Unit 01: Introduction/Overview of DSS-WISE Web

WEB-BASED FLOOD INUNDATION MODELING WITH DSS-WISE WEB: A SHORT COURSE ON RECENT UPDATES WITH HANDS-ON TRAINING

For
FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA

Technical Workshop

May 19, 2024

Baird Center, 400 W. Wisconsin Ave, Room S 102 C
Milwaukee, WI 53203

Developed by

NATIONAL CENTER FOR COMPUTATIONAL HYDROSCIENCE AND ENGINEERING
THE UNIVERSITY OF MISSISSIPPI

Agenda

Time	Topic
1:00 PM – 1:50 PM	Introduction/Overview of DSS-WISE Web
1:50 PM – 2:30 PM	Simulation scenario setup research and data entry
2:30 PM – 2:40 PM	SHORT 10 MINUTE BREAK
2:40 PM – 3:10 PM	Understanding simulation outputs
3:10 PM – 3:50 PM	Hands on exercises using the new system features
3:50 PM – 4:00 PM	SHORT 10 MINUTE BREAK
4:00 PM – 4:30 PM	Tips and Tricks/Advanced Techniques
4:30 PM –4:45 PM	Future system enhancements
4:45 PM – 5:00 PM	Questions / Discussion

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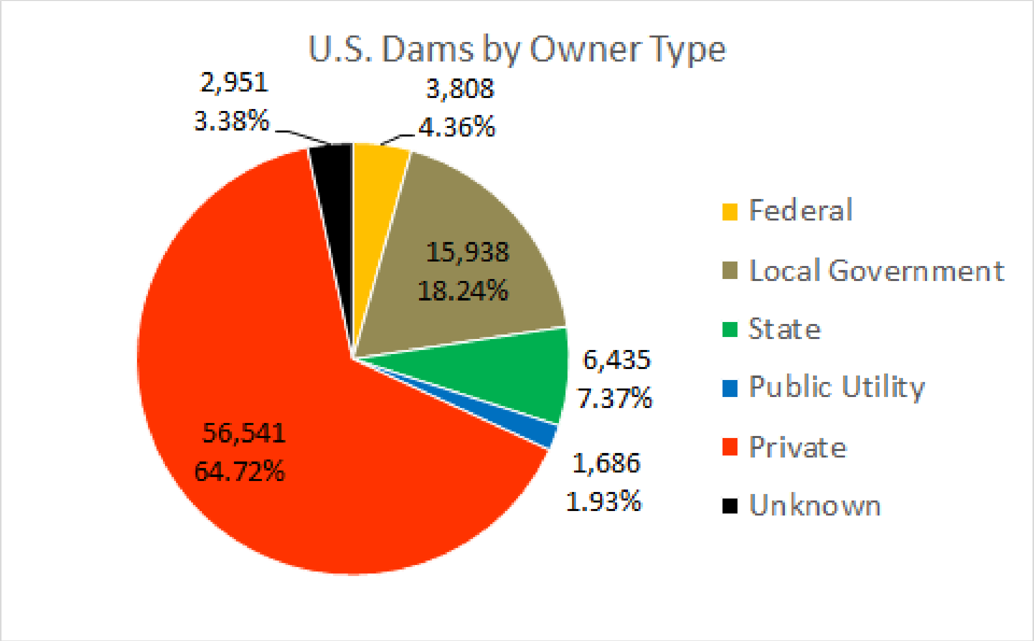
Acknowledgements

1. USDHS Science and Technology Directorate
2. FEMA National Dam Safety Program
3. California Department of Water Resources Division of Safety of Dams
4. Current NCCHE Team Members: Dr. Mohammad Al-Hamdan, Marcus McGrath, Dr. Nuttita Pophet, Paul Smith, Seth-Daniel Lambert
5. Former NCCHE Team Members: Dr. Mustafa S. Altinakar (Former NCCHE Director and Project's PI), Dr. Vijay P. Ramalingam, Dr. Greg Easson (Former NCCHE Acting Director and Project's PI), Dr. Hazem Shatnawi
6. Dr. Gokhan Inci, Mr. James Demby, and Mr. Preston Wilson from the National Dam Safety Program at FEMA
7. Dr. David Alexander and Mr. Ronald Langhelm from the Science & Technology Directorate at USDHS
8. Dr. Christian Carleton from the Office of Water Programs at California State University, Sacramento
9. Mr. Kyle Pfeiffer from the National Preparedness Analytics Group, Decision and Infrastructure Sciences Division at ANL
10. Dr. Olufemi Omitaomu and Dr. Amy Rose from the Geographic Information Science and Technology Group, Computational Sciences and Engineering Division at ORNL
11. U.S. Army Corps of Engineers (USACE), Oak Ridge National Laboratory & Argonne National Laboratory for hosting/monitoring SERRI and DSAT
12. All the active users of DSS-WISE™ Lite for their valuable feedback and support

Introduction/Overview of DSS-WISE Web

1.1

A large majority of the dams (**~65%**) listed in the NID are **privately owned**.
Dam safety requires **collaboration with private dam owners**



Many private dam owners **do not fully understand** their personal responsibilities in case of a failure

Many private dam owners **do not have the funds** to hire engineering companies to study their dams and prepare EAPs

The dam safety is under the responsibility of the states.

The **states do not have the budget or the manpower** to closely follow the large number of dams under their jurisdictions, and they lack the judicial authority to impose the EAP studies on private dam owners.

Challenges of Legacy Flood Modeling Solutions and Benefits of DSS-WISE Lite

Legacy Dam-break Flood Modeling Challenges:

Web-based DSS-WISE Lite Solution: **User-friendly** **Fast** **Free** **24/7**

Difficult → User-friendly

- Web-based setup and results download
- Ph.D. in numerical modeling is not required
- Fully-automated data preparation with minimal setup
- Verified and validated 2-D numerical flood model
- GIS compatible results become available as soon as the simulation finishes

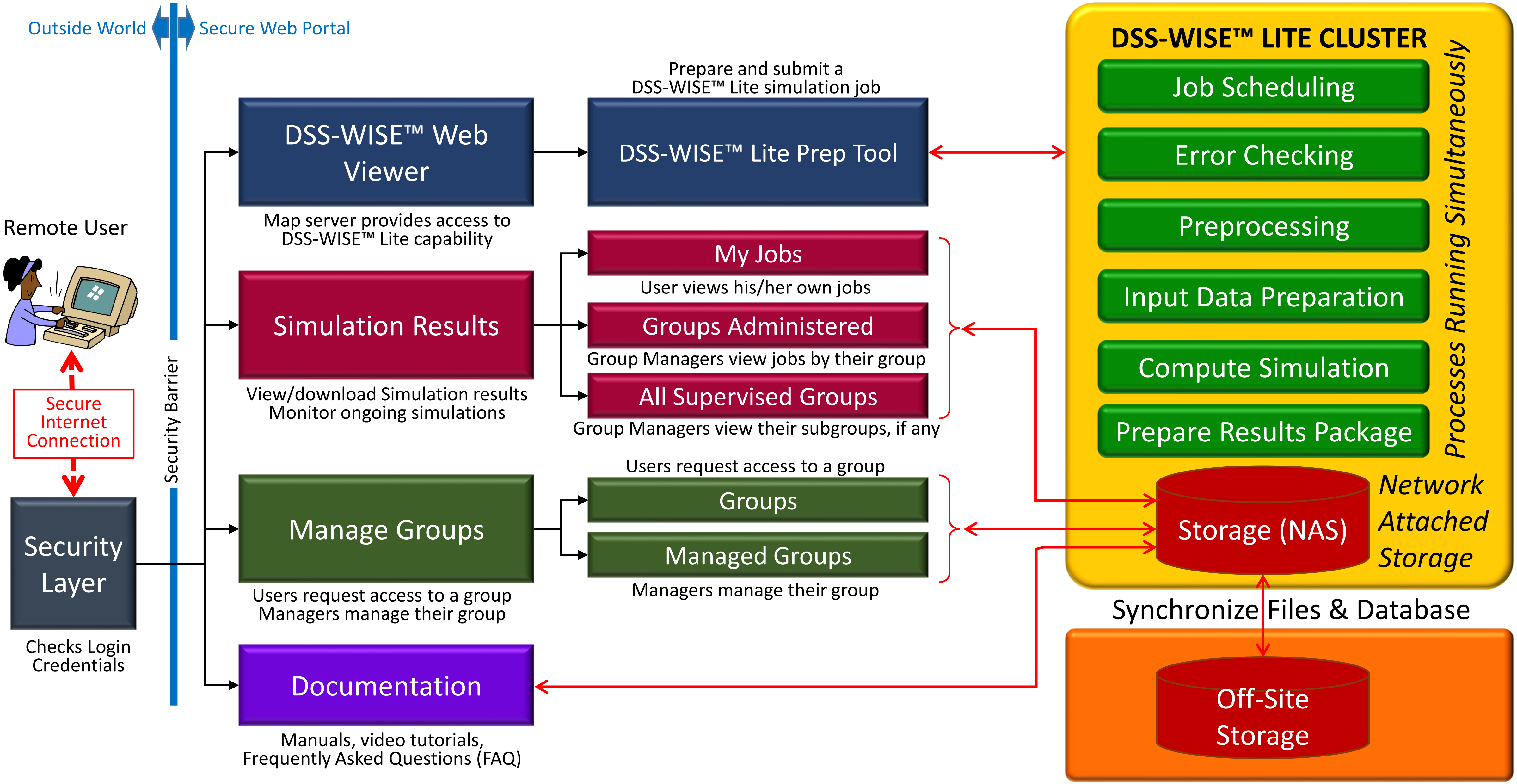
Slow → Fast

- Simple simulation setup can be done in < 5 minutes
- State-of-the-art model uses multithreading to fully take advantage of available compute hardware
- **In 87% of the cases results are returned to the user within 30 minutes and in 92% of the cases within one hour**

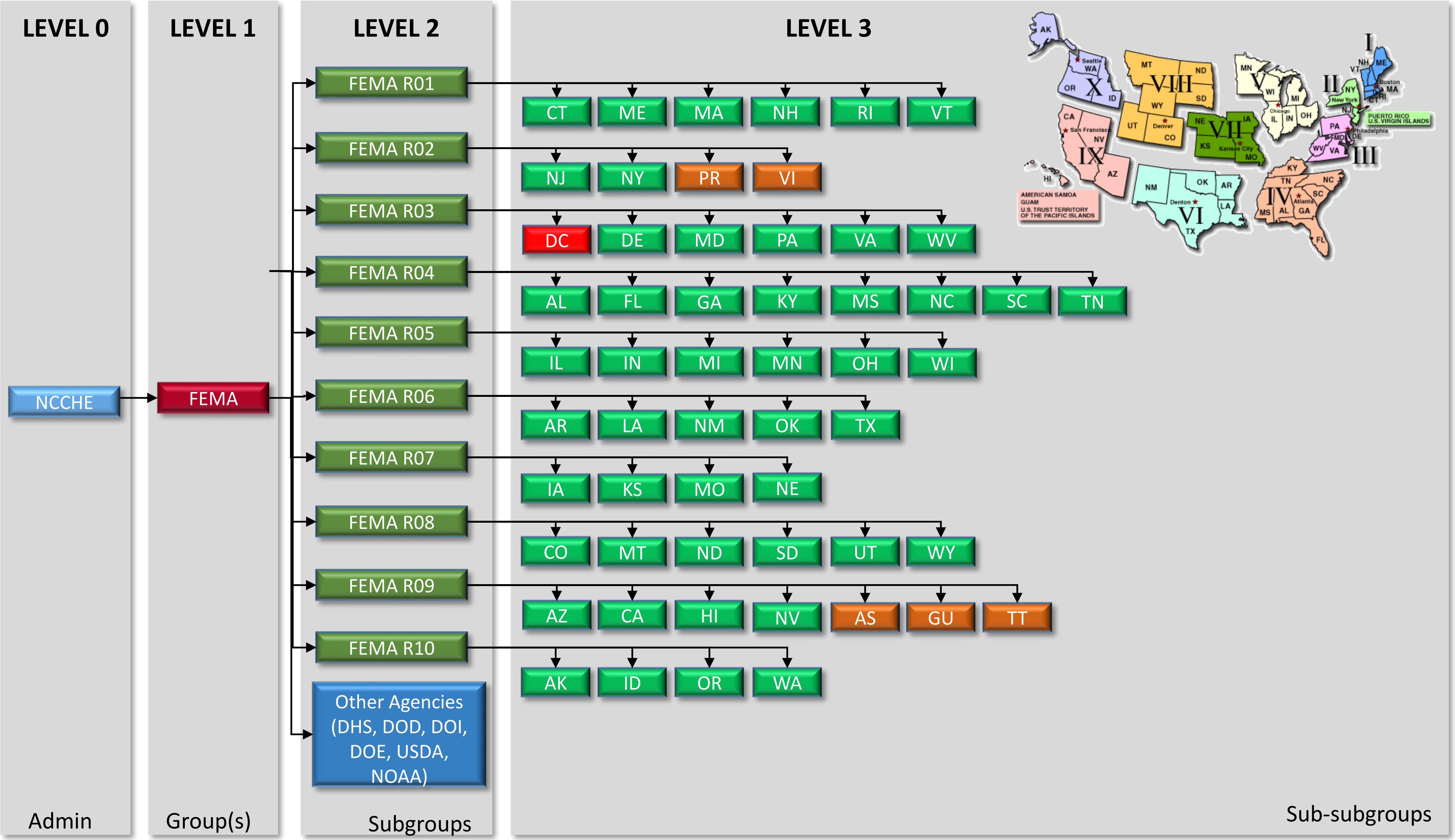
Expensive → Free

- No charge for use, licensing, or compute time
- Simulations run on NCCHE's servers- no need for expensive hardware
- Expensive engineering company is not required to obtain results
- **Available 24/7**

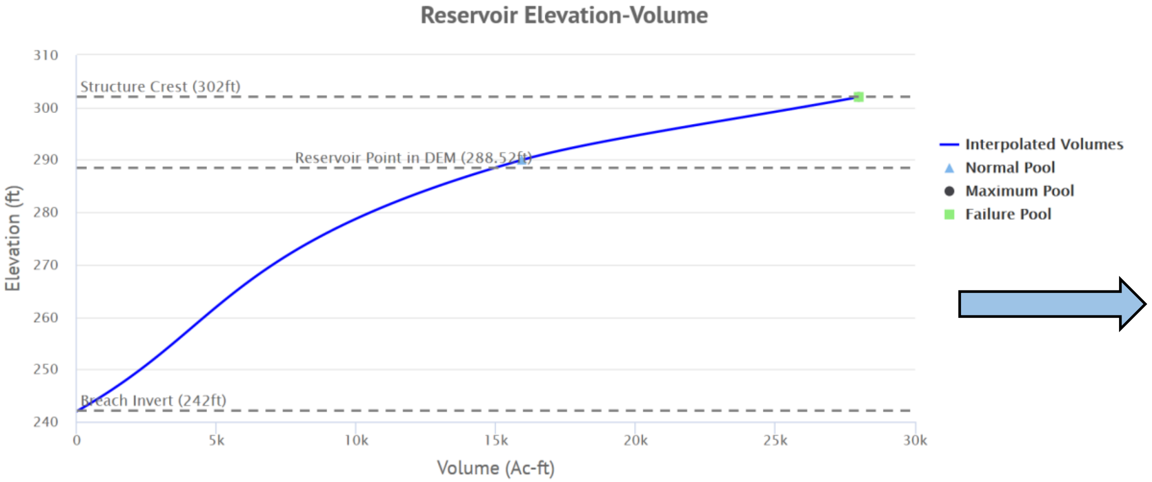
General Flow Diagram of the DSS-WISE Web Portal with Map Server and Graphical User Interface (GUI)

