* Coastal Climate Change & Adaptation: PART I

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Co-Director – C-Change (Canada)

Professor Emeritus, Telfer School of Management,
University of Ottawa

Presentation to the 3rd China- ASEAN Academy on Oceans Law & Governance, NISCSS Haikou, Hainan

PART 1 – Morning, November 10, 2017

Knowledge & Lessons

- Overall theme: *Climate Change Adaptation & Problem Solving*
  - ✓ *Accepting the need for action on climate change*
  - ✓ *Scientific method of problem solving*
- How to identify issues and prepare for adapting to coastal climate issues?
  - ✓ Profiling community, region, nation and setting priorities
  - ✓ Assessing vulnerability
- What are possible adaptation decisions?
  - ✓ Generalization of strategy options
- How to make practical adaptation decisions in your local, regional, national coastal environments?
  - ✓ Application of decision preference tools, decision analysis
  - ✓ Course module assignments

* Objective: Adaptation Problem Solving

1. Profile the Community (Problem Definition & Data)
   * GIS, local issues, key participants, identify community preferences, pairwise comparison (tradeoffs) – AHP (*Lane et al 2015*)
2. Assess Vulnerability "hotspots" (Data Analysis)
   * Determine potential impacts based on historical events, develop adaptation alternatives and options, costs (*Camare & Lane 2013*)

Part I

Part II

3. Simulate Strategic Systems (Modelling & Analysis)
   * System dynamics modelling, strategic planning period (*Lane et al 2017*)
4. Evaluate Strategy Alternatives
   * Apply indices for Vulnerability, Resilience, Adaptive Capacity (*Lane et al 2018*)
5. Recommend, Implement & Monitor

*Coastal Climate Change & Adaptation - Outline

PART I - Morning

1. Introduction
2. Challenges for the 21st Century - Coastal Zones
3. Understanding Adaptation Needs - Profiling
4. Pillars of Sustainability - Reflecting Importance**

PART II

5. Vulnerability Assessment
6. Estimating Coastal Impacts
7. Adaptation Problem Solving and Strategy Options
8. Evaluating Decisions**
9. Climate Change Governance

**Class Assignment

*1. Introduction

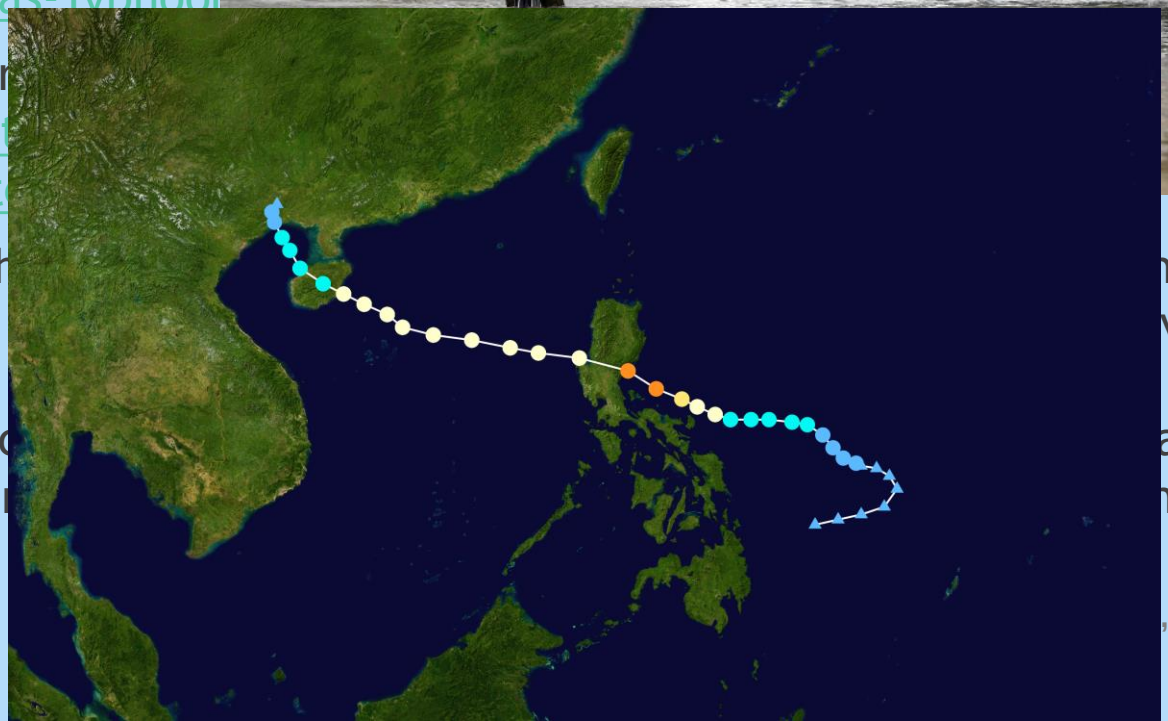
*Weather versus Climate

- The difference between weather and climate is a measure of time. Weather is what conditions of the atmosphere are over a short period of time, and cli
"behaves" over relatively lor
- Climate: temperature anom sea level rise, erosion, severe st)
- Weather: January 2016 colc i + "90% of China", 30-year low

"This has led to an overload of the sand households without power in the c casters say the current weather system is ms which battered much of China in 2008. Heavy snow, ice and cold temperatures caused extensive damage throughout the region back then, disrupting transportation for thousands during that year's Spring Festival travel season." (CRI English News website)

*Hainan & Typhoons

* Vietnam's death toll f
  http://www.abc.net.
  nears-50/9123170
* Tour of Hainan, Octob
  (http://velonews.com
  two-typhoons_42352
* 500,000 evacuated as
  Daily News) October
  evacuated-as-Typhoo
* Typhoon Sar
  19, 2016 (h
  10/19/cont



"Sarika, th
than 1.55
as well as
81,700 hec
total failu

ne life of more
vincial capital,
and about
ain to suffer
nistry of Civil
Affairs."

*ASEAN Climate and Security Cooperation

* August 2-8, 2017 ASEAN Ministerial Meeting in Manila, Philippines
* "While climate-related matters were not explicitly integrated into the security cooperation framework, it will establish the types of structures necessary to successfully manage climate security risks. Taken together, these joint actions reaffirm that managing these risks will require more than implementing the Paris agreement, and that ongoing regional cooperation to address climate security risks, particularly in a vulnerable region like Southeast Asia, will also require greater cooperation and coordination amongst the security and foreign policy communities."
* For more on climate and national security in the Asia-Pacific see: The Asia-Pacific Rebalance, National Security and Climate Change.

China and Climate Change

* China's 13th five year plan (FYP)

  released in March 2016 and covers the period up to 2020. The headline targets are to reduce energy intensity by 15 percent and carbon intensity by 18 percent compared to 2015 levels. In addition, energy consumption will be capped at 5 billion tons of coal equivalent, and the share of primary energy consumption from non-renewable sources will increase to 15 percent. The increased carbon intensity goal means that China would reach, or potentially exceed, its Copenhagen pledge to reduce carbon intensity 40-45 percent below 2005 levels.

  (Source: Center for Climate and Energy Solutions http://www.c2es.org/international/key-country-policies/china)

* China ratifies Paris climate change agreement ahead of G20

  (Source: The Guardian, September 3, 2016https://www.theguardian.com/world/2016/sep/03/china-ratifies-paris-climate-change-agreement)

