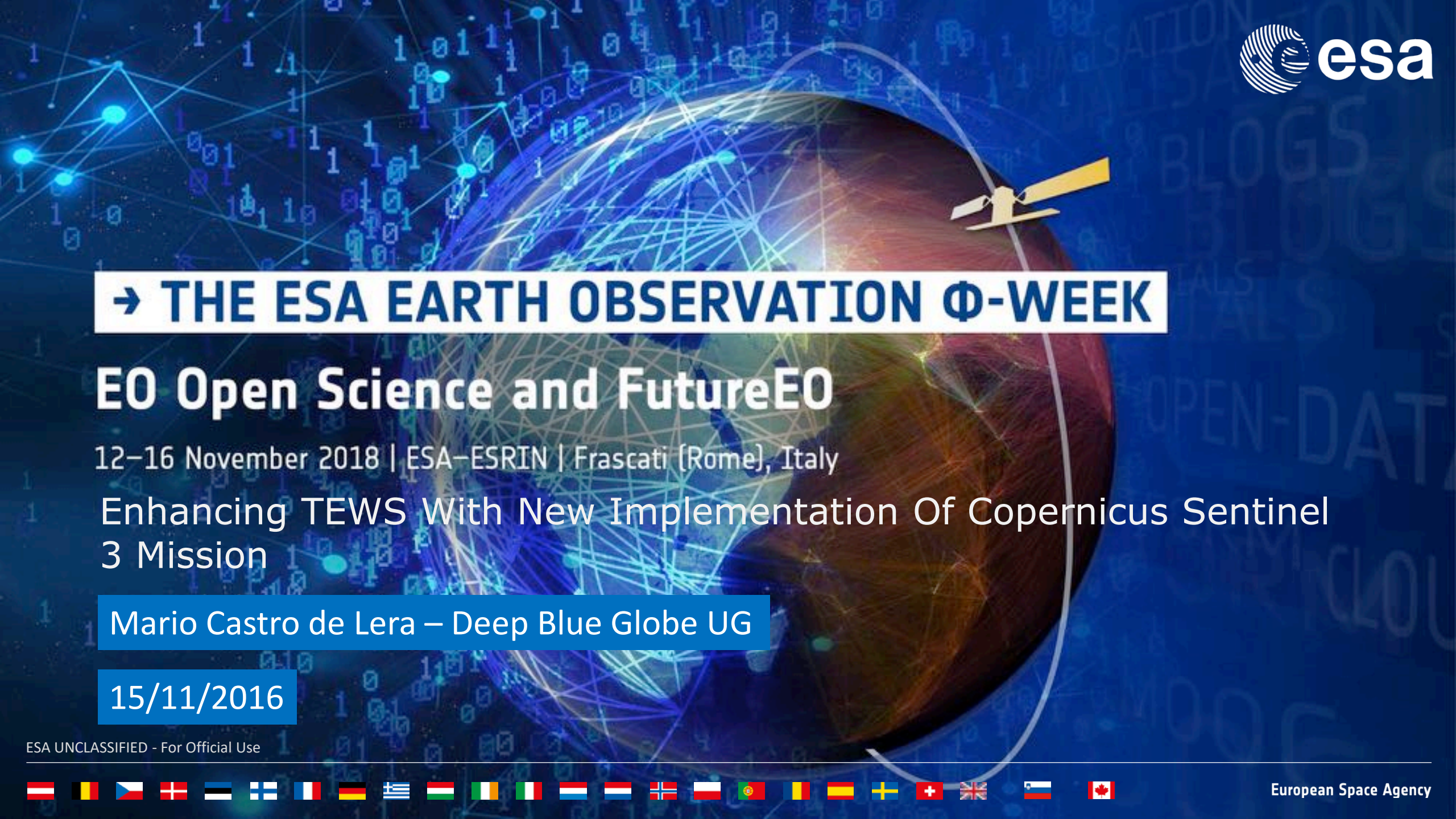


→ THE ESA EARTH OBSERVATION Φ-WEEK

EO Open Science and FutureEO

12–16 November 2018 | ESA–ESRIN | Frascati (Rome), Italy

Enhancing TEWS With New Implementation Of Copernicus Sentinel 3 Mission

Mario Castro de Lera – Deep Blue Globe UG

15/11/2016

DBG Team

Sentinels Spacecraft Operations Engineers and Mission planners for Sentinel 3 and Sentinel 5P

