MONITORING LONG-RANG ATMOSPHEIC TRANSPORT (LRAT) OF ORGANOCHLORINE PESTICIDES (OCPs) AT A REMOTE BACKGROUND SITE (TENGCHONG MOUNTAIN) IN SOUTHWESTERN CHINA

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Abstract

Southeast Asian countries have consumed abundant OCPs, which could be an important source of POPs, but the atmospheric output data are relatively sparse. Tengchong Mountain (TM) station located in southwest China was chosen to study related LRAT of OCPs from Southeast Asia to remote tropical region. The average concentrations of OCPs were higher than those in other remote stations, except for α-HCH (α-hexachlorocyclohexane). The OCP levels were found to be controlled by the air parcel back trajectories on the basis of four distinct clusters. Elevated levels of HCH and DDT were observed when the air parcels originated from India. High levels of γ-HCH and TC were associated with air mass from China and surrounding areas.

Introduction

Organochlorine pesticides (OCPs) were extensively applied in Southeast Asia. The pollution there is a subject of concern for the high pollution levels, as well as the potential mobility at local to global scales by LRAT[1] . Therefore, observations conducted at remote sites are necessary to trace concentration levels, pollution traits, and transport mechanism of OCPs in this region. A background sites absent from human activity in western China were chosen to monitor OCPs in this region. TM site is a WMO (World Meteorological Organization) observatory station in tropical zone of the Global Climate Observing System, located at the eastern edge of the Tibetan Plateau. Mainly influenced by air mass from Southeast Asia, observation at TM site can help in understanding pollution status of OCPs and their LRAT from adjacent regions.

Materials and Methods

24hrs Hi-Volume air samples were conducted once a week from 22 October 2005 to 27 December 2006 at TM site (24.95º N, 98.48º E) at a flow rate of approximately 430 m^3 / day. Air samples were collected by baked quartz fibre filters (QFFs), and in turn by pre-cleaned polyurethane foam (PUF). Samples were purified on aluminum/silica column and analyzed on Agilent 6890 gas chromatograph equipped with a capillary column (CP-Sil 8 CB, 50 m, 0.25 mm, 0.25 μm) and an electron capture detector (ECD).

Five-day air parcel back trajectories were calculated at 6 hours intervals for sampling days by the Hybrid-Single Particle Integrated Trajectories (HYSPLIT 4.8). Each trajectory was estimated at 100 m above ground level and was cross checked at 500 m and 1000 m levels above the ground.

Results and Discussion

OCPs. The concentration levels of OCPs at TM site were 41.9 ± 26.4, 128.6 ± 150.0, 11.3 ± 14.6, 19.5 ± 11.3, 6.1 ± 3.5, 40.3 ± 96.8, 58.5 ± 106.7 pg m^{-3} for α-HCH, γ-HCH, *o,p´*-DDT, *p,p´*-DDT, *p,p´*-DDE (*p,p´*-dichlorodiphenyldichloroethylene), TC (*Trans*-chlordane) and CC (*cis*-chlordane), respectively. The average concentrations of OCPs showed much higher levels than those measured at polar region stations, except for α-HCH, which is a result of restriction of technical HCH in Southeast Asia [2].

The ratio of isomers is accepted widely as an index to distinguish pollution sources or the extent of degradation. The average α-HCH/γ-HCH ratio of 0.56 ± 0.48 at TM site confirms the extensive usage of lindane in Southeast Asia, except for occasionally high ratios influenced by technical HCH. The TC/CC ratio was 0.61 ± 0.34 at TM site and indicated an aged source. But relatively high TC/CC ratio and elevated chlordane concentration occurred in winter possibly because of usage of chlordane as termiticides or pesticides. As for DDTs, an *o,p´*-DDT/ *p,p´*-DDT ratio as low as 0.56 ± 0.32 suggests technical DDT is the major source. In addition, the *p,p´*-DDT/ *p,p´*-DDE ratio was above that of technical DDT from January to February in 2006, implying the existence of fresh sources.

Long-rang atmospheric transport. There was no significant temperature dependence of all the OCPs at TM site, which suggested OCPs in this region were more susceptible to LRAT. All the air mass back trajectories generated by HYSPLIT were clustered into four types (Figure 1).

