GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION No. - 176
ANSWERED ON 08/12/2022

ACCURACY OF MONSOON PREDICTION

176. SHRI SANJEEV ARORA:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) the accuracy in prediction of monsoon precipitation at block level within the country and the State of Punjab in particular; and
(b) the resolution at which the high-performance Super Computers acquired by Government can forecast for extreme weather and climate events- tsunamis, cyclones, extreme heat waves and cold snaps and the accuracy of the same during the last five years?

ANSWER
THE MINISTER OF STATE (INDEPENDENT CHARGE) FOR
MINISTRY OF SCIENCE AND TECHNOLOGY
AND EARTH SCIENCES
(DR. JITENDRA SINGH)

(a) Presently IMD issuing Monsoon precipitation forecast at district and block level 1 to 5 days in advance. The accuracy of the prediction of monsoon rainfall for the country as a whole is given in Annexure-I and at district level for the State of Punjab is given below for the year 2022.

Districts	**VALUE ADDED FORECAST**					
	Result	**DAY 1**	**DAY 2**	**DAY 3**	**DAY 4**	**DAY 5**
Amritsar	Correct	51.35	57.14	51.43	57.14	48.57
	Usable	10.81	0	5.71	0	5.71
	Unusable	37.84	42.86	42.86	42.86	45.71
Barnala	Correct	64.86	65.71	60.61	57.58	62.5
	Usable	0	2.86	0	0	0
	Unusable	35.14	31.43	39.39	42.42	37.5
Bhatinda	Correct	62.16	60	57.14	62.86	60
	Usable	5.41	5.71	2.86	0	0
	Unusable	32.43	34.29	40	37.14	40
Faridkot	Correct	72.97	60	68.57	68.57	65.71
	Usable	0	2.86	0	2.86	0
	Unusable	27.03	37.14	31.43	28.57	34.29

F Sahib	Correct	56.76	57.14	45.71	51.43	48.57
	Usable	0	0	5.71	0	2.86
	Unusable	43.24	42.86	48.57	48.57	48.57
Ferozpur	Correct	62.16	60	60	57.14	60
	Usable	2.7	5.71	5.71	2.86	2.86
	Unusable	35.14	34.29	34.29	40	37.14
Gurdaspur	Correct	56.76	54.29	51.43	51.43	51.43
	Usable	2.7	0	2.86	2.86	2.86
	Unusable	40.54	45.71	45.71	45.71	45.71
Hoshiarpur	Correct	51.35	51.43	51.43	51.43	48.57
	Usable	2.7	0	0	0	2.86
	Unusable	45.95	48.57	48.57	48.57	48.57
Jalandhar	Correct	48.65	51.43	40	51.43	42.86
	Usable	5.41	2.86	11.43	2.86	8.57
	Unusable	45.95	45.71	48.57	45.71	48.57
Kapurthala	Correct	51.35	57.14	54.29	48.57	54.29
	Usable	2.7	0	5.71	8.57	2.86
	Unusable	45.95	42.86	40	42.86	42.86
Ludhiana	Correct	59.46	60	54.29	54.29	51.43
	Usable	5.41	2.86	0	2.86	2.86
	Unusable	35.14	37.14	45.71	42.86	45.71
Mansa	Correct	64.86	60	65.71	65.71	60
	Usable	0	2.86	5.71	0	0
	Unusable	35.14	37.14	28.57	34.29	40
Moga	Correct	62.16	54.29	62.86	60	54.29
	Usable	8.11	5.71	0	0	5.71
	Unusable	29.73	40	37.14	40	40
Muktsar	Correct	62.16	57.14	60	62.86	65.71
	Usable	2.7	2.86	8.57	0	2.86
	Unusable	35.14	40	31.43	37.14	31.43
Patiala	Correct	51.35	60	54.29	57.14	48.57
	Usable	10.81	0	2.86	2.86	5.71
	Unusable	37.84	40	42.86	40	45.71

