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Vulnerability assessment of the deltas of 26 transboundary rivers

Wim van Driel, Tom Bucx. et al

TWAP TRANSBOUNDARY WATERS ASSESSMENT PROGRAMME

gef

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Centre on Water and Environment

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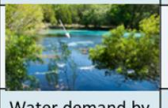
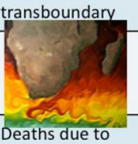
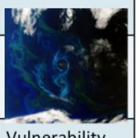
Transboundary Waters Assessment Programme (TWAP)

Elements	Transboundary Aquifers:	Transboundary Lakes Basins & Reservoirs	Transboundary River Basins	Large Marine Ecosystems	The Open Ocean
Spatial coverage, 2010, 2030, 2050	166 aquifers 43 groundwater systems in SIDS	200 lakes/ reservoirs	276 river basins	66 LMEs, of which 55 are transboundary	Global Open Ocean
Biophysical indicators					
Socioeconomic Indicators (e.g.)	Water demand by economic sector	GDP Fisheries GDP Tourism	Access to water Access to sanitation	Deaths due to climate related natural disasters	Vulnerability to sea level rise
Governance architecture/ arrangement (e.g.)	For Water Quantity	For Water Distribution	For Habitat Destruction	For Fisheries	For Biodiversity

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Identification and delineation of deltas

Delineation

- On basis of Geomorphological characteristics
- Using Remote Sensing

Identification/selection

- Only deltas in transboundary basins
- Area of upstream river basin
- Delta area (in relation to basin)
- Delta population (in relation to basin)
- Ecological and/or agricultural importance
- Data availability

Selection

- 26 deltas selected, global distribution

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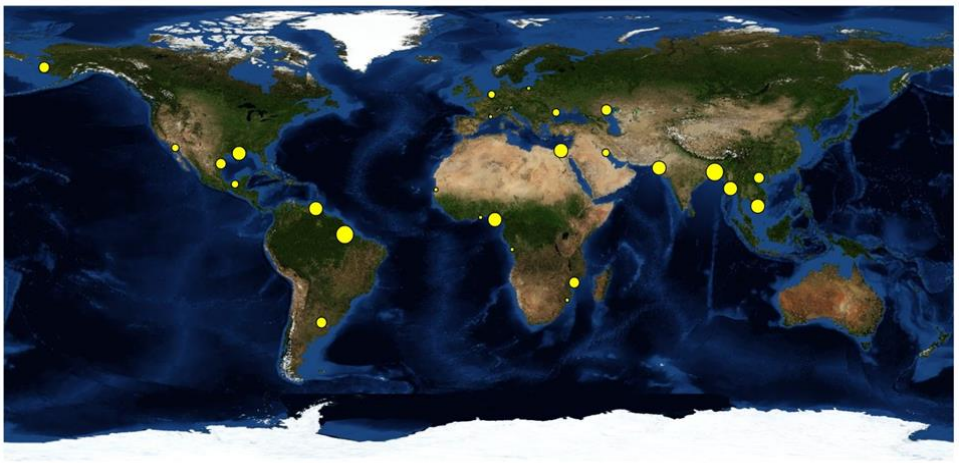
Global distribution of selected Deltas



TWAP: 26 deltas selected

Delta Vulnerability Indicators

- Development of suitable vulnerability indicators
  - Relative sea level rise indicator
  - Wetland/ecosystems indicator
  - Population pressure indicator
  - Delta governance indicator
- Data
  - Existing global databases and studies, no field work
- Computation
  - All indicators score on 1 to 5 scale
- Vulnerability indicators are defined as **relative risk indicators.**

