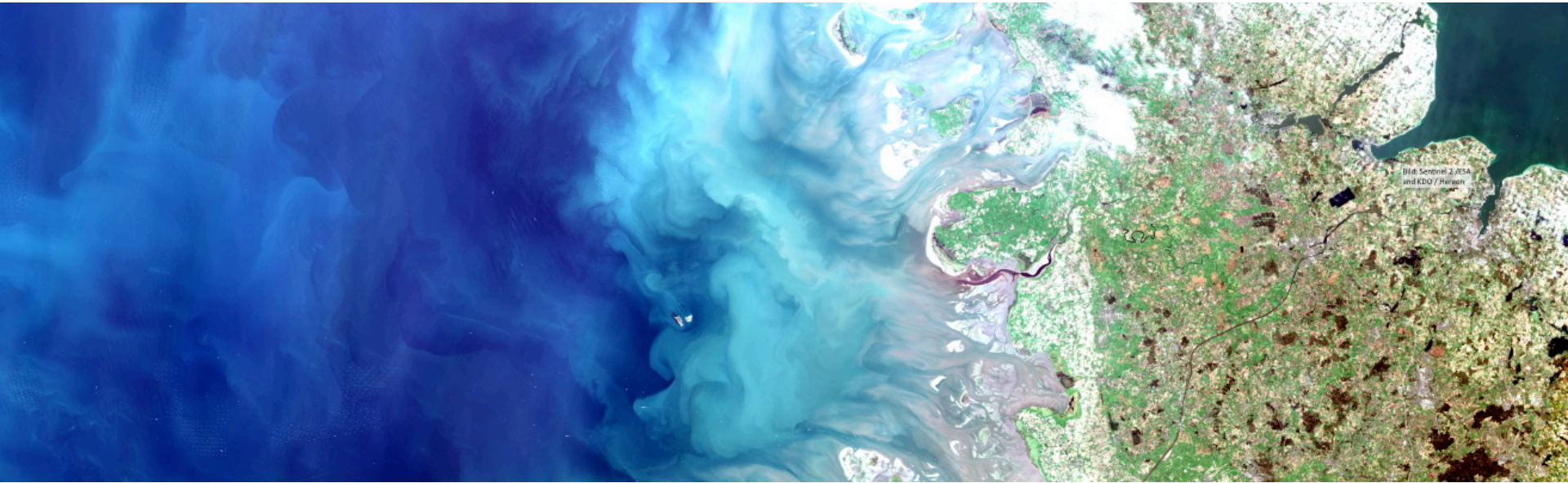


# ICON-MERCY

A global model for marine Hg cycling and bioaccumulation



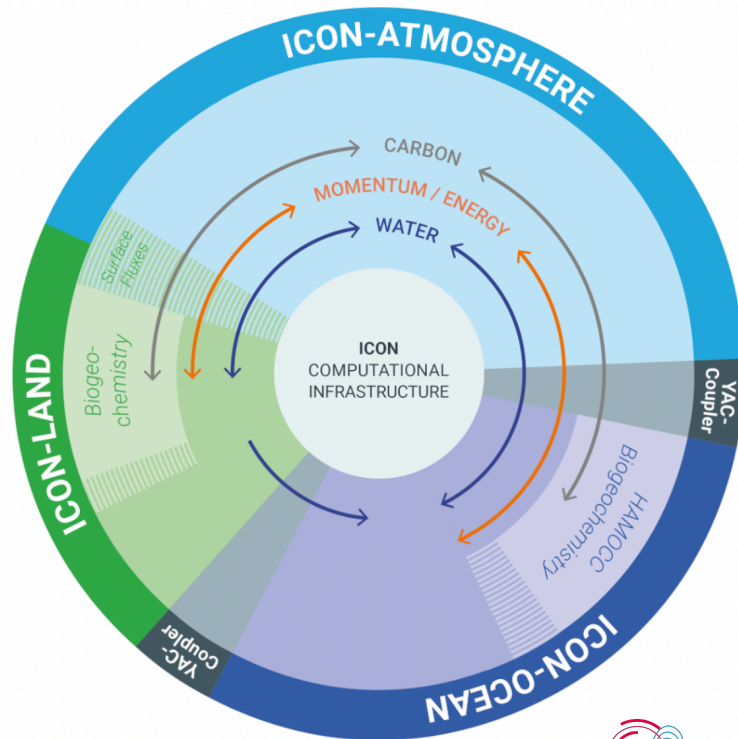
**Johannes Bieser**, Kai Logemann, Ute Daewel  
**Helmholtz-Zentrum Hereon**  
Institute for Modeling and System Analysis