Ropar	Correct	54.05	42.86	48.57	45.71	54.29
	Usable	0	8.57	2.86	5.71	0
	Unusable	45.95	48.57	48.57	48.57	45.71
Sangrur	Correct	64.86	60	60	60	60
	Usable	2.7	2.86	0	0	2.86
	Unusable	32.43	37.14	40	40	37.14
SAS Nagar	Correct	56.76	54.29	51.43	54.29	51.43
	Usable	0	5.71	5.71	0	5.71
	Unusable	43.24	40	42.86	45.71	42.86
Nawanshahar	Correct	45.95	48.57	48.57	48.57	54.29
	Usable	10.81	5.71	8.57	5.71	2.86
	Unusable	43.24	45.71	42.86	45.71	42.86
TaranTaran	Correct	62.16	51.43	54.29	57.14	57.14
	Usable	0	2.86	0	0	0
	Unusable	37.84	45.71	45.71	42.86	42.86

(b) Two High Performance Computing (HPC) Systems, Pratyush and Mihir, installed at IITM, Pune and NCMRWF, Noida respectively have a total computing capacity of 6.8 peta flops. Along with this the Data Assimilation of NWP models has gone up to 500 GB per day. The HPC system is being used for the advanced dynamical prediction systems which are now being used for Short & Medium Range, Extended Range, Monthly and Seasonal prediction

Presently, two Global models (GFS & NCUM) at a spatial resolution of 12 km are being used with analysis and product updates are generated 2-4 times a day valid upto 10 days. These products are regularly analyzed and incorporated day to day in the forecasts and extreme weather events.

Implementation of HPC system has helped to improve the skill of general and extreme weather forecasts over the country. Improvement in weather forecast accuracy is as follows:

- Heavy rainfall warning skill score during last five years (2018-2022) is given in Fig.-1. Probability of Detection (POD) varies between 75% to 51% for Day 1 to Day 5 and False Alarm Rate (FAR) varies between 29% to 18% for Day 1 to Day 5.

- Heavy rainfall warning skill for All India Southwest Monsoon rainfall of 2021 vs. that of 2002-2020 is given in Fig.-2. POD for heavy rainfall warning with 24 hrs. lead period is 74% in 2021, which has improved by 51% in year 2021 as compared to their skill between 2002-20. False Alarm Rate (FAR) and Missing Rate (MR) are 26% in 2021, which has improved by 21% & 53% respectively in year 2021 as compared to their skill for 2002-20.

- Heatwave warning skill score during last five years (2018-2022) is given in Fig.-3. POD varies between 96% to 38% for Day1 to Day5 and FAR varies between 5% to 3% for Day1 to Day5.
- Heatwave warning skill for April to June 2021 vs. 2014-2020 is given in Fig.-4.
- Probability of Detection (POD) for heat wave warning with 24 hr lead period is 97% in 2021, which has improved by 15% as compared to their skill for 2014-20. False Alarm Rate (FAR) and Missing Rate (MR) are 2% & 3% respectively in 2021, which has improved by 63% & 82% respectively as compared to their skill for 2014-20.
- The augmentation of nowcast stations from 2016-2017 onwards are given in Fig.-5. Till date station level nowcast is being issued for 1124 cities and towns.
- The verification of 24 hrs. thunderstorm forecast during the period from 2016 to 2022 is given in Fig.-6. The POD is found to be increasing during the period and POD for thunderstorm warning with 24 hrs. Lead period is about 89% in 2022 against 31% in 2016.
- The verification details of 3 hourly thunderstorm nowcast are given in Fig.-7 for ready reference.
- Forecast skills for Heavy rainfall, Heatwave and Thunderstorm are given in ***Annexure-I.***
- Forecast skills for cyclone are given in ***Annexure-II***

Annexure-I

Heavy Rainfall skill:

Heavy rainfall skill score during last 05 years (2018-2022) shown in following figure

