



Visualizing connections: Mapping the landscape of adaptation research and practice through weADAPT

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Cover photo: Visualization of the geographic distribution of projects across weADAPT climate adaptation themes, April 2014. Image produced by Michael Rastall, using Gephi software.

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ABSTRACT

Information and communications technology (ICT) has transformative potential in several key areas in sustainable development, and is already facilitating multi-stakeholder engagement, knowledge exchange and capacity-building. This paper describes the Climate Actor Mapping for Adaptation (CAMA) project, which built on a collaboration with Sciences Po médialab in Paris, known for its innovative approach to “controversy mapping”. The project combined semantic tagging in weADAPT with innovative visualization techniques developed by Sciences Po to generate new insights about climate adaptation research and practice. The work was based on the dataset of adaptation projects maintained by weADAPT, along with project information from SEI’s Africa and Asia Centres, as outlined on the SEI website and in SEI’s internal Planning, Monitoring, Evaluation and Communication (PMEC) system. By identifying patterns in the data, we can learn to ask better questions. The participatory nature of such mapping exercises, including user engagement and feedback elicited at different stages of map development to test and refine the maps, can provide valuable insights. This process also helps increase ownership of the analysis and visualizations by participants. Such an approach has potential application in a wide range of sustainable development contexts and would significantly strengthen SEI’s toolkit for engaging and communicating with different stakeholders.

1. INTRODUCTION

New information and communications technology (ICT) has transformative potential in several key areas in sustainable development, not only to address vulnerability and support adaptation, but also potentially to increase the long-term resilience of communities (Heeks and Ospina 2012). Though in many cases, direct impact is yet to be evaluated, multi-stakeholder engagement, knowledge exchange and capacity-building have been enhanced by access to the internet and mobile networks in much of the developing world. This has increased access to all types and formats of information, ranging from text and voice messages on agricultural crop prices, market access, disease prevention and financial credit using SMS technology,¹ to the development of early warning systems and disaster risk mapping.² For example, remote weather stations and water sensors³ (Mehta et al. 2013) have been set up in Bangalore, connected via mobile networks to assess water demand, and SMS technology and crowdsourcing techniques (Hutchings et al. 2012) have allowed researchers to better study water, sanitation, and hygiene (WASH) services in East Africa.

In parallel, new online climate adaptation knowledge platforms are emerging daily. These also aim to facilitate stakeholder engagement, decision-making, reflection and learning, and have curated large amounts of data to support climate adaptation research and practice. However, there are also concerns about “portal proliferation syndrome” (Barnard 2011), and the increasing mass of unstructured and fragmented information on climate adaptation issues that confuse rather than inform users (Hammill et al. 2013). In recognition of similar issues, UN Secretary-General Ban Ki-moon established a global Expert Advisory Group on the Data Revolution for Sustainable Development⁴ in 2014 which called for the development of global consensus on data principles and standards, the sharing of knowledge for the common good, new resources for capacity development, and greater data coordination.

At the European level, part of the European Commission Seventh Framework Programme (SiS.2011.3.0.6-1) has focused on science-society interaction in the digital age. It called for an assessment of “the opportunities and risks in the use of the web and the social media as a meaningful information tool and for developing a participatory communication between scientists and the different publics”. Sciences Po médialab in Paris responded to this call with the three-year project Electronic Maps to Assist Public Science (EMAPS),⁵ which explored the use of the web as a tool for collective endeavour and public debate, with a focus on ageing in the UK and climate change adaptation globally (see Venturini et al. 2014).

Sciences Po médialab specializes in “controversy mapping” – a methodology designed to improve public understanding of topics through analysis and visualization of areas of disagreement within a discipline, drawing on a set of theories and practices, digital methods, science and technology studies, communication design and social innovation. SEI provided data and climate adaptation expertise to the EMAPS project both through its researchers and via SEI’s weADAPT platform (www.weadapt.org). This paper describes the results of a comparatively small, parallel project, with support provided by the Swedish International Development Cooperation Agency (Sida), that built on this collaboration: the Climate Actor Mapping for Adaptation (CAMA) project.

¹ For example, M-Pesa was first launched in 2007 in Kenya, allowing users to transfer money via text message.

² See, e.g., <http://www.usahidi.com> and the Crisis Mappers Network (<http://www.crisismappers.net>).

³ See the Bangalore Urban Metabolism Project (BUMP): <http://www.urbanmetabolism.in/bump>.

⁴ See <http://www.undatarevolution.org>.

⁵ See <http://www.medialab.sciences-po.fr/projets/emaps> and <http://www.climaps.org> for project outputs. The result of the adaptation analysis is Climaps, a “global issue atlas” of adaptation: <http://climaps.eu>.

SEI has been trying to understand patterns and divergences in the rich weADAPT knowledge base, to better structure and tailor the information for different user groups. The CAMA project sought to combine the benefits of new ICT capabilities, specifically semantic tagging in weADAPT, with innovative visualization techniques championed by Sciences Po, as a first step to make sense of the proliferation and fragmentation of climate information and generate new insights about climate adaptation research and practice. The work was based on the dataset of adaptation projects maintained by weADAPT, along with project information from SEI's Africa and Asia Centres, as outlined on the SEI website and in SEI's internal Planning, Monitoring, Evaluation and Communication (PMEC) system.⁶ To help address these issues, structured semantic metadata were incorporated in weADAPT, in the form of "tagging" from the web services Open Calais and Climate Tagger.⁷

Simple visualizations of key climate adaptation issues could be powerful tools for engaging stakeholders in developing countries with potentially complex issues to encourage greater participation, ownership and consultation. The participatory nature of the mapping exercise, including extensive user engagement and feedback elicited at different stages of map development to test and refine the maps, can provide valuable insights and help increase ownership of the visualizations. Such an approach has potential application in a wide range of sustainable development contexts and would significantly strengthen SEI's toolkit for engaging and communicating with different stakeholders.

This project was designed to build capacity within SEI for the use of innovative mapping tools to link science and society, and specifically to understand what communication of this kind can offer in a developing-world context. The objective was to map the partner networks of SEI Africa and SEI Asia in a way that would be beneficial for increasing collaboration, broadening networks, and identifying research gaps and "hot topics" that other organizations are working on. Extended analysis of this kind would allow us to explore questions such as: Who are the biggest producers of knowledge? Who collaborates with whom? Which sub-areas of adaptation are emerging priorities? Where are the biggest gaps in adaptation competency, and in the regions where SEI is working?

Through the project, we visualized key areas of climate adaptation research and practise in Southeast Asia and East Africa in three categories: i) weADAPT members; ii) SEI researchers, and iii) SEI partners and networks. In the following section, we describe the methodology used to consult with boundary partners (SEI Africa and Asia); develop a weADAPT application programme interface (API); collect, process and "clean" the data; and create the visualizations. Some limitations of the methodology are also discussed. Section 3 describes the results of the analysis.

2. METHODOLOGY

2.1 Collecting the data

Strategy documents from SEI Africa and Asia were provided at an early stage in the project. Assessing these documents gave insights into which thematic areas of research were desired focal areas, as well as which potential funders could be approached to support research in these areas. This allowed us to begin thinking about potential collaborations that would be useful in order to increase capacity and visibility in these areas.

⁶ For an overview of PMEC, see de Bruin (2013).

⁷ Open Calais is a product of Thomson Reuters; see <http://new.opencalais.com>. Climate Tagger is developed by REEEP; see <http://www.climatetagger.net>.

Each centre's circumstances and desired outcomes of this project were different. SEI Africa was established only in 2008, and has only begun to grow its staff since moving to Nairobi in 2013. The centre's 2012–2015 strategy set out to “build a strong network of partnerships for its own activities as well as to support research by other centres around the world”, and to “develop relationships with national-level African policy-makers as well as regional inter-governmental entities and policy-making bodies, such as African Union, East African Community, South African Development Community and African Climate Policy Centre”. The need to establish a wide and effective network for research on sustainable development (including adaptation, an area in which SEI Africa has not worked extensively) as a result of the centre move from Tanzania to Kenya was also highlighted. This has been a transformative period for SEI Africa, which has actively tried to build capacity for climate change adaptation research in recent years.

SEI Asia, established in Bangkok in 2004, found in its strategic assessment for 2012–2015 that the centre was well placed, and had succeeded to an extent in building a “strong network of research and policy organizations in the region and platforms for multi-stakeholder communication of knowledge to influence policy in region”. Communication with Asia Centre staff helped to determine what would be relevant and useful outputs from the project for their region. For example, one researcher suggested that adaptation networks were often in close communication, and met regularly at conferences and workshops, but these collaborations were not being formalized through funded projects. It would thus be helpful to identify funders willing to support adaptation both within the region and externally (where they would not normally consider looking), as well as pathways to those funders, backed by empirical examples of other organizations following similar routes. The centre was also interested in better understanding the role and relative importance in the region of the Sida-supported Sustainable Mekong Research Network (SUMERNET), which SEI coordinates. It was hypothesized that understanding the importance that SUMERNET holds within the adaptation network would help facilitate important insights that could, in turn, be communicated to regional stakeholders and donors.

After the first round of feedback from boundary partners for SEI Africa and Asia, it was clear that while weADAPT provided a useful representation of the “adaptation landscape” in general, it was not completely representative of SEI's research on climate adaptation. The data were therefore supplemented with materials from SEI's website (for project data since 2009) and PMEC (for all current projects). This combined dataset was then filtered to only those projects related to climate adaptation and based in Asia or Africa. These projects were added to weADAPT in order to create the same required data structure as the original dataset, including geo-referenced location data, organizational information and tags or metadata (keywords).

In addition to this, contact points at SEI Africa and Asia Centres connected with existing and potential associates in their networks who work on adaptation issues. They were introduced to the weADAPT platform and asked to register their organizations and share their adaptation projects. The idea was to raise awareness of their work while also expanding the CAMA dataset with “tagged” climate adaptation project information. The resulting visualizations could provide those contributors with strategic insights about the regional adaptation landscape.

The combination of these two processes resulted in the weADAPT database being inclusive of metadata regarding SEI adaptation projects in Africa and Asia, as well as information on organizations with which they do not necessarily collaborate yet. This in theory meant that by visualizing the metadata (tags) related to these projects, we could illustrate potential gaps in the network that SEI Africa and Asia could try to address.

2.2 Creation of a weADAPT API

In order to access weADAPT data in the format necessary for visualization a REST API was developed. This provides access to JSON data representing information needed for mapping a range of relationships in the weADAPT database. The API that was developed is available here: <http://api.weadapt.org/docs/>. The initial information required was as follows:

For each **case study**:

- associated geographical coordinates;
- date on which it was published;
- associated tags;
- authors;
- authors' affiliation (to which organization they belong).

For each **article**:⁸

- date on which it was published;
- associated tags;
- authors;
- authors' affiliation (to which organization they belong).

For each **organization**:

- members;
- articles posted by its members;
- case studies posted by its members.

For each **initiative**:

- subscribing users;
- subscribing organizations;
- articles posted in the initiative;
- case studies posted in the initiative.

For each **tag**:

- articles in which it has been used;
- case studies in which it has been used;
- users who used it (and how many times);
- organizations which used it.

