

## Measuring climate change adaptation in Pacific small island states: nissology and success

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### ABSTRACT

Pacific small island states (PSIS) currently experience harsh impacts of a changing climate: sea level rise, saltwater intrusion, internal migration and displacement. Are adaptation strategies based upon island-centric principles more successful than those originating from a more continental point of view? This research examined the principles of island-centric thinking using an island-centric lens by which to determine 'successful' climate adaptation planning. The findings illustrate a statistically significant relationship between PSIS that have higher nissological (island-centric) levels displayed within their climate change action plans (CCAPs) and CCAPs that were found to be more successful. In other words, highly nissological states are forecasted to be more successful in planning for the current and future impacts of climate change than those with lower nissological scores. In total, nissology explains approximately 28.37% of a PSIS's success. The policy relevance is rooted in the unique cultural, geographical, and social aspects of islands. Findings are applicable to other islands as well countries that share islander-based qualities. The methodological and quantitative-based areas of the study assist in forming policy-relevant determinations for island societies based on the climate-related parameters and metrics tested and evaluated herein.

**Key words** | adaptation, climate change, climate policy, nissology, Pacific small island states

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### INTRODUCTION

Pacific small island states (PSIS) are Earth's frontline states, acting as early warning systems for global climate change and situated at the forefront of emerging policy-based solutions (Petit & Prudent 2010, p. 175; Betzold 2010, pp. 139–140; Lata & Nunn 2012, pp. 170–171). Difficult implications can potentially include loss of sovereignty and culture, migration, and disruptions of national and cultural institutions when islanders can no longer inhabit their independent and self-governing states (Lange 2010, p. 613). This study analyzes the importance, urgency, and seriousness that a nissological (island-centric) understanding of islands within climate change and adaptation strategies can bring to worldwide concerns, such as impending United Nations Framework Convention on Climate Change (UNFCCC) negotiations and meetings.

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The research question for the study investigates whether PSIS that use a climate change action plan (CCAP) based more deeply on a nissological understanding of 'islandness' will have more successful plans, policies, and projects than PSIS with a more continentally derived CCAP. The investigation focuses on the geographic area commonly referred to as the Pacific, and more specifically on 18 small island states (see States listed in the first column of Table 1) and their plans, policies, and projects involving climate change. Nissology, discussed further in-depth within the study, is used as the proxy for an island-centric framework and lens by which to evaluate the degree to which islands and islander-based thinking is relevant to successful climate change plans and to the greater juxtaposition between islands and climate change-related research.

**Table 1** | List of the 51 CCAPs coded, analyzed, and examined as part of nissological analyses and indices creation

State	CCAP	NAPA	ICC	Other
American Territories	X	–	–	X
Cook Islands	X	–	X	X
Micronesia, Fed. States of	X	–	X	X
Fiji	X	–	X	X
French Territories	X	–	–	X
Kiribati	X	X	–	X
Marshall Islands	X	–	X	X
Nauru	–	–	X	XX
Niue	XX	–	X	–
Palau	–	–	X	XX
Papua New Guinea	–	–	X	XX
Samoa	–	X	X	X
Solomon Islands	X	X	X	–
Timor-Leste	–	X	–	XX
Tokelau	–	–	–	XX
Tonga	X	–	X	X
Tuvalu	X	X	X	–
Vanuatu	X	X	X	–

Note: CCAP = PSIS in question had, in name, an actual climate change plan for its state. NAPA = National Adaptation Program of Action, created for Least Developed Countries; ICC = In Country Consultations (on behalf of United Nations and subsidiaries); Other = Another type of CCAP addressing climate change, but not a CCAP in name; – = 0 no plan; X = 1 plan; XX = 2 plans.

### Defining success

Researchers have sought to define success and its relationship to an array of factors, but the definition is subjective and difficult to pinpoint. With ‘no consensus on the overall objective of adaptation and with little scope for defining the success or failure of adaptive actions,’ the lack of definition could be caused by a ‘lack of consensus’, where ‘observed adaptation and its impacts on sustainability, equity and resilience use many criteria as their yardstick of success’ (Doria *et al.* 2009, p. 810). Doria *et al.* described ‘successful adaptation as any adjustment that reduces the risks associated with climate change, or vulnerability to climate change impacts, to a predetermined level, without compromising economic, social, and environmental sustainability’, leaving a palette of available options to fulfill their definitions that is explored further within the methodology section (p. 815). This research study used the definition by Doria *et al.*

(2009) combined with the definition put forth by Adger *et al.* (2005) designating climate change success as being both on the spatial and the temporal scale, and should not simply be assessed in terms of the stated objectives of individual adaptors ... [a]daptation to climate change, therefore, can be evaluated through generic principles of policy appraisal seeking to promote equitable, effective, efficient, and legitimate action harmonious with wider sustainability’ (Adger *et al.* 2005, p. 80).

