**NHESS-2015-261**

**Responses to Anonymous Referee#3**

**Date: 25 January 2016**

**Referee#3 recommendation:**

This paper covers a topic relevant for natural hazards scope of NHESS and provides dominant processes of extreme rainfall which recorded over metropolitan area in Korea. The observational study explained in detail the cause and contributing factors of the extreme rainfall; that is, most of parts of the paper are devoted to the description of the structure and evolution of the extreme rainfall-producing mesoscale convective system. In this sense, this reviewer thinks that the present study presents a detailed description for extreme rainfall event. Thus, the paper can be published after minor revisions according to my comments in the following.

**Authors Response**

We appreciated very much your constructive comments/suggestions on our manuscript. The manuscript will be revised according to the recommendations provided by the reviewer. A point-by-point response to each of your comments/suggestions is given below.

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**Major comments:**

1) In introduction, authors should include previous studies, probably by comparing the present case study with the other MCS studies. For example, P 6468 Line 19-23 in this paragraph refer to the TS-MCS associated with stationary warm front, which may be a strong point with this paper. Authors should be compared with previous studies.

**Response**

Thank you for this suggestion. We fully agree your opinion. The previous studies associated with TS-MCS which formed along the cold front added into the paper. The sentences added as follow:

- TS–MCSs are often associated with a synoptic cold front, because TS–MCSs along the cold front was formed along the cold front with a large temperature gradient with the

strongly barolinic environment (Hopper and Schumacher, 2012). (page 12, line 243-246)

Reference

Hopper, L. J., and Schumacher, C.: Modeled and observed variations in storm divergence and stratiform rain production in southeastern Texas. J. Atmos. Sci., 69, 1159–1181, 2012.

2) Section 2, please add the information how to use the surface observation data set.

**Response**

Thank you for this suggestion. We added the sentence as follow:

- The surface observational data was interpolated from the measured points within neighborhoods, which was analyzed larger spatial areas near MCSs. (page 7, line 121-123)

3) Section 3.1, please remove the interpretation about cyclonic vorticity advection which could be inconsistence of this analysis. And the coupling between upper-level jet and low-level jet should be more interpreted.

**Response**

Thank you for this suggestion. We revised the paper as follow:

- Southern Korea and adjacent area were located under the exit region of ULJ streak and clear directional diffluence also existed. Uccellini (1990) found that the diffluence at the north side of the exit region of ULJ was favorable for the development of convection. Uccellini and Johnson (1979) also suggested that LLJ beneath the exit region of ULJ is coupled with ULJ streak by indirect circulation, which is forced two–layer mass adjustment. This is because relatively cool dry air near ULJ streak can combine with LLJ with warm moist air. In this case, the northwesterly ULJ was probably coupled with southwesterly LLJ. The two-layer mass adjustment acted to destabilize the atmosphere and could support the development of the intense MCS over southern Korea and adjacent area. (page 8, line 154-162)

4) Section 3.3, please add the interpretation why the authors investigated the upstream environment.

**Response**

Thank you for this suggestion. We agree your opinion and added the sentences for the reasons which investigate the upstream environment as follow:

- The source of convective instability was from upstream south of quasi-stationary MCS over Busan. The atmospheric thermodynamic and kinematic upstream environment was examined in this section. (page 11, line 205-207)

5) Section 4.1, Figure 10, the interpretation of back-building process is written well. However, the figure could not be shown clearly. The figure needs to be fixed.

**Response**

Thank you for this suggestion. The figure was revised to more see clearly. Each convective cell was marked by the abbreviation to more show clearly.

