Improving Port Safety through Geographic Information Systems (GIS)

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28th May 2014

Contents – Geographical Information Systems

1. Who Marico are and what we do.
2. Explanation of the Emerging Capability and Benefits of GIS for Risk Assessment.
3. Practical Examples from around the Globe.

Marico Marine

- We operate out of Southampton UK and Wellington NZ. Operating since 1999, 15 Years Trading;
- Opened in New Zealand in 2004;
- Provide Development and Risk Management support in many Harbours worldwide;
- Navigational Risk Assessments for Decision Making;
- HAZMAN II Online Port and Harbour Risk Management Tool (Linked Incident Database);
- We are a marriage of salt water and science, employing master mariners, harbour masters, engineers and scientists.

What is GIS? Well it has a Definition!

- **"A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information." ESRI (2014).**

The Problem GIS Solved

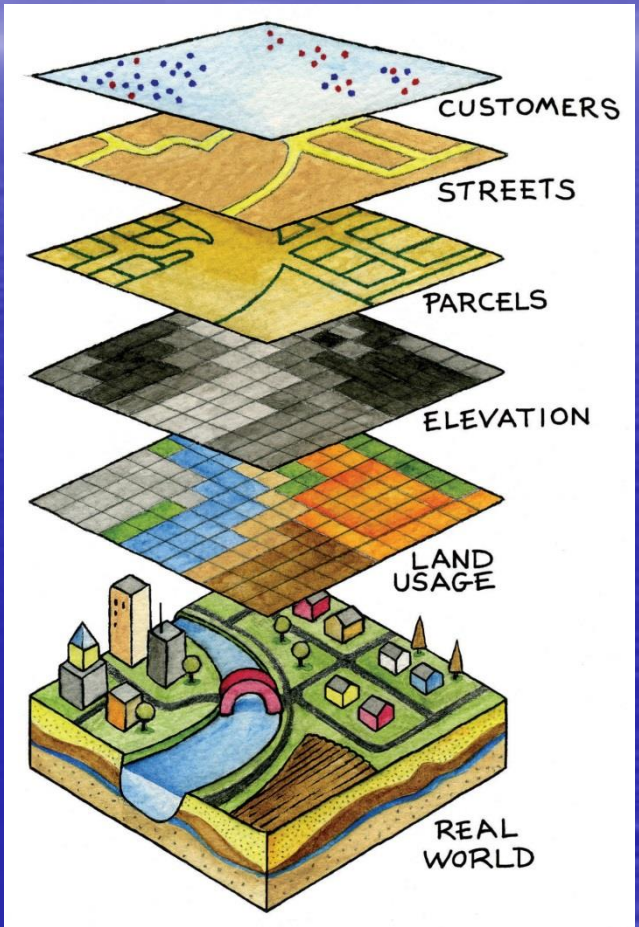
- **Limitations of traditional risk assessment:**
  - **Expert Judgement (traditional marine expertise is getting difficult to find);**
  - **Incident Analysis; and**
  - **Presentation of results in complex harbour systems.**

The Case for Geographical Information Systems(GIS)

- **GIS has been around now for quite some time but it has though become much more powerful;**
- **Synthesis (Connection) of multiple data sets;**
- **Provides a geographical visual interface;**
- **Powerfully informs and complements expert judgement with data driven analysis;**
- **Can supply clarity when the scale of a study area is large.**

Geographic Approach

- **Collect data;**
- **Store and Manage data;**
- **Analyse the data; and**
- **Present the data (Charts/Maps).**



Case Studies

RIVER THAMES CENTRAL LONDON TRAFFIC STUDY

PORT OF LONDON AUTHORITY

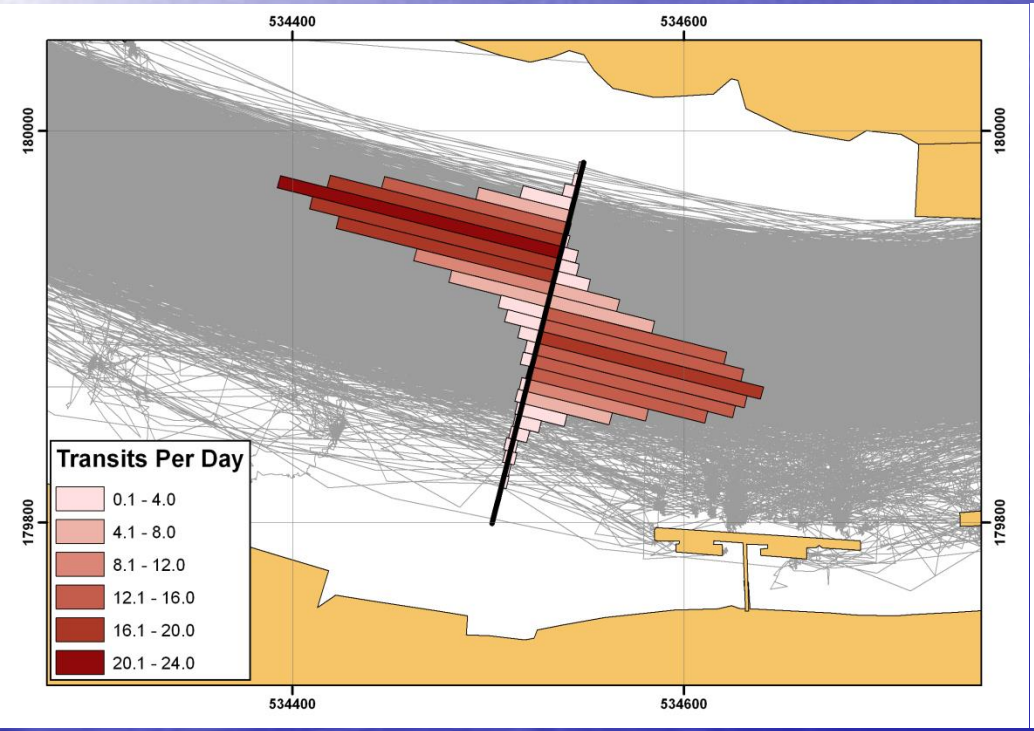
28th May 2014

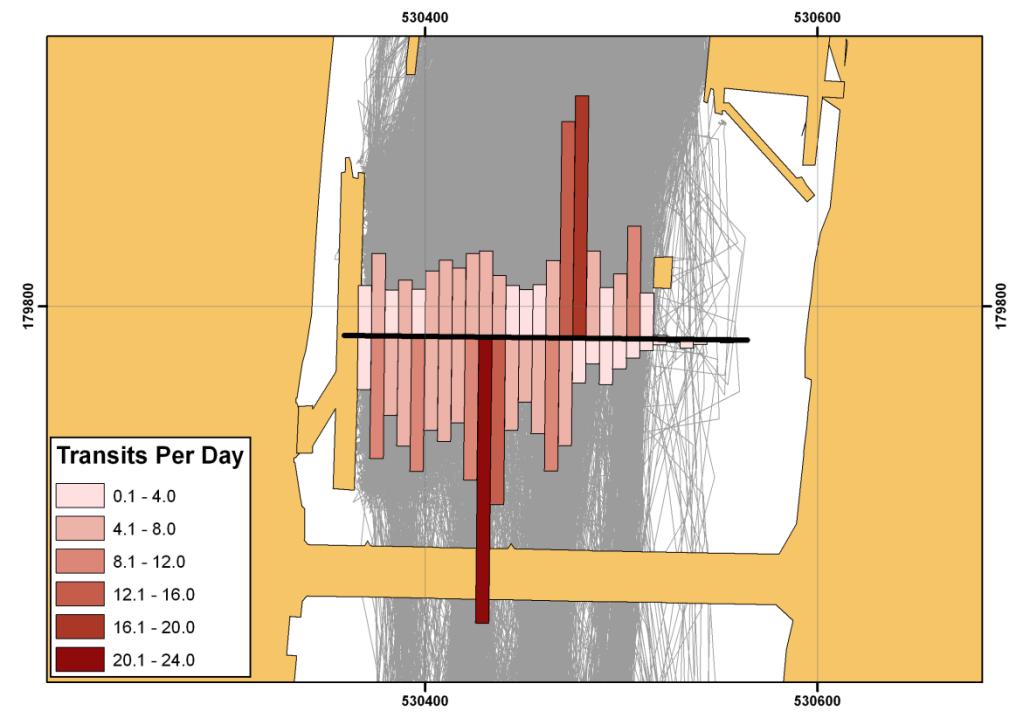
MARICO MARINE

9th IHMA Congress
26th – 30th May 2014, Bruges – Ghent, Belgium

Traffic under London Bridge – 1 Hour

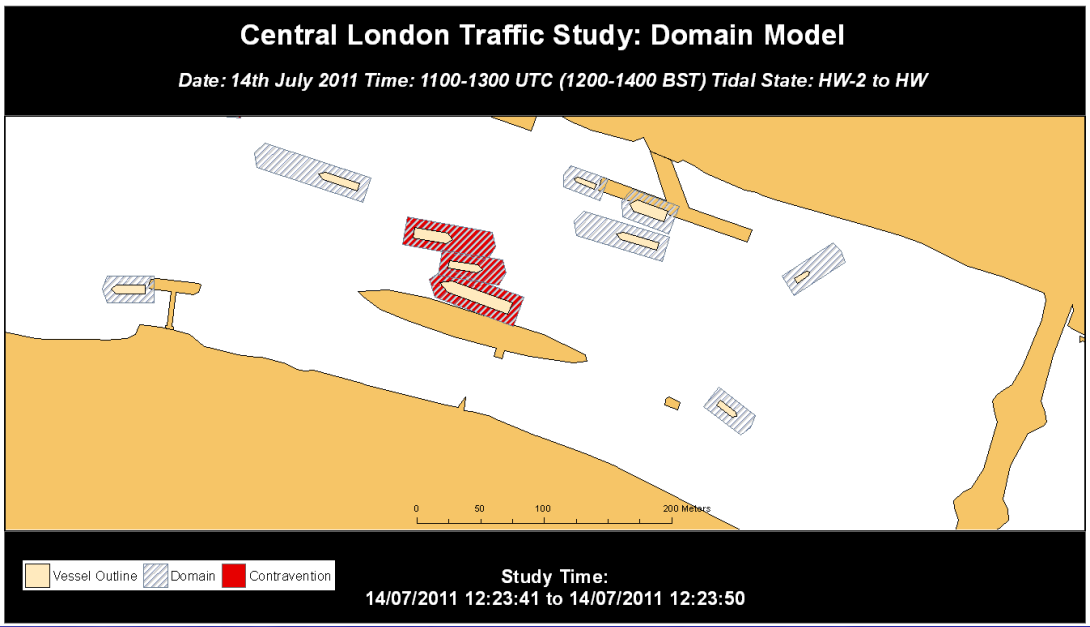
Traffic Density Profile
The Detail Supplied by Data is Key





