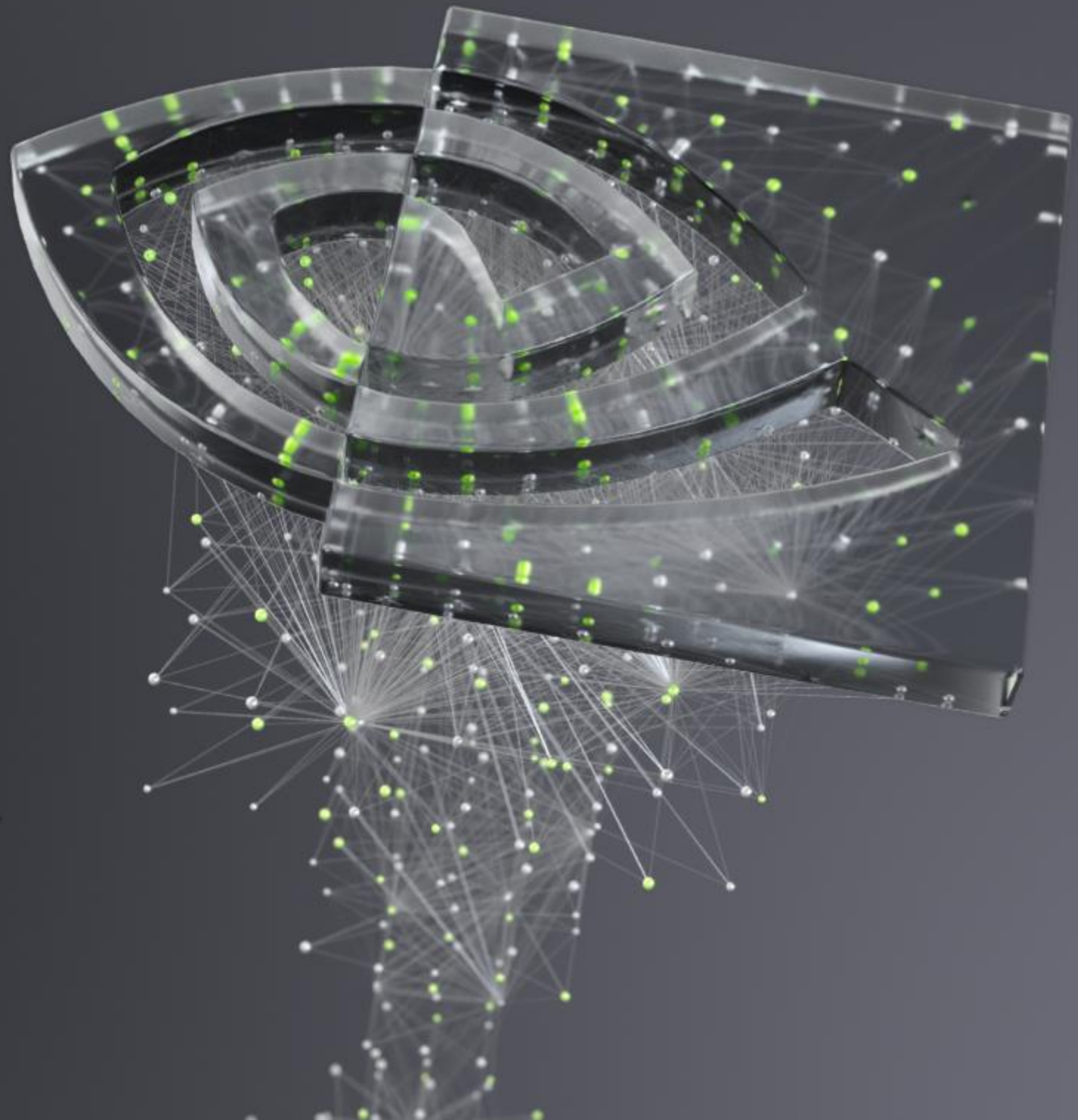


DISASTER RISK MONITORING USING SATELLITE IMAGERY

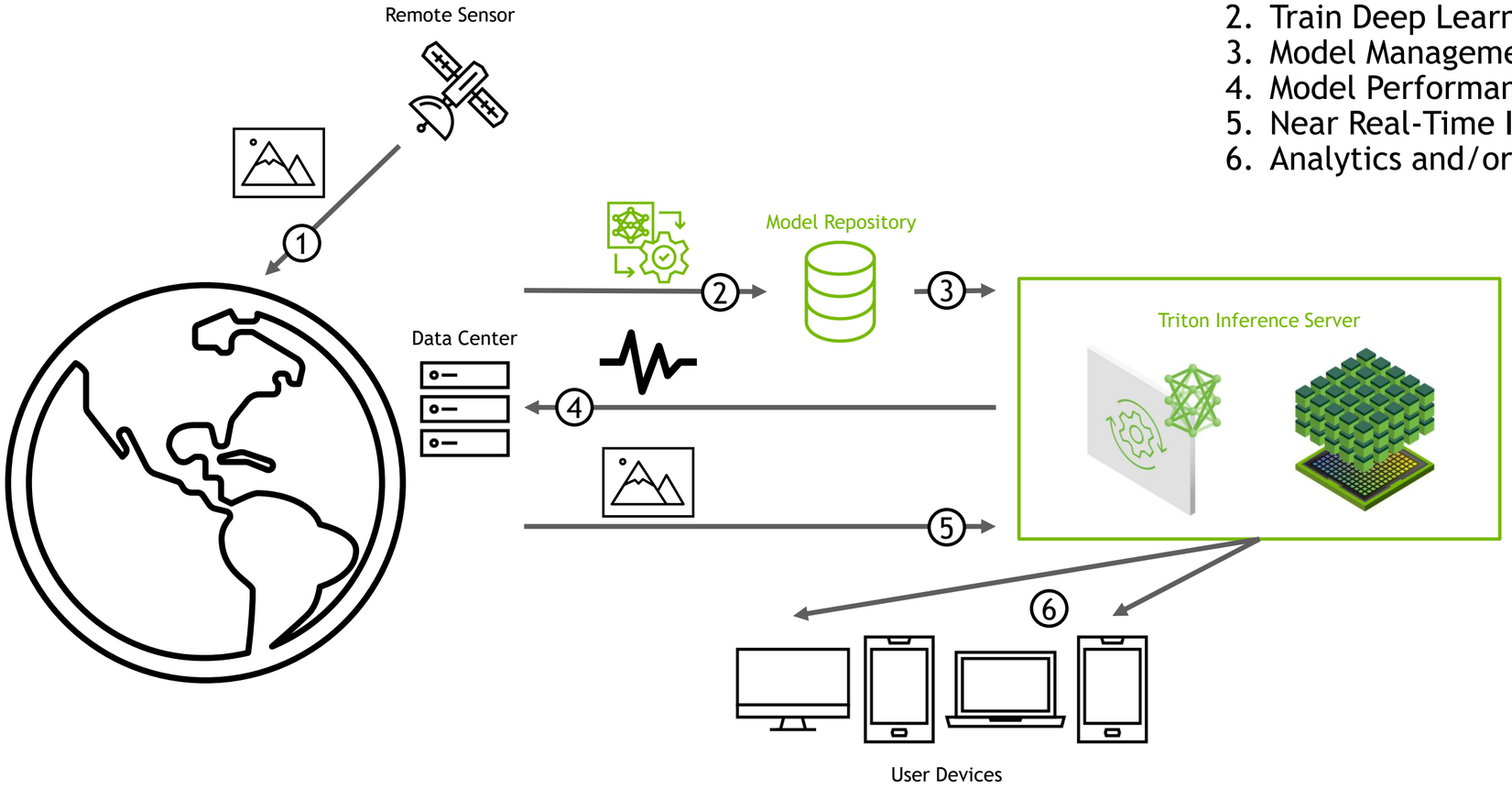
NVIDIA DLI

Workshop Table of Contents

DISASTER RISK MONITORING USING SATELLITE IMAGERY

End-to-End Disaster Risk Monitoring System Workflow

1. Data Capture
2. Train Deep Learning Model
3. Model Management
4. Model Performance Monitoring
5. Near Real-Time Inference
6. Analytics and/or Alerts



