

Visualizing Flood, Drought, and Fire from one tool: *The Rapid Image Viewer*

Kenneth Ekpeterere^{1, 2}

Jude Kastens²

Xingong Li^{1, 2}

James Coll¹



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2022 Governor's Conference on the Future of Water in Kansas



Outline:

- Background to RIV Project
- RIV Collections and Components
- RIV Workflow
- Hazard scenarios and use cases
- Real-time Demo
- RIV SWOT assessment and future directions

Background

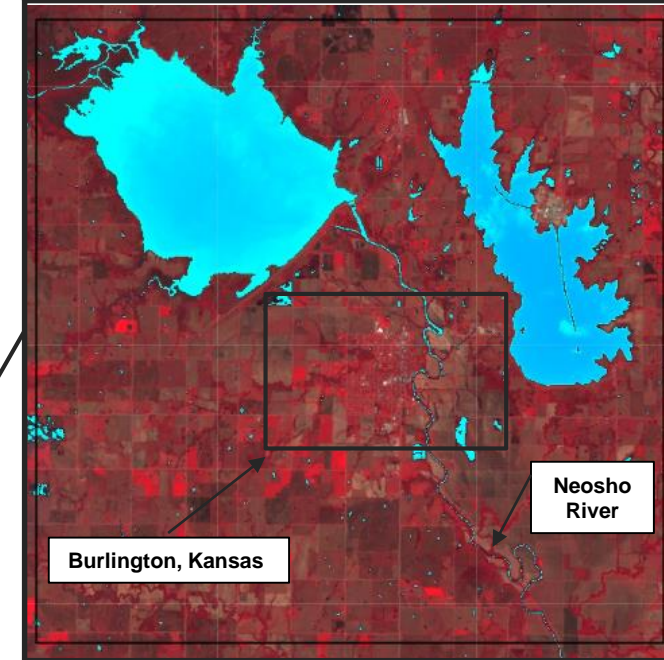
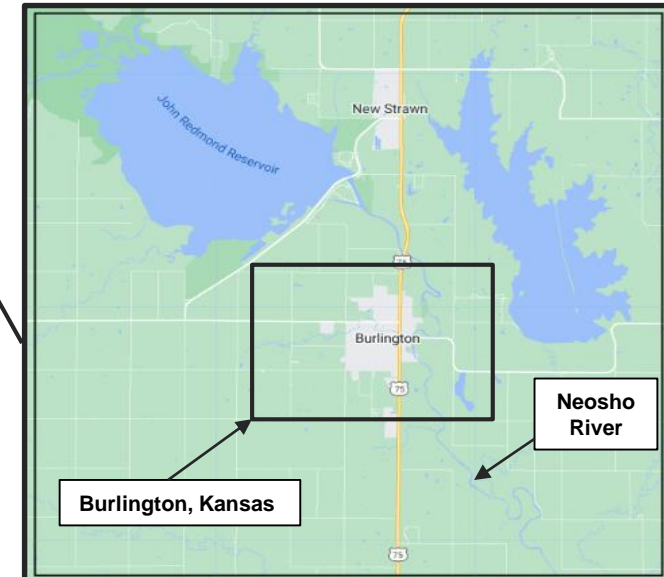
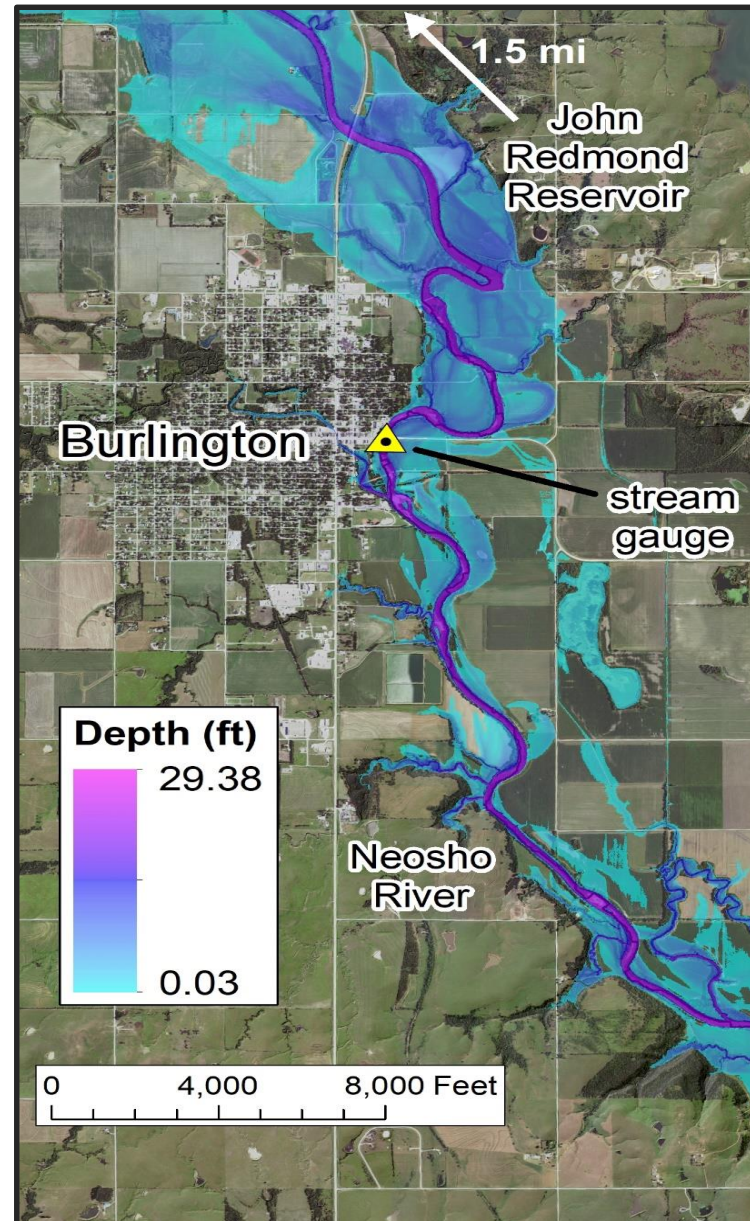
Flood mapping tools rely on remotely sensed images for validation.

Retrieving remote sensing images can be a hassle needing lots of experience.

The need for a tool that supports rapid visualization, monitoring, and download of remote sensing images is necessary for environmental researches.

The Rapid Image Viewer (RIV), thus helps breach that gap. RIV supports research related to flood, drought, and fire.

FLDPLN Map update for Lower Neosho around Burlington, including planned release from John Redmond (5/22/19) compared with RIV product. (2019 Great Flood of the Midwest).

