

# Space as a tool supporting the energy package

**Dr Adam Candy**

with Maria Lems-de Jong, Berend Jan Kleute, Rémi Blokker,  
Paul Dinnissen, Julie Pietrzak, Laurence Crosnier and  
Copernicus Marine Environment Monitoring Service (CMEMS) team



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e.g. carbon fuels: gas, oil, coal fire powered,  
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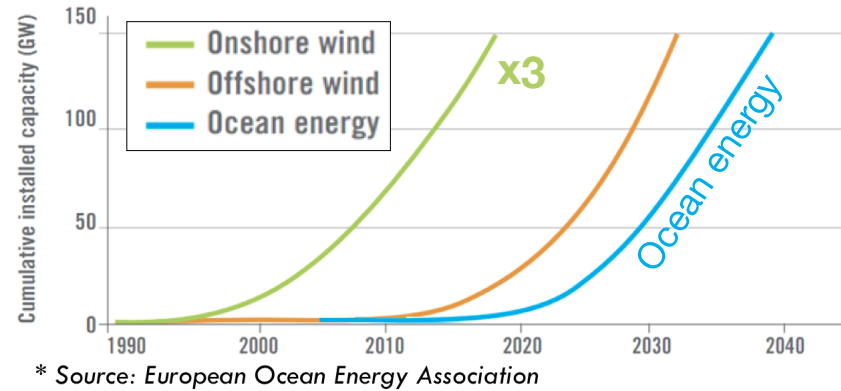
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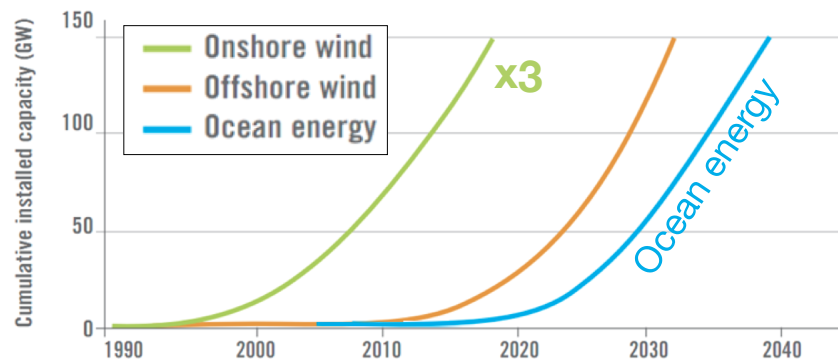
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The transition to sustainable energy sources is underway.

Diverse mix is central to its success.



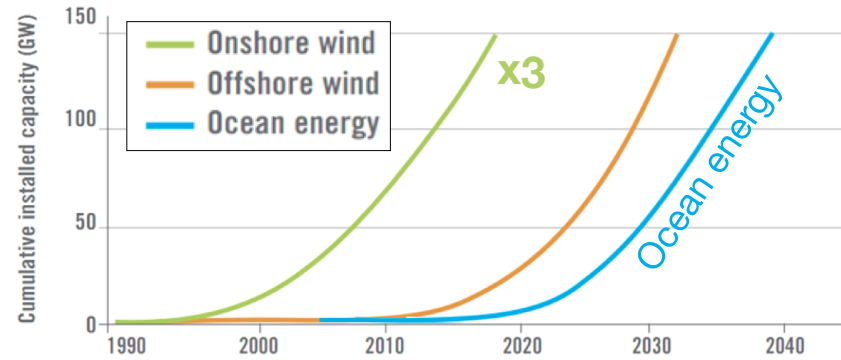
\* Source: European Ocean Energy Association



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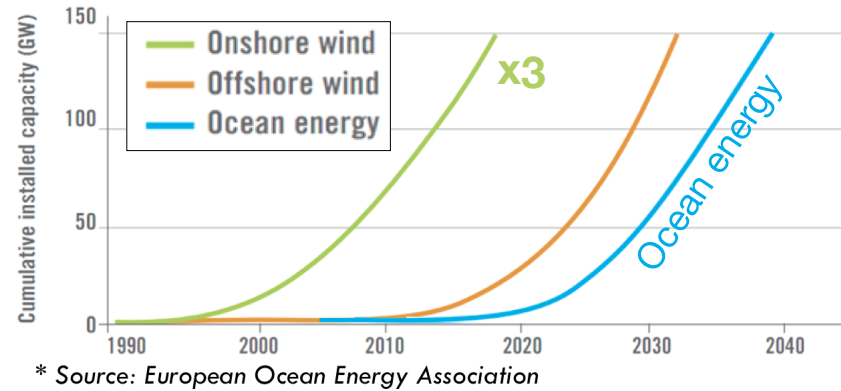
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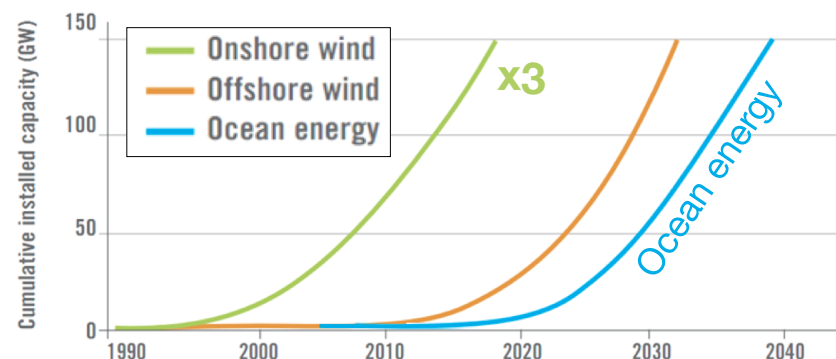
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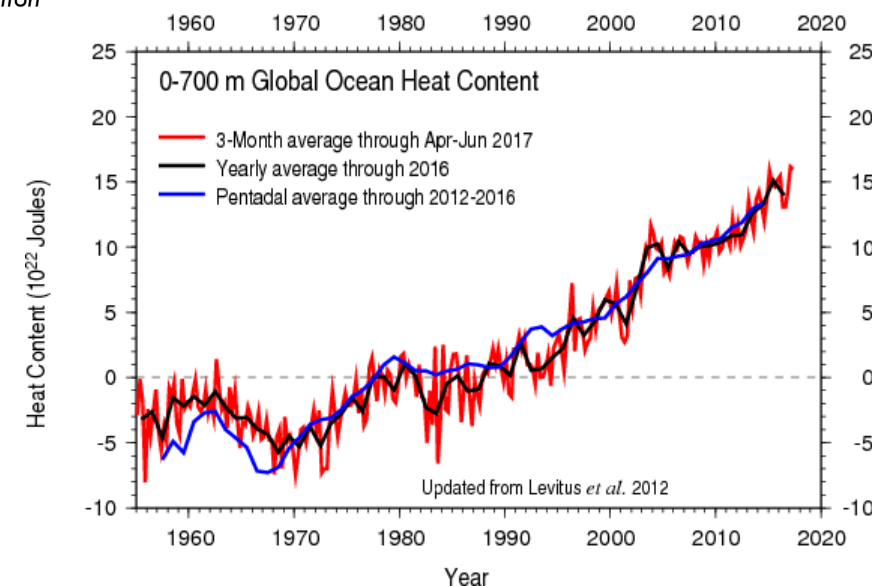
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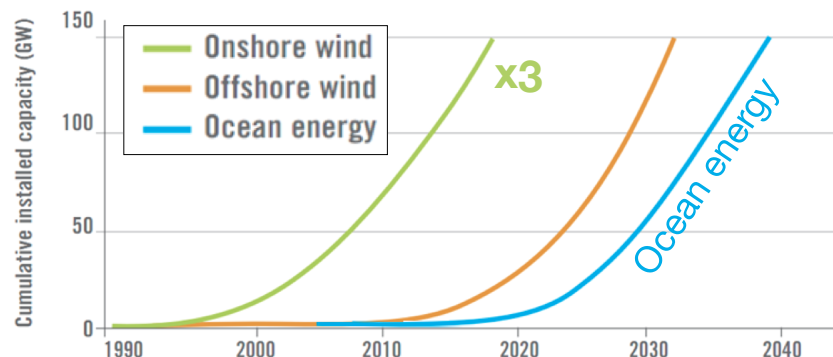
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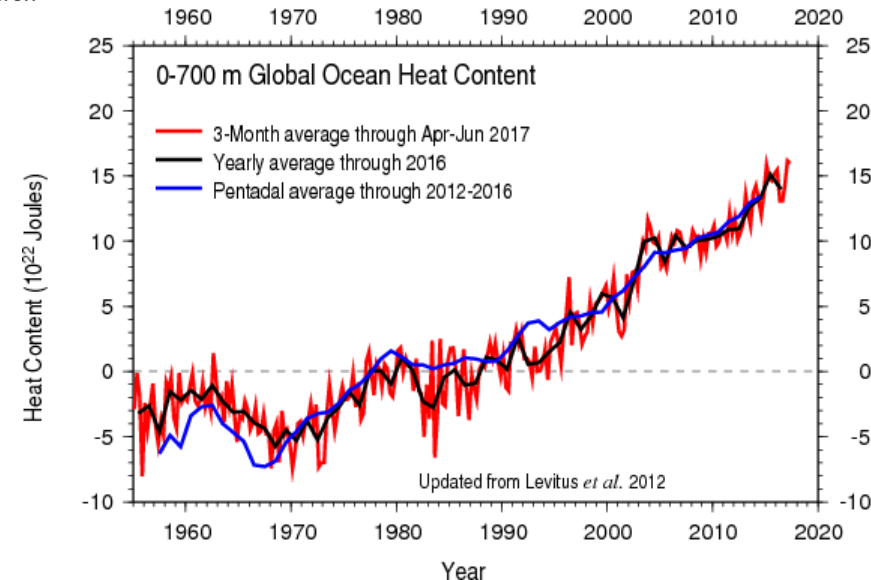
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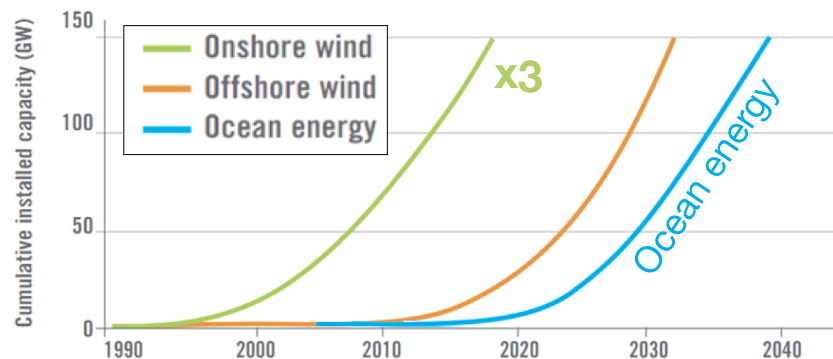




