# Climate Modeling over the Mediterranean Sea: Impact of Resolution and Ocean Coupling

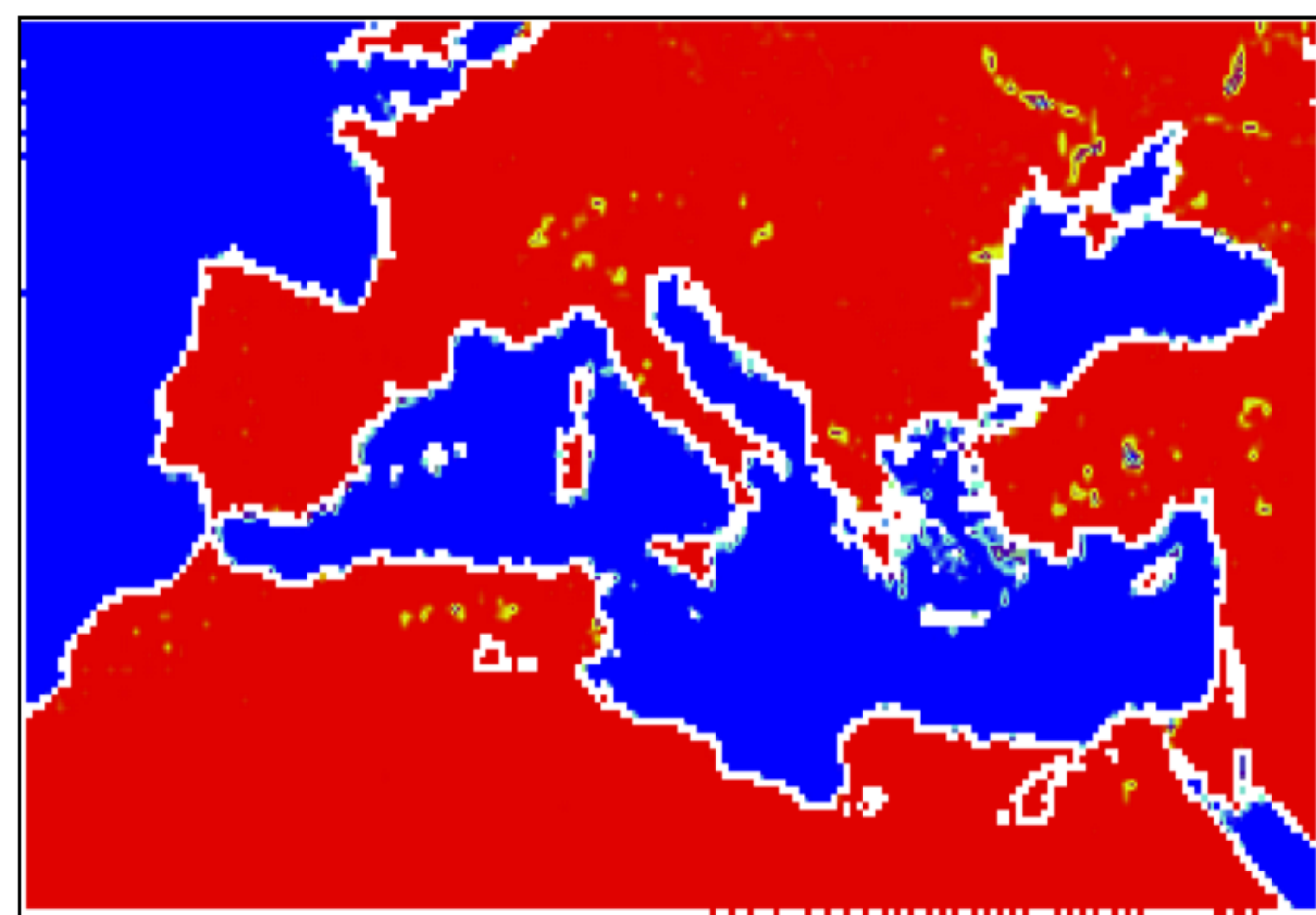**N**aveed Akhtar[1], **J**ennifer Brauch[2] and **B**odo Ahrens[1]

## MOTIVATION

The Mediterranean region is known as a Hot Spot in future climate change projections due to large decrease in mean precipitation and increase in precipitation variability during warm and dry seasons [1]. The air-sea interactions and feedbacks between the atmosphere and the Mediterranean Sea at various temporal and spatial scales play an important role in the regional climate system. The development of a regional coupled climate model is a logical step to understand the local interactions between atmosphere and ocean.

