Is insular tourism threatened by climate change: An assessment from a composite index of physical vulnerability

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Small island economies [SIE] and tourism specialization: between opportunity and vulnerability

- Tourism specialization as an evidence for SIE

  - Several structural impediments making difficult an economic development based on agriculture or industry (Blancard and Hoarau, 2016)

    → some geographical features (small size, remoteness, exposure to major risks, ecosystem fragility, …), the historical context (dependence from outside, close relations with the former colonial powers, …), the social conditions (a lack and a strong volatility of human capital, labor market failures, economic insecurity, …), and the economic structure (a lack of economies of scale, small local markets, weak economic diversification, high access costs to foreign resources, …)

  - Numbers of opportunities in favour of SIE in the field of tourism (Logossah and Maupertuis, 2007)

    → an unskilled labour pool compatible with a development by tourism, some comparative advantage in the field with natural and cultural assets, and good perspectives in world economic growth for the tourism sector

- A factor of resilience for the « tourism-led growth hypothesis » theory (Brida et al., 2014)

  → better results in terms of economic growth and development for economic model based on a strong tourism sector

- Tourism also gives some social, cultural and environmental benefits (Higgins-Desbiolles, 2006)

- However tourism specialization could also represent a potential danger for the development of SIE

  - The presence of several factors reducing the economic effectiveness of tourism spilovers

    → internal, external and invisible leakages, a potential « dutch disease » dynamics, a strong exposure to cyclical variations in the tourism source markets, emergence of a trap of low education and weak economic growth

  - A narrow link between tourism activity and ecological conditions that could question the sustainability of tourism-led development model

    → the tourism sector highly confronted to environmental extreme events (storms, floods, earthquates, heat waves, …), and inconsistency between tourism pressure and ecological and cultural balances resulting in a decrease in territorial attractiveness

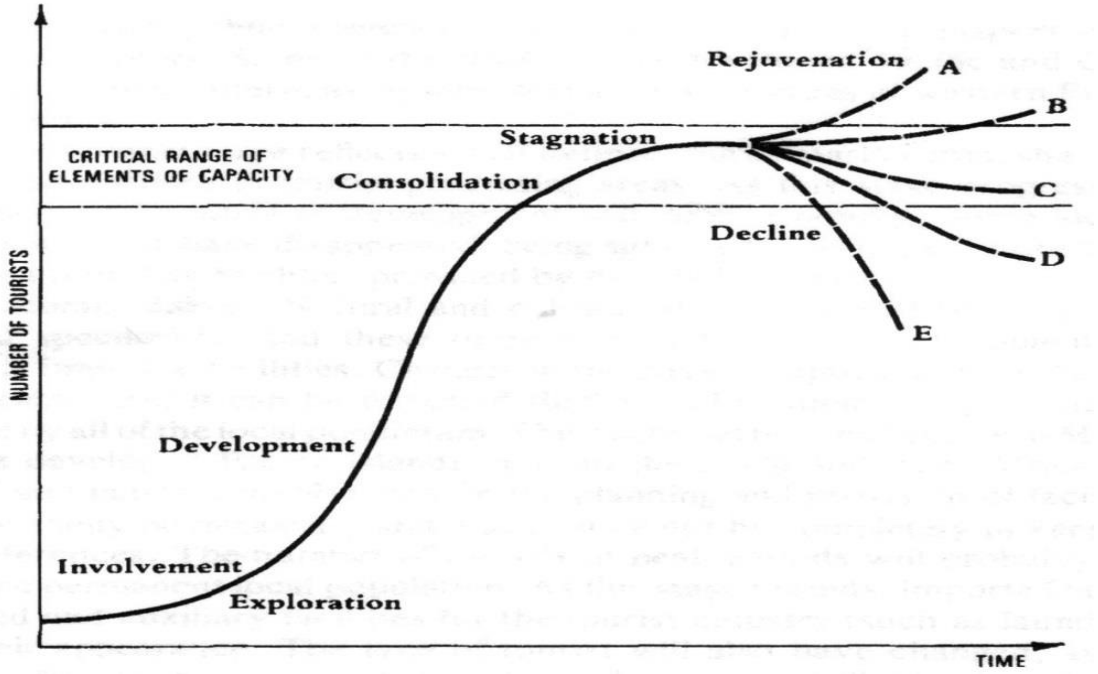
- Then a major finding: SIE adopting a tourism specialization are doubly structurally vulnerable

