

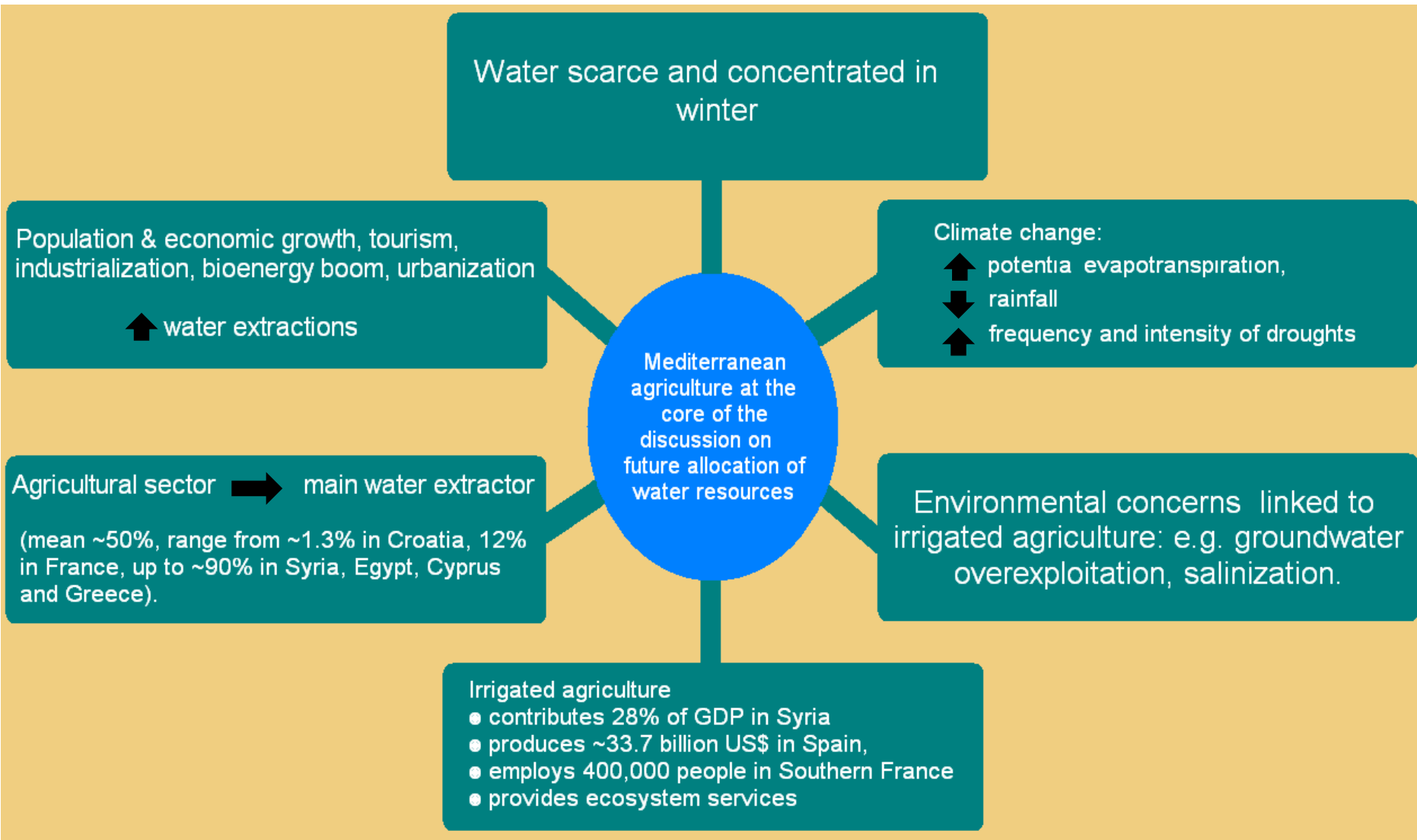
Mediterranean agriculture: More efficient irrigation needed to compensate increases in future irrigation water requirements

