## Supporting Information

Measurement	Equipment and Company	Measurement range	Limit of Detection
СО	Horiba (Kyoto, Japan)	0 – 50 ppm	0.05 ppm
$SO_2$	Ecotech 9850 (Victoria, Australia)	0-500  ppb	0.5 ppb
NO and $NO_x$	Ecotech 9841 (Victoria, Australia)	0-500  ppb	0.5 ppb
O <sub>3</sub>	Ecotech 9810 (Victoria, Australia)	$0-500 \; ppb$	1 ppb

Table S1. Equipment information of observations used from Taiwan EPA.

Table S2. Reaction rate constants of OH-related oxidation reactions (Burkholder et al., 2020).

	CH <sub>4</sub>	СО	NO	NO <sub>2</sub>	SO <sub>2</sub>
$k_{OH}$ (298 K) (cm <sup>3</sup> molecule <sup>-1</sup> s <sup>-1</sup> )	6.3×10 <sup>-15</sup>	2.4×10 <sup>-13</sup>	3.6×10 <sup>-11</sup>	2.8×10 <sup>-11</sup>	1.7×10 <sup>-12</sup>
Relative k (compared to k <sub>OH-SO2</sub> )	0.0037	0.14	21.2	16.5	1
Typical order (ppb)	10 <sup>3</sup>	10 <sup>2</sup>	10 <sup>1</sup>	10 <sup>1</sup>	10 <sup>1</sup>
Relative reaction rate (ppb $\times$ k <sub>relative</sub> )	3.7	14	212	165	10

**Table S3.** Annual emission (tons per year) of SO<sub>2</sub>, NO<sub>x</sub>, and CO of different sources from Taiwan Emission Data System 10.1.

	Taichung Power Plant	Hsinta Power Plant	Sixth Naphtha Cracker	Mailiao Power Plant	Taipei City traffic	Taichung City traffic	Kaohsiung City traffic	Whole Taiwan traffic
SO <sub>2</sub>	15179.3	8284.0	5087.4	1466.5	8	18	15	141
NOX	22026.7	10545.6	13709.2	3550.7	5837	21520	22255	184275
CO	766.6	1375.5	17502.0	5656.0	28587	38831	56390	345513



Figure S1. Flight tracks of the EMeRGe-Asia campaign over West Pacific.



Figure S2. Geographic location of the 11 sampling sites used for the averaged composition of PM<sub>2.5</sub>.



**Figure S3.** Relationship between VOCs-OH radical reaction rates and the summation of other trace gases (CH<sub>4</sub>, CO, NO, NO<sub>2</sub>, and SO<sub>2</sub>)-OH reaction rates. The reaction rate constant "k" of each trace gas is the second-order or pseudo-second-order reaction rate constant ( $k_A[A][OH]$ , in which A represents the trace gases that we study in this research) at 298K. VOCs include formaldehyde, methanol, acetonitrile, acetaldehyde acetone, isoprene, benzene, toluene, and xylene.



**Figure S4.** Relationship between PAN and NO<sub>y</sub> at an altitude of 600 m over Western Taiwan. The slope of the regression line is utilized to estimate the proportion of PAN in NO<sub>y</sub>.



**Figure S5.** Correlation coefficients ( $R^2$ ) before and after the O<sub>3</sub> normalization of CO-SO<sub>2</sub> (a), NO-SO<sub>2</sub> (b), and NO<sub>2</sub>-SO<sub>2</sub> (c) of EPA stations over Western Taiwan illustrated in the left and right side of circles, respectively.



Figure S6. Five self-defined regions over Western Taiwan with the flight tracks in these regions.



**Figure S7.** Backward trajectories from NOAA HYSPLIT of air masses (a) at 300 m in East China Sea on March 24<sup>th</sup>, (b) at 300 m in East China Sea on March 17<sup>th</sup>, (c) at 700 m over Taiwan on March 30<sup>th</sup>, (d) at 900 m over Taiwan on Aril 3<sup>rd</sup>.



**Figure S8.** The average zonal wind (u) and meridional wind (v) speeds in m/s during March 17<sup>th</sup> to April 7<sup>th</sup> of each region at the surface (a) and the altitude of 600 m (b).