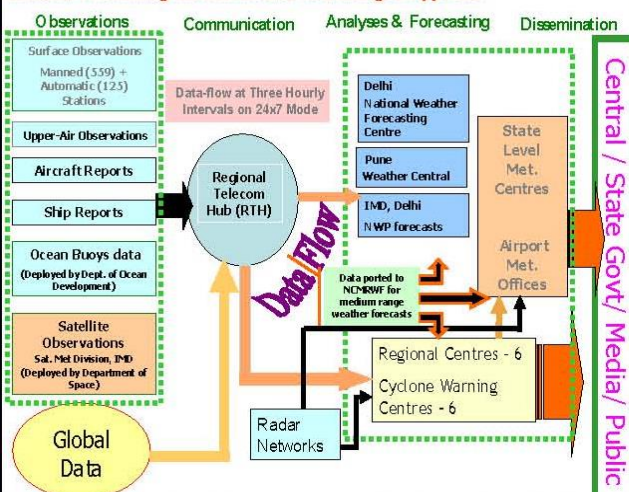


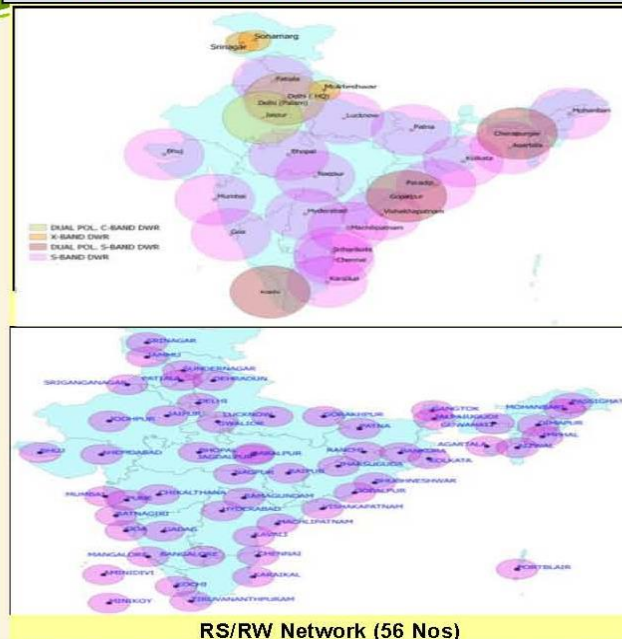
## WEATHER FORECASTING AND WARNING SERVICES FOR PUBLIC SAFETY & SOCIO-ECONOMIC BENEFITS



### Weather Forecasting Services in IMD : An Integral Approach



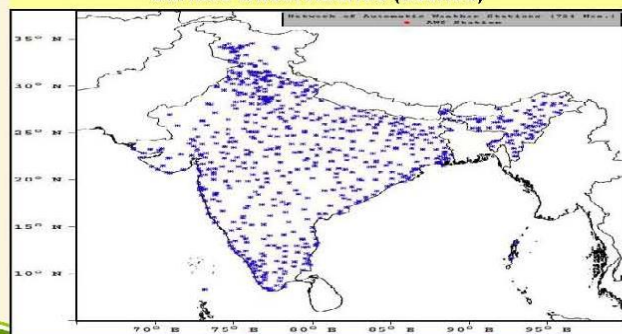
## UPPER AIR OBSERVATIONAL NETWORK



## SURFACE OBSERVATIONAL NETWORK



Surface Observatories (206nos)



AWS Network (735nos)



भारतमौसमविज्ञानविभाग

India Meteorological Department

1875 मेंस्थापित

(Established in 1875)

पृथ्वीविज्ञानमंत्रालय

Ministry of Earth Sciences

भारतसरकार

Government of India

March, 2021

## VISION AND MISSION OF IMD

- Meteorological observations & forecast for optimum operation of weather sensitive activities
- No weather hazard to go undetected and unpredicted
- Accurate warnings against hazards with reasonable lead time, triggering response from disaster managers and public to save life and property.



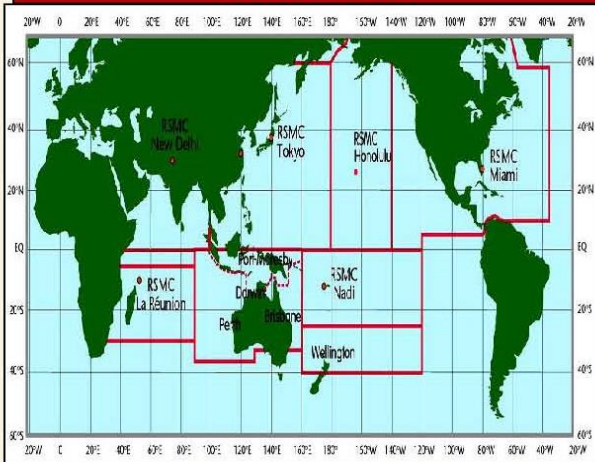
- India Meteorological Department (IMD) is Nodal Agency for National Meteorological Services.
- It is the principal Government agency in all matters related to Meteorology and allied Sciences.
- It provides weather and climate services for public safety and socio-economic benefits.

