UNIVERSITAT POLITÈCNICA DE VALÈNCIA

MODELLING THE SPATIAL DISTRIBUTION AND TEMPORAL DYNAMICS OF MEDITERRANEAN RIPARIAN VEGETATION IN A REACH OF THE MIJARES RIVER (SPAIN)

Instituto de Ingeniería del Agua y Medio Ambiente

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iwrm-net Regional and national research programmes network on Integrated Water Resource Management
scarce
CONSOLIDER Ingenio 2010
GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Introduction

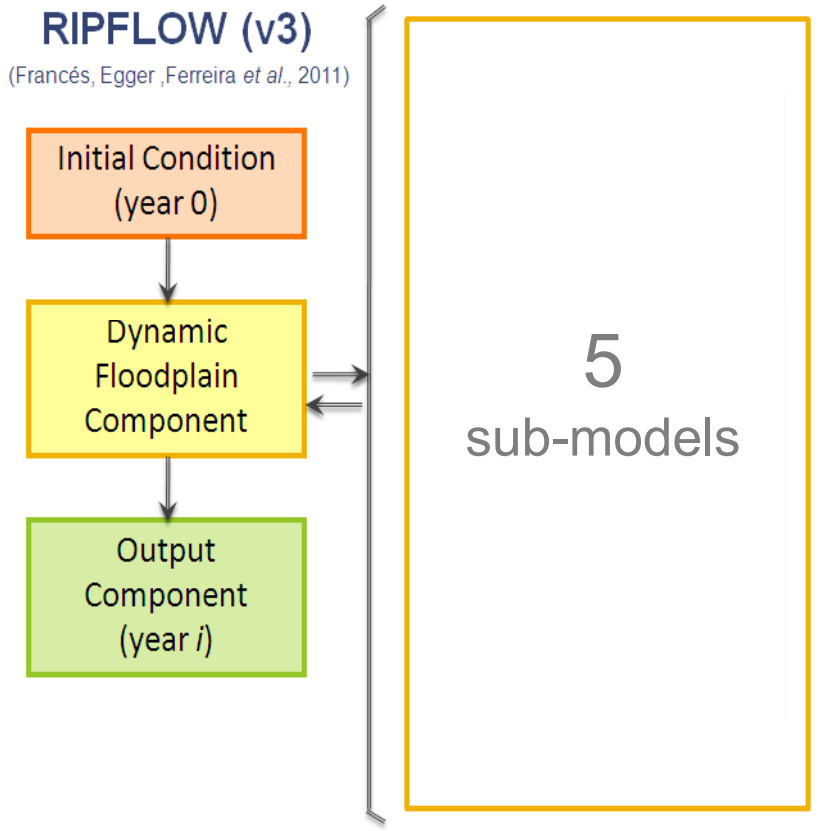
- Riparian ecosystems main elements
  - Water, soil and vegetation
- Riparian vegetation
  - Diversity of Habitats
  - Soil and nutrients retention
  - Temperature regulation (Shadow effect)

River ecological status (WFD)

- Modelling the riparian vegetation distribution
  - RIPFLOW model

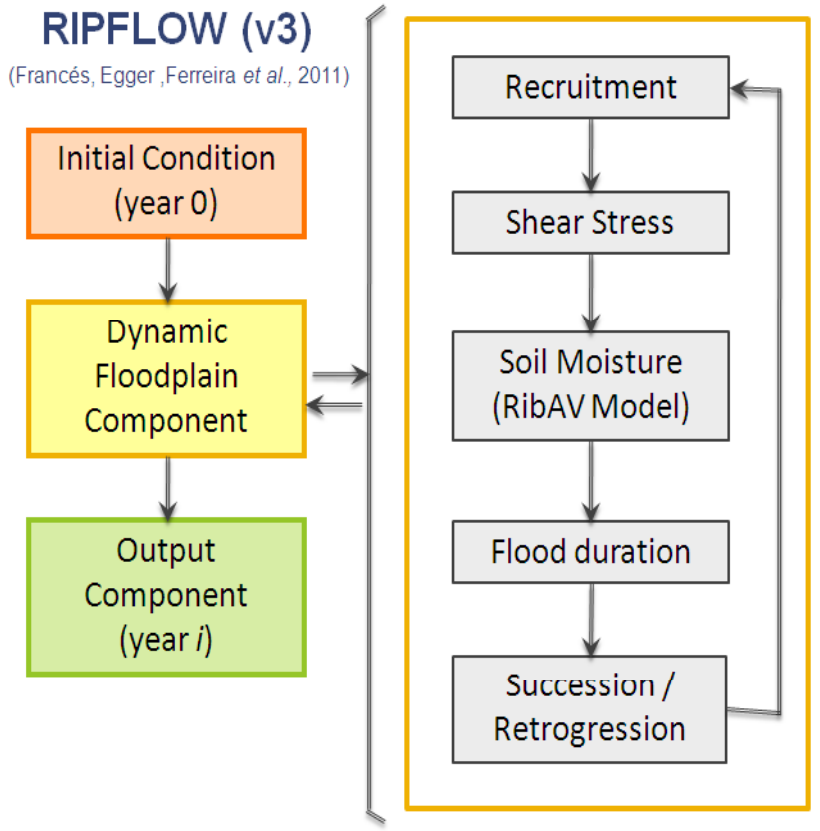
RIPFLOW model

- Distributed model (cell resolution 1m)
- Annual temporal scale (soil moisture daily)
- Main state variable
  - vegetation succession phase
- Dynamic riparian vegetation distribution
  - Physical parameters → Succession or retrogression



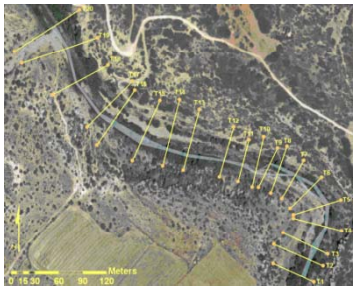
RIPFLOW model definition

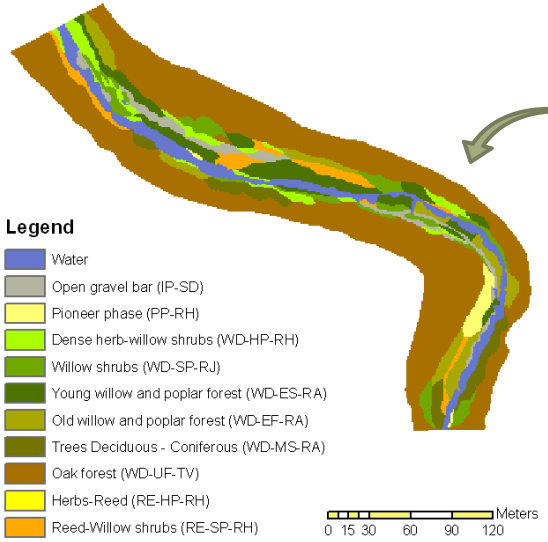
- Five successive sub-models:
  - Recruitment → morphology, scour disturbances & WTE
  - Shear stress → vegetation remotion (SSlim)
  - Flood duration → physiological stress, root asphyxia
  - Soil moisture → water stress (ETidx)
  - Succession progression → different succession series
- Parameters → thresholds



Terde reach at the Mijares River

- 539 m long, 850 masl
- Basin area: 665 km^2
- **Permanent** flow regime
- Bankfull Q = 5 m^3/s
- **No flow regulation** upstream
- Riparian vegetation:
  - *Salix eleagnos*
  - *Salix purpurea*
  - *Populus nigra*
- Upland forest:
  - *Pinus* and *Querqus*