July 25th, 2024  
16th ICMGP, Cape Town, South Africa



# ICON

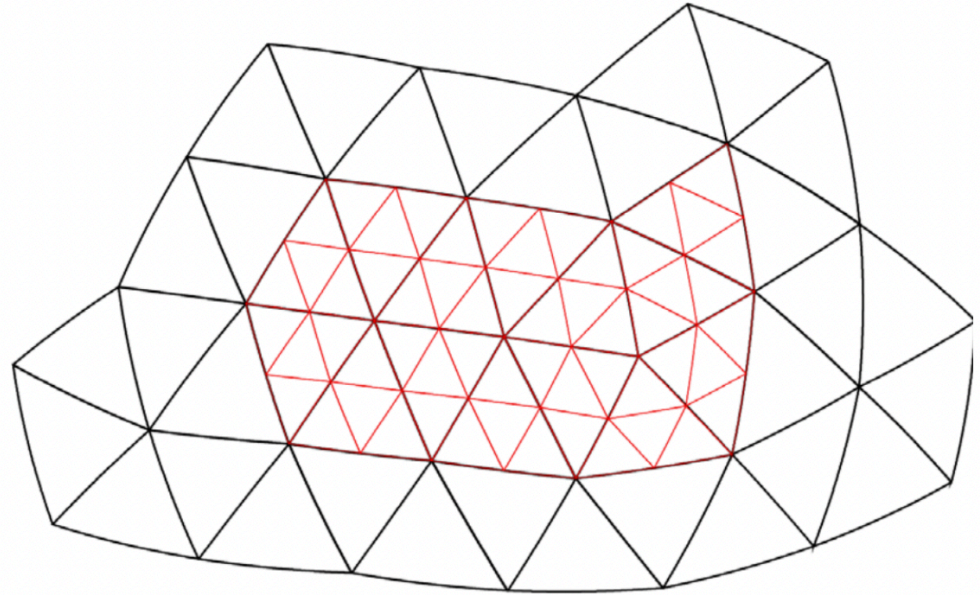
ICOsahedral Non-hydrostatic model



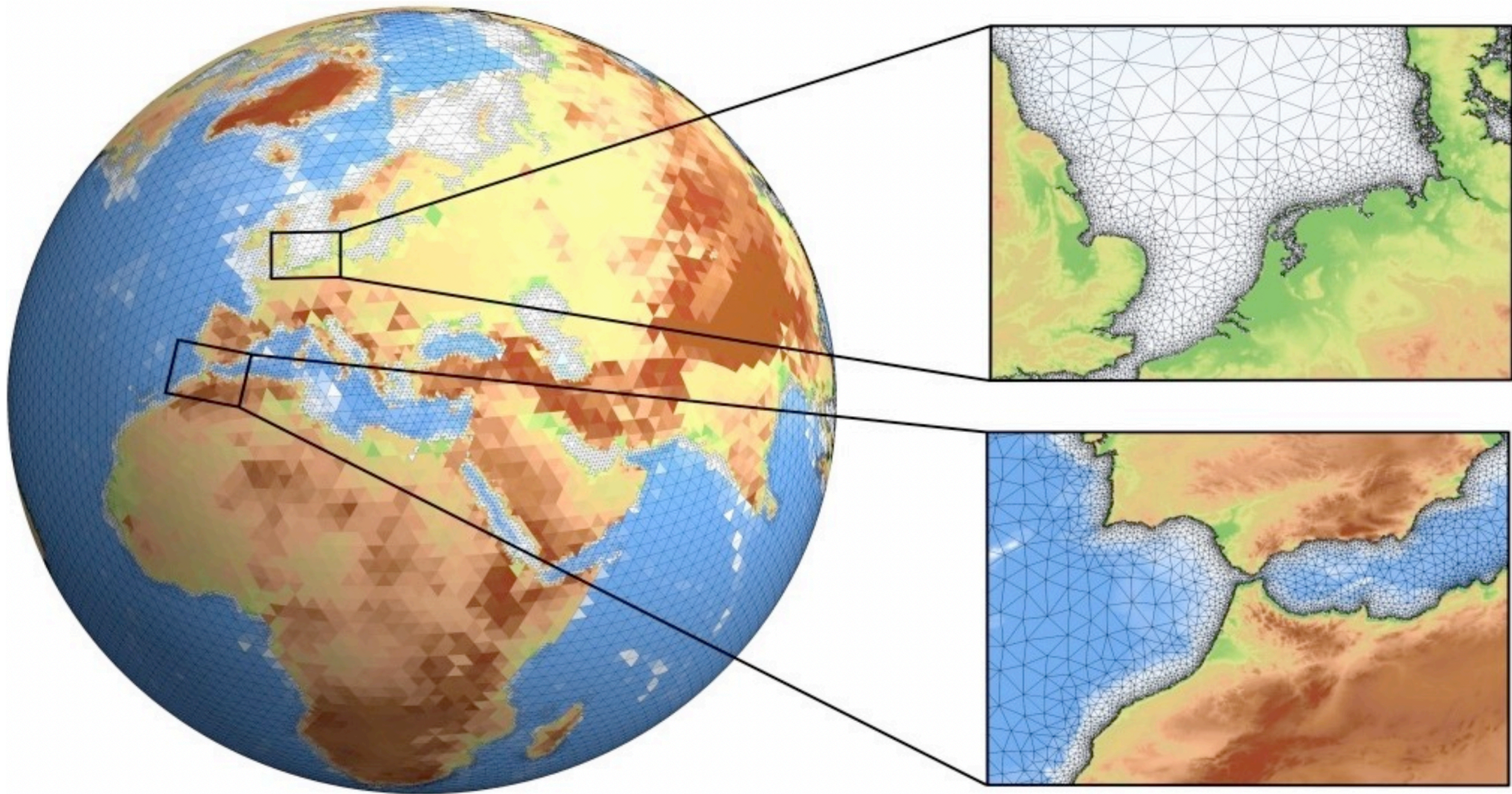


The diagram illustrates a triangular lattice structure. A central green dot is labeled  $i$ . A red arrow labeled  $l$  points from  $i$  to a green dot labeled  $y$ . A blue arrow labeled  $l'$  points from  $i$  to a black dot. A black arrow labeled  $l^*$  points from  $i(l^*, 1)$  to  $i(l^*, 2)$ . A shaded triangle is labeled  $\delta_i \lambda_i / 8$ . A red bracket labeled  $\lambda_i$  spans the width of the lattice. A red bracket labeled  $\delta_i$  spans the height of the lattice.

## ... in the presence of nesting



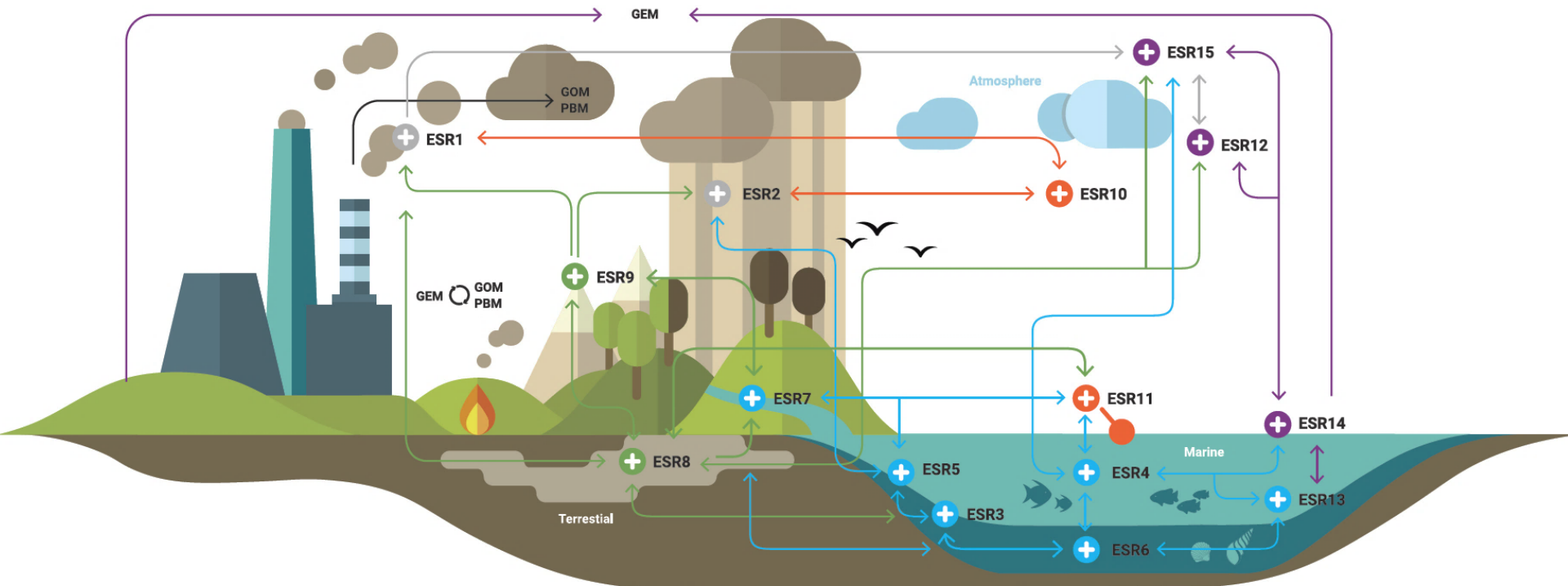
Red cells refer to refined domain  
Boundary interpolation is needed from  
parent to child mass points and velocity  
points





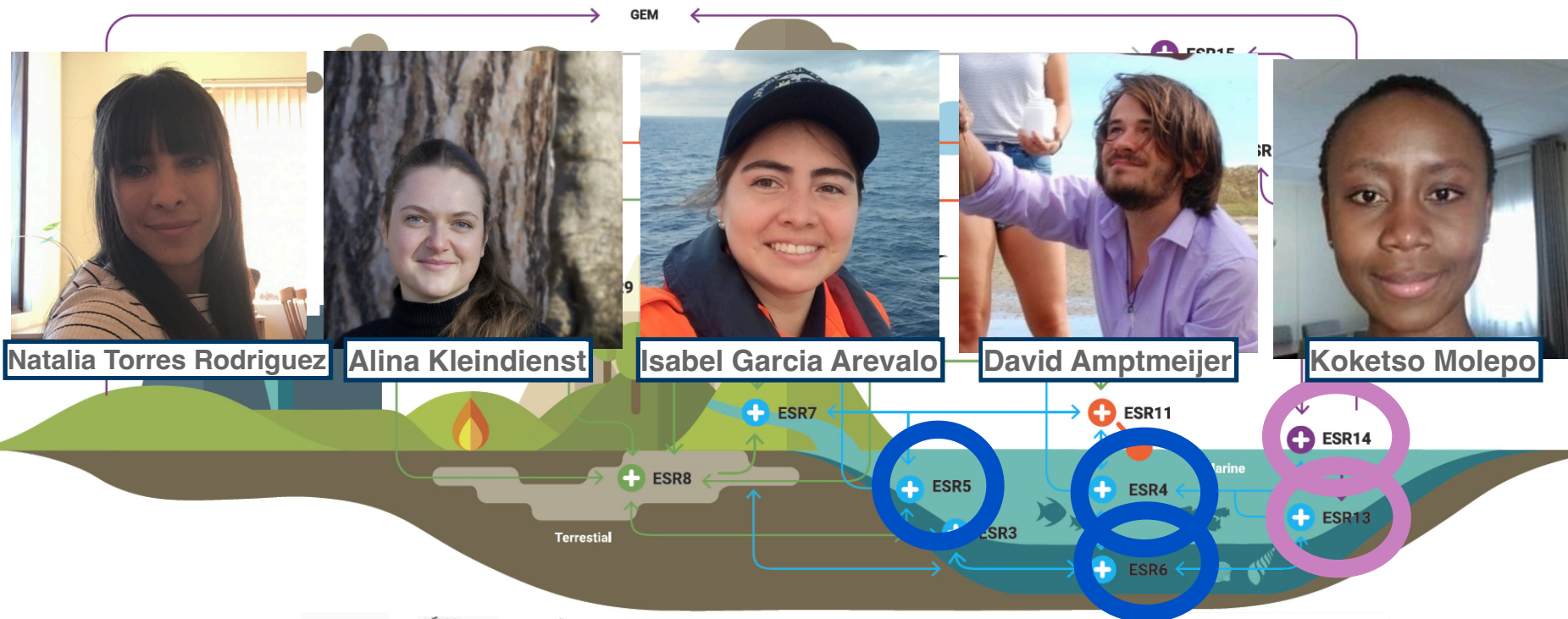
## Work Packages

- WP1** (ESRs 1-2) Atmospheric processes
- WP2** (ESRs 3-7) Marine processes
- WP3** (ESRs 8-9) Terrestrial and water systems
- WP4** (ESRs 10-11) Traceability & sensors
- WP5** (ESRs 12-13) & **WP6** (ESRs 14-15) Modelling