  - A structural economic vulnerability linked to their insular nature

  - Their strong dependence to a highly vulnerable sector

A structural vulnerability strenghtened by the new constraint of climate change

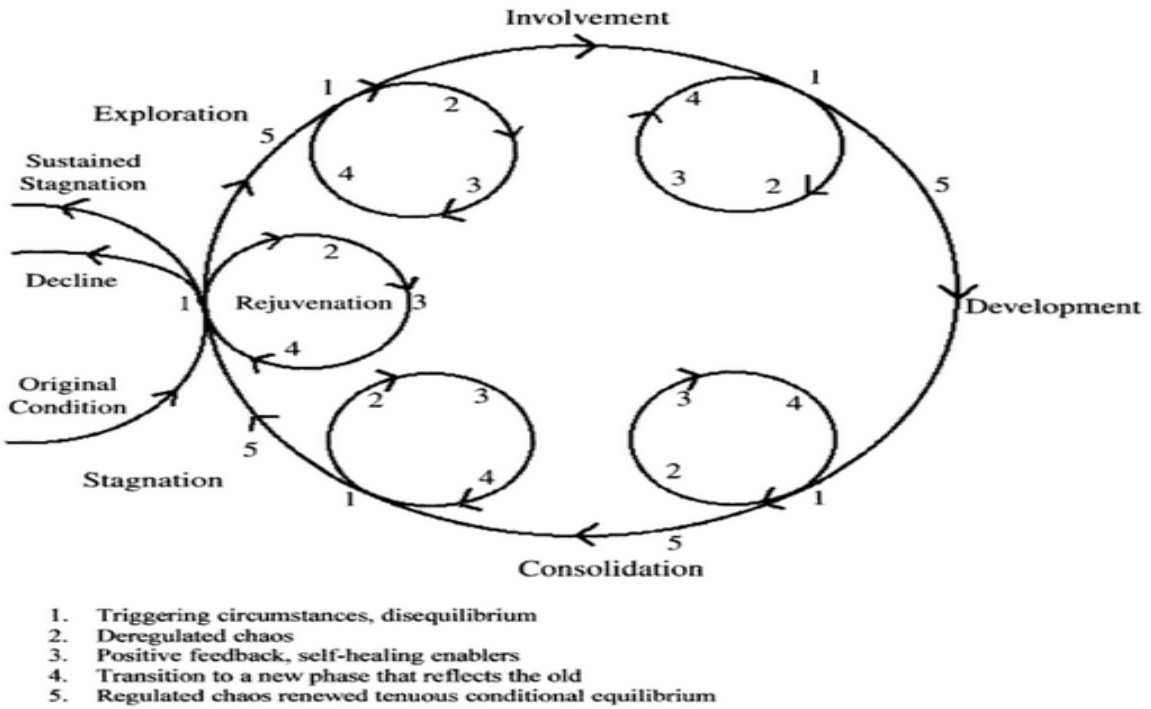
- A theoretical outcome: the environmental factor as a fundamental determinant of the development process of the tourism resort
  - The natural capital is both crucial for the attractiveness of tourism destination and for preserving the carrying capacity of a territory in the long-run: the Tourist Area Life Cycle Model (Butler, 2011)



Source : Butler (2011)

Figure 1. The standard TALC approach

- Some environmental manifestations (for instance extreme events) as a source of instability then disturbing the development process in the short-run: the chaos approach (Russel, 2006)



Source : Russel et Faulkner (2004)

Figure 2. The TALC approach with chaos

- A main finding: The consequences of climate change (the sea level rise, ocean acidification, temperature warming, more intense extreme events, decrease in water resources, loss of biodiversity) will strongly increase the disturbing role of environment (Nurse et al., 2014)

  - ❖ In the short-run through the frequence and the intensity of climate extreme events (storms, droughts, floods, heat waves, …)

  - ❖ In the medium/long-run by reducing the carrying capacity of the territory

- The empirical literature largely supports the theoretical insight

  - A main stylized fact: the quest of more convenient climate conditions is one of the most important determinants of international tourism flows (Rosselo-Nadal, 2014)

    → a progressive change in the international tourism demand to the benefit of higher latitudes and altitudes so that penalizing particularly tropical destinations and amongst them even more small tropical islands (Hamilton et al., 2005)

  - An adaptation strategy as a priority for SIE but so difficult to implement (Nurse et al., 2014)

