OPTIMIZING COSMO_REA6 REANALYSIS RADIATION FLUX FOR A HIGH RESOLUTION COASTAL OCEAN MODEL

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INTRODUCTION

Complex coastline and coastal orography exert strong influence on atmospheric fields, wind in particular, and therefore high resolution atmospheric models are highly preferential in regional ocean modeling. The east Adriatic coast with numerous islands and coastal mountain ridges is a fine example. We use a high resolution COSMO_REA6 (6 km horizontal resolution) atmospheric reanalysis for our long term ROMS_AGRIF hindcasts, but the atmospheric model significantly underestimates the short wave (SW) flux over the Mediterranean Sea. Probably due to overestimation of high clouds formation and erroneous sea surface temperature used as a boundary condition. The underestimation of shortwave flux led to negative bias in model sea surface temperature (SST) and we performed several experiments with modified flux in order to improve model performance.

FLUX CONFIGURATIONS

- COSMO: original SW flux as in COSMO_REA6.
- ERA5: SW flux taken from ERA5.
- K*COSMO: COSMO_REA6 SW flux multiplied by a constant factor K (K=1.23).
- modSW: at every timestep COSMO_REA6 SW flux is multiplied by a constant factor in order that surface averaged flux matches ERA5.

MODEL SETUP

- Ocean model: ROMS_AGRIF with 1.9 km horizontal resolution and 31 sigma levels.
- Open boundary conditions: Mediterranean Forecast System, daily values.
- Bulk forcing (COAMPS formula).
- 36 freshwater sources.
- test year 2015.

MODEL SST

Model SST was compared with L4 satellite product obained fom CMEMS web portal (https://marine.copernicus.eu/). Modeled midnight values were used daily for the whole year 2015. SW flux was modified for each run, while other parameters (2m temperature, wind, humidity, precipitation, LW flux) were taken from COSMO_REA6.

