MIDDLE EAST TECHNICAL UNIVERSITY
INSTITUTE OF MARINE SCIENCES

Assessing impacts of the jellyfish blooms and transparent exopolymer particle aggregates in functioning of the eutrophic marine food webs

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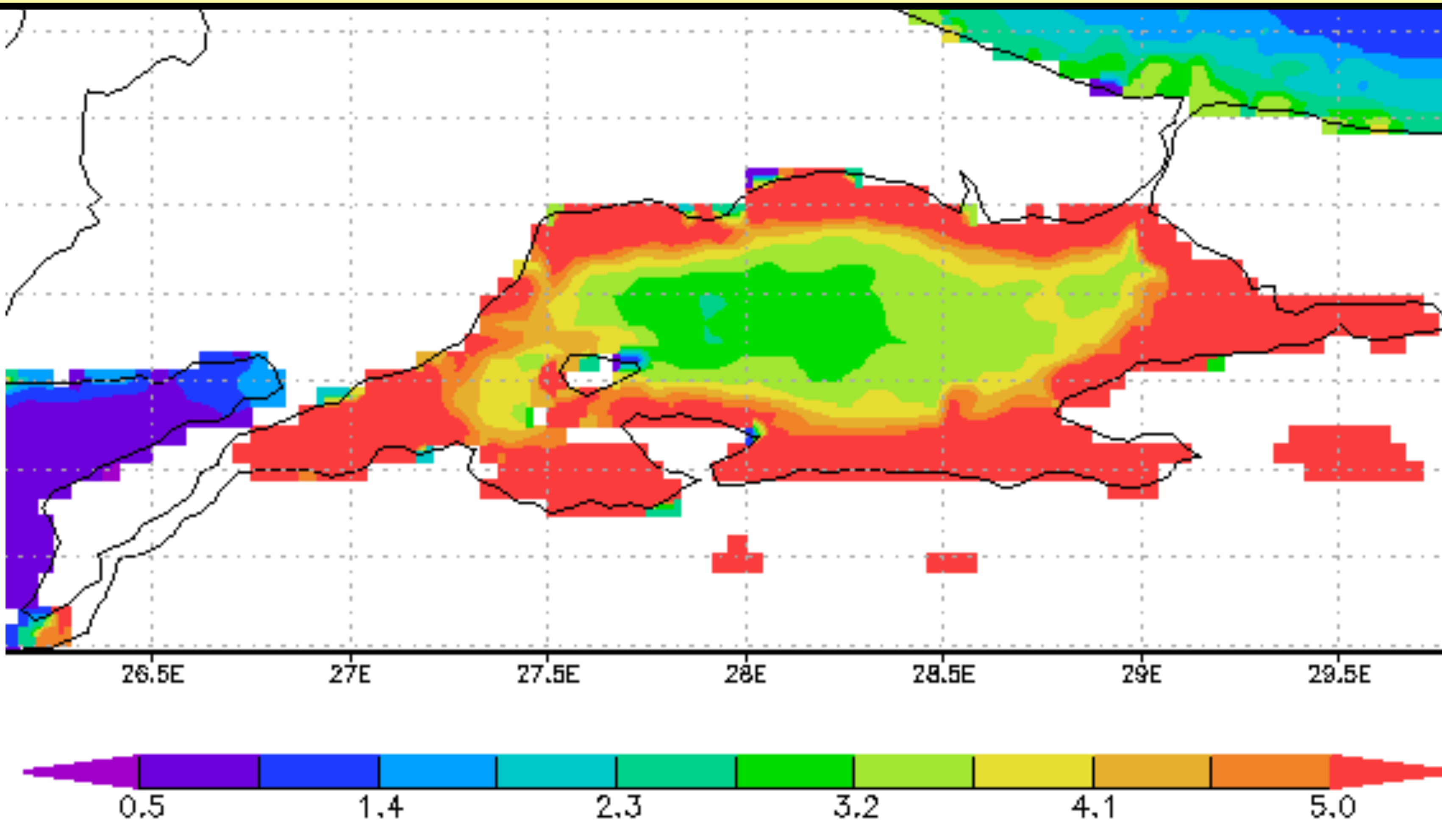
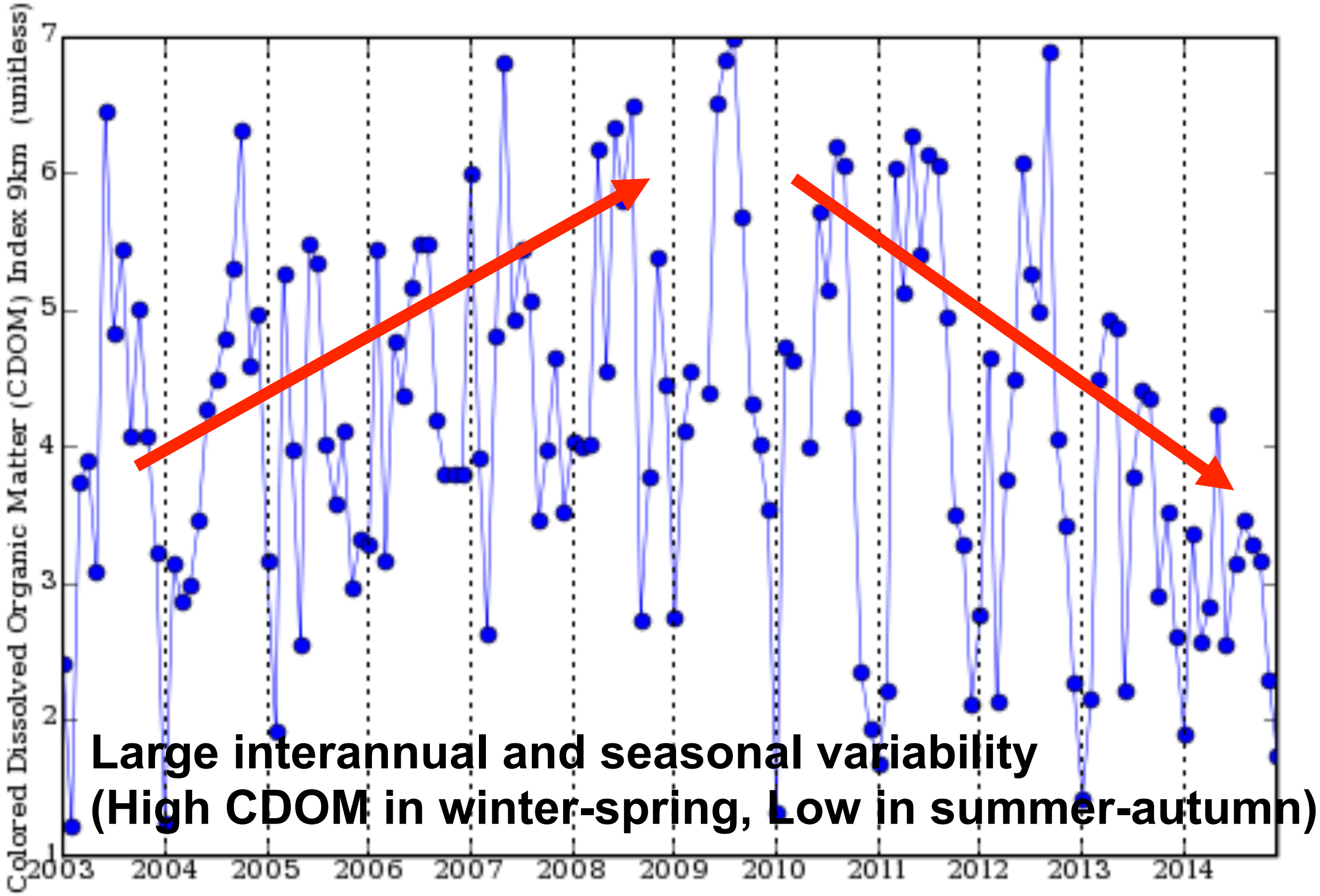
Contents:

- Motivation of the study (observations from the Marmara Sea)
- Theoretical considerations on POM-DOM continuum
- Modeling of particle aggregates and interactions with the FW structures
- Conclusions

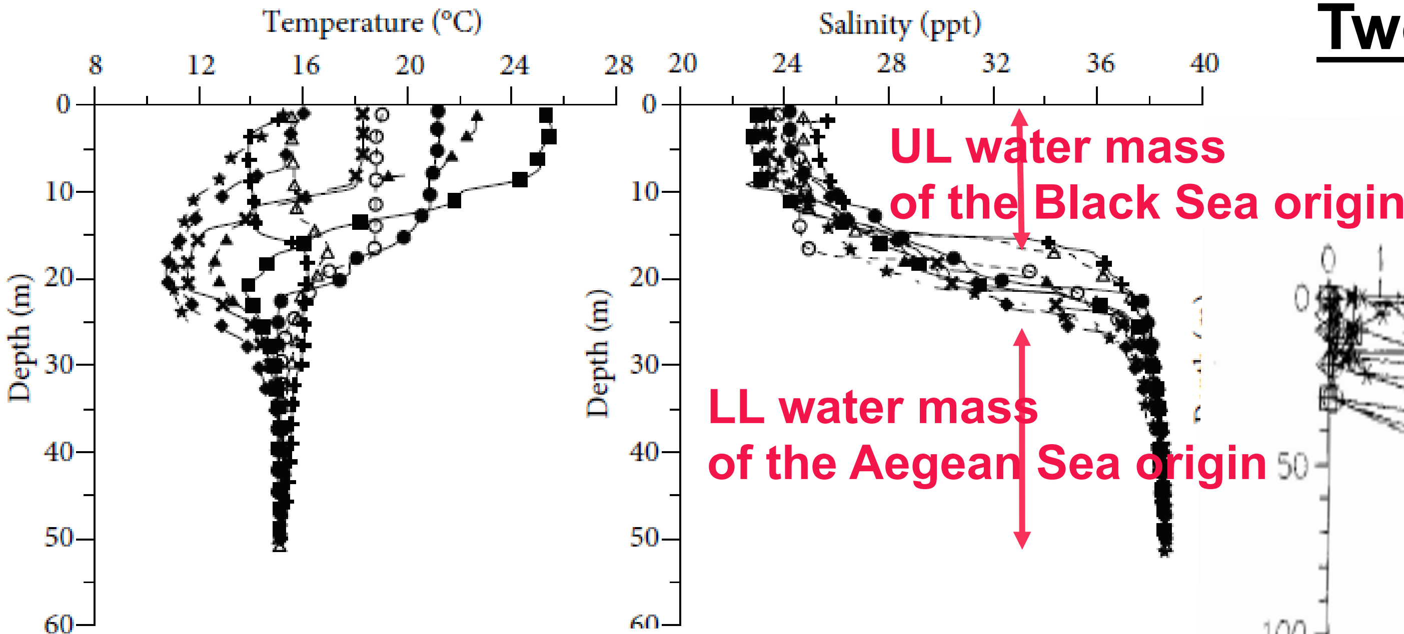
MARMARA SEA ECOSYSTEM

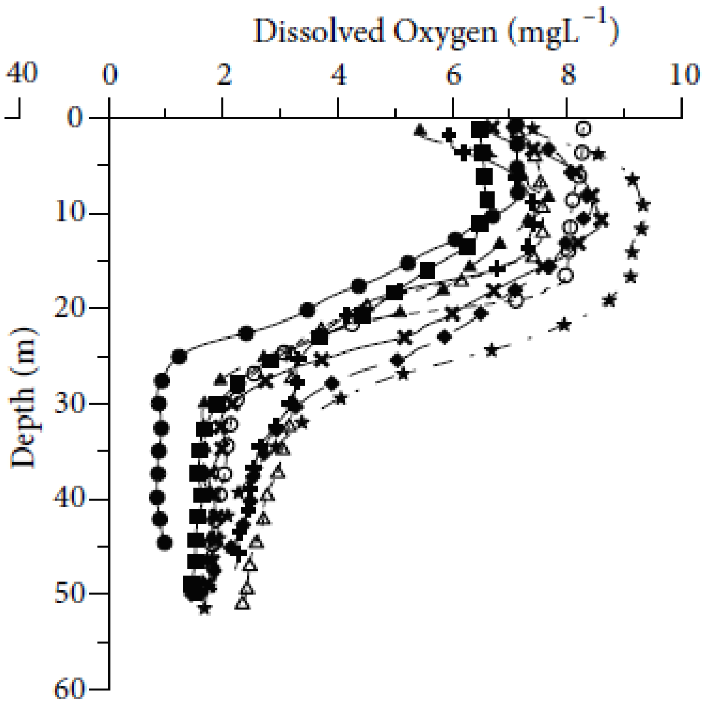
- **Highly eutrophic and degraded ecosystem**
- **Invasion by jellyfish *Liriope tetraphyla* during 2006-2008**
- **Dense *mucilage* events and temporal collapse of the ecosystem**

