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Mapping global climate governance by membership: A network approach

1. Introduction

Over the past 20 years, global efforts to combat climate change have become a complicated matter. The central forum for multilateral global climate governance, the United Nations Framework Convention on Climate Change (UNFCCC), has been complemented by numerous cross-border initiatives comprising both state and non-state actors including NGOs, companies, academia, cities, and international organizations (Biermann et al. 2009; Keohane and Victor 2011; Abbott 2011; Bulkeley et al. 2014). The broader institutional structure has thus developed from a single regime to a regime complex, and is now rather characterized by fragmentation and functional overlaps than by coherence and hierarchy (Keohane and Victor 2011, 15; Biermann et al. 2009). In Elinor Ostrom's words, global climate governance is best described as a polycentric system with "multiple governing authorities at different scales rather than a monocentric unit" (2010, 552). However, while statements about the structure of global climate governance, using concepts such as polycentrism, complexes and fragmentation, we have few empirical methods for mapping, visualizing and measuring the structure of global climate governance. A central problem is that current mappings generally are confined to lists and typologies that provide little information on how the dots are connected (see e.g. Keohane and Victor 2011; Abbott 2011; Bulkeley et al. 2014). This causes problems for scholars and policy-makers alike since it hinders a more in-depth evaluation of interactions between actors and institutions and to understand the drivers and impacts of structural properties of global climate governance such as fragmentation. It also impedes the evaluation of hypotheses about the topology of global climate governance structures made by, for example, Biermann and colleagues who emphasize the centrality of the UNFCCC (2009), Keohane and Victor describing it as "loosely-coupled set of regimes" (2011) or Ostrom's polycentric world view.

To bridge this knowledge gap, this paper introduces a novel way to map climate mitigation initiatives and their members active in global climate governance. It focuses on international and transnational initiatives created to mitigate climate change and combines traditional insights on global governance and institutions with the burgeoning scholarship on networks and new techniques for gathering data. To this end, a network of actor-constellations is created by tying actors together that are connected via their involvement and membership in institutions. The results show a network of initiatives and their members with a "core-periphery" structure with nation states at the core and non-state actors in the periphery. The UNFCCC holds a relatively central position compared to other state-led initiative however, it is not the only important node and the analysis identifies a few key players from states, firms, international organizations and CSOs that take up key positions.

The article is structured into five sections. First, an overview of current mapping attempts sets the scene and identify gaps in knowledge. Second, the analytical framework and methodological approach are described in detail. Third, the results of the mapping is presented. Fourth, the results are discussed. Finally, the conclusions summarize the observations and propose further research topics.

2. Mapping global climate governance

A central feature of global climate governance is the proliferation of actors and institutions and scholars have been quick to invent new terminology to describe these novel institutional arrangements. For instance, "experiments" (Hoffmann 2011), "climate clubs" (Weischer, Morgan, and Patel 2012), "transnational climate governance initiatives" (Bulkeley et al. 2014), and "International Cooperative Initiative" (Widerberg and Pattberg forthcoming), all refer to the same phenomenon of new collaborations between different public and/or private actors trying to govern some domain of climate change. Global governance architectures are thus becoming more densely populated by different institutional arrangements – also described as treaty congestion, fragmentation, or regime complexity – (Brown Weiss 1993; International Law Commission 2006; Raustiala and Victor 2004) and there has been an array of attempts to map the new and emerging structure. Most of these studies can be categorized into either listings or conceptual maps.

The first type of mappings lists and categorizes institutions active in international and transnational climate governance. Data entries are based on expert judgments and analyses rely on descriptive statistics of attributes such as governance function, type and origin of members and type of institutions. Bulkeley and colleagues, for example, list 60 transnational climate initiatives and divide them into two distinct groups: one which is involved in providing funding and often are hybrid, and a second which is focused on rule setting and tending to be private (2012, 609). Several other scholars such as Hoffman (2011), Weischer and collegues (2012) and Hale and Rogers (2014) also engage in similar exercises of listing institutions. Abbott (2011), based on a list of 67 transnational organizations, moves one step beyond listing institutions by placing them into a "governance triangle" (Abbott and Snidal 2009) which improves our overall understanding of how the global climate governance architecture is structured by adding visual detail but stops short of showing relationships between the data-points. While the result of these type of studies have provided us with a rather stable set of 60 to 100 mainly transnational institutions constituting the global climate governance architecture, they fail to show relationships between the institutions and actors.

The second type of mappings tries to go beyond lists and typologies toward visually depicting the global climate governance architecture and theorize about its structure. Three studies in particular stand out. First, Biermann and colleagues have created an "onion" model (see figure 1) with the UNFCCC at its core surrounded by three consecutive layers including multilateral forums on energy and climate, other environmental institutions and organizations, and international non-environmental institutions and organizations (Zelli 2011).

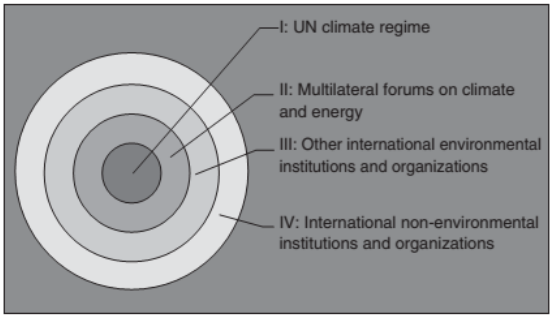


Figure 1 The Onion model

A slightly more detailed mapping has been suggested by Keohane and Victor (2011) who make a coarse overview of international climate related institutions. The authors include UN agreements such as the UNFCCC and the Montreal Protocol on Ozone Depleting Substances but also expert assessments (IPCC), clubs (e.g Major Economies Forum, G8), bilateral initiatives and geoengineering governance (see figure 2).

Figure 2 Climate regime complex

The third mapping is carried out by Abbott (2011) who observed that the climate regime complex suggested by Keohane and Victor omits the large number of transnational institutions active in global climate governance. By using a "governance triangle", first developed by Abbott and Snidal (2009), Abbott is able to visually map and categorize the transnational climate regime complex by function and membership type, to a more detailed extent than both the previous mapping attempts (see figure 3).

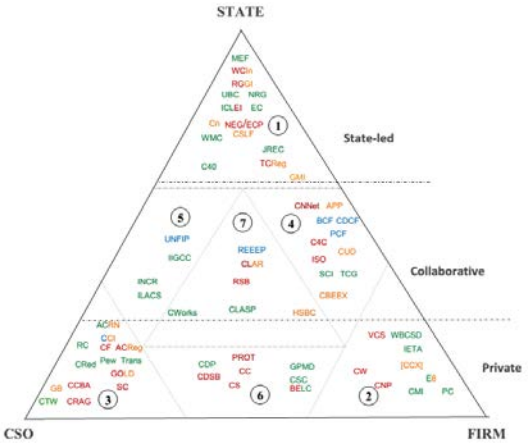


Figure 3 The transnational climate regime complex

Comparing the three mappings depicted in figure 1, 2 and 3, we observe an increasing level of detail and information embedded in the figures. However, the lack of relational data, i.e. how the different institutions and actors connect, impedes further analysis on to what extent we can describe the structure as fragmented.

The two types of mappings – lists and typologies (type 1) and conceptual maps (type 2 and 3) – are complementary in the sense that they provide both a conceptual understanding of the structure of the architecture and adding much detail to each institution in the architecture. However, both types share at least two important short-comings: first, a division is made between international and transnational levels. If complexity and fragmentation in architectures partly are a result of a proliferation of non-state actors and shifts in authority away from states, then the two levels should be linked or at least part of the same map. Second, mappings have hitherto been unable to analyze or even plot the relationships between the different actors on the level of the architecture. To address these two short-comings and move beyond theorization about the structural properties of global climate governance towards empirical testing and reproducible results, we need new methods to connect the dots.

