Knowledge-Action Network (KAN)
on Emergent Risks and Extreme Events
- Reducing Disaster Risks under Environmental Change -

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Motivation

The frequency and impact of disasters continue to rise both in developing and industrialized countries. Many are the result of environmental events that are extreme or that have extreme impacts on economic, health, infrastructure, socio-ecological, and other systems. This is despite the development of science and technology in detecting, understanding and predicting natural hazards and vulnerability, and in supporting actions aimed at reducing and recovering from event impacts. Insufficient resilience across many sectors has the potential to severely threaten the achievement of the majority of the Sustainable Development Goals (SDGs). If science and technology are properly utilized, loss and damaged can be significantly reduced.

There is a fundamental lack of understanding of integrated human, ecological, and physical processes shaping risks from cascades of impacts and feedbacks in the context of the Anthropocene. Key obstacles to understanding linked to action often surround data gaps. Data gaps result from limitations in the compatibility of existing data, the need for agreements between data holding institutions to support joined-up analysis of cascades and feedbacks, lack of local access and ownership of data and partially missing governance structures and legislation for emergent and complex risks.

Without better understanding of the root causes of risks, which are co-determined by social and physical system interactions, the opportunity will be missed to reduce risk through development, and break cycles of risk accumulation. Increasing risks of loss and damage are related to unsustainable and inequitable development that increases exposure, vulnerability and reduces the scope for enhanced wellbeing as an outcome of disaster response and risk management. Breaking cycles of risk accumulation requires not only fundamental and action oriented science but for science to be a stakeholder in facilitating and contributing to policy processes at all scales on the risk-development nexus.

Weather and climate extremes are a key concern in terms of changing disaster risks (cf. IPCC WG2 2014), through both direct impacts on humans or indirect impacts mediated by ecosystems, technology and natural resources. Global environmental change shifts the context conditions for all hazards and risk analysis leading to changing frequencies, intensities, and durations of weather and climate extremes, in particular related to the water cycle with implications for vulnerability to geophysical hazards and for multi-hazard interaction. A particular source of concern are emergent risks from multi-hazards, compound events and cascading extremes that can amplify impacts on society, and may even lead to abrupt system changes or tipping points. These phenomena are mediated through rapid social changes including urbanization, lifestyle, land use change, and socio-economic inequality. Reducing these emergent risks will therefore require knowledge, exchange and integration with communities across other hazard types (e.g., geophysical, hydrological, biological).

The full solution space for disaster risk reduction also includes reflection on and redirection of development priorities, practices and trajectories in the context of global environmental change. Recognising disaster causation as a function of development requires a fundamental reappraisal of the relationship between development, risk and risk management. Risks can only partially be managed through preparedness, response and recovery. This realisation is especially acute because of very complicated and cascade-shaped hazard impacts and risks emerging from existing adverse development pathways. Globalised development pathways and global environmental change both expose local places to globalised processes masking simple cause and effect relationships and governance solutions for risk management.

Multi-hazard interactions and cascading impacts including those involving technological hazards and social/political impacts are recognized but not yet supported by a systematic science agenda. To date, interventions focus on single hazards and sectoral interventions. This contrasts with international agreements that recognise the challenge posed by systemic, complex and cascading risk. The Sendai Framework for Disaster Risk Reduction (SFDRR), the UN Sustainable Development Goals, UNFCCC Paris Agreement and New Urban Agenda in particular are clear about the need for integrated work that can cut across societal and policy sectors and scales. The international science community needs to be better connected to each of these agendas, for example through the UN Science and Technology Major Group and the IPCC process.

This Knowledge-Action Network (KAN) aims to define an interaction network between its core partners and wider stakeholders to allow a structured integration and synthesis of expertise, professional and local knowledge. The goal is to accelerate action on the root causes of multi-hazard and compound events and hence to support the achievement of the SDGs. The goal of reducing complex, actual and present disaster risk in an integrated manner requires scientific collaboration among existing expert communities and a range of stakeholders. In this context, three ICSU programmes – all with strong stakeholder partnerships are establishing a new KAN on Emergent Risks and Extreme Events: Future Earth, Integrated Research on Disaster Risk (IRDR) and the World Climate Research Programme (WCRP). Figure 1 introduces this partnership and the new spaces for action oriented research opened by integration and facilitated by new interaction between existing networks.