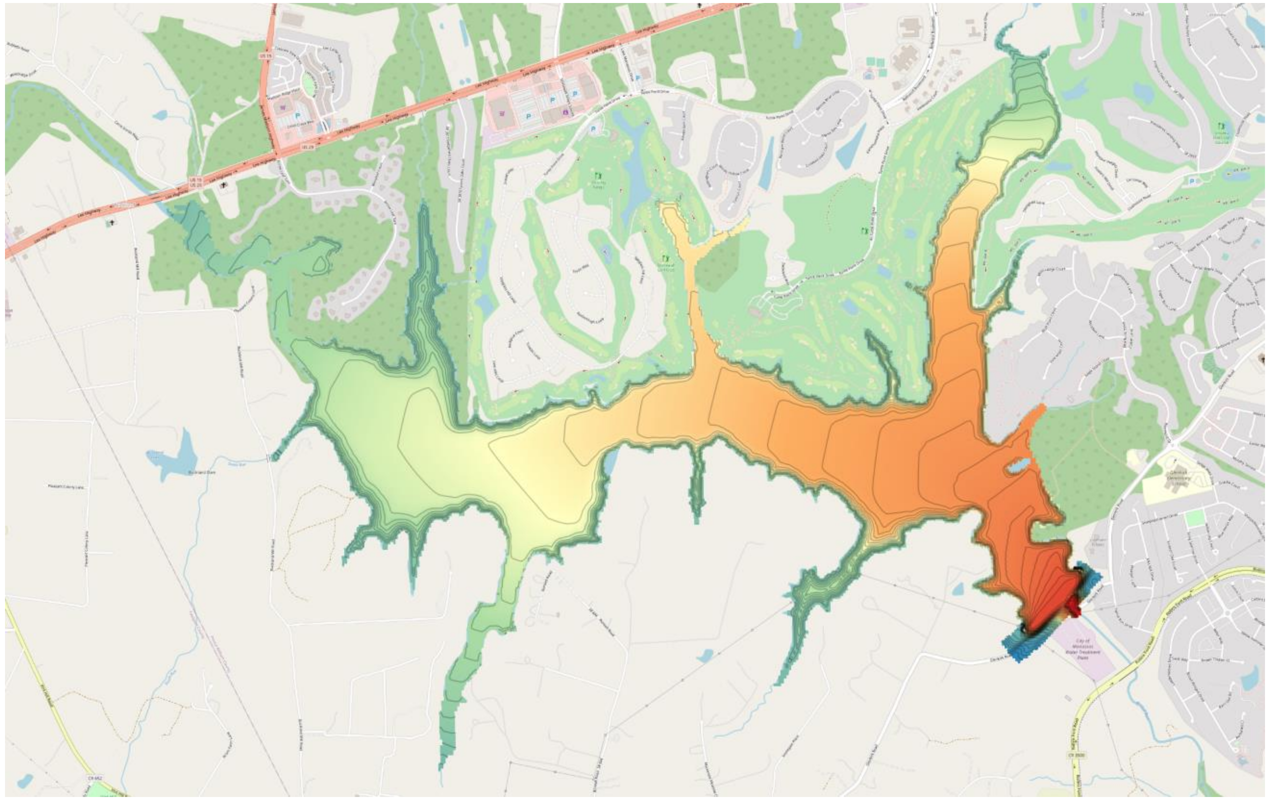


DSS-WISE Lite Group Concept

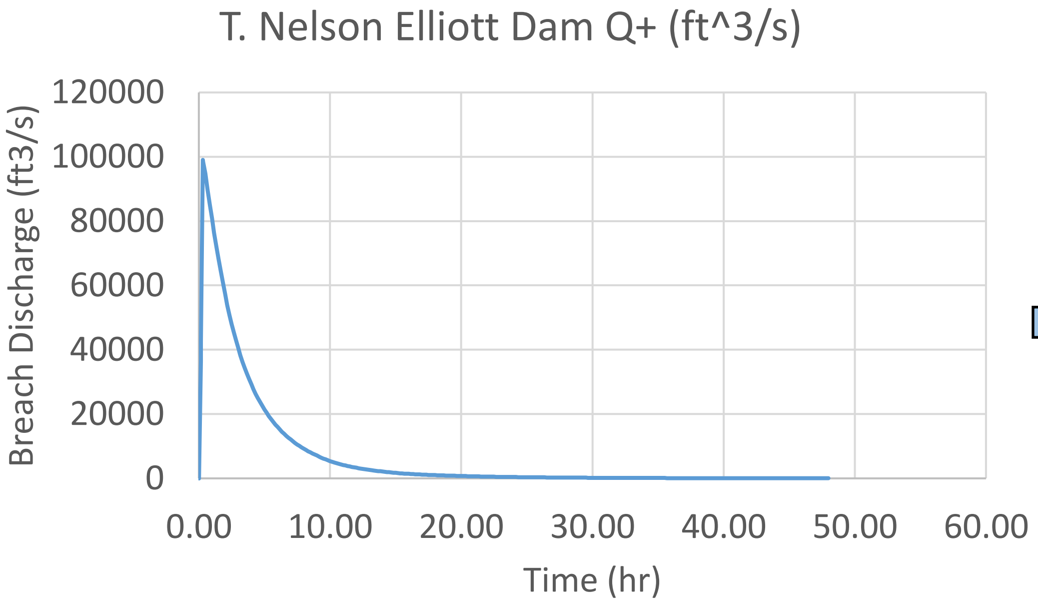


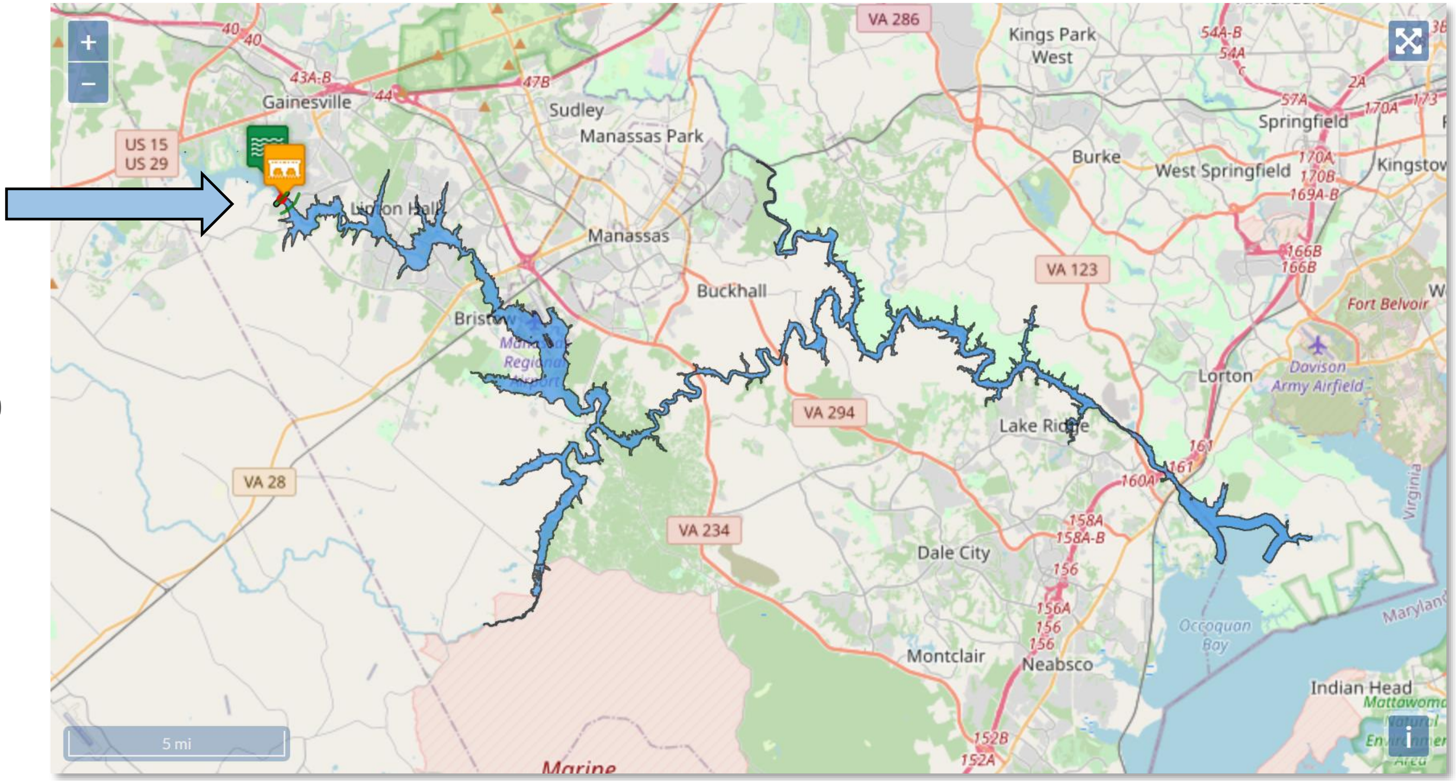
Ability to model sunny-day failures- reservoir is modeled at a given pool level, reservoir bathymetry is automatically spatially interpolated from user-supplied data



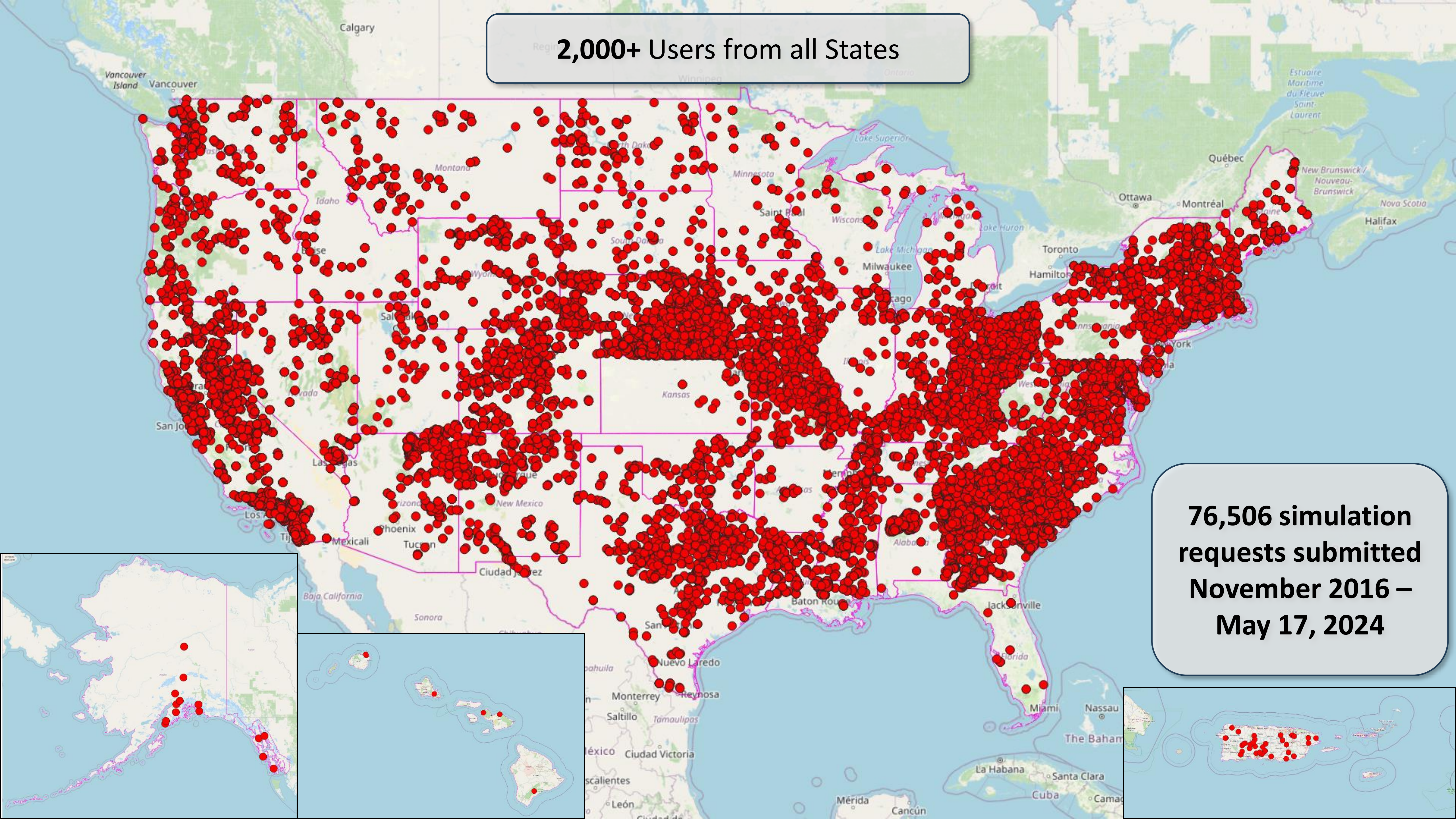


Ability to model a user-supplied breach hydrograph instead of modeling the reservoir



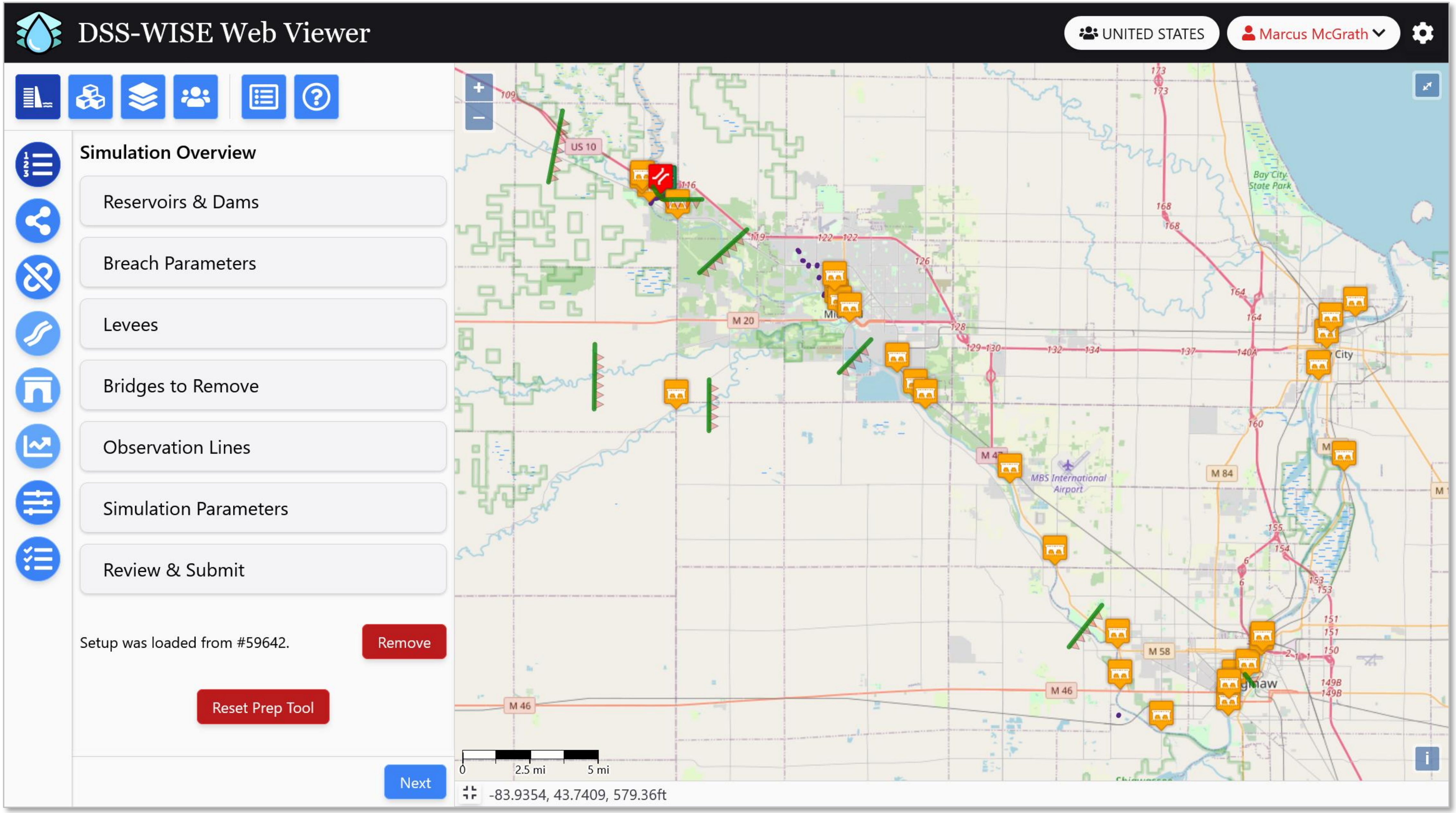


2,000+ Users from all States



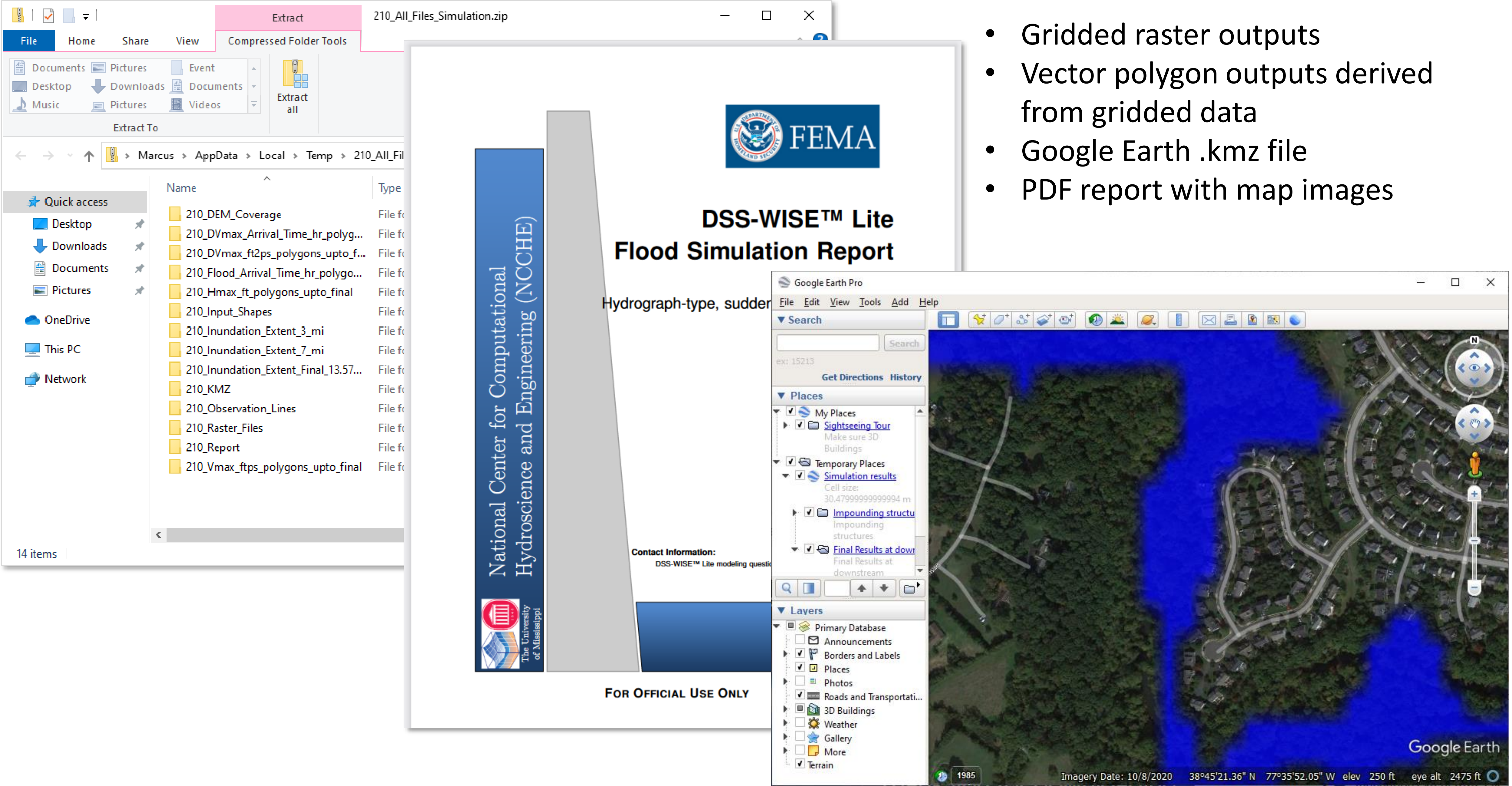
76,506 simulation requests submitted November 2016 – May 17, 2024

