Virtual Water Values (ViWA)

GROW – Collaborative Project ViWA:
Multiscale Monitoring of Global Water Resources and
Options for their Efficient and Sustainable Use

viwa.geographie-muenchen.de/viwa-marketplace/
Side-Event on Friday, Oct 23, 10:00 a.m.

ViWA – science issues

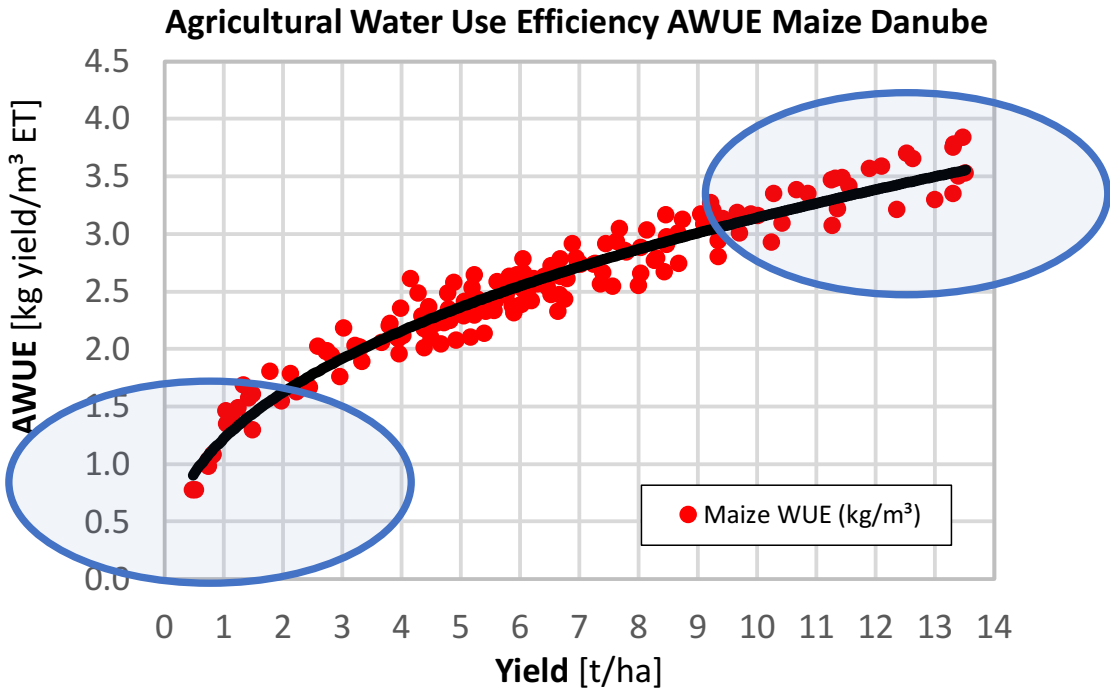
- Agriculture uses 92 % of all green and blue water (rainwater, irrigation). Water-inefficient, wasteful agriculture withholds water from natural ecosytems and human use without any gain for both. Monitoring and improving agricultural water use efficiency (AWUE) contributes to SDGs 2 and 6.

- Sustainable development postulates that natural resources, like water, be used with the highest possible sustainable efficiency; globally – regionally – locally.

- The ViWA question consequently is not
  - "how much virtual water is used by agriculture?"

  but

  - "how can water use in agriculture become more efficient and sustainable?"



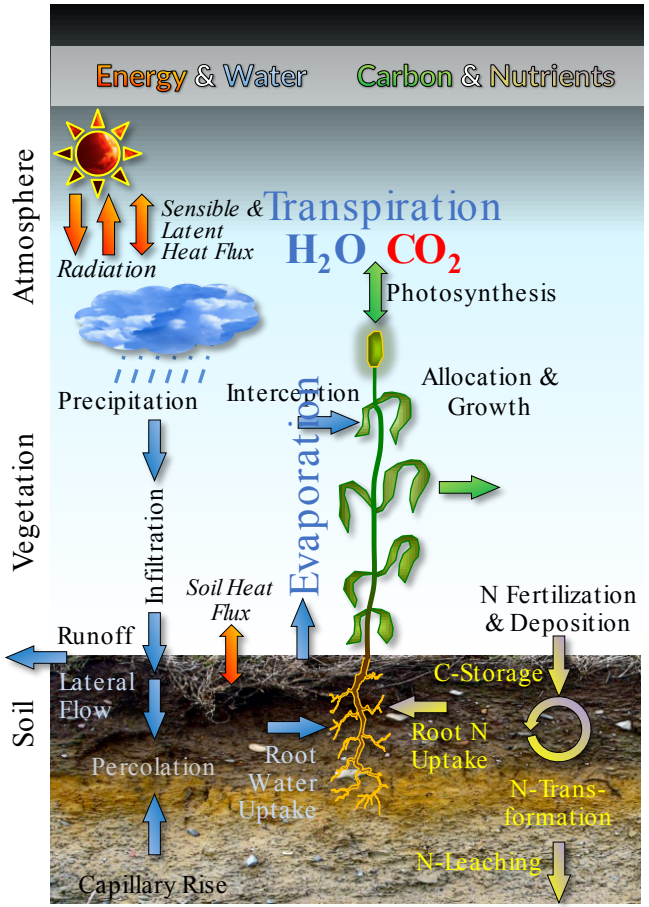
ViWA – Three Research Goals

ViWA aims at improving practical understanding of efficiency and sustainability in agricultural water use. On the global, regional and local scale!

1. How can AWUE be monitored globally and regionally using big environmental data that informs water-food-energy simulations?

