Groundwater Quality, a health issue?

GEOSS Joint Asia-Africa Water Cycle Symposium

Annette Johnson

Eawag: Swiss Federal Institute of Aquatic Science and Technology

Arsenic

An estimated 140 million people are exposed to arsenic

⇒ **Via drinking water**

• Soluble under chemically reducing conditions

• Geothermal waters, volcanic ashes

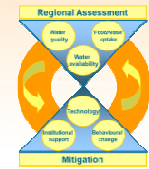⇒ **Via food and food preparation**

• Paddy field rice

• Contaminated water for cooking

⇒ **Health effects**

• Dermal lesions

• peripheral neuropathy

• diabetes mellitus

• cancers

⇒ **WHO recommended guideline**

• 10 µg/L for drinking water

Fluoride

An estimated 200 million people are exposed to fluoride

⇒ **Via drinking water**

• Ultramafic rocks, granites, volcanic ashes
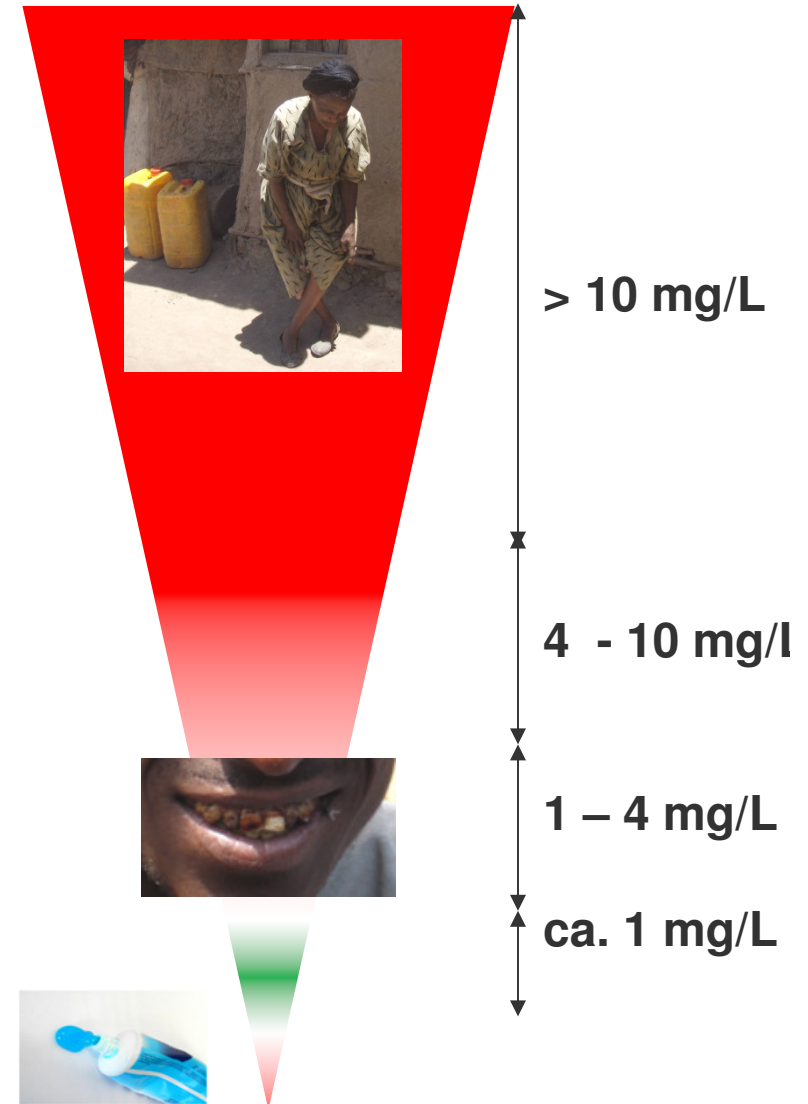
• Arid conditions

