More efficient irrigation may compensate for increases in irrigation water requirements due to climate change in the Mediterranean area

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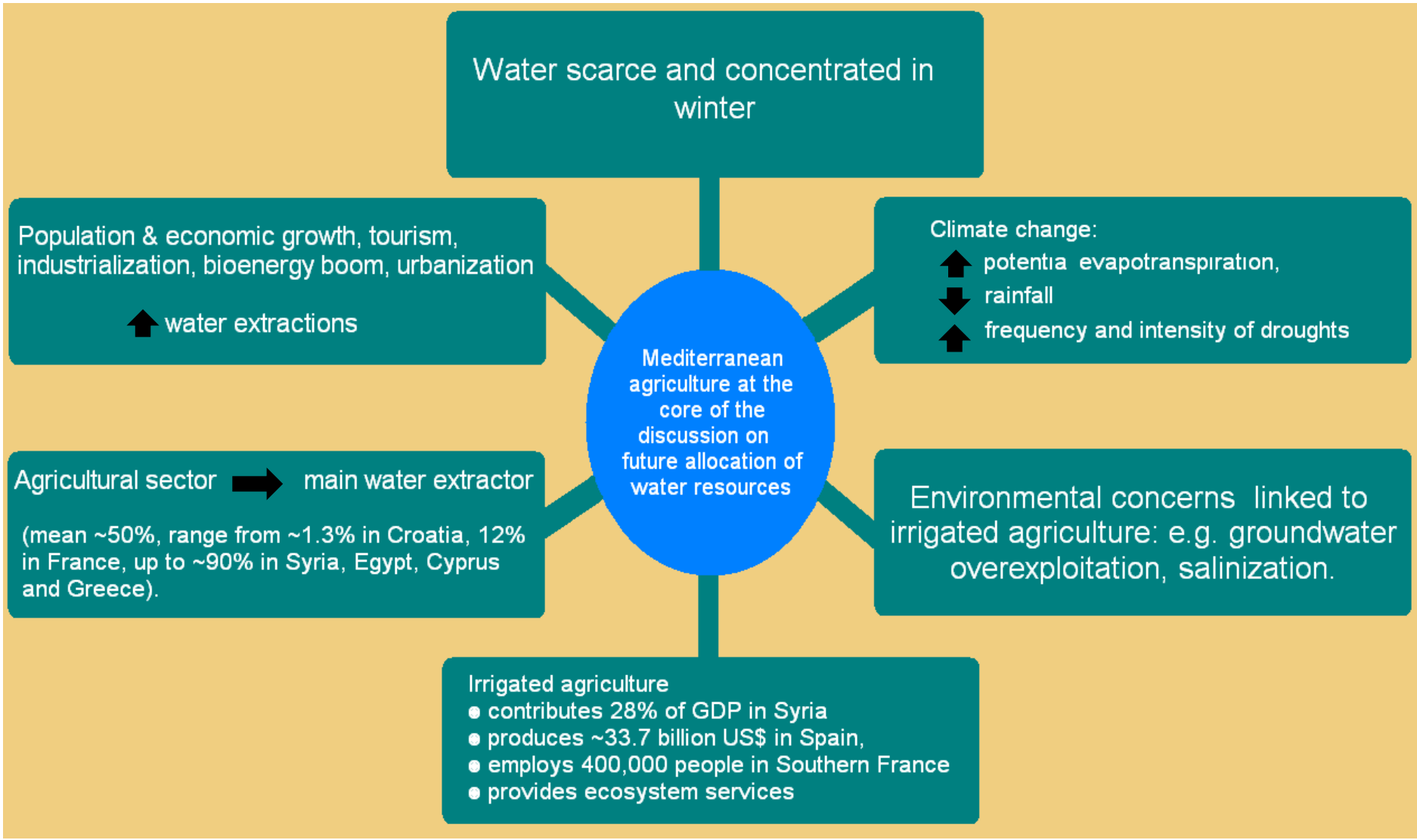
Outline