Web browser-based simulation setup

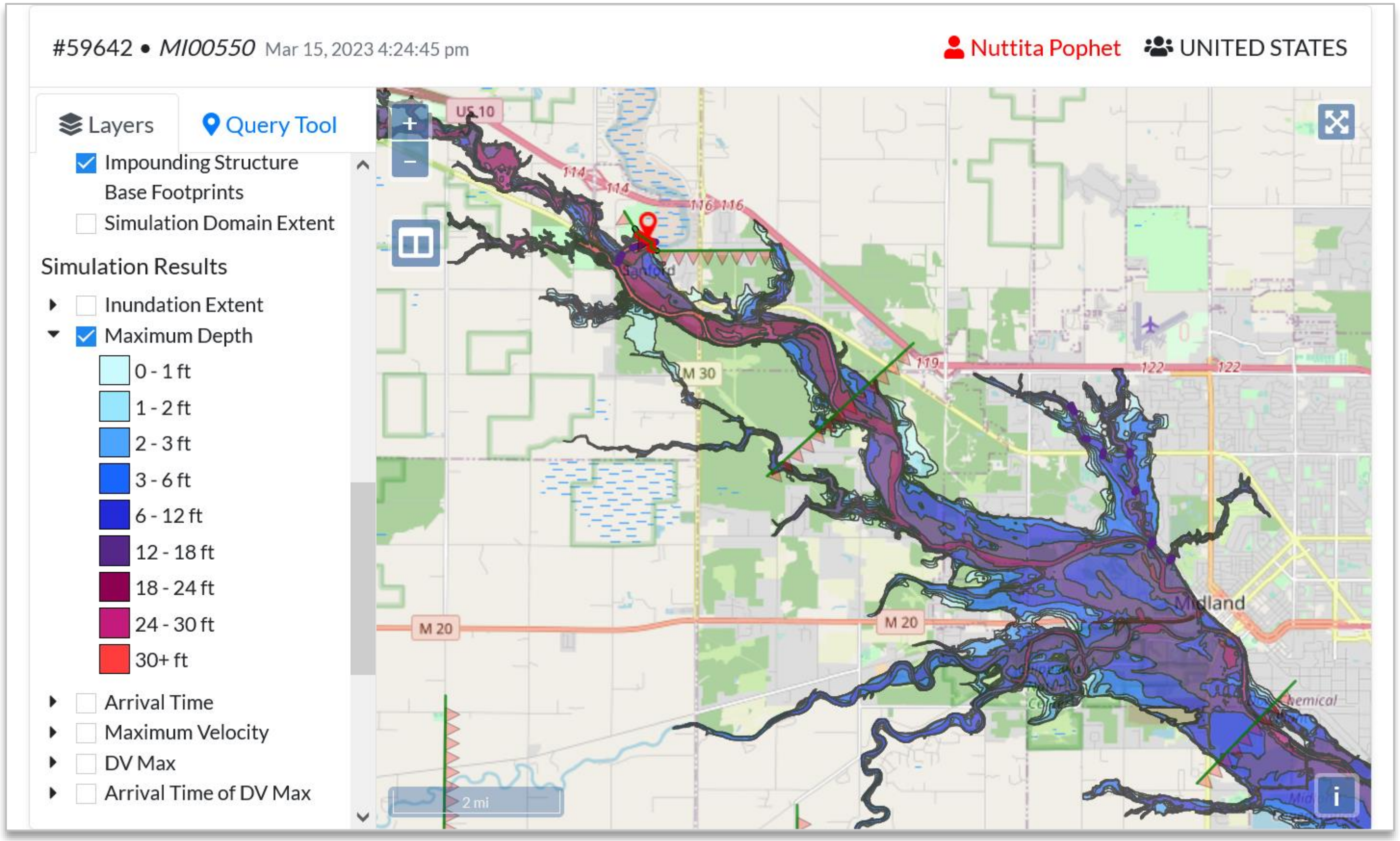


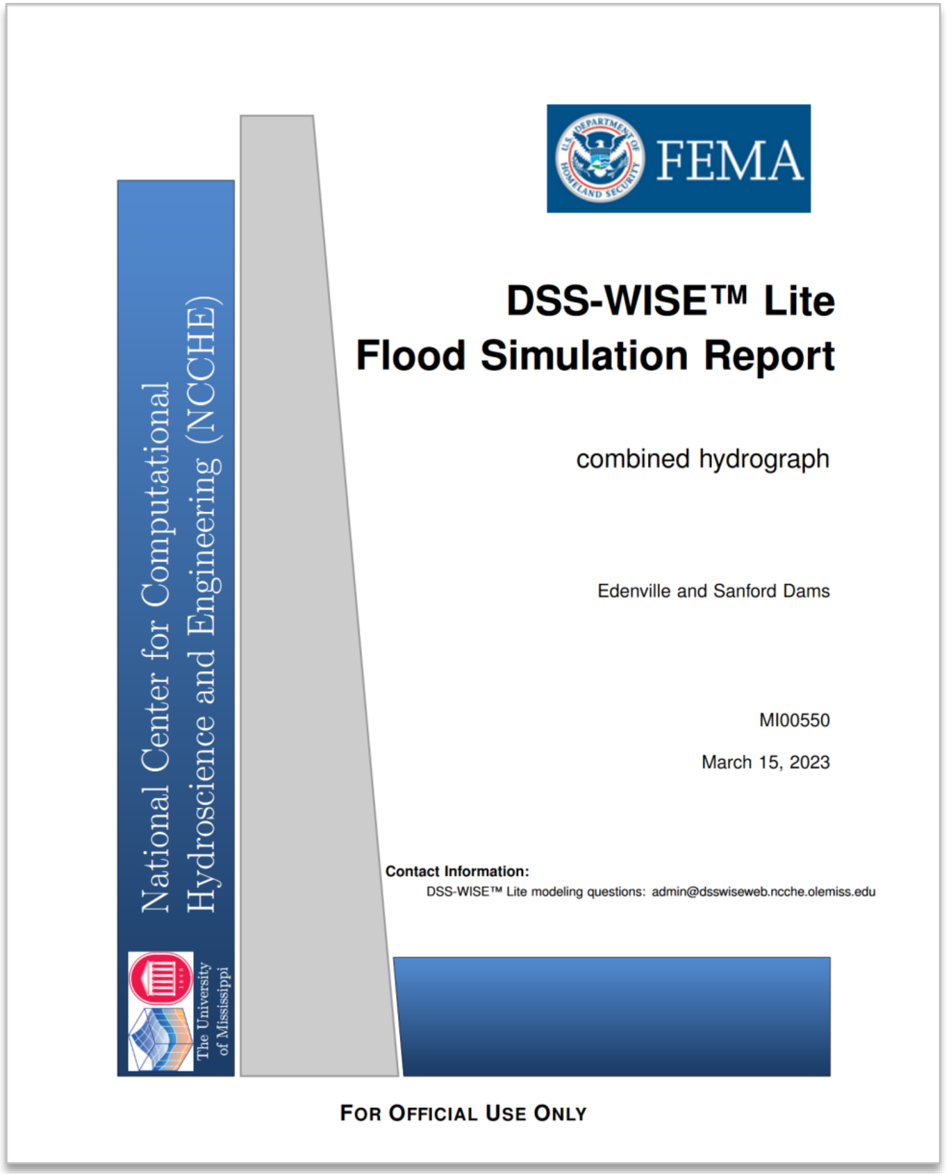
DSS-WISE Lite Simulation Results package

- Gridded raster outputs
- Vector polygon outputs derived from gridded data
- Google Earth .kmz file
- PDF report with map images



Users can visualize results/maps via the system's interactive GUI on their personal computers and smart phones or download them onto their own servers as GIS layers or just as a summarized PDF report to be handed to emergency managers and first responders.





DSS-WISE™ Lite
Flood Simulation Report

combined hydrograph

Edenville and Sanford Dams

MI00550

March 15, 2023

Contact Information:
DSS-WISE™ Lite modeling questions: admin@dsswiseweb.ncche.olemiss.edu

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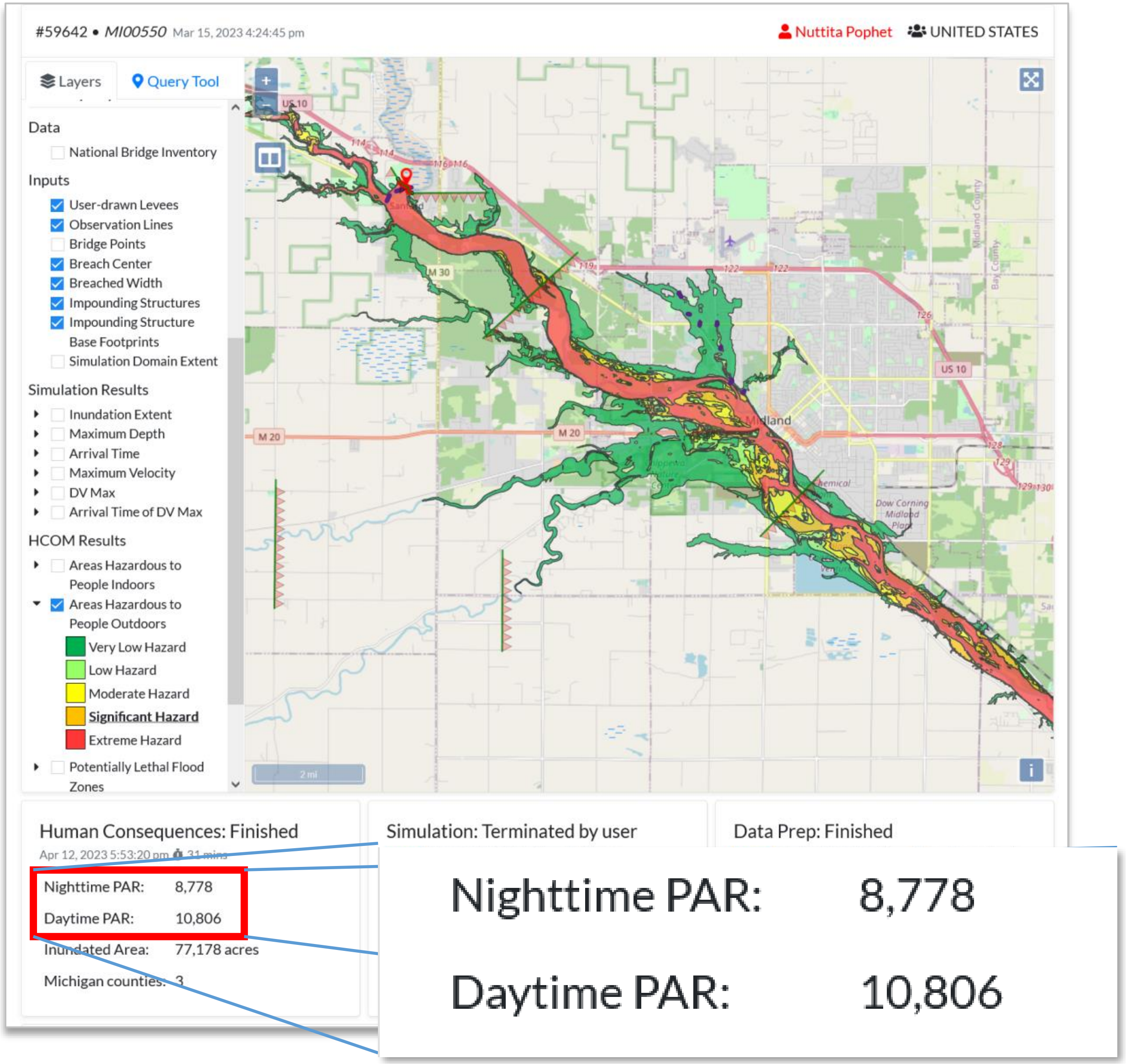
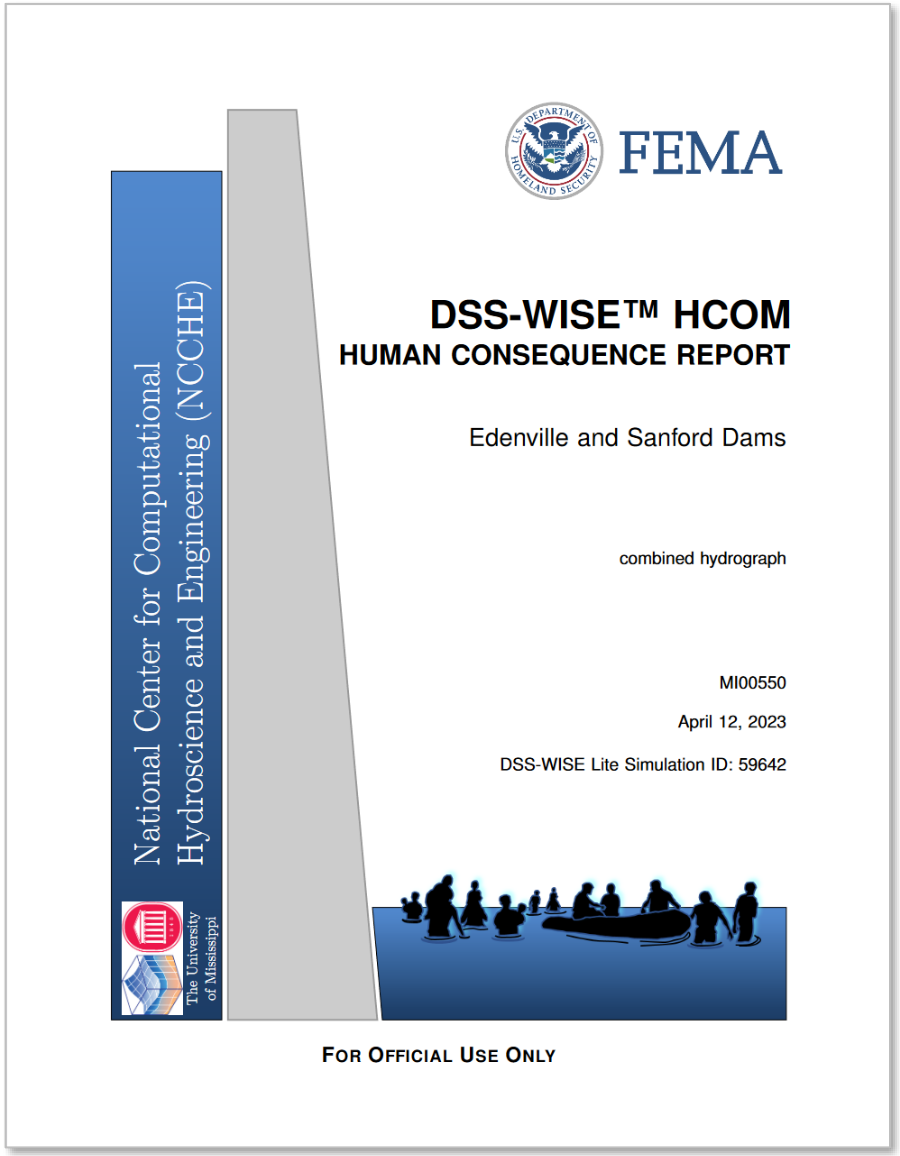
DSS-WISE HCOM: Human Consequences Module





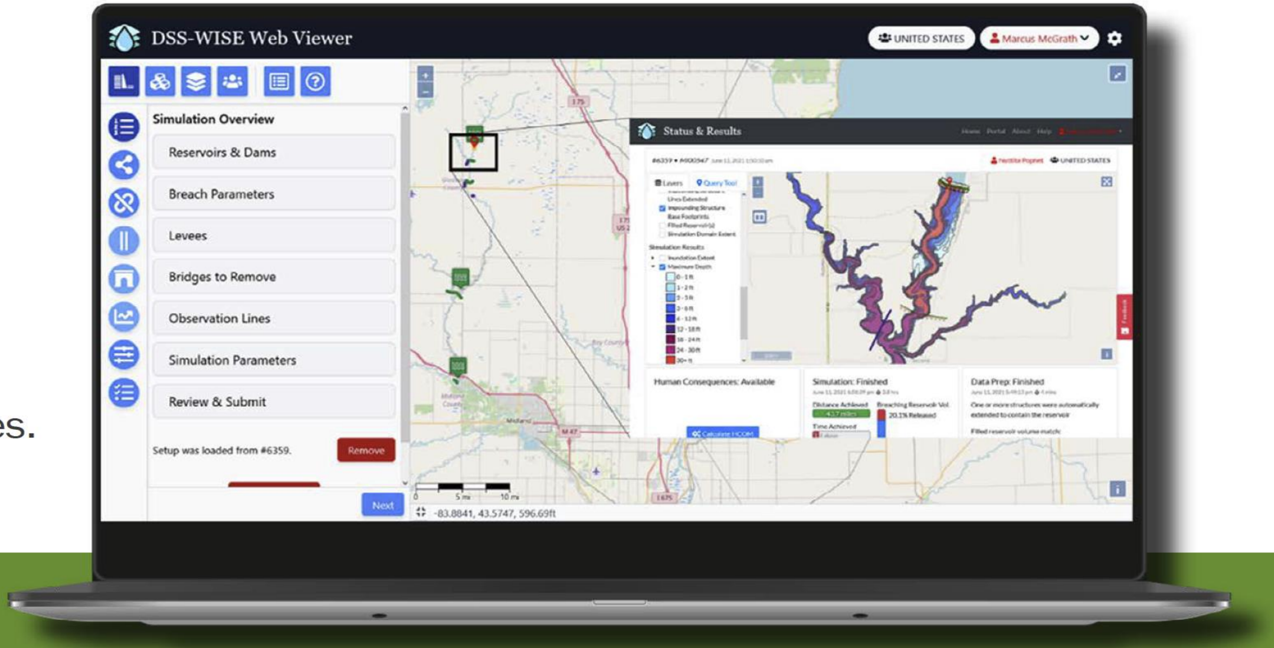
DSS-WISE WEB 3.0

NOW AVAILABLE

The National Center for Computational Hydroscience and Engineering (NCCHE) at the University of Mississippi recently released the new beta version 3.0 of the Decision Support System for Water Infrastructure Security (DSS-WISE) Web system. This was done in coordination with the U.S. Department of Homeland Security Science and Technology Directorate, the Federal Emergency Management Agency National Dam Safety Program, and the California Department of Water Resources Division of Safety of Dams. This update builds upon the previous version 2.0 with a host of powerful new features and a redesigned user interface to assist dam safety professionals, dam safety regulators, community officials, and emergency managers with dam break and flood hazard inundation mapping. These new capabilities and enhancements include the following:

1. A completely redesigned web user interface.
2. An improved, contextualized help system.
3. The generation of intermediate results upon user request.
4. A new dam NID search tool.
5. A new point query tool for results.
6. An improved breach parameter calculator.
7. Improvements to the results package.
8. The ability to load new simulation parameters from a previous submission.
9. The ability to include the presence of user-drawn levees.
10. The ability to model dams in series.

