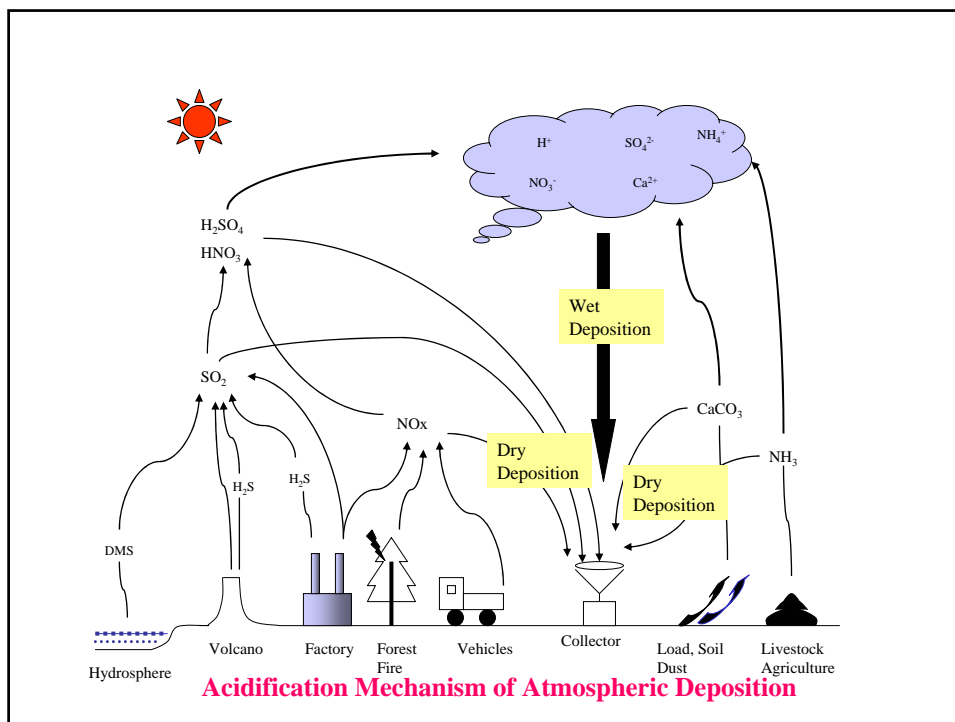


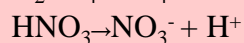
Precipitation Chemistry

Acid deposition and Oxidant
Research Center

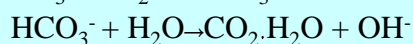
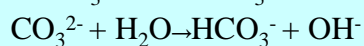
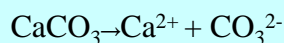
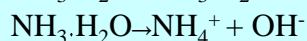
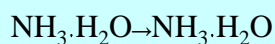


Acidity of Precipitation

•Acid



•Bases



$$[\text{H}^+] = [\text{Acid}] - [\text{Bases}]$$

$$= ([\text{H}_2\text{SO}_4] + [\text{HNO}_3]) - ([\text{NH}_3 \cdot \text{H}_2\text{O}] + [\text{CaCO}_3])$$

$$= ([\text{SO}_4^{2-}] + [\text{NO}_3^-]) - ([\text{NH}_4^+] + [\text{Ca}^{2+}])$$

