



Building Capacity to Use Earth Observations in Addressing Environmental Challenges in Bhutan

Day 2 – Disasters: Floods, Landslides, Fires

Agenda: May 13 – 16, 2024 Thimphu Tech Park

- https://appliedsciences.nasa.gov/sites/default/files/2024-04/Agenda_Bhutan_1.pdf
- **Day 2 – Tuesday, May 14 – 8:30am – 5:00pm**
 - Session III: Disasters – Floods, Landslides, Fires
 - Assessing Landslide Hazard Probability
 - Extreme Weather and Flood Monitoring
 - Surface Inundation Monitoring
 - Pre-Fire Risk Assessment
 - Active Fire & Post-Fire Assessment
 - Monitoring Pre- and Post-Fire Conditions



Session 3 Objectives

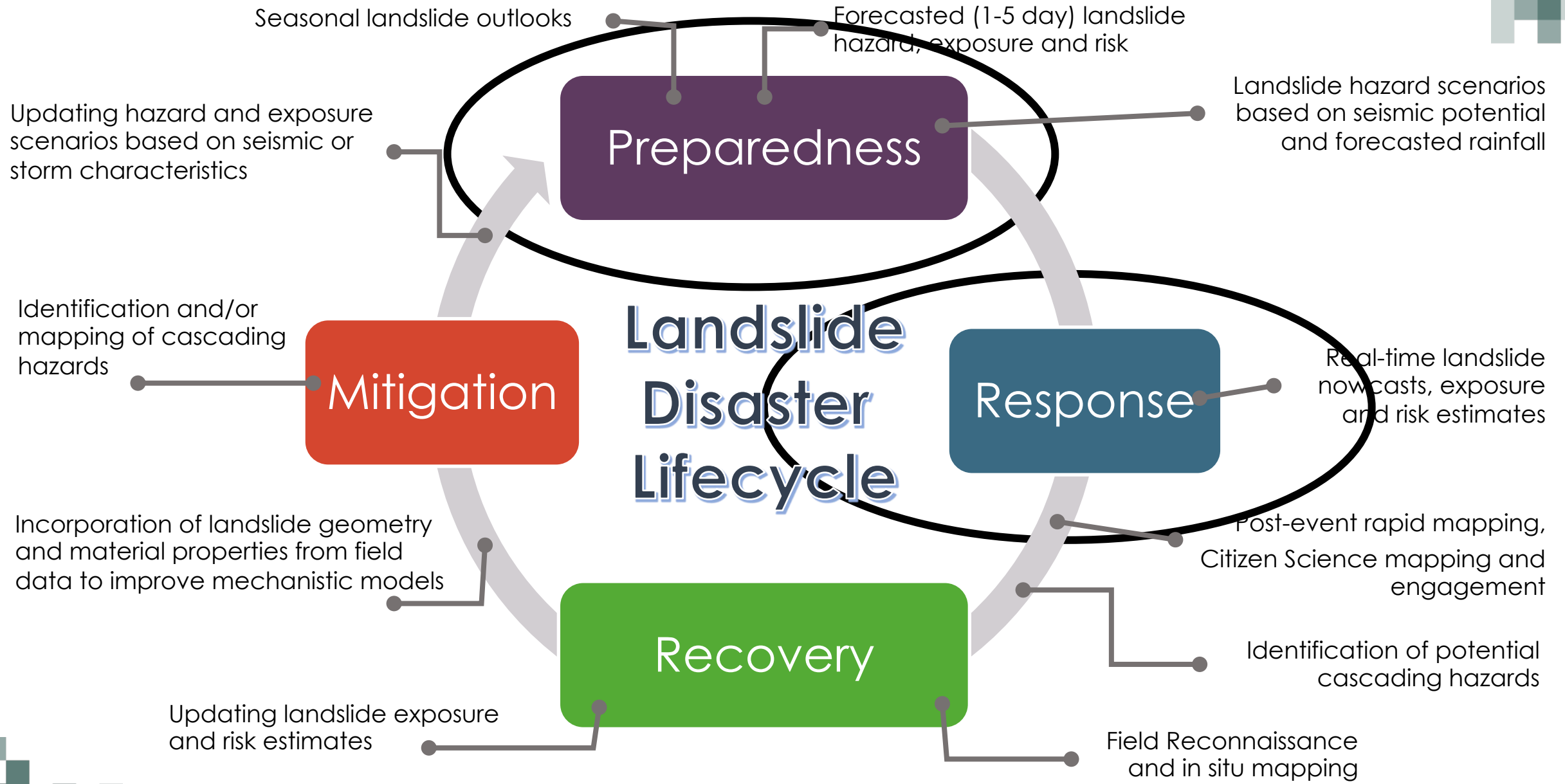
By the end of Day 2, participants will be able to:

- Identify the different remote sensing (passive [optical] and active [microwave]) data for monitoring disasters (fire, flood, landslide)
- Demonstrate the applications of remote sensing and modeled data for monitoring disasters
- Develop case studies using remote sensing data for disasters in Bhutan



