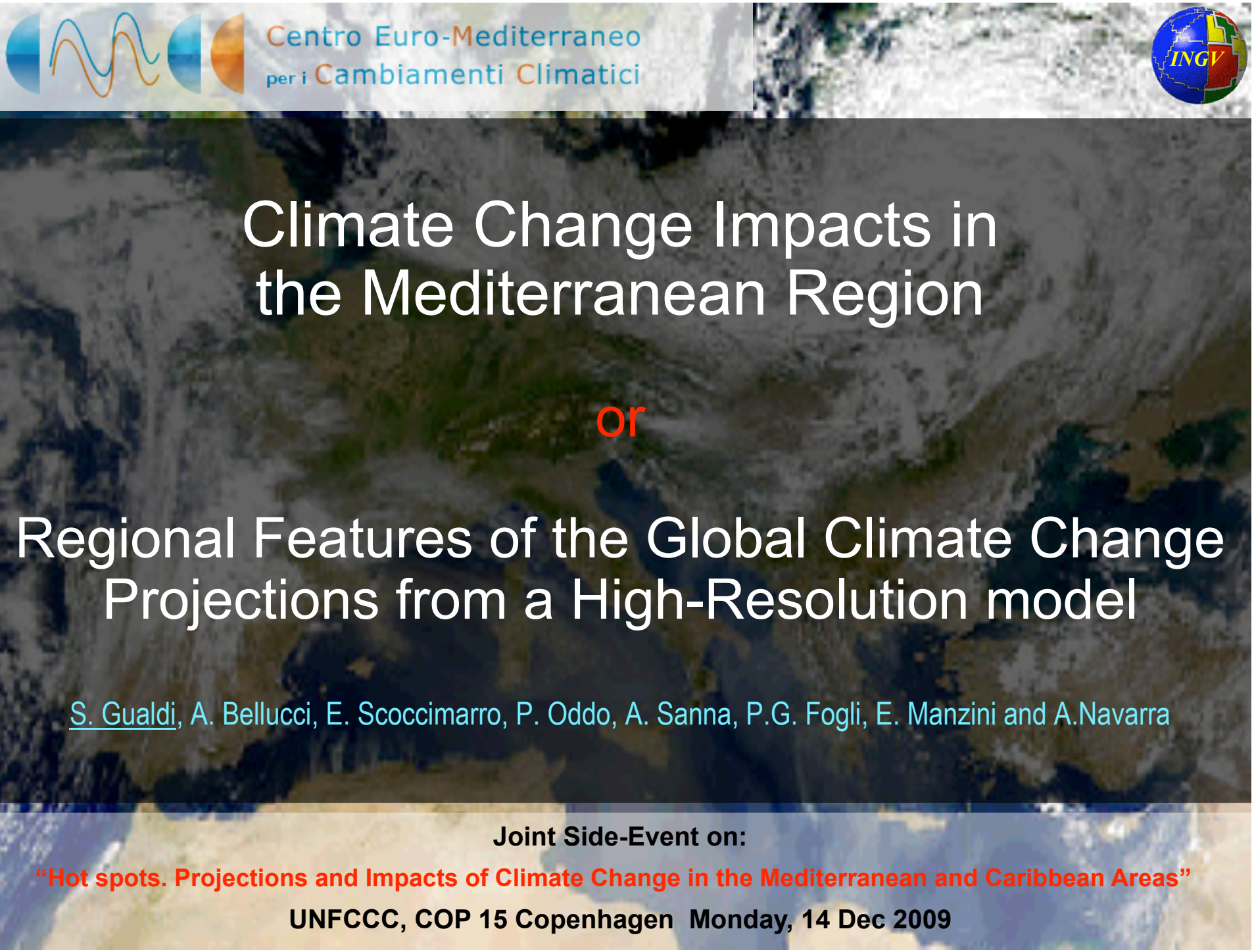


Climate Change Impacts in the Mediterranean Region

or

Regional Features of the Global Climate Change Projections from a High-Resolution model

S. Gualdi, A. Bellucci, E. Scoccimarro, P. Oddo, A. Sanna, P.G. Fogli, E. Manzini and A.Navarra

Joint Side-Event on:

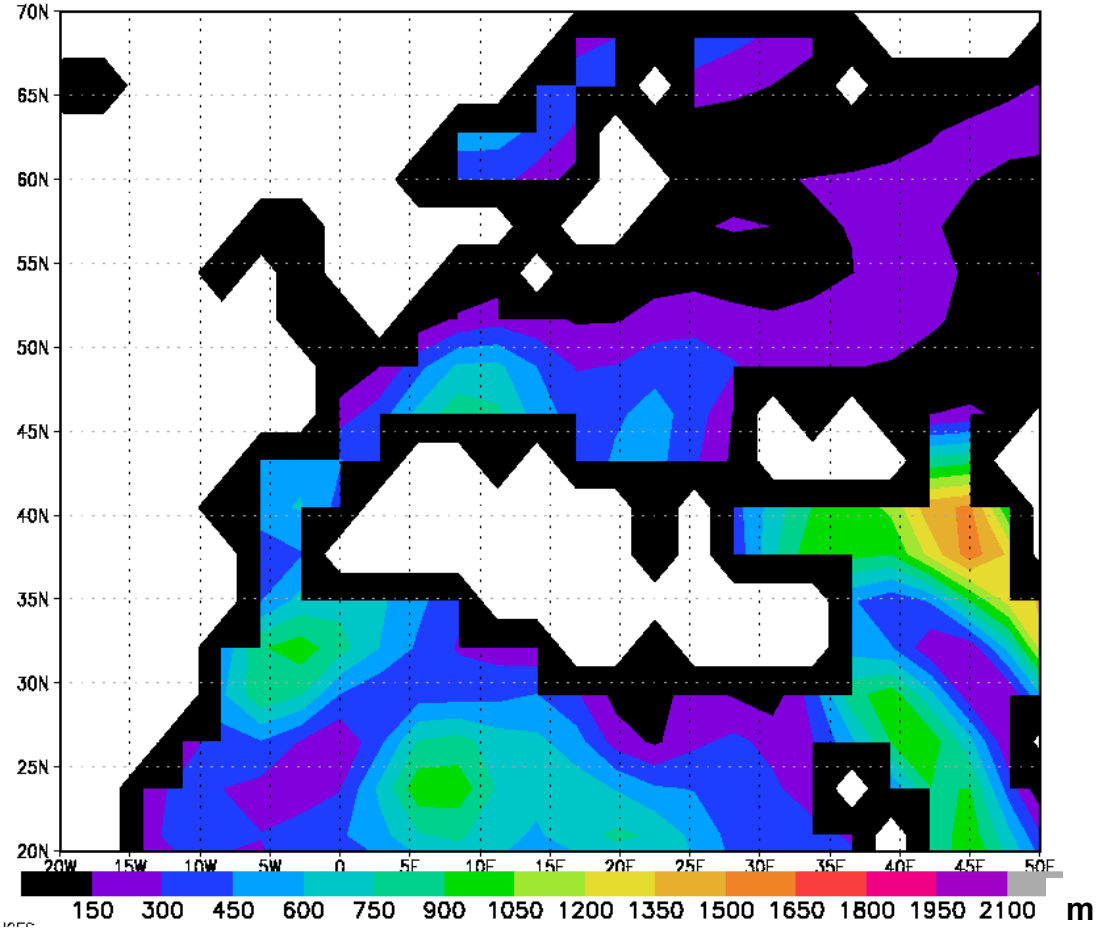
"Hot spots. Projections and Impacts of Climate Change in the Mediterranean and Caribbean Areas"

UNFCCC, COP 15 Copenhagen Monday, 14 Dec 2009

OBJECTIVE & MOTIVATION

The assessment of the regional patterns of the climate change is of primary importance to implement effective adaptation policies

