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Objective and Experimental setup

Objective: To study the impact of initial and boundary condition perturbation along with stochastic physics on precipitation forecasts of extremely heavy precipitation events over India.

Experimental Setup: Experiments have been performed using the NCMRWF regional ensemble prediction system (Based on the Met Office Regional Ensemble Prediction system :UM version 11.1) for the extremely heavy rain events over Uttarakhand and Kerala states on India.

Experiment-1: Using Initial condition perturbations(ICP), Boundary condition perturbation(BCP) and Random Parameters (RP); (ICP+BGP+RP.)

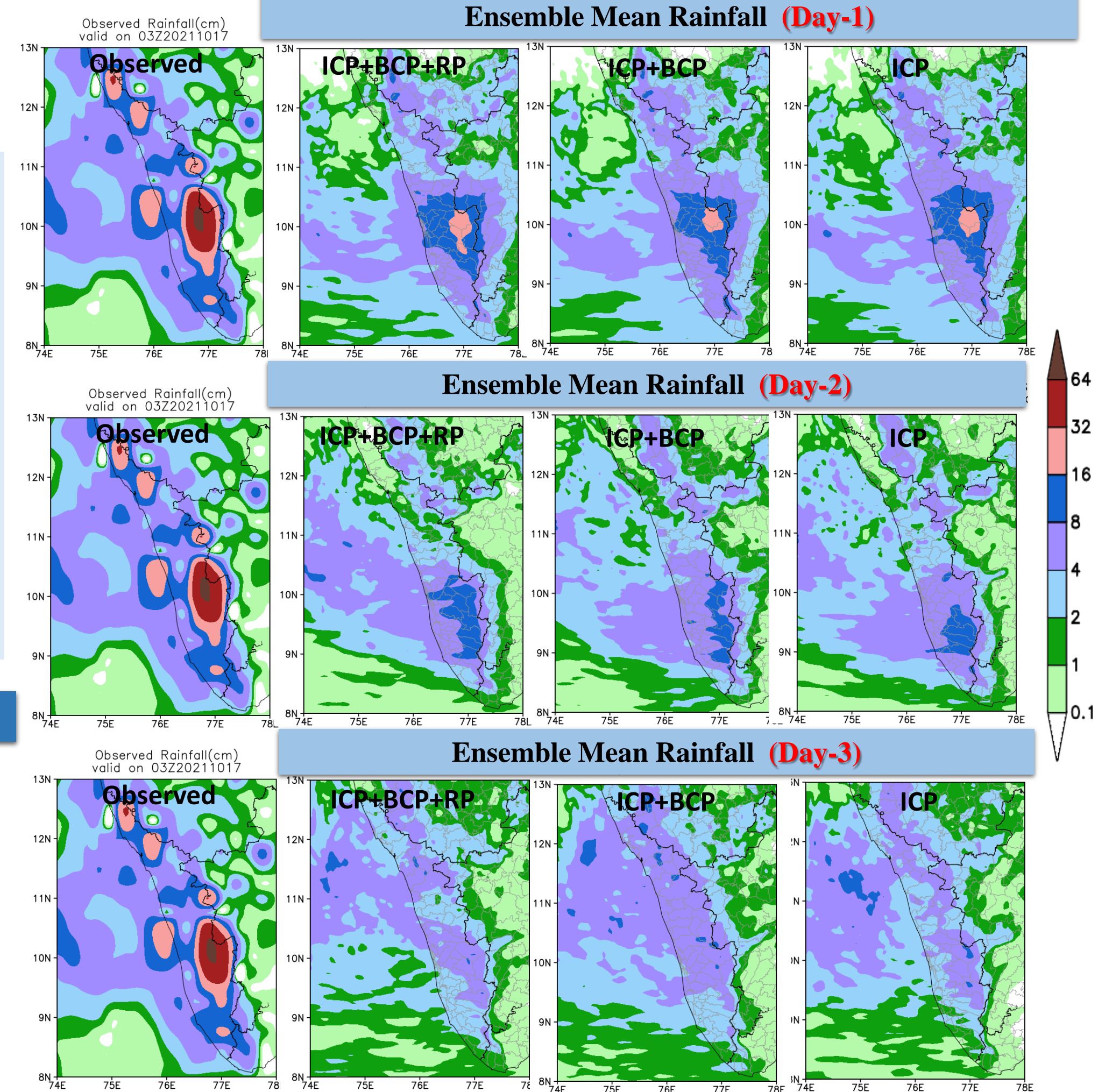
Experiment-2: Using ICP and BCP and no RP; (ICP+BGP).

