# DIRECTORATE OF ADVANCED STUDIES EVENT CATALOGUE 2021

#### **5**<sup>TH</sup> SEMINAR OF DAS EVENTS CALENDAR – 2021

# ESTIMATION OF RAINFALL OVER THE POTOHAR PLATEAU USING MULTI-SATELLITE PRODUCTS



5<sup>th</sup> Seminar (Online through ZOOM) of DAS Events Calendar - 2021

### ESTIMATION OF RAINFALL OVER THE POTOHAR PLATEAU USING MULTI-SATELLITE PRODUCTS

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Wednesday, 17th March, 2021 at 02:00 pm

**ZOOM MEETING ID: 955 408 3170 - PASSCODE: 67890** 

Organized By: Directorate of Advance Studies, PMAS-AAUR

#### **ACTIVITIES**

#### Outline

- Introduction
  - + Importance of rainfall data
  - + Rainfall measurement methods
- Satellite rain estimation methods
  - + How they work and when to use them or not
- Accuracy of satellite-based rainfall products over Potohar Region
- Conclusions

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#### Rainfall Measurement Methods

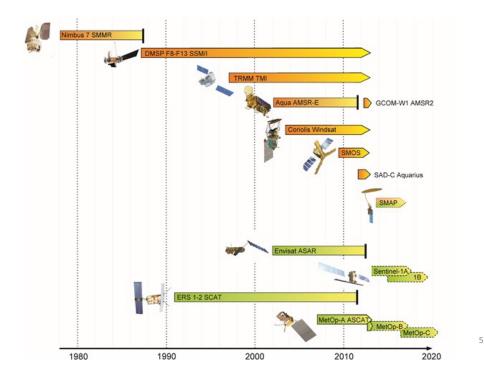
 Ground-based meteorological stations (rain gauges and weather radars) are generally regarded as the most accurate source of precipitation data.





 However, in physically inaccessible regions of the world, these ground-based meteorological instruments are often sparse or unavailable, leading to the poor representation of spatial and temporal characteristics of precipitation.

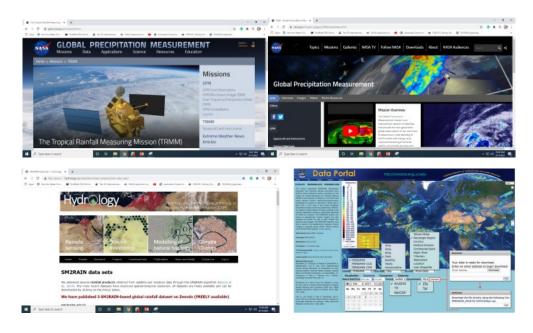
#### Satellite-based Rainfall Data



## Satellite-based Rainfall Estimation Systems

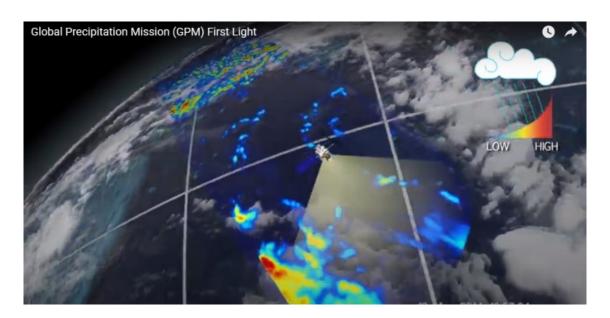
- Geostationary Satellites (VIS/IR)
  - + Good space and time resolution
  - + Observation in near real time
  - + Samples oceans and remote regions
  - + Consistent measurement system
  - Measure cloud top properties instead of rain
- Passive Microwave from Polar Orbiting Satellite
  - + More physically based
  - + More accurate than VIS/IR system
  - Poor time and space resolution
- Special Sensor MW Imager (SSM/I)
- Advanced Microwave Sounding Unit (AMSU)
- TMI, PR, DFPR

