario)

Channel bed processes

- plausibility checks
- detailed studies at Tagliamento (Tockner et al.)
- first characterisation of sediments

Albujon, SE Spain

sample	OM [%]	total P [mgP/kg]
Al7	1,2	686
Al1	1,4	342
Al8	7,6	2640
Al9	2,8	1260
Al2	1,6	207
Al10	1,9	235
Al4	5,8	150
Al5	5,8	467
Al6	6,5	784
Al11	2,8	647



The PESERA/RDI model

- A physically based model to estimate soil erosion rates at 250-1000 m resolution across Europe
- Based on a partition of precipitation to forecast overland flow runoff etc from
  - Climate, land use and topography
- Embedded in GIS for data layers and visualisation

- Developed since 1985 and in EU projects
  - MEDALUS I, II, III, MODEM
  - DESERTLINKS, PESERA, tempQsim

  (M. Kirkby et al., 2002)

Example of SWAT relevant activities I

Application of SWAT to the Mulargia catchment (Sardinia)

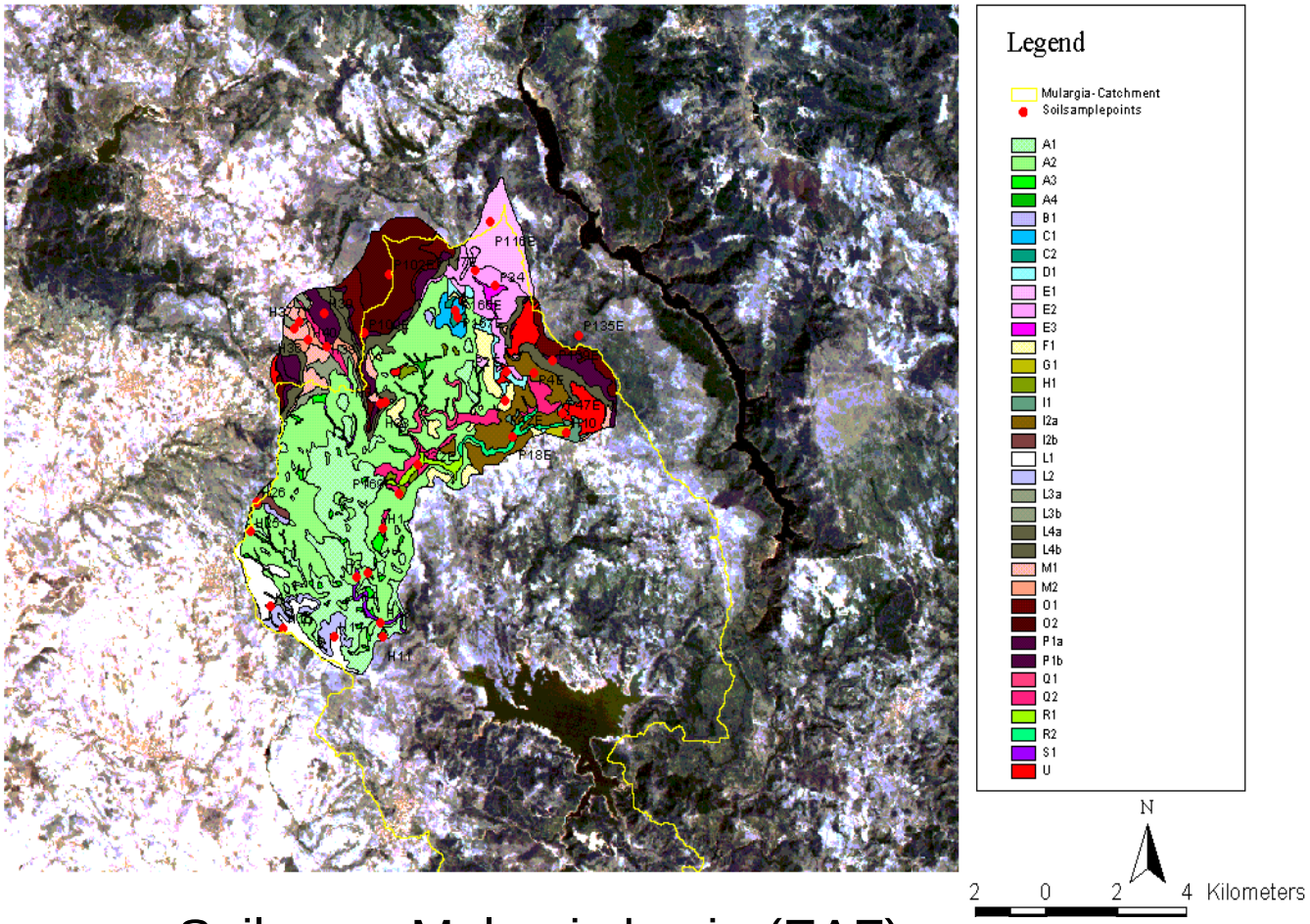
P6 IRSA, Italy

Antonio Lo Porto
Anna Maria De Girolamo
Filomena De Luca
Anna Barra Caracciolo
Albero Puddu
Maria Zoppini

Main research aims :

- **water management and pollution control**
- **to enhance the water quality of Mulargia reservoir**

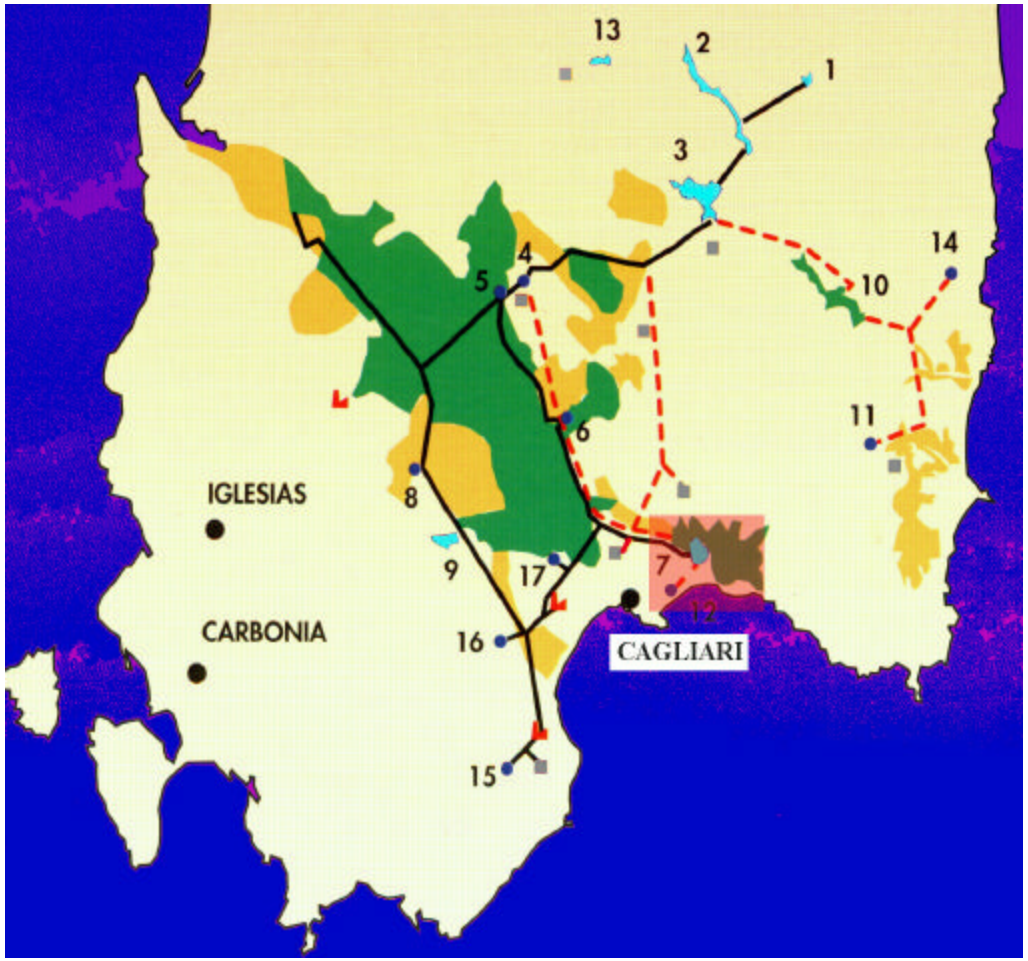
Processing model input data based on available data



Soil map, Mulargia basin (EAF)

IRSA CNR

Flumendosa - Campidano hydraulic system



FEATURES

Supplied population: 700.000 in.