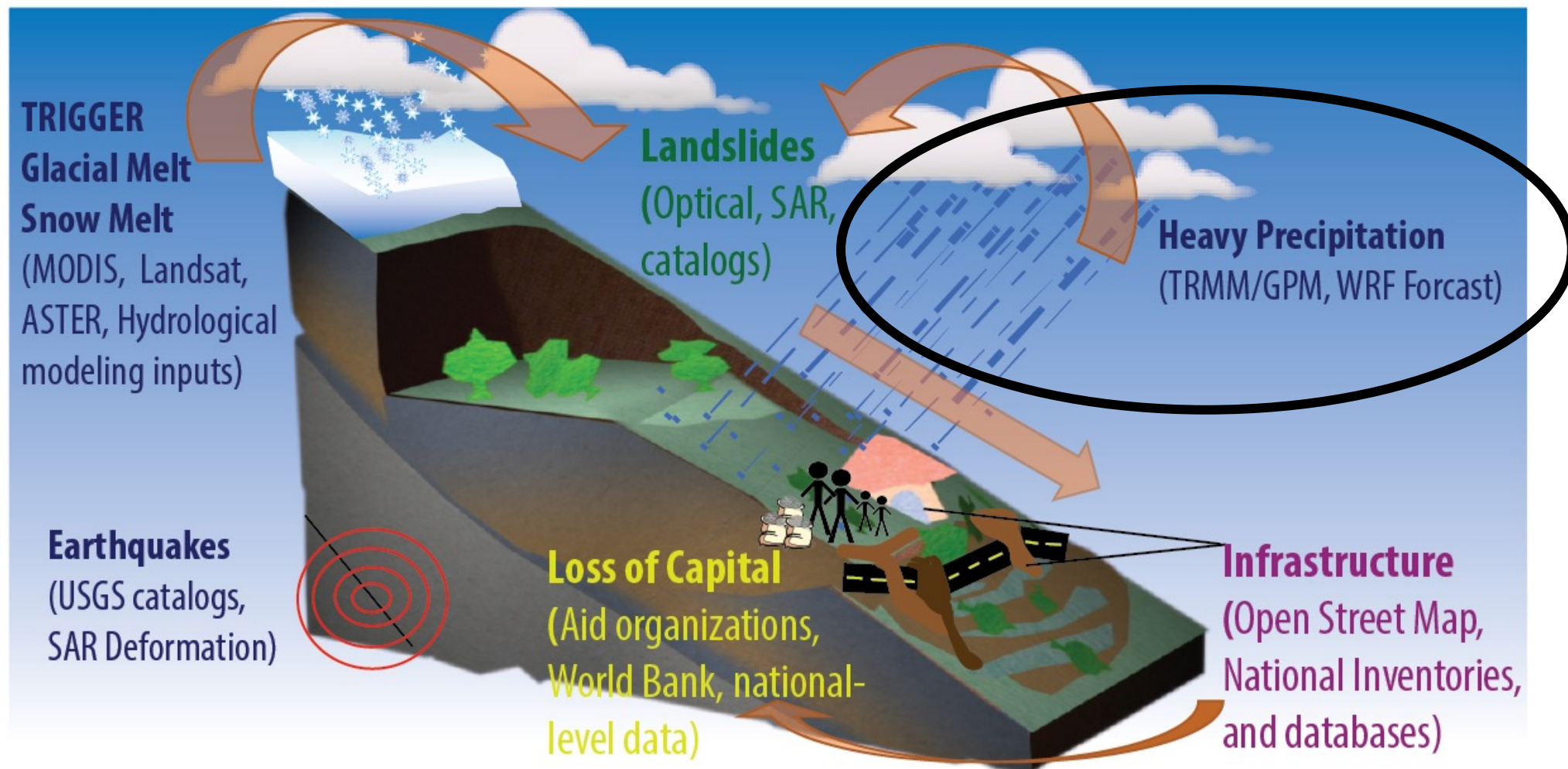


Assessing Landslide Hazards Before and During an Event



Landslides are a major problem...

And they have many causes.



