Assessment of the Impact of Optimal Irrigation Scheduling with Rainwater Harvesting for Water Conservation and Runoff Reduction in Large Urban Areas

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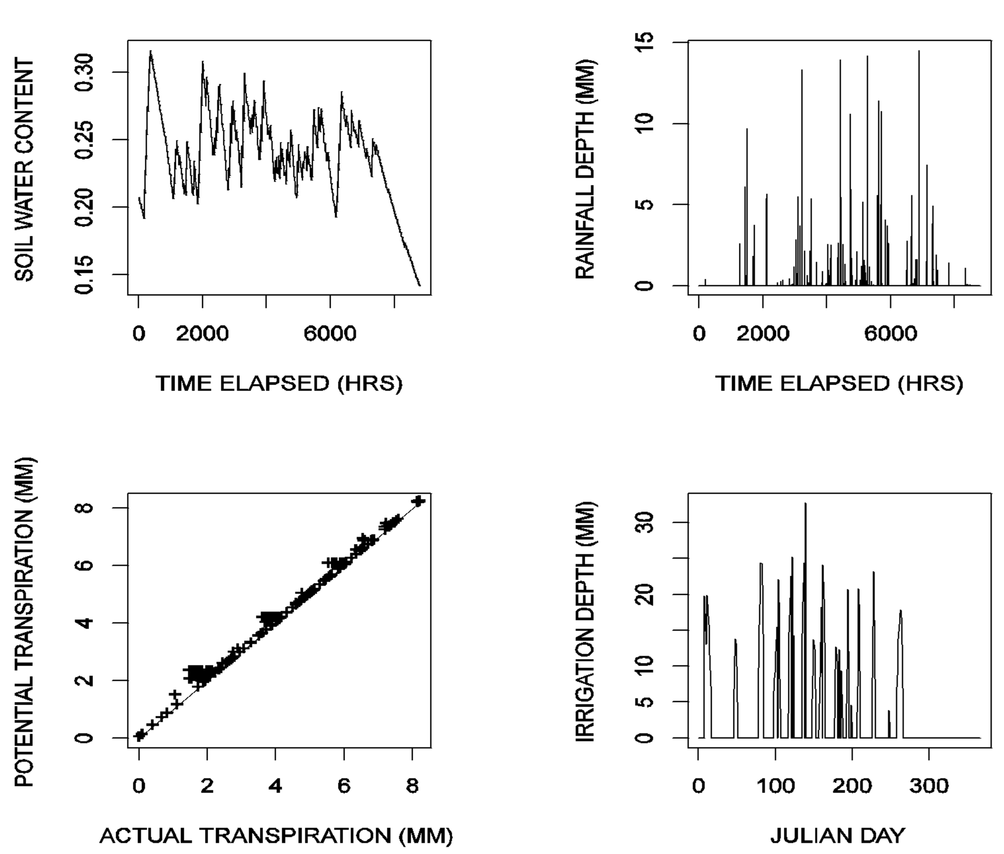
MOTIVATION

- If **lawn irrigation scheduling** can be optimized location-specifically and adaptively to the changing environmental conditions, one may expect **significant water use reductions**
- While a great deal of research has been carried out on smart irrigation and rainwater harvesting (RWH) individually at scales ranging from a house to a subdivision, very limited knowledge currently exists on how the impact and potential benefits may scale when lawn irrigation and RHW are controlled **at regional scales**

OBJECTIVES

- Develop a prototype system for **integrated control** of **lawn irrigation** and **RWH** for water conservation and stormwater management
- Assess and demonstrate the potential impact and value of the system