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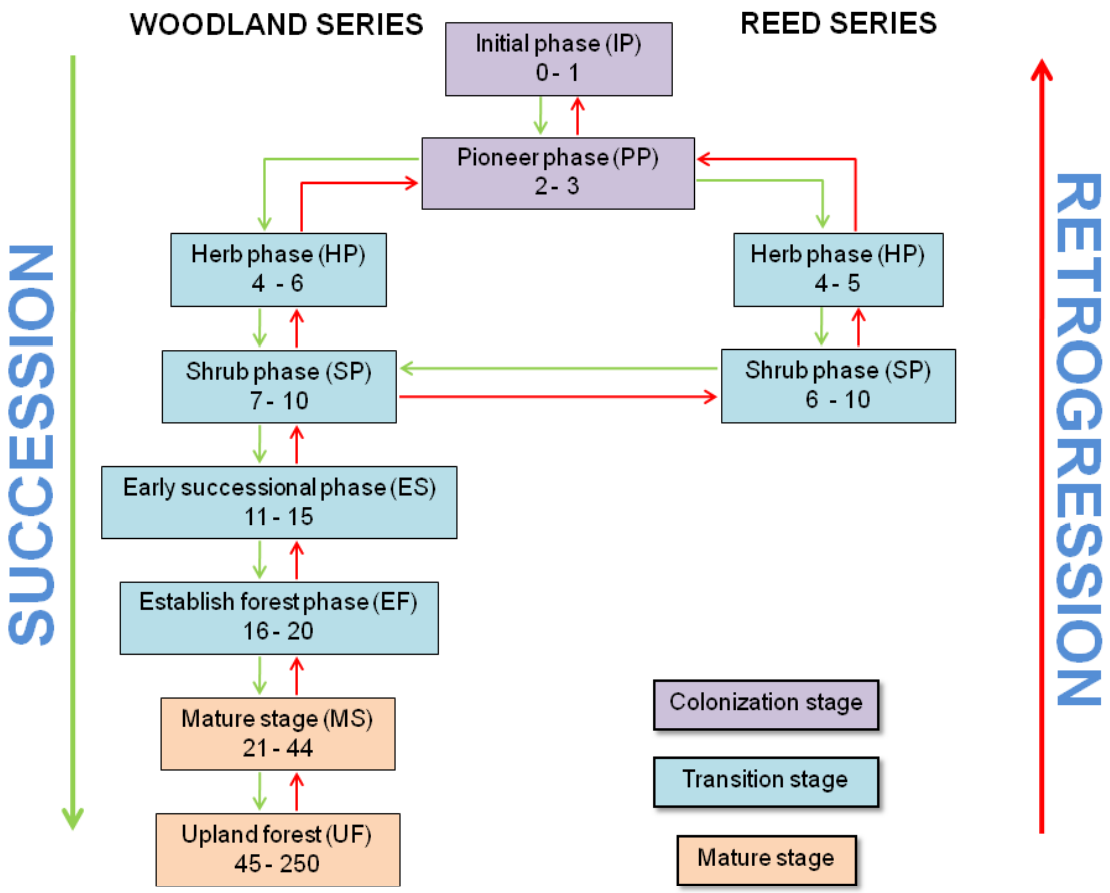
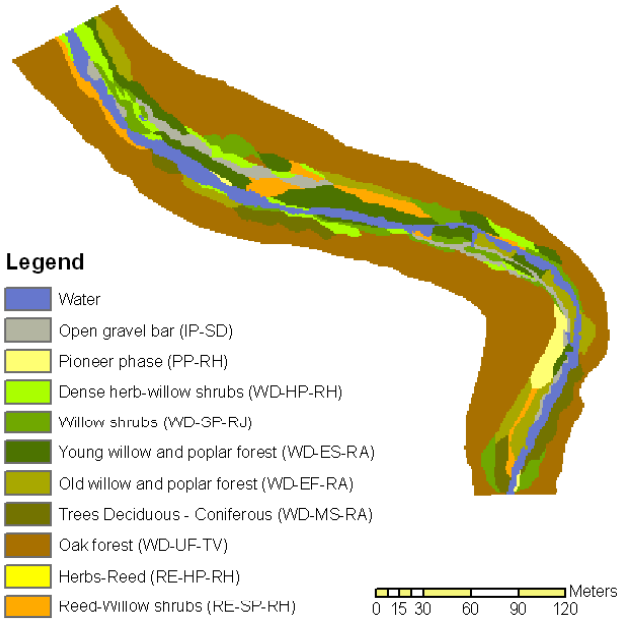
Vegetation survey

Succession and retrogression



Terde reach (Mijares River, Spain)



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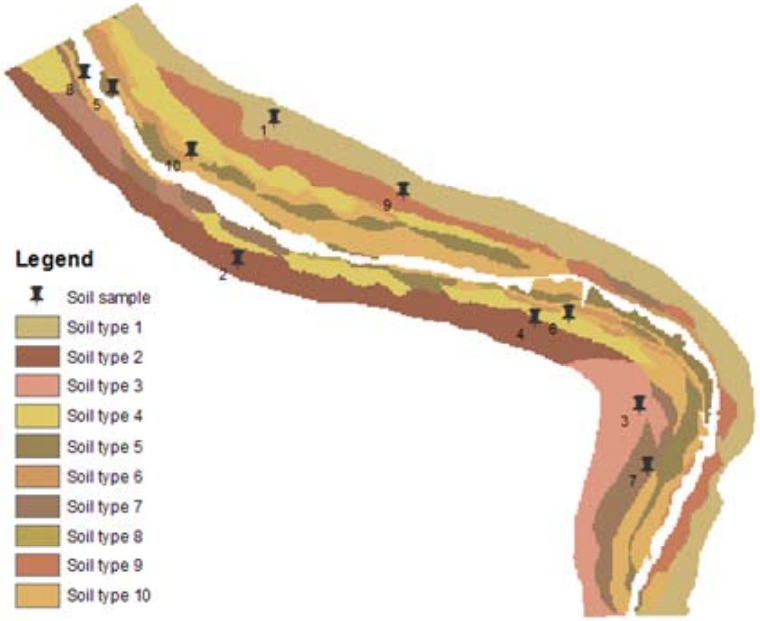
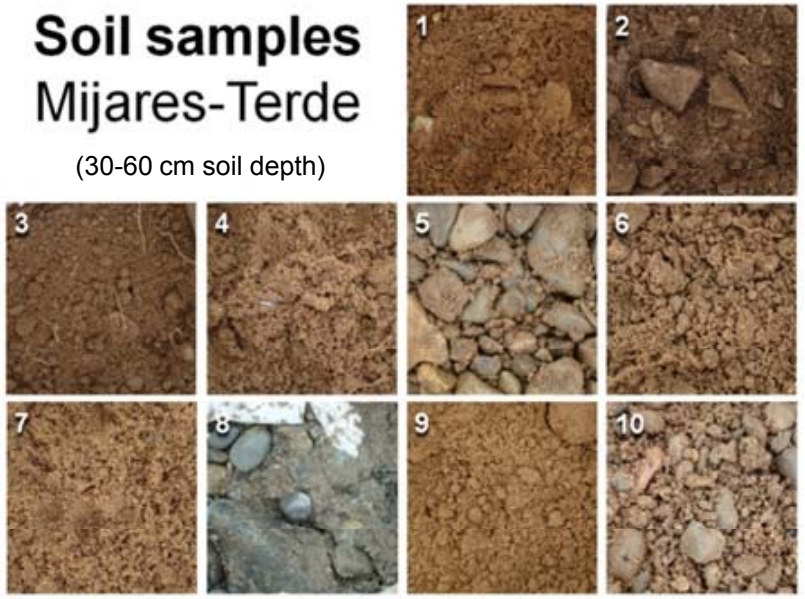
Soil survey

