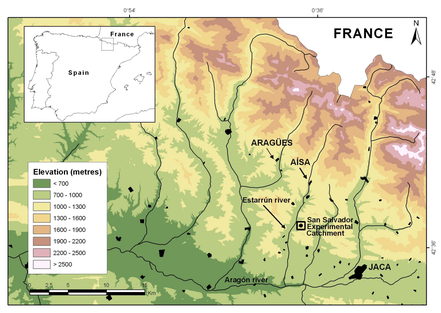
San Salvador catchment

Upper Aragón valley, Spain

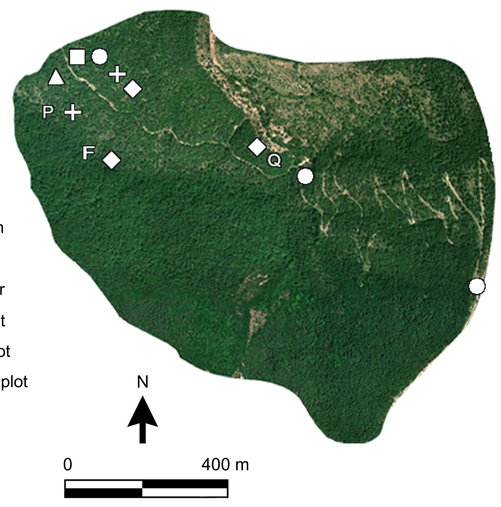
Basin characteristics

River Basin / River Basin (according EU-WFD)	Estarrún river basin/ Aragón river basin
Operation (from… to…)	Since 1998, still in operation
Gauge coordinates / Gauge datum:	42º37'51" N/0º38'33" W m a.s.l.
Catchment area:	0.92 km²
Elevation range:	878-1325 m a.s.l.
Basin type: (alpine, mountainous, lowland)	Mountainous
Climatic parameters: (mean precipitation, temperature and others)	929,7 mm (1999-2006)
Land use:	98% forest, 1% shrubs, 0% grass, 1% bare soil
Soils:	Regosols, Cambisols, Kastanozems and Phaeozems
Geology:	Eocene flysch
Hydrogeology: (Type of aquifers, hydraulic conductivity)	Limestones
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	0.0 l/s, 6,45 l/s, 1200 l/s

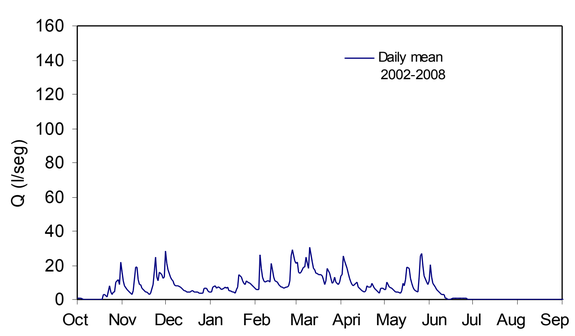
Map of the research basin

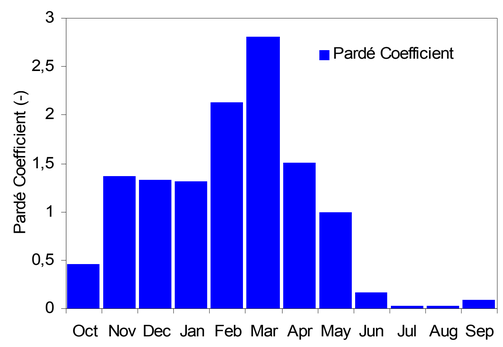


- Rainfall recorder
- Gauging station
- Meteorological station
- TDR profile
- Recording piezometer
- Pinus interception plot
- Fagus interception plot
- Quercus interception plot



Mean hydrograph / Pardé flow regime

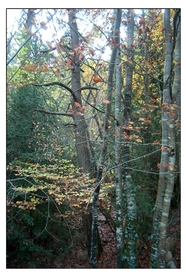




Special basin characteristics (hydrogeology, lakes, reservoirs etc.)

The entire catchment is covered by a dense forest of *Pinus sylvestris, Fagus sylvatica* (in the shady concavities) and *Quercus gr. faginea* (areas with a sunny aspect). Soils are relatively deep (generally in excess of 50 cm), more in the shady than in the sunny aspect, where some evidence of old agricultural activities appears, particularly in the lowest part.