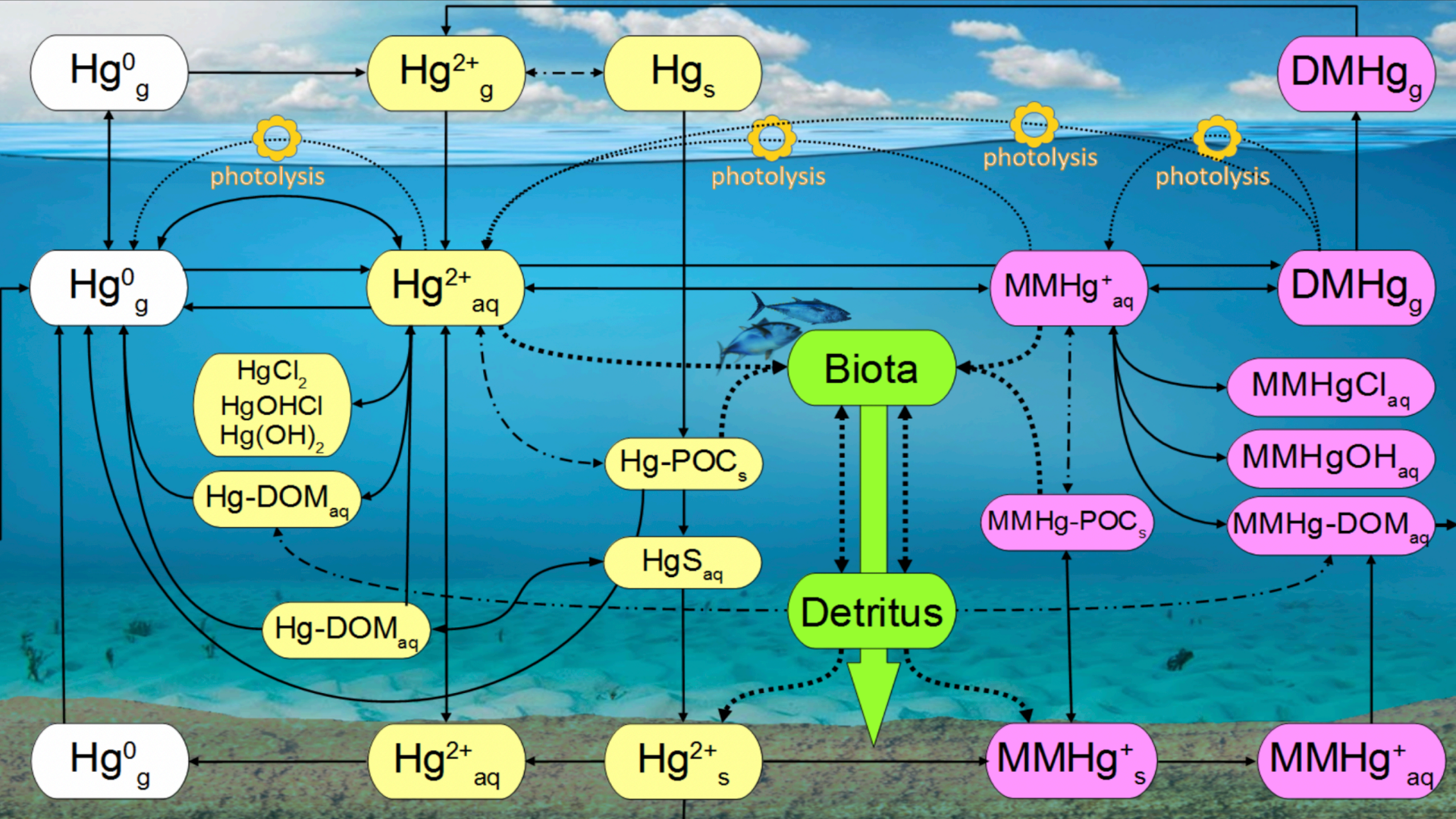


## Work Packages

- WP1** (ESRs 1-2) Atmospheric processes
- WP2** (ESRs 3-7) Marine processes
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# Article

Articles / Volume 16, issue 9 / GMD, 16, 2649–2688, 2023

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Model description paper | 

## The 3D biogeochemical marine mercury cycling model MERCY v2.0 – linking atmospheric Hg to methylmercury in fish

Johannes Bieser , David J. Amptmeijer, Ute Daewael, Joachim Kuss, Anne L. Soerensen, and Corinna Schrum

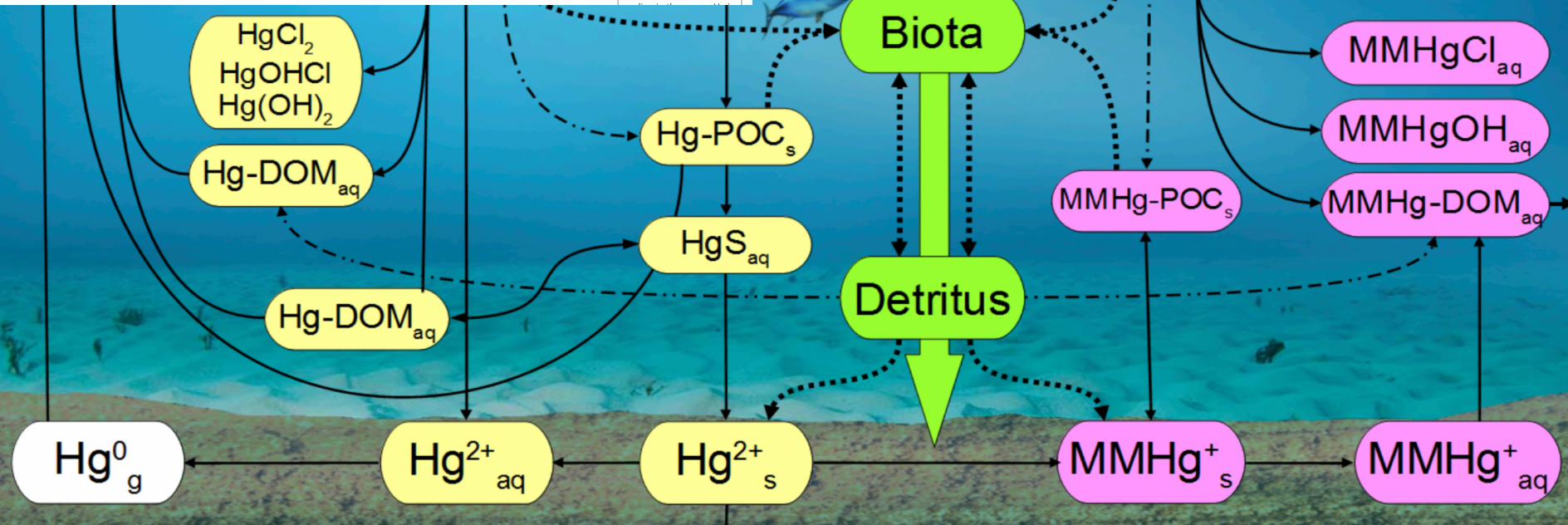
17 May 2023

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- EndNote

### Short summary

MERCY is a 3D model to  
study mercury (Hg)



