Climate change and sea level rise in the Mediterranean region from a high-resolution coupled AOGCM perspective

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This work is part of the activity of an international working group aimed to provide a quantitative assessment of possible SLR in Venice at the end of the 21st Century

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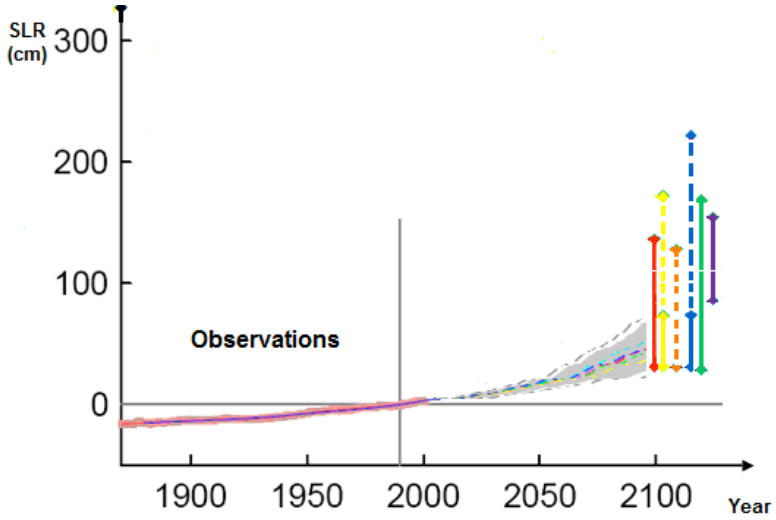
The position of the city makes it vulnerable to projected SLR

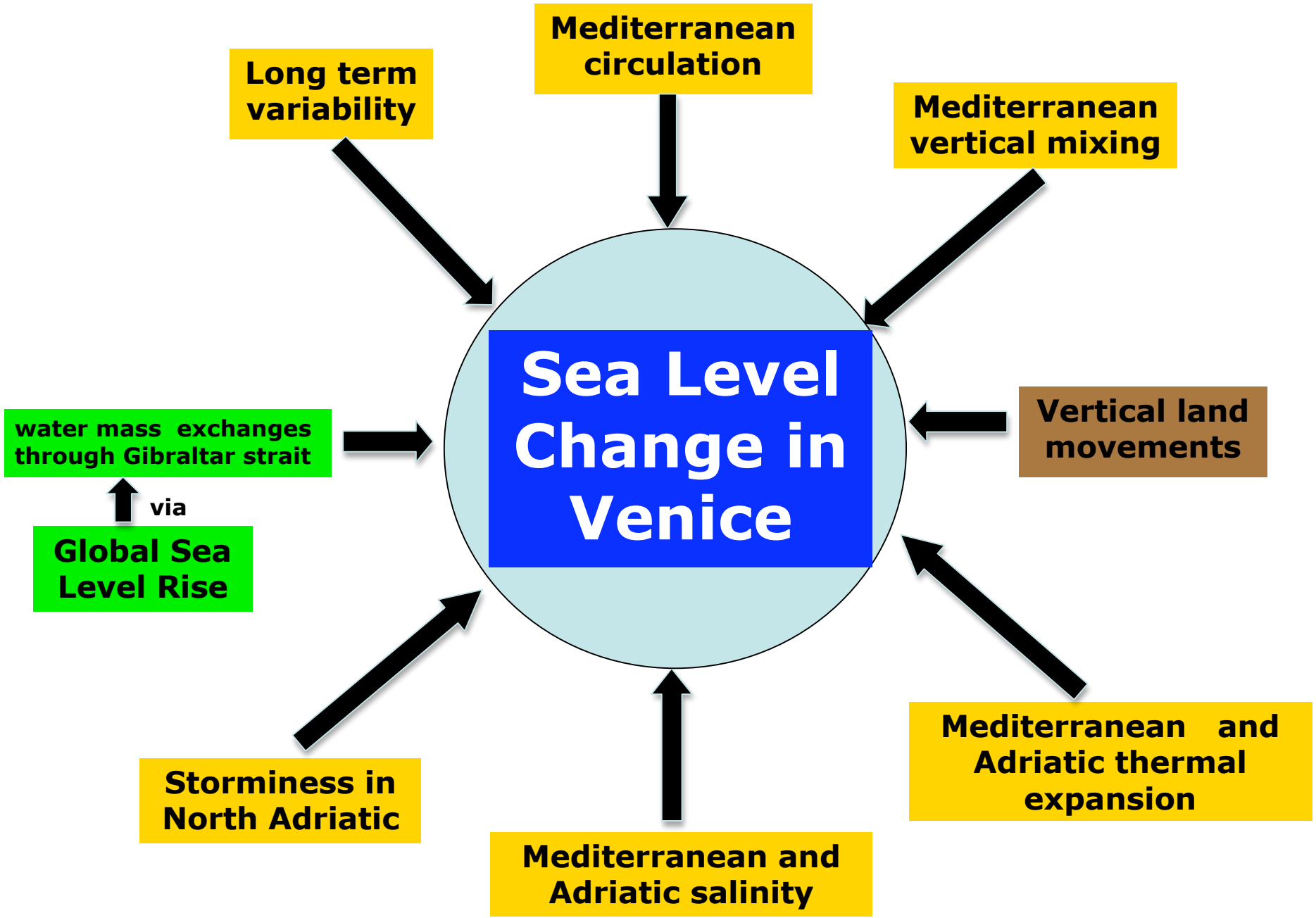
Post IPCC studies have produced new global sea-level projections



red Rahmstorf 2007 - yellow Pfeffer et al. 2008 – orange Delta Committee 2008 - blue UKCP09 – green Vermeer and Rahmstorf 2009 – purple Grinsted et al. 2010 - grey area IPCC.