3. A network approach to mapping governance architectures

Architecture, regime complex, polycentrism and fragmentation all refer to the structural properties of governance. According to the Oxford English Dictionary, structure can be defined as "[a] combination or network of mutually connected and dependent parts or elements; an organized body or system" (OED). While previous

mappings outlined in section 2 have been highly successful in listing the discrete elements, few have investigated the constitutive relationships that connects and binds them into architectures.

3.1. Networks and network analysis

One way of conceptualizing global governance in line with relational thinking is in terms of networks. Network analysis looks at the relations between discrete objects and has been applied in a wide-range of disciplines including computer science, biology, economics and sociology. In particular the latter has been applying network theory to study the meaning of social structures between, for example, individuals, companies or organizations, and developed what is called Social Network Analysis (SNA). SNA includes a range of quantitative tools and measures to measure global and local structural properties (i.e. the topology) of a network consisting of nodes connected by edges. For example, SNA allows us to explore properties on individual node-level and answer questions such as *who is the most important player*? But also to explore global and regional level and check for *inter alia* clustering tendencies, network density and shortest paths between nodes.

Networks-based approaches have recently gained in popularity in International Relations in general, and studies on global environmental and climate governance in particular (Kahler 2009; Slaughter 2004; Hafner-Burton, Kahler, and Montgomery 2009; Pattberg 2010; Kim Rakhyun 2013). For example, in global climate governance studies, network-based approaches have been used to examine relationships between different carbon trading and standards. In more detail, Green (2013) explores how private carbon standards relate to the rules created under the Kyoto Protocol by developing an exhaustive list of private carbon standards and measure to what extent they recognize other standards. She shows how public rules acts as "anchors" for private rules and that a certain degree of policy convergence have occurred in global emission trading. In another study, Paterson and colleagues (2013) describe how the design and implementation of different emission trading schemes in Europe and the US were diffused through a network of individuals and organizations taking part in several governance processes. The next section outlines the methodological choices and case-selection for this paper.

3.2. Choosing nodes and edges

A network consists of nodes and edges, and we need to decide on what constitutes a node and what constitutes an edge. For this study, international and transnational climate initiatives are considered the nodes of the network. To identify the nodes, mappings described in aforementioned sections are used starting with Abbott (2011), Bulkeley et al (2012), Hale and Roger (2014), and the UNFCCC's Portal on Cooperative Initiatives (2014). To structure the data, Abbott's governance triangle has been used as a framework. The triangle is divided into seven zones, each featuring climate initiatives driven by states, civil society organizations (CSOs), firms, or collaborations between the different types. Zones 1, 2 and 3 include those initiatives involving exclusively states, firms or CSOs respectively. Zones 4, 5, and 6 shows collaborations between the three different types, and zone 7 in the center, shows climate initiatives that include all three types of actors. Moreover, the colors of the initiatives (red, yellow, green, blue or mixed), show the main type of functions that each initiative engage in (for more information on the governance triangle, please consult Abbott and Snidal 2009).

The original climate governance triangle presented by Abbott in 2011 has been updated by adding new climate initiatives that have emerged after 2011 and initiatives that are no longer active has been removed. The criteria for being included in the governance triangle are based on Pattberg et al. (2014) and for an initiative to be included it needs to be "*an (1) international or transnational institution, which not only has (2) intentionality to steer the behavior of members, but also explicitly mentions a (3) governance goal and (4) displays significant governance functions"* (ibid.). The final cut was made on 1 October, 2014, and thus represent a snapshot of the global climate governance structure from that date. The final database includes 80 entries.

The figure below shows the final selection of initiatives arranged by type of members and function in a governance triangle:

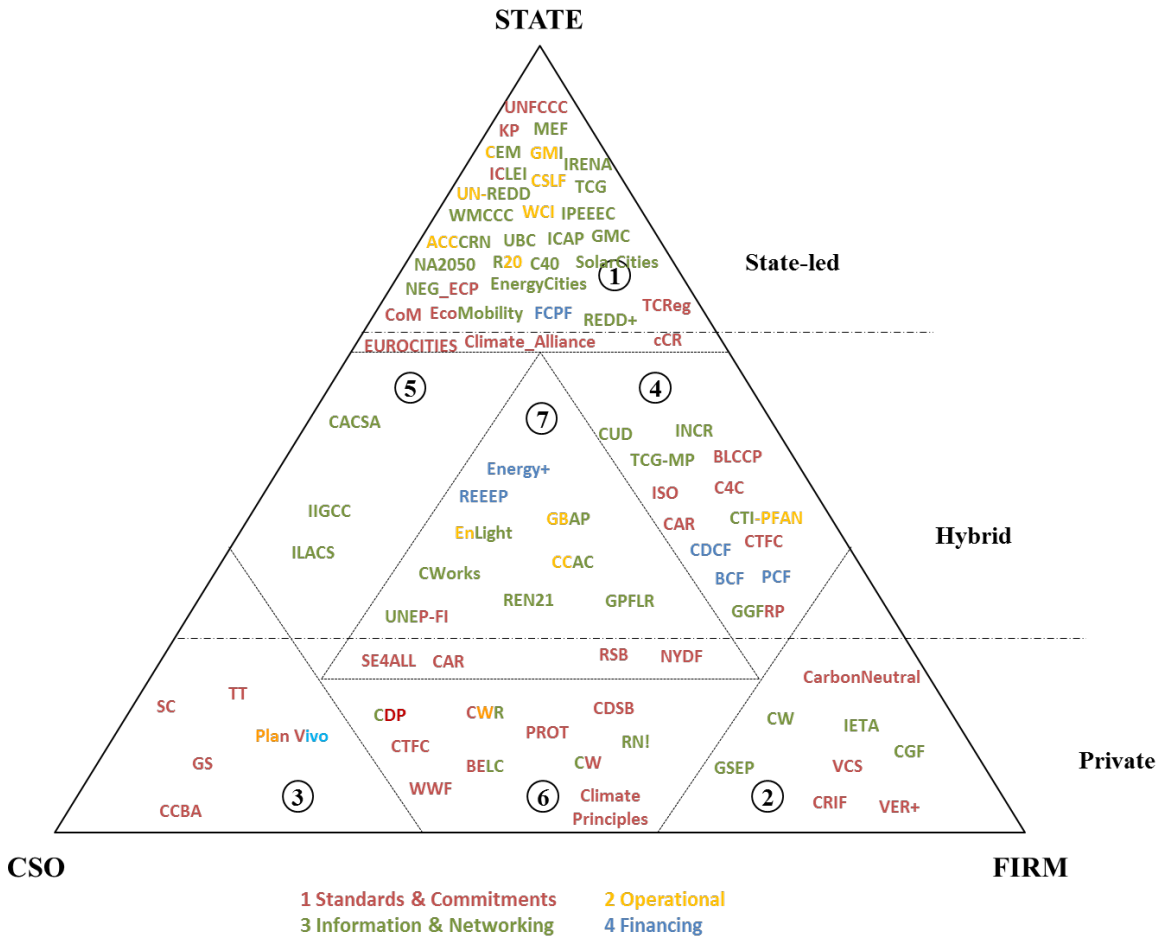


Figure 4 The global climate governance triangle

Second, connecting the nodes in the network are edges representing membership to the initiatives. The membership network leans on affiliation network theory that social ties matter and are developed between actors that attend common events, i.e. being part of an institutions increases the likelihood of two actors having a social relation in some way (Wasserman and Faust 1994). Besides attending the same meetings, network affiliations are also more likely to foster resource and knowledge exchange, policy diffusion, and policy innovations (Jordan and Huitema 2014). A "member" is defined as an actor with the formal position to influence the rules, norms, operations or performance of the institution. Members are also those that have access to the network an institution provides and benefits from the privileges it may accrue. Those actors that merely supports an institution or ascribe to their values, rules, norms or mission, without the ability to influence the governance of the institution, are hence excluded. Furthermore, membership criteria have been elaborated for the institutions based on their function, and effectively "membership" has been defined on a case-by-case basis, but the most common type are signatories and official members to the legal framework of the institutions (the treaty). For example, a signatory country to the UNFCCC is considered a member.[1]

The results for the networks have been collected in 2-mode data matrices where $X_{ij} = 1$ when actor *i* is affiliated with institution *j* and $X_{ij} = 0$ otherwise. Moreover, to enable more extensive analysis, two 1-mode affiliation networks were created based on Actors (X_A) and Institutions (X_I). For example, two institutions are connected if

[1] The case-by-case assessment is on file with author.

they share *at least* one member. Data-gathering and cleaning was made in Microsoft Excel (2010) and R (R Core Team 2014); all network measures were calculated using UCINET 6 (Borgatti, Everett, and Freeman 2002).

