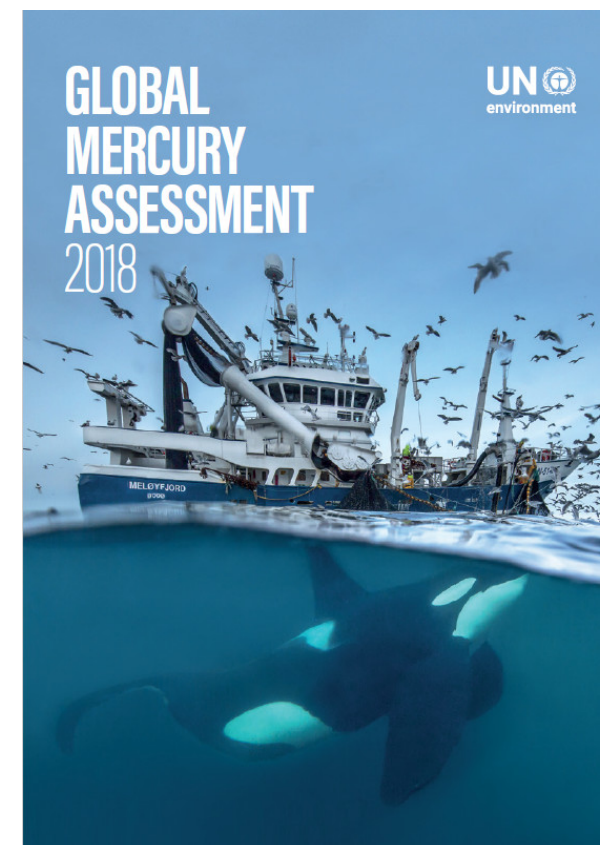


UN Environment Global Mercury Partnership: Fate & Transport Partnership Area

Co-Chairs: Nicola Pirrone (CNR, Italy) and David Evers (BRI, USA)

Objective: To provide a scientific support to the policy making process to better characterize the relative contributions of chemical, physical and biological processes affecting the global Hg cycle and its impact on human health and ecosystems.

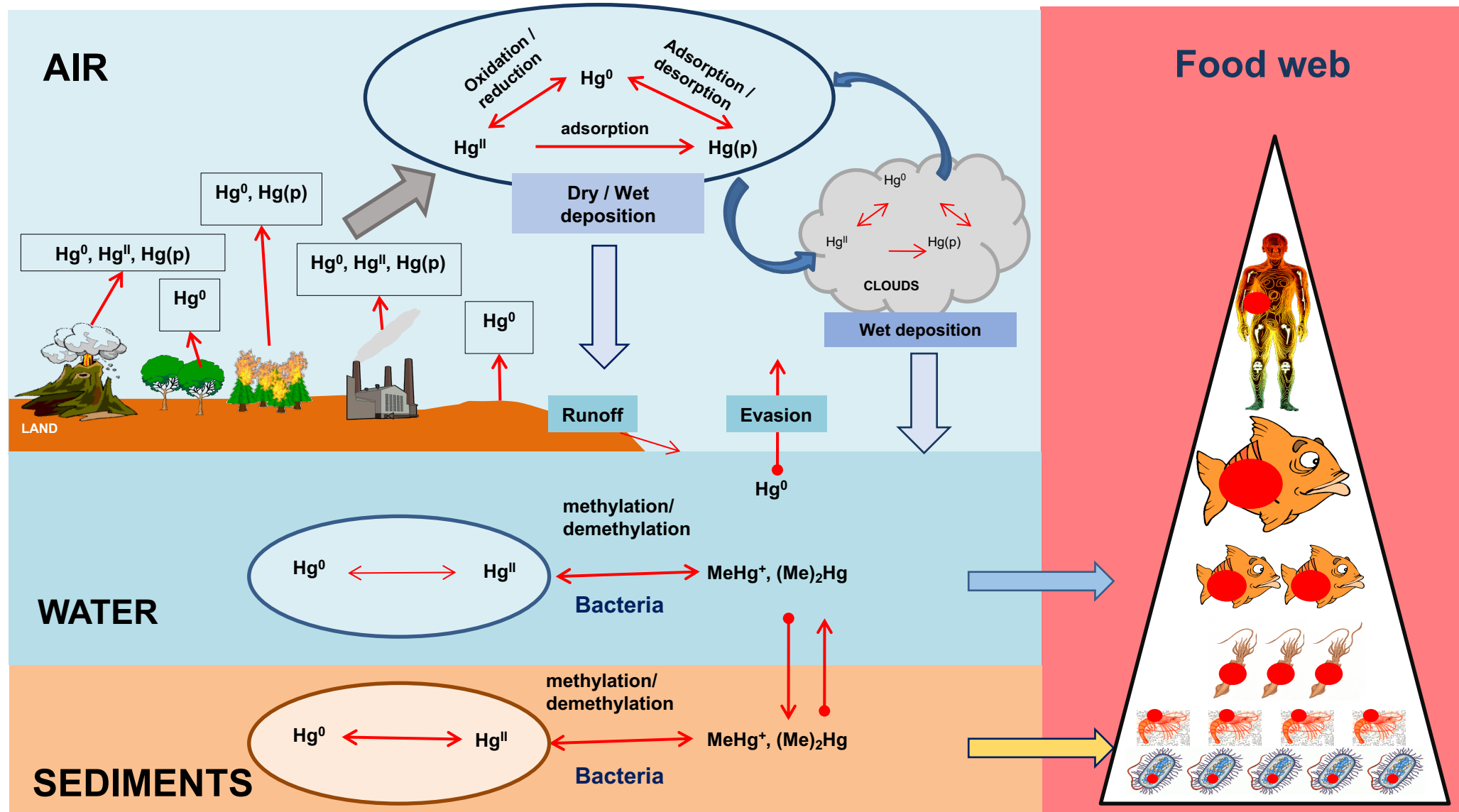
How: Fostering broad and inclusive cooperation with ongoing national and international projects and programs