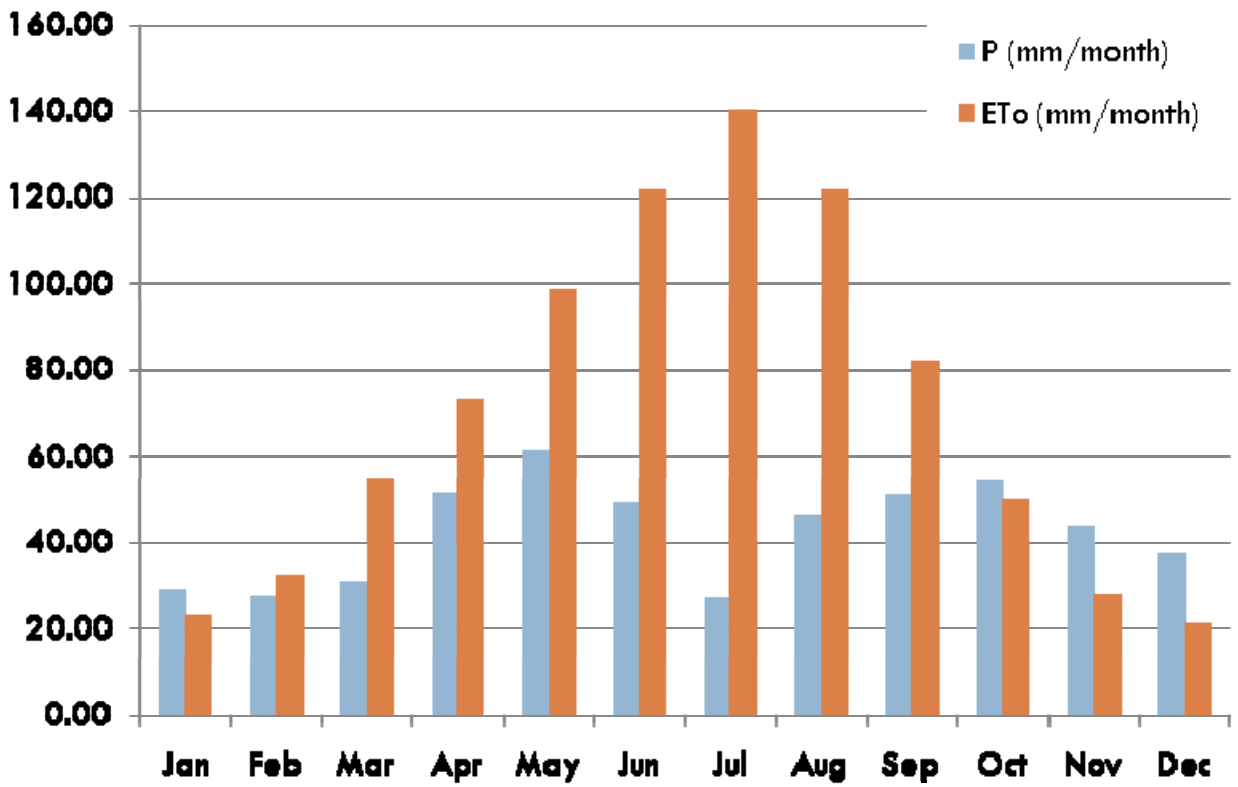




Soil types parameters

Field Capacity Moisture [ ] (Typical value, moisture to 33 Kpa)
Porosity [ ]
Soil Saturated Hydraulic Conductivity [mm/hr]
Bubble pressure [Kpa]
Porosity index

Hidro-meteorological data



Time period:
1968 - 2009

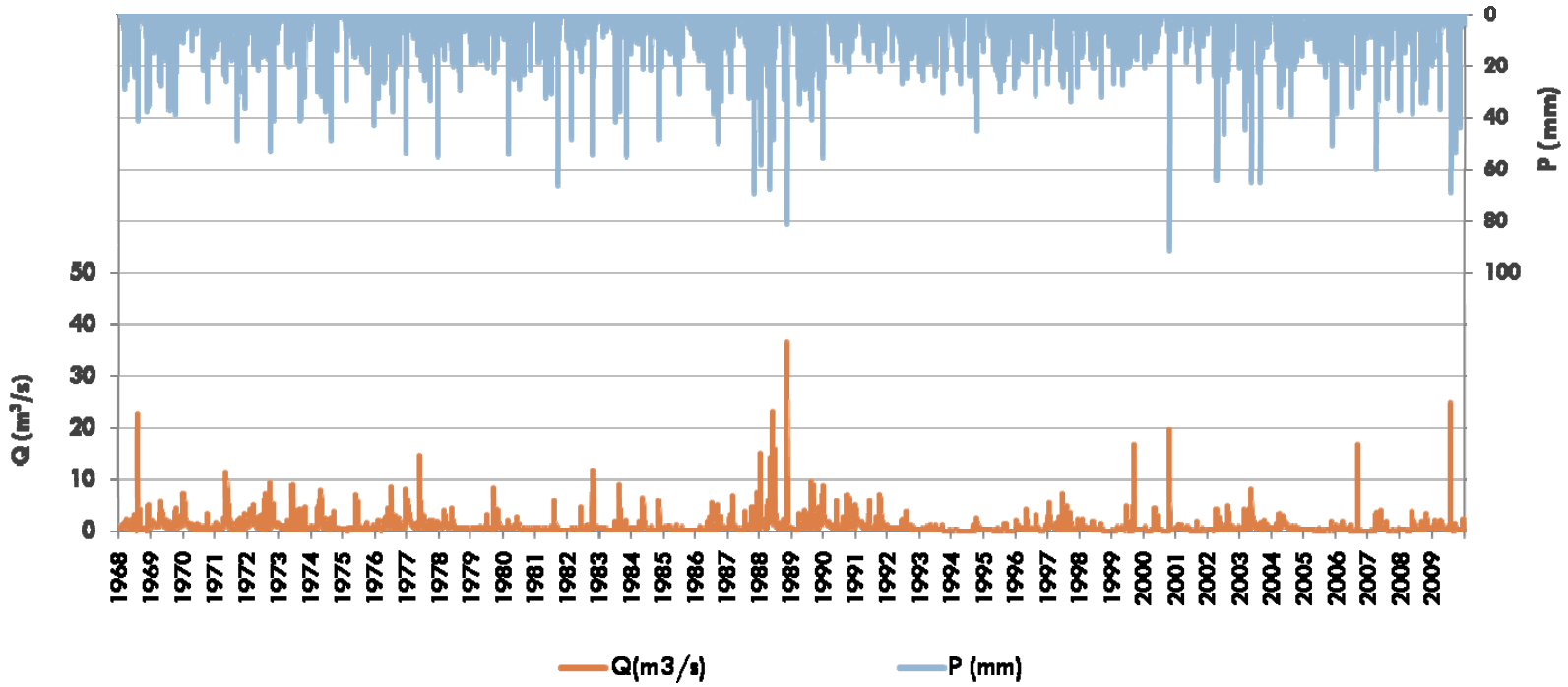
- **P= 506 mm/year**
- **ET_0 = 843 mm/year**

$ET_0 > P$

SEMIARID ENVIRONMENT

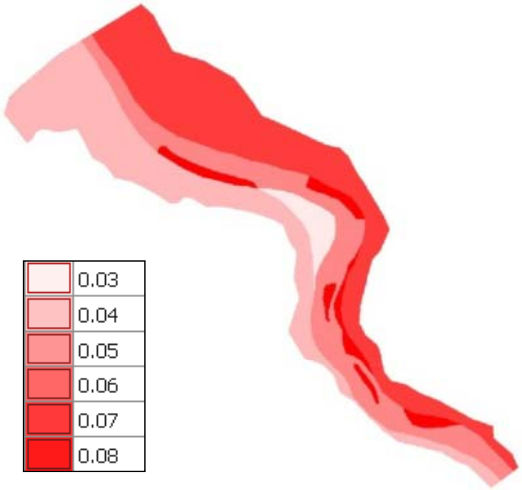
Hidro-meteorological data

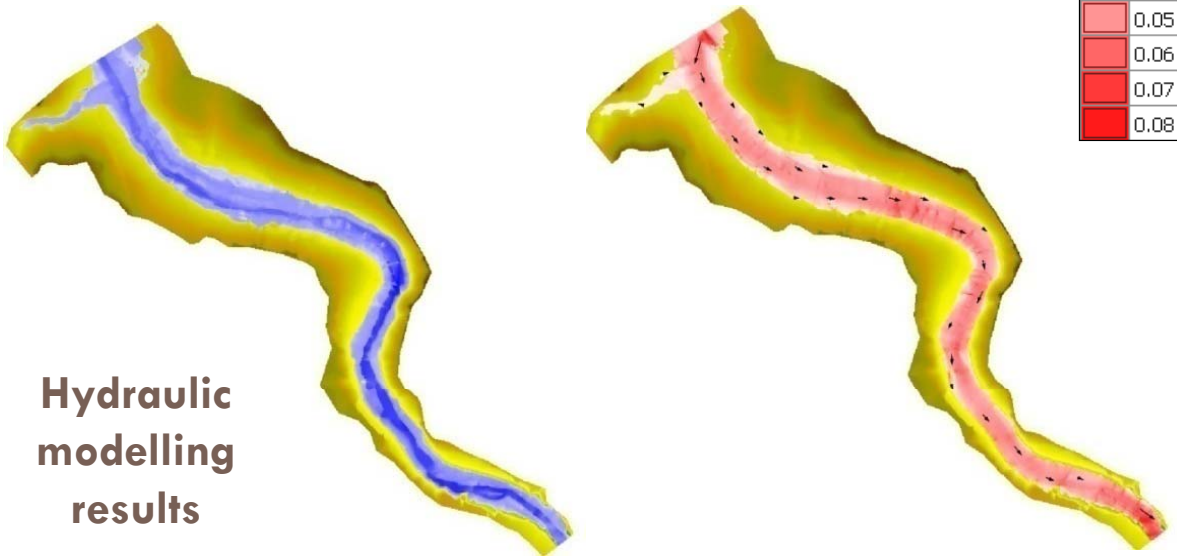
- Daily river discharge (m^3/s) period 1968 – 2009
  - **Q= 0,894 m^3/s**



