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MEDIATION
Deliverable D5.2

**Report on stocktaking for the case studies:
definition of guidelines for data structure and representation; concepts for
impact and vulnerability assessment**

responsible: PIK

Markus Wrobel, Jürgen Kropp

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Content

Abstract

The MEDIATION common platform aims at efficiently supporting users in interactively identifying appropriate methods and tools for specific climate change adaptation problems, based on the MEDIATION integrated methodology. The MEDIATION case studies will be embedded into the common platform such that they can serve as initial pool of consistently structured illustrative examples of problem - method combinations.

D5.2 develops and describes a framework to guide the subsequent integration of cases into the common platform. To this end, an initial framework for the common platform is outlined, sketching core user functionality, as well as logical key components, entities and their interrelations. Based on this, the various relevant dimensions of integrating case studies into the common platform are derived and discussed.

Key elements of MEDIATION, including its integrated methodology, the toolbox, the common platform and the case studies are subject to ongoing research. Thus, rather than defining a strict and final set of integration guidelines, D5.2 provides the initial version of a living document, as the framework for case study integration will be subsequently refined and developed further in an iterative manner throughout the project's runtime.

1. Introduction

MEDIATION aims to aid European decision making in the context of the challenges posed by the fragmented knowledge required to efficiently deal with climate change impacts, vulnerabilities and adaptation. In order to do so, the project follows four main objectives (cf. DoW, 10):

a) *Defining the policy needs:* to assess the knowledge requirements associated with the ongoing impact assessment and adaptation policy developments in Europe in various decision domains, in consultation with the appropriate decision-makers and stakeholders;

b) *Reviewing, linking and improving or developing appropriate methods, tools and metrics*: to identify, consolidate, complement, apply and test available methods and tools for analysing and assessing impacts, vulnerability and adaptation options, including but not limited to costeffectiveness criteria, focusing on a selected number of case studies;

c) *Developing an overarching integrated methodology*: to integrate available knowledge from previous national and international programmes and projects into an integrated methodology (or framework) to analyse and assess impacts, vulnerability and adaptation options;

d) *Making a tool box available and disseminating the project results:* to make the methods and the knowledge available through a designated common platform, designed to last beyond the project's lifetime, flexibly incorporating new knowledge, and disseminating the project results in Europe.

The aim of deliverable 5.2 is to provide a framework enabling and guiding the iterative integration of MEDIATION's case studies into the project's common platform. This process of integration will need to consider aspects both of result representation and of data delivery.

The two central deliverables of MEDIATION are its *integrated methodology* to link decision domains with appropriate methods, and an interactive *common platform* to make assessment methods and metrics accessible (cf. DoW, 10). The main ingredients of the common platform will relate to research conducted by the project's other work packages, namely the analysis of the knowledge demand of the decision making context and a taxonomy of adaptation options (WP1), a toolbox, consisting of (i) methods and metrics for assessing impacts and vulnerabilities (WP2), as well as of (ii) methods and metrics for socio-economic evaluation of adaptation strategies (WP3), and the integrated methodology as MEDIATION's overarching framework (WP4). A key task in this context is to integrate MEDIATION's case studies into the common platform.

The MEDIATION common platform aims at, and explores ways for, efficiently supporting users in interactively identifying appropriate methods or tools for specific climate change adaptation problems, based on the problem types of the MEDIATION integrated methodology. To this end it will, among others, develop means to incorporate information from a diversity of case studies to serve as consistently structured illustrative examples of problem type - method combinations. In order to do so, the various links between case studies and other elements of the common platform need to be identified and systematized.

Note that key elements of MEDIATION, including its integrated methodology, the toolbox, the common platform, as well as the case studies themselves are subject to ongoing research. Thus, rather than defining a strict and final set of integration guidelines, deliverable 5.2 is set up to become the initial version of a **living document**. As such, it identifies a set of structuring elements and dimensions considered as crucial for the case studies' meaningful integration into a common platform. In order to be matched against both user expectations, which will become increasingly clear, e.g., through stakeholder workshops, and practical limitations and requirements, each of these structuring elements will need to be further elaborated and refined iteratively in close co-operation with the MEDIATION partners from the various work packages and case studies.

Central parts of the research undertaken in MEDIATION relate to a set of case studies, which are also meant to provide one of the projects mechanisms to crosscut and connect its work packages. The DoW states (DoW, 19):

[…] cutting across the MEDIATION Work Packages will be a set of five case studies […] Of these, four case studies address particular geographical regions within Europe, while a fifth considers prioritization within Europe as a whole. The case studies are marked by a set of common questions:

- What is the governance structure, set of legal principles, socio-economic context and group of actors across multiple scales that make decisions with respect to adaptation within the case study region? (WP1)

- What are the particular climate impacts, demanding adaptation needs within a timeframe relevant to actors, within that case study region? (WP1)

- Out of the methods and metrics for assessing climate impacts, vulnerability, and desirability of adaptation options , which are those that are valuable for the particular case study region, and which, if any, are actually counterproductive? For example, on what criteria can adaptation options be 'screened' and what are the 'conditions of applicability' of these various methods i.e. those that are limited by data, scale, skill level (WP 1, 2, 3 and 4)

- How can these methods and metrics best be communicated with and to stakeholders in the case study region? (WP5).

Note that several of the five MEDIATION case studies mentioned in the above excerpt from the DoW perform more that one (sub) case study, thus the actual number of case studies to be integrated exceeds the number of five (Table 1).

#	id	title	sector	focal region
1	NE1	Vulnerability of the elderly to climate change in the Nordic region	Human health and welfare	Northern Europe: Norway, Sweden and Finland
2	NE2	Implications of biodiversity change for conservation policy in Finland	Biodiversity, land management, nature conservation	Northern Europe: southern and central Finland
3	WE1	The Rhine-Meuse delta	water scarcity/drought, flooding	Western Europe (Rhine basin)
4	CE1	Upper Warta Case study	Agriculture; water management	Central Europe (Upper Warta region)
5	SE1	Tuscan agriculture in a climate change regime	Agriculture (Water scarcity)	Southern Europe (Tuscany region, Italy)
6	SE2	Effects of climate change (heat waves) on health and tourism in Tuscany	Health, tourism	Southern Europe (Tuscany region, Italy)
7	SE3	Guadiana Basin (Spain)	Water scarcity/drought, agriculture	Southern Europe (Guadiana basin, Spain)
8	SE4	Guadalquivir Basin (Spain)	Water scarcity/drought, agriculture	Southern Europe (Guadalquivir basin, Spain)
9	EU FLOODS	Flood risk in Europe in a changing climate	Water/flood sector/regional development	EU-wide
10	EU FOREST	Forest fires – effects of fires on European forests	Forest fires	EU-wide

Table 1 – Overview on the MEDIATION case studies

Complementary to other legitimate, more narrow approaches as followed, e.g., in CLIMSAVE, MEDIATION has intentionally chosen a broad set up in order to reflect real word diversity, allowing for different sectors, time and spatial scales. Due to this approach, MEDIATION does not use a single dimension (like sector, region, administrative or geographic unit or decision domain) as main organizing structure for project or case studies. Instead, several dimensions are combined into a pragmatic set of case studies, each with a different focus on main vulnerable sector and decision domain (cf. DoW, 22f.).

As a consequence, a certain implicit heterogeneity across MEDIATION's case studies is unavoidable, e.g., concerning the following dimensions:

- sector (e.g., health, agriculture, water management …)

- spatial reference (e.g., Europe as a whole, the Tuscany region, the Guadiana basin, …)

- spatial resolution (e.g., administrative units, grid cells, river basins, …)

Nevertheless, from the perspective of building an interactive common platform, the use of structuring elements is mandatory, and homogeneity across case studies would facilitate this task. Not least, since MEDIATION is tackling the fragmentation of knowledge in the climate change adaptation context, its common platform should lead by example and avoid unnecessary heterogeneity where possible.

Thus, from a common platform point of view it would be desirable that all MEDIATION case studies strive for as much consistency as possible concerning a set of dimensions in order to increase homogeneity and to enhance comparability. These dimensions should include the use of a common set of scenarios, of GCMs, and of time slices for projections:

- *common scenarios.* While MEDIATION is not aiming at the development of new scenarios, the project has proposed to select consistent global and regional climate and socio-economic scenarios from existing sources like MA, GEO4 and SRES (cf. DoW, 23f.). Accordingly we propose that the MEDIATION partners agree upon a common set of scenarios that should be applied throughout all of the project's case studies (e.g., the complete set or a subset of the SRES scenarios).

- *common GCMs.* Similarly, to increase consistency we propose that the MEDIATION partners decide whether all case studies should base upon a common set of GCMs, and which GCMs should be chosen.

- *common time slices for projections.* In order to further increase comparability, we propose that the MEDIATION partners agree upon a common set of time slices (e.g., 2020s, 2040s, 2060s, and 2080s) to be used for projections across the case studies.

Feedback from the cases shows, however, that practical issues (typically due to restricted availability of data and models) are likely to get into the way of this aim and will restrict options for achieving a fully homogenous picture. Thus a certain pragmatism – "*as homogenous as possible and as heterogeneous as necessary*" – seems to be most appropriate in order to avoid building up unnecessary impediments for the case studies' respective research aims.

In addition, since the common platform will be designed such that it embeds case studies as exemplarily problem-method combinations according to the integrated methodology, the pool of case studies should be extensible and not restricted by conditions that might be achievable only within a specific research project. In other words, even if a high degree of consistency concerning the above mentioned dimensions could be imposed across all MEDIATION case studies, it is likely that such strict requirements would rule out further case studies as candidates for subsequent incorporation, e.g., case studies that have been performed in other projects.

