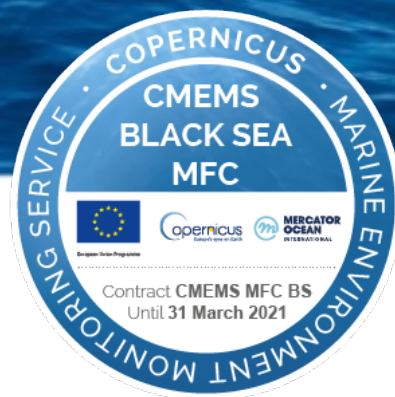




The BS-MFC service and system evolutions within Copernicus Marine Service



cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici



LIÈGE
université



**Helmholtz-Zentrum
Geesthacht**
Centre for Materials and Coastal Research



Copernicus
Marine Service



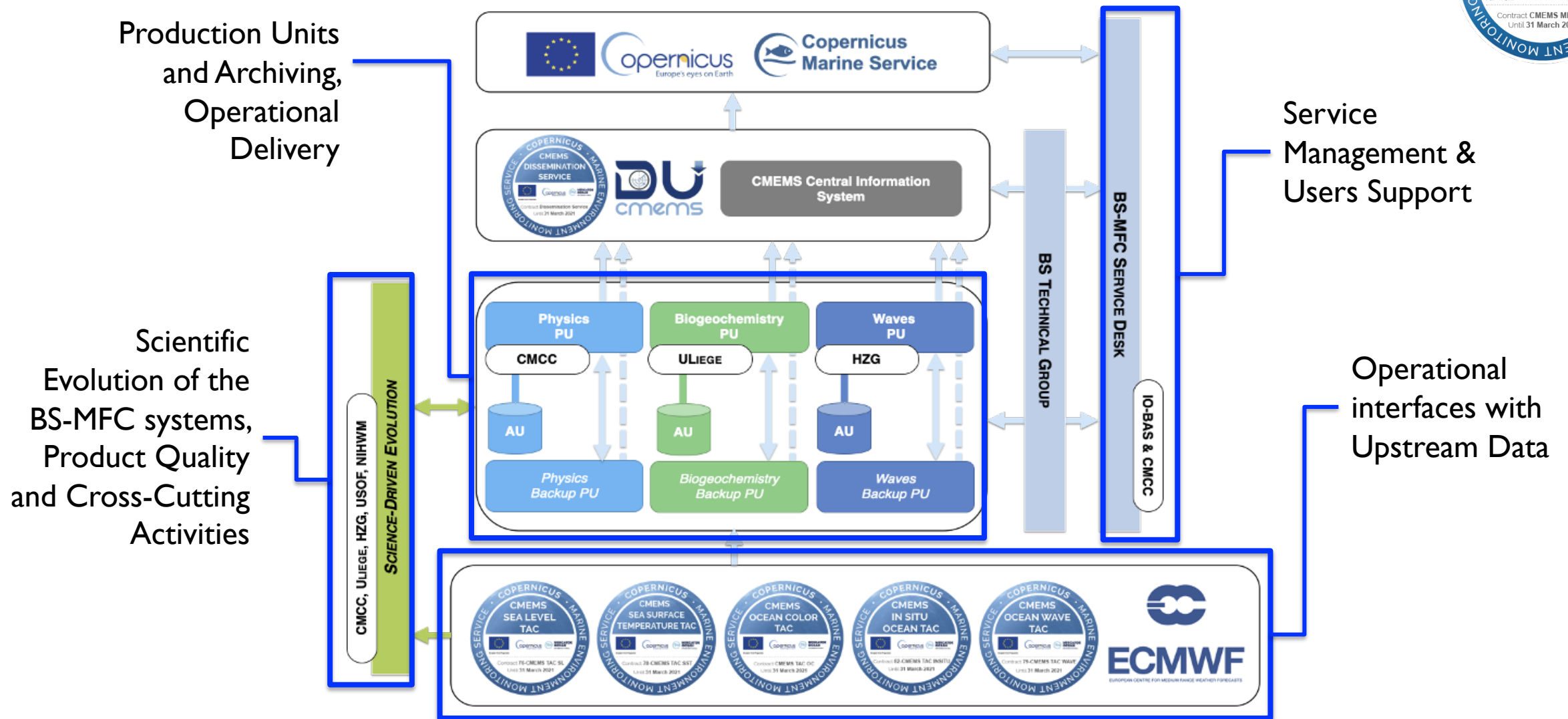
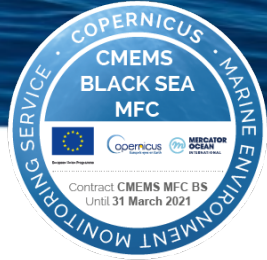
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**EGU 2021 Virtual General Assembly, 28/04/2021
OS4.6 - The Copernicus Marine Service (CMEMS)**

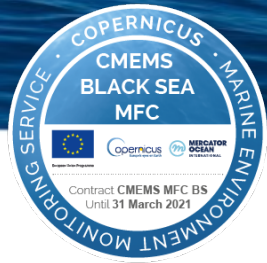
EGU General
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A. Palazov (IO-BAS), S. Ciliberti (CMCC), M. Gregoire (ULiège), J. Staneva (HZG), R. Lecci (CMCC), E. Peneva (USOF), V. Marinova (IO-BAS), L. Vandenbulcke (ULiège), A. Capet (ULiège), A. Behrens (HZG), M. Ricker (HZG), G. Gayer (HZG), M. Matreata (NIHWM), C. Meulders (ULiège), E. Ivanov (ULiège), E. Jansen (CMCC), D. Azevedo (CMCC), L. Lima (CMCC), F. Palermo (CMCC), S. Creti' (CMCC), L. Stefanizzi (CMCC), S. Causio (CMCC), G. Coppini (CMCC), Simona Masina (CMCC), M. Ilicak (ITU), M. Gunduz (CMCC), Nadia Pinardi (CMCC, UNIBO), N. Valcheva (IO-BAS), P. Agostini (CMCC)

The BS-MFC High Level Architecture



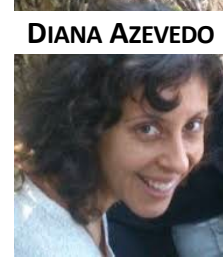
The BS-PHY Team



STEFANIA CILIBERTI



ERIC JANSEN



DIANA AZEVEDO



MEHMET ILICAK



MURAT GUNDUZ



LAURA STEFANIZZI



SERGIO CRETİ'



