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# Assessing institutional capacities to adapt to climate change – integrating psychological dimensions in the Adaptive Capacity Wheel

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Several case studies show that “soft social factors” (e.g. institutions, perceptions, social capital) strongly affect social capacities to adapt to climate change. Many soft social factors can probably be changed faster than “hard social factors” (e.g. economic and technological development) and are therefore particularly important for building social capacities.

However, there are almost no methodologies for the systematic assessment of soft social factors. Gupta et al. (2010) have developed the Adaptive Capacity Wheel (ACW) for assessing the adaptive capacity of institutions. The ACW differentiates 22 criteria to assess six dimensions: variety, learning capacity, room for autonomous change, leadership, availability of resources, fair governance.

To include important psychological factors we extended the ACW by two dimensions: “adaptation motivation” refers to actors’ motivation to realise, support and/or promote adaptation to climate. “Adaptation belief” refers to actors’ perceptions of realisability and effectiveness of adaptation measures.

We applied the extended ACW to assess adaptive capacities of four sectors – water management, flood/coastal protection, civil protection and regional planning – in North Western Germany. The assessments of adaptation motivation and belief provided a clear added value. The results also revealed some methodological problems in applying the ACW (e.g. overlap of dimensions), for which we propose methodological solutions.

1 Introduction

Assessments of adaptive capacity in climate change research developed from (climate impact and vulnerability assessments (Füssel and Klein, 2006). “Climate impact assessments” only looked at exposure and sensitivity to climatic stimuli (e.g. changes in temperature or precipitation) to assess potential impacts of climate change. In the

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Many soft social factors have a particular importance for reducing vulnerabilities and building social capacities because they can probably be changed easier and faster than hard social factors like economic, technological or infrastructural development, which often need longer time frames to be altered (see also Werg et al., 2013, in this issue). Jones and Boyd (2011) and Adger et al. (2009) argue similarly and stress the changeability of factors such as perceptions of risk, knowledge, experience, habitual behaviour, norms and values so that they act as (changeable) barriers to adaptation rather than as (fixed) limits. Therefore, assessments of soft social factors open up a promising perspective for increasing social capacities to adapt. For example, if adaptation to increasing flood risk in a particular locality can be realised by behavioural adaptations of its residents (e.g. by measures to stop floodwater from entering the buildings) an analysis of the soft social factors that hamper these behavioural adaptations (e.g. lack of risk perception in the community) can be used to identify, which barriers have to be overcome to increase social capacities for adaptation.

Although the importance of soft social factors for adaptive capacities of social systems has been shown in several case studies (for a recent overview see Jones and Boyd, 2011) there is a lack of standardised assessment concepts for these factors. Also in general, there is lack of systematic methodological development in social science research on climate change vulnerability and adaptation research (Grothmann et al., 2011).

The lack of systematic methodological development is partly due to the complexity and diversity of adaptation situations. Different sectors (water management, agriculture, health etc.), actors (government, business, civil society etc.), regions (mountainous, coastal, urban, rural etc.) and levels of decision-making (local, national, European, international etc.) are affected differently by climate change and its impacts (Grothmann, 2011). Therefore, also the necessary adaptations and adaptive capacities vary between these different social systems. Furthermore, even if the climate change problem addressed is the same, the determinants of adaptive capacities, the barriers to and drivers of adaptation processes seem to vary between different social systems.

In a study on adaptation to water scarcity in the European Alps the conducted six regional case studies highlighted the diversity of the social factors hindering or driving the adaptation processes (Grothmann et al., 2009).

Nevertheless, for stimulating better learning between different social systems sensitive to climate change a more systematic methodological development for assessing social adaptive capacities and social barriers to adaptation seems promising. Even if the weighting of the indicators of adaptive capacities has to vary between different social systems (to correspond to existing differences) a systematic list of potentially influential social factors of adaptive capacities would be very helpful.

Gupta et al. (2010) have developed such a systematic list for assessing the adaptive capacity of *institutions*, the so called Adaptive Capacity Wheel (ACW). In this paper we primarily describe how we extended the ACW to include important psychological determinants of institutional adaptive capacities not considered in the concept by Gupta et al. (2010).

Therefore, this paper focuses on the *institutional* dimension of adaptive capacities concerning climate change. We define institutions – like Gupta et al. (2010, p. 460) – according to the definition by the Institutions Project of the International Human Dimensions Programme as “systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of the relevant roles” (IDGEC, 1999, p. 14).

In the following, we first describe the ACW in more detail. Second, we show how we extended the ACW to include important psychological determinants of institutional adaptive capacities. Third, we explain how we applied the extended ACW to assess the adaptive capacities of water management, flood/coastal protection, civil protection and regional planning in North Western Germany. In the final part of this article we discuss the methodological lessons we have learned from this test: the usefulness of the extended ACW to address important and as yet neglected dimensions of adaptive capacity but also methodological problems in the assessment, for which we propose several methodological solutions.

