Climate Change Issues - Building Resilience & Reversal of Global Warming

Presented by -

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Presentation Overview

- ✧Recent disasters - Serious concern
- ✧Two Prong Approach –
  - ✧Building Climate Resilience
  - ✧Take steps for reversal of the global warming trend
- ✧ Disaster relief – during and after a disaster
- ✧ Emergency Response
- ✧ Disaster risk reductions
  - ✧Use of innovative approaches
- ✧ Preliminary study of Khatling Glacier
- ✧Need to conduct a detail study for developing options for Resilience
- ✧Conclusions & Recommendations
- ✧Q & A

Glacier Outbursts

~ 205 people lost life, Many relocated, Feb. 2021.

Forest Fires

Over 5 Million Acres Burnt, Sep. 2020

Glacier Break in Uttarakhand Lead to Deadly Flooding in Feb. 2021

Massive debris flow/flash flood occurred in the Rishi Ganga and the Dhauli Ganga valleys.

Unusual for the winter time.

Flash flood swept through Ramgarh in Nainital district on October 19, 2021. At least 34 people died and more were missing (Source: ANI, report by HT Dehradun)
Unusually Extreme Rainfall: 340.8 mm (13.4 “) in 24 hours.

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West Coast, USA, the 2020 fire season took a disastrous toll. With about a month left for the fire season, over five million acres have burned in California, Oregon and Washington so far.

Thousands of buildings have been destroyed by some of the largest fires ever recorded.

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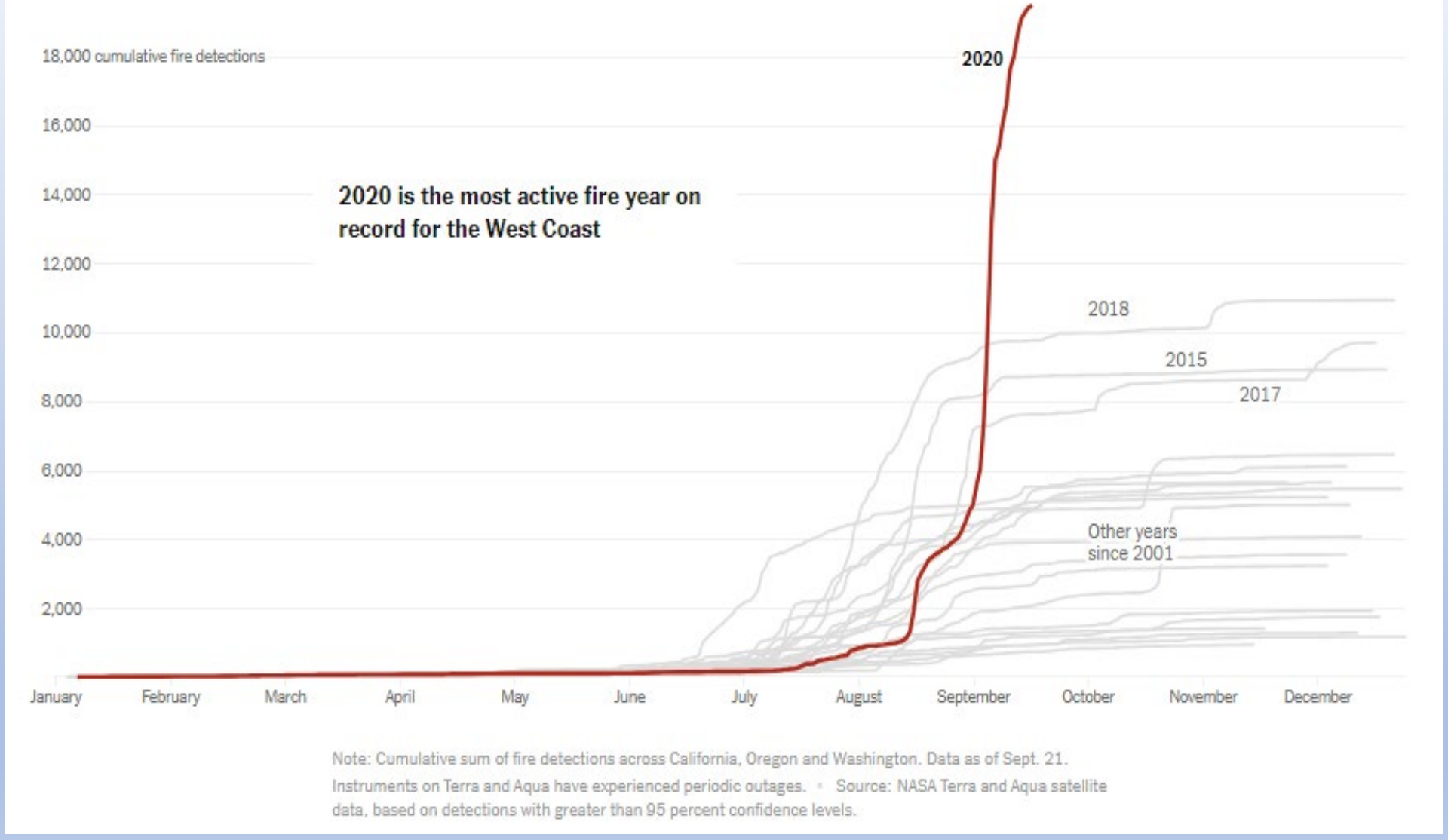

Note: Cumulative sum of fire detections across California, Oregon and Washington. Data as of Sept. 21. Instruments on Terra and Aqua have experienced periodic outages. • Source: NASA Terra and Aqua satellite data, based on detections with greater than 95 percent confidence levels.

Climate Resiliency and Reversal Initiative

Recent disasters due to the weather pattern changes and calamities all across the globe underscores the need to focus on this issue.

1. A few major findings by the EC[1] and the National Aeronautics and Space Administration (NASA[2]) on tracking greenhouse gas emissions and the lower earth temperature increases are listed below:

- Human activities are increasingly adding an enormous amount of greenhouse gases to those naturally occurring in the atmosphere, which is causing the greenhouse effect and global warming (EC, 2020).
- It is evident from the data that greenhouse gases are trapping heat in the lower parts of the atmosphere causing the temperature rise.