⇒ **Via food and food preparation**

• Beverages, specialty salts

• Local produce from contaminated soils

⇒ **Health effects**

• Dental fluorosis

• Skeletal fluorosis

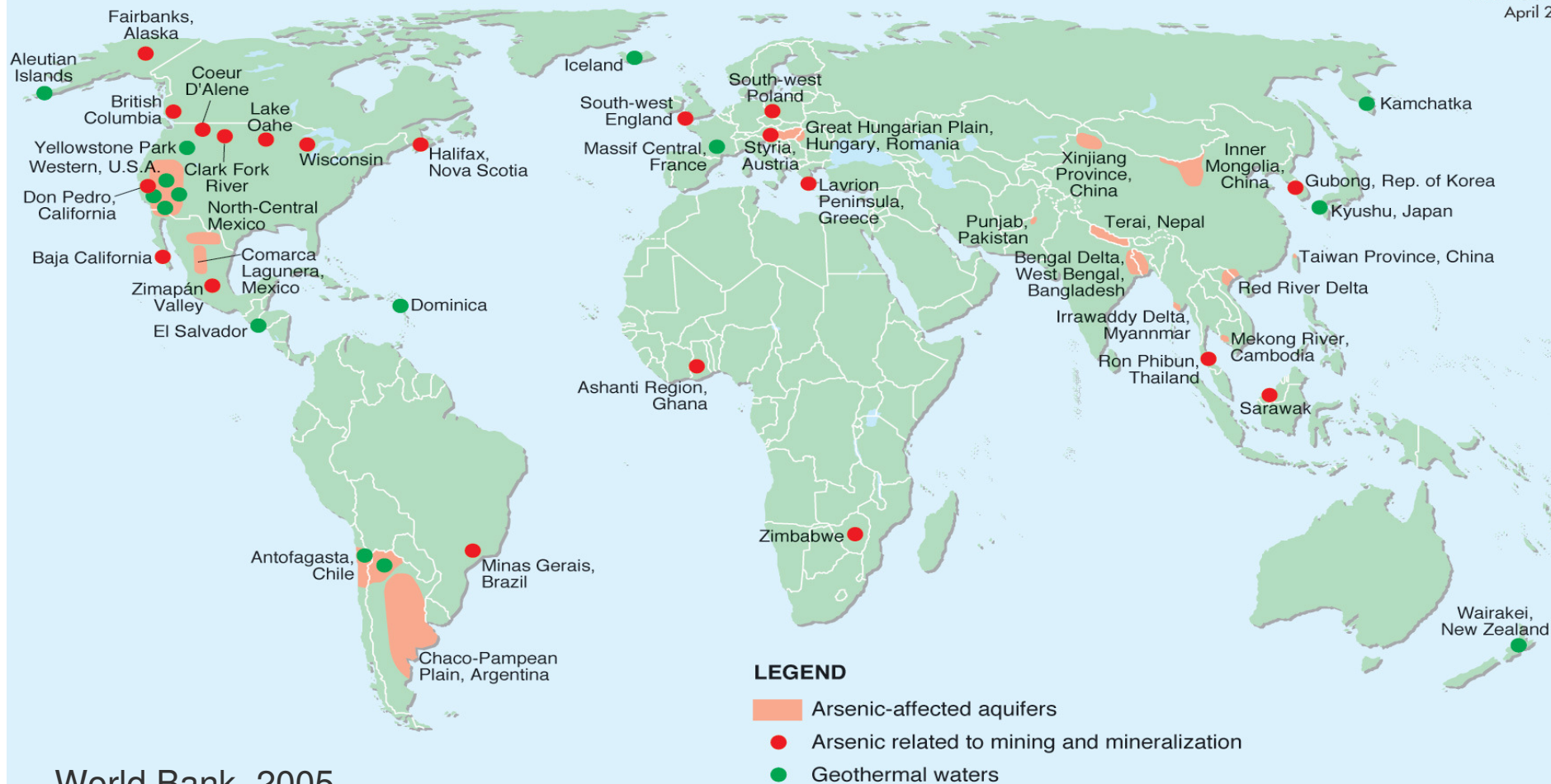• Multiple non-skeletal symptoms