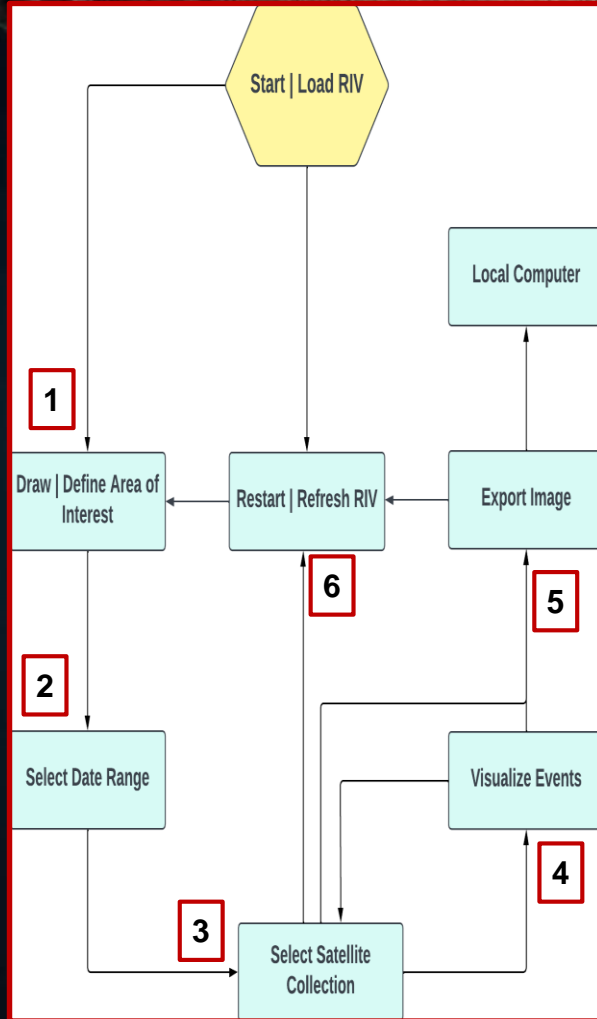


RIV Collections and Components

| Datasets | Sensor Type | Resolution Scale | Spatial Resolution (meters) | Start Date | End Date |
|--|-------------|------------------|-----------------------------|-------------|------------|
| National Agricultural Imagery Program (NAIP) | Optical | High | 1 | 2002-06-15 | 2020-12-17 |
| Sentinel-1 | Radar | High - medium | 10 | 2014 -09-11 | Present |
| Sentinel-2 | Optical | High | 10 | 2015-06-27 | Present |
| Sentinel-3 | Optical | Coarse | 300 | 2016-10-18 | Present |
| Landsat-9 | Optical | Medium | 30 | 2021-09-09 | Present |
| Landsat-8 | Optical | Medium | 30 | 2013-03-13 | Present |
| Landsat-7 | Optical | Medium | 30 | 1999-04-15 | Present |
| Landsat-5 | Optical | Medium | 30 | 1984-03-01 | 1993-12-31 |
| MODIS Aqua | Optical | Coarse | 250 | 2001-01-01 | Present |
| MODIS Terra | Optical | Coarse | 250 | 2001-01-01 | Present |

- True color image band combinations (RGB).
- False Color Image band combination (NRG-bands).
- Normalized difference water Index (NDWI).
- Segmented Image (for water edge identification).

RIV Workflow



The screenshot shows the RIV web application interface. At the top, it displays the logos for the University of Kansas, Kansas Biological Survey & Center for Ecological Research, Department of Geography & Atmospheric Science, and the Kansas Water Office. The main title is 'The Rapid Image Viewer'. Below this is a description of the application and a list of dataset information. The interface is divided into several sections: 'Dataset Information', 'App Project Team', 'App Information', and 'Acknowledgments'. The central part of the interface is a satellite image viewer showing a map of John Redmond Dam and Reservoir, Burlington, KS, USA. A red rectangle is drawn over the reservoir area, labeled '4'. To the right of the map is a 'Dataset Handler Tabs' panel with the following sections:

- 1) Draw Area Of Interest:** Includes a 'Click to Draw AOI' button and a 'Rectangle' selection tool, labeled '1'.
- 2) Date Filter (YYYY-MM-DD):** Includes 'Enter End Date' (2019-05-22) and 'Prior Day(s)' (30) fields, labeled '2'.
- 3) Select Collection Checkbox:** Includes checkboxes for 'Optical (moderate to high resolutions)' (Sentinel-2 True/False Color, Landsat-9 True/False Color, Landsat-8 True/False Color, Landsat-7 True/False Color, Landsat-5 True/False Color) and 'Optical (low spatial/temporal resolutions)' (NAIP True Color, MODIS Terra, Sentinel-1 VV Polarized, Sentinel-1 VH Polarized), labeled '3'.
- 4) Export Image:** Includes a 'Download' button and a 'Reset | Refresh App.' button, labeled '5'.
- 6) Refresh:** A 'Click to Refresh App' button is located at the bottom of the panel, labeled '6'.