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## 2 Assessing institutional capacities: the Adaptive Capacity Wheel

Some studies have empirically shown the importance of institutions for the capacity of social systems to adapt to climate change (e.g. Brooks et al., 2005; Grothmann et al., 2009; Tol and Yohe, 2007). There are also studies that have shown the importance of institutional factors for natural hazard management and Disaster Risk Reduction (DRR) (e.g. Carey et al., 2012; Djalante et al., 2012).

Nevertheless, there is lack of concepts and methodologies to systematically assess capacities of institutions to adapt to climate change. Furthermore, while much of the climate change literature on adaptive capacity does mention institutions, the word is used quite loosely and often refers to organisations instead of systems of rules, decision-making procedures, and programs (Gupta et al., 2010, p. 460).

The Adaptive Capacity Wheel by Gupta et al. (2010) is the only highly operationalised methodology for assessing institutional capacities to adapt to climate change, with the claim to be applicable in a wide range of institutional settings. Other frameworks for assessing institutional adaptive capacities focus on sector specific institutional settings. For example, Pahl-Wostl (2009) developed a framework for analysing resource governance systems (mainly water governance) to adapt to various stressors and changes, not only to climate change. Also Huntjens et al. (2012) developed institutional design propositions for the water sector, focusing on governance of adaptation to climate change. Hagedorn (2002) developed a conceptual framework for institutions relevant to efficient coordination between agricultural and environmental actors. Kuhlicke et al. (2011) outlined a typology of social capacities for natural hazards governance. Broader frameworks for institutional analysis, which often focus on socio-ecological systems (e.g. Folke et al., 2005; Ostrom, 2005, 2007, 2009), also claim – like Gupta et al. (2010) – to be applicable in various institutional settings, but are not focusing – like Gupta et al. (2010) – on climate change adaptation and were therefore not developed for addressing the specific challenges of climate change adaptation.

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Based on Prutsch et al. (2013) we differentiate six main challenges for adaptation to climate change: (1) *Uncertainty*: most of the scientific projections of climate change and climate change impacts are highly uncertain, particularly at local and regional levels, where many of the adaptation decisions have to be taken. (2) *Lack of knowledge*: most of the scientific projections of climate change (impacts) are long term (e.g. 2050, 2100) and at global scale, whereas most adaptation decision makers need short term and local information. (3) *Adaptation mainstreaming*: for decision makers climate change is only one process among others and they have to integrate adaptation to climate change into existing structures and processes of decision making. Furthermore, they need to integrate adaptation to climate change with adaptations to other developments like globalisation or demographic development. (4) *Policy integration*: adaptation is a highly complex issue due to the fact that climate change affects regions (e.g. mountainous, coastal), sectors (e.g. agriculture, water management), levels of decision making (e.g. local, national) and actors (e.g. government, business) differently, but it is necessary to coordinate the adaptation measures of different regions, sectors, levels and actors to avoid conflicts and make use of synergies between different adaptation measures. (5) *Equity*: the achievement of social and ecological justice presents a further challenge for adaptation and also relates to disparities in climate change impacts and adaptation needs between different regions, sectors, actors, population groups and species. Governmental decision makers often have the task to distribute the burden of impacts and adaptation measures fairly. (6) *Adaptation barriers*: the final challenge of adaptation poses the existence of multiple barriers (e.g. lack of financial resources or political will for adaptation, regulative barriers etc.) and the question how to tackle them.

All of these challenges are explicitly or implicitly addressed in the Adaptive Capacity Wheel by Gupta et al. (2010) (see Table 1). Furthermore, their framework is more operationalised and more specific regarding the criteria for assessing institutional adaptive capacities than other frameworks for assessing institutional adaptive capacities.

Gupta and her colleagues define institutional adaptive capacity as “the inherent characteristics of institutions that empower social actors to respond to short and long-term





some dimensions and criteria may be more important than others so that they “are not additive in the sense that values given to each criterion can be simply added” (ibid., p. 465).

Although the ACW has been developed to assess *institutional* adaptive capacities, its comparison with the categorisation of six general determinants of adaptive capacity in the 3rd assessment report of the IPCC (Smit and Pilifosova, 2001) (see Table 1) makes clear that it assesses not only institutional factors, but all soft social factors of adaptive capacity included in the IPCC categorisation (information and skills, institutions, equity) and also one hard social factor: economic resources. Technology and infrastructure are not assessed, but with regard to soft social factors the ACW is much more differentiated than the categorisation by the IPCC.

The comparison with the “Typology of social capacities” for dealing with natural hazards (Kuhlicke et al., 2011) (see Table 1) shows that there is a strong overlap with the ACW. Kuhlicke et al. have developed their typology also based on Gupta et al. (2010). Nevertheless, except for “Human resources” respectively “Knowledge capacities” the ACW is more differentiated than the “Typology of social capacities”.