Note that the work undertaken in WP2 (cf. deliverable D2.2) will contribute to a consistent view on the MEDIATION case studies. To this end WP2 has developed a template to elicit information from each of the case studies undertaken, in order to identify appropriate categories to structure the toolbox. The categories that emerge there will also inform the subsequent design of the common platform.

The rest of this document is structured as follows. Section 2 shortly reviews current approaches towards web-enabled applications in the context of climate change adaptation, focusing on categories used to filter their respective content, and on approaches to integrate and structure the representation of case study related information. Section 3 outlines an initial framework for the common platform, identifying core user functionality, as well as logical key components, entities and their interrelations. Based on this, in section 4 the relevant dimensions of integrating case studies into the common platform are derived.

2. Context

The design of interactive applications aiming at facilitating access to knowledge for climate change adaptation has to acknowledge the fact that as yet there is no consistent standard to be built on. A recent UNDP stocktaking report confirms that mainstreaming of climate change adaptation is characterized by a variety of different approaches, as well as the absence of a common terminology across guidance documents and tools (Olhoff and Schaer, 2010).

Although research from the field of Human-Computer Interaction (HCI) suggests that consistency within and across user interfaces aids users in fulfilling interactive tasks (e.g., Nielsen, 1989; Kellogg, 1989; Chimera and Shneiderman, 1993), we can not observe common approaches for user interaction across climate change related web applications, even for fairly common tasks like utilizing interactive maps to display climate change related information. In fact, users should not expect to find consistent approaches across platforms, e.g., for selection of content to be displayed on maps and related user tasks like specifying variables, time frames, temporal aggregations, and locations. A review of the user interfaces of 30 web enabled platforms providing map-based access to climate change related information found a considerable degree of external inconsistency between user interfaces, e.g., with respect to wording, the attribution of sub tasks to user interface elements, or map interactions like zooming (Wrobel et al., 2010).

Similarly, there is currently no prevalent approach for integrating climate change information with adaptation information in interactive platforms. A recent review of 10 web enabled adaptation related platforms (Pradhan et al., 2010) found a variety of different approaches, including (i) presenting background climate change information and adaptation options together on one interactive map, (ii) embedding an adaptation platform into a larger website which provides background information on climate change in other sections of the respective site; (iii) linking to the website of a different organization, e.g., to the Climate Change Data Portal of the World Bank, and (iv) breaking the pure web based interaction paradigm by offering downloadable desktop applications like the "Climate Change Explorer".

ALM	CASES
- Location - Themes - Types - Funding Source - Keywords and text *(free text entry)* - Leading Organization	- Country - State/Province/Other - Impact Areas - Population Range - Political Jurisdictions - Adaptation Activities
WBCCKP	**WRI**
- Location *(interactive map)* - Climate change projects - keywords *(unstructured list)*[2]	- Region - Country - Scale - Settlement Type - Impacts - Objective "Targetedness" - Adaptation Strategies Employed
CCAD	
- Likely Impact on Biodiversity - Biome - Adaptation Type	
LCSD	**ADC**[3]
- Hazard - Impact - Strategy	- Extreme event - Option type - Risk management - Sector - Landscape type

Table 2 – Top level filter categories in seven web-based adaptation platforms (for acronyms used and URLs see the reference section)

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[2] accessible via an alternative entry point to the Climate Change Knowledge Portal's „knowledge base":
http://sdwebx.worldbank.org/climateportal/home.cfm?page=display_projects&type=k
[3] the compendium's overall tagging facility allows additional filtering of the options by hazard and location.

This heterogeneous picture does not change if we take a closer look at the categories offered to the user to filter adaptation related content. Table 2 lists the top level categories used as content filters in seven web-enabled adaptation platforms. It can easily be seen that no single two platforms adhere to an identical set of top level categories. This also holds true for the 2nd level categories to be selected under each top level category (see table 5 in the annex for a detailed overview).

The heterogeneity introduced through different terminology can be reduced if the top level categories are mapped against a set of semantic categories, regardless of the actual wording used. Table 3 depicts the mapping against 8 of such categories: hazard; impact; sector; location; (type of adaptation) strategy; scale; potential effect of the measure; landscape (or settlement) type. However, the resulting matrix still shows a remarkably scattered pattern for the seven platforms taken into account. It is worth noting that the 'impact' category provided in two of the platforms implicitly also defines affected sectors, so that the sector category (either explicitly or implicitly) appears to be the only filter category made available to the user across all seven platforms.

	ALM	CASES	WBCCKP	WRI	LCSD	ADC	CCAD
hazard					X	X	
impact				X	X		
sector	X	X	X			X	X
location	X	X	X	X			
strategy		X		X	X	X	X
scale		X		X			
pot. effect							X
landscape type				X		X	

Table 3 – Attributing of top level filter categories in seven web-based adaptation platforms
to semantic categories (for acronyms used and URLs see the reference section)

Case studies form a common component in many climate change adaptation related research projects. Respective information, however, is often only loosely integrated into the web-based presentation of project results. Information on cases and results are typically made available via the respective project's website and can be accessed via the website's navigation and the site's free text search facility. Requirement driven filtering can be enhanced if a consequent semantic tagging is applied. An example is the ADAM Digital Compendium (Wrobel et al., 2009) where a consistent tagging is applied over the compendium's five content sections. As a consequence, a set of learning examples (similar to case studies) can be filtered by hazard, sector or location, together with the compendium's remaining adaptation related content, including, e.g., risk maps and a catalogue of adaptation measures.

On the other hand, filter functionality is severely constrained if content on web sites is provided via PDF documents, which is also not an uncommon approach in providing scientific information on the web. Although downloadable documents clearly have their merits, research indicates that usability problems are encountered with PDF on websites, related to, among others, the linear structure of such documents leading to long text that may be tedious to read, a disturbance of the user experience due to the need to switch to a different environment, a break in the flow due to delays in response times, a shift away from the web site's navigation, as well as limited document search options (Nielsen, 2003).

Finally, we can observe that different categories are used to structure the presentation of case study related information (see Table 4 for a set of examples from different web platforms). Most of the observed examples adhere to semantic categories that in a way reflect the heterogeneity of the respective filtering categories. A different approach is followed in the UKCIP Adaptation Wizard, where a small number of cases is used as illustrative examples for the application of the adaptation related steps proposed in the wizard. Accordingly, the structure of the representation of these case studies has been organized along the proposed steps (Table 4).

LCSD	CASES	WRI

▪ Title
▪ Hazard(s)
▪ Impact(s)
▪ Strategy(s)
▪ Summary
▪ Resources required
▪ Non-climate benefits
▪ Potential maladaptation
▪ Additional information
▪ Contact information
	▪ Title
	▪ Community Contact Information
	  o Name
	  o Title
	  o Phone
	  o Website URL
	Location
	Case Study Report
	Report Data
	  o Population range
	  o Impact Areas
	  o Political Jurisdiction Category
	  o Adaptation Activities Include
		▪ Title
		▪ Last Updated
		▪ Summary
		▪ Link to Source
		▪ Region
		▪ Sector
		▪ Scale
		▪ Settlement Type
		▪ Objective
		▪ Impacts
		▪ Targetedness
		▪ Country
		▪ Adaptation Strategies Employed

ALM	ADC (1)	ADC (2)
▪ Title ▪ Project ▪ Funding Source ▪ Summary ▪ Results and Learning ▪ Sustainability ▪ Replication	▪ Title ▪ Tags ▪ Introduction ▪ Key players ▪ Factors promoting action ▪ Factors constraining action ▪ Adaptation considered ▪ Future steps	▪ Title ▪ Tags ▪ Introduction ▪ The drivers of desertification ▪ Adapting to Climate Change ▪ Current responses ▪ Challenges and opportunities ▪ Conclusions ▪ References

UKCIP Adaptation Wizard

▪ Step 1: Getting started
  o Task 1.5: What do I want to achieve by using the Wizard?
    ▪ What is our motivation for adapting to climate change?
    ▪ What is the problem we need to address?
    ▪ What do we want to achieve?
    ▪ What are the criteria against which we will judge a successful outcome?
    ▪ Who needs to be involved?
    ▪ What is the lifetime of my decision?
  o Task 1.10: What difficulties might be faced and how could they be overcome?
    ▪ Identify potential barriers. How they might be overcome? How are changes made in your organisation?
▪ Step 2: Am I vulnerable to the current climate? ´
  o Task 2.1: Why should I worry about the climate?
    ▪ Set the context for your work on climate adaptation and the Wizard. Describe how weather and climate affects you, and what is it about your particular organisation that makes climate change a concern to you.
  o Task 2.2: How have previous weather events affected the organisation?
    ▪ Demonstrate how your organisation has been affected by recent weather events by completing Table 2.2.
  o Task 2.3: What is my attitude to risk?
    ▪ State your risk attitude.
  o Task 2.4: What are the critical thresholds for the current situation
  o Task 2.5: How confident am I in this assessment?
▪ Step 3: How will […] be affected by climate change?
  o Task 3.1: How is the UK's climate expected to change?
    ▪ The UKCP09 headline messages were used in this assessment.
  o Task 3.2: What are the key climate impacts on the respondent's area of responsibility?
    ▪ Identify specific impacts, or climate risks, to your organisation by completing Table 3.2
  o Task 3.3: Are there indirect climate impacts that need to be considered? Complete in Table 3.2
  o Task 3.4: What risks do these climate impacts present? Complete in Table 3.2
  o Task 3.5: Will climate risks be more or less important than non-climate risks?
  o Task 3.6: What are the priority risks that require an adaptation response?
  o Task 3.7: What level of confidence is there in this assessment?
▪ Step 4: What should be done next?

