The ESPREssO Action Database: Collecting and assessing measures for disaster risk reduction and climate change adaptation

Audrey Baills, Gilles Grandjean, Aurélie Maspataud, Susanne Ettinger, Jaime Abad, Nuwan Dias, Kristoffer Albris, Jaqueline Hemmers, Georgina Clegg, Casimiro Martucci

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Audrey Baills [a],[*], Gilles Grandjean [a], Aurélie Maspataud [a], Susanne Ettinger [a], Jaime Abad [b], Nuwan Dias [c], Kristoffer Albris [d], Jaqueline Hemmers [e], Georgina Clegg [c], Casimiro Martucci [f]

[a] *BRGM, 3 Avenue Claude Guillemin, 45100, Orléans, France*
[b] *BRGM, Direction Régionale Hauts-de-France, Arteparc Bâtiment A, 2 Rue des Peupliers, 59810, Lesquin, France*
[c] *University of Huddersfield · School of Art, Design and Architecture, Queen St S, Huddersfield, HD1 3BZ, UK*
[d] *University of Copenhaguen, Institut for Antropologi, 1353 København K, CSS - Bygning 16, Opgang, Denmark*
[e] *DKKV, Kaiser-Friedrich-Straße 13, 53113, Bonn, Germany*
[f] *PLINIVS-LUPT Study Centre, University of Naples Federico II, Via Toledo 402, 80134, Naples, Italy*

ARTICLE INFO

ABSTRACT

The Action Database (ADB) was developed during the ESPREssO project (Enhancing Synergies for Disaster Prevention in the European Union) in order to store and analyze relevant ideas emerging during the project to deal with the challenges. It provides the opportunity to formalize discussions and to store their content in a synthetic format, as well as to collect experiences and evaluate the impacts they had at their respective scales of implementation and on different parameters. The major aim of the ESPREssO-ADB tool, and its main innovation, is to deal with multi-hazard and multi-challenge actions, in an international context and notably in a cross-border initiative. The ESPREssO project aimed at contributing to a new strategic vision on Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) in Europe. To do so, stakeholders working with CCA and/or DRR in Europe were consulted to identify measures boosting adaptation or societies' resilience. Each idea, measure or comment was stored and ranked in the ADB using qualitative criteria based on the Sendai Priorities and the SHIELD model proposed by the ESPREssO Team. Each action was assessed through multi-criteria analysis and effectiveness was approached under two different angles. The first one in line with the priorities of the Sendai Framework; and the second one with the SHIELD model. This model incorporate recommendations on how to optimize risk management capabilities through DRR. Positive actions had fed the Vision Paper and Guidelines produced by the project. This paper describes in details the ADB structure and the multi-criteria analysis performed.

1. Introduction

Global change is modifying risk profiles in Europe and all over the world. Exposure is increasing due to population growth and urbanization, whereas climate change affects some hazards' occurrences and intensities [1]. The ESPREssO project (Enhancing Synergies for disaster PRevention in the EurOpean Union) is a Coordination and Support Action that was funded by DG RESEARCH under the H2020 Programme. It addresses the European Union's Horizon H2020 topic (DRS-10-2015) on "Disaster Resilience & Climate Change" regarding topic 2 for "Natural Hazards: Toward risk reduction science and innovation plans at national and European level". ESPREssO aims at contributing to a new strategic

vision on disaster risk reduction (DRR) and climate change adaptation (CCA) in Europe. The project focusses on the policy sphere and barriers identified as three main challenges:

1 - Integration of CCA and DRR to foster resilience
2 - Integration of Science and Legal/Policy issues in DRR and CCA
3 - Improvement of national regulations to prepare for *trans*-boundary crises.

To overcome these three challenges, the ESPREssO project looked at the needs and opinions of stakeholders working with either CCA or DRR (or both) in Europe, in order to identify measures boosting adaptation or

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societies' resilience. To gather such information, the ESPREssO project has organized one Stakeholder Forum, at the beginning of the project and as basis structure for the application of a bottom-up approach, and three Think Tanks events (each one focusing on one of the ESPREssO challenges) during which three board games (see Ref. [2] Fleming et al. in this issue [3], Booth et al. in this issue [4], Abad et al. in this issue [5], Schueller et al. in this issue) where played. In order to gather, store and then analyze the proposed measures raised during these events a database of actions, or Action Database (ADB), has thus been developed during the project.

It is obvious that many databases exist, worldwide and in Europe, and several of them are fully accessible online on web portals (i.e., US Geological Survey database, NOAA/WDS Global Historical Tsunami Database, [6]; etc.). They are generally different in terms of content (events, losses, damages, risk mapping, solutions, etc.), scales (from local to world) and shapes (presented as a catalog or inviting people to contribute). It should be noted that many of these databases concern either a single country or a single topic or issue. Their formats are conditioned by the typology of projects' activity, most of the time focused on participatory sciences and involving scientific, educational and general public spheres.

Databases gathering data on disaster events and induced losses are numerous, at national or regional levels and for specific or multiple hazards. There are few multi-hazards and international level databases, e.g., the International Disaster Database (https://www.emdat.be/; [7, 8]. Some of them are expected to be sustainable, continuous, credible, publicly accessible, and in the same time quality assured. They can be either government-hosted or non-government hosted [9]. Most of them are often (in whole or in part) funded by major international funders, such as the World Bank or the United Nations Development Program (https://www.adaptation-undp.org/action-database), or major reinsurance companies such as Swiss Re (Sigma Explorer[1]) and Munich Re (NatCatSERVICE[2]).

Similarly, global partnerships (such as those managed by the World bank), could lead to proactive disaster risk management (DRM) and investing to ensure DRM continuity by building technical capacity at a federal, state, or municipal levels. For example, the grant-funding mechanism of the Global Facility for Disaster Reduction and Recovery (GFDRR) supports worldwide disaster risk management projects and contributes to the implementation of the Sendai Framework for Disaster Risk Reduction (DRR) by helping countries to integrate DRR and CCA into development strategies and investment programs and recover from disasters more quickly and effectively.

From climate change adaptation perspective, databases are focused on proposing solutions (e.g., http://www.climateapp.nl/, https://platform.think-nature.eu/, etc.). As synthesized by Sanderson et al. [10] data could be shared globally via specific web portals [11] dedicated to sharing and linking knowledge and facilitating adaptation measures. In 2015, the European Environment Agency report [12] provide an extensive overview of European adaptation portals as well. Because all these databases and web-portals contain different levels of information, stored in many heterogeneous formats, a need was recognized for a system that could store, filter, evaluate the ideas and measures proposed by stakeholders during the ESPREssO project.

The ESPREssO-ADB is a new tool that aims at collecting and evaluating the feedback from stakeholders in disaster risk reduction, climate change adaptation and cross border crisis management. It provides the opportunity to formalize discussions during workshops and to store their content in a synthetic format, as well as to collect experiences and evaluate the impacts they had at their respective scales of

implementation and on different parameters. The major aim of the ESPREssO-ADB tool, and also its main innovation, is to deal with multi-hazard and multi-challenge actions, in an international context and notably in a cross-border European initiative.

2. Material and methods

2.1. Design of the ADB tool

The above listed objectives for the ESPREssO-ADB led to identify a global concept of the database, with the following requirements:

- The structure has to be exhaustive enough to describe, characterize, and evaluate an action proposed by a stakeholder; an action being defined as any initiative related to DRR, CCA or cross border management. The action can refer to a process as a whole, be a constitutive element of a larger framework or correspond to a particular effort. The action can be of varying nature: it can relate to a research project, urban or land use planning procedures, the implementation of a new legislative framework, an improved coordination strategy for first aid response, a risk education initiative, etc.
- The criteria used in the evaluation need to be general enough to allow comprehensive situations and not too detailed to avoid a large number of cases referring to each of them; the compromise found by the ESPREssO Consortium was to restrict criteria to those describing situations at national and regional level;
- Each action needs to be characterized by a set of contextual parameters (metadata) allowing quick searching and filtering (title, date of entry, author that proposes the action, challenge concerned, etc.);
- Each action needs to be described by a number of qualitative criteria to understand the framework it applies to: the typology (legal, scientific, …), the thematic context and respective scale of implementation (prevention, crisis, mitigation, preparedness), the gap it refers to, etc.;
- Each action is evaluated by quantitative indicators referring to different criteria, so that it is easy to rank the actions to identify the best and the worse, as understood by the user that completed the form.