Hydraulic model: GUAD 2D

- 2D hydraulic simulations
  - Digital elevation model
  - Manning roughness shape



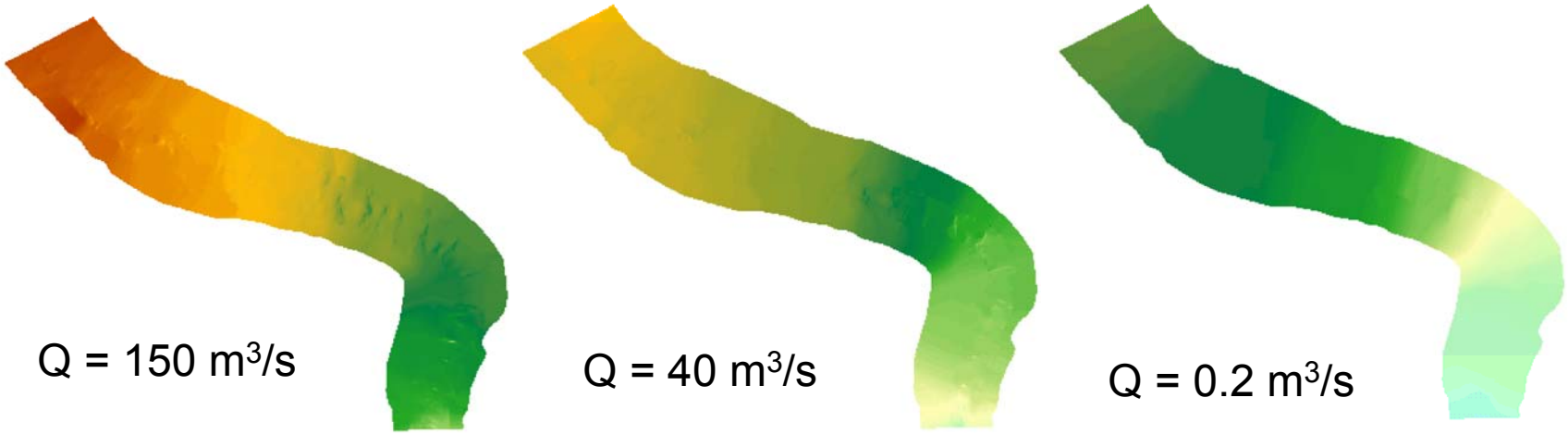


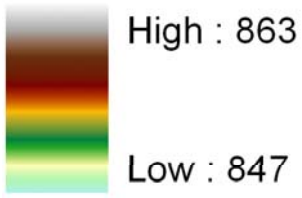
Hydraulic modelling results

Water depths and velocities maps for Q from 0 to 650 m^3/s

Hydraulic inputs to RIPFLOW

- Water table elevations

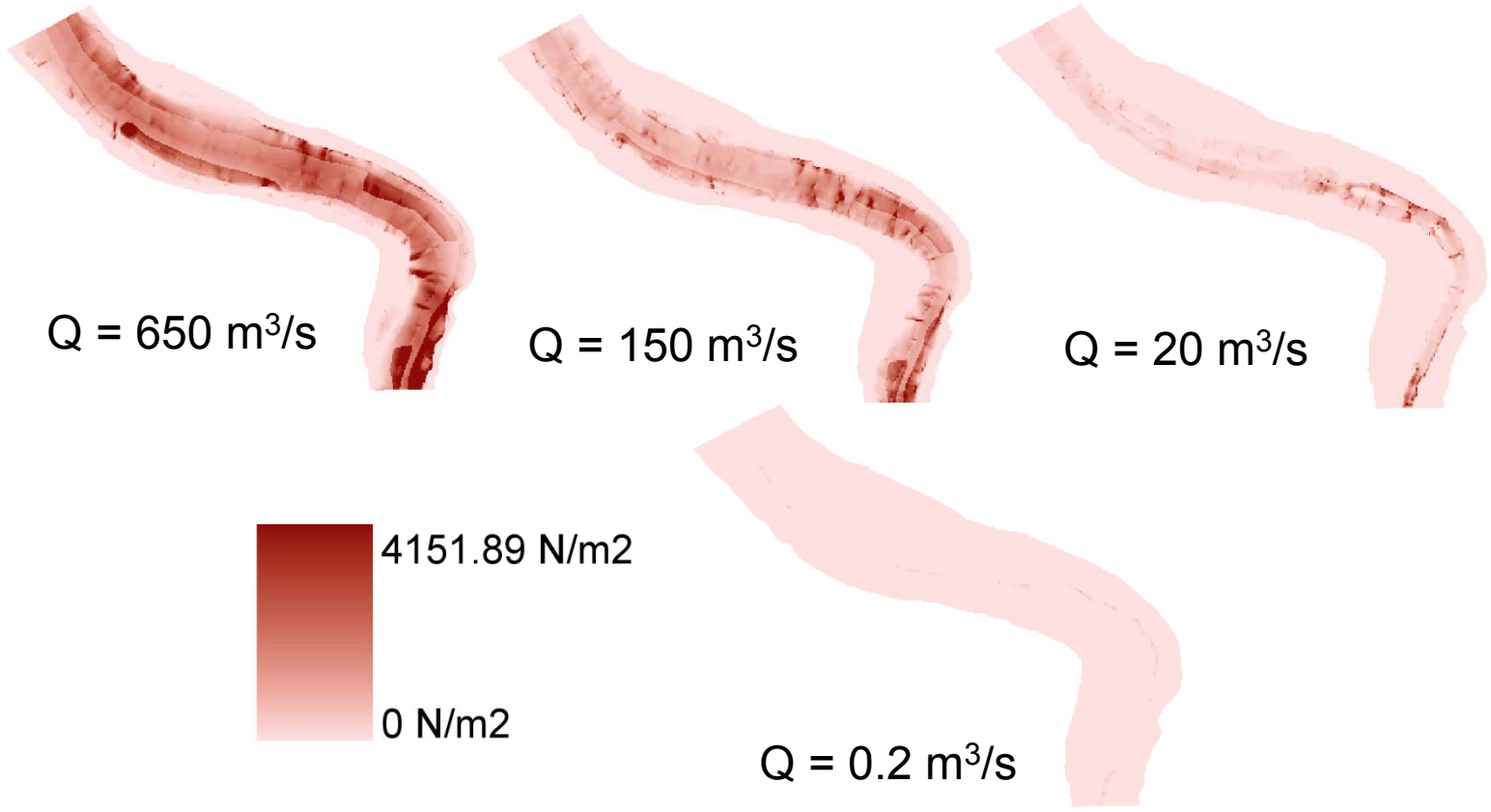




WTE was considered horizontal under the banks

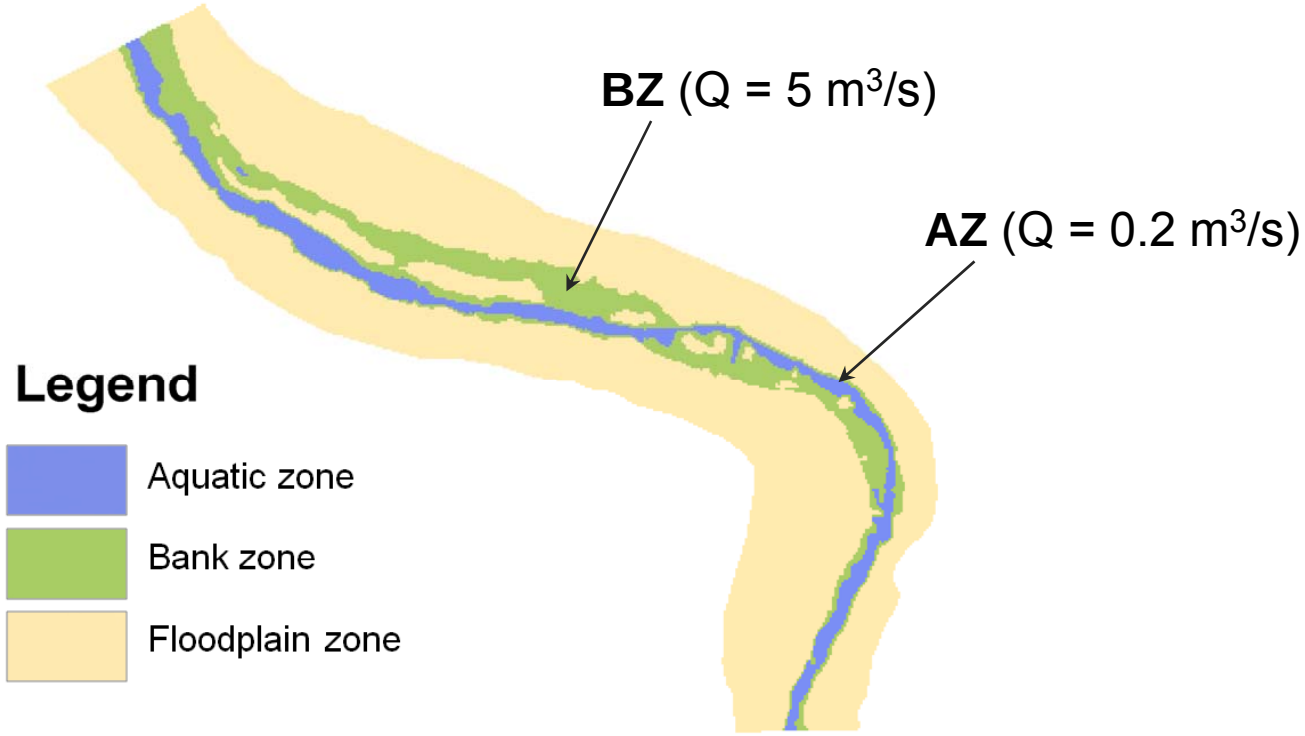
Hydraulic inputs to RIPFLOW

- Shear stress $\tau = \rho \cdot u^{*2}$ where: $u^{*} = 2.102 \frac{v \cdot n}{y^{1/6}}$