Table 4 – Examples for structuring case study information in different adaptation related web platforms

3. Outlining an initial common platform framework

From a high level perspective, the common platform will be designed to enable users to interactively identify problem-method combinations in the context of climate change adaptation. To this end the common platform will (a) base on the typology of climate change adaptation problems (in the following short: problem types) of the integrated methodology being developed in WP4, in order to (b) identify and provide information on appropriate methods / tools / metrics, based on their inventory and classification by WP2 and WP3 (the MEDIATION toolbox).

This section first outlines - and discusses open issues of - core user functionality of the common platform in form of a basic requirements specification. Based on this, in a second step logical components and entities of the common platform are sketched. Note that since we regard it as crucial to avoid premature determination and restrictions, we consciously abstract from any detailed specification, as well as from prescribing user interface or other implementation details.

3.1 Core user functionality

As a first step we sketch a set of user tasks we consider as central for the common platform. To this end, we move along the following seven dimensions: (1) interactive specification of the user's problem context; (2) decision support; (3) accessing the toolbox; (4) accessing adaptation options; (5) accessing guidance / best practice and uncertainty information; (6) accessing multi-dimensional spatio-temporal data; and (7) accessing MEDIATION case studies as illustrative examples of problem-method-combinations.

3.1.1 Interactive problem context specification

This first dimension of user tasks relates to efficient and intuitive identification of and access to content of interest for specific user requirements. This covers the issues of enabling the user to interactively specify his problem context (/CF0110/) and of mapping respective user input against the problem types of the integrated methodology (/CF0120/). Closely related to this is an appropriate overview on the derived subset of problem types that can be used for further interaction (/CF0130/).

> **/CF0110/ User context specification.** The user should be enabled to specify his climate change adaptation related problem context via an appropriate interactive problem specification interface.

> **/CF0120/ User context – problem type mapping.** The user input obtained via /CF0110/ needs to be decomposed and mapped to identify the set of respective problem types according to the integrated methodology.

> **/CF0130/ Result representation.** The resulting set of problem types derived from /CF0120/ should be presented to the user in a way that supports orientation and enables subsequent filtering of related content.

As discussed in sec. 2, there is as yet no standard approach to design interactive access to adaptation related information. In the specific context of the common platform especially the following interrelated issues need to be addressed.

The problem typology is under research and will evolve over time (see Fig. 1 for an overview of the initial set of problem types identified in Hinkel (2010)). Thus it is as yet unclear and needs to be explored in an ongoing manner how the emerging categories of the final problem typology should best be presented in an interactive problem specification interface.

Furthermore it needs to be explored which combination of entry points and navigation paths should be provided to accommodate best for different user perspectives. Alternatives could reflect different problem perspectives (e.g., climate-related or vulnerability-related, sector-specific or cross-sectoral, problem- or solution-oriented), but also the need to enable 'short cuts', e.g., allowing for direct access to filter the toolbox or adaptation options.

Finally, appropriate interaction metaphors and a suited design of the problem specification interface need to be identified. This relates to several non-trivial tasks from the field of HCI, including the need of successfully matching the common platform's internal model with the users' respective mental models (Norman, 1988), and factors like ease of learning, user satisfaction, and minimized input errors (Shneiderman, 1998).

```
-   Single Perspective Problems
        o    Vulnerability Identification
        o    Action Situation Identification
        o    Effective Choice
-   Facilitation Problems
        o    Communication
                ▪    Awareness Raising
                ▪    Communication of Action Situation Identification
                ▪    Communication of Effective Choice
        o    Institutional design
                ▪    Institutional design
-   Collective Action Problems
        o    Collective Action Problems (narrow sense)
                ▪    Coordination
                ▪    Negotiation
-   Governance Problems
```
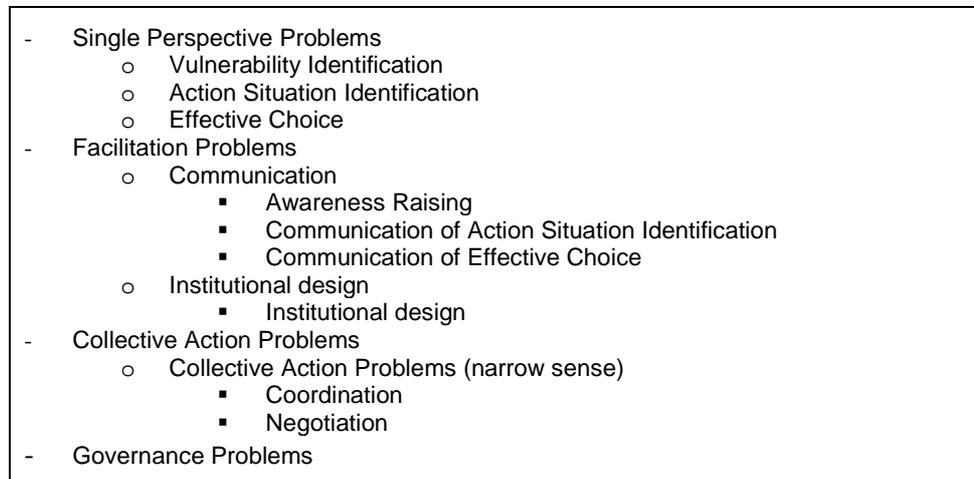
Fig. 1 – Initial typology of climate change adaptation problems as identified in Hinkel (2010)

3.1.2 Decision support

Closely related to the user tasks outlined in 3.1.1 is the need for specific decision support, e.g., with respect to support in identifying decision making methods and in identifying adaptation options. It might well be that the user tasks outlined in 3.1.1. and 3.1.2 can be merged in the final common platform, however, it requires further clarification to what extent required decision support will be provided by the emerging integrated methodology. We thus introduce decision support as a separate dimension of user functionality to underline that it deserves special attention:

/CF0210/ **Choosing between decision-making methods.** The user should be supported in identifying available decision-making methods and in choosing between them.

/CF0220/ **Choosing between adaptation measures**. The user should be supported in choosing between adaptation measures.

Providing appropriate adaptation related decision support to the user constitutes the ultimate aim of the common platform and one of its central challenges. This complex task relates to virtually every part researched within MEDIATION: decision making context (WP1), toolbox (WP2 and WP3), integrated methodology (WP4), and options to facilitate interactive access (WP5). How to best approach this aim and designing respective functionalities appropriately within an common platform requires to the take stock of the synergies between all parts, and thus will be explored and refined in an ongoing manner in close co-operation with all work packages, taking advantage of and building on respective deliverables.

3.1.3 Accessing the toolbox

The third user task dimension central to the common platform relates to the toolbox. Respective user tasks refer to the following interrelated issues: user-defined filtering, based both on problem types (/CF0310/) and on additional, toolbox specific categories (/CF0320/), the representation of resulting subsets (/CF0330/), subsequent access to further details on methods, tools and metrics (/CF0340/), access to related uncertainty information and guidance (/CF0350/), and access to externally available information (/CF0360/).

/CF0310/ Problem type based toolbox filtering. The user should be enabled to identify the respective methods, tools and metrics from the toolbox that are related to a specific problem type.

/CF0320/ Additional toolbox filtering criteria. Alternatively, the user should be enabled to filter the methods, tools and metrics documented in the toolbox by additional categories the toolbox may provide.

/CF0330/ Result representation. A filtered subset of methods, tools and metrics should be presented in a way that provides intuitive orientation on the result. The result presentation should additionally reflect the ranking based on the applied filter criteria. Where appropriate, the user should be able to change the order of the result presentation by applying alternative sorting criteria.

/CF0340/ Detail access. The user should be enabled to access the descriptive details compiled in the toolbox for a specific tool, metric or method.

/CF0350/ Uncertainty and guidance. The task of enabling access to guidance, best practices, as well as to uncertainty information related to specific methods, tools or metrics is addressed as a separate dimension of user functionality (see /CF0510/ and /CF0520/).

/CF0360/ External information. The user should be enabled to navigate directly to externally available web resources, e.g., related to a specific tool like an impact assessment model, if the required access information (URL) is documented in the toolbox.

The toolbox will consist of various layers of information, comprising tagging for identification of tools that meet specific criteria, a structured description of relevant categories for easy orientation on a tool, an abstract, links to further information, etc. This information will be partly managed in a Wiki (cf. deliverable D2.2). Regardless of the final structure of the toolbox, from a common platform perspective it is mandatory that the information collated in the toolbox is organised in a way that allows (a) for fast automated identification of selection criteria (tags) as well as of specific content sections, and (b) for a structured and homogeneous representation. This also holds true for accessing guidance and uncertainty information related to specific tools or methods. While this information is considered as part of the toolbox, it should be managed in a way that allows for consistent identification and representation via the common platform. Ways to ensure this will be identified in close co-operation between WP5, WP2 and WP3.

In addition it needs to be further explored if the different scope of methods, tools and metrics addressed in WP2 (focusing on assessment of impacts and vulnerabilities) and WP3, respectively (focusing on assessment of adaptation options) will induce differences (e.g., related to structure, filtering or representation) relevant for integrating the respective toolbox content into the common platform.

3.1.4 Filtering and representing adaptation options

Complementary to section 3.1.2, the fourth dimension of user tasks refers to the more 'basic' aspects of accessing adaptation options in the common platform. This includes filtering (/CF0410/), presenting an appropriate overview on a resulting set of options (/CF0420/), presenting details on demand for selectable options (/CF0430/), the identification of available, related uncertainty information and guidance (/CF0440/), as well as of respective assessment methods, tools and metrics in the toolbox (/CF0450/).

