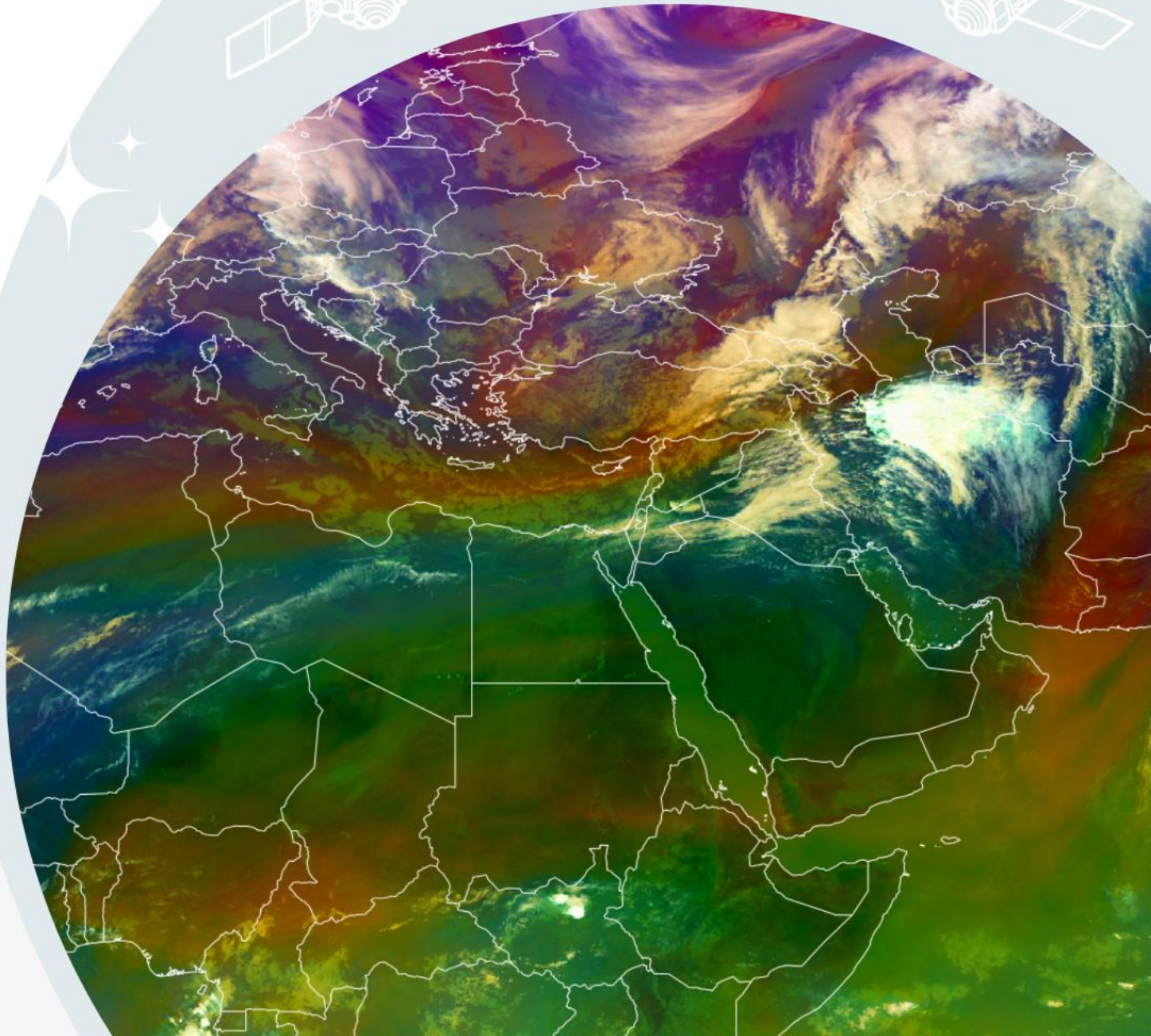
Artificial Intelligence Techniques for Precipitations Estimation



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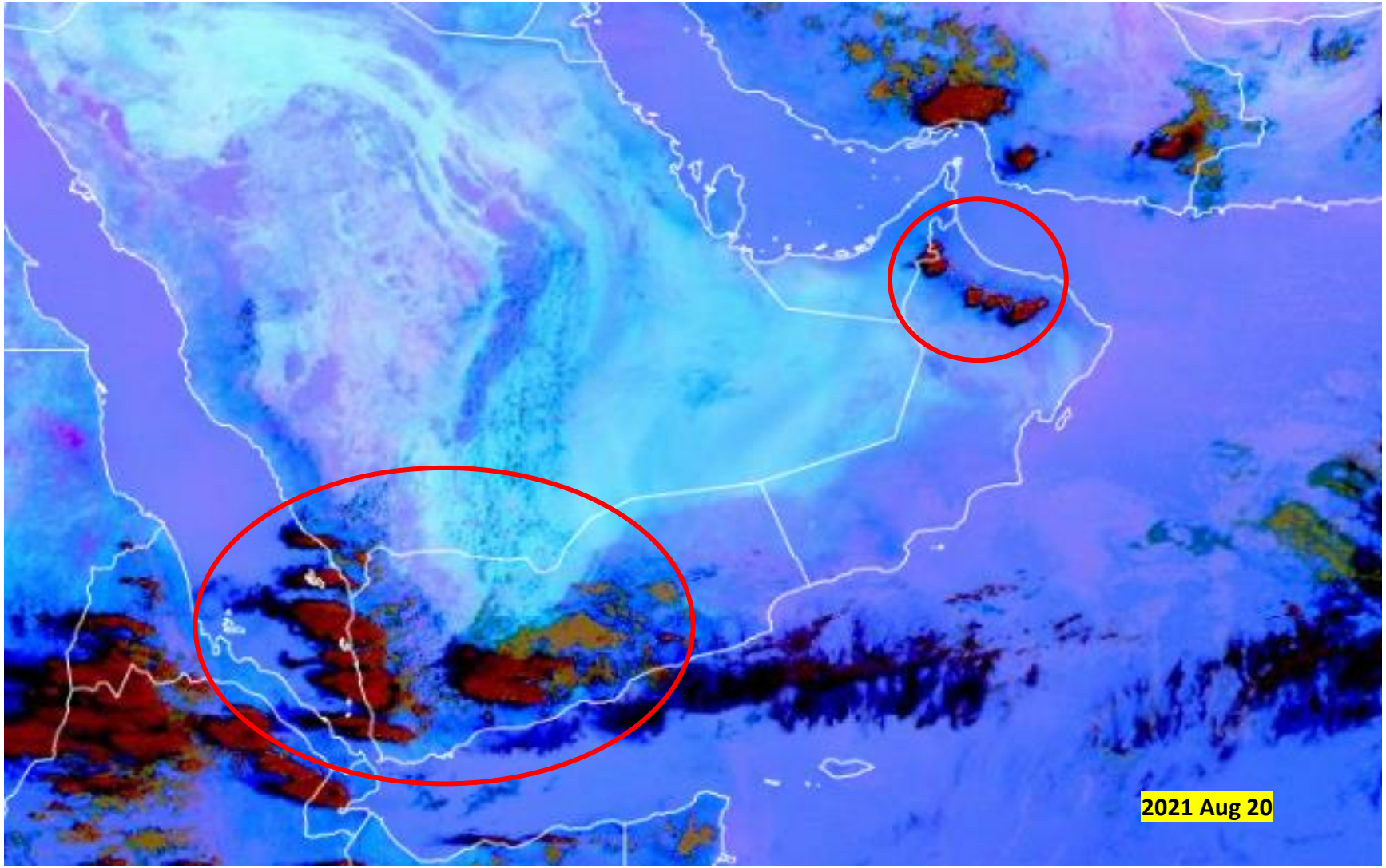
Contents :

- Type of Precipitation
- Rain Measurements
- Rain measurements limitation and problems
- Artificial inelegance in precipitation estimation
- Practical

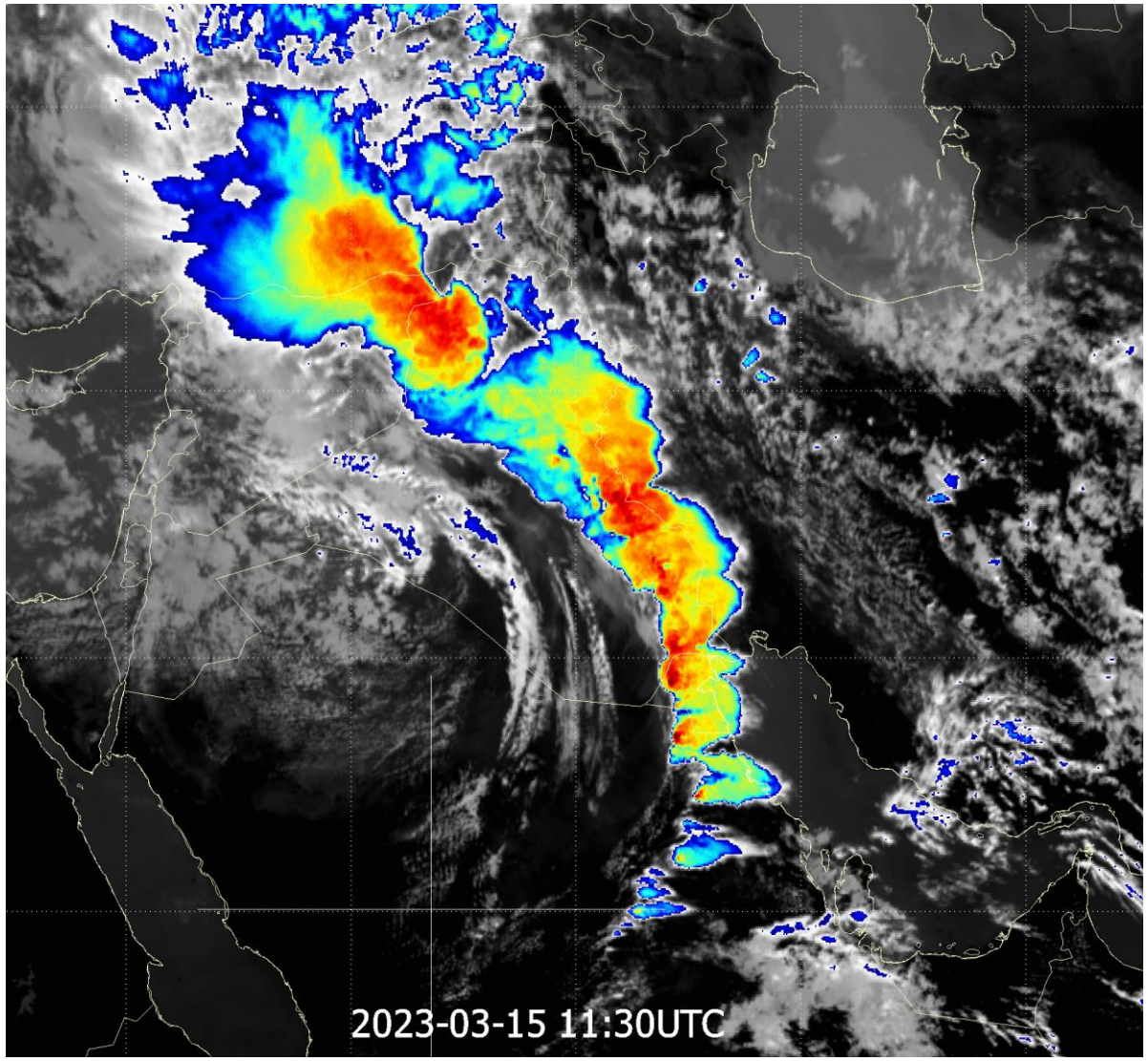
Precipitation : Any form of water that falls from clouds towards the ground.

