Convective Cloud Model for Analyzing of Heavy Rainfall of Weather Extreme at Semarang Indonesia

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Submission date: 20-Jan-2020 01:21PM (UTC+0700)
Submission ID: 1243952997
File name: g_of_Heavy_Rainfall_of_Weather_Extreme_at_Semarang_Indonesia.pdf (8.15M)
Word count: 1840
Character count: 9582

Advanced Science Letters
Vol. 23, 6593–6597, 2017

Convective Cloud Model for Analyzing of Heavy Rainfall of Weather Extreme at Semarang Indonesia

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Rainfall in Tembalang Semarang 2–3 July 2016 causes flood. The accumulation of rainfall until 3 July 2016 is 182.5 mm, it exceeds BMKG's threshold about intensity of extreme condition, that more than 50 mm/day. It is related to dynamic of weather's parameter, especially with convection process and clouds. In this case, weather condition analysis uses Weather Research and Forecasting (WRF) Model one domain with 6 kilometer (km) resolution. Some weather's parameters show significant result. Their fluctuations prove there is a strong convection that produces convective cloud (Cumulonimbus) so that cloud has a long lifetime and produce rain. Default setting and without nesting on WRF Model show good output to represent weather's condition commonly. Difference between output rainfall rate of observation result and output of model around 6–12 hours is because spinning-up of processing. Satellite Images of MTSAT (Multifunctional Transport Satellite) are used as a verification data to prove the result of WRF. The cloud cover from data MTSAT IR 1 Kochi University that indicates there is cloud's top for Kochi University. This image consolidate that the output of WRF is good enough to analyze Semarang condition when the case happened.

Keywords: Rainfall, Cloud Model, WRF, MTSAT IR 1 Data, Satellite Image.

1. INTRODUCTION

The floods of natural disaster, what knocks over approximate 70% of all region in Tembalang Semarang takes place from date 2 July 2016 to 3 July 2016 with pond height ranges from 10–250 cm.[1] The nature phenomenon because of taking place torrential rains for hours for area that is wide enough and added with consignment floods. The floods of disaster knocking over area of Tembalang Semarang and its surroundings is because of big and the duration close rainfall as case of atmosphere change anomaly. The change anomaly of atmosphere from rainfall, as in Figure 1 graph of rainfall on 2016 of Tembalang Semarang, with maximum of rainfall time periodicity happened on 3 July 2016.

In this paper will be studied mechanism the happening of extremely rain floods Tembalang Semarang the year 2016. The diurnal cycle of rainfall and its regional variations are important in the tropics, where the monsoon that cause rainfall in extra-tropical regions don't exist. Because tropical rainfall involves to up take and release of significant amounts of latent heat of vaporization.[3] The extremely rainfall phenomenon evaluated from effect synoptic which is change of atmosphere regional, can be in the form of factor change condition of ENSO (El Nino South Oscillation) and streamline of wind of area Tembalang Semarang.

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2. EXPERIMENTAL DETAILS

WRF model is a numerical weather prediction (NWP) and atmospheric simulation system designed for both re-search and operational applications. WRF is supported as a common tool for the university/research and operational com-munities to promote closer ties between them and to address the needs of both. The development of WRF has been a multi-agency effort to build a next-generation mesoscale forecast model and data assimilation system to advance the understanding and prediction of mesoscale weather and accelerate the transfer of research advances into operations.[11]

In order to conducts numerical experiments, three nested WRF model domains have been used. Domains have horizontal resolutions of 39 km, 13 km and 4.3 km. With these characteristics of numerical domains, the main features of the bottom topography are well resolved. In this study, for correct description of atmospheric processes in equatorial zone cylindrical (Mercator) map projection in the Cartesian system coordinate was used.[7,10]

Initial and lateral boundary conditions which used in this study were downloaded from National Center for Environment Prediction (NCEP). The data updated every six hour. Initial conditions must specify the three-dimensional distribution of three velocity components, temperature, pressure and humidity, and the boundary conditions for temperature, humidity and velocity components, as well as the heat, moisture and momentum fluxes at the lower boundary of the model do-main.

