

# Predicting Flash Floods in the Dallas-Fort Worth Metroplex Using Workflows and Cloud Computing

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## Introduction

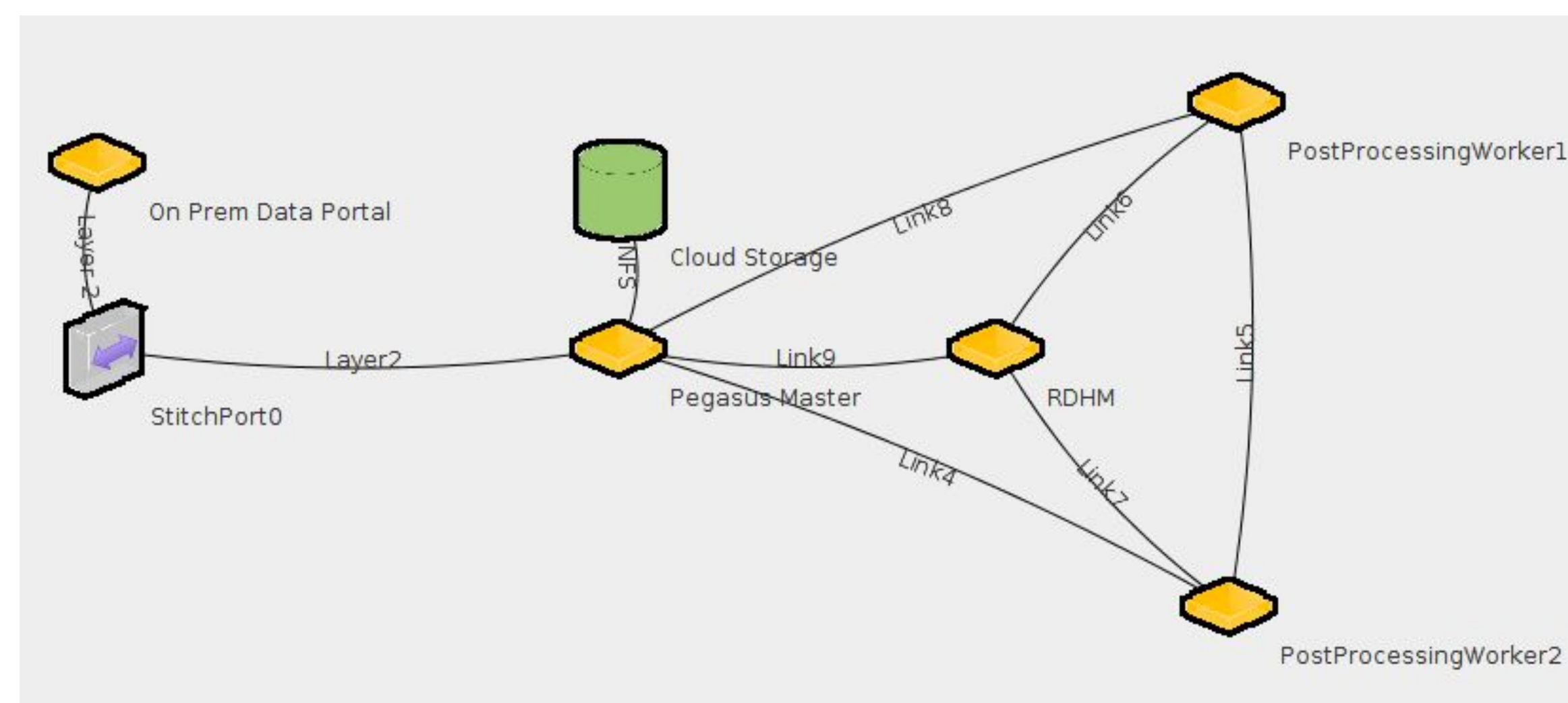
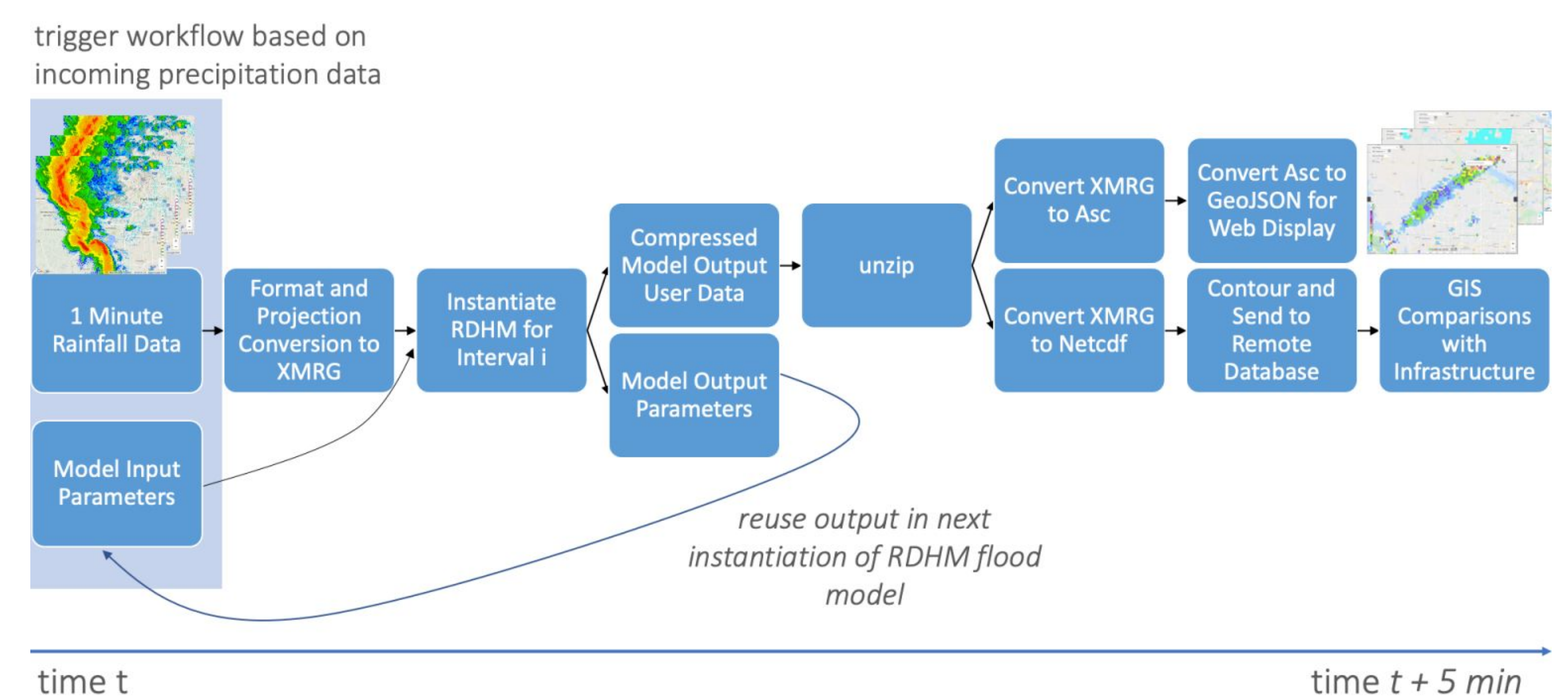
Accurate and timely **prediction of flash flooding events** can be a very useful tool for stormwater officials and first responders.

