

A dynamic background image featuring a large, horizontal splash of water in shades of blue and white, with smaller droplets and splashes scattered throughout. The water appears to be moving from left to right, creating a sense of motion and freshness.

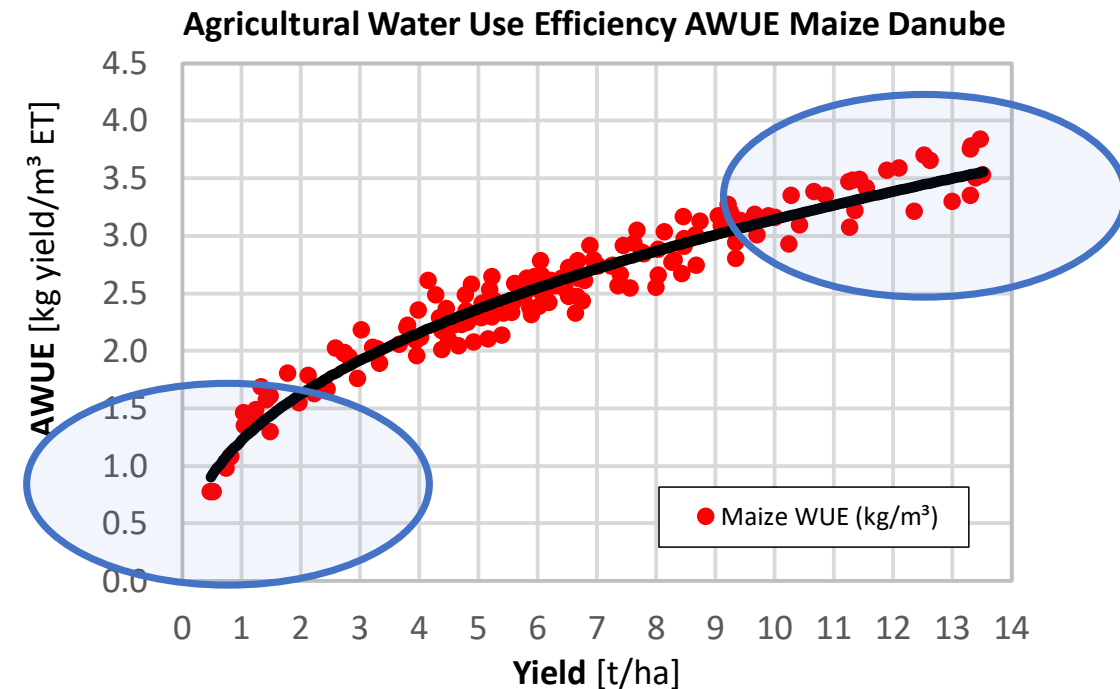
Virtual Water Values (ViWA)

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 ecosystems 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?**”