4. Results

In the coming sections I sketch the main results from the network analysis. The first section makes a zone-by-zone analysis to compare the different zones in more detail both in terms of structure and identifying central nodes. Particular attention is given to Zone 1 and 7 because these are more populated than the others and thus show more interesting behavior. The second section focuses on the entire network of all zones. It explores the overall structure of the networks and zoom in on whether or not they connect. Third and finally, the last section turns to the presence of "bridging organizations" namely those members that are part of initiatives across different zones. These are interesting since they could be considered "key nodes" connecting the different networks and act as intermediaries between different initiatives.

4.1. A zone-by-zone analysis

In the first step of the analysis, each zone in the governance triangle has been mapped in terms of initiatives and their members. In total 80 initiatives with 8389 unique members consisting of states, sub-national authorities, NGOs, companies, philanthropists have been mapped and connected. The figures below shows and overview of the network-structures per zone.

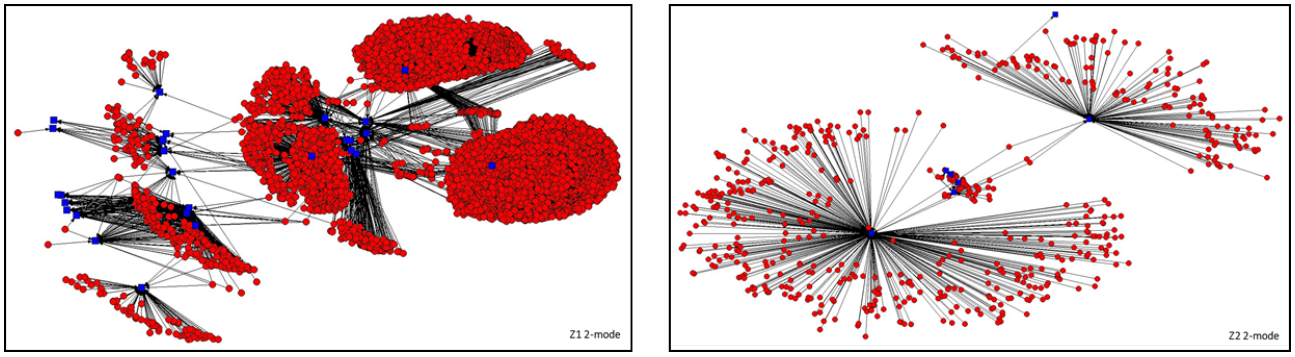


Figure 5 Zone 1 (left) and Zone 2 (right)

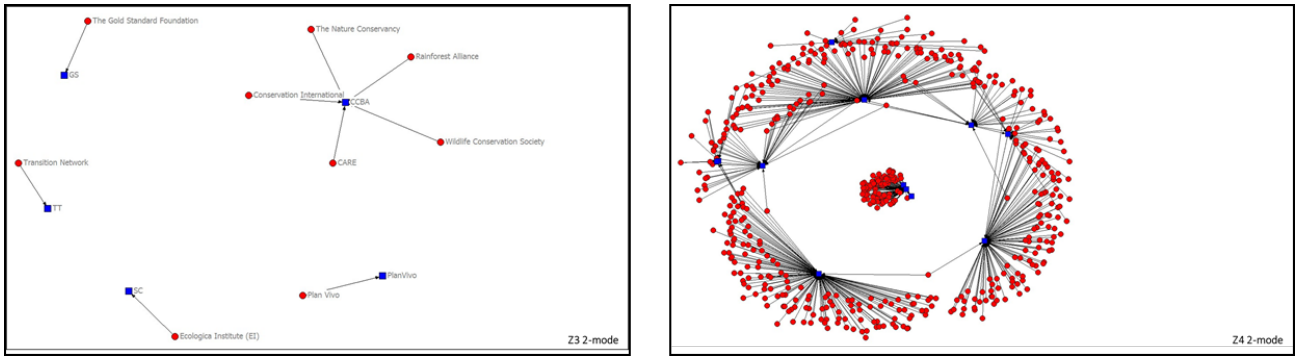
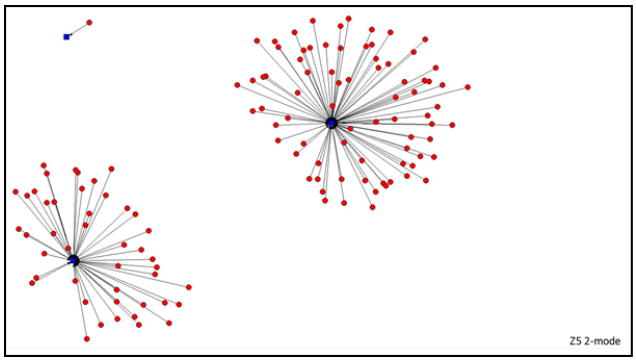


Figure 6 Zone 3 (left) and Zone 4 (right)



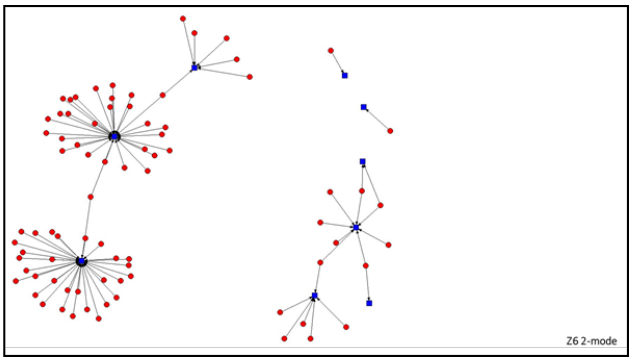


Figure 7 Zone 5 (left) and Zone 6 (right)

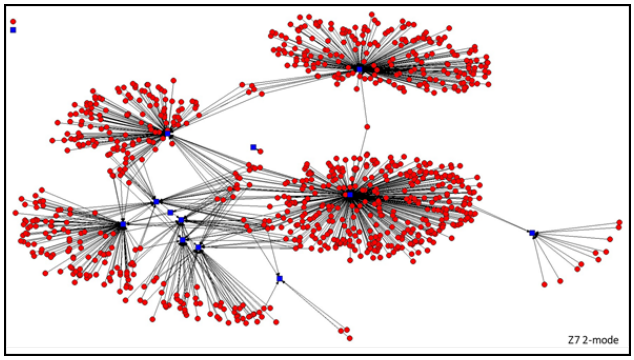


Figure 8 Zone 7

Inspecting the figures clearly show the vast differences in network structure between the zones ranging from the highly connected and dense networks in Zone 1 to the very sparsely populated network in Zone 3 with largely isolated initiatives.

Zone 1 – which features initiatives including states, sub-national authorities and cities – is by far the most populated largely due to the inclusion of initiatives involved large amounts of cities and regions. The Covenant of Mayors, for example, has nearly 5300 members and the Climate Alliance of European Cities with Indigenous Rainforest Peoples has 1693 members. It also shows how some of the initiatives tend to cluster together. To further explore clustering behavior visually we can transform the 2-mode network consisting of initiative and the their members to a 1-mode network where initiatives connect if they share a member. This allows for a more micro-level analysis of the structure of Zone 1 to identify, for example, whether different administrative levels such as states and cities connect via climate initiatives. In the figure below, the initiatives have been connected by their members.