MBA Aerospace Engineer

Software Architect

Data scientist and AI expert advisor from ESA Advanced Mission Concept department

Deep Blue Globe

PARTNERS

esa business incubation centre

NVIDIA INCEPTION PROGRAM

IH cantabria INSTITUTO DE HIDRÁULICA AMBIENTAL UNIVERSIDAD DE CANTABRIA

EUROPÄISCHE UNION

WEkEO by COPERNICUS

SSC

Copernicus incubation

Description of the problem (I)

WORST DESTRUCTIVE TSUNAMIS

Sumatra, Indonesia – 26 December 2004
… around 230,000 people reported dead.

North Pacific Coast, Japan – 11 March 2011
… killing more than 18,000 people …

Lisbon, Portugal – 1 November 1755
… killing 60,000 in the Portugal, Morocco and Spain.

Krakatau, Indonesia – 27 August 1883
… as many as 2,000 deaths …

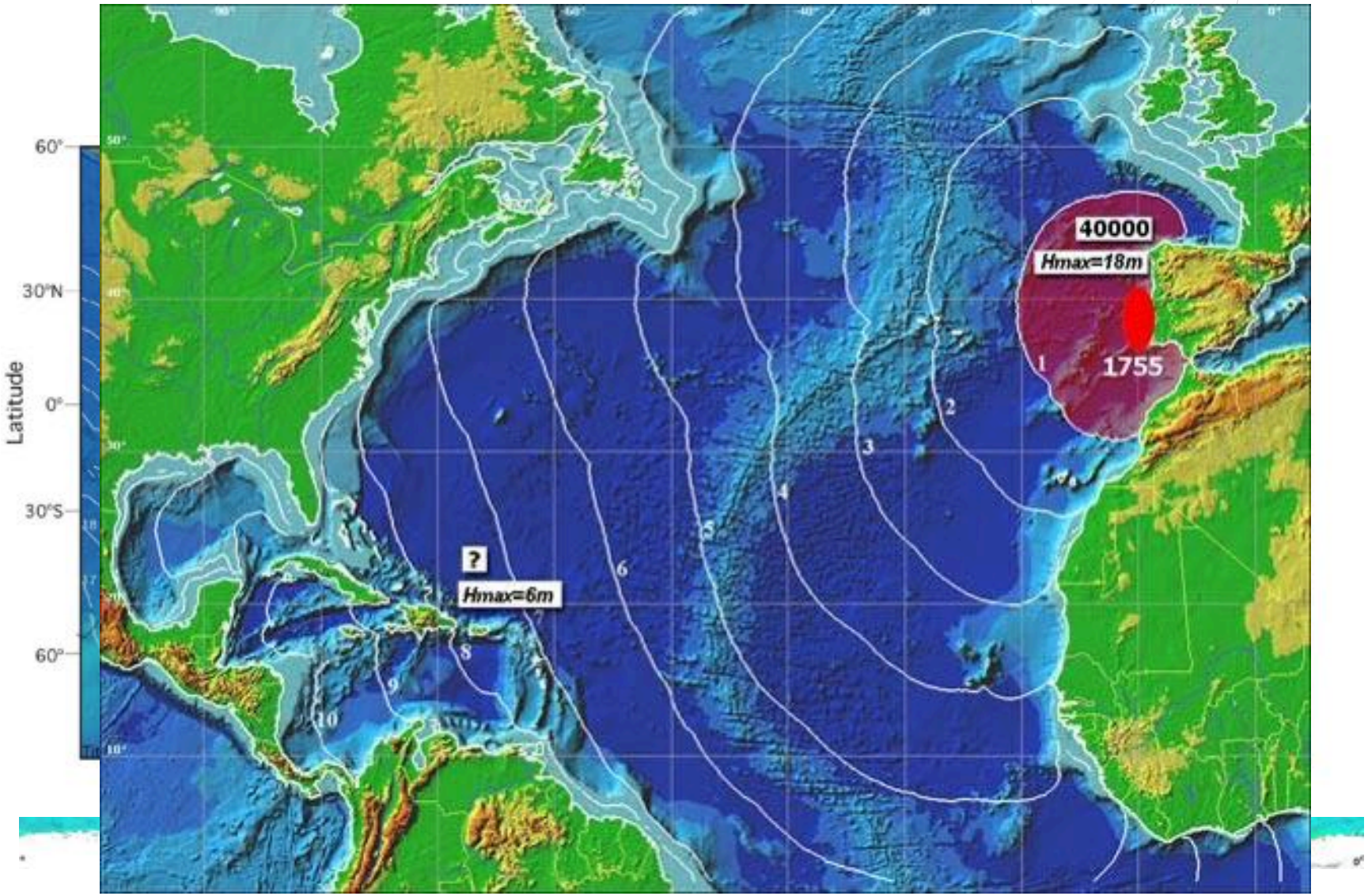
Enshunada Sea, Japan – 20 September 1498
… at least 31,000 people killed.

