From SST measurements to actionable information for public and private users: Rheticus® services

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GHRSST
GROUP FOR HIGH RESOLUTION SEA SURFACE TEMPERATURE

GHRSST XX, ESA/ESRIN, Frascati, Italy
4 June 2019

Since 1994…

planetek italia — Bari

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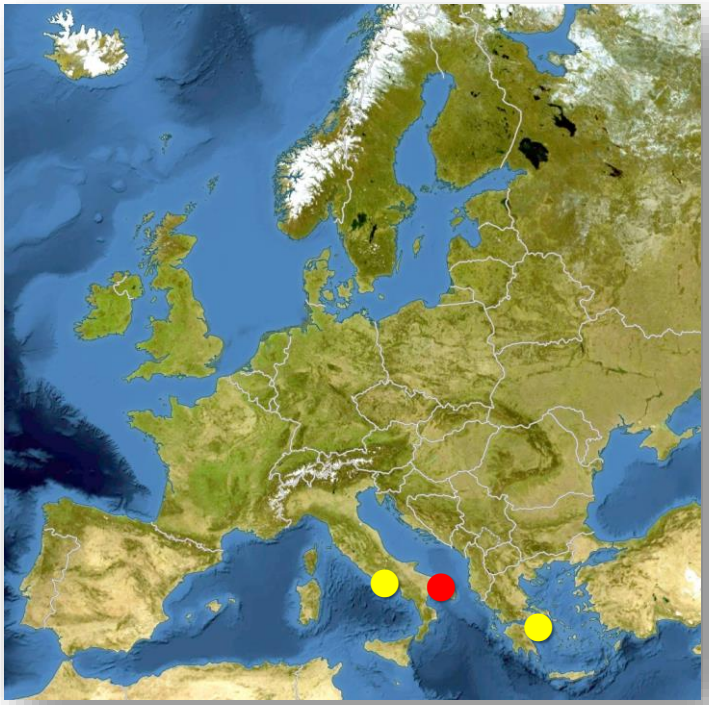
GEO-K — Roma

LWG — Bari



Earth Observation

Spatial Data Infrastructure & GIS

Location Based Systems

Space Software

Premium Partner

HEXAGON GEOSPATIAL

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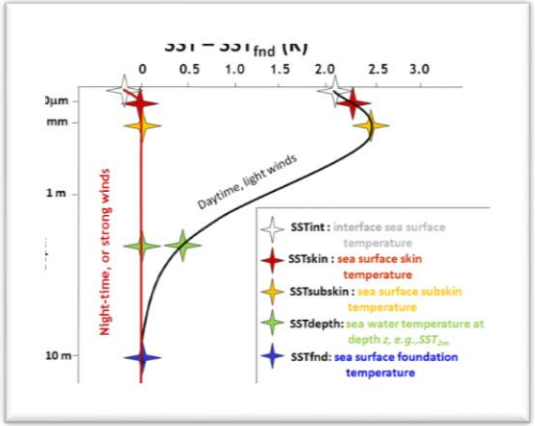
Sea Surface Temperature

Sea surface temperature (SST): the water temperature close to the ocean's surface(*)

- SST is influenced by and influences many relevant phenomena
  - Ocean heat content
  - Coastal areas
  - Air masses in the Earth' atmosphere
  - …



SST definitions from GHRSST website

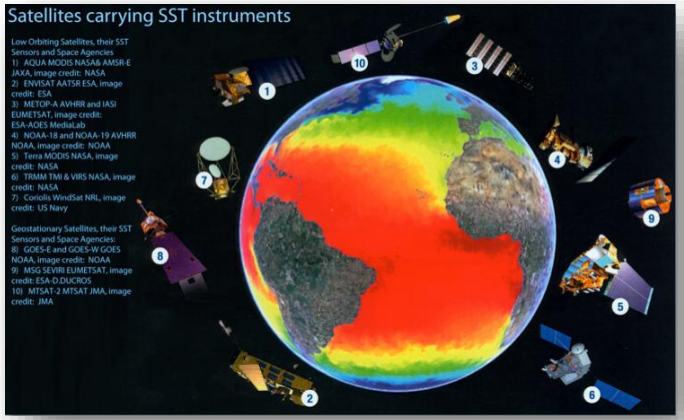
➢ SST is involved as **key parameter** as input and/or output to **algorithms and models** which try to describe and/or measure such phenomena

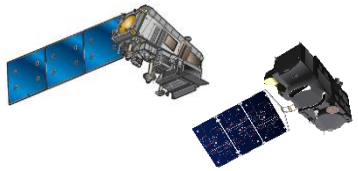
(*) Definition from Wikipedia

Sea Surface Temperature from satellite

SST measurement from Earth Observation (EO) sensors

- More than 30 years of measurements from satellites
- Consolidated algorithms to process satellite images and calculate SST
- Next decades secured by recent missions like Suomi NPP, Copernicus Sentinel-3, etc.