The comparison of the framework by Gupta et al. (2010) with the typology of Kuhlicke et al. (2011) supports our argument of a lack of an important soft social factor in the ACW and also in the categorisation of Smit and Pilifosova (2001): motivational capacities (see Table 1). In the next section we describe how we extended the ACW to include such important psychological capacities.

### 3 Integrating psychological dimensions in assessments of institutional adaptive capacities

Although Gupta et al. (2010, p. 461) define “beliefs”, a psychological term, as an element of institutions they neglect their role in the ACW. This neglect is consistent with larger climate change research, which generally overlooks the role of psychological factors (Grothmann and Patt, 2005; O’Brien, 2009).

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In the following, we argue for the importance of psychological factors in assessments of institutional adaptive capacities. In order to address important psychological determinants of adaptive capacity – as yet not considered in the approach by Gupta et al. – we included “adaptation motivation” and “adaptation belief”<sup>4</sup> (based on Grothmann and Patt, 2005, Grothmann et al., 2009) in an extended version of the ACW, which now has eight dimensions (see Fig. 1).

*Adaptation motivation* refers to actors’ motivations to realise, support and/or promote adaptation to climate change. If there is a lack of adaptation motivation of decision makers in a social system its adaptive capacity is reduced because there is lack of political will for adaptation (Grothmann et al., 2009; Grothmann, 2011). The main determinant of the adaptation motivation is the perception of risks (or: risk appraisal) and/or chances of climate change and its potential impacts. The risk/chances perception expresses the perceived probability of being exposed to climate change impacts and to the appraisal of how harmful/useful these impacts would be to things that an actor values. Perceptions of climate change risks and/or chances have been shown as important determinants of adaptation in various empirical studies, at household level (e.g. Grothmann and Patt, 2005; Weber, 1997), organisational level (e.g. Berkhout, 2012) and at community level (e.g. Jones and Boyd, 2011). Therefore, Adger (2006, p. 268) concludes that “the challenges for vulnerability research are [...] to incorporate diverse methods that include perceptions of risk and vulnerability”. More comprehensively, Adger et al. (2009, p. 339) argue “that social and individual factors limit adaptation action. Factors such as perception of risk, habit, social status and age operate at individual decision-making levels but also constrain collective action. Individual adaptation hinges on whether an impact, anticipated or experienced, is perceived as a risk and whether it should (and could) be acted upon. At the policy level, adaptation policies, like many other areas of public policy, are constrained by inertia, cultures of risk denial, and other phenomena well known in policy sciences. We suggest that individual

<sup>4</sup> We use these terms instead of the psychologically more precise terms “risk/chances perception” and “controllability beliefs” to achieve wider and easier understandability.

and social characteristics, in particular risk perception, interact with underlying values to form subjective and mutable limits to adaptation that currently hinder society's ability to act."

Kuhlicke et al. (2011, p. 806) refer to this psychological factor by "Motivation to prepare for, cope with and recover from the negative impact of a hazard". Many climate change adaptation guidelines (e.g. UNDP, 2010) and some scientific authors (e.g. Moser and Ekstrom, 2010) speak of "awareness" of climate change and its impacts instead of risk perception, but basically mean the same.

But if adaptation motivation really leads to adaptation measures is decided upon a cognitive factor that is disregarded in the adaptation literature (also by Kuhlicke et al., 2011): *adaptation belief* (similar concepts are: adaptation appraisal, perceptions of self-efficacy *and* outcome-efficacy, control beliefs, perceived adaptive capacity; see Grothmann and Patt, 2005). Adaptation belief refers to an "I/we *can* successfully adapt to climate change"-conviction. Figure 2 illustrates that adaptation beliefs can be assessed either by asking actors whether they believe that they can successfully adapt to climate change (control belief) or by asking actors whether they believe that there are adaptation measures available, which are effective (outcome-efficacy belief) *and* realisable by them (self-efficacy belief).

The "objective" ability or capacity of a human actor (e.g. available financial resources, institutional entitlements) only partly determines if an adaptive response is taken. Even as important as the "objective" ability is the subjective or perceived ability of human actors (i.e. adaptation belief) because the subjective ability can be very different from the "objective" ability. People and decision makers can under- and overestimate their action scope. "Because climate change is a global problem, many individuals understandably believe that they can do nothing about it" (APA, 2010, p. 67). Adger et al. (2009, p. 344) also argue for the importance of "perceptions of self-efficacy and controllability" and that these together with perceptions of risk and other psychological factors determine what is perceived to be a limit to adaptation at both individual and social levels. There are also studies that explicitly show that low adaptation beliefs can become barriers

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to adaptation of private households (e.g. Grothmann and Patt, 2005) and communities (e.g. Jones and Boyd, 2011). Hence, there could be a systematic bias towards underestimating the capacity to adapt to climate change impacts. We are not proposing that objective aspects of adaptive capacity (see above) are insignificant determinants of adaptive capacity and adaptation. They are included in the ACW by Gupta et al. (2010) in the resources dimension. “But if agents systematically underestimate their own ability to adapt, this qualifies as a more important ‘bottleneck’ for adaptation than the objective physical, institutional or economic constraints” (Grothmann and Patt, 2005, p. 203).

