IOWA STATE UNIVERSITY
Agricultural and Biosystems Engineering

DataFEWSion Annual Symposium
January 11th, 2022.

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The Daily Erosion Project Going Global: Analyzing Distinct Precipitation Datasets

KEYWORDS: Precipitation, modeling, soil erosion, WEPP.

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DAILY EROSION PROJECT

Acknowledgements: Iowa Nutrient Research Center, Farm Service Agency, and Daily Erosion Project.

INTRODUCTION

- The Daily Erosion Project (DEP - https://dailyerosion.org), started about 20 years ago as the Iowa DEP, a daily **sheet and rill hillslope** erosion estimator for the states of Iowa, Minnesota and parts of surrounding states.

- Inputs used previously: radar estimated precipitation, the USDA National Resources Inventory database, and the Water Erosion Prediction Project (WEPP) model (Flanagan and Nearing, 1995).

Source: Dr. Richard Cruse

- Current inputs: higher resolution radar precipitation along with field level crop rotation and management information from the Agricultural Conservation Planning Framework (ACPF - https://acpf4watersheds.org), the gridded Soil Survey Geographic Database (SSURGO), and lidar derived 3m Digital Elevation Models (DEM)

INTRODUCTION

- **GLOBAL EXPANSION**:

There is interest in expanding DEP at selected locations around the globe, but current DEP input data requirements are greater than is readily supported internationally. Global expansion of DEP requires an evaluation of available global input datasets.

Our objectives are to review **potential sources of WEPP inputs**, develop frameworks for global expansion of sheet and rill DEP estimates using these inputs, and develop an understanding of how these estimates may differ from those where DEP currently operates.

For this abstract, our goal is to analyze how distinct precipitation datasets will impact runoff and soil detachment estimates.

DATA & METHODS

Precipitation data (2008-2020) sources used to edit WEPP climate files:

- Integrated Multi-satellitE Retrievals for GPM (IMERG);
- The Automated Surface Observing Systems (ASOS).

Spatial and temporal resolution:

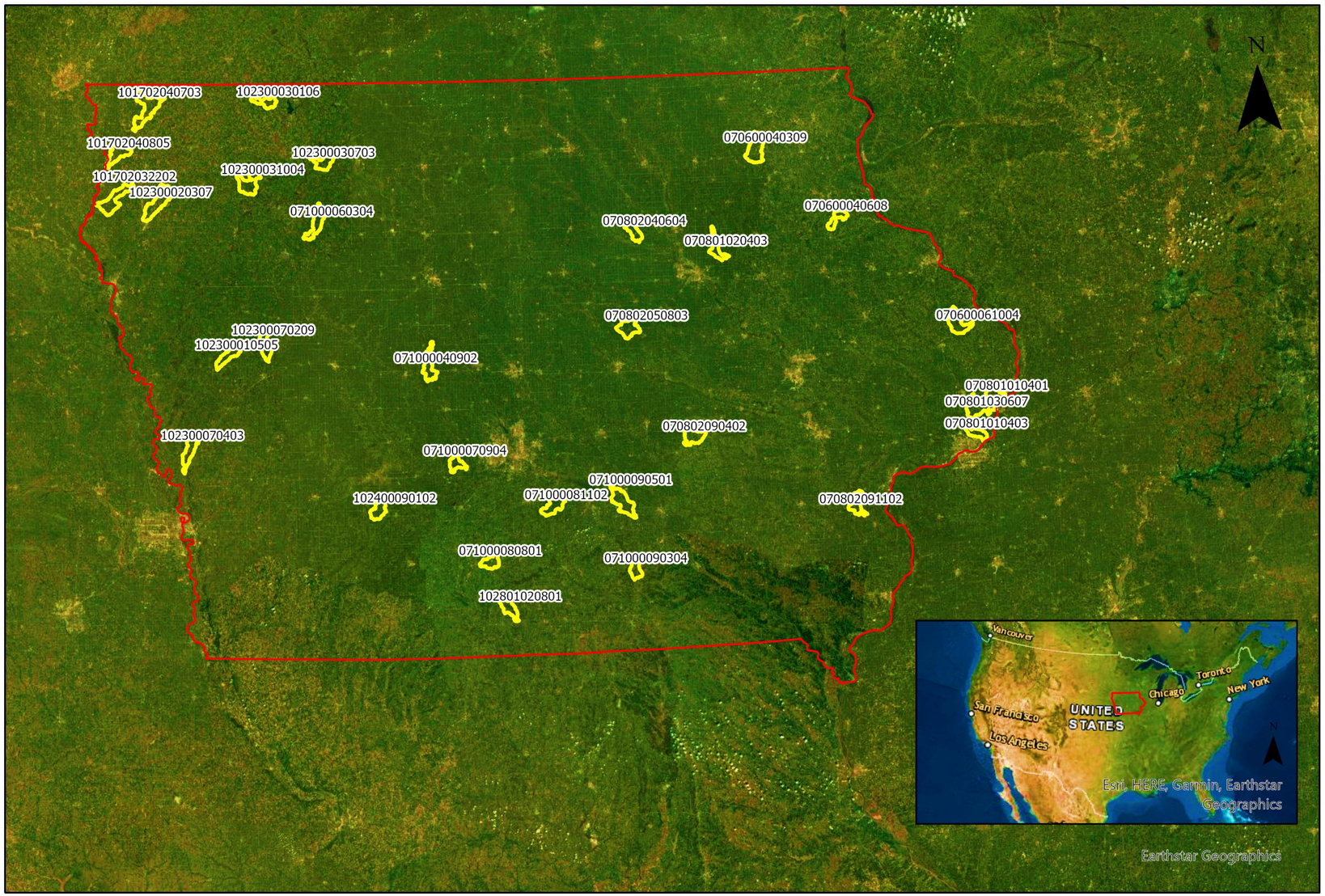
- WEPP (NOAA MRMSRadar-Only Q3 Product) : 1 km × 1 km, 2 minutes.
- Integrated Multi-satellitE Retrievals for GPM (IMERG): 10 km × 10 km, 30 minutes.
- The Automated Surface Observing Systems (ASOS): Heated Tipping Bucket (HTB) gauges at airports, hourly intervals.