<https://kars.geoplatform.ku.edu/pages/e0bbb6ddfa7b444b9741cc4222817d4>

Hazard Scenario

1a. Flood

2019 Great Flood of the Midwest

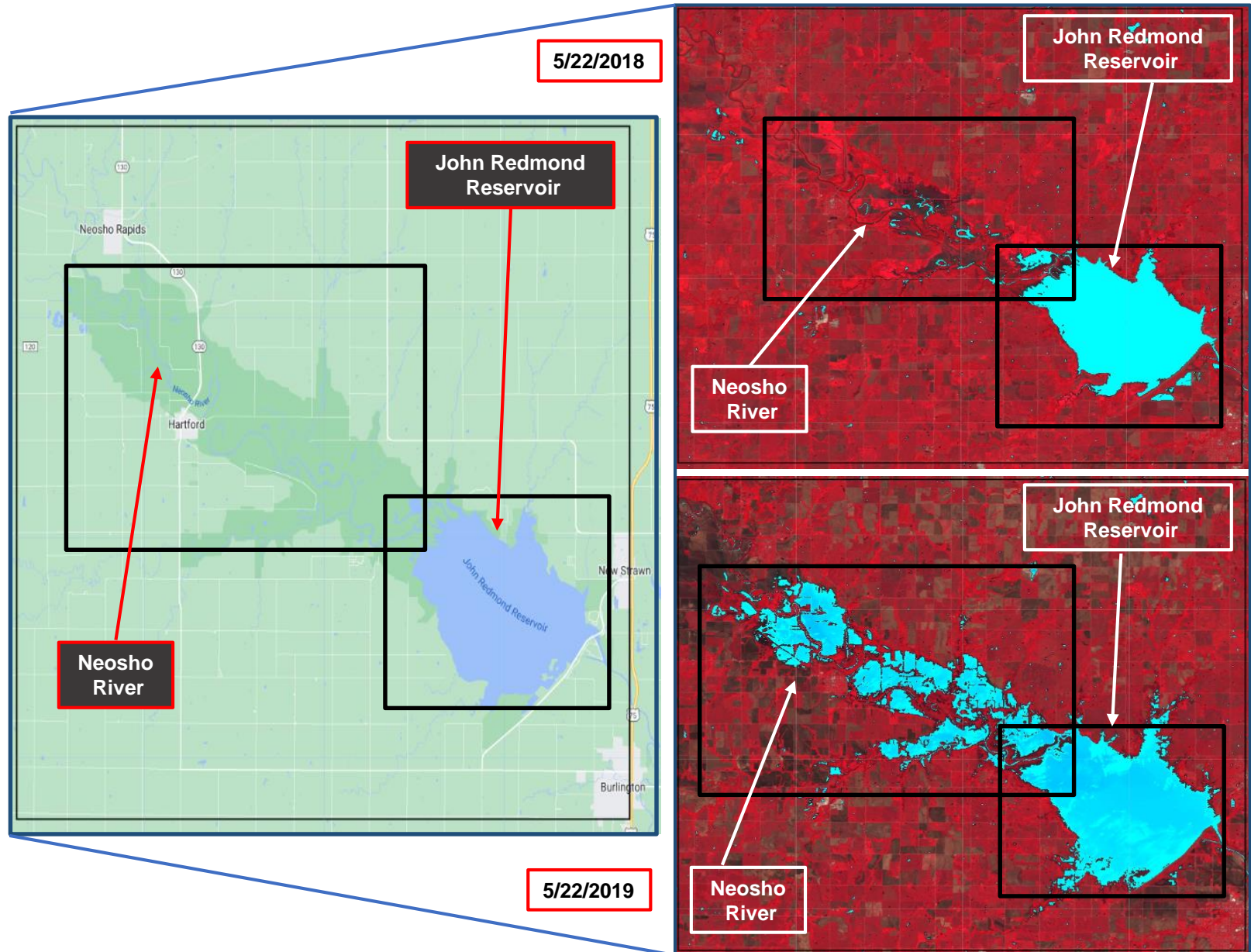
The flood impacted nearly 14 million people in the Midwest.

Over \$2.9 billion in property damage.

Flooding in the upper Neosho River and water increase in John Redmond Reservoir (5/22/19).

Over 50% increase in water extent.

Impacted many small towns and cities along the rivers (Neosho Rapids, Hartford, Burlington, New Strawn, to mention a few).



Hazard Scenario

1b. Flood

2019 Great Flood of the Midwest

1

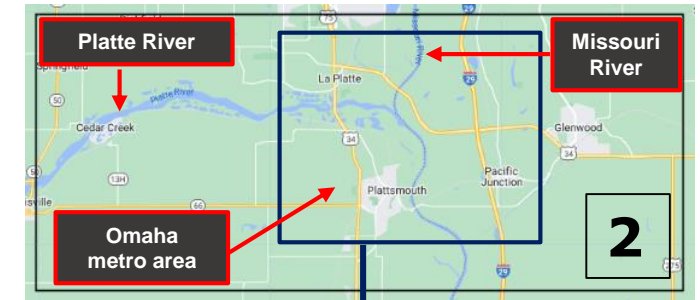
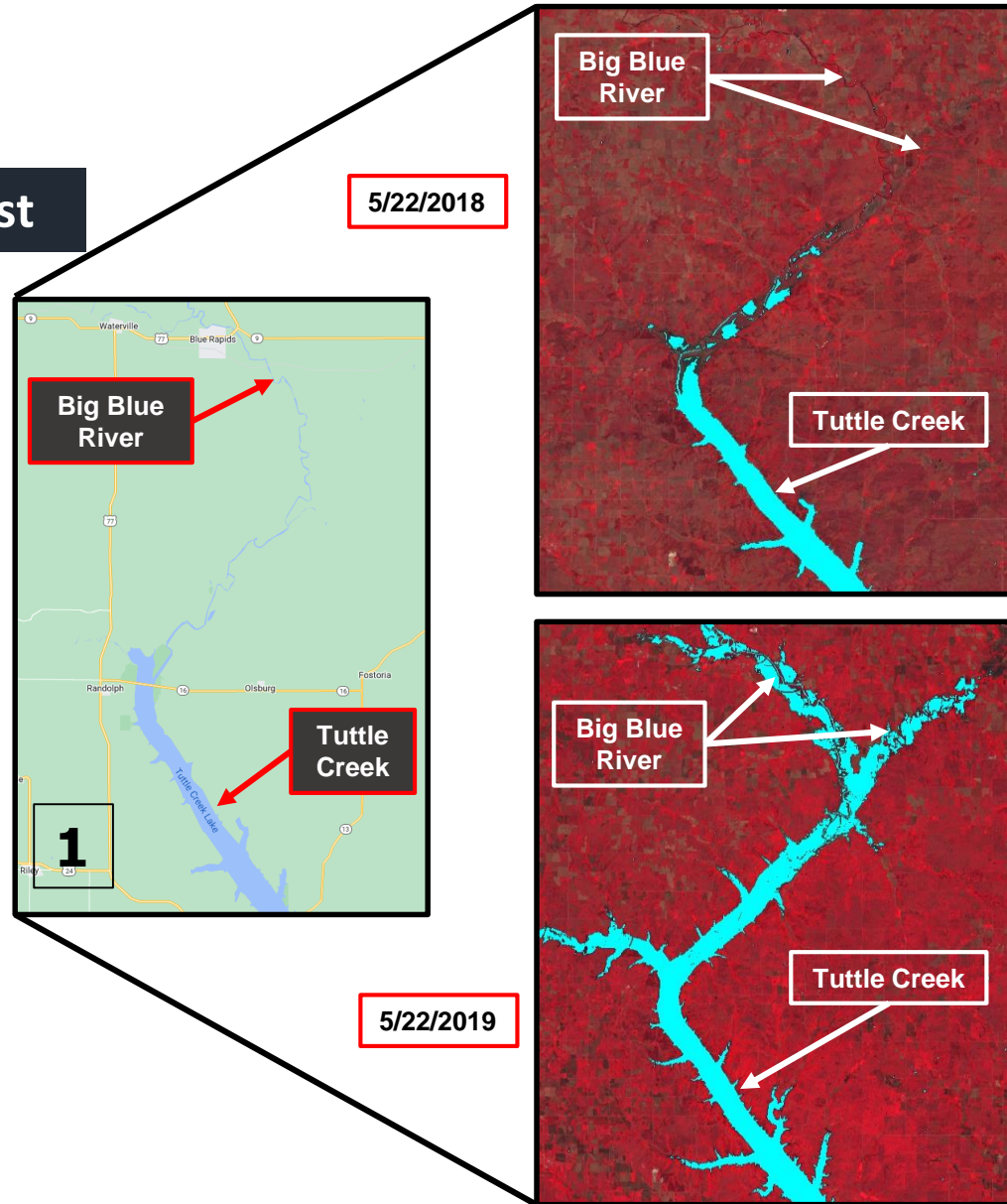
Tuttle creek rose by 29.56 ft to nearly 1,200 ft above sea level (U.S. Army Corps of Engineering).

