Hazard mitigation with cloud model based rainfall and convective data

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Hazard mitigation with cloud model based rainfall and convective data

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Abstract. Heavy rain in Semarang 15 January 2013 causes flood. It is related to dynamic of weather's parameter, especially with convection process, clouds and rainfall data. In this case, weather condition analysis uses Weather Research and Forecasting (WRF) model used to analyze. Some weather's parameters show significant result. Their fluctuations prove there is a strong convection that produces convective cloud (Cumulonimbus). Nesting and 2 domains on WRF model show good output to represent weather's condition commonly. The results of this study different between output cloud cover 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. White color of satellite image is Coldest Dark Grey (CDG) that indicates there is cloud's top. This image consolidates that the output of WRF is good enough to analyze Semarang's condition when the case happened.

Keywords:Hazard Mitigation, cloud Model, Rainfall data and Convective data.

1. Introduction

One extreme weather phenomenon according to the Meteorology Climatology and Geophysics agency is heavy rain with intensity of more than 20 mm / h or more than 50 mm / day. Heavy rain in Semarang 15 January 2013 causes flood.Seen from rainfalldata, flood case that happened in Semarang city is one example of flood caused by heavy rain with intensity exceeds the extreme value threshold set by BMKG (Meteorological Organization Agency in Indonesia)**[1].**

Extreme weather conditions are the output of significant conditions that occur on weather parameters that cause this to happen. These parameters include wind, humidity, and temperature conditions, ie, if the weather parameters are in a condition that supports a strong convection process it will form a convective cloud that can produce rain with a large rainfall**[2].**

In this research, to perform the analysis used model simulation using numerical weather model of WRF. This is done as one of the steps to determine the condition of weather parameters that support (cause) the occurrence of heavy rain. In addition this matter, as a comparison that shown MTSATsatellite image data from Kochi University.

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2. Experimental details

The method beused in this research are:

***2.1**. WRF Model Analysis Method:*

a. Download FNL (Final Analysis) data for January 15, 2013 from NCEP (National Centers for Environmental Prediction) for 24 hours.

b. Processing the data using WRF application**[3].**

c. Analyze the parameters of the WRF output and its relation to the flood event and compare it with MTSAT and Kochi University observation data

***2.2**. Data needed in this research are:*

a. Observation Data:

The observational data used in this analysis is obtained from MTSAT satellite image observation data, the data taken is hourly data (January 15, 2013). This data is used as supporting data that serves to provide an overview of the surface weather conditions in the area around Semarang, on the above date there has been heavy rains which caused the flood.

.b. Model Data:

The model data of final analysis (FNL) data used in this analysis is data on January 15, 2013 drawn from NCEP-NCAR, used as WRF input data**[4].**

c. Satellite Data:

The satellite data in the form of OLR model data used in this analysis is data every 6 hours on January 15, 2013 to obtain stable data on the model results, which are used as output data from WRF**[4].**

WRF is a weather numerical modeling or NWP (Numerical Weather Prediction) created by the cooperation of several institutions such as NCAR, AFWA and FSL for weather prediction and atmospheric research**[5].** The data input for WRF in addition to WRF-ARW running data (Advance research WRF) or the WRF-NMM (Non hydrostatic mesoscale model) also uses observed observations of top surface and air data and uses satellite observation data and makes it possible to use weather radar observation data, called assimilation data**[1].** The thing to note is the physical selection and dynamic WRF, because each region has a climate with different configurations, so that predictions are not missed. WRF running results can be visualized in various ways, such as Grads, ncl graphics, or vapor so that weather prediction can be generated for the next few days (The weather research and forecasting model, 1990)**[6], [7].**

3. Results and Discussion

The based on daily rainfall data obtained graph of rainfall in Semarang area in January 2013 as supporting information of heavy rain event. The rainfall at 06z or 06.00 UTCon January 15 2013 have seen in Figure 3.1. The Rainfall 06z results from WRF (Weather Research and Forecasting), illustrates moderate rainfall. Due to the results of this model the position of rainfall is still there in the sea area of

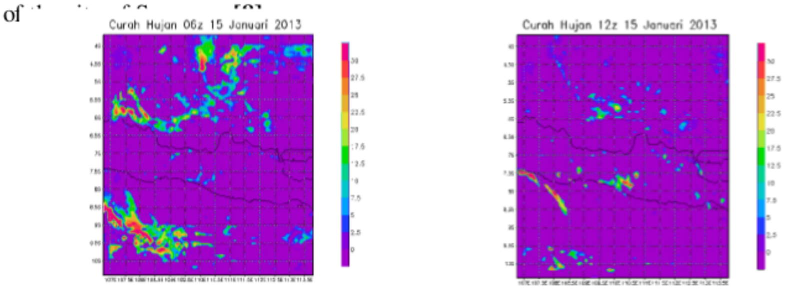

Figure 3.1.Rainfall Model 06z at 10:59 and 11:29 from WRFModel.