Weather Features and Clouds Causing Precipitations

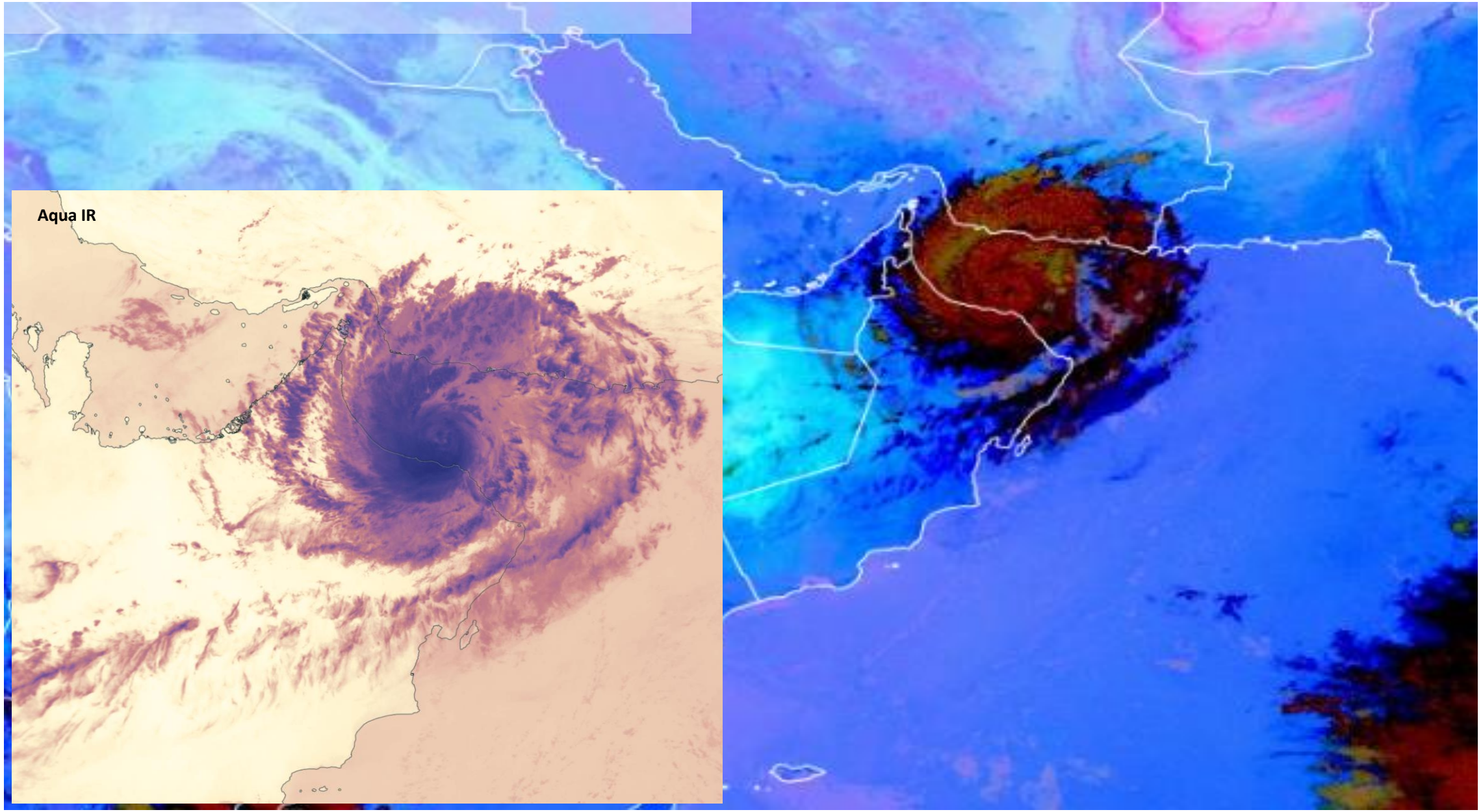
Convective Clouds :



Frontal Systems :