RITA LECCI



FRANCESCO PALERMO



SALVATORE CAUSIO



ALI AYDOGDU



LEONARDO LIMA



ELISAVETA PENEVA



MARIUS MATREATA



SIMONA MASINA



GIOVANNI COPPINI

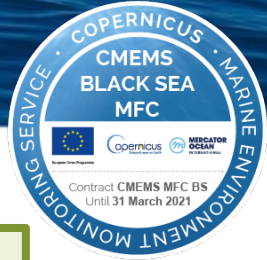


NADIA PINARDI

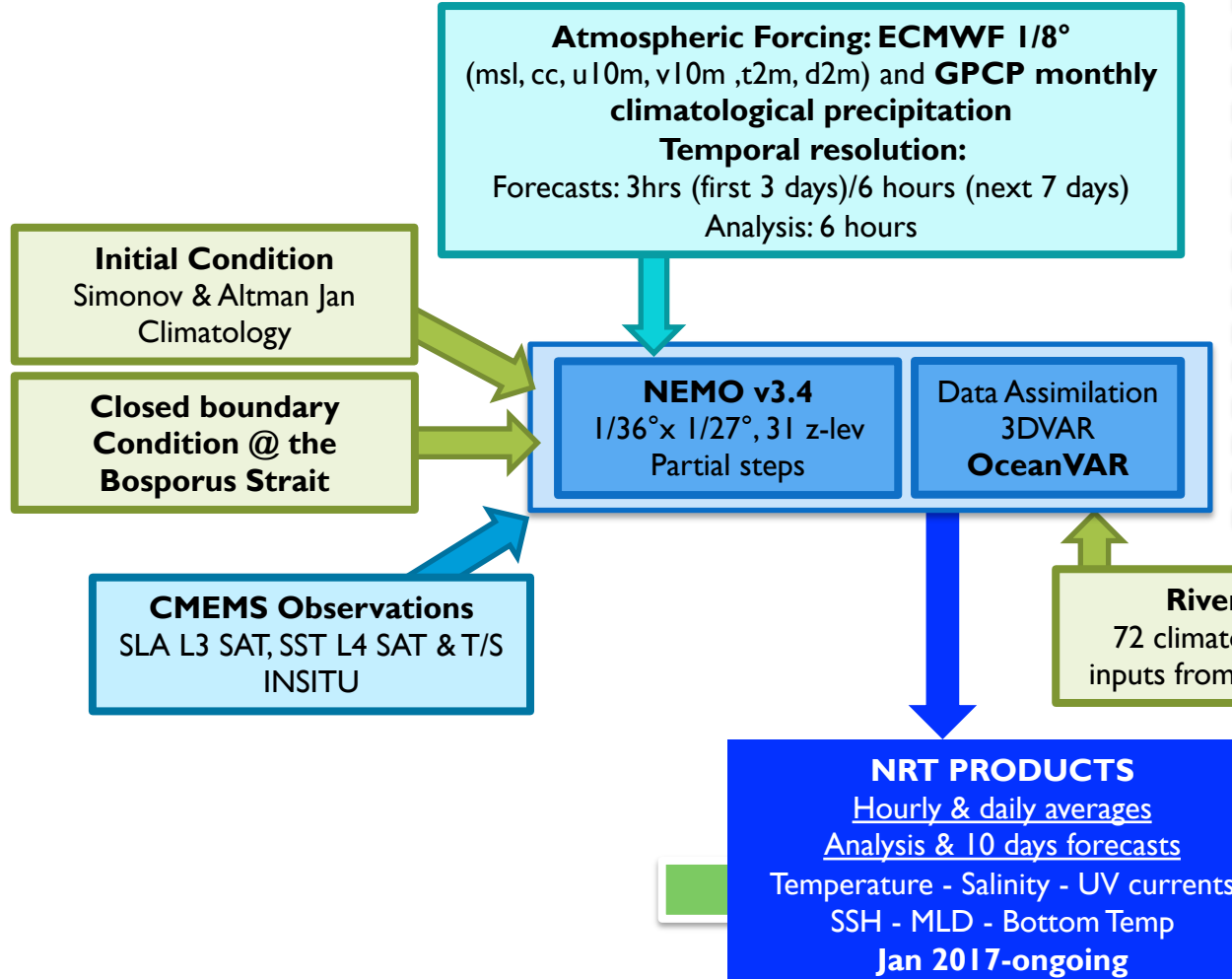


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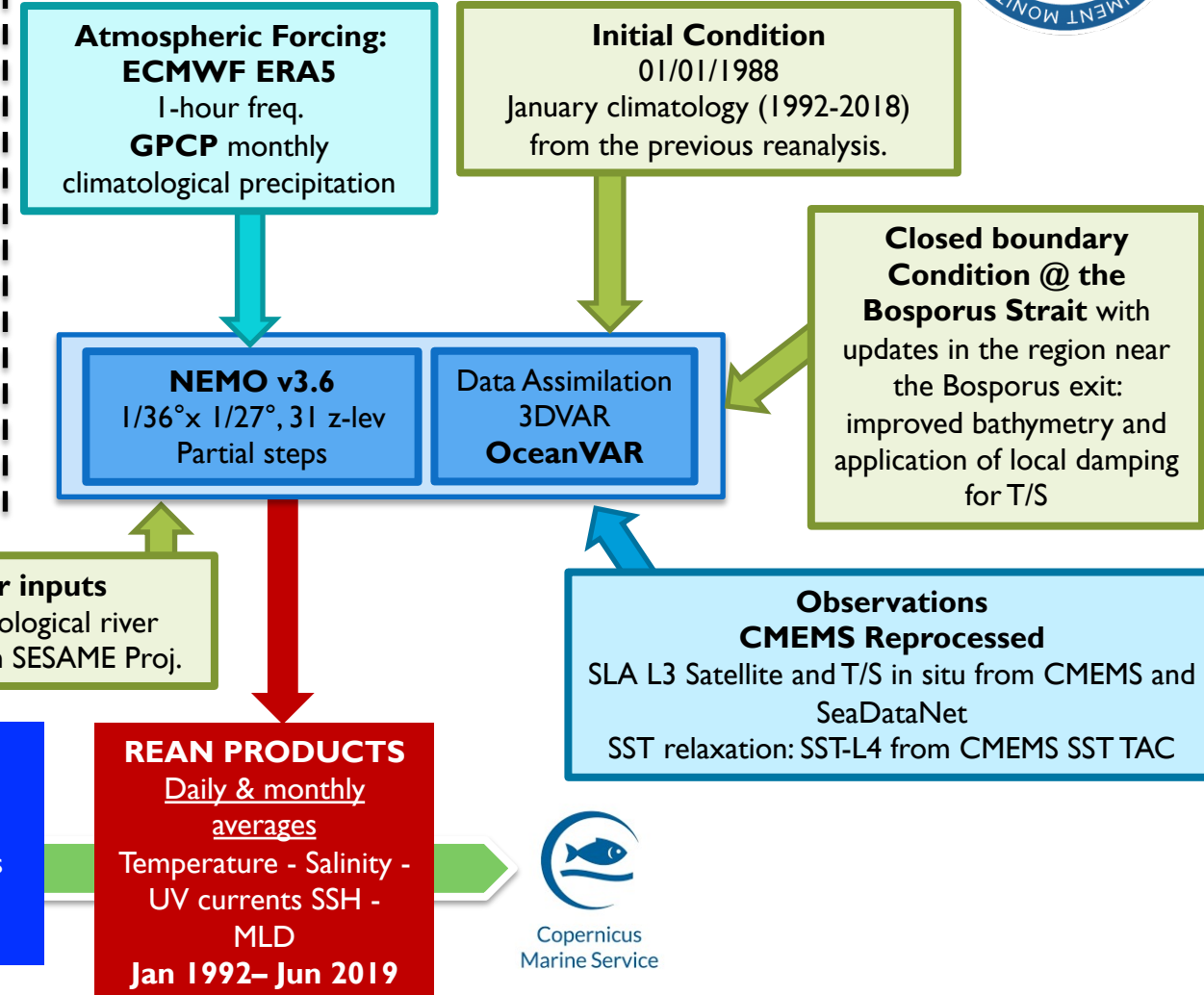
Overview of the current **Black Sea Physics** operational and reanalysis systems