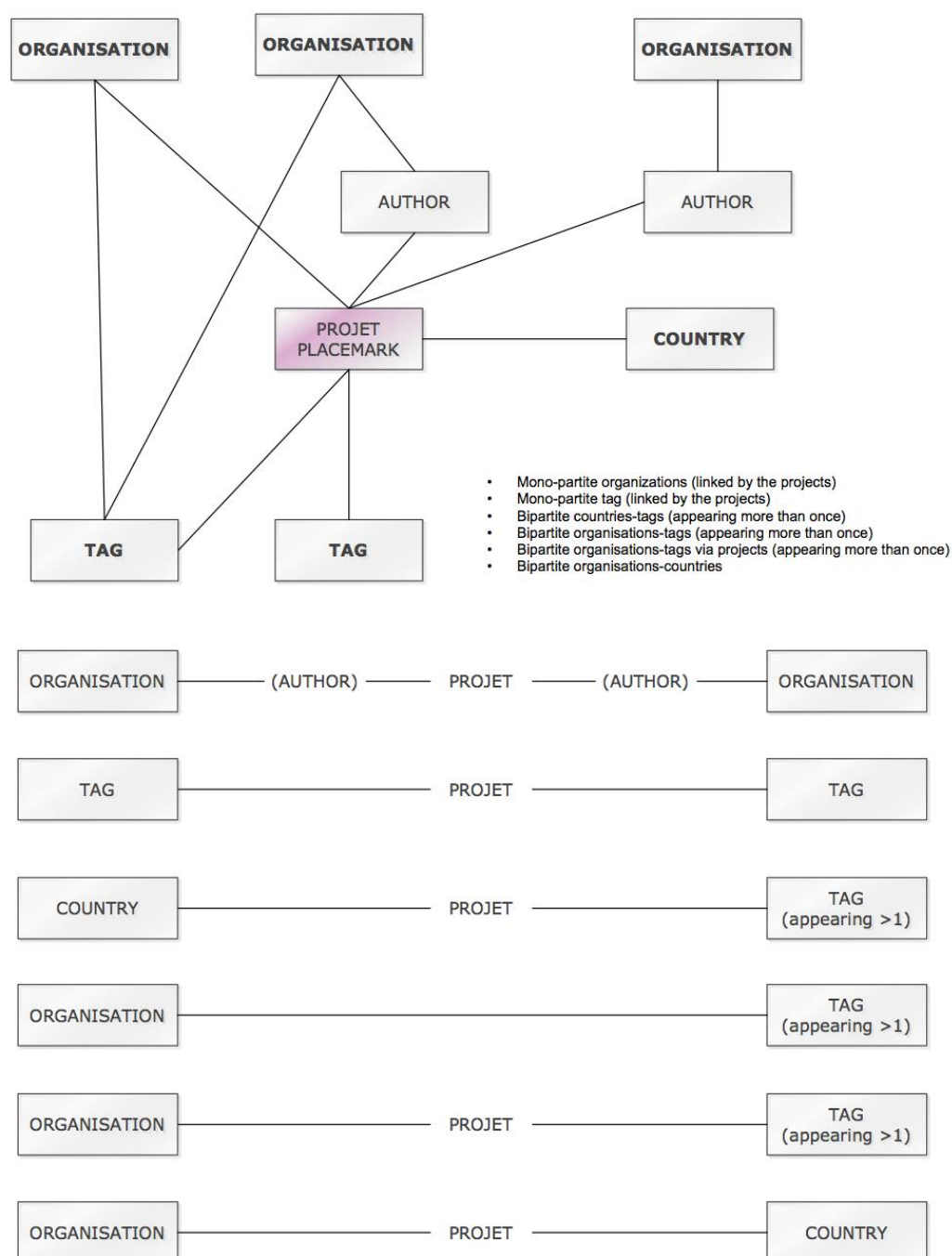
This information has been reduced to the schema in Figure 1: a project placemark has *latitude* and *longitude*, *keywords* (tags) and an *author* (or *authors*) who belongs to an *organization*; there are also *organizations related to the project*. In this way it is possible to map which organizations are working on which particular issues or “hot topics” (tags) and where. The creation of the API meant that a dynamic link could eventually be established so that any new content shared on weADAPT could automatically be included in dynamically updated visualizations mapping specific networks.

After consultations with the SEI Africa and Asia Centres on their different needs, it was decided that the visualizations to be produced would fall into three basic categories collected at the beginning of this project (April 2013): which *organizations* are working, on which *issues*, and *where* (variables include tags, organizations and geospatial data).

⁸ Articles were not included in the CAMA dataset, but they can be accessed through the API.

The same methodology was applied to an updated dataset one year later (April 2014), to see whether any changes were visible in the networks. In addition, producing graphs detailing these categories enabled the testing of certain hypotheses, such as that an SEI-led network is a key network in the Mekong region, or that historically, SEI adaptation research in East Africa focused heavily on economics.

Figure 1: Schema for the weADAPT API



Source: Sciences Po.

2.3 Gephi

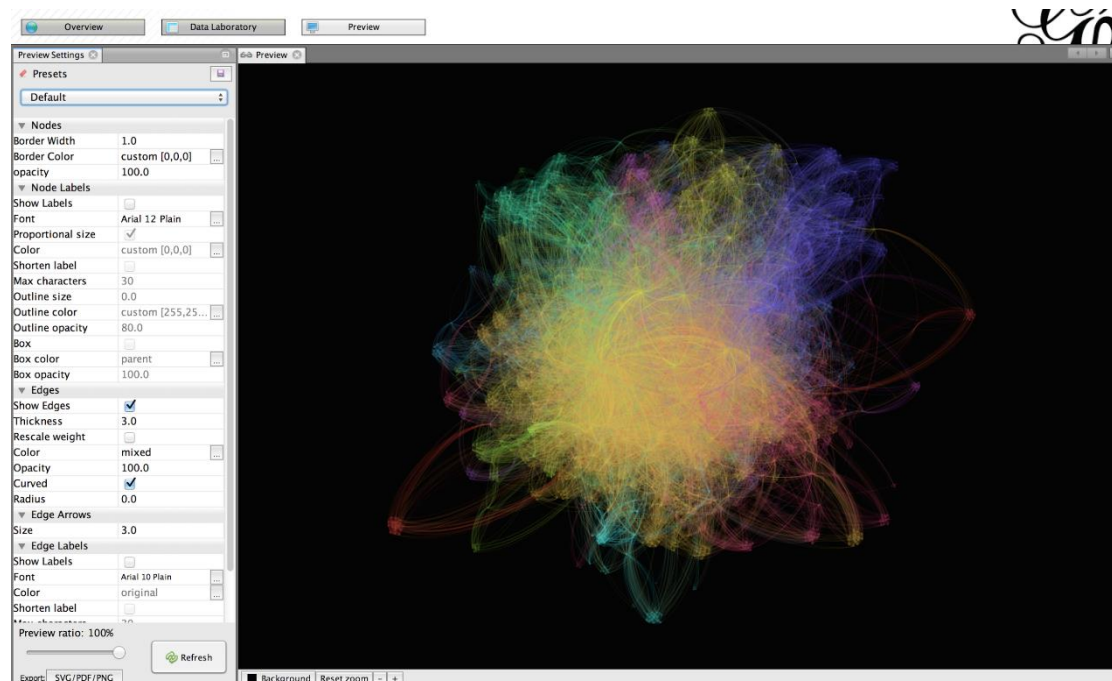
Using a combination of basic Python programming, tools and scripts for data manipulation, we constructed a methodology for producing the necessary network graph files. The primary means

of visualizing this data was using Gephi open-source software developed in 2008 by the Médialab at Sciences Po.⁹ Gephi is designed to “leverage the perceptual abilities of humans to find features in network structure and data” (Bastian et al. 2009, p.361) and is capable of handling large data sets (20,000 nodes or more).

The basic premise of the Gephi algorithm is that nodes repel and edges (links) attract, but the extent to which these forces are applied to produce clusters is customizable. Therefore it should not be assumed that the visualizations produced here are “conclusive”. They were simply produced to facilitate graphical analysis of a research question, or set of questions. Importantly, annotations can be made to make design steps transparent and replicable.

The software is designed for use by non-specialists, and enables the user to perform statistical analysis and visualization in the same working space. A “data laboratory” module is also available within the software to facilitate the participatory process of “playing with the data” (Nascimbeni 2012). For example, in some cases we used this functionality to remove nodes within the network to determine the impact of their absence on the structure of the network. While Gephi provides statistical data, we have mainly produced a qualitative analysis here based on statistical insights and using theoretical concepts from social network analysis.

Figure 2: Screenshot of a visualization of a network using Gephi software



⁹ See <http://gephi.github.io>.

Processing the data

To map weADAPT keywords (“tags”) in Gephi, it was important to apply a manual processing phase to the data to remove all keywords that:

- referenced a location¹⁰ (e.g. “Cape Town”);
- had one connection or less to other nodes;
- seemed incongruous with adaptation; or
- were too general to be useful (e.g. “environment” or “global warming”).

In addition, nodes were merged where they had similar meanings but were represented differently. For example, “flood”, “floods”, and “flooding” were merged to encompass all related content. The new aggregated node would generally take the mean of the nodes’ statistics, except in some cases where it was deemed that the assimilated nodes were sufficiently different that it was likely that they had been used in different placemarks in weADAPT; in those cases, the sum of the statistics, rather than the average, was taken.

Once the data was imported into Gephi, processed and “cleaned”, the network was represented spatially. Visualizations typically used the ForceAtlas2 algorithm (Jacomy et al. 2014) or, occasionally, the Yihon Fu algorithm. For more information on the settings used for spatialization and analysis, see Appendix 1.

Using visualization software, “communities” of nodes, or “modularity”, can easily be identified by colour (usually, with one-mode networks) as well as other network characteristics. In the visualizations that follow, there are some key social network theory classifications that are of relevance to the analysis:

Strength of connections: This refers to a) the proximity of nodes to each other and b) the weight of the links between the nodes. The closer the nodes are to each other and/or the greater the weight, the stronger the bond. Weights depend on the way the network is built, but is normally calculated by counting the number of items that occur in two nodes – e.g. the number of projects in which two tags are mentioned together.

Clusters: In social networks in general, clusters exist where nodes have significantly more ties between group members than between members and non-members (Bodin and Crona 2009). The existence of many sub-clusters of organizations within a network can be a barrier to collaboration, as such low “network cohesion” can produce “us vs. them” attitudes or create distance between organizations with different specializations or missions.

Bridges: Bridging nodes connect different clusters of actors, facilitating collaboration and the flow of information between organizations which would otherwise not be connected. Links between subgroups, known as “bridging ties”, are thus important for innovation and adaptive management. A lack of links to important or influential actors, on the other hand, can be a barrier to collaboration.

Centrality: There are two types of centrality that were used in the project: degree centrality (number of ties an actor has) and “between-ness” centrality (the degree to which an actor connects other actors who would not otherwise be connected). Degree centrality can be problematic if there is too much responsibility for one actor (Bodin and Crona 2009), while actors with high between-ness centrality are critical to providing access to parts of the network that would otherwise remain isolated.

¹⁰ This prevented them from interfering with geo-referenced information.

2.4 Limitations

The project used weADAPT data to test the applicability and utility of these visualization techniques to the field of climate adaptation. The results presented show how these techniques can be used to draw useful conclusions about the adaptation work represented on weADAPT. While this covers a broad number of projects (there were more than 160 geo-referenced case studies from Africa and Asia on weADAPT), there is no reason to assume that this is representative of the adaptation landscape as a whole.

This limitation was mitigated significantly by the incorporation of adaptation project data from PMEC and from the SEI website, which resulted in a combined dataset that was also inclusive of SEI's historical work on adaptation. Still, the dataset remains relatively small, with 38 SEI projects in Asia, and 31 SEI projects in Africa. This is partly due to the fact that SEI has only in recent years required all projects to be recorded on the SEI website and in PMEC. Nevertheless, further application of the visualization technique with more data could provide useful insights for strategic planning and capacity building at each SEI centre involved.

Lastly, qualitative analysis depends on the algorithm selected, choice of attribute/measures, initial seed, etc., but there was no investigation into the sensitivity of the outputs to such factors in this study. Therefore, all observations offered in the next section should be considered with all these limitations in mind.

3. RESULTS

In the sections below, we describe the results of mapping: i) the global weADAPT dataset, ii) SEI's research and partner network in Southeast Asia, and iii) SEI's research and partner networks in East Africa. Along with the limitations noted above, we should stress that all these network maps should be seen as discrete, relational entities; comparisons between graphs should be made with caution. Nevertheless, visualizing data in this way allows rapid exploration of patterns and relationships that would otherwise be more difficult or time-consuming to deduce.