1. Introduction & research questions
2. Main tool: LPJmL
3. Current irrigation water use and efficiency
4. Irrigation water needs under climate and demographic change
5. Take home messages

Introduction

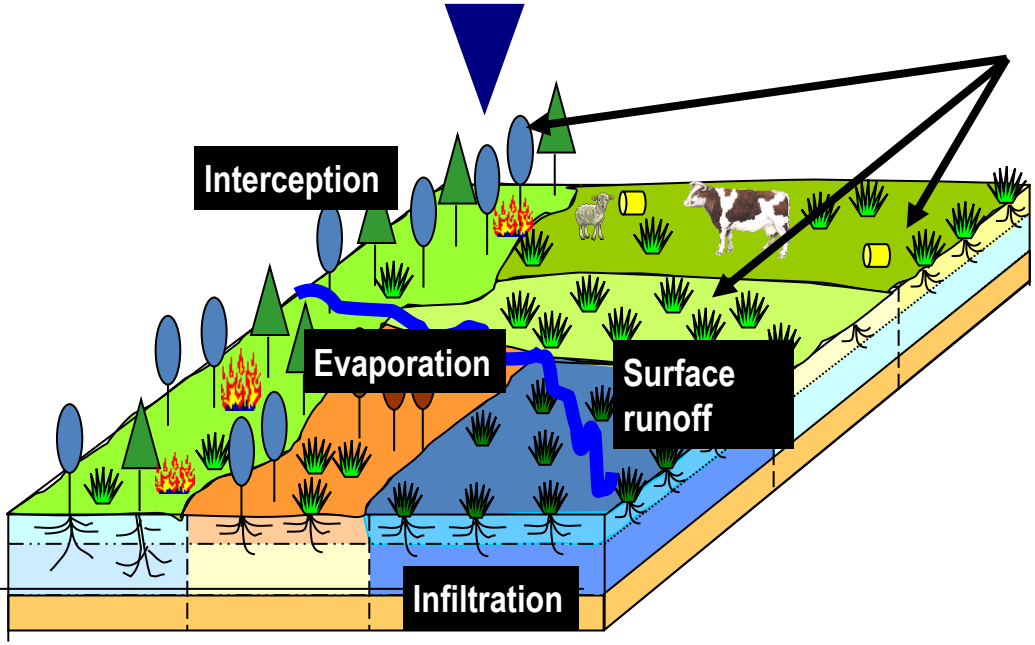


Research questions

1. Irrigation water needs today & water-intensity of crops
2. Countries' potentials for saving water
3. Impact of climate change on irrigation requirements
4. Influence of demographic change and water scarcity in future water requirements

Modelling tool: LPJmL

Climate, CO_2 concentration, soil structure, land use



Irrigated and rainfed agriculture, grasslands, natural vegetation

C, H_2O exchange

Photosynthesis ⇔ Water availability

Phenology Management Production

- River discharge (Gerten et al., 2004; Biemans et al. , 2009)
- Irrigation water requirements (Rost et al., 2008)
- Water consumption of crops (Fader et al., 2010)

(Sitch et al. 2003, Bondeau et al. 2007, Rost et al. 2008, Behringer et al., 2008, Fader et al., 2010, Schapfhoff et al. 2013, Fader et al. 2015a)

