# WATER DAYS 2022

**Herrsching am Ammersee, 04 October 2022**

# Detecting hidden Shoals from Space

How Satellite Imagery is helping to improve safety of Navigation

**CIO+ StayAway**

ChartWorld Group

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# Overview

- CIO+ StayAway Background
- EO data for shoal detection
- Accuracy of navigational charts
- Pilot Project
- Case Studies
- Conclusions

# Quick Facts

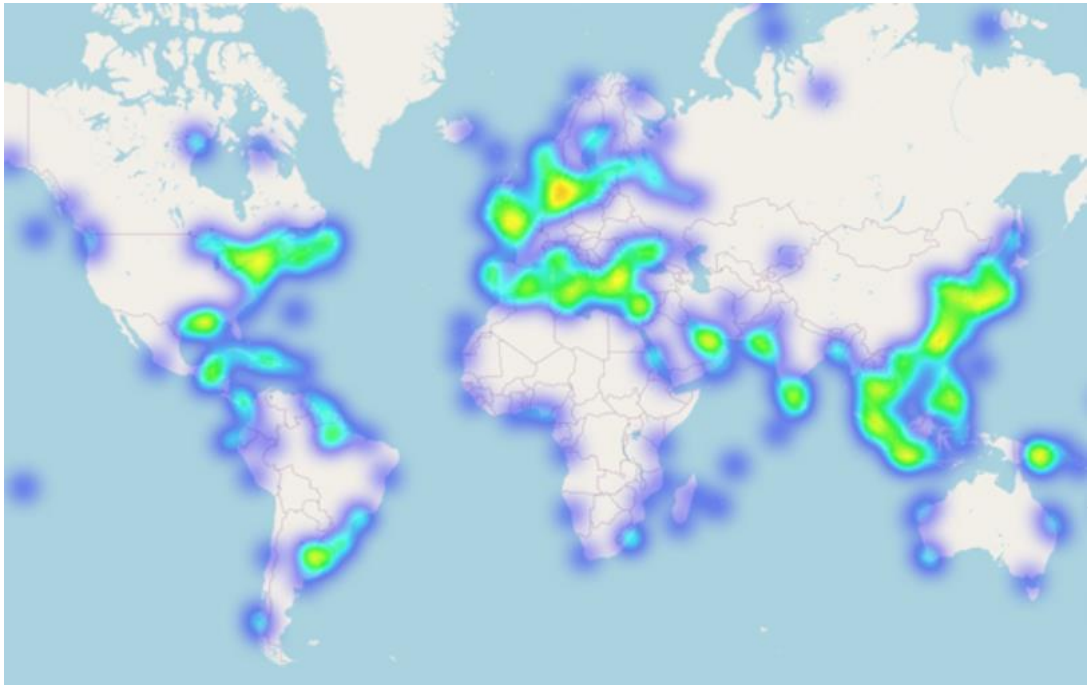
- Ship grounding incidents (foundered/sunk/submerged ships) were reported to be the main cause of total losses in the maritime sector in 2020.

- As high as 2,703 shipping incidents were reported in 2020, among which 49 of them led to total losses within the same period.

- The South-east Asian region, especially South China, Indochina, Indonesia and the Philippines were reported to be the main hotspots for incidents resulting in total losses globally.

Source: AGCS 2021; Lloyd's Intelligence 2021

# Quick Facts



Heatmap of incident hotspots in 2020

# Core Issue

## Groundings due to inadequate charted areas

Some of the reported groundings happen because:

- Outdated / not detailed enough chart data
- Misinterpretation of available data
- Negligence of the CATZOC values in ENCs

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**Causing severe losses and millions in insurance claims**

# The Idea Question(s)

## Can Earth Observation data detect underwater shoals?

Can we **locate shoals and underwater rocks** on the basis of satellite imagery?

Can we **determine positions** of features that are located in poor CATZOC areas **more precisely**?

Is it possible to **make hidden shoals visible to mariners** in ECDIS and mark them as “StayAway” areas that must be avoided ?

