

Regional Stakeholder Perceptions of Climate Change: Baltic Case Study Screening

-- final draft --

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1. Summary

This case study screening on regional perceptions on Climate Change was performed within the ASTRA project consortium. It was designed to obtain a synopsis of focal issues in the case study areas, to help identifying challenges for the development of adaptation strategies, and to assess stakeholder views on the problem in a qualitative and explorative way. It is based on the responses to a semi-structured email interview.

Problem framing

Although the foci of the partners and the particularities of the case studies are very diverse, some likely hypotheses of stakeholders' problem perception can be made:

1. General problem awareness about Climate Change is primarily framed by the potential impacts that may affect the case study regions. On the local level there is little attention for vulnerable exposure units and to policy responses. Primal attention is paid to Climate Change in the form of hypothesized impacts (underlined by demand for excessive data of climate projections) and by the fact and of complaints about "soft factors" as missing know ledge, inaction and bad coordination. It is open in how far this awareness can be shifted to vulnerabilities and adaptation strategies in the future.
2. Climate change is mainly seen as mitigation problem, while adaptation issues are vague, unclear, difficult to structure and integrated into other policy sectors.
3. There is little strategic knowledge on actors and institutions which support or constrain adaptation to climate change. It may be necessary to get a more concrete perspective on local exposure units, actors and institutional arrangements, to disentangle and structure the implementation problems of adaptation policies.

Institutions and actors

The responses provide a broad set of institutions somehow relevant for climate change, which are mainly described in general terms. They include local and regional administrative bodies, spatial and sectoral planning, rescue services, national ministries, agencies and strategies, European and global institutions, various economic sectors and informal factors as knowledge transfer, coordination and environmental awareness. Only a small number are particular local arrangements or specific actors which could or should be taken into account if adaptation strategies are to be implemented in singular case study regions.

Exposure units

From the respondents a set of exposure units is collected. It can be clustered as built environment (e.g. buildings, urban area, cultural heritage, heating, infrastructure), natural environment (e.g. ecosystems, beaches, municipal parks, rivers), economic sectors (tourism, forestry, transportation, energy, agriculture, fishery, industry, water) and further actors (e.g. inhabitants and private households). Institutions seldom appear as exposure units, while economic sectors and infrastructure are more important.

Impacts

The impacts considered by the interviewees partially refer to very specific situations, indicating that respondents might have concrete ideas or experience in mind. They can be systematized along the climatic variables they are related to: temperature (increasing temperatures, extreme temperature events), precipitation increase, wind (storms), sea level (loss of land), temperature and precipitation (droughts, changing growth conditions, less snow), river floods (sea level and precipitation), changes in humidity/aridity and eutrophication (temperature, wind and precipitation), storm surges (sea level, wind and waves), erosion (sea level, wind, precipitation and waves).

Many stakeholders express very detailed data needs related to these impacts (much variables in a fine resolution). The question arises whether decision-makers could process such detailed information. Since state of the art climate modelling cannot provide such detailed data, a re-framing of data expectations is necessary to bring scientific with practical reasoning in line and to avoid frustration of stakeholders.

Constraints and supporters for adaptation

To contribute to the development of adaptation policies, local constraining and supporting factors are collected. Mainly informal institutions or those related to greenhouse gas mitigation measures were mentioned. The comparison of constraining and supporting factors indicates that problems are more found on the local scale, while enabling forces are more biased to higher levels. It is likely that there is a shift of responsibilities to higher institutional scales.

Examples for the latter are local administrative bodies, local/regional planning and hazard management, environmental centres, NGOs, coastal protection strategies, and on national level diverse policies, environmental objectives, state government, mitigation and adaptation strategies. There is also a broad set of informal supporters as research, awareness raising activities and knowledge transfer. Also local residents and some economic sectors are mentioned (e.g. insurance companies, industry, fishery and transport). There seems to be some kind of helplessness in the sense that advocates of mitigation and adaptation policies are opposed by barriers that are difficult to resolve and that there is little awareness about strategic partners. Local adaptation policies are in most cases not in the implementation phase, but at a stage where the mere necessity of such policies has to be established.

Local authorities also appear on the constraining side, i.a. with the argument that "local interests are more important than global" or simply by complaining about inaction. Some constraints advert at local interactions between various actors which may be constraining the implementation of adaptation policies. The respondents also point to institutional failures or mal-adaptions, e.g. in building restrictions, planning standards, hazard management and gaps in legislation. Lack of finances hinders adaptation, but also that climate change is not a priority on the local or regional level in many cases. Informal problems relate to missing information and uncertainties, missing awareness and coordination and inadequate education. As constraining economic actors, business on local level, the construction sector and industry were mentioned. NGOs were partially also seen as constraint. A particular field of problems relates to the transition towards a democratic market society.

Focal issues

Based on the case study screening results, the following focal issues are recommended for further investigation:

1. Urban building activities
2. Adaptation of water supply systems
3. Energy utilities and planning for energy infrastructure
4. Integration of climate change into hazard protection policies and coastal protection
5. Development of tourism and forestry

Hypotheses

The following hypotheses about obstacles and chances for the development and implementation of adaptation policies on the local level could guide research. Although there is a “kernel” of basic problem awareness, mainly related to potential impacts and international mitigation policies, little is done in concrete terms. One reason may be that awareness in terms of impacts is not sufficient, since for strategic decisions under uncertainty, exposure units should be considered. Awareness in terms of impacts is not sufficient under uncertainty. Joint work of scientists and stakeholders may help putting attention to exposure units and adaptation issues, contributing to a shift in thinking to deal adequately with uncertainties. It is an open question whether current planning procedures are adequate for the challenges of climate change. To establish appropriate analytical procedures for local decision-makers, the classical risk approach, based on extreme event statistics, has to be complemented with a vulnerability assessment. Knowledge about those groups and sectors who are vulnerable and the costs of potential impacts could enhance processes towards the development and implementation of adaptation strategies. Due to local capacity limits it may be helpful to enhance adaptive capacity by supplying regional and local authorities with an appropriate mix of information, education, obligations and resources. In addition it would be valuable to enhance the strategic awareness of local actors on how to overcome reservations against adaptation measures. For that actual or potential links to key players that can be activated to promote adaptation should be identified. This could change the situation by providing new strategies and opportunities.

2. Objectives

The case study screening was designed for multiple purposes. One is to pave the ground for the development of adaptation strategies and to assess stakeholder knowledge on Climate Change, but they also relate to work flow in the project and to scientific questions. To integrate these partially diverging objectives into one screening questionnaire is risky. As one may find out when comparing with the main findings given above, not all objectives were met, but at the same time unexpected but interesting results were made. This is in line with the main objective to **obtain a synopsis in an explorative style**, i.e. to give first impressions of the case study areas, to obtain preliminary ideas for developing adaptation strategies, and to formulate first working hypotheses that can guide further scientific work.

The original objectives are:

- Exploration of project cases, issues and problems.
- Synopsis of climate change related problems in the case study areas.
- Priorization of research and development needs.

- Assessment of stakeholder opinions, knowledge and problem framing.

The **explorative objectives** aim at discovering particularities of case study areas, participating stakeholders and climate change related problems, which can not be hypothesized by theorists from the onset. This can be due to particularities which are not aware to most project partners, due to gaps in current scientific knowledge, or due to initial misunderstanding of diverse project partners (e.g. between practitioners and scientists or between scientists from different disciplines). We want to note that this objective implies an idiographic approach. The case study screening is intended to describe a broad range of differences in their entirety but not to discover general features common to a representative set of cases. Instead of drawing conclusions from the frequency of certain responses, it is meant to generate hypotheses which lead to further research.

A **synopsis of case studies**, i.e. regions and municipalities involved in the ASTRA project, is necessary to obtain an overview of the variability of conditions in the different regions. It should cover the basic Climate Change related problem structures (potential impacts and exposure units) and show the state of the art, potential and limitations for adaptation strategies. This is essential to obtain transferable results and particular solutions in later project stages. At the same time the synopsis contributes to mutual understanding in the project and offers a chance to identify and clarify differences or vagueness in terminology at an early stage.

Of course, there are potentially multiple impacts of climate change, but to develop adaptation strategies, **priorities have to be set**. The exploration of focal exposure units, responses and policy options is an important input for the selection of common research efforts. Moreover, it is essential as an early stage of stakeholder involvement to assure that project results will fit to their needs.

The **assessment of stakeholder views** is also important for further reasons. At first, local partners are acquainted with particularities typically not known to the scientific partners, but which can be central for problem analysis and policy development. The main problems identified by stakeholders may differ from what is initially expected, and climate change related decision-making may be constrained by case study conditions, e.g. budgets, traditions or particular actors. Recognising such conditions at an early stage helps guiding towards a portfolio of adequate adaptation and mitigation options. However, it has to be expected that there is a very diverse knowledge about climate change impacts, about adaptation and mitigation strategies, and about the certainty of climate projections. Assessing this knowledge gives an overview where to start from with the developments of new instruments and with the provision of information to the stakeholder partners. More basically, the case study screening should reveal how participating stakeholders frame the issue of climate change. This is deeply related to problem awareness, an important domain of activities in ASTRA, but also to estimate which policy options are likely to be communicated successfully.