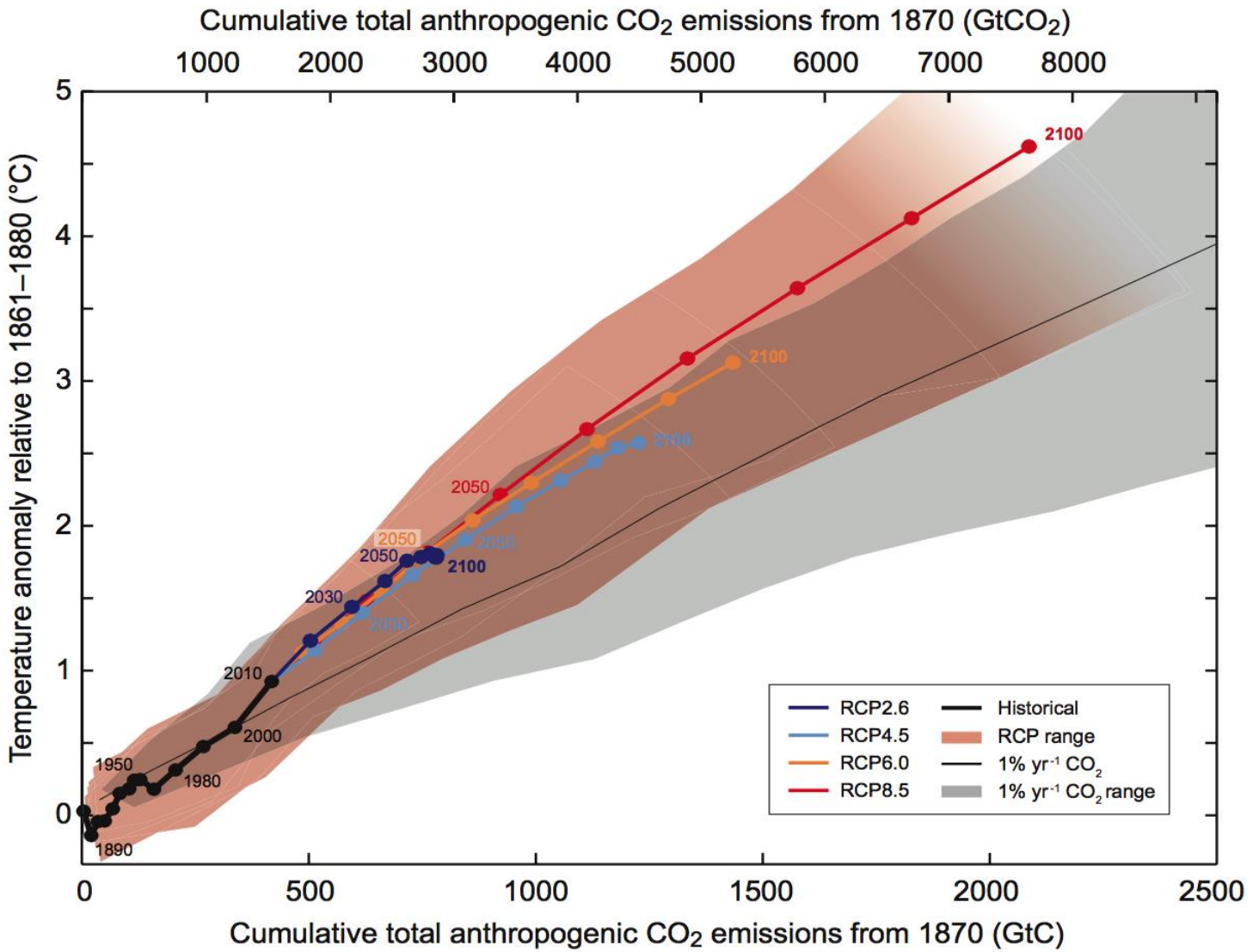
* Donald Trump, China, ASEAN, US Retraction from the Paris Accord Climate Change:

  On November 6, 2012, Donald Trump tweeted:

  "The concept of global warming was created by and for the Chinese

  in order to make U.S. manufacturing non-competitive."

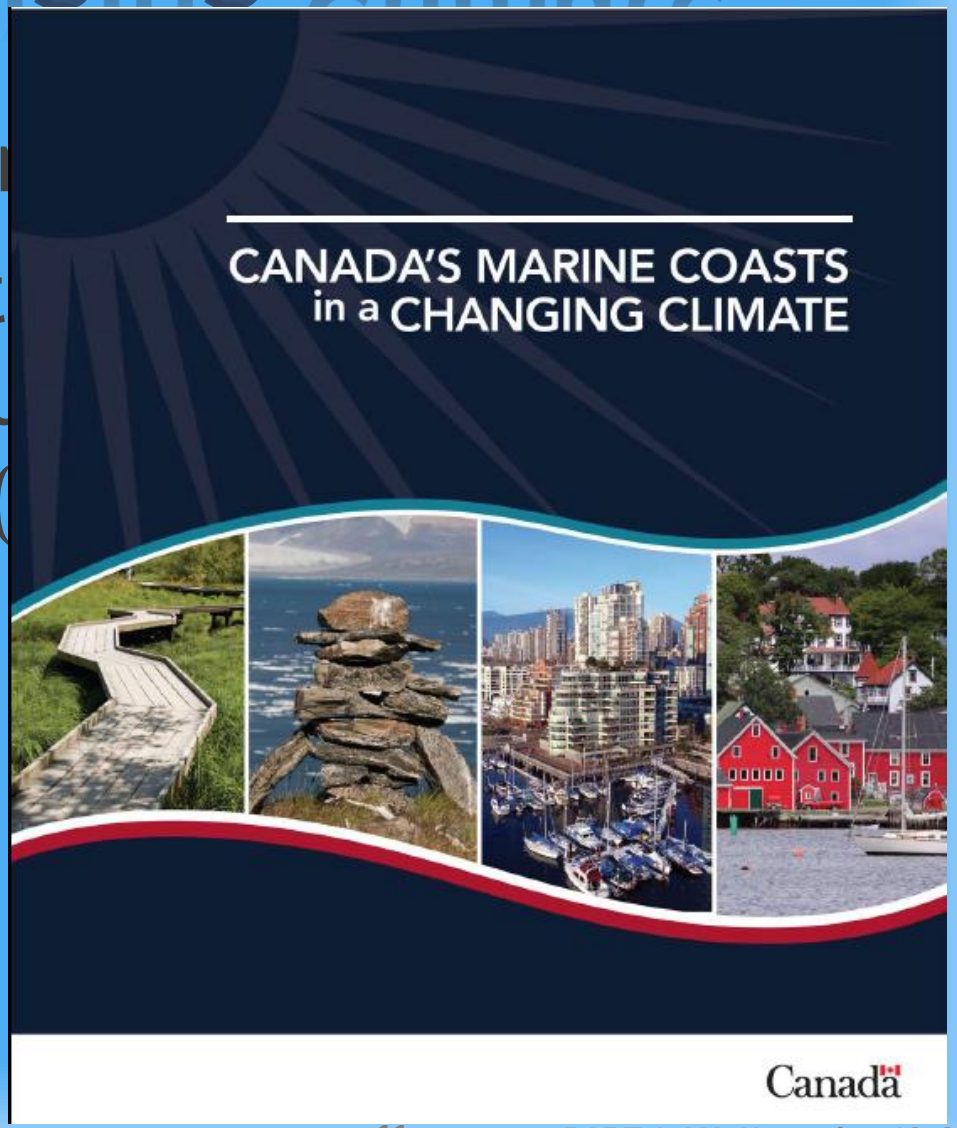
  https://www.cbsnews.com/pictures/wild-donald-trump-quotes/13/



Source: IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Figure SPM 10, p.28
Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

*The Changing Climate

- *Global evide
- *Canada's nat
  Natural Resou
  government (



Climate Change Impacts and Adaptation
ASSESSMENT OF CANADA'S MARINE COASTS

-Natural Resources Canada document in development (2016)

1. Warming – air temperatures, land surface, oceans trend attributed to global warming due to increasing GHGs in the atmosphere
2. Increased frequency an severity of coastal storms – events of extreme precipitation, high winds and seasonal storms, storm surge aggravated by sea-level rise, extended periods of drought
3. More human development in coastal areas – higher pollution, GHG emissions, and maladaptation practices along the coastal zones.

*Guangdong coast evidence

*Guangdong coast – Guangzhou loss potential from sea level rise is world's highest (World Bank, China Climate Science Report 2015, Dec 2015)

*http://www.theglobeandmail.com/news/rising-waters-prompt-chinas-sea-change-onclimate/article27608966/

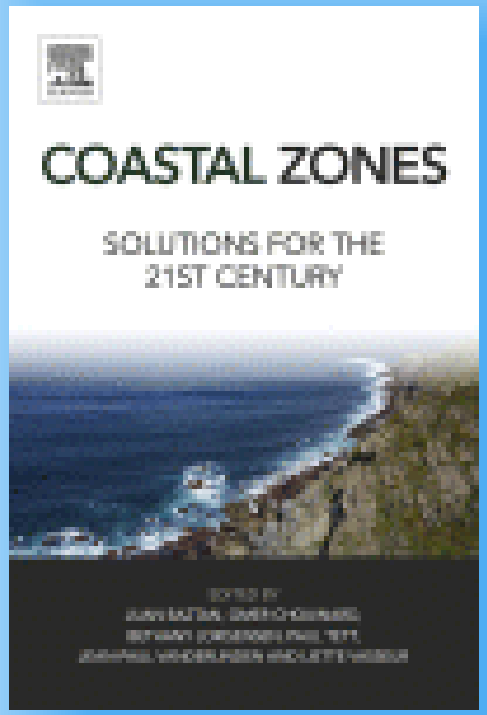
*2. Coastal Climate Challenges

*Climate Challenges for the 21st Century

United Nations

Report of the United Nations Conference on Sustainable Development

Rio de Janeiro, Brazil
20–22 June 2012



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ISBN: 978-0-12-802748-6

Chapter 10

Managing Adaptation to Changing Climate in Coastal Zones

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[1]Telfer School of Management, University of Ottawa, Ottawa, ON, Canada; [2]The University of the West Indies, St. Augustine Campus, Trinidad and Tobago

Chapter Outline

INTRODUCTION

Coastal zones are the most biologically and economically productive regions in the world. Over 40% of the world's population lives within 150 km of the shore (United Nations Atlas of the Oceans, 2010), and that figure is growing. In Canada, approximately 38% of Canadians live within only 50 km of one of three surrounding oceans—the Atlantic, Pacific, or Arctic Oceans—or one of the Great Lakes. In the Caribbean region, coastal populations in 28 independent territories and island states are generally clustered along thin bands of land in close proximity to the shore. An estimated 60% of the Caribbean's total population of approximately 40 million people lives within less than 100 km from the coast, and approximately 40% of the population resides within a mere 2 km of the coast.