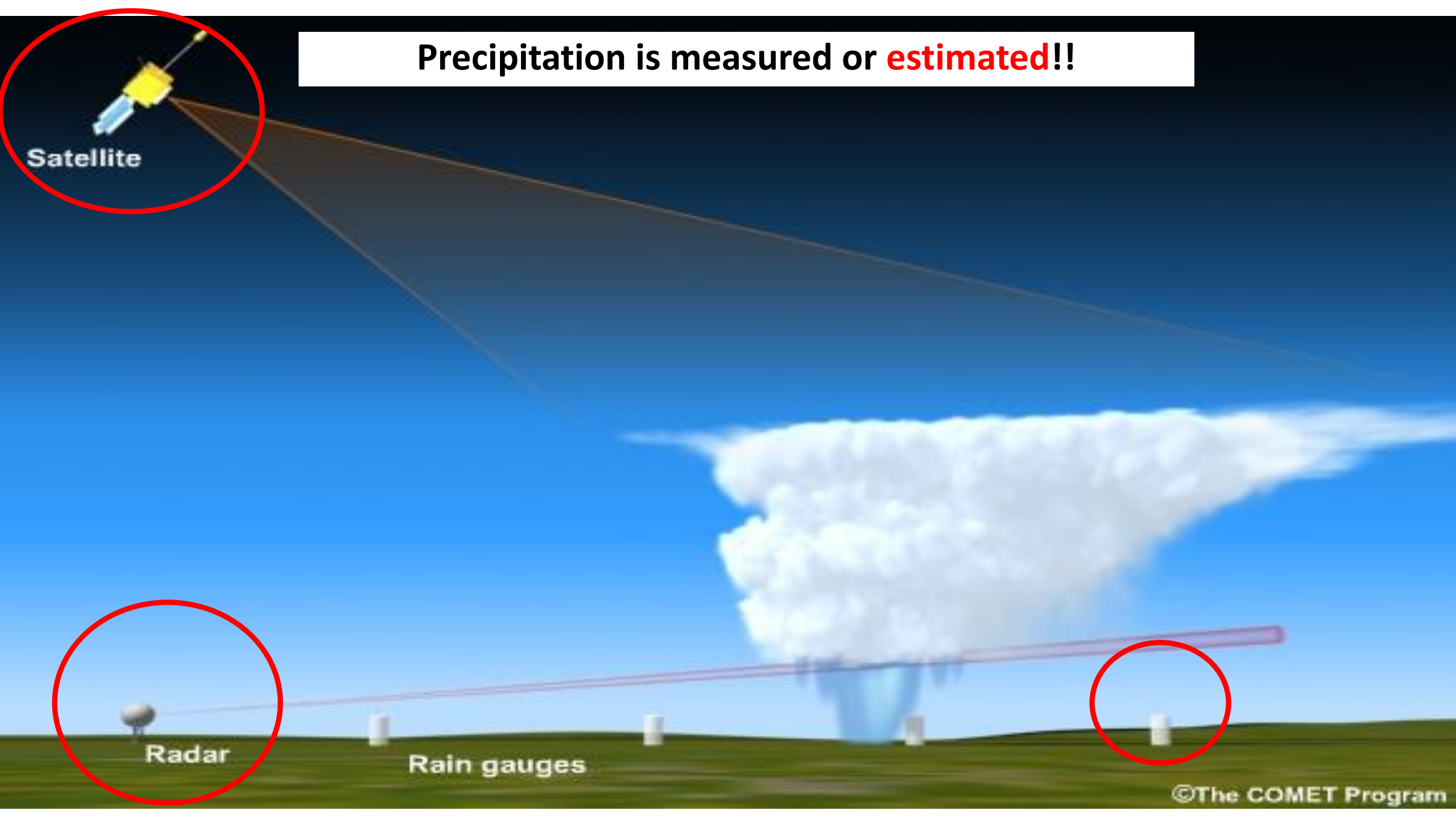


Tropical Storms and Cyclones



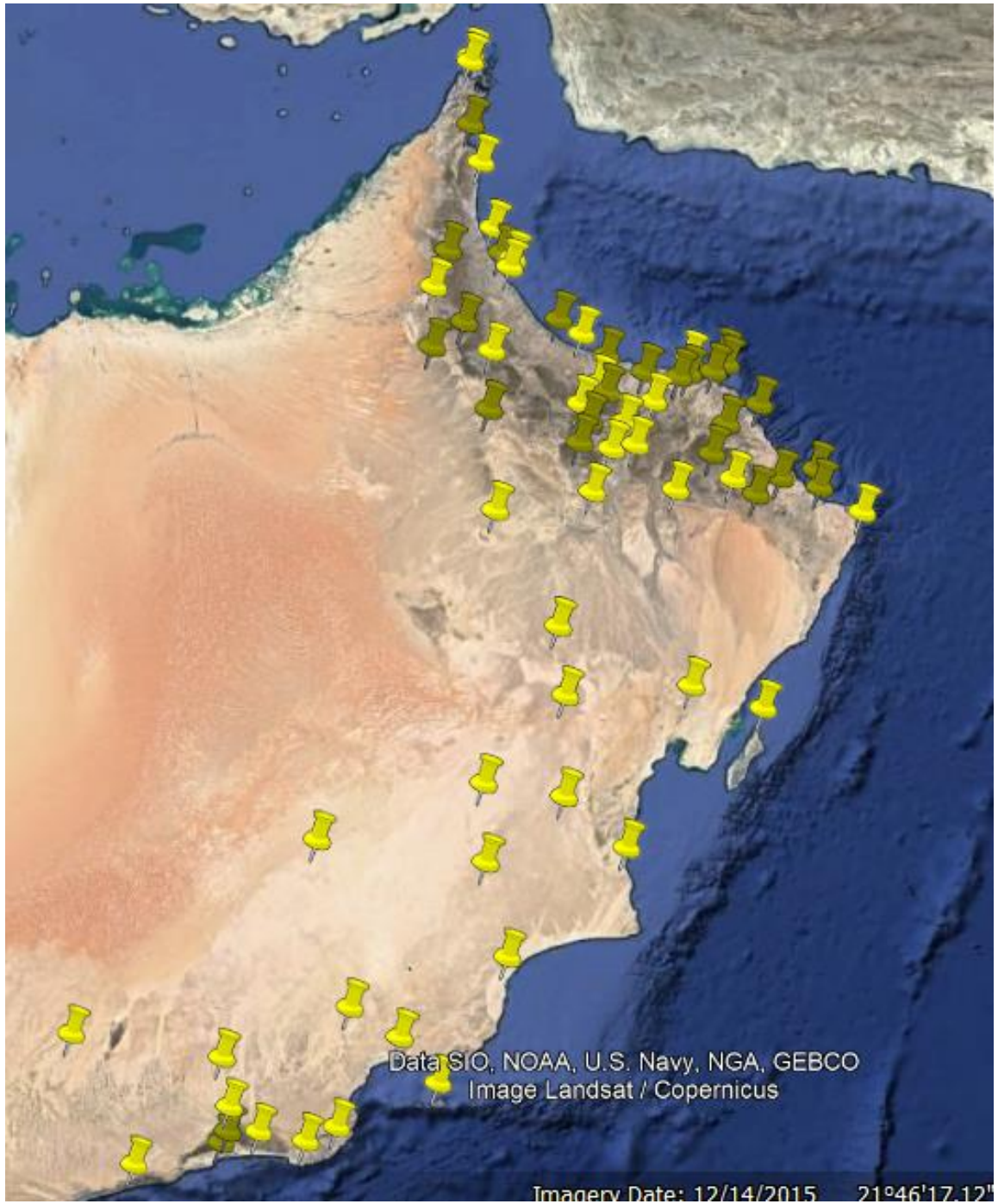
Shaheen 2021 Oct 03

Precipitation is measured or estimated!!



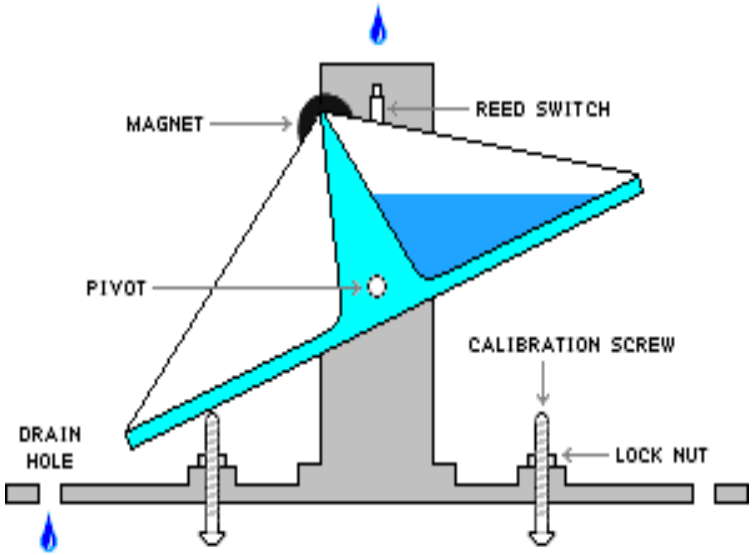
Precipitation Measurement Problems

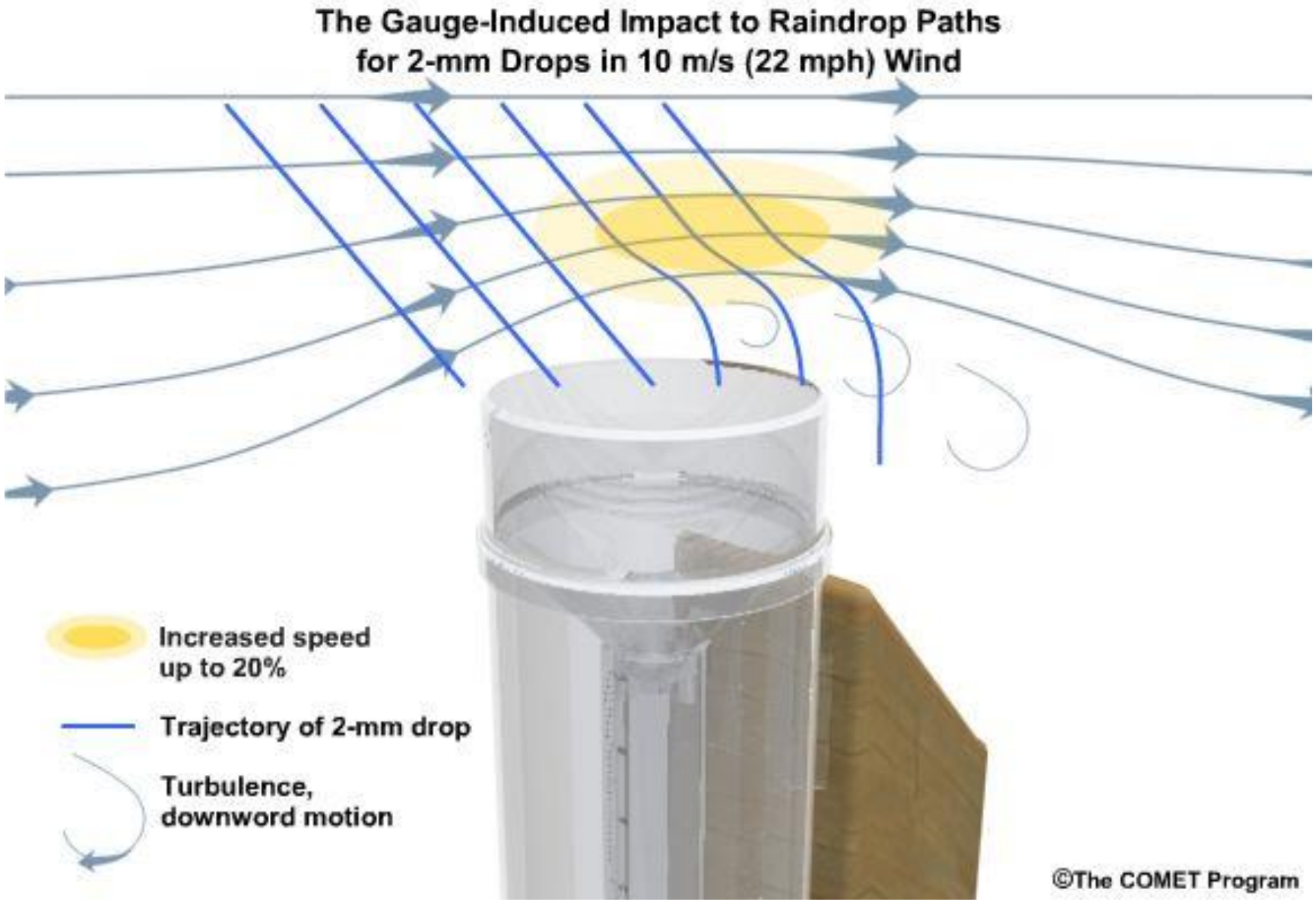
Ground Weather Stations



Wind Impact !