3.1 Global weADAPT dataset – issue-based analysis

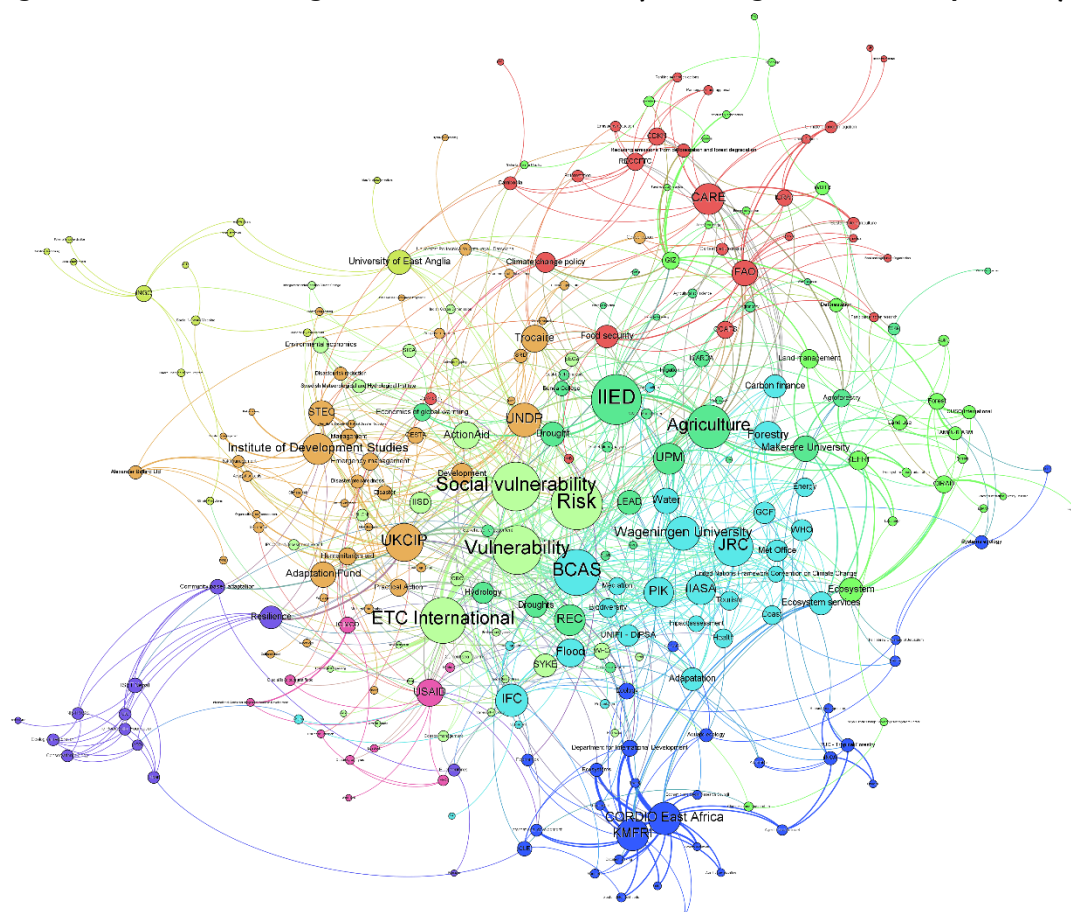
The network graph in Figure 3 maps organizations and the major issues (keywords or *tags*) they are working on, as determined by the frequency with which that the organization is linked to a keyword (from a project) in the dataset. The size of the node is determined by the *degree centrality* of nodes. This represents the number of links (“edges”) a node has i.e. the more keywords an organization node is linked to, the larger the node will be. This is also an indication of number of projects (and therefore the level of contribution to weADAPT by that organization) if one assumes that case studies on weADAPT contain a similar number of tags on average. For a much larger, high-resolution version of Figure 3, go to <http://www.sei-international.org/publications?pid=2812>.

In the case of CSAG, ENDA, START and UNITAR, the common keywords are “social vulnerability”, “vulnerability” and “risk”. It is interesting to note that all of these nodes are also long-term partners of SEI, many of which have now become specialist editors of themes or networks¹¹ on weADAPT (CIFOR, UNITAR, CSAG), and which have worked together on many of the projects posted on weADAPT. The sphere of influence of these partners also permeates into most communities in this visualization. Figure 3 is useful for weADAPT in indicating which partners could potentially become *new* editors due to their high level of activity (e.g. ENDA and START).

¹¹ See <http://weadapt.org/initiatives> for an up-to-date list of the emerging weADAPT themes and networks.

partners allows other active organizations to be seen more clearly. This is shown in Figure 4, which shows the next set of largest contributors to weADAPT, which would otherwise be hidden by SEI and SEI main partners' hyper-connectivity. These are organizations that work on adaptation issues, but not necessarily with SEI. For a high-resolution version of Figure 4, see <http://www.sei-international.org/publications?pid=2812>.

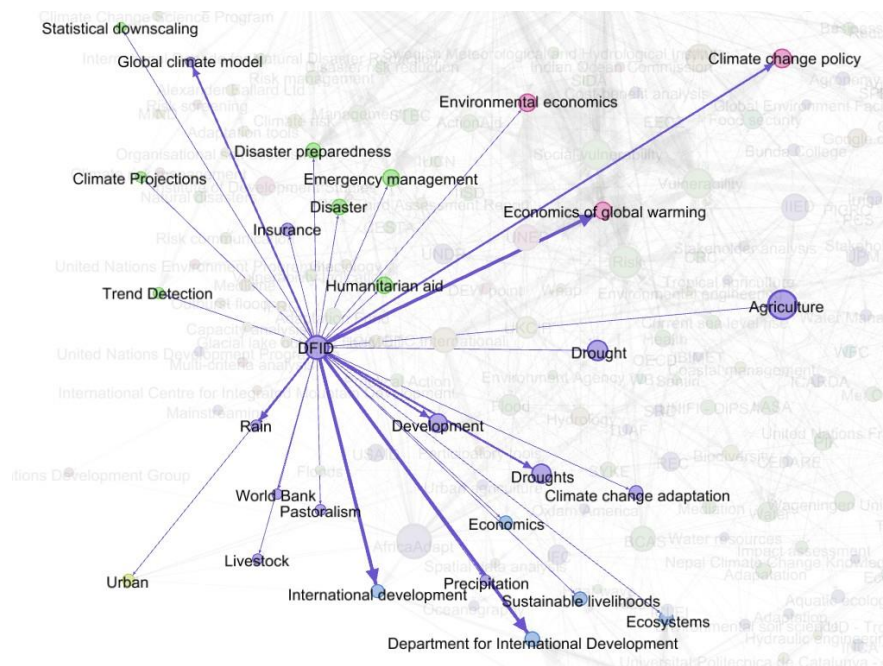
Figure 4: Other active organizations on weADAPT (excluding SEI and main partners)



These organizations include the Bangladesh Centre for Advanced Studies (BCAS), UKCIP, CARE International and other potential new specialist editors of themes or networks. These are also organizations with which SEI is forging increasingly strong partnerships, so it is perhaps no coincidence that they are also particularly active on weADAPT. In addition, there is an interesting clustering of various European Commission Seventh Framework Programme consortia that SEI belongs to. The key common areas of research are “agriculture” and “social vulnerability”. However, it also includes other organizations who want to invest time in sharing resources on weADAPT due the benefits this brings, such as increased visibility for their work.

More detailed analysis allows us to identify organizations which have played a key role in supporting projects included in the full weADAPT dataset, and the major topics that have been funded. Figure 5 illustrates this for the UK Department for International Development (DFID), showing clear links with areas of work that it has supported, such as urban issues, economics of adaptation, disaster resilience, and agriculture.

Figure 5: Issues areas in which DFID has supported projects listed on weADAPT



The graphs presented so far show the state of the dataset at the beginning of the project, April 2013. The same methodologies were applied at the end of the project, in April 2014, to see whether noticeable changes could be detected. Figure 6 shows an increased number of coloured areas or “communities” on the map compared with the same graph in Figure 4 from 2013, and in some cases existing communities of expertise have become further populated. This trend is indicative of the large amount of content that weADAPT has received between 2013 and 2014, both through the CAMA project and through increased user participation in the portal. For a much larger, high-resolution version of Figure 6, go to <http://www.sei-international.org/publications?pid=2812>.

Figure 6: 'Hot topics' in content shared by organizations on weADAPT in 2014

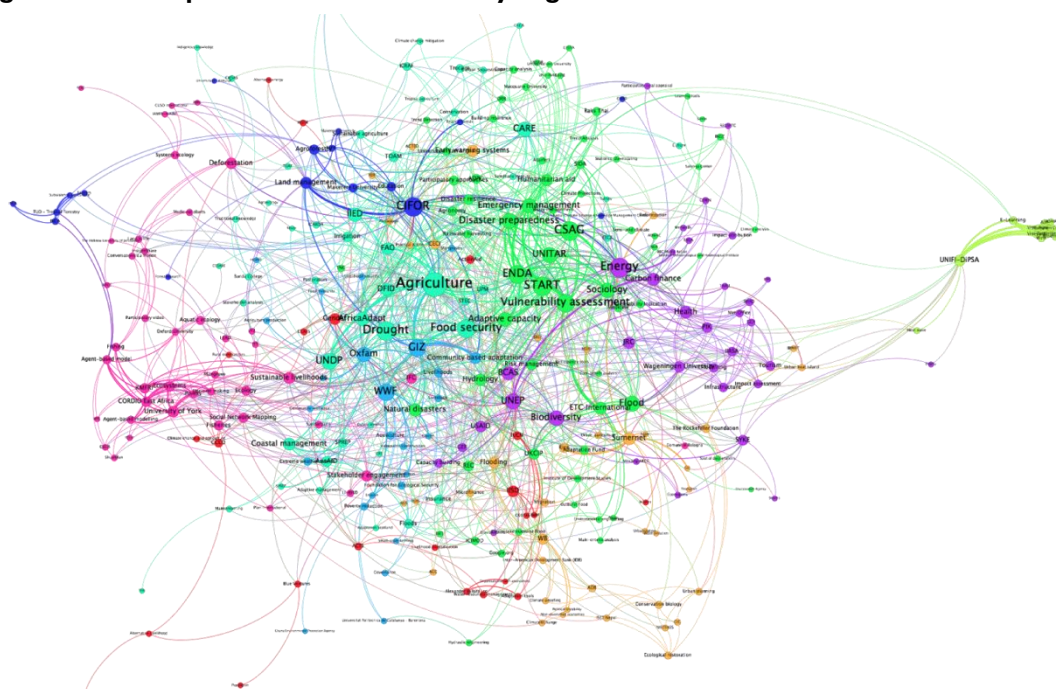
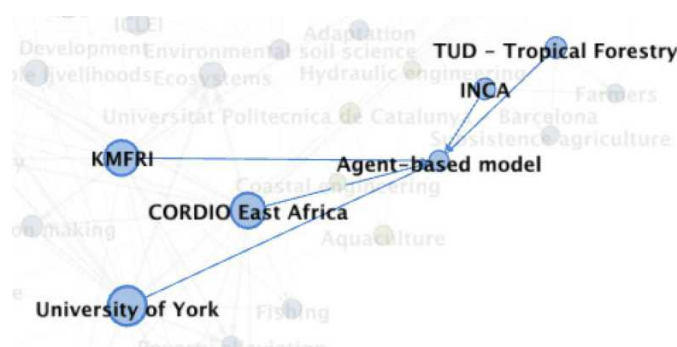
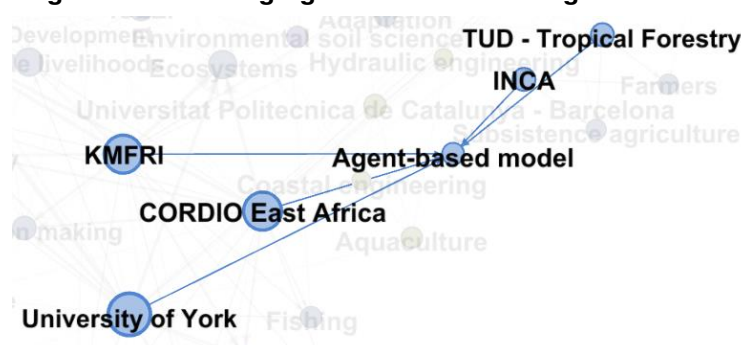


Figure 7: Cluster from Figure 3 showing organizations using agent-based modelling in their research, as found on weADAPT in 2013



¹² See <http://www.espa.ac.uk>.