2

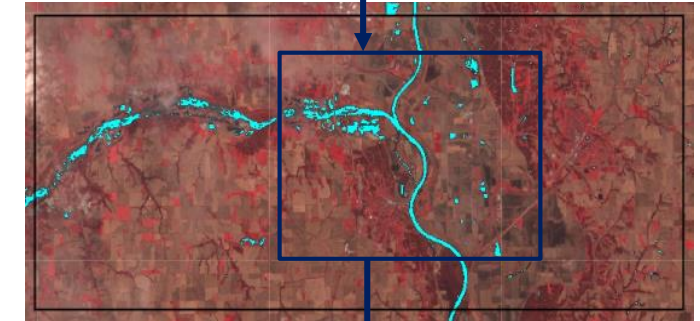
Flooding of Omaha metro area (Plattsmouth, Glenwood).

Flooding in Missouri River Basin.

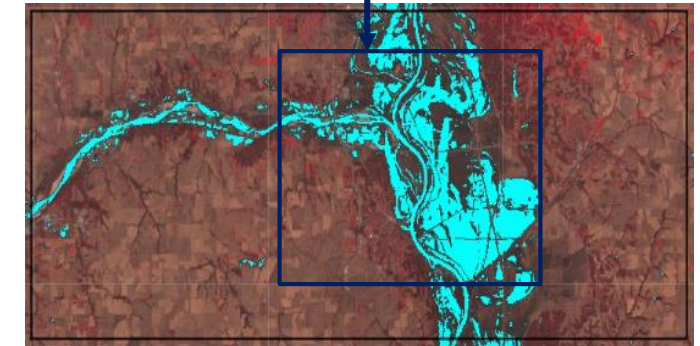
Over \$1.3 billion in property damage from ¾ of 93 counties in Nebraska.



5/22/2018



5/22/2019



Hazard Scenario

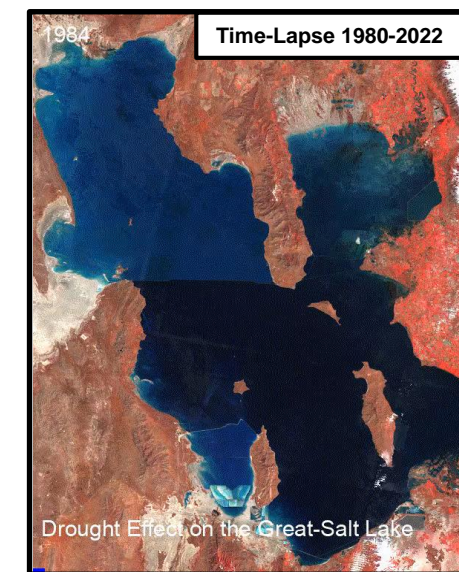
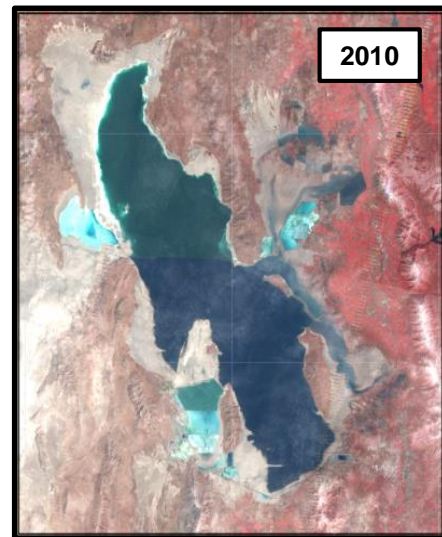
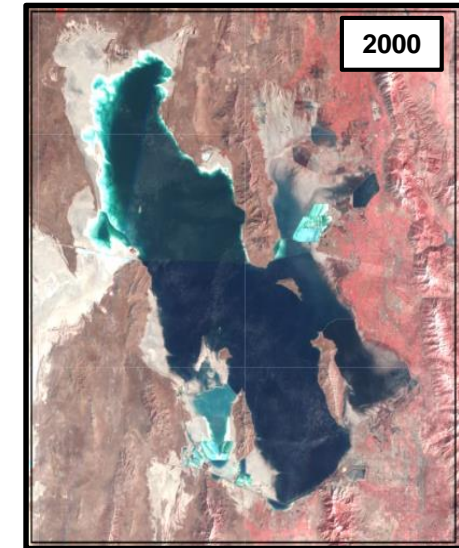
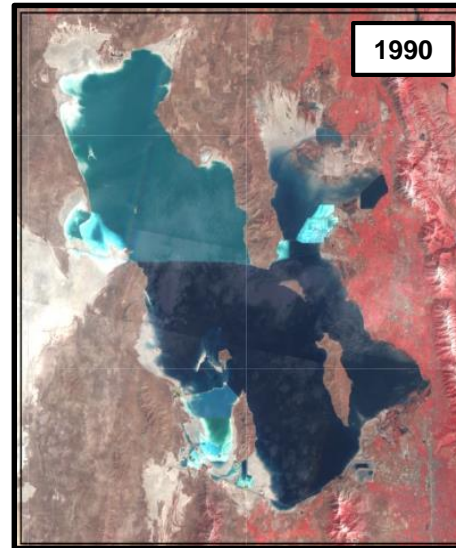
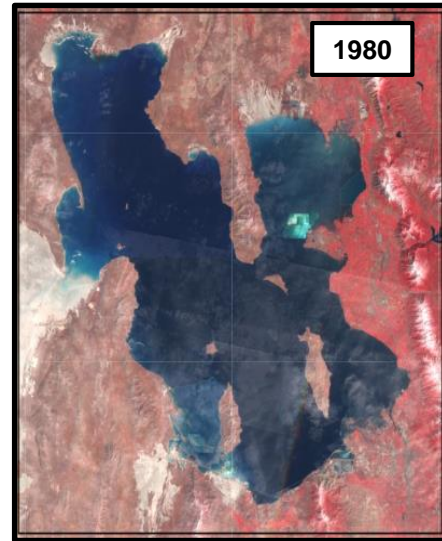
2a. Drought

Long-term Drought Impact on Lake Area Extent

Decline in Great-Salt Lake from 1980 to 2020.

Nearly 50% decline in GSL area extent.

Decreased from 7,000 km.sq in 1980's to below 3,500 km.sq in 2020's.

