ATMOSPHERIC DEPOSITION CONTROLS ON THE EAST MEDITERANNEAN MARINE ECOSYSTEM

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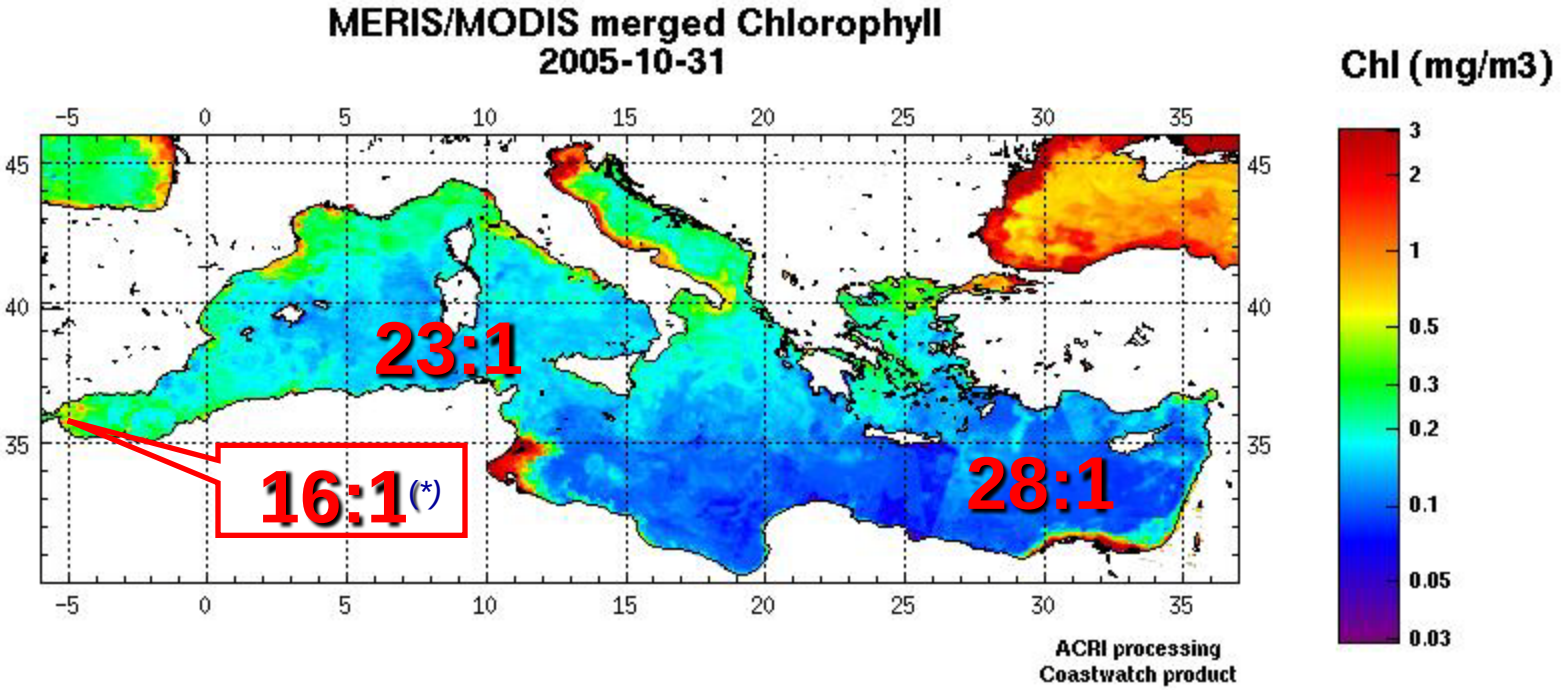
Interest of the area

