

First version of the network database and related documentation

Work Package 2

CMCC

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Social Network Analysis of the PLACARD Project Stakeholders

1. Introduction

This report presents activities conducted within the Work Package 2 (WP2) of the PLACARD project: *Stocktaking of the decision-making context* and in particular within Task 2.2: *Clustering and network analysis*. The report corresponds to the Milestone 2.2: *Release of the first version of the network database and related documentation* (due M21).

The report investigates the interactions within a selected group of key actors associated with the climate change adaptation (CCA) and disaster risk reduction (DRR) fields. We applied a social network analysis to answer questions about how actors are connected to each other, how strong their relationships are, which actors are best positioned to connect other actors in the network, which clusters can be recognized within this network and whether these clusters correspond to the CCA and DRR communities.

Participants were selected from the SPINE list. The SPINE list was developed in task 2.1 of the PLACARD project to provide an overview of the *Stakeholder and boundary organizations, knowledge Platforms, policy and research Initiatives, existing Networks/ partnerships and End-user needs* within the CCA and DRR landscape. Responses considered in the social network analysis presented in this report were collected from 32 actors out of 35 that were invited to participate in an online survey.

The survey investigated two aspects of relationships between actors: intensity of interaction between actors and type of interaction, i.e., whether it is related to CCA, DRR, or both. Social network metrics were calculated to quantitatively assess the importance or influence of different actors in the network. In particular, we presented the centrality measures – degree, betweenness and eigenvector – that are considered good indicators of actors' power position. Degree centrality is a good indicator for illustrating the ability of an actor to communicate directly with other actors in the network. Actors with high betweenness centrality have the power to connect disconnected groups, broker opinions and control information flow. Finally, eigenvector centrality shows how well an actor is connected to high-scoring (powerful) actors. Furthermore, cluster analysis was applied to identify clusters of actors with similar patterns of connections.

2. Objectives

The social network analysis (SNA), including clustering, of the key actors in the climate change adaptation (CCA) and disaster risk reduction (DRR) fields is an exercise which aims to investigate the interactions within a selected group (nest) of stakeholders and to quantitatively assess the importance of different actors in the network. In particular, SNA was used with the aim to improve the understanding of how actors are connected to each other, how strong their relationships are, which actors are best positioned to connect other actors in the network, what are the clusters within this network and whether they correspond to the CCA and DRR communities.

Task 2.2 used as input the results from the Task 2.1: Stocktaking and mapping of existing networks and partnerships, international, European and national initiatives, programmes, projects, platforms and organizations and end user needs for CCA and DRR at scales relevant for EU concerted action (the outcome of the first round finalized in April 2016 and described in the "First report on the inventory

and mapping of SPINE” (Milestone 2.1.)¹. This exercise aimed at providing an overview of the relevant actors, their activities and relationships within the CCA and DRR landscape.

3. Methodology

The SNA of the key actors in the CCA and DRR fields was conducted using data collected through an online survey. The survey was developed on the SurveyMonkey platform and answers were collected between 4 July and 25 August 2016 (the survey is available in Annex I). From almost 140 actors presented in the SPINE list, the WP2 team carefully selected 35 most prominent actors as potential participants and distributed the survey to them (the list of invited participants is presented in Annex II). Responses were received from 32 actors, while no contact could be established with the three remaining actors (i.e., Climate-KIC, ENCA CCA IG, and ICLEI Europe) during the period of the data collection.

The survey aimed at collecting information about the relationships among the selected actors and analysed two aspects of them:

- a) **Intensity of interaction** between the actors on the scale from 1-5, with the following meaning:
 - 1 – I am aware that this actor exists, but to my knowledge, we do not have any contact with them
 - 2 – Myself and/or my colleagues communicate with this actor from time to time
 - 3 – Myself and/or my colleagues have frequent communication exchange with this actor
 - 4 – Myself and/or my colleagues collaborate with this actor from time to time
 - 5 – Myself and/or my colleagues have regular and/or institutional collaborations with this actor
- b) **Type of interaction** (related to CCA and/or DRR):
 - Predominantly CCA
 - Predominantly DRR
 - CCA and DRR

In SNA, social structures are presented as a network with ties (edges) that connect actors (nodes), while the focus is on the characteristics of ties rather than on the members of the network (Wetherell et al., 1994). Data analysis includes the computation of social network metrics and the graphical representation of the network. The graphical representation of the network provides an immediate understanding of the structure of the interactions and relationships within the network. In this study, analysis was performed with the SNA software NodeXL, which is an open source template for Excel (Hansen et al., 2011). Graphical representation of the network was revised by editing shapes and colours of the symbols in accordance with the findings of the computational analysis. This refinement of the network visualization through sorting, filtering and clustering functions aimed at providing a more comprehensive presentation of the network.

¹ The first report on SPINE inventory and mapping of SPINE can be found under the following link: https://www.dropbox.com/s/uwekzreyp8zret5/PLACARD_WP2_M2.1_finalversion.pdf?dl=0

Social network metrics show the basic properties of social networks, e.g., the influence or importance of individual nodes within a network. Traditionally, the centrality measures of actors have been considered as good indicators of their power position (Hansen et al., 2011). Here “power” is intended in a very broad sense, meaning the strength of the role played by an individual actor in influencing interactions in the social network. Metrics considered in this analysis include (Stuetze et al., 2013):

- **Degree centrality** – the measure of the total number of edges connected to a particular node – is a good indicator of ability of an actor to communicate directly with others in the network. Directed graphs, such as the one presented in this analysis, have edges that indicate a *one-way* relationship. In the case of directed networks degree centrality is divided into in-degree, i.e., the number of ties to a given actor, and out-degree, i.e., the sum of all connections from one actor to the others. In this analysis, we calculated degree centrality as a sum of in- and out-degree. Actors with a high degree centrality have an important role in transferring information.
- **In-degree centrality** of an actor does not consider an actor’s own assessment, but only interactions that other actors specified having with this actor. Thus, in this case in-degree was preferred to out-degree to avoid potential biases from not having responses from the three missing actors.
- **Betweenness centrality** – a measure showing how often a given node lies on the shortest path between two other nodes – can represent the control of an actor over connections or the ability of an actor to restrict connections in the network. A node high in betweenness centrality has the power to connect disconnected groups, to broker opinions and to control information flow.
- **Eigenvector centrality** is another measure of the importance of a node in a network. Eigenvector centrality accounts not only for the node’s own degree, but also the degrees of the nodes to which it connects. Namely, eigenvector centrality assigns relative scores to all nodes in a network based on the principle that connections to high-scoring nodes contribute more to the score of the node in question than an equal number of connections to low-scoring nodes.

In addition, we conducted a cluster analysis to detect clusters of vertices with similar patterns of connections. Cluster analysis assigns each vertex to one group based on decision rules which may adopt different algorithms. Clustering algorithms try to place collections of densely connected vertices into separate groups or clusters, minimising the diversity within a cluster and maximising the diversity between clusters. The NodeXL group findings tools provide the Clauset-Newman-Moore algorithm and the Girvan-Newman algorithm. The Clauset-Newman-Moore algorithm is an agglomerative algorithm. It starts with a community partition, where each single vertex represents a community. Then at each iteration, a pair of communities is merged into a single one, improving the measure of cluster quality until the final step in which further aggregations would decrease the overall quality (Newman, 2004a). In contrast, the Girvan–Newman algorithm is a divisive method based on the edge removal. It progressively removes edges from the network, focusing on edges between loosely connected communities (i.e. those with high “betweenness” value). By removing these edges, the communities are separated from one another and presented as clusters (Newman, 2004b).

A **clustering coefficient** is calculated, which quantifies the degree to which nodes in a graph tend to cluster together. Nodes with high degree values have relatively lower clustering coefficients because

they connect to many people who are not connected among them. In contrast, nodes with high clustering coefficients typically have fewer connections, since small groups are more able to connect every member to one another.

4. Results

4.1 SNA metrics

Network data statistics are provided in Table 1.

Table 1. Basic network characteristics.

Metric	Number
Vertices	35
Total Edges	470
Graph Density	0.39

Social network graphics were obtained using the Haren-Korel Fast Multiscale layout algorithm, provided by NodeXL. We considered all relations except for those marked with 1 – “I am aware that this actor exists, but to my knowledge, we do not have any contact with them” (Fig. 1).

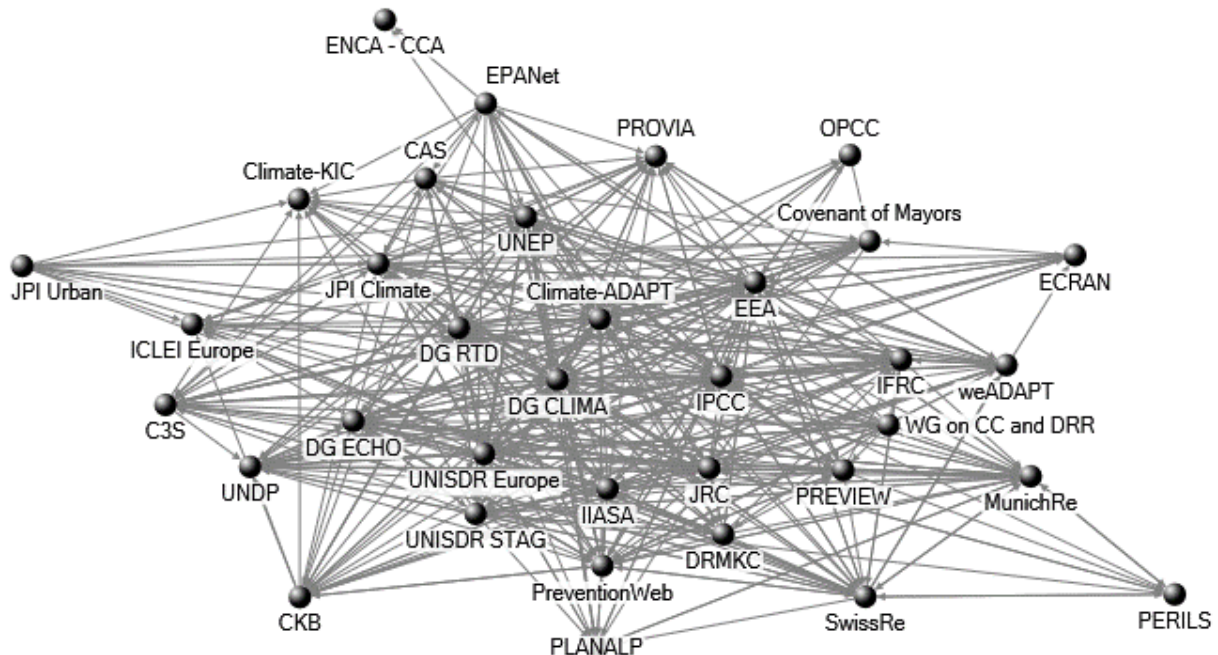


Fig. 1 SNA of 35 actors². Ties present connections marked by 2-5 on the connection intensity scale.

