

InsuRisk Special Report on SIDS – Annex

This annex provides an overview of the **indicators, datasets** and their sources as well as of key **methodological steps** taken in the development of the 2020 InsuRisk Assessment tool for SIDS.

1. CONCEPT & TERMINOLOGY

Following the restructuring of the conceptual framework of the InsuRisk Assessment tool, changes were made to the terminology of the components and sub-components used in the assessment compared to previous versions. In particular, in the 2020 version “*vulnerability*” refers to the combination of *overall susceptibility* (itself an output of the combination of *socioeconomic susceptibility, land-use & economic production susceptibility* and *infrastructure susceptibility*) and *overall coping capacity* (which combines *coping capacity* at the *individual* and *national* level). “*Climate and disaster risk*” in the present assessment describes the product of *overall vulnerability* and *overall exposure*.

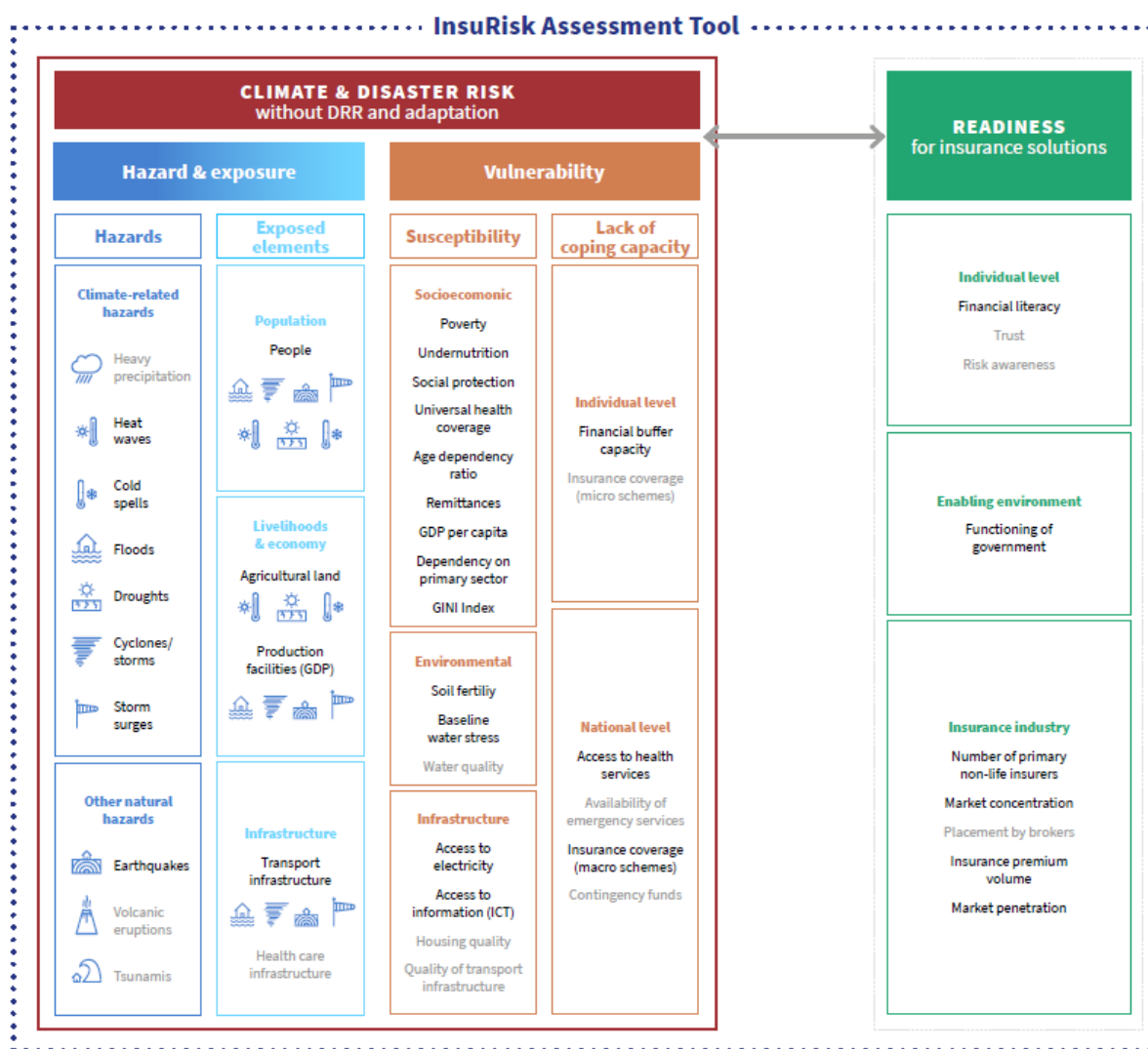


Figure 1: Conceptual framework of the InsuRisk Assessment tool. Elements in grey font are considered relevant but lack publically accessible data with global coverage.

