

# Measuring Fire Scars with JPSS Satellites to Provide Preliminary Burn Intensity Estimates to NWS for Debris Flow Hazard Assessment

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# Providing *Faster* Satellite-derived Input Maps for Mudslide Forecasters

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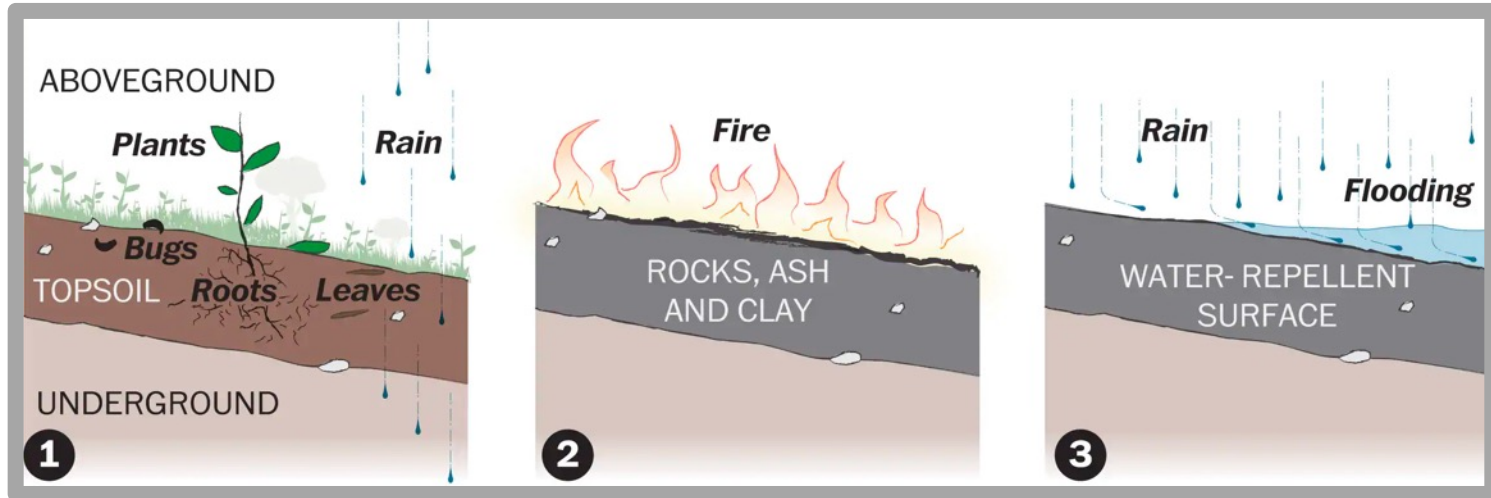
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# The Situation – Debris Flows after Fires



Source of graphic: “How the harrowing Thomas Fire planted the seed for California's deadly mudslides” Washington Post, By Angela Fritz January 10, 2018

- 1) Healthy soil and vegetation absorbs rain and stabilizes slopes.
- 2) Fire destroys this stability.
- 3) Risk of mudslides increases after fires.