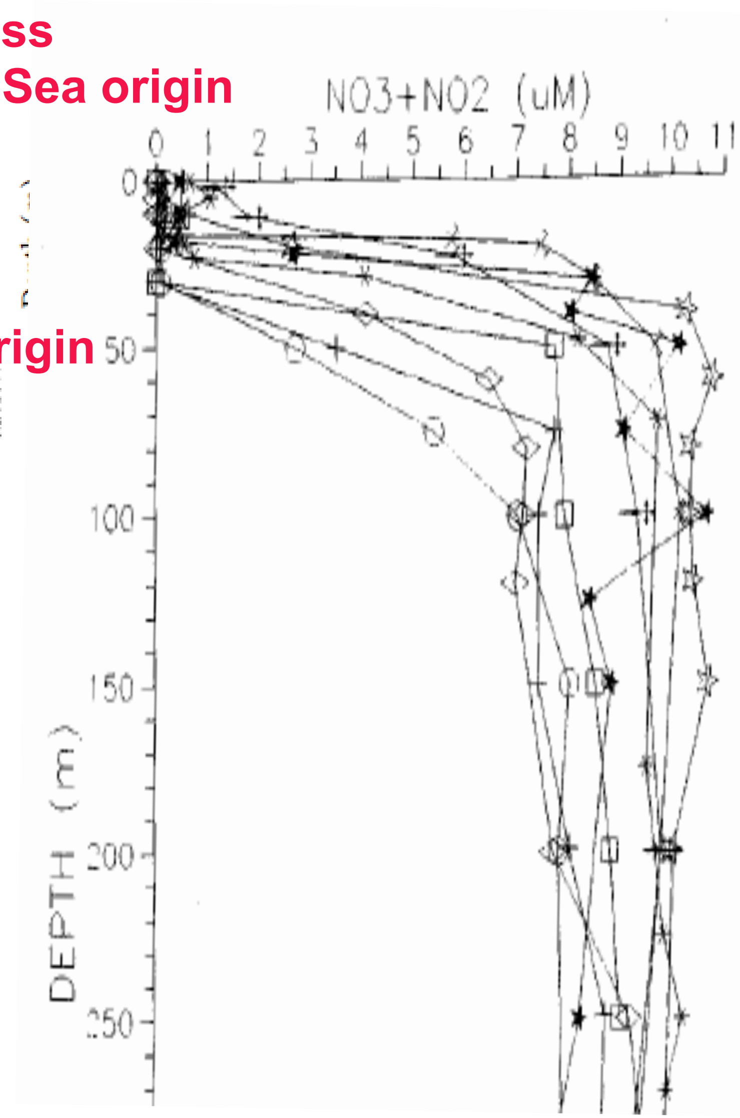



Colored Dissolved Organic Matter (CDOM) Index 9km (unitless)
Large interannual and seasonal variability
(High CDOM in winter-spring, Low in summer-autumn)
1
2
3
4
5
6
7
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Two-Layer System