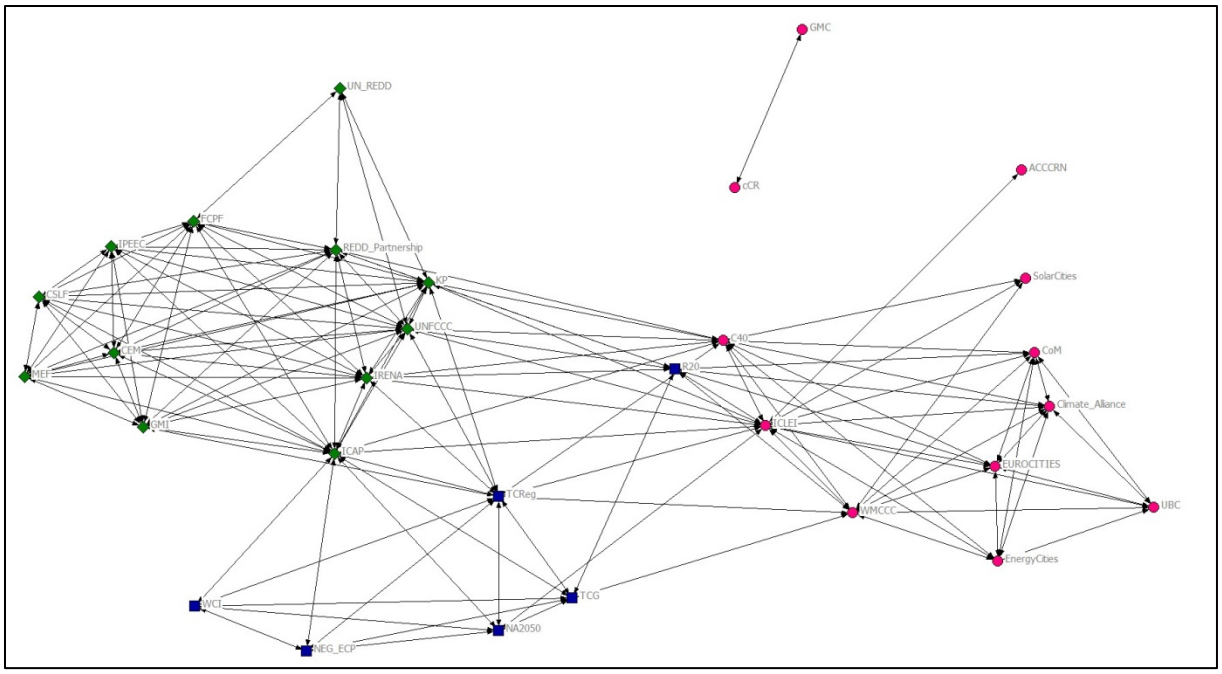


Figure 9 Zone 1 initiatives in 1-mode network

The color and shape of the nodes signifies different types of initiatives. Green diamond-shaped nodes are state-driven initiatives such as the UNFCCC, blue squares mainly include regional authorities such as R20, and the pink circles represents city-networks such as ICLEI. There is a clear clustering tendency among the initiatives based on types of members. The differentiation between different types of initiatives is perhaps not too surprising, however it is interesting to note that there are connections between the different clusters which indicates the presence of "bridging institutions", which to some scholar are important for linking communities to foster learning and resource exchange (see for example Bodin and Crona 2009). To elicit which initiatives that act as bridges we can plot two network centrality measure, degree (how many connection does a node have) and betweenness (number of shortest paths from all edges to all others passing through a node).

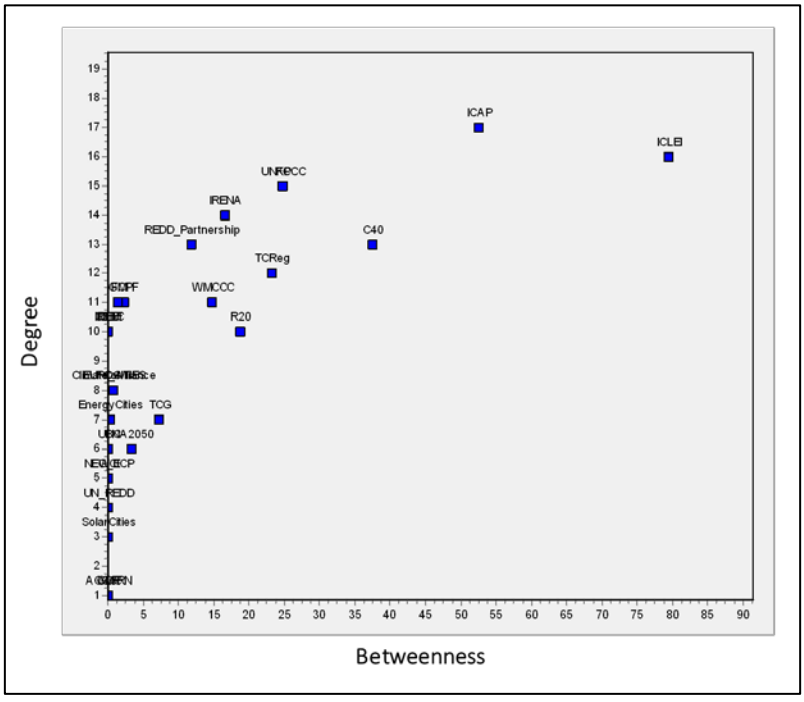


Figure 10 Zone 1 Betweenness and degree

From the graph we can make two important observations. First, while there are many initiatives that are well-connected by degree-count, there are very few initiatives that scores high on betweenness which makes bridging organizations in the network quite rare. Second, around nine initiatives form a cluster of nodes with both high degree and betweeneess. Among these, two initiatives involving sub-national authorities could be considered outliers namely ICLEI and C40. For the state-driven initiatives, UNFCCC and the Kyoto Protocol together with IRENA scores high. The links between the state-driven and the sub-national initiatives are much more sparse and generally represented by a few city states such as Luxembourg and Singapore. Only one initiative, the International Carbon Action Partnership (ICAP), which has a hybrid character, brings together states and public authorities working on emissions trading, and scores particularly high. Besides ICAP, bridging organizations between initiatives constituted by regions and cities often include members where the administrative levels are blurred such as large cities. The city of Vienna in Austria, for example, is a member of R20, ICLEI, and the Covenant of Mayors, and thus linking the initiatives together.

For Zones 2,3,4,5 and 6, the structural pattern of the networks are comparable. All networks include relatively few initiatives, compared to Zone 1 and Zone 7, which are sparsely connected and often include isolates. In Zone 3, for example, which gather initiatives driven by Civil Society Organizations (CSOs), only four initiatives have been identified with no links connecting them.

In Zone 7 – which maps initiatives that have a multi-stakeholder character including states, firms and CSOs – the pattern is comparable with Zone 1 in terms of number of nodes, density and connectivity. Just like in Zone 1, there are a few initiatives hogging the majority of members. The structure of the 1-mode network of institutions however, is very different from the one in Zone 1.