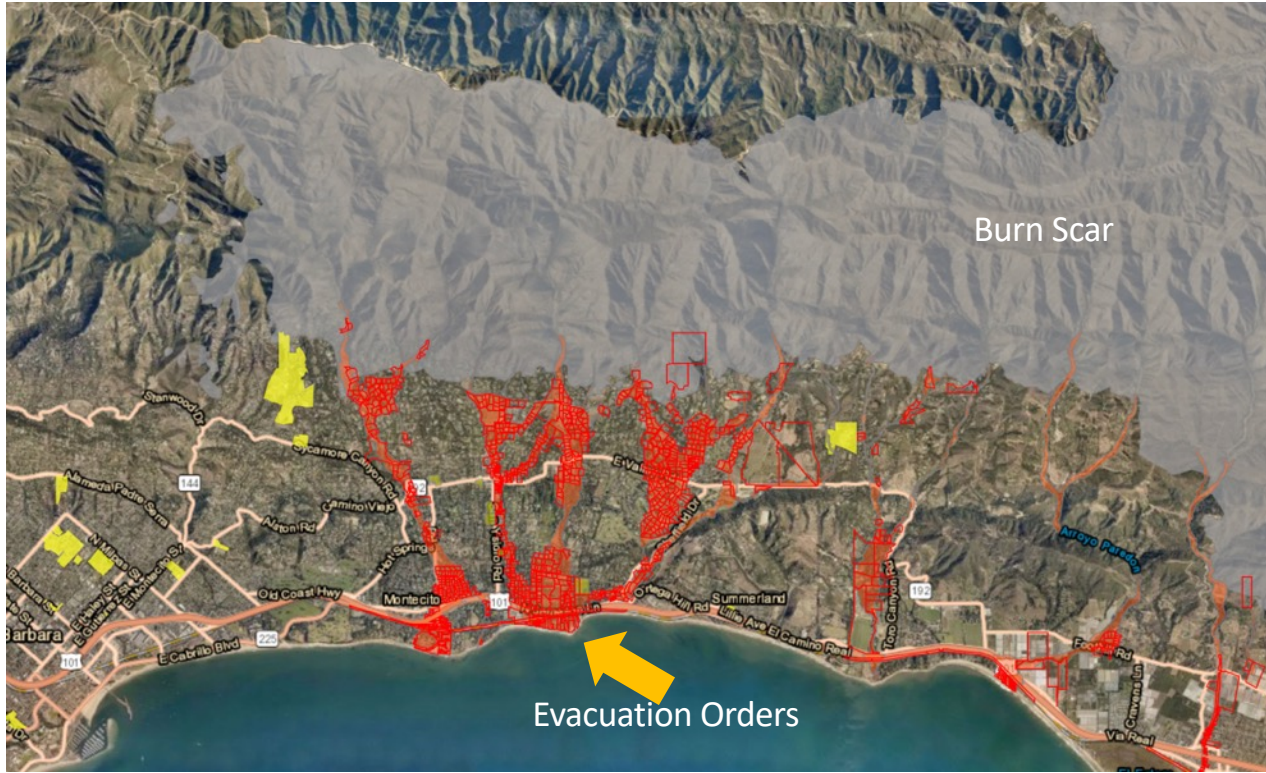
# The Situation – Debris Flows After Fires



Montecito, CA, January 7, 2018. Source: "Your Questions About The California Mudslides, Answered." Huffingtonpost.com, By Lydia O'Connor January 11, 2018 08:37 pm ET Updated Nov 26, 2018.



