Coastal Rapid Environmental Assessment in the Northern Adriatic Sea

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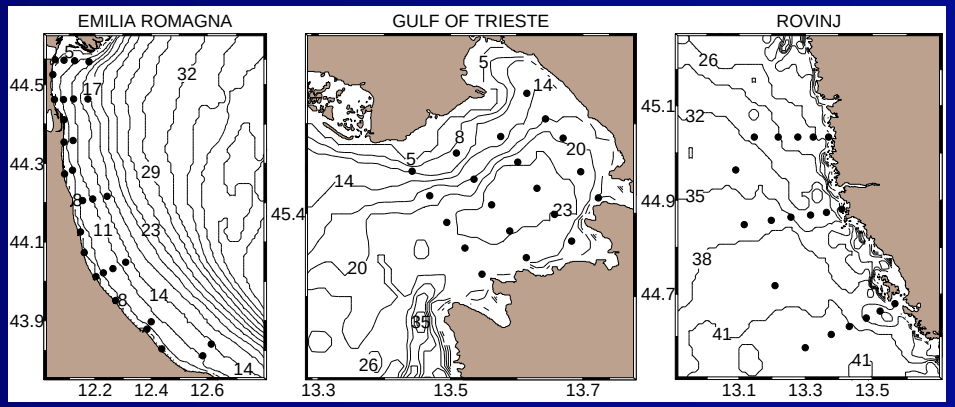
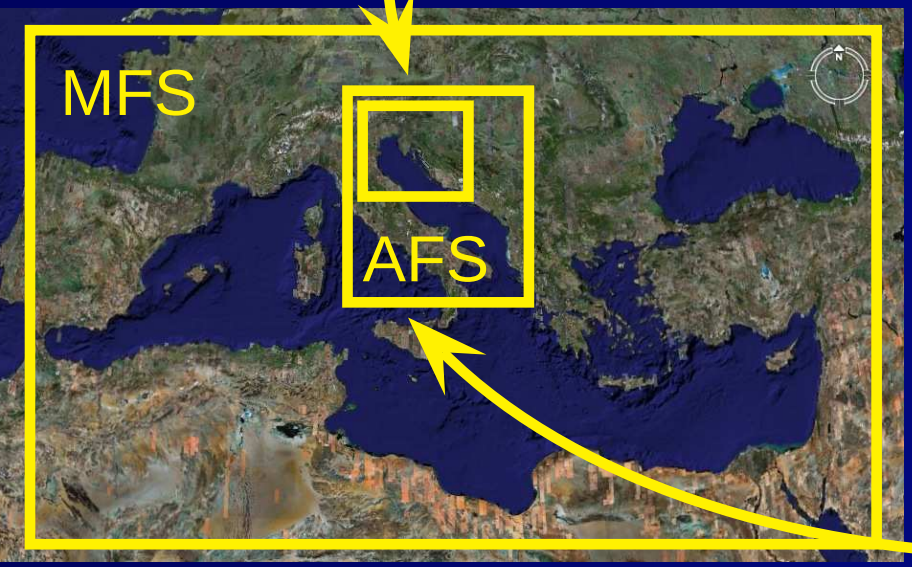
Coastal Rapid Environmental Assessment (CREA)

CREA exploits coastal networks of opportunity and an operational forecasting system to initialize a nested high resolution model and produce short time forecast

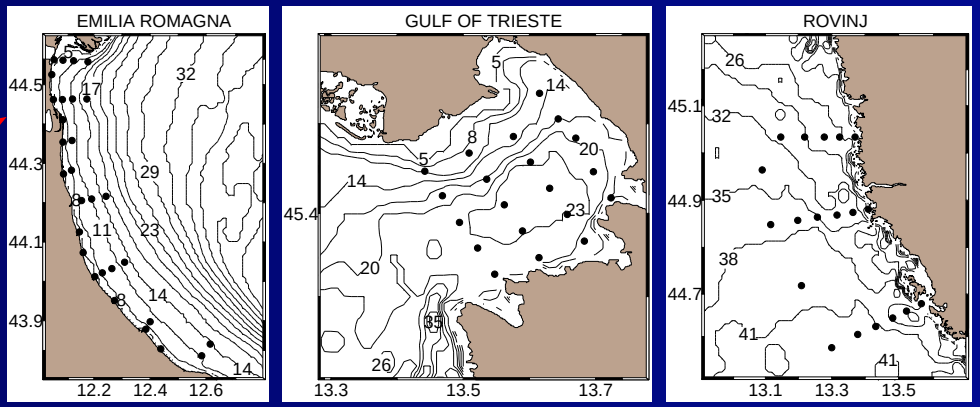


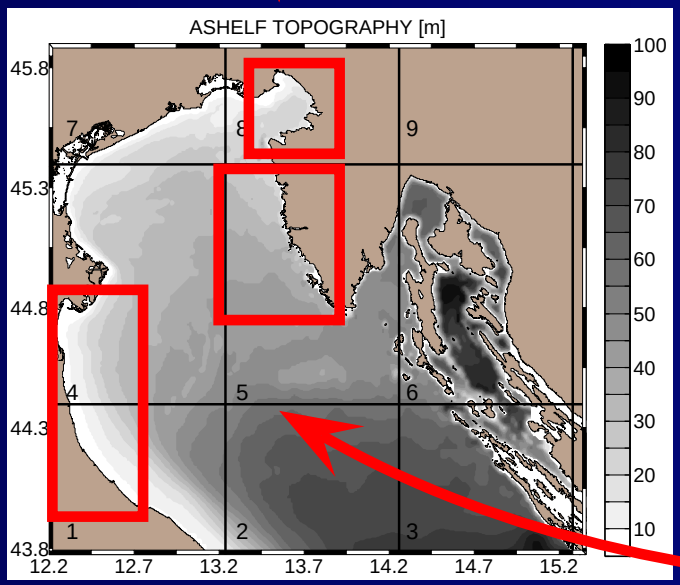


DATA ASSIMILATION SCHEME

Coastal Rapid Environmental Assessment (CREA)