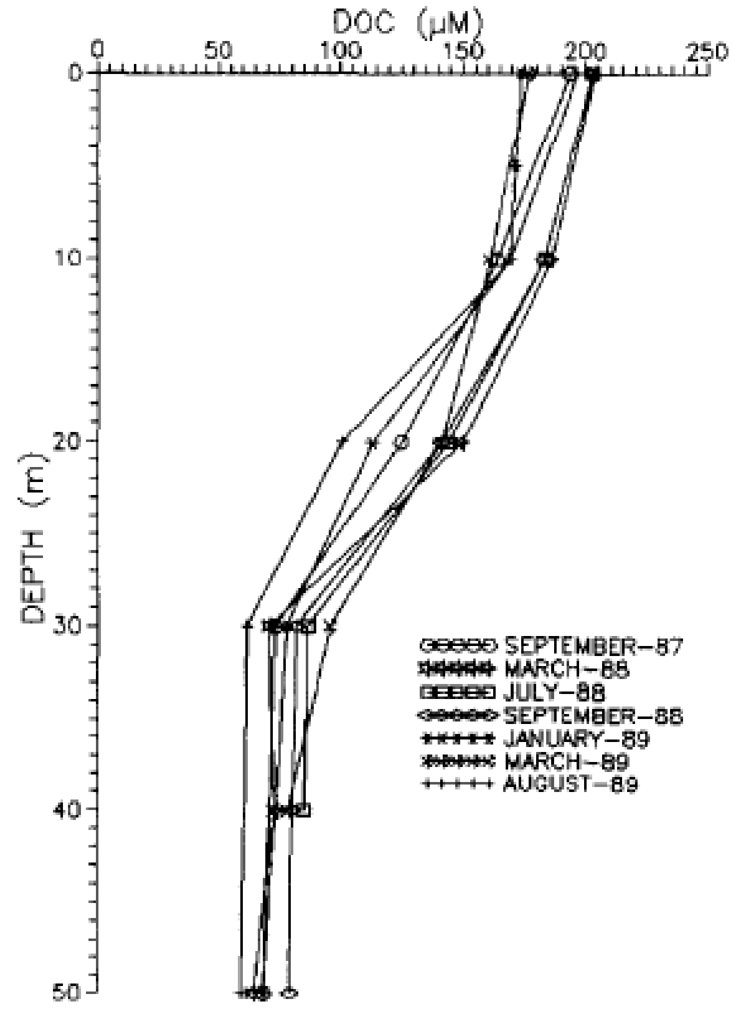




Eutrophic systems

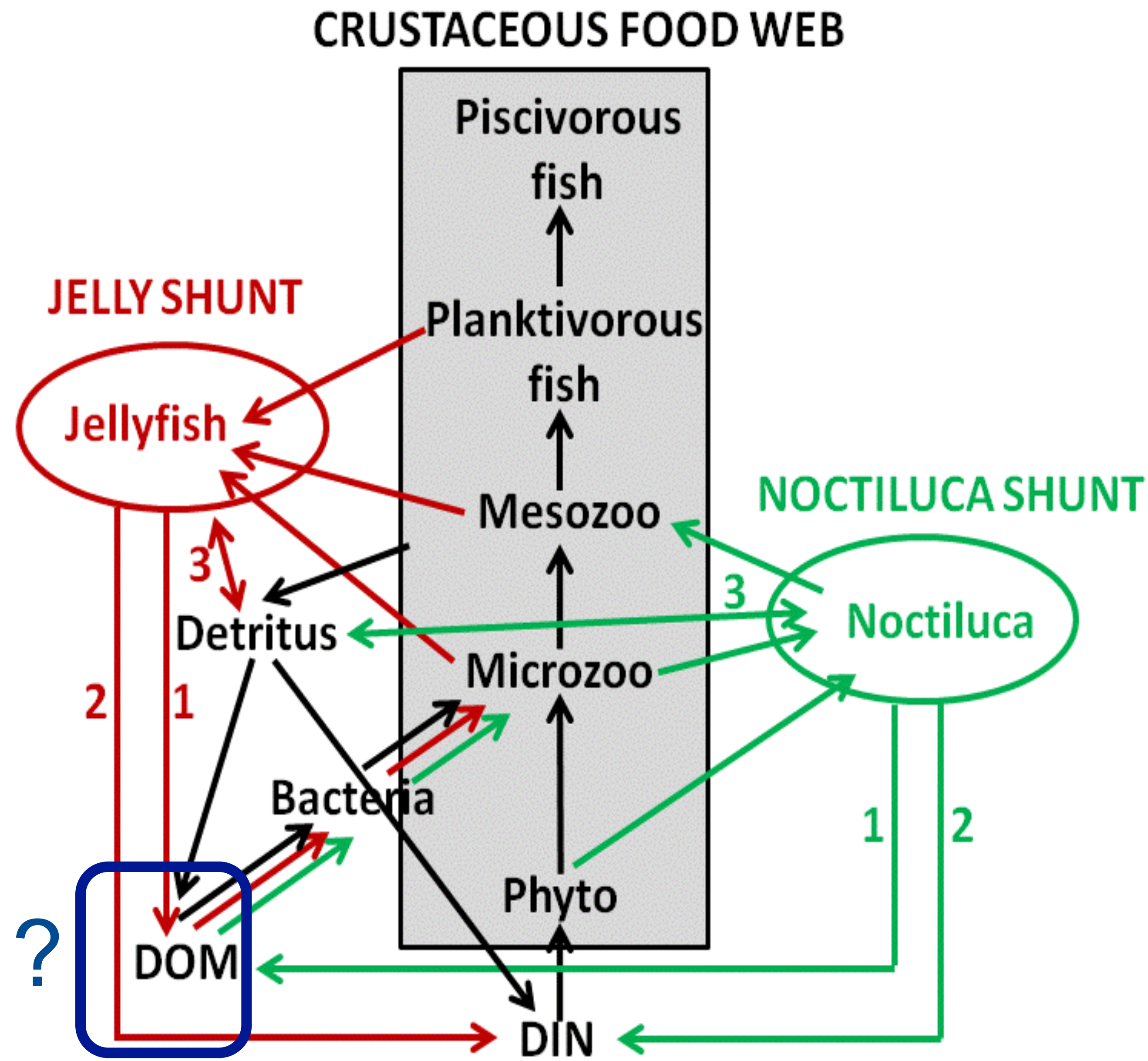
- high DOM availability,
- complex food web structure and nonlinear trophic interactions,
- important DOM recycling through microbial loop.

- models require a careful treatment of the DOM cycling that are often not the case.

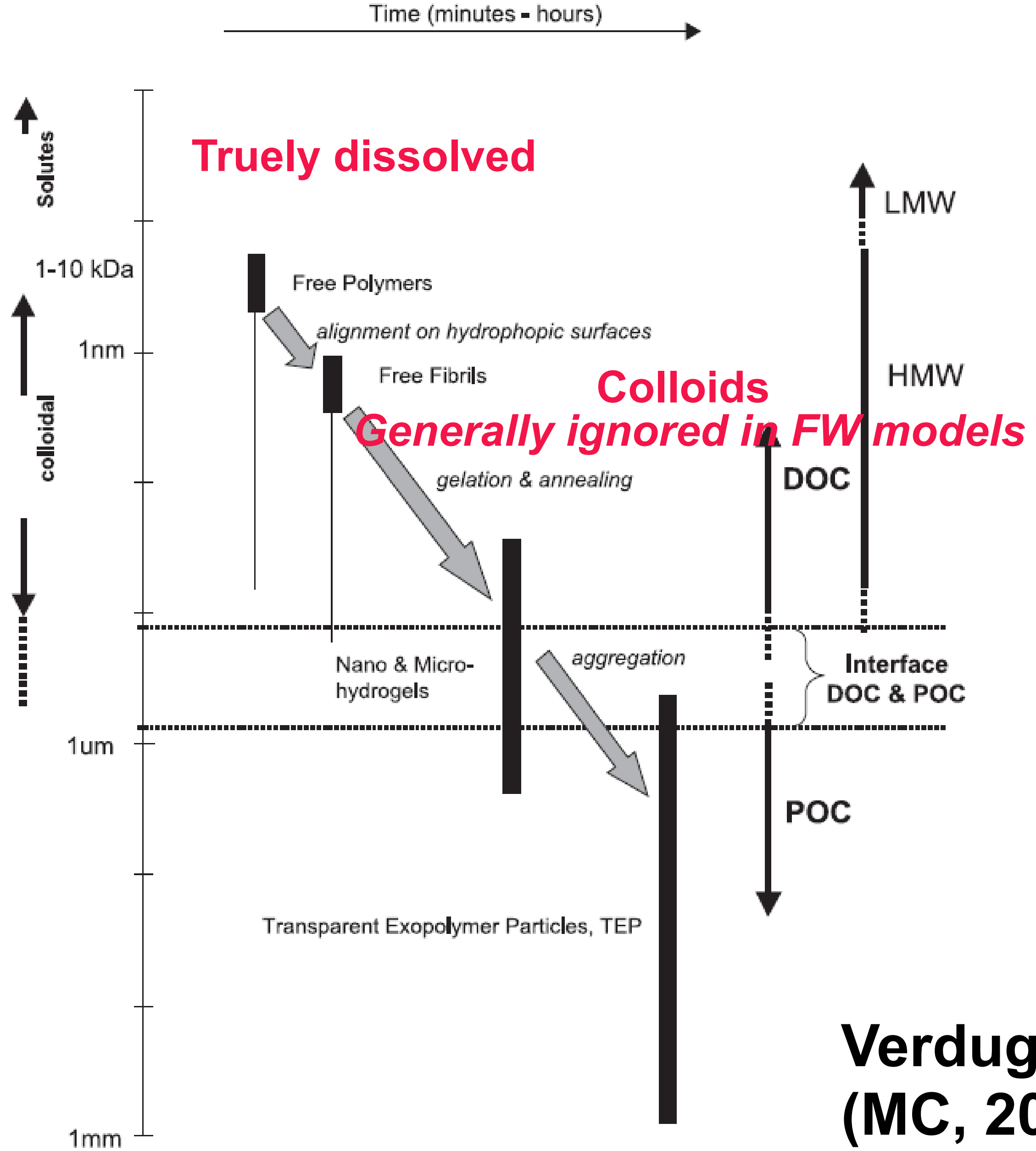


DOC profiles at the southern end of the Bosphorus Strait. Polat and Tugrul (1995)

