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# LOICZ

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Land-Ocean Interactions in the Coastal Zone

## Wadden Sea Research and Comparative Analysis

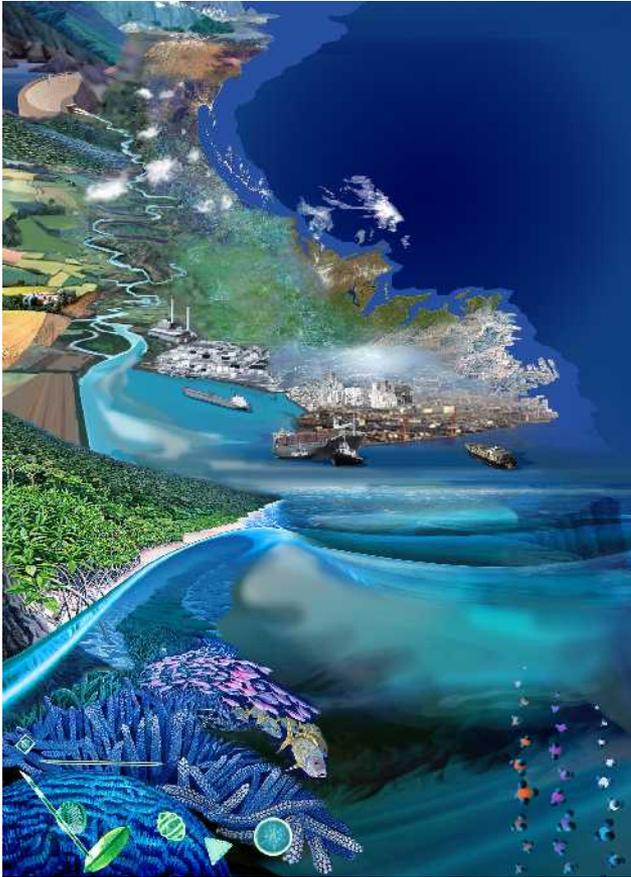
building a reference site of global relevance  
in the context of future Earth system sciences



Dr. Hartwig Kremer, Marcus Lange  
LOICZ International Project Office  
Helmholtz-Zentrum Geesthacht, Germany



# Purpose of this Presentation



1. To introduce recent developments in the Earth system science arena (Grand Challenges and Belmont Process)
2. To map actual and future research of the Wadden Academy against those challenges
3. To outline a nested concept for ESS up scaling and gauging sustainability achievements
4. To formulate a few key aspects in which research by the Wadden Academy may take a lead as an Earth system regional pilot site
5. To feature a role for LOICZ to support

# 1. Recent Developments in the Earth system science arena

**A matter of fact:**

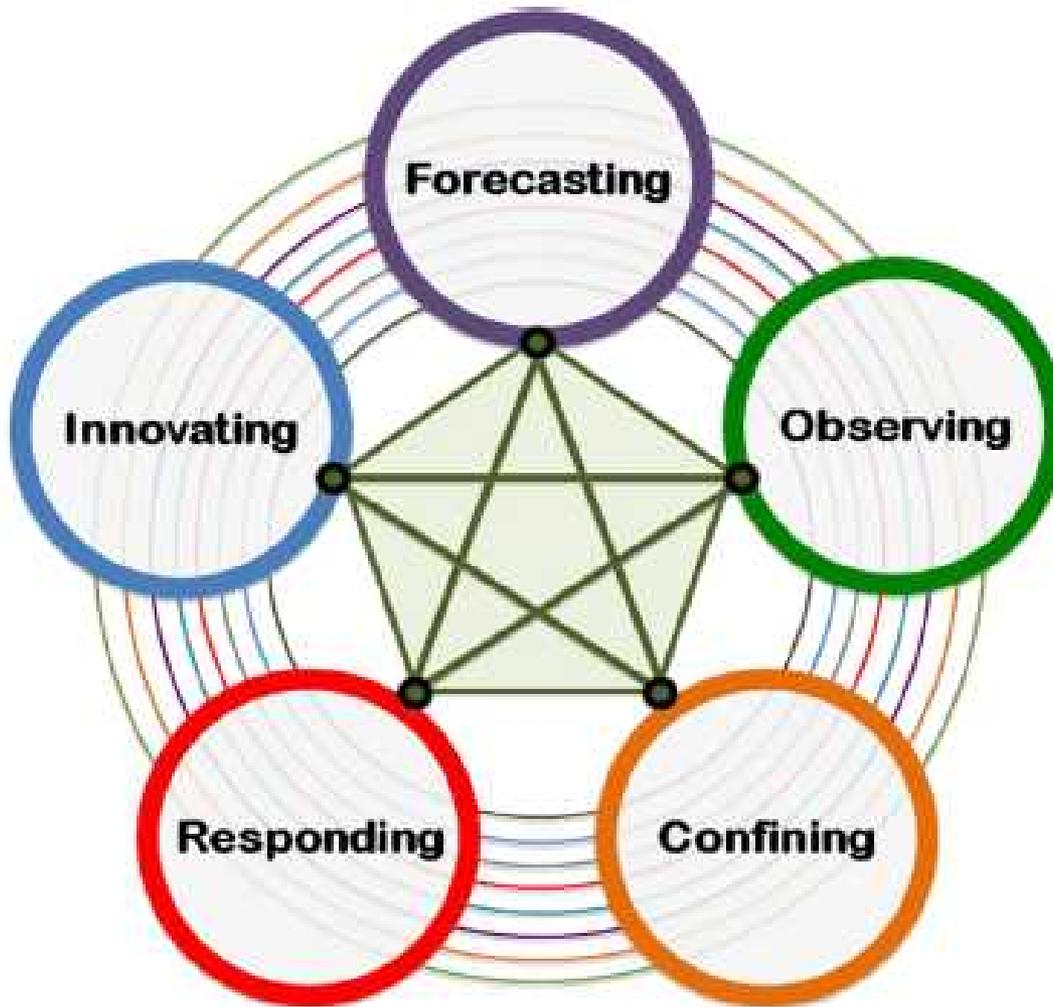
**“The environmental problems facing today’s society cannot be overcome by a single nation or a single scientific discipline”** (Belmont report 2010 by ICSU)

- **Five Grand Challenges (ICSU, ISSC)**
  - **The Belmont Challenge**



# 1. Five Grand Challenges of Future

## Earth system science



### Criteria (next decade):

- **Scientific importance** (cutting edge towards global sustainability)
- **Global Coordination** (transboundary and interdisciplinary effort?)
- **Relevance to Decision Makers** (cope with GC and achieving MDG?)
- **Leverage** (breakthrough and/or transferable knowledge?)

