Overview of scientific work on estimation of Hg current and future emissions

Minamata Online Session

Mercury Emission – Estimation and projections

5 November, 2020

Jozef M. Pacyna

AGH University of Science and Technology, Krakow, Poland

Major questions to be addressed

What are the levels of emissions from natural and anthropogenic sources and how accurate are estimates of these emissions?

What is the spatial distribution of these emissions?

What are the future emission projections?

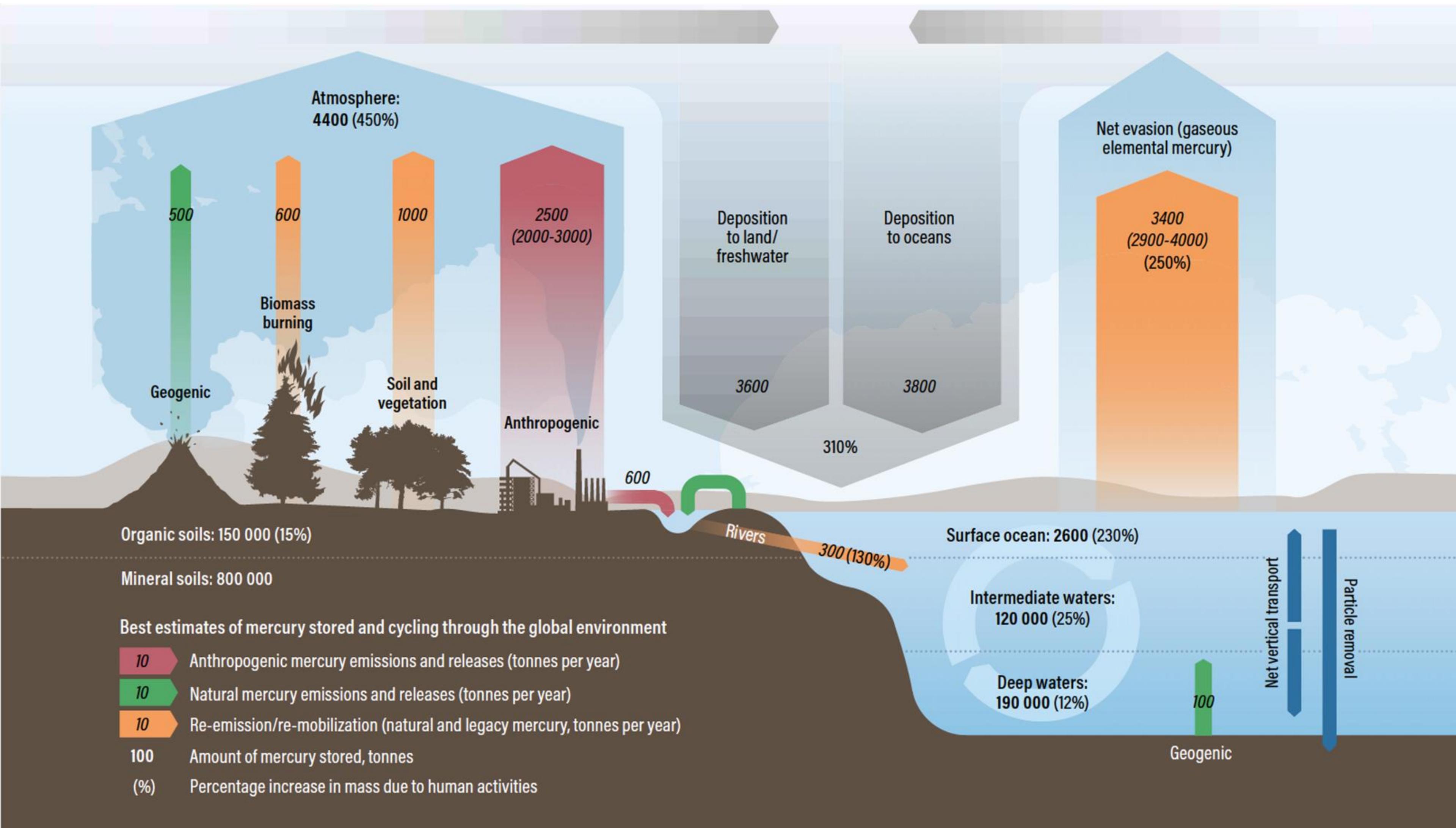
How may research on emissions support the implementation of the Minamata Convention?

