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CAPE TOWN INTERNATIONAL CONVENTION CENTRE

Taking Into Account the Phycosphere: What Does it Mean for Regional Hg and MeHg Bioaccumulation?

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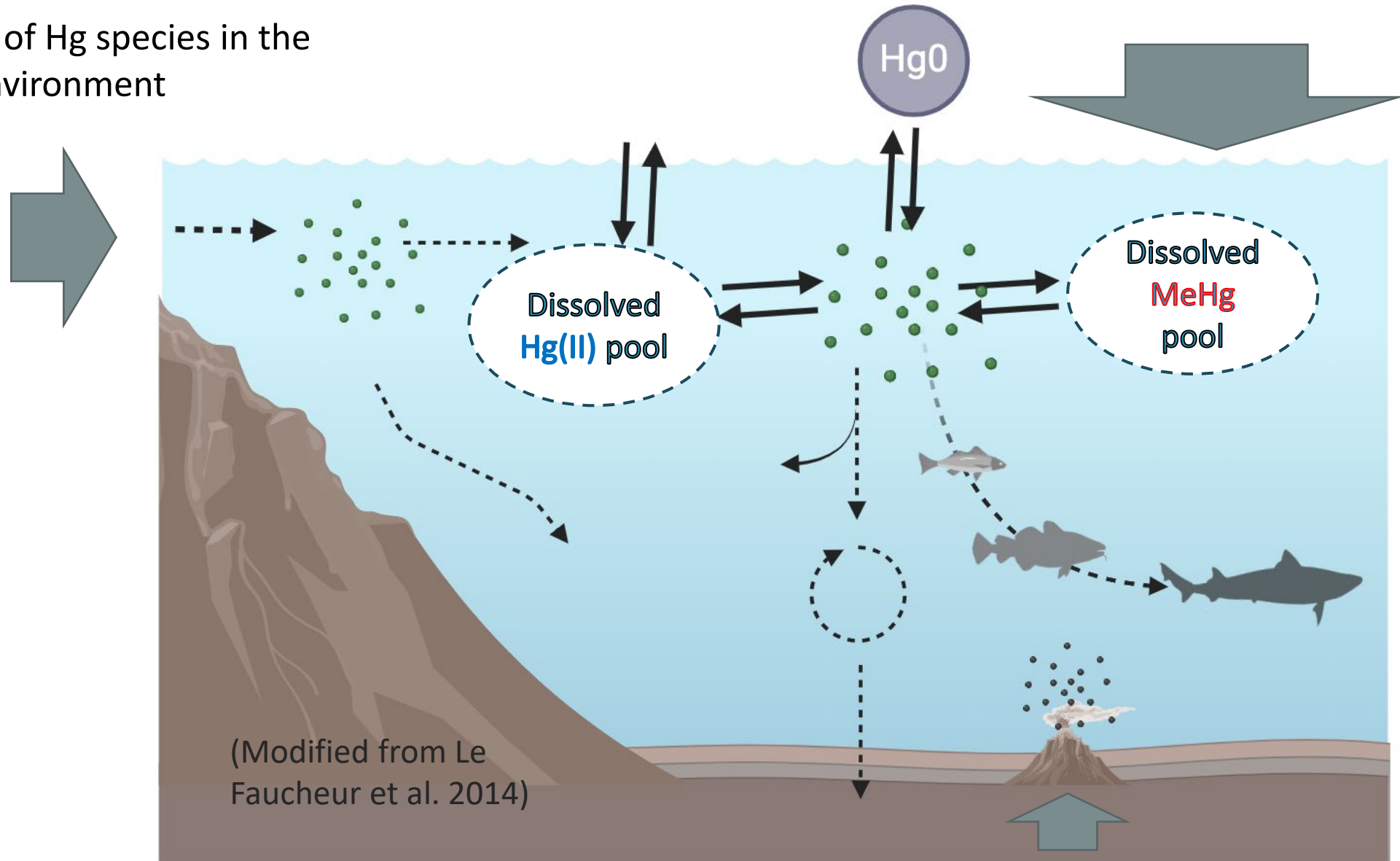
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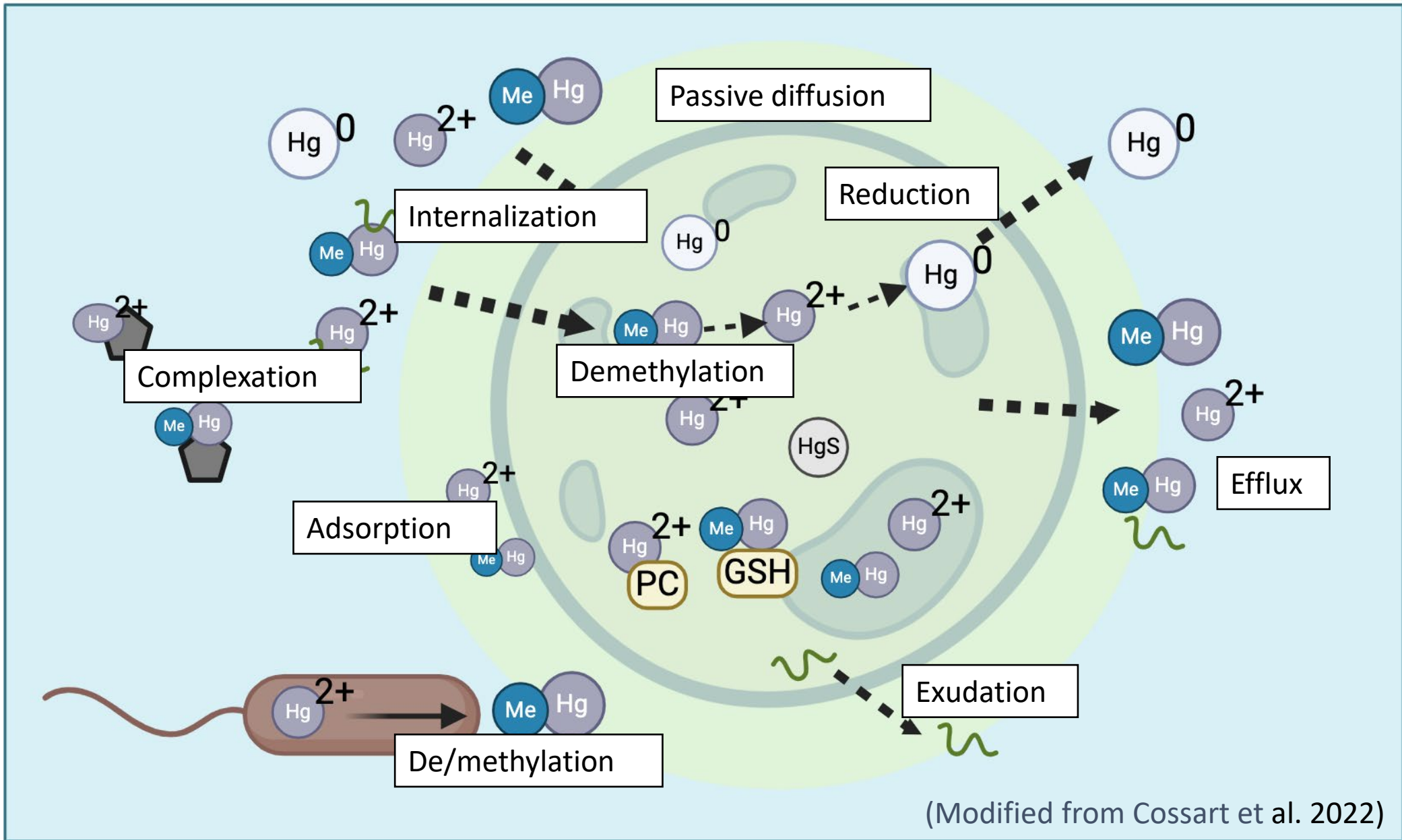
Hereon