In other words, it seems highly improbable that any actor or decision maker would take measures to adapt to climate change without the perception that adaptation is necessary/useful (adaptation motivation) and possible (adaptation belief). Whereas the adaptation motivation refers to an “I/we *want* to adapt”- conviction, the adaptation belief refers to an “I/we *can* adapt”-conviction. Kuhlicke et al. (2011, p. 806) refer to another potentially important psychological factor: “sense of responsibility for one’s own actions but also for those of other actors”. We refrained from including such a normative/moral “I/we *should* adapt”-conviction in our extended ACW because as yet we do not know of any empirical proof of its influence on adaptive capacity or adaptation to climate change. Nevertheless, such an inclusion might become necessary in the future, if climate change adaptation becomes a social norm and influence people’s adaptation decisions.

Adaptation motivation and adaptation belief are central factors of various psychological models explaining human behaviour in the context of natural hazards. Protection Motivation Theory (PMT; Rogers, 1983; Rogers and Prentice-Dunn, 1997) differentiates threat appraisal and coping appraisal. Threat appraisal is basically the same as risk perception, which is – besides the perception of chances of climate change – the main determinant of adaptation motivation. Coping appraisal is very similar to adaptation belief. The Person-relative-to-event (PrE) model (Mulilis and Duval, 1997) conceptualises the relation between perceived risks and the perceived opportunities to prevent harm from these risks as the main determinant of preventive behaviour.

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that it would indicate a higher probability for adaptation than just based on the original, six-dimensional ACW by Gupta et al. (2010).

4 Measuring adaptive capacities in North Western Germany – a case study in four climate sensitive sectors

We empirically tested the extended ACW within the project “nordwest2050” in the metropolitan area Bremen–Oldenburg, which is a region of North Western Germany with more than 2.3 million inhabitants. Part of the project was an analysis of capacities to adapt to potential climate change impacts (sea level rise, storm surges, river flooding, droughts etc.) in the region, focusing on four climate sensitive sectors: water management, flood/coastal protection, civil protection and spatial/regional planning. These sectors were chosen from the list of climate sensitive sectors named in the German Strategy for Adaptation to Climate Change (2008) due to their particular relevance for adaptation to climate change in Germany’s north western region.

In operationalising the extended ACW we generally followed the research protocol described by Gupta et al. (2010, 465–466). In the following, we focus on the methodological procedures we applied to assess adaptation motivation and adaptation belief.

4.1 Methods

4.1.1 Data collection

To get an understanding of the institutional adaptive capacities in the four sectors we conducted a literature review, document analyses, and half-standardised interviews.

The *literature review* included scientific studies that assessed impacts of and vulnerabilities to climate change in North Western Germany. After identifying these studies (peer-reviewed articles, reports without peer review etc.) they were systematically reviewed. Although several studies analysed potential climate change impacts in North

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*Adaptation motivation* was assessed by the following question: “Which relevance does adaptation to climate change currently have in your organisation? I am not asking for the relevance of mitigation of climate change (that is: reduction of greenhouse gas emissions) but only for the relevance of adaptation to climate change. Please rate the relevance of climate change adaptation in your organisation on the following scale [visual presentation of the scale]: no relevance, small relevance, medium relevance, high relevance. Please consider in your rating also other current challenges of your organisation, with which adaptation to climate change probably competes.”

*Adaptation belief* was assessed by interview partner ratings of the realisability of sector specific adaptation measures they regarded as necessary and effective. Therefore, in this study adaptation belief was measured by assessing self-efficacy beliefs and outcome-efficacy beliefs (see Sect. 3). More specifically, we generated indicators of adaptation beliefs in the following way. First, the interview partners read a list of potential sector specific adaptation measures that was generated from the German Strategy for Adaptation to Climate Change (2008), which names feasible adaptation measures for various climate sensitive sectors. Second, the interviewers openly discussed these measures with the interview partners to gain an understanding, which of them they see as most needed and effective for avoiding the risks and make use of the chances of climate change for their sector in the region. Third, the interview partners were asked to select three adaptation measures that are – according to their opinion – most needed and effective (indicating outcome-efficacy beliefs). Fourth, for each of these three measures they were asked, (a) which barriers to realising the adaptation measures and (b) which potential synergies with other useful measures (e.g. with mitigation measures) they perceive. Fifth and finally, – as the main indicator of adaptation belief – interview partners answered the following question for each of the three measures:

“On the background of the barriers and potential synergies you have named: How realisable you assess the measure? Please rate the realisability on the following scale:

not at all realisable, difficult to realise, realisable, easy to realise” (indicating self-efficacy beliefs<sup>5</sup>).