Irrigated land: 60.000 ha

Storage capacity: 730 Mm^3

stored water at January 7th 2003: 31.468 Mm^3

(E.A. Flumendosa)

IRSA CNR

Relevancy of surface runoff and mass inputs

SWAT activities for the Mulargia study site

- processing and inclusion of existing ime series data from the enduser
- design and execution of specific field campaigns
- analyses of applicability of unmodified SWAT
- contribution to the improvement of the model (WP5)

Example of SWAT relevant activities II

Application of ATHYS-POL and SWAT to the Vene catchment

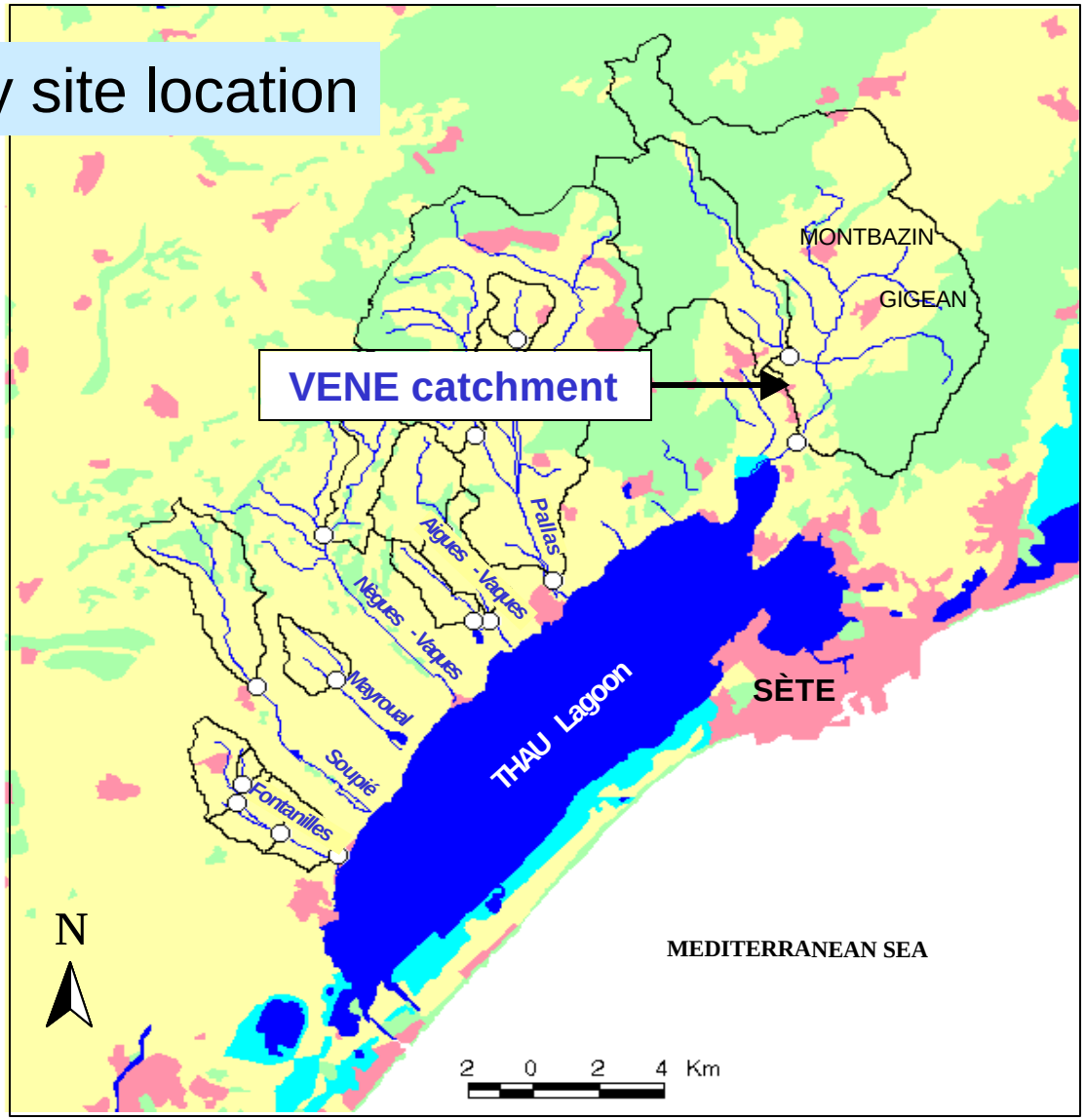
P8 Hydrosciences (Univ. Montpellier, IRD, CNRS), France