Sampling:

- 30 Hydrologic Unit Codes (HUC12) watersheds (90 km^2 or 35 mi^2 in size each).
- Within the HUC 12, only agricultural fields of 15 ha or more were tested.
- For selecting representative samples: three HUC12s sampled per the ten Major Land Resource Areas found in Iowa.
- The HUC12 DEP values are location specific and averaged over the spatial domain within that HUC12.

DATA & METHODS

Iowa DEP Hydrologic Units



RESULTS

- Precipitation

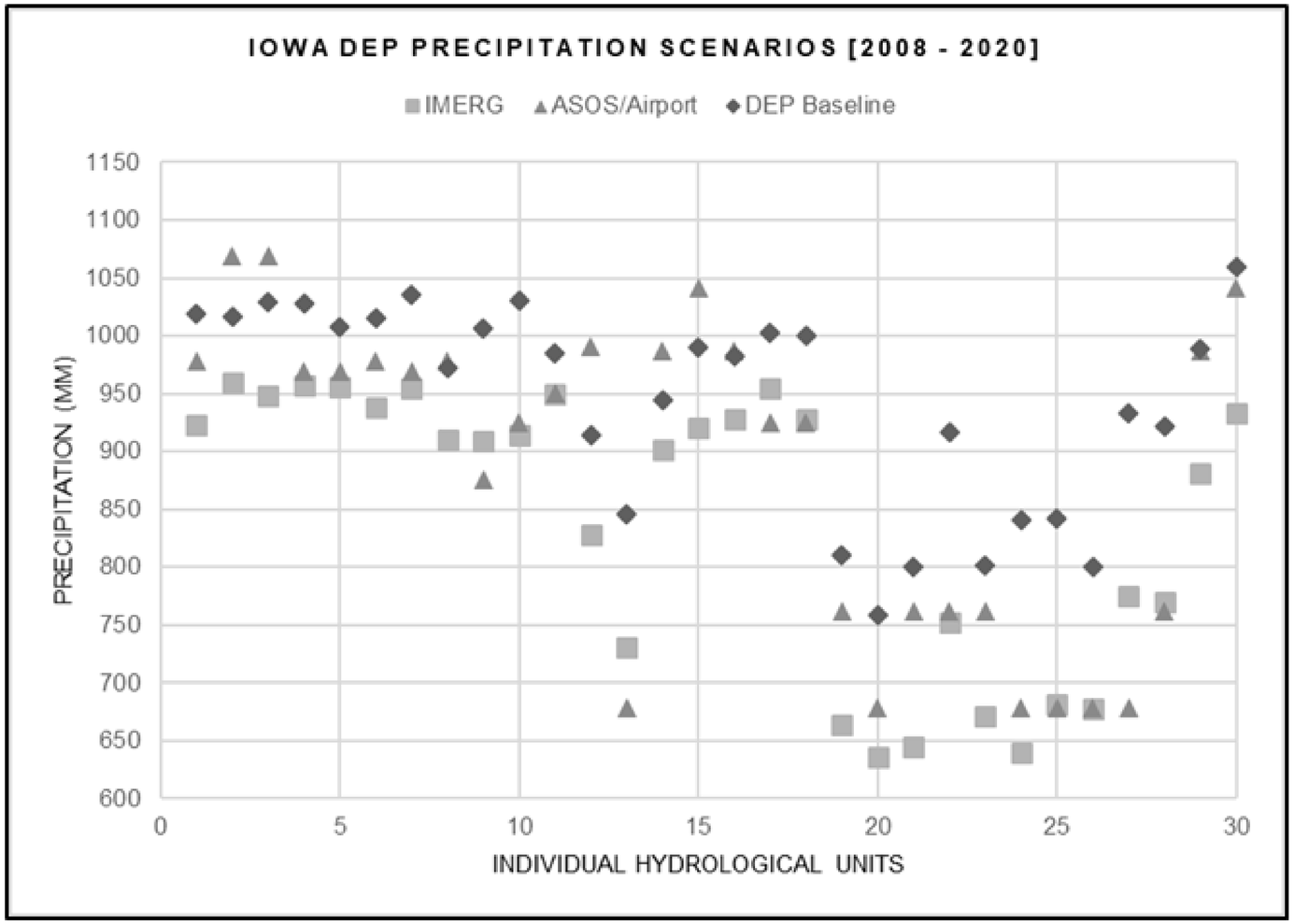


Figure 1. Precipitation differences from WEPP, IMERG, and ASOS modeled data. Each hydrologic unit is identified by a number from 1 – 30

Testing the sensitivity of hydrologic parameters such as rainfall intensity and runoff rate is crucial in erosion models as stated by Nearing et al., (1990) because these parameters are directly correlated, and will drive soil detachment processes. Figure 1 represents precipitation accumulation differences in which there was an average precipitation decrease **from 943 mm at the DEP baseline, to 883 mm (6% decrease), and 841 mm (11% decrease) for ASOS and IMERG**, respectively, across all modeled hillslopes within each HUC12.

