International Association for Hydro-Environment Engineering and Research

Supported by Spain Water and IWHR, China

IAHR World Water Day Forum on "Hydro-environment Engineering and Adaptation to Climate Change"
March 21, 2020

International Panel Discussion

Climate Change and Adaptive Management Challenges and Issues

The IAHR white paper on climate change

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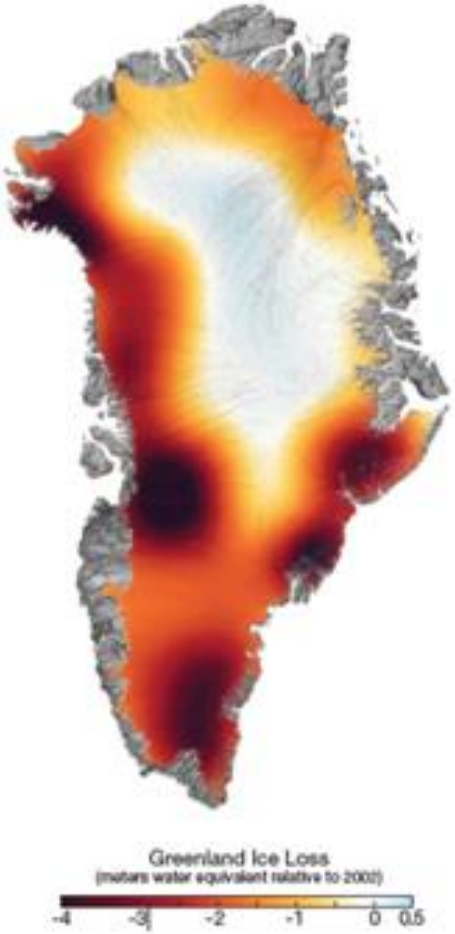
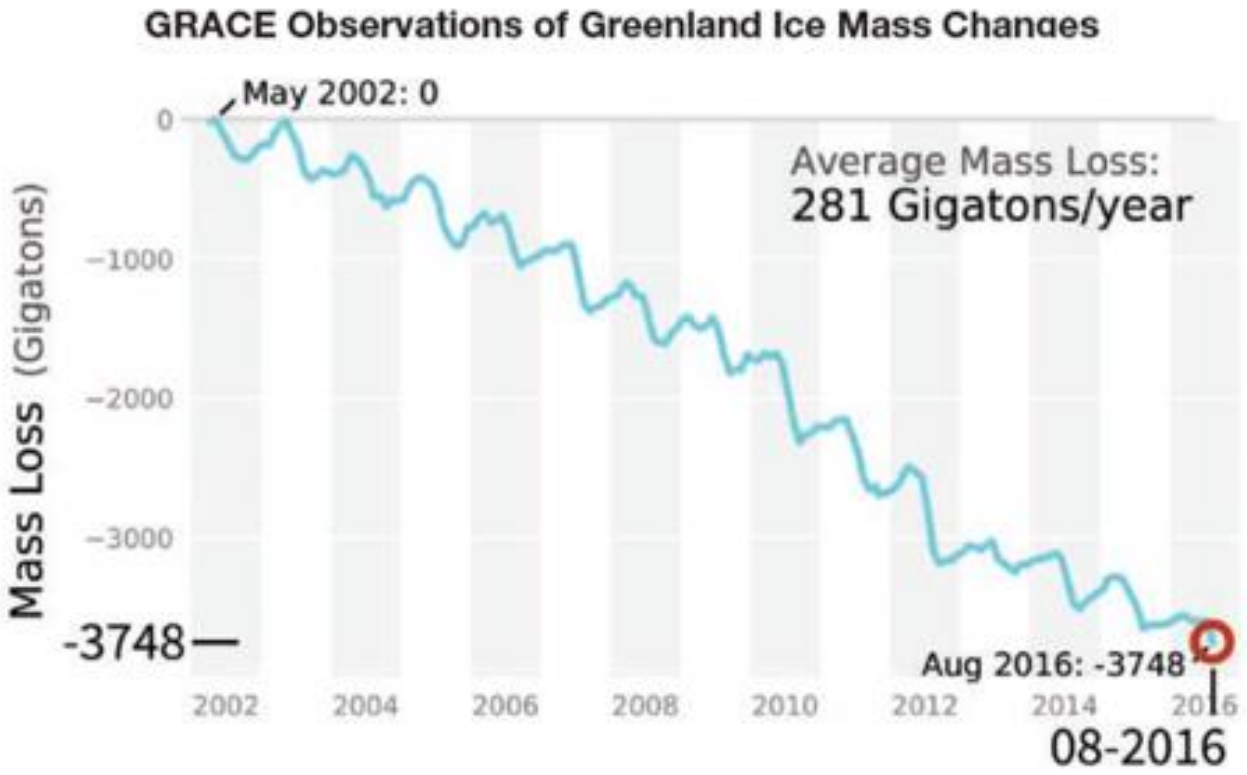
Little doubt exists about the impact Climate Change is having on some components of the hydrosphere