Objective: to demonstrate the feasibility and the quality of a CREA system for 7-8 days forecast in the near coastal areas of the Northern Adriatic Sea





ADRICOSM Project 2003

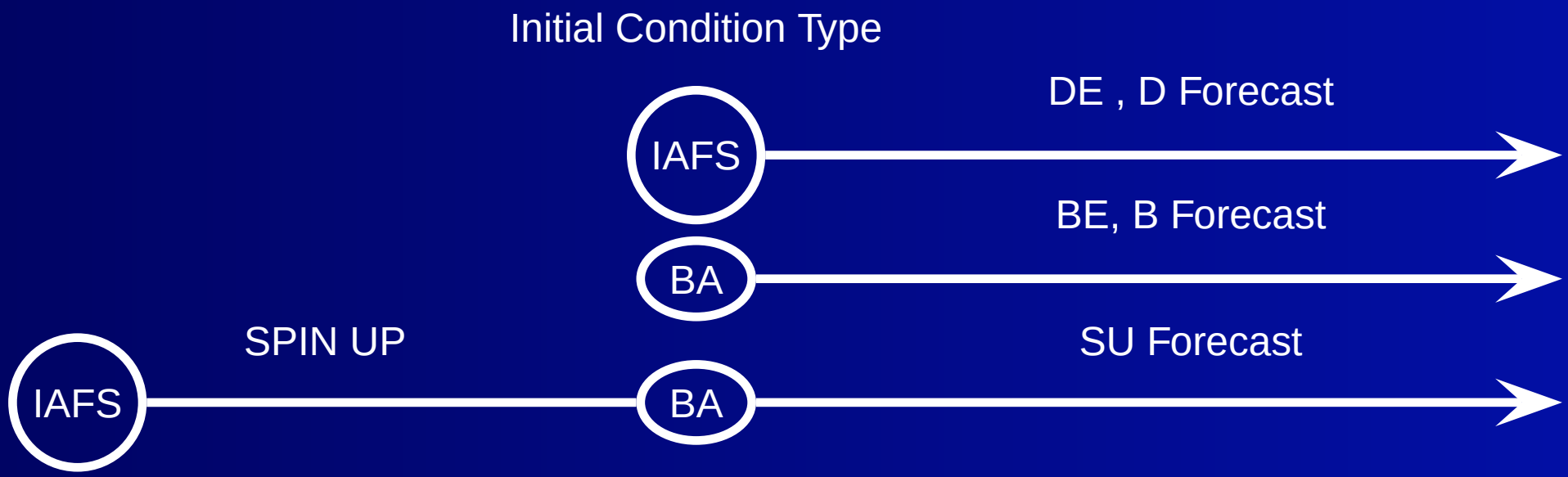
Objective Analysis

(Mariano&Brown92)

Modeling System

	ASHELF	AFS
Model	POM	POM
Horiz Resolution	0.8 km	2.2 km
Vert Resolution	31σ layers	31σ layers
Bathymetry	0.5 km res	DBDB1 1min res
Min depth	5m	10m
Light Abs	double exp (WT II)	single exp (WT IA)
LOB	from AFS	from MFS
Po River	Daily Runoff + Temp	Daily Runoff
Reno River	Daily Runoff	Monthly Runoff
Italian Rivers	*Raicich* Climat.	*Raicich* Climat.
Croatian Rivers	*Pasaric* Climat.	*Raicich* Climat.
Atm Forcing	ECMWF / LAMI($7km, 3hrs$)	ECMWF($0.5\,\mathrm{deg}, 6hrs$)

CREA Initialization and Forecast Procedure



IAFS = AFS fields interpolated on ASHELF grid (IAFS);

BA = AFS fields blended with coastal observations;

DE, D start from IAFS and use ECMWF data and LAMI data

BE, B start from BA and use ECMWF data and LAMI data

SU a spin-up period is applied before blending to form BA, the forecast uses LAMI data

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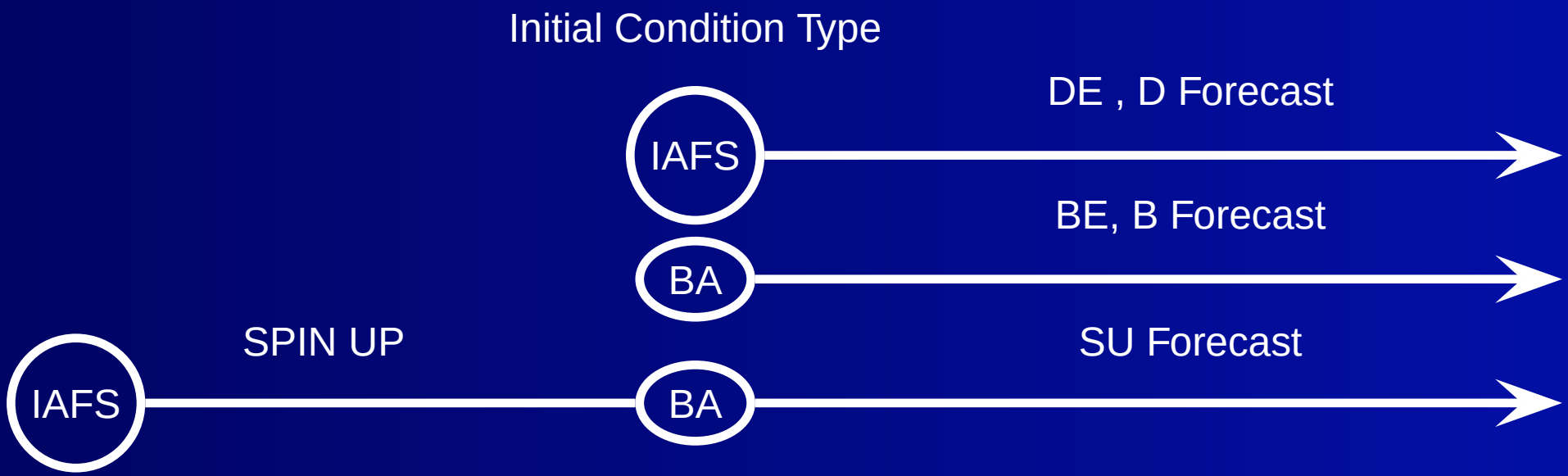