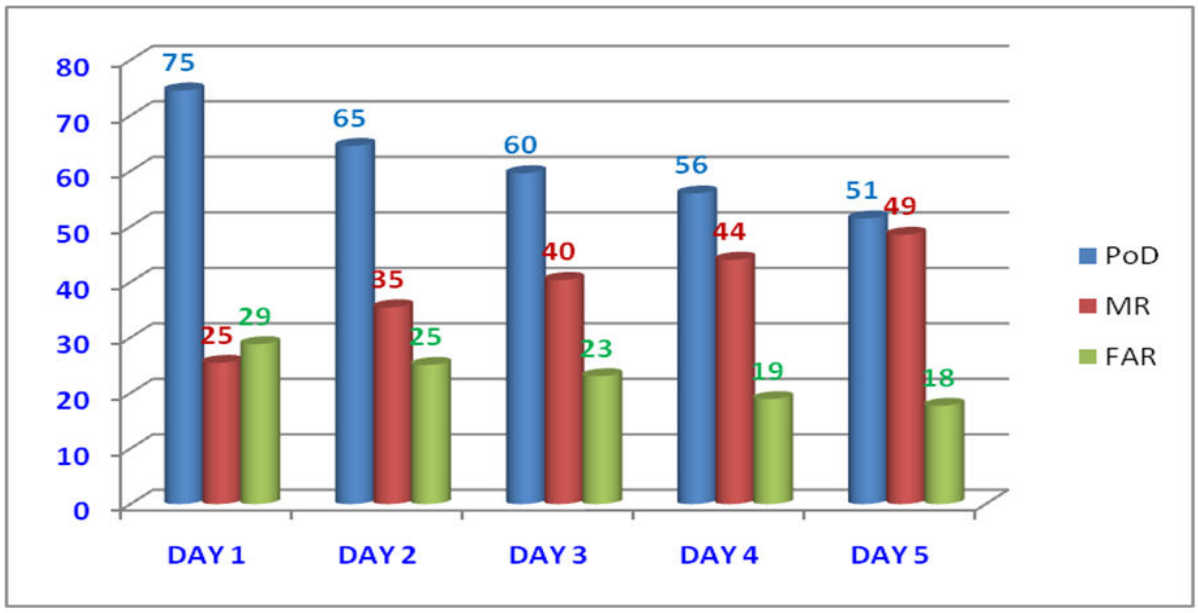


Fig.-1

All India southwest Monsoon (June to September) 2021 vs 2002-20 heavy rainfall skill scores for Day 1

