Impacts modelling

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Impacts from global to local, past, present & future

Met Office
Hadley Centre

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Are we seeing impacts of climate change already?

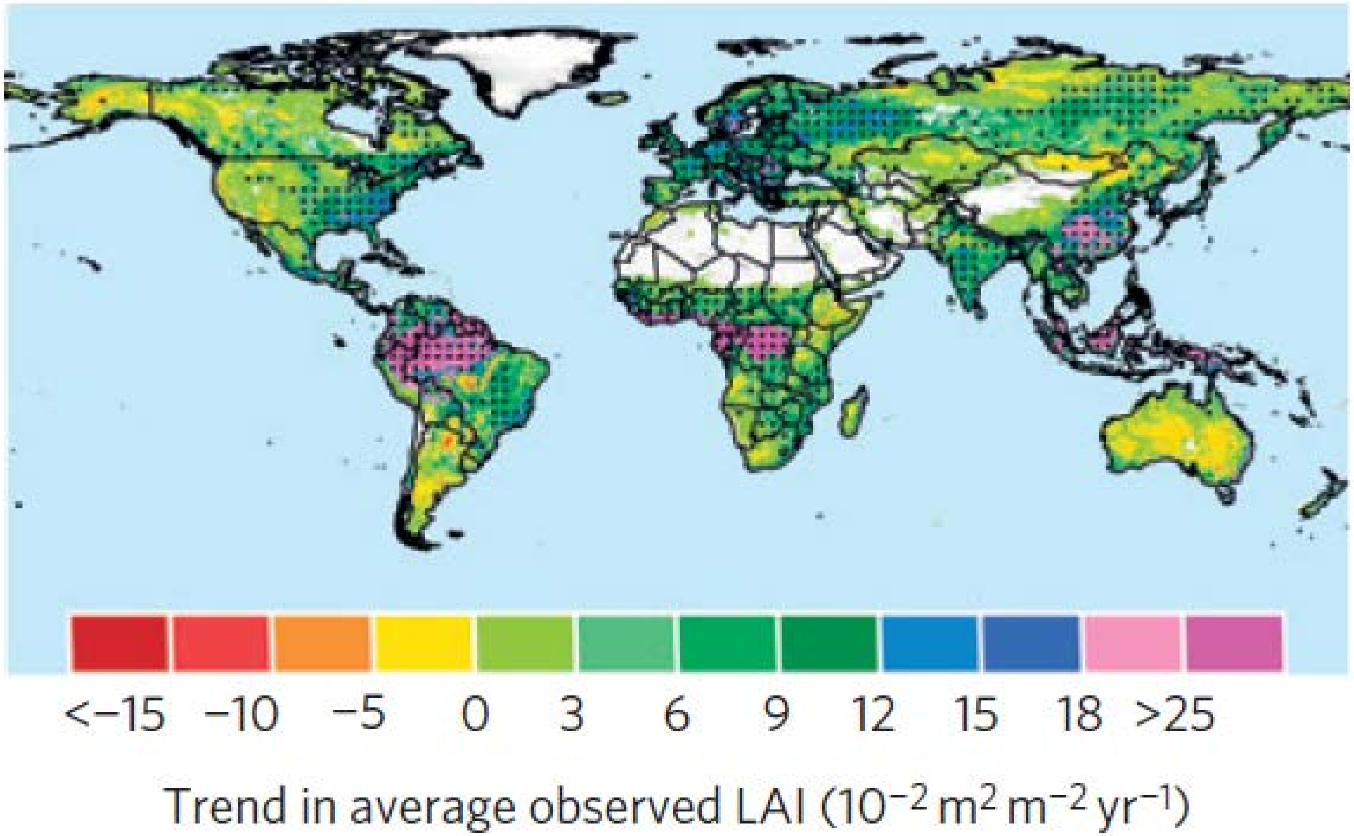
Can we forecast impacts of climate variability on seasonal timescales?

What might be the long-term impacts of anthropogenic climate change?

What are the implications of & for adaptation and mitigation choices?

Detection and attribution of impacts

eg. why is the world "greening-up?"



Zhu *et al* (2016)