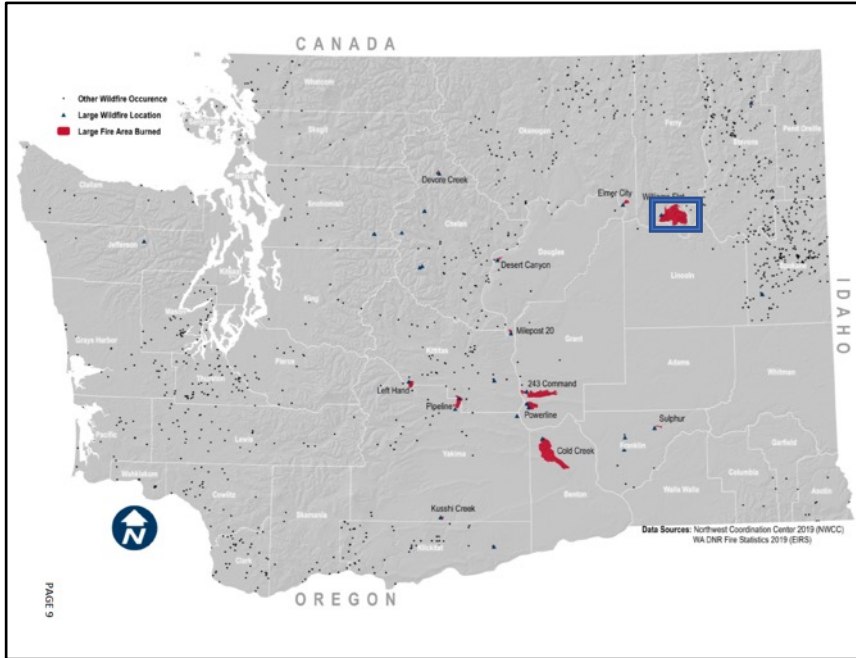
# The Concern – Hazard Warnings



Example evacuation order map from 5 March 2019. Source: County of Santa Barbara, Emergency Operation Center and Santa Barbara County Sheriff

# Williams Flats Fire Example

44,446 Acres :: 8/2/2019- 8/25/2019 :: Lightning



Location of fire from “Fire Season Summary – 2019”, Washington DNR



Landsat 8 True Color RGB image Aug. 7, 2019, (WRS-2: Path 44, Row 27)  
<https://earthobservatory.nasa.gov/images/145446/flying-through-a-fire-cloud>

# BARC vs BRIDGE

**Current Method:**  
Normalized Burn Ratio (NBR)  
is an index designed to  
highlight burnt areas in large  
fire zones.

$$\text{NBR} = \frac{(\text{NIR} - \text{SWIR})}{(\text{NIR} + \text{SWIR})}$$

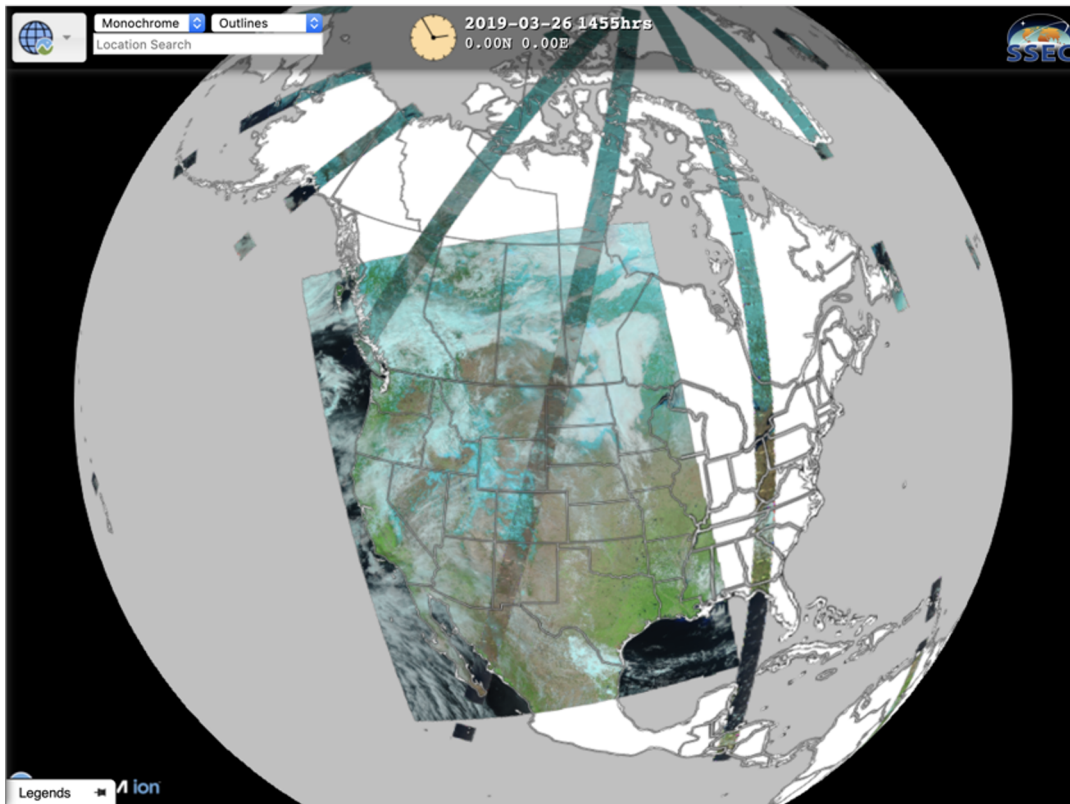
- Used with Landsat imagery as input for Burned Area Reflectance Classification “**BARC**” maps at 30m resolution
- Good accuracy, but 16-day repeat cycle
- Latency issue for NWS - **sometimes late or never**
- MODIS 500m product (MCD64A1) only monthly
- No VIIRS version of this product (yet?)

