Overview of Satellite based flood monitoring

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Presented by William Straka III

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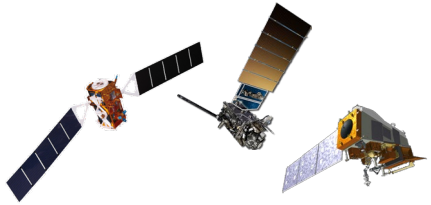
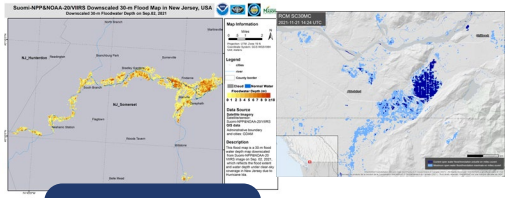
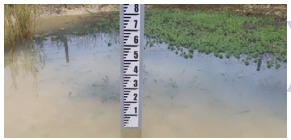
World Meteorological Organization
Organisation météorologique mondiale

Flood Monitoring Scheme







Data collection and analysis

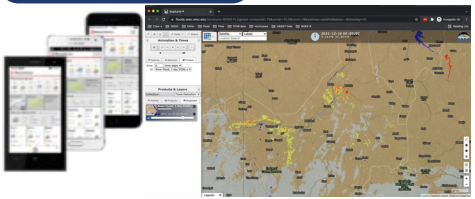
Flood extent monitoring

Input for Modelling for prediction

Model validation

Dissemination of products, training and services to users

Flood response



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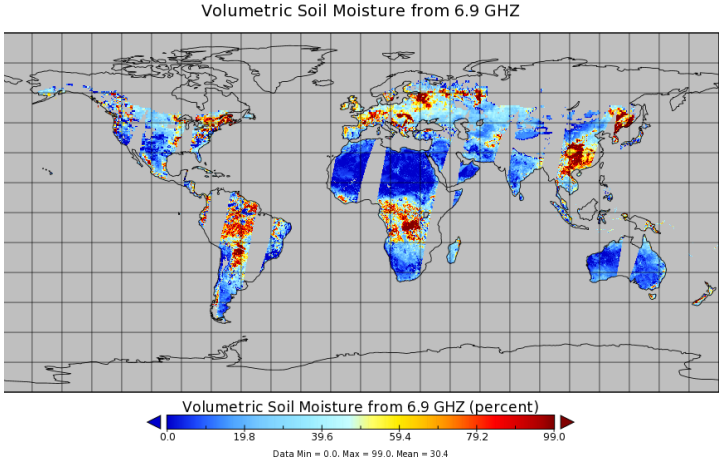
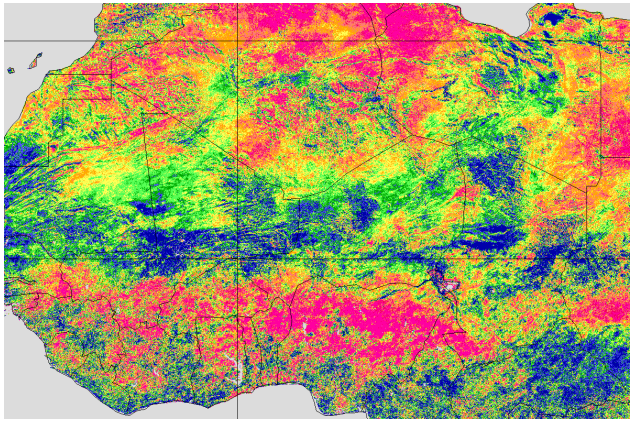
Satellite based soil moisture monitoring

- Soil moisture is important in the forecasting and monitoring of drought conditions as well as helping forecast areas where wildfires are likely to occur as well as helping indicate where impending drought or flood conditions are before other indicators see the event.
- There are several satellite based soil moisture products that are available from active and passive microwave instruments, scatterometers (ex. ASCAT) and imagers (ex. VIIRS) on polar orbiting satellites
- These include the Soil Moisture Operational Products System (SMOPS), which is a blended product including multiple types of instruments; Soil Moisture Active Passive (SMAP); AMSR2/GCOM-W1 surface soil moisture (LPRM) L3 product and VIIRS Vegetation Health Product (VVHP, right image below)
- Owing to the type of product, these are fairly coarse (4km and greater)