3. Methods

The study objectives stated above imply several methodological requirements. Due to the explorative approach, open interviews with project partners may have been appropriate. **A more open design is also essential to assess stakeholder views**. Making a structured multiple-choice style questionnaire would only confirm or reject scientists hypotheses about

practitioners. It would not be possible to develop new assumptions about stakeholder frames. On the knowledge level, only those local particularities, impacts and exposure units which were explicitly considered in the study design phase could have been reported by respondents, potentially leaving out essential information.

On the other hand there are also reasons for a strictly structured approach. **For a synopsis it is necessary to produce responses that are comparable. The same applies if the results should be used for prioritization processes in the project:** if a broad set of incommensurable answers to an open interview is given, it may be difficult to extract common research and knowledge transfer issues. If the resulting text corpus were analyzed strictly qualitative, a study covering a very broad variety would be made, which does not allow drawing conclusions from frequencies in the sample. This would also hinder the identification of the most urgent Climate Change adaptation needs that are common to most case studies. It was another argument for a structured questionnaire that a rapid start of the study was required in the kick-off phase of ASTRA, making it impossible to employ interviewers in every case study and to translate the responses.

The tension between both options also lies in the use of terminology. Assessing the differences in terminology would require abstaining from technical terms in an open interview. But in doing so, we would have missed an opportunity of introducing common project concepts via the screening. Finally, the international character of the project poses language problems, which is likely to result in misunderstandings or wrong translations.

Having these challenges in mind, we want to note that it is unquestionable in the context of this study that a nomothetic approach which identifies general/statistical features would not be adequate, since it is required to obtain a broad overview of adaptation options, Climate Change related problems and stakeholder perceptions *within* the ASTRA consortium. **The case study screening is thus intended to cover a broad range of differences in a comparable way.** More general conclusions can be drawn in later project stages based on the hypotheses generated in this work.

Based on the above discussion, the following decisions were made for the study design. Due to the practical constraints, **an email questionnaire was prepared which was sent to all project partners.** It was formulated in English, knowing that scientists are involved in every case study region which could help with translations. **The questionnaire is semi-structured, leaving space for individual answers but focusing the attention on a particular framing of the issue** (see below). The respondents were encouraged to answer the questions shortly and rapidly due to three reasons: (i) reservations due to potentially uncorrect English should be kept to a minimum by requiring no well-formulated answers; (ii) time requirements for respondents should be low to have a fast and efficient follow-up; (iii) rapid answers increase the likelihood to reveal prejudices or misleading assumptions which is preferable to assess stakeholder views. See Annex for the questionnaire and the email letter to the interviewees.

The structure of the questionnaire was guided by ASTRA communication and research needs. **The conceptual base was developed from Environmental Impact Assessment (EIA) and the DPSIR (Driver – Pressure – State – Impact – Response) Framework.** Although these approaches are criticized for several reasons, they offer a relatively easy accessible and established terminology. Put into this framework, Climate Change refers to changes of the *state* of average of meteorological properties (e.g. temperature, precipitation). This is distinguished from *impacts*, being the consequences of a changing climate state influencing society and the environment (people, species, institutions, firms etc.). All that can be

potentially affected by impacts is subsumed under the term *exposure unit* (e.g. people, species, economic sectors, infrastructure, ecosystems, places, institutions, firms and organizations). *Responses* are planning procedures, policy options and other societal reactions to impacts and climate change. By using this terminology only to formulate and structure the questions it was intended to establish it in the project while at the same time leaving it open in how far respondents will pick it up in their answers, and in how far their answers fit into these categories – allowing for the assessment of stakeholder frames. In contrast, **the terms ‘adaptation’ and ‘mitigation’ were only mentioned in the cover letter**. It was interesting to know whether respondents will use these terms or are aware of this distinction, and no urgency was seen to strongly establish both terms in the consortium at this stage.

The first block of questions focuses on the impacts stakeholders find likely and the exposure units which should be considered. Here, it is interesting to know which problems the respondents are aware of, where they omit scientifically known issues and where they probably point at problems missed so far. We also wanted to know if the exposure units and impact are described very detailed or if the respondents only have rough ideas.

The second block assessed already existing (actual or potential) responses. This was complemented with questions related to more general policy objectives, supporting and constraining factors. The latter concepts are modified versions from the force field method in policy analysis, which establishes opportunities and threats for proposed policy instruments. Asking for constraints and supporters aims at identifying basic strategic conditions which have to be taken into account for the development of adaptation strategies.

A final block gave the opportunity to deliver background information of the case study areas. Moreover, since in the ASTRA kick-off phase we had the impression that many partners had very ambitious data needs, they were given the space to express them in written form.

The evaluation of the retrieved questionnaire is based on an open coding system, which takes advantage from a modified grounded theory approach. It was technically implemented by using the coding software atlas.ti (XXX), which iteratively produces a data base of quotes from the questionnaire which are linked to codes developed during reading the responses. This approach is appropriate due to several reasons:

1. Although the concrete phrasing of respondents can be very diverse, a commensurable system of concepts emerges by defining and assigning the same abstract codes to similar quotes.
2. The result is not a statistic of used concepts, but a list of concept definitions and a set of relevant relations between the concepts mentioned in the project consortium. Thus, stakeholder frames become visible and a kind of common terminology emerges.
3. The open structure allows changing and extending the code structure during analysis to react directly on new observations, such that the final code systems is meant to fit the needs of the respondents and not the analysts (meaning that it is “grounded” in the retrieved questionnaires). This is in particular adequate for the explorative character of the study and the assessment of stakeholder views.
4. The resulting code and quote system can be easily used for further investigations by data base queries. This is essential for confirming preliminary observations and to assess, e.g. which actors are mentioned as constraints and which as supporters of adaptation to climate change.

The quality of the coding process is i.a. affirmed by the following criteria. At first, the definitions and assignments of codes can be cross checked by other researches who have access to all responses (be it per review or per independent coding). Second, during successful

coding, a saturation can be observed, meaning that after the coding of most of questionnaires only little new codes are needed, such that the conceptual system has a degree of completeness and becomes stable. More formally, a code system is saturated if by removing all quotes of one primary document the whole code system only undergoes minor changes.

To take account for the diverse study objectives, the coding procedure was modified for the case study screening not to be completely open. Of course, the semi-structured questions give first structural pre-qualifications. Moreover, it was planned from the onset to systematize basic codes using the conceptual base outlined above, more concretely the codes are supposed to be clustered using the following abstract categories:

- Built environment (to code exposure units)
- Natural environment (to code exposure units)
- Actors (to code exposure units and answers to constraints and supporters)
- Economic sectors (to code exposure units, constraints or supporters)
- Institutions (to code exposure units, constraints, supporters or responses)
- Impacts and States

Therefore, the final code system is not meant to be completely grounded but respects also theoretical requirements. In the following, all codes are printed in sans serif.

4. Results

The questionnaire was distributed to 33 project partners (inner circle, outer circle, interested partners), where all participating persons from every partner received an email. Of these, 9 were scientists taking care for particular case studies (which were asked to consult local stakeholders for their responses), the rest being stakeholders from various institutional levels (6 national, 6 regional, 21 local). Some sent it to further stakeholders. After two waves of follow-up, 15 answers were retrieved. The respondents are located in cities (Gdansk, Espoo, Riga, Hamburg, Klaipeda, Kokkola, Neringa, Pärnu, Tallinn, Warnemünde), regional (Salaca River Basin, Pirkanmaa) or national institutions (Swedish Environmental Protection Agency, Estonia).

The concepts used by the respondents to answer the questions are formalized using ca. 120 codes, of which eight are introduced for technical reasons, and eight refer to abstract concepts which are introduced to systematize the other codes (they do not directly correspond to quotes from the questionnaires). In the following, all codes are printed sans serif.

In the final codebook (see Appendix), except technical and abstract categories and four important exceptions (*“coastal dynamic as objective for conservation”*, *Local climate strategy*, *“adaptation: limited effectiveness of action on the regional level”*, *“loss of land because of a large [...] estuary”*), all codes refer to at least two quotes, and 95 codes to three or more.

The foci of the partners and the particularities of the case studies are very diverse. This became especially clear from questions relating to the local background (*“General Information”*). While the codes relating to exposure units and impacts saturated after coding half of the questionnaires and those relating to institutions and actors were not changing very much in the end, the local background was not coded. Otherwise, the codebook would have been much longer, with many codes only referring to single quotes. However, we provide an

analysis of answers provided to the question “*Current main problems (not climate related)*” below.

Saturating of codes does not imply a homogeneous terminology. Although impacts could be categorized with 23 codes, they generalize diverse phrasing, for example the code storm from “*wind storms*” over “*thunderstorms*” to “*high wind speed*” or the code eros with “*coastal erosion*” and “*landslides*”.