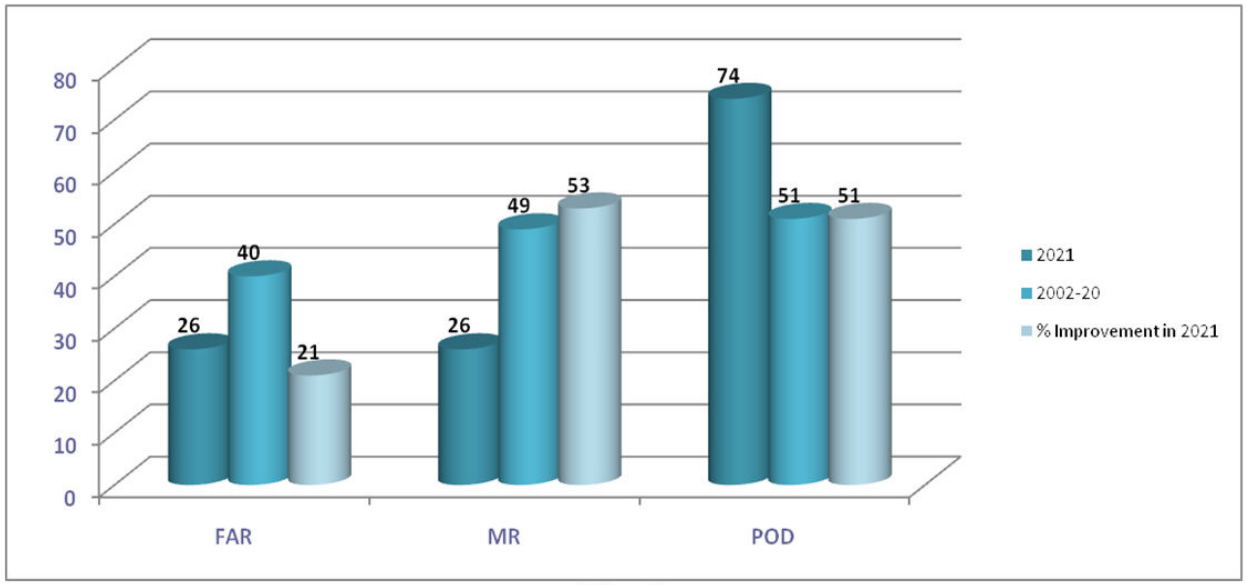


Fig.-2

❖ **Heat Wave skill:**

Heat wave skill score during last 05 years (2018-2022) shown in following figure

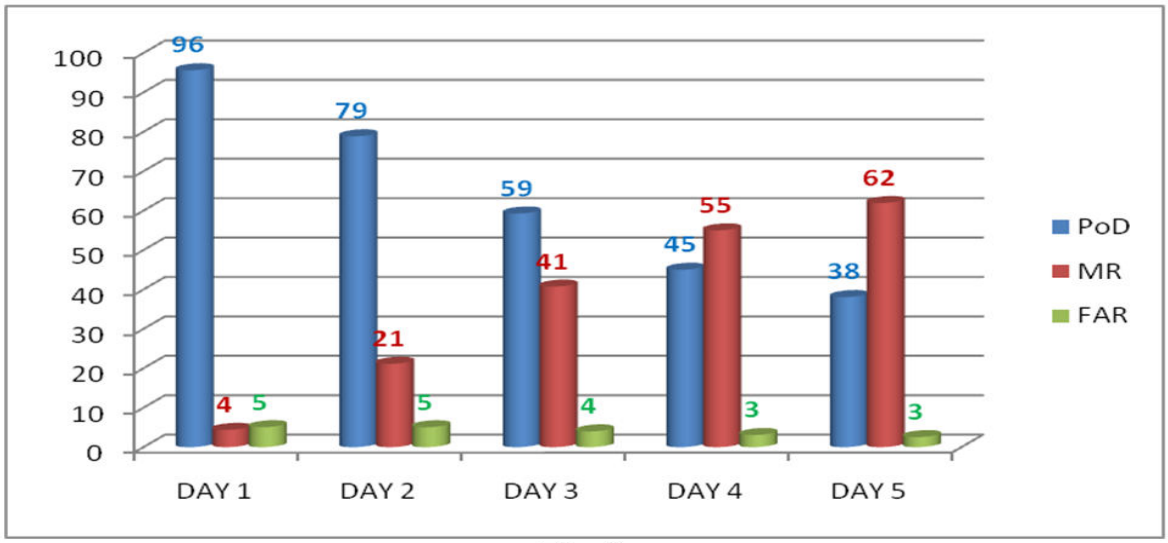


Fig.-3

All India Summer months (April to June) 2021 vs 2014-20 heat wave skill scores for Day 1