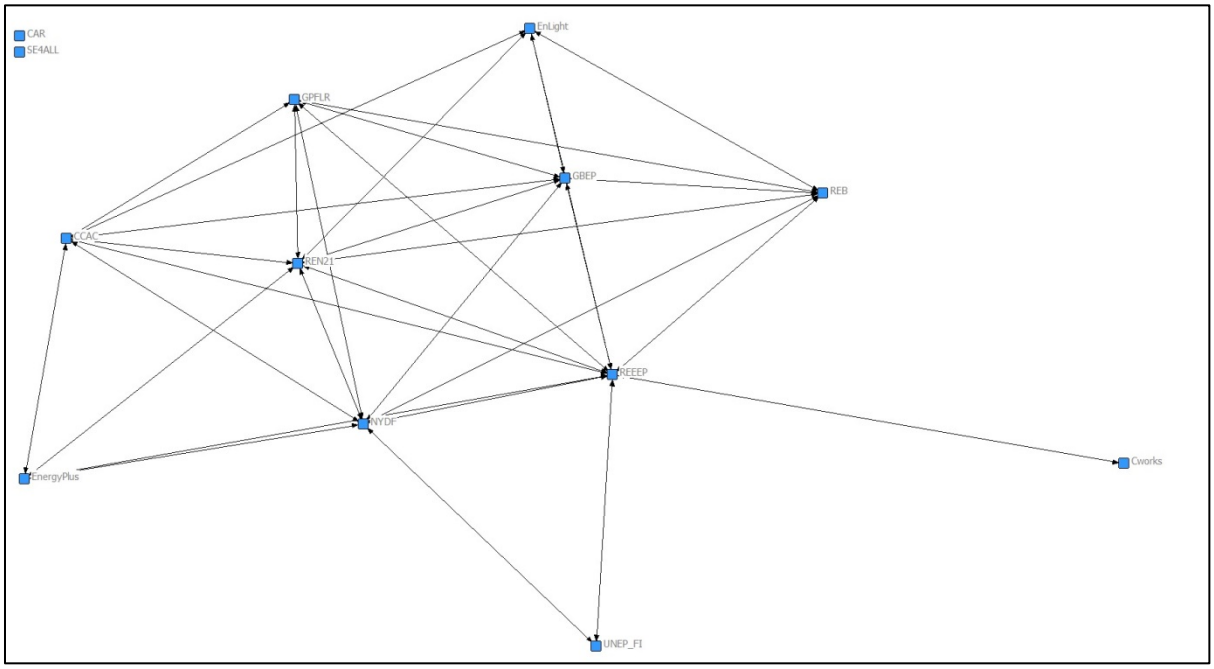


Figure 11 Zone 7 network of institutions

The figure above show a highly connected network where all initiatives are linked except for the Climate Action Reserve (CAR) and Sustainable Energy for All (SE4ALL). In contrast to Zone 1, we here see no cluster formations and thus no bridging organizations.

In sum, what we can discern from analyzing the network at different levels is the variation in structure and character of each Zone in terms of number of initiatives and members, clustering tendencies and presence of bridging organizations.

4.2. The full network

The next step of this paper is to explore the entire network including all 80 initiatives and their 8389 members. The large number of members makes the 2-mode network unsuitable for graphical representation and instead the 1-mode network of institution could be used for visualization. Figure 12 below shows the results.

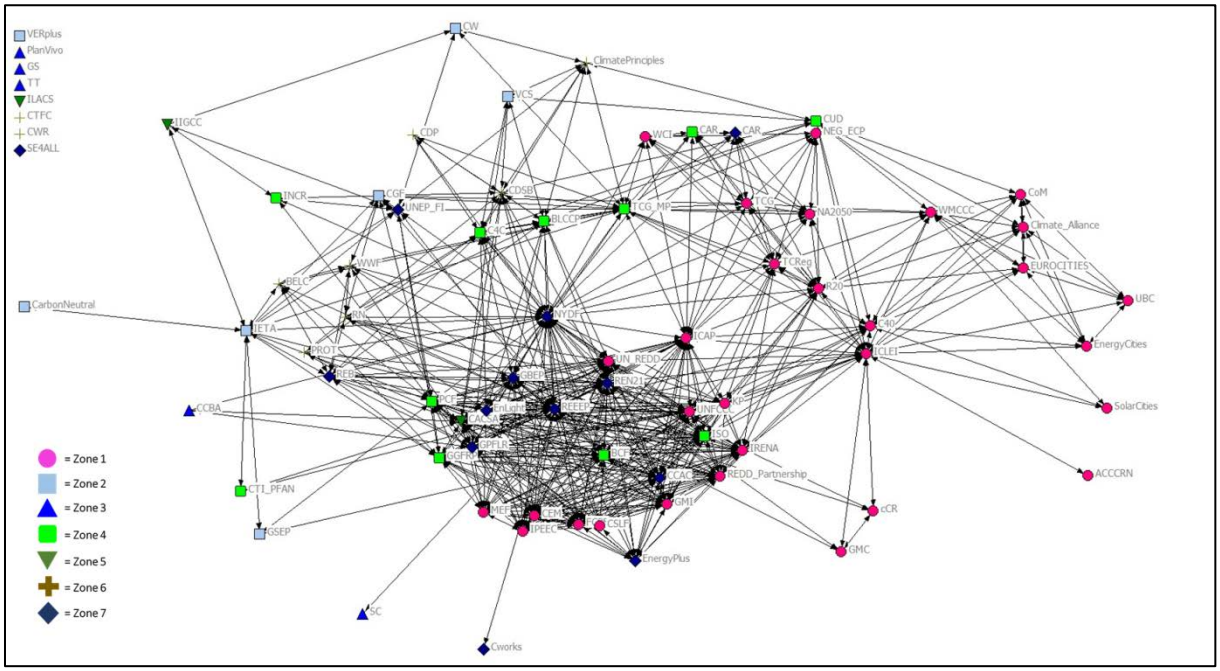


Figure 12 Full network

To explore how the different initiatives connect and where they end up on the graph, each Zone has been coded by both color and shape. What the network shows is a dense web of interlinked initiatives mainly from Zones 1, 4 and 7. Initiatives by sub-national authorities from Zone 1 have a tendency to form a loosely coupled group on the right side of the graph. The upper-left corner shows seven isolates with no connections by membership to the other initiatives. Three of these are from Zone 3 which in total has five initiatives, displaying an overall disconnect by this group to the rest of the network. The remaining initiatives are fairly evenly spread out across the networks and forms, what can be described as a second layer of initiatives around the core group, in other words, a perfiphery.

Probing the data presented in Figure 12 on the whole network further, we find a number of initiatives taking up central positions in terms of connectivity. In figure 13, the betweenness and degree has been plotted to discern which initiatives that are both well-connected and acting as bridging initiatives. Using this methods, the data shows how large hybrid, partnership-type, initiatives such as the Renewable Energy and Energy Efficiency Partnership (REEEP) and the New York Declaration on Forests (NYDF) score high on both betweenness and degree.

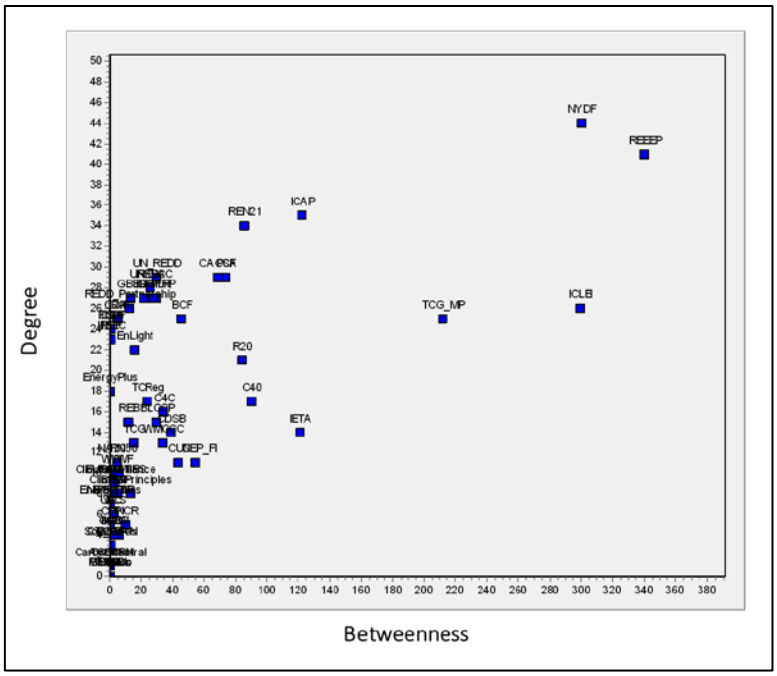


Figure 13 All zones Betweenness and degree

4.3. Differentiation by function

Besides looking at the overall structure of the networks we can start analyzing to what extent functions in the network are distributed across the zones and the initiatives. Mapping functions and it's distributions is important since functional overlaps are considered a central characteristics of fragmentation in global governance architectures (Biermann et al. 2009). Should the analysis show that one can observe a differentiation among functions in the network, this could indicate that there is an self-organizing ongoing process of distribution of labor in the architecture that may result in coherence rather than fragmentation and thus enabling an examination of the degree of fragmentation in an issue area.

