



Global modeling of atmospheric deposition of N, P and Fe with TM4-ECPL

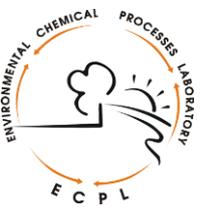
M. Kanakidou, S. Myriokefalitakis, N. Daskalakis, G. Fanourgakis

*Environmental Chemical Processes Laboratory
Department of Chemistry, University of Crete, Heraklion, Greece*
mariak@chemistry.uoc.gr

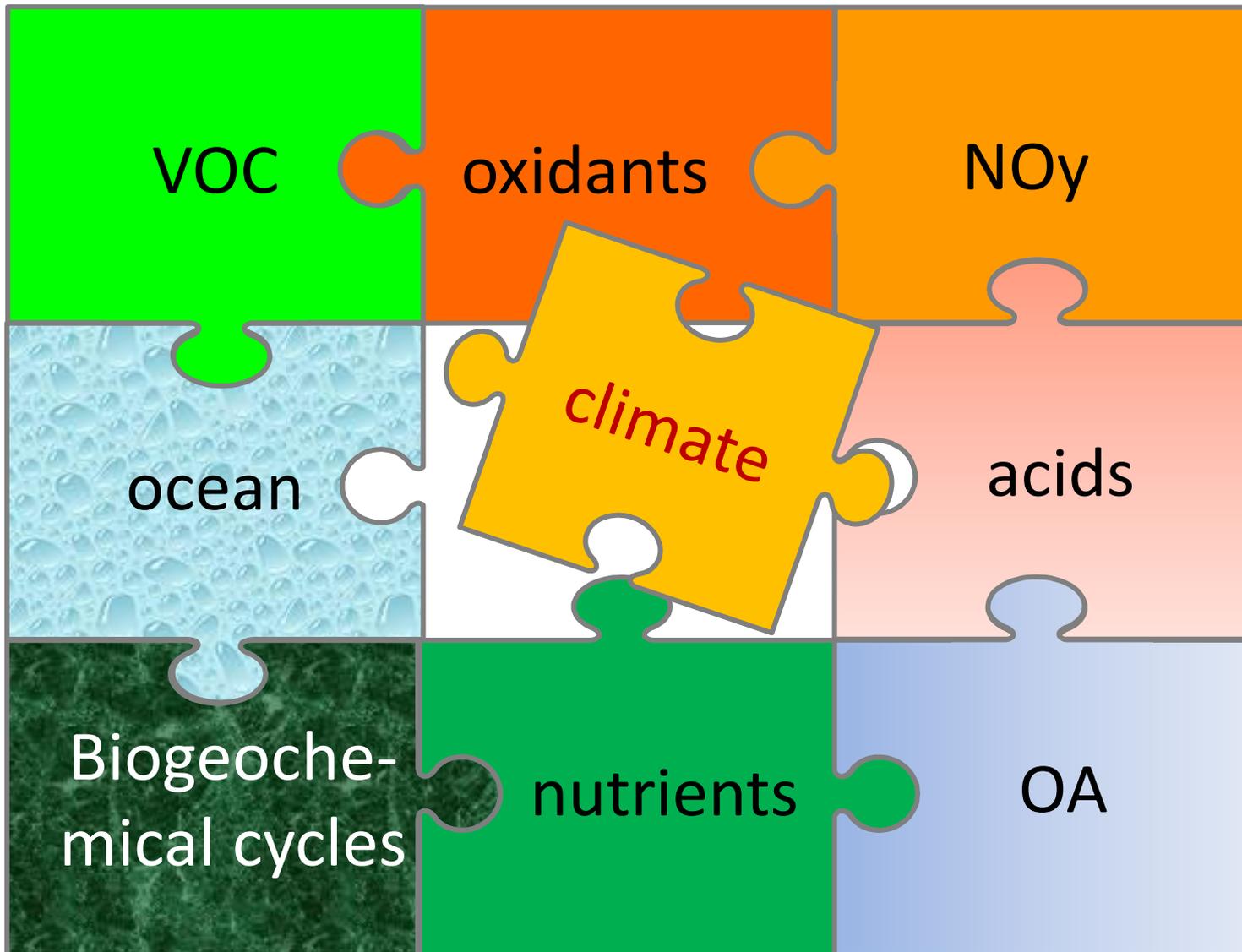
And coworkers

K. Tsigaridis, A. Nenes, A. Baker, N. Mihalopoulos

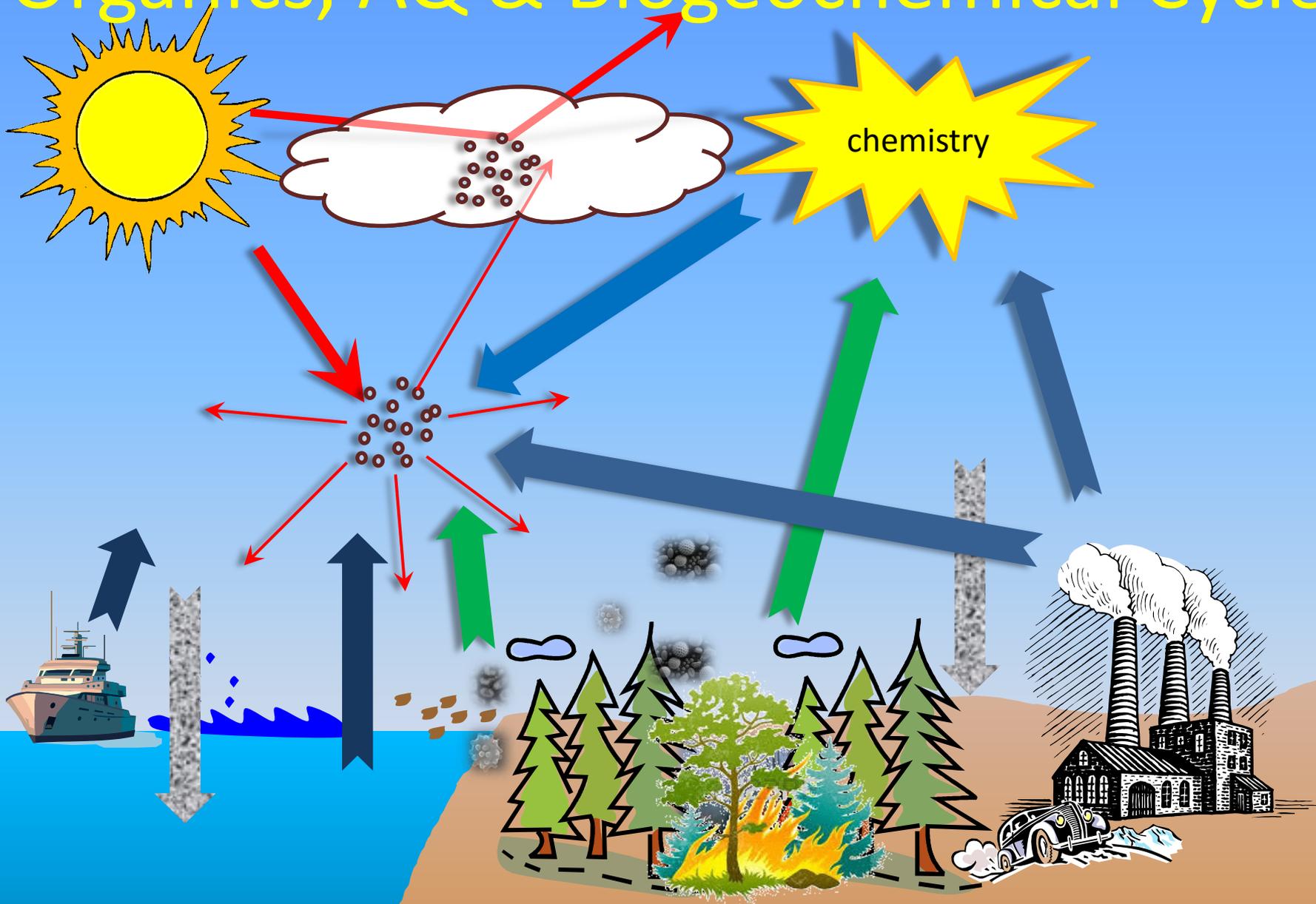
24th International TM5 meeting (27-28 June 2016), JRC, Ispra