⇒ **WHO guideline**

• 1.5 mg/L for drinking water

> 10 mg/L

4 - 10 mg/l

1 – 4 mg/L

ca. 1 mg/L

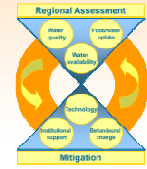# Arsenic contamination map – World Bank 2006
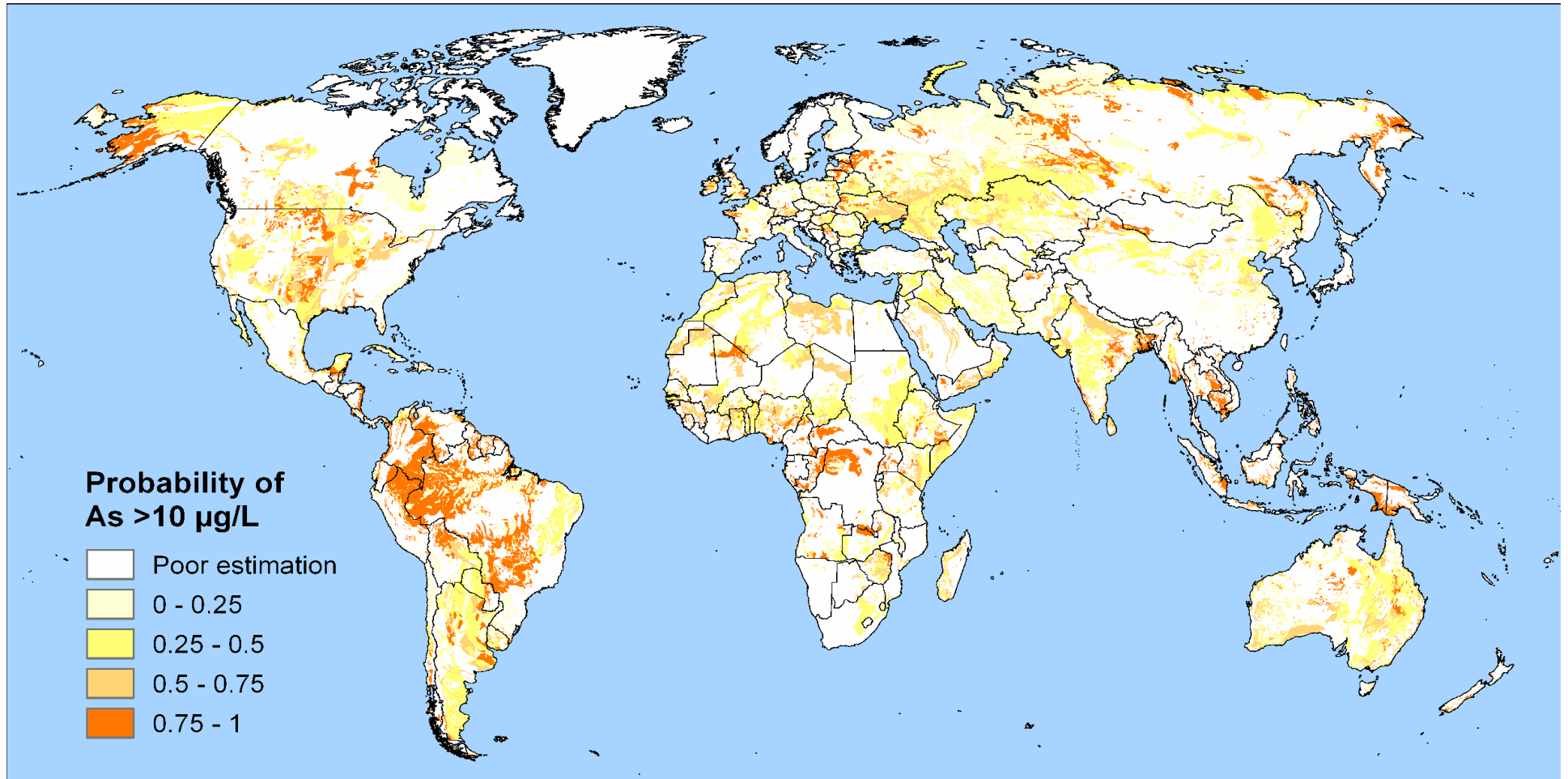