² For the three actors that did not participate in the survey, we considered relationships that other actors specified to have with them.

Considering the high number of connections in the network and in order to improve the visualisation of individual connections, in all graphs that follow below we considered only strong relations: frequent communication (marked with 3) and frequent or institutionalised collaboration (marked with 5).

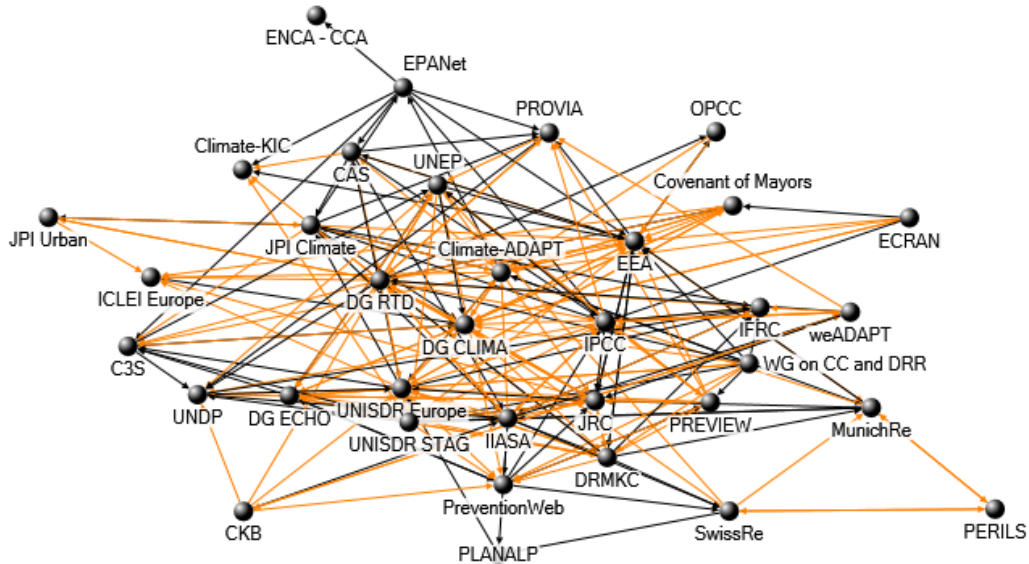


Fig. 2 SNA based on intensive communication and collaboration. Intensive communication is represented with black ties and intensive collaboration with orange ties.

In the rest of this section we will look into the main social analysis metrics, comparing different values (Table 2) and graphically presenting each of the metrics (Figures 3-12).

Table 2. Top ten actors based on their degree, in-degree, betweenness, Eigenvector centrality and clustering coefficient.

Rank	Degree centrality	In-Degree	Betweenness Centrality	Eigenvector centrality	Clustering coefficient
1	Climate-ADAPT	DG Clima	Climate-ADAPT	Climate-ADAPT, DG RTD	ENCA-CCA
2	DG RTD	EEA	DG RTD	DG Clima	OPCC
3	EEA, DG Clima	IPCC	DG Clima	UNEP	PLANALP
4	UNISDR Europe	JRC	EEA	EEA, UNISDR Europe	ECRAN
5	IPCC	Climate-ADAPT, UNEP, PreventionWeb	JRC	IPCC, IIASA, PreventionWeb	PERILS
6	UNEP	UNISDR Europe, UNDP	UNEP	IFRC, UNISDR STAG	PREVIEW
7	PreventionWeb	DG RTD, IFRC CC	IPCC	JRC	DRMKC
8	IIASA	DG ECHO, MunichRe,	UNISDR Europe	DG ECHO, SwissRe, UNDP	MunichRe
9	JRC	ICLEI Europe	EPANet	JPI Climate	JPI Urban

10	UNISDR STAG, JPI Climate, SwissRe	PROVIA, SwissRe	IIASA	MunichRe	ICLEI Europe
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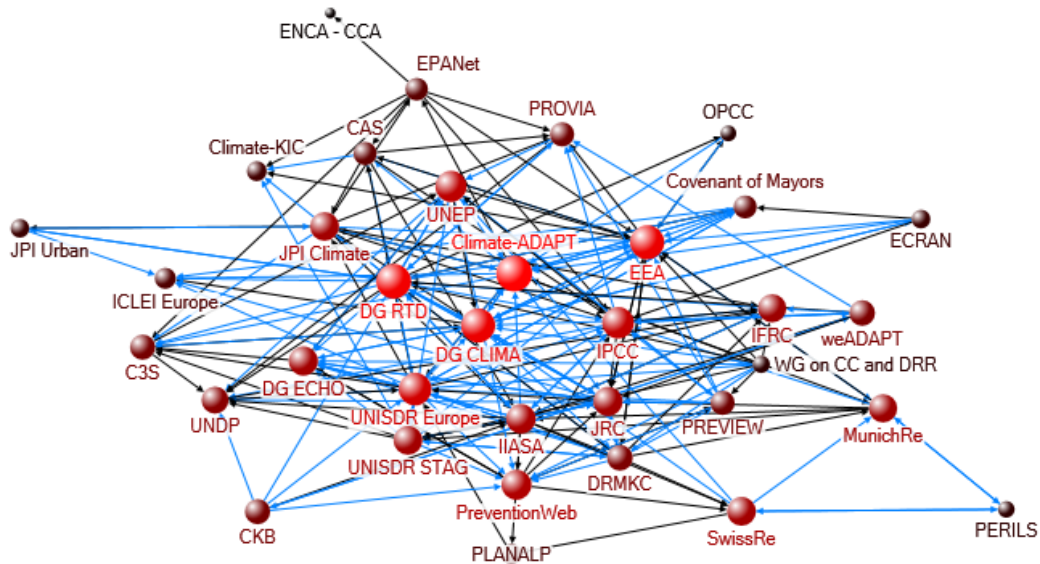


Fig. 3 SNA based on intensive communication and collaboration, presenting degree centrality. Node size and colour are determined by the node's degree centrality. Strong communication is represented with black and strong collaboration with blue edges.

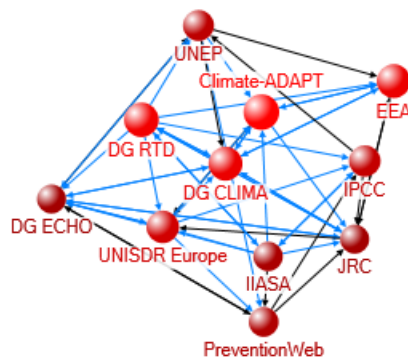


Fig. 4 Actors with the highest degree centrality

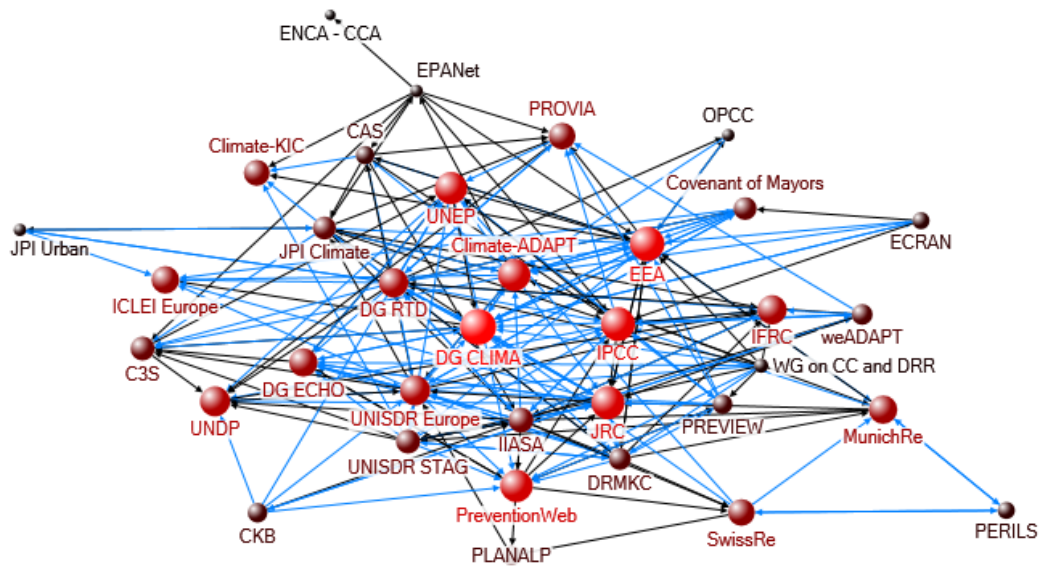


Fig. 5 SNA based on intensive communication and collaboration, presenting in-degree centrality. Node size and colour are determined by the node's in-degree centrality. Strong communication is represented with black and strong collaboration with blue edges.

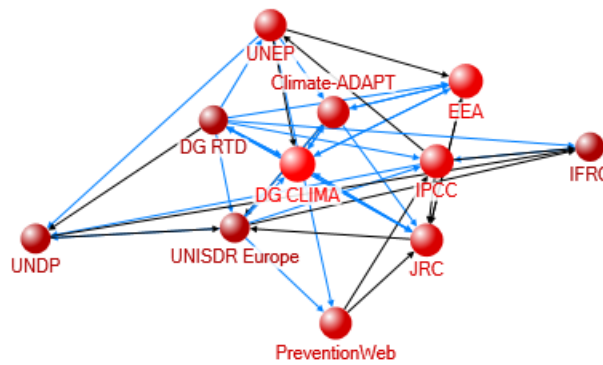


Fig.6 Actors with the highest in-degree values

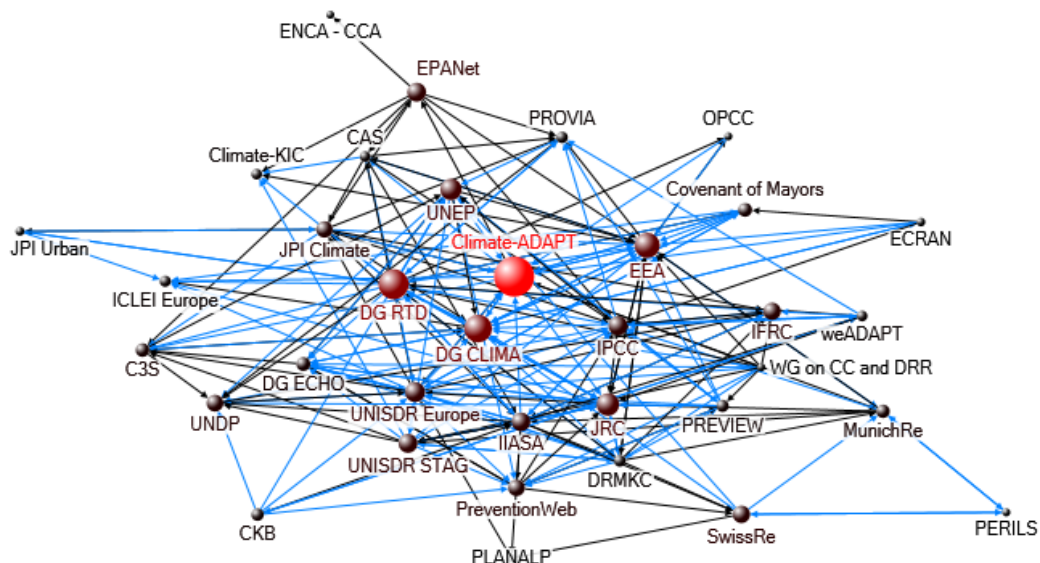


Fig. 7 SNA based on intensive communication and collaboration, presenting betweenness centrality. Node size and colour are determined by the node's betweenness centrality value. Strong communication is represented with black and strong collaboration with blue edges.

