Environmental Chemical Processes Laboratory

University of Crete

1. Acidity in the atmosphere and nutrients deposition
2. ongoing+ future activities at UoC

Maria Kanakidou

ECPL, UoC

mariak@uoc.gr

A ACPD review paper on atmospheric acidity

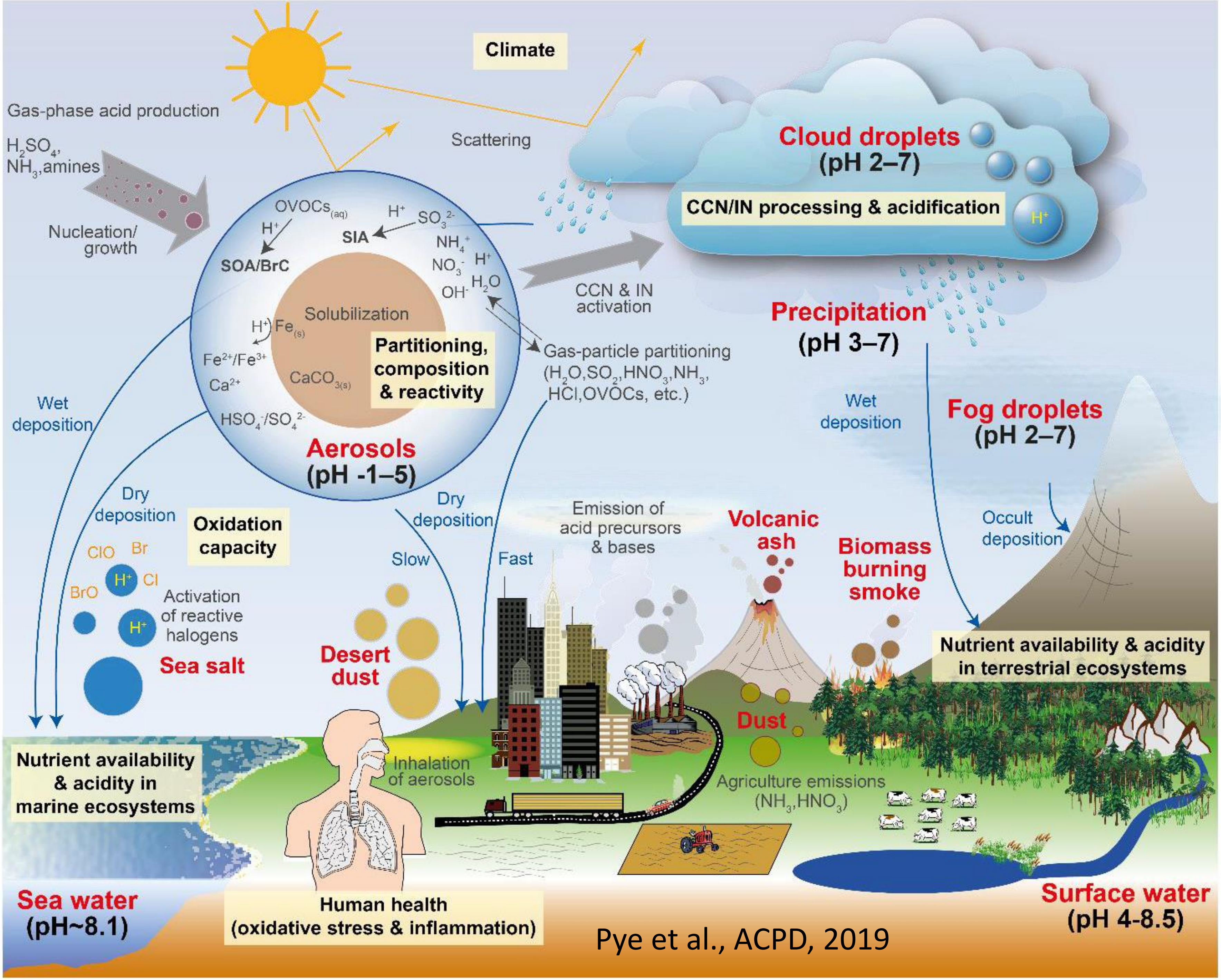
https://doi.org/10.5194/acp-2019-889
Preprint. Discussion started: 18 October 2019

Atmospheric Chemistry and Physics
Discussions

The Acidity of Atmospheric Particles and Clouds

Havala O. T. Pye[1], Athanasios Nenes[2,3], Becky Alexander[4], Andrew P. Ault[5], Mary C. Barth[6], Simon L. Clegg[7], Jeffrey L. Collett, Jr.[8], Kathleen M. Fahey[1], Christopher J. Hennigan[9], Hartmut Herrmann[10], Maria Kanakidou[11], James T. Kelly[12], I-Ting Ku[8], V. Faye McNeill[13], Nicole Riemer[14], Thomas Schaefer[10], Guoliang Shi[15], Andreas Tilgner[10], John T. Walker[1], Tao Wang[16], Rodney Weber[17], Jia Xing[18], Rahul A. Zaveri[19], Andreas Zuend[20]

