Report as of FY2007 for 2006FL140B: "A comparison of FSU/NWS and OneRain precipitation data and their insertion into the WAM hydrologic model"

Publications

- Dissertations:
  - Sullivan, J.L., Jr. 2008: Modeling streamflow using gauge-only versus multi-sensor rainfall. M.S. Thesis, Department of Meteorology, Florida State University, Tallahassee, 65 pp.
- Articles in Refereed Scientific Journals:
  - Martinaitis, S.M., H.E. Fuelberg, J.L. Sullivan, and C.S. Pathak, 2008: Using independent gauges to evaluate precipitation values from multi-sensor procedures of the OneRain Corporation and the National Weather Service, Submitted to Journal of the American Water Resources Association.
- Conference Proceedings:
  - Fuelberg, H.E., S.M. Martinaitis, J.L. Sullivan, Jr., and C.S. Pathak, 2007: An intercomparison of precipitation values from the OneRain Corp. algorithm and the National Weather Service Procedures. World Environmental and Water Resources Congress, Tampa, May 2007, in press.
  - Fuelberg, H.E., D.D VanCleve, Jr., and T.S. Wu 2007: An intercomparison of mean areal precipitation from gauges and a multisensor procedure, World Environmental and Water Resources Congress, Tampa, May 2007, in press.
  - D.D. VanCleve, and H.E. Fuelberg, 2007: An intercomparison between mean areal precipitation from gauges and a multisensor procedure, 21st Conf. on Hydrology, Amer. Meteor. Soc., San Antonio, January 2007, in press.
  - Martinaitis, S.M., H.E. Fuelberg, J.L. Sullivan, Jr., and C. Pathak, 2007: An intercomparison of precipitation values from the OneRain Corp. algorithm and the National Weather Service procedure. 21st Conf. on Hydrology, Amer. Meteor. Soc., San Antonio, January 2007, in press.
  - Fuelberg, H.E., 2008: Adventures in creating an historical multi-sensor precipitation dataset. Paper H43B-06, 2008 Joint Assembly, Fort Lauderdale, Amer. Geophys. Union.
  - Martinaitis, S.M., H.E. Fuelberg, J.L. Sullivan, Jr., and C. Pathak, 2007: An intercomparison of precipitation values from the OneRain Corp. algorithm and the National Weather Service procedure. 21st Conf. on Hydrology, Amer. Meteor. Soc., San Antonio, January 2007, paper 2.6.
  - Martinaitis, S., H. Fuelberg, J. Sullivan, Jr., and C. Pathak, 2008: Using independent NCDC gauges to analyze precipitation values from the OneRain Corporation algorithm and the National Weather Service procedure. 22nd Conf. Hydrology, Amer. Meteor. Soc., New Orleans, Paper 3.4.
  - Martinaitis, S.M., H.E. Fuelberg, J.L. Sullivan, Jr., and C. Pathak, 2007: An intercomparison of precipitation values from the OneRain Corp. algorithm and the National Weather Service procedure. World Environmental and Water Resources Confernce 2007, American Society for Civil Engineers, Tampa, May 2007, on CD.
  - Martinaitis, S., H. Fuelberg, J. Sullivan, Jr., and C. Pathak, 2007: Using independent NCDC gauges to analyze precipitation values from the OneRain Corporation algorithm and the National Weather Service procedure. Fall meeting of Amer. Geophys. Union, San Francisco, Paper H23K-05.
  - Sullivan J.L., Jr., H.E. Fuelberg, S. Martinaitis, D. Bottcher, B. Jacobson, J. Bradberry, J. Mandrup-Poulsen, D. Gilbert, and T.S. Wu, 2008: Modeling streamflow using Gauge-only

versus radar-derived rainfall. Fall meeting of Amer. Geophys. Union, San Francisco, Paper H21E-0802.

- Sullivan J.L., Jr., H.E. Fuelberg, S. Martinaitis, D. Bottcher, B. Jacobson, J. Bradberry, J. Mandrup-Poulsen, D. Gilbert, and T.S. Wu, 2008: Modeling streamflow using Gauge-only versus radar-derived rainfall. 22nd Conf. Hydrology, Amer. Meteor. Soc., Paper P2.5.

Report Follows

Progress Report

A comparison of FSU/NWS and OneRain precipitation data and their insertion into the WAM hydrologic model

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1. Background

Two widely used procedures by which radar- and gauge-derived rainfall can be optimally combined are those by the OneRain Corporation and the National Weather Service (NWS). Until recently, the several Florida Water Management Districts have used rainfall data from the OneRain algorithm. Conversely, Florida State University (FSU) has employed the National Weather Service Multi-sensor Precipitation Estimator (MPE) scheme to create an historical precipitation database for the Florida Department of Environmental Protection (FDEP). The methodologies to produce each dataset differ, and the resolutions of the final products also differ, i.e., 2×2 (OneRain) vs. 4×4 km (MPE) grid, and 15 min (OneRain) vs. hourly (MPE) intervals. Nonetheless, each dataset is being used by their respective agencies to make water management and regulatory decisions. Thus, it is important to know how rainfall values from the two schemes compare to each other.

The original objectives of this research are to 1) quantify the amount of that difference and 2) develop procedures to insert both types of rainfall data into the WAM hydrologic model, and make separate runs using each type of data for selected watersheds within the SFWMD.

The research constitutes the M.S. thesis research for Mr. Steve Martinaitis, who is pursuing a graduate degree in meteorology at Florida State University. A portion of John Sullivan's M.S. thesis research also was based on this research.