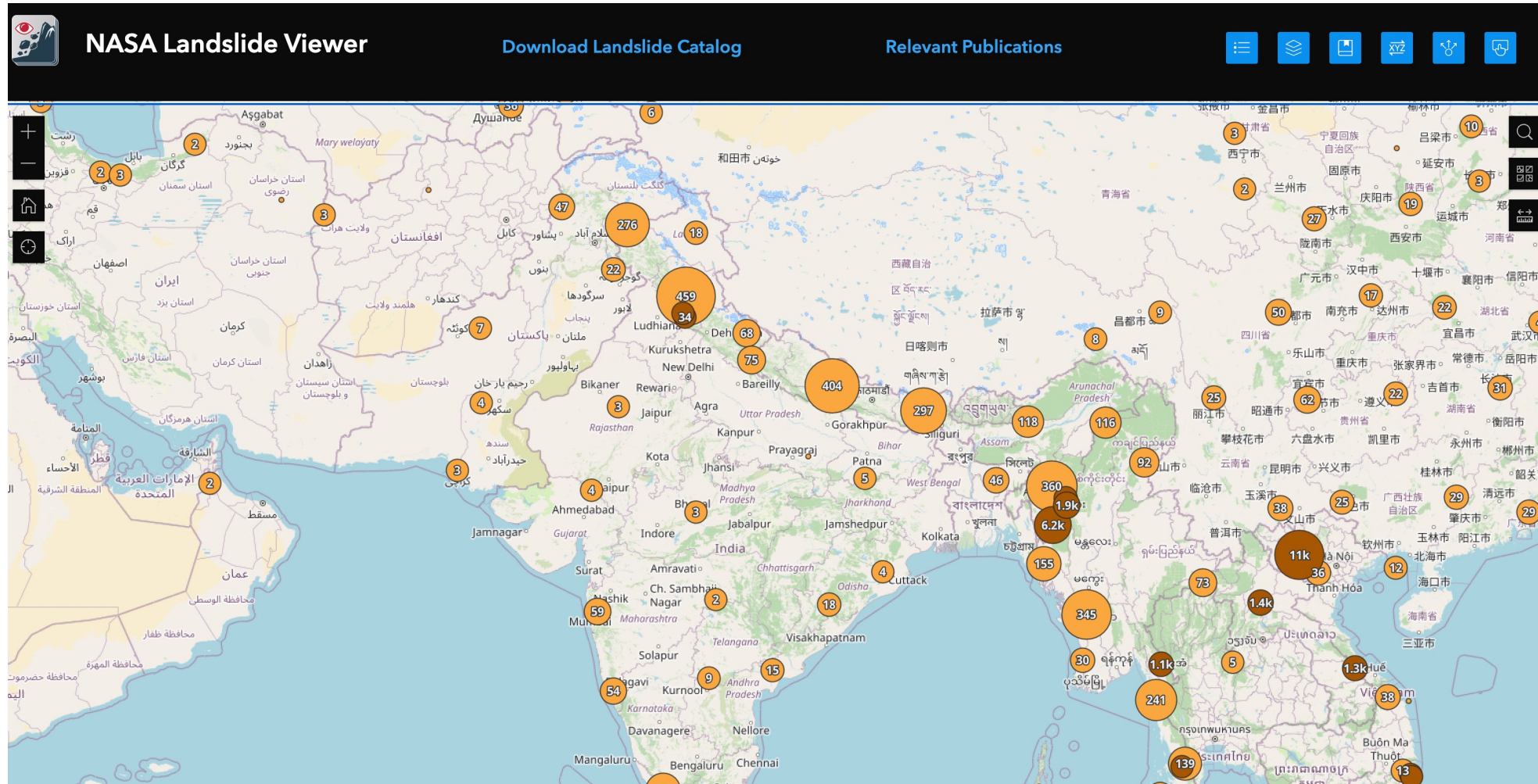


Some Resources for Assessing Landslide Hazard
Before an Event

Global Landslide Catalog (GLC)



At Landslide Viewer (landslides.nasa.gov/viewer)



More from the Cooperative Open Online Landslide Repository (COOLR)

At Landslide Viewer (landslides.nasa.gov/viewer)

The screenshot displays the NASA Landslide Viewer web application. At the top, there is a navigation bar with the title "NASA Landslide Viewer" and two main links: "Download Landslide Catalog" and "Relevant Publications". To the right of these links are several utility icons for home, layers, print, zoom, and other functions. The main area is a map of Bhutan, showing various administrative divisions and geographical features. A popup window is open over a specific landslide point, displaying the following information:

| COOLR Reports Point - COOLR Reports (Point): | |
|--|-------------|
| Administrative Division | Chhukha |
| Associated Storm Name | |
| Closest Gazetteer Point | Getta Dzong |
| Country Code | BT |
| Country Name | Bhutan |
| Distance to Gazetteer Point | 10.49 |
| Estimated Size | Medium |
| Event Comments | |

Below the popup, there is a "Zoom to" button and a page indicator "2 of 5". On the right side of the map, a "Basemap" panel is open, showing a list of map styles: Imagery, Imagery with Labels, Streets, Topographic, Dark Gray Canvas, Light Gray Canvas, National Geographic, and Terrain with Labels. The map itself shows several landslide points marked with orange circles and numbers (e.g., 2, 3, 4, 6, 11, 13, 14, 36, 37).

Download All the Data in COOLR

At Landslide Viewer (landslides.nasa.gov/viewer)



Global Landslide Catalog Downloadable Products Gallery

Global Landslide Catalog Downloadable Products

The Cooperative Open Online Landslide Repository (COOLR) is a worldwide database of landslide events from NASA, scientists, and citizen scientists. You can download the COOLR catalog as a file geodatabase (.gdb), shapefiles (.shp), or comma-separated values (.csv). Learn more about the data and citizen science at landslides.nasa.gov.