Dynamic global vegetation models

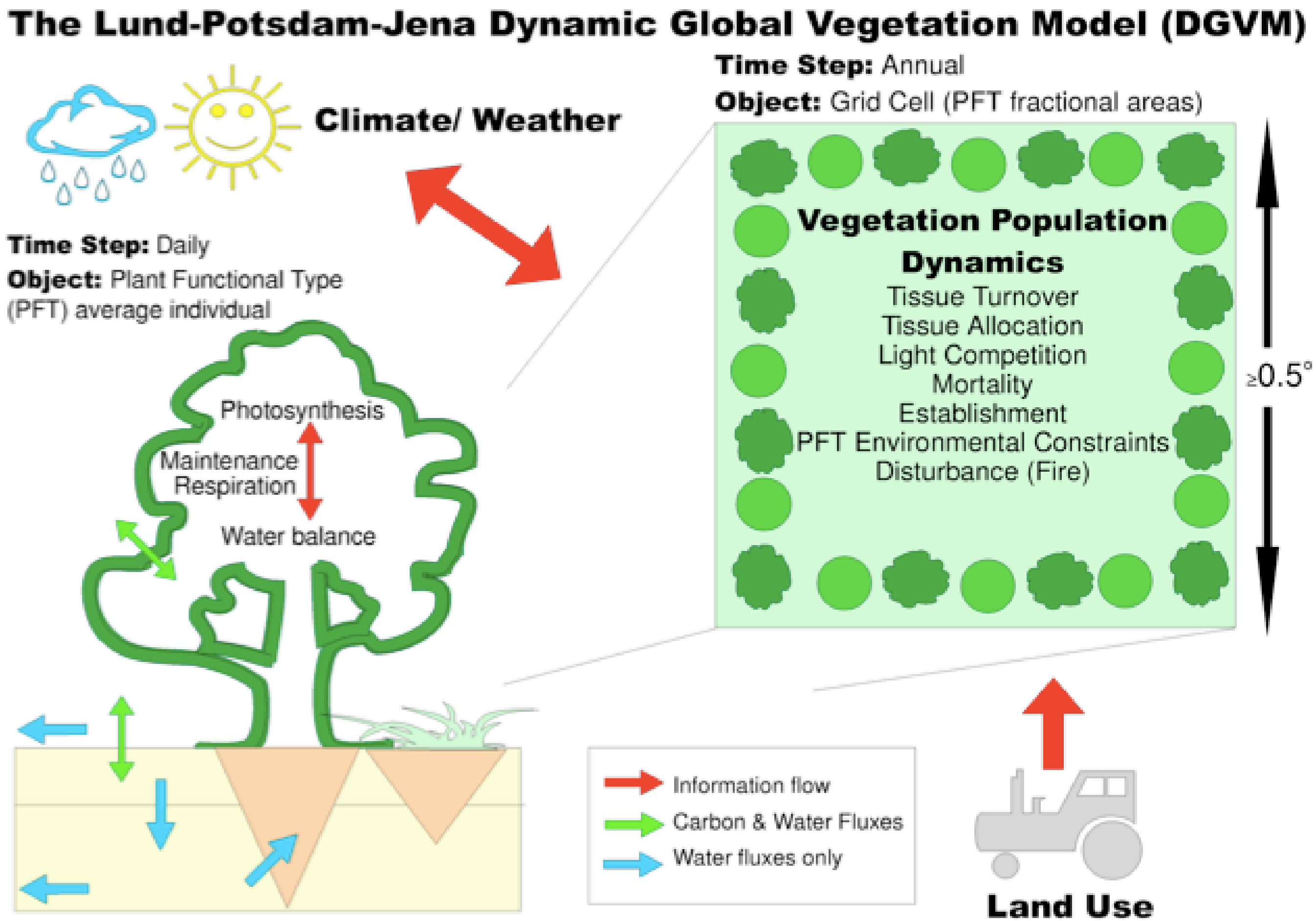
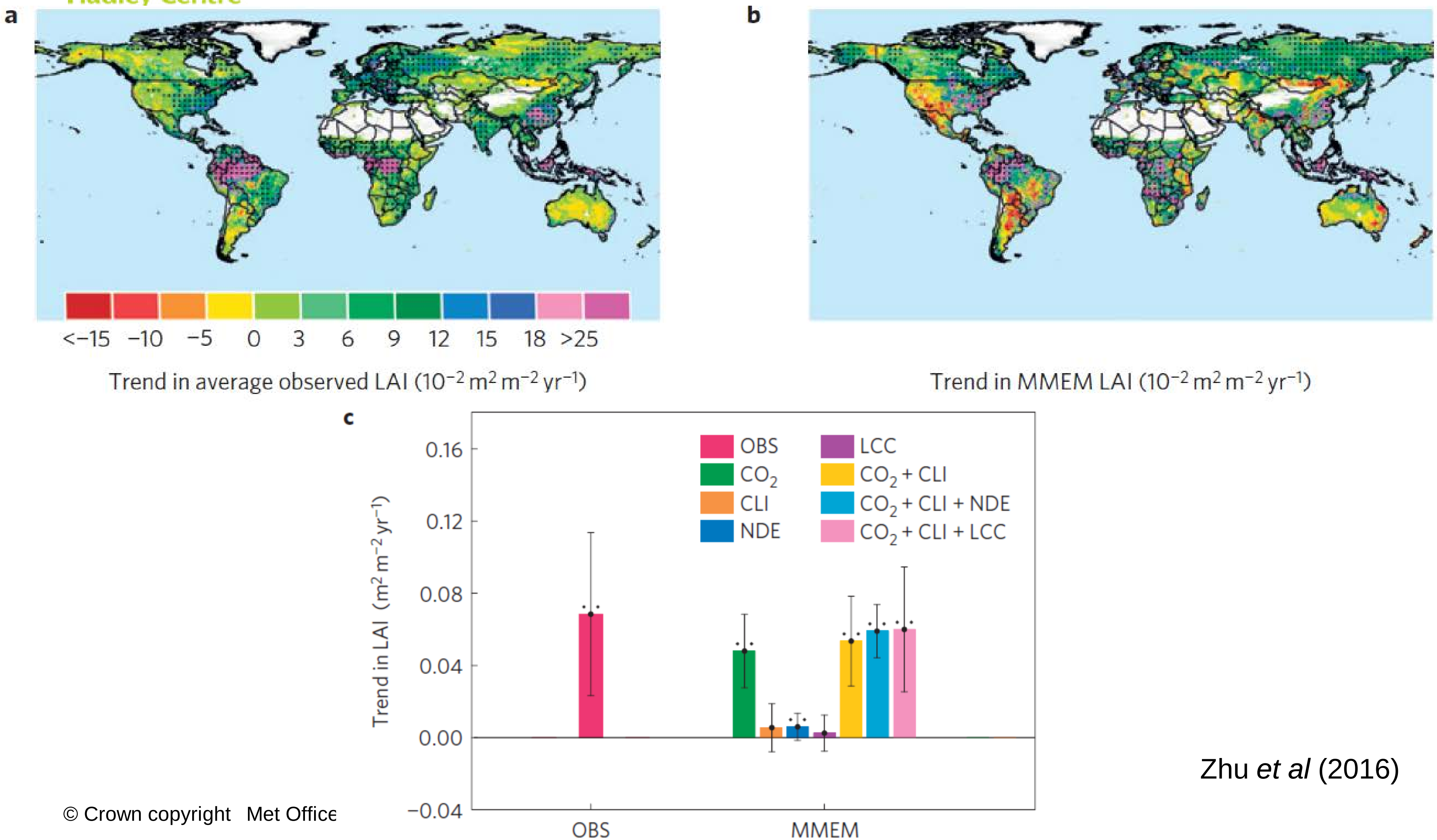


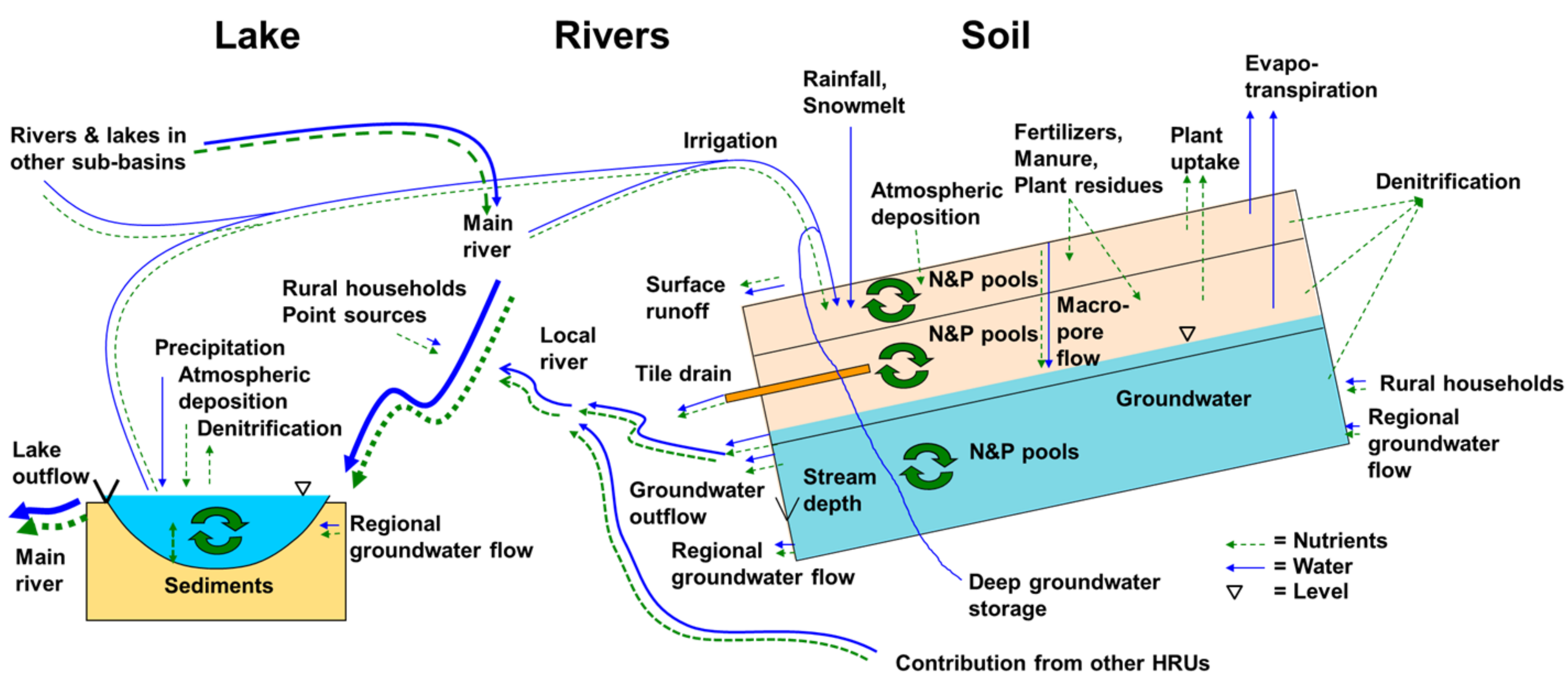
Fig. 1: Scaling from the average individual plant to a grid cell in the LPJ-DGVM

