Jochen Froebrich

Water quality dynamics in semiarid regions with temporary streams

Palermo - 2004

Water Quality Protection and Management
Prof. Dr.-Ing. habil. Herwig Lehmann
University of Hannover

Jochen Froebrich

Water quality protection and management group, University Hannover, Germany

specialized in water management problems for **semi-arid regions** (MENA, Central Asia)

Co-ordinator of tempQsim

Domain leader water availability, AQUASTRESS

availability of safe water resources by combined **water quality** and **quantity** management

structure

- to introduce the project tempQsim
- typical **water quality dynamics** in temporary streams
- outline of future **mitigation options**
- conclusions for **modelling strategies**

Rational

In many water stressed regions world wide:

- water use from reservoirs at risk due to eutrophication and toxic algae blooms
- reservoir capacity losses by sedimentation

adapted quality mangement needs knowledge on pollution pathways and adapted management tools

EU-WFD & EU-WIMC adresses improvement of water quality in the framework of IWRM

Intermittent streams:

are dry **part of the year**, but contain flow when the groundwater is high enough as well as during and after a storm event.

Ephemeral streams:

contain water during and immediately after a storm event but are dry the **rest of the year**.

temporary waters

forms a major part of the catchments

- about 40% of all catchments in Greece (after Nikolaidis et al. 2004), much higher with consideration of dry tributaries
- about 100% in the southern part of Sardinia
- large number of ramblas in Spain

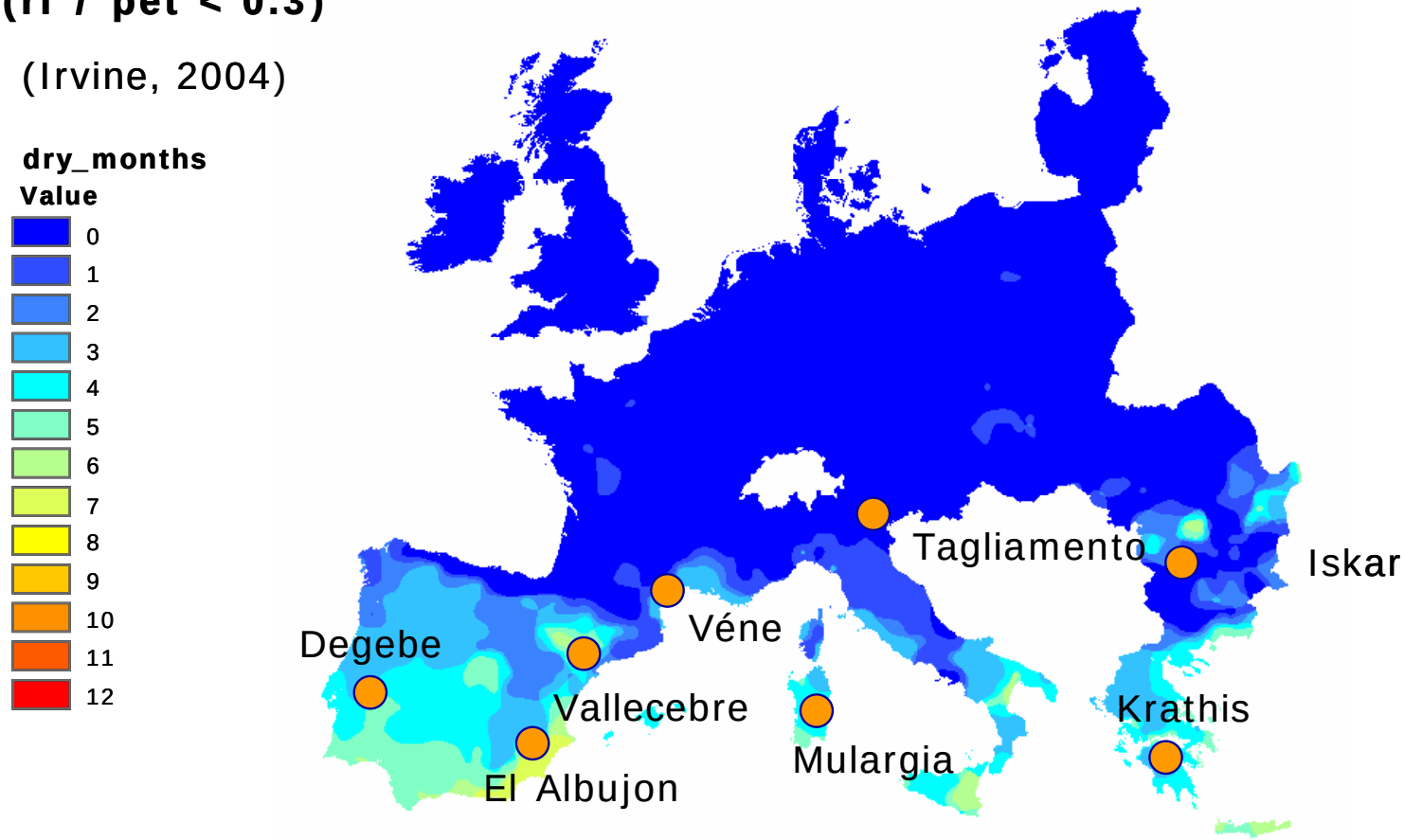
despite this fact, very vew knowledge on water quality dyanmics, ecosystem functioning and available modelling tools