Rain Gauges

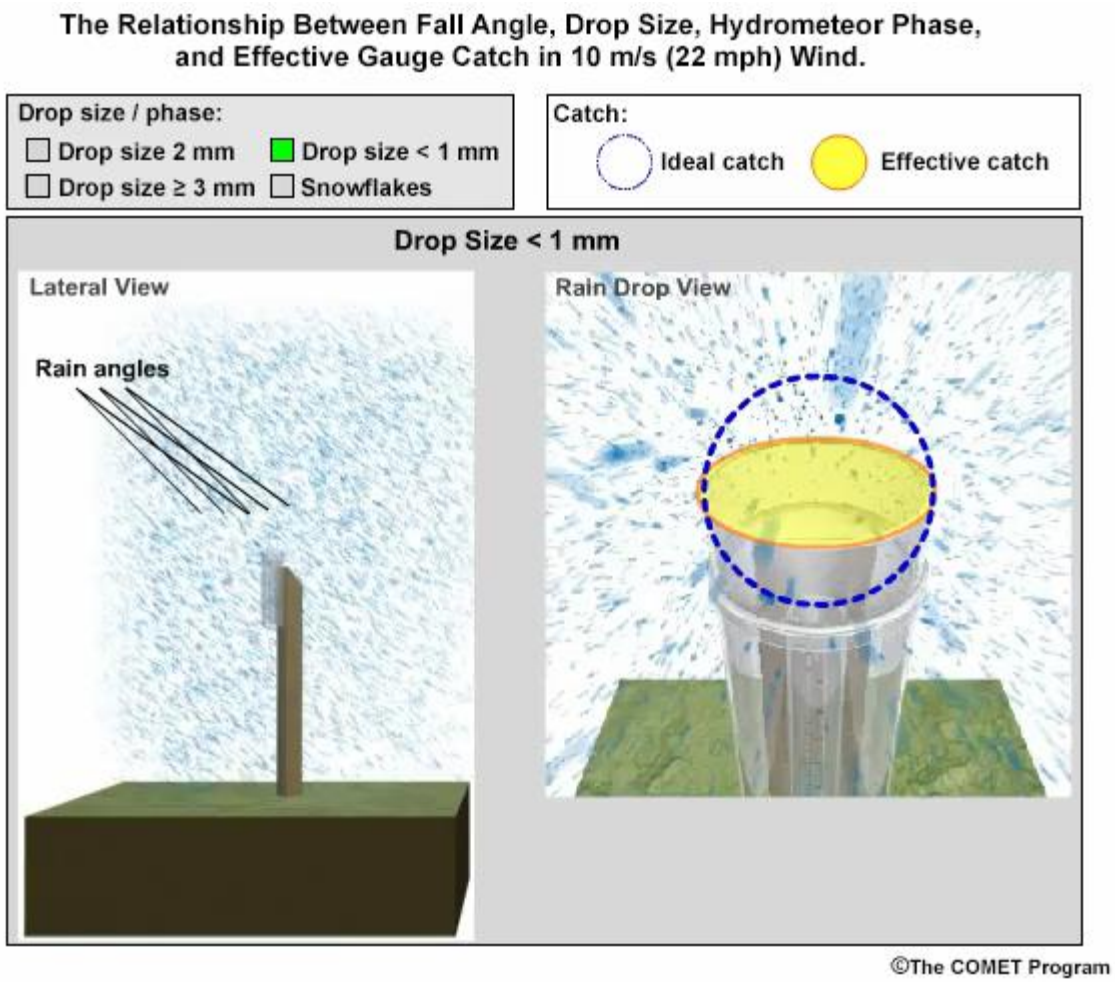

MAGNET
REED SWITCH
PIVOT
CALIBRATION SCREW
DRAIN HOLE
LOCK NUT

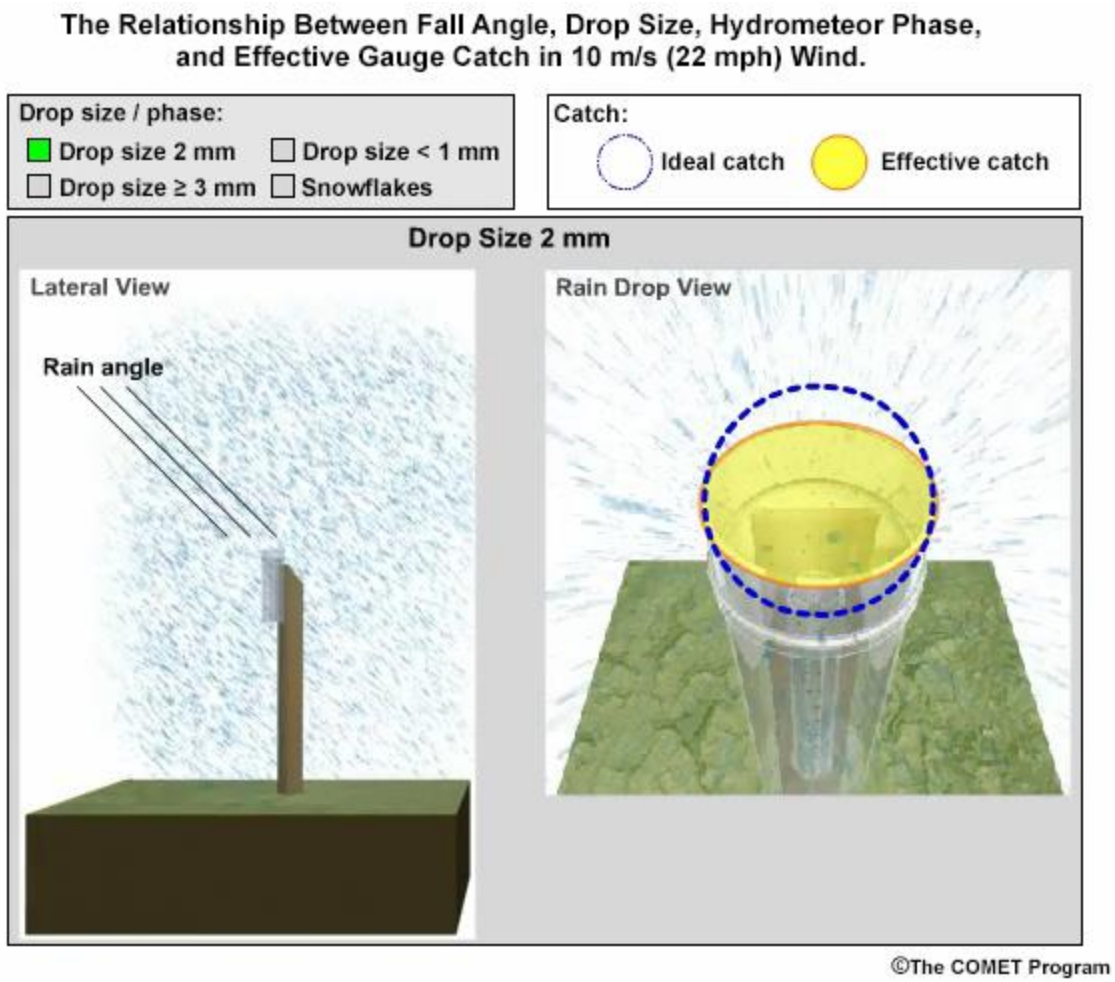

The Gauge-Induced Impact to Raindrop Paths
for 2-mm Drops in 10 m/s (22 mph) Wind
Increased speed
up to 20%
Trajectory of 2-mm drop
Turbulence,
downword motion
©The COMET Program