/CF0410/ Filtering of adaptation options. The user should be enabled to identify a set of adaptation options that match given selection criteria (e.g., related to a specific hazard and a specific sector). This should not be confused with choosing *between* available options (/CF0220/); /CF0410/ rather constitutes a prerequisite in enabling the user to do so.

/CF0420/ **Result representation.** A filtered subset of adaptation options should be presented in a way that provides intuitive orientation on the result. The result presentation should reflect a ranking based on the applied filter criteria. Where appropriate, the user should be able to change the order of the result presentation by applying alternative sorting criteria.

/CF0430/ **Detail access.** The user should be enabled to access a detailed description for each adaptation option of the result set.

/CF0440/ **Uncertainty and guidance.** The task of enabling access to guidance, best practices, as well as to uncertainty information related to adaptation measures is addressed as a separate dimension of user functionality (see /CF0510/ and /CF0520/) .

/CF0450/ **Identifying methods, tools and metrics.** The user should be enabled to filter the toolbox to identify respective methods, tools and metrics that could be used to assess specific adaptation options.

It should be noted that access to uncertainty related information and guidance, as well as identifying methods, tools and metrics for assessment of adaptation measures relate closely to the task of decision support (3.1.2). Several additional issues related to the management of and requirement driven access to adaptation measures in the context of the common platform will require further elaboration. As yet it is not fully clear whether descriptions of adaptation measures should be considered logically (and managed) as part of the toolbox, as a separate and independent adaptation database, or in a combination of both approaches. It also needs further consideration whether and how single adaptation measures will best be linked to the integrated methodology, which in turn will have consequences for potential navigation paths that can be offered to the user (3.1.1). A related issue refers to the question to what extendt the descriptions of all compiled adaptation measures should follow a rigid structure, as this will influence or constrain opportunities for user-defined filtering and sorting, as well as for a representation that is consistent across options. Different approaches to structure adaptation measures have been applied in existing web platforms that could be based on to define such a structure (see Fig. 2 for an example, taken from the adaptation catalogue of the ADAM Digital Compendium).

```
1.  Header
      -   Title
      -   Compendium tags (sector, hazard, location)
      -   Authors of the entry
2.  "What"-section
      -   Description of the option
      -   Extreme event
      -   Type of option
      -   Risk management
      -   Sector
      -   Landscape type
      -   Location
3.  "Why"-section
      -   Drivers of change
4.  "How and who"-section
      -   Implementation
      -   Institutional context
      -   Potential barriers
5.  Implications for sustainable development
6.  Resources
      -   Learning and knowledge transfer
      -   Evaluation
7.  Scientific references
```

Fig. 2 – Example of a structured representation of adaptation measures (ADAM Digital Compendium)

3.1.5 Accessing guidance, best practice, and uncertainty information

This fifth user task dimension deals with enabling the user to better assess documented methods, tools, metrics and adaptation options by providing support in identifying available guidance and best practice information (/CF0510/), as well as available uncertainty information (/CF0520/).

/CF0510/ **Accessing context related guidance and best practice information.** The user should be enabled to identify and access available guidance and best practice information related to selected content of the common platform, e.g., to methods, tools and metrics, and to adaptation options.

/CF0520/ **Accessing context related uncertainty information.** The user should be enabled to identify and access available uncertainty information related to selected content of the common platform, e.g., to methods, tools and metrics, and to adaptation options.

The crucial role of the various dimensions of uncertainty in the context of climate change and its communication has been recognized (e.g., Tol, 2003; Dessai and Hulme, 2004; IPCC 2005; Patt et al., 2005; Moss, 2007). How this complex task should best be approached within the common platform will be informed by the upcoming deliverable D4.1. Note that the semantically related field of providing access to guidance and best practices is also considered of high importance for the user.

Respective information should be organized and structured such that sections of relevance for a specific question can easily be identified and presented appropriately to the user. Providing, e.g., one large, downloadable document containing the guidance information for all tools would not be ideal since it would hamper efficient identification and selection of content of interest. As opposed to this, both appropriate structuring and tagging are required to link guidance and uncertainty information to respective content parts of the common platform. In order to do so, relations to specific content or content categories (e.g., classes of or specific problem types, processes, adaptation options, tools, methods, metrics) will need to be identified.

3.1.6 Assessing multi-dimensional spatio-temporal data

The sixth dimension of user tasks deals with aiding the user in visually assessing multi-dimensional spatio-temporal data as will be produced as part of the outcome of the case studies. While appropriate visualisation of data (e.g., Bürger and Hauser, 2007; Aigner et al., 2008) can considerably facilitate its interpretation by the user, the various dimensions (e.g., space, time, variables, scenarios, aggregations, …) of such potentially complex data sets can exceed the restricted number of dimensions easily discernable by the human eye. Since common two-dimensional visual representations limit the amount of information that can be perceived simultaneously, assessing such data intuitively requires support by appropriate and interactive visual representations. Functionality issues thus relate to:

/CF0610/ **Appropriate representations.** The user should be supported in intuitively assessing (selected) multi-dimensional spatio-temporal data in the context of the common platform. To this end the respective data should be visualised in form of appropriate interactive representations like maps and diagrams.

/CF0620/ **Interactions.** The user should be enabled to efficiently browse and select the content to be represented visually. Further, a suited set of interactions with the respective representations will need to be identified and implemented, including map zooming and panning and access to time series diagrams for user-selectable locations.

/CF0630/ **Representing uncertainty.** Where applicable the user should be supported in identifying uncertainty inherent to spatio-temporal data in the context of MEDIATION by appropriate representations.

While interactive maps have become a common feature in web enabled applications aiming at access to spatial explicit climate change related information, we can not observe a consistent approach for related UI design across platforms (sec. 2). Beside this absence of a representation standard, additional challenges related to the appropriate visualisation of uncertainty in this context. While there are

approaches available for visually representing uncertainty (e.g., Griethe and Schumann, 2005), techniques need to be identified that work best both in a web-enabled environment and for users that are non-visualisation experts.

3.1.7 Cases as exemplarily problem-method-combinations

This last section outlines core user functionality related to the integration of the MEDIATION case studies into the common platform in order to serve as exemplarily and illustrative problem-method-combinations. Central user tasks relate to the identification of cases, as well based on problem types (/CF0710/), on methods, tools or metrics (/CF0720/), on adaptation options (/CF0730/) as on additional criteria (/CF0740/). Equally important are aspects of case study representation in general (/CF0750/) and with respect to the representation of spatio-temporal results produced in the respective cases (/CF0760/). From a functional perspective the following basic requirements should be met:

> **/CF0710/ Identification of case studies by problem type.** The user should be enabled to identify case studies that deal with problems that have been related to specific problem types.

> **/CF0720/ Identification of case studies by methods, tools or metrics.** The user should be enabled to identify case studies that have applied a specific method, tool or metric as inventoried in the toolbox.

> **/CF0730/ Identification of case studies by adaptation options.** The user should be enabled to identify case studies that refer to specific adaptation options.

> **/CF0740/ Identification of case studies by additional criteria.** The user should be enabled to identify cases studies by appropriate additional criteria, e.g., sector, location, policy context, etc.

> **/CF0750/ Case study representation.** The representation of information related to case studies should facilitate the identification of relevant parts (e.g., the problem addressed, the approach taken, the results obtained), both within each case study and across case studies. This requires, e.g., a consistent representation structure.

> **/CF0760/ Spatio-temporal results**. The user should be supported in intuitive access to (selected) spatio-temporal result data that is produced in the various case studies (cf. /CF0610/).

Implications derived for data delivery from the cases and representation of the cases are further discussed and refined in section 4.

3.2 Logical key components, entities and interrelations

Based on the initial outline of user functionality we can distinguish a number of logical key components to constitute the common platform (Fig. 3). Note that the set of components considered here should be regarded as preliminary and does do not necessarily need to refer to actual information technological modules in the final implementation of the common platform. Rather, at this state of MEDIATION the components act as representatives of the core functionality (sec. 3) the common platform aims to provide.

- An interactive MEDIATOR component[4] to allow the mapping of a user's actual problem context with the content and structure provided by the common platform. This will comprise an interactive problem identification and classification facility to allow identifying specific user problems and mapping them to the problem categories as identified by the MEDIATION integrated methodology, and a problem-method-mapping facility to allow the mapping of a

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[4] Note: the label "MEDIATOR component" was chosen to point to the central aim of MEDIATION and should not be confused with the concept of mediators to integrate heterogeneous data as introduced by (Wiederhold, 1992).

specific problem category to appropriate methods, tools and metrics as identified and systematized by the toolbox. The MEDIATOR component will base on the problem types that emerge from the integrated methodology and other means for decision support that will be identified within MEDIATION;

- the MEDIATION toolbox to provide a systematic overview on available tools, methods and metrics to assess climate change related impacts and vulnerabilities as well as adaptation costs;

- an adaptation measures database to hold a structured collection of options to adapt to climate change;

- a structured collection of information on uncertainty and guidance / best practices;

- a structured collection of related background documents like policy plans (literature database);