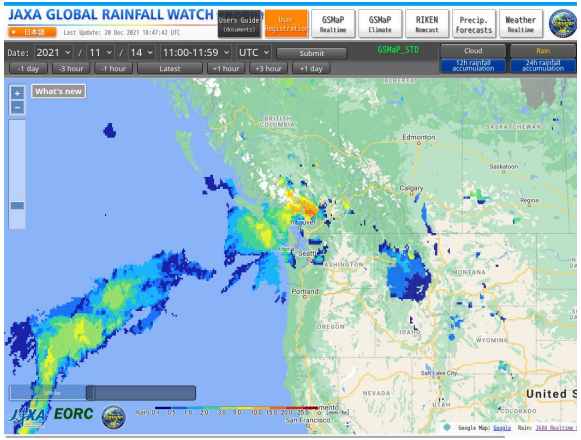
AMSR2/GCOM-W1 surface soil moisture product



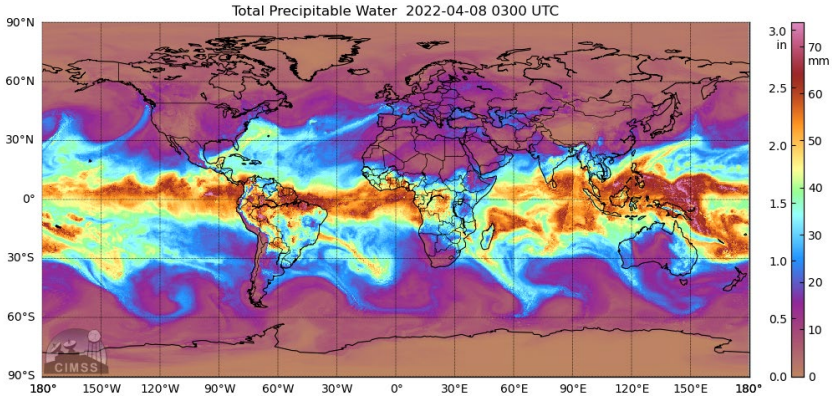
VIIRS Vegetation Health Product

Satellite based precipitation products

- There are several satellite based precipitation algorithms, which can be used to estimate rainfall amounts where there is limited or no radar coverage.
- Other products are able to measure the total precipitable water, which are useful to show where atmospheric river and moisture transport are occuring
- Most algorithms use microwave or infrared sensors from both geostationary and polar orbiting satellites. However, they are at very coarse resolution as compared to ground based weather radars
- Some examples of these include CMORPH2 and GSMaP (precipitation) and MIMIC-TPW (moisture advection).



GSMaP



MIMIC-TPW

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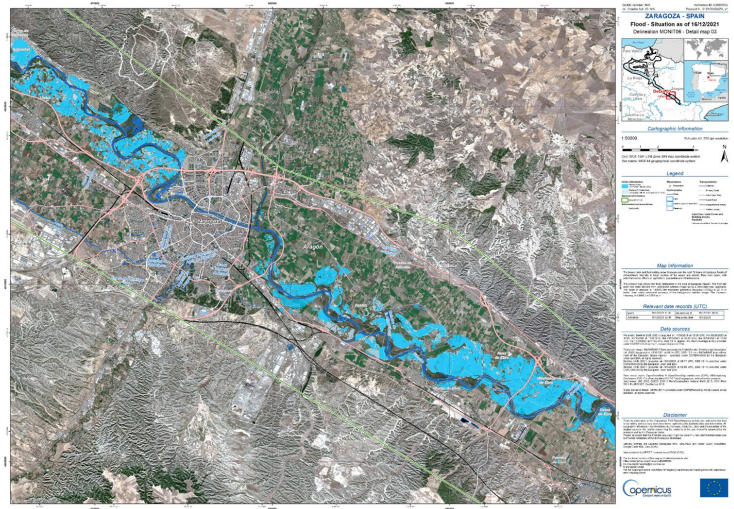
Flood monitoring capabilities from satellites - SAR