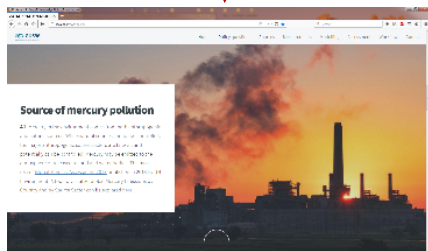
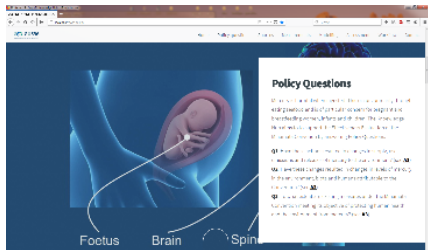
Monitoring & Modeling vs Effectiveness Evaluation

(Qs proposed by Terry Keating for EE)

- **What is the level and form** of mercury in the observed matrix (air, biota, human) at a given location?
- Are there observed **spatial patterns or gradients**?
- Are observed levels **changing over time**?
- Are the observed **trends consistent with model estimates**?
- What information do observed trends and consistent models provide about:
 - ✓ **Sources** (local, regional, global) **and sinks** of the mercury?
 - ✓ **Environmental processes** driving transport and fate?
 - ✓ **Exposure and adverse impacts** to humans or other biota?
- **Can observed trends be attributed** using current models **to changes in**:
 - ✓ **natural sources or sinks** of mercury?
 - ✓ **anthropogenic sources** (local, regional, global) of mercury, in general?
 - ✓ **mitigation measures** associated with implementation of the Convention, specifically?



Policy questions

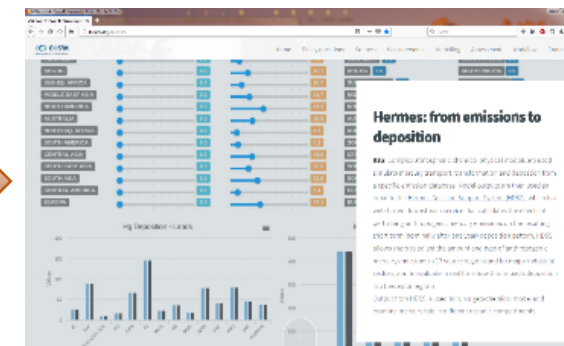
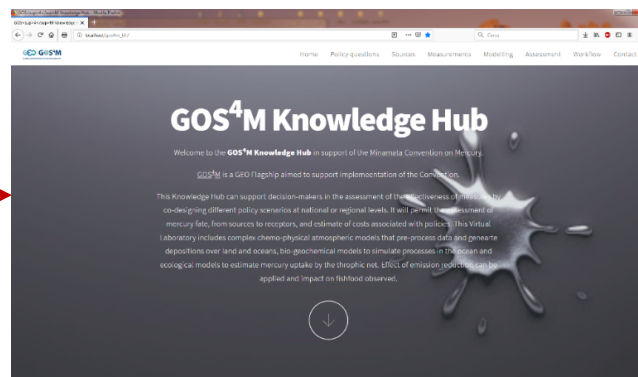


Co-design Policy Scenarios

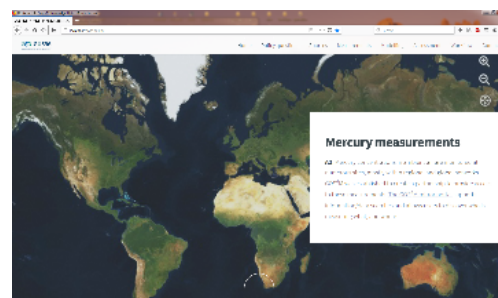
GOS4M Knowledge Hub (conceptual framework)