ViWA – Highlights

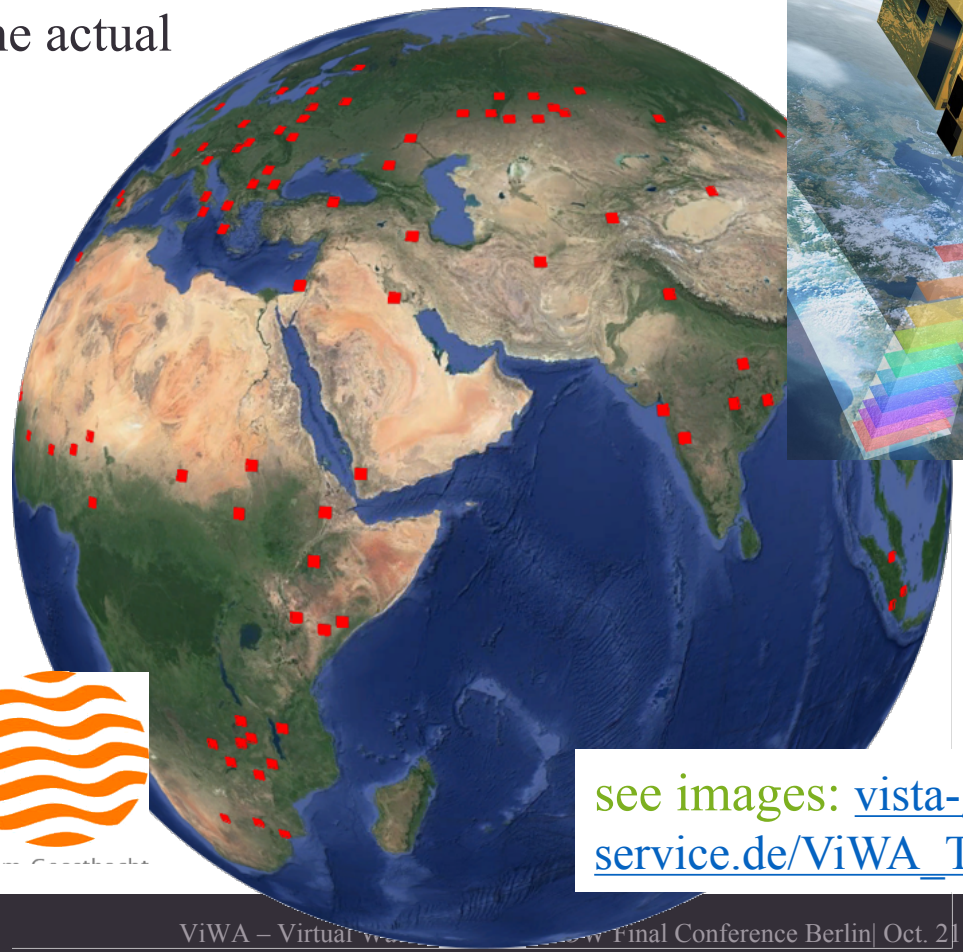
Global Agricultural Water Use Efficiency (AWUE) Monitor

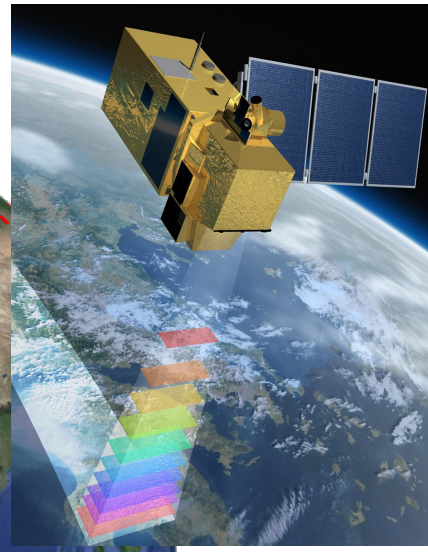


Crop growth simulations informed by satellite observations determine actual AWUE and yields.

Big Environmental Data: 15000 Sentinel-2 images have been analysed.

High Performance Environmental Computing: global simulations with 1km/1h resolution





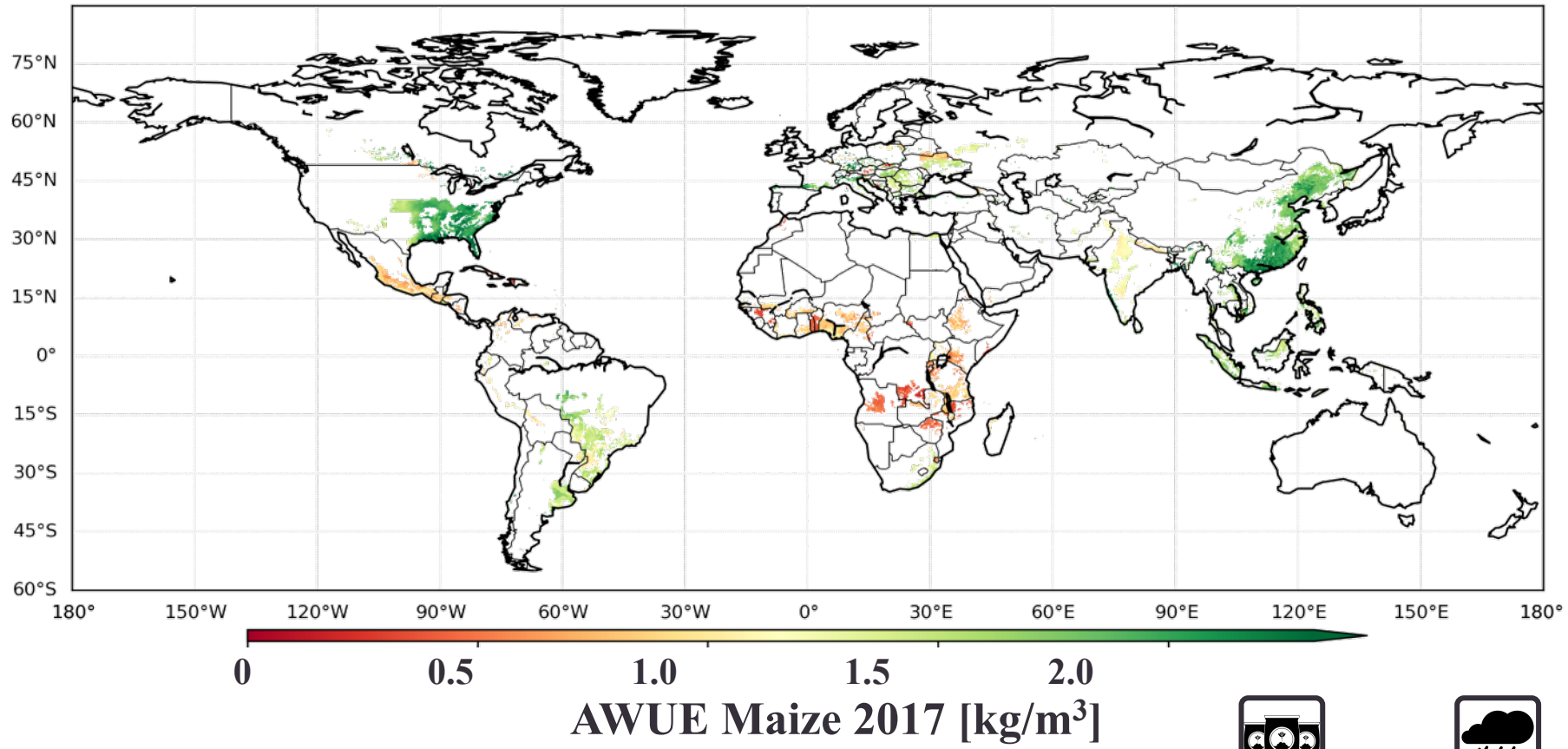
see images: vista-geo-service.de/ViWA_Testsites/

ViWA – Highlights

Global **A**gricultural **W**ater **U**se **E**fficiency (AWUE) Monitor

Map shows a result of global AWUE for Maize 2017 under real management conditions (fertilization, irrigation).

