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Organic amine weakens chloride depletion in coastal atmosphere

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S1. Calculation of particle viscosity

The dry glass transition temperature of the organic components ($T_{g,org}$) in SSA particles was first calculated using the number of carbon, hydrogen, and oxygen atoms (n_C, n_H, and n_O):

$$T_{g,org}=\left(n_C^0+ln(n_C)\right)b_C+ln(n_H)b_H+ln(n_C)ln(n_H)b_{CH}+ln(n_O)b_O+ln(n_C)ln(n_O)b_{CO} \quad \text{(S1)}$$

Here, the values of n_C^0, b_C, b_H and b_O,b_{CH} and b_{CO} are best-fit parameters presented in Derieux et al. (2018). Then, the average glass transition temperature of organic–water mixtures ($T_{g,org,w}$) can be calculated using the Gordon-Taylor equation (Derieux et al., 2018; Tumminello et al., 2021):

$$T_{g,org,w} = \frac{T_{g,w}f_{ALW}+\frac{1}{k_{GT}}f_{org}T_{g,org}}{f_{ALW}+\frac{1}{k_{GT}}f_{org}} \quad \text{(S2)}$$

$$f_{ALW} = \frac{m_{w,org}}{m_{w,org}+m_{org}} \quad \text{(S3)}$$

where $T_{g,w}$ and k_{GT} are the glass transition temperature of water (136 K) and the Gordon-Taylor constant (1), respectively. $m_{w,org}$ and m_{org} refer to the mass of water and organic components, respectively. Subsequently, the viscosity of the organic component (η_{org}) can be obtained through the conversion of $T_{g,org,w}$ using Eq.S4 and Eq.S5. Among them, the fragility parameter (z) was assumed to be 12 (Tumminello et al., 2021). T is the experimental temperature.

$$T_0 = \frac{39.17T_{g,org,w}}{z+39.17} \quad \text{(S4)}$$

$$log\eta_{org} = -5 + 0.434\frac{T_0 z}{T-T_0} \quad \text{(S5)}$$

For the viscosity of inorganic components (η_{iorg}), calculations can be performed using the viscosity of water at 25°C (η_w, 0.8904 cP), the mole fraction of cations in the solution (X_c), the free energy associated with NaCl (E), and the molar volume of

the hole formed by the movement of cations and anions (*V*):

$$\eta_{inorg} = \frac{\eta_w e^{X_c E}}{1+X_c V} \quad \text{(S6)}$$

where E and V are determined from the data presented by Goldsack and Franchetto (1977).

Finally, the SSA particle viscosity (η_{mix}) calculated by Eq.S7 based on the assumption that the organic and inorganic components of SSA particles are homogeneous and internally-mixed (Tumminello et al., 2021).

$$ln(\eta_{mix}) = \sum_{i=1}^{N} x_i ln(\eta_i) \quad \text{(S7)}$$

Here, x_i and η_i are the mole fraction and viscosity of component i (organic or inorganic components), respectively.

Additionally, the Extended AIM Aerosol Thermodynamics Model (E-AIM, https://www.aim.env.uea.ac.uk/aim/aim.php) was used to assess the content of the components of SSA particles.

Table S1. Summary of model simulation conditions and results.

Experiment[a]	$[NO_x]_0$	$[NH_3]_0$	HNO_3 exposure	Cl exposure
	(ppb)	(ppb)	(molecules cm^{-3} s)	(molecules cm^{-3} s)
NA.0	50	0	3.35439e+015	1.05106e+010
NA.5	50	5	3.12956e+015	1.0508e+010
NA.20	50	20	2.5492e+015	1.05006e+010

[a]Abbreviations used in experimental codes correspond to the reactants introduced into the model. "N" represents NO_x, and "A" represents NH_3. "NA.0-NA.20" represent 0 ppb – 20 ppb NH_3 concentrations, with a fixed initial NO_x concentration of 50 ppb.

Table S2. Toxicity prediction results for chemical structures of identified organic chlorinated compounds.

Molecular formula	Oral rat pLD_{50} (-log10(pred), mol kg^{-1})	pLD50 level*	Pred Developmental Toxicity**	Pred Mutagenicity**
$C_9H_{14}ClNO_9$	2.29	class 4	N/A	N/A
$C_7H_{13}ClN_2O_4$	2.61	class 3	0.80	0.33
$C_7H_{13}ClN_2O_9$	2.29	class 4	0.83	0.49
$C_6H_{10}ClNO_3$	1.74	class 4	0.77	0.24
$C_6H_{10}ClNO_4$	2.36	class 4	0.78	0.99
$C_7H_{14}ClNO_3$	2.29	class 4	0.80	0.95
$C_7H_{13}Cl_2NO_3$	1.56	class 5	0.66	0.07

*The class levels can be divided into five categories: class 1 (highest hazard, $pLD_{50} \geq 4.3$), class 2 ($4.3 > pLD_{50} > 3.3$), class 3 ($3.3 > pLD_{50} > 2.5$), class 4 ($2.5 > pLD_{50} > 1.69$), and class 5 (likely hazard, $1.69 > pLD_{50} > 1.3$) (Europe, 2021; Li et al., 2025).

