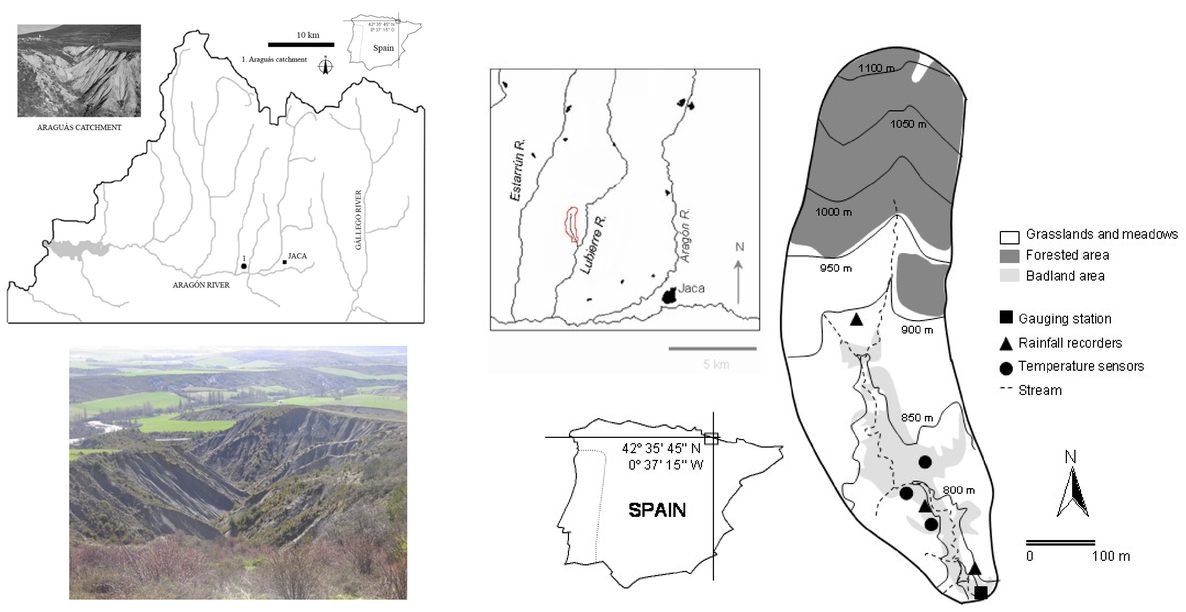
Araguás catchment

Upper Aragón Valley, Spain

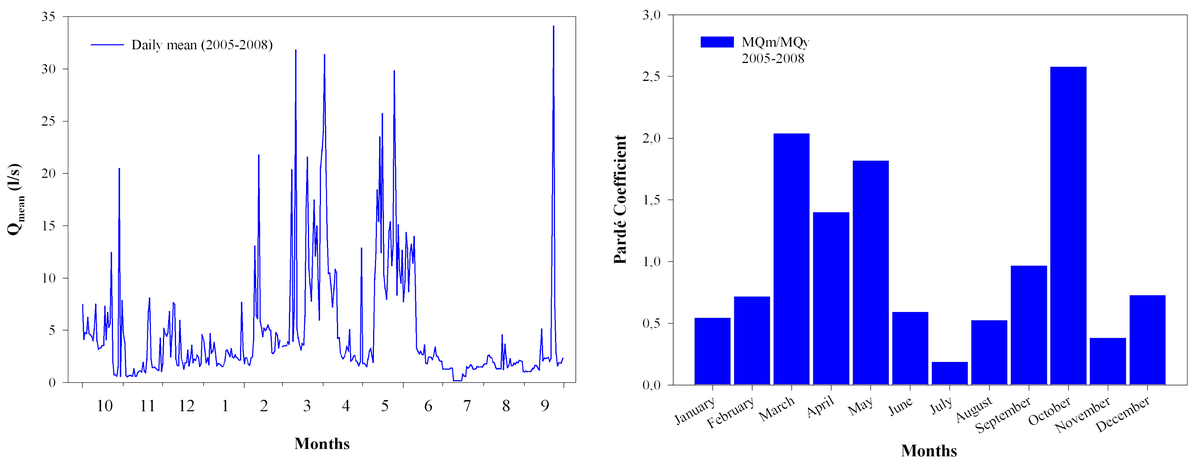
Basin characteristics

River Basin / River Basin (according EU-WFD)	Lubierre river basin/ Aragón river basin
Operation (from… to…)	Since 2004, still in operation
Gauge coordinates / Gauge datum:	42° 35' 45''N; 0° 37' 15''W/ 917 m a.m.s.l.
Catchment area:	0.45 km^2
Elevation range:	780-1105 m a.m.s.l.
Basin type: (alpine, mountainous, lowland)	mountainous
Climatic parameters: (mean precipitation, temperature and others)	800 mm (1976-2006), 11.4 °C (1976-2006)
Land use:	45.3% shrubs, grassland and meadows, 27.5% forest, 27.2% badlands
Soils:	Regosoil, Haplic Kastanozem
Geology:	Eocene marls and Eocene Flysch
Hydrogeology: (Type of aquifers, hydraulic conductivity)	
Characteristic water discharges: (Q_{min}, Q_{max}, Q_{mean})	0 l/s, 2050 l/s, 3.09 l/s