- a spatial (meta) database to document and manage spatially explicit results generated by the case studies as well as selected additional climate change background information;
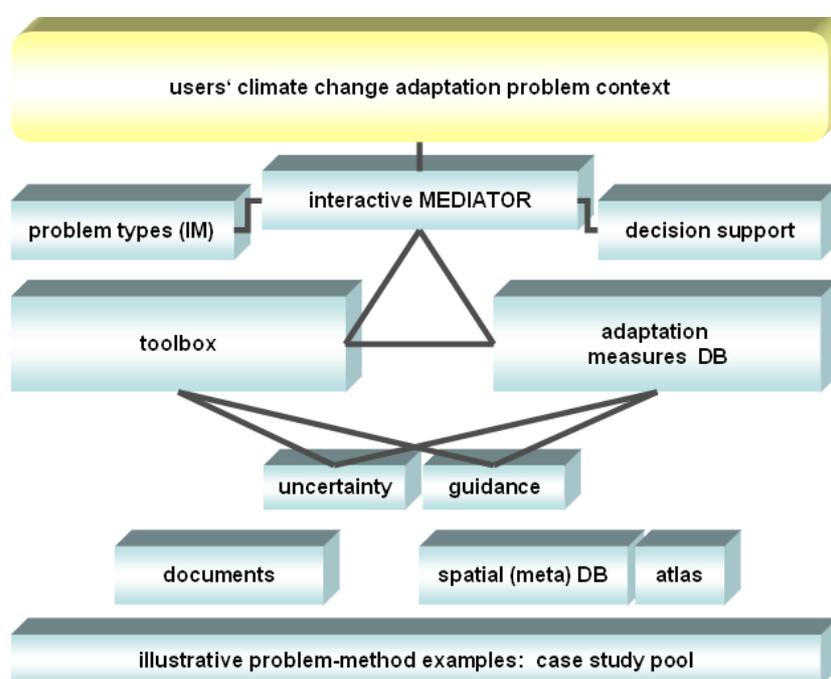

Fig. 3 – Logical key components constituting the MEDIATION common Platform

- an interactive atlas including a diagram server to allow users for comfortable access to spatio-temporal data of relevance for MEDIATION, e.g., in form of interactive maps and time series diagrams. This could also include the representation of adaptation projects in their spatial context;

- a pool of case studies to act as extensible inventory of the EU-wide and region-specific case studies performed within MEDIATION, utilizing them to serve as initial illustrations for selected problem-method combinations.

Finally we take a look at core interrelations between a set of entities considered to represent the major parts of content to be interlinked and made available via the common platform: problem type (abbrev.: PT); method / tool / metric (MTM); case study (CS); adaptation option (AO); uncertainty information (UI); guidelines / best practices (G&BP); and spatially explicit information (SEI). Each 'entity' (or 'class' in an object-oriented terminology) is understood here as a high level representation of its actual incarnations ('objects') in the future common platform; e.g., the entity 'method / tool / metric' is an abstraction of any specific method, tool or metric that will be documented in the toolbox. Similarly, entities like 'adaptation option' or 'uncertainty information' are used to abstract away all details that

might distinguish actual adaptation options or specific uncertainty related information to be provided to the user.
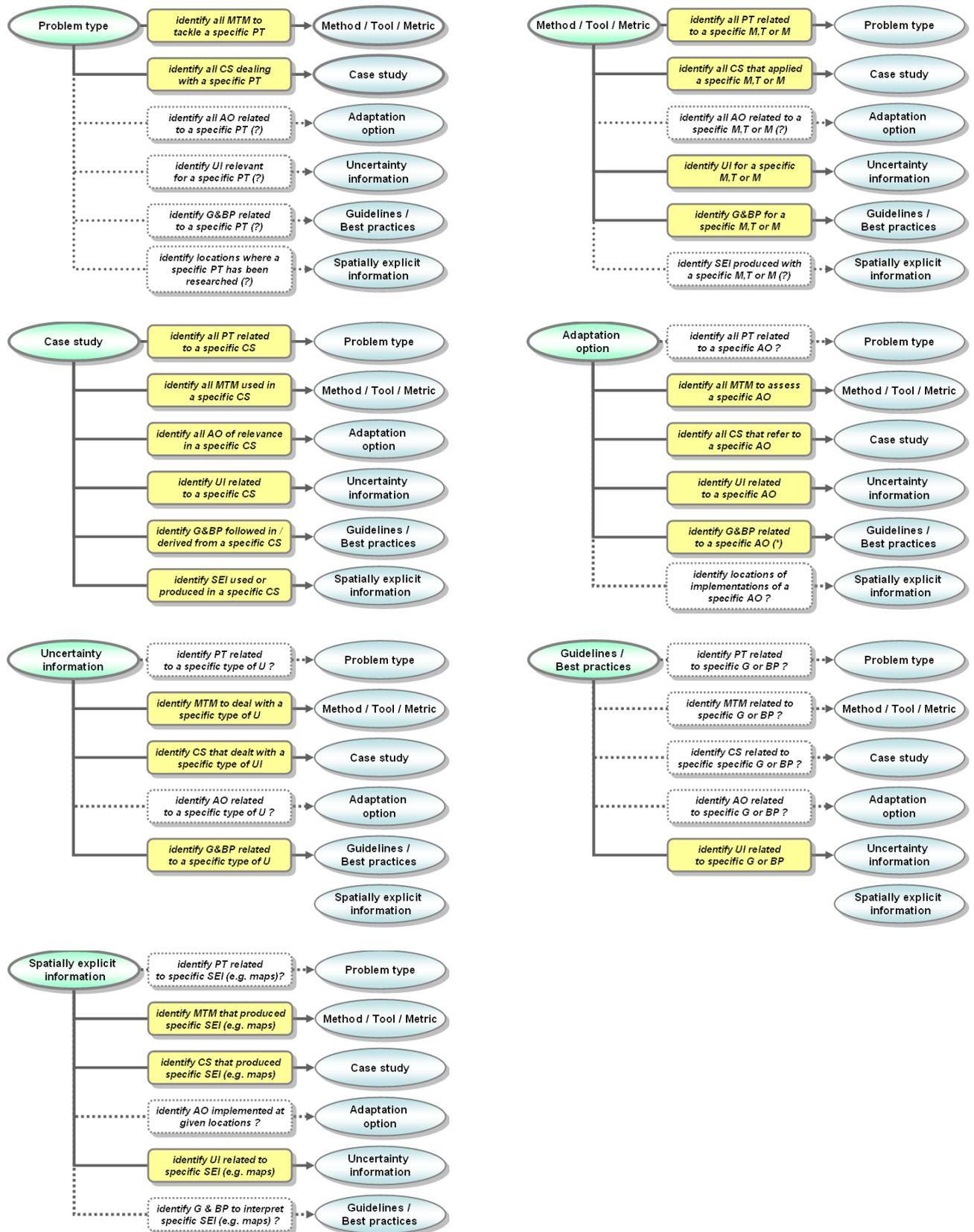

Fig. 4 – Possible interrelations between common platform content entities

Fig. 4 depicts possible interrelations between each of the seven entities and the remaining six, respectively. Solid boxes indicate interrelations that, at the time being, are considered as likely

candidates for implementation, whereas dotted boxes indicate linkage candidates that require further clarification. Note that the depicted set of entities and their interrelations is not meant to be concluded, but to be adapted or extended whenever new entities or interrelations emerge to be appropriate.

4. Dimensions of integrating case studies into the common platform

4.1 Multiple facets of case studies in the context of the common platform

The aim of MEDIATION's common platform is to aid decision making in the context of climate change impacts, vulnerability and adaptation by helping to interactively identify and assess problem categories, methods and adaptation options. It is worth recognizing that the case studies will serve multiple roles in this context. To highlight this, we distinguish in a first step conceptual aspects of content that each case study would typically provide to the common platform. From this 'high level' point of view, the following four aspects can be identified (Fig. 5):

Fig. 5 – High level view on case study related information to be made available via the common platform

4.1.1 Context-related (specific view)

First, each case study performs assessments of observable or projected impacts of climate change on one or more specific sectors in a specific region, the degree of vulnerability, and available options to successfully adapt. In the context of the overall MEDIATION structure, the decision domain dimension is addressed by WP1. A first pillar of relevant information to be integrated into the common platform refers to the description of each case study's specific context and the motivation behind the research performed.

4.1.2 Approach-related (generic view)

Second, each case study constitutes a sample solution to approach a state-of-the-art assessment referring to a specific type of a climate change related decision problem. Thus, a second – and crucial – source of information to be integrated appropriately into the common platform for each of the case studies refers to an explicit description of the design of the approach undertaken (including methods, models, metrics and input data), as well as to information on its transferability (and known impediments). In the context of the overall MEDIATION structure, this perspective is addressed by WP2, WP3 and WP4. This approach-related view understands each case study as illustrative example of one or more problem-method combinations and will need to make the links of each case study to the problem types defined by the integrated methodology and to the methods, tools and metrics as documented in the toolbox explicit.

4.1.3 Result and (output) data related

Third, each case study will produce results for the specific problem addressed. The third source of case study content to be integrated into the common platform thus relates to textual descriptions of the results obtained, as well as to data that has been generated as part of the results. A case study will typically not only base on existing data sources, but will apply the MEDIATION toolbox (or more specifically: methods, tools and metrics that are documented and systematised there) to produce new output data that has not been available before and thus is of a value of its own. Spatially explicit output data of common interest should be integrable into the common platform in order to add to a centrally accessible pool of MEDIATION's spatial information that can be made available using interactive mapping facilities (3.1.6).