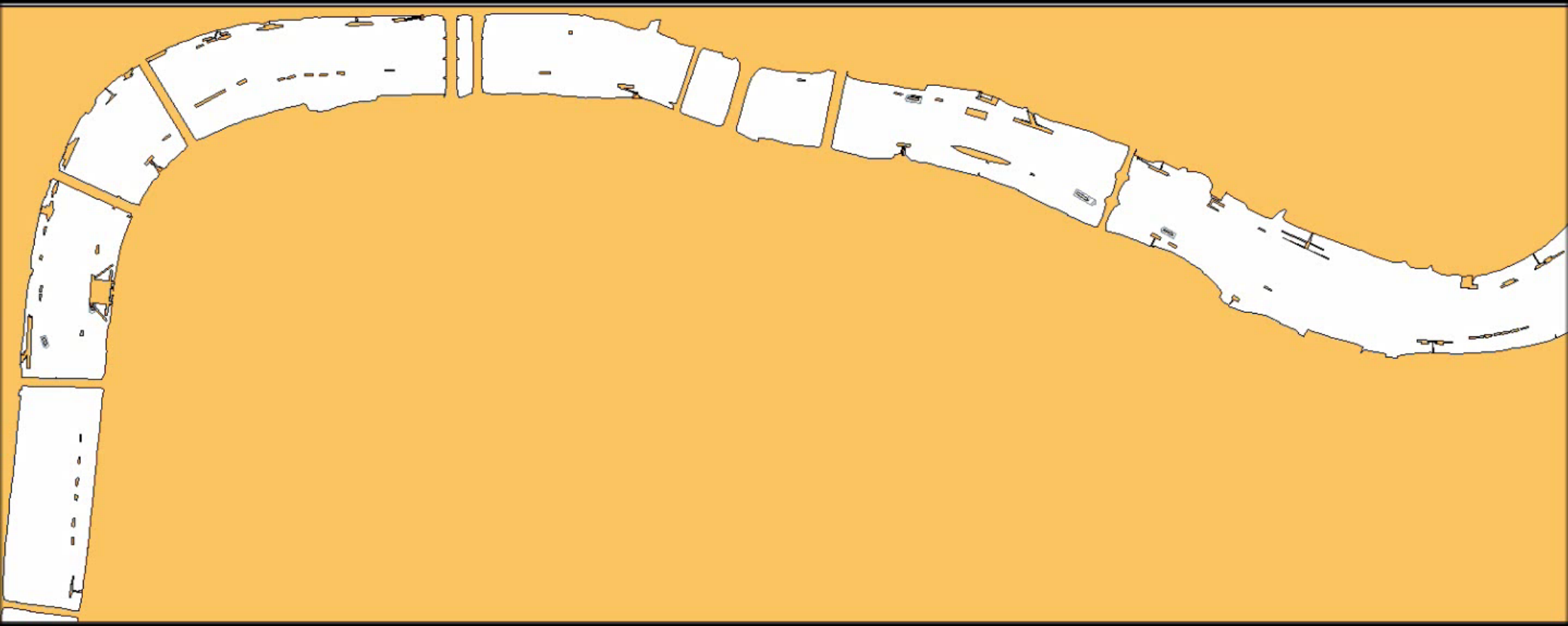
Vessel Encounter Assessments

- **Dynamic safety buffer around vessels - "Domains"**
- **Count the number of vessel encounters at different times of day and number of exposed vessels.**



Central London Traffic Study: Domain Model

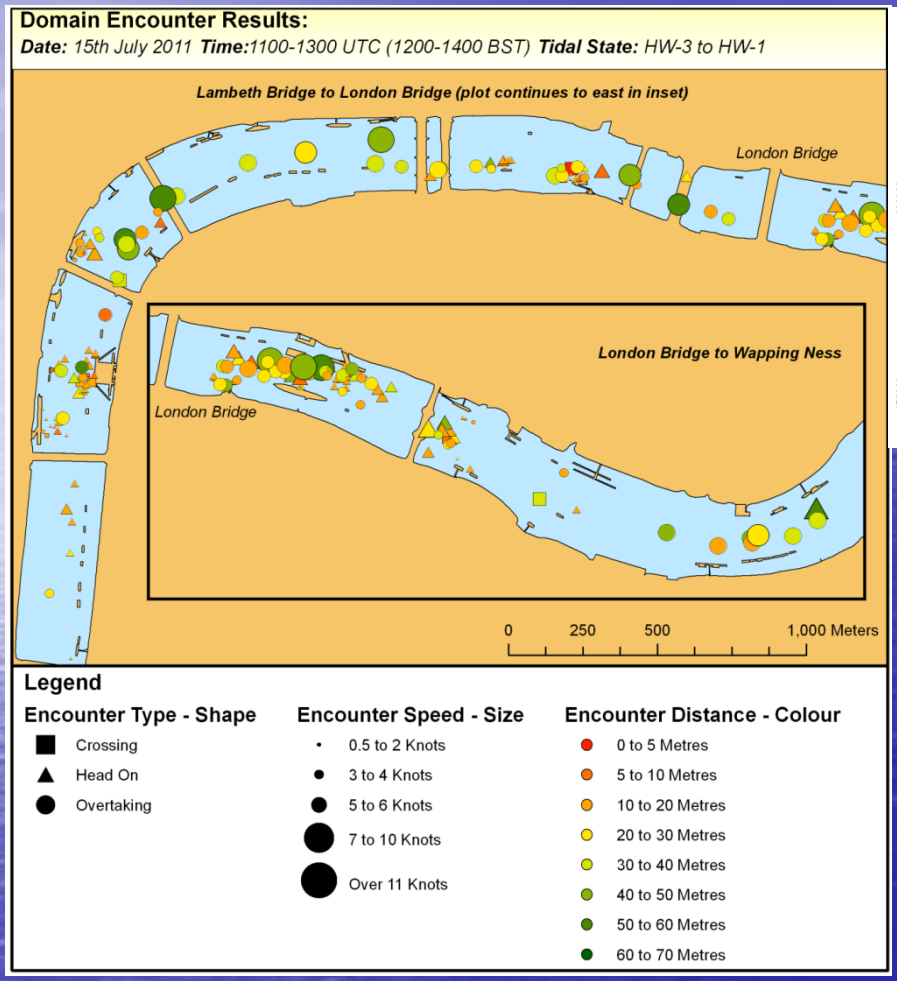
Date: 14th July 2011 Time: 1100-1300 UTC (1200-1400 BST) Tidal State: HW-2 to HW

