

Management of Health and Environmental Effects of Artisanal Gold Mining from a Developing Country Perspective



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Characteristics - Suriname

- 163,820 sq. km.
- The total population 492,829 inhabitants (2004)
- The medium age of the population is 26.5 years
- Ethnic diversity: Creoles, 17.7%; Maroons, 14.7%; Hindustani, 27.4%; Javanese, 14.6%; Mixed, 12.5%; Others (Chinese, Indigenous peoples, Lebanese, Chinese, European, etc), 6.5%; Unknown); Not reported, 6.6%.
- The rural population consists of 163,897 inhabitants, 33.3% of the population
- Interior tropical rainforest 48.351 inhabitants traditional Maroon and Amerindian communities



Characteristics – Gold Mining

- History

- First activities data back to last quarter 19th century
- Gold industry peak production 1908 1209 kilogram
- Artisanal miners, porknockers, 5000 registered mainly Caribbean island
- Collapse gold industry 1930
- Gold production 1940-1970 less 200 kg/yr
- Mid 1970's thought that porknockers would disappear

Characteristics – Gold Mining

- Second boom
 - Small-scale gold mining became significant 1986-1992
 - Period civil war interior
 - South-Eastern Suriname isolated, gold only tender
 - Peace treaty signed 1992
 - Second boom quickly took off
 - Favorable gold prices
 - Devaluation local currency, with hyperinflation 1995

Characteristics – Gold Mining

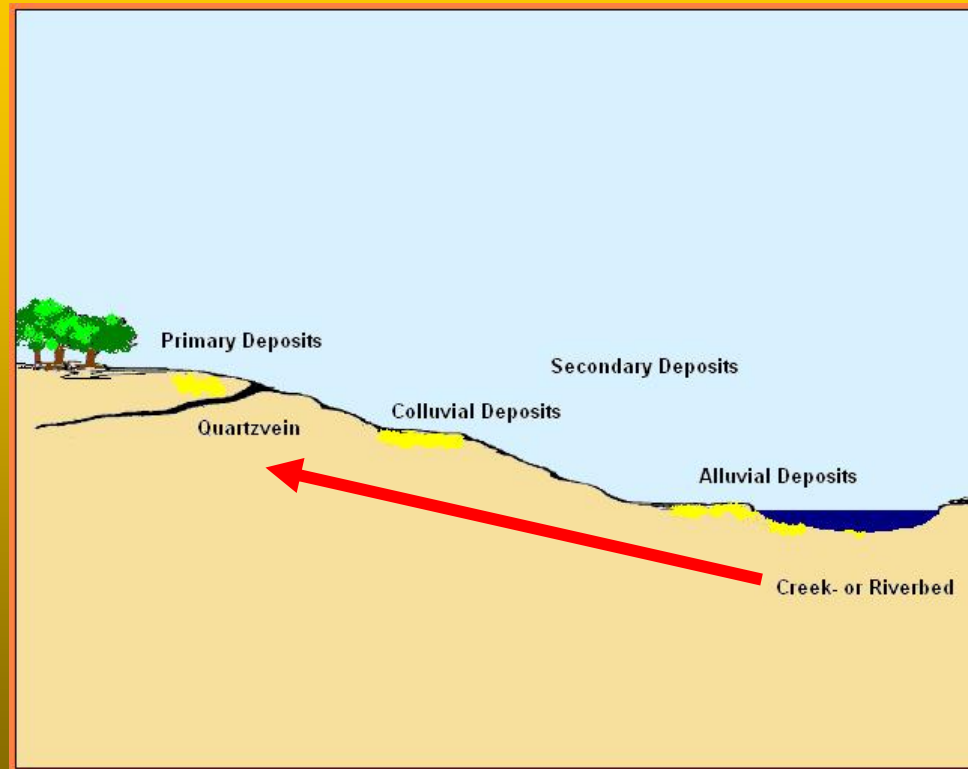
- Second boom
 - At least 10,000 miners involved
 - In the beginning locals, mainly Maroons, involved
 - Influx Brazilian ‘garimpeiros’, subcontracted by Maroons
 - Expertise in hydraulic and small-scale mining
 - Scarcity alluvial ores in Brazilian Amazon