Although 32 codes are needed to formalize exposure units, the heterogeneity of terms is less broad. This is also due to the frequent use of general terms to describe consequences of impacts (e.g. 30 quotes NATENV: *ecosystems*, 25 quotes ECON: *economic losses*, and 14 quotes infra: *infrastructure*), one extreme example being “*all sectors and activities*”. More specific exposure units as economic sectors like fishery, agriculture or tourism (the latter with 29 quotes) are used frequently and homogeneous. **However, there are little codes further refining the view on particular local exposure units. This leaves the impression that exposure units were phrased not with particular local problems or experience in mind, but from causal reasoning or lay knowledge. If this hypothesis is true, this points at a capacity of ASTRA stakeholders to imagine a broad set of climate change consequences, but little practice to relate this imagination to the concrete case study situation.**

Some exposure units are part of a very broad class of codes which relate to institutions or actors. They also play an important role in the questions about existing response mechanisms, constraints and supporters. The codes do not make a crisp distinction between institutions, instruments and actors (for which organizations are an example), because the information provided in many cases does not allow for a decision. If a certain institutional factor was mentioned as relevant, or the same factor was mentioned as missing, thus causing problems, two separate codes were introduced to distinguish both cases. Many of the resulting 50 codes subsume a large class of cases, for example in local (26 codes): “*Local administration*”; “*City development office*”; “*Environmental departments at local municipalities*”; “*Construction office*”; “*Port authority*”; “*City government*”, etc. or knowtrans (14 quotes): “*Local & Government seminars and workshops*”; “*Research based analysis and planning for climate change mitigation and adaptation*”; “*Improvement of education system, particularly for the people involved in planning and making decisions*”; “*Access to needful and relevant data for planners*”; “*Decision-makers should be better informed about anticipating events and risks*”; “*Environmental education*”, etc. **It is likely that the large set of broad codes of this class has to be attributed to the variety of local institutional settings (independently from climate change issues) and that multiple questions of the questionnaire ask for institutional information.** Despite this broad variety, many codes for institutions are still very general in the sense as being easily transferable between cases (see above examples) or too unspecific to reveal concrete options or constraints (e.g. Blex: “*gaps in legislation*”). This may be interpreted as efforts of most respondents to provide information to “outsiders”, but alternatively as a **limited awareness of particular supporting or constraining factors.**

4.1. ***Institutions and actors***

We first provide an overview on the institutions, instruments and actors mentioned by the respondents, because some appear as exposure units, others as responses, constraining or supporting factors. These three perspectives will be discussed below.

Since several questions asked for institutional aspects, the coding revealed a broad list, which seems, although not exhaustive, at least comprehensive. The phrasing used by the respondents is sufficiently abstract to be transferable to other case studies in most instances. On the other hand, **the questionnaires provides only a small number of institutions which are particular local arrangements or specific local actors which could or should be taken into account if adaptation strategies are to be implemented in singular case study regions.**

Although initially planned for the case study screening, institutions, actors and instruments are not distinguished in the coding system. From the theoretical viewpoint, institutions are only the rules of behaviour, such that e.g. a planning office (an actor) has to obtain another code than the planning regulations. Finally, this distinction is not made in the case study screening, since the code book would have become unnecessarily large, and since the information provided by the respondents is often not sufficient to decide between these options. When we speak of institutions in this section, we also mean actors.

The variety of institutions can be systematized along several dimensions. One obvious is the scale, where the local, regional, national, European and international level are distinguished. Institutions which relate to several levels (e.g. compens: *compensation of losses*) or which are important enough to account for an own category (e.g. natadap: *national adaptation strategy*) are provided with an individual code, making codes like inlocal (*local actors and institutions*) a residual category which mainly includes quotes like “*local government*”, “*municipalities*” or “*city [...] development office*”. Another differentiation is between formal institutions, which exist by law or official agreement (e.g. hazman: “*rescue services*”), and informal institutions, which are informal or have only an enabling effect (e.g. aware: *awareness of climate change problems*, or knowtrans, see above). Due to the large amount of the latter type, these codes were not classified by their scale. Furthermore, while some institutions are regarded as advantageous (research: *information and data retrieval, research and research organisations*) or neutral (planning: *planning in general*), some are explicitly related to problems or are regretted to miss (e.g. Bcoord: *lack of coordination or cooperation, conflicts*). All codes of the latter type are written with a B prefix. This made it necessary to split some codes (e.g. coaststrat: *strategies for coastal management* and Bcoaststrat: “*weak ICZM*”; Warnemünde), where the neutral cases are put into the unproblematic category. This distinction was made both for hard and for soft institutions. Finally, the planning category was divided into sub-categories, in particular infraplan (*planning of infrastructure and built-up of specialized infrastructure*), buildplan (*building restrictions and recommendations*) and spaplan (*spatial planning procedures and instruments in general*), since many examples were provided in this area, and due to the special ASTRA focus. Finally, economic sectors like enerutil (*energy utilities, transmission lines*) or agric (*agriculture*) are introduced as a further type. Partially, they represent vulnerable exposure units, partially constraining or supporting factors.

The institutions mentioned in the questionnaire are summarized as follows:

- **Local level:** local administration, authorities and sectoral departments (e.g. construction, environment, development, coast), local climate strategy.
- **Local and/or regional level:** planning in general (instruments, procedures), sectoral planning departments and utilities (technical, energy, water and transportation infrastructure, coastal protection), rescue services, building restrictions and recommendations, spatial planning (e.g. identification of affected areas, protection of areas, retention areas, legal and economic responsibilities), county administration, regional authorities, committees (crisis-, investigation-), port authorities, environmental centres.

- **National level:** ministries (e.g. environment, building and regional development, forestry, trade and industry, transport and communication), national environmental protection agency, national strategies (coastal protection, adaptation, mitigation, promotion of renewable energies), national environmental objectives.
- **Local to national level:** compensation of losses, politicians and political parties, strategies for coastal management.
- **European and global level:** EU policies, law and research, international pressure.
- **Informal:** training, education and knowledge transfer (education of planners and the public, seminars, education system, involvement of science in decision making, availability of relevant information and adaptation research), scientific research, coordination and cooperation (e.g. compilation of planning procedures, coordination between hazard management and planning, communication between scientists, policy makers and administrations), environmental awareness, changing lifestyles, anticipatory instead of reactive planning, inaction.
- **Economic Sectors:** Energy utilities, industry, construction sector, forestry, fishery, water utilities, finance sector (insurance companies, investors), service sector, agriculture, transportation sector, pastoralists, tourism, private households.
- **Further mentioned** were institutions like: investment policies, sustainability targets, climate protections as global business, stakeholder involvement, nature conservation, environmental permission processes, NGOs, local residents and employees.

The broad variety of local to regional institutions may be attributed to the local focus of most respondents, but also to the diversity of sectors which are somehow involved in the issue. However, as they seldom appear as exposure units (see below), where economic sectors are more important. The questions relating to constraints and supporters typically produce informal institutions or relate to mitigation measures (see below).

4.2. Exposure units

The exposure units collected in the question “*Impacts of Climate Change*” are roughly characterized by the following types. Some relate to institutions and actors as introduced above. Additionally, different parts of the built environment are seen as being exposed to climate change impacts. Further exposure units are classified as natural environment. **Most exposure units are presented in a general way not making reference to local particularities.** The view on the economic sectors is mostly very general, i.e. no particular firms are mentioned. It may be that these exposure units are not derived from local experience, but by causal reasoning from the mentioned impacts. In many cases, they are only provided in a very general way (e.g. 23 quotes linked to the code NATENV: *ecosystems*, and 25 quotes to the code ECON with “*economy*”, “*economic losses*”, “*companies*”, etc.). **It must be assumed that stakeholder intuitions about exposure units are not well-developed in many cases. Also, more research is needed to assess the local relevance to the collected exposure units.** The more detailed view on the built environment most likely results from the local or professional expertise of the respondents.

The exposure units collected in the questionnaire are summarized as follows:

- **Built environment:** buildings and urban area in general, in particular buildings near the shore, cultural heritage, heating (energy demand depending on temperatures and housing conditions), infrastructure (shore infrastructure, water supply systems, coastal protection, communication, transportation and technical infrastructure, waste dumps).

- **Natural environment:** ecosystems in general, in particular coastal ecosystems, beaches, shore meadows, municipal parks, rivers.
- **Economic Sectors :** economic and material losses in general, tourism, forestry, transportation (roads, sea transport, ports, airports), energy utilities (transmission lines, hydro power, renewable energies, demand for heating energy), agriculture, fishery, industry, water utilities (groundwater, water supply).
- **Institutions and further Actors:** inhabitants and private households, public health, coastal management authorities, local administration (and local budgets), spatial planning authorities.

4.3. Impacts

The list of impacts collected from the questionnaire is relatively low compared to the other lists. This may be caused by a relatively limited amount of distinguishable weather events of climatic stresses. However, **some of them refer to very specific impacts, indicating that respondents might have concrete ideas or experience in mind** (e.g. divimpact : “changes of number of fogs”). On the other hand, not all mentioned impacts are related to climate change (e.g. uv: “increasing of UV radiation intensity”). It is also not straightforward to disentangle impacts from changes in the climatic conditions. **Many respondents phrased them in a way that does not allow for disjointed categories** (e.g. “flooding” as flood: *river floods*, caused by heavy rains, or as surg: *storm surges*, related to strong winds, waves and sea level rise). Most likely, this caused by the absence of a common terminology. The summary is one possibility to distinguish the impacts by their relation to climatic or physical variables:

- **Temperature :** increasing temperatures (“less frequency of winter frost”, “mild weather in winter”, “less cold winters”, “winter is shorter”, “increasing of summer temperature”), extreme temperature events (“heat waves”), “increasing temperature of sea water”, “decrease in sea ice cover”.
- **Precipitation:** overall increase, “more water in reservoirs”, “changed water supply”, “heavy rainfalls”, “increases in winter”, “decrease in summer”.
- **Wind:** storms (“more frequent and stronger storms”, “thunderstorms”, “hurricanes”).
- **Sea level:** loss of land.
- **Temperature and precipitation:** droughts, changing growth conditions (“lengthening of growing season”, “overwintering of plants is harder”), less snow.
- **Sea level and precipitation:** river floods, “flash floods”, “changes of [groundwater] salinity”.
- **Temperature, wind and precipitation:** changes in winter humidity and summer aridity, eutrophication (“shift in nutrient loads”), “public health”.
- **Sea level, wind and waves:** storm surges (“height and frequency of storm tides”).
- **Sea level, wind, precipitation and waves:** erosion (“coastal erosion”, “land slides”).

