



VAAST - Vulnerability Assessment for Aviation Systems Tool

Presented by: Jana Saadi

Apsara Mitra, Rupal Nigam, Parimal H. Kopardekar, and Larry A. Young- *NASA Ames Research Center*

Nikita Aggarwal - *Crown Consulting, Inc*

Nicole S. Fichera, Jennifer M. Hinkel, Jana Saadi, and Jason C. Wong - *Ensemble Consultancy*

Helena Kent – *OSTEM Intern from University of California, Berkeley*

Meghan E. Stancliff – *OSTEM Intern from University of Colorado Boulder*

Eric Reynolds Brubaker, *NASA Langley Research Center*



Motivation

Hartsfield-Jackson Atlanta International Airport - June 27, 2025

Evacuate Control Tower

Delta cancelled 360 flights on Thursday, and 554 flights so far on Saturday.

100 Delta planes grounded to inspect for hail damage

JFK, LGA, EWR, BOS, DCA- July 14, 2025

Heavy rainfall leading to flash floods

Ripple effect across the country
- 7,875 flights delayed, 1,457 cancelled

State-by-state hazard effects

Wildfire Smoke (Sept 2020)

Alaskan Airlines suspended flights for 24 hours to implement new safety protocol for outdoor work in poor air quality

Phoenix Heat Wave (Jun 2017)

50 AA cancellations
Partial closure for two days, mostly affecting smaller aircrafts



Hurricane Harvey (Aug 2017)

4539 cancellations
7547 delays
\$32 million in airline lost revenue per day

Winter Storm Elliott (Dec 2022)

19000 cancellations
Southwest's outdated scheduling system failure

Winter Storm Jonas (Jan 2016)

12000 cancellations
37 airports affected
\$200 million in airline lost revenue

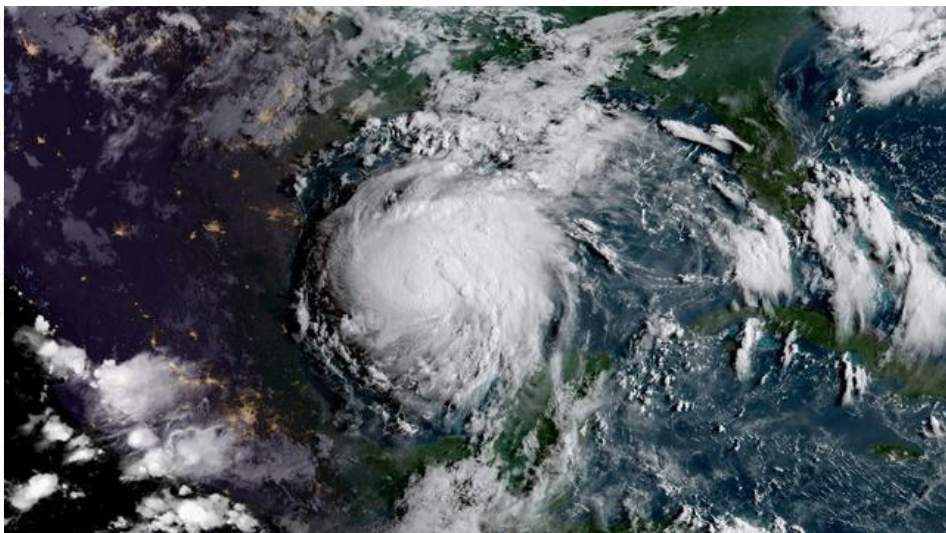


Hurricane Harvey

Aug 25-31, 2017 | Houston, Texas | George Bush Intercontinental Airport (IAH) and William P. Hobby Airport (HOU)
Hurricane leading to complete airport closures of main airports causing a ripple effect in the national aviation system.