World Bank, 2005

Amini et al., ES+T 2008a

Modeling geogenic contamination
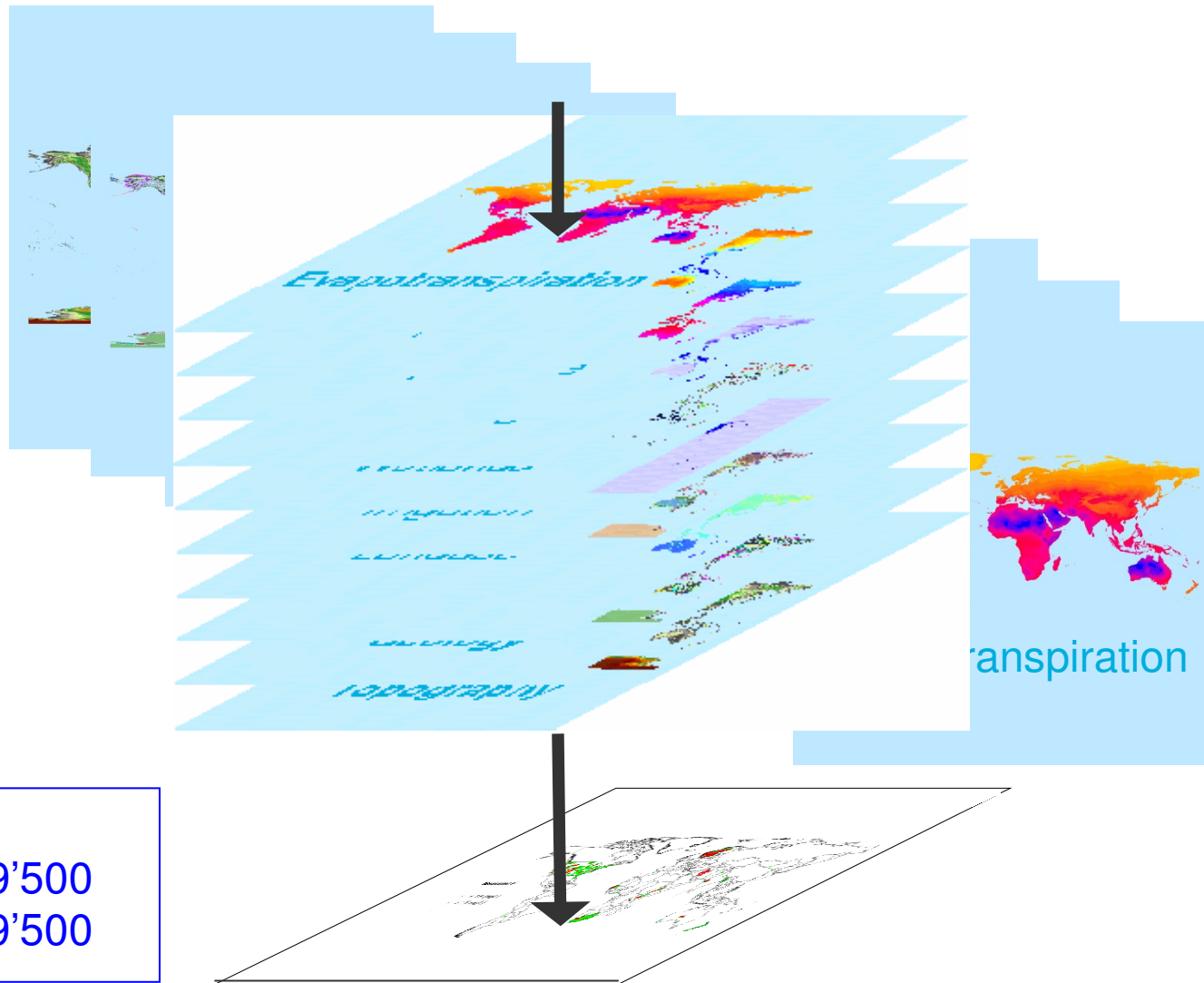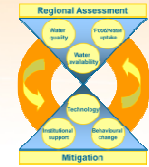
Data points
Fluoride: 69'500
Arsenic: 19'500

