Climate Change Adaptation Program
Global Cities Institute
RMIT

Climate Smart Seaports [beta]

User Guidance Document

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Produced through collaboration between
RMIT University Climate Change Adaptation & e-Research Programs

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FROM THE AMERICAN PEOPLE

Contents

1. Introduction

The risk from the impact of climate change differs according to the location, function and business model of a port. Climate Smart Seaports in the Pacific need to understand the relevant climate impacts and risks for their particular assets and operations; only then can they determine what adaptation measures may be most appropriate.

The Climate Smart Seaports-Pacific Tool [beta] is designed primarily for port personnel who make (or influence) decisions around long-term port planning for infrastructure, assets and management systems. However, it will also be of value to other related businesses, government departments, local authorities concerned with ports and infrastructure, and the research community.

The CSS-Pacific Tool facilitates the collection of information so ports are able to identify their current and future climate risks. It is designed to generate material for the scope and context setting stages of the ISO 31000 risk management standard. It is also compatible with other guides such as ISO 14001 environmental management system standard and the initial stages of Engineers Australia's Guidelines for Responding to the Effects of Climate Change in Coastal and Ocean Engineering

The climate change impacts that Pacific Island National ports will experience vary significantly depending upon their location, surrounding geography and the nature of the business. Impacts can be directly climate related, such as infrastructure damage caused by storms, workflow interruptions due to extreme temperatures or heavy rain on site. Alternatively, impacts can be indirect such as interruptions to supply chains caused by damaged rail or road infrastructure or disruptions to production at suppliers' sites. These impacts can potentially extend beyond the nations' island boundaries. For example, 'the millennium' drought in Australia through the 2000s affected wheat and rice exports which lead to some island nations having to import more expensive rice from other countries. The same drought affected the sugar industry in Fiji lowering the exported tonnage.

Projected climate impacts in certain regions are likely to have only minor direct impacts on the port. For other ports, damages may be economically significant; or else lead to insurance cost increases, lost business, or changed port trade. Understanding the impacts and risks allows port decision-makers to put in place appropriate measures, rather than being caught by surprise or being left behind by competitors. This CSS-Pacific Tool enables ports to undertake some of the relevant data gathering and context-setting steps to help assess their climate change exposure and risk.

This guidance document supports the browser-based CSS-Pacific Tool, providing more in-depth discussion of issues, as well as the necessary technical assistance. After providing a broad overview, the guidance describes each function, taking users through each of the relevant data tabs including; current and future climate and marine data, non-climate data, as well as applications - in the form of questionnaires or tables – that are designed to support port personnel in gaining a better understanding of climate risks across all aspects of the business. Finally, the guide explains how the user can create and manipulate their own data summary, and report for public viewing (if desired).

It should be stressed; this is the first step in undertaking a climate risk assessment. Direction is provided in this guidance document for subsequent steps that ports can take to complete a formal risk assessment, however, while the browser-based tool provides useful support information; it does not perform this function. Knowledge about adapting to climate change is still in its early stages and all organisations are learning how to better manage climate risks. Communication is a key aspect of building adaptive capacity. The CSS-Pacific Tool supports users to publish via reports to the Climate Smart Seaports-Pacific site, promoting peer-to-peer learning, and the spread of knowledge. Climate change poses risks to all areas of a business. This Tool provides a platform for integrating multiple sources of data and knowledge relevant to different areas of the business into one report, acting as a stimulus for more holistic and integrated climate risk assessment.

2. CSS-Pacific Tool Overview

The CSS-Pacific Tool [beta] may be used by port personnel as part of ongoing risk assessment and / or internal capacity building activity. It can assist in framing the scope and context for a port's future climate risk assessment. It is divided into four core activities. These are:

- **Set scope and purpose**: describe "why you are using the CSS-Pacific Tool" and "what you are investigating".
- **Add content and analyse**: choose data to support the assessment and add comments and analysis. Data available includes:
    - Observed climate and marine data
    - Future climate and marine data
    - Non-climate contextual data

  Applications (in the form of questionnaires and tables) can be downloaded to support:
    - Analysing port responses to extreme weather events in the past,
    - Collating the perceptions of different business areas of current port vulnerabilities to extreme weather events
    - Providing a port priority rating for future climate-related impacts
- **Design Report**: create a report from the chosen data and applications and add port-specific images or information
- **Publish Report**: preview then print the report, save as a PDF for internal purposes, or choose to publish it online.

The CSS-Pacific Tool allows the user to progress through each of these activities, selecting data parameters that are relevant to their port and their climate risk enquiry. Users can also choose to add further port-specific data as required and add additional analysis if desired. The logical workflow for a user is illustrated below (Fig 1).

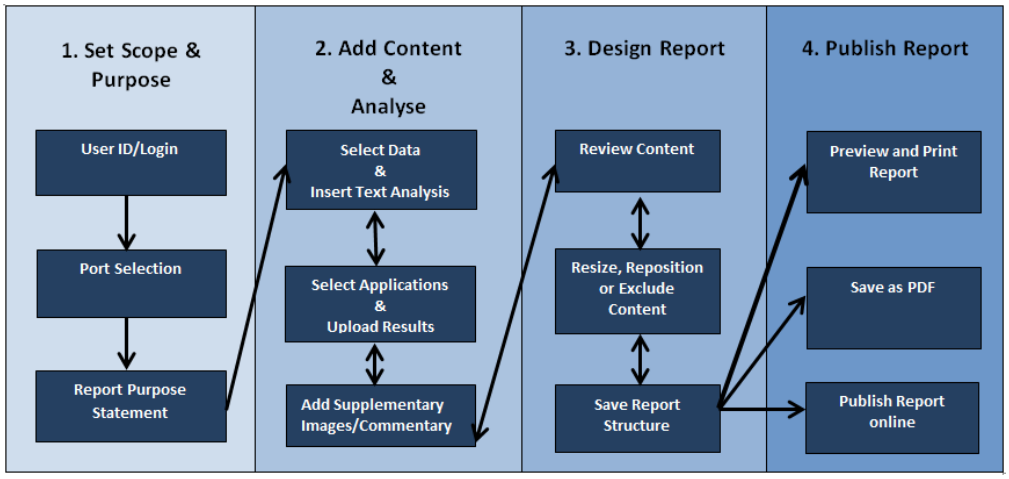


Figure 1: Climate Smart Seaports-Pacific User Workflow

The CSS-Pacific Tool is agile and it is possible to move freely within and between steps 2, 3 as the Report generated remains available to the user to re-edit after a version has been printed or published (note: the published version cannot be changed).

Step 1. Set Scope & Purpose

User ID/Login

Users Sign Up and Login.

This stage allows a User to create an account. Users fill in the SIGN UP form providing name and email address. An account will be created automatically. Once this account is created, Users are able to log-out and log back into the portal, where work and data selection will be securely saved. These

details will only be used to identify the owner of a report that is published online. The site will be monitored for mischievous use and any report published that is defamatory will be removed, as well as the account that created it.

Port Selection
When users first login, they are directed to create a new report.
This is where the user defines the geographic scope and purpose/context of the assessment. The geographic scope is determined by the island regions, which are graphically represented on this map (see Figure 2: Island Regions). Users select the region they wish to focus on by clicking on that region. Users then select a particular port in that region from a drop-down box.
This proof-of-concept version of the Tool incorporates data for two regions; Fiji and PNG.