Observed Greenland Ice Mass Changes after gravimetric GRACE measurements corresponding to 8 cm/century Sea Level Rise (NASA, The Earth Observer, 30 (3), 2018)





But the impact of global warming on the water cycle shows regional variability, for instance in

Flood intensity and timing …

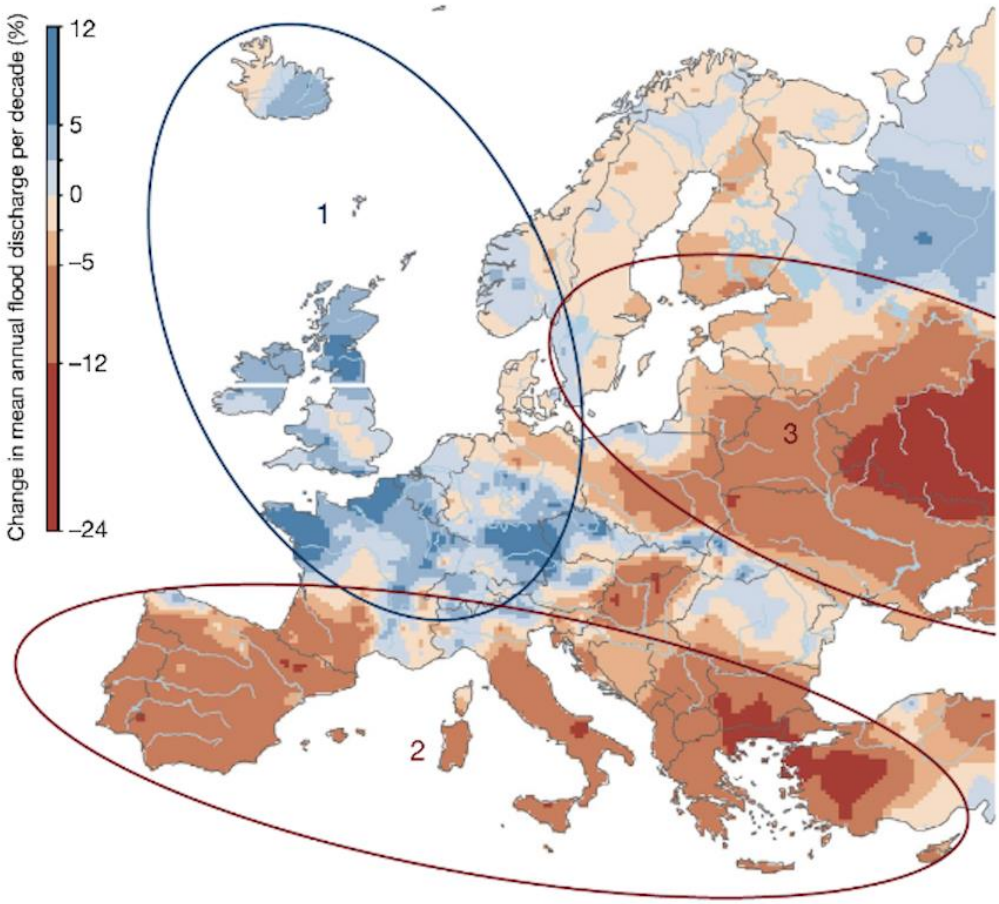


Fig. 1 | Observed regional trends of river flood discharges in Europe (1960–2010). Blue indicates increasing flood discharges and red denotes decreasing flood discharges (in per cent change of the mean annual flood discharge per decade). Numbers 1–3 indicate regions with distinct drivers. 1, Northwestern Europe: increasing rainfall and soil moisture. 2, Southern Europe: decreasing rainfall and increasing evaporation. 3, Eastern Europe: decreasing and earlier snowmelt. The trends are based on data from $n = 2{,}370$ hydrometric stations. For uncertainties see Extended Data Fig. 2b.

Bloeschl et al., Nature, https://doi.org/10.1038/s41586-019-1495-6, 2019

..and annual runoff. Data about monthly and annual riverflow of 916 rivers flowing into the oceans (1948–2004) show for 120 a positive trend and for 51 a negative one (Su et al. J. Hydrol., 2018)