Doted lines represent the upper bound of the projections

CONTRIBUTION TO SEA-LEVEL RISE IN VENICE



From global to local projections – processes involved

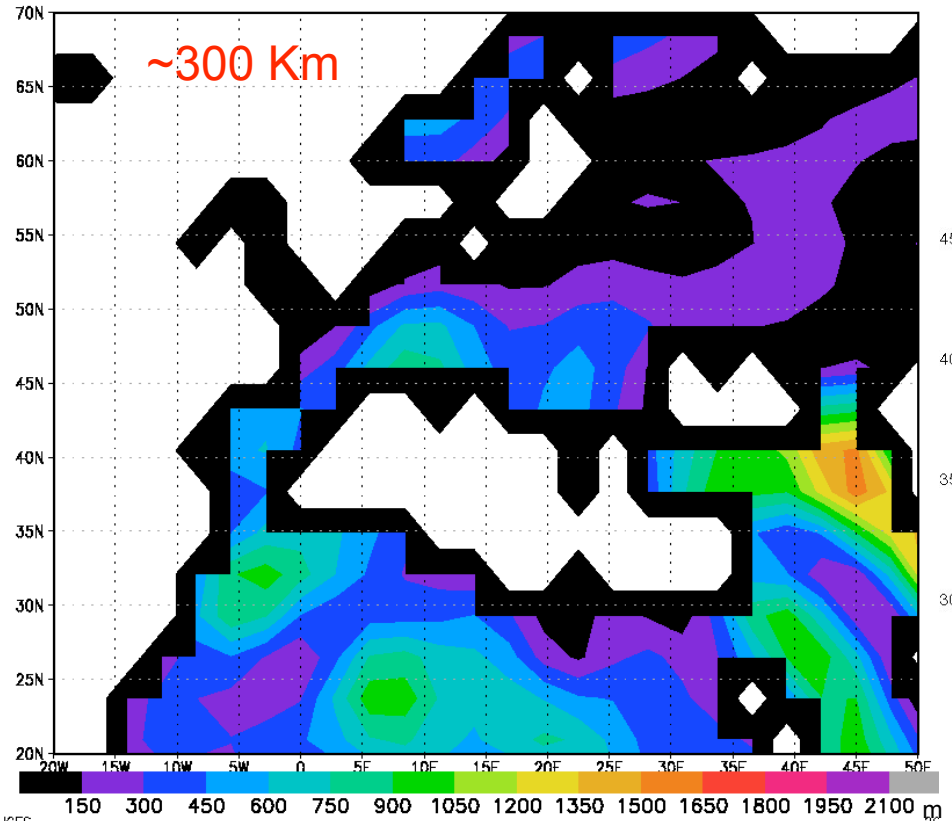
GLOBAL SLR – IPCC projections: thermal expansion, salinity, melting of glaciers and ice sheets

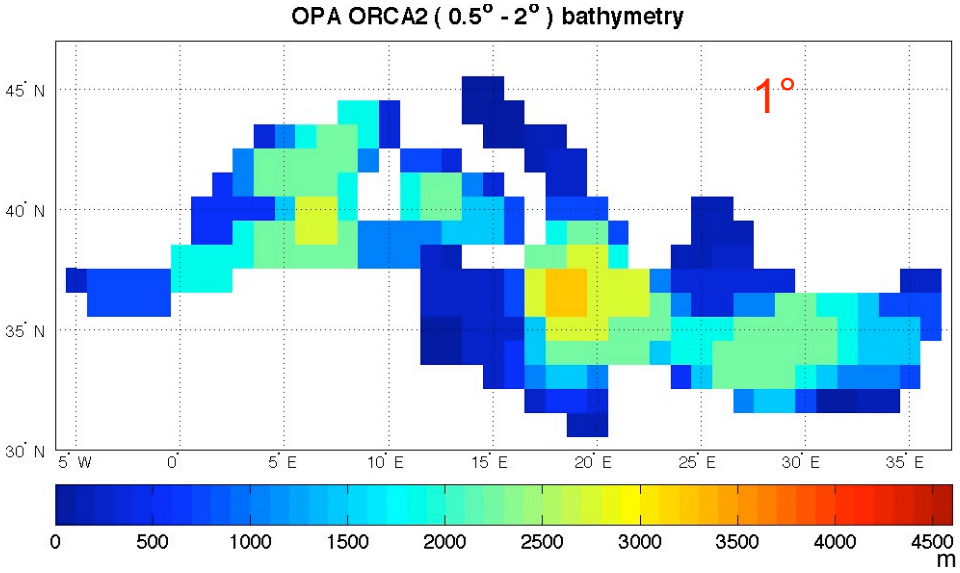
MEDITERANNEAN SLR – Global SLR, Gibraltar strait, salinity and thermal expansion, driven by evaporation, precipitation and river discharge, circulations, vertical mixing, etc.