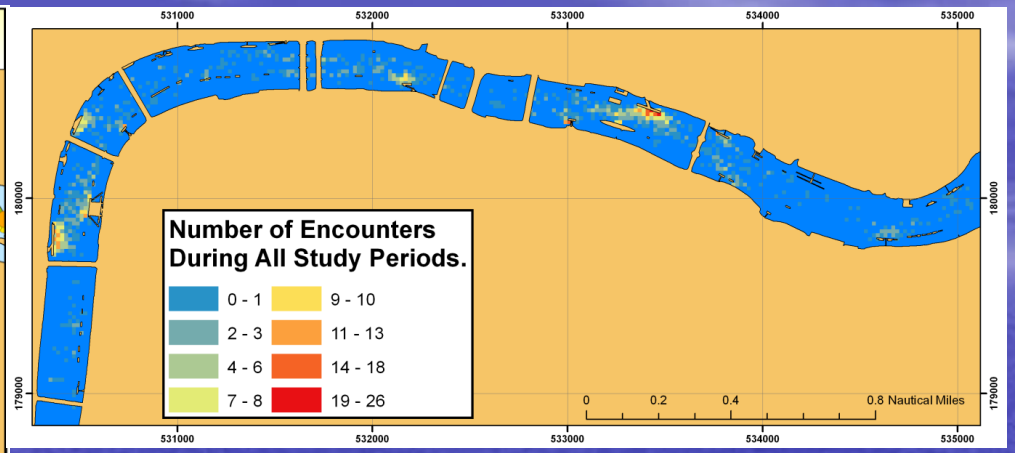


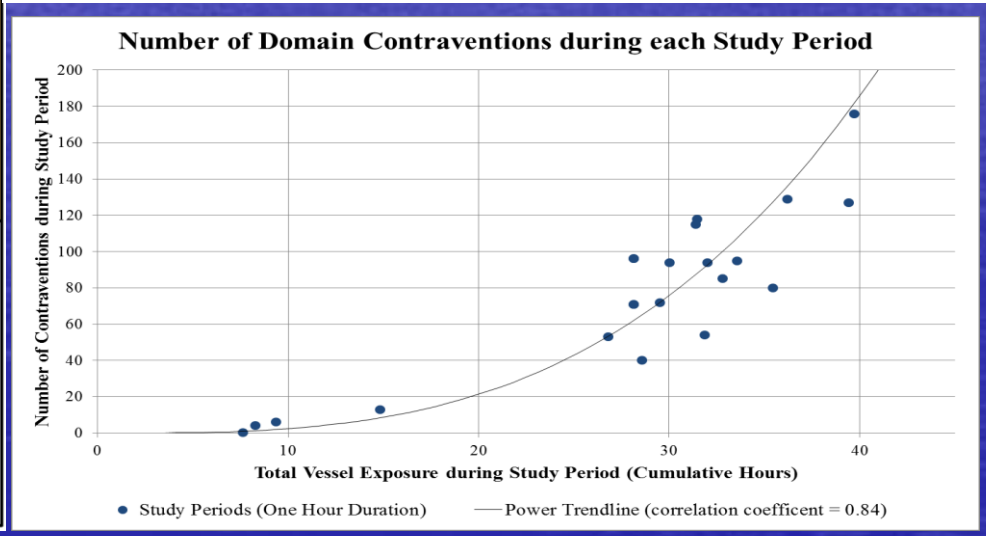
PORT OF LONDON AUTHORITY

Study Time:
14/07/2011 10:59:51 to 14/07/2011 11:00:00

MARICO MARINE







Rawson et al. (2014), Journal of Navigation

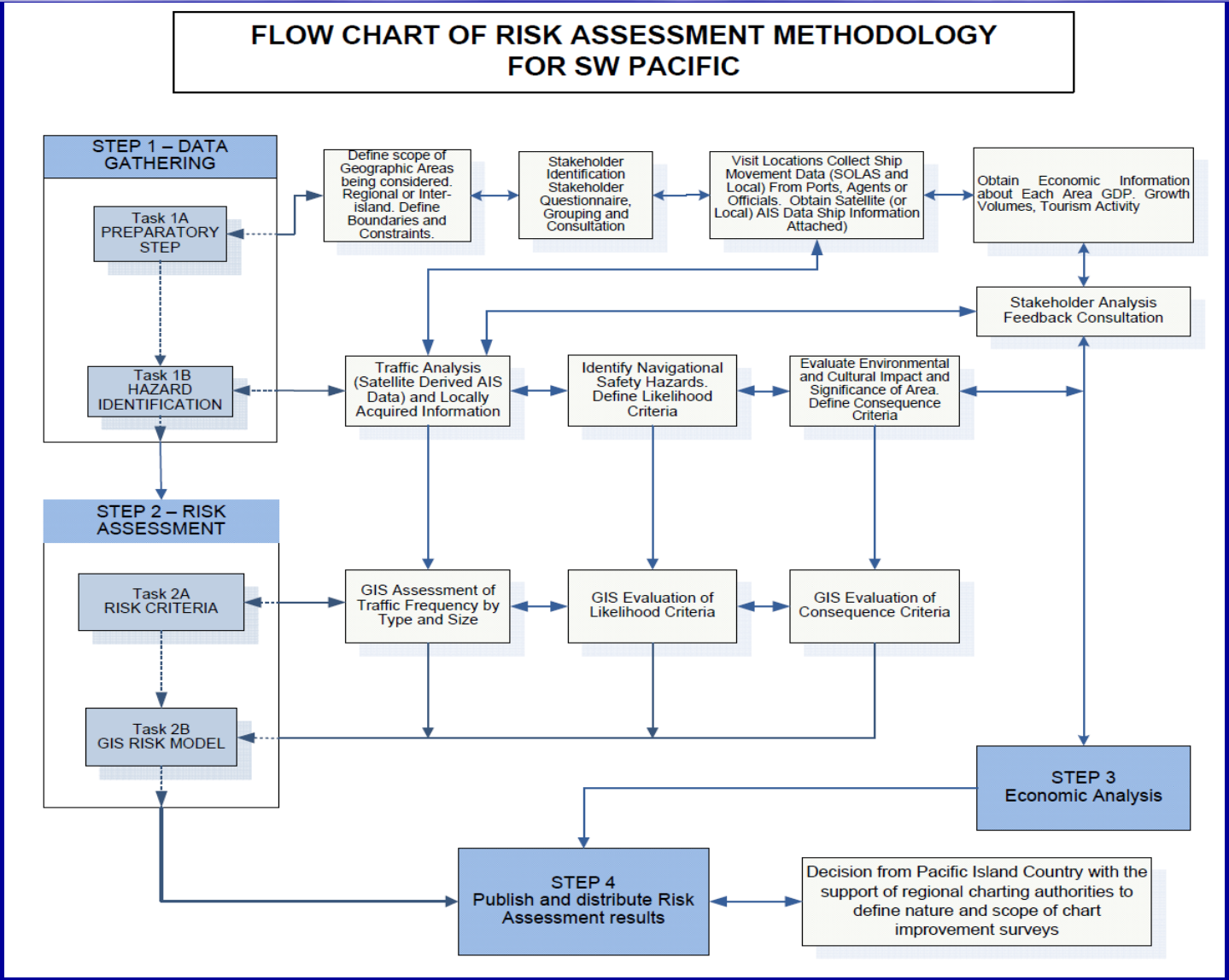
South West Pacific Hydrography Risk Assessment

- **A Large Risk Assessment Programme in the SW Pacific using GIS to derive where Nautical Charts Should be improved.**
- **Methodology Developed similar to the IMO Formal Safety Assessment Methodology, with Hydrography needs Paramount.**

NEW ZEALAND
FOREIGN AFFAIRS & TRADE
Aid Programme

Land Information New Zealand
Toitū te whenua

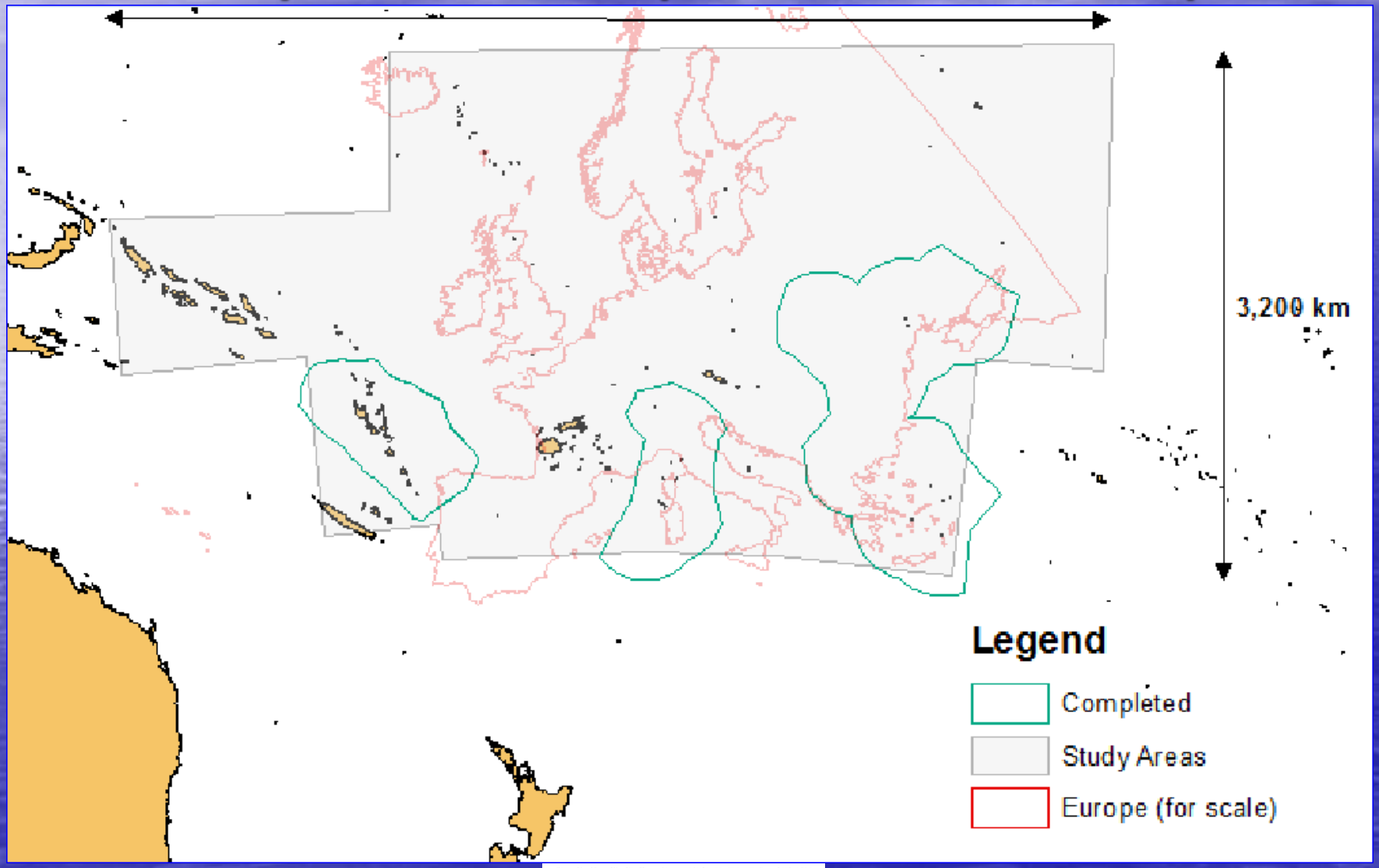
Hydrographic Risk Assessment Methodology