10 additional crops included in LPJmL

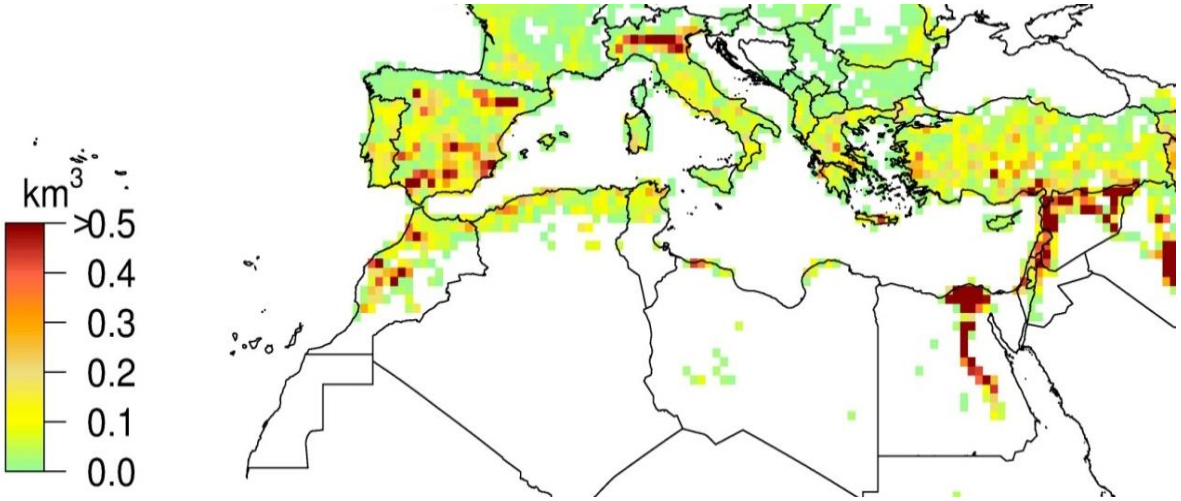
Fruit trees, cotton, nut trees, vegetables, fodder grasses, potatoes olives, graps, date palms

10 additional crops included in LPJmL

1. Land use input
2. Parametrisation
3. Dev. phenology approach
4. Dev. management module
5. Calibration
6. Validation

Current irrigation water needs and efficiencies

