Supplementary Information

Characterization of Particulate Matter Measured at Remote Forest Site in Relation to Local and Distant Contributing Sources

Nguyen Thi Kim Oanh[1,*], Nguyen Thanh Hang[1], Tipayarom Aungsiri [1,2], Thiansathit Worrarat[1]

and Tipayarom Danutawat[1,2]

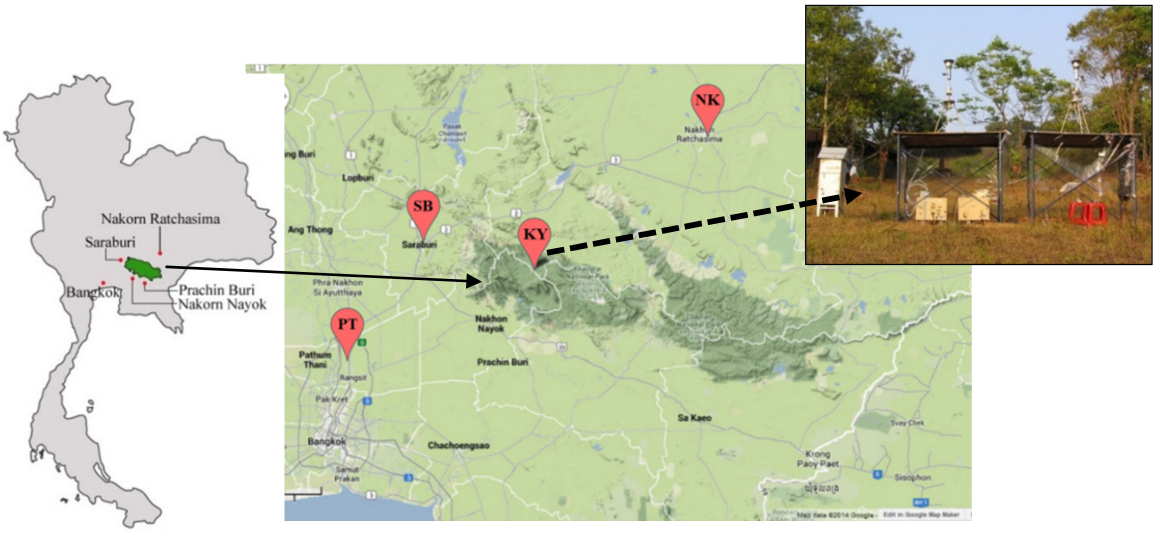

Fig. S1. Map of Khao Yai and the sampling point (KY)

Indicated are the locations of PCD sampling stations with PM_{10} data presented in Fig. S2

(NK: Nakon Ratchasima, SB: Saraburi, PT: Pathumthani)

Table S1. Climate of Khao Yai National Park vs. Bangkok

Parameters	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Khao Yai												
Relative humidity, %	84	80	81	81	84	82	82	82	82	86	82	79
Hours of sun, h	8	8	4	8	6	5	5	5	4	5	5	5
Precipitation sum, mm	84	67	82	103	184	174	193	197	168	**307**	**328**	164
Precipitation days, days	15	7	18	13	24	18	26	23	23	27	14	9
Bangkok												
Relative humidity, %	68	69	73	75	76	76	74	74	78	81	68	62
Hours of sun, h	8	9	8	7	7	6	5	4	5	6	7	8
Precipitation sum, mm	10	28	32	72	**193**	**153**	**157**	**188**	**321**	**237**	58	10
Precipitation days, day	3	4	8	15	25	18	21	23	25	25	7	3

Sources:
http://www.zoover.co.uk/thailand/thailand/Bangkok/weather#UzDqCHYk2zt6gp9x.99
http://www.zoover.co.uk/thailand/thailand/khao-yai-national-park/weather

Textbox S1: Detail of QA/QC for sampling and chemical analysis

Sampler calibration: The dichot samplers were calibrated at the site for the designated flow rates (1.67 L/min for coarse fraction and 15.03 L/min for fine fraction) to ensure the correct fractionation of fine ($PM_{2.5}$) and coarse ($PM_{10-2.5}$) particles.

