SYMPOSIUM OP'24 — ADVANCING OCEAN PREDICTION SCIENCE FOR SOCIETAL BENEFITS

NECCTON

Kalman Filter based approach to ensemble forecast correction using spectral ocean color satellite data in the coupled ecosystem model of the Black Sea

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Motivation

- Ocean physical parameter DA improves models forecasting performance [1,2,3]
- Amount of data is crucial and always lacking [4], especially BGC data
- BGC processes high non-linearity restricts assimilation of processed products, as CHL [5]

RRS and model state variables

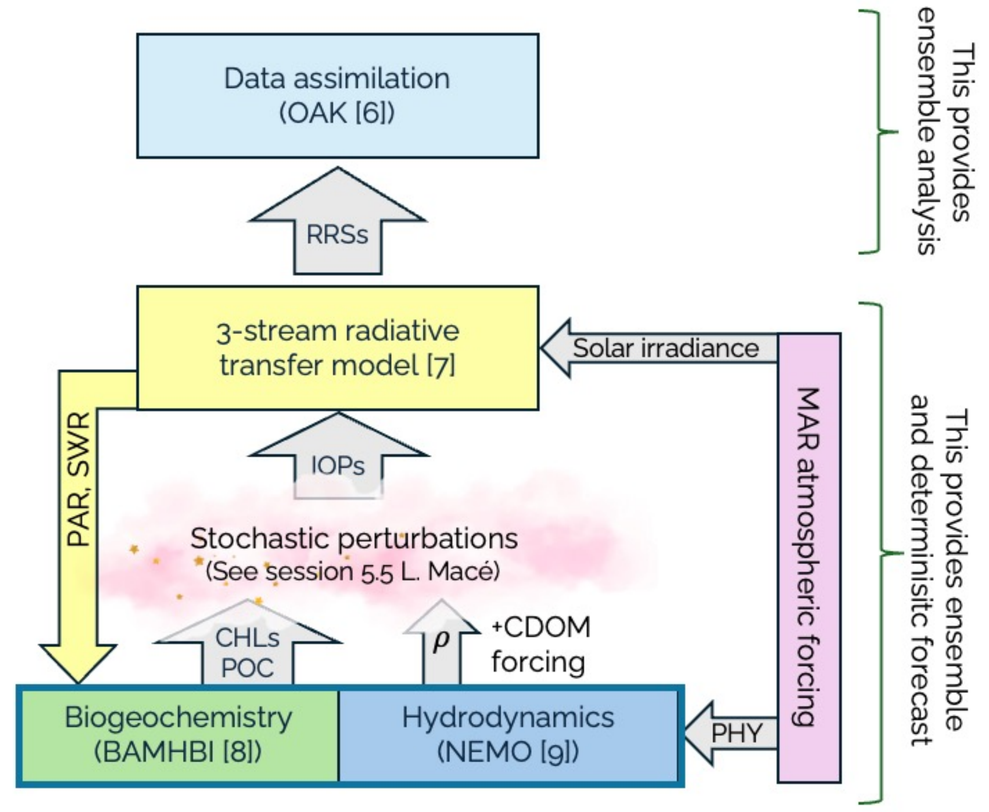
$$RRS \sim R(\lambda) = \frac{E_u^{below}(\lambda)|_{k=0}}{E_{d_o}^{below}(\lambda) + E_{s_o}^{below}(\lambda)},$$

E_d, E_s, E_u = f(a, b, b_b) - Light streams are function of IOPs

$(a, b, b_b)_w$	$(a, b, b_b)_{phy}$	$(a, b, b_b)_{det}$	a_{CDOM}
Pure water absorption, scattering and backscaterring	**3 phytoplankton groups** absorption, scattering and backscaterring	**POC** absorption, scattering and backscaterring	**Colored dissolved organic matter** absorption

Phytoplankton and detritus IOPs depend on their concertation – CDI, CEM, CFL and POC (in BAMHBI model)

Methods and tools



Satellite data and Twin approach

We want to assimilate: Copernicus satellite reflectances at 412, 443, 490, 510, 555, 670 nm from either Sentinel-3 (300 m sp.res.) or multi-censor (1 km sp.res.)
Why we don't: real data assimilation lacks independent data for method validation

We assimilate: RRSs (412, 443, 490, 510, 555, 670 nm) produced by deterministic run
Why? Twin approach allows for comprehend validation against the deterministic run
What we correct: ensemble E_d, E_s, E_u, PAR, *diatom*, *flagellates* and *emiliana* concentrations in carbon, POC concentration.