Characteristics – Gold Mining

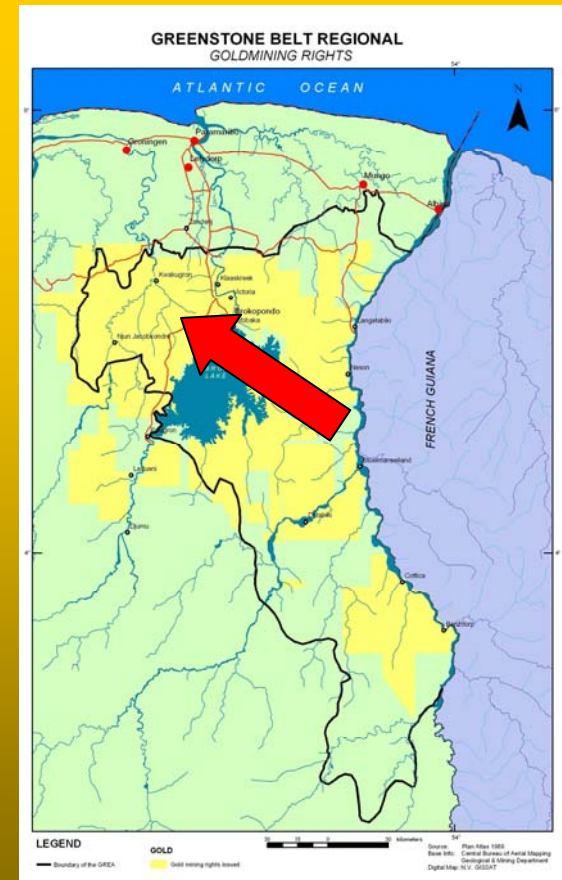
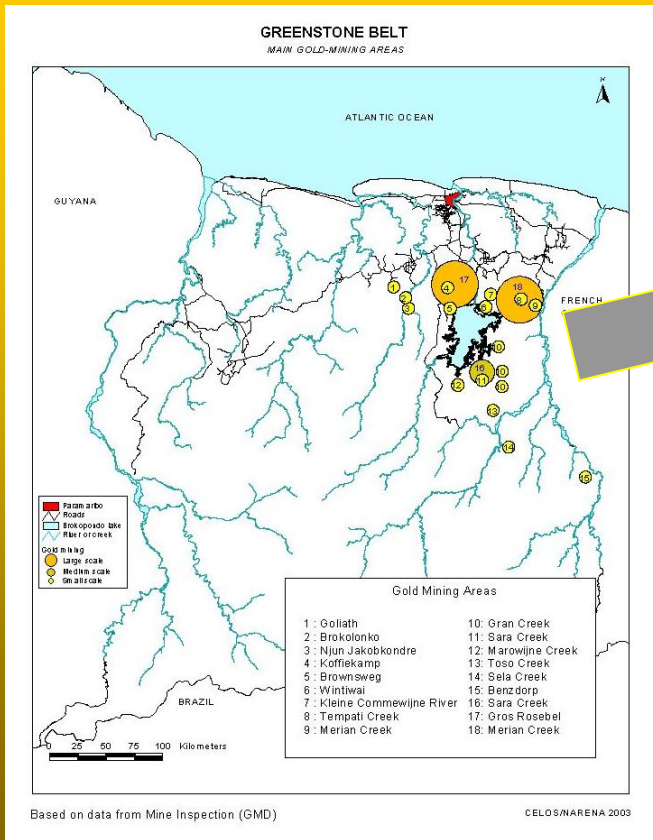
- Type of production
 - 1980's gold production by dredges operations introduced from Guyana
 - River deposits became exhausted
 - Production moved on land, mining high alluvial grades, second- and third reworking old mine sites
 - Hydraulic mining techniques 'garimpeiros' most common extraction method