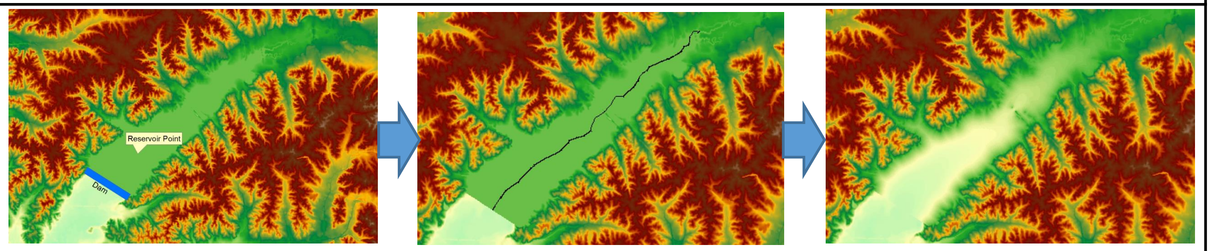
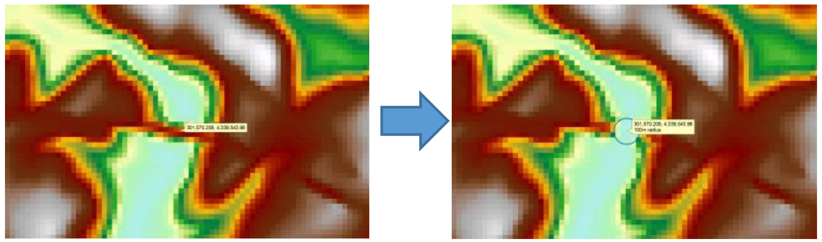
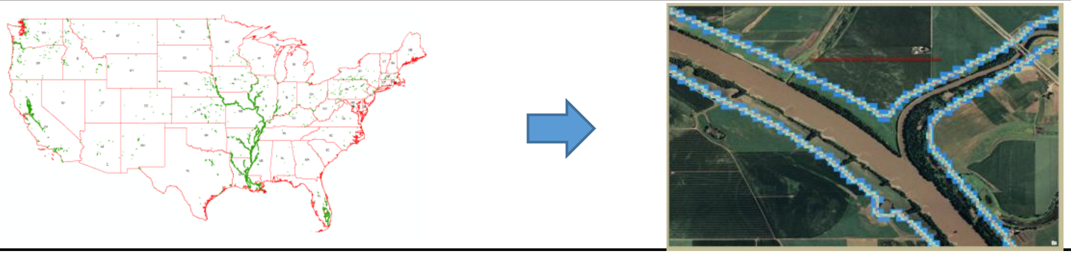
National Center for Computational Hydroscience and Engineering
The University of Mississippi



Steps of Automated Input Data Preparation

1.2

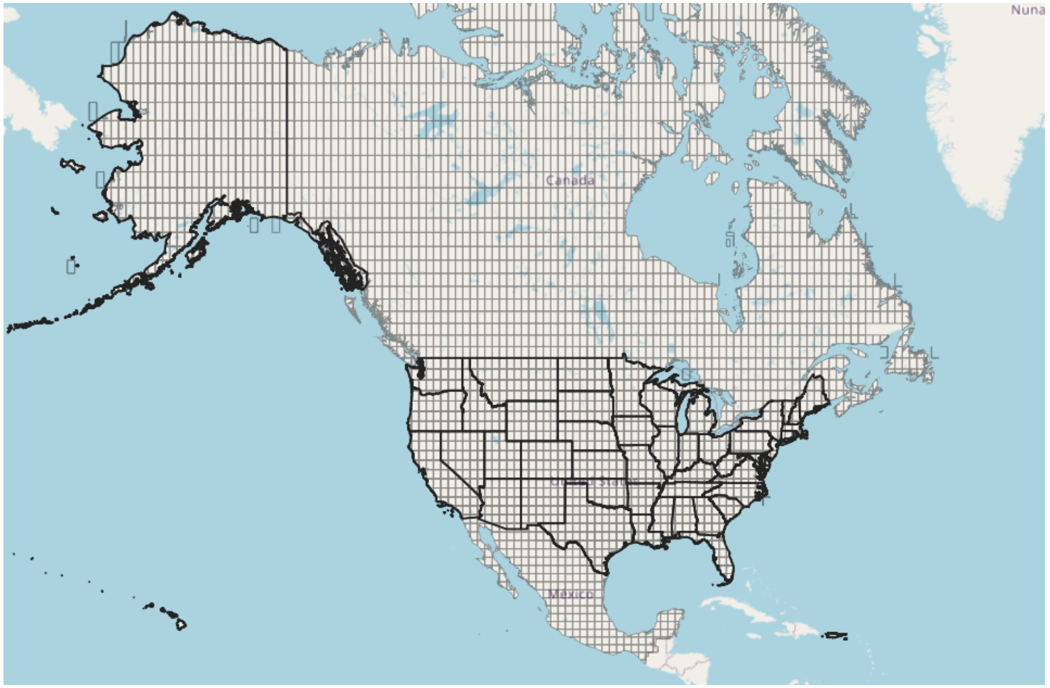
Step-by-Step Automated Input Data Preparation

<table>
<tr><td>1</td><td>The computational domain centered at the dam is prepared as a virtual raster (15-200 ft) from USGS 3DEP tiles</td><td></td></tr>
<tr><td>2</td><td>Reservoir bed topography is estimated using specially developed skeletonization algorithms</td><td></td></tr>
<tr><td>3</td><td>The bridges identified by the user are removed if they are represented in the DEM as elevation</td><td></td></tr>
<tr><td>4</td><td>Levees from the National Levee Database (NLD) are burned into the DEM at the correct cell size</td><td></td></tr>
<tr><td>5</td><td>Roughness values are assigned based on the 21 classified land use/cover classes from NLCD 2016</td><td>
<table>
<tr><th>CODE</th><th>n VALUE</th><th>LANDUSE</th></tr>
<tr><td>0</td><td>0.035</td><td>Unclassified</td></tr>
<tr><td>11</td><td>0.033</td><td>Open Water</td></tr>
<tr><td>12</td><td>0.01</td><td>Perennial Snow/Ice</td></tr>
<tr><td>21</td><td>0.0404</td><td>Developed, Open Space</td></tr>
<tr><td>22</td><td>0.0678</td><td>Developed, Low Intensity</td></tr>
<tr><td>23</td><td>0.0678</td><td>Developed, Medium Intensity</td></tr>
<tr><td>24</td><td>0.0404</td><td>Developed, High Intensity</td></tr>
<tr><td>31</td><td>0.0113</td><td>Barren Land</td></tr>
<tr><td>41</td><td>0.1</td><td>Deciduous Forest *</td></tr>
<tr><td>42</td><td>0.1</td><td>Evergreen Forest *</td></tr>
<tr><td>43</td><td>0.12</td><td>Mixed Forest *</td></tr>
<tr><td>51</td><td>0.035</td><td>Dwarf Scrub *</td></tr>
<tr><td>52</td><td>0.04</td><td>Shrub/Scrub</td></tr>
<tr><td>71</td><td>0.04</td><td>Grassland/Herbaceuous</td></tr>
<tr><td>72</td><td>0.035</td><td>Sedge/Herbaceous *</td></tr>
<tr><td>73</td><td>0.035</td><td>Lichens *</td></tr>
<tr><td>74</td><td>0.035</td><td>Moss *</td></tr>
<tr><td>81</td><td>0.035</td><td>Hay/Pasture</td></tr>
<tr><td>82</td><td>0.07</td><td>Cultivated Crops</td></tr>
<tr><td>90</td><td>0.15</td><td>Woody Wetlands</td></tr>
<tr><td>95</td><td>0.1825</td><td>Emergent Herbaceuous Wetlands</td></tr>
</table>
* Indicates n values assigned by NCCHE, otherwise it is obtained from literature.</td></tr>
</table>

DSSWISE™ Lite Uses USGS 3DEP DEM Data After Removing Cells of Large Waterbodies Clipped to the Ocean Shoreline

1.3

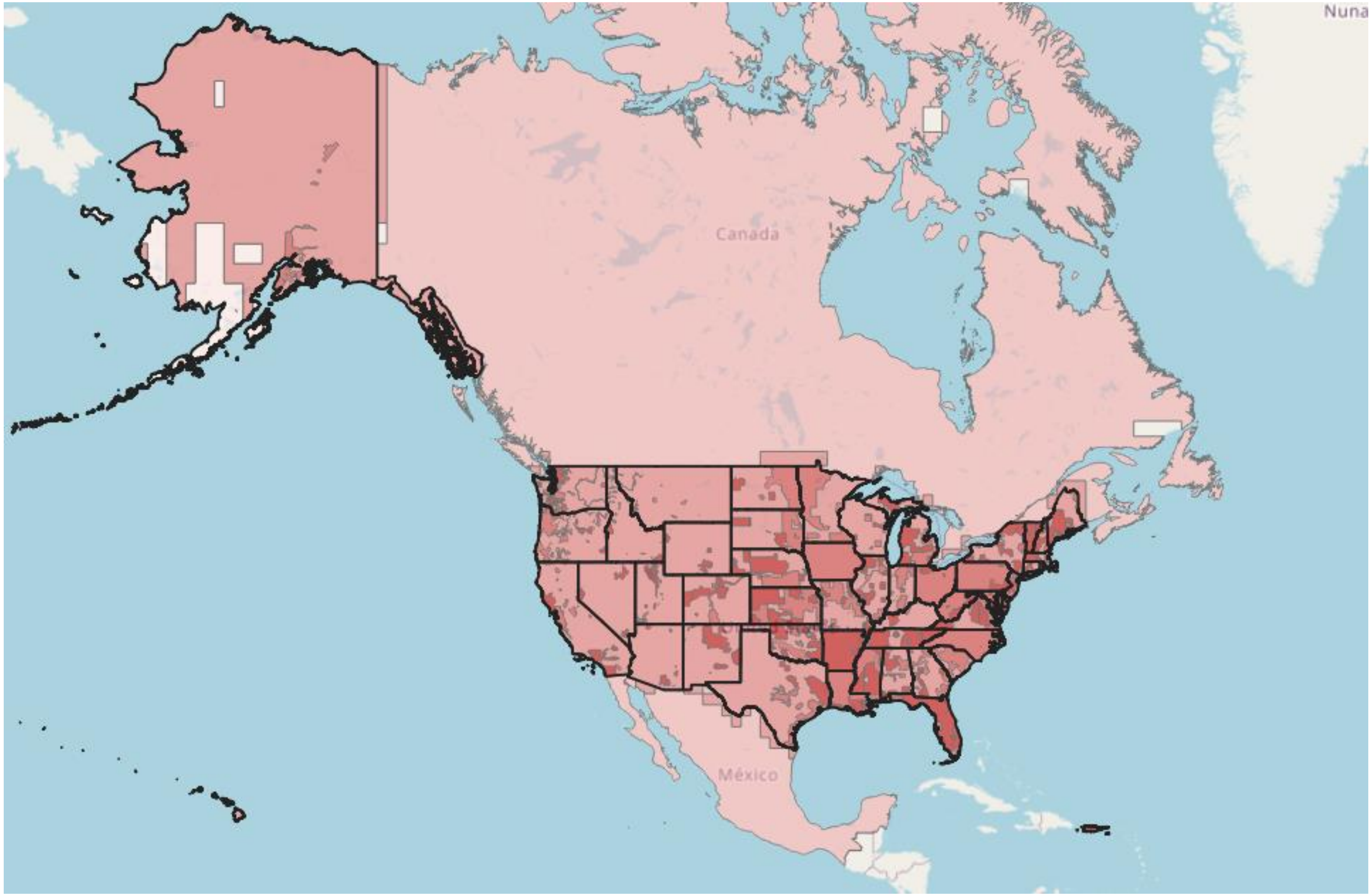
USGS 3DEP Tiles



DSS-WISE Lite Simulations Use a 2019 Snapshot of the Available 3DEP Data:

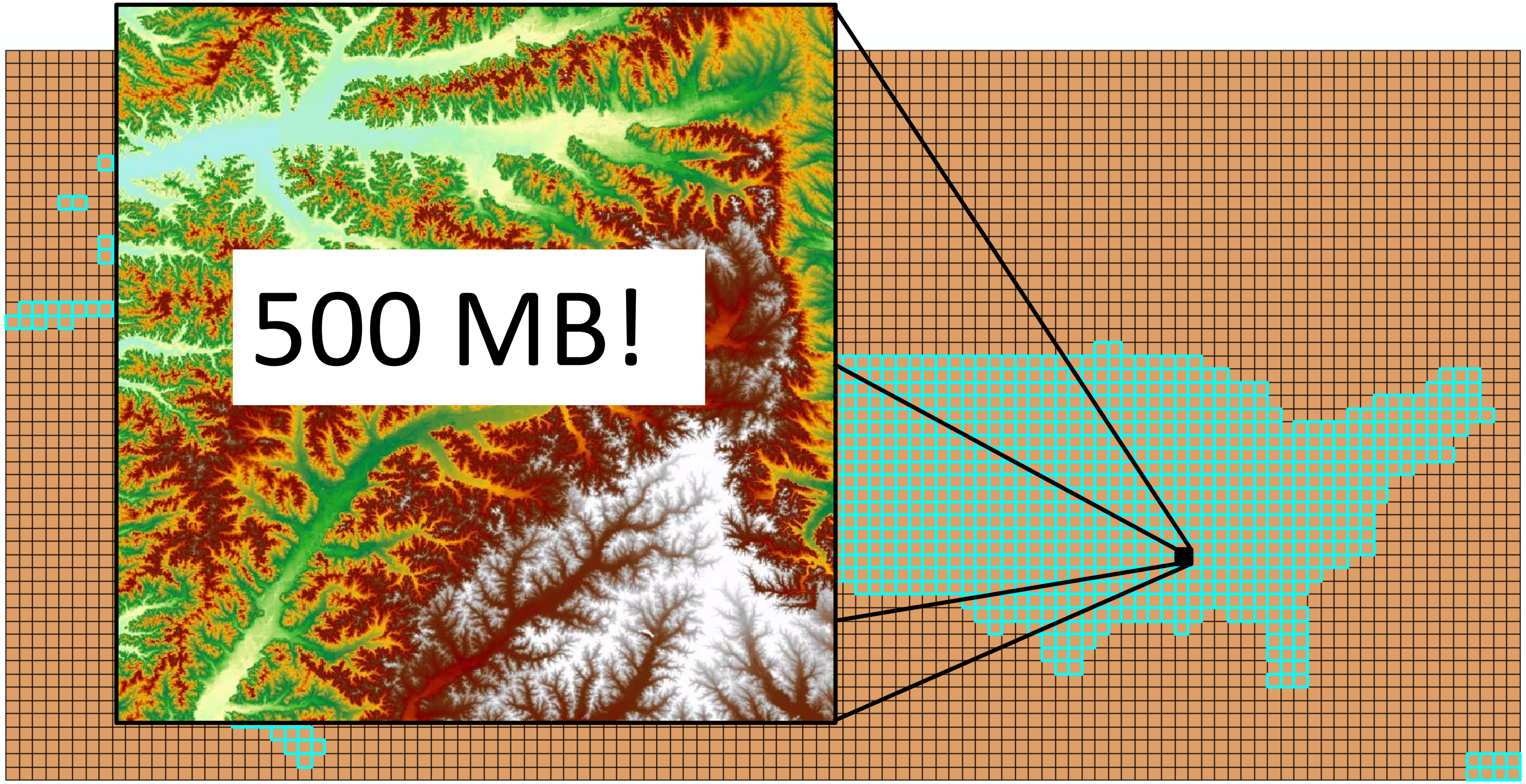
Dataset	Coverage	# Tiles	Total Size
2 arc-second (~60-meter)	Alaska	512	5 GB
1 arc-second (~30-meter)	North and South America	3,811	130 G B
1/3 arc-second (~10-meter)	CONUS seamless	1,438	490 GB
1/9 arc-second (~3-meter)	Partial	8,345	865 GB
1-meter	Partial	30,930	4.5 TB

USGS 3DEP 2019 Coverage



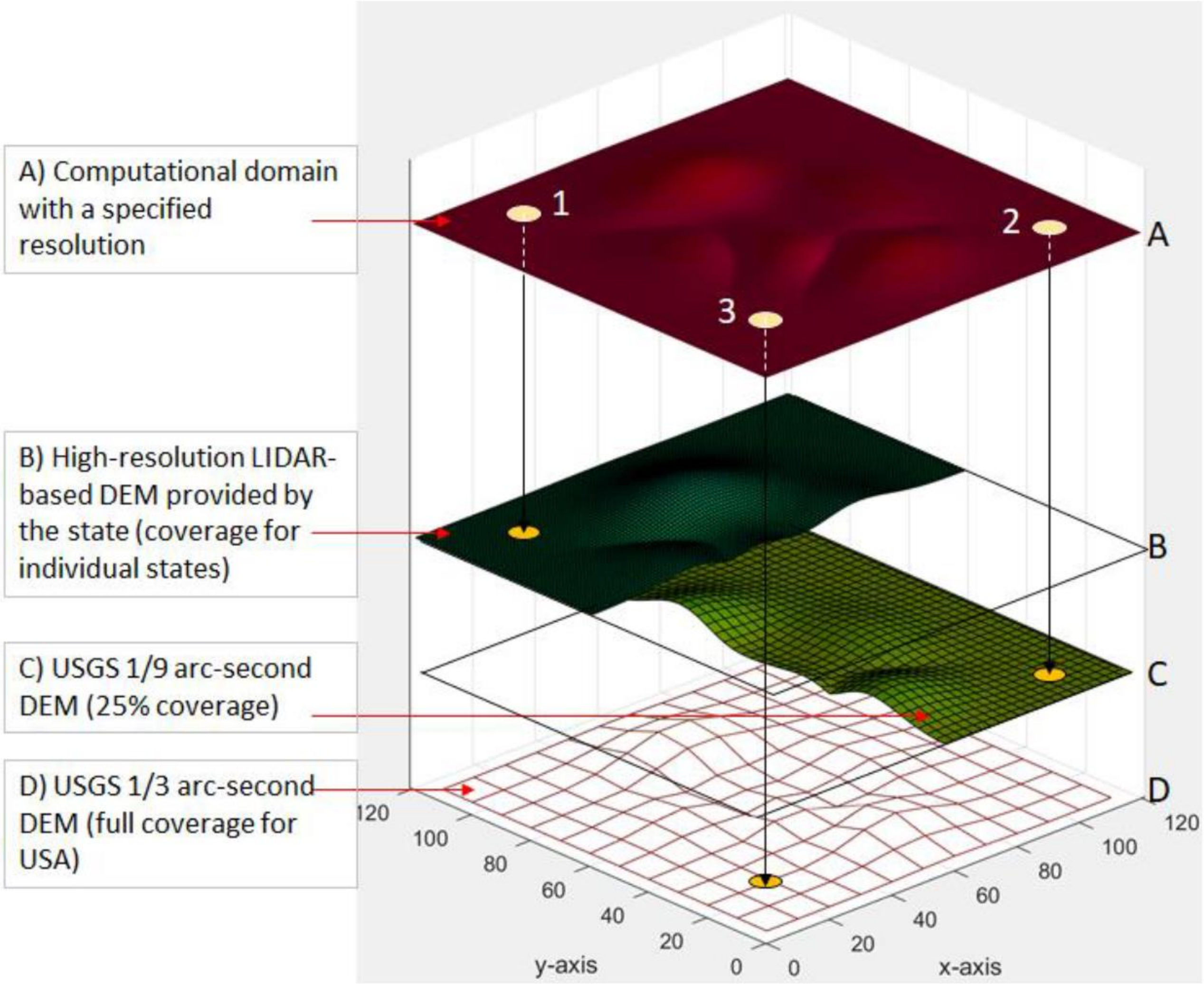
1 meter USGS
1/9 arc-second USGS
1/3 arc-second USGS
1 arc-second USGS
2 arc-second USGS

1/3 arc-second USGS 3DEP Tiles



Each 1/3 arc-second tile is about 500MB and covers and area of roughly 110 km by 110 km.

Composite DEM with Best Available Elevation Information



The states will be able to provide their own high-resolution data, which may even remain proprietary and be used only by the state providing the data.

To find the elevation of a point in the computational domain, the algorithm searches the available layers from top to bottom.

The search for the elevation value stops when a value is obtained from the first layer encountered in the search, which will be the highest resolution elevation data available for that particular point.

- Point 1 will get its elevation from 1-meter DEM (layer B)
- Point 2 will get its elevation from the 1/9 arc-second USGS NED (layer C)
- Point 3 will get its elevation from the 1/3 arc-second USGS layer.