Local SLR FOR VENICE – Mediterranean/Adriatic SLR and land movements

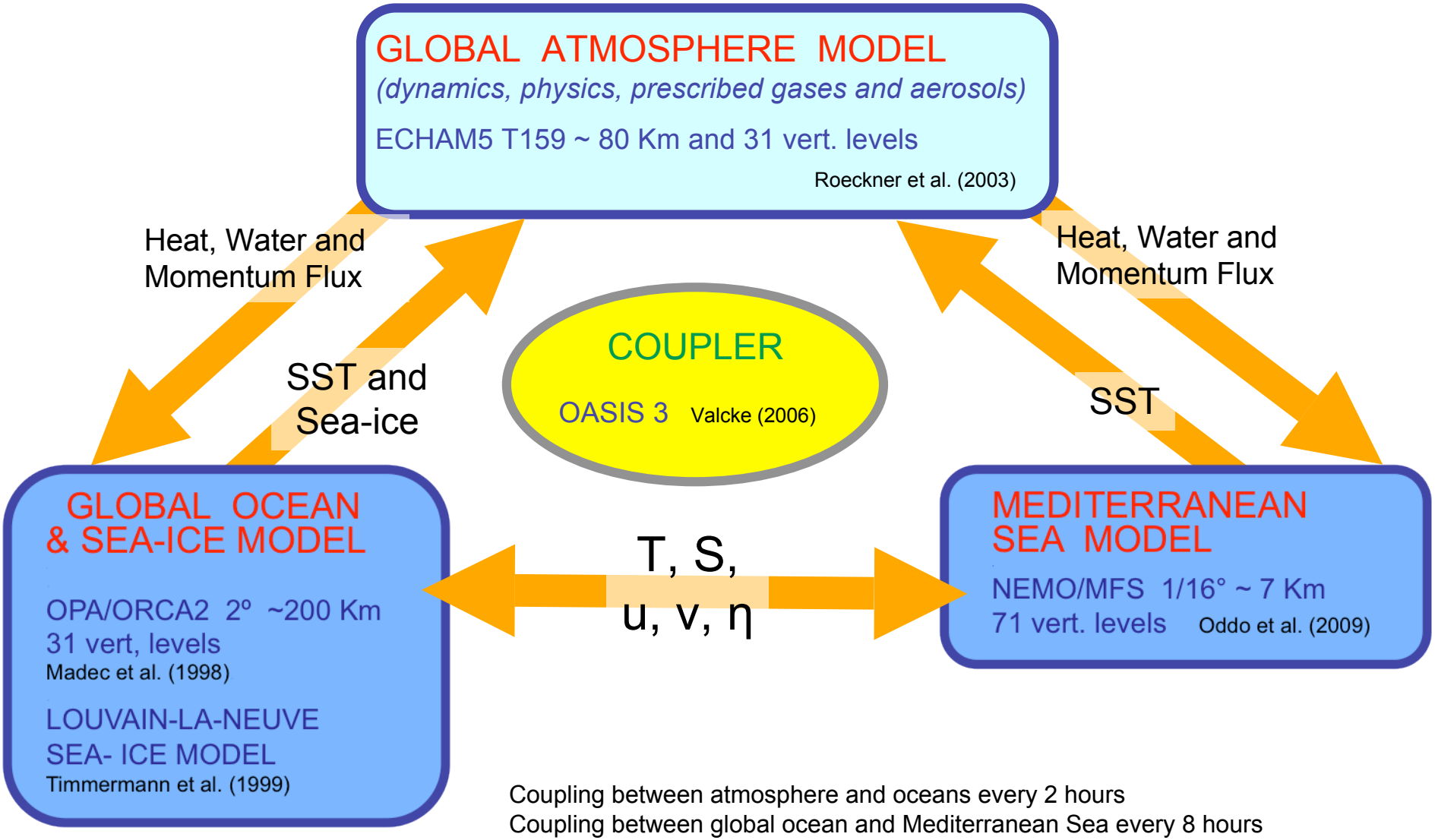
State of the art (CMIP3-AR4) coupled models are inadequate to resolve the dynamical features of the Euro-Mediterranean region