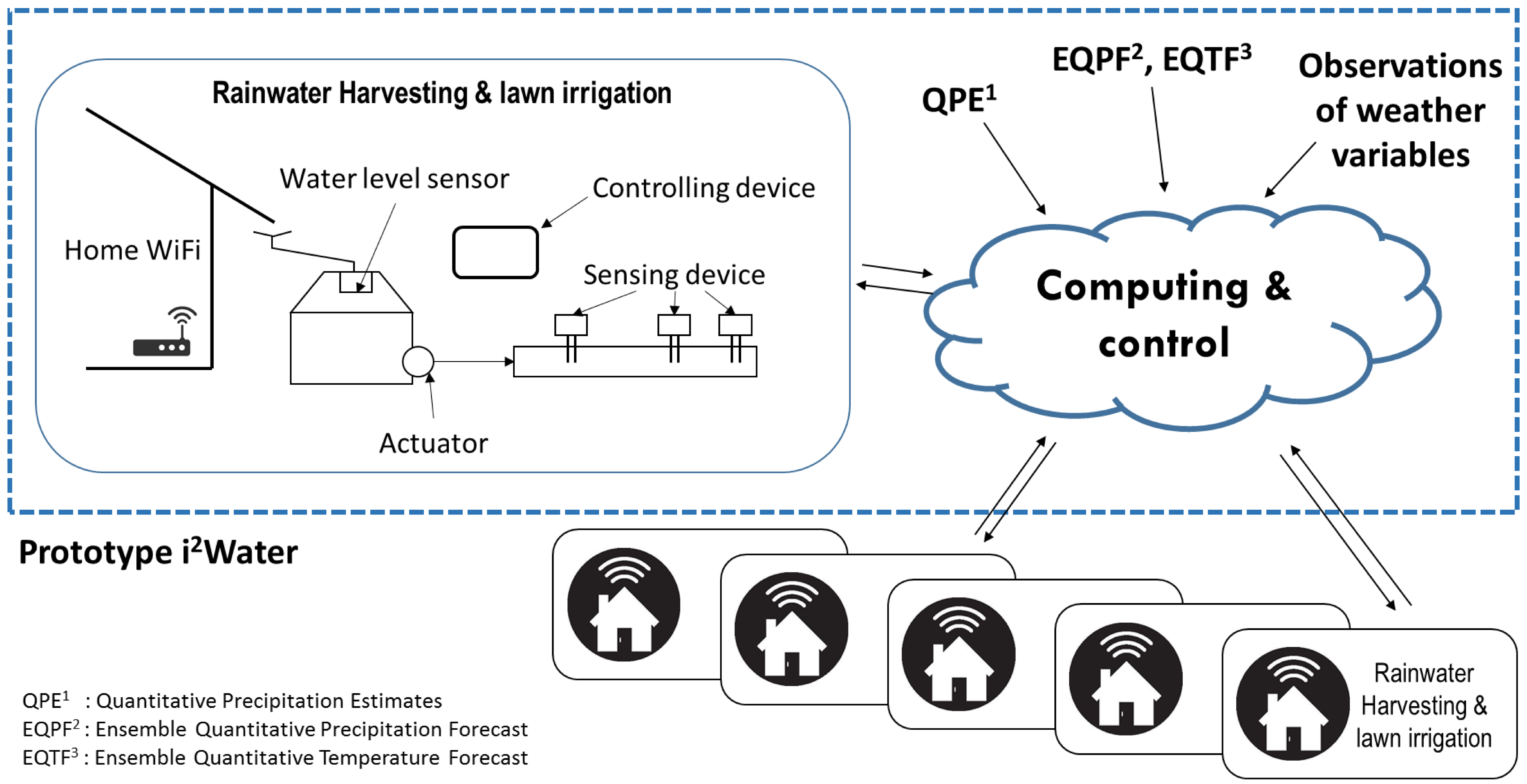
RWH & IRRIGATION CONTROL



Given the soil moisture state and rainwater available in the rain barrels, we solve for the optimal timing and amount of irrigation necessary to keep the lawn healthy while minimizing stormwater runoff and the cost of tap water

Fig 1. An example open-loop solution for irrigation scheduling using the WSV model and VAR

i²Water integrated + intelligent



WEATHER-SOIL-VEGETATION MODELING AND STATE UPDATING

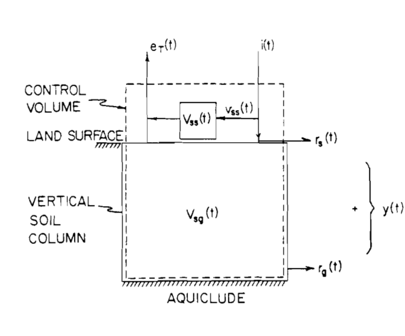


Fig 2. WSV model

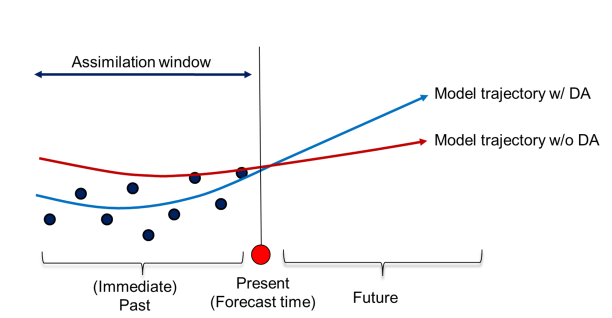


Fig. 3 Variational method

- WSV model is modified from the climate-soil-vegetation model (Eagleson 1978)
- IC and states of WSV will be updated via advance data assimilation method (e.g. variational method) (Lee and Seo 2014)

ENSEMBLE WEATHER FORECASTING

- Medium-range forecasts of precipitation and temperature (i.e., up to 15 days into the future) will be used as input of computational models