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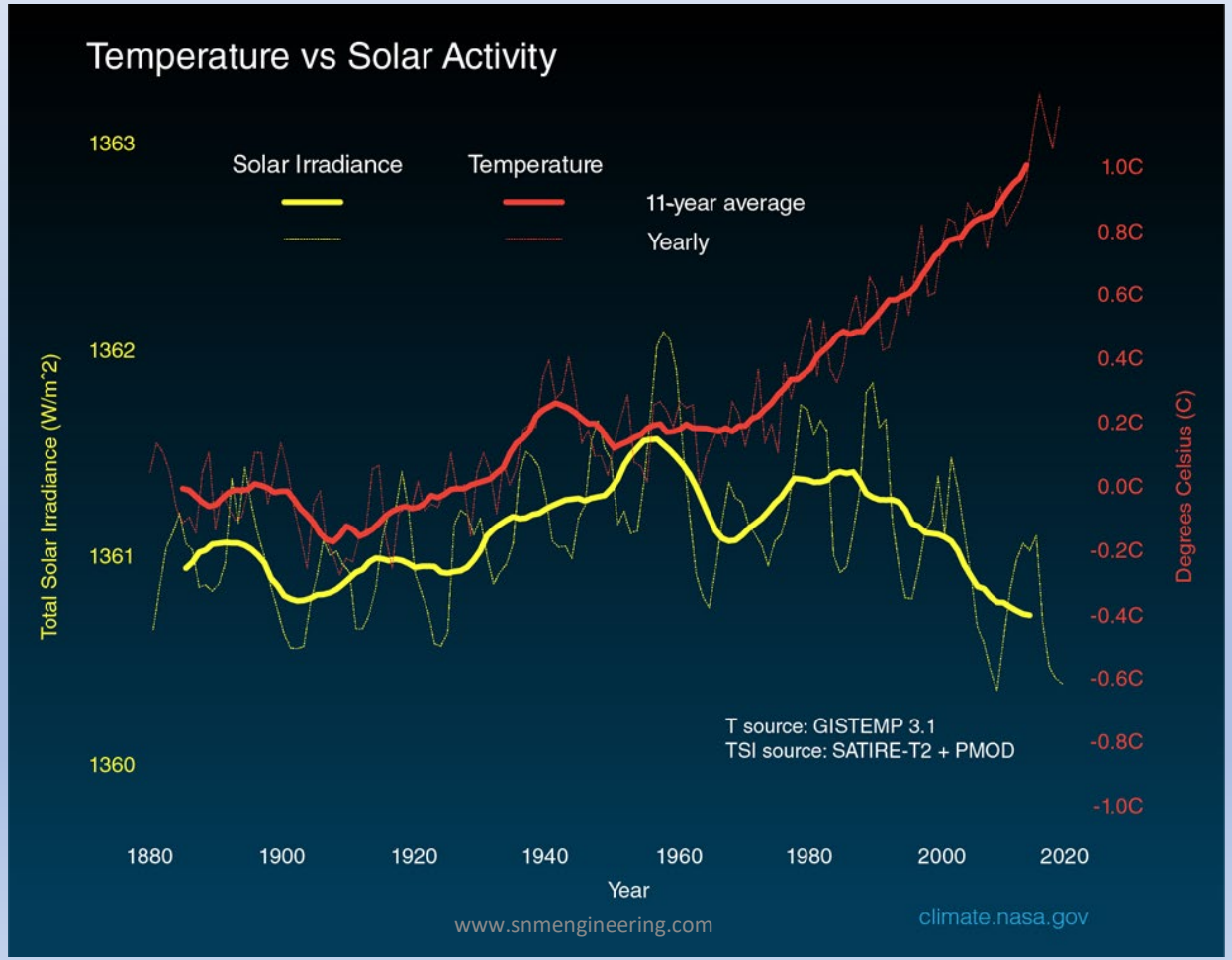
1 European Commission (EC). (2020) *Causes of climate change* [Online] Available from: https://ec.europa.eu/clima/change/causes_en .

2 NASA. (2020) Global Climate Change, Vital Signs of the planet, [Online] Available from: https://climate.nasa.gov/causes/ .

- This global warming are not caused by a more active Sun. That would have caused warmer temperatures in all layers of the atmosphere.
- Instead, scientists have observed a cooling in the upper atmosphere, and a warming at the surface and in the lower parts of the atmosphere. (NASA, 2020)



- Many of these gases causing global warming occur naturally, but human activity is increasing the concentrations of some of them in the atmosphere, in particular (EC, 2020):

  - carbon dioxide (CO2),
  - methane,
  - nitrous oxide, and
  - fluorinated gases.

The resulting climatic disasters during the past few years causing unprecedented –

floods, landslides, mudslides, tornadoes, hurricanes, forest fires, drought, and evolving viral outbreaks.

These intense climatic events are causing huge loss of lives, damages to properties, and businesses supporting current agricultural, and industrial infrastructure.

