

ClimProspect, a new theoretical and methodological approach to disaster risks resilience

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Letter

Abstract

For many territories around the world, one of the threats related to climate change would be increased pressure of disaster risks on economic and social development. Responses to this challenge include promoting improved disaster risks resilience, by improving the scientific basis, methodological and decision-making aspects of resilience processes and actions.

The objective of this letter is to present ClimProspect, an innovative theoretical and methodological approach that offers robust scientific tools for more efficient and effective disaster risks resilience processes.

Specifically, ClimProspect suggests focusing resilience processes and actions on resilience configurations and proposes methodological units to characterize and build such configurations

Keywords: Disaster risks, resilience, ClimProspect

1. Introduction

In many territories around the world, disaster risks, through their impacts, are obstacles to achieving the conditions for sustainable economic and social development. In fragile environments, these impacts can affect economic and social sectors, ecosystems, infrastructure, social and political dynamics (Wahlström, 2009 Paali et al., 2010, Kreiman, 2010, Marx et al, 2012, Adeagbo et al. 2016, Calo et al., 2017).

A major aspect of climate change is the increase in the frequency and intensity of extreme events (IPCC, 2007a). This would result in an increase in pressure of disaster risks. A basic response to this threat is the promotion of improved resilience (Christian, 2013; Denis, 2016), by improving the scientific bases, methodological and decision-making aspects of resilience processes and actions.

In this letter, we propose an innovative theoretical and methodological approach for developing corpus of decision-support frameworks related to improving resilience to disaster risk. This approach is ClimProspect (Badolo, 2011; Gahi et al., 2015; Sanou and Badolo, 2017). It distinguishes itself by taking into

account the main components of the considered systems and distinguishes the vulnerability of these systems from contextual sensitivity. It includes methodological units to develop decision support tools for resilience processes or actions, that are more focused on resilience needs.

ClimProspect can be implemented by standard methods such as expert judgment method, analog method or participatory assessment. It could therefore be used to build local and endogenous dynamics resulting in incremental changes regarding resilient states or configurations.

2. Theoretical aspects

The theoretical basis of ClimProspect is the impact equation (Badolo, 2011), which distinguishes a vulnerability configuration from a resilient configuration to a specified disaster risk.

For a system S in a state or configuration (e) and a disaster risk r , the impact equation is:

$$\hat{r}e = d \quad (1)$$

In Eq (1), \hat{r} is an operator associated with the risk r and (d) is the set of direct and indirect impacts of r .

If $d \neq \emptyset$, then the system S is vulnerable to risk r and (e) a configuration of vulnerability; if $d = \emptyset$, then the system S is resilient to r and (e) a configuration of resilience.

A resilience process is efficient and effective if it is able to change the vulnerability configuration of a given system into a resilient configuration.

3. Methodological aspects

ClimProspect methodological approaches are the three methodological units described in figure (1), the "Impacts unit", the "Vulnerability unit" and the "Resilience unit" (Badolo, 2011; Sanou and Badolo 2017).

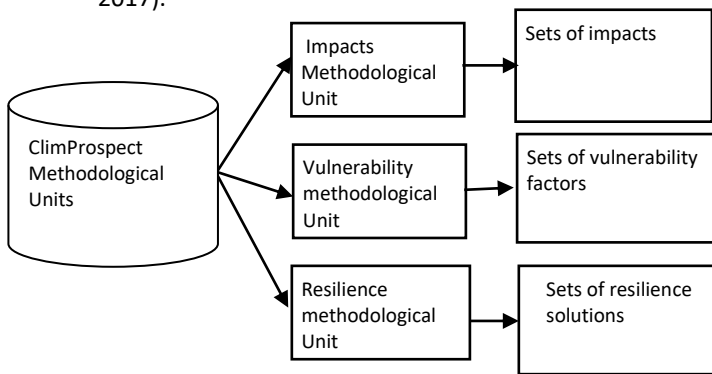


Figure (1): ClimProspect methodological units

The Impacts methodological unit is for impact assessment that include impact chains, impact sets, socio-economic impact envelopes and impact families.

