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3 **SIMULATION OF AUTOMATIC CONTROL OF AN IRRIGATION CANAL**4 D. Lozano^a, C. Arranja^b, M. Rijo^b, L. Mateos^{a*}5 ^a*Instituto de Agricultura Sostenible, CSIC, Córdoba, Spain*6 ^b*Departamento de Engenharia Rural, Universidade de Évora, Portugal*

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8 **Abstract**

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10 Improved water management and efficient investment in the modernization of irrigation schemes
11 are essential measures in many countries to satisfy the increasing demand for water. Automatic
12 control of the main canals is one method for increasing the efficiency and flexibility of irrigation
13 systems. In 2005, one canal in the irrigation scheme ‘Sector BXII del Bajo Guadalquivir’ was
14 monitored. This canal is representative of irrigation schemes in Southern Spain; it is divided into
15 four pools and supplies an area of 5,154 ha. Ultrasonic sensors and pressure transducers were
16 used to record the opening of gates and water levels at the upstream and downstream ends of
17 each canal pool. Using the recorded data and the SIC (Simulation of Irrigation Canals) hydraulic
18 model, two canal control options (local upstream control and distant downstream control) were
19 evaluated using a Proportional-Integral control algorithm. First, the SIC model was calibrated
20 and validated under steady-state conditions. Then the proportional and integral gains of the PI
21 algorithm were calibrated. The controllers were tested using theoretical demand changes
22 (constant outflow followed by a sudden demand increase or decrease) and real demand changes
23 generated on the basis of a spatially distributed crop water balance that included a number of
24 sources of variability (random and not random) in the determination of field irrigation timing and
25 depth. The results obtained show that only the distant downstream controller was able, quickly
26 and automatically, to adjust the canal dynamics to the varying water demands; it achieved this
27 efficiently and with few spills at the canal tail, even when there were sudden and significant flow
28 variations.

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30 Keywords: flexibility of water delivery, on-demand operation, local upstream control, distant
31 downstream control, proportional-integral controller