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Sea Surface Temperature from satellite

Availability of SST measurement from EO makes it more easily exploitable to develop "**vertical" applications**

- Specific sensor/mission

  SST measurements available as routinely products of Level 2 or higher
- Global services providing routinely, also in near real time, SST measurements from EO, e.g.:
  - GHRSST
  - Copernicus Marine Environment Monitoring Service (CMEMS)
- Provision of forecast SST exploiting measurements from EO

  (e.g. CMEMS)

All accessible with free and open policies

Automatic access (in most cases)

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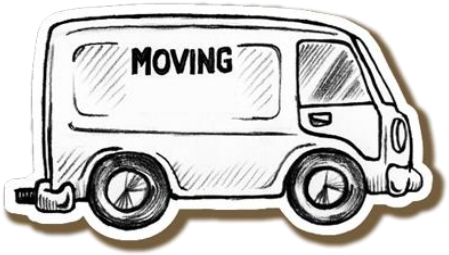
To exploit SST and other satellite data to provide applications

Rheticus®
Monitoring the evolution of our Earth

from **Data**



to actionable knowledge: **Geo-Analytics**

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Rheticus® approach to implement a service

Customers with a problem to solve («pain»)

Customers receive concrete support to solve the problem («gain»)

Application need

Revenue
$ $

R&D actors

(e.g. scientists, research institutions, private companies, Planetek team, etc.)

Tailored and actionable *Information as a Service*

Innovative EO based solution

Rheticus®

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Rheticus® Marine

Rheticus® Marine is an innovative, high-performing geo-information service for monitoring coastal water quality and eutrophication status.

The service provides key parameters of water quality retrieved from satellite open data through extensively tested models and algorithms, and generates thematic maps, dynamic geo-analytics and pre-set reports.

Rheticus® Marine is useful to different customers:

- National and Regional Governmental Institutions in charge of environmental monitoring and reporting;
- Policy and Decision Makers, from international to local level;
- Private sector (e.g. industries involved in offshore drilling, wind plants, wastewater services, desalination, etc.);
- Conservation groups.

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Rheticus® Marine: methods

Input information

- Satellite measurements of:
  - **SST**, Chlorophyll
  - Water leaving radiances

  (various sources, e.g. Copernicus Monitoring Environment Service)
- Ancillary data
  - Relevant sea (sub) zones
  - In situ measurements

  (generally user provided)

Output information

- Web application
  - Near Real Time daily maps
    (locally re-calibrated: SST, Chlorophyll, Water Transparency, Turbidity)
  - Temporal aggregated maps (10 days, month, year, user defined)
  - Spatially aggregated maps
  - Temporally and spatially aggregated maps

  (aggregation by arithmetic/geometric mean, min/max, percentile)
- Smart web application:
  - Dynamic and tailored geo-analytics
  - Reports