Tags

617 catalog coolr csv file geodatabase gic global landslide landslide inventory landslides nasa point polygon shapefile

- NASA Cooperative Open Online Landslide Repository (COOLR) (File Geodatabase)**
File Geodatabase
The NASA Cooperative Open Online Landslide Repository (COOLR) points and polygons, downloadable as a .gdb file.
- NASA Cooperative Open Online Landslide Repository (COOLR) Reports Points (Shapefile)**
Shapefile
The NASA Cooperative Open Online Landslide Repository (COOLR) points, downloadable as a .shp file.
- NASA Cooperative Open Online Landslide Repository (COOLR) Reports Points (CSV)**
CSV
The NASA Cooperative Open Online Landslide Repository (COOLR) points, downloadable as a .csv file.
- NASA Cooperative Open Online Landslide Repository (COOLR) Reports Polygons (Shapefile)**
Shapefile
The NASA Cooperative Open Online Landslide Repository (COOLR) polygons, downloadable as a .shp file.
- Global Gridded Landslide Inventory**
CSV
Count of landslides mapped within each 1-km grid cell. This file contains most of the landslide inventories used for train "Data-Driven Landslide Nowcasting at the Global Scale."

NASA Landslide Viewer

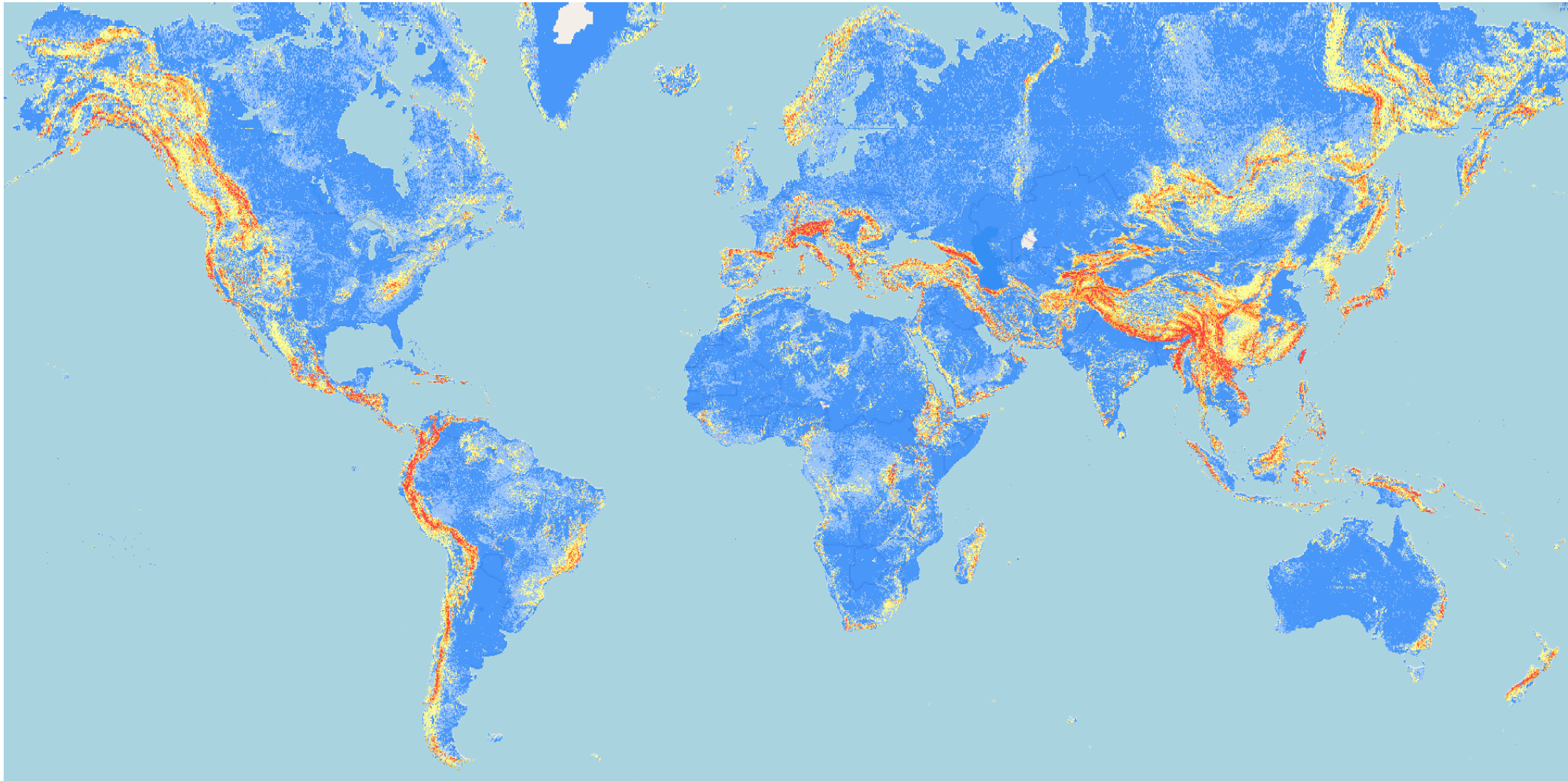
Download Landslide Catalog

The screenshot shows the NASA Landslide Viewer interface. At the top, there is a navigation bar with the NASA Landslide Viewer logo and a button labeled "Download Landslide Catalog" which is circled in red. Below the navigation bar is a map of China with various geographical features and labels in Chinese. The map includes a scale bar, a search bar, and a legend.