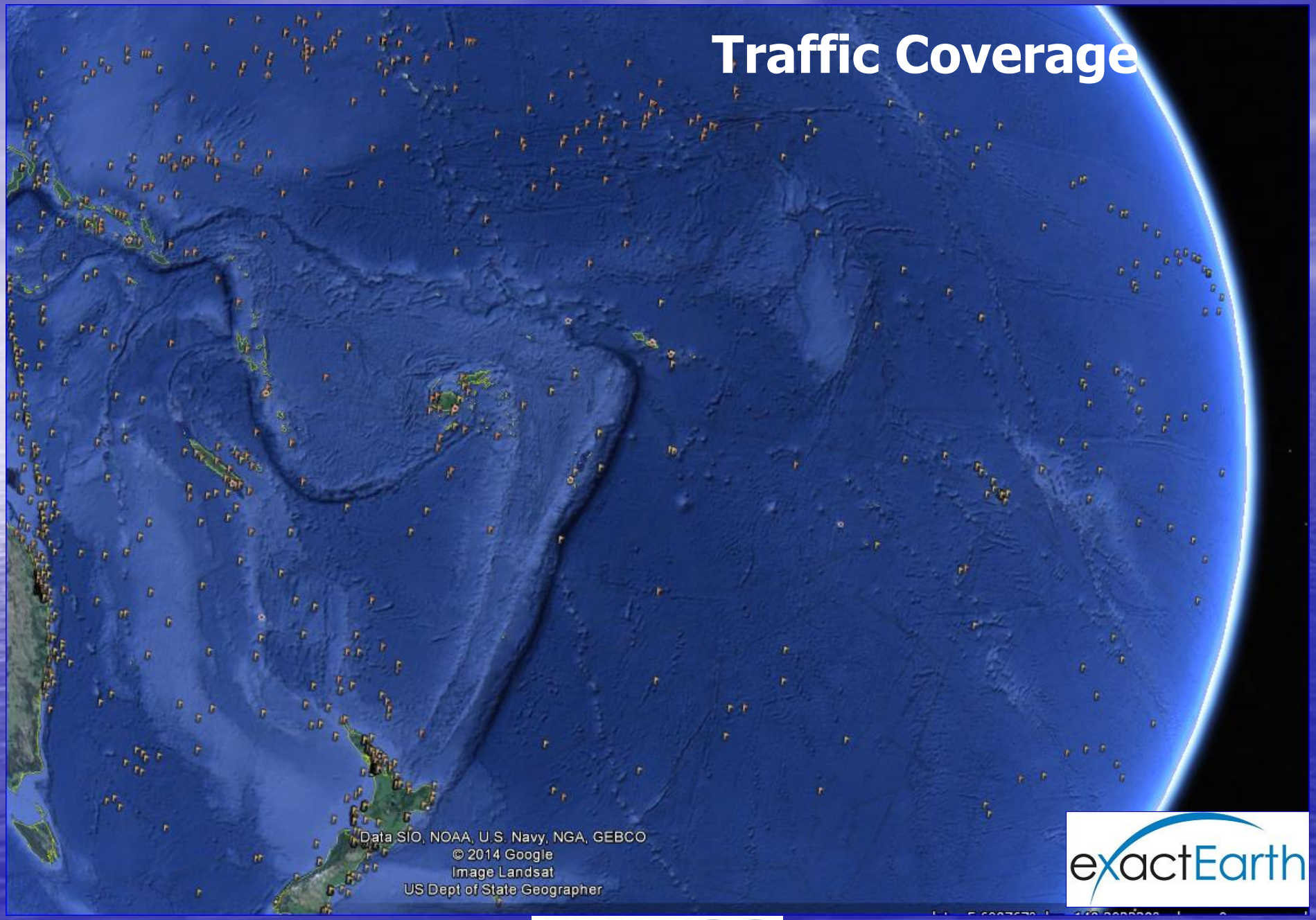
SW Pacific Scope

- Study area is 6,100 km wide and 3,200 km high.
- Approx. Total area is 16.3 million square km.
- Approx. Total area completed is 3.1 million square km (19%).
- The European Union could fit in 4 times, and the total area is equivalent to 75% of Europe's landmass.
- Even Australia could fit in twice.

Scale of the Charting Problem
Study Area Compared with Europe

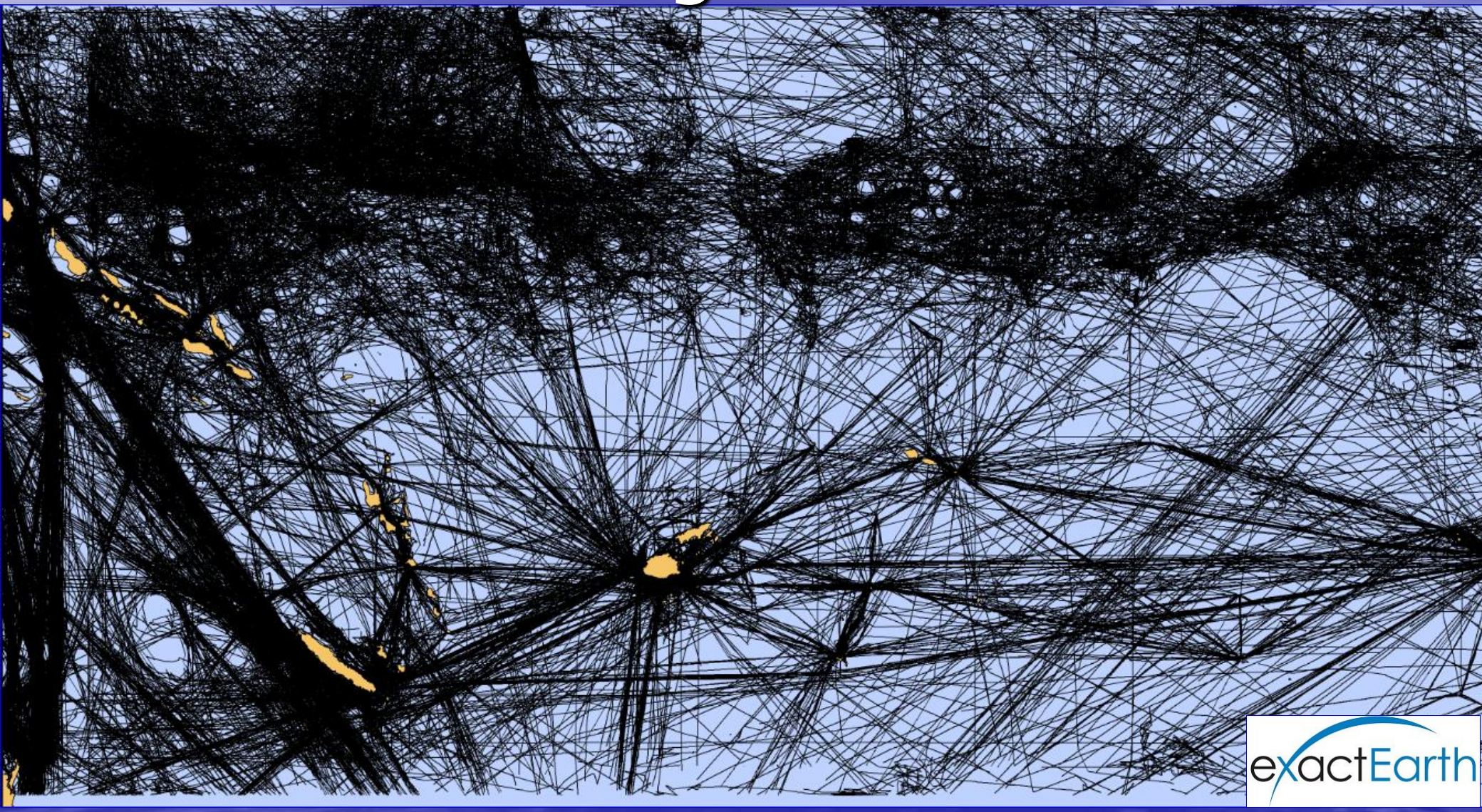


Traffic Coverage



exactEarth

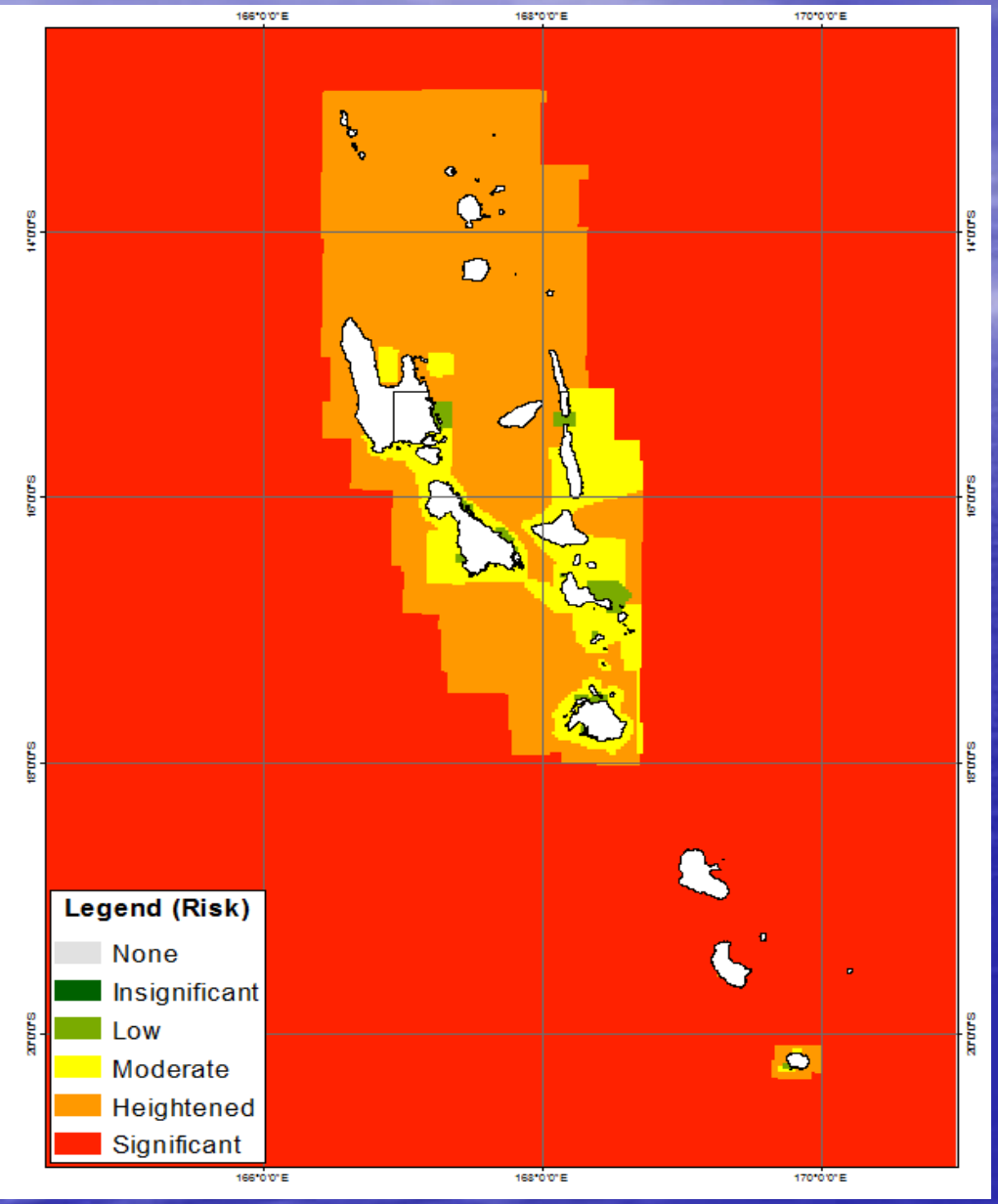
AIS Live Coverage – SW Pacific



GIS Risk Terrain Modelling (RTM)

