# FIG WORKING WEEK 2019

## 22–26 April, Hanoi, Vietnam



"Geospatial Information for a Smarter Life and Environmental Resilience"




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# International Standards for Hydrographic Surveyors and Nautical Cartographers

(Knowing your Limits & Boundaries)

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# Standards

Introduction
Standards
Rationale
Coverage and relevance re Marine Boundaries
Marine Boundaires & Surveyors – It is Important
Conclusions


- **SDGs**
- **1,2,5,11,15,16 are directly related to Land issues**
- **New Urban Agenda & Rapid Urbanisation**
- **1,2,3,6,7,8,9,11,12,13,14,(15 & 17) are related to seas and oceans**

# International Standards for Hydrographic Surveyors

**Historical development of the Standards:** During the International Congress of Surveyors (FIG) at Wiesbaden in **1971**, a Working Group (WG) was formed by Commission IV (Hydrography) to develop International Standards of Competence within the profession of surveying at sea.

In 1972, during the International Hydrographic Conference in Monaco, the International Hydrographic Organization (IHO) set up a working group for the compilation of training programmes in Hydrography conducted by Member States.

In **1974, at the XIV FIG Congress in Washington**, it was resolved that the FIG and IHO working groups combine to study and modify the Report of the FIG working group on Educational Standards. The Report of the joint FIG-IHO WG was **accepted** by the two parent bodies at their respective conferences **in 1977**.

In consequence of similar resolutions passed at these conferences an FIG/IHO International Advisory Board on Standards of Competence for Hydrographic Surveyors (the Board) was formed.

**The 42nd meeting was held in Honolulu last month ☺**

- **1971……**



- Petrol (Gas) was **33 cents a gallon** in USA
- The UK introduced decimal currency
- Walt Disney World opens
- **Intel** develops the first microprocessor, the 4004
- **India and Pakistan** at war over their border
- The **United Arab Emirates** is established
- Apollo 14 lands on the **Moon**
- Salyut 1 space station goes into orbit
- Mariner 9 reaches **Mars**
- The earth has less than 5% of its seas and oceans mapped.
- **Switzerland** grants Women the right to vote……

# The Standards are maintained by FIG, IHO and ICA

## The International Board for Standards of Competences

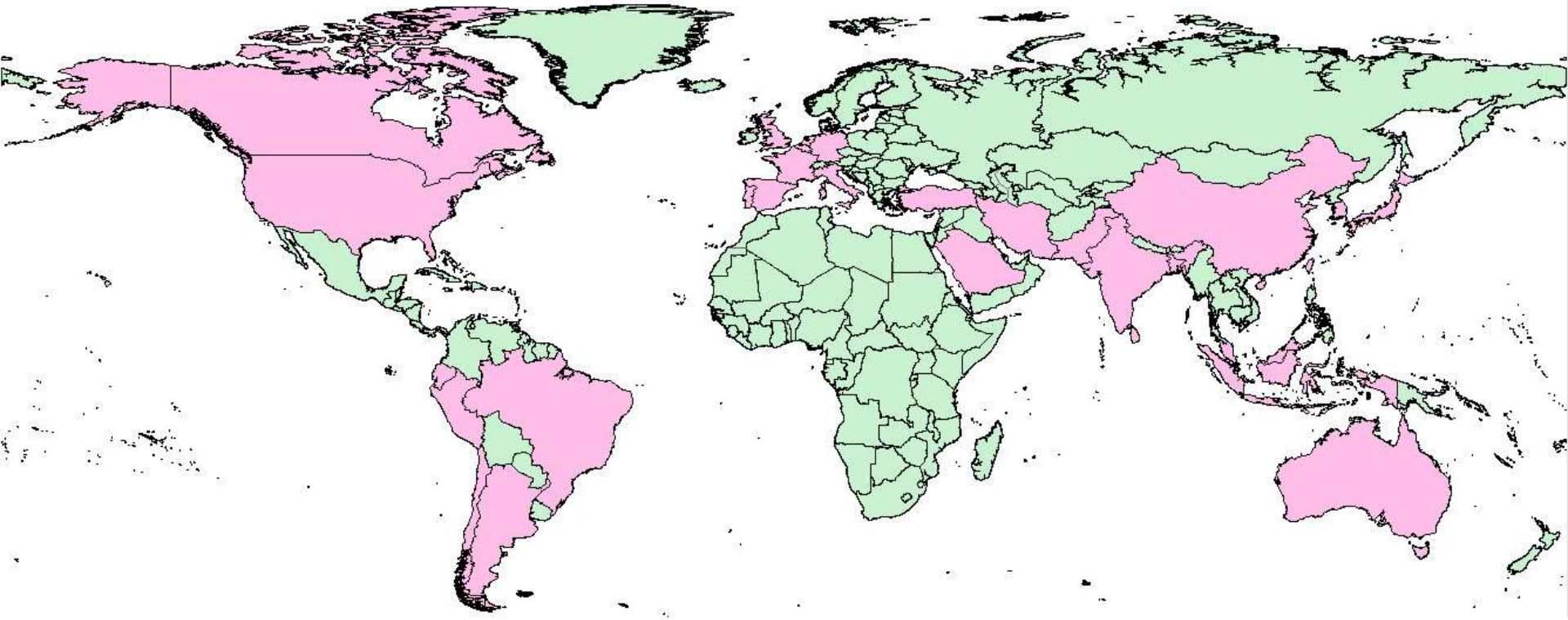
- 10 members from parent organisations (4 FIG, 4 IHO and 2 ICA),
- Governemental, educational and civil sector;
- Experienced professionals in education, hydrography and cartography, from various areas of the world (Australia, Brazil,France, Caribbean, Greece, Indonesia, New Zealand, UK, USA)

# The role of the Board

- **Review** syllabi of programmes and individual recognition schemes from education and training organizations (**60+** recognized programs, average 15-18 submissions in December each year);
- **Maintain IBSC publications**
- **Provide guidance** to education and training institutions;
- **Supports the IHB and others** in the establishment of new hydrographic programs where regional training capacity does not exist.

- The work is carried out on a voluntary basis

# Recognized Course Distribution



# IBSC worked to Update Standards (from 2013 to 2017)

**"IBSC to develop a new Standards framework to separate competency requirements for Cat A and Cat B hydrographers and nautical cartographers" by:**

- developing **two discrete parts** in the standards S-5 and S-8 ;
- **updating their content to comply with the scientific and technological developments in the fields of Hydrography and Nautical Cartography."**

The IBSC acknowledges the:

- various ways to deliver cat A or cat B through **e-learning and/or distance learning** ;
- need for **modular learning** through limited periods of time to accumulate a full cat A and cat B curriculum ;
- role played by the **private sector** in educational activities

# Rationale for category A and category B separation (1)

**Cat A:**

- **Project leader** : design, plan, choose appropriate technology, select and supervise a survey team
- Should be familiar with underlying physics and mathematics of survey or cartographic works
- Able to evaluate survey or cartographic product against initial expectations
- In the navy : hydrographer in charge of a major survey unit
- In the industry: lead hydrographer or chief surveyor of a major project

## Rationale for category A and category B separation(2)

**Cat A standards** will be aimed at *theoretical educational and foundational background* necessary for Hydrographers/Nautical Cartographers-In-Charge and hydrographic/cartographic managers who will

- Develop specifications for surveys and charts;
- establish quality control and quality assurance systems;
- respond to the specific requirements of a full range of hydrographic/cartographic projects.

# Rationale for category A and category B separation (3)

**Category B:**

- **Watchleader** : reports to a category A project leader
- Should be familiar with fundementals and practical aspects of hydrographic surveying and/or cartographic works
- In the Navy : junior officer in charge of a survey launch
- In the Industry: team leader in charge of localized surveys

Standards will be aimed at the *Basic educational level and training of survey technicians*

# Rationale for category A and category B separation (4)

**For both categories, the ability:**

- to conduct or operate hydrographic surveys in the field;
- to utilize hydrographic/cartographic databases to compile and produce charts,

**remains a fundamental competence**, and thus an important part of education and training through **practicals** (field exercises and/or projects).

# Hydrography and Cartography context (1)

- New use of the seas has shifted hydrographic products from safety of navigation purposes to a wide variety of appplications:
  - Renewable energy;
  - Marine environment issues (habitat mapping, coastal erosion, …);
  - Remote bathymetry (Unmanned Vehicles, Satellite);
  - Wide variety of scales (subsea infrastructure mapping , regional satellite bathymetry);
- Increased complexity of field operations and of survey systems components.

**Mobile mapping systems**

## Hydrographic /cartographic data

Environment

Acoustics, LiDAR

Geodesy and Inertial measurements

Positioning (surface, subsea)

Acquisition devices and software

Data processing and visualization tools

Analysis

Sounding selection, generalization

**Cat. A/B level**

Reactivity
Autonomy
Independent thinking

WIDE VARIETY OF COMPETENCES

Physics

Applied mathematics

ADDED COMPLEXITY

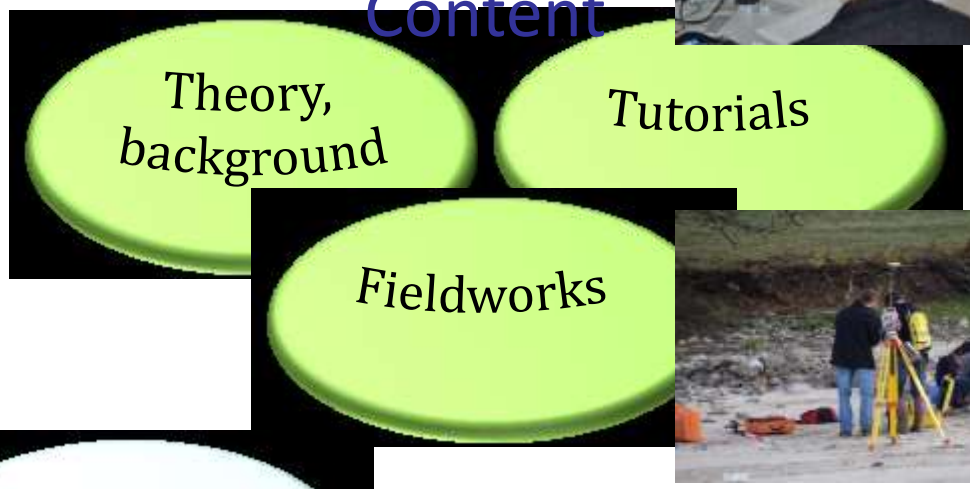
Hydrography/Cartography Education and Training