Irrigation water requirements today



Average: 2000-2009

Total irrigation water requirements by plants = 128 km^3 = net irrigation water requirements (NIR)

Total water "lost" from source to plant = 95 km^3

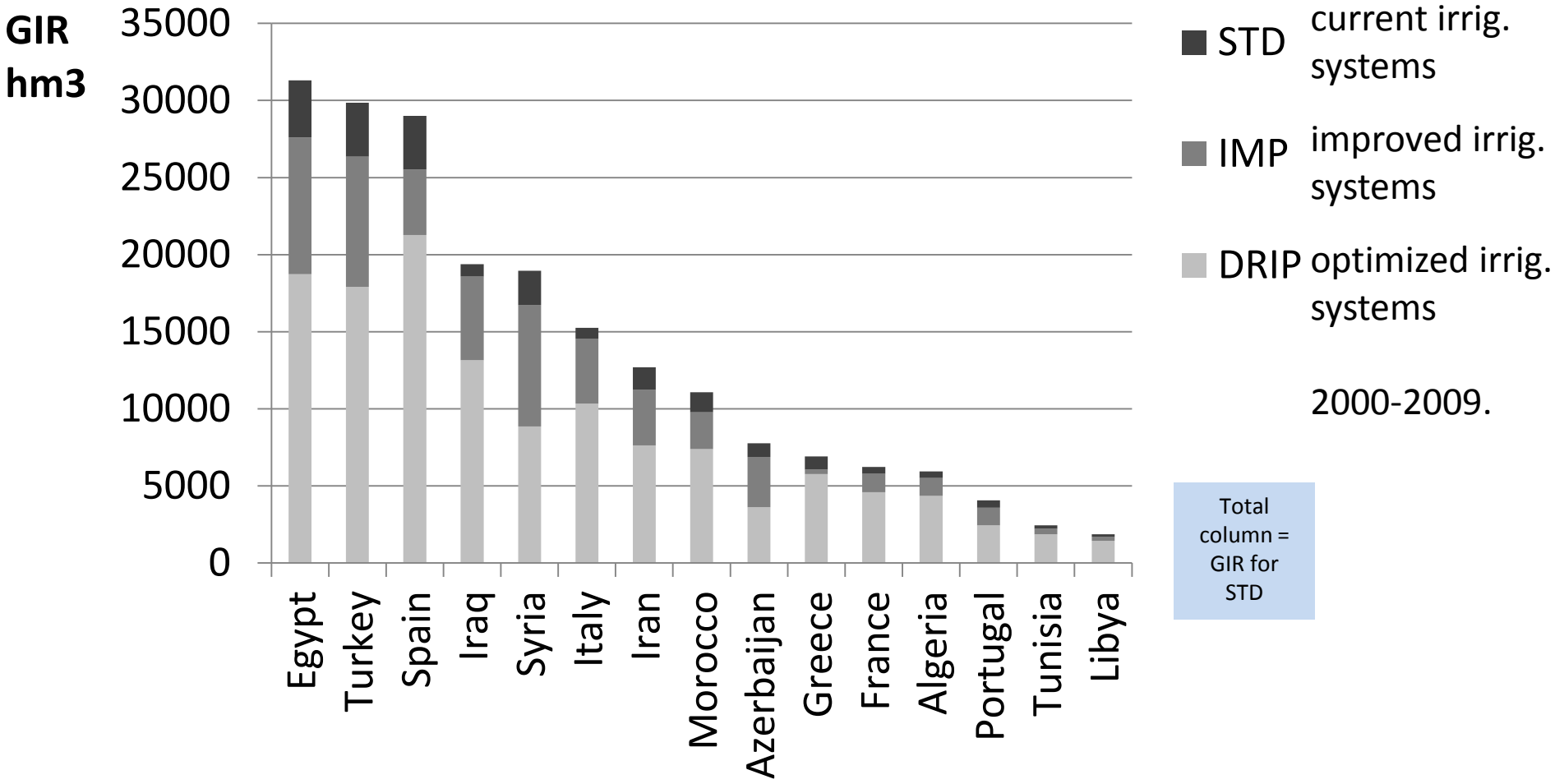
Current water withdrawal from source = 223 km^3 = gross irrigation water requirements (GIR)

