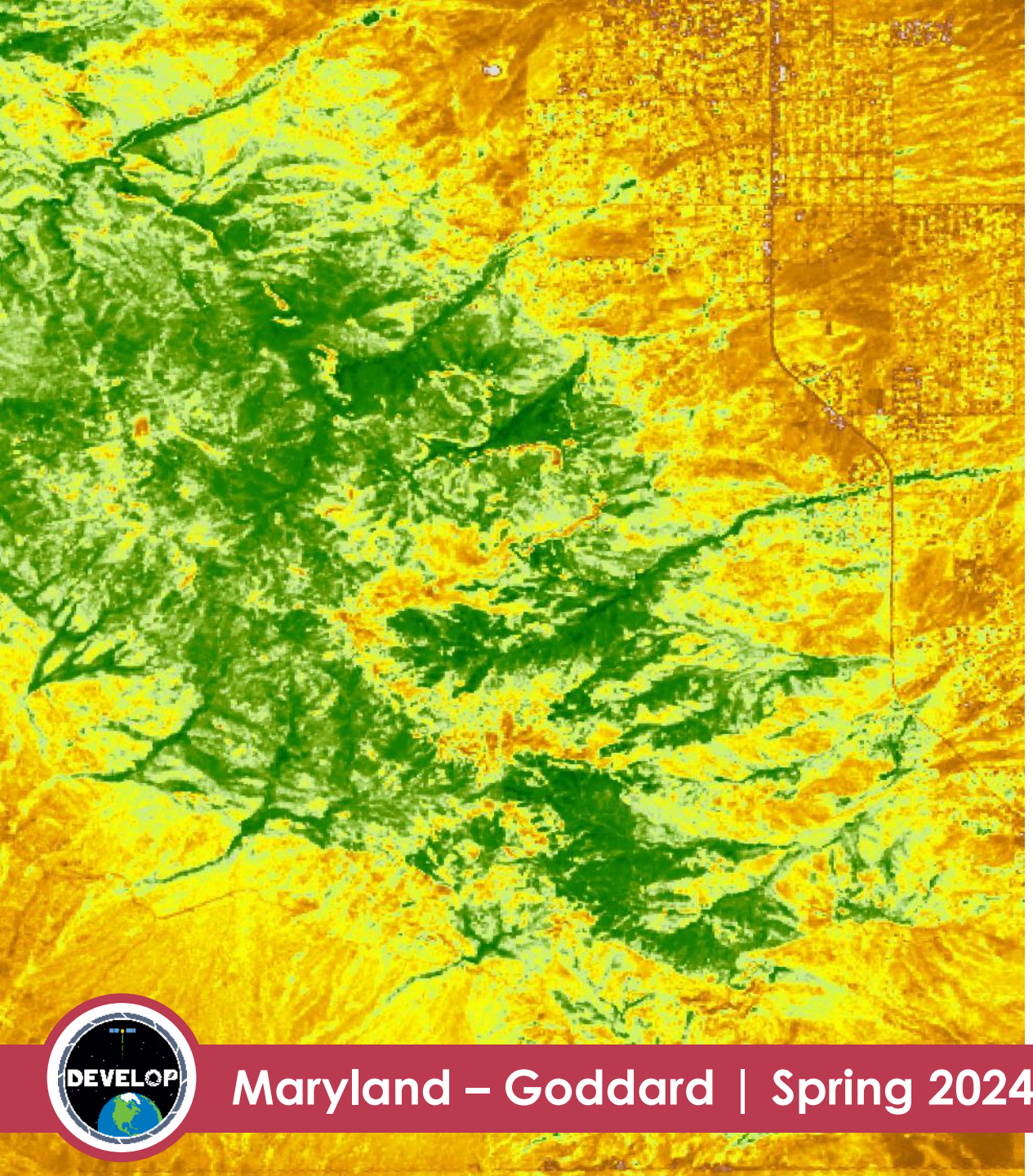


National Aeronautics and Space Administration

CORONADO DISASTERS

Investigating Geohazards & Slope Failure Susceptibility Utilizing NASA Earth Observations

Andrea Slotke

Mikki Arimitsu

Alex Behzadi

Maggie Drelichman

Maryland – Goddard | Spring 2024

OUTLINE

OVERVIEW

- Introductions
- Area of interest (AOI)

GOALS

- Concerns
- End Products

METHODS

- NASA EO
- Data Analysis

OUTCOMES

- Results
- Limitations & Uncertainties

CONCLUSIONS

- Future Work
- Acknowledgements

THE DEVELOP TEAM

Andrea Slotke

Mikki Arimitsu

Alex Behzadi

Maggie Drelichman

THE PARTNERS

Coronado National Memorial

National Park Service, Southeast Arizona Group

- Resource **management** and **preservation**
- Educate the public to **provide safe engagement** with the park
- **Evaluate risks** associated with natural hazards

Credit: NPS SEAZ

CORONADO NATIONAL MEMORIAL

Arizona, USA

Hereford

Mexico

N

- Sits on 4,750 acres in the **Huachuca Mountains**
- Established to recognize the **Coronado Expedition of 1540**
- Shares ~5.5 km of its **boundary with Mexico**