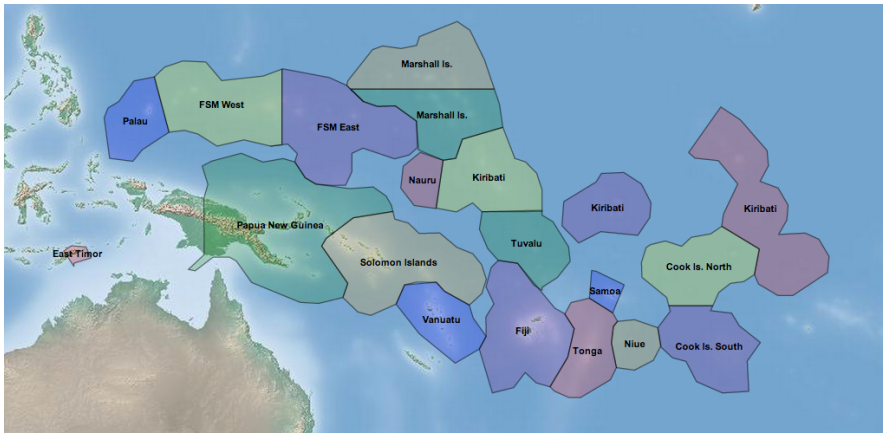


Figure 2: Island Regions

Report Purpose Statement
The Login phase also asks users to nominate their purpose; for example, for research, for supporting a work-related climate risk assessment, for internal capacity building, and supporting decisions related to adaptation. Clarifying this purpose will help focus the report and choice of data, leading to clearer adaptation decision-making.

Section Headings
At this stage it is possible to choose to create pre-formatted headings in the report, with the same wording as the content tabs ie: 'Observed Climate and Marine', 'Future Climate and Marine' and 'Non-Climate Context'. The headings can be changed in the final structuring of the report.

Step 2. Add Content & Analyse

Select data, insert text analysis and add your own files

Users can select data to insert in a Report using the ADD DATA function.

Users can also write their own commentary about the chosen data using the ADD TEXT function.

Users can add supplementary images or external data using the ADD FILE function. Users can import relevant pictures or data from the port's data base to further customise a Report.

Content

The CSS-Pacific Tool has a number of tabs to progress through. The first three tabs cover the data available for a Report and include: (i) Observed Climate & Marine; (ii) Future Climate & Marine; and (iii) Non-Climate Context.
The fourth tab called (iv) Applications provides questionnaires and downloadable tables that can be used to increase the port's understanding of its climate risks and vulnerabilities. Users can access these using the ADD DATA function. They can be downloaded and used in a workshop setting to incorporate valuable knowledge held by port employees. This important 'internally generated' information gained can then be uploaded to appear in a report.
These applications are also available under the observed and future climate and marine data tabs for ease of use.

Tab (i). Observed Climate and Marine Data includes data publicly available from the Bureau of Meteorology (BoM), the CSIRO and the Fiji Meteorological Service. It sets the historical and current context for the chosen Island region for climate variables (including temperature and rainfall) and ocean trends (average sea level changes over time). Refer to Section 3.3.1 for more detail.

Tab (ii). The Future Climate and Marine Data section provides climate projections, selected using data from the CSIRO Pacific Climate Change Science Project, for the different Island regions. Users select one of three different time frames (2030, 2055, 2070), and investigate two climate variables (temperature, rainfall). Drawing on global climate models a low, medium and a high emissions scenario are available, representing changes from a 1990 base line. Data related to sea level rise can also be selected. Refer to Section 3.3.2 for more detail.

Tab (iii). Non-Climate Data refers to social and trade data in the region of the port. This section displays demographic data from the World Bank and trade (import and export) data for Fiji from Fiji Statistics. Refer Section to 3.3.3 for more detail.

Tab (iv). Applications include aids to help ports understand their past responses to extreme weather events, their perception of current port vulnerability to all extreme weather events and their priority rating for dealing with future climate impacts. Refer to Section 3.3.4 for more detail.

Step 3. Design Report

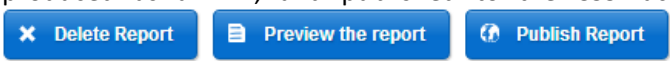
Review content
Users can review all chosen content: data, text, applications, graphs, images etc.
Users may decide to go back to any of the tabs and add more data, or choose to delete chosen data at this stage. Users can also choose to keep elements for later Reports but "hide" them and they will not appear in the active Report. Users can also add more commentary or create headings to structure the Report.

Resize, reposition or exclude content
Users can adjust the sizing of each element – data, text, file – from 100% (full page width) to 50% (or 2 column width) from the drop-down menu provided. Users can change the order of the data within each of the data TABS by dragging the element (using the header of the element 'box') and dropping it into the desired place. Click SAVE ORDER will then save the data in this new order

Save report structure
The Report will automatically be saved.
Saving is necessary after changing the position of each of the chosen elements during the design stage

Step 4. Publish Report

Preview and print report
Users can preview the report to see how it looks, and go back and adjust it or add new data and subtract existing data.
When Users are happy with everything the report can be printed (through the PREVIEW function), produced as a PDF, and published to the CSS-Pacific website to make it publicly available



A Published Report is a snapshot of the current state of a report. Users can keep editing the report stored in MY REPORTS (and create other publications using this report) however the published snap shot will not change. Users can also delete a published report without deleting the original.
The PUBLISH function stores the final report on the Climate Smart Seaports-Pacific site, to provide a growing repository of information and knowledge about climate change adaptation for peer-to-peer learning. Published reports are searchable and readable by anyone (even people who don't have an account).

3. The Climate Smart Seaports – Explained in detail

3.1 Getting Started

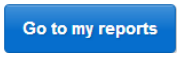
User ID/Login

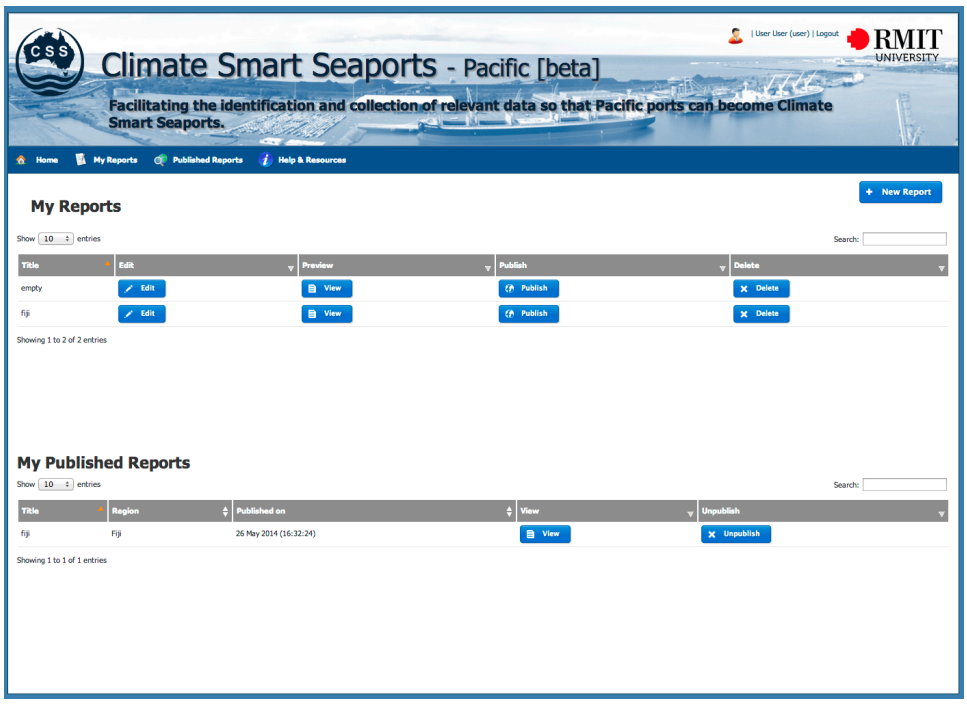
First time Users will use the SIGN UP function.
Users fill in the SIGN UP form to create an account (including name and email address). An account will then be automatically created.
This account will only be used to identify the user, if needed. The site will be monitored for mischievous use and any report published that is defamatory will be removed.