## METHODS

- The atmospheric and ocean models are coupled via **OASIS3-MECT2**
- $0.44^o$; coupled and atmosphere–only simulations are done from 1980 to 2011
- $0.08^o$; coupled and atmosphere–only simulations are done from 2000 to 2003
- Validation data; OAFlux [2] & NOAA [3]
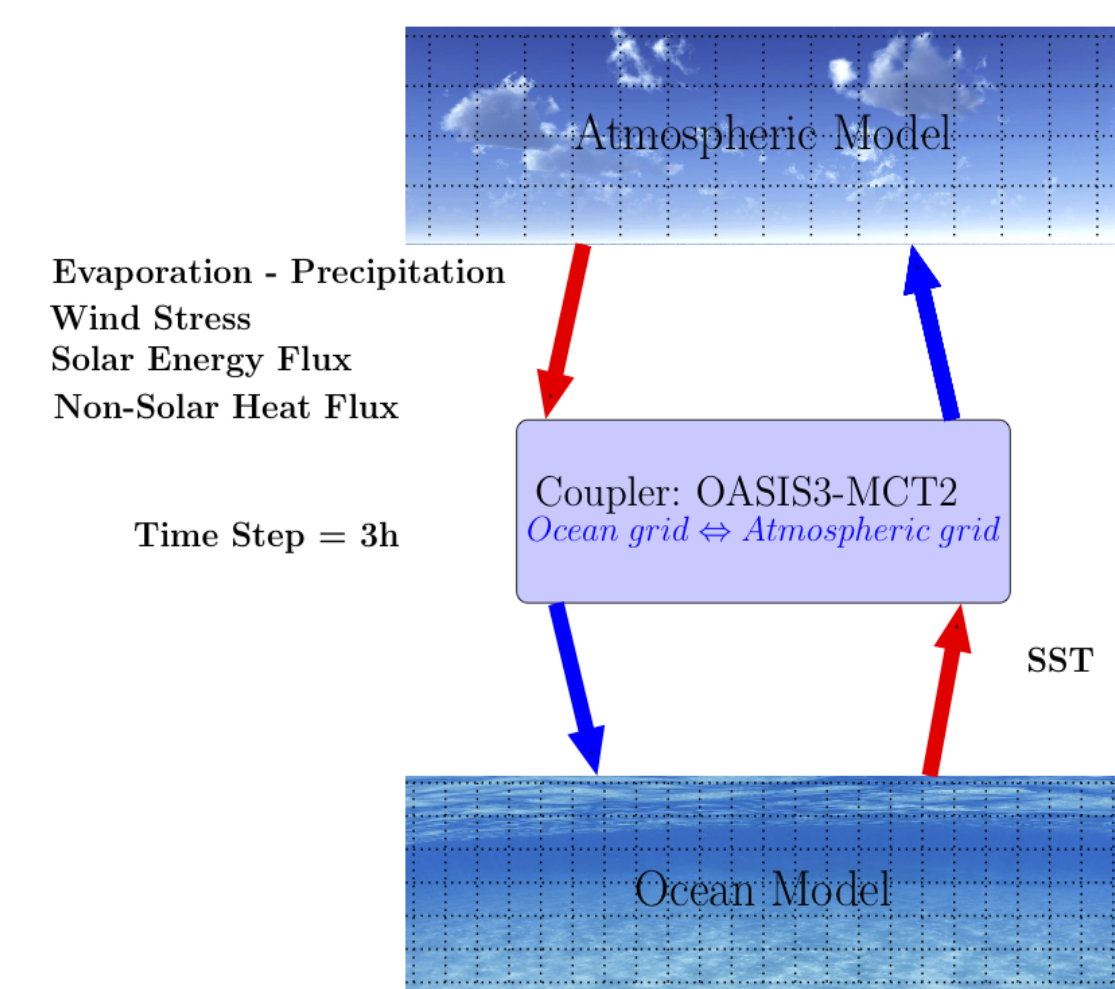


## ATMOSPHERIC MODEL

The chosen atmospheric model **COSMO-CLM** [4] is setup based on Med-Cordex domain. ERA-Interim reanalysis data is used for the lateral and lower boundary conditions in atmosphere–only and except SST in coupled simulations.