- **The GIS approach allows many layers of data to be presented to decision makers;**
- **Common Likelihood & Consequence risk factors for each area result in 29 Different GIS Layers, including shipping traffic from AIS;**
- **A Risk Matrix sets the risk criteria for calculations on each layer;**
- **Other Layers are Environmentally Important Locations, Culturally Valuable locations and Areas of Economic Activity;**
- **Shipping Traffic (International and Domestic) is the key underlying layer - no ships no risk.**

Risk Model Variables



Causation Risk Factors

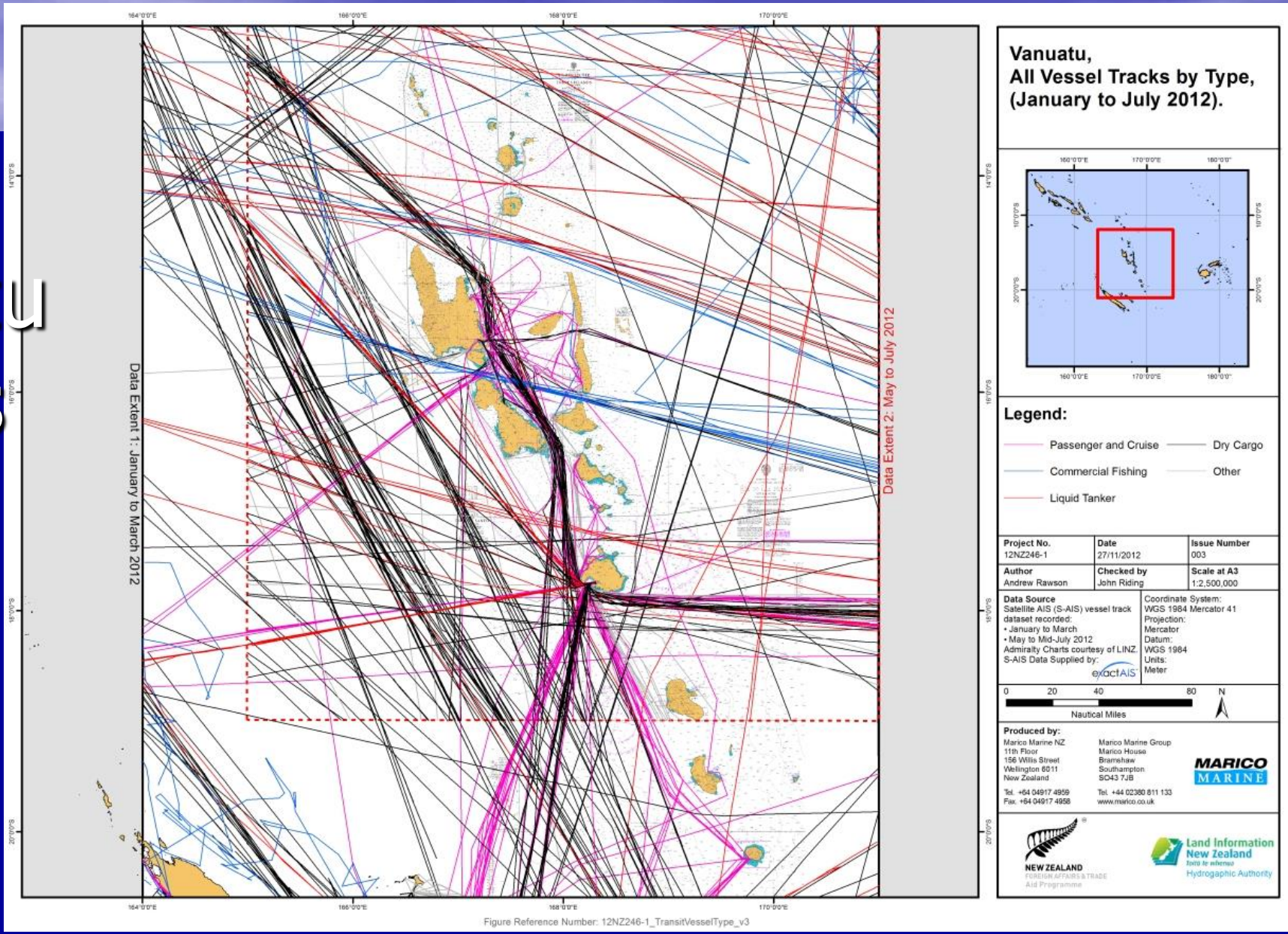
- Bottom type
- Navigationally complexity
- Chart quality - CATZOC
- Aids to navigation
- Depth – bathymetry

Consequence Risk Factors

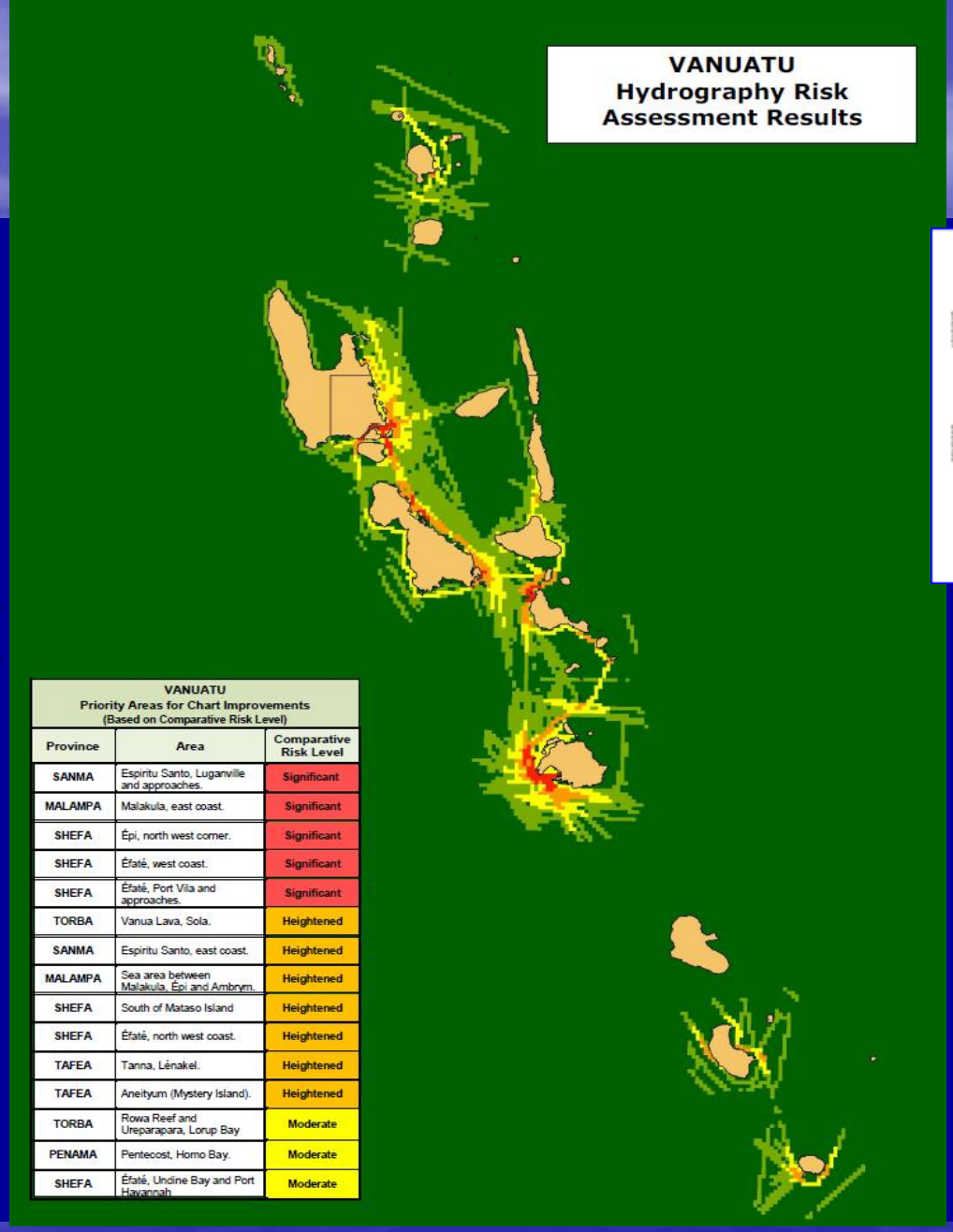
- Coral Reefs
- Mangroves
- Breeding grounds
- Protected sites
- Key infrastructure - ports