## Major science themes/applications/services



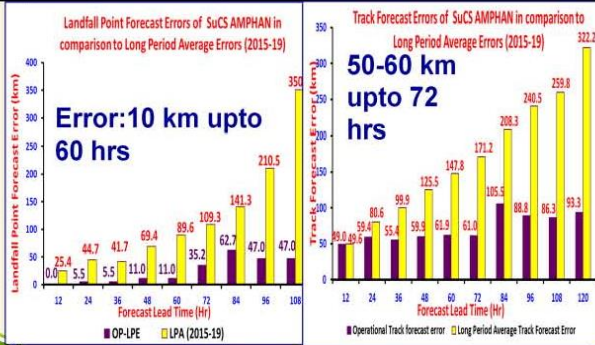


## TROPICAL CYCLONE MONITORING & PREDICTION



Area of responsibility for Regional Specialized Meteorological Centre (RSMC) for tropical cyclone forecasting

- 169 New names of cyclones over the north Indian Ocean were introduced beginning with cyclone, Nisarga in June 2020.
- Accurate forecasting for two major cyclones of 2020 by IMD:
- Super Cyclone AMPHAN** (during 16-21 May, 2020), as predicted crossed West Bengal coast over Sundarbans during 1530-1730 IST of 20<sup>th</sup> May 2020 with wind speed of 155-165 kmph gusting to 185 kmph.
- Severe Cyclonic Storm NISARGA** (during 01-04 June, 2020), as predicted crossed Maharashtra coast near Alibagh during 1230-1430 IST of 3<sup>rd</sup> June 2020 with wind speed of 100-110 kmph gusting to 120 kmph.



Forecast Skill for super cyclone "AMPHAN"



Communication Infrastructure: Warning Dissemination



National Telecommunication Network

**New Hydro-Meteorological Service**  
Flash Flood Guidance System caters flash flood guidance at sub catchment scale over the entire South Asian region.  
WMO recognised IMD as a Regional Leader in catering services to Nepal, Bhutan, Bangladesh, Sri Lanka & India

**SASIAFFG - South Asia Flash Flood Guidance System**

2018-05-08 04:20:41 IST

2018-03-07 22:50:41 V

Focuses mainly on Hilly regions, Steep terrains, Urban cities

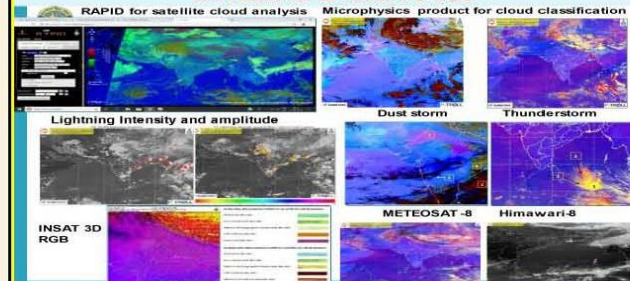
Advanced Functionalities of this system are providing guidance on Impact based flood warning, Landslide occurrence prediction, Urban Flash Flood Warning, Riverine / Channel routing, Seasonal to

## RECENT ACHIEVEMENTS

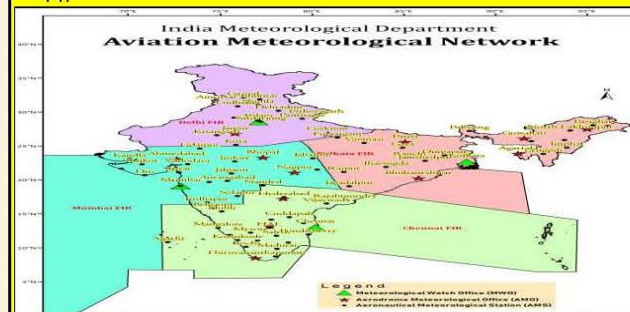
### Observation

- With the commissioning of three X-Band Doppler Weather Radars (DWR) at Sonmarg, Mukteshwar and Kufri, IMD's DWR network expanded to 27 DWRs operational across the country.
- Multi-Mission Meteorological Data Receiving & Processing System for satellite meteorological applications established and dedicated to the nation.