The development of the ESPREssO-ADB database thus required several steps. First, a literature review was performed to identify key metadata and a first set of assessment criteria [13–15]. Indeed, during the first phase of the project, a preliminary draft of the database was sketched thanks to an extensive analysis of existing knowledge from the bibliography. This literature review led to the first version of the ESPREssO-ADB that has been refined with feedback from ESPREssO project partners following the project meeting in Copenhagen in January 2017, and was tested a first time by BRGM teams in the spring of 2017. Furthermore, the ESPREssO-ADB has featured an operational web service since the Stakeholder Forum meeting organized by the ESPREssO project in Bonn on May 4, 2017.

This first draft was refined again in late 2017 early 2018 with the drafting of the final products of the project. Taking into account testers, partners and stakeholders' feedback, the ESPREssO-ADB has evolved toward a 2nd prototype which was finally validated as the definitive tool [16]. During and following the Forum, and Think Tank meetings, new statements of stakeholders were entered into the database. Detailed information on the metadata, the criteria and indicators describing the action as well as technical details concerning the ADB's online implementation, are provided in Ref. [17].

The structure of the evaluation questionnaire refers to the goals of the Sendai Framework [14]. The Sendai Framework for Disaster Risk Reduction 2015–2030 is the global instrument for DRR that was adopted during the Third United Nations World Conference on DRR in 2015. It falls in with the Hyogo Framework for Action and identifies strategies

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[1] http://www.swissre.com/reinsurance/insurers/sigma_explorer_the_data_you_need_at_your_fingertips.html.

[2] https://www.munichre.com/en/reinsurance/business/non-life/natcatservice/index.html.

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for disaster risk reduction. It presents guidance for the implementation of instruments, policies, programs, guidelines and standards to support risk reduction strategies in relation to the four priority areas [18]:

- Priority 1. Understanding disaster risk;
- Priority 2. Strengthening disaster risk governance to manage disaster risk;
- Priority 3. Investing in DRR for resilience;
- Priority 4. Enhancing disaster preparedness for effective response and to Build Back Better in recovery, rehabilitation and reconstruction.

So that the first four sections of the evaluation questionnaire correspond to the four Sendai priorities. The fifth and final section further aims at evaluating the action in terms of its potential for transformative changes, a concept currently used by the UN and the Belmont Forum. This last section evaluate the capacity of the action to create lasting, sustainable change and political will. In addition to the Sendai Framework, questions themselves are based on previous work developed by Birkmann and von Teichmann [13] and Scolobig et al. [15].

2.2. Structure and operating

The ESPREssO-ADB website and database have been developed using the Drupal open-source content management system. Its technical solution to implement the ADB was chosen following close exchanges between the project management and BRGM's IT services, responsible for implementing the project's technical tools. Indeed, Drupal is an open-source content management software that is very flexible and modular. It allowed easy modification to the structure of the ADB to

adapt the needs of the ESPREssO project all along its duration. This aspect is important because the database was and is still intended to be used during different kinds of activity (forum, scenario study, think tank discussions …). In addition, Drupal benefits from a performant search module, which is useful to navigate within the ADB entries. The Drupal content (text fields) is then supported by a database that manages the structure of the information system.

To ensure accessibility and to avoid simultaneous multiple versions, the ESPREssO-ADB has been implemented as a web service [19] and can be accessed using its specific URL (http://adb-espresso.brgm.fr) or via the official ESPREssO website (http://www.espressoproject.eu/wp/wp 4.html). The portal is now available in 4 different languages: English, German, French, and Italian [20]. Access to the website is open but submitting new entries require a password identification. Thereby to contribute, a user account is necessary but it can be created by self-registration to ensure a good dissemination.

The main interface of the ESPREssO-ADB portal is structured into six main blocks (Fig. 1):

- Block 1: Clicking on the ESPRESSO logo, allows to reset the page to return to the homepage after having explored individual actions.
- Block 2: The filter body to the left allow selecting certain criteria to filter specific actions fulfilling the search criteria.
- Block 3: The main block, listing the already entered actions with their respective title (in orange), the thematic context (light gray) and a short descriptive of the action (dark gray). The orange button enables to add an action for logged-in users.
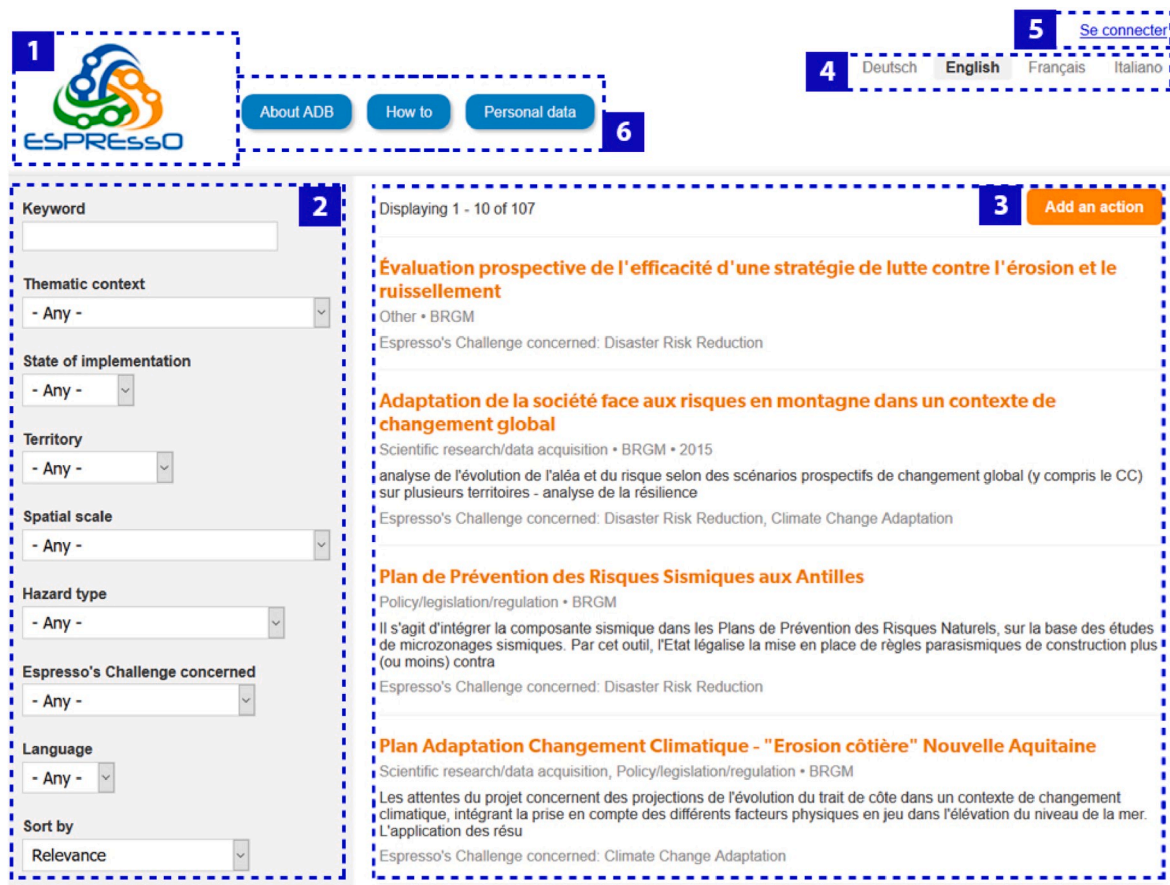- Block 4: Language section, enabling to choose between English, French, German and Italian.