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



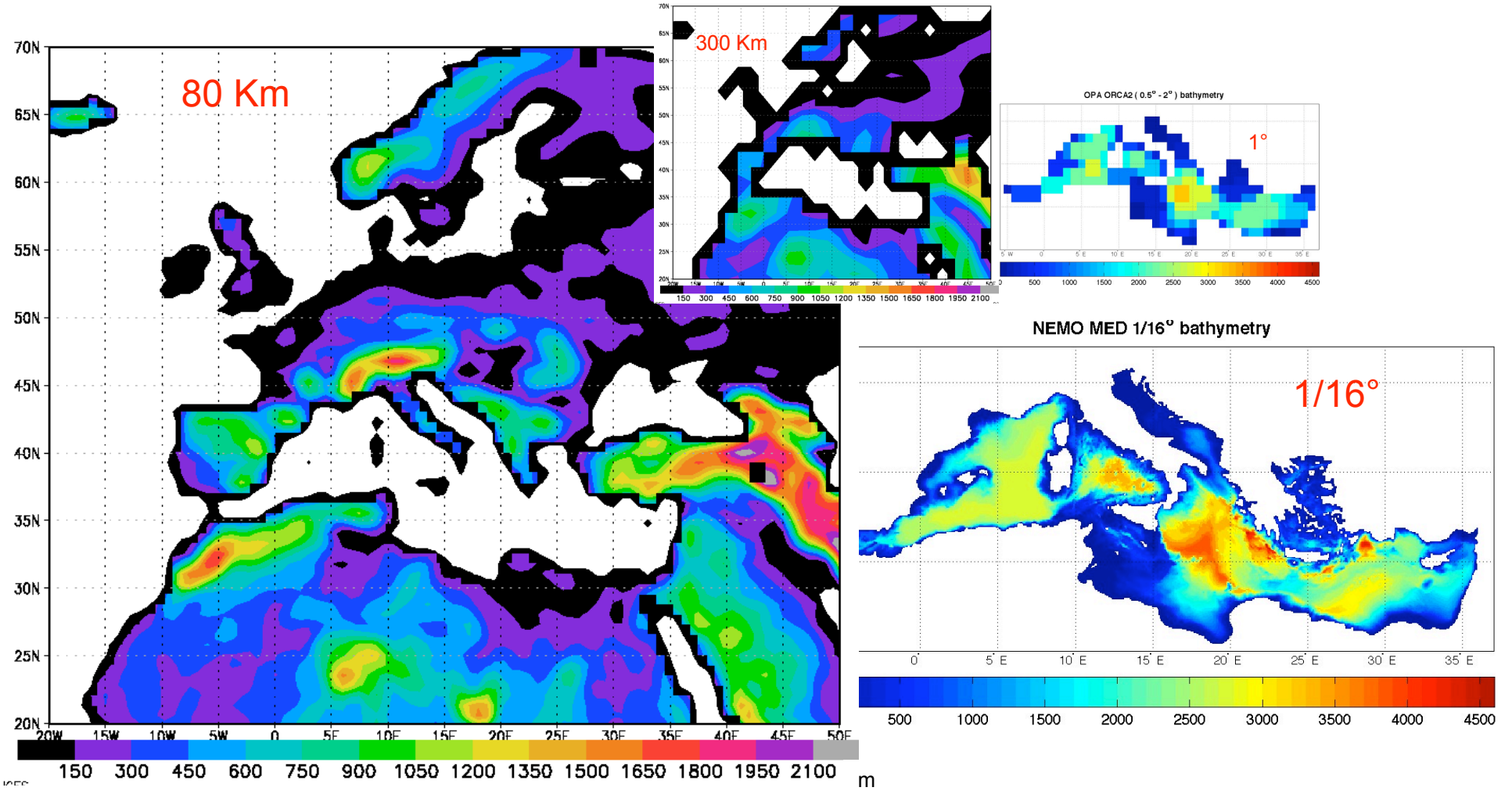


The CMCC-MED MODEL: a global climate model with a fully resolved interactive Mediterranean Sea developed in the framework of CIRCE (EU-FP7)



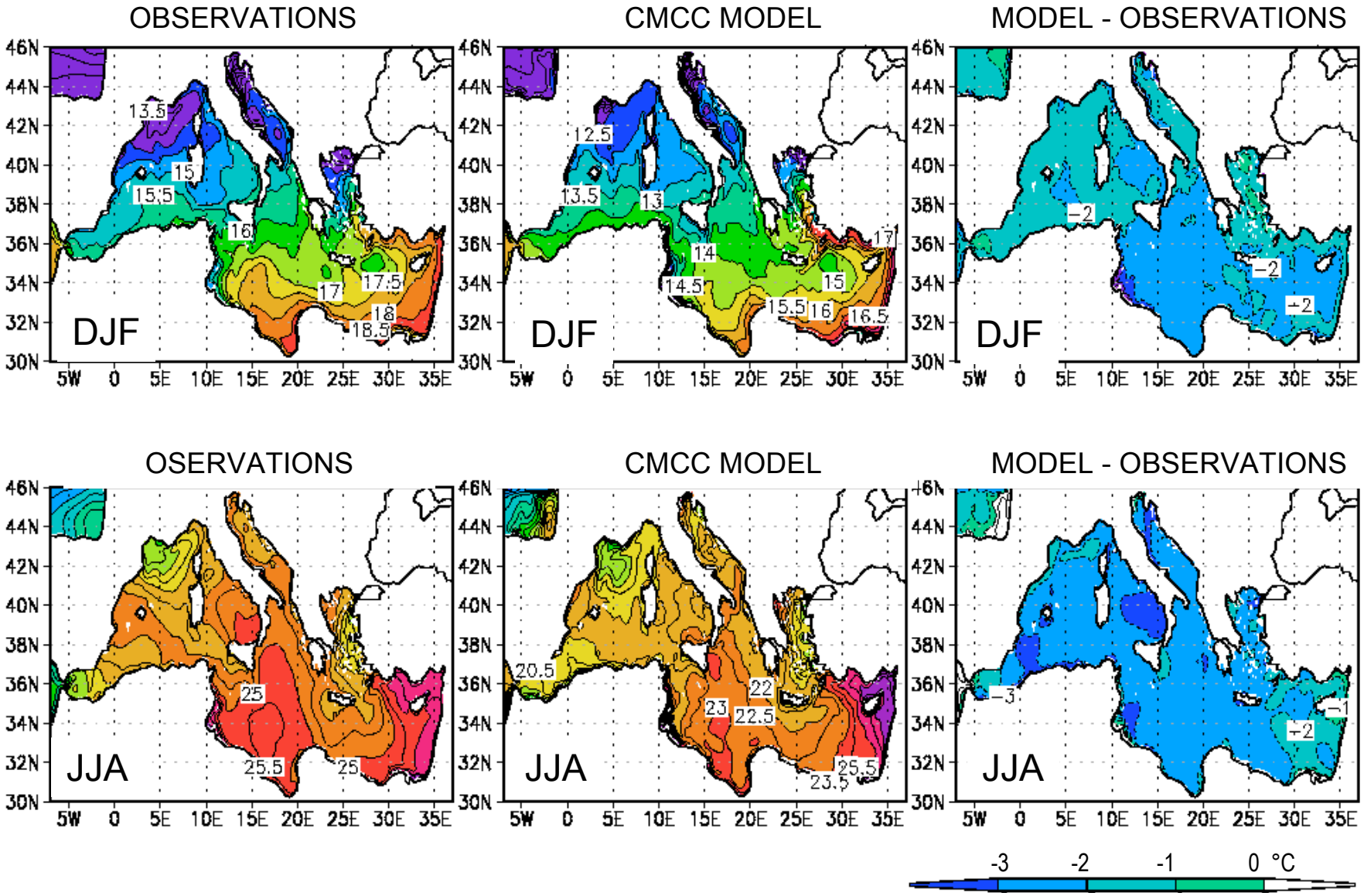
Coupling between atmosphere and oceans every 2 hours
Coupling between global ocean and Mediterranean Sea every 8 hours