Work with TM4



Organics, AQ & Biogeochemical Cycles





3-d global modeling of atmospheric composition and deposition – TM4-ECPL



➤ Oxidants/gases/aerosols/multiphase chemistry

VOC /NO_x/oxidants / oxalate & all major aerosol components including POA/SOA, coupled with ISORROPIA II (Myriokefalitakis et al., ACP, 2008, *Advances in Meteorology* 2010, ACP, 2011)

➤ Nitrogen and Organic P deposition

(Kanakidou et al., GBC 2012
Kanakidou et al., JAS 2016)

➤ Fe & dust atmospheric cycle

(Myriokefalitakis et al. *Biogeosci.* 2015)

➤ AEROCOM OA intercomparison

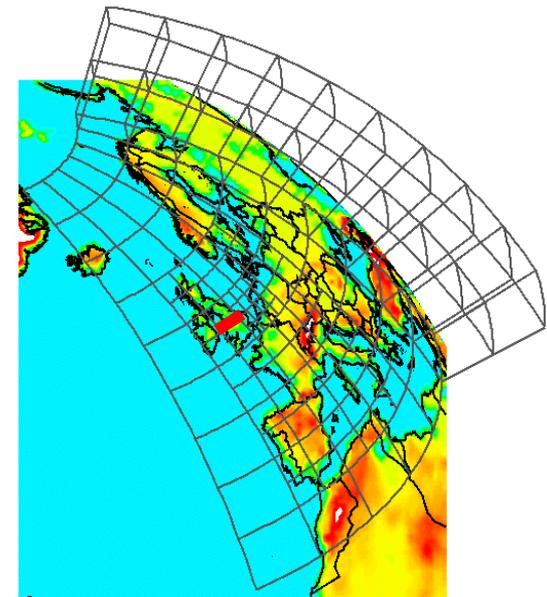
(Tsigaridis et al., ACP, 2014)

➤ Interannual emissions - ACCMIP anthropogenic emissions

MEGAN MACC biogenic, ACCMIP anthropogenic, ACCMIP fire emissions, AEROCOM dust, Online sea salt and marine POA (Daskalakis et al., ACP, 2015)

➤ P & dust atmospheric cycle

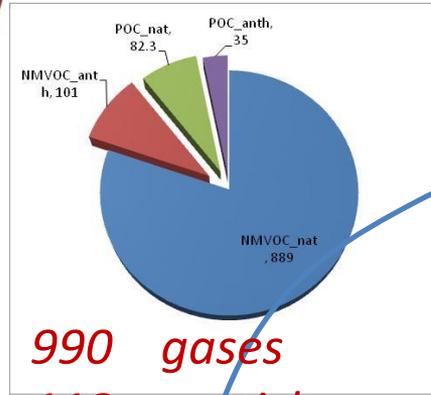
(Myriokefalitakis et al., *Biogeosci. Disc.*, 2016)



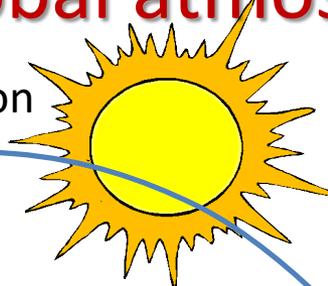
Organic C, N, P in the global atmosphere