Fig. 1. Screenshot of the main interface of the ESPREssO-ADB portal (http://adb-espresso.brgm.fr).

- Block 5: Setting board enables to connect, disconnect and consult your drafts when connected.
- Block 6: Links to ADB pages on the ESPREssO website

A click on "Add an action" button redirects logged-in contributors to the questionnaire page. This page is introduced by a few lines providing background information on the ESPREssO project and a short description of what actions are interesting for this project. The questionnaire was design to collect stakeholders' experience, enabling them to describe and evaluate an "action" in term of its impact at its respective scale of implementation. This form takes about 15–20 min to complete. It includes 50 questions divided into 7 sections:

- Secion 1 "Participant's information" collects basic data about the person filling in the questionnaire, such as its host institution, the area of expertise, the level of involvement in the action or project, etc.

- Section 2 collects basic information about the action. It includes title and acronym of the action as well as its thematic context, a short description, countries involved, spatial scale, etc.
- Sections 3 to 7 deal with the action evaluation (Table 1 & Table 2); they relate to criteria outlined in the Sendai framework of action and are entitled, respectively as "Risk evaluation and understanding", "Optimizing governance", "Investment for increasing resilience", "Improvement of response", and "Potential for transformative change".

Several criteria also illustrate the SHIELD model [18,21] in this issue), which depicts recommendations for optimizing risk capabilities in terms of disaster risk governance (Fig. 2). The SHIELD model was developed by the ESPREssO team around the four traditional DRM phases: response, recovery, prevention and preparedness. This model thus "illustrates the interlinkages and interdependencies between management and governance in DRR and CCA" [18]. It includes

Table 1

Group questions corresponding to each of the questionnaire sections (3–7) dealing with the action evaluation in the ESPREssO-ADB questionnaire.

Action evaluation	Question numbers	Detailed questions
3 - RISK EVALUATION AND UNDERSTANDING	1	Does the action have an impact on the fundamental scientific understanding of natural risks and/or climate change?
	2	Please evaluate the action's influence on transparency and public access to non-sensitive natural risk and/or climate change data
	3	Is the action able to federate different fields of expertise?
	4	Does the action contribute to create, enrich or improve data contents?
	5	Does the action have an impact on local risk culture or risk memory among the population?
	6	Does the action integrate local and indigenous knowledge?
4 - OPTIMIZING GOVERNANCE	7	Does the action contribute to integrating scientific research into public policy or decision-making process?
	8	Please evaluate the action's impact on improving the coordinated cooperation between various institutions/ organisations from DRR and CCA?
	9	Does the action contribute to improving the quality control of norms and standards relating to disaster risk reduction and/or climate change adaptation?
	10	Please evaluate the action's contribution in reducing incoherence between existing legal, normative and contractual references in the field of disaster risk reduction and/or climate change adaptation, including between different countries
	11	What is the action's contribution towards reducing incoherencies in the management of different natural hazards in view of an evolution towards a multi-hazard approach?
	12	How does the action contribute towards integrating civil society and local business/private sector in decision-making processes?
	13	Does the action contribute to building or maintaining the expertise, knowledge and/or skills among public bodies?
5 - INVESTMENT FOR INCREASING RESILIENCE	14	What is the action's contribution to ensure the funding of new initiatives and equipment (retrofit of critical infrastructure, building of laboratories, and implementation of outreach programs …)?
	15	How would you describe the action's impact on promoting public and private actors' self-investment in preventing and reducing disaster risk or adapting to climate change?
	16	Please evaluate the action's contribution to risk sharing/transfer via appropriate financial instruments (insurance, etc.)
	17	How does the action contribute to economic development (innovation, new markets, job creation)?
	18	Please evaluate the action's contribution to reducing social vulnerability by decreasing poverty and developing social safety nets
	19	Disadvantaged and/or socially isolated groups (children/senior citizens/people with disabilities, racial/sexual/religious minorities) have specific needs in terms of risk prevention. Does the action account for these needs?
6 - IMPROVEMENT OF RESPONSE	20	Does the action contribute to establishing or improving early warning systems, including via the implementation of crisis simulation exercises?
	21	Does the action contribute to better identifying and quantifying the impacts of natural hazards, particularly long-term effects?
	22	Does the action contribute to creating opportunities for reducing vulnerability during the post-disaster reconstruction phase? (Build Back Better)
	23	Please evaluate the action's contribution to facilitating emergency response and population evacuation in the event of a crisis
	24	Please evaluate the action's impact on the timespan needed for the restoration of critical facilities and services (transportation, healthcare, energy …)
7 - POTENTIAL FOR TRANSFORMATIVE CHANGE	25	Does the action enhance political will to act on disaster risk reduction and/or climate change adaptation?
	26	Please evaluate the action's contribution to promote local population's involvement in disaster risk reduction and/or climate change adaptation activities
	27	Is the action supported and approved by the concerned public?
	28	Is the action sustainable from an economic point of view (e.g. maintenance costs)?
	29	Does the action account for environmental sustainability (respect and preservation of natural landscape, biodiversity, ecosystems, soil and water quality …)?
	30	Does the action explicitly take into account climate change issues?
	31	Is the action transferable to a different territorial, national or cultural context?
	32	Is the action transferable to a different spatial or temporal scale?

Table 2
Detail of questions meeting each criteria of the Extended Sendai Framework (ESF 1 to 5) and the SHIELD model (SM 1 to 7).

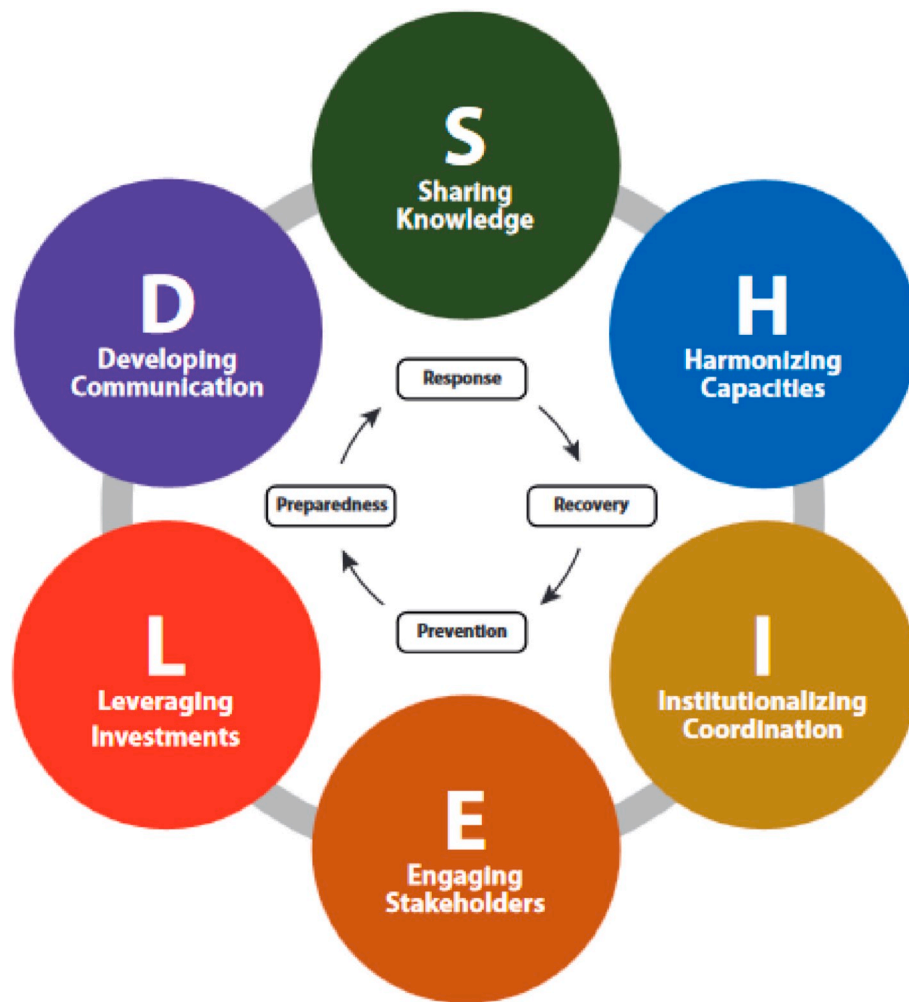| Question numbers	Extended Sendai Framework					SHIELD Model						
	ESF1 - Risk evaluation and understanding	ESF2 - Optimizing governance	ESF3 - Investment for increasing resilience	ESF4 - Improvement of response	ESF5 - Potential for transformative change	SM1 - From Disaster Risk Management to Disaster Risk Governance	SM2 - Sharing Knowledge	SM3 - Harmonizing Capacities	SM4 - Institutionalizing Coordination	SM5 - Engaging Stakeholders	SM6 - Leveraging Political Commitment	SM7 - Developing Communication
1	X											
2	X						X					X
3	X						X					
4	X						X					
5	X						X					X
6	X						X			X		
7		X				X	X					
8		X							X			
9		X						X				
10		X				X						
11		X							X			
12		X								X		
13		X						X				
14			X								X	
15			X							X		
16			X							X	X	
17			X									
18			X									
19			X									
20				X				X				
21				X			X					
22				X		X						
23				X								
24				X								
25					X					X	X	
26					X							
27					X							
28					X						X	X
29					X							
30					X							
31					X					X		
32					X					X		