Marie-George TOURNOUD
Jean-Louis PERRIN
Bernadette PICOT
Christian SALLES
Christine GRILLOT
Claire RODIER

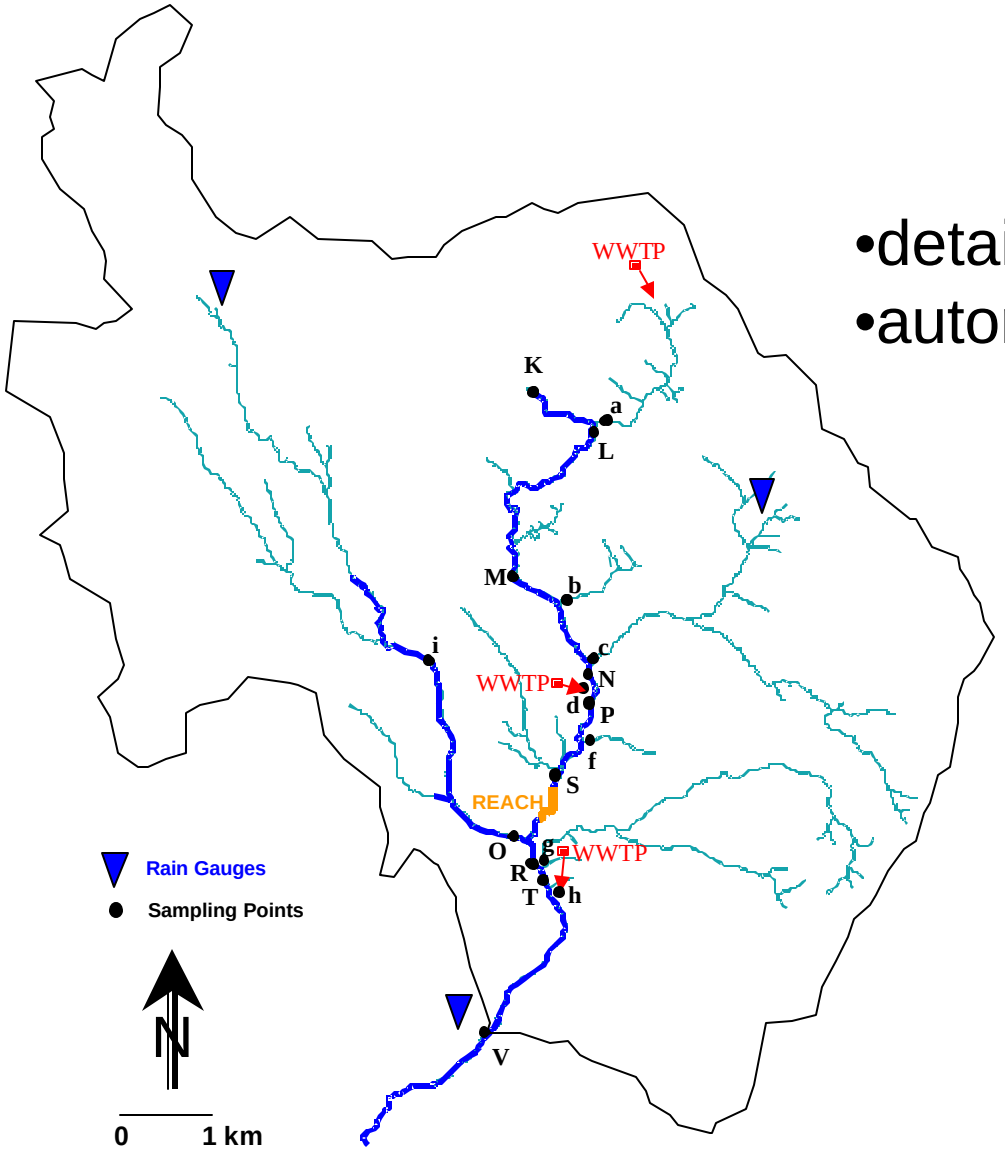
Main research aims :

