



# Marine Microbial Biodiversity, Bioinformatics & Biotechnology



Grant agreement n°287589

Acronym: Micro B3

Start date of project: 01/01/2012, funded for 48 month

## Deliverable 3.7

# Tara Oceans data included in the oceanographic data infrastructure

Version: 1

Circulated to: WP3 partners and WP4,5,6 leaders (08.01.2015)

Approved by: Prof. Frank Oliver Glöckner, 17/01/2015

Expected Submission Date: 31/12/2014  
Actual Submission Date: 17/01/2015  
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Public (PU)	X
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The Micro B3 project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 287589 (Joint Call OCEAN.2011-2: Marine microbial diversity – new insights into marine ecosystems functioning and its biotechnological potential.

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## Summary

One objective of the Tara Oceans expedition is to generate open access datasets to be used in probing the morphological and molecular makeup, diversity, evolution, ecology and global impacts of plankton on the Earth system. Genomics data were submitted to the European Nucleotides Archive (EBI/ENA), and oceanographic data were submitted to PANGAEA, Data Publisher for Earth and Environmental Science. In addition to direct programmatic access offered by these two data archives, environmental data were also disseminated to the SeaDataNet oceanographic data infrastructure. The present deliverable provides an overview of oceanographic data available from PANGAEA and SeaDataNet.

## Context of the deliverable

Over many centuries, global expeditions have led to major scientific breakthroughs, notably with the early voyages of the H.M.S. Beagle (1831-1836) and the H.M.S. Challenger (1872-1876). Ocean exploration now provides promising first steps towards understanding the role of the ocean in global biogeochemical cycles and the impact of global climate change on ocean processes and marine biodiversity. Recently, the Sorcerer II expeditions (2003-2010) (1) and the Malaspina expedition (2010-2011) (2) carried out global surveys of prokaryotic metagenomes from the ocean's surface and bathypelagic layer (>1000 m), respectively. The Tara Oceans Expedition (2009-2013) complemented these surveys by collecting a wide variety of planktonic organisms (from viruses to fish larvae) along with extensive environmental data from the ocean's surface (0-200 m) and mesopelagic zone (200-1000m) at a global scale. Moreover, Tara Oceans takes such surveys one step further by combining modern sequencing and state-of-the-art imaging technologies (3). Tara Oceans Data are particularly suited to study the genetic, morphological and functional diversity of viruses, giant viruses, prokaryotes (bacteria and archaea), protists (unicellular eukaryotes), and metazoans (multicellular eukaryotes) in their environmental context.

The present deliverable is a direct contribution to Work Package 3 of the MicroB3 project and describes Tara Oceans oceanographic data archived at PANGAEA and further disseminated to the SeaDataNet network. The deliverable is also of significant importance to Work Package 6 of the MicroB3 project since it addresses in particular the analysis of Tara Oceans. The ability to access oceanographic data generated by the Tara Oceans expedition is also an important proof of concept for the Information System developed under Work Package 5 of the MicroB3 project.



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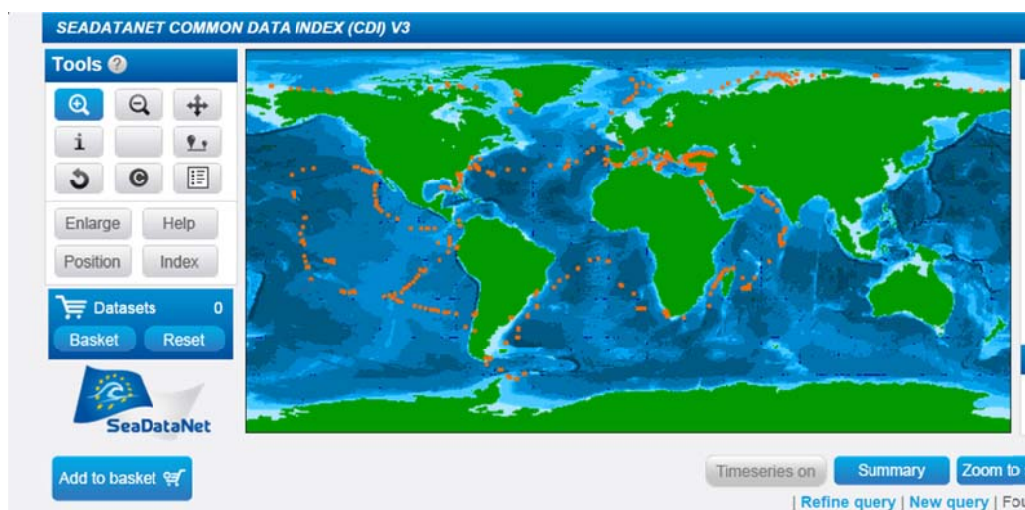
## Overview of Tara Oceans oceanographic data