Click on "Get started" to log in and start.

Once registered Users enter through the LOG IN function.

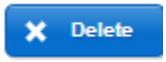
This will take Users to



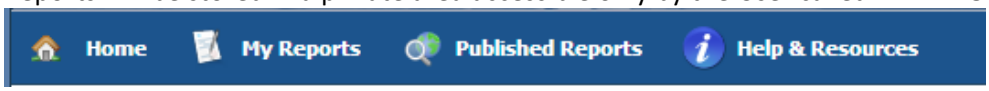


Use  to start the process of creating a Report

If Users have a Report saved the following options are available:



Reports will be stored in a private area accessible only by the User called MY REPORTS



Once logged in Users can move between these 4 areas.

HOME	goes to the front page
MY REPORTS	goes to a User's collection of reports (all available for further editing)
PUBLISHED REPORTS	goes to all reports that are publicly available (this can be accessed without logging in)
HELP & RESOURCES	goes to video help, the Downloadable Guidance and Resources (this can be accessed without logging in)

3.2 Scope & Purpose

Each report will benefit from a clear definition of its contextual scope and purpose. The user defines the geographic scope by selecting a region from an interactive map.

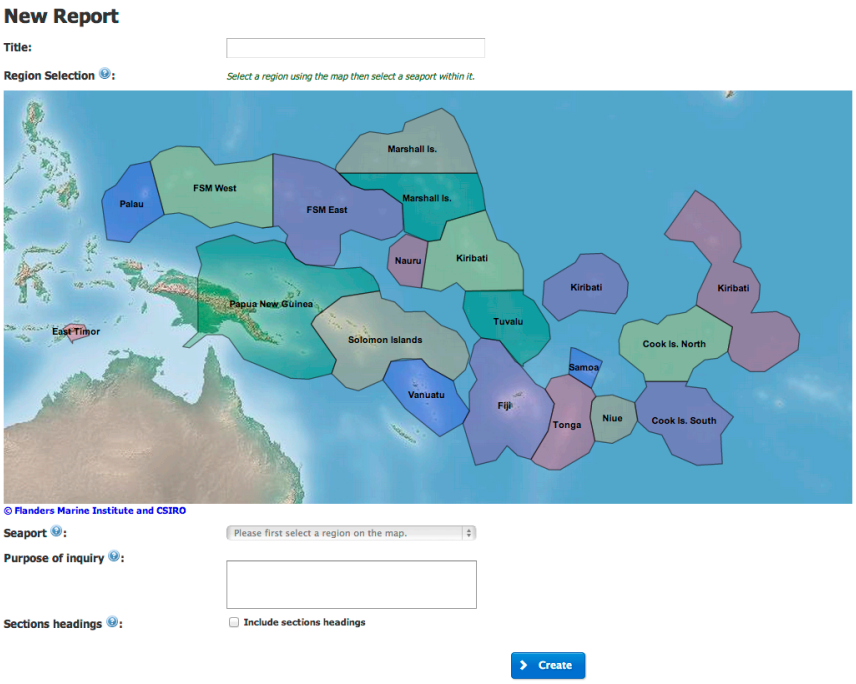


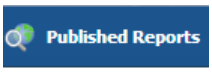
Figure 3: Island Regions

Users then select a particular port in that region from a drop-down box.

This proof-of-concept version of the CSS-Pacific Tool incorporates data for two regions; Fiji and PNG.

Purpose of Inquiry

What is the aim of this report; for example, for research, for supporting a work-related climate risk assessment, for capacity building, and supporting decisions related to adaptation options. Clarifying this purpose will help focus the report and choice of data.

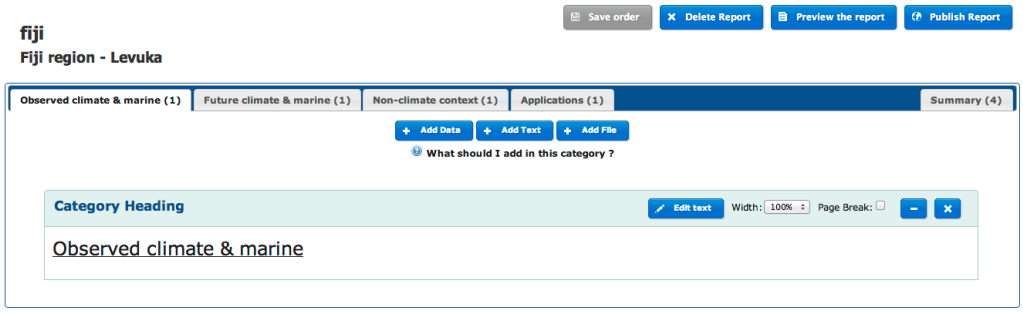


It is possible to use the CSS-Pacific Tool to create more than one report. See PUBLISHED REPORTS for examples and templates of different reports.

Section Headings

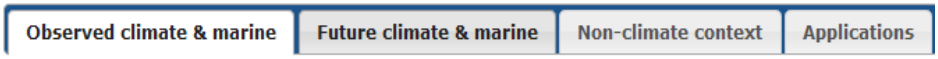
It is possible at this point, to choose to create pre-formatted headings in the report. Users click the SECTION HEADINGS function to create headings. These headings will have the same wording as the content tabs i.e.: 'Observed Climate and Marine', 'Future Climate and Marine' and 'Non-Climate Context'. The headings can be changed in the final structuring of the report. All data chosen from a specific tab will appear underneath the related heading.

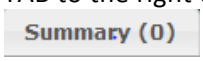
3.3 Add Content & Analyse

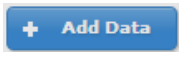


Adding content

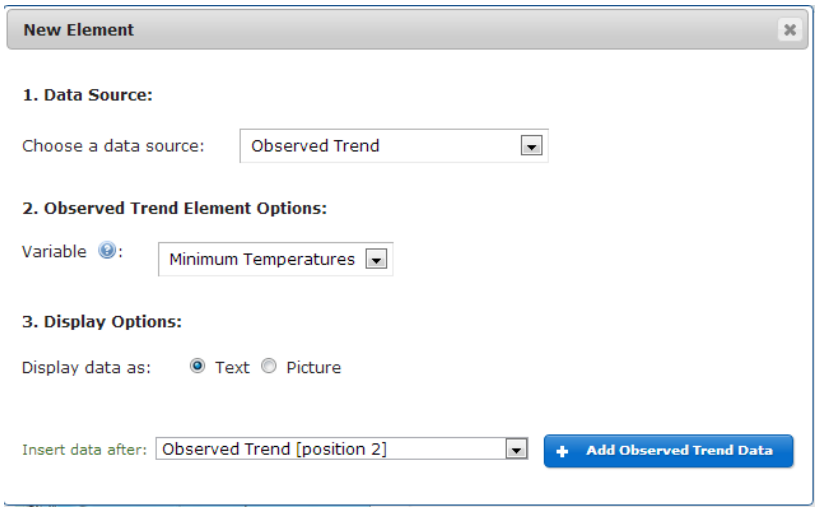
1) To add data to a Report, select the appropriate TAB. Choose from Observed Climate & Marine, Future Climate & Marine, Non-Climate Context, or Applications. Although it is logical to move from left to right, Users do not need to add data in any particular order.