Fig. 2. The SHIELD model revolving around the four disaster management phases [18].

recommendations for Sharing knowledge, Harmonizing capacities, Institutionalizing coordination, Engaging stakeholders, Leveraging political commitment and Developing communication.

Questionnaire items are either close-ended questions, close-ended questions with rating scales and anchors as labels or open-ended questions (statements) and are presented in various formats (Fig. 3). In practice, a drop-down list box containing the possible answers follow each statement. Drop-down lists are considering either thematic, or challenges and so on … The questionnaire form is mainly built from multiple statements or questions associated with multi-item scales, frequently used to collect quantitative data with defined characteristics. Each response point has an accompanying adjective anchor (e.g., "very strongly") ascending from top to bottom, associated with an object (impact/ability/contribution …) corresponding to the asked question.
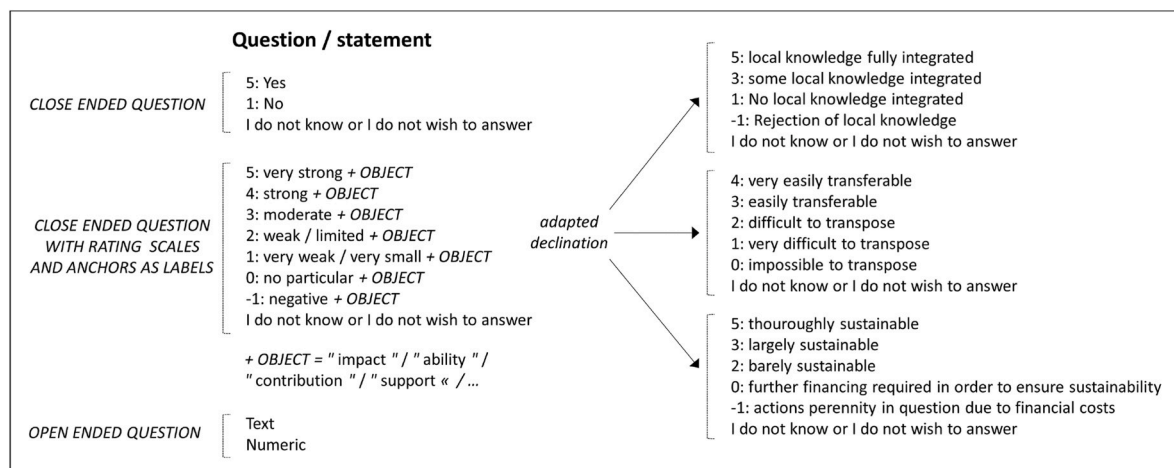

Fig. 3. Questionnaire multi-items format in the ESPREssO-ADB.

Anchors here required to be balanced to reflect equal intervals between response-points. Here, for clarity and efficiency, multiple sets of anchors are presented for multiple rating scales in the questionnaire (adapted declination for specific adjectives) (right part of Fig. 3).

The questionnaire can be saved at any time before submission (Fig. 4), and can be found in "My drafts" section. All submitted actions are validated by a member of the ESPREssO team before being published on the ESPREssO-ADB website. Once approved, each action can be visualized in detail together with its final scoring. Scoring systems are detailed in next sections.

2.3. Personal data and compliance with GDRP

The personal data concept covers all information related to an individual who is identified or who may be identified, directly or indirectly, in particular with reference to an identifier (for example, a name or identification number) or to one or more elements specific to their physical, physiological, genetic, mental, economic, cultural or social identity.

To this end, the ADB-plateform undertakes to respect Regulation (EU) 2016/679 of the European Parliament and Council of April 27, 2016 on the protection of natural persons with regards to the processing of personal data and the free movement of such data, and repealing Directive 95/46/EC, hereafter referred to as "GDPR", and the modified law n° 78–17 of January 6, 1978 on IT, files and liberties, hereafter referred to as "the Regulation".

The policy that describes how we collect, use and manage personal data and the rights of the users concerned is available online: http://adb-espresso.brgm.fr/en/page/third-party-personal-data-protection-policy.

For any information about personal data protection, you may also consult the website of the French National IT and Liberties Commission.

2.4. Sustainability of data

The ADB will be maintained with its dedicated platform for at least 5 years after the end of the project, which means by the end of 2023. After this date, if it is still used (with regular new data being implemented), it will be maintained this way for 5 extra years. On the case no data would be added, the content of the ADB would be transferred to "permanent" data repository such as BRGM institutional web site and/or Mendeley Data Repository to ensure durability of access to the content.

3. Results

3.1. Assessment of actions

In the ADB-ESPREssO context, the definition of action is a broad one: any program, project or initiative dealing with DRR, CCA or cross border crisis management. The action can refer to a process as a whole, be a constitutive element of a larger framework or correspond to a particular effort. The action can also be of varying nature: it can relate to a research project, urban or land use planning procedures, the implementation of a new legislative framework, an improved coordination strategy for first aid response, a risk education initiative, etc. Actions are likely to meet a variety of scales, from cities to countries and Europe, and a variety of challenges (DRR, CCA, transboundary issues, science-policy interfaces, etc.). The ADB attempts to measure an action's beneficial impacts through desirable outcomes for risk reduction (within Sendai protocol), difficulties between DRR and CCA [13], and transformative change [22].

Within the ESPREssO-ADB, effectiveness is approached under two different angles. The first one to align with the priorities of the Sendai Framework. It thus includes "Risk evaluation and Understanding", "Optimizing governance", "Investment for increasing resilience" and "Improvement of Response" categories (Table 2). A fifth category on the "Potential for transformative change" of the action has been added to complete this first level of the multi-criteria analysis; this is what we refer to as the Extended Sendai Framework (ESF) in Table 3.