How much Hg is in the ocean?

UNEP Global Mercury Assessment 2018

2013: 0.36 ng L^{-1} = 1,8 pM => 358,000 t

2018: 0.31 ng L^{-1} = 1.6 pM => 313,000 t

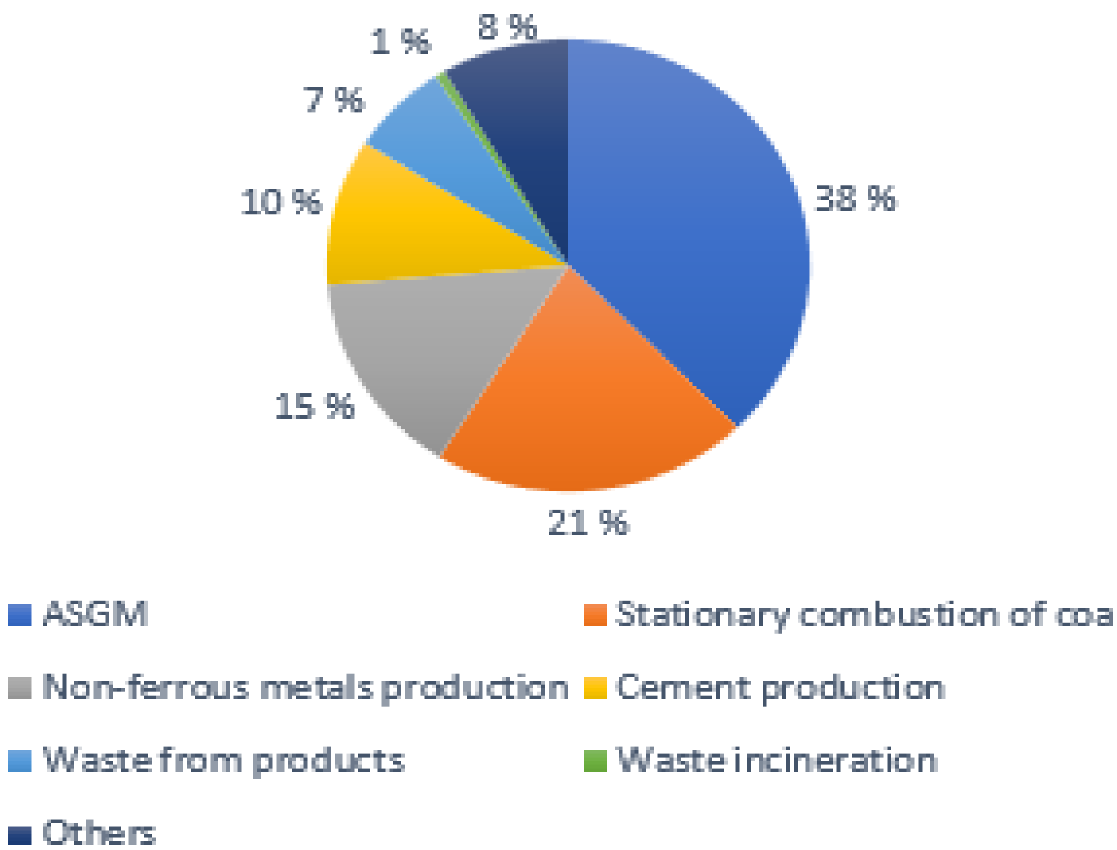


Natural sources and re-emission (in t/y)