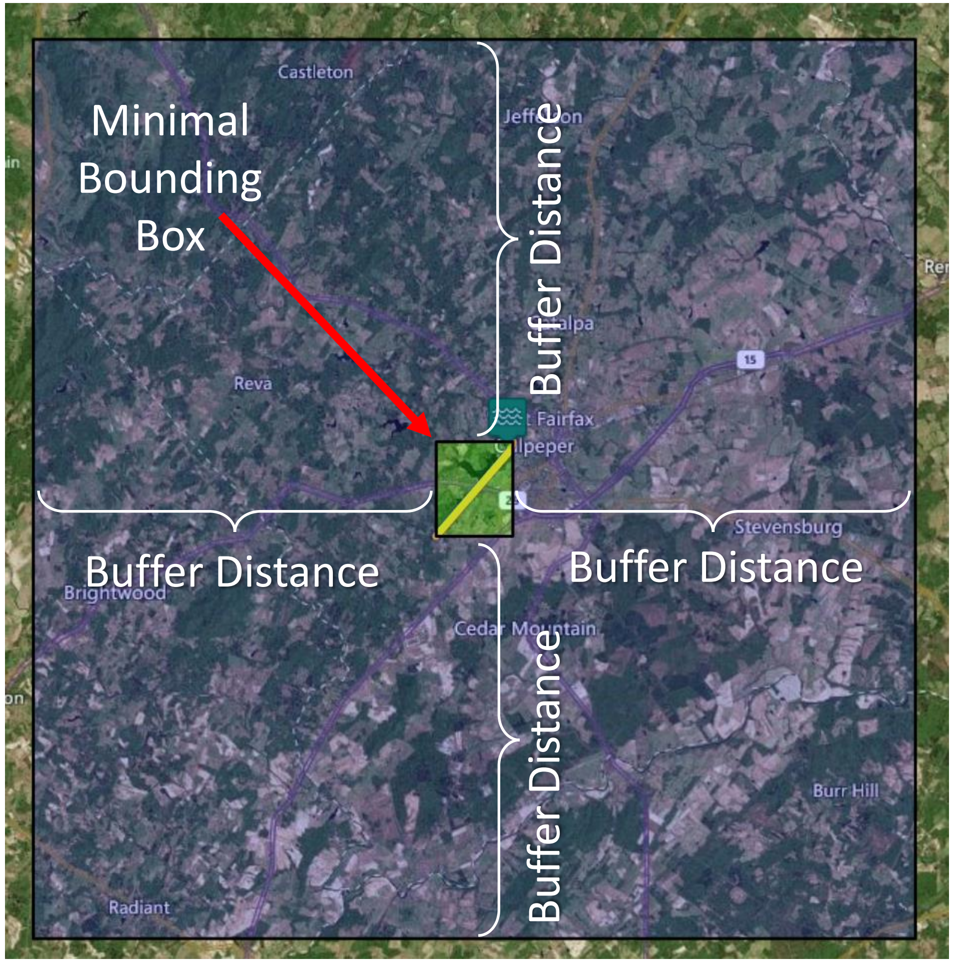
As the coverage of the layer B grows with new tiles of 1-m DEM released by USGS. More points will be able to get their elevation from it. Thus, the proposed algorithm is general, flexible and remains valid as new data is added to any layer or the existing tiles are updated.

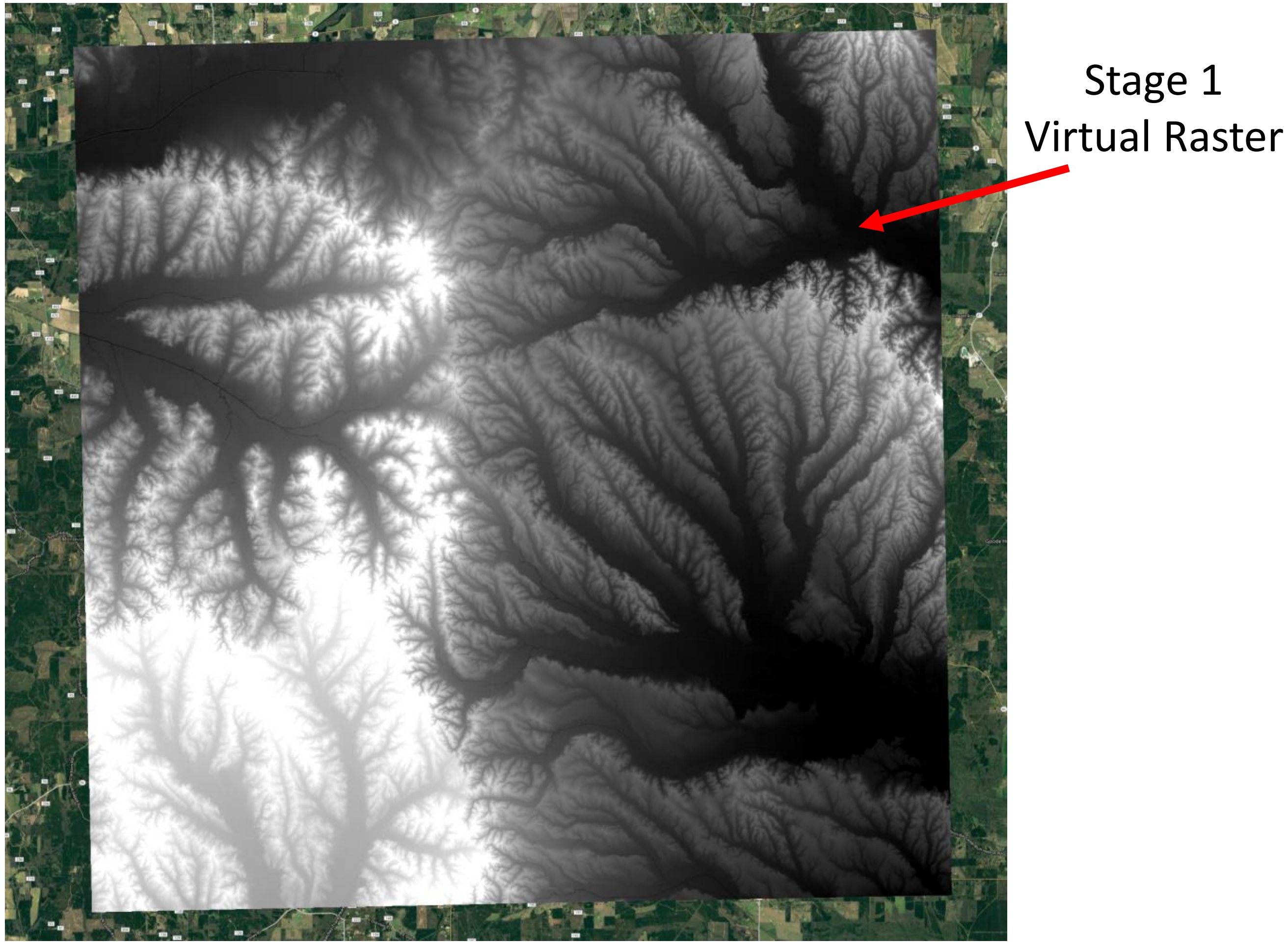
Automated Preparation of Geospatial Model Inputs

1.4

Set up domain size and perform consistency checks

The downstream buffer distance provided by the user is used to extract the boundary of the DEM (computational grid) to be prepared. With the minimal bounding box at the center, the domain extends one buffer distance in four cardinal directions.

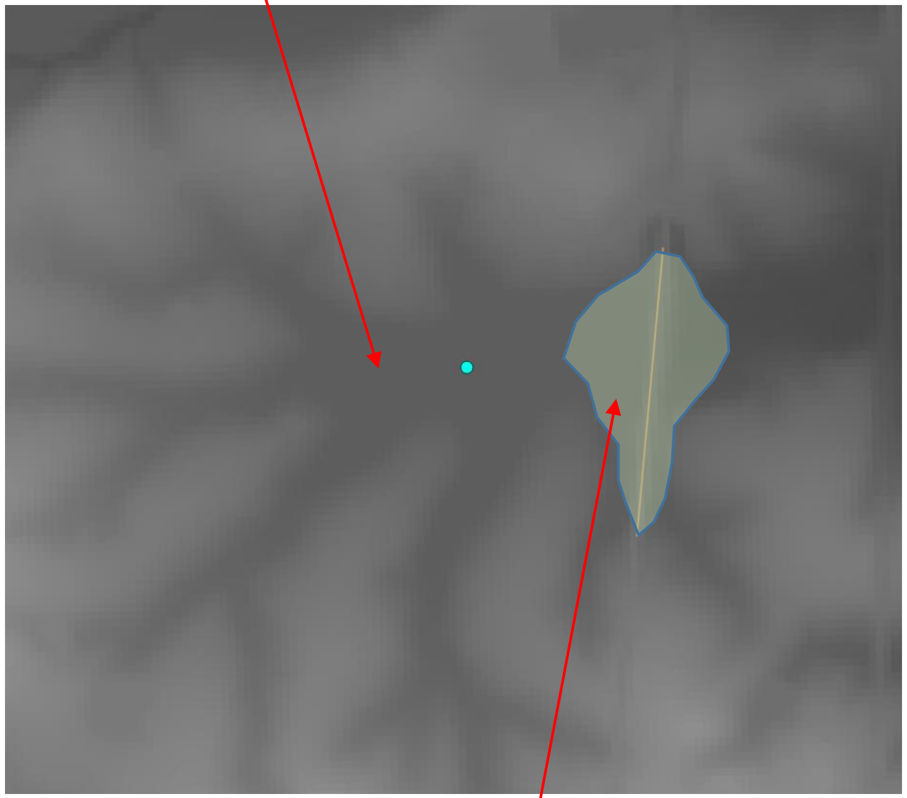




Calculate the footprint of the dam

In this step, first the footprint of the dam at its base is calculated based on some prescribed rules. The area under this base width is removed from the DEM. Later, after the unknown bed topography is estimated, an idealized dam with a constant width will be erected by raising the DEM cells under the footprint of average width to the crest elevation.

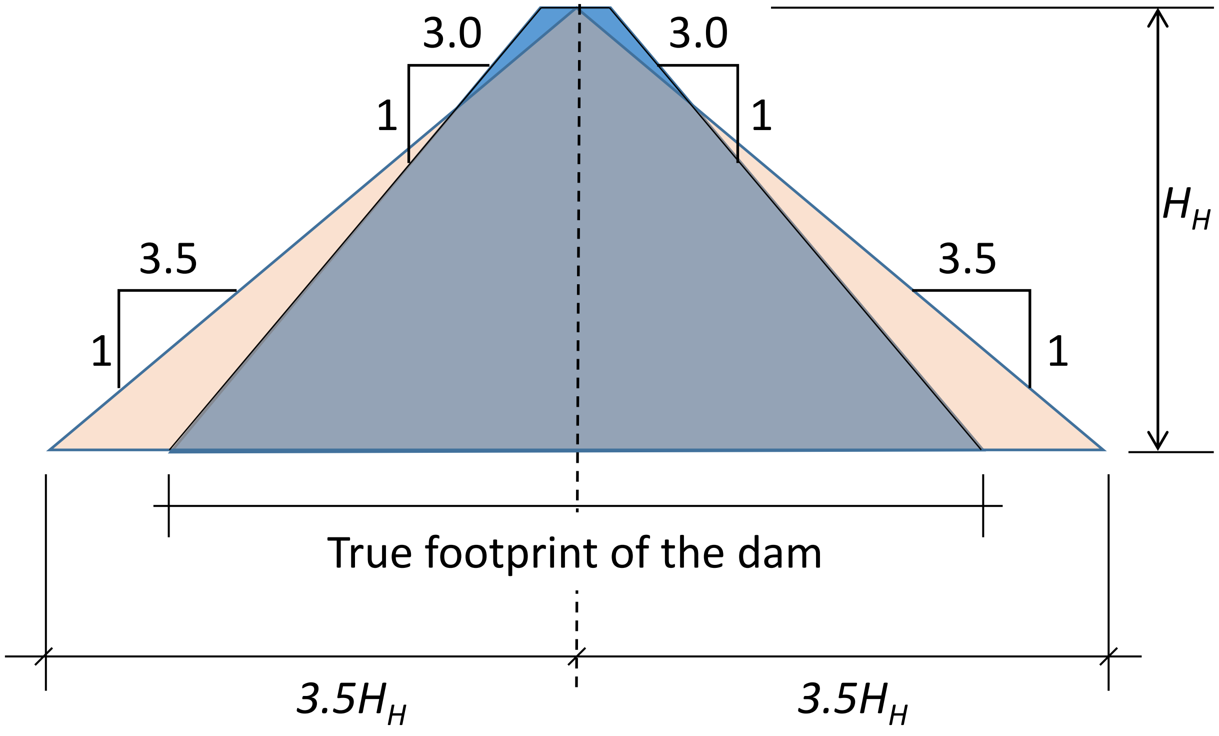
Water surface in the lake is detected as a "quasi" flat topography.



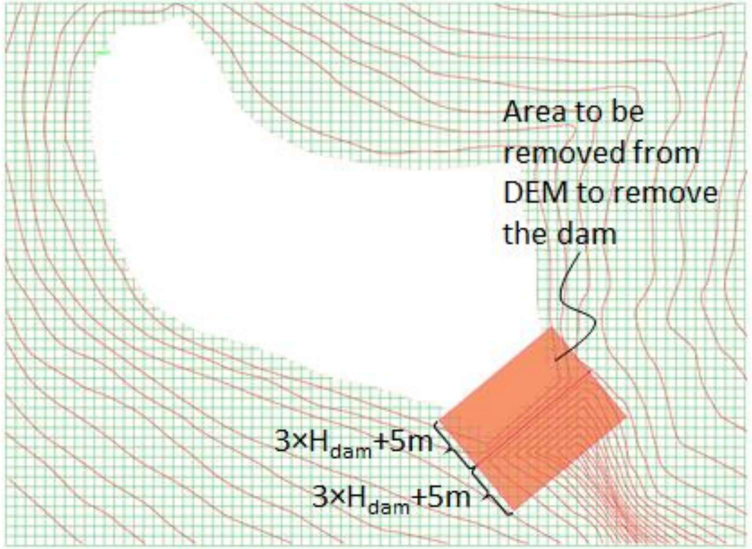
Footprint of the dam in reality

Crest Line digitized by the user

H_H = Hydraulic height

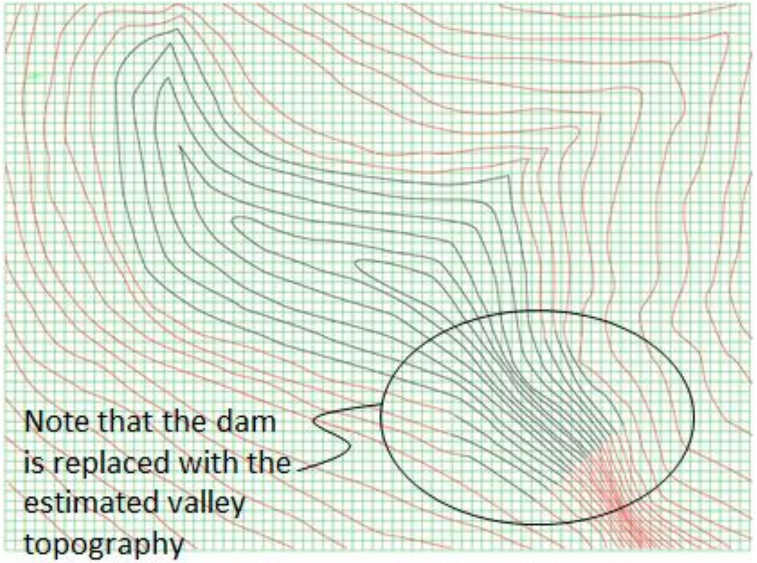


Simplified Illustration of the Estimation of the Removal of Dams, Reservoir Bed Elevation, and Breaching Process

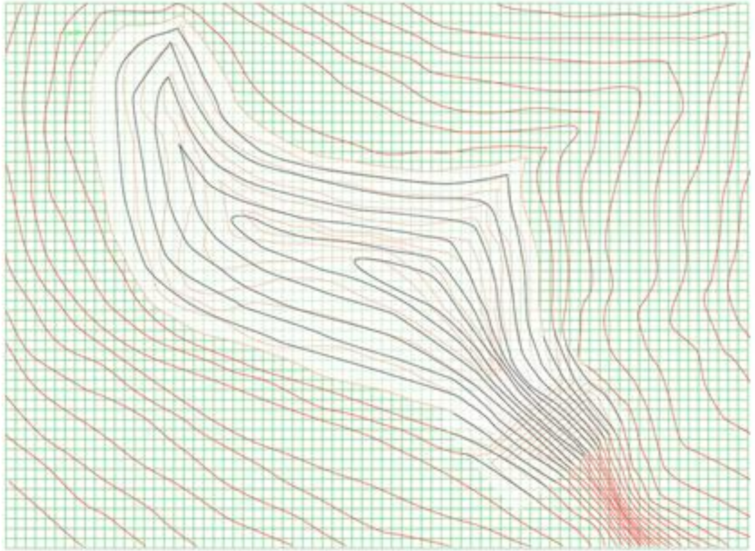


Using the polyline along the dam crest and assuming a profile based on the dam type, the area to remove is determined

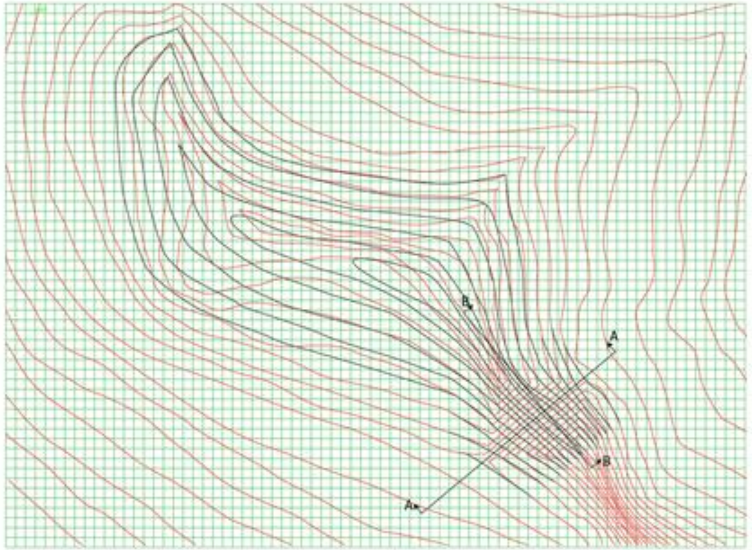
Both the area representing the water surface and the dam are removed from the DEM.



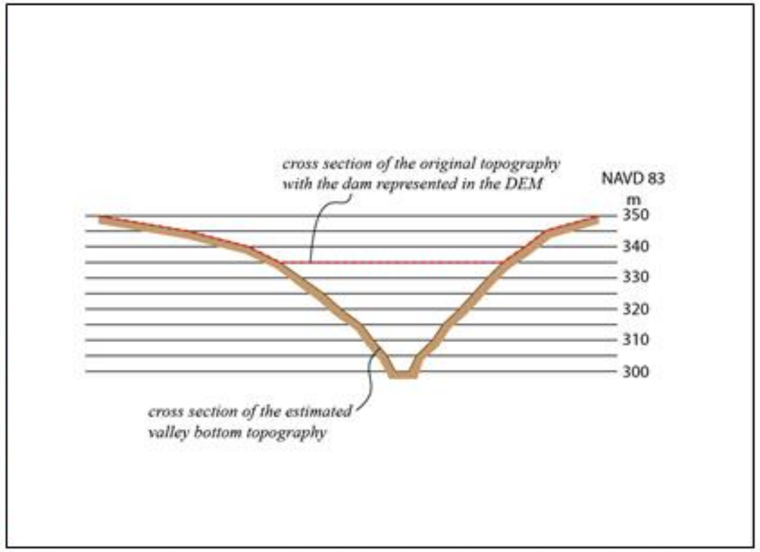
Using special algorithms DSS-WISE™ Lite estimates the bottom topography of (black contour lines) the reservoir.