Hydrographic Services

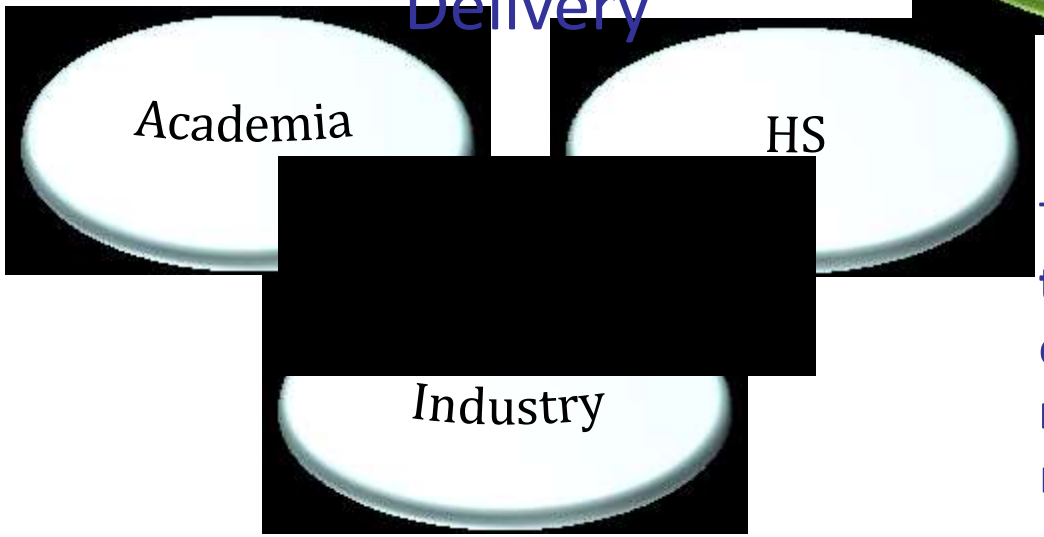
Hydro/Carto systems and processing tools

Industry

The Standards need to reflect an up to date set of requirements as well as **offering a basis for a surveyor to make progress**






The Standards must **maintain the balance for students' expectations and employers' needs** whilst allowing for the new e-learning experience

Two of the Port of London Authority vessels used by MSc students for practical work – the Galloper is generally used in near-shore surveys, while the Verifier is capable of operating in the Thames Estuary.

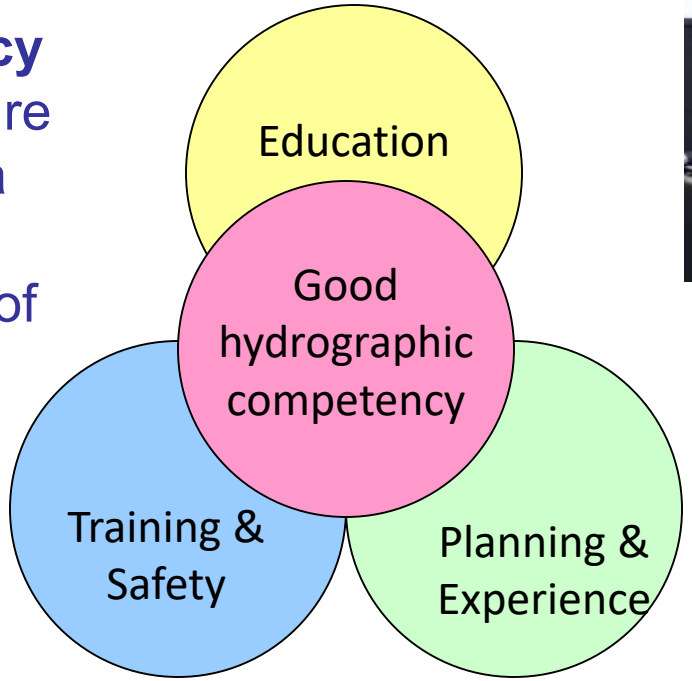
**Resources are required!**

## ENSTA Bretagne survey launch


## The launch from CCOM UNH

# Standards in the work place

**Individual Competency Schemes** offer to ensure and demonstrate that a surveyor maintains appropriate standards of practice.




# Recognition of Individuals

- The Board recognises courses, **not individuals** ;
- Individual Recognition Schemes objective :

To maintain the level of competence and field proficiency of hydrographers/cartographers;

- Individual recognition should be sought at national or regional level:
  - Recognition of individuals should not be left to HS, but preferably to Hydrographic Societies;
  - Should ideally involve both HS, Academia and the Industry.
- Life-long learning, refreshment and modular courses ;

# New category A and category B standards

**S-5 and S-8 standards are not syllabi** ;

- New standards are written in terms of learning outcomes (i.e; constructive alignment) ;
- Category B is not a stepping stone toward category A
- Options will not be systematically included in the core of the essential subjects;
- Category A and B do not refer to a particular academic level;
- Will include e-learning and distance learning specific requirements

- https://www.iho.int/iho_pubs/standard/S-5/S-5A_Ed1.0.2.pdf
- https://www.iho.int/iho_pubs/standard/S-5/S-5B_Ed1.0.1.pdf
- https://www.iho.int/iho_pubs/standard/S-8/S-8A_Ed1.0.1.pdf
- https://www.iho.int/iho_pubs/standard/S-8/S-8B_Ed1.0.0.pdf
- https://www.iho.int/iho_pubs/standard/S-5/S-5_S-8-Guidelines-Ed_2.0.0.pdf

# New category A and category B standards

- Present standards are not fully written in terms learning outcomes ;
- **S-5 and S-8 standards are not syllabi** ;
- New standards will be written in terms of learning outcomes (i.e; constructive alignment) ;
- Category B is not a stepping stone toward category A
- Options will not be systematically included in the core of the essential subjects;
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- The S5-A standard contains the following list of ***B**asic subjects, **F**oundation Science subjects* and ***H**ydrographic Science subjects*

- B1 : Mathematics, statistics, theory of observations
- B2 : Information and Communication Technology
- B3 : Physics
- B4 : Nautical science
- B5 : Meteorology
- F1 : Earth Models
- F2 : Oceanography
- F3 : Geology and geophysics

- The S5-A standard contains the following list of ***B**asic subjects, **F**oundation Science subjects* and ***H**ydrographic Science subjects*:

- H1 : Positioning
- H2 : Underwater Sensors and Data Processing
- H3 : LiDAR and Remote Sensing
- H4 : Survey Operations and Applications
- H5 : Water Levels and Flow
- H6 : Hydrographic Data Acquisition and Processing
- H7 : Management of Hydrographic Data
- H8 : Legal Aspects
- CMFP : COMPLEX MULTIDISCIPLINARY FIELD PROJECT

- Example of a Cat S-5A Hydrographic subject with Content and the Learning Outcomes

| H8 : Legal Aspects | | |
|---|---|---|
| **Element** | **Learning outcomes** | **Content** |
| **H8.1 Product liability** | | |
| H8.1a Responsibilities of the hydrographic surveyor<br><br>*(B, I)* | Detail the role and responsibilities of the hydrographic surveyor as required under industrial standards and national/international legislation/conventions. *(B)*<br><br>Identify the sources of ethical guidance and discuss ethical considerations when dealing in a professional capacity with client and contracts. *(I)*<br><br>Discuss the potential liability of the hydrographic surveyor in common hydrographic endeavors. *(I)* | (i) Nautical charts.<br>(ii) Notice to mariners.<br>(iii) Survey notes and reports.<br>(iv) Fundamentals of professional liability relating to surveying<br>(v) Professional ethics relating to commercial and government projects<br>(vi) Legal issues and liability associated with hydrographic equipment and products. |
| H8.1b Contracts<br><br>*(I)* | Develop the technical content of an invitation to tender.<br><br>Analyze the risk and develop the technical content of a response that would include details and cost of necessary resources.<br><br>Interpret contractual obligations in terms of survey planning, execution and deliverables. | (i) Invitation to tender and survey work specifications<br>(ii) Response to tender<br>(iii) Contractual obligations and insurance<br>(iv) Survey work and deliverables |

- Example of a Cat S-5A Hydrographic subject with Content and the Learning Outcomes

| **H8.2 Maritime zones** | | |
|---|---|---|
| H8.2a Delimitations<br><br>*(B)* | Define the types of baselines under UNCLOS and how the territorial sea limit and other limits are projected from them, including the use of low tide elevations.<br><br>Conduct and document surveys with appreciation for the type of baselines and the implication of the baselines.<br><br>Describe the legal operational constraints that apply within maritime zones. | (i) Historical development of 1982 UNCLOS Baselines – normal (including closing lines); straight and archipelagic<br>(ii) Base points<br>(iii) Baselines<br>(iv) Internal waters.<br>(v) Territorial seas.<br>(vi) Contiguous zones.<br>(vii) Exclusive Economic Zone<br>(viii) Extended continental shelf.<br>(ix) High seas |
| E8.2b Impact of surveys<br><br>*(I)* | Specify appropriate procedures and limitations for use of surveying equipment in compliance with environmental laws and marine protected area regulations. | (i) Vessel speed restrictions and permanent and temporary threshold shifts (hearing) and harassment levels for marine mammals.<br>(ii) Limitation of use of physical techniques such as bottom sampling and moorings in environmentally sensitive areas.<br>(iii) Respect for cultural traditions in relation to use of the environment<br>(iv) Marine protected areas |