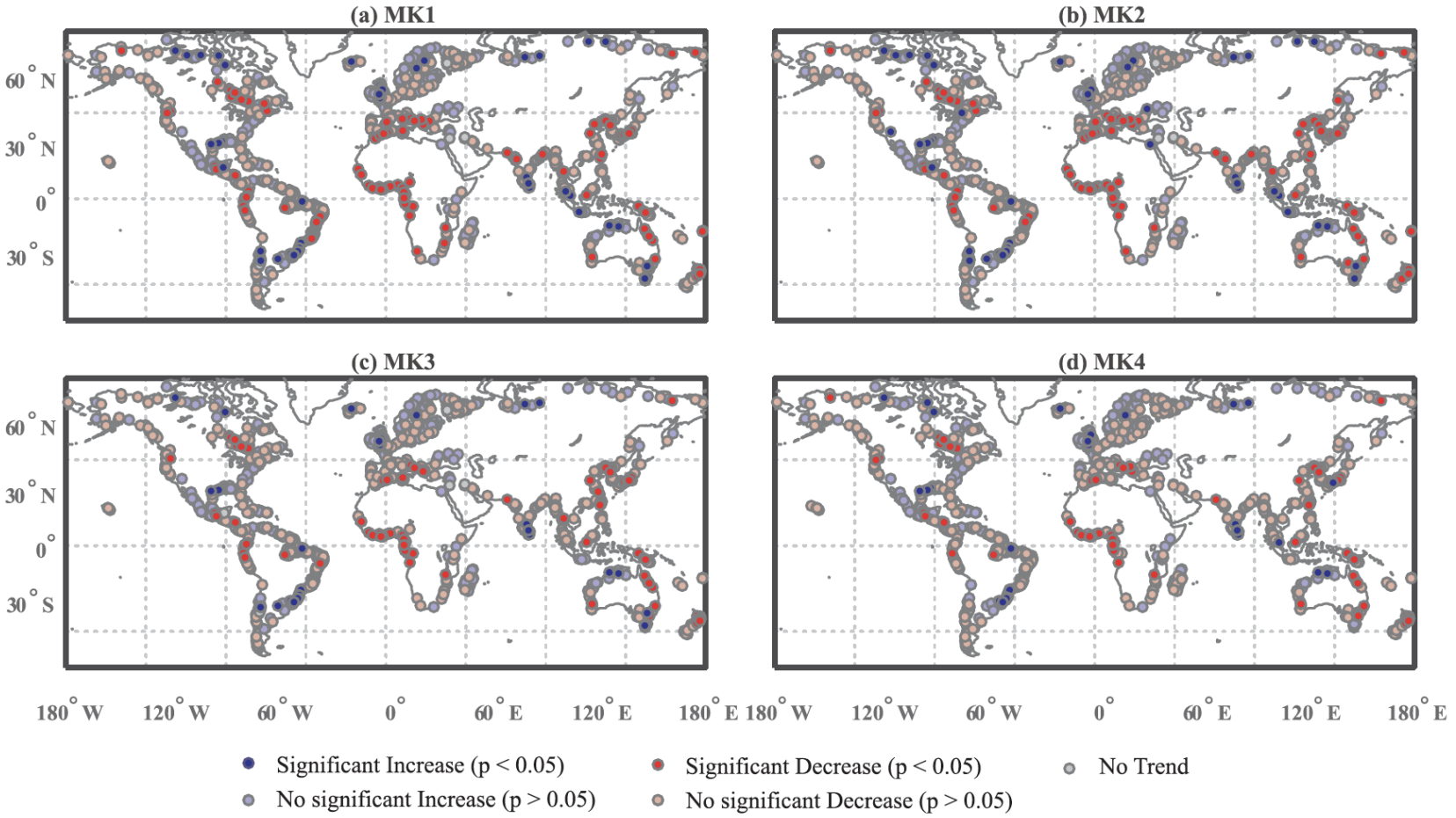


Fig. 3. Spatial distribution of stations with streamflow trends deemed significant by the MK1/MK2/MK3/MK4 tests (5% significance level). Rivers with significant increases in streamflow are represented by dark blue dots; rivers with streamflow increases that were not significant are represented by pale blue dots. Similarly, rivers with significant decreases in streamflow are represented by red dots and rivers with streamflow decreases that were not significant are represented by pink dots. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Adaptation in water engineering design

Funding agencies as the World Bank Group[1] and the Asia Development Bank[2] request more and more frequently that climate change scenarios be included in the engineering design of large water projects