Orography, Land-Sea mask and Mediterranean Sea bathymetry in the new CMCC model



Climate Change and SLR in the Mediterranean Sea

Simulation of the observed climate: Sea-Surface Temperature (SST) 1981-2000 mean

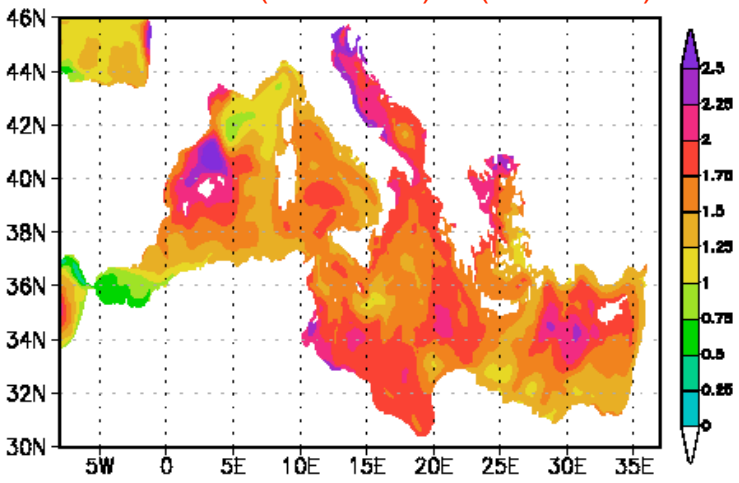


Climate Change and SLR in the Mediterranean Sea

Climate projection from an A1B scenario simulation

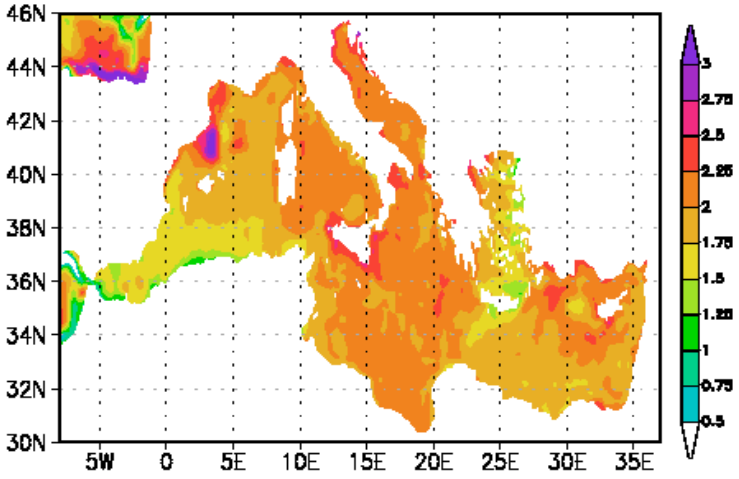
SST change

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



DJF

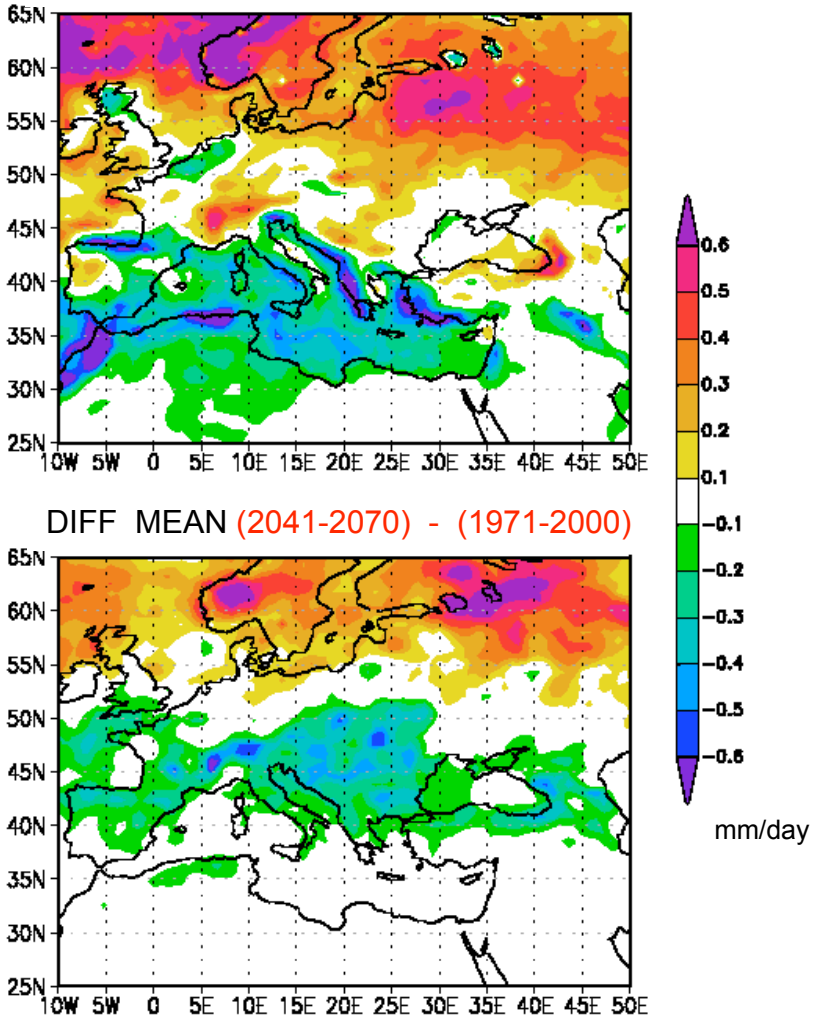
DIFF MEAN (2041-2070) - (1971-2000)



JJA

PRECIPITATION change

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



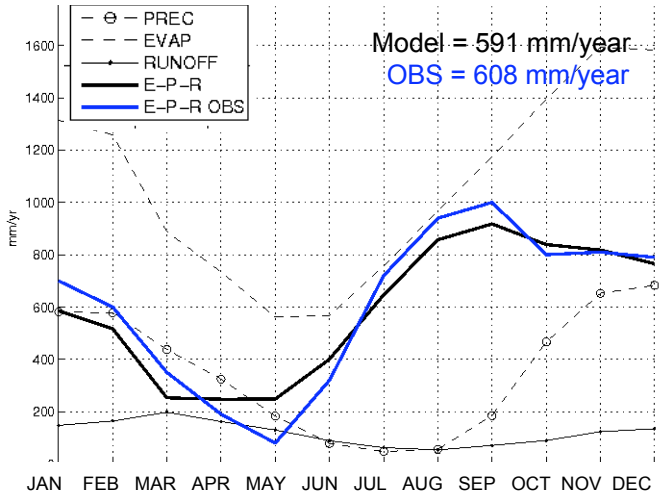
DIFF MEAN (2041-2070) - (1971-2000)