Figure 8: New organizations doing agent-based modelling found on weADAPT, 2014



3.2 Global weADAPT dataset – geographic analysis

In this section, we show key issues that organizations are working on in different countries, as determined by the frequency of keywords that appear in the dataset in each country. Figure 9 shows that there is a high proportion of community-based adaptation case studies globally, and a concentration of projects centred on adaptation decision-making in the UK. It also highlights regions with few or no case studies,¹³ such as North America, Australia and Russia. Clearly these are regions from which SEI might want to seek contributions to weADAPT.

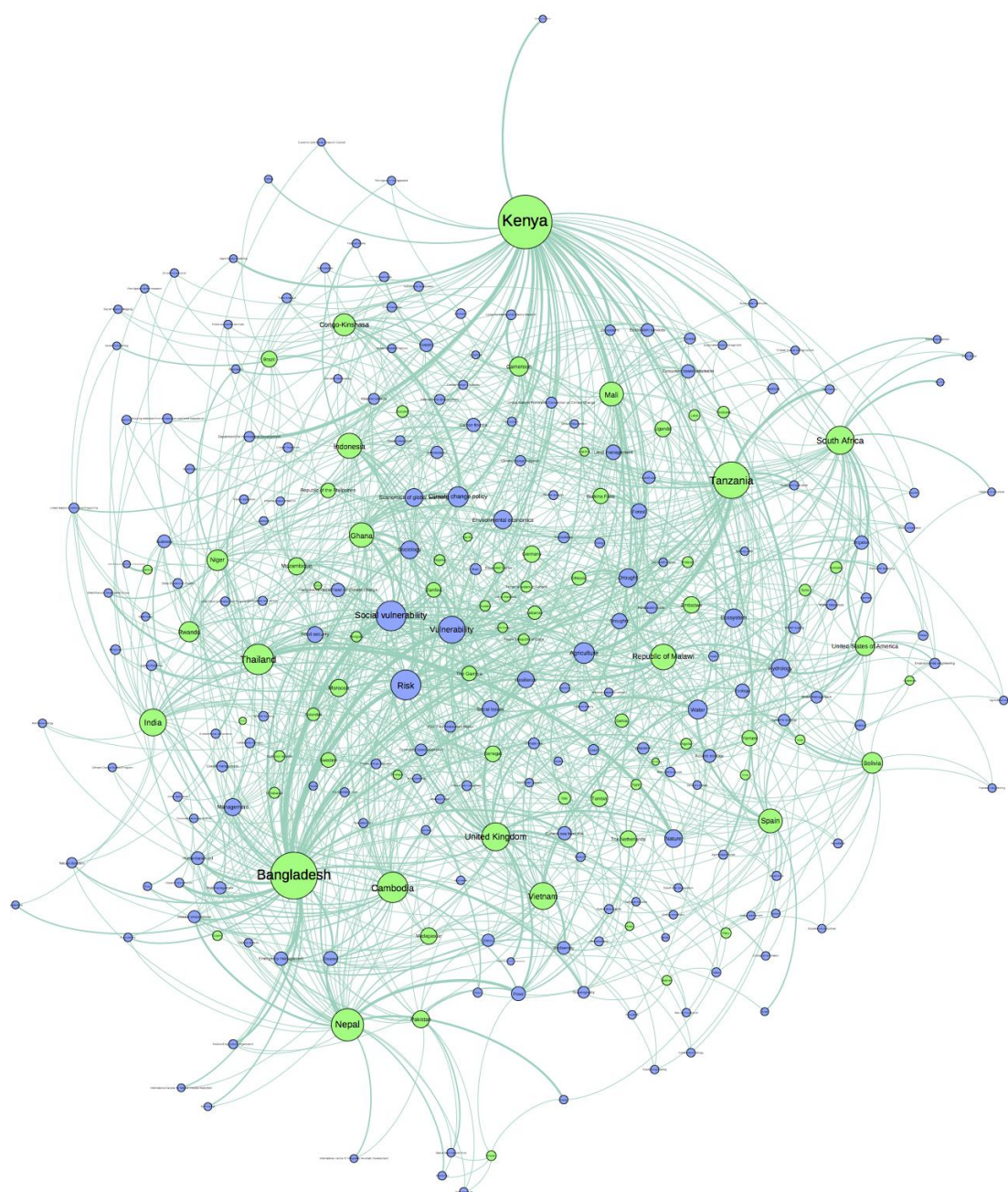
Figure 9: Geographic distribution of projects across weADAPT themes, April 2014



In Figure 10, at a finer scale, it is possible to explore nodes that consist of i) country name derived from geo-coordinates of weADAPT case studies and ii) keywords associated with those case studies. This shows where most case studies were situated geographically and the primary issues being explored or different tools and methods applied in different countries as of April 2013. Two country nodes were most prominent in the network in 2013 – Kenya and Bangladesh – indicating that the largest numbers of case studies on weADAPT focused on these countries. Although they shared some keywords such as vulnerability, risk and environmental economics, the differences in the issues they touched upon were sufficient to keep them at opposite ends of the network.

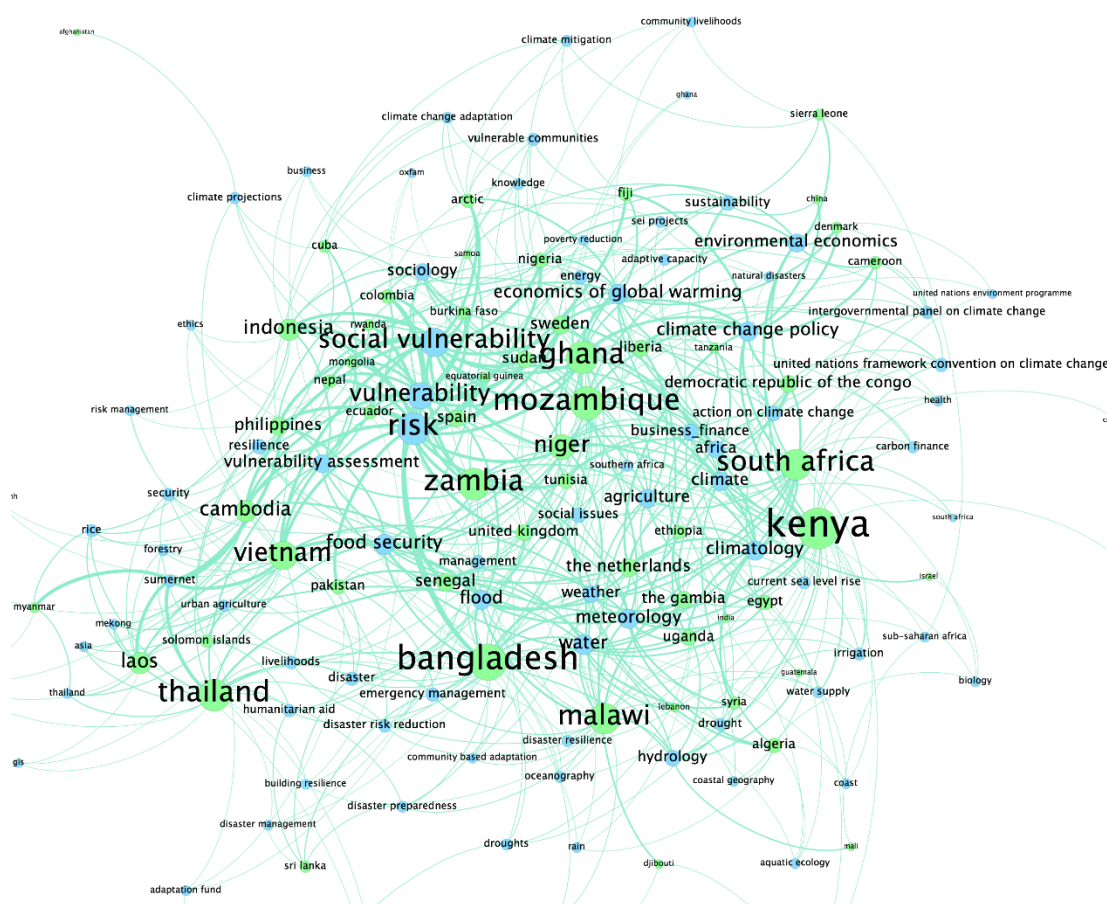
¹³ However, there are many articles and reports from most of these regions on weADAPT that are not geographically referenced, and therefore not included in the dataset.

Figure 10: Geographic coverage of issues by country on weADAPT, 2013



However, by April 2014, some new trends were evident geographically (Figure 11). South Africa, Malawi, Mozambique, Vietnam and Thailand are noticeably larger relative to other country nodes than they were previously, indicating an increase in the amount of content coming from these regions. And though possibly an artefact of the spatialization, the distance between Kenya and Bangladesh – two dominant nodes that polarized this network a year before – appeared to have narrowed. While an increased number of case studies and commonalities in these countries concerning water resources, current sea-level rise, climatological studies and agriculture may have contributed to this change in some regard, further research would need to be done to confirm whether this was actually the case.

Figure 11: Geographic coverage of issues by country on weADAPT, 2014



3.3 Mapping SEI's organizational networks

In order to explore the potential for highlighting gaps in SEI's own network and potential new collaborations, we mapped data from SEI Africa and SEI Asia projects. We supplemented the existing weADAPT dataset with information about adaptation case study project listed on SEI's internal project reporting system (PMEC), as well as all information on current and past adaptation case study projects found on the SEI website.¹⁴ The following graphs show how this type of visualization can be used to identify strengths and weaknesses in organizational networks and uses data from 2014. However, much of the project information has already changed (at the time of print of this report), and thus there are many new projects, partnerships and networks in each region, which would be reflected if the mapping exercise were repeated.

SEI in Asia

Using the combined dataset, we were able to create the several visualizations of SEI's adaptation research in Asia, and particularly in Southeast Asia, and explore interesting patterns and relationships within SEI's network, as well as possible ideas for future research, collaborations and partnerships. Along with SEI Asia's own projects, we mapped the activities of SUMERNET, a network focused on sustainable development of the Mekong Region that SEI coordinates (SEI has secured the funding, through Sida, and serves as the SUMERNET

¹⁴ It is worth noting that the materials posted on weADAPT cover a broader range of topics than those taken from PMEC and the website.

SEI has done extensive adaptation research in Asia. Figure 12 shows details of a map of SEI and partner organizations and the countries where they have conducted research since 2009.¹⁶ SEI's activities cover a wide range of countries, with the largest concentration of case studies in Thailand (where SEI Asia is based) and Bangladesh. Though there has been some work in the Pacific Islands, and in Fiji in particular, there are many boundary partners working in this region who do not work in other countries in Asia, keeping the node far from the rest of the network. On the other hand, there are many other partner organizations working alongside SEI in the same other countries highlighted in Asia, which keeps them clustered around the highlighted SEI node.

The figure consists of two network graphs. The left graph shows a central cluster of countries (indonesia, afghanistan, sri lanka, china, thailand, nepal, mongolia, philippines, bangladesh) with 'sei' at the center, and 'fiji' connected to 'sei' by a thick red line. The right graph shows a central node 'sumernet' connected to 'thailand', 'laos', 'philippines', 'cambodia', 'myanmar', and 'vietnam'.

¹⁶ This is the date of the earliest case studies found on the SEI website.