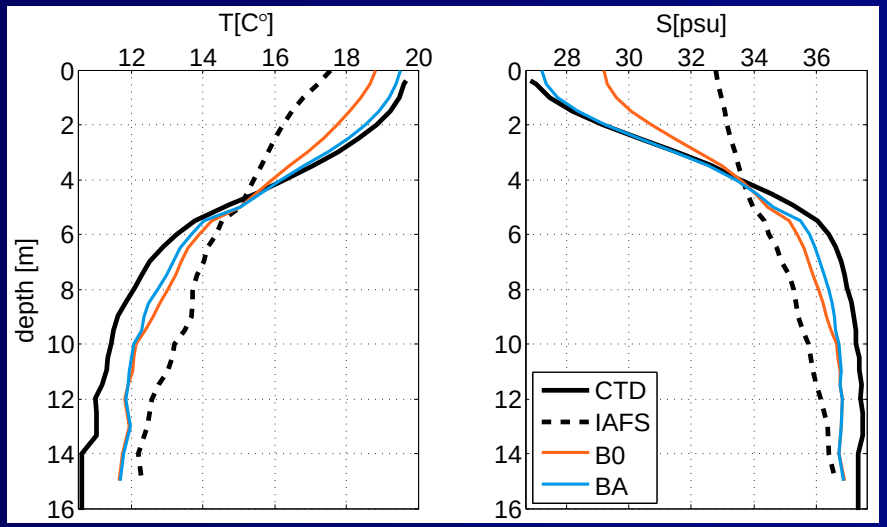
Two test scenarios in 2003 to evaluate the CREA methodology with different atmospheric forcing conditions and different AFS initial skills:

1. *Spring experiment* May 5 to May 13
2. *Summer experiment* August 11 to August 19

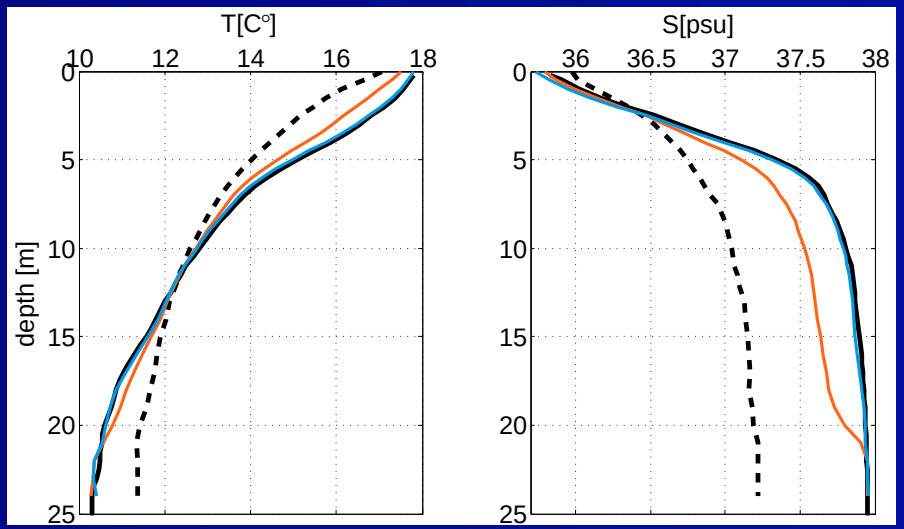
Time periods chosen on the basis of the availability of coastal observations (weekly sampling freq) for both model initialization and validation after 7-8 days of forecast