Background information

Dynamics of Hg species in the marine environment





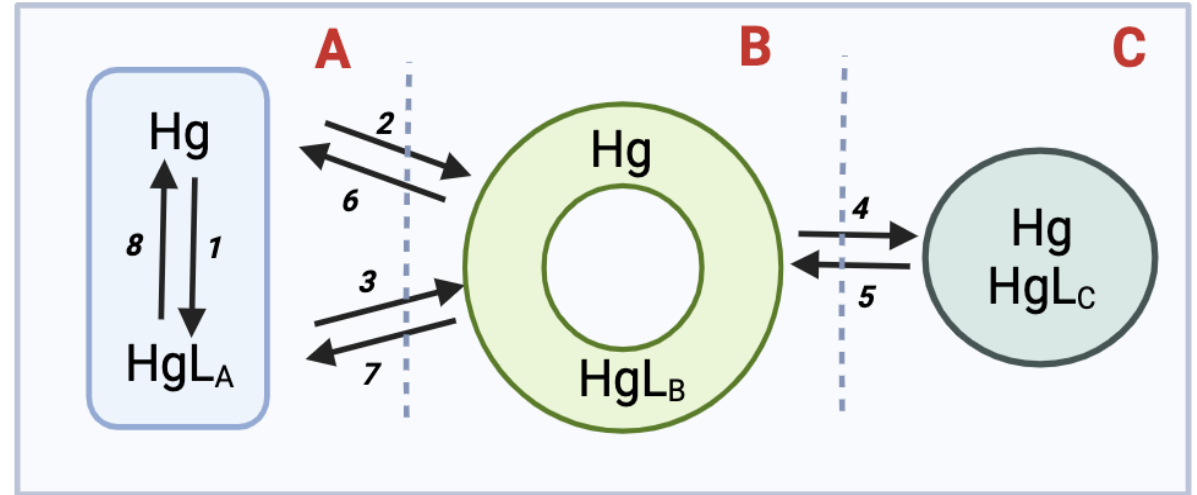
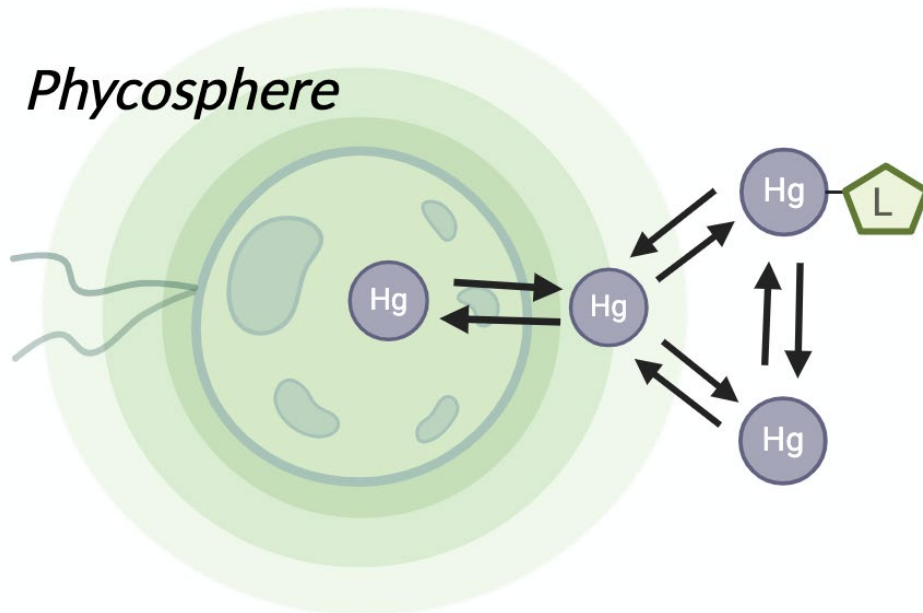
(Modified from Cossart et al. 2022)



Mercury accumulation pathways in a model marine microalga: Hg species sorption, uptake and partition kinetics

Kinetic modelling:

ODE box model



$$\text{spiked } Hg_t = [H \text{ Mass balance } Hg]LA_t$$

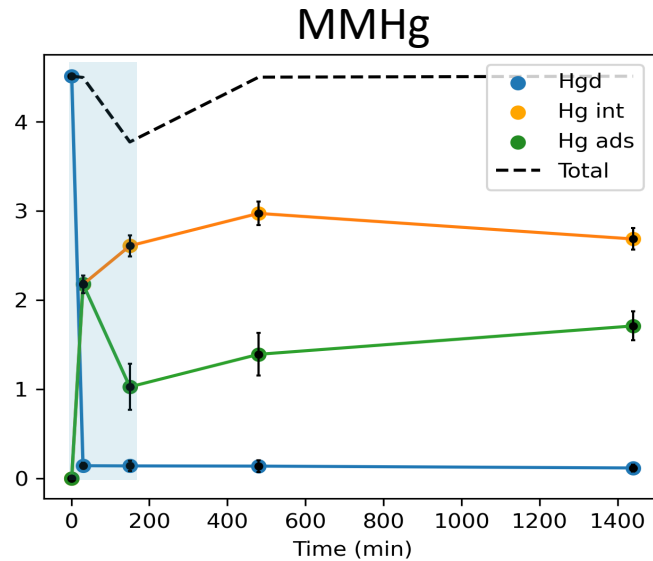
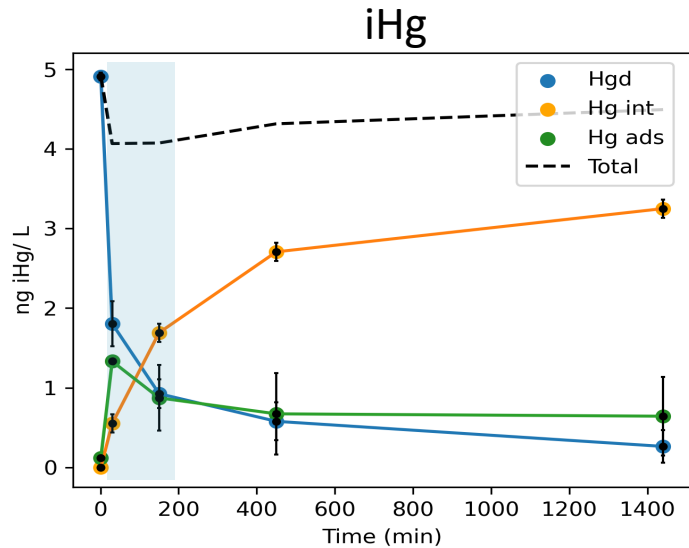
$$\frac{d[Hg]_{ads}}{dt} \text{ PFO reversible reactions } * e^{-tk_6}$$

$$\frac{d[Hg]_{ads}}{dt} = [Hg]ads_t - (k_6 + k_3 * [Hg]LA_t \text{ ODE based on diffusion driven by concentration gradient } k_3 * [Hg]LA_t$$



