Supplement to the Author's response to Referee #1 (C1517):

WRF simulation of the tropical cyclone Rashmi
Model initialization strategy

The comment of the Referee #1 reveals that the WRF model configuration used in our study is not sufficiently introduced. In this short supplement, we want to justify our choice of a daily reinitialization instead of a week-long single run.

The general context and the main reasons of our choice are explained in the general and specific answers of our response. For more relevance, the results of a test case enlightening this point are showed here.

We use the evaluation methods described in the manuscript to compare two set-ups:

A. the configuration described in the original manuscript: the simulations cover the period 22–28 October 2008, totalizing seven 36 h long runs starting at 12:00 UTC, each run contributing to 24 h effective output (with 12 h spin-up time)

B. same physical parametrization as in the original manuscript, but the simulation is initialized once on the 21 October 2008, 12 h UTC, the first twelve hours are withdrawn for spin-up, and the seven following days are used as effective output.

The accumulated amounts over seven days and the time series are computed for the period 22-28 October 2008, and both cases (A and B) are compared using the statistical scores and methods described in the submitted manuscript. The validation methods using the three available observational datasets are applied to the WRF output in all resolutions.

1. Comparison with TRMM

In this section, the output from WRF in the 30 km resolution accumulated over the seven days is spatially compared to TRMM using contingency tables approach. For three thresholds (10, 50 and 100 mm/7 days) applied to the fields from TRMM and WRF30, the skill scores are computed in cases A and B. Please refer to the manuscript for a comprehensive test description.