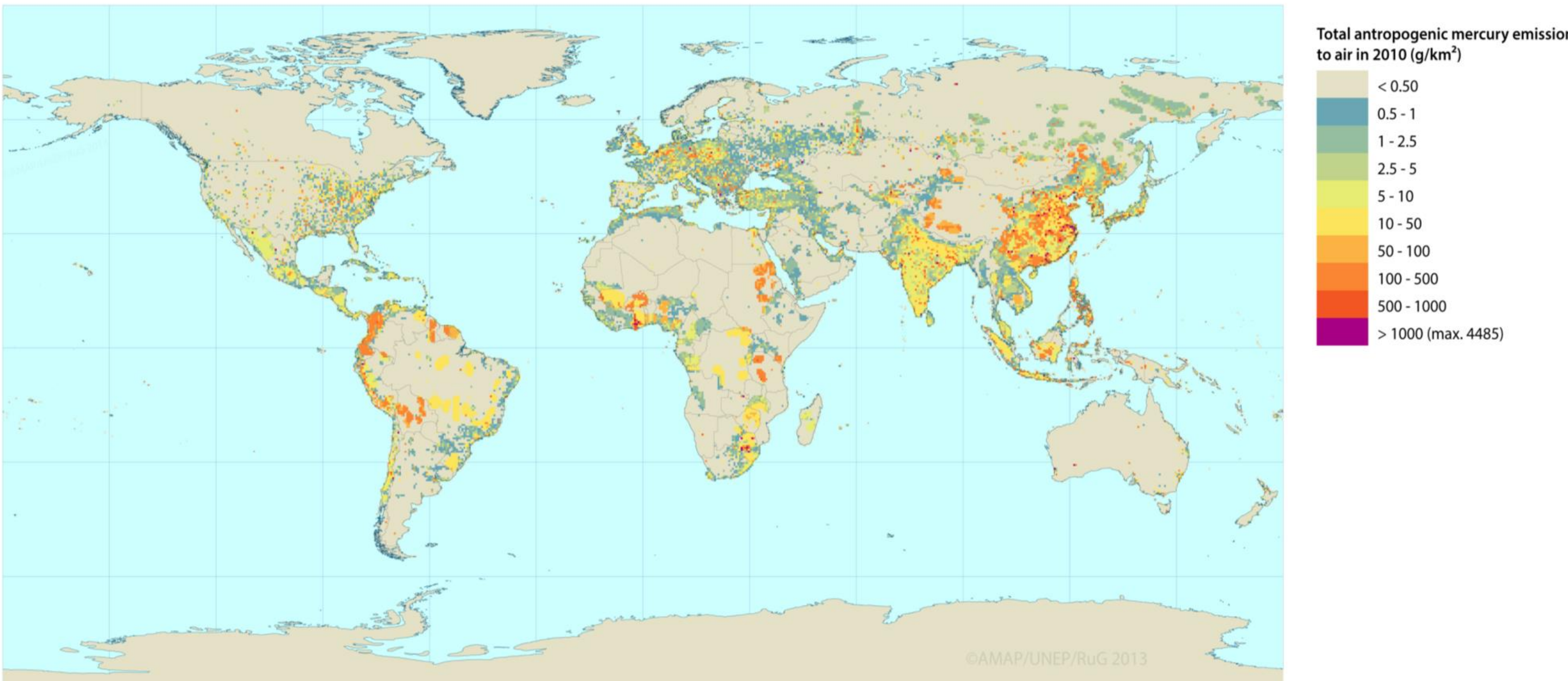
Source/ process	UNEP 2013 (Selin et al. 2007)	UNEP 2013 (Holmes et al.2010)	UNEP 2013 (Mason et al. 2012)	GMOS (Pirrone et al. 2010)
1. Natural emissions from land to atmosphere	900	500	80 – 600	90
2. Re-emission from land	1 500	1 700	1 700 – 2 800	1 664
3. Biomass burning	-	300	300 – 600	675
4. Re-emission from ocean to atmosphere	2 400	3 700	200 – 2 900	2 778
TOTAL	**4 800**	**6 200**	**4 080 – 6 900**	**5 207***