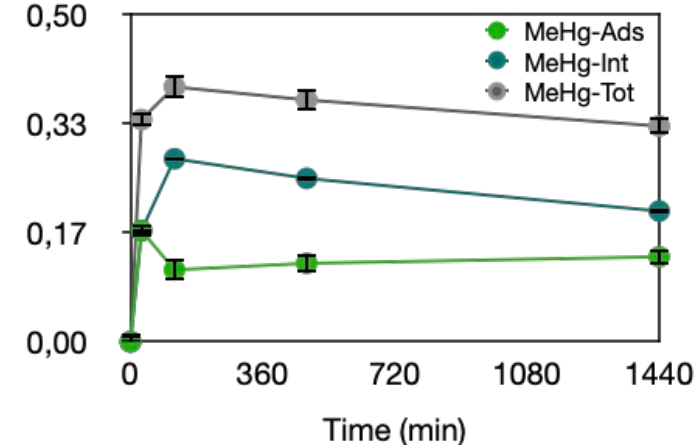
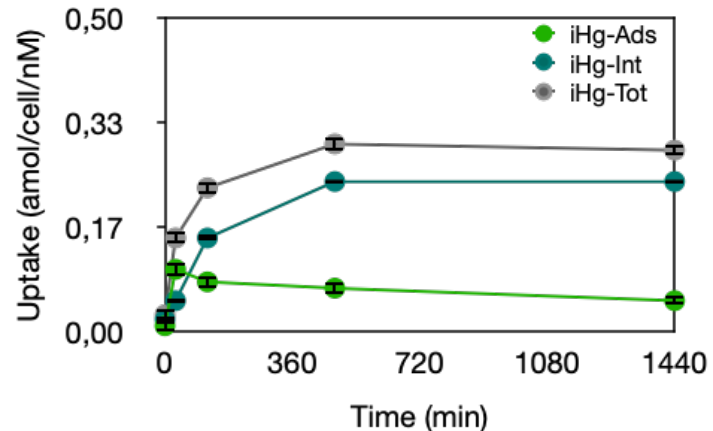
Mercury accumulation pathways in a model marine microalga: Hg species sorption, uptake and partition kinetics

Hg distribution



Determination of sorption, uptake, and release rates for both Hg species.

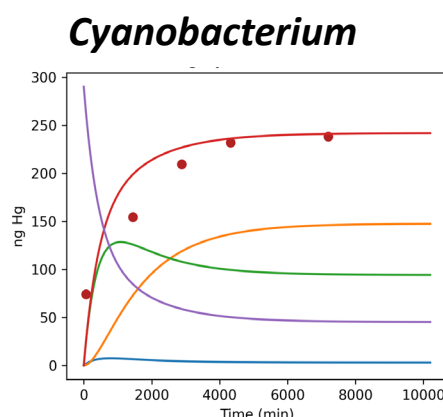
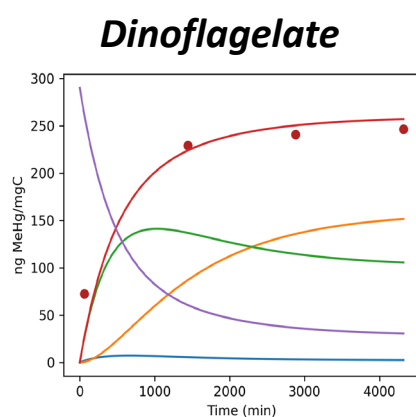
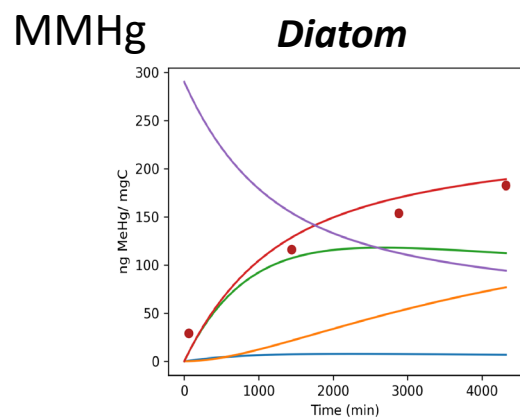
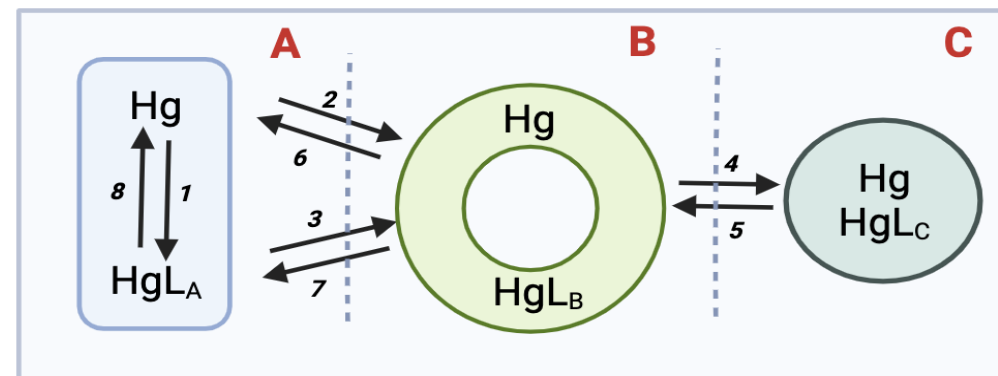
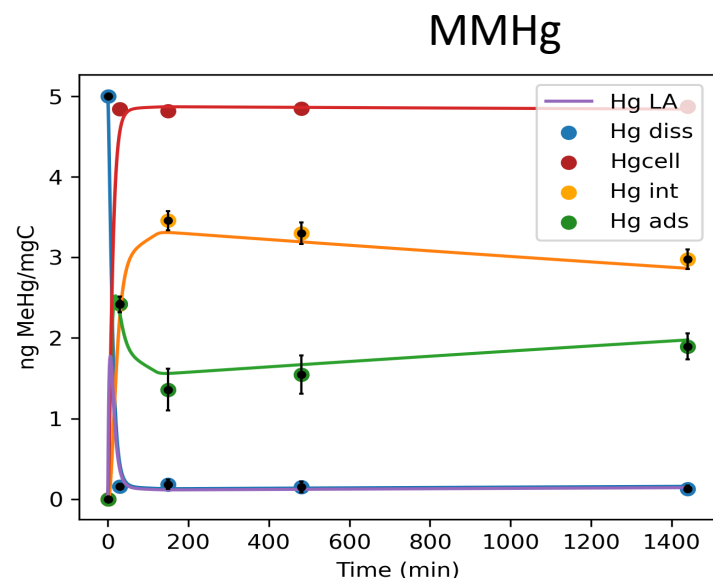
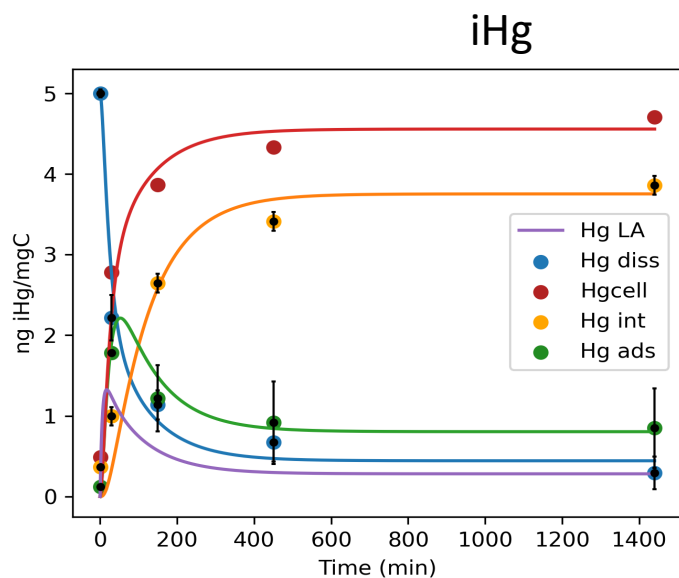
Cellular uptake



K_d (log L kg⁻¹)

	iHg	MMHg
Lab/Coastal	5.34 ±	5.96 ±
Open ocean	0.30	0.08
	6.59 ±	6.94 ±
	0.30	0.08