# Five Grand Challenges of Future Earth system science

<b>(1) Forecasting</b>	<b>Improve the usefulness of forecasts of future environmental conditions and their consequences for people</b>
	<ul style="list-style-type: none"><li>• significant environmental change resulting from human actions;</li><li>• affects on human well-being...(which, as we learned, is more than income and health, it is also socio cultural integrity)</li><li>• threats of global environmental change for vulnerable communities and most effective responses...</li></ul>
<b>(2) Observation</b>	<b>Develop enhance and integrate the observation systems needed to manage global &amp; regional environmental change</b>
	<ul style="list-style-type: none"><li>• observation in coupled social-environmental systems, at appropriate scales, i.o. to respond to, adapt to, and influence g.c. (incl. land-based, ocean-based and atmospheric forcing as well as sea bottom – water column interactions)</li><li>• characteristics of an adequate system for observing and communicating this information</li></ul>



# Five Grand Challenges of Future Earth system science

<p><b>(3)</b> <b>Confining</b> (thresholds)</p>	<p><b>Determine how to anticipate, avoid and manage disruptive global environmental change</b></p>
	<ul style="list-style-type: none"><li>• coupled social-environmental system (scales in time and space!) that pose significant risks of positive feedback with harmful consequences</li><li>• proximity to thresholds and discontinuities in coupled social-environmental systems... (incl. effects of rapid change and surprises)</li><li>• strategies for avoidance, adaptation and transformation that are effective for coping with abrupt changes,...</li><li>• risks of global change and options for response to effectively catalyze and support appropriate actions by citizens and decision-makers...</li></ul>



# Five Grand Challenges of Future

## Earth system science

<p>(4) Responding</p>	<p><b>Determine what institutional, economic and behavioral changes can enable effective steps toward global sustainability</b></p>
	<ul style="list-style-type: none"><li>• institutions and organizational structures effective in balancing the trade-offs inherent in social-environmental systems at and across local, regional and global scales</li><li>• changes in economic systems that would contribute most to improving global sustainability and how could they be achieved ... (also a matter of governance)</li><li>• changes in behavior or lifestyle, adopted by multiple societies, that contribute to improving global sustainability ... (again touching upon mentalities, values and believe systems)</li><li>• effective, legitimate, accountable and just collective environmental solutions to be mobilized at multiple scales;</li><li>• catalyze the adoption of appropriate institutional, economic, or behavioral changes</li></ul>



# Five Grand Challenges of Future

## Earth system science

<p><b>(5) Innovation</b></p>	<p><b>Encourage innovation (coupled with sound mechanisms for evaluation) in developing technological, policy, and social responses to achieve global sustainability</b></p>
	<ul style="list-style-type: none"><li>•incentives to strengthen systems for technology, policy and institutional innovation and good existing models</li><li>•meeting pressing needs for innovation and evaluation in the following key sectors:<ul style="list-style-type: none"><li>– global energy security</li><li>– competing demands for scarce land/water while protecting biodiversity, &amp; maintaining/enhancing ecosystem services</li><li>– changes in communication to increase feedback &amp; learning as well as to provide rapid &amp; effective feedback to scientists...(critical elements of adaptive management)</li><li>– potentials and risks of geo-engineering to address climate change, and related local to global institutional arrangements</li></ul></li></ul>



## 2. Mapping Wadden Sea research against the Five Grand Challenges

<p><b>(1)</b> <b>Forecasting</b></p>	<p><b>Improve the usefulness of forecasts of future environmental conditions and their consequences for people</b></p>
	<ul style="list-style-type: none"> <li>• Quality Status Reports and other state of the Wadden Sea reports (Quality Status Report (e.g. Coastal Protection and Sea Level Rise (CPSL 1-3), World Heritage Nomination Dossier) determine the baseline and reflect change</li> <li>• consequences for people are sometimes lacking in the trilateral cooperation and scientific discussions (also difficult to assess)</li> <li>• Wadden Sea Forum (WSF) involves stakeholders and users</li> </ul>
<p><b>(2)</b> <b>Observation</b></p>	<p><b>Develop enhance and integrate the observation systems needed to manage global &amp; regional environmental change</b></p>
	<p>Trilateral Monitoring and Assessment TMAP', status assessment of the ecosystem and the targets of the Wadden Sea Plan.</p> <p>Extensive data e.g.: Breeding Birds, Migratory Birds, Contaminants in Birds Eggs, Habitats, Climate, Hazardous Substances, Eutrophication, Nutrients, Alien Species, Fish, Marine Mammals</p>



# Mapping Wadden Sea research against the Five Grand Challenges

<p><b>(3)</b> <b>Confining</b> (thresholds)</p>	<p><b>Determine how to anticipate, avoid and manage disruptive global environmental change</b></p>
	<ul style="list-style-type: none"><li>• Common objectives for future development are sometimes missing ...</li><li>• A common visioning process of the Wadden Sea Forum leads to a very important document 'Breaking the Ice'</li><li>• Initial research e.g. Coastal Futures explores the pros and cons of new forms of sea use and the land-based effects</li><li>• ELME provides visions (scenarios) for the Regional Sea as a whole</li></ul>



# Mapping Wadden Sea research against the Five Grand Challenges

<p><b>(4) Responding</b></p>	<p><b>Determine what institutional, economic and behavioral changes can enable effective steps toward global sustainability</b></p>
	<ul style="list-style-type: none"><li>• The whole approach for the Wadden Sea region (conservation, research, protection/use concepts, socio ecological perspective) points towards regional sustainability</li><li>• The WSF is an opening towards user groups participation; and regional sustainability indicators</li><li>• The Wadden Academy research agenda is an institutional research oriented effort considering transboundary and global drivers of change in a concept of interdisciplinary research</li><li>• This will be most effective by utilizing and enhancing existing and new Information Service channels (not just Climate!)</li><li>• Underlying legal frameworks address the complexity of scales relevant in this region</li></ul>



# Mapping Wadden Sea research against the Five Grand Challenges

<b>(5) Innovation</b>	<b>Encourage innovation (coupled with sound mechanisms for evaluation) in developing technological, policy, and social responses to achieve global sustainability</b>
	<ul style="list-style-type: none"><li>•Social ecological system approach – including environmental economics, ecosystem goods and services assessment, informing options for trade offs in time and space</li><li>•Governance baselines (where are we in terms of response options incl. transboundary issues)</li><li>•New forms of land and sea use embedded in holistic development assessment and scenarios</li><li>•Advanced scenarios to include social science information based for example on probability assessment</li></ul>