# Article

Articles / Volume 16, issue 9 / GMD, 16, 2649–2688, 2023

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Model description paper | ©

## The 3D biogeochemical marine mercury cycling model MERCY v2.0 – linking atmospheric Hg to methylmercury in fish

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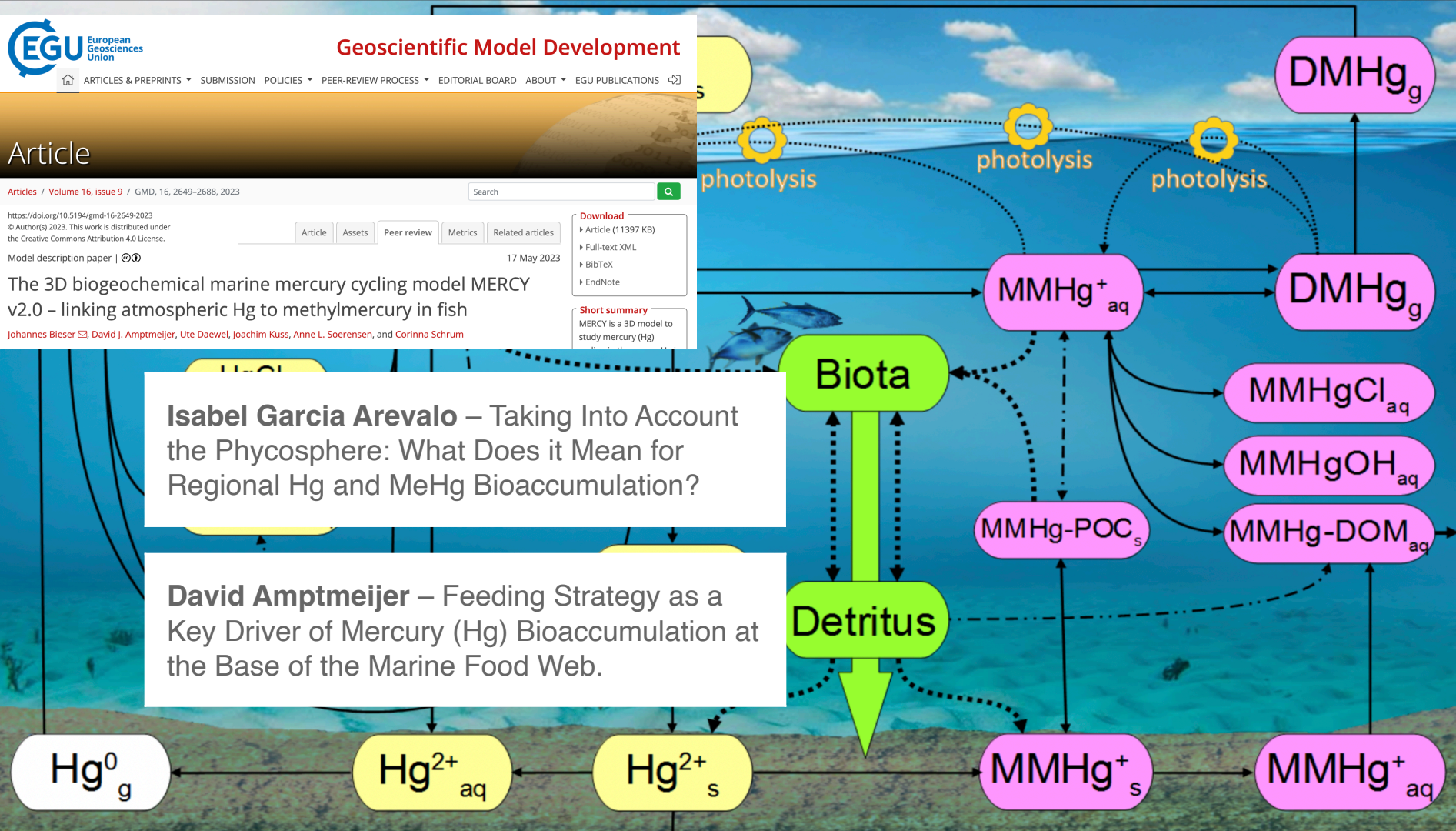
EndNote

### Short summary

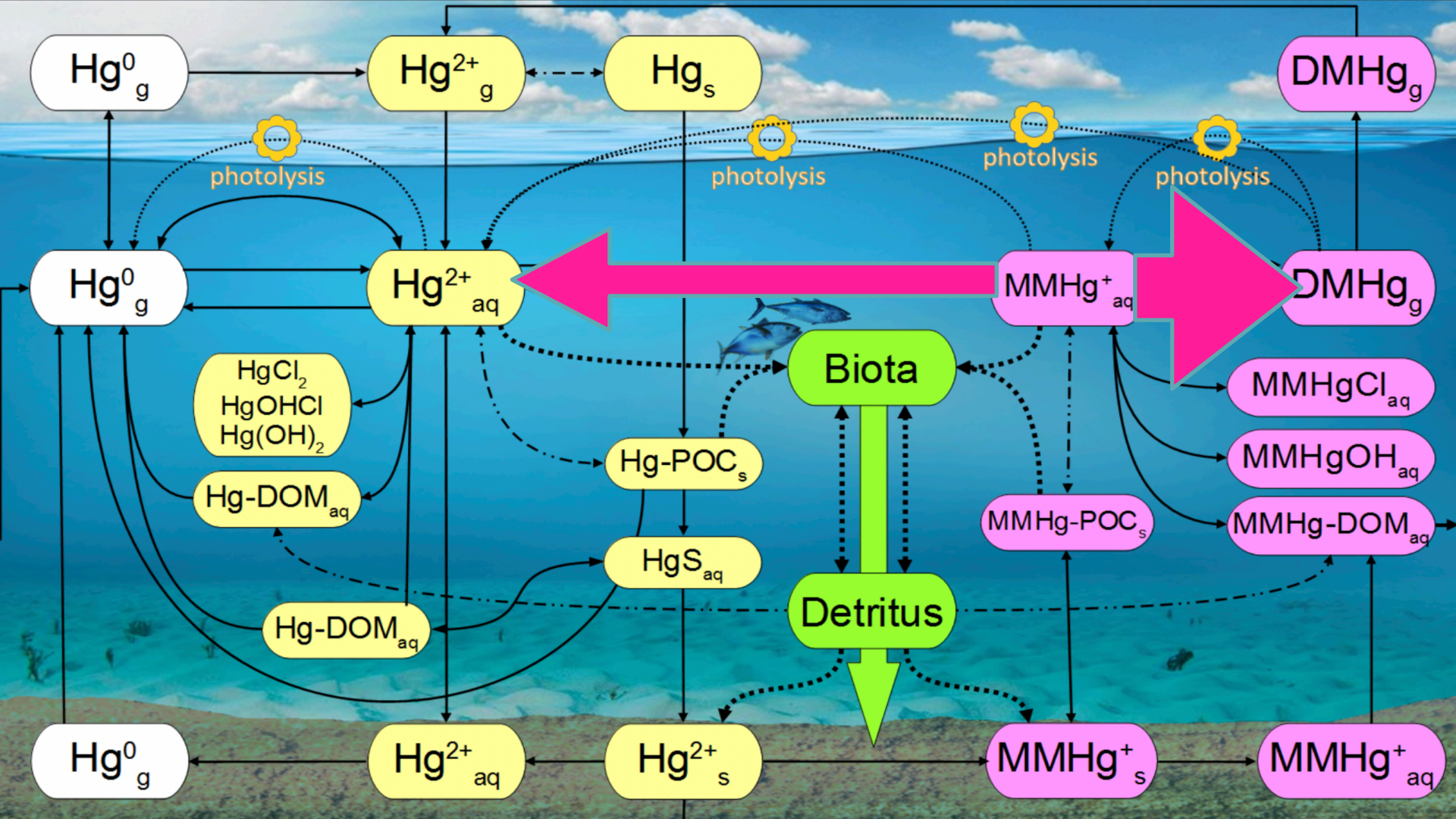
MERCY is a 3D model to study mercury (Hg) cycling in the marine environment.

**Isabel Garcia Arevalo** – Taking Into Account the Phycosphere: What Does it Mean for Regional Hg and MeHg Bioaccumulation?

**David Amptmeijer** – Feeding Strategy as a Key Driver of Mercury (Hg) Bioaccumulation at the Base of the Marine Food Web.