A second level analysis has been developed in the last year of the ESPREssO project to evaluate the actions regarding the SHIELD model. This model incorporate a set of recommendations on how to optimize risk management capabilities through disaster risk reduction. This second level of multicriteria analysis takes the six categories of the SHIELD model over and complete them with a broader one "From Disaster Risk Management to Disaster Risk". Details of questions used to assess the different criteria are detailed in Tables 1 and 2. Table 2 summarizes in more detail the content of sections 3 to 7 and provides main references used to determining the relevant criteria for each section that are presented in form of questions.
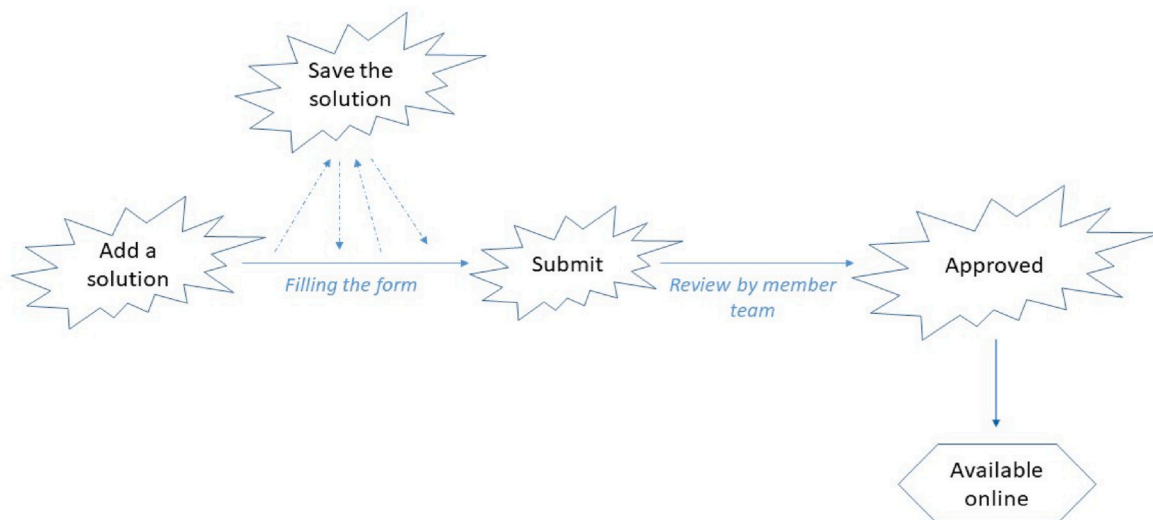

Fig. 4. Process of action submission.

Table 3

Percentage of actions meeting each range of quotation (rows) and for each criteria of the 2 multi-criteria analysis (columns): the Extended Sendai Framework (ESF 1 to 5) and the SHIELD model (SM 1 to 7).

	ESF1	ESF2	ESF3	ESF4	ESF5	SM1	SM2	SM3	SM4	SM5	SM6	SM7
[0-1[	10,2%	8,3%	41,7%	25,9%	3,7%	9,3%	2,8%	15,7%	10,2%	3,7%	22,2%	15,7%
[1-2[	20,4%	18,5%	26,9%	23,1%	29,6%	23,1%	21,3%	25,0%	11,1%	27,8%	27,8%	16,7%
[2-3[	18,5%	31,5%	14,8%	25,0%	23,1%	25,9%	23,1%	25,0%	13,9%	33,3%	19,4%	19,4%
[3-4[	26,9%	31,5%	11,1%	13,9%	32,4%	22,2%	31,5%	25,9%	27,8%	25,0%	22,2%	18,5%
[4-5]	24,1%	10,2%	5,6%	12,0%	10,2%	17,6%	21,3%	8,3%	36,1%	10,2%	7,4%	29,6%
Not rated	0,0%	0,0%	0,0%	0,0%	0,9%	1,9%	0,0%	0,0%	0,9%	0,0%	0,9%	0,0%

3.2. Data management and analysis

By the end of the ESPREssO project, the ADB has been filled with 110 actions meanly coming from projects report or deliverables (31%), ESPREssO Think tanks (29%) and professional experiences (20%) of Stakeholders (Fig. 5). Actions coming from literature review and scientific publications represent 11% and 7%, respectively.

The Think Tanks represent more than a quarter of the actions. Indeed, actions discussed in the Stakeholder forum and during the three Think Tanks are detailed in the database and associated with at least one of the three ESPREssO challenges, and different criteria. The ADB provides the opportunity to formalize discussions during workshops and to store their content in a synthetic format. Once this information is classified using different criteria, including some meta-data like the date of the entry, it enables to know about the impacts of each action and their evolution in time. Version tracking of the database has also be considered in the implementation of the database in order to track stakeholders' opinion about these actions during the life of the ESPREssO project and associated activities (forum, think tanks, etc.). Let's remember that the first version of the ADB has been elaborated thanks to literature reviews performed in the dedicated project work-package (WP) and other WP's inputs that were taken into account as soon as useable inputs were available. In addition, the ADB structure has been adapted to fit the Vision Paper [23] and Guidelines purposes [18].

Among those 110 actions, most of them are related to a single challenge (Fig. 6). It is to highlight that actions mainly concerned
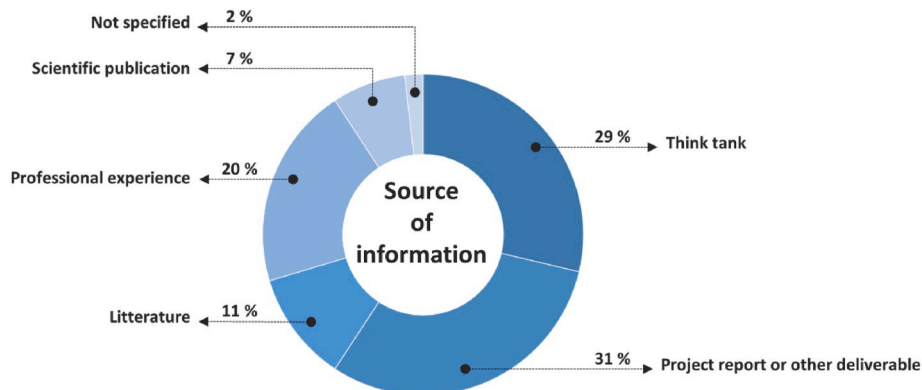

Fig. 5. Percentage of each source of information considered for the ESPREssO-ADB.
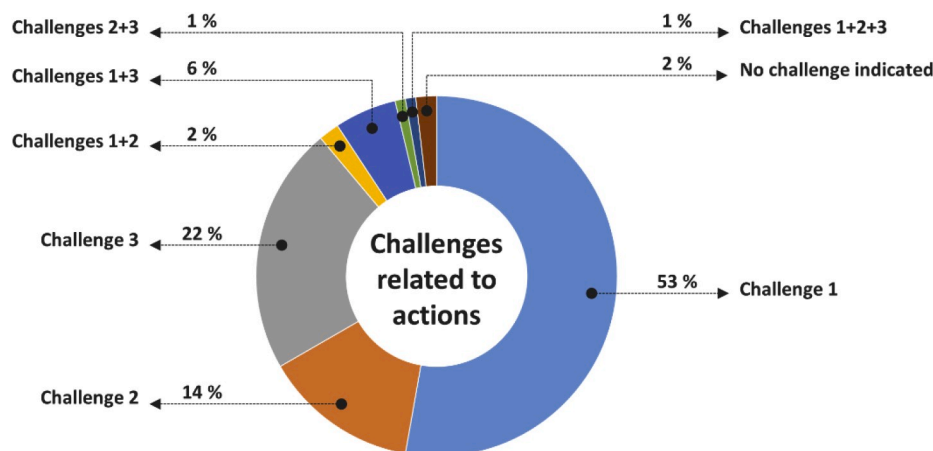

Fig. 6. Percentage of ESPREssO challenges related to actions of the ADB. In short, challenge 1 mean "DRR and CCA integration", challenge 2 "Policy-Science interface" and challenge 3 "Transboundary event" (previously described).