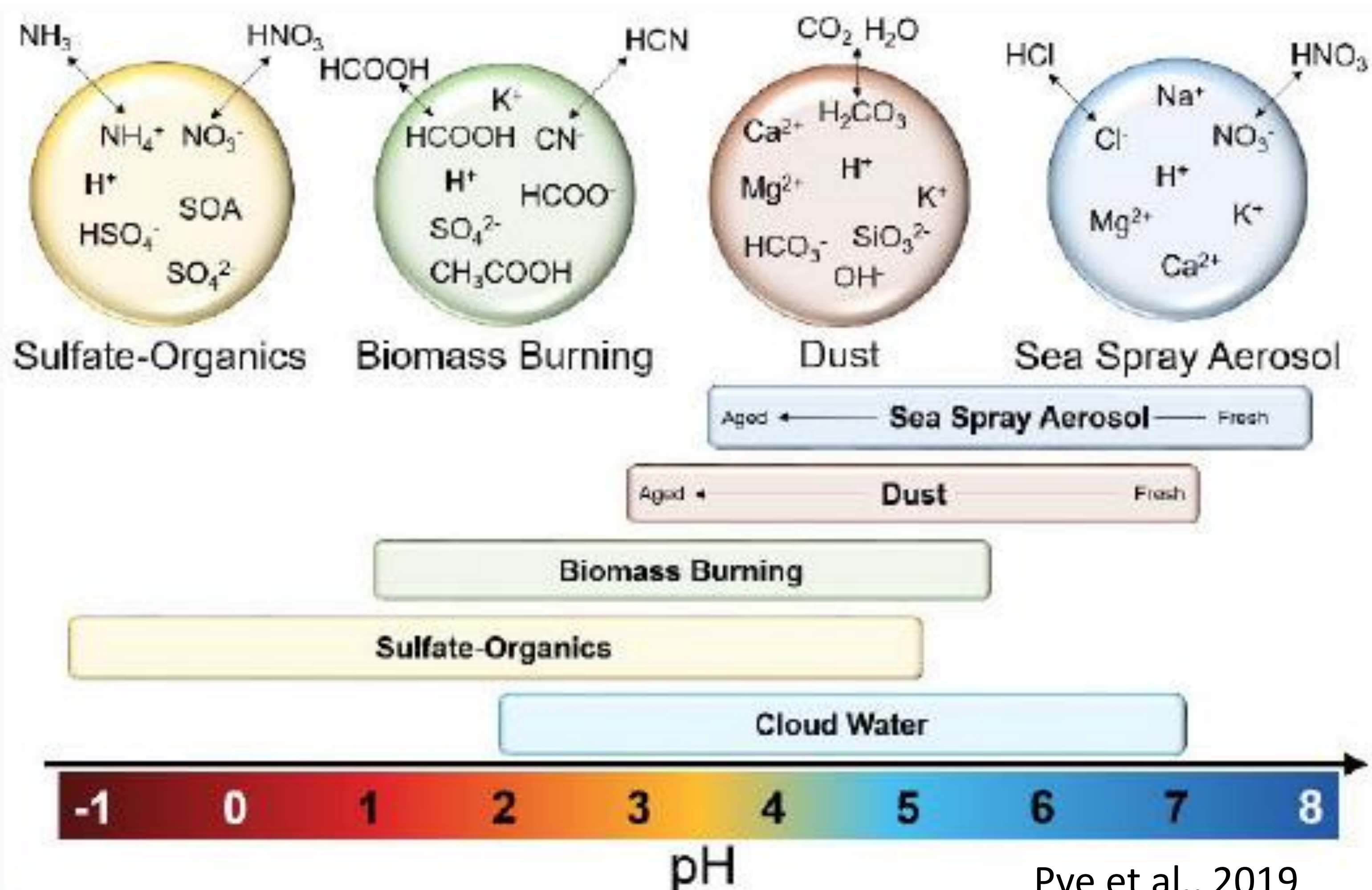
Environmental Chemical Processes Laboratory, University of Crete, mariak@uoc.gr