2) Chosen content from each of the TABS are displayed on both the individual TAB, as well as collated in the Summary TAB to the right of the screen: the (bracket) displays the number of data elements collected. 

3) To add data: select 

Choose data source from the dropdown box
Choose variable
Choose display option (this option can be changed later)
Choose the ADD function



ADD more than one data element by repeating this process

4) ADD analysis or comments through the ADD TEXT function, and add images or external data through the ADD FILE function 

3.3.1 Observed Climate and Marine

Data background

Climate variability can translate into extreme events. However, climate change will influence the frequency and intensity of such events into the future. This section sets the historical and current context of climate and marine observations for seaports. It draws on data publicly available from the Bureau of Meteorology (BoM), the CSIRO and the Fiji Meteorological Service. It sets the historical and current context for the chosen Island region for climate variables (including temperature and rainfall) and ocean trends (sea level changes over time).

Current and historical weather trends and extreme weather events

As the basis for undertaking a climate risk assessment, ports should first consider their current and historical exposure to changing weather patterns and extreme weather events. Two types of data have been selected to assist with this understanding:

- observed trends for temperature, rainfall and sea level;
- specific weather station data (where available) providing return periods measured in years for some extreme climate variables (heat, rain, wind, sea level).

All data have been chosen to support the data sourced for the Future Climate section, however it is important to note that the Future Climate is based on modelled data and is not directly comparable to the ***actual*** data sourced in this section.

Data are not presented for specific ports. It is presented either on the regional scale, or according to the location of specific weather stations.

Each port will have knowledge of past weather events that have affected operations or infrastructure. This information would be a useful addition at the analysis stage. Identifying a threshold beyond which a climate event will cause disruption is a useful way to think about climate risks. For example, in many workplaces personnel are required to stop working outside once the temperature reaches a certain number of degrees, and cranes cannot operate beyond a certain wind force. If the number of hot days increases or the number of windy days decrease, this will affect port operations.

Regional climate trends

The trend tables and graphs show how temperature or rainfall has changed over time. They need to be interpreted with caution. Trend values are evened out, but the actual change indicated may not have been gradual. The trend values use past observations and cannot show the rate of future change.

This data is useful for ports to understand their current operating context, before considering how the operating context may alter under changed climate conditions in the future. Many of the climate impacts to be felt in the future are related to increasing intensity of existing climate hazards ie: more intense rainfall or more hot days.

Global and Regional Marine Trends

As with the trend graphs for temperature and rainfall, the graphs and tables depicting sea-level change show how sea levels have changed over time. Past trend observations cannot be used as a predictor of the rate of future change. Sea level rise does contain regional variation, largely due to differences in the warming of the ocean waters around the coastline. Each port may have its own records of sea levels over time. This information would be useful to add to a Report at the analysis stage.

The sea-level data includes a graph of global sea-level rise measurements that includes aggregated data from local tide gauges and satellite images. Where available more specific data from relevant local tide gauges and reconstructed historical records have been included.

Globally, average sea levels have risen more than 200mm since 1880 (fig. 4).

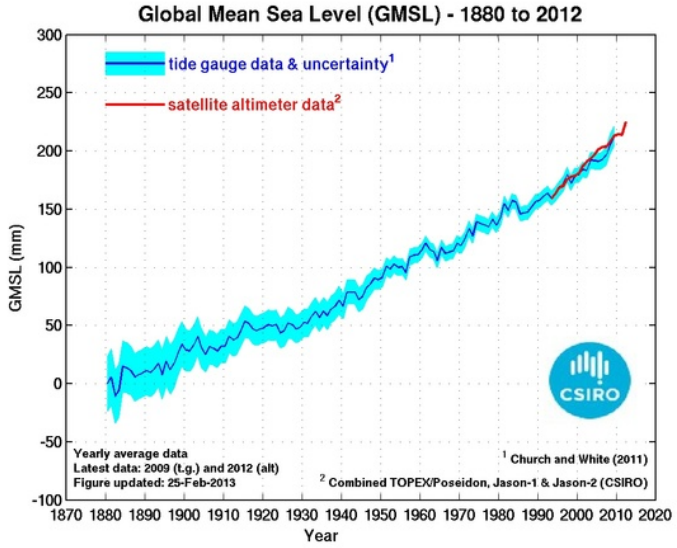


Fig 4 Global mean seal level 1880 – 2012 (Source: CSIRO)

More information can be found at:
CSIRO and BoM Pacific Climate Futures website
BoM Climate & Ocean Support Program in the Pacific
CSIRO Marine and Atmospheric Research website

For the applications available here see (3.3.4)

3.3.2 Future Climate and Marine

Data background

This section assists ports to identify some future climate projections relevant for their region. It provides information from the InterGovernmental Panel on Climate Change (IPCC) Scenarios, which underpin scientific modelling of future climate. Additionally, it explains what global climate models are, and how they are used.

IPCC Scenarios and Global Climate Models

Modelling future climate change requires an estimation of the concentrations of greenhouse gases and other substances in the atmosphere, in the years to come. The IPCC emissions scenarios describe these possible future releases of gases; the product of complex, dynamic systems, determined by factors such as population change, socio-economic development, and technological advances. The three emissions scenarios selected for the CSS - Pacific Tool are:

- B1 a low emissions future, where clean and resource-efficient technologies are employed and there is a global emphasis on economic, social, and environmental sustainability
- A1B a medium emissions future, more efficient technologies introduced and a balanced use of fossil fuel and renewable fuel sources.
- A2 a high emissions future, with less development of renewable energy sources, more a 'business as usual' story.

For more information see IPCC Special Reports

Global climate models (GCMs) are computer modelled mathematical representations of the behaviour of the planet's climate system through time. Modelling of the climate system has become possible due to increased computer power and advances are continually being made that increase the models' accuracy. The data provided uses the combined information of many different models and often the data is presented with a range of values in order to address the extent to which the models differ in their results. This provides a range of uncertainty that needs to be considered in any future adaptation planning

Climate variables and marine data

The information for this section has largely been drawn from work by the CSIRO and the Bureau of Meteorology in collaboration with Meteorological services of Pacific Island Nations. See the Pacific Climate Futures website.

For each of the Island regions, future climate projections are available for:

- Two climate variables: temperature and rainfall
- Three emissions scenarios: B1 (low), A1B (medium) and A2 (high)
- Three time periods: 2030, 2055 and 2070 (or 2090). These dates represent multi-decadal averages centred upon the stated year.

The sea level data includes global sea level rise calculations from the CSIRO. This figure (Fig 5) shows projections of global-averaged sea-level rise for six greenhouse gas scenarios to 2100 with respect to 1990 ie: after setting the level at 0 in 1990.