ESPREssO challenge 1 "DRR and CCA integration" (53%) and challenge 3 "Transboundary event" (22%), while less actions are indicated to be related to 2 or 3 challenges (less than 10%). Regarding the predominance of Challenge 1, it needs to be put into perspective as concerned actions may be related to CCA or DRR but not specifically to the interaction of both.

3.3. Indicators: definition and analysis

To assess the actions hosted in the database, a multi-criteria analysis was developed using the criteria previously presented (see Table 2). Table 2: Detail of questions meeting each criteria of the Extended Sendai Framework (ESF 1 to 5) and the SHIELD model (SM 1 to 7).

The first level of multicriteria analysis, structured according to the Sendai Framework priorities, is composed by 32 criteria/questions split over 5 categories: "Risk evaluation and understanding", "Optimizing governance", "Investment for increasing resilience", "Improvement of response", "Potential for transformative change" (see Table 2). The second level of multi-criteria analysis, developed around the SHIELD model [18]; Albris et al., in this issue), is composed by the 7 categories related to the ESPREssO guidelines structure (Table 2): "From disaster risk management to disaster risk governance", "Sharing knowledge", "Harmonizing capacities", "Institutionalizing coordination", "Engaging stakeholders", "Leveraging political commitment", "Developing communication". The SHIELD model was developed by the ESPREssO team to answer DRR objectives in the scope of the ESPREssO challenge, while the Sendai Framework offer a general context. The SHIELD model is built upon the four traditional DRM phases and illustrates the interlinkages and interdependencies between management and governance in DRR and CCA.

To illustrate and assess the items of the SHIELD model, 25 out of the 32 criteria were used and rearranged (Table 1 & Table 2). Each action of the ADB is thus scored over these 12 categories (Extended Sendai and SHIELD model framework, see Fig. 1).

Within each category, the final score is the mean of scores obtained for each criterion/question. For each of the 32 questions/criterion of the evaluation questionnaire, answers are mainly quoted between 0 and 5 (Fig. 3). For the few close-ended questions with responses "Yes" or "No", it was decided to score as follows: "Yes" equals 5 points, "No" to 1 point. Moreover, as evidenced in Fig. 3, quotation also include negatives ones, considering that rejection of some item or its negative impact/contribution could also led to affect or to threaten the perenity of the

considered action. For each category, the resulting score of the action is the mean of the scores collected for each questions. Question that were not answered are not taken into account for the final score. Responses as "I do not know or I do not wish to answer" are not considered either for the final score. Choosing to count a zero score for questions not answered would have been the other solution, but it would have penalized the action due to lack of data. Thus for each evaluation criterion, the action is affected a quotation which is calculated by averaging quotation of each answer. For example, see in Fig. 7. Considering the "Investment for Increasing Resilience" criterion, the action « Promote multi-institutional funding including both DRR and CCA in the same programs" obtained 5, 0, 0, 3, 0, 1 as evaluation for the different questions. Its overall quotation for the criteria is thus equal to 1.5, i.e., $(5 + 3 + 1)/6$.

The results can be shown on radar diagrams for the two notation systems (Fig. 8). This radar diagrams are available at the bottom of the action record page and allows quickly seeing strengths and weaknesses of the action. This is a global and final view of each action's performance and of the assessment quotation for either the ESF or SM, with the quotations for each categories.

Diagrams also help to define different "profiles" between the actions mainly focused on one or the other of the challenges of the ESPREssO project, or according to the notation of the Extended Sendai Framework or the SHIELD model. For example in Fig. 8 the examples 2 and 3 perform better than example 1 on the "improvement of response" category and the 3 examples perform differently regarding "Chapter 3: Harmonizing Capacity" category.

As results, the ADB actions performances regarding the 12 categories have been analyzed and summarized in Table 3. They highlight a first an interesting point: most of the actions of the database are not very efficient for the "Investment for increasing resilience" (EFS3), "Improvement of response" (EFS4), "Leveraging Political Commitment" (SM6) and, in less extent, for "Harmonizing Capacities" (SM3). Whereas, on the contrary, some actions globaly perform well for "Risk evaluation and understanding" (EFS1), "Sharing Knowledge" (SM2), "Institutionalizing Coordination" (SM4), "Developing Communication" (SM7) and, in less extend, for "Optimizing governance" (ESF2) and "Engaging Stakeholders" (SF5).

Looking more in detail to actions, 29 actions have a score above 4 for at least one of the ESF criteria, and 14 more actions have a score above 4, for at least one criteria if the SM criteria are added. 39.8% of the ADB actions thus reach a high score for at least one of the 12 criteria. Among

Investment for increasing resilience (Average : 1.5)

What is the action's contribution to ensure the funding of new initiatives and equipment (retrofit of critical infrastructure, building of laboratories, implementation of outreach programmes...)?
5 : very strong contribution

How would you describe the action's impact on promoting public and private actors' self-investment in preventing and reducing disaster risk or adapting to climate change?
0 : no impact

Please evaluate the action's contribution to risk sharing/transfer via appropriate financial instruments (insurance, etc.)
0 : no contribution

How does the action contribute to economic development (innovation, new markets, job creation)?
3 : moderate impact

Please evaluate the action's contribution to reducing social vulnerability by decreasing poverty and developing social safety nets
0 : no contribution

Disadvantaged and/or socially isolated groups (children/senior citizens/people with disabilities, racial/sexual/religious minorities) have specific needs in terms of risk prevention. Does the action account for these needs?
1 : These needs were not considered in the action

Fig. 7. Example of quotation within a section of the questionnaire: quotation for each question and average quotation for the overall section considered for the action evaluation.
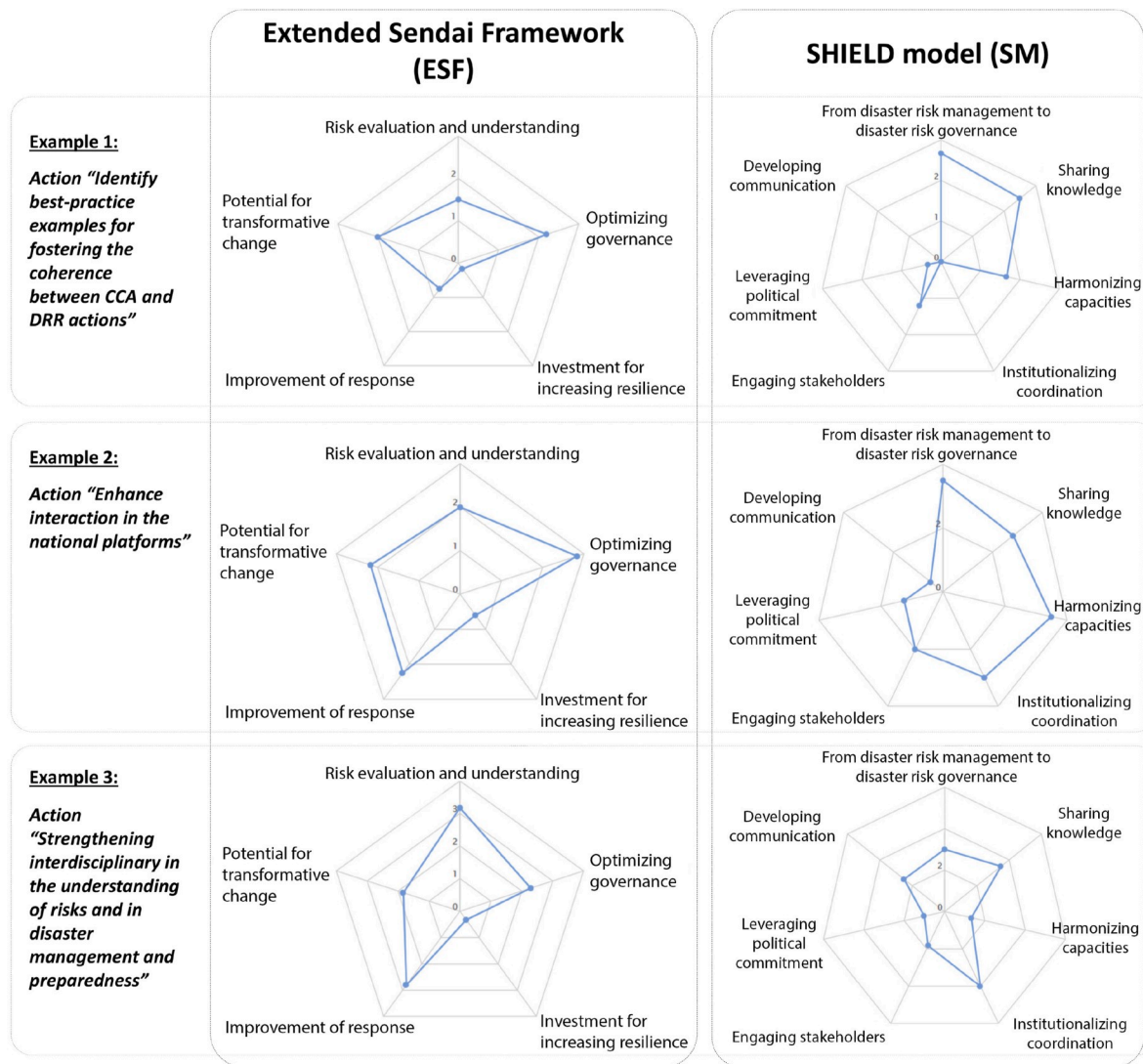
Fig. 8. Examples of radar chart with scores of actions for the Extended Sendai Framework and the SHIELD model criteria.

