Project Title: Integrating NASA Satellite Soil Moisture and Precipitation Products with Operational Hydrologic Prediction Capabilities of River Authorities in Texas

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Project description:

Texas experiences frequent floods and droughts, and reservoirs are critical for water supply and flood risk management. Reservoir operators in Texas rely on HEC-HMS configured in event-base mode for predicting reservoir inflow. The major sources of error in these predictions are precipitation and loss factors. This project aims to integrate satellite-based soil moisture and precipitation products to improve inflow prediction. The University of Texas-Arlington team is working closely with the Army Corps of Engineer (USACE; Figure 1) and Lower Colorado River Authority (LCRA; Figure 1) to i) create a blended precipitation product by combining precipitation products from Global Precipitation Mission (GPM) and ground-based weather radar units operated by National Weather Service; and ii) enhance real-time soil moisture estimates and incorporate these estimates in producing and adjusting loss factors in real time. The products and systems will be tested using operational configurations of HEC-HMS models from USACE and LCRA before delivering to LCRA for operational adoption.

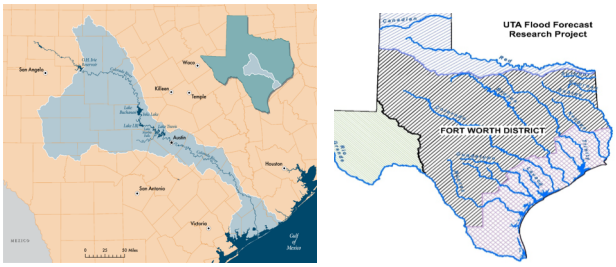

Figure 1: Service area of LCRA and USACE- Fort Worth District that currently employs HEC-HMS for reservoir management.

End users/partners:

Army Corps of Engineers-Fort Worth District (USACE-SWF), Lower Colorado River Authority, Brazos River Authority (BRA), San Antonio River Authority (SARA), NASA Goddard Space Flight Center (GSFC), NASA Short-term Prediction Research and Transition Center (SPoRT), WEST Consultants, and National Weather Service West Gulf River Forecast Center

Data sources, models, technology:

The satellite data sources include IMERG precipitation product, SMAP soil moisture, ALEXI, and potentially SMAP vegetation optical depth and GOES-16 lightning mapper data.

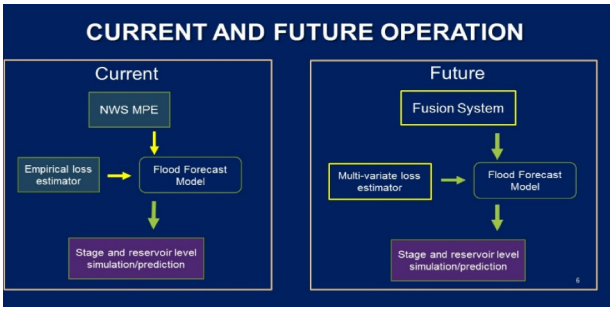

Figure 2: Operation concept for the new precipitation blending and loss estimation systems.

Ground-based sensor data includes precipitation data from the National Weather Service NEXRAD network, in situ rain gauge data and soil moisture sensor products.

Models include the NASA Land Information System (LIS) and HEC-HMS models maintained by USACE-SWF and LCRA.

Technology includes the current Total Runoff Tool (TRT) developed by WEST Consultants for estimating loss factors from soil moisture. A precipitation fusion system and automated real-time loss estimation module (Figure 2) are being developed.

Major accomplishments in CY19, lans/expectations for 2020:

Accomplishment 1: The team set up the USACE and LCRA HEC-HMS models, and adopted the Total Runoff Tool (TRT) developed by WEST Consultants by February 2020.

Accomplishment 2: The team performed HEC-HMS simulations using the initial and constant loss factors estimated using TRT with the North American Land Data Assimilation System (NLDAS) soil moisture products as inputs (Figure 3).

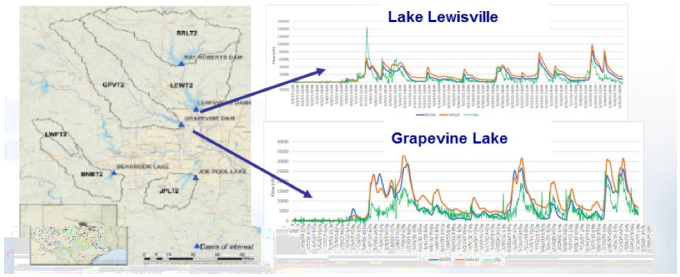

Figure 3: HEC-HMS simulations using NLDAS SM-based initial and constant loss parameters for May 2015 flood event. Using SM-based loss factors resulted in improved simulations.

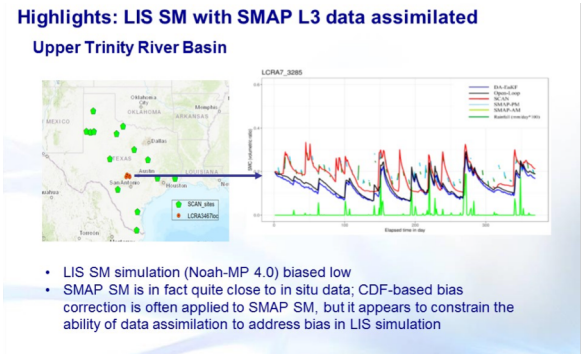

Figure 4: Comparison of soil moisture simulations from LIS against in situ observations collected at a LCRA station.

Accomplishment 3: The team set up the Land Information System and successfully assimilated SMAP Level 3 soil moisture products into the Noah-MP model. The results were validated against in situ data (Figure 4).

In 2020, the team will focus on the following tasks:

Task 1: Adjust the loss estimates from TRT for use in HEC-HMS, and refine the loss estimation scheme to include spatially distributed soil moisture.

Task 2: Complete the testing of the soil moisture-based loss estimates for the Lower Colorado River basin.

Task 3: Generate blended precipitation products that infuse IMERG 4-h data.

Task 4: Create a bias-adjusted soil moisture product through LIS for testing using the refined loss estimation scheme.