- **water management and pollution control**
- **to enhance the quality of the Thau lagoon**

Overview study site location



extreme runoff events



- detailled field work
- automatic sampler installation

SWAT activities for the Vene study site

- comparison with results of the ATHYS-POL model
- sensitivity of parameters affecting

  - hydrological response of the catchment, at various spatial scales (the whole catchment, on subcatchments)

  - hydrological balance (e.g. interception)

  - water quality dynamics at the outlet.

- limitation of time step concepts for event modelling
- impact of the high degrees of freedom in the model
- investigation of potential resuspension

Example of SWAT relevant activities III

Application of SWAT to the Degebe catchment (Portugal)

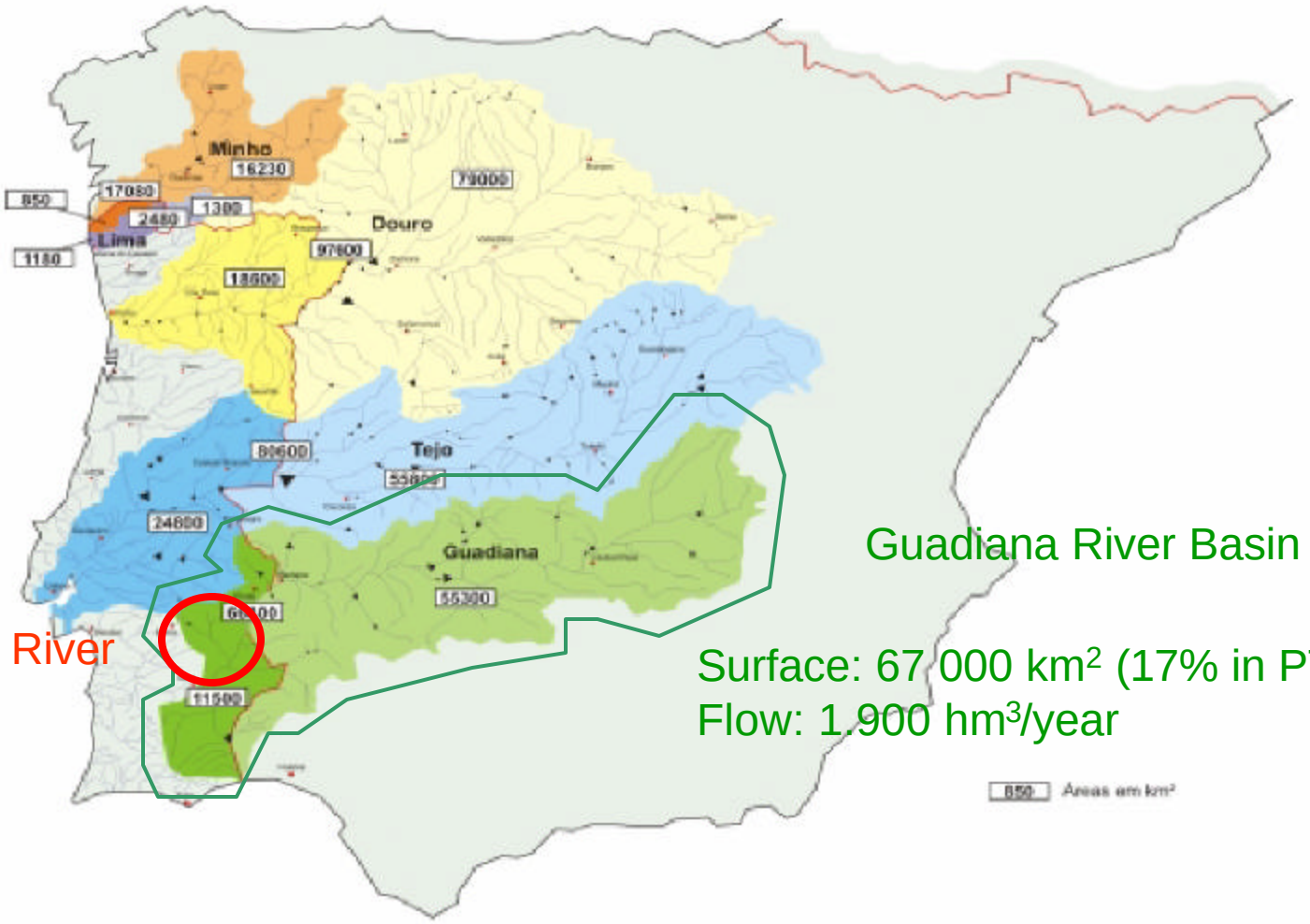
P5 IMAR, Portugal

Ramiro Neves
Pedro B. Galvão
Frank Braunschweig
Sibila Sousa

Main research aims :

- **consideration of pool formation and related water quality processes**
- **to enhance the quality of the Alqueva dam**

Overview study site location



Degebe River

Guadiana River Basin

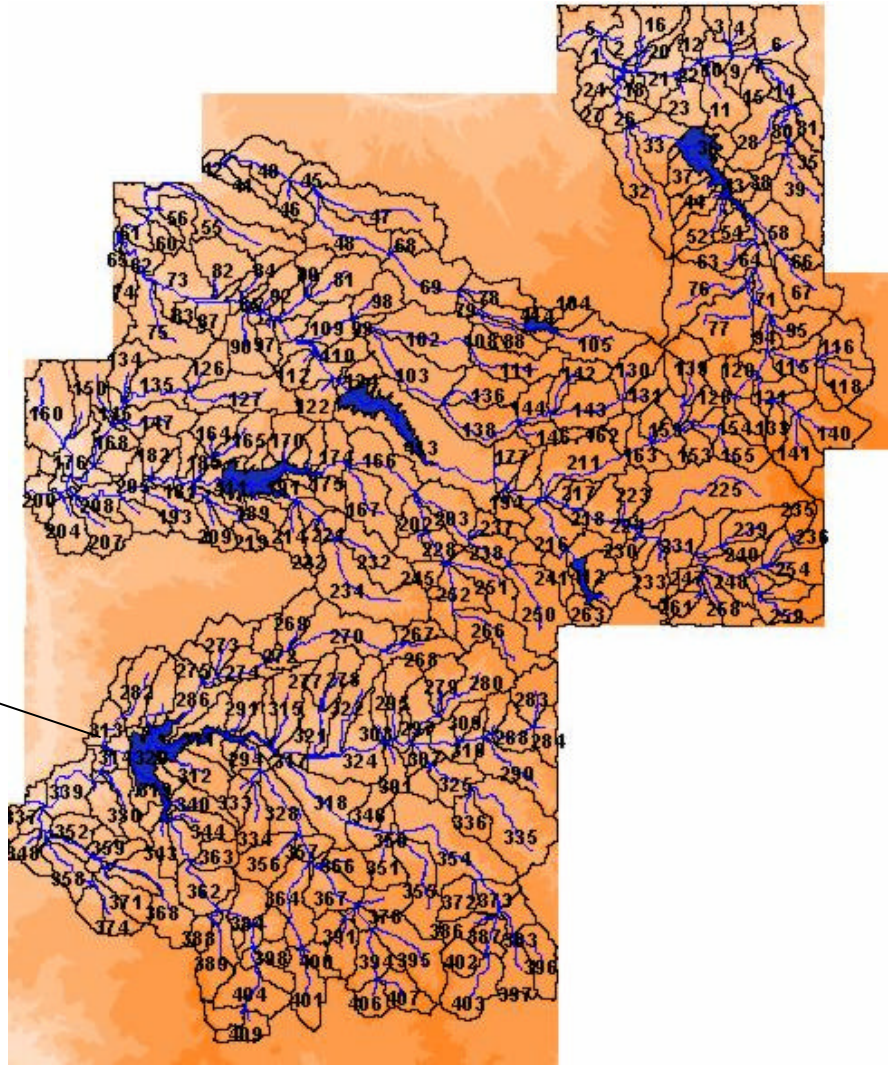
Surface: 67 000 km^2 (17% in PT)