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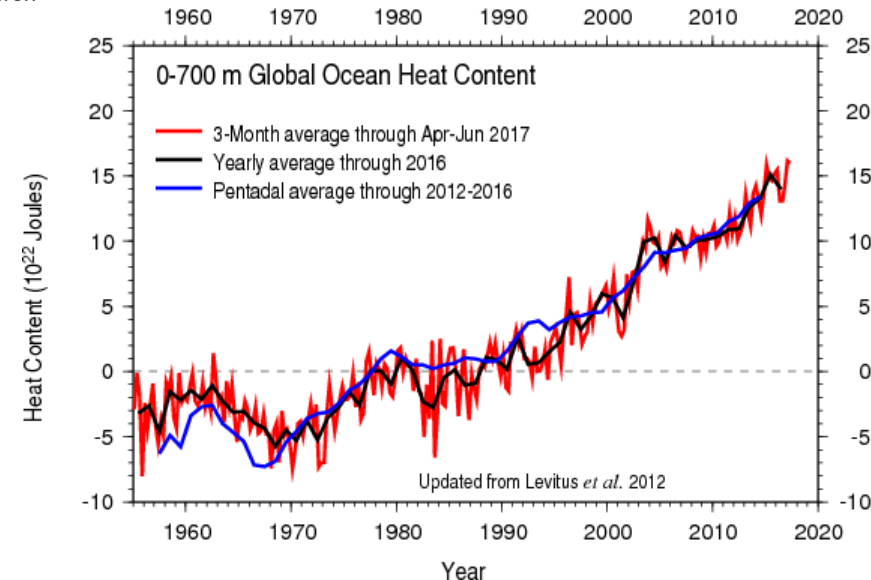
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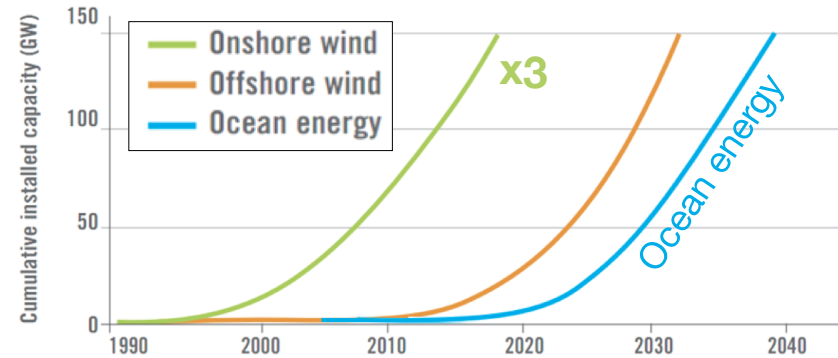
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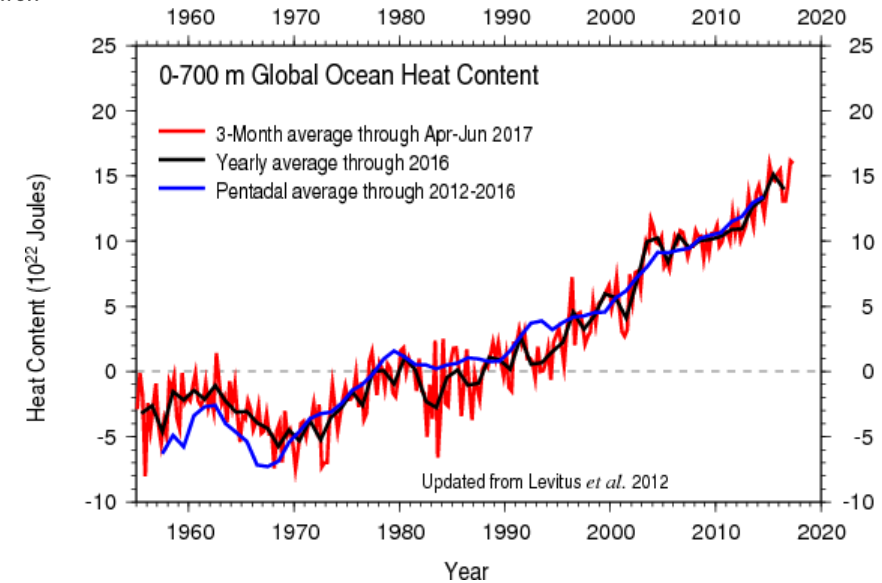


