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PRECIPITATIONS AND FLOODS IN THE JARAMA-TAJO BASIN (CENTRAL SPAIN) IN THE LATE 16TH CENTURY

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The study site is located in the centre of the Iberian Peninsula. It forms part of the basin of the river Jarama, a tributary of the river Tagus. This river drains the territory of Madrid and, at the southern border of the area, it joins with the Tagus.

Some sections of the rivers studied possess a snow regime, as their heads are situated in mountain areas, and other sections present torrential drainage, with a high erosive capacity, as they start on flatlands and moors lying upon unconsolidated sediments, situated to the south of the mountains of the Central System. The current regulation system, with numerous reservoirs upriver, has modified the natural circulation of the waters. The numerous interventions and extractions of sand and gravel in the channels and on the riverbanks have eliminated many of the sediment records that had accumulated on the floodplain.

The rivers present great mobility within the floodplains they have shaped. The land uses and other human actions developed in these riparian zones since at least medieval times have been adapted to the changing fluvial dynamics, and many of the events related thereto are reflected in written and graphic documents: «*And the above mentioned Jarama river is therefore variable and tends to move away from its mother and flow elsewhere*» (16th August, 1579. General Archive of *Simancas Casas y Sitios Reales*. *Legajo* 247. *Folio* 189). This study is based upon the data contained in different documentary sources, to be found in different state, religious and municipal archives and which refer specifically to the study area.

1. WORK METHODS

These are organised into two main lines:

1.1. Analysis of graphic documents and texts, with the aim of learning of all the aspects related with the modification of the form and localisation of permanent channels, as well as their connection with land uses and with the legal boundaries of land.

1.2. Numerical transformation and statistical treatment of the data explaining different precipitation events, droughts or river floods. We considered successively:

a) Interpretation of the data. For each datum we considered an intrinsic meaning and the possibilities of it supporting or completing the interpretation of others. We differentiated among direct, mixed and indirect data.
b) Determination of numerical indices. Each event referring to one of the contents selected is valued according to its intensity. Likewise, the duration of the precipitations, the hydrological importance of the course effected and the regional or local extent of the floods described are taken into account.
c) Definition of the series of precipitation, droughts and floods and statistical treatment thereof.

2. RESULTS

We collected information on three types of floods: 1. Habitual floods,that cover the floodplain with very little height and hardly cause any damage. 2. Extraordinary floods, caused by intense rains or snowmelt, causing the river to burst its banks, as occurred in 1556-57, 1586-87, 1593-94 y 1595-96. 3. Flash floods: The ones detected occurred in summer months, caused by short intense precipitation giving rise to sudden increases in water flow.

The new sediments formed by the rivers are incorporated into the whole territory exploited without destruction of the pre-existing agricultural structures. Likewise, many of the old boundaries of fields or land that were demarcated by abandoned channels are maintained.

The series has been reduced to the years in which most information was available (1554-1599) and has been smoothed by means of moving averages for 5 periods. The result indicates that there are several intensity/duration groups of precipitations situated above and below the normal value. The most significant positive group, with maximum standard deviations, developed from 1557 to 1574, the second one occurred from 1585 to 1591. Among the negative groups, the one from 1577 to 1584 presents an extreme value in 1584, but as a whole is less intense than the one from 1592 to 1599, in which 5 years have values lower than -2 points of the normal value. The series of floods shows that from 1564 to 1573 there was an increase in floods, a sharp decline therein from 1574 and 1584, as they fall below the normal value, and that between 1591 and 1599 they exceed the normal value.

The floods that occurred from 1557 to 1573 coincide with groups of years presenting maximum precipitation intensity; the few and scant floods from 1574 to 1584 coincided with a lower precipitation intensity; but the most abundant floods from 1585 to 1599 took place in a general context of noteworthy droughts and a lack of precipitation.

3. CONCLUSIONS

The fluvial modifications that take place on the floodplains studied are inscribed in the agricultural structures and land boundaries developed therein. Reconstruction of these structures and boundaries enables us to establish, at secular scale, the evolution of the changes that occur in form and localisation.

Three different types of floods have been detected. The most habitual ones are generally beneficial and the different land uses and historical techniques for conditioning and discharge control have been adapted to them. Extraordinary floods cause serious damage and eventually modify the layout of the water courses. Flash floods, the consequence of intense precipitation, have been infrequently described in this fluvial system, and they should be taken into account on determining the potential risks of this sector.

Three sets of years with different hydrological significance have been differentiated:

1. From 1557 to 1575, with regular precipitation distributed from autumn to spring, which generally causes lower-intensity floods than what is to be expected, considering the intensity of the precipitation.
2. From 1576 to 1584 very intense drought and few floods.
3. From 1585 to 1599 alternating droughts and very intense precipitation, associated with big floods.

The rains do not always fall at a suitable moment for cereal growth and that they are not of the necessary intensity and regularity, either, for the water to be absorbed into the soil. This is interpreted as a typical feature of the runoff in the Mediterranean environments to which the rivers studied belong.

The set of temperature and rainfall data complete a scenario presenting well-defined climatic conditions. Superposition of the results of the previously performed temperature analyses and those referring to precipitations show that the second half of the XVI century presented clear climatic contrasts.

1554-1556	Years of drought interspersed with periods of abundant rainfall. Succession of floods and low waters
1557-1575	Wet characters. Intense precipitation; frequent and generally not very intense floods
1576- 1584	Dominance of dry years. Few floods in the rivers.
1585-1599	Dominance of dry years alternating with others with abundant rainfall. Very intense floods.