In addition to the questions on adaptation motivation and adaptation belief the interviews explicitly included questions regarding learning capacity and room for autonomous change. Due to the restricted time of the interviews, not all eight dimensions of the extended ACW could be explicitly addressed. Nevertheless, answers of the respondents were related also to ACW-dimensions, which were not explicitly addressed in the interview guideline, so that some interview data were also available for assessing variety, leadership, resources and fair governance. In the document analyses we could address all eight dimensions of adaptive capacity. Nevertheless, for some criteria of the ACW, due to lack of data, no assessment could be generated.

#### 4.1.2 Data analysis

The collected documents and partly transcribed interviews were analysed based on the method of *qualitative content analysis* (Mayring, 2008) taking the extended ACW as the categorization scheme. To guarantee comparability and reliability of data analysis the assessments were reviewed by another rater and discussed, if raters disagreed in order to generate a consensual assessment.

Figure 1 shows the eight dimensions and the 24 indicators of the ACW. Following Gupta et al. (2010) the inner circle symbolizes adaptive capacity as a whole, the middle circle the dimensions and the outer circle the criteria. We rated the 22 criteria of the original ACW on five level scales: very low = 1, low = 2, medium = 3, high = 4, very

<sup>5</sup> To be precise, this question addresses less a *self-efficacy* (“I can realise this adaptation measure”) than a *collective-efficacy* belief (“We/my organisation/my sector can realise this adaptation measure”). Since most adaptation measures have to be realised collectively, often cooperatively by different organisations or governmental bodies, this actor-unspecific formulation of the question appeared adequate.

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high = 5<sup>6</sup>. To gain values for the six dimensions we calculated arithmetic means of the respective criteria and rounded to whole numbers (e.g. means between 2.50 and 3.49 were rounded to 3 = medium). Raters could deviate from this procedure and give specific criteria a higher weight, if the criteria were regarded as particularly important for the adaptive capacity of a sector. Such deviations had to be explicitly justified in the sector reports.

Based on the four level scales used in the interviews, adaptation motivation and adaptation belief were rated on four level scales (very low = 1, low = 2, medium = 3, high = 4). To generate sector specific values, we calculated arithmetic means of all interview partner ratings for relevance (criterion of adaptation motivation) and realisability of adaptation (criterion of adaptation belief) and rounded to whole numbers.

The overall sectorial adaptive capacities (middle circle) were rated as low, medium or high. Before the arithmetic mean of the eight dimensions of the extended ACW could be calculated the dimension values had to be normalized (values of the six dimensions by Gupta et al. were divided by 5, the values of the two new dimensions were divided by 4) to give equal weights to all dimensions. Arithmetic means of these normalized dimension values were categorised as low (values from 0 to 0.33), medium (0.34 to 0.66) or high (0.67 to 1) sectorial adaptive capacity. Again, raters could deviate from this procedure and give specific criteria a higher weight, if the criteria were regarded as particularly important for the adaptive capacity of a sector.

### 4.1.3 Data interpretation and presentation

Following Gupta et al. (2010) the steps after data analysis were data interpretation and presentation. We prepared four sector reports that comprehensively describe the data

<sup>6</sup> We used this rating scheme in our data analyses because it was easier and more intuitive for us to use than the original scoring scheme by Gupta et al. (2010, p. 464) which uses the following scale: negative effect of institution on adaptive capacity = -2; slightly negative effect = -1; neutral or no effect = 0; slightly positive effect = 1; positive effect = 2.

and results for the 24 criteria of the extended ACW. For most criteria the data were sufficient to produce a text of at least one page, which describes the available data, their interpretation and relations to other criteria. Each criterion description concludes with a rating according to the rating scheme described in the previous section. This rating is explained by a short paragraph summing up the most important points of the text before, which justify the rating.

After all criteria descriptions for a particular dimension we state the dimension rating and justify it by a short paragraph summing up the respective criteria ratings and explaining, how the various criteria ratings are integrated to gain a dimension rating (in some cases by giving a particularly important criterion a higher weight).

Each sector report concludes with a visual presentation of a coloured ACW. Following Gupta et al. (2010) we used a traffic light system to visualise our assessments of the criteria, dimensions and the overall sectorial adaptive capacities, where green symbolises high values, yellow and orange medium values and red low values. Different from Gupta et al. (2010) we did not include any numbers in the visual presentations to avoid the impression of a high accuracy of our ratings.