Stories

- 500+ people were stranded at William P. Hobby Airport (HOU) until Spirit Airlines were able to evacuate them. ([CNN](#))
- 20% of U.S. refining capacity went offline, leading to jet fuel shortages and a price spike that added an estimated \$350–400m to airlines' fuel costs in the following month. ([IATA](#))



NASA ID: GSFC_20171208_Archive_e000004

~110,000

Passengers Affected²

\$125B

Total Economic Impact

Airport Data

Flights delayed	4539 (first weekend) ¹
Flights canceled	7547 (first weekend) ¹
Airport closure duration	3-5 days

Cost Data

Total Airline Loss	~\$32M ²
Houston/Harris County Loss	~\$125B*
State Loss	\$16B in GDP*

1: FlightAware.com
2: IATA, 3 Texas State Comptroller
*: Denotes loss due to aviation disruptions and the hurricane



Impact on Aviation

Operations

Delays

Cancellations

Reduced airport capacity

Reduced flight capacity

Airport evacuations

Tourism shift

Inspections, Maintenance and Repairs

Infrastructure

Obstructed runways

Infrastructure damage

Power outages

Navigation

Equipment disruptions

Aircraft

Decreased engine efficiency

Engine performance

Aircraft damage

Increased fuel burn

Health and Safety

Passenger injuries

Working conditions

Working injuries

Ground accidents

Energy and natural resource consumption

Carbon emissions

Goals of the tool

Vulnerability Modeling

- flooding translation model
- airport demand model

Hazard Visualization

- UX interface
- user configuration

Economic and Operational Impact

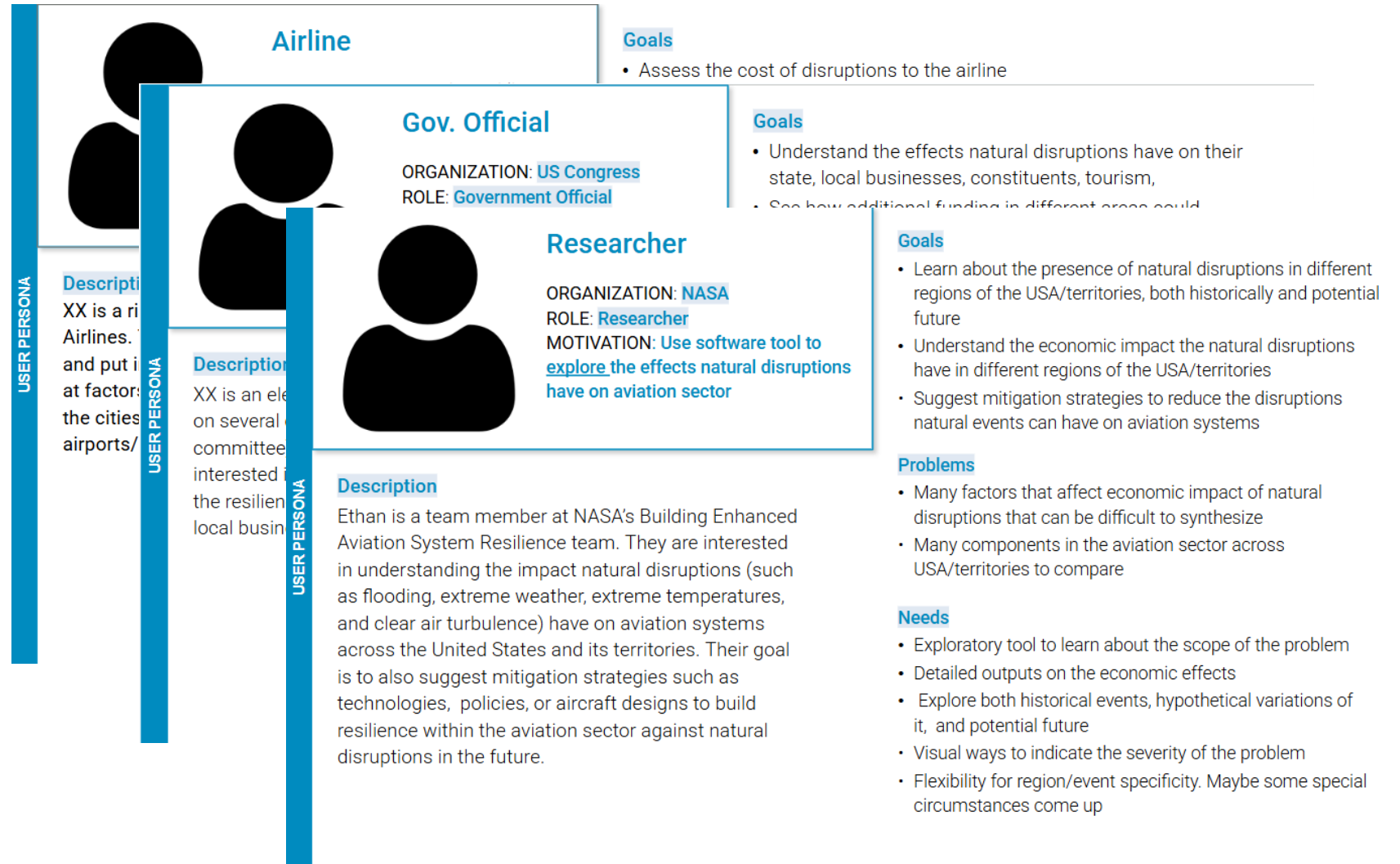
- static, historical, and forecast data
- economic and demand model