Characteristics – Gold Mining

- Type of gold deposits



Characteristics – Gold Mining



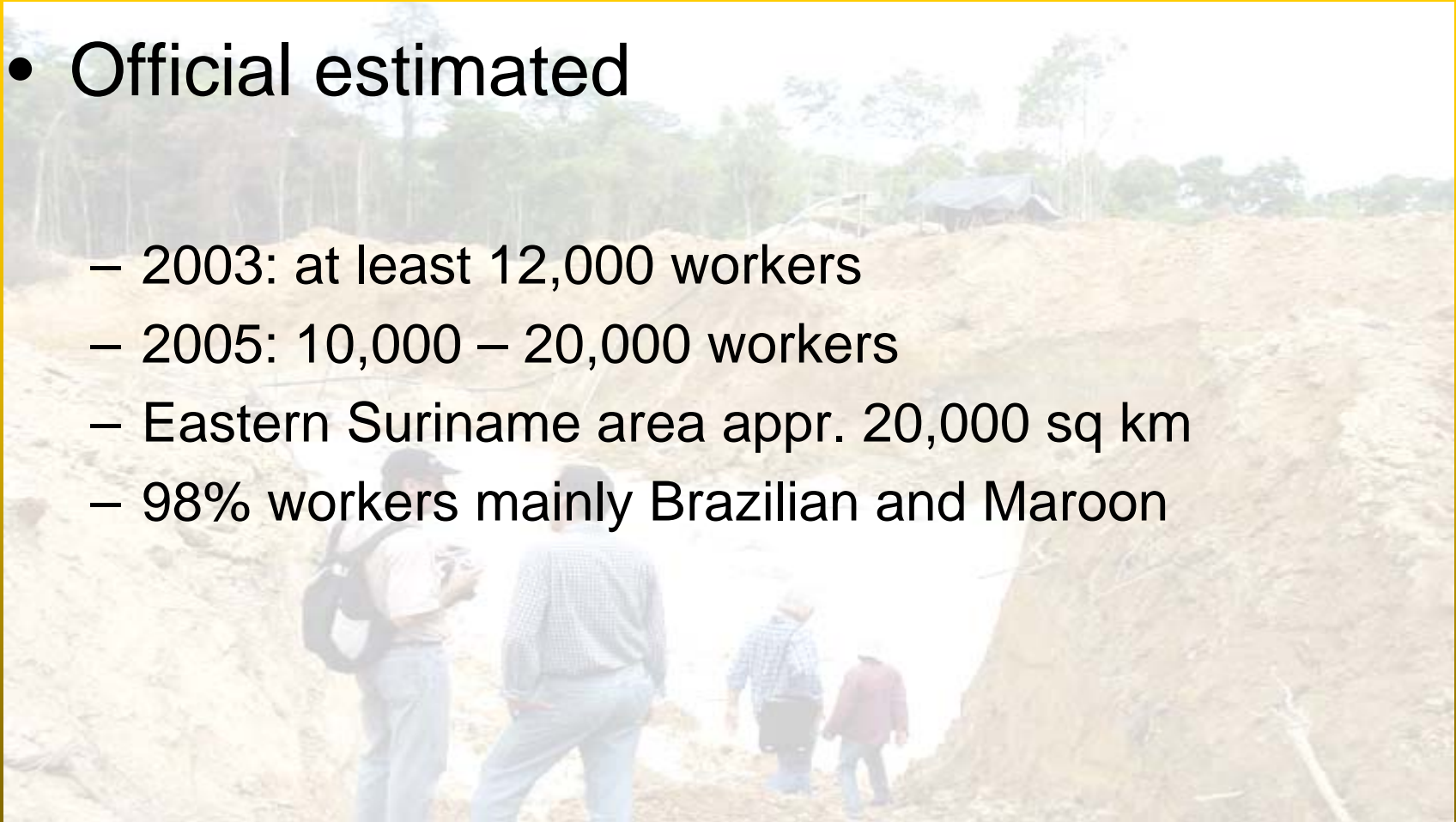
Characteristics – Gold Mining

- Small to medium scale / Artisanal
 - Rudimentary prospecting and extraction
 - Mercury use very often no retort
 - Large volumes of tailings
 - Informal, subcontracting
 - Little government control



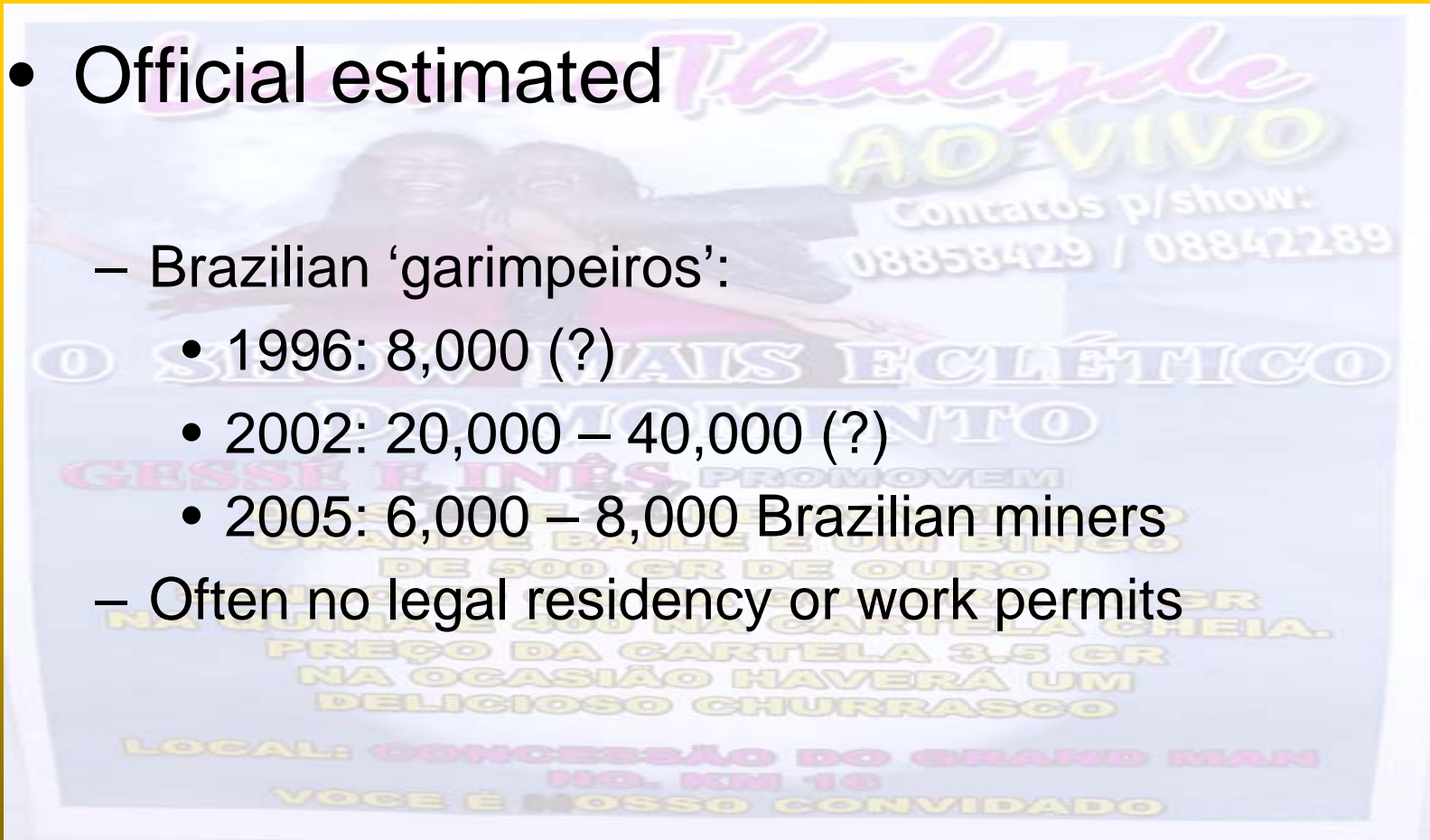
Characteristics – Gold Mining

- Official estimated
 - 2003: at least 12,000 workers
 - 2005: 10,000 – 20,000 workers
 - Eastern Suriname area appr. 20,000 sq km
 - 98% workers mainly Brazilian and Maroon