Orography and Land-Sea mask as represented in a "standard" CMIP3 (IPCC-AR4) model with horizontal resolution of ~300 Km



OBJECTIVE & OUTLINE

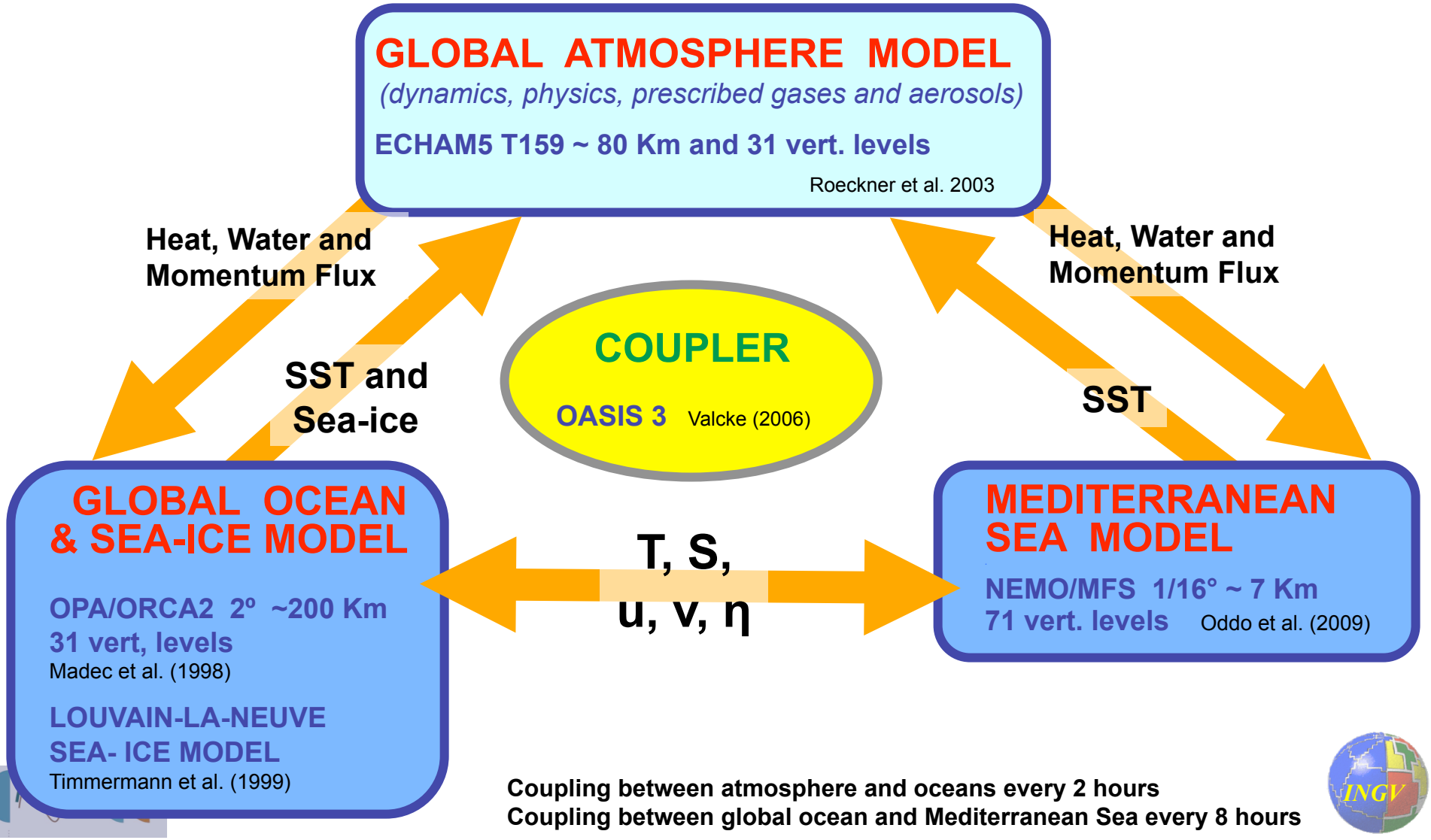
1. illustrate the regional features of future climate projections obtained with the new CMCC model: a global, fully coupled atmosphere-ocean-seaice, high-resolution model

2. special focus on the Euro-Mediterranean region, which appears to be particularly sensitive to anthropogenic climate change

3. results from a 20th Century (1951-2000) simulations are compared with the observations to validate the model

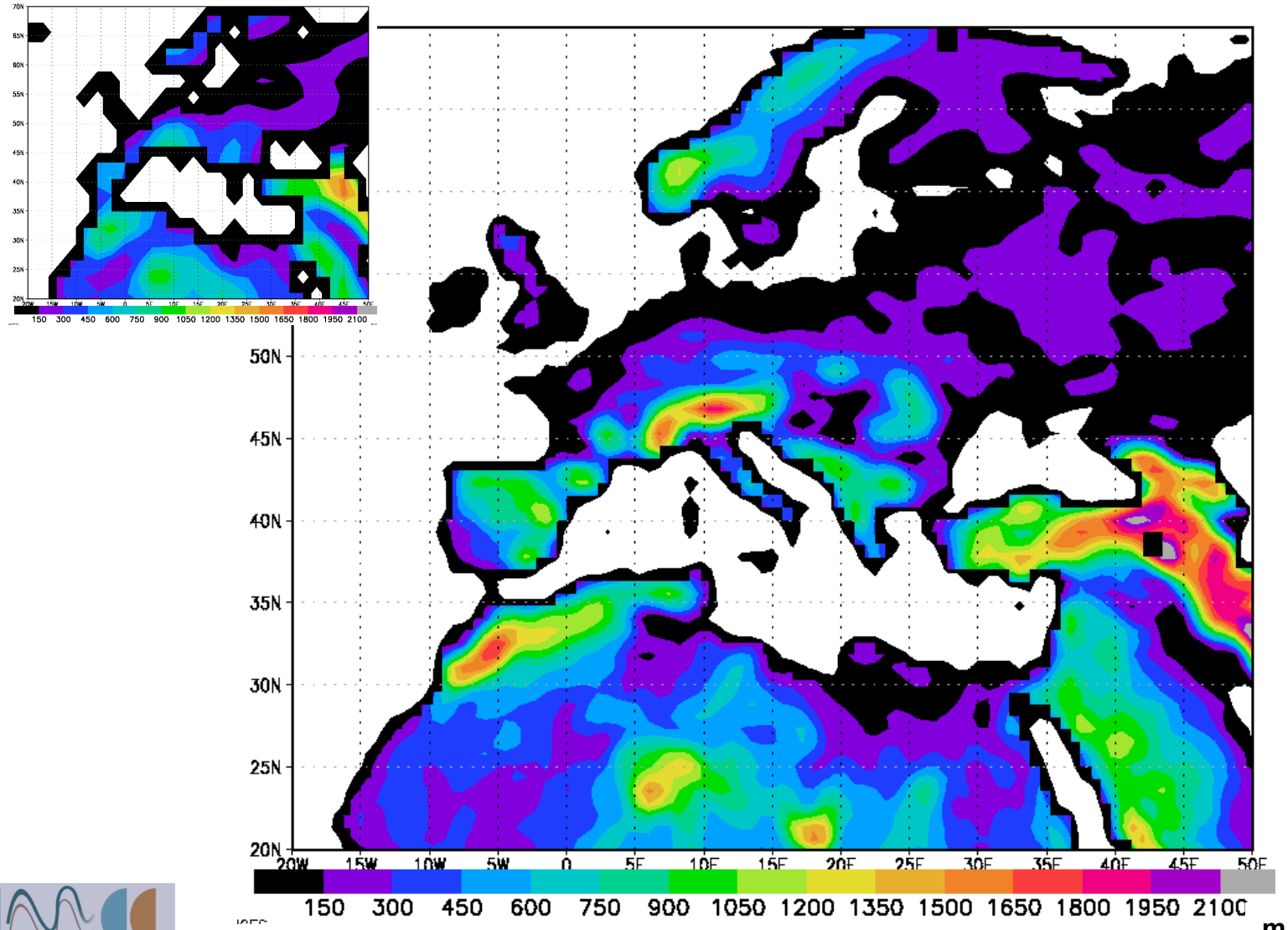
4. results from a 21st Century scenario (A1B) simulation are shown and compared with the reference simulation (20th Century) to analyse the possible change on regional scale