All results will be made available through foodsecurtity-tep.net



Visit:
ViWA.geographie-muenchen.de/ViWA-marketplace

realistic

realistic

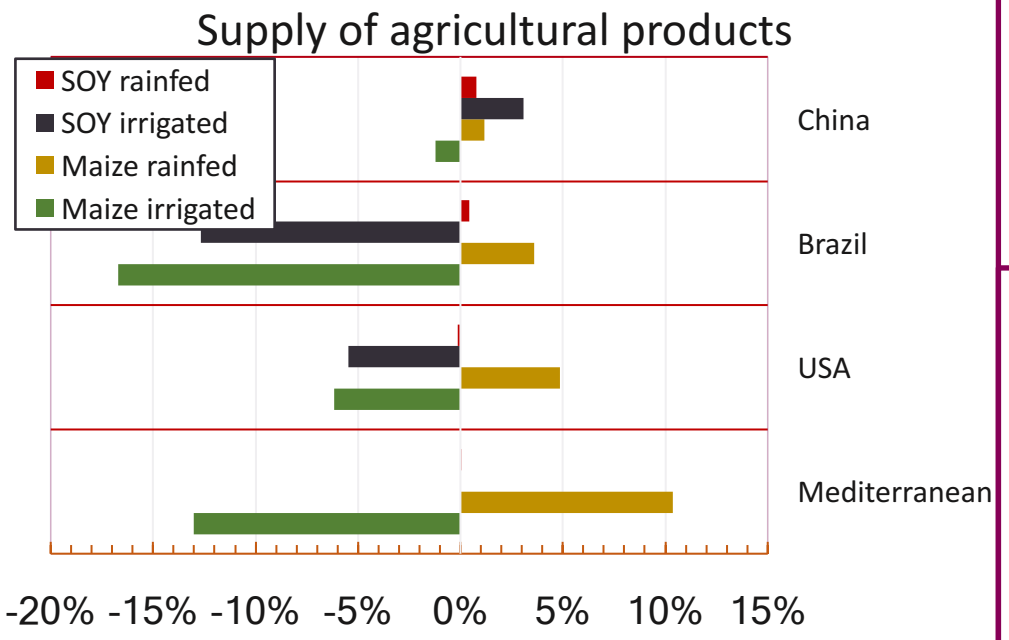
ViWA – Three Research Goals

ViWA aims at improving practical understanding of efficiency and sustainability in agricultural water use. On the global, regional and local scale!

1. How can AWUE be monitored globally and regionally using big environmental data that informs water-food-energy simulations?
2. How can improvements in AWUE best be incentivised through its consideration in ecological and economic analyses of water use and food trade scenarios?

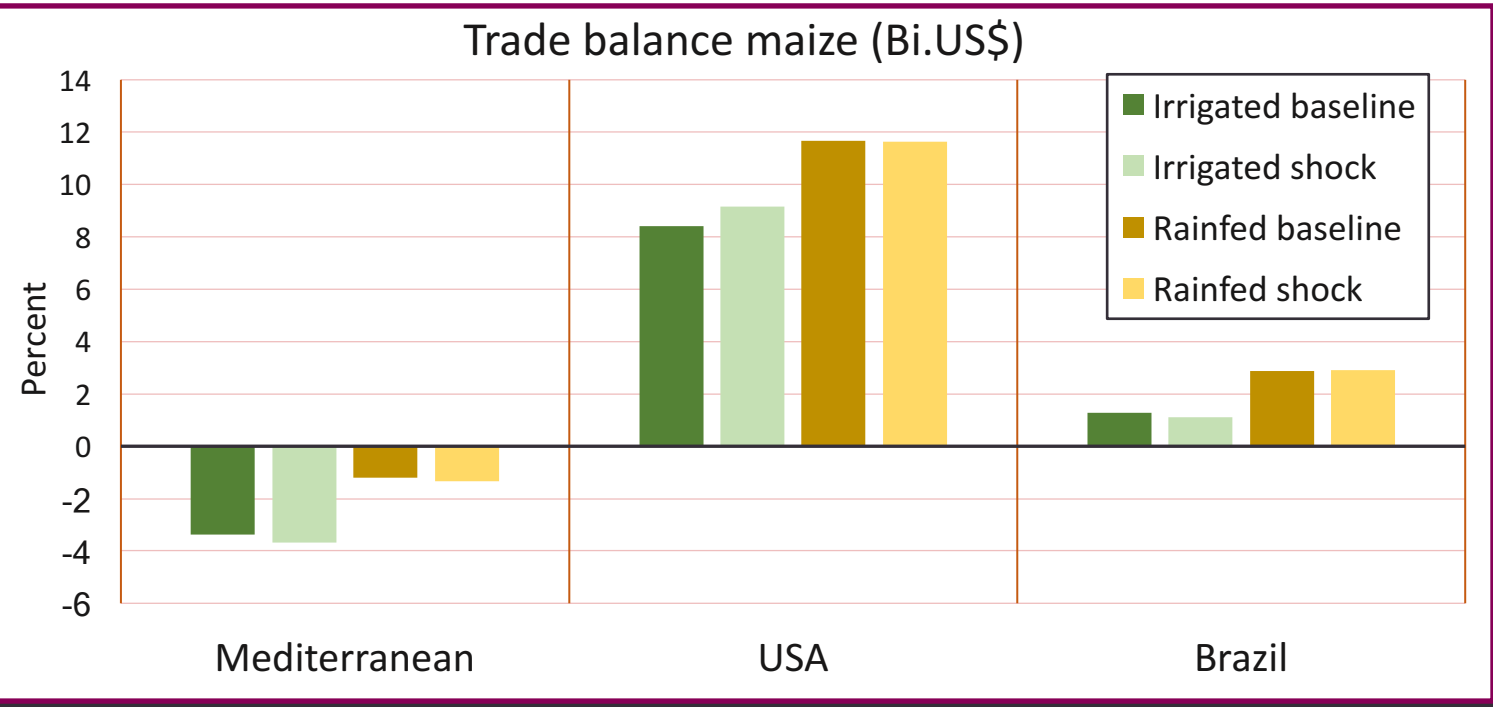
ViWA – Highlights

CGE-Simulations of Policy Impacts: Pricing of Irrigation Water



Simulation based on the ART-model of the Kiel Institute for the World Economy

Scenario: Introduction of water pricing for irrigation globally on all agricultural land and crops