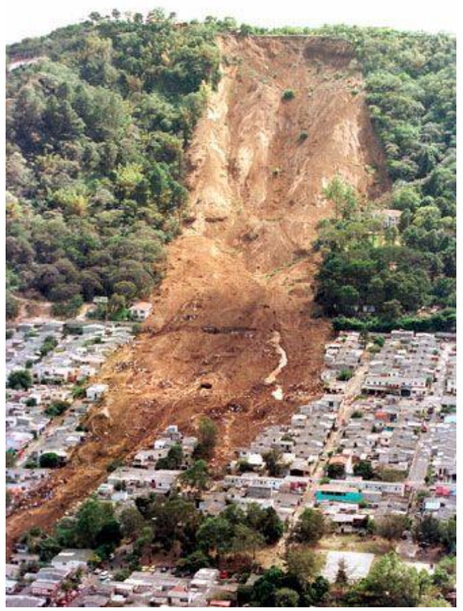
DISASTER RISK

Ability to Detect and Quantify Helps Reduce Economic Impact and Loss of Human Lives

Tsunami

Drought

Landslide



Flood

Wildfire

ABOUT FLOODS

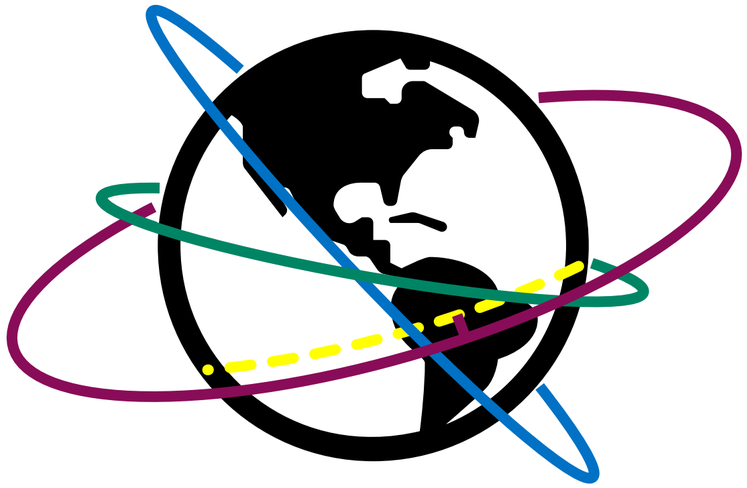
Flooding Events Are On the Rise Due to Climate Change and Increasing Sea Levels

- Costs more than $40 billion annually
- 40% of the population lives close to coasts
- Flood monitoring needs to be done remotely due to limited physical access
- Deploying instruments in potential flood zones can be dangerous
- Ability to measure and understand floods enables tactical responses and long-term mitigation strategies

COPERNICUS SENTINEL-1 MISSION

Performs C-Band Synthetic Aperture Radar Imaging

- Enables data collection day and night, as well as under cloud cover
- Operates in **LEO** for fast data transfer and orbit speed
- Comprises of 2 identical satellites 180° apart to image the planet with a repeat frequency of 6 days
- Provides an independent operational capability for continuous radar mapping of the Earth with enhanced revisit frequency, coverage, timeliness and reliability
- Ideal for operational services and applications requiring long time series