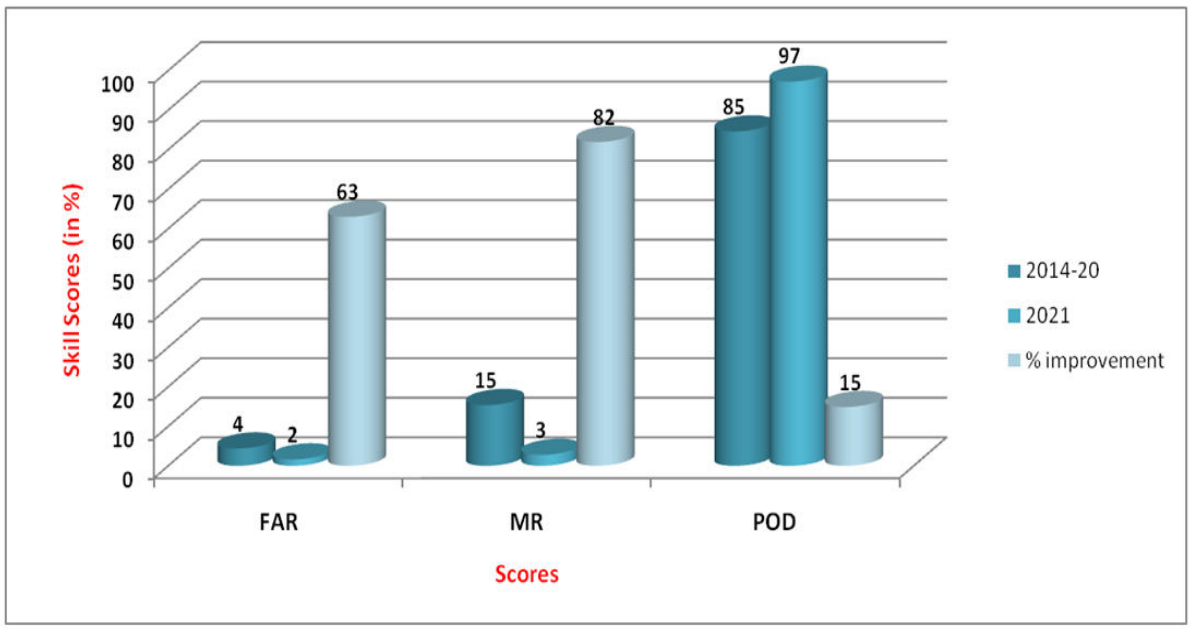


Fig.-4

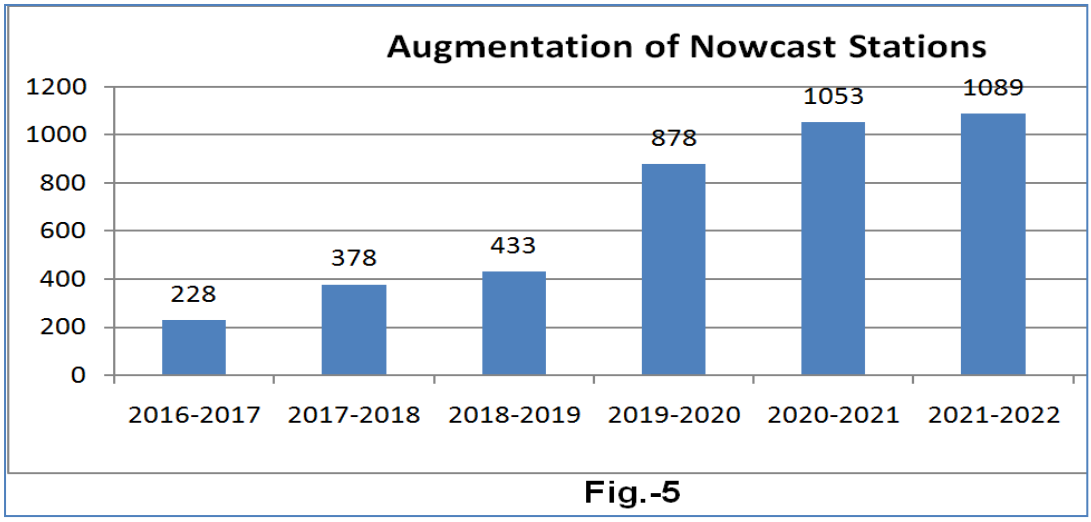


Fig.-5