Using dynamic global vegetation models for detection and attribution of impacts



Zhu *et al* (2016)

Hydrological models



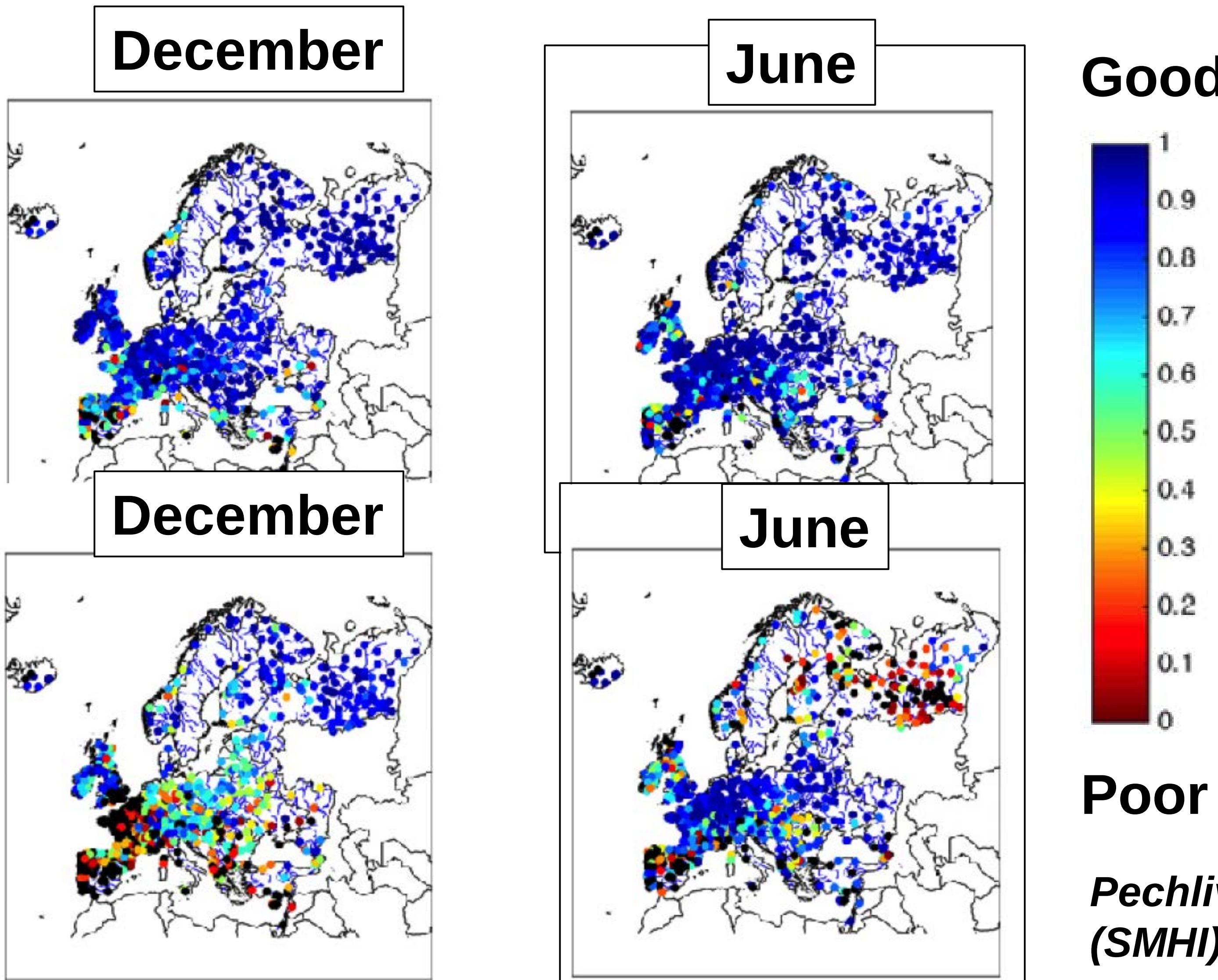
HYPE model, SMHI

Assessing skill of seasonal river flow forecasts – EHYPE

hydrological model driven by ECMWF System 4 climate

Lead month 0

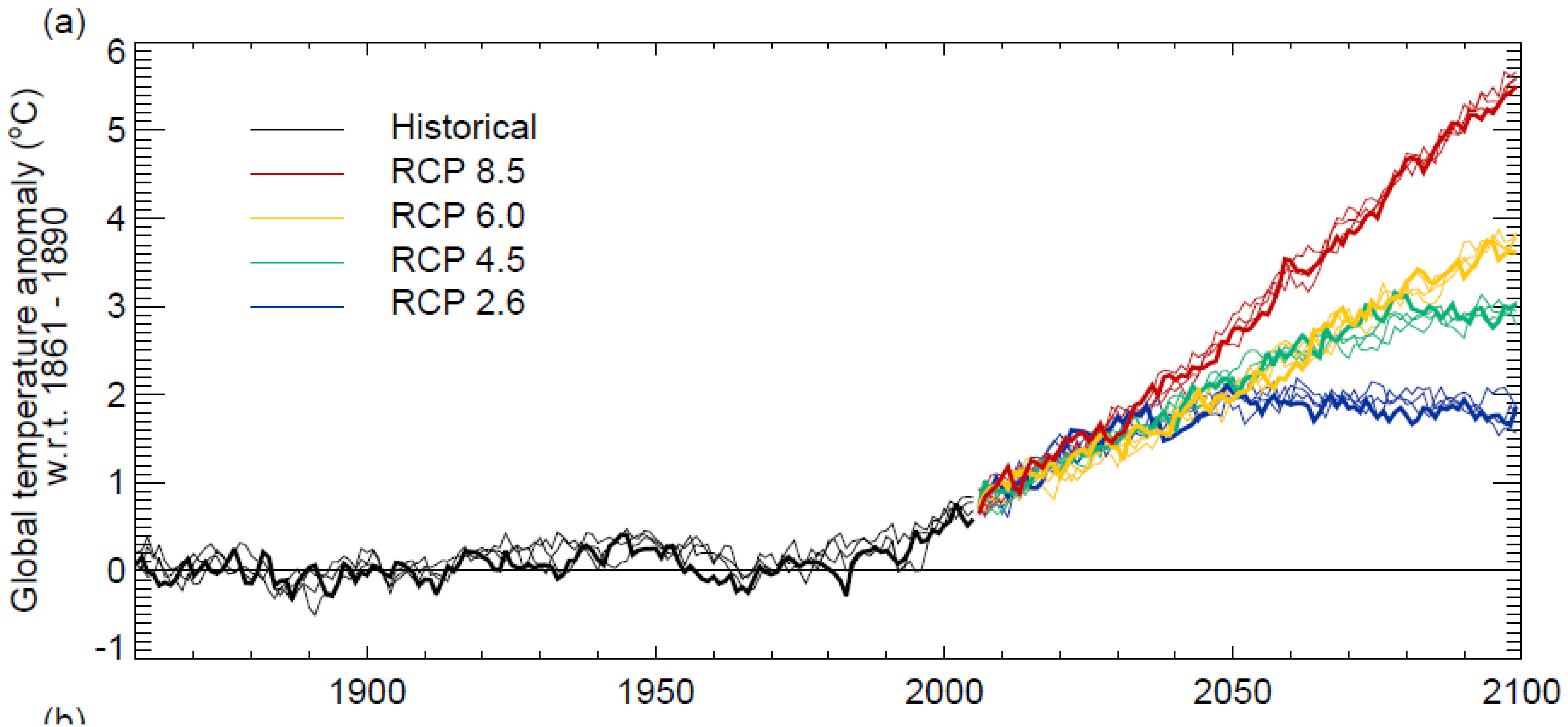
Lead month 4



Pechlivanidis (SMHI)