**Alternative Method:**  
Normalized Difference Vegetation  
Index (NDVI) is a quantitative  
index of greenness that relates to  
vegetation health.

$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$

- Shows promise for rapid production of preliminary Burn Intensity Delta Greenness Estimation “**BRIDGE**” maps at 375m
- Medium Accuracy, but nearly daily
- Rapidly Available
- Fire damages vegetation
- NDVI is an **operational** JPSS product

# Observation: OLI and VIIRS



Landsat OLI:  
185km

S-NPP and NOAA-20  
VIIRS:  
3000km

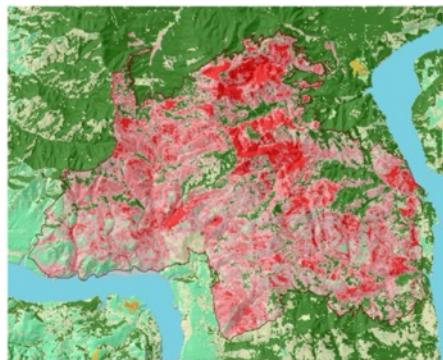
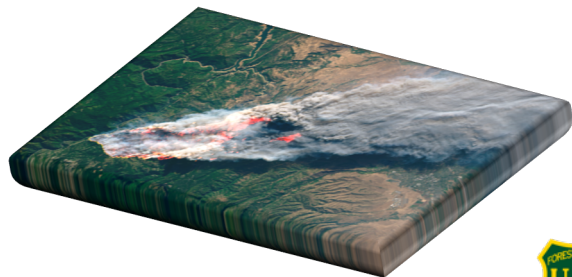


# BARC Map

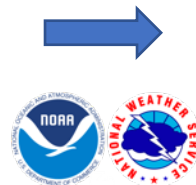


16-day Repeat Cycle  
185km Swath Width

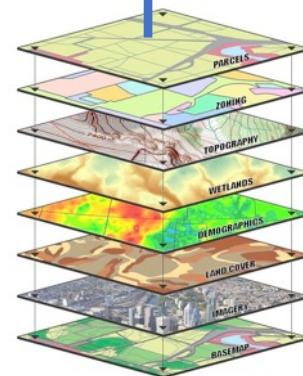
Fire → Burn Scar → **Observation** → **Processing** → **BARC** → GIS Model → Weather Forecast → Warning!