Characteristics – Gold Mining

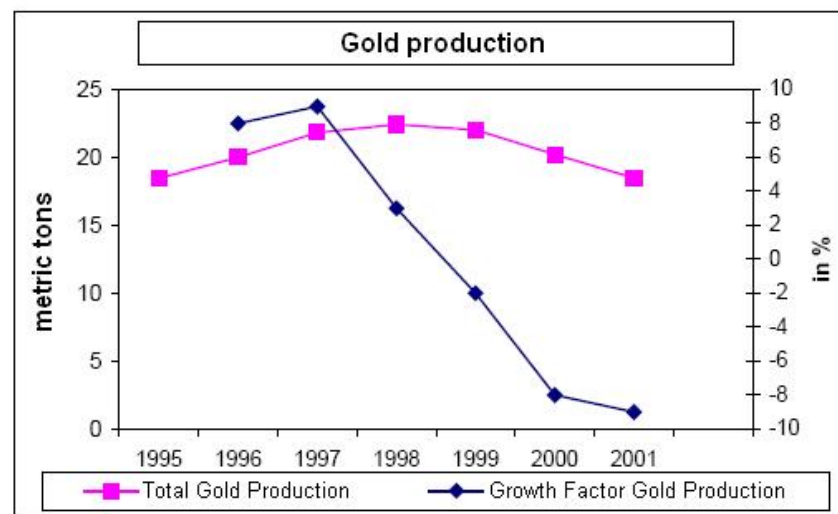
- Official estimated
 - Brazilian ‘garimpeiros’:
 - 1996: 8,000 (?)
 - 2002: 20,000 – 40,000 (?)
 - 2005: 6,000 – 8,000 Brazilian miners
 - Often no legal residency or work permits



Characteristics – Gold Mining

- Production figures

- 2003 15 m. tons (1.8% 825.5 m. tons Western Hemisphere, 35% total world production)
- 1997-2001 production 15% of GDP (\pm 900 M US\$)



Source: SPS 2003

Characteristics – Gold Mining

- Formal large-scale gold mining
 - Cambior Rosebel Gold Operation (February 2004, life span mine 10 yrs)
 - Area 17,000 sq km,
 - Extraction with cyanide in recirculated process
 - Production
 - 2004: 9,700 m. tons (equivalent 10% GDP)
 - 2005: 12,000 m. tons
 - Explorations
 - CANARC, SURALCO/NEWMONT

Characteristics – Exposure Sources

Mercury

- **Anthropogenic – artisanal gold mining**
 - Gold refining new and old sites: 15,000 kg/yr ?
 - Gold refining in 10 goldshops and 59 jewelers: kg/yr ?
 - Infrastructure and deforestation: 300 kg/yr ?
- **Anthropogenic – mobilization mercury impurities**
 - SURALCO Aluminum refinery mercury emissions: 500 kg 2001, 2002
 - STAATSOLIE Mineral oils extraction and refining: no data
- **Anthropogenic – mobilization mercury impurities**
 - Shifting cultivation traditional Maroons and Amerindians: 33 kg/yr ?
- **Anthropogenic – others**
 - Hydroelectric reservoir: ?
 - Mercury bulbs, dental, medical devices, etc
 - Other sources cultural use: anecdotal data
- **Natural mobilization**
 - Weathering of rocks
 - Natural mercury deposits

Characteristics – Variables Exposure

- **Exposed**
 - Occupational (mining, refining, goldshops)
 - Environmental (fish or goldshops)
- **Fish**
 - Area
 - Piscivorous (fish eating) versus nonpiscivorous
 - Length
 - Seasonal variation
 - Seasonal extreme flooding
- **Communities**
 - Consumption patterns
 - Traditional Maroon and Amerindians: subsistence fishing
 - Recreational: hydroelectric reservoir
 - Urban: interior, estuarine and marine fishes coastal waters
- **Vulnerable groups**
 - Children, pregnant women

Characteristics – Data Exposure

- **Studies occupational mercury exposure small scale gold miners/refiners**

- Maroon miners specific location (De Kom et al, 1998)
- Miners main gold mining locations, Jewelers Paramaribo (De Kom et al, 1998)

Location	Subjects	N	Blood ($\mu\text{g/L}$) Mean \pm SD	Urine ($\mu\text{g/g creatinine}$) Mean \pm SD; Range
Tapanahony river	Gold miners	28	18.1 \pm 11.0 (n=25)	27.5 \pm 21.1
	Control group	17	26.8 \pm 14.6 (n=16)	5.2 \pm 2.9
Main mining regions	Gold miners	71		10.4 \pm 8.6; 1.1 - 40.2
Capital	Jewelers	39		9.2 \pm 7.4

- **Studies environmental methylmercury exposure**

- Pregnant and non-pregnant women and children 0-6 yrs nearby gold mining areas (De Kom et al, 1998)