The CMCC-MED model: a global climate model with a fully resolved interactive Mediterranean Sea



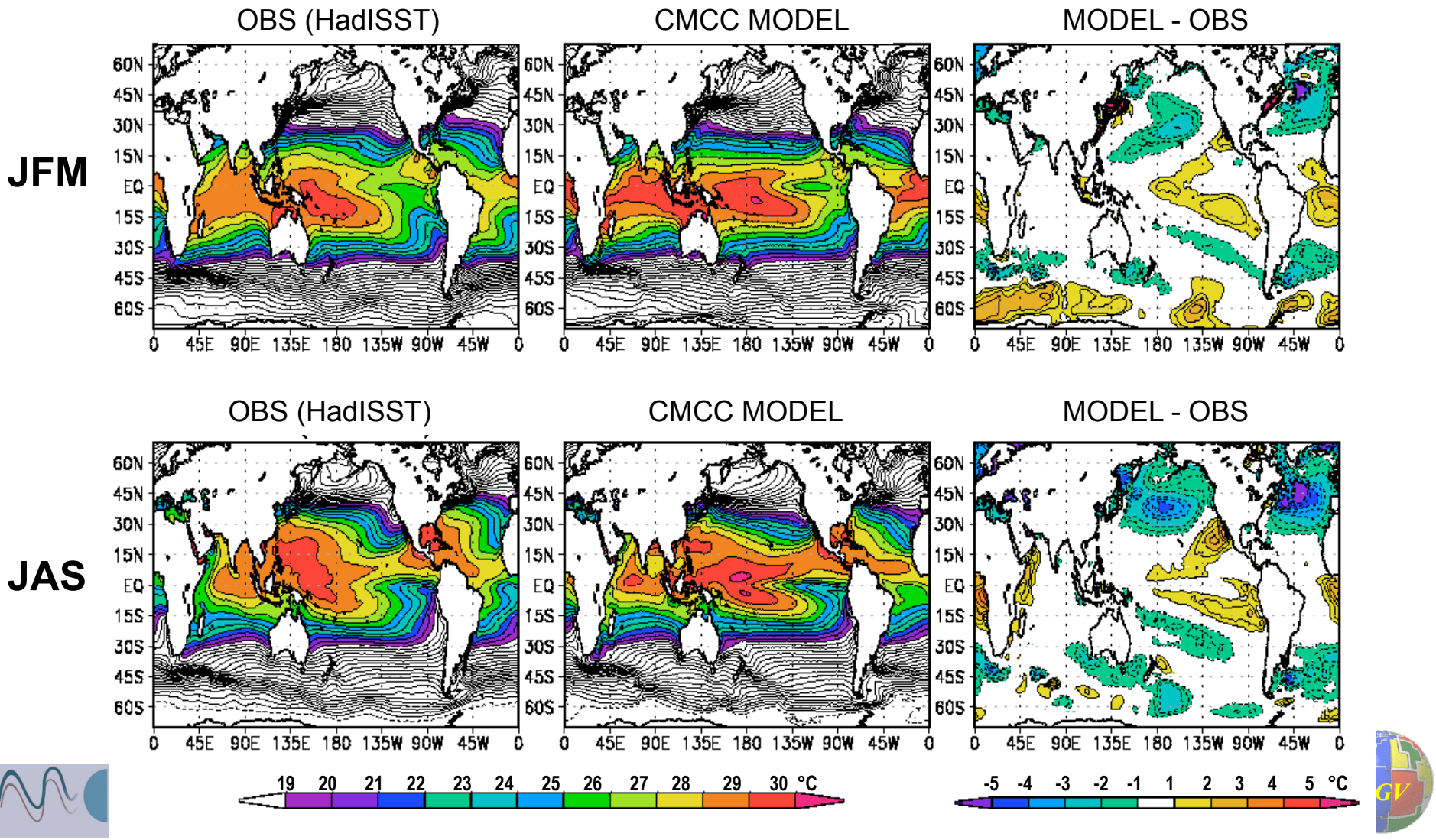
Coupling between atmosphere and oceans every 2 hours
Coupling between global ocean and Mediterranean Sea every 8 hours

Orography and Land-Sea mask in the new CMCC model (~80 Km)



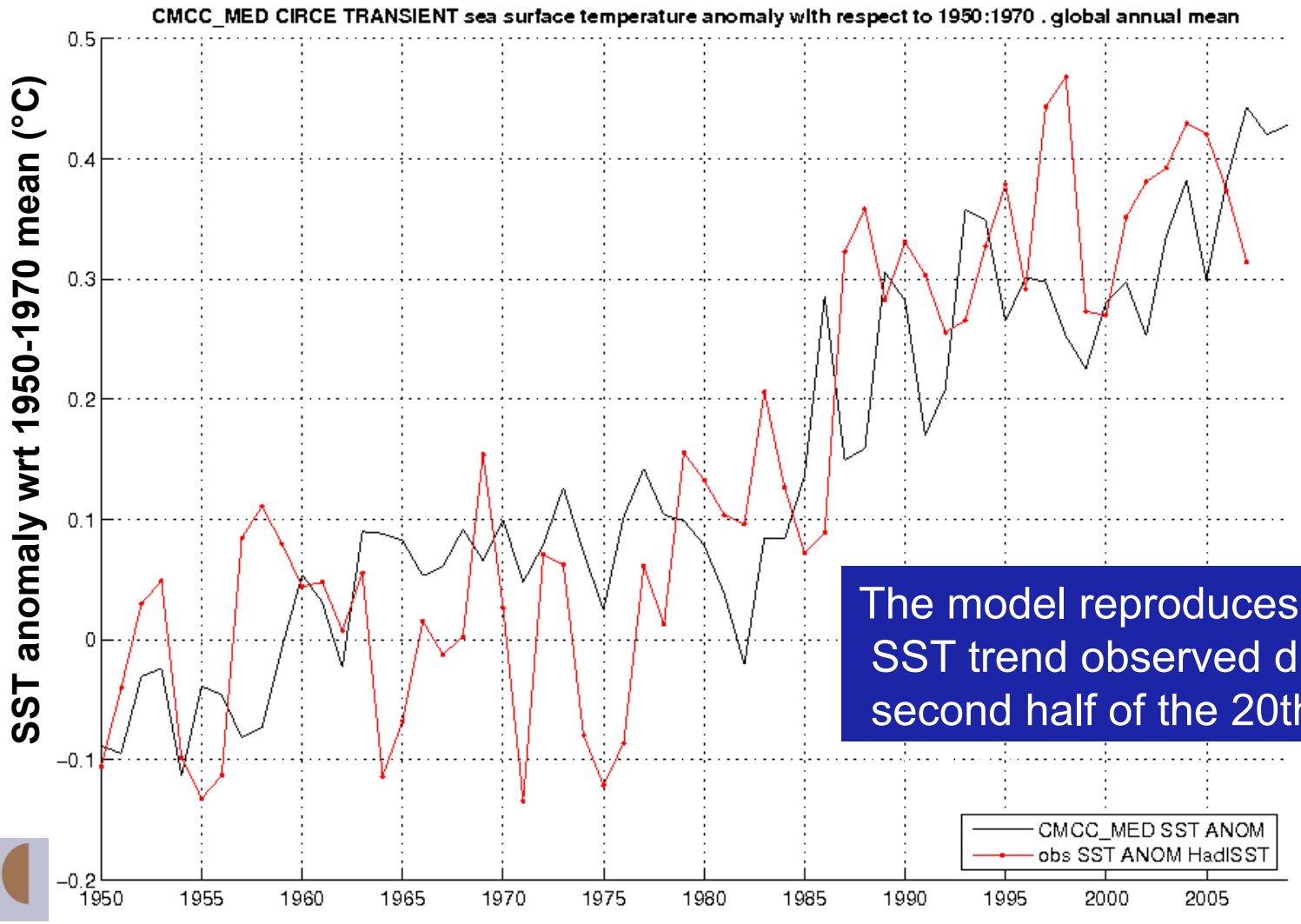
The CMCC climate simulations: **reproduction of the observed climate**