INITIAL CONDITIONS May 5th

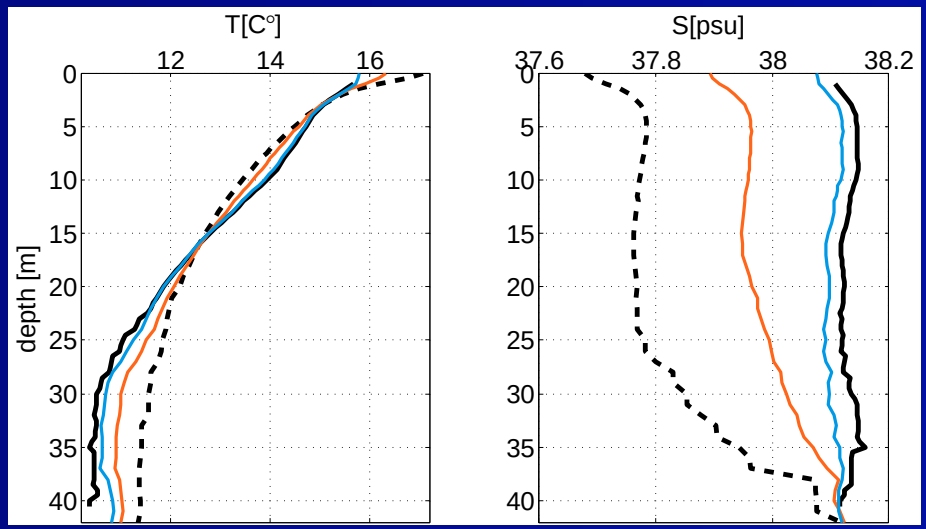
Emilia Romagna



Gulf of Trieste



Rovinj



IAFS = AFS interpolated/extrapolated

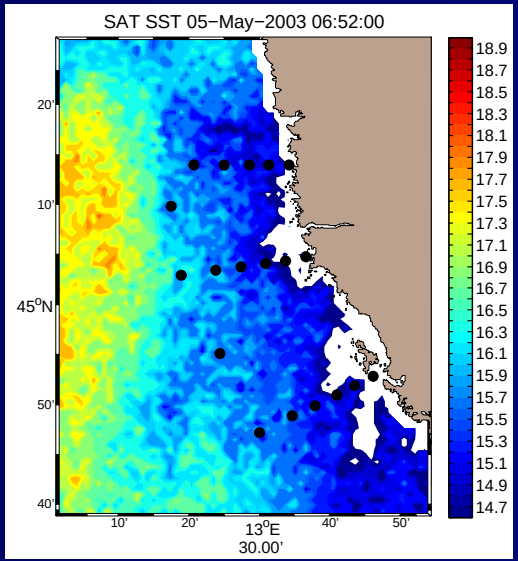
Blending AFS+CTDs (Mariano&Brown ’92)

B0 Homogeneous Parameter Matrix and Isotropic Correlation Function

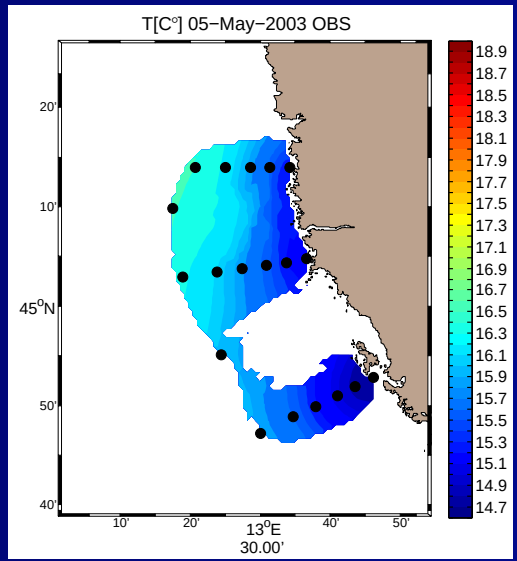
BA Heterogeneous Parameter Matrix and Anisotropic Correlation Function