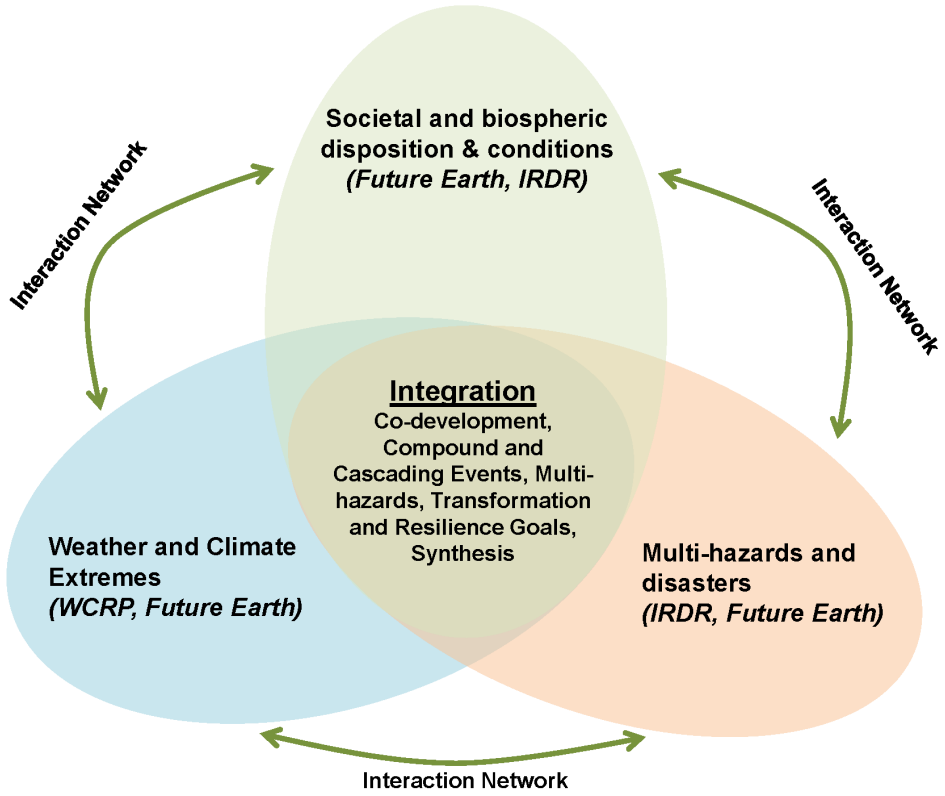

Figure 1: Conceptual illustration of the idea and scope of the Emergent Risks and Extreme Events KAN as the overlapping and integration platform of the core areas of Future Earth, IRDR and WCRP and the opportunity for building wider networks between all communities.

Principles of the KAN

The following KAN principles will guide the organizational structure, aims and objectives, rationale for collaboration, working routines and research objectives:

Solution-oriented, using existing and generating new knowledge and data to address tangible risk management challenges.

Collaborative, including partnerships between scientific communities, people and ecosystems at risk, administrative, business and policy actors.

Synthetic, moving toward synthesizing existing scientific knowledge across sectors, using common terminologies and categories for analysis.

Open, for all data, analysis ideas and outcomes.

Inclusive, respecting gender, career stage and geographical equity.

Cutting-edge, innovative, developing tools and analysis based on excellent science and technology.

Aims of the KAN

- **To build a global partnership and network of science excellence and practitioner expertise across disciplines** and sectors to accelerate integration and synthesis for ground breaking and solution oriented research and synthesis for disaster risk reduction and for respective governance and decision making under global environmental and societal change
- **To identify priorities and support complementarity of research on systemic risk**, including the interaction of climate-change induced extreme events and other disasters
- **To explore and enhance the role of science as an active participant in transformation to sustainability and resilience** through systematic scientific synthesis and research, facilitation and convening roles among diverse science communities and in collaboration with societal actors (business, administration, policy, NGOs)