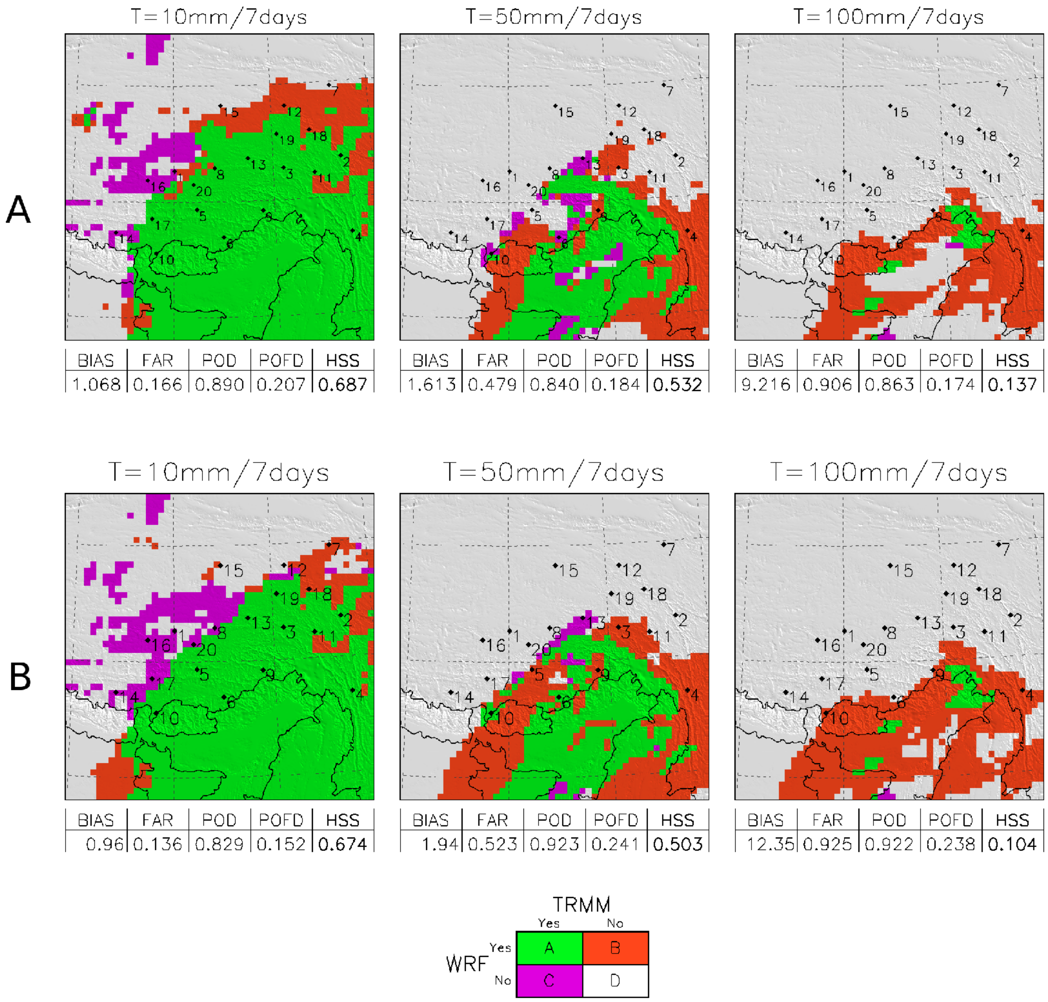

Figure 1: Seven days accumulated precipitation fields from TRMM and WRF30 comparing (A), the daily initialization and (B), the weekly run. Each grid point is classified following the contingency table conventions for the 10, 50 and 100mm events. The corresponding scores are given under each plot.

Looking at the majority of the scores, WRF is closer to TRMM observations in case A than in case B. One noticeable fact is the smaller number of 10 mm events in case B (smaller BIAS and POD) with a larger number of 100 mm events (higher BIAS and FAR). This is reflected in the HSS, which is systematically lower.

2. Comparison with MODIS

Here two tests are performed over the accumulated amounts of snow from WRF output in the 10 and 2 km resolutions. Given a static spatial repartition of snow events recovered from the differences between MODIS scenes before and after the event, we first analyze the development of the HSS score accordingly to the threshold applied to accumulated snowfall amounts for WRF10 and WRF2 in cases A and B. Please refer to the manuscript for a comprehensive test description.

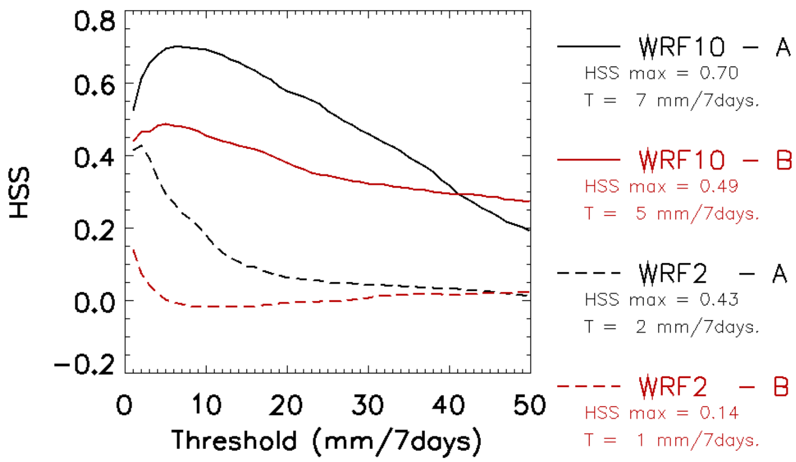

Figure 2: WRF snowfall fields in comparison with MODIS. Evolution of the HSS score with the augmentation of the threshold applied to the seven days accumulated snowfall from WRF10 output over the medium domain and WRF2 output over the small domain comparing (A), the daily initialization and (B), the weekly run. The best scores and corresponding optimal thresholds are given for information.

For the threshold range 1 to 40 mm/7 days, the model HSS are higher in case A. The case B scores over the small domain reveal a very bad performance that is enlightened in Figure 3. The threshold of 7 mm/7 days is applied to both cases and both domains to analyze the spatial repartition of the simulated snowfall fields.