- $0.44^o$; $\sim 50\ km$; 118x83 and 32 $\sigma$–levels with time step of 150 sec
- $0.08^o$; $\sim 09\ km$; 536x295 and 40 $\sigma$–levels with time step of 40 sec



## OCEAN MODEL

The **NEMO-MED12**[5] is regional configuration for the Mediterranean Sea of a global ocean model **NEMO** (Nucleus for European Modelling of the Ocean) version 3.2. It includes the whole Mediterranean Sea and a part of the near Atlantic Ocean as a buffer zone.
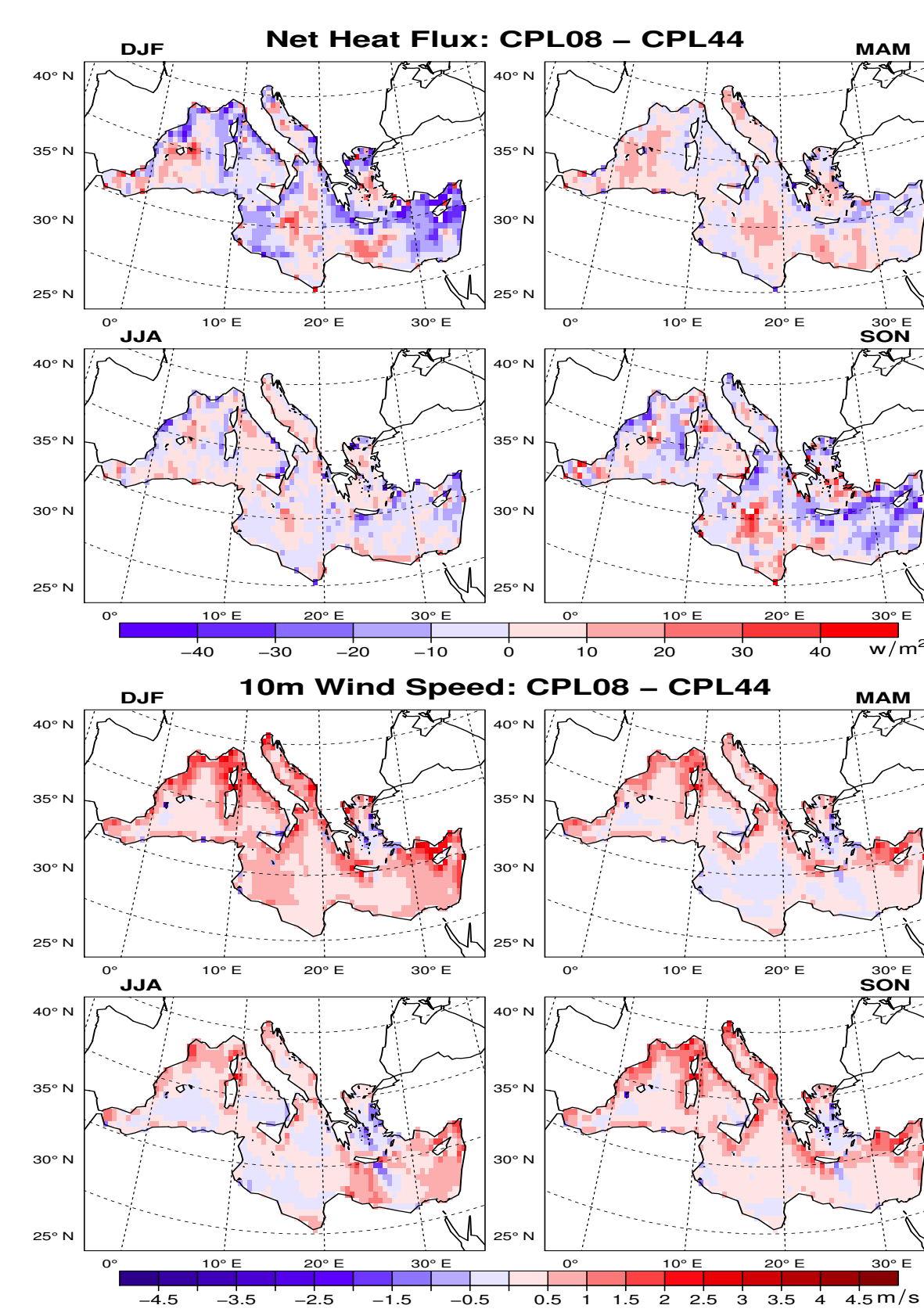