2. INDICATORS

The following tables provide an overview of the factors and indicators (incl. data source, year, missing data) for each of the different components of the conceptual framework. Factors highlighted in red were not considered in the analysis tool due to insufficient data or absence of representative indicators. For all indicators, the latest available data for each country was collected. In case of missing data for the reference year, data was imputed from the most recent available year or using alternative sources.

2.1 Hazard and exposure

*Table 1: Hazards (climate-related and other)**

Hazards (climate related)			
Hazard	Indicator	Return period	Source
Heat waves	Warm Spell Duration Index	n/a (1970-2016)	Mistry (2019)
Cold waves	Cold Spell Duration Index	n/a (1970-2016)	Mistry (2019)
Floods	-	50 years	Dottori and others (2016)
Droughts	4-6 months Standardized Precipitation Index (SPI)	50 years	He and Sheffield (2020)
Cyclones / storms	Wind speed of > 119 km/h	50 years	UNDRR (2015)
Storm surges	-	50 years	UNDRR (2015)
Hazards (other natural)			
Earthquakes	Peak Ground Acceleration (PGA) > 8.1 cm/s	475 years	Pagani and others (2018)

*** Note:** Next to the climate-related extreme events and natural hazards considered in this report (i.e., heat waves, cold spells, river floods, droughts, storms/tropical cyclones, storm surges, and earthquakes), many islands (including SIDS) are actually highly exposed to a wide array of additional slow onset events, such as sea level rise, and the associated, aggravated impact of swells, king tides, coastal erosion, and salt water intrusion. Due to the lack of comparable data across SIDS, these slow onset events are – despite their high relevance – not considered in the exposure analysis presented in this report.

Table 2: Exposed elements

Exposure				
Exposed element	Indicator	Year	Source	Resolution
Population	Population	2020	WorldPop	1 km
Land use	Agricultural areas*	2018	European Space Agency (ESA 2019)	300m
Economic production	Gross Domestic Product (GDP)	2015	Kummu and others (2018)	1 km
Infrastructure	Major roads	2020	Open Street Map (OSM)	--
	Railways	2020	Open Street Map (OSM)	--
	Ports	2020	Maritime Safety Information	--
	Airports	2020	Our Airports	--

*includes the following classes: rainfed cropland, irrigated cropland, mosaic cropland, mosaic natural vegetation (>50%) / cropland (<50%).

2.2 Vulnerability

Table 3: Vulnerability indicators (susceptibility sub-component)

Susceptibility (socioeconomic factors)				
Factor	Indicator	Source	Year	Missing
Poverty	Poverty headcount ratio at national poverty lines (% of population)	WorldBank; CIA-Factbook; OECD	2002-2019	17 / 188
Social protection	Breadth of Social Protection: Proportion of population covered by at least one social protection benefit (%)	ILO	2016 - 2019	66 / 188
	Depth of Social Protection: average transfer amount (% of GDP)	WorldBank (ASPIRE)	2000-2016	77 / 188
	<i>Aggregated indicator: Social protection performance</i>			35 / 188
Universal Health Coverage (UHC) - access to essential health services	Tuberculosis treatment success rate for new TB cases (%)	WHO	2003 - 2016	3 / 188
	Antenatal care coverage - at least 4 visits (%)	WHO; OECD; UNICEF	2000 - 2018	38 / 188
	Birth attended by skilled health personnel (%)	WHO	2002 - 2018	8 / 188
	Diphtheria-tetanus-pertussis (DTP3) immunization coverage among 1-year olds (%)	WHO	2018	1 / 188
	Estimated ARV coverage among people living with HIV (%)	UNAIDS; WorldBank	2016 - 2018	30 / 188
	Married or in-union women of reproductive age who have their need for family planning satisfied with modern methods (%)	UNDESA; WHO	2011 - 2017	9 / 188
	At least basic, improved drinking water source (% of population)	WHO-UNICEF	2013 - 2017	0 / 188
	At least basic, improved sanitation facilities (% of population)	WHO-UNICEF	2010 - 2017	2 / 188
	<i>Aggregated indicator: UHC - Access to essential health services</i>			1 / 188
Universal health coverage (UHC) - financial protection	General government expenditure on health as a % of total government expenditure (%)	WHO	2014	1 / 188
	Out-of-pocket expenditure on health as a % of total expenditure on health (%)	WHO	2011 - 2017	3 / 188
	<i>Aggregated indicator: UHC - Financial protection</i>			1 / 188
Undernutrition	Prevalence of undernourishment (% of population)	FAO	2017	28 / 188
Age dependency ratio	Age dependency ratio (% of working-age population)	WorldBank	2011 - 2018	6 / 188
Remittances	Personal remittances, received (% of GDP)	WorldBank	2000 - 2018	2 / 188
Dependency on primary sector	Agriculture, value added (% of GDP)	WorldBank	2006 - 2018	0 / 188
GINI Index	GINI-Index	WorldBank; CIA-Factbook	2003 - 2018	25 / 188
GDP per capita	GDP per capita, PPP (current international \$)	WorldBank	2011 - 2018	2 / 188

