Application Of Simple Wind Model For Weather Modification Activity In Indonesia

***GAME International Project Office[1] , Endarwin[2]**
(1: HyARC, Nagoya University, 2: Meteorological And Geophysical Agency Indonesia , MGA Building 4th floor Jl. Angkasa I No. 2 Jakarta, Indonesia 10720. e-mail : endarwin@lycos.com)
*** GAME International Project Office (GIPO), HyARC, Nagoya University, Japan, 464-8601, Furo-cho, Chikusa Nagoya, Japan. e-mail : game@hyarc.nagoya-u.ac.jp**

Abstract

Weather modification activity in Indonesia to overcome drought impact or to accelerate condensation to produce rain, usually is worked every year especially in transition period between rainy season and dry season or the opposite.

One of the important factor that can support this activity by using of simple wind model that can give the information about the atmospheric condition especially about the possibility of growing cloudy area (cloudy potency) and atmospheric instability in micro until meso scale area with analog analysis. By this model, the limitation of upper wind data spreading as a consequence of limitation number of observation points can be overcome without spend high cost with good accuracy.

By this model, the meteorologist can give suggestion or decide where the flight engineer should spread the salt brought from land to the air by an aircraft. So that the effectiveness and the result of expected will be better.

To develop this model is needed minimum number of upper air observation point that can coverage or representatively for all area will be managed. In this event usually provided at least 4 points observation that located in irregular place of all area. From 4 points, can be increased become 5 or more, depend on the necessity by interpolation after pass the scalar processing.

The interpolation method that will be used is Kriging Interpolation Method that can interpolate the scalar value in irregular to irregular place or from irregular to regular place. In this chance will be develop the new value from irregular to regular place in grid shape. That is from 4 or 5 points in irregular became 80 points in regular position.

So from this result the wind condition in the atmosphere can be viewed clearly and easier to be analyzed. And finally determination of cloudy potency area and instability area base on wind pattern in every layer can be worked accurately.

Keyword : weather modification, wind model analysis, Interpolation

1. Introduction

1.1. Background

When an aircraft in weather modification activity will spread salt (NaCl) powder in the atmosphere to accelerate condensation as shown in figure 1, of course it need good information about the destination area that will be spread before it flies, in order to give good result matching with planned.

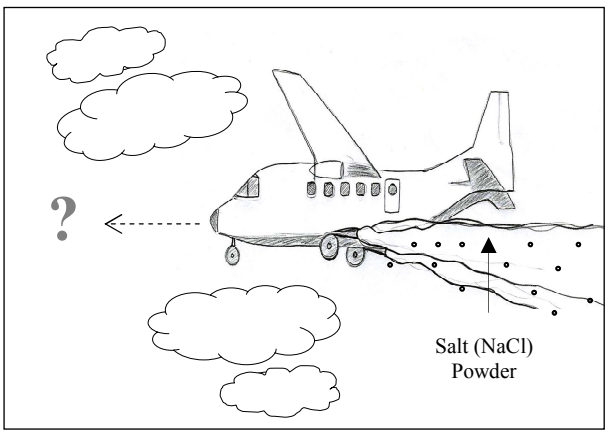

Fig. 1 : Aircraft is spreading the salt on destination area

The destination area usually is decided base on the result of direct observation in ground or in the aircraft while it flies before spread the salt. By this way, the cloudy potency area or instability area as the destination is rarely known first because it more dominated by view in observation that can get cell cloud as the instability result than as an analysis result.

Besides that actually the observation of atmosphere condition is also supported by pilot balloon (pibal) observation. By this way the approach detection of atmospheric instability on the one place can be done. But unfortunately the amount and distribution of pibal observation points are still restricted compared with large area will be managed, whereas the increasing of pibal observation point will need more cost.

To overcome these problems, in this chance will be offered the method that can support the weather modification activity by using application of simple wind model. By this model all the limitedness data distribution of observation and instability area detection can be overcome without spend high cost but can give good result.

1.2. Objective

To give amenity, increase of amount and data distribution especially for wind data and also improve quality in analysis of atmosphere condition so that can

be yielded the information which is good for efficacy of weather modification activity without spend a lot of costly expense.

2. Method

2.1. Source of Data

To develop simple wind model in this event is required wind data in the form of direction and speed of wind from some points that available in the area will be manage, and usually available 4 points in irregular place. And the wind data from these points is called data source.

As shown in figure 2, there are 4 or 5 points data source (black marked) and then will be increased become 80 points to regular place in grid shape. The location is around region of Bandung in West Java Indonesia, with large area will be managed around 5000 km square.