# The View of the Funders

## Belmont Challenge

(defined by the leading research funding nations)

*Delivering knowledge to support human action and adaptation to regional environmental change;*

The group identified **coastal zones** among the **top priority regions** for global scientific attention – **horizon 20 years:**

**...coastal zones in the 21st century: ecosystems, people, commerce and security – promoting Pilot Studies as “Regional Earth system integrated studies”**

4 key elements:

1. Observation and monitoring systems; (long time series, strong investments (e.g. COSYNA, multinational funding))
2. Analysis and prediction systems (hind and forecasting, baseline definitions e.g. NOSCCA);
3. Information and communication tools (and platforms such as the CWSS setting standards); and
4. Capacity building; (a trilateral Wadden Sea school/Master/PhD programme?)



# 3. Nested concept for ESS up scaling and gauging sustainability achievements

## *Working definition* *Social-ecological System (SES)*

- a) **bio-geo-physical territory**  
(e.g., ecosystem, or catchment, lagoon, pelagic, sea bottom, upwelling areas, Wadden Areas. Inverse deltas and deltas)
- b) **specific and defined social actors** (e.g., fishers, coastal tourists, energy companies, informal networks),  
and **institutions** (e.g., National Parks, World Heritage, legal frameworks, NGOs, communities)
- c) **a particular problem context**  
(e.g., sediment dynamics, migratory birds, ecosystem degradation, marine pollution, low economic development, climate change, wind parks)
- gives boundaries
  - focuses on ecosystem services
  - connects existing knowledge systems
  - fosters societal relevant analysis

Adapted from Glaser  
et al in Saint-Paul and  
Schneider, in press



# SES theoretical development – a test-bed for indicator-systems)

- **Ecosystem –based adaptive management: The social dimension**
- seven criteria to define the social dimension (all of which have been discussed during the last three days to populate the agenda of the Wadden Academy):
  1. Population and Resource Use
  2. Poverty, basic needs and well-being,
  3. Equity and justice,
  4. Social capital,
  5. Resilience, and adaptive capacity,
  6. Participation in management and governance,
  7. Collaborative learning and reflexivity
- A conceptual framework to addresses the social dimension in ecosystem/SES management developed and pretested (Glaser and Glaeser in Elsevier Treatise (accepted))



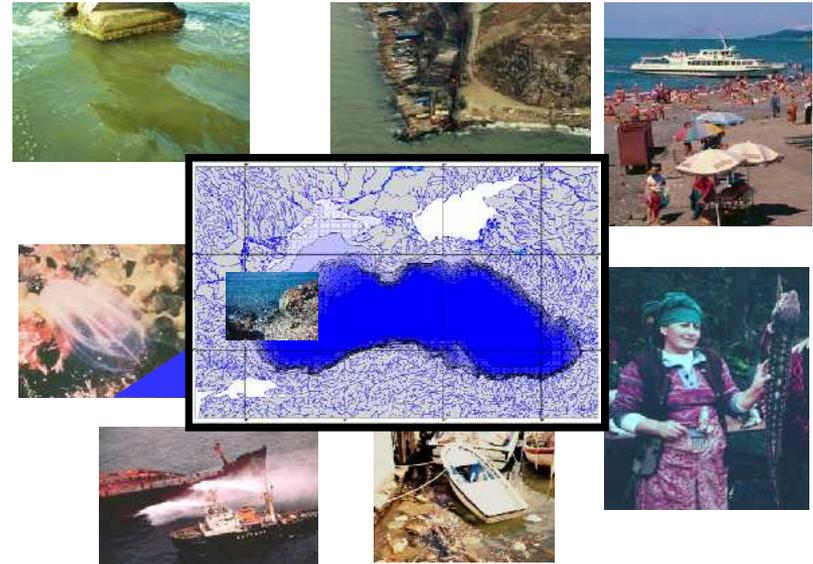
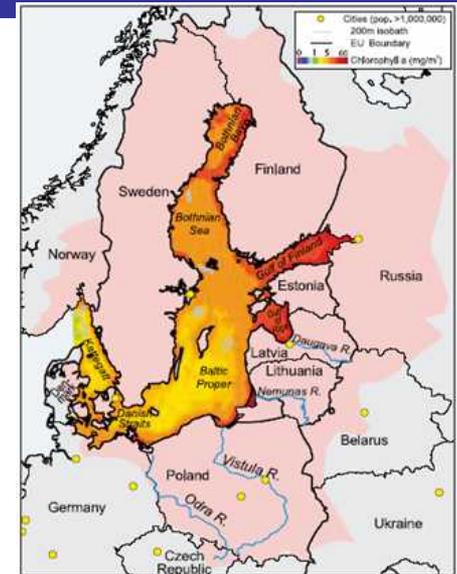
# SES contribution in global context

## ...why is it difficult to model SES?

Natural and human sciences have different epistemologies and often lack a common currency (the notion of valuation monetary / non monetary, defining commodities to lead into marketing concepts, carbon, water, sediment ?).

S-E systems demonstrate :

1. Non matching scales (e.g. regional seas scale analysis requires understanding of sub-systems in space and time!)
2. surprises (non-linearities – chaotic systems e.g. fish/climate)
3. Interconnection with other systems
4. memory-effects
5. choke and switch points



# Winners and Losers in likely Futures

And example from ELME (Baltic)

Baseline Scenario (2025) refers to current situation

Two groups of likely futures:

Negative: National enterprise and World markets

Positive: Local responsibility and Global community (but they both refer to the Baseline (BAU))