In this context, it is interesting to consider the claimed data needs of respondents. The following data was mentioned as being helpful:

- Temperature: average, extreme values, heat waves.
- Water: average precipitation, extreme values, water balance, heavy rains, droughts.
- Wind: average and extreme values, direction, speed, storm frequency, thunderstorms, number of hurricanes.
- Sea level rise
- Storm Surges: waves, storm lift.

- Radiation: sunshine hours.
- Humidity: fog.
- Atmospheric pressure
- Erosion: soils, moving of sand.
- Seasonal information: vegetation period, snow cover, sea ice conditions.
- Other: budgets, migration of diseases.

Depending on the respondent, the aspired spatial resolution of meteorological data ranges from 1km to 50km, and for climate scenarios from 1km to 500km (leaving out the most extreme respondents, the ranges narrow to 7-50km and 7-200km). **Taking these comprehensive data needs on such a fine scale, the question arises whether decision-makers could process such detailed information. It is also clear, that state of the art climate modelling cannot provide such detailed data, and is questionable whether this is in principle possible. This indicates that a re-framing of data expectations is necessary to bring scientific with practical reasoning in line and to avoid frustration of stakeholders.** The detailed data needs confirm the observation from other questions that partners from the case studies have a relatively detailed biophysical problem framing, which is contrasted by less specific knowledge on adaptation policies, an observation we will make again in the next section.

4.4. **Constraints and supporters**

The above codes are used to collect the institutions and actors which are estimated as constraining or supporting adaptation policies. On the constraining side, the following were mentioned:

- **Local level:** inlocal: *“local policies (e.g. City board, other boards): local interests are more important than global”*.
- **Local and/or regional level:** inlocal/inregional: *“Local authorities and business on county and local authority level (i.e. opposition against building restrictions)”*, buildplan: *“it is necessary to work out recommendations on building, measures and recommendations on construction of buildings to prevent heavy consequences of storm”*, Bplan: *“wrong standards, insufficient provision for extreme conditions ...”*, Bhazman: *“inadequate responses to critical events”*, *“insufficient clear and real plans for cases of crisis situations”*, *“deficiencies and mistakes of operating of crisis-committee and its divisions”*.
- **National level:** innational: *“national policies [...] inadequate responses to the threats of climate change”*, Blex: *“gaps in legislation [...] different interpretation of what is allowed or what is not”*, *“different legal input and targets of authorities and decision makers”*.
- **Local to national level:** inlocal/inregional/innational: *“administrative bodies: temporary absence of responsible”*, Bpublibudmiss: *“financial problems in public bodies”*, *“stained municipal budgets”*, *“lack of finances (climate change is not a priority in many cases)”*, *“lack of human resources and knowledge”*, Bcoaststrat: *“weak integrated coastal zone management”*.
- **Informal:** Buncert: *“lack of relevant information”*, *“uncertainty of forecasts of climate change on the regional level”*, *“uncertainty of research results on the issue of climate change provides uncertainties in the discussions for investments in better infrastructure”*, *“the vulnerability of different economy sectors, social sectors, ecosystems for climate change is not fully evaluated (there is a lack of arguments for decision-makers and public)”*, *“information of the forecast not in time”*, Binaction: *“spatial development*

planning policies do not include adaptation to climate change impacts”, “*no climate change adaptation measures prepared*”, “*necessity to include climate change adaptation issues into political, planning and decision-making agenda*”, Baware: “*lack of decision-makers awareness and not sufficient public information about climate change and related problems*”, “*some politicians do not take seriously the climate change issues*”, Bknowtrans: “*inadequate education of planners*”, Bcoord: “*necessity of cooperation on the regional or national level*”, “*unsatisfactory communication between scientist, services, planners and administrations*”, “*conflict of private and national interests in spatial planning*”, “*conflicts between different interest groups*”, freeride: “*no influence of regional action on the global situation encourages inaction and free riding*”, “*local interests are more important than global*”.

- **Economic Sectors**: ECON: “*economy*”, “*development of trade and industry*”, “*business on county and local authority level (i.e. opposition against building restrictions)*”, construct: “*interest of buildings near streams and lakes*”, “*building lots’ owners*”, fish: “*fishers*”, finance: “*investors*”, “*insufficient insurances*”, agric/indust/people: “*unions of industry, agriculture and employees*”.
- **Further**: ngo: “*ecologists*”, Bdivinst: “*problems related to development of democratic society*”, “*spatial development planning system itself is at the development phase that means frequent alterations in legislation*”, “*missing strategy of development*”.

Some constraints advert at local interactions between various actors which may be constraining the implementation of adaptation policies (e.g. “*local interests are more important than global*”, “*opposition against building restrictions*”, “*interest of buildings near streams*”, “*unions of industry, agriculture and employees*”). Some further constraining factors confirm the observation that **climate change is currently not a priority issue on the local or regional level** (e.g. “*climate change is not a priority*”, “*lack of human resources and knowledge*”, “*stained municipal budgets*”). Finally, some constraints seem to be related to the specific situation of new EU member states.

However, as discussed above in the general part about actors and institutions, there is a wide variety of informal institutions. **This may also be attributed to the current state of local adaptation policies, namely that they are in most cases not in the implementation phase, but at a stage where the mere necessity of such policies has to be established.** It might further be interpreted as a kind of helplessness in the sense that **advocates of mitigation and adaptation policies are opposed by barriers that are difficult to resolve and that there is little awareness about strategic partners.** All these hypotheses are confirmed by the fact that also formal institutions on various scales are described in a vague way (e.g. “*national policies [...] inadequate responses to the threats of climate change*”).

Although there are some interesting differences, we make similar observations on the supporting side:

- **Local level**: inlocal: “*city of [...] office*”, “*municipalities*”.
- **Local and/or regional level**: planning/spaplan: “*local planning instruments*”, “*improving the planning of new infrastructure*”, “*spatial planning*”, “*compilation of territorial planning process on a strong scientific and comprehensive basis reducing conflicts between different interest groups*”, hazman: “*upgrading of meteorological, hydrological, rescue etc. services, better coordination between each other*”, envcent: “*environmental centres*”, “*the status of the National Park helps to release the environmental initiatives*”.

- **National level**: innational: “ministries”, “state government”, “national environmental objectives”, “elaboration of development strategy for the whole country in longer perspective”, natadap: “adaptation: support (financial, information) from the federal level”, natmitig: “the objective to reduce the emissions”, “mitigation: high oil prices and environmental taxation”.
- **Local to national level**: polit: “politicians”, “political parties in national level”, coastprot: “coastal protection authorities”, “strategies for coastal protection”.
- **European and global level**: ineurope: “financial support on the same [EU] level”, inglobal: “mitigation: supra national pressure”.
- **Informal**: research: “strong and authoritative national research on climate change”, “reliable knowledge and information”, “academic and research institutions”, aware: “international recognition of climate change impact importance and need of its mitigation”, “visible and tangible impact of climate change can strengthen public attention and pressure on decision-makers”, “raising role of environmental questions into political agenda”, “general high awareness of risks”, knowtrans: “local & government seminars and workshops”, “national research on climate change will provide bases for the policy and its recommendations preparations at national, subregional and local levels in various policy fields including spatial planning”, “improvement of education system, particularly for the people involved in planning and making decisions”, coord: “efficient regional and global cooperation in the area”.
- **Economic Sectors**: ECON: “high oil prices”, “engagement of multinational companies (Swiss Re, Shell)”, “enterprises and institutions”, tour: “tourist sector”, fish: “fishers”, finance: “insurance companies”, “increasing number of insured people and properties will lead to the higher interest of insurance companies and lobbying activities”, indust: “industry (e.g. refinery)”, transport: “possibility to minimise losses caused by storms stimulates investments of harbour”.
- **Further**: ngo: “active work of NGOs”, “environmental NGOs”, people: “inhabitants”, “local permanent residents”, divinst: “beneficial investment policy supporting activities addressed to mitigate climate change impacts”.

Again, many informal institutions and vague descriptions are provided. The analysis is complicated because it is not always clear whether the respondents refer to existing or only to potentially supporting institutions. On the other hand, there are some interesting exceptions of relatively concrete (strategic) supporters (e.g. “coastal protection authorities”), in particular on the economic side (e.g. “Swiss Re, Shell”), which may partially be related to sectors being potential exposure units (e.g. tourism, transport, “refinery”). **The more explicit and formal institutions are related to mitigation measures** (e.g. “the objective to reduce the emissions”, “supra national pressure”), **while adaptation related supporters are integrated in other policy sectors** (hazard management, coastal protection, spatial planning, environmental objectives). This conclusion becomes even more obvious when the question on already existing responses is analysed.

