P4.8 A NEW ADVECTION SCHEME FOR CALCULATING THE LONG DISTANCE TRANSPORT OF WATER VAPOR

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1. INTRODUCTION

The first nuclear power station was built at USSR in 1954, and there have been 432 nuclear power stations in the world until in 1994, which take one sixth of the total electricity capacity in the world forecasting models. In our opinion, one of the reasons is that water vapor field in real atmosphere is discontinuously distributed, however, our modeler treated water vapor field continuous because our main-stream scientists get used to solve problems basing on some quantitatively data by some known mathematical formula or methods. In this paper, we show a new way to improve the forecasting of precipitation by using the PTPR advection scheme, which is put forward by the first author for the purpose of calculating the advection item for the long distance transport of hazard materials in 2001 & 2002 when he worked in MRI, JMA.

2. THE PROBLEM FOR CALCULATING THE ADVECTION ITEM OF DISCONTINUOUSLY DISTRIBUTED WATER VAPOR FIELD

Because the forecasting score for rainfall is much worse than other products of numerical forecasting models, we think the lower ability to calculate the advection of water vapor field during it is discontinuously distributed. However, most advection schemes, at present, have been distributed by supposing that the water vapor field is continuously distributed. Tan Jiqing & Masaru Chiba (2002) put forward a PTPR advection scheme, which is used here just to show how the PTPR scheme might improve the forecasting score for rainfall if we put the scheme into operational use in our weather forecasting models.

2.1 THE RESULT FOR THE 2-D ADVECTION FOR WATER VAPOR FIELD IN UNIFORM VELOCITY FIELD

If there is a high concentration of water vapor field in a small local area, at the same time, there is relatively dry air for other region nearby, this would cause problem because water vapor field during it is discontinuously distributed. In order to make this feature much clearly, we suppose that there is a high discontinuously distributed water vapor field at initial time with the uniform velocity field surrounded. If no artificial interfere during the calculation of 2-D advection equation as:

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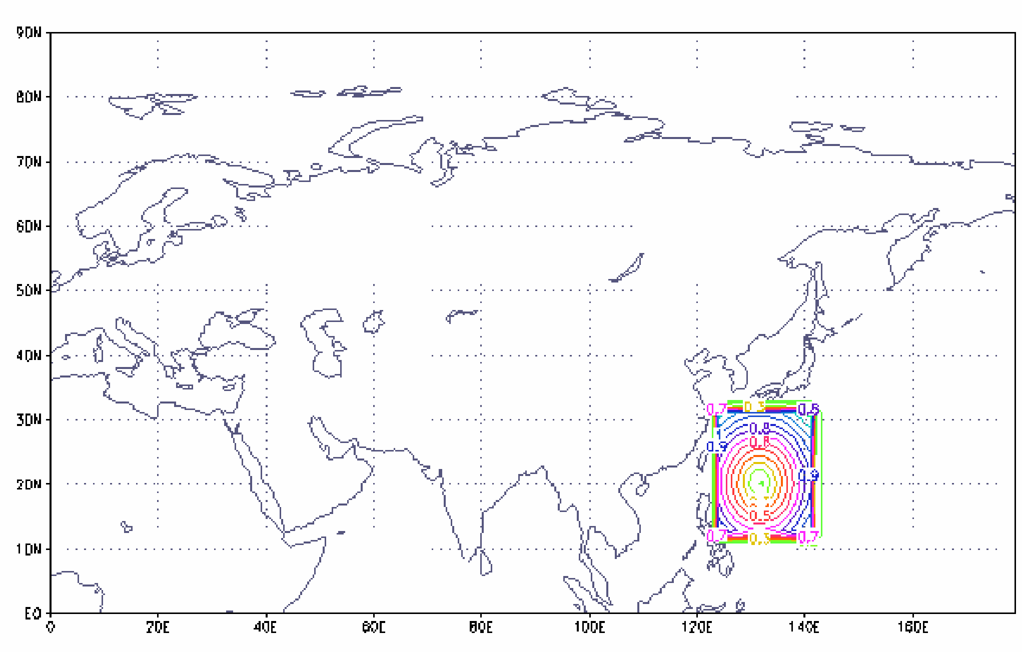