The vulnerability factors sets that can be obtained by the Vulnerability methodological unit include vulnerability factor groups, vulnerability factor sets, vulnerability classes and socio-economic vulnerability envelopes.

The third methodological unit is the "Resilience unit", for resilience sets of solutions, which can be resilience solutions groups, resilience solutions sets, resilience solutions classes, and resilience solutions envelopes.

In the implementation of ClimProspect, a considered system S is replaced by a vector e (e_1, e_2, \dots, e_m), where e_1, e_2, \dots, e_m are the main dimensions or components of S . This is a particularity of ClimProspect allowing innovative approaches to resilience.

4. Results

4.1. Sets of impacts

The first category of impact sets includes chains of impacts. For a component e_i ($i = 1, \dots, m$) of the vector (e), a chain of impacts ce_i is of the form: $ce_i \equiv eid_0, eid_1, \dots, eid_p$,

p is the length of the chain and eid_0 is the direct impact or zero order (0) impact of r on e_i . An impact eid_l ($l = 1, \dots, p$) is the indirect or contextual impact of order l ; it is the most important immediate consequence or repercussion of the impact eid_{l-1} .

A direct impact eid_0 ($i = 1, \dots, m$) indicates the sensitivity of the component e_i of (e) to the risk (r). The indirect impacts eid_l ($i = 1, \dots, m, l = 1, \dots, p$) denotes economic, social, environmental, institutional or political sensitivity of the context of the studied S system to the direct impacts of the disaster risk (r).

global impact sets of are the second category of sets of impacts. A global set of impacts (dr) is the set of all direct and indirect impacts of a given disaster risk. It is obtained by the combination of (m) chains of impacts, $dr = ce_1U \dots Ucem$

Two specific subsets of impacts are associated with (dr): dS , consisting of elements of (dr) that are direct impacts and $d\Omega$, the subset formed by indirect or contextual impacts of (dr).

The third category of impact sets consists of envelopes of socio-economic impacts, which are obtained by grouping by type (dr) elements. In this letter, social impacts envelope (dr_{social}), environmental impacts envelope ($dr_{environnemental}$), economic impacts envelope ($dr_{economic}$), institutional impacts envelope ($dr_{institutionnel}$) and political impacts envelope (dr_{policy}) are considered:

- $dr_{social} = \{social\ elements\ of\ dr\}$
- $dr_{environmental} = \{environmental\ elements\ of\ the\ dr\}$
- $dr_{economic} = \{economic\ elements\ of\ dr\}$
- $dr_{institutionnel} = \{institutional\ elements\ of\ dr\}$
- $dr_{policy} = \{political\ elements\ of\ dr\}$

The last category of sets of impacts considered is that of families of impacts. A family of impacts fd (k) of order k ($= 0, \dots, p$) is a subset of impacts including impacts of the same order k : $e_1dk, e_2dk, \dots, emdk$.

4.2. Sets of vulnerability factors

Vulnerability is the basic information that determines responses to disaster risks. It results in practice from the combination of vulnerability factors.

A vulnerability factor is defined here as a character or a characteristic of the considered system S or of the context of this system. It is a problem to be addressed to mitigate an impact.

In general, each impact set is associated with a vulnerability factors set.

an eid_j impact ($i = 1, \dots, m; j = 0, \dots, p$) is associated with a specific vulnerability factors subset $veid_j$, which includes all the vulnerability factors to be addressed to mitigate the impact eid_j . For $j = 0$, $veid_j$ is a combination of characters of the studied system and characteristics of the context of that system. For $j > 0$, $veid_j$ only includes characteristics of the system context.

The set of vulnerability factors associated with a chain of impacts ce_i ($i = 1, \dots, m$) is the group vce_i of vulnerability factors. It is obtained by a combination of subsets the vulnerability factors $veid_j$ ($i = 1, \dots, m, j = 0, \dots, p$).