These coastal zones, where land and water interact, are key landscapes when considering (1) the environmental challenges faced by human societies and (2)

Coastal Zones. http://dx.doi.org/10.1016/B978-0-12-802748-6.00010-3

10010-BAZTAN-9780128027486

*Challenges for the 21st Century

Rio +20

1. Identify community priorities
2. Cede authority to local communities, municipalities
3. Measure, track, and exercise preparedness
4. Implement the precautionary approach and plan strategically
5. Build an education legacy

Laudato Si'

1. ...dialogue that includes everyone
2. We require a new and universal solidarity.
3. drawing on the results of the best scientific research available today (Chapter 1)
4. Article 186 and the Rio Declaration (1992)
5. change is impossible without motivation and a process of education (Article 15)

*3. Understanding Adaptation Needs - Profiling Coastal Communities

*Understanding Adaptation Needs

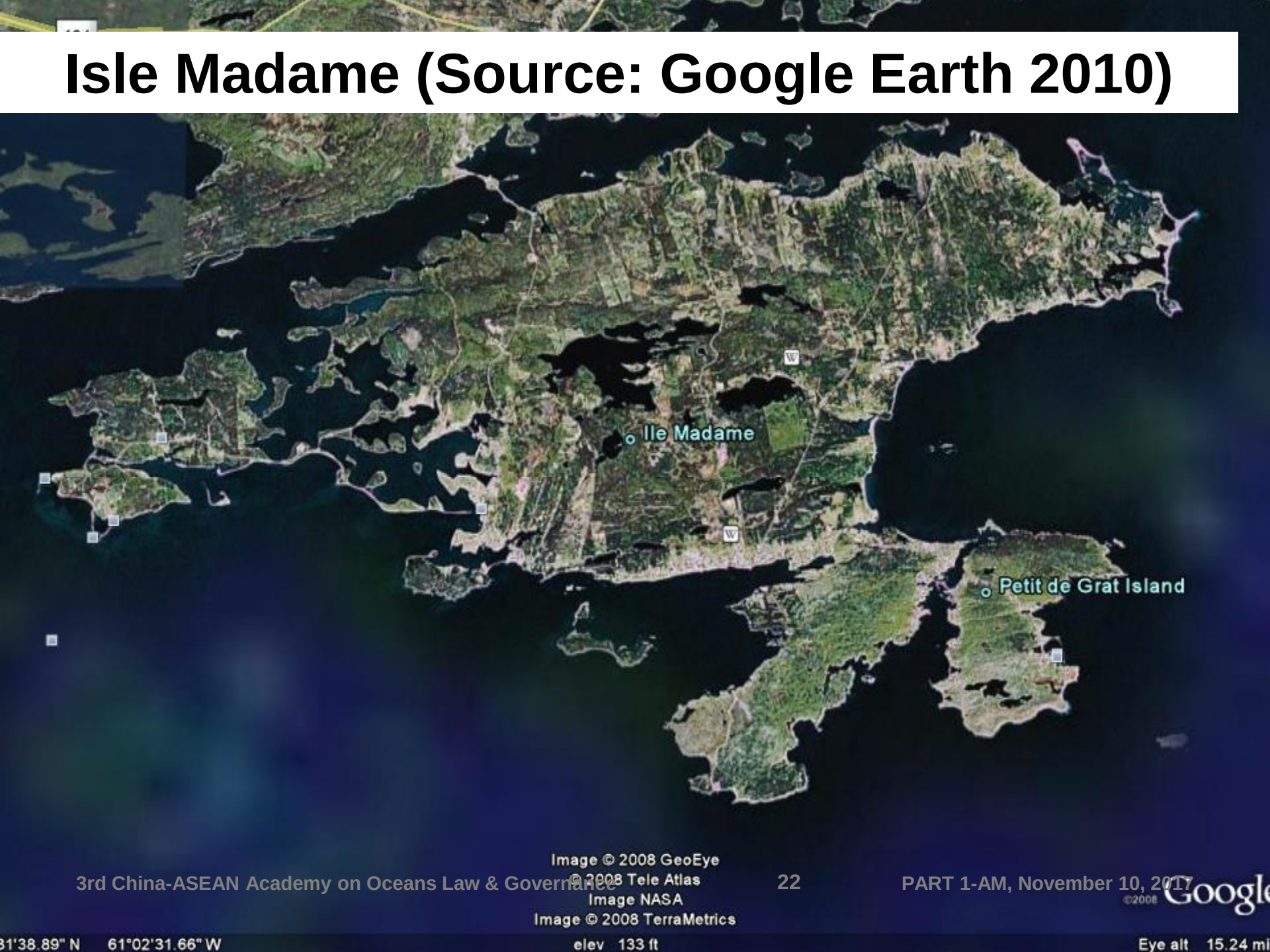
1. Profiling Coastal Communities
2. Assessing Coastal Vulnerabilities
3. Determining Relative Importance of Sustainability Pillars

*The Importance of Context - Examples from C-Change

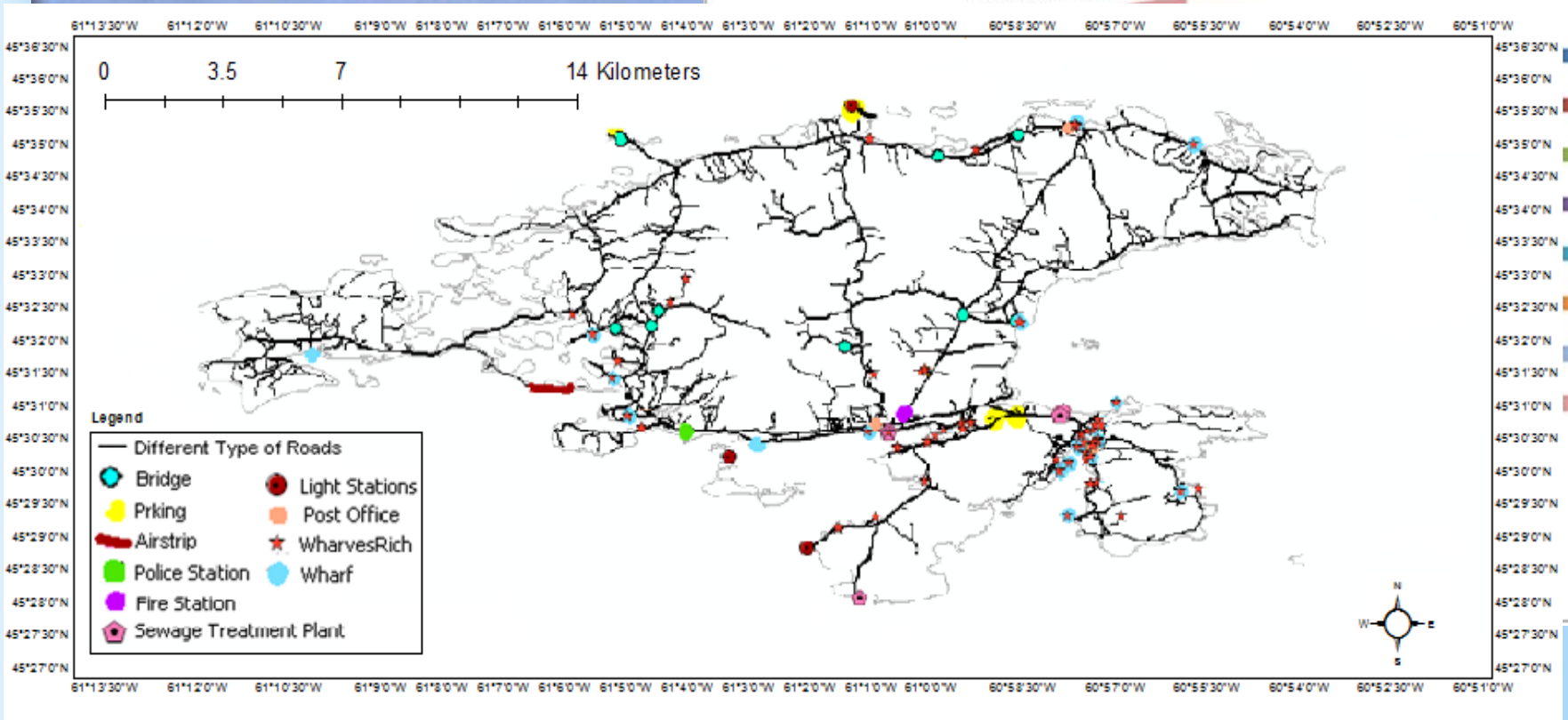
1. Isle Madame – coastal community, aging and declining population
2. Charlottetown – coastal community; location on 3 rivers; provincial capital city
3. Grande Riviere, Trinidad – tourism development versus conservation