Experiment-3: Using only ICP; (ICP).

Above mentioned experiments have been performed for a lead time of 24hour (day-1), 48hour(day-2), and 72hour(day-3).

Verification statistics such as CRPS, Briers Score, RMSE, Spread etc are used to evaluate the forecasts.

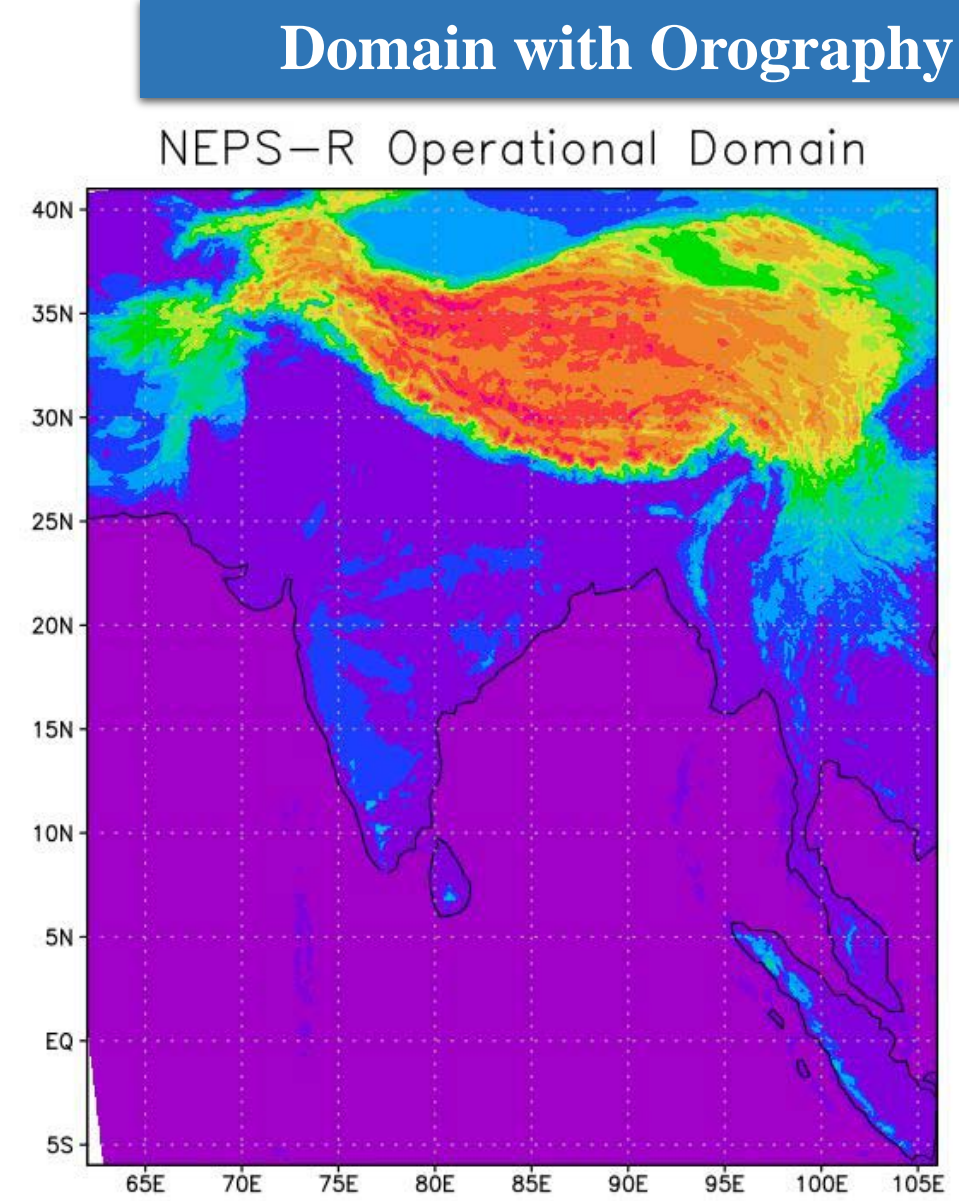
Kerala Heavy Rain Event of 16th Oct 2021