Marianela Fader, Sinan Shi,
Werner von Bloh, Alberte
Bondeau, Wolfgang Cramer

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

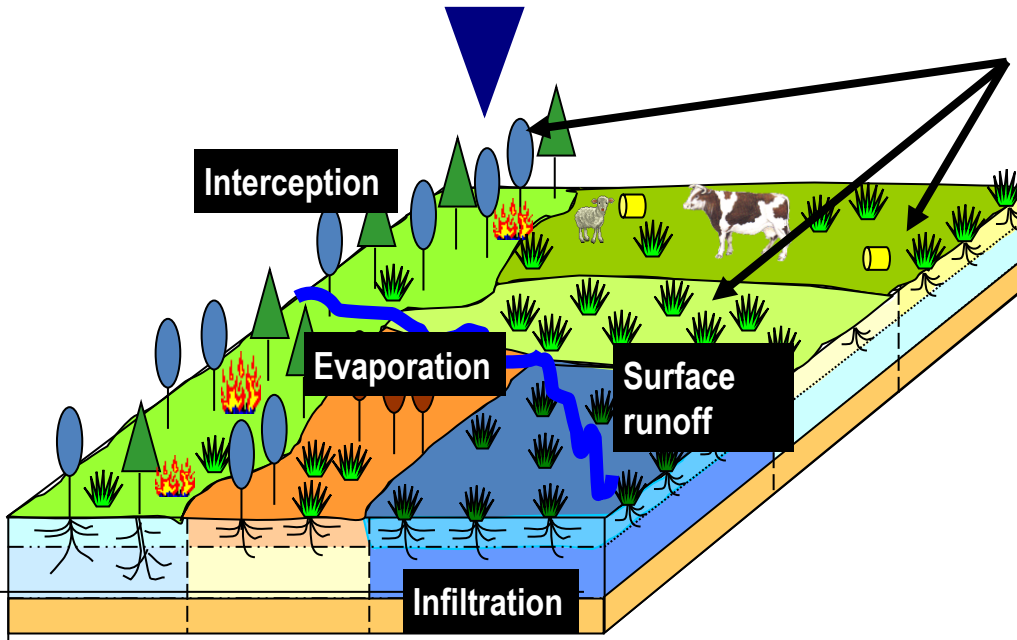


Research questions

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

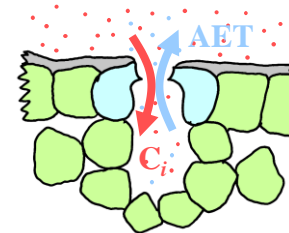
Modelling tool: LPJmL

Climate, CO₂ concentration, soil structure, land use



Irrigated and rainfed agriculture, grasslands, natural vegetation

C, H₂O exchange



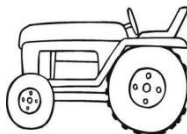
Photosynthesis

⇌
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, Schapfhoef et al. 2013, Fader et al. 2015a)

10 additional crops included in LPJmL

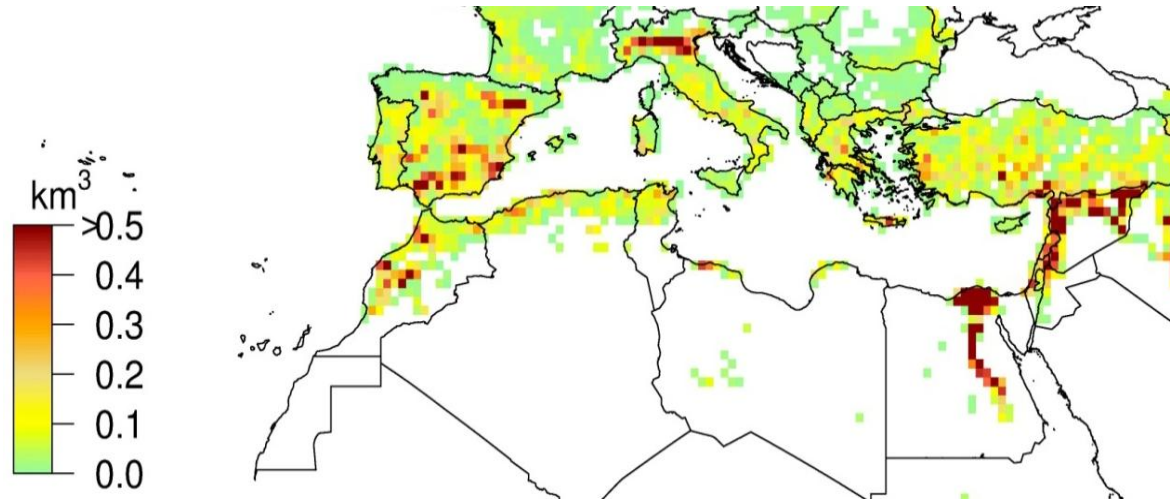
- Fruit trees
- Nut trees
- Citrus trees
- Olive trees
- Potatoes
- Vegetables
- Fodder grasses
- Date Palms
- Cotton
- Grapes