Hydraulic inputs to RIPFLOW

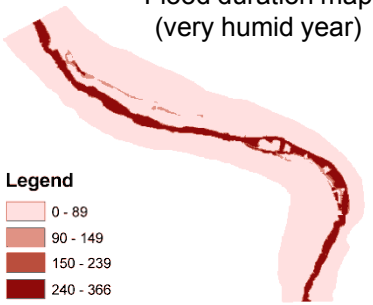
- Definition of aquatic, bank and floodplain zones

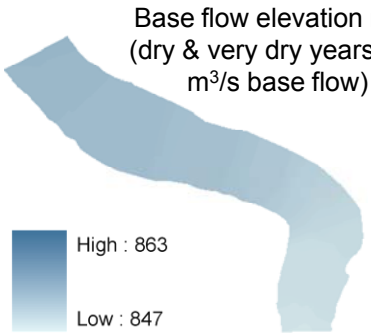


Calibration methodology

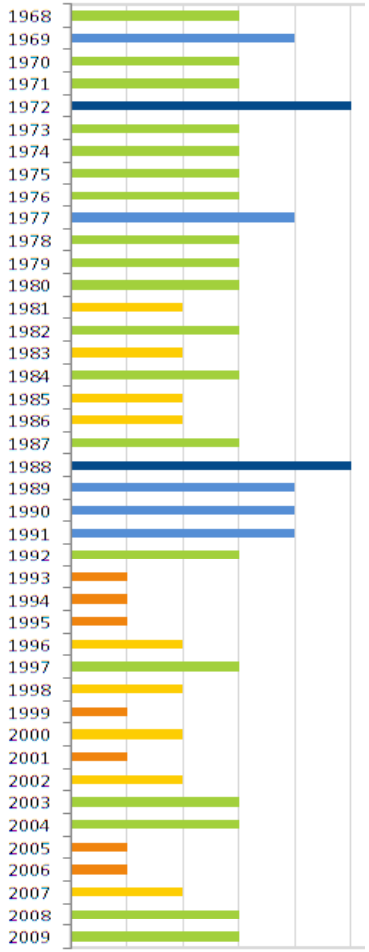
- 42 years (1968 – 2009)
- Starting condition → current vegetation
- Hydraulic maps selection:
  - Flood duration maps
  - Base flow elevation maps

→ Year type clasification



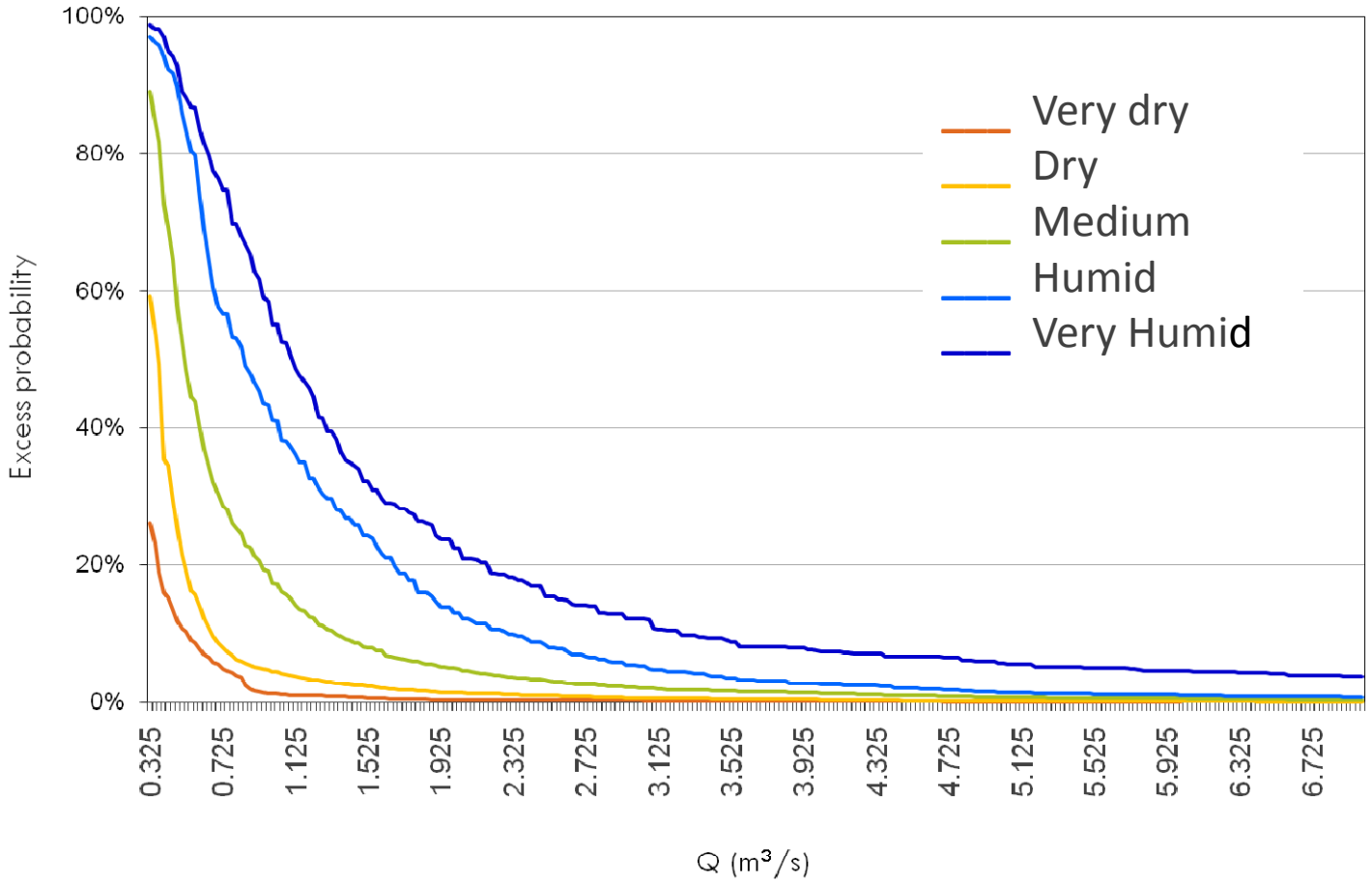


Very dry
Dry
Medium
Humid
Very Humid



- Shear stress maps → maximum instantaneous flow
- WTE maps (soil moisture sub-model) → interpolation