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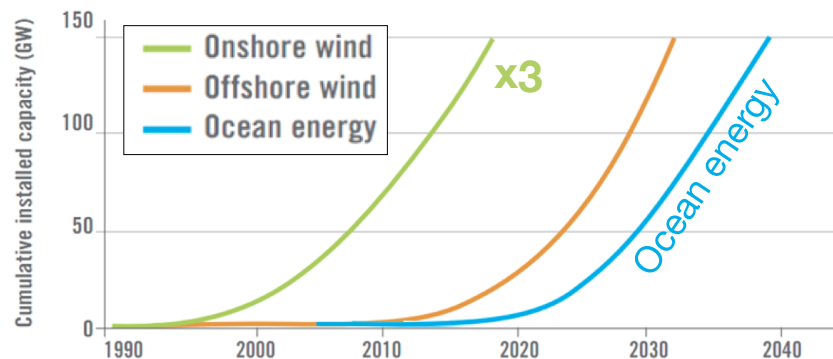
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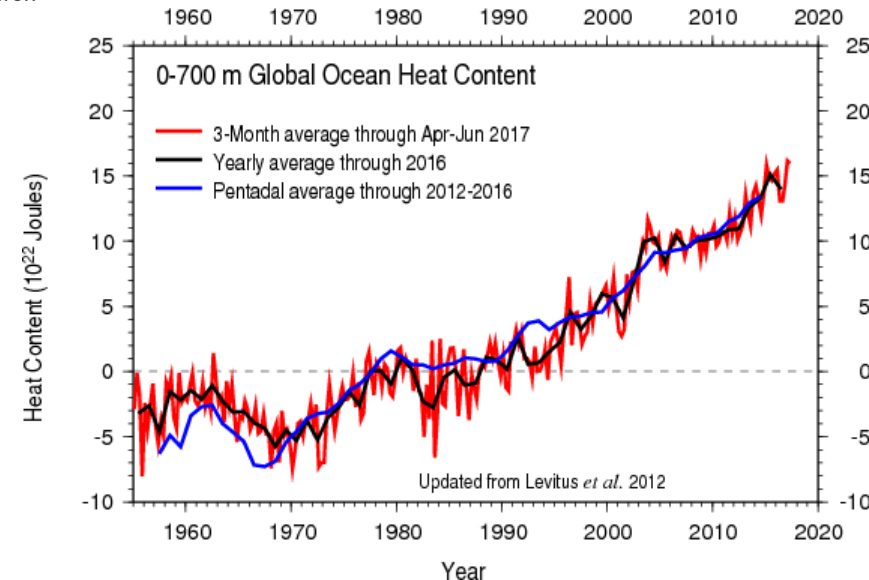
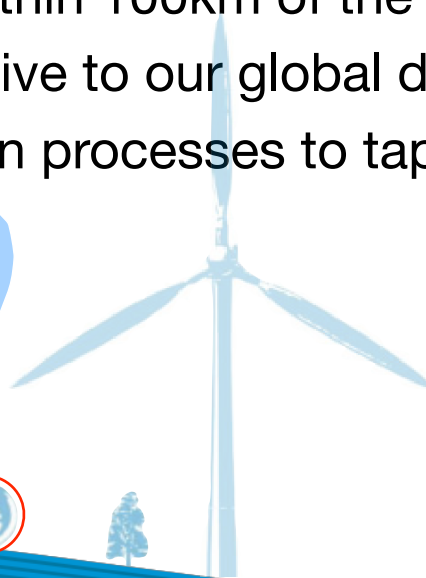


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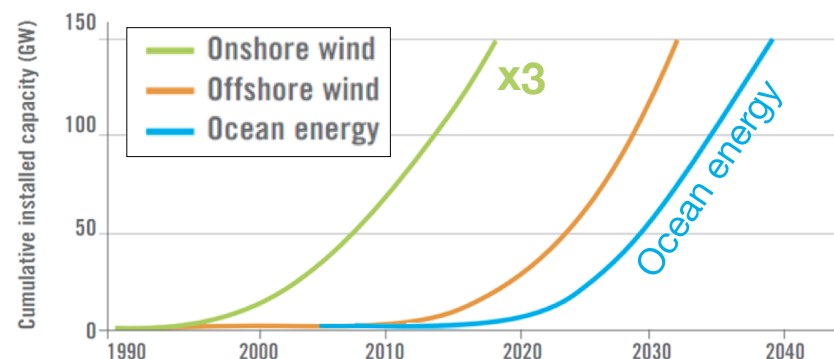
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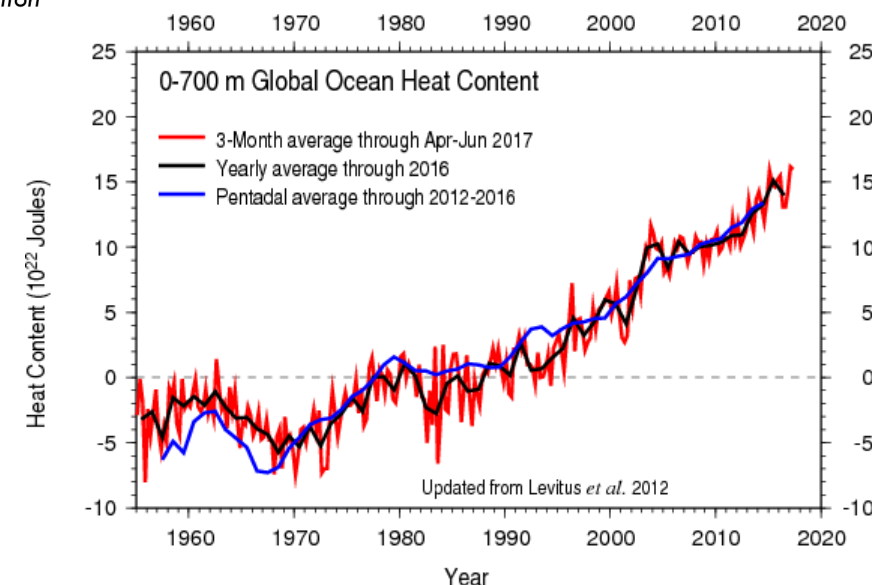


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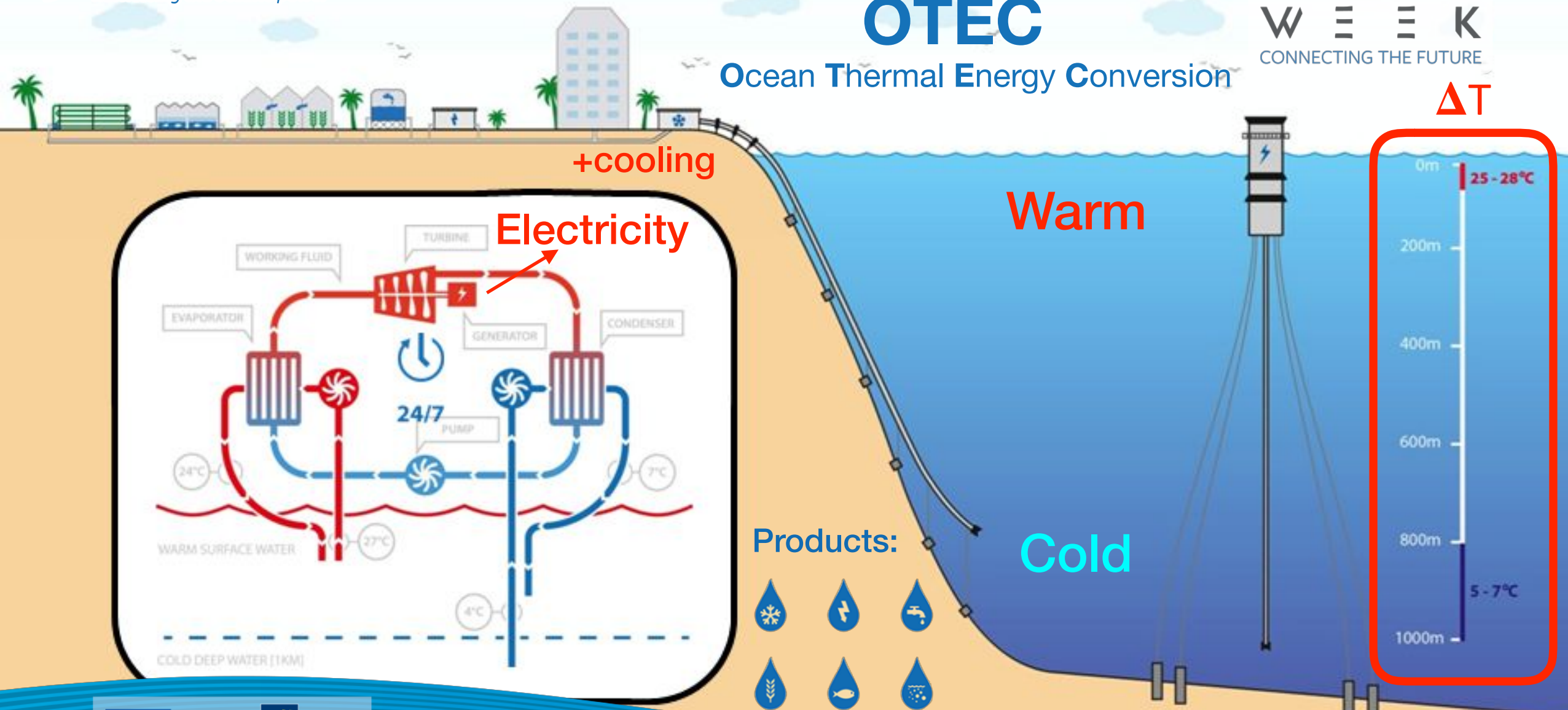
**Bluerise OTEC**  
harnessing the ocean's power