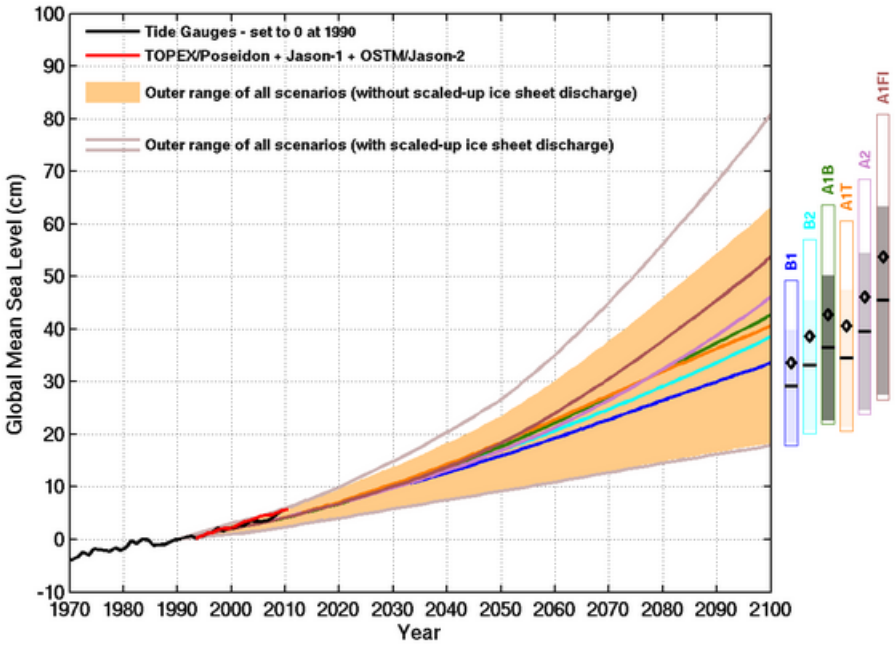


Fig 5: Projected global sea level rise to 2100 (IPCC, AR4, 2007) http://www.cmar.csiro.au/sealevel/sl_proj_21st.html

The shaded region shows the full range of projections, without ice sheet discharge. The horizontal lines/diamonds in the bars are the central values without and with the ice sheet discharge respectively. Observed sea level rise (based on tide-gauge measurements and satellite-altimeter data) are shown in black and red, respectively. The tide-gauge data are set to zero at the start of the projections in 1990, and the altimeter data calibrated to match the tide-gauge data at the start of the record in 1993.
(Source: CSIRO Marine and Atmospheric Research website)

For the applications available here see (3.3.4)

3.3.3 Non-climate context

Data background

This section identifies some of the non-climate-related context for the nominated port, and its region. It considers trade data and population data. Note that only limited data may be available, as much data is held privately by Port Authorities.

Ports and Non-Climate Data

Non-climate data helps to set the operational context of ports. It also provides a starting point for consideration of possible impacts of non-climate factors into the future.

Port authorities generally have extensive data regarding their organisation's characteristics, throughput and local context. Using the ADD FILE function allows a port to upload custom data files.

Port files that may support the development of an integrated report include: information regarding core organisational objectives and/or current risks; graphic depictions of the port system and its assets; spatial representations of the port; key information about the port operations (see Figure 6 and Figure 7); data on throughput volume trends; or, the types of activity that characterise the port.

Fig 6: Fiji Ports - Port of Suva from http://www.fijiports.com.fj/port-of-suva/

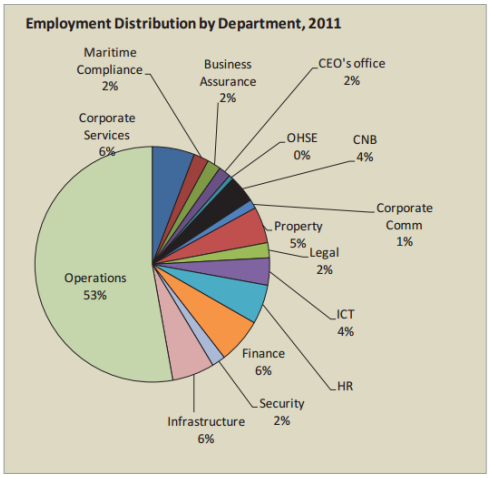


Fig 7: PNGPorts - Employment distribution from PNG Ports 2011 Annual Report
http://www.pngports.com.pg/docs/Annual-Reports/PNGPCL-2011-ANNUAL-REPORT(web-version).pdf

Two publicly available non-climate data sets are available in this tab. These are population trends derived from the World Bank and trade (import and export) derived from island nation statistics offices. Refer to Section 6: Limitations for a discussion of data limitations.

Data on Urban Pressure has been sourced from the World Development Indicators of The World Bank 2012 (based on United Nations World Population Prospects). These figures show national population trends over a ten year period. In the future, population growth will affect the ports in direct and indirect ways. The most obvious of the direct impacts will be an increased throughput of goods through container ports to meet the increased demands of a growing population. However increasing population also invites a discussion on the ability of urban ports to retreat from slow-onset sea-level rise impacts if they are surrounded by a growing city.

Freight data for Island ports was beyond the current reach of this CSS-Pacific Tool. Broad national data is available for Fiji and PNG; however ports will have their own trade data that will be of great use here.

As urban populations increase, ports in urban centres will find expansion capacity limited. Capacity constraints will also be felt through increasing pressure on transport infrastructure. Additionally, population growth may create pressure on other forms of critical infrastructure such as energy generation and distribution and water resources, which may then have cascading impacts on port operations under changes to extreme climate events.

For the application available here see (3.3.4)

3.3.4 Applications

Adapting to climate change will be different for each port; determined by a port's operations, geography, current exposure to climate impacts, its tolerance of risk and its stated vision. Adaptation depends on understanding the risk that the port is facing now from the climate and looking at what might happen to the climate in the future. This can be most effectively done by incorporating the experiences and knowledge of port personnel.

A selection of applications is provided to help a port harness the knowledge that already exists. They provide a sequence from past actions to present knowledge and future possibilities.
Three applications (in the form of questionnaires and tables) can be downloaded to support:

1) *Past Climate Impact Description*: analysing port responses to extreme weather events in the past
2) *Current Climate Vulnerability Assessment*: Collating perceptions of current port vulnerabilities to extreme weather events
3) *Future Climate Risk Assessment*: providing a port priority rating for dealing with future climate impacts

These applications aim to improve a Port's understanding and framing of risk from climate change, providing a decision-support framework for action. If a chosen action involves a major investment a port will need further work beyond the scope of this CSS-Pacific Tool. The applications are downloadable as they are exercises better done in a group/workshop environment than by a single user.

When considering the impacts of climate change, the term vulnerability represents exposure to a particular climate variable combined with the level of sensitivity to that variable, or the degree of impact. The "Observed Climate" tab provides the context for ports to consider their current exposure to extreme events, while the "Future Climate" tab looks at potential future exposure. Ports are a combination of 1) hard infrastructure, 2) management systems and procedures and 3) the workforce. It could be any one, or all three, of these elements that are impacted by climate change. The following figure represents the common components of a port system, and relevant climate variables likely to impact the port.