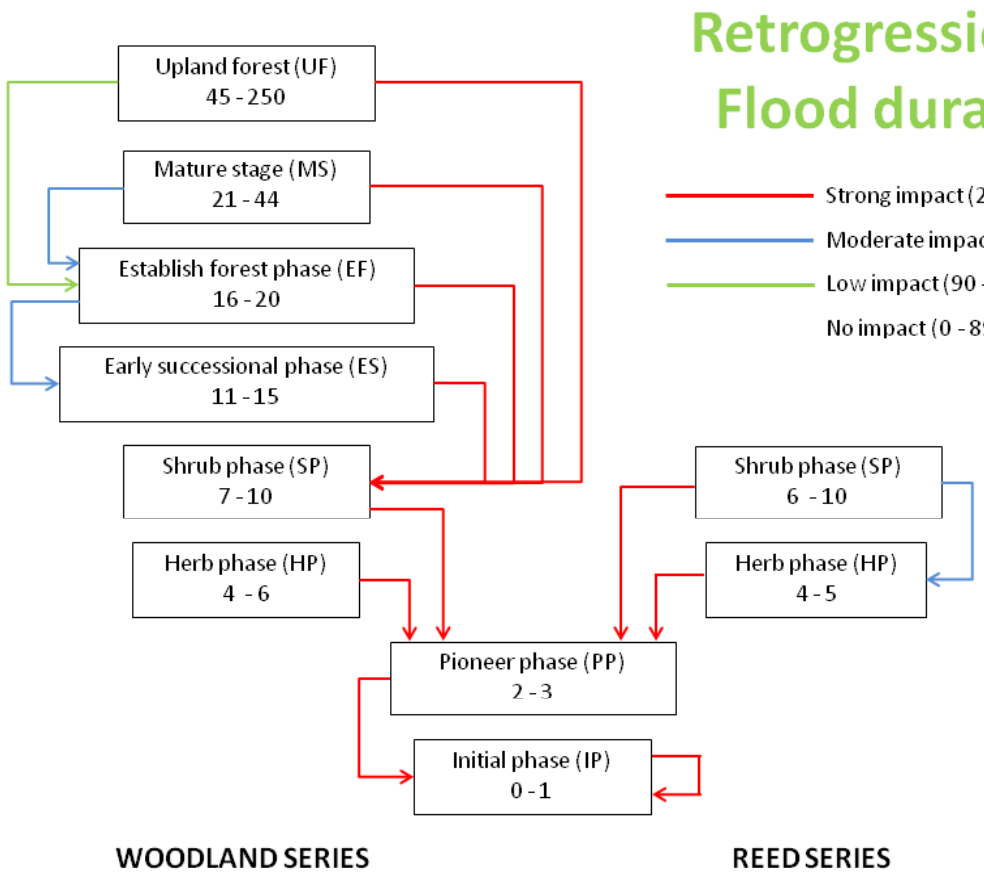
Year type classification

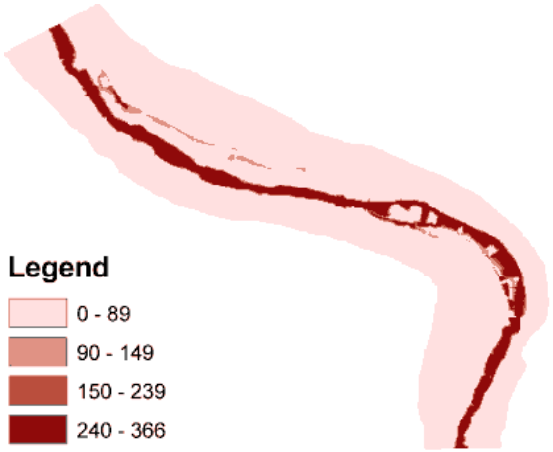


Calibrated Ripflow parameters

Phases	Vegetation parameters		
	SSlim [$N \cdot m^{-2}$]	**ETidx upper limit** [ ]	**ETidx lower limit** [ ]
IP	95	0.5	0.15
PP-HP-HP*	100	0.6	0.4
SP-SP*	150	0.85	0.35
ES-EF-MS	200	0.95	0.15
UF	500	0.95	0.05

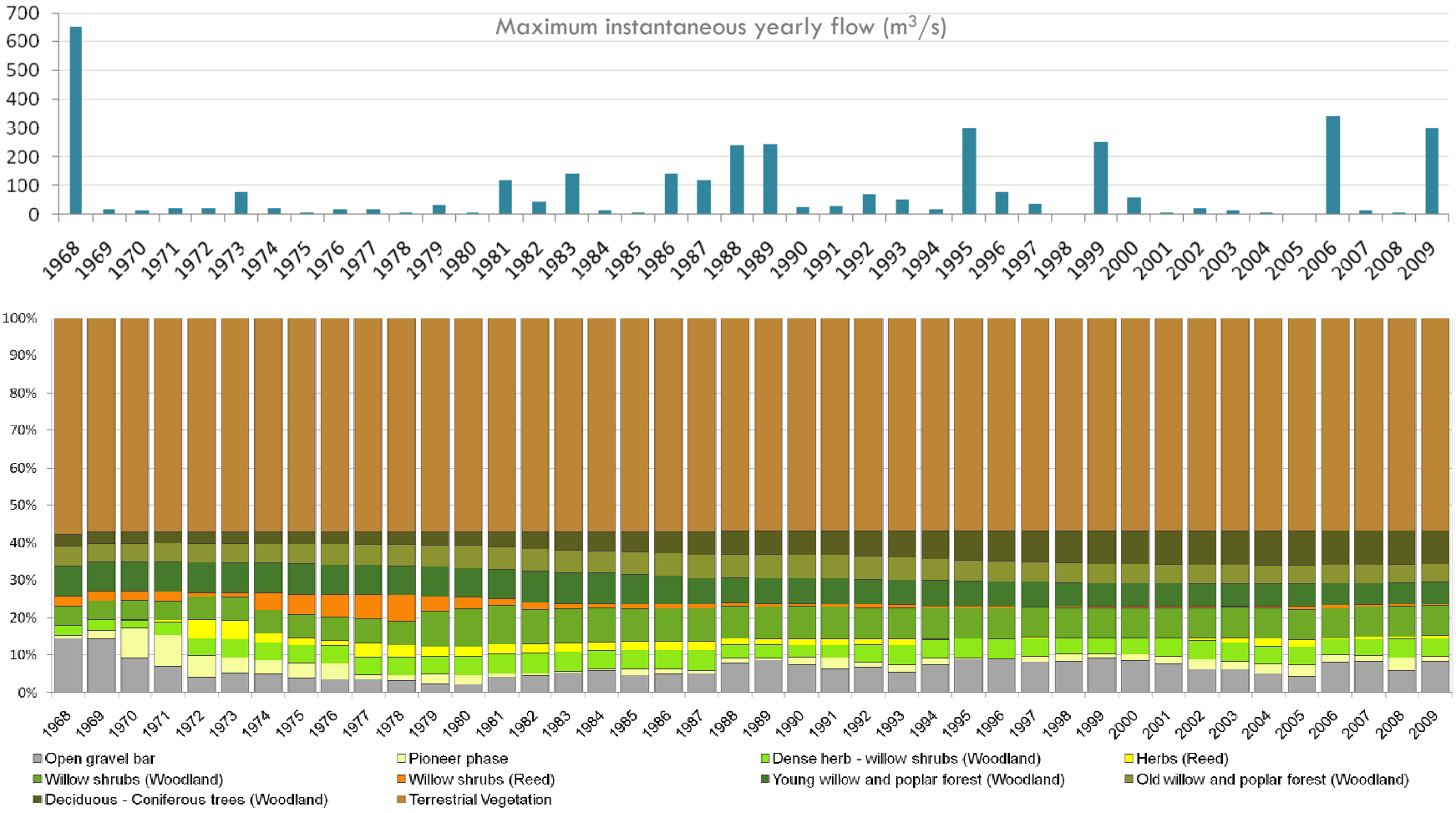
Flood duration sub-model parameters





Parameter	Value (days)
Flood Strong Impacts	240 – 366
Flood Moderate Impacts	150 – 239
Flood Low Impacts	90 – 149
No flood impacts	0 – 89