Figure 3.2 is a graph of temperature over a 24-hour period in Semarang. At that time span Semarang was washed down by rain from high to low intensity. It is known that the temperature fluctuates even though it is still within the range of 1-1.5 ºC, that is, when before the rain of high intensity flushed Semarang (15 / 12.00 UTC-16 / 18.00 UTC), the temperature had risen, meaning that there had been a warming that added air upward for cloud formation. Thus, after an increase in temperature indicated the air rises and then adds air particles to the still-formed cloud. So, the clouds are getting bigger and the air content is getting thicker, so when the cloud has not enough to hold the air particles, it decays in the form of rain.

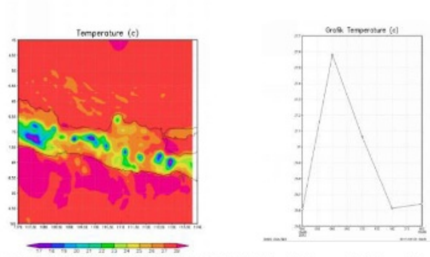

Figure 3.2 The air temperature from WRF Model and Graph from FNL Data

Figure 3.3 is the speed and direction of the wind just before the rain high intensity flushed Semarang. The direction of the central wind means convergence in the Semarang region, and the wind speed tends to weaken or tend to converge. Thus, at that hour in both layers indicated Cumulonimbus cloud has undergone a mature stage. Vorticity value during January 15, 2013 at 00:00 UTCs / d at 12:00 UTC shows during this time Semarang was showered by rain from high to low intensity. It is known that the value of vortices indicates an upward motion of air.

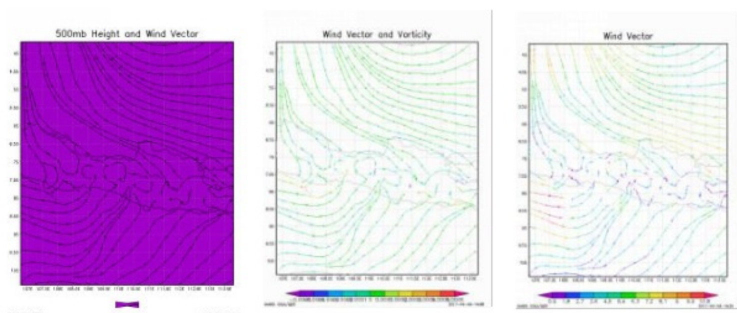

Figure 3.3 Wind Vector from 500mb, Wind Vector and Vorticity and Wind Vector.

Based on the OLR satellite data in Figure 3.4 it can be seen that in the Semarang area on January 15, 2013 there is a convective cloud growth. Outgoing Longwave Radiation (OLR) is associated with the growth of clouds because it is a long wave that is reflected or radiated by the earth's surface with an indication that if there is cloud cover eating the OLR value will be lower and vice versa. Increased cloud growth can be seen from 00:00 UTC in the Semarang area until the cloud growth at 06.00 UTC is 6 hours before the event and at the time of the incident at 12.00 UTC or after the event at 18.00 UTC still looks large convective cloud but has shifted. This is what can trigger bad weather at that time**[8].**

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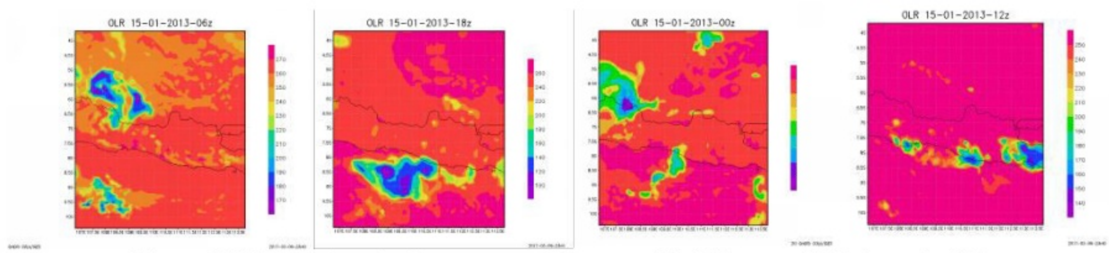

Figure 3.4 Convective cloud cover every 6 hours on 15-16 January 2013 from the right at 06z,18z, 00z and 12z.