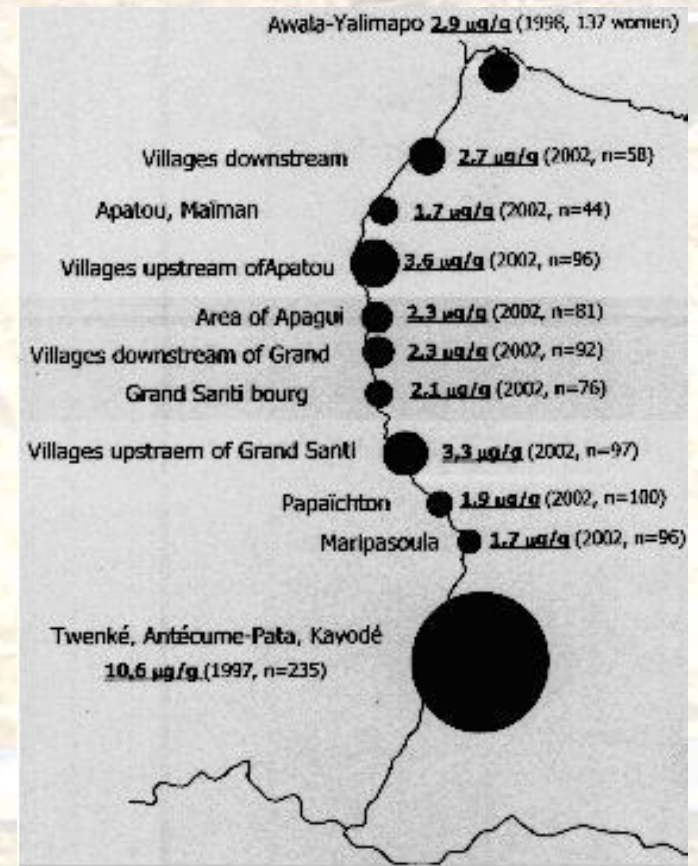
Location	Subjects	N	Hair (Hg $\mu\text{g/g}$ hair) Mean \pm SD	Hair (MeHg $\mu\text{g/g}$ hair) Mean \pm SD
Nearby main mining areas	Women pregnant	39	2.7 \pm 0.3	2.0 \pm 0.2
	Women (n-pregnant)	16	2.1 \pm 1.2	1.6 \pm 0.3
	Childr 0-6 yrs	105	3.1 \pm 2.7 *	2.7 \pm 1.6 (76)

* Highest levels Hg 11.6 (2) and 20.1

Characteristics – Data Exposure

- **Studies environmental methylmercury exposure**

- Mercury exposure of mothers and newborns in Suriname (Mohan et al 2003)
- Mercury in French Guyana: Results of surveys about impregnation of population conducted from September to November 2002 in the Marowijne River Valley (Terzan L, 2005)



Characteristics – Data Exposure

- **Mercury in water, sediment and fish:**

- Relation mercury in different environmental compartments to artisanal gold mining (Mol, 2001; MOW, 2001; Quik, 2000; Quik, 1998)

Location	Water samples, unfiltered (µg/l) Mean±SD;	Sediment (mg/kg) Mean±SD; Range (N)	Fish	
			Species	(mg/kg ww) Mean±SD; Range (N)
Main mining regions	1.88 ± 1.71 (41)	0.2 ± 0.2 (39)	Carnivorous	0.14 - 1.64 (14)
			Herbivorous	0.01 - 0.07 (8)
			Omnivorous	0.05 - 0.08 (3)
Different locations			Piscivorous freshwater	>0.5 57% (269)
			Estuarine fish	>0.5 8.9% (45)
			Sea fish	>0.5 16.8% (101)
Paramaribo		0.02 - 1.5 (16)	Carnivorous	>0.5 57% (7)
Commewijne river	0.02 ± 0.05 – 0.07 ± 0.08 (22) *	0.05 ± 0.01 - 0.12 ± 0.03 (22) *	Herbivorous	0.06 ± 0.07 - 0.07 ± 0.03 (8)
	<0.02 (12) – <0.03 (20)**	0.04 ± 0 - 0.10 ± 0.04 (23)**	Omnivorous	0.10 ± 0.04 - 0.13 ± 0.05 (10)
			Predator	0.09 ± 0.06 - 0.52 ± 0.3 (71)
* dry season	** rainy season			

Characteristics – Related Issues

- Public Health Issues (Malaria, Sexual Transmittable Diseases, incl. HIV/AIDS, Mercury Contamination)
- Occupational Health and Safety
- Social
- Environmental
- Legal