INITIAL CONDITIONS May 5th Rovinj Region

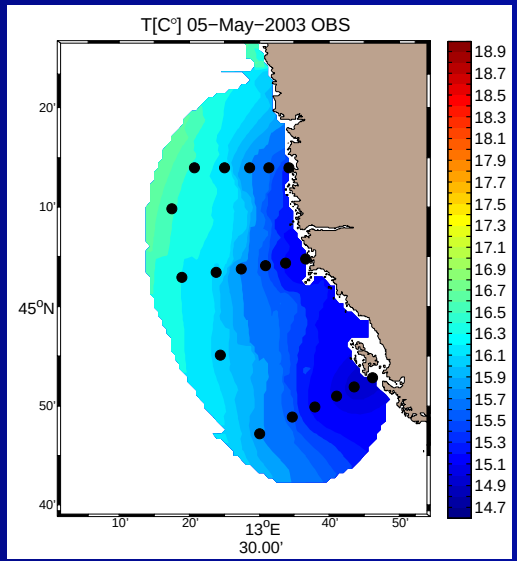
SATELLITE OBS



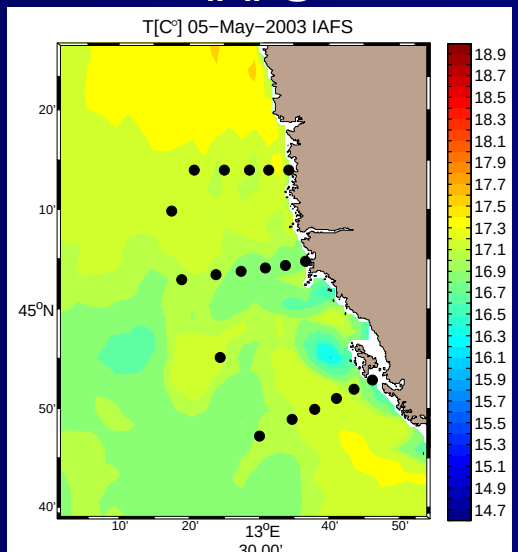
B0 OBS



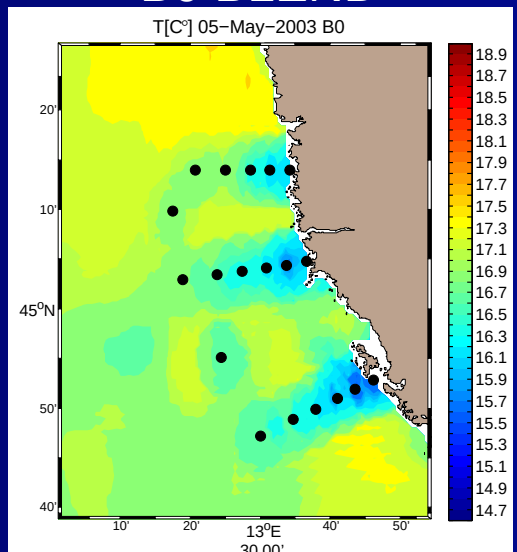
BA OBS



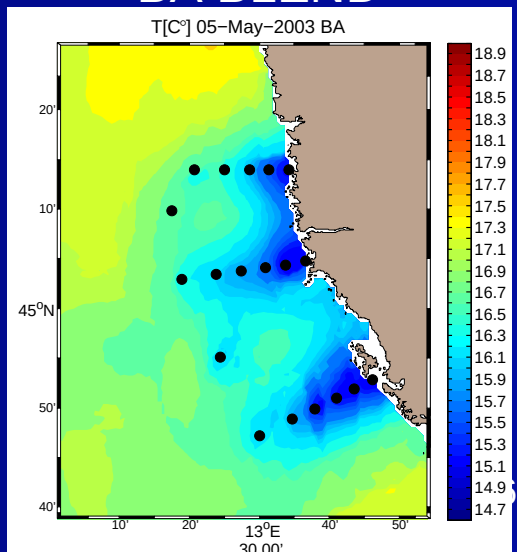
IAFS



B0 BLEND

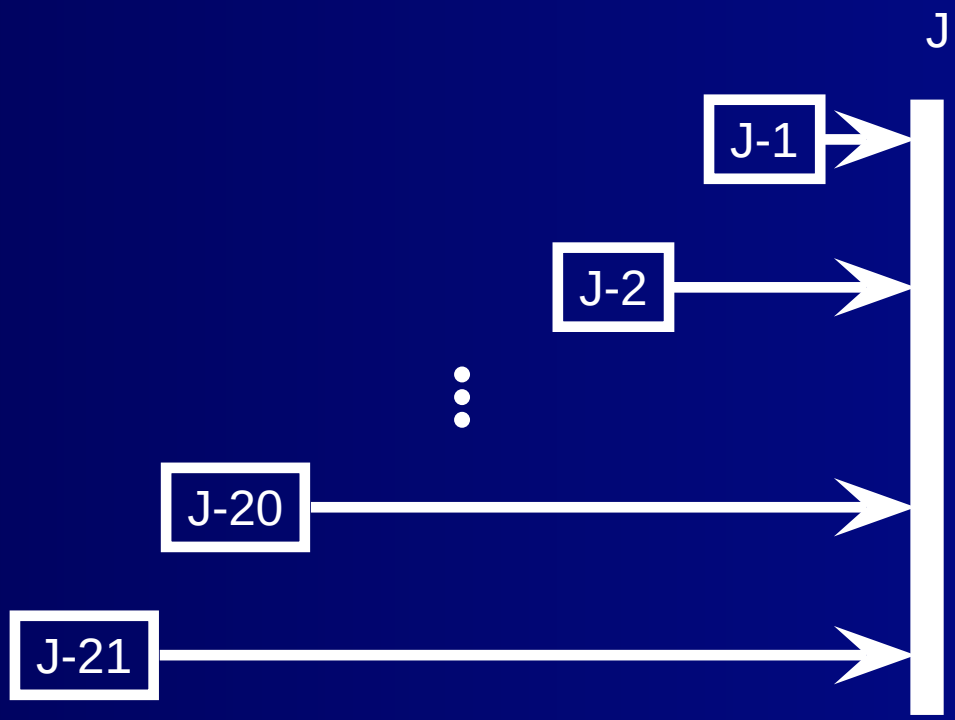


BA BLEND



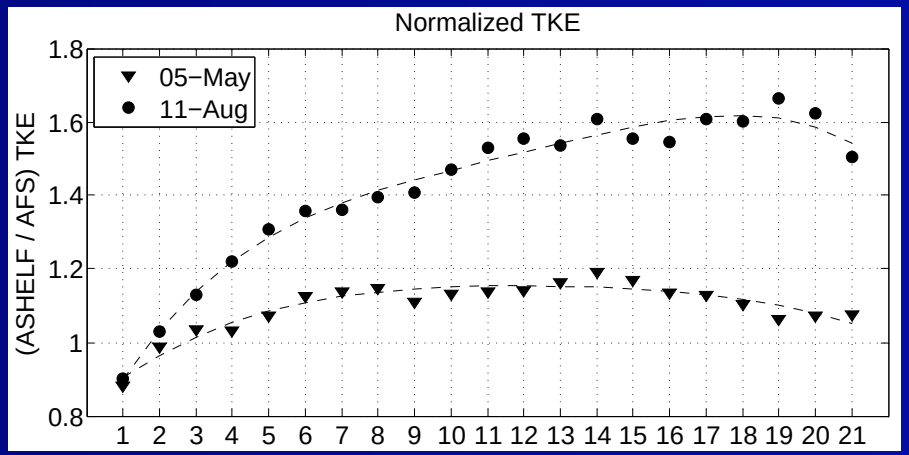
SPIN UP

Target IC day



Objective: to define the time necessary by ASHELF to reach a new dynamical equilibrium allowed by the increased horizontal resolution