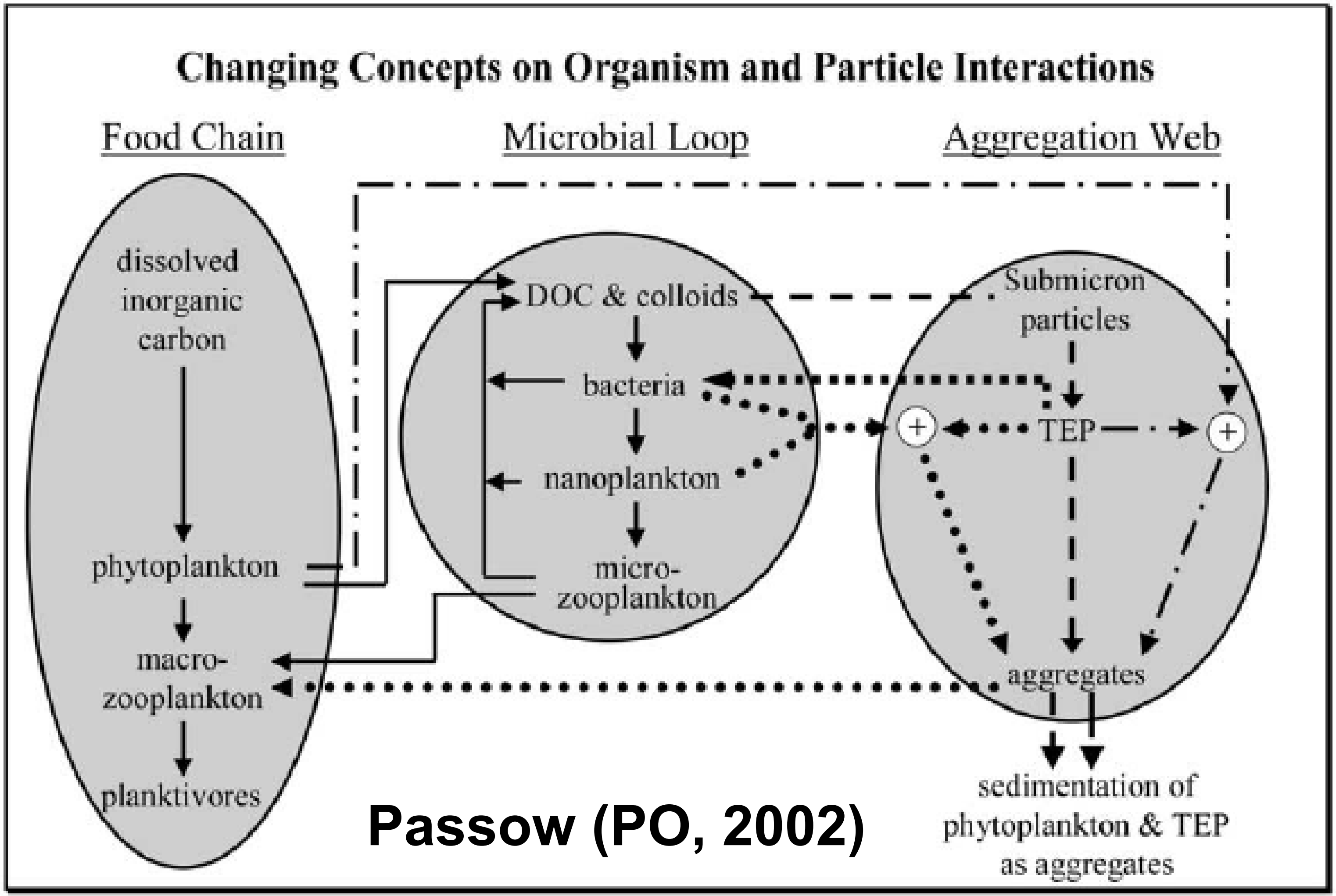
A COMPLEX FOOD WEB STRUCTURE



DOM - to - POM Continuum



Verdugo et al.
(MC, 2004)