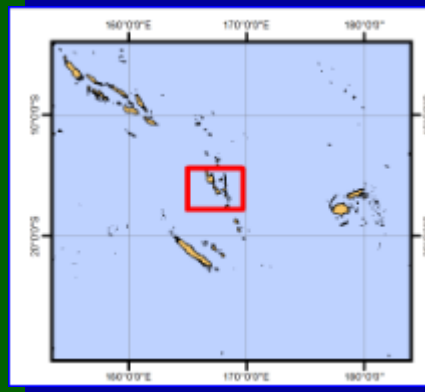
Vanuatu Results

All Traffic



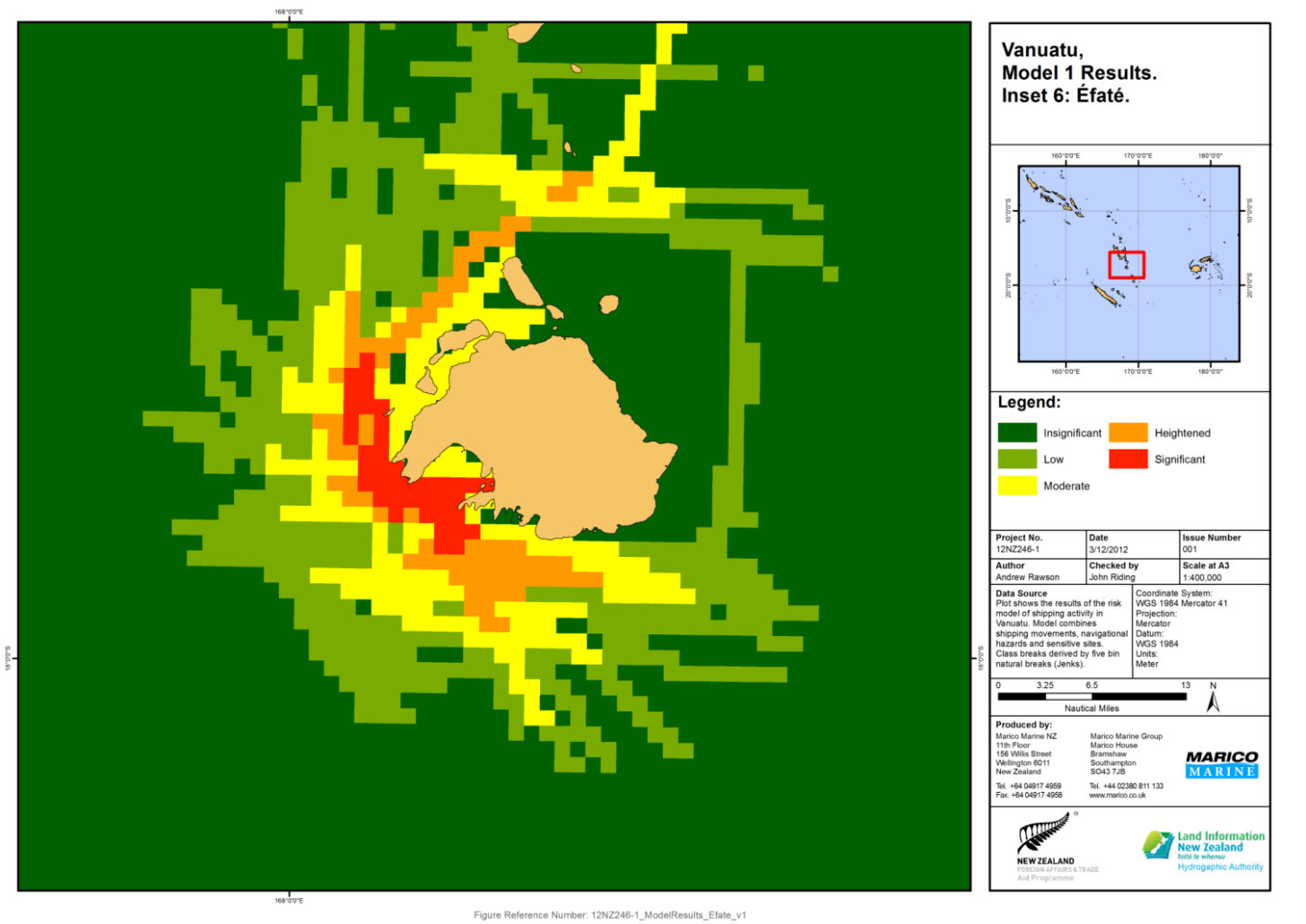
Vanuatu Results Risk Output





VANUATU Priority Areas for Chart Improvements (Based on Comparative Risk Level)		
Province	Area	Comparative Risk Level
SANMA	Espiritu Santo, Luganville and approaches.	Significant
MALAMPA	Malakula, east coast.	Significant
SHEFA	Épi, north west corner.	Significant
SHEFA	Éfaté, west coast.	Significant
SHEFA	Éfaté, Port Vila and approaches.	Significant
TORBA	Vanua Lava, Sola.	Heightened
SANMA	Espiritu Santo, east coast.	Heightened
MALAMPA	Sea area between Malakula, Épi and Ambrym.	Heightened
SHEFA	South of Mataso Island	Heightened
SHEFA	Éfaté, north west coast.	Heightened
TAFEA	Tanna, Lénakel.	Heightened
TAFEA	Aneityum (Mystery Island).	Heightened
TORBA	Rowa Reef and Ureparapara, Lorup Bay	Moderate
PENAMA	Pentecost, Homo Bay.	Moderate
SHEFA	Éfaté, Undine Bay and Port Havannah	Moderate

Vanuatu Zoom - Efaté



Tonga Results

Cruise Ships

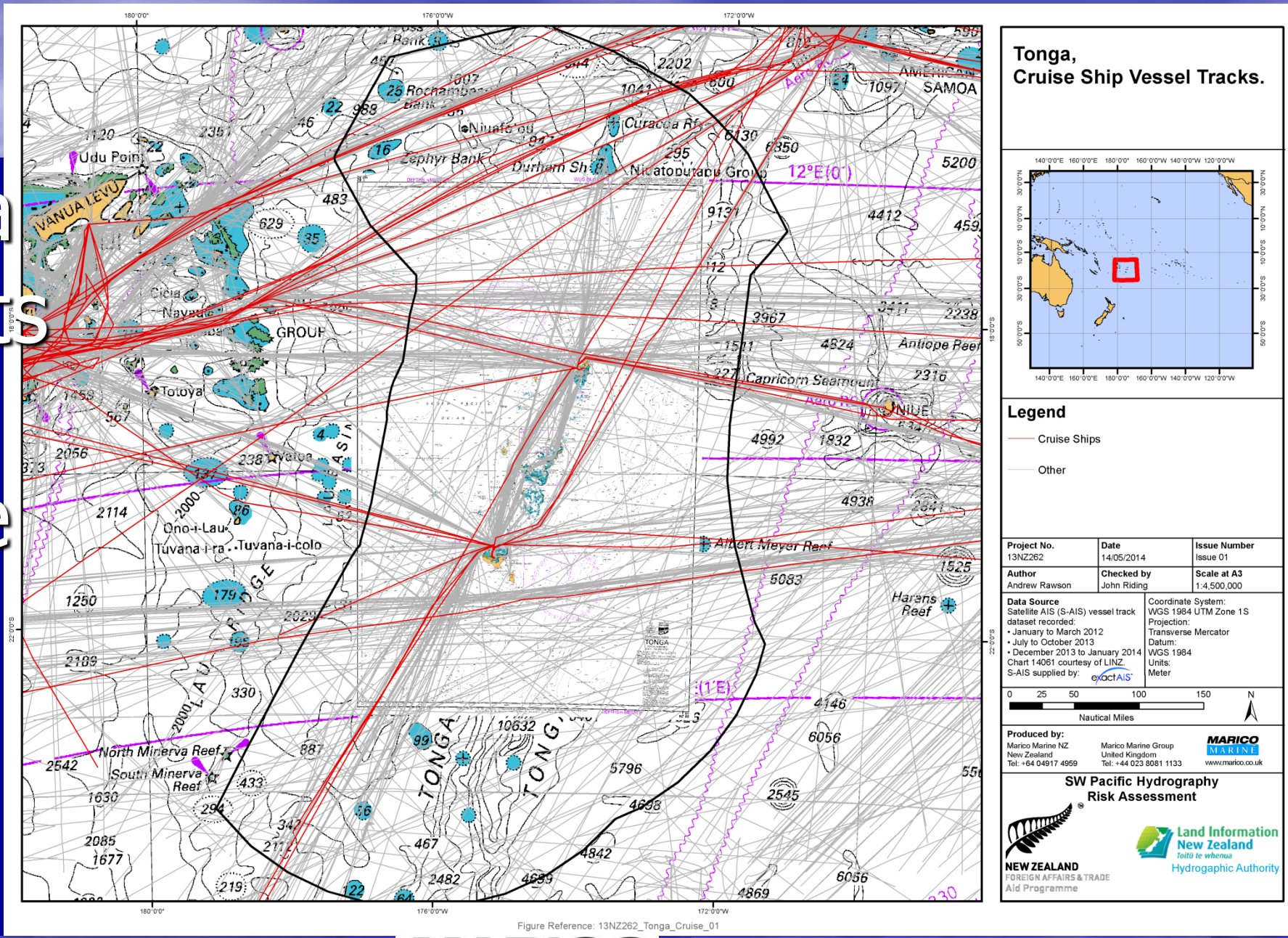
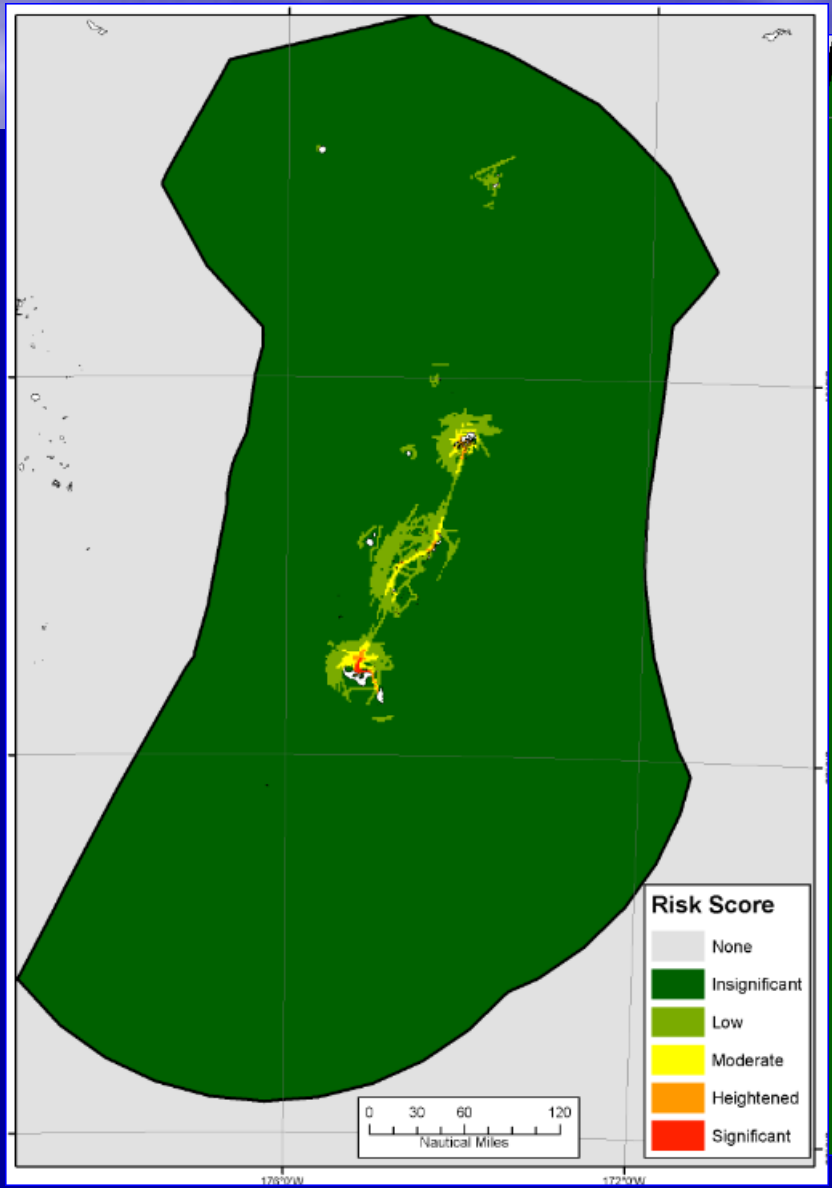
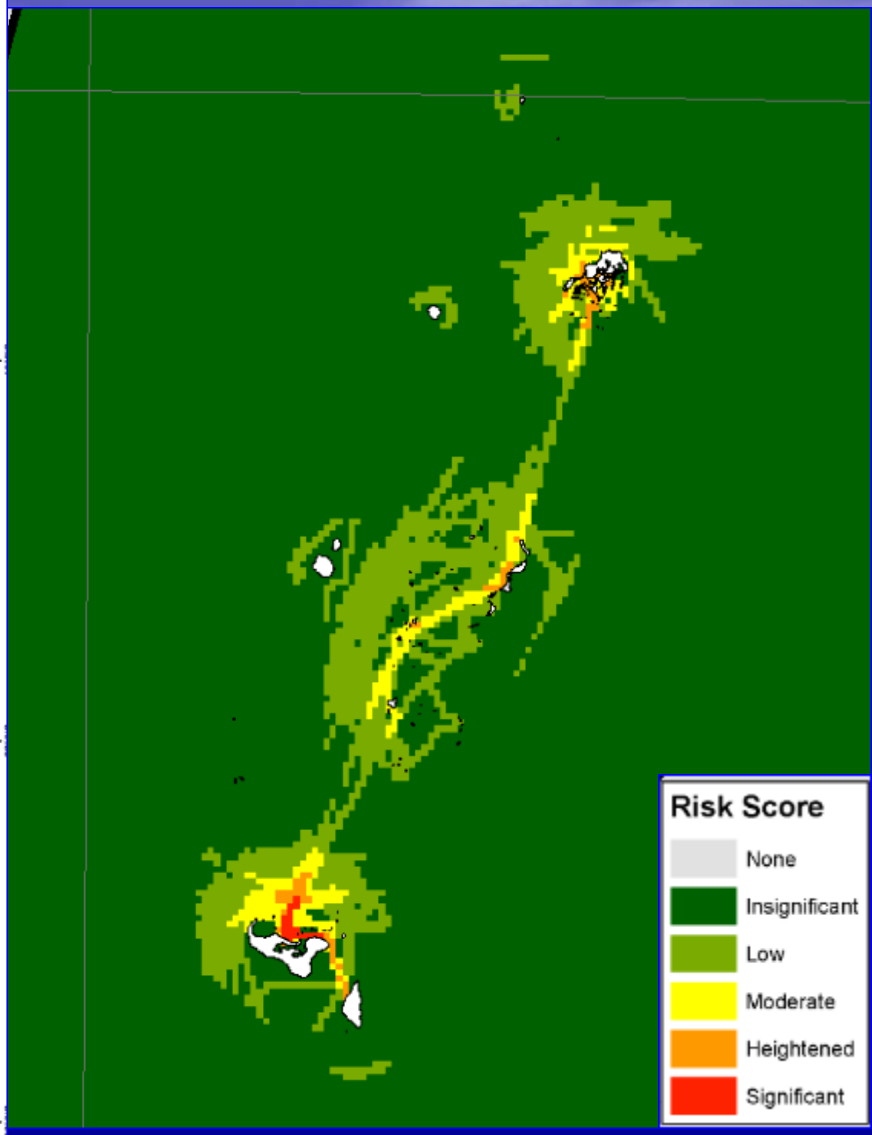