## 4.2 Exemplary results

In the following, we mainly describe results for adaptation motivation and adaptation belief, because this paper focuses on our extension of the ACW by these two dimensions. The comprehensive analyses for flood/coastal protection can be found in Garrelts (2012a), for civil protection in Garrelts (2012b), for water management in Grecksch (2012, 2013) and for spatial/regional planning in Wings (2012).

We rated *adaptation motivation* as low in spatial/regional planning, medium in civil protection and water management, high in flood/coastal protection. In interpreting the levels of adaptation motivations it is important to mention that in flood/coastal protection and civil protection the interview partners stressed that there is no urgent need for adaptation to climate change because protection levels in their sectors would already be quite high. In water management there were clear indications that other topics,

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which compete with the adaptation topic for “organisational attention”, were reducing organisations’ adaptation motivation. In spatial/regional planning the adaptation motivations varied to a large extent between different regional entities within North Western Germany. Furthermore, adaptation motivation differed also between levels of government.

Interestingly, in spatial/regional planning adaptation motivation was quite low compared to many other dimensions of the ACW that were rated as medium or high. The main reason for this result probably was the frustration of the interviewed actors regarding their lack of resources, especially of their authoritative resources, to implement adaptation measures. Because they perceived a lack of resources they were not very motivated to take adaptation action. This indicates that the different dimensions of the ACW are interconnected and that the factors assessed in these dimensions can influence each other. It seems plausible to assume that the “objective” factors such as resource availability assessed in the resources dimension have a strong influence on subjective adaptation motivations and adaptation beliefs of many actors whereas the factors assessed in other dimensions of the ACW (e.g. variety, learning capacity, leadership and fair governance) probably have a much lower impact on these subjective dimensions because factors like learning capacity are much less prevalent in people’s minds than their (financial) resources.

*Adaptation belief* was assessed as low in water management, medium in spatial/regional planning, and high in flood/coastal protection and civil protection. While in the latter two sectors barriers to adaptation (e.g. lack of resources, existing conflicts) named by the interview partners in other parts of the interviews did not seem to have influenced their ratings of adaptation options’ realisability, in water management and spatial/regional planning this was seemingly the case. In general, this might be due to the fact that the region itself so far did not experience any disasters in conjunction with natural extreme events – all storm surges, for example, could be coped with. Additional possible explanations for this difference might be, that interview partners from governmental agencies – as has been described before, most interview partners had

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this organisational background – in sectors, where the state has the explicit responsibility to protect citizens from harm, feel obliged to communicate high adaptation beliefs. Perhaps, this tendency to give socially desirable answers has led to communication of higher adaptation beliefs than they actually are. Furthermore, the tendency to avoid blame might have played a role. If the interviewed actors had communicated low adaptation beliefs, they could be blamed for failing to fulfil their duties. Another explanation might be that they are afraid of causing panic reactions by showing doubts regarding the realisability of adaptation in their sectors, where there is the risk of fatal casualties if protection levels are not sufficient.

In water management the rating for adaptation belief, derived from the *subjective* assessments of adaptation options by the interviewed actors, was lower than for any other dimension of the ACW. Assuming that the six dimensions of the original ACW represent “*objective*” aspects of adaptive capacities this result can be interpreted as an indication that there is an underestimation of adaptive capacities by the actors in water management of North Western Germany.

Contrary to this result, in civil protection the rating for adaptation belief was higher than for any other dimension of the ACW. This perception is probably rooted in a special professional ethos, that is, being always able and obliged to cope with extreme events (be it by improvisation); in the long run however, this might lead to an overestimation of capacities to cope with extreme events due to climate change.

## 5 Discussion and conclusions

The results indicate an added value of including the psychological/subjective dimensions adaptation motivation and adaptation belief in an extended ACW. For example, in spatial/regional planning the quite low adaptation motivation seems to be major barrier to adaptation, eventually caused by a lack of objective resources. The apparent underestimation of adaptive capacities in water management indicated that it might be useful to raise the awareness for the many objective adaptive strengths of this sector.





in organisation). Including also questions to assess the perceptions of *future* relevance of adaptation and questions from classical risk perception surveys would minimize the danger of false positive (assessment of adaptation motivation as high) or false negative (assessments of motivation as low) ratings. Including further questions (perhaps in the form of questionnaires) seems also advisable for the assessment of adaptation beliefs, because answers of interview partners can be biased by the tendencies to give socially desirable answers and to avoid blame or panic (see results section).

The regional and organisational differences in adaptation motivations of the spatial/regional planning sector point to the importance of describing the *variance* of the adaptation motivation in addition to the *average* of motivation ratings of the interview partners because the sole communication of averages camouflages existing differences. This recommendation also applies for the other dimensions of the extended ACW.