EUPORIAS

Projecting impacts of anthropogenic climate change – informing mitigation and adaptation



Impacts on crop yield: varying sowing date to maximise benefit

CERES-Wheat in DSSAT4.0

UKCP09 11-member ensemble 2071-2100 vs 1971-2000

Mean % change in crop yield.

Early (10th September) **Middle** (10th October) **Late** (10th November)

Benefits of early sowing further north

Smaller gains for late sowing

Cho et al. 2012

Uncertainties in impacts arising from uncertainty

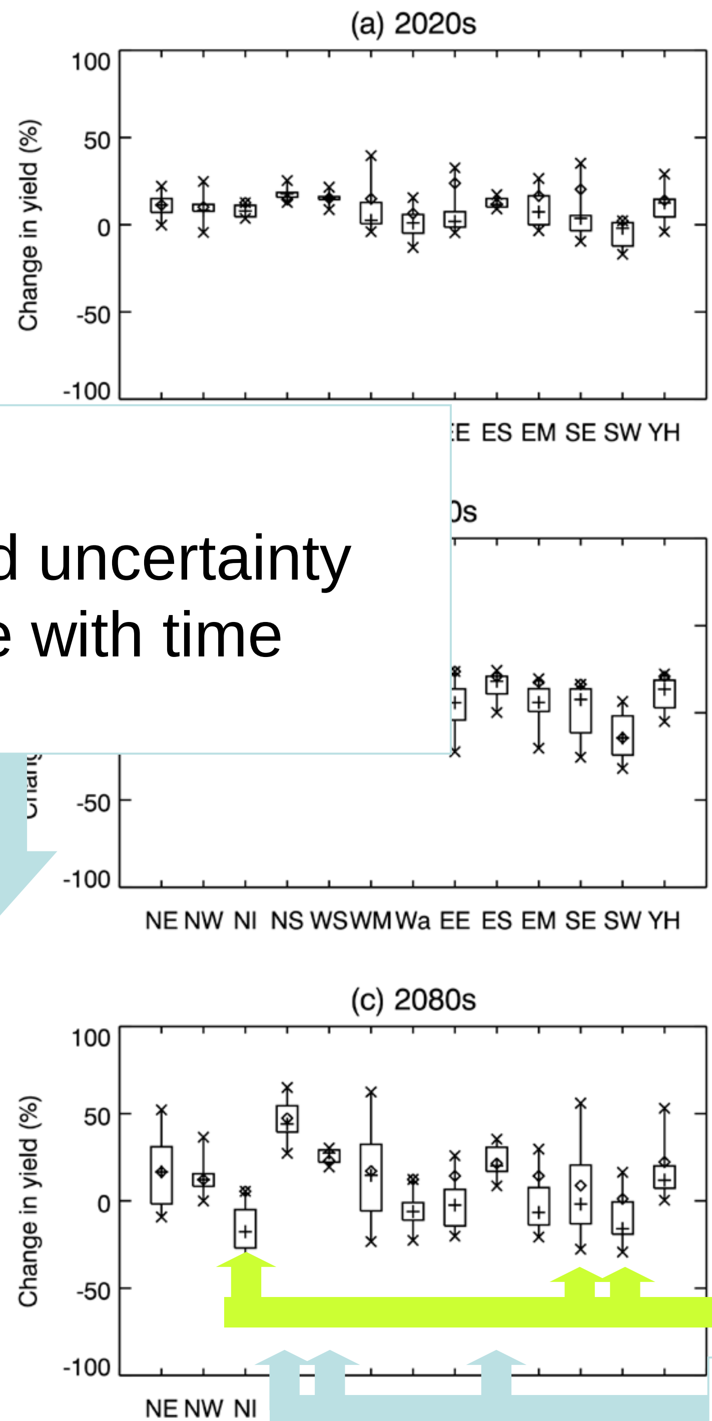
Impact and uncertainty increase with time

Impacts of UK[obscured] projections on [obscured] yields (CERES crop model)

Yield (%)
Change in 30 y average, from baseline (1971-2000)

Sowing date 10th October

Cho et al. 2012



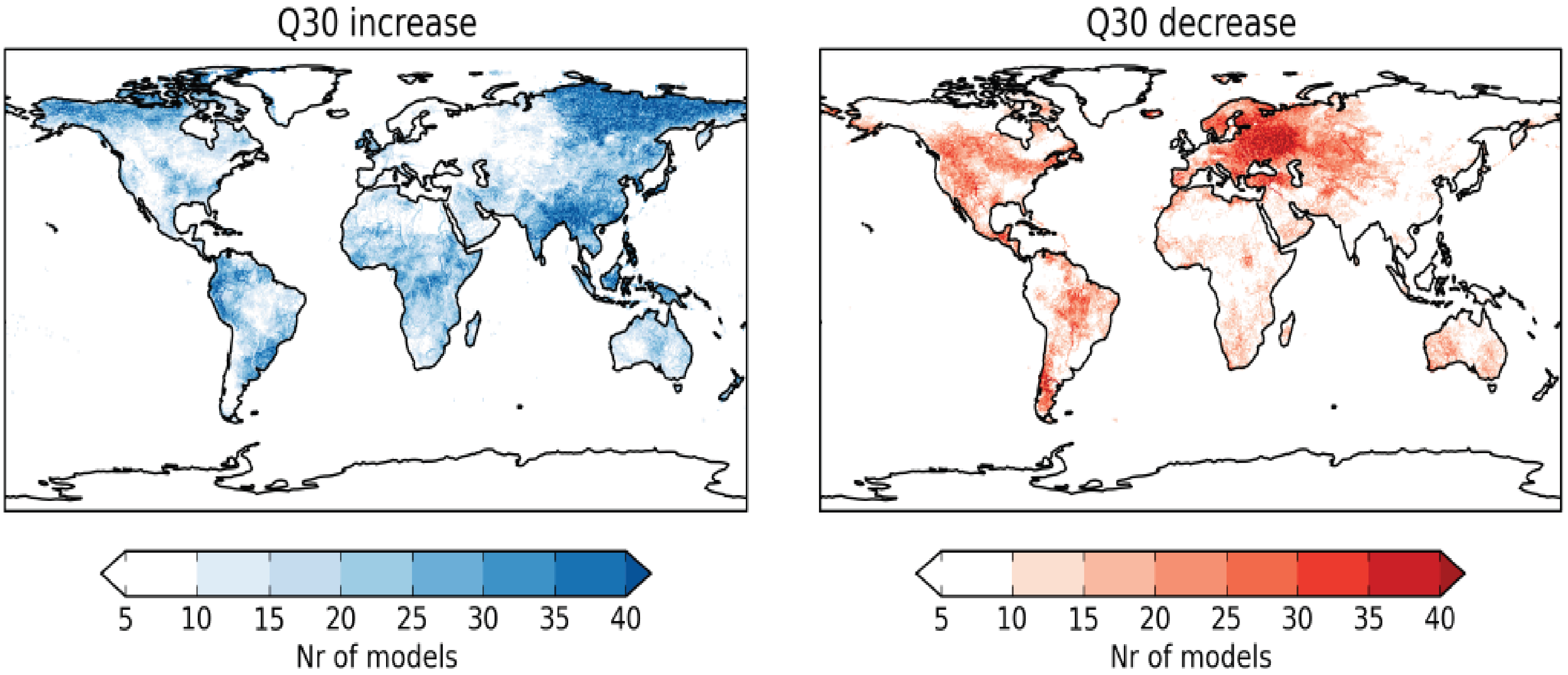
NE N.E. England
NW N.W. England
NI N. Ireland
NS N. Scotland
WS W. Scotland
WM W. Midlands
Wa Wales
EE E. of England
ES E. Scotland
EM E. Midlands
SE S.E. England
SW S.W. England
YH Yorks & Humber.