ViWA – Three Research Goals

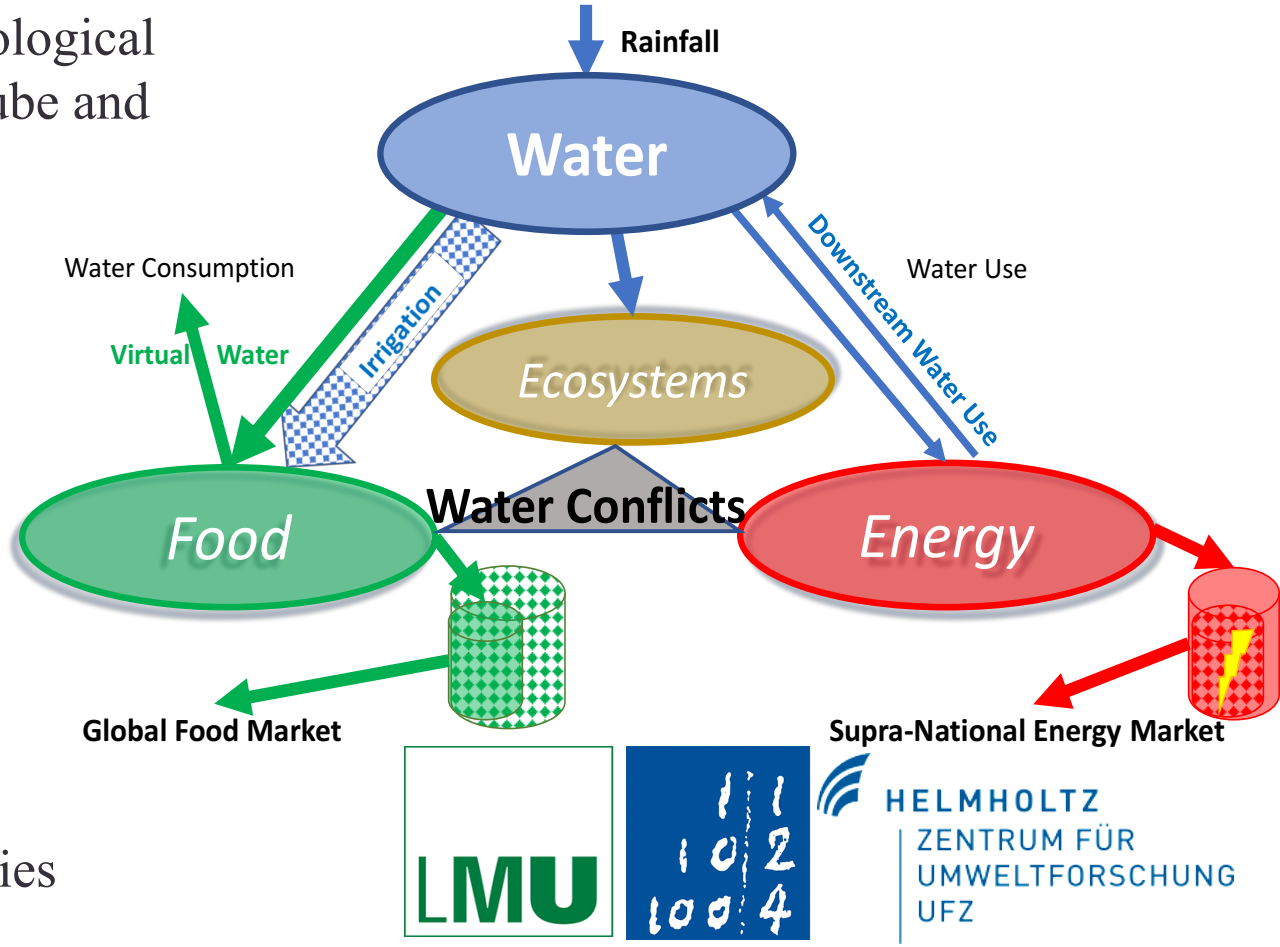
ViWA aims at improving practical understanding of efficiency and sustainability in agricultural water use. On the global, regional and local scale!

1. How can AWUE be monitored globally and regionally using big environmental data that informs water-food-energy simulations?
2. How can improvements in AWUE best be incentivised through its consideration in ecological and economic analyses of water use and food trade scenarios?
3. How can regional water-food-energy conflicts be analysed and negative ecological impacts be assesed?

ViWA – Highlights

Regional Water-Food-Energy-Ecosystems Assessment

ViWA analyses water-food-energy conflicts and their ecological consequences in large transnational basins, like the Danube and the Zambesi.