This effort is looking into two specific outcomes –

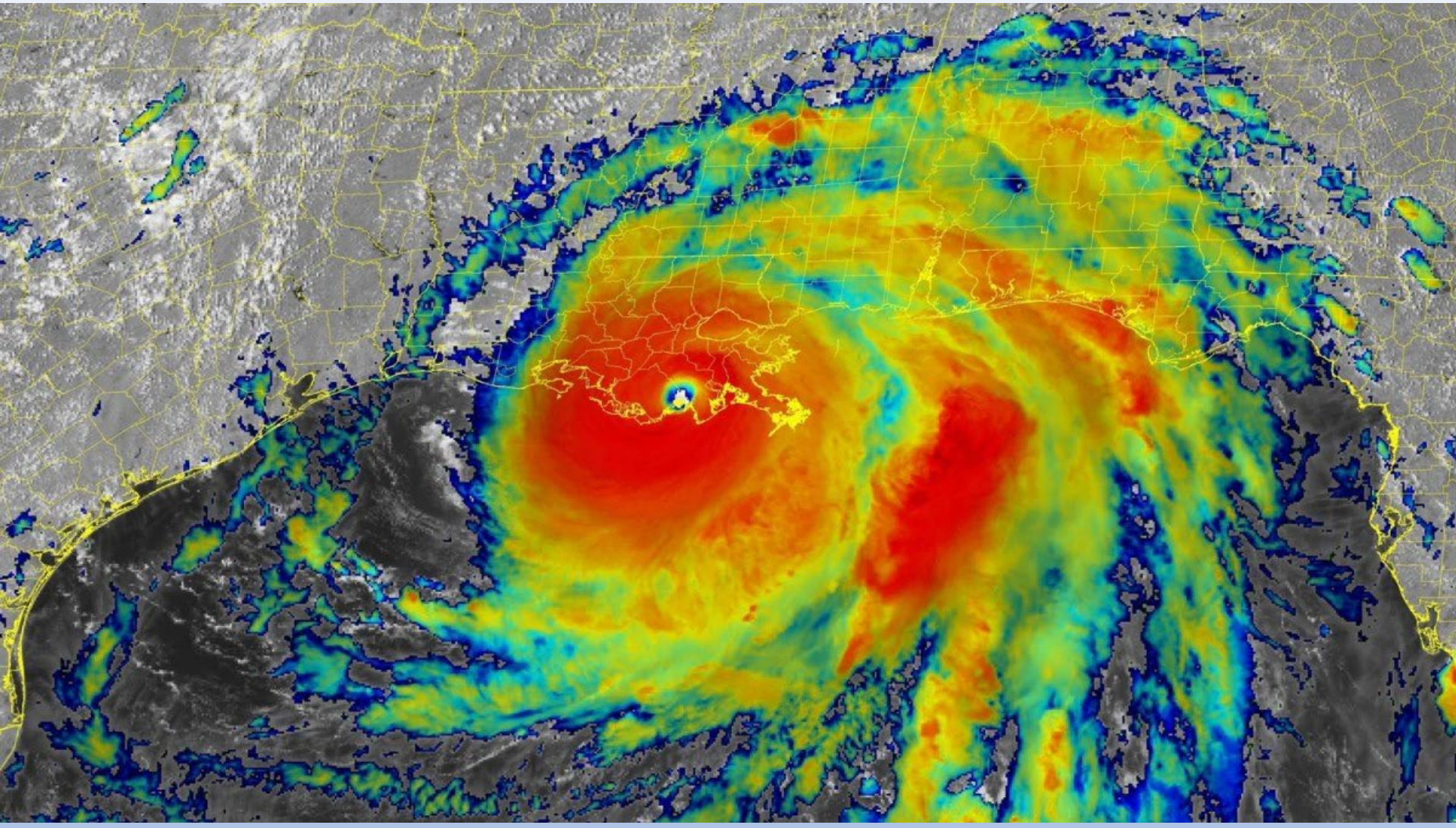
1. develop steps to prevent the loss/damage of lives and properties due to unprecedented weather events, build ***Climate Resiliency*** and
2. remedial steps involving ***Climate Reversal –*** reversal of global warming trend.

The remedial step involving climate reversal is a long-term effort to begin the reversal of the increasing trend of global temperature rise for the past six decades (NASA, 2020).

To build the ***Climate Resiliency*** among various global communities, it is prudent to begin with a few model areas where local facilities, supporting community contacts, and hydrological information on related waterbodies (streams/rivers) are available.

The Summary Approach:

- Developing a short background on
  - river basins and watersheds, their interdependency and
  - other watershed parameters that impact the quantity and quality
- Develop emergency drinking water purification systems for the climatic disasters.
- Develop a precise predictive model for a specific town/city/area of interest where we are hoping to predict the climate intensity and timing with a high level of accuracy.
- This effort includes ground sensors data gathering and satellite based live weather extremes in partnership with NASA/NOAA- and combining the two.
- Some of our team members already have partnership arrangements with NASA



Infrared satellite image of Hurricane Ida at 3:21 p.m. EDT August 29, 2021, after making landfall near Port Fourchon, Louisiana. Ida was the most expensive weather disaster of 2021, with $75 billion in damages. (Image credit: NOAA)

Local Ground-level Monitoring :

River Monitoring

The river basin monitoring primarily consists of -

- measuring hydrological fluxes, storages and quality changes. This includes :
  - ***tracking*** of essential hydro-geo-meteorological parameters such as –
  - water level/estimated flow, water quality, topography, and weather.
  - Vulnerability of the local residents/villages –
    - proximity to the 25-50-100 year flood plain of the streams and rivers
    - Identify flood prone areas
    - Elevations and integrity of Bridges on roadways