Note that the estimated topography is not exactly like true topography but DSS-WISE™ Lite tries to match the volumes

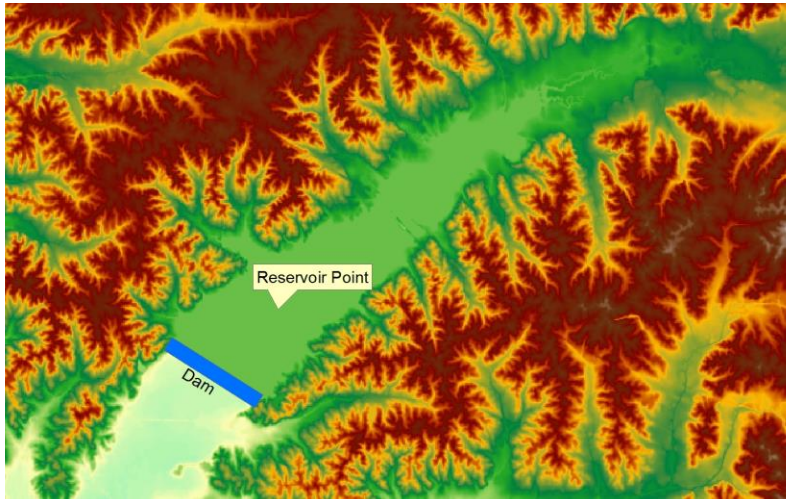


Let us define two cross section to see the topography before and after the modification of the DEM by DSS-WISE™ Lite

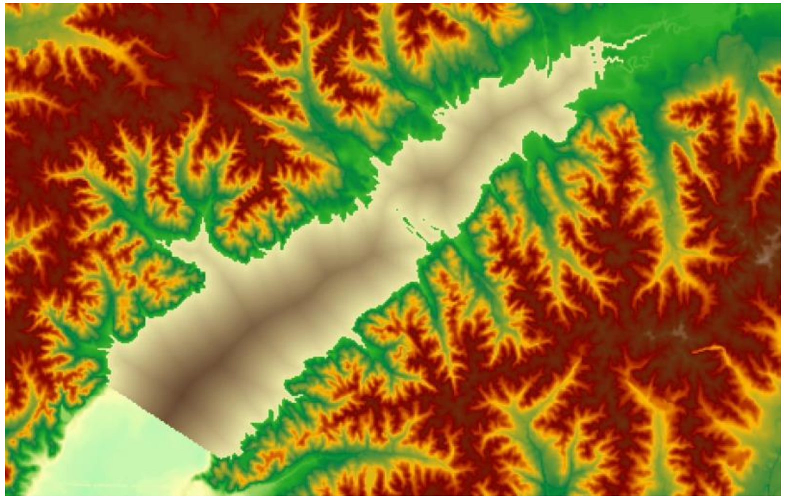


Transversal cross section A-A shows the estimated valley topography and the original topography

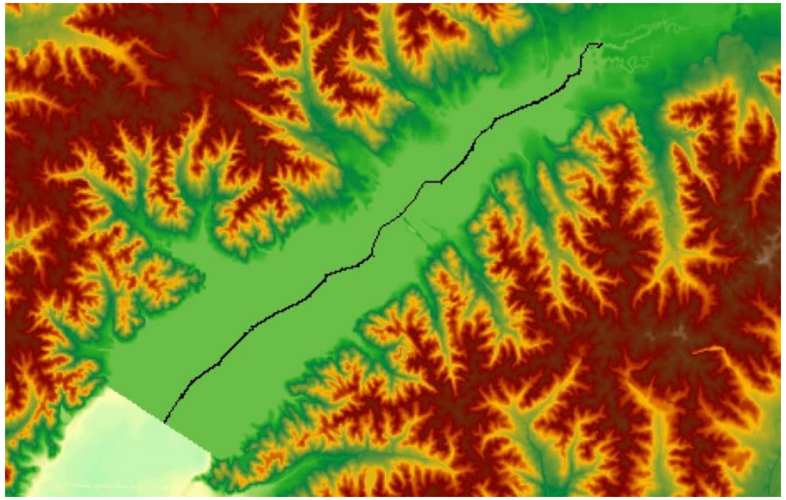
Estimate the reservoir bed topography (execute this step if reservoir bed topography is to be estimated)



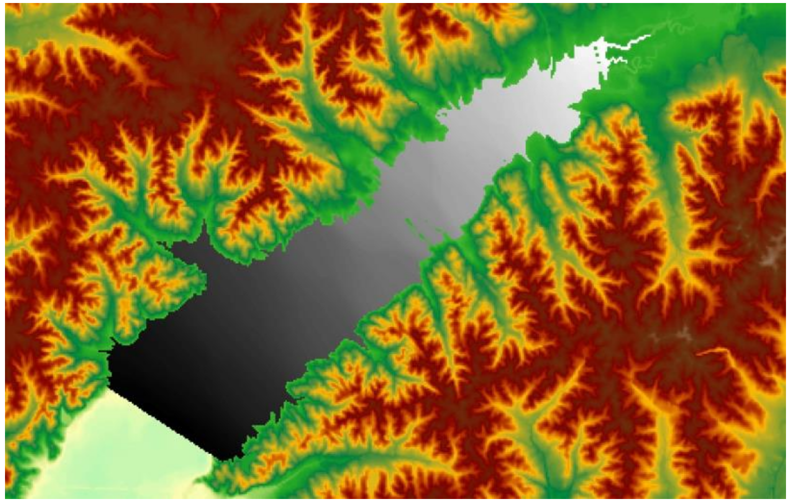
Original DEM.



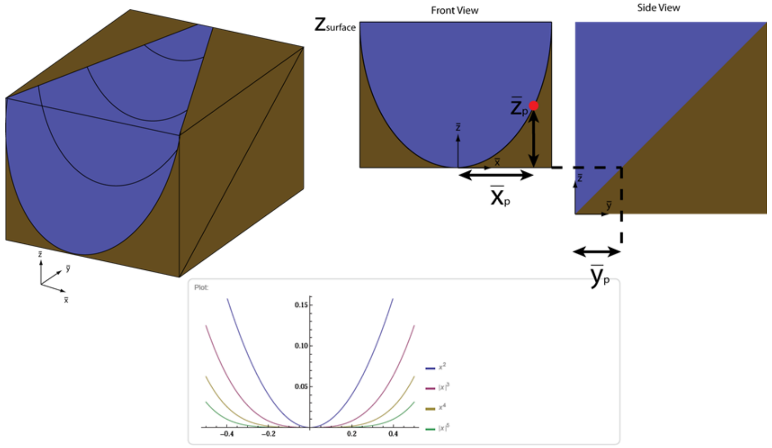
Distance to the shore map is calculated.



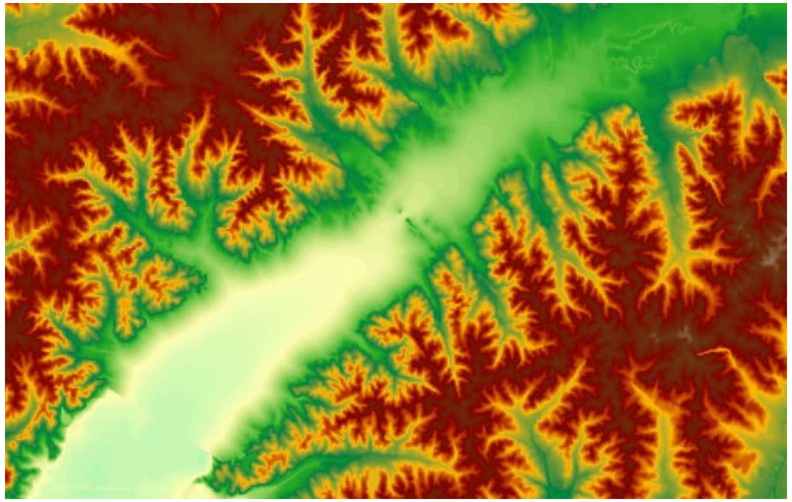
Centerline is obtained



Distance from the reservoir to each cell is calculated



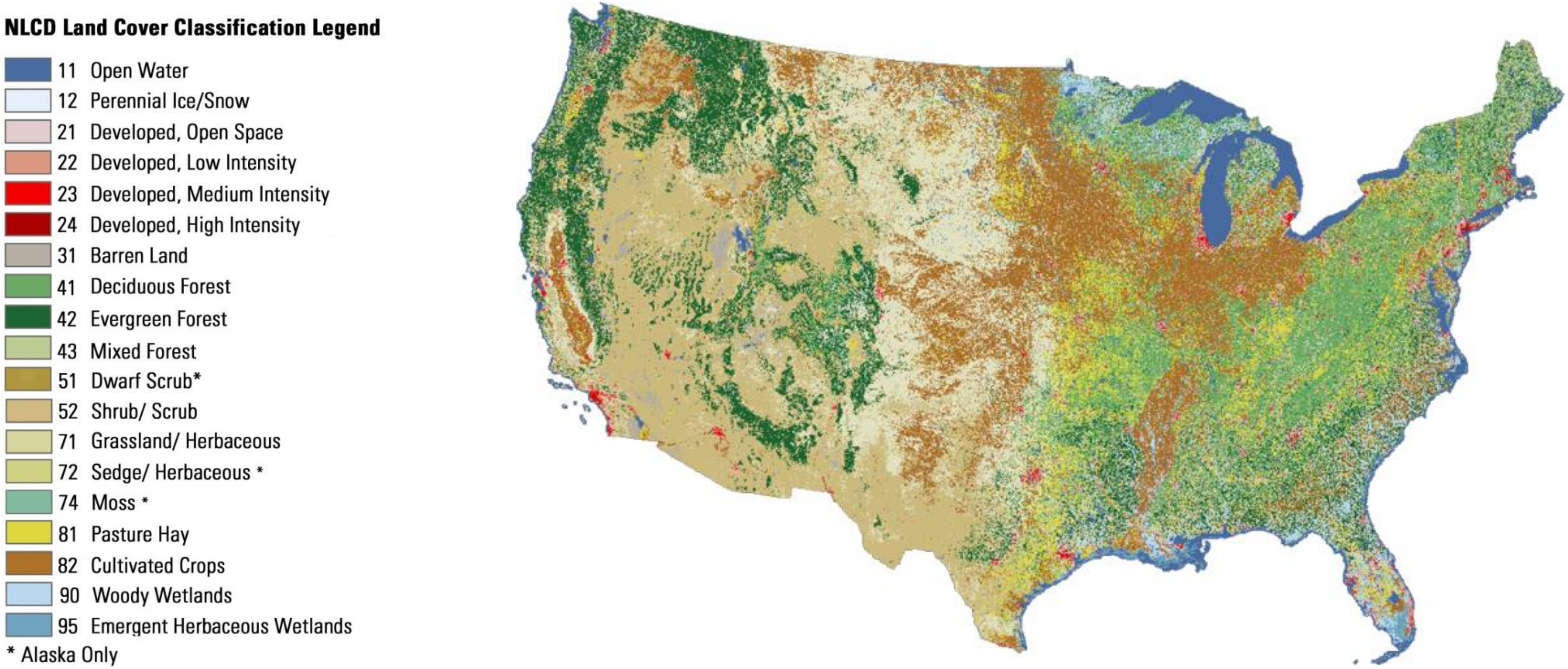
Bottom topography is calculated using parametric cross sections



Final interpolated topography is obtained.

Manning’s Coefficients are Assigned Based on NLCD 2016 Classified Land Use/Cover Map

The automated input data preparation module uses NLCD 2016 classified land use/cover map to assign Manning’s roughness values to computational cells.



INTRODUCTION TO DSS-WISE™ HCOM

1.5

What is DSS-WISE™ HCOM?

DSS-WISE HCOM is a post-processing module available under DSS-WISE Web. It provides an assessment of the potential consequences of a dam-break (or a levee-break) floods on humans by

- providing flood hazards maps for **humans** (but also indirectly for **structures**) for preparedness, and
- assessing nighttime and daytime PAR counts to assist in emergency response planning and evacuation planning.

DSS-WISE HCOM generates four types of analysis:

1. Flood Hazard Mapping for humans
    a. Flood hazard mapping for population caught outdoors
    b. Flood hazard mapping for population caught indoors

2. Mapping of Potentially Lethal Flood Zones (PLFZ) for humans
    a. PLFZ for children
    b. PLFZ for adults

3. Analysis of Population at Risk (PAR) numbers by interfacing results from DSS-WISE Lite with population data
    a. Nighttime PAR analysis using LandScan USA nighttime population
    b. Daytime PAR analysis using LandScan USA daytime population
    c. PAR analysis using 2010 census block data

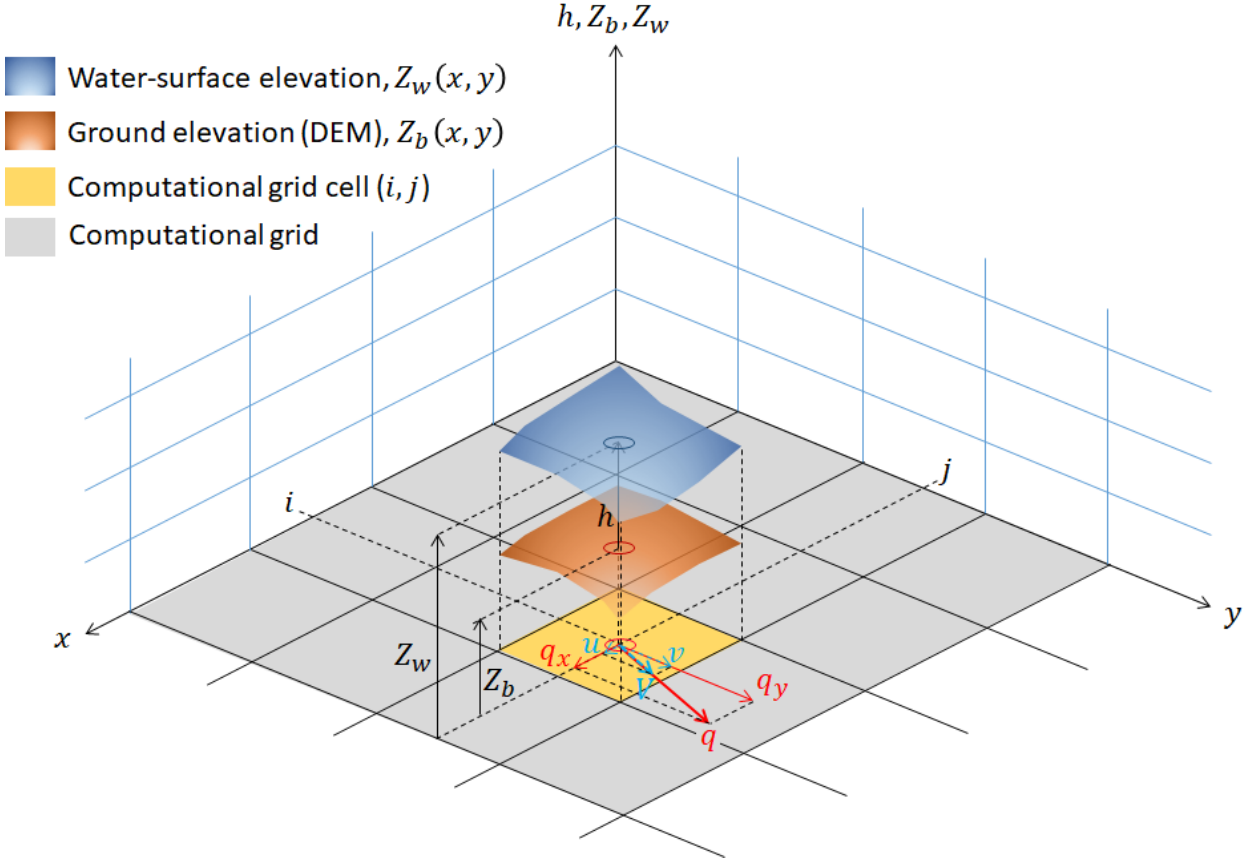
Maximum Specific Discharge ≡ Maximum DV (D: Depth and V: Velocity) / Units: ft^2/s

Raster file of the magnitude of the maximum specific discharge, q_{max} (ft^2/s), which is calculated from the maximum values of its components in x- and y-directions using the expression:

$$q_{max} = \sqrt{\left(q_{x_{max}}\right)^2 + \left(q_{y_{max}}\right)^2}$$

In literature on the estimation of the consequences of dam-break floods, the specific discharge, q, is sometimes denoted by DV, referring to the product of the depth of flood, D, and the velocity magnitude, V.

Early consequence analysis methods were based on the results provided by one-dimensional flood models. The DV value was not based on depth and velocity computed at any specific location and it could only be computed in an average sense for a cross section or a reach (FEMA 2011, p.20).



Two-dimensional flood models, such as DSS-WISE™ Lite, compute the DV value at the center of each cell. The consequence analysis provided in the present report considers DV to be the same as q. It is implicitly implied that we consider the maximum value:

$$DV \equiv DV_{max} \equiv q_{max}$$

DSS-WISE HCOM: Potential Flood Hazard for People Caught **Outdoors**

For humans caught outdoors, DSS-WISE HCOM maps the ranges of DV_{max} corresponding to five potential hazard (or danger) levels identified by different color codes:

1. “Very Low Hazard: Shallow flow or deep standing water”;
2. “Low Hazard: Dangerous to children”;
3. “Moderate Hazard: Dangerous to some adults”;
4. “Significant Hazard: Dangerous to most adults”; and
5. “Extreme Hazard: Dangerous to all”.

The basis is the Cox et al. (2010) (adopted also by FEMA and USBR).