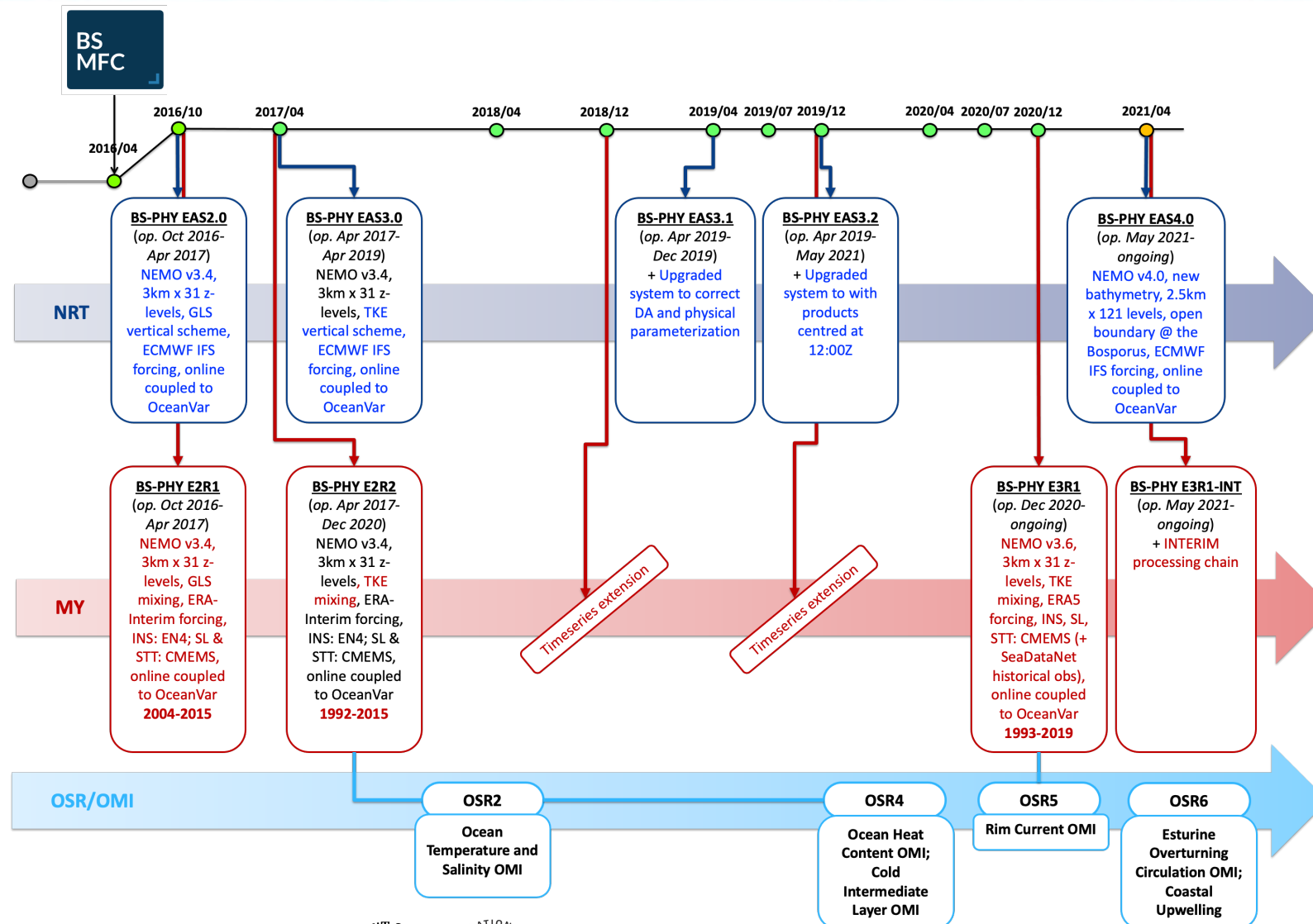
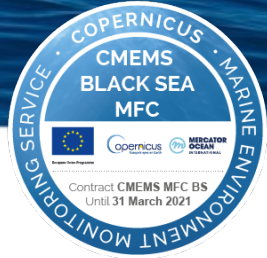
Near Real Time System



Multi-Year System

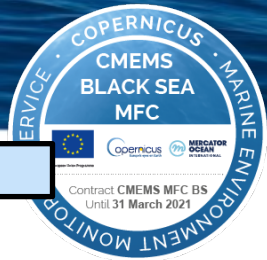


Black Sea Physics: Evolution of the Systems from the Scientific Perspective

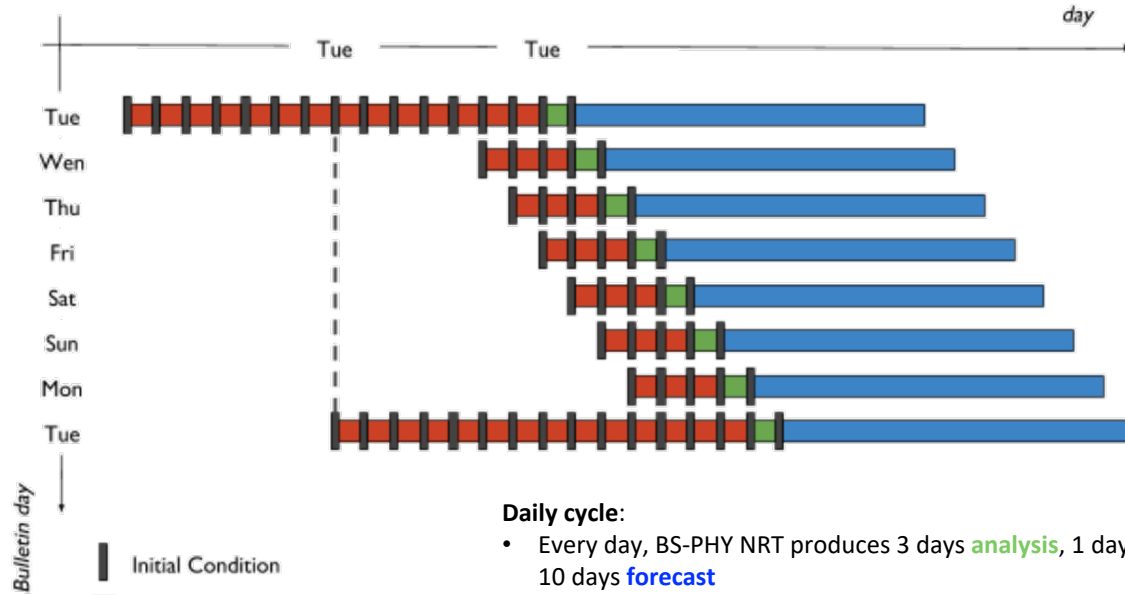


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The Black Sea Physics NRT System



PROCESSING SYSTEM



Daily cycle:

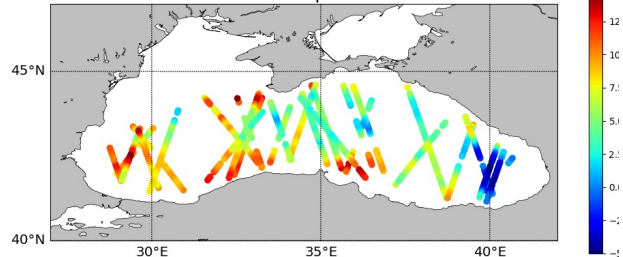
- Every day, BS-PHY NRT produces 3 days **analysis**, 1 day **simulation** and 10 days **forecast**

Weekly cycle:

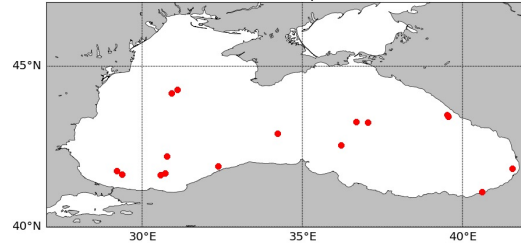
- On Tuesday, BS-PHY NRT produces 14 days **analysis**, 1 day **simulation** and 10 days **forecast** → **best forecast initial condition**