Actions Undertaken since 1993

- **General**

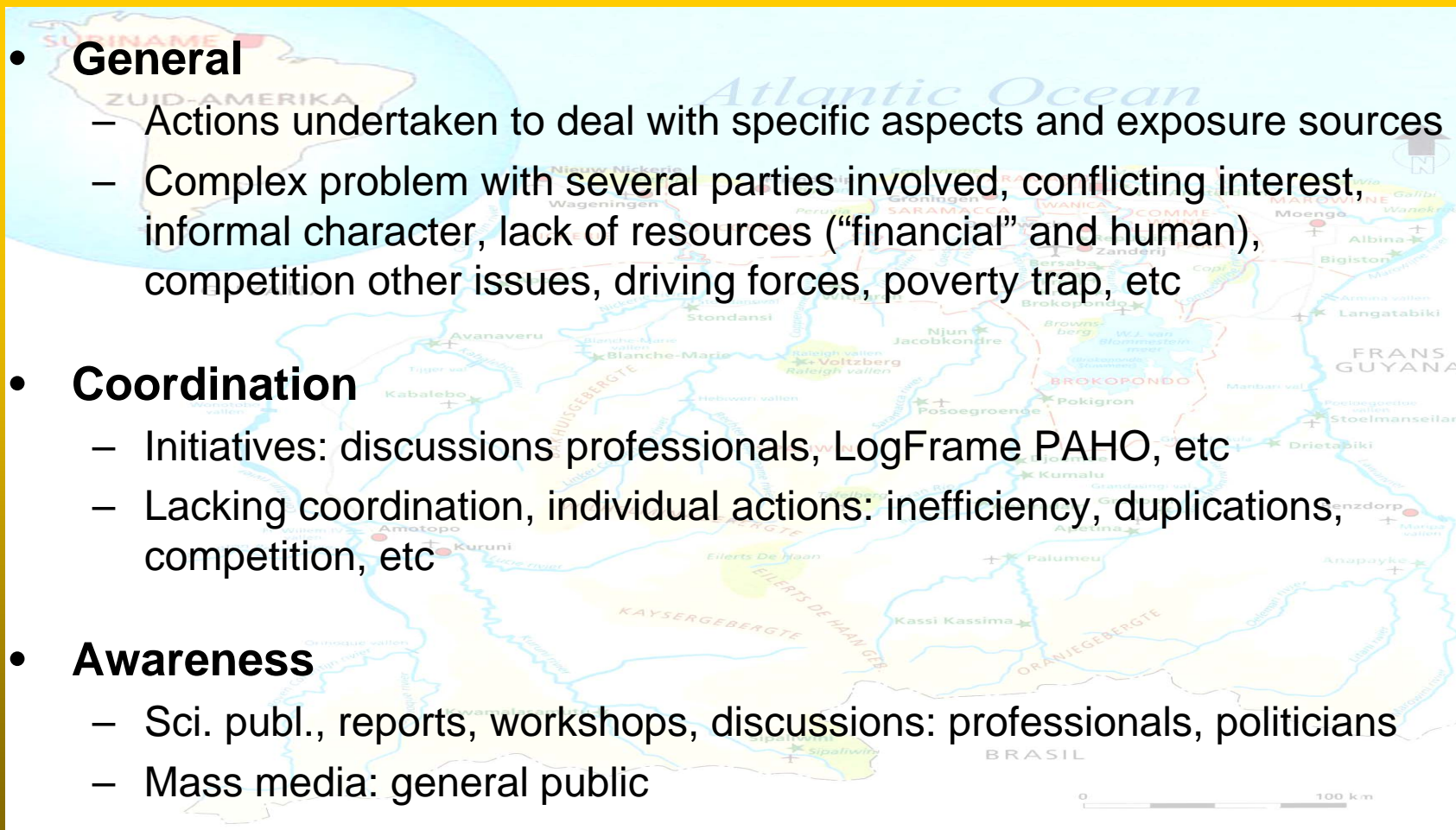
- Actions undertaken to deal with specific aspects and exposure sources
- Complex problem with several parties involved, conflicting interest, informal character, lack of resources (“financial” and human), competition other issues, driving forces, poverty trap, etc

- **Coordination**

- Initiatives: discussions professionals, LogFrame PAHO, etc
- Lacking coordination, individual actions: inefficiency, duplications, competition, etc

- **Awareness**

- Sci. publ., reports, workshops, discussions: professionals, politicians
- Mass media: general public



Actions Undertaken since 1993

- **Reports**

- No shortage
- Issues: environmental, mining, legal, health, etc

- **Projects**

- Several parties involved
 - Embassies: Netherlands, America, Brazil, France, Japan
 - EU, IO's: OAS, PAHO, UNEP, etc
 - NGO's: WWF
- Agenda donors