Stakeholder Analysis

Considered different potential users of the software tool

Initial stakeholder interviews and expert feedback



Tool Prototypes



Tool Features

Location Search

Analytics

Flooding level input

Filters

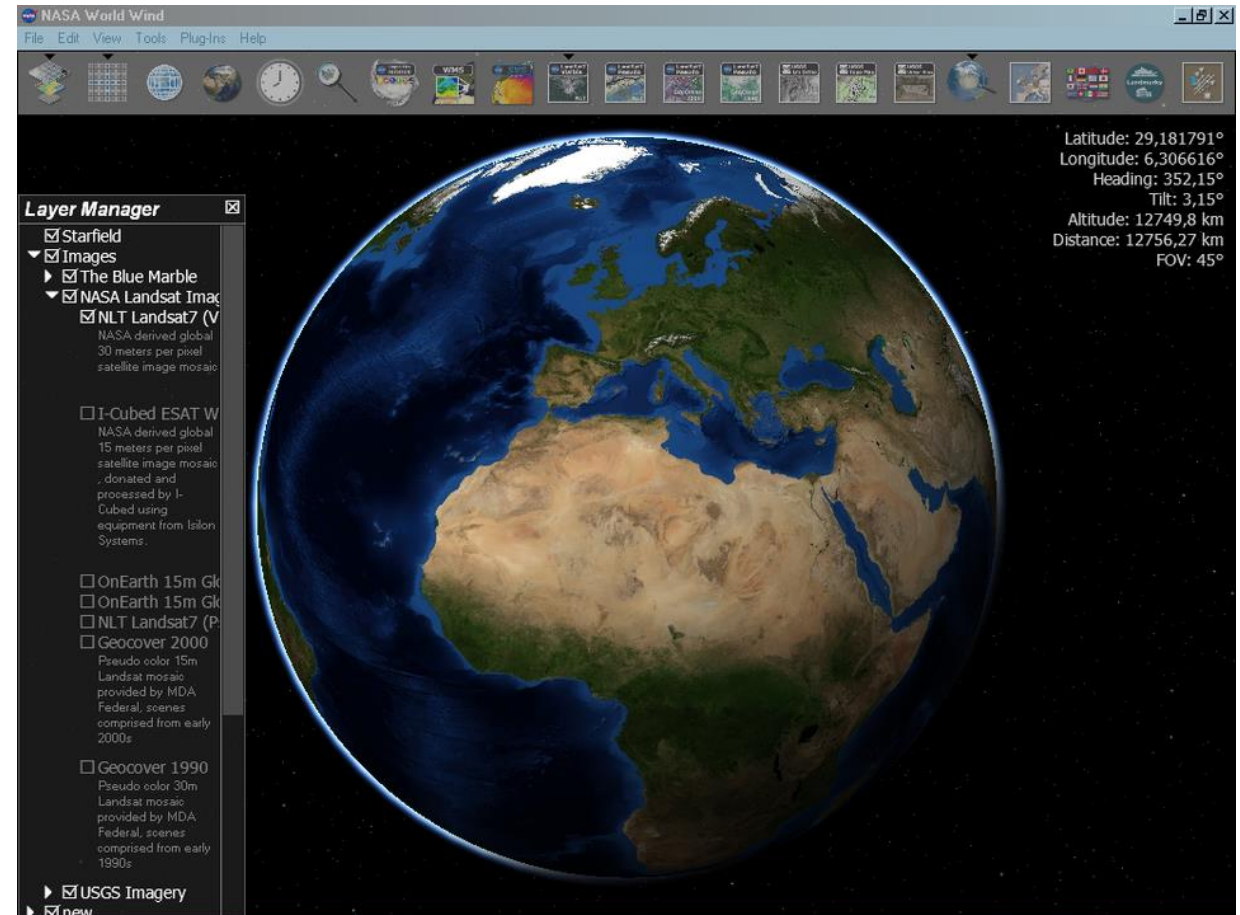
Building on existing sources

NASA Worldwind- 3D planetary globe engine

NASA's Sherlock Data Warehouse will be utilized to collect and project geospatial data for aviation infrastructure