Observation: Deterministic forecast → RRSs → OAK assimilation → Model: Ensemble **(20 members)** forecast → Ensemble analysis

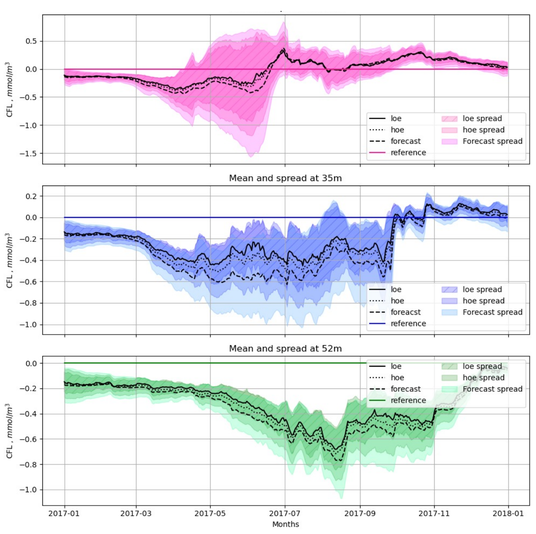
Data is assimilated daily at 11:30

"**High**" observation error (**HOE**) estimate: **R = SQRT(monthly STD)/9**

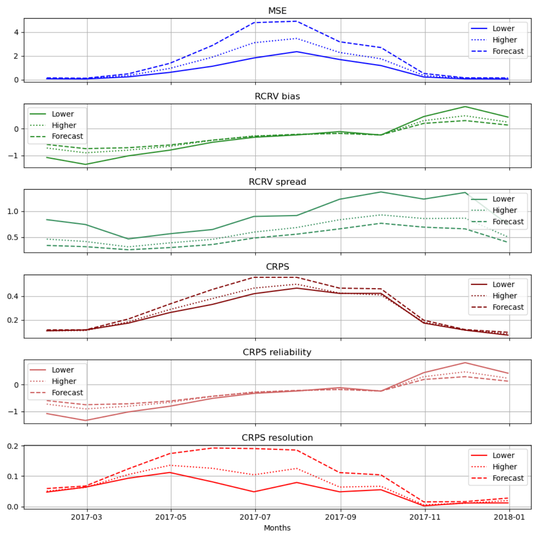
"Low" observation error (**LOE**) estimate: **R = (monthly STD)*2**

Phytoplankton and organic carbon

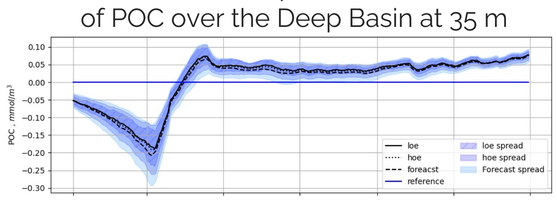
Ensemble mean and spread – reference mean of CFL over the Continental Shelf (<200 m)



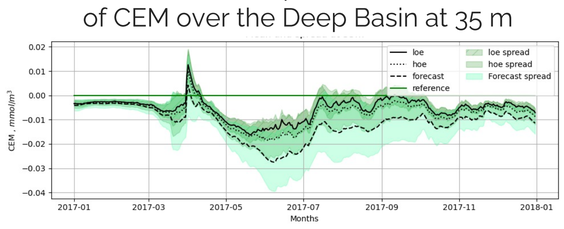
Ensemble scores for CFL over the Continental Shelf at 35 m



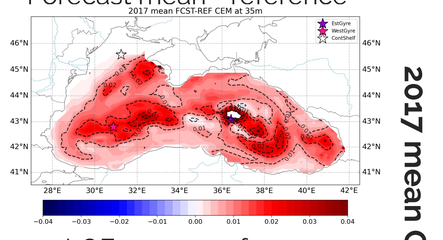
Ensemble mean and spread – reference mean of POC over the Deep Basin at 35 m



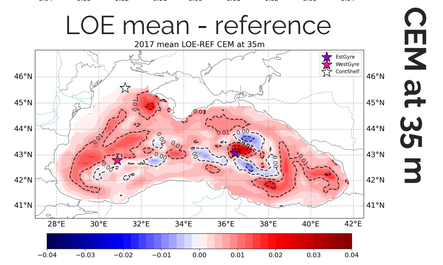
Ensemble mean and spread – reference mean of CEM over the Deep Basin at 35 m