### SATELLITE BASED TOOLS



- 190 District Agrometeorological Field Units established.
- Meteorological Centre, Leh was established and inaugurated by Hon'ble Minister of Earth Sciences.
- Revival of about 250 AWS/ARG/Agro-AWS. Establishment of about 15 AWS in Kerala and about 60 ARG in Mumbai.
- Current Weather Instrument Systems installed at 32 airports and 12 systems supplied to IAF for installation in Myanmar.
- Three transmissometer (Drishti System) installed at Kochi, Thiruvananthapuram and Bhubaneswar thus totaling to 44.



- 203 new raingauge stations added in the District-wise Rainfall Monitoring Scheme taking the total number of stations to 4940.
- Preparation of real-time rainfall statistics enhanced to 690 districts.
- Observations from ground-based lightning networks of IITM & IAF brought within forecast framework of IMD.



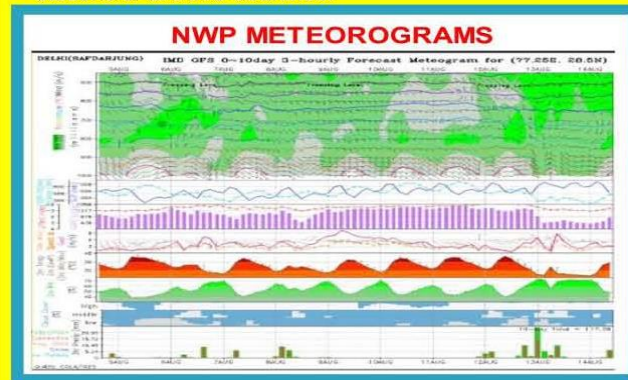
# RECENT ACHIEVEMENTS

## Numerical Modelling

- Global Forecast System (GFS) model upgraded & run 4 times from 2 times a day to generate 10 days forecast.
- Global Ensemble Forecast System model at 12 km generated forecast for 717 Districts and 6867 Blocks.
- Regional WRF mesoscale model upgraded from 9 km to 3 km resolution.
- Hurricane WRF was run as a coupled model at a resolution of 2 km in collaboration with INCOIS to generate six hourly forecasts.
- New numerical models, SILAM and ENFUSER made operational for Air Quality Early Warning System for Delhi during 2020.

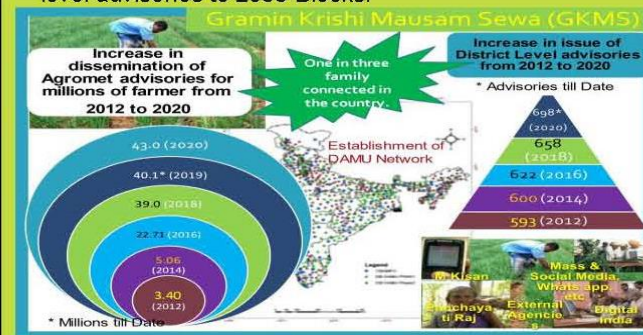


- Climate Forecast System model is operational to generate extended range forecast for 4 weeks and Monsoon Mission Climate Forecast System is operational for seasonal forecast.
- IMD in collaboration with NCMRWF & IITM implemented Thunderstorm and Lightning Modelling and Warning System with installation of lightning detectors at 82 locations to provide location specific lightning warning.
- Location specific Meteograms, based on NWP models, prepared for 751 districts, 658 stations of India and 491 stations of SAARC countries.

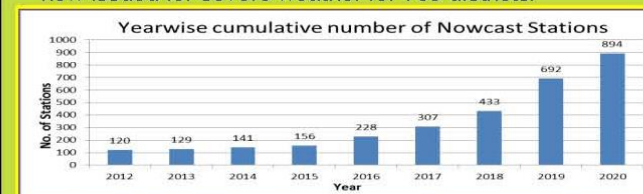


# Forecasting and Applications Products

- Impact based forecast was provided for all types of severe weather including cyclone, heat wave, cold wave, fog, heavy rain, thunderstorm at 739 districts and 25 capital cities.
- Generation and issue of Flash flood Guidance for all watersheds of the country. Flash flood Guidance to Nepal, Bhutan, Bangladesh, Sri Lanka every 6 hours commenced from the Monsoon season 2020.
- Health guidance product based on Extended Range (up to Two Weeks) forecast for all meteorological subdivisions and districts.
- The tourism forecast is being provided in collaboration with Incredible India through integration of information in website and mobile app.
- Increase in issue of District level agrometeorological advisories from 593 to 698 districts in 2020 and Block level advisories to 2300 Blocks.