The combined definitions offered a comprehensive and specific subset of policy analysis research on which to base the study’s forthcoming analyses and triangulation.

### Nissological context and literature

A nissological approach is used because it studies the uniquely island-centric viewpoints of islands versus more continentally driven strategies (Box 1; McCall 1996).

#### Box 1 | Eight principles of nissology (McCall 1996, pp. 82–83)

- Islands have a clear delineation of land borders, but a less-firm comprehension of watery and maritime boundaries (LB)
- Significance is placed on ocean resources (SR)
- Recognition of past (or present) forceful acquisitions and use of island lands by continental states (CC)
- The perceived scarcity of land quantity and resources increases as does the distance between the island and continent (PS)
- Islands are seen as culturally delimited and bounded lands, disparate to expansive continental states and cultures (BE)
- A sense of moderation or limitation can pervade islanders’ thinking if adopting continental resource perspective (SL)
- Cooperation and creativity can be fostered within small islands due to close relations, small populations (PP)
- Migration forms a large anxiety for island states – whether based on immigration or emigration (MT)

Islanders and island-based points of view have obviously been discussed prior to the 20th century neologism of nissology; and this research and analysis is significant in that it is the very first time that the conceptualization of the eight principles of a formalized island-centric perspective has been analyzed and evaluated. Continental-based (non-island) viewpoints pervade in international policymaking because of PSIS's often peripheral and indirect influence. Nissological research examines how integrating the 'nissological way' into 'broader interdisciplinary (geographical) approaches' is key to understanding the multifaceted systems at work in islands and whether using this type of method leads to climate change adaptation and preparation for island states (Christensen & Mertz 2010, p. 285). Recent studies continue to utilize the nissological approach to better understand how islanders' viewpoints are uniquely positioned to better self-assess and understand (Burholt *et al.* 2013; Azzopardi 2015).

A nissological perspective is 'a short-hand way of reminding continental dwellers that island reality is not theirs; that an island world view is not theirs; and that an island integrity belongs to Islanders' (McCall 1996, p. 82). These forceful statements, along with the general views of supporters of nissology, are illustrative of a society frustrated with others' norms framing issues. Islanders and islands are unique and the proposition of having their own methodology of analysis could be considered similar to casting off former colonial rulers dictating how islanders should live. Others expand on McCall's framework, stating that nissology 'suggests a process of empowerment, a reclaiming' from processes where 'islands are treated as fair game for mainland subjugation and organization' (Baldacchino 2008, pp. 37–38).

The concept of nissology is controversial due to the diversity of islands, island types, and whether this geographical typology necessarily needs its own framework by which to self-evaluate and self-assess actionable behavior. Notwithstanding, without an island-centric perspective, characterizations of islanders would be from others' viewpoints, and investigators would study subjects who are unable to offer their own explanations. However, others state that 'nissology appears to be another variation of the classical place-based and interdisciplinary approaches in human geography and analytical framework' that may be too heavily focused on a single subset rather than on a

greater literature as a whole (Christensen & Mertz 2010, p. 285). Nonetheless, no matter whether island-centric frameworks are given their own 'ology' status or not, the contributions and experiences of islanders are necessary to examine within social science research and analyses in conjunction with climate change, even if some argue that a binary between islandness and continentality is not an exclusively dualistic subset.

## METHODOLOGY

As previously stated: the research study used the definition of success from Doria *et al.* (2009) combined with Adger *et al.* (2005) designating climate change success as being 'both on the spatial and the temporal scale (see 'Defining success', above). As success is a broad and difficult term to define, numerous characteristics of success were evaluated for each PSIS. Table 1 lists American Territories (AT) in the Pacific and French Territories (FT) in an agglomerated fashion due to the scarcity of plans to analyze and code for these territories of the United States and France, respectively. It should be underscored that the AT (American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands) as well as the numerous FT throughout distinct reaches of the Pacific vary greatly in their cultural and geographical characteristics; however, there was a dearth of available CCAPs at the time of the study documenting these particular PSIS.

Many of these characteristics were derived from the book *Successful Adaptation to Climate Change: Linking Science and Policy in a Rapidly Changing World*, which itself scoured the broad range of what defines success, what may categorize the absence of success, and related policy and ambiguities where the frameworks intersect (Moser & Boykoff 2013). Deeply scrutinizing hundreds of past, present, and planned studies and climate change strategies throughout the developed and developing world, Moser and Boykoff acknowledged that there is no list or recipe to evaluate successful climate change adaptation due to desired outcomes and intrinsic differences (Moser & Boykoff 2013).