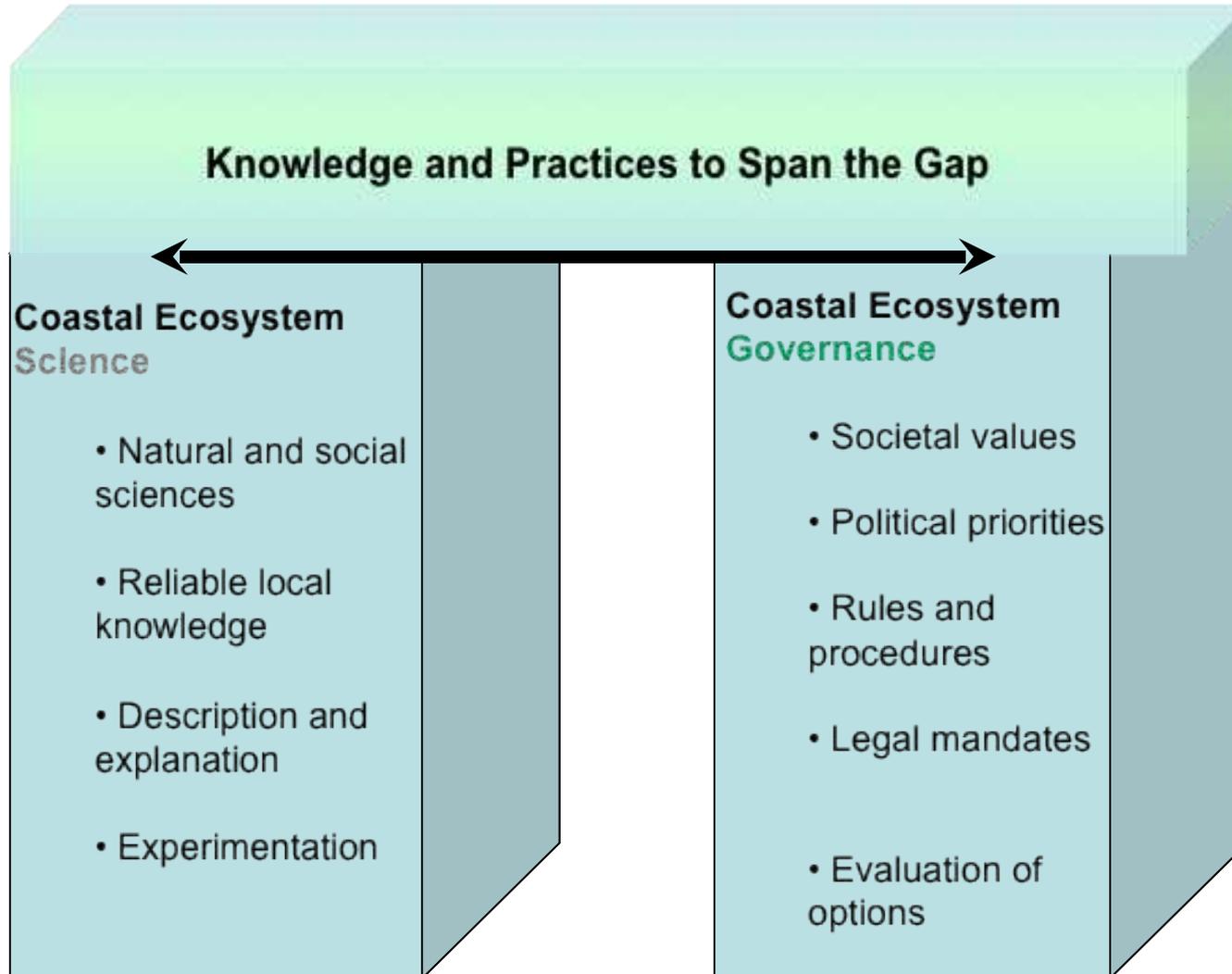


		Baseline Scenario (changes relative to current)
DRIVERS	Dredging & trawling effort	↑
	Shipping activity	↑
	Fishing effort	→
	Landclaim	↑
	Municipal waste	→
	Livestock production	↑
	P fertiliser use	→
	Urban waste water treatment	↑
PRESSURES	Transparency	↓
	Hypoxia	↑
	Demersal catch	↓
	Pelagic catch	→
STATES	<i>Cystoseira</i> habitat	↓
	<i>Zostera</i> habitat	↓
	<i>Phyllophora</i> habitat	↓
	Pelagic predator stocks	→
	Small pelagic stocks	→
	Wetland habitat	↓
	Demersal stocks	↓
	Zoobenthos	↓
	Phytoplankton	↑
	Introduced species	↑

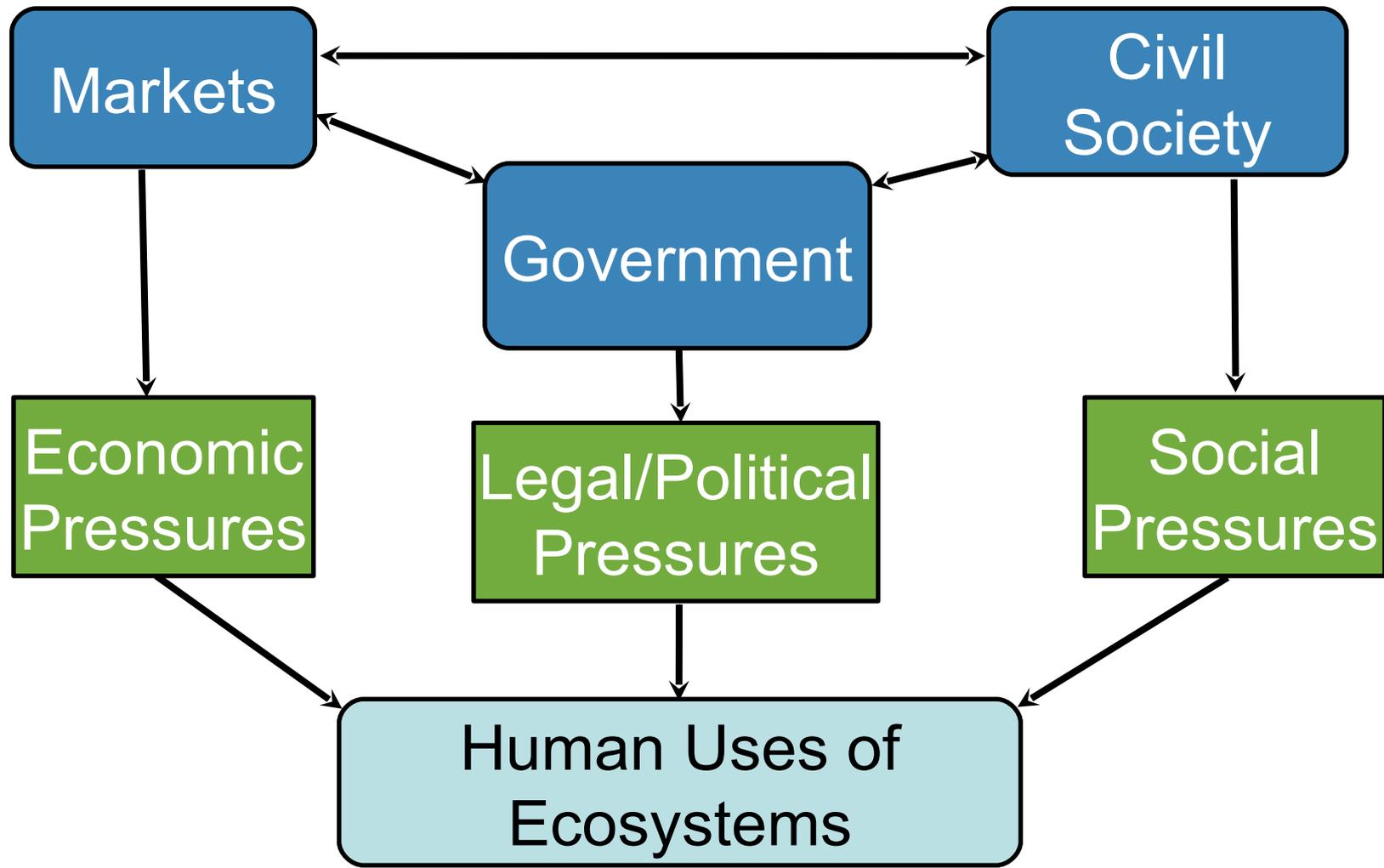
	Alternative Scenarios (changes relative to Baseline Scenario)		
	National Enterprise	Local Responsibility	World Markets
DRIVERS	→	↓	→
PRESSURES	↓	→	↓
STATES	↓	→	↓