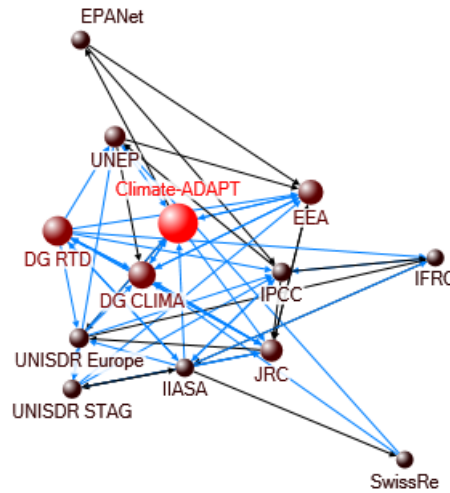


Fig. 8 Actors with the highest betweenness centrality values

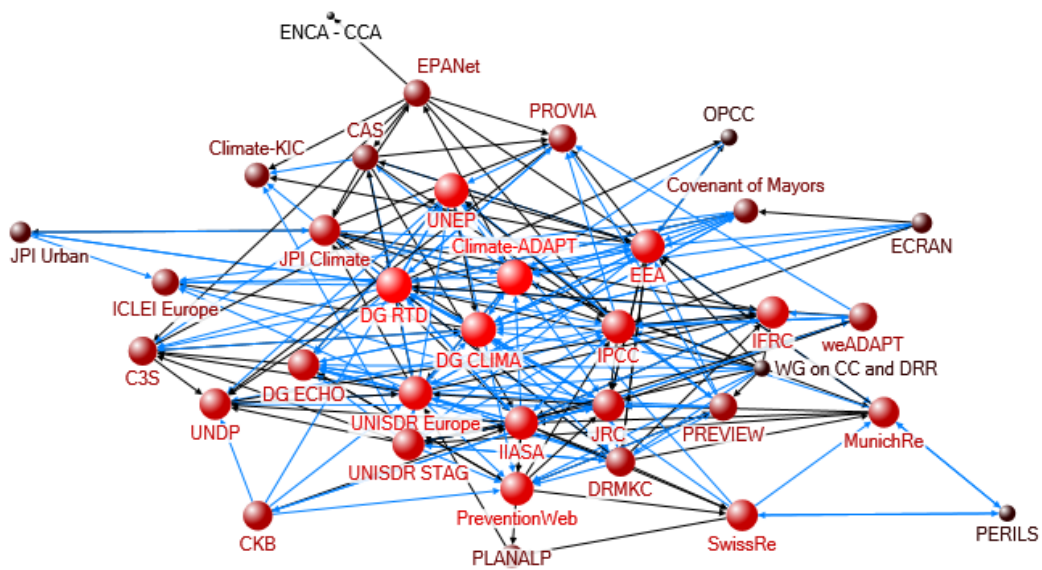


Fig. 9 SNA based on intensive communication and collaboration, presenting eigenvector centrality. Node size and colour are determined by the node's eigenvector value. Strong communication is represented with black and strong collaboration with blue edges.

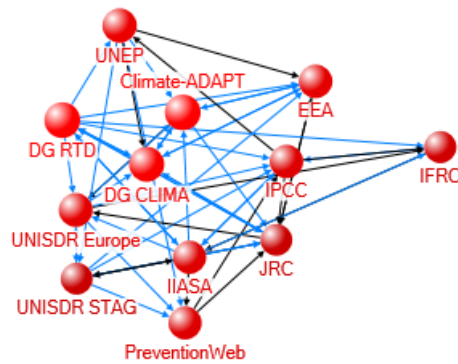


Fig. 10 Actors with the highest eigenvector values

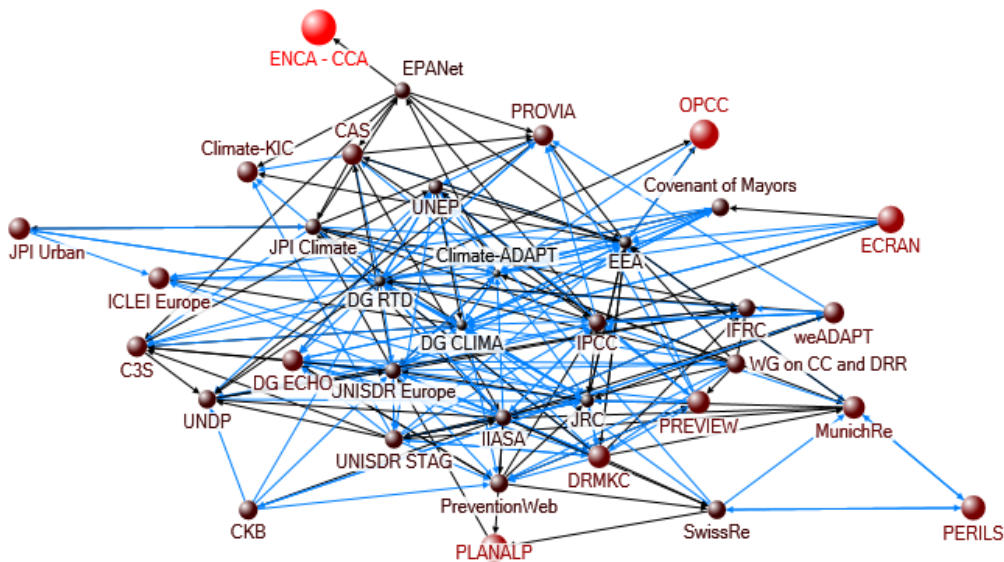


Fig. 11 SNA based on intensive communication and collaboration presenting clustering coefficient. Node size and colour are determined by the node's clustering coefficient. Strong communication is represented with black and strong collaboration with blue edges.

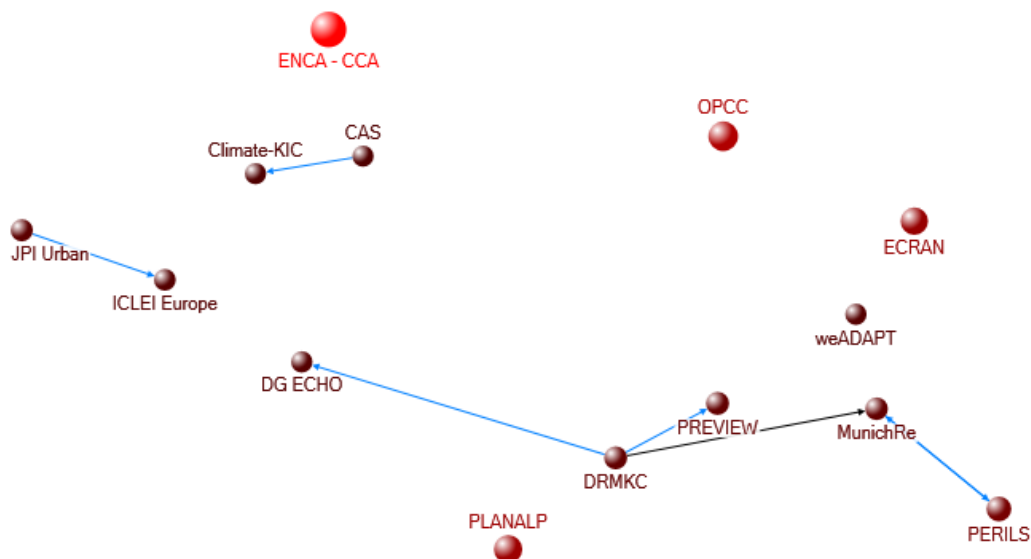


Fig. 12 Actors with the highest clustering coefficient

4.2 Actors' scope and field of work

The geographical scope and field of actors' work were described in the SPINE exercise. The following figures present these characteristics together with the actor metrics obtained in the PLACARD SNA. In particular, the node size is determined by the actor's betweenness centrality and nodes are positioned on the in-degree vs. degree scale. The colour presents actors' geographical scope (Europe, international, regional) in Figure 13, and actors' field of work (CCA, DRR, CCA and DRR, insurance, research, sustainability and data) in Figure 14.

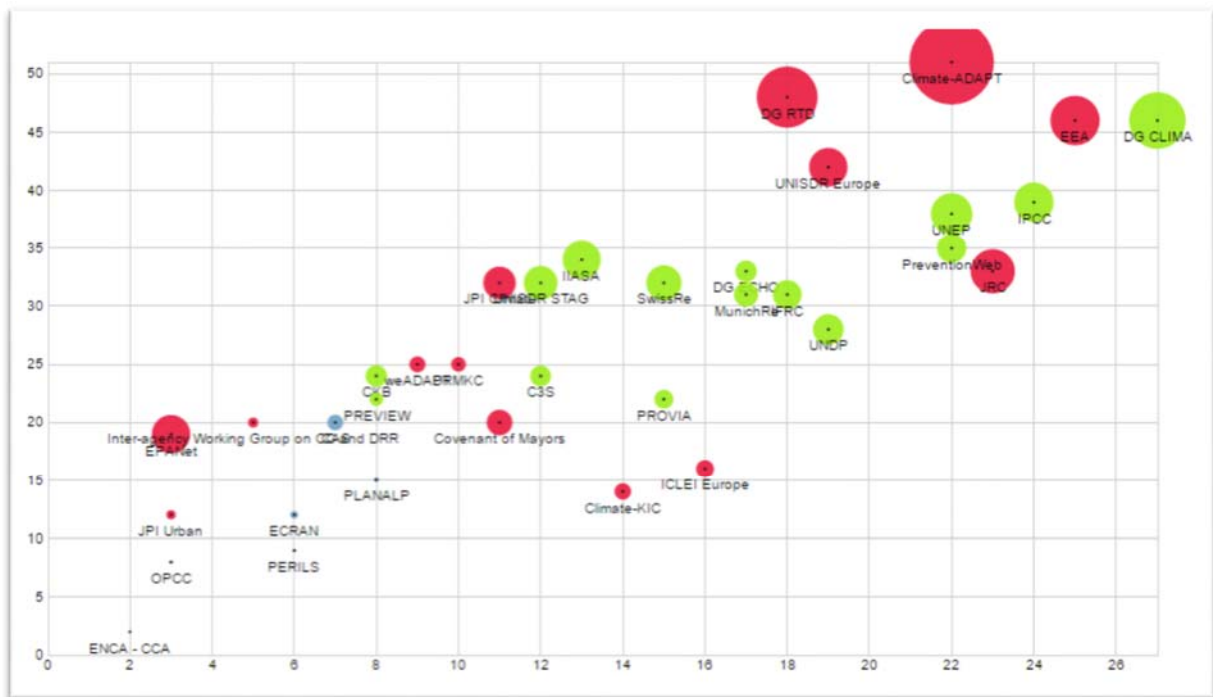


Fig. 13 Actors' scope. X axis – in-degree, Y axis – degree centrality, node size – betweenness centrality, colour – actor's scope³ (Europe – red, International – green, regional – blue).