* **Upper and lower bound of Hg emission from natural sources estimated in GMOS: 2157 and 10222 t/y, respectively (accuracy ±100% !)**

Estimated source contributions to anthropogenic mercury emission to air in 2015, in percentage (UNEP, 2019)



Geospatial distribution of global antropogenic mercury emissions to air (2010)

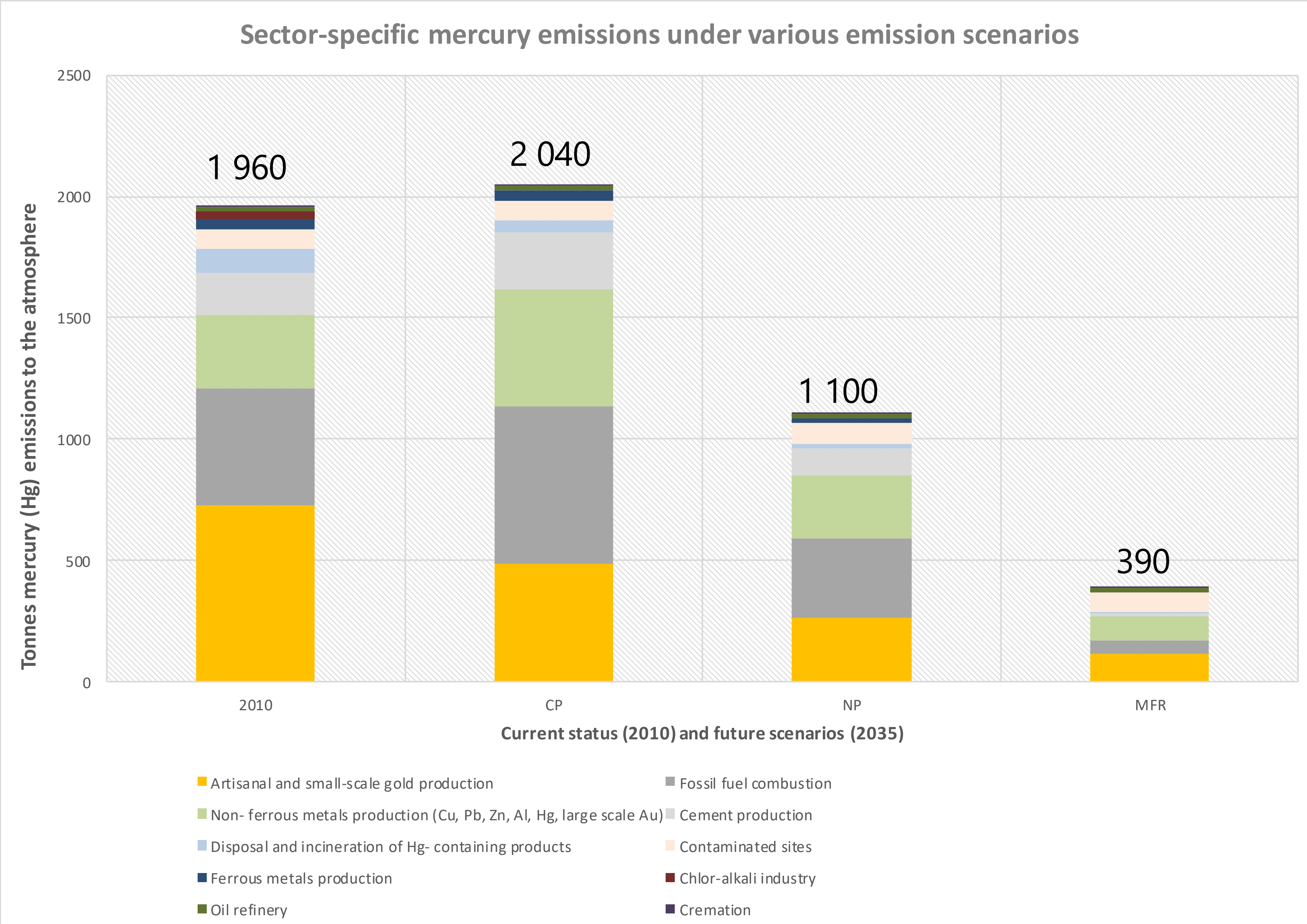


