



07-20-2015



07-07-2022

Earth Observations for Informing Disaster Risk and Response to Drought, Wildfire, and Flooding in Mexico

Overview of Flood Monitoring Tools

May 9, 2023



Objectives

By the end of this presentation, you will be familiar with remote sensing-based web-tools useful for flood monitoring and management.

For details see:

<https://appliedsciences.nasa.gov/join-mission/training/english/arset-monitoring-and-modeling-floods-using-earth-observations>



Outline

- Overview of flood monitoring and modeling techniques
- Flood monitoring tools based on remote sensing
- Demonstration of the flood monitoring tools





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Overview of Flood Monitoring and Modeling Techniques

About Floods

<https://www.ready.gov/floods>

- Flooding is a temporary overflow of water onto land that is normally dry.
 - The most common disaster affecting human lives
 - Can cause infrastructure damage & power outages
 - Disrupts transportation
 - Creates landslides

About six inches (15 cm) of moving water can knock a person down, and one foot (30 cm) of moving water can sweep a vehicle away!



Flood Monitoring and Management

- Requires geophysical and socioeconomic data:
 - Floodplain map: terrain, Digital Elevation Model, low-lying areas
 - Precipitation intensity, frequency
 - River stage, streamflow, inundation
 - Coastal surges and inundation
 - Land use change: exposed soil versus built-up areas, soil moisture
 - Population, infrastructure, drainage, and storm water system capacity (for urban floods)
 - Flood return period
 - Hydrology and routing model

<https://appliedsciences.nasa.gov/join-mission/training/english/arset-monitoring-urban-floods-using-remote-sensing>



Remote Sensing-Based Flood Detection

There are several approaches to using remote sensing observations for flood monitoring:

- Detecting flood water on previously dry land surfaces using satellite-derived land cover observations
- Hydrology models that derive streamflow and runoff using precipitation and weather data from satellites and models
- Inferring flooding conditions using satellite-derived precipitation rate and amount and soil moisture conditions using statistical methodology

Note: Each flooding approach also uses model and/or surface-based data in addition to satellite data.

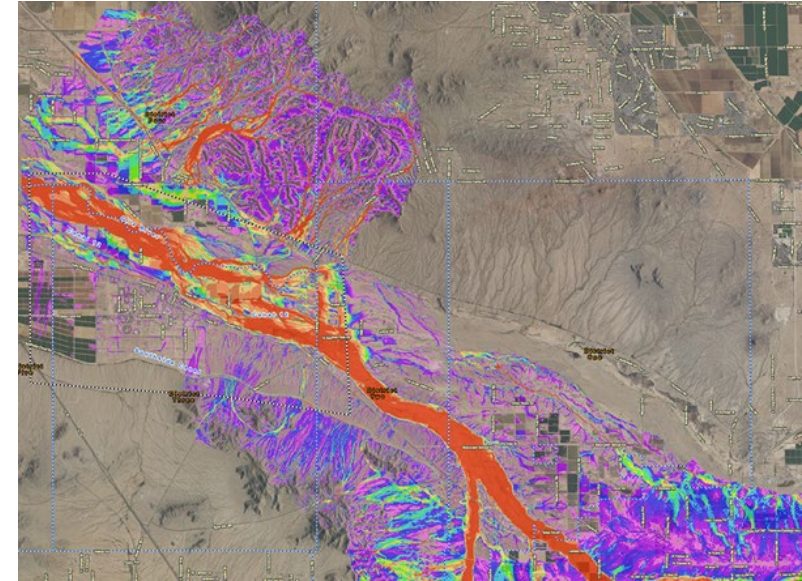


Flood Modeling Techniques

Two broad groups of flood modeling approaches:

- Empirical and statistical models based on observations, including remote sensing.
- Hydrodynamic models with 1-, 2-, or 3-dimensional representation of water flow in an open or closed channel.
 - Hydrologic and Hydraulic models