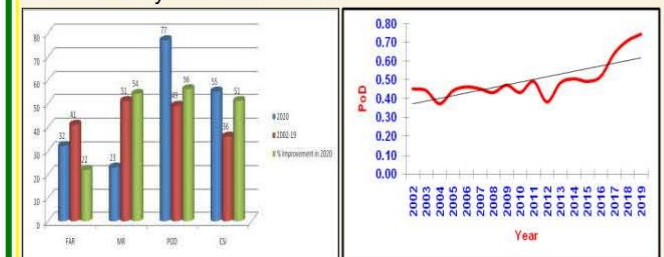
- NWP Model based gridded rainfall data are provided to Central Water Commission for their flood forecasting model for all 153 river catchments and Extended Range model products for 10 river basins.
- Location specific forecast within the capital cities as well as nowcast have been extended to 526 and 894 stations respectively. Also, three hourly nowcast warnings are now issued for severe weather for 739 districts.



- New normal for onset and withdrawal dates of monsoon was introduced based on the latest data of 1961-2010.
- Climate of capital cities and smart cities prepared along with the trend analysis.
- Climatological Summaries published for 22 airports during the year 2020.
- Long range forecast of temperature and rainfall was issued for all the seasons under South Asia Climate Outlook Forum (SASCOF).

## Improvement in Forecast Accuracy

- Significant improvement in forecast accuracy of severe weather events by 15 to 35% during last 5 years.
- All India SW Monsoon heavy rainfall (24 hrs) skill for 2020vs 2002-19 (left panel). There is also an increasing trend in POD of 24 hr heavy rainfall forecast.

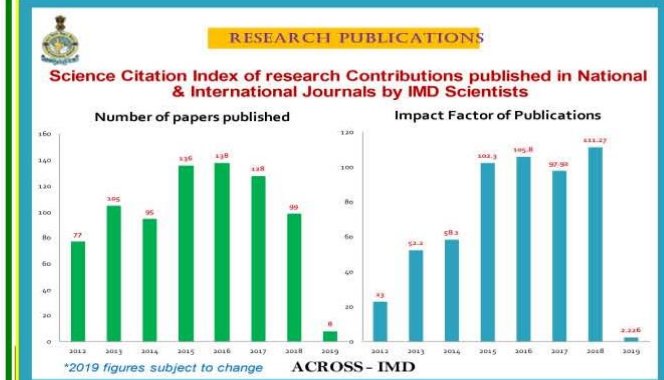
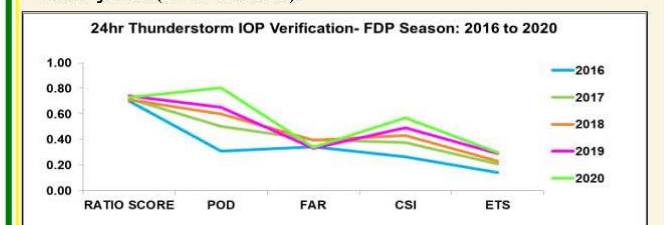


## Skill Scores Related to Heat Wave Warning

All India	FAR			MR			CSI			POD		
	D1	D2	D3	D1	D2	D3	D1	D2	D3	D1	D2	D3
2017	.07	.06	.02	.33	.51	.77	.40	.32	.19	.67	.49	.23
2018	.03	.04	.02	.09	.28	.52	.54	.40	.32	.91	.72	.48
2019	.11	.10	.08	.08	.15	.38	.49	.47	.38	.92	.85	.62

## Advances in Thunderstorm Warning

- Skill Scores for 24 hr Thunderstorm forecast verification during last 5 years (2016 to 2020).





Dissemination

- New website: [www.mausam.imd.gov.in](http://www.mausam.imd.gov.in) launched for public.



- IMD services on UMANG App inaugurated.
- Hindi version of the Mausam website developed and implemented.
- API for weather observed and forecast products Of IMD has been developed and provided to different states, different central Government organizations including NITI Aayog, Tourism, DD News etc. About 10 states have implemented this API for their services.
- Mobile Apps MEGHDOOT and MAUSAM launched.



- IMD launched Weekly Weather Video capsule of current weather status and forecast for next two weeks. Video capsule is uploaded on Facebook and Youtube pages of IMD every Thursday in both English & Hindi. Similar videos are uploaded in some regional languages by IMD's State Met. Centres.
- Common Alert Protocol (CAP) implemented as per WMO standard for severe weather warning. It is being utilized for Global Multi-hazard Alert System of WMO.
- Crowd Source Platform has been launched through website and mobile app for collecting the weather observations from people.