Landsat-Based 30m

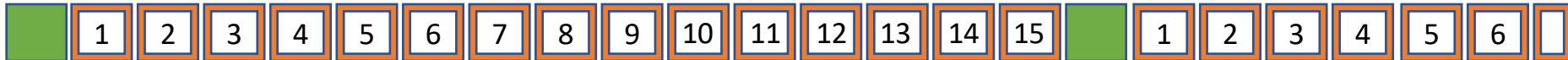


Sept 8

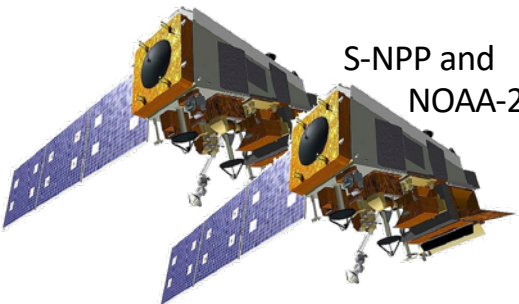


Oct 10

Aug 23



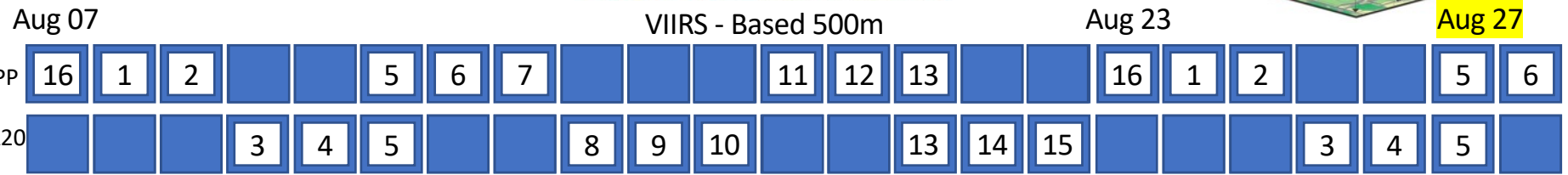
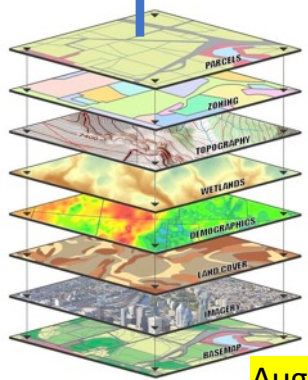
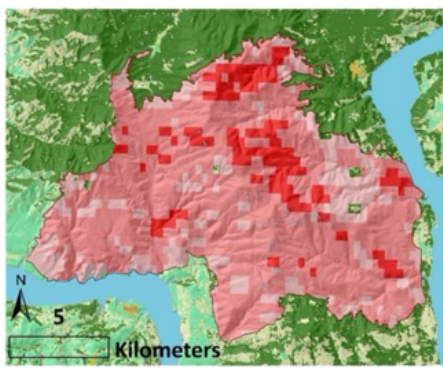
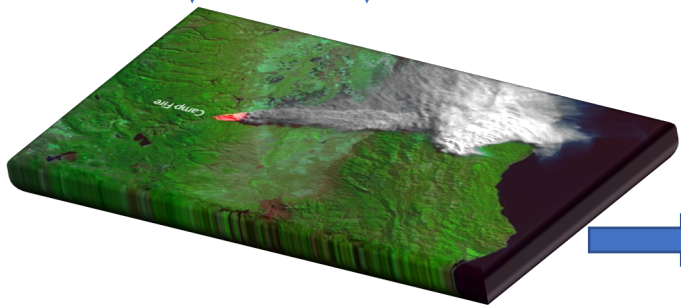
S-NPP and NOAA-20



# BRIDGE Map

1-day Repeat Cycle  
3000km Swath Width

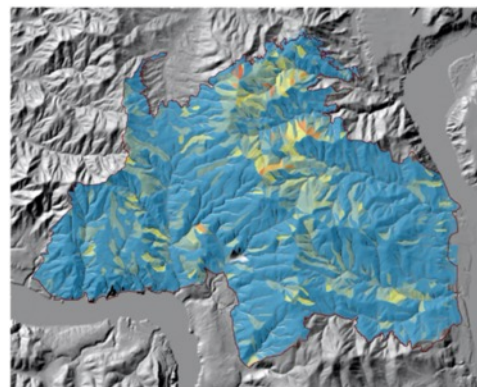
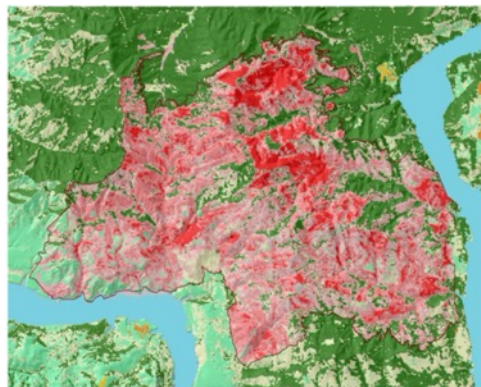
Fire → Burn Scar → **Observation** → **Processing** → **BRIDGE** → GIS Model → Weather Forecast → Warning!