    → small size, lack of economies of scale and high unit cost of public policies in the context of insularity

How measuring the degree of this vulnerability to climate change for SIE

- The imperative need to develop internationally comparative quantitative tools to assess vulnerability to climate change

  - The impacts of climate change are heterogenous depending on geographical locations … even amongst the SIE grouping (Wall, 1998)

  - Implementing effective adaptation policies requires first a consistent assessment of the nature of the vulnerability and the resilience caracterizing each territory (Fussel and Hilden, 2014)

    → the identification of the specific sources of vulnerability for each economy

  - In accordance with the COP21 framework, objective criteria are welcome to select countries eligible to financial assistance (Guillaumont, 2015)

- Our base indicator: The Physical Vulnerability to Climate Change Index [PVCCI] (Guillaumont et Simonet, 2011a,b; Closset et al., 2018)

  - A physical index which assesses the vulnerability not depending on the present will or behavior of the political authorities

    → the main goal is to measure structural vulnerability but not a lack of resilience

  - An index taking into account two types of risks resulting from climate change: permanent and progressive risks (the sea level rise and aridity) and risks related to more intense recurrent shocks (rainfall and temperature shocks, and storms)

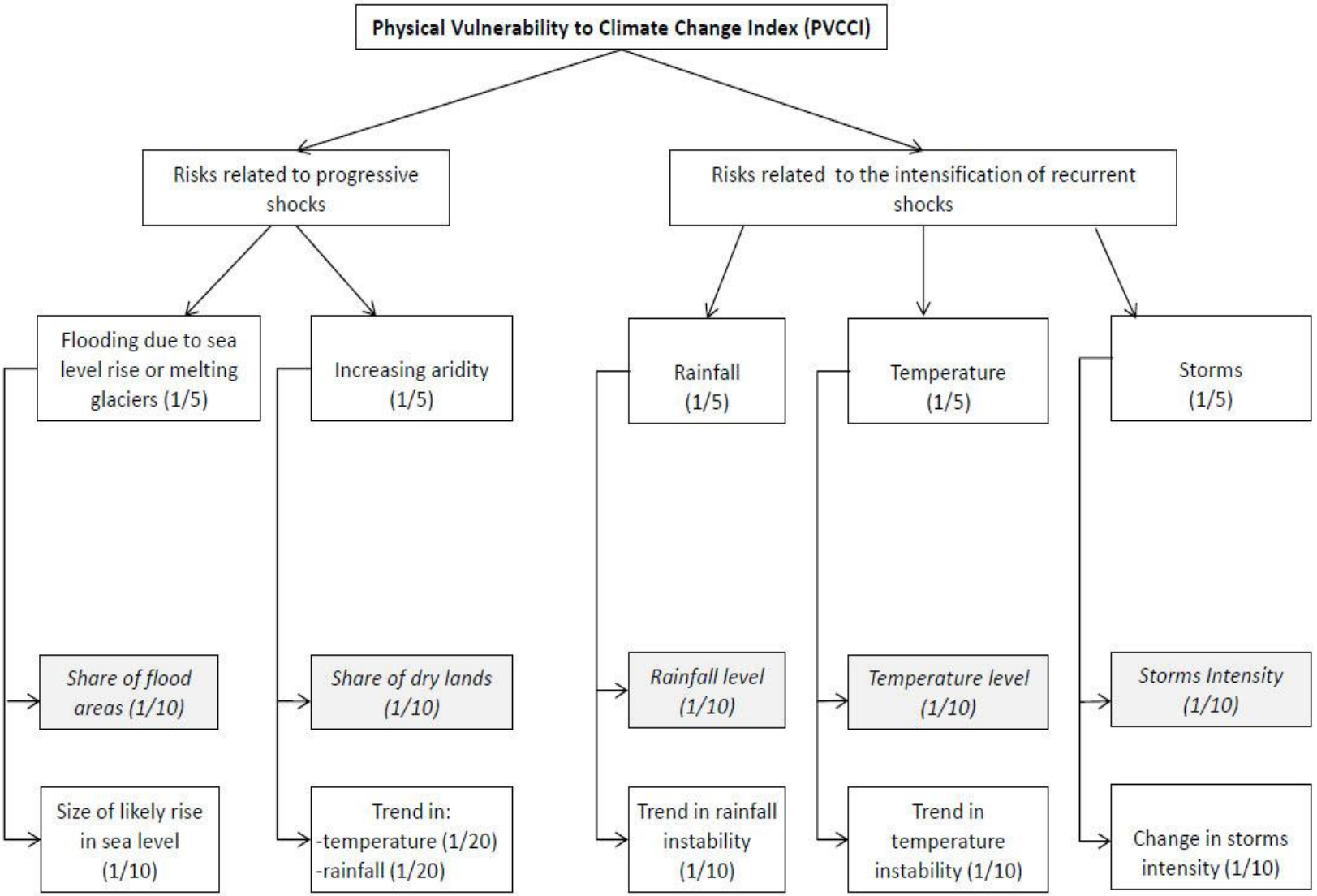
    → the shocks are grouped into five components, each of them including both an exposure index and a shock index