Nankaido, Japan – 28 October 1707
… about 30,000 people were killed …

Sanriku, Japan – 15 June 1896
… killing some 22,000 people.

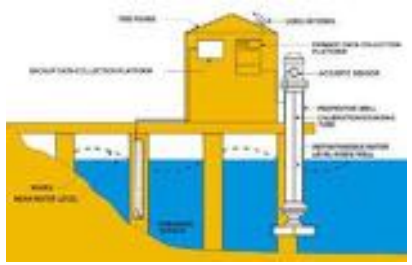
Northern Chile – 13 August 1868
A total of 25,000 deaths were estimated …

Ryuku Islands, Japan – 24 April 1771
… killing nearly 12,000 people in total.



Source:
https://www.australiangeographic.com.au/topics/science-environment/2011/03/the-10-most-destructive-tsunamis-in-history/

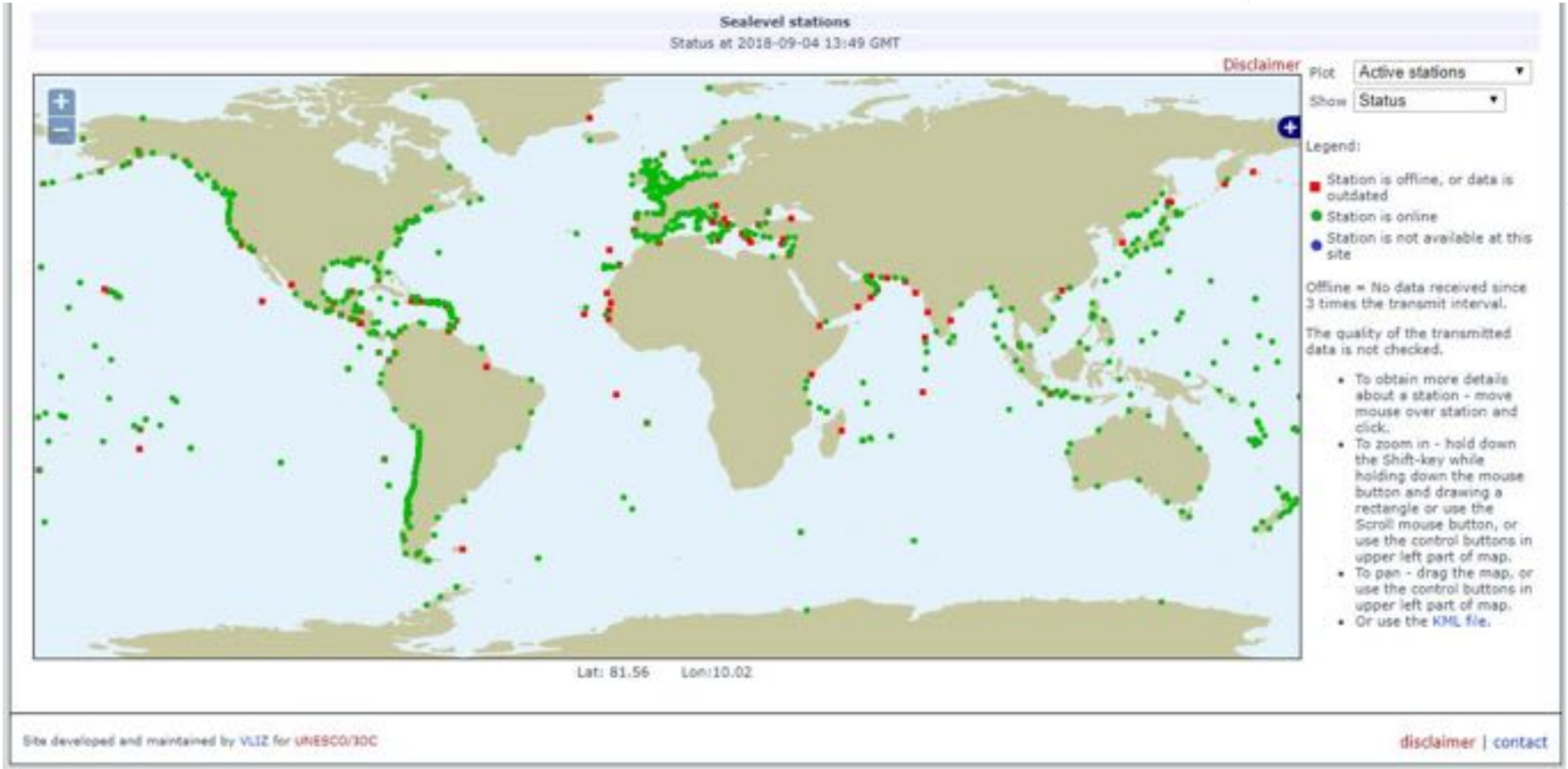
CURRENT MONITORING SYSTEMS



Pacific Marine Environmental Laboratory

Big open ocean areas are still out of the monitoring systems.

Description of the problem (II)



CHANNELS

UN-DLR High Level Forum

Presentation in front of potential users has been done in November 2018

Big Data World Singapore 2018

During **Big Data & Analytics Keynote** and **AI and Machine Learning**, we were speaking about this project to an audience of 1000's of people

Description of the solution (I)

Tsunami event detection based on satellite measurement

Altimetry instruments on board of different satellite mission are providing measurements of the Sea Surface Height.