Losses in south

Gains in north

Uncertainties in impacts projections – differences among impacts and climate models

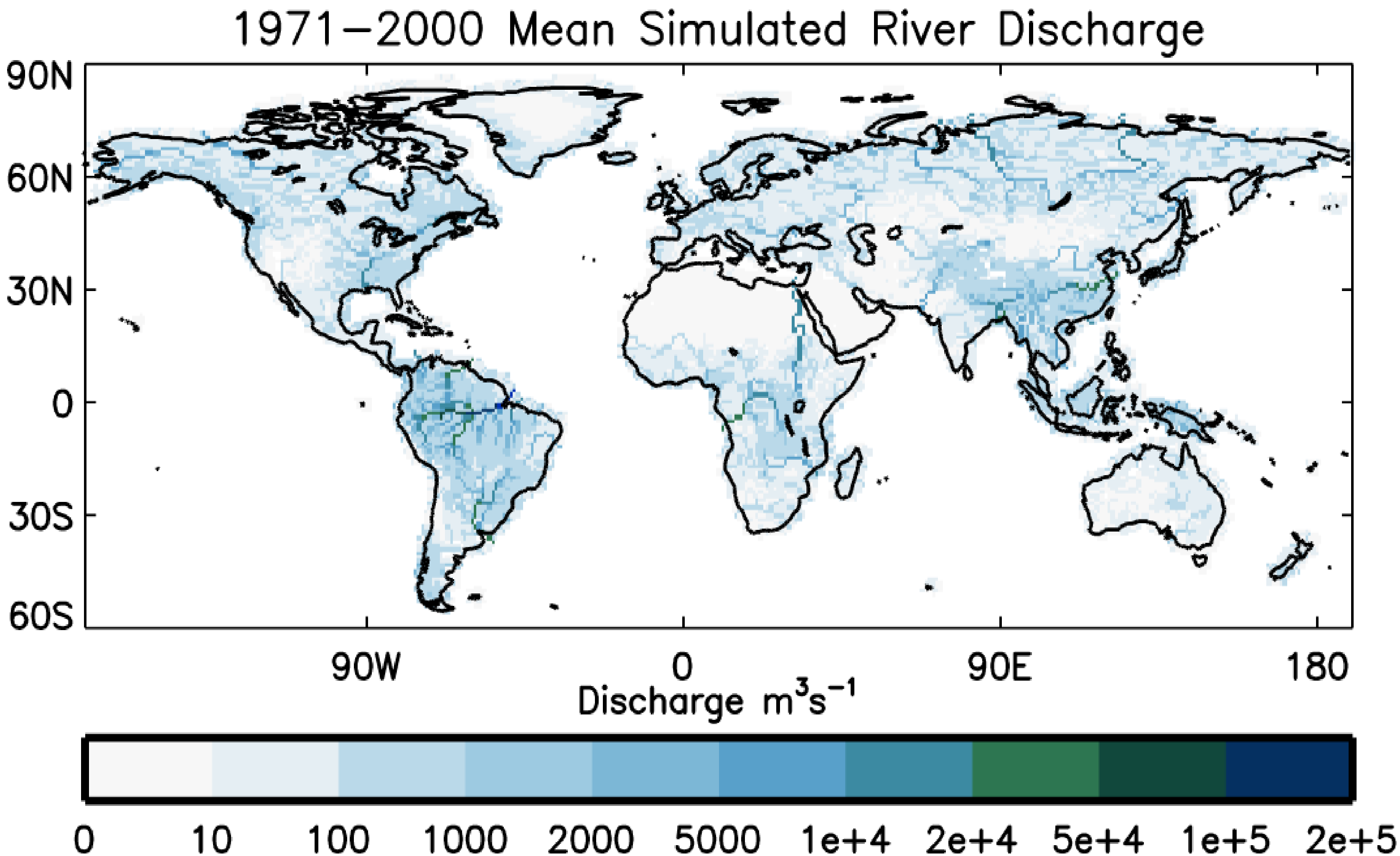
Changes in the 30-year return level of 5-daily peak river flows (Q30)



Total model combinations: 45
(5 Earth System Models, 9 hydrology/land surface models)
Inter-Sectoral Impacts Model Intercomparison Project (ISI-MIP)

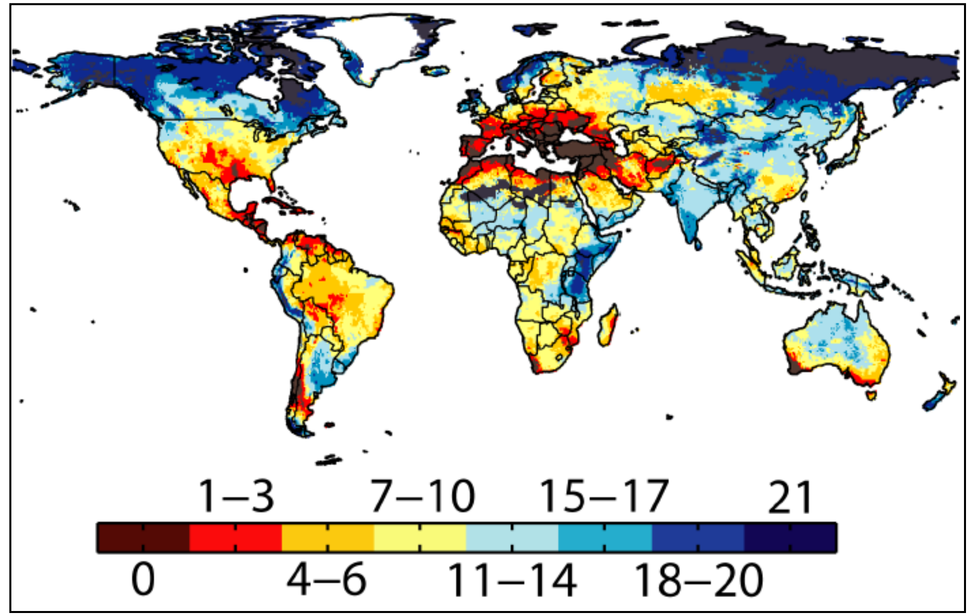
Dankers *et al* (2013)