Based on MTSAT satellite data at the time of the incident, it can be seen the convective cloud coverage for Semarang area, that is:

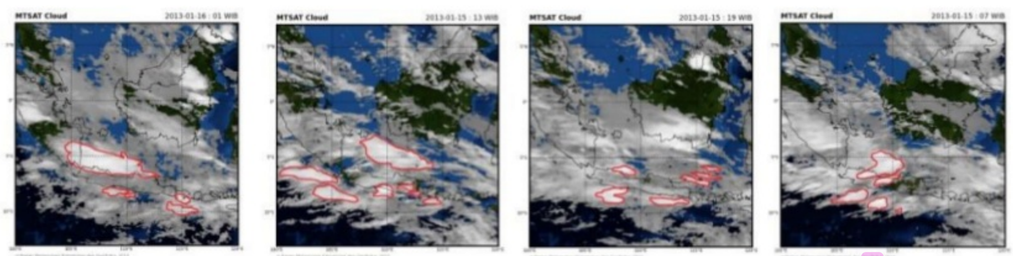

Figure 3.5 Convective cloud cover every 6 hours on 15-16 January 2013 from the right at 00.00 UTC, 06.00 UTC, 12.00 UTC, and 18.00 UTC

Based on MTSAT observation data in Figure 3.5 it can be seen that the Semarang area on January 15, 2013 there is a convective cloud growth which is characterized by the existence of Coldest Dark Gray (CDG) which indicates that the presence of Cumulonimbus clouds in the atmosphere at that time has a very high peak with potential bad weather. At 00.00 UTC the growth of clouds in the Semarang area is very visible and there has been an increase in cloud growth at 06.00 UTC which is 6 hours before the incident and at the time of the incident that is at 12.00 UTC or after the event at 18.00 UTC still looks big convective cloud. This is what can trigger bad weather at that time**[9].**

The analysis of FNL and OLR satellite data with WRF model on the date of the incident, the result of indication of increase of cloud growth can be seen starting at 00.00 UTC in Semarang area until the growth of cloud at 06.00 UTC which is 6 hours before the incident and at the time of the incident that is at 12.00 UTC and after the event at 18:00 UTC still looks large but shifting convective clouds. This is what can trigger bad weather at that time.

From the analysis of observation data, both parameters and satellite monitoring as well as analysis using WRF model data, it can be seen that the volatile air in the event of heavy rain that causes flooding.

4. Conclusion

Based on the data that has been analyzed, there are some conclusions. The results of WRF modeling on January 15, 2013 from 00 UTC to 16 January 2013 at 00 UTC provide timely detailed explanations of some parameters. The air temperature parameters describe the significant conditions occurring in the Semarang atmosphere during heavy rains. From the analysis of airflow shows the convergence (air mass compression). Vortices show an upward movement that helps the convection process and the formation of strong clouds. The comparisons of analytical results with MTSAT satellite imagery clarifying conditions occurring during heavy rains. The color classification (Coldest Dark Gray) is very rare except for the lowest peak cloud temperature conditions indicating the occurrence of heavy rain.

References

[1] Arini E.Y., Hidayat R., and Faqih A., 2015.,*ProcediaEnviromental Science*, Vol.24 pp 70-86
[2] Gernowo R., Adi K., and Yulianto T., 2017, *Journal ofAdvanced Science Letters* Vol. 23, 6593–6597.
[3] Skamarock W.C., Klemp J.B., Dudhia J., Gill D.O., Barker D.M., Wang W. dan Powers J.G. (2005): *A Description of the Advanced Research WRF Version 2*, Mesosscale and Microscale Meteorology Division, National Center for Atmospheric Research Colorado USA.
[4] NOAA, Climate Data OnLine, (https://www.ncdc.noaa.gov/cdo-web/)
[5] Kogan Y.L.1990, *Journal of American Meteorological Societeonline*(https://journals.ametsoc.org/doi/abs/10.1175/1520-0469(1991)048%3C1160:TSOACC%3E2.0.CO%3B2)
[6] Wisdom, D and Suyatim. 2014., *Journalof Meteorology Climatology and Geophysics* Vol.2 no.3.
[7] Kain J.S., 2002., *Journal of American Meteorological Societeonline*(https://journals.ametsoc.org/doi/abs/10.1175/1520-0450(2004)043%3C0170:TKCPAU%3E2.0.CO;2)
[8] Wang H., Skamarock W.C., and Feingold G.,2009., *Journal of American Meteorological Societe online*(https://journals.ametsoc.org/doi/abs/10.1175/2009MWR2820.1)
[9] Wardah T.,.Bakar S.H.A.,,Bardossy A., and Maznorizan M., 2008.,*Journal of Hydrology*, Vol.356 Issue 3-4 pp. 283-294.

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