FAST AEROSOL OPTICAL DEPTH RETRIEVAL FROM MODIS

Jianping Guo[1, 3], *Huadong Xiao*[2], *Chunxiang Cao*[3], *Yong Xue*[3, 4], *Jie Guang*[3], *Jianwen Ai*[3]， *and Xiaozhou Xin*[3]

[1]Chinese Academy of Meteorological Sciences, China Meteorological Administration, Beijing 100081, China

[2]National Meteorological Information Center, China Meteorological Administration, Beijing 100081, China

[3]State Key Laboratory of Remote Sensing Sciences, Jointly Sponsored by the Institute of Remote Sensing Applications of Chinese Academy of Sciences and Beijing Normal University, Institute of Remote Sensing Applications, Chinese Academy of Sciences, PO Box 9718, Beijing 100101, China

[4]Department of Computing, London Metropolitan University, 166-220 Holloway Road, London N7 8DB, UK

E-mail: {cao413@irsa.ac.cn, jpguo@cams.cma.gov.cn}

ABSTRACT

Aerosol optical depth (hereinafter called AOD) is an important geophysical parameter, and its retrieval from satellite data such as Moderate Resolution Imaging Spectroradiometer (MODIS) are data demanding and computationally intensive. The wealth of numerical computations in the AOD retrieval from the simplified atmospheric radiative transfer equation developed by Xue and Cracknell [1] and from the SYNTAM algorithm developed by Tang et al. [2] is time consuming and resources demanding, which will introduce large volume of data processing and computation challenges. In particular, application fields such as air quality modeling and assessment, and climate modeling always require a quick response to AOD status in (near) real time. Traditional serial computation of AOD hardly meets the requirement of the real time response. Parallel computation, however, can overcome the difficulties in real-time computing of AOD from satellite images based on serial algorithm. Therefore, it has to be developed a fast algorithm based on parallel computation.

Because of the tremendous advantage of parallel computation over serial computation in both time and efficiency, it has been gaining more and more popularity in computationally intensive applications such as climate modeling, remote sensing applications and digital signal processing. Moreover, parallel computing is advantageous in that it makes it possible to obtain the solution to a problem faster. Traditionally, parallel computing has been considered to be "the high end of computing" and has been motivated by numerical simulations of complex systems and "Grand Challenge Problems" such as climate modeling and air quality monitoring and modeling. Despite the growing interest in atmospheric correction in remote sensing applications, only a few parallel processing implementations exist in the open literature. For example, Fallah-Adl et al. [3] developed a fast parallel algorithm for estimating AOD from Thematic Mapper (TM), which cannot accommodate multiple spectral remotely sensed imagery such as MODIS, Multiangle Imaging SpectroRadiometer (MISR) etc.

This paper presents the implementation of parallel AOD retrieval from the MODIS data, which is based on IBM System Cluster 1600 deployed in Chinese Meteorological Administration (CMA), with focuses on the design of parallel tactic through Single Program Multiple Data (SPMD) model and the message passing interface (MPI). In order to demonstrate the parallel performance of the proposed parallel

implementation, experiment of parallel AOD retrieval is given, with 4000╳5000 pixels applied to the parallel algorithm. The parallel performance, i.e. efficiency and speedup, of AOD parallel implementation will be discussed and results show that the implementation of AOD parallel computing, as a viable cost-effective method, has great scalability on clusters machines. As shown in Fig.1, the efficiency of parallel computation deceases linearly with the number of processors, while the speedup exhibited the inverse trends, and it can obtain optimum performance at 128 processors. Fig. 2 shows the AOD at 0.55μm wavelength from the implementation deployed in this paper, which well characterized the spatial pattern of aerosol loading in China. Thus, the parallel algorithm can be possibly operationally used in AOD retrieval in the near future, as an important input parameter for the air quality model.

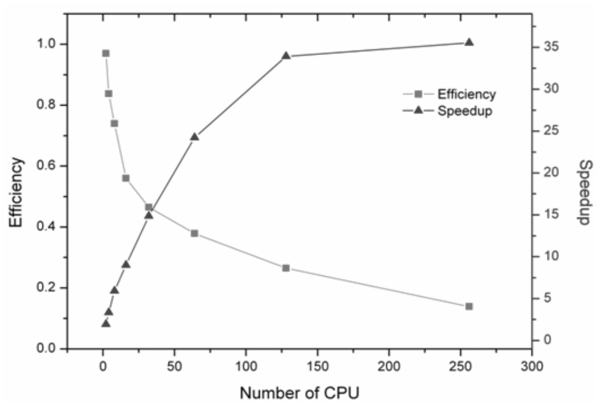

Fig. 1 Efficiency (triangle) and Speedup (square) of SYNTAM implemented on parallel systems, as a function of number of processors.

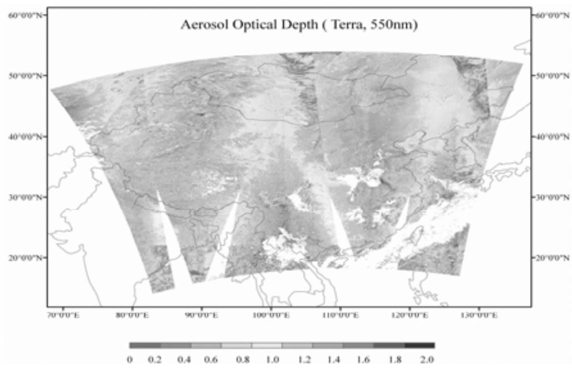

Fig. 2 AOD result retrieved from the parallel implementation developed in this paper

REFERENCES

[1] Y. Xue, and A. P. Cracknell, "Operational bi-angle approach to retrieve the earth surface albedo from AVHRR data in the visible band", Int. J. Remote Sens., vol. 16, pp. 417– 429, 1995.

[2] J. K. Tang, Y. Xue, T. Yu, Y. N.Guan, "AOD Determination by Exploiting the Synergy of TERRA and AQUA MODIS", Remote Sens. Environ., vol. 94, pp. 327-334, 2005.

[3] H. Fallah-Adl, J. JaJa, and S. Liang, "Fast algorithms for estimating aerosol optical depth of thematic mapper (TM) imagery", Journal of Supercomputing, vol.10, pp. 315–330, 1997.