RESULTS

- Runoff

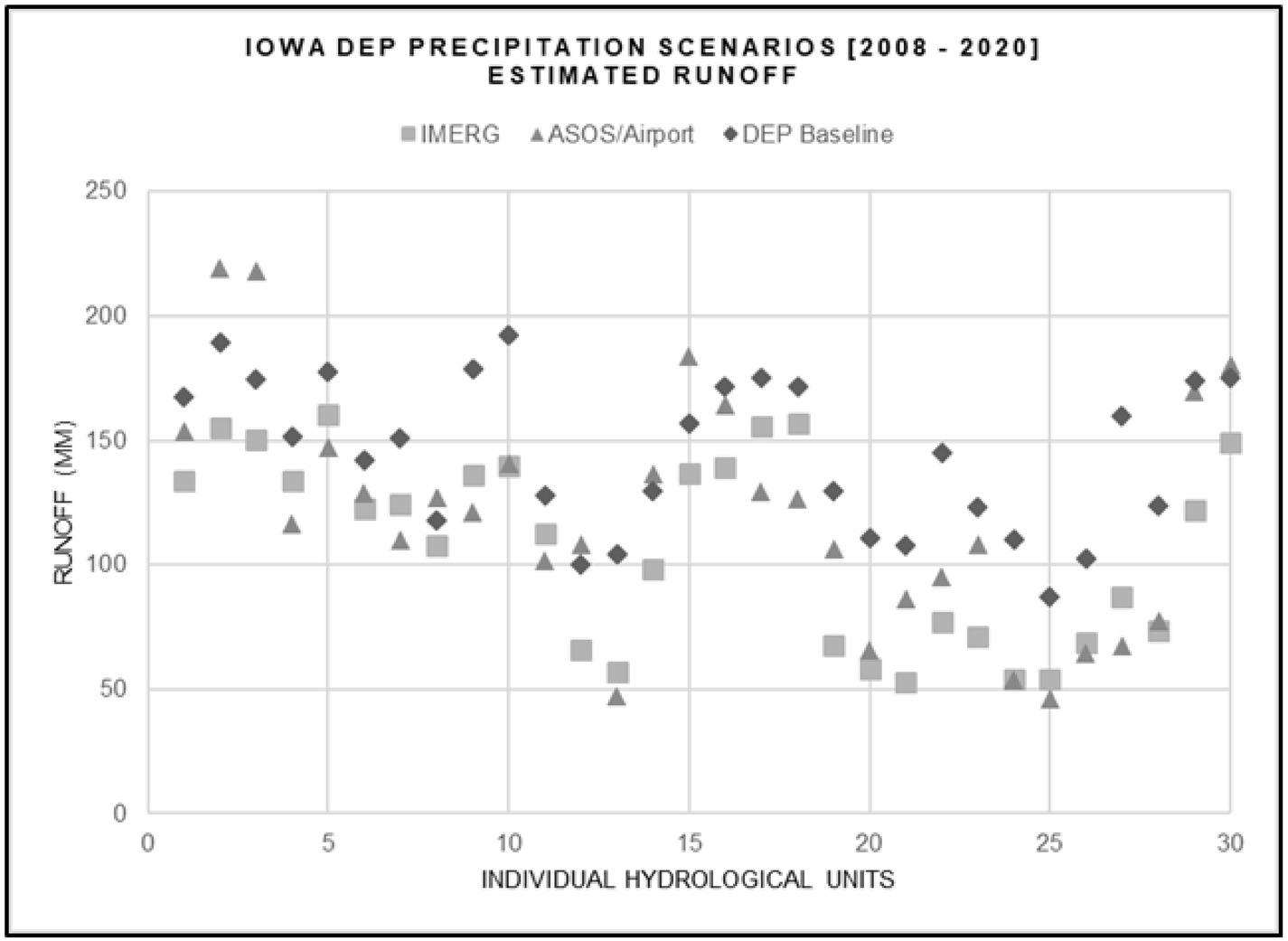


Figure 2. Estimated runoff differences from WEPP, IMERG, and ASOS modeled data. Each hydrologic unit is identified by a number from 1 – 30

Runoff estimates are driven by precipitation intensity and properties of overland flow elements, which is a combination of slope, soil type, and land use (Gelder et al, 2018). Testing our precipitation scenarios, runoff decreased **from an average of 144 mm at the DEP baseline to 107 mm for IMERG, or a 26% decrease**. Furthermore, **ASOS runoff estimates showed an average runoff of 120 mm, or a 17% decrease.**