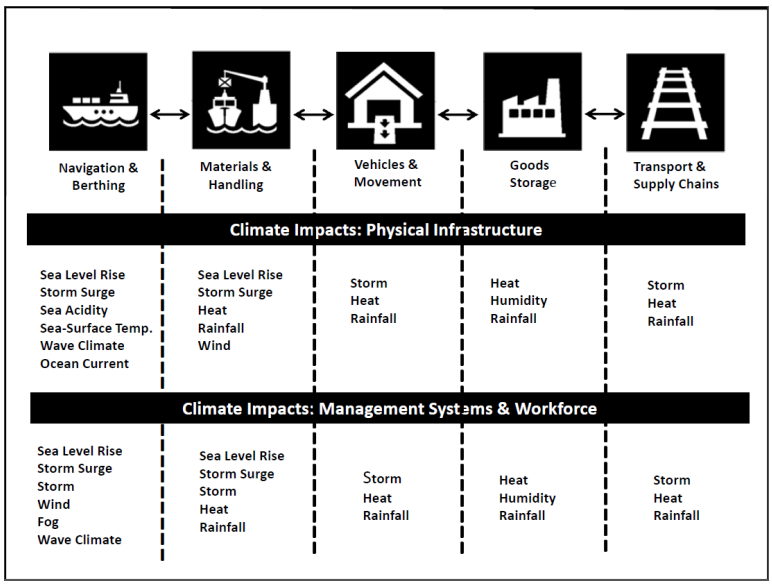


Fig 8: Components of a port system vulnerable to different climate impacts

Past Climate Impact Description

This application looks at how a port has dealt with extreme climate events in the past. It provides a visual representation and process that allows for port personnel to discuss: what climate impacts have been dealt with; how personnel have responded; and how the management of these future risks could be improved.

How the port dealt with past events can be an indication of how well it will cope with future climate change. If its infrastructure does not cope with extreme events now (for example, the drainage system cannot manage heavy rainfall and flooding events), then it will not be able to cope in the future if these events may become more intense. If management systems and processes are lacking now, then changes need to be made to the system to integrate future climate impacts, and the workforce (management and frontline staff) need to understand climate change and its consequences in order to influence change.

Select one climate-related event for each time users complete this application. Users can run through the application multiple times, to cover multiple events. Users can also add information about the event and an evaluation of how the port handled the event and any changes that the port made to its business as a result of learning from the impact.

When considering the questions in this section, think about port assets (machinery, buildings, equipment), infrastructure (drainage, rail, road, berths), people (injuries, work disruptions) and more widely to the port's wider responsibilities.

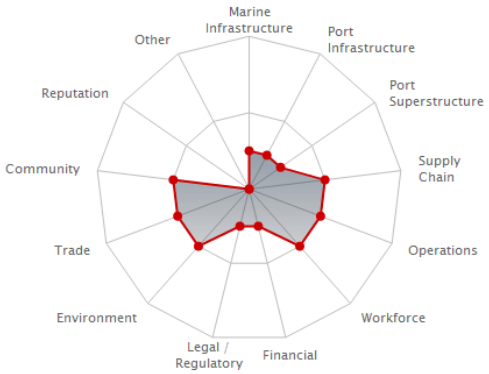
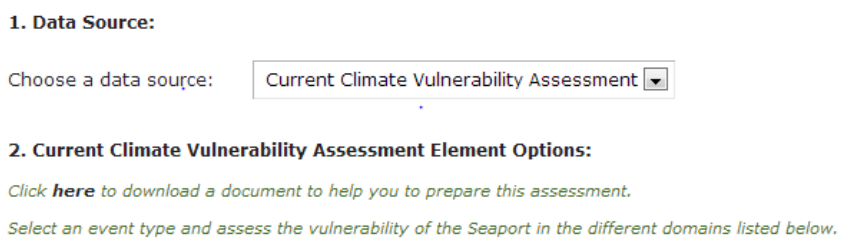


Fig 9: Example of the output from the Past Climate Impact Description Visualisation

Current Climate Vulnerability Assessment

This application is in the form of a two-step process:

1) Download a table that can be filled in by a number of people in a workshop. Getting the right people to work though this form will lead to a better understanding of the port's current vulnerability. Knowledge from the operational staff will be very useful here. The workshop will also provide a chance for people to share information across different parts of the port operations.



The table uses the same port activity areas as the previous application, providing a framework for thinking about impacts in the past and present (and will also appear in applications related to the future.

		CLIMATIC EVENTS										
		Sea current	Wave climate	Sea surface temperature	Sea acidity	Storm surge	Cyclones	Intense rainfall	Wind speed / direction	Heat wave	Drought	
Marine infrastructure	***Channels***											
	Port entrance											
Port infrastructure	***Shore protection*** (seawalls, breakwaters)											
	Vessel roadstead (berths, jetties)											

Fig 10: Part of the current climate vulnerability assessment table that can be downloaded

It provides a rating from 1 (not vulnerable) to 5 (significantly vulnerable) to help identify the areas of a port's business that has the most significant vulnerability to current climate impacts.

2) Load the findings, using the interactive table, including the rating application, to provide data for a report. Select one climate-related event for each time this application is used. The application can be used multiple times, to cover multiple events.

Use the ADD function to upload each table to a Report:

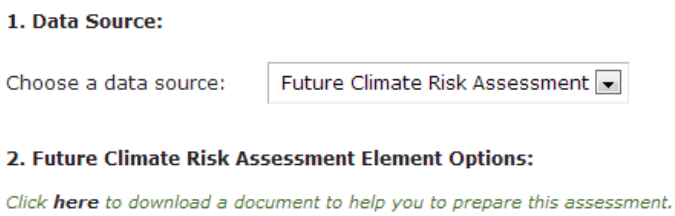
Future Climate Risk Assessment

This is the most complex application. It aims to provide an indication of the level of risk a port may be exposed to from projected future climate events. It is based on a risk matrix used by the IFC (World Bank Group) in the climate risk assessment of Terminal Maritimo Muelles le Boaque Cartagena, Columbia published as Climate Risk and Business Ports.

This Application is in the form of a two-step process:

1) Download a table that can be filled in by a number of people in a workshop. Getting the right people to work though this form will lead to a better understanding of the port's future climate

risk. Knowledge from management staff will be very useful here. The workshop will also provide a chance for people to share information across different parts of the port operations.



The table encourages the use of the same risk areas as the other applications, providing a framework for thinking about impacts in the past, present and future.

Risk no.	Climate change event/s	Risk area	Risk description	Details of risk (threshold analysis)	Future impacts	Likelihood X Consequence = Risk Level
Example	Increased sea surge	Marine infrastructure	Sediment movement, channels need clearing	Dredging is based on an annual cycle	Increased cost if dredging more often	3 x 4 = 12 High risk level
	Increased sea surge	Port Operations	Wetting of equipment with saltwater spray	Costs of maintenance/ replacement of equipment	Less time between maintenance and replacement of equipment	1 x 4 = 4 Medium risk level
	Increased sea surge	Supply chain	Flooding of key road for transport of harvest	High risk if road washes out (washout occurs every 70 years)	Halt to supply chain increases if washouts increases	4 x 2 = 8 Medium risk level

Fig 11: Part of the future climate risk assessment table that can be downloaded

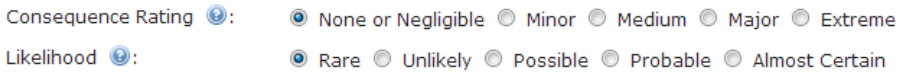
This table should be filled in by hand. Ideally it will synthesise the thoughts of many people working in the port.