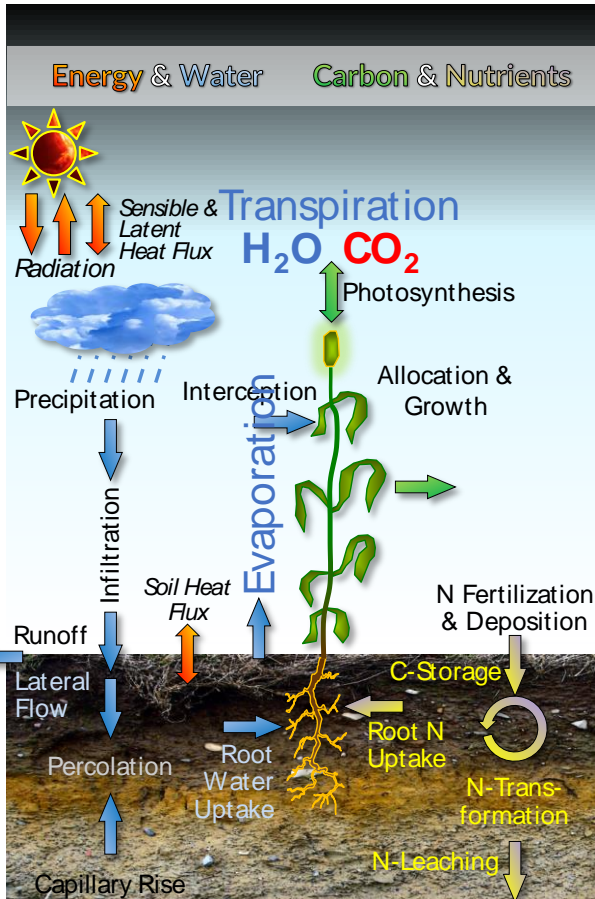
ViWA – Three Research Goals

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

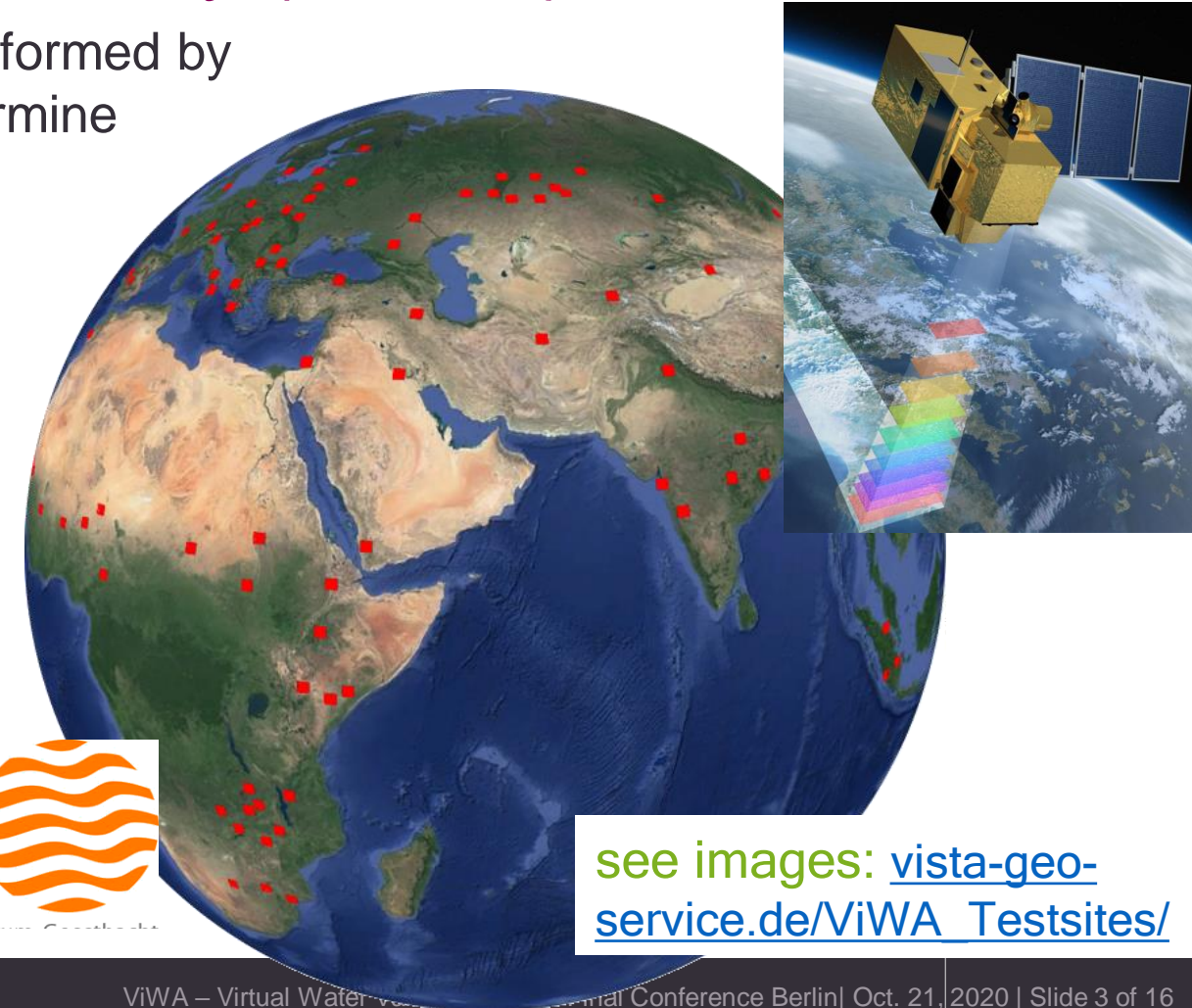
Global Agricultural Water Use Efficiency (AWUE) Monitor