Susceptibility (environmental factors)				
Factor	Indicator	Source	Year	Missing
Soil fertility	Mean soil organic carbon stock (t/ha)	GSOmap (FAO)	2019	0 / 188
Baseline water stress	Freshwater withdrawal rate as % of total renewable water resources	Aquastat (FAO); WorldBank	2000 - 2019	11 / 188
Water quality	<i>No indicator available</i>			

Susceptibility (infrastructure-related factors)				
Factor	Indicator	Source	Year	Missing
Access to electricity	% of the population with access to electricity	WorldBank	2017	0 / 188
Housing quality	Population living in slums (% of urban population)	UN-HABITAT	<i>Insufficient data</i>	
Quality of transport infrastructure	Quality of road infrastructure	World Economic Forum (Global Competitiveness Index)	<i>Insufficient data</i>	
Access to information (ICT)	% of households with access to one of the following: radio, TV, mobile phones, internet access (max. value of the four used)	ITU	2015 - 2019	0 / 188
	Individuals using the internet (% of population) – for imputation	International Telecommunication Union	2004 - 2018	0 / 188
	Mobile cellular subscriptions (per 100 people) – for imputation	International Telecommunication Union	2015 - 2018	0 / 188
	<i>Aggregated indicator: Access to ICT services (% of households)</i>			0 / 188

Table 4: Vulnerability indicators (lack of coping capacity sub-component)

Lack of coping capacity (individual level)				
Factor	Indicator	Source	Year	Missing
Financial buffer capacity	Saved any money in the past year, income, poorest 40% (percentage ages 15+)	World Bank (Global Findex)	2014 - 2017	40 / 188
	Coming up with emergency funds: possible, income, poorest 40% (% age 15+)	World Bank (Global Findex)	2014 - 2017	40 / 188
	<i>Aggregated indicator: Financial buffer capacity</i>			40 / 188
Insurance coverage (micro-schemes)	Total micro-insurance coverage ratio (%)	Microinsurance Network	<i>Insufficient data</i>	

Lack of coping capacity (national level)				
Factor	Indicator	Source	Year	Missing
Access to health services	# hospital beds (per 1000 pop.)	WHO; WorldBank	2004 - 2015	3 / 188
	Density of physicians (total # per 1.000 pop.)	WHO	2001 - 2018	1 / 188
	<i>Aggregated indicator: Access to health care</i>			1 / 188

Availability of emergency services	<i>No indicator available</i>			
Insurance coverage (macro-schemes)	Membership in the Sovereign Catastrophe Risk Pools CCRIF, ARC, PCRAFI, SEADRIF	CCRIF; ARC; PCRAFI; SEADRIF	2020	0 / 188
Contingency funds	<i>No indicator available</i>			