Figure 13: SEI's Asia network (organizations and countries), including links through SUMERNET

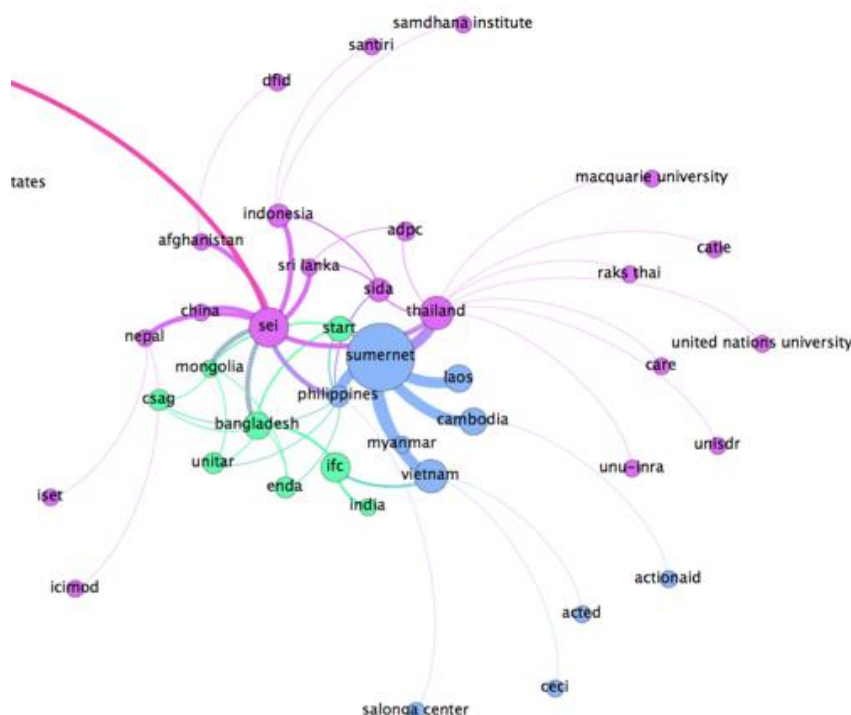


Figure 14: SEI's Asia network – links within each country facilitated by SUMERNET

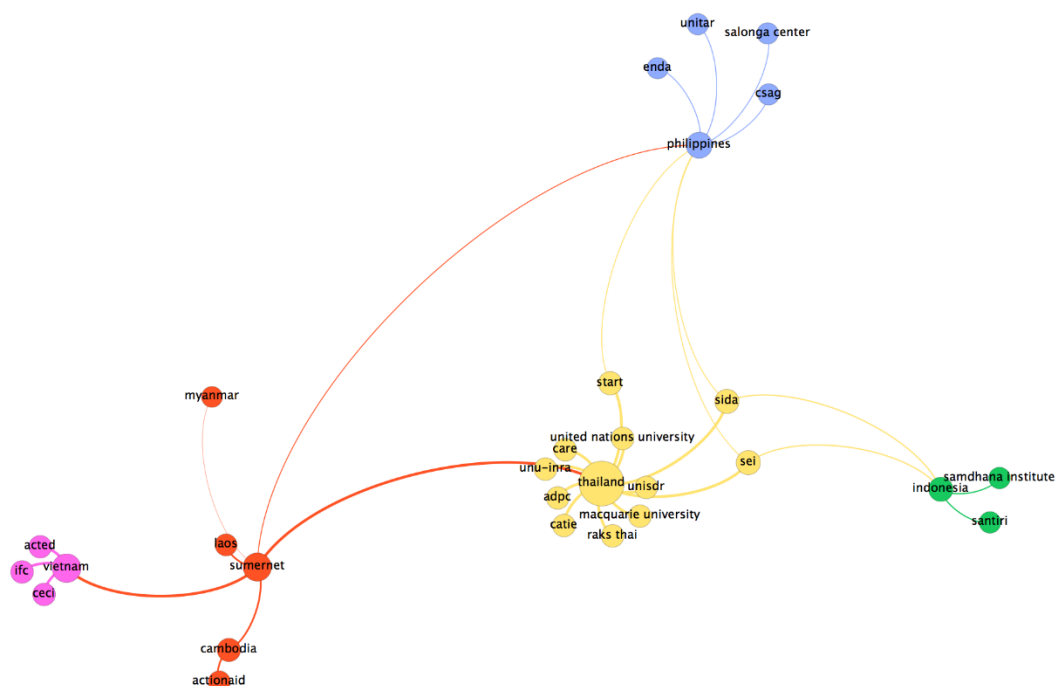
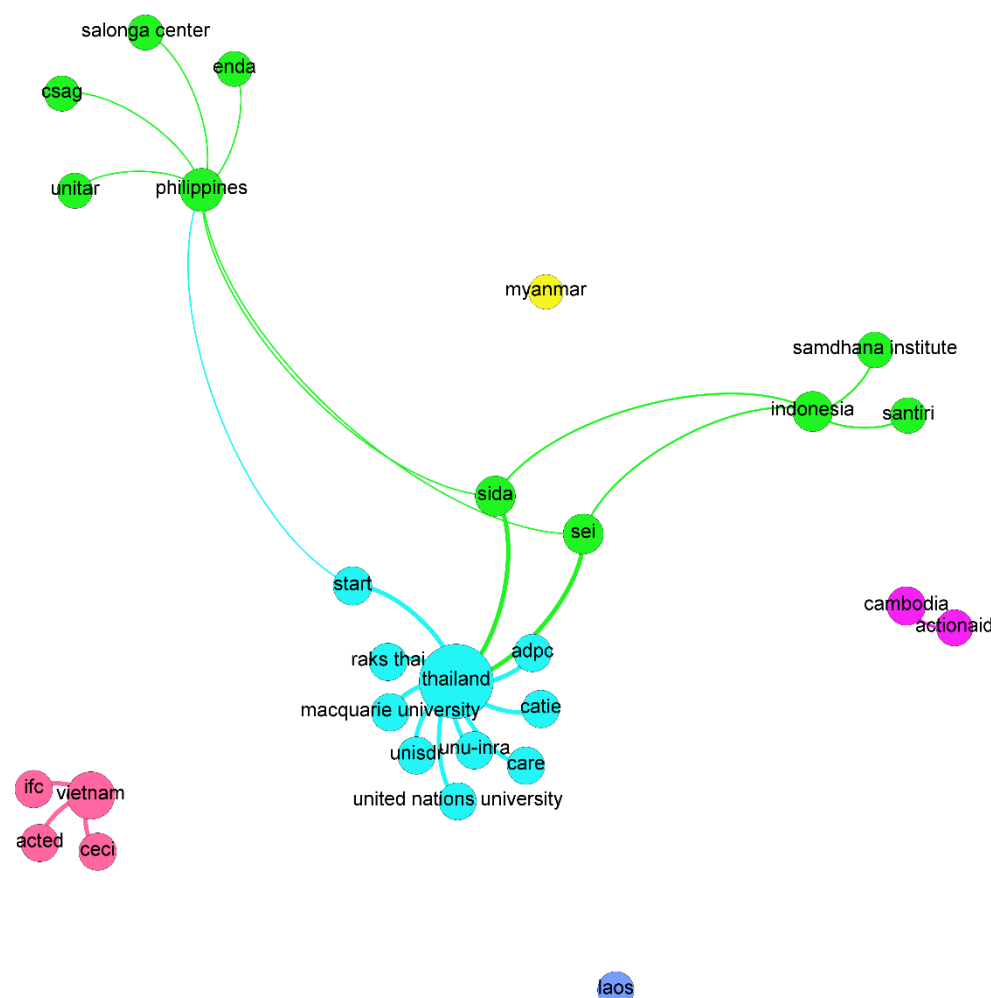


Figure 14 shows that removing SUMERNET reduces the number of countries in which SEI is directly engaged in adaptation work (isolating Myanmar, Cambodia, Laos and Vietnam), highlighting its importance as a regional network. SUMERNET thus serves as a bridging network for SEI in Asia, particularly in Southeast Asia (Figure 14), facilitating connections to a wider range of countries and organizations than SEI might be able to reach through direct

engagement. As shown in Figure 17 further below, it also enables research in a large range of issue areas additional to SEI's direct research. Thus, SUMERNET exhibits high "betweenness" centrality (the degree to which it connects actors who would not otherwise be connected is high). It is important to recognize the important role that such regional actors play, and the potential repercussions on the network if they ceased to exist. This also suggests that connecting with – or developing – a similar regional network in sub-Saharan Africa could be very valuable for SEI's Africa Centre as it seeks to make new connections across the region.

Figure 15: SEI's Asia network without SUMERNET



Deeper analysis of the same dataset allowed the visualization of issues that are key topics of research by SEI in different countries. The network graphs below highlights selected insights from the maps that were created.

Figure 17 shows that a large proportion of SEI's work on climate adaptation focuses on *disaster resilience* and *preparedness* in Thailand and *climate risk communication tools*, *climate trends* and *projections* in Vietnam, while common areas of research in both countries are *tourism*, *early warning systems*, *floodings* and *disaster risk reduction*. There is also a large amount of work in the region on *rice cultivation*, *social vulnerability*, *economic integration* and *transboundary trade*. The Philippines and Indonesia are growing but very distinct areas of research (distant from the rest of the network), with new areas of work focusing on *customized*

learning approaches for adaptation planning in small islands and governance analysis of *cultural landscapes* in a UNESCO World Heritage Site (in Bali, Indonesia).

Figure 16: Key research topics in SEI's work in Southeast Asian countries

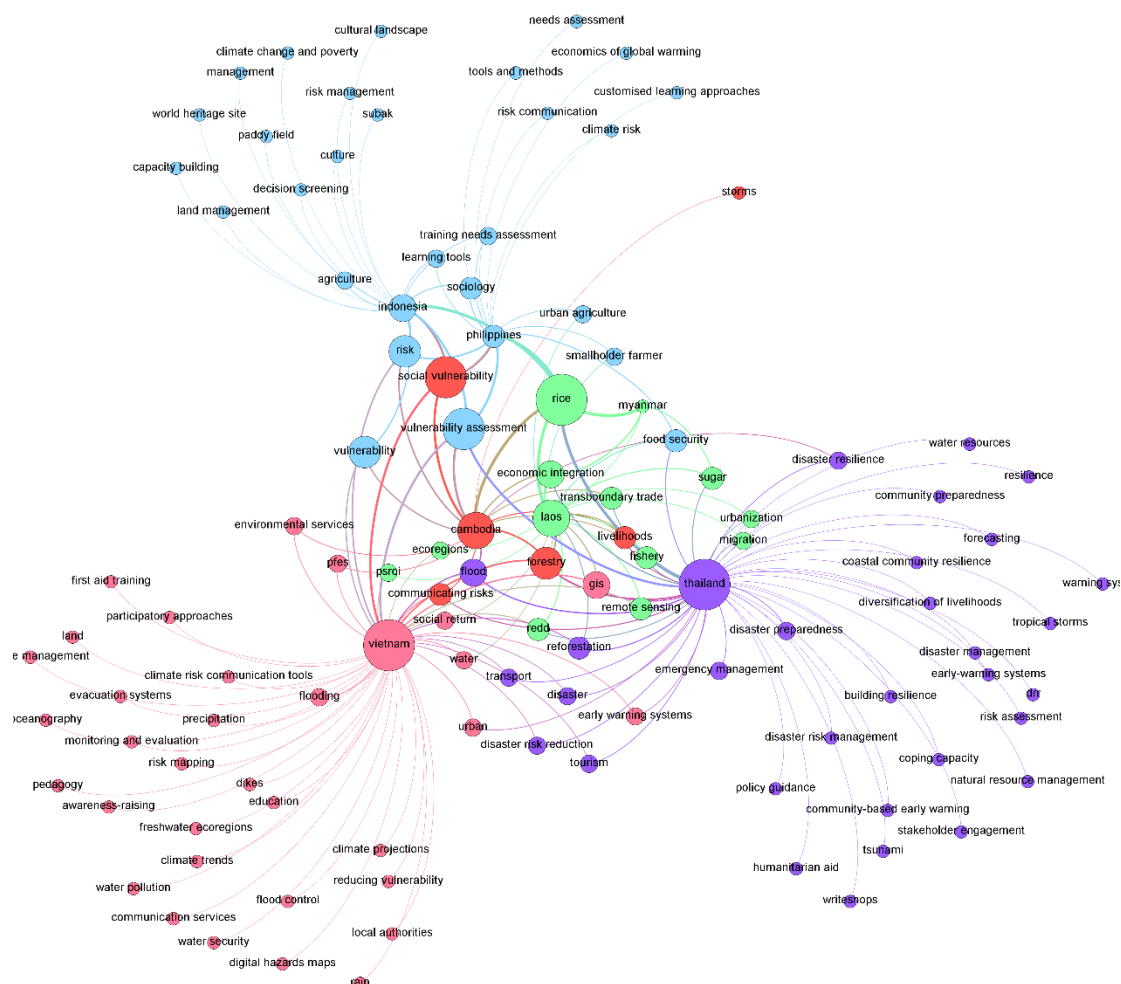
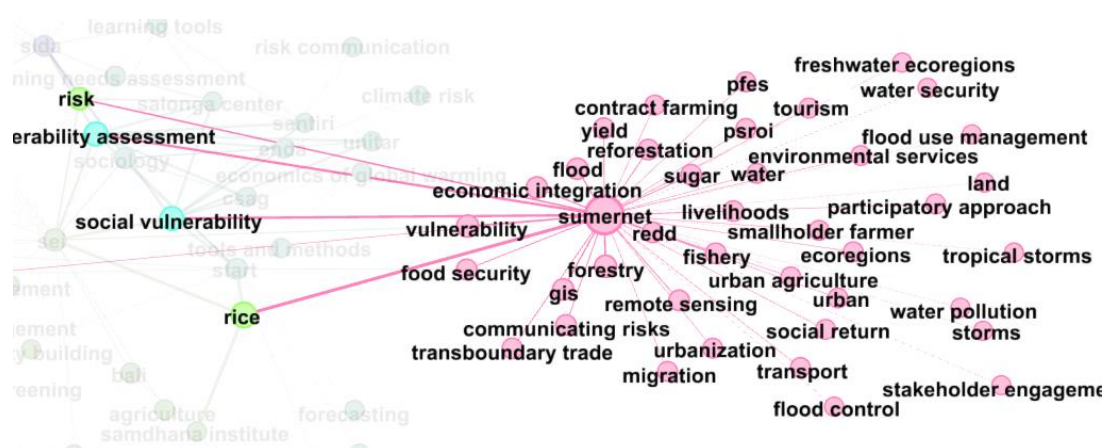