Wind Shade

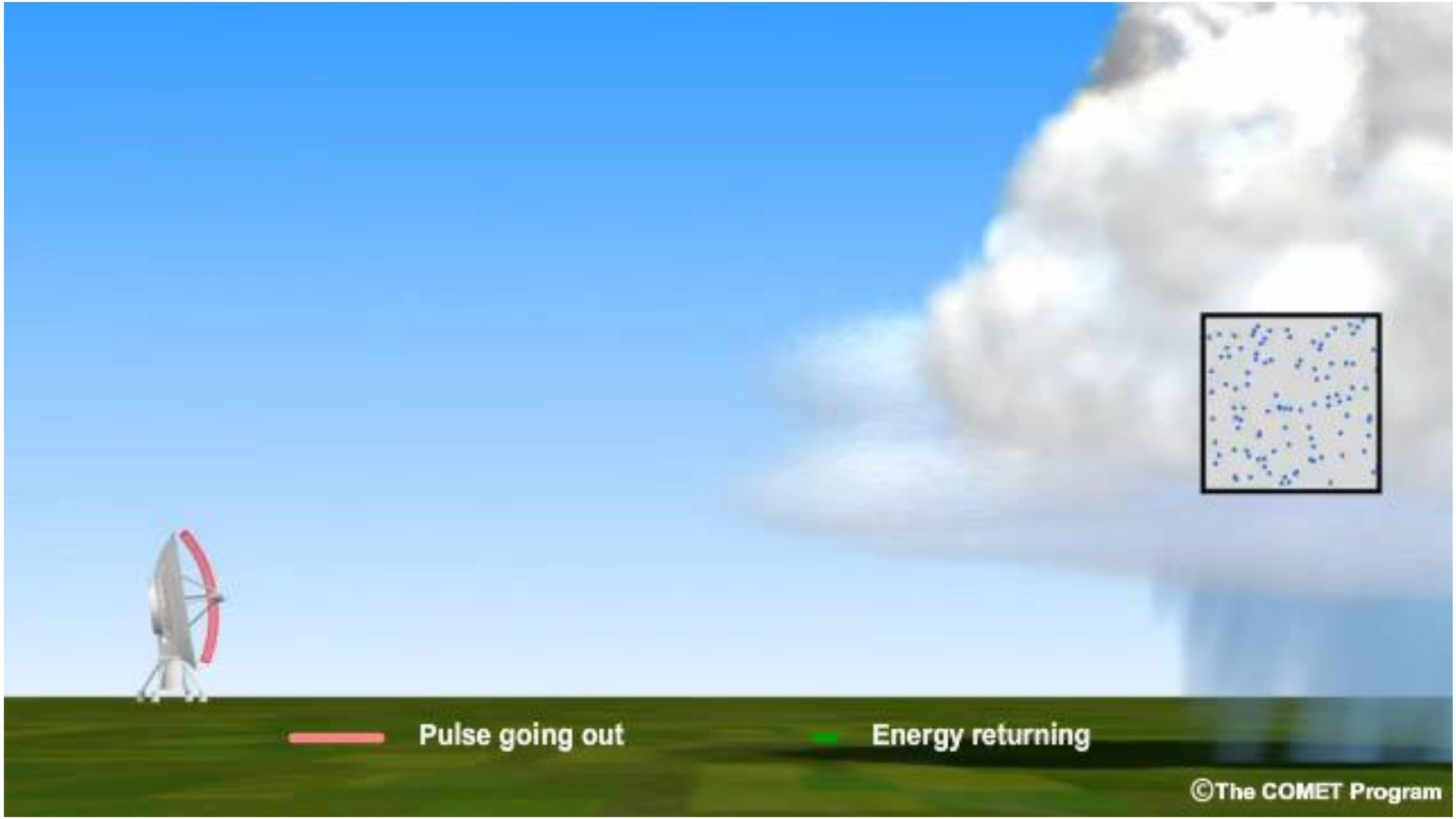

فلم وثائقي لاعصار #شاهين شاهد مركز العاصفة في عين إعصار شاهين
العاصفة
Fall Angle

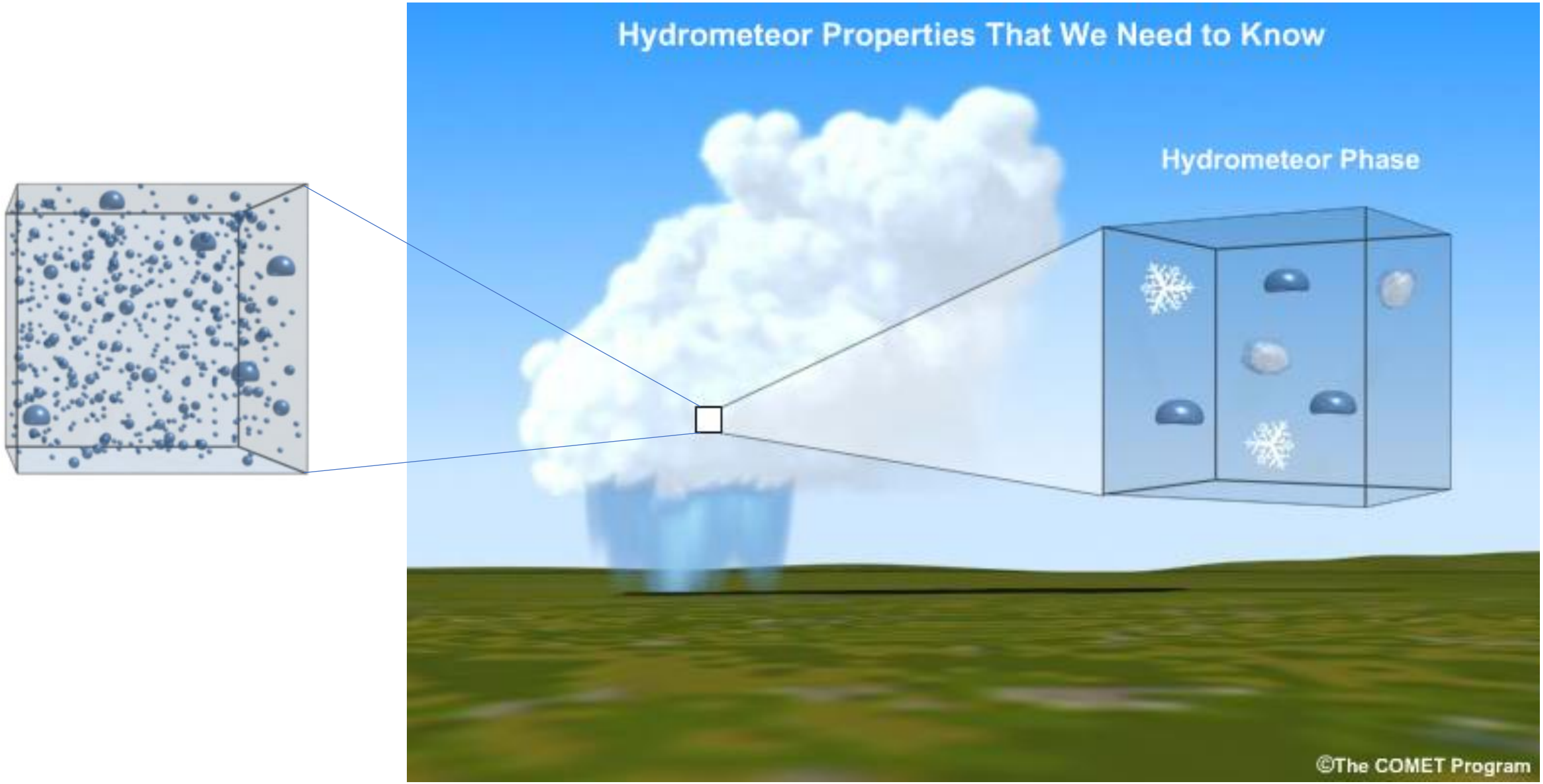
Fall Angle





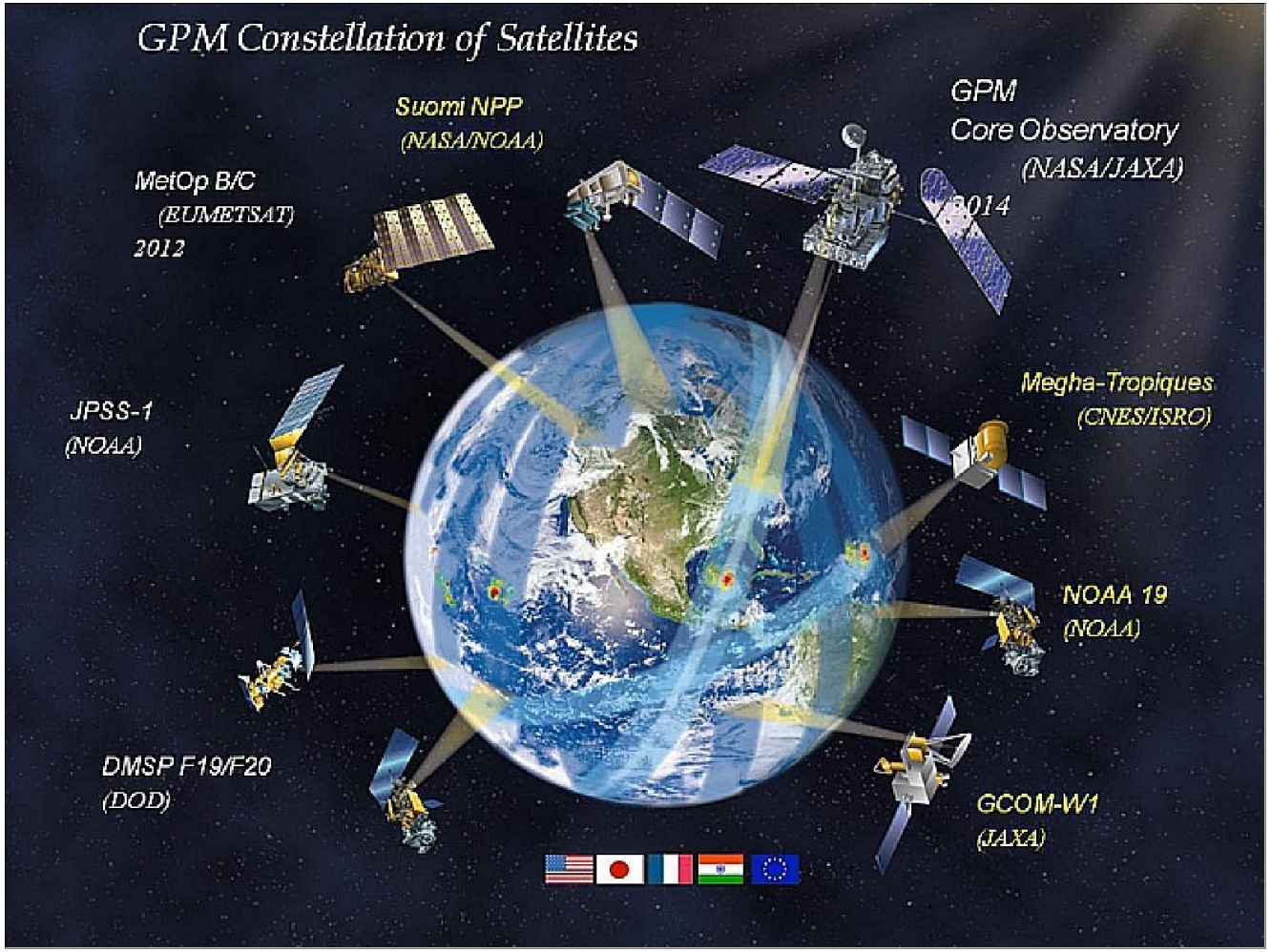
https://www.meted.ucar.edu/hydro/precip_est/part1_measurement/print.php

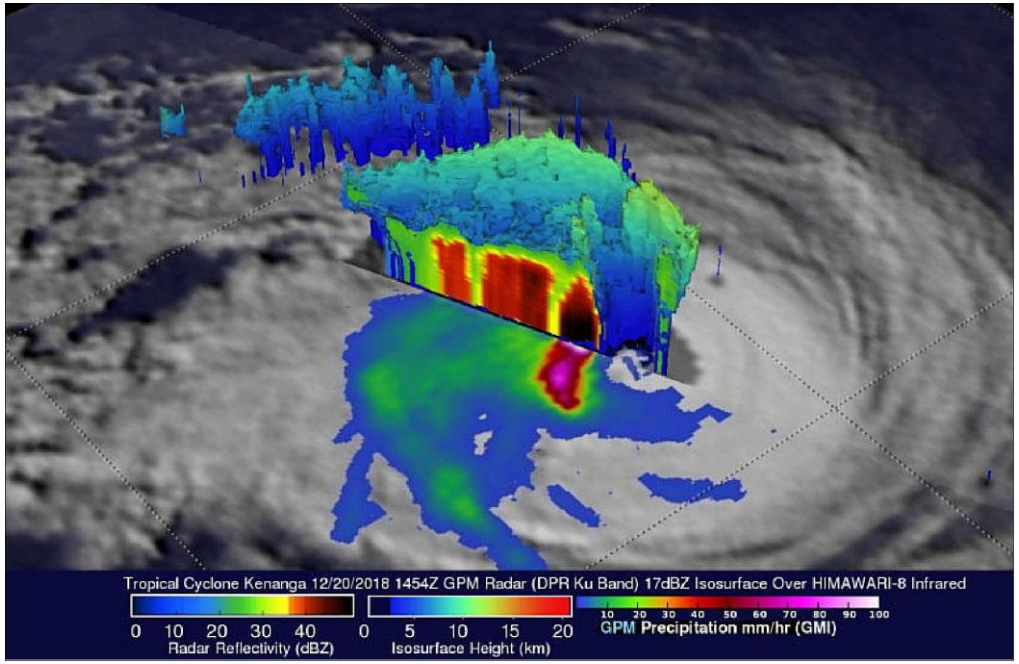

Pulse going out
Energy returning
©The COMET Program

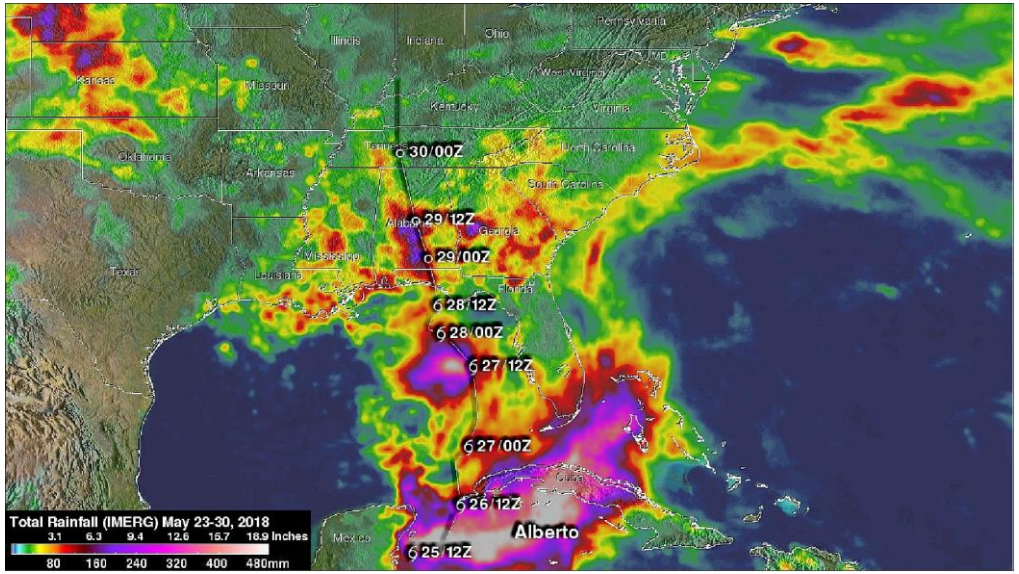

Hydrometeor Properties That We Need to Know
Hydrometeor Phase
©The COMET Program


Influences On Radar Coverage
©The COMET Program

Satellites


GPM Constellation of Satellites
Suomi NPP
(NASA/NOAA)
GPM
Core Observatory
(NASA/JAXA)
2014
MetOp B/C
(EUMETSAT)
2012
JPSS-1
(NOAA)
Megha-Tropiques
(CNES/ISRO)
NOAA 19
(NOAA)
DMSP F19/F20
(DOD)
GCOM-W1
(JAXA)