Withdrawal using drip irrigation and optimising distribution systems = 143 km^3

That means saving potentials of ~35%

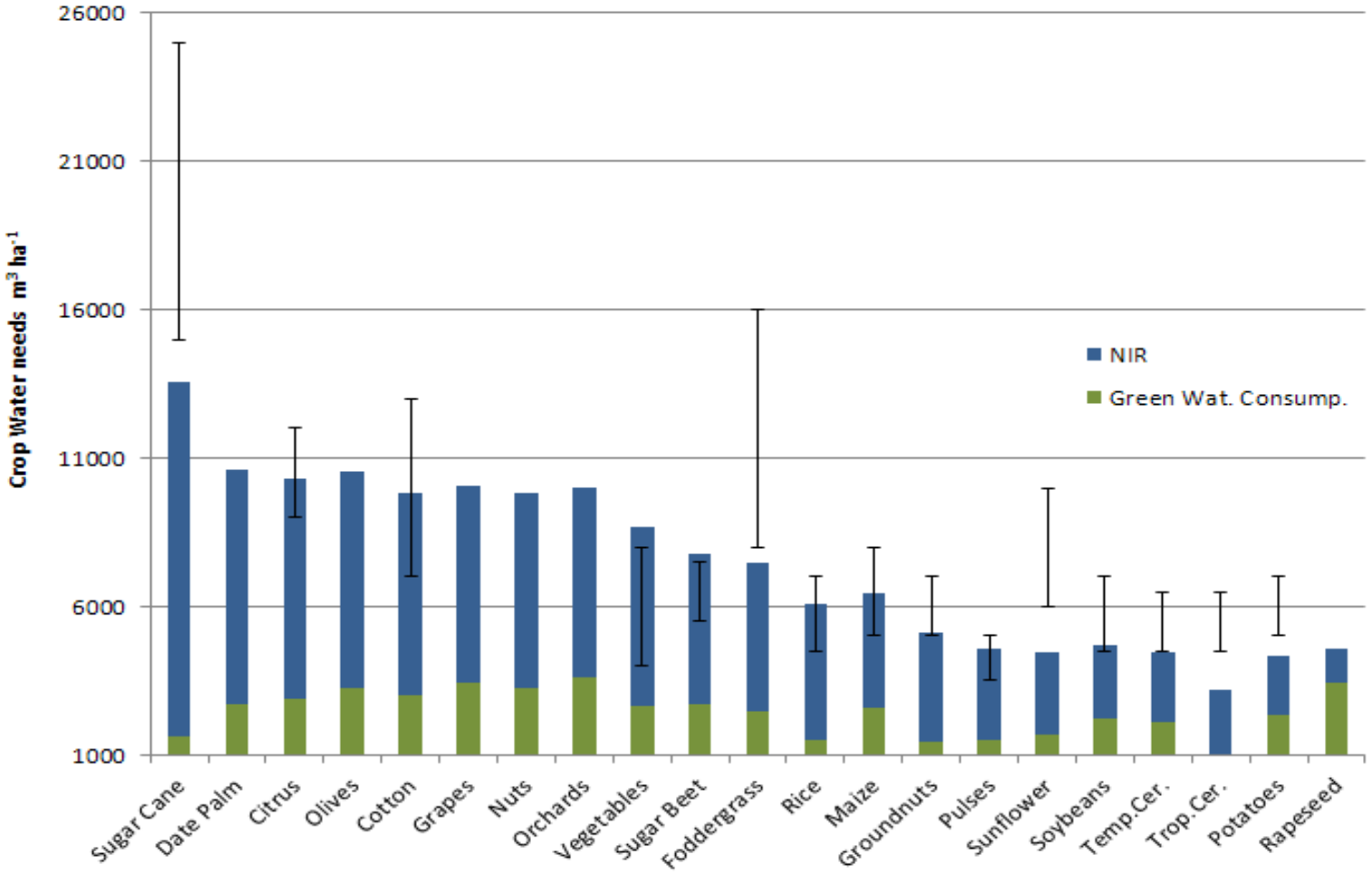
(Fader et al., 2016, HESS)

National gross irrigation water requirements and saving potentials



(Fader et al., 2016, HESS)

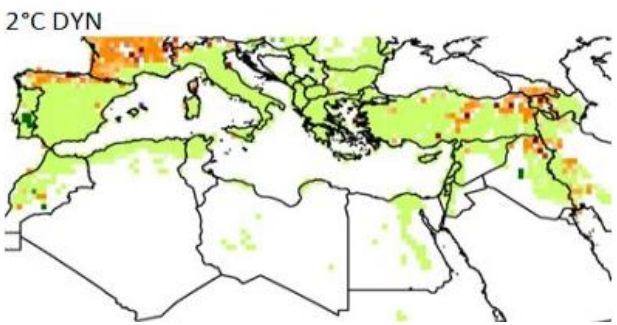
Agricultural trees have higher water requirements