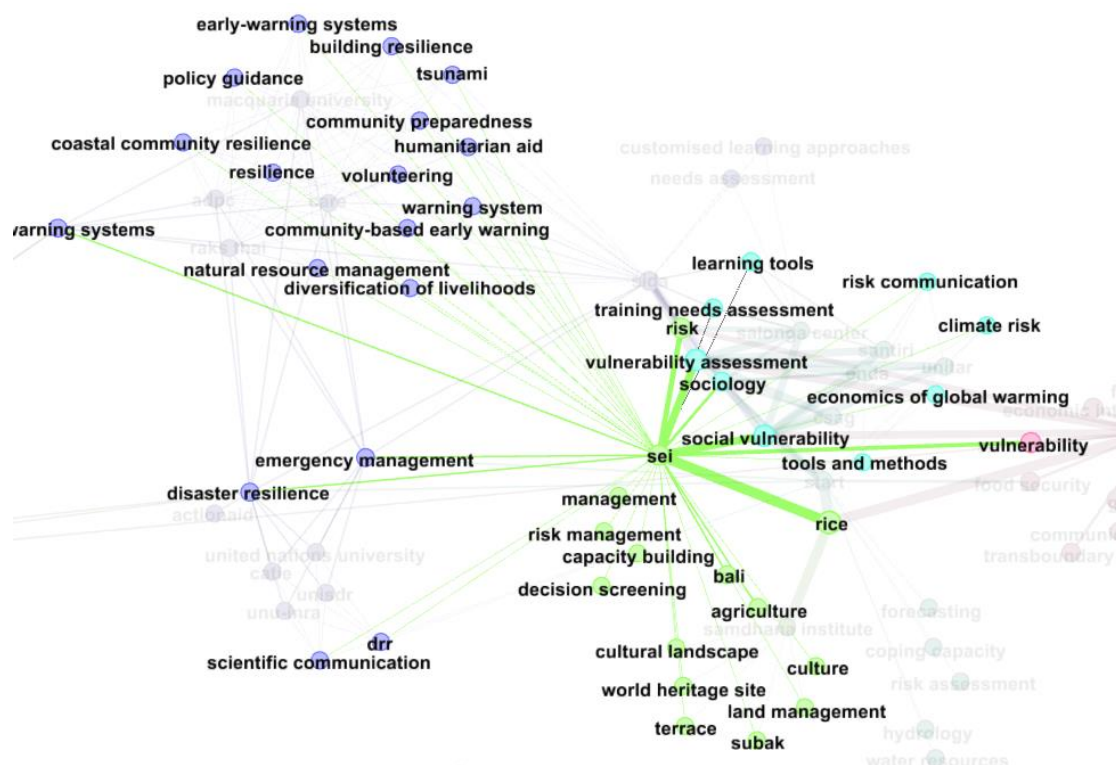
Figure 17 highlights key areas of research by SUMERNET, with the size of nodes indicating where the concentration of work lies. Similarly to the location of the research (Figure 14), links through SUMERNET also open up new areas of work for SEI. In particular, key areas of cross-country research facilitated through SUMERNET include *forestry* and *flooding*.

Figure 17: Issues SEI is working on through SUMERNET in Southeast Asia



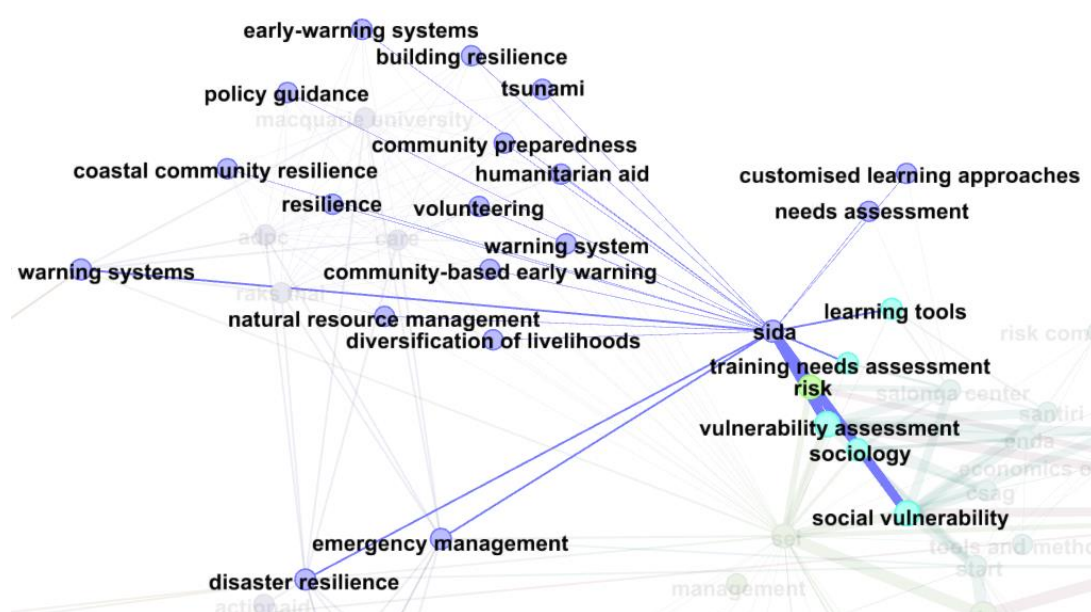
This can be confirmed with Figure 18 below, which shows SEI's direct research where *forestry* and *flooding* are not visible (according to this limited combined dataset).

Figure 18: Issues SEI is working on directly in Southeast Asia



It is also possible to examine areas of work being funded by different donors. For example Figure 19 shows that much of the work on disaster management, community preparedness, early warning, capacity-building and training by SEI in Southeast Asia has been supported by Sida (which, as noted above, is also the funder of SUMERNET).

Figure 19: Issues on which SEI has worked in Southeast Asia with Sida funding



SEI in Africa

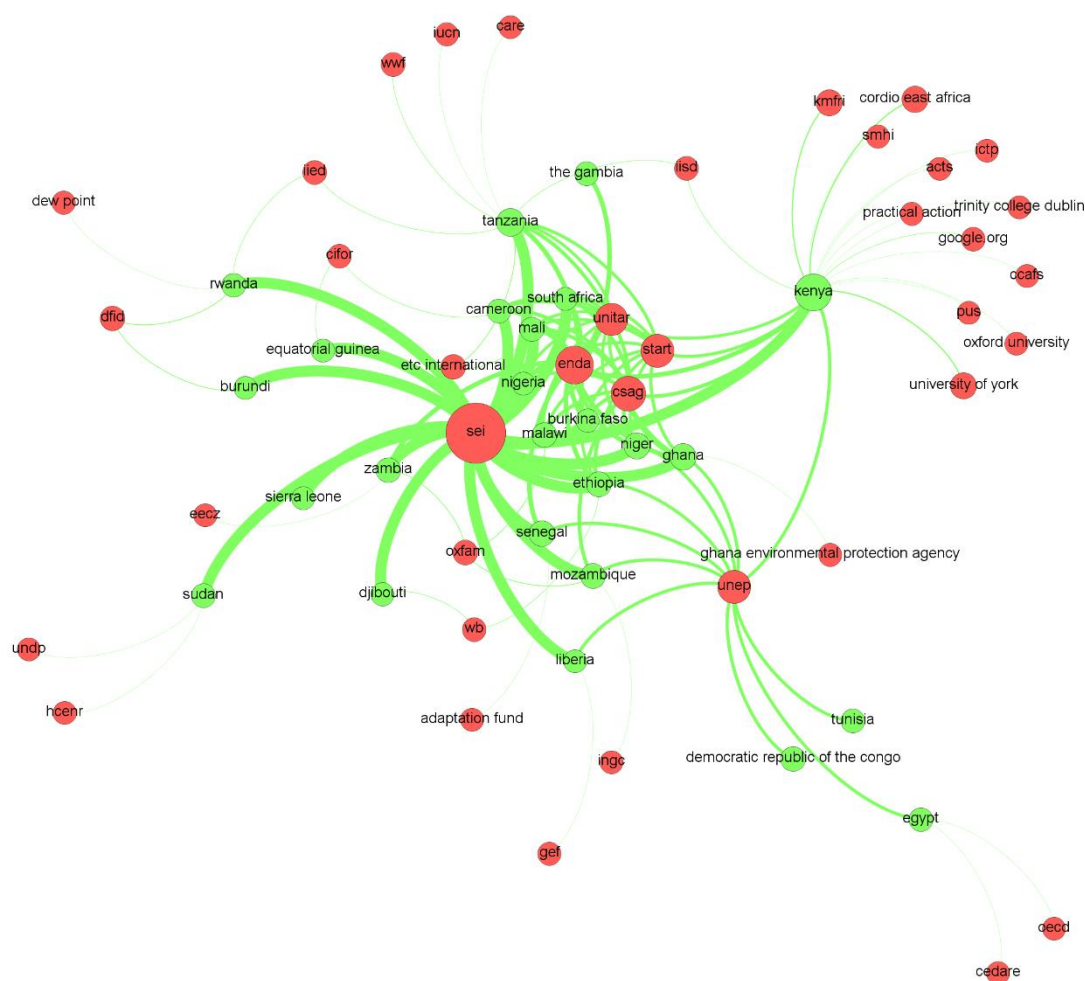
A common challenge in a distributed organization such as SEI is to ensure that different parts of the organization are aware of what others are doing – including where they are working, and with whom. This is particularly important for leveraging the partnerships and contacts developed by one part of the organization to advance the work of other parts.

This is relevant in supporting the SEI Africa Centre as it works to expand its activities on climate change adaptation. Since moving to Nairobi, SEI Africa has made several strategic recruitments for adaptation research; as the centre builds its networks, it is useful to understand what other SEI centres have done in the region. Visualizing the network of organizations with which SEI has collaborated in East Africa can provide a simple way of identifying possible partners for future work, as shown in Figure 20. Knowing that relationships with these organizations already exist at some level within the organization will assist SEI Africa in building partnerships and expanding its network.

Using the combined dataset, we created several visualizations of SEI's adaptation research in Africa, and particularly in East Africa. As in Asia, we expect that with further in-depth analysis of particular issue areas, sectors or countries, this could be a powerful tool for communicating activities, strengths and “niche” areas to donors, boundary partners and regional networks, such as AfricaAdapt and the Africa Adaptation Knowledge Network (AAKNet) of the UNEP Global Adaptation Network (GAN).