❖ **Thunderstorm Skill:**

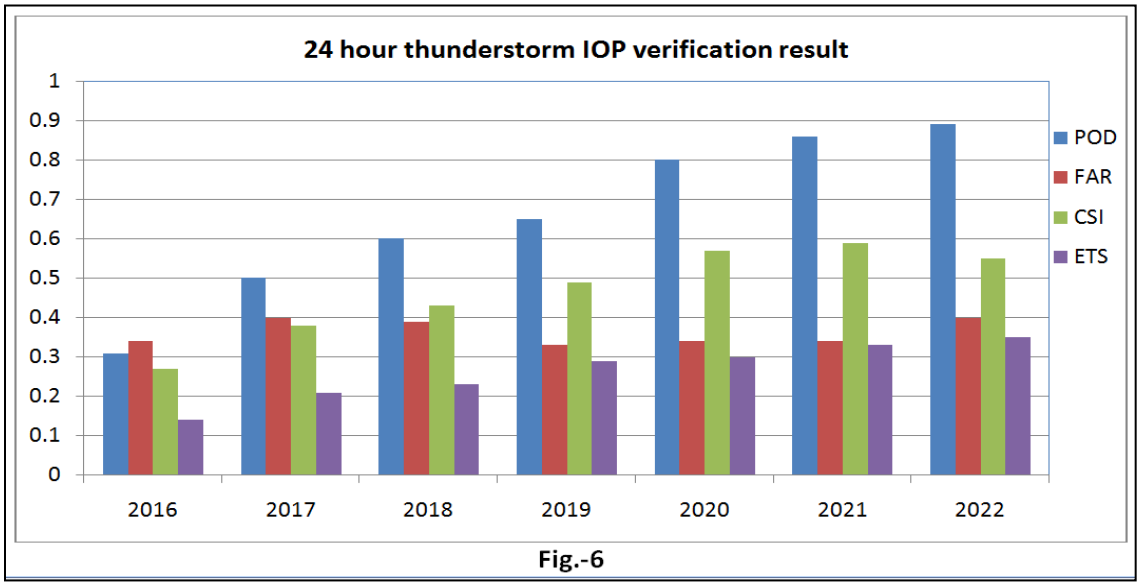


Fig.-6

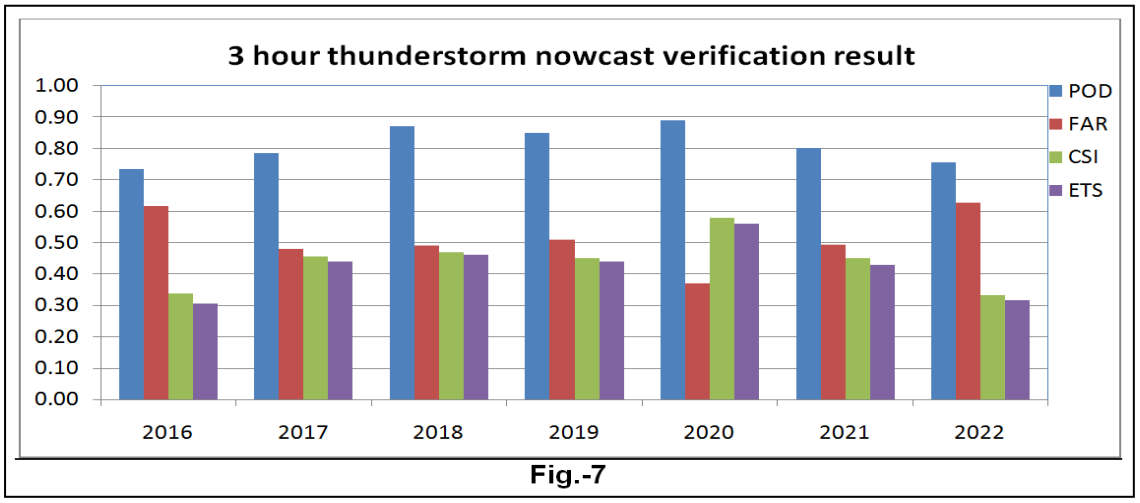