Well defined decreasing trend in Chl from the West to the East

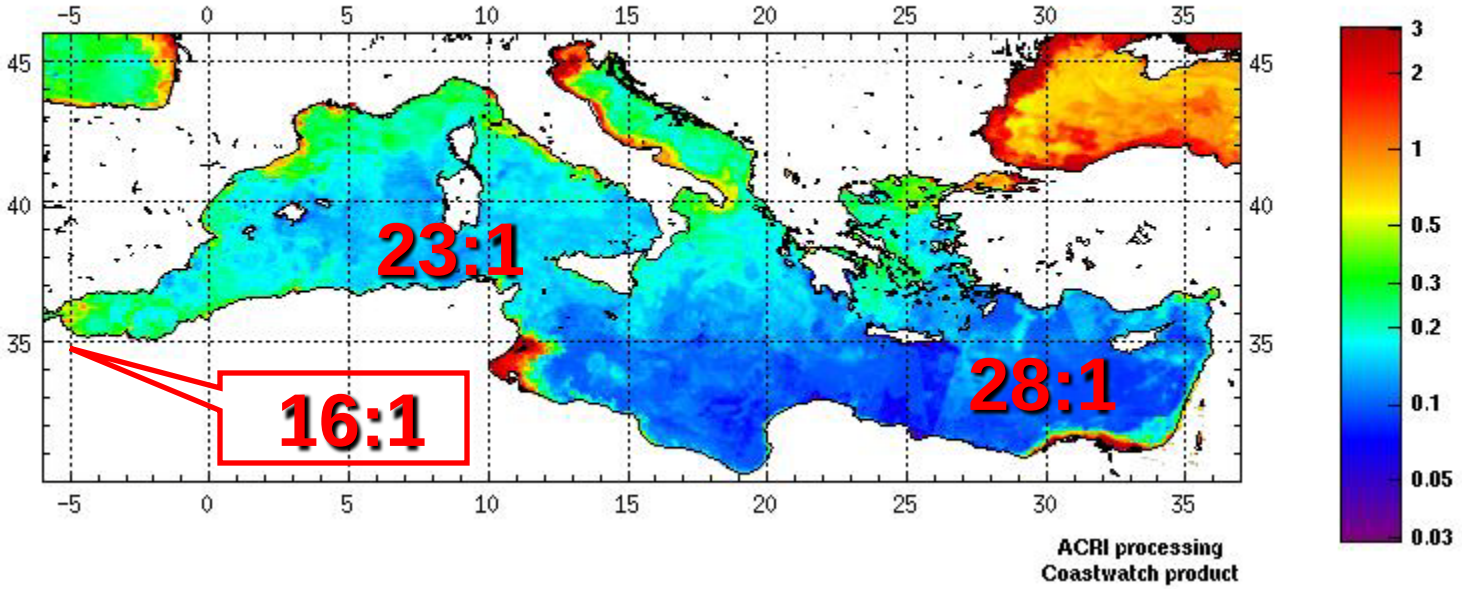


N:P ratio has been measured to increase in the same direction with the oligotrophic character of the sea

*Redfield, A. C., University of Liverpool, 1934

Interest of the area

Questions to be addressed



Can N and P atmospheric deposition explain the unusually high N/P sea water ratio?

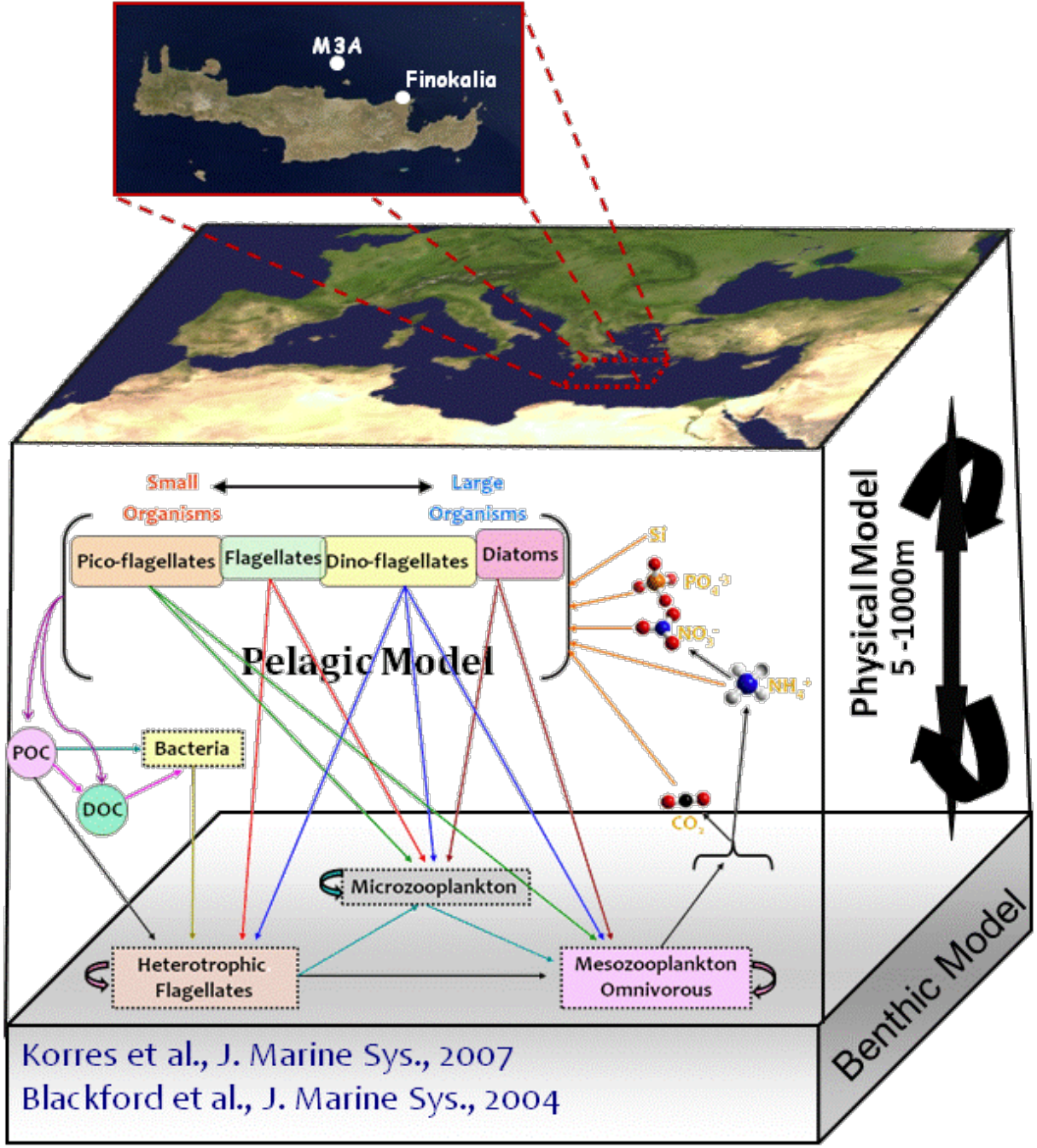
How important is atmospheric deposition for the marine ecosystem?