Climate Change and SLR in the Mediterranean Sea

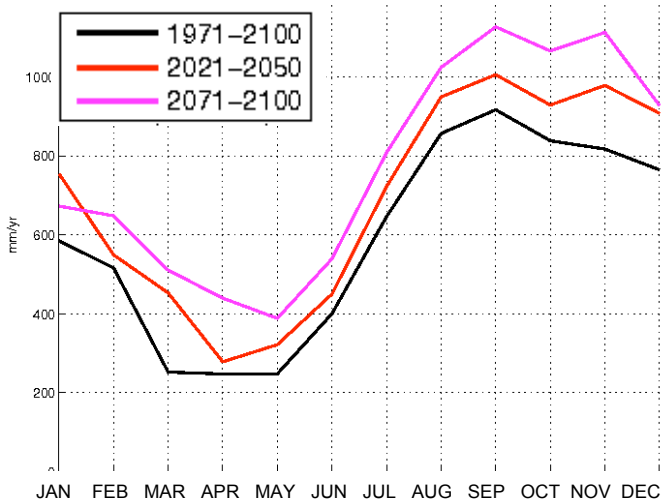
Climate projection from an A1B scenario simulation

Hydrologic cycle in the Mediterranean basin:

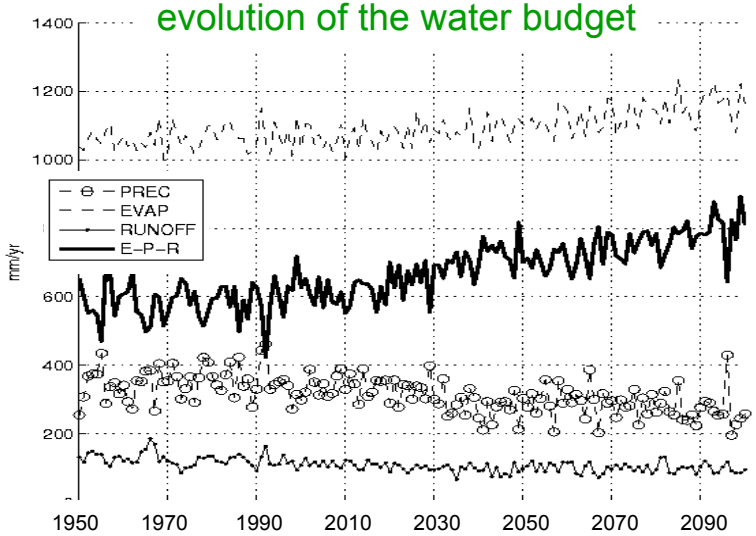
water budget seasonal cycle (1971-2000)



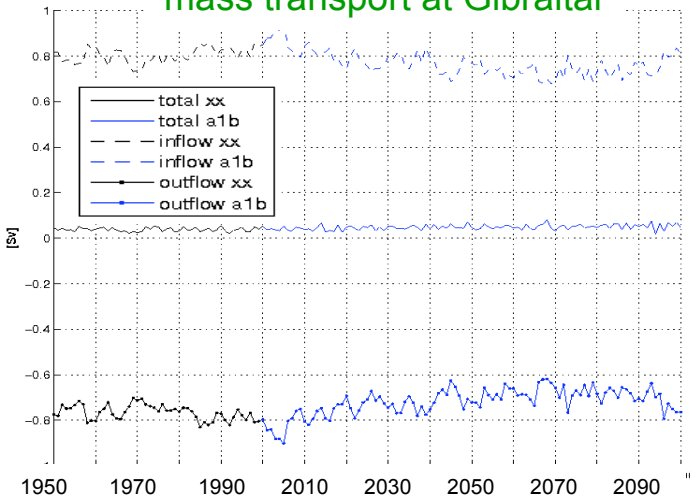
change in the water budget seasonal cycle