Having lead time with which to issue evacuation directives, to close flood prone roadways, to deploy rescue gear and personnel, and to fortify areas against flooding is essential to minimize property damage and risk of casualties.

In this poster, we are presenting a flash flooding prediction workflow based on the *Hydrology Lab-Research Distributed Hydrologic Model (HL-RDHM)*. This workflow leverages cloud computing and the *Pegasus Workflow Management System* to provide continuous high resolution flood predictions for the **Dallas-Fort Worth Metroplex area in North Texas**. DFW hosts the CASA X-Band radar network which provides accurate, high resolution rainfall data, which is the primary forcing input to the model.

## The RDHM Workflow

- The RDHM workflow was developed using Pegasus' 5.0 API (<https://pegasus.isi.edu>)
- It is consisted by 20 jobs that receive as input 1 minute rainfall data and the output of previous model runs.
- The cloud compute and networking infrastructure is procured and configured with the open source provisioning tool Mobius.



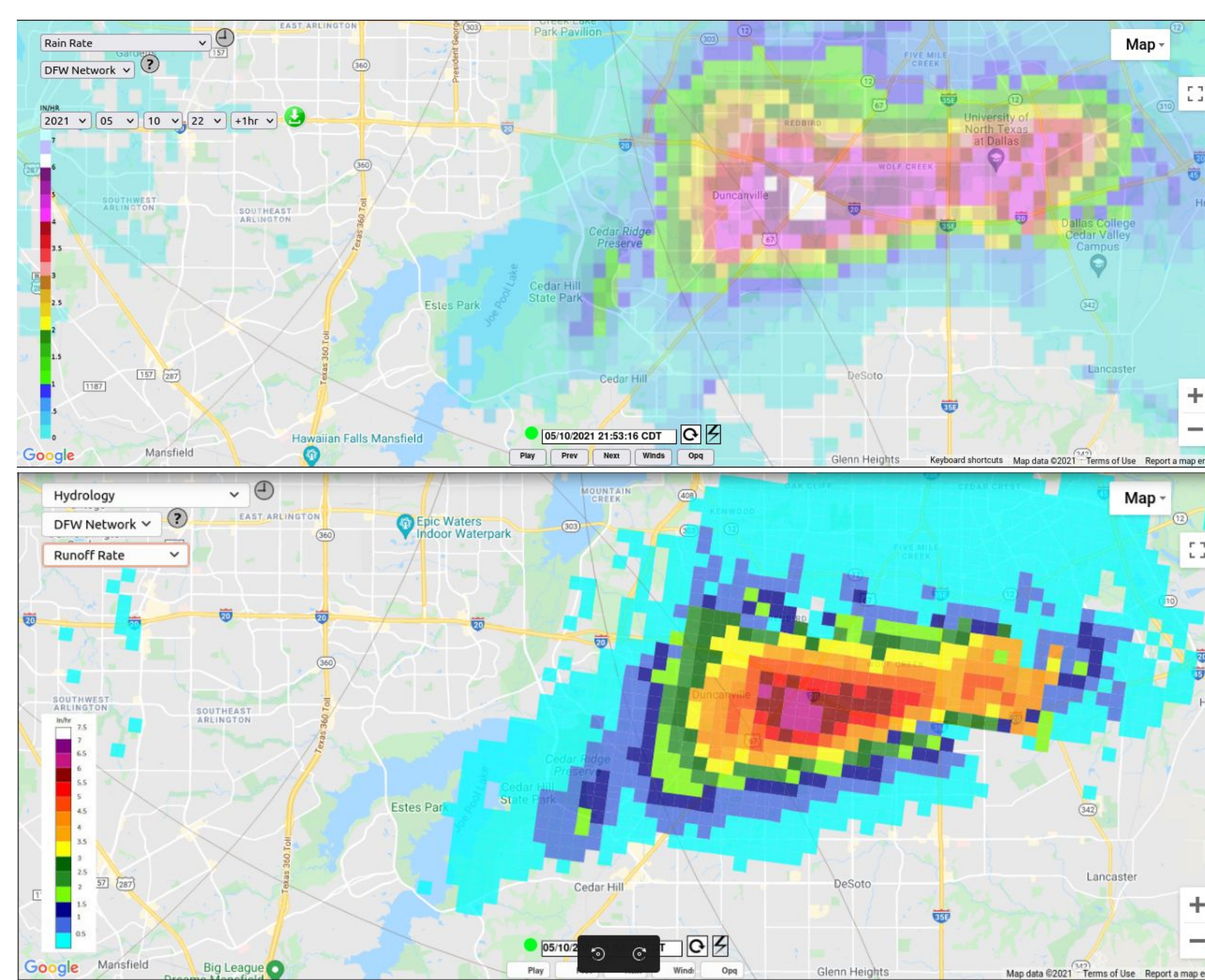
A sample RDHM architecture as organized on ExoGENI

- Layer 2 Stitchport created from dedicated data portal to Pegasus/Condor Master node with attached NFS storage device
- 3 Condor worker nodes, one typically running RDHM, 2 running post processing analysis, creating images, and alerting users to detected hazards.

