A message to GEO from the Ocean Community

*Early Thoughts/Suggestions*

1. The relative importance of the individual GEO societal benefits. Are they in balance? Are they related? Should there be a hierarchical order?

4. Flooding of low countries, a slowly developing risk. How to predict accurately? Present and future impacts. Subject for ministerial GEO meeting in November?
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Relationship between social benefits

The 9 social benefits of GEO:

-Disasters (floods, tsunami’s, fires, landslides,…….)
-Health (pollution, weather-related diseases,…….)
-Energy (greenhouse effects, pollutants,…….)
-Climate (modeling, mitigation and adaptation,…..)
-Water (precipitation, glaciers, ice, ground water,…) 
-Weather (wind, humidity, precipitation,…..)
-Ecosystems (forests, rangelands, oceans,…..)
-Agriculture (fisheries, food, desertification,…..)
-Biodiversity (species distributions, genetic diversity,…..)
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Relationship between social benefits

- Disasters
- Health
- Energy
- Water
- Weather
- Ecosystems
- Agriculture
- Biodiversity

(Rapid) Climate (Change)
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Relationship between social benefits

More focus on (Rapid) Climate (Change) will be highly beneficial for the other social benefits, since a better qualitative and quantitative understanding of Natural and Anthropogenic Climate Change is crucial to improve models and thereby to predict more accurately future trends within these other social benefit areas.
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*Future flooding of low countries*

- Sea level rise is probably seen as the most threatening consequence of Climate Change on the long term (say 50 -100 yrs) since hundreds of millions of people in low regions (e.g. New York, Florida, NW-Europe, Beijing, Shanghai, Calcutta, Bangladesh) representing major world economies will be in major trouble (Reminder: over 60 % of the world population lives and works in coastal areas).

- Predictions vary widely:
  a. IPCC-1999: 0.1 – 1 meter by 2100
  b. Al Gore: 5.5 – 6 meters (a.o. considering moulin formation)

- Politicians, Governments, Societies don’t know what to do partly because of these major uncertainties

- However, phenomenal present day investments to build houses and buildings and to implement new infrastructures in low countries are made for periods of 50 – 100 years. Are such present-day investments justifiable?
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*Future flooding of low countries*

How to improve the predictions on long term sea level rise?

Or better (for decision makers):
How to predict flooding probabilities for e.g. 2050, 2100, 2150?
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Future flooding of low countries

What determines flood probability?
Not only sea level!

\[ P_{\text{flood}}(x,t) = SL(x,t) + ST(x,t) + TD(x,t) + (TS(x,t) + \ldots) \]

\[ \text{max. } P_{\text{flood}}(x,t) = SL(x,t) + \text{max. } ST(x,t) + \text{max. } TD(x,t) + (TS(x,t) + \ldots) \]

Notes:
- The increasing flooding by rivers due to sea level rise and other reasons has not been taken into account.
- Vertical movements of the continent are not taken into account.

Past, present and future Observations, understanding and modeling of the parameters determining max. \( P_{\text{flood}}(x,t) \) are therefore crucial to make reliable predictions for the future enabling decision making now.
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*Future flooding of low countries*

**SL (Sea Level)**

What determines sea level (rise)?

Water temperature (thermal expansion), tectonic movements, sea currents, land ice melting, ....

Monitoring:

tide gauges, altimetry, ....

but also: water temperature (3D), ice cap dynamics, glacier dynamics, tectonic dynamics, sea currents, ....
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Future flooding of low countries

ST (Storminess incl. hurricanes, taifoons)

What determines (increasing) storminess?
Water temperature (3D), atm. pressure, atm. temperature wind, ….

Monitoring:
Wave height, Wave energy, storm/hurricane frequencies,..,
But also: water temperature (3D), atmospheric parameters, sea currents,.....
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*Future flooding of low countries*

**TD (Tidal changes)**

What determines tidal changes?
Sun & moon position (spring-tide, neap-tide), artificial (human made) waterworks, sea currents, topography,….

Monitoring:
Tidal gauges, altimetry, ……..
But also: ……………….
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*Future flooding of low countries*

**TS (Tsunami’s)**

Monitoring:
Seismographic networks, Tsunami warning systems, ........

However, it’s difficult if not impossible to take into account tsunami events to determine the maximum flood probability at any time. Thus, in terms of flood protection, separate measurements have to be taken for this sudden events in tsunami-sensitive areas.

**Observation density**

It should be noted that a dense network of the above-mentioned and other observations is required in flood-prone areas.
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Conclusion.
It is very timely to much better predict maximum flood probabilities for low countries by intensifying the appropriate observations, by assembling and re-analysis of previous appropriate data and by filling observational gaps to better understand the mechanisms of processes leading to potential flooding and thereby enabling much better predictions through modeling.

This is crucial since we (governments, ministers, parliaments, societies) have to make major decisions now regarding huge investments for either protection of the low countries or for the emigration of hundreds of millions of people with their houses, offices, factories and infrastructure to “higher locations” (stay or leave), since such present-day investments have major consequences for a time span of 50-100 years from now.
GEO tasks with POGO as potential lead

Task CL-06-06.
Enhance and improve coordination of coastal and marine climate observations in support of a global observation programme.

NB. Initiative has been taken by JCOMM to coordinate all marine in-situ observations, starting with ARGO (this meeting).

Task EC-06-07.
Build upon existing initiatives (e.g. ANTARES) to develop a global network of organization networks for ecosystems, and coordinate workshops to strengthen observing capacity in developing countries.