The comparison of constraining and supporting factors indicates that **problems are more found on the local scale, while en-abling forces are more biased to higher levels**. It is likely that there is a shift of responsibilities to higher institutional scales. Several reasons may explain this: (1) Since most respondents are situated on the local level, they are more familiar with the local problems while from higher level preferably positive influences are noticed. (2) Constrained municipal budgets, limited human resources on the local level and the high degree of capacity needed for climate related issues hinder implementation, while resources, frame law and information from the national or European level have a positive impact. (3)

Local conflicts of interest and a closer relation between local administration and their electorates favor myopic compromises where long-term goals and challenges are given low priority.

It can also be observed that the diversity for supporters is lower than for constraints. The positive side is that supporters are perceived a little bit more concretely, but it can also be interpreted as a pessimistic view on the chances to implement climate change policies on the local level.

4.5. **Problem framing**

From these observations, conclusions about the problem framing of ASTRA case study partners and stakeholders can be drawn.

General problem awareness about Climate Change is primarily framed by the potential impacts that may affect the case study regions. However, on the local level there is little attention for vulnerable exposure units and to policy responses. This is supported by the observation that many institutions mentioned by respondents are not specific to climate change (e.g. “local government”), vague (e.g. “politicians”) or informal (e.g. “necessity of cooperation on the regional or national level”). In particular, the prevalence of the latter as constraining factor indicates that the mere necessity of adaptation policies still has to be established. The conclusion is further confirmed by the very generalized notions of exposure units used by the interviewees (e.g. “economy”). In this regard it must be assumed that stakeholder intuitions are still very vague when it comes to local exposure units, while there is enough lay knowledge and attention to formulate vulnerable sectors in an abstract way. In other words, there seems to be little concrete knowledge about who or what is potentially affected by climate change. Otherwise such actors or institutions were likely to be constituents of arrangements which promote awareness rising or adaptation strategies, but the case study screening (see below) as well as other studies show that climate change is currently not a priority issue on the local or regional level. Other policy sectors strongly compete with Climate Change as a field of public decision making. On the other hand, it cannot be stated that there is no problem awareness (the mere existence of the ASTRA project gives evidence). The concrete and specific description of various potential impacts of climate change (e.g. “changes of number of fogs”) indicates that respondents have devoted substantial degrees of attention towards this issue. It would also be wrong to claim that there is little done. However, if we conclude from the case study screening that most existing adaptation policies are integrated in other policy sectors, e.g. hazard management and coastal protection, this is in line with the observation that the challenges of these sectors are often not perceived as awareness to climate change per se. To sum up, except the problem awareness framed in terms of mitigation measures (which is not rooted in the local conditions; see below), primal attention is paid to Climate Change in the form of imagined impacts and of complaints about “soft factors” as missing knowledge, inaction and bad coordination. It is open in how far this awareness can be shifted to vulnerabilities and adaptation strategies in the future.

Climate change is mainly seen as mitigation problem, while adaptation issues are vague, unclear or difficult to structure. While questions relating to constraints and supporters typically produce informal institutions, many more formal exceptions relate to mitigation measures (e.g. “promotion of renewable energies”) or the national level (e.g. “the objective to reduce the emissions”). The latter is, again, associated with greenhouse gas mitigation

strategies, renewable energies and international commitments. As discussed above, adaptation strategies are mainly put in less concrete terms or integrated into other policy sectors.

There seems to be little strategic knowledge on actors and institutions which support or constrain adaptation to climate change. As stressed above, the questions relating to constraints and supporters of adaptation policies typically produce informal institutions or describe actors in a general way. Some more concrete constraining factors are related to the observation that climate change competes not very well with other policy sectors on the local level (see above). Although these limitations of problem awareness contribute to the barriers which advocates of mitigation and adaptation policies have to face, there seems to be even more limited awareness of particular supporting or constraining factors also to those people which are motivated to promote necessary changes. The questionnaires provides only a small number of institutions which are particular local arrangements or specific local actors which could or should be taken into account if adaptation strategies are to be implemented in singular case study regions. It may be necessary to get a more concrete perspective on local exposure units, actors and institutional arrangements, to disentangle and structure the implementation problems of adaptation policies.

4.6. *Climate un-related issues*

Although not coded, we want to point at the set of answers provided to the question “Current main problems (not climate related)”:

- *“Disorganized occupation of coastal areas in order to develop tourism and business, erecting buildings and other facilities” [Estonia].*
- *“Transport infrastructure, against-flooding infrastructure, technical infrastructure [...], lack of spatial order, unemployment” [Gdansk].*
- *“Slow growth, high unemployment”; “unemployment provides social problems, in some areas very high housing costs, Elbe river as an important barrier for morning and evening traffic”; “economy ...” [Hamburg].*
- *“Intensive urbanisation of the city. Development of harbour, modernisation, deep-sea harbour, modernisation of transport infrastructure” [Klaipeda]*
- *“Unemployment...” [Kokkola].*
- *“Semi legal building lots for dwelling houses in protected area, the environmental impacts raised from the large number of tourists, the drinking water quality and complicated communication with Klaipeda port” [Neringa].*
- *“Poorest nation in the EU (low GDP), poverty, high unemployment, low wages, not sufficient infrastructure and social services, low support to R&D” [Latvia].*
- *“Lack of human resources and knowledge. It is necessary to work out recommendations on building [...] and other recommendations for technical infrastructure.” [Pärnu]*
- *“Fragmentation due to expansion of infrastructure” [Sweden].*
- *“Transport of hazardous conveying stocks (fuels, acids etc) in ample quantity through the city to ports.” [Tallinn]*
- *“Unemployment, economic power, depopulation, age structure” [Warnemünde].*

This underlines – again – the broad perspective brought in by the different respondents. Although many answers relate to economic problems, there are also other urgent issues. **This stresses that other policy sectors strongly compete with Climate Change as a field of public decision making.**

4.7. *Focal issues*

Based on the case study screening, we recommend the following focal issues for further project work (which of course have to be modified by results from other project studies).

Urban building activities: This seems to some degree a cross-cutting issue. Urban areas, including infrastructure are an important exposure unit mentioned by many respondents, jointly with various institutional arrangements, e.g. spatial planning and building restrictions. It was also stated that the construction sector may be an important player. Some problematic processes may be related to this issue, e.g. local pressure to approve certain construction sites which are risky when increased flooding or sea level rise has to be faced, but where potential losses are partially compensated by the public. Here, insurance companies come in as an additional player mentioned by some respondents. Building codes may further take changed winter temperatures under consideration. Construction has also a relation to mitigation of Climate Change via potential energy savings. For some case studies there seems to be some window of opportunity in changing the built environment, since restructuring is happening anyway in the still continuing transformation process.

Adaptation of water supply systems: Many water-related impacts were mentioned by the respondents. Water supply is mainly influenced by precipitation and temperature patterns, but in coastal cities, salinisation of ground water can result from sea level rise, additionally. Also some institutions in relation to water management were provided, and exposure of and planning for urban infrastructure are grounded in the case study screening answers. This issue may open strategic alliances with water utilities and industry sectors which heavily rely on process water. Water supply also interferes with privatization processes currently going on in many case study areas. Finally, referring to drinking water as a basic need may help raising public awareness to Climate Change.

Energy utilities and planning for energy infrastructure: Although mainly associated with greenhouse gas mitigation, energy producers are also exposed to climate change. Transmission lines are vulnerable to storms, and energy demand may change if winters are becoming warmer. Also renewable energies are vulnerable, e.g. hydropower is affected by changed hydrological conditions, and wind energy depends on a stable wind regime. Thus, considering energy utilities for adaptation strategies may break up “traditional” lines of confrontation.

Integration of climate change into hazard protection policies and coastal protection: Although these sectors are not dealing with Climate Change per se, adaptation responses are likely to happen there already or at least the awareness to consider Climate Change is high. However, one challenge is to take current and fundamental uncertainties about Climate Change into account where methods of (probabilistic) risk analysis established in these areas are no longer appropriate.

Development of tourism and forestry: Both sectors were mentioned as being vulnerable by many respondents. Forestry is affected by changed vegetation patterns and also by storms, the latter in a very tangible way, which draws a connection to public awareness. Tourism is affected by climatic conditions, e.g. via sunshine hours, temperatures or snow cover. As changes of these influences are not completely established yet, this sector may also be thought of as profiting from Climate Change. Finally, this sector is an important source of income in many case study regions.

5. Discussion and Conclusions

Although the coding process saturated, it cannot be assumed that the list of collected exposure units, impacts, constraining and supporting factors is exhaustive. However, this was not the objective of the study, which should instead provide an explorative synopsis of Climate Change in the project case study areas and a starting point for further analysis. In that respect several relevant issues for further investigation were identified, which at the same time show roads beyond the state of the art of coastal vulnerability research, which has focussed much on sea level rise in the past.

On the other hand, there is also some divergence in the kind of results compared to expectations during the design phase of the study. The synoptic results are too weak to really put the different case studies in juxtaposition (e.g. in a table or on a map). This became obviously during coding when those case study partners which provided multiple filled questionnaires were compared with those providing one. Even within case studies, the stakeholder perceptions are too diverse to characterize their site by interviewing only one person. For that objective, more time consuming local assessments have to be made. So, **the main result is an extensive collection of concepts, impacts, actors and institutions which helps guiding such refined assessments and providing some vocabulary for further joint project work.** Finally, it was a positive surprise that **this collection provides more insights about stakeholder views and problem framing than expected.** These were mainly derived from the conceptual density and depth used by respondents to answer the different open questions, where some striking similarities evolved.