4.1.4 Adaptation options related

Fourthly, a case study will identify and assess a set of adaptation options for its given problem context. Related information should be provided in a standardized, structured and explicit manner allowing to facilitate its identification and comparison across case studies and other content of the common platform.
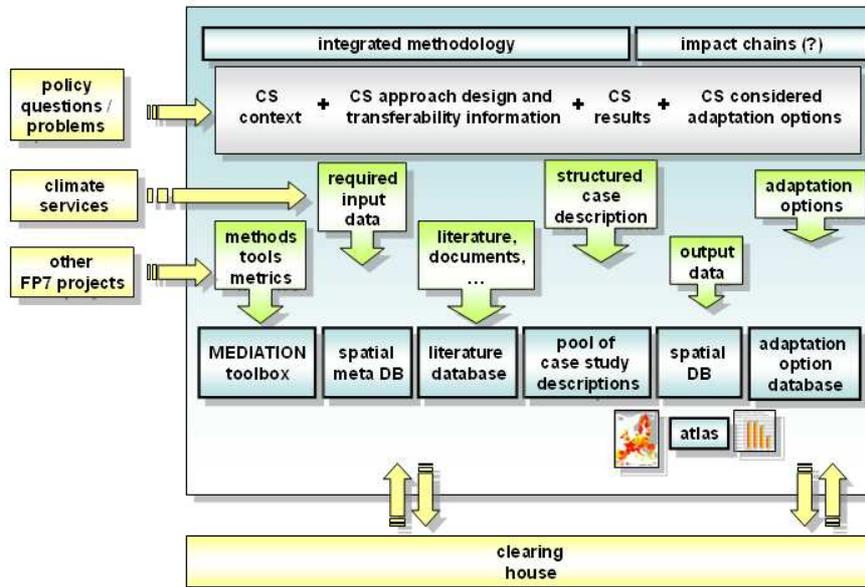

Fig. 6 – Relating case studies to functional components of the common platform. In addition, potential links to the outside world are depicted.

Subsequently we consider logical key components of the common platform (sec. 3) and explore the relation of case studies to these components (Fig. 6). Note that Fig. 6 does not depict all possible interconnections; rather the diagram focuses on a schematic representation of exemplary relations between case studies and other platform components.

4.2 Integration based on the integrated methodology

The iterative development of an overarching integrated methodology (WP4) is one of MEDIATION's core objectives. The integrated methodology is aiming to emerge a typology of problem categories, allowing to effectively organize knowledge related to climate change impacts, vulnerabilities and adaptation. The results of this research will also provide the key approach in structuring and integrating content of the common platform and to design user navigation. Consequently the categories emerged by the integrated methodology will also be central for the integration of the case studies into the common platform.

All cases will need to be tied explicitly and in a coherent way to the categories that will emerge, such that a user of the common platform will be enabled to, e.g., easily identify case studies relating to a specific problem type (cf. /CF0710/, identification of case studies by problem type). The emerging problem types will also play a central role in deriving a common structure to consistently represent cases in the common platform (4.6).

Note that timing and co-ordination between the development of the integrated methodology and the development of the common platform are of critical importance. Since categories and structure resulting from the integrated methodology will influence the integration of the case studies, it is crucial that the main structuring elements can be identified in an early enough phase of the project's runtime in order to leave sufficient time (a) to allow the case studies to develop and deliver according representations, and (b) to integrate them into the common platform in an respective manner. Since the integrated methodology will define its categories throughout the project runtime in an iterative fashion, the definition of guidelines on how to use these categories to integrate the case studies into the

common platform can start only after the first iteration in the development of the integrated methodology has been completed.

4.3 Consistent description of approach design and transferability

We propose that each case study should provide an explicit, well-structured and consistent representation of the design of the approach that has been undertaken (including methods, tools, metrics and input data), as well as information on its transferability and limitations, respectively. Additionally, information on uncertainties related to the approach should be provided.

A suited representation of this information within the common platform will contribute to MEDIATION's aim of efficiently providing information on methods, models and tools. Furthermore it is likely that comparable steps will need to be performed across case studies, e.g., downscaling of GCM data or spatial (dis)aggregation to integrate heterogeneous data sources. An explicit workflow description could exhibit such common steps and provide a basis for identifying 'best practices' or alternative approaches; these information could then be made available systematically through the common platform.

As a next step, we propose that the MEDIATION partners should discuss options (as well as impediments) on how the case studies' approach design, together with information on uncertainty and transferability, should best be represented in the common platform (e.g., using flowcharts that are linked directly to information on toolbox resources). In this context it also will need to be identified whether the task of deriving consistent approach representations should be best coordinated by WP4 (integrated methodology), by the toolbox related work packages (WP2 and WP3), or in a combined approach. In a subsequent step respective guidelines can be derived to ensure consistency across cases. Note that dealing with uncertainty is specifically addressed in deliverable D4.1 which will further inform an appropriate design of the common platform with respect to this issue.

4.4 Integration based on systematic cause-effect relations: impact chains

A standardized approach to present climate change related information in a structured manner in the context of adaptation platforms can not be observed (Pradhan et al., 2010). The web-based ci:grasp platform, currently jointly developed by PIK and GTZ to provide access to adaptation information and related climate change context, utilizes the concept of impact chains to structure its overall content (Kropp et al., in prep.). Impact chains can be regarded as a kind of formalisation depicting how a certain stimulus propagates through a sector or a region, thus allowing to systematically relate, e.g., climate drivers, impacts, and adaptation options. Graphical representations of impact chains can be used to represent this context and can provide an intuitive means to navigate and select related content (see Fig. 7 for an example).
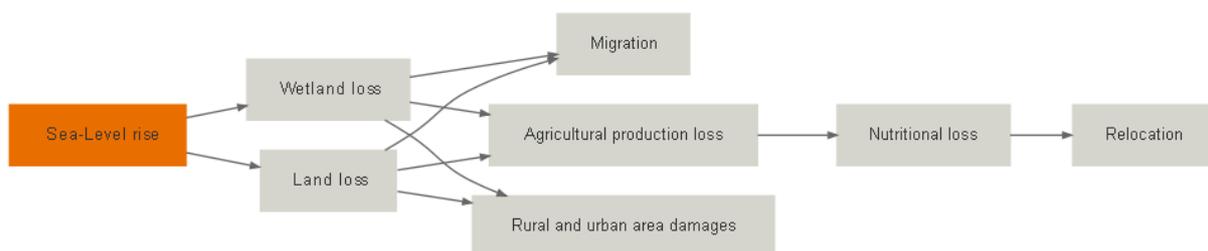

Fig. 7 – Example impact chain for sea level rise (from the ci:grasp platform)

The MEDIATION partners should collaboratively decide whether impact chains should, in addition to the categories provided by the integrated methodology, be applied as an orthogonal layer to relate and navigate the content of MEDIATION's common platform. Note that deriving and applying impact chains as a structuring element would not only relate to the case studies, but also to other content, e.g., spatial data and adaptation options. In addition it needs to be explored how impact chains could best fit into the final concept of the common platform, e.g., as part of the integrated methodology or reflected in additional toolbox categories. Thus, as a next step we propose that the case study leaders should suggest respective impact chains for each of the case studies. Feedback that will be available for the

ci:grasp platform can provide additional hints on potential benefits (or limits) of the concept of impact chains for the aim of the common platform.

4.5 Toolbox and toolbox meta data

MEDIATION will compile a toolbox of methods and metrics (a) for assessing impacts and vulnerability (WP2), and (b) for socio-economic evaluation of adaptation strategies including cost-effectiveness (WP3). Making this toolbox available is a central aim of the common platform, and a structured and standardized description of all toolbox resources - resulting in a kind of toolbox meta database - is a prerequisite to allow user-driven identification of specific resources.

In order to enable requirement driven filtering, all methods, models and metrics applied in the case studies need to be documented based on appropriate toolbox meta data (or "tags"). Additionally, in order to provide the necessary links between toolbox and case studies in the common platform, the case studies need to provide in a standardized way the information required to programmatically identify all toolbox resources applied in a specific case study, as well as all case studies that have made use of a specific toolbox resource.

The required set of appropriate toolbox meta data attributes / tags will be identified and refined in collaboration with and based on the work of WP2 and WP3. It will draw upon the deliverables D2.1 (January 2011), D3.1 (July 2012), D3.2 (January 2011) and D3.3 (January 2012).

4.6 Ensuring a common structure for the descriptive (textual) parts of the case studies

User orientation and readability can be significantly enhanced if the descriptive parts of the case studies to be made available through the common platform adhere as far as possible to a common structure. In addition, the outline of core user functionality (sec. 3) and interrelations between entities (Fig. 4) clearly indicates the requirement to efficiently relate specific elements of each case study description to various other parts of the common platform (e.g., problem types, toolbox, adaptation option database), and vice versa. We thus propose to represent each case study in the common platform using a common structure along each of the problem types tackled. In order to do so, each case study description should explicitly be decomposed along the problem types addressed, following a consistent structure to describe the handling of each problem type (Fig. 8).
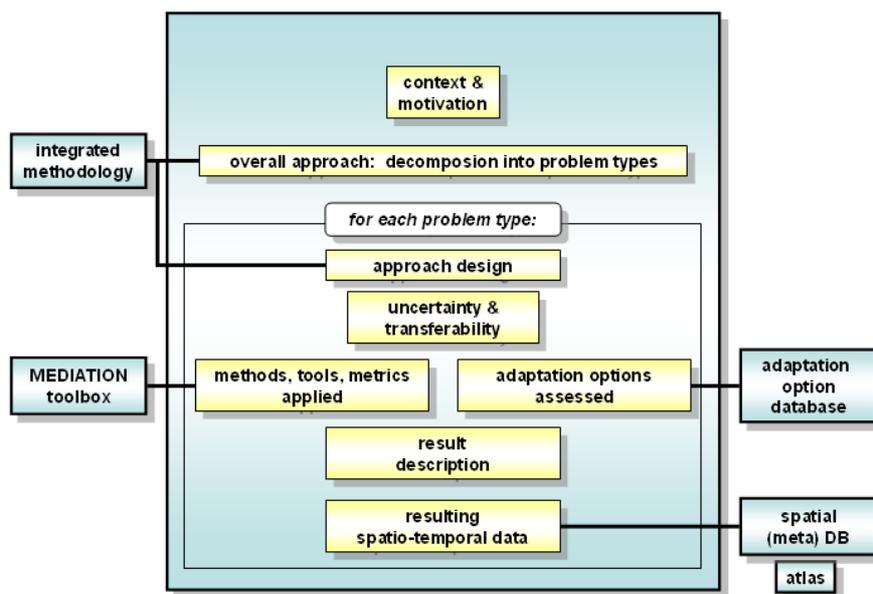

Fig. 8 – Initial structure for consistent representation of case studies in the common platform. Links to other key components are indicated

We propose to base on the structure depicted in Fig. 8 as a starting point to identify a suited representation structure for the case studies. In addition, the familiar structure of scientific papers with

sections like introduction, related work, approach, results and discussion can be considered for refinement of this structure. The initial structure needs to be adapted jointly together with the case studies leaders and should especially take into account the results and requirements that will emerge from the development of the integrated methodology.