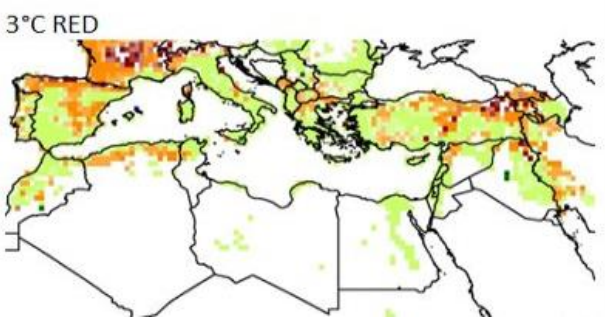


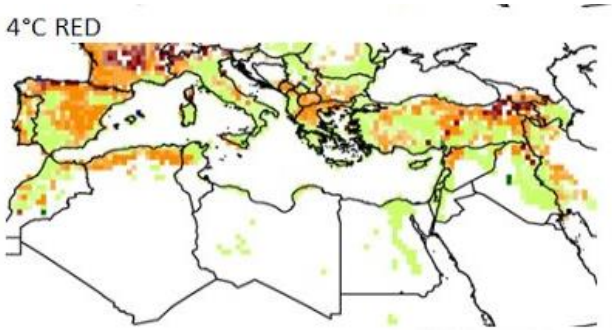
Crops water needs = green water consumption + NIR. Average: 2000-2009. Error bars show the maximum and minimum values for crop water needs published by FAO (1989).

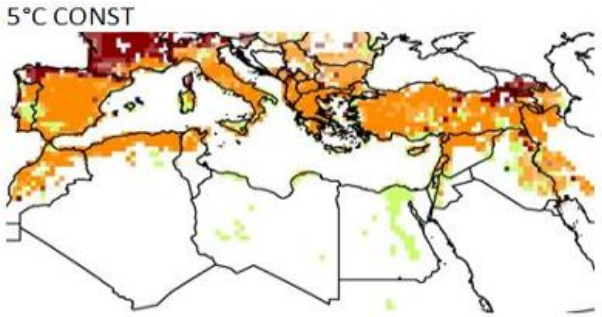
Mediterranean irrigation water requirements under climate and demographic change

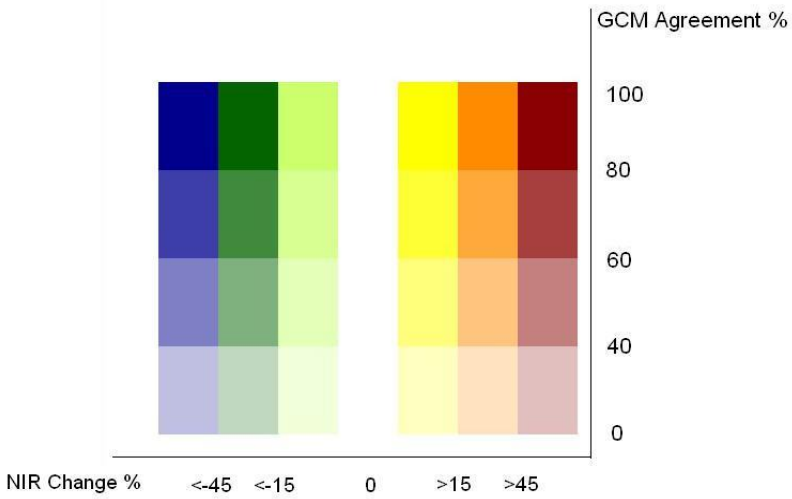
Change in net irrigation requirements (2080-2090)