Vegetation dynamic distribution



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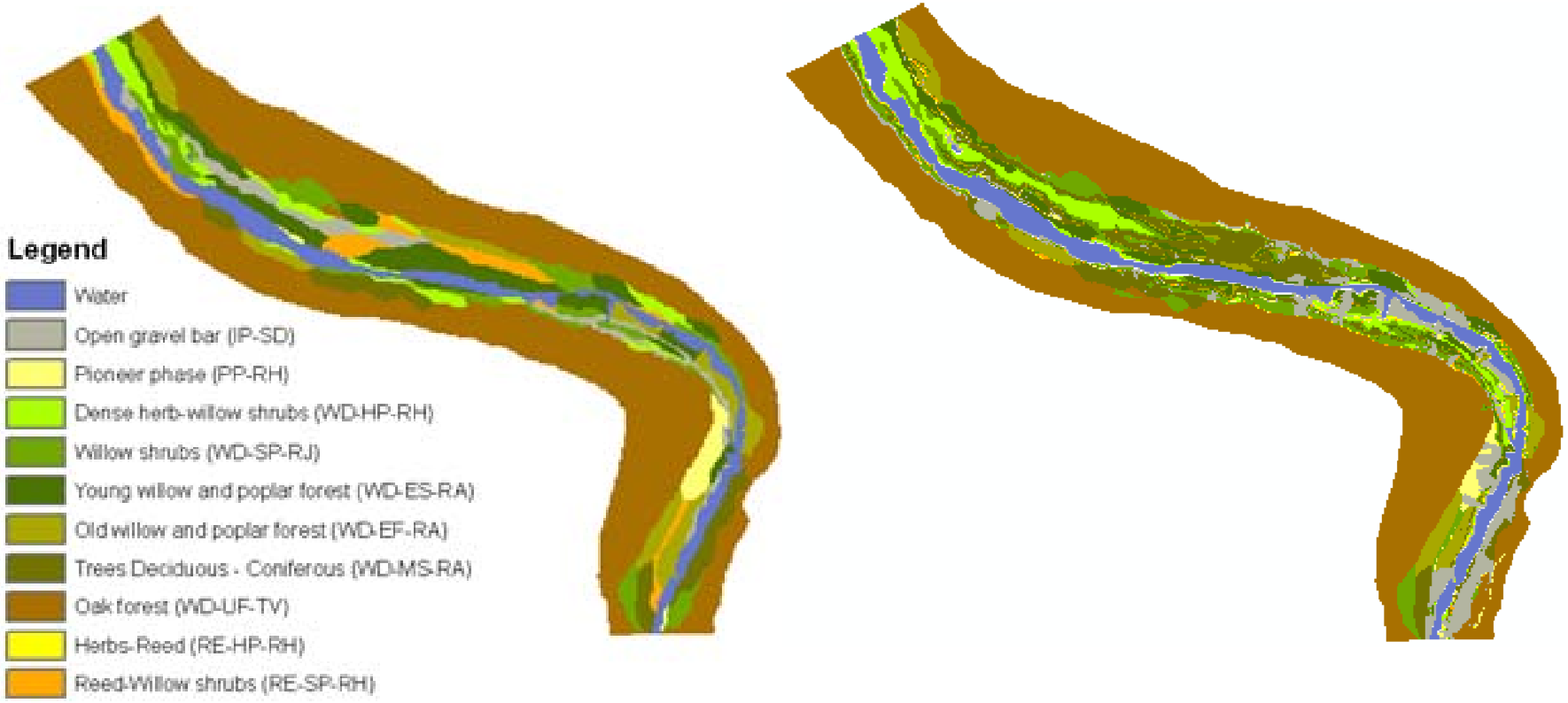
Performance evaluation



Performance evaluation

- Confusion matrix

Table 1. Confusion matrix. Observed vegetation in rows; simulated vegetation in columns.

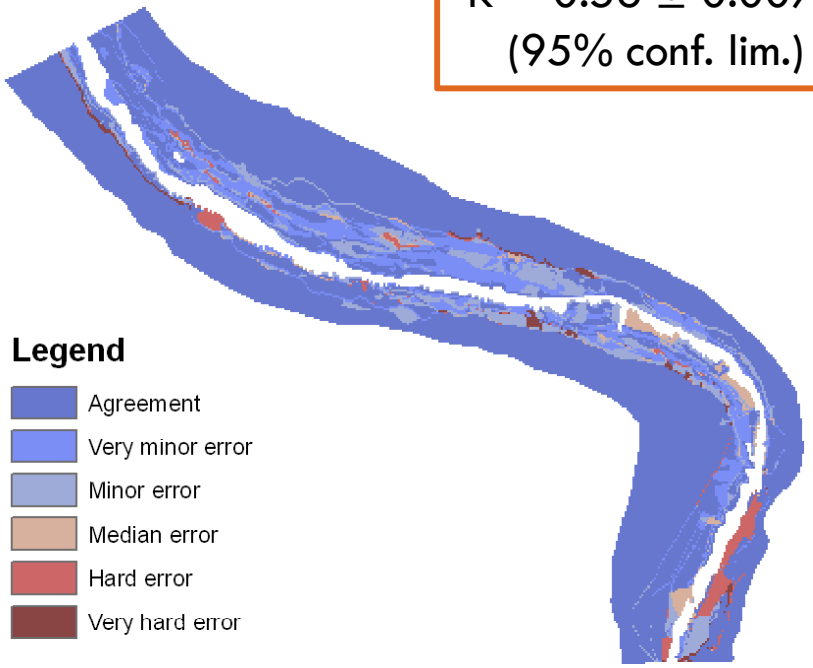
Phases	IP	PP	HP	HP*	SP	SP*	ES	EF	MS	UF
IP	**145**	19	611	29	153	3	131	55	105	0
PP	196	**181**	36	13	38	5	36	1	4	17
HP	243	14	**551**	13	163	3	128	36	98	29
HP*	0	0	0	**0**	0	0	0	0	0	0
SP	335	30	197	19	**931**	12	130	34	164	45
SP*	179	23	75	17	349	**25**	66	81	455	7
ES	313	47	23	16	84	13	**1255**	156	757	59
EF	389	28	22	45	97	22	5	**1112**	229	62
MS	496	12	12	4	78	12	27	13	**750**	4
UF	304	76	41	32	637	46	37	60	205	**17678**

* Reed succession series

main diagonal → 71.86 %
terrestrial vegetation → 93.64 %
riparian vegetation → 98.80 %

- Cohen's kappa → coefficient of agreement, chance effect

K = 0.56 ± 0.0079
(95% conf. lim.)



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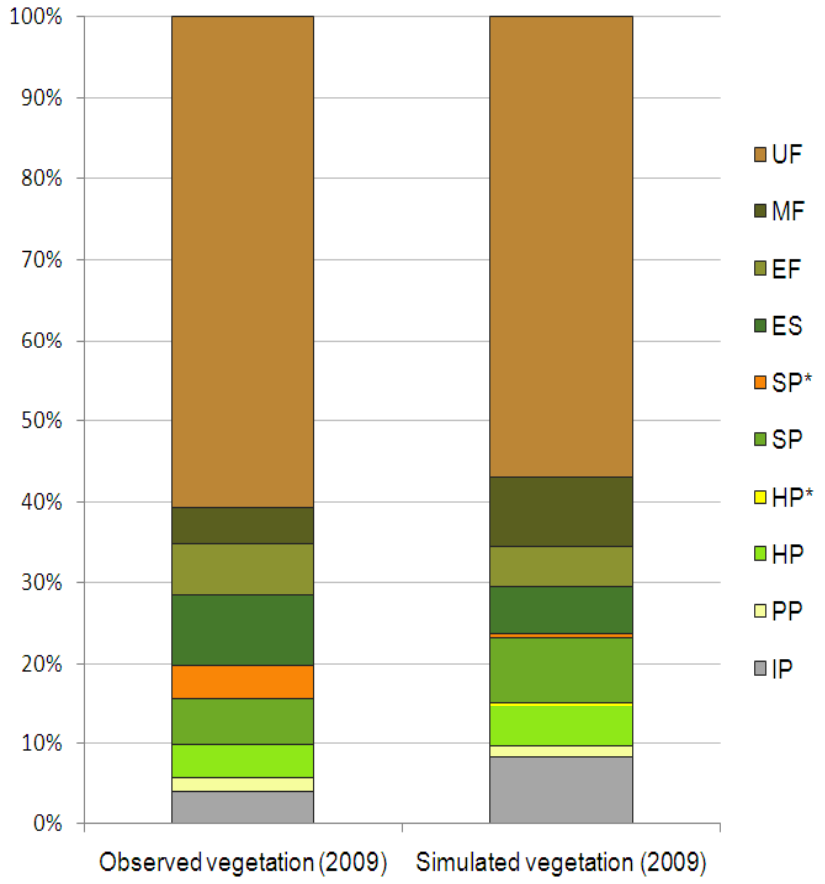