Objectives of the KAN

- To provide an open platform for scientific communities from across science disciplines and engineering working on extreme events, disaster risk reduction and governance under the umbrella of Future Earth, IRDR and WCRP programs, to exchange information, knowledge and data, and to co-define a collective scientific focus beyond any single partner.
- To engage with societal actors from local/national/international legislation, administration, business sector, practitioners, civil society and UN frameworks to co-design research agendas and co-create new knowledge for effectively reducing disaster risks through partnerships and joint outputs.
- To stimulate groundbreaking and solution-oriented scientific research and synthesis with major impact on the development of effective strategies for transitioning development from a risk accumulation to a risk reduction process.
- To address systemic, complex and cascading risks by synthesis of various scientific approaches and products, in addition to small-scale frequent disasters and large-scale geophysical and climate extremes, also in order to contribute to the Sustainable Development Goals.
- To follow a common conceptualization of risk and associated terminology across science and practice communities, if applicable, and make efforts to provide or generate the necessary data and knowledge to feed into both communities.
- To build on and help coordinate existing data platforms to integrate data categories of disaster events, impact, ecological, climatic, geo-hazard, and demographic data to help understand risk, risk assessment and reduction and progress on implementation of SFDRR and SDG's.
- To work with partners to confront the disaster data gap: this includes limitations in the compatibility of existing data, the need for agreements between data holding institutions to support joined-up analysis of cascades and feedbacks and missing governance structures and legislation for emergent and complex risk and that can democratize ownership and use of data and its analysis.
- To support informed decision-making by multiple actors seeking social-ecological resilience or transformation.
- Support societies seeking to transform development pathways through promoting and strengthening national platforms for disaster risk reduction, and so to contribute to the Sendai Framework for Disaster Risk Reduction (SFDRR) and SDGs.

Rationale for Collaboration

Each of the three co-proposing programmes brings a specific science orientation and community of practice:

Future Earth, covers various sustainability research agendas though its interconnected thematic Global Research Projects and KANs, cutting across the nexus of social and environmental sciences and engaging stakeholder expertise, focusing on longer-term development and associated risk scenarios with a broad sustainability perspective to risk and vulnerability.

IRDR contributes a core focus on vulnerability and risk analysis from behaviours through to social sciences and a multi-hazard understanding of risk, it also brings close connections to UNISDR and through its International Centres of Excellence to nationally embedded action oriented research excellence.

WCRP brings in extensive expertise and data resources on climate change, weather and climate extremes and other climate related hazards, and is contributing significantly to the IPCC assessment reports.

Strength in collaboration

The three programmes believe that collaboration can provide holistic understanding on the complex interaction among various hazards, emergent risks, and impacts on the society, effective solutions, and incentives for funders to support scientific activities for a more risk resilient the society. By collaborating through the KAN, the programmes can:

- cover wide range of scientific expertise and identify and fill the gaps which were not well recognized by single programmes.
- provide integrative synthesis capacity across disciplines by a mix of inter-/trans-disciplinary expertise.
- align and coordinate joint research agendas.
- jointly engage and contribute to existing international stakeholder interactions:
  - Future Earth: ISSC, UNESCO, WMO, UNU, SDSN, UNEP, Belmont Forum, STS forum, IPCC, IPBES and other strategic partners
  - IRDR: ISSC, UNISDR, SFDRR, Asian Ministerial Conference on Disaster Risk Reduction, and Partners
  - WCRP: WMO, UNESCO-IOC, IPCC, and Partners

  and through ICSU:
  - Union and National members, Regional Offices/Committees, Urban Health & Wellbeing and other Thematic Organizations, Monitoring and Observation systems, Data and Information related initiatives, and more international academic societies/partners
- share experiences and methodologies in research and stakeholder engagement,
- share resources including secretariat supports and budgets in some of the operations
- coordinate outreach to common funders (e.g. Belmont Forum)
- collaborate in capacity building of young researchers, professionals and the supporting national systems

Possible research agenda examples

1. What are the expected potential impacts that might be caused by extreme events across different sectors?
2. Which SDGs are endangered by lack of resilience against extreme events in which way?
3. What are the data gaps to be filled, standards and methods to be developed to understand risk and resilience?
4. What are the most important measures to understand underlying vulnerability and hazard factors to build resilience?
5. What are the major obstacles to build resilience in front of extreme events and disaster risk?
6. How can science, research, teaching and learning be best positioned to support critical reflection and goal orientation towards more resilient and sustainable development pathways?
7. What local to global governance arrangements best support equitable and sustainable risk reduction?
8. How to incorporate knowledge into decision-making tools and wider governance contexts to better deal with global systemic risks with unintended consequences?
9. How can science and technology provide opportunities for innovation and economic growth and what are the largest obstacles to overcome across and between sectors (lack of knowledge, lack of governance, etc.) in order to find and establish sustainable and just solutions for reducing disaster risk?