Sea-Surface Temperature (SST) 1951-2000 mean



The CMCC climate simulations: reproduction of the observed climate

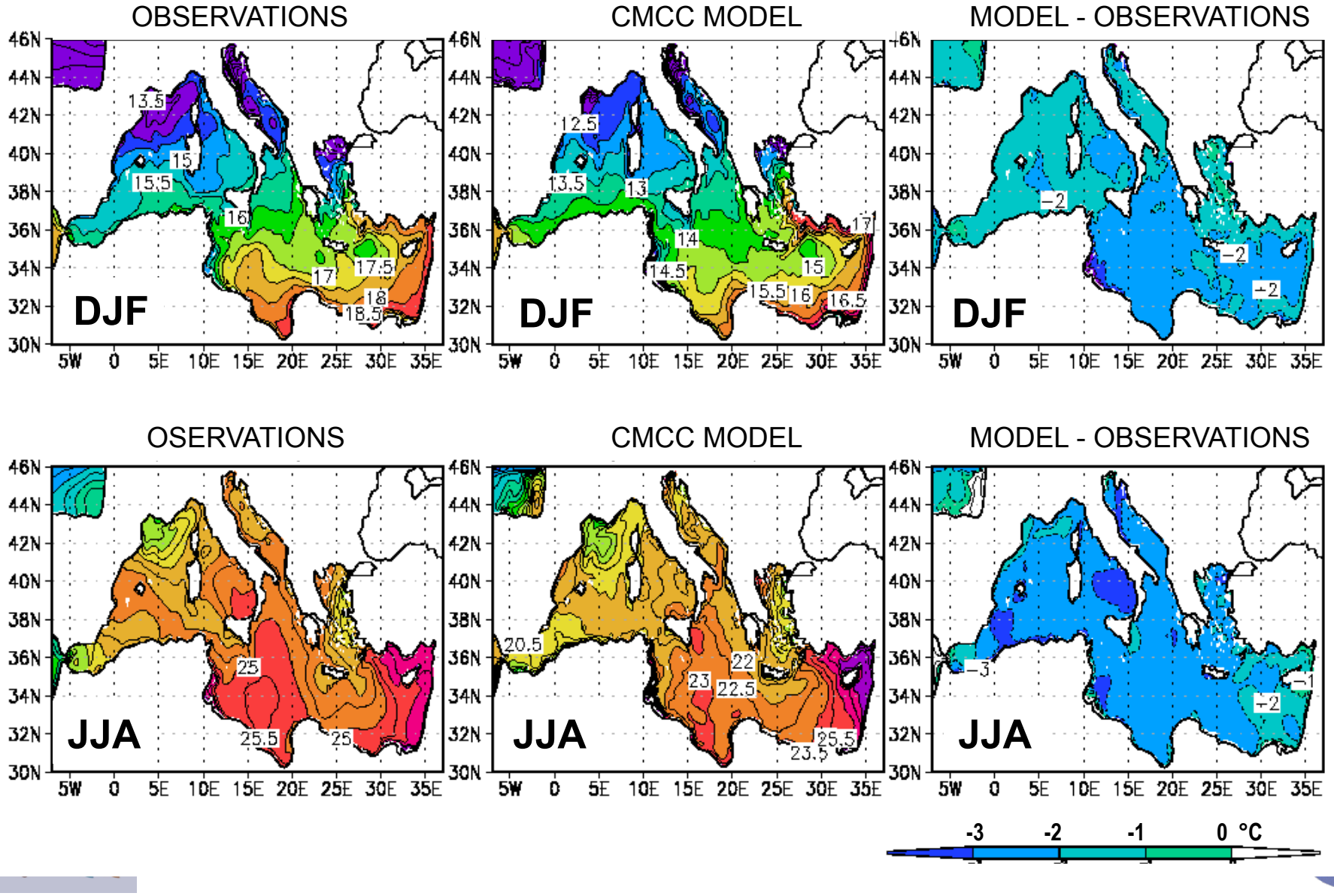
Evolution of the global mean SST from 1951 to 2000: observation vs. model



The model reproduces well the SST trend observed during the second half of the 20th

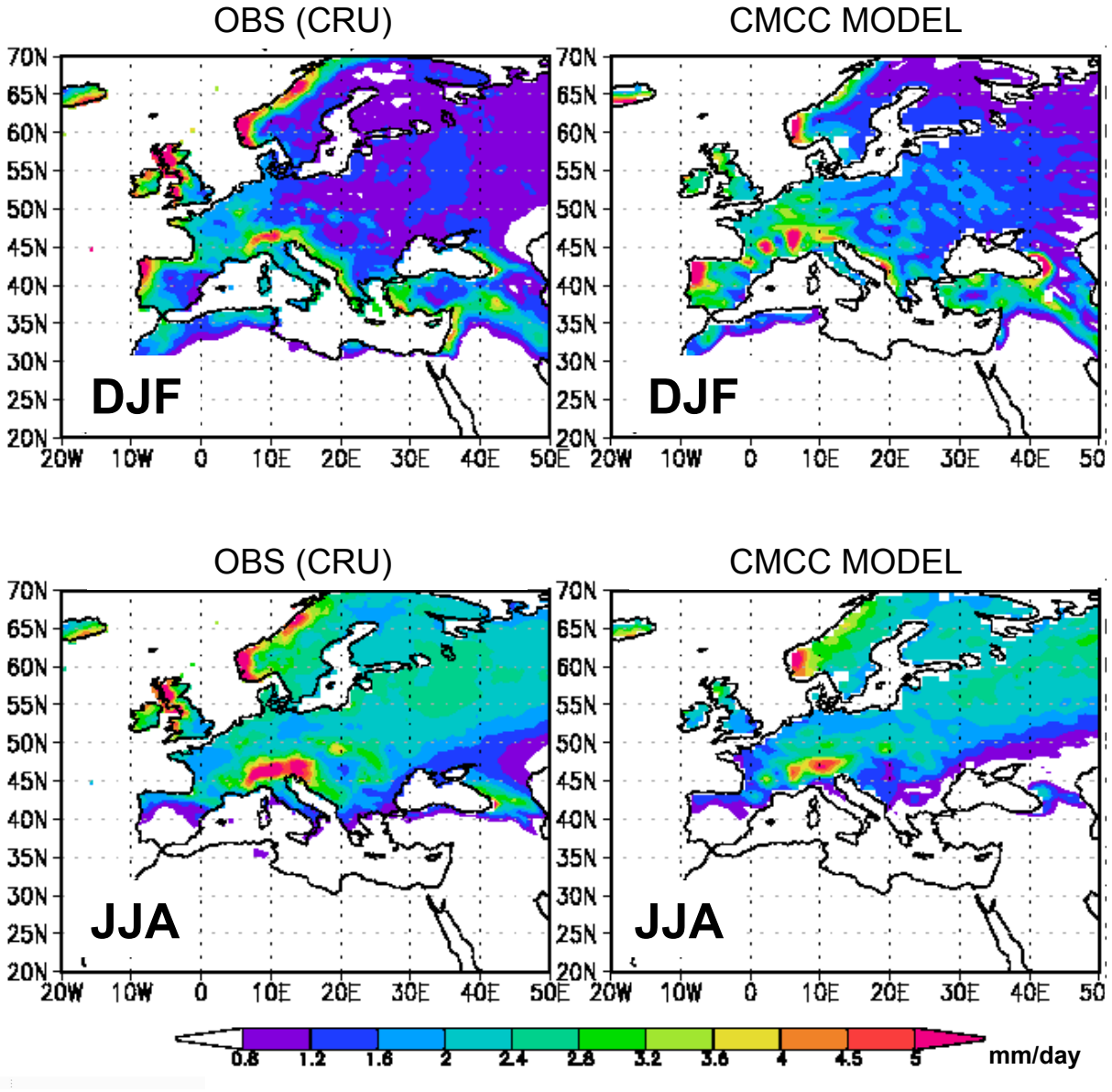
The CMCC climate simulations: reproduction of the observed climate