Arctic Ocean
NORTH
Beaufort Sea
Yukon Territory
Whitehorse
Northwest Territories
Yellowknife
Nunavut
Baffin Island
Iqaluit
Hudson Strait
Labrador Sea
Pacific Ocean
British Columbia
Alberta
Edmonton
Saskatchewan
Regina
Manitoba
Winnipeg
Hudson Bay
Ontario
Quebec
Québec
Newfoundland & Labrador
St. John's
Prince Edward Island
Charlottetown
Fredericton
New Brunswick
Nova Scotia
Isle Madame
Gibsons
Victoria
OTTAWA
Toronto
UNITED STATES OF AMERICA
Atlantic Ocean

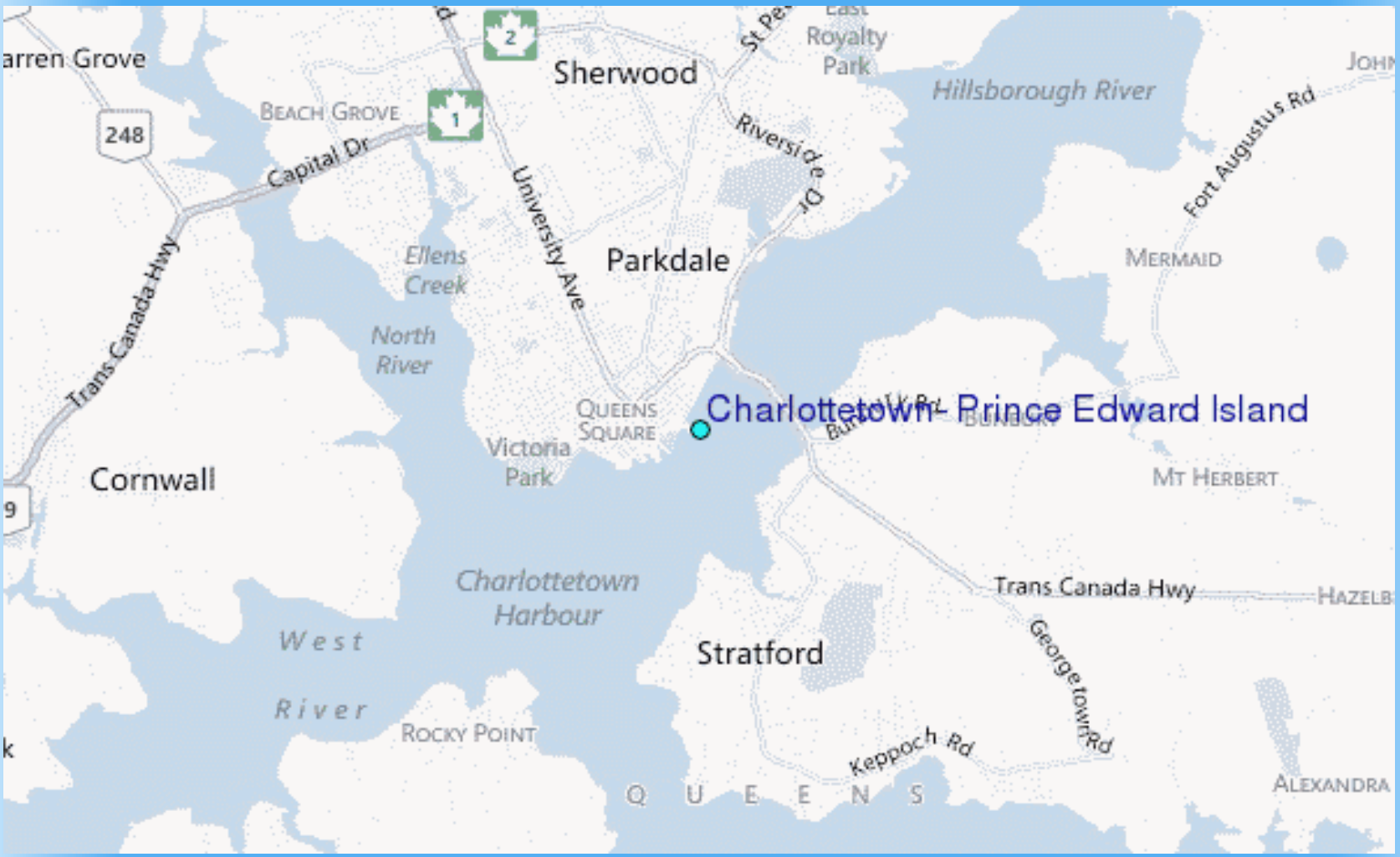
Isle Madame (Source: Google Earth 2010)