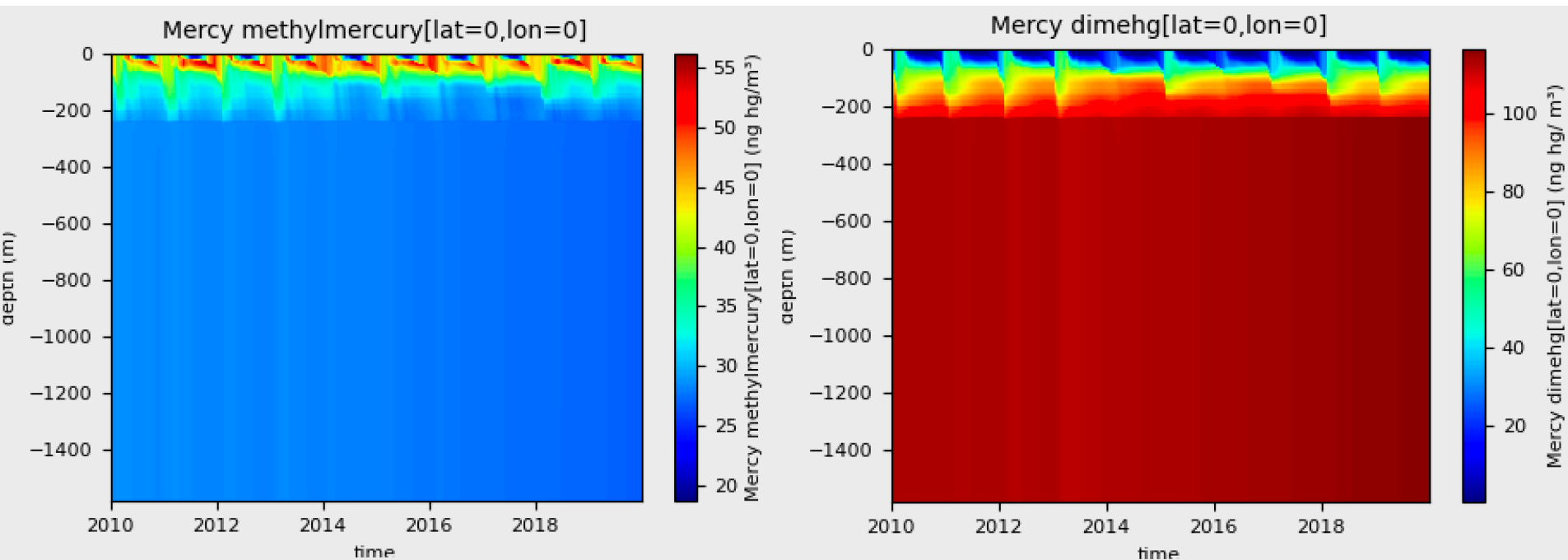






# Updated marine Hg chemistry

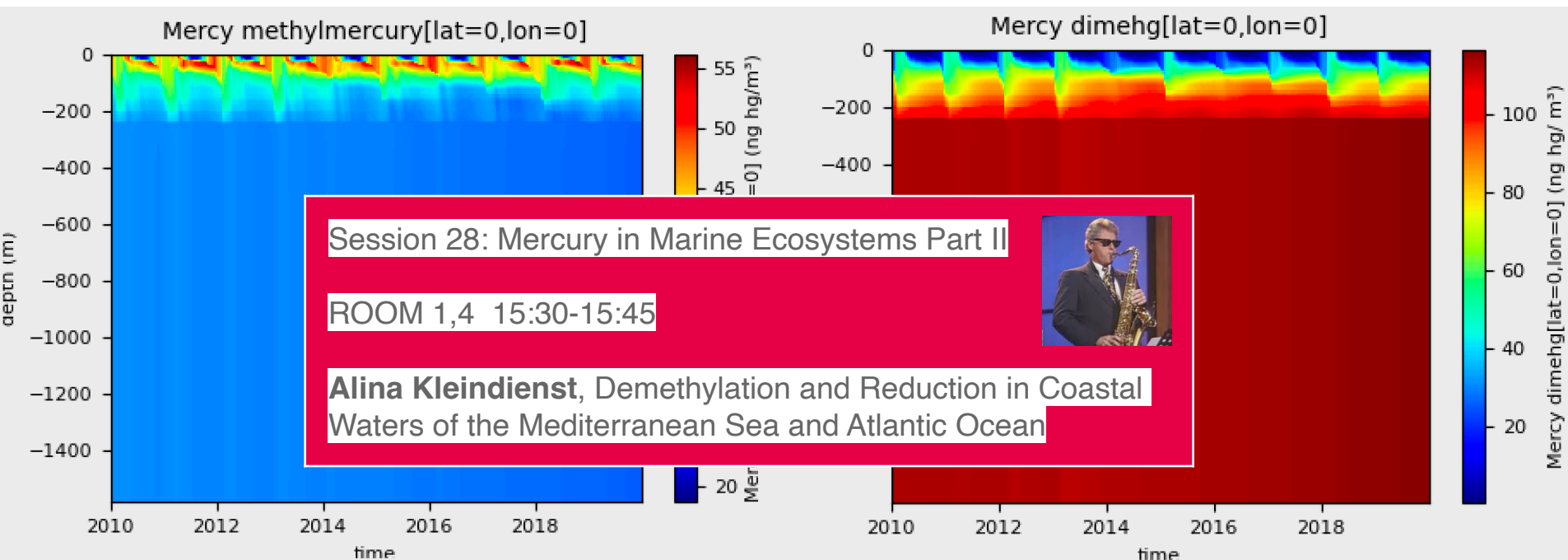
New mechanism and rates for red-ox and (de-)methylation based on novel observations.





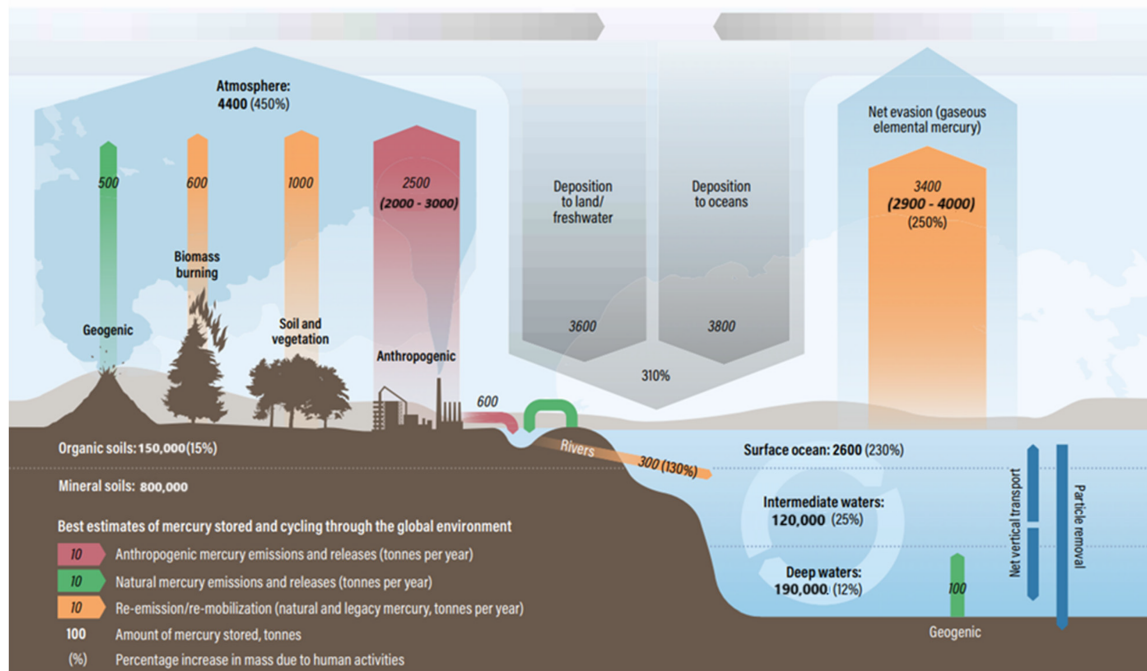
# Updated marine Hg chemistry

It's dimethyl, stupid!



# GMA2018 air-sea exchange estimates

current flux estimates

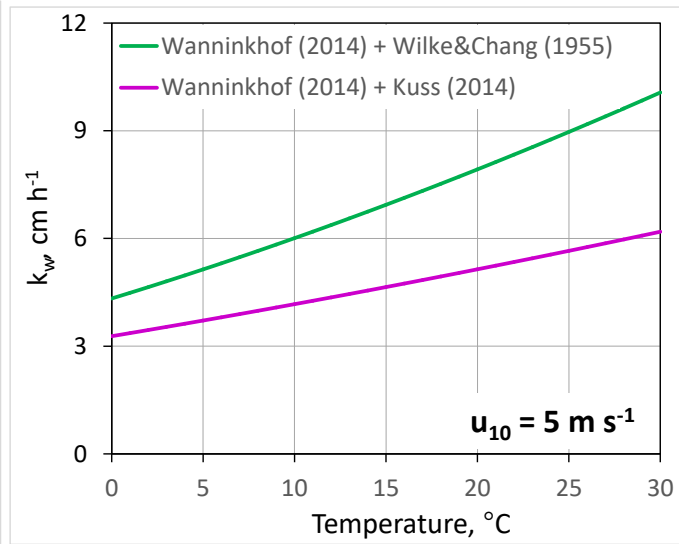
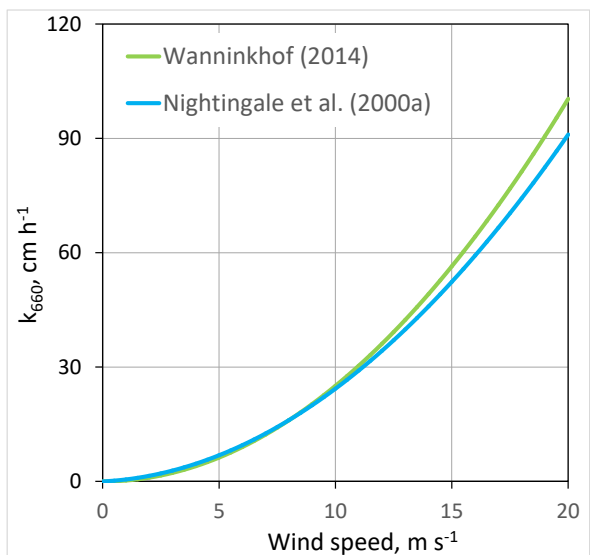
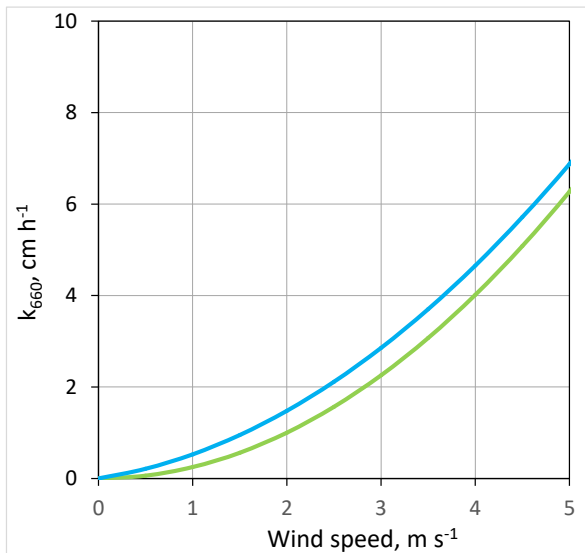