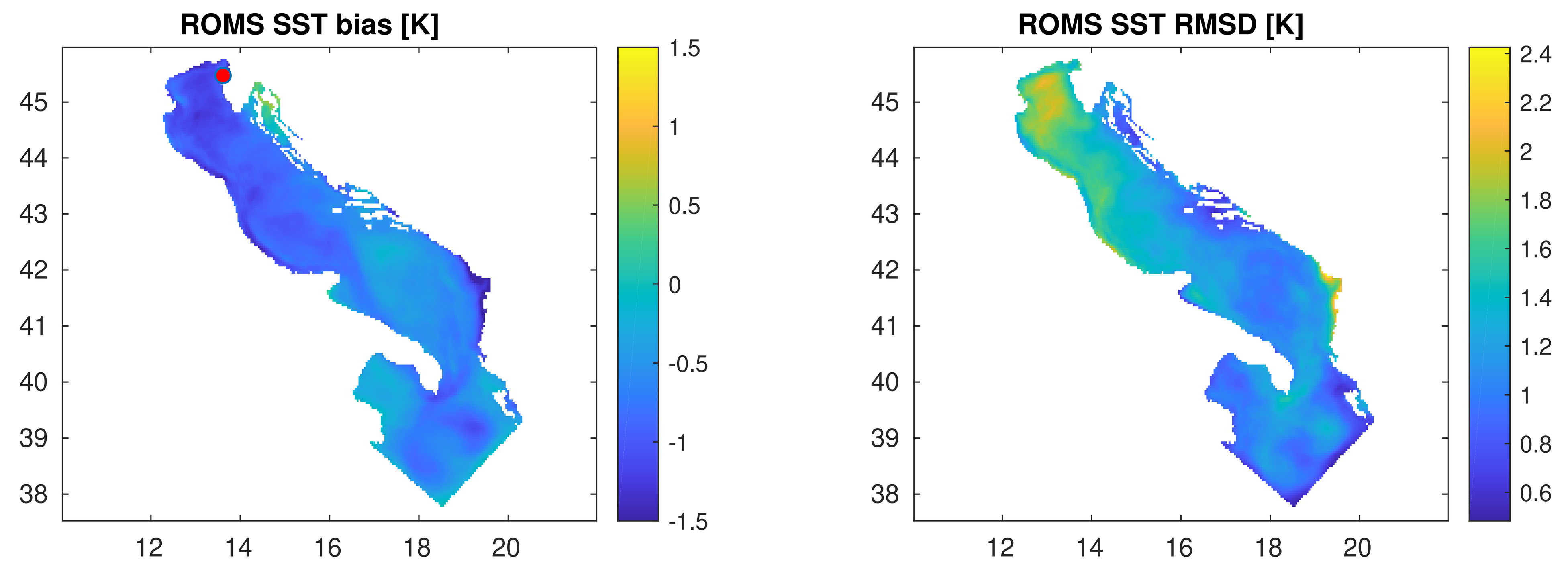

Fig. 1: SST bias (left) and RMSD (right) for test year run with original forcing. Red dot shows the location of Portorož meteorological station and Vida oceanographic buoy.

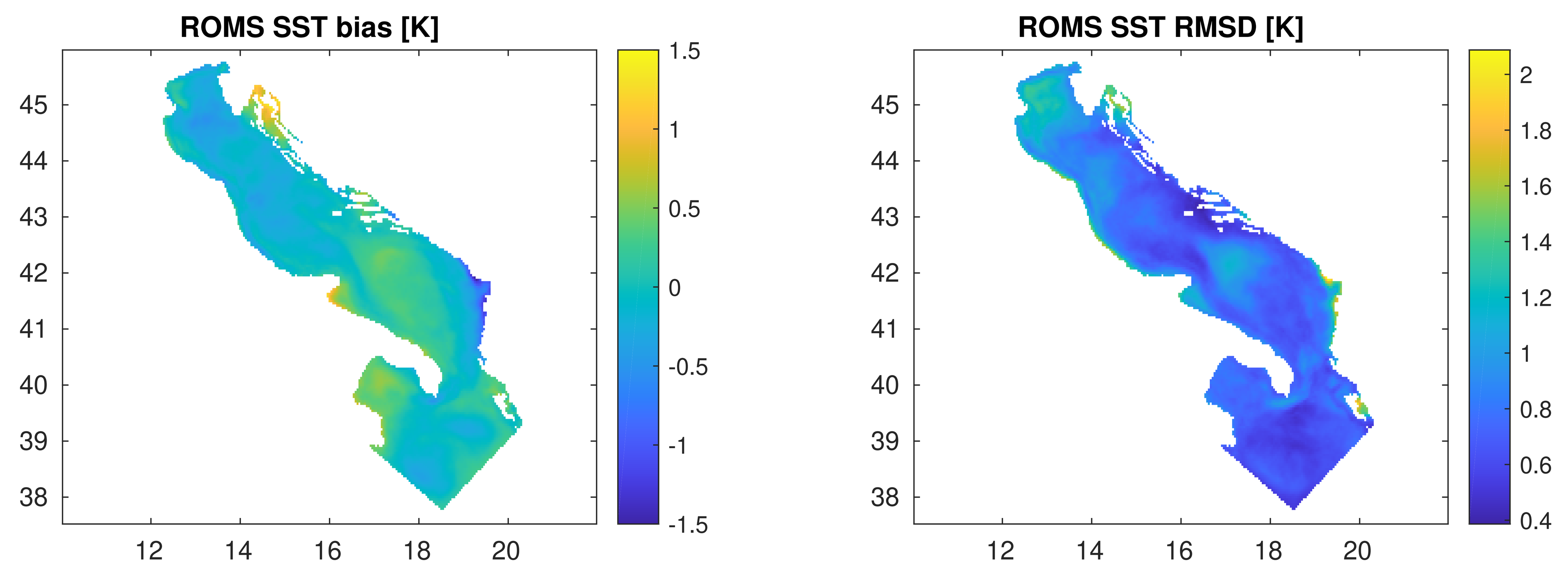

Fig. 2: SST bias (left) and RMSD (right) for K*COSMO configuration.

SW flux	bias [K]	RMSD [K]
COSMO	-0.70	1.23
ERA5	-0.10	0.89
K*COSMO	-0.03	0.81
modSW	-0.07	0.87

Fig. 3: Comparison of model SST using different SW flux configurations with CMEMS L4 satellite SST product (daily midnight values).