Because of the observed regional variability a consensus is being searched between scientists and professionals on how to upgrade design criteria of water infrastructures including climate change scenarios

IAHR is preparing a Monograph on

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Supported by
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Water engineering design guidance in a changing climate

[1] Asian Development Bank, Guidelines for Climate Proofing Investment in the Energy Sector, Manila, 2013.
[2] World Bank Group, Action Plan on Climate Change. Adaptation and Resilience, Washington DC, 2019.

WORLD BANK GROUP

Climate Change Action Plan 2016–2020

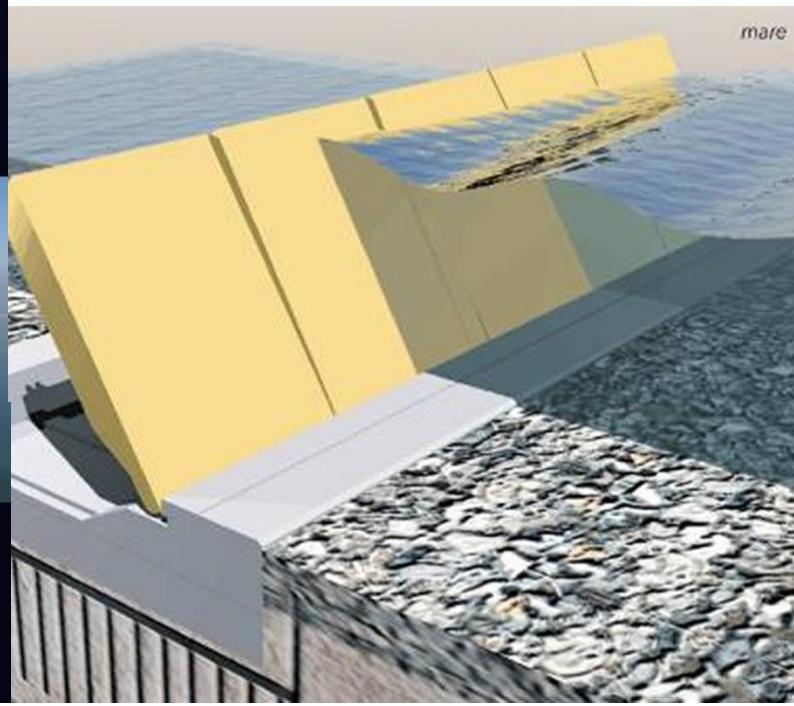
Combination of ‘grey’ and ‘green’ Nature Based Solutions