Tenh et al., 2017: <https://doi.org/10.1016/j.envsoft.2017.01.006>



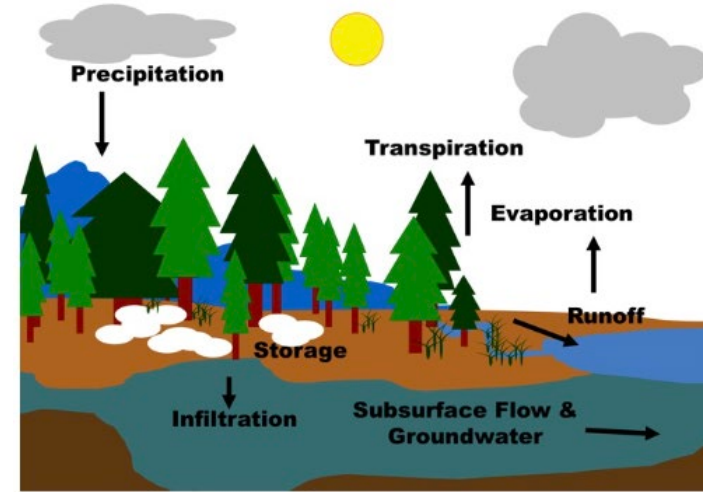
Flood modeling and management use hydrologic, hydraulic, and sediment transport modeling and analyses.

<http://www.helm.world/hydrology-hydraulics.html>

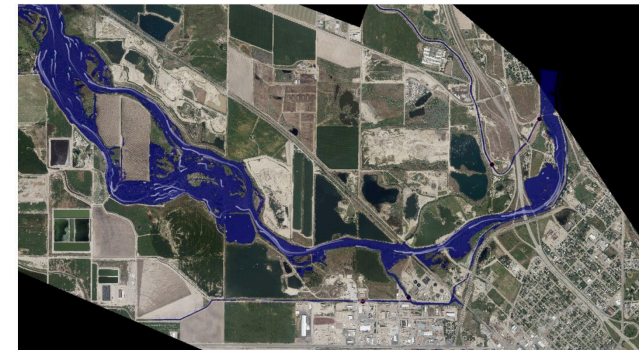


Hydrologic and Hydraulic Flood Modeling

- **Hydrologic Models:** Circulation of water through the hydrologic cycle and quantification of runoff flow produced by precipitation. It deals with precipitation, evaporation, infiltration, groundwater flow, surface runoff, and streamflow.
- **Hydraulics Models:** The mechanical behavior of water in open or closed channels. It provides water flow and depth as water moves from one point to the next in a channel.