#EUSpaceWeek



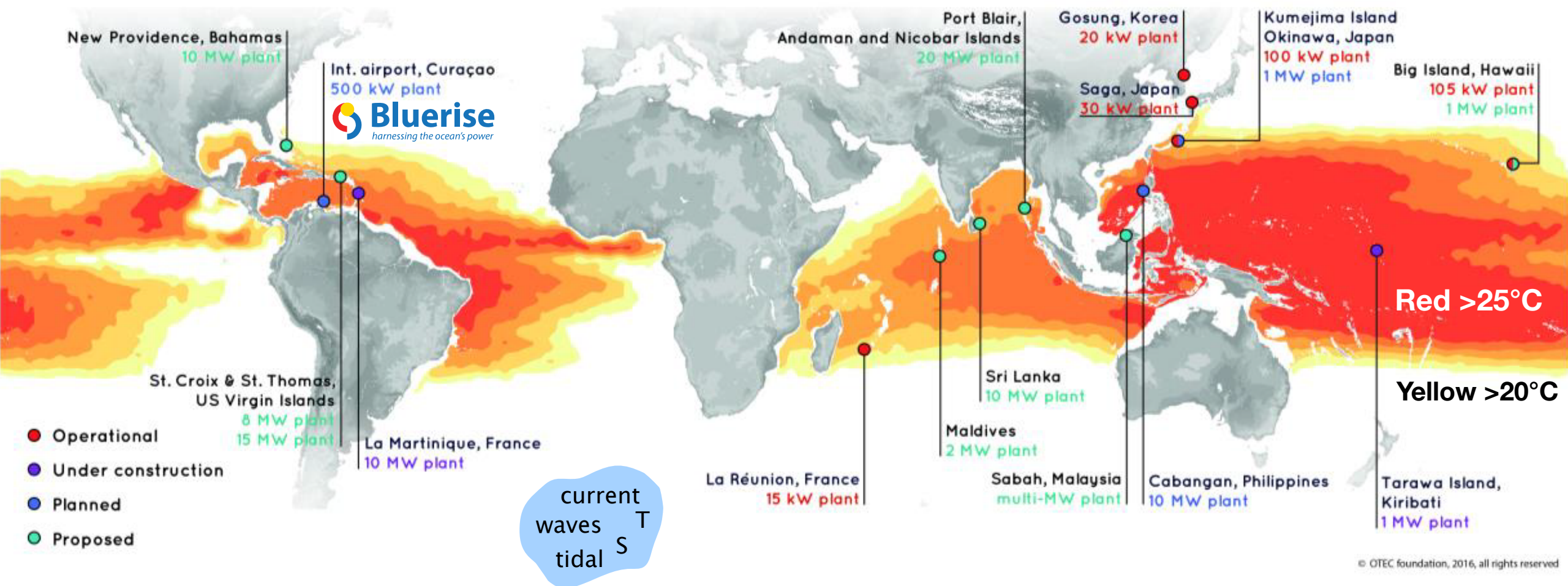
# OTEC

## Ocean Thermal Energy Conversion

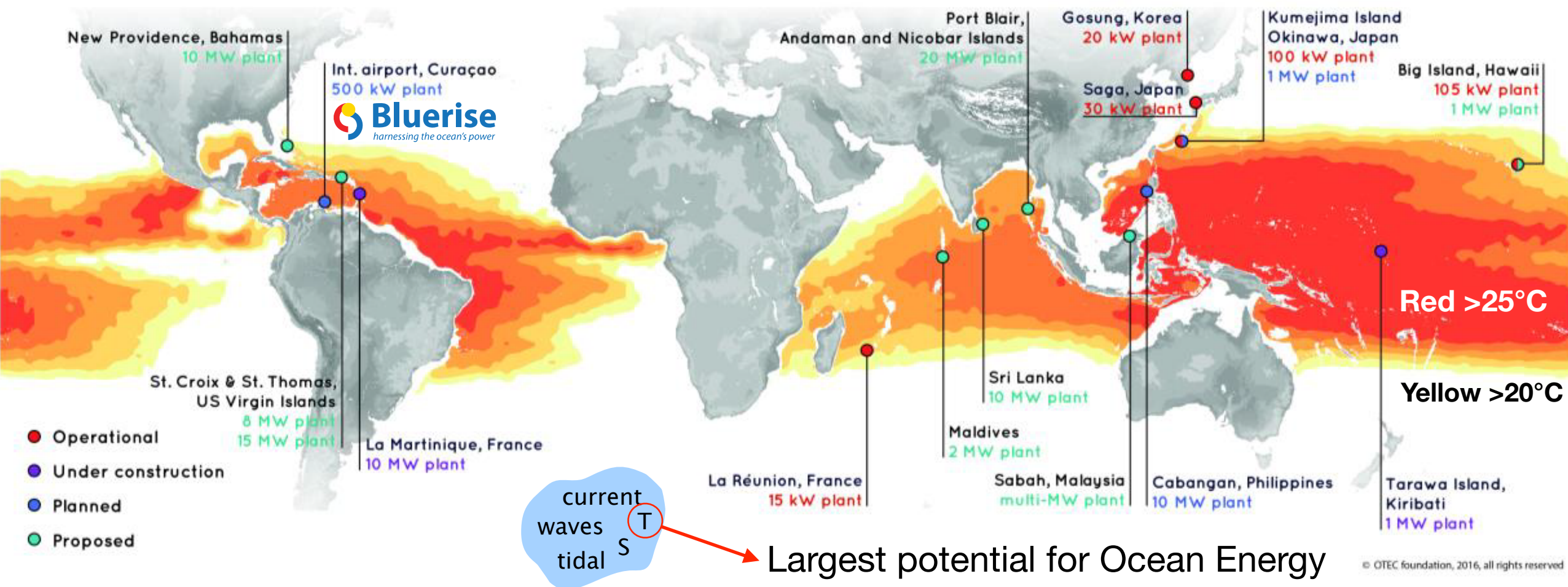




## Worldwide operational, planned and proposed OTEC and its potential

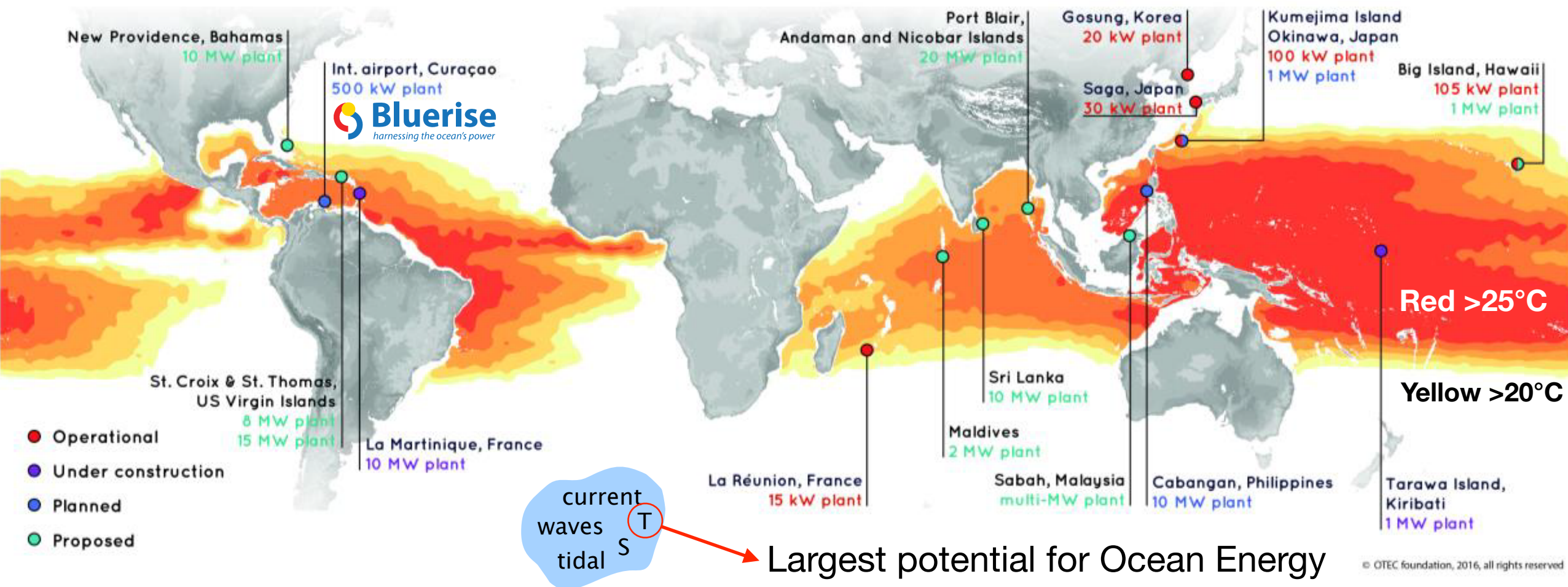


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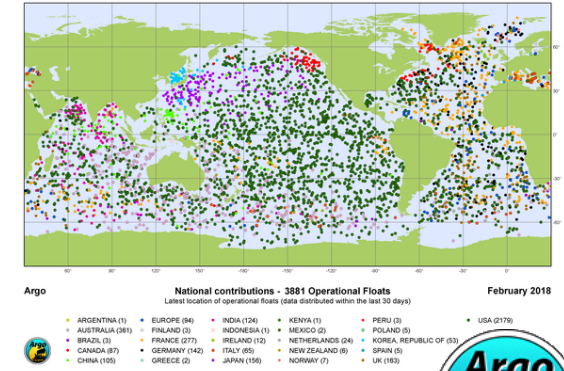
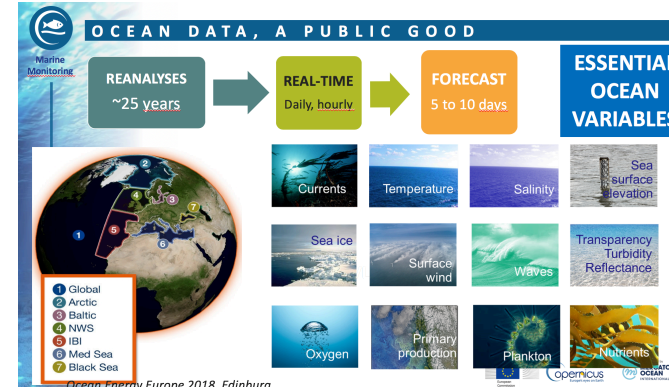
**Motivation:** Why is space now important for our future energy security?

## NEW CHALLENGES

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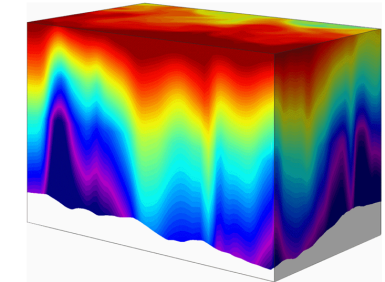