Pye et al., ACPD, 2019

Envir

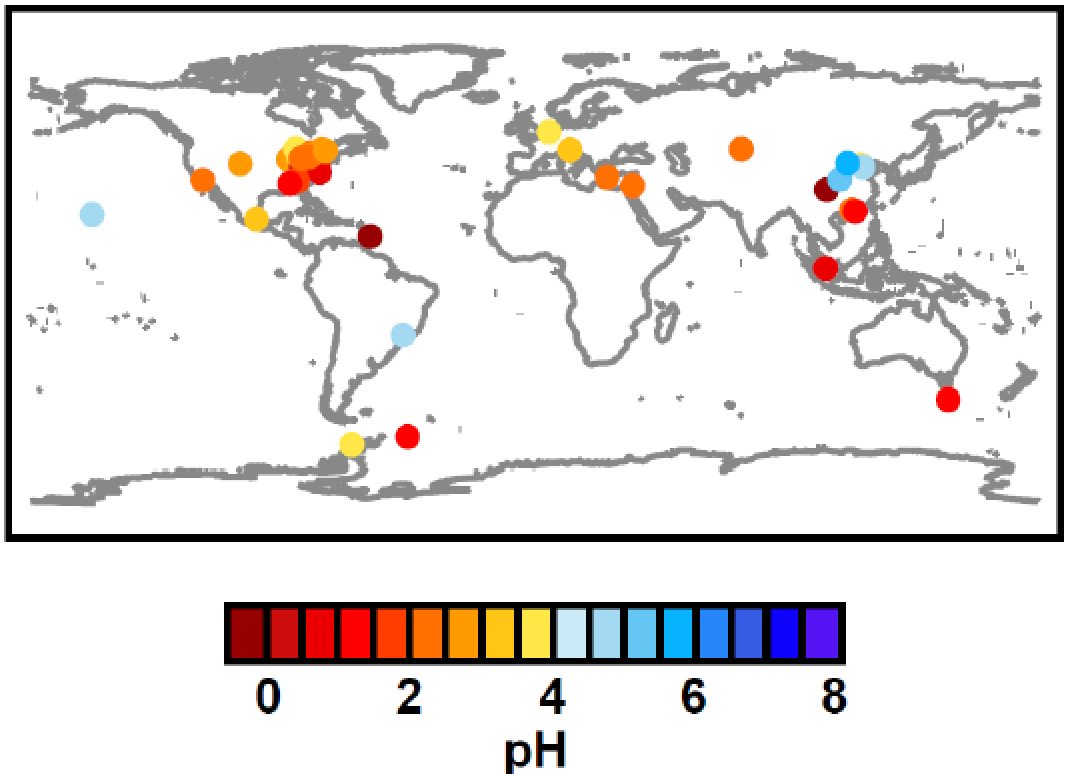
Acidity of various types of aerosols



Pye et al., 2019

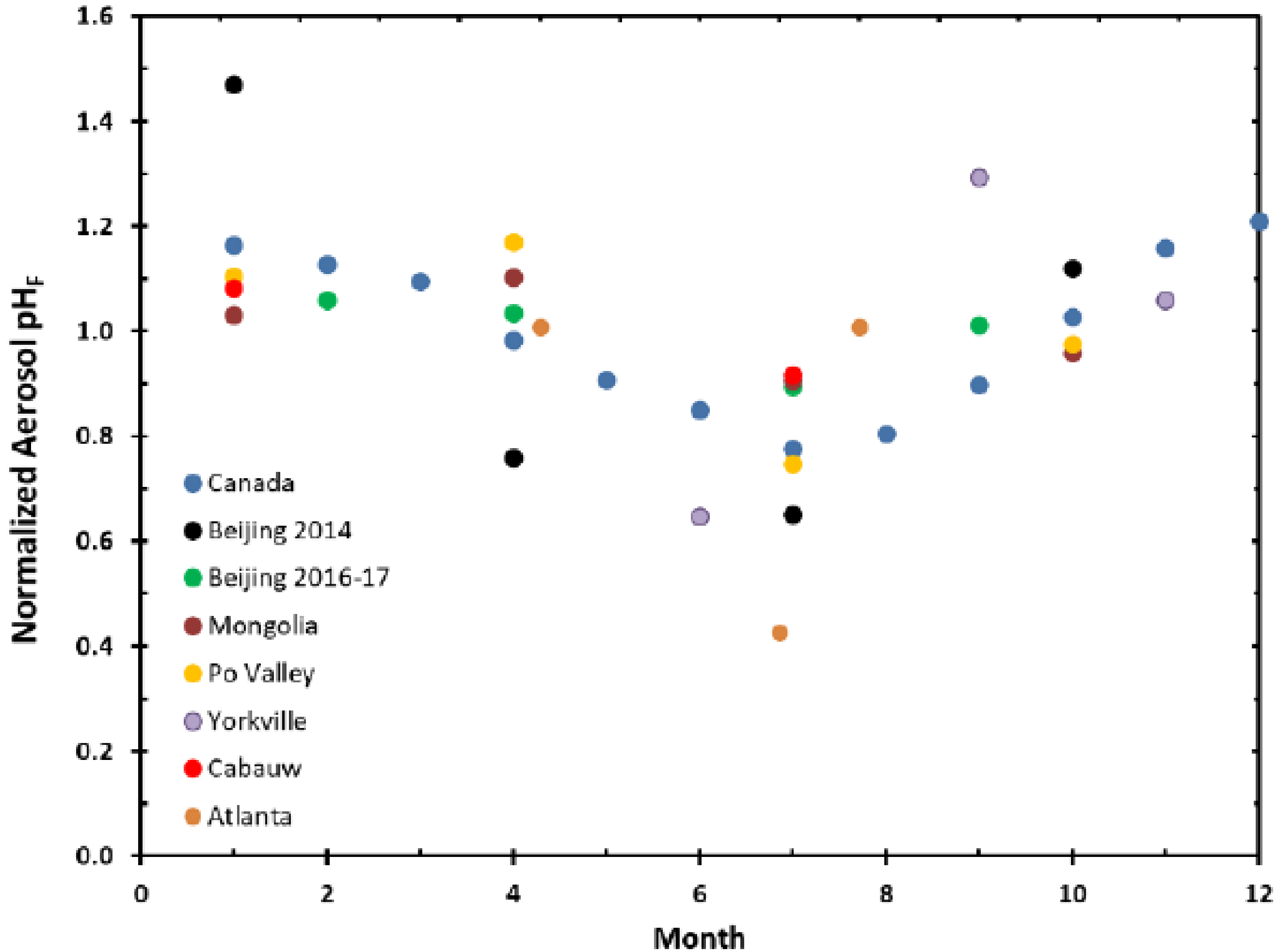
Environmental Chemical Processes Laboratory, University of Crete, mariak@uoc.gr