Global Landslide Susceptibility Map

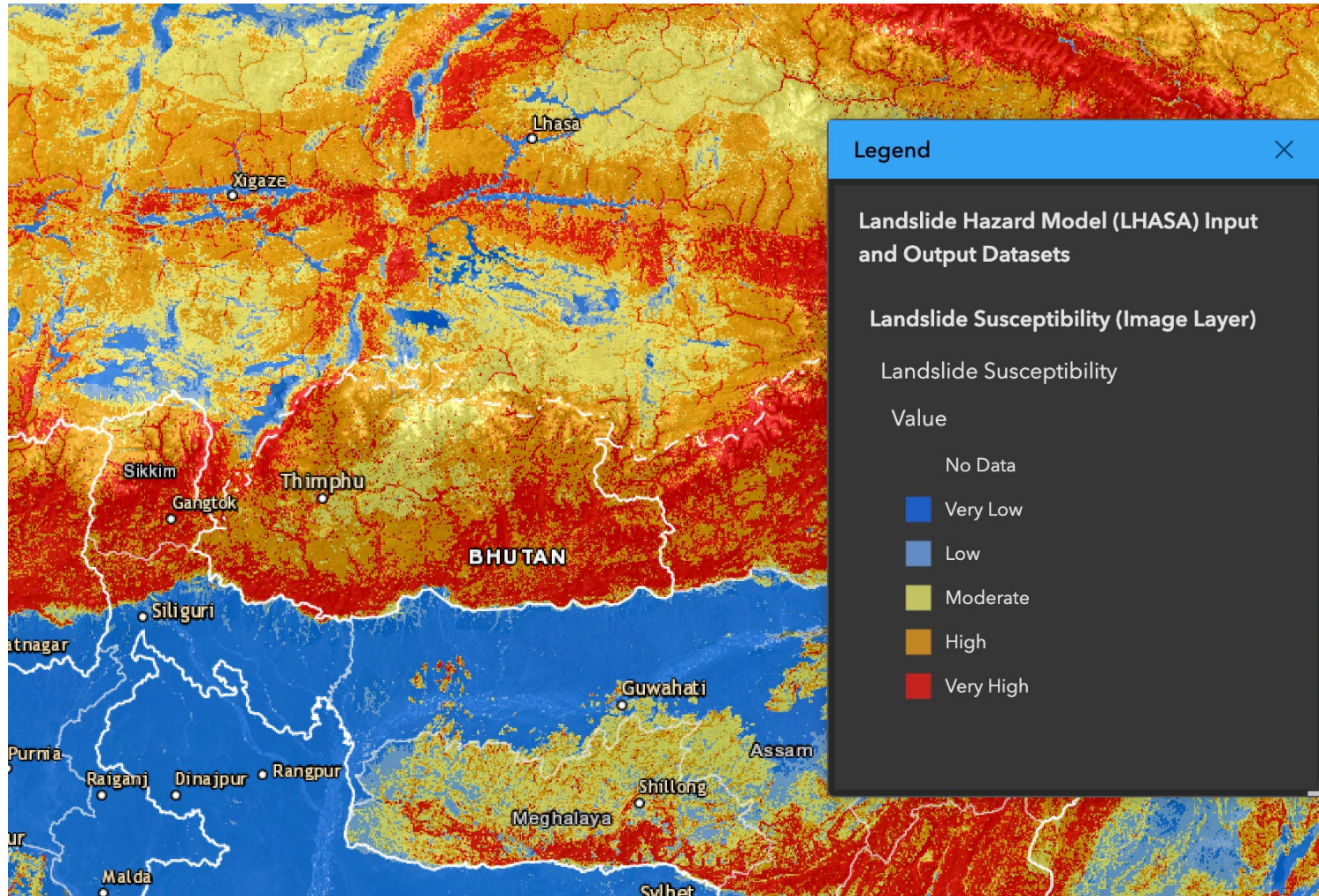


At Landslide Viewer (landslides.nasa.gov/viewer)



Global Landslide Susceptibility Map

At Landslide Viewer (landslides.nasa.gov/viewer)