First generation risk map for arsenic > 10 µg/L

Probability of
As >10 µg/L

- Poor estimation
- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1

Amini et al., ES+T 2008a

Number of locally affected lives becomes global challenge

>50% probability of contaminated groundwater overlain with population density

Arsenic Hazard Index
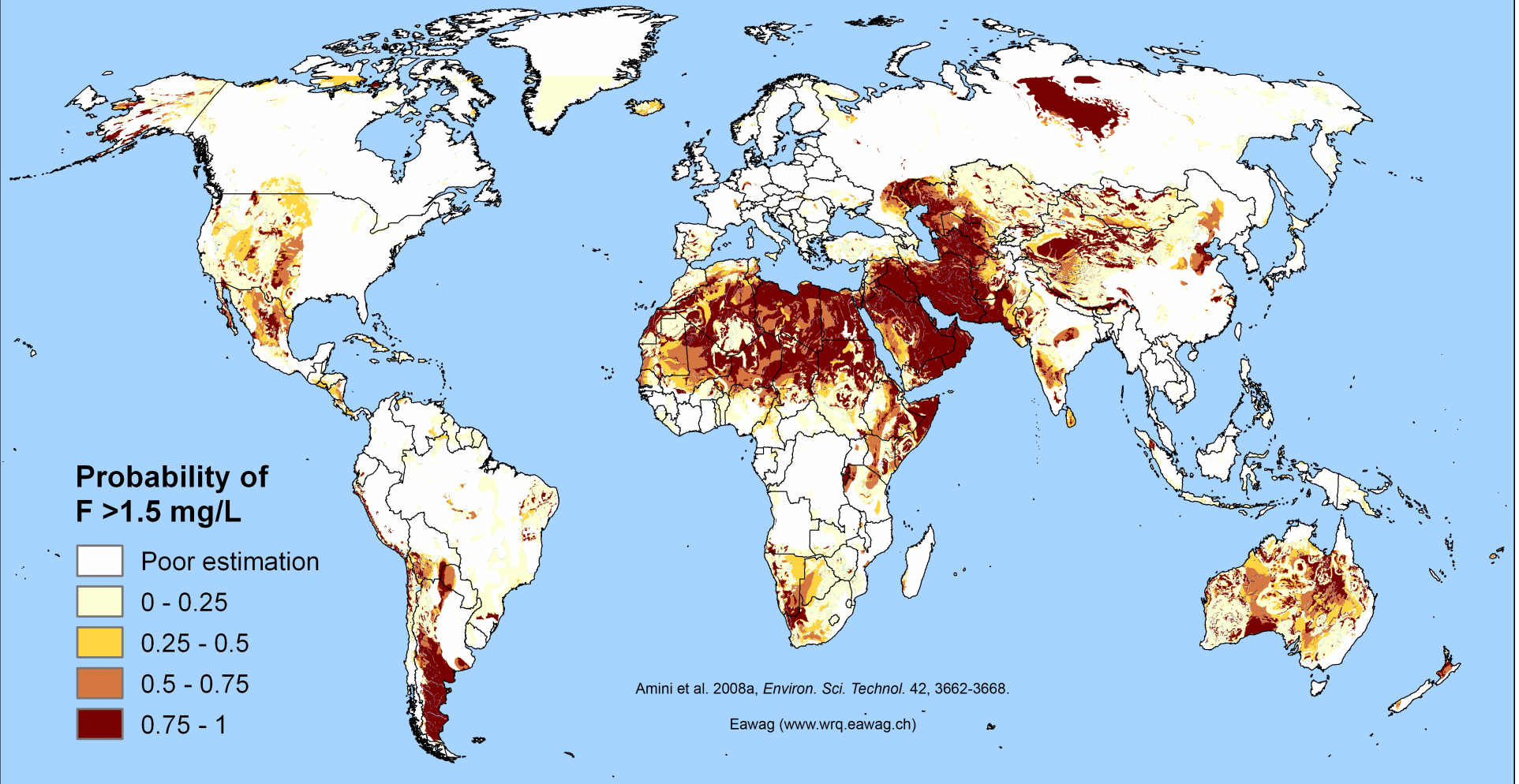
- no hazard
- low
- medium
- high
- very high
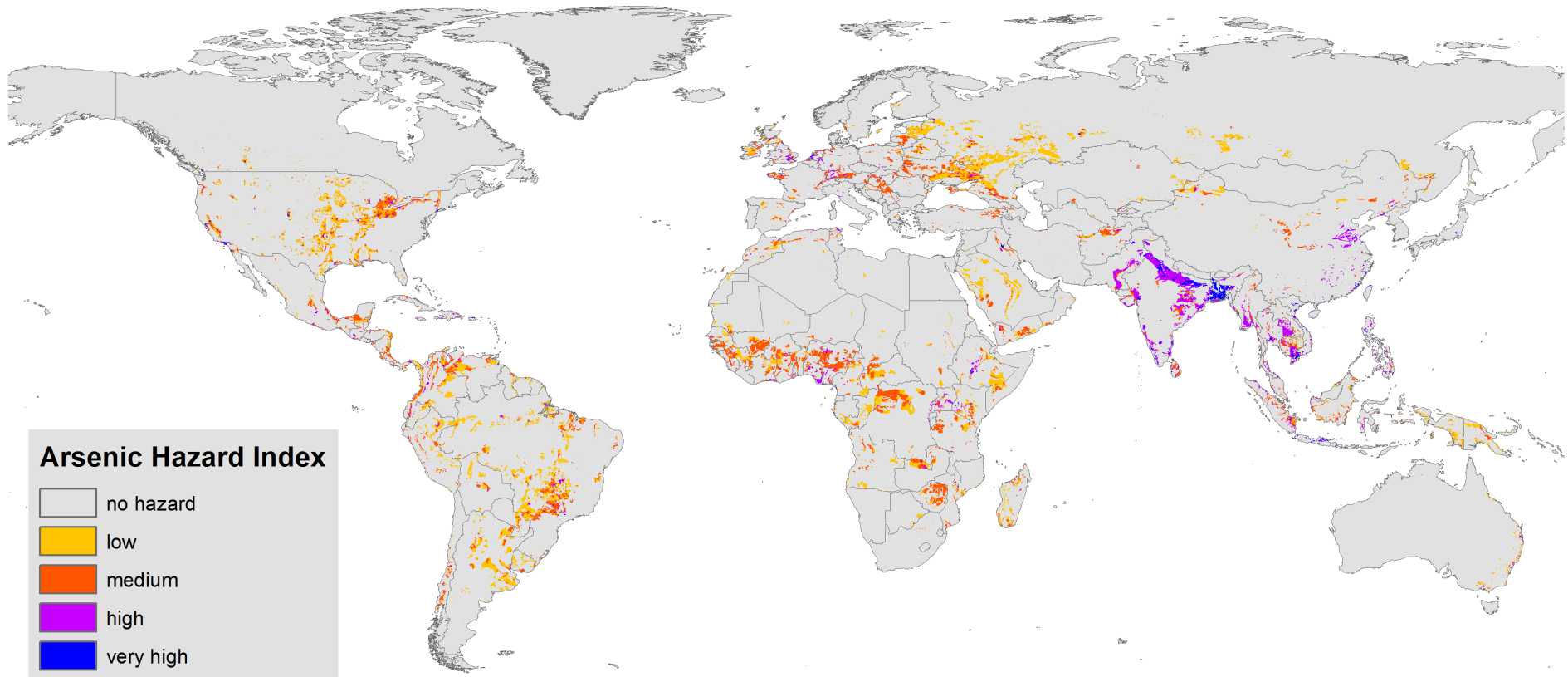
Population living in arsenic hazard areas:
754 million (2010 population estimate, SEDAC)
1/3 drinking groundwater? ⇒ about 250 million