The book analyzes research and researchers' methods concerning which strategies begin to lean toward achieving

or failing in climate preparation in a qualitative discussion. The researchers for this paper were able to synthesize Moser and Boykoff's qualitative discussions of the hundreds of studies to develop 36 key characteristics which are ultimately derived specifically for this nissological study, after reviewing Moser and Boykoff's work, labeled from this point forward as the 36 SIQs (success indicator questions) (2013, p. 9). The 36 SIQs were derived from the aforementioned authors' qualitative discussion across many chapters.

Related, while the aforementioned hundreds of past, present, and planned studies analyzed by Moser and Boykoff do include examples from continental and island perspectives, the authors examined and studied successful adaptation across numerous landforms, states, countries, and continents. Thus, while some could argue that the derivation of the 36 SIQs could have a certain slant toward more island-centric or less (depending on Moser and Boykoff's citations), their vast study of peer-reviewed and gray literature in the climate adaptation subject matter foundationizes the rationale for usage in this study.

Data were collected (see process for obtaining documentation, below) and catalogued from the 18 PSIS's CCAPs. The data were evaluated on the nissological understandings of islandness. Methods included using the eight principles of nissology (see [Box 1](#) for basic principles) from the literature to conduct an intensive content analysis and review of each state's CCAPs. CCAPs were evaluated alongside peers so that any arguable impreciseness in evaluation of words was curtailed by comparing the depths and brevities of plans against others by the same individual coding the plans.

[Table 2](#) illustrates a spectrum by which the nissological characteristics were qualitatively evaluated. Because each nissological category is diverse in which aspects of island-centric life it may represent, [Table 2](#) aided the evaluation of the CCAPs for each of the nissological categories allowing them to be operationalized into the study (see following paragraph for scale creation description). This work culminated in an analysis of each state's nissological characteristics via two indexed scales: first, a simplified nissological scale and, second, a more complex and multifaceted nissological scale. A family-resemblance concept structure of analysis was used so 'substitutability' of like factors could be implemented in which 'one dimension can be

compensated by the presence of other dimensions' (Goertz 2006, pp. 44–45).

The simplified nissological scale was created from 0 through 8. Because PSIS spoke in their CCAPs about nissology in varying terms, the [Table 2](#) rubric was created and utilized to identify how different ideals of nissology pertained to certain principles. Each mention of a principle of nissology via content analysis with assistance of [Table 2](#) by a PSIS adds +1 to a state's count, and a CCAP strategy not utilizing a nissological category would receive a 0 for that particular category. A cumulative score of 8 indicated that the plan heavily swayed toward a nissological viewpoint whereas a score of zero 0 indicated that the plan had highly continental, or non-nissological tendencies. An intermediate score of 4 indicated intermediate levels of a nissological or continental-type tendency, respectively. At this stage, having a high or low nissological score was neither deemed to be beneficial nor detrimental – it solely analyzed the degree of island-centricity for each PSIS.

The second indexed scale, a more complex and multifaceted nissological scale, ranged from 0 through 24; each of the eight principles of nissology were evaluated on how profoundly they were used within states' CCAPs. Within this second scale, the PSIS scores were determined based on the intensity of their mention of the nissological principle. For example, a PSIS focusing on the significance of ocean resources (which is just one of the eight nissological principles) within its CCAP received from 0 through 3 points for addressing that particular principle of nissology: 0 for no mention, +1 for a brief mention and slight emphasis, a +2 for significant mention with moderate emphasis, and +3 for repeated mention with heavy emphasis. Once again, PSIS were evaluated alongside peers so that any arguable impreciseness in evaluation of words was curtailed by comparing the depths and brevities of plans against others by the same individual coding the plans.

The process to obtain pertinent plans was conducted via several online databases, depositories, and portals that house PSIS climate-related data in 2013. Institutions such as the Pacific Climate Change Portal, SPREP, the University of the South Pacific, United Nations, UNFCCC and other clearinghouses were evaluated to find the three most pertinent CCAPs for each PSIS. Certain PSIS had plans that were labeled as CCAP while others had plans that were

**Table 2** | Derivation of identifiable characteristics from McCall's nissological principles to categorize CCAPs and nissological indices

Nissological category	← Identifiable characteristics of nissology for analysis →		
Land borders (LB)	Clear border observable	Shore naturally acts as an edge	EEZs and their ability to abut and overlap
Sea resources (SR)	In the EEZ and surrounding areas	More surface area as a state via the marine territory versus land	Incongruity between sea-claims and terrestrial territory
Claims/Colonization (CC)	Tendency to be occupied, or not independent	Seen as fortification of continental interests	Viewed as peripheral settlement for continental influence/protection
Perception of scarcity of land (PS)	Mirrored in perception of lack of land resources	As distance from continent increases so does perceived lands scarcity	Marine resources are not viewed as scarcely as land resources
Bounded entities (BE)	Clear contrast between on/off island	Although, culture is not stopped at land's edge, can flow	Recognizes the start and ending of physical land
Sense of limitation (SL)	When viewed with reference to continental (large areas/resources)	A lesser sense of limitedness appears with less continental influence	When keeping an island culture and sentiment, a sense of limitlessness can pervade
Particularistic places (PP)	State-focused, island society-focused populations in surroundings	Smallness of islands' populations leading to creative cooperation	Embeddedness of local opinions in localized projects, policies, and more
Migration (MT)	Emigration out or immigration in from other lands or islands	Optional versus more forcible or necessary migrations	Relocation to continent or other islands and the ability to return