## Some Examples of Satellite-based Rainfall Products



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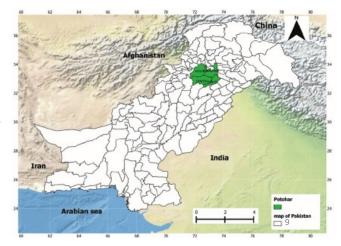
## Accuracy of Satellite-based Products



## Accuracy of Satellite-based Products over Potohar Region

## Study Area

- > The Potohar Plateau is a plateau in north-eastern Pakistan, forming the northern part of Punjab.
- > Potohar Plateau is bounded on the east by the Jhelum River, on the west by the Indus River, on the north by the Kala Chitta Range and the Margalla Hills, and on the south by the Salt Range.
- > Agriculture is dependent largely on rainfall, which averages 380-500 mm annually.
- > Rainfall is greatest in the northwest and declines to arid conditions in the southwest



## Satellite Datasets

- High resolution multi-satellite rainfall estimates from four satellite-based products.
  - 1. **IMERG Version 6** 65° N-65° S

    - 0.1º lat/lon; 30-min
      - June 2014 to the present

#### 2. SM2RAIN-ASCAT

- Land 12 Km; Daily January2007 to the present

#### 3. PERSIANN

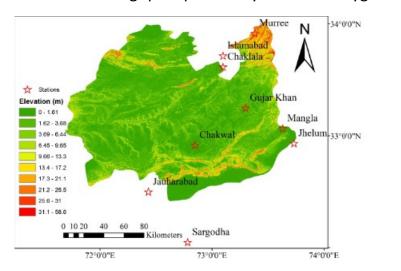
- 60° N-60° S
- 0.25° lat/lon; 1-hr March 2000to the present

## 4. **TRMM Version 7**• 50° N-50° S

- 0.25° lat/lon; 3-hr 1997 to 2019
- The observed daily precipitation records from a total of 09 in situ gauging stations from 2010 to 2018 were obtained PMD.

## Methodology

- Point to pixel comparison
- Analysis of spatiotemporal distribution of the regional precipitation
- Estimation of areal average precipitation by Thiessen Polygon Method.



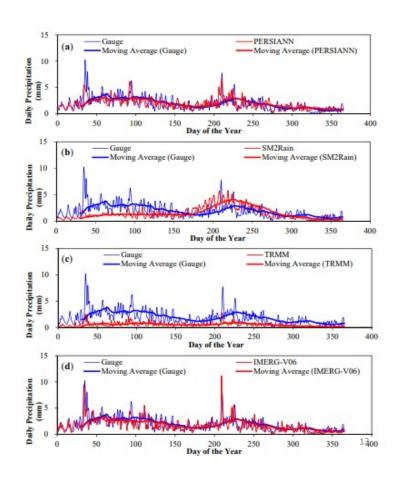
# Methodology

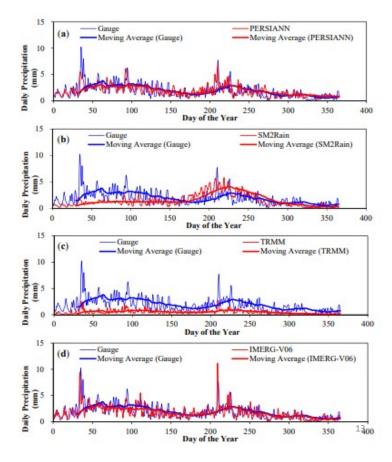
#### Statisticalindices for the evaluation of satellite precipitation products