Aerosol pH geographic distribution



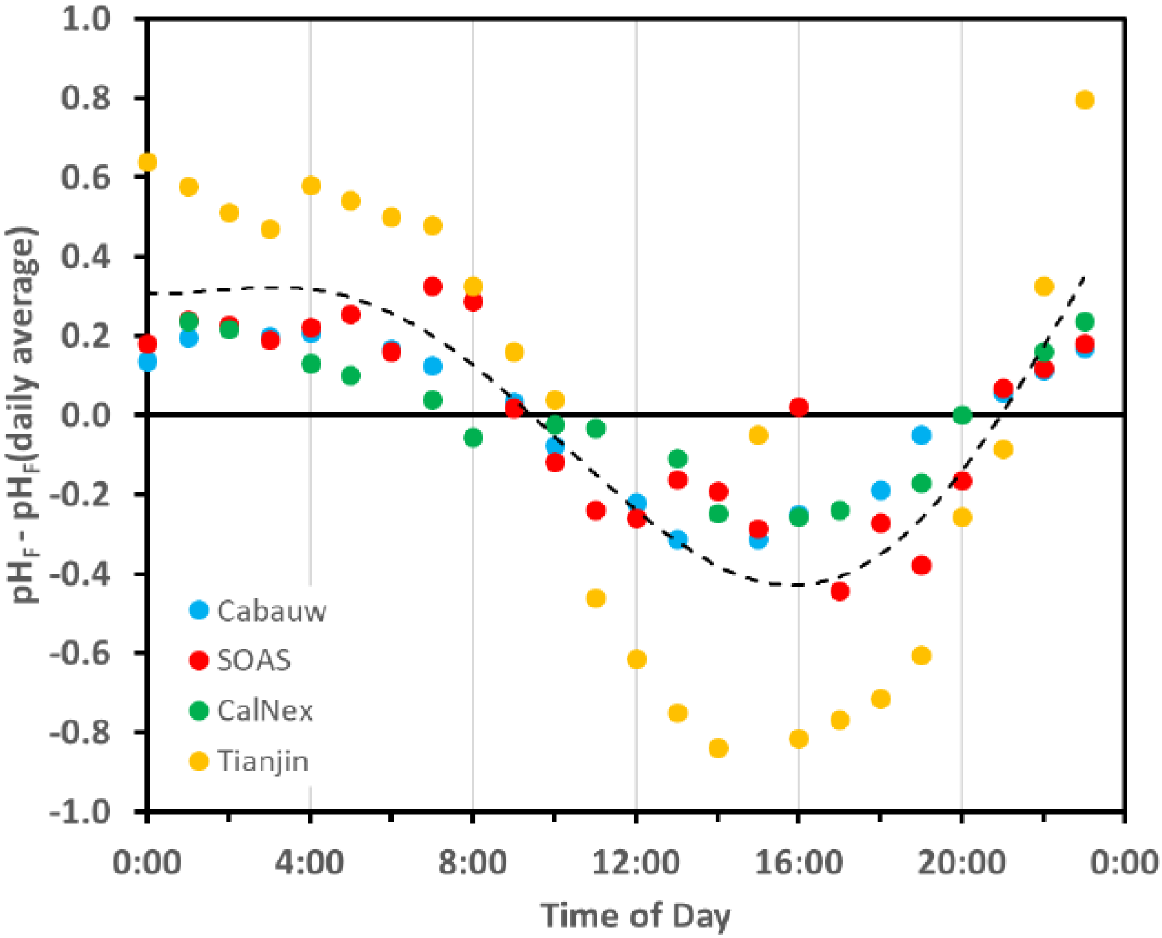
Pye et al., 2019

Seasonal variability of aerosol pH



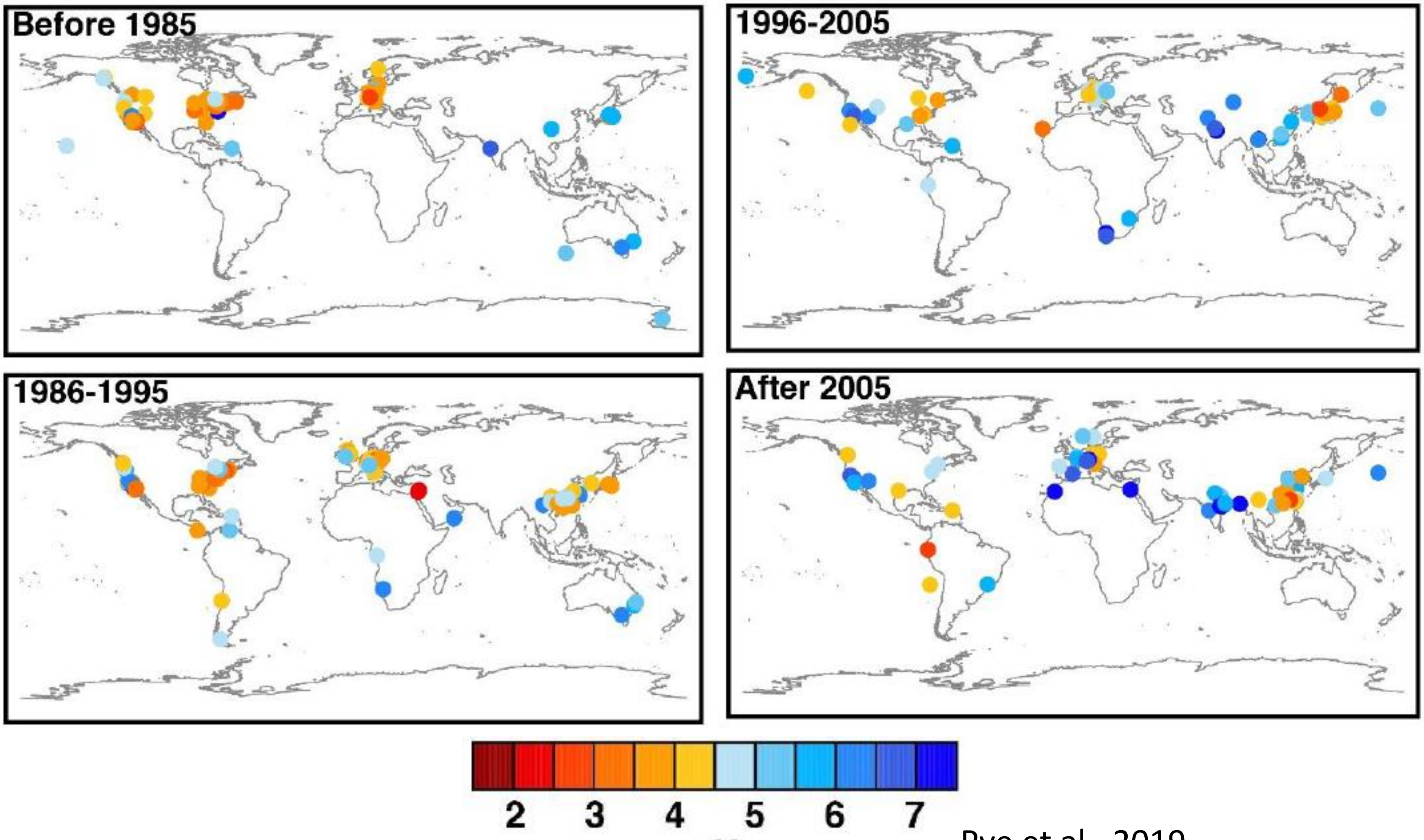
Pye et al., 2019