tempQsim objectives:

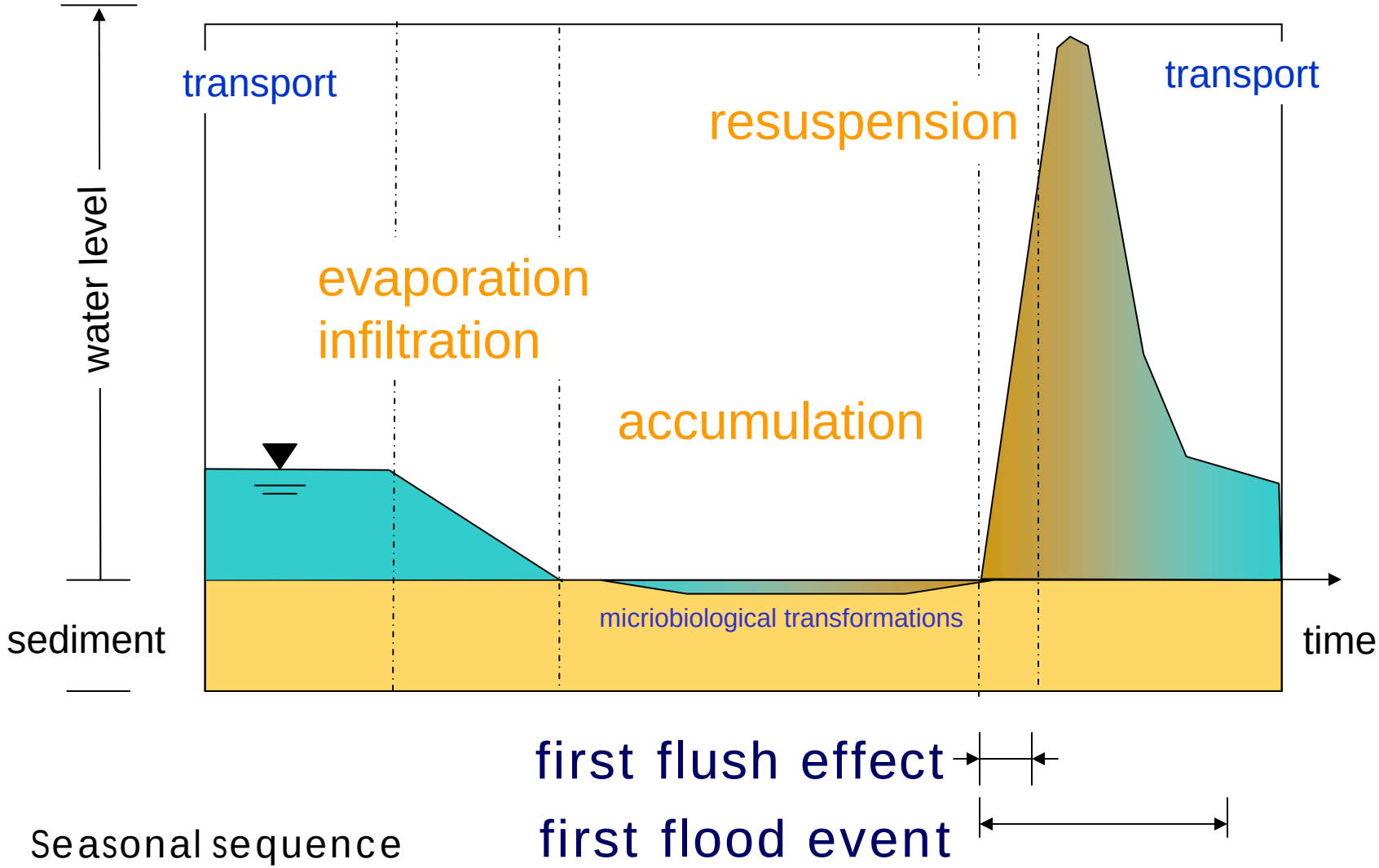
- to test a number of catchment models in study sites with temporary waters
- to develop detailed conceptual models for each study sites (sediment and water phase)
- to improve modelling tools for its applicability in semi-arid basins