The three columns do not have distinct meanings – they represent a spectrum by which to evaluate the corresponding row's nissological category. EEZ, exclusive economic zones (based on McCall 1996, pp. 82–83).

labeled as DRR (disaster risk reduction plans), whereas other PSIS characterized as LDCs (Least Developed Countries) were required to have a NAPA (National Adaptation Program of Action). Plans were read by the author of the research and coded appropriately following the process mentioned above. Table 1 identifies the specific types of CCAP obtained for each PSIS.

## Data

Three CCAPs for each of the 18 PSIS were analyzed and coded to quantify the level of nissological thoroughness used within a particular PSIS' plan, totaling 51 plans (three PSIS (AT, FT and Tokelau) only contained two pertinent CCAPs each to analyze at the time of data collection) analyzed together (the 51 CCAPs are listed at the end of the article). Within each column, there are two numbers in an 'Inst (Rigor)' position format. The 'Inst' refers to the number of times or *instances* a nissological principle is mentioned within the PSIS plans. The 'Rigor' position indicates the rigorousness with which the nissological principle is mentioned – the importance given to that principle within

a state's plans. The variation in length or wordiness of documents is taken into account. A CCAP that may have mentioned sea resources (SR) only a few times in a brief document would be scored differently from a lengthy CCAP also having only a few SR mentions. In other words, both a qualitative and quantitative measure were derived from the number of mentions as well as how those nissological principles were discussed: either at length in paragraphs full of policy or economic ramifications or in a glib phrase with neither explanation nor insight or perhaps somewhere in between.

Approximately 75% of PSIS mentioned all of the principles of nissology within their CCAPs. The other approximately 25% of PSIS mentioned all but one of the principles within their plans. However, when examining the instances and rate with which each PSIS speaks to particular nissological characteristics, substantive differences are present. Because each PSIS can receive a score between 0 and 3 for each of the eight principles of nissology, they can receive a nissological total of 0 through 24. After analysis, PSIS resulted in an actual spectrum ranging from 9 through 22, seen in Table 3.

**Table 3** | Instances and rigor [Inst (Rigor)] of nissological characteristics in CCAPs with totals

PSIS	LB Inst	SR Inst	CC Inst	PS Inst	BE Inst	SL Inst	PP Inst	MT Inst	Total 0-8	Total 0-24
AT	1 (1)	8 (2)	0 (0)	1 (1)	2 (1)	6 (3)	1 (1)	1 (1)	7	10
CI	6 (2)	7 (2)	2 (1)	1 (1)	4 (2)	3 (1)	1 (1)	2 (1)	8	11
FS	12 (3)	21 (3)	11 (3)	5 (2)	3 (1)	2 (1)	11 (3)	6 (2)	8	18
FI	5 (2)	9 (2)	0 (0)	1 (1)	1 (1)	4 (1)	5 (2)	3 (1)	7	10
FT	5 (1)	8 (2)	1 (1)	1 (1)	3 (1)	1 (1)	1 (1)	1 (1)	8	9
KI	7 (3)	18 (3)	1 (1)	1 (1)	4 (2)	6 (3)	4 (1)	3 (1)	8	15
MI	7 (3)	10 (3)	11 (3)	2 (1)	5 (3)	5 (2)	12 (3)	1 (1)	8	19
NA	5 (2)	7 (2)	3 (2)	2 (1)	4 (2)	10 (3)	1 (1)	2 (1)	8	14
NI	5 (2)	5 (1)	2 (1)	1 (1)	3 (1)	8 (2)	3 (1)	3 (1)	8	10
PA	7 (2)	24 (3)	5 (3)	0 (0)	4 (2)	2 (1)	1 (1)	2 (1)	7	13
PN	5 (2)	14 (3)	1 (1)	2 (1)	1 (1)	7 (2)	2 (1)	3 (1)	8	12
SA	5 (2)	9 (2)	1 (1)	1 (1)	2 (1)	5 (1)	3 (1)	1 (1)	8	10
SI	13 (3)	27 (3)	3 (1)	8 (2)	6 (2)	17 (3)	5 (1)	11 (3)	8	18
TL	4 (1)	13 (3)	6 (2)	17 (3)	2 (1)	4 (1)	4 (1)	0 (0)	7	12
TK	9 (3)	9 (3)	10 (3)	5 (2)	6 (3)	7 (3)	7 (3)	2 (1)	8	21
TN	3 (1)	10 (3)	1 (1)	9 (3)	4 (2)	6 (2)	7 (3)	3 (1)	8	16
TU	5 (2)	13 (3)	6 (3)	7 (3)	5 (3)	7 (2)	7 (3)	4 (3)	8	22
VA	1 (1)	7 (3)	1 (1)	6 (3)	2 (1)	4 (2)	9 (3)	5 (2)	8	16
Average	5.83 (2.00)	12.17 (2.56)	3.61 (1.56)	3.89 (1.56)	3.39 (1.67)	5.78 (1.89)	4.67 (1.72)	2.94 (1.28)	7.78	14.22