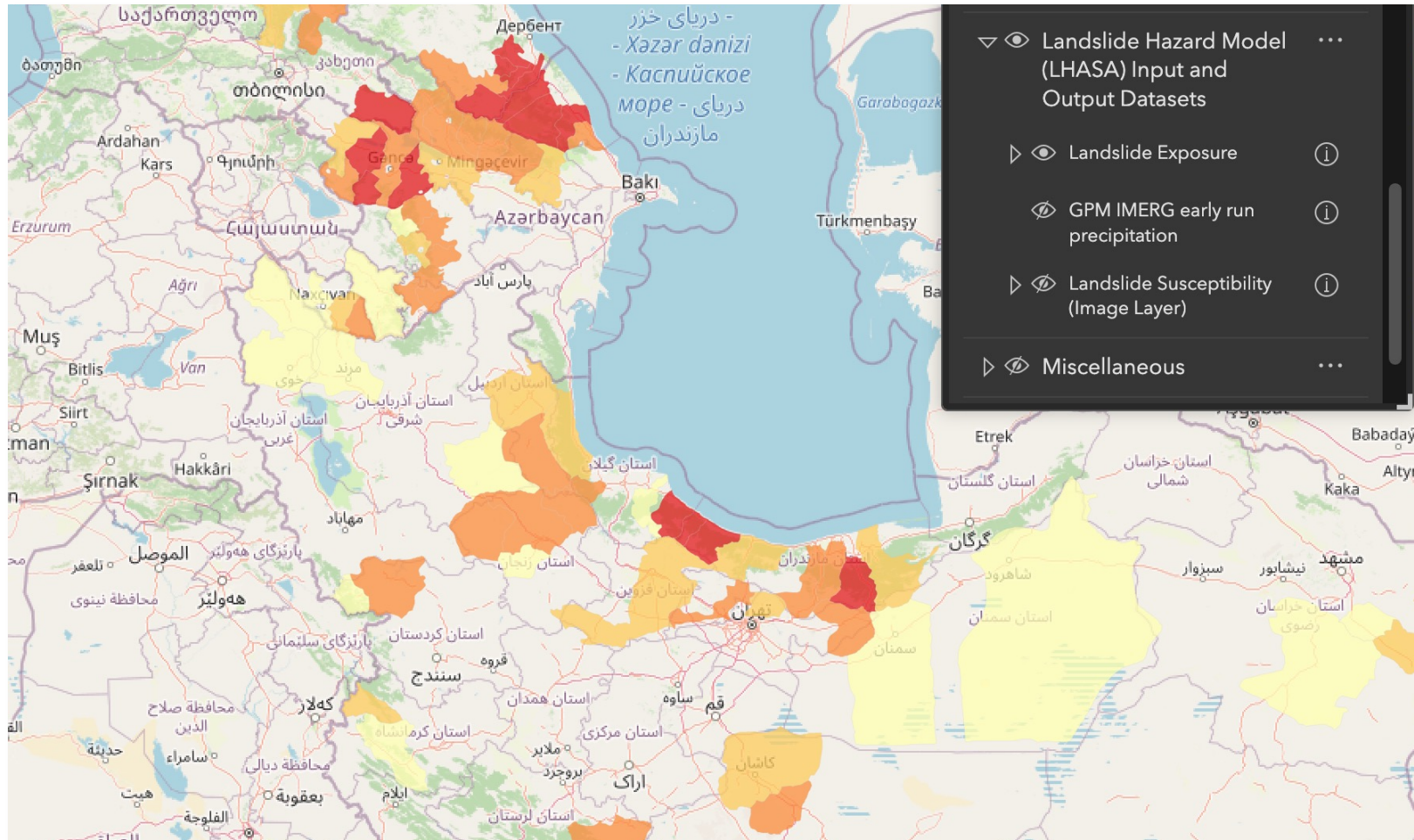


Some Resources for Assessing Landslide Hazard During an Event