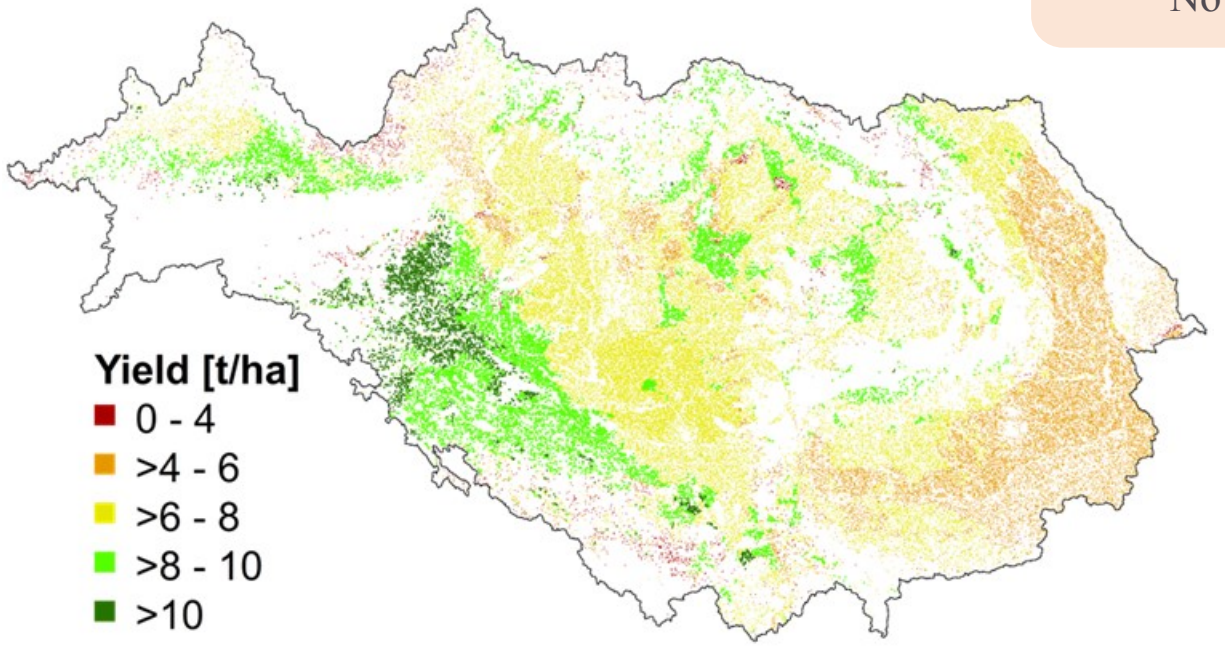


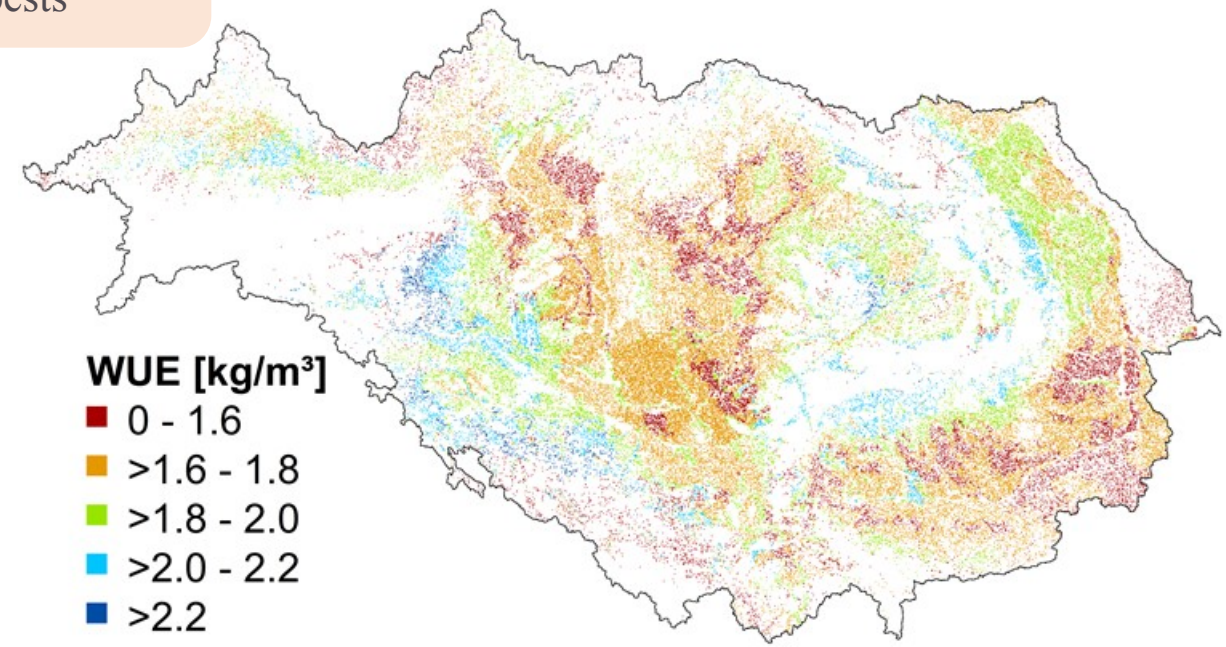
Use Case: expansion of irrigation in the Danube basin
- the case of maize
- Lower Danube Contries push for expansion
- ICPDR uses our simulations to inform national Ministries

Taking maize as an example: actual situation yield + AWUE

Mean actual yield (2015-2018)

Rainfed,
standard fertilization,
No pests



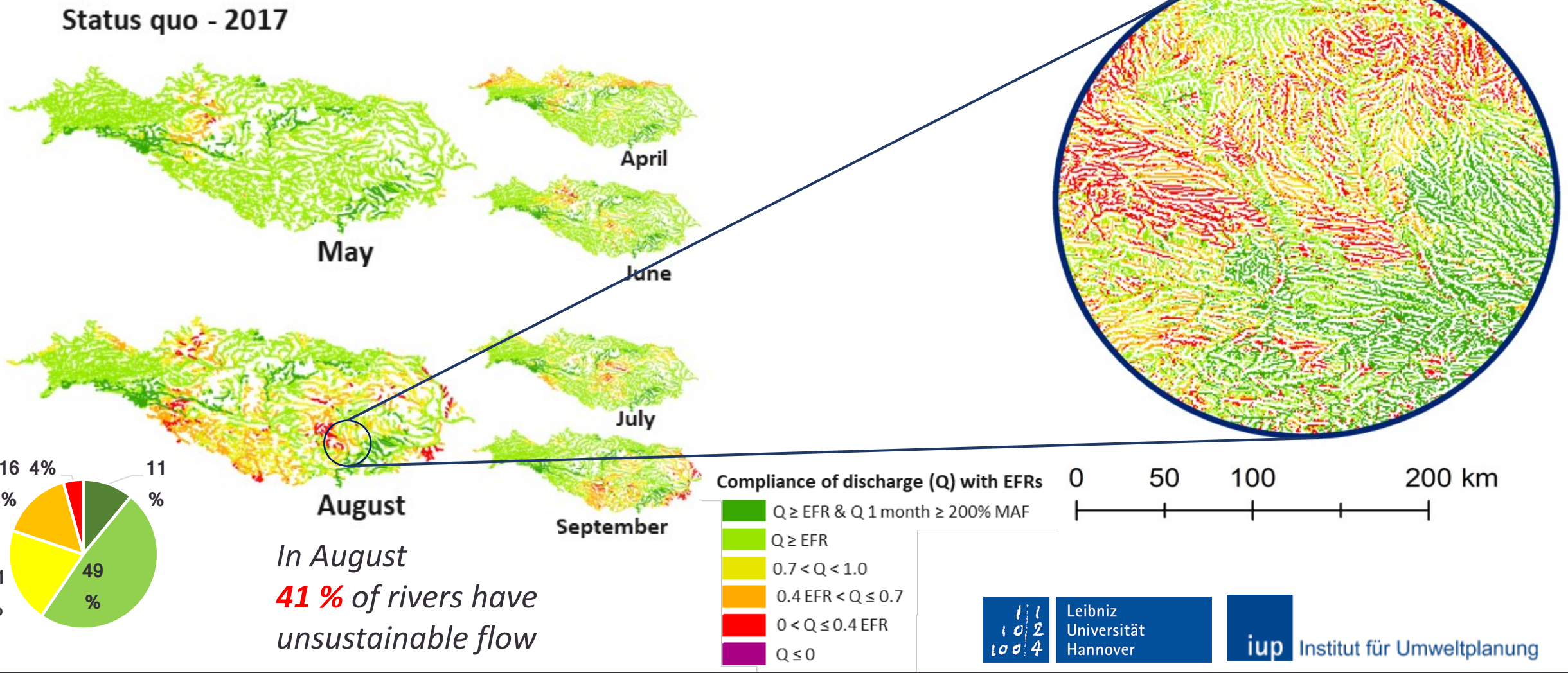


Modelled maize yield: **6.9 t/ha**
EUROSTAT (Danube countries): **6.8 t/ha**

Total production: **40.2 Mio t**

mean WUE maize : 1.8 kg/m³

Taking maize as an example: actual situation Ecological Sustainability Assessment