SST 1980-2000 mean



The CMCC climate simulations: **reproduction of the observed climate**

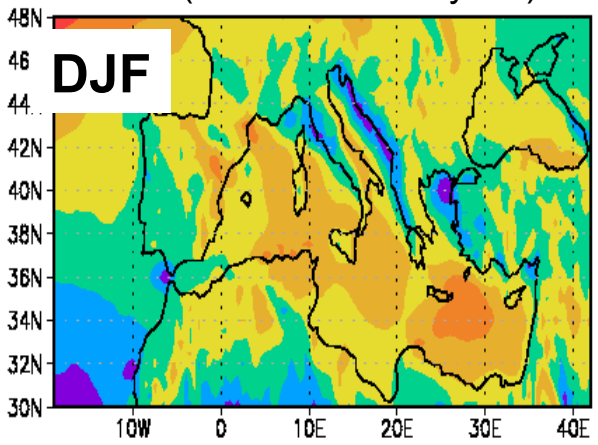
Precipitation 1951-2000 mean



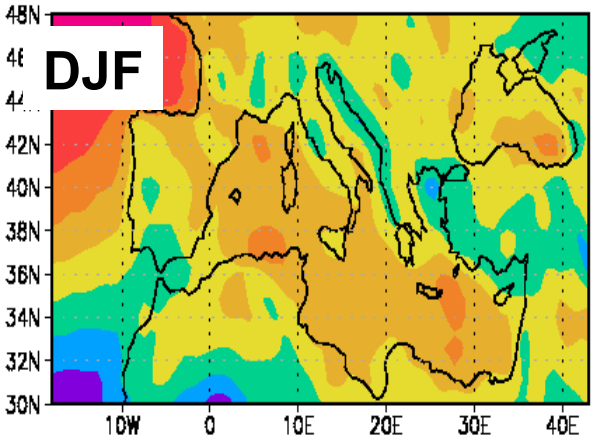
The CMCC climate simulations: **reproduction of the observed climate**

10-m wind zonal (east-west) component 1951-2000 mean

OBS (ECMWF reanalyses)

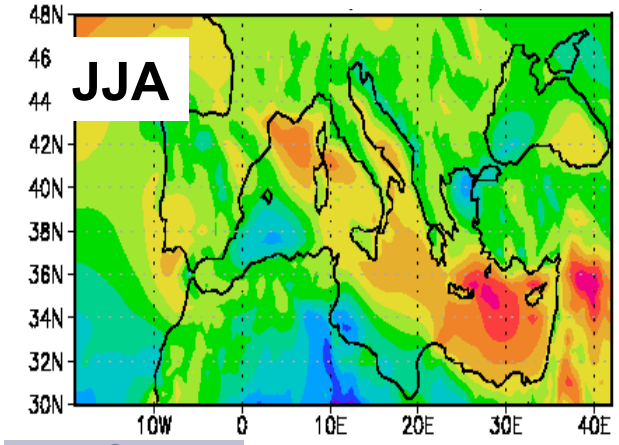


CMCC MODEL

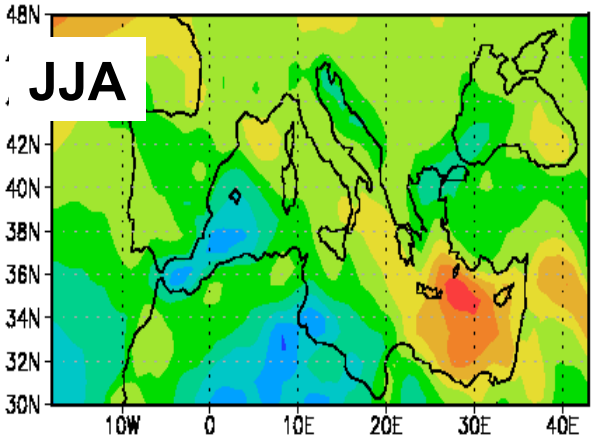


m/s

OBS (ECMWF reanalyses)