References: Bollmeyer, C., J. D. Keller, C. Ohlwein, S. Bentzien, S. Crewell, P. Friederichs, A. Hense, J. Keune, S. Kneifel, I. Pscheidt, S. Redl, S. Steinke (2015): Towards a high-resolution regional reanalysis for the European CORDEX domain, Q. J. Royal Met. Soc., 141 (686), 1-15
COSMO_REA6 source: Hans-Ertel-Centre for Weather Research (http://reanalysis.meteo.uni-bonn.de)

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COMPARISON WITH METEOROLOGICAL DATA

Portorož meteorological station is located in close proximity to the sea and measures downward short wave radiation in hourly intervals (http://meteo.arso.gov.si/met/sl/app/webmet/). Vida oceanographic buoy is located approx. 2 nautical miles from the town of Piran and continually measures air temperature 2m above sea surface (http://www.nib.si/mbp/en/).

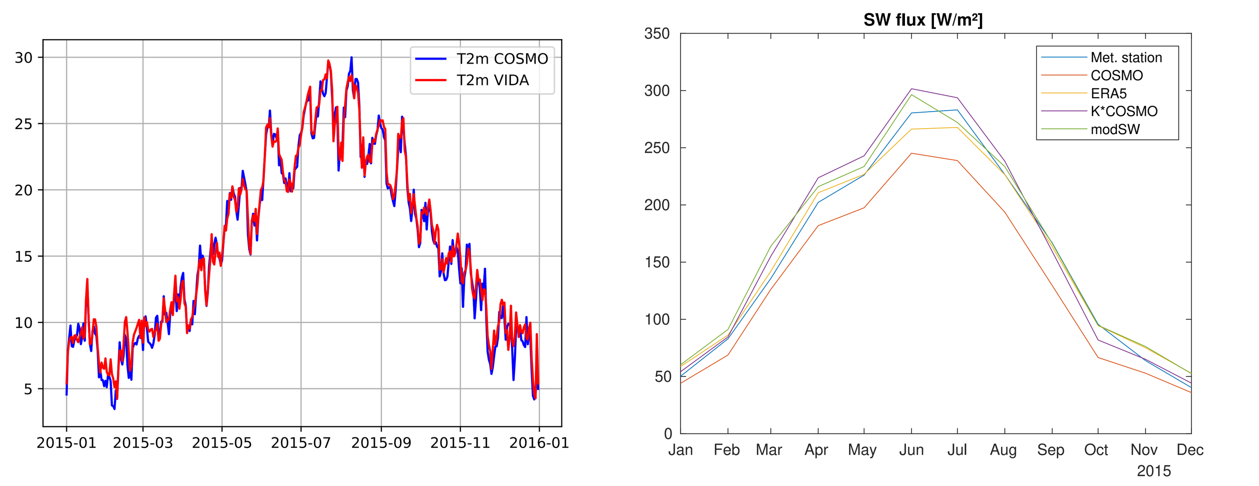

Fig. 4: Comparison of atmospheric model 2m air temperature with measurements at Vida oceanographic bouy (left). Monthly averaged SW flux at Portorož meteorological station compared to different model configurations (right).

Source	yearly average [W/m^2]	RMSD [W/m^2]
Met. station	155	
COSMO	132	82
ERA5	156	65
K*COSMO	162	83
modSW	163	87

Fig. 5: Comparison of downward SW flux used in bulk forcing files in the wet grid point closest to the meteorological station Portorož. Hourly values were used.

CONCLUSIONS

Shortwave radiation is obviously underestimated (Figure 4 - right) while other meteorological variables from COSMO_ERA6 show no bias (2m temperature shown in Figure 4; long-wave radiation and humidity not shown). Even though the comparison with meteorological single point measurements favors ERA5 SW flux in combination with COSMO_REA6 atmospheric forcing, the model SST results show a different picture. According to the test runs, COSMO SW flux multiplied by a constant factor $K = 1.23$ shows best performance over the model area.

ACKGNOWLEDGMENTS

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