³ The assessment of the **scope of actors' activities** was based on the information provided on their webpage or, if not explicitly indicated, on an analysis of the activities described on the webpage.

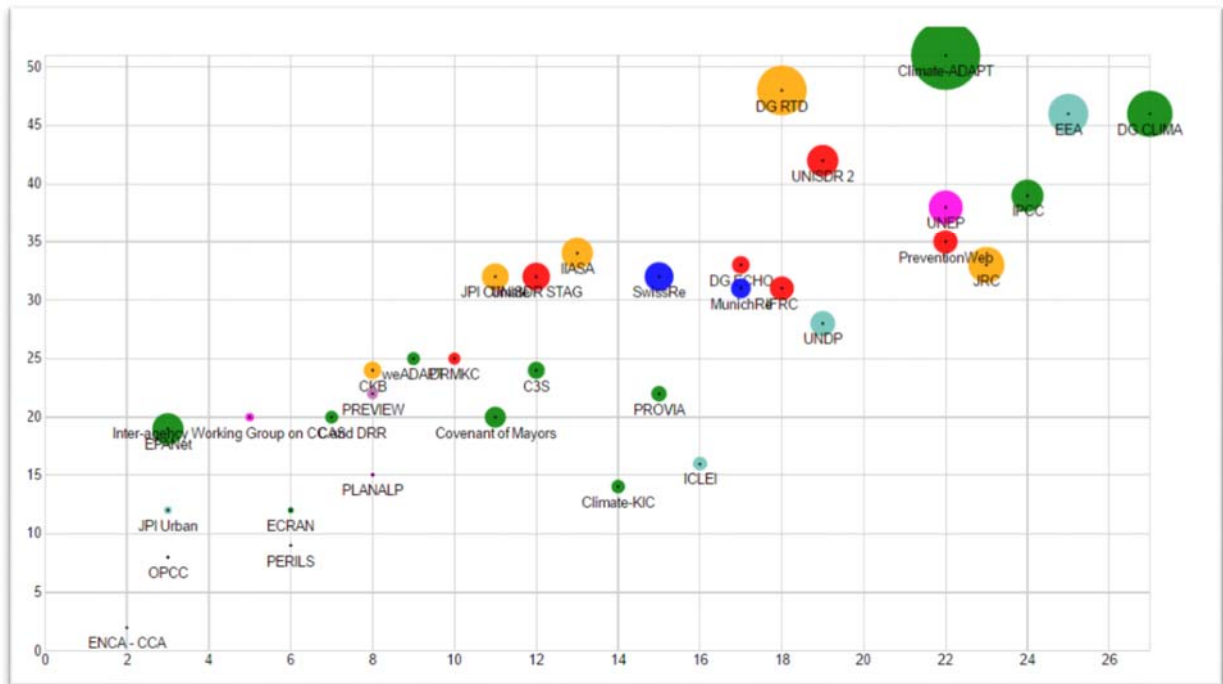


Fig. 14 Actors’ field of work. X axis – in-degree, Y –axis degree centrality, node size –betweenness centrality, colour – actor’s field of work⁴ (CCA – green, DRR – red, CCA&DRR – purple, insurance – blue, research – orange, sustainability – light blue, work with data – yellow).

4.3 Type of interaction

This section presents the types of interactions between the considered actors: statistically (Table 3) and graphically (Figures 15-17).

Table 3. Type of interaction

Interaction related to	CCA	DRR	CCA&DRR	Unspecified	TOTAL
Communication	93	60	78	27	258
Collaboration	71	45	86	10	212

As shown in Table 3, collaboration is most often related to both CCA and DRR, while communication in many cases tackles only one of the two areas. The type of collaborative relation was in most cases specified by participants, while in more than 10% of the responses communication was unspecified.

⁴ The assessment of the **actors’ field of work** is based on the information provided on their webpage, or if not explicitly indicated, on an analysis of the activities described on the webpage.

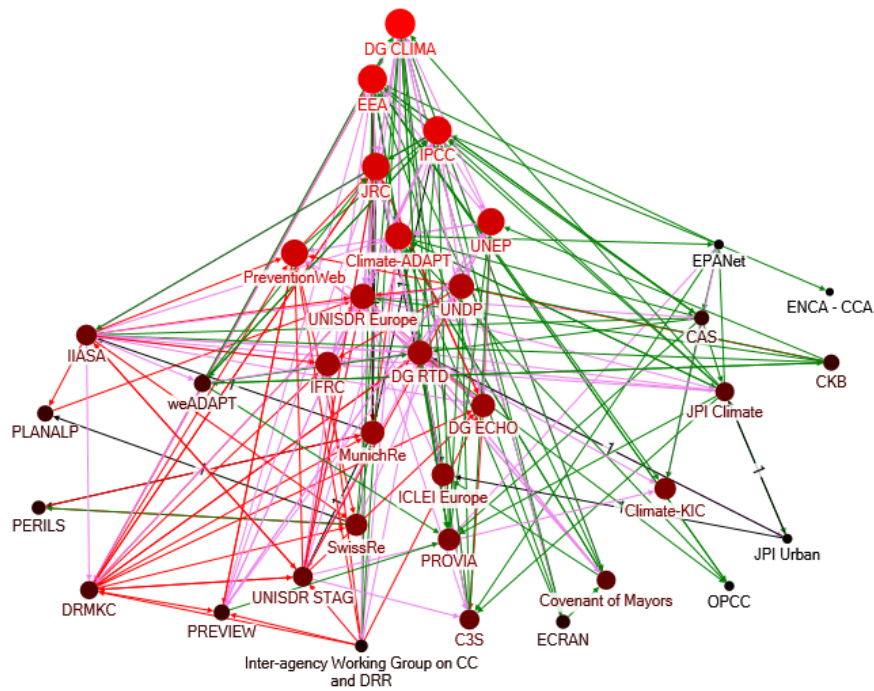


Fig. 15 SNA presenting the type of interaction. Green edges present interactions predominately related to CCA, red – predominately to DRR, violet – interactions related to both CCA and DRR. Black edges are unspecified. Node size and colour are determined by the node’s **in-degree value**. Nodes with the highest in-degree values are placed in the centre of the network, from top to down.

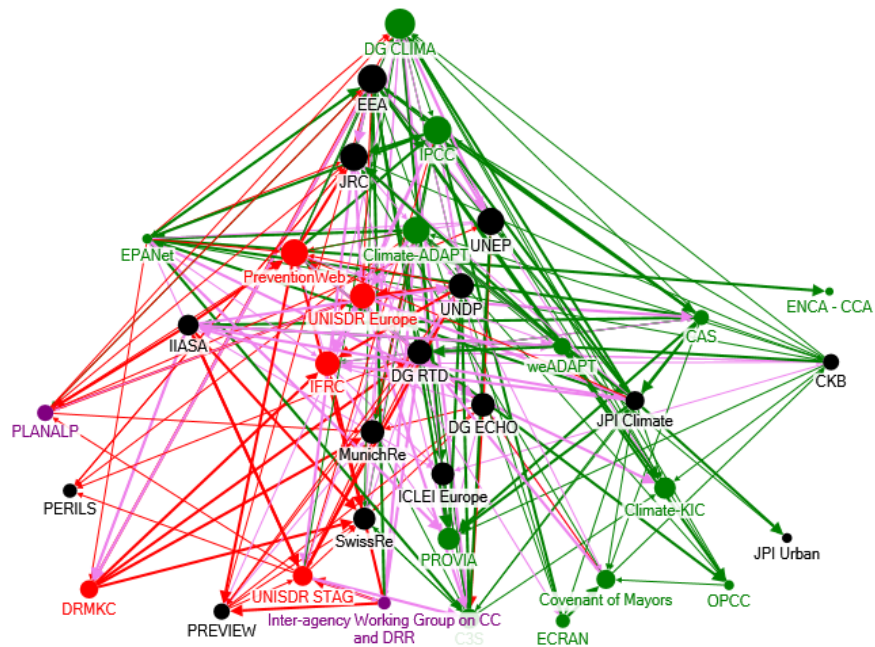


Fig. 16 SNA presenting the type of **communication**. Communication related connections (marked with 2 and 3) are green when predominately related to CCA, red when predominately related to DRR and violet when related to both CCA and DRR (unspecified connections are removed). Node colour is based on the **actors’ main field of work** (green – CCA, red – DRR, purple – both, black – other). Node size is determined by the node’s **in-degree value**.

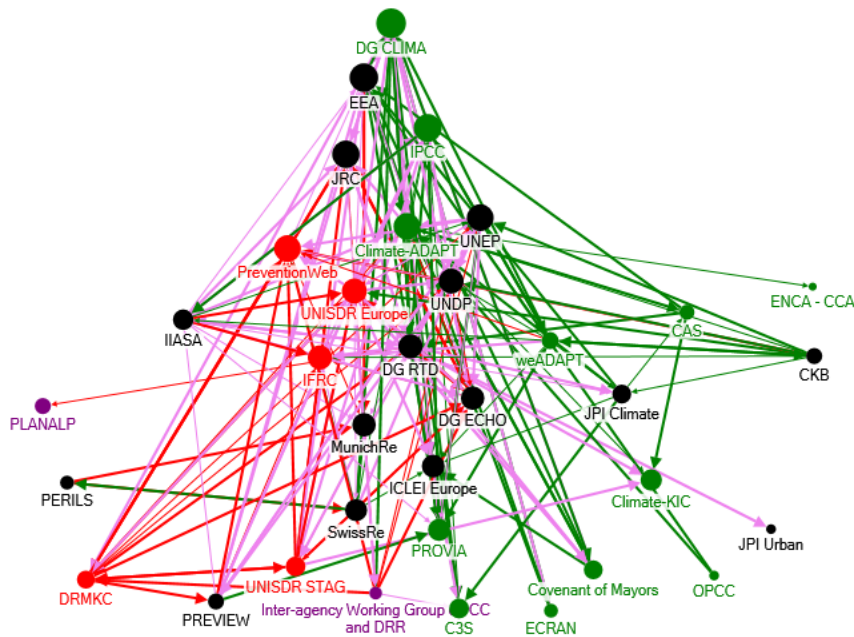


Fig. 17 SNA presenting the type of **collaboration**. Collaborative edges (marked with 4 or 5) are green when predominantly related to CCA, red when predominantly related to DRR and violet when related to both CCA and DRR (unspecified connections are removed). Node colour is based on the **actors' main field of work** (green – CCA, red – DRR, purple – both, black – other). Node size is determined by the node's **in-degree** value.