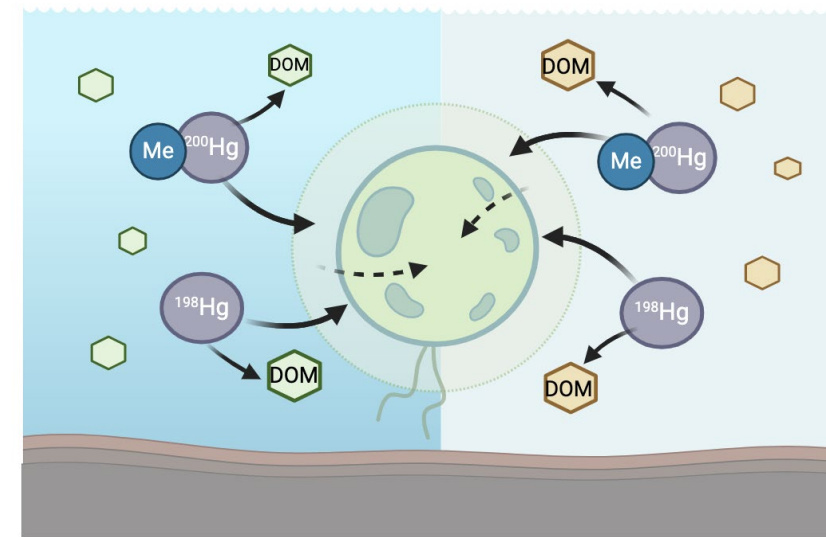
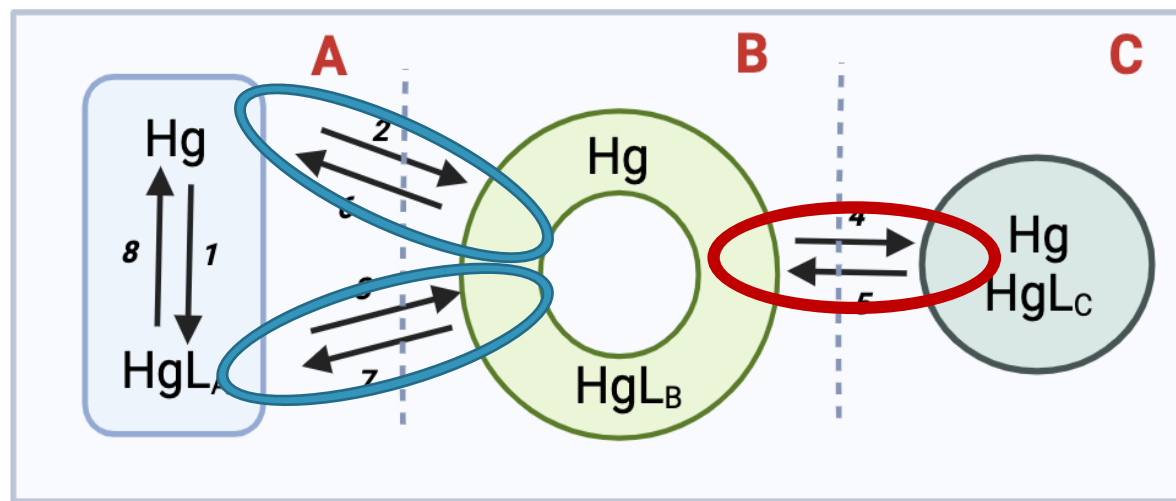
Cellular accumulation of Hg in marine phytoplankton: 4-site model



- New kinetic parameters proved to be applicable to model cellular accumulation of different groups of phytoplankton

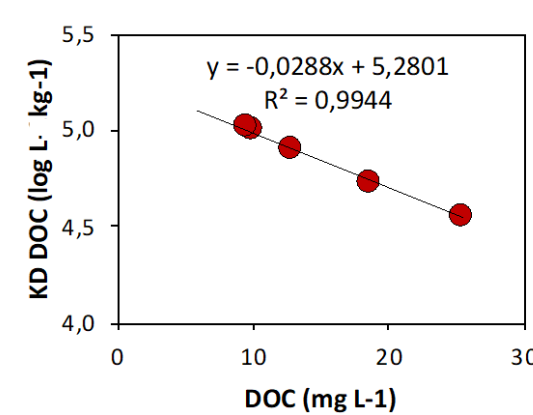
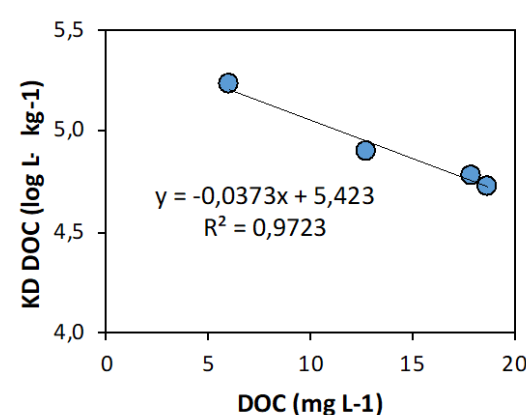
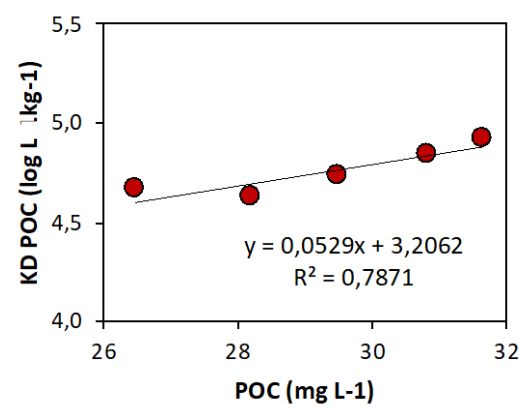
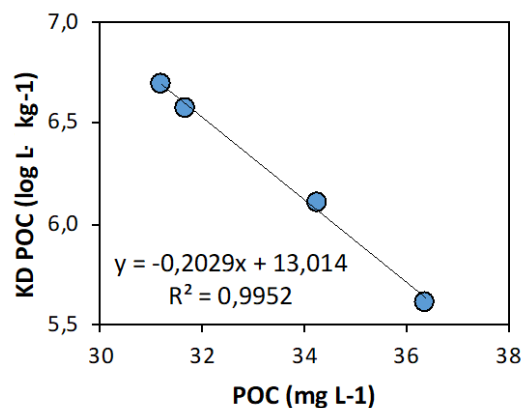


How do internalization rates of iHg and MMHg by phytoplankton vary due to DOM characteristics and/or concentration?