River flows within Earth System Models

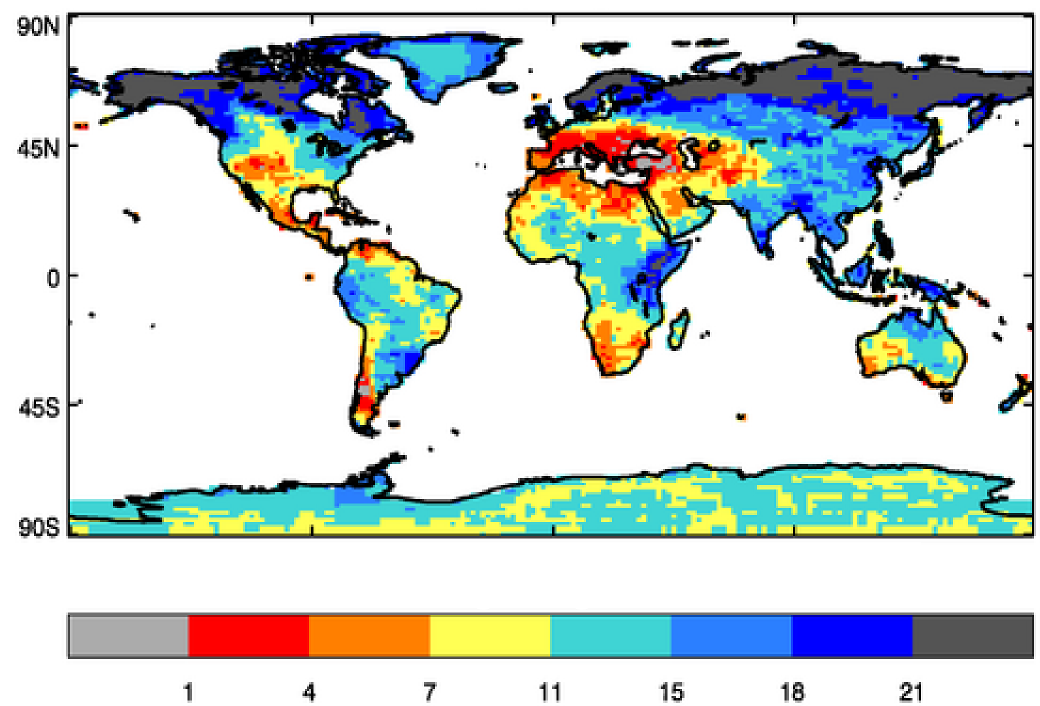


Different predictions using hydrology models inside and outside of climate models

River runoff changes simulated by a hydrology model separate from climate models



River runoff changes directly simulated *within* climate models



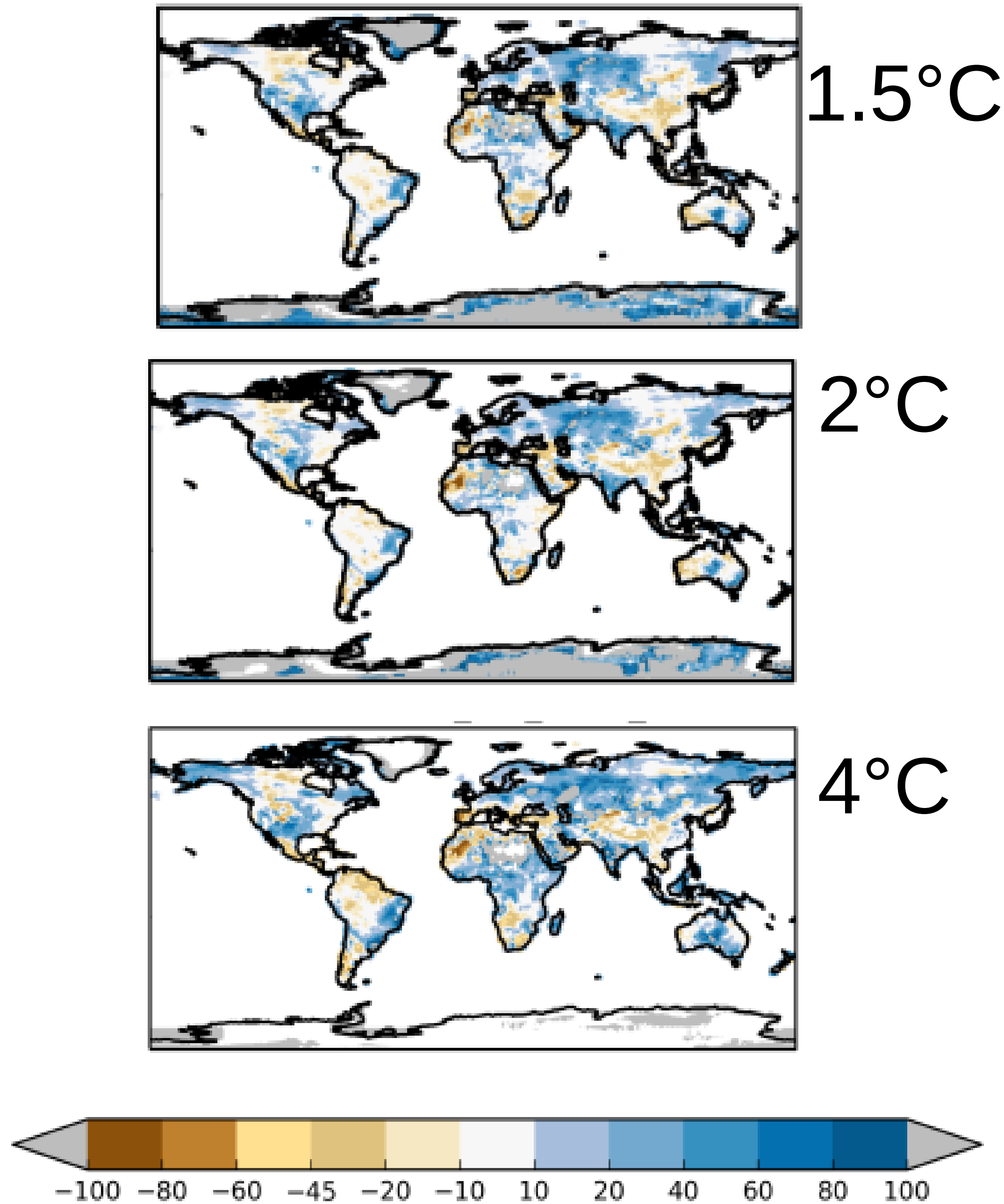
(Number of models simulating increased runoff at 4°C warming)

Comparing impacts at different levels of global warming

River flow changes (%) simulated by HadGEM2-ES Earth System Model

RCP8.5 scenario (high emissions)