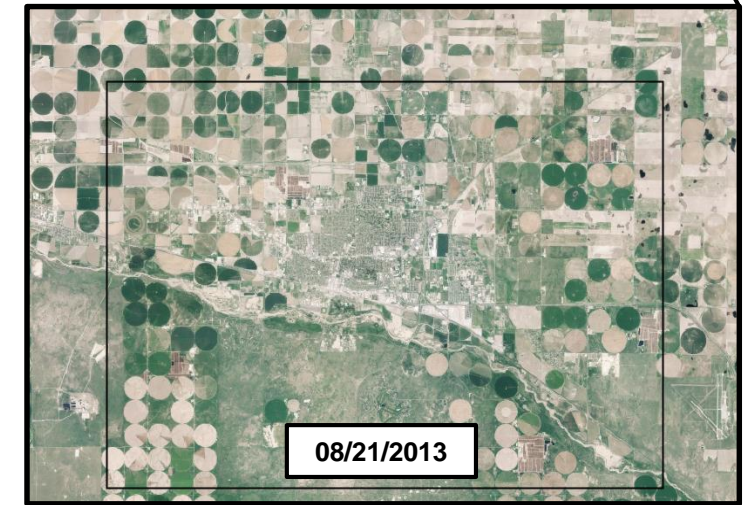
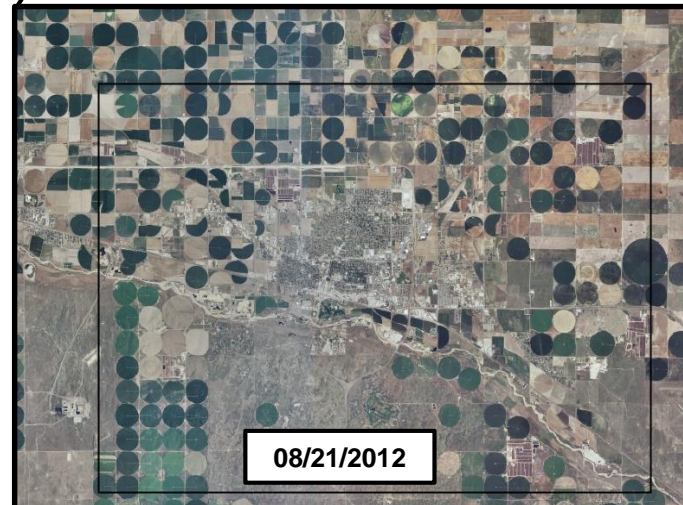
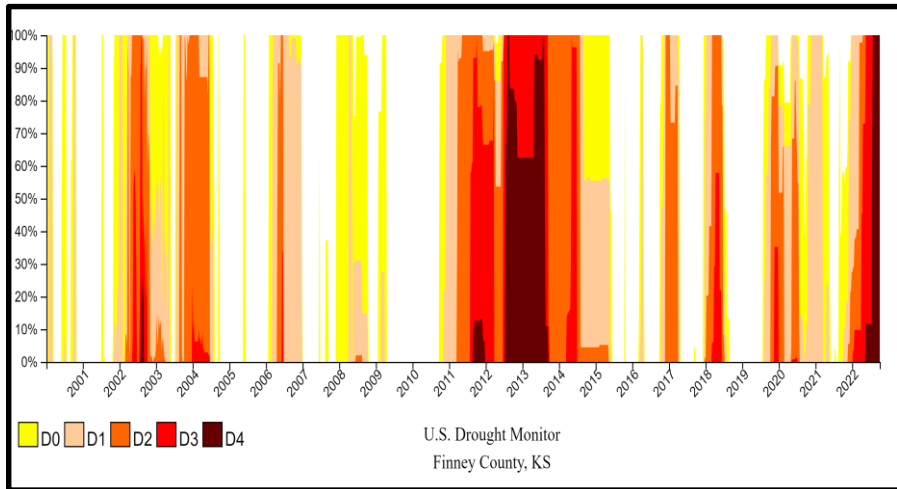
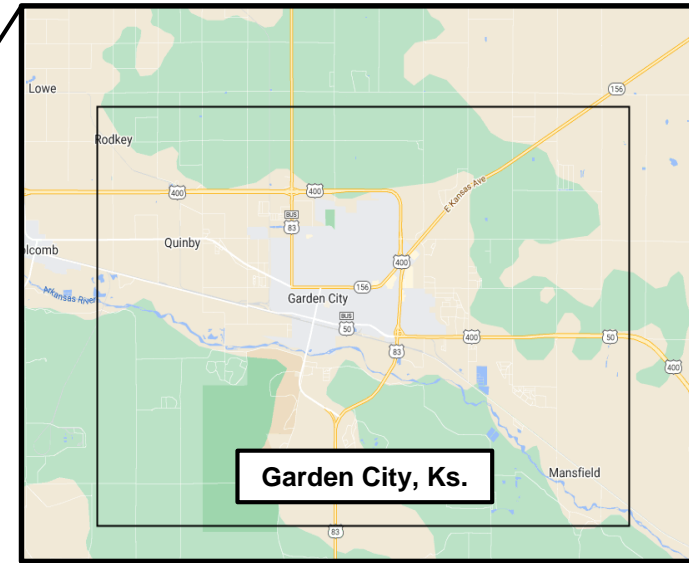


Hazard Scenario

2b. Drought

**Drought Impact on Crops.
(August 21, 2013)
Farmlands in Garden City,
Finney county, Kansas.**

- D4 – Exceptional Drought.
- Impacted 34.6 % of Kansas.
- Severe Impact on crops and aquatic species.