ASSIMILATED OBSERVATIONS: SPATIAL COVERAGE

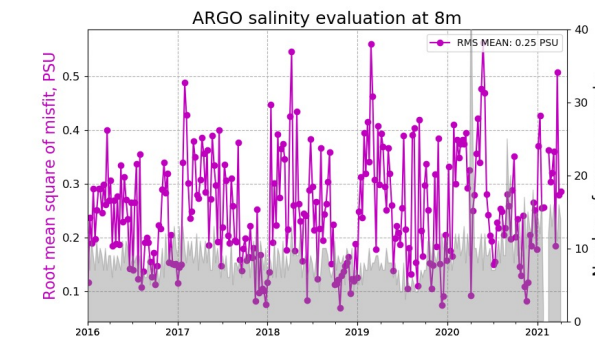
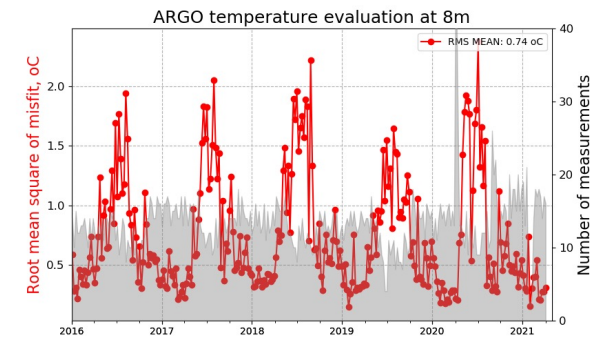
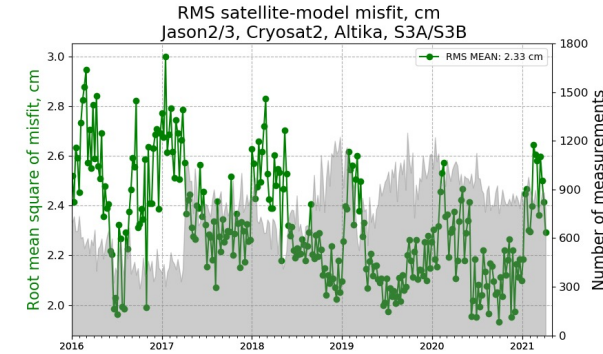
SL observations for the period of assimilation



ARGO observations for the period of assimilation



PRODUCT QUALITY: CLASS 4

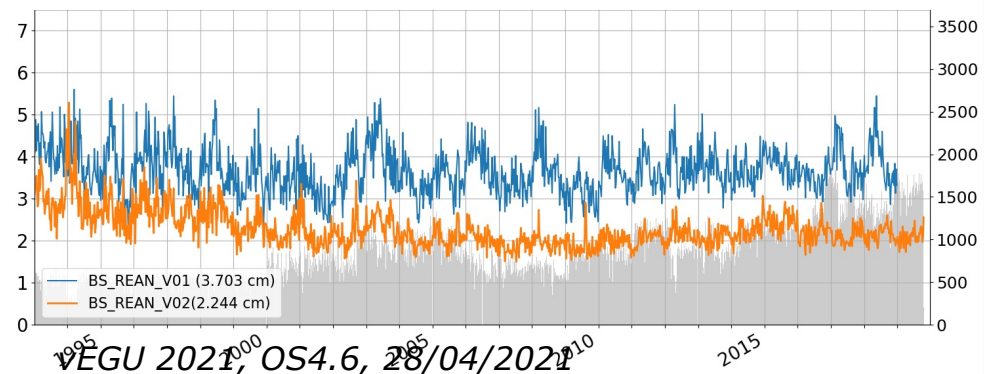
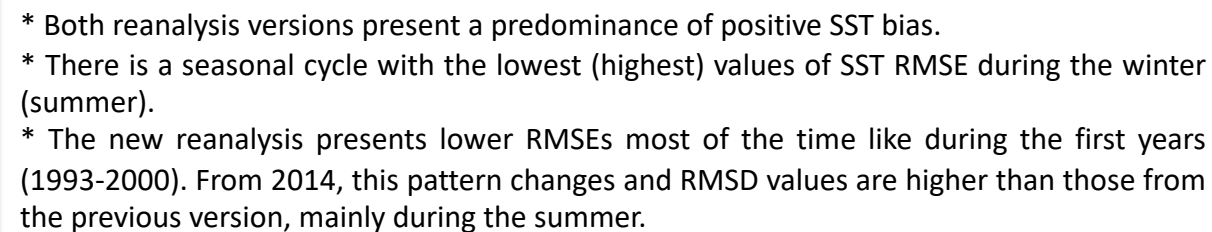


SSH accuracy using SLA data for all available assimilated observations (Altika, Cryosat2, Jason2/3, Sentinel3A/2B) and SLA along track assimilated observations during last weekly cycle. Mean error of about 2 cm (Al: 2.5 cm; Cr: 2.3 cm; J2: 2.2 cm; J3: 2.1 cm; S3A: 2.1 cm; S3B: 2.1 cm)

T/S RMS misfits at 8 m (up to 600 m) and assimilated ARGO profiles during last weekly cycle. Higher errors in temperature during summertime (up to 2.5°C in the upper layer. 0-150 m mean error: ~1°C/~0.25 PSU)

[HTTP://BSFS.CMCC.IT](http://BSFS.CMCC.IT)

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MFC
2021



MARILAURE GREGOIRE



LUC VANDENBULCKE



ARTHUR CAPET



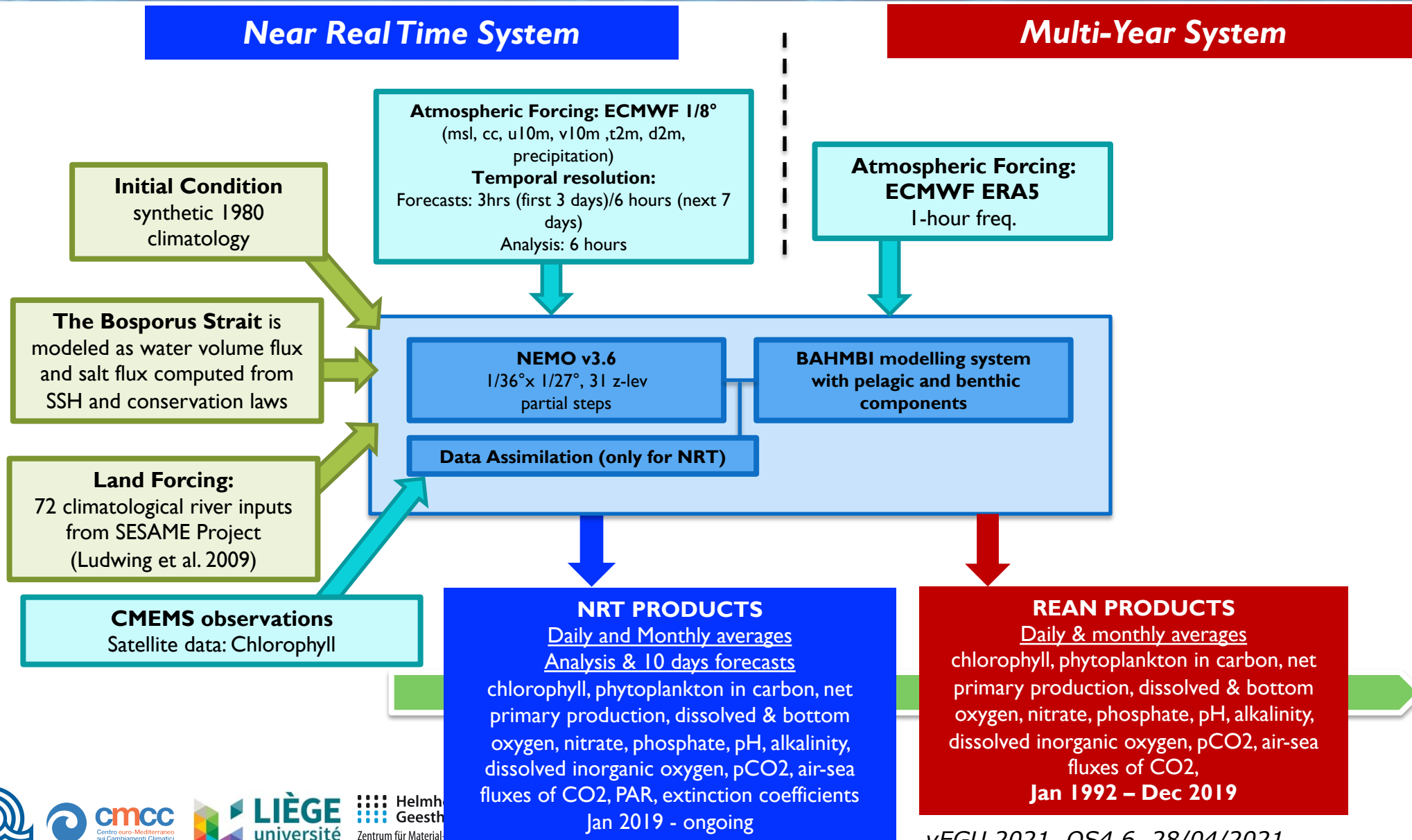
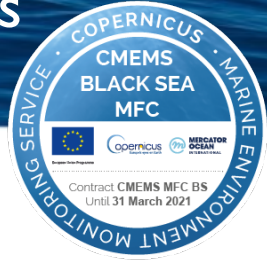
CATHERINE MEULDERS