Global Landslide Exposure

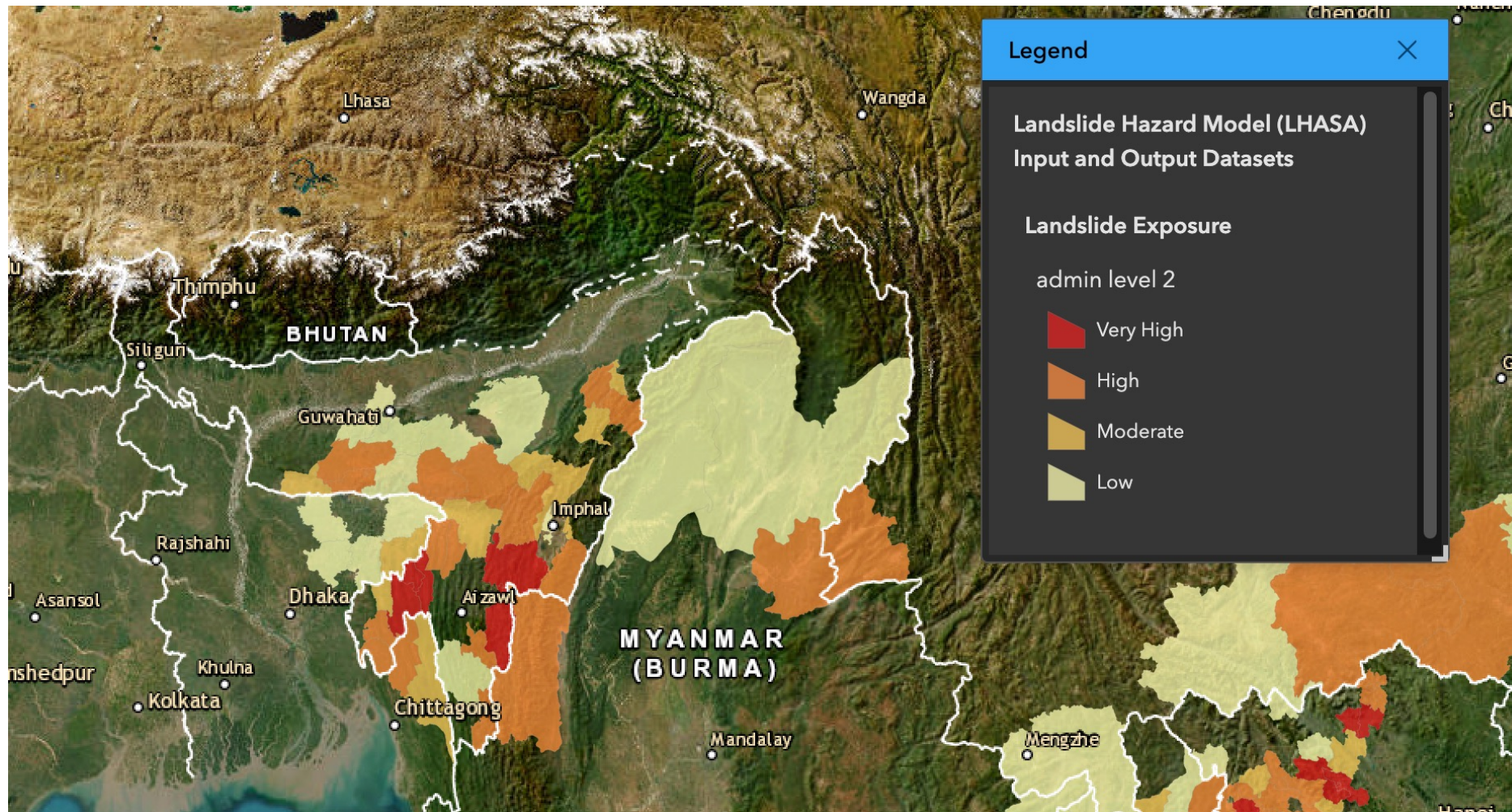


At Landslide Viewer (landslides.nasa.gov/viewer)