Filter weighing: Before sampling, quartz fiber filters were prebaked at 550°C for about five hours to remove possible organic contaminants. The filters (both types: MCE and quartz) were desiccated for 24h in a conditioned room with a relative humidity of 42±5% and temperature of 22±2°C before pre-weight were taken using a 6D Analytical Mettler Balance. Each pre-weighted filter was kept in a separate Petri-dish and refrigerated during the transportation (by car) to the sampling site and back from the sampling site to the Environmental Engineering Laboratory at the Asian Institute of Technology (AIT) for analysis. The post-weight of both MCE and quartz filters was determined after being desiccated in the same conditioned room for 24h. However, the quartz filters were often observed to have broken edges, and not all parts could be recovered properly, perhaps due to a high humidity at the site. The weighing results of quartz filters were shown with high uncertainty, thus the mass determination was done based on MCE. The QA/QC for the filter weighing was done following US EPA (1998). Each sample filter was weighed at least three times or until a constant weight was obtained. Reconstructed mass, ion balance and ammonium balance were used to check the consistency of the analytical results.

Blank samples: On average, one filter was used as a lab blank for every 20 filters taken from a filter lot. One pair of trip blanks (a quartz and a MCE) was prepared in each sampling period (dry and wet). The trip blank was kept in a Petri-dish which was remained insight an airtight bag during the sampling and transportation of the samples. In addition, two pairs of passive exposure blanks in the dry sampling and one pair in the wet sampling periods were also prepared. Each exposure blank was a clean filter (quartz or MCE) that was kept in an open Petri-dish to allow contact with air during 24h sampling, i.e., without pumping air through the filter.

Black carbon (BC) was also measured optically, using a M43D Digital Smoke Stain Reflectometer, at 5 points across a MCE sampled filter and the average value was used. This BC is referred to as equivalent BC (EBC). However, a comparison between EC (Sunset analyzer) and BC (reflectometer) showed that BC was consistently higher than EC, especially for large values. The exponential equation has a better fit with a higher R^2 (0.85) than the linear equation (R^2 = 0.81) between BC and EC measured in $PM_{2.5}$, hence showed a good correlation. For the coarse fractions, BC appeared to be higher than EC but there was no correlation between EC and BC which may be due to their overall low levels (EC <0.3 µg/m^3) hence high uncertainty associated with the measurement methods, especially for low BC values.

