

**1. Report Title and Type:**

Title: Study possibility of long-range transport of Asian dust to Thailand using modeling and satellite data

Type: Master Thesis

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**4. Field of Study:** Environmental Technology and Management (ETM)

**5. School:** School of Environment, Resources and Development (SERD)

**6. Abstract of the work:**

This study assessed on the possibility of Asian Dust reaching Thailand using ambient air monitoring data ( $PM_{10}$  and  $SO_2$ ), the 10-day backward air mass trajectory from HYSPLIT4 model, MODIS satellite data during November 2001 and April 2002.

The selected days were in November 2001 and January 2002. All the days during the period were screened for the possible dates of the dust events using the monitoring data and the HYSPLIT4 model. The MODIS images were processed using YDI for 21, 23 November 2001 and 8, 10 January 2002 which showed no yellow dust sign occurred in Thailand. However, some indicators of sandy dust were seen in Prey Veng and Takeo provinces of Cambodia. It was further shown that those were indicators of the local sandy dust rather than the long-range transported Asian dust. Forward trajectories were analyzed for a minor sand storm occurred over China on 1 and 2 January 2002, which show that the air mass from China was not transported to Thailand or other Southeast Asia countries during those days.

The high concentrations of  $PM_{10}$  and  $SO_2$  of ambient air monitoring stations in various provinces of Thailand were possibly caused by local emission, stable atmosphere during the dry season, and perhaps long-range transported pollutants from other origins rather than the Asian dust.

## 7. Keywords:

Asian Dust, HYSPLIT4, MODIS, YDI, PM<sub>10</sub>, and SO<sub>2</sub>

## 8. Bibliographic data:

1. Arimoto, R., Zhang, X.Y., Huebert, B.J., (2004). 'Chemical composition of atmospheric aerosols from Zhenbeitai, China and Gosan, South Korea, during ACE-ASIA'. *Journal of geographical research*, 109(D19S04), 1-15.
2. Bai, N., Zhang, K., (2001). *About Sandstorms in China, 2000 – 2001: Proceedings of Seventh International Joint Seminar on the Regional Deposition Processes in the Atmosphere, 20–22 November, 2001*. Tsukuba, Japan.
3. Gillette, D. (1978). 'A wind tunnel simulation of the erosion of soil: Effect of soil texture, sand-blasting, wind speed, and soil consolidation on the dust production'. *Journal of Atmospheric Environment*, 12, 1735–1743.
4. Husar, R. B., J. M. Prospero, and L. L. Stowe, (1997). 'Characterization of tropospheric aerosols over the oceans with the NOAA advanced very high resolution radiometer optical thickness operational product'. *Journal of geophysical research*, 102, 16,889–16,909.
5. Husar, R.B., Tratt, D.M., Schichtel, B.A., Falke, S.R., Li, F., Jaffe, D., Gasso, S., Gill, T., Laulainen, N.S., Lu, F., Reheis, M.C., Chun, Y., Westphal, D., Holben, B.N., Gueymard, C., McKendry, I., Kuring, N., Feldman, G.C., McClain, C., Frouin, R.J., Merrill, J., DuBois, D., Vignola, F., Murayama, T., Nickovic, S., Wilxon, W.E., Sassen, K., Sugimoto, N., (2001). 'The Asian dust events of April 1998'. *Journal of geophysical research*, 106, 18317–18330.
6. In, H.-J., Park, S.-U., (2002). 'A simulation of long-range transport of Yellow Sand observed in April 1998 in Korea'. *Journal of atmospheric environment*, 36, 4173–4187.
7. In, H.-J., Park, S.-U., (2003). 'The soil particle size dependent emission parameterization for an Asian dust (Yellow Sand) observed in Korea on April 2002'. *Journal of atmospheric environment*, 37, 4625–4636.
8. IPCC (the International Panel on Climate Change) (1995). *Climate Change 1994*, edited by J. T. Houghton et al., Cambridge Univ. Press, New York.
9. IPCC (the Intergovernmental Panel on Climate Change) (2001), *Climate Change 2001: The Scientific Basis*, J. T. Houghton, Y. Ding, D. J. Griggs, M. Noguer, P. J. van der Linden, D. Xiaosu, K. Maskell, and C. A. Johnson (Eds.), 896 pp. Cambridge Univ. Press, New York.