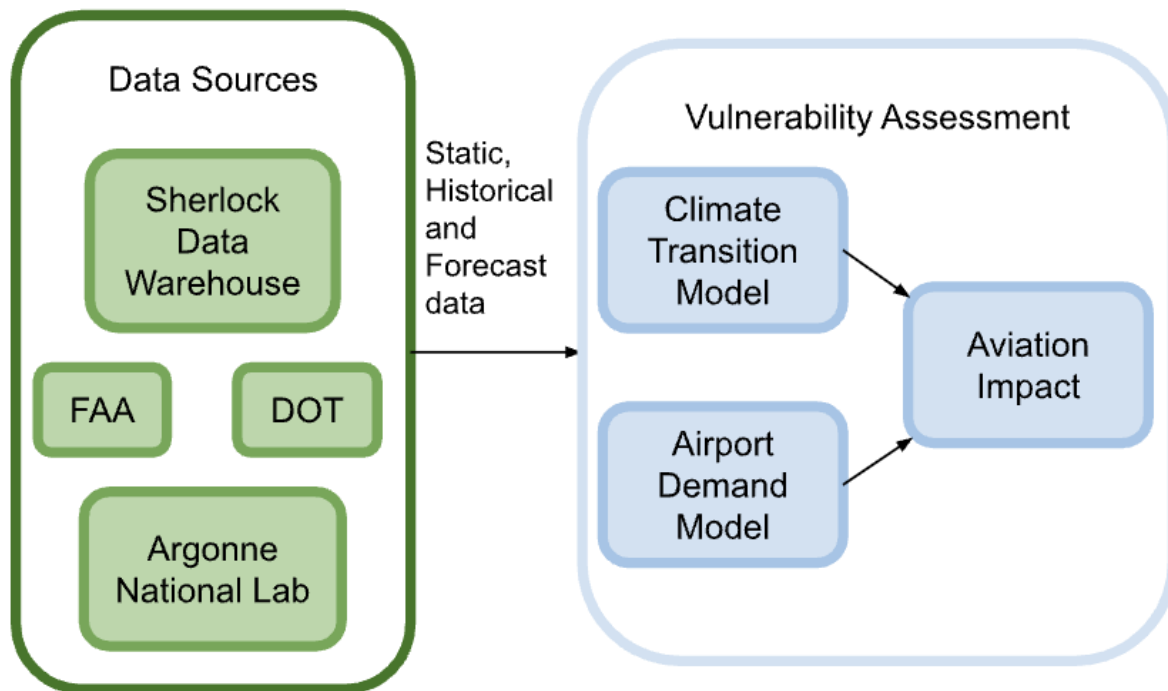
NASA's Sea Level Projection Tool

NASA's Flooding Analysis Tool

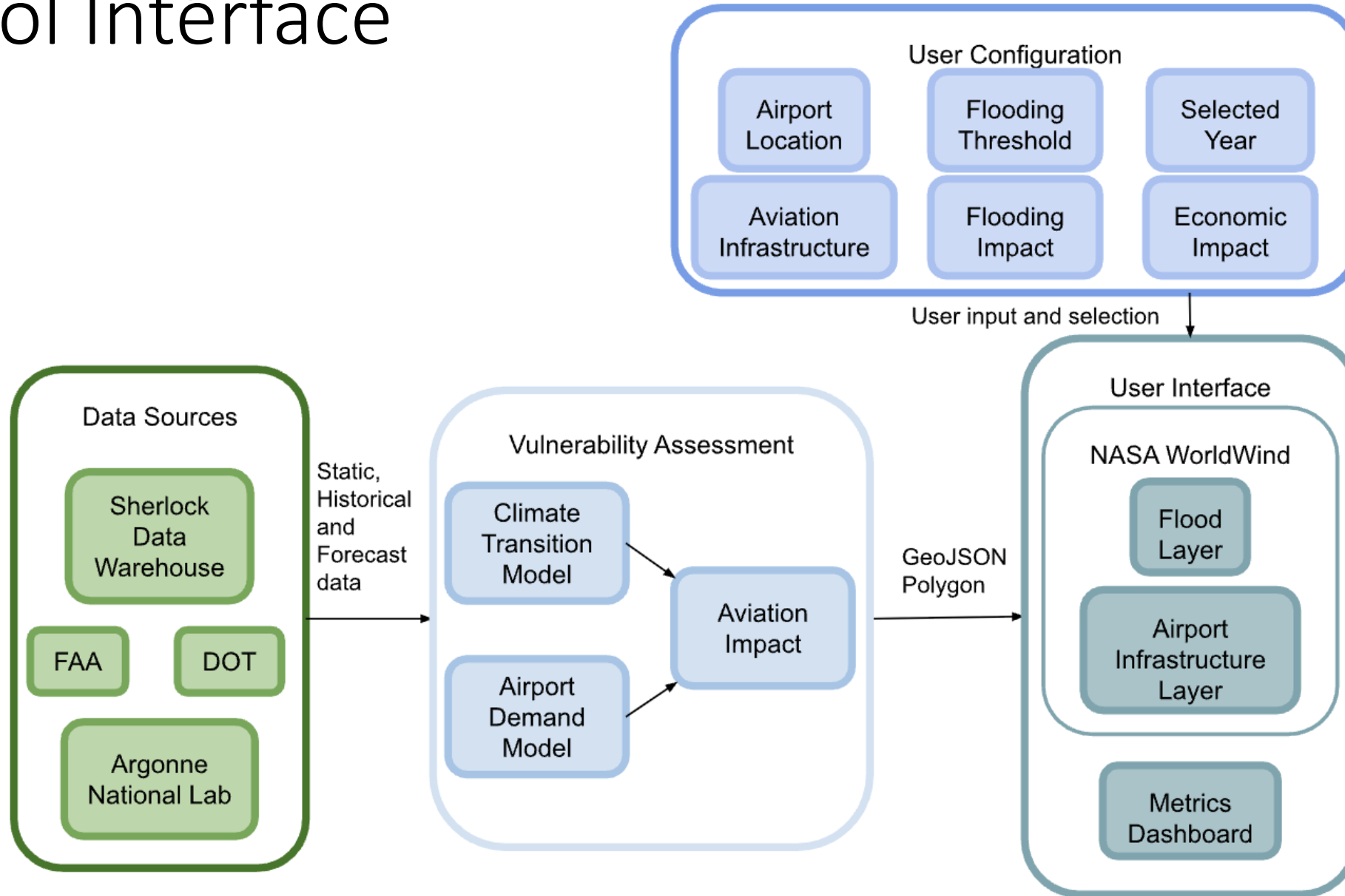


NASA WorldWind Interface

Tool Interface



Tool Interface





Operations Impact

Number of
flights delayed

Number of
flights
cancelled

Total minutes
of delay

Number of
passengers
impacted

Number of
flood days



Economic Impact

Cost of flight
cancellations

Cost of flight
delays

Airport
revenue loss

Repair and
maintenance
cost

Current VAAST Prototype





Next steps

Beta level prototype of VAAST

User testing of tool

Expanding the tool beyond flooding



Summary - VAAST

Vulnerability Modeling

- flooding translation model
- airport demand model

Hazard Visualization

- UX interface
- user configuration

Economic and Operational Impact

- static, historical, and forecast data
- economic and demand model