Forecast mean - reference



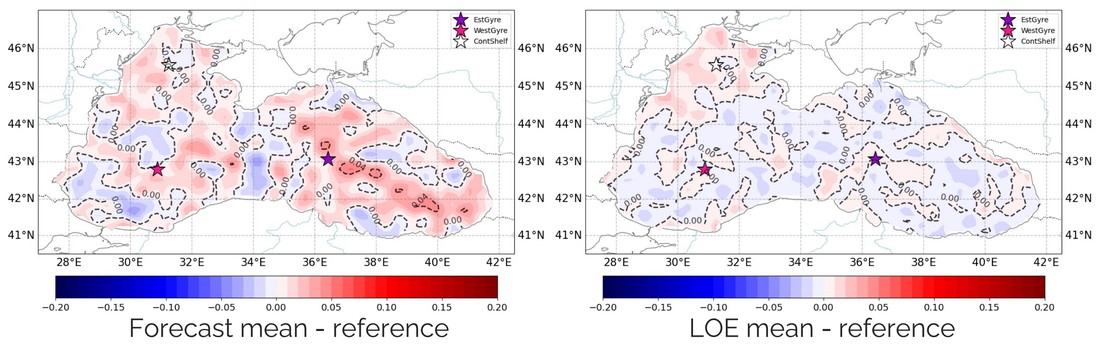
LOE mean - reference



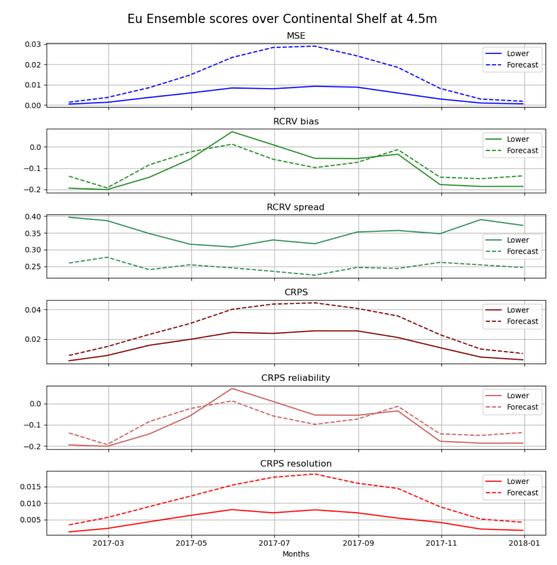
2017 mean CEM at 35 m

E_d, E_s, E_u (490 nm) and PAR

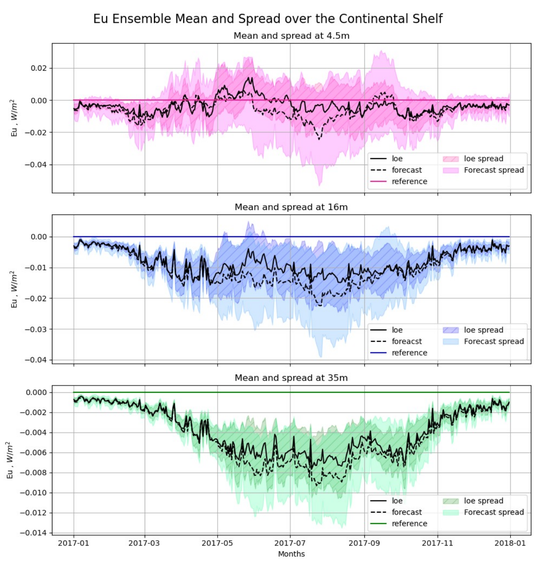
Yearly mean E_u (490 nm) at 4.5 m



Eu Ensemble scores over Continental Shelf at 4.5m



Eu Ensemble Mean and Spread over the Continental Shelf



Discussion

1. New method successfully corrects (some) ocean BGC model state variables;
2. For some variables (CDI, CEM, POC) too high light attenuation on shelf prevents effective assimilation;
3. For some (CFL, CHF), on the contrary, variable is highly correlated with reflected field at different depths, that allows for more effective assimilation

NECCTON — NEW COPERNICUS CAPABILITY FOR TROPHIC OCEAN NETWORKS

Ocean Predict — In partnership with unesco Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development