Dutch Research Vessel Pelagia, docked at  
Pointe-à-Pitre, Guadeloupe, Aug 2016



**SATELLITE  
OBSERVATION**



**IN SITU  
OBSERVATION**



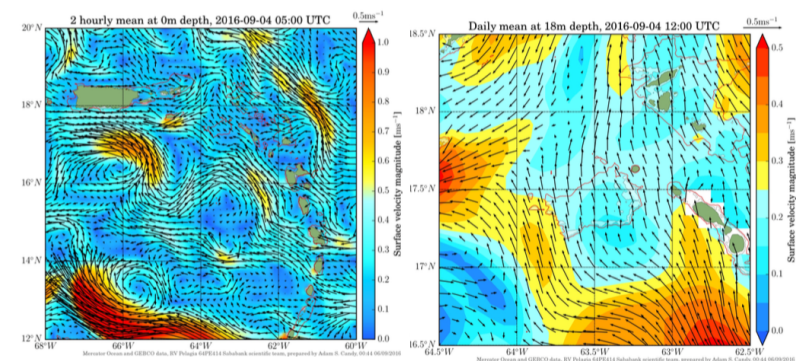
**OCEAN MODEL  
COMPUTATION**



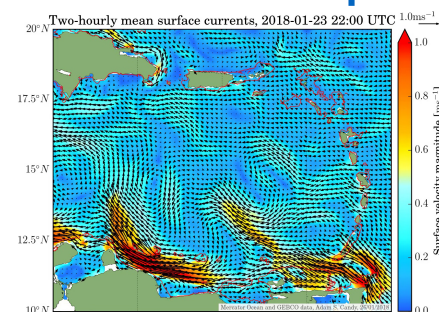
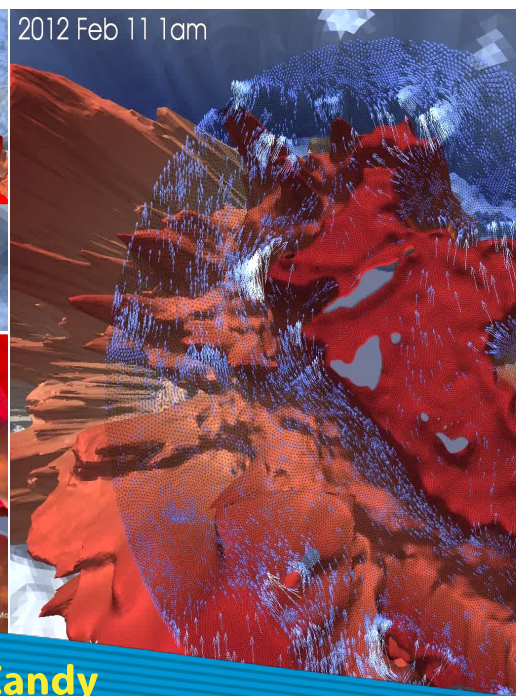
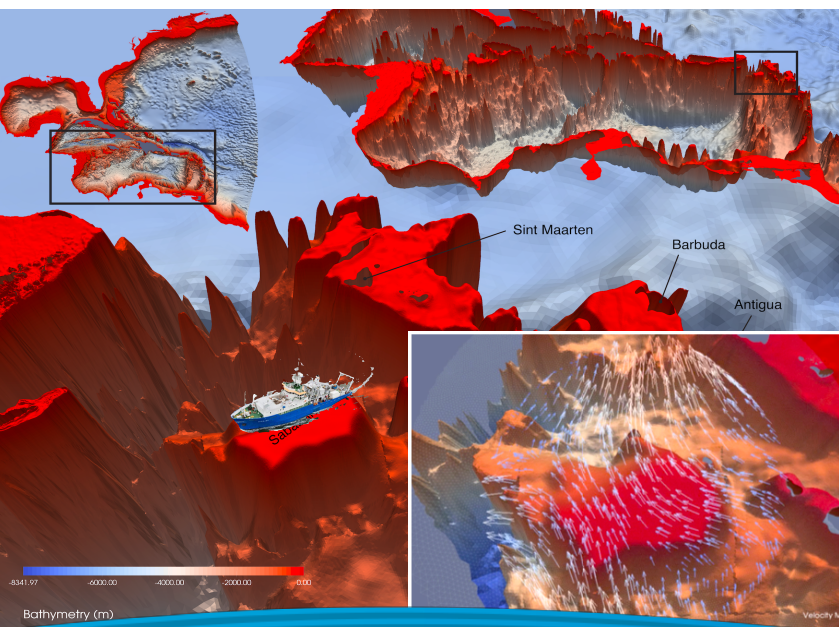
Importance of ensemble and data assimilation  
for assessment and forecasting of the resource  
→ Space as a tool supporting Supercomputing Science