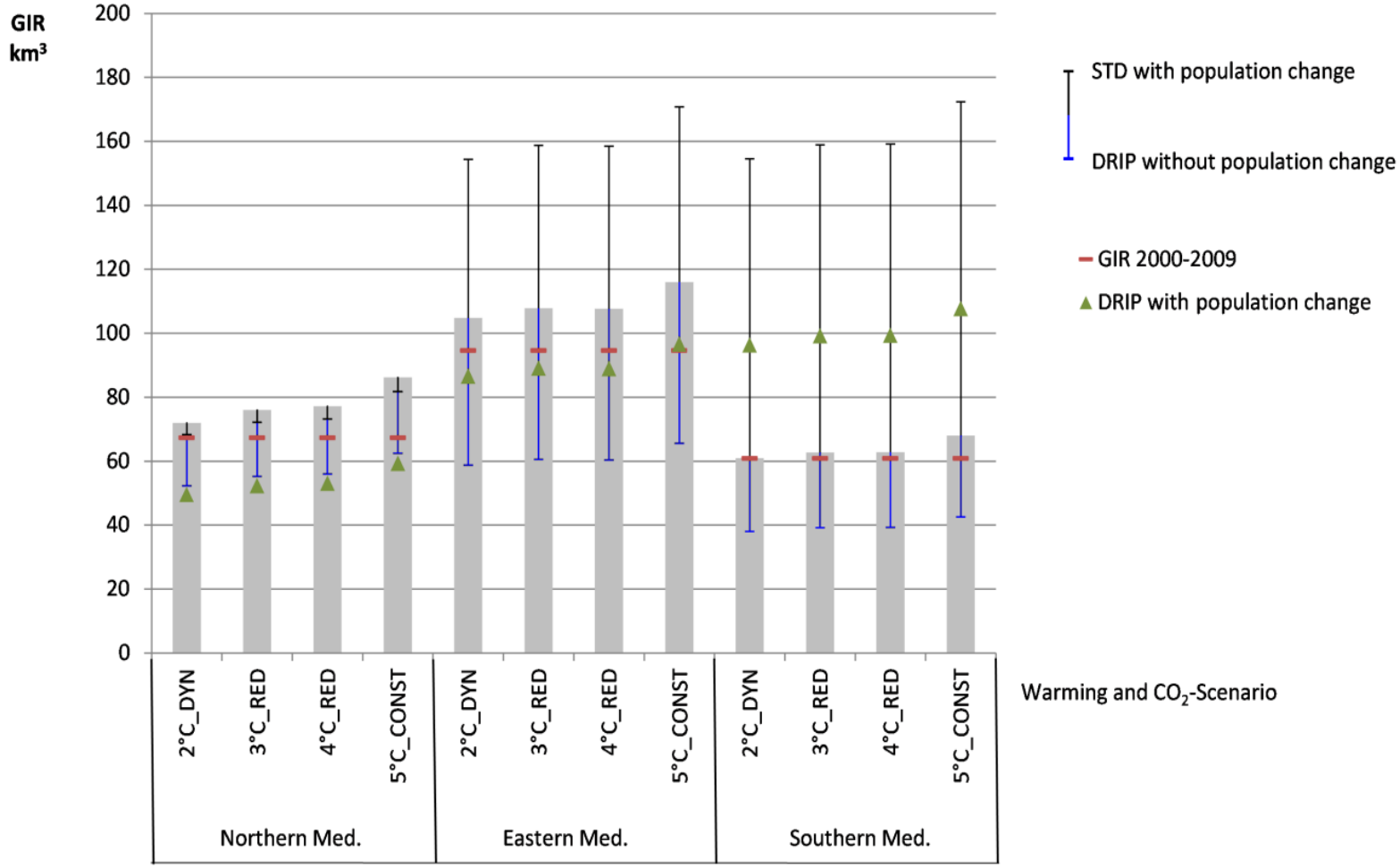




In total ~ 700 runs for different scenarios

(Fader et al., 2016, HESS)

Southern Mediterranean strongest affected by population growth



2080-2090

(Fader et al., 2016, HESS)

Will they have enough water?

- Scenarios of water availability,
  irrigation technology,
  efficiency of conveyance systems,
  management of aquatic ecosystems,
  climate and population growth.
- Algeria, Libya, Israel, Jordan, Lebanon, Syria, Serbia, Morocco, Tunisia and Spain have problems to meet irrigation water requirements in some scenarios (2080-2090).
- That is 10 out of 22 Mediterranean countries!

(Fader et al., 2016, HESS)

Take home messages

Agricultural trees essential for simulation of irrig. requirements & carbon

Mediterranean region could save 35% of water

Climate change will increase irrigation requirements (4-18%)

More efficient irrigation may partially compensate those increases

Population growth may increase irrig. req. even stronger (additionally 56%)

Water scarcity may pose problems for irrigated agriculture in 10 out of 22 countries

More details here ☺

Geosci. Model Dev., 8, 3545–3561, 2015
www.geosci-model-dev.net/8/3545/2015/
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Modelling Mediterranean agro-ecosystems by including agricultural trees in the LPJmL model

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