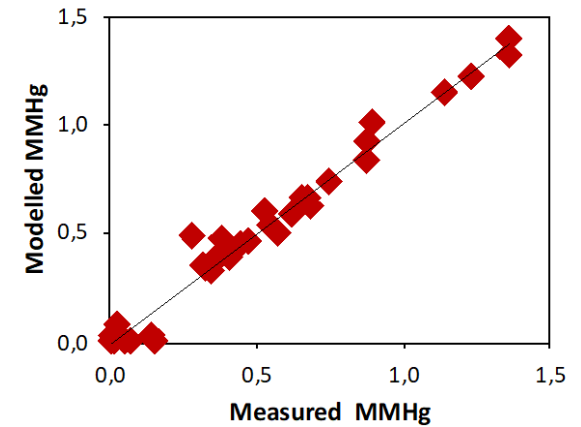
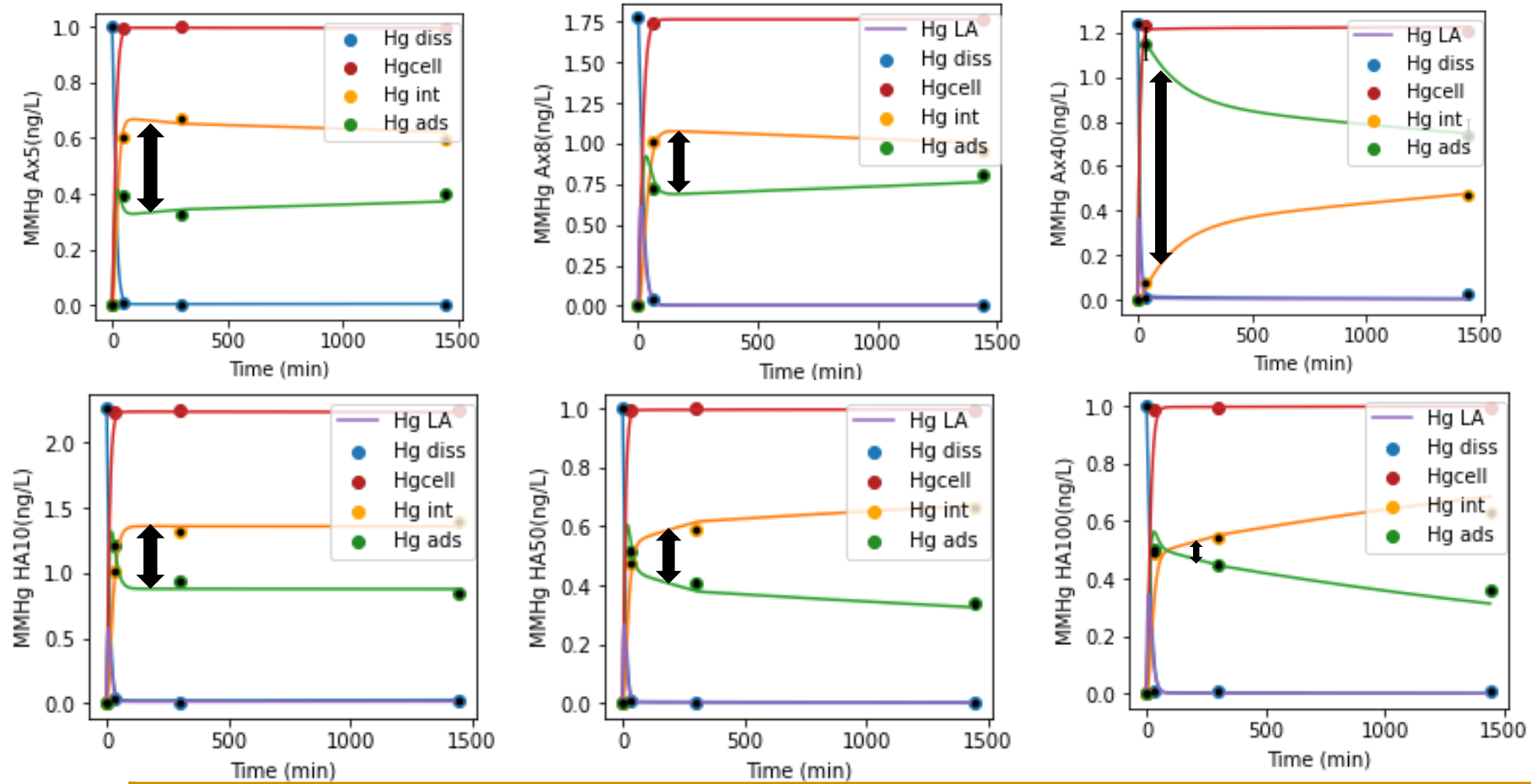


iHg

MMHg

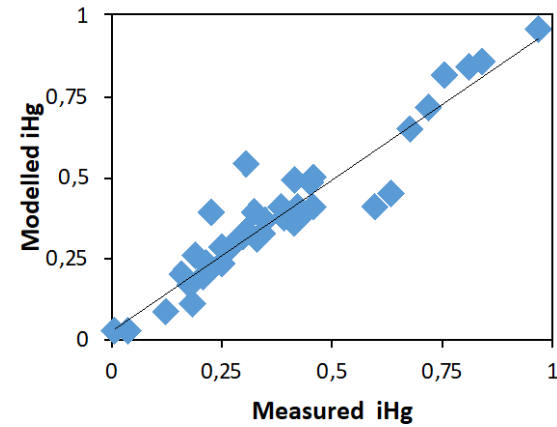
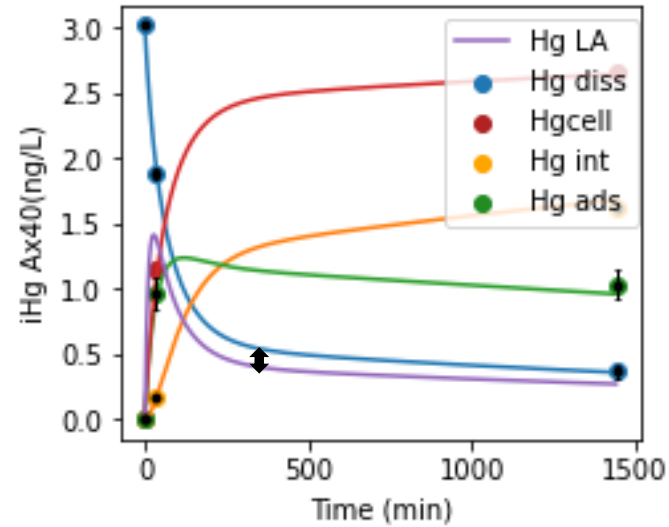
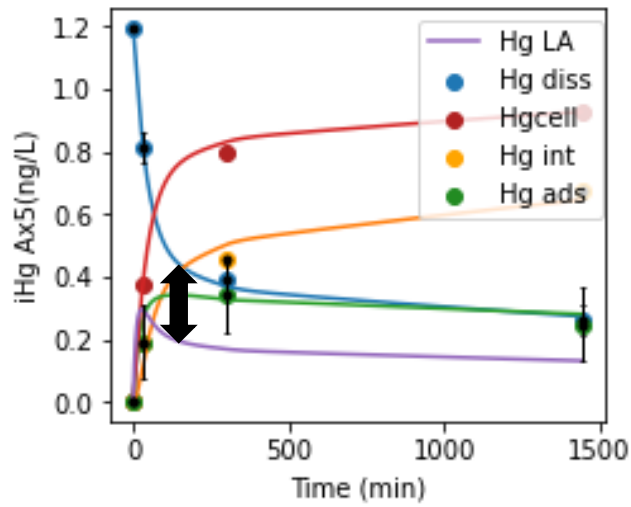