2. Progress on Task 1—Quantifying Differences in the Two Algorithms

Mr. Martinaitis has completed all of the work on Task 1. He has presented his finding at conferences sponsored by the American Meteorological Society, American Geophysical Union, and the American Society for Civil Engineers (see publication list). In addition, a manuscript to the *Journal of the American Water Resources Association* has been prepared, and will be submitted as soon as comments from a final contributor are received. The abstract to that manuscript (see below) nicely summarizes the findings of Task 1.

"Using independent gauges to evaluate precipitation values
from multi-sensor procedures of the OneRain Corporation
and the National Weather Service"

Steven Martinaitis
Henry Fuelberg
John Sullivan
Chandra Pathak

Two widely used procedures for optimally combining radar- and gauge-derived rainfall are those of the OneRain Corporation and the National

Weather Service (NWS). The NWS procedure, called the Multi-sensor Precipitation Estimator (MPE), produces an hourly product on the ~ 4×4 km Hydrologic Rainfall Analysis Project (HRAP) grid. Florida State University (FSU) employed the MPE scheme to create an hourly historical precipitation database for Florida. The OneRain procedure creates a product at 15 min intervals on a 2×2 km Cartesian grid. Their values were produced by the corporation. Although the methodologies and temporal and spatial resolutions of the two schemes differ, each dataset is used to make water management and regulatory decisions. Thus, it is useful to evaluate the two procedures against independent data to determine if they can be used interchangeably. Results of daily precipitation comparisons against thirteen NCDC Cooperative Observer Program (COOP) gauges are presented for various time periods. Both algorithms produce relatively similar estimates during stratiform-type rain events. However, large differences can occur when estimating convective-type events during the summer months. During Hurricane Wilma, the two multi-sensor schemes only could be compared with each other due to numerous missing or erroneous gauge reports. Results were found to change as Wilma made landfall, traversed the state, and re-entered the Atlantic Basin.

3. **Progress on Task 2-- Develop procedures to insert both types of rainfall data into the WAM hydrologic model, and make separate runs using each type of data for selected watersheds within the SFWMD**.

Graduate student John Sullivan completed the first half of this task—inserting 4 ×4 km MPE data into the Watershed Assessment Model (WAM), and comparing results with those from rain gauges alone. This research constituted John's M.S. thesis, and he graduated during April 2008. Findings have been presented at a number of conferences (see publications). The abstract to John's thesis summarizes his findings.

"Modeling Streamflow using gauge-only
versus multi-sensor rainfall"

John Sullivan

This study evaluates the impacts of two different rainfall inputs on simulated streamflow using a specialized, fully-distributed hydrologic model—the Watershed Assessment Model (WAM). We compare gauge-only Thiessen polygon input data with the gridded 4 × 4 km Florida State University (FSU) version of the National Weather Service (NWS) Multi-sensor Precipitation Estimator (MPE) scheme. Streamflow results are compared to observed amounts over six years (2000-2005) at two U.S. Geological Survey (USGS) stream gauge sites in the greater Florida Suwannee River basin. Previously, comparisons were made between the

two different precipitation data types using mean areal precipitation calculations over several Florida basins. This study expands upon that knowledge.

There are significant differences in simulated streamflow when using the higher-resolution FSU MPE rainfall input to WAM. However, it is not always true that the FSU MPE dataset provides better results with this model configuration. The improvement of WAM simulated streamflow results are dependant on a combination of factors, including the desired type of comparison to observed amounts (volume or predictive correlation), rainfall pattern characteristics, and individual event scenarios.

Overall, the FSU MPE WAM streamflow accumulation is more accurate than the Thiessen polygon accumulation. During drought periods, FSU MPE-derived WAM streamflow provided more accurate accumulations as well, but coefficients of determination were not always improved. Years with more average rainfall events led to more underestimation of accumulation amounts by the FSU MPE rainfall input and better approximation by the Thiessen polygon input to WAM. Seasonal results emphasize the weaknesses of each data source. Rain gauges usually are not able to capture the spatial variability during summer rainfall events and radar-derived precipitation values generally are underestimated during stratiform winter events. In simulating streamflow with a hydrologic model using rain gauges input, it is apparent that the gauge locations are far more important than the number of gauges. Furthermore, smaller basins are prone to significant underestimation of accumulations and lower coefficients of determination regardless of the rainfall input; however, the statistical change from the larger basin to the smaller basin for each rainfall input is not as drastic with the FSU MPE data. Although errors lie in both the hydrologic model's ability to utilize the rainfall data and the rainfall data measurements themselves, the results highlight areas for improvement to both.

As the WAM/MPE research was being finalized, Dr. Chandra Pathak (SFWMD) urged us to perform the research with OneRain input using the MIKE SHE model instead of WAM. We agreed that there are many advantages to MIKE SHE, and graduate student Steve Martinaitis began to become familiar with the software. Dr. Pathak said that SFWMD currently was configuring the model to run real-time at a 500 ft resolution for the Big Cypress Creek Basin—a good basin for us to study.

SFWMD was delayed approximately 4 months in delivering the 500 ft model to us. However, the model delivered was an earlier version since DHI was re-calibrating the final version of the model. The version received at FSU either terminates due to dry ground water conditions and/or runs abnormally slowly. We have been working closely with SFWMD and DHI to solve these problems, and believe that we are close to a full solution. While working with the 500 ft version of the model, it was noted that it will require extensive computational

time (~1 month for 4 years of data). We currently are discussing with Dr. Pathak whether to execute several multi-day model runs at the 500 ft resolution or a multi-year period at the 1500 ft resolution in order to complete the research in a timely manner.

Once we have a fully functional model and have decided on what resolution to use, it will be run with OneRain multi-sensor data interpolated down to the MIKE SHE grid resolution and then with rain gauge data only. Our plan is to complete all of the research and for Steve to write his thesis and graduate by December 2008.