First generation risk map for fluoride > 1.5 mg/L

Modeled global probability of fluoride concentration in groundwater exceeding the WHO guideline for drinking water of 1.5 mg/L

Probability of F >1.5 mg/L

- Poor estimation
- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1

Amini et al. 2008a, *Environ. Sci. Technol.* 42, 3662-3668.

Eawag (www.wrq.eawag.ch)

Amini et al., ES+T 2008b

Number of locally affected lives becomes global challenge

>50% probability of contaminated groundwater overlain with population density

Fluoride Hazard Index
- no hazard
- low
- medium
- high
- very high
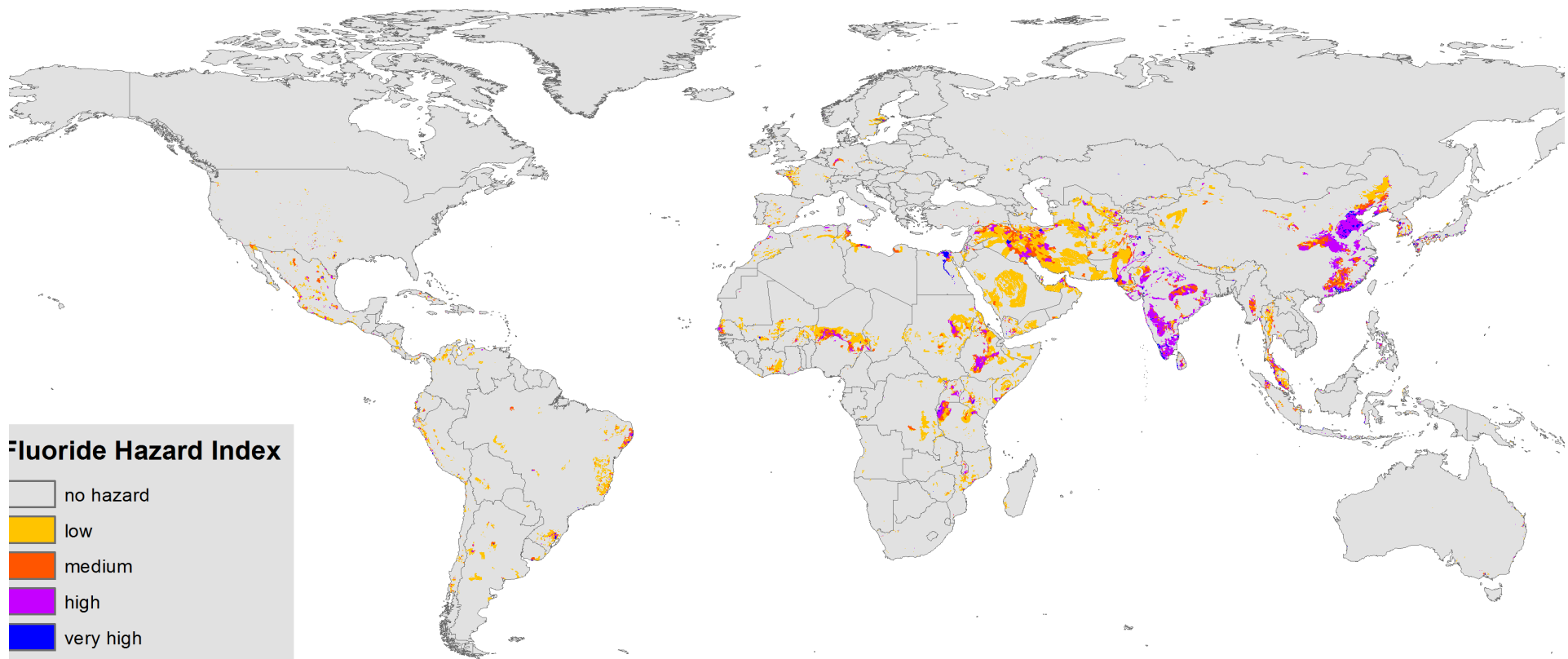
Population living in fluoride hazard areas:
561 million (2010 population estimate, SEDAC)
1/3 drinking groundwater? $\Rightarrow$ about 200 million