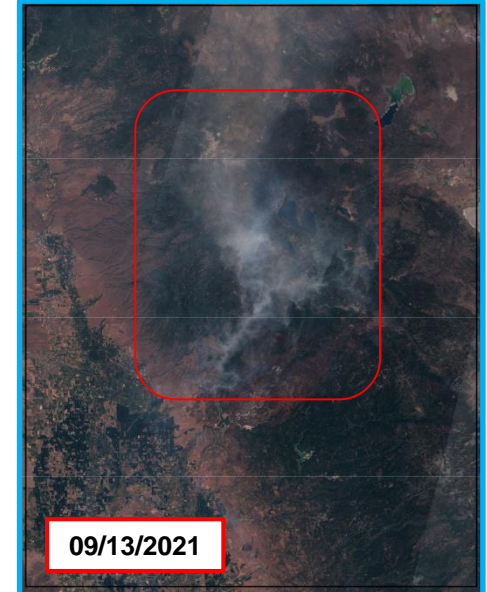
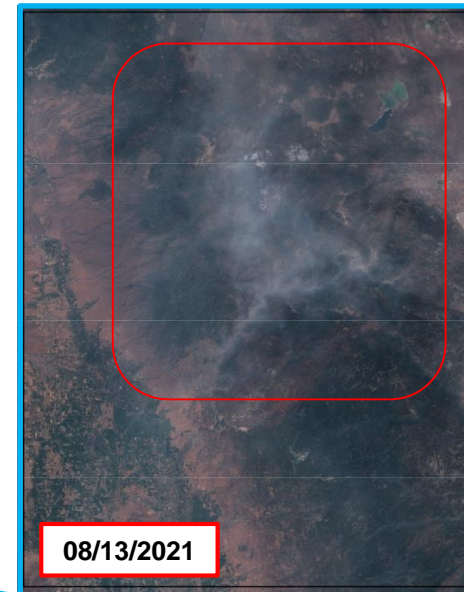
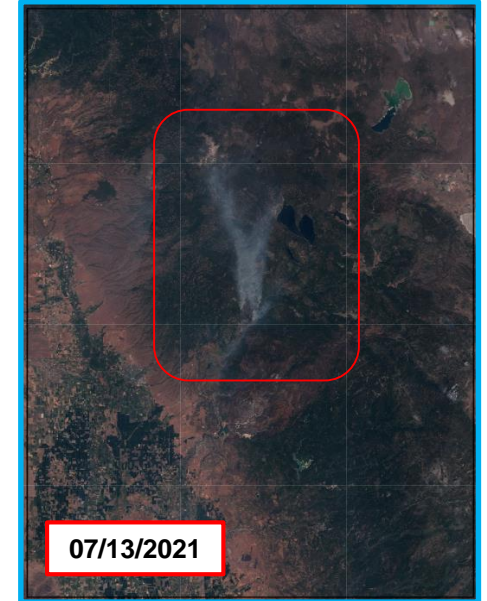
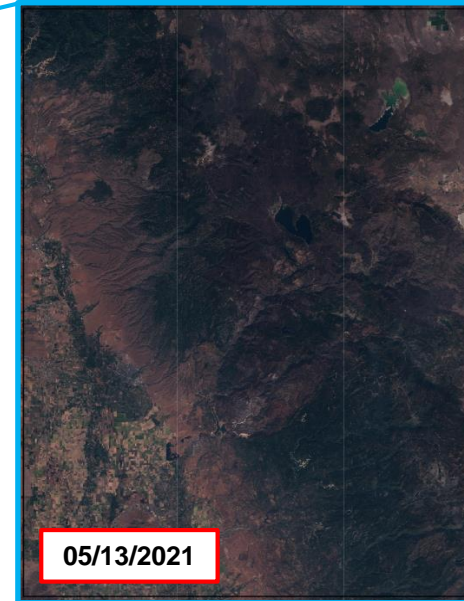
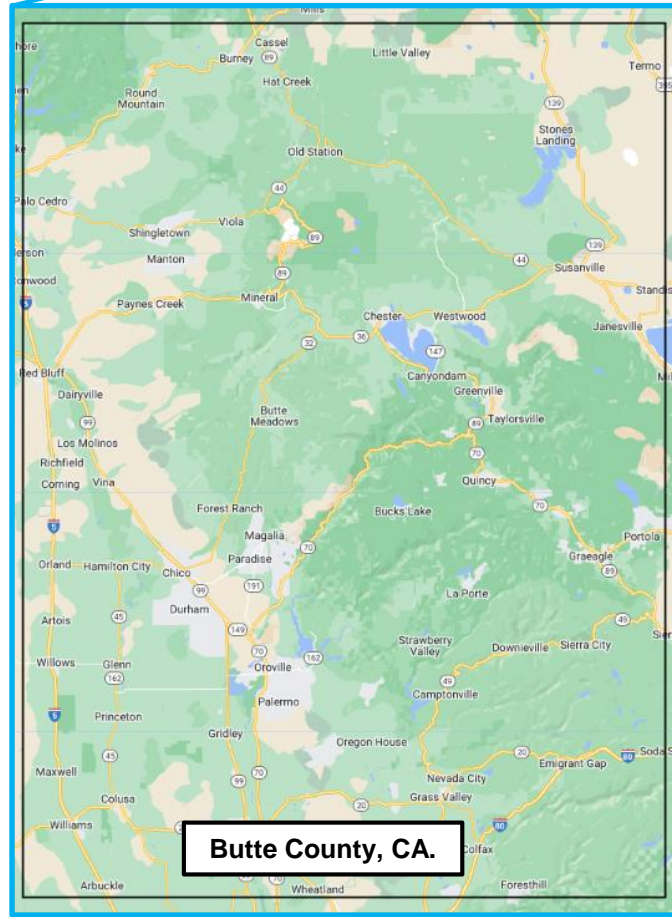
Hazard Scenario

3a. Wildfire

2021 Wildfire in California

- Nicknamed the Dixie Fire of CA.
- Started July 13, 2021, up to October 25, 2021.
- Burned over 963,837 acres.
- Impacted several counties (Butte, Plumas, Lassen, Shasta, and Tehama).
- Largest single wildfire in CA. and second largest wildfire overall.
- First known wildfire to cross the crest of the Sierra Nevada.
- Cost over \$637.4 million to fight.

Source: [CalFire](https://www.calfire.ca.gov/)

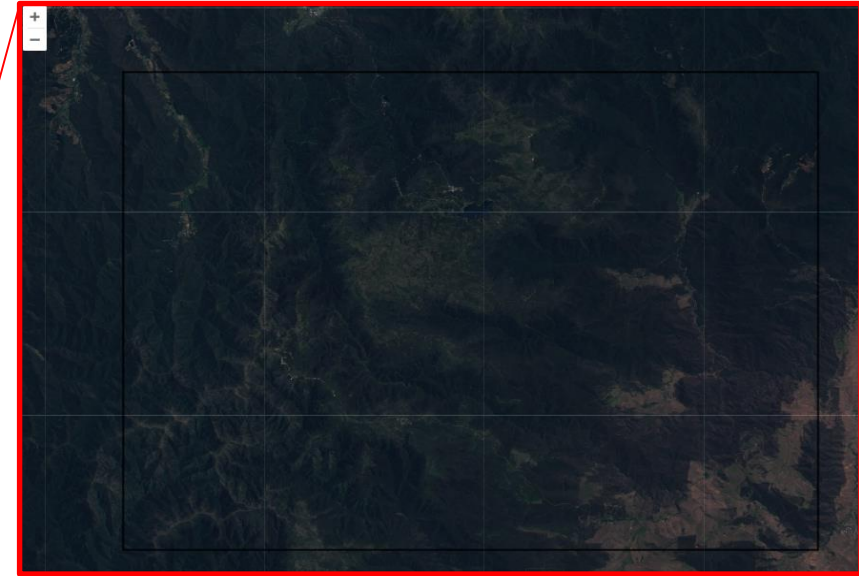
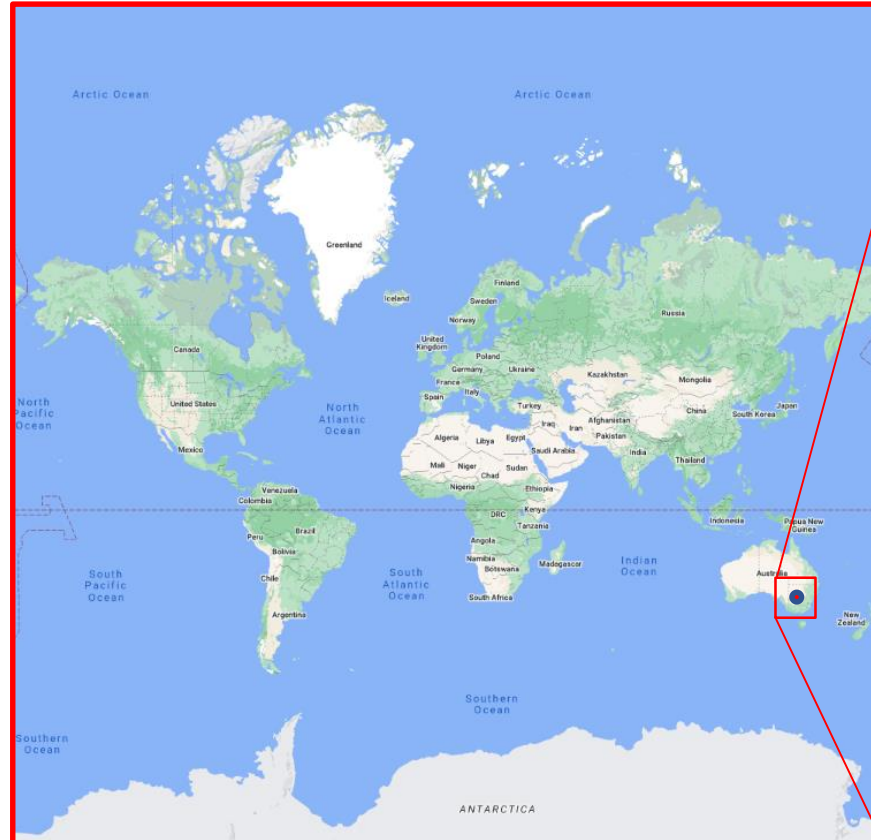