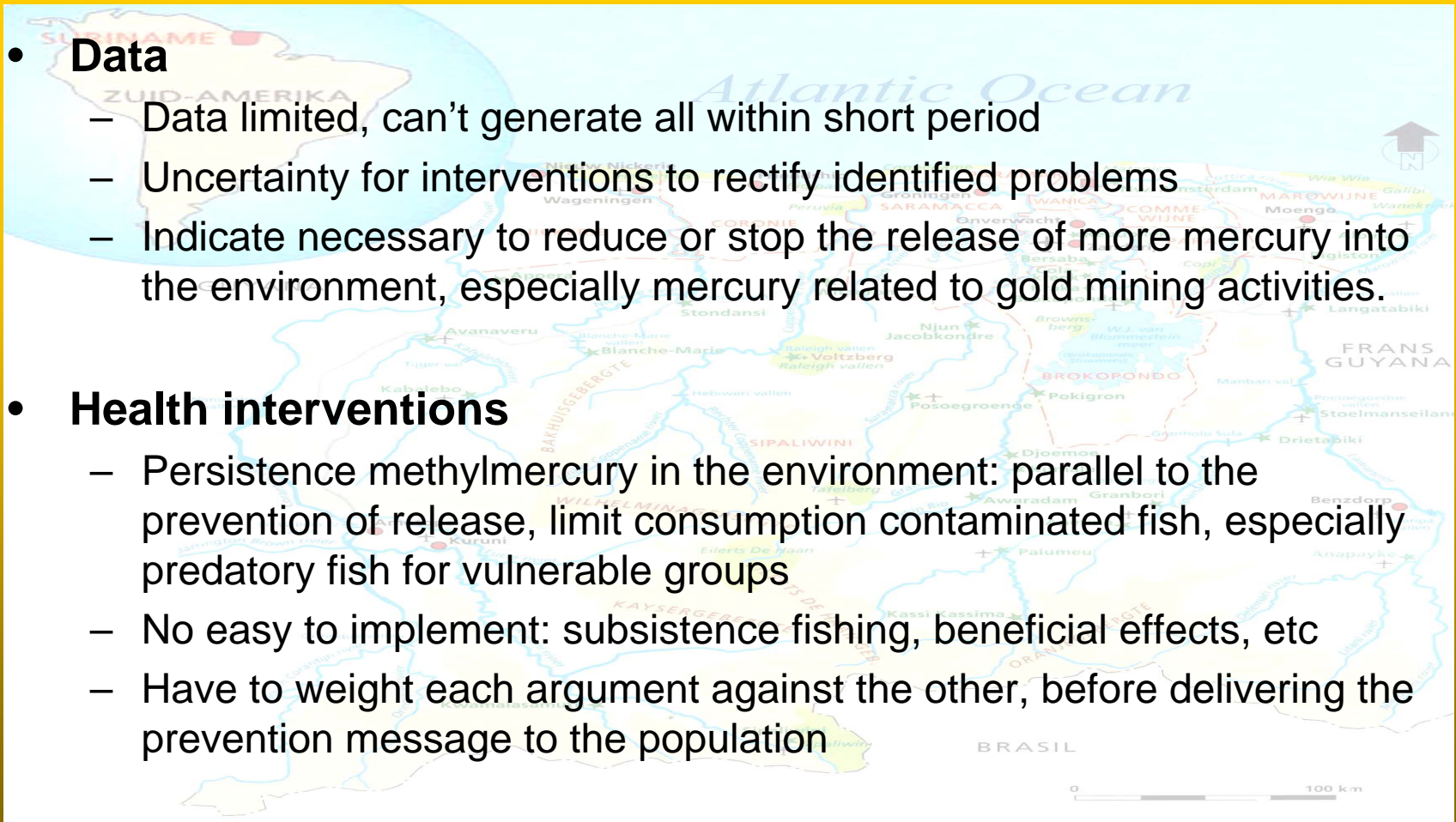
Actions Undertaken since 1993

- **Data**

- Data limited, can't generate all within short period
- Uncertainty for interventions to rectify identified problems
- Indicate necessary to reduce or stop the release of more mercury into the environment, especially mercury related to gold mining activities.

- **Health interventions**

- Persistence methylmercury in the environment: parallel to the prevention of release, limit consumption contaminated fish, especially predatory fish for vulnerable groups
- No easy to implement: subsistence fishing, beneficial effects, etc
- Have to weight each argument against the other, before delivering the prevention message to the population



Actions Undertaken since 1993

- **Health interventions related issues**

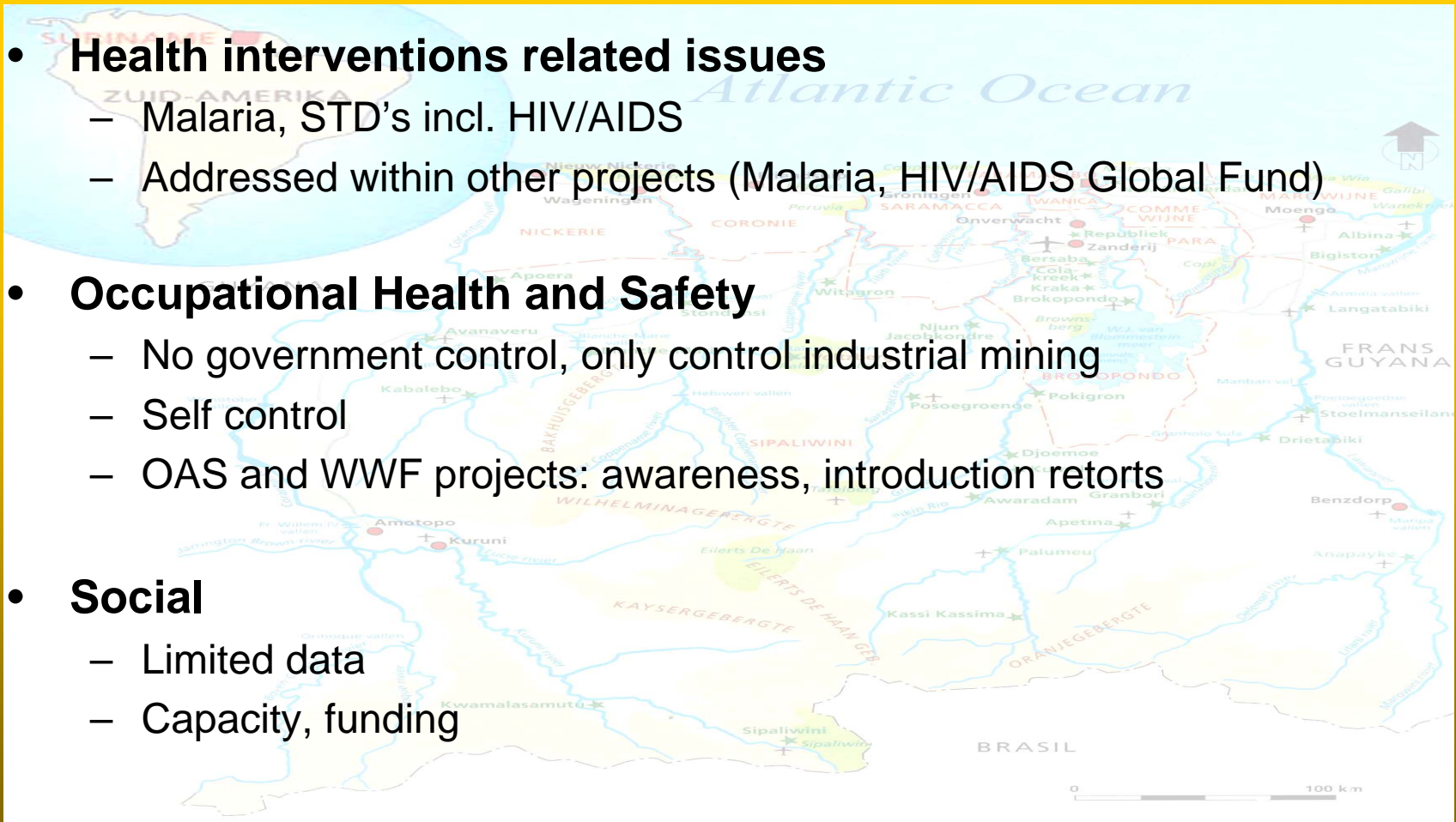
- Malaria, STD's incl. HIV/AIDS
- Addressed within other projects (Malaria, HIV/AIDS Global Fund)