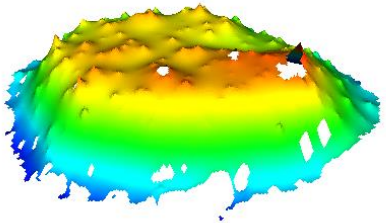
# SDB Capabilities

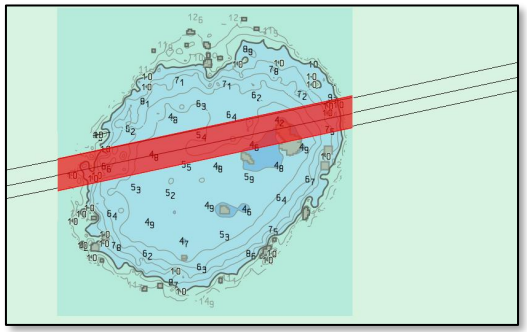
Bathymetry can be derived from multi-spectral satellite imagery and underwater **objects can be detected**.

Under **ideal conditions** this works for water depths of **up to max. 30 m**.

Hence, **underwater shoals and rocks** can be identified from satellite imagery.

The satellite images can be **processed and vectorized** to display optically detected shoals as overlay on ECDIS.





# Chart Accuracy, SDB Accuracy and the CATZOC Schema

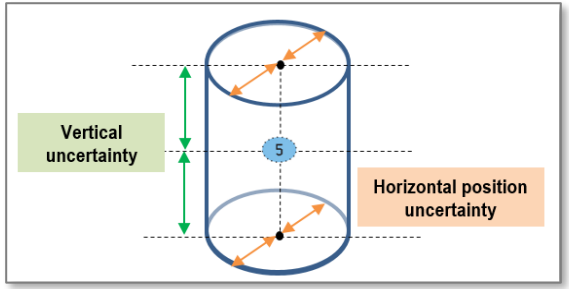
# Accuracy of navigational charts

Quality depends on age and accuracy of individual surveys. Remote areas tend to be less well surveyed, and less frequently.

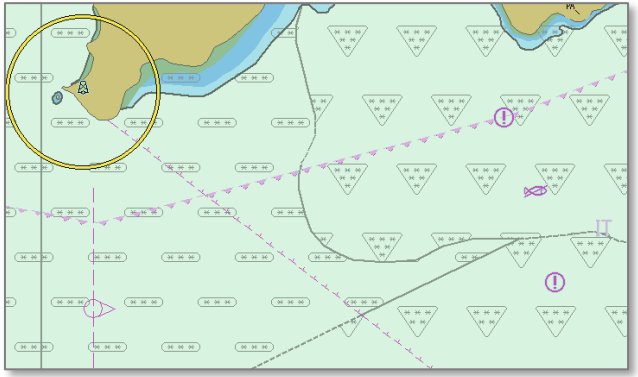
Accuracy of navigational charts consist of both vertical and horizontal accuracy which respectively defines the depth and positional accuracy of any ENC

The chart producer provides accuracy information of the ENC by assigning a CATZOC rating to charted areas

Mariners must take this into account during route planning and when vessels are sailing with ECDIS/ENCs.




*IHO, S-67, Mariners' Guide to Accuracy of Depth Information in Electronic Navigational Charts (ENC), Edition 1.0.0 – October 2020*



# What is CATZOC and why is it important?

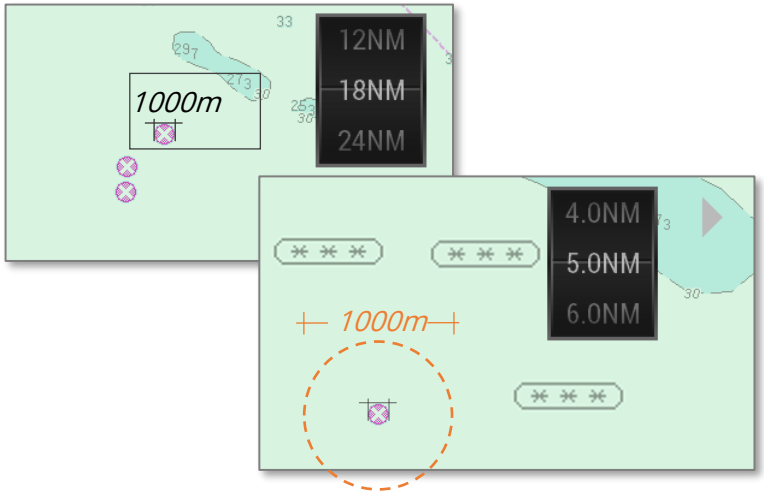
The accuracy of depth information in navigational charts can vary (very good -> poor).

The CATZOC Schema exists to encode and visualize the quality of depth information of the ENC

Several cases have been reported in the past, where disregard of CATZOC contributed to the groundings.