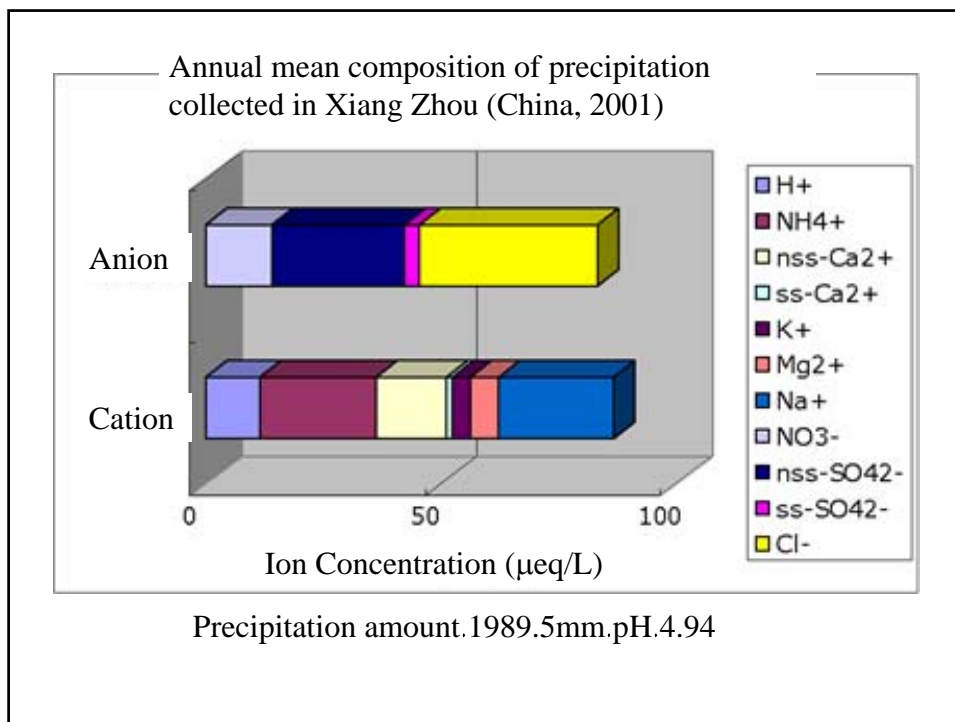
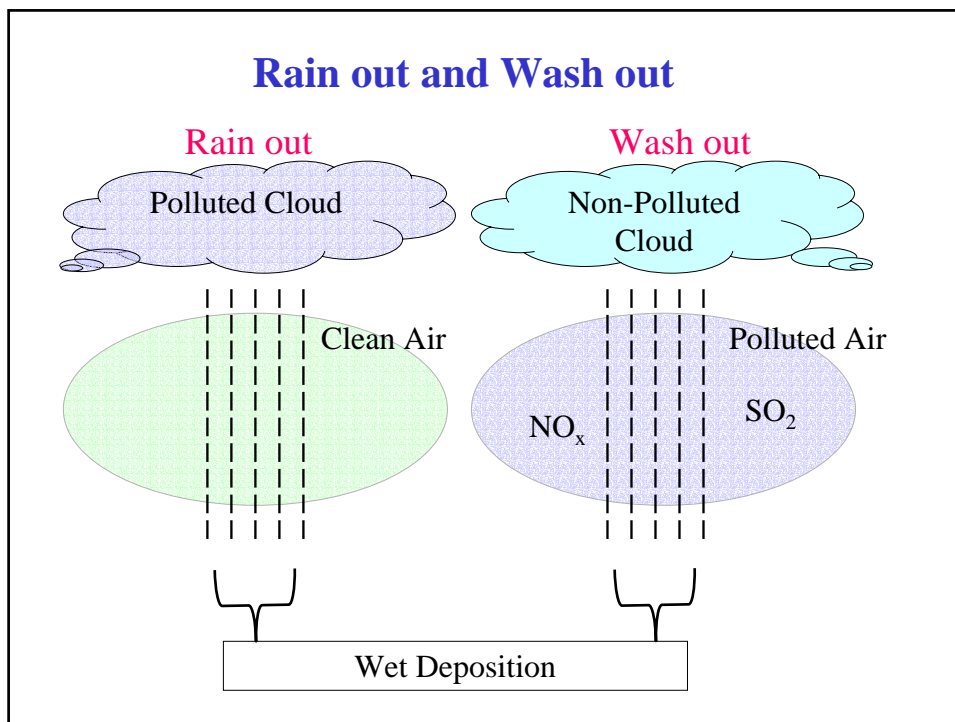
Input Acidity

$$[\text{H}^+] = [\text{Acid}] - [\text{Bases}]$$

$$= ([\text{H}_2\text{SO}_4] + [\text{HNO}_3]) - ([\text{NH}_3 \cdot \text{H}_2\text{O}] + [\text{CaCO}_3])$$

$$= ([\text{SO}_4^{2-}] + [\text{NO}_3^-]) - ([\text{NH}_4^+] + [\text{Ca}^{2+}])$$

We can not measure input acidity. We can measure acidity of precipitation after neutralization. But we can assume input acidity from sulfate and nitrate concentration in precipitation. Because these concentration correspond to hydrogen ion concentration before neutralization.



