Where Old Data Meets New Technology: The Los Angeles Flood Control District Hydraulic and Hydrologic Model

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Highlights

- Consolidates 50 years of rainfall, stream gage, and water quality data with latest technological advancements
- Los Angeles Flood Control District includes complex hydraulic systems such as diversions, dams, and debris basins.
- Used for several studies including for climate change, water quality compliance, and stormwater capture master plans.

Introduction

The Los Angeles County Flood Control District (LACFCD) released The Watershed Management Modelling System (WMMS) in June 2020. The model simulates historical rainfall and runoff through the complex flood infrastructure and urban Los Angeles County region using a combination of historical data and new data.

Methodology

Rainfall Data Update

WMMS relies on 149 quality-controlled rainfall gage network (ALERT) that were assigned to model subwatersheds using Thiessen polygons but is enhanced by incorporating gridded meteorological products from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) and North American Land Data Assimilation System-2 (NLDAS). Use of this hybrid approach that blends ground-based stations with remotely sensed precipitation products yields improved representation of rainfall than just ground-based stations alone.

Hydraulic Response Units (HRU) Update

Land is categorized into HRUs, which are the core hydrologic modeling land units in the watershed model. Each HRU represents areas of similar physical characteristics attributable to certain processes. The HRU development process uses primary data types that are typically closely associated with hydrology in the watershed. WMMS builds upon existing Land Cover and hydrologic soil group data by leveraging more recent, higher-resolution datasets.

Calibrate and Validate

The model incorporates complex drainage infrastructure including spreading grounds, diversion, dams, debris basins, detention basins, and irrigated landscaping. Calibration occurs by comparing existing stream gage data against modelled flow.

Results and discussion

Data from PRISM and NLDAS provide complete spatial and temporal coverage of the model area and capture meteorological heterogeneity where station density is less than ideal for high-resolution modeling. 483 PRISM grid cells and 77 NLDAS grid cells overlap the model domain and were leveraged in

the hybrid data approach. The PRISM data provide more resolution for spatial variability, while the NLDAS provide hourly temporal resolution. Spatially associating and scaling NLDAS hourly distributions with PRISM monthly totals provides a combined benefit for representing rainfall boundary conditions. The hybrid approach developed for meteorological conditions leveraged both ALERT ground observations and PRISM and NLDAS gridded datasets. This hybrid approach consolidated and downscaled meteorological data to best represent the heterogeneity of precipitation and evapotranspiration across the region, which can capture orographic influences. PRISM, NLDAS, and ALERT points were spatially intersected and ALERT stations were patched, a spatial Voronoi mesh was developed across the model area for downscaling the associated timeseries to the modeled subwatersheds as shown in Figure 1.

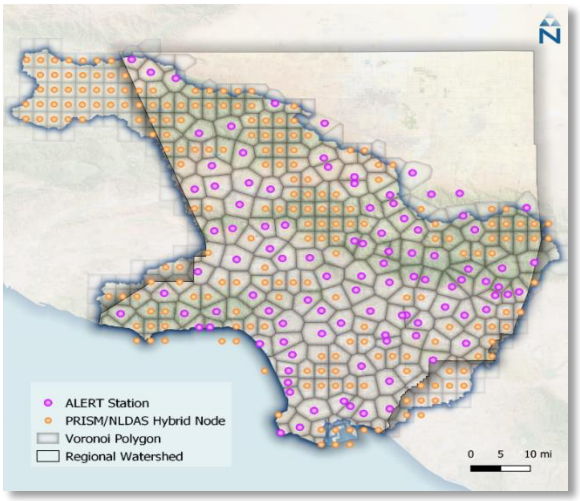

Figure 1. PRISM, NLDAS, and ALERT Hybrid Rainfall Data Map

HRUs were implemented to balance the need for spatial resolution with model simulation efficiency, resulting in a set of meaningful HRUs for model configuration. Five spatial layers were used to create the WMMS 2.0 HRU raster which includes parcel level land use, LIDAR based land cover, soils group based on hydrologic soils group, slope from Digital Elevation Model (DEM) data, and recharge potential from LACFCD experience that resulted in 96 HRUs. These 96 HRUs are used as the basis for the land representation in WMMS and provide the ability to uniquely parameterize their associated hydrology and water quality processes (e.g., infiltration rates, pollutant loading rates, etc.). Figure 2 shows the high-resolution nature of the HRU in WMMS.