2.3 Readiness for insurance solutions

Table 5: Readiness indicators

Readiness for insurance solutions (individual)				
Factor	Indicator	Source	Year	Missing
Financial literacy	Access to account or mobile money service, income, poorest 40% (% ages 15+)	World Bank (Global Findex)	2011 - 2017	35 / 188
Trust	<i>No indicator available</i>			
Risk awareness	<i>No indicator available</i>			
Readiness for insurance solutions (enabling environment)				
Functioning of government	Functioning of government	Economist Intelligence Unit	2019	24 / 188
Readiness for insurance solutions (insurance industry)				
Number of primary non-life insurers	No. of competitors (non-life)	Axco Insurance Information Services	2011 - 2019	22 / 188
Market concentration	Market concentration of up to top 5 (%)		2014 - 2020	38 / 188
Placement by brokers	% of Non-Life Broker placement		<i>Insufficient data</i>	
Insurance premium volume	Total (in mn USD) inc. PA and healthcare		2011 - 2019	20 / 188
Market penetration	Market penetration		2011 - 2019	20 / 188

3. UPDATES IN THE 2020 VERSION (INDICATORS)

In contrast to previous editions, the 2020 version of the InsuRisk Assessment tool takes into account all countries at the global level. For this reason, all indicators have been expanded to include countries previously not considered and updated to the latest available data (cut-off date for data collection: April 2020). Therefore, even indicators for which no update was available since the last version of the tool (2018) may present different ranges, thus resulting in modified scores after data treatment (see section 4 of the annex). Having global coverage allows not only comparing the relative patterns across SIDS, but also comparing their risk and readiness levels in the global picture.

Data sources for the following indicators were changed in order to obtain higher data coverage and/or enhance their adherence to the factor represented:

- Breadth of Social Protection: Proportion of population covered by at least one social protection benefit (%): data obtained from the International Labour Organization (ILO) (previously World Bank –ASPIRE)
- Access to account or mobile money service, income, poorest 40% (% ages 15+): the indicator takes into consideration access to accounts for the poorest 40% of the population aged 15 or above (previously only for population with secondary education or more)
- Membership in the Sovereign Catastrophe Risk Pools: the Southeast Asia Disaster Risk Reduction Facility (SEADRIF) was added.

The following indicators were dropped because of high percentage (>25%) of missing data at the global level (188 countries) (see section 4 of the annex):

- Population living in slums (% of urban population)
- Quality of road infrastructure
- Total microinsurance coverage ratio (%)
- % of Non-Life Broker placement

Two indicators from the 2018 version were dropped following modifications to the conceptual framework of InsuRisk Assessment tool: *Total renewable water resources per capita* and *% of the cultivated area equipped for irrigation*.

Contrary to previous versions of the tool, indicators for the component *Readiness for insurance solutions (insurance industry)* were included in the dataset without regional calibrations and reclassification, in order to allow for a wider range of variability between countries.

4. KEY METHODOLOGICAL STEPS

The InsuRisk Assessment tool builds on a modular design, where the different indicators are aggregated into their respective sub-components (e.g. susceptibility and lack of coping capacity) and components (e.g. climate and disaster risk, readiness for insurance solutions) using an index-based approach. Components and sub-components can be combined in multiple ways. This enables users such as governments, insurers and researchers to select and access the required information based on their respective interests. Index scores for each component and sub-component were derived pursuing a composite indicator approach comprising the following key steps: (1) definition of the conceptual framework; (2) identification of potential indicators for each component of the framework based on a systematic review of literature, expert consultations, and selection criteria (e.g. relevance, validity, etc.), (3) acquisition of data for each of the identified

indicators, (4) data transformation (e.g. absolute into relative values), (5) analysis and imputation of missing data, (6) outlier detection and treatment, (7) normalization, (8) assessment and reduction of potential multicollinearities, and (9) weighted aggregation of indicators. For the 2020 InsuRisk Assessment tool, data was acquired from reliable and publically available sources (open source) focusing on datasets with global coverage (see tables on indicators and data in section 2 of the annex).

For the hazard exposure component, the spatial assessment for 2020 includes several methodological developments next to extending the hazards list and updating the dataset of the exposed elements: (i) people, (ii) agricultural land, (iii) GDP grids, and (iv) infrastructure located in potentially hazard-prone areas. The data sets were updated to ensure maximum global coverage. Moreover, heat and cold waves hazards were added. For the integrated snapshot assessment, typical return periods of 50 years across all the climatic-related hazards and 475 years for earthquakes hazard were selected. Furthermore, the processing workflow for the exposure calculation was optimized in order to reduce the double-counting (overlap) of the exposed elements among the considered hazards (e.g., drought exposure is now restricted to the agricultural lands).