4.4 Cluster analysis

Cluster analysis of the PLACARD social network, using the Clauset-Newman-Moore algorithm resulted in two large and one small cluster (Fig. 18-23c). In the following figures the intergroup (inter-cluster) edges are combined for a better visual representation of the clusters.

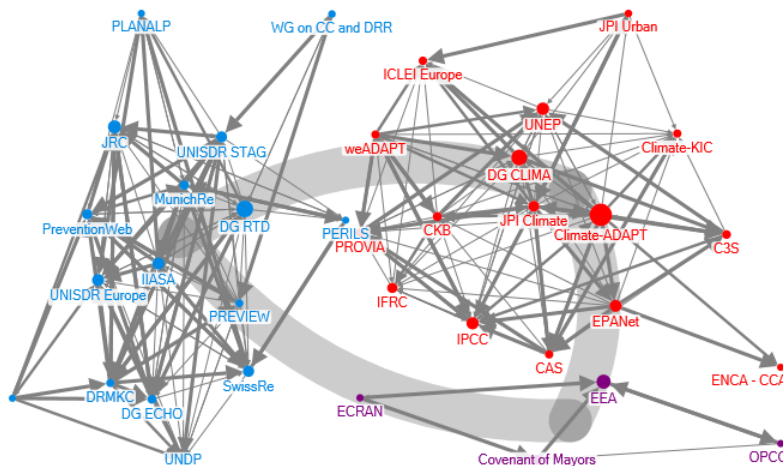


Fig. 18 Cluster analysis using the Clauset-Newman-Moore algorithm. Node size is determined by betweenness centrality values.

The visual presentation of the cluster analysis in the following three figures shows that connections related to CCA predominantly appear in one large and in the small cluster, while some appear also in the other large cluster (Fig. 19). Then again, connections related to DRR are mainly in the other large cluster (Fig.20).

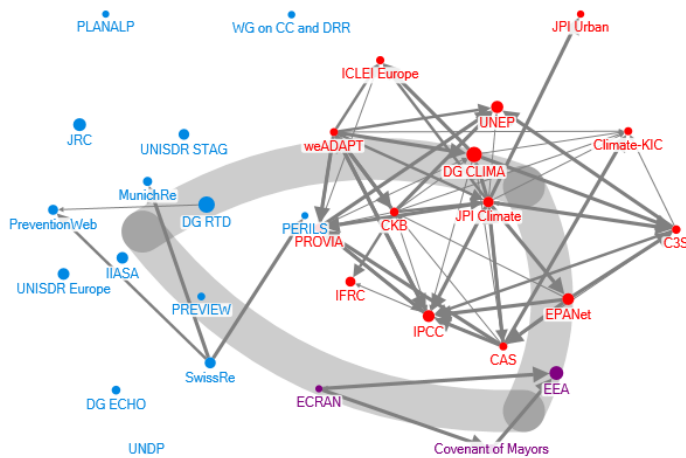


Fig. 19 Cluster analysis presenting **connections predominantly related to CCA**. Node size is determined by betweenness centrality values.

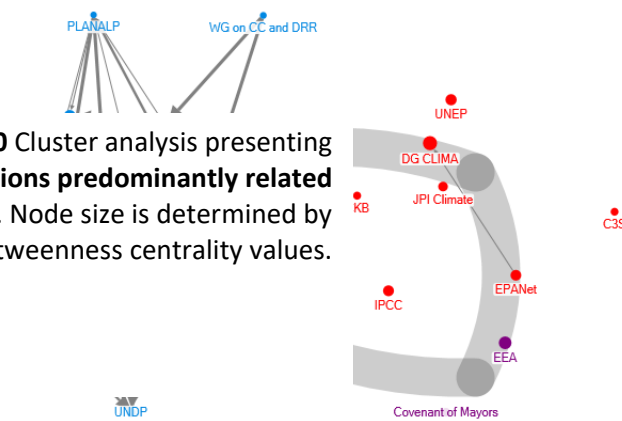


Fig. 20 Cluster analysis presenting **connections predominantly related to DRR**. Node size is determined by betweenness centrality values.

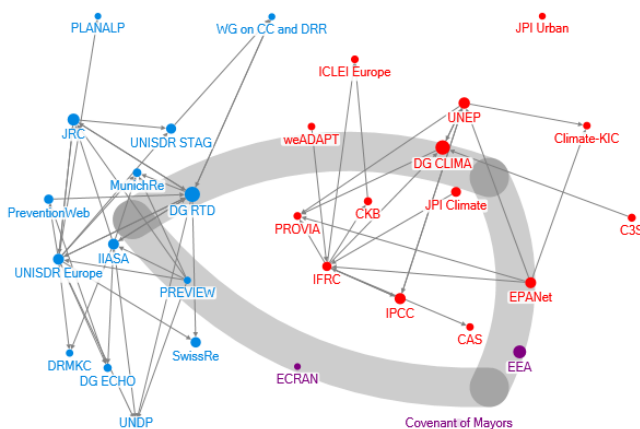


Fig. 21 Cluster analysis presenting **connections related to both CCA and DRR**. Node size is determined by betweenness centrality values.

When considering only connections related to communication (connections marked with 2&3), the Clauset-Newman-Moore algorithm produces three different clusters, compared to those produced using all the connections. In this case, the three clusters are of similar size. (Fig.22). Connections based

on communication appear in all three clusters, regardless whether they are related to CCA (Fig. 22a) or DRR (Fig. 22b).

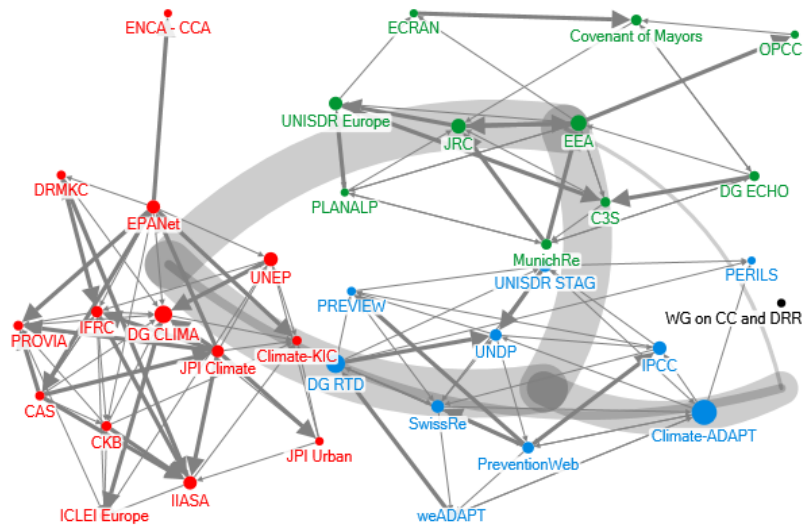


Fig. 22 Cluster analysis based on **communication**. Node size is determined by betweenness centrality.

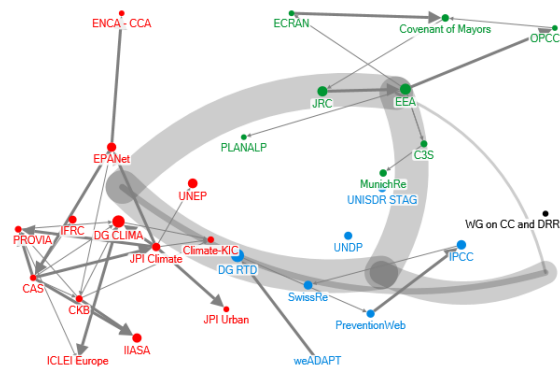


Fig. 22a Communication related to CCA

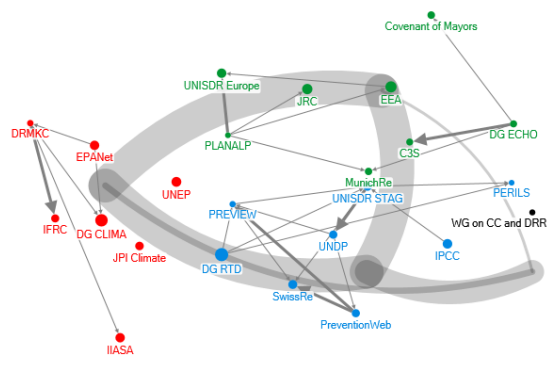


Fig. 22b Communication related to DRR

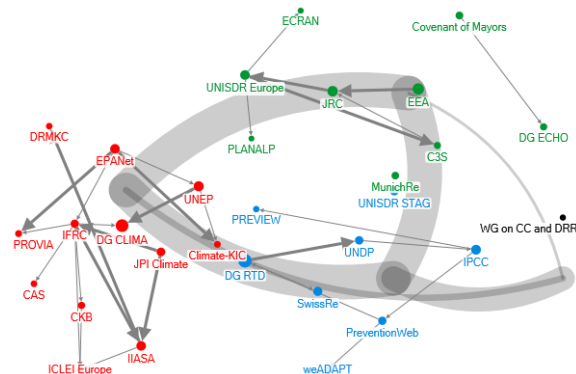


Fig. 22c Communication related to both DRR and CCA

Although the nodes are differently allocated than in figure 18, the cluster analysis of the connections based on collaboration (connections marked with 4 & 5) also gives two large and one small cluster (Fig. 23). Again, CCA related connections are distributed in all three clusters (Fig. 23a), while

connections related to DRR mainly appear in one cluster (Fig. 23b), which appears once more as a relatively cohesive, but maybe also rather isolated community.

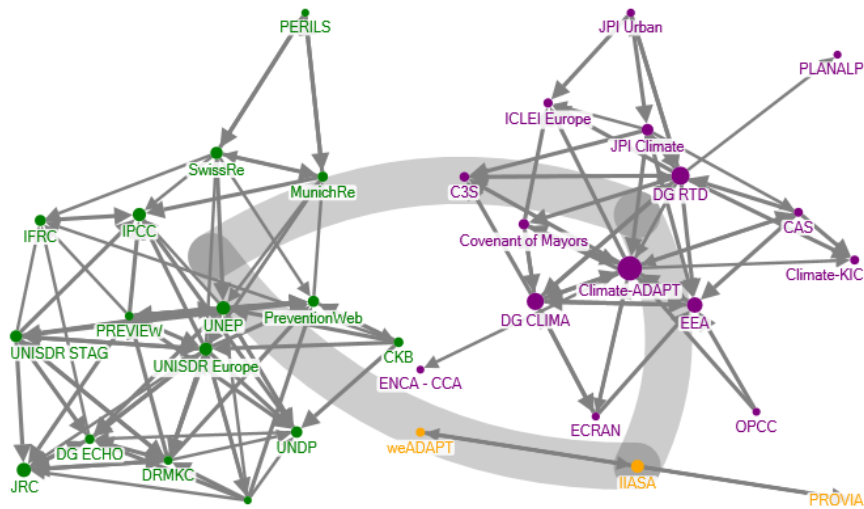


Fig. 23 Cluster analysis based on **collaboration**. Node size is determined with betweenness centrality.