CMCC MODEL

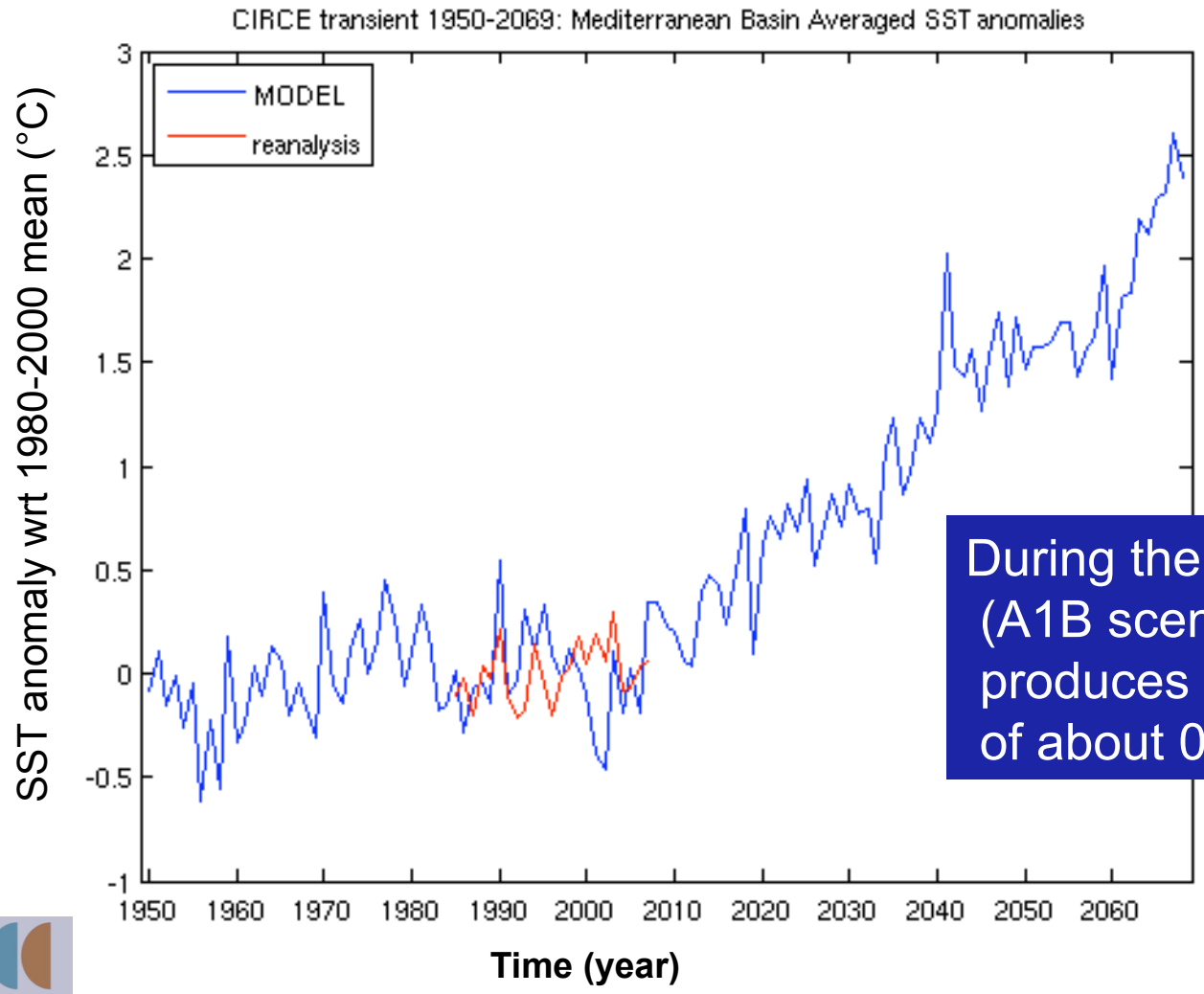


m/s

Climate change projections from an A1B scenario simulations: assessment of the climate change signal in the Euro -Mediterranean region

The CMCC climate simulations: **climate projection A1B scenario**

Evolution of the simulated Mediterranean basin mean SST from 1951 to 2070 (A1B)

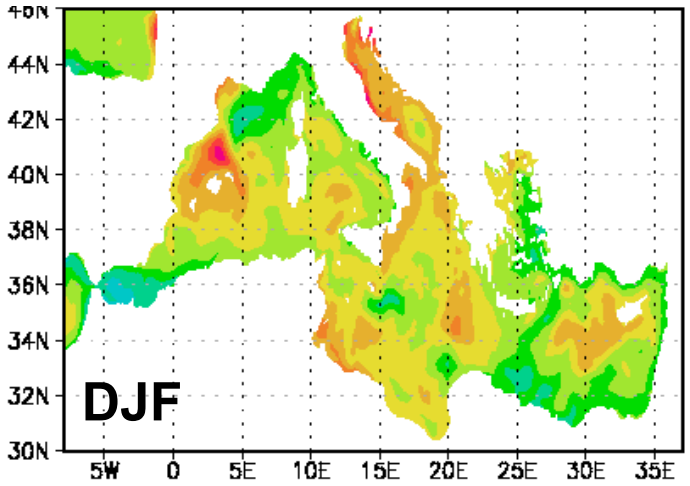


During the 2000-2070 period (A1B scenario) the model produces a warming trend of about 0.36 °C/decade

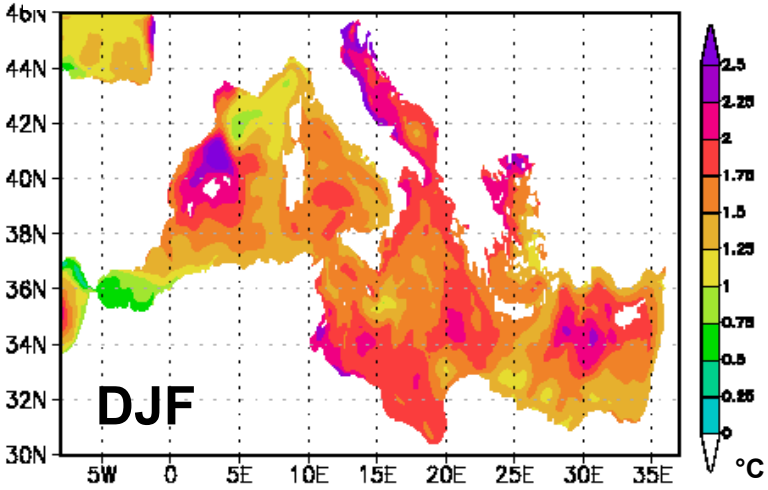
The CMCC climate simulations: **climate projection A1B scenario**

SST change in the Mediterranean Sea

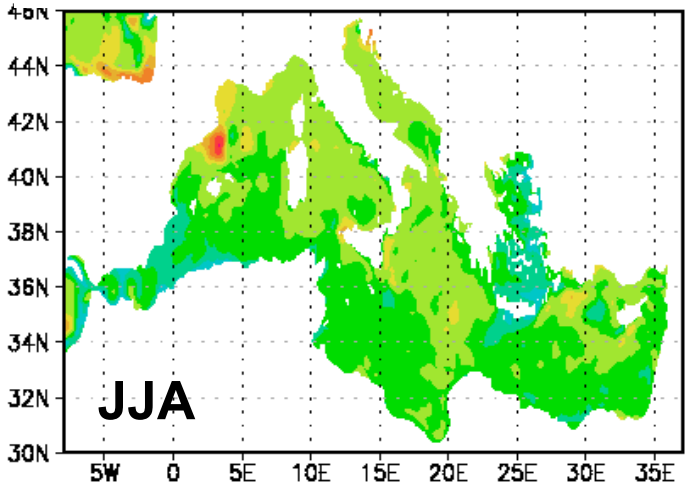
DIFF MEAN (2021-2050) - (1971-2000)



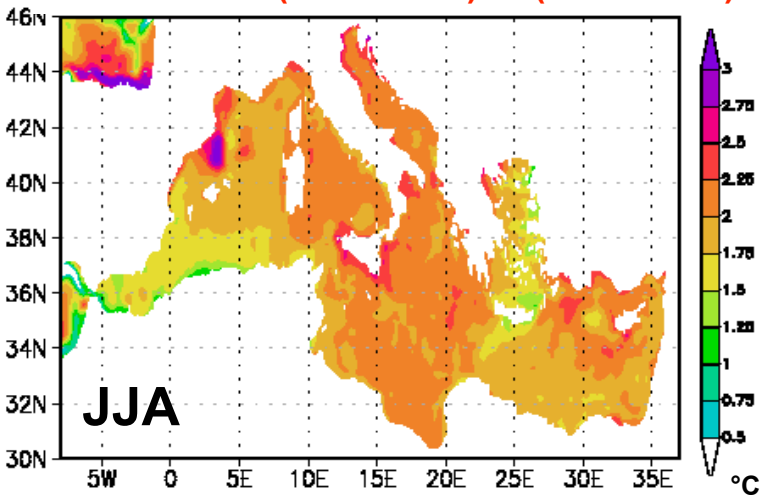
DIFF MEAN (2041-2070) - (1971-2000)



DIFF MEAN (2021-2050) - (1971-2000)