## Mercator Ocean 7-day short term forecasts used during sea research expedition



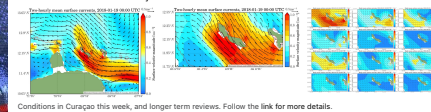
Nightly-updated  
forecast outputs



### Regions of the Caribbean Sea

Further analysis for regions of the Caribbean Sea, including daily-updated current conditions and longer-term annual datasets.

#### CaribbeanWatch: Curacao



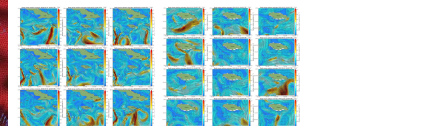
Conditions in Curacao this week, and longer term reviews. Follow the link for more details.

#### CaribbeanWatch: Sababank



Conditions in Sababank this week, and longer term reviews. Follow the link for more details.

#### CaribbeanWatch: Jamaica



Conditions in Jamaica over the past year 2017 and 2016. Follow the link for more details.

#### CaribbeanWatch: Sint Maarten

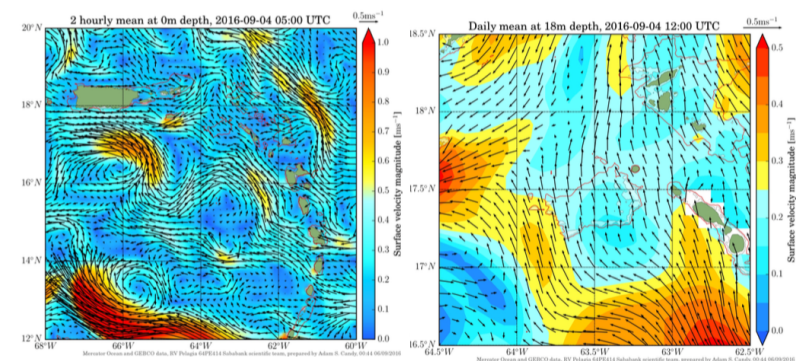


<http://candylab.org/caribbeanwatch/>  
[@caribbean\\_watch](https://twitter.com/caribbean_watch)



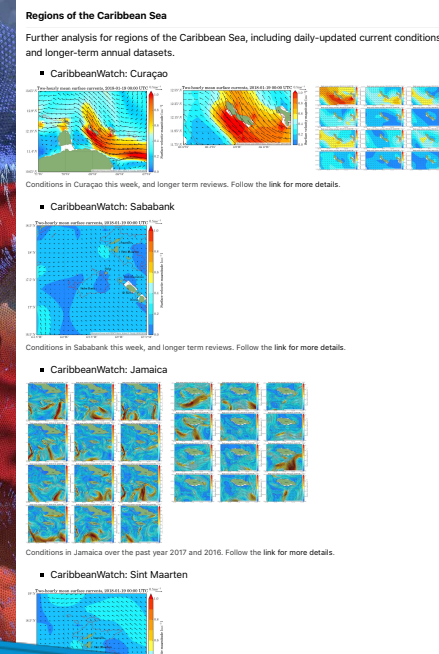
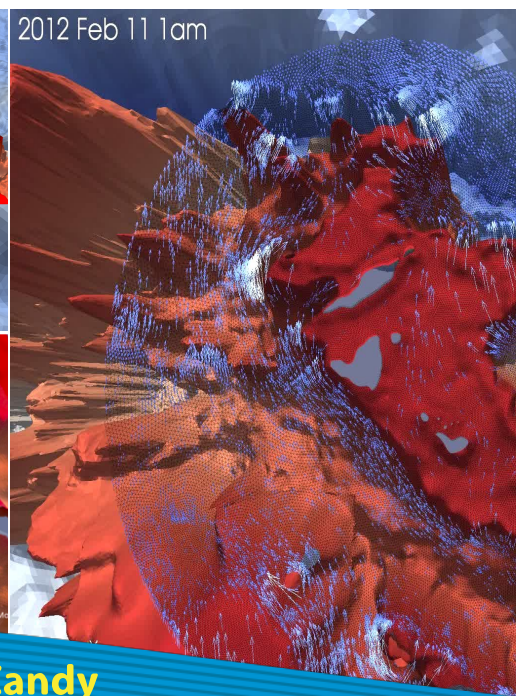
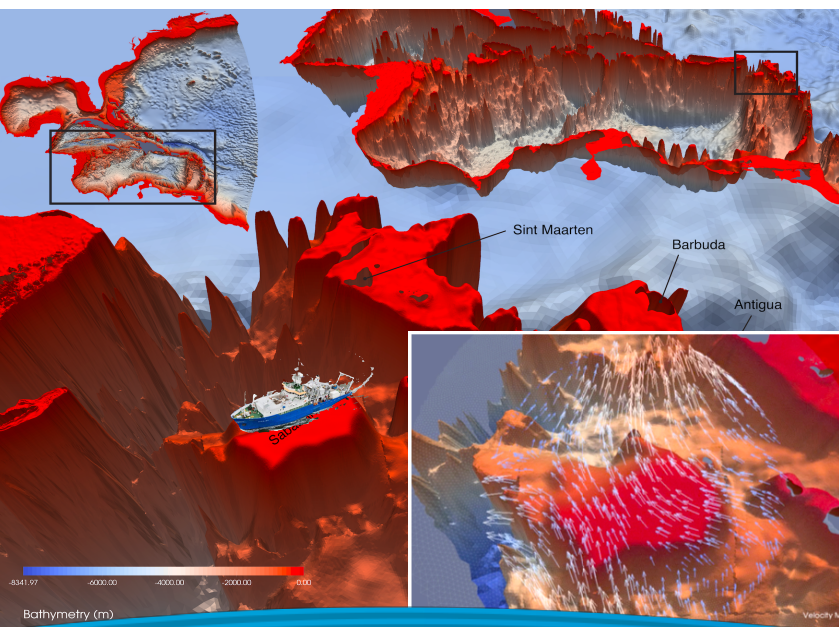
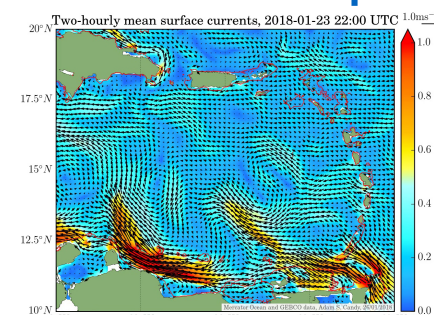