The adaptation to the observed and projected changes on the water cycle has to be based on a combination of up-to-date traditional ‘grey’ engineering and ‘green’ Nature Based Solutions, for instance in coastal defencs (Venice barriers, Sand motor, mangrove forests) and in regenerating ‘sponge’ cities more resilient to floods and heat -waves

Chang & Mori, Engineering functional evaluation of mangrove forests for coastal disaster reduction, Hydrolink, 4/2019

A mangrove forest on the edge of a remote island in Raja Ampat, Indonesia (gettyimages)

Adaptation & Resilience: the Venice barrier ‘traditional hard’ engineering completed, now operation and management being tested, combined with BwN systems



Water – agriculture and soil conservation

We need to blend advanced technologies with traditional irrigation systems for a sustainable water-efficient agriculture. The so-called VWT-Virtual Water Trade i.e. the trade of food and goods produced in areas rich of water toward countries affected by water scarcity is strongly influenced by new and old challenges, posed by climate change, population growth, trade regulation and food security.

Adaptation: non structural measures, e.g. land use, agricultural practices and 'virtual' water trade

ipcc

INTERGOVERNMENTAL PANEL ON climate change

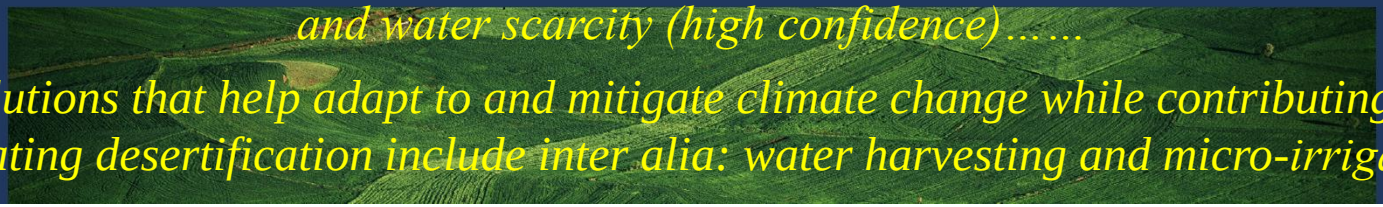
Climate Change and Land

An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems

Summary for Policymakers

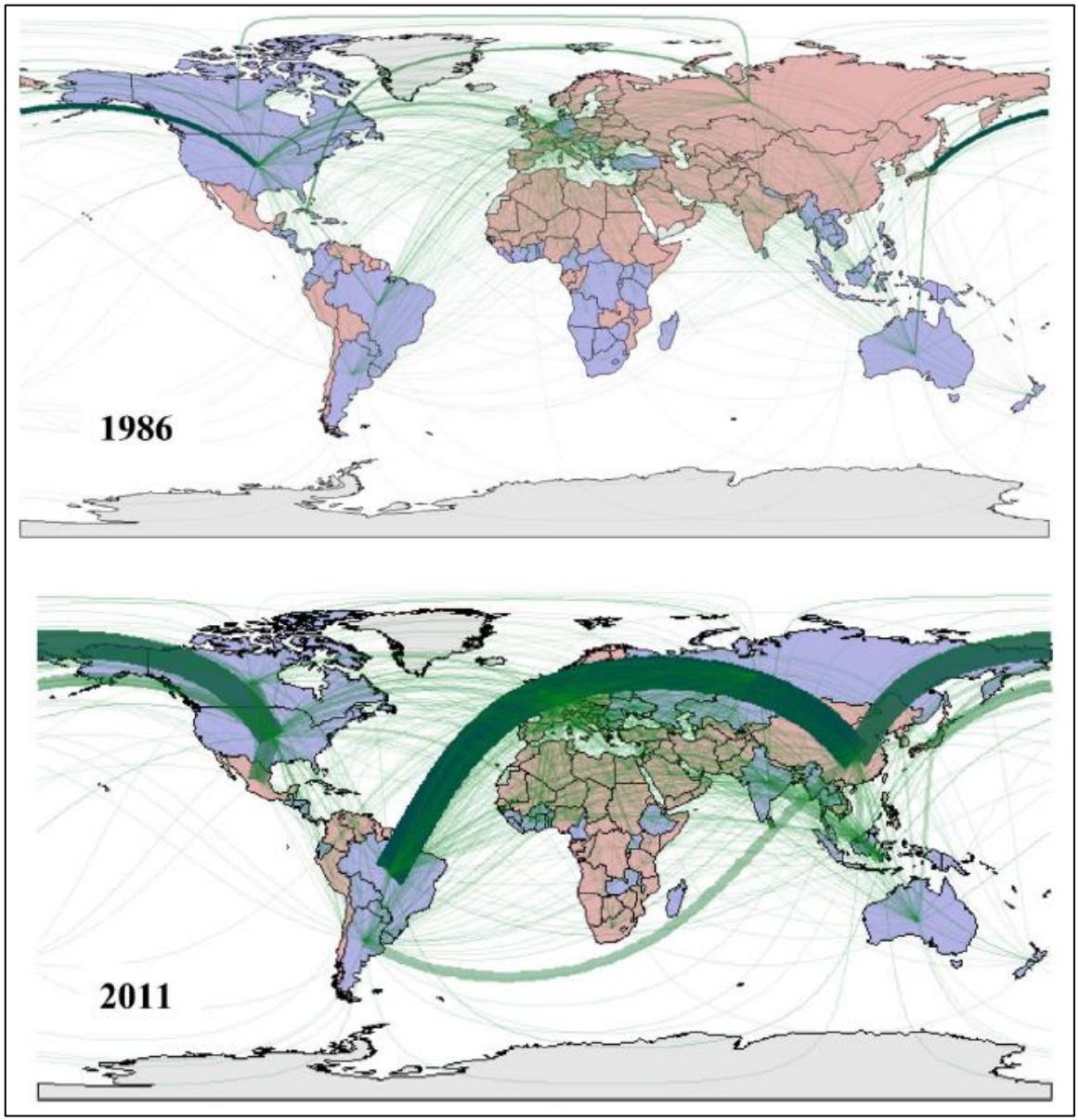
"All assessed future socio-economic pathways result in increases in water demand and water scarcity (high confidence)……

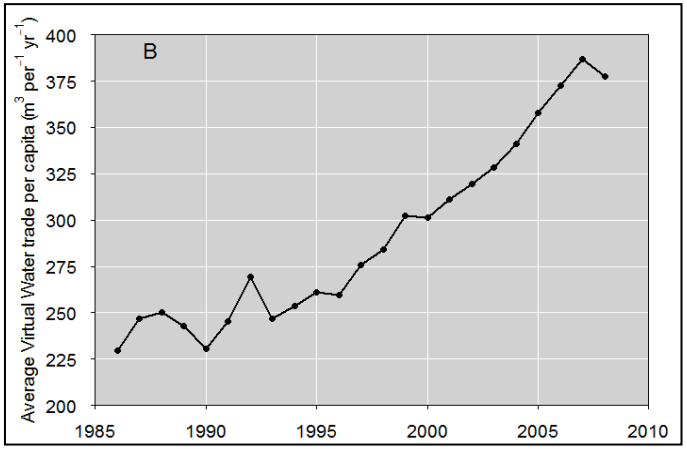
Solutions that help adapt to and mitigate climate change while contributing to combating desertification include inter alia: water harvesting and micro-irrigation"



IPCC Geneva, 2019

Food trade → Virtual water trade





D'Odorico et al.
Global virtual water trade and the hydrological cycle: patterns, drivers and socio-environment impacts.
Environmental Research Letters, 14 (053001), 2019.

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Conclusions

- The impact of CC on the water cycle is evident, although regional variability is high
- Consensus between scientists and professionals in water engineering design
- Combination of ‘grey’ and ‘green’ Nature Based Solutions for adaptation
- Blend advanced technologies with traditional irrigation systems for a sustainable agriculture to combat challenges posed by climate change, population growth, trade regulation and food security.