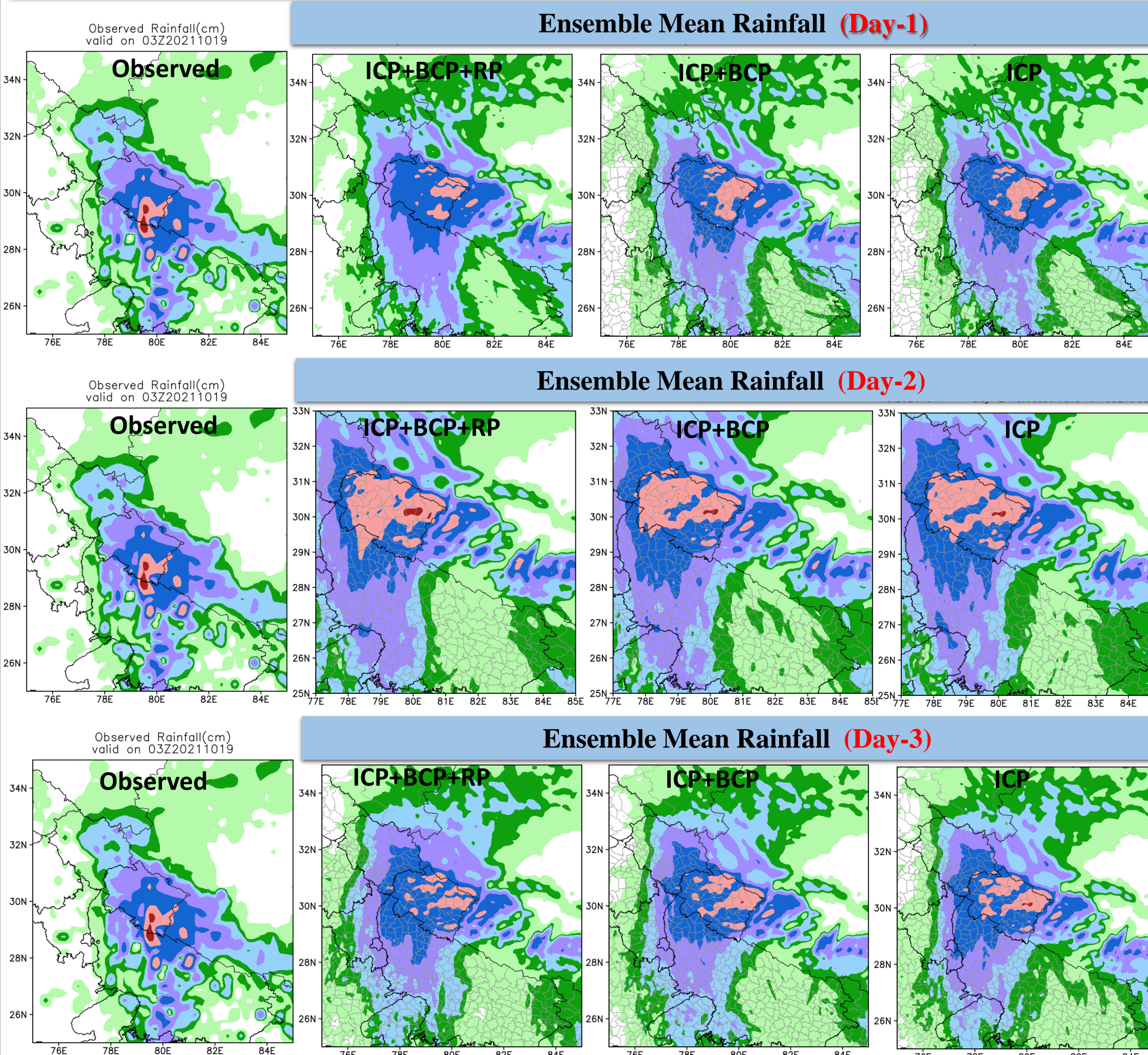
		Day-1			Day-2			Day-3			
Date	Case	statistics	ICP+BGP+RP	ICP+BGP	ICP	ICP+BGP+RP	ICP+BGP	ICP	ICP+BGP+RP	ICP+BGP	ICP
18 Oct	Kerala	CRPS(mm)	32.111	32.101	31.449	31.776	32.303	32.729	32.634	30.671	32.451
		Briers Score (>195mm)	0.1974	0.1799	0.1889	0.2079	0.1512	0.1765	0.1709	0.1515	0.1893
		Briers Score (>115mm)	0.17581	0.16230	0.16757	0.19242	0.1499	0.1645	0.1608	0.1413	0.1732
		Briers Score (>65.5mm)	0.17453	0.16649	0.1707	0.1864	0.1565	0.1644	0.1544	0.1452	0.1630
		Briers Score (>15.6mm)	0.35375	0.36751	0.3700	0.3222	0.3289	0.3361	0.3035	0.3765	0.3324
		Briers Score (>2.5mm)	0.63492	0.62899	0.64868	0.5697	0.5554	0.5689	0.6293	0.6787	0.6090