Watershed Monitoring

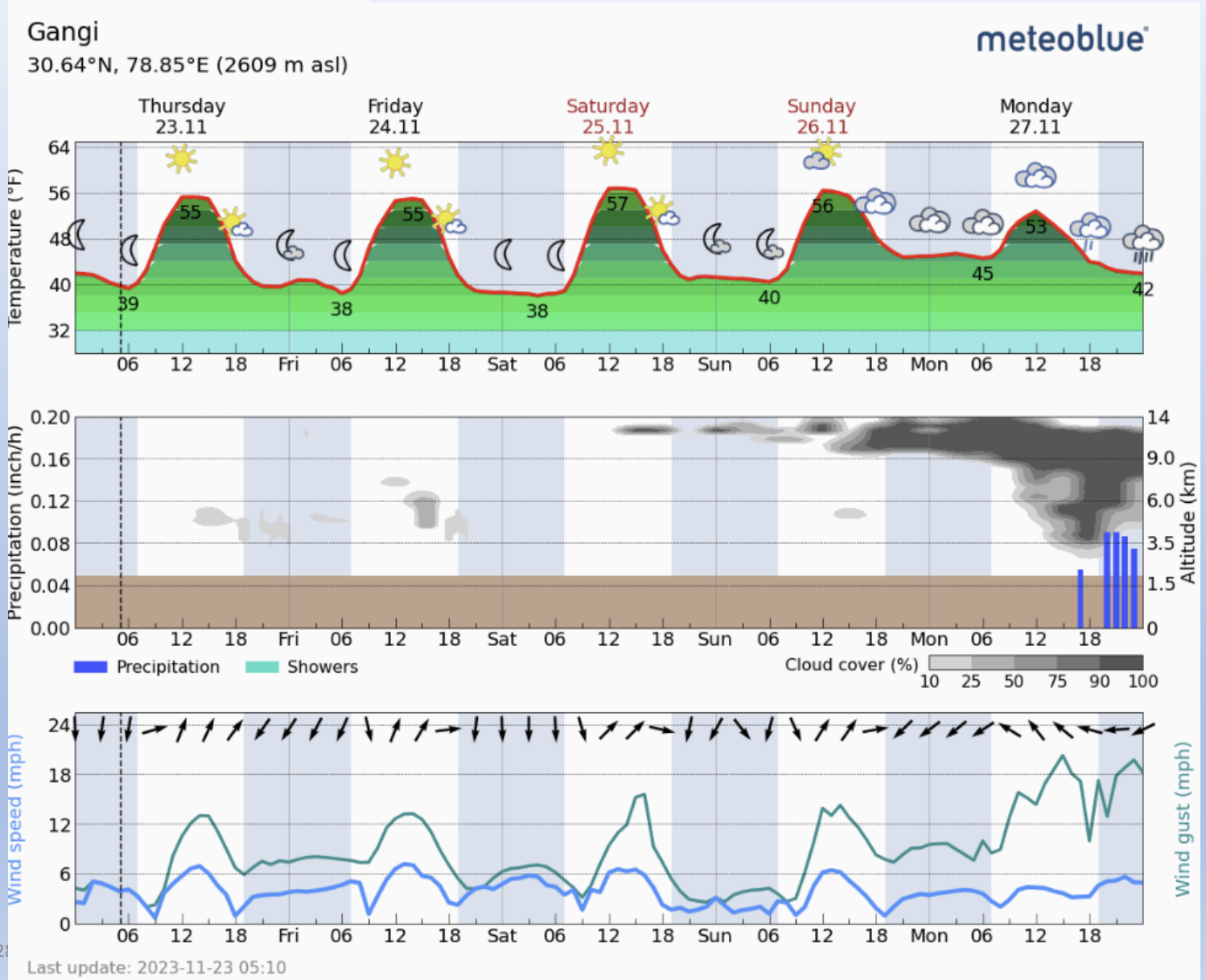
- Monitor the watershed under study by using data from NOAA, NASA and other resources to track and monitor storm systems
- Undertaking a few such studies currently
- One such studies - **Yamuna River Bank Towns – STP Survey and Water Quality Testing**
- Conducted January 10 – 16, 2022

Weather Monitoring

- Monitor the local weather under study .
- Use of data from NOAA, NASA, IMD, Meteoblue and other resources
- Example of historical data for Gangi village (8608 ft) next slide

Current Wind on Nov 22, 2023 at 4:30 AM IST Source: Meteoblue

Weather Monitoring



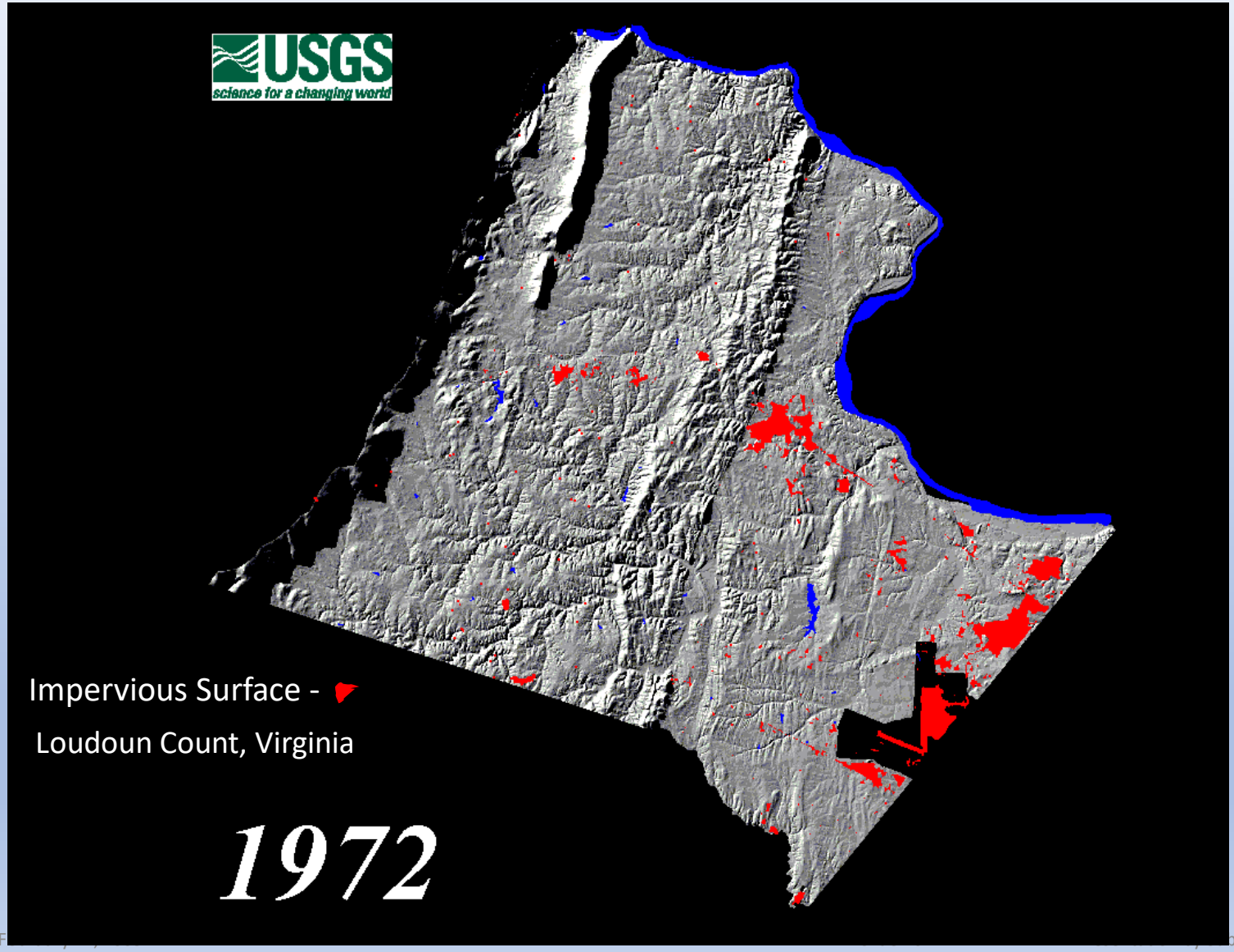
Disaster Risk Reduction - Preventing the disaster and minimizing its impacts