https://ncar.github.io/hydrology/projects/hydrologic_modeling



boise river 2d modelling software

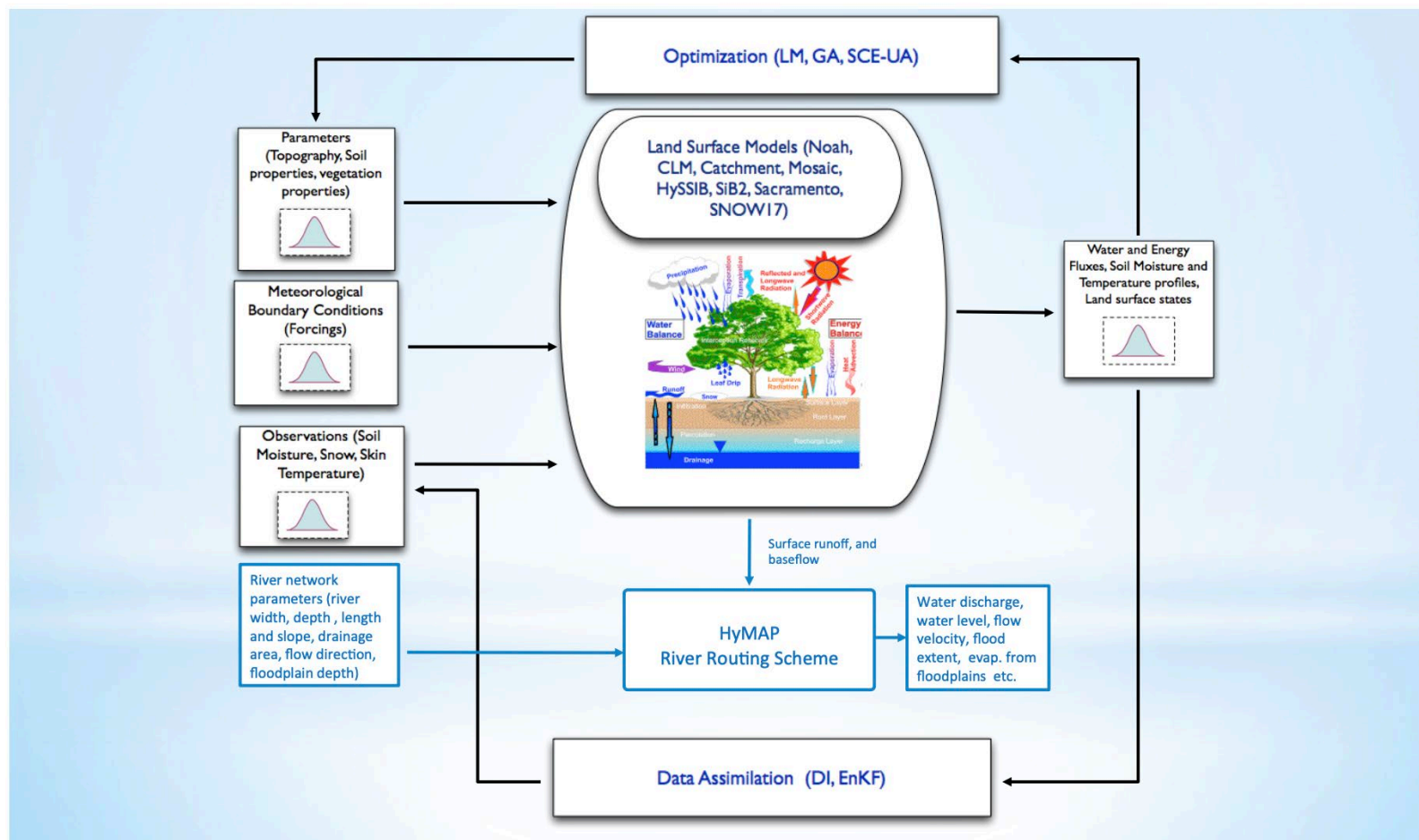
<https://dudek.com/do-you-know-the-difference-between-hydrology-and-hydraulics/>