For the vulnerability and readiness components, the percentage of missing data was assessed at both the indicator level (i.e. for each indicator, the ratio of countries with missing data on the total number of countries considered) and at the country level (i.e. for each country, the ratio of indicators with missing data on the total number of indicators considered). In order to ensure comparability and coherence of results, thresholds were set to drop indicators and countries that presented values of missingness too elevated, following recommendations and practices derived from index construction literature. For indicators, the threshold was set at 25% (i.e. indicators with higher ratios were excluded from the analysis), leading to the exclusion of four indicators (see paragraph 3); for countries, the threshold was set at 35% (i.e. countries with higher ratios were excluded from the analysis), leading to the exclusion of six countries (Andorra, Liechtenstein, Monaco, Democratic People's Republic of Korea, San Marino, Somalia) from the original 194 considered. For each indicator, potential outliers in the data were analyzed by assessing skewness and kurtosis as parameters for normal distribution. Indicators that exceeded fixed thresholds (skewness > 2; kurtosis > 3.5) in one of the two parameters were classified as potential outliers. Identified outliers were treated using a winsorization approach, i.e. by an iterative replacement of the highest/ lowest with the second highest/ lowest indicator scores. Data was normalized for all indicators using linear min-max normalization based on global minimum and maximum values. This approach allows for changes in the selection of the target countries while ensuring that the index scores of the individual countries do not change. The outcome are re-scaled indicator scores in the range between zero and one [0-1]. Where necessary, the direction of the indicator was adjusted during the normalization process to ensure that all indicators 'point' into the same direction (e.g. high scores always contributing to increased vulnerability and exposure). Potential multicollinearities (or redundancies) in the data were analyzed using Spearman's correlation coefficient (with $r > 0.9$ indicating multicollinearity). Equal weights were applied when aggregating the indicators into sub-components (e.g. socioeconomic vulnerability) and when aggregating sub-components into components (e.g. climate and disaster risk). The following aggregation methods were used:

Compared to the other elements, for the aggregation of the *Overall readiness for insurance solutions* a higher tolerance of missingness was applied, allowing the representation of the component with up to 2 out of 3 sub-components - i.e. readiness for insurance solutions (individual); readiness for

insurance solutions (enabling environment); readiness for insurance solutions (insurance industry) – presenting missing data.

For *Hazard exposure*, an aggregated exposure was calculated for each type of exposed element (i.e. population, agricultural land, production facilities, and infrastructure) based on the applicable hazards. Subsequently, the resulting four exposure scores were aggregated by mean of arithmetic aggregation into an overall score, which was then normalized (using min-max normalization) to obtain the final overall exposure score.

5. ESTIMATION OF DATA RELIABILITY/VALIDITY

5.1 Hazard occurrence

The following table reports the complete overview of hazard occurrences in SIDS countries as estimated by 2020 InsuRisk Assessment tool and the recorded events obtained by the EM-DAT database. Cell colors indicate whether a hazard was i) only detected by the InsuRisk assessment tool (yellow shading), therefore indicating a possible overestimation in the current assessment; ii) only detected by the EM-DAT database (blue shading), therefore indicating a possible underestimation in the current assessment; iii) detected in both databases (gradient shading), therefore indicating a match between the sources.

Table 6: Hazard occurrence based on global data vs data from the EM-DAT events database

		Cyclones	Storm surges	Flood	Drought	Earthquake	Cold spells	Heat waves
Atlantic, Indian Ocean and South China Sea (AIS)	Bahrain							
	Cabo Verde							
	Comoros							
	Guinea-Bissau							
	Maldives							
	Mauritius							
	Sao Tome and Principe							
	Seychelles							
	Singapore							
Caribbean	Antigua and Barbuda							
	Bahamas							
	Barbados							
	Belize							
	Cuba							
	Dominica							
	Dominican Republic							
	Grenada							
	Guyana							
	Haiti							
	Jamaica							
	Saint Kitts and Nevis							
	Saint Lucia							
	Saint Vincent and the Grenadines							
	Suriname							
	Trinidad and Tobago							
Pacific	Fiji							
	Kiribati							
	Marshall Islands							
	Micronesia (Federated States of)							
	Nauru							
	Palau							
	Papua New Guinea							
	Samoa							
	Solomon Islands							
	Timor-Leste							
	Tonga							
Tuvalu								
Vanuatu								

*** Note:** Next to the climate-related extreme events and natural hazards considered in this report (i.e., heat waves, cold spells, river floods, droughts, storms/tropical cyclones, storm surges, and earthquakes), many islands (including SIDS) are actually highly exposed to a wide array of additional slow onset events, such as sea level rise, and the associated, aggravated impact of swells, king tides, coastal erosion, and salt water intrusion. Due to the lack of comparable data across SIDS, these slow onset events are – despite their high relevance – not considered in the exposure analysis presented in this report.