those 43 actions, 79% are actions belonging to education/information, governance/public infrastructure and/or policy/regulation categories.

4. Discussion

The ADB attempts to measure an action's beneficial impact in terms of (i) its desirable outcomes for risk reduction following the Sendai Framework for action 2015–2030, (ii) existing difficulties between DRR and CCA communities and topics [13] and (iii) the transformative change in the spirit of UNDP/UNESCAP directives. The main objective of the ESPREssO-ADB was to identify best practice solutions and projects in response to the diverse challenges raised by natural hazards in terms of the organization of a territory. Achieving this goal, the ADB tool turns four principles into 4 benefits:

- SHARE: Make existing and notable experiences available to future risk managers. Contribute to ESPREssO by sharing good practices in managing disaster risks and adapting to climate change. ESPREssO-ADB allows to evaluate actions in terms of effectiveness and overcoming barriers.
- DISCOVER: Some solution to DRR or CCA challenges may have already been implemented elsewhere. The tool offer information about new or unknown initiatives, how they achieved their goals and created lasting change.

- TRANSPOSE: Build a DRR or CCA action that works for each region by transposing effective solutions for each social, cultural and geographical context.
- HARMONIZE: Help in work towards a European Union without boundaries for DRR and CCA by participating in the discussion about how to reduce incoherencies and build a common approach for co-ordinated action.

Rich in lessons on the numerous actions brought to knowledge, the ADB keeps to this day some limitations inherent to its format and its management. Despite the efforts made to feed the online database, both from project members and other users, it is not excluded that the ADB is not fully exhaustive (related to the youth of the project). However, this remains a living tool that will continue after the project. The already noticeable number of actions, at the writing of this article, is probably (and already) led to evolve over new future additions.

This raises the question of the accessibility of the questionnaire and its dissemination. Indeed, the duration and the constraints of the project initially limited the role of author to the members and partners of the project, and then opened to the circle of professional acquaintances and project related actions, etc. Further larger opening to specialists related to the three main challenges of ESPREssO could later enrich the completeness of the ADB. Based on the voluntarism and the expertise of the authors who have entered actions in the database, questions may

arise as to the reliability of the actions considered. Are these actions necessarily the most representative? Have the initiatives further from the project circle been explored?

The quality control and the validation of the submitted actions for integration in the database was assumed by the members of the ESPREssO project. But it has sometimes proved difficult to evaluate the total relevance of the targeted actions, or even the accuracy of the criteria evaluated for the actions by each of the authors. Actually, two contributors (Authors 1 and 2) entered more than half of the actions, suggesting a quite unbalanced repartition of contributions (a maximum of 46 actions entered for 1 author, a minimum of 1). For the rest, the main contributors that will be considered are those who entered at least three actions in the ADB. Seven authors entered at least three actions into the ESPREssO database. If the reliability of authors is certain, there could be differences in the action evaluation and, consequently, in quotation. Looking into bias induced by authors reveals that some of them are sometimes harder on quotation than others. Comparing average (Fig. 9), minimum and maximum quotations per criteria stresses that Authors 3, 5 and 6 give higher quotations and to a lesser extent Author 2, while Authors 1 and 4 assign lower rating. When looking at the minimum quotation instead of the mean, it appears that some contributors do not use the full range of possible quotation.

There are two possible ways to correct this bias. The first one would be to correct systematically action's quotation during the validation process and the second one would be to apply a weighting factor to the contributors. The systematic correction of action notation does not seem appropriate. Strong recommendations to authors, provided in advance, could help in more consistency for scoring criteria.

The analysis of the ADB content identified 68 possible solutions and 30 good cases to overcome at least one of the three ESPREssO challenges [24]. The possible solutions identified to overcome Challenge 1 (integrating CCA and DRR) are particularly in line with recommendation formulated in Birkmann and von Teichman [13] (see Table 4).

The ESPREssO Action Database strives to be a database of good examples and good ideas for DRR and CCA. Not reliving the wheel, but gathering stakeholder experience in a centralized way everyone can learn from what has worked in the past, why it worked and how to find ways to adapt those solutions to other contexts and/or scales. This analysis served as the basis for the ESPREssO Vision Paper [23] and Guidelines [18], while identifying solutions to overcome the three ESPREssO challenges using the inputs from other WPs and providing inputs to the final deliverables of the project.

5. Conclusion

The ESPREssO project was dedicated to identify a new strategic vision on DRR and CCA in Europe. This strategic vision was analyzed through three challenges: how to integrate CCA and DRR to foster resilience? How to integrate Science and Legal/Policy issues in DRR and CCA? How to improve national regulations to prepare for *trans*-boundary crises? To overcome these issues, stakeholders working with CCA and/or DRR in Europe were consulted to identify measures boosting adaptation or societies' resilience. To compile, manage and analyze such information, an Action Data Base (ADB) was developed. This database was filled by the measured proposed during Stakeholder Forums, Think Tanks events and serious games organized during the project. Each idea, measure or comment raised during these events were stored and ranked in the ADB using qualitative and quantitative criteria based on the Sendai Priorities and the SHIELD model proposed by the ESPREssO Team. From this information, a multi-criteria analysis was performed and positive actions, as well as negative ones, were identified. Among the 68 possible solutions identified from the ADB, the top actions identified for Challenge 1 (integrating CCA and DRR) detail and go further recommendations from key literature paper.