Statistical Index	Unit	Equation	Perfect Value
Relative bias (Bias)	NA	$Bias = \frac{\sum_{i=1}^{n} (S_i - G_i)}{\sum_{i=1}^{n} S_i}$	0
Correlation coefficient (CC)	NA	$CC = \frac{\sum_{i=1}^{n} (S_i - \overline{S}) \cdot (G_i - \overline{G})}{\sum_{i=1}^{n} (S_i - \overline{S}) \cdot \sum_{i=1}^{n} (G_i - \overline{G})^2}$	1
Root-mean-square error (RMSE)	mm	$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^{n} \left( S_i - G_i \right)^2}$	0
Probability of detection (POD)	NA	$POD = \frac{a}{a+c}$	1
Frequency of hit (FOH)	NA	$FOH = \frac{a}{a+b}$	1
False alarm ratio (FAR)	NA	$FAR = \frac{b}{a+b}$	0
Critical success index (CSI)	NA	$CSI = \frac{a}{a+b+c}$	1

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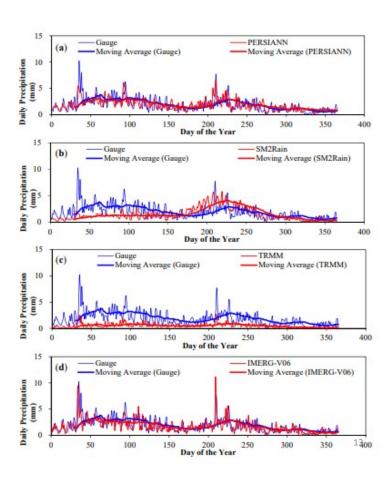
Temporal distribution of



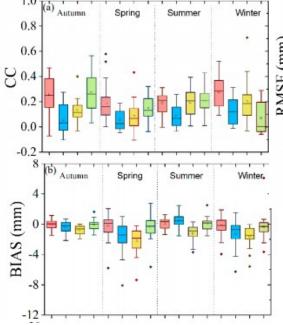


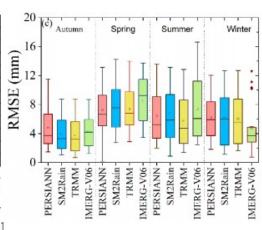
Results

Temporal distribution of rainfall

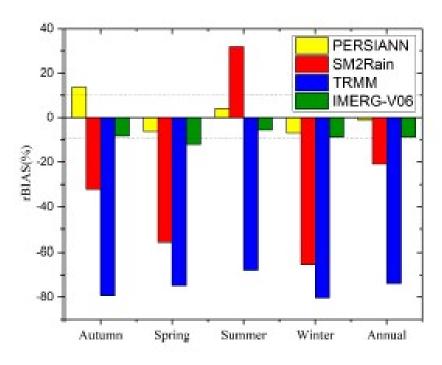


#### Seasonal Variation of Evaluations Indices





## Relative Bias of Satellite-based Rainfall Products

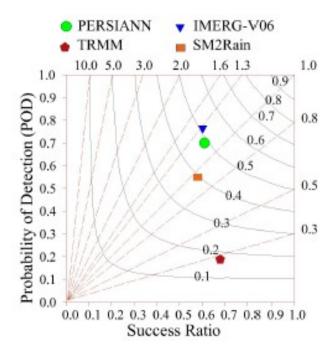


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## Performance of Satellite-based Rainfall Products

Results

Results



## **Conclusions**

- IMERG-V06 and PERSIANN were capable to characterize the spatio-temporal variability of the observed rainfall over the study region which advocated their application to understand the spatio-temporal distribution of rainfall over the Potohar Plateau of Pakistan.
- TRMM and SM2Rain showed a significant underestimation (-73.95% and -20.89%, respectively) of rain amount, while IMERG and PERSIANN exhibited a slight underestimation of the precipitation amount by -0.85% and -1.24%, respectively.

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## Conclusions...

- The overall performances of all considered SPPs were better at the monthly scale than the daily scale.
- Moreover, the value of CC for IMERG-V06 and PERSIANN products was >0.70 and rBias was within the acceptable limit (±10%).
- Thus, we recommend the use of their rainfall estimates as a complimentary substitute for hydro-climatological studies in the Potohar Plateau.