Figure 1

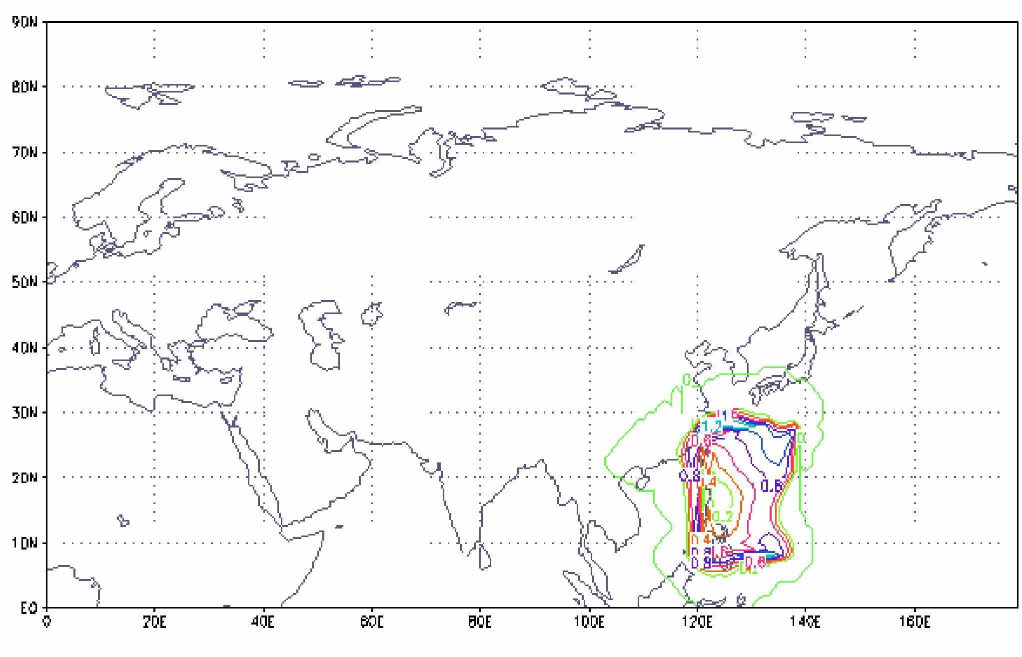

Figure 2

$$\frac{\partial q}{\partial t} + u\frac{\partial q}{\partial x} + v\frac{\partial q}{\partial y} = 0 \qquad （1）$$

其中 $\begin{cases} u = 10.\cos(\varphi) \\ v = 10. \end{cases}$

If we use the traditional advection scheme Figure 1 basing on grid-points，the 48 forecast field for an idea initial distribution field (figure 1a） under the uniform velocity field as above-mentioned in formula （1） would be showed in figure 1b：

You could see that the shape and the structure for the advection scheme even in a uniform velocity field changes too much. If PTPR advection scheme (Tan Jiqing & Masaru Chiba,2002) is used, the 48 hour forecasting scheme would be showed in figure 2.

From figure 2, we see that the shape and structure of the idea source doesn't change anything in the uniform velocity field.

2.2 The result for the 2-D advection for the same idea initial distribution field, but with the real wind fields during the typhoon Maisha in 2005

Figure 3a and Figure 3d is obtained by the idea distribution field but under the real velocity field dated from July 31 to August 5,2005.After 48 hours calculation (figure 3a) and 120 hours calculation (figure3b),we just recognized slightly affected by typhoon Maisha. However, if PTPR advection scheme is used, we obtain the reasonable water vapor distribution results : In the figure of 48 hours calculation (figure 4a) and the figure of 120 hours calculation (figure 4b),we recognized the remarkable discontinuous features match the twist wind belt.