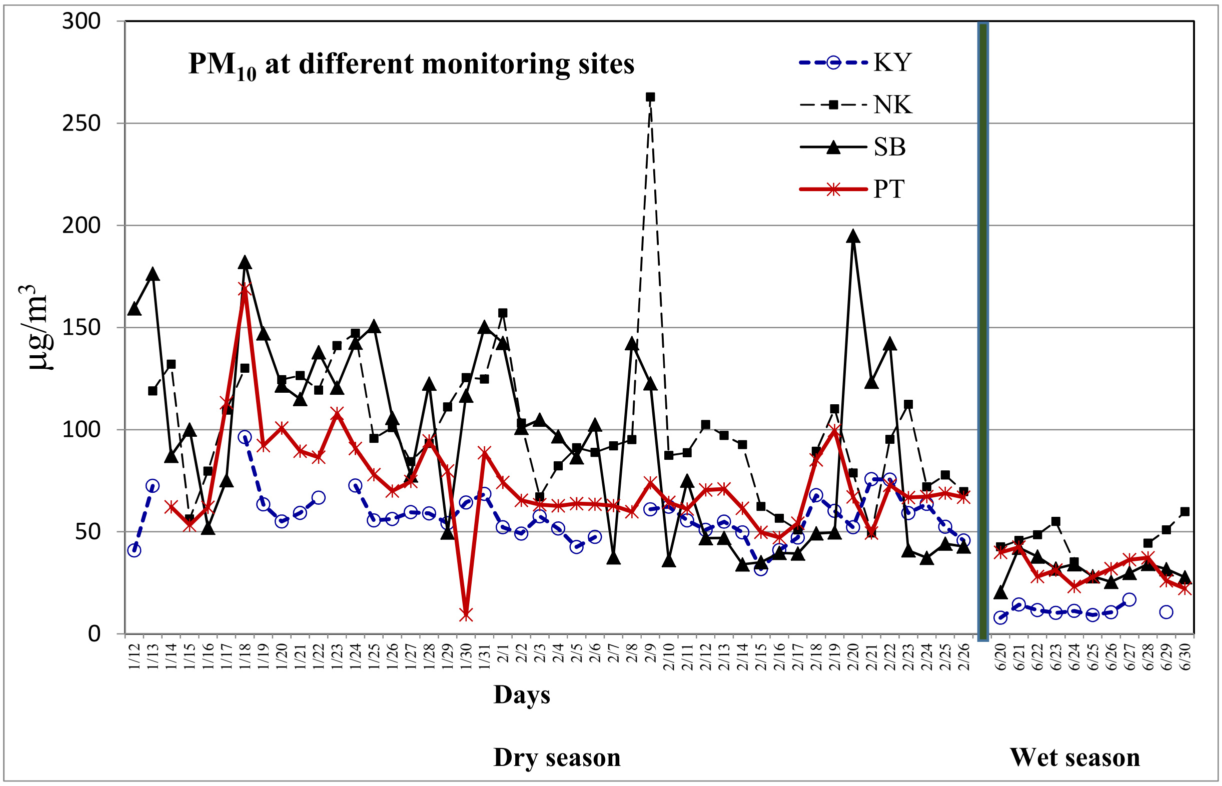

Fig. S2. PM$_{10}$ levels in Khaoyai (KY) as compared to other locations in the surrounding towns (NK: Nakon Ratchasima, SB: Saraburi) and in Bangkok Metropolitan Region (PT: Pathumthani), locations are indicated in Figure S1.

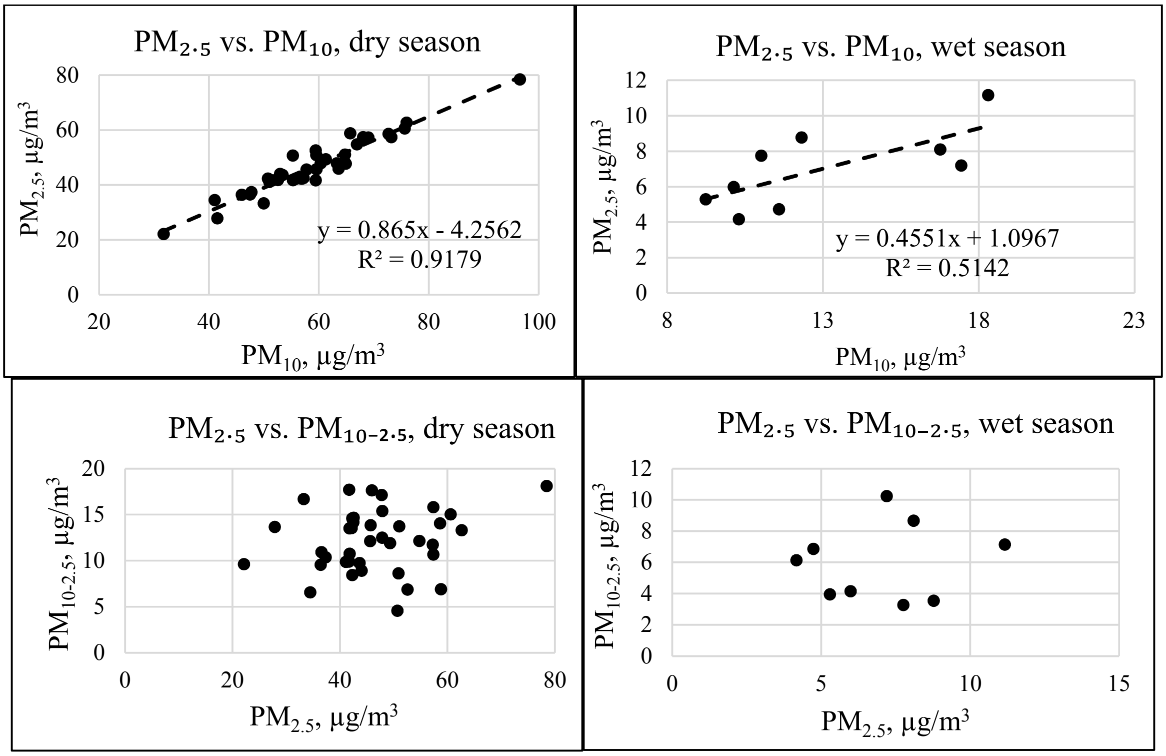

Fig. S3. Scatter plots for $PM_{2.5}$ vs. $PM_{10\text{-}2.5}$ and $PM_{2.5}$ vs. PM_{10} in wet and dry sampling periods, Khao Yai