4.7 Literature database

References to documents relevant to the aim of MEDIATION, e.g., documents on institutional context and scientific literature, will be made available via the common platform in form of a structured and searchable collection. References to all documents of relevance for a case study (background knowledge, scientific papers etc.) should thus be described in a standardized fashion allowing to integrate them into a central collection. Additional information should be provided allowing to identify those reference entries relating to a specific case study, as well as all case studies that refer to a specific document.

```
@article{lin1973,
    author  = {Shen Lin and Brian W. Kernighan},
    title   = {An Effective Heuristic Algorithm for the Travelling-Salesman
Problem},
    journal = {Operations Research},
    volume  = {21},
    year    = {1973},
    pages   = {498--516},
  }
```

Fig. 9 – Simple BibTeX example (taken from http://de.wikipedia.org/wiki/BibTeX)

To ensure a consistent documentation of references, we propose that all MEDIATION partners should adhere to an open standard like BibTex (see Fig. 9 for an example) to provide their references. However, it needs to be clarified to what degree online access to documents can and should be made available, or if it is more appropriate, e.g., due to practical or legal reasons, to restrict user access to references only. In this context, it will also be discussed if the additional burden imposed by the need to provide consistent reference formats to be stored in a central repository might conflict with any pragmatic issues.

4.8 Spatial meta database

In order to provide integrated access to information on spatial data relevant to MEDIATION, spatial data used or generated in the context of MEDIATION should be documented in a standardized fashion using a spatial meta database. This approach allows to centrally manage information on relevant spatial data sources without the need to physically integrate the data itself (see also deliverable D5.1). The spatial meta database will be made accessible via the common platform and will be linked to the spatial database that will provide access to those subset of spatial data that will be managed centrally.

As a consequence, (a) spatial input data used by the case studies, as well as (b) spatial data produced within the case studies should be documented using consistent spatial meta. Further, for each case study additional information is required to (c) link a case study to respective entries in the spatial meta database, and to (d) identify those case studies that have used or produced specific spatial data documented in the spatial meta database.

In order to be compliant with the ongoing initiative to establish a consistent infrastructure for spatial information in Europe, we aim to base on a set of respective meta data attributes adhering to the requirements of the Infrastructure for Spatial Information in the European Community (INSPIRE)[5]. The Commission Regulation (EC) No 1205/2008 of 3 December 2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata[6] provides the definition

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[5] http://inspire.jrc.ec.europa.eu/

[6] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1205:EN:NOT

of such a set of meta data, which we consider to be both sufficiently detailed to be adequate for MEDIATION's purposes, and small enough to allow for pragmatic handling. Issues that need further clarification relate, among others, to the question whether input data as required for specific tools (models) should be considered as 'tool' as well and thus be documented within the toolbox, and to the need to identify a both sufficient and pragmatic degree of granularity with respect to the datasets to be documented.

4.9 Spatial database (1) - interactive mapping

It is envisaged that the common platform will enable access to selected spatially explicit data based on a web-based interactive MEDIATION atlas (cf. 3.1.6 and deliverable D5.1). Information technological improvements related to concepts like Ajax (Garret, 2005) have changed web-based mapping considerably during the last years (Haklay et al., 2008). Although additional usability challenges are to be considered (e.g., Newman et al., 2010; Haklay and Zafiri, 2008), benefits of interactive mapping are obvious: as compared to static maps, the user can view spatial explicit results in greater degrees of freedom, e.g., concerning spatial extent and level of detail. Candidates of spatio-temporal data to be made available in such a fashion via the common platform include a selection of available climate, vulnerability or risk maps, as well as spatially explicit data that will be generated within the case studies.

In order to allow their spatio-temporal output data to be integrated into an interactive MEDIATION atlas, case studies will need to provide this data using appropriate standard formats, e.g., raster or shape, together with a small set of required meta data and setup information (e.g., to define a colour mapping to be applied). PIK is currently developing a first prototype of the interactive atlas and will develop and provide a short document with respective guidelines according required formats and setup information. Alternatively, MEDIATION partners might opt to provide own Web Map Services[7], allowing to keep case study result data at different locations. Integrated access to these distributed data by the interactive atlas can be enabled on-the-fly, using a central web client to select and display maps from distributed servers. If this approach is to be taken, a basic set of common rules for the Web Map Services (e.g., concerning a common map projection) needs to be agreed upon.

4.10 Spatial database (2) - downloadable data

In addition to result representation using interactive mapping, direct access to downloadable result data from the case studies could become an additional feature of the common platform.

As a next step, the MEDIATION partners need to decide whether data resulting from research undertaken in the case studies (e.g., model output) should be centrally made available for download via the common platform. If this kind of data access is to be provided, the MEDIATION partners will need additionally to agree upon access strategies (free vs. restricted to specific users or groups of users; in the case of free access: registration required vs. without registration), and a common data format for the downloadable data (e.g., NetCDF) in order to enhance homogeneity. The case studies would need to provide data for download in this respective format, either to be integrated into a central data pool, or deliver it in a web-accessible manner such that it can be linked with the common platform. Additionally, to facilitate central orientation, all data made available for download need to be described using according meta data.

4.11 Additional result representations

In addition to textual descriptions, downloadable data and interactive mapping, it can be foreseen that the case studies will provide various other result representations, e.g., static maps, diagrams or tables that need to be made available via the common platform.

In the case of multi-dimensional spatio-temporal data, it can be most appropriate to produce time series diagrams on the fly using a diagram generator in combination with the interactive atlas. Such

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[7] http://www.opengeospatial.org/standards/wms

dynamic approaches especially come into question if the parameter variations to be supported (space, time, scenario, variable, etc.) result in a large number of possible combinations that would rule out producing all required diagrams in advance.

With respect to various other types of result representations that can be imagined, we would argue at the time being that details concerning the design of such representations should be left to the case studies in order to preserve the desirable degree of freedom in generating these representations. Nevertheless, to enhance consistency across representations, which clearly is desirable, it should proof valuable to agree upon a minimal set of rules concerning aspects used across case studies, e.g., common map projections for static maps, or consistent colour scales to map variables like temperature or precipitation.

4.12 Linking with MEDIATION's adaptation measures database

Adaptation measures compiled in the context of MEDIATION will be made available as a structured and searchable collection of information, and flexible access to such a central database of adaptation measures will form another important functional component of the common platform (3.1.4). Since case studies will typically identify and assess a set of adaptation measures, these should be effectively linked with MEDIATION's collection of adaptation measures.

Thus, all adaptation measures considered by a case study should be documented in the common platform's database of adaptation options in a consistent manner. Further, the case studies should provide all necessary information required to allow to (a) link a case study to respective options in the database, and (b) to identify case studies that have considered a specific adaptation option. As well, it should be possible to link to the toolbox such that respective methods used to assess the adaptation measures can be identified for further information.

The structured description of adaptation measures will be addressed in cooperation between WP5 and WP1 and WP4. The linking of the case studies to MEDIATION's database of adaptation measures will draw upon deliverable D5.3 – report on construction and definition of an adaptation database in terms of characteristic attributes and problem categories (January 2012). In addition, options for synergies with the upcoming Adaptation Clearinghouse for Europe (ACE), which will also develop a database of adaptation measures, will be explored.

4.13 Ensuring a common level of language and readability

A final dimension that should be noted here relates to the requirement to achieve a consistent level of language quality concerning the descriptive parts of the case studies. To enhance usability it is desirable that all textual descriptions made available through the common platform adhere to a appropriate level of comprehensibility and readability.

An option that has been discussed in this context is hiring a scientific journalist to take care of the text quality and comprehensibility. In addition, a (MEDIATION-internal) review process should be timely established to ensure that all textual descriptions generated by the cases meet the required level of quality and readability.

5. Summary and outlook

Being one of MEDIATION's key deliverables, the common platform aims at supporting users in interactively identifying appropriate methods or tools for climate change adaptation problems based on the MEDIATION integrated methodology. The aim of this document was to develop a framework that will subsequently enable and guide the iterative integration of the case studies performed within MEDIATION into the common platform.

In the context of the common platform the case studies will serve as consistently structured illustrations (or examples) of specific combinations of problem types and respective methods and tools. To enable this kind of integration it is mandatory that the various links between the case studies and other key elements of the common platform are identified and systematized.

We started with a short review of the state of art in designing applications for web-enabled access to information related to climate change adaptation. It can be concluded that this important and evolving field is currently characterized by a clearly observable lack of standardization across applications, e.g., with respect to wording and categories used for content filtering, or to the approaches followed to integrate and structure case study related information.

In a next step, we outlined an initial framework for the common platform. To this end, core user functionality has been identified, and central components, key entities and their interrelations have been sketched. Against this, we finally derived a set of dimensions we consider as crucial for efficiently integrating case studies into the common platform, and shortly outlined open issues and foreseen next steps to proceed for each of this dimensions.