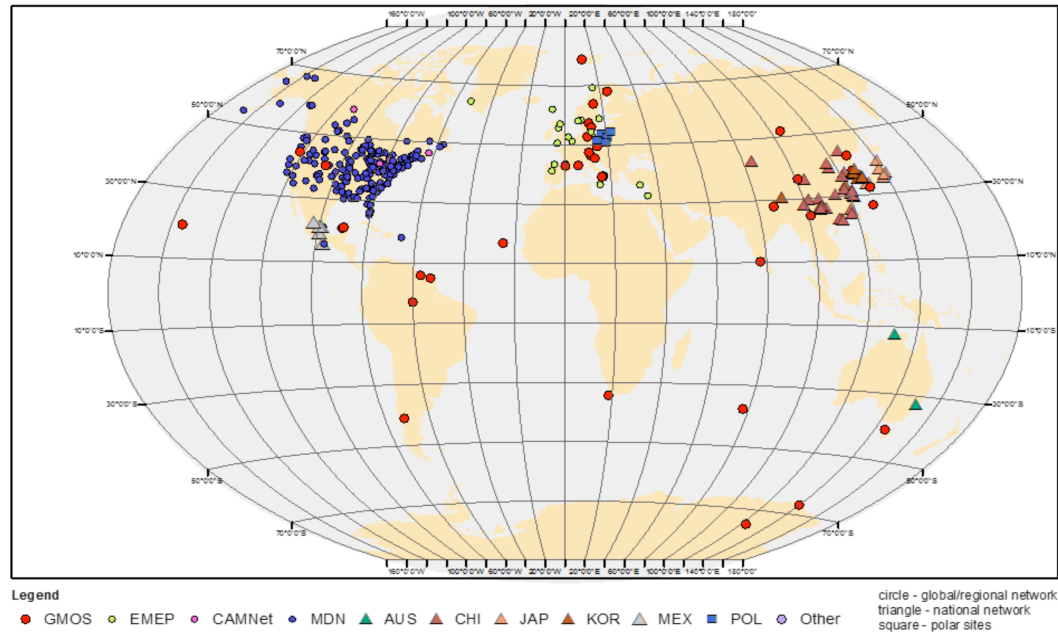
Policy scenarios assessment



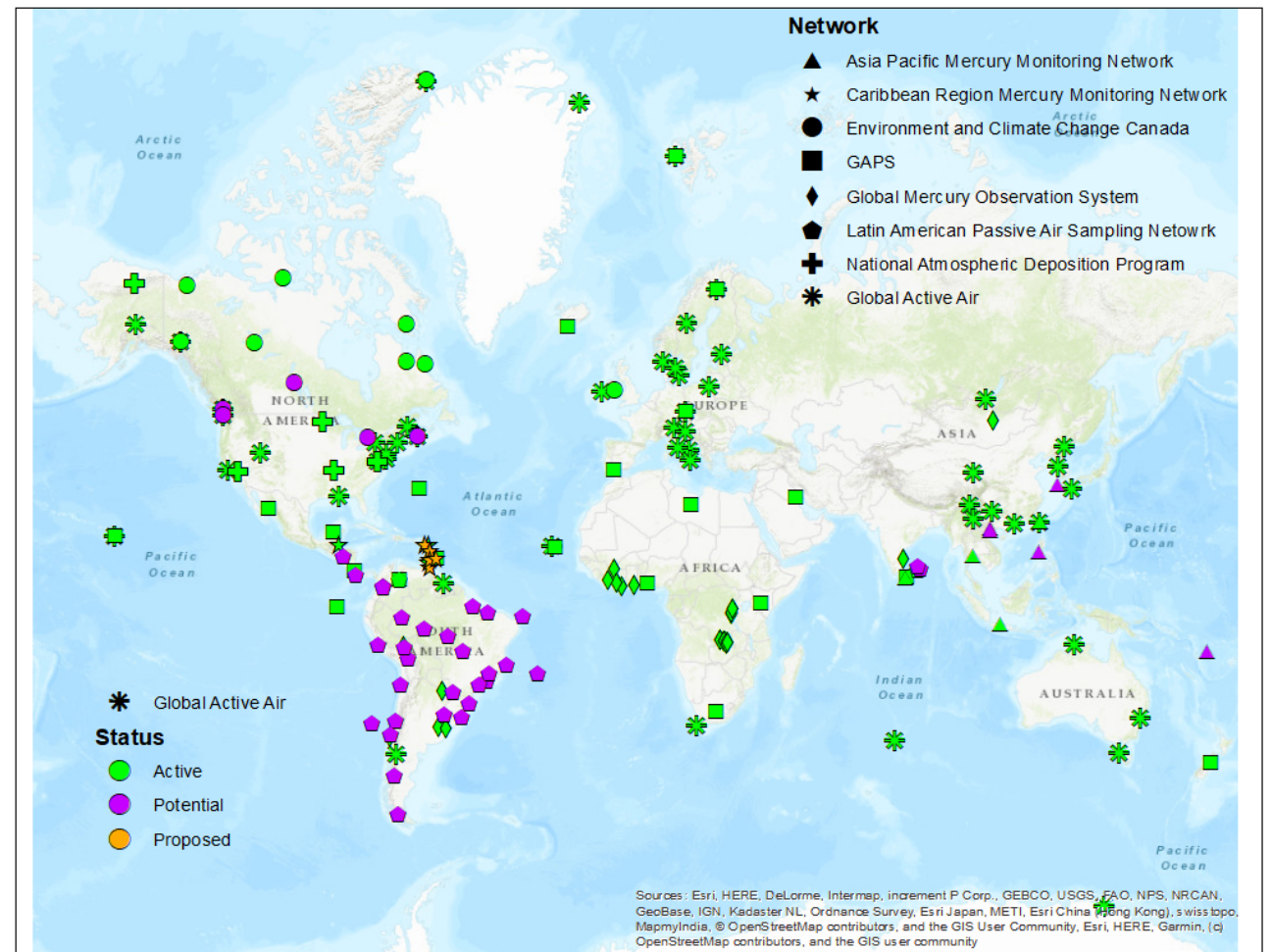
EOs data sets



Global Coverage of in-situ Hg monitoring

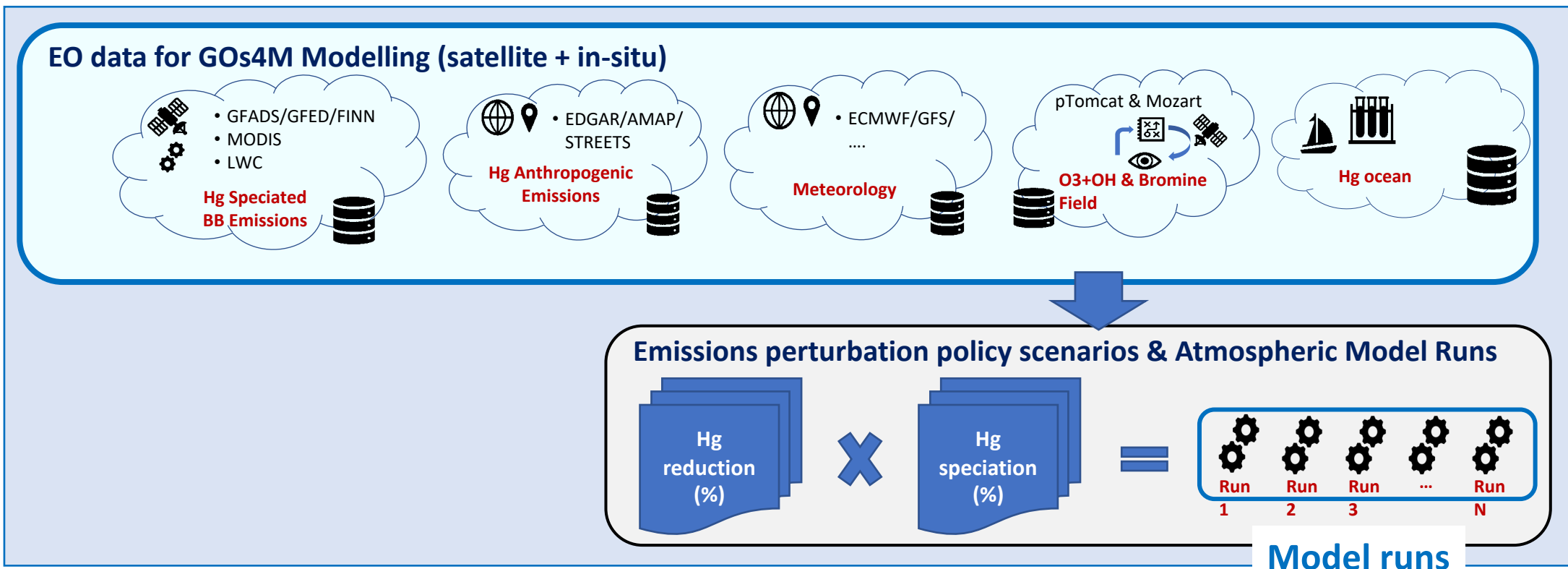


Source: Fig.1 of "Levels of Mercury in Air". Chapter-3, GMA-2019 for COP3

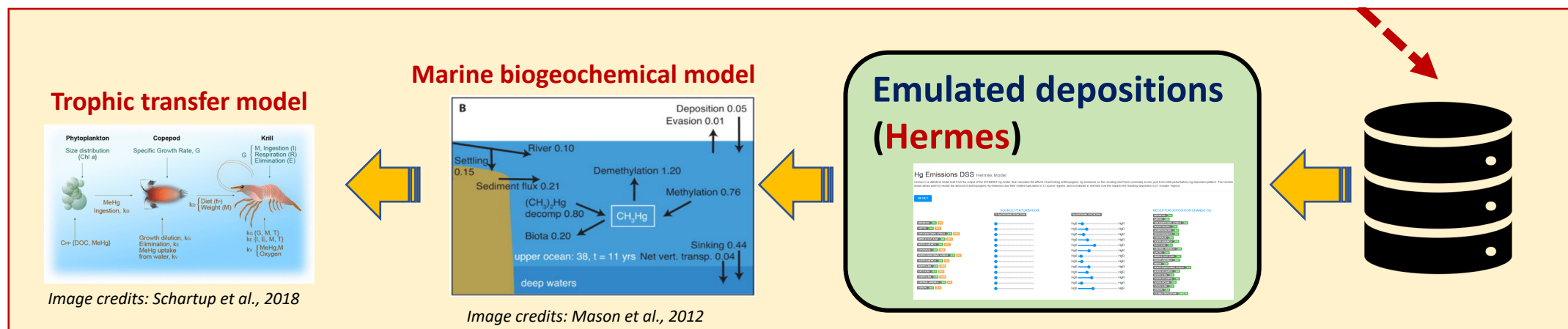


Source: Revised Fig.1 of "Levels of Mercury in Air". Chapter-3, GMA-2019 for COP3 (by A. Steffen)

Pre-processing