Salient features of NCMRWF Regional Ensemble Prediction System (NEPS-R)

NEPS-Regional (4km) (UM Version 11.1)	
No of ensemble members	Control + 11 members
Driving model	Global EPS- N1024 (NEPS-G)
Domain	62°E-106°E, 6°S-41°N
Horizontal Resolution	4km with 1200 grid points in the east-west and North-South direction
Vertical levels	80 levels up to 38.5 km
Science configuration	Pre-chill RA2T (conserve)
LBC frequency	3hr
Forecast Length	75hrs
Model time step	120 seconds
Convection	Explicit

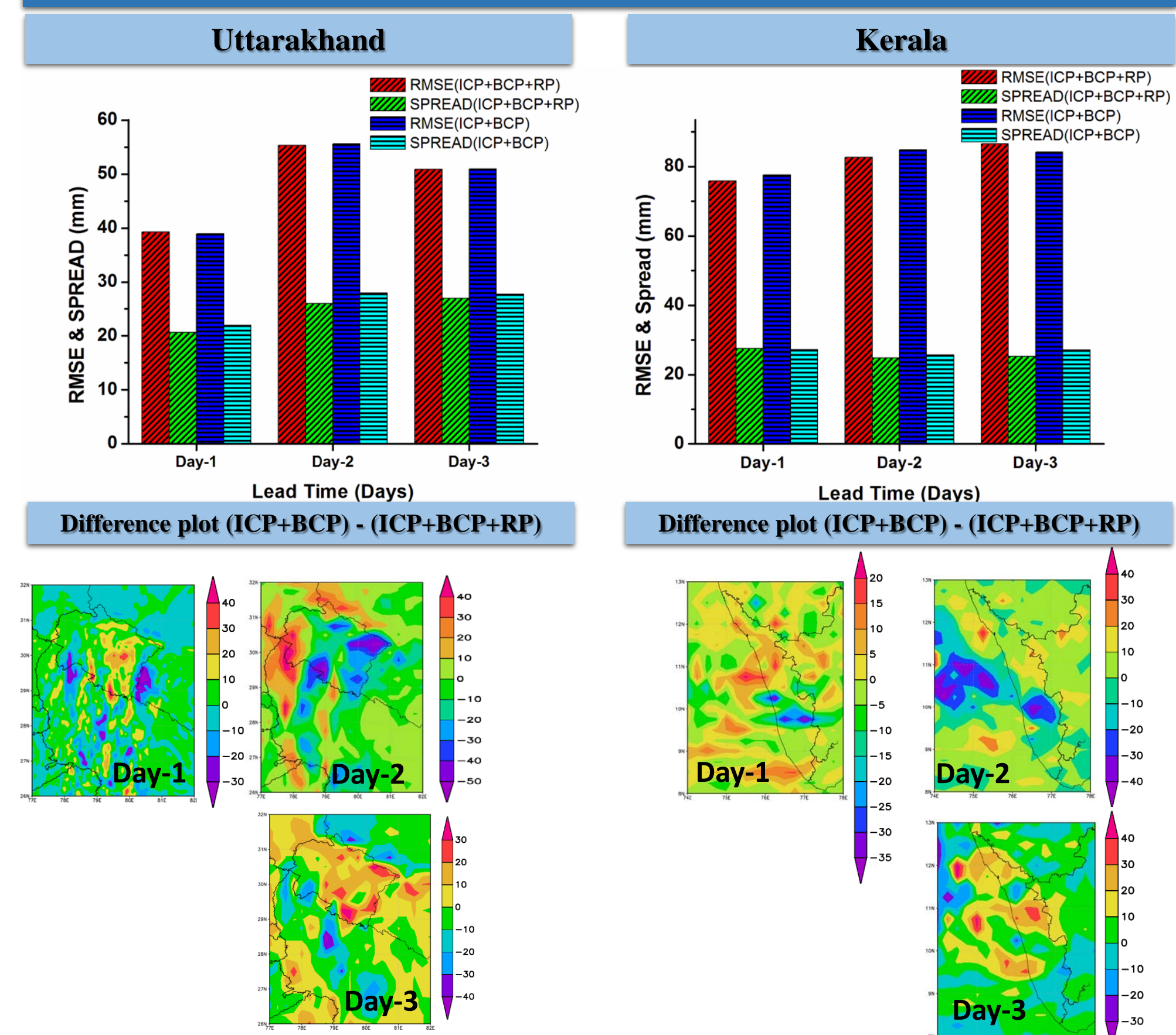


Uttarakhand Heavy Rain Event of 18th Oct 2021



		Day-1			Day-2			Day-3			
Date	Case	statistics	ICP+BGP+RP	ICP+BGP	ICP	ICP+BGP+RP	ICP+BGP	ICP	ICP+BGP+RP	ICP+BGP	ICP
18 Oct	Uttarakhand	CRPS(mm)	16.791	16.589	16.602	24.476	24.919	24.460	22.482	21.656	23.196
		Briers Score (>195mm)	0.0656	0.0602	0.0614	0.1001	0.0916	0.0959	0.0870	0.0923	0.0919
		Briers Score (>115mm)	0.0965	0.0920	0.0941	0.1313	0.1247	0.1300	0.1147	0.1182	0.1188
		Briers Score (>65.5mm)	0.1481	0.1438	0.1450	0.1787	0.1757	0.1779	0.1604	0.1619	0.1643
		Briers Score (>15.6mm)	0.3587	0.3547	0.3543	0.3583	0.3587	0.3603	0.3443	0.3324	0.3344
		Briers Score (>2.5mm)	0.5587	0.5603	0.5536	0.5169	0.5107	0.5118	0.5020	0.5101	0.5004

RMSE and Spread



SUMMARY

- The study returns contrasting results in the two cases.
- Precipitation intensity decreases (maximum of up to 4cm/day) with the use of Random Parameters(RP) Scheme on day-1 and day-3, increases (maximum of up to 5cm/day) in day-2 in the Uttarakhand case.