Note: LB = land borders; SR = sea resources; CC = claims/colonization; PS = perception of land scarcity; BE = bounded entities; SL = sense of limitation; PP = particularistic places; MT = migration; Inst = number of mentions (0-99+); Rigor = rigor of mentions (0-3).

## Hypotheses

Because there is a divide among scholars as to whether nissological analysis is useful, the research question and results specifically analyzed this ongoing inquiry. The hypothesis stated that *PSIS that use a CCAP based more deeply on a nissological understanding of 'islandness' will have more successful plans, policies, and projects than PSIS with a neutral or more continentally derived CCAP*. Thus the next part of the analysis will quantify the success of the 18 PSIS's CCAPs, to be measured against how nissological or island-centric a PSIS happens to be.

## RESULTS

When the PSIS's scores and distribution (Table 3) are evaluated on the spectrum of nissology, the results speak to the key differences between states. Instead of varying by a single

number in the simplified nissological scale, PSIS vary between a nissological score of 9 through 22 in the multifaceted scale. In fact, the FT, with the lowest score had only a single category (SR) in which it did not score the lowest possible 'rigor' score, whereas Tuvalu garnered the highest score possible in 75% of nissological categories. The average score for PSIS was 14.22 out of 22. In other words, PSIS's CCAPs could be classified as 65% nissological in the manner and breadth in which they were created, on average. As previously stated, having a higher nissological score at this point of the research process neither signifies nor disproves more successful climate change planning tendencies.

Are other factors such as island height part of the equation affecting nissology and climate change adaptation? Next, the instances and rates of the nissological principles uncovered how certain PSIS sway in their nissological tendencies. The top five scoring PSIS on the 0 to 24 index are Tuvalu (TU), Tokelau (TK), Marshall Islands (MI), Federated States of Micronesia (FS), and Solomon Islands at 22,

**Table 4** | PSIS nissology and success scores and rank

State	Nissology score	Nissology rank	Success score <sup>a</sup>	Success rank
American Territories	10	3-LNS	19.33	1-HSS
Cook Islands	11	2-ANS	18.00	2-ASS
Fed. States of Micronesia	18	1-HNS	18.00	2-ASS
Fiji	10	3-LNS	18.00	2-ASS
French Territories	9	3-LNS	12.67	3-LSS
Kiribati	15	2-ANS	16.00	3-LSS
Marshall Islands	19	1-HNS	19.33	1-HSS
Nauru	14	2-ANS	18.67	2-ASS
Niue	10	3-LNS	18.00	2-ASS
Palau	13	2-ANS	17.33	3-LSS
Papua New Guinea	12	2-ANS	17.33	3-LSS
Samoa	10	3-LNS	17.33	3-LSS
Solomon Islands	18	1-HNS	20.67	1-HSS
Timor-Leste	12	2-ANS	17.33	3-LSS
Tokelau	21	1-HNS	19.33	1-HSS
Tonga	16	2-ANS	18.67	2-ASS
Tuvalu	22	1-HNS	21.33	1-HSS
Vanuatu	16	2-ANS	18.67	2-ASS

Note: HNS = highly nissological state; ANS = average nissological state; LNS = low nissological state; HSS = highly successful state; ASS = average successful state; LSS = low successful state; <sup>a</sup> = normalized success score converted from  $x/36$  to  $x/24$  (e.g.  $30/36 = 20/24$ ).

21, 19, 18, and 18 respectively (Table 4). These highly nissological states (HNS) are mostly low-lying atoll states (aside from Solomon Islands) with the first two PSIS consisting of only three and nine atolls, respectively. On the other side, the five lowest scoring PSIS on the 0 to 24 index (LNS) are the FT at 9, followed by the AT, Fiji (FI), Niue (NI), and Samoa (SA), of which all scored 10. Of these five lowest-scoring PSIS, four-fifths are high islands, with the FT being a quasi-outlier (also, see above regarding the agglomeration of territories for this analysis). Parts of the FT, such as portions of French Polynesia, are low-lying atolls, but other areas are not low-lying islands, such as Wallis and Futuna, which is why the FT are categorized as mixed island typology, which also includes the islands of New Caledonia.