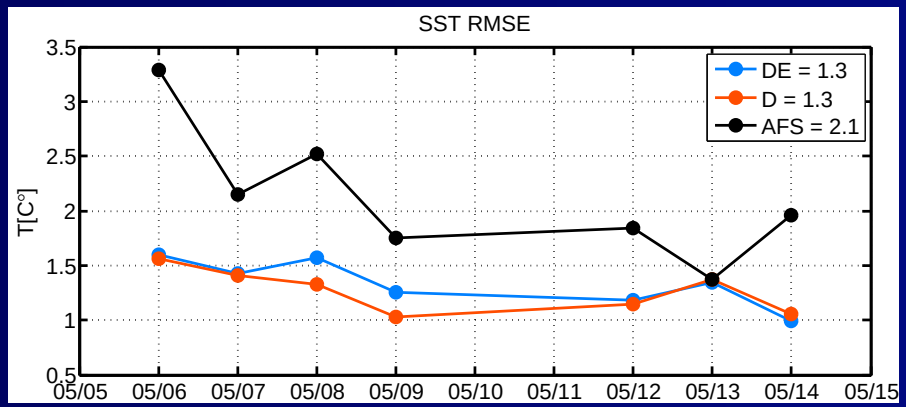
(IAFS ICs & LOBCs - ECMWF forcing)



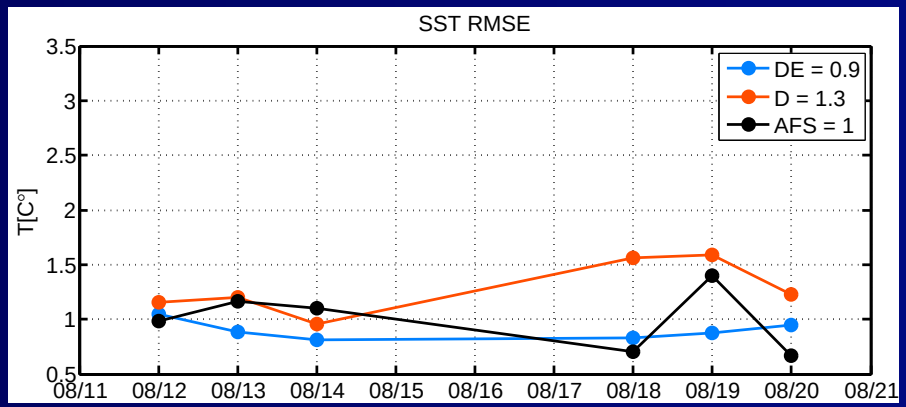
Total Kinetic Energy ratio between ASHELF and AFS at J from 21 ASHELF realizations as function of the spin-up period length: TKE value increases progressively reaching a plateaux when integration time overtakes 7/9 days.

CREA Results: SST

SPRING



SUMMER



Sat SST observations are cloud masked, only maps with more than 50% of available points inside ASHELF domain have been considered

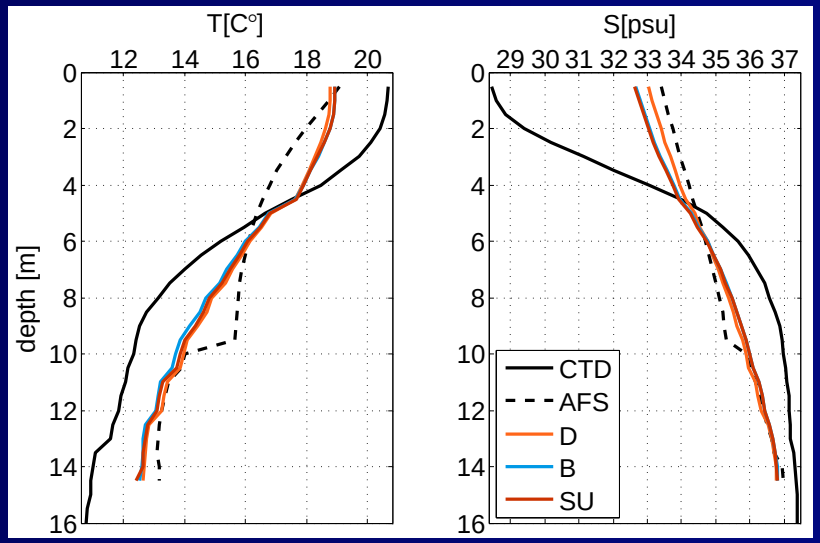
$RMSE(°C)$	AFS	DE	D
SPRING	2.1	1.3	1.3
SUMMER	1.0	0.9	1.3

SPRING: ASHELF largely improves AFS score reducing its RMSE of a 38% independently from the atm forcing applied (new light penetration parameterization and smaller LAMI air temperature diurnal excursion);

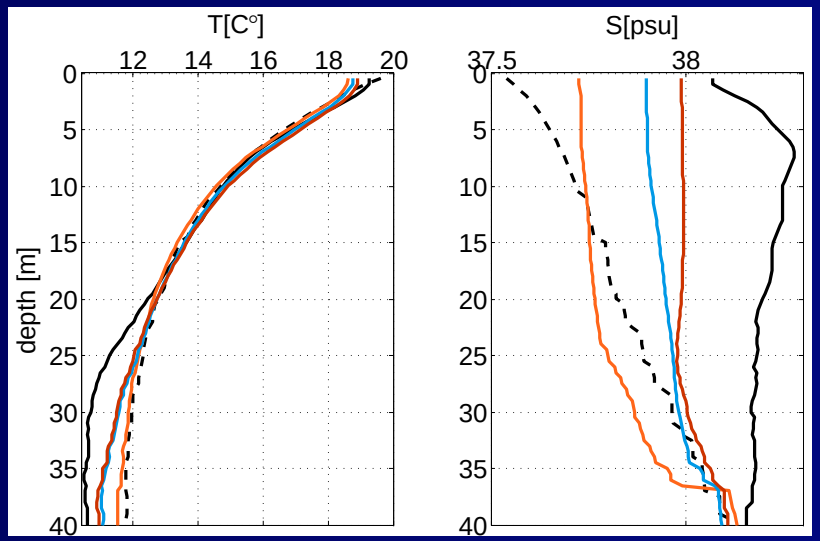
SUMMER: DE has better skill score than AFS by 10% while D presents a higher RMSE value (very different cloud cover in the two forcing data sets and a better estimation of it in the ECMWF analyses)