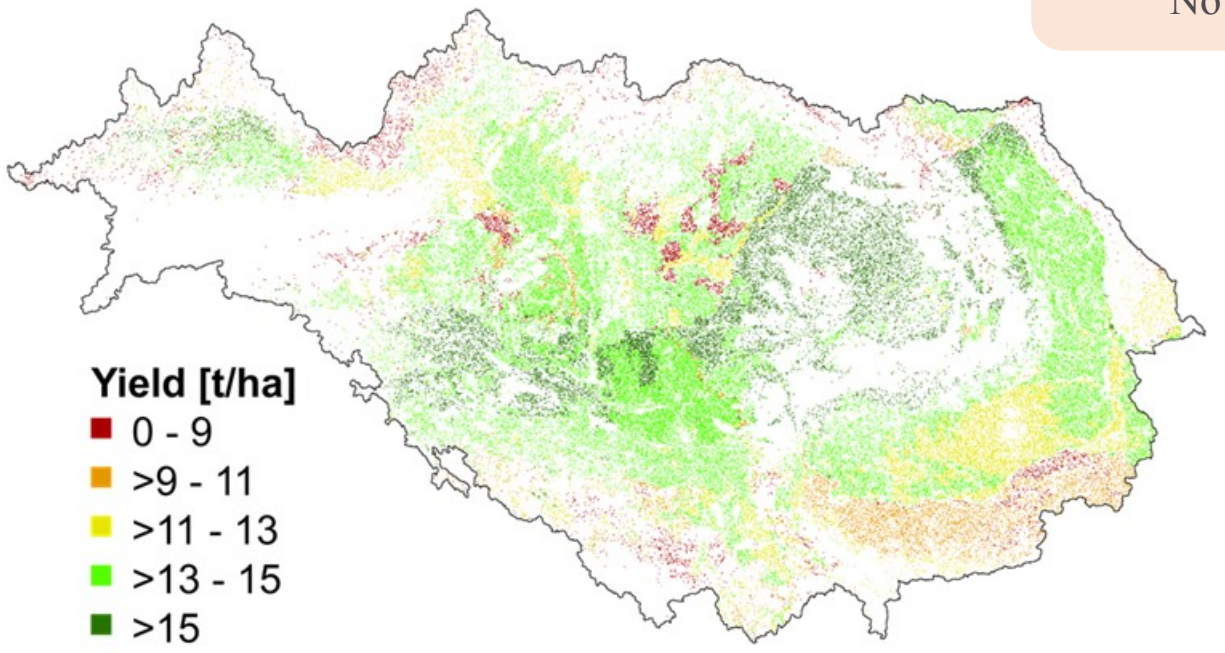
In August
41 % *of rivers have unsustainable flow*

Leibniz Universität Hannover
iup Institut für Umweltplanung

What happens, if large-scale irrigation is introduced? yield + AWUE

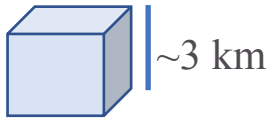
Full irrigation,
Full fertilization,
No pests

Mean potential yield (2015-2018)

