Basic Details of the Team and Problem Statement

Ministry/Organization Name/Student Innovation: Ministry of Jal Shakti

PS Code: SIH1289

Problem Statement Title: Projection of the extent of inundation corresponding to the forecasts of flood levels in a river.

Team Name: SKYNET

Team Leader Name: Samarth Pratap Singh

Institute Code (AISHE): 15782701/U0202

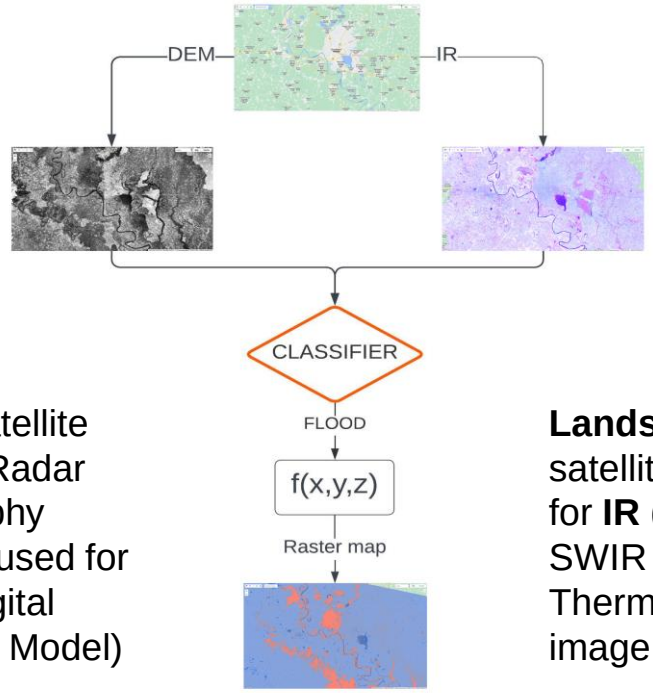
Institute Name: Birla Institute of Technology, Mesra

Theme Name: Disaster Management

Idea/Approach Details

Idea/Solution/Prototype:

- Our model aims to assess the spatial **extent of inundation** using **Machine Learning (ML)** and **GIS** techniques, with a focus on data-driven analysis, modeling and visualization.
- The input for our model consists of 3 major parameters which include **increase in water level of the river**, **elevation of the point under consideration wrt river** and the **distance of the point from the river**.
- Our model employs a **classifier (supervised learning)** trained on data from various **bands** and satellites to categorize the location of interest into two distinct classes: 'Flood' and 'No Flood'.
- Then the model utilizes a **polynomial regression** function that incorporates the mentioned parameters, along with historical data, to dynamically adjust the exponents associated with these parameters. This adjustment process is guided by **loss functions**, which help fine-tune the model's parameters for improved accuracy.
- We utilize this function for the regions marked as 'Flood' by our classifier, to generate a value that is subsequently **normalized** to represent the **likelihood** of inundation within the region.
- The probabilities associated with the regions are then visually represented on a GIS-based application, using a raster map.



SRTM satellite (Shuttle Radar Topography Mission) used for **DEM** (Digital Elevation Model)

Landsat 8 satellite used for **IR** (NIR + SWIR + Thermal IR) image

Technology stack:

- **GIS-based application -** Google Earth Engine and Google Earth Pro, QGIS.
- **Languages and frameworks -** JavaScript, python, pandas, NumPy, Scikit-learn, TensorFlow.
- **Satellite Imagery provided by -** SRTM, Copernicus, Landsat, Sentinel.
- **VCS -** Git, GitHub.

Idea/Approach Details

Use Cases:

- **Disaster Management and Response**- Providing real-time information on flooded areas, helping emergency services plan rescue and relief operations efficiently.
- **Flood Forecasting and Early Warning Systems-** Predicting the likelihood and severity of floods in real-time to provide early warnings to relevant authorities and communities.
- **Urban Planning and Infrastructure Development-** Identify areas at risk of floods and plan infrastructure and land use accordingly.
- **Infrastructure Monitoring**- Implement an early warning system to detect potential threats in infrastructures such as dams and bridges.
- **Ecosystem Conservation**- Monitor water levels in critical ecosystems using satellite data to ensure that water levels remain within the required range to support biodiversity and maintain ecological balance.
- **Agriculture and Crop Management-** Optimize irrigation scheduling based on water levels in nearby rivers or reservoirs. Help farmers make data-driven decisions to conserve water resources.

Dependencies / Show stoppers:

- **Data Availability and Quality**: Incomplete, outdated, or noisy data can lead to inaccurate predictions.
- **Spatial and Temporal Resolution:** The spatial and temporal resolution of satellite imagery may not be sufficient for certain localized or rapidly changing flood events.
- **Cloud Cover and Atmospheric Conditions:** Cloud cover and atmospheric conditions can obstruct the view of the Earth's surface, making it challenging to obtain clear and continuous data.
- **Data Processing Complexity:** Processing and analyzing large volumes of remote sensing data, can be computationally intensive.
- **Model Generalization:** Ensuring that the model is capable of generalizing to different geographic regions.

Future scope:

- Increase the input parameters.
- Replacing regression by a **CNN (Convolutional Neural Network)**.
- Improvement in the classifier to extend classes to ‘High flood’, ‘Mid flood’ and ‘Low flood’.
- Analysis of concealed features in the exported GEOTIFF files.

Team Member Details

Team Leader Name: **Samarth Pratap Singh**		
Branch (Btech/Mtech/PhD etc): Btech	Stream (ECE, CSE etc): IT	Year (I,II,III,IV): III
Team Member 1 Name: **Amogh Huddar**		
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Team Member 2 Name: **Kshitij Jha**		
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