# Comparing Results

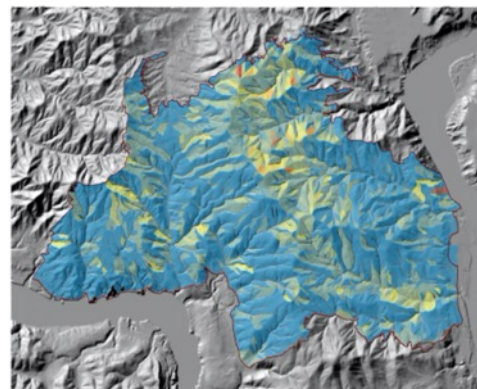
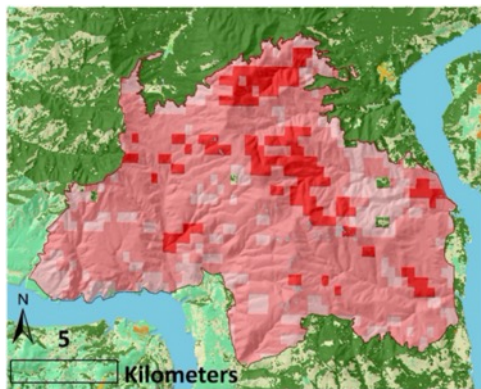
## Landsat - BARC

- 30m
- Oct 10 (first clear scene)



## VIIRS - BRIDGE

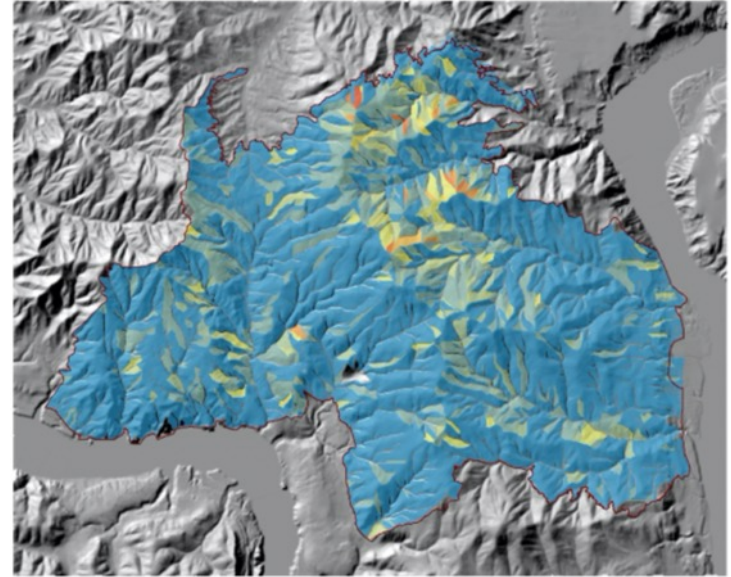
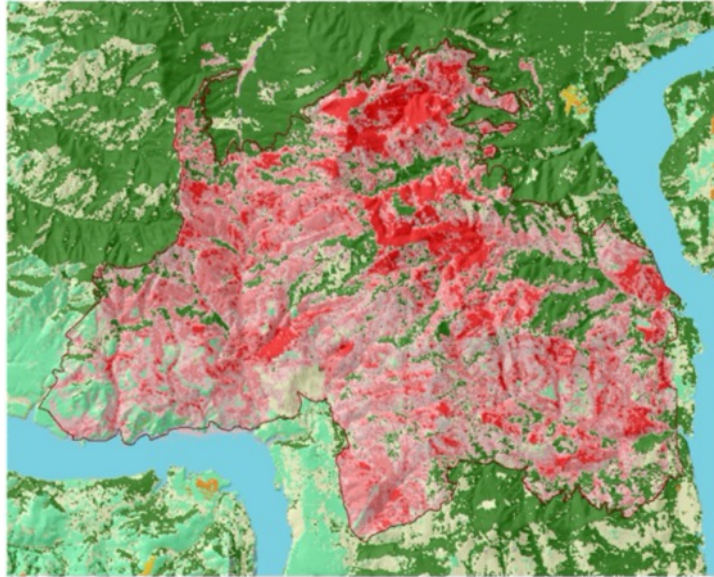
- 500m
- Aug 27 (first clear scene)
- 44-Days Earlier