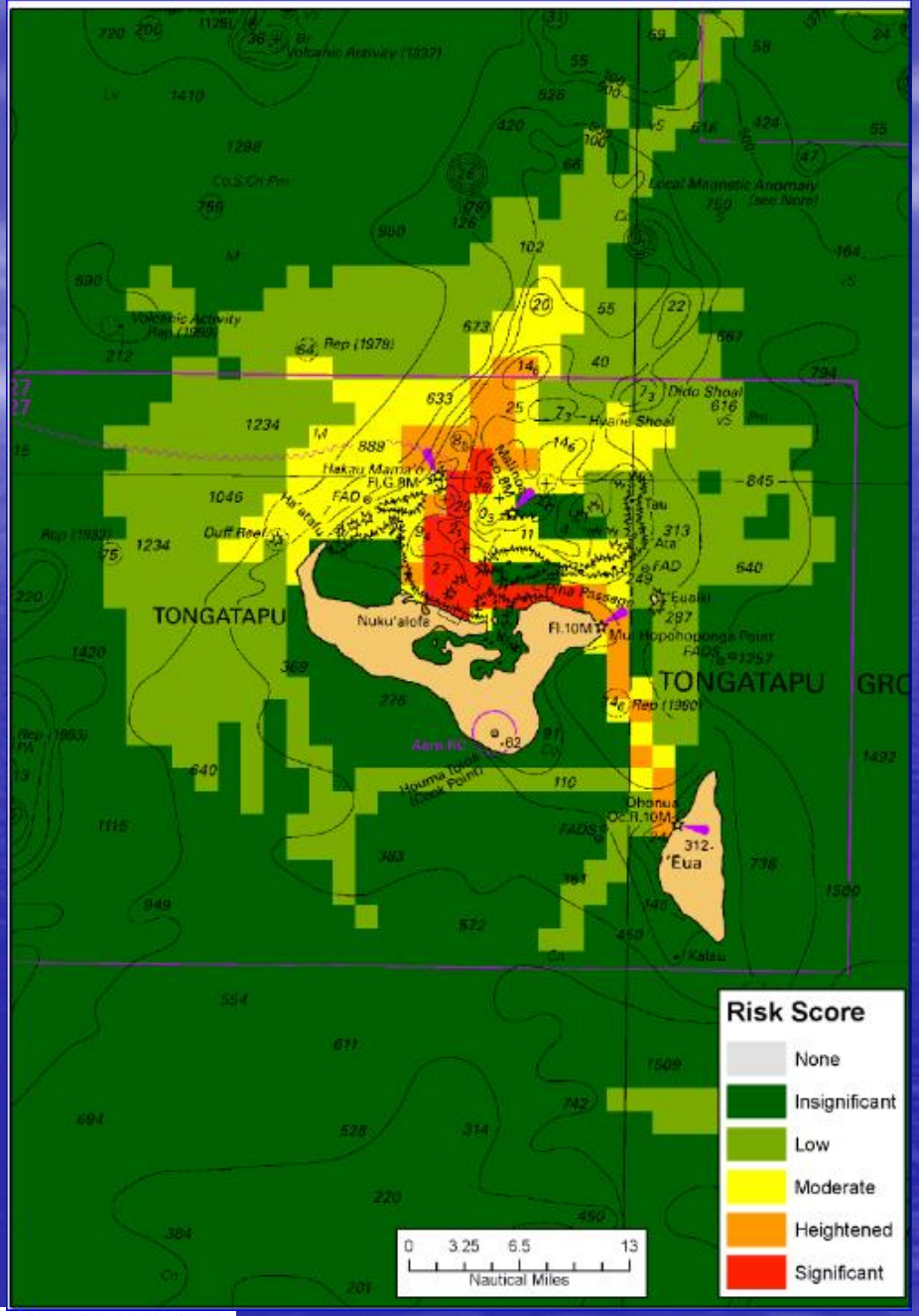
Figure Reference: 13NZ262_Tonga_Cruise_01