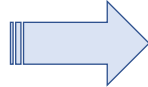
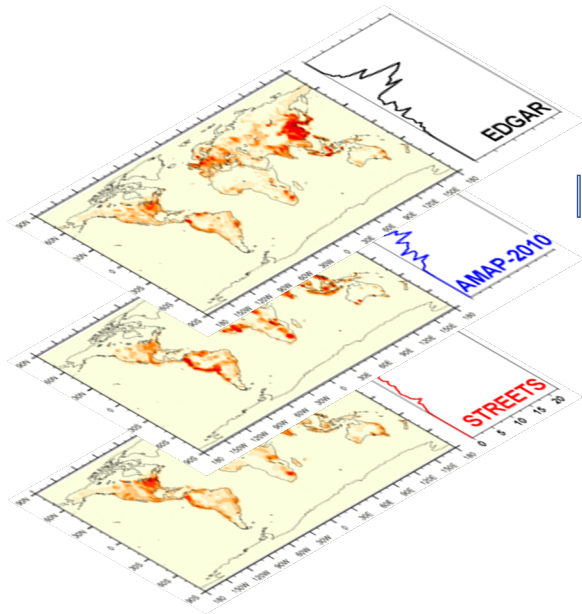


Post-processing



Ensemble of Atmospheric Hg Global Models

Emission Inventories: EDGAR, AMAP, ...

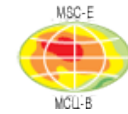


ECH^{MERIT}

Global EMEP Multi-media
Modeling System (**GLEMOS**)

GEOS-Chem

Global/Regional Atmospheric
Heavy Metals Model (**GRAHM**)

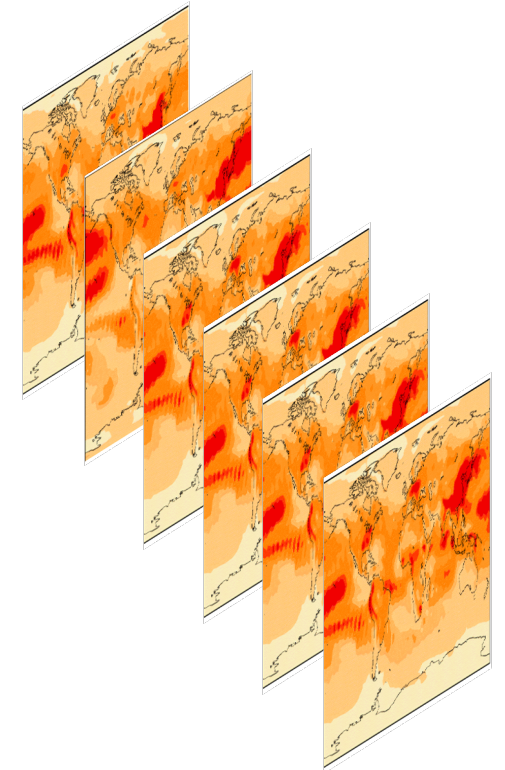
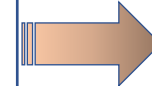