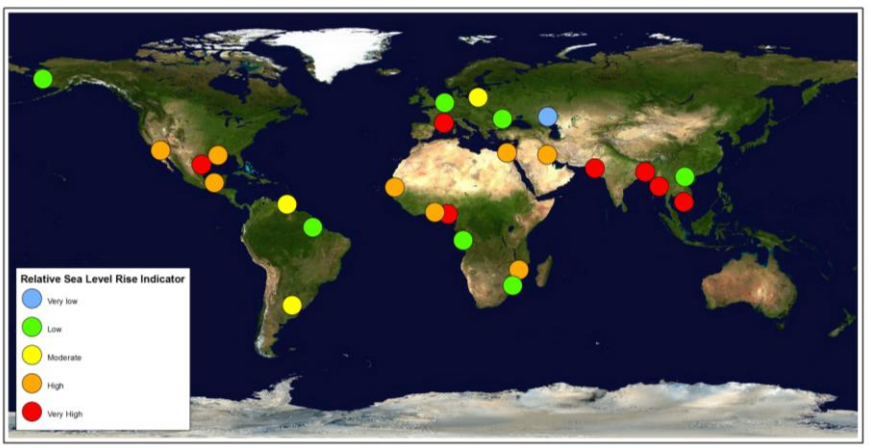
Relative Sea Level Rise Indicator

Computation

- **Relative sea level rise consisting of**:
  - Delta aggradation (by sedimentation)
  - Subsidence
  - Sea level rise (absolute)

- **Assessed for each delta by using published quantitative data**
  - Syvitski et al 2009
  - Ericson et al 2006

Relative Sea Level Rise Indicator



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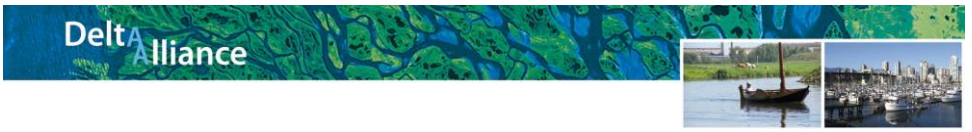
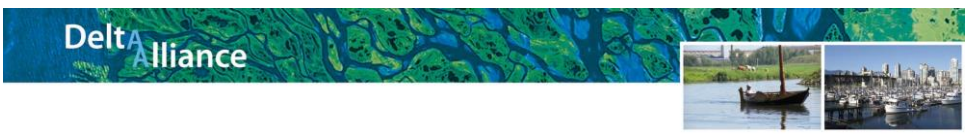


Relative Sea Level Rise Indicator

Interpretation of results

- The most deltas at highest risk are in Asia (Ganges, Indus, Irrawaddy and Mekong)
- In Africa and America also a considerable number of deltas are at high risk, especially the Niger and Rio Grande
- Europe only the Rhone at high risk
- Important factor for RSLR is increasing population in delta (mega) cities => less delta aggregation and increased land subsidence by groundwater extraction



Wetlands Ecosystem Indicator

Computation

- **Share of wetland ecosystems** within the delta, (GLWD- 3)
- **Ecological value** determined by the presence of/in:
  - ***Biodiversity Hotspot(s):*** regions of global conservation importance
  - ***Key Biodiversity Area(s)*** (KBA)
  - ***Ramsar site(s)***
  - ***Global 200***: ecoregions with conservation priority (WWF)
  - ***Man and Biosphere Reserves (MAB-Reserve***): (UNESCO)
  - ***Formally protected areas:*** IUCN category 1-2.
- **Ecological threats,** as mentioned in:
  - ***Global 200***
  - ***Biodiversity hotspots***
  - ***Ramsar description***s

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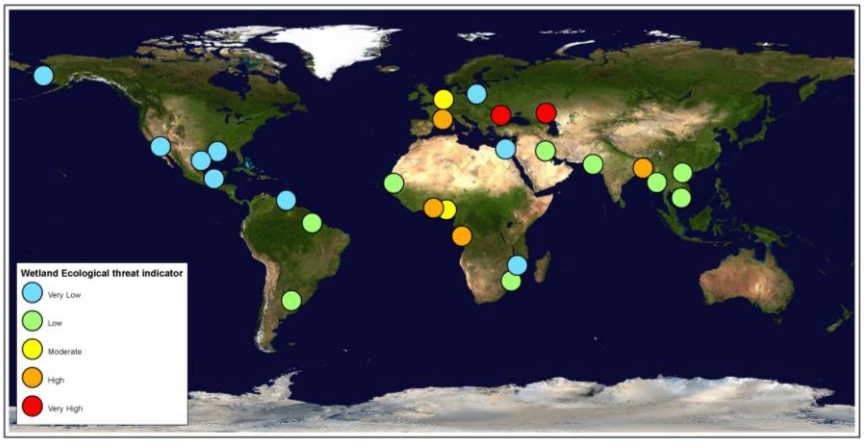
Wetlands Ecosystem Indicator