- Aggregation method: the use of a quadratic average for the calculation of both the global PVCCI and each dimension to take into account the limited substitutability between components

  → the quadratic mean gives greater weight to larger values so gives more importance to the largest risks

$$\boldsymbol{indice\ agr\acute{e}g\acute{e}_i} = \sqrt{\frac{\boldsymbol{1}}{\boldsymbol{n}}\sum_{\boldsymbol{k=1}}^{\boldsymbol{n}} \boldsymbol{indice_{ki}}^{\boldsymbol{2}}}$$

Avec $indice_k$ la valeur de l'indice k



Notes: * or to ice melting. The two last lines give exposure to (in italics) and size of shocks respectively.
Source: Closset et al. (2018).

Figure 3. PVCCI and its components

An empirical implementation of the PVCCI based on a worldwide sample

- The sample: a worldwide database introducing for the first time a large set of SIE (both independent and non sovereign small island spaces)

  - A sample of 250 economies (with 100 SIE) including 56 new territories

  - Following our main objective focusing on the assessment of vulnerability to climate change for SIE, and particularly SIE specialized in tourism, several groupings have been constituted

    → Developed countries, developing countries, SIE, non insular economies, Least developed countries, MIRAB, TOURAB, SITE, SITE/PROFIT, PROFIT, MIRAB/PROFIT

PEI MIRAB	TBOI, Cap Vert, Île Christmas, Îles Cocos, Îles Marshall, Comores, Dominique, Guinée Bissau, Guyana, Guyane française, Haïti, Kiribati, Mayotte, Micronésie, Montserrat, PNG, PTAAF, SP&M, Samoa, ST&P, Suriname, Timor-Leste, Tokelau, Tonga, Tuvalu, Wallis et Futuna, île Heard et îles McDonald, Svalbard et Jan Mayen, Géorgie du Sud et îles Sandwich du Sud.
PEI TOURAB	*Corse, République Dominicaine, Guadeloupe, Jamaïque, Martinique, Niue, Palau, Pitcairn, Polynésie Française, Réunion, Saba, Saint-Eustache.*
PEI SITE	**Bonaire, Curaçao, Guam, Hawaï, Îles Canaries, Îles Cook, Saint-Barthélemy, Saint-Martin, Sin Marteen, Turks et Caïques, Zanzibar.**
PEI SITE/PROFIT	**Anguilla, Antigua-et-Barbuda, Aruba, Bahamas, Barbade, Belize, Bermudes, Îles Caïmans, Chypre, Fidji, Grenade, Macao, Maldives, Malte, Îles Mariannes du Nord, SK&N, Sainte-Lucie, SV&G, Seychelles, Vanuatu, Îles Vierges américaines, Îles Vierges britanniques.**
PEI PROFIT	Bahreïn, Cuba, Gibraltar, Guernesey, Hong-Kong, Île de Man, Îles Åland, Îles Falkland, Îles Féroé, Îles Norfolk, Islande, Jersey, Madère, Maurice, Monaco, Samoa américaines, Singapour, Taïwan, T&T.
PEI MIRAB/PROFIT	Açores, Groenland, Îles Salomon, Nauru, Nouvelle-Calédonie, Porto-Rico, Sainte-Hélène.