*Profiling - Examples

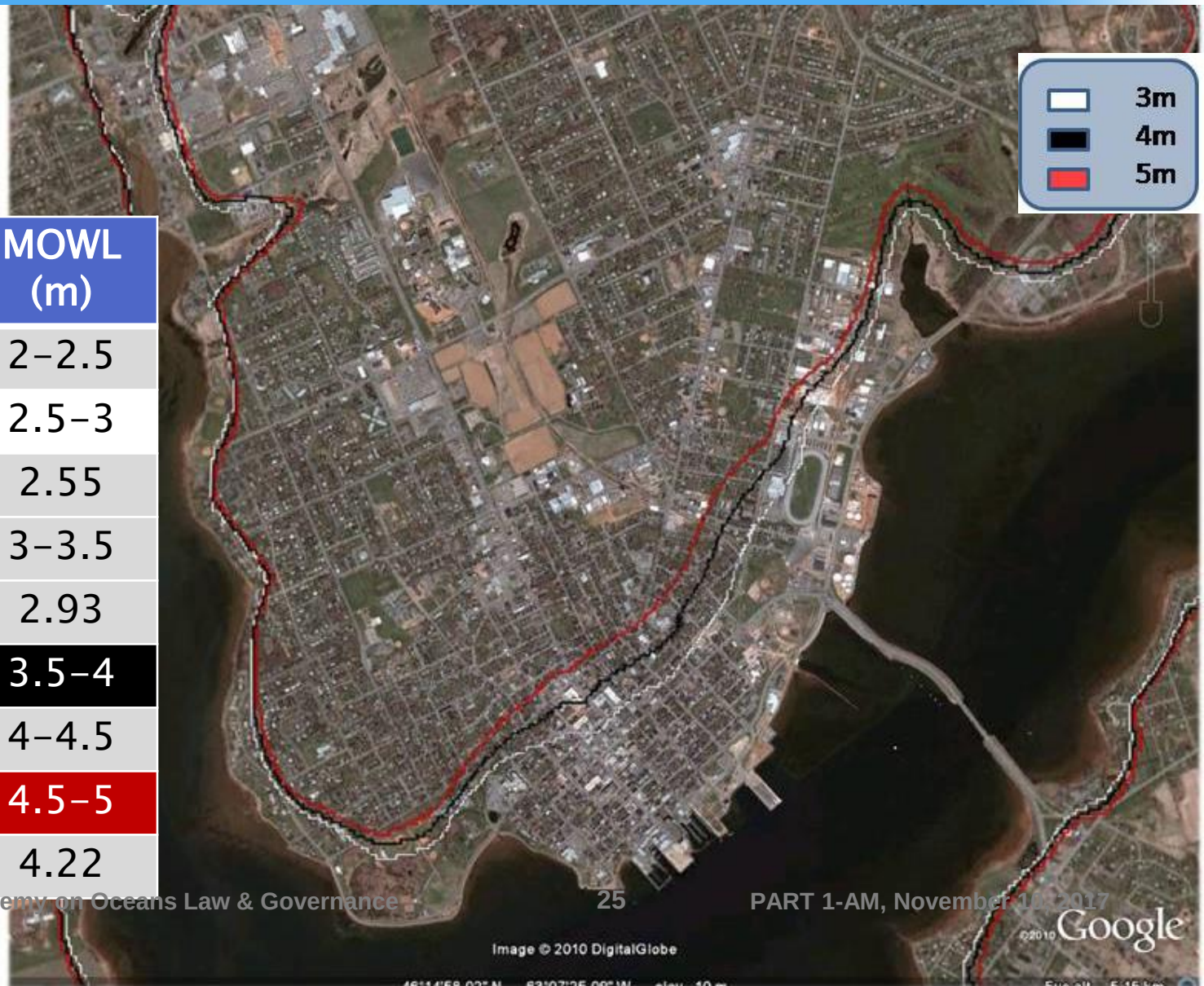


*City of Charlottetown



Charlottetown Spatial/GIS Model

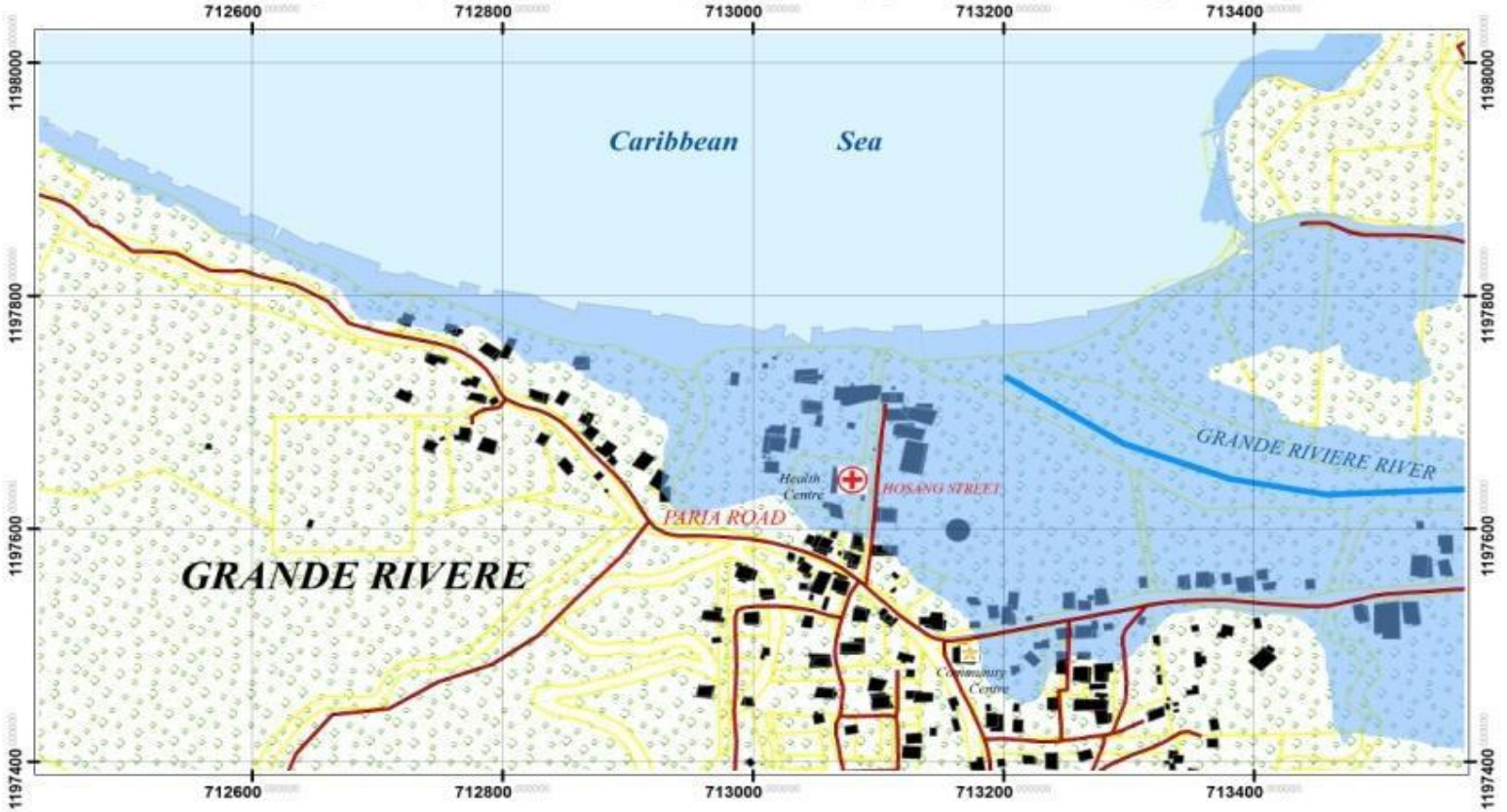
Scenario	MOWL (m)
I	2-2.5
II	2.5-3
NN1962	2.55
III	3-3.5
Juan	2.93
IV	3.5-4
V	4-4.5
VI	4.5-5
NN2000	4.22




Gulf of Mexico
Atlantic Ocean
Caribbean Sea
Pacific Ocean
Greater Antilles
Lesser Antilles
0
500 Miles
0
500 KM
Parallel scale
at 20 degrees N 0 degrees E
20 degrees N
U.S.A.
Sarasota
Fort Myers
Fort Lauderdale
Miami
West Palm Beach
Key West
Grand Bahama
Abaco
THE BAHAMAS
Nassau
Eleuthera
Cat Island
New Providence
Andros
San Salvador
Rum Cay
Samana Cay
Great Exuma
Long Island
Crooked Island
Long Cay
Mayaguana
Acklins
Little Inagua
Great Inagua
Caicos Islands
TURKS AND CAICOS ISLANDS
Turk Islands
Havana
Colon
Guane
CUBA
Cabaiguan
Camaguey
Isla De La Juventud
Merida
Cancun
Campeche
MEXICO
Chetumal
Little Cayman
Cayman Brac
Grand Cayman
CAYMAN ISLANDS
George Town
Guantanamo
Baracoa
Gonaives
Esperanza
HAITI
DOMINICAN REPUBLIC
Port-au-Prince
JAMAICA
Kingston
San Juan
Santo Domingo
PUERTO RICO
VIRGIN ISLANDS (U.S. & UK.)
St. Thomas
Tortola
Anegada
Virgin Gorda
St. John
St. Croix
ANGUILLA
St. Martin
St. Barthelemy
St. Eustatius
St. Kitts
Nevis
Barbuda
Antigua
ANTIGUA AND BARBUDA
SAINT KITTS AND NEVIS
Plymouth
MONTSERRAT
GUADELOUPE
Basse-Terre
Grande-Terre
Maria-Galante
Roseau
DOMINICA
MARTINIQUE
Castries
SAINT LUCIA
Kingstown
BARBADOS
Bridgetown
SAINT VINCENT AND THE GRENADINES
Grenadines
St. Vincent
NETHERLANDS ANTILLES
Oranjestad
ARUBA
Curacao
Bonaire
Bequia
St. George's
GRENADA
Port of Spain
TRINIDAD AND TOBAGO
Grand'Rivière
BELIZE
Belmopan
Puerto Barrios
GUATEMALA
San Pedro Sula
Puerto Lempira
HONDURAS
Guatemala
Tegucigalpa
Puerto Cabezas
San Salvador
EL SALVADOR
NICARAGUA
Managua
Granada
Bluefields
Lake Nicaragua
Rivas
Liberia
San Jose
Puntarenas
COSTA RICA
Colon
Panama
PANAMA
David
Barranquilla
Maracaibo
Willemstad
Valencia
Caracas
Barquisimeto
Maturin
Ciudad Guayana
Ciudad Bolivar
VENEZUELA
Monteria
Cucuta
San Cristobal
Rio Magdalena
Rio Orinoco
Medellin
COLOMBIA
GUYANA
Georgetown

* Grande Riviere, NE T&T - Leatherback turtle tracks (March 22, 2010)

MAP OF GRANDE RIVIERE SHOWING 7m RISE IN SEA LEVEL



0 155 310 620 Meters

Data collected by Surveying and Existing Topographic Data
Data process in ArcGIS 9.3 & Map created in ArcGIS 9.3

1:5,000

Projection: UTM Zone 20N
Datum: WGS84
Vertical Datum: Mean Sea Level

Prediction of 50m was derived from the M.E.T office in the U.K Government

Produced on 3rd April 2010 by Amit Seeram

Roads
River
7m rise
Buildings
Contours
Parcels

N

*Tools

1. Geographical Information Systems – (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.
   * ArcGIS – Esri Mapping Systems
2. System dynamics - a computer-aided approach to policy analysis and design. It applies to dynamic problems arising in complex social, managerial, economic, or ecological systems — literally any dynamic systems characterized by interdependence, mutual interaction, information feedback, and circular causality.
   * STELLA – ISEE Systems
   * Vensim (Open source, free download)
3. MCDM – MultiCriteria Decision Making - Problems characterized by multiple stakeholders, community participants, many and conflicting criteria (environmental, economic, social)
   * AHP – the Analytic Hierarchy Process (Saaty)