To examine the extent of functional differentiation we make use of the functional attribute in the governance triangle indicated by color (see figure 4) and is divided into 4 different types: Standards and Commitments; Operational; Information and Networking; and Financing (Abbott 2011). Furthermore, initiatives can have several different functions, indicated in the governance triangle by several colors. In figure 14, the result of this attempt are shown:

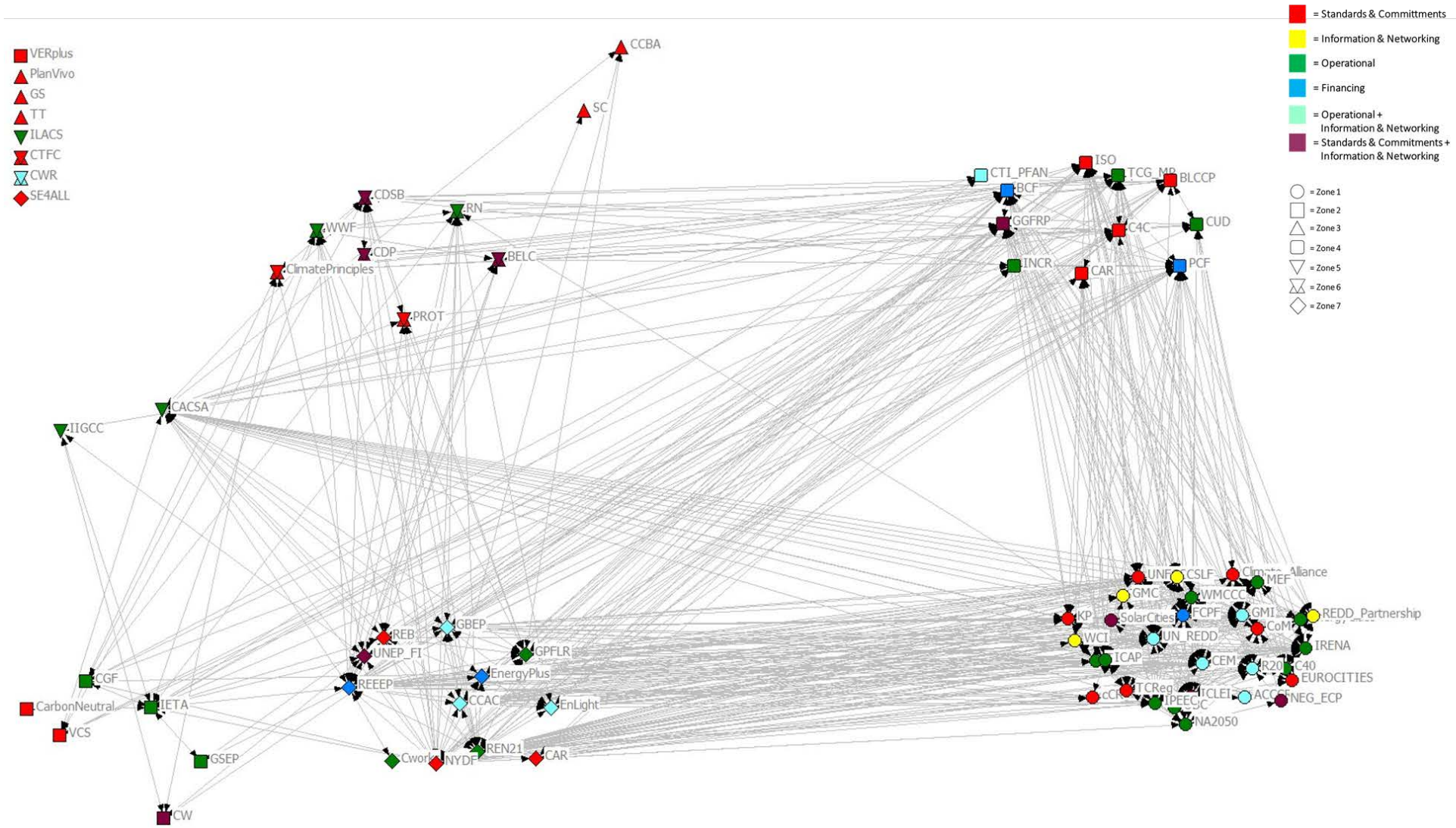


Figure 14 Grouping by zone, color by function

The graph in figure 14 which visualizes the functions in each zone shows, at least, two noteworthy things. First, there is a good spread of functions in zone 1, 4 and 7, there is much less variety in zone 3 and 5. Zone 3 and 5 almost only include operational and standards and commitments initiatives. Second, zone 1, 4, and 7 are the only ones which have financing initiatives in place. It should be noted that this map provides the same information as the colors used in Abbott's governance triangle, however in a slightly different visual representation.

5. Discussion

The coming section discusses the results presented in section four with a view towards current mapping and global climate governance literature as well as noting the main caveats of the network-based approach.

5.1. Architecture, complex or polycentric structure

The approach taken in this paper shows how global climate governance looks like if conceptualized as a network consisting of climate mitigation initiatives and their members. We can compare the result with some of the suggestions made by scholars on the structural properties by drawing maps and figures outlined in Section 2 of this paper. I argue that the network-approach both corroborates and questions many of the assumptions made by Biermann and colleagues on architecture, Keohane and Victor on regime complexes, and Ostrom on polycentric governance, respectively.

First, the membership network presented in figure 12 supports Biermann and colleagues' idea that the UNFCCC remains relatively central in global climate governance. A dense web of initiatives driven by states has formed around the UNFCCC and the Kyoto Protocol (see figure 10). Other state-led initiatives such as IRENA and the REDD Partnerships also score high but the core of international efforts to curb global climate change remains with the UNFCCC. However, looking beyond states and including sub-national authorities suggests a more nuanced, almost polycentric, structure. ICLEI and C40 for example, hold key positions in binding different levels together. Moreover, the few links between the state level and the sub-state level is made up by a couple of single states, Singapore and Mali. If one increases the constraints of the model to demand institutions to share at least two members then the links between the state-level and the sub-state level would be confined to one institution namely the ICAP. The findings thus implies that while the UNFCCC and the state-led efforts remains central players in global climate governance it largely fails to connect with other large and widely spread mitigation initiatives created by sub-national authorities.

Second, the data generally questions some of the suggestions by Keohane and Victor that the global climate regime complex is "loosely coupled" (Keohane and Victor 2011). Despite that the terminology used by the authors is too vague to test with hard figures – when is something loosely or strongly coupled?, when is there a "semi-hierarchy"?, etc. – the network in figure 12 would suggest that the network formed between state-led initiatives is very dense. If one zooms in on only the nodes in Zone 1 that are led by nations states, there is not a single initiative that is not connected to another with at least one member of all other initiatives. Consequently, state-led initiatives for climate mitigation are highly integrated in terms of membership, but less so with any other type of private or hybrid initiative.