This will be improved by adding Sea Surface Roughness data coming from imaging radar mission

Supported by propagation methods and buoys measurements data.

Tsunami propagation methods allows a better detection of these events. Satellite detection contribute to validate and improve those propagation functions.

Provision of buoy measurements are injected to the system for consolidation of the algorithm.

Event detection enhanced by a AI algorithm implementation

Data analytics of stored data from historical tsunami event, but also other meteo tsunamis, is under preparation to train a dedicated neural network providing our solution with a better classification algorithm

First operational implementation of the Sentinel 3 local data dumps.

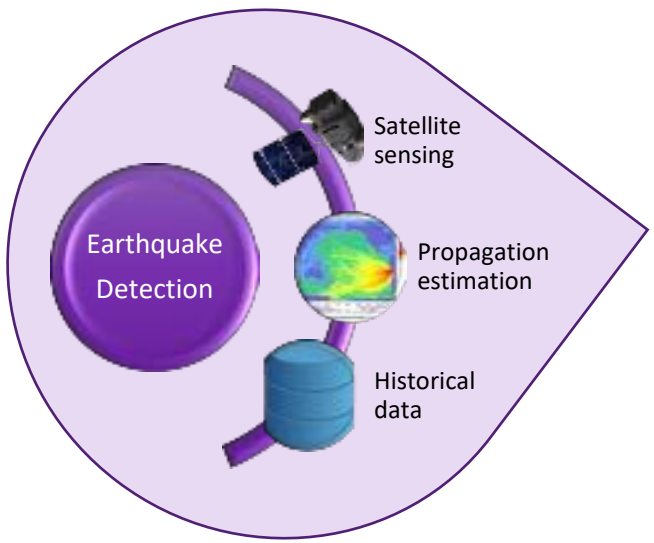
Copernicus Sentinel 3 satellites have been design to access data in specific regions on demand.

TEWS could be the first implementation of the Sentinels Collaborative Ground Segment of the Copernicus Sentinel 3 satellites

SYSTEM DESCRIPTION

Description of the solution (II)

TEWS implementation



TEWS Processor

COPERNICUS SATELLITES

High open ocean coverage using Sentinel 3 satellites, including all oceans.