Hazard Scenario

3b. Wildfire

2020 Wildfire in Victoria Region, Australia.

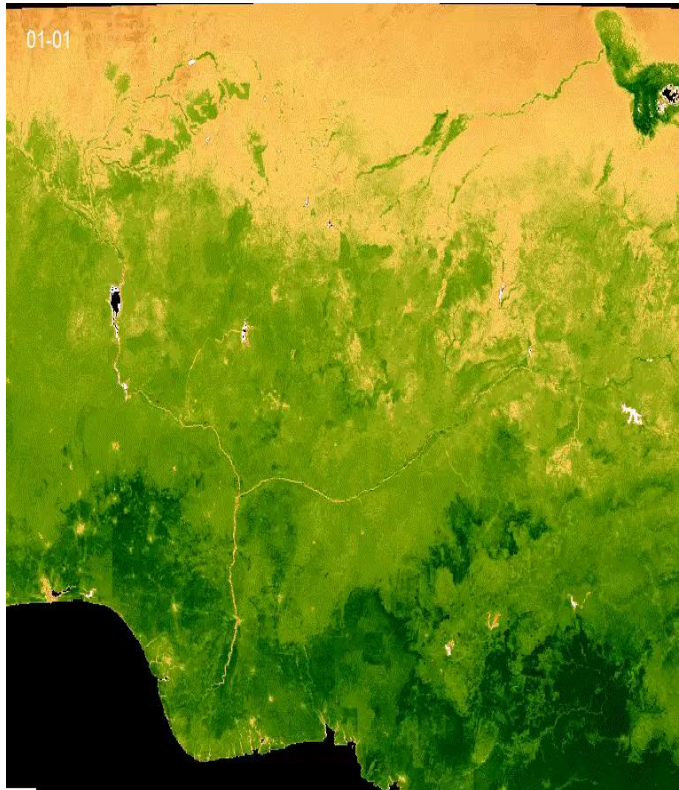
- Triggered by the 2019 droughts in Australia.
- Decimated over a billion animal.
- Killed 75 people (20 fire fighters).
- Caused air pollution, and vegetation depletion.
- Direct impact on climate change.
- Cost between \$4 billion - \$5 billion.



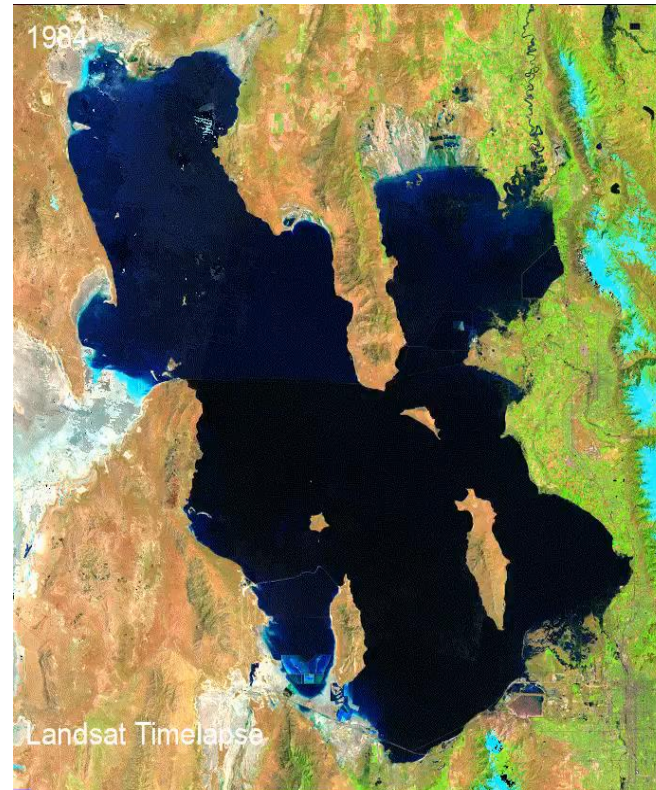
Other Areas Of RIV Applications

4. Global Monitoring

Vegetation Change (Nigeria)



Lake Area Change (Utah, USA)



Lekki Expansion (Nigeria)



RIV SWOT ASSESSMENT

Strengths

- Fast and easy to use.
- No programming skill.
- Daily update.
- Work online, no app download needed.
- Variety of collections.
- Applicable to various fields.

Weaknesses

- Require knowledge of remote sensing.
- Workflow must be maintained.
- Daily reload to update collections.
- Require Internet connection.
- Users cannot access script.

Opportunities

- Global coverage.
- Daily update.
- Many fields of applications.
- Retrieves past and current images.
- Multiple users at a time.

Threats

- Require GEE platform to mount.
- Host platform policy changes.
- No offline capability.