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Wetlands Ecosystem Indicator

Interpretation of results

- Most valuable deltas: Danube and Volga; large valuable delta systems but important ecological threats
- The deltas in the Americas seem to be less at risk (less threats)
- In more developed countries more data available

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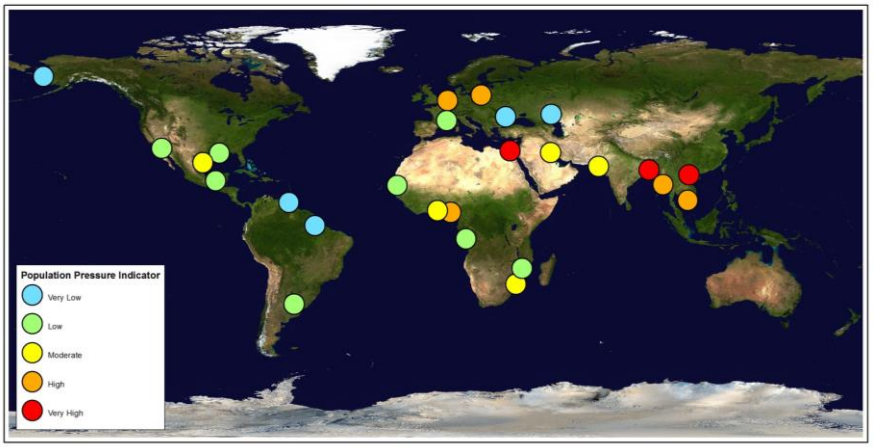
Population Pressure Indicator

Computation

- **Gridded Population of the World Database**
  - Distribution of human population across the globe.
  - Projection of population for the year 2010, based on census data of the year 2000.
  - Average population density per delta calculated.

Population Pressure Indicator



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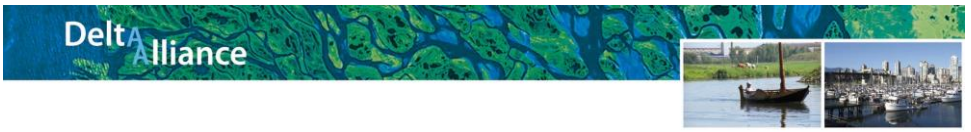
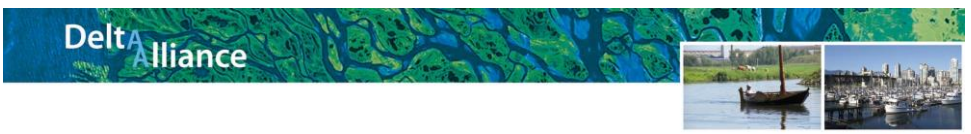


Population Pressure Indicator

Interpretation of results

- Deltas with highest population density: Ganges-Brahmaputra, Hong and Nile
- The indicator quantifies only average density, no information on the heterogeneity. Difference for vulnerability?
- Vulnerability/risk also depending on quality of houses, evacuation routes, etc..
- At which elevation level do the people live?