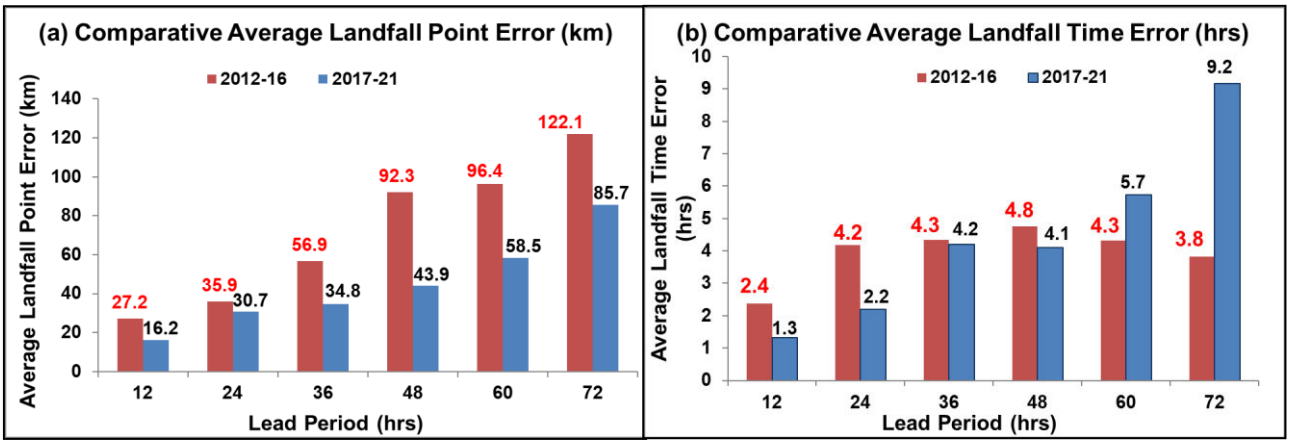
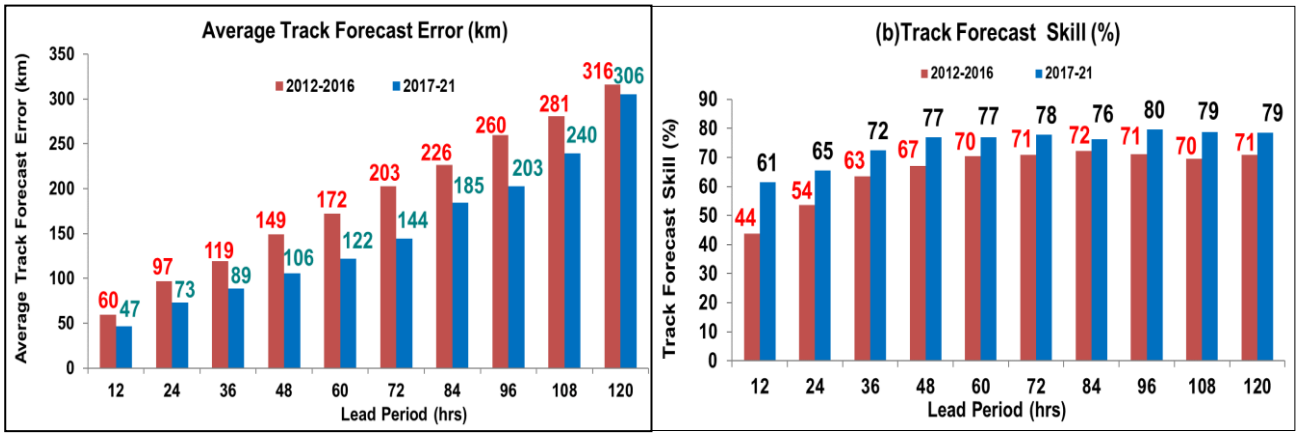