MSC-E



Environment and
Climate Change Canada
Environnement et
Changement climatique Canada

Models' Outputs for Emission Scenarios



Workflow

Example

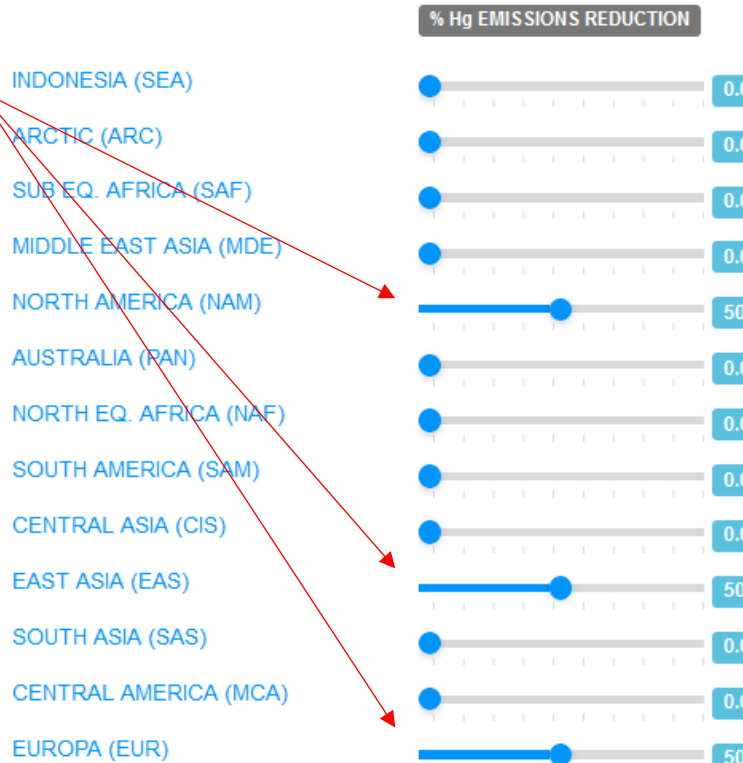
-50%

- Europe
- North America
- East Asia

ANTHROPOGENIC EMISSION PERTURBATION

It is possible to reduce Hg Anthropogenic emission from 12 source regions

CURRENT GLOBAL DEPOSITION 1912.79 Show Map



DEPOSITION CHANGES

The inputs are passed in near-real time to the statistical engine that calculates the change (%) on Hg deposition due to the selected emission reductions. If a reduction is not statistically significant (95% confidence interval) the deposition change is shown in blue. If reduction is significant for a given receptor the value is displayed in green. (De Simone et al., 2017)

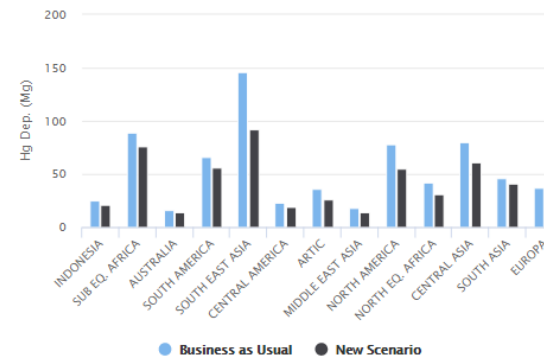
GLOBAL DEPOSITION SCENARIO 1492.08

LAND (%)	OCEAN (%)
INDONESIA (SEA)	-17.99
ARCTIC (ARC)	-26.48
SUB EQ. AFRICA (SAF)	-15.39
MIDDLE EAST ASIA (MDE)	-21.93
NORTH AMERICA (NAM)	-29.95
AUSTRALIA (PAN)	-13.09
NORTH EQ. AFRICA (NAF)	-25.28
SOUTH AMERICA (SAM)	-15.22
CENTRAL ASIA (CIS)	-23.06
EAST ASIA (EAS)	-37.05
SOUTH ASIA (SAS)	-10.61
CENTRAL AMERICA (MCA)	-20.16
EUROPA (EUR)	-37.11
NORTH PACIFIC	-25.01
SOUTH PACIFIC	-15.69
MEDITERRANEAN	-31.82
INDIAN	-15.76
NORTH ATLANTIC	-25.43
SOUTH ATLANTIC	-14.92
SOUTH OCEAN	-14.28
ANTARCTIC (ANT)	-14.06
GLOBAL OCEANS	-20.41
Biogeochemical response	
Oceans at 10 years	-17.59