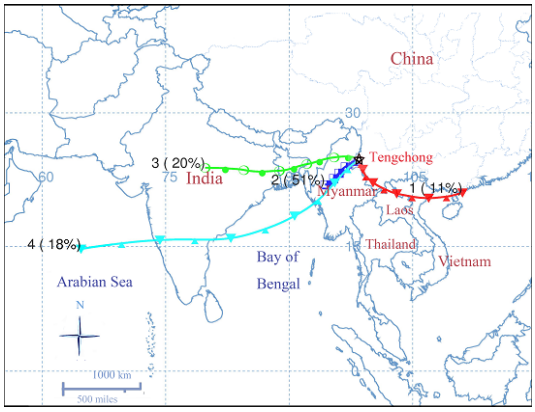

Figure 1. Four types of clusters of air masses backward trajectories at TM site

The average concentrations of OCPs related to type 1 were lower than or similar to those of type 2 and type 3, with the exception of γ-HCH and TC (Figure 2). It could be attributed to the usage of lindane and technical chlordane as insecticide and termitecide in Southern China. Interestingly, low ratio of *o,p´*-DDT/ *p,p´*-DDT indicating more usage of technical DDT was different from characters observed in the same site before[3] . It is probable that *p,p´*-DDT was brought to TM site when air masses swept across relevant source regions.

The highest γ-HCH concentration among all the four types (Figure 2) was associated with type 2 air mass, especially when air mass came from the border between Myanmar and China. Both of γ-HCH and chlordane

showed elevated concentrations during spring and winter. Generally, it appears that outflow from this region could be one of potential sources for γ-HCH.

Type 3 air mass was characterized with high levels of α-HCH and DDTs from India, where OCPs were consumed in quantity[4]. The ratio of α-HCH/γ-HCH indicates the usage of technical HCH, with occasionally lindane application. Usage of technical DDT in India was supported by a concurrence of low *o,p´*-DDT/ *p,p´*-DDT, high *p,p´*-DDT/ *p, p´*-DDE ratios and high *p,p´*-DDT concentration.

Most of OCPs related to type 4 cluster exhibited relatively lower concentration levels (Figure 2), because relatively clean air mass from ocean effectively diluted the pollutants.

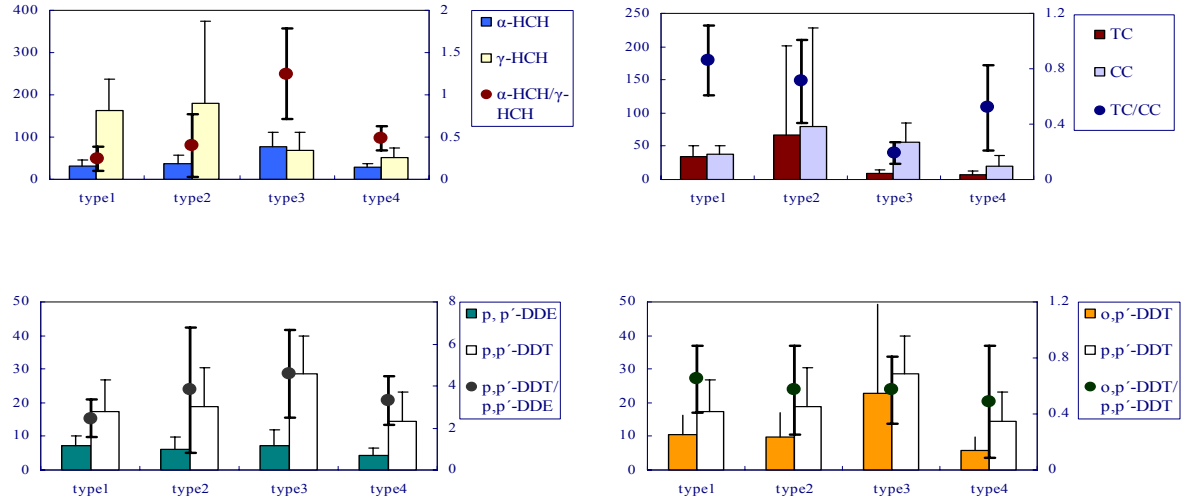

Figure 2. Average and standard deviation concentrations of OCPs (pg m^{-3}) for four trajectory types at TM site

Potential source contribution function (PSCF). As discussed above, the PSCF analysis suggested India could be a significant source for α-HCH and DDTs, while γ-HCH and TC mainly originated from Southern China and surrounding areas (Figure 3).