Tonga Results Risk Output

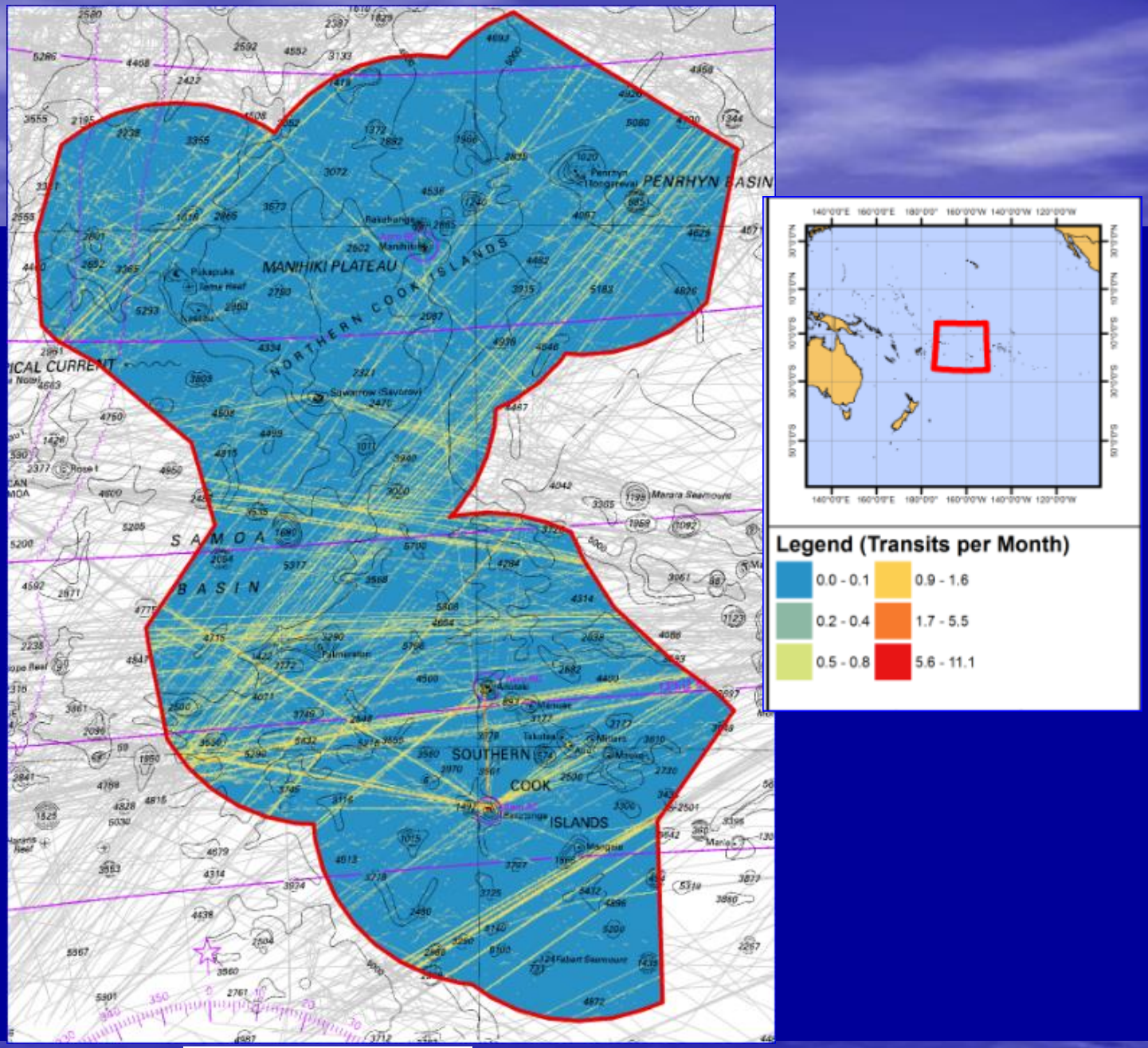




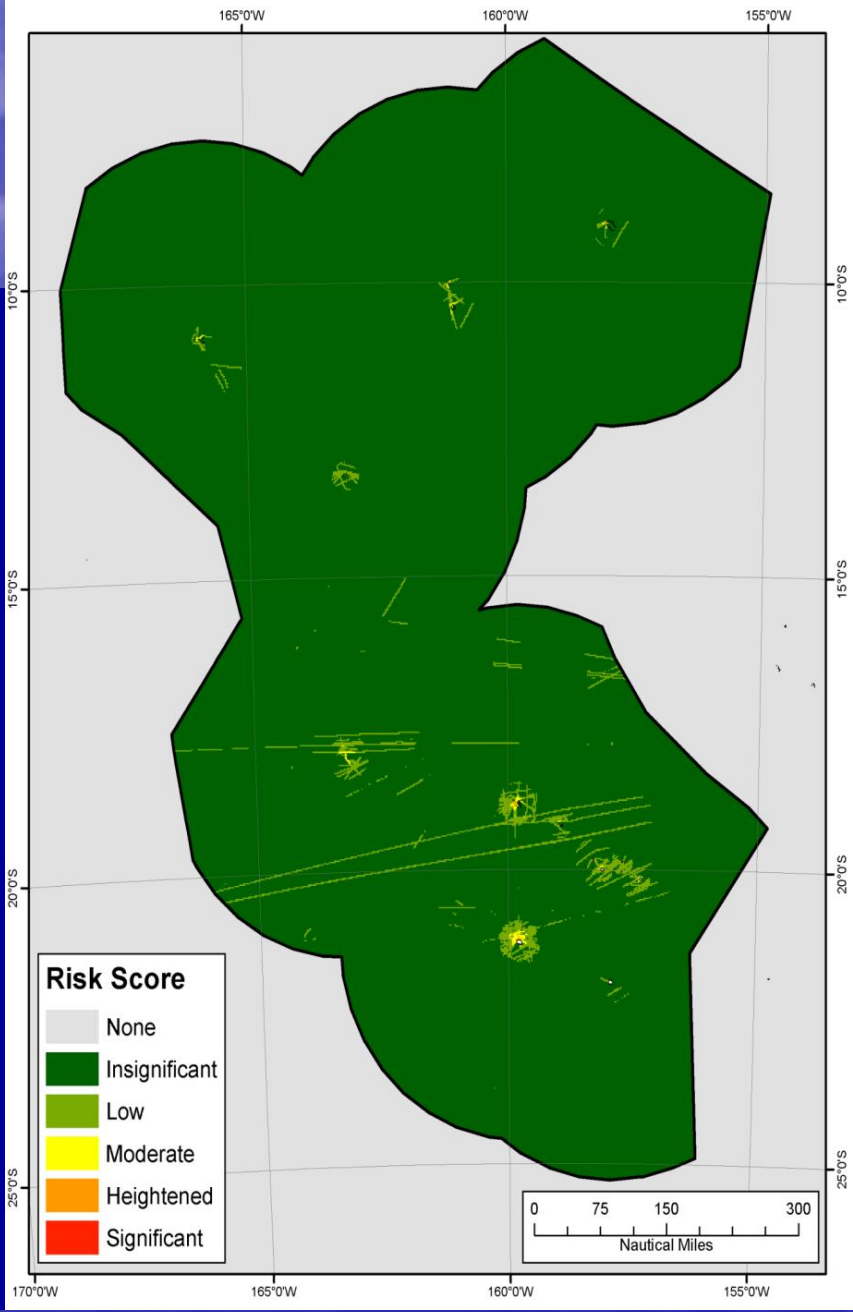
Tonga Zoom Nuku'akofa



Cooks Result Track Density

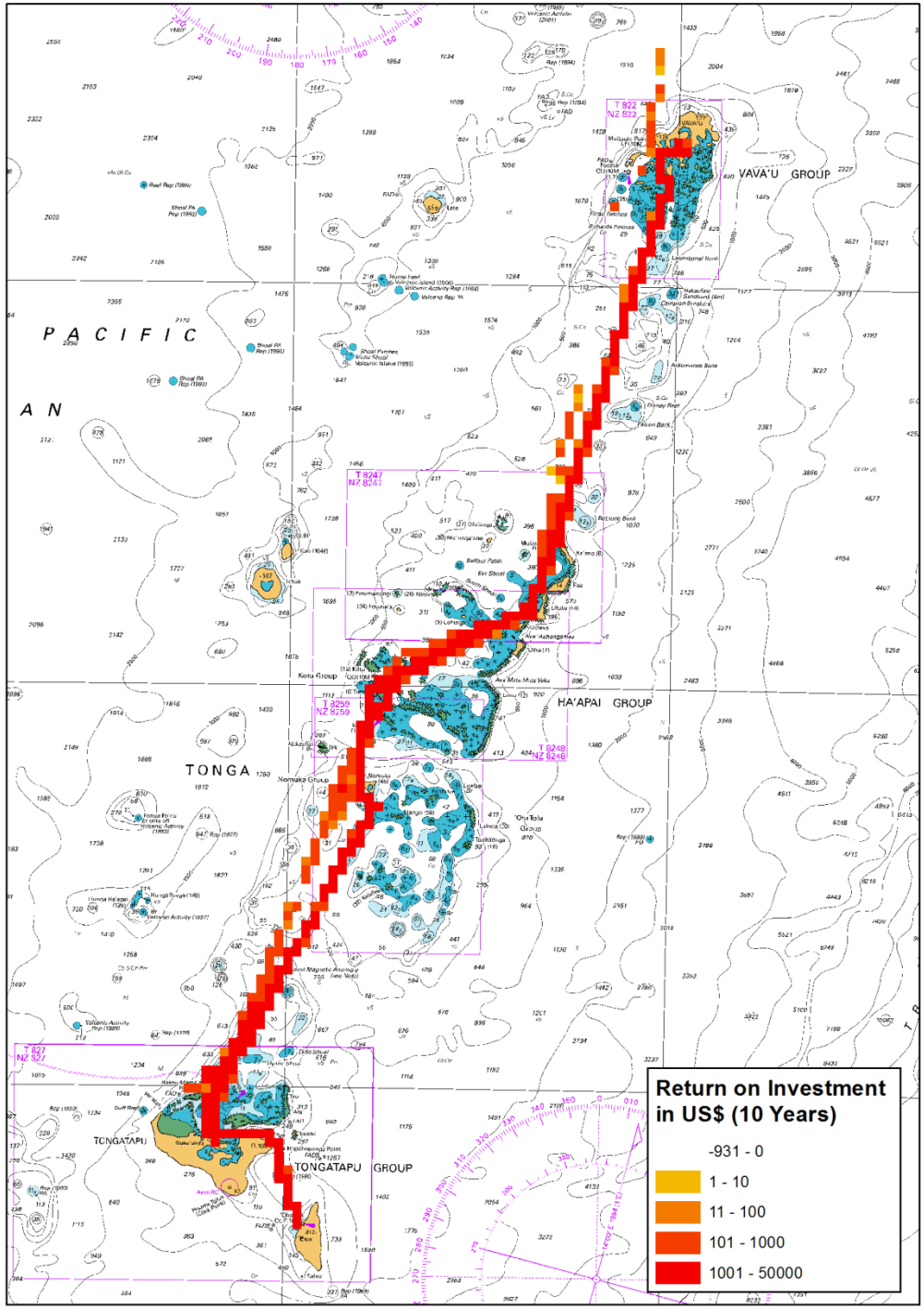


Cooks Results



Add a Financial Layer…….

Plot of +Ve Cost Benefit For Charting Update



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Summary

- **Risk assessments become much more powerful when they can access multiple data sources;**
- **GIS can improve risk assessments using data driven scientific analysis;**
- **GIS can readily communicate complex results.**

Thanks for Listening!

John Riding
Andrew Rawson

28th May 2014