- **Occupational Health and Safety**

- No government control, only control industrial mining
- Self control
- OAS and WWF projects: awareness, introduction retorts

- **Social**

- Limited data
- Capacity, funding



Actions Undertaken since 1993

- **Environmental**

- Introduction of new mining techniques
- Retorts on small scale, cost aspects, incentives, etc
- Sediment and fish monitoring on project basis

- **Government efforts to bring the sector under control**

- Focus securing fiscal revenues: 1997-1999 tax collection in the field
- Registering miners (15,000, payment of annual fee US\$ 200)
- Interdepartmental commissions (units in the field: no success (poor planning), Security incidents: military, police, mining department in the field)
- There is no optimal presence of the government in the field:
 - Mining zones controlled by the miners themselves in the remote areas
 - Concession owners have established infrastructure in remote areas.
- New mining law drafted
- Import of mercury stopped since 2005



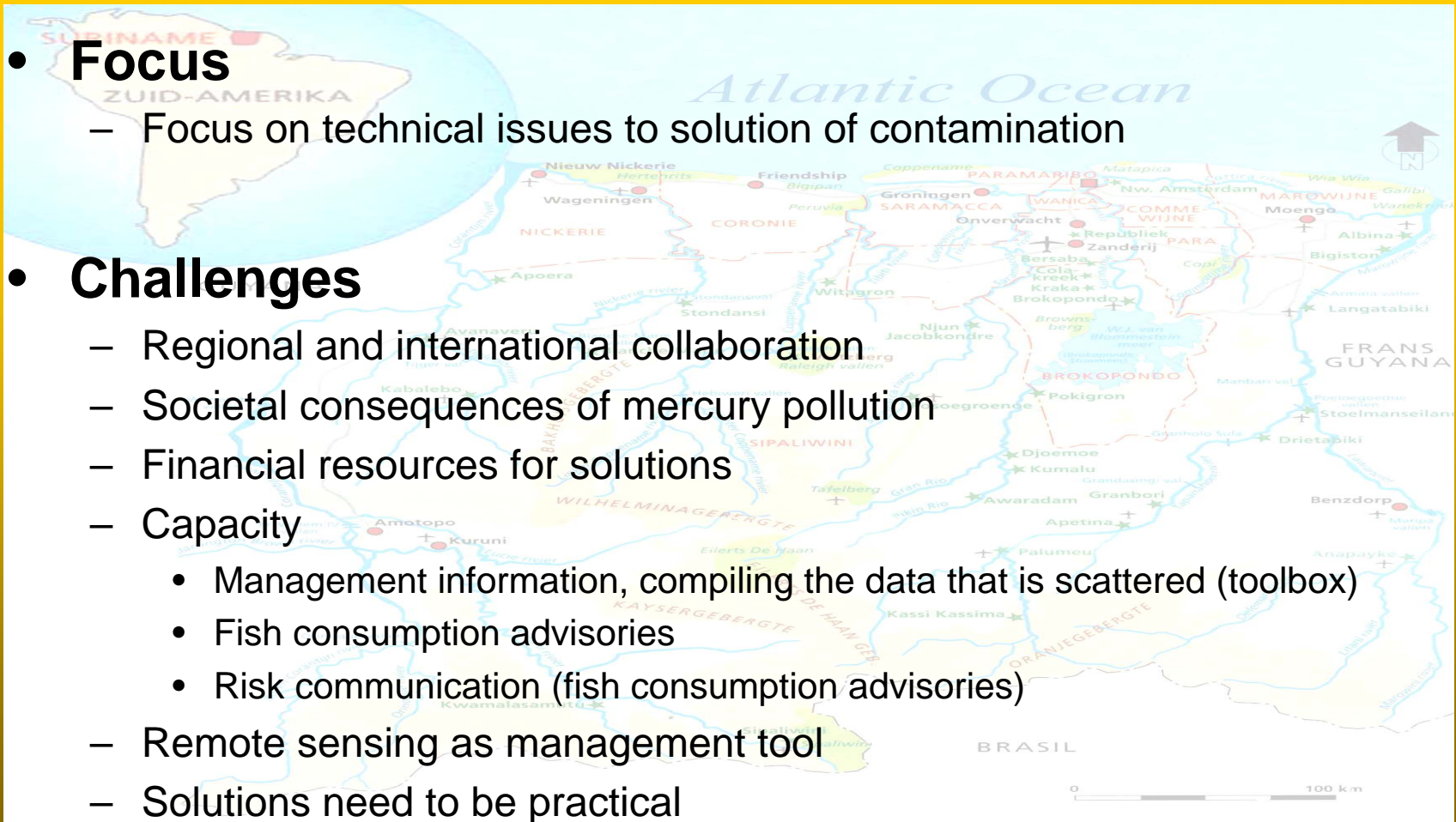
International Dimensions Challenges

- **Focus**

- Focus on technical issues to solution of contamination

- **Challenges**

- Regional and international collaboration
- Societal consequences of mercury pollution
- Financial resources for solutions
- Capacity
 - Management information, compiling the data that is scattered (toolbox)
 - Fish consumption advisories
 - Risk communication (fish consumption advisories)
- Remote sensing as management tool
- Solutions need to be practical





Budapest, 23 September 2006