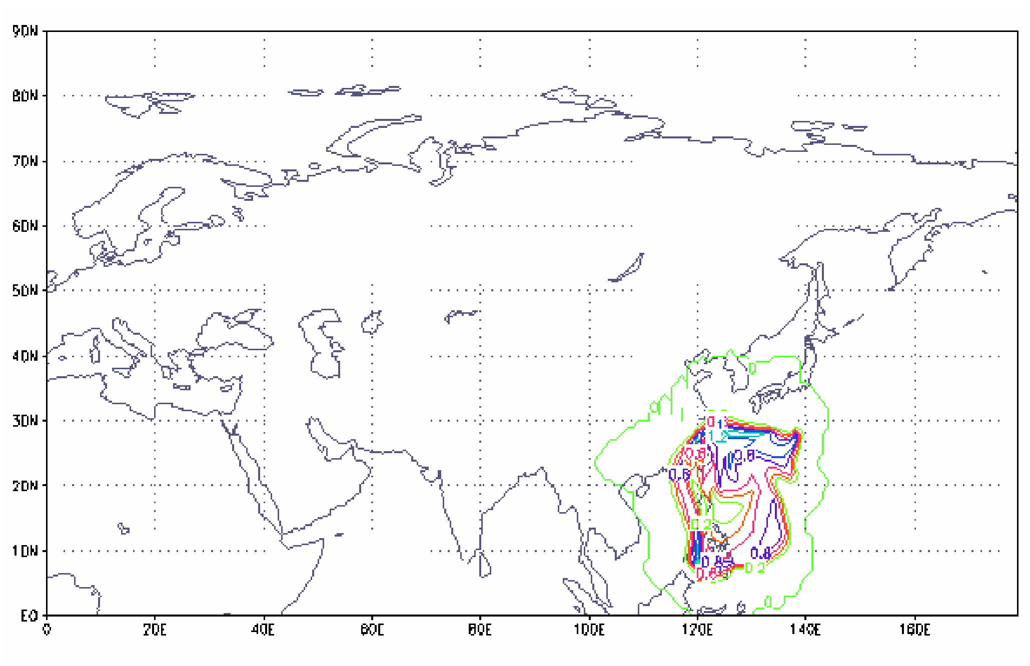

Figure 3a

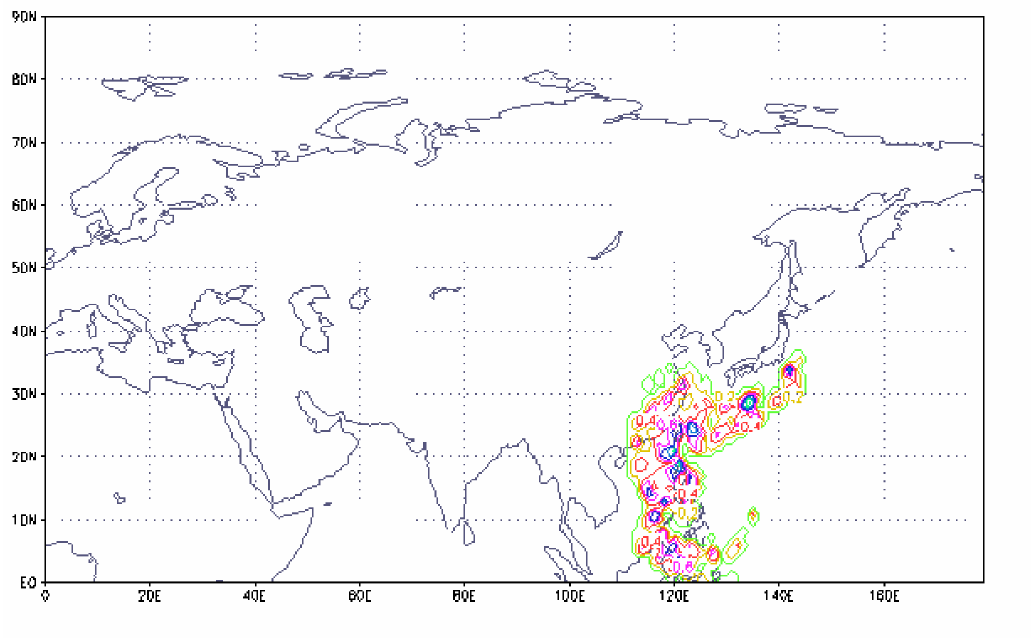

Figure 3b

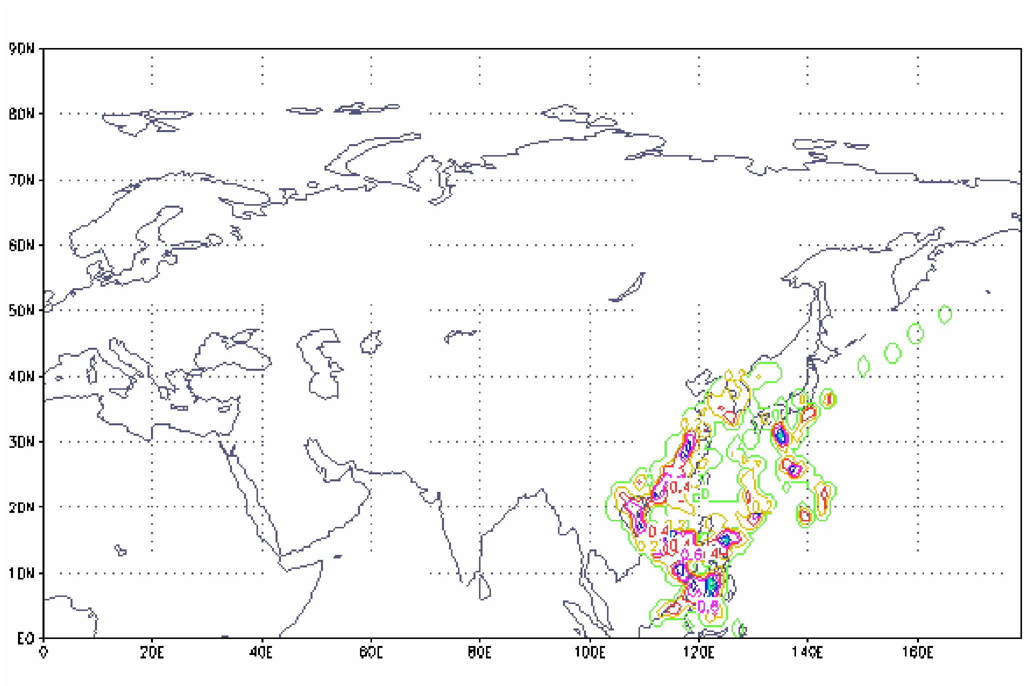

Figure 4b

3. DISCUSSION AND CONCLUSION

Forecast skill of precipitation is much worse than other products of numerical models. In our opinion, one of the reasons is that water vapor field in real atmosphere is discontinuously distributed, however, our modeler treated water vapor field continuously and this might be one of the shortcomings exists in our numerical models.

In this paper, we show a new way to improve the forecasting of precipitation by using the PTPR advection scheme, which is put forward by the first author for the purpose of calculating the advection item for the long distance transport of hazard materials (2001 & 2002).

Because the idea of PTPR advection scheme ,designed basing on analysissitus, is quit different from what we design numerical weather forecasting models, it would be a long way to go to introduce the PTPR advection scheme to improve the forecast skill of precipitation since it would be a lot of work to do in order to persuade the main stream scientists to take full consideration of our research interest: How to describe the imperfect discontinuous fields with discontinuous methods?

This paper show a simple results under idea situation. We have already seen the remarkable difference. We hope that there would be a lot of work to be done in near future with this idea basing on analysissitus.

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