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

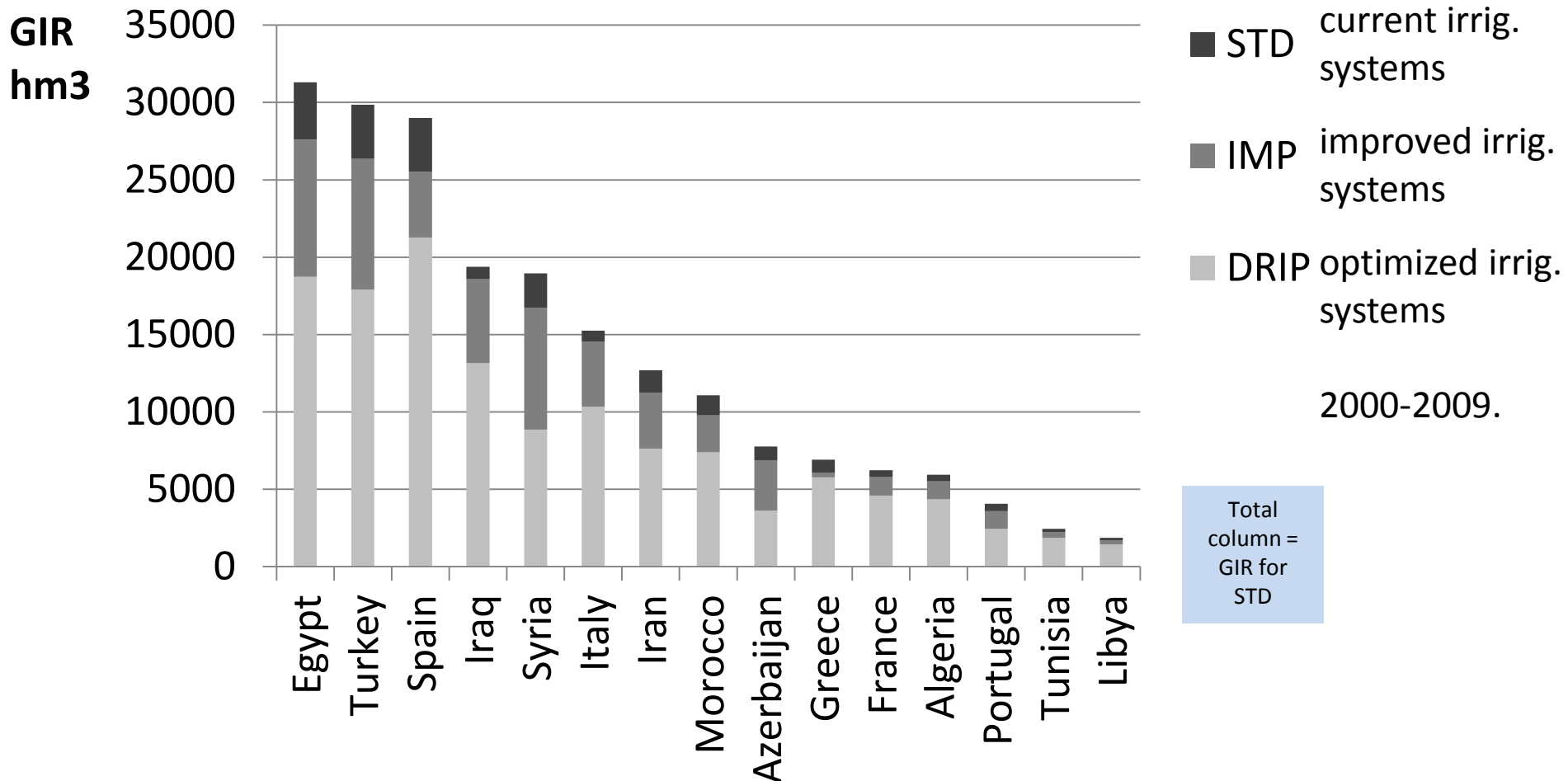
Current water withdrawal from source = 223 km^3 = gross irrigation water requirements (GIR)