Studied area

Approach

Sea Water Observations are coupled with Atmospheric Deposition Measurements by means of 1-D Ocean Physical Biogeochemical Model

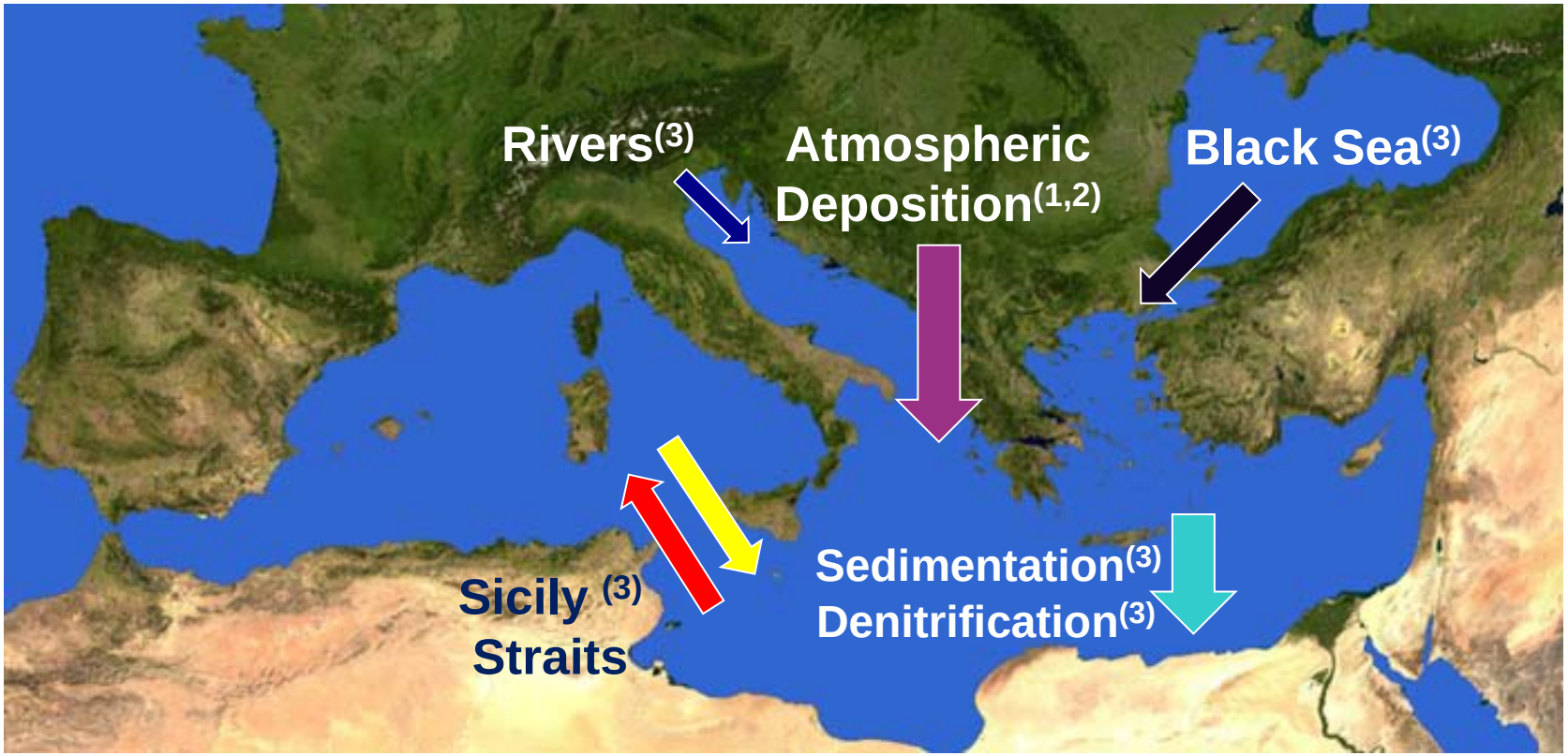
The 1-d Model



Christodoulaki et al., Journal of Marine Systems,2012