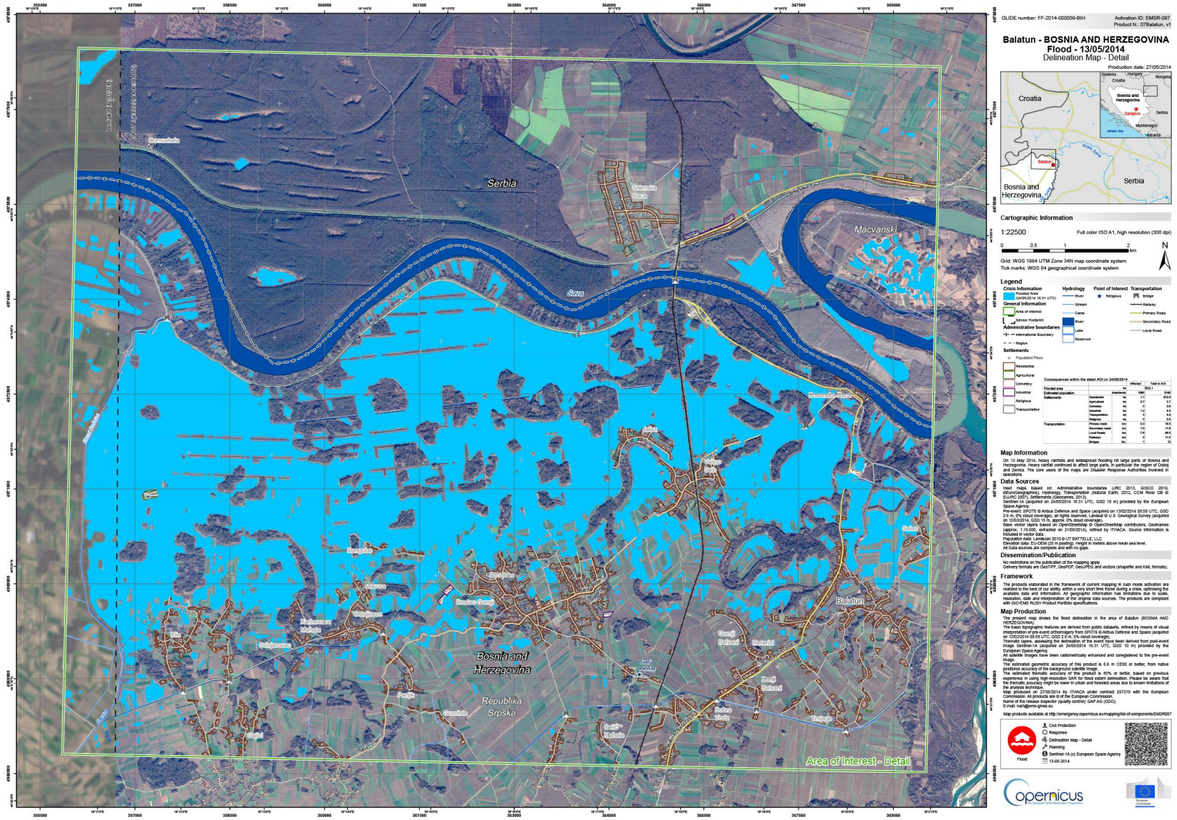
Orbit Type	Description
Low Earth Orbit LEO (<1,000 km)	Almost all human activity in space is in LEO due to desirable speed of orbit and data transfer
Medium Earth Orbit MEO (1,000 km – 35,786 km)	MEO comprises of orbits between LEO and GEO. This is commonly used by navigation satellites but is also used by a variety of satellites with different applications
Geosynchronous Earth Orbit GEO (35,786 km)	Satellites in GEO circle the Earth above the equator following Earth's rotation, which make them appear "stationary" over a fixed position. This is commonly used by communication satellites
Elliptical (Not Pictured)	Least common of satellite orbits

MODERN COMPUTER VISION USES DEEP LEARNING

Flood Detection Using Semantic Segmentation

- Traditional Disaster Risk Monitoring (DRM) requires significant domain expertise. It also relies upon many different data types, information sources, and types of models to be effective
- Modern computer vision, using machine learning techniques, can perform different tasks such as classification, object detection, and segmentation
- Promising results but requires powerful technology to enable complex computations