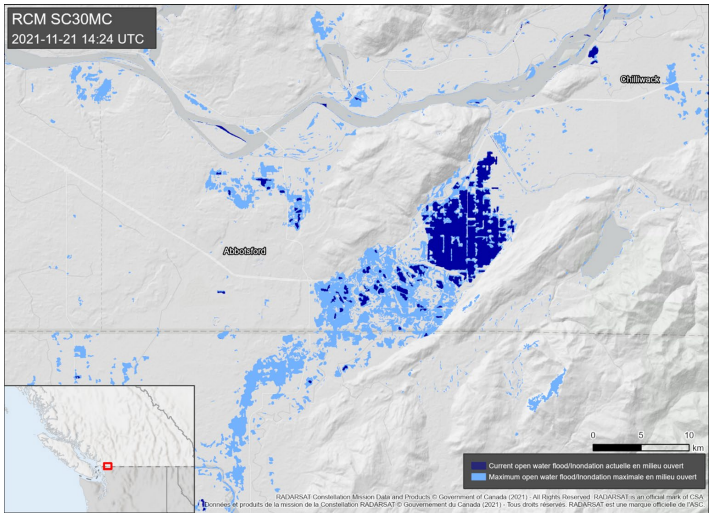
- Provides extremely high resolution flood mapping (10m or less) even at night and through clouds
- Low latency mapping (16+ day repeat, depending on location and constellation)
- Limited availability (data are restricted from some agencies)
- Some operational processing (Copernicus Emergency Management Service (EMS), NRCan, ISRO) as well as some products under development.

Spain: December 16, 2021 (Sentinel-1/SAR-C)



Copernicus Emergency Management Service (EMS)

British Columbia: November 21, 2021 (RCM)



RCM - NR-Can

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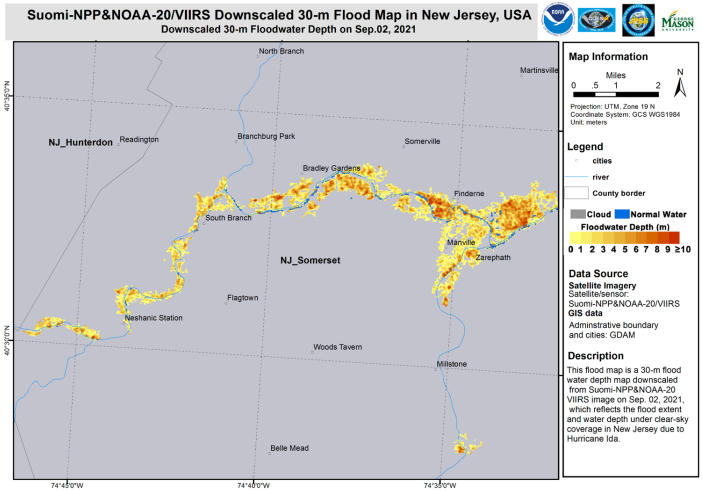
Flood monitoring capabilities from satellites - Optical

- Can provide high temporal resolution flood monitoring
- Consistent monitoring on a daily or hourly basis
- Geostationary satellites can provide flood extent over the course of the day and can help with cloud clearing
- Polar satellites can provide higher resolution flood monitoring in the morning and afternoon



USA: September 02, 2021
(Suomi-NPP, NOAA/VIIRS)

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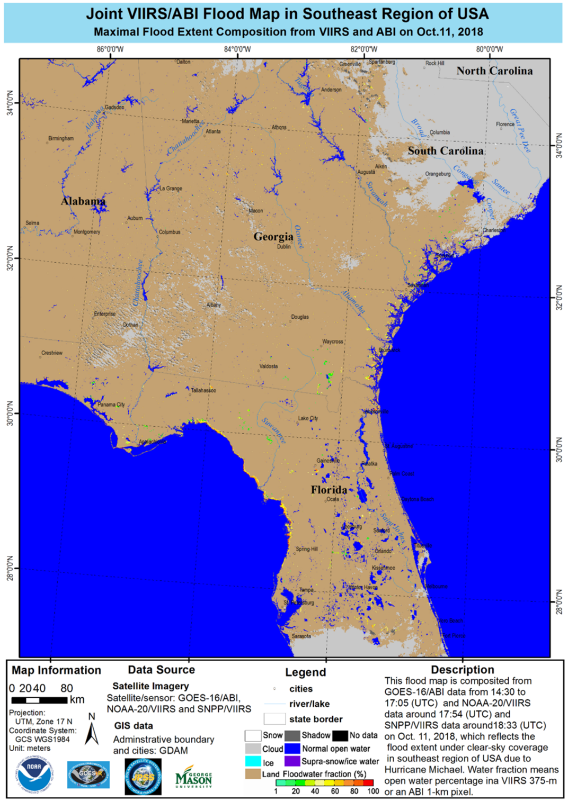
Optical flood monitoring capabilities from satellites - Combined