Credit: Basemap - Esri, Maxar, Earthstar Geographics, and the GIS User Community; Images - NPS SEAZ

COMMUNITY CONCERNS

- Construction 2019-2020
- Road is incomplete due to steep topography

Credit: NPS SEAZ

COMMUNITY CONCERNS

July 2023

Issues from Slope Instability:

- Rockfall
- Embankment Failure
- Exposure to Debris Flow

Credit: Map - Google Earth, Airbus, Landsat/Copernicus, Image - NPS SEAZ

GOALS

Determine Focus for Damage Mitigation

Change Detection Maps

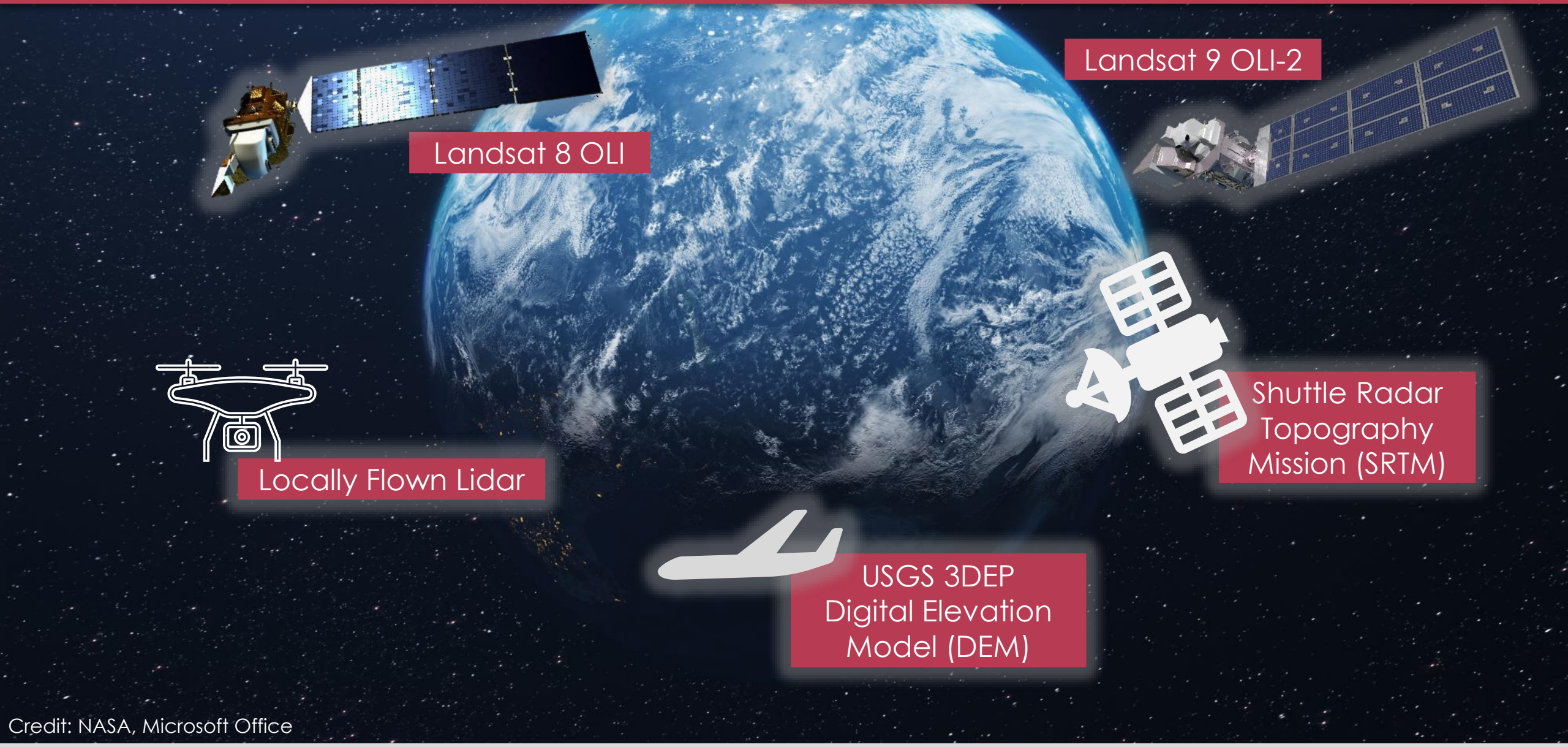
Map Areas Most Susceptible to Slope Failures