# Linking Governance and Science towards Ecosystem Stewardship as Practice



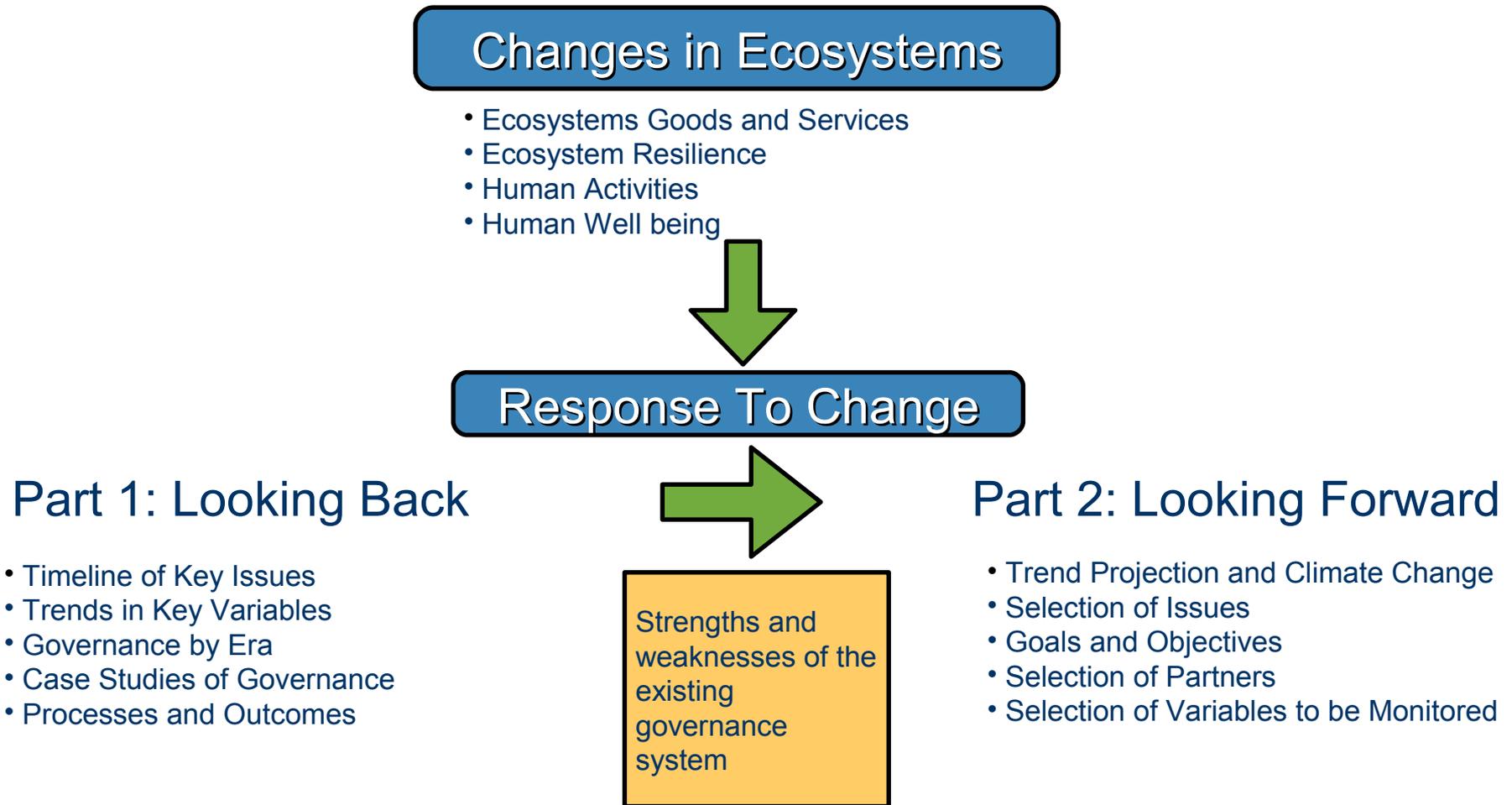
# Principle Sources and Mechanisms of Governance