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

That means saving potentials of ~35%

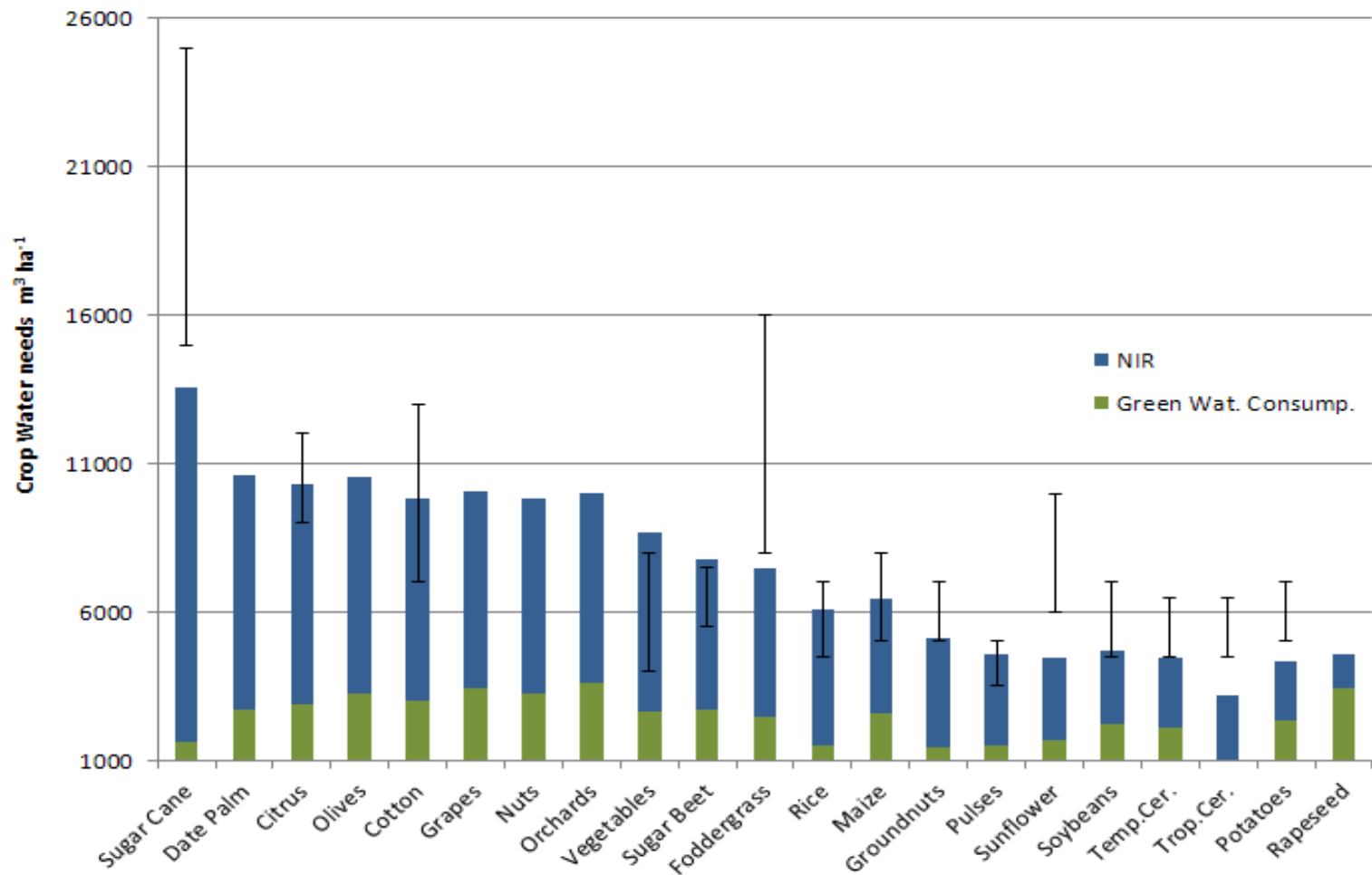
(Fader et al., 2016, HESS)

National gross irrigation water requirements and saving potentials



(Fader et al., 2016, HESS)