PLEASE VISIT

- IMD Apps: Mausam/ Meghdoot /DAMINI / RAIN ALARM
- Social Media: Facebook, Twitter, Instagram, BLOG
- FB: <https://www.facebook.com/India.Meteorological.Department/>
- Twitter: <https://twitter.com/Indiametdept>
- Blog: <https://imdweather1875.wordpress.com/>
- Instagram: [https://www.instagram.com/mausam\\_nwfc](https://www.instagram.com/mausam_nwfc)
- Youtube: [https://www.youtube.com/channel/UC\\_qxTRe\\_oq07UvARm87CuyQw](https://www.youtube.com/channel/UC_qxTRe_oq07UvARm87CuyQw)

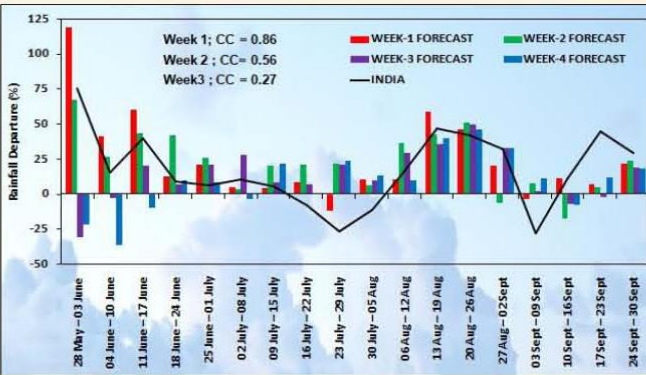
SOUTHWEST MONSOON FORECAST 2020

- Long range forecast of monsoon rainfall issued on 15<sup>th</sup> April, 2020 and was updated on 31<sup>st</sup> May 2020.
- The forecast for 2<sup>nd</sup> Half was issued on 31<sup>st</sup> July 2020.

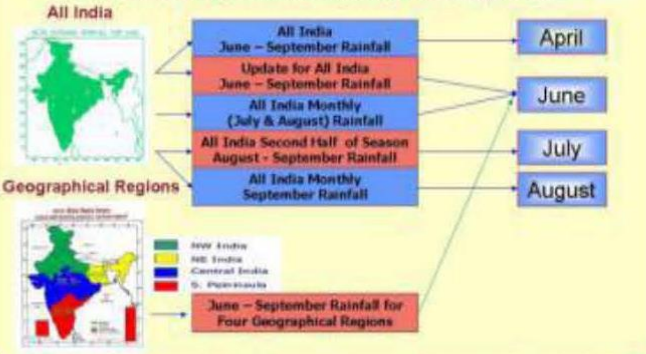
Region	Period	Forecast (% of LPA)			Actual Rainfall (% of LPA)
		15 <sup>th</sup> April	31 <sup>st</sup> May	31 <sup>st</sup> July	
All India	Jun to Sep	100± 5	102± 4		107 (1 June-6 Sep)
All India	Aug to Sep			104± 8	127 (1-31 Aug)

Extended Range Forecast (ERF)

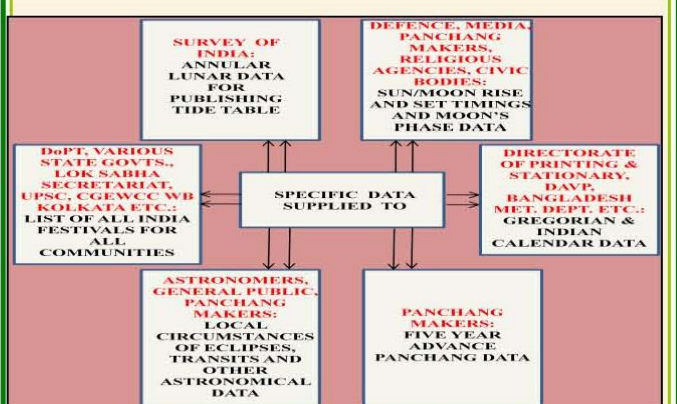
- Meteorological subdivisions level Extended Range Forecast based on coupled models run at IMD operational on every Thursday.
- These forecasts for two weeks are used to issue ERFs at state levels.
- Performance for 2020 monsoon:



Operational Long Range Forecast Issued For the Southwest Monsoon Rainfall



In addition, Forecast for Date of Monsoon Onset over Kerala in May



POSITIONAL ASTRONOMY DATA SERVICES