Adapted from Olsen, Page, Ochoa 2009



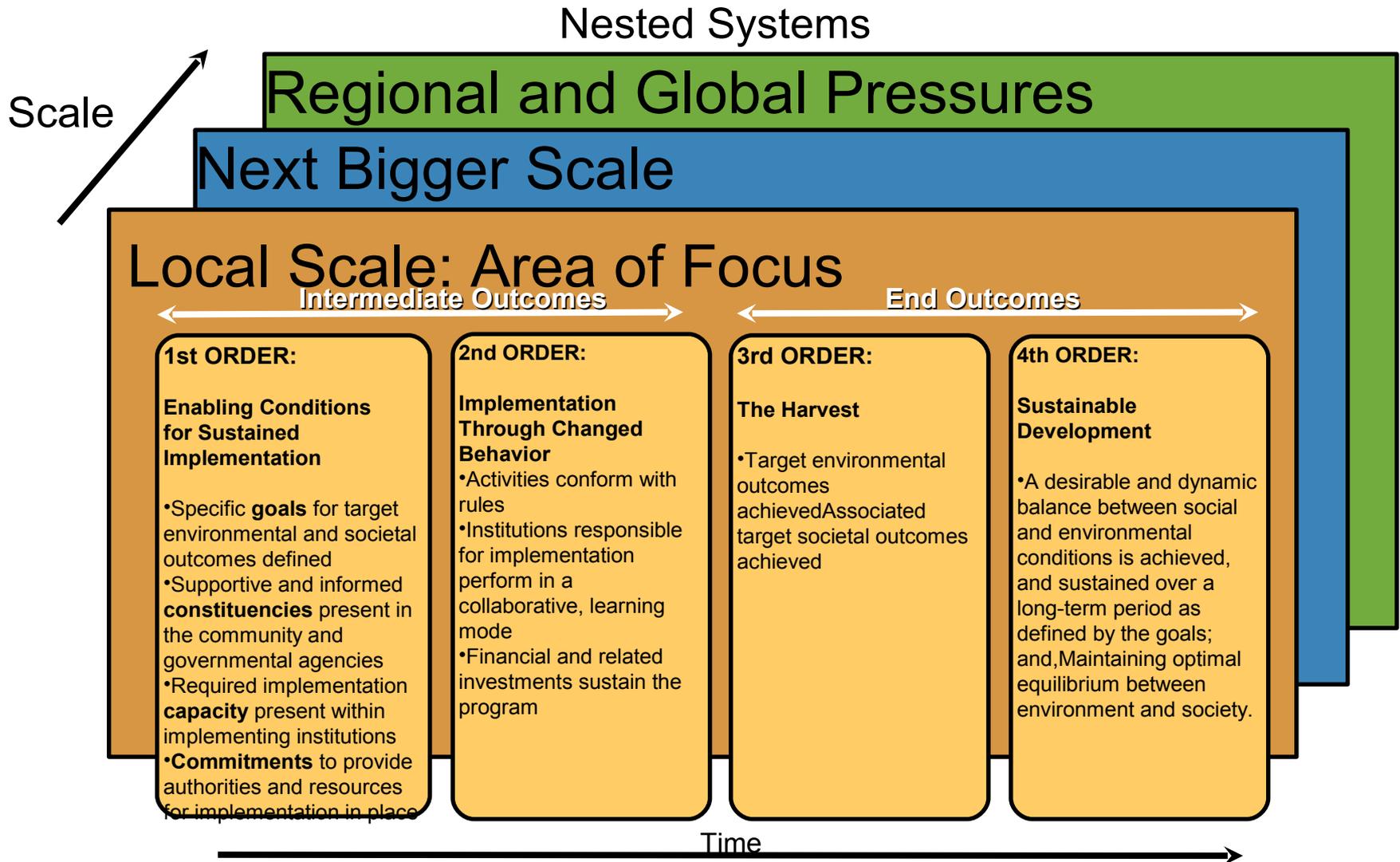
# Developing a harmonized Approach for Governance Baselines in an SES context



Major Components of Parts 1 and 2 of a Governance Baseline



# To Create Orders of Outcomes to gauge success



Adapted from Olsen, Page, Ochoa 2009



# 4. key aspects to take a lead as an Earth system regional pilot site

Some reflections from the last 3 days:

Both nested concepts (SES and analyzing issues of governance incl. setting the baseline) have been discussed extensively and are reflected by past and current research.

The region as been identified to play a key role in Earth system context and to qualify for comparative analysis with other areas – NOT in a way that there are similar systems elsewhere but those with similarities and similar characteristics in an Earth system context (estuaries, deltas to name a few)

Key is to explore international comparison of concepts, of scientific approaches and by application of harmonized methodology (see above) to achieve some potential of up scaling (e.g. a typology of governance baselines enabling us to characterize systems vulnerability and risk



# key aspects to take a lead as an Earth system regional pilot site

Some reflections from the last 3 days:

A data rich area with long time series and a tradition of research which evolved over time into a multidisciplinary and ultimately interdisciplinary approach may qualify as a pool for transfer of concepts and methods to other areas;

It may also serve as a test bed for innovation (new research concepts and those of crossing traditional disciplinary boundaries) i.e. a pilot site where the challenges formulated by the global scientific peers and funders are addressed in a holistic regional effort;

The latter also involves to discuss how institutional structures in the Wadden Sea (those which are and those which may come) have evolved and became operational e.g. in informing across the science – policy – user boundary



# key aspects to take a lead as an Earth system regional pilot site

Some highlights (subjective impressions of the **Wadden Sea Landscape**) from the last 3 days:

- **Mentality matters** – a motivator for ownership and action and a filter of “acceptable/unacceptable” information, a determinant of risk
- **Religion matters** – values, and world views to categorize the interaction of humans with nature
- **Social choice matters** – but is often based on just a small glimpse on current system features, a snapshot in time and space to determine “What it actually is that we want to preserve”
- In a **nested approach** i.e. **top down** (with a full trilateral system view and global contexts) = the big picture as well as **bottom up** = looking at local and near time scale develops a better idea of what needs to be sustained
- The Wadden Academy and other institutions can develop a feeling on how the **regional questions** populate a **global Earth system agenda**