evolution of the water budget



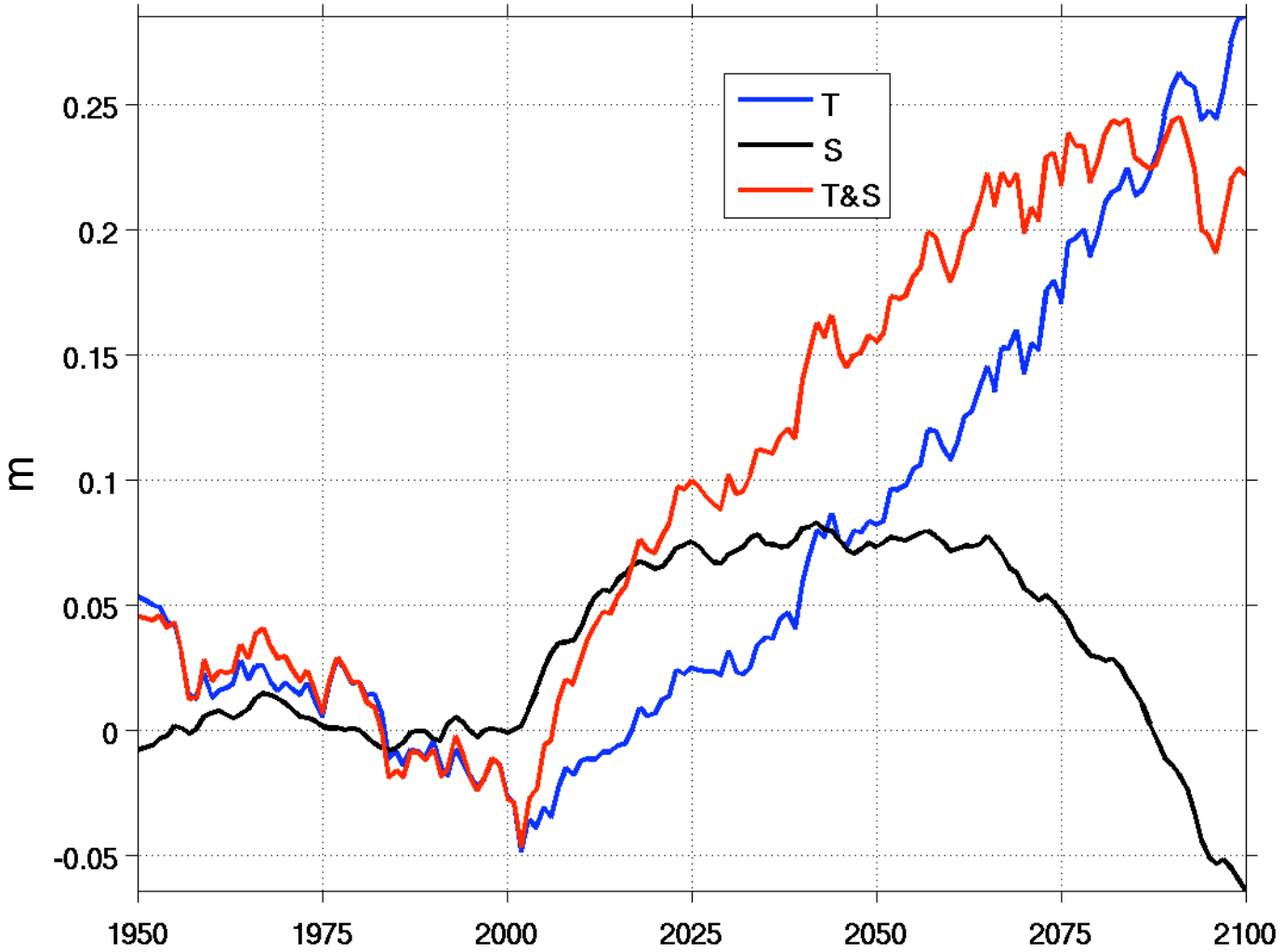
mass transport at Gibraltar



Climate Change and SLR in the Mediterranean Sea

Climate projection from an A1B scenario simulation

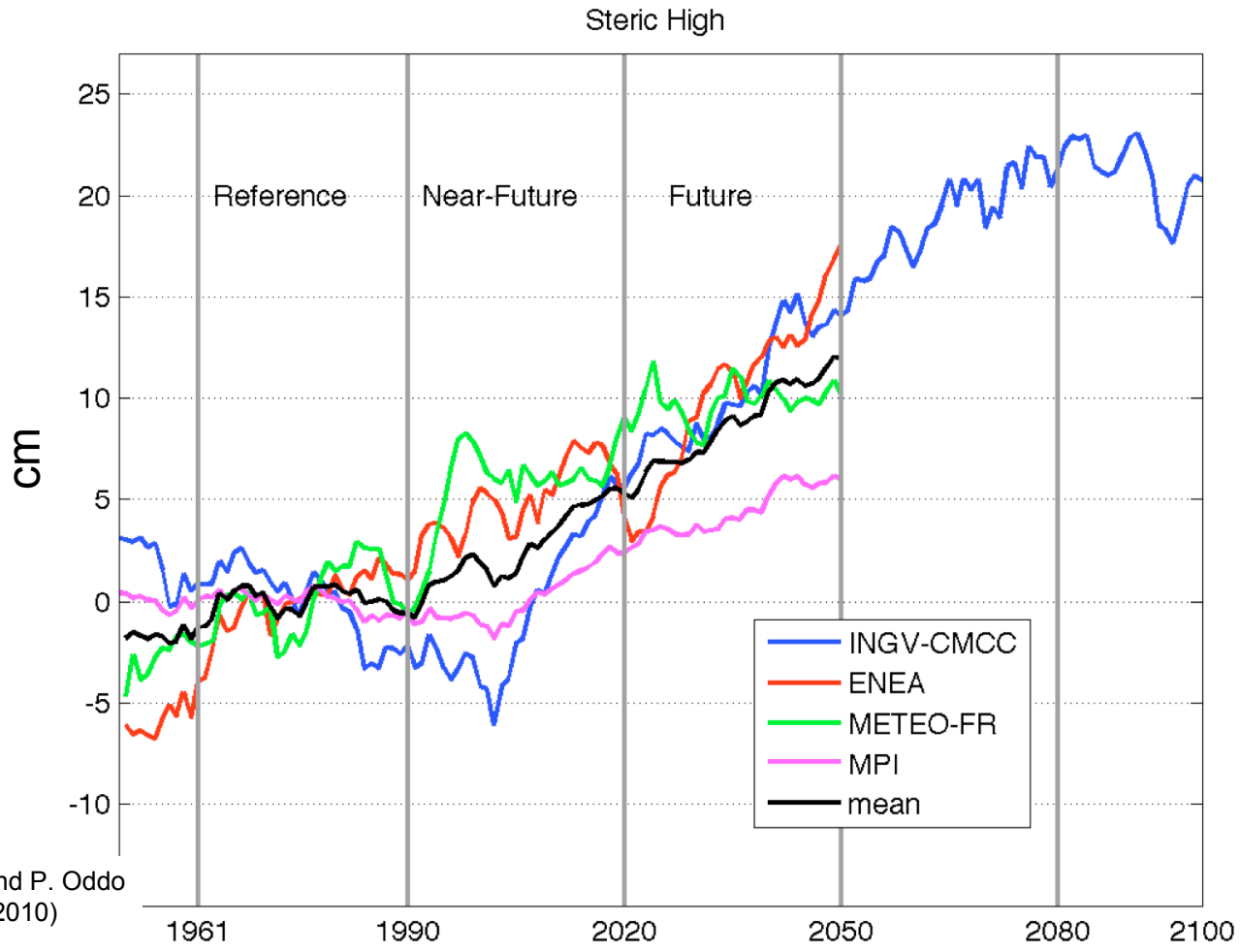
STERIC contribution to SLR in the Mediterranean basin from 1951 to 2100