5.2 Vulnerability and reliability index

The following charts show the overall level of validity at the country level for the vulnerability and readiness components of the tool by plotting the recency (i.e. average year of reference for all indicators) and completeness (i.e. percentage of indicators without missing data) of the data against each other. Countries in the upper right quadrant of the scatterplots have the highest reliability/validity in relative terms.

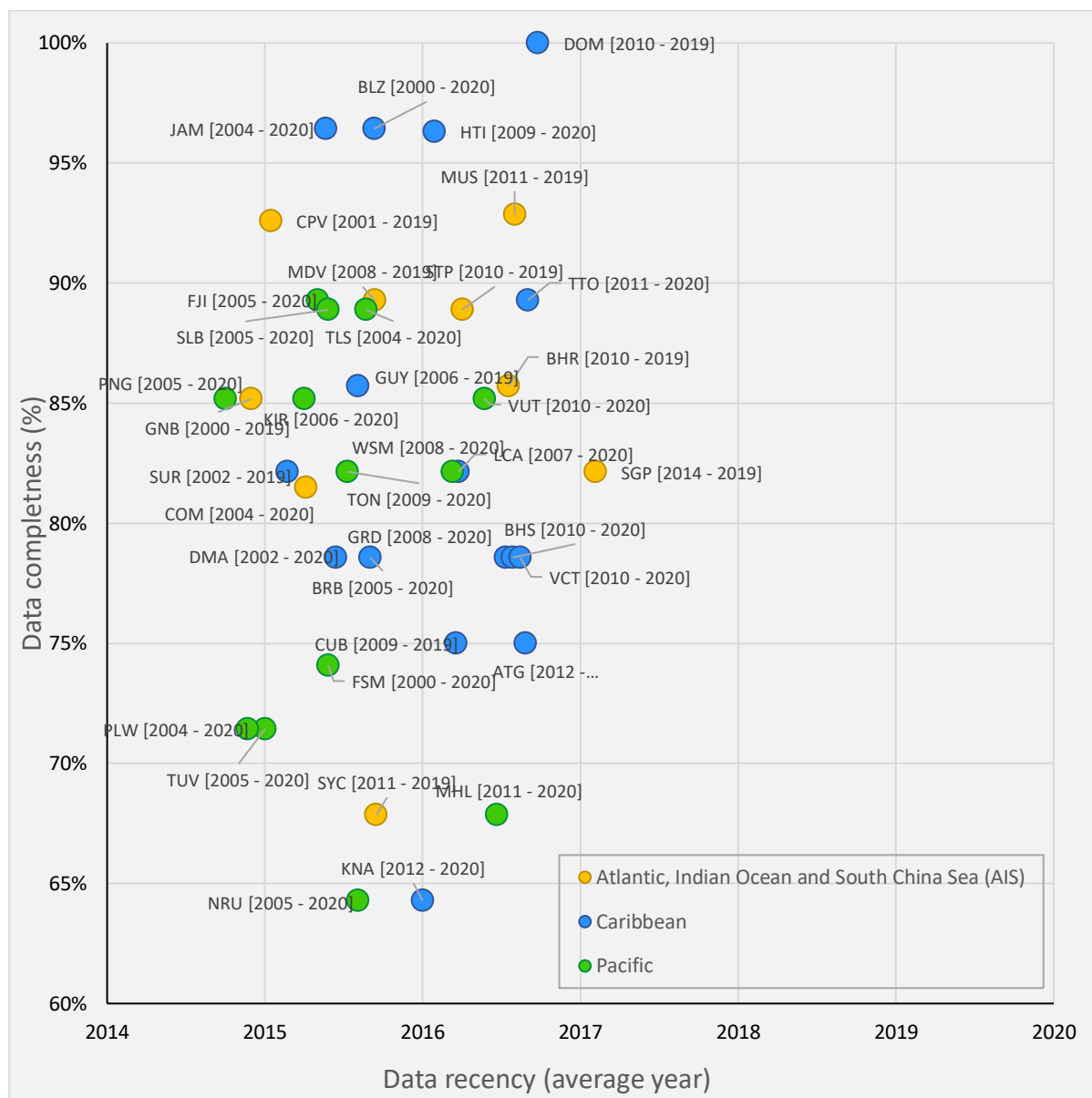


Figure 2: Data completeness vs average recency for the vulnerability component (SIDS only).