It was confirmed by the case study screening that **Climate Change is not a priority issue on the local or regional level** in many cases. Public authorities (and enterprises) consider mainly economic and social issues, where climate related problems are seen as marginal. **Although adaptation issues are partially integrated in sectoral policies and although there is a “kernel” of basic problem awareness (mainly related to potential impacts and international mitigation policies), little is done in concrete terms.** This may be attributed to tight municipal budgets, limited capacities and constrained problem awareness beyond the basic kernel. Therefore, deeper cooperation between stakeholders and scientist may be advantageous. The communication of media and policy makers may be insufficient to change basic perceptions of Climate Change. Awareness could probably be more comprehensive if more concrete knowledge about those groups and sectors who are vulnerable would be spread and more appropriate information would be available to decision-makers.

Awareness in terms of impacts is not sufficient, since for strategic decisions under uncertainty, exposure units should be considered mainly. Here, the problem framing has to be changed, which is underlined by stakeholders' demand for excessive data of climate projections and by the fact that knowledge transfer was mentioned as an essential supporting factor for adaptation strategies. Joint work of scientists and stakeholders may help identifying the discrepancies and data needs and available data. **A shift in thinking is needed to deal adequately with uncertainties. This rises the question whether current planning procedures are adequate for the challenges of climate change.** If not, procedural changes are needed and obstacles for integrating climate issues in different planning sectors have to be expected. Although climate models provide a good overview over future developments, projections of climate change impacts on the local scale are still highly uncertain. Predicting

changed conditions would presuppose perfect foresight about future GHG emission paths. Thus, global climate impact research relies on multiple storylines and scenarios. When it comes to local effects, further uncertainties complicate the analysis, since global scenarios have to be downscaled. Consequently, the set of possible climate futures for a given place is difficult to overview. It would be questionable if extensive scenario data could be processed by administrative bodies in a productive way. This raises the question of (i) how to shift problem framing, (ii) how to communicate scientific information, and (iii) which analytical procedures can help stakeholders. **Knowledge about vulnerable exposure units and the costs of potential impacts could, in addition to public perception of the global climate problem and tangible consequences of extreme weather events, enhance problem awareness towards the need of implementing adaptation strategies.** To establish appropriate analytical procedures, the classical risk approach, which is based on extreme event statistics, has to be complemented by a vulnerability assessment which analytically starts from those which are sensitive to Climate Change impacts or have limited adaptive capacity. **Obstacles to adaptation processes have to be overcome by new approaches and not by new data.**

Another framing issue is the perception of the climate problem mainly as a challenge to mitigate greenhouse gas emissions. Although approaching the causes of Climate Change is a basic necessity, it is now unavoidable that some adverse effects will occur, making it a crucial responsibility to complement mitigation with adaptation policies. **Decision-makers should be aware of the potential of anticipatory adaptation to decrease future costs** from e.g. weather extremes. That this perspective is yet not deeply rooted in local decision processes is in contrast to what one might expect due to the theoretical argument that the freerider problem deeply connected to global climate policies would favour adaptation instead of mitigation: abatement costs account for the player which reduces emissions, while all agents would benefit from reduced climate damage. In contrast, for adaptation measures costs and benefits would be accounted for at the local level. Anticipatory adaptation can substantially decrease future costs and create business opportunities. Several reasons may explain the priority for mitigation. Since Climate Change was historically considered from an international perspective, shaped by scientists, NGOs and nation states, the public framing of it is currently not focussed on adaptation. This may have been supported by the feeling that it is a matter of justice to approach the problem via those who cause it. Therefore, although local interests may be different, also municipal and regional policies (if in place, at all) concentrate on emission reductions. This situation converts in objective incentives for mitigation measures when national programmes support e.g. investment in renewable energies. Such incentives are in particular more effective if local and regional bodies have only limited capacities to develop own strategies (and are not obligated to do this by law). Such limited capacities can additionally explain the weaker emphasis on adaptation if vulnerabilities and benefits of adaptation are unclear, but there are no resources to explore these issues. Finally, it may be in the worst case that policies having effects on long time scales are often ignored if municipalities are struck in local problems and particular interests. **In all these cases it may be helpful to supply regional and local authorities with an appropriate mix of information, education, obligations and resources.**

In addition to such top-down approaches it would be valuable to enhance the strategic awareness of local actors on how to overcome reservations against implementation of adaptation measures. Besides awareness raising activities on vulnerabilities as proposed above, this requires further research on case study level since the case study screening provides only limited information about local arrangements of key actors and institutions due to the stakeholders' problem framing discussed before. As it was observed that constraining

factors are more found on the local level, and sometimes refer to diverse interactions between various actors and institutions, **such a bottom-up analysis would identify actual or potential links to key players that can be activated to promote adaptation policies**. This could change the situation by providing new strategies and opportunities.

6. Appendix: Complete Code List

agric	<is a> inregional <is a> PROBLEMS
"agriculture" <is a> ECON	Binaction
allexp	"Missing past or present activities related to climate change" <is a> Bsoft
"All exposure units"	
anticip	Binfra
"Anticipatory planning (in contrast to reactive)" <is a> soft	"Poor public infrastructure" <is a> BUILTENV <is a> PROBLEMS
areassess	Bknowtrans
"Land use planning, zoning" <is a> spaplan	"Missing or unadequate knowledge transfer" <is a> Bsoft
aware	Blex
"Awareness of climate change problems" <is a> soft	"Problems with legal issues" <is a> innational <is a> PROBLEMS
Badap	Bplan
"Bad adaptation policies" <is a> inlocal <is a> innational <is a> inregional <is a> PROBLEMS	"Malfunctioning spatial planning" <is a> inlocal <is a> inregional <is a> PROBLEMS
Baware	Bpublibudmiss
"Lack of awareness (about threats from climate change)" <is a> Bsoft	"Strained public budgets, lack of resources" <is a> Bdivinst
Bcoaststrat	Bsettle
"Weak ICZM" <is a> innational <is a> inregional <is a> PROBLEMS	"Poor housing conditions and spatial order" <is a> BUILTENV <is a> PROBLEMS
Bcoord	Bsoft
"Lack of coordination or cooperation, conflicts" <is a> Bsoft	"Malfunctioning informal institutions" <is a> INSTIACT <is a> PROBLEMS Baware <is a> Bcoord <is a> Binaction <is a> Bknowtrans <is a> Buncert <is a> freeride <is a>
Bdivinst	
"Diverse problems related to institutions or actors No problem type appears in more than one PD (Subsumes i.a. Problems related to transition to democratic society Missing development strategy)" <is a> INSTIACT <is a> PROBLEMS Bpublibudmiss <is a>	
Bhazman	buildplan
"Missing responses to extreme events or bad hazard management" <is a> inlocal <is a> innational	"Building restrictions and recommendations" <is a> planning BUILTENV "Built environment, buildings and infrastructure in general" Binfra <is a> Bsettle <is a> infra <is a> lowareas <is a> settle <is a>

Buncert	"Problems related to information availability and research. Bad knowledge transfer is under Bknowtrans" <is a> Bsoft	"Diverse institutions (none appears in 2 or more PDs) (subsumes investment policies, sustainable development strategies, business options, nature and environment planning)" <is a> INSTIACT ngo <is a> people <is a>
climstrat	"Strategies for climate change in general" <is a> innational natadap <is a> natmitig <is a>	drought
coast	"Coastal and beach ecosystems" <is a> NATENV	"Extreme events: droughts" <is a> Sprecip <is a> Stemp
coastprot	"Measures and infrastructure for coastal protection and against flooding, marine and coastal protection authorities" <is a> inlocal <is a> innational <is a> inregional	dump
coaststrat	"Strategies for coastal management, ICZM, Nature conservation of the coast" <is a> innational <is a> inregional	"Landfill dumps" <is a> infra
compens	"Compensation of losses" <is a> ineurope <is a> inlocal <is a> innational <is a> inregional	ECON
construct	"Building activities and investors" <is a> ECON	"Economic actors, exposure units, changes and losses in general" agric <is a> construct <is a> enerutil <is a> finance <is a> fish <is a> forest <is a> indust <is a> matloss <is a> private <is a> service <is a> tour <is a> transport <is a> waterutil <is a>
coord	"Cooperation, coordination and conflict-related measures" <is a> soft	enerutil
cultherit	"Cultural heritage" <is a> settle	"Energy utilities, transmission lines" <is a> ECON <is a> infraplan
DATA	"Various codes to characterize data properties"	envcent
divimpact	"Diverse impacts, Subsumes i.a. fogs, wildfires, plant diseases, water runoff, salinity, pollution" <is a> IMPACTS	"Environmental centres, national park authorities etc." <is a> inlocal <is a> inregional
divinst		eros
		"Coastal erosion and landslides" <is a> Sprecip <is a> Sseal <is a> Swaves <is a> Swind
		finance
		"Finance sector, insurance companies, investors" <is a> ECON
		fish
		"Fishery" <is a> ECON
		flood