 1936-6612/2017/23/6593/005 doi:10.1166/asl.2017.9691

Advantage of using WRF model is that it provides a large set of options from which to choose suitable parameterization scheme for the description of physics of non adiabatic processes. The WRF model offers multiple physics options that can be combined in many ways. In this study, we examined the impacts of seven convective parameterization schemes on the quality of rainfall forecast in Tembalang Semarang. Since the aim is to examine the effect of cumulus schemes, in this paper, other schemes like radiation schemes (short and long waves).

3. RESULTS AND DISCUSSION

The Heavy rain phenomenon is analyzed based on cloud dynamics pattern (IR1 Temperature data) in Tembalang Semarang. The growth pattern of cloud is started on 2 July 2016, but growth of maximum cloud happened on 3 July 2016 started when 00-03 UTC (07-09 WIB) and finished on 3 July 2016 (Figs. 1 and 2).

The study in this research will be analyzed from data AVN/FNL for date on 3 to 4 July 2016 in Tembalang Semarang. Data of contour pattern AVN/FNL for example covering divergence by streamline of wind, absolute vorticity obtained from data NCEP/NCAR (see Figs. 3 and 4). Data of every 6 hours from the NCEP/NCAR reanalysis data was used to know that extremely rain influence was predominated by local factor.[2,9]

Figure 3 show Change pattern of IR1 Temperature 2–3 July 2002, at 00 UTC in Semarang Central Java of Tembalang Semarang and Indian Ocean. The Change of pattern was started on 2 July 2016 and became maximal above Java's island on 3 July 2016 and finished on 4 July 2016.

As according to Figure 4 in its the research telling that any three aspect of wind divergence over tropical site if Tembalang

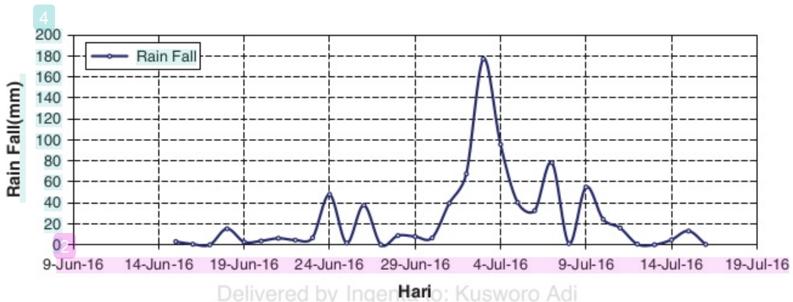

Fig. 1. Rainfall graph the year 2016 of Tembalang Semarang Indonesia.

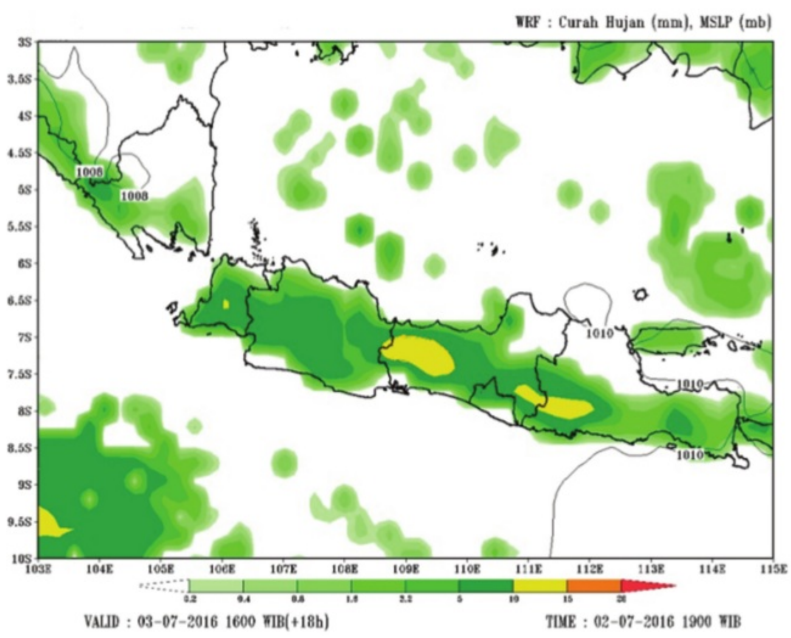

Fig. 2. Heavy rain on 3 July 2002, at 00 UTC in Semarang Central Java.