Three types of oceanographic data from the Tara Oceans expedition are archived at PANGAEA: **(1)** Properties of seawater and particulate matter from physical, optical and imaging sensors mounted on the continuous surface water sampling system; **(2)** Properties of seawater and particulate & dissolved matter from physical, optical and imaging sensors mounted on the vertical profile sampling system; and **(3)** Properties of seawater and particulate & dissolved matter from discrete water samples.



**Figure 1.** Geographic distribution of Tara Oceans oceanographic data sets published at PANGAEA

In addition to direct programmatic access offered by PANGAEA, selected parameters from these data sets were disseminated to SeaDataNet. A total of 1580 records are discoverable by the SeaDataNet Common Data Index (CDI).



**Figure 2.** Geographic distribution of Tara Oceans data discoverable at SeaDataNet

## (1) Properties of seawater and particulate matter from physical, optical and imaging sensors mounted on the continuous surface water sampling system

Continuous measurements of surface water physical, chemical and biological properties served the dual purpose of a) assessing the boundaries and the homogeneity/heterogeneity of a system studied during a station, and b) assessing the connectivity between stations. Underway measurements were often used to fine tune the location of sampling stations that were initially selected based on satellite images.

The in-line, Continuous Surface Sampling System installed on SV Tara comprised a SeaBird TSG temperature and conductivity sensor, a WETLabs Ac-S spectrophotometer, a WETLabs chlorophyll fluorometer, and a Fast Repetition Rate Fluorometer (FRRF) to assess photosynthetic efficiency. All data were recorded simultaneously and archived daily in a single file, including navigation, date/time and GPS position. Water was pumped at the front of the vessel from ~2m depth, then de-bubbled and circulated through the spectrophotometer, TSG, chlorophyll fluorometer, and FRRF. An automated switching system provided periodic 0.2µm filtered samples to the Ac-S, such that its particulate optical properties were not affected by instrument drift. Systems maintenance (instrument cleaning, flushing) was done approximately once a week and in port between successive campaigns. In the Arctic Ocean and Arctic Seas (2013 campaigns), additional sensors for pH, PCO<sub>2</sub>, optical backscattering (3 wavelengths), fluorescence emission (2 excitation wavelengths ALFA) and a Surface Photoactive Photosynthetic Radiation (PAR) were added to the in-line system (15,000 miles long track). A FlowCytobot also recorded images of microplankton every 20 minutes. Using daily discrete measurements of CDOM absorption with an UltraPath system, we calibrated the Ac-S to also provide hourly CDOM absorption (besides particulate absorption and attenuation). Data were processed, quality-controlled, and are consistent with remote sensing. A total of 46 tracks of continuous measurements from the Tara Oceans expedition are published in open access at PANGAEA. Continuous measurements from the Arctic portion of the expedition (14 additional tracks) are still undergoing validation. At SeaDataNet, each track is accessed separately and referenced by a distinct Common Data Index (CDI) record.

[Link](#) to the corresponding data sets published at PANGAEA

[Link](#) to a map of the corresponding data sets published at PANGAEA

[Link](#) to download all corresponding data compiled in a single file (NetCDF format) archived at PANGAEA (<http://doi.pangaea.de/10.1594/PANGAEA.836320>)

**Table 1.** List of parameters disseminated to the SeaDataNet network, regarding properties of seawater from physical sensors mounted on the continuous surface water sampling system.

PARAMETER NAME	SDN:P02 code	SDN:P06 code	SDN:P011 code
Pressure	AHGT	UPDB	PRESPO2
Salinity	PSAL		PSALZZXX
Temperature	TEMP	UPAA	TEMPZZXX

## (2) Properties of seawater and particulate & dissolved matter from physical, optical and imaging sensors mounted on the vertical profile sampling system