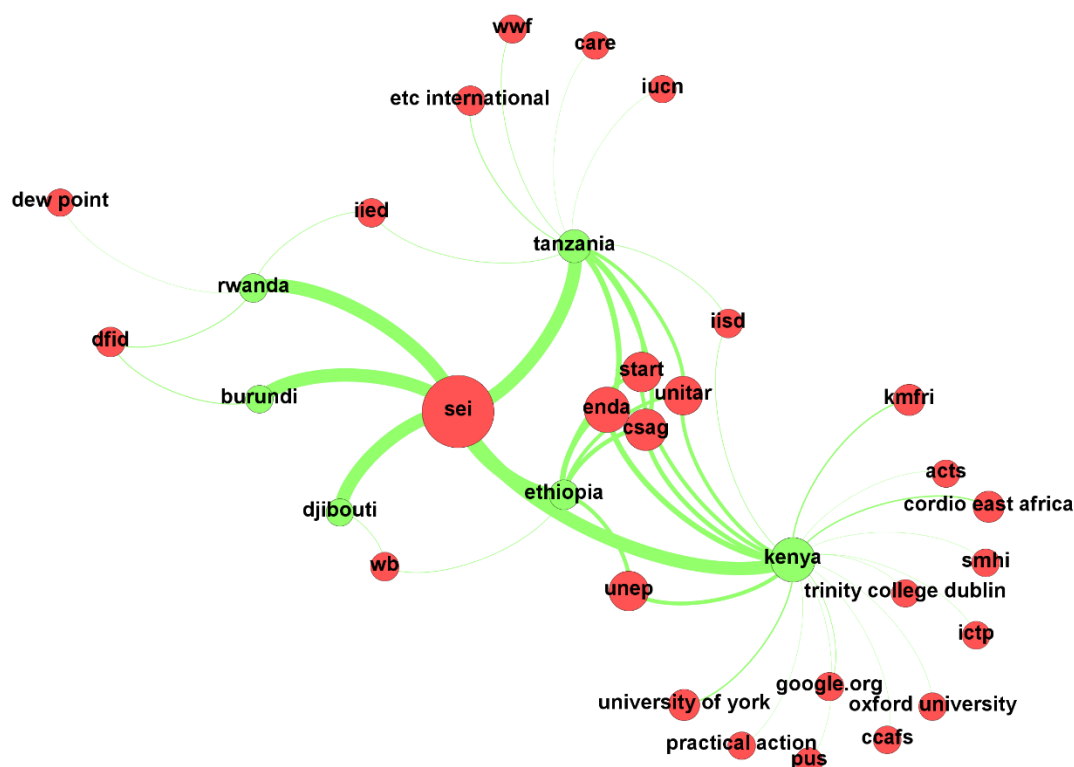
Figure 20 shows the African countries in which SEI has worked historically, and with which partners; Figure 21 does the same for East Africa specifically. It is interesting to note that there are certain organizations SEI works with in multiple locations across the region (e.g. ENDA, START, UNITAR and CSAG), while some partnerships are specific to one project or country – for example, many of those in Kenya.

Figure 20: SEI's adaptation research in Africa, by country and organizations involved



As shown in Figure 21, in East Africa, SEI's main climate adaptation activities have been carried out with DFID, UNITAR, ENDA, START, CSAG and UNEP. They largely involve research on the economics of adaptation and capacity-building activities through the Advancing Capacity for Climate Change Adaptation (ACCCA) initiative. In the bottom right of Figure 21 are research projects on health and adaptation and decision-making for coastal adaptation.

Figure 21: SEI's adaptation research in East Africa, by country and organizations involved

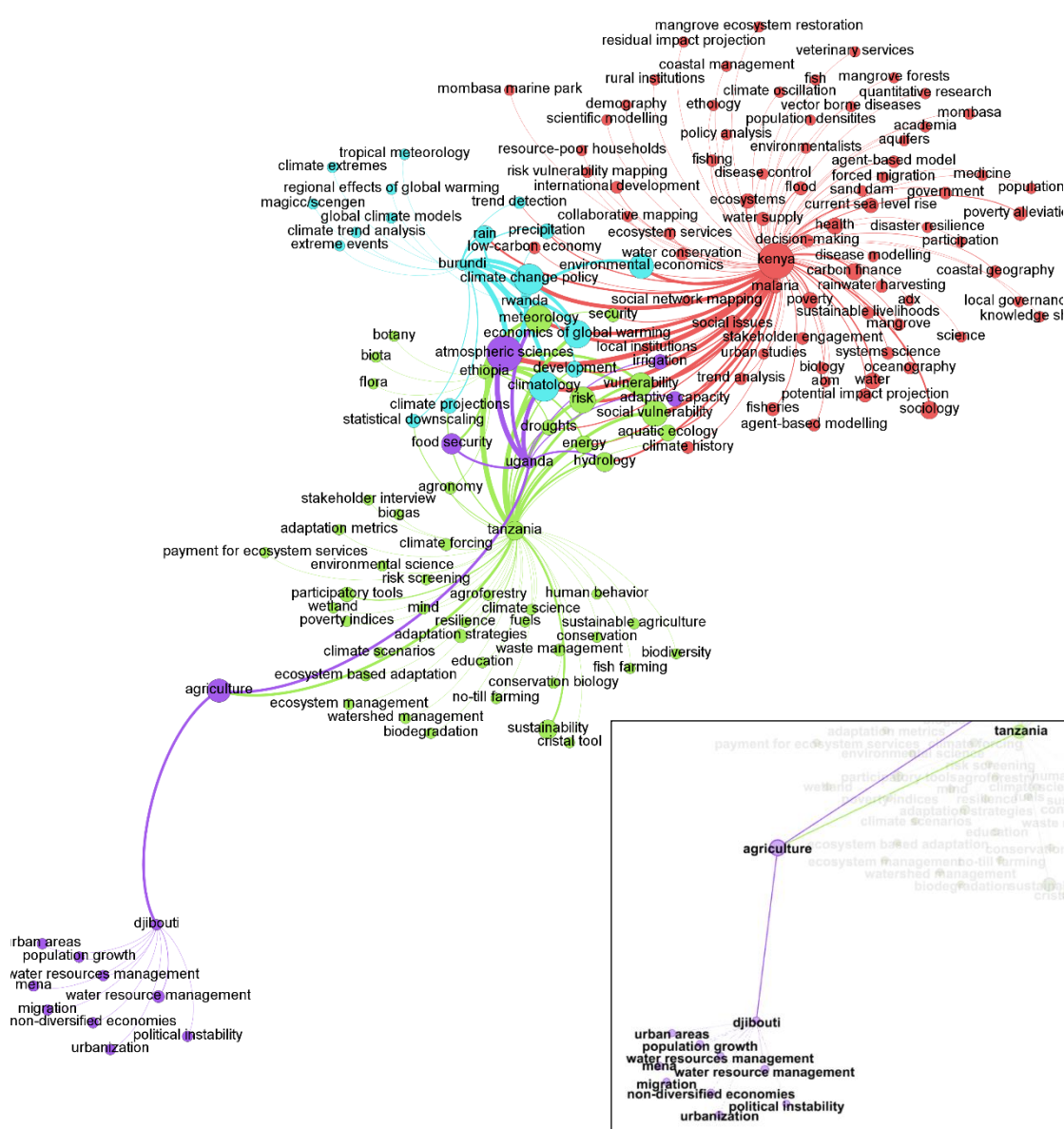


Mapping key areas of SEI's climate adaptation research in East Africa

Deeper analysis of the same dataset allowed the visualization of issues that are key topics of research by SEI in different countries. Figure 22 shows that there are distinct areas of research taking place in Kenya and Tanzania, with the largest overlapping areas between the two in the fields of *social vulnerability* analysis, *meteorology* and *risk management*. The Kenya node exhibits high degree centrality with many links to keywords, equivalent to a high volume of case study research. This also reflects the high proportion of research taking place in general by organizations in Kenya, as seen in earlier graphs showing weADAPT data (Figure 12).

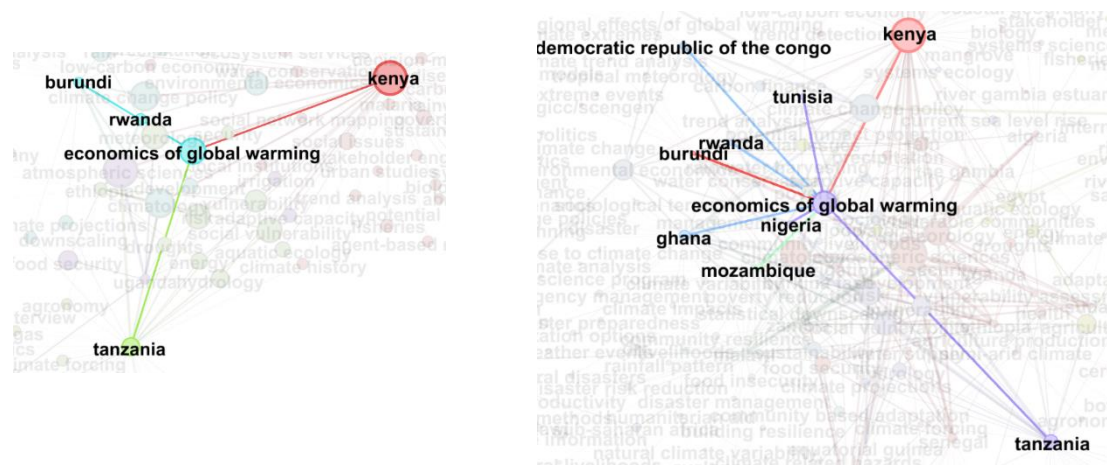
A large proportion of SEI's work on climate adaptation is denoted by the *atmospheric sciences* keyword and notably *agriculture* and *food security* are large areas of research, but only linked to Djibouti, Uganda and Tanzania (that is, specific climate adaptation research related to agriculture and food security). Additionally, it is clear from the graph that the type of research being done in Djibouti is, on the whole, distinct from that which is being done in the rest of East Africa.

Figure 22: Key areas of research for SEI in East Africa



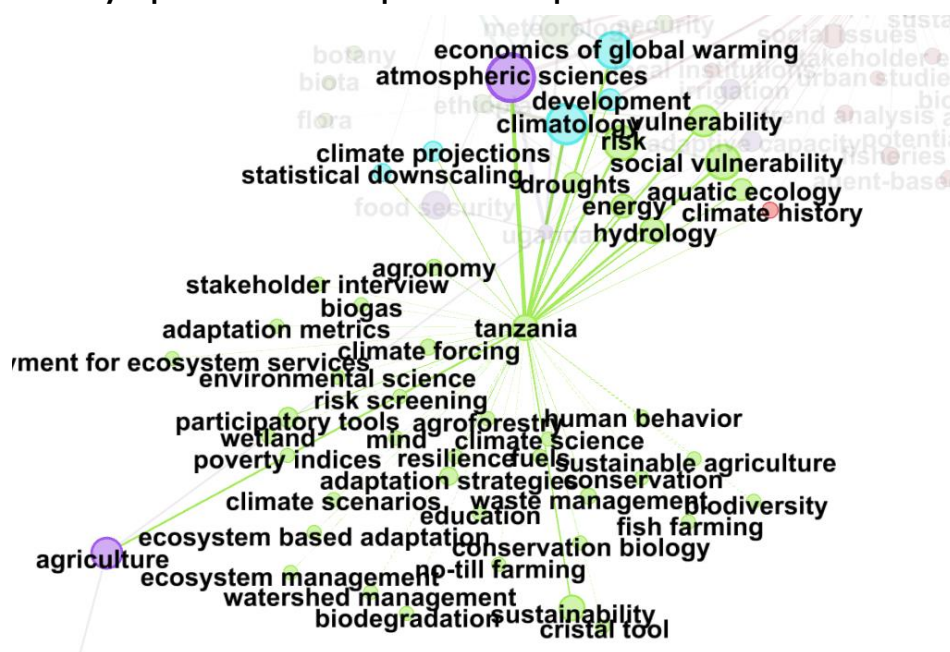
As mentioned, SEI Oxford's economics (DFID, UNEP) and ACCCA (UNITAR) work is a significant research contribution on climate adaptation in East Africa (from the combined dataset). The former links work in several countries in East Africa (Burundi, Rwanda, Kenya and Tanzania), where individual studies were conducted at the national level. Interestingly, there is also other work on the economics of adaptation in other parts of Africa, conducted by different SEI researchers in other centres; it might be useful to compare their methodological approaches (Figure 23).