Areas Most Susceptible to Slope Failures

Prioritize Safety at Most Vulnerable Assets

Prioritize Safety to Areas Most Vulnerable

EARTH OBSERVATIONS



Credit: NASA, Microsoft Office

METHODS

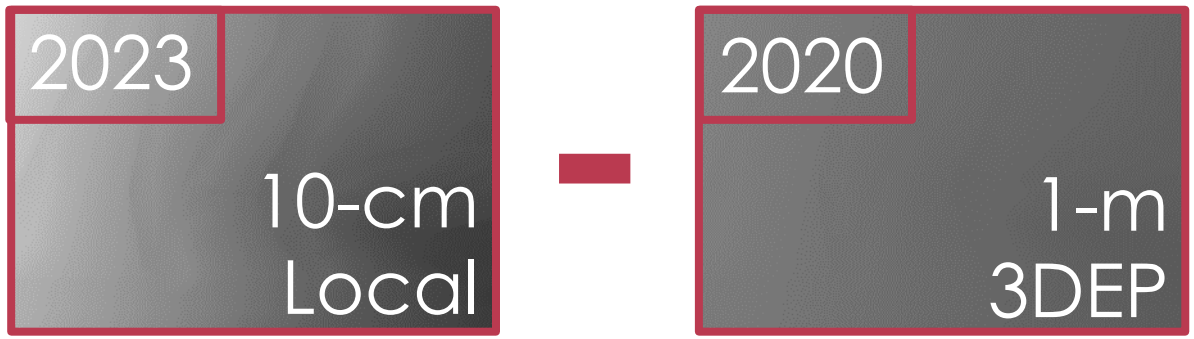

Change Detection
Map

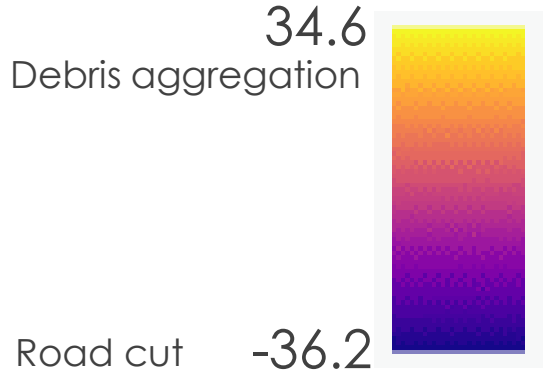

Slope Failure
Susceptibility Map


Slope Failure
Prioritization Model

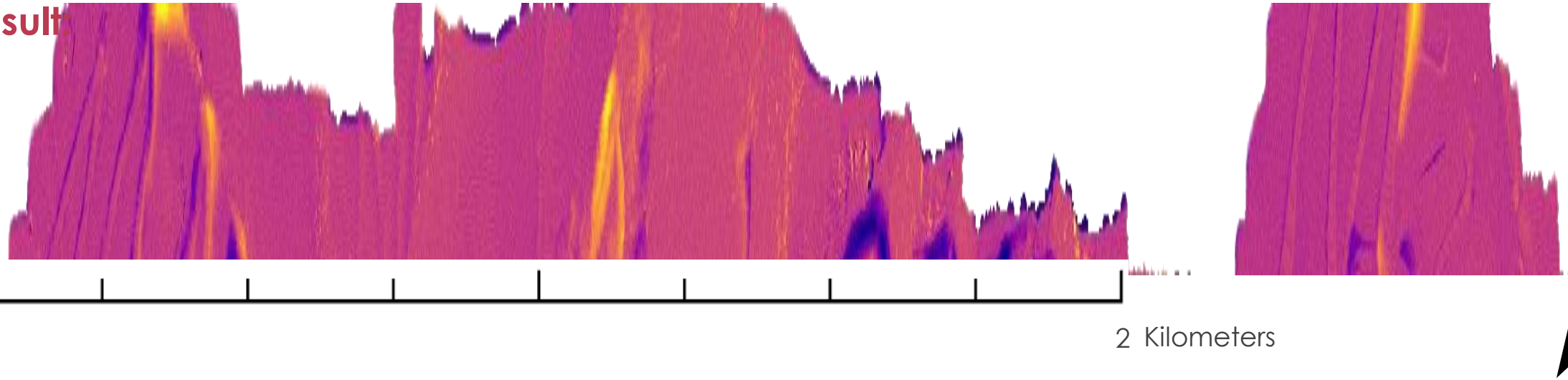
CHANGE DETECTION MAP

Method: DEM whole image subtraction

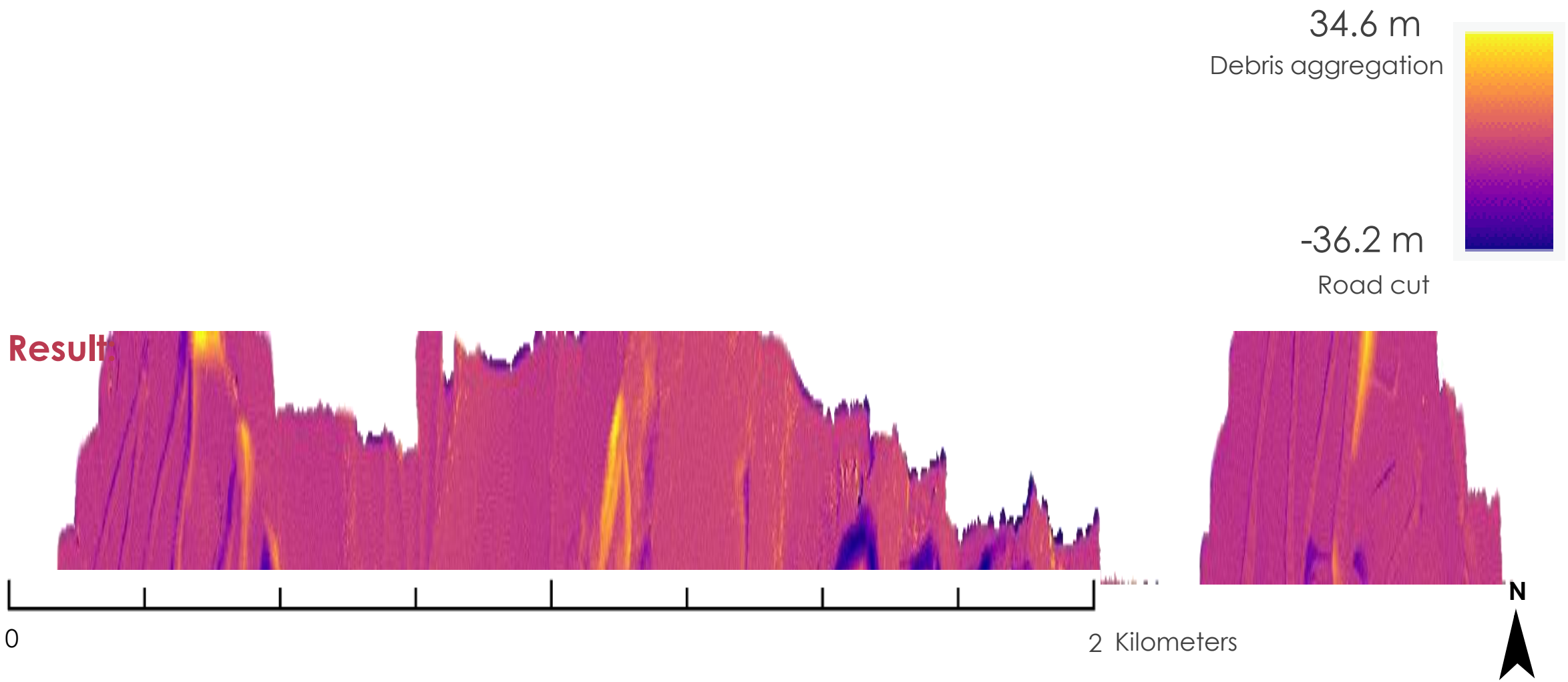




Result:

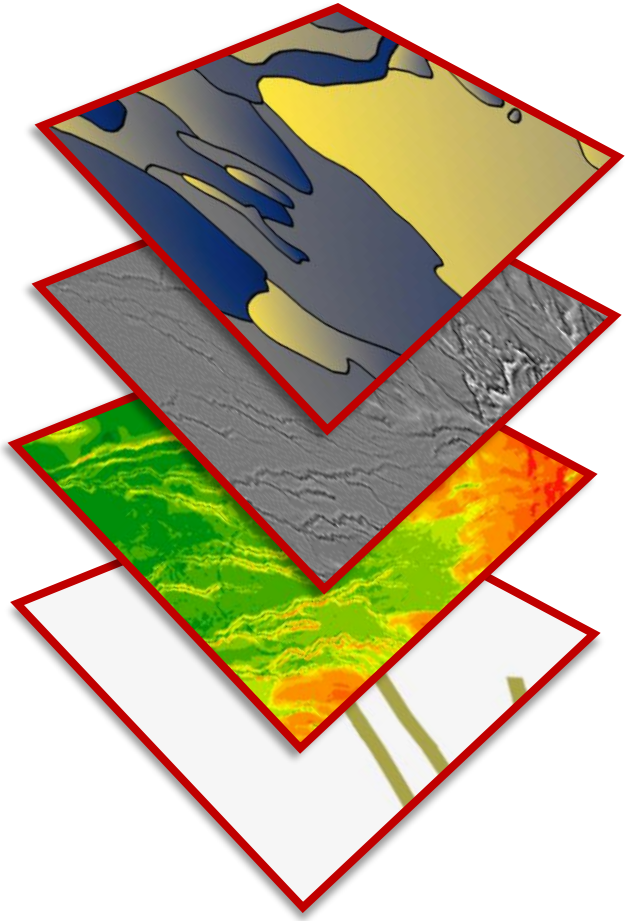


CHANGE DETECTION MAP



SLOPE FAILURE SUSCEPTIBILITY MAP

Method

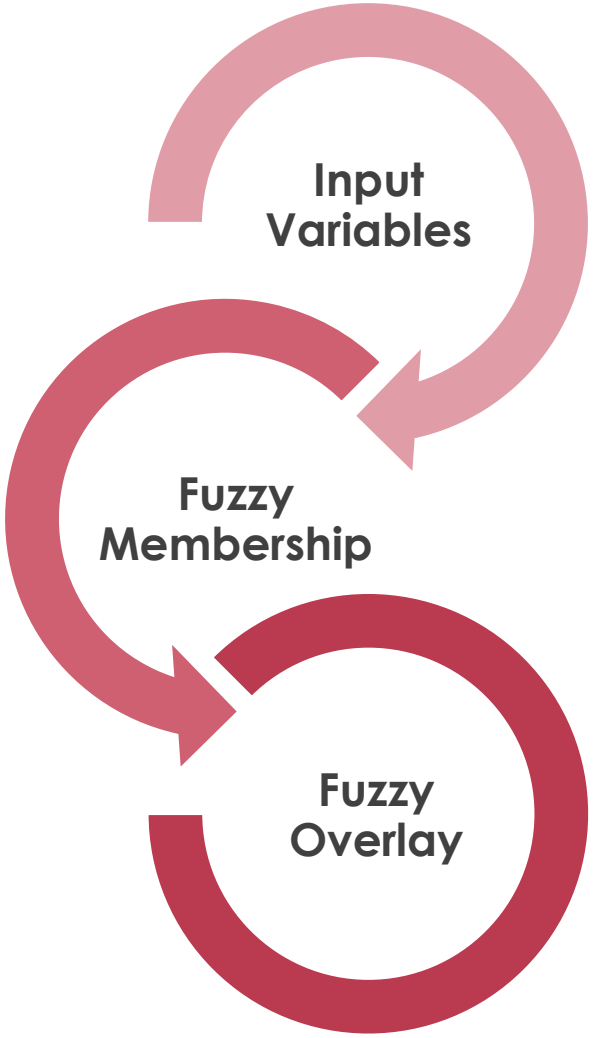


Erosion Risk

Distance to Faults

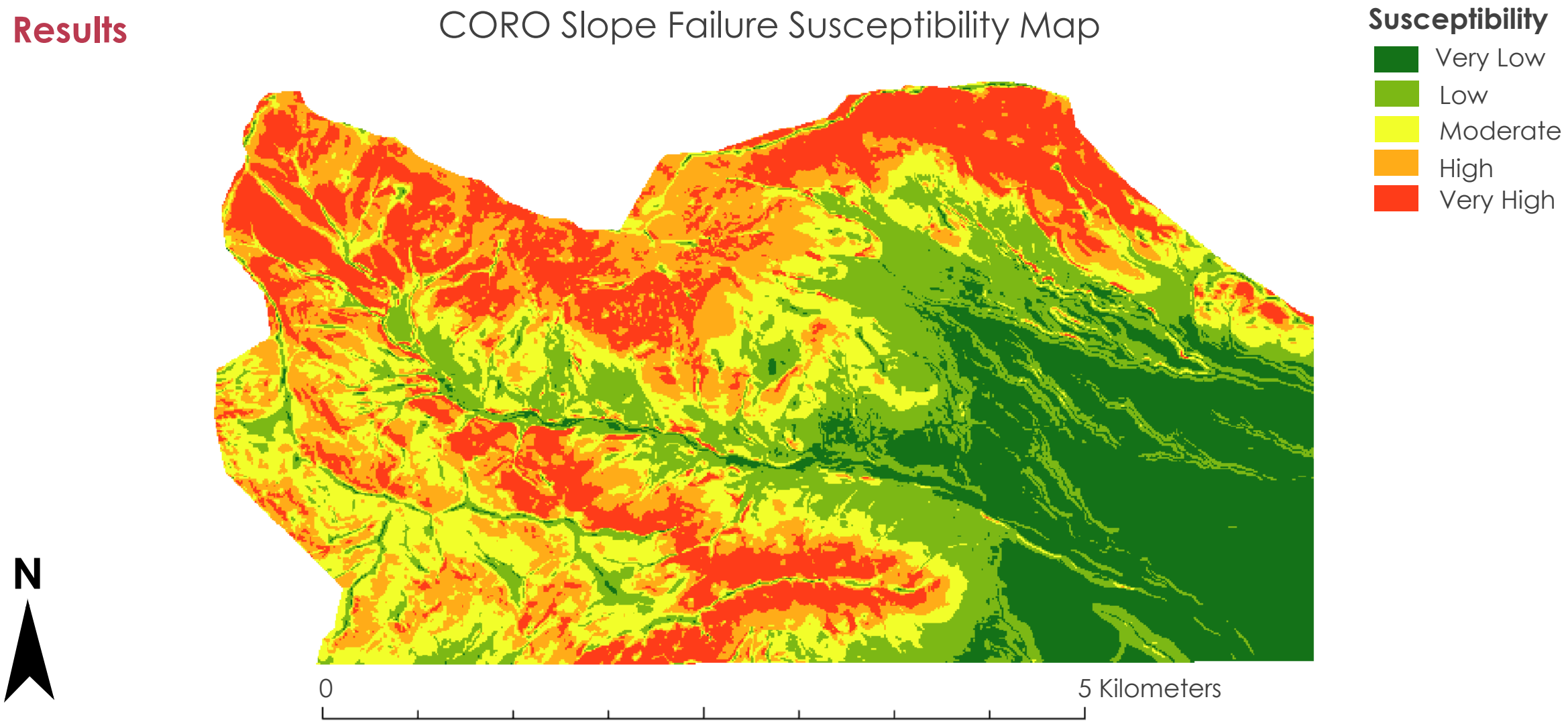
Slope

Plan Curvature



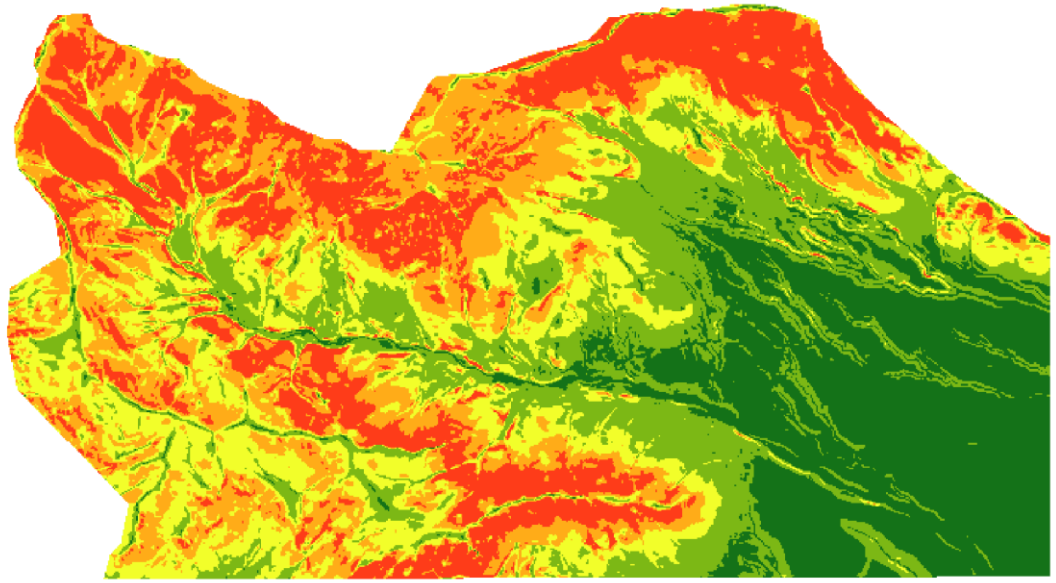
SLOPE FAILURE SUSCEPTIBILITY MAP

Results



SLOPE FAILURE PRIORITIZATION MODEL

Method



Fuzzy Overlay Results

Trails