- Encourage development of local resilience and contingency plans.
  - Recent disasters in Uttarakhand and Himachal Pradesh
  - Calls for higher design factors considering intense (100-yr+) weather events and local hydrogeological conditions for the area.
  - Emergency response – Disaster relief
    - *Food and Water supplies*
    - *Government collaboration*
    - *Shelter management*
    - *Debris clearance and*
    - *community support*

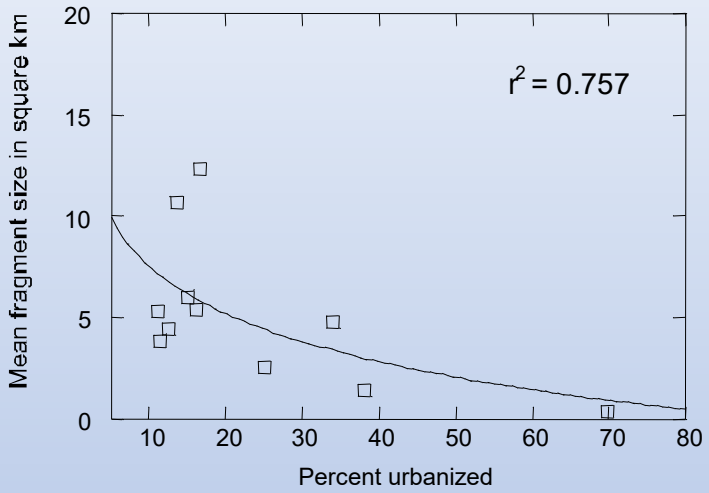
Survival kit - Supports two (2) to six (6) people for a period of six (6) to eight (8) days.

- **Use of Environmental indicators**
  - Study the environmental impact of proliferating growth and development
  - Use roadside imagery, aerial imagery, forest areas, urbanized areas, key soil types, surface- and ground water quality and quantity.
  - Examples of impacts – following slides

Environmental Indicator – Impact of growth - Example



Environmental Indicator – Forest Fragmentation- Example



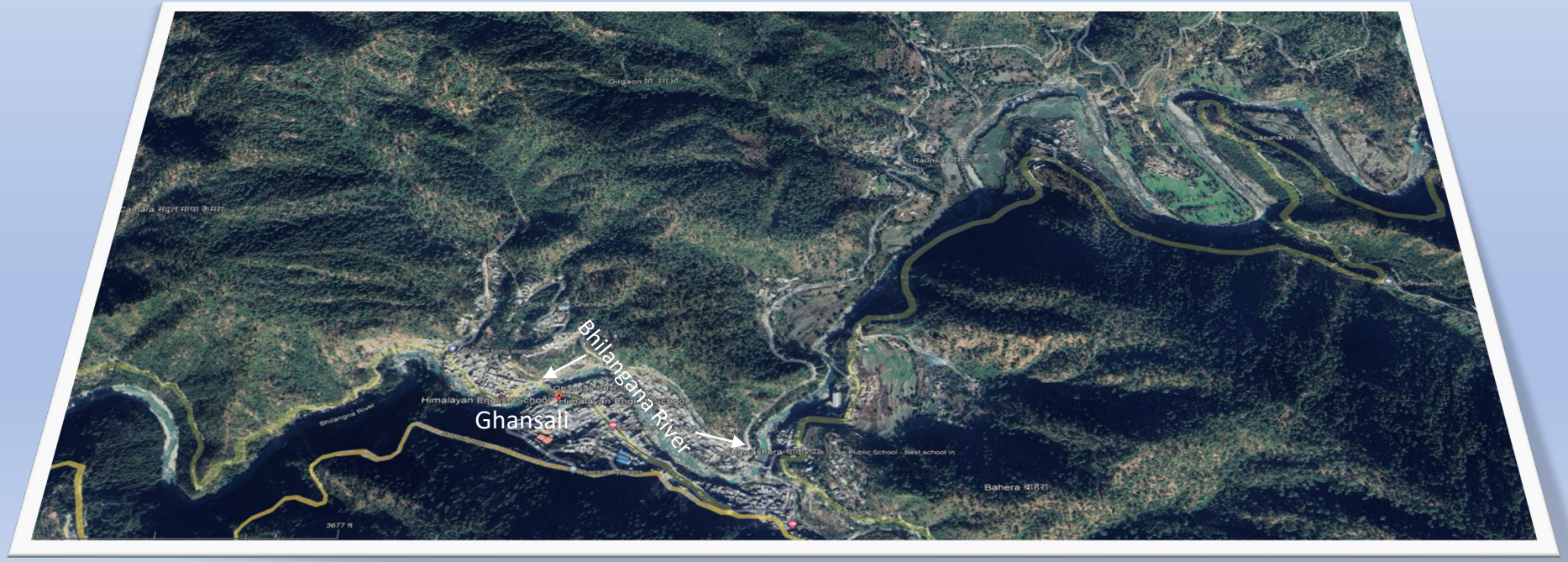
Mean forest fragment size (in km^2) versus percent urbanized land in major watersheds, Loudoun County, VA (Source: Fuller 2000)

- Minimum Forest patches for viable Songbird population is 1 Km^2 .
- Similarly, forest fragmentation could be tied to local conditions on - erosion, landslides, recharge and other factors identified in a watershed.