Map of the research basin



Mean hydrograph / Pardé flow regime



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

The Araguás catchment is characterized by the presence of a dense network of badlands in its lower part. The upper part of the catchment was cultivated until the middle of the 20th century, before being reforested with *Pinus sylvestris* and *Pinus Nigra*. Nowadays, 30% of the catchment is covered by forest.

A gauging station measures discharge and sediment output at the outlet of the catchment and a water-level probe, installed above the badland areas, controls the hydrological response of the forested and upper part of the catchment.

Instrumentation and data

Measured hydrological parameters	Measuring period	Temporal resolution	Number of stations
Air temperature and precipitation	February 2004-cont	30 minutes	2 and 3
Regolith physical indicators and moisture	February 2004-January2007	Weekly	2 sampling plots
Regolith temperature	February 2004-cont	30 minutes	2
Stream flow	October 2005-cont	5 minutes	2
Suspended concentration	October 2005-cont	5 minutes	1
Solute concentration	October 2005-cont	Event dependent	Event base

Applied models

None

Main scientific results

1. The Araguás catchment is characterized by the presence of a Mediterranean humid badland areas, with intense processes of weathering, hillslopes erosion and sediment transport.
2. The relatively high values of annual precipitation in combination with contrasting trends in temperature and moisture at different temporal scales, and easily weathered bedrock (Eocene marl) explain the capacity of the catchment to yield and deliver high quantities of sediment.
3. Clear seasonal weathering dynamics were observed, with the most active weathering processes in winter when hillslopes regolith becomes increasingly susceptible to erosion.
4. The seasonal trend of sediment transport dynamics was linked to weathering and erosion temporal processes and discharge distribution.
5. The hydrological response tends to be related with different land uses and to rainfall characteristics (rainfall intensity and rainfall volume).
6. Runoff generation occurs throughout the year, even during summertime.
   i. During dry conditions, infiltration excess runoff process (Hortonian flows) was found to be the only active runoff processes occurring in response to short and intense rainstorms, and the hydrological and sedimentological response was limited to badland areas.
   ii. During wet periods, both infiltration excess runoff and saturation excess runoff were the runoff processes operating within the catchment. Saturation excess is the only mechanism on the forested area.
7. Badlands areas in the Araguás catchment always yield significant volumes of sediment. Nevertheless, most of the annual sediment yield was a result of just a few precipitation events.
8. The values of sediment outputs recorded during a hydrological year were about 57000 Mg km^{-2} yr^{-1}.

Key references for the basin

1. Nadal-Romero, E. & Regüés, D. 2009. Detachment and infiltration variations as consequence of regolith development in a Pyrenean badland system. *Earth Surface Processes and Landforms*.
2. Nadal-Romero, E. 2008. Las áreas de cárcavas (badlands) como fuente de sedimento en cuencas de montaña: procesos de meteorización, erosión y transporte en margas del Pirineo Central. Phd Tesis. Zaragoza
3. Nadal-Romero, E., Regüés, D., Latron J. (2008). Relationships among rainfall, runoff and suspended sediment in a small catchment with badland areas. *Catena*, 74: 139-150. doi: 10.1016/j.catena.2008.03.014.
4. Nadal-Romero, E., Latron, J., Lana-Renault, N., Serrano-Muela, P., Martí-Bono, C., Regüés, D. (2008). Temporal variability in hydrological response within a small catchment with badland areas, Central Pyrenees. *Hydrological Science Journal*, 53 (3): 629-639.
5. Nadal-Romero, E., Latron, J., Martí-Bono, C., Regüés, D. (2008). Temporal distribution of suspended sediment transport in a humid Mediterranean badland area: The Araguás catchment, Central Pyrenees. *Geomorphology*, 97 (3-4): 601-616. doi:10.1016/j.geomorph. 2007.09.009.
6. Nadal-Romero, E., Regüés, D., Martí-Bono, C., Serrano-Muela, P. (2007). Badland dynamics in the Central Pyrenees: temporal and spatial patterns of weathering processes. *Earth Surface Processes and Landforms*, 32 (6), 888-904.

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