2900 t/a  
to  
4000 t/a

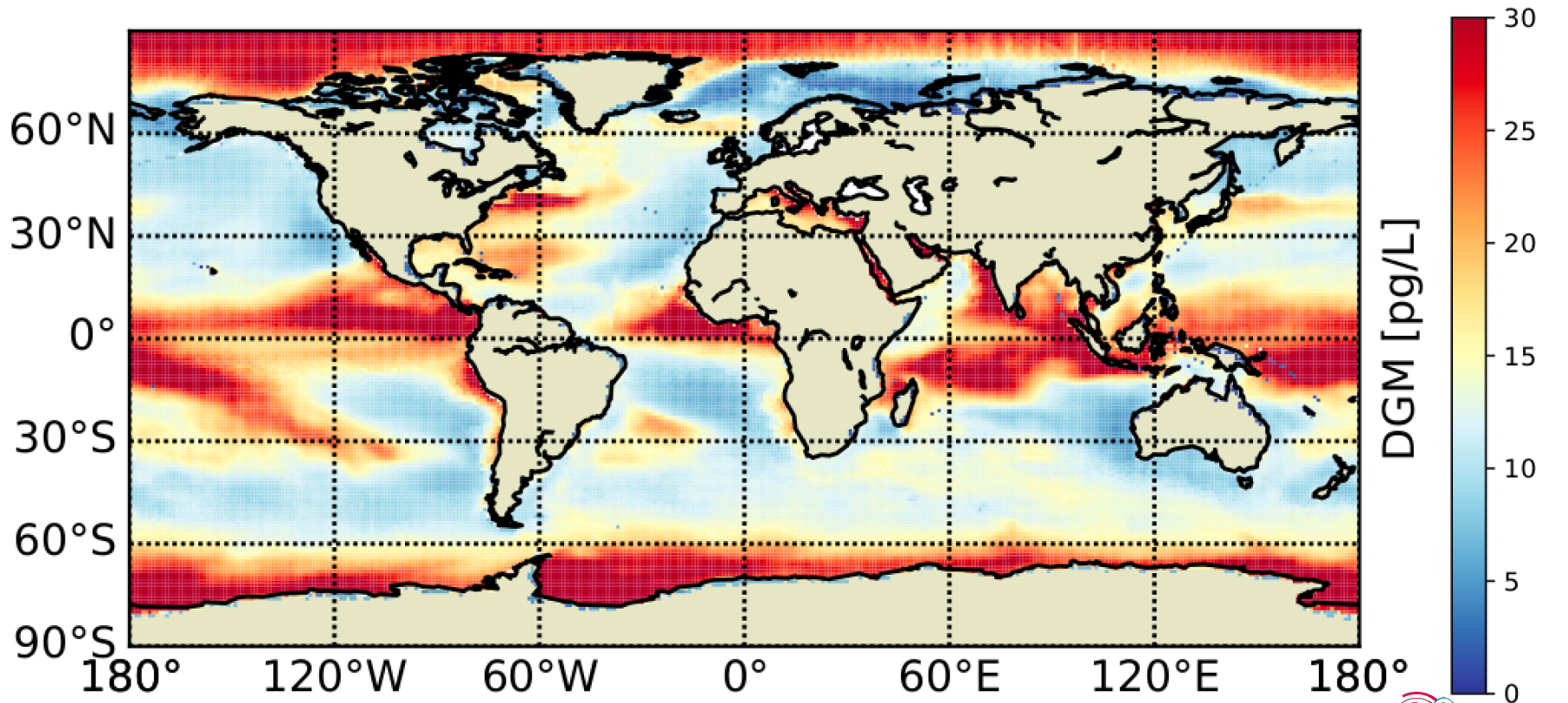


# Air-sea exchange parametrization

To infinity and beyond...