Acknowledge

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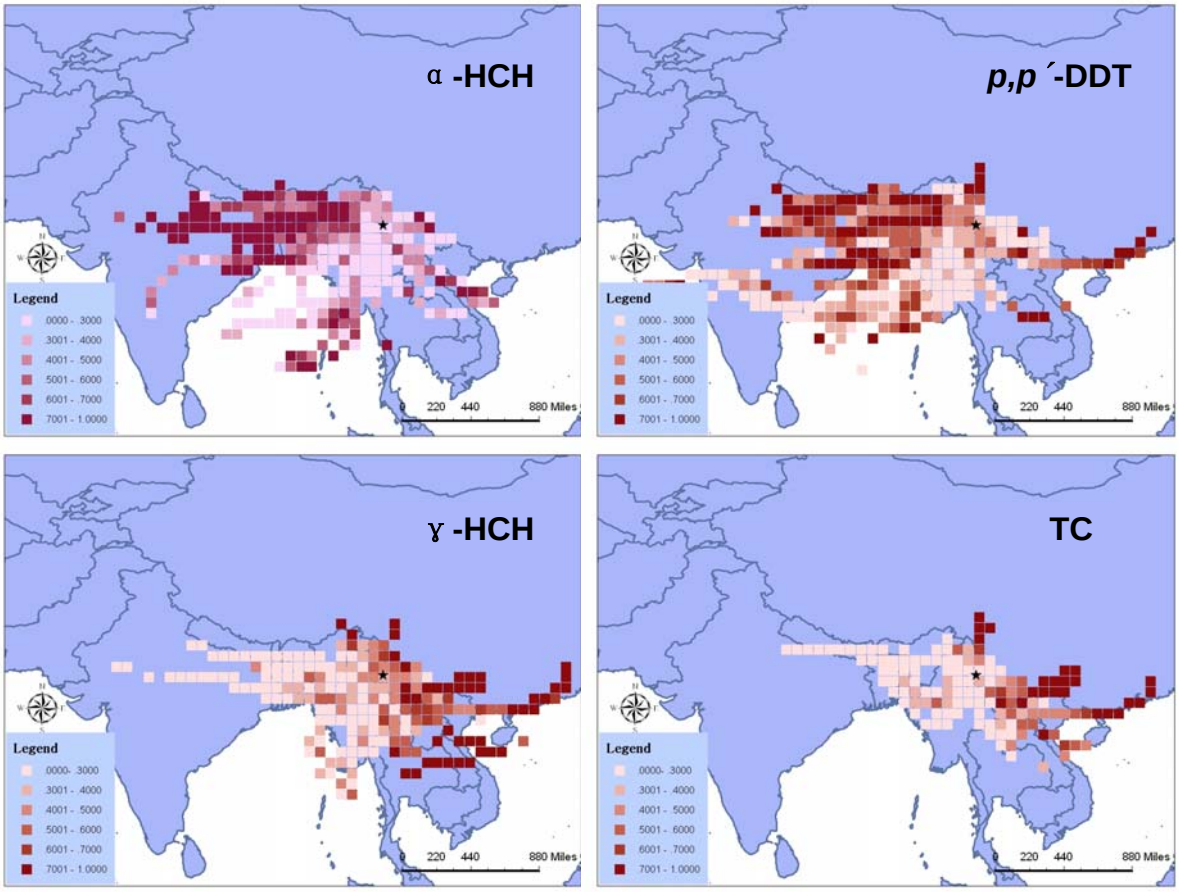

Figure 3. Maps of potential source contribution function for α-HCH, *p,p´*-DDT, γ-HCH and TC

Reference

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