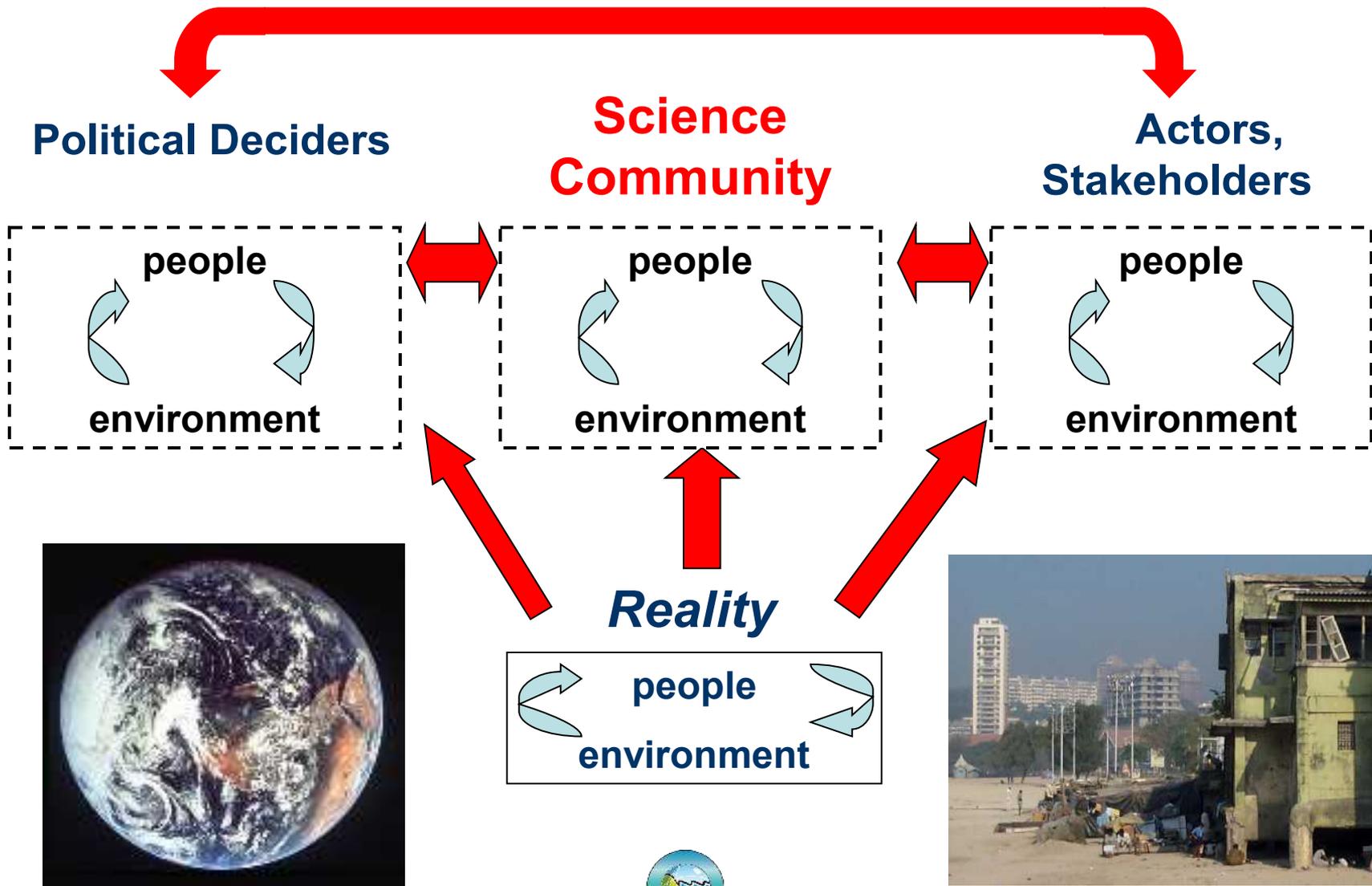
# key aspects to take a lead as an Earth system regional pilot site

Some highlights (subjective impressions) from the last 3 days:

- **Psychology matters** – relations of actors are critical in discussions about equity and common ownership
- This feeds into concepts of **compensation** following steps to either avoid or minimize in a hierarchical sense
- **Economic valuation** - is tricky but can be an eye opener in delineating what sustainability actually means in terms of preserving values across space and time
- Can there be more **tradable commodities** than “just” Carbon? (sediment, water?)
- **Adaptive management** needs to be based on holistic concepts e.g. **Social Impact assessment** and, its all about **intercultural learning**



# 5. a role for LOICZ: An Earth system science experiment and network aiming to bridge between different world views (realities)



# A role for LOICZ

## What? Core Project of the

- International Geosphere-Biosphere Programme
- International Human Dimensions Programme on Global Environmental Change (since 2004)



## Who?

- Several Thousand Researchers (incl. Affiliated Projects)
- Scientific Steering Committee (15 members)
- Regional Nodes (Chennai, Singapore, Yantai, Faro\*, Accra\*\*, *Latin America under consideration*)
- International Project Office (Geesthacht)

\* = co-located with UNESCO's Ecohydrology Centre, focus Mediterranean/North Africa/PALOP States

\*\* = associated through PACOM



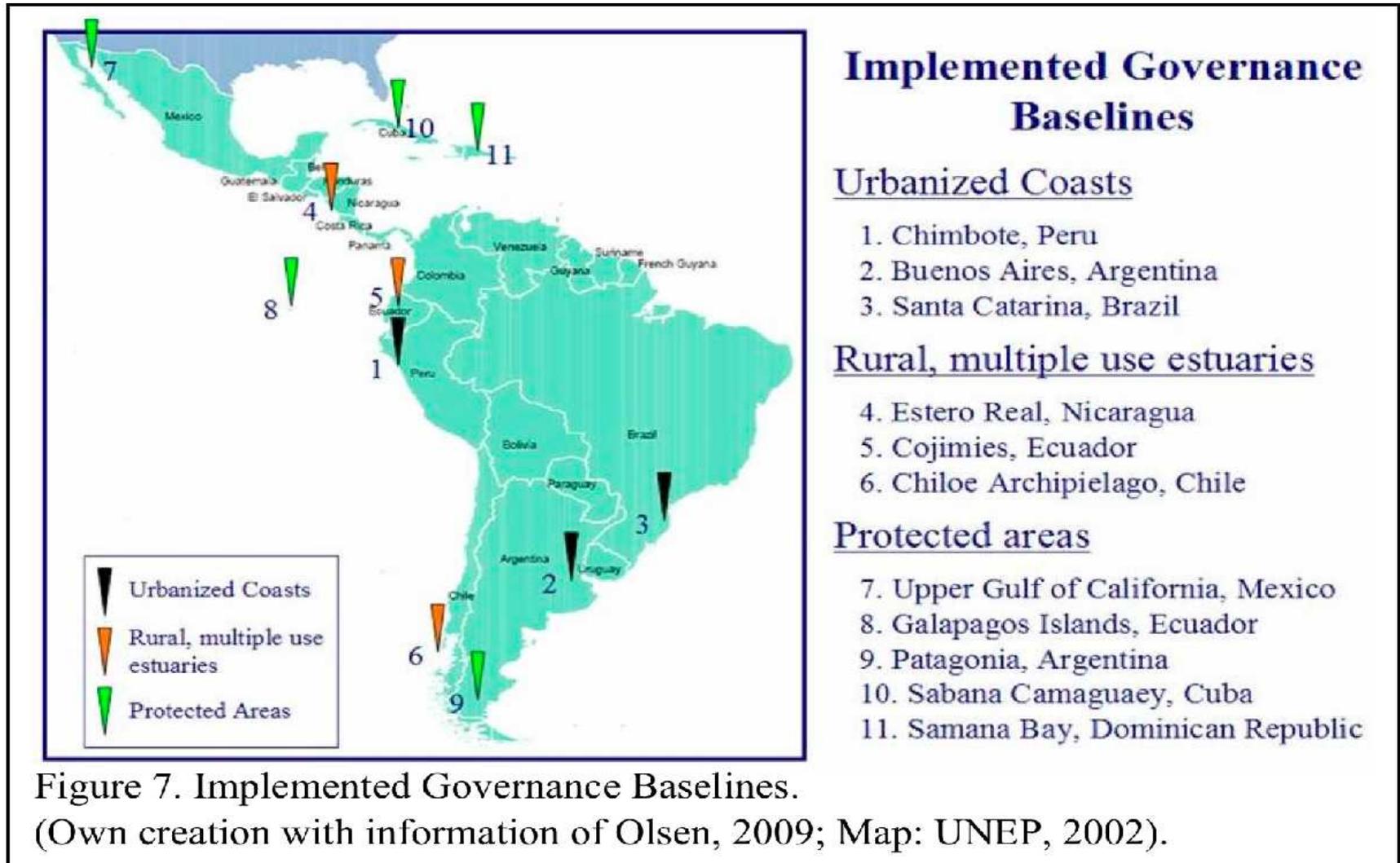
# Exchange and learning with other affiliates applying/developing relevant concepts