Initial leadership

Institutional partners providing input and resources to develop the KAN to establishment of its Development Team:

- Future Earth
  - Cluster Activity "Extreme events and environments: from climate to society (E^3S)" (Markus Reichstein, Dorothea Frank and Miguel Mahecha)
  - Global Research Project "Integrated Risk Governance (IRG) Project", but not limited and other projects will be invited in due time and steps
    - Secretariat coordinators (Thorsten Kiefer and Fumiko Kasuga)
- IRDR
  - IRDR SC (Science Committee) members, NC (National Committees) and ICoE (International Center of Excellence) (Mark Pelling and Shuaib Lwasa)
  - IRDR working groups: FORIN, DATA and RIA
  - LIRDR Young Scientist network
  - Feedback through science and other stakeholders dialogues at regional and global levels
- WCRP
  - WCRP Grand Challenge on Weather and Climate Extremes (GC-Extremes; Jana Sillmann and Sonia Seneviratne)
  - WCRP Core Projects and Working Groups, of which input will be synthesised through the coordination of GC-Extremes
  - Scientific input from partner projects and activities, such as WMO/CCL-JCOMM-WCRP Expert Team on Climate Change Detection and Indices (ETCCDI), and Global Framework for Climate Services (GFCS), WMO HiWeather Project, etc.
  - Secretariat coordination (By WCRP Joint Planning Staff, Boram Lee) upon the guidance of the Joint Scientific Committee (JSC)

Planning process to date

1. June 2016, expression of Interest for a Future Earth Knowledge Action Network on Extreme Events and Disaster Risk Reduction sent by E^3S to various Future Earth global hubs
2. September 2016 to April 2017, exchange and dialogue with Asian disaster risk communities (IRDR, IRG), WCRP and with other Future Earth related core projects (e.g. PAGES, ESG, IHOPE), initiated by E^3S
3. April 2017, Paris, initiation meeting between Future Earth, WCRP, IRDR convened by ICSU with Belmont Forum participation.
4. 13-14 May 2017, Shenzhen, China, information sharing opportunity with IRDR and IRG.
5. 22-23 May 2017, Cancun, IRDR Science Committee and International Centres of Excellence support development of the KAN.
6. Belmont Forum Scoping Workshop on D3R: 5-7 June, 2017 in Florence, Italy

Planned steps and possible participatory occasions forward

At the earliest occasion, a Development Team should be established for focussed discussions on a research and engagement agenda, governance structure, funding strategies and further development of external partnerships of this KAN.

Timeline:

The goal is to formally launch the KAN by the 4^{th} quarter 2018. To this end the following preparatory development tasks will be pursued after establishing a development team in the 1st quarter 2018:

- Elaboration of research agendas with stakeholders
- Structuring collaboration across existing programmes/projects
- Identifying stakeholders and engaging them
- Developing fundraising strategies and governance principles

The following related events and possibilities of face-to-face meetings, among others, will facilitate this process:

ICSS International Conference on Sustainable Sciences	24-26 Aug 2017, Stockholm, Sweden
Global Forum on Science and Technology for Disaster Resilience	23-25 November 2017, Tokyo, Japan
Davos-Sendai World Bosai Forum (IDRC 2017)	25-28 November 2017, Sendai, Japan
WCRP/GEWEX Open Science Conference	6 May – 11 May, 2018, Canmore, AB, Canada
WCRP meeting	May 1-3, 2018 in Barcelona
The Adaptation Futures meeting in Cape Town	11-14 June, 2018

Box 1: Glossary (adapted from IPCC AR5 or indicated otherwise)

Compound Event: Events that refer to multiple drivers that combine to affect hazards contributing to societal or environmental risk (Workshop on compound events, ETH Zurich)

Disaster: Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Emergent risk: A risk that arises from the interaction of phenomena in a complex system, for example, the risk caused when geographic shifts in human population in response to climate change lead to increased vulnerability and exposure of populations in the receiving region.

Extreme weather or climate event: An extreme weather event is an event that is rare (normally be as rare as or rarer than the 10th or 90th percentile) at a particular place and time of year. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

Extreme event in the context of this KAN: Rare (low probability) event (bio-geophysical) with high-impact on society.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

Key risks: are potentially severe adverse consequences for humans and social-ecological systems resulting from the interaction of climate-related hazards with vulnerabilities of societies and systems exposed. Risks are considered "key" due to high hazard or high vulnerability of societies and systems exposed, or both.

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term risk is used primarily to refer to the risks of climate-change impacts.

Risk assessment: The qualitative and/or quantitative scientific estimation of risks.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.