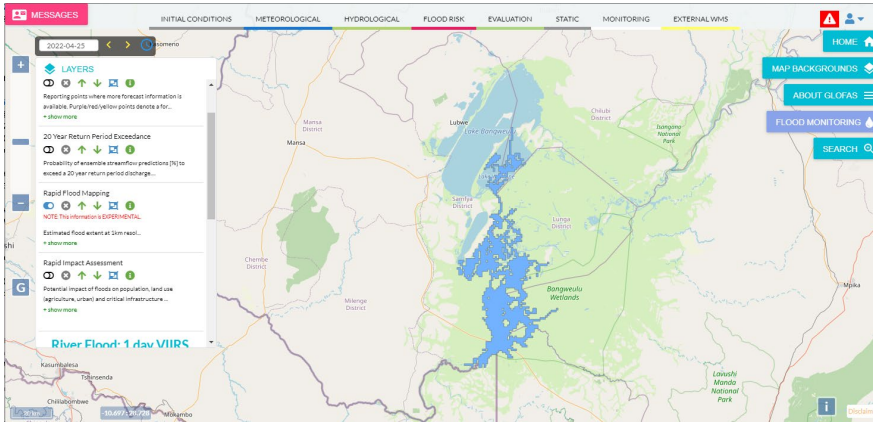
- LEO/GEO
  - Currently being run routinely for NOAA (and JMA) satellites by NOAA
  - Provides best daily and multi-day composites globally
- LEO/GEO/SAR
  - Would combine the best flood mapping from all three types of satellite sensors
  - Currently under investigation with multiple agencies through CEOS (WGDisasters) and other initiatives.



USA: October 11, 2018
(GOES-16/ABI & NOAA-20, Suomi-NPP/VIIRS)

Flood modeling

- There are many different flood modeling systems, both regional and global, that are available for users.
- Currently the only satellite data utilized in flood models is from the radiances and winds assimilated into NWP models, which are then used to model precipitation used by flood models
- GloFAS is a model that provides downstream countries with information on upstream river conditions as well as continental and global overviews.
  - Produces daily flood forecasts and monthly seasonal streamflow outlooks
  - GloFAS provides freely available transboundary forecasts of river conditions



GloFAS website (https://www.globalfloods.eu/) from 25 April 2022 over Zambia

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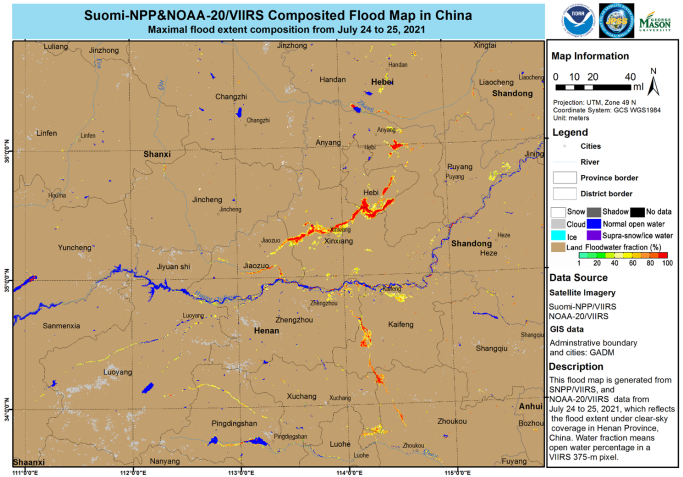
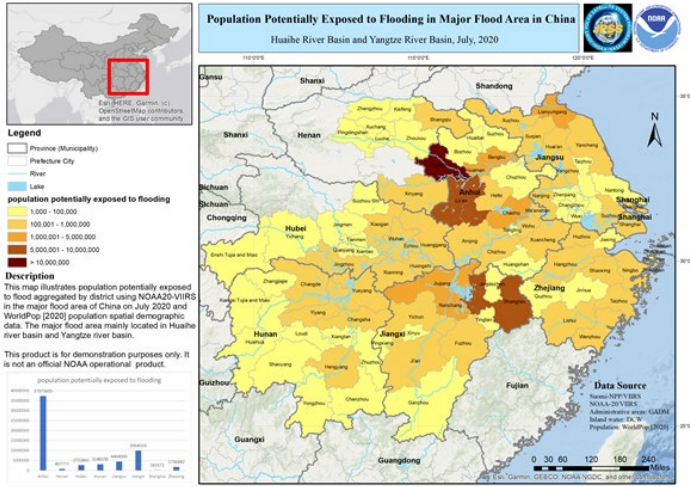
Tying satellite data and socio-economic information together