Precipitation amount weighted mean concentration of components

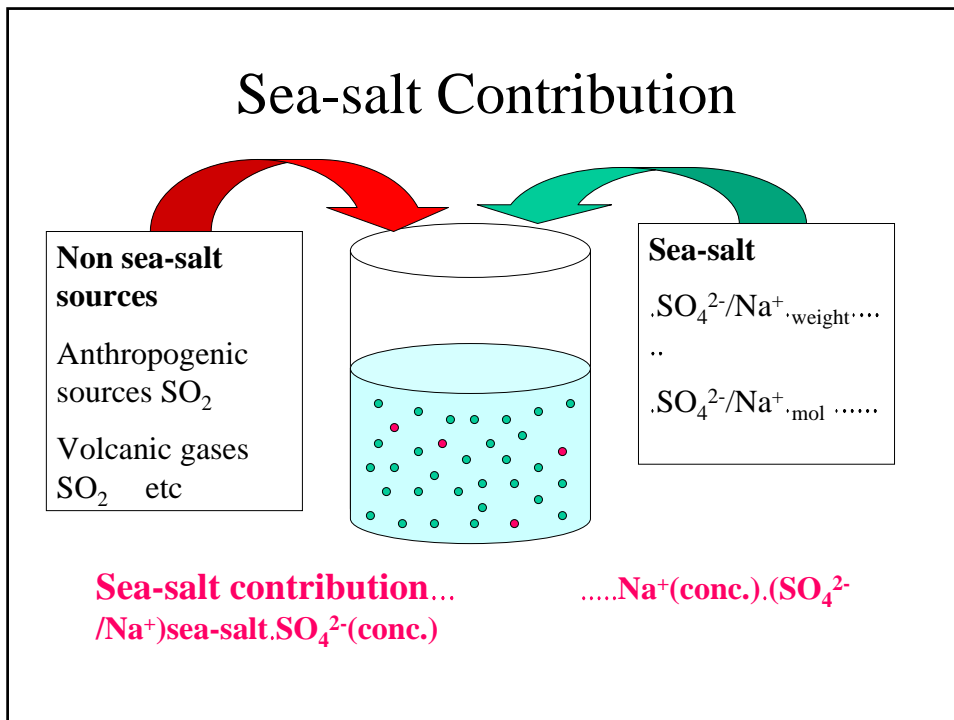
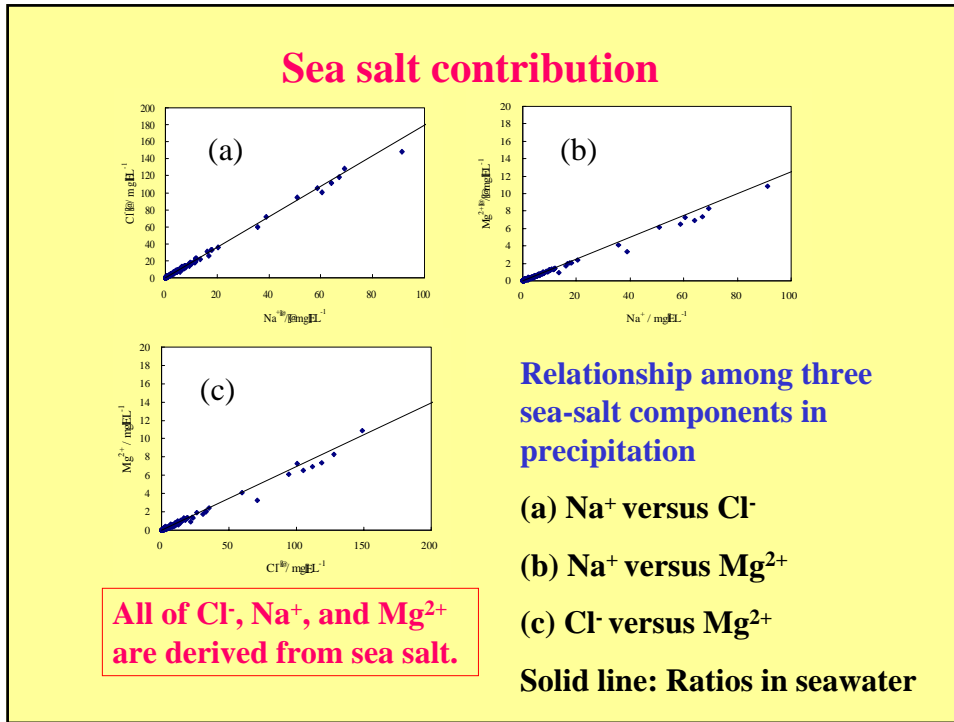
Sample	PA (mm)	SO ₄ ²⁻ (mg/L)	SO ₄ ²⁻ (mg/m ²)
A
B
C
..