Concept: link ON and OP to OC atmospheric budget



990 gases
118 particles
Tg-C/yr



transformation

transport

Links to nutrients

secondary OC, ON

OC, ON, OP

transformation

deposition

primary OC, ON, OP
bioaerosols

VOCs

NO_x

NH₃

NH₃

26.6

0.54

2.3 p

30 p
72 g

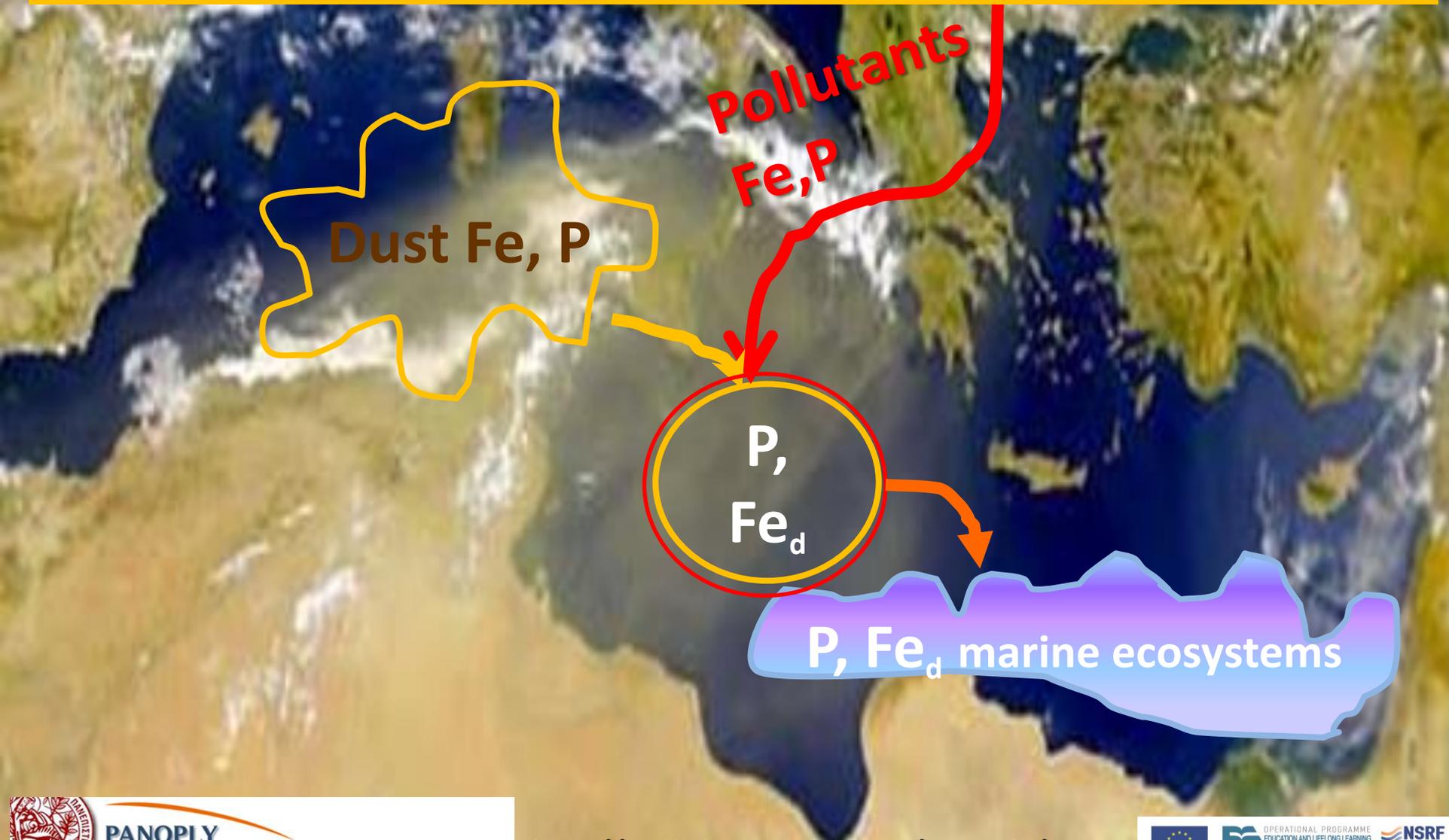
50 p
817 g

35 p
101 g

Present day

Kanakidou et al., GBC, 2012, doi 10.10.1029/2011GB004277

Interactions natural & anthropogenic emissions Ligands and nutrients (Fe)



PANOPLY

Pollution Alters Natural aerosol composition:
implications for Ocean Productivity, cLimate and air qualityY