Spring CREA Results

Emilia Romagna May 12th



Rovinj May 13th

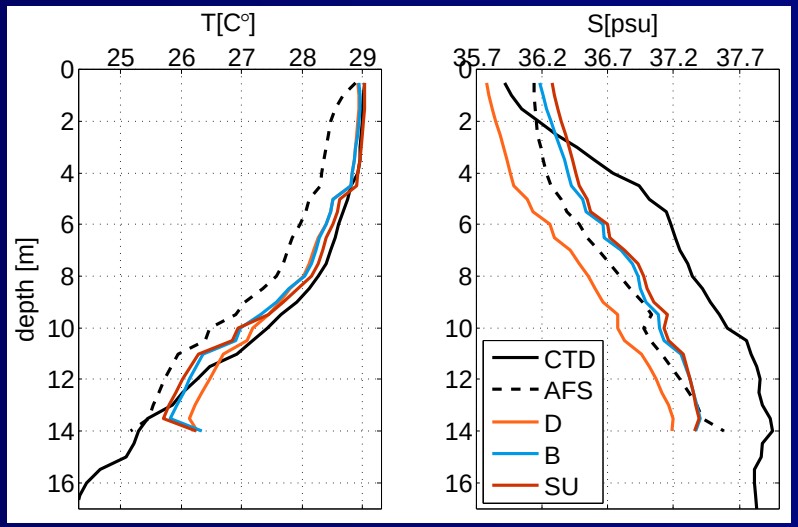


RMSE	AFS	D	B	SU
Emilia Romagna				
T	2.3	2.0	1.9	1.9
S	3.4	3.2	3.0	3.0
Rovinj				
T	1.0	0.9	0.8	0.7
S	0.5	0.5	0.3	0.3
Tot gain %		13.4	25.5	27.5

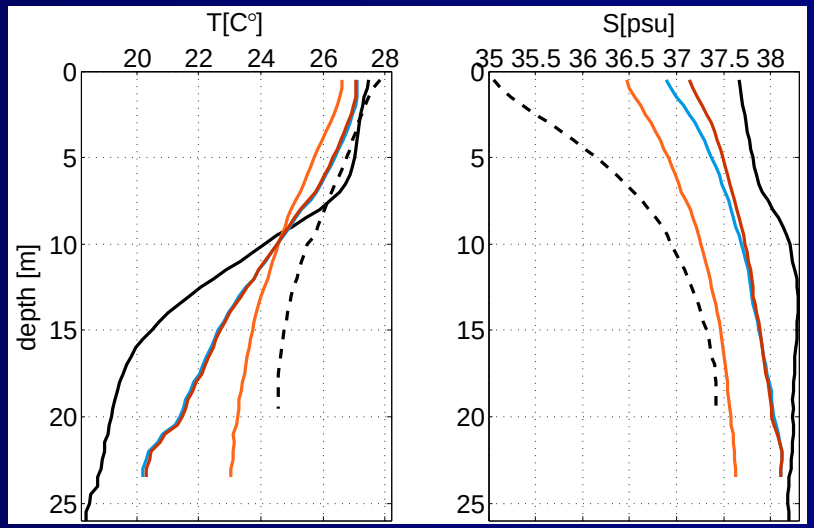
IC is partially corrected by the observations (bottom layer); the information (fresh water signal) can be lost during forecast due to dynamical adjustment and evolution