Use of point symbols representing dangerous underwater obstructions led to wrong conclusions.

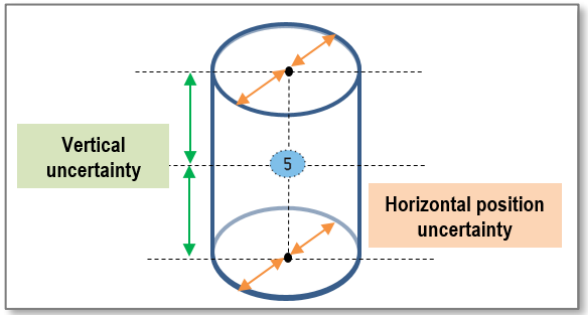
Evidently, mariners tend to assume that digital data is more accurate than the traditional paper chart.



# SDB Accuracy

The vertical accuracy (appr. 0.5 m + 0.1 *depth => 2.5m in 20m depth) corresponds to CATZOC C.

**Horizontal accuracy** is much better and is close to image resolution.



# Shoal detection from space

# StayAway Concept

## The Bird-Eye view Analogy

Since **Horizontal accuracy** is much better and is closer to image resolution.

The mariner is equipped with **an aerial view** of the chart domain

As though the mariner was looking from above and has **bird's eye view** of the area to be navigated

The mariner has a better perception of the **location and extent** of underwater shoals that could obstruct navigation

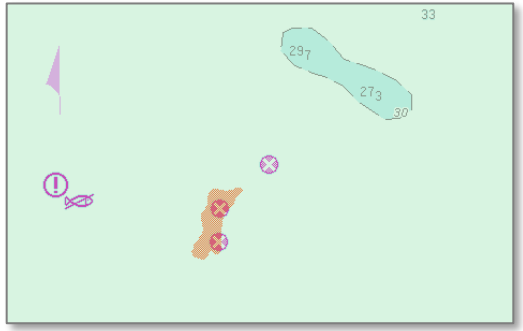
The mariner can easily make **informed decisions to avoid hidden shoals** during route planning or during transit

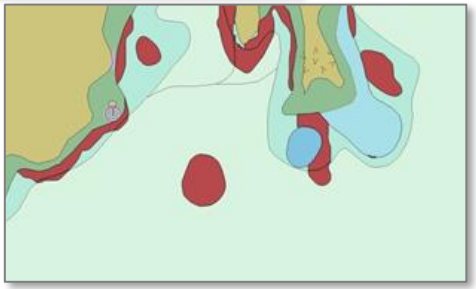
# Proof of Concept – Pilot Project

# Pilot Project – South East Asia

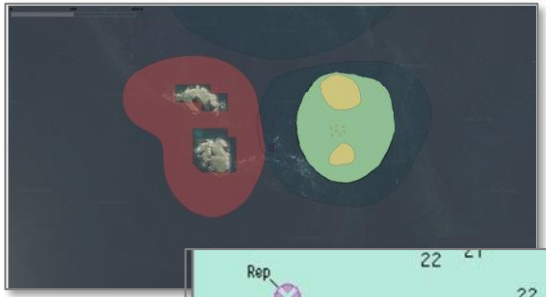
# Analysis of Pilot Project results

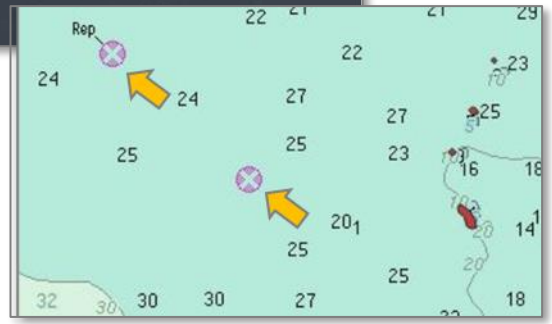
Compare StayAway Areas with charted underwater obstructions. 4 categories of findings:



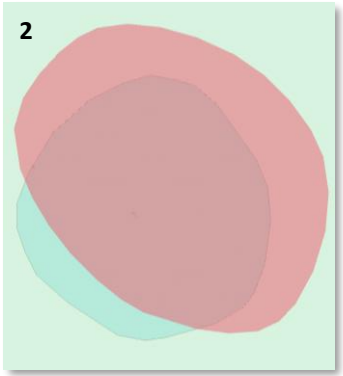
1. Matching shoals / obstructions
2. Uncharted shoals / obstructions
3. Misplaced shoals / obstructions
4. Shoals / obstructions not detected