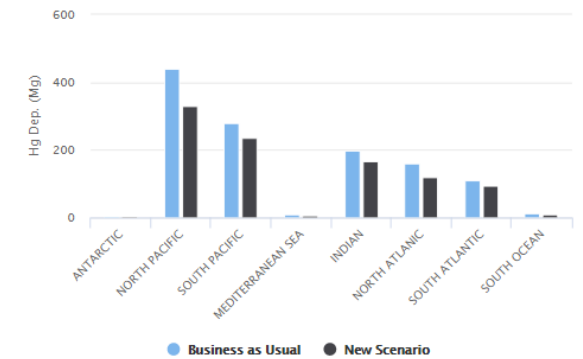
% of reduction is shown

blue = not significant
green = significant

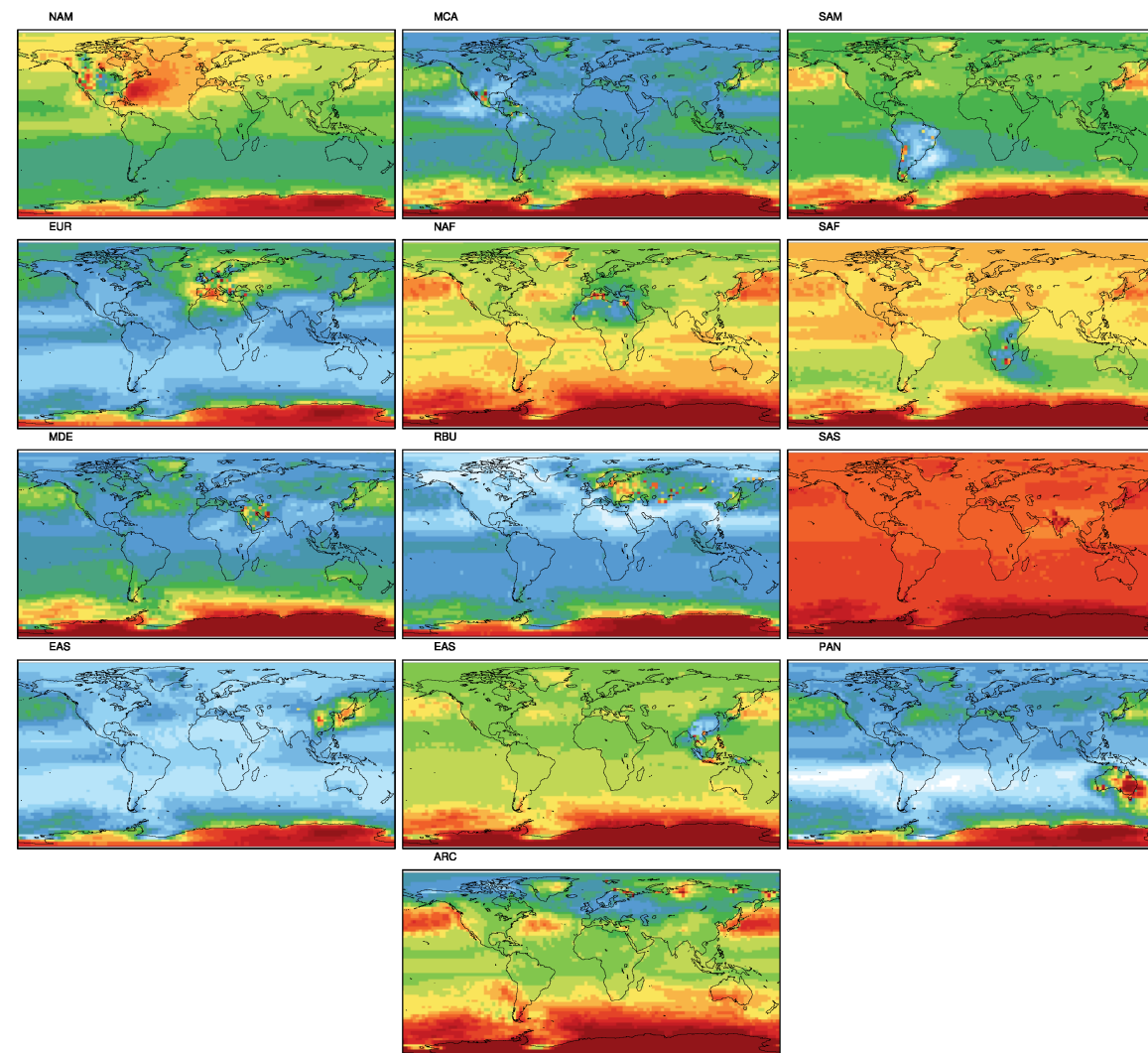
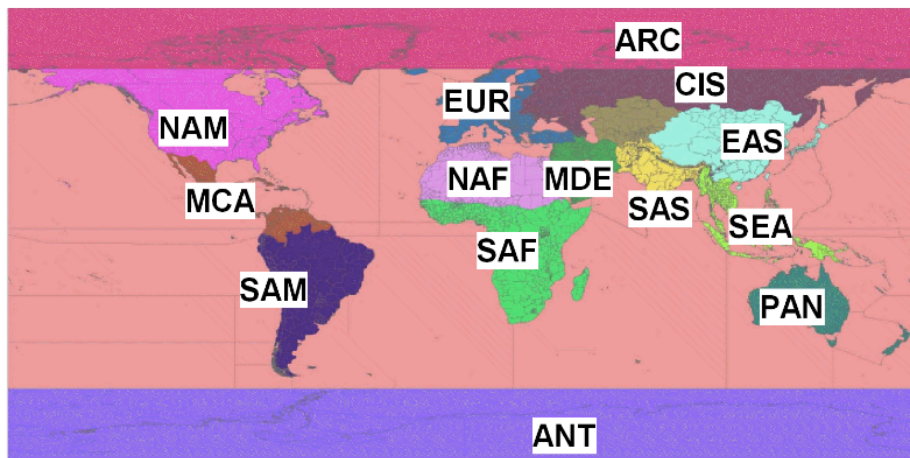
Hg Deposition - Lands



Hg Deposition - Oceans



Tagging Hg from regions & sources



Tagging Hg species emitted from regions and industrial sector allows multiple experiments in one single model run

Sources of uncertainty that may affect the EE

(Atmosphere)

- **Emission sources (the top three):**
 - **ASGM:** Els, LRT, deposition patterns & their geographical coverage
 - **Ocean:** re-emission / air-water interface, sea spray in coastal zones
 - **Forest fires:** occurrence, type of fires, extension
- **Processes:**
 - Air-water exchange processes for Hg(0)
 - Impact of CC: Hg releases from oceans and thawing permafrost