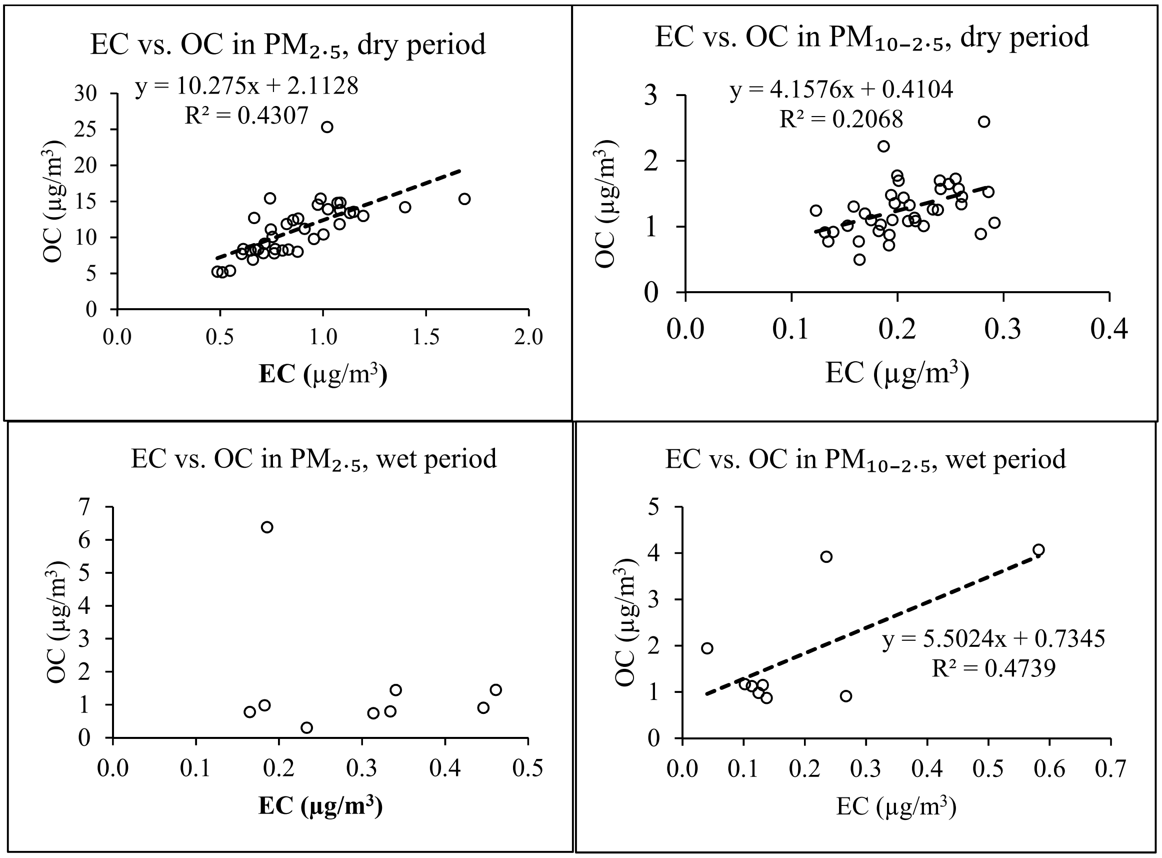

Fig. S4. Relationship between EC and OC

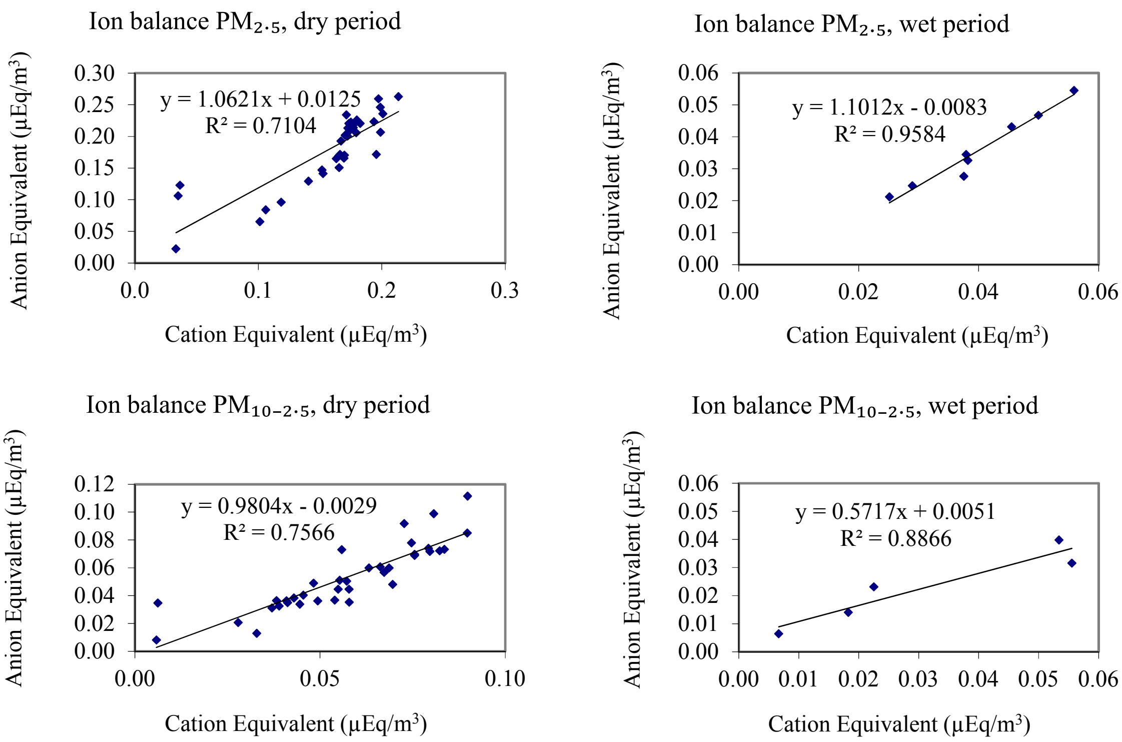

Fig. S5. Ion balance of $PM_{2.5}$ and $PM_{10\text{-}2.5}$ in wet and dry sampling periods, Khao Yai