Dirunal variability of aerosol pH



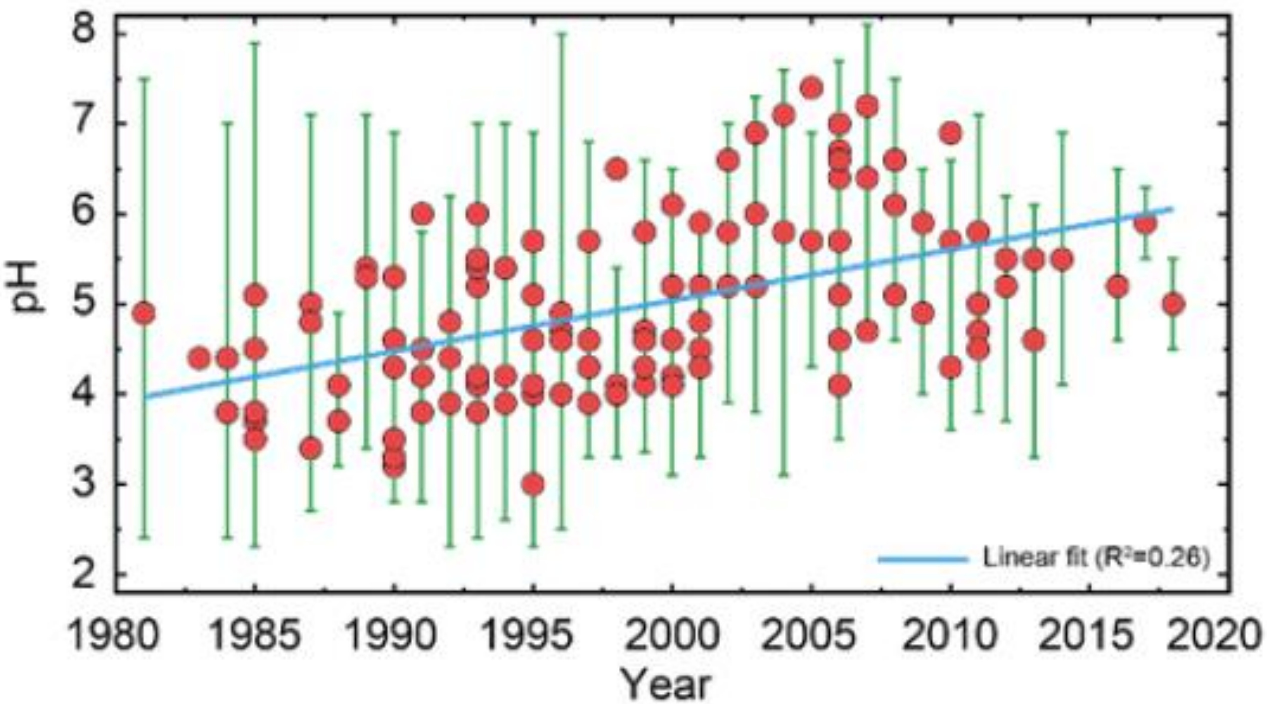
Pye et al., 2019

Fog and Cloud water pH



Pye et al., 2019

Trend of pH in fog and cloud water in Europe

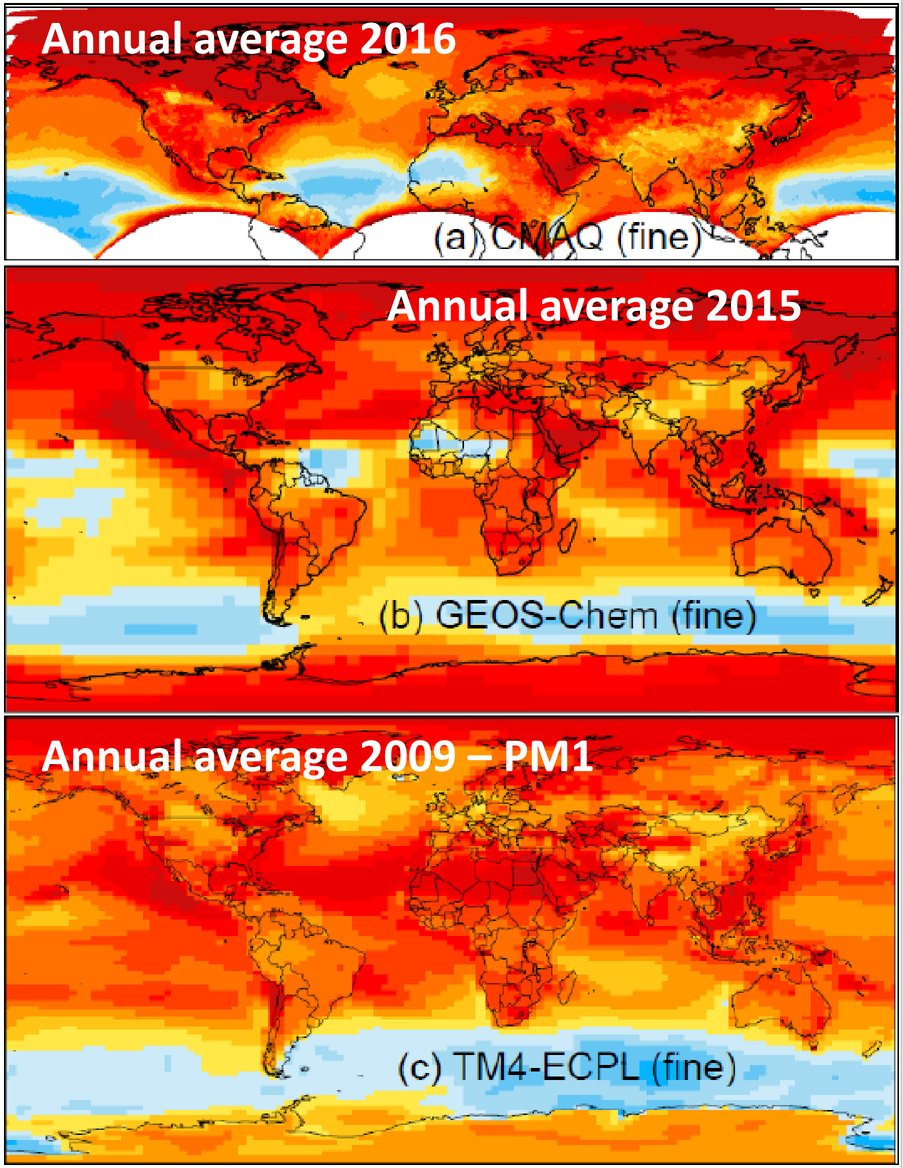