* Objective: Adaptation Problem Solving

1. **Profile the Community (Problem Definition & Data)**
   * **GIS, local issues, key participants, identify community preferences, pairwise comparison (tradeoffs) - AHP (*Lane et al 2015*)**
2. Assess Vulnerability "hotspots" (Data Analysis)
   * Determine potential impacts based on historical events, develop adaptation alternatives and options, costs (*Camare & Lane 2013*)

Part I

Part II

3. Simulate Strategic Systems (Modelling & Analysis)
   * System dynamics modelling, strategic planning period (*Lane et al 2017*)
4. Evaluate Strategy Alternatives
   * Apply indices for Vulnerability, Resilience, Adaptive Capacity (*Lane et al 2018*)
5. Recommend, Implement & Monitor

Profiling Communities

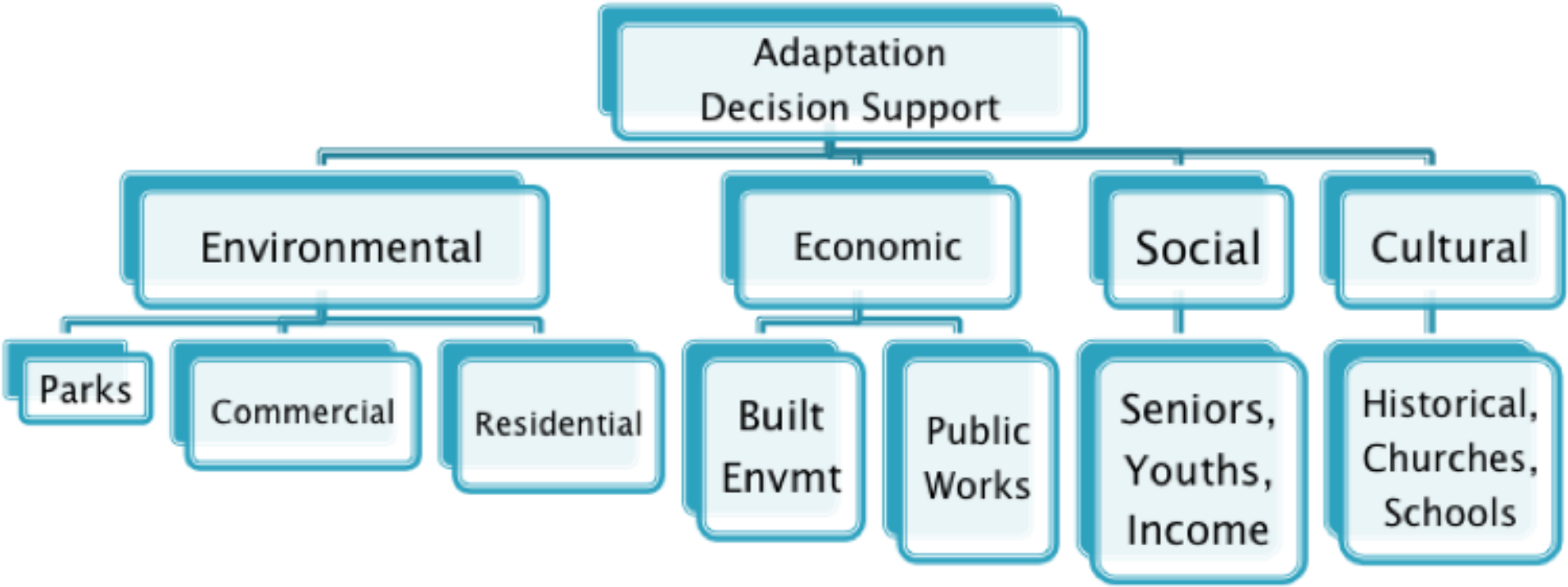
1. Community preferences
   - *Ecological, economic, social, cultural
2. Recognition of assets
   - *Natural, industrial, demographic, cultural
3. History of storm events and impacts
   - *Hurricanes, high wind and snow/rain events
4. Sources of community vulnerability

*4. Pillars of Sustainability

* Community Profile - 4 Pillars of Sustainability (ICSPs)

	Dimension	Sub-categories
1	**Environmental**	Topography, Land and Marine Use, Natural Resources, Climate
2	**Economic**	Employment, Industry, Property, Occupation, Revenues, Earnings, Public Works, Built Environment
3	**Social**	Population, Health, Education, Communications, Community Dynamics, Governance
4	**Cultural**	Places, Groups, Events, Language

*Coastal Community Adaptation Problem Hierarchy



*How to compare the relative importance of problem elements?

* Pairwise comparison exercise
* Example: Community Profile Dimensions – Environmental, Economic, Social and Cultural

	Economic	Social	Cultural
Environmental	Value1	Value2	Value3
Economic	-	Value4	Value5
Social	-	-	Value6

*MCDM Worksheets

(1) Row		Pairwise Scores 1 2 3 4 5 6 7 8 9		(2) Calculated Cells Ratio
1	Environmental		Economic	
2	Environmental		Social	
3	Environmental		Cultural	
4	Economic		Social	
5	Economic		Cultural	
6	Social		Cultural	

(2) Go back to row 1 and calculate the cells ratio for each row 1-6.

(3) Fill in the table below that summarizes the overall weights for all the pillars.

(3)	Environmental	Economic	Social	Cultural
1 Environmental	1			
2 Economic	-	1		
3 Social	-	-	1	
4 Cultural	-	-	-	1

* MCDM Worksheet Worked Example

(1) Pairwise Scores

Row		1 2 3 4 5 6 7 8 9	
1	Environmental	■	Economic
2	Environmental	■	Social
3	Environmental	■	Cultural
4	Economic	■	Social
5	Economic	■	Cultural
6	Social	■	Cultural

(2) Calculated Cells Ratio

Row	Col	Ratio
5	4	1.25
4	5	0.8
5	4	1.25
6	3	2
6	3	2
4	5	0.8

(2) Go back to row 1 and calculate the cells ratio for each row 1-6.

(3) Fill in the table below that summarizes the overall weights for all the pillars.

(3) Matrix

	Environmental	Economic	Social	Cultural
1 Environmental	1	1.25	0.80	1.25
2 Economic	0.80	1	2.00	2.00
3 Social	1.25	0.5	1	0.80
4 Cultural	0.80	0.5	1.25	1

*Participants' Preferences/Profiling Exercise

China-ASEAN Academy 1 (January 2016)

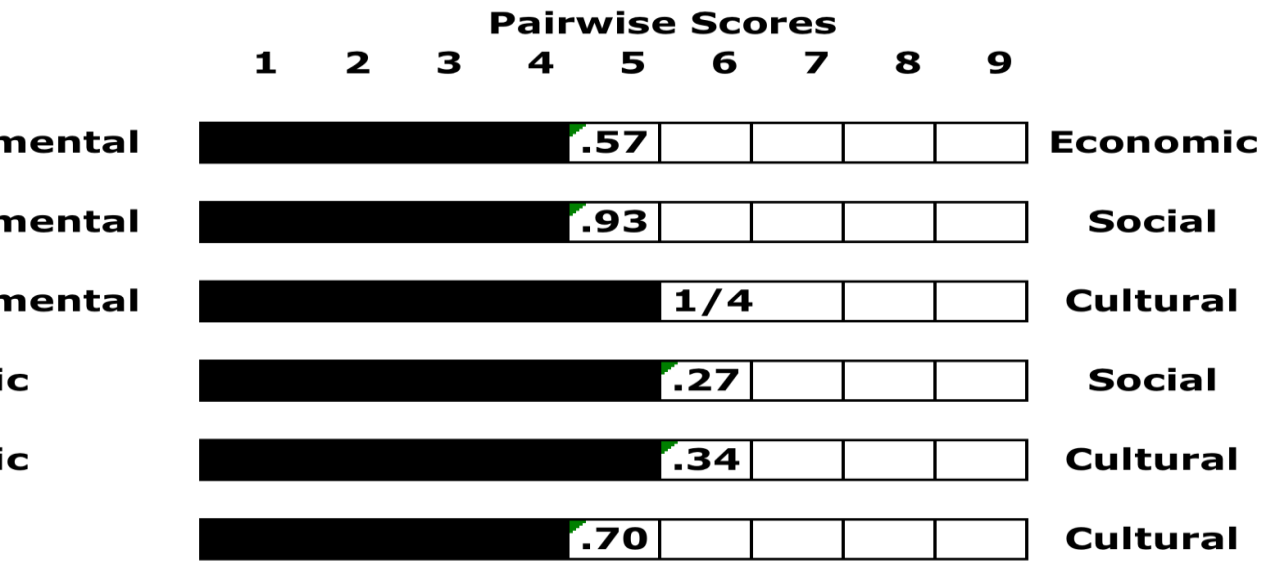
China-ASEAN Academy on Ocean Law and Governance **January 24-31, 201**
NISCSS, Haikou, Hainan, China