Needs

Lessons we have learnt:

1) Many countries are struggling to provide drinking water from improved sources

2) There are well known cases where countries are struggling to provide arsenic- or fluoride- free water

E.g. Bangladesh (As), India (F)

1) But many countries may have contamination they still need to address

2) There is a need for such prediction maps
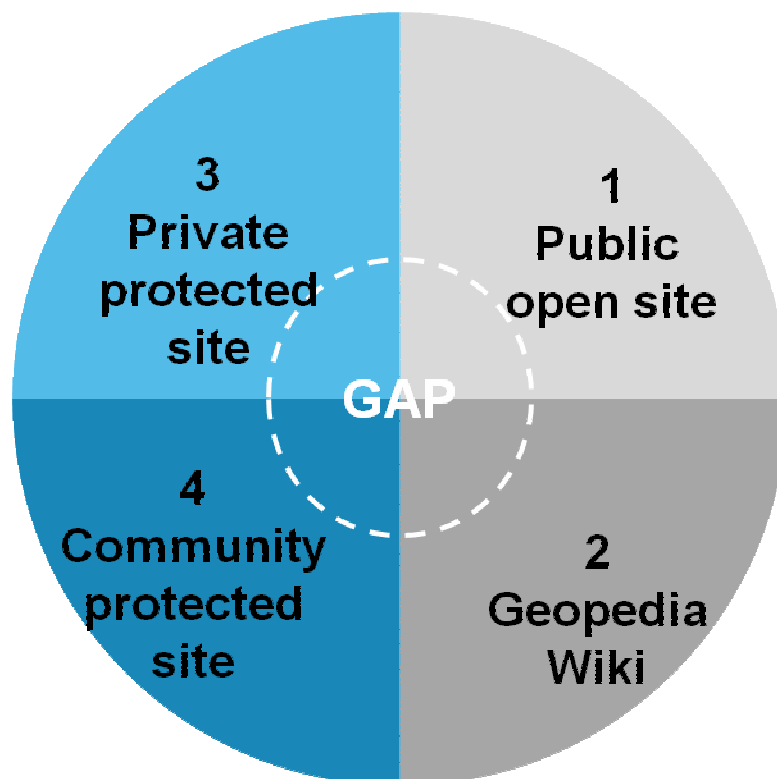
3) There is a need for information exchange and sharing

Groundwater Assessment Platform (GAP)

A user-friendly, open-source online platform for water quality information

- Upload data
- Data analysis and modeling
- Connect to and initiate new peer communities
- Comprehensive 'data rights' management

- All of the above
- Building community networks

- Visualization
- Aggregate statistics
- Connection to external databases
- Download georef'ed information
- Links

- Platform for open discussion & exchange
- Public sharing of information and advice
- HUB for networking and connecting

Linkages?

We are at the very beginning and there may be opportunities

1) To link to quantitative water resource issues

- Alternative water resources

- Mapping of water points

- etc.

1) To partner with other organisations

- Regional hubs to provide water-quality training, data management, modeling

- Mapping o/modelling of other quality issues – e.g. salinity

- Long-term hosting of platform