RESULTS

- Soil Detachment

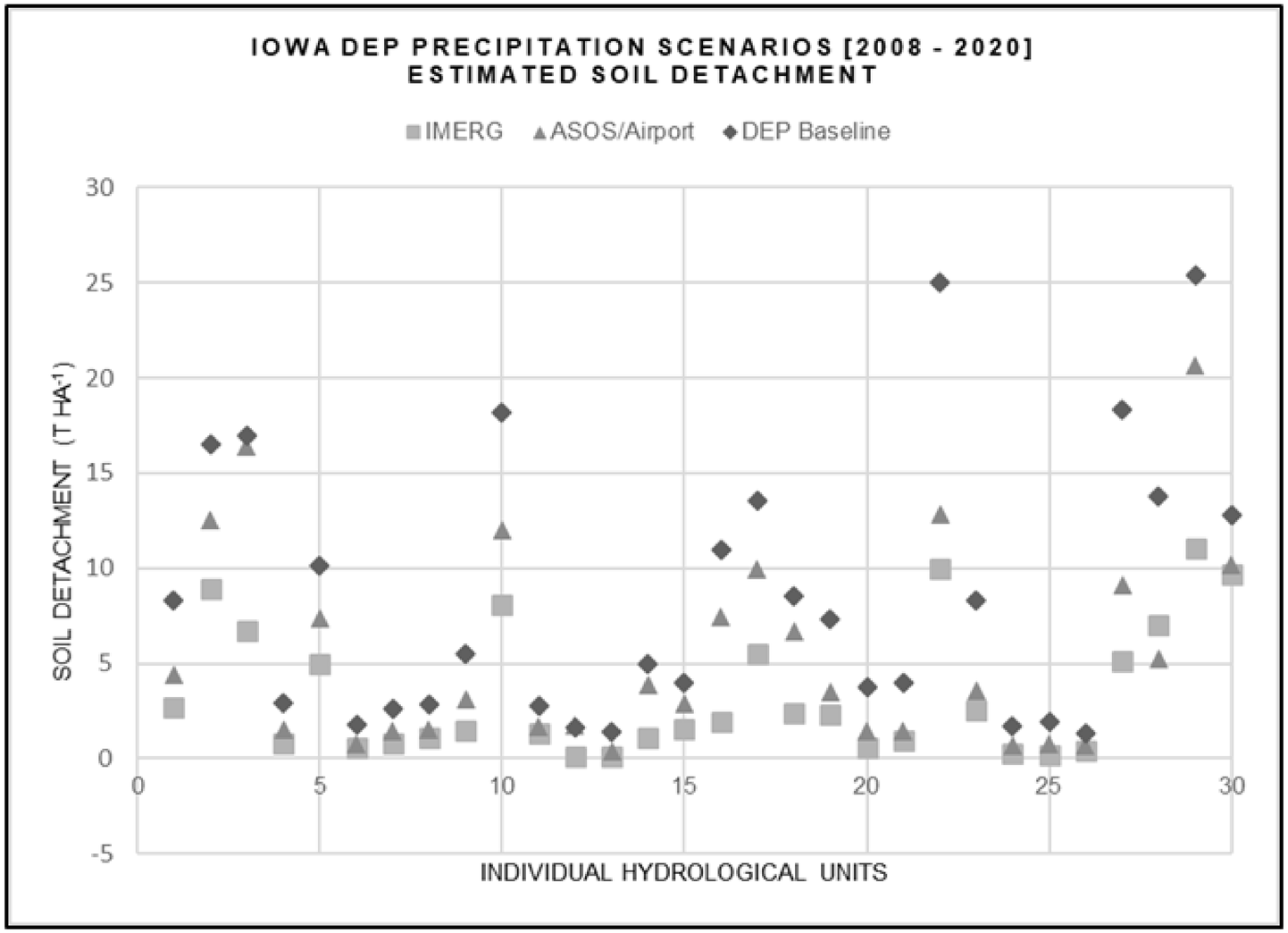


Figure 3. Estimated soil detachment differences from WEPP, IMERG, and ASOS modeled data. Each hydrologic unit is identified by a number from 1 – 30

Soil detachment is one of the three processes in erosion (detachment, transport, and deposition) highly influenced by precipitation and runoff patterns. Changing precipitation datasets was expected to show substantial differences in our soil detachment estimates. The results for this variable revealed average values of **8.5 t ha-1 from our DEP baseline, to 5.5 t ha-1 from ASOS, and 3.3 t ha-1 from IMERG**, presenting a 35% and 61% decrease, respectively

CONCLUSIONS

- Coarser spatial and temporal resolution will substantially impact runoff and soil detachment estimates due to decrease in rainfall intensity by averaging over longer time periods and greater spatial areas.

- Overall, IMERG results showed higher percentage difference estimates compared to ASOS. The ASOS readings derived from the nearest airport of the HUC12 being tested, which is often many kilometers away, revealed lower percentage decrease for precipitation, runoff, and soil detachment estimates when comparing to the IMERG product.

- The ASOS precipitation could be considered to be of similar or finer resolution spatially than the DEP baseline but of even coarser temporal resolution than IMERG. For future research it would be valuable to test watersheds where ASOS stations are located, allowing DEP precipitation product validations to be further investigated.

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ACKNOWLEGMENTS

DAILY EROSION PROJECT

FSA
FARM SERVICE AGENCY

IOWA NUTRIENT RESEARCH CENTER
INRC
Science for Iowa's Water

DataFEWSion Traineeship Program
Data Driven Decision Making at the Nexus of Food-Energy-Water Systems

NSF


Thank you!
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