Pye et al., 2019

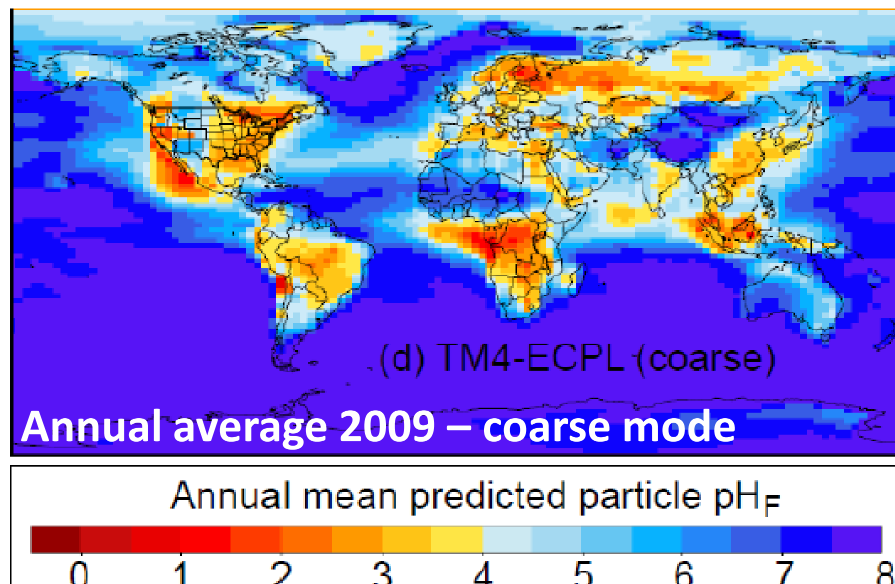
$$pH_F = -\log_{10}(m_{H^+})$$

free H^+ approximation of pH

pH of aerosol water global simulations

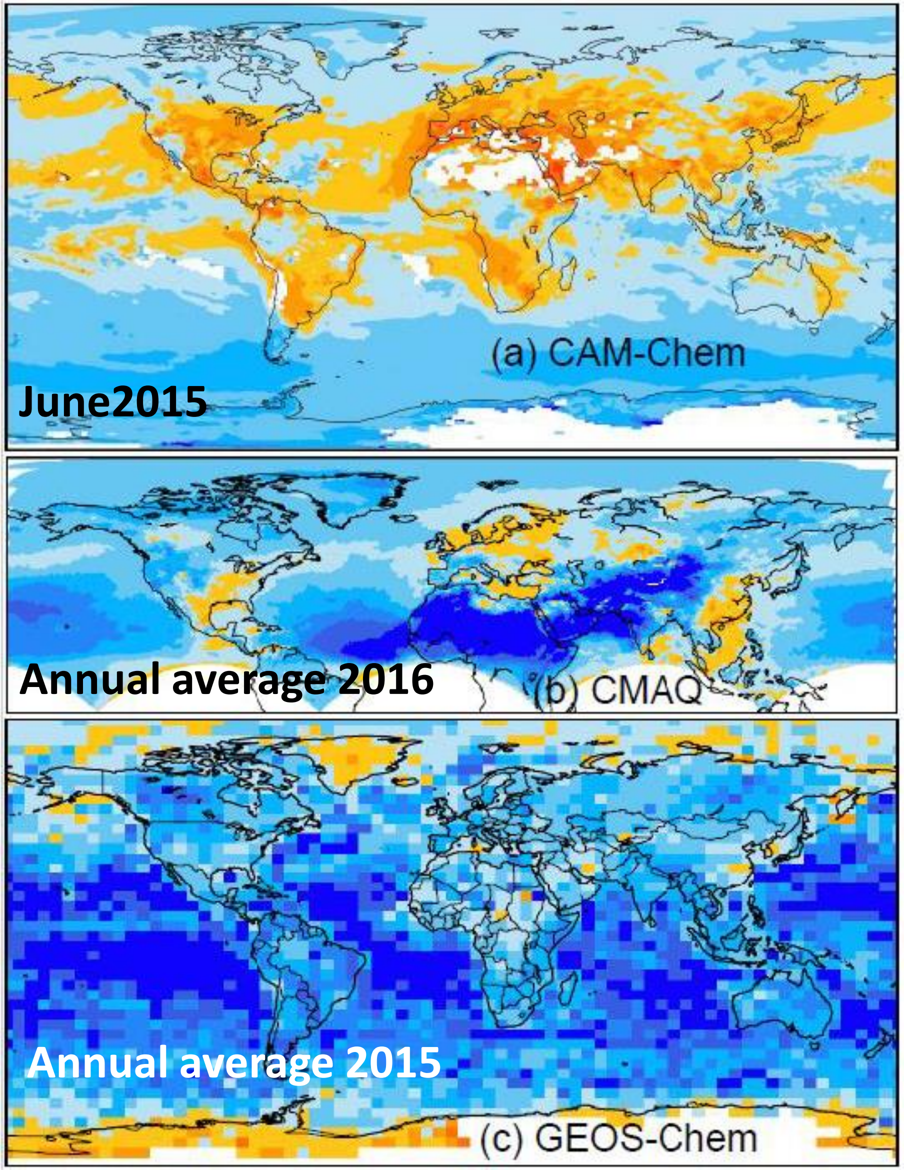