Population or other socio-economic database

ArcGIS or other GIS application



Li, S.; Goldberg, M.D.; Sjoberg, W.; Zhou, L.; Nandi, S.; Chowdhury, N.; Straka, W., III; Yang, T.; Sun, D. Assessment of the Catastrophic Asia Floods and Potentially Affected Population in Summer 2020 Using VIIRS Flood Products. *Remote Sens.* **2020**, *12*, 3176. https://doi.org/10.3390/rs12193176

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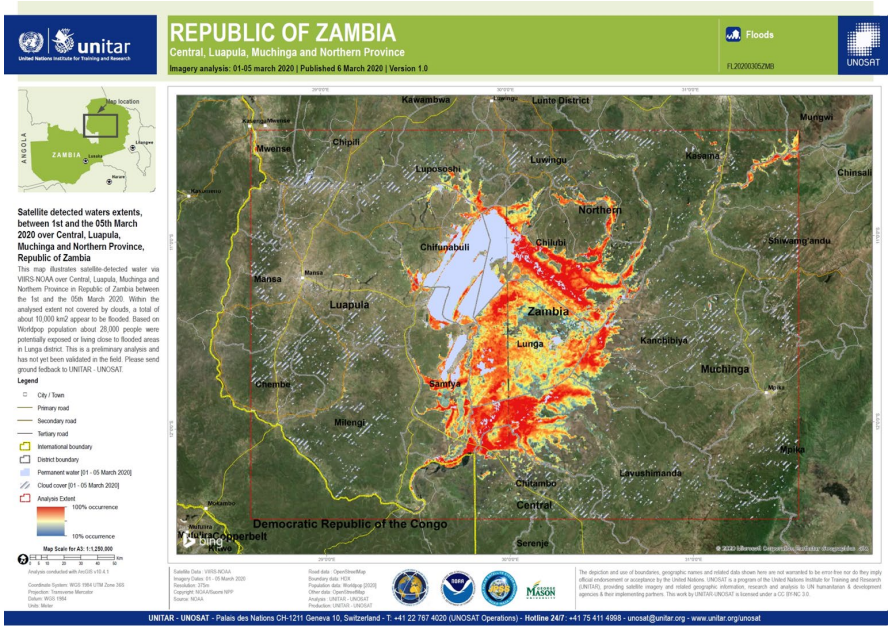
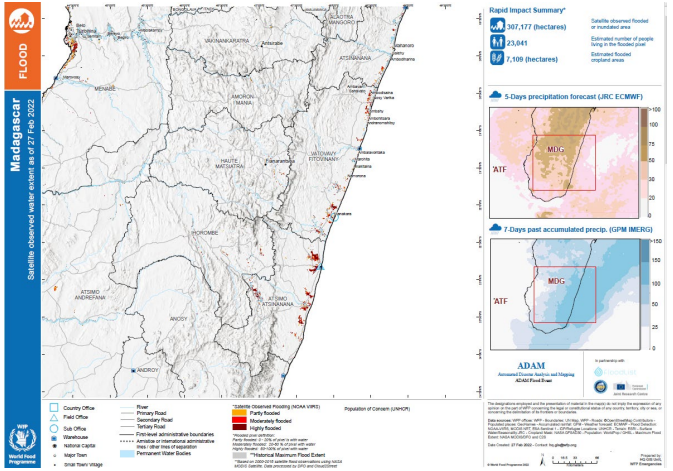
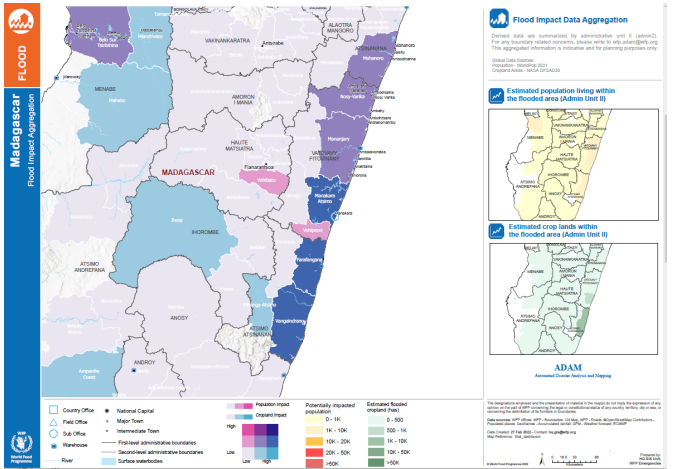
Use cases