Future studies should use five level answer scales in the interviews for assessing adaptation motivation and adaptation belief. We have used four level scales in the interviews to avoid a middle answer category, which is often chosen by respondents to avoid decisions. But in presenting our results for the extended ACW to stakeholders the two different scales (four levels for adaptation motivation and adaptation belief, five levels for the six dimensions of the original ACW) decreased understandability for stakeholders.

Whether adaptation motivation and adaptation belief should be included as additional dimensions or be included as criteria in one or more of the six dimensions of the original ACW is a question of theoretical perspective and the weight, one would like to give these dimensions in assessing institutional adaptive capacities. Adaptation motivation and also the adaptation belief can be seen as necessary “psychological resources” for adaptation so that they could also be regarded as criteria of the resources dimension. Since they relate very much to motivations and beliefs of (potential) leaders of an adaptation process they could also be regarded as criteria of the leadership dimension. If one understands them as very much driven by knowledge and learning

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**Table 1.** Comparison of Adaptive Capacity Wheel by Gupta et al. (2010) with other frameworks of adaptive or social capacities.

Gupta et al. (2010, p. 462): Dimensions and criteria of the Adaptive Capacity Wheel (ACW)			Kuhlicke et al. (2011, p. 806): Typology of social capacities		Smit and Pilifosova (2001, 895–897): Determinants of adaptive capacity <sup>a</sup>	Prutsch et al. (2013): Adaptation challenges addressed by Gupta et al. (2010)
Dimension	Criterion	Definition	Types of social capacities <sup>b</sup>	Specification/description		
1. Variety	Variety of problem frames	Room for multiple frames of references, opinions and problem definitions			No equivalent	
	Multi-actor, multi-level, multi-sector Diversity of solutions	Involvement of different actors, levels and sectors in the governance process Availability of a wide range of different policy options to tackle a problem	Institutional capacities	Consideration of a variety of problem frames, multi-actor, multi-level, multi-sector, diversity of solutions and redundancy	No equivalent	Uncertainty, lack of knowledge, adaptation mainstreaming, policy integration
	Redundancy (duplication)	Presence of overlapping measures and back-up systems; not cost-effective			No equivalent	
2. Learning capacity	Trust	Presence of institutional patterns that promote mutual respect and trust	Network capacities	Possession or development of the ability to establish and stabilise trustful relationships among and between different organisational, local and individual actors	No equivalent	Uncertainty, lack of knowledge, adaptation mainstreaming, policy integration, equity, adaptation barriers
	Single loop learning	Ability of institutional patterns to learn from past experiences and improve their routines	No equivalent		No equivalent	
	Double loop learning	Evidence of changes in assumptions underlying institutional patterns	No equivalent		No equivalent	
	Discuss doubts	Institutional openness towards uncertainties	No equivalent		No equivalent	
	Institutional	Institutional provision of monitoring and evaluation processes of policy experiences	No equivalent		No equivalent	
3. Room for autonomous change	Continuous access to information	Accessibility of data within institutional memory and early warning systems to individuals	No equivalent		Equity	Uncertainty, lack of knowledge, equity
	Act according to plan	Increasing the ability of individuals to act by providing plans and scripts for action, especially in case of disasters	No equivalent		Institutions	
	Capacity to improvise	Increasing the capacity of individuals to self-organize and innovate; foster social capital	No equivalent		Institutions	

<sup>a</sup> Smit and Pilifosova (2001) do not define or operationalize their six determinants of adaptive capacities. Therefore, the assignment of these determinants to the criteria named by Gupta et al. (2010) had to be done based on the case studies referenced by Smit and Pilifosova for the six determinants.

<sup>b</sup> "Institutional capacities" and "network capacities" are addressed in various dimensions of the ACW. Hence, they appear more than one time in the table.

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**Table 1.** Continued.