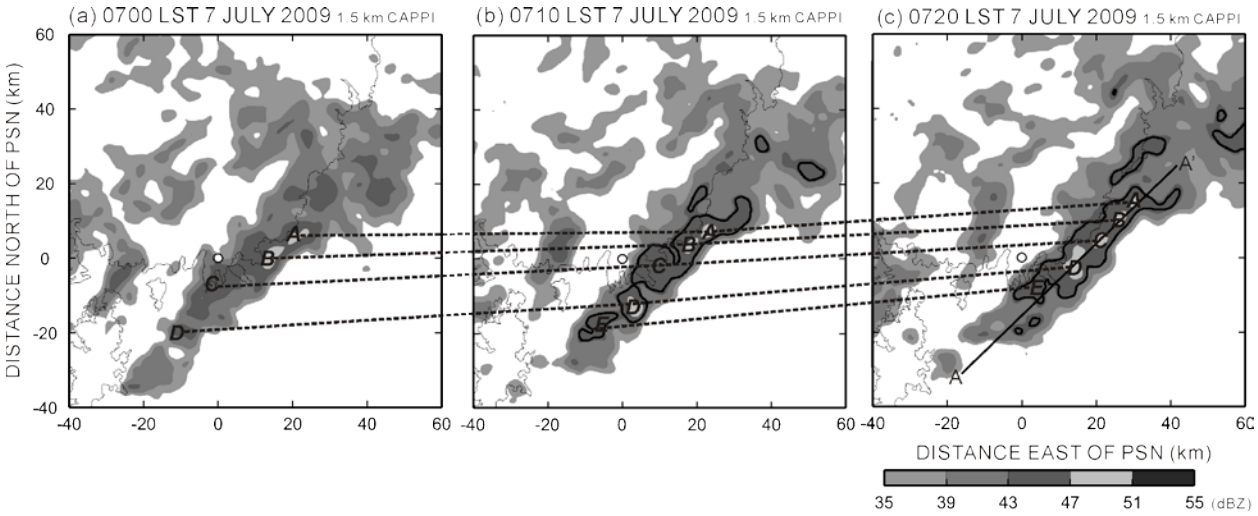


**Fig. 9**

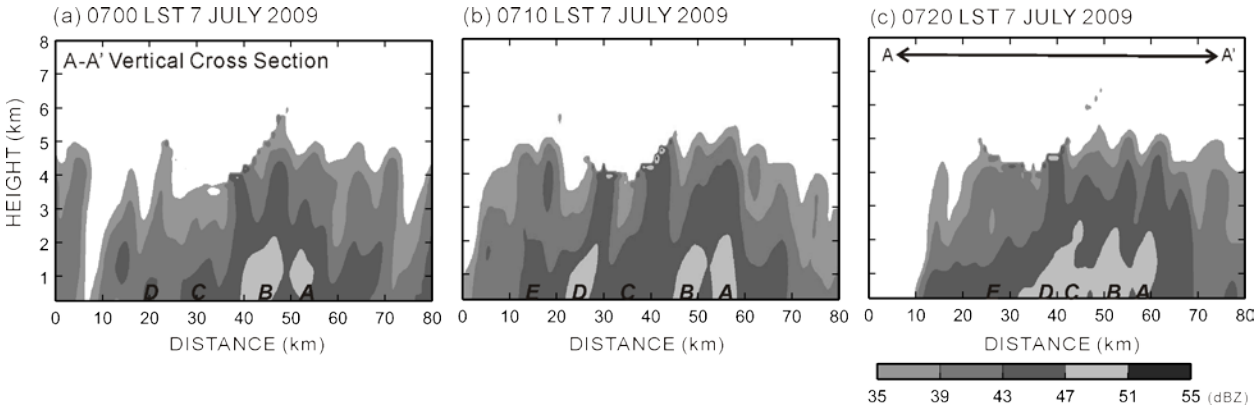


**Fig. 10**

6) Figure 5, hard to see geography on Fig. 5. Hard to distinguish theta-e and specific humidity on Fig. 6. Please remove the line about specific humidity, if the contents would not be important.

**Response**

Thanks for your suggestion. The specific humidity on Fig. 6 was removed.

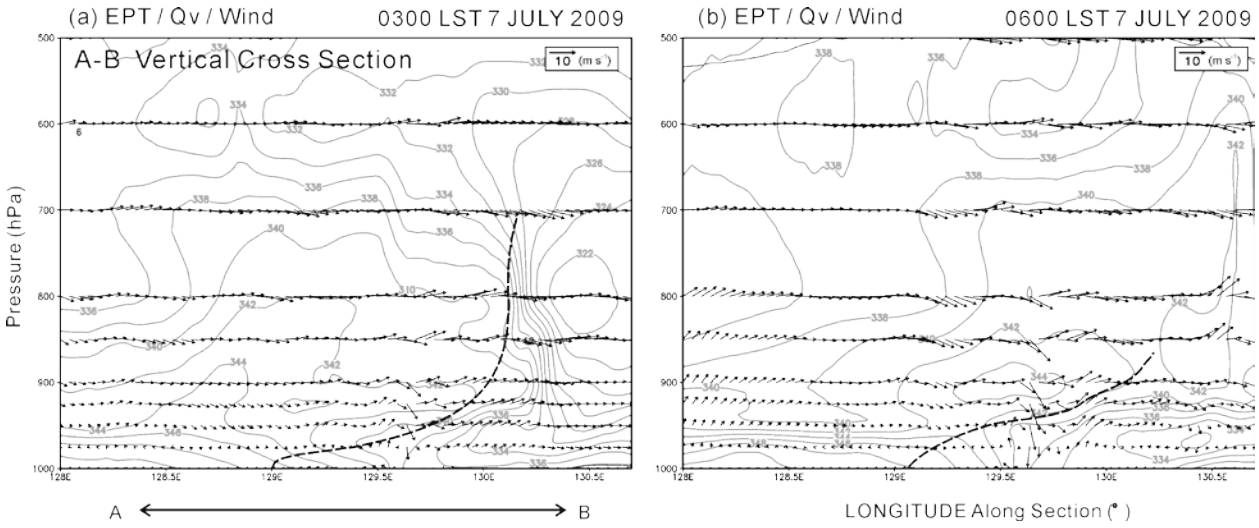


**Fig. 6**