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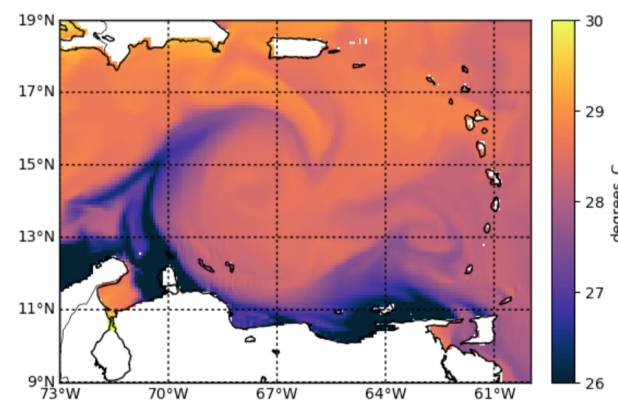
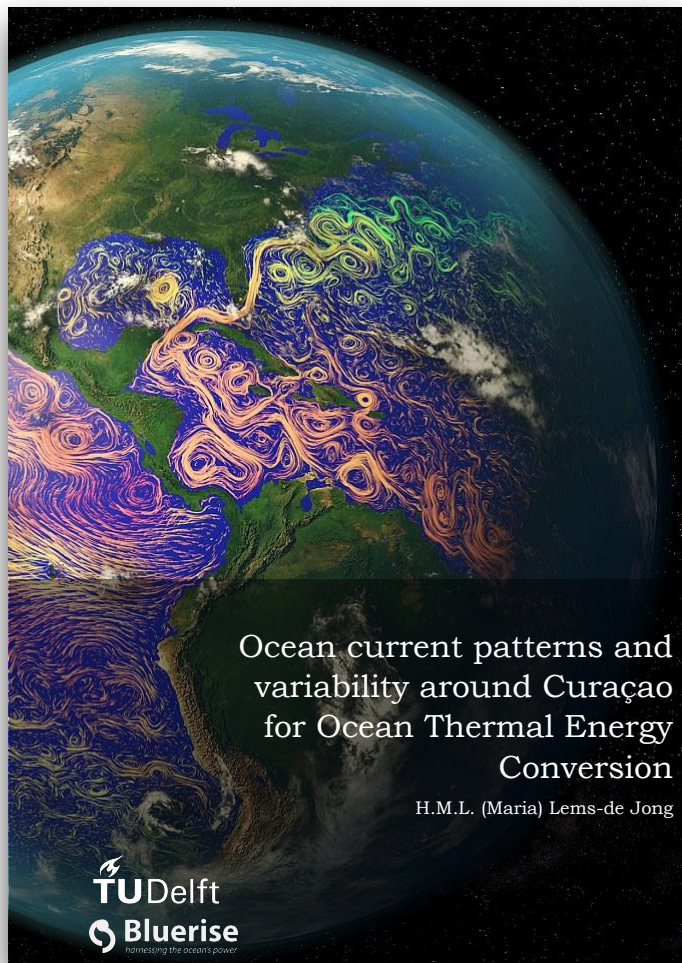
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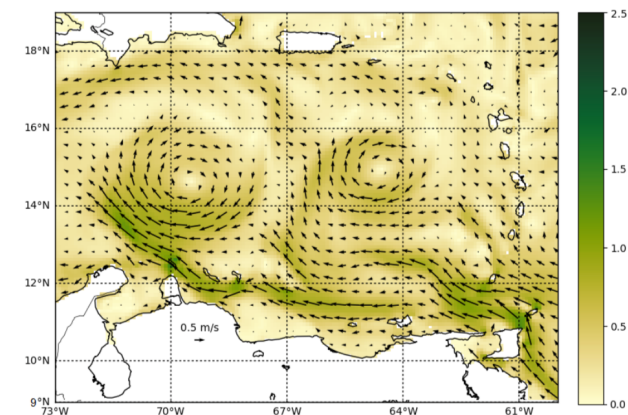




## Research into variability using Mercator Ocean data-data-assimilated space products



(a) Sea surface temperature on July 13th, 2007, when a large cold-water ligament extended up to 17°N.



(b) Sea surface currents on July 10th, 2016, when current velocity was up to 1.5 m/s.

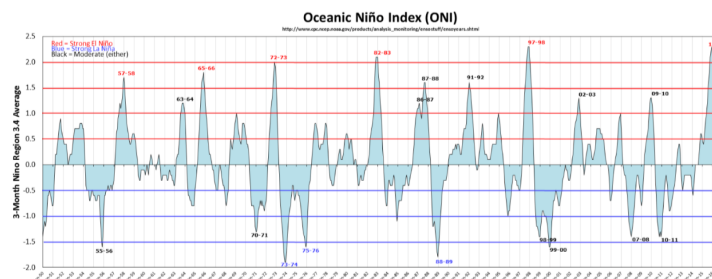


Figure 2.3: Overview of the ONI values from 1950 up to 2016. Three months average values are used. From NOAA Climate Prediction Center [2017]

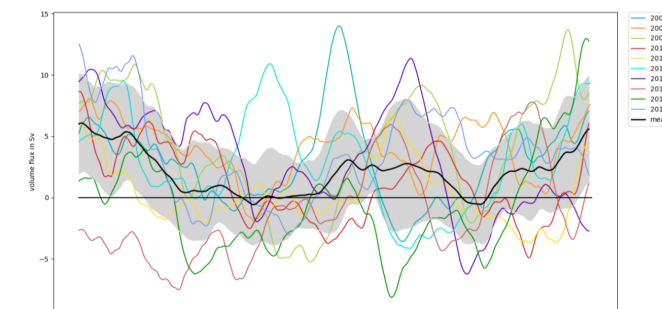
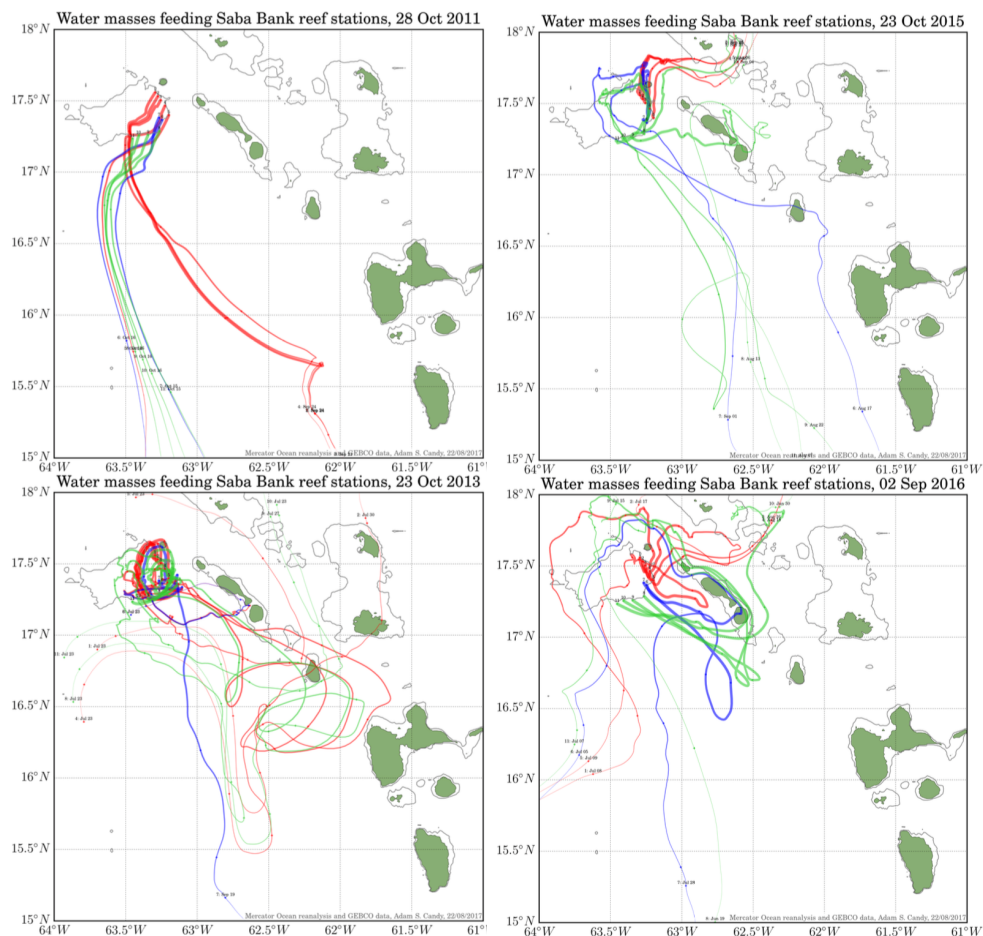


Figure 6.1: Volume flux for the years 2007 to 2016 over the transect line in the channel and sheltered region. The mean is plotted in black and the grey areas indicate the magnitude of the standard deviation. A rolling average of eight days was used to smooth the lines. Plots per year can be found in Figures I.1 to I.10.