Summer CREA Results

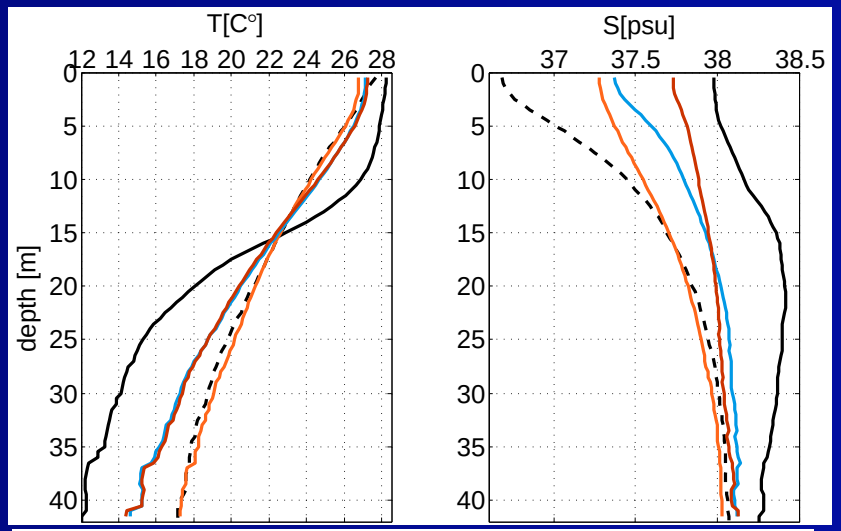
Emilia Romagna



Rovinj



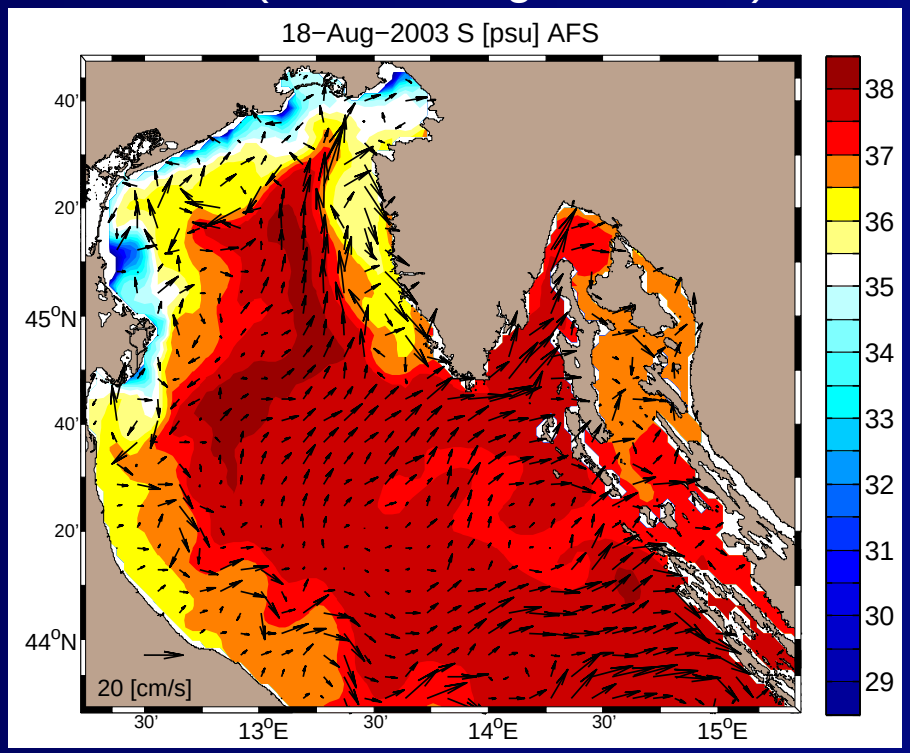
Gulf of Trieste



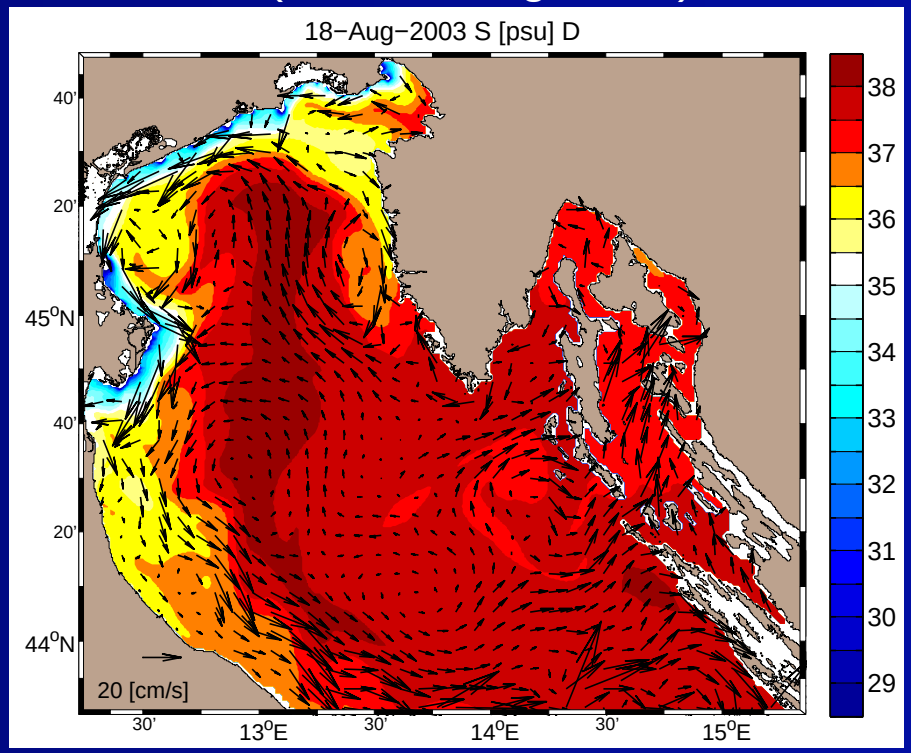
RMSE	AFS	D	B	SU
ER T	0.9	0.6	0.7	0.6
ER S	1.1	1.1	0.9	0.9
TR T	2.4	1.9	1.3	1.4
TR S	1.7	1.0	0.6	0.5
RO T	3.4	3.5	2.5	2.6
RO S	0.8	0.6	0.5	0.4
Tot gain %		12.5	28.1	31.3

Summer CREA Results

AFS (Atm Forcing: ECMWF)



D (Atm Forcing LAMI)



Different salinity and current patterns after a week on August 18:

- in AFS the ICCC (Istrian Coastal Counter-current) is part of an anti-cyclonic structure advecting fresher waters along the Istrian peninsula;
- D weakens the anticyclone and does not advect so far southward the river waters improving salinity results both along Rovinj costal region and in the Gulf of Trieste

Conclusions

- CREA based on an operational forecasting system and opportunity observations to initialize a nested high resolution model increased our predictive capabilities;
- Downscaling approach improves AFS results of a 12%, without significant differences between the atmospheric forcing applied;
- Blending approach corrects AFS fields with the available coastal observations and improves AFS results by 25%;
- 7 days spin up time, suggested from energetic considerations, determines an additional benefit reaching the 30% of total gain (positive effect of new river data and a more realistic river outlets representation);
- CREA succeeded less in Emilia Romagna, a shallow area under the direct influence of Po River and the WACC characterized by a very high space/time variability. ASHELF uncertainty might be due to unresolved processes and to a sampling scheme not optimal for CREA.

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