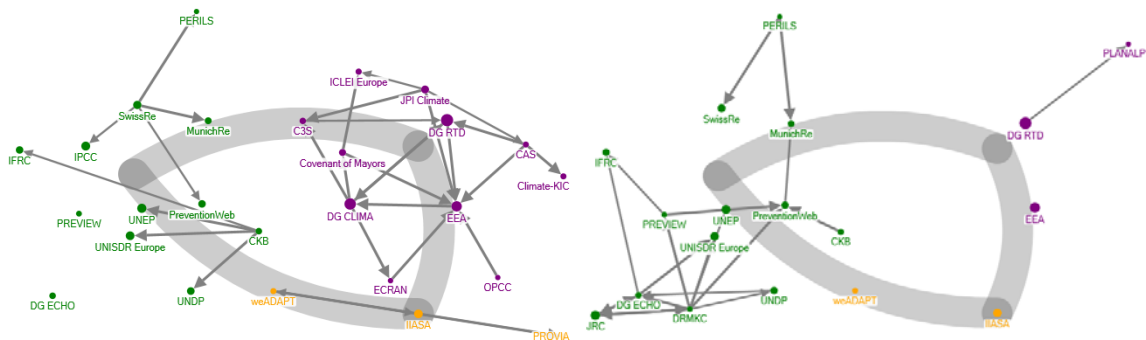


Fig. 23a Collaboration related to **CCA**

Fig. 23b Collaboration related to **DRR**

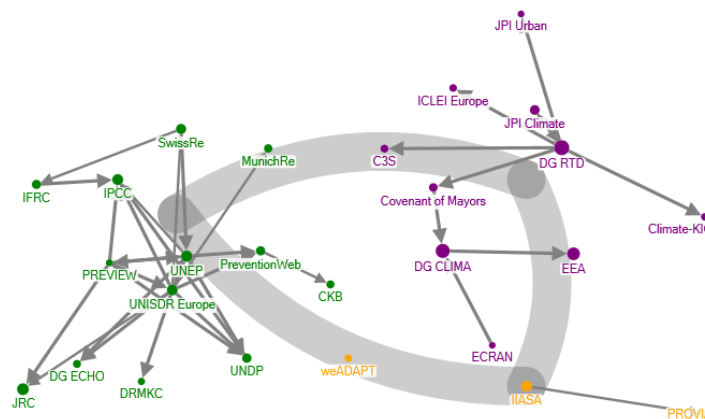


Fig. 23c Collaboration related to **both CCA and DRR**

Using the Girvan-Newman algorithm, based on edge removal, we detected one large and many very small clusters – containing one actor per cluster (Fig. 24-27). The large cluster aggregates mainly DRR actors, thus confirming the relatively stronger aggregation of that community, in comparison to CCA.

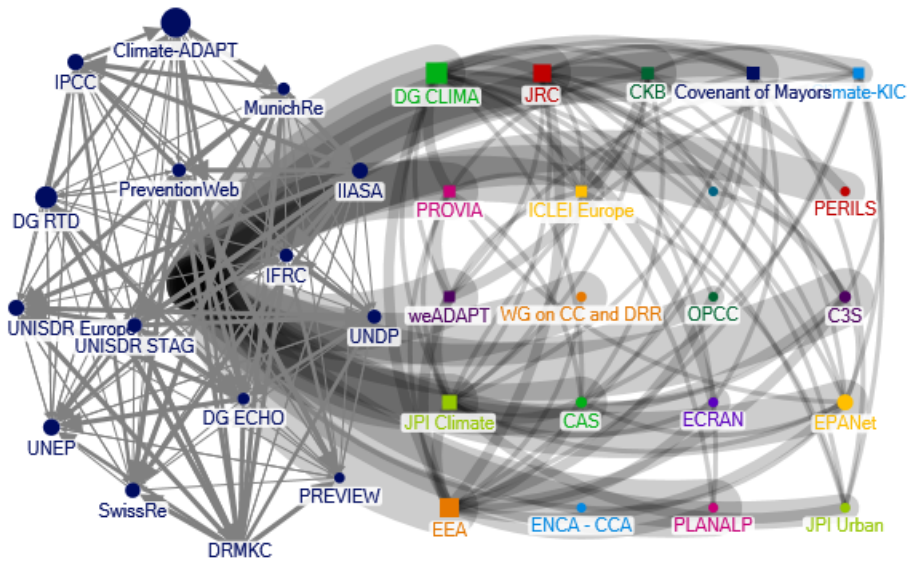


Fig. 24 Cluster analysis with the Girvan-Newman algorithm. Node size is determined by the betweenness centrality values.

Scrutinising the type of connection, the pattern detected with the first clustering analysis repeats: connections related to DRR pertain to one apparent cluster (Fig. 26). The Girvan-Newman clustering algorithm does not find any obvious clustering pattern when it comes to connections related to CCA (Fig. 25).

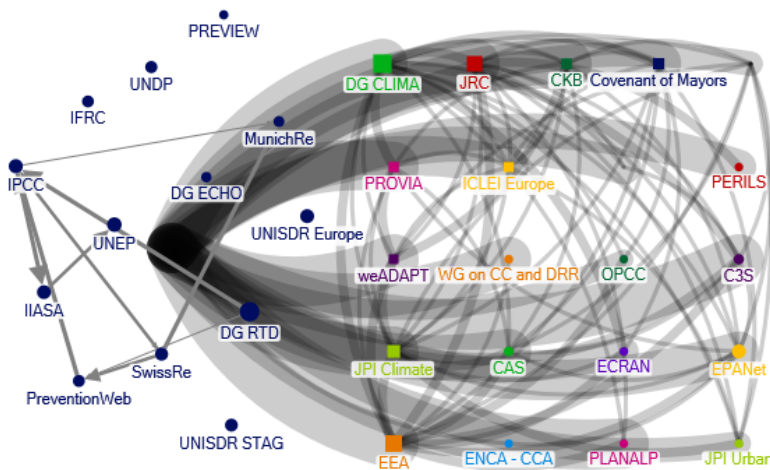


Fig. 25 Cluster analysis presenting connections predominantly related to CCA. Node size is determined by the betweenness centrality values.

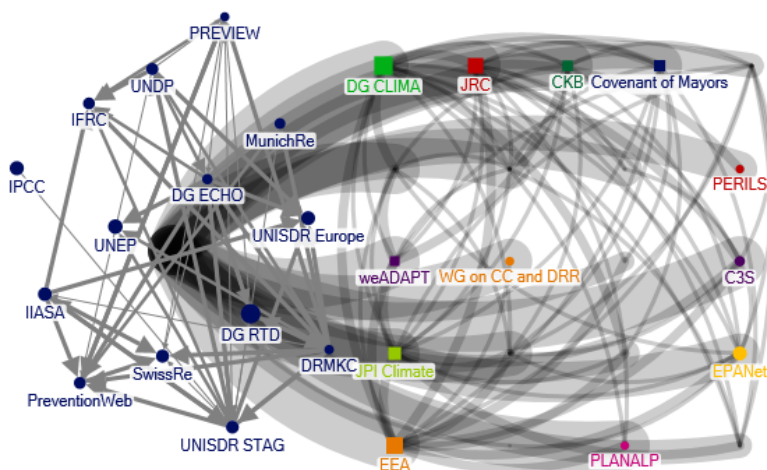


Fig. 26 Cluster analysis presenting connections predominantly related to DRR. Node size is determined by the betweenness centrality values.

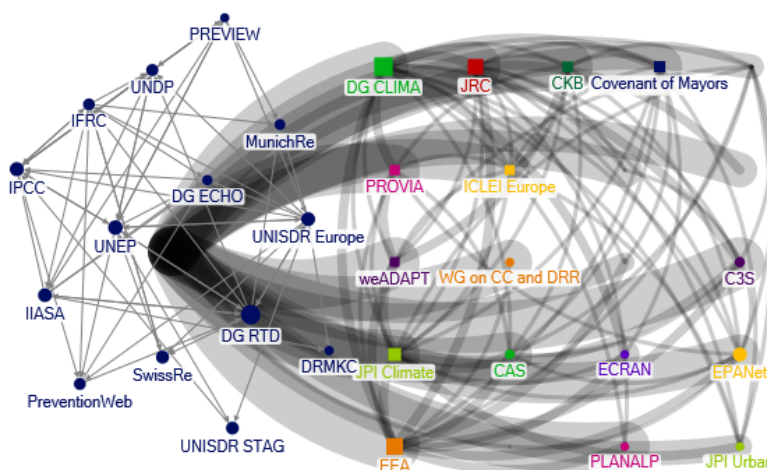


Fig. 27 Cluster analysis presenting connections related to both CCA and DRR. Node size is determined by betweenness centrality values.

After using two different clustering algorithms, the results signal that connections predominantly related to DRR gravitate towards one single cluster (Fig. 20 and Fig. 26). This clustering tendency of communication and collaboration connections related to DRR is clearer than it is in the case of connections predominantly related to CCA or to both CCA and DRR.

5. Conclusive remarks and future work and outreach possibilities

The analysis of social networks applied to selected actors identified in the SPINE analysis of Placard WP2 allowed to map the relationships between key international actors in the field of CCA and DRR. Results showed that in general two “communities” can be identified, corresponding to actors involved mainly in CCA or in DRR activities. The allocation of actors to two groups is not rigid and variations are observed depending on the applied algorithms and the considered indicators, but in general it appears clear that DRR actors form a more cohesive and relatively isolated group, while CCA actors are more sparse and diverse. Communication and collaboration exist both with groups and between groups. In relative terms, communication appears to be stronger within groups, while collaboration is also relatively relevant between groups.

In this study, Climate-ADAPT emerged as the actor with the highest degree, betweenness and eigenvector centrality, thus showing a relevant role in communicating with the actors involved in the

survey and setting up communication also with those that do not have reciprocal interactions. Besides this platform, the Directorate-General for Research and Innovation (DG RTD), the European Environment Agency (EEA) and the Directorate-General for Climate Action (DG CLIMA) were identified as other actors with high centrality values. The actor with the highest in-degree, i.e., the number of ties others specified to have with them, was DG CLIMA, followed by EEA and IPCC.

When it comes to the type of interaction, collaboration is most often related to both CCA and DRR, while communication in many cases tackles one of the two areas. Then again, unlike the type of collaboration that was mainly specified in the survey, in more than 10% of the responses type of communication was unspecified.

Furthermore, cluster analysis was applied to identify clusters of actors with similar patterns of connections. We used two different clustering approaches: the Clauset-Newman-Moore algorithm and the Girvan-Newman algorithm. When applying the Clauset-Newman-Moore algorithm, analysis revealed two large and one significantly smaller cluster: connections predominantly related to DRR were clearly grouped in one cluster; connections related to CCA mainly belonged to the second large cluster, but had elements in the other two clusters as well; connections related to both CCA and DRR had elements mainly in the two large clusters. Instead, when applying the Girvan-Newman algorithm, we obtained one large cluster – where most of the DRR related connections pertained to, and 21 small (single actor) clusters. According to the cluster analysis, actors tied with DRR related connections were more prone to clustering, i.e. had a recognizable pattern of connections, while CCA and mixed related connections were more diverse, without an obvious clustering affinity.