### Success coding results

The definition and determinants of successful climate change adaptation are divided over 36 binary indicators

(SIQs; see Appendix for the individual questions, available with the online version of this paper), based on scholarly research (see previous section on defining success) regarding what constitutes successful adaptation. The 51 CCAPs were coded once more via a content analysis focusing on the 36 indicators of success. Not included in the manuscript due to size limitation, but available from the author upon request, is the large matrix that takes the questions listed in the Appendix to create a 36 (SIQs) by 18 (PSIS) table. At the bottom of each question's column is a value indicating, on average, the percentage of PSIS in which the indicator of success is present. For example, Question 6 states, 'Do the plans contain monitoring, assessment, and evaluation opportunities within them?' Question 6 has a 0.83 average, with 15 of the 18 states fulfilling this characteristic of success. At the end of each row is a state's total 'X' quantity, or the number of the 36 indicators of success fulfilled, in both number and percentage format.

This percentage is not meant to be simply read as a PSIS being '61% successful toward climate change,' but rather as a tool by which to compare and contrast specific PSIS with other PSIS. These averages allow patterns to be read, such as which state is the only one not answering in the affirmative to question 22: 'Do the plans identify the barriers and risks to adaptation?' Similarly, the analysis can attempt to decipher why only 2 of the 18 PSIS affirmatively answered question 1: 'Do the plans use a systemic approach, such as use of metrics, to determine success?' While select SIQs will be analyzed herein, due to the data-rich aspects of the results, future research will investigate the 36 SIQs further in-depth to understand which may be weighted more than others.

### Analysis of success coding results

PSIS scores were normalized to scores of 24 to create easier comparisons with the nissology scale that has a maximum of 24; therefore, a PSIS scoring 30/36 would be marked as 20/24. The average among the 18 PSIS is a success score of 75.4% or 18.1/24. The percentages give certain benchmarks based on what experts in the field say should be done. Some of the 36 indicators of success are actual implementation-based activities, whereas others are planning-based activities (not necessarily doing anything at this particular time, but having the potential to effect change

in the future). The distribution of the success scores (along with the previous nissology scores shown) of the 18 PSIS is illustrated in Table 4, with Tuvalu and Solomon Islands taking the top two positions, scoring 21.33/24 (89%) and 20.67/24 (86%), respectively. The next top-scoring states are the AT, Marshall Islands, and Tokelau, all scoring approximately 19.33/24 or 81% on the success scale. Coming in at just less than 78%, Nauru, Tonga, and Vanuatu round out the top 8 of the 18 PSIS, with these states scoring above the mean of 75.4%, and the other PSIS scoring below. The lower-scoring 9 states are Cook Islands, Federated States of Micronesia, Fiji, and Niue (all coming in at 75%), then Palau, Papua New Guinea, Samoa, and Timor-Leste, coming in at 72%. Last are Kiribati, and the FT scoring 67% and 53%, respectively. Again, this is not to suggest that Papua New Guinea is, for example, 72% successful at preparing for climate change, but rather to evaluate the state among its peers. Table 4 illustrated the PSIS's nissology and success scores, while also grouping them into high, average, and low scores, based on their fulfillment of the 36 SIQs.

As stated above, the large matrix that takes the questions listed in the Appendix to create a 36 (SIQs) by 18 (PSIS) table shows that four of the SIQs are fulfilled in the affirmative by all 18 PSIS, whereas an additional nine SIQs are answered in the affirmative by 90% of the PSIS. Conversely, the indicator question with the lowest number of PSIS answering affirmatively was question 1.

### Combined nissological and success results

Do PSIS that score high in nissological characterizations also score high in success-related characteristics? The nissological scores of PSIS Fiji are used as the dependent variable on the scale of 0 through 24. On the independent variable axis are the indicators of success for each of the PSIS. Although there were 36 indicators of success, they were normalized over a scale of 24 for comparative purposes: a score of 30/36 is shown (and is mathematically equivalent) as 20/24.