Climate Change and SLR in the Mediterranean Sea

Climate projection from an A1B scenario simulation

STERIC contribution to SLR in the Mediterranean basin from 1951 to 2100 as obtained from an ensemble of coupled models (CIRCE)



Courtesy of S. Somot and P. Oddo
From CIRCE RACCM (2010)

SUMMARY:

- a new high-resolution model suitable to investigate the regional scales and the role of the Mediterranean Sea in the global climate.

FROM AN A1B SCENARIO SIMULATION:

- Mediterranean SST increases of about 2°C in the next decades (2041-2070); precipitation increases in North Europe and decreases in the Mediterranean area.

- hydrologic cycle in the Mediterranean affected by global warming: increased evaporation and reduced precipitation. Implications for water mass transport at the Gibraltar Strait.

- change in salinity and temperature induce a steric SLR of ~22 cm wrt 1971-2000 mean

UNRESOLVED ISSUES:

- Gibraltar still not well resolved.

- Atmospheric pressure is not accounted for in the oceanic model: implications for sea-level change (short time scales)

- continental ice prescribed: no continental ice melting

Sea level scenarios for Venice in 2100
International assessment

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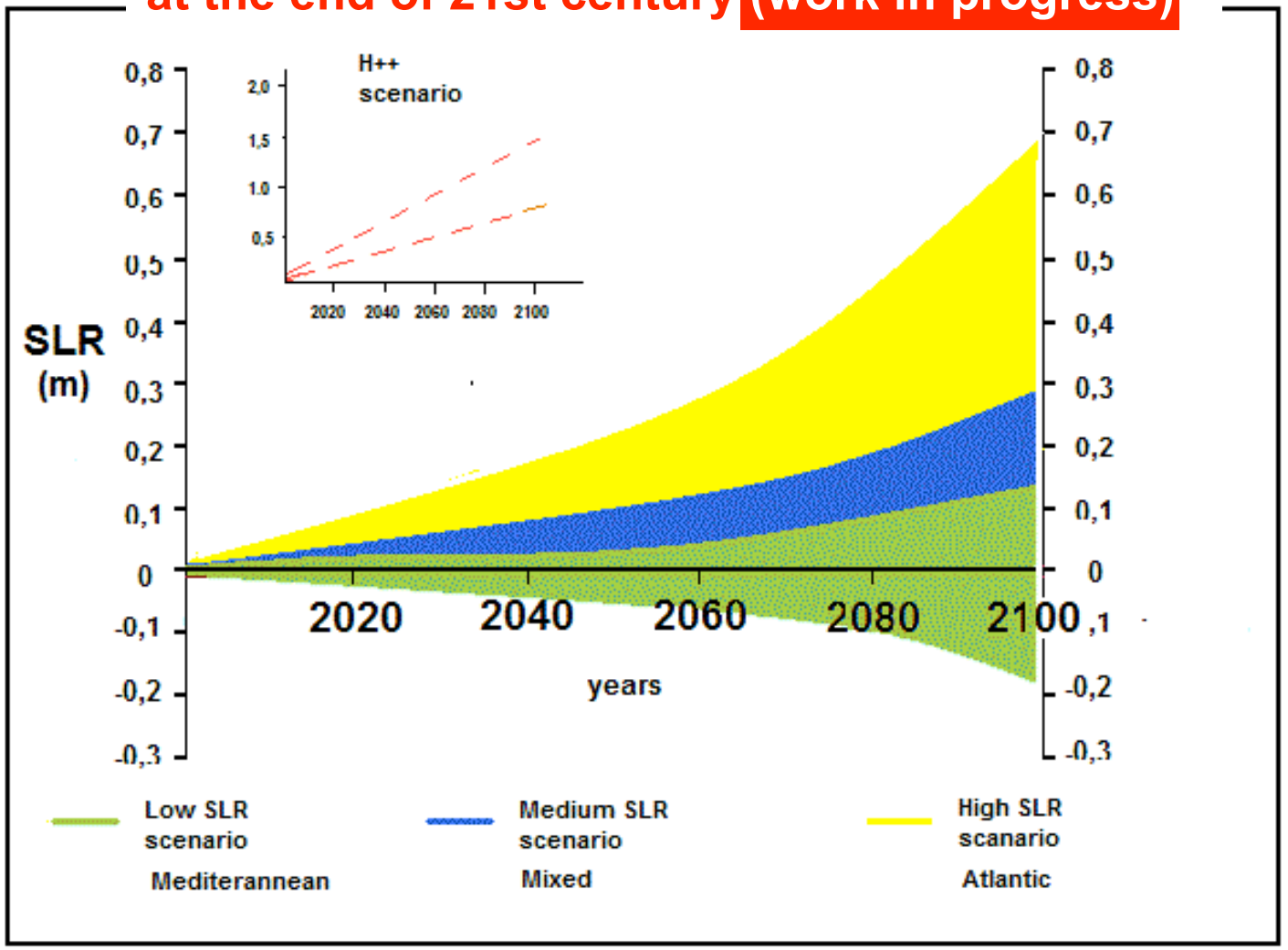
Practical sea level rise scenarios for Venice at the end of 21st century (work in progress)



THANK YOU