Dry Months
(rf / pet < 0.3)

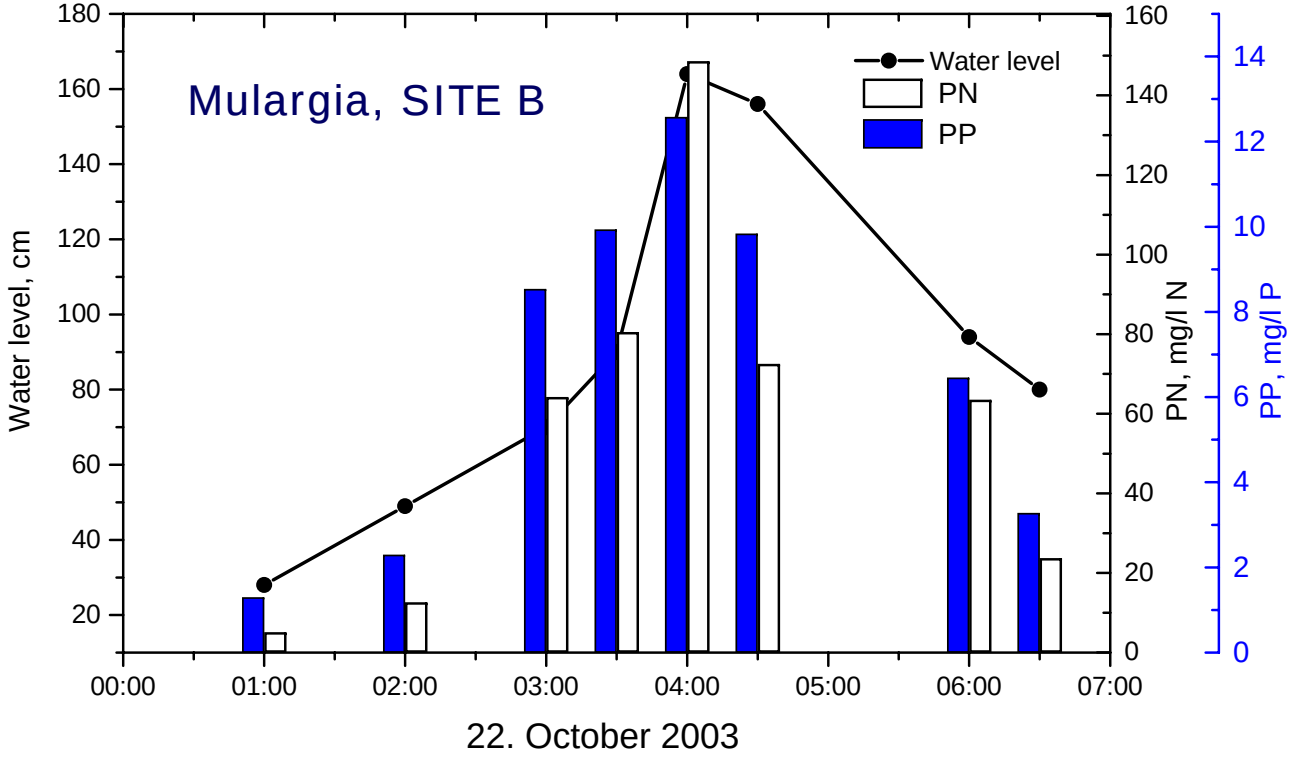
(Irvine, 2004)