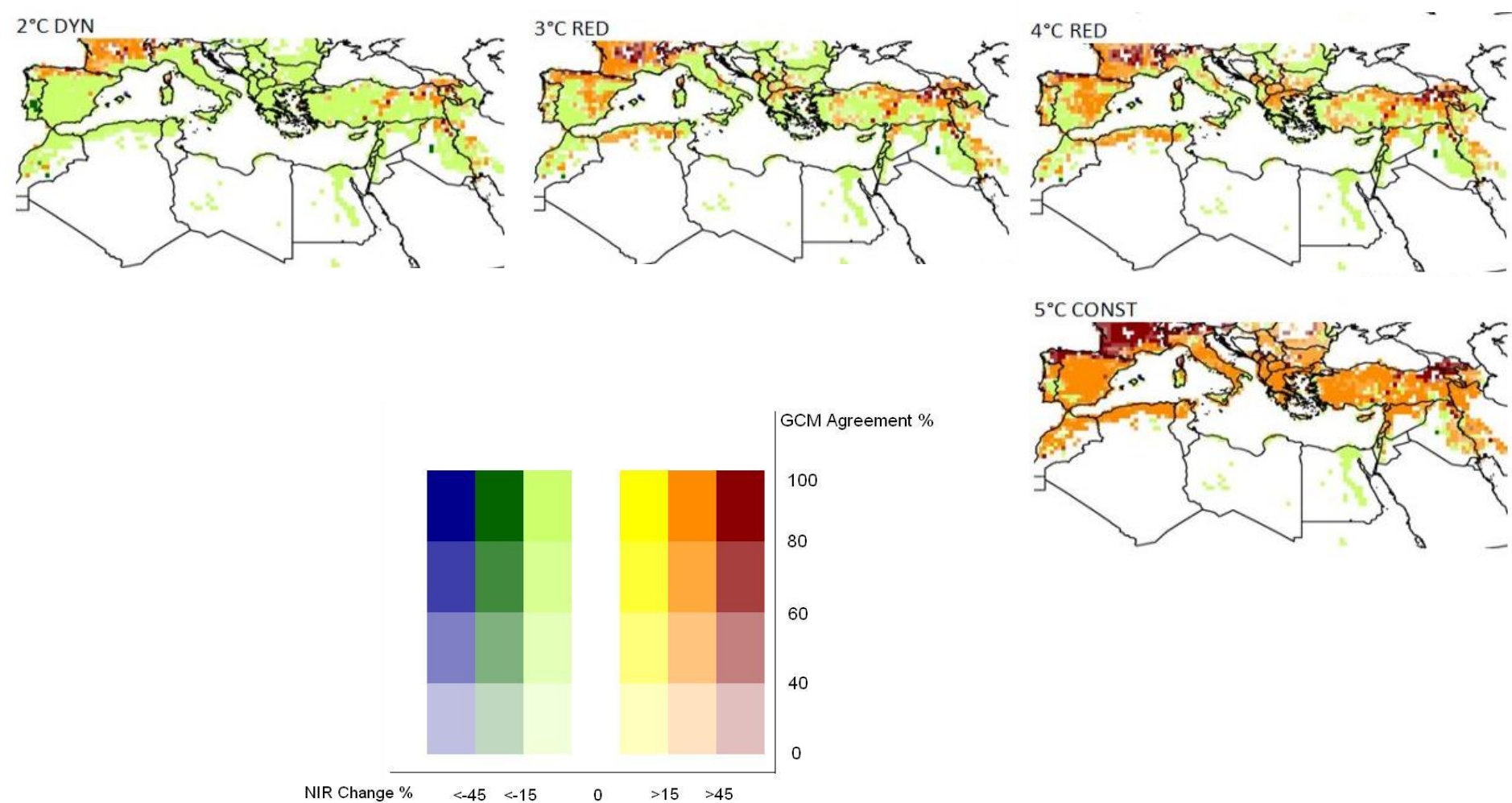
Agricultural trees have higher water requirements