- CRPS increases on day-1 and day-3, decreases on day-2 with the use of RP scheme. Briers Score(BS) for precipitation thresholds >65.5mm, >115mm and 195mm is better without using RP scheme on day-1 and day-2, better on day-3 using RP scheme.
- RMSE is relatively the same in with and without RP experiments and a slight decrease in spread is observed on all days in the Uttarakhand case.
- Precipitation intensity increases (maximum of up to 4cm/day) with the use of Random Parameters(RP) Scheme on day-1 and day-2, decreases (maximum of up to 4cm/day) in day-3 in the Kerala case.
- CRPS increases on day-1 and day-3, decreases on day-2 with the use of RP scheme. Briers Score(BS) for precipitation thresholds >65.5mm, >115mm and 195mm is better without using RP scheme at all lead times using RP scheme.
- RMSE decreases slightly on day-1 and day-2 and increases slightly on day-3 in with RP experiment and spread increases marginally on day-1 and decreases on day-2 and day-3 in with RP experiment in the Kerala case.
- The decrease/increase in precipitation mentioned above is mostly confined to the regions of maximum precipitation, while the rest of the areas have a decreasing trend with the use of RP scheme in both the cases.
- More cases need to be studied to arrive at a robust conclusion regarding the impact of RP scheme.

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