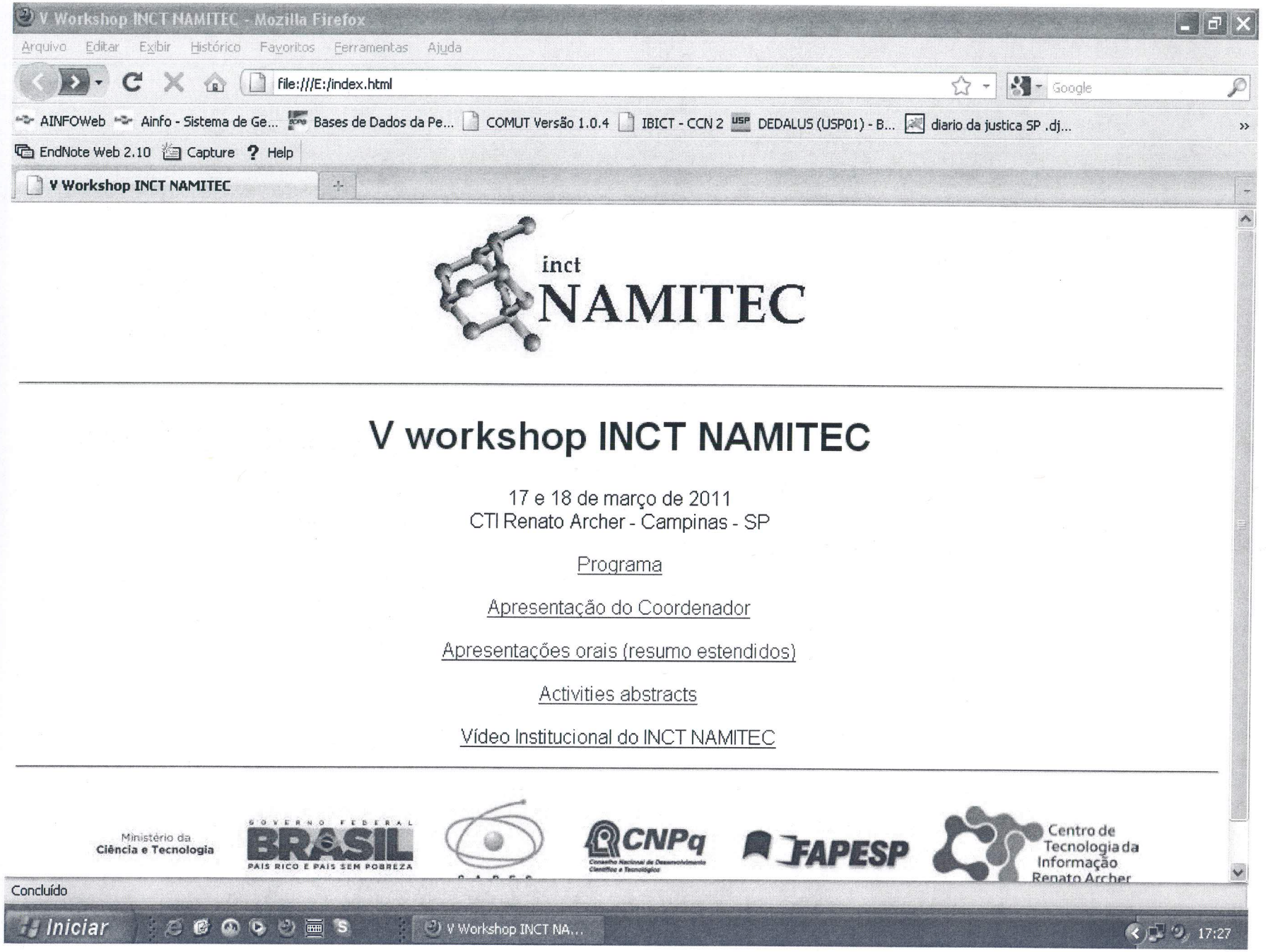
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A1.4 PRECISION IRRIGATION

Dr. Andre Torre-Neto (Embrapa), activity leader
Dr. Ladislau Marcelino Rabello (Embrapa), researcher
Danilo Mendes (USP), undergraduate student
Rodrigo Correa (USP), undergraduate student

I. INTRODUCTION

Spatially-variable crop production, often known as precision agriculture, has been widely studied and developed to improve agricultural use efficiencies and to reduce environmental impacts. But most of the early research and commercial developments in spatially-variable crop production have been concentrated on variable-rate fertilizer and pesticide application [1]. Experiences with yield maps have convinced many researchers and agriculturalists of the importance of water availability in determining spatial yield patterns. Many think that water availability is the major determinant of yield variation. There has therefore been some significant research into variable irrigation, most of it with center pivot or linear moving systems [2][3]. Some efforts to work with variable rate microsprinkler irrigation, the predominant and most efficient type of irrigation used for citrus and similar tree crops, have been carried out in Florida, USA [4].