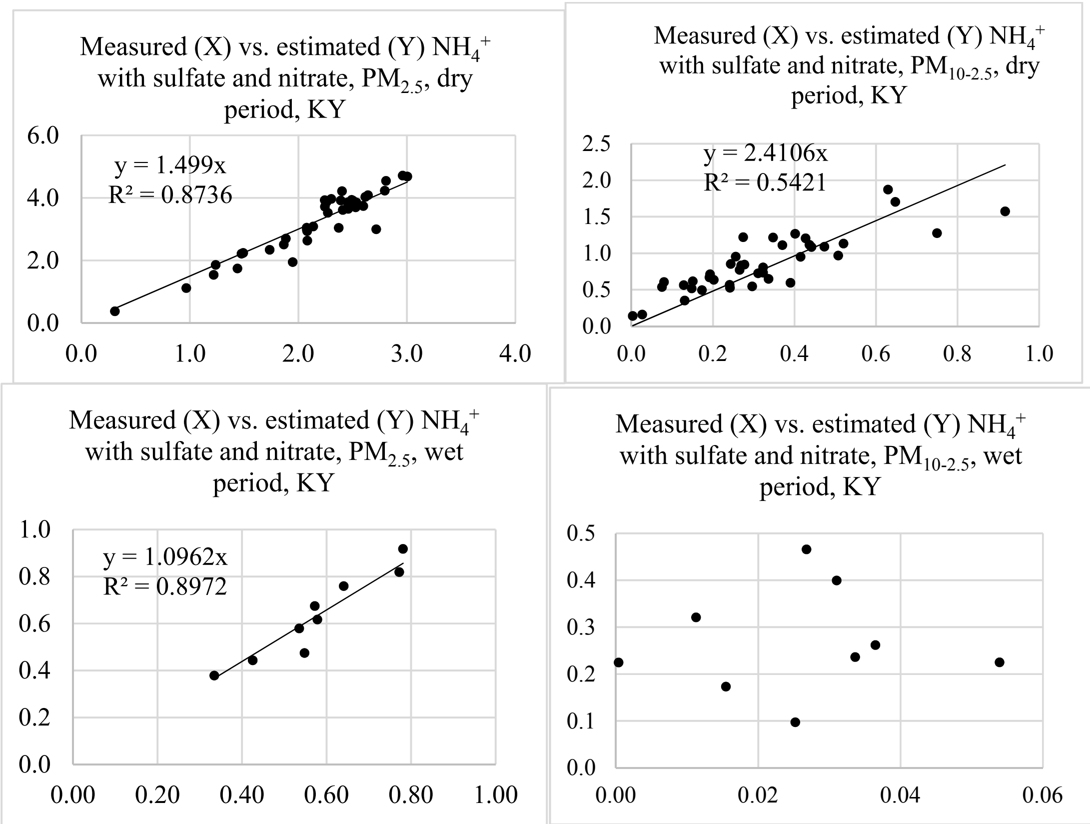

Fig. S6(a). Measured and estimated NH_4^+ with **sulfate** and nitrate salts ($\mu g/m^3$) for PM, KY

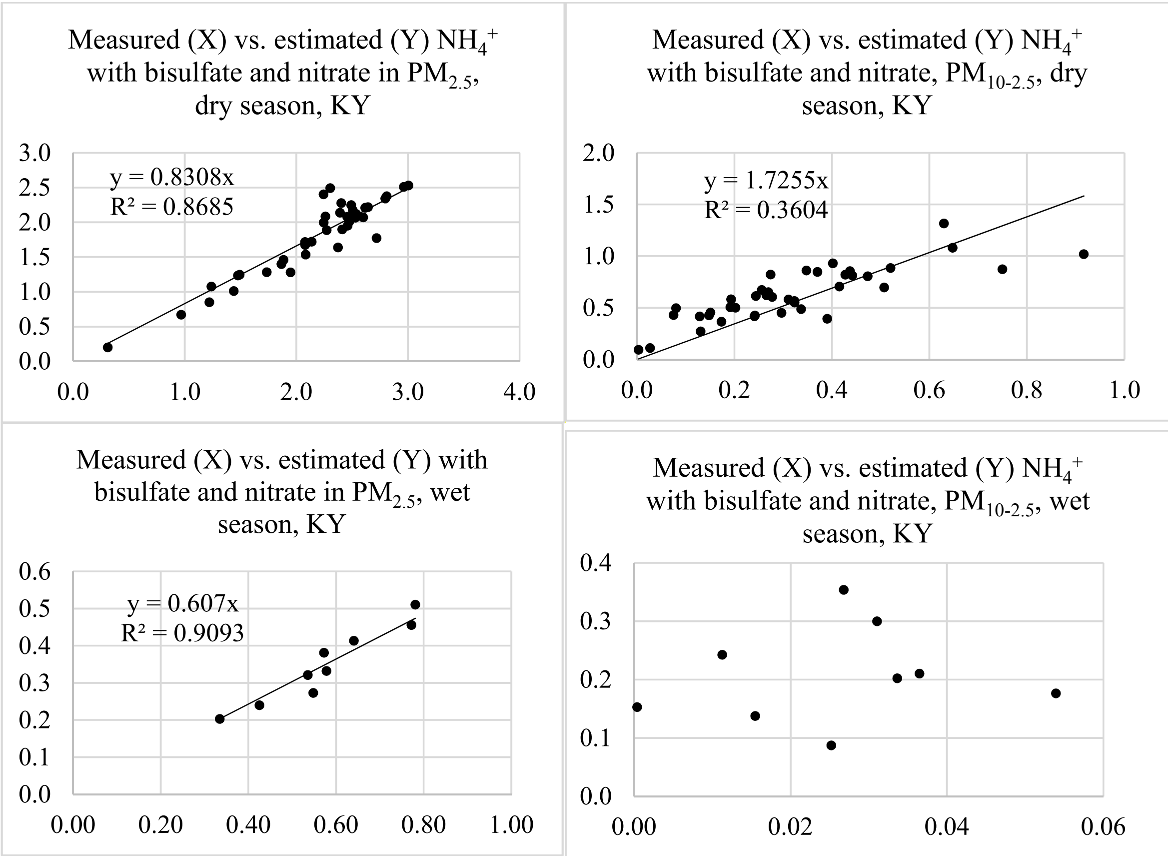

Fig. S6(b). Measured and estimated NH_4^+ with **bisulfate** and nitrate salts ($\mu g/m^3$) for PM, KY