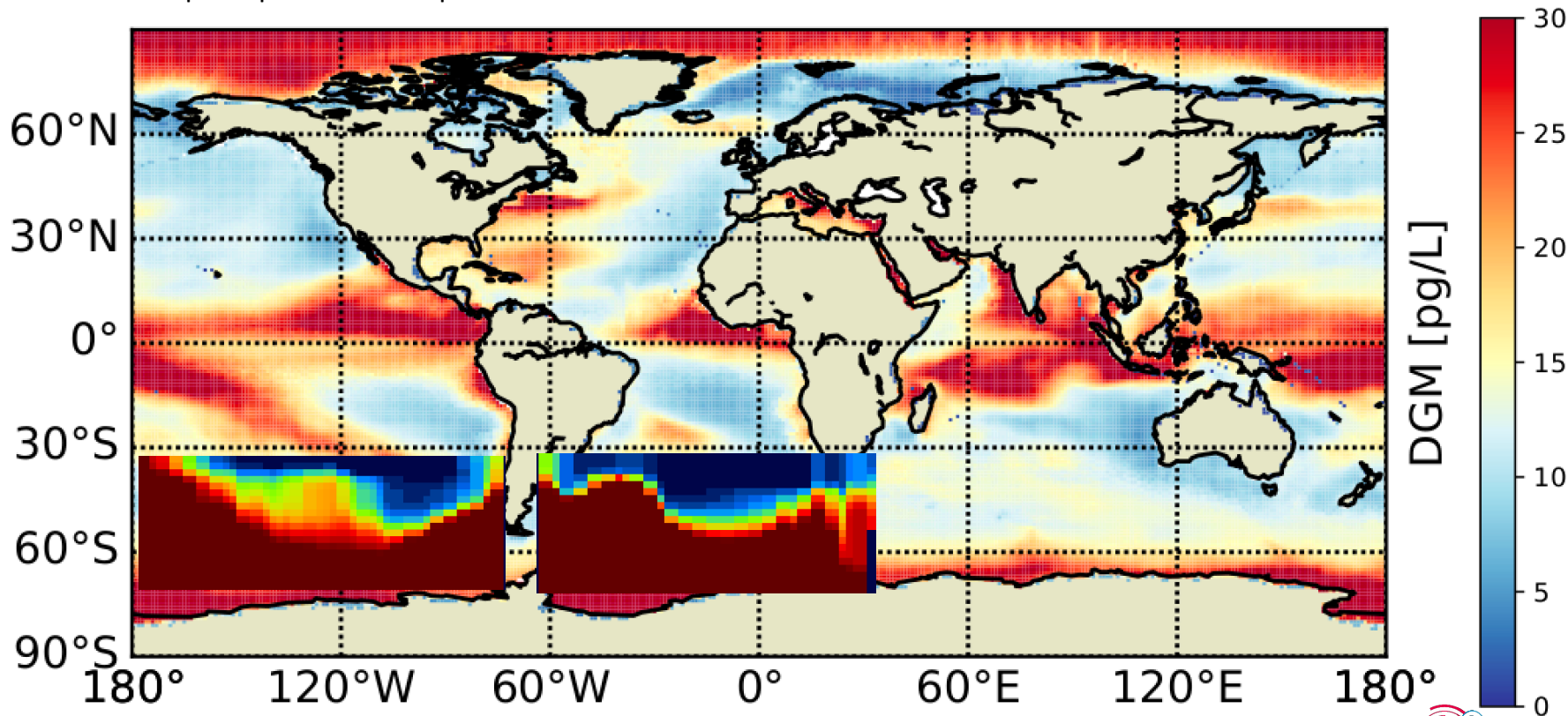


## Average ocean surface dissolved elemental Hg<sup>0</sup> concentration



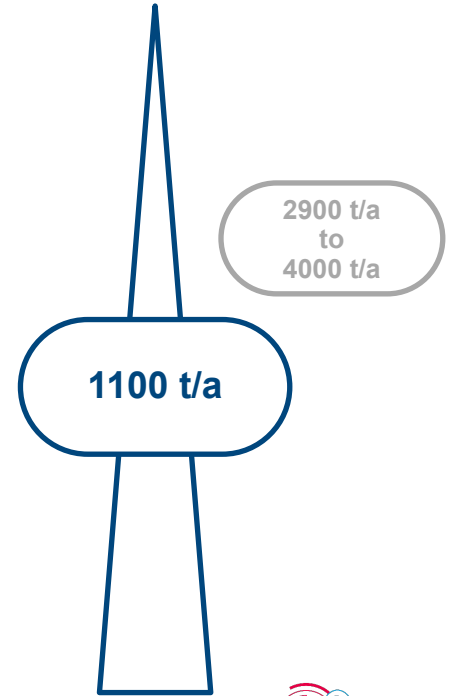
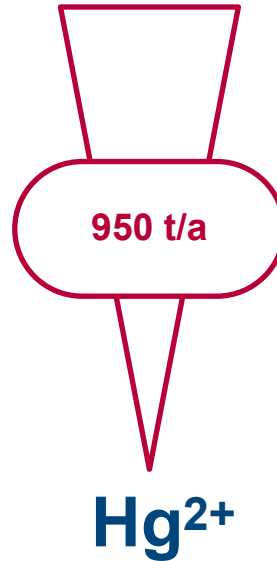
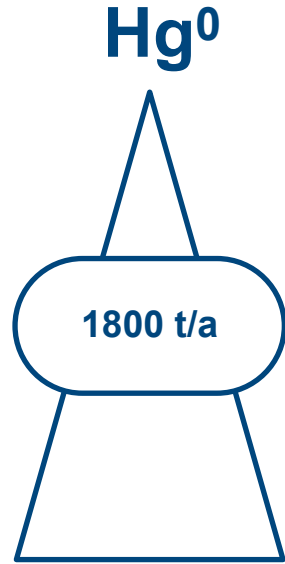
# Average ocean surface dissolved elemental Hg<sup>0</sup> concentration

with superimposed vertical profiles



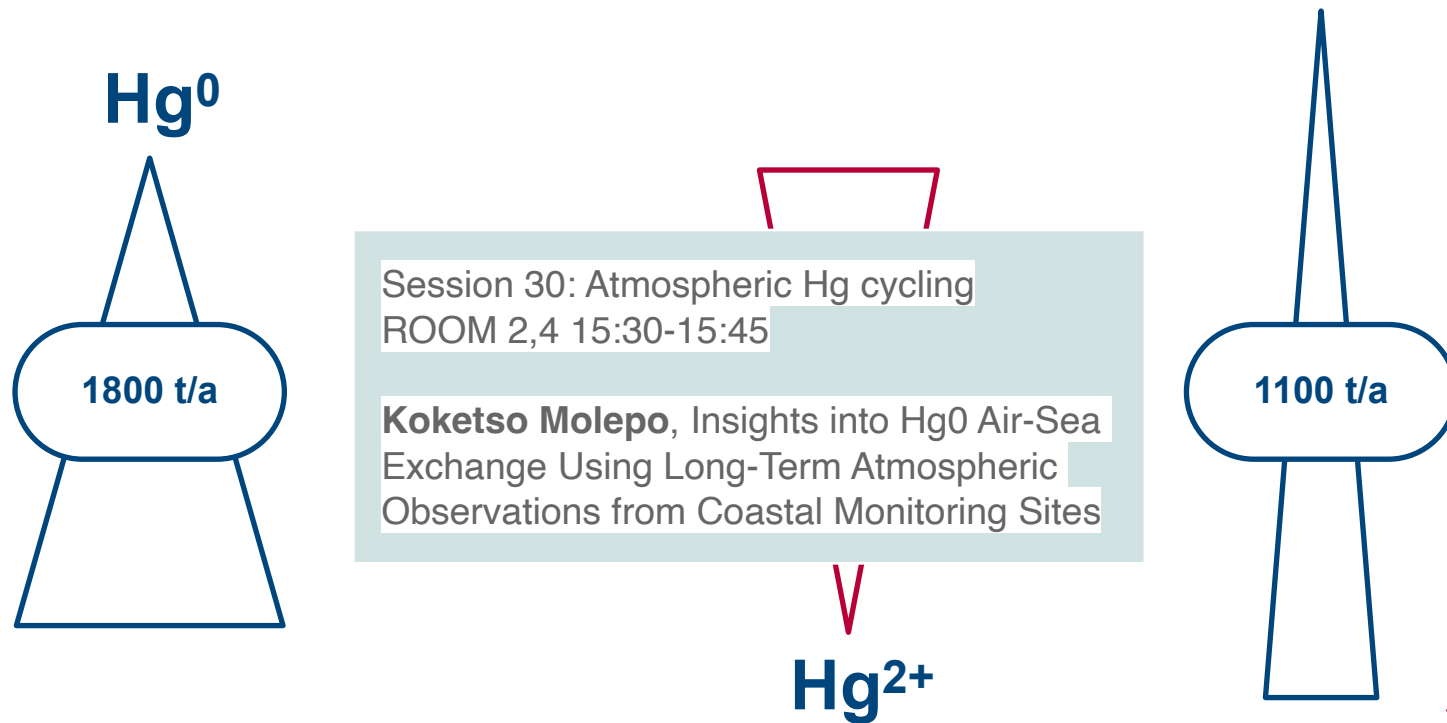


# Annual Hg air-sea exchange fluxes



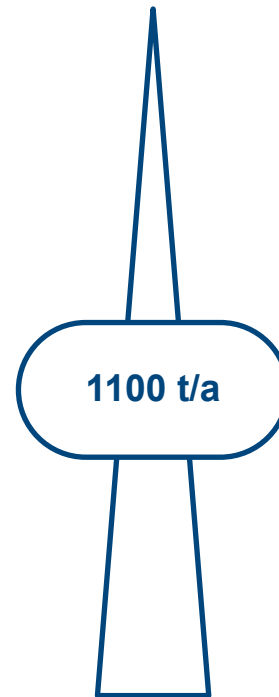
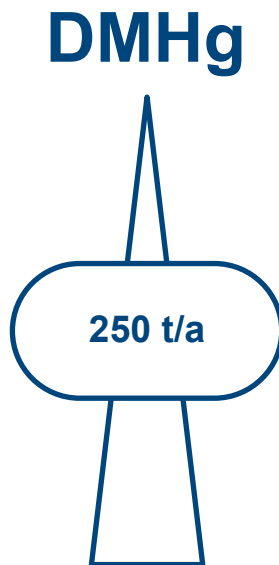
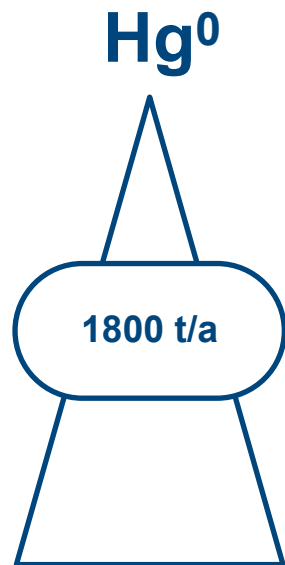
# Annual Hg air-sea exchange fluxes

with superimposed vertical profiles



# Annual Hg air-sea exchange fluxes

with superimposed vertical profiles





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## Dimethylmercury in Coastal Upwelling Waters, Monterey Bay, California

Christopher H. Conaway<sup>†</sup>, Frank J. Black<sup>†</sup>, Melanie Gault-Ringold<sup>†‡</sup>, J. Timothy Pennington<sup>§</sup>, Francisco P. Chavez<sup>§</sup>, and A. Russell Flegal<sup>†</sup>

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Hannah M. Adams<sup>\*</sup>, Xinyun Cui, Carl H. Lamborg, and Amina T. Scharfup<sup>\*</sup>

Cite this: *Environ. Sci. Technol.* 2024, 58, 24, 10591–10600  
Publication Date: June 7, 2024  
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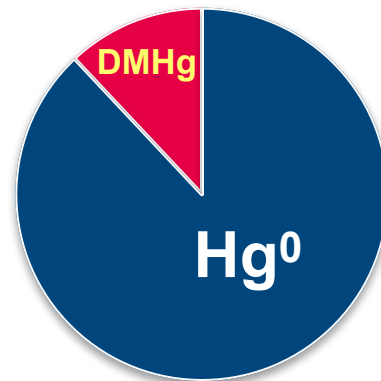
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## Marine fog inputs appear to increase methylmercury bioaccumulation in a coastal terrestrial food web