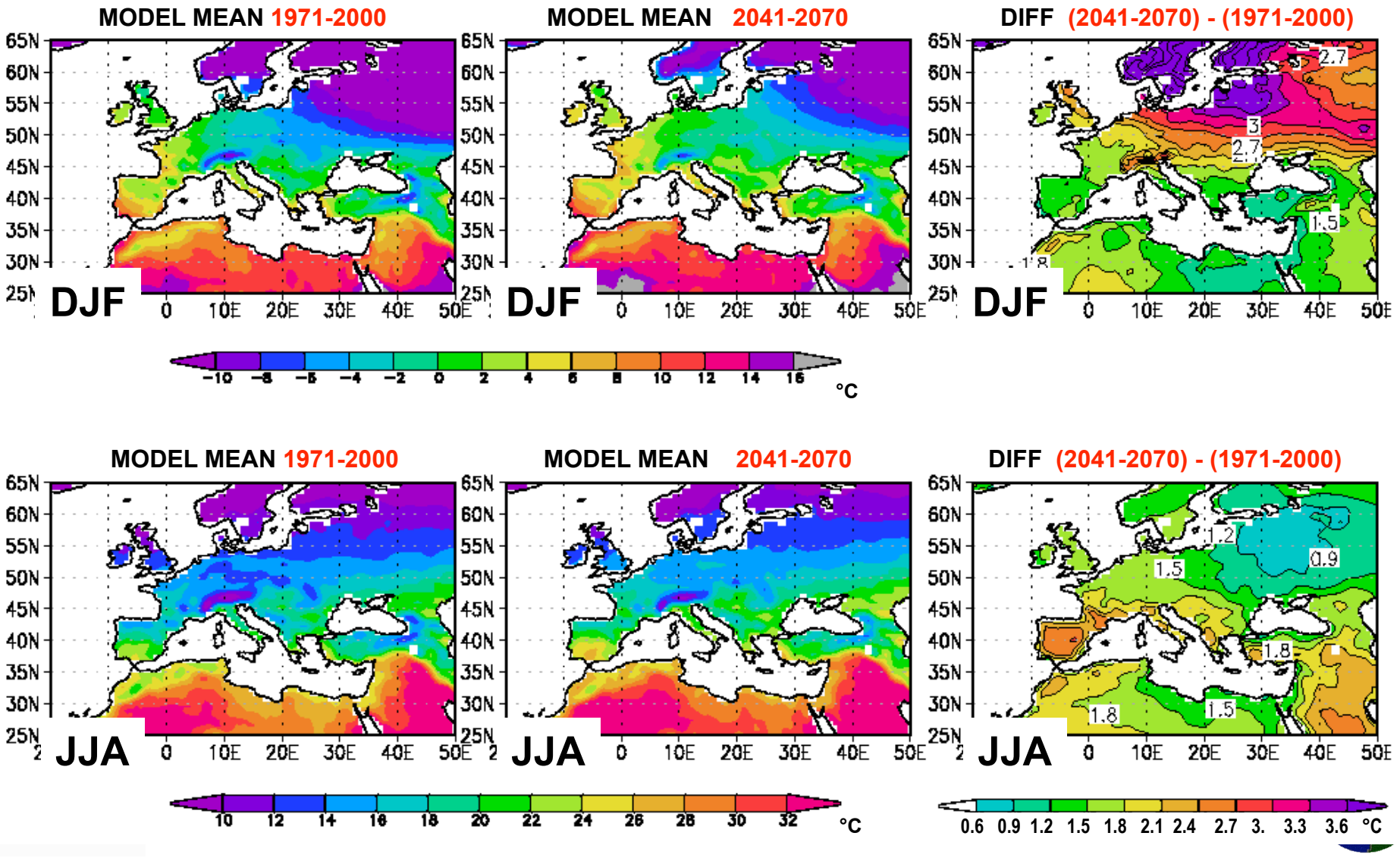


DIFF MEAN (2041-2070) - (1971-2000)



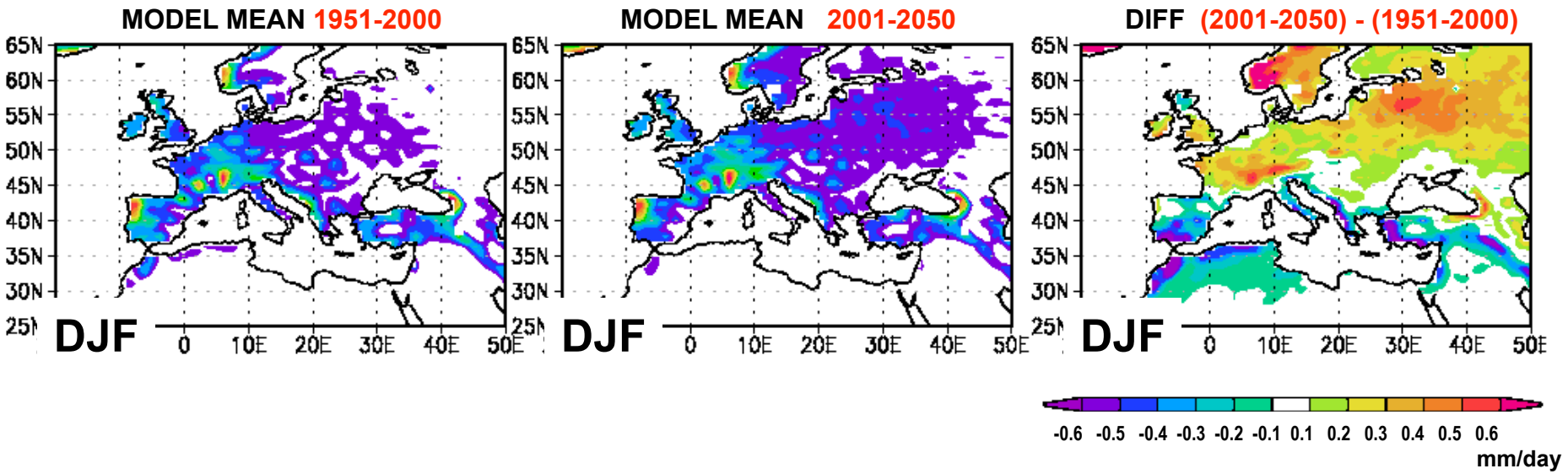
The CMCC climate simulations: **climate projection A1B scenario**

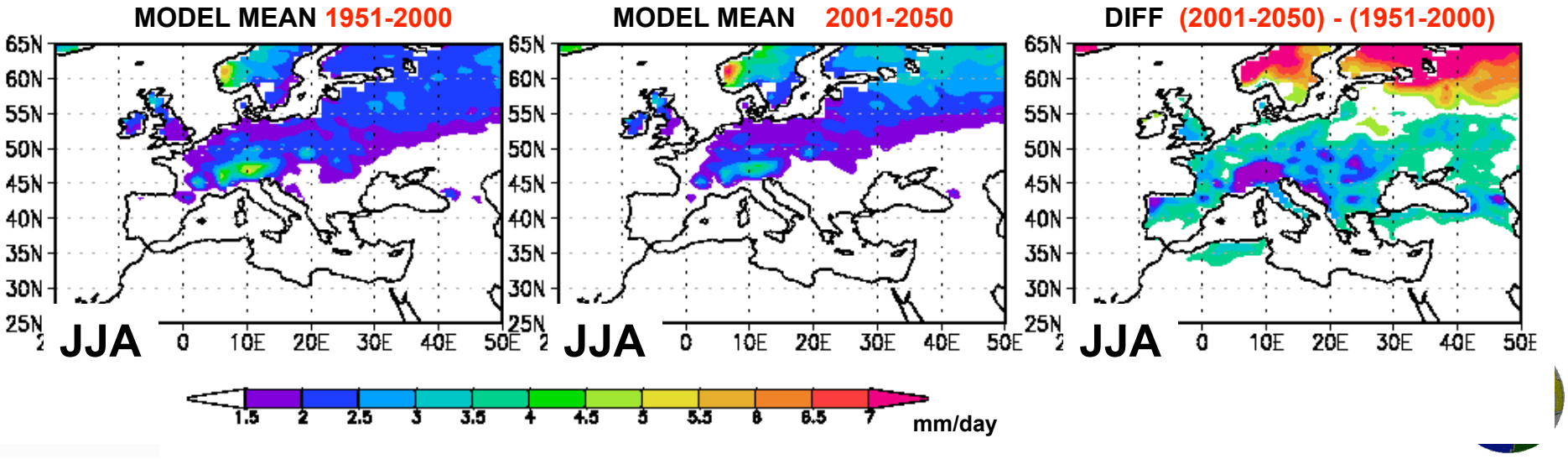
2-meter TEMPERATURE change in the Euro-Mediterranean region