Climate Change Event/s	The future climate event/s the user (or workshop participants) think will impact on the port
Risk Area	Use the same description of risk areas as the other applications (see fig 9, fig 10)
Risk Description	A brief description of the projected risk
Details of risk (threshold analysis)	Thinking about the thresholds that are now in place will help to identify how the changing climate will impact port operations. For example; - Drains may able to carry away rain of up to 100mm in an hour. What happens if this intensity increases? - Current insurance is based on a Category 4 cyclone occurring once every 50 years. What if this return period changes to once every 30 years?
Future impacts	Describe what the future impact might be
Likelihood x consequences = risk level	Choose a likelihood and consequence rating from the tables provided. Likelihood refers to how likely it is that this climate event will occur. Consequence refers to how much impact this climate event will have Multiply the 2 ratings (Likelihood x Consequence) to get a final risk level

LIKELIHOOD AND CONSEQUENCE COMBINED FOR RISK LEVEL						
Likelihood rating		Consequence rating				
		1	2	3	4	5
5	Almost certain	Medium	High	Very high	Very high	Very high
4	Probable	Low	Medium	High	Very high	Very high
3	Possible	Low	Medium	Medium	high	Very high
2	Unlikely	Low	low	Medium	Medium	High
1	Rare	Low	Low	Low	Medium	Medium

Fig 12: The Risk Level table that is part of the downloadable future climate risk assessment table

2) Load the findings, using the interactive table. Select one climate-related event for each time this application is used. The application can be used multiple times, to cover multiple events. Load in the consequence and likelihood ratings into the separate buttons and the application will combine them and provide a final risk level, which will be expressed as text in your report



Concrete Deterioration Model

Please note: This application is under development.

The concrete deterioration model looks at the impacts of long term climate change on port concrete infrastructure. Specifically, it analyses the deterioration rates of concrete using different climate change scenarios.

Climate change will affect the rate of deterioration of materials such as concrete, timber and steel. The main construction material at ports is concrete and the rate of its deterioration will affect maintenance schedules, budgets and long term plans for refurbishment and replacement.

The concrete deterioration model is a mathematical representation of how long it takes chlorine to penetrate the concrete and reach the steel bar and then how long it takes for the steel bar to corrode. The creation of this model was funded by the National Climate Change Adaptation Research Facility (NCCARF). For the full report see: Structural resilience of core port infrastructure in a changing climate

A predefined example for FijiPorts at Suva is under development. This predefined example will provide a set of hypothetical outputs for concrete structures that could conceivably have been built in the Port of Suva and are located in the 'splash zone' – where they are wet by waves during storms and high tides. As soon as the example is completed it will be uploaded here.

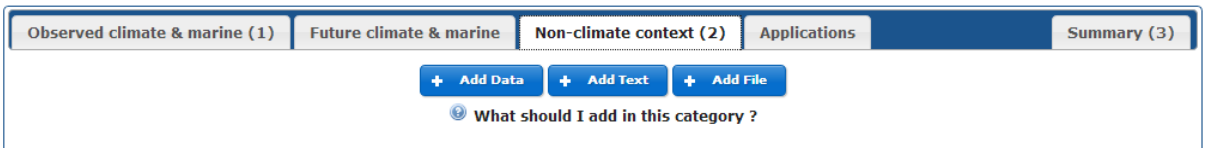
3.4 Design Report

Review Content

This stage allows users to view all chosen content: data, text, applications, graphs, images etc.

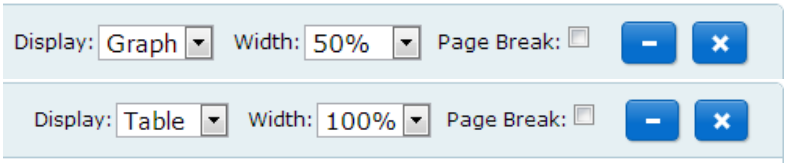
Users can decide to go back to any of the tabs and add more data, or choose to delete data at this stage. Users can also choose keep elements for later reports but "hide" them and they will not appear in the current report. Users can also add more commentary or create headings

The SUMMARY function to the right of the screen is where all the data elements are collected for the user to review.



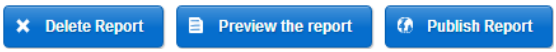
Resize, reposition or exclude content

Adjust the sizing of each element – data, text, file – from 100% (full page width) to 50% (or 1/2 column width) and change position of each chosen element within each of the data tabs. A page break can be added to the final printout for optimum formatting.



Save report structure
The report will automatically be saved.
Saving is necessary after changing the position of each of the chosen elements. Use the SAVE ORDER function.

3.5 Publish Report



Delete Report
Users can delete a report from their collection of My Reports

Preview and print report
Users can preview a report to see how it looks, and go back and adjust it or add new data and subtract existing data.
When Users are happy with everything the report can be printed (through the PREVIEW function) or a PDF version created.

Publish Report online
Users can publish the report to the Climate Smart Seaports-Pacific site.
A published report is a snapshot of the current state of a report, which once published will not change. Users can keep editing the report version stored in the private area called MY REPORTS (and create other publications based on this report). Users can also delete a Published Report without deleting the original report.
The PUBLISH function stores the final report on the Climate Smart Seaports-Pacific site, to provide a growing repository of information and knowledge about climate change adaptation for peer-to-peer learning.

3.6 Report Template

Here is one possible report template. Ideas of how to present a report can be found in PUBLISHED REPORTS.

Title of Report
Island Region

Purpose of Report
This is drawn from the text entered when the user creates NEW REPORT
Users may wish to add further text to this section – why the Port is undertaking the climate change decision-support activity

Current and Future Port Context
Users may wish to provide some introductory commentary to introduce the Port.
Include description of the port and its operation; its mission and aims and its future plans, which may be affected by the changing climate including goals and forecasts of the port

Current and Future Climate and Marine Context
Observed Climate and Marine Context
Include here the Graphs and Tables added to the Observed Climate and Marine Tab
Include here any related text commentary and files
Include here the 2 Applications that are related to Observed Impacts:

- *Past Climate Impact Description*: analysing port responses to extreme weather events in the past
- *Current Climate Vulnerability Assessment:* collating port perception of current port vulnerability to all extreme weather events

Future Climate and Marine Context
Include here the Graphs and Tables added to the Future Climate and Marine Tab
Include here any related text commentary and files
Include here the Application related to Future Impacts:

- *Future Climate Risk Assessment*: analysing the level of risk a port may be exposed to from projected future climate events

Non-Climate Context
Include here the Graphs and Tables added to the Non-Climate and Tab
Include here any related text commentary and files

Conclusion
Users may wish to provide a conclusion to their report (or it could be put in the front as an Executive Summary)
This will present the overall findings from understanding the data that is available in the tool and using the applications to understand better the past, present and projected future impacts of a changing climate

At the Bottom of the Report the following information will be recorded:
This report was created in reference to (port name) located in the (Island) region. The report is composed of (list of data chosen by the User) and User's personal analysis. It has been created by (name of the User) using the Climate Smart Seaports tool available at
http://118.138.241.5:8080/auth/report/view?id=8

4. Next Steps

The data collected through the Climate Smart Seaports-Pacific Tool [beta] provides some of the information to inform a climate risk assessment for a port; however, it does not complete the risk assessment. A risk assessment process for ports in Australia is outlined in *"Climate change adaptation guidelines for ports"*.

The guidelines suggest there are six main stages involved in undertaking a climate risk assessment.

Stage 0: Getting started: executive support.
Stage 1: Establish the port context
Stage 2: Identify current vulnerabilities and future risks
Stage 3: Analyse and evaluate risks
Stage 4: Identify and prioritise adaptation options
Stage 5: Monitoring and evaluation

The Climate Smart Seaports-Pacific Tool [beta] can assist ports with Stages 0, 1 and part of 2 and beginning of 3.

Stage 0: Getting started – executive support
Producing an initial report may assist risk managers at ports to highlight potential climate risks, and open the discussions with executive management about completing a full risk assessment.