**The class levels can be divided into two categories: class 1 (highest hazard, > 0.5), and class 2 (likely hazard, ≤ 0.5) (Europe, 2021; Li et al., 2025).

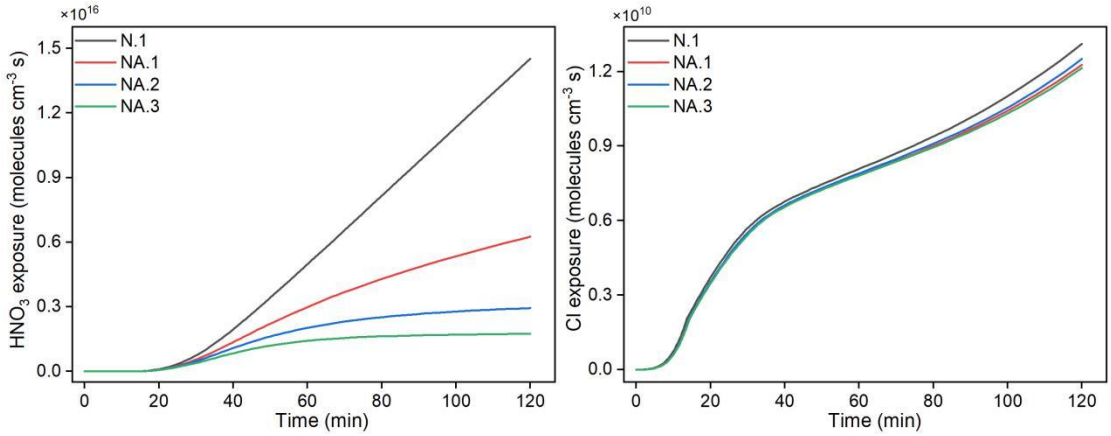

Figure S1. Time series of HNO_3 and Cl exposure for Exp.N.1-NA.3 obtained from model simulation.