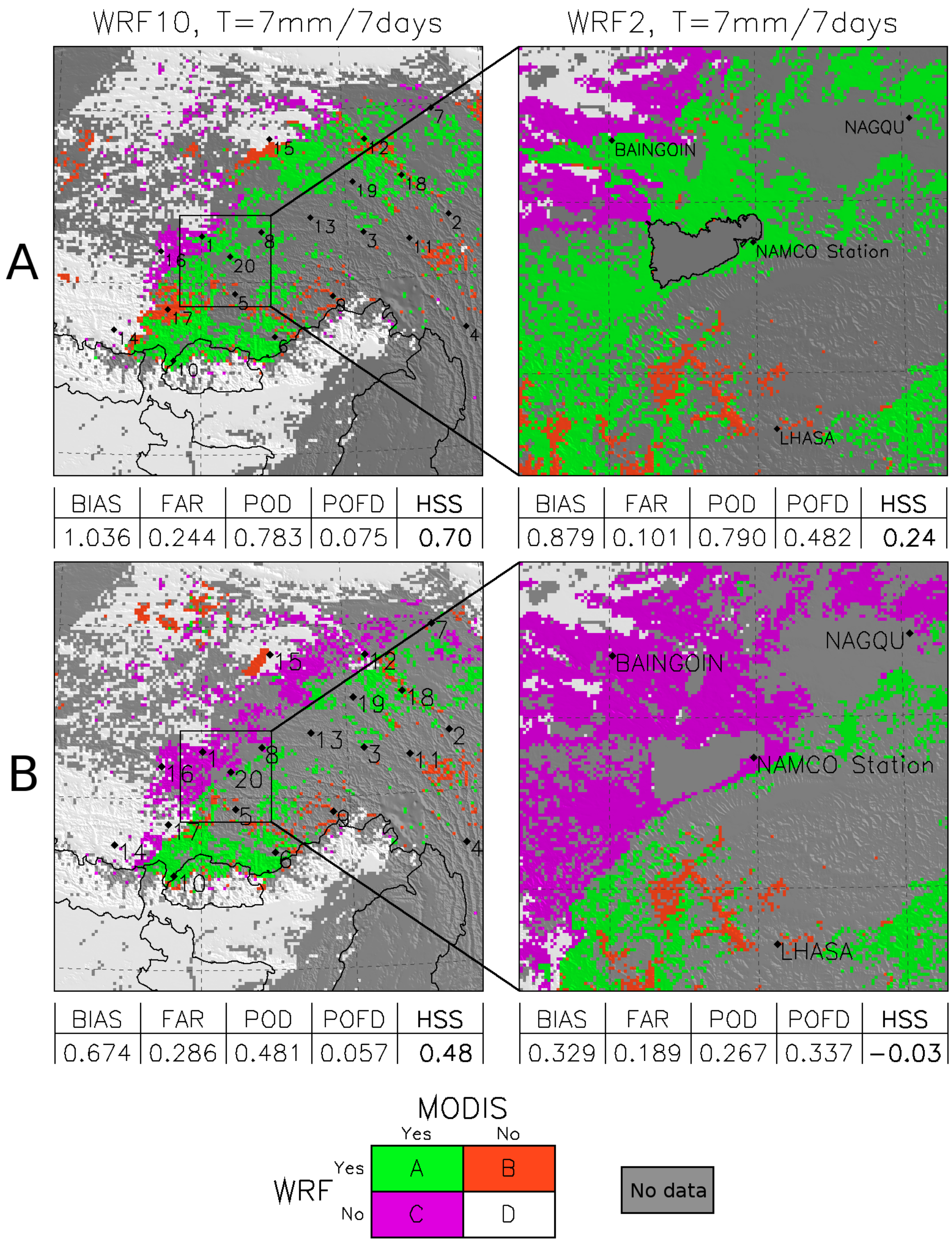

Figure 3: Seven days accumulated snowfall fields that reached the threshold 7 mm/7 days for WRF10 and WRF2 datasets in reference to MODIS comparing (A), the daily initialization and (B), the weekly run. Each grid point is classified following the contingency table conventions. The corresponding scores are given under each plot.

