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Atmospheric Measurement Techniques Discussions

Interactive comment on "An Assessment of the Impact of ATMS and CrIS Data Assimilation on Precipitation Prediction over the Tibetan Plateau" *by* Tong Xue et al.

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Major points 1. Section 2.1.2 Observation data: Even if there is the reference to a previous study on the (Guo et al., 2014), it is interesting to have some more details about it, especially about its performance on the TP, considering that the rain gauges are sparse over the TP. Answer: Thanks for these thoughtful suggestions. Due to the gauge distribution is very sparse in TP area, satellite-based estimates have become very important sources for precipitation information. We have further explain the performance of the CMORPH dataset for TP in the revised that paragraph in lines 129-151: Considering the topographically complex terrain characterizing the TP, satellite precipitation data with very high spatial resolution is especially needed. CMORPH product makes use of the precipitation estimates technique that have been derived from low orbiter satellite microwave observations and geostationary satellite IR data with spatial propagation features. Several studies (Gao et al., 2013; Guo et al., 2014; Tong et al., 2014; Zhang et al., 2015) have compared the CMORPH data with satellite precipitation data sets in the TP area with the conclusion that CMORPH data is one of the most suitable product to use in studying precipitation over the TP. During the period from May to October 2004-2009, Tropical Rainfall Measuring Mission (TRMM) Multisatellite Precipitation Analysis real-time research 3B42 version 6 (TMPA) and CMORPH show better performance in higher correlation and lower RMSE than the Precipitation Estimation from Remotely Sensed Information using Artificial Neural Network (PERSIANN) and its real time version (TMPART) over the TP(Gao et al., 2013). Of the several merged satellite precipitation products (i.e.TMPA, PERSIANN, and the Global Satellite Mapping of Precipitation (GSMaP)), the CMORPH product with the highest resolution (8 km) can capture the afternoon-to-evening precipitation pattern (Guo et al.,2014). Tong (2014) has also compared the performance of four widely-used high resolution satellite precipitation estimates against gauge observations (the CMA data) over the TP during January 2006-December 2012. It's worth noticing that TMPA and CMORPH data had better performance in depicting precipitation timing and amount than the TMPART and PERSIANN at both the plateau and basin scale. Zhang (2015) has also made a conclusion that the high resolution CMORPH data can depict finer regional details, such as a less coherent phase pattern over the TP and better capture the features of the diurnal cycle of summer precipitation compared with TRMM 3B42. Gao, Y. C., & Liu, M. F. Evaluation of high-resolution satellite precipitation products using rain gauge observations over the tibetan plateau. Hydrology & Earth System Sciences Discussions, 2013, 9(8), 9503-9532. Tong, K., Su, F., Yang, D., & Hao, Z. Evaluation ofÂăsatellite precipitation retrievals and their potential utilities in hydrologic modeling over the tibetan plateau. Journal of Hydrology, 2014, 519, 423–437.

2. Section 4.1- Lines 255-264: I can't understand what is shown in Figure 4. If the panels a) and c) are observed values for July they should be the same, while they

show different values. Explain. Answer: Thanks for your attention, we have explained it in the revised manuscript in lines 290-295. Due to the Figure 4 a) standing for the F24H, the first day calculated in Figure 4 a) was during the period of 06:00 UTC 1st July to 06:00 UTC 2nd July and finally ended in the period of 06:00 UTC 29th July to 06:00 UTC 30th July. Therefore the different values in Figure 4 a) and c) can be explained that the Figure 4 c) shows the L24H observed monthly mean accumulated precipitation of which the computing process are different in in two days with Figure 4 a).

3. Section 4.3- Details need to be added on the computations you did in Figure 10, including the mathematical formulation. Answer: Thanks for your suggestion, we have revised the manuscript in lines 403-418 as follows: Zonal component of wind velocity (u), meridional component of wind velocity (v), specific humidity (q), and covariance, which are needed for flux computations, are provided at eight standard pressure levels (1000, 925, 850, 700, 600, 500, 400, and 300 hPa). The equation of unit side length, vertically integrated between the surface level and the top of the atmosphere and averaged in time atmospheric water vapor flux (unit: kg*m-1*s-1) can be written as: (11) The zonal and merdional component of vapor flux is described by: (12), and (13) , respectively. ÂăWhere ps is the surface pressure and p is the pressure at the "top" of the atmosphere, g is the gravitational constant (9.8 m*s-2Âă). The water vapor flux divergence (D, unit: kgâĂćm-2âĂćs-1) is given by: + (14) where a is the radius of the model earth taken as 6371.2 km, Âăis latitude in radians, andÂăÂăis longitude in radians.