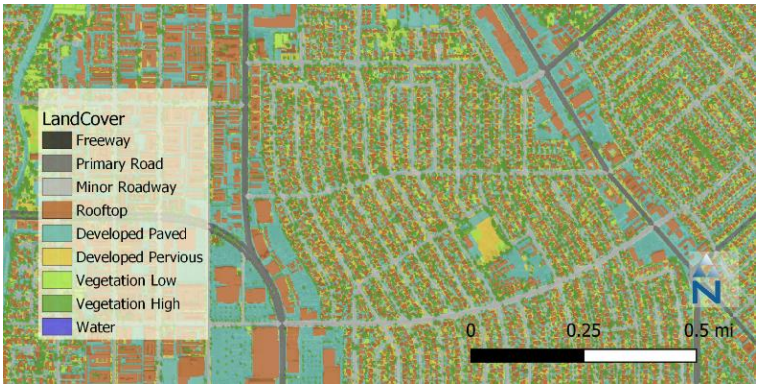

Figure 2. HRU representation in WMMS.

To provide a qualitative assessment of performance (e.g., confirm consistent temporal trends), comparisons between modeled and observed values were evaluated visually by examining timeseries plots. Figure 3 illustrates modeled and observed average streamflow for Arcadia Wash below Grand Avenue:

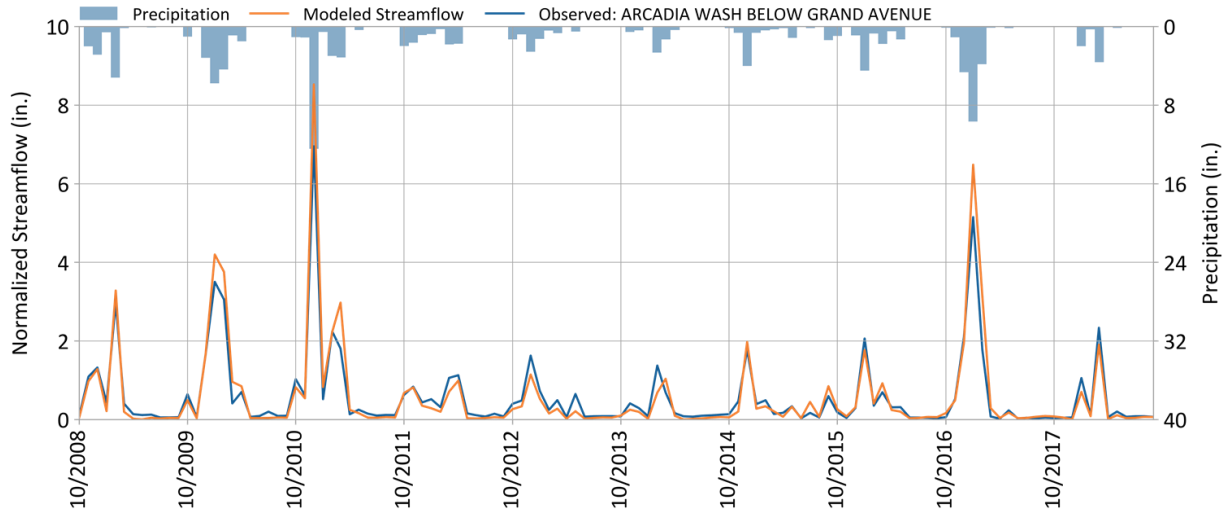

Figure 3. Observed compared to Model Flow at Arcadia Wash below Grand Avenue from October 2008 to October 2018.

Conclusions and future work

The WMMS hydrology model described above reflects a regional calibration effort, which sets a foundation and starting point to support future watershed planning efforts. WMMS has been used by the following:

- Los Angeles Department of Water and Power – Stormwater Capture Master Plan
- Municipal Separate Storm Sewer System (MS4) Permit compliance – Development of Watershed Management Programs
- Los Angeles Basin Study Climate Change Study – LACFCD and the U.S. Bureau of Reclamation.
- Safe Clean Water Program – Project Scoring Criteria

WMMS can be downloaded at www.LACountyWMMS.com.

References