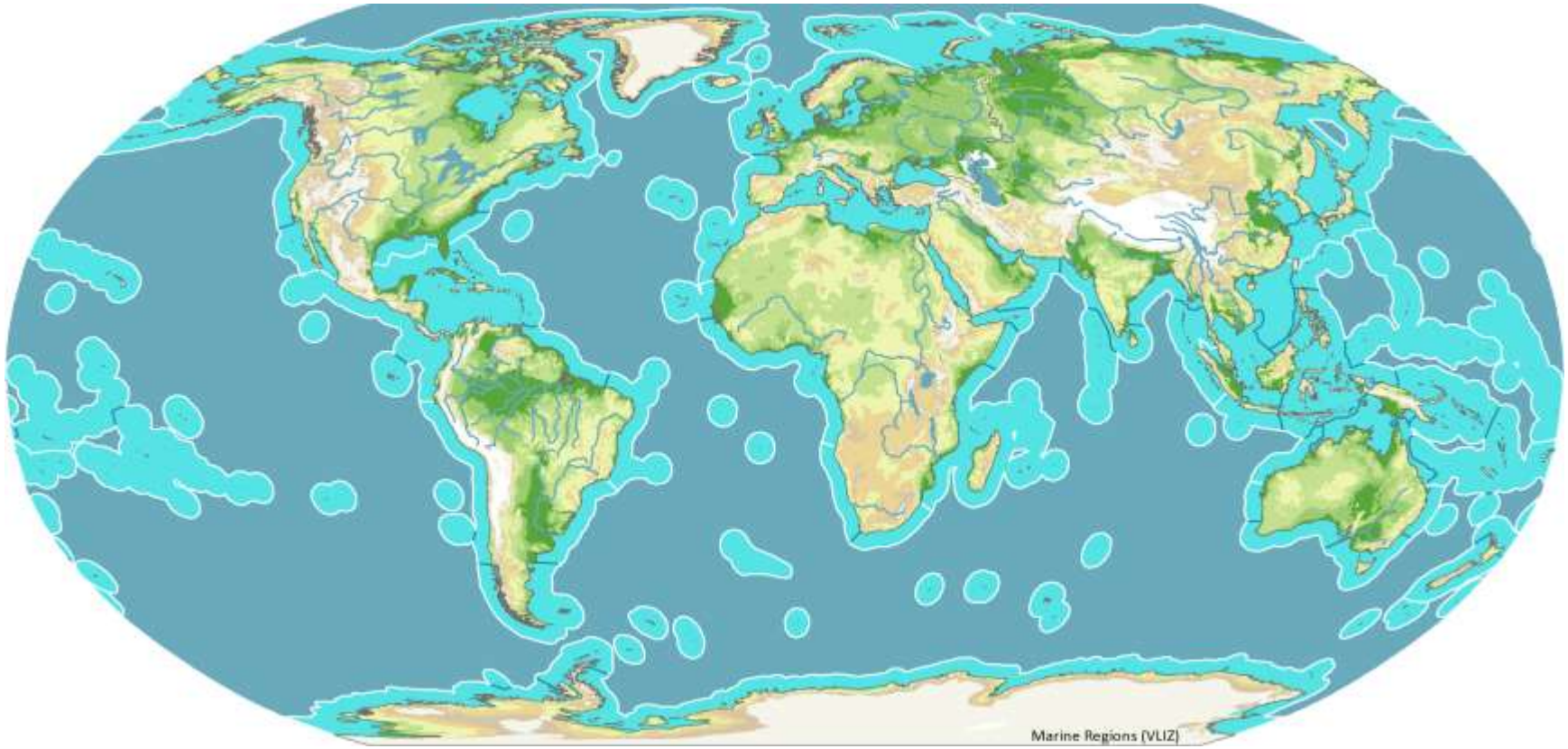
# Boundaries - Background

- Unstable world political map
  - ≈ 800 territorial changes 1815-2015
  - ≈ 200 territorial disputes since 1990
- 31 new Nation States since 1990
- Since 1980, 32 boundary sovereignty disputes submitted and settled to third party adjudication, a further 29 are waiting
- United Nations Convention on the Law of the Sea (UNCLOS)
  - Developed to settle all issues to the law of the sea as an important contribution to peace, justice and progress for all people of the world
  - 167 states ratified since enforcement in 1994
  - 50% of all marine boundaries still require formal agreement
  - 30% of ocean has potential to be attributed to sovereign states

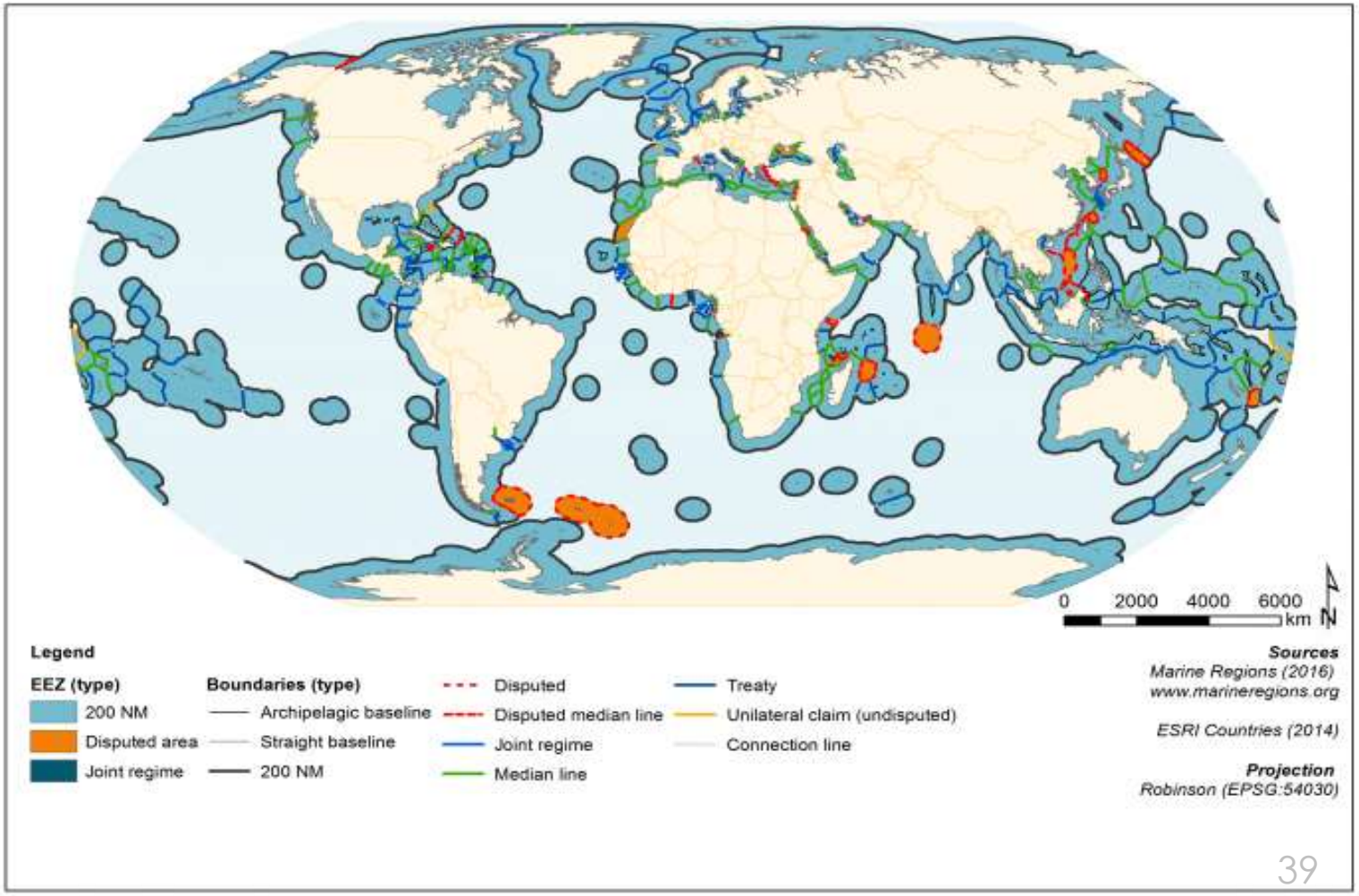
# The SDG 14, and a Business Context

- Uncertain international boundary delineation affects society & industry in the following ways:
  - Unstable geopolitical status is commercially unattractive
  - Energy operators concessions and block licenses
  - Shared and sustainable resource management
  - Data purchases and drilling/installation permissions
  - Exploration, drilling, and development operations
  - Product transportation by cables, pipelines and tankers
- Reliable and accessible information about boundary disputes and affected block licenses is not always available

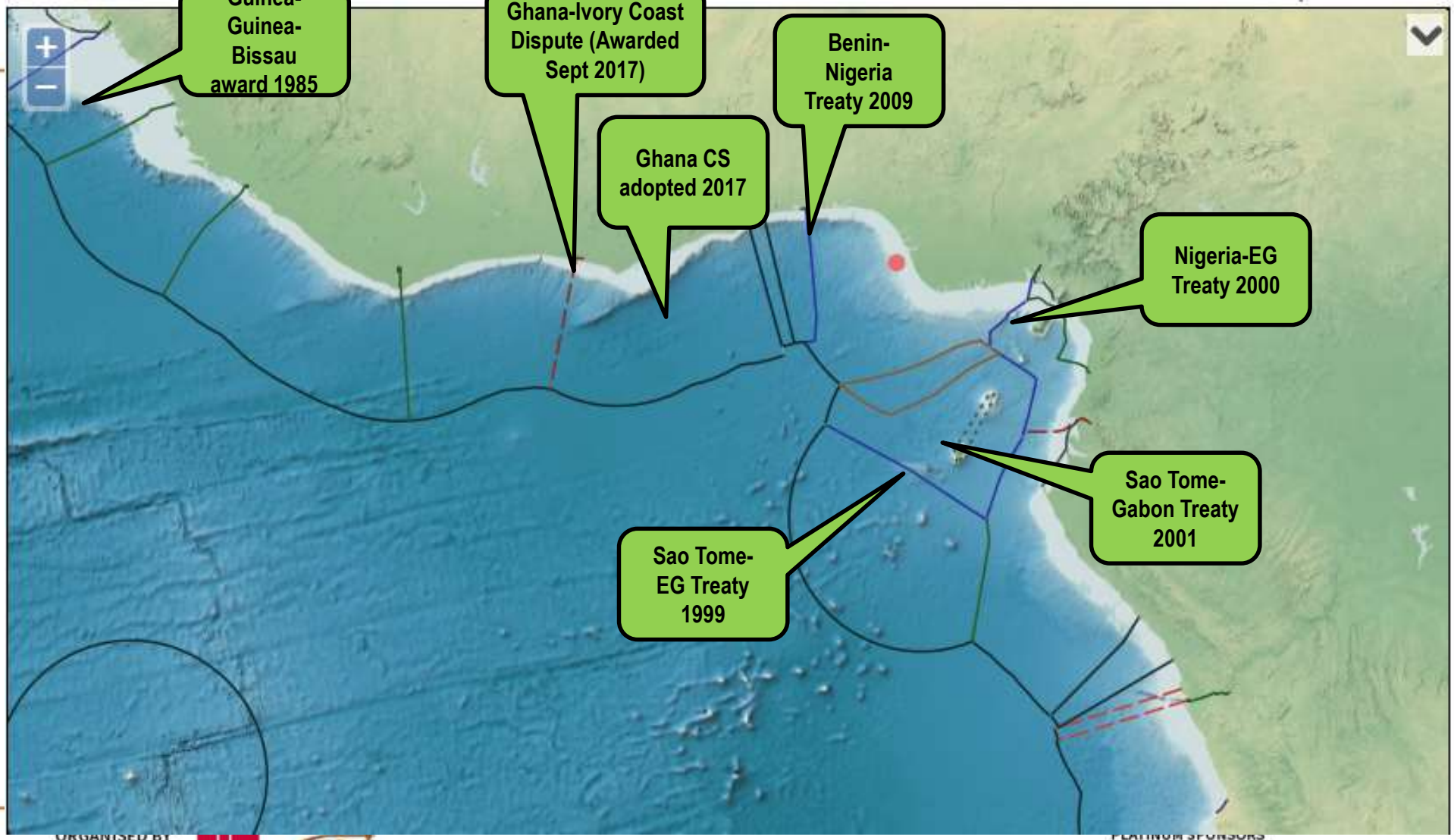
# Exclusive Economic Zones (EEZ) at 200 nM