Ocean Current Patterns and Variability around Curaçao: An Analysis for Ocean Thermal Energy Conversion, Lems-de Jong HML, Candy AS, Hoving JS, Kleute BJ and Pietrzak JD, 2017, 5th International Ocean Thermal Energy Conversion Symposium, La Réunion, 7-9 Nov 2017

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## Future work and use of space products





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Article

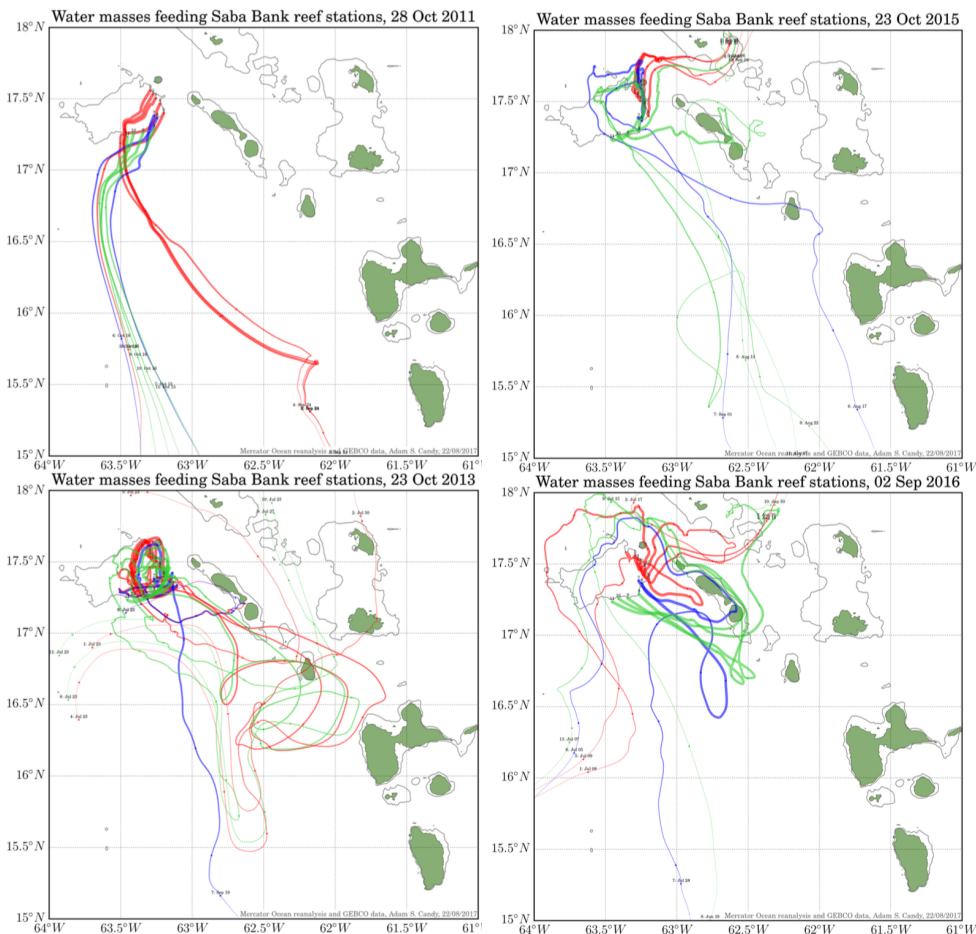
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Yanli Jia <sup>1,\*</sup>, Gérard C. Nihous <sup>2</sup> and

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→ **Power output is 56% originally predicted**

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## Future work and use of space products



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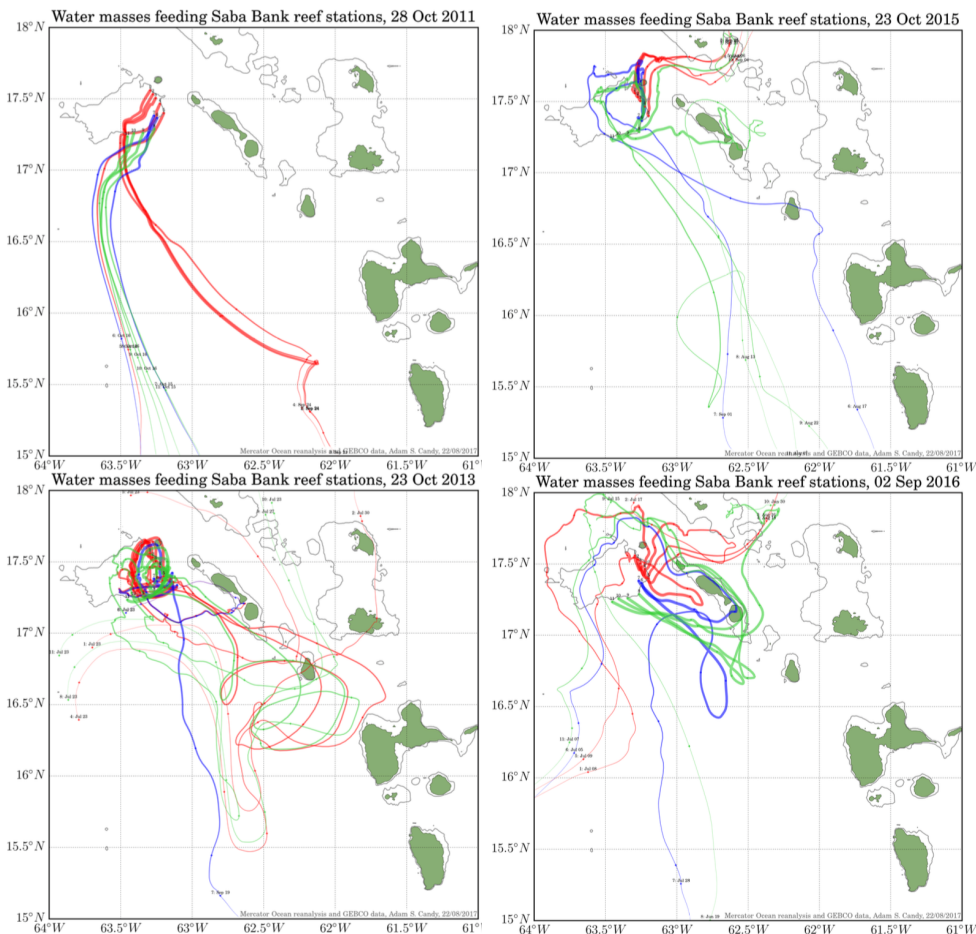
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## Requirements to make OTEC viable, especially for deploying large scale.

- Investigating the effect of OTEC on the environment
- Two-way feedbacks
- Impact of a changing climate, lifecycle, 2050 timeframe
- Lagrangian advection to accurately determine water sources, large variability in Caribbean
- Ecosystem impacts







Space as a tool supporting the energy package  
Space as a tool supporting Small Island Developing States

Get in touch!

**Dr Adam Candy** [candylab.org](http://candylab.org) /OceanEnergy

[candy@cantab.net](mailto:candy@cantab.net) [@DrAdamCandy](https://twitter.com/DrAdamCandy)