Nutrient Fluxes

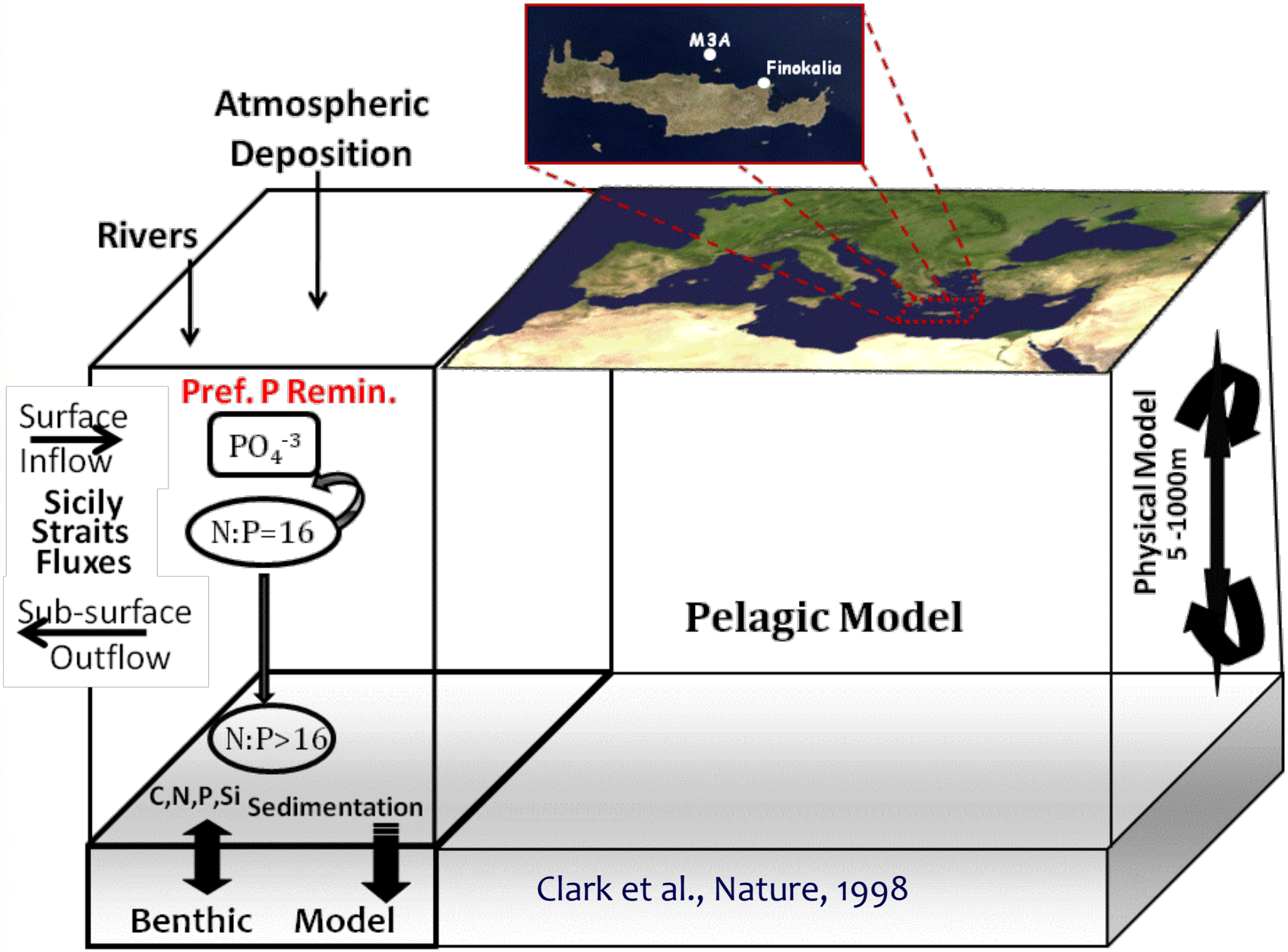
Nitrogen and Phosphorus Fluxes in The Eastern Mediterranean Basin



1:Kouvarakis et al., GBC, 2001; 2: Markaki et al., Llmnol. Oceanogr., 2003; 3: Krom et al., Limnol. Oceanogr., 2004