Minor points 4. Line 36: “hourand” should be “hour and”. Answer: Thanks for pointing out this issue to us. We have corrected it in the revised manuscript in lines 30-31. For the first 24-hour and last 24-hour accumulated daily precipitation. . .. . .

5. Lines 42-45: reformulate the last sentence of the abstract because is not clearly understandable. Answer: Thanks for your suggestion. We have revised the abstract in the last sentence into “ Overall, based on the experiments in July 2015, the satellite

data assimilation improved to some extent the prediction of precipitation pattern over the Tibetan Plateau although the simulation of rainbelt without data assimilation shows the regional shifting."

6. Lines 75: Put a dot after "2008)". Answer: Thanks for your attention. We have revised it in line 71.

7. Line 85: two dots after "2013)". Answer: Thanks for your attention. We have deleted one dot in line 81.

8. Line 96: change "has" with "had". Answer: Thanks for pointing out this mistake for us. We have revised it in line 92.

9. Line 113: "The GFS data are. . ." Answer: Thanks for pointing out this mistake for us. We have revised it in line 199.

10. Lines 291-294: The two sentences are unclear. Please, rewrite. Answer: Thanks for your attention. We have revised it in lines 326-330 as follows: The ~84-89% high percentage of hits and correct rejections events indicates that rainfall events are well predicted. Furthermore, as the false alarms were primarily located in the east of the TP in contrast to the misses in the west, this special pattern can help WRF-ARW model reduce model error in the future which means that WRF-ARW model has promising potential in TP area.

11. Line 314: put a space between events and "(". Answer: Thanks for your attention. We have revised it.

12. Line 316 and after: I would not call a 6 mm/day precipitation as a "heavy rains". Check thorough the paper. Answer: Thanks for your attention. Precipitation is mainly distributed in the south edge of the TP, and the rainfall in other area is very small (Figure 4). The threshold of 6 mm is defined by calculating the whole D02 regional average precipitation so that the value seems relatively small.

13. Line 318: "between" is "among". Answer: Thanks for pointing out this mistake for

us. We have revised it in line 355.

14. Line 359: In the figure 10 the period is 3-5 July and not 3-6. Please change. Answer: Thanks for your attention. We have revised the period in the manuscript in line 403.

1. Line 374: The score shown is FSS not ETS. Answer: Thanks for pointing out this issue for us. We have revised it in line 434.

2. Line 383: Figure 10l does not exist. Answer: Thanks for your attention. We have revised it the manuscript in line 444 as follows: the precipitation experiments all underestimated the amount of precipitation, and CRIS performed particularly badly (Fig. 10c, f, i).

3. Line 385: Change "This phenomenon" with "This result". Answer: We have followed your suggestion in the revised manuscript in line 446 as follows: This result indicates that DA can indeed improve the heavy rainfall forecast.

4. Line 386: Figure 10 refers to CTRL and not to DA experiments, likely you would refer Figure 11. Answer: Thanks for pointing out this mistake for us. We have revised it in line 447: From the above analysis of Figure 9 and 11, it is clear that before the heavy rainfall, DA can improve the simulation of precipitation spatially.

5. Figure 2: It is unclear what is shown on the right-y axis. The Figure caption must clearly state what is represented. Answer: We have followed your suggestion in the revised caption of figure 2 as follows: Figure 2. Blue bars indicate the total amount of radiance read in the DA system. Red bars present the number of kept radiance after first step of quality control. The used percentage after final quality control is shown as black curves. The right y-axis indicates the ratio of used amount to read amount. Top panel is for ATMS (a) and bottom is for CrIS data (b).

6. Figure 4: The Figure 4 caption must be rewritten. It is unclear. "Spatial pattern of the monthly mean precipitation in July 2015". I believe it is the daily precipitation averaged

for the month of July 2015 Answer: We have followed your suggestion in the revised caption of figure 4 as follows: Figure 4. Daily precipitation averaged (unit: mm) for the month of July 2015. (a), (b) are F24H forecast and (c), (d) are L24H forecast. Black contours are altitude (unit: m).

7. Figure 8: title is “precipatation”. Answer: Thanks for pointing out this mistake for us. We have corrected the title.

8. Figure 10: the period is 3-5 July not 3-6 July. In the caption, “precipitation quantity” is“precipitation”. Answer: Thanks for pointing out this mistake for us. We have corrected the caption. Figure 10. (a)–(f) 24 h forecasts of precipitation quantity (shadings) and water vapor flux (vectors) during 3–5 July for (a)–(c) OBS and (d)–(f) CTRL. (g)–(i) Differences in water vapor flux (vectors) and water vapor divergence (shadings) between CTRL and OBS. The unit of precipitation is mm. The units for water vapor flux and divergence is kg/(m*s) and kg/(m2*s), respectively.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/amt-2017-31/amt-2017-31-AC2-supplement.zip

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