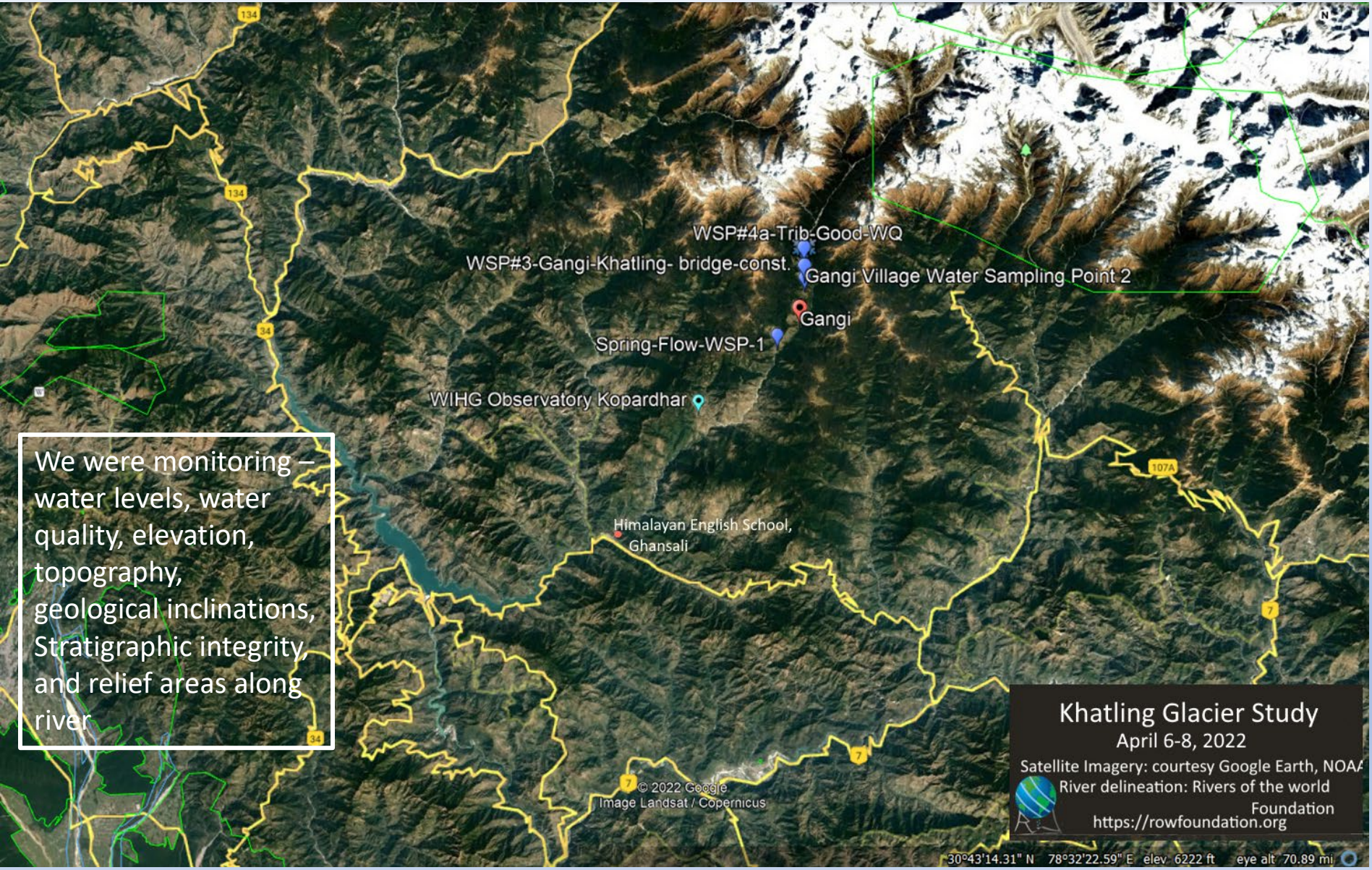
Preliminary Study of the Khatling Glacier

Why this Study?

- Since 2014 we have been providing training to students in Ghansali, Uttarakhand.
- During that time, we have been observing the periodic overflow rivers and streams.
- The 2021 glacier break and devastation in the Rishiganga caused serious concerns about the safety of the School and nearby areas.
- Bhilangana River laces the school and other areas in the Ghansali area and upstream.
- It originates from the Khatling glacier (17,408 ft.) not too distant from Ghansali.
- These facts led me to study the current status of the Khatling glacier and relevant vulnerabilities and options for minimizing impacts.



Preliminary study - Khatling Glacier



A conglomerate of metamorphosed slate and schist captured on way to the Khatling Glacier. (photo: Subijoy Dutta)