Deposition (mg/m²) = PA (mm) * Conc. (mg/L)
PAWM.Total Depo..Total Precipitation amount
 PAWM SO₄²⁻(mg/L)
 =... (mg/m²) ... (mm)

Precipitation amount weighted mean of pH

Sample	PA (mm)	pH	H ⁺ (mmol/L)	H ⁺ (mmol/m ²)
A
B
C
Total

pH=-log₁₀[H⁺] ([H⁺]:mol/L)
PAWM of H.-log(Total Depo. of H⁺.Total Prec.)
 PAWM of pH
 .-log(10⁻³*1.19 (mmol/m²) /40 (mm))

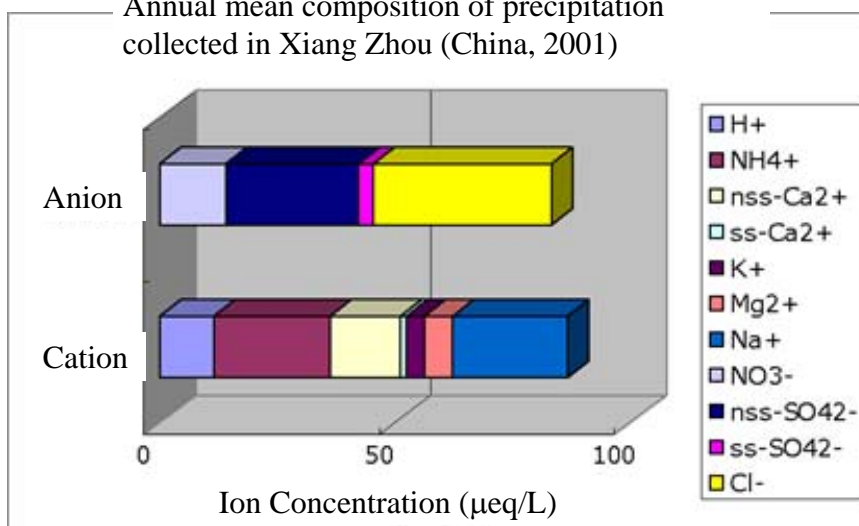


Ionic Composition of Precipitation

Site	pH	H ⁺	SO ₄ ²⁻	Nss-SO ₄ ²⁻	NO ₃ ⁻	NH ₄ ⁺	Na ⁺	K ⁺	Ca ²⁺	Nss-Ca ²⁺	Mg ²⁺
Xiang Zhou	4.94		15.7		14.1	25.0	24.6	4.0	8.0		2.9
		11.4		14.6						7.4	
Ijira	4.43		22.0		21.7	17.6	29.7	4.1	5.6		4.0
		37.1		20.2						5.0	

$$\text{SO}_4^{2-} = \text{nss-SO}_4^{2-} + \text{ss-SO}_4^{2-}, \text{Ca}^{2+} = \text{nss-Ca}^{2+} + \text{ss-Ca}^{2+}$$

Annual mean composition of precipitation collected in Xiang Zhou (China, 2001)



Precipitation amount. 1989.5mm.pH.4.94