ESA (European Space Agency) Flood Map



MODEL DEVELOPMENT WORKFLOW

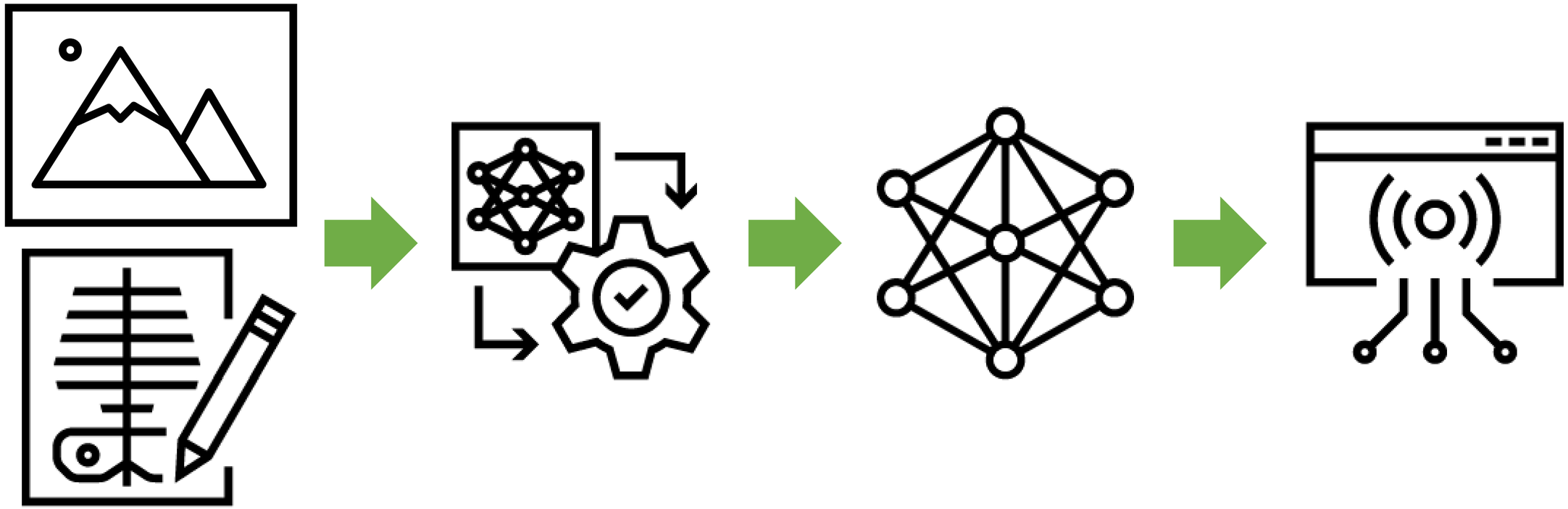
Machine Learning Workflow

Preprocessing -> Image + Label

Model training

Trained Model

Model Deployment



UNOSAT RAPID MAPPING SERVICE: SATELLITE IMAGERY ANALYSIS IN SUPPORT OF HUMANITARIAN EMERGENCIES

UNITED NATIONS SATELLITE CENTRE
UNOSAT

Division for Satellite Analysis and Applied Research at the United Nations Institute for Training and Research (UNITAR). Operational since 2001, recognized as the United Nations Satellite Centre in June 2021.

Celebrated 20 years of operations in 2021!