The linear model in Figure 1 illustrates a relationship between nissology and success as evidenced by a trend where an increase in a nissological score generally yields an increase within the success of the PSIS. With a *p* value of 0.0056, the relationship is statistically significant. The

following linear equation which is also represented by the solid line in Figure 1, calculates success as:

$$y = 14.0761 + 0.2837 \times \text{NissScore} = \text{Success}$$

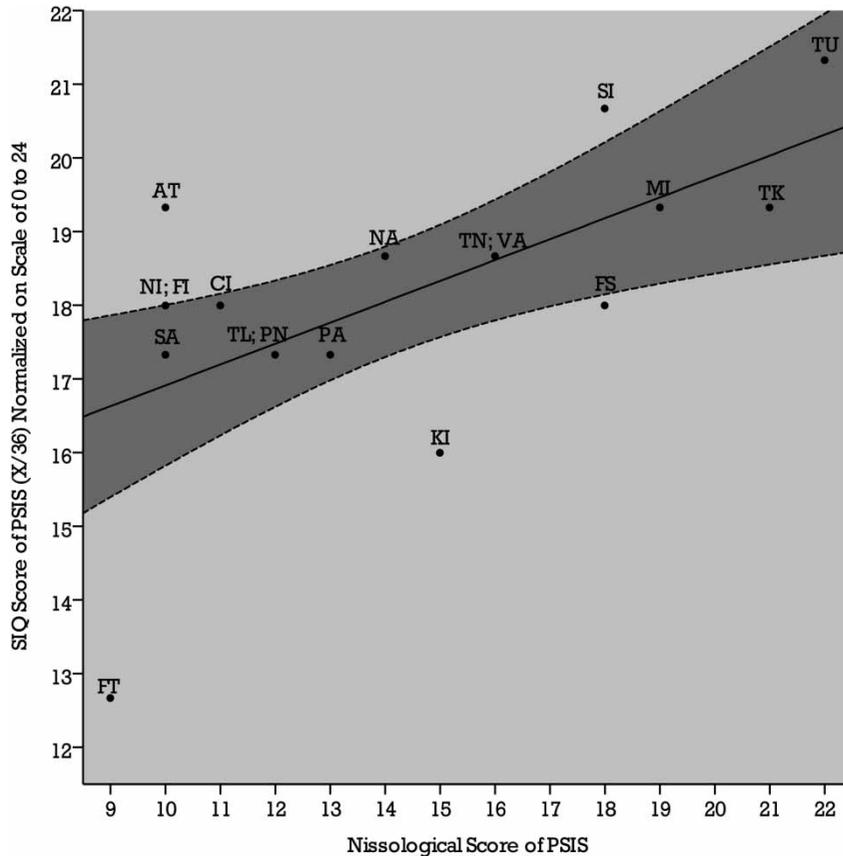
The base success rate is  $[14.0761 + (0 \times 0.2837)]/24$  or 58.65%; and the highest possible value is  $[14.0761 + (24 \times 0.2837)]/24$  or 87.02%. The actual bounds for nissological scores are the FT and Tuvalu, scoring a success rate of 69.28% and 84.66%, respectively, with nissology scores of 9 and 22, respectively. In other words, every additional nissological point attained yields an approximate 1.2% increase in success. These data show that plans that do not include any nissological principles and characteristics may be less successful. Thus, nissology explains approximately 28.37% of a state's success score.

## DISCUSSION

The hypothesis states that PSIS that use a CCAP based more deeply on a nissological understanding of 'islandness' will have more successful plans, policies, and projects than PSIS with a neutral or more continentally derived CCAP. Through the statistical and qualitative data, analyses, and observations, the null hypothesis can be rejected, and the data thereby form a foundation of successful climate change adaptation aligning with a nissological viewpoint along with other criteria.

With respect to the potential for success, PSIS are excelling and should continue to extend various stakeholder invites, be future oriented in their thinking, and strive toward projects that concentrate on adaptive capacity, based on how they scored on the 36 SIQs. Plans are quite specific to the state to which they pertain, are fairly knowledgeable about what is doable and achievable at the state-level, and appear open to an iterative, evolving process as time moves on. In addition, PSIS's goals, synergies between goals and plans, and a seeming openness to input across sectors are positive features within the CCAPs.

Based on the SIQs which evaluated PSIS's CCAPs, other areas where PSIS are excelling are by avoiding the commission of repeated studies before taking policy-related action, having plans that invest in people as well as technology and infrastructure, and fostering a collaboration



**Figure 1** | Nissological scores of PSIS by success scores of PSIS. Note: CI = Cook Islands (S); FS = Federated States of Micronesia (I); FI = Fiji (I); KI = Kiribati (I); NA = Nauru (I); NI = Niue (S); PA = Palau (I); PN = Papua New Guinea (I); SA = Samoa (I); SI = Solomon Islands (I); TL = Timor-Leste (I); TK = Tokelau (T); TG = Tonga (I); TV = Tuvalu (I); VN = Vanuatu (I); AT = American Territories (T); FT = French Territories (T); S = semiautonomous; I = independent; T = territory.

between knowledge sources and decision-makers. Similarly, risk communication and awareness as well as framing the issue of climate change adaptation as a more desirable future and a better-off state for islanders versus taking no action are additional strong points for PSIS. Finally, PSIS also exhibit success in identifying barriers to adaptation, satisfying multiple actors (e.g. policy, science, or cultural), and preserving environmental and resource value within PSIS, evidenced by SIQs with higher percentages.

