OBSERVATIONAL DATA SCREENING TECHNIQUE USING ATMOSPHERIC TRANSPORT MODEL AND INVERSE MODEL IN ESTIMATING CO_2 FLUX HISTORY.

T. Maki[1], K. Kamide[2] and Y. Tsutsumi[3]

[1] *Atmospheric Environment Division, Global Environment and Marine Department, Japan Meteorological Agency, Tokyo, Japan 100-8122; maki@met.kishou.go.jp*

[2] *Administration Division, Observations Department, Japan Meteorological Agency, Tokyo, Japan 100-8122;kaz-kamide@met.kishou.go.jp*

[3] *Atmospheric Environment Division, Global Environment and Marine Department, Japan Meteorological Agency, Tokyo, Japan 100-8122; y-tsutsumi@met.kishou.go.jp*

ABSTRACT

We have developed a new data screening technique using an atmospheric transport model and an inverse model. Using this technique, we can use original (not smoothed) observational data for the inversion method. This means that we can enlarge the number of observational data for inversion method and we can estimate carbon dioxide (CO_2) flux history consistently in long period in accordance with the number of the observational sites.

INTRODUCTION

The CO_2 is one of the most important greenhouse gases. However, we do not fully understand its sources and sinks distributions. The inverse model is one of the most useful tools to estimate them. Up to now, we usually use smoothed observational data in inverse model. However, when we try to estimate high spatial and temporal resolution CO_2 flux, we should use original observational data in inverse model. In such a case, the data screening methods determines the quality of estimation. We have developed a new data screening technique for using the inverse model.

METHODS

Inversion setup is based on TransCom 3 experimental protocol [*Gurney et al*, 2000]. The transport model is Japan Meteorological Agency Carbon Dioxide Transport Model [JMA CDTM , *Sasaki et al*, 2003]. JMACDTM is an off-line model and the model is driven by the meteorological field in 1997 which are operationally analyzed by JMA. The inversion approach is time-dependant inversion (TDI) from 1984 to 2003 based on the Bayesian synthesis method [*Tarantola*, 1984] and the prior flux and its uncertainty are adopted from TransCom 3 [*Gurney et al.,* 2004].

When we use original (not smoothed) monthly mean observational data, we should treat observational data in accordance with their representatives of space and time and we should reject a data which is affected by local sources or sinks. In TDI, data uncertainties show the representatives of observational data. We have created the uniform data set whose lacking data were filled by interpolation or extrapolation (WMO, 2000) and the data uncertainties are calculated from the standard deviation of observational data and smoothed data. In no observational data period, we use the smoothed data but give a large uncertainty as a penalty to reject it from analysis.

The data screening method consists of four steps.

1. We use all original monthly mean observational data in TDI at first.
2. We reject (give a large uncertainty as a penalty) observational data when the difference between observational data and estimated data from TDI is larger than the threshold value.
3. We use only selected observational data in inversion with same condition.
4. We repeat process 2 and 3 until we have no rejected data.

We can reject the observational data apart from the estimated concentration (estimated flux) that has been determined by the majority of the observational data. In most cases, it is enough to make only 4-5 times repetition of step 2-3 to finish the analysis. This method needs only one important parameter that is the threshold value of data selection. We have determined the proper threshold value in checking data selection rate of background site and we choose 2 ppm as a threshold value. In this threshold value, the data selection rate is about 80% for all original data collected by World Data Centre for Greenhouse Gases (WDCGG).

To evaluate this technique, we have performed the threshold value sensitivity test. In this test, we have changed the threshold value from 1.0 ppm to 3.0 ppm at an interval of 0.5ppm.

Table 1. The data selection rate in each threshold value experiment.

Threshold value	1.0ppm	1.5ppm	2.0ppm	2.5ppm	3.0ppm
Data selection rate	0.647	0.759	0.812	0.846	0.863

RESULTS

Table 1 shows the relationship between the threshold value and the data selection rate. The data selection rate has changed from 65% to 86%. Map of observation sites with selection rate (threshold value of 2 ppm case) is shown in Fig.1. The data selection rates of remote site tend to higher than those of urban site. There is little difference in global scale flux in each experiment except restrict selection case (Fig.2). This means that the threshold value for the data selection has little effects on global scale flux distribution.

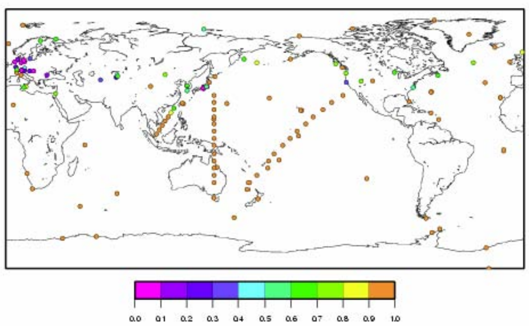

Fig. 1. The data selection rate distribution

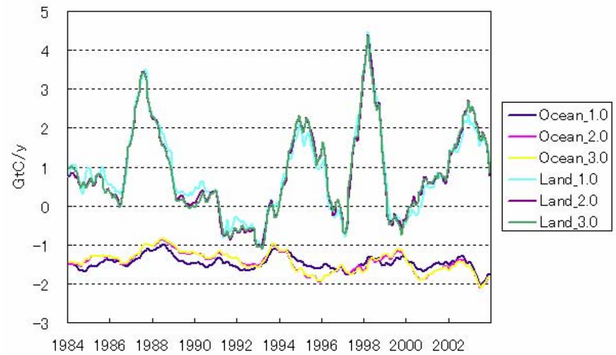

Fig. 2. The flux sensitivity to the threshold value

CONCLUSIONS

We have developed a new original data selection technique making use of an atmospheric transport model and an inverse model. In global scale, the threshold value of data selection plays little role in estimated flux. From this technique, we can enlarge the number of observational data in estimating flux history especially long analysis period. This means that we can get "best effort" flux analysis in accordance with the numbers of sites in real observational network.

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