Repeated deployments of a Rosette Vertical Sampling System also served the dual purpose of a) assessing the boundaries and the homogeneity/heterogeneity of mesoscale features during a station, and b) assessing the connectivity between stations. These deployments were essential to locate features that have a vertical component and have a signature below the surface, such as eddies, upwellings, fronts, deep chlorophyll maxima, and oxygen minimum zones. The Rosette Vertical Sampling System was specifically designed with various sensors, comprising 2 pairs of conductivity and temperature sensors (Sea-Bird), chlorophyll and CDOM fluorometers (WETLabs), a 25 cm transmissiometer for particles 0.5-20  $\mu\text{m}$  (WETLabs), a one-wavelength backscatter meter for particles 0.5-20  $\mu\text{m}$  (WETLabs), and a Underwater Vision Profiler (18) for particles >100  $\mu\text{m}$  and zooplankton >600  $\mu\text{m}$  (Hydroptic). A sbe43 oxygen sensor (Sea-Bird) and an In Situ Ultraviolet Spectrophotometer (ISUS) nitrate sensor (SATLANTIC) were also mounted on the Rosette. In the Arctic Ocean and Arctic Seas (2013 campaigns), a second sbe43 oxygen sensor (Sea-Bird) and a four frequency acoustic profiler (Aquascap) were added. Each component was powered on specific Li-Ion batteries and CTD data were self-recorded at 24Hz. All sensors were calibrated in factory before, during and after the four year programme. Oxygen data were validated using climatologies. Nitrate and Fluorescence data were adjusted with discrete measurements from Niskin bottles mounted on the Rosette, and dark calibrations of the optical sensors were performed monthly on-board. A total of 837 vertical profiles from the Tara Oceans expedition are published in open access at PANGAEA. At PANGAEA, vertical profiles are packaged into 201 citable data publications, one per sampling station. At SeaDataNet, each vertical profile is accessed separately and referenced by a distinct Common Data Index (CDI) record.

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**Table 2.** List of parameters disseminated to the SeaDataNet network, regarding properties of seawater and particulate matter from physical and optical sensors mounted on the vertical profile sampling system.

PARAMETER NAME	SDN:P02 code	SDN:P06 code	SDN:P011 code
Pressure	AHGT	UPDB	PRESPO2
Conductivity	CNDC	UECA	CNDCZZ01
Temperature	TEMP	UPAA	TEMPZZXX
Salinity	PSAL		PSALZZXX
Nitrate	NTRA	UPOX	NTRAZZXX
Oxygen	DOXY	KGUM	DOXMZZXX
Chlorophyll	CPWC	UMMC	CPHLPR01

### (3) Properties of seawater and particulate & dissolved matter from discrete water samples

In addition to sensors mounted on the Rosette Vertical Sampling System, seawater was collected using Niskin bottles (6 x 8-L Niskins and 4 x 12-L Niskins) in order to further characterise environmental conditions in the ecosystem under study. Measurements include pigment concentrations from HPLC analysis (10 depths per vertical profile; 25 pigments per depth), the carbonate system (Surface and 400m; pHT, CO<sub>2</sub>, pCO<sub>2</sub>, fCO<sub>2</sub>, HCO<sub>3</sub>, CO<sub>3</sub>, Total alkalinity, Total carbon, OmegaAragonite, OmegaCalcite, and quality Flag), nutrients (10 depths per vertical profile; NO<sub>2</sub>, PO<sub>4</sub>, NO<sub>2</sub>/NO<sub>3</sub>, SI, quality Flags), DOC, CDOM, and dissolved oxygen isotopes. More than 200 vertical profiles of these properties were made across the world ocean. DOC, CDOM and dissolved oxygen isotopes are available only for the Arctic Ocean and Arctic Seas (2013 campaigns). Tara Oceans Data corresponding to these parameters are published in open access at PANGAEA. At PANGAEA, vertical profiles are packaged into 201 citable data publications, i.e. one per sampling station. At SeaDataNet, each vertical profile is accessed separately and referenced by a distinct Common Data Index (CDI) record.

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[Link](#) to download all corresponding data compiled in a single file (NetCDF format) archived at PANGAEA (<http://doi.pangaea.de/10.1594/PANGAEA.836319>)

**Table 3.** List of parameters disseminated to the SeaDataNet network, regarding properties of seawater and dissolved matter from discrete water samples.

PARAMETER NAME	SDN:P02 code	SDN:P06 code	SDN:P011 code
Pressure	AHGT	UPDB	PRESPO2
Conductivity	CNDC	UECA	CNDCZZ01
Temperature	TEMP	UPAA	TEMPZZXX
Salinity	PSAL		PSALZZXX
Silicate	SLCA	UPOX	SLCAZZXX
Nitrate and Nitrite	NTRZ	UPOX	NTRZZZXX
Nitrite	NTRI	UPOX	NTRIZZXX
Phosphate	PHOS	UPOX	PHOSZZXX