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VLab as a Global Network of Training Providers in satellite meteorology and related fields

WMO and CGMS established the Virtual Laboratory for Training and Education in Satellite Meteorology (VLab) in 2000. It is a global network of 13 specialized training centres and 8 satellite operators working together to improve the utilization of data and products from meteorological and environmental satellites.

Satellite Agencies

CMA, CONAE, EUMETSAT, INPE, JMA, KMA, NOAA, and ROSHYDROMET

Centres of Excellence

Costa Rica, Barbados, Brazil, Argentina, Morocco, Niger, Oman, Kenya, South Africa, Russian Federation, Republic of Korea, China, Australia

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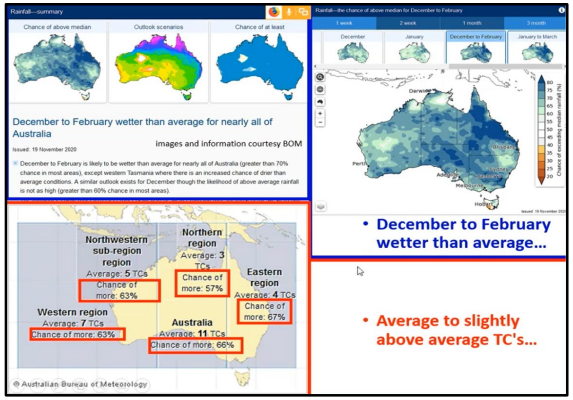
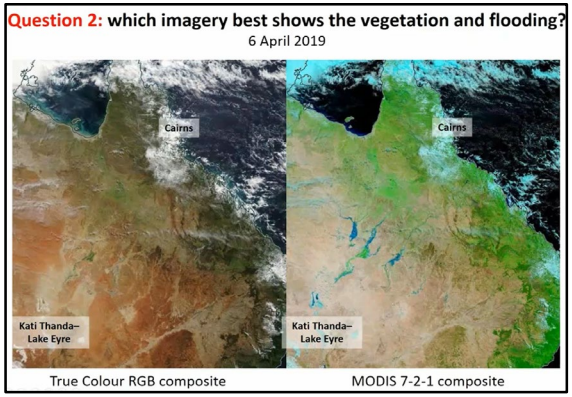
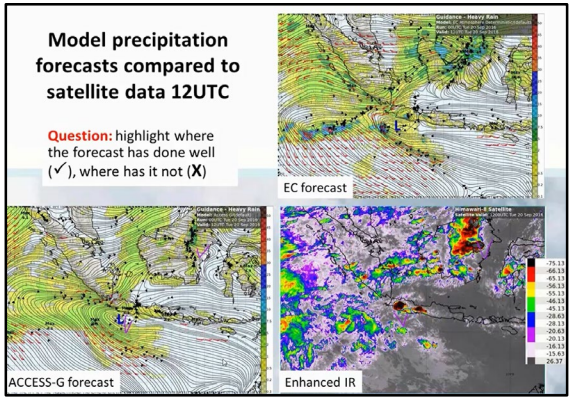
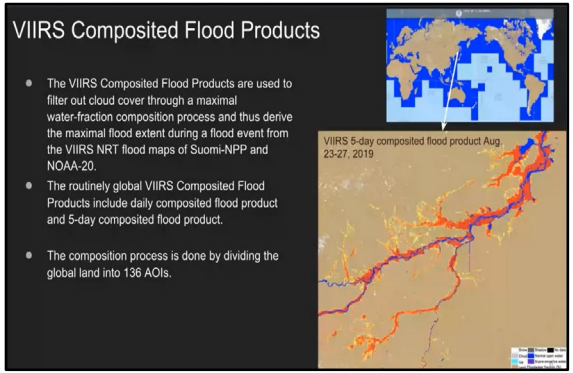
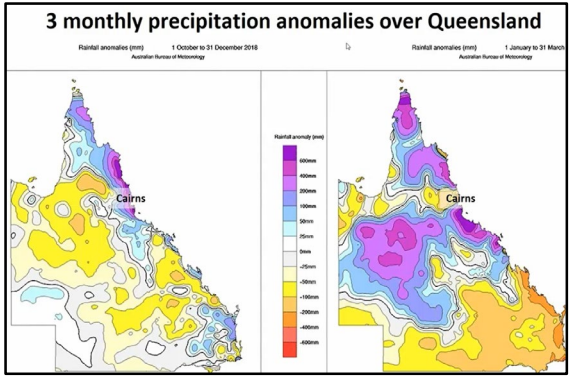
BoM VLab Training - Examples