Flow: 1.900 hm^3/year

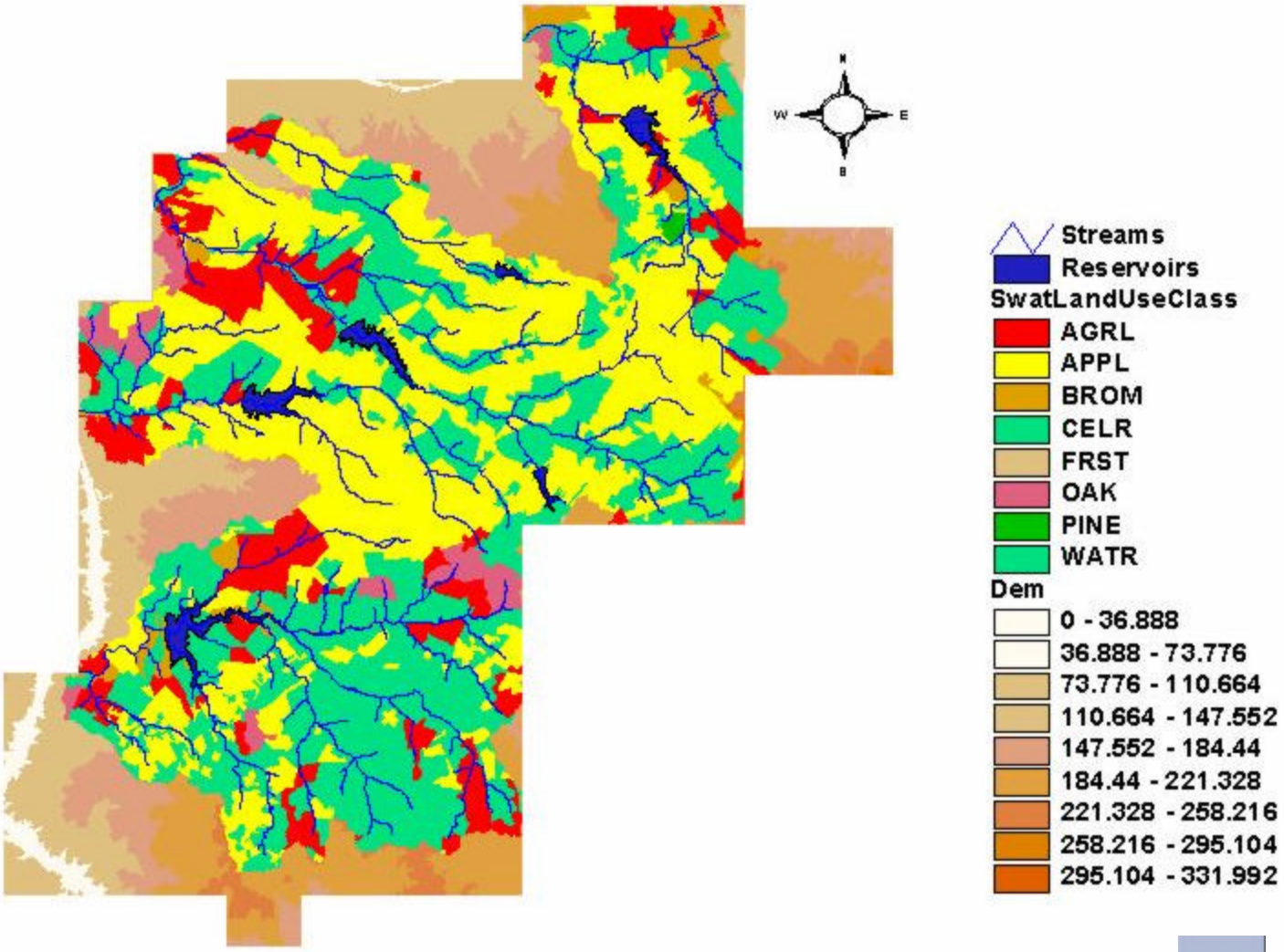
SWAT application
Ardila irrigation system