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



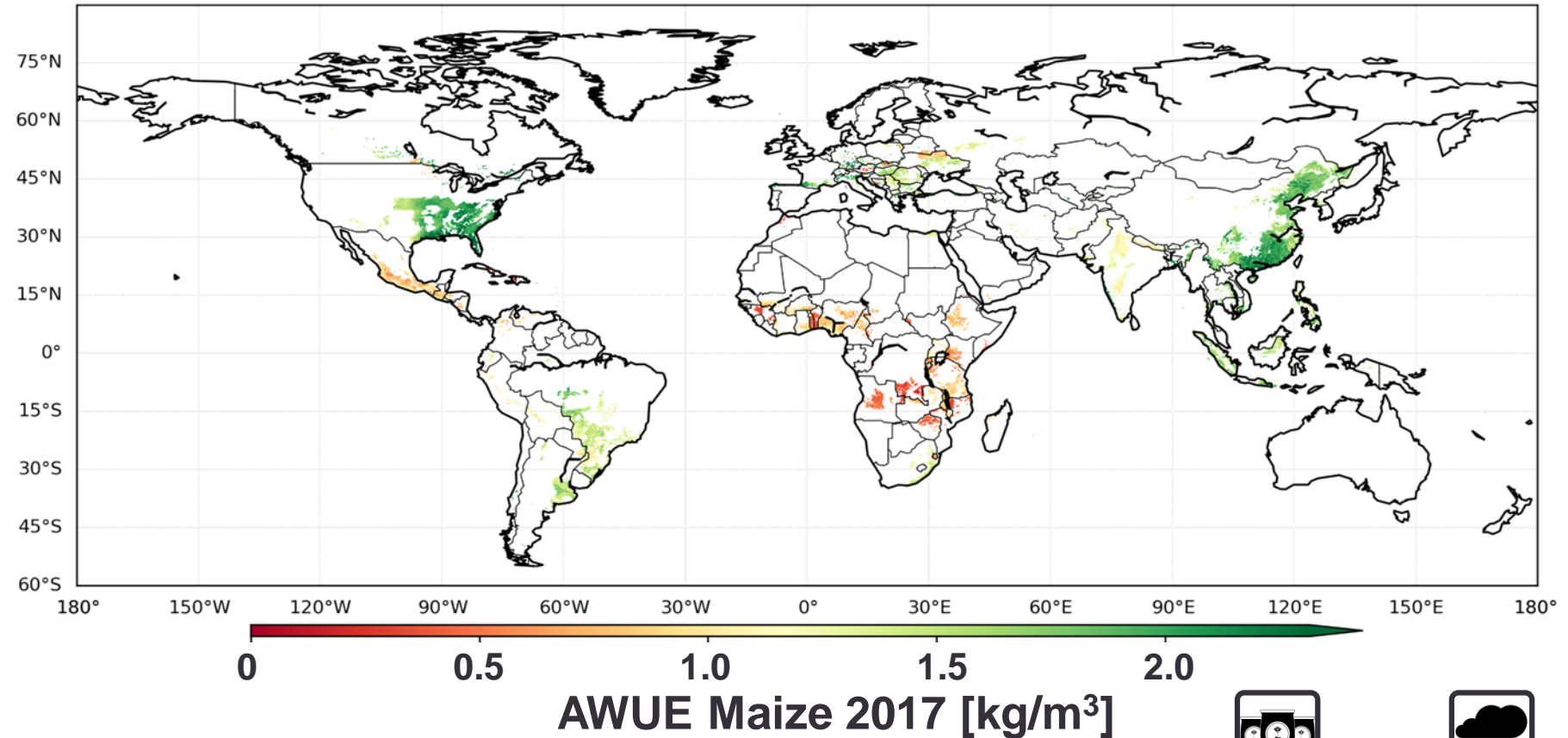
see images: vista-geo-service.de/ViWA_Testsites/

ViWA – Highlights

Global Agricultural Water Use Efficiency (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 foodsecurity-tep.net



Visit:

