HAS Weekly Hybrid Colloquium

Title: Near real-time flood maps across CONUS using the U.S. National Water Model, satellite observations and convolutional neural networks

Wednesday, Sep 21, 2022

12:00pm-1:00 pm in JW Harshbarger Building ROOM 110

https://arizona.zoom.us/j/84630723415

Speaker: Dr. Jonathan Frame
Cloud to Street

Abstract

Advances in satellite remote sensing enable accurate, rapid and cost-effective mapping of flood extent anywhere in the world. However, high resolution satellite observations are temporally sparse and are prone to have cloud gaps. Hydrologic and hydraulic models offer a continuous stream of information for flood mapping, but require trade-offs related to geospatial scale, computational efficiency, and accuracy. Deep learning algorithms can be used to learn the information compressed within such models for flood maps without the need for intensive runtime computations or time consuming curation of local data sources. We trained a fully convolutional encoder-decoder network to regress fractional flooded areas that can substitute direct satellite observations at a 2km grid cell resolution. Our training targets are 5740 CNN-produced flood maps from 189 events from the Dartmouth Flood Observatory archive across the CONtiguous United States (CONUS) from 2000-2021 observed by MODIS. Inputs to this network include two state variables from the U.S. National Water Model (NWM): soil moisture from the land surface component (NOAH-MP) and ponded depth from the terrain router. We also include three static inputs: a digital elevation model derived flow direction raster and flow accumulation raster, and a global surface water raster. NWM inputs include those from the NWM retrospective run (2000-2019; version 2.1) and NWM forecasts (2019-2021). We present case studies of eight hurricanes that passed over New Orleans, and seven hurricanes that passed over Houston. We find that our model accurately reflects the flood extents of these events. We apply this model to distinguish between hurricane events that cause, or do not cause, severe flooding.

Biography

Jonathan completed his PhD this year from the University of Alabama, studying physics-informed machine learning for hydrological modeling under HAS alumnus Grey Nearing. Jonathan is currently a Senior Hydrologist at Cloud to Street, where he is part of an R&D team developing a satellite-based flood inundation monitoring, prediction and forecasting system. Previously, Jonathan has worked at the U.S. National Water Center developing a deep learning component of the Next Generation U.S. National Water Model. Jonathan is a licensed engineer in his home state of California.