- $1/12^o$; $\sim 7.5\ km$; 567x264 and 50 z-vertical levels with time step of 720 sec
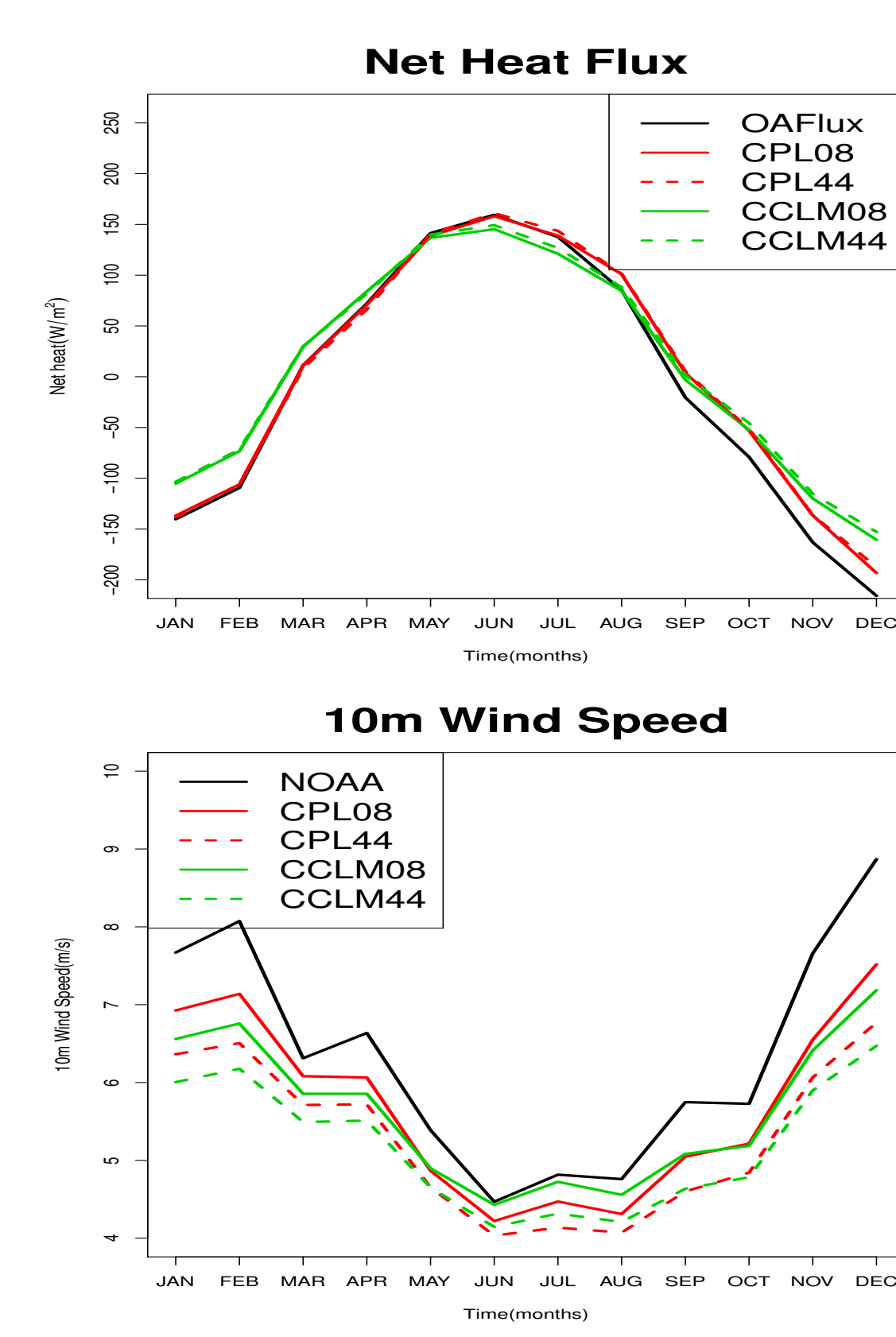- Initial condition from MEDATLAS-II climatology [6]
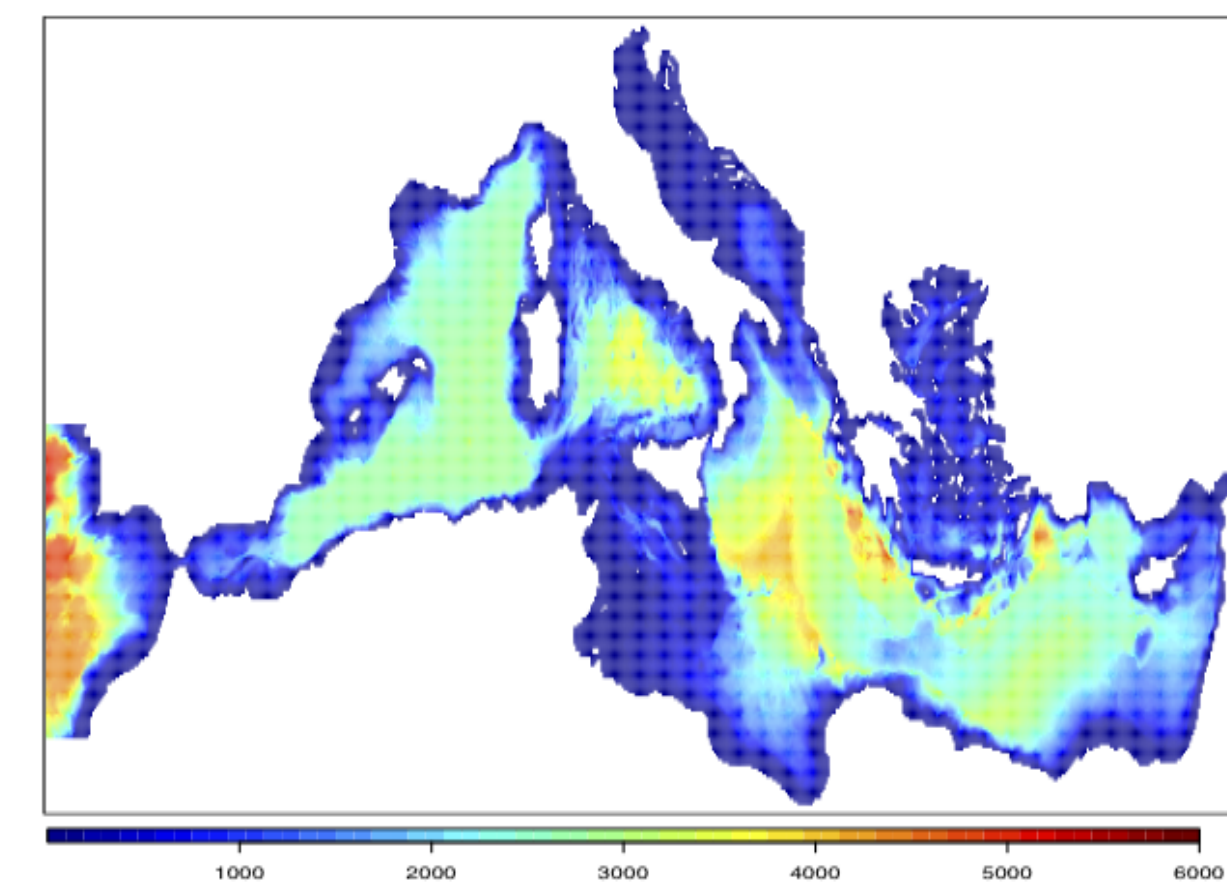