Interpretation of these five zones are given for three population categories defined by an index value corresponding to the product of height (H) and mass (M) of the individual:

1. “Infants and Small Children”,
2. “Children”, and
3. “Adults”;

<table>
<tr><th colspan="4">$q_{max} \equiv DV_{max}$</th><th rowspan="3">Potential Hazard (or Danger) Category</th><th colspan="3">Explanation based on Cox et al. (2010)</th></tr>
<tr><th colspan="2">(m²/s)</th><th colspan="2">(ft²/s)</th><th rowspan="2">Adults</th><th rowspan="2">Children</th><th rowspan="2">Infants, Small Children and Frail/Older Persons</th></tr>
<tr><th>from</th><th>to</th><th>from</th><th>to</th></tr>
<tr><td>0.0</td><td>0.4</td><td>0.0</td><td>4.3</td><td>Very Low Hazard: Shallow flow or deep standing water</td><td rowspan="2">Low Hazard</td><td>Low Hazard</td><td rowspan="5">Extreme Hazard Dangerous to all Infants, Small Children and Frail/Older Persons</td></tr>
<tr><td>0.4</td><td>0.6</td><td>4.3</td><td>6.5</td><td>Low Hazard: Dangerous to Children</td><td>Significant Hazard; Dangerous to most children</td></tr>
<tr><td>0.6</td><td>0.8(2)</td><td>6.5</td><td>8.7(2)</td><td>Moderate Hazard: Dangerous to some adults</td><td>Moderate Hazard: Dangerous to some adults</td><td rowspan="3">Extreme Hazard: Dangerous to all children</td></tr>
<tr><td>0.8</td><td>1.2(3)</td><td>8.7</td><td>13.0(3)</td><td>Significant Hazard: Dangerous to most adults</td><td>Significant Hazard: Dangerous to most adults</td></tr>
<tr><td>1.2(3)</td><td></td><td>13.0(3)</td><td></td><td>Extreme Hazard: Dangerous to all</td><td>Extreme Hazard: Dangerous to all</td></tr>
<tr><td colspan="8">1) Small children, children and adult categories are defined based on height (H) time mass (M)
Small children: H×M ≤ 25 (m.kg) H×M ≤ 181 (ft.Lb)
Children: 25 < H×M (m.kg) ≤ 50 181 < H×M (m.kg) ≤ 362
Adult: 50 < H×M (m.kg) 362 < H×M (ft.Lb)</td></tr>
<tr><td colspan="8">2) Recommended upper limit of tolerable working flow regime for trained safety workers or experienced and well-equipped persons</td></tr>
<tr><td colspan="8">3) Above this value, the hazard is extreme according to majority of the past studies.</td></tr>
</table>

Potential Flood Hazard for People Caught **Indoors**

For people caught indoors during the flood, it will be assumed that the potential danger is associated with the collapse of the building (see FEMA 2011, p. 43).

Thus, the approach neglects the potential of drowning in the structure. Only collapse of the building is considered. Thus, the map of Potential Flood Hazard for People Caught Indoors can also be used as flood hazard map for the structures and can be used in evaluating potential structural damage.

The table below lists the $q_{max}(DV_{max})$-values for the potential collapse of different types of buildings, which are taken from the technical report of the Life Safety Model (LSM) developed by British Columbia Hydro (BCH 2006).

DV_{max}		Color Code	Building Type
(m^2/s)	(ft^2/s)		
≥5	≥54		HZ06: Poorly constructed building
≥10	≥108		HZ07: Well-built timber building
≥15	≥161		HZ08: Well-built masonry building
≥20	≥215		HZ09: Concrete building
≥35	≥377		HZ10: Large concrete building

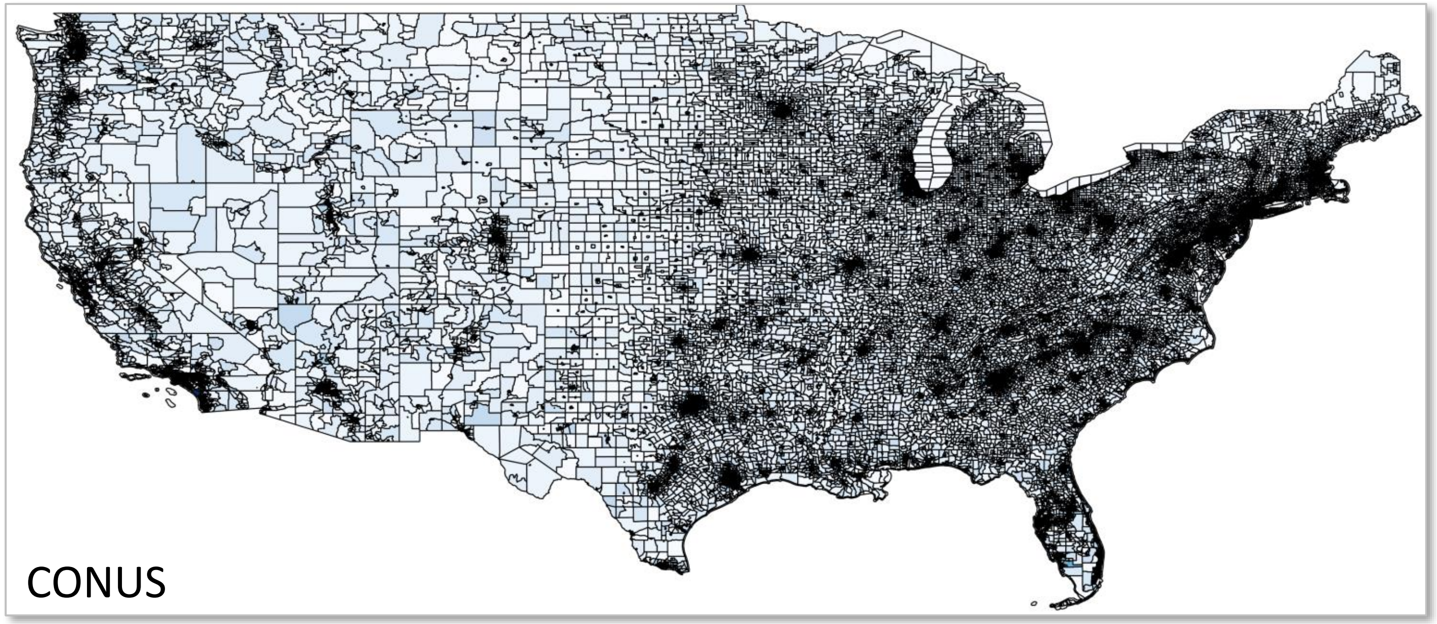
The mapping of potentially lethal flood zones (PLFZs) for humans consists of partitioning the inundation area into zones of pre-defined potential lethality classes for humans. The resulting map is an ESRI polygon shapefile. The polygons correspond to different levels of potential lethality that are defined based on the maximum depth, $h_{max} \equiv D_{max}$, and maximum specific discharge, $q_{max} \equiv DV_{max}$.

The definition of PLFZs for different categories of people caught outdoors, cars, mobile homes and typical residential structures are listed in the table below (Feinberg, 2017).

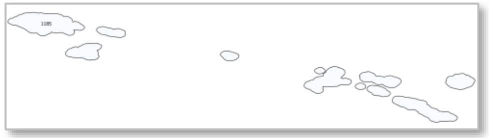
Category	Color Code	D_{max} $(ft.)$		DV_{max} (ft^2/s)
Children caught outdoors (tent camping, fishing, hiking, etc.)		≥ 2	or	≥ 5.4
Adults caught outdoors (tent camping, fishing, hiking, etc.)		≥ 4	or	≥ 6.5
Motor vehicle (compact car) floating	None	≥ 1	or	≥ 4.3
Motor vehicle (compact car) sliding/toppling	None			≥ 5.4
Mobile homes	None	≥ 2	or	≥ 30
Typical residential structures	None	≥ 4	or	≥ 75

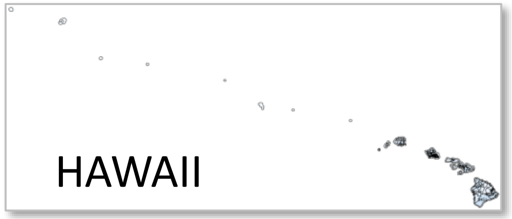
Feinberg, B. 2017. "Using Potentially Lethal Flood Zones to Assess Downstream Impacts from Dam Failure." Presentation at the National Dam Safety Training Seminar.

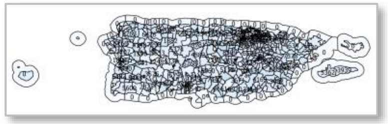
2010 Census Block Data


CONUS


ALASKA


ALEUTIAN (EAST) ISLANDS


HAWAII


PUERTO RICO

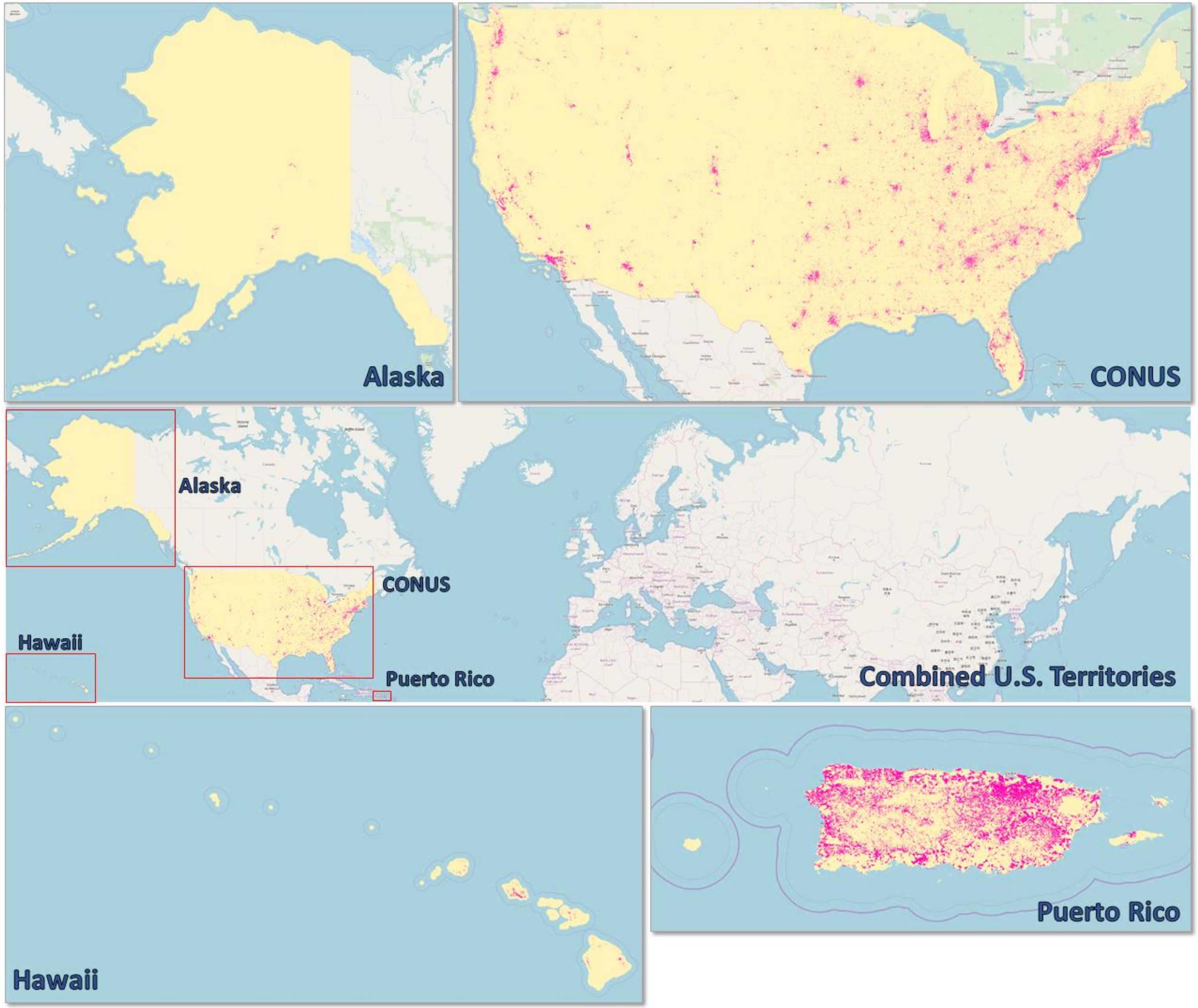
2010 Census Block data is provided by the United States Census Bureau.

A census block is the smallest geographic unit for which USCB collects data from all the houses in the unit (rather than a sample of houses). Census Blocks are bounded by visible features such as streets, roads, streams and nonvisible features such as property lines and limits of city, township, school district, and counties, etc.

2010 Census includes **11,166,336** Census Blocks and 545,653 “water-only” Census Blocks covering the Unites States, Puerto Rico and the Island Areas.

4,871,270 blocks have zero population and they cover an area of 4.61 million square kilometers, which corresponds to 47% of the total territory of the U.S.

Combined (Seamless) LandScan USA Gridded (3 arc-second) Population Data



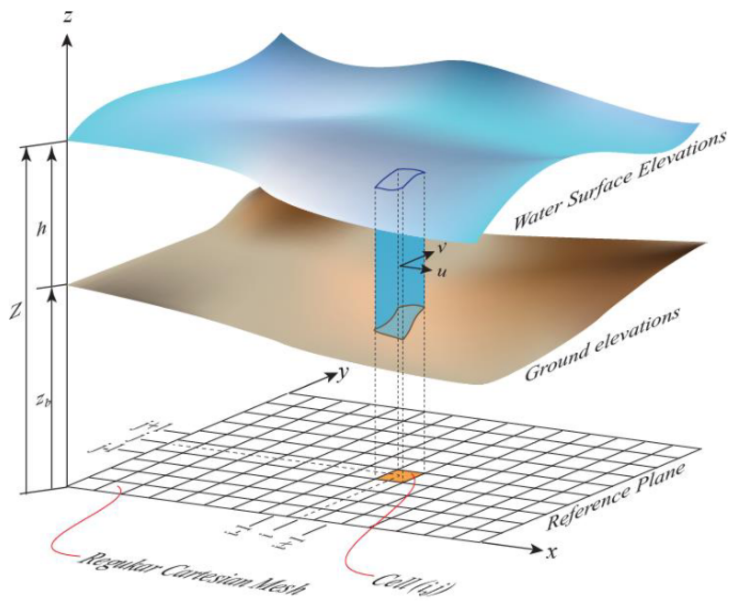
Combined nighttime population density raster at 1/3 arc-second resolution. The scale for the population density in the inserts is locally varied for visibility purposes.

Verified and validated hydrodynamic model: Comparison studies

1.6

Conservative Form of 2D Shallow Water Equations (SWE)

DSS-WISE™ Lite solves 2D Shallow Water Equations (SWE) using finite-volume discretization



$$\boldsymbol{U}_t + [\boldsymbol{F}(\boldsymbol{U})]_x + [\boldsymbol{G}(\boldsymbol{U})]_y = \boldsymbol{S}(\boldsymbol{U})$$

$$\boldsymbol{U} = \begin{bmatrix} h \\ hu \\ hv \end{bmatrix}$$

Vector of Conserved Variables

$$\boldsymbol{F}(\boldsymbol{U}) = \begin{bmatrix} hu \\ huu + g\,h^2/2 \\ huv \end{bmatrix}$$

Vector of Fluxes in x-direction

$$\boldsymbol{G}(\boldsymbol{U}) = \begin{bmatrix} hv \\ hvu \\ hvv + g\,h^2/2 \end{bmatrix}$$

Vector of Fluxes in y-direction

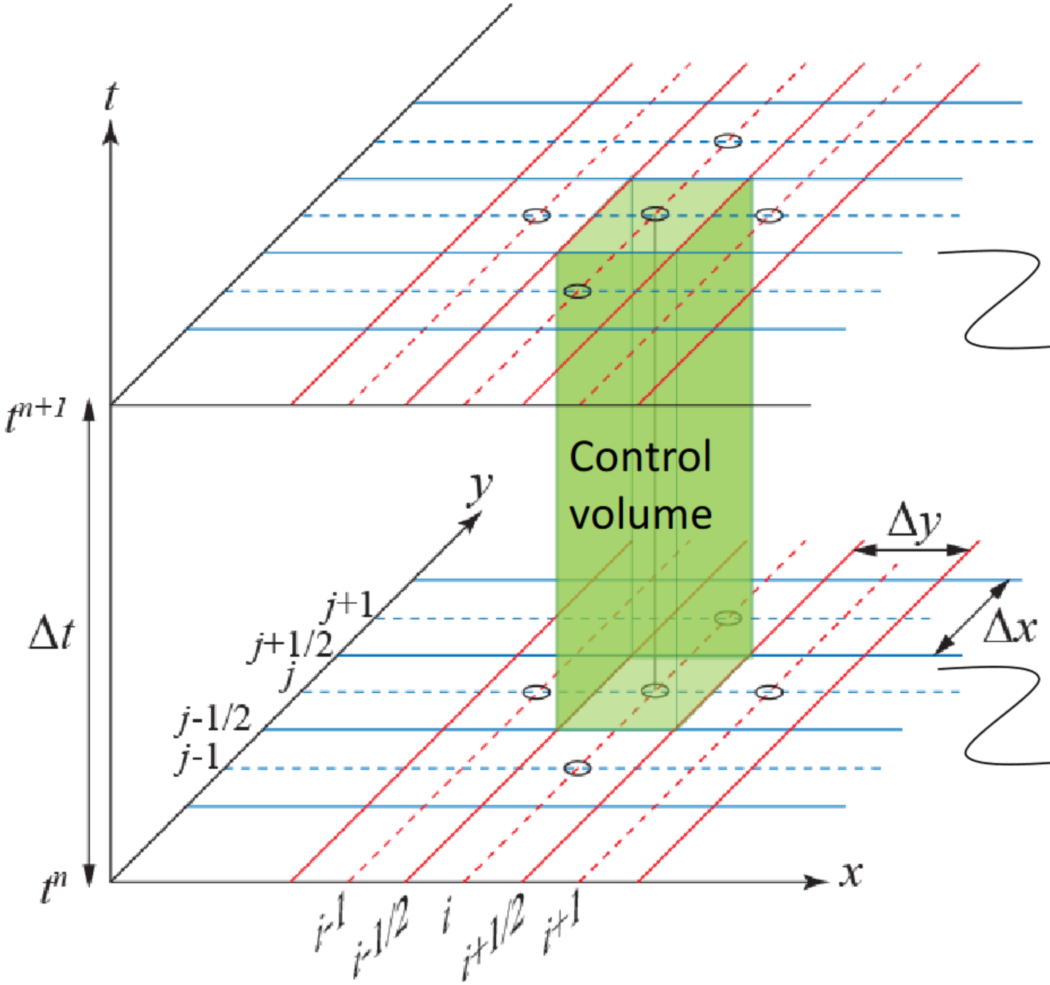
q_v

$$\boldsymbol{S}(\boldsymbol{U}) = \begin{bmatrix} -gh\left(\dfrac{u\,n^2\sqrt{u^2+v^2}}{h^{4/3}}\right) - g\,\dfrac{1}{2}\,(h_L + h_R)\left(\dfrac{\partial z_b}{\partial x}\right) \\ -gh\left(\dfrac{v\,n^2\sqrt{u^2+v^2}}{h^{4/3}}\right) - g\,\dfrac{1}{2}\,(h_B + h_T)\left(\dfrac{\partial z_b}{\partial y}\right) \end{bmatrix}$$

Vector of Source Terms (due to bed slope and bed friction)

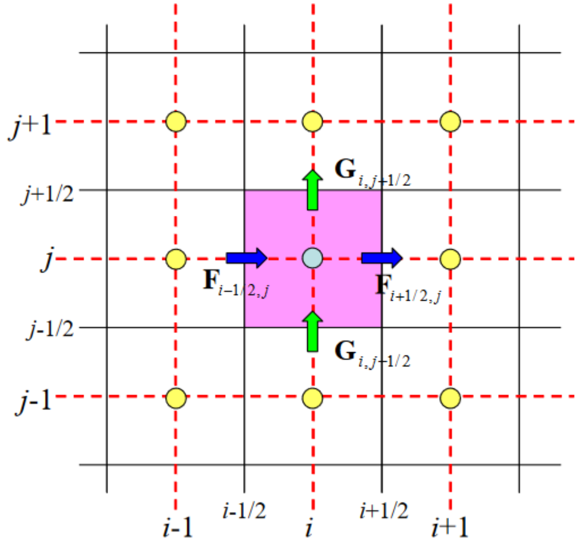
Finite Volume Discretization of the Conservative SWE over a Regular Cartesian Grid

We discretize the domain by creating a computational grid. In the present case, we will use a regular Cartesian mesh with elements Δx by Δy (Δx = Δy). Δx (= Δy) is the spatial resolution of the solution.