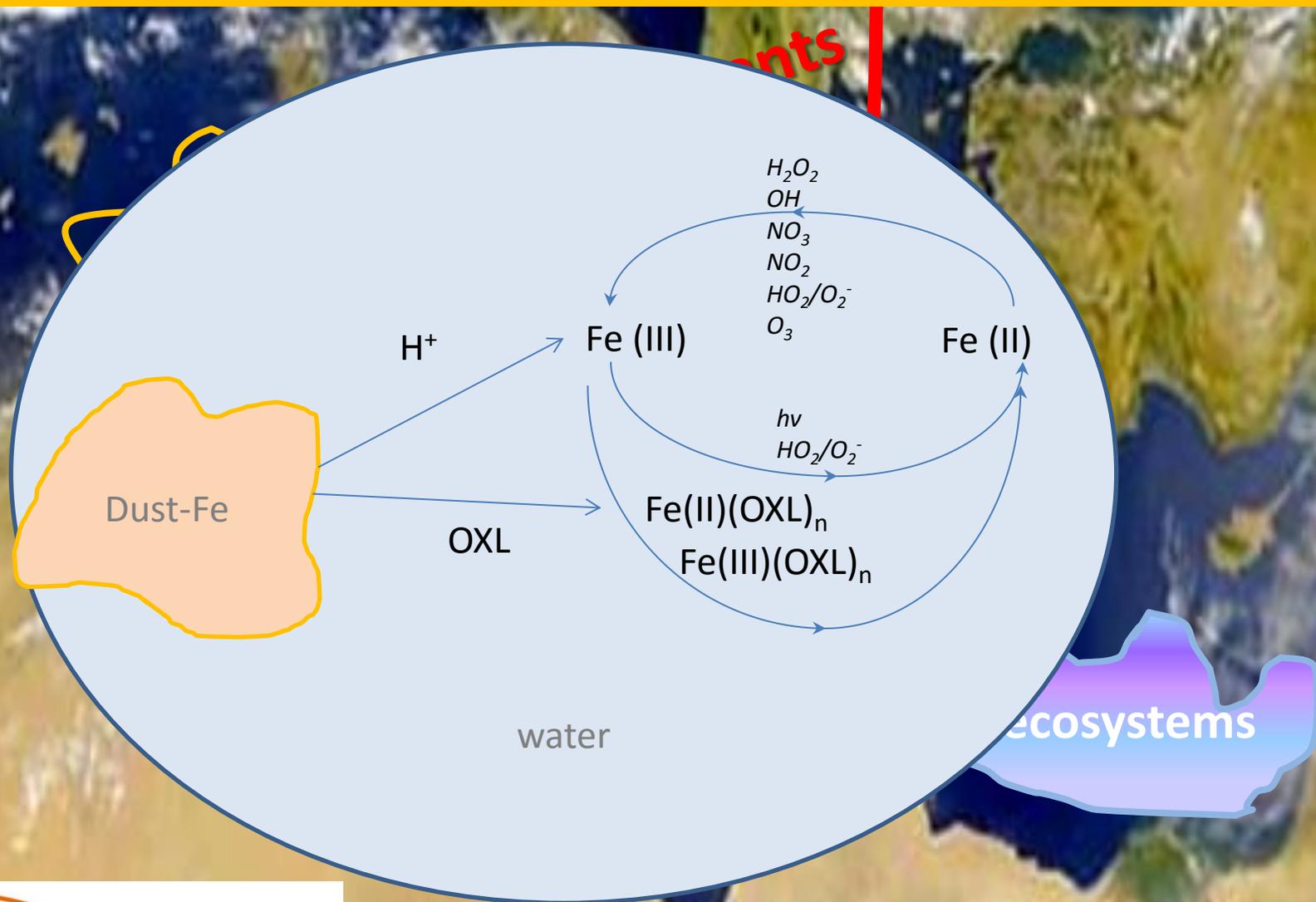
<http://ecpl.chemistry.uoc.gr/panoply/>



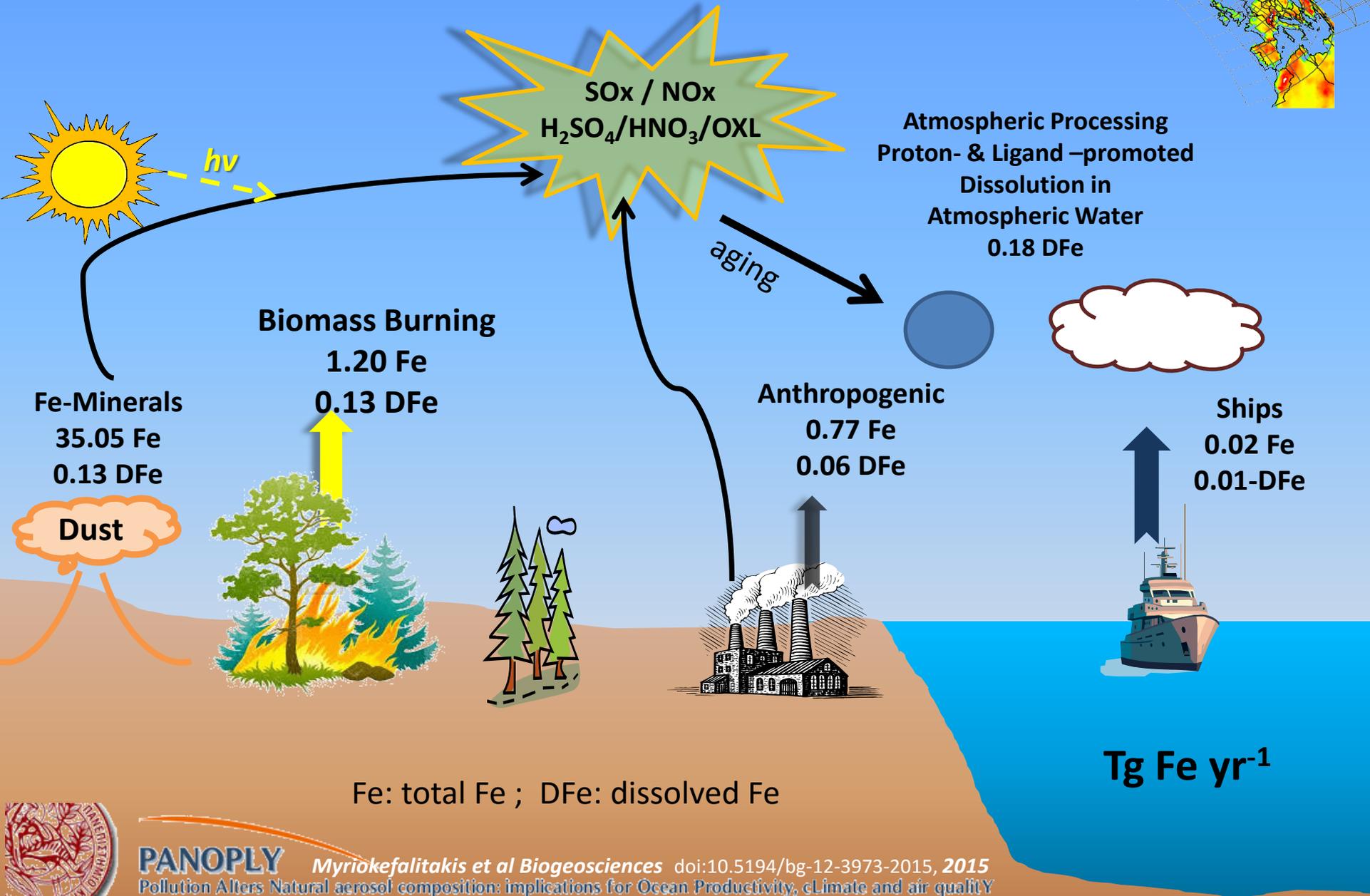
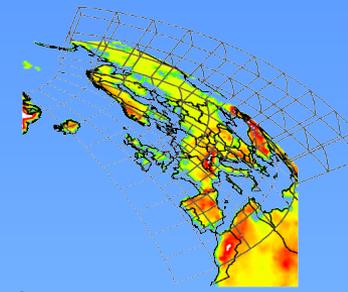
OPERATIONAL PROGRAMME
EDUCATION AND LIFELONG LEARNING
Investing in knowledge society
MINISTRY OF EDUCATION & RELIGIOUS AFFAIRS
MANAGING AUTHORITY

NSRF
2007-2013
EUROPEAN SOCIAL FUND
Co-financed by Greece and the European Union

Interactions natural & anthropogenic emissions Ligands and nutrients (Fe)



