Tri-lateral research agenda, climate and water.
Draft on the basis of workshop 29/30 June Texel.

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1. Introduction.

The necessity for a Trilateral Research Agenda for the Wadden Sea Region originates from the declarations by the Trilateral Ministers meetings 2010 and 2014, stating that:

Sylt-declaration 2010, pkt. 41

> "*Support the establishment of a trilateral research platform directly connected with existing national networks. The platform will elaborate a trilateral agenda for policy-relevant research in consultation with the Board…"*

Tønder-declaration 2014 pkt. 63

> *"Encourage discussions by the scientific community and policy makers on the major policy issues and related knowledge as a basis for further developing a trilateral research agenda and a trilateral research platform."*

The latter has been included in the Priorities of the Dutch presidency of the Trilateral Wadden Sea Cooperation in June 2015:

> ***7. Scientific agenda for the Wadden Sea World Heritage Site***
> *The Wadden Sea has long been a site of much and diverse scientific research. For good management of the World Heritage Site there are plenty of questions that will require common and better coordinated research.*
>
> *Objective:*
> *A coherent scientific agenda, relevant to the World Heritage Site which supports decision-making on current and future issues, captures the interest of young scientists and promotes scientific cooperation between institutions.*

As a start, a trilateral science-policy matrix has been elaborated and in this connection five main fields of interest have been identified 1. Geosciences 2. Ecology 3. Economy and Society 4. Cultural Heritage and 5. Climate and Water.

The policymakers of the three Waddensea countries dealing with the Waddensea area have asked the Waddensea Forum to develop this research agenda for the Waddensea area, see appendix 1. Folkert de Jong of the Common Waddensea Secretariat has taken the lead in this exercise in cooperation with Prof. Dr. Jouke van Dijk, Dr. Mette Guldberg and Prof. Dr. Karsten Reise.
These organizers have defined a number of working groups to do the preparatory work. In this framework Prof. Horst Sterr of Germany, prof. Aart Kroon of Denmark and prof. Pier Vellinga (as chairman) have been asked to develop an agenda on issues regarding Water and

Climate Change. Each of them has invited two colleagues to join the working group. Early June 2016 the working group consisted of: Horst Sterr, Frank Alhorn and Jacobus Hofstede from Germany; Aart Kroon and Per Sorensen from Denmark and Hessel Speelman, Jeroen Aerts and Pier Vellinga from the Netherlands. The working group met on June 29 and June 30 on the Island of Texel, unfortunately Jacobus Hofstede could no be present.

2. Providing a framework for setting priorities for research

The working group came to the following reasoning, arguments and priorities for research in the field of climate and water for the Waddensea Region.

Reasoning: what are the societal values we consider important in the Waddensea Region? For us Waddensea Region includes the land areas and cities bordering the Waddensea up to say 20 km inland. We came to the following societal values:

1) Unique dynamic geo-eco system, Unesco World Heritage;
2) Tourism;
3) Food (agriculture and fisheries);
4) Coastal protection / flood protection;
5) Not mentioned during our discussions but added later by Pier Vellinga, for consideration by the working group: Seaports and transport over water;

In our workshop we considered to what extent these societal values would be affected by natural processes and/or by human activities and interventions and to what extent additional knowledge would help to address and or manage such effects.

3. Research priorities in summary

We jointly identified three priorities for the tri-lateral research agenda:

1) **Analysis of the dynamics of the sediment system (silt and sand)** at Waddensea level and at the level of the various tidal basins;
2) **Climate change impacts, adaptation processes and options for intervention**, including climate change scenarios, impacts on natural and human systems, adaptations strategies; innovative options and public participation;
3) **Options for achieving climate neutrality for the Waddensea Region**, including energy provision, transport, agricultural practices and nature management and the impacts of the transition towards climate neutrality for the natural system and cultural historic landscape;

4. Sediment system

Climate change including accelerated sea level rise is very likely to affect the Waddensea system including water temperatures, water and storm surge levels, tidal system, wave action, sediment dynamics and ecosystem. In fact the mere existence of the Waddensea islands and shoals is threatened by accelerated sea level rise in particular by the “upper end scenarios”.

Moreover the historic actions and ongoing patterns of human intervention in the sediment system in the Waddensea Region have a significant effect on the sediment dynamics, sand, silt and mud and as such on the character of the Unesco World Heritage.