30-year means



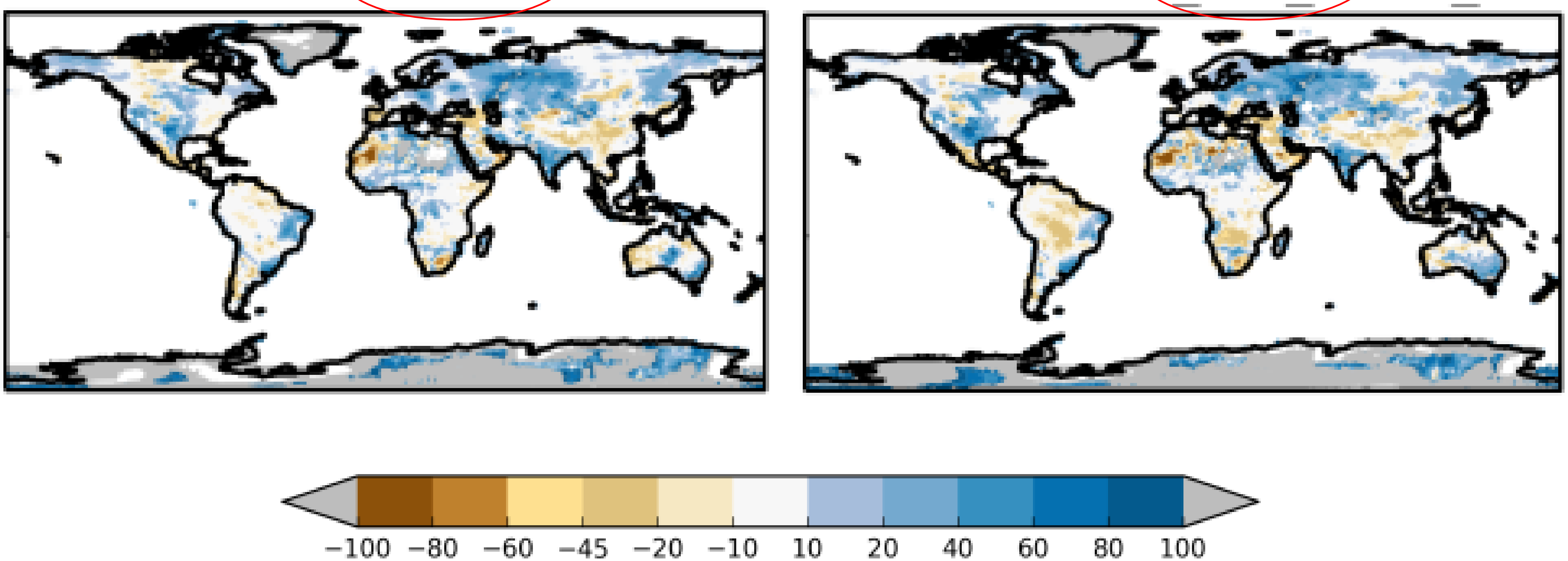
Changes in river flows (%) at 2°C global warming reached earlier (high emissions) or later (low emissions)

Less time to adapt

More time to adapt

RCP8.5 2021-2050

RCP2.6 2045-2074



www.helixclimate.eu

Modelling impacts of sea level rise

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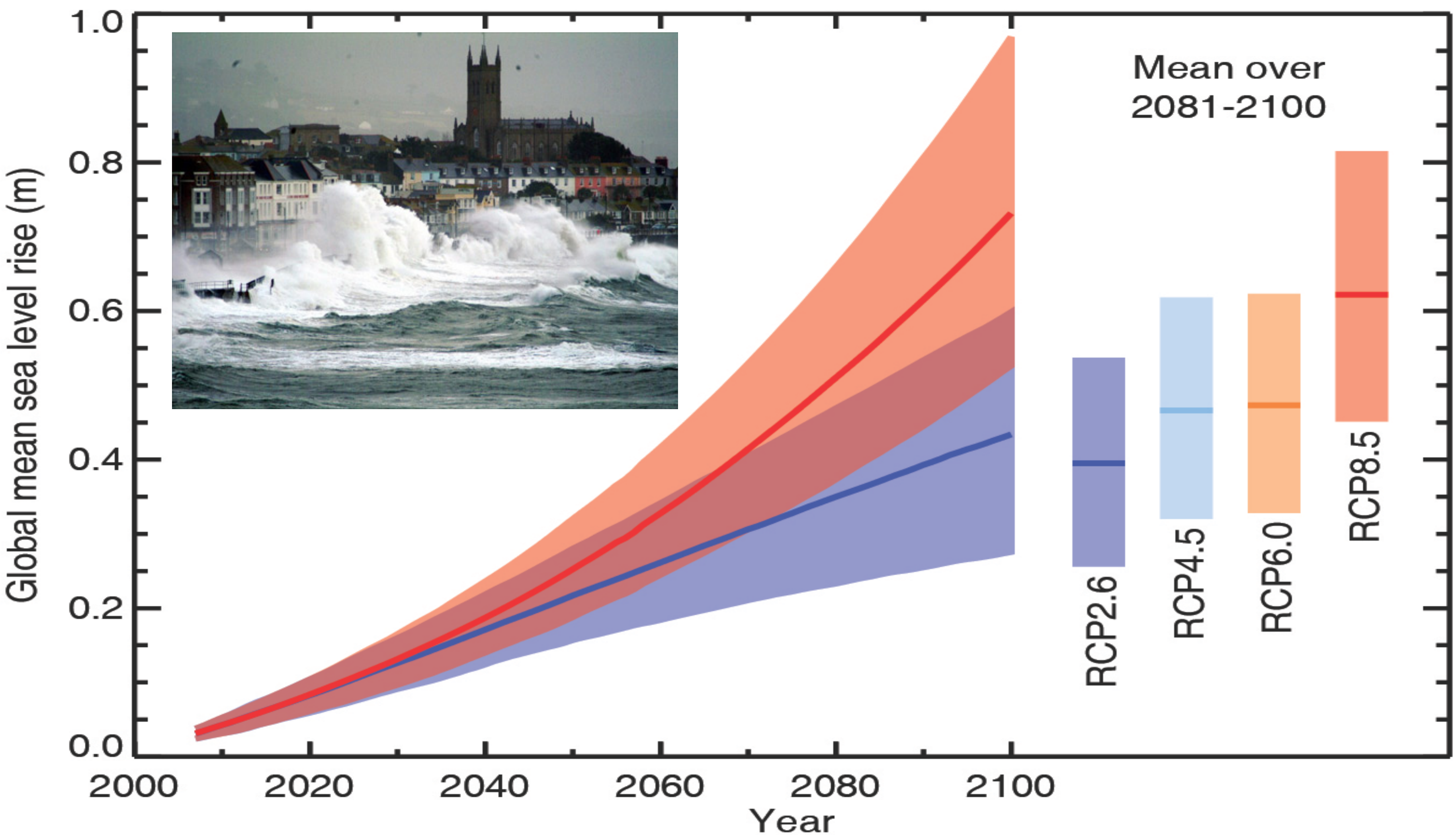
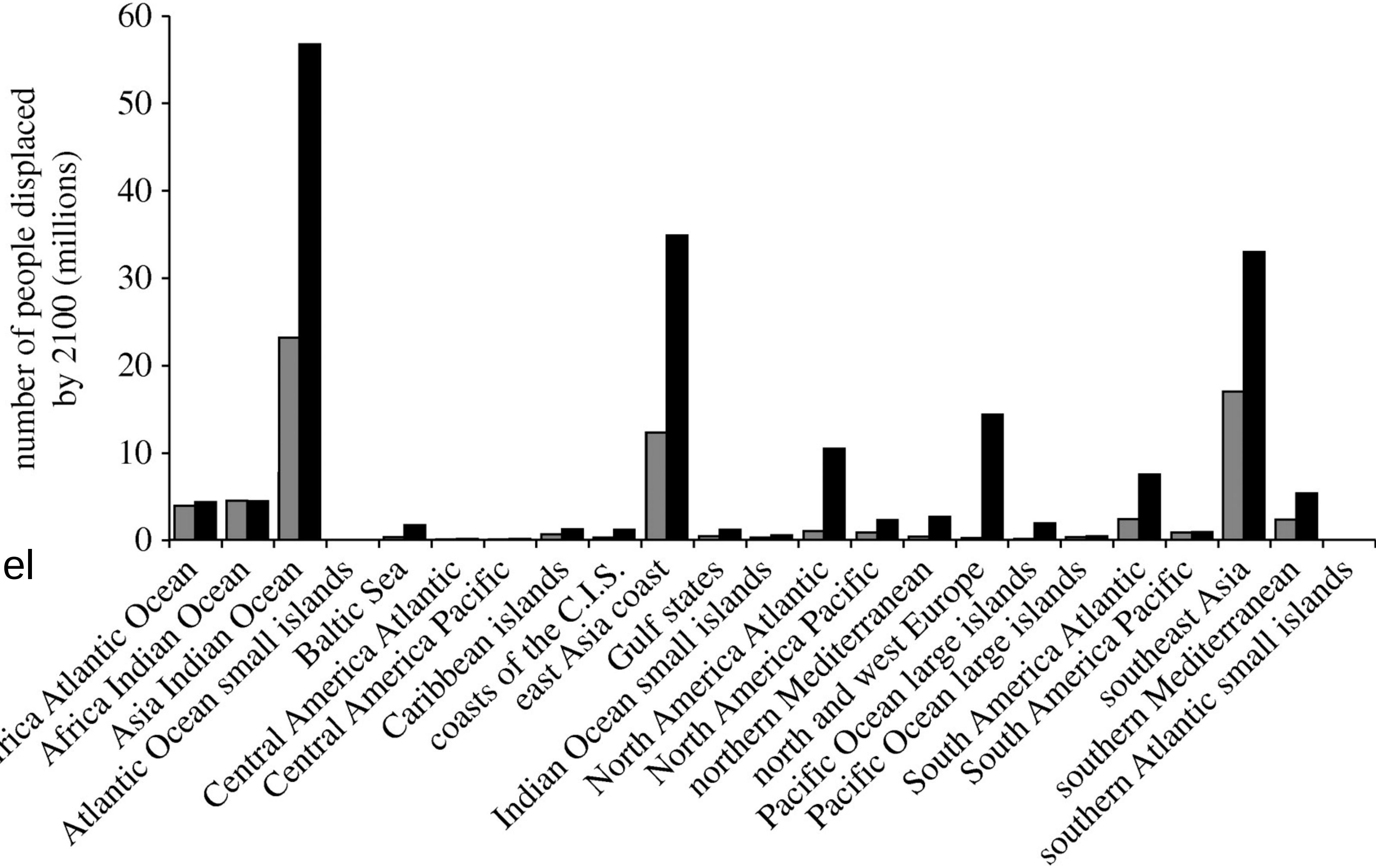