Modelling the Fe-Cycle in PANOPLY



Fe: total Fe ; DFe: dissolved Fe

Tg Fe yr⁻¹

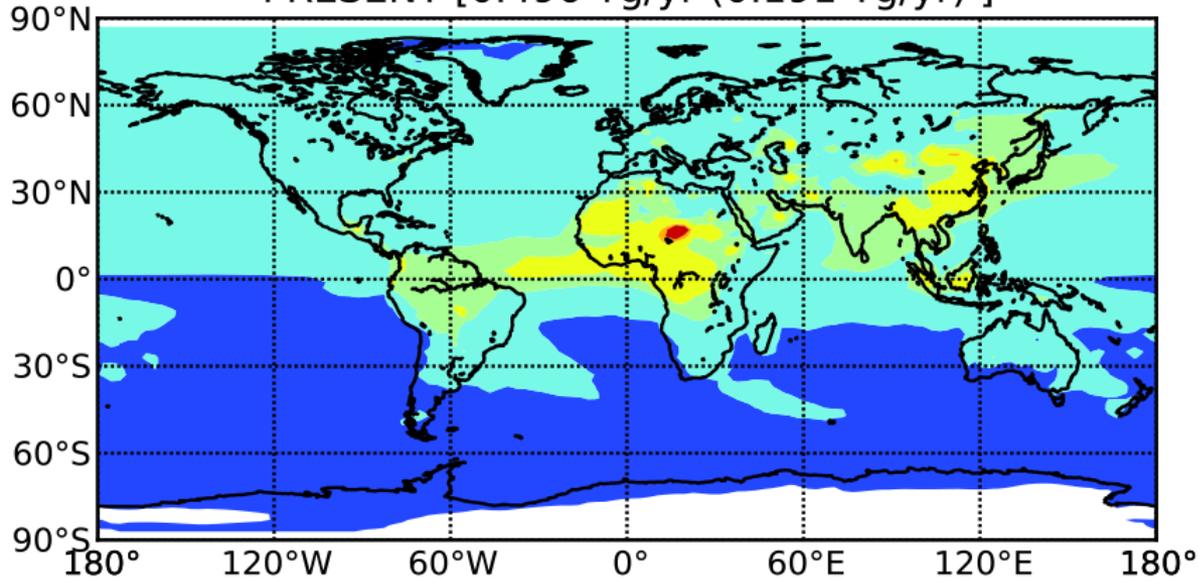




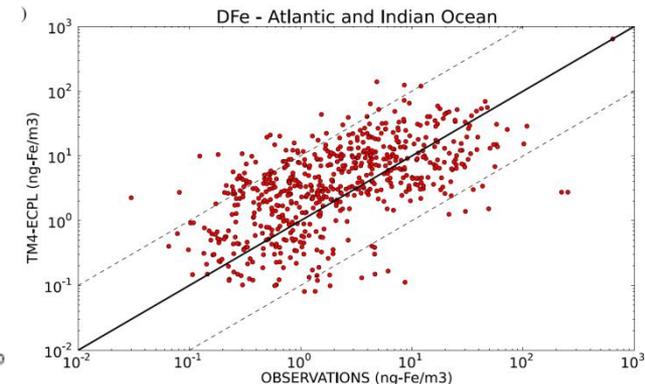
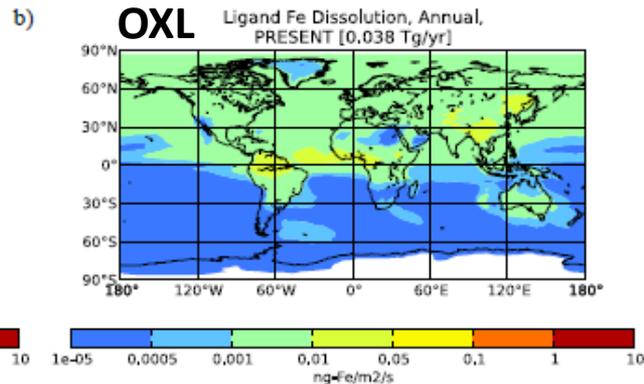
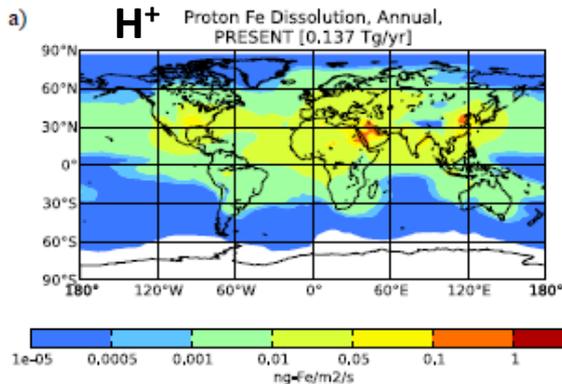
Dissolved Fe deposition



DFe Deposition, Annual
PRESENT [0.496 Tg/yr (0.191 Tg/yr)]

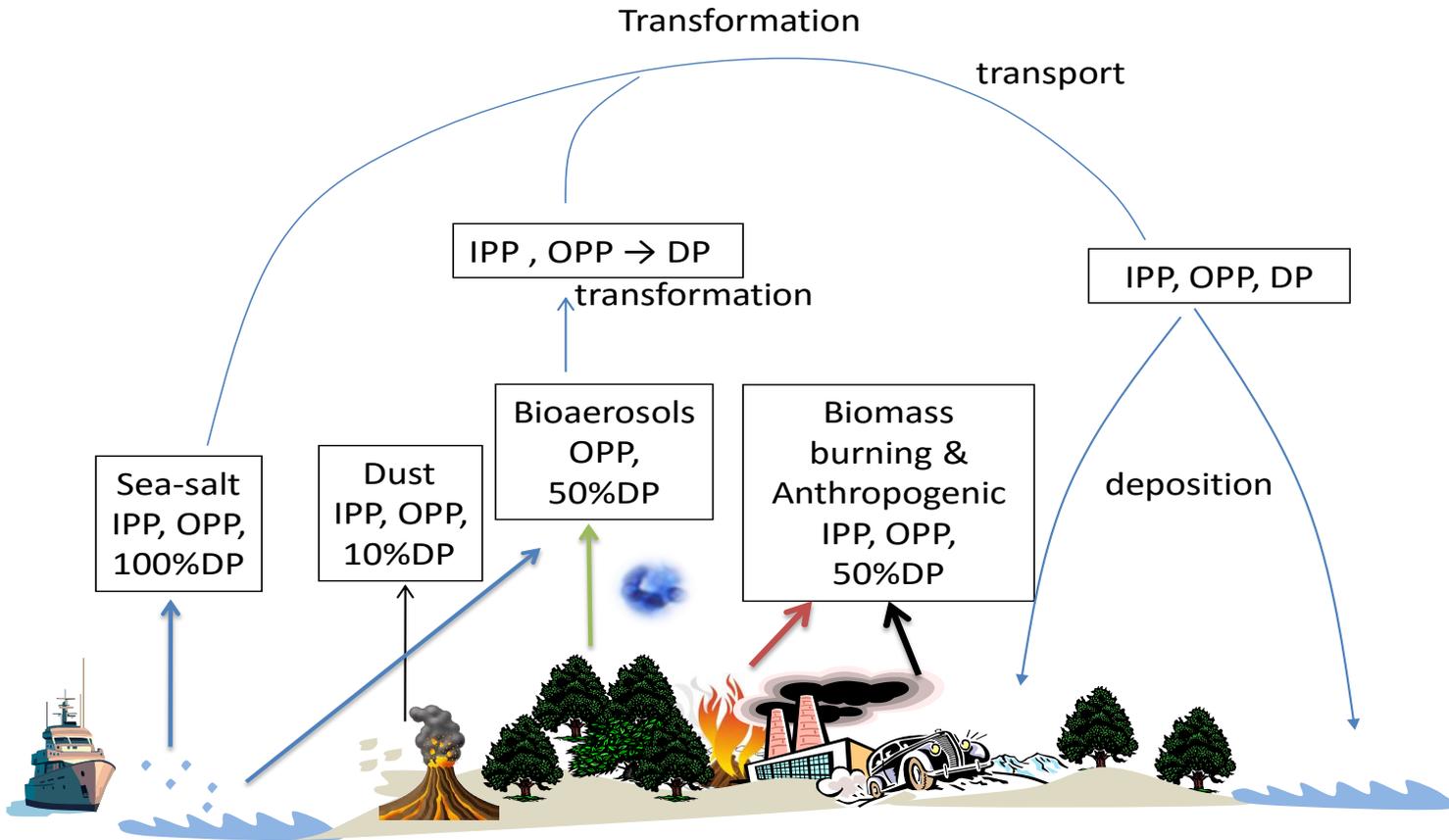
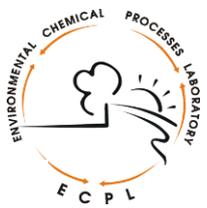


Myriokefalitakis et al. Biogeoscience, doi:10.5194/bg-12-3973-2015





Atmospheric Phosphorus cycle



IPP: Inorganic P insol.; OPP: Organic P insol.; DP: Dissolved (IP+OP)