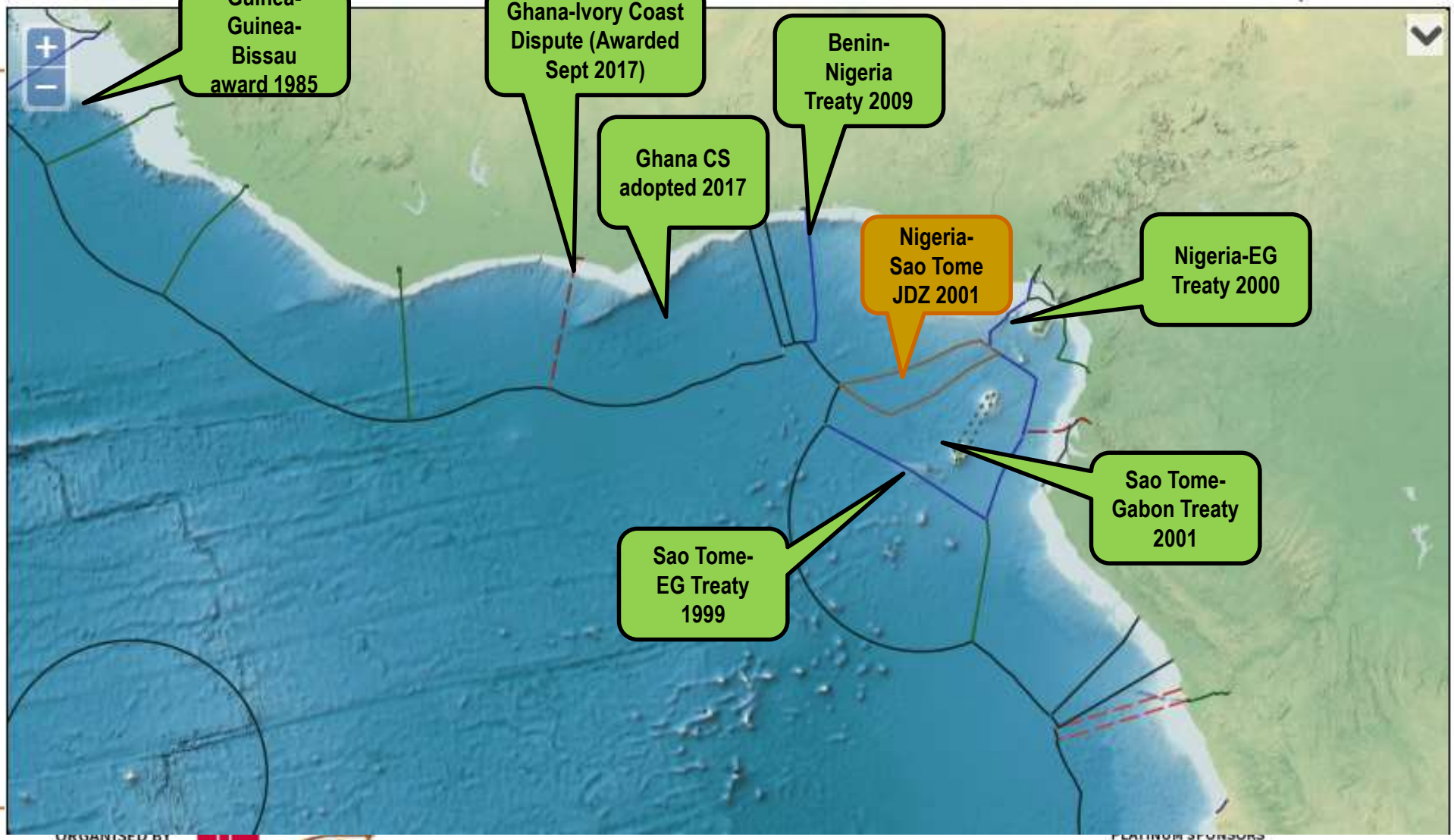
# Many un-ratified or disputed areas and lines