water quality dynamics

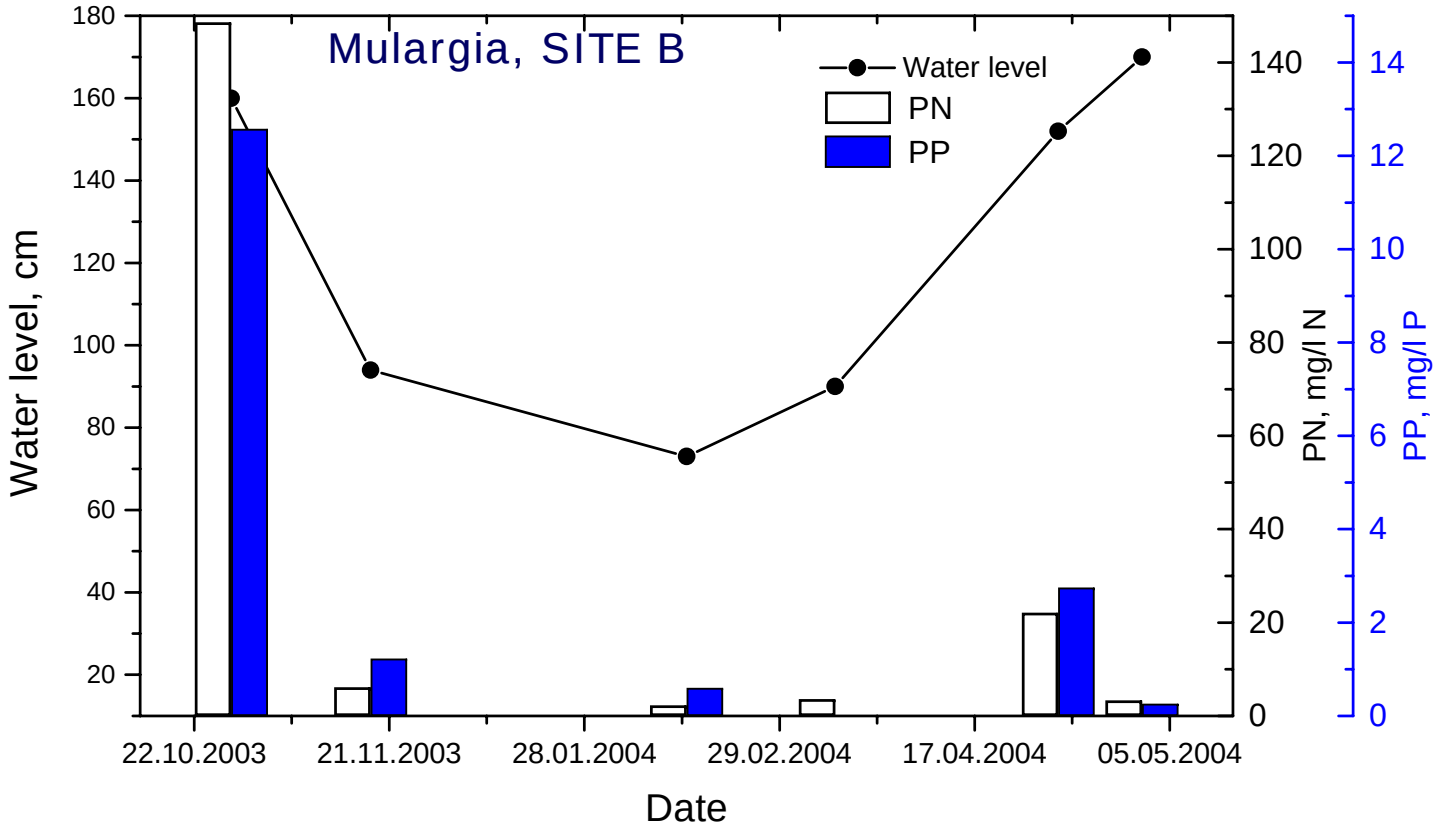


first flush effects



Diliberto, Botti, 2004

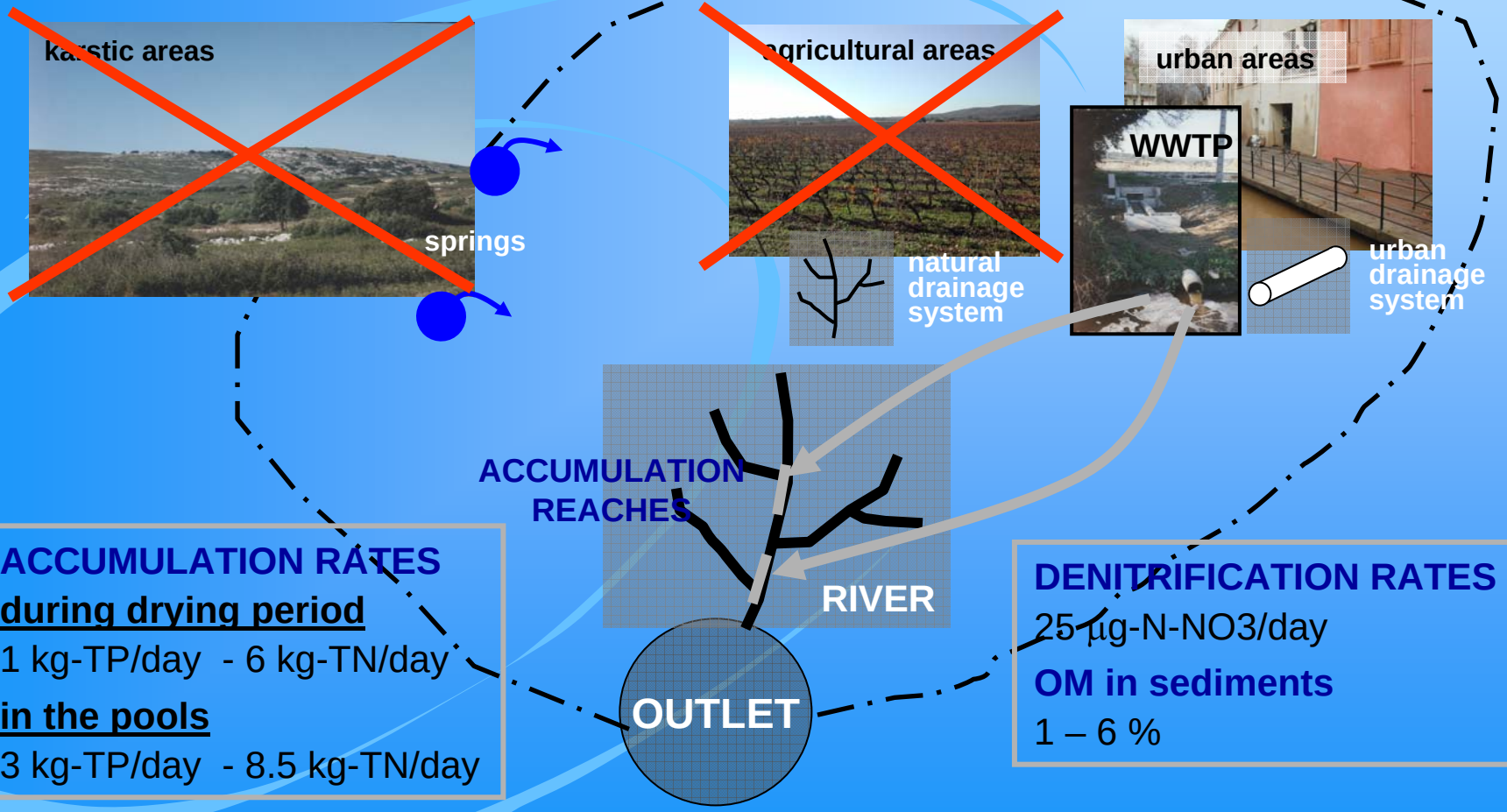
imortance of first flood events



Diliberto, Botti, 2004

Marie George Tournoud, Jean-Louis Perrin, 2004

Dry period



ACCUMULATION RATES

during drying period

1 kg-TP/day - 6 kg-TN/day

in the pools

3 kg-TP/day - 8.5 kg-TN/day

DENITRIFICATION RATES

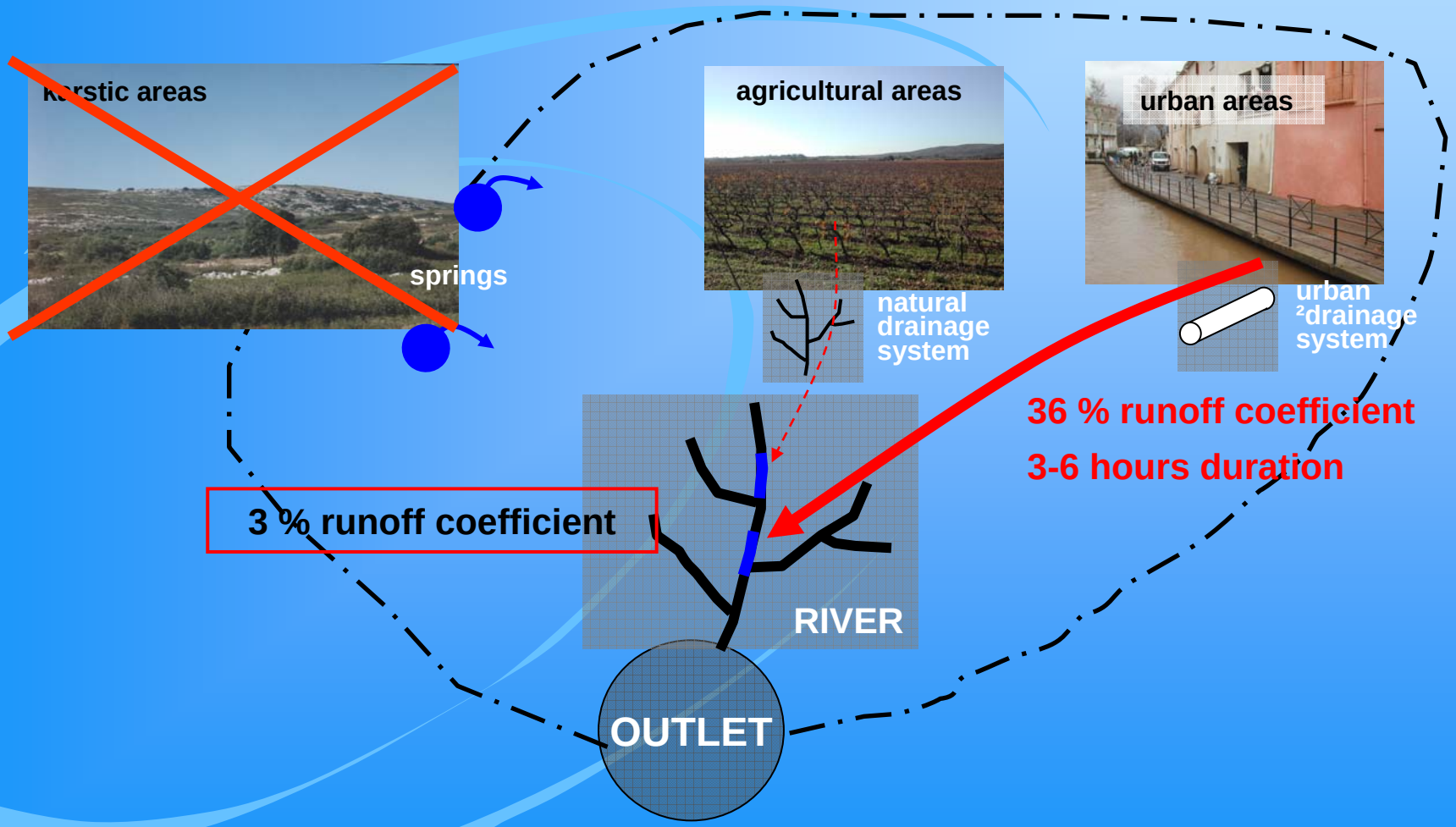
25 µg-N-NO3/day

OM in sediments

1 – 6 %

Marie George Tournoud, Jean-Louis Perrin, 2004

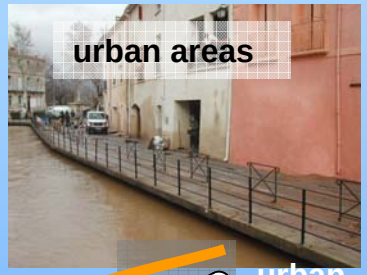
1st FLOOD



Marie George Tournoud, Jean-Louis Perrin, 2004

2nd FLOOD

springs



high initial losses

natural drainage system