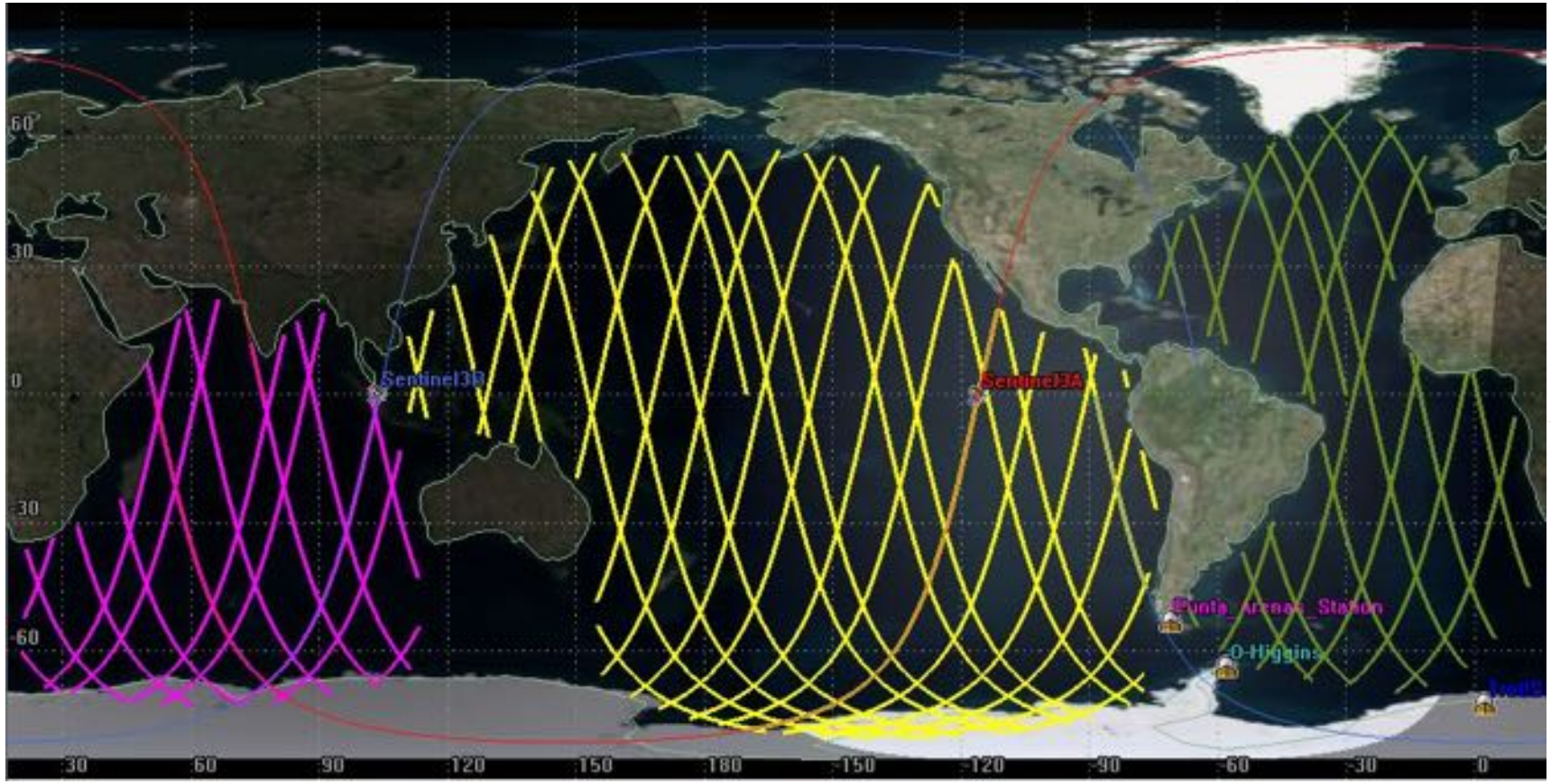
Complemented for other altimetry current missions like Jason2 and Jason3, Cryosat, HY-2, Saral.

Copernicus Mission Sentinel 6 will contribute from end of 2020.