"river floods" <is a> Sprecip <is a> Sseal	ineurope "Institutions on European level" <is a> INSTIACT compens <is a>
forest	
"Forestry" <is a> ECON	infra "Infrastructure in general" <is a> BUILTENV dump <is a> shoreinfra <is a> techinfra <is a> transinfra <is a> waterss <is a>
freeride	
"Freerider problems" <is a> Bsoft	
grow	
"Changing growth conditions for vegetation" <is a> Sprecip <is a> Stemp	infraplan "Planning of infrastructure and built-up of specialized infrastructre" <is a> planning enerutil <is a> transplan <is a> waterutil <is a>
gwater	
"Groundwater changes (except grondwater level: waterlevel)" <is a> NATENV	inglobal
hazman	"Global institutions" <is a> INSTIACT
"Rescue services and planning for hazards and risk management" <is a> inlocal <is a> innational <is a> inregional	inlocal "Local actors and institutions" <is a> INSTIACT Badap <is a> Bhazman <is a> Bplan <is a> coastprot <is a> compens <is a> envcent <is a> hazman <is a> loclimstrat <is a> planning <is a> polit <is a>
health	
"Public health" <is a> Sprecip <is a> Stemp <is a> Swind	
heat	
"Extreme temperature events: heat waves" <is a> Stemp	innational
heating	"National actors and institutions" <is a> INSTIACT Badap <is a> Bcoaststrat <is a> Bhazman <is a> Blex <is a> climstrat <is a> coastprot <is a> coaststrat <is a> compens <is a> hazman <is a> law <is a> polit <is a> renew <is a>
"Heating of houses" <is a> settle	
humidity	
"Changes in humidity/aridity" <is a> Sprecip <is a> Stemp <is a> Swind	
ice	
"decrease in sea ice cover" <is a> Stemp	inregional
IMPACTS divimpact <is a> Sprecip <is a> Sseal <is a> Stemp <is a> Swaves <is a> Swind <is a>	"Regional actors and institutions" <is a> INSTIACT Badap <is a> Bcoaststrat <is a> Bhazman <is a> Bplan <is a> coastprot <is a> coaststrat <is a> compens <is a> envcent <is a> hazman <is a> planning <is a> polit <is a>
indust	
"Industry (production)" <is a> ECON	

INSTIACT	"Shifts in nutrient loads and internal eutrophication"
"Institutions, instruments and actors"	<is a> Sprecip
Bdivinst <is a>	<is a> Stemp
Bsoft <is a>	<is a> Swind
divinst <is a>	people
ineurope <is a>	"Local residents, people, employees; material losses of private households are under private, private houses under urbanarea"
inglobal <is a>	<is a> divinst
inlocal <is a>	planning
innational <is a>	"Planning in general"
inregional <is a>	<is a> inlocal
soft <is a>	<is a> inregional
knowtrans	buildplan <is a>
"Training, education and knowledge transfer"	infraplan <is a>
<is a> soft	spaplan <is a>
landloss	polit
"Loss of land"	"Politicians and political parties in general."
<is a> Sseal	<is a> inlocal
law	<is a> inregional
"Laws in general"	buildplan <is a>
<is a> innational	infraplan <is a>
lifestyle	spaplan <is a>
"Changing lifestyle, attitudes and behaviour"	private
<is a> soft	"Private households: meant economically. People as persons are under people."
loclimstrat	<is a> ECON
"Local climate strategy"	PROBLEMS
<is a> inlocal	"General meta-category for problems which are also found below BUILTENV and INSTIACT"
lowareas	Badap <is a>
"Particular: Infrastructure and buildings located near shore on low above sea level."	Bcoaststrat <is a>
<is a> BUILTENV	Bdivinst <is a>
matloss	Bhazman <is a>
"Material and economic losses in general"	Binfra <is a>
<is a> ECON	Blex <is a>
natadap	Bplan <is a>
"National adaptation strategy"	Bsettle <is a>
<is a> climstrat	Bsoft <is a>
NATENV	protect
"Natural environment, ecosystems in general"	"Protect areas from flooding etc."
coast <is a>	<is a> spaplan
gwater <is a>	QConstraints
rivers <is a>	"To mark all answers to the question on constraints"
natmitig	QImpact
"National mitigation strategy"	"To mark all answers to the question on impacts."
<is a> climstrat	QResponse
ngo	"To mark all answers to the question on responses."
"NGOs, Environmentalists"	QSupporters
<is a> divinst	"To mark all answers to the question on Supporters."
nutri	renew
	"Promotion of renewable energies"

<is a> innational	grow <is a>
research	health <is a>
"Information and data retrieval, research and research organizations"	humidity <is a>
<is a> soft	nutri <is a>
	snow <is a>
	watersupply <is a>
retreat	Sseal
"Retention areas"	"sea level changes"
<is a> spaplan	<is a> IMPACTS
rivers	<is a> STATE
"Changes in rivers"	eros <is a>
<is a> NATENV	flood <is a>
	landloss <is a>
	surg <is a>
service	STATE
"Service sector"	"Markes impacts which are correctly speaking climate states"
<is a> ECON	Sprecip <is a>
settle	Sseal <is a>
"Buildings in general"	Stemp <is a>
<is a> BUILTENV	Swaves <is a>
cultherit <is a>	Swind <is a>
heating <is a>	
shorebuild <is a>	Stemp
urbanarea <is a>	"Extreme and continuous temperature change"
shorebuild	<is a> IMPACTS
"Buildings near shore"	<is a> STATE
<is a> settle	drought <is a>
shoreinfra	grow <is a>
"Infrastructure near shore."	health <is a>
<is a> infra	heat <is a>
snow	humidity <is a>
"decrease in snow cover"	ice <is a>
<is a> Sprecip	nutri <is a>
<is a> Stemp	snow <is a>
soft	warmsummer <is a>
"Informal institutions realted to communication, awareness, knowledge etc."	warmwater <is a>
<is a> INSTIACT	warmwinter <is a>
anticip <is a>	storm
aware <is a>	"more frequent and strong storms"
coord <is a>	<is a> Swind
knowtrans <is a>	surg
lifestyle <is a>	"Storm surges, storm tides"
research <is a>	<is a> Sseal
spaplan	<is a> Swaves
"Spatial planning procedures and instruments in general."	<is a> Swind
<is a> planning	Swaves
areassess <is a>	"Wave regime with higher waves"
protect <is a>	<is a> IMPACTS
retreat <is a>	<is a> STATE
Sprecip	eros <is a>
"Precipitation: Extremes and Averages"	surg <is a>
<is a> IMPACTS	Swind
<is a> STATE	"Wind extremes"
drought <is a>	<is a> IMPACTS
eros <is a>	<is a> STATE
flood <is a>	eros <is a>
	health <is a>
	humidity <is a>
	nutri <is a>
	storm <is a>
	surg <is a>

techinfra	warmsummer
"Technical and communiacion infrastructure" <is a> infra	"Increasing summer temperature" <is a> Stemp
tour	warmwater
"Tourism and recreation" <is a> ECON	"Increasing temperature of sea water" <is a> Stemp
transinfra	warmwinter
"Transportation infrastructure, places." <is a> infra	"warmer winters -- differentiate shorter winters, snow cover etc.?" <is a> Stemp
transplan	waterss
"Transportation facilities management (distinct from transinfra)" <is a> infraplan	"Water supply system infrastructure, sewage plants" <is a> infra
transport	watersupply
"Transportation and traffic" <is a> ECON	"water supply, ground water level etc." <is a> Sprecip
urbanarea	waterutil
"Urban area in general." <is a> settle	"Water management, planning and utilities" <is a> ECON <is a> infraplan
uv	
"uv radiation intensity (not climate related)"	

7. Appendix: Email to Interviewees

Dear ASTRA Project Partner,

You find in the attachment the questionnaire for the ASTRA screening study, which is distributed to all decision-making and planning partners of the project. As discussed during the kick-off workshop, we have prepared this questionnaire to obtain a first synopsis of all regions and municipalities involved in the ASTRA project. Your answers will be used for a first qualitative assessment of climate change impacts in your region and to explore possible response options. The results will be presented at a project workshop and made available to all partners.

Please answer the questions briefly from your perspective with your municipality or region in mind - possibly with some of your colleagues. There is no need for extensive data retrieval at this stage. We would be happy if you type the answers directly after the questions into the document. Please mail it back to us before December 20th.

Note: This screening is not part of the winter storm case study (WP 3). A further questionnaire will be distributed for this issue, taking account of the information already obtained from the current one.

If something is unclear or if you want to make comments, don't hesitate to contact us.

Best regards,
Klaus Eisenack and
Jürgen Kropp
(Potsdam Institute for Climate Impact Research)

8. Appendix: Questionnaire

(see next page)

ASTRA Case Study Screening Questionnaire

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Introduction and Motivation

The aim of the following questionnaire is a case study screening to provide a first synopsis of all regions and municipalities involved in the ASTRA project. During the ASTRA kick-off meeting it became clear that there is a variability of conditions in the different regions, which is hard to be overviewed by all project partners. There is also different knowledge about climate change impacts, about adaptation and mitigation strategies, and about the certainty of scientific projections. We have prepared this questionnaire to obtain a first impression of the project and to get insights about the regional perception of climate change. We want to preliminary identify relevant features of the case study regions and to contribute to mutual understanding in the project. The screening is meant to provide all project partners with primal information about the regions and municipalities involved. The questions address climate impacts, responses to impacts and socio-economic conditions. Although there are overlaps, this screening is *not* part of the winter storm case study (WP 3). A further questionnaire will be distributed for this issue, taking account of the information already obtained from the current one.