While the foundation for working towards the integration of case studies into the common platform has been laid, there is a lot of remaining work to be done. In addition to proceeding along the dimensions outlined in sec. 4, the following complementary, orthogonal steps will be followed in the next phase:

Work with pilot cases: for subsequent progress we will base on a small number of MEDIATION case studies as pilots. This will allow to drill down along several lines of interest for integration and to identify alternatives, impediments and commonalities both in more detail and on a less theoretical level. As well, this approach will help to obtain the first candidates of spatial explicit input and (preliminary) output data that can be used to test and refine the functionality of the interactive atlas that is being designed as part of the common platform. Candidates for pilot cases are, e.g., the EU-wide forest fire case and the Tuscany cases.

Implement functional component prototypes: several key components of the common platform as identified in section 3 are going to be implemented as functional prototypes. This will not only allow to learn more about the specific requirements for each of these key components, but also to obtain feedback on initial design and functionality. Since the case studies are related to various tasks researched within MEDIATION, these prototypes will also help to progress with the integration of the case studies into the common platform. In addition, such prototypical implementations can enable the case studies to use and test preliminary versions of parts of the common platform for communication with their respective stakeholders and thus lead to additional insights both for cases study and common platform design. Currently identified candidates for key components to be implemented prototypically include the toolbox, the interactive atlas, a spatial meta data database and a database of adaptation measures.

Support flexible tagging: discussions with partners from the MEDIATION consortium showed that flexible tagging (i.e. attaching keywords to content entities to denote them semantically) is perceived as more appropriate and convenient for describing content systematically than basing on a more rigid structure of relational attributes that might be cumbersome to extend. We will thus explore options for providing a mechanism supporting flexible tagging (e.g., via graph database approaches) for the prototypical implementations of key components for the common platform, e.g., the toolbox. We assume that such a mechanism can support and facilitate identification and implementation of semantic categories by the consortium, which the common platform can subsequently exploit to integrate, structure and link its content – including information related to case studies – efficiently.

Identify options for synergies with ACE: Not least, the commission's decision to establish an Adaptation Clearinghouse for Europe (ACE) offers important potential for mutual linkages and synergies between common platform and ACE. The common platform could become one of the tools that the ACE will link to, and on the other hand it could make use of or link to information that will be compiled and homogenised in the ACE. The options for such synergies between the two ongoing approaches still deserve further clarification and elaboration and will be discussed in greater detail during the upcoming Budapest meeting in March 2011.

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Web applications

ADC : ADAM Digital Compendium - Adaptation Catalogue.
        http://adam-digital-compendium.pik-potsdam.de/adaptation-catalogue/

ALM: Adaptation Learning Mechanism Global Knowledge Sharing Platform.
        http://www.adaptationlearning.net/

CASES: Climate Impacts Group: CASES Database and Adaptation Library.
        http://cses.washington.edu/cig/cases/search

CCAD: Climate Change Adaptation Database: Integrating Biodiversity into Climate Change Adaptation Planning.
        http://adaptation.cbd.int/options.shtml#sec1

LCSD: United Nations Framework Convention on Climate Change: Local Coping Strategies Database.
        http://maindb.unfccc.int/public/adaptation/

UKCIP: The UKCIP Adaptation Wizard V 3.0. UKCIP, Oxford.
        http://www.ukcip.org.uk/wizard

WBCCKP: The World Bank Climate Change Knowledge Portal.
        http://sdwebx.worldbank.org/climateportal/home.cfm?page=globlemap

WRI: World Resources Institute: Vulnerability & Adaptation Database.
        http://projects.wri.org/adaptation-database

Appendix

ALM Global Knowledge Sharing Platform		
Location - region or country *(via interactive map)*	Themes - Agricultural / Food - Infrastructure - Education - Coastal Zone Management - Disaster Risk Management - Natural Resource Management - Public Health - Water Resources	Types - Assessment - Climate Data - Development Programming - Case Study - Guidance and Tools - Policy Documents and Strategy - Programs - Project or Initiative - Research and Publications - Teaching and Training Material - Workshop Materials
Funding Source - *predefined list* *(details omitted here)*	Keywords and text - *free text entry*	Leading Organization - *free text entry*

CASES Database and Adaptation Library		
Country - US - Canada - Mexico	State/Province/Other - list	Impact Areas: - Agriculture - Biodiversity - Coasts - Emergency Management - Fisheries - Flooding - Forests - Infrastructure - Public health - Recreation/tourism - Water supply/drought
Population Range: - 1 - 10.000 - 50.000 - 100.000 - 500.000 - 1 million - 5 million	Political Jurisdictions: - County/Local - State/Provincial - Tribal/First Nation - Federal	Adaptation Activities: - Creating an adaptation team - Developing an adaptation plan/strategy - Drafting legislation - Implementing components of adaptation plan/strategy - Modeling/impacts scenario development - Public education and outreach activities - Developing new or enhancing existing community partnerships related to adaptation planning

The World Bank Climate Change Knowledge Portal		
location - *(interactive map)*	„climate change projects" - Agriculture - Education - Energy/mining - Finance - Industry - Administration - Transportation - Water	keywords[8] *(long list of alphabetically sorted, not further structured tags, ranging from* - *adaptation to climate change* - *adaptive management* *to* - *water use efficiency* - *wood tracking)*

World Resources Institute: Vulnerability & Adaptation Database			
Region - *(predefined list)*	Country - *(predefined list)*	Scale - Community - Subnational - National - Multinational	Settlement Type - Rural - Urban - Rural and Urban
Impacts - Biodiversity Loss - Coastal Inundation and Flooding - Crop Yield Decrease - Damage to Human Settlements	Objective - "Serendipitous" Adaptation - Climate-Proofing of Ongoing Development Efforts - Discrete Adaptation	"Targetedness" - Addressing the Drivers of Vulnerability - Building Response Capacity - Managing Climate	Adaptation Strategies Employed - Changing Natural Resource Management Practices - Building Institutions - Launching Planning Processes - Raising Awareness - Promoting Technology Change

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[8] accessible via an alternative entry point to the Climate Change Knowledge Portal's „knowledge base":
http://sdwebx.worldbank.org/climateportal/home.cfm?page=display_projects&type=k

		Risk - Confronting Climate Change	- Establishing Monitoring/Early Warning Systems. - Changing Agricultural Practices - Empowering People - Promoting Policy Change - Improving Infrastructure - Providing Insurance Mechanisms - Other Strategies
- Decline in Fishery Productivity - Decline in Productivity of Livestock-Poultry - Drought and Aridity - Flooding - Glacial Lake Outburst Floods - Land Degradation - Landslides - Spread of Vector-Borne Diseases - Water Shortages - Other			

UNFCCC Local Coping Strategies Database

Hazard	Impact	Strategy
- Shift of season - Drought/ aridity - Erratic rainfall - Floods - Sea-level rise - Storms - Extreme heat - Extreme cold - Vector-borne diseases	- Damage to forests - Decreased food security - Decreased functionality of human settlements - Landslides - Loss of crops - Water shortage - Land degradation - Soil erosion - Loss of livelihoods - Low survival/ productivity of livestock - Low survival/ productivity of poultry - Low productivity of fisheries - Loss of land - Waterlogging - Coastal inundation/erosion - Damage to human settlements - Urban heat islands - Increased disease incidences	- Dissemination of knowledge, education - Improved farm-level infrastructure design - Vector control - Appropriate crop selection - Alternative cultivation methods - Post-harvest management - Pest control - Rainwater harvesting - Sustainable water management - Soil conservation - Natural resource management - Nutrient management - Livelihood diversification - Appropriate livestock selection - Appropriate poultry selection - Diet diversification - Disaster risk management - Improved housing design - Appropriate appliances - Land redistribution - Land reclamation

ADAM Digital Compendium - Adaptation Catalogue[9]

Extreme event	Option type	Risk management	Sector	Landscape type
- Drought - Flooding - Heat wave - Sea level rise	- Technological - Soft engineering - Management best practice - Planning and design - Legal and regulatory instruments - Insurance and financial incentives - Institutional	- Risk identification and assessment - Risk reduction - Preparedness - Risk transfer - Disaster response - Emergency response - Relief and reconstruction	- Agriculture - Biodiversity (and nature conservation) - Buildings and construction - Energy - Fisheries - Forestry - Health - Industry - Insurance and financial services - Tourism - Transport - Urban planning and design - Water resources - Other	- Urban - Rural - Coastal - Geographically non-specific

Climate Change Adaptation Database

Likely Impact on Biodiversity	Biome	Adaptation Type
- Adverse - Adverse to Neutral	- Agricultural Biodiversity - Dry and Sub-Humid Lands	- Behavioural and Individual - Behavioural, Individual and

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[9] the compendium's overall tagging facility allows additional filtering of the options by hazard and location

- Adverse to Positive - Neutral to Positive - Positive	Biodiversity - Forest Biodiversity - Inland Water Biodiversity - Island Biodiversity - Marine and Coastal Biodiversity - Mountain Biodiversity	Technological - Economic - Economic, Institutional and Regulatory - Economic, Institutional and Technological - Economic and Regulatory - Economic, Regulatory and Technological - Economic, Scientific and Technological - Economic and Technological - Institutional and Regulatory - Institutional, Regulatory and Scientific - Regulatory and Scientific - Regulatory, Scientific and Technological

Colour coding								
hazard	impact	sector	location	strategy	scale	pot. effect	landscape type	landscape type

Table 5 – Overview on top level filter categories and second level filter categories in seven web-based adaptation platforms. The colour coding indicates the mapping of the top level filter categories to a set of semantic categories (cf. Table 3)