MMHg

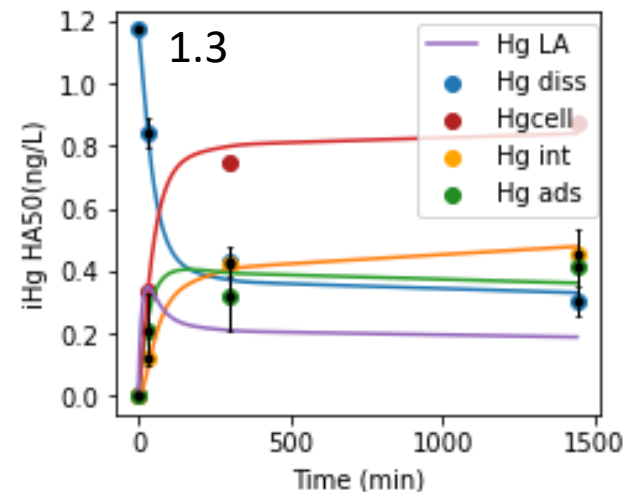
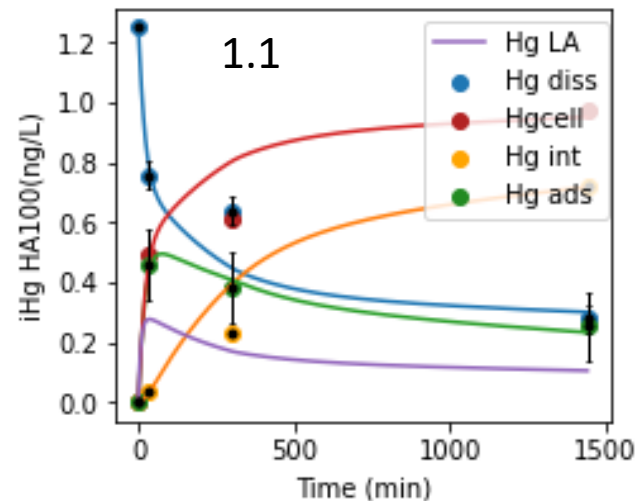
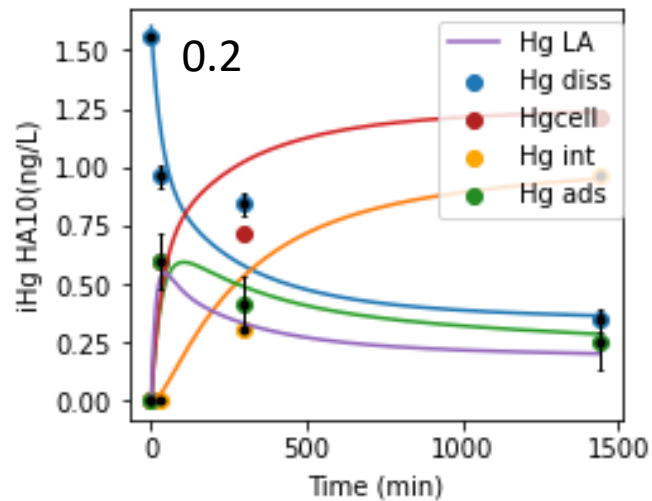


DOC was successfully used as a proxy for both Algae-derived and HA DOM impacts on MMHg internalization and adsorption.

iHg

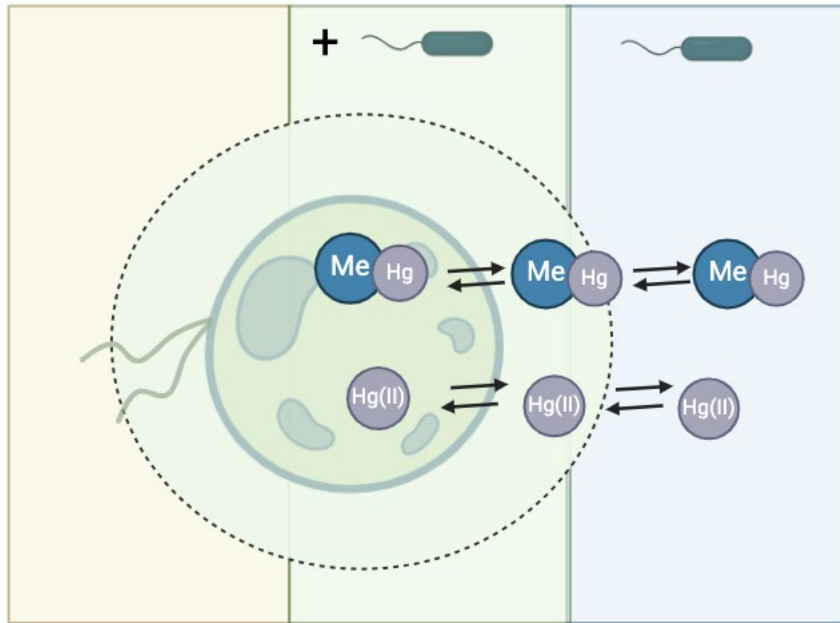


DOC was successfully used as a proxy for Algae-derived impacts on iHg internalization and adsorption.



HA-DOM/A-DOM ratio is needed to predict HA effects.

Mercury transformation mediated by a model marine microalga (*Tisochrysis lutea*)

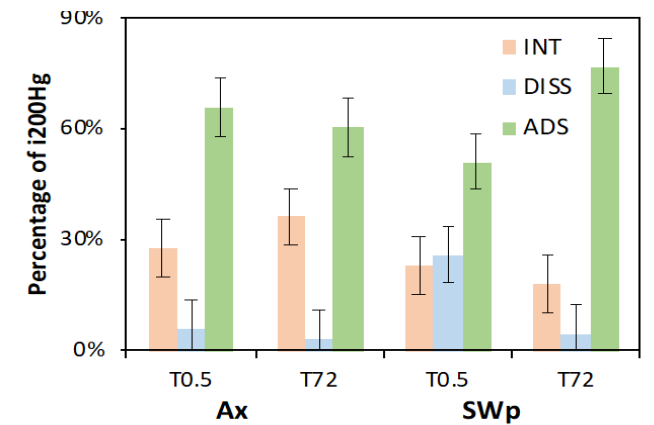
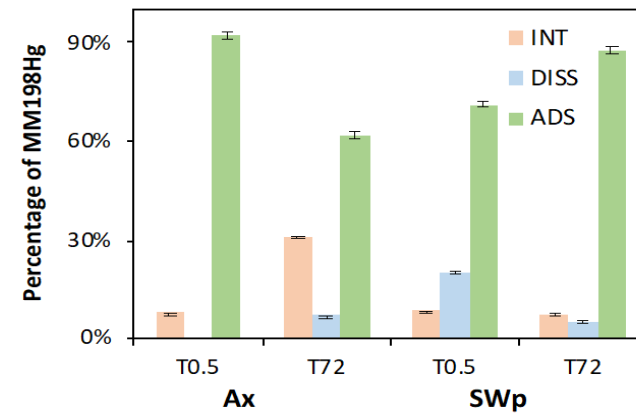
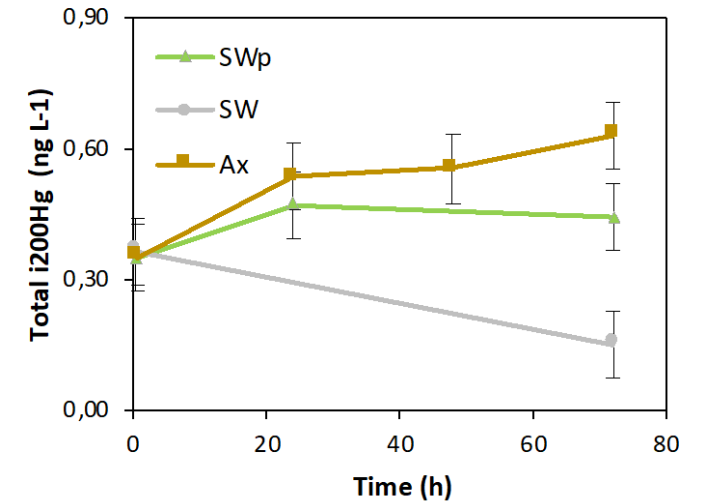
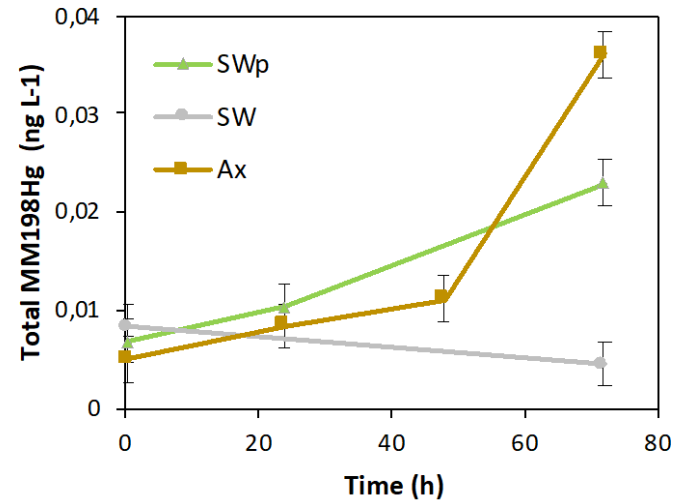