Third, while some individual zones could be viewed as highly polycentric in character, in particular where there are only a few large initiatives, the overall network structure is only partly polycentric. To some extent, there is a clear differentiation with observable separate centers of gravity in zone 1 between states, regions and cities. However, for the remaining zones there is much less of this tendency to strongly cluster around a certain type of member. Instead state-led initiatives seem to have an attraction power for the rest of the initiatives.

Summing up, the networks as seen in figure 12 contains parts of all three stories on the structure of global climate governance. States appears to have a central role and form a dense network where sub-national authorities, firms, and to a lesser extent, CSOs cling onto in different ways.

5.2. Finding key players

An notable observation is the dominance of initiatives in Zone 1, 4, and 7 in terms of number, connectivity, functional differentiation and members. These are all zones where public authorities work closely together with firms in different initiatives. Zone 3, 5 and to a lesser extent 6 – that all three are, at least, partly driven by CSOs. Zone 3, which maps CSOs only, is a prime example of the disconnected and few initiatives that are led by the civil society and NGOs. One possible explanation for this behavior could simply be differences in capacity. Consider for example a graph plotting the degree against betweenness for a 1-mode graph the members in Zone 4, here visualized in figure 15.

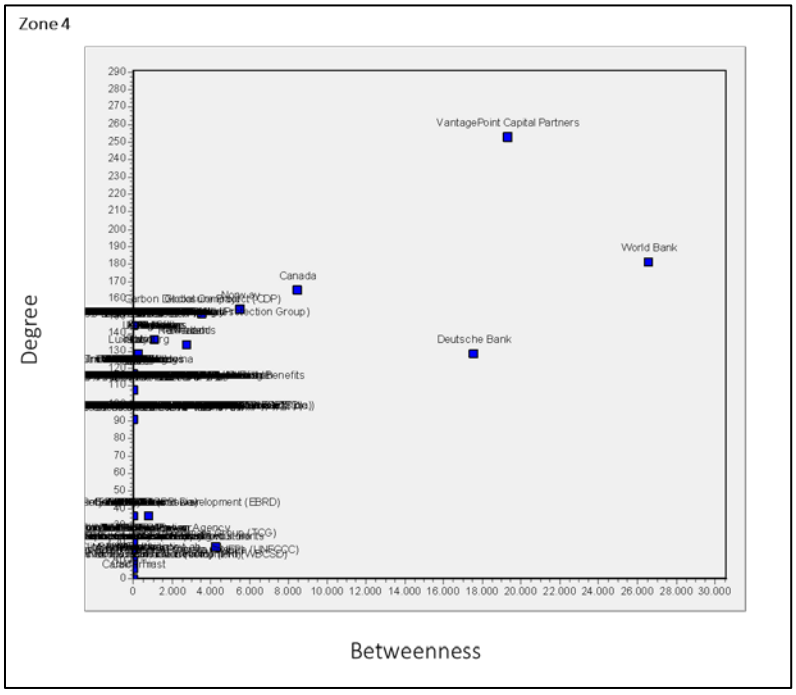


Figure 15 Zone 4 Betweenness and degree

The results show how three actors, World Bank, VantagePoint Capital Partners and Deutsche Bank, have a relatively high degree and exceptionally high betweenness, making them key players in collaborations between states and firms. All three of these members have large resources at their disposal both in terms of capital and human resources which they can leverage when setting up transnational climate initiatives. A similar pattern occurs if we plot the same relationship on Zone 6, where HewlettPackard, a computer hard-ware supplier, and the Coca-Cola Company scores very high on both metrics (Figure 16).

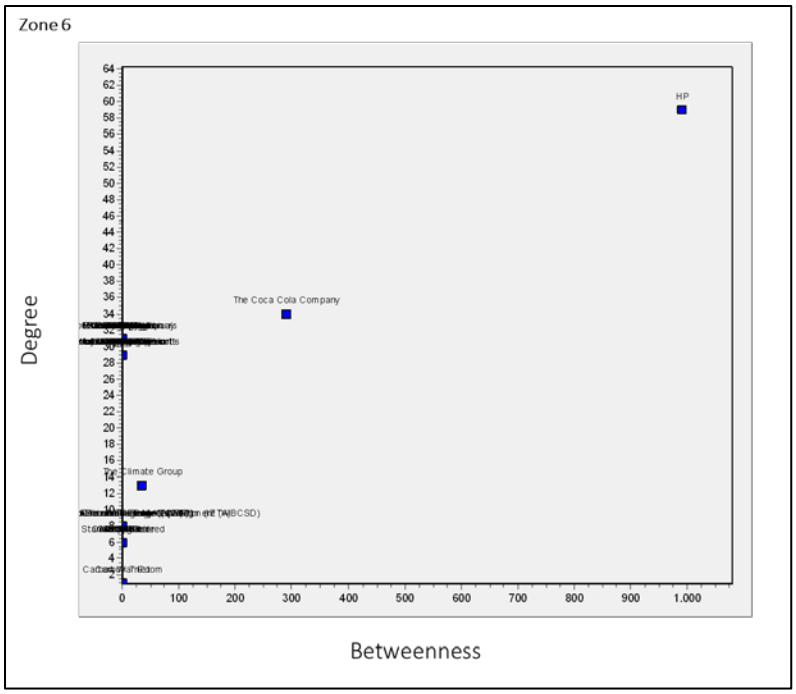


Figure 16 Zone 6, Betweenness and degree

The data thus suggest that a few companies have been highly successful in establishing themselves in several climate mitigation initiatives making them both highly connected but also able to function as bridging organizations between the initiatives. The only zone where this trend is somewhat broken is in Zone 7 that includes multi-stakeholder partnership. Here a few CSOs, firms and countries have established themselves key players in the network. By again plotting degree against betweenness we can discern a few members (figure 17).

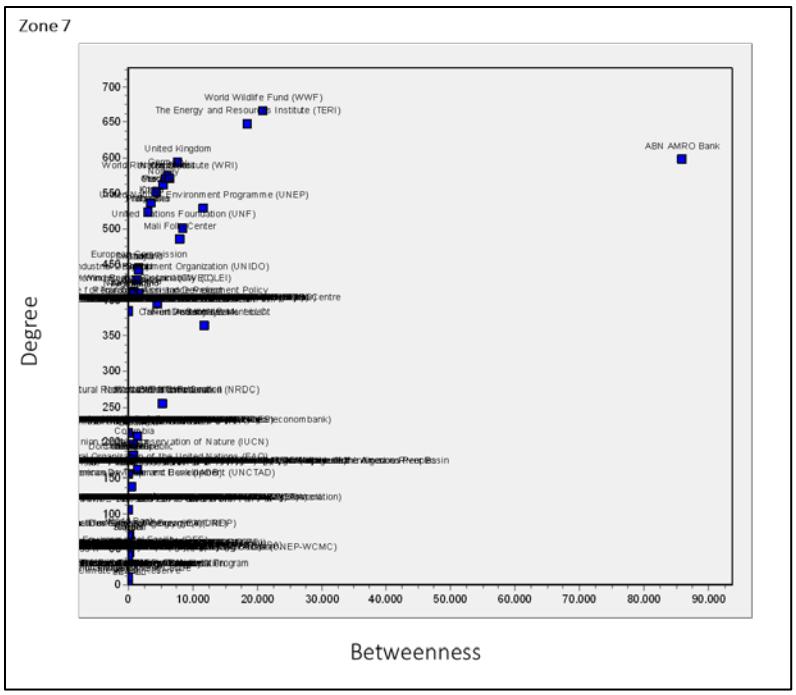


Figure 17 Zone 7, Betweenness and degree

Here companies (ABN AMRO Bank), CSOs (WWF, TERI, and WRI), International Organizations (UNEP) and states (UK and Germany) scores high.