Despite significant research efforts of the last 50 years, including numerical model simulations it remains rather difficult to predict the effect of climate change, sea level rise and the effects of human interventions on the system. This holds true for the Waddensea system as a whole (including the dynamics of the islands and tidal channels and the import and export of sand, silt and mud) as for each of the islands, tidal basins and channels.

We therefore recommend to develop a research program with the goal to better understand the dynamics of the system including it's response to climate change and accelerated sea and it's response to dredging activities and other human interventions. Such a research program should include an analysis of the historic sediment dynamics and morphological processes (of say the last 4000 years). Particular attentions should be given to the dynamics of silt and mud, in view of dredging and dumping activities and their effects on the dynamics and the ecological qualities of the system.

We argue this research is important as the major societal functions of the Waddensea area are potentially seriously affected by climate change, sea level rise and its effects on the sediment dynamics. The societal functions potentially most affected are: 1) long term coastal safety of existing islands and mainland; 2) The nature and dynamics of the Unesco World Heritage; 3) Tourism.

5. Climate Change impacts and adaptation.

Climate change and accelerated sea level rise is likely to trigger human actions to protect the existing islands and mainland form erosion and inundation and to safeguard the availability of fresh water for agriculture behind the dikes of the mainland.

Over the last 1000 years, the Waddensea area has strongly been influenced by human interventions including the building of sea dikes, the creation of a rigid divide between fresh and salt water, the reinforcement and the nourishment of coastal dunes and sandy shores, the construction of storm surge barriers and dikes like the Afsluitdijk. In fact the Waddensea area, in particular its present contours and to some extent its dynamics have strongly been affected by human interventions. Despite the many interventions the dynamics of tidal channels, shoals and flats at the level of the tidal basins is predominantly characterized by natural dynamics. In fact the Waddensea is one of the largest shallow tidal water systems of the world.

With accelerated sea level rise as now expected a competition will arise between two different goals: "keeping the natural dynamics as much as possible" versus "protecting the existing islands, the dynamics of shoals and flats and the mainland from erosion and flooding and to safeguard fresh water availability for agriculture behind the dikes of the mainland". We therefore recommend to develop a research program with the goal the explore how the two targets: keeping natural dynamics on the one hand and maintaining a solid protection against floods and salt water intrusion on the other hand can best be reconciled. This should

include the exploration of options for innovative interventions inspired by the concept of “building with nature”.

As adaptation to climate change and sea level rise is a long term issue that requires timely interventions for safeguarding the societal values at stake, it is important to enhance public understanding of the issues and options for intervention. In particular as such options are likely to require significant amounts of public funding and the options are likely to have an impact on the landscape. It is therefore recommended to include public participation in problem analysis and in the development of options for intervention in this part of the research agenda. We argue that research into the effects of climate change and sea level rise is of major importance as all five societal values are affected by it and by the human interventions it is likely to trigger. The societal values at stake are:

1) Coastal protection including fresh water availability for agriculture on the mainland;
2) Flood protection of harbor facilities and urban settlements adjacent to the Waddensea;
3) Agriculture, see also under 1) and fisheries;
4) Tourism, in terms of threats as well as in terms of opportunities; the latter in view of a warmer climate;

6. Transition towards climate neutrality, i.e. no net contribution to the accumulation of greenhouse gasses in the atmosphere;

The international heads of state climate change conference held in Paris in December 2015 concluded that all countries of the world should jointly aim to adjust human activities and practices in such a way that climate neutrality of human activities is reached by the end of the 21 st century, while such a level should be reached in the European region for 90 to 95 percent by 2050.

This requires a major effort over the decades to come. We are already witnessing the construction of wind parks on land and at sea and we are seeing the first solar parks to be build on the Waddensea islands. Proposals to exploit the tidal energies and the salt/fresh water interfaces for energy generation are coming forward. We expect that agriculture and nature management will also be affected in some way by this transition. The transition towards climate neutrality is likely to affect the landscape and maybe the ecology in many different ways. As this transition should be implemented in the next 35 years, it is important to set up a research program to explore the options and their consequences for the societal values identified above, in particular:

1) The Unesco World Heritage;
2) Tourism;

sofar my draft, Pier Vellinga, July 15, 2016.