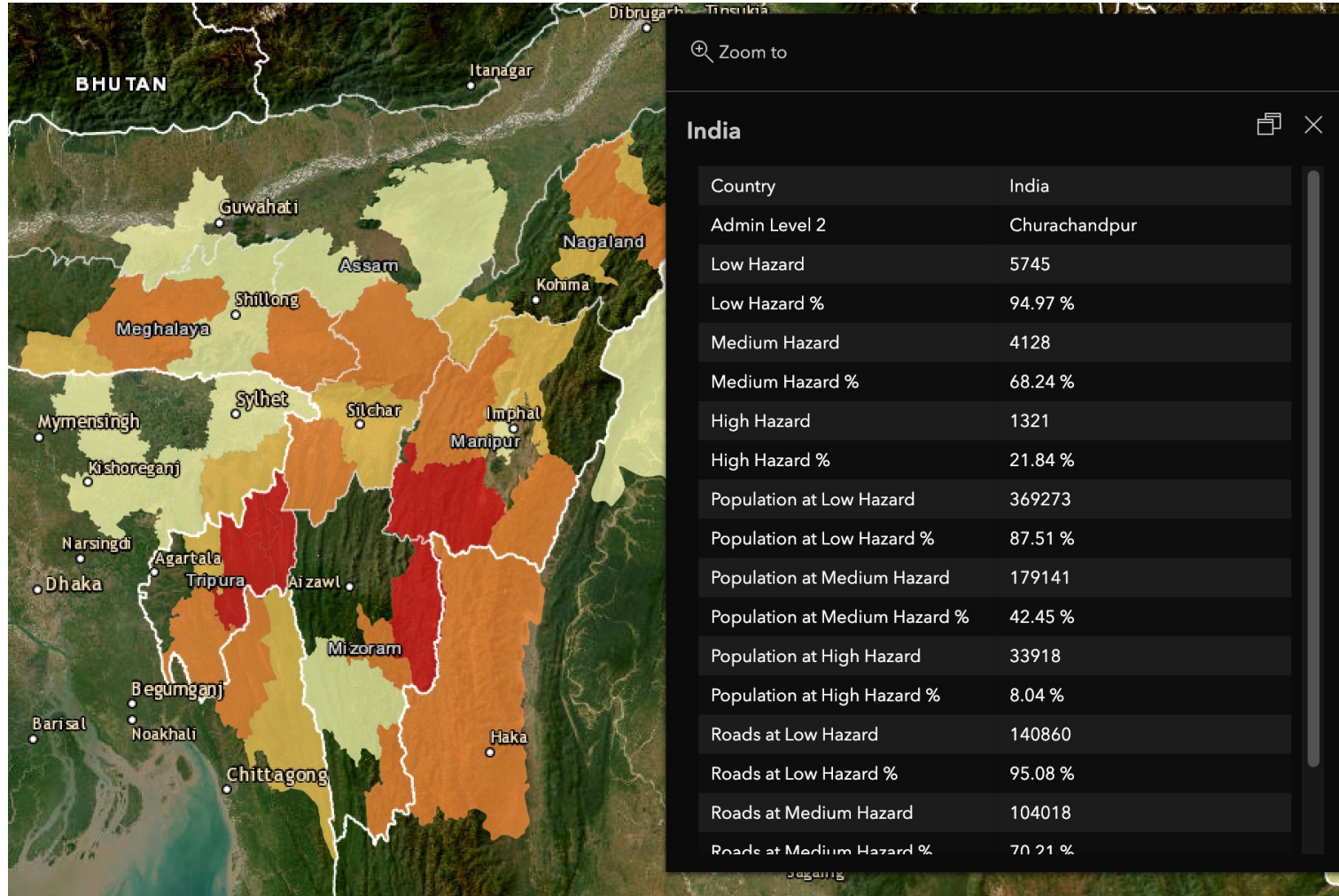
Global Landslide Nowcast

At Landslide Viewer (landslides.nasa.gov/viewer)



Exposed Population and Roads from the Global Landslide Nowcast

At Landslide Viewer (landslides.nasa.gov/viewer)



New Features in the Global Landslide Nowcast (LHASA 2.0)

- Probabilistic, rather than categorical outputs
 - Due to the use of machine learning
 - Incorporates soil moisture and snow mass
- Increased accuracy
- Exposure analysis
- However, version 1.1 is still published at <https://pmmmpublisher.pps.eosdis.nasa.gov/> and <https://gpm.nasa.gov/data/visualizations/precip-apps>.
- Both sites allow you to view the “classic” model output:



Pacific Disaster Center

DisasterAWARE (<https://www.pdc.org/disasteraware/>)



Summary

- Information on landslides can be useful at all stages of the disaster life cycle.
- NASA has several online resources:
 - At [Landslide Viewer](#)
 - At [Landslide Reporter](#)
- The LHASA model uses IMERG precipitation to produce global landslide nowcasts.
- You can implement [LHASA version 2.0](#) with open-source code and open data.
 - But customizing it for your region is recommended.



Resources

- Global Precipitation Measurement → Landslides
 - <https://gpm.nasa.gov/applications/landslides>
- GPM Precipitation and Applications Viewer
 - <https://gpm.nasa.gov/data/visualizations/precip-apps>
- Landslide Hazard Assessment for Situational Awareness (LHASA) Model
 - LHASA 2.0
 - <https://gpm.nasa.gov/landslides/projects.html#LHASA>



References

- Kumar, B., S. Thomas A., D. Kirschbaum, et al. 2022 "A dynamic landslide hazard monitoring framework for the Lower Mekong Region." *Frontiers in Earth Science*, 10: [10.3389/feart.2022.1057796]
- Stanley, T. A., D. B. Kirschbaum, G. Benz, et al. 2021. "Data-Driven Landslide Nowcasting at the Global Scale." *Frontiers in Earth Science*, 9: [10.3389/feart.2021.640043]
- Emberson, R., D. Kirschbaum, and T. Stanley. 2020. "New global characterisation of landslide exposure." *Natural Hazards and Earth System Sciences*, 20 (12): 3413-3424 [10.5194/nhess-20-3413-2020]
- Juang, C. S., T. A. Stanley, and D. B. Kirschbaum. 2019. "Using citizen science to expand the global map of landslides: Introducing the Cooperative Open Online Landslide Repository (COOLR)." *PLOS ONE*, 14 (7): e0218657 [10.1371/journal.pone.0218657]
- Kirschbaum, D., and T. Stanley. 2018. "Satellite-Based Assessment of Rainfall-Triggered Landslide Hazard for Situational Awareness." *Earth's Future*, 6 (3): 505-523 [10.1002/2017ef000715]
- Stanley, T., and D. B. Kirschbaum. 2017. "A heuristic approach to global landslide susceptibility mapping." *Natural Hazards*, 1-20 [10.1007/s11069-017-2757-y]
- Kirschbaum, D. B., T. Stanley, and Y. Zhou. 2015. "Spatial and temporal analysis of a global landslide catalog." *Geomorphology*, 249 (Geohazard Databases): 4-15 [10.1016/j.geomorph.2015.03.016]
- Kirschbaum, D. B., R. F. Adler, Y. Hong, S. Hill, and A. Lerner-Lam. 2010. "A global landslide catalog for hazard applications: method, results, and limitations." *Natural Hazards* 52 (3): 561-575 [10.1007/s11069-009-9401-4]