Table 1: The SIE clustered by models of economic development

- Several common results with prior works (Goujon et al., 2015; Closset et al., 2018)

Groupes	Nombre	Moyenne	Médiane	É-type	Minimum	Maximum
TOUS	250	51,5	50,5	7,8	34,3	72,9
PD	40	47,2	45,2	8	34,3	67,3
PED	154	52,4	50,8	7,2	37,5	72,9
PMA	47	53,9	52	6,9	41,4	66,3
PNI	150	50,8	49,5	7,6	35,8	67,3
PEI	**100**	**52,6**	**52,1**	**8**	**34,3**	**72,9**

Table 2a: PVCCI by groups, the whole sample

- All countries are confronted to the consequences of climate change
  → including developed countries especially Netherlands, Australia and Japan

- Unsurprisingly the group of developed countries is the less vulnerable one and the group of the least developed countries is the most vulnerable one

- The components of rainfall and temperature shocks are the most damaging ones whatever the groupings considered

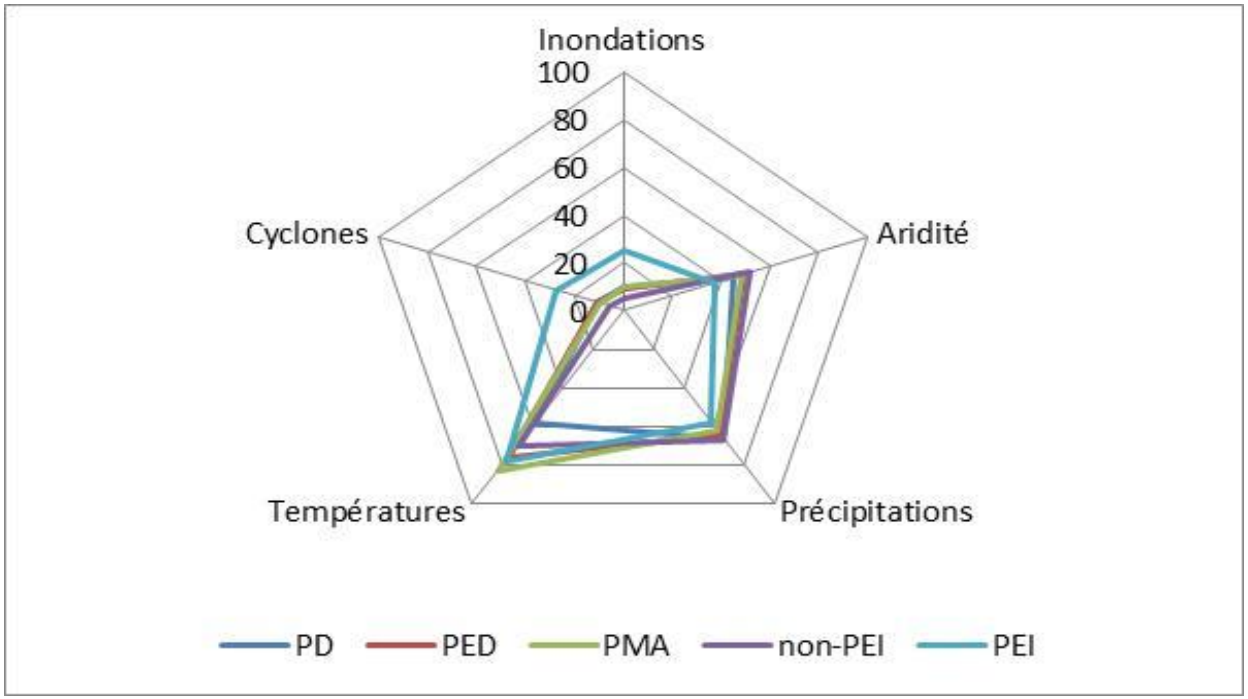


Figure 4. The components of PVCCI for the different groups with a radar chart

- A high heterogeneity across all country groups according to the values of standard errors