Within WP2, PLACARD project will monitor, use and support ongoing and future stocktaking activities in the CCA and DRR fields, e.g., updates of the reports on CCA and DRR platforms. It will also continue to trace follow-up developments of the 2016 UNISDR Science and Technology Conference on the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030, in particular those related to the knowledge of existing networks, partnerships and other relationships and their interactions (cf. Aitsi-Selmi et al. 2016).

The information collected in Task 2.2 will provide a point of reference for the work that will be carried out in WP6 on a dynamic and interactive network visualization of the evolving CCA and DRR landscape. It will also provide information for the work of WP3 related to the analysis of fragmented knowledge in the CCA and DRR communities. Results from this analysis will be shared with all the participants of the survey.

6. References

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Annex I – Online PLACARD SNA survey template

<div data-bbox="215 362 735 521" data-label="Image">  </div> <p>Having in mind the institution/ initiative/ office/ platform you represent, please make an assessment of your interaction with the actors included in the list below by selecting on the scale 1-5, and indicate if the interaction is related to Climate Change Adaptation (CCA), Disaster Risk Reduction (DRR), or both.</p> <p>The meaning of the scale is the following: 1 – I am aware that this actor exists, but to my knowledge, we do not have any contact with them 2 – Myself and/or my colleagues communicate with this actor from time to time 3 – Myself and/or my colleagues have frequent communication exchange with this actor 4 – Myself and/or my colleagues collaborate with this actor from time to time 5 – Myself and/or my colleagues have regular and/or institutional collaborations with this actor</p> <p>Please compile the entire list (no compilation will be interpreted as: "I am not aware of this actor")</p> <p>You can provide your feedback in the "Comment" field, including recommendations for any other important actor to be considered in</p> <p style="text-align: right;">1</p>	<p>How would you characterise and assess your interaction with the following actors in the fields of DRR and CCA?</p> <table border="1"> <thead> <tr> <th>Intensity of Interaction (1-5)</th> <th>Type of Interaction (related to CCA and/or DRR)</th> </tr> </thead> <tbody> <tr><td>Climata-ADAPT</td><td></td></tr> <tr><td>CAB (Climate Adaptation Services)</td><td></td></tr> <tr><td>Climata-KIC (Knowledge and Innovation Community)</td><td></td></tr> <tr><td>CKB (Climate Knowledge Brokers) Group</td><td></td></tr> <tr><td>Covenant of Mayors</td><td></td></tr> <tr><td>C3S (Copernicus Climate Change Service)</td><td></td></tr> <tr><td>DG CLIMA</td><td></td></tr> <tr><td>DG ECHO (Humanitarian Aid and Civil Protection department)</td><td></td></tr> <tr><td>DG RTD (Research & Innovation)</td><td></td></tr> <tr><td>DRM/KC (Disaster Risk Management Knowledge Centre)</td><td></td></tr> <tr><td>ECORAN (Environment and Climate Regional Accession Network)</td><td></td></tr> <tr><td>ENCA - CCA Interest Group</td><td></td></tr> </tbody> </table> <p style="text-align: right;">3</p>	Intensity of Interaction (1-5)	Type of Interaction (related to CCA and/or DRR)	Climata-ADAPT		CAB (Climate Adaptation Services)		Climata-KIC (Knowledge and Innovation Community)		CKB (Climate Knowledge Brokers) Group		Covenant of Mayors		C3S (Copernicus Climate Change Service)		DG CLIMA		DG ECHO (Humanitarian Aid and Civil Protection department)		DG RTD (Research & Innovation)		DRM/KC (Disaster Risk Management Knowledge Centre)		ECORAN (Environment and Climate Regional Accession Network)		ENCA - CCA Interest Group																									
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Annex II – List of Survey Participants

Table B1. List of actors invited to participate in the PLACARD SNA online survey

No.	Stakeholder name	Brief description	Core competencies	Field
1	Climate-ADAPT	European CCA online platform and reference point to EU climate change impacts, vulnerabilities, adaptation tools, options and case studies to support Europe in adapting to climate change.	'Providing access and sharing information on the following topics: expected CC in Europe, current and future vulnerability of regions and sectors EU, national and transnational adaptation strategies and actions, adaptation case studies and potential adaptation options, tools that support adaptation planning.'	CCA
2	Climate Adaptation Services (CAS)	'(...) non-profit organisation that provides user-centered visualisation tools to anticipate the effects of climate change. CAS supports governments, policy makers and professionals in gaining an understanding of (local) climate impacts and provides methods and tools to support the process of spatial adaptation.'	Making climate information accessible and understandable to practitioners: visualisation of climate change impacts, interpretation of climate scenarios.	Climate research, CCA
3	Climate-Knowledge and Innovation Community (Climate-KIC)	'(...) Europe's largest public-private innovation partnership focused on climate change, consisting of dynamic companies, the best academic institutions and the public sector.' Its mission is to create zero-emission, resilient society. KIC was established in 2001 by European Institute of Innovation and Technology (EIT - EU body).	Integration of education, entrepreneurship and innovation resulting in connected, creative transformation of knowledge and ideas into economically viable products or services in the following areas: urban transitions, sustainable production systems, decision metrics & finance, sustainable land use.	CCM, CCA
4	Climate Knowledge Brokers Group (CKB)	An alliance of leading global, regional and national websites specialised in climate and development information. Its focus is on online initiatives that play an explicit knowledge brokerage role, rather than being simply institutional websites.	Developing common tools for an efficient sharing of and searching for climate data, initiating joint projects to connect different websites, test out innovations and generate new thinking on how to best meet user needs, supporting peer learning, building capacity by offering hands-on advice to new initiatives being set up, providing leadership to create a focal point and a voice for the community as a whole.	Climate research
5	Covenant of Mayors	'World biggest urban climate and energy initiative'. It consists of regional and local governments that voluntarily commit to fulfil the requirements of EU Climate and Energy framework.	Three main work areas of Covenant of Mayors (as agreed in October 2015) are: mitigation, adaptation, and securing sustainable and affordable energy.	CCM, CCA, Sustainability

6	Copernicus Climate Change Service (C3S)	Earth observation programme coordinated and managed by the European Commission. It collects the data from earth observation satellites and in situ sensors such as ground stations, airborne and sea-borne sensors and processes these data to provide users with reliable and up-to-date information through a set of services related to environmental and security issues. Established in 2014.	Copernicus services address the following thematic areas: environment protection, management of urban areas, regional and local planning, agriculture, forestry, fisheries, health, transport, climate change, sustainable development, civil protection and tourism.	Climate Services, CCA
7	DG CLIMA (Directorate General for Climate Action)	DG CLIMA is in charge of the EU climate policy. In particular, it prepares and implements EU-wide climate regulations, it participates in international climate negotiations, supervises implementation of the EU ETS and monitors national emission levels. Last, but not least DG CLIMA propagates green technologies and their implementation. This directorate was founded in 2010.	Specific tasks performed by specialized DG CLIMA units include: A) International mainstreaming (e.g. implementation of the Paris Agreement, climate finance, mainstreaming of the Montreal Protocol), B) European and international carbon markets, C) Climate strategy, governance and emissions from non-trading sectors, D) Shared resources. In particular, Unit A3 Adaptation is responsible for the implementation of the adaptation policy and strategy in order to develop climate resilience, incorporation of the adaptation into other policy areas such as water or infrastructure, promotion of climate adaptation actions in the climate negotiations and among least developed countries as well as its acknowledgement in specific funds.	CCM, CCA
8	DG ECHO (EU Humanitarian Aid and Civil Protection department)	DG ECHO aims to 'save and preserve life, prevent and alleviate human suffering and safeguard the integrity and dignity of populations affected by natural disasters and man-made crises.'	Two pillars of work of DG ECHO are humanitarian aid and civil protection. Within the first category, DG ECHO deals with many different topics ranging from refugee help to international humanitarian law. Particularly important to PLACARD are the following topics: resilience, disaster risk reduction and capacity building. Within the second category, DG ECHO manages EU Civil protection mechanism, Emergency Response Coordination Center, monitoring tools etc.	Humanitarian Aid, DRR
9	DG RTD (Directorate-General for Research and Innovation)	DG RTD is in charge of the innovation policy with the overall aim of creating an Innovation Union. Its long-term objectives include boosting EU competitiveness, job creation and dealing with main societal challenges (incl. CC).	The work of DG RTD includes: the analyses of national R&I policies, provision of recommendations, creation and implementation of the European Research Area, funding research and innovation through corresponding Framework Programmes such as FP7 or H2020.	Research and Innovation

	Research and Innovation)			
10	Disaster Risk Management Knowledge Centre (DRMKC)	'European Commission's initiative to improve and deepen the communication between policy makers and scientists in the field of disaster risk management.'	' translation of complex scientific data and analyses into usable information, (...) science-based advice for DRM policies, as well as timely and reliable scientific-based analyses for emergency preparedness and coordinated response activities. It brings together existing initiatives in which science and innovative practices contribute to the management of disaster risks'	DRR
11	Environment and Climate Regional Accession Network - ECRAN	EU-financed and EC-managed programme that supports cooperation between EU and prospective EU candidate countries in the area of environmental and climate protection as well as the alignment of their policies and actions to the EU standards. The work of ECRAN is conducted in three WPs related to environment, climate action and cross-cutting issues (such as enforcement and compliance or public participation).	Facilitation of exchange of information and promotion of best practices related to the EU accession and corresponding environmental requirements. In particular, the Adaptation Working Group aims to encourage development and implementation of adaptation policies in the beneficiary countries, to make economic sectors incl. infrastructure 'climate proof', to improve adaptation decision making process and connect it to WeAdapt.	Environmental protection, CCM, CCA
12	The Heads of European Nature Conservation Agencies ENCA - CCA	ENCA is '(...) an informal network which aims to strengthen nature conservation in Europe by enhancing cooperation and collaboration between its members.'	Supporting policy development, establishing a forum for sharing information, experiences and best practices, strengthening scientific evidence base to improve decision making in the field of nature conservation and landscape protection.	Environmental protection, nature conservation
13	EPANet	Interest Group of European Network of Heads of Environment Protection Agencies (EPANet)	Investigating in details issues related to CC and CCA important to the network.	CCA
14	European Commission Joint Research Centre (JRC)	JRC is 'European Commission's science and knowledge service which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy.'	Providing independent scientific evidence to the EU policymaking process, collaboration with scientific institutions.	Civil protection, Environmental protection
15	European Environmental Agency (EEA)	EU institution to provide information to those involved in developing, adopting, implementing and evaluating environmental policy, and also to the general public. An important field of work of EEA is climate change	Helping the Community and Member Countries make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability, coordination of	Environmental protection,