UNOSAT | UNOSAT OPERATIONAL PILLARS

SATELLITE ANALYSIS

Satellite imagery derived geospatial products

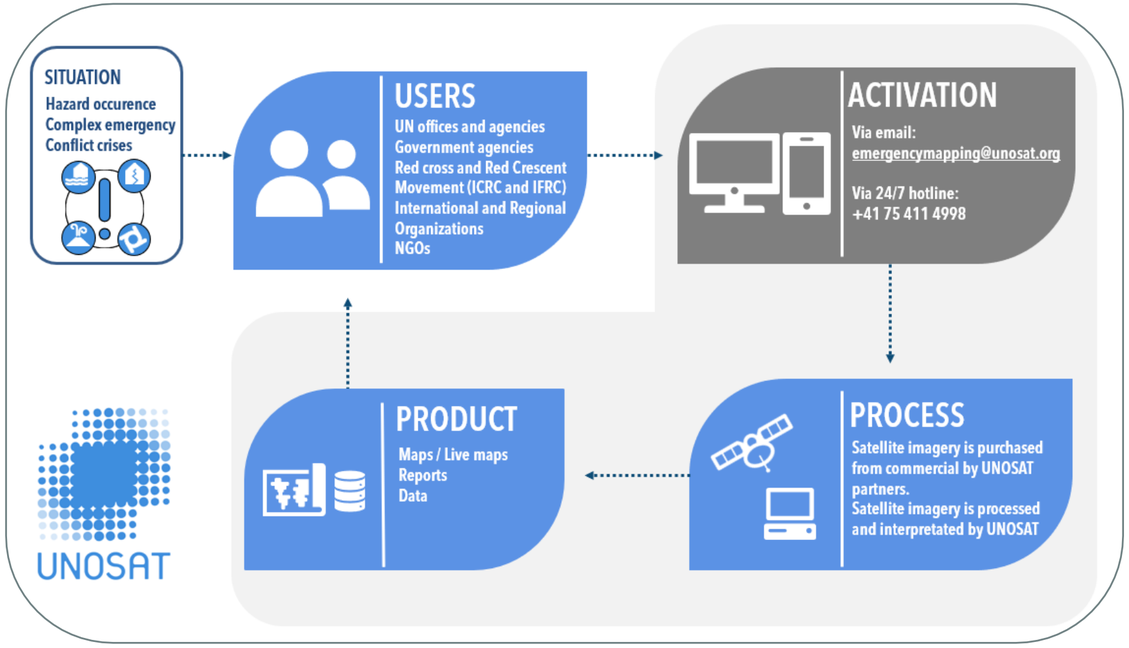
TRAINING AND CAPACITY DEVELOPMENT

Hands-on technical training, awareness raising and technical backstopping

APPLIED RESEARCH AND INNOVATION

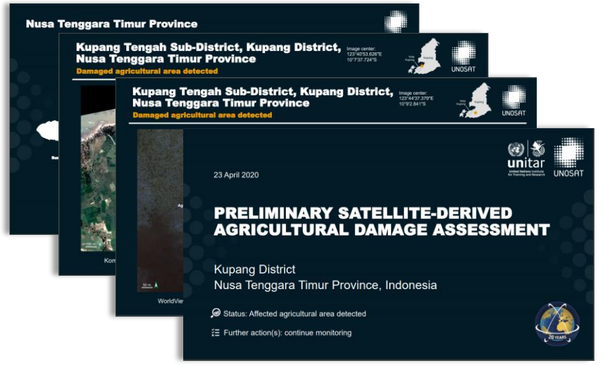
EO, AI, Machine Learning, Big Data Analytics, crowdsourcing

UNOSAT | HOW TO ACTIVATE RAPID MAPPING SERVICE?



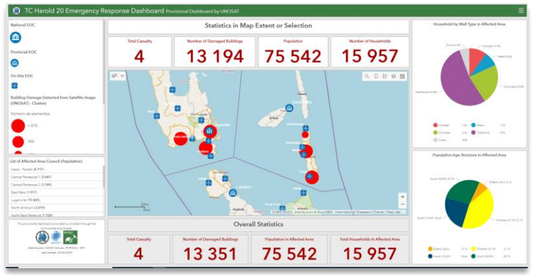
https://www.unitar.org/maps/unosat-rapid-mapping-service