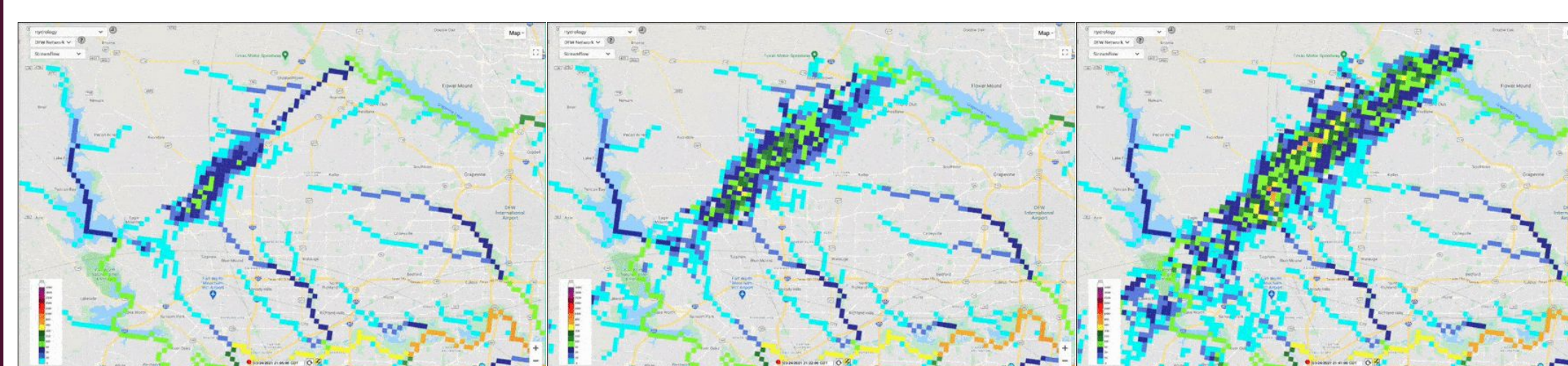
## The RDHM Model

- The RDHM model was developed by the United States National Weather Service's Office of Hydrologic Development (OHD) Hydrology Laboratory.
- Their goal was to improve:
  - Streamflow prediction in streams and rivers
  - Flash flood forecasting
    - Runoff Estimates
    - Water Depth
    - Return Period
- To achieve this, apart from **rainfall**, they incorporated in the model evolving estimates of parameters, including:
  - Soil moisture and temperature
  - Surface permeability
  - Vegetation
  - Topography
- Traditionally, the RDHM runs on a single powerful dedicated server. We have modified this to run in the cloud, with model output further processed by a pool of worker computers to provide rapid analysis to users.