In sum, the data on key players, at least according to the measures used here, suggests that there are a handful of countries, international organizations, companies and CSOs that are playing a more important role than others in global climate governance. It is noteworthy that the data supports and complements the analysis made by, for example Hale and Rogers (2014), on "orchestrators" in global climate governance. Orchestrators are actors that engages in orchestration which, according to Hale and Roger, is "a process whereby states or intergovernmental organizations initiate, guide, broaden, and strengthen transnational governance by non-state and/or sub-state actors" (Hale and Roger 2014), and the authors identify the World Bank, UNEP, the UK as particularly active in orchestration. All three have emerged as important actors in the analysis above but have also been complemented by companies (ABN AMRO, HP, and the Coca-Cola Company) and CSOs (e.g. WWF, TERI and WRI) suggesting that there might be more actors involved in orchestration. However, the analysis above is silent on the direction of the relationships, meaning that it is impossible to say who orchestrates who, in the global climate governance network.

5.3. Functional differentiation and self-organizing division of labor

Fragmentation in global governance structure have become a central research question for governance scholars over the last few years, in particular in relation to climate change (see e.g. Zelli 2011; Biermann et al. 2009; Zelli and Van Asselt 2013). By conceptualizing fragmentation as functional overlap, the network-based approach could have provided new insights into the division of roles with in each zone and also between different zones. Abbott's triangle already hints at this analysis by assigning functions to each initiative by coloring their names. Unfortunately, grouping by zones and examining functions in the network adds little new information to the analysis. Functional overlaps might require more qualitative data-gathering and analysis to be understood properly, in particular on a micro-level. Literature on regime interplay, for example, exemplifies this argument by looking at dyadic relationship between two regimes and trying to understand how they influence each other (Oberthür and Gehring 2006). Nevertheless, while the network-based approach using membership as connectors is not ripe for analyzing functional overlaps, it could be highly useful for making a first cut on which initiatives that may deserve closer investigation.

5.4. Methodological caveats

Finally, some words should be said about the limitations of employing network-based approaches for analyzing governance structures. First, the accuracy of the results hinges on the quality and quantity of the data collected. The data collection effort required is often considerable. The only remedy for the data-collection problem is to acknowledge this short-coming, be transparent with our assumptions and honest about how representative our sub-set of the total population is. Second, the results are highly dependent on what edges that are chosen and how these are defined. In this paper, climate mitigation initiatives and their members were the subjects for investigation. Clearly, the way "members" are defined and included or excluded in the networks affects the final results. Moreover, by building the initial data-set of initiatives on existing literature and typologies, the paper certainly "inherits" methodological short-comings from previous projects. Third, an analysis of the network-structure is unsuitable for questions regarding effectiveness. This is part of a broader problem for mapping exercise to look at process and causality since the data is, by virtue, a snap-shot of reality. Fourth and finally, the existence of clusters and other structural characteristics do not tell us much about the quality of network components or explanation for the structure. Why do actors choose to cluster? Do they share norms with other members of the constellation and what discourses are prevalent? What is the relationship between clusters and institutions? Nevertheless, network-based approaches move us towards a relational perspective where transactions are central units for analysis and, according to Emirbayer, actors "derive their meaning, significance, and identity from the (changing) functional roles they play within the transaction" (1997, 287). Hence, the method could have large potentials when exploring how norms, resources and discourses travel and changes throughout a network. While merely exposing a network structure of global climate governance is not equal to showing all the transactions that take place within the network, I would argue that mapping the structure of the

network is important to show where interaction such as learning, exchange of best-practice, policy diffusion and spread of norms, is more likely to take place.

6. Conclusion

This paper presents an attempt to empirically show the structure of global climate governance, identify key players, and assess fragmentation, by employing a network-based approach to map the relation between climate mitigation initiatives and their members. To this end, a Membership Network was created based on previous mappings, in particular the climate governance triangle designed by Abbott.

The results show four main conclusions. First, previous account on the structure of global climate governance are only partly right in their assumptions. The network of initiatives and their members can best be described as having a "core-periphery" structure with nation states at the core and non-state actors, including public sub-national authorities, in the periphery. In the core, the UNFCCC holds a relatively central position compared to other state-led initiative however, it is not the only important node. Second, initiatives where states, international organizations and firms are involved are more numerous, more integrated between the zones and between the members. Third, the analysis show that there are a few key players from states, firms, international organizations and CSOs that take up key positions in the network. Fourth, the network-based approach provides an empirically grounded, reproducible and transparent approach to validate or dispute the many theoretical claims that has been made in the context of governance architectures, regime complexes, polycentrism and fragmentation.

The next steps of this research is to increase the number of data in the network to include private and hybrid institutions. The methods should also be refined to further investigate what appropriate measures for degree of fragmentation are. In this quest, comparative studies between different issue areas would be highly beneficial to calibrate the models and methods. Finally, the implications of different structural characteristics of networks are highly under-researched (for exceptions see Rydin 2012; Bodin and Crona 2009; Newig, Guenther, and Pahl-Wostl 2010). For example, based on literature from formal network theory, Rydin (2012) has suggested that a 'hub-and-spoke' structure of a policy network – where most nodes in the network could be reached with only a few steps – could be superior to other structures for efficacy of the resource exchange that is a pivotal activity for networks. Also Bodin and Crona have started to examine the meaning of structure of natural resource governance on a local level (2009). Nevertheless, while it would be highly interesting to connect evaluation concepts from the social sciences such as effectiveness, legitimacy and efficiency to the structural characteristics of a global governance architecture, we first need a robust method for mapping and comparing different issue areas and points in time.

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ANNEX 1 - Coding scheme – Membership networks: What constitutes a "Member"?

To assess what constitutes a "member" clear coding rules are needed. To this end, this document explains the coding rules for different types of governance arrangements to assist the researchers in the set-up of a membership-database.

Member are, for example:

- founding actors still active in the institution
- signatories to accords
- decision-making bodies

Non-members are, for example:

- Users of standards
- Strategic partners

The table below provides further examples and explains which actors that should be considered a member.

Function	Examples	Description	Members
Standard-setting and commitments	UNFCCC, WCI, Roundtable on Sustainable Biofuels, ISO	Institutions that where actors have signed up to a commitment or use a standard in some form, e.g. certifications, quality standards, registries, and are continuously involved in shaping its implementation and development.	• Members are the creators of standard or commitment and still actively involved in governance of the initiative • Members are signatories to standards or commitments if they have the opportunity to join the governing body
Information and networking	Multi-stakeholder partnerships, CEM, SolarCities, EUROCITIES, MEF, IPEEC, R20, ACCCRN, CUD, TT	Institutions defined by their network-character of horizontal decision-making and networked governance.	• Members are those that engage in exchange of resources • Members are those in an administrative/coordinating body
Operational	REDD+ Partnership	Institutions that implements projects such as installing low-carbon technologies, improve energy efficiency, or remove and mitigate HFC and methane emissions.	• Members are those that govern the implementation, e.g. funders and governing actors.
Financing	BioCarbon fund	Institutions that fund projects implemented in the field.	• Members are those that contribute to the Fund and/or are part of the governing body of the Fund.

Examples of reasoning:

- City Networks: In the Covenant of Mayors (CoM) cities and regional authorities are not members since they simply commit to the goals set on a European level. The governance of the network is primarily run by the European Commission. In the Climate Alliance however has a rolling schedule for members to join the executive board and have the possibility to meet and discuss topics, activities and positions at the annual assembly.
- Standard setting and commitments: The Verified Carbon Standard (VCS) is a standard. It's board is made up of individuals from companies and NGOs who arguably cannot be considered members of the institution. Neither the actors using the VCS can be called members since they don't have the ability to change the standard. The VCS, hence, does not have any members. Another example is the UN Global Compact's Caring for Climate (C4C) program. It is based on signatures by companies to a number of principles. The signatories cannot be considered members however, C4C is an initiative of the UNFCCC, UNEP and UN Global Compact which thus can be considered members of the institution.