Preferential P remineralization in oligotrophic marine ecosystems

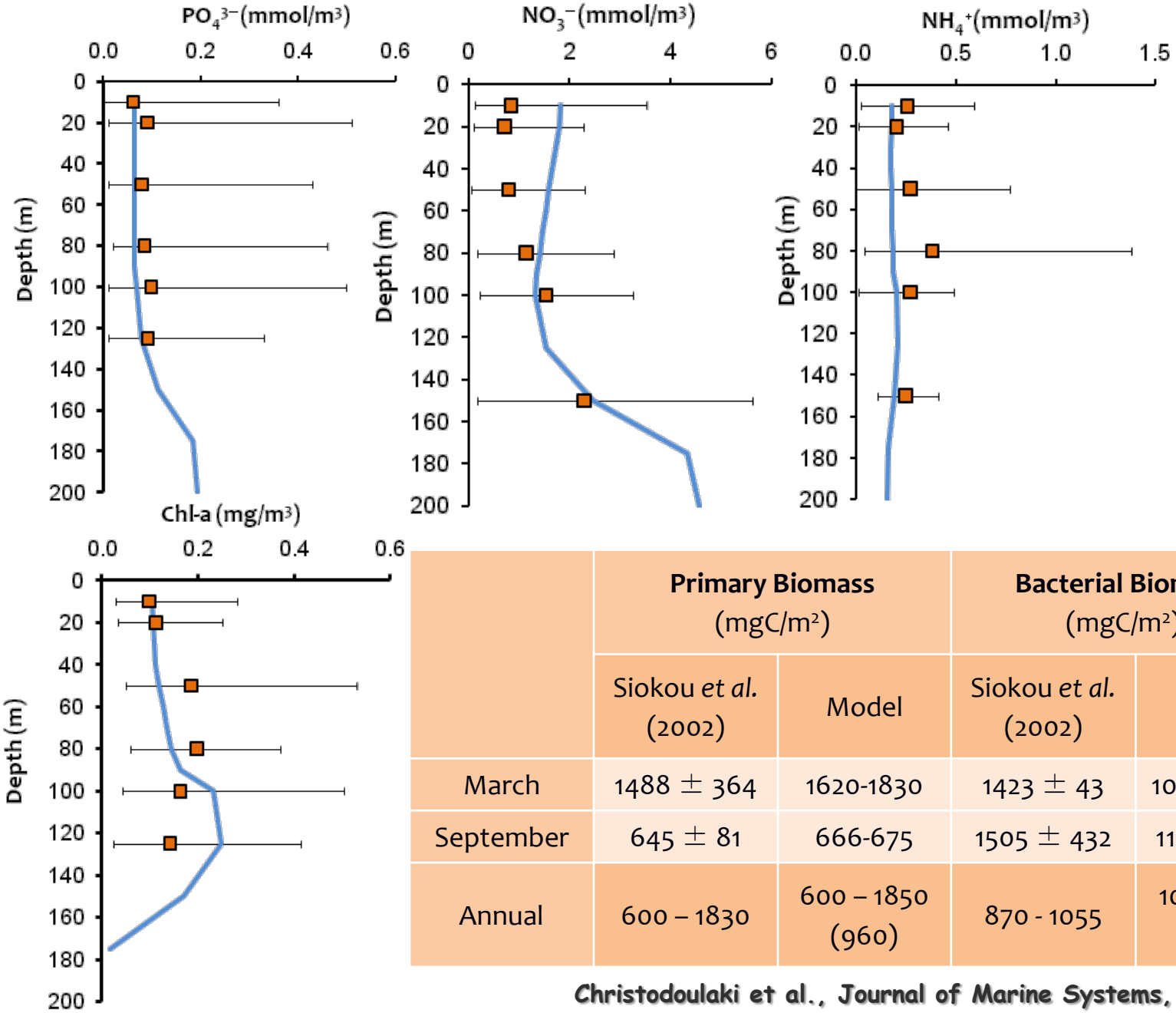
The 1-d Model



Christodoulaki et al., Journal of Marine Systems, 2012

Model versus observations

Annual Mean Profiles



	Primary Biomass (mgC/m²)		Bacterial Biomass (mgC/m²)	
	Siokou *et al.* (2002)	Model	Siokou *et al.* (2002)	Model
March	1488 ± 364	1620-1830	1423 ± 43	1060 - 1100
September	645 ± 81	666-675	1505 ± 432	1190 - 1210
Annual	600 – 1830	600 – 1850 (960)	870 - 1055	1060-1210 (1142)