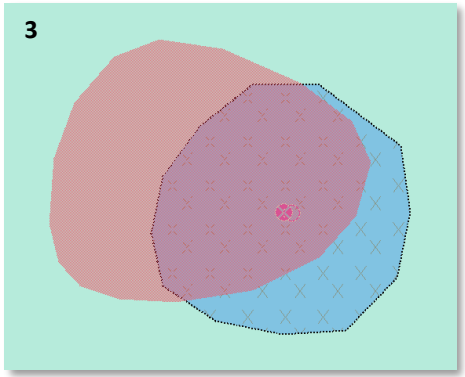


# More Examples

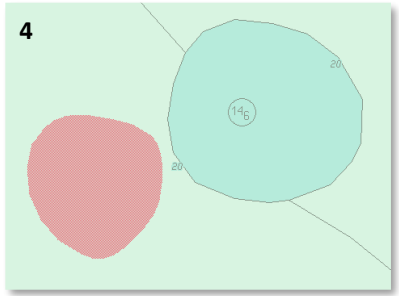

Perfect fit/Matching Shoals




Slightly Mismatching Shoals

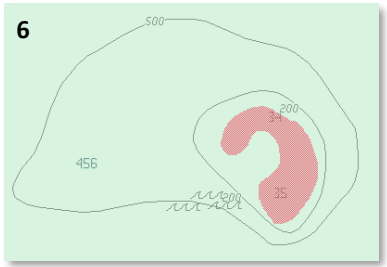



Largely Mismatching Shoals




Slightly Displaced Shoals


Largely Displaced Shoals



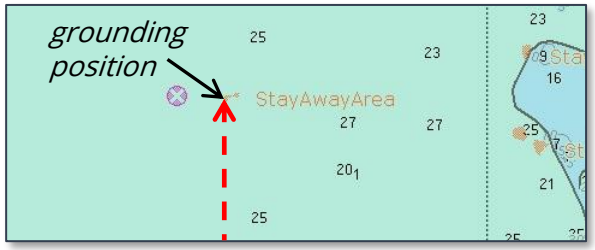

Uncharted Shoal

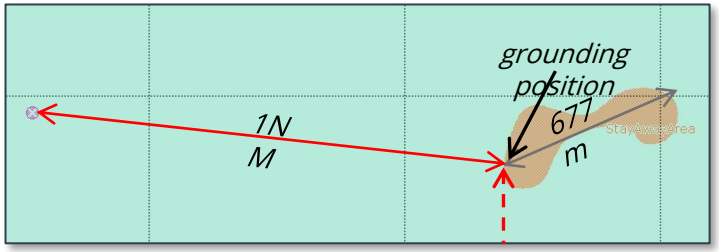
- Shoals detected from EO data (StayAway)

# Looking at Groundings

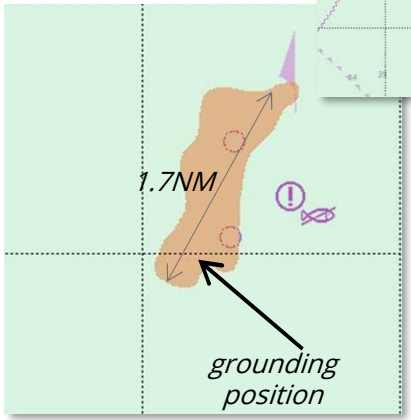
## Some Case Studies

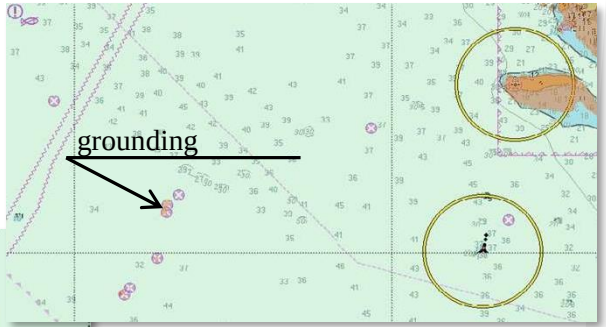
### Case Study 1

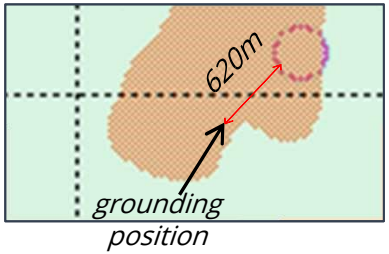



### Case Study 2






To examine the full details of all case study reviews, visit: https://cio-plus.chartworld.com/

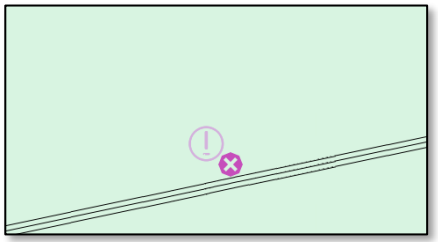
# Looking at Groundings

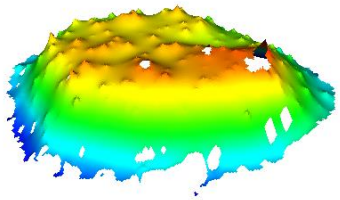
## From another perspective (depth information)

Grounding of the Vessel “Kea Trader”

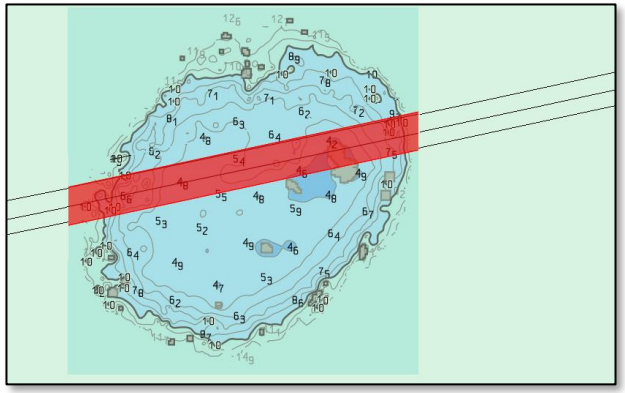
*MARINE SAFETY INVESTIGATION REPORT: NO. 14/2018, © Copyright TM, 2018.*
*MARINE SAFETY INVESTIGATION UNIT, Malta Transport Centre, Marsa MRS 1917*

- Carrying out the full SDB process to extract depth information for the shoals
- On-demand customer request, for customers who are interested in having depth information for detected shoals

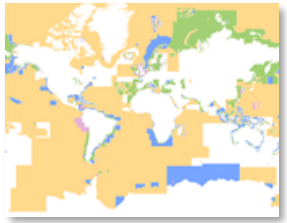




High resolution SDB data

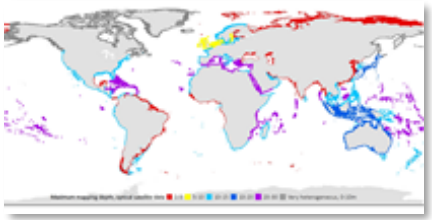


# Feasibility



ENC CATZOC C,D & U

+



WATER CLARITY

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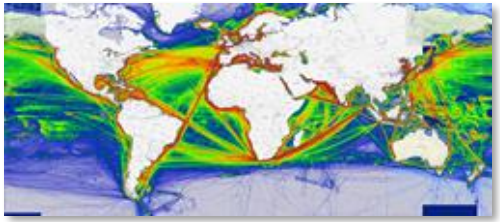

VESSEL TRAFFIC

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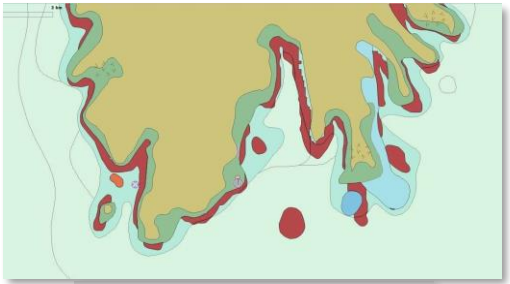
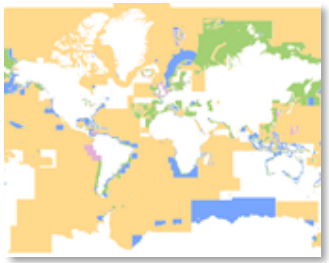


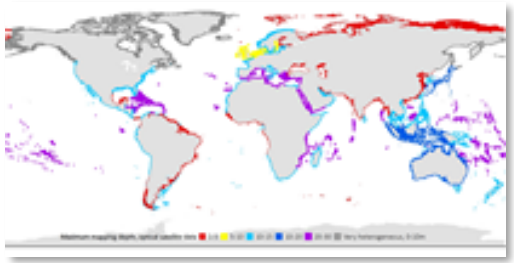
StayAway Areas

# Feasibility Criteria

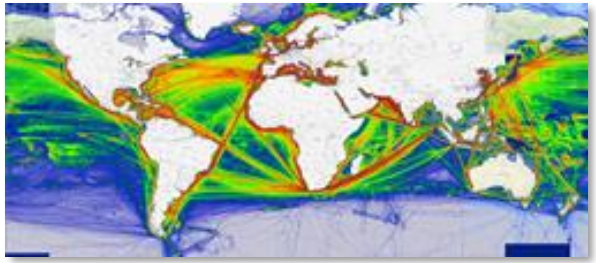
## Looking for suitable regions

**CATZOC distribution:**
low CATZOC values => poor depth and position accuracy
CATZOC C,D,U





**Technical feasibility:**
water clarity and mapping potential



**Vessel traffic:**
significant vessel traffic activities

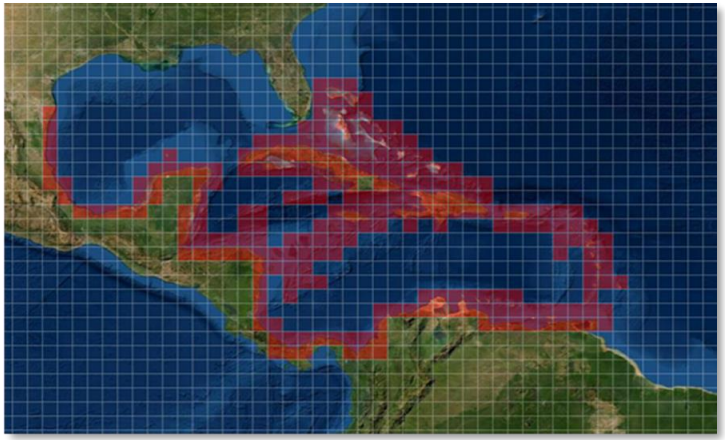
# Regions matching the feasibility criteria

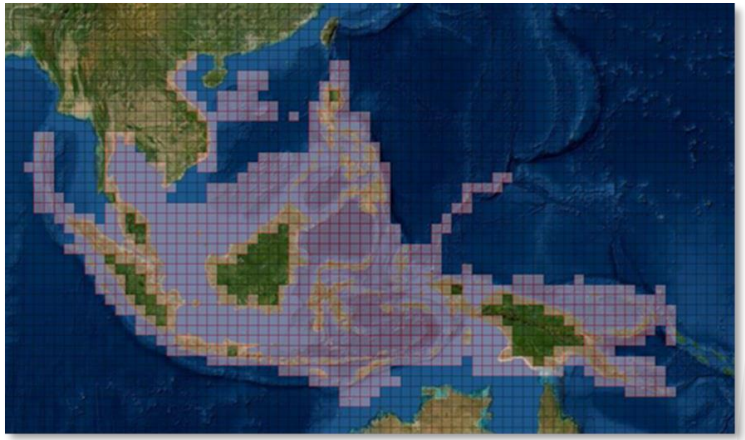
**Areas identified so far:**

- Caribbean
- South East Asia

**1000 1°x1° Tiles:**

Projected 400k shoal areas to be detected

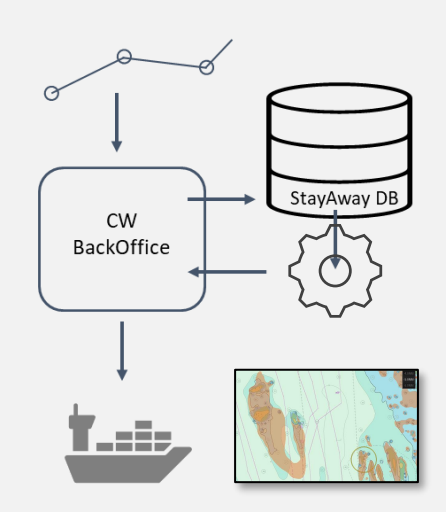




# From pilot project to a global service

Selection of suitable areas to create a global StayAway Area database.

Integrate StayAway Areas to **ChartWorld's Chart Information Overlay** (CIO+) service (T&P, NAVAREA, ENVIRONMENTAL).




# Thank you!

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Scan the QR-code or click here to read more about CIO+ StayAway