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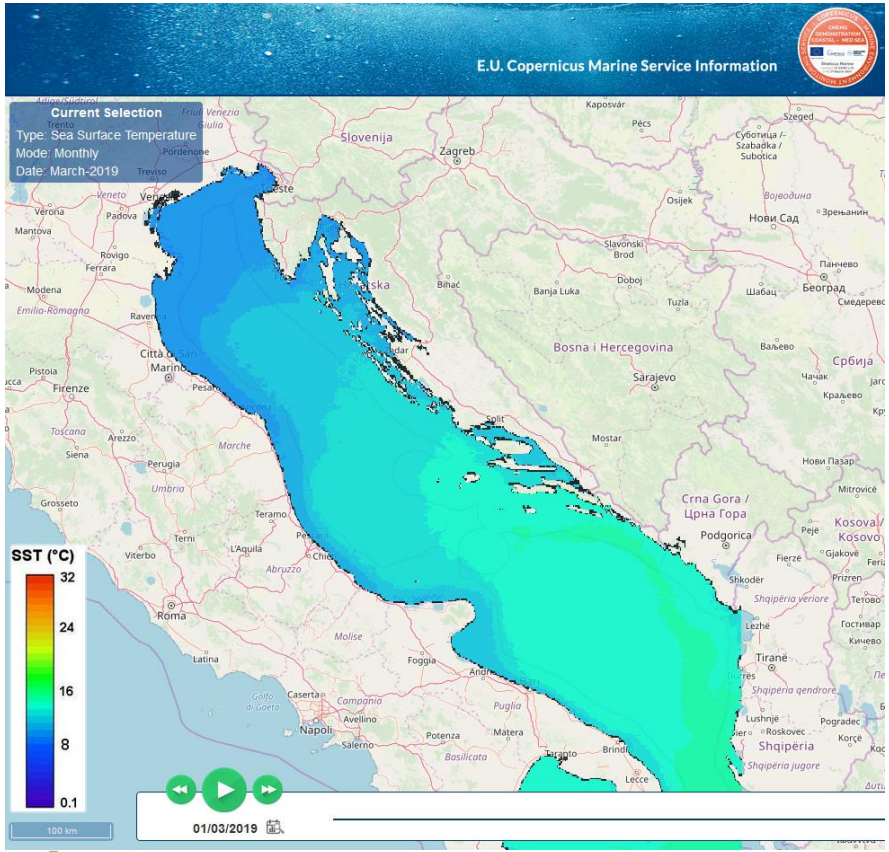
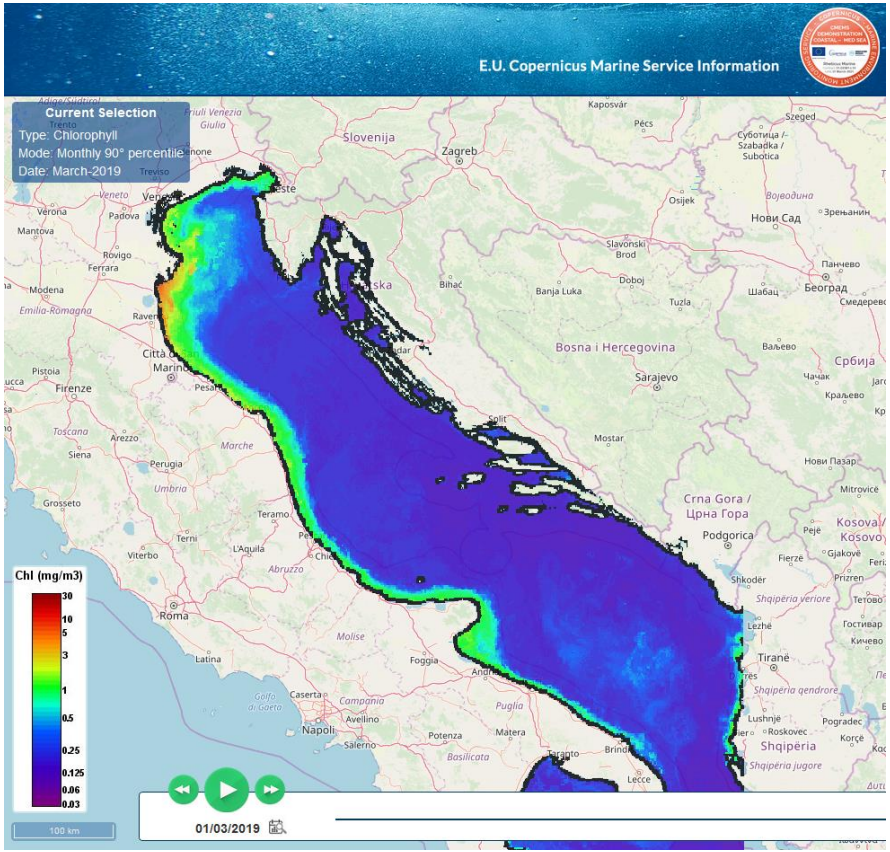
Rheticus® Marine: Web Application