ViWA.geographie-muenchen.de/ViWA-marketplace



realistic



realistic

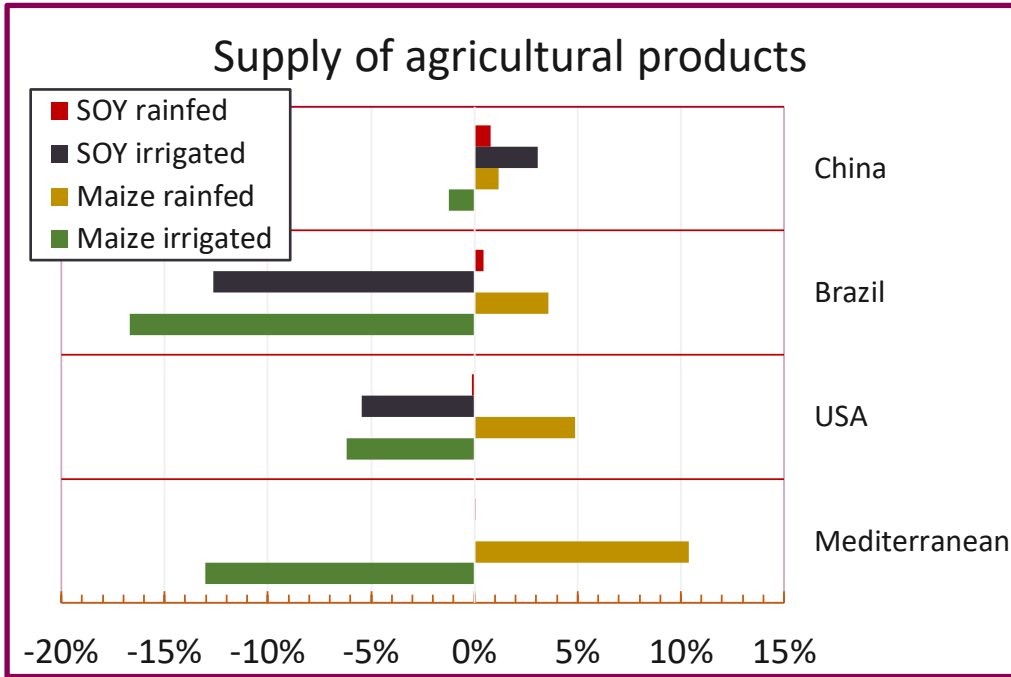
ViWA – Three Research Goals

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?

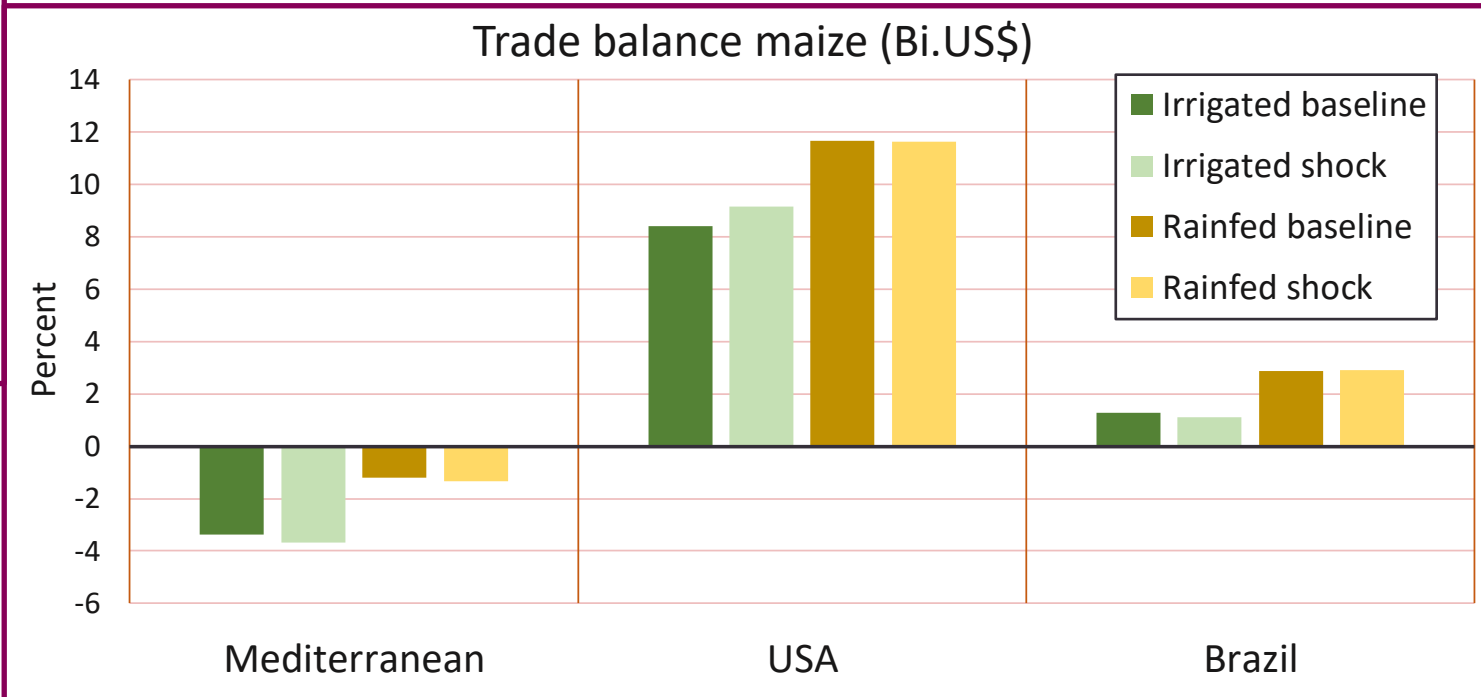
ViWA – Highlights

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