## **Key affiliates contributing to SES research and scenarios**

- ELME, European Regional Seas, (European Regional Seas)
- KnowSeas (European Regional Seas)
- SPICE, Indonesia (local sites and regional markets)
- MADAM, Brazil (local sites and regional markets)
- Coastal Futures, Germany (North Sea – coastal Land and Sea-use)
- ICZM Oder, Germany-Poland (Baltic – Transboundary River and Coastal Management)

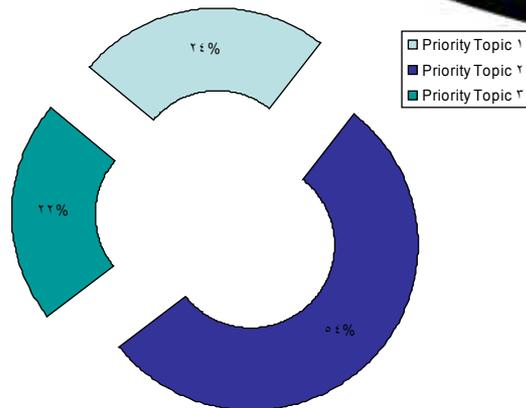
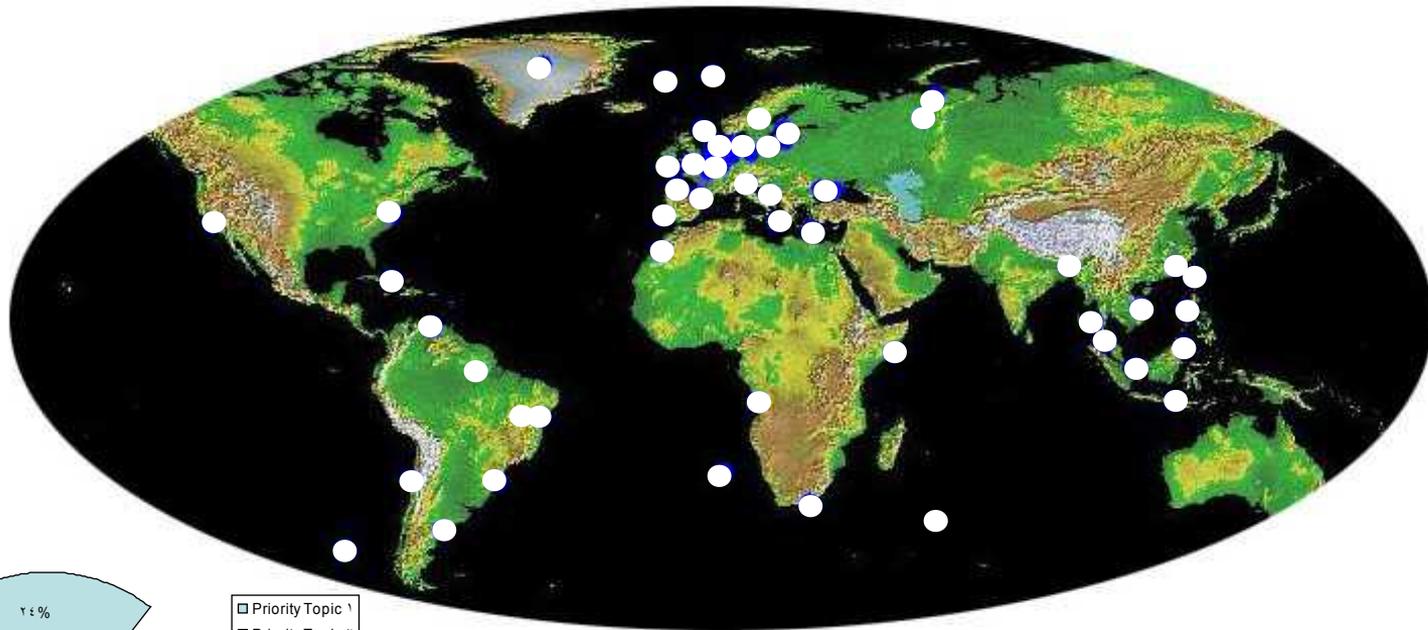


# Completed Baselines In Latin America



# The role of LOICZ Affiliated Research

## Geographic coverage of Affiliated research activities



Project affiliation mapped to the 3 LOICZ Priority Topics

Projects are mostly affiliated to more than one LOICZ Priority Topic. (portfolio > 180 Mio €)



# Conclusion

A **collaborative link** with the Wadden Academy and Wadden Sea institutions can prove mutually beneficial for the researchers involved and outreach as well as for LOICZ – particularly in its new priorities on islands and dynamic river mouth systems (2011-2015) and as part of the global commitment to synthesis.

LOICZ can be supportive in bringing the global change interface and the active coupling of the human dimensions.

The Wadden Sea could serve as a pilot or reference site in global change context and a social ecological system scope.

**A concrete step: An international session is encouraged to present and exchange Wadden Sea Research at the LOICZ Open Science Congress 12-15 September 2011 in Yantai, China, - comparative analysis and new concepts could be focused – Just a jump for our colleagues from Korea!**

**Thanks very much for your attention!**