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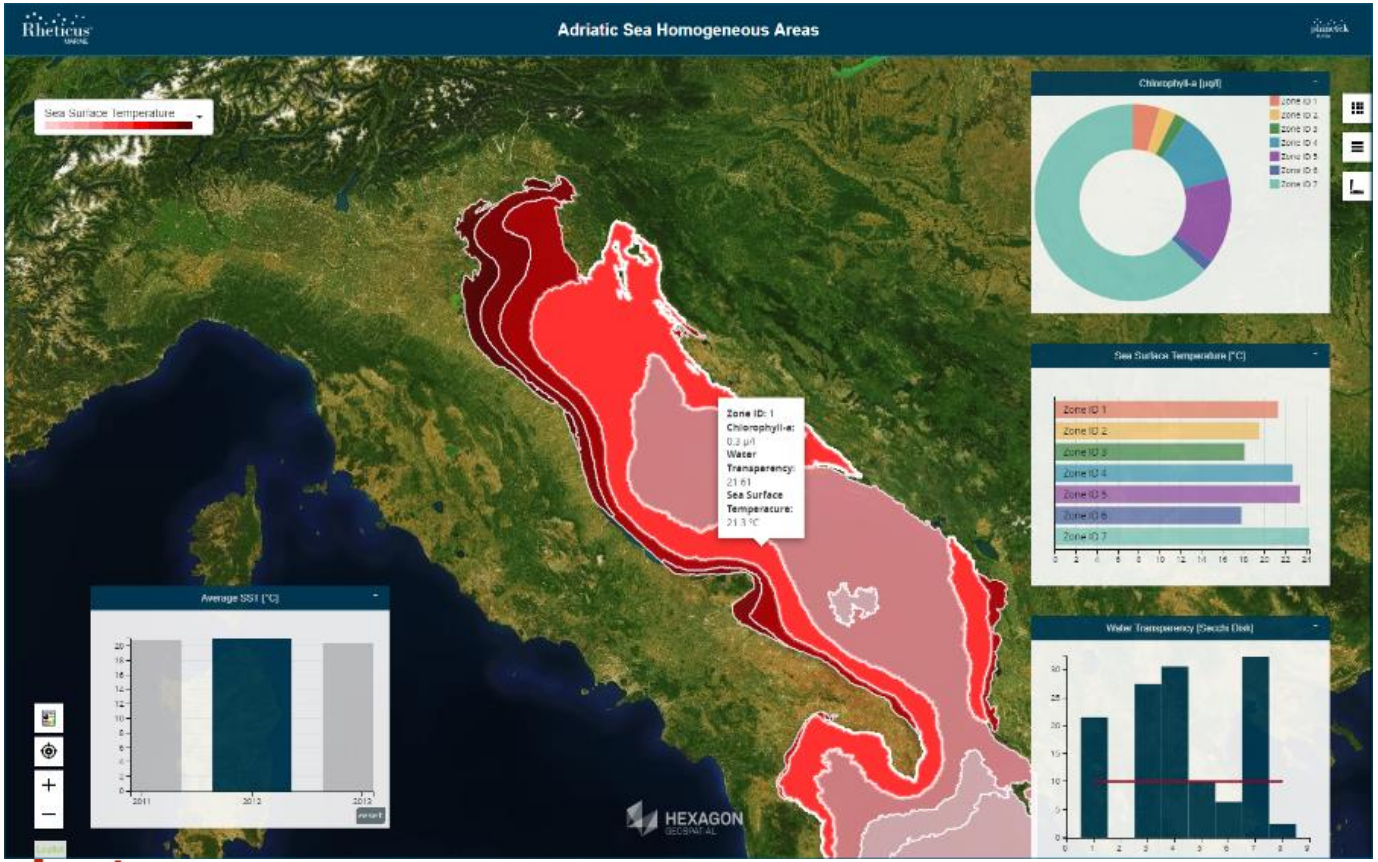
Rheticus® Marine: Smart Web Application for EU Marine Water Framework Directive



Target: Good Environmental Status

Descriptor 5: Eutrophication

Needs:

- **Identification of homogeneous sea areas**
- Yearly evaluation of eutrophication

Geo-analytics:

- Chlorophyll
- Temperature
- Transparency

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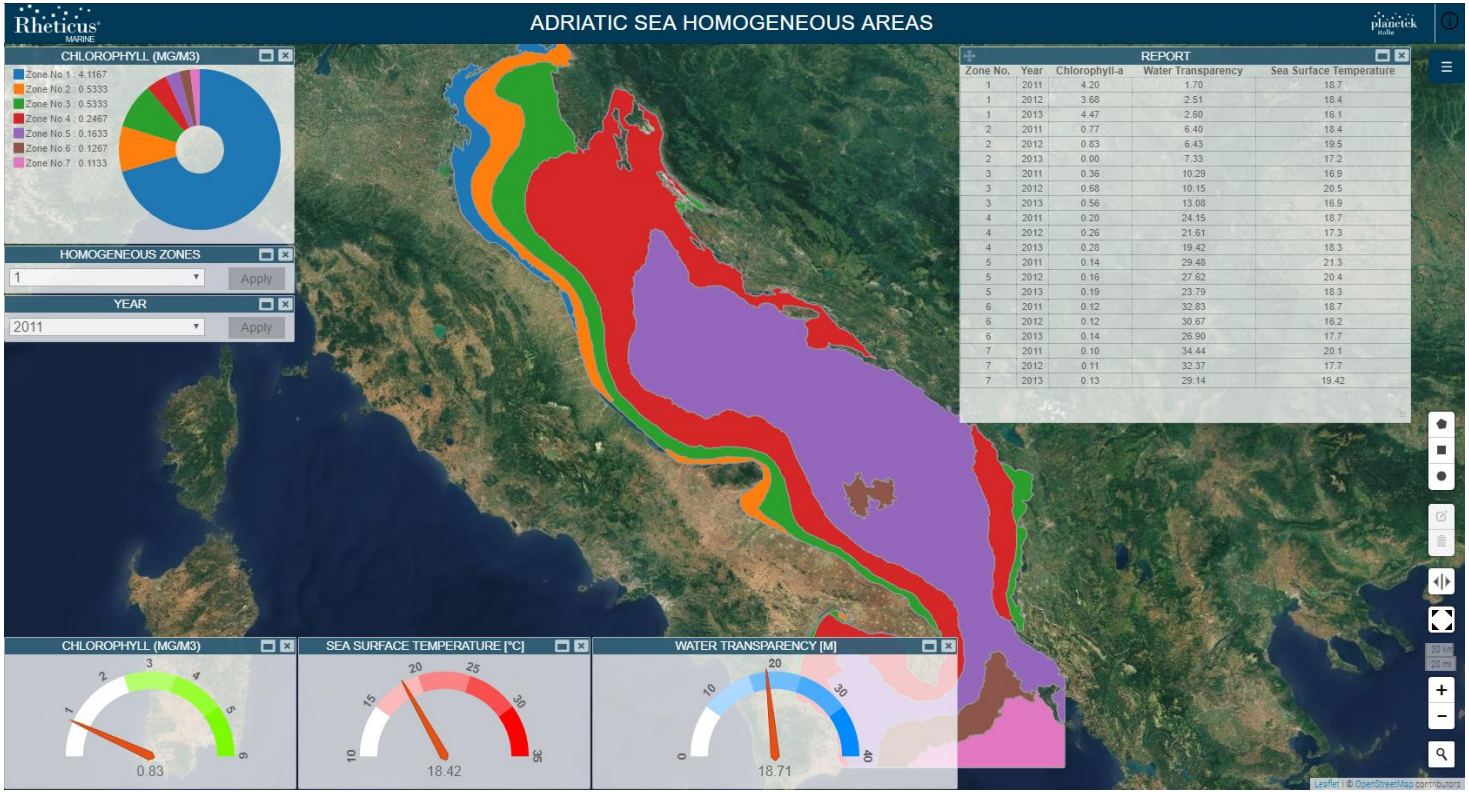
Rheticus® Marine: Smart Web Application for EU Marine Water Framework Directive



Target: Good Environmental Status

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Rheticus® Aquaculture

- Best harvesting and selling time identification
- Identifying best locations for new aquaculture farms
- Monitoring and forecasting environmental conditions for operational aquaculture
- Estimating products growth rates, days to market size, product values
- A posteriori environmental analysis and characterisation

Rheticus® Aquaculture: methods

Input information

- Historical and Near Real Time satellite measurements:
  - **SST**, Chlorophyll, Turbidity

  (from Rheticus Marine)
- User provided data
  - Location of ropes (shellfish) or cages (fish)
  - In situ measurements

Model(*): growing rate

Hind cast and forecast of shellfishes length, weight, etc.