Few contrasts can be found between the north- and the south-facing slopes of the catchment.



Instrumentation and data

Measured hydrological parameters	Measuring period	Temporal resolution	Number of stations
Stream flow	1999 – cont.	5 min	1
Precipitation	1999 – cont. 2005 – cont.	5 min Impuls/ 0.2 mm	1 2
Air temp., Air hum, wind speed, radiation	1999 – cont.	15 min	1
Groundwater level	2005, 2007 – cont	20 min	2
Soil temp.	2007 – Cont	20 min	2
Throughfall	2006 – 2007 – 2008	At event scale 2/3 month	3
Stemflow	April 2006 – 2007 – March 2008	At event scale 2/3 month	3
Soil water moisture	2008 – Cont	20 min	3

Main scientific results

1. Rainfall and runoff show a strong non-linearity during the hydrological year; streamflow response is determined by catchment moisture conditions, in particular by water-table dynamics.
2. The water table level seems to have a large influence on the discharge: the discharge of the San Salvador catchment only increases in the event of rainfall when the soil is previously saturated, that is, when the water table is close to the soil surface at the start of the rainfall event. It is interesting to note that the water table level undergoes intense fluctuations, with sharp falls once rainfall has ceased.
3. The rainfall events at the beginning of the hydrological year (autumn) produce no or only a very limited hydrological response in the catchment, even though they are relatively intense. This should be attributed to the exhaustion of the water reserves by the previous dry period and the high water consumption by vegetation.
4. The only high flow period in San Salvador arises in spring and coincides with the long rainy period with continuous rainfall from the season.
5. There is no discharge increase in the San Salvador catchment at the end of the hydrological year.
6. The discharge responses to rainfall events are very variable, in the range 0 to 1300 Ls^{-1} km^{-2}, and are not related to the volume or intensity of rainfall.
7. Most sediment exported from the San Salvador catchment is in the form of solutes (75% of the total), and the rest is suspended sediment. There is no bedload.
8. Throughfall (the precipitation that falls directly to the ground) is important in the basin of San Salvador due to the dense cover of forest. Throughfall depends on the type of tree and on the season. In summer it represents 71,7 % of the rainfall under beech, whereas in winter it increases up to 83% under the same type of tree ; 81,85 % under oak and 82,19 % under pine. Such differences are related to the percentage of coverage of each one of the species in every season of the year. Thus, in summer the coverage in the beech plot is 95 %, in the oak plot is around 73 % and in the pine plot is slightly lower, 54 %. In winter the coverage in the decidious tree plot is only 49% and in the oak plot is 40%. Pine cover remains relatively stable the whole year and therefore throughfall does not show seasonal differences. Although oak coverage decreases in winter, througfall under oak remains more or less stable during the whole year.

Key references for the basin

1. Serrano-Muela MP, Regüés D, Latron J, Martí-Bono C, Lana-Renault N, Nadal-Romero E. 2005. Hydrological response of a forest catchment in the Pyrenean middle mountain: The San Salvador case study. Cuadernos de Investigación Geográfica 31:59-76.
2. M.P. Serrano-Muela, N. Lana-Renault, E. Nadal-Romero, D. Regüés, J. Latron, C. Martí-Bono, and J.M. García-Ruiz. Forests and their hydrological effects in mediterranean mountains: the case of the central Spanish Pyrenees. Mountain Research Development, 876, issue 28. 3/4. 279-285.
3. José M. García-Ruiz, David Regüés, Bernardo Alvera, Noemí Lana-Renault, Pilar Serrano-Muela, Estela Nadal-Romero, Ana Navas, Jérôme Latron, Carlos Martí-Bono, José Arnáez (2008) Flood generation and sediment transport in experimental catchments affected by land use changes in the central Pyrenees. Journal of Hydrology, Volume 356, Issues 1-2, 1, pp 245-260.

Contact

P. Serrano-Muela, Dr. D Regüés, Dr. JM García Ruiz
Instituto Pirenaico de Ecología, CSIC, Campus de Aula Dei, Apdo. 13034, 50080 Zaragoza, Spain
pili@ipe.csic.es, dregues@ipe.csic.es, humberto@ipe.csic.es