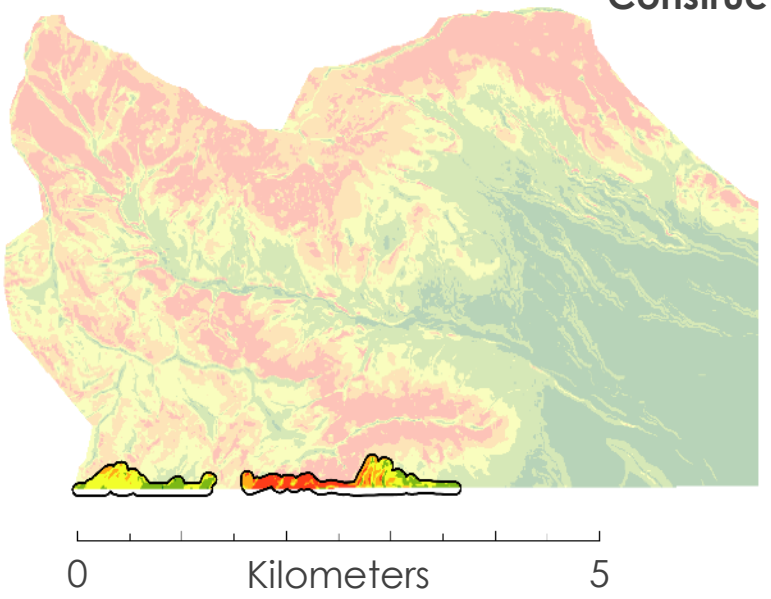
Roads

Border Construction

SLOPE FAILURE PRIORITIZATION MODEL

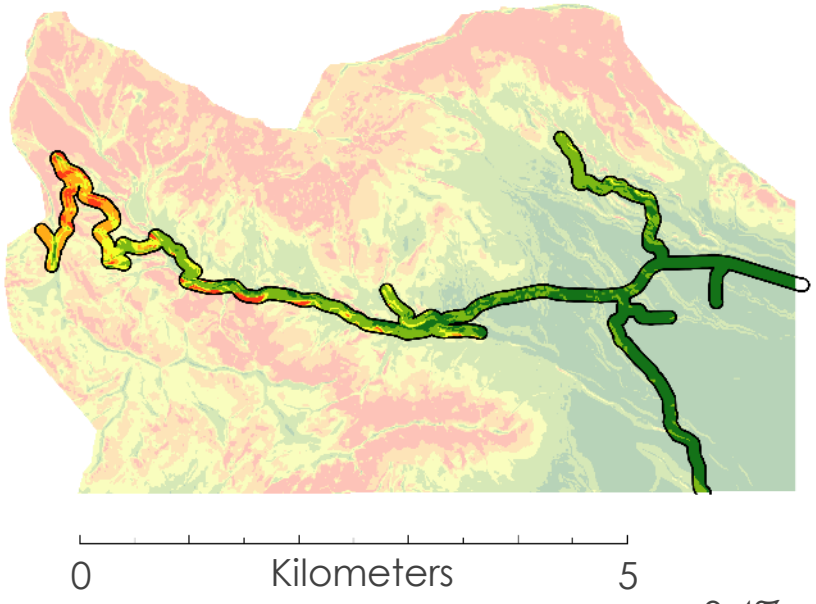
Results

Border Construction



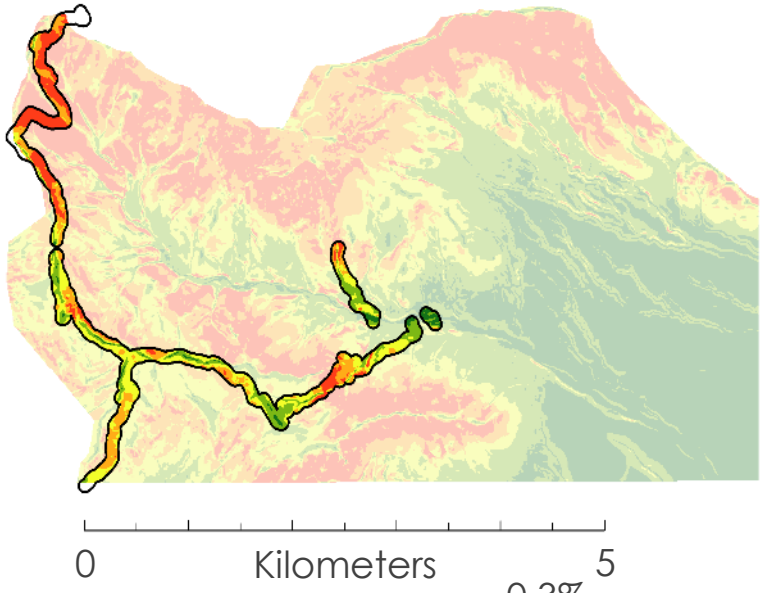
0 Kilometers 5

Roads



0 Kilometers 5

Trails

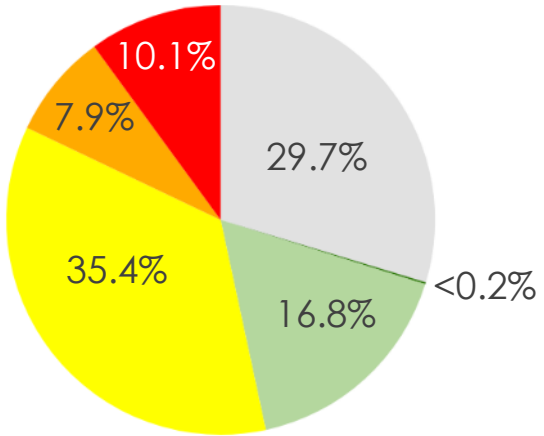


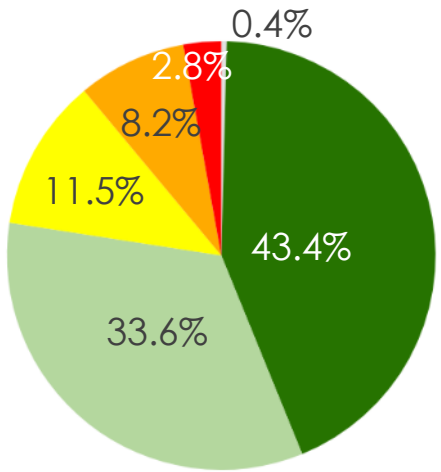
0 Kilometers 5

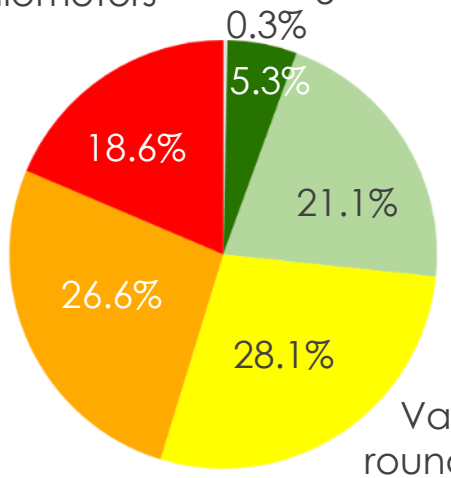
N