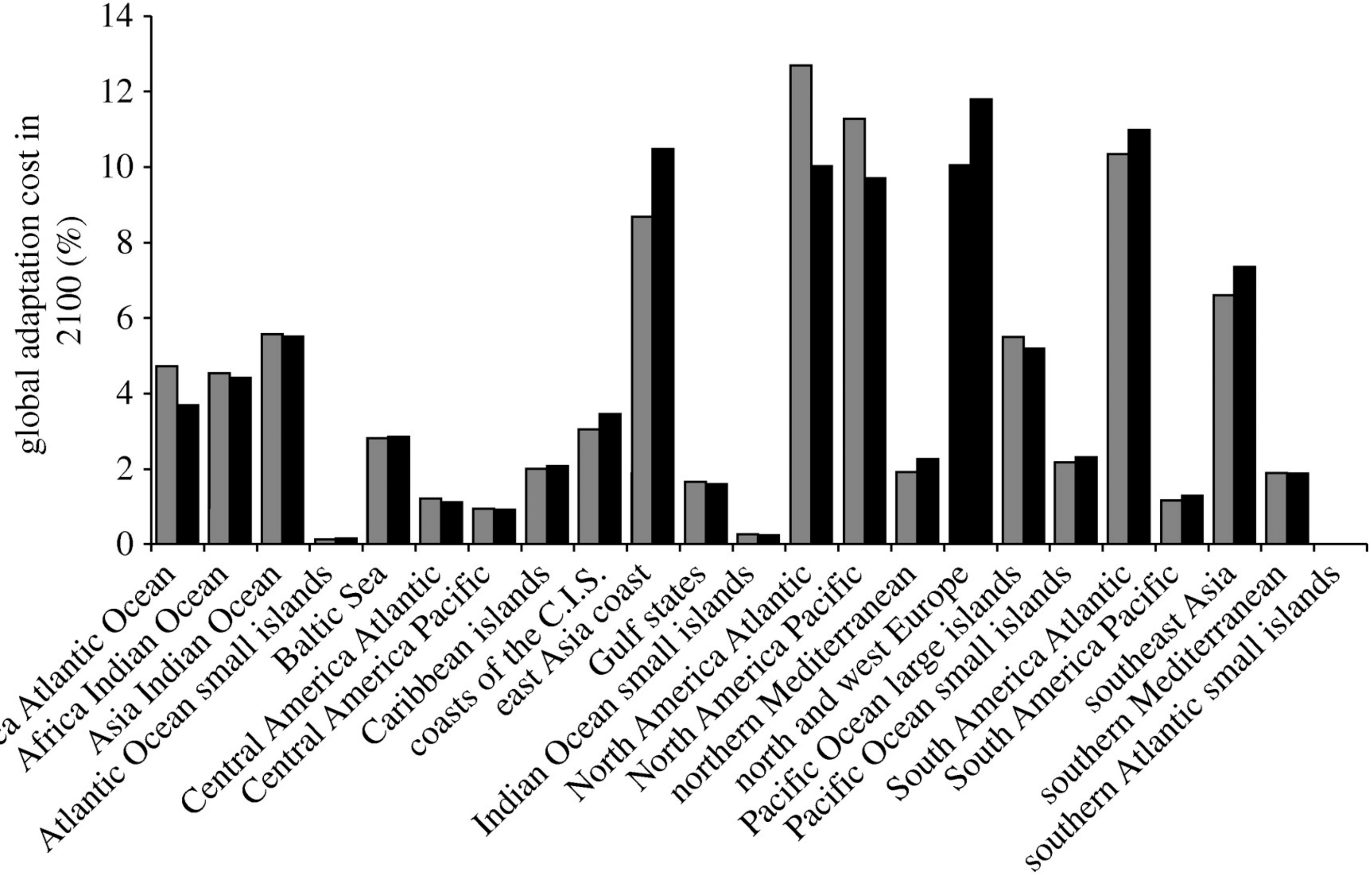
Net population displacement over 21st Century for sea level rise of 0.5 m (grey bars) and a 2.0 m (black bars) – assuming no protection



DIVA coastal impacts model

Nicholls et al. 2011

Annual protection cost by coastal region in 2100, as a percentage of global protection investment for a 0.5 m (grey bars) and a 2.0 m (black bars) rise in sea level by 2100.



DIVA coastal impacts model

“The incremental adaptation costs are estimated at roughly between US $25 and $270 billion (1995 values) per annum for 0.5 and 2.0 m in 2100”

 Nicholls R J et al. Phil. Trans. R. Soc. A 2011;369:161-181

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