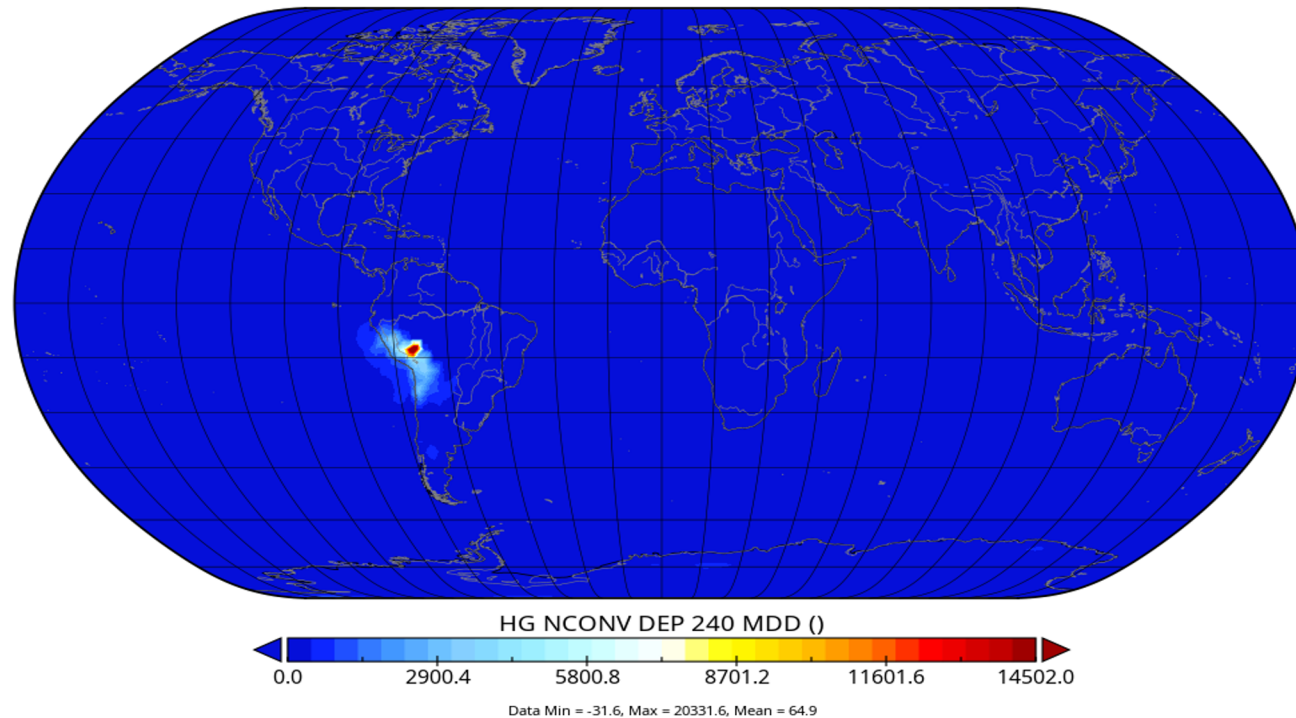
Deposition from ASGM

Simulations assume an **atmospheric lifetime of 8 months** and show the deposition from non-convective rainfall
(**60 days simulation**).

Deposition from convective rainfall is similar, it's the tropics.

Deposition due to uptake by vegetation is being evaluated. We're concerned about the Himalayas

HG NCONV DEP 240 MDD



The Andes block: Hg deposition from the Madre de Dios reserve in the Amazon.