Christodoulaki et al., Journal of Marine Systems, 2012

Scenarios

- Reference simulation with atmospheric deposition fluxes

Model +atm.dep.2000

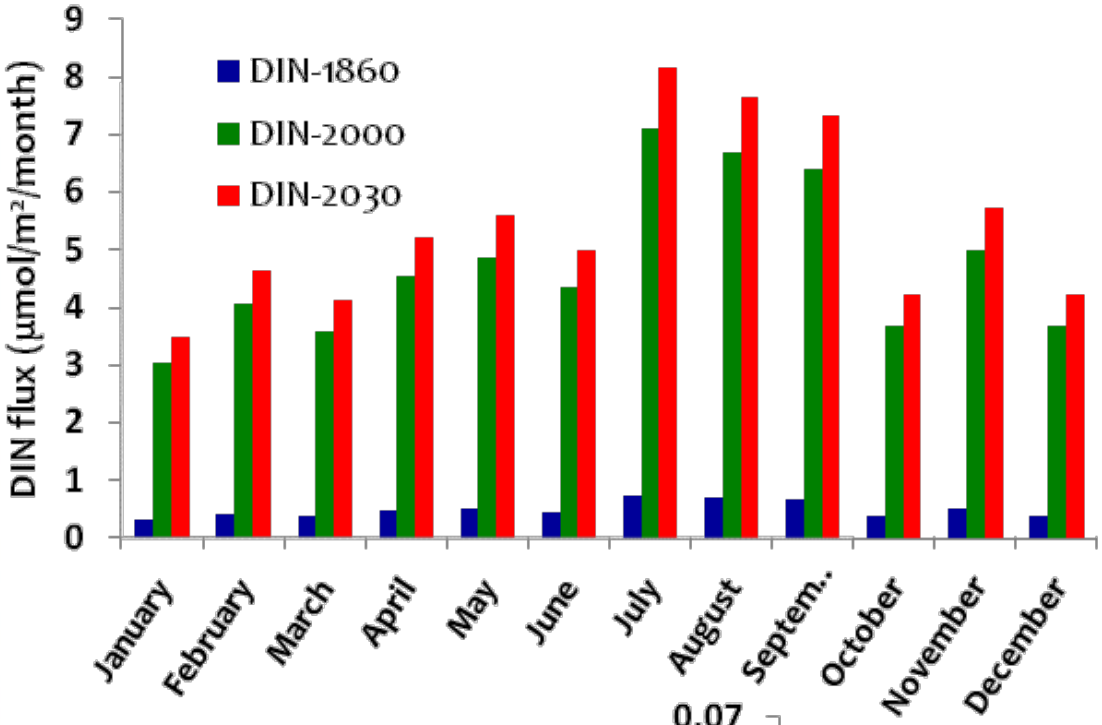
- Simulation with reduced atmospheric deposition fluxes