Satellite derived map products and Analysed GIS data – ready to use

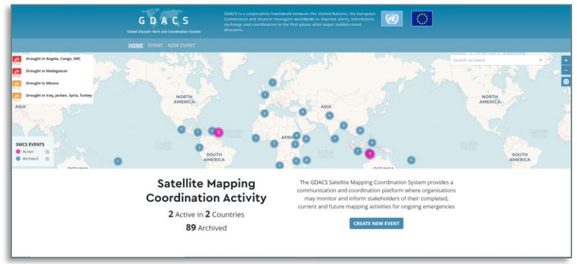


Satellite derived reports

Web maps



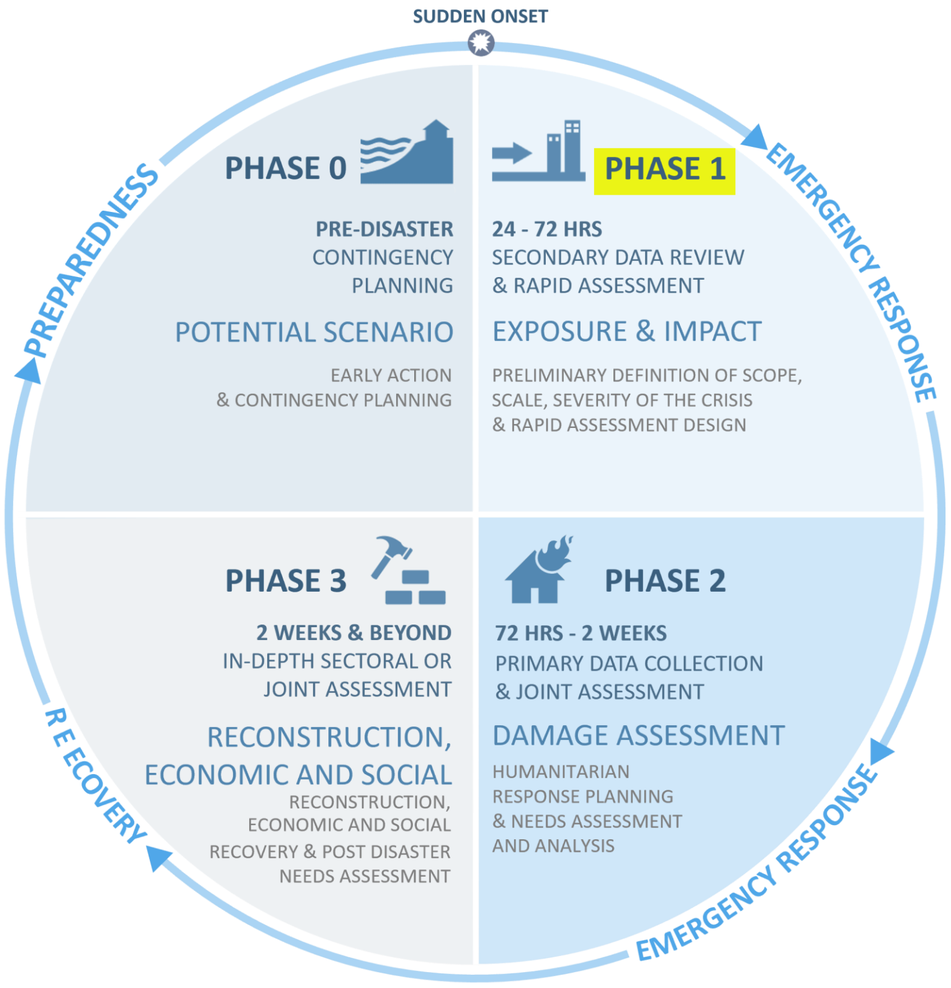
Dashboards and Statistics



Satellite Mapping Coordination Tool (GDACS-SMCS)

UNOSAT UNOSAT RAPID MAPPING SERVICE:

SATELLITE IMAGERY ANALYSIS WORKFLOW



FLOOD IMPACT ANALYSIS

Location / Preliminary Situation Map

Situation Analysis updated / Impact and Preliminary Damage Analysis

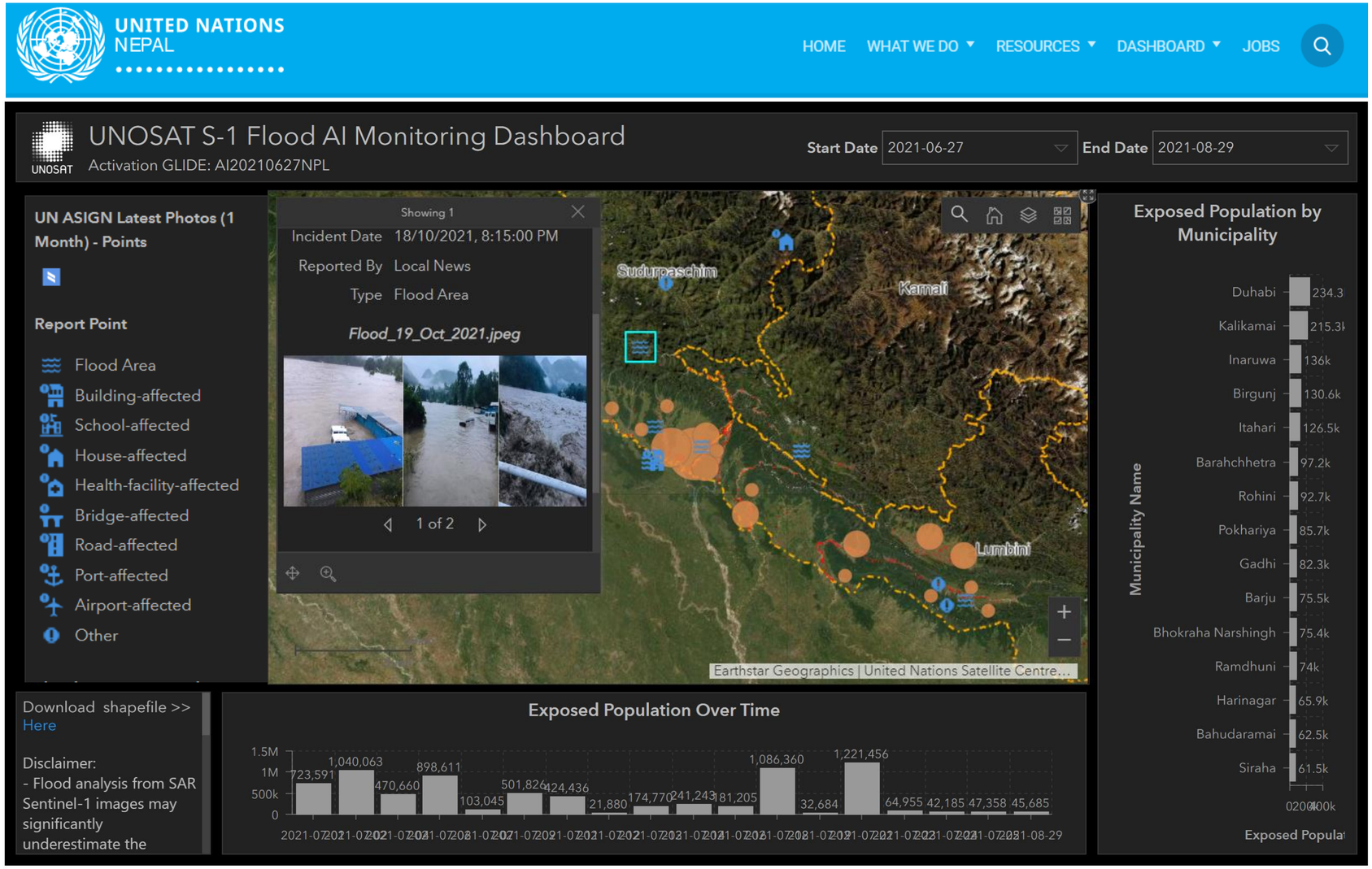
Flood monitoring / Cumulative flood extent / Sectoral Assessment

24 HOURS | 72 HOURS | 2 WEEKS

PRE-CRISES

PHASE 0	PHASE 1	PHASE 2	PHASE 3
Preliminary Situation Awareness	Rapid Impact Analysis	Impact/Damage Assessment	

UNOSAT | NEAR-REAL-TIME ACTIVATION: NEPAL



UNOSAT | AI-BASED FLOOD DETECTION TOOL

Area of Interest

Daily Monitoring

Automatic Downloading

sentinel-1

Download Pipeline

S-1 images

Deep Learning Model

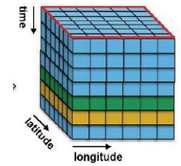
Deep Learning And Post Processing Pipeline

Deployment

- GPUs at CERN
- 64 TB data storage server and a high-speed CERN internet connection

User

Flood AI Output



Multidimensional Aggregate

Multidimensional Zonal Statistics

Raster Mosaic And Multidimensional Stats Pipeline

Statistics Charts/Graphs

Flood Extent

Download Data Link

NVIDIA AND UNOSAT COLLABORATION

Using AI to Boost Sustainable Development Goals

- UNOSAT collaborates with NVIDIA on training and research activities to promote the use of Artificial Intelligence (AI) for Earth Observation activities in support of the Sustainable Development Goals (SDGS), with an emphasis on disaster management. [Link] [Link]

- During the course learners will not only train a flood detection model, but also run inference on a satellite imagery taken from the latest activation in Nepal just presented and perform an impact analysis assessment. All of these activities are dedicated to serve a central vision: the promotion of evidence-based decision making for peace, security and resilience. UNOSAT's goal is thus to make satellite solutions and geographic information easily accessible to the UN family and experts worldwide, with a professional commitment to producing concrete, tangible and usable results in every activity.