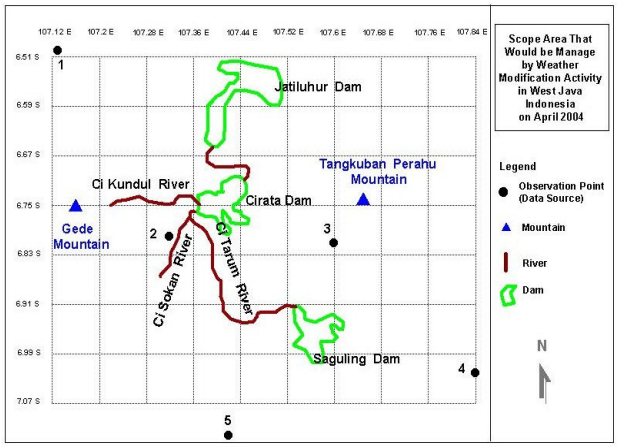

Fig. 2 : Location of observation points as data source

In figure 2, also can be seen there are some river and dam or barrage that representing goals area of this event. Where the flow and debit of water in those goals area usually will decrease in dry season and in the end can give bad impact to many people life.

2.2. Data Processing

After get source data the next step is process the data by interpolation. The method of interpolation would be used is Kriging method. This method has assumption that the parameter being interpolated can be treated as regionalized variable. A regionalized variable is intermediate between a truly random variable and a completely deterministic variable in that it varies in a continues manner from one location to the next and therefore points that are near each other have a certain degree of spatial correlation, but points that are widely separated are statistically independent (Davis, 1986).

So, all new value in regular position base on the weight factor of the all data source in every irregular position, and the sum of all weight factor (W_1 ,W_2 , …… , W_n) is equal to 1 for each new value in each position.

Because wind is vector, so before processed must be separated between the value of direction and value of speed, and finally will be got 2 scalar values. So, that will be processed is the scalar value of the wind.

2.3. Analysis

Analysis to model of this wind is done analogously, where through this analysis is searched by the possibility of existence of pattern of wind enabling for the happening of updraft or instability.

The pattern of wind that enable for the updraft condition so that yield cloud or precipitation is the convergent or confluence (Trewartha & Horn, 1980), and the opposite will not yield cloud but clear condition relatively. Hence, finally at the picture of wind model will be searched the pattern of that wind .

To facilitate determination result of analysis, hence can be used the map in figure 2 that divided in 4 region as shown in figure 3.

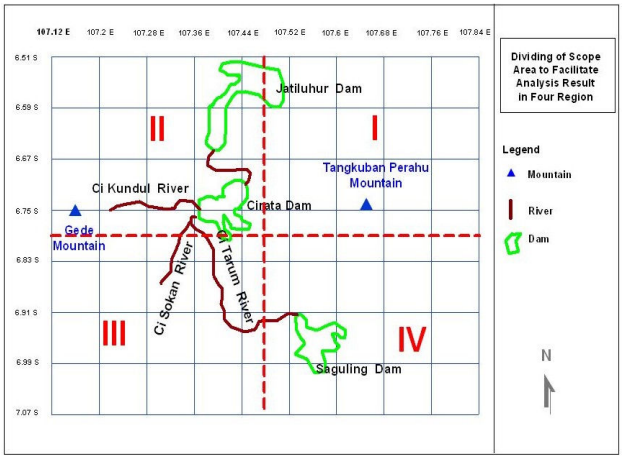

Fig. 3 : Dividing of scope area to facilitate result of analysis in four region

By this way, every result of analysis can be shown more exactly, in region I, II, III or IV, besides by the coordinate.

3. Result

After conducted by interpolation process from every existing data source hence obtainable in the end picture from expected wind model.

Some examples of wind model picture can be seen in figure 4, 5, 6, 7 below.

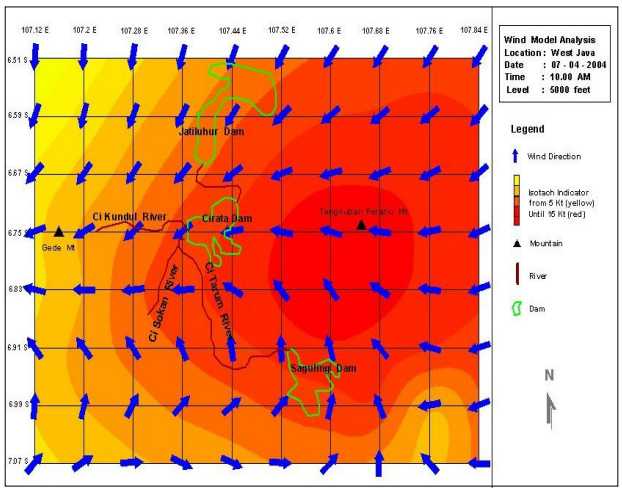

Fig. 4: Picture model of wind that shown convergence pattern especially in region II and III