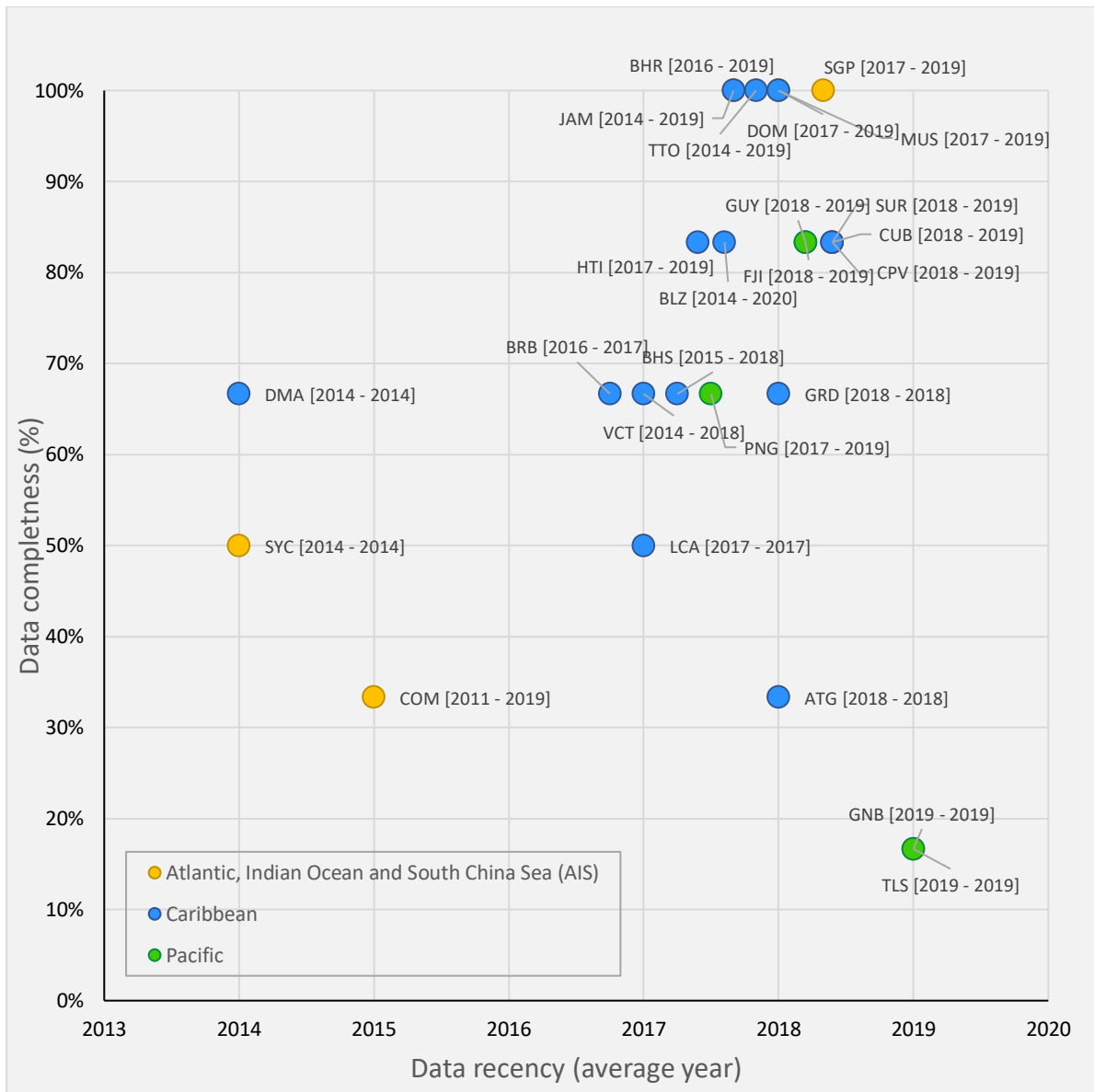


Figure 3: Data completeness vs average recency for the readiness component (SIDS only).