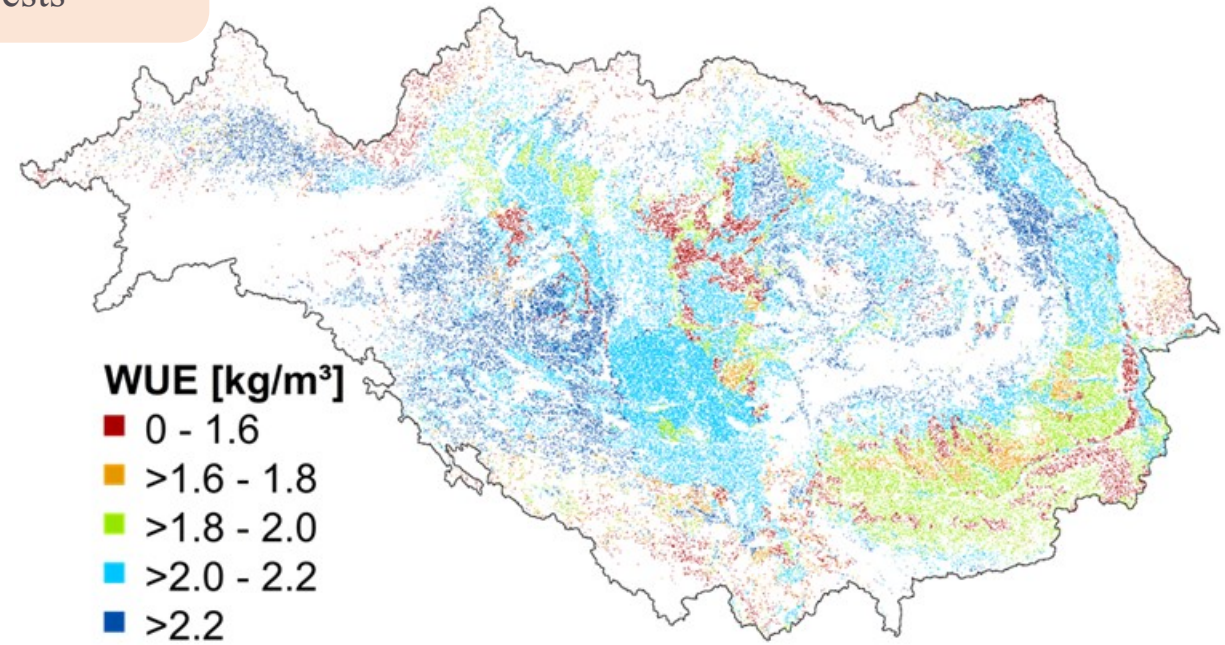


Modelled maize yield: **13.4 t/ha**
Total production: **77.8 Mio t**

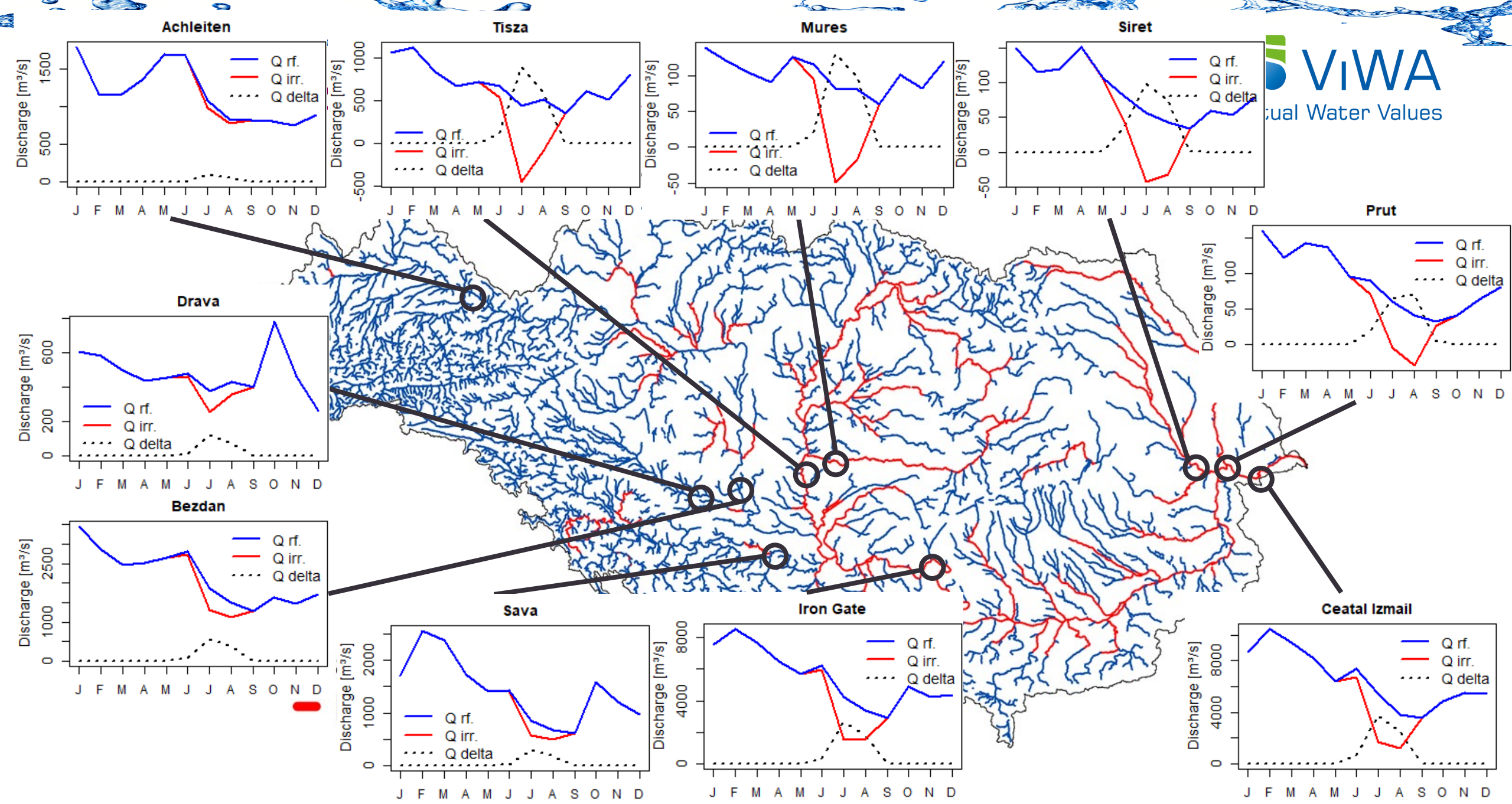
Total irrigation water: **29 Gm³**



Mean potential WUE (2015-2018)