(*) model owned by a spin-off of Venice University

Output information

- Smart Web application
  - Near real time and forecast information on shell fish status
  - Dynamic geo-analytics
  - Alerting
- Report

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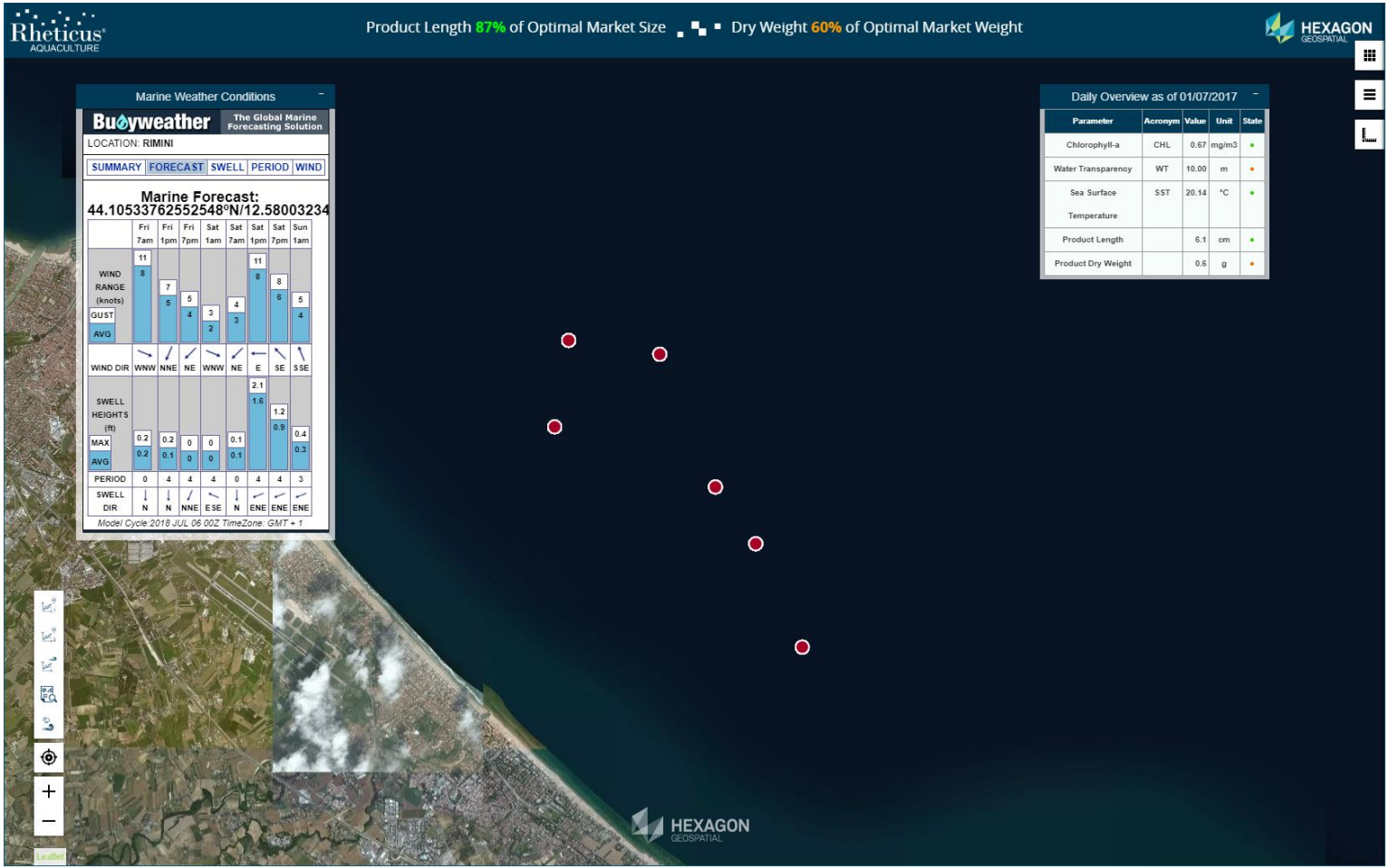
Rheticus® Aquaculture: Smart Web Application



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Rheticus® Aquaculture: Smart Web Application

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Rheticus® Aquaculture: user-tailored reports