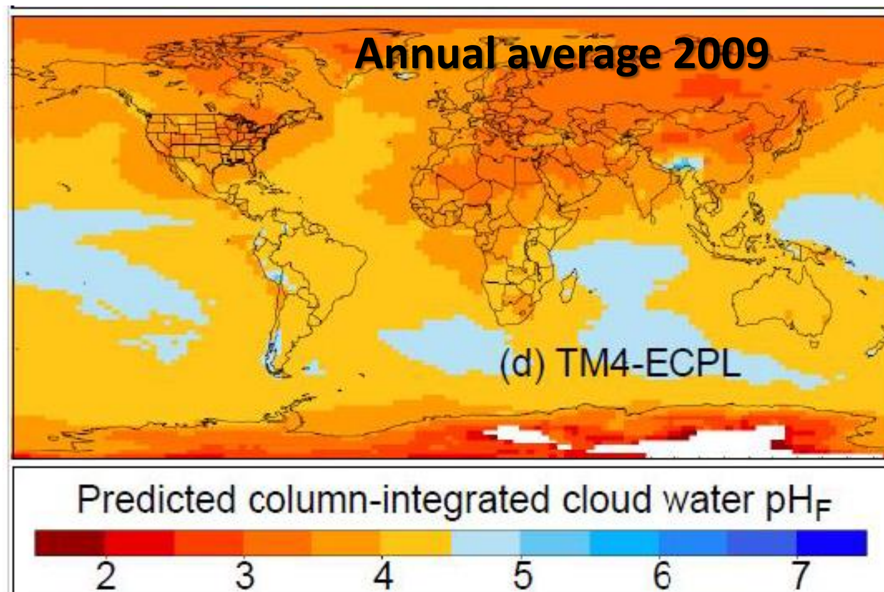
Values averaged over aerosol liquid water content greater than 0.01 ug m^{-3}. The solvent for H^+ is water associated with inorganic electrolytes.