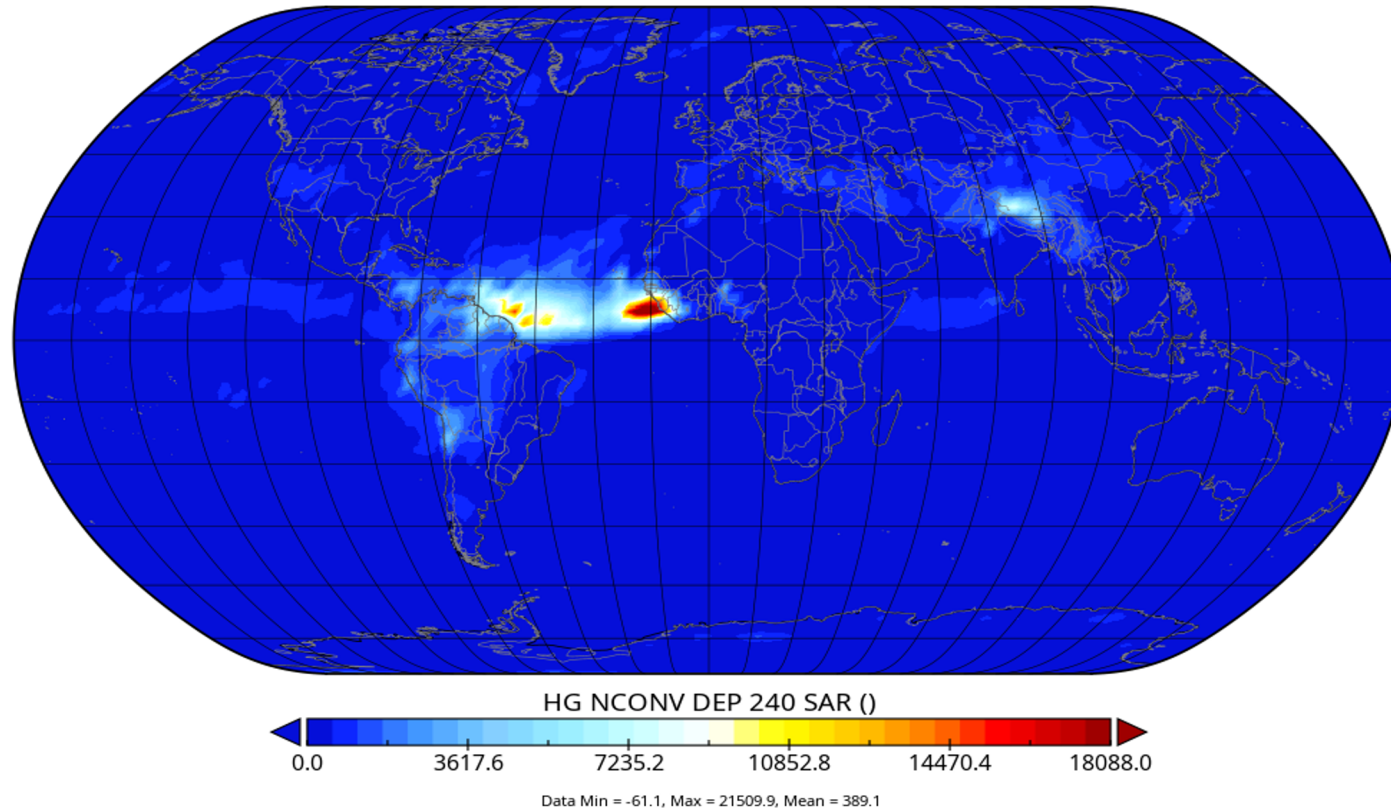
Deposition from ASGM

Simulations assume an **atmospheric lifetime of 8 months** and show the deposition from non-convective rainfall
(**60 days simulation**).

Deposition from convective rainfall is similar, it's the tropics.

Deposition due to uptake by vegetation is being evaluated. We're concerned about the Himalayas

HG NCONV DEP 240 SAR



ASGM in Senegal: Because of prevailing winds Hg can be widely dispersed.

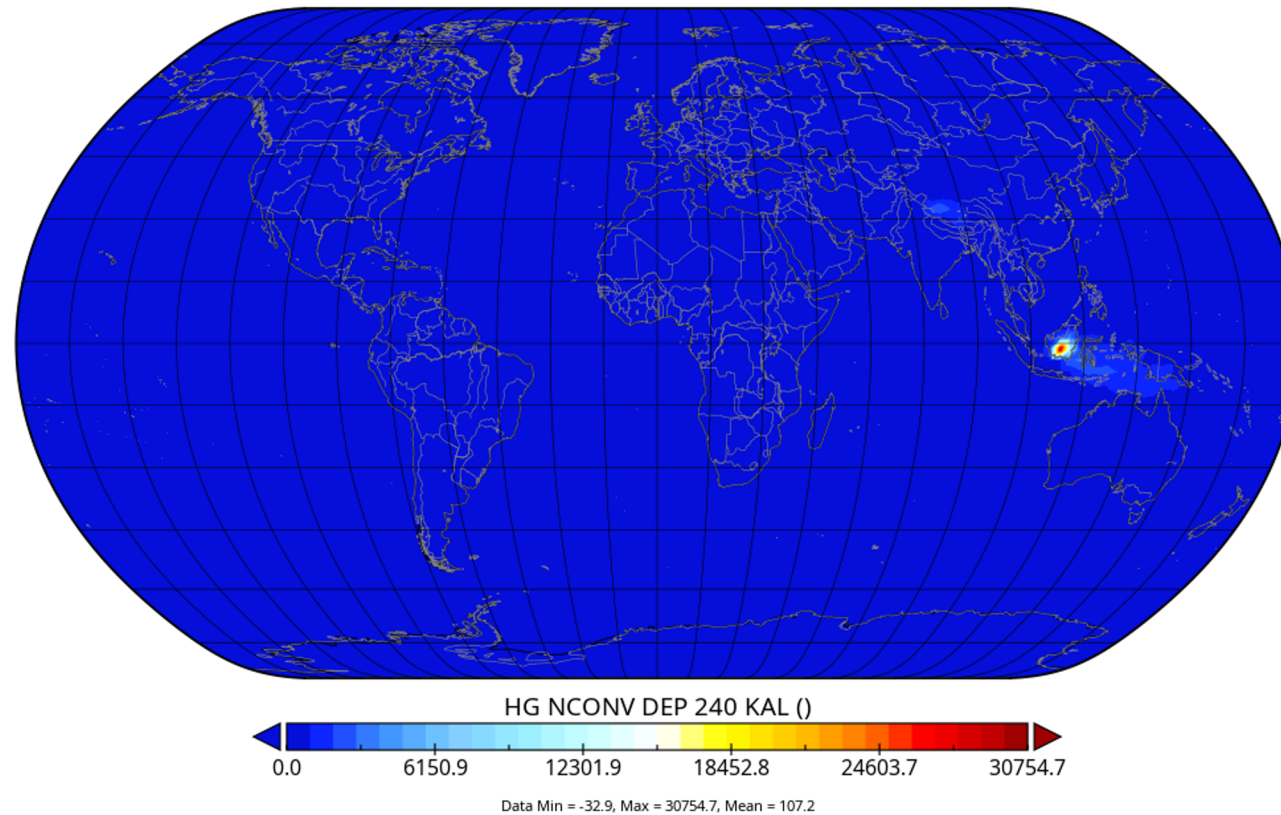
Deposition from ASGM

Simulations assume an **atmospheric lifetime of 8 months** and show the deposition from non-convective rainfall
(**60 days simulation**).

Deposition from convective rainfall is similar, it's the tropics.

Deposition due to uptake by vegetation is being evaluated. We're concerned about the Himalayas

HG NCONV DEP 240 KAL



ASGM in Kalimantan: local rainfall patterns determine the rapid deposition of Hg.

Thanks