<https://www.nww.usace.army.mil/Media/Images/igphoto/2002565818/>



NASA Land Information System and HyMAP Routing Model

<https://lis.gsfc.nasa.gov/software/lis>

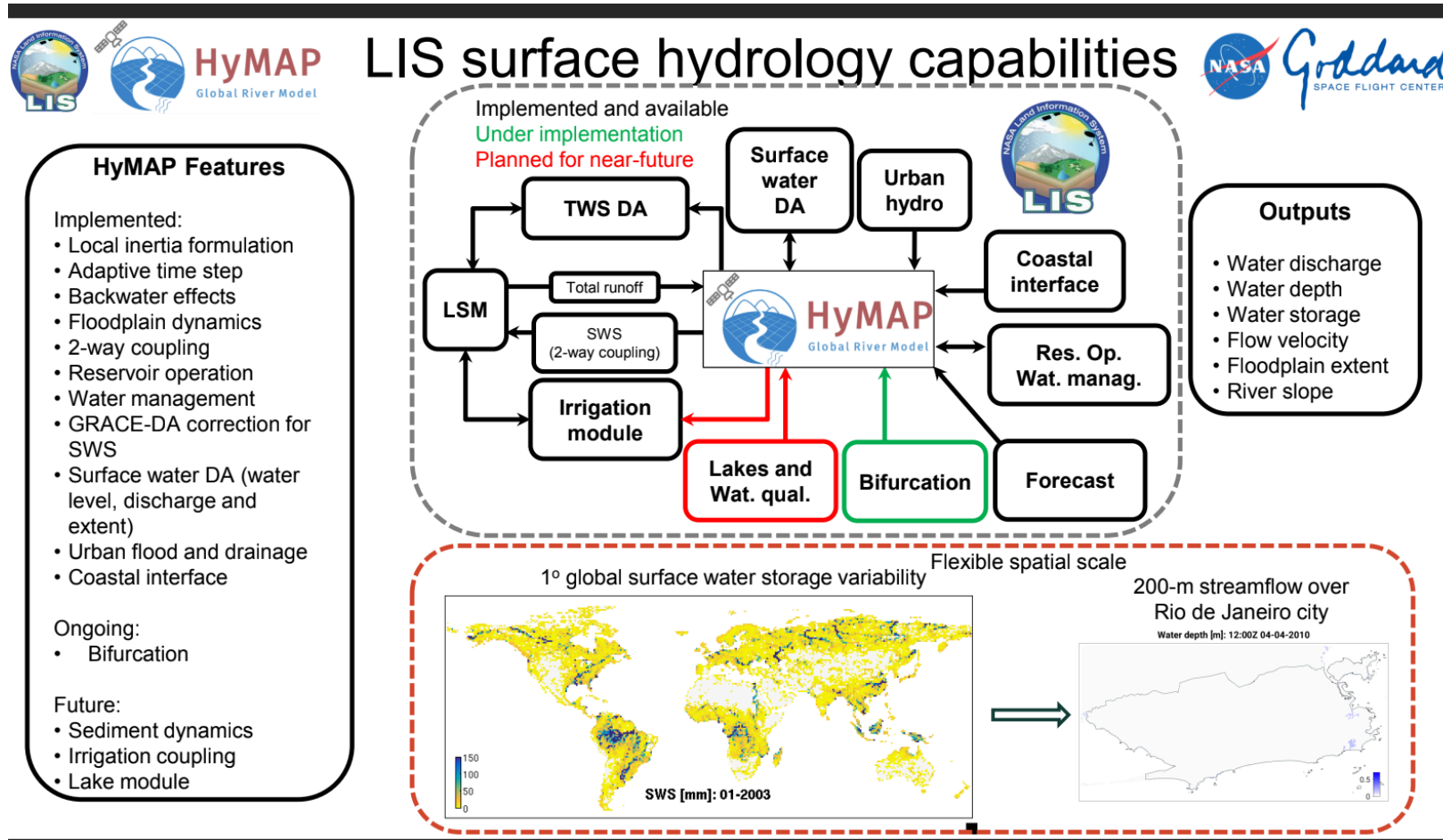


https://ldas.gsfc.nasa.gov/sites/default/files/ldas/nldas/presentations/Getirana_NLDAS_HyMAP_10Nov2016.pdf



NASA Land Information System and HyMAP Routing Model

<https://lis.gsfc.nasa.gov/software/lis>



From A. Getirana, SAIC, NASA-GSFC



Flood Modeling

- Both hydrologic and hydraulic modeling are required for flood mapping and flood risk mapping at watershed level.
- Remote sensing observations are routinely used for inputs:
 - Weather and precipitation data
 - Digital elevation
 - Land cover
- Calibration of flood model parameters is necessary and is performed using historic floods on stream reaches where discharge, flood flow, and elevation data are available.

- NASA Earth observations used for flood monitoring, mapping, and modeling from:
 - MODIS
 - Landsat
 - GPM
 - SRTM
 - SMAP
 - Sentinel-1 and -2 (ESA)

Munawar et al. 2022: Remote Sensing Methods for Flood Prediction: A Review, Sensors (Basel). 2022 Jan 26;22(3):960. doi: 10.3390/s22030960. PMID: 35161706; PMCID: PMC8838435.





Flood Monitoring Tools Based on Remote Sensing

In this training we will focus on observation-based flood monitoring.