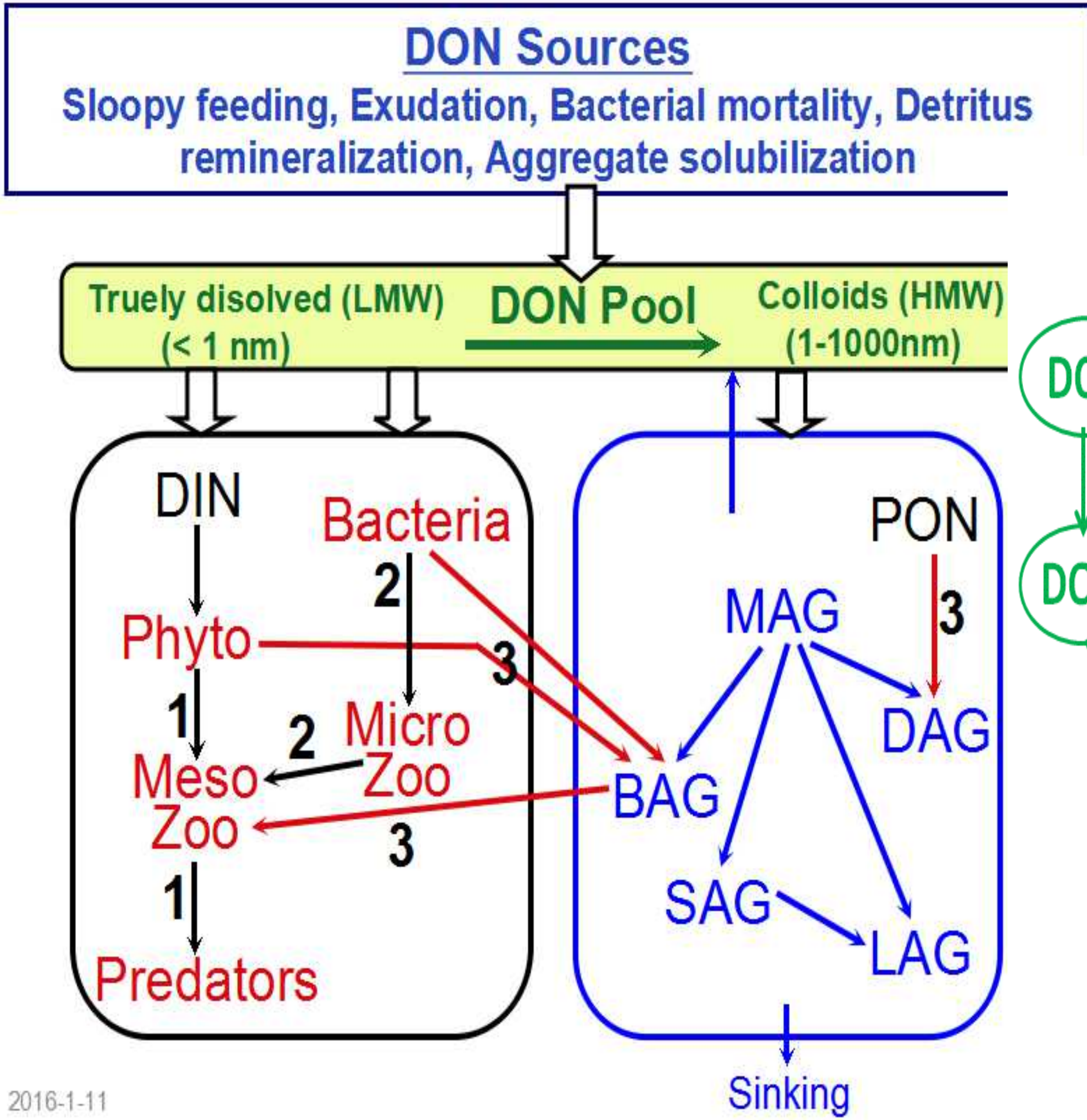


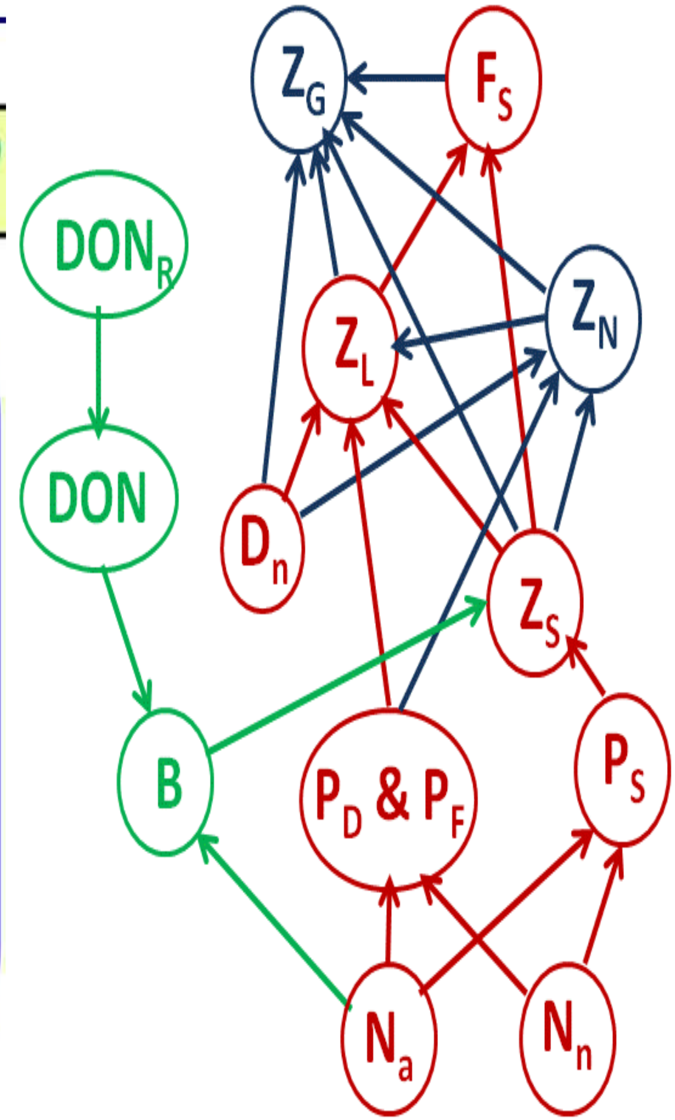
Passow (PO, 2002)

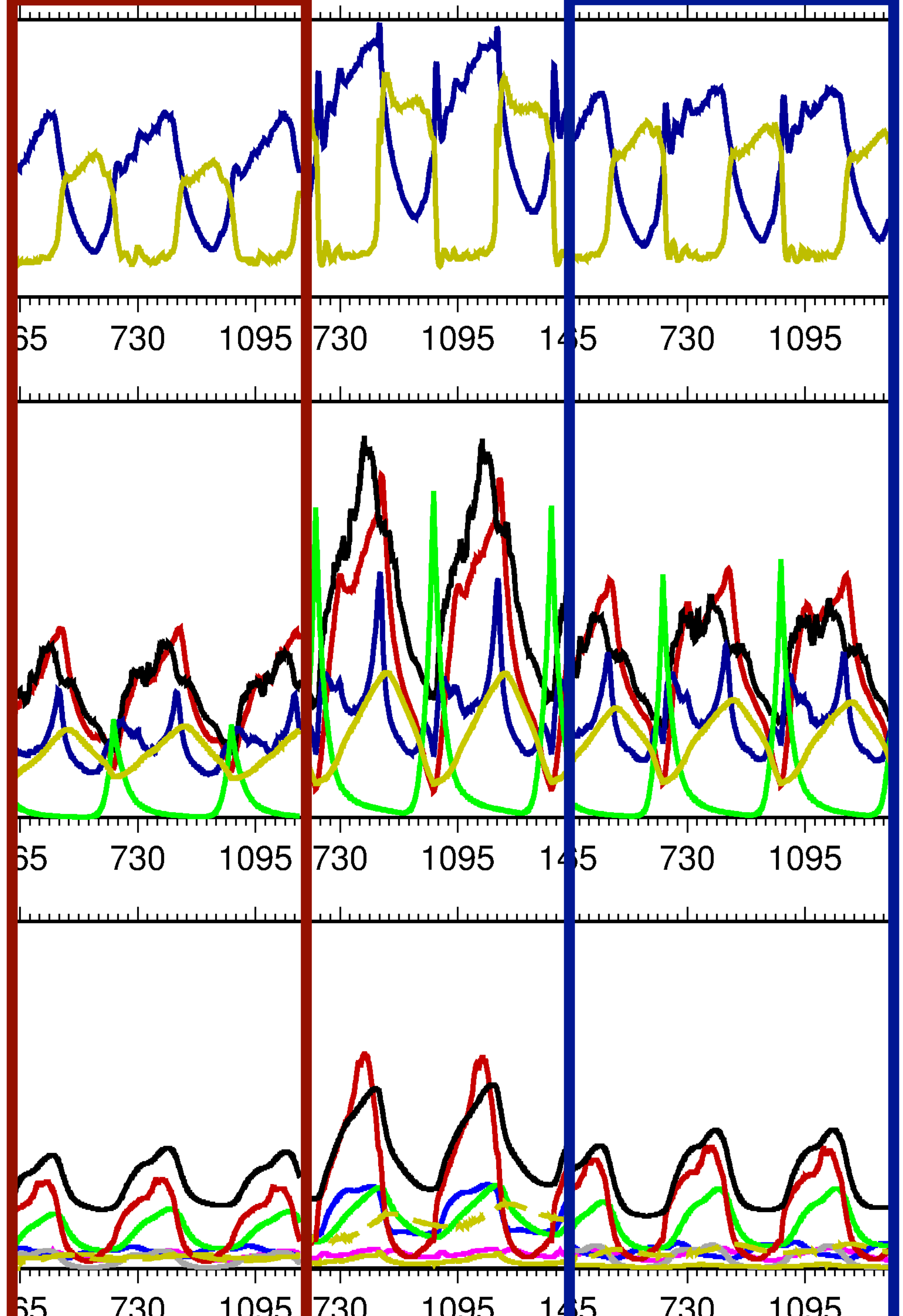
The aggregate web and its interactions with the general food web have not been introduced into the ecosystem models so far.