axenic conditions = Ax

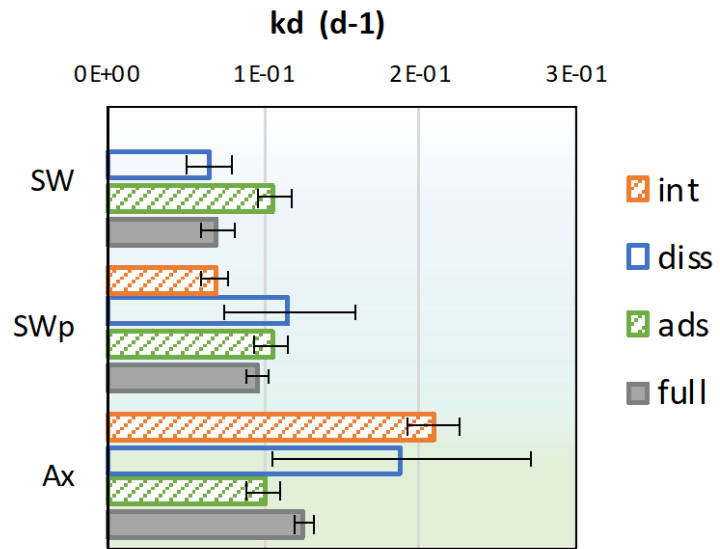
T. lutea + seawater = SWp

unfiltered seawater = WP

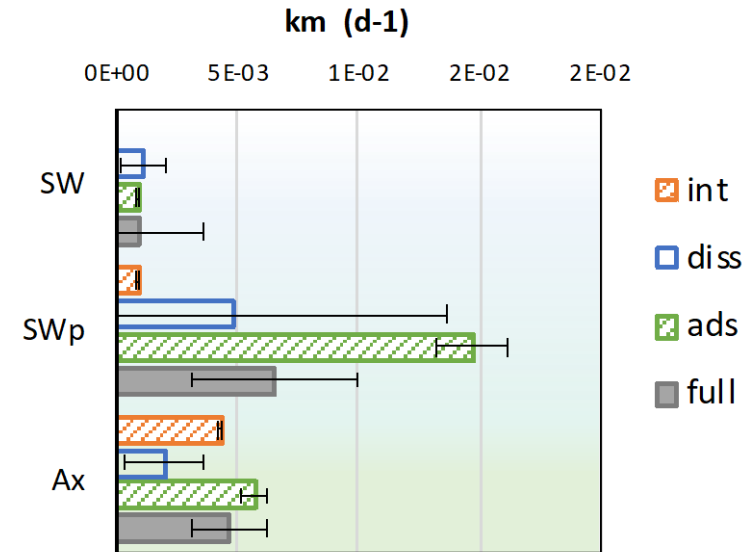
Tracer transformation in each compartment



Demethylation potential

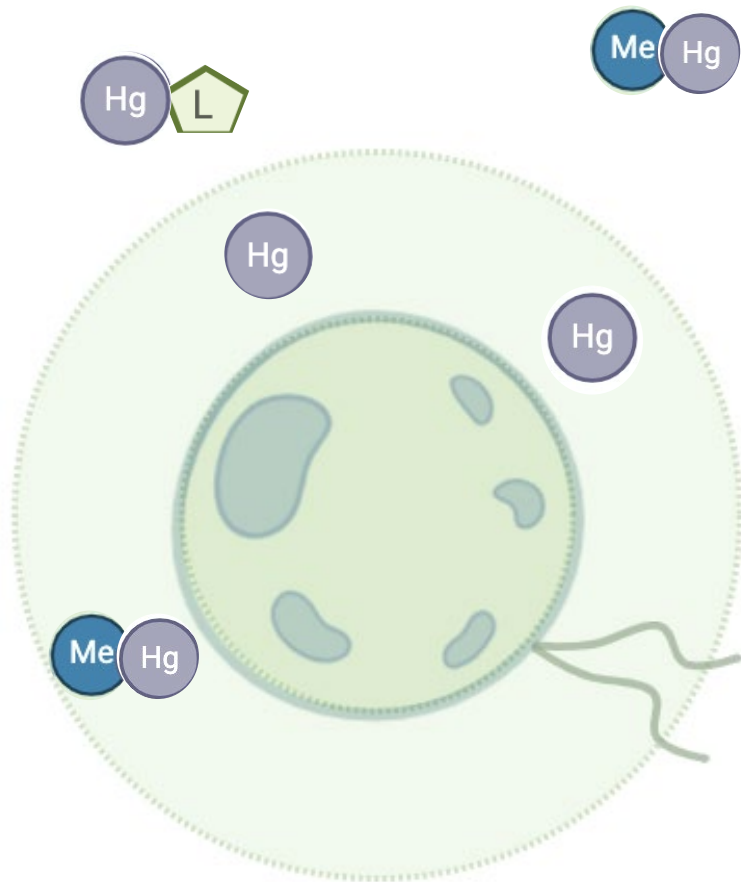


Methylation potential



- Significant MeHg >> iHg transformation
 - Higher potential for axenic conditions in dissolved and internalized compartments

- Insights of mercury methylation potential
 - Higher potential methylation in the phycosphere