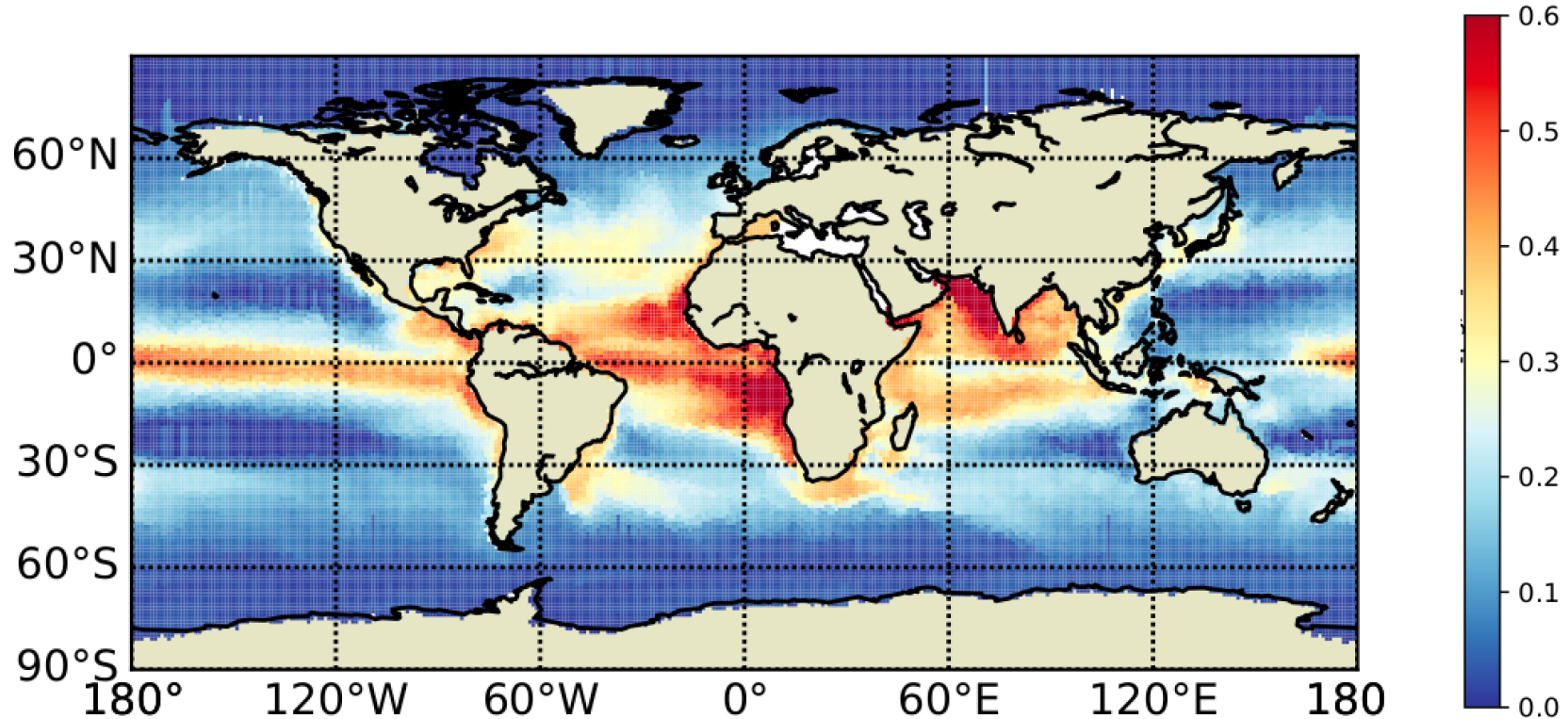
Peter S. Weiss-Penzias<sup>✉</sup>, Michael S. Bank, Deana L. Clifford, Alicia Torregrosa, Belle Zheng, Wendy Lin & Christopher C. Wilmers

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# Fraction of mercury air-sea exchange due to DMHg



# Multi-Compartment Hg Modeling and Analysis Project (MCHgMAP): Model experiments on Mercury trends and source attribution

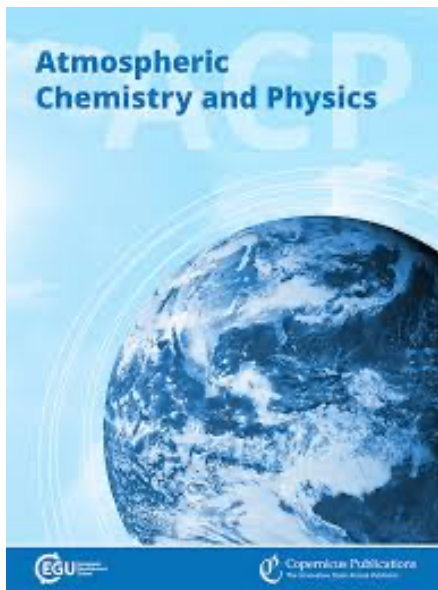
Ashu Dastoor<sup>1\*</sup>, Hélène Angot<sup>2</sup>, Johannes Bieser<sup>3</sup>, Flora Brocza<sup>4,5</sup>, Brock Edwards<sup>6</sup>, Arveh Feinberg<sup>7,8</sup>, Xinbin Feng<sup>9,10</sup>, Benjamin Geyman<sup>11</sup>, Charikleia Gournia<sup>12</sup>, Yipeng He<sup>13</sup>, Ian M. Hedgecock<sup>14</sup>, Shaojian Huang<sup>15</sup>, Ilia Ilyin<sup>16</sup>, Una Jermilova<sup>17</sup>, Terry Keating<sup>18</sup>, Jane Kirk<sup>1</sup>, Che-Jen Lin<sup>19</sup>, Taylor Luu<sup>1</sup>, Igor Lehnher<sup>20</sup>, Robert Mason<sup>21</sup>, David McLagan<sup>22</sup>, Marilena Muntean<sup>23</sup>, Peter Rafaj<sup>4</sup>, Eric M. Rov<sup>7</sup>, Andrei Rvikov<sup>1</sup>, Noelle E. Selin<sup>7</sup>, Francesco De Simone<sup>14</sup>, Anne L. Soerensen<sup>24</sup>, Frits Steenhuisen<sup>25</sup>, Oleg Travnikov<sup>26</sup>, Shuxiao Wang<sup>27</sup>, Xun Wang<sup>9</sup>, Simon Wilson<sup>28</sup>, Rosa Wu<sup>1</sup>, Qingru Wu<sup>26</sup>, Yanxu Zhang<sup>15</sup>, Jun Zhou<sup>26</sup>, Wei Zhu<sup>29</sup>, Scott Zolkos<sup>30</sup>

## Affiliations:

<sup>1</sup>Environment and Climate Change Canada (Canada), <sup>2</sup>Université Grenoble Alpes (France), <sup>3</sup>Helmholtz-Zentrum Hereon GmbH (Germany), <sup>4</sup>International Institute for Applied Systems Analysis (Austria), <sup>5</sup>University of Leeds (United Kingdom), <sup>6</sup>University of Manitoba (Canada), <sup>7</sup>Massachusetts Institute of Technology (USA), <sup>8</sup>Institute of Physical Chemistry Blas Cabrera (Spain), <sup>9</sup>Institute of Geochemistry, Chinese Academy of Sciences (China), <sup>10</sup>University of Chinese Academy of Sciences (China), <sup>11</sup>Harvard University (USA), <sup>12</sup>Jožef Stefan International Postgraduate School (Slovenia), <sup>13</sup>Florida International University (USA), <sup>14</sup>CNR-Institute of Atmospheric Pollution Research (Italy), <sup>15</sup>Nanjing University (China), <sup>16</sup>MSC East (Russia), <sup>17</sup>Trent University (Canada), <sup>18</sup>U.S. Environmental Protection Agency (USA), <sup>19</sup>Lamar University (USA), <sup>20</sup>University of Toronto Mississauga (Canada), <sup>21</sup>University of Connecticut (USA), <sup>22</sup>Queen's University (Canada), <sup>23</sup>European Commission (Italy), <sup>24</sup>Swedish Museum of Natural History (Sweden), <sup>25</sup>University of Groningen (Netherlands), <sup>26</sup>Jožef Stefan Institute (Slovenia), <sup>27</sup>Tsinghua University (China), <sup>28</sup>Arctic Monitoring and Assessment Programme Secretariat (Norway), <sup>29</sup>Swedish University of Agricultural Sciences (Sweden), <sup>30</sup>Woodwell Climate Research Center (USA)



# MCHgMAP — Triple Special



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement no. 860497.