This is the plane of next time t^{n+1} (= t^n +Δt). Values of conserved variables are to be calculated based on the known values of the previous time step.

This is the plane of current time t^n. Values of all conserved variables are known at this time



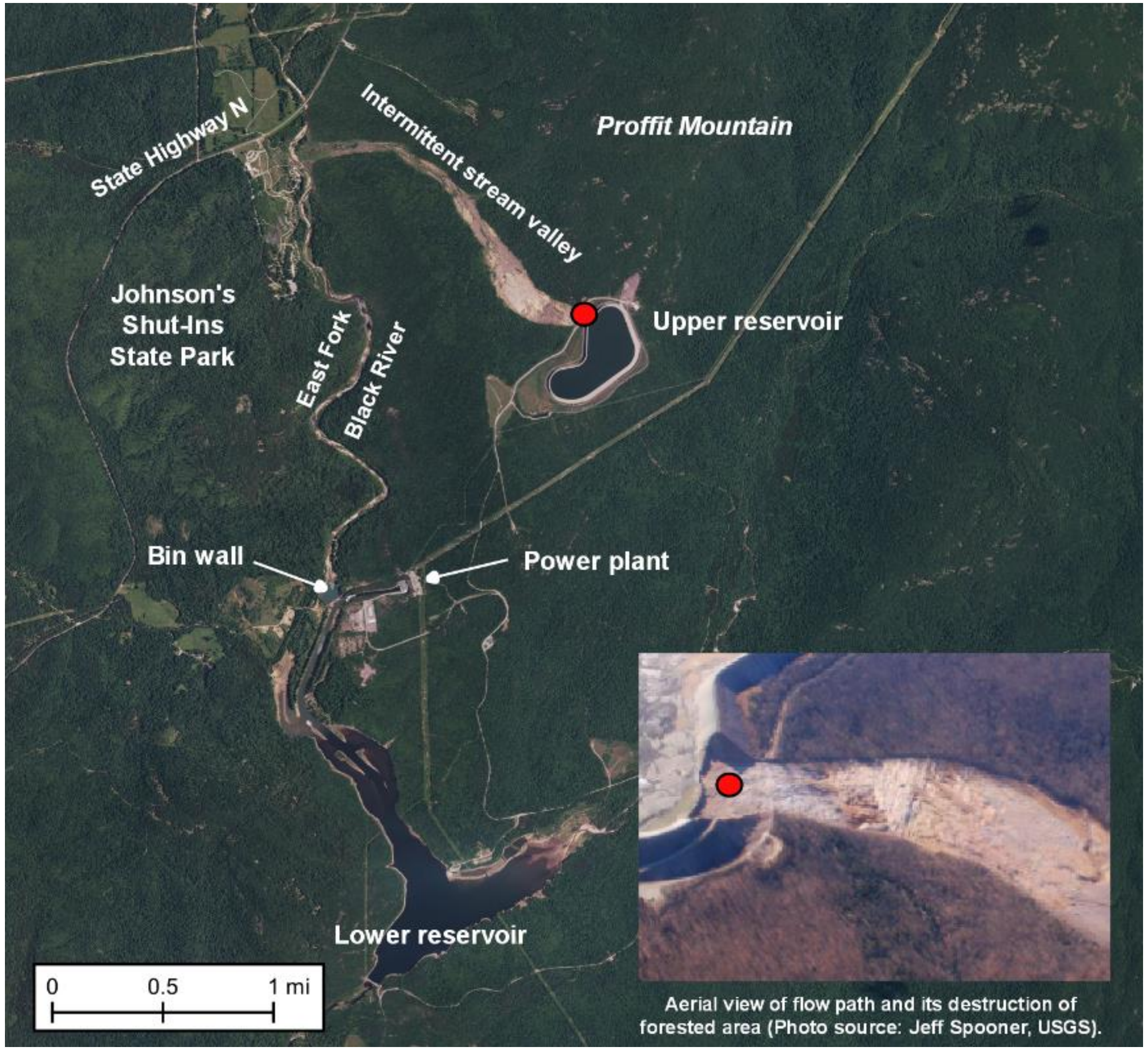
The finite volume formulation is obtained by integrating the vector form of the shallow water equations over the control volume.

Taum Sauk comparison study

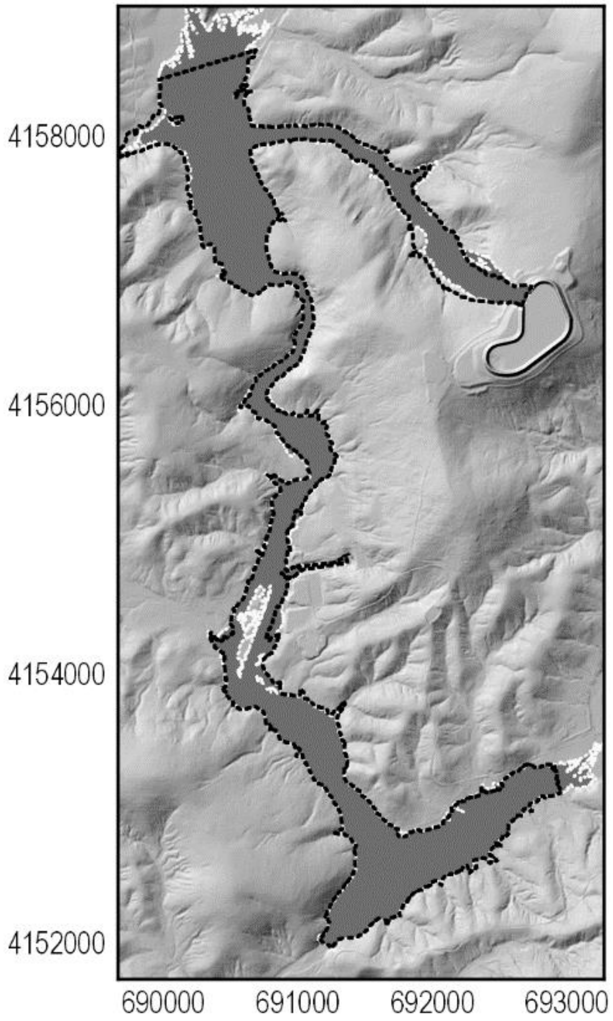
- Pumped storage powerplant reservoir in Missouri failed in December 2015
- No loss of life, but injuries reported
- DSS-WISE Lite simulation results compared with observed inundation extent, discharge hydrograph
- Inundation area match is superior to other published model results

Metric	% DSS-WISE Lite	% Flood2D-GPU (Kalyanapu et al., 2011)	% FIT2D (Judi, 2009)
F	84.1	75.1	76.3
Commission	12.2	15.3	16.6
Omission	4.7	13.1	9.5

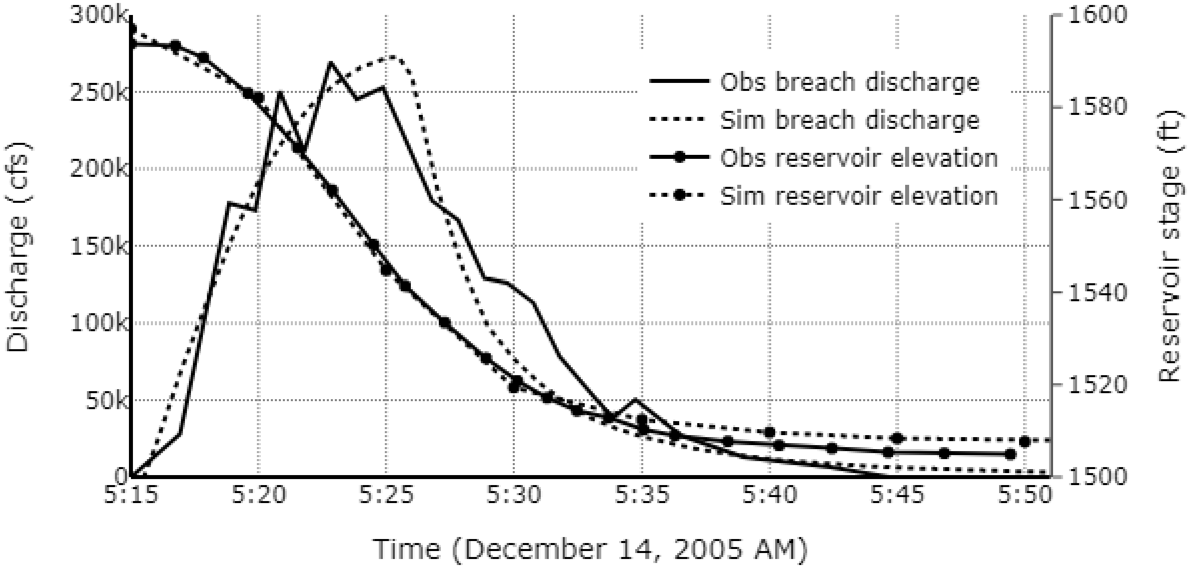
Taum Sauk flooded area statistical comparison



Aerial view of flow path and its destruction of forested area (Photo source: Jeff Spooner, USGS).



Comparison of simulated inundation extent (gray fill) with observation for the Taum Sauk Dam Breach



Breach outflow discharge hydrograph and reservoir stage

While HEC-RAS and DSS-WISE Lite employ different numerical schemes and computational methods, …results are very similar."

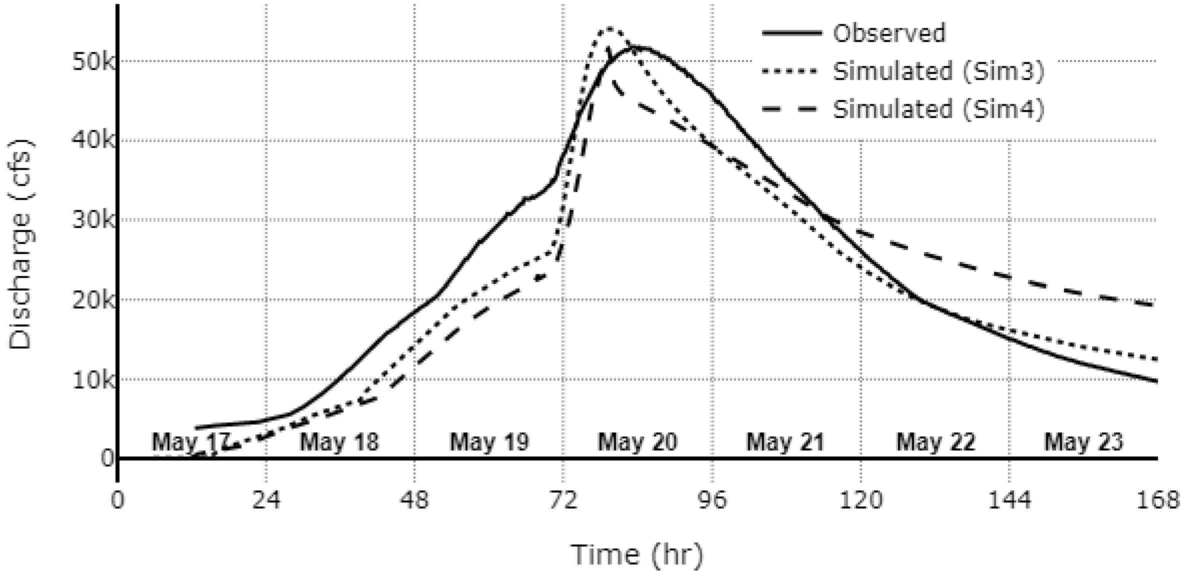
"…DSS-WISE Lite is the model of choice for fast run time, ease of use, and low computational demand…"

-Dr. Danielle Salt

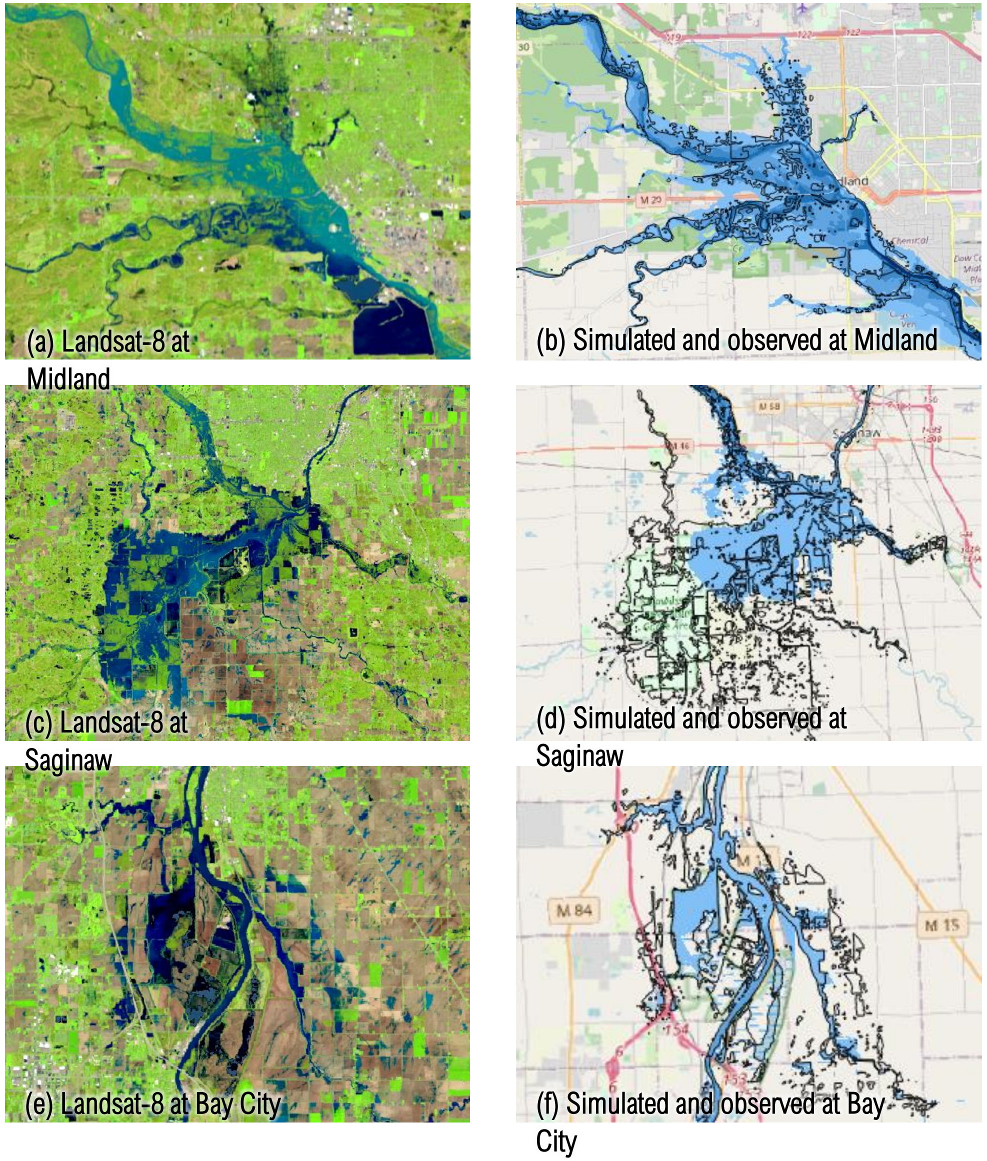
Salt, D. V. (2019). A comparison of HEC-RAS and DSS-WISE Lite 2D hydraulic models for a Rancho Cielito Dam breach. California State University: Sacramento, CA, USA.

- Edenville embankment dam failed in central Michigan In May 2020
- Subsequent flood overtopped downstream Sandford Dam causing it to fail
- Combined flood impacted more than 4,000 structures, no loss of life
- DSS-WISE Lite simulation matched well in both inundation area and observed gauge station hydrograph

Edenville comparison study

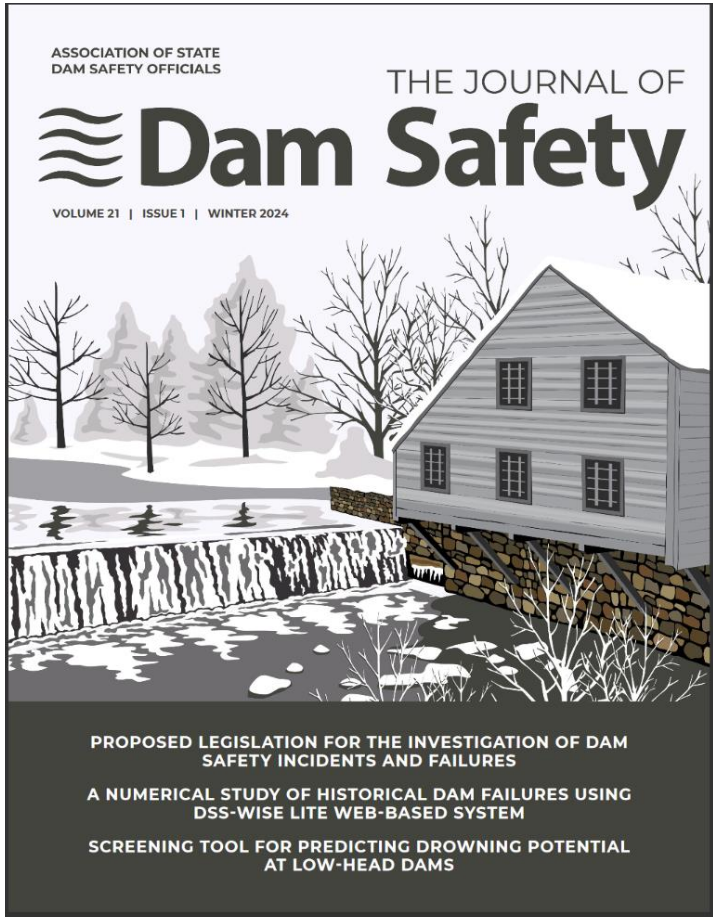


Discharge hydrograph at USGS gage station 04156000 Tittabawassee River at Midland, MI



Lansat-8 satellite imagery from May 20, 2020, (Lucey, 2020) and simulated (blue) and observed (black solid line, DFO, 2020) extents from the same day

Publication Reference



Pophet, N., McGrath, M., Al-Hamdan, M., Smith, P., Lambert, S., Inci, G., & Demby, J. (2023). Sensitivity analysis of input parameters to flood characteristics for historical dam failures using DSS-WISE Lite web-based system. ASDSO Dam Safety Conference, September 17 – 21, 2023, Palm Springs, CA.

Pophet, N., McGrath, M., Al-Hamdan, M., Smith, P., Inci, G., Demby, J. (2024). A Numerical Study of Historical Dam Failures Using DSS-WISE Lite Web-Based System. ASDSO Journal of Dam Safety, 21(1)