Model +atm.dep.1860

- Simulation with increased atmospheric deposition fluxes

Model +atm.dep.2030

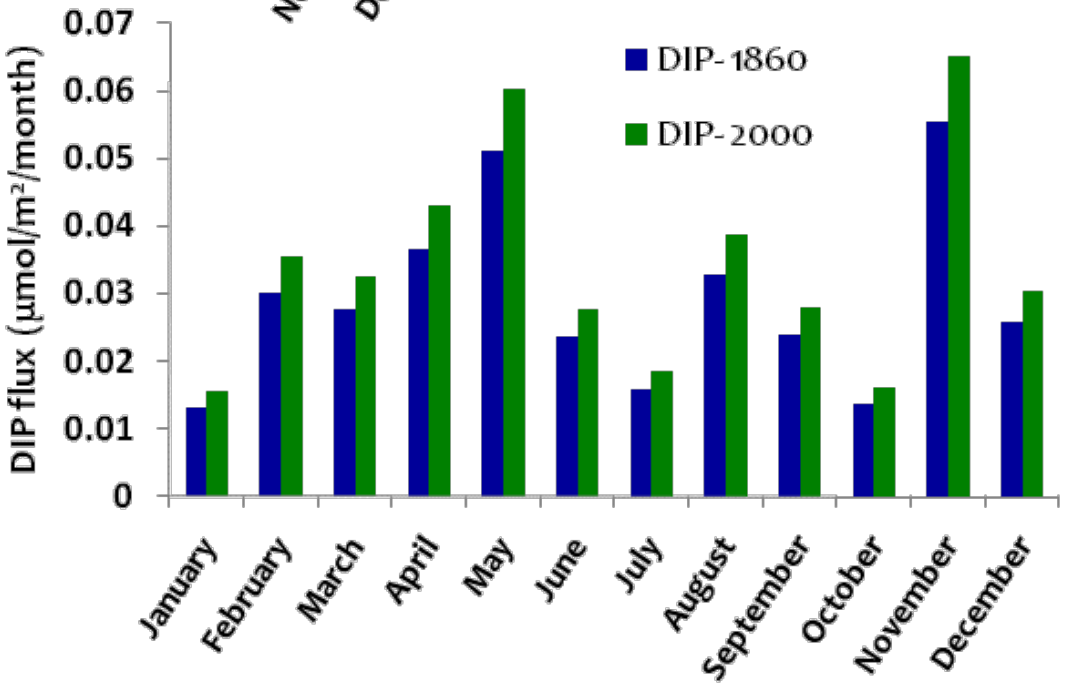
Atmospheric Deposition Input



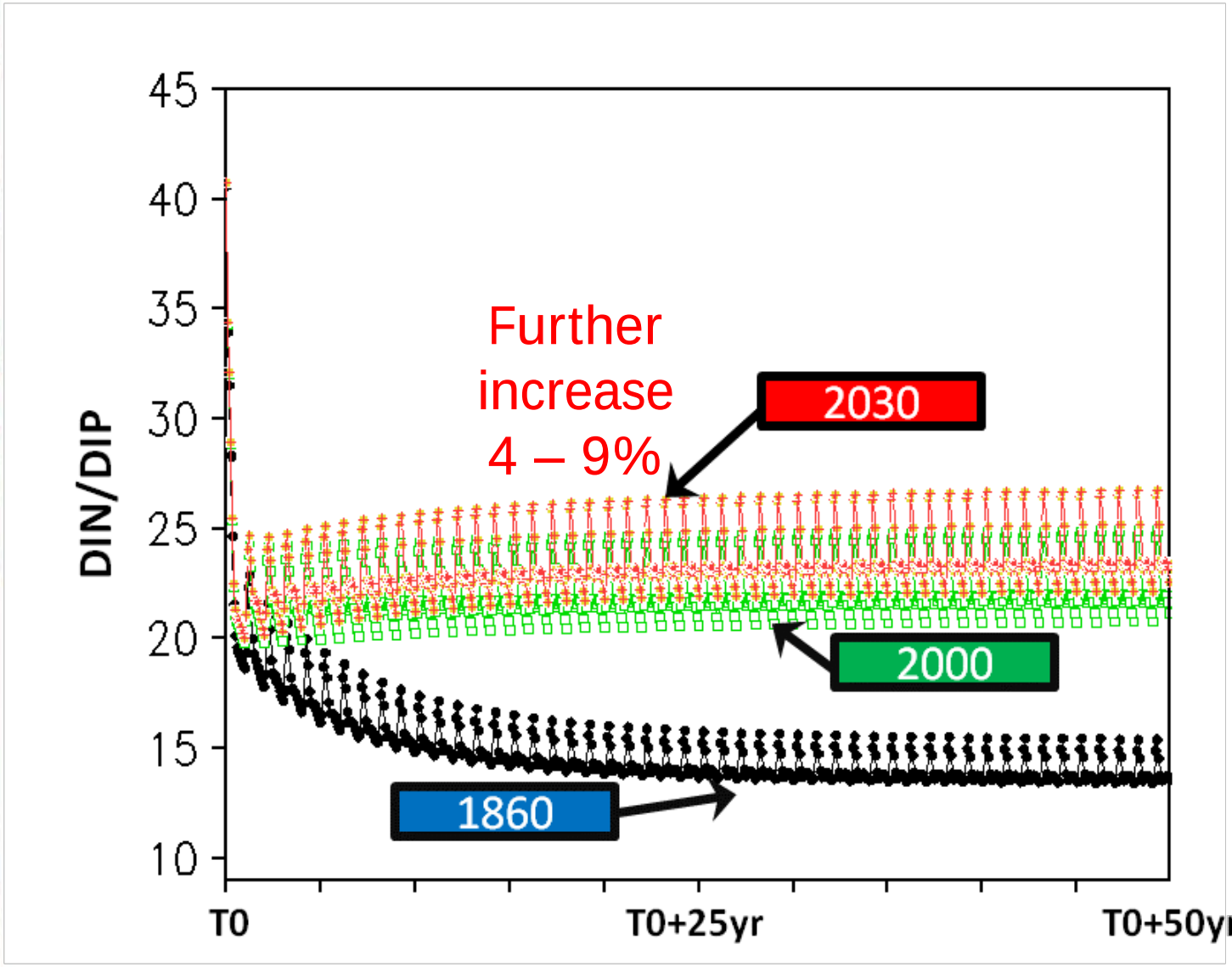
1860
Reduced Atmospheric Deposition Run:
Duce et al., *GBC*, 2008;
Mahowald et al., *GBC*, 2008