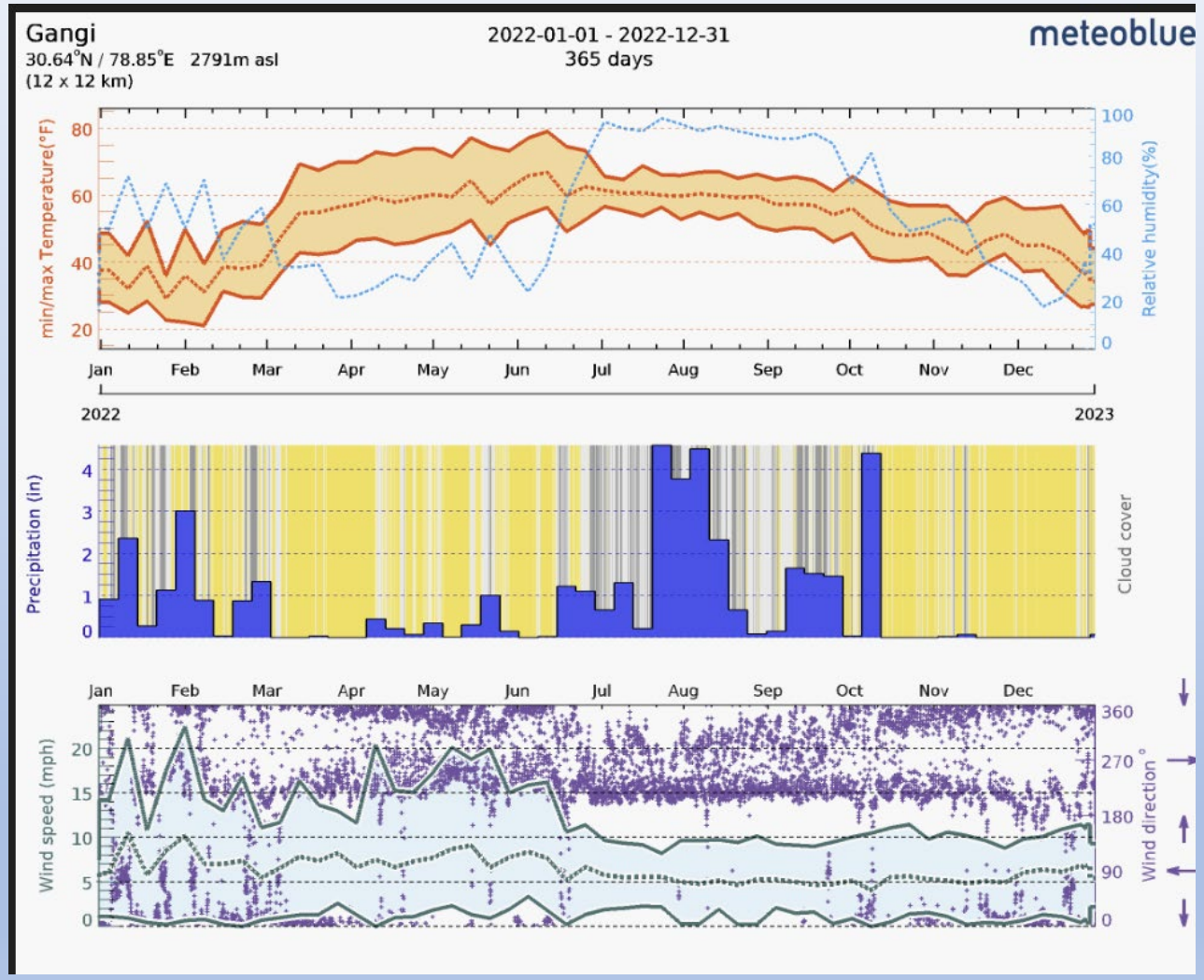

Bhilangana-River-below-Khatling-Glacirer -WSP#4B
WSP#4a-Trib-Good-WQ
Image © 2022 Maxar Technologies
Khatling Glacier Study
April 6-8, 2022
Satellite Imagery: courtesy Google Earth, NOAA
River delineation: Rivers of the world
Foundation
https://rowfoundation.org
11/28/2023
www.snmengineering.com
25
1985
Imagery Date: 11/30/2018 30°39'41.61" N 78°50'52.01" E elev 8643 ft eye alt 11152 ft

Metamorphic rocks – Schist, Gneiss, and others washed downhill by the Bhilangana River. Elev. 7952 ft.

(photo: Subijoy Dutta)

- The river was flowing with a high volume of water from the glacial melt.

Weather Monitoring data



- There was very little or no rain in this region for the past 30 days of our visit on April 7, 2022

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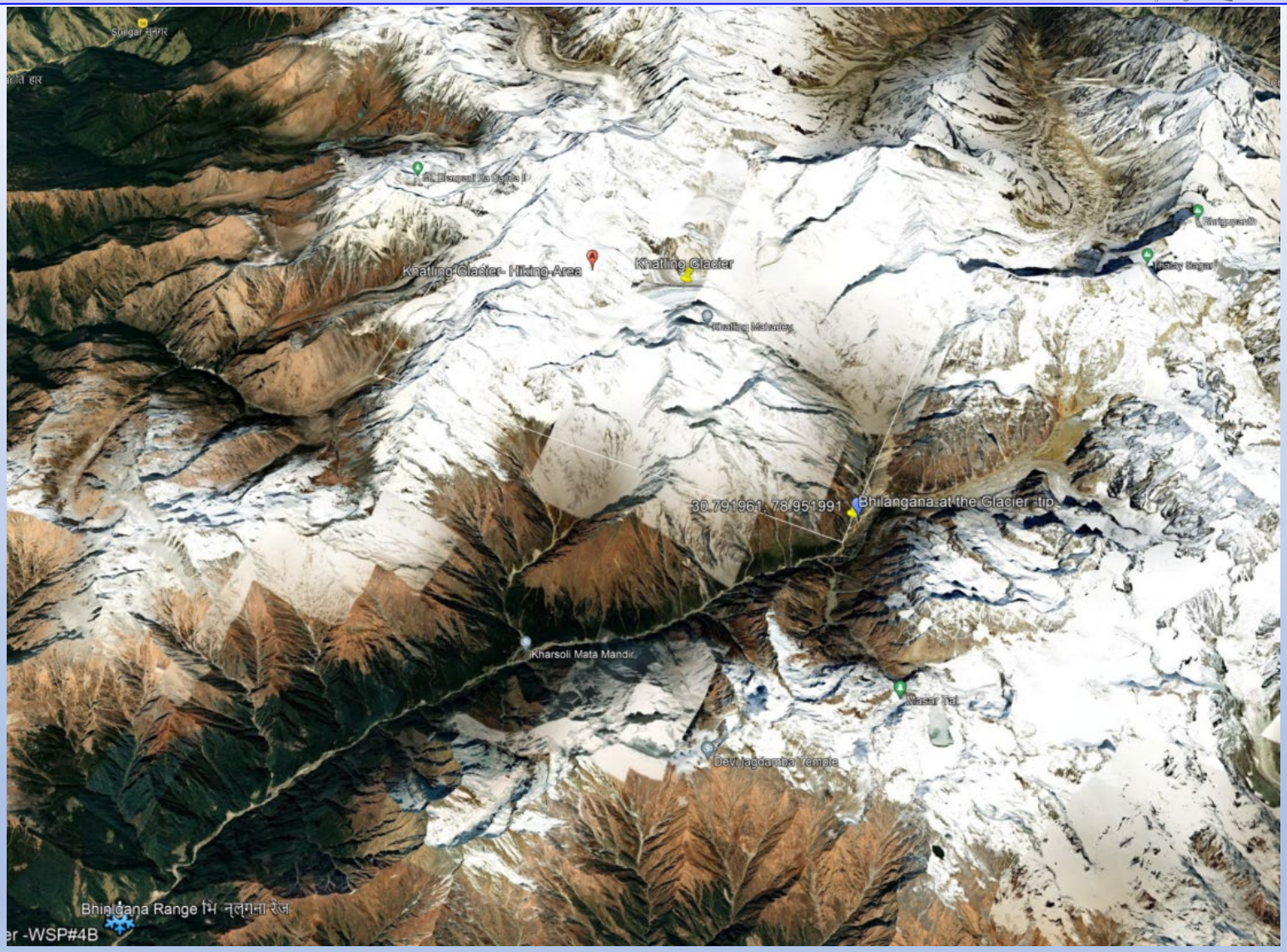