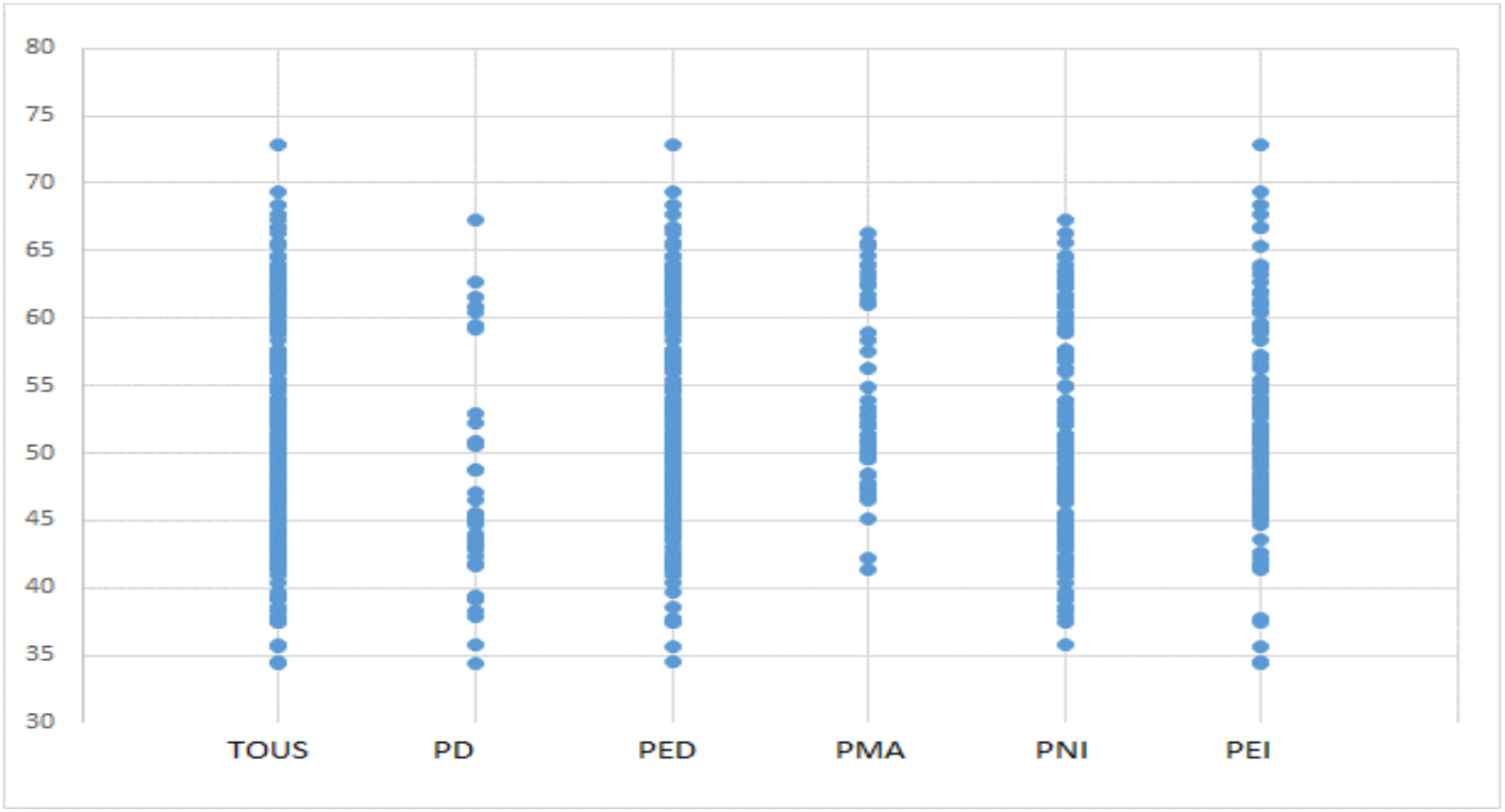


Figure 5. Scatter plot of the PVCCI by groups

- Some new interesting findings

  - Insularity is not a strong differenciating criterion in terms of climate change impacts when taking into account a large set of SIE belonging to all geographical areas

    - The group of SIE is more vulnerable to climate change than the Non-insular group only marginally, not more than the average of developing countries, and clearly less vulnerable than the group of Least developed countries

    - A group highly heterogeneous: 42% of small islands belong to the second part of the panel that is the least vulnerable one

- A strong link appears between tourism specialization and ~~structural~~physical vulnerability to climate change for the insular world: the most significantly impacted groups by climate change are SITE and SITE/PROFIT

Groupes	Nombre	Moyenne	Médiane	É-type	Minimum	Maximum
PEI	100	52,6	52,1	8	34,3	72,9
SITE	**11**	**58,1**	**59,2**	**6,1**	**48,5**	**69,3**
SITE/PROFIT	**22**	**57,2**	**56**	**6,6**	**48**	**72,9**
TOURAB	12	51,2	51	3,8	46	57,3
MIRAB	29	50,6	50,2	7,7	35,6	66,8
MIRAB/PROFIT	7	48,6	47,5	4,7	41,6	53,9
PROFIT	19	49,7	47,5	10	34,3	67,6