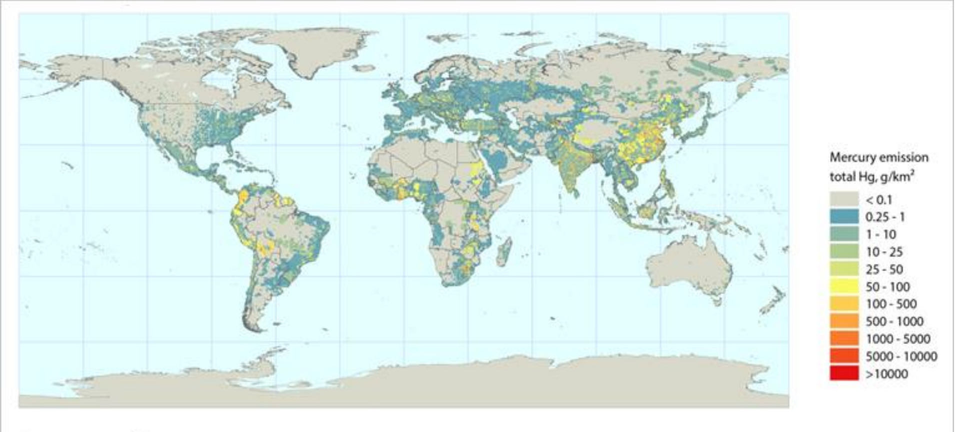
Frits Steenhuisen, Arctic Centre RuG (f.steenhuisen@rug.nl, http://www.rug.nl/research/arctisch-centrum/)
Simon Wilson, AMAP Secretariat (www.amap.no)
February 2013

university of groningen

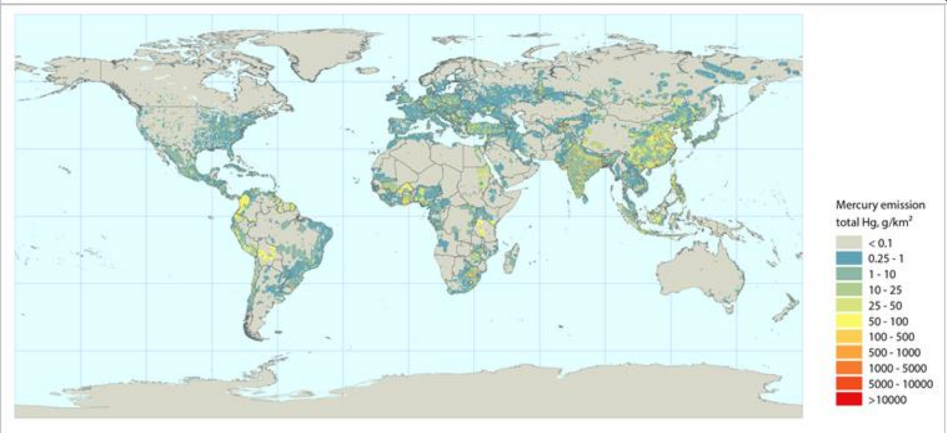
Available literature on future global anthropogenic emissions