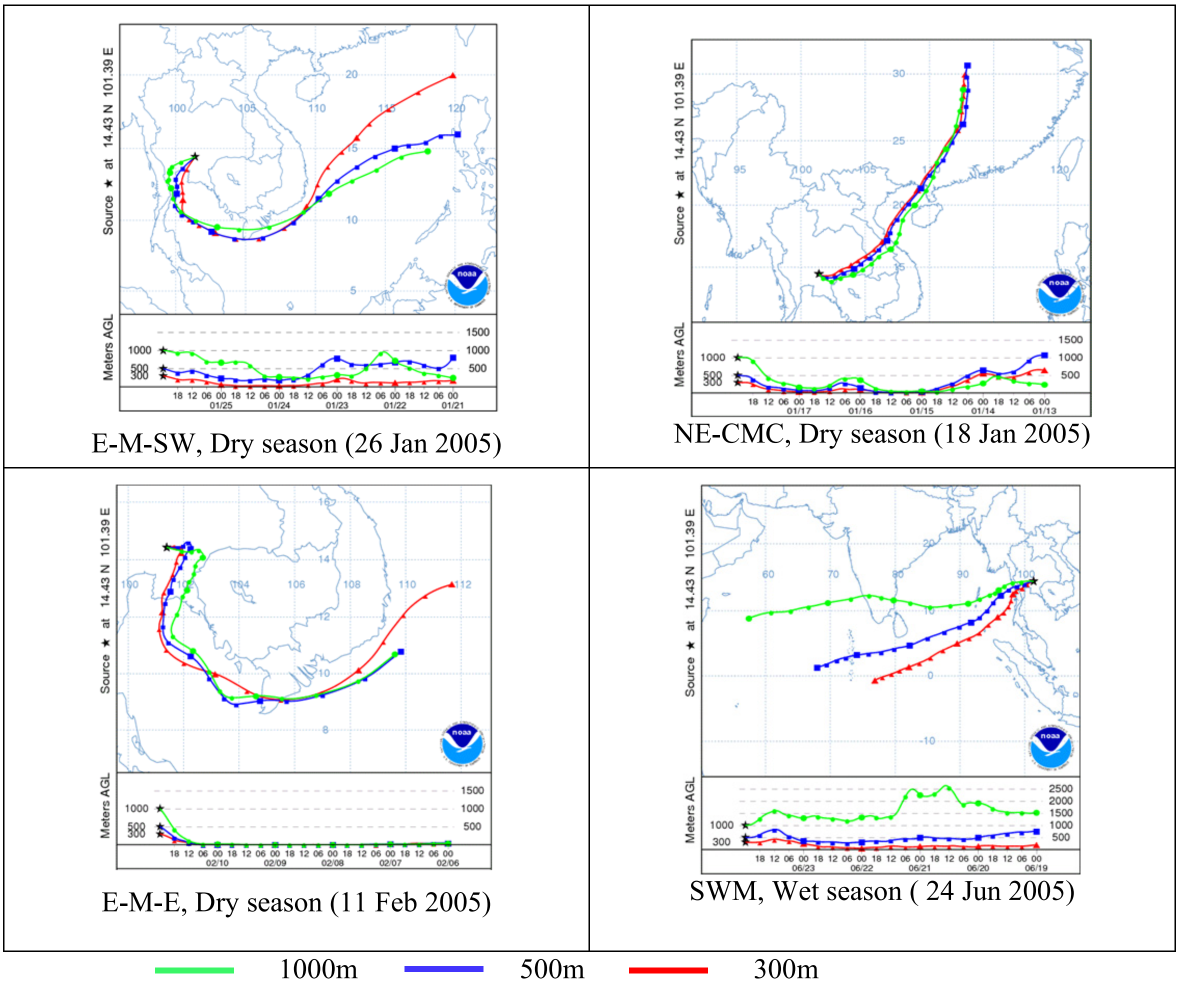

Fig. S7. HYSPLIT 5-day back trajectory patterns showing the air mass arriving at KY site at different heights above the ground