urban drainage system

RIVER

OUTLET

3 % runoff coefficient at the outlet

duration: less than 1 day
peak flow: 0.5 – 10 m^3/s

velocity: 0.6 – 1.1 m/s
⇒ 45 to 50 mn time transfert




major contribution of **1st flood** to total load &runoff

Albujon	Vene	Mulargia	Krathis
Significant for **P_{tot}** compared to other floods	Urban stormwater, remobilisation of mass, **no discharge at the outlet**	Significant **30% of annual TSS**, 10% of total Discharge	**Relatively small** compared to 2nd flood, significant increase for NH4 , particulate nutrients




major contribution of **2nd** or later flood

Albujon	Vene	Mulargia	Krathis
Indication of **high NO_3-N** release	The 2nd flood produces the first discharge that **reaches** the **catchment outlet**	Only for an **exceptional spring** flood	Significant for **all particulate nutrients**, increase in NH_4 NO2, DON & DOP

Conclusions

Storms are dominant drivers causing **pollution remobilisation** and **transport**

- erosion and washing **pollutants from land surface** are important pathways in sloping areas

- **instream resuspension** of waste water originated organic matters and nutrients

Accumulation during dry period

Accumulation on **land side**

manure, animal faecals, plant residues, nutrient enriched topsoil

Accumulation of **sewage water** discharge

contribute to resuspension of waste water originated organic matters and nutrients

Spatial and temporal variability of loads and fluxes

- most important constraint for existing modelling tools
- attractive starting points for practical measures

Conclusions

Option	relevant aspects to be considered	model requirements
landuse change	long term reaction	consideration of actual practice and response of the watershed
erosion control	identification of erosion hot spots	simulation of measure efficiency
sewage water treatment	significance of pollution point sources	simulation of impact, evaluation of investment efficiency
settling ponds pre-dams	identification of potential events	simulation of purification processes, short time consideration of pollution variability

Hydrology:

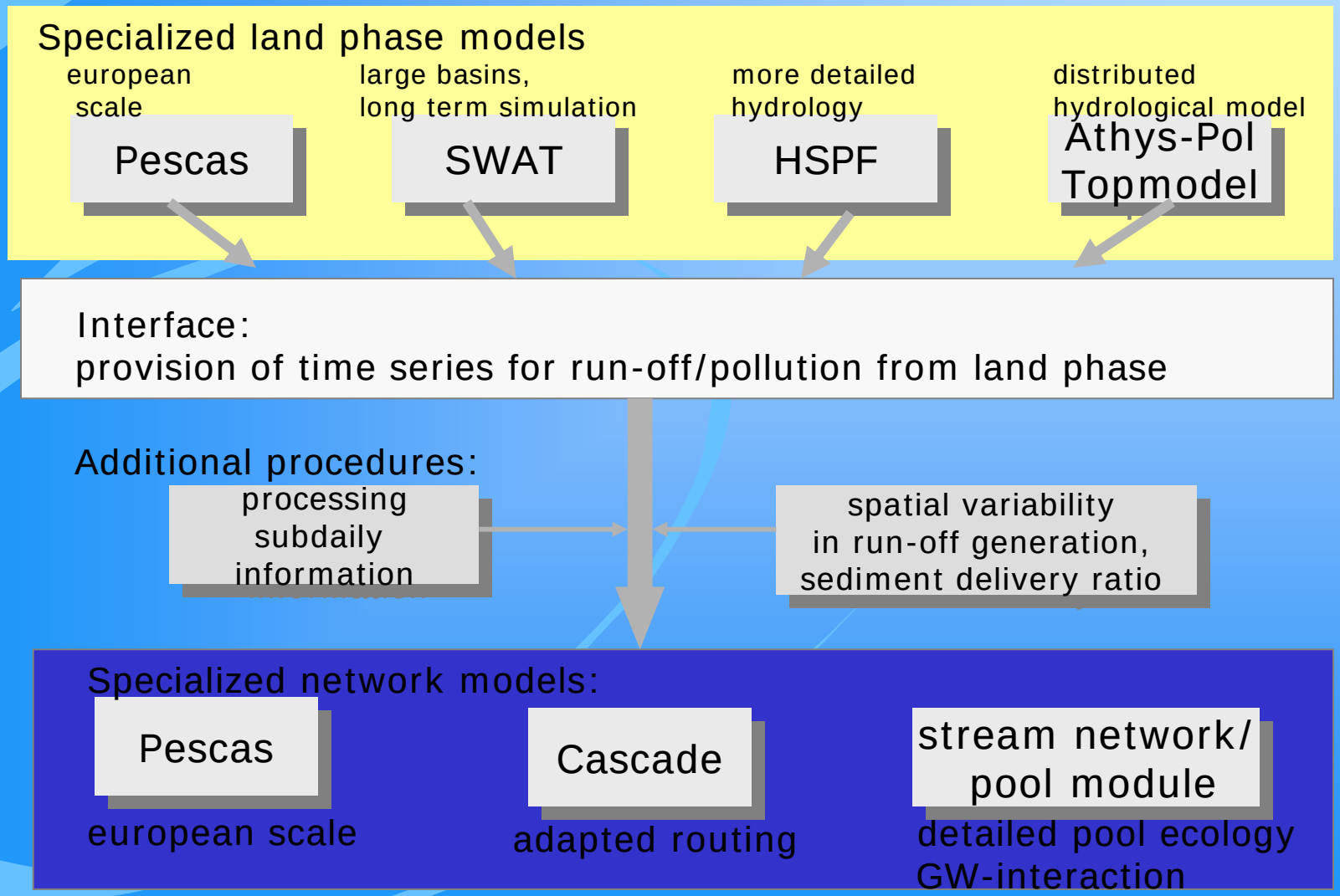
- **spatial** rainfall distribution
- interruption of flow due to **transmission losses**
- sufficiently **short time steps** during flood events

Water quality: missing capabilities

- Linkage of **erosive nutrient leaching** to rainfall distribution and run-off generation

- mass **accumulation** between significant floods

the tempQsim tools



adapted consideration of highly variable hydrology and poullution dynamic

localisation of highest pollution sources, prioritise of actions

improved modelling tools

tempQsim

identification of **controlable flow intervals** for diverting higher polluted flows

technical soil conservation measures

rural development policy and land use management

operation of diversion structures, weirs,

flooding of sedimentation areas

Improved river water quality

Increased availability of safe water resources in main rivers and reservoirs