Stage 1: Establish the port context
The Climate Smart Seaports-Pacific Tool [beta] enables ports to establish geographic boundaries for the scope of their risk assessment, and to collect data on their current operating context, and their future operating context. This includes both climate and non-climate elements. Ports will need to analyse this data for what it means to their particular situation, and add data elements that are particular to the port, however the CSS-Pacific Tool [beta] provides the backbone for establishing the context.

Stage 2: Identify current vulnerabilities and future risks
Identifying current vulnerabilities and future risks is a process best done in a collaborative manner with staff and management at a port. However, the CSS-Pacific Tool enables ports to document: (i) how they have dealt with past climate impacts, (ii) their current vulnerability to extreme weather events, and (ii) provides an ambitious process for describing the possible risk level that they face under changed climate conditions.

Stage 3 to Stage 5
The Climate Smart Seaports-Pacific Tool [beta] does not address these areas of a climate risk assessment in detail. Users need to take the information from a report and use it to progress through these stages.

5. Limitations

The proof-of-concept version of the Climate Smart Seaports-Pacific Tool [beta] only incorporates data for two Island regions: Fiji and Papua New Guinea. Data availability differs across the regions.

Observed climate and marine

The climate trend data is taken from BoM, CSIRO and Fiji Met sources. This data is updated every year. The current data is correct for 2014, but will change in the future.

All data has been chosen to support the data sourced for the Future Climate and Marine section, however please note that the Future Climate is based on modelled data and is not directly comparable to the ***actual*** data sourced in this section.

Future climate

The future climate modelling is based on global climate models that are being refined by climate scientists all the time. The information provided by the models is the best possible at the time this site was created. The use of SRES socio-economic scenarios (B1, A1B, A2) as a way of describing possible future is being replaced by a description purely related to the amount of CO_2 (or CO_2 equivalent gasses in the atmosphere).

This description is called 'Representative Concentration Pathways' Information about them can be found here. The data used in this CSS-Pacific Tool however still uses the SRES Scenarios approach.

Non-climate data

The World Bank population information is not linked directly to ports and their surrounds. Not all ports are located near urban centres, so for some ports, this data is not applicable.

The trade data is based on publicly reported information at the Island Region level. Individual ports will have their own data and trend forecasts that will be more useful for context setting.

A**pplications**

Users need to be aware that the three applications are not intended as robust assessments. They serve only to indicate areas that may need further investigation.

Glossary

Administrator: A *User* with administration rights for the Climate Smart Seaports application. An *Administrator* can access a list of all the users, remove users and block their account.
Commentary: Text added to a *Report* containing analysis produced by the *User*.
Climate Model: *see Global Climate Model*
Data: A piece of information from a *Data Source* that is added to a *Report* as an independent entity. *Data* can be added or removed from a *Report*, and later can be re-ordered, included or excluded from a Report.
Data Format: The way a piece of data is displayed. The *Data Format* is usually directly related to the *Data Source* (for example, data from the *Concrete deterioration Model* is formatted as a Graph followed by a table).
Data Source: An available provider of data. The available *Data Sources* are: CSIRO, BoM, FijiPorts, PNGPorts, World Bank, Fiji Statistics and custom files provided by the *User*.
Emission Scenario: A possible future greenhouse gas emission scenario. This is used as a parameter to compute the future evolution of climate variables. Two possible scenarios are taken into account into the Climate Smart Seaports-Pacific Tool: a "High emissions" (corresponding to the CSIRO's A1FI scenario) and a "Medium emissions" (corresponding to the CSIRO's A1B scenario).
Global Climate Models: Mathematical representations of the behaviour of the planet's climate system through time. Global climate models interpret climate data to forecast the values of climate variables such as temperature, wind speed, sea level, etc.
Region: Refers to a region of the Pacific that has been used as the spatial boundary for developing a set of future climate data.
Report: A document which is able to be saved and printed by the *User,* and which can then be *published* within the Climate Smart Seaport-Pacific application.
User: An operator of the Climate Smart Seaports-Pacific application, typically from port authorities or researchers.
Workflow: The process followed by the *User* from starting a new *Report* to *Publishing* a *Report*.

Acronyms

BoM: Bureau of Meteorology
CMAR: CSIRO Marine and Atmospheric Research
CSIRO: Commonwealth Scientific and Industrial Research Organisation
GCM: Global Climate Model
IPCC: Intergovernmental Panel on Climate Change

Resources

Climate data can be sourced from CSIRO and the Bureau of Meteorology via the Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program:

Country specific climate data can be found at Pacific Climate Change Science Reports:

CSIRO and BoM Pacific Climate Futures website

BoM Climate & Ocean Support Program in the Pacific

CSIRO Marine and Atmospheric Research website

Adaptation resources include can be sourced from the following:

UKCIP is based at the Environmental Change Institute at the University of Oxford. It provides an online adaptation Tool (Wizard). The Wizard is a 5-step process to help assess an organisation's vulnerability to current climate and future climate change, identify options to address an organisation's key climate risks, and help develop and implement a climate change adaptation strategy. The Wizard is also a further guide to information, tools and resources.

The IFC World Bank Group 's Climate Risk and Business Ports: Terminal Maritimo Muelles le Boaque Cartagena, Columbia is a climate risk assessment available online that provides one of the first comprehensive risk assessments of a large sea port.

UK Port adaptation plans
91 key infrastructure providers were asked to submit adaptation plans in response to Directions to Report under the UK Climate Change Act 2008. This information is still online in a DEFRA Archive.
Scroll down to the Ports section.

Engineering Australia has published a set of guidelines for responding to climate change. Although they use only Australian conditions, there is much information that may be useful.
They include:

i. Guidelines for Responding to the Effects of Climate Change in Coastal and Ocean Engineering Examines possible climate change scenarios affecting coastal engineering.
ii. Guidelines for Working with the Australian Coast in an Ecologically Sustainable Way Directed primarily at professional engineers practicing in the coastal zone and allied professionals such as planners and managers with decision making roles.
iii. Climate Change Adaptation Guidelines in Coastal Management and Planning Examines possible climate change scenarios affecting coastal engineering.

All three resources can be downloaded from the Engineers Australia website.

NCCARF Guidelines for Adapting Seaports to a Changing Climate.
These guideline were produced as part of a research project, focused on Australian seaports. The full suite of reports from this project can be downloaded from the NCCARF site.

Acknowledgements

The Climate Smart Seaports-Pacific Tool [beta] was developed by the Climate Change Adaptation Program in partnership with the RMIT University eResearch unit, with funding originally provided by the Australian National Data Service (ANDS) and refined for the Pacific Island Nation context with funding from USAID.

RMIT would particularly like to thank Fiji Ports Corporation Ltd., PNG Ports Corporation Ltd., and Swire Shipping for their support in the development of this Pacific version of the Climate Smart Seaports Tool [beta].

Thanks to the Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program and specifically the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Bureau of Meteorology (BoM), for permission to use climate and marine datasets.

Thanks to the Fiji Meteorological Service for additional climate data.

The Climate Smart Seaports [beta] User Guidance Document was authored by Helen Scott, with input from members of the RMIT Climate Change Adaptation Program (Darryn McEvoy, Jane Mullett, Alexei Trundle and Sophie Millin). The Climate Smart Seaports-Pacific [beta] version was revised by Jane Mullett (with input from Guillaume Prevost, Darryn McEvoy and Alexei Trundle).

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