The objective of the present work is to improve those preliminary efforts in Florida using the wireless technology. It has been developed and implemented a demonstration unit of an automated, spatially-variable irrigation system for citrus, based on a wireless sensor and actuator network. The system was conceived to be low-cost, reliable, and compatible with contemporary local citrus production practices and other perennial crops, like coffee.

II. ACTION AND RESULTS

A ten hectares pilot unit was installed and put in operation to evaluate the system operation in field condition. It was selected a ten-year-old orange grove with trees about 3m tall. There were installed 49 sensor Nodes and one Field Station which stayed in operation for 4 years. The system was programmed to acquire data every 15 minutes and transmit data to a Field Station every hour. Figure 1 shows a sequence of soil moisture maps obtained by interpolation of the 7x7 grid of sensors. Operational problems were addressed during this technical evaluation. Despite of minor problems the system was quite reliable to map soil moisture in almost real-time.

Next steps include expanding the pilot unit to 25 hectares, what means the installation of a 100 sensor Nodes. Soil moisture map sequences for a whole draught season shall be obtained. The expected result from those maps analyses is to have the grove divided in five or more management zones with different needs of irrigation water. Those zones will reflect the spatial variability for the combination of different factors like, soil texture, terrain topology and individual tree needs. The irrigation system will be modified to site-specifically irrigate the crop accordingly to those zones. For each zone it will be addressed an automated valve and established a control loop with its own set point. This set point will be compared to the average soil moisture obtained by the sensor network subset concerned to that zone. The water consumption will be measured by an automated flow meter for the entire plot and will be compared to the consumption of a conventionally automated plot.

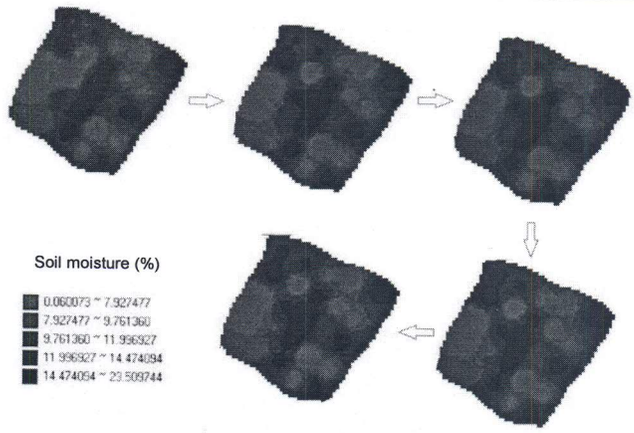

Figure 1- Sequence of soil moisture maps at 25cm depth, obtained by a 7x7 grid of wireless sensors spaced 50 m from each other at one-hour time interval.

III. MAIN PUBLICATIONS

[1] TORRE-NETO, A.; FERRAREZI, R.A.; RAZERA, D.E.; SPERANZA, E.; LOPES, W.C.; LIMA, T.P.F.S.; RABELLO, L.M.; VAZ, C.M.P. Wireless sensor network for variable rate irrigation in Citrus. Proc. Fruit, Nut and Vegetable Production Engineering Symposium, 7th – Information & Technology for Sustainable Fruit & Vegetable Production. Montpellier, France Sept. CD-ROM. 2005.

IV. REFERENCES

[1] Fraisse, C.W., Heermann, D.F., Duke, H.R. 1995. Simulation of variable water application with linear-move irrigation systems. *Trans. ASAE.* 38(5):1371-1376.

[2] Sadler, E.J., Camp, C.R., Evans, D.E., Usrey, L.J. 1996. Irrigation system for coastal plain soils. Proc. *Precision Agriculture: 3rd International Conference.* Minneapolis, USA. vol.1 p.827-834.

[3] Schueller, J.K. 1997. Technology for precision agriculture. European Conference on Precision Agriculture. vol.1 p.33-44.

[4] Torre-Neto, A.; Schueller, J.K.; Haman, D.Z. 2001. Automated System for Variable Rate Microsprinkler Irrigation in Citrus: A Demonstration Unit. Proc. Third European Conference on Precision Agriculture. Montpellier, France June 18-20. p.725-730. CD- ROM.

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