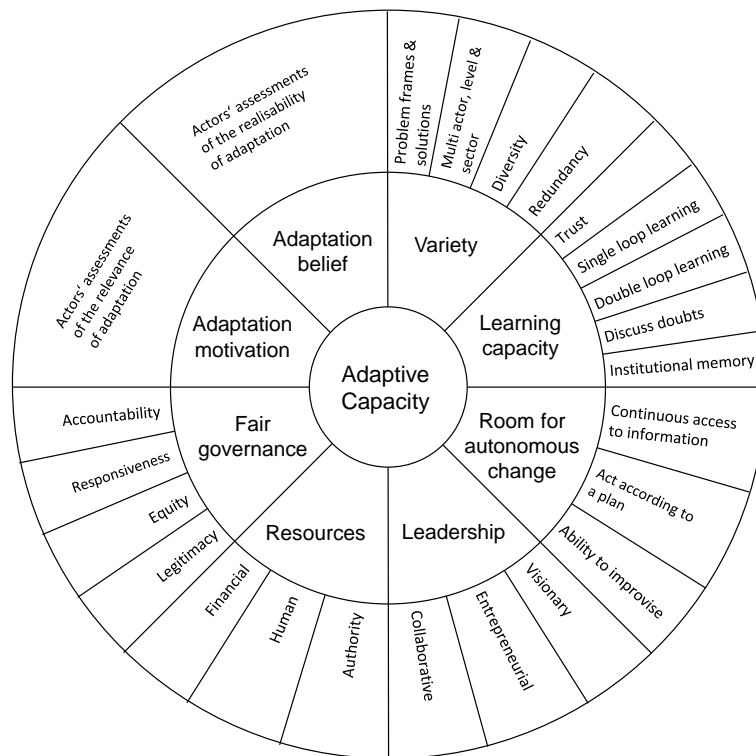
Gupta et al. (2010, p. 462): Dimensions and criteria of the Adaptive Capacity Wheel (ACW)			Kuhlicke et al. (2011, p. 806): Typology of social capacities		Smit and Pilifosova (2001)	Prutsch et al. (2013)
Dimension	Criterion	Definition	Social capacities	Specification/description		
4. Leadership	Visionary	Room for long-term visions and reformist leaders	No equivalent		No equivalent	
	Entrepreneurial	Room for leaders that stimulate actions and undertakings; leadership by example	No equivalent		No equivalent	Adaptation mainstreaming, policy integration, equity, adaptation barriers
	Collaborative	Room for leaders who encourage collaboration between different actors; adaptive co-management	Network capacities	Possession and exploitation of social capital, that is, the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance recognition <sup>c</sup>	No equivalent	
5. Resources	Authority	Provision of accepted or legitimate forms of power; whether or not institutional rules are embedded in constitutional laws	No equivalent		No equivalent	
	Human resources	Availability of expertise, knowledge and human labour	Knowledge capacities	Knowledge about the hazard and the risk; Knowledge about how to prepare for, cope with and recover from the negative impact of a hazard; Knowledge about other actors involved in the handling of hazards and disasters; Knowledge about formal institutions such as legal frameworks and specific laws; Knowledge about underlying informal values, norms and beliefs of different actors	Information and skills	Uncertainty, lack of knowledge, adaptation barriers
	Financial resources	Availability of financial resources to support policy measures and financial incentives policy measures	Economic capacities	Availability of financial resources	Economic resources	
6. Fair governance	Legitimacy	Whether there is public support for a specific institution			No equivalent	
	Equity	Whether or not institutional rules are fair	Institutional capacities	Consideration of principles of fair governance (legitimacy, equity, transparency, responsiveness and accountability)	Equity	Adaptation mainstreaming, policy integration, equity, adaptation barriers
	Responsiveness	Whether or not institutional patterns show response to society			No equivalent	
	Accountability	Whether or not institutional patterns provide accountability procedures				
No equivalent			Motivational	Motivation to prepare for, cope with and recover from the negative impact of a hazard. Building a sense of responsibility for one's own actions but also for those of other actors	No equivalent	
No equivalent			No equivalent		Technology	
No equivalent			No equivalent		Infrastructure	

<sup>b</sup> "Institutional capacities" and "network capacities" are addressed in various dimensions of the ACW. Hence, they appear more than one time in the table.

<sup>c</sup> Social capital is not identical with collaborative leadership mentioned by Gupta et al. (2010), but both factors aim at the same: network capacities.

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**Fig. 1.** Extended Adaptive Capacity Wheel – including two psychological dimensions.

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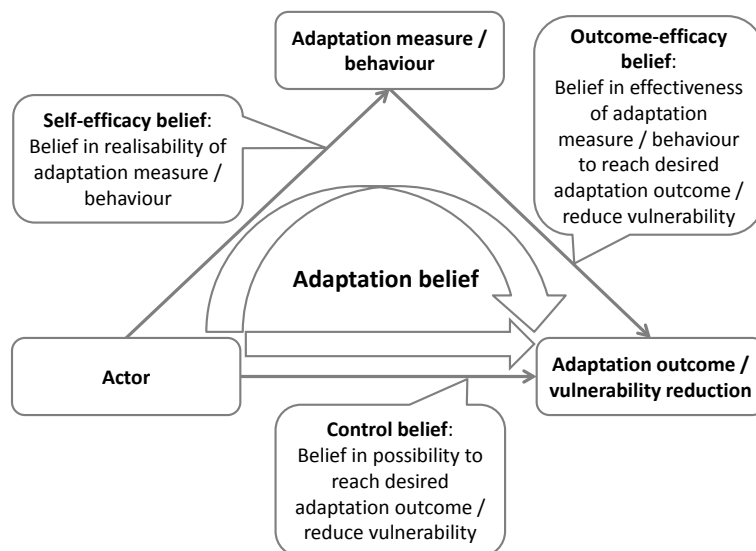
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**Fig. 2.** Illustration of the adaptation belief concept and ways to assess it (developed from Hoff and Walter, 1996).

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