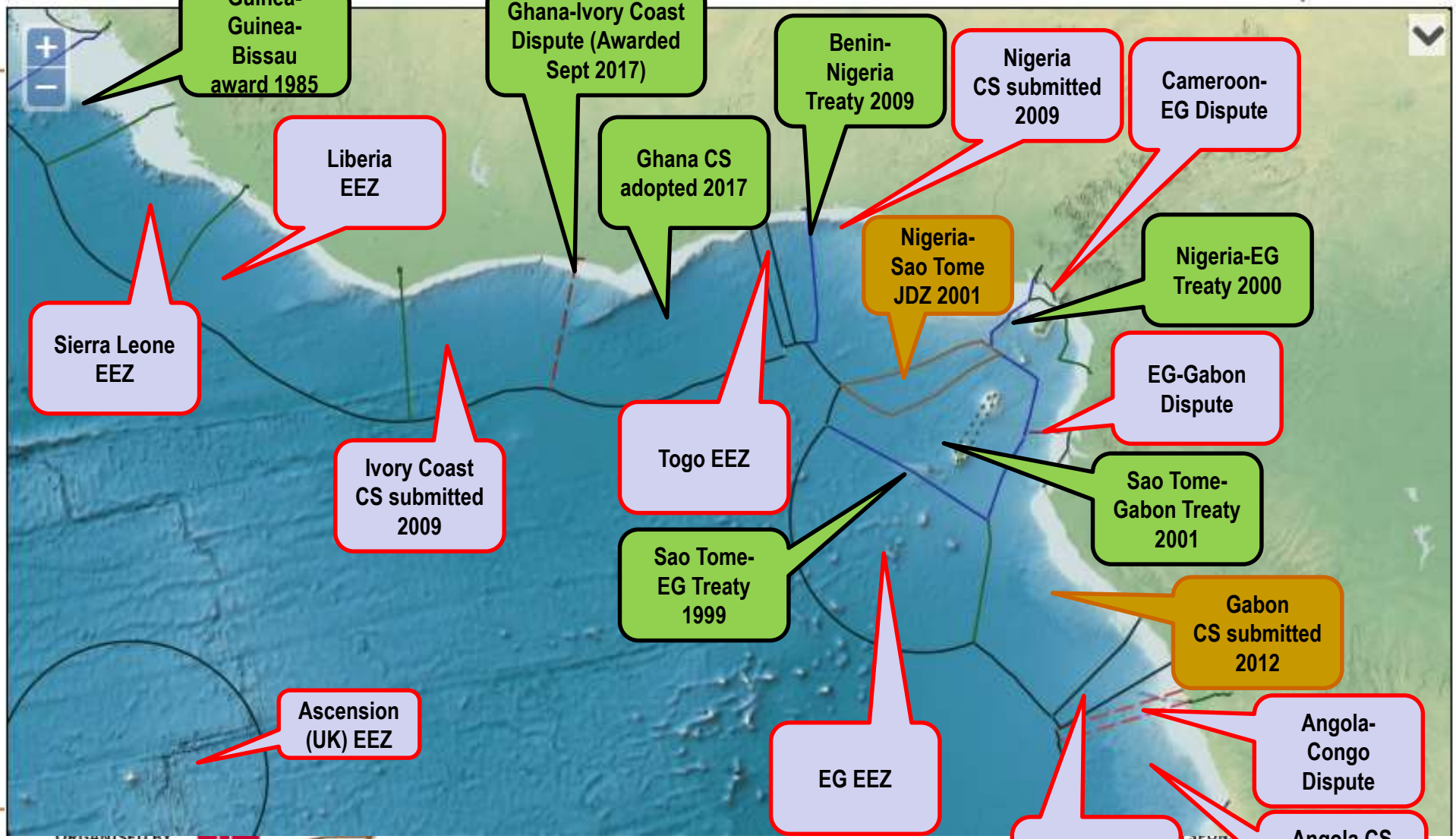
# Gulf of Guinea UNCLOS Status



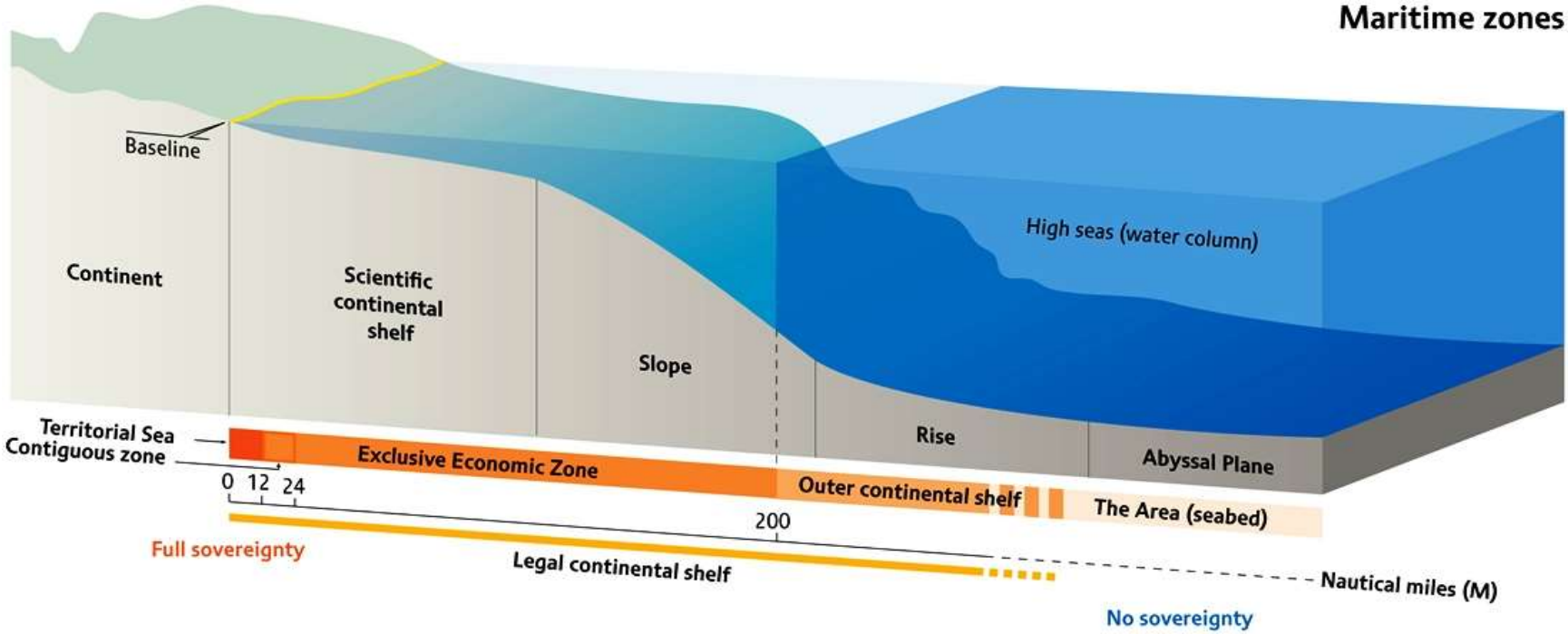
# Gulf of Guinea UNCLOS Status



# Gulf of Guinea UNCLOS Status



# UNCLOS Basic Explanation

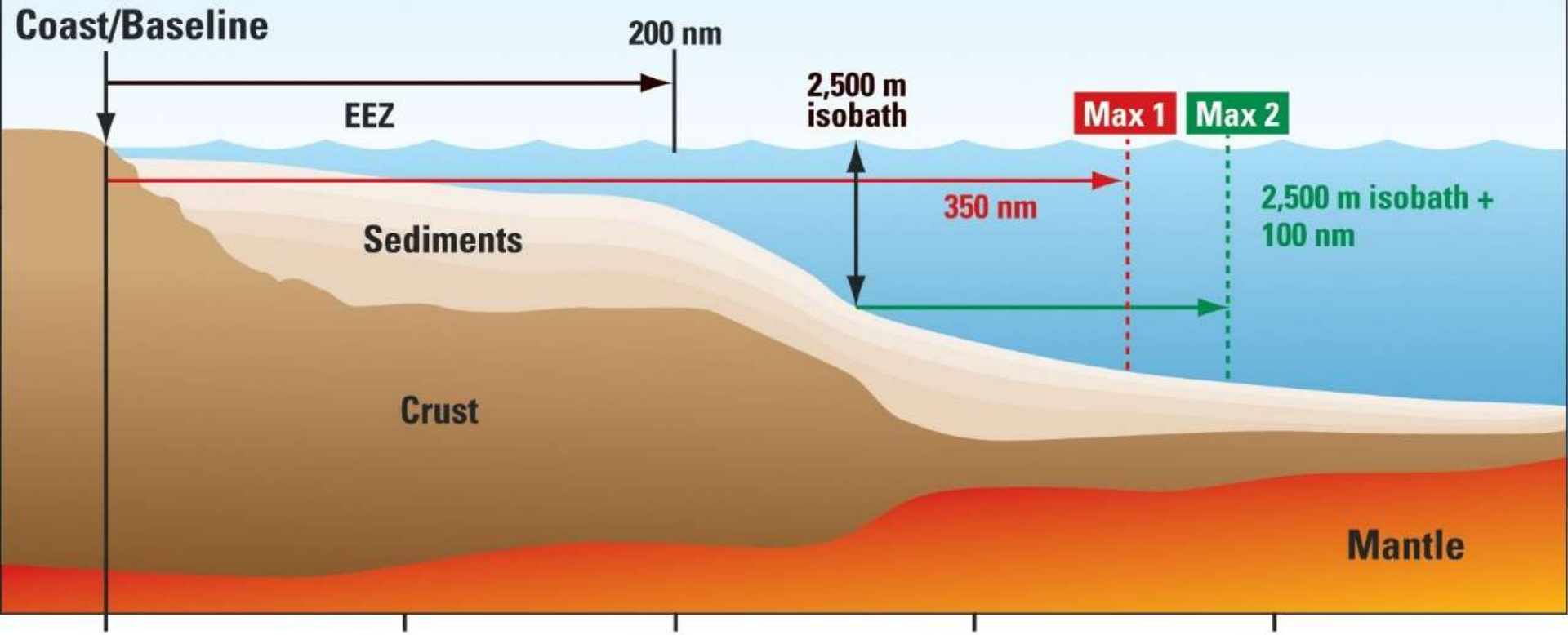



Many legal and technical words describe these rights

# Extended Continental Shelf Constraint Lines

Many nation states have this potential

**Max 1:** 350 nautical miles (nm) from baselines OR
**Max 2:** 2,500 meter (m) isobath plus 100 nm

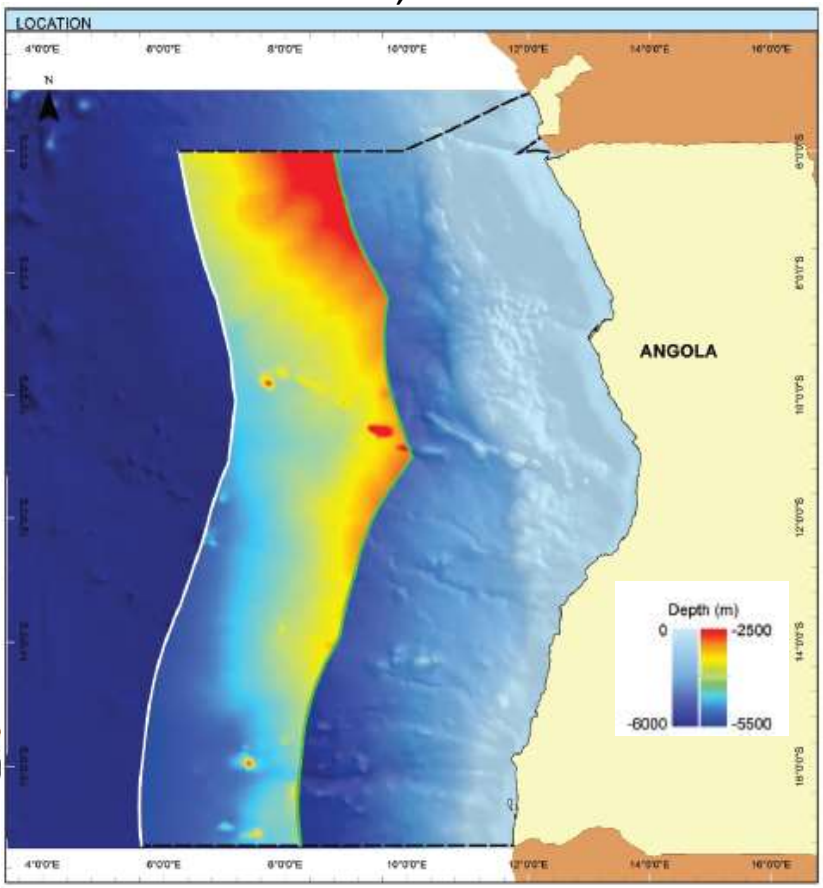



The effect is claims can be significant

# Potential of Extended Continental Shelf

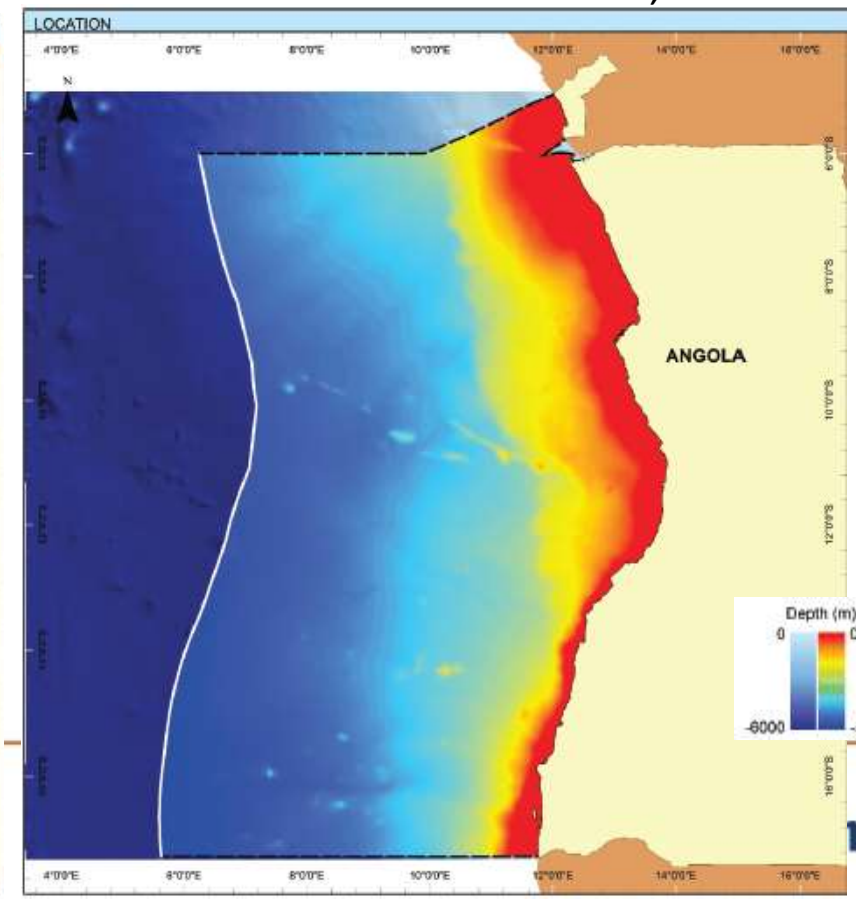
**Exclusive Economic Zone**

EEZ ≈ 380,000 km²

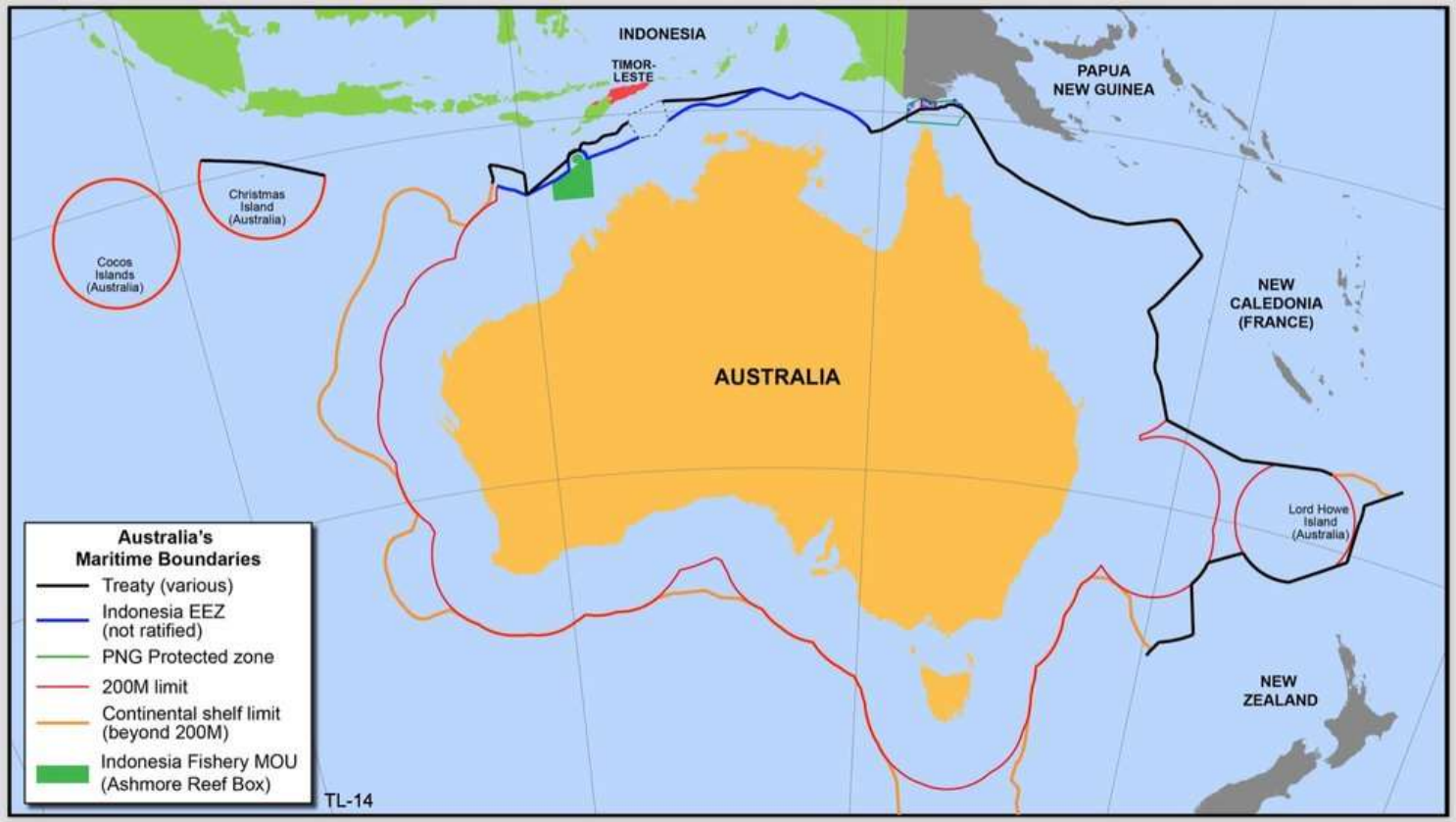



**Natural Prolongation of Land**

EEZ + Continental Shelf ≈ 920,000 km²



# Australia: a developing picture




Excluding Antarctic Territories and southern islands

# Geodesy, Hydrography and Cartography

- **Definitions**
  - Geodetic Datum, Map Projection, and Datum Transformations (**Essential Subjects**)
- **Baseline Construction**
  - to measure the territorial sea from low water line to 12 nM outwards
  - the geometric basis for all Law of the Sea delineations
- **Joining Turn Points**
  - parallel, meridian, geodesic