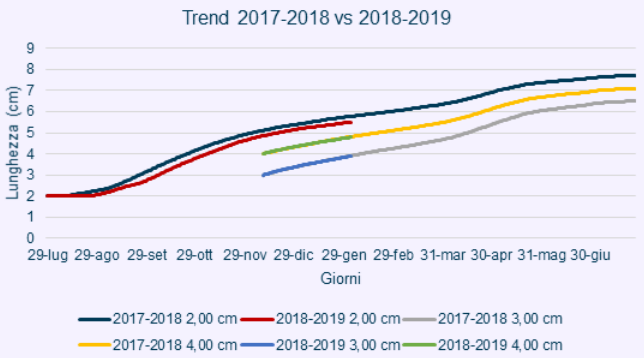
Rheticus® AQUACULTURE

Produttore	[redacted]
Produzione	Mitili
Coordinate impianto	[redacted]
Abbonamento N.	[redacted]
Scadenza abbonamento	28/01/2020
Bollettino N.	02/2019
Data bollettino	04/02/2019

Semina 2 cm	5,50 cm
Trend	- 4,74 %
Rincalzo 3 cm	3,89 cm
Trend	- 0,61 %
Rincalzo 4 cm	4,79 cm
Trend	- 0,51 %

Semina - Rincalzi	Data Semina - Rincalzi	Lunghezza alla Semina - Rincalzi	Data	Lunghezza raggiunta	Trend	Peso totale individuo medio	Lunghezza a 14 gg	N. Filari
Semina	29/07/2018	2,00 cm	03/02/2019	5,50 cm	- 4,74 %	8,83 g	5,55 cm	N/D
Rincalzo 1 – 3 cm	10/12/2018	3,00 cm	03/02/2019	3,89 cm	- 0,61 %	2,68 g	4,02 cm	N/D
Rincalzo 1 – 4 cm	10/12/2018	4,00 cm	03/02/2019	4,79 cm	- 0,51 %	5,46 g	4,88 cm	N/D

		Ottimo	Buono	Discreto	Critico
N. cumulativo di giorni dalla SEMINA	Nutrienti	191	0	0	0
	Temperatura	57	14	87	33
N. cumulativo di giorni da ultimo RINCALZO	Nutrienti	57	0	0	0
	Temperatura	0	0	55	2



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1/2

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Fishing tourism: web/mobile pilot service

- Fishing tourism: increasing segment of maritime tourism industry
- Identify locations with higher pelagic fish concentration probability
- Combination of information to maximize fishing experience
- Targeted users:
  - companies and organizations that associate with fish tourism (“where will we find fish today to satisfy our clients/tourists ?”)
  - separate individuals (professional anglers or interested in sportive/recreational fishing)

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Fishing tourism: Map2Fish pilot service

Input information

- Near Real Time satellite measurements of:
  - **SST**, Chlorophyll, Water Transp. (from Rheticus Marine)
  - Dissolved oxygen, waves, currents (from CMEMS)

Innovative Model(*): pelagic fish concentration probability

- Based on detection of SST and chlorophyll fronts
- Trained/validated vs. historical catching reports from professional fishermen

(*) Model owned by a spin-off of Bari University

Web & Mobile application

- Near real time and forecast of probability of pelagic fish concentration
- Crowdsourcing
- On demand information:
  - SST, Chlorophyll concentration
  - Dissolved oxygen, water transparency, waves, currents

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SST from satellite: recommendations for improvements - 1

- Spatial details:

  Current best spatial resolution for routinely coverage is usually 1km, not enough to catch phenomena in proximity of shoreline

- Coastal areas:

  Near shore SST maps are usually masked by most common algorithms

- Temporal factor:

  Usually daily night mean is provided (foundation SST)

  Reliable and comparable SST measurements near shore in some cases are needed at different daytimes (e.g. diurnal cycle for shellfish growing models)

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SST from satellite: recommendations for improvements - 2

Large availability of historical and new measurements from satellite provides great opportunities, but also poses a *challenge for their effective exploitation*:

- Different sensors
- Different retrieval methods
- Different spatial resolution
- Different SST measured

Inter-sensor comparability

Unified point of access

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Conclusions

SST from satellite

- Mature methodologies
- Long-term and ongoing measurements available
- Easy and automatic access

> consolidated asset, well suited for developing advanced applications

Example: Rheticus®Marine, Rheticus®Aquaculture and Map2Fish exploit SST with other satellite measurements, to provide actionable information to public and private users

< applications near shore requires spatial and temporal improvements, as well as inter-sensor comparability

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Thank you for your attention

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