Data latency reduce by the implementation of Local Dumps on South pole station or other specific locations like Indonesia

Description of the solution (III)

TEWS - Copernicus Sentinel 3 Mission Analysis



Current Sentinel 3 Mission implementation

Sentinel Core Ground Segment

GLOBAL DUMPS

SLSTR

OLCI

SRAL

MWR

GNSS

DORIS

Ancillary data

- Data dump over Svalbard ground station once per orbit.
- Data distribution through PDGS.
- Timeless ~3h

LOCAL DUMPS

SRAL

Ancillary data

No impact in nominal mission

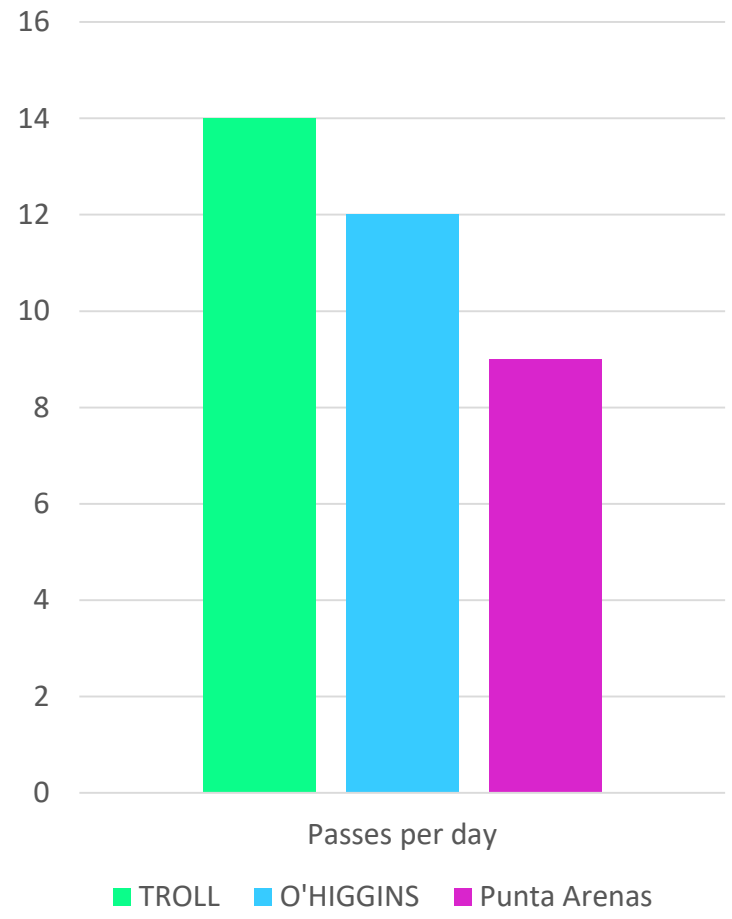
New Sentinel 3 Mission implementation

Sentinel Collaborative Ground Segment

- Complementary products and algorithms definitions.
- Data dissemination and access, supporting redistribution of SENTINEL core products by establishing additional pick-up points
- Complementary support to calibration/validation activities.
- **Data acquisition and (quasi-) real time production.**
- **Development of innovative tools and applications.**