Increase in algae DOM

- ↑ Internalization
- ↓ Adsorption
- ↓ Efflux
- ↓ Desorption

iHg	MMHg
↓ ++	↑+++
↑+++	↓ ++
↓ +++	↓++
↓+	↓+

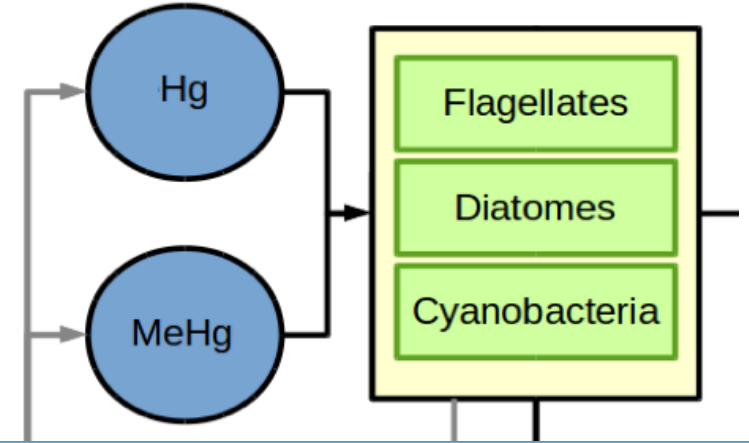
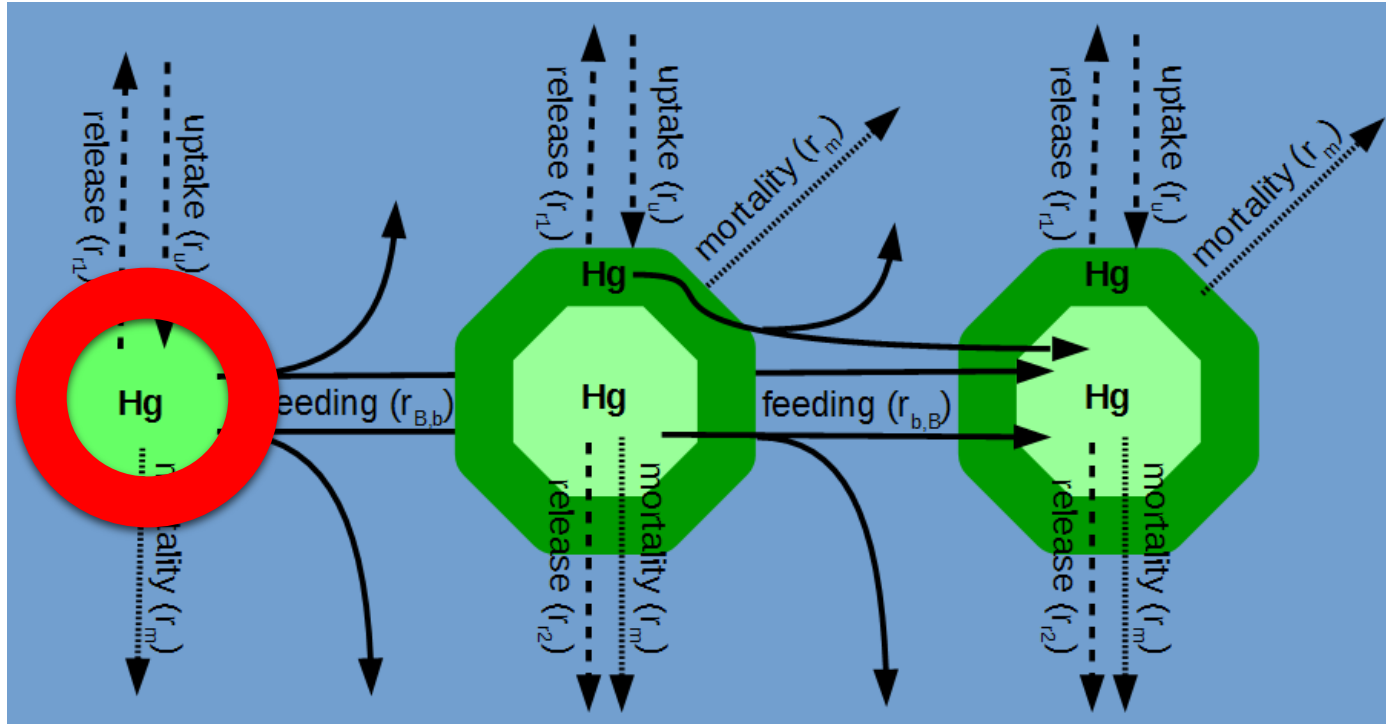
Increase in T DOM

- ↑ Internalization
- ↑ Adsorption
- ↑ Efflux
- ↑ Desorption

iHg	MMHg
↓++	↑ +
↑++	↑ ++
↓ ++	↑ ++
↑ ++	↑ +

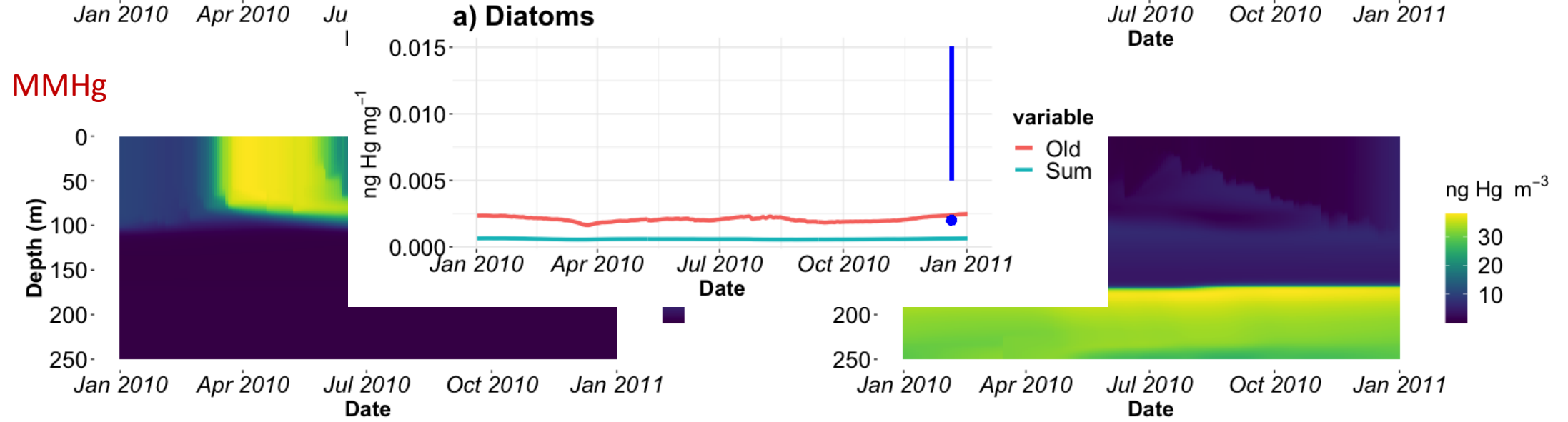
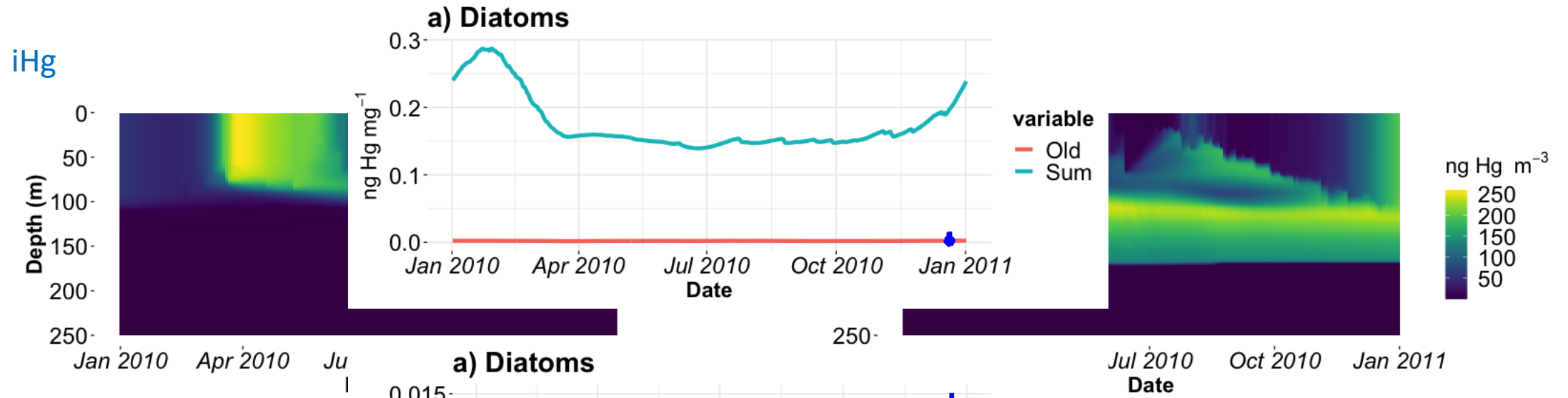


Implications: Role of phycosphere in mercury species sorption, uptake and transformations by phytoplankton



- Uptake rates
- Release rates
- Hg transformation within compartments





Conclusions and perspectives

>> Processes

- > Sorption and uptake of Hg species by marine phytoplankton
- > Hg transformation mediated by a model living particle

>> Role of:

- > Compartments: phycosphere
- > DOM influence on sorption and uptake

Internalization is the predominant process for iHg uptake, while adsorption is still relevant for MeHg uptake.

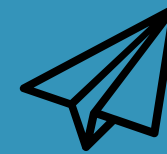
Higher proportion of MMHg produced in the phycosphere.

The results are enriched by adding an using ODE numerical integration model and applied model scenario with the new parameters.

PHYTOX



THANK YOU



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Open to work!

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