Flood Monitoring Tools

- ¹MODIS-Based Flood Mapping (NASA Worldview)
- ¹The Flood Observatory River Watch (DFO River Watch)
- ²Global Disaster Alert and Coordination System (GDACS)

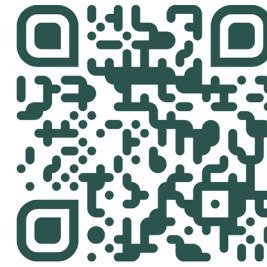
[^1https://appliedsciences.nasa.gov/join-mission/training/satellite-remote-sensing-flood-monitoring-and-management](https://appliedsciences.nasa.gov/join-mission/training/satellite-remote-sensing-flood-monitoring-and-management)

[^2https://appliedsciences.nasa.gov/join-mission/training/english/arset-overview-global-disaster-alert-and-coordination-system-gdacs](https://appliedsciences.nasa.gov/join-mission/training/english/arset-overview-global-disaster-alert-and-coordination-system-gdacs)

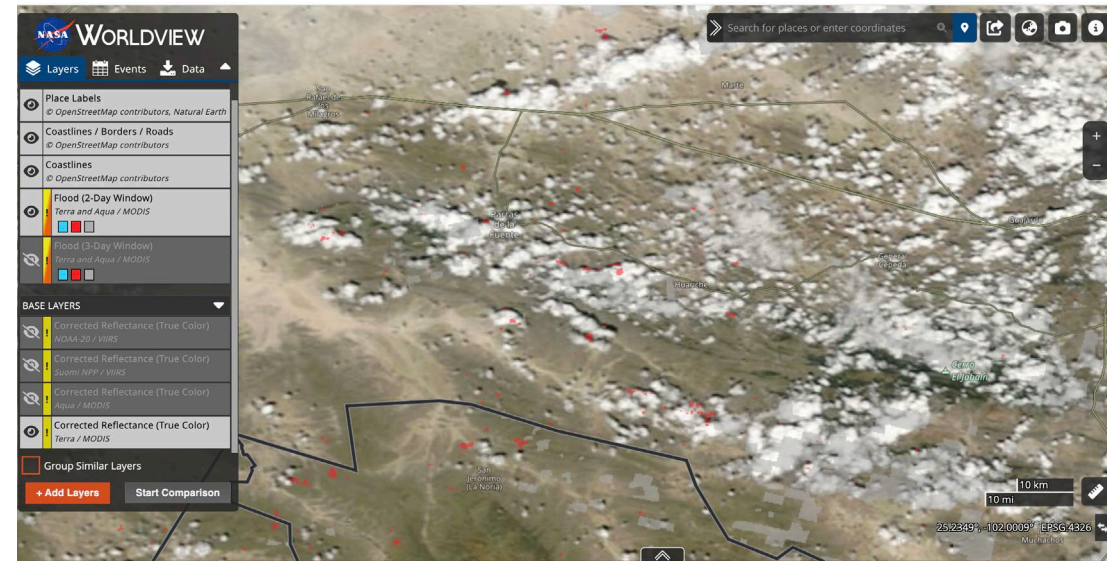
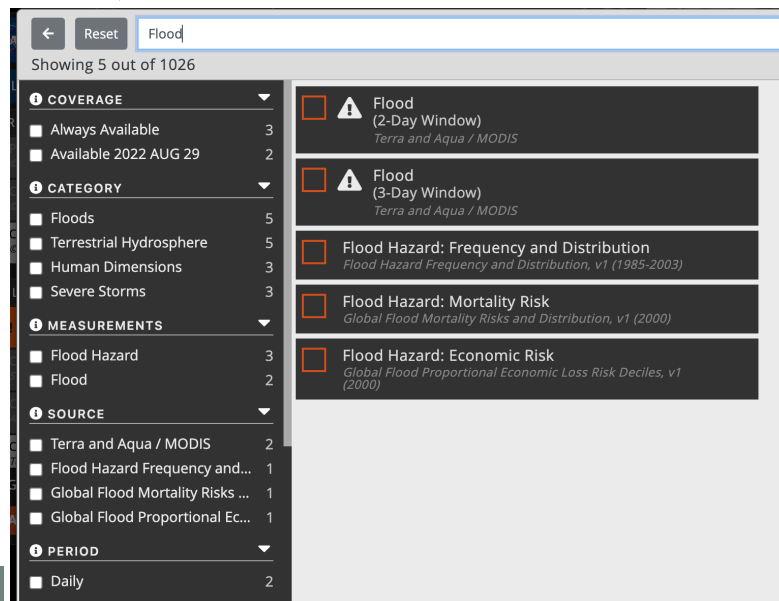
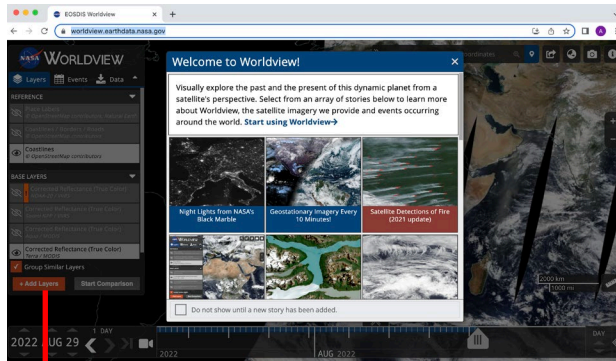