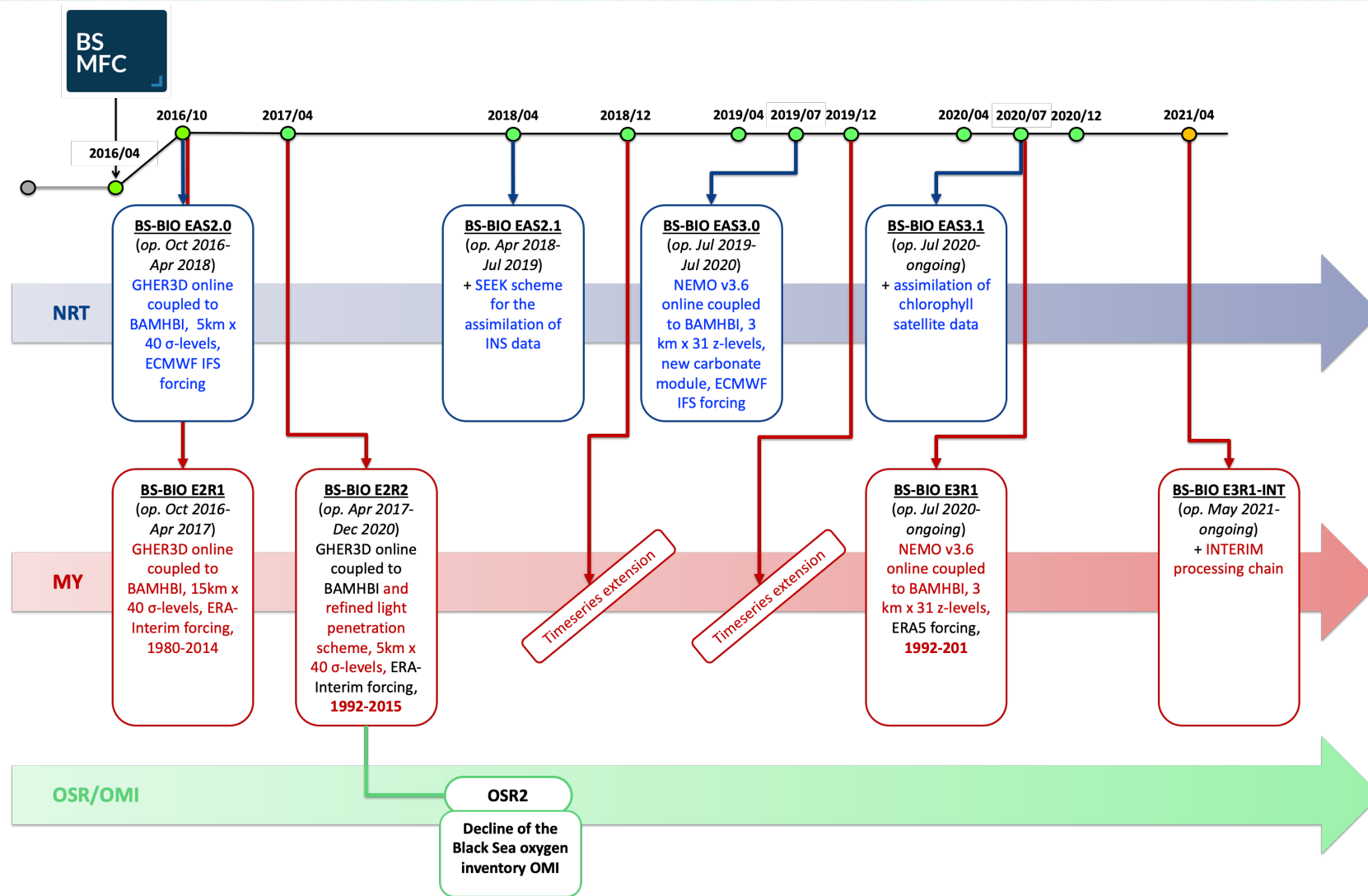
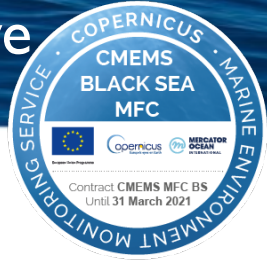
EVGENY IVANOV



Overview of the current **Black Sea Biogeochemistry** operational and reanalysis systems