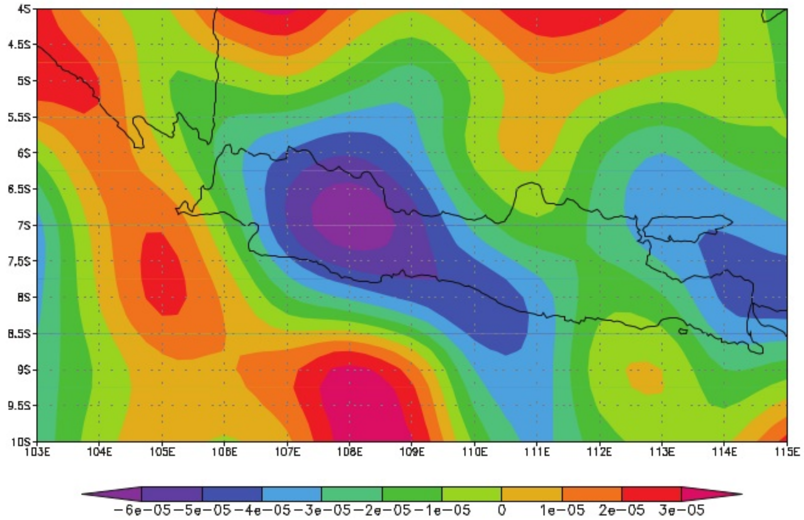

Fig. 3. Change pattern of IR1 Temperature 2–3 July 2002, at 00 UTC in Semarang Central Java.

Semarang, Indonesia, have been investigated. With regard to the horizontal extent, satellite image obtained during the dry season clearly show that see breeze front develops well along the northern coastal plain of west Java. A propagates inland until its structure is modified over more complex topography at a distance of about 60–80 km from the coastline.[4,5]

Figure 5 show a negative absolute vorticity for on 3 July 2016 between Java's sea and Indian Ocean, around of Tembalang Semarang area. Then on 3 July 2016, the negative vorticity anomaly was happened above part of Java's island and finished on 4 July 2016. This thing proves that the activity of tropic convection above ocean is more actively with large variations.

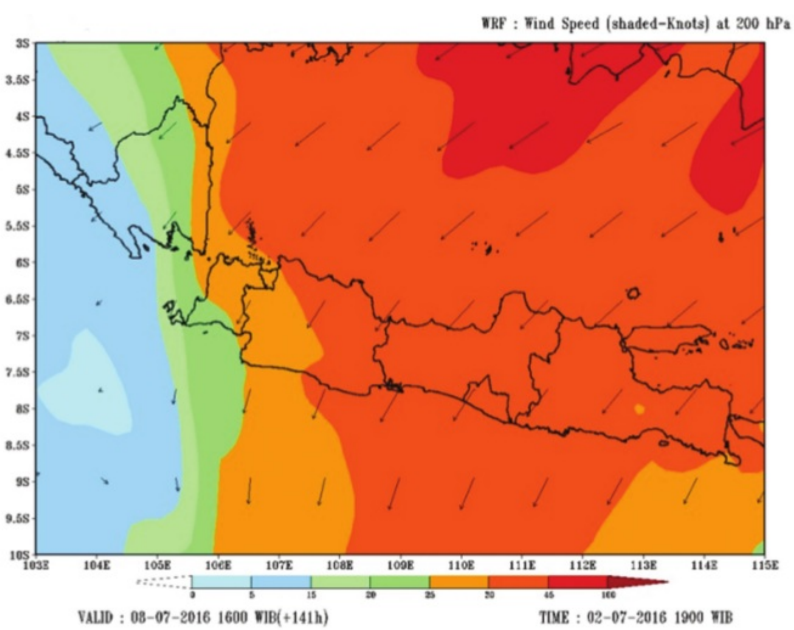

Fig. 4. Wind divergence of Tembalang Semarang Date of 3 July 2016.