Beginning point of the Bhilangana River, up above at 12,120 ft (3,695 m), (img. Jun 2023: courtesy Maxar Technologies, GEP 2023)

- We could clearly identify the eroded path of the water flow at the glacier due to the fast melting

Results from preliminary Study

- The study results are Tabulated on the next slide.

- The test results indicates that the glacial water flowing through the springs are of the highest quality reflecting glacial melt flowing through the ground without exposure to human interactions and ambient air during our visit.
- The water quality of surface waters may improve slightly during the winter.
- Some typical geological strata exposed in some areas along the hiking trail to the bottom of the glacier is shown on a previous slide.
- A conglomerate of metamorphosed type of slate, schist, sandstone and shale were seen in the area.

Khatling Glacier Study - Location and WQ Data +		
Study Points	**Location Lat/Lon**	**Remarks/WQ Test data**
pring-Flow-Water Sampling oint WSP #1	30° 35' 15.18025'' N 78° 49' 30.50058'' E	Check Dam area Elev. 6735 ft. TDS: 37 ppm Conductivity: 78 umho/cm Temp.: 22.2 C pH - 6.0
Gangi Village WSP #2	30° 38' 6.7902'' N 78° 51' 5.55142'' E	Gangi Village - North ~200 ft. above the end of Vehicular Traffic Elev. 8608 TDS: 28 ppm Cond.: 59 umho/cm Temp.: 20 C pH - 6.0
Gangi-Khatling- bridge-const. WSP #3	30° 38' 32.62074'' N 78° 51' 3.69295'' E	Elev. 8543 Gangi to base of Khatling midway. Pul (Bridge u/ construction) TDS: 16ppm Conductivity: 34 umho/cm Temp.: 15.4C pH - 6.0
rib-Good-WQ WSP#4a	30° 39' 33.94595'' N 78° 51' 2.83691'' E	WSP #4A 1.0 Tributary of Bhilangana River from West side. Elev. 7957 ft. TDS: 13 ppm Conductivity: 27 umho/cm Temp.: 12.3C pH - 6.5
hilangana-below-Khatling - VSP#4B	30° 39' 34.34429'' N 78° 51' 4.42919'' E	WSP #4B 2.0 Bhilangana from the source Khatling Glacier Elev. 7952 ft. TDS: 27 ppm Conductivity: 58umho/cm Temp.: 14.4 C pH - 6.0.

Conclusions

- The results of the water quality data from a spring at the highest point we accessed (WSP#4A) showed signs of glacial melt, had the lowest temperature, high clarity and best water quality data among all the samples tested.
- As we approached higher elevations, the water from the streams and rivers were clearer and showed better water quality.
- The spring water flowing into a community outlet in the Gangi village showed a relatively higher level of contaminants, possibly due to the clothes washing activities of the community in that area.
- The flow of the river Bhilangana at the point below the Glacier indicates a very high flow volume despite no rainfall in that region for the past 30 days of our visit. This was possibly due to *glacial melt.*
- By looking at the high-resolution imagery using Lidar sensors (Jenkins 2000), we could clearly identify the eroded trail of the water flow due to the *fast melting of the glacier*.

Recommendations

1. **We recommend the following steps** towards **disaster reductions** and building **Climate Resilience -**

- It is imperative that local people and any supporting organization/s should play a crucial role in responding to a crisis and helping those affected.
- **Help in evacuating people**, work with communities and local agencies, to take emergency steps for recovery and relocation of impacted people.
- **conduct a detail study** to determine options to minimize the potential impacts of a glacial outburst. This is the *most important step* we recommend at this time.
- This study is being planned with active involvement of our local team, along with Uttarakhand Council of Science and Technology (UCOST), our contacts in US, such as - MIT's Jamil water and food sciences research in Cambridge, Massachusetts, and other progressive organizations.
- The detailed study minimally include – analysis of the current rate of retreat and stability of the Khatling Glacier, analysis of the watershed and sub-watersheds of River Bhilangana, seasonal variations in water quality and quantity of the rivers and streams, and potential vulnerabilities of areas in the Bhilangana River watershed, and other relevant parameters.

Recommendations …contd.

2. We recommend the following for **climate reversal** or to **reverse the global warming** trend –

- **Pursue the goals set** in the UN's (Sustainable Development Goals) SDGs to lower GHG emissions and plant more trees than what we are removing every day to build and expand the human settlement.
- **Provide education and training** to local communities, rural populations, and students at all levels about climate change impacts and reducing the GHG emissions.
- **Promote the initiatives** involving - *renewable energy, save water, reuse/recycle* used products and safe disposal of the remaining waste products.
- **Provide a strong emphasis** on *reducing air emissions* in our daily practices.

Thank You

QUESTIONS?

Please send comments or questions to Subijoy Dutta

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