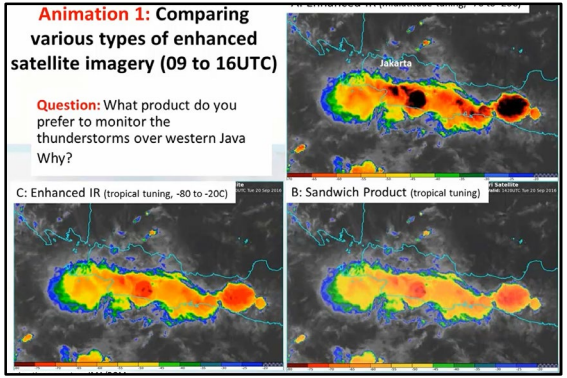












23rd November 2020 Regional Focus Group meeting

30th April 2019 Regional Focus Group meeting

11th October 2016 Regional Focus Group meeting

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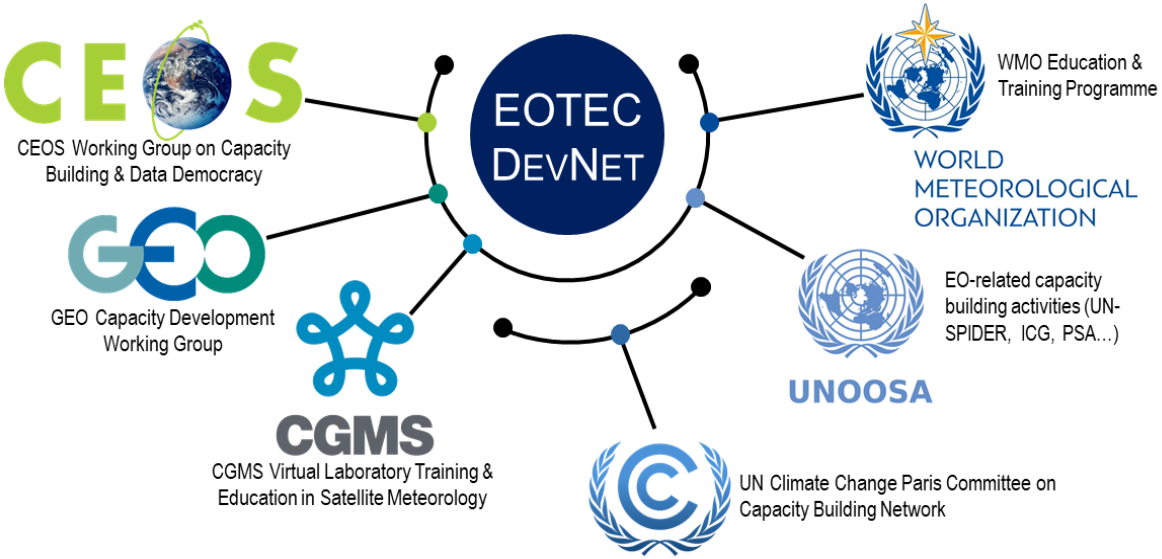
EOTEC DevNet partners, aim and themes



AIM: Improve collaboration among EO-capacity building providers, foster exchange of capacity building resources, support needs assessment

THEMATIC FOCUS: Global sustainable development outcomes related to disaster risk reduction, climate adaptation and climate mitigation

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How EOTEC DevNet operates

EOTEC DevNet

Regional Communities of Practice (COP)

Africa, Americas, Asia/Oceania, Europe

Regional Task Teams

Thematic Working Groups

+

Global Structures

Leadership

Task Team

Secretariat

Thank you
Merci

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TEMPS CLIMAT EAU

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