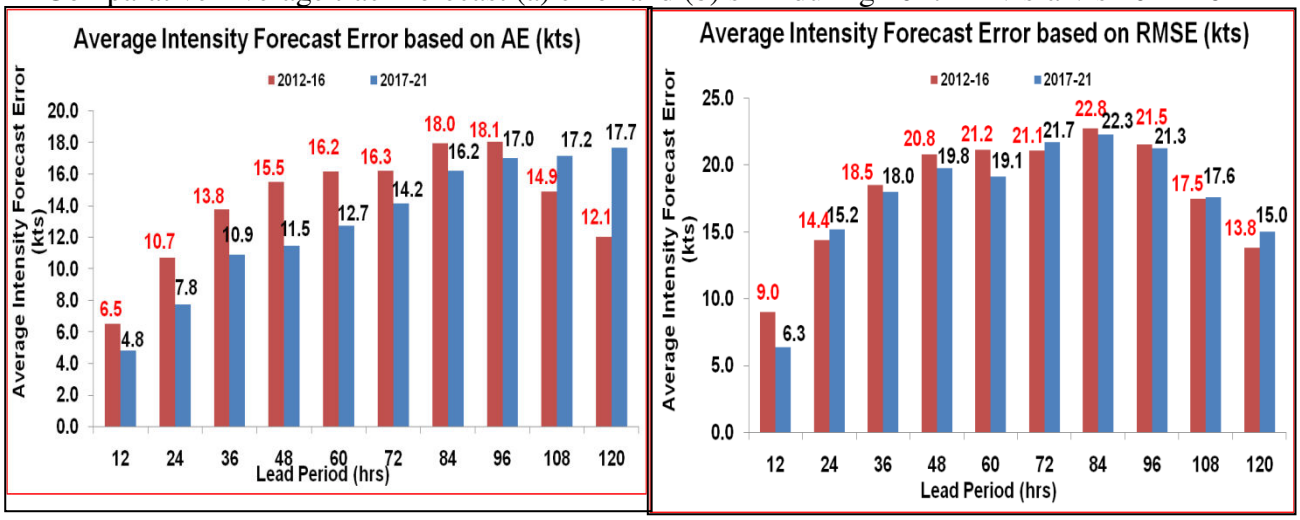
Fig.-7



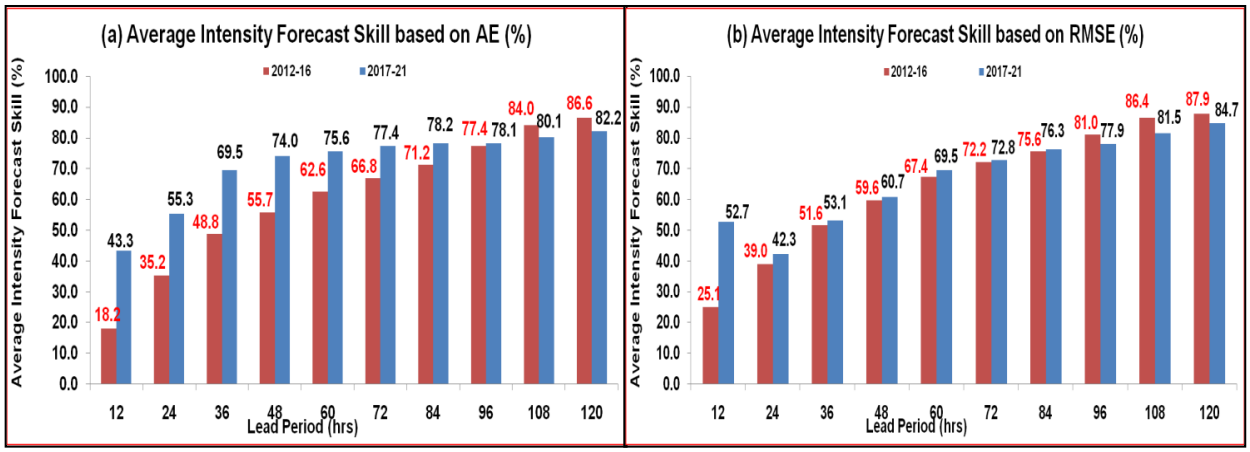
Comparative average landfall (a) point and (b) time forecast errors during 2017-21 vis-à-vis 2012-16



Comparative Average track forecast (a) error and (b) skill during 2017-21 vis-à-vis 2012-16



Comparative Average Intensity forecast errors (kts) based on (a) absolute error and (b) root mean square errors during 2017-21 vis-à-vis 2012-16



Comparative Average Intensity forecast skill(%) based on (a) absolute error and (b) root mean square errors during 2017-21 vis-à-vis 2012-16

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