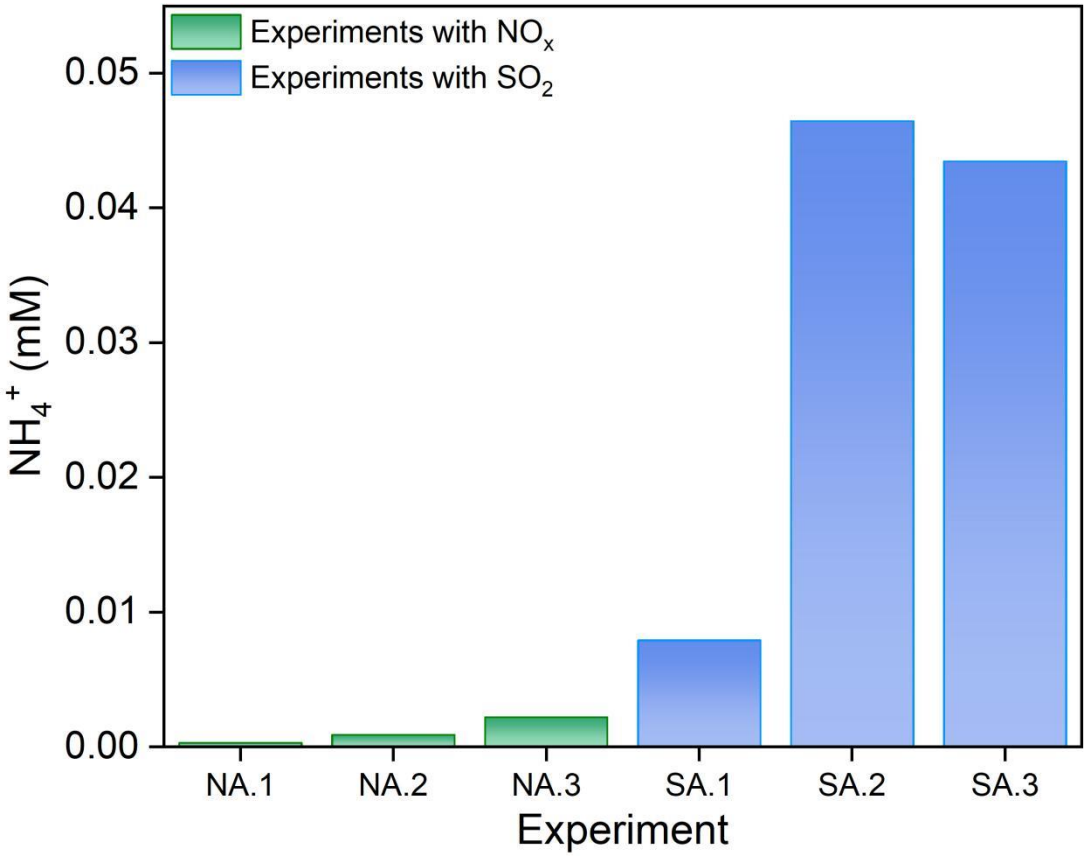

Figure S2. NH_4^+ concentration under different experimental conditions.

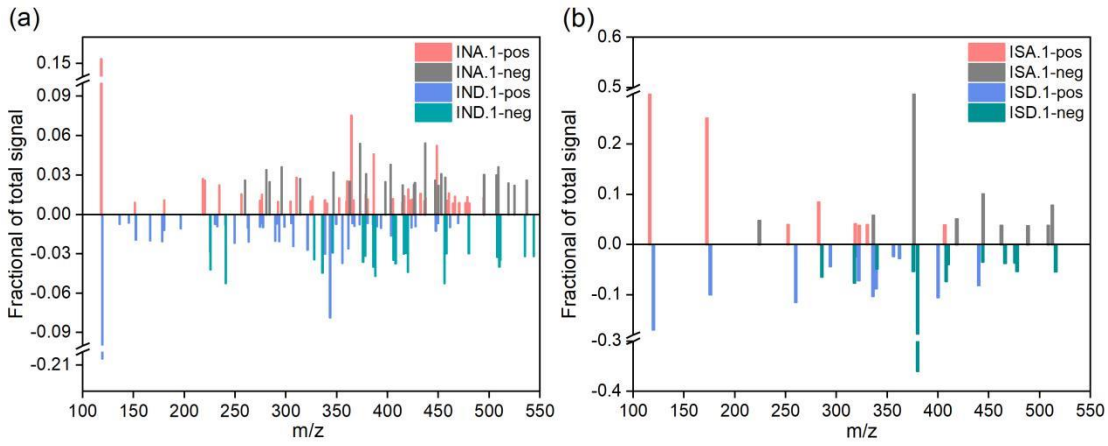

Figure S3. Mass spectra of organic chlorinated compounds for different experiments in the presence of (a) NO_x and (b) SO_2.