NASA Worldview

<https://worldview.earthdata.nasa.gov/>



2-Day Composite Flooding from MODIS



Replacing the MODIS NRT Flood Map Portal

<https://floodmap.modaps.eosdis.nasa.gov/>



Dartmouth Flood Observatory (DFO River Watch)

<http://floodobservatory.colorado.edu/>

- Based on passive microwave observations and river gauge measurements.
- Currently, a new version and validation of river discharge methodology is underway.

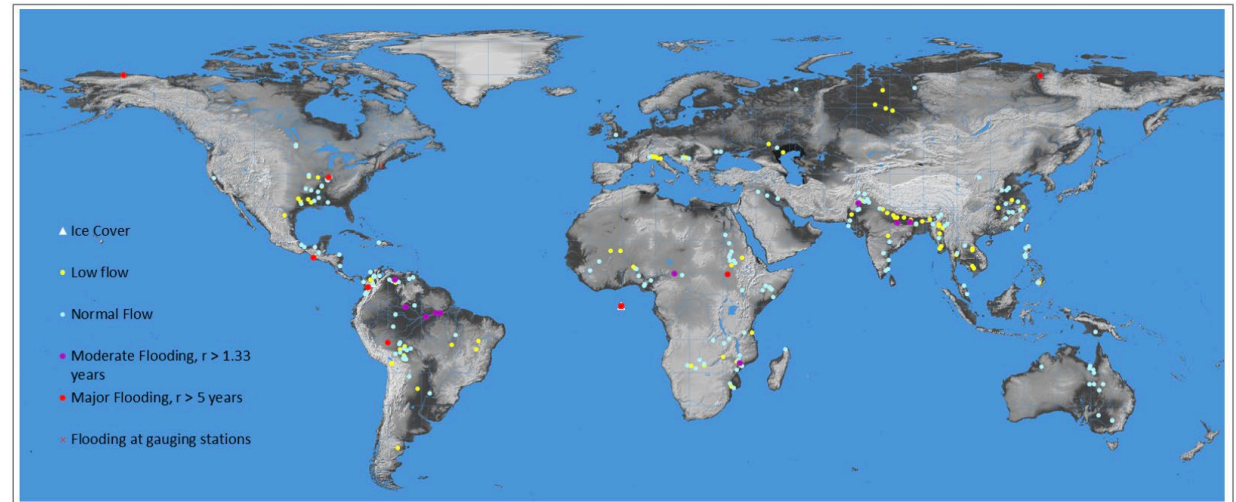


River and Reservoir Watch (Under revision to Version 4.5)

DFO's River and Reservoir Watch provides experimental, fully-automated satellite-based river discharge and reservoir area measurements. Only Version 4.5 has been fully validated to specified error limits.

Twice-daily updates at 2:30 and 14:30 Local Denver Time

See sample [Movie of this Display](#).



<https://floodobservatory.colorado.edu/DischargeAccess.html>



Global Disaster Alert and Coordination System (GDACS)

<https://gdacs.org/>



GDACS is a cooperation framework between the United Nations, the European Commission and disaster managers worldwide to improve alerts, information exchange and coordination in the first phase after major sudden-onset disasters.