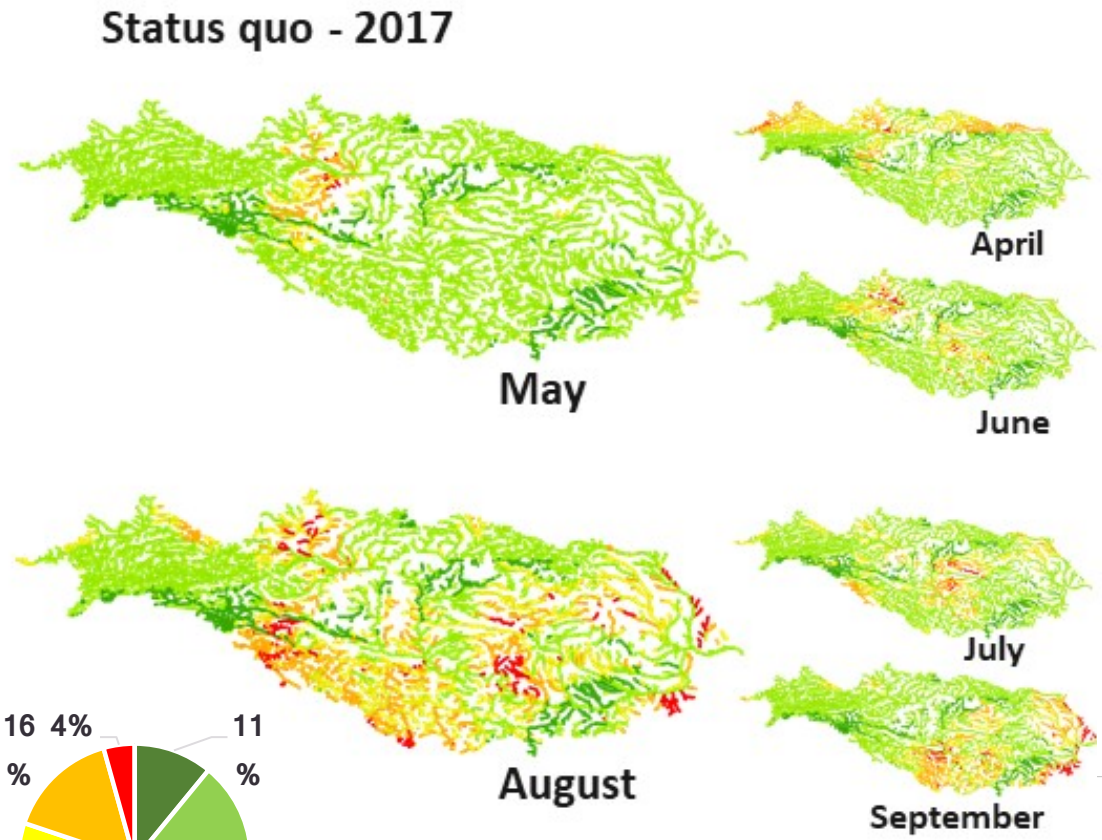


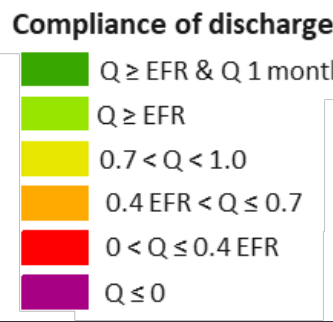
mean WUE maize: 2.1 kg/m³

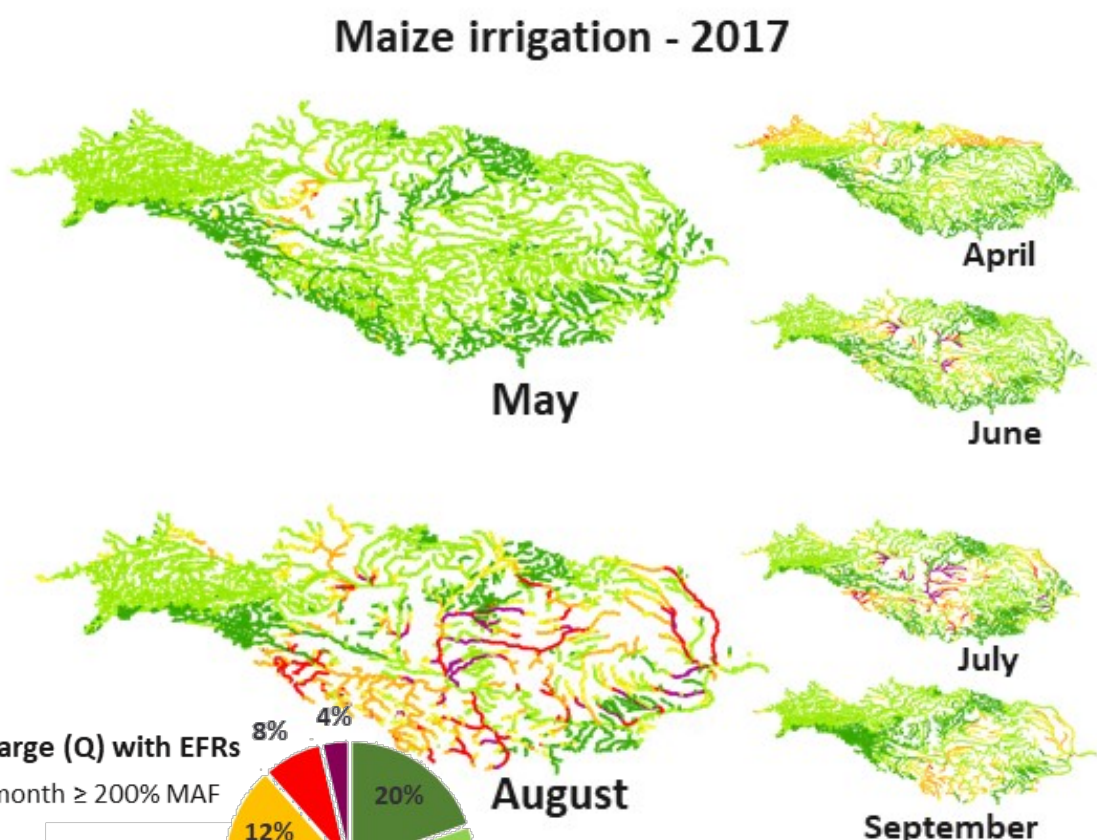


ViWA
Virtual Water Values

Taking maize as an example: actual situation Ecological Sustainability Assessment







ViWA – Highlights

Regional Water-Food-Energy-Ecosystems Assessment

Integrated Assessment (2017):

Water: ~ 29 billion m³ extracted per year mostly Hungary and Romanian affected

Food: maize production increased from ~40 to 78 mio t (roughly doubled),
increase in volume of sales by ~ 6 billion € (@ 160 €/t maize)

Energy: reduction of hydropower production from 37.5 to 36.7 PWh/a
decrease in volume of sales by app. 30 mio. € (@ 0.04 €/kWh)

Ecology: severe impacts of introducing irrigation of maize on almost all rivers in the Lower Danube, more than 15 % of wetlands are negatively affected

ViWA – Achievements

- Global AWUE Monitor up and running, roll out on foodsecurity-tep
- Spin-off from development of Global AWUE Monitor:
  - *Europe Early Yield Forecast System by VISTA GmbH*
- The General Comptutable Equlibrium model ART for the first time incorporates agricultural water (blue and green water) in the evaluation of scenarios for moving towards a more sustainable water use in agriculture and industry by taking into account global commodity trade.
- New tools for regional water-food-energy-ecology assessment successfully implemented and tested in the complex Danube basin
  - *Regional ICPDR workshops to inform Danube country Ministries*
- Water Governance Assessment Scheme to support management of water shortage challenges

Partners

Dept. of Geography, University of Munich

Prof. Dr. Wolfram Mauser (coordinator)
Dr. Tobias Hank
Elisabeth Probst
Christine Werner

Institute for the World Economy, Kiel

Dr. Ruth Delzeit
Prof. Dr Gernot Klepper

Helmholtz Center for Environmental Research (UFZ), Leipzig

Prof. Dr. Sabine Attinger

Institute for Environmental Planning, University of Hanover

Prof. Dr. Christina von Haaren

Helmholtz-Zentrum Geesthacht, Climate Service Center Germany, Hamburg

Prof. Dr. Daniela Jacob
Dr. Susanne Pfeiffer

Leibniz Supercomputing Centre (LRZ) of the Bavarian Academy of Sciences, Munich

Prof. Dr. Dieter Kranzlmüller
Dr. Jens Weissmüller

VISTA Geoscience Remote Sensing GmbH, Munich

Dr. Heike Bach
Philipp Klug

Funded by

SPONSORED BY THE

Federal Ministry of Education and Research

The collaborative project ViWA is sponsored by the Federal Ministry of Education and Research (BMBF) as part of the funding measure „Water as a Global Resource" (GRoW)

GRoW
WATER AS A GLOBAL RESOURCE

in the framework program FONA (Research for Sustainability)

FONA
Forschung für Nachhaltige Entwicklung
BMBF