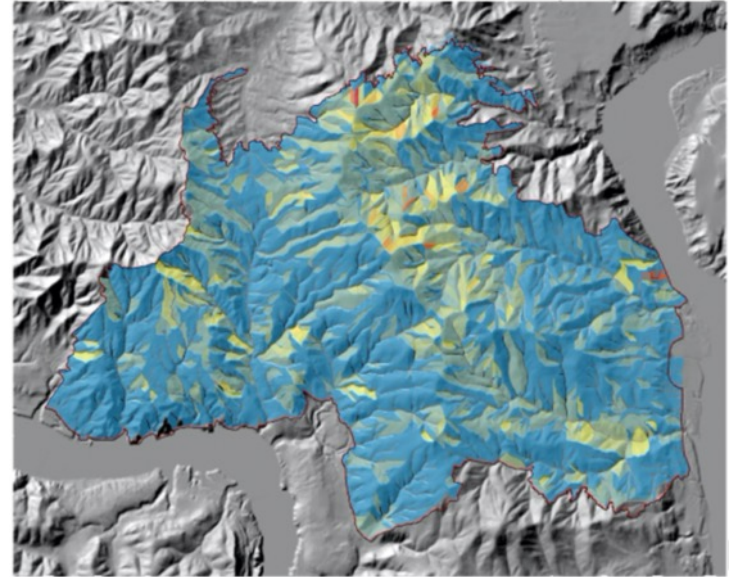
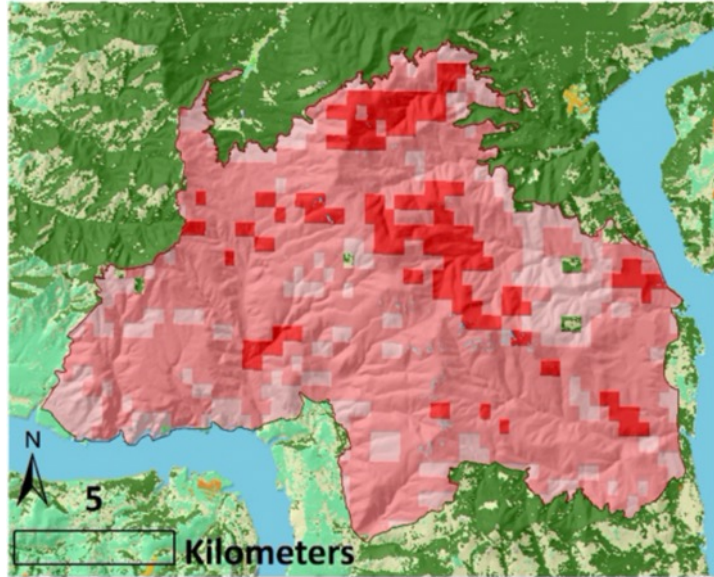
# Comparing Results

Landsat - BARC



# Comparing Results

VIIRS - BRIDGE



# Conclusion



BARC maps are more accurate



BRIDGE maps are more timely



BRIDGE maps appear to be accurate “enough”



# Considerations and Next Steps

- More case studies will be processed
- Continue efforts to automate with web- based dashboard
- Utilize Direct broadcast for "after" imagery to cut latency