GDACS
Global Disaster Alert and Coordination System

HOME ALERTS VIRTUAL OSOCC MAPS & SATELLITE IMAGERY KNOWLEDGE ABOUT

Latest news ON (ECHO 29 Aug 2022) **Indonesia - Floods and landslides (ECHO 29**

Map of disaster alerts in the past 4 days. European Union, 2022. Map produced by EC-JRC. The designations employed and the presentation of material on the map do not imply the expression of any opinion whatsoever on the part of the European Union concerning the legal status of any country, territory or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The blurred events in the list below are the past events before last 4 days. For drought alerts, all the events listed in the homepage are ongoing events. In bold: i) new events; ii) events where a significant worsening has been detected (+ 0.5 GDACS score or increase in the Alert Level); iii) events where new information products are available (Global Drought Observatory Report). For Forest Fires alerts, the events are all the ongoing events of class Orange or Red plus the Green alerts with burned area exceeding 5k ha and population within 5 km exceeding 10k.

EARTHQUAKES	TROPICAL CYCLONES	FLOODS	VOLCANOES	DROUGHTS	FOREST FIRES
Guam (M 5.7) - 29 Aug 12:55	HINNAMNOR-22 (269 km/h) - 29 Aug 12:00	Pakistan - 29 Aug 2022	Krysuvik (Iceland) - 03 Aug 2022	Central South America-2019 - 140 Weeks	The Democratic Republic of Congo (12393 ha) - 28 Aug 2022
Indonesia (M 5.9) - 29 Aug 03:20	TOKAGE-22 (176 km/h) - 25 Aug 2022	Philippines - 26 Aug 2022	Sakurajima (Japan) - 25 Jul 2022	Central Asia-2021 - 97 Weeks	The Democratic Republic of Congo (10159 ha) - 28 Aug 2022

Overall Orange alert Flood
In Pakistan

Summary Impact Media Resources Covid19

Event summary

This flood can have a medium humanitarian impact based on the magnitude and the affected population and their vulnerability.

GDACS Score

0 1 2 3 **2.5**

For more info on GDACS alert score click here.

GDACS ID: FL 1101522
Glide number: FL-2022-000270-PAK
Death: 1061
Displaced: 215997
Countries: Pakistan
From - To: 14 Jun - 29 Aug

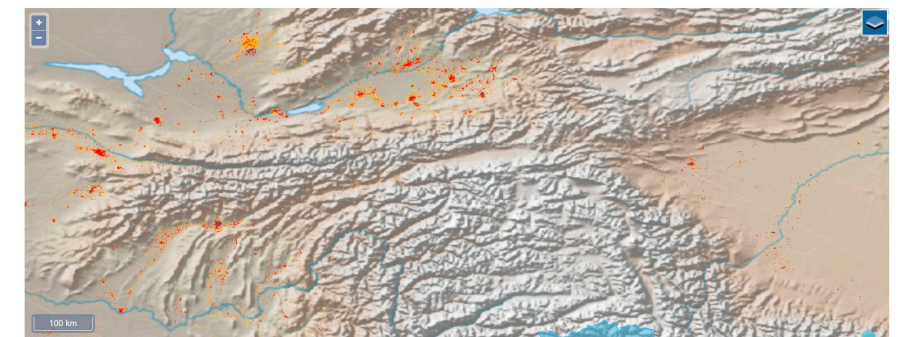
Virtual OSOCC | Meteor assessment | Satellite products | Analytical products

Pakistan, June 2022

Since the beginning of the monsoon season 1,061 people of died (including almost 360 children), 1,575 have been injured and more than 33 million people have been affected across the Provinces of Gilgit-Baltistan, Azad Jammu and Kashmir, Balochistan, Khyber Pakhtunkhwa, Punjab, and Sindh. National authorities and humanitarian partners are providing help across the most affected areas. The EU is providing € 2.15 million in humanitarian aid to families affected by flash floods across the hardest-hit districts of Sindh, Balochistan, Punjab and Khyber Pakhtunkhwa provinces.

Mon 29 Aug 2022

FloodList provided by Copernicus GloFAS



Detailed event map. European Union, 2022. Map produced by EC-JRC. The boundaries and the names shown on this map do not imply official endorsement or acceptance by the European Union.





Demonstration: Flood Monitoring Tools



Thank You!