From the analysis carried out using the ADB, two documents were produced: the ESPREssO Vision Paper [23] and the Guidelines [18]. These documents identify and describe solutions that should overcome the three challenges, opening the way to develop the best CCA and DRR strategies and the best research issues needed to be addressed in the future European research agendas. In particular, the ADB was useful to identify and structure the main missions proposed in the Vision Document: MISSION 1: improved risk and impact assessments – supported by the ADB ESF4 criteria (improvement of response) and ADB ESF1 (risk evaluation and understanding); MISSION 2: better data for a resilient future-supported by the ADB ESF3 criteria (investment for increasing resilience); MISSION 3: risk governance and partnership – supported by the ADB SM5 (institutionalizing coordination) and ADB ESF2 criteria (optimizing governance); MISSION 4: overcoming the implementation gap in DRR and CCA – supported by the ADB SM7 criteria (developing communication); MISSION 5: human behavior and disaster risk – supported by the ADB SM6 criteria (Leveraging political commitment), ADB SM2 criteria (sharing knowledge) and ADB ESF5 criteria (engaging stakeholders). Since the Guidelines are structured according the SHIELD model, as well as the ADB ESF criteria, the contribution of our results was in the definition of the main recommendations of each SHEILD theme and the related underlying questions.
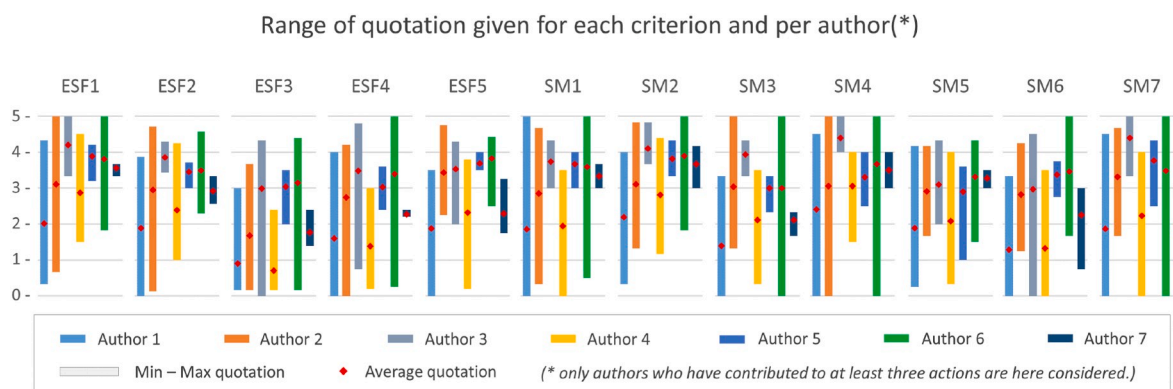

Fig. 9. Range of quotation given for each criterion and per author.

Table 4

Comparaison of possible solutions proposed by ESPREssO [24]] with recommendations from Birkmann and von Teichman [13]].

Recommendations from Birkmann and von Teichman [13]	Some possible solutions identified from the ADB to overcome challenge 1 [24]
"Adoption of a cross-sectoral, multi-scale and integrative approach to link DRR and CCA and to mainstream both into other activities on sustainable development." "Development of a comprehensive and internationally accepted framework that could serve as a conceptual and practical tool when integrating DRR and CCA in practice."	"Adoption of a cross-sectoral, multi-scale and integrative approach: CCA and DRR can be linked through a cross-sectoral, multi-scale and integrative approach and could be mainstreamed into other activities on sustainable development. DRR and CCA could also be brought together through integration into the Urban Development Planning process. Establish multidisciplinary working groups: Multidisciplinary working groups within organisations and ministries to develop a coherent set of norms and goals for CCA and DRR. Develop alliances and collaborations between CCA and DRR communities. Enhance multidirectional collaboration and communication through events and conferences."
"Development of standardised methods and quality criteria for impact and needs assessment as well as vulnerability, capacity and adaptation assessment."	"Revise DRR standards and laws taking into account climate change relevant issues. Revise DRR standards and laws respecting their enhancement of long-term sustainability and taking into account climate change relevant issues."
"Translation of guiding principles, such as resilience and adaptive societies into more precise goals in order to be useful for practical actions and strategies on the ground."	"Promote resilience and sustainable development: one method suggested frequently is to shift the focus from the notion of separate CCA and DRR practices to a more holistic, long-term notion, such as resilience or sustainable development. This provides a more holistic focus point, rather than DRR and CCA concepts which may appear abstract to decision makers who lack relevant knowledge."
"Coordination of actors, institutions and organisations to build on existing capacities and explore synergies."	"Increase bottom up communication from the local to the national/federal level: engage relevant local stakeholders in national decision making through stakeholder forums. Make use of local knowledge: community level knowledge (e.g. from local response services and local communities) should not be neglected and should be integrated in risk assessment maps (bottom-up and top-down integration). Flexibility in national frameworks: national frameworks/agendas should have flexibility to allow the regional/local level to adapt the framework to their specific needs. Promote the local level as a key actor: CCA/DRR activities often have improved longevity if promoted and taken ownership by the local government (but the ability of local authorities to do this depends on funding availability, see section on funding)."
"Creation of flexible funding schemes that shift from short-term and project-oriented financing to the support of forward-oriented strategies that ultimately lead to long-term sustainability."	"Clear identification of overlaps: the clear identification of overlaps between CCA and DRR will allow resources to be allocated efficiently and reduce duplication of work, thus reducing strain on local resources. International links to tackle DRR and CCA: bringing actors together from around the world through joint international projects can help actors learn from one another, allowing them to develop their own plans through example. Increase availability of funding for local authorities for CCA and DRR: local authorities require greater financial support from central government to be able to implement CCA and DRR strategies. Engage the Private Sector: engaging the private sector to investing in joint CCA-DRR programmes could relieve resource strain at the local level. Greater coherency and efficiency in funding mechanisms: promote multi-institutional funding which includes CCA and DRR funding in the same programme through the creation of new funding schemes. Flexible funding schemes: creation of flexible funding schemes that shift from short-term and project-oriented financing to the support of forward-oriented strategies that ultimately lead to long-term sustainability. Funding would be flexible and could be shifted from one year to another. Funding for a specific disaster could also be used to promote CCA in the region."
"Consideration of disasters as windows of opportunities that allow for change and progress if appropriate measures are taken, and a long-term perspective is adopted."	"Eco-system Based Approaches: eco-system based approaches provide a low regrets option for CCA as they present immediate benefits as well as adaptation to a range of climate change futures. Such approaches also provide co-benefits for DRR, for example restoration of coastal salt marsh provides protection against rising sea levels but also against storm surges and coastal flooding. Nature-based solutions (NBSs) are a prime example of means for simultaneously reducing natural hazard risks and boosting societal resilience that address both CCA and DRR [25]."
"Creation of structures and instruments that improve social learning and memory."	"Develop the observational network: develop the observation network to increase knowledge on local effect of climate change and to complement the information provided by existing monitoring systems. Promote public awareness: Raising awareness in the public and engaging them with the issue and building support can often influence decisions at higher levels. Promote education and web-based knowledge portals for communities: Local government investments in society and education is important as at the national policy level there is often too much bureaucracy. These administrative and cultural barriers can present a barrier to DRR and CCA integration. Education allows communities to make their own decisions and makes them aware of the dangers and their vulnerabilities."
"Provision of necessary information, such as scientific data, local knowledge or experimental knowledge accumulated in institutional and personal memory."	"Identify best practice examples for fostering the coherence between CCA and DRR actions: as the full potential of integrating CCA and DRR has yet to be exploited, it could be useful to identify and review existing actions. Although these actions are presently relatively rare, they hold great potential for transferable lessons learned. Coherent monitoring of implemented schemes: coherent and coordinated monitoring of the effectiveness of implemented CCA-DRR schemes would allow for comparisons to be made and lessons to be learned."

Nevertheless, the ADB was also conceived to be extensively used beyond the ESPRESSO project. Indeed, the platform allow volunteers to contribute to the database by entering additional information about past or current actions so that the system can be enriched gradually in time. In addition to be an interesting valuable media to see what is the state of the art in the domain, our ADB could be used in future research/ governance activities to evaluate decisions related to disaster risk reduction planning or policies. To this end, ADB is now more broadly open to the community.

Acknowledgements

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