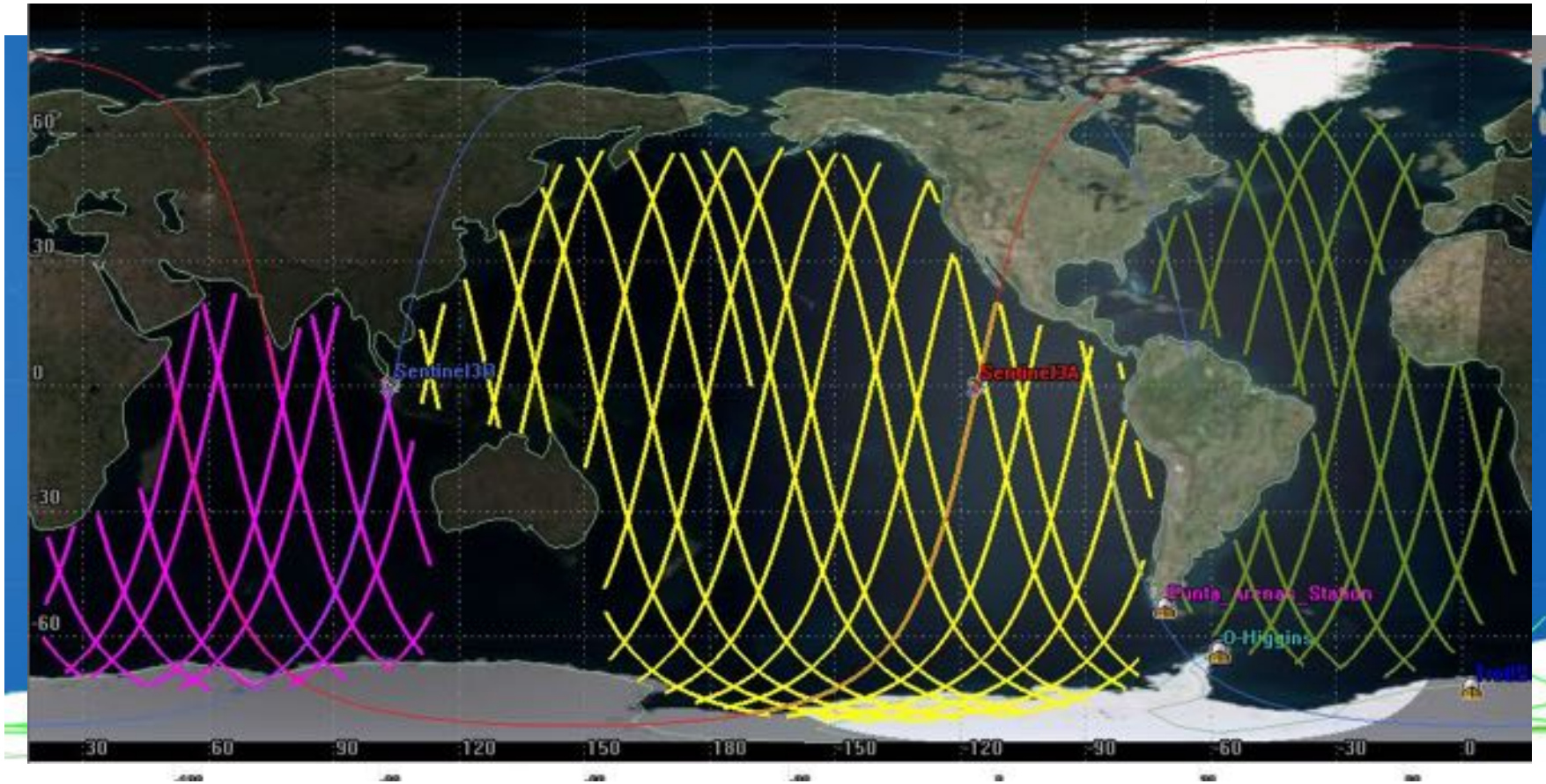
Deep Blue Globe

SOUTH POLE GLOBAL COVERAGE



USE CASES

TEWS - Copernicus Sentinel 3 Mission Analysis



INDONESIA USE CASE

Sentinel 3 Quasi Real time data

10 -12

Altimetry satellite Missions

Number of passes per day

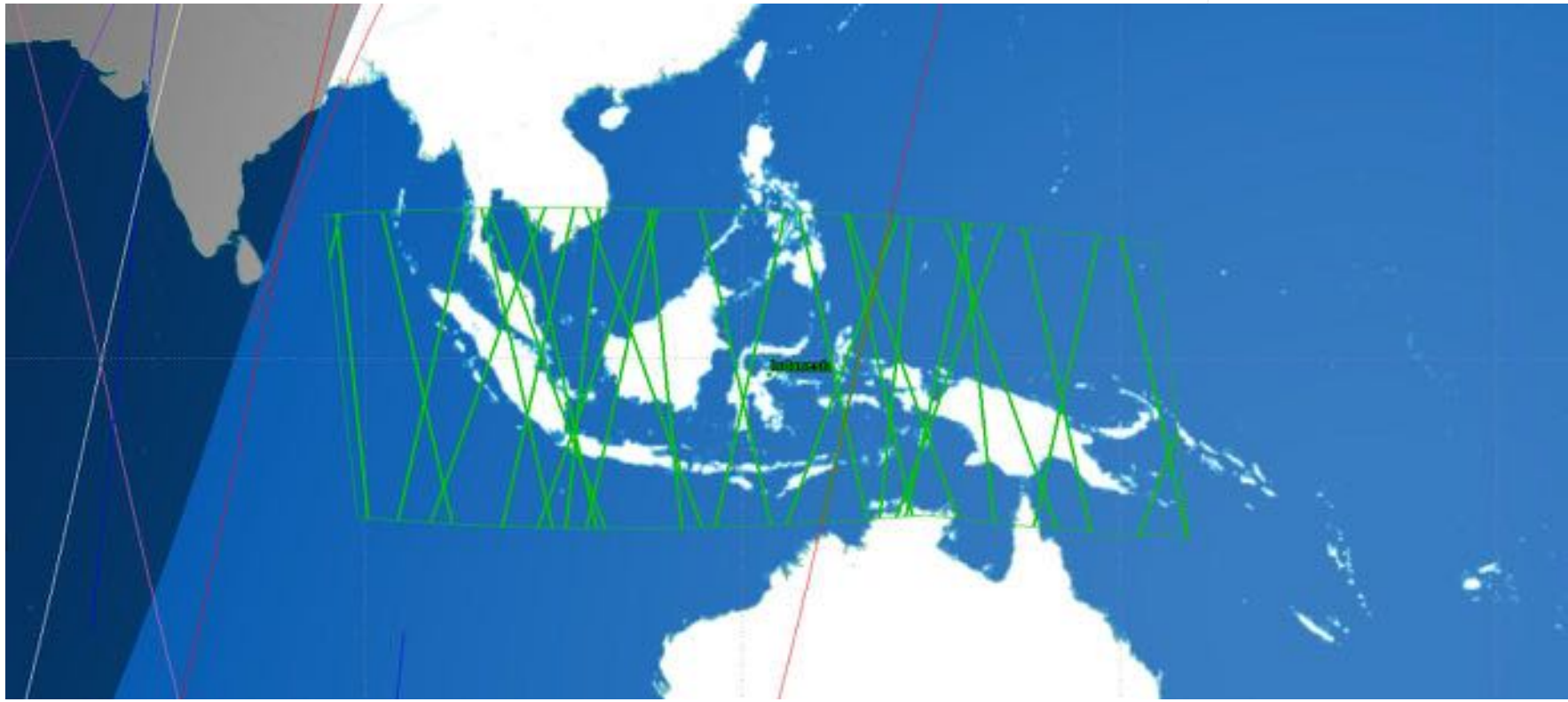
30

Complemented by passes of Sentinel 1-A and B radar

12

USE CASES

TEWS - Copernicus Sentinel 3 Mission Analysis



CONCLUSION

DBG - TSUNAMI EARLY WARNING SYSTEM

- Global coverage for tsunami detection including open seas
- First Sentinel 3 Collaborative Ground Segment implementation.
- No Impact in the Nominal Mission (slightly increase of the mission planning)
- Altimetry data timeless reduced up to quasi real-time for specific areas

REFERENCES

PAPERS

Could satellite altimetry have improved early detection and warning of the 2011 Tohoku tsunami?
B. D. Hamlington R. R. Leben O. A. Godin E. Gica V. V. Titov B. J. Haines S. D. Desai

The 26 December 2004 tsunami source estimated from satellite radar altimetry and seismic waves
Y. Tony Song Chen Ji L.-L. Fu Victor Zlotnicki C. K. Shum Yuchan Yi Vala Hjorleifsdottir

DOCUMENTS

Sentinel-3 User Handbook
GMES-S3OP-EOPG-TN-13-0001
https://sentinels.copernicus.eu/documents/247904/685236/Sentinel-3_User_Handbook

WEBSITES

IOC – Sea level station monitoring facility Map

NOAA Center for Tsunami Research – Tsunami forecast

NOAA – Ocean Service

Sentinel Collaborative Ground Segment

Radar Altimetry Tutorial and Toolbox

Big Data World Singapore speaker list

IH-Tsunamis System

THANK YOU

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