  - loxodrome (rhumb line)
  - grid (plane)
- **Calculation of Area** (**Essential Subjects & Competency**)
  - Map Grid (with and without correct scale factor)
  - Ellipsoidal
  - Ground Level

***NB: Prior S-5 modules give technical content***

# Geodesy, Hydrography and Cartography

- **Claim preparation:**
  - accuracy of historic survey and mapping data, land terminal points, quantifying customary delineation descriptions
  - claims are often complex with disparate geodetic sources
  - Reference ellipsoids and datums are often confused, omitted, misinformed, or inaccurately attributed
- **Claim presentation:**
  - correct, consistent, complete, and clear to reader
- **Claim documentation**:
  - lack of unambiguous datum definitions (≈50% have no datum)
  - metadata, UN depositary, availability of reference charts.
- **Use Qualified Hydrographic Surveyors with Category A or Category B education**

# Survey Competency & Standards supporting Legal Developments

- Recent dispute settlement
- Joint Development Zones
- License Blocks beyond 200 nautical miles
- Complex multiple disputed claims
- The Arctic
- Marine Cadastre
- GEBCO Seabed 2030 initiative

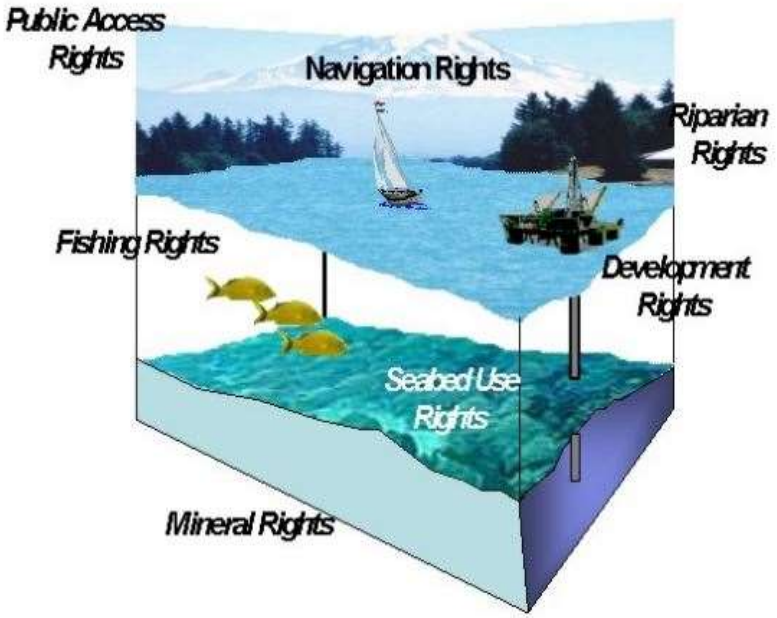
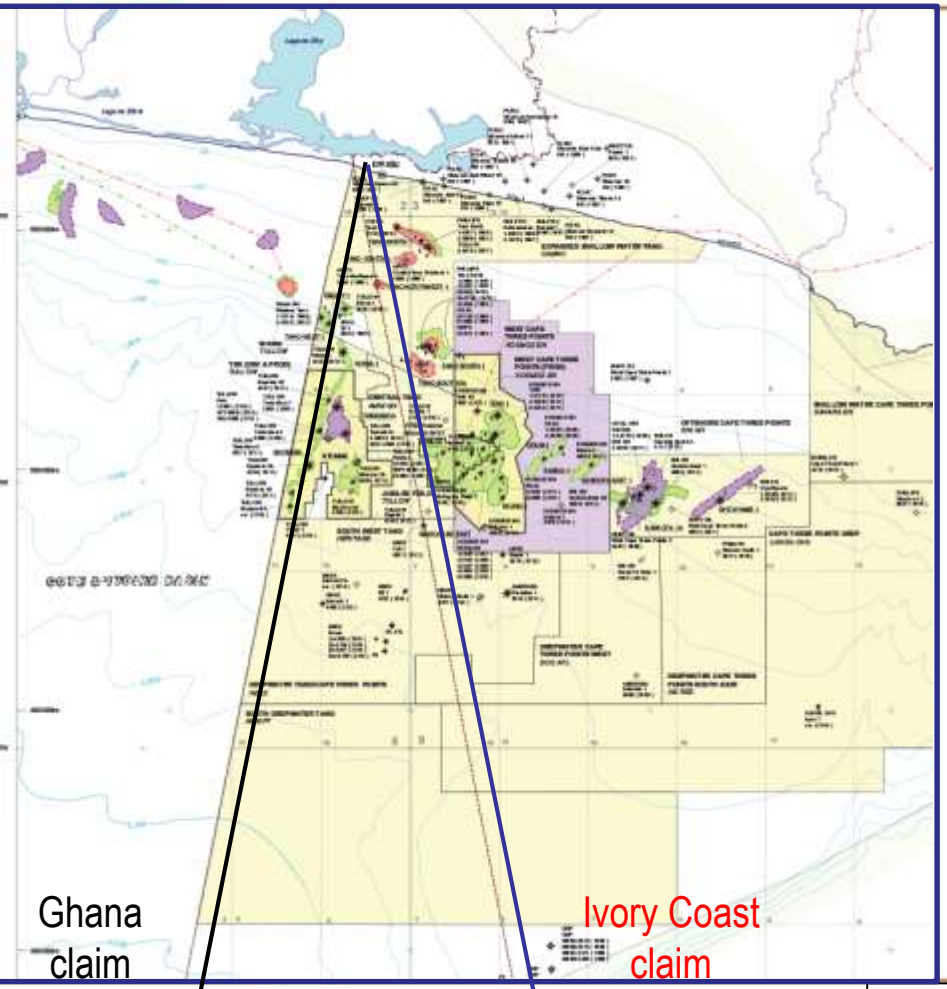
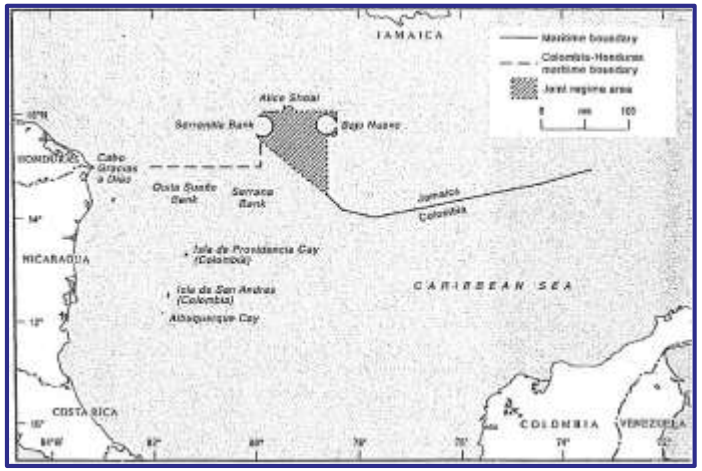