Table 2b: PVCCI by groups, the insular sample

- In comparison to the other islands groups, the most damaging factors for SITE and SITE/PROFIT are temperature shocks, storms and floods due to the sea level rise

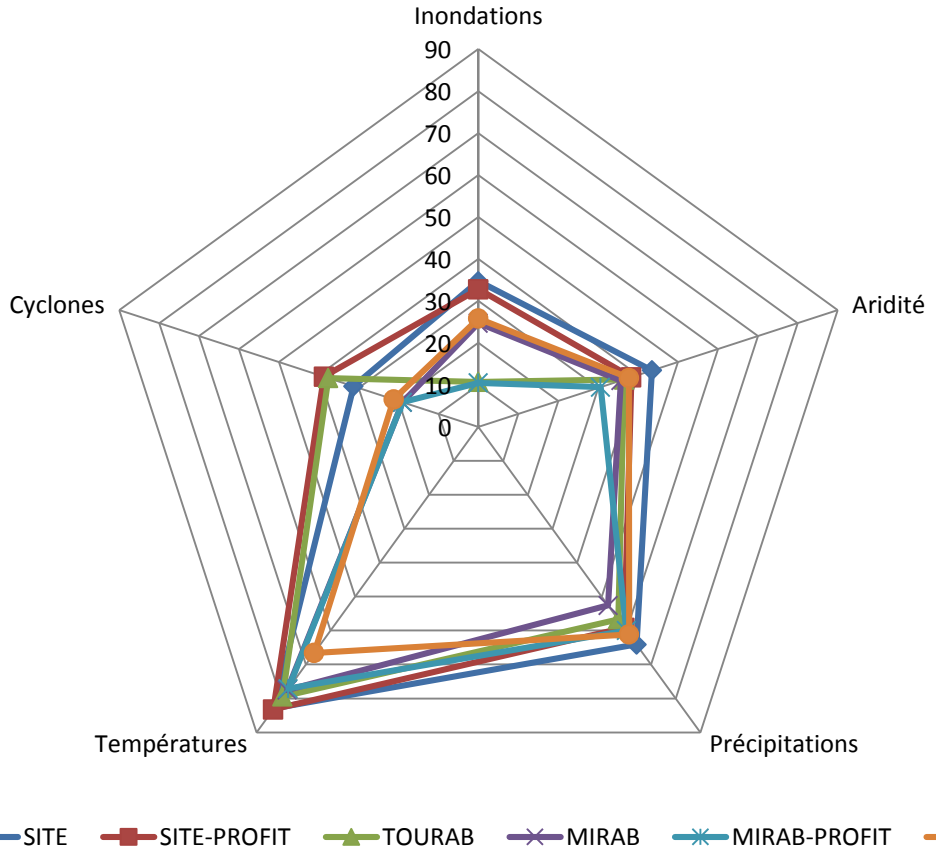


Figure 5. The components of PVCCI for the different insular groups with a radar chart

Conclusion: the tourism specialization is not a sustained strategy for SIE in the new world designed by climate change

- Insularity is not a factor of vulnerability by its own but becomes a significant problem when associated with a tourism-led growth model

  - The most dependent SIEs to the tourism sector are obviously the most vulnerable to climate change

  - However insularity can be considered as a factor of vulnerability in the extent that many SIEs have no other possible economic choices apart from tourism specialization

    → tropical economies are often locked into a trap of tourism dependence

- Tourism activity is also a major source of climate change strenghtening the vulnerability of SIE

  - A significant contribution to greenhouse gas emissions (Lenzen et al., 2018)

    → a carbon footprint per capita of the tourism sector especially strong for SIE due to international tourism flows using necessarily the air transport mode

  - The air transport dependence of insular tourism introduces an additional fragility for the futur development of SIE

    → a progressive change in the behaviour of European consumers in the detriment to air transport (the so-called « flygskam » movement) and the new international regulation context for mitigating world greenhouse gas emissions

- The unavoidable quest for a new form of tourism excluding the « sea, sand and sun » strategy

  - A development model based on

    - More diversification

    - A small and high value-added tourism sector (ecotourism, agrotourism, cultural tourism, medical tourism, sport tourism, …)

    - Domestic tourism rather than international tourism when it is possible

  - With the implementation of mitigation and adaptation policies

    - Restoration and protection of the natural capital and the territorial carrying capacity, anticipation and management of natural risks, and spatial planning

    - The urgent call for international assistance for most developing SIE