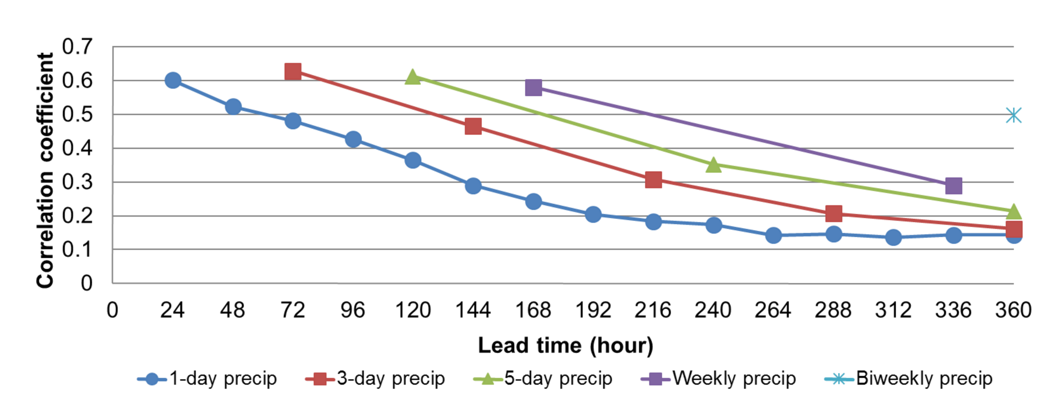
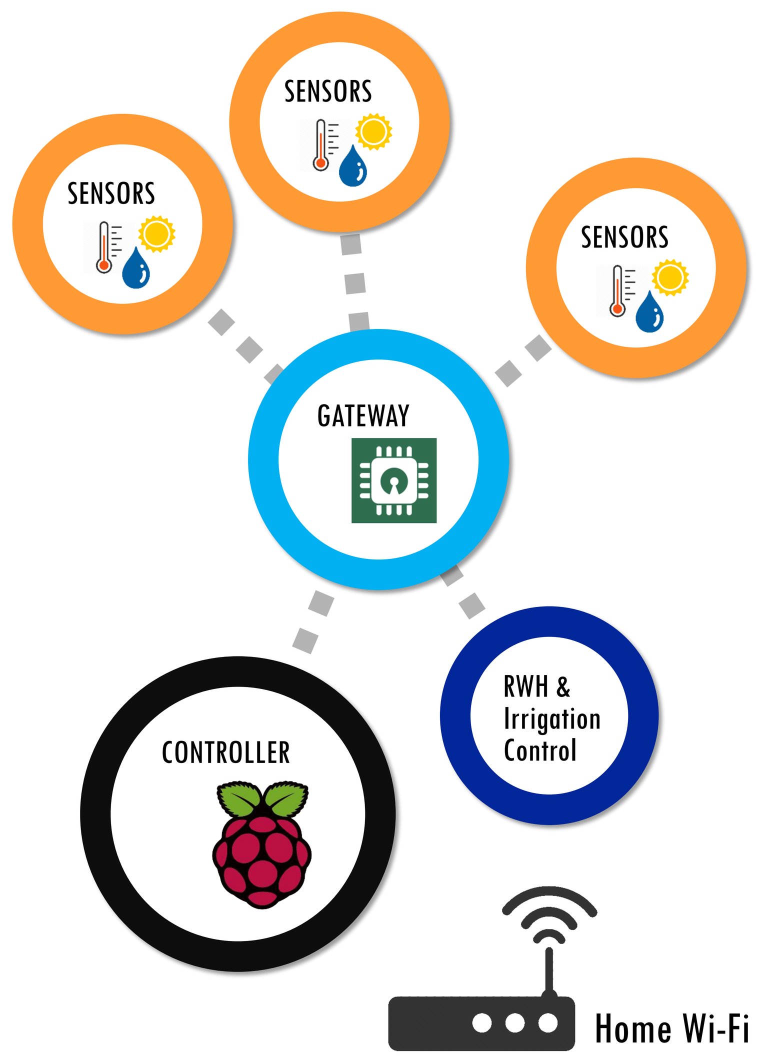


Fig. 4 Correlation between forecasts (GEFS) and precip. obs. for North Central Texas

ENVIONMENTAL SENSING

- Wireless sensor network using low-cost off-the-shelf wireless sensors and open-sourced components
- Collect data for temperature, humidity, soil moisture, and solar radiation
- Monitor real-time environmental conditions and lawn status
- Record outdoor water usage and available harvested water amount
- Feed back to the cloud-based water management system



IN-SITU EVALUATION

Fig 5. UTA Community Garden (site scale)

- Use multiple risk-based decision criteria for integrated control in an ensemble paradigm
- Evaluate water savings, lawn health, and runoff reduction
- Test reliability and performance of fully automated i²water
- Assess from house to regional scales

REFERENCES & ACKNOWLEDGEMENT

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- Eagleson, P. S., 1978. Climate, soil and vegetation, 5, A derived distribution of storm surface runoff. Water Resour Res, 14(5): 740-748.

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