agronomy

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Editorial

Crop Evapotranspiration

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Received: 10 September 2019; Accepted: 3 October 2019; Published: 5 October 2019

Abstract: Evapotranspiration (ET) is one of the largest components of the water cycle, and accurately measuring and modeling ET is critical for improving and optimizing agricultural water management. However, parameterizing ET in croplands can be challenging due to the wide variety of irrigation strategies and techniques, crop varieties, and management approaches that employ traditional tabular ET and make crop coefficient approaches obsolete. This special issue of *Agronomy* highlights nine approaches to improve the measurement and modeling of ET across a range of spatial and temporal resolutions and differing environments that address some of the challenges encountered.

Keywords: evapotranspiration; irrigation; remote sensing

1. Introduction

Knowledge of the evapotranspiration (ET) over croplands is becoming increasingly important across multiple disciplines, spatial scales, and time as water supplies become increasingly constrained in the 21st century [1–3]. ET estimation is critical for addressing immediate needs at farm scales, including improved crop water management and irrigation efficiencies, weather and crop-stress forecasting, and decision-support tools. Additionally, large-scale ET model development and validation are critically needed at watershed to continental scales to help assess the agronomic, hydrological, and economic impacts of drought and climate change.

Despite the importance of ET for optimal water management, the development of data, models, and tools has not kept pace with changes in many managed ecosystems. One of the most commonly used models, the Food and Agriculture Organization publication 56 (FAO-56) [4] relies on tabular crop coefficients that are decades old and do not reflect changes in cultivars or irrigation practices. A diverse array of high value, non-cereal crops are increasing grown in many regions of the world, and they are often grown under a variety of biotic and abiotic stressors. The use of greenhouses and screenhouses to increase fruit and vegetable production is particularly notable, but these environments greatly alter microclimates. This makes translating open air evaporative demand (e.g., reference ET) into actual crop ET much more challenging. Finally, other irrigated managed landscapes (e.g., irrigated lawns and forests) are greatly increasing in area. For example, the area of turfgrass in the United States is more than 300% that of the largest irrigated crop [5]. To this end, this special issue of *Agronomy* is focused on studies of novel cropping systems as well as new observational approaches to measure and model ET.

2. New ET Approaches

New techniques to observe and model ET in a variety of systems will be needed in the future. In this issue, Monje and Bugbee [6] use infrared thermometers to better assess ET in a controlled growth chamber where atmospheric resistance can be controlled. Their observations will be useful for using radiometric techniques in environments where a normal wind log profile does not apply. Kelley and Pardyjak [7] used a low cost, on-farm, meteorological station in conjunction with ET observations to train a neural network to accurately model ET with a training period of as little as a week. This approach eliminates the need for a crop coefficient to calculate the actual ET. Moorhead et al. [8] intercompared a large weighing lysimeter with eddy covariance (EC) observations to evaluate the accuracy of ET observations with EC, which has been an ongoing source of uncertainty due to the energy budget closure issues that EC suffers. They found that errors were well correlated with total biomass and that such errors were significantly reduced if energy budgets were closed daily as opposed to at 30 min timescales. French et al. [9] conducted an evaluation of three satellite-based thermal ET models at a regional scale in an irrigation district. They found that using an ensemble of models could help identify outliers and areas for future ground validation. Katsoulas and Stanghellini [10] reviewed different ET models and their application to greenhouse environments.

3. ET under Different Cropping Systems

This special issue covers diverse crop production systems. Nilahyane et al. [11] assessed ET in drip irrigated silage maize fields where water and agronomic management goals were substantially different from grain maize. They found no significant differences in water use efficiency between the two highest irrigation treatments (100% and 80% ETc). Guenette and Hernandez-Ramirez [12] evaluated the effect of soil compaction in conjunction with irrigation treatments in faba beans and found that maintaining high soil water content helps offset compaction damage. Suarez et al. [13] evaluated the combined abiotic stresses of deficit irrigation and saline water on different wine (Cabernet Sauvignon) rootstocks. Unlike previous work, these researchers found that salinity stress does not reduce growth and ET further than drought stress alone at intermediate and severe deficit irrigations (less than 60% of the control), which is contrary to the FAO-56 model, where drought and salinity stresses are multiplicative. Finally, Badzmierowski et al. [14] compared the utility of hyperspectral versus lower-cost multispectral sensors for evaluating turfgrass water use and turf quality. For this application they found that the predictive capabilities of multispectral sensors were just as good as those of hyperspectral sensors.

Author Contributions: A.N.F. and R.G.A. edited the special issue "Crop Evapotranspiration" and wrote this editorial foreword.

Acknowledgments: A.N.F. and R.G.A. were supported by USDA Agricultural Research Service, Office of National Programs—Program 211 "Water Availability and Watershed Management" (program numbers: 2036-61000-018-00-D and 2020-13660-008-00-D). The authors thank the editorial staff at MDPI (Aileen Song, Amanda Li, Adeline Chen, Alicia Ren, Yanping Mou, Felicia Li, Leda Xuan, and Shelly Sun) and all of the authors who submitted manuscripts to this special issue.

Conflicts of Interest: The authors declare no conflict of interest.

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