Tropical Cyclone Kenanga 12/20/2018 1454Z GPM Radar (DPR Ku Band) 17dBZ Isosurface Over HIMAWARI-8 Infrared
0 10 20 30 40
Radar Reflectivity (dBZ)
0 5 10 15 20
Isosurface Height (km)
10 20 30 40 50 60 70 80 90 100
GPM Precipitation mm/hr (GMI)

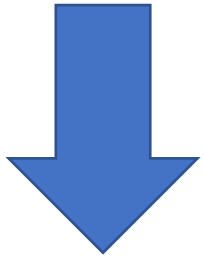

30/00Z
29/12Z
29/00Z
28/12Z
28/00Z
27/12Z
27/00Z
26/12Z
25/12Z
Alberto
Total Rainfall (IMERG) May 23-30, 2018
3.1 6.3 9.4 12.6 15.7 18.9 Inches
80 160 240 320 400 480mm

Satellites

Radars

Rain Gauges

Others

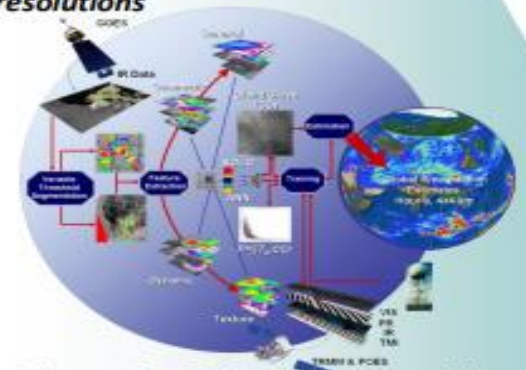


Integrated Products to Estimate Precipitation

CHRS : Center For Hydrometeorology & Remote Sensing

University of California

Develop state-of-the-art systems to estimate rainfall from satellite observations at global scale and high spatial and temporal resolutions



Information Technology to provide world-wide access to real-time global precipitation products:

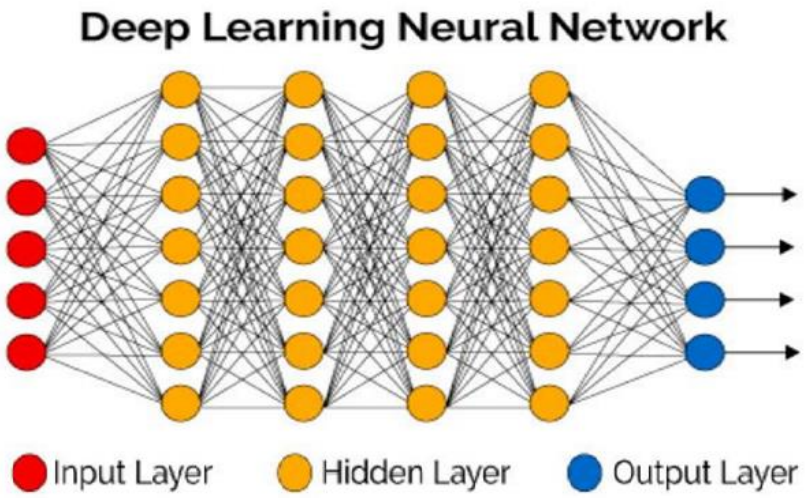
http://hydis.eng.uci.edu/

Goal:

High spatial and temporal resolution of precipitation measurements at global scale for hydrological applications:

- ***Short-term operational applications***
  - ***Flood forecasting***
  - ***Data assimilation in numerical weather models***
- ***Long-term climate extreme event analysis***
- ***Hydro-climate studies***
- ***Validation GCM models***

Artificial neural network



I

what is Artificial Neural Network

Artificial Neural Networks (ANNs) are a type of machine learning model that is inspired by the structure and function of the human brain. ANNs are composed of interconnected nodes, or "neurons," that process and transmit information.

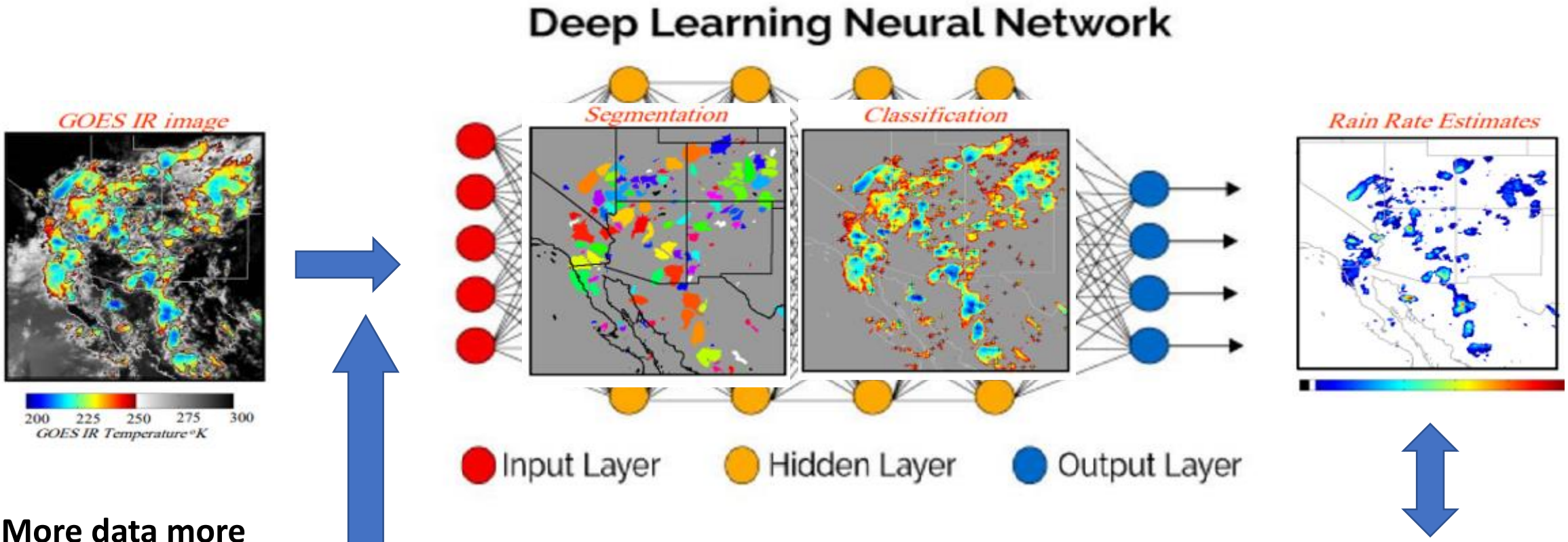
In an ANN, input data is passed through a network of interconnected neurons, each of which applies a mathematical function to the input data and produces an output. These outputs are then used as inputs for other neurons in the network, until a final output is produced.

ANNs are often used for tasks such as image and speech recognition, natural language processing, and prediction. They can be trained using a variety of techniques, including supervised learning (where the network is trained using labeled data) and unsupervised learning (where the network learns to identify patterns in unlabeled data).

ANNs can be designed with different numbers of layers and types of neurons, and their architecture can be tailored to the specific task at hand. While ANNs have been successful in many applications, they can be computationally expensive and require a large amount of training data to achieve high levels of accuracy.

https://chat.openai.com/chat

PERSIANN (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks)



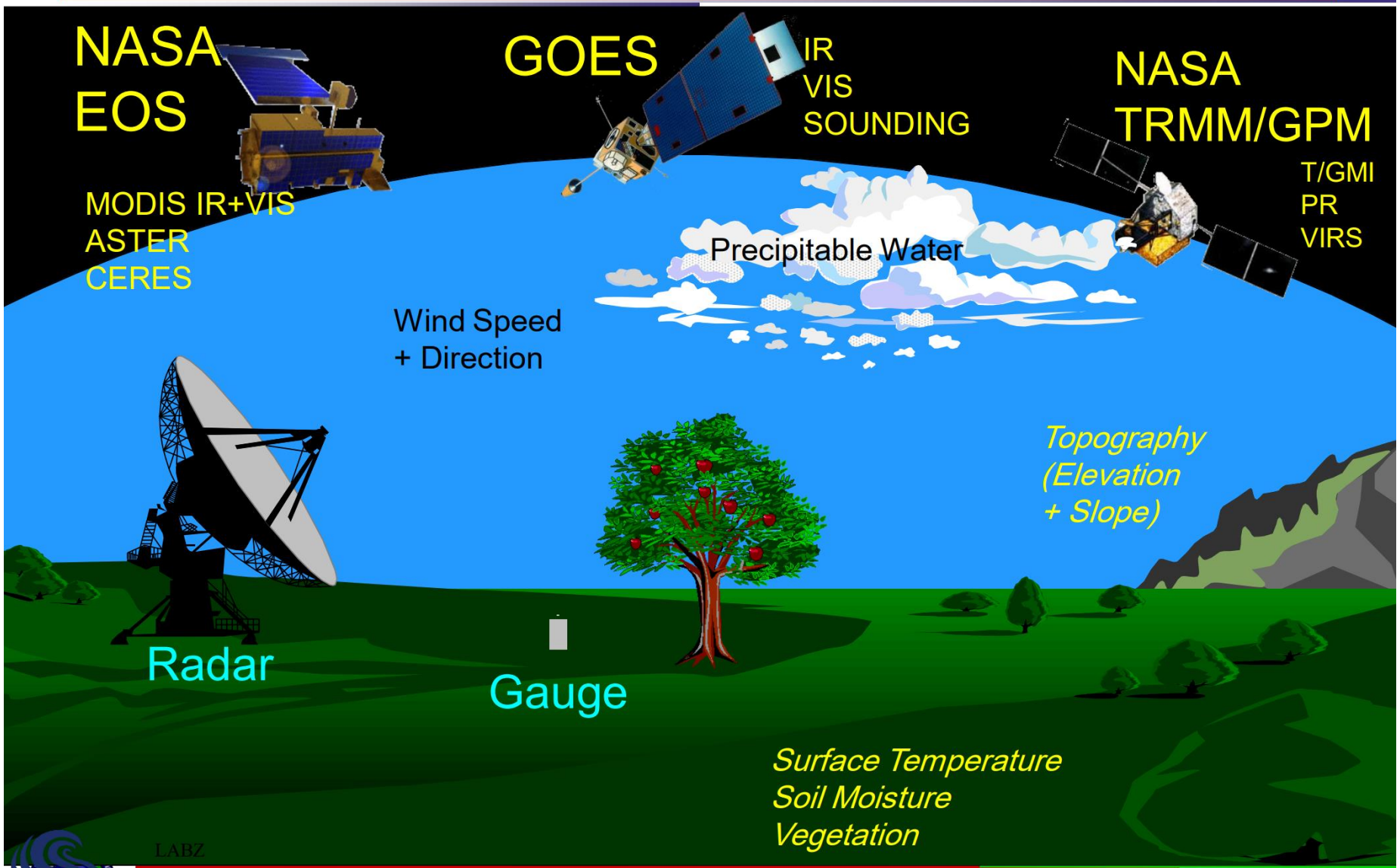
More data more experience and accuracy

Feedback and Corrections

Data from:
other satellites products , radar , rain gauges ,NWP and .....