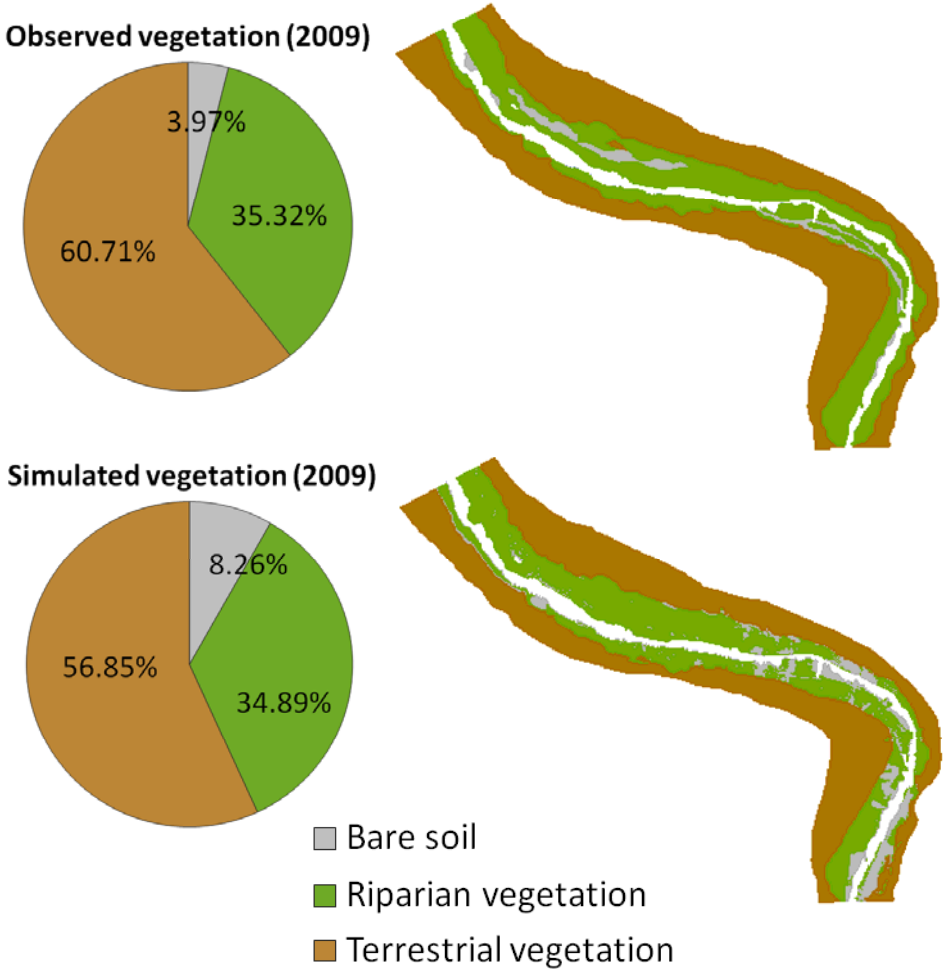

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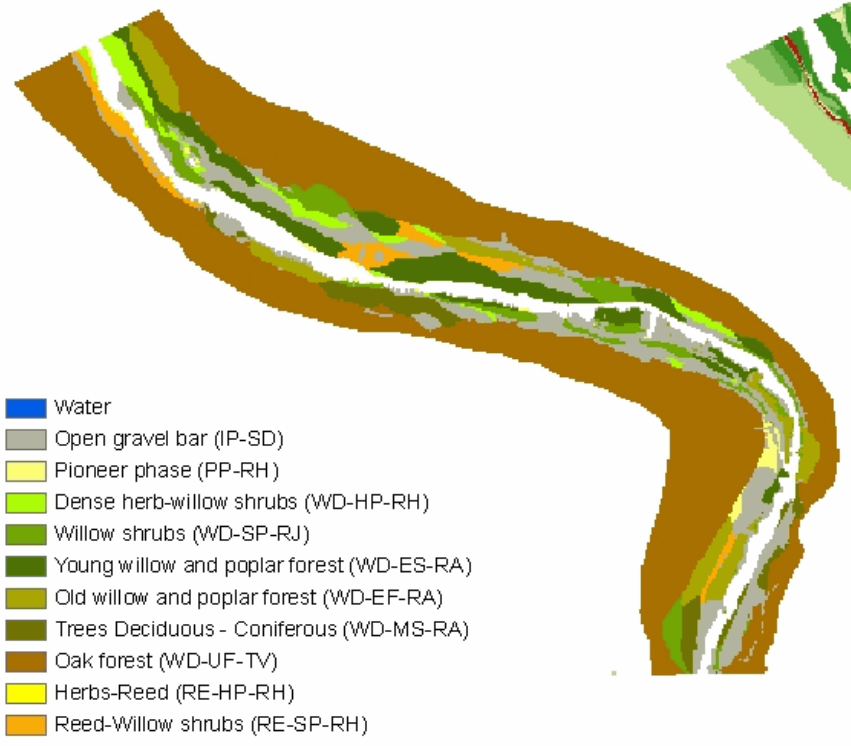
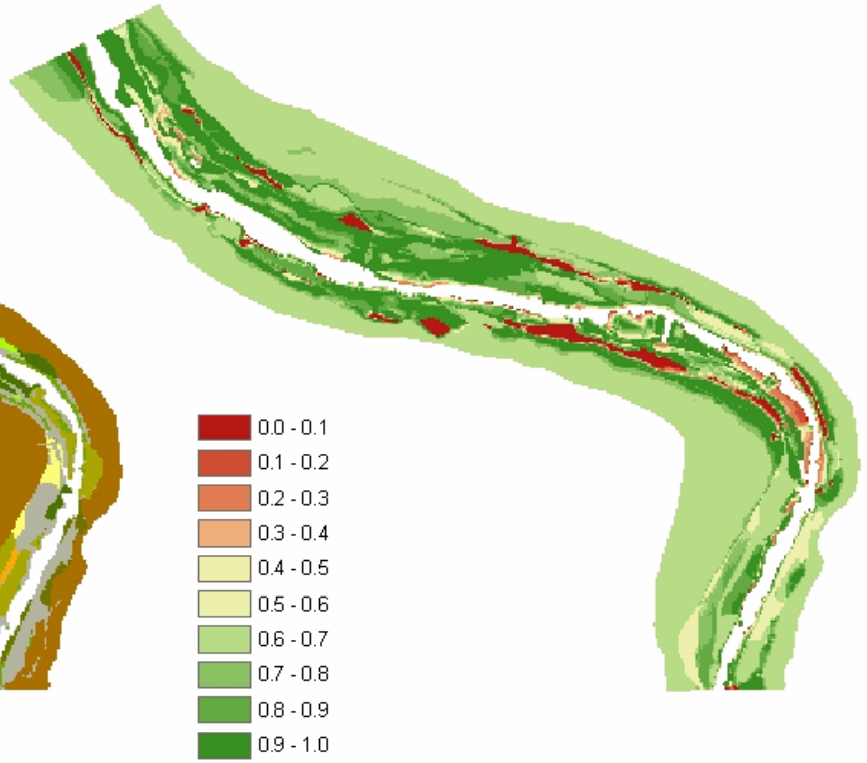
Year 1968





Vegetation phases

Evapotranspiration Index (ETidx)

Conclusions

- The RIPFLOW model was well calibrated:
  - high values of correctly classified instances (71.86 % of the simulated cells)
  - good kappa value (0.56 ± 0.0079, 95 % confidence limit)
  - simulating the vegetation community presence and distribution
  - showing an excellent distinction between riparian and terrestrial bands

- The RIPFLOW model is now available for several hydrological, morphological and climate scenarios analyses
  - in the Terde reach, or in reaches with similar characteristics

Aknowledgements

***RIPFLOW* project:** Riparian vegetation modelling for the assessment of environmental flow regimes and climate change impacts within the WFD. Era-net IWRM Funding Initiative, Acciones Complementarias del MEC (ref.: CGL2008-03076-E/BTE)
http://www.iiama.upv.es/RipFlow/index.htm

SCARCE project: Assessing and Predicting Effects on Water Quantity and Quality in Iberian Rivers caused by Global Change. CONSOLIDER Plan, Ministerio de Ciencia e Innovación (ref.: CSD2009-00065).
http://www.idaea.csic.es/scarceconsolider

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THANK YOU FOR YOUR ATTENTION

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