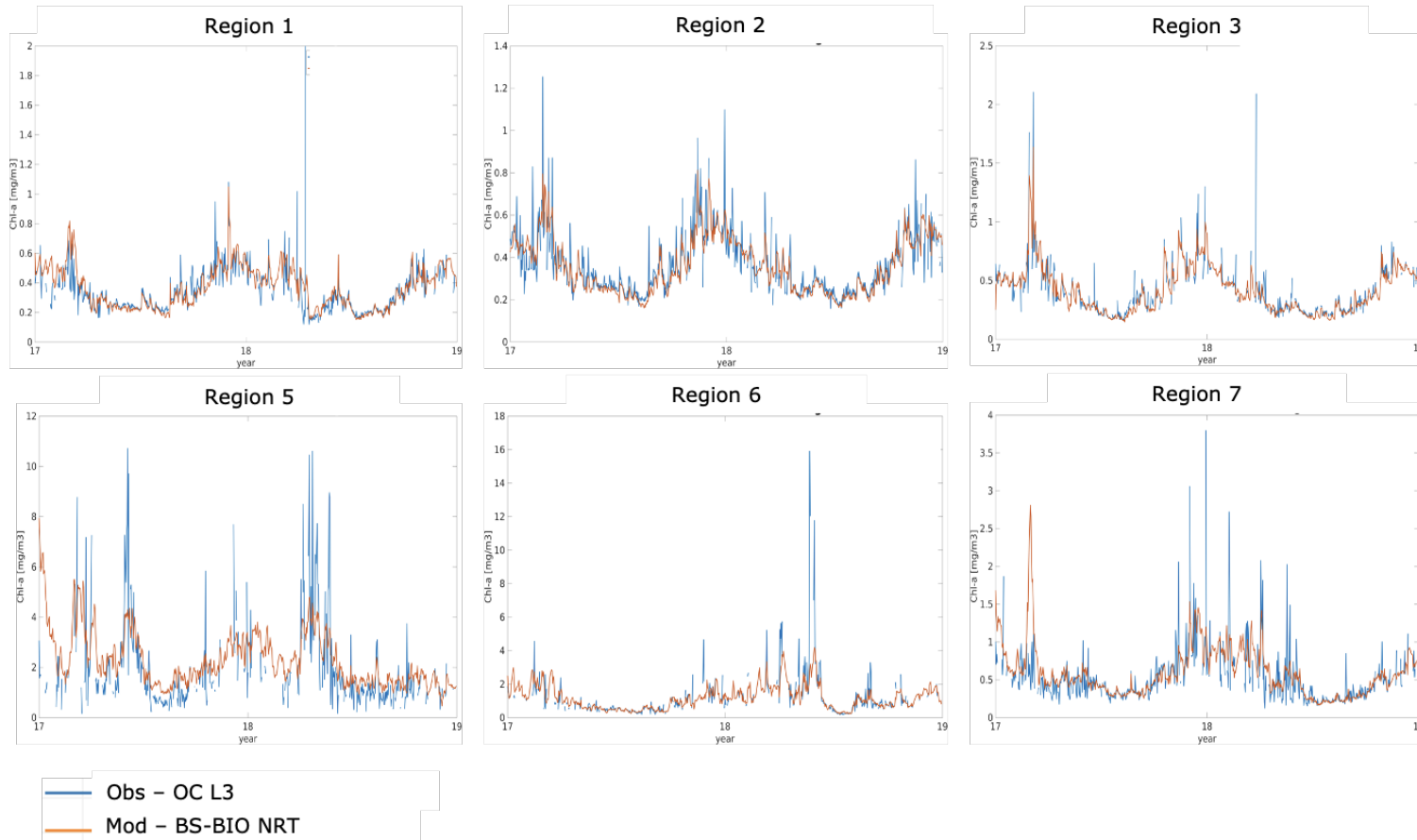


Black Sea Biogeochemistry: Evolution of the Systems from the Scientific Perspective



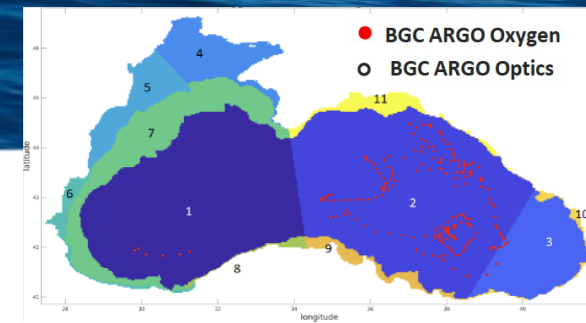
The Black Sea Biogeochemistry NRT System

Time series of satellite (in blue) and model (in red) **chlorophyll** spatial averages computed for (top row) open sea sub-regions 1, 2 and 3, and (bottom row) NWS regions 5, 6 and 7

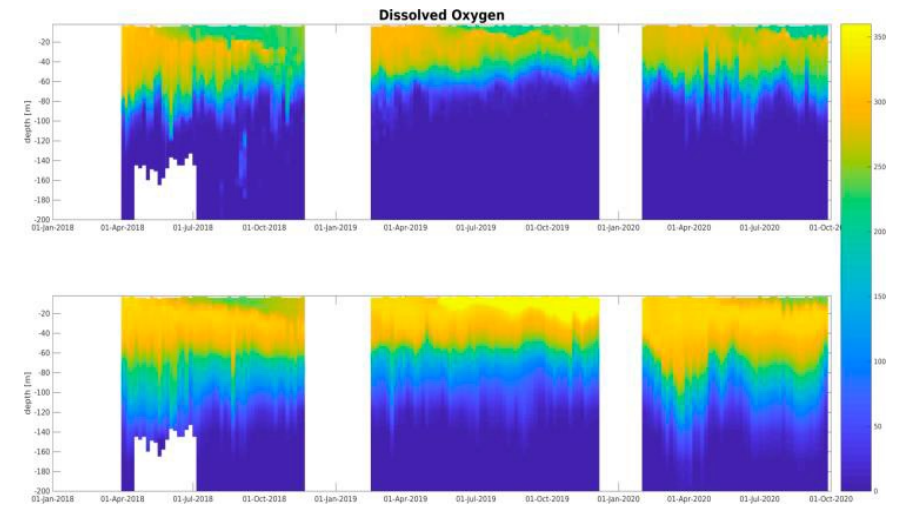


Region	1	2	3	4	5	6
EAN	0.012	-0.012	-0.011	0.19	0.15	0.014
Region	7	8	9	10	11	
EAN	0.04	0.009	0.055	0.07	-0.07	

Bias (log10) statistic for chlorophyll obtained for BS-BIO NRT when considering the observation-model prediction pairs, for the different regions (1 to 11).