Over the 10 km domain, we see that snowfall repartition in case B stayed more to the south than observed by MODIS and modeled in case A. Over the smaller 2 km domain, the north western limit of snow is not caught by the weekly initialization case. The mountain range at the south of the lake acts as an orographic barrier, as shown by the line that follows exactly the range in the SW – NE direction. Once again, the HSS underlines these differences, with even negative scores in the worst case.

3. Comparison with ground observations

After having spatially compared the model output with TRMM and MODIS, the output of WRF is analyzed on a point basis for each meteorological station position (Table 1), and also in time using time series of measured and modeled values (Figure 4). Please refer to the manuscript for a comprehensive test description.

		Observations		A – Daily Initialization			B – Weekly initialization		
Station		NCDC	TRMM	WRF30	WRF10	WRF2	WRF30	WRF10	WRF2
01*	BAINGOIN	**6.1**	8.2	9.1	7	7.9	1.8	1.6	1.2
02	DEGE	**12.2**	24.6	44.2	40.4		39.6	36.8	
03	DENGQEN	**36.6**	22.6	51.5	46.2		62.9	59.3	
04*	DEQEN	**138.4**	26.7	212.3	147.7		174.2	136	
05*	LHASA	**6.9**	47.8	43	36.9	34.3	57.4	50.5	43.7
06*	LHUNZE	**25.1**	55.5	36.3	29.3		75.1	64.0	
07	MADOI	**6.1**	4.9	5.5	4.5		12.7	13.4	
08	NAGQU	**22.1**	23.0	24.2	22.2	21.8	4.9	3.5	3.3
09*	NYINGCHI	**46.2**	30.4	78.9	58.1		108.8	85.2	
10*	PAGRI	**65.0**	69.7	45	46.6		108.5	114.7	
11	QAMDO	**25.9**	17.3	38.7	38.8		43.6	39.2	
12	QUMARLEB	**11.9**	4.6	20.6	18.5		6.6	5.1	
13*	SOG_XIAN	**30.2**	75.7	42.9	37.7		16.9	11.8	
14	TINGRI	**0.0**	28.1	0	0		0.0	0.0	
15	TUOTUOHE	**0.8**	1.4	4.9	5.3		5.0	7.7	
16	XAINZA	**2.0**	29.9	1	0.8		0.5	0.5	
17	XIGAZE	**5.8**	19.8	14.8	8.3		0.6	0.0	
18*	YUSHU	**26.9**	3.1	39.6	38		18.5	18.0	
19	ZADOI	**17.3**	29.3	41.6	43.2		19.9	20.0	
20*	NAMCO	**15.9**	18.9	26.4	31.8	31	1.9	1.5	1.2
RMSD :			31.94	**23.4**	**13.6**	**-**	**27.18**	**22.24**	**-**
MB :			2.00	**13.9**	**8**	**-**	**12.90**	**8.37**	**-**

Table 1: Accumulated precipitation (mm/7 days) for each station from NCDC, TRMM, WRF30, WRF10 and WRF2 comparing (A), the daily initialization and (B), the weekly run. Root Mean Square Deviation (RMSD) and Mean Bias (MB) are given for comparison. The time-series of stations marked with a (*) are presented on Figure 4.

The overall performance of the daily reinitialization case is better with respect to the RMSD. The differences are highest for the 10 km resolution, which is the closest to observations between all considered datasets. The MB is nearly the same in A and B cases, despite the number of stations where WRF in case B modelled no precipitation. This is explained by the relatively high biases on the southern stations where WRF B over-predicted the amounts.

The last analyse concerns the time series of 9 from the 20 available stations (Figure 4).