https://chat.openai.com/chat

Multiple-Source Rainfall Estimation



PERSIANN Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks

PERSIANN-CCS PERSIANN-Cloud Classification System

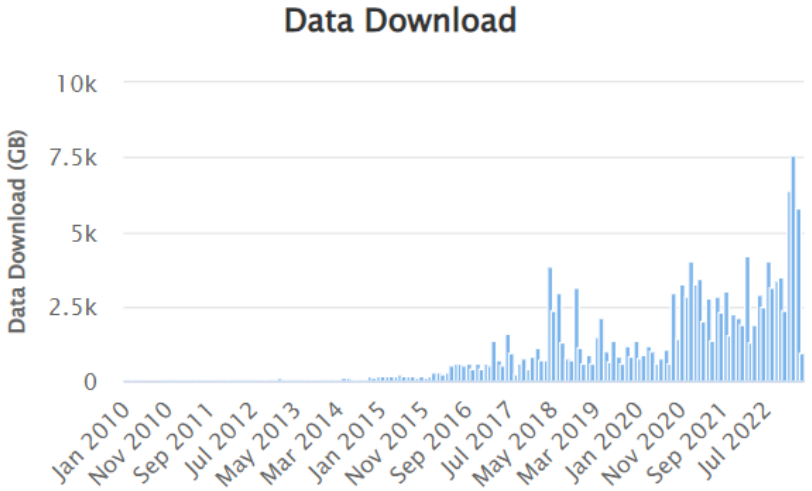
PERSIANN-CDR PERSIANN-Climate Data Record

PDIR-Now PERSIANN-Dynamic Infrared Rain Rate near real-time

PERSIANN-CCS-CDR PERSIANN-CCS + PERSIANN-CDR

Data Portal

https://chrsdata.eng.uci.edu/



iRain

Accuracy

Type of rain and clouds

Spatial resolution

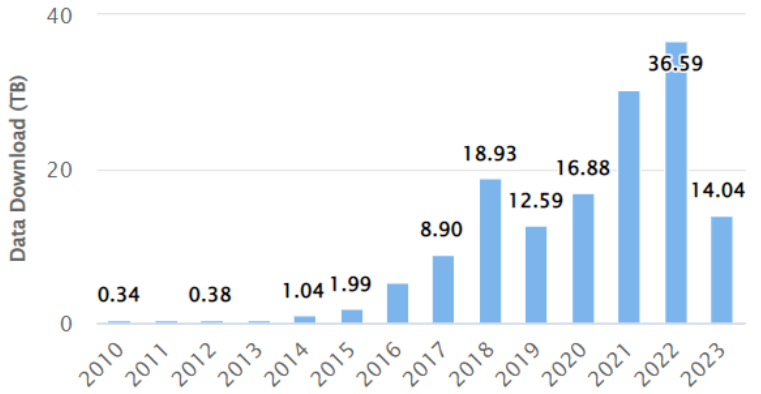
PDIR-Now PERSIANN-Dynamic Infrared Rain Rate near real-time