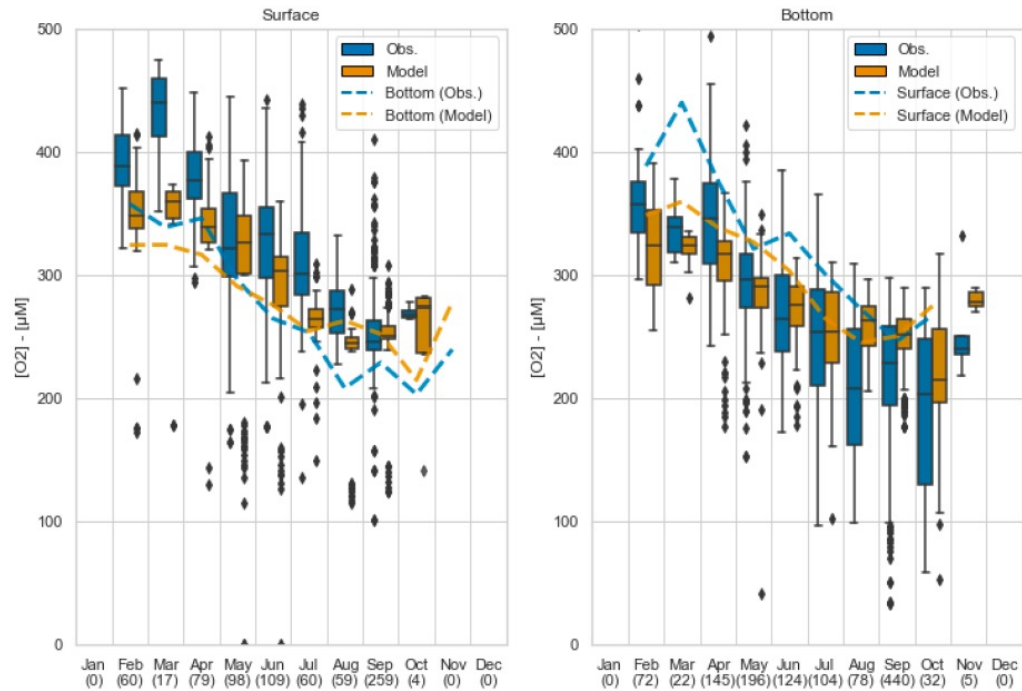
Oxygen



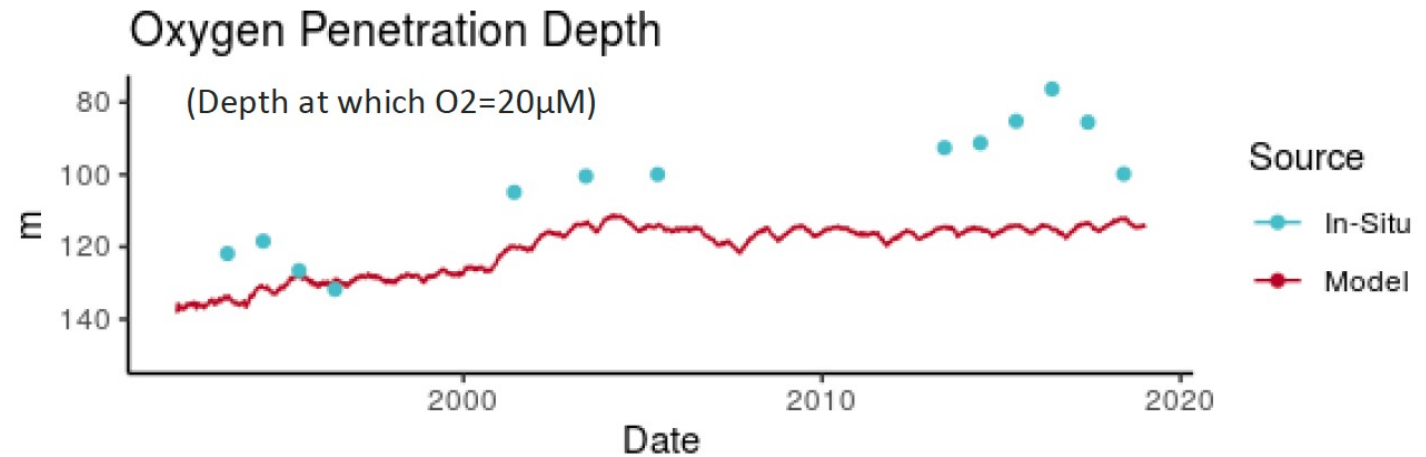
Oxygen

Bias (mmol m ⁻³)	24.2
Rms (mmol m ⁻³)	63.9
Standard deviation ratio (no unit)	0.92
Nash-Sutcliffe (no unit)	0.67
Pearson coefficient (no unit)	0.94

North-western shelf



Deep sea

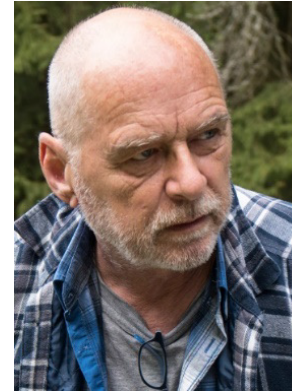




JOANNA STANEVA



ARNO BEHRENS



GERHARD GAYER



MARCEL RICKER

 **Helmholtz-Zentrum
Geesthacht**
Centre for Materials and Coastal Research

Overview of the current **Black Sea Waves** operational and reanalysis systems



Near Real Time System

Atmospheric Forcing: ECMWF 1/8°
(u10m, v10m)

Temporal resolution:

Forecasts: 3hrs (first 3 days)/6 hours (next 7 days)
Analysis: 6 hours

Multi-Year System

Atmospheric Forcing: ECMWF ERA5
1/4°
(u10m, v10m)

Temporal resolution:
1 hour

Initial Condition

Initial 2D wave spectrum
generated via fetch law from
local wind field

WAM Cycle 6, 1/36°x 1/27°

Directional Resolution: 24 degrees
30 frequency bands (0.043-0.663 Hz)
Including shallow water, depth refraction,
current refraction and wave breaking
parameterization

**One-way offline
coupling with NEMO
currents and water level
deviations**

Assimilation of satellite data recorded by
the radar altimeters of Jason-1, Jason-2 and
Jason-3

NRT PRODUCTS

Hourly instantaneous
Analysis & 10 days forecasts

Significant Wave Height, Wave Mean Period, Wave direction, Stokes drifts, Wind Wave
Significant Height, Wind Wave Mean Period, Wind Wave Direction, Primary Swell Wave
Significant Height/Period/Direction, Secondary Swell Wave Significant
Height/Period/Direction
Jan 2019 - ongoing

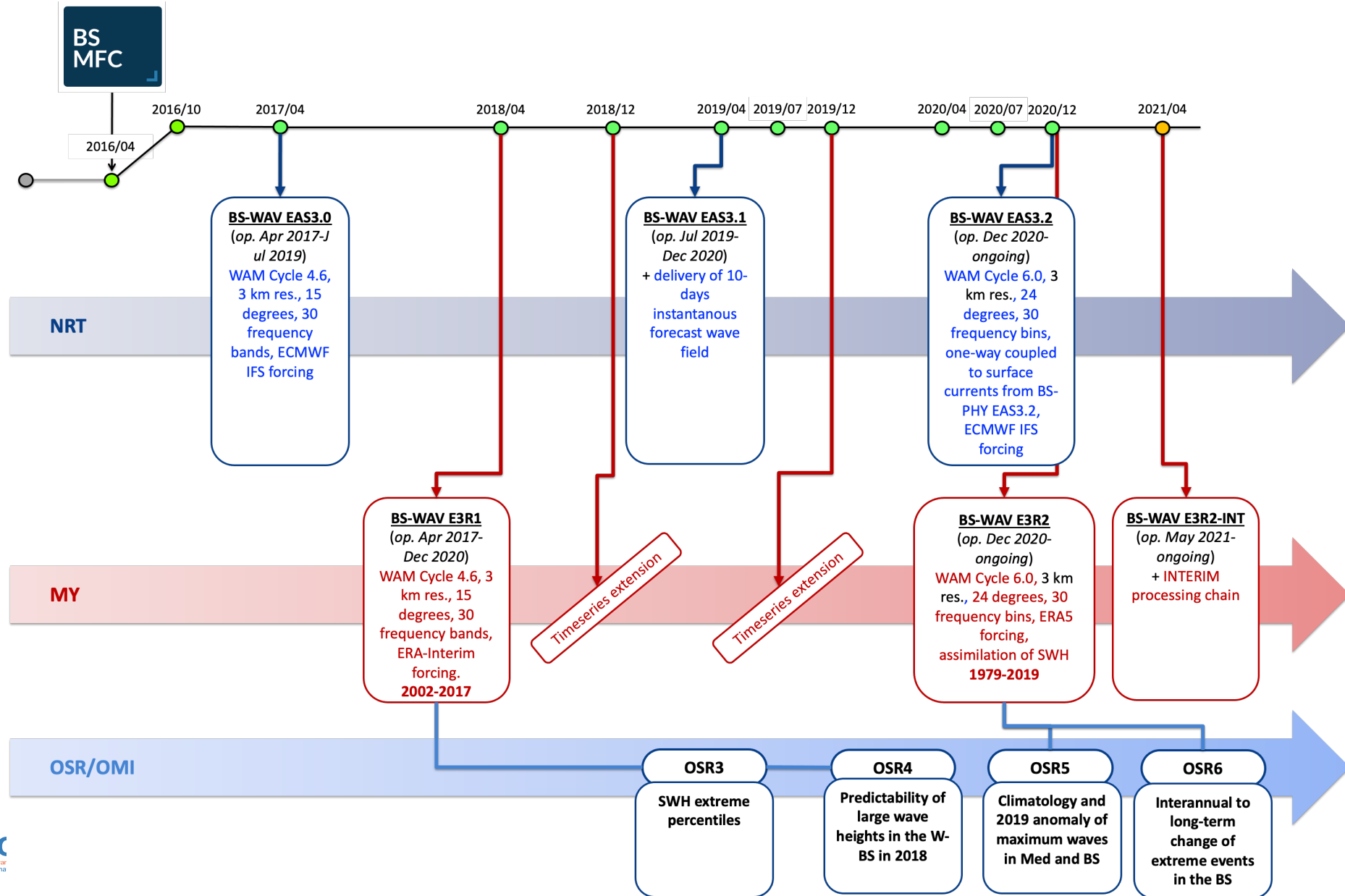
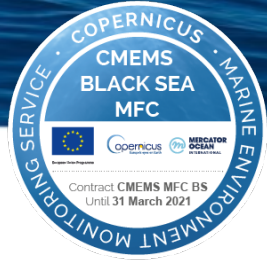
REAN PRODUCTS