Figure 23: Geographical spread of SEI research on the economics of adaptation in East Africa (left) and across Africa (right)



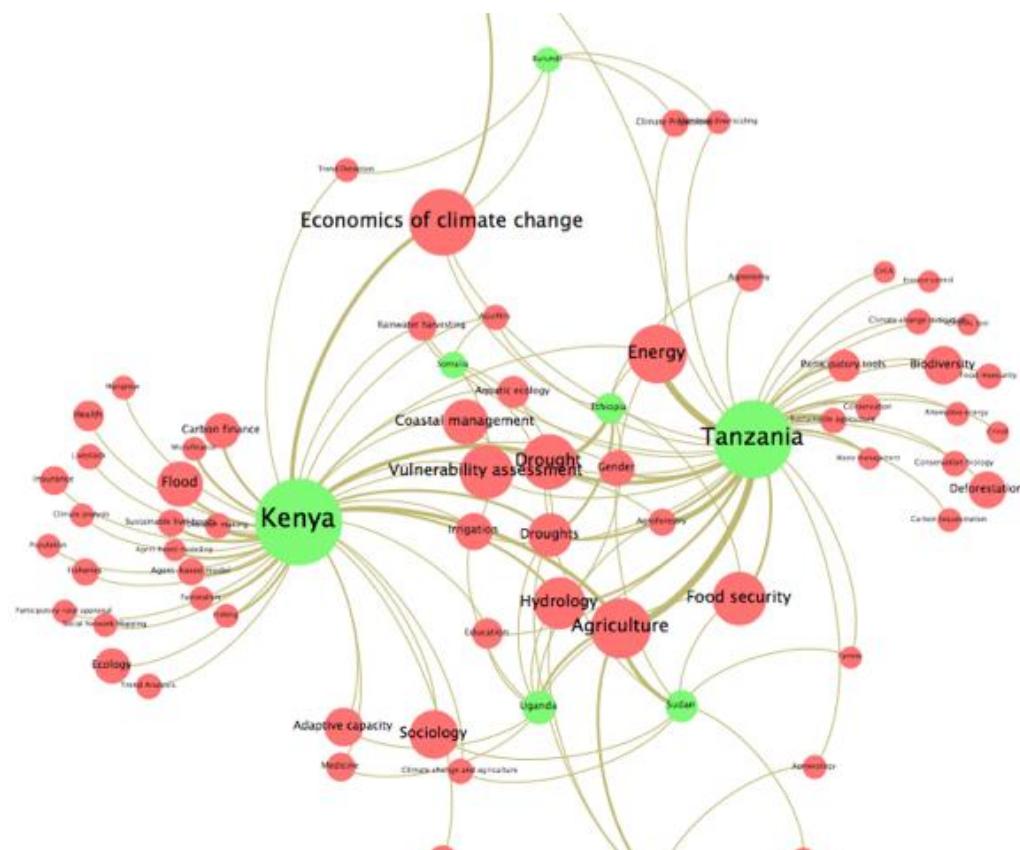
Clearly there are country-specific differences in the focus of adaptation work that SEI has carried out. In Tanzania, for example, there is a large amount of SEI research on biophysical issues related to adaptation (Figure 24). This reflects with SEI's partnerships with the International Union for Conservation of Nature (IUCN) and WWF in Tanzania. In Kenya, meanwhile, SEI's focus has been on health and disease modelling, coastal adaptation, rural institutions, fisheries and forced migration (Figure 22).

Figure 24: Key topics of SEI and its partners' adaptation research in Tanzania



Some interesting comparisons can be made between climate adaptation research that SEI has carried out and research that other organizations have been doing in the region. For example, comparing SEI's research in Tanzania (Figure 24) with the research in East Africa by other organizations (Figure 25) shows topics that do not come up in the SEI only dataset for Tanzania, e.g. at this time and with this limited dataset, other organizations had worked on gender and climate change.

Figure 25: Key topics of research in East Africa posted on weADAPT by organizations other than SEI



We can also break down the regional picture to look at which organizations are working on specific topics. These types of comparisons could be useful in strategically seeking out collaborations on specific topics, or where SEI does not yet have a particular presence in the region.

§

Much further work could be done along the lines illustrated in this section. For example, mapping the keywords that are associated with particular donors could help to identify areas of interest to funders (and potentially differences in focal areas between them). This type of information could be valuable for the SEI Africa and Asia Centres to highlight SEI strengths when approaching donors, and to address gaps when planning their long-term strategies.

4. CONCLUSIONS AND KEY MESSAGES

Innovative visualization techniques, like ICTs in general, have great potential in the field of climate adaptation and sustainable development, both to reveal patterns and relationships within complex datasets and to communicate complicated information in a simplified way, and to a non-scientific audience.

Through the Climate Actor Mapping for Adaptation project, we have tested a methodology for visualization using data from adaptation projects contributed to weADAPT and listed on SEI's website and PMEC system. We have demonstrated the potential of the method to identify new collaborative opportunities, boundary partner and donor profiles, and strengths and gaps in our research. All of this can go some way to help strengthen the climate adaptation networks of the SEI Africa and SEI Asia Centres and inform their long-term strategic planning.

Repeated mapping of this kind would reveal how SEI's focal areas and countries of research change over time, as well as how this compares to the adaptation landscape of our partners more broadly (e.g. the weADAPT dataset). There is clearly scope to use a similar approach to map the work of SEI's overarching research themes¹⁷ and to support our monitoring, evaluation and learning processes.

The limitations of this short study have been mentioned, and there is more that could be done in terms of analysis. For example, it would be interesting to explore what happens to the network maps when we remove the most connected keywords, such as "vulnerability" and "risk", which are fairly vague terms; their hyper-connectivity may hide other thematic clustering.

We learned several lessons from the project which will greatly improve future analysis:

- Producing large networks is not a neutral process: from designing the research questions to be answered, to eliciting feedback, graphic design and presentation, there are assumptions and biases that need to be made explicit in any interpretation of the results.
- It is critical to start with clear research questions to know what data to collect and pre-process before visualization takes place.
- Regular feedback from boundary partners is essential to improve future iterations and the utility of the visualization technique.
- The time required to carry out visualization, data-cleaning and collate and incorporate partner feedback is often underestimated.
- There is a need to better understand the types of visualization that will be most useful to different boundary partners and stakeholders.
- Visualizations and resulting insights are limited in this study by the quality of the tagging or metadata applied. This is an area that can be improved, as we better understand our users' content and information needs.
- While visualization can help us to ask better questions about our data, further research needs to be conducted on the ways in which visualizations are or are not effective in communication with boundary partners and stakeholders.

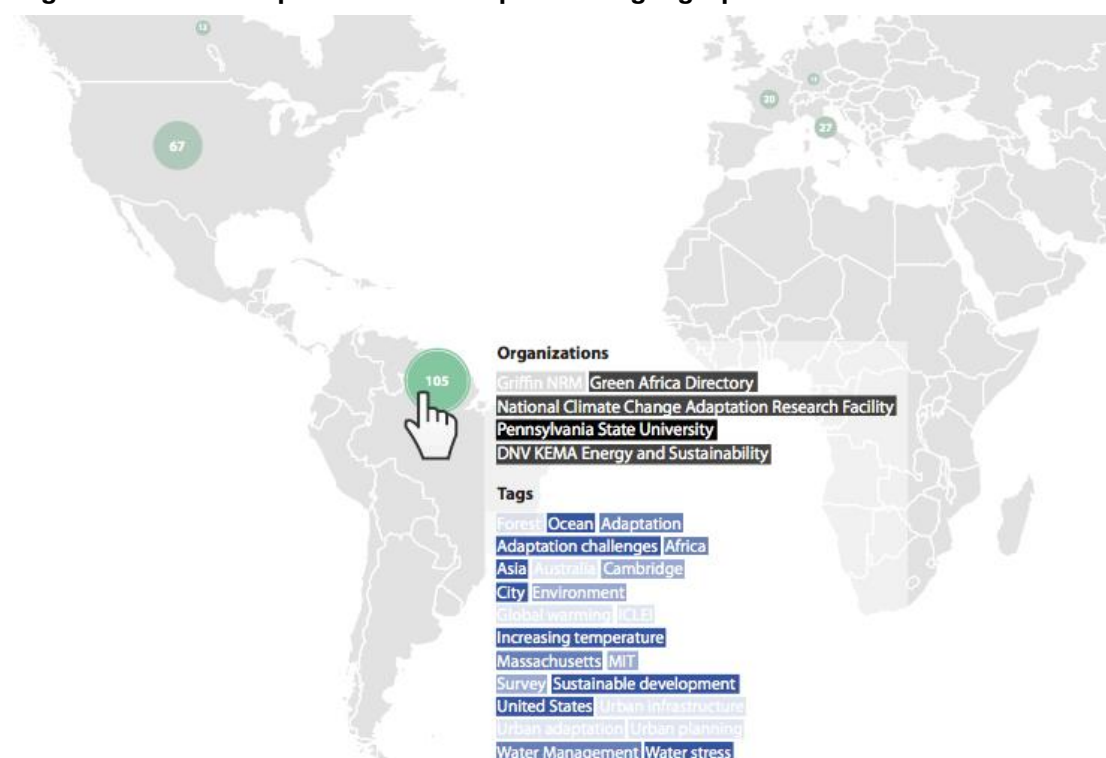
There are many potential variations of the networks graphs presented here. For instance, the graphs can have an interactive element and be hosted online, to introduce a dynamic aspect to visualize how a network changes over time when new data are added (see examples of this at www.climaps.eu, the output of the EMAPS project). Alternatively, one could click on a map

¹⁷ SEI has four overarching research themes: Managing Environmental Systems, Reducing Climate Risk, Transforming Governance, and Rethinking Development. To learn more, go to <http://www.sei-international.org>.

and explore intelligently/semantically linked data based on keywords or the work of different organizations (see Figure 26 where the brightness of the colour is indicative of the quantity of projects by those organizations or on that topic area).

In many climate and development contexts, the issue is not “big data”, but rather a lack of data, the wrong data, and fragmented, sparse or old data. In summary, further capacity-building will be needed to a) ensure “citizen science” or public participation in data collection, so that the issues and data are driven by those affected by the challenge at hand and the outputs represent their needs and b) meet the growing demand for the application of visualization and big or “complex” data analysis techniques in the field of sustainable development research.

Figure 26: Possible future steps – a rollover tag cloud of number of active organizations and topics covered in a particular geographic area



Source: Sciences Po.

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ANNEX 1: SETTINGS FOR SPATIALIZATION

For the ForceAtlas 2 option, we used the following settings:

- LinLog mode (for smaller networks where clusters needed emphasizing);
- no prevent overlap;
- no approximation.

To finalize the spatialization, we did the following:

- ranked node size by occurrence count or degree;
- applied Noverlap (prevents overlap of nodes);
- applied Label Adjust (prevents overlap of node labels);
- made minor manual adjustment.

For the colouring of the network, we used three different schemes depending on the desired effect. In general, we used a white background, and set the edge colouring to copy the node from which it emanated, rather than a mix of source and target so as to produce a cleaner graph. See the table below for details on the applied schemes.

Scheme	Conditions of applicability
Modularity (community clustering)	To emphasize different communities within a network, by colour, usually in one-mode networks.
Occurrences count or degree	To emphasize the most connected nodes within a network. Useful generally in small networks where communities are already obvious, and key connecting nodes are interesting to highlight. Typically a linear scale, for example, from light blue to dark-blue.
Type of node	It is important for the viewer to be able to easily differentiate between the different components in the network. Used in bi-partite networks, such as countries and organizations.

The following statistics were run on each graph:

- average degree;
- average weighted degree;
- modularity (with resolution typically between 0.8 and 1.2).

Finally, the giant component filter was applied to hide unconnected nodes where appropriate.¹⁸

¹⁸ It was sometimes important to leave in nodes that were unconnected.

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