Policy scenarios addressed	Projections	Reference
Four IPCC SRES scenarios	2050 – projection year 2006 – base year	Streets et al., 2009
- **Projections of energy consumption** - **Activity projections complemented with assumptions on air pollution and Hg control measures**	2050 – projection year 2010 – base year	Rafaj et al., 2013
Three IPCC SRES scenarios	2050 – projection year 2000 – base year (from Pacyna et al., 2006)	Lei et al., 2014
Projected future activities and emission factors – CP, NP and MFR	2035 – projection year 2010 – base year	Pacyna et al., 2016

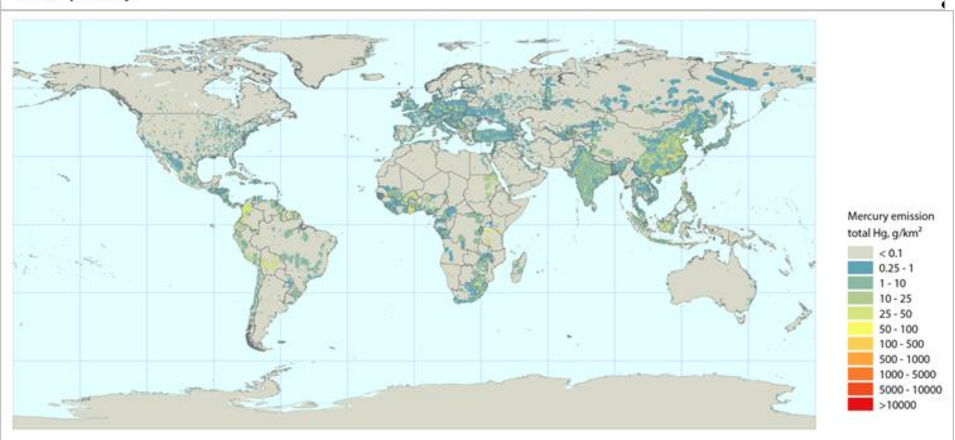

Sector-specific mercury emissions under various emission scenarios
Tonnes mercury (Hg) emissions to the atmosphere
2500
2000
1500
1000
500
0
1 960
2 040
1 100
390
2010
CP
NP
MFR
Current status (2010) and future scenarios (2035)
Artisanal and small-scale gold production
Fossil fuel combustion
Non- ferrous metals production (Cu, Pb, Zn, Al, Hg, large scale Au)
Cement production
Disposal and incineration of Hg- containing products
Contaminated sites
Ferrous metals production
Chlor-alkali industry
Oil refinery
Cremation



Current policy



New policy



Maximum feasible reduction

Spatial distribution of mercury emissions in 2035 according to various scenarios

What to expect in the future? (1)

1. Decrease of Hg emissions from electric power plants, due to implementation of emission control equipment (FGD, CCS), clean combustion technologies (combustion efficiency up to 40%), different energy mix
2. Decrease of Hg emissions from industrial sources through the application of BATs and BEPs (example in non-ferrous metal industry in China)
3. Status quo in Hg emissions from small residential units and waste incineration
4. Decrease of Hg emissions from various users of mercury due to implementation of various bans on Hg use

What to expect in the future? (2)

5. Possible increase of re-emission of Hg from aquatic and terrestrial surfaces due to climate change impacts

In summary:

Lowering of anthropogenic emissions, constant emissions from natural sources, and potential increase of re-emission

Contribution of future research to the Minamata Convention: Improvement of information on:

1. Emissions from selected sources, such as CHP and residential/ commercial units (amount and type of coal, content of Hg in coal) - emission factors and database
2. Chemical speciation in emissions of Hg from various source categories – emission profiles
3. Emission projections for Hg emissions in the future – methodologies for scenario estimates
4. Technological measures to reduce Hg emissions, incl. BAT – efficiency coefficients of various measures
5. Non-technological measures to reduce emissions, incl. BEP on national and enterprise level – list of measures

Thank you!