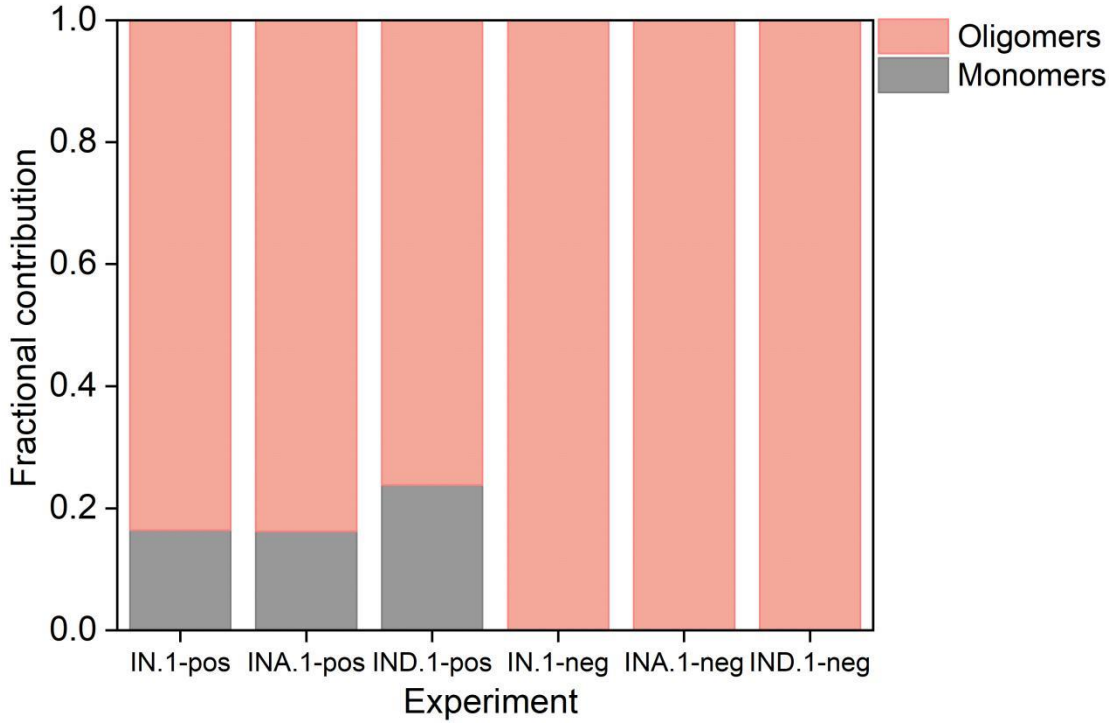

Figure S4. Fractional contribution of organic chlorinated monomers (C≤5) and oligomers (C>5) for different experiments with NO_x.

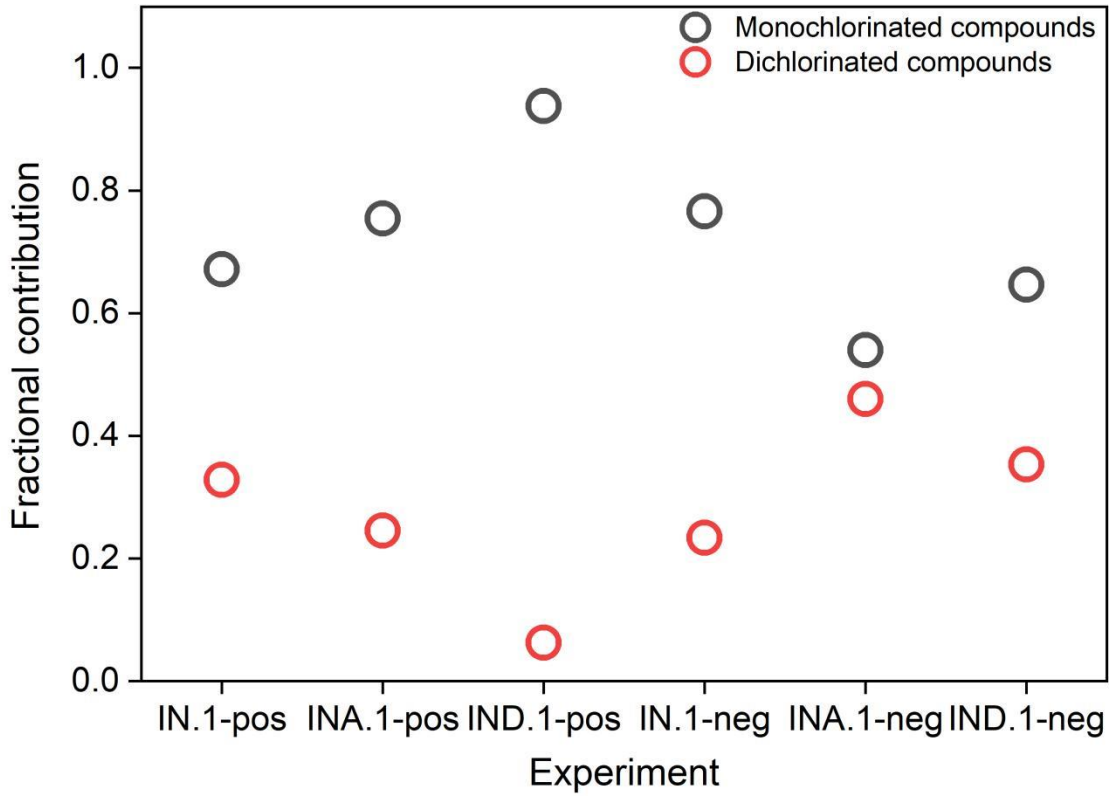

Figure S5. Fractional contribution of monochlorinated and dichlorinated compounds in the total organic chlorinated compounds for different experiments with NO_x.