		(mitigation and adaptation). Established in 1990, entered into force 1993.	the European environment information and observation network Eionet (http://www.eionet.europa.eu/)	sustainability
16	ICLEI Europe	'ICLEI is the only network of sustainable cities operating worldwide. The organisation facilitates local government input to United Nations (UN), processes such as the UN Framework Conventions on Climate Change, and Biodiversity. In partnership with the UN and other organisations, as well as national governments, ICLEI puts in the groundwork for more ambitious and more responsible international commitments - and seeks global recognition and support for local action.'	Facilitating strategic alliances, advocacy, exchange of experiences and best practices, organisation of campaigns and programmes, provision of tools and technical trainings to enable sustainable growth.	(Urban) Sustainability
17	International Federation of Red Cross and Red Crescent Societies (IFRC)	'IFRC carries out relief operations to assist victims of disasters, and combines this with development work to strengthen the capacities of its member National Societies. The IFRC's work focuses on four core areas: promoting humanitarian values, disaster response, disaster preparedness, and health and community care.'	Crisis relief, disaster risk management, preparedness, capacity building.	Humanitarian Aid, DRR, CCA
18	International Institute for Applied Systems Analysis (IIASA)	International independent scientific organisation conducting research on policy-relevant topics such as global environmental, economic, technological, and social change and providing guidance to policymakers. Its goal is to protect the environment and improve social wellbeing. IIASA was founded in 1972 and it has been funded by research funding agencies.	Research on specific solutions to complex problems (e.g. CC) that affect countries' economies, environment and society, creation of research base for systems analysis, developing multilateral scientific relationships. One of its main strategic research themes is Risk and Resilience.	Sustainability
19	Intergovernmental Panel on Climate Change (IPCC)	Leading international body for the assessment of climate change established by UNEP and WMO '(...) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts.'	Review and assessment of the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change.	CCM, CCA
20	Climate Joint Programming Initiative (JPI Climate)	'(...) collaboration between 14 EU Member States to coordinate their climate research and fund new transnational research initiatives. It connects scientific disciplines, enables cross-border research and increases the science-practice interaction.'	User-driven development and provision of knowledge for understanding the climate, climate change and its impacts, as well as guidance in its use.	Climate change research

21	JPI Urban Europe	'As one of the resulting joint programming initiatives the JPI Urban Europe was created in 2010 to address the global urban challenges of today with the ambition to develop a European research and innovation hub on urban matters and create European solutions by means of coordinated research. Currently, JPI Urban Europe has 13 members (...).'	Supporting '(...) transition of European urban areas towards sustainable, resilient and liveable ones by establishing a transnational mission-oriented research, technological development and innovation programme and acting as the European hub on sustainable urban development; supporting collaborative research, technological development and innovation within and beyond Europe.'	Urban development, (urban) sustainability
22	MunichRe	One of the world's leading reinsurers funded in 1880 in Munich.	Risk assessment, risk transfer solutions, assessment management.	Insurance
23	PERILS	Insurance industry initiative aimed at improving the availability of catastrophe insurance market data. PERILS' industry data are based on information exclusively received from insurance companies writing business in the territories covered by PERILS. The industry benchmark data are available to all interested parties via a subscription service.	Industry exposure and event loss data and an associated industry loss index service for Europe windstorm, UK flood, Italy earthquake and flood and Turkey earthquake and flood.	Risk Assessment
24	Platform on Natural Hazards of the Alpine Convention (PLANALP)	PLANALP 'was set up as part of Alpine Convention to develop common strategies designed to prevent natural hazards in the Alps as well as to exchange on adaptation strategies'.	Formulation of strategic concepts on integrated risk management against natural hazards and the coordinated implementation of subsequent measures, knowledge transfer and exchange of best practices, implementation of flood (risk) management plans, propagating the use of standards for natural hazards and risk.	CCA, DRR
25	PreventionWeb	'participatory web platform for the disaster risk reduction community', created by UNISDR.	'facilitation of an understanding of the subject of disaster risk reduction (DRR) and the work of professionals in this area by providing current news and views on the topic, and tools for exchange and collaboration.'	DRR
26	PREVIEW	'The PREVIEW Global Risk Data Platform is a multiple agencies effort to share spatial data information on global risk from natural hazards. Users can visualise, download or extract data on past hazardous events, human & economical hazard exposure and risk from natural hazards. (...), developed as a support to the Global Assessment Report on Disaster Risk Reduction (GAR).'	Providing spatial data information on natural hazards.	Risk Assessment and Exposure
27	PROVIA	'(...) global initiative which aims to provide direction and coherence at the international level for research on vulnerability, impacts and adaptation.' It acts as a	Advancing policy-relevant research on vulnerability, impacts, and adaptation related to climate change, dissemination and	CCA

		'network of scientists, practitioners and decision-makers working towards identifying research gaps and meeting policy needs.'	practical application of this research for the benefit and value of society.	
28	Pyrénéen du Changement Climatique (OPCC) (eng. Pyrenees Climate Change Observatory)	'Working Community of the Pyrenees is a consortium of 8 territorial governments (7 sub national governments and one national government) launched in 2010 the Pyrenees Climate Change Observatory. The OPCC's goal is to monitor and understand the climate evolution in the Pyrenees, with the aim of becoming less vulnerable to the impacts of climate change, and adapting to its effects by defining appropriate adaptation strategies for socio- economic sectors and the most fragile natural areas.'	The objectives of the OPCC are the following: (1) gathering the existing knowledge on impact of CC in the Pyrenees and identifying knowledge gaps, (2) analysing vulnerability in the region and its socio-economic impact (3) provision of recommendations concerning adaptation to climate change to ensure sustainable development (4) education of population (5) propagation of adaptation and observation measures taken in the Pyrenees.	Sustainability, CCA
29	SwissRe	Re-insurance and risk expertise provider established in 1863. Its goal is to make the world a more resilient place.	Operation of databases on disasters and loss and damage, developing models to predict future events and their potential impact, calculation of the corresponding risk premium.	Insurance
30	Inter-agency Working Group on CC and DRR	This group was established to share information between the disaster risk reduction and climate change communities. It has been supported by UNISDR and co-chaired by UNDP and WMO.	'gathering and sharing good practices in climate risk-reduction, providing policy guidance to UNFCCC processes on the post-2012 climate change regime and developing methods for reducing the carbon footprint of disaster risk reduction activities.'	DRR, CCA
31	UNISDR Europe	UNISDR regional office for Europe	'(...) ensuring disaster risk reduction (DRR) is applied to climate change adaptation, increasing investments for DRR, building disaster-resilient cities, schools and hospitals, and strengthening the international system for DRR'.	DRR
32	UNISDR STAG	The purpose of the STAG is to provide 'technical advice and support in the formulation and implementation of activities carried out by the disaster risk reduction community.' The work of the STAG encompasses all aspects of the scientific and technical dimensions of risk reduction, with particular emphasis on the needs of developing countries. STAG consists of up to 20 representatives of the institutions involved in the Scientific and Technical Partnership and a couple of individual experts.	Improving policymaking and practice by the means of scientific research, interdisciplinary multi-hazard research, translation of science into practice, bringing together national and regional DRR platforms and networks.	DRR

33	United Nations Environment Programme (UNEP)	Environmental authority of the UN responsible for setting the global environmental agenda and promotion of the coherent implementation of the environmental dimension of sustainable development. Its field of work encompasses dealing with climate change (incl. CCA especially in the developing world) and disasters and conflicts (incl. DRR). UNEP works also on mainstreaming eco-based disaster risk reduction (Eco-DRR) into climate adaptation strategies.	Assessing global, regional and national environmental conditions and trends, developing international and national environmental instruments, strengthening institutions for the wise management of the environment, field-testing of Eco-DRR solution, promotion of sustainable and resilient development.	Environmental protection, CCA, (Eco)DRR
34	United Nations Development Programme (UNDP)	UNDP aims to fight poverty, inequality and exclusion. It supports countries in developing corresponding policies to build reliance and in achievement of Sustainable Development Goals. Its area of work relates to the consequences of climate change and disaster risk reduction.	UNDP's main areas of work include: sustainable development, democratic governance and peace-building, climate and disaster resilience.	Development cooperation, Sustainable Growth
35	weADAPT	Collaborative online 'open space' on climate adaptation issues and synergies with mitigation which allows practitioners, researchers and policy makers to access credible, high quality information and to share experiences and lessons learnt.	Facilitation of learning, exchange, collaboration and knowledge integration with the aim of building a professional community of research and practice on adaptation issues, developing policy-relevant tools and guidance for adaptation planning and decision-making.	CCA

Annex III – Social network metrics

Table B2: Social network metrics of individual actors

Vertex \ Metric	Degree centrality	In-degree	Out-degree	Betweenness centrality	Eigenvector centrality	Clustering coefficient
weADAPT	25	9	16	3.698	0.027	0.581
UNDP	28	19	9	13.409	0.033	0.539
UNEP	38	22	16	24.510	0.039	0.476
UNISDR STAG	31	12	19	16.391	0.035	0.540
UNISDR Europe	43	20	23	21.106	0.038	0.498
Inter-agency Working Group on CC and DRR	16	1	15	1.407	0.025	0.700
SwissRe	32	15	17	17.693	0.033	0.524
OPCC	8	3	5	0.154	0.010	0.800
PROVIA	22	15	7	5.211	0.027	0.570
PREVIEW	22	8	14	2.640	0.027	0.651
PreventionWeb	35	22	13	12.558	0.037	0.545
PLANALP	15	8	7	0.285	0.019	0.764
PERILS	9	6	3	0.111	0.010	0.667
MunichRe	31	17	14	8.564	0.031	0.611
JPI Urban	12	3	9	1.162	0.016	0.600
JPI Climate	32	11	21	15.141	0.032	0.483
IPCC	39	24	15	22.166	0.037	0.505
IIASA	34	13	21	20.709	0.037	0.483
IFRC	31	18	13	12.105	0.035	0.528
ICLEI Europe	16	16	0	4.579	0.025	0.592
EEA	46	25	21	34.670	0.038	0.442
JRC	33	23	10	27.886	0.034	0.453
EPANet	19	3	16	21.019	0.025	0.485
ENCA - CCA	2	2	0	0.000	0.003	1.000
ECRAN	12	6	6	0.752	0.015	0.736
DRMKC	25	10	15	3.104	0.029	0.650
DG RTD	47	18	29	52.863	0.043	0.419
DG ECHO	33	17	16	6.765	0.033	0.605
DG CLIMA	46	27	19	45.396	0.041	0.411
C3S	24	12	12	6.283	0.028	0.588
Covenant of Mayors	20	11	9	9.556	0.021	0.514
CKB	24	8	16	6.749	0.029	0.538
Climate-KIC	14	14	0	3.917	0.021	0.577
CAS	20	7	13	3.623	0.023	0.576
Climate-ADAPT	50	22	28	101.815	0.043	0.385