Thursday, January 28
Climate Change Adaptation (Lane, IOI-Canada)
Multicriteria Problem Solving Session - Participant Feedback Pillar Importance Inputs

Name:	**All 40 China-ASEAN participants (12 empty)**
Country:	**All nations - China-ASEAN**

Pairwise Comparison Exercise

(1)



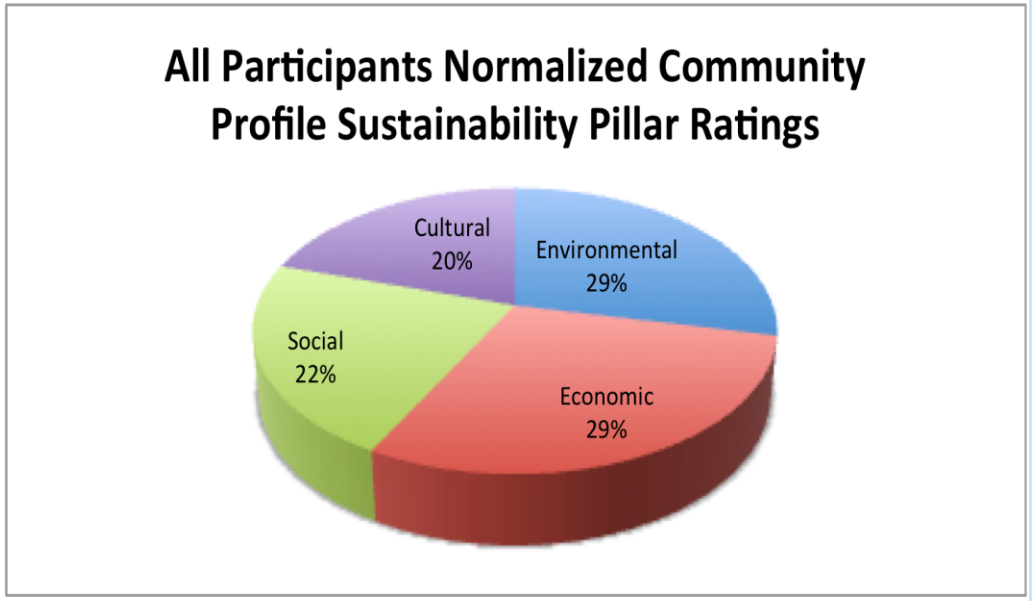
* 1st China-ASEAN Academy Results (January 2016)

AHP Community Profile Dimensions Results

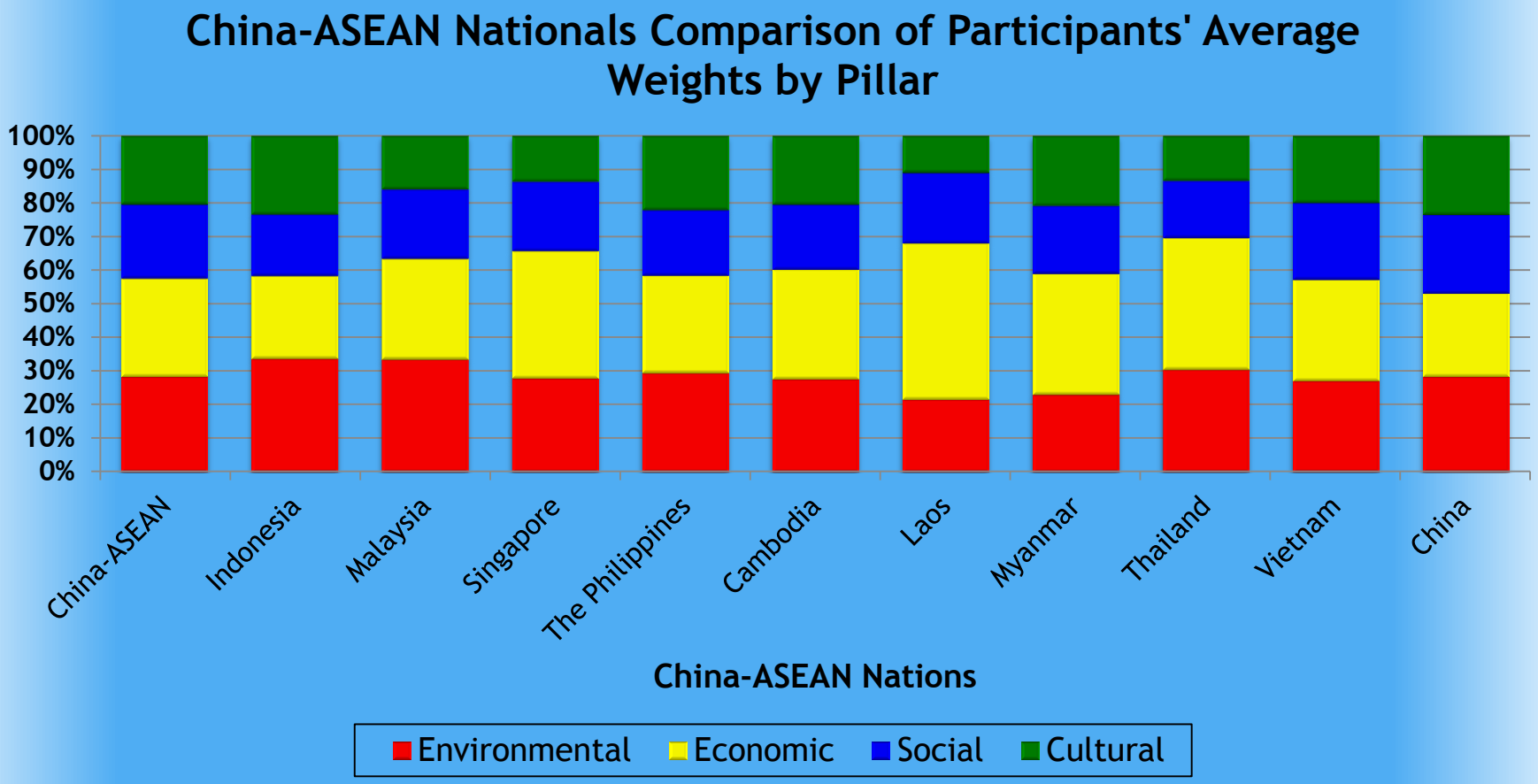
Inconsistency Measure*	0.0011

*This indicator should not exceed 0.10 for reliable rational results.