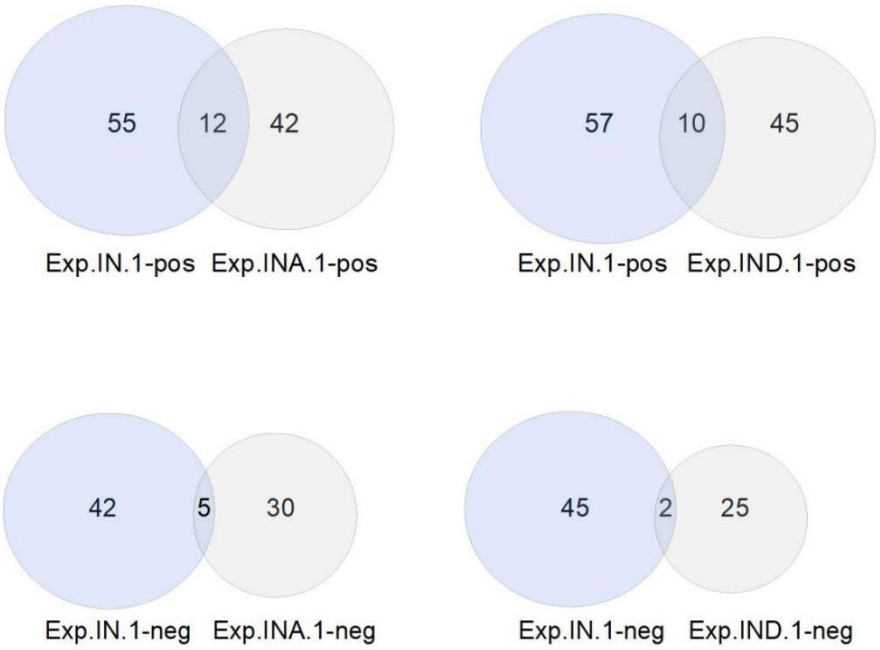

Figure S6. Venn diagram for all molecular formulas of organic chlorinated compounds between Exp.IN.1 and Exp.INA.1/Exp.IND.1. Numbers represent the count of molecular formulas within each subset.

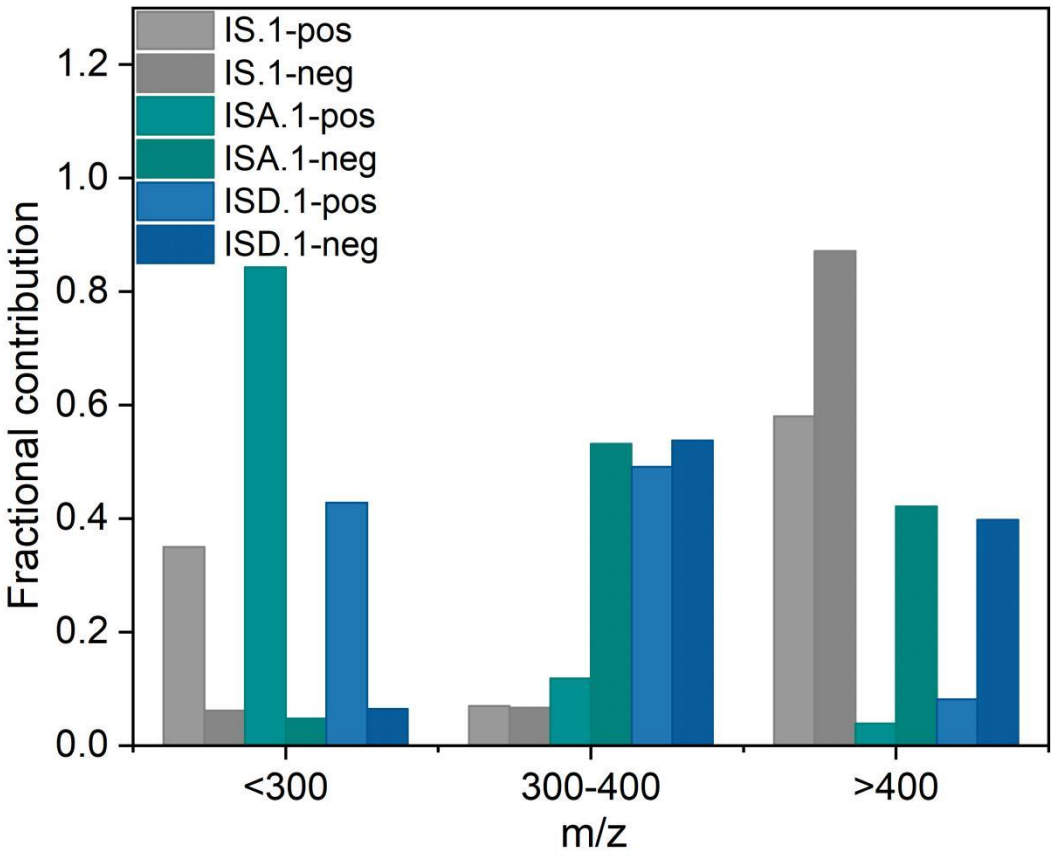

Figure S7. Distribution of identified molecules for different experiments with SO_2.

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