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

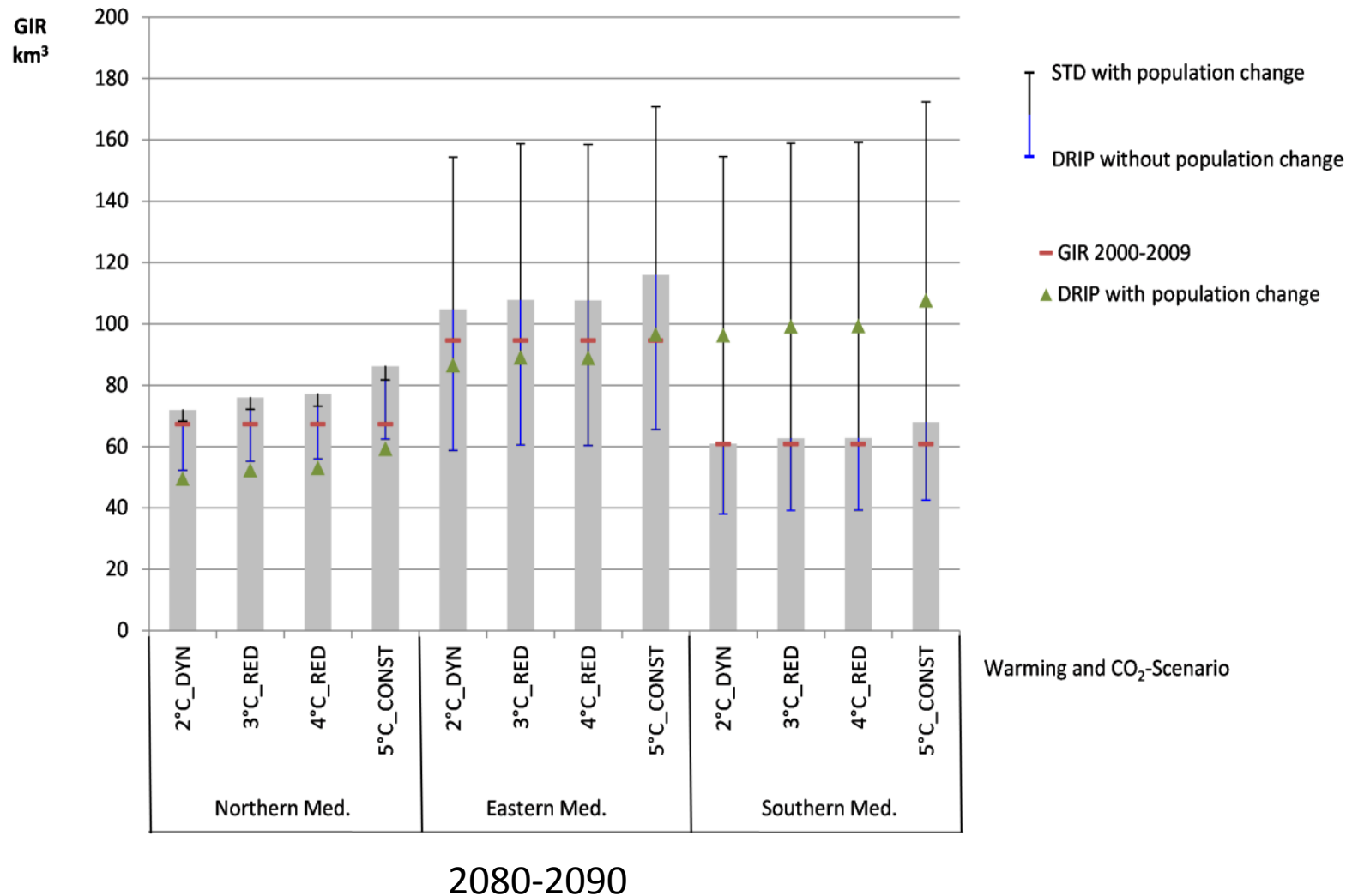
Change in net irrigation requirements (2080-2090)



In total ~ 700 runs for different scenarios

(Fader et al., 2016, HESS)

Southern Mediterranean strongest affected by population growth



(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

1

Agricultural trees essential
for simulation of irrig.
requirements & carbon

Mediterranean
region could save
35% of water

4

2

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

More efficient
irrigation may
partially compensate
those increases

5

3

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

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

6

More details here ☺

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

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Abstract. In the Mediterranean region, climate and land use change are expected to impact on natural and agricultural ecosystems by warming, reduced rainfall, direct degradation of ecosystems and biodiversity loss. Human population growth and socioeconomic changes, notably on the east-

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