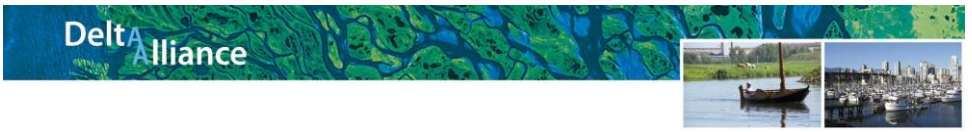
Delta Governance Indicator

Computation

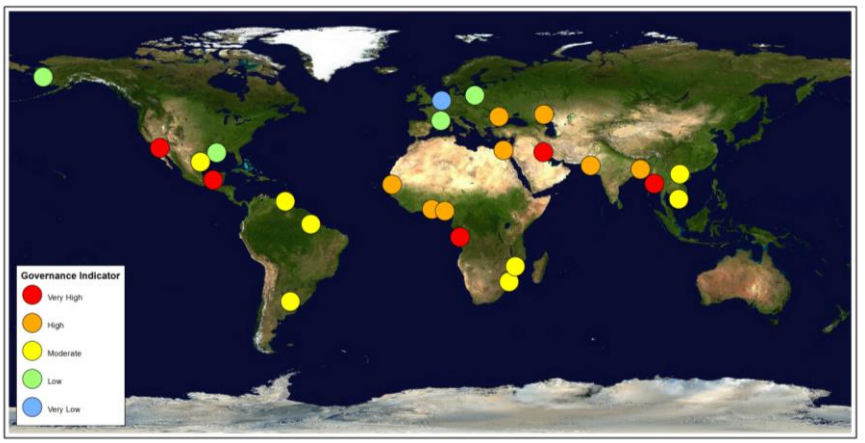
- **Determining how different countries score on three key principles of delta governance:**
  - Adaptivity (regarding economic and political environment)
  - Participation (regarding transparency, accountability and participation – institutional performance)
  - Fragmentation (regarding governance structures)

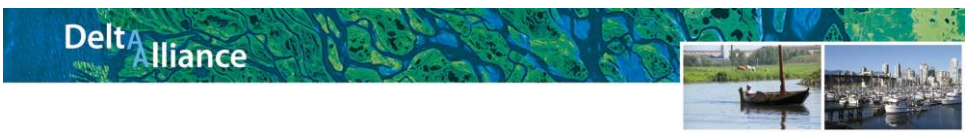
- **For 4 different levels of institutionalization:**
  - meta level, (norms, values, codes, orientation, culture, informal institutions)
  - macro level (formal rules, laws, regulations, constitutions and related process arrangements
  - meso level (convenants, contracts, agreements, plans and related processes
  - micro level (actors /interactions, aimed at creating or influencing services, provisions, planning, outcome

- **Data sources:**
  - Actionable Governance Indicators (AGI Data Portal)
  - Hofstede Centre
- **In total 21 subindicators**: 8 for Adaptivity, 5 for Participation, 8 for Fragmentation



Delta Governance Indicator

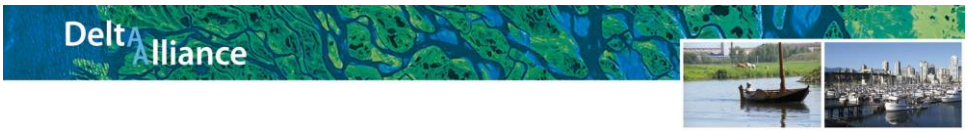




Delta Governance Indicator

Interpretation of results

- Most deltas have certain level of (institutional) Governance capacity
- Highest scores are – as expected - in Europe and North America
- Some of the lowest scores also in Europe and North America (Colorado Delta and Danube Delta) => the transboundary aspect contributes to this lower score

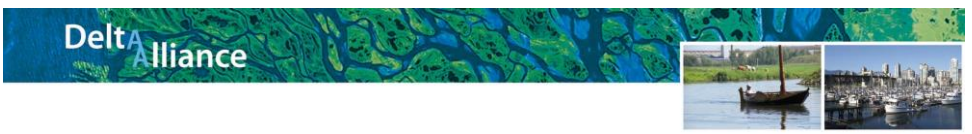


Relative Risk Categories

Deltas	Indicators			
	Relative sea level rise	Wetland Ecological threat	Population pressure	Delta Governance
Asia				
Ganges-Brahmaputra-Meghna	5	2	5	4
Hong (Red)	2	1	5	3
Indus	5	2	3	4
Irrawaddy	5	2	4	3
Mekong	5	2	4	3
Shatt-al-Arab	4	2	3	5
Africa				
Congo	2	4	2	5
Limpopo	2	2	3	3
Niger	5	3	4	4
Nile	4	2	5	4
Senegal	4	2	2	4
Volta	4	4	3	4
Zambezi	4	2	2	3