Pye et al., 2019

Liquid-water-weighted vertical column integrated Cloud Water pH

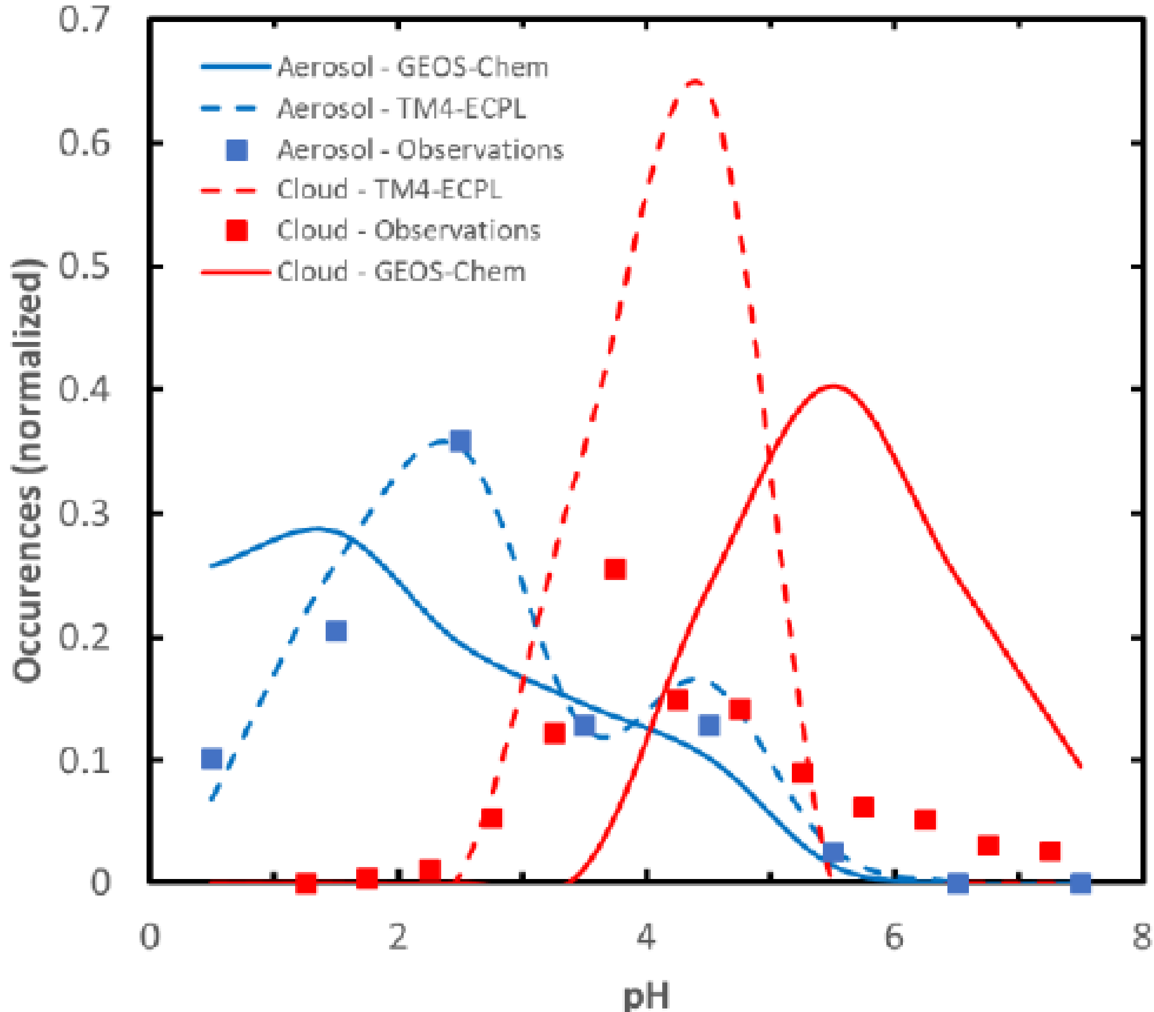




Pye et al., 2019

Environmental Chemical Processes Laboratory, University of Crete, mariak@uoc.gr

How TM4-ECPL performs compared to observations



Pye et al., 2019

Environmental Chemical Processes Laboratory, University of Crete, mariak@uoc.gr

pH changes are affecting nutrient atmospheric deposition

Impact on

The partitioning of NO_3/HNO_3 → change in the lifetime of N and LRT → deposition patterns

(see in Weber et al., 2016 and in Nenes et al., ACPD, 2019 for the partitioning)

The solubilization of Fe, P and other metals

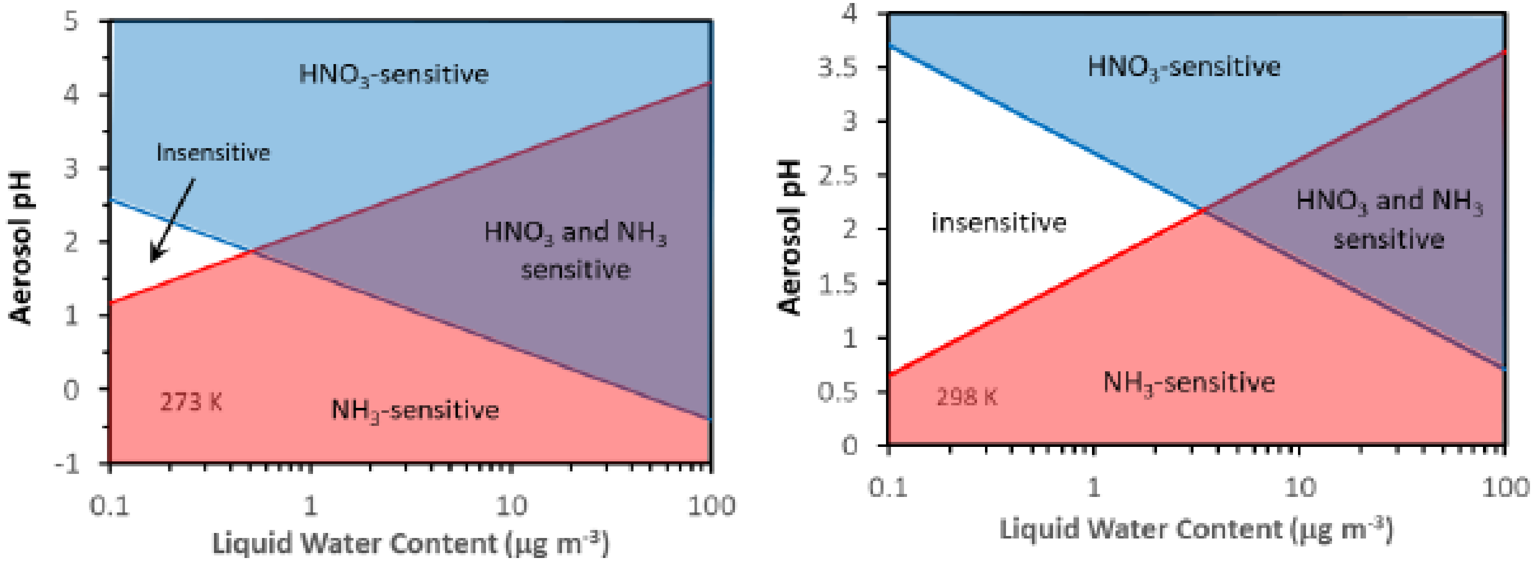
(see in Myriokefalitakis et al., Biogeosciences, 2015, 2016, 2018 & Kanakidou et al., ERL, 2018)

Aerosol pH and liquid water content determine when particulate matter is sensitive to ammonia and nitrate availability

Athanasios Nenes[1,2*], Spyros N. Pandis[1,3], Rodney J. Weber[4], Armistead Russell[5]

https://doi.org/10.5194/acp-2019-840

Chemical domains of aerosol response to ammonia and nitrate emissions.



four policy-relevant regimes emerge in terms of sensitivity: i) NH_3-dominated, ii) HNO_3-dominated, iii) combined NH_3 and HNO_3 sensitive, and, iv) a domain where neither NH_3 and HNO_3 are important for PM levels (but only nonvolatile precursors such as NVCs and sulfate).

Next steps on deposition (UoC)

- Evaluate the impact of pH changes on atmospheric deposition of nitrogen

(shift in contribution of dry deposition-to-total deposition of NOy and NHx and changes in the geographic distribution of deposition driven by pH and LWC changes –ongoing work with Nenes and Baker - GESAMP)

- Constrain the model with satellite observations (NO_2 and NH_3)

(collaboration with Bremen)

Further work at UoC

- Improving NO_3/HNO_3 partitioning in TM and introducing BrC contribution to OA/BC (Aggelos Gkouvousis) (*PhD jointly with Stelios, NOA*)

- on CCN/IN in TM model : interplay between CCN and IN (Marios Chatziparaschos) *(collaboration with Nenes)*

- Understand Greenhouse Gases levels in the East Mediterranean (Nikos Gialesakis)

(collaboration with Gif-sur- Yvette, Bremen, NL)