SWOT
ANALYSIS

S

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Real-time Demo

<https://kars.geoplatform.ku.edu/pages/e0bbb6ddfa7b444b9741cc42222817d4>

Future Direction

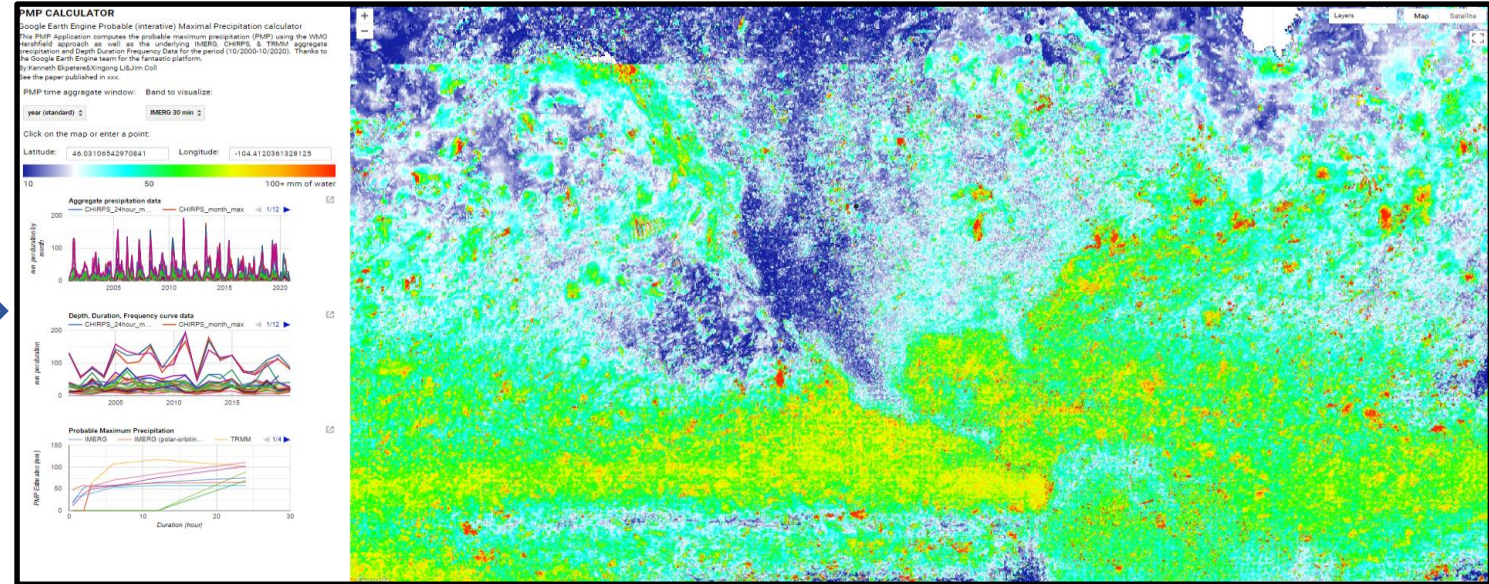
- On-the-fly image segmentation and feature classification.
- Additional indices (burn ration, burn severity, and drought indices).

Additional Tools from the developer

PMP Calculator

<https://cartoviews.users.earthengine.app/view/pmp-calculator>

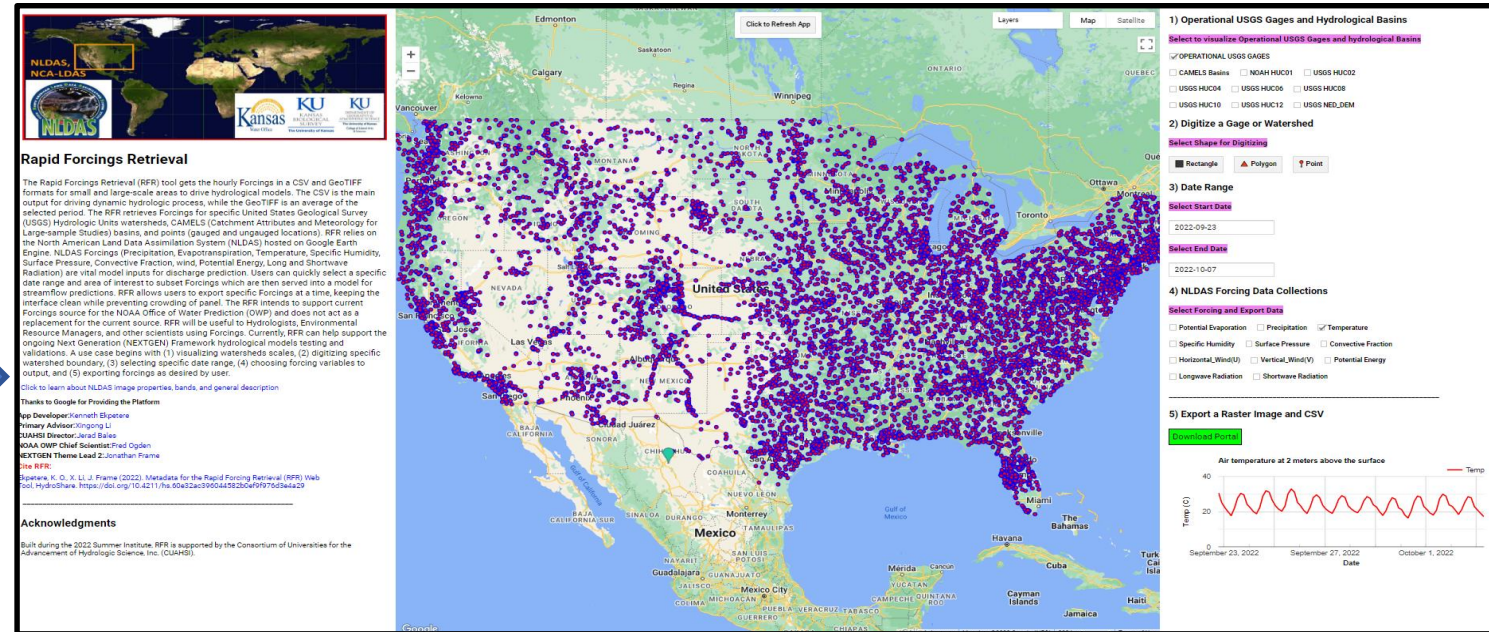
- PMP and Maximum Flood Risk Mapping.



Rapid Forcing Retrieval

<https://cartoviews.users.earthengine.app/view/rapid-forcings-retrieval>

- Hydrological modeling components.



Acknowledgement

Special thanks to these agencies for their supports in several capacities.



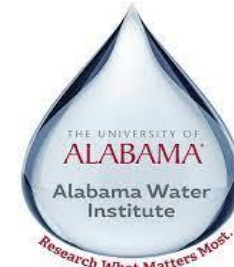
Google Earth Engine

KARS

Kansas Applied Remote Sensing Program



Google



CUAHSI
universities allied for water research



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Questions

Kenneth Ekpeterere

Doctoral Student | University of Kansas

Kennethekpeterere@ku.edu