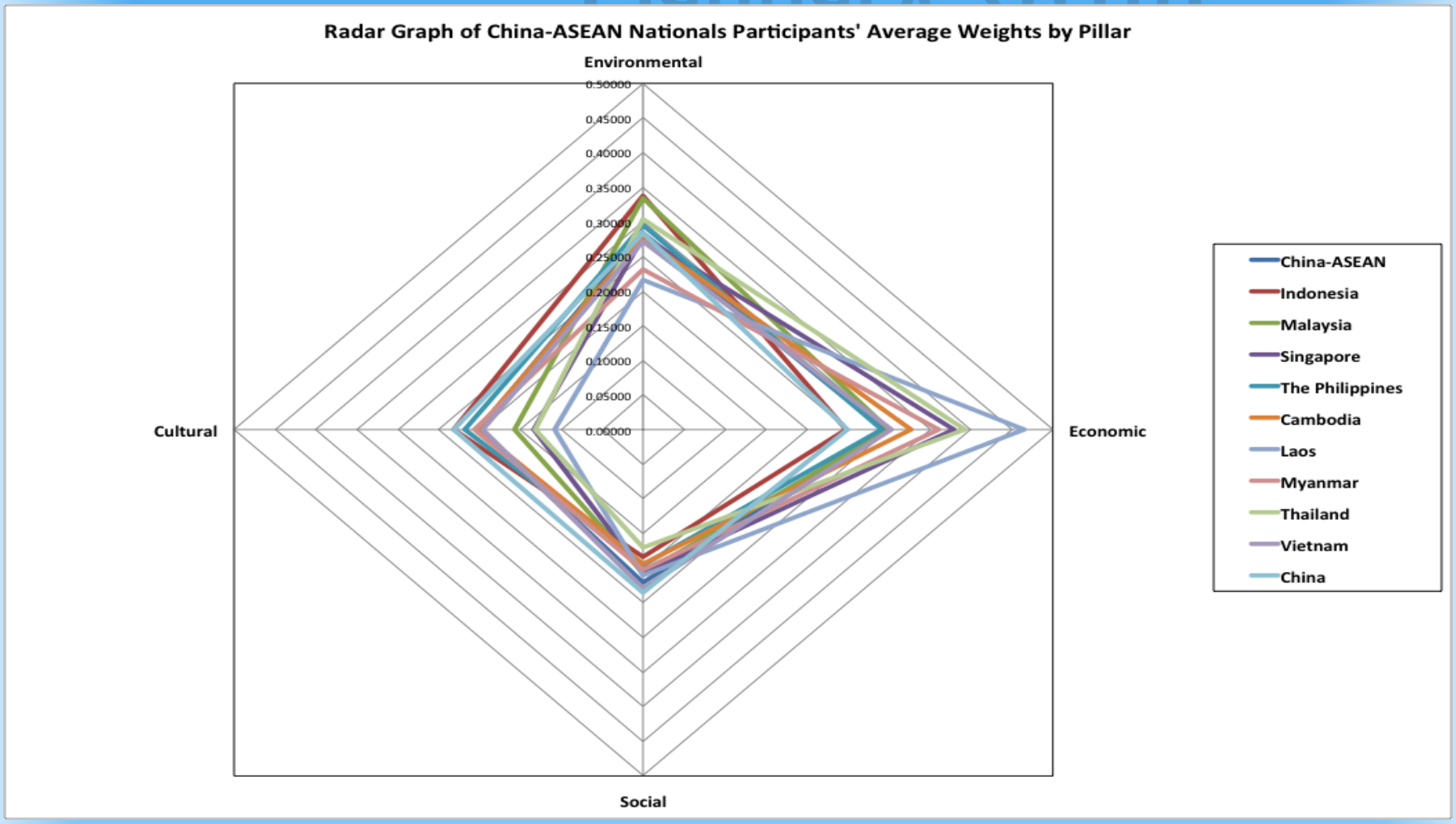
Pillar Ratings	**Normalized**	**Idealized**
Environmental	0.28378	0.96665
Economic	0.29357	1
Social	0.22073	0.75189
Cultural	0.20191	0.68776
Total	1	



China-ASEAN Academy 1 (January 2016)



China-ASEAN Academy 1 (January 2016)

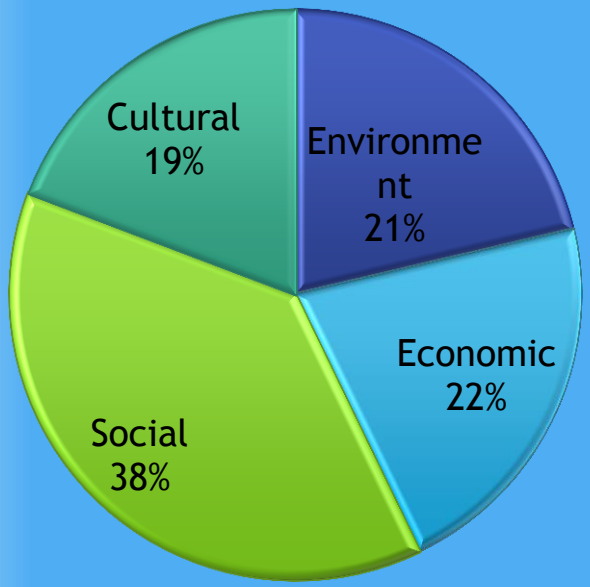


*Priorities & Multi-Participants

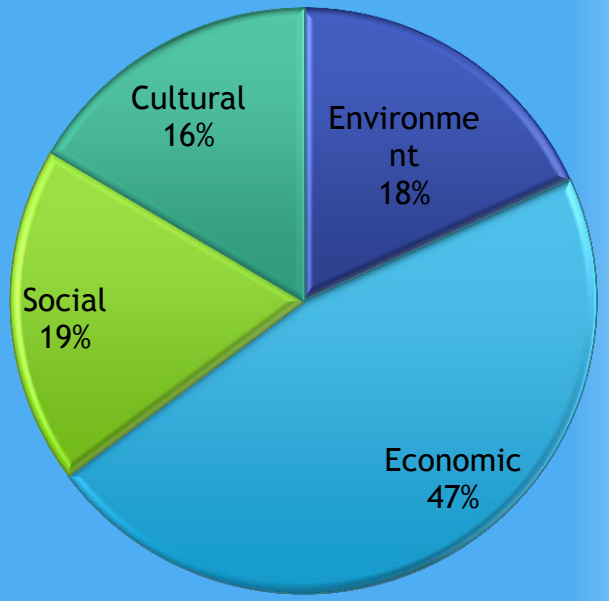
1. **Community**: representatives of the community at large
2. **Local Government**: representatives of local (municipal) government
3. **Business/Industry**: community industries
4. **Professional**: professionals providing service to the community, e.g., lawyers, doctors, nurses, engineers, etc.

*Participants

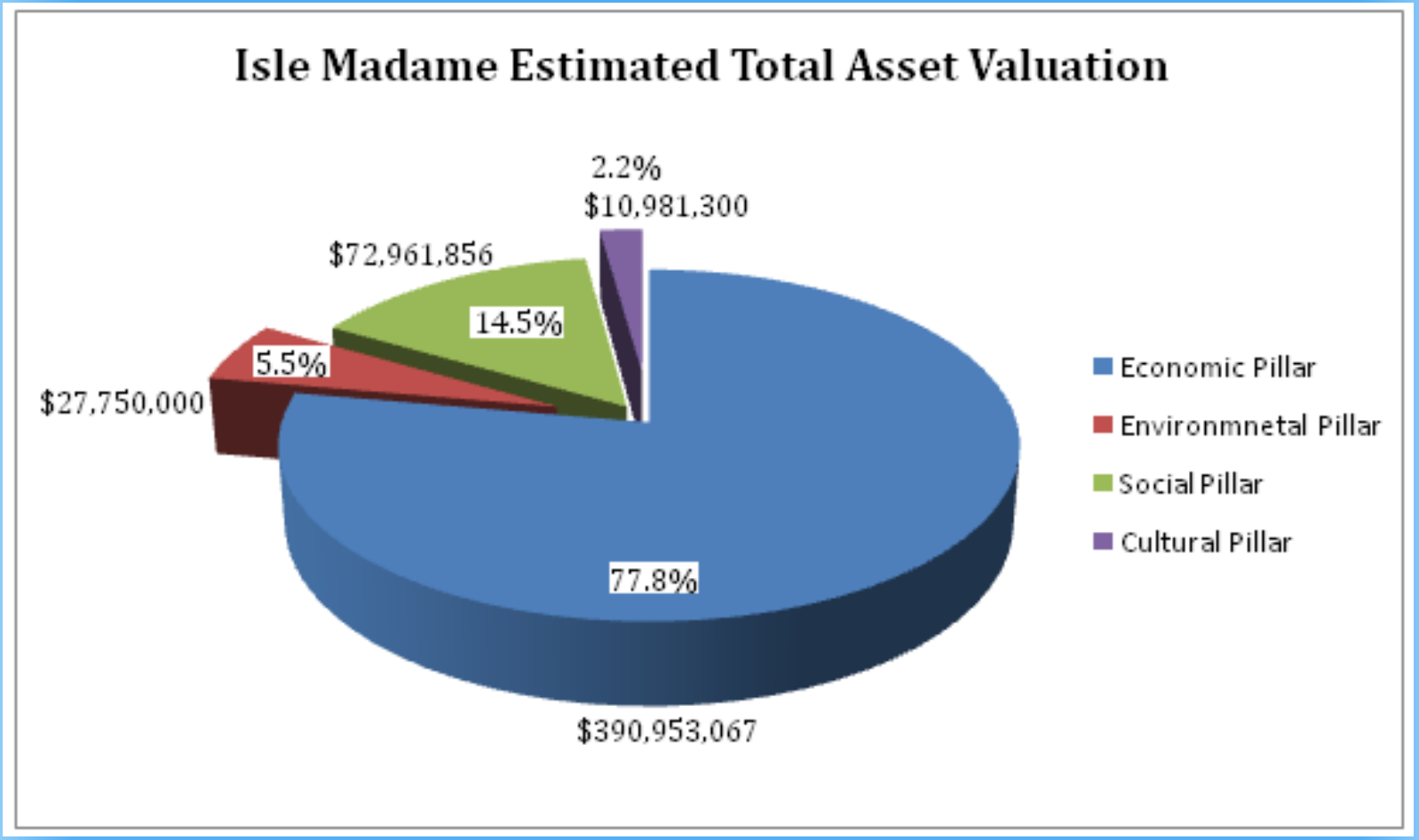
Local Government



Business/Industry



* Isle Madame Asset (Pakdel 2011)



*Coffee Break