Existing Aggregation Models:

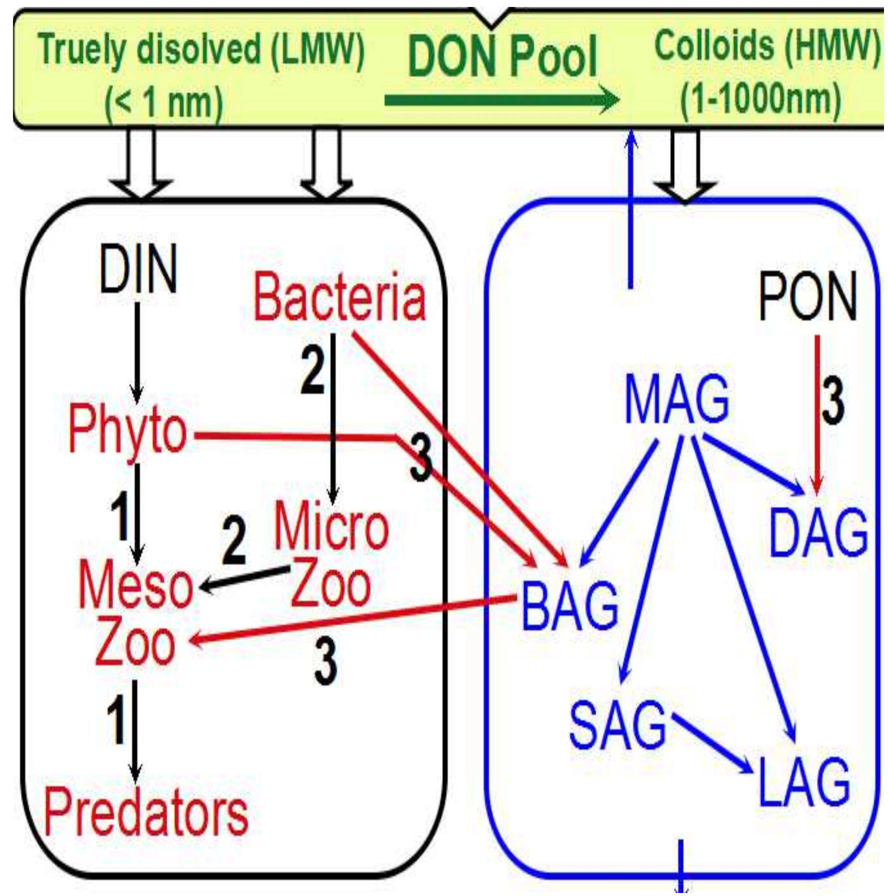
- Mainly focus on more realistic representation of the sinking organic carbon flux to deep sea.
- Aggregates are based on the collision of phytoplankton cells and detritus particles that are provided by the FW models.
- Collision process is parameterized by the collision theory of solid particles and do not consider TEP aggregation and colonization.
- Aggregate concentrations are expressed by continuous size spectrum and sinking speed and involve complex set of expressions not practical to incorporate into 3D coupled circulation-ecosystem models.
- Alternatively size class models are proposed in which the aggregates are expressed by few number of size classes.
- They did not explore how the aggregation web impact on the food web.