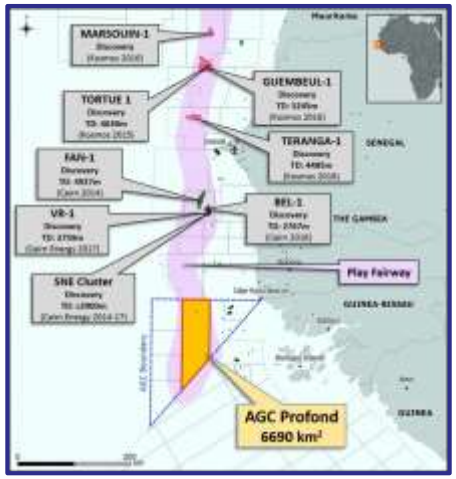

Figure 1: The Marine Parcel (after Sutherland, 2001)




# Ghana-Ivory Coast 2017 Settlement

# Provisional Arrangement to Share Resources

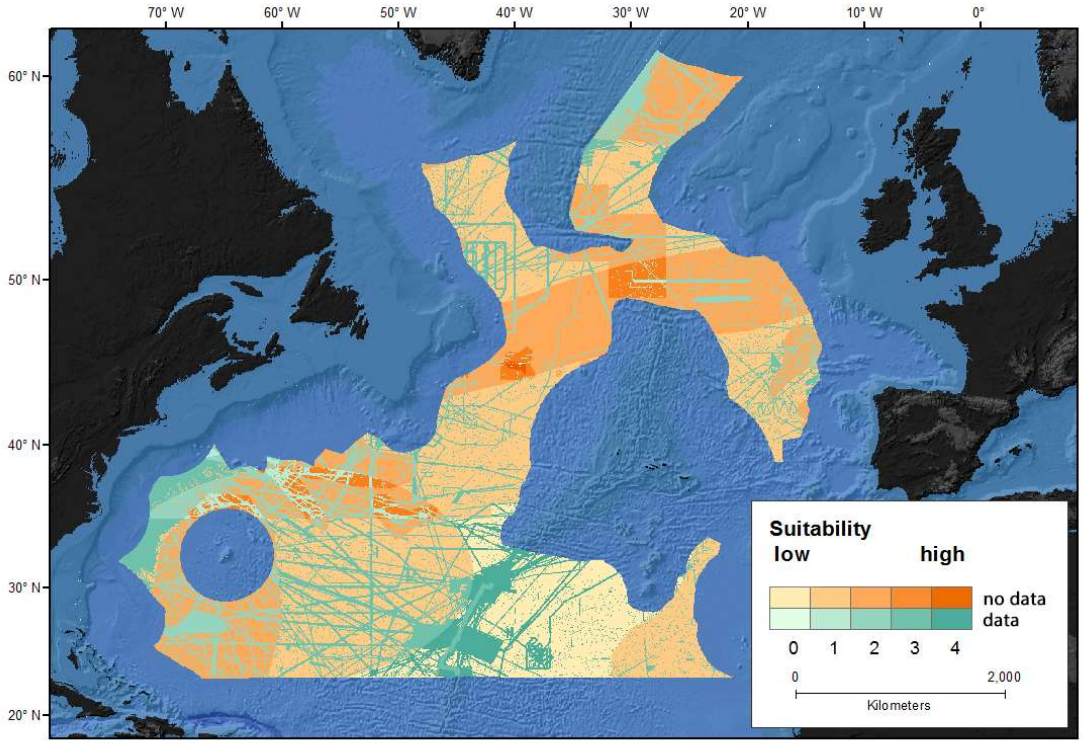


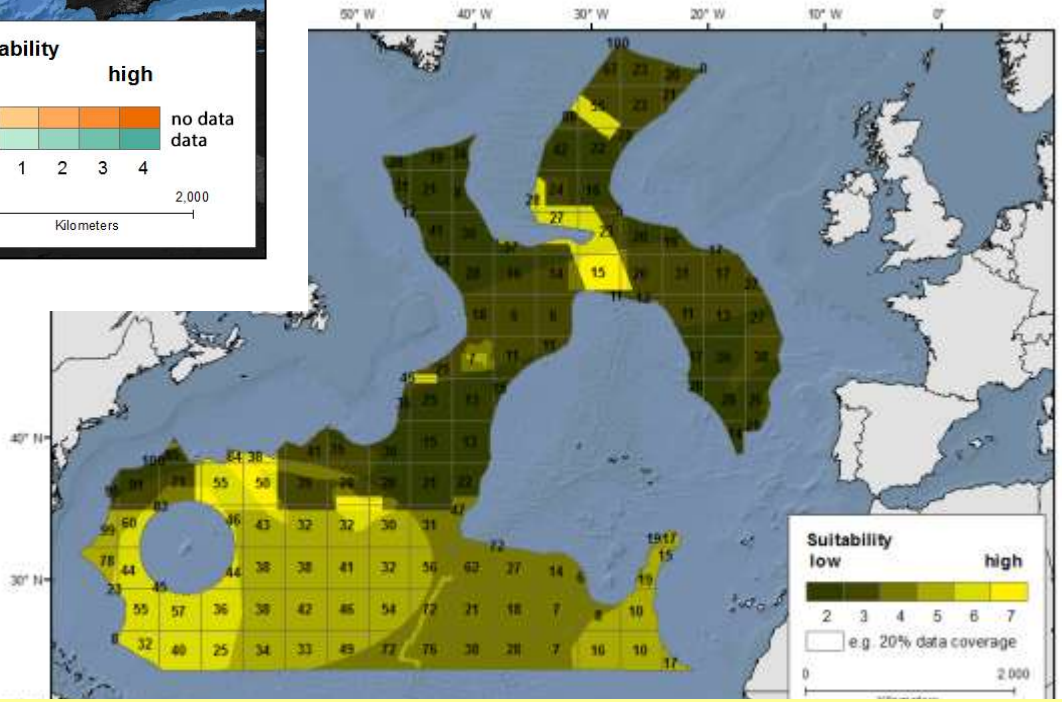


Case Study 18 Joint Development Zones worldwide

## Subject to International Seabed Authority


Example depictions of potential survey areas, in International Waters, based upon presence of existing bathymetry data




ATLANTIC OCEAN RESEARCH ALLIANCE

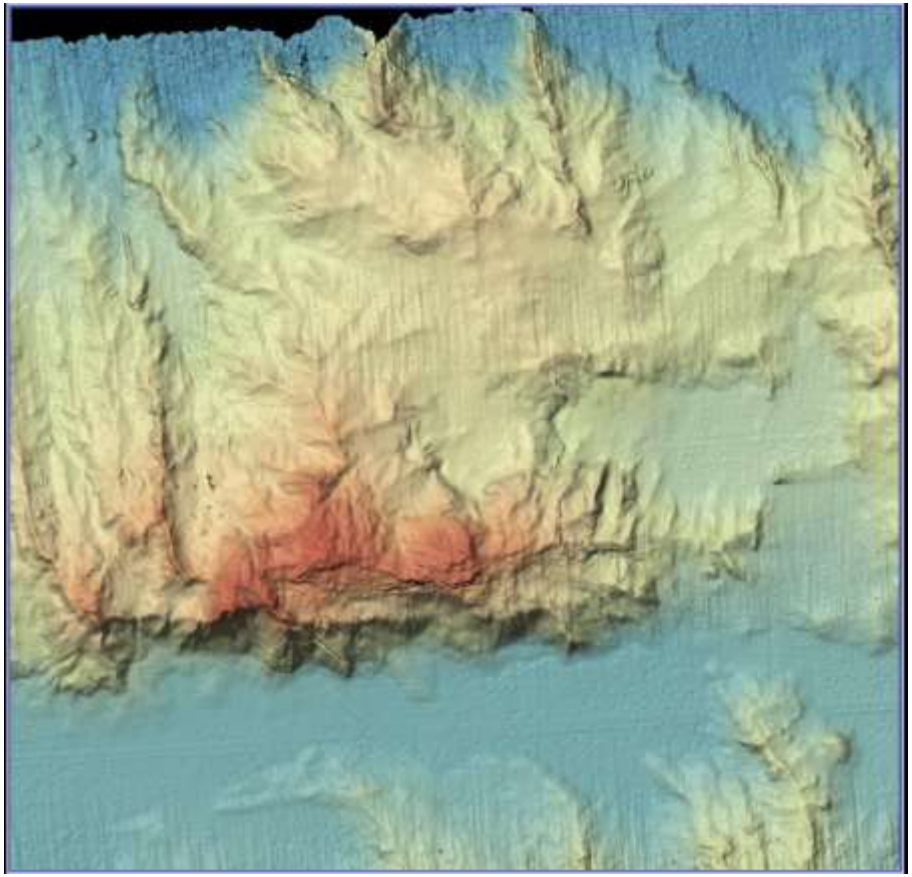
# International Waters and Bathymetry data in the N Atlantic

Improved Resolution – just slightly!