Susceptibility

- Very Low
- Low
- Moderate
- High
- Very High
- No Data







Values rounded

LIMITATIONS

Data Availability

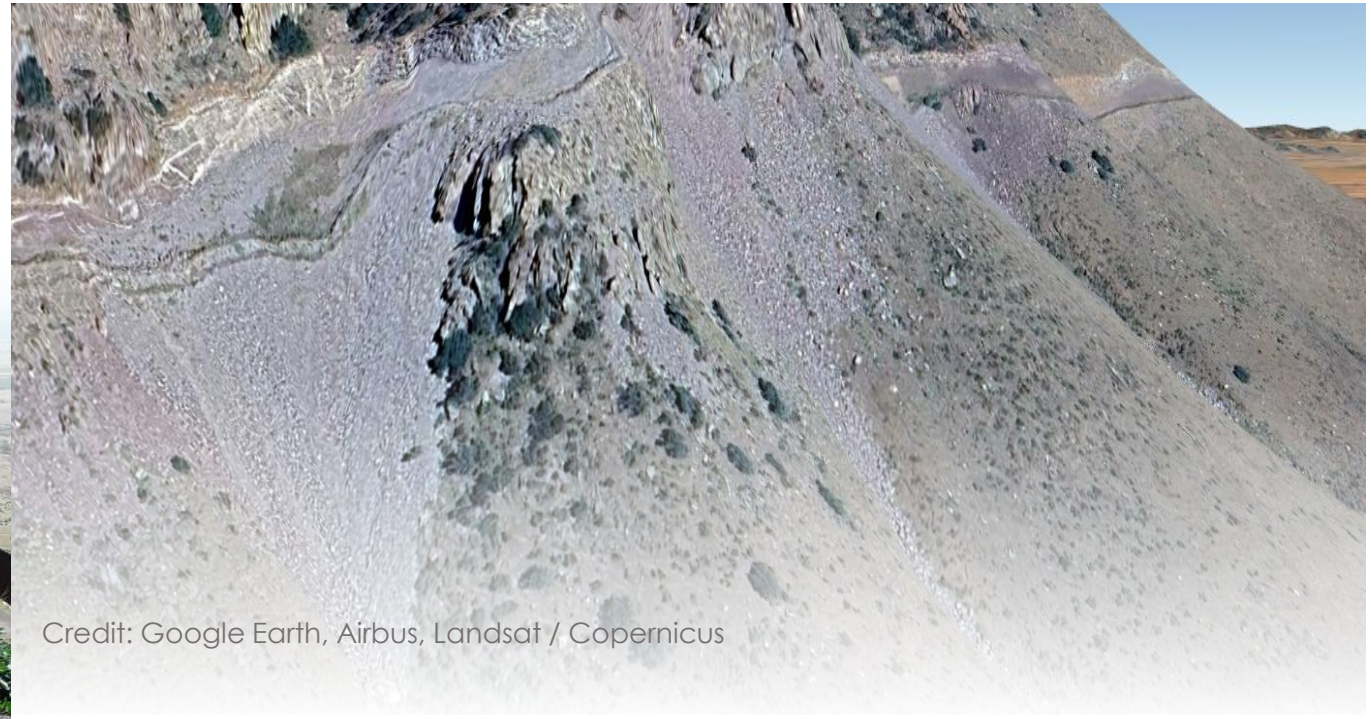
- Spatial Resolution
  - Lack of variability
- Spatial Extent
  - Study area
- Temporal Resolution
  - Imagery
  - Verification dataset

UNCERTAINTIES

Change Detection Map

- Conflicting changes
- Cannot identify cause or timing

Credit: NPS SEAZ