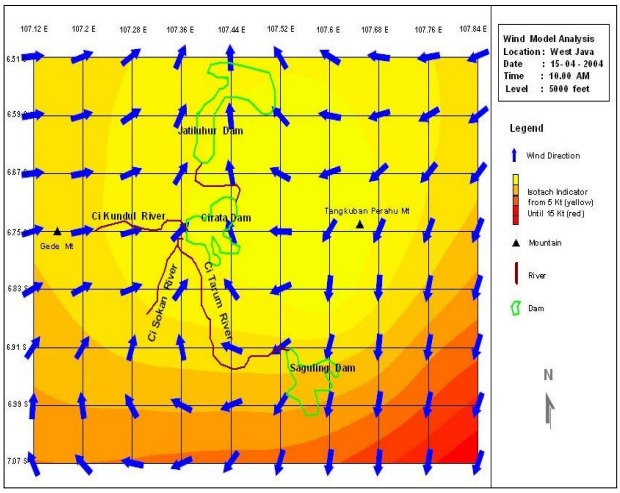

Fig. 5: Picture model of wind that shown confluence pattern especially in region III, IV and convergence pattern in border of region I and II

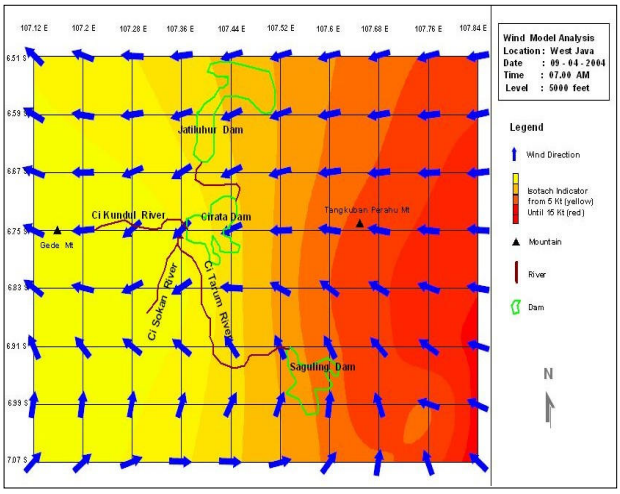

Fig. 6: Picture model of wind that shown divergence pattern especially in region I, IV and convergence pattern in region II and III

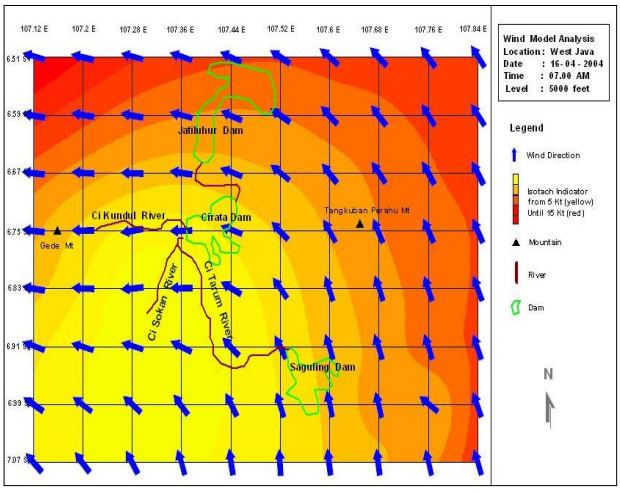

Fig. 7: Picture model of wind that shown diffluent pattern especially in region II, III and IV

And all the pictures represent example of wind pattern which is possible formed at the time of perception conducted such as those which have been explained previously at section 2.3.

4. Discussion

Base on the results in section 3, wind model which is there are in figure 4, 5, 6 and 7 can give clear picture to the meteorologist about atmosphere condition on area that will be managed.

All of picture in section 3 are the pictures of wind condition in same level that is 5000 feet but in different time (different day). From those picture can be determined the possibility area of updraft or instability like convergence or confluence and the opposite can be shown in each region in more precise, so that can be determined when and where the aircraft spread the salt . By this way of course this effort is hoped more effective and efficient.

Ordinary resistance in making and conducting analysis by this model is difficulty to get good data from every observation point (data source) in each level of pibal observation. For example, sometimes in one observation point there is not data (missing) in one or more height level of observation whereas in the other point is available. To overcome this problem, of course the observation method by pibal should be changed by another way that more good like use radiosonde.

But fortunately so far, although there is limitedness to get source data completely but the wind model which is resulted, still can good contribution to this activity.

5. Conclusion

The limitedness of amount and distribution of upper air data observation at every level in weather modification activity can be overcome by simple wind model, even this wind model can give more benefit and support for success this event.

To improve wind model quality is needed good data source as input. So that the method of upper air observation in this event if possible should be improved too.

References

Trewartha, G.T and Horn, L.H, An introduction to Climate, Mc Graw-Hill Company, 5th edition, 1980.

Davis, J.C, Statistic and data analysis in Geology, John Wiley & Sons Inc, 2nd edition, 1986.

Dorsel, D and La Breche, T, Kriging, Enviromental Sampling and Monitoring, Virginia, 1997.

Anonymous, Kriging, Enviromental Modeling System Inc, 1997

Endarwin, Overcoming limitation of rainfall data distribution on micro scale area by simple interpolation, *J. Meteor and Geoph*, **5**, 1411-3082, 2004

Endarwin, Utilization of simple wind model to analysis atmosphere condition on meso scale area, Proceeding of seminar for 54th Meteorological day, 2004