Pedro B. Galvão

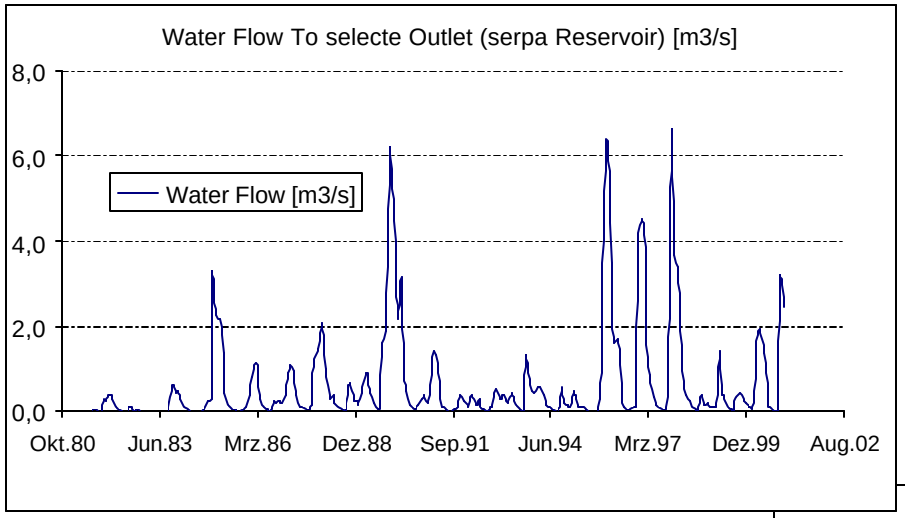
Serpa reservoir



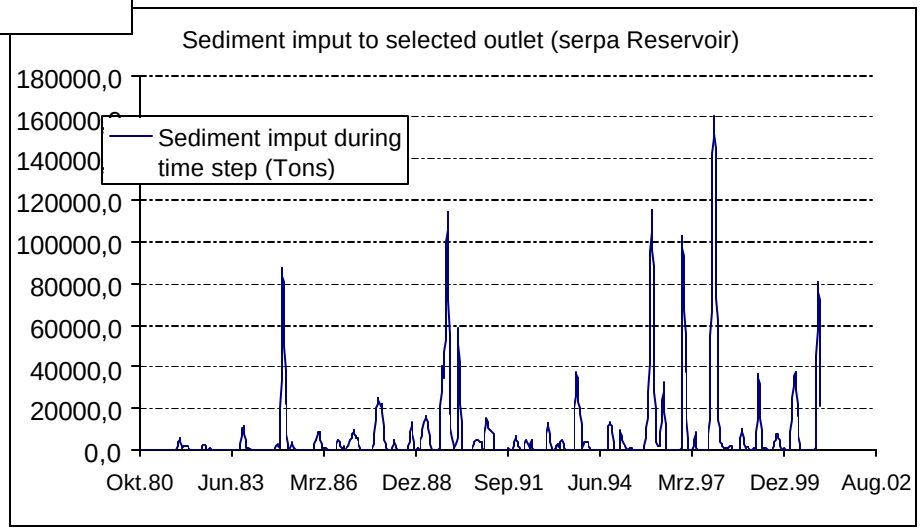
Provision of data sets for model testing



preliminary model results



Serpa reservoir,
Ardila irrigation system



next SWAT activities for the Degebe study site

- validation of runoff modelling at Ardila subsystem
- comparison with Pesera (M. Kirkby, Univ. Leeds) and Cascade (D. Cooper, CEH) results
- processing of hydrological data for Degebe study site
- installation of automatic samplers and process studies
- development of model concepts for consideration of dry period and resuspension dynamics

Terrestrial mass inputs

mass accumulation, erosion,flushing of fertilizers, fecals

accumulation of mass in sediments

by

- *remaining and reducing flow conditions*
- *waste water inflow*
- *input from non-point sources*

biochemical processes

- *formation and decomposition of OM*
- *nutrient turnover*

resuspension and first flush events

tempQsim

- still difficult to consider wide gradient in specific stream characteristics and water management problems in the Mediterranean adequately in models
- more focus on terrestrial mass accumulation and first flush inputs from organic sediments/adsorbed nutrients
- shallow aquatic systems (lagoons) suffers especially from nutrient inputs
- need for better monitoring of bigger run off events

future adressing of water crisis

hydrological variability

desertification / land use practices erosion and mass inputs

first flush dynamics
nutrients
salinity
toxic pollutants

adequate modelling tools

adapted river and reservoir operation

pollution reduction and increased availability of safe water resources