RainSphere

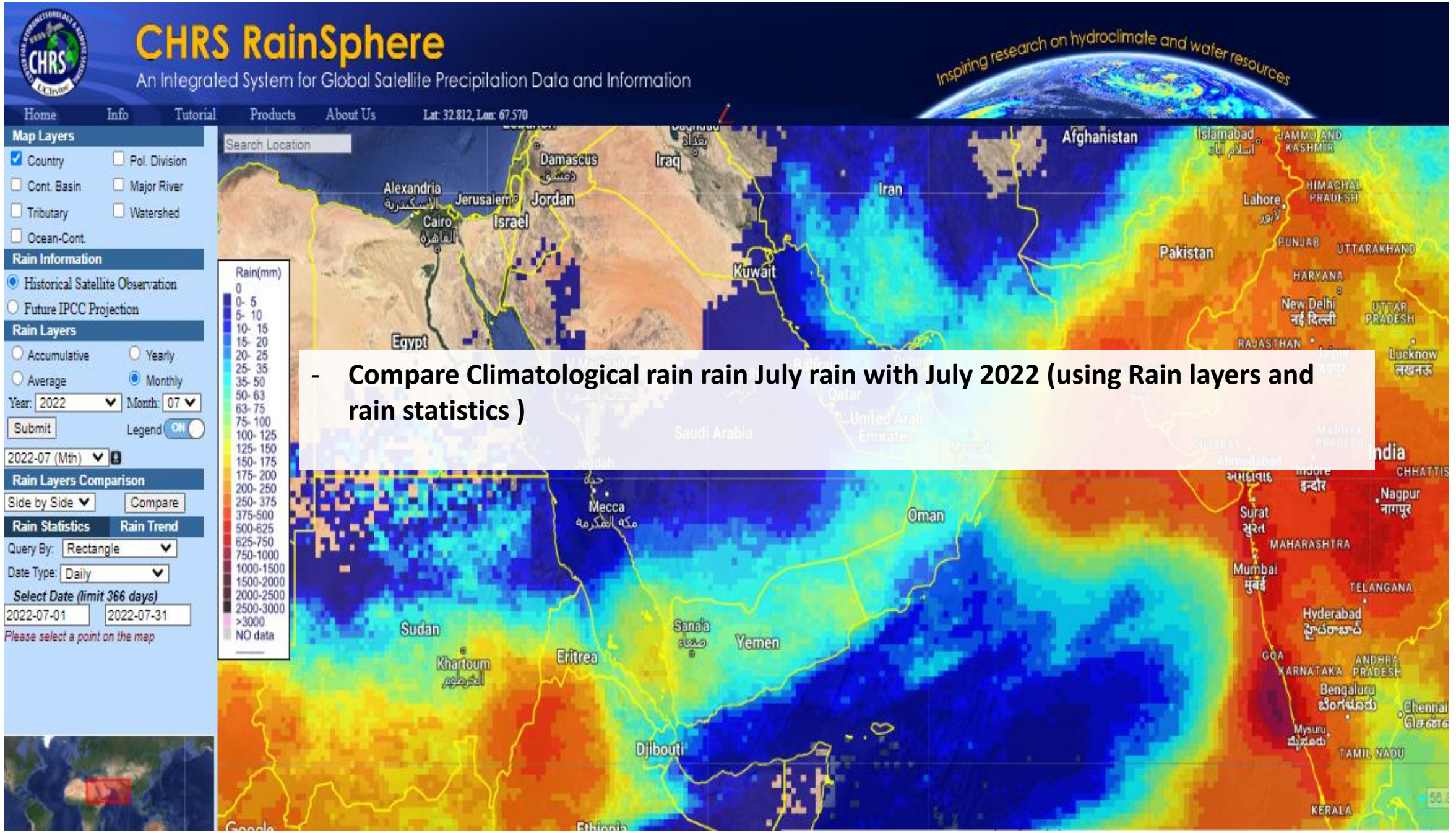
changes and trends in precipitation

extreme precipitation events

climate change and natural variability

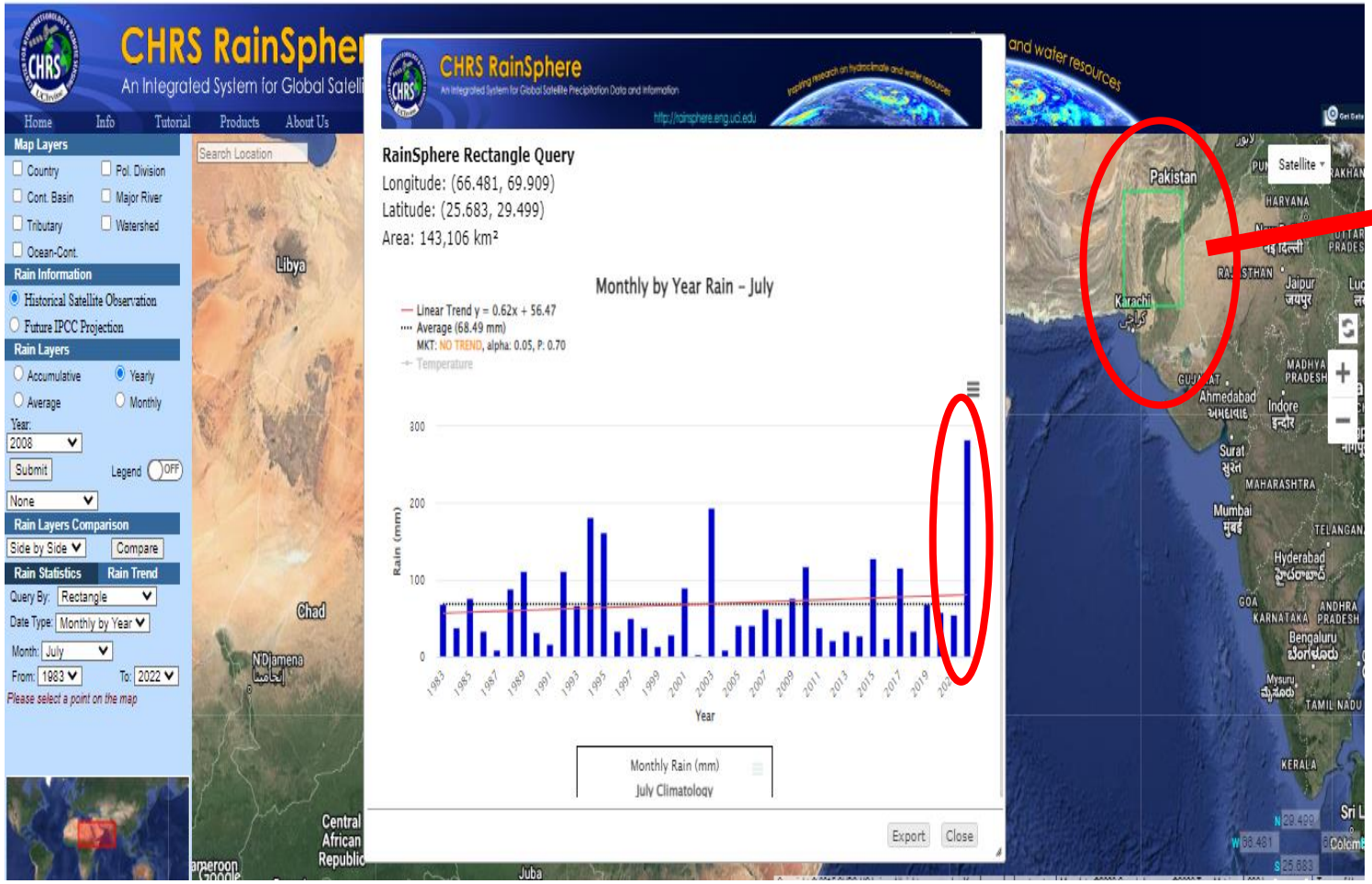


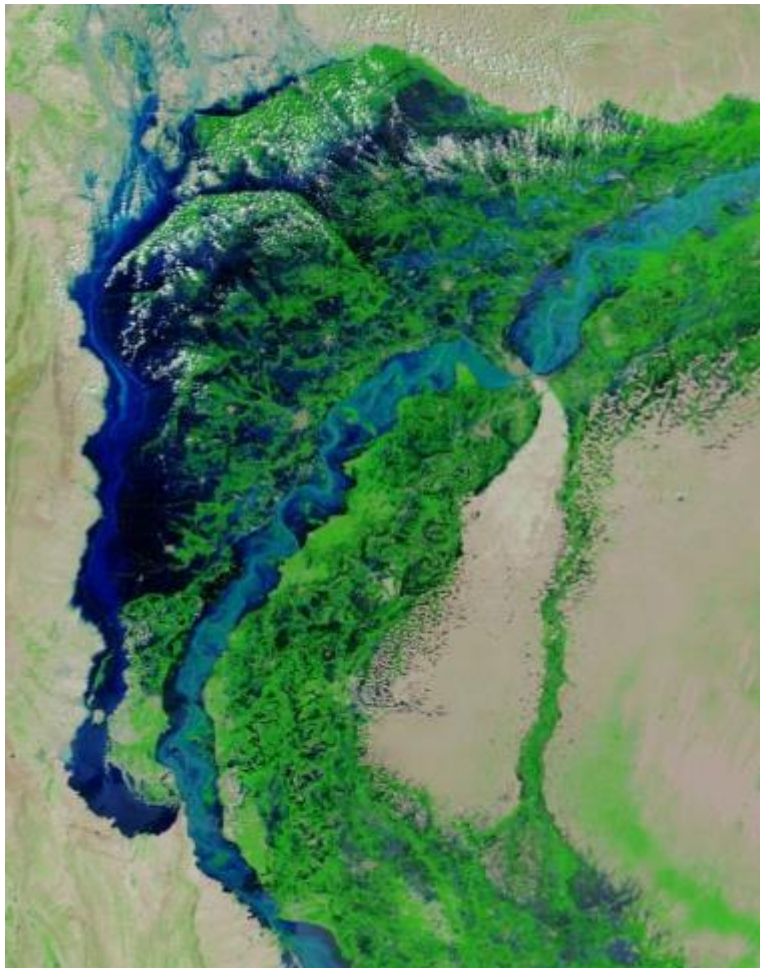
PERSIANN-CDR (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks - Climate Data Record)



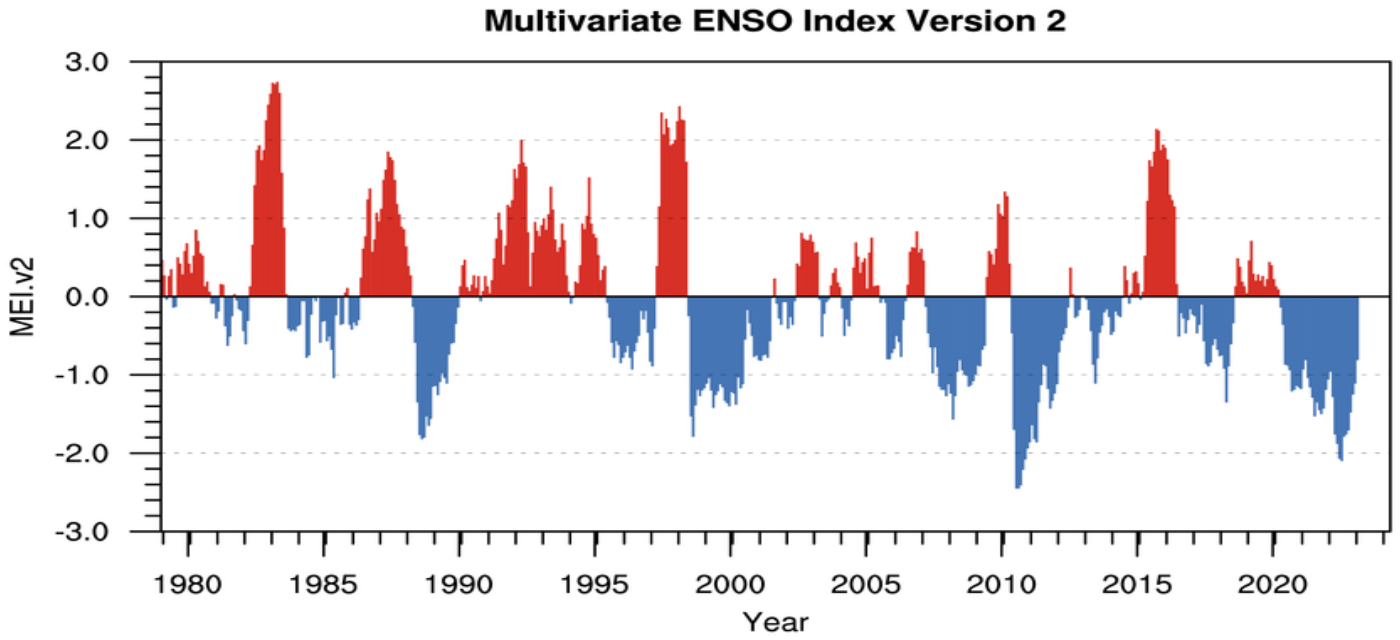
- **Compare Climatological rain rain July rain with July 2022 (using Rain layers and rain statistics)**

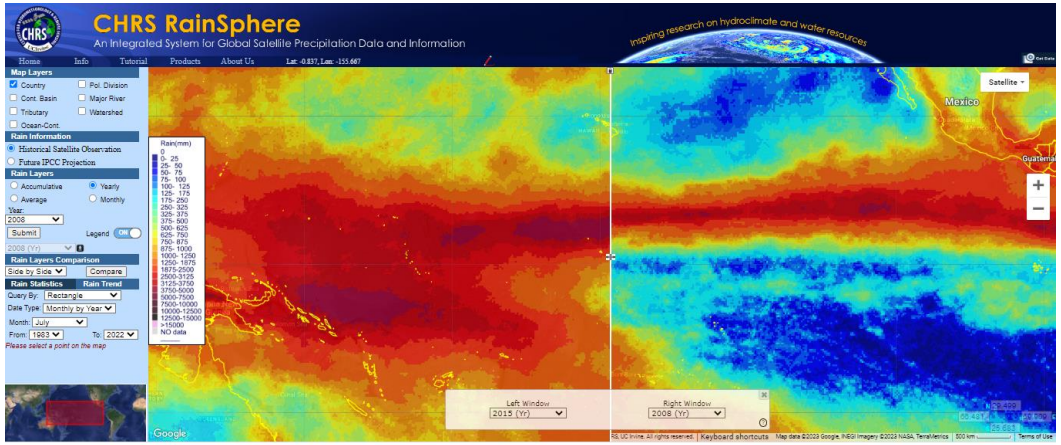
Flood over Pakistan July-Aug 2022

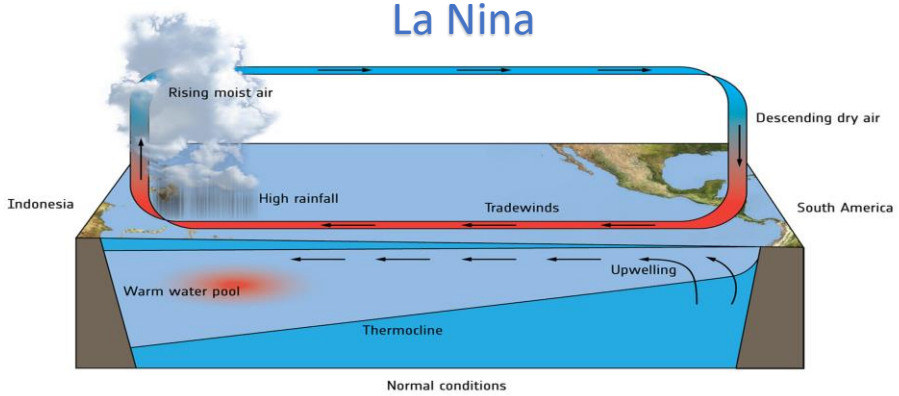


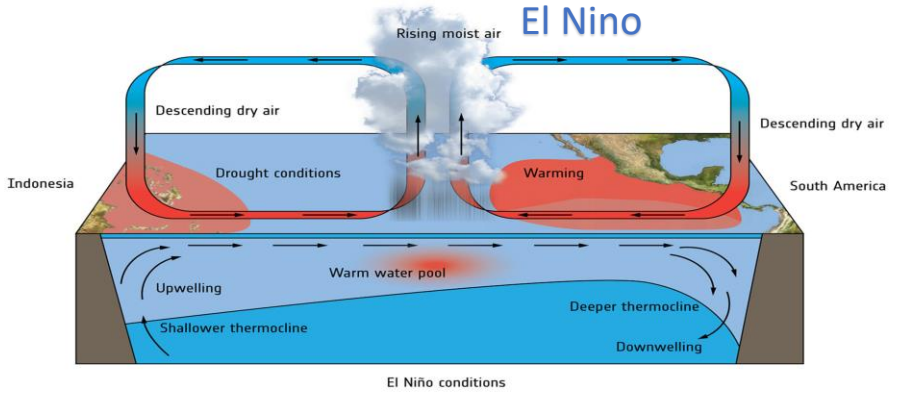


Compare La Nina and El Nino rain and see if there is impact over Middle East / globally !









For more information, please ask ChatGPT

Thank You