The CMCC climate simulations: climate projection A1B scenario

PRECIPITATION change in the Euro-Mediterranean region



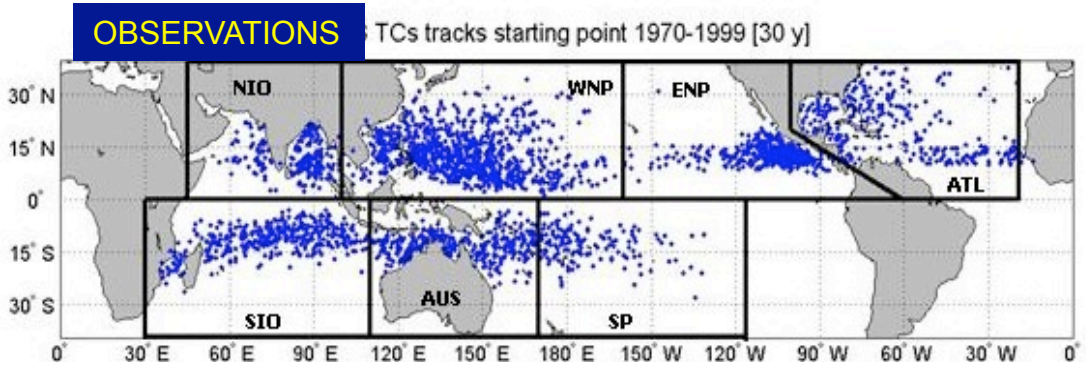


Tropical Cyclones in the CMCC climate simulations

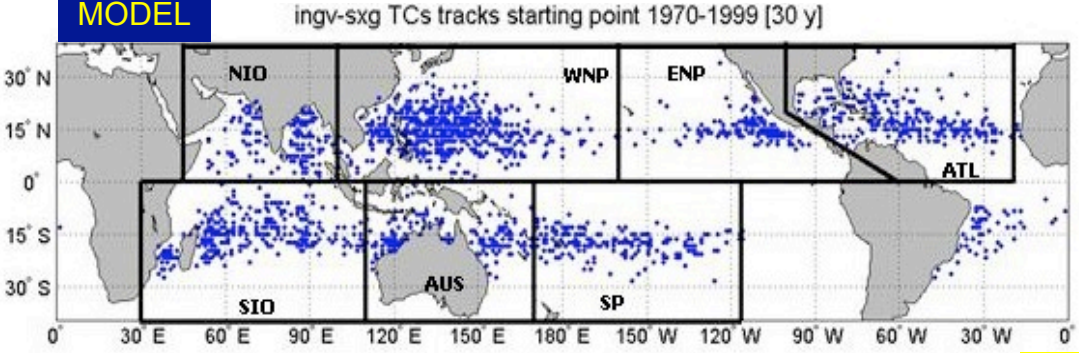
Gualdi et al. *J. Climate* 2008

Tropical Cyclone tracks starting points 1970-1999

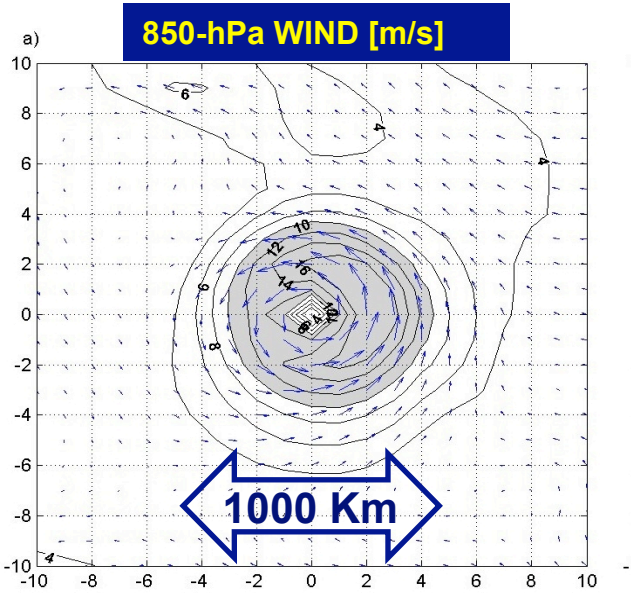
OBSERVATIONS



MODEL



Composite of a simulated TC



Mean number of TC per year in a warmer climate

The model exhibits a reduction of the mean number of TCs in a warmer (CO2) climate

	Preind	2xCO2	4xCO2
WNP	27	20	14
ATL	9	7	4

Tropical Cyclones in the new high-resolution CMCC climate model

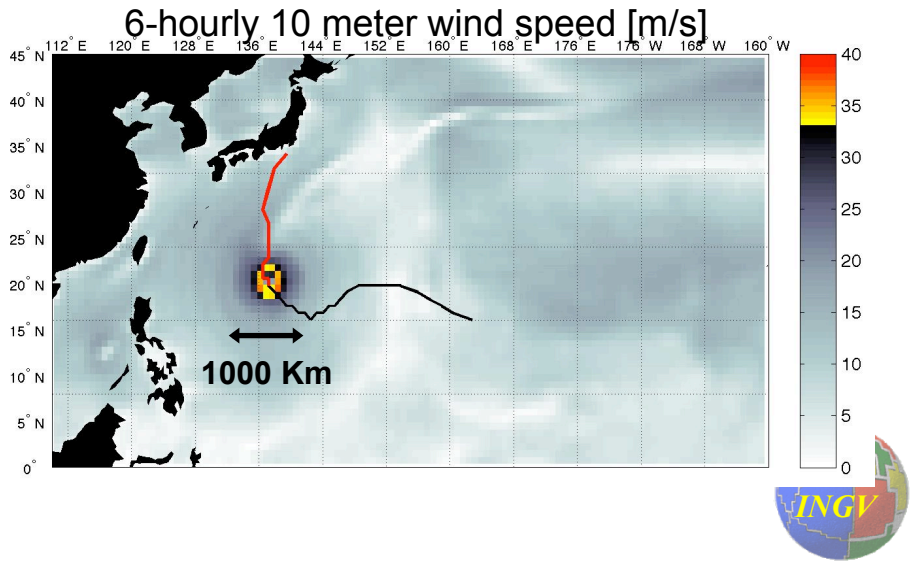
Scoccimarro et al. 2009 - in preparation

Mean number of TCs per year in present climate

	OBS	Previous (CMIP3) low-res. model	New CMCC high-res. model
TC/yr	93.8	66.2	80.2
STD	10.9	9.2	7.5

With the new model the number of simulated TCs per year is closer to the observations

Hurricane detection in the CMCC model: 10m wind speed > 33 m/s



The new high-resolution model produces TCs with realistic intensity in terms of surface wind speed

SUMMARY:

a new global high-resolution climate model has been developed at CMCC, which makes possible, for the first time, to investigate and assess the role and the feedbacks of the Mediterranean Sea in the global climate system

this model represents an innovative tool to investigate climate variability and change on regional scale with a global model

the model shows some skill in reproducing the major features of the observed Euro-Mediterranean climate. In particular it exhibits some substantial improvements wrt CMIP3 models

the model appears to simulate also relatively small-scale but intense phenomena such as Tropical Cyclones with remarkable realism and can be used to investigate the effects of global warming on their basic features

SUMMARY:

results from a scenario simulation (A1B) indicates that the Mediterranean Sea Surface Temperature might increase of about 2°C in the next decades (2041-2070)

on the land, the warming might be even larger (up to 3°C), especially in north-eastern Europe and Alpine region during winter and in southern Europe in summer

changes in mean precipitation are mostly consistent with previous scenario simulations: increase in northern Europe and decrease on the Mediterranean shores especially during summer

our simulations indicate also a large sensitivity of the Alpine region, where precipitation appears to change as much as 15-20% during both seasons


Thank you!