10. Jaffe, D. A., A. Mahura, J. Kelley, J. Atkins, P. C. Novelli, and J. Merrill (1997). 'Impact of Asian emissions on the remote North Pacific atmosphere: Interpretation of CO data from Shemya, Guam, Midway, and Mauna Loa'. *Journal of geophysical research*, 102, 28,627–28,636.
11. Jaffe, D. A., et al. (1999). 'Transport of Asian air pollution to North America'. *Journal of geophysical research*, 26, 711–714.
12. Jaffe, D. A., et al. (2003). 'The 2001 Asian dust events: transport and impacts on surface aerosol concentrations in US'. *Journal of geophysical research*, 46, 501–516.
13. Jankowiak, I., and D. Tanre (1992). 'Satellite climatology of Saharan dust outbreaks: Method and preliminary results'. *Journal of climate*, 5, 646–656.
14. Kotamarthi, V. and Carmichael, G. (1993). 'Modeling study of the long range transport of Kosa using particle trajectory analysis'. *Tellus*, 45B, 426-441
15. Kurosaki, Y. and M. Mikami (2003). 'Recent frequent dust events and their relation to surface wind in East Asia'. *Journal of geophysical research*, 30, 1736.
16. Kwon, H-J., Cho, S-H., Chun, Y., Lagarde, F., and Pershagen, G. (2002). *Effects of the Asian Dust Events on Daily Mortality in Seoul, Korea*. Environmental Research Section A 90, 1-5 doi:10.1006/enrs.2002.4377
17. Li, X., H. Maring, D. Savoie, K. Voss, and J. M. Prospero (1996). 'Dominance of mineral dust in aerosol light-scattering in the North Atlantic trade wind'. *Nature*, 380, 416–419.
18. McKendry, I. G., J. P. Hacker, R. Stull, S. Sakiyama, D. Mignacca, and K. Reid (2001). 'Long-range transport of Asian dust to the Lower Fraser Valley, British Columbia, Canada'. *Journal of geophysical research*, 106, 18,361–18,370.
19. Merrill, J. T., R. Blake, and L. Avila (1985). 'Modeling atmospheric transport to the Marshall Island', *Journal of geophysical research*, 90, 12,927–12,936.
20. Mishchenko, M. I., and K. Sassen (1998). 'Depolarization of lidar returns by small ice crystals: An application to contrails', *Journal of geophysical research*, 25, 309–312.
21. Nakajima, T., M. Sekiguchi, T. Takemura, I. Uno, A. Higurashi, D. Kim, B. J. Sohn, S. N. Oh, T. Y. Nakajima, S. Ohta, I. Okada, T. Takamura, and K. Kawamoto (2003). 'Significance of direct and indirect radiative forcings of aerosols in the East China Sea region'. *Journal of geophysical research*, (in press).

22. Park, S.-U., (2002). *Field survey of Yellow Sand source regions. Proceedings of workshop of Asian dust, 22 March, 2002*. Korea Meteorological Administration, Korea.
23. Park, S.-U., In, H.-J., (2003). 'Parameterization of dust emission for the simulation of the Yellow Sand (Asian dust) observed in March 2002 in Korea'. *Journal of geophysical research*, 108 (D19), 4618.
24. Prospero, J. M. (1990). *Mineral aerosol transport to the North Atlantic and North Pacific: The impact of African and Asian sources*, in *The Long-Range Transport of Natural and Contaminated Substances*, edited by A. H. Knap, NATO ASE Ser., 297, 1908- 1917, 1990.
25. Prospero, J. M., and D. L. Savoie (1989). 'Effect of continental sources of nitrate concentrations over the Pacific Ocean'. *Nature*, 339, 687–689.
26. Pye, K. (1992). *Aeolian dust and dust deposits*, in *Encyclopedia of Earth System Science*, vol. 1, pp. 35–42, Academic, San Diego, Calif., 1992.
27. Qian, W., Quan, L., Shi, S. (2002). 'Variations of the Dust Storm in China and its Climatic Control'. *Journal of Climate*, 15(10), 1216-1229.
28. Sassen, K. (1997). 'Contrail-cirrus and their potential for regional climate change'. *Bull. Am. Meteorol. Soc.*, 78, 1885–1903.
29. Sheehy, D. (1992). 'A Perspective on desertification of grazingland and ecosystems in North China'. *Ambio*, 21, 303–307.
30. Simpson, J. J., G. L. Hufford, R. Servranckx, J. Berg, and D. Pieri (2003). 'Airborne Asian Dust: Case study of long-range transport and implications for the detection of volcanic ash'. *Weather and Forecasting*, 18, 121– 141.
31. Sokolik, I. N., and O. B. Toon (1996). 'Direct radiative forcing by anthropogenic airborne mineral aerosols'. *Nature*, 381, 681–683.
32. Song, J., Park, J.G., Yasuda, Y. (2003). 'Capture of yellow dust blow by MODIS data' *Journal of geophysical research*, (in press).
33. Symons, G. J. (1888). *The Eruption of Krakatoa and Subsequent Phenomena*, Harrison and Sons, Truebner & Co., London.
34. Talbot, R. W., et al. (1997). 'Chemical characteristics of continental outflow from Asia to the troposphere over the western Pacific Ocean during February-March 1994: Results from PEM West-B'. *Journal of geophysical research*, 102, 28,255–28,274.

35. Tegen, S. R., A. A. Lacis, and I. Fung (1996). 'The influence on climate forcing of mineral aerosols from disturbed soils'. *Nature*, 380, 419–422.
36. Tratt, D. M., R. J. Frouin, and D. L. Westphal (2001). 'April 1998 Asian dust event: A southern California perspective'. *Journal of geophysical research*, 106(D16), 18,325.
37. Uematsu M., Duce R. A., Prospero J. M., Chen L., Merrill J. T. and McDonald R. L. (1983). 'Transport of mineral aerosol from Asia over the North Pacific Ocean'. *Journal of geophysical research*, 88, 5343-5352.
38. Wang, X., Dong, Z., Zhang, J., Lui, L., (2004). 'Modern dust storms in China: an overview'. *Journal of Arid Environments*, 58, 559-574
39. Yoon, C. H. (2000). *Asian dust from China blests Korea*. The English JoonAngeIlbo, Apr. 7.

**9. Internet Sources:**

1. Dundee Satellite Receiving Station, Dundee University, UK (2000). <URL: <http://www.sat.dundee.ac.uk>>
2. The LESA Project Kirdkao Observatory (2003). 'Circulation of the atmosphere'. <URL: [http://www.lesaproject.com/lesa/atmosphere/atm\\_circulation.htm](http://www.lesaproject.com/lesa/atmosphere/atm_circulation.htm)>

**10. Type of Project: Sponsored: None**

**11. Details of the Donor: Royal Thai Government (RTG)**

**12. Specific Agreement involved in the Sponsorship Agreement: None**

**13. AIT Code Number:**