50x50 Km

Before

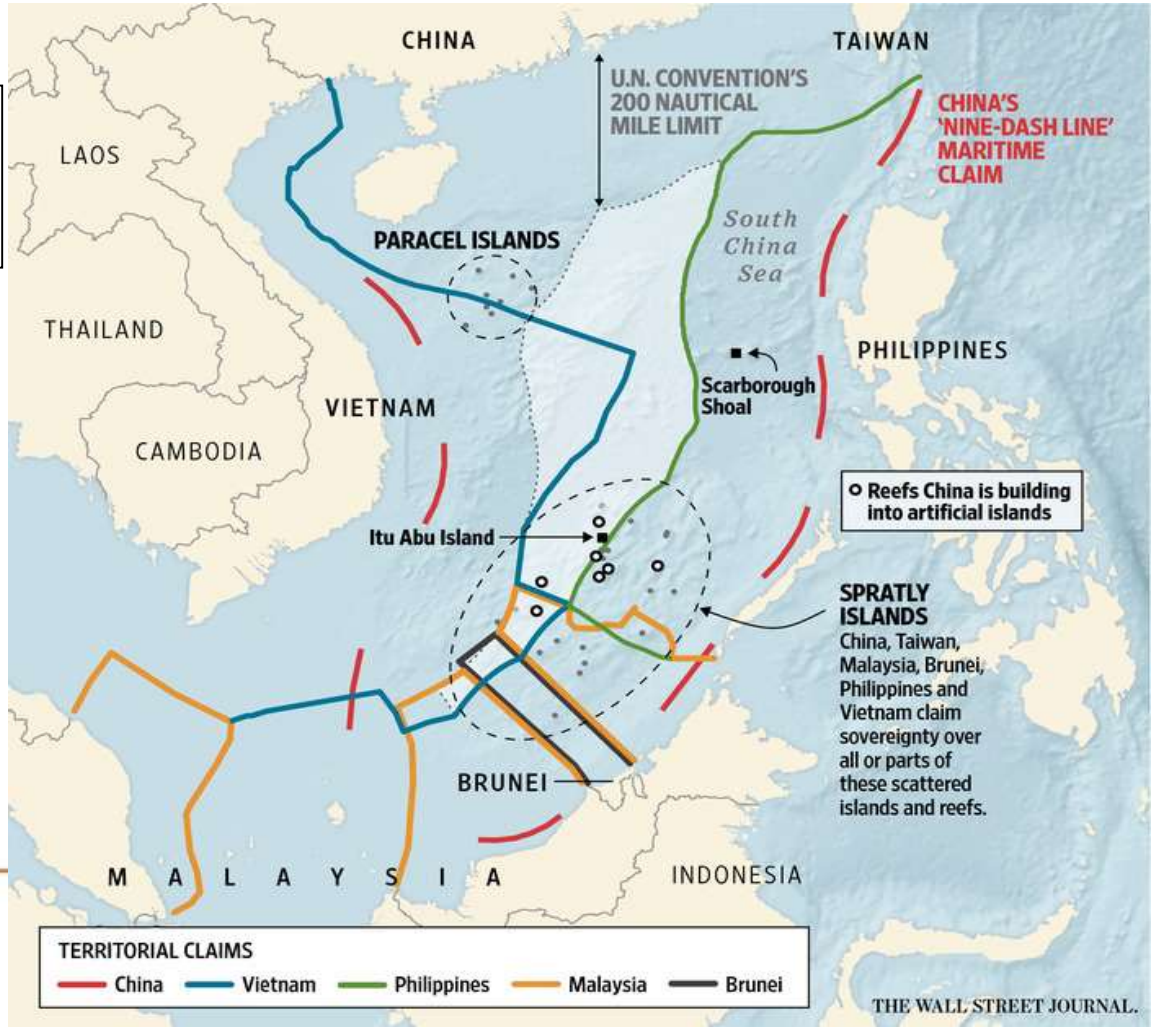
After



Mapping with the EM122 system aboard RV "Sonne II" in the equatorial Atlantic (around 11°N). Left is what is available from GeoMapApp, right the same feature, gridded at 50m and comprising 3 E-W swaths of coverage. Courtesy GEOMAR

Case Study: Complex Multiple Overlapping Claims

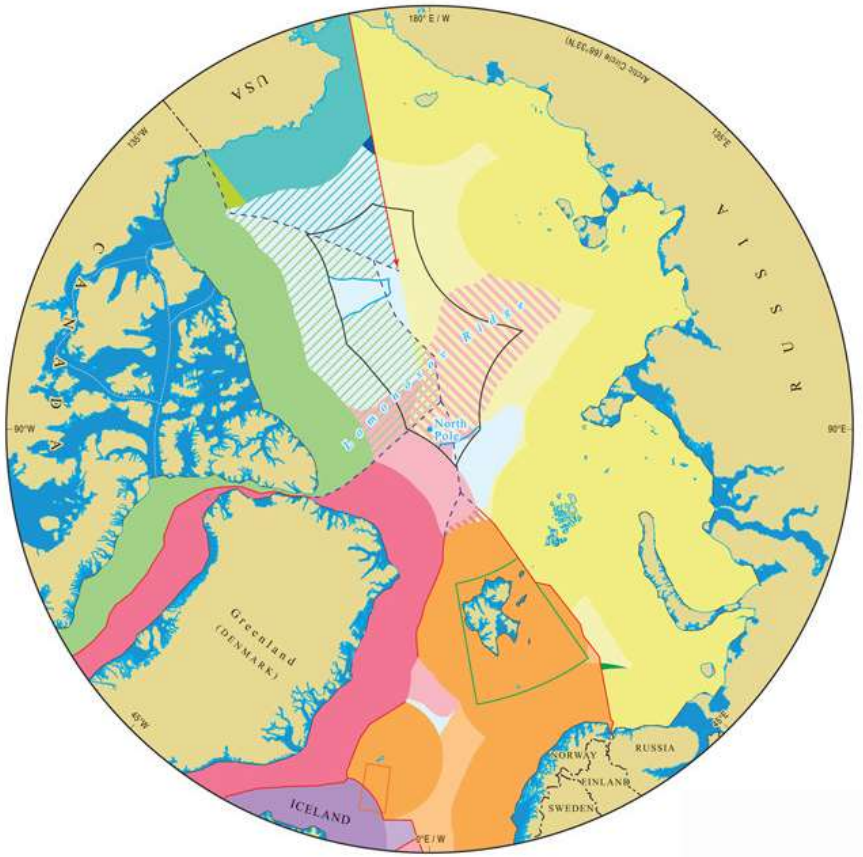
# Geopolitical tangle in the South China Sea



# Prospects for 90 billion Barrels of Oil & 1.7 trillion Cubic Feet Gas

Case Study: The Arctic by IBRU, Durham University

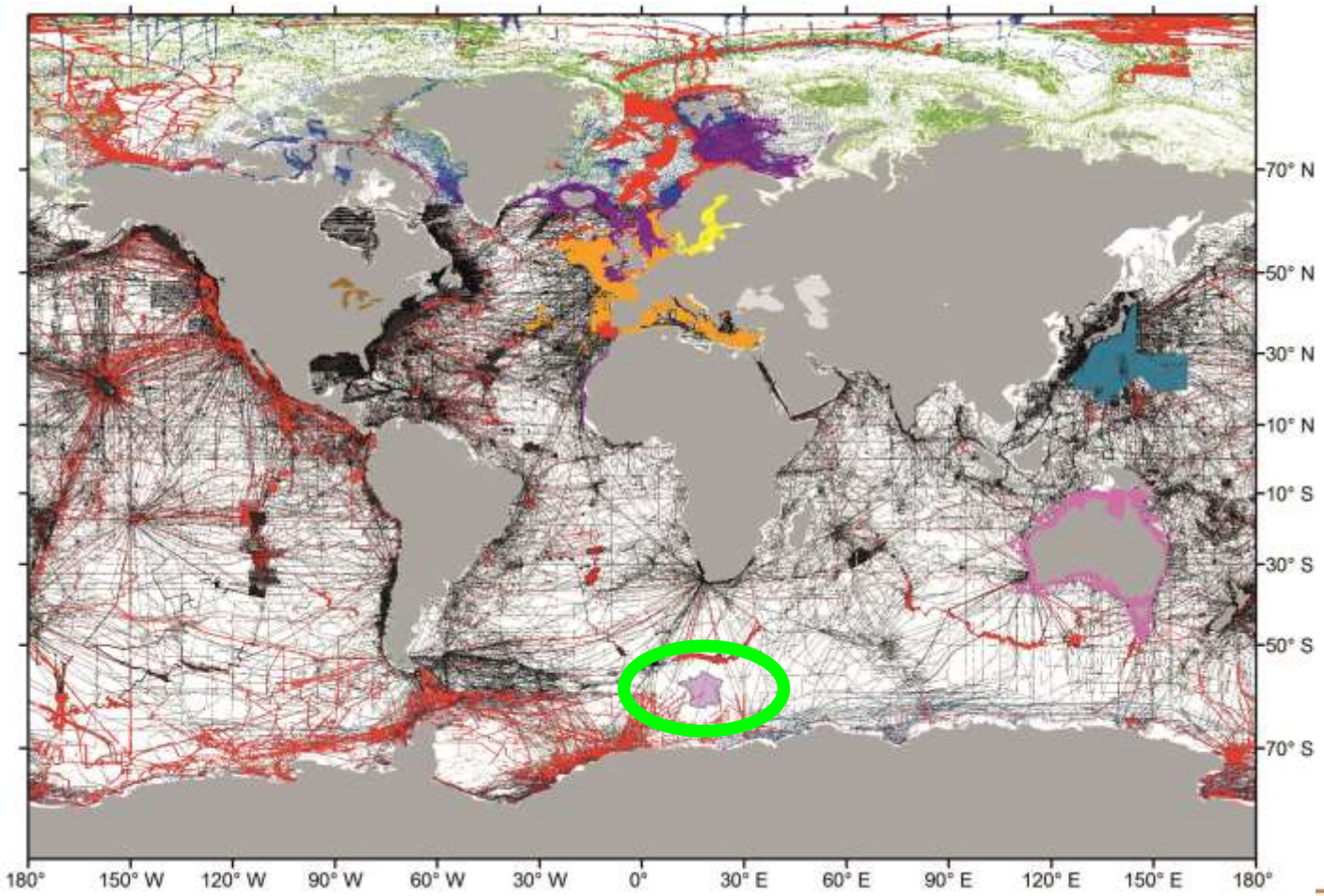
**USGS estimate:**
13% world undiscovered oil
30% world undiscovered gas




http://www.durham.ac.uk/ibru/resources/arctic

The latest General Bathymetric Charts of the Oceans, 2019 has improved our knowledge and coverage to….

19%



# Conclusions

- The FIG/IHO/ICA Standards enable trusted international maritime boundaries to be defined with qualified Subject Matter Experts. We need to know our limits!
- This impacts the commercial, legal, and technical disciplines of all phases of the full marine resource and asset life cycle; from access, development to retirement
- De-risking projects with geodetic checks would be appropriate at license access stage
- Qualified Surveyors, Hydrographers and Geospatial Subject Experts must be engaged to ensure a robust, reliable and efficient process can produce a positive outcome.
- If we are to develop our understanding of our oceans & seas through initiatives such as the GEBCO Seabed 2030 then the international High Seas will evolve to become a vital component of our sustainable environment. SDG 14 affects us all.


- 1,2,5,11,15,16 are directly related to Land issues
- New Urban Agenda & Rapid Urbanisation
- 1,2,3,6,7,8,9,11,12,13,14,(15 & 17) are related to seas and oceans

## Further References

- IHO International Board on the Standards of Competence for Hydrographic Surveyors and Nautical Cartographers (IBSC)
  - https://www.iho.int/srv1/index.php?option=com_content&view=article&id=440&Itemid=398&lang=en
  - UN Convention on the Law of the Sea (UNCLOS)
  - ➢ http://www.un.org/depts/los/
- OGP Guidance Notes
  - "Contract Area Description" (373-03)
  - http://www.iogp.org/bookstore/portfolio-item/geomatics/
- IBRU: Center for Borders Research, Durham University
  - ➢ https://www.dur.ac.uk/ibru/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