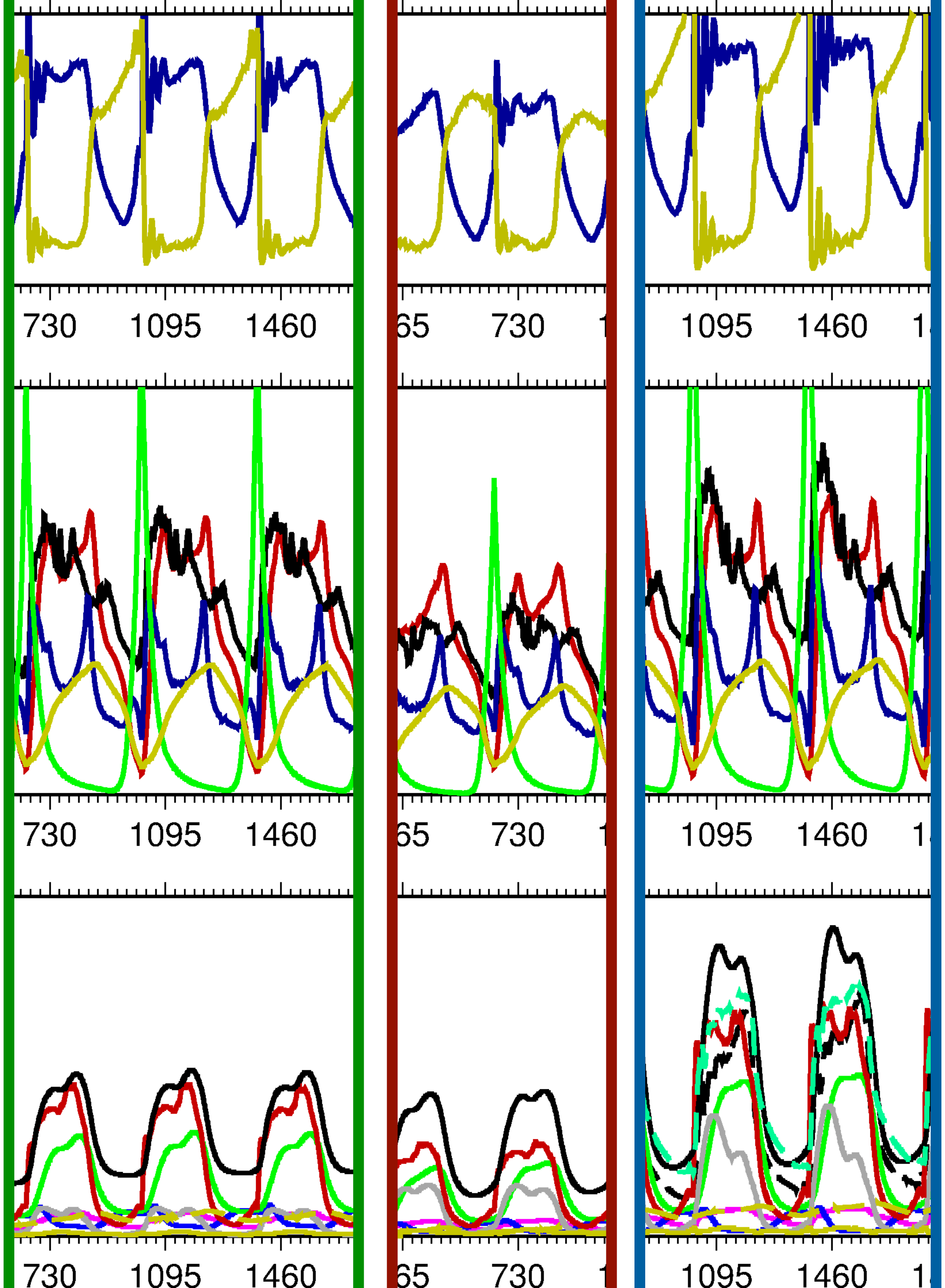

DON Sources
Sloopy feeding, Exudation, Bacterial mortality, Detritus remineralization, Aggregate solubilization
Truely disolved (LMW) (< 1 nm)
DON Pool
Colloids (HMW) (1-1000nm)
DIN
Bacteria
Phyto
Micro Zoo
Meso Zoo
Predators
MAG
PON
BAG
DAG
SAG
LAG
Sinking
1
2
3


Z_G
F_S
DON_R
Z_L
Z_N
DON
D_n
Z_S
B
P_D & P_F
P_S
N_a
N_n



(A) NO coupling
(B) ONE-WAY coupling
(C) TWO-WAY coupling





Two-WAY Coupling

(a) with a slightly higher DON production

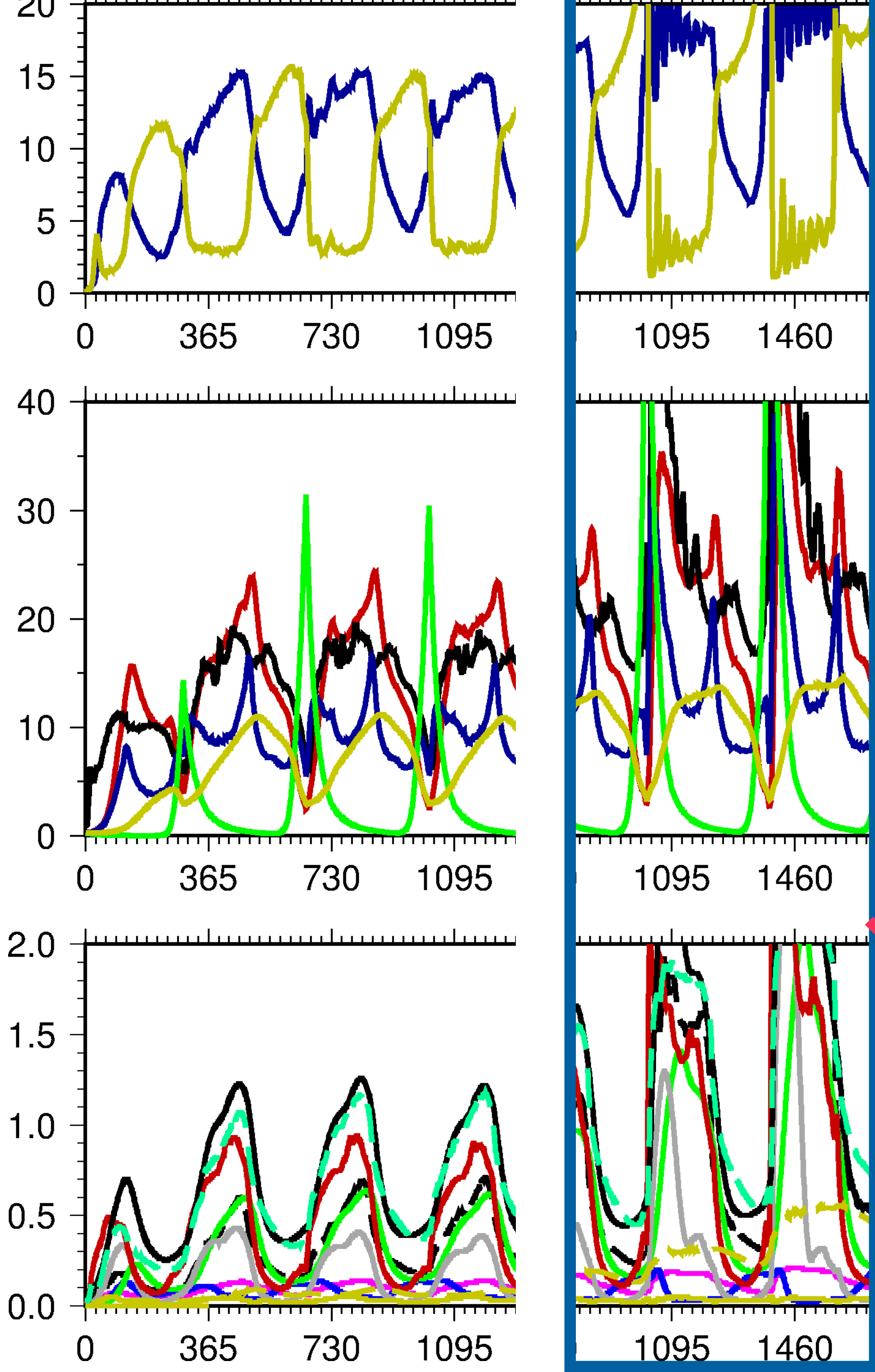
(b) with higher stickness

(c) lower DON(TEP) flux and higher stickiness

$$Source_{MAG} = \frac{1}{h_i}\int_{-h_i}^{0} r_{TEP} \cdot \frac{DON_L}{K_{TEP} + DON_L}$$

r_{TEP}=0.075 versus 0.065 mmol N m^{-3} d^{-1}

stickiness= 0.3 versus 0.5



Jelly excretion = $\mu^* Z_G$

$\mu = \mu_b * Z_G/(R_G+Z_G)$

$\mu_b = 0.05\ d^{-1}$
R_G=0.3 mmol m^{-3}

with additional excretion (or exudation) flux into the DON pool.

Conclusions

Incorporation of theTEP aggregation web modifies the food web structure by shifting a part of the overall planktonic biomass to the particulate form. This feature leads to a self-control of eutrophication on ecosystems.

The sinking aggregation particles give rise to additional remineralization and thus additional DIN accumulation below the euthopic layer. In the ecosystems with high denitrification (e.g. the Black Sea), this process help to maintain a higher nitrate peak to support stronger new production.

The additional DON exudation by jellyfish leads to more active organic matter recycling and higher planktonic biomass within the food web.