PANOPLY

Pollution Alters Natural aerosol composition: implications for Ocean Productivity, cLimate and air quality

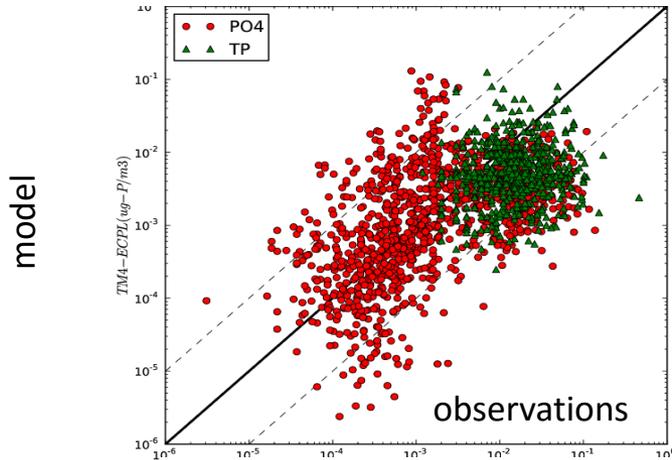
Myriokefalitakis et al. Biogeoscience Disc., 2016



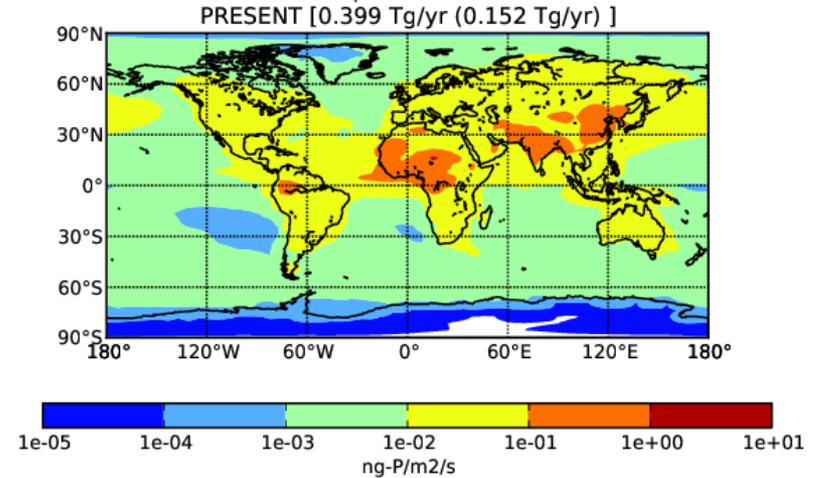
Atmospheric Phosphorus deposition



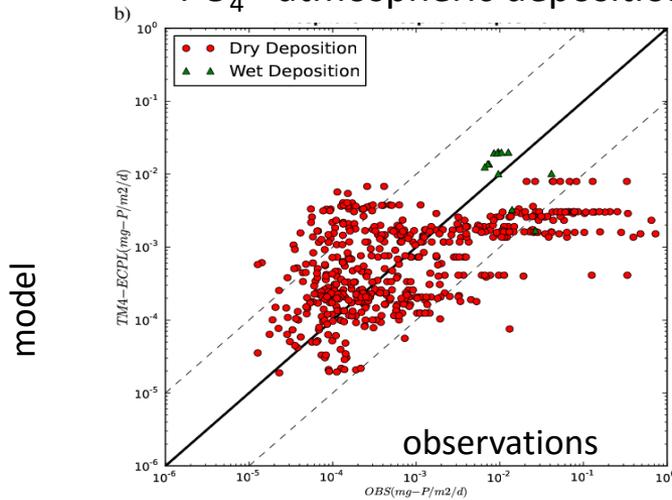
P atmospheric concentrations



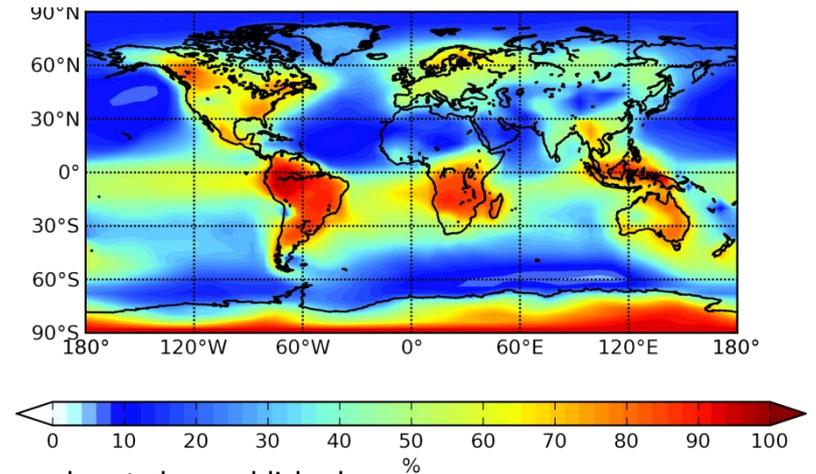
Dissolved P



PO₄³⁻ atmospheric deposition



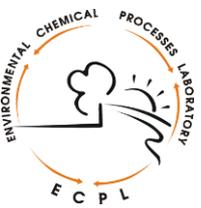
Dissolved Organic P/total Dissolved P



Data from Vet et al., AE 2014; Baker et al., 2006; Mihalopoulos et al. unpublished