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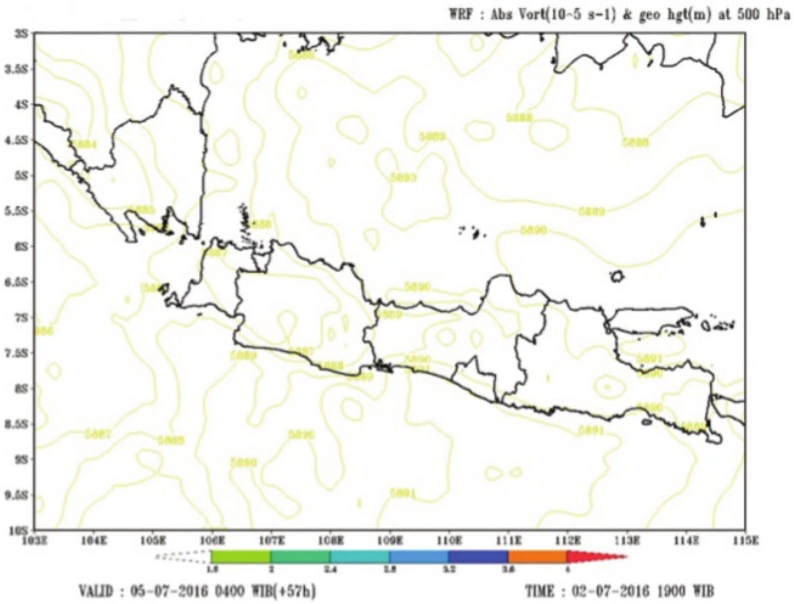

Fig. 5. Absolute Vorticity [/s] of Tembalang Semarang Date of 3 July 2016 from data NCEP/NCAR.

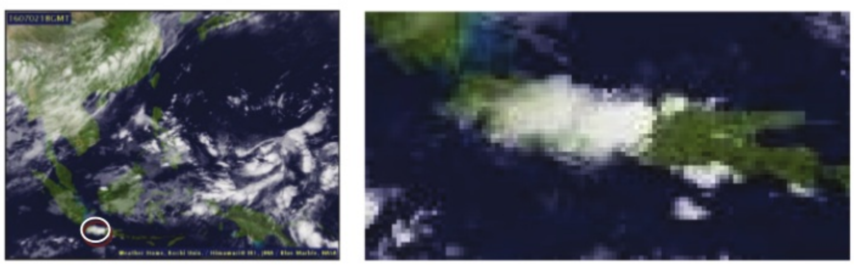

Fig. 6. Cloud cover from data MTSAT IR 1 Kochi University of Tembalang Semarang Date of 3 July 2016.

The growth pattern of cloud in Tembalang Semarang was caused by circulation factor of local atmosphere. This thing proves that change of climate anomaly on 2016 is affected by the growth of convection.[6]

Figure 6 is data of MTSAT IR 1 Kochi University. This thing proves that the activity of tropic convection above central Java Island is more actively with large variations.

4. CONCLUSION

The extremely rain phenomenon in region of Tembalang Semarang was analyzed based on change pattern of anomaly ENSO phenomenon. However, this analysis doesn't show extremely change of pattern. This thing proves that case of floods the year 2016 having resemblance, in the case of atmosphere analysis.

Based on AVN/FNL data analysis and IR Temperature, the floods in Tembalang Semarang on 2016 are dominated by circulation factor of local and global atmosphere. The dynamics of rain cloud caused torrential rain or extremely rain is caused by the growth of convection cloud in Tembalang Semarang.

Acknowledgments: The authors would like to express heartfelt thanks to PNPB Research Diponegoro University (under Contract PNBP DIPA Universitas Diponegoro No: SP DIPA-042.01.2 400898/2016, 2015 December for providing financial support.

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Received: 5 September 2016. Accepted: 13 December 2016.

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