Areas where PSIS are making strides but still need to focus more strongly are in identifying past lessons, mistakes, and successes and learning how to weave them into proposed policy instead of just listing the need to do so. In addition, baseline data need to be better identified so these future strides and challenges have clear benchmarks to be judged against. Finally, PSIS need to integrate data and plans into other related policy forums.

Avoiding maladaptation, mentioning how exactly to integrate policies, and being forthcoming with no-regrets approaches are additional aspects that PSIS need to improve. Additional areas where PSIS are making some progress but need to refocus are stating their values and the target of their goals, growing community buy-in, and describing how goals relate to particular community and partner meetings. In addition, policy evaluations, the relevance and personal meanings of these policies, and the trade-offs and synergies involved need to be considered, evidenced by SIQs with neither higher nor lower percentages.

Capacities where PSIS are currently failing, according to the SIQs, are in determining what would constitute successful adaptation planning along with developing useable metrics for evaluation. Further, reliable financing is needed or at the very least an estimate or proposed budget so PSIS do not identify robust strategies that are effectively

wish lists because they do not have any likely financial support or backing. Other areas that need attention are climate-based migration and resettlement approaches such as strategies, protocols, and policy connections with other jurisdictions. Monitoring, evaluation, and reassessment as well as the timeline of such activities need to be included within future CCAPs. In addition, the flexibility of adaptive management and mechanisms to change or shift focus should be included, evidenced by SIQs with lower percentages.

The research illustrates that certain PSIS are crafting their CCAPs in such a way that, according to expert opinion about what constitutes successful climate change adaptation, they are better forecast to more ably adjust to a changing climate. However, perhaps there are similarities between using a nissological plan and one that is considered successful: both look to context on the islands, using local and appropriate means by which to accomplish tasks and defining jurisdictions or borders with respect to certain policies. The argument can also be made that the eight nissological principles can be considered success indicators; and, when statistically tested, there was no evidence of an endogenous relationship.

Although some of the SIQs deal with current strategies, others approach future topics; solely because a document says that a PSIS government needs to do something does not guarantee that it will be accomplished. Some success indicators hold observably greater weight than others: should having a timeline and budget available for adaptation activities be weighted the same as having a positive outlook with regard to how adaptation is framed within the document? This is the subject of future research.

The PSIS that have the highest rates of nissology are statistically shown to be indicative of states with higher levels of successful adaptation to climate change. In the mid-1990s, McCall made the case for nissology, proposing that nissology 'be employed as both a rhetorical and a political device ... the study of islands on their own terms ... reminding continental dwellers that island reality is' for islanders to decide and no one else (McCall 1996, p. 82). It is the very islander-based frameworks and decisions that produced results associated with what climate change experts have deemed successful adaptation to climate change, whether or not the term nissology is utilized.

Are islands special in that they are more apt to plan and create projects and implement policies than counterparts

which are not islands? Although one could argue either way, the crux of the research is that the islanders who look to their history, elevation, way of life, successes, failures, colonization, lifestyles, food source, location, linkages, associations, and any other island-based characteristics are more likely to be successful, because they are implementing plans that relate to their people, policies that align with their culture, and projects where community buy-in is inherent with perpetuating islanders' longevity.

## FUTURE WORK

At the beginning of the study, PSIS using a more nissological approach – with relatively high content levels of island-centric principles – were hypothesized to be indicative of states with more successful climate change plans and policies. It was thought that PSIS that were more self-conscious and had a greater awareness of their strengths, limitations, and natural assets as islands would be more successful at addressing climate change. 'Island specialists have criticized the 'continental prejudice' that tends to regard nissology and island studies 'as some kind of aberration, even by islanders,' causing a divide in island-centric literature (Depraetere 2008, p. 4). It was only two decades ago that McCall put forth a formal list of eight principles of nissology (Box 1) to 'cope with understanding the reality of island economies, their regional integration and their future,' features that this study found key to CCAPs and related disaster risk reduction plan planning (McCall 1996, p. 82).

Perhaps it is better and more productive not to argue about whether nissology should be distinct theory or a variation of one but rather to acknowledge the vital and significant findings on which it allows scholars to operationalize. Regardless of whether nissology is placed within the category of theorem, framework, or branch of study, the research hypothesis for this study was substantiated by the data findings. PSIS that have more nissological or locally based CCAPs tend to be states with more successful policies and projects than those with non-island-based plans.

With a firm, yes, CCAPs that are more nissological in this study are more successful; statistical regression illustrated that about 30% of a state's success can be determined by how nissological it is. Next, how can that

research inform islanders, policymakers, and decision-makers in the future? The primary answer is that those parties involved in climate change adaptation within islands should understand and use islanders' unique perspectives when creating policy and linkages as it has the potential – and within this study a solid validation – to increase success.

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