Hourly instantaneous
As the NRT
Jan 1979 – Dec 2019



Copernicus
Marine Service

Black Sea Waves: Evolution of the Systems from the Scientific Perspective



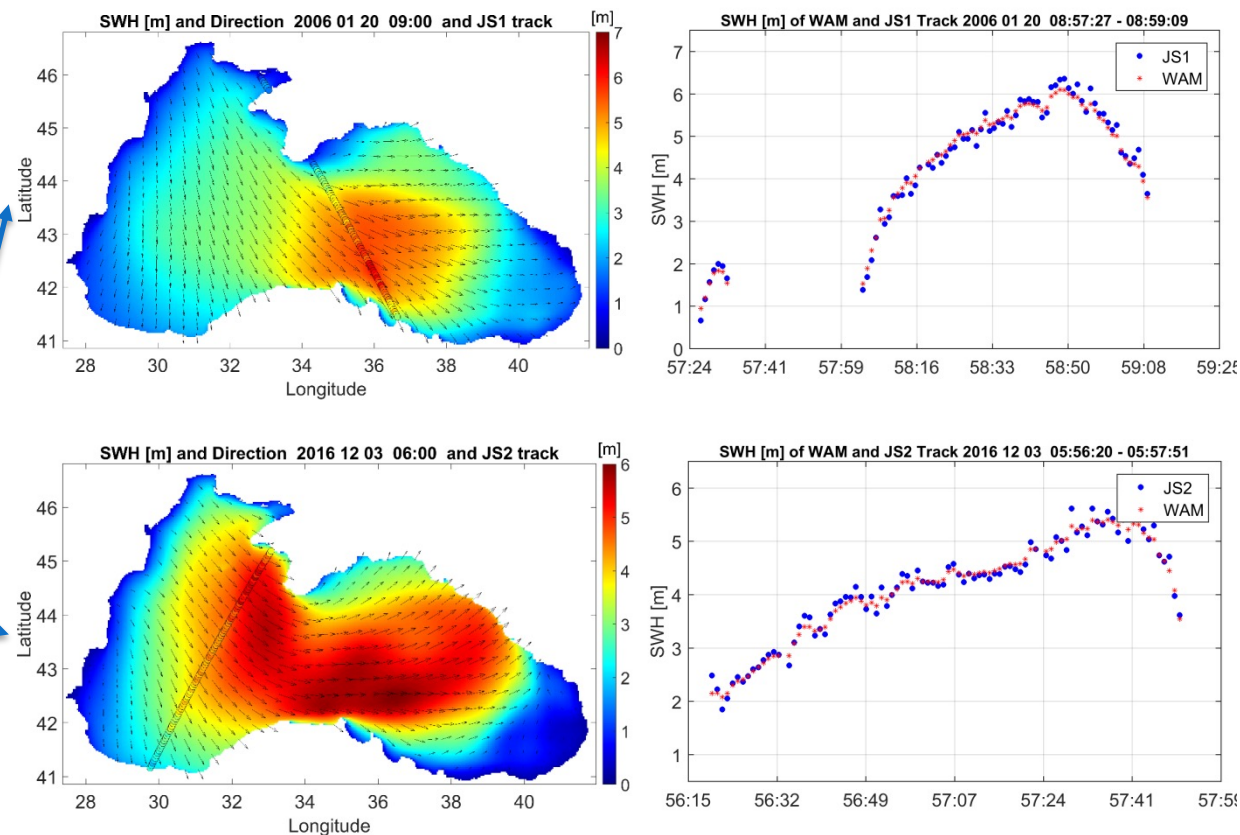
The logo is a circular emblem. The outer ring contains the text 'COPIERNICUS' at the top and 'MARINE ENVIRONMENT MONITORING SERVICE' around the bottom. The center of the logo features the text 'CMEMS BLACK SEA MFC' in large, bold, black letters. Below this central text are three logos: the European Union flag, the Copernicus logo with the tagline 'European Space Programme', and the Mercator Ocean logo with the tagline 'an ocean for the future'.

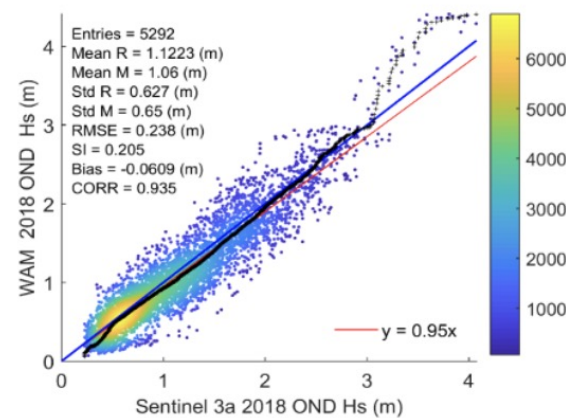
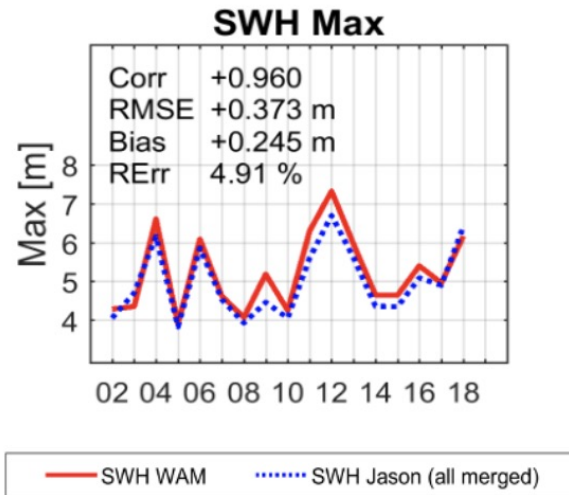
[illegible]

- Every day, BS-WAV NRT produces 1 day **simulation** and 10 days **forecast**

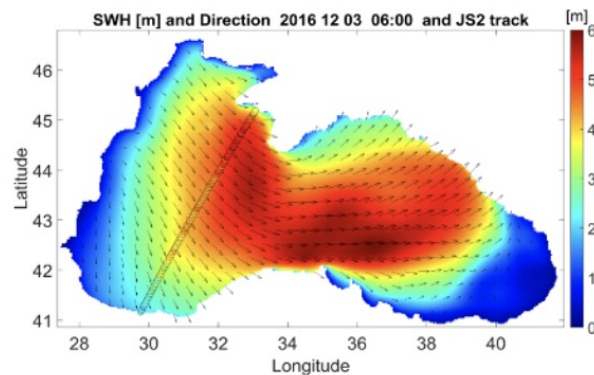
Two examples for the along track validation (WAM /Jason-1 and WAM/Jason-2)

PRODUCT QUALITY DASHBOARD





Time series of maximum significant wave heights derived from the combined Jason satellite measurements and from BS-WAM MYP (left); Scatter plots showing Sentinel 3a satellite measurements versus BS-WAV NRT significant wave heights for Q4 2018 (right).



Distribution of significant wave height of WAM with overlaid Jason-2 satellite track (left) on 03 December 2016 06:00 UTC and along-track measured and computed significant wave height (right).

Thank You!
Questions?