## COUPLING
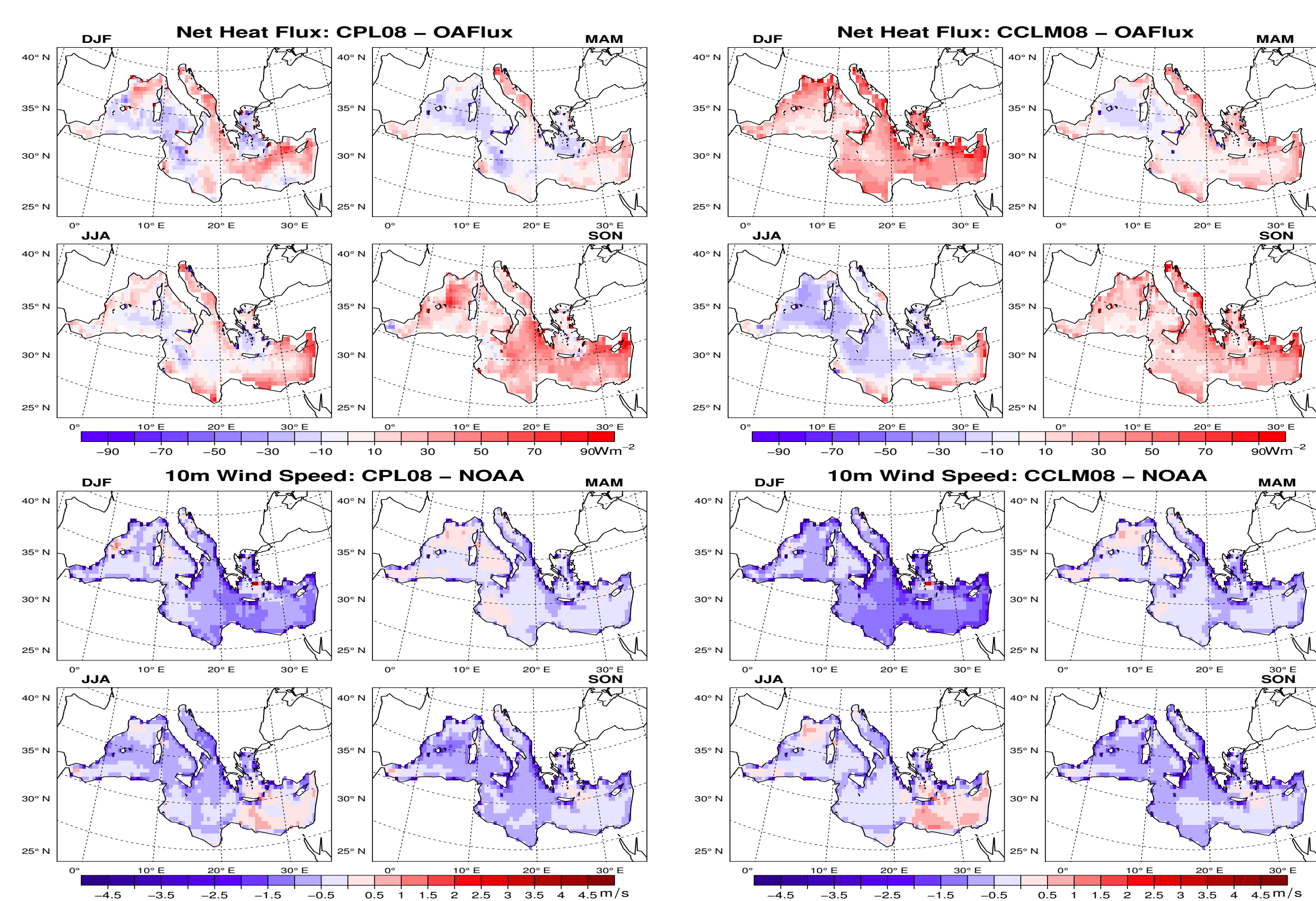


## RESOLUTION



## ANNUAL CYCLE



## REFERENCES

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[3] Zhang, H. M., Bates, J. J., and Reynolds, R. W.: Assessment of composite global sampling: sea surface wind speed, Geophys Res. Lett., 33, L17, 2006.

[4] Rockel, B., Will, A and A. Hense: Rockel B, Will A, Hense A (2008) The regional climate model COSMO-CLM (CCLM). Meteorol Z, 17, 347–348, 2008.

[5] Lebeaupin, B. C., Béranger, K., Deltel, C., and Drobinski, P.: The Mediterranean response to different space-time resolution atmospheric forcings using perpetual mode sensitivity simulations, Ocean Model., 36, 1–25, 2011.

[6] Rixen, M: MEDAR/MEDATLAS-II, HyMeX.MEDAR/MEDATLAS-II.20120112, 2012.

## CONCLUSION

- Air-sea fluxes are more realistic in the coupled simulations compared to the atmosphere-only simulations with both coarse ($0.44^o$) and fine ($0.08^o$) atmospheric grid resolutions

- Compared to the ocean coupling, atmospheric grid resolution has less impact on the air-sea fluxes of heat

- The 10-m wind speed is better resolved in fine ($0.08^o$) atmospheric grid simulations than the coarse ($0.44^o$) atmospheric grid simulations

- Ocean coupling has less impact on the 10-m wind speed compared to the atmosphere grid resolution

- Fine atmospheric grid resolution ($0.08^o$) improves the seasonal mean of air-sea fluxes of heat in the western and northern parts and reduce in the southern parts of the Mediterranean Sea

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