The set of vulnerability factors vdr is associated with the impact set dr . it results from the combination of (m) groups of vulnerability factors $vce_1, vce_2, \dots, vcem$, $vdr = vce_1 \cup \dots \cup vcem$

In disaster risks responses, the two subsets of vulnerability factors vd_S and vd_Ω are usually distinguished: vd_S is composed of the elements of vdr which are characters of the system S and vd_Ω elements of vdr which are characteristics or specificities of the system context Ω .

Vulnerability classes $v_early_warning, v_response, v_recovery$ constitute the category of sets of vulnerability factors related respectively to early warning, response and recovery; they are defined by Figure (2).

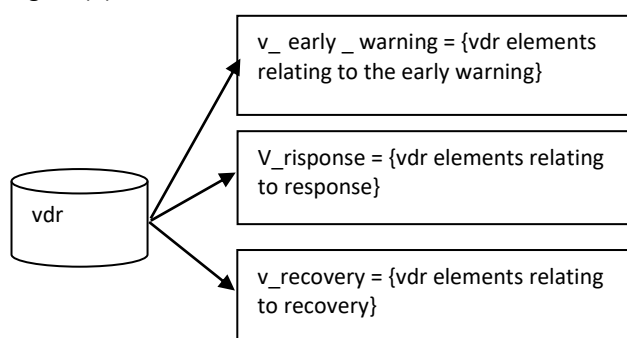


Figure (2): Vulnerability Classes

Sets of Vulnerability factors proposed could be used to establish vulnerability configurations ev ($e1fv, \dots, emfv$) of a given system or contextual vulnerability configurations v_Ω ($\Omega_social, \Omega_environmental, \Omega_economic, \Omega_scientific, \Omega_technological, \Omega_institutional, \Omega_policy$) of the context of this system. The components of (ev) are elements of vdr respectively denoting characters of the components e_1, \dots, e_m .

The components of v_Ω are respectively social, environmental, economic, scientific, technological,

institutional and political characteristics of the context Ω of the studied system included in vdr .

4.3. Sets of resilience solutions

ClimProspect resilience unit develops for each vulnerability factors set a set of resilience solutions, as shown in Table (1). A combination of sets of resilience solutions can be performed to obtain a resiliency scheme in connection with a desired resilience configuration.

Vulnerability factors sets	Resilience solutions set associated
Vulnerability factors group, vce_i	zce_i , group of resilience solutions associated
Vulnerability factors set, vdr	zdr , set of resilience solutions associated
Vulnerability factors subset, vd_S	zds , subset of resilience solutions associated
Vulnerability factors subset, vd_Ω	zd_Ω , subset of resilience solutions associated
Vulnerability factors Classes $v_early_warning, v_response, v_recovery$,	$z_early_warning, z_response, z_recovery$, classes of resilience solutions associated
Vulnerability factors Envelopes $vdr_social, vdr_environmental, vdr_economic, vdr_institutional$ and vdr_policy	$zdr_social, zdr_environmental, zdr_economic, zdr_institutional, zdr_policy$, envelopes of resilience solutions associated

5. Discussion

ClimProspect, based on its methodological units, is an approach to efficiently and effectively respond to information needs related to impacts, vulnerability or resilience. It distinguishes the vulnerability of the studied systems from the contextual vulnerability, and indicates that the resilience consists in intervening on characters of a system or specificities of the context of this system.

Disaster risks resilience is achieved through specific processes or actions. ClimProspect offers tools for developing such process, more in line with resilience needs (Christian, 2013).

A mapping of methodological methods related to resilience to disaster risks has been proposed by Emlyn Witt and Irene Lill (2012). ClimProspect particularities in relation to these methods are the consideration of the main components of the studied systems, specification of system vulnerability and contextual vulnerability, three specific methodological units and the focus of resilience processes on resilience configurations.

6. Conclusion

The objective of this letter was to present ClimProspect, an innovative approach to disaster risk resilience processes.

ClimProspect, through its different methodological units, provides tools to efficiently and effectively respond to information needs for decision making related to impacts, vulnerability and resilience. It considers the vulnerability of the studied systems and contextual vulnerability, and indicates that resilience consists of changing or transforming characters or specificities.

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