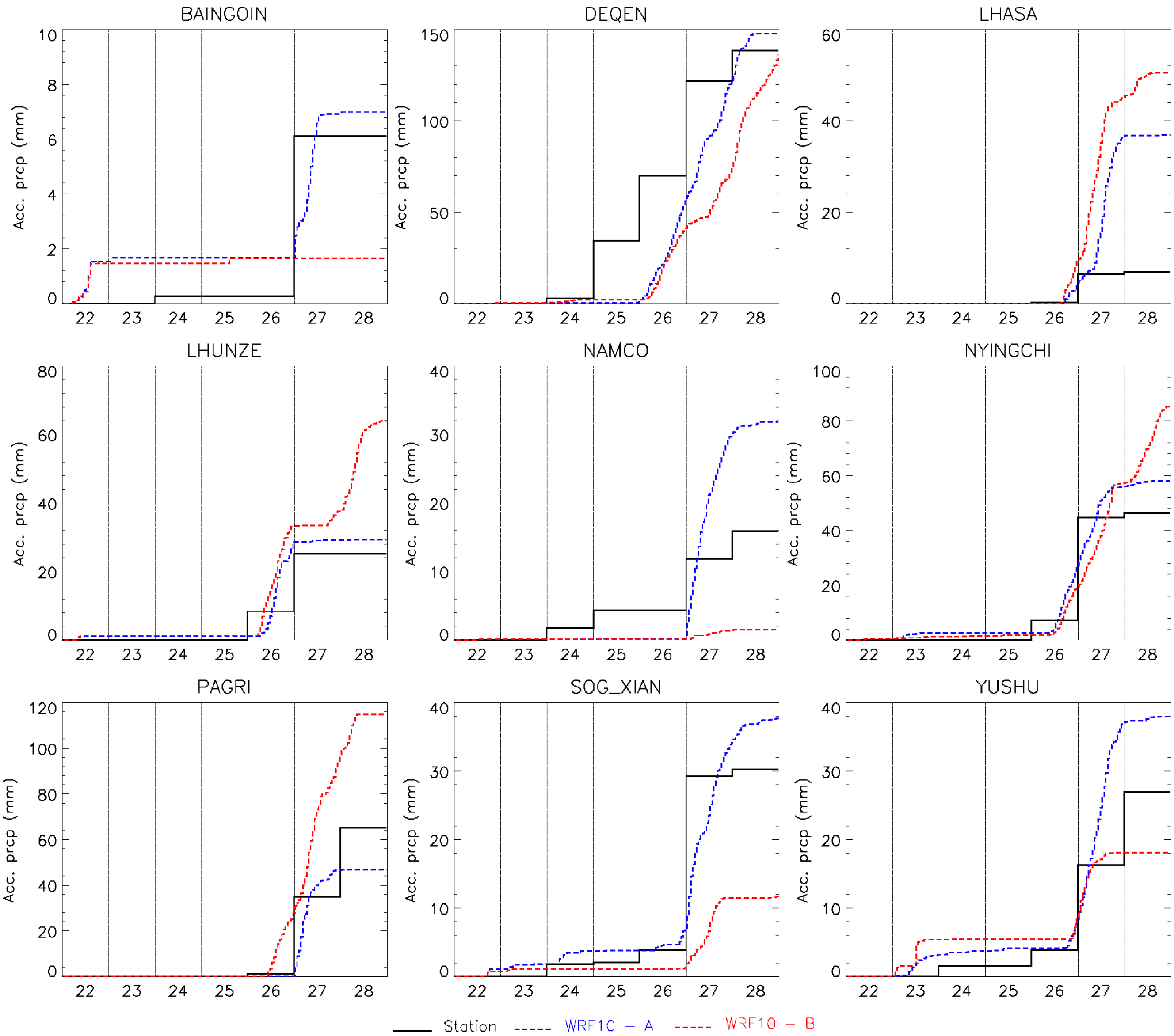

Figure 4: Accumulated precipitation time-series (Acc. prcp, in mm) from NCDC, WRF10 in case (A), the daily initialization and (B), the weekly run for a selection of nine meteorological stations. Units on the x-axis are the days in October 2008. Data time resolution is daily for the stations, hourly for WRF output.

The timing of the front is generally close in both cases, but the amounts are closer to observations in case A than in case B for seven from the nine shown stations.

Conclusion:

For all tests, WRF performs better with the daily initialization. This is the reason why we chose this set-up for our reanalysis purposes.