## Visualization



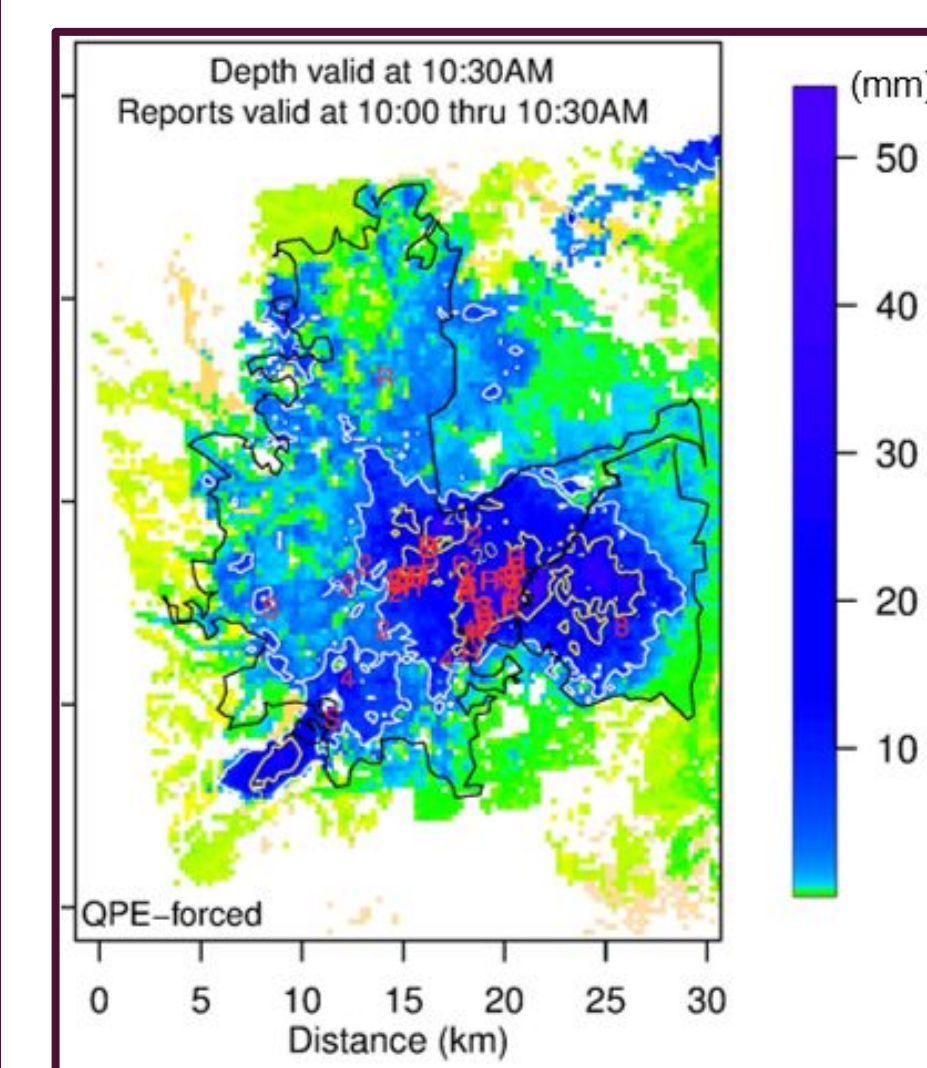
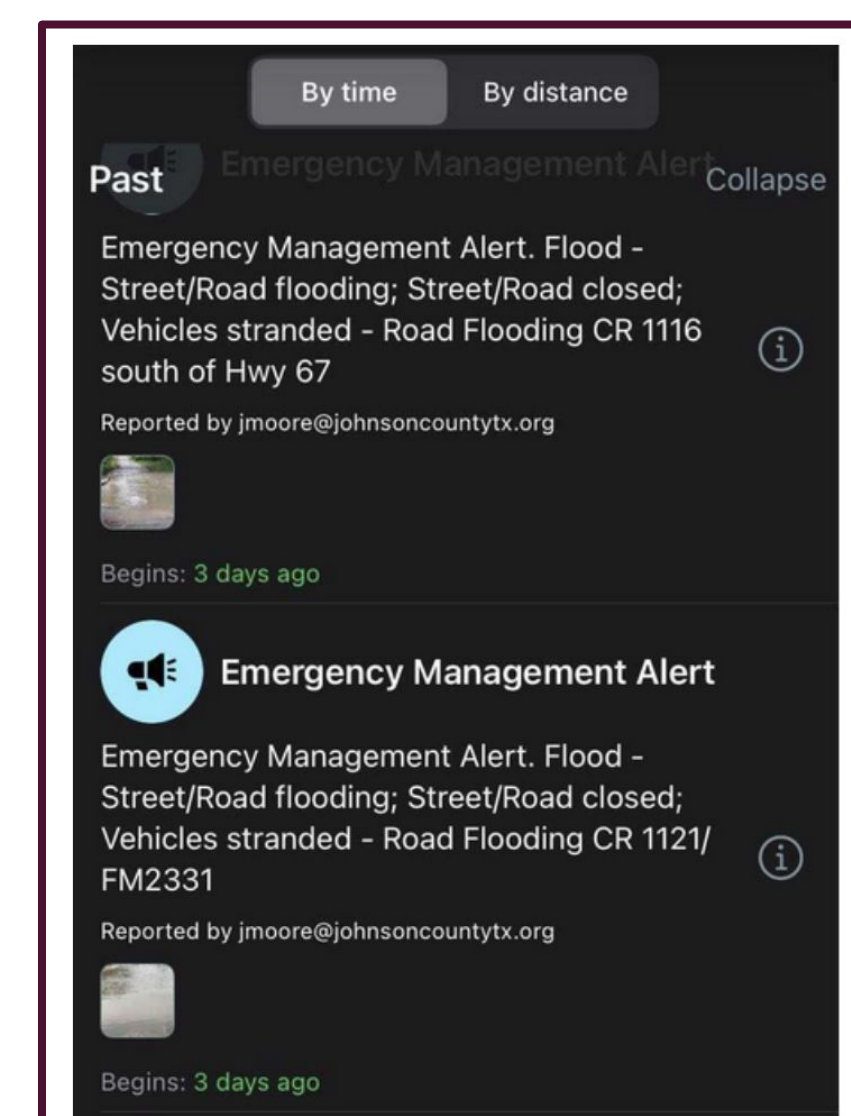
CASA Instantaneous Rainfall Rate product (top) is fed into RDHM once a minute. Using the latest parameterizations RDHM produces Runoff Rate (bottom), and accumulates into total water depth and changes in streamflow levels.



Streamflow predictions over time depicting water flowing over the surface from a severe thunderstorm and the local river basin spilling over its banks. The workflow produces 15 minute forecasts of streamflow, runoff, water depth, and estimated return period.

## Community Impact

- The workflow is capable of pushing alerts to a mobile app
- Alerts are displayed to over 1000 emergency managers
- The CASA website also displays live values



- RDHM predicted water depth with high water rescues (R), road closures (H), and flood reports to police (S).
- By forcing model with rainfall nowcast, we may further extend lead time.

## Learn More

- Workflow Github: <https://github.com/CASAelyons/rdhmworkflow>
- RDHM Container Docker Hub: [https://hub.docker.com/repository/docker/casaelyons/rdhm\\_container](https://hub.docker.com/repository/docker/casaelyons/rdhm_container)
- RENCI Mobius: <https://github.com/RENCI-NRIG/Mobius>
- CASA DFW Radar Network <https://www.nctcog.org/ep/casawx>