Credit: Google Earth, Airbus, Landsat / Copernicus

Slope Failure Susceptibility Map

- Limited specificity

Prioritization Model

- Vulnerability and value

CONCLUSIONS

Spatial and temporal resolution proved to be **limiting factors** for analysis

- Prevented use of NASA Earth observation products
- Local datasets proved most useful

End products can be used **for decision making**

- Identify areas to prioritize in-situ monitoring and remediation
- Provide maps of areas and assets prone to slope failure

Credit: Alb2001 & NPS SEAZ

FUTURE WORK

Validation

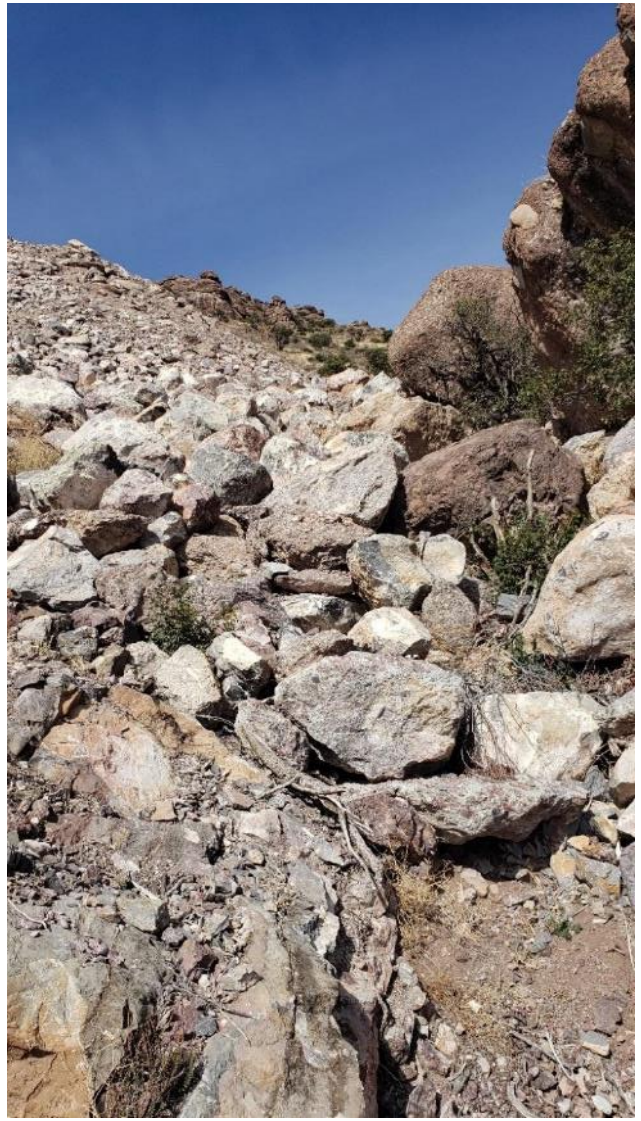
- Further analyses

Susceptibility Model

- Rockfall mechanistic model
- Gully erosion model

Prioritization Map

- Weighted prioritization



Credit: NPS SEAZ

Acknowledgments

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