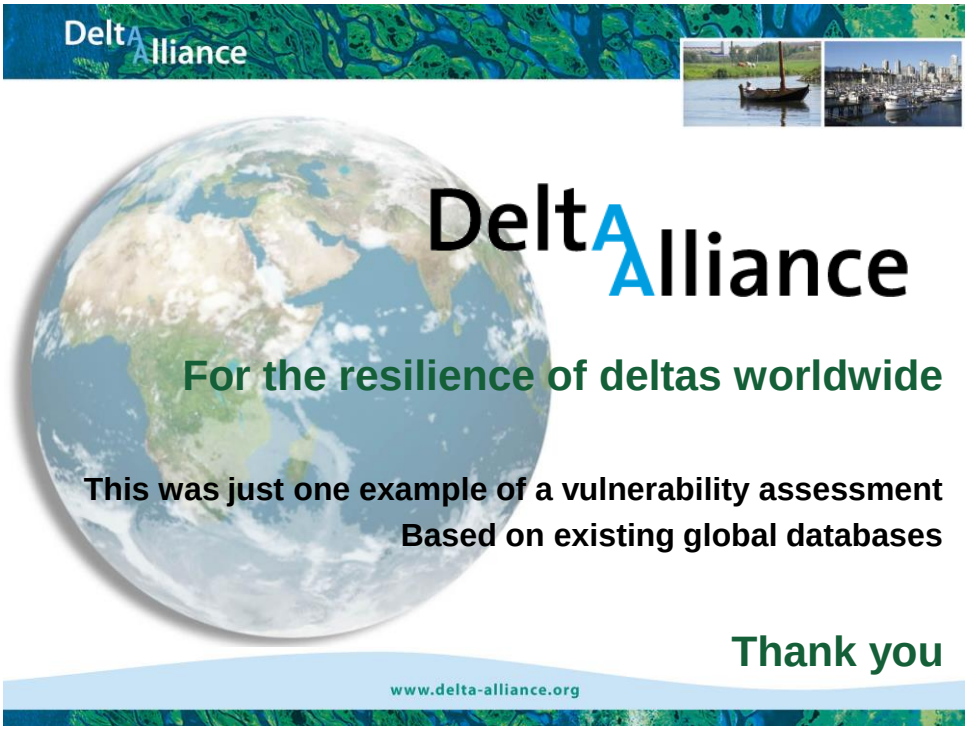
Deltas	Indicators			
	Relative sea level rise	Wetland Ecological threat	Population pressure	Delta Governance
America				
Amazon	2	2	1	3
Colorado	4	1	2	5
Grijalva	4	1	2	5
Mississippi	4	1	2	2
Orinoco	3	2	1	3
Parana (La Plata)	3	2	2	3
Rio Grande	5	1	3	3
Yukon	2	2	1	2
Europe				
Danube	2	5	1	4
Rhine-Meuse	2	3	4	1
Rhone	5	4	2	2
Volga	1	5	1	4
Wisla	3	1	4	2

	Relative risk categories
1	Very low
2	Low
3	Moderate
4	High
5	Very High



Highlights – conclusions

- The assessment makes clear that many deltas are quite vulnerable and some are highly vulnerable (especially in Asia)
  - Highest: Ganges-Brahmaputra-Meghna, Indus, Niger
  - Lowest: Rhine-Meuse and Wisla
- Method is relatively simple: on basis of existing data, scoring is semi-quantitative, indicator values are considered as best available estimates
- Intra-delta spatial variability (often high) is not taken into account
- To be completed/checked with an expert judgment?
- Improvements possible (T, $)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For the resilience of deltas worldwide
This was just one example of a vulnerability assessment
Based on existing global databases
Thank you
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