2000
Reference Run:
Kouvarakis et al., *GBC*, 2001;
Markaki et al., *Llmn. Ocean.*, 2003

2030
Increased Nitrogen Atmospheric Deposition Run:
Duce et al., *GBC*, 2008



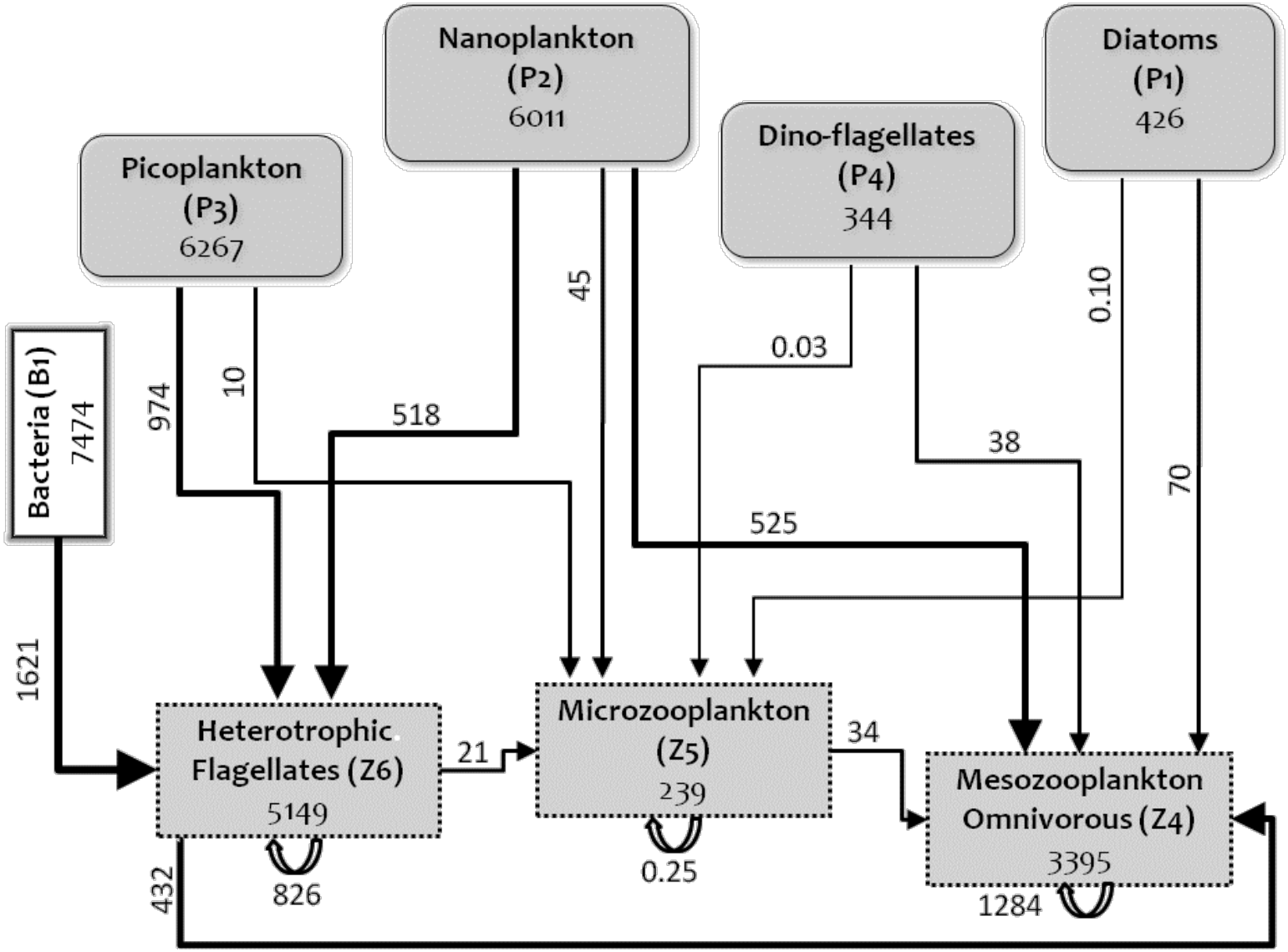
Atmospheric Deposition Impact on DIN/DIP



Increase
20-45%

Integrated in the first 200 m

Reference run (2000)



Annual carbon fluxes (mg C m^{-2} yr^{-1}) and biomasses (mg C m^{-2})
(integrated within the top 100m)

Changes due to anthropogenic inputs to the ocean

	1860	2000	2030	Difference(%)	
				(2000–1860)/ 2000	(2030-2000)/ 2000
Phyto Biomass (mg C/m²)	548 - 1750	600 - 1850	690 - 1850	**4 - 20**	**0.1 – 2.1**
Primary Production (mg C/m²/d)	150 750	200-890	200 - 890	**7 - 26**	**0.2 – 2.6**
Bacterial Biomass (mg C/m²)	1040 - 1210	1040-1220	1040 - 1220	**-2.5 to 4.5**	**-0.25 to +0.25**

Monthly mean values -variability

Questions to be addressed

Can N and P atmospheric deposition explain the unusually high N/P sea water ratio?

How important is atmospheric deposition for the marine ecosystem?

Main conclusions

Anthropogenic atmospheric deposition inputs to the marine ecosystem in the East Mediterranean can explain the high N/P ratio in the seawater

They increased PP to 26% (since 1860)

They are expected to further increase it to 2.6% (2030)

Need for better understanding of

Ecosystem functioning (including the role of bacteria)

Atmospheric deposition (changes + bioavailability)

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Adamant