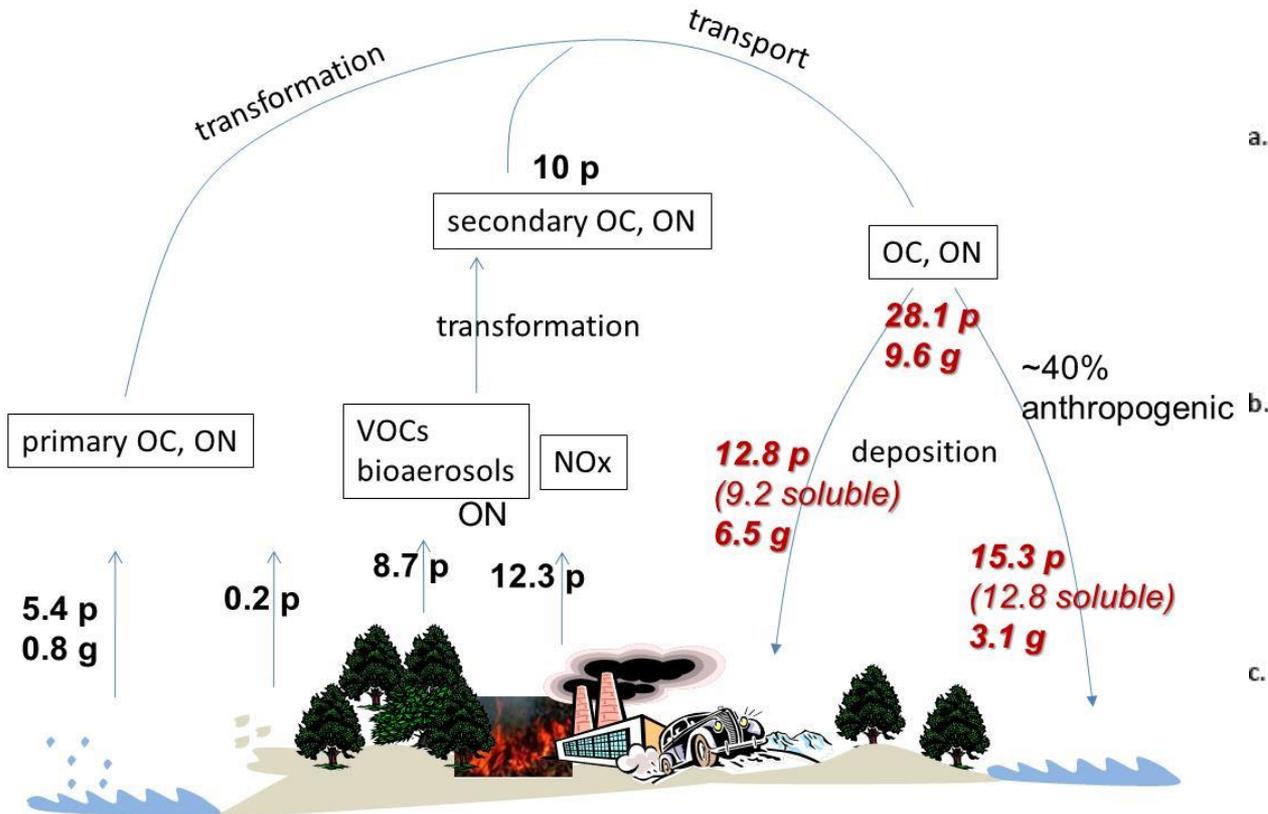
Myriokefalitakis et al. Biogeosci. Discuss., doi:10.5194/bg-2016-215, 20162016

PANOPLY



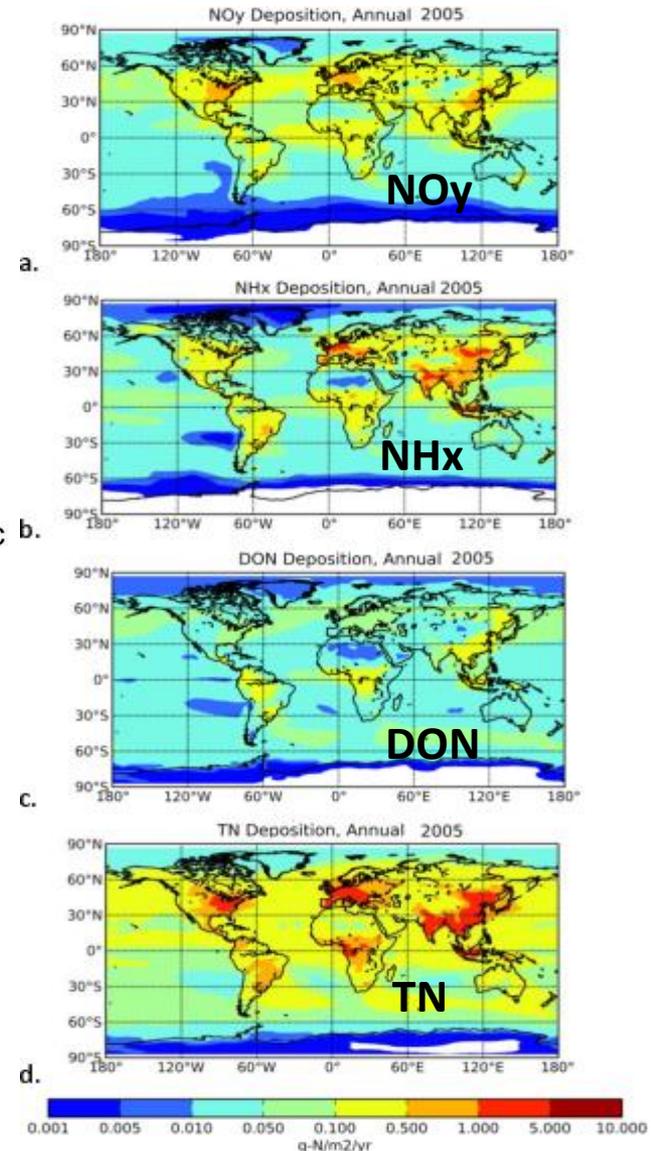
Organics carrier of nutrients

Organic Nitrogen global budget Tg-N/yr



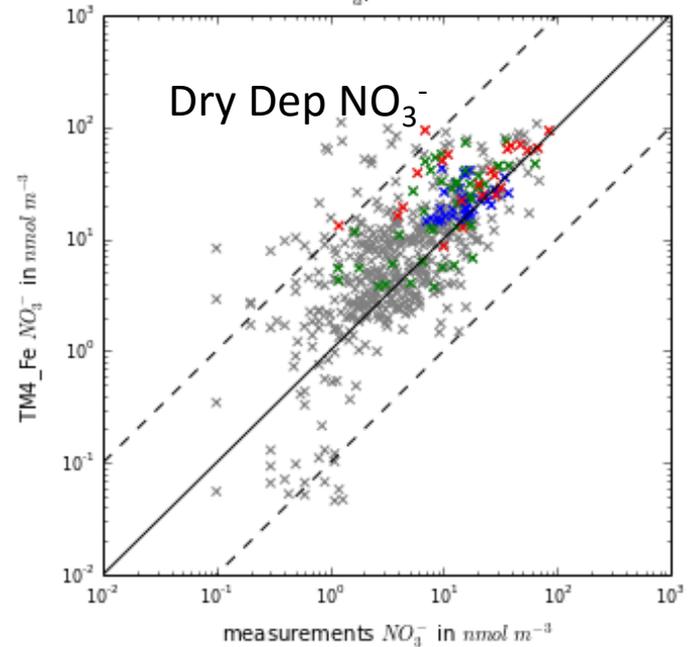
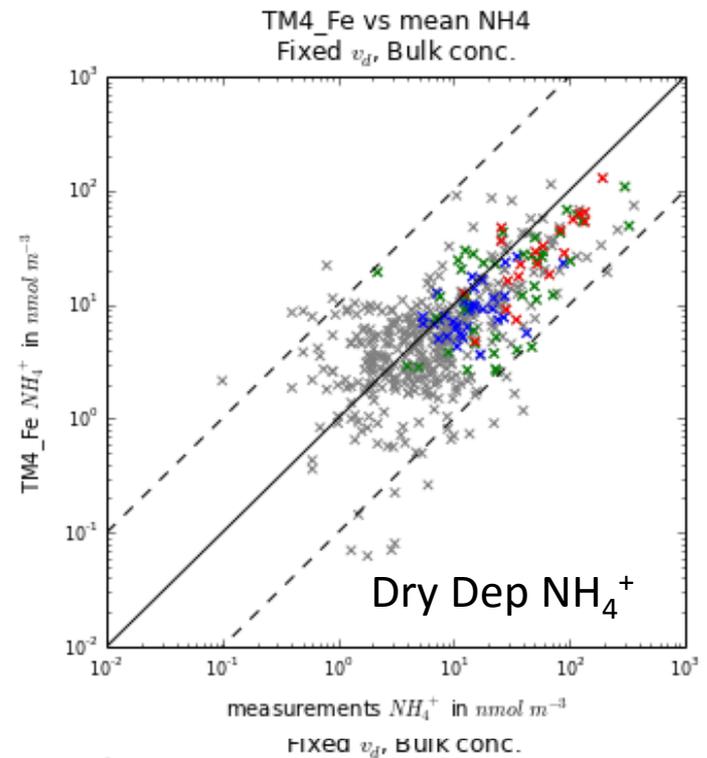
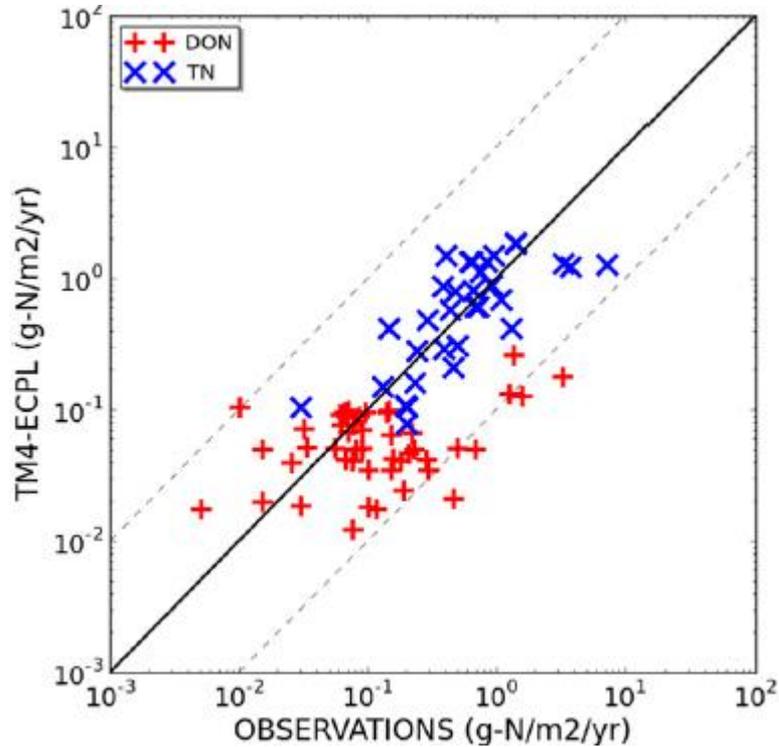
Kanakidou, et al. *Global Biogeochemical Cycles*, 2011GB004277, 2012

Kanakidou et al., *JAS* D150278, 2016



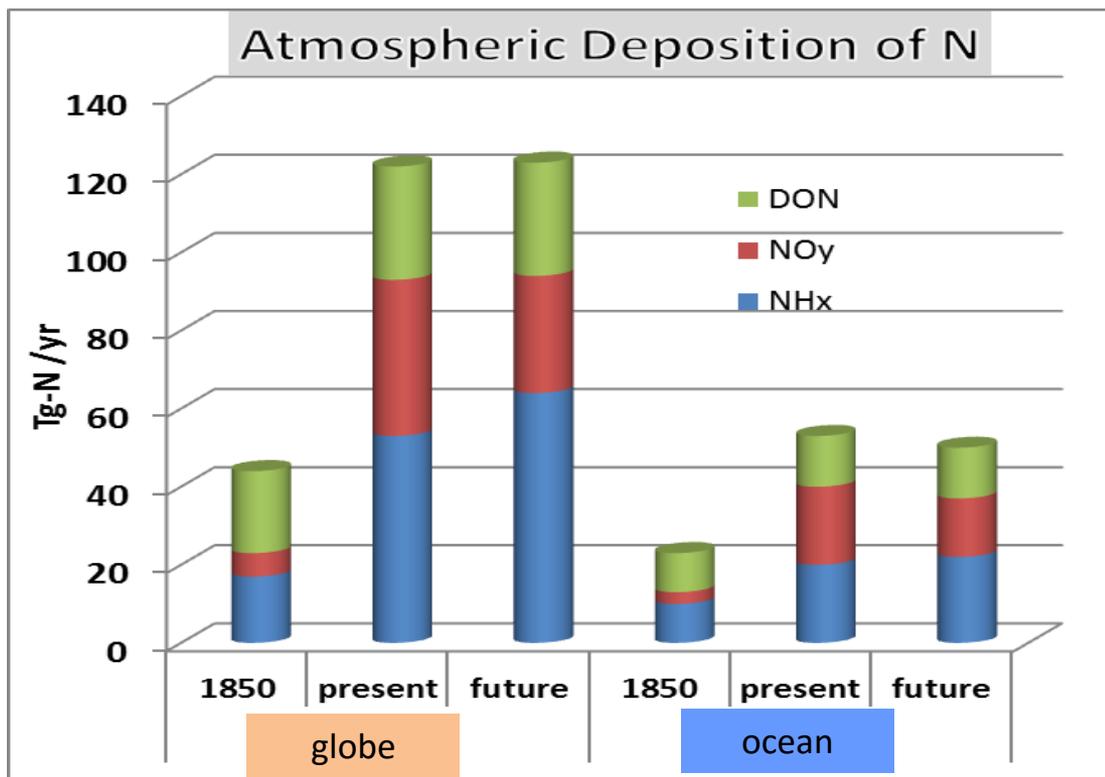


Atmospheric N deposition





Atmospheric N deposition changes



Kanakidou et al., JAS 2016



PANOPLY
Pollution Alters Natural aerosol composition: implications for Ocean Productivity, cLimate and air quality

- Large uncertainties associated with the estimates
- What is the impact on the ecosystems?

Conclusions

- ✓ Important quantities of nutrients are in organic form and in aerosols → to be considered to understand ecosystem functioning.
- ✓ Atmospheric deposition of soluble nutrients to the ocean could have increased due to human activities and projections are sensitive to emission controls and changes in atmospheric acidity.
- ✓ The change in deposition affects marine ecosystems as well as the atmospheric carbon cycle.