In many cases climate change related decision-making is constrained, e.g. by legislative and regulatory settings, budgets or different stakeholders. Stakeholders may have different knowledge and sometimes conflicting decision-making criteria. Regarding climate change any decision-maker needs to recognise these constraints at an early stage, since they guide him towards the portfolio of adequate adaptation and mitigation options. Some questions deal with this issue to foster a better understanding of your specific – climate change related - planning (adaptation) problems. Your answers will be used for a first qualitative assessment of climate change impacts in your region and to explore possible response options.

The case study screening is thus an important base for further steps in the project. It will serve to identify central research issues and to structure the work. For a systematic inter-comparison of adaptation problems and potential solutions, the results of the screening can be used for a strongly focussed data retrieval in later phases. It also serves as a starting point for a refined definition of the decision problems in our context. As we have seen in the various discussions on the ASTRA kick-off meeting, although it is the major focal point of our project, adaptation is only a peripheral policy objective in many cases. However, climate change and its associated risks constrain various other policy objectives. Therefore it is essential to recognise the nature and significance of climatic risks, in particular on local scales. We suggest the following steps of analysis:

- Identification of problems and policy objectives
- Establishing exposed units, decision-making criteria and targets
- Factors to consider and risk assessment
- Identification of options and options appraisal
- Decision implementation and monitoring (outside ASTRA's aims)

Consider the following “invented” example for these steps; assumption: *heat waves will be more intense and a more frequent impact due to climate change*. If we are trying to adapt to serious developments it is important to become more specific about the general problem; here, for instance, *the increase of heat wave related deaths* and the decision making target, i.e.

- Policy objective: *reduction of heat wave related deaths in the elderly population.*
- Exposed unit: *elderly people above the age of 60*. Adaptation target (decision making target): *reduction of 20% of deaths by 2050 compared to the year 2000.*
- Possible indicators to consider: *summer months (climate)meteo-data, housing situation, income/social status, regional climate change scenarios, etc.*

Instructions

Please answer the following questions from your perspective with your municipality or region in mind. The questions are meant to provide a first snapshot on the case studies. It is not needed to invest time for extensive data retrieval or research at this stage. Although some questions may sound demanding, you don't need to provide detailed answers. It is sufficient to answer the questions briefly from the information and intuitions you have at hand – possibly with some of your colleagues.

Your answers are only for project internal use. The results will be presented at a project workshop and made available to all partners. If information is meant to be included in official project reports or in scientific or other publications, issues of confidentiality and anonymity will be amicably clarified

We would be happy if you type the answers into this document directly after the questions. The appropriate space begins with a small line “_”. There is no minimum or maximum number of lines for the answers.

If something is unclear about the questionnaire, don't hesitate to contact us. You can also provide additional comments or questions at the end of this document.

Deadline: December 20th, 2005

Thanks you in advance for your efforts. Contact details:

Email: Dr. J. Kropp, kropp@pik-potsdam.de , phone +49-331-2882526

Email: K. Eisenack, eisenack@pik-potsdam.de , phone +49-331-2882625

9. Impacts of Climate Change

Climate Change refers to changes in the 30 year average of meteorological properties (e.g. temperature, precipitation, etc). Such changes have to be distinguished from impacts. While climate change is the cause, the impacts are the consequences of climate change which influence society and the environment (people, species, institutions, firms etc.). They are related to extreme weather events or changed environmental conditions and they can be either positive or negative.

☞ Please provide a list of at least 5 impacts of climate change which affect or may affect your municipality/region.

☞ If possible, indicate for each impact if it is likely to be very important (+), intermediate (0) or of limited importance (-) for your municipality/region.

☞ If possible, indicate for each impact whether it has a positive (+) or negative (-) effect for your municipality/region.

☞ Indicate which “exposure units” you expect to be affected by each impact (“units” can be economic sectors, infrastructure, ecosystems, places, institutions, important firms and organizations etc.).

Impact 1: _____

Importance (+) (0) (-): _____

Effect (+) (-): _____

Exposure units: _____

Impact 2: _____

Importance (+) (0) (-): _____

Effect (+) (-): _____

Exposure units: _____

Impact 3: _____

Importance (+) (0) (-): _____

Effect (+) (-): _____

Exposure units: _____

Impact 4: _____

Importance (+) (0) (-): _____

Effect (+) (-): _____

Exposure units: _____

Impact 5: _____

Importance (+) (0) (-): _____

Effect (+) (-): —

Exposure units: —

Add more if you want.

10. Responses to Impacts

10.1. Responses

Responses are planning procedures, policy options and other societal reactions to impacts and climate change.

☞ Which responses to climate change and impacts listed above do you expect?

—

☞ What are the most important institutions in your municipality/region that make decisions related to the impacts you listed above?

—

☞ Please indicate – if available – institutionalised response mechanisms that already exist in your municipality or region.

—

☞ Please suggest other response options which would be adequate to your opinion.

—

10.2. Constraints

There may be forces opposing adequate responses. These can be legal constraints, economic sectors, environmental conditions, parties, firms, organizations, administrative bodies etc. They can be on the local, regional, national level.

☞ Please provide a list of at least 5 constraints which may limit an adequate response.

☞ Indicate for each constraint if it is – to your opinion – strong (+), intermediate (0) or weak (-).

☞ Indicate for each constraint to which of your impacts from above it is related.

Constraint 1: —

Strength (+) (0) (-): —

Impacts: —

Constraint 2: —

Strength (+) (0) (-): —

Impacts: —

Constraint 3: —

Strength (+) (0) (-): —

Impacts: —

Constraint 4: —
 Strength (+) (0) (-): —
 Impacts: —

Constraint 5: —
 Strength (+) (0) (-): —
 Impacts: —

Add more constraints if you want.

10.3. **Supporters**

There may be forces supporting adequate responses. These can be legal requirements, economic opportunities, environmental conditions, parties, firms, organizations, administrative bodies etc. They can be on the local, regional, national level.

☞ *Please provide a list of at least 5 supporting forces which may contribute to an adequate response.*

☞ *Indicate for each supporter if it is – to your opinion – strong (+), intermediate (0) or weak (-).*

☞ *Indicate for each supporter to which of your impacts from above it is related.*

Supporter 1: —
 Strength (+) (0) (-): —
 Impacts: —

Supporter 2: —
 Strength (+) (0) (-): —
 Impacts: —

Supporter 3: —
 Strength (+) (0) (-): —
 Impacts: —

Supporter 4: —
 Strength (+) (0) (-): —
 Impacts: —

Supporter 5: —
 Strength (+) (0) (-): —
 Impacts: —

Add more supporters if you want.

10.4. **Policy Objectives**

Policy objectives are essential to understand decision problems. We are interested in important climate change related policy objectives which are already implemented or possibly

under preparation, which should be considered in your region and could guide the ASTRA project work. It can be objectives on the level of legal directives but also of policy instruments. Exposure units may correspond to the list of impacts in question 1.1.

☞ *From your perspective, what are the most relevant existing policy objectives for you which are relevant in the climate change context?*

—

☞ *Please describe the exposure units which are considered by these objectives.*

—

☞ *Which decision making targets are associated with these objectives?*

—

☞ *Which new policy objectives with respect to climate change should be established to your opinion in your region?*

—

☞ *If possible, specify exposure units and the decision making targets for these objectives.*

—

11. General Information

11.1. Your Region or Municipality

For background information for the project partners we need some basic information about your region or municipality.

☞ *Name of municipality or region:*

—

☞ *Province, country:*

—

☞ *Governing body (e.g. major, local, federal government, etc.):*

—

☞ *Area, number of inhabitants (total area, area occupied by water, built-up area, etc.):*

—

☞ *Main economic sectors (e.g. forestry, fishery, agriculture, industry, tourism, etc.):*

—

☞ *Infrastructure conditions (bad/good public infrastructure, public transportation system, housing conditions, building height, etc.):*

—

☞ *Environmental conditions (specific flora or fauna habitats, vegetation, susceptibility of coastlines, weather conditions, landscapes, etc.):*

—

☞ *Current main problems (not climate related):*

—

☞ *Important cultural peculiarities (monuments, traditions, etc.):*

—

☞ *Your role / the role of your administration/body in your area:*

—

11.2. Useful Information for Planning Purposes

Considering the fact the climate change already happens and will continue, what kind of information would you (ideally) like to have at hand for planning purposes? Taking into account that scientific projections about climate change cannot provide an exact prognosis, how should we handle such uncertainties to your opinion? We are interested to understand what is useful for planning procedures and where existing scientific knowledge fits to that.

☞ *Which spatial resolution of meteorological data (km x km) do you ideally need for your purposes?*

—

☞ *Which spatial resolution of climate scenario data (km x km) do you ideally need for your purposes?*

—

☞ *What would be your the planning horizon for new adaptation strategies, i.e. how many years would you think ahead?*

—

☞ *Which variables or indicators do you expect to be important (e.g. temperature, sunshine hours, precipitation, budgets, soil erosion, etc.)?*

—

☞ *One common method to deal with uncertainties are scenarios, which describe different “story lines” of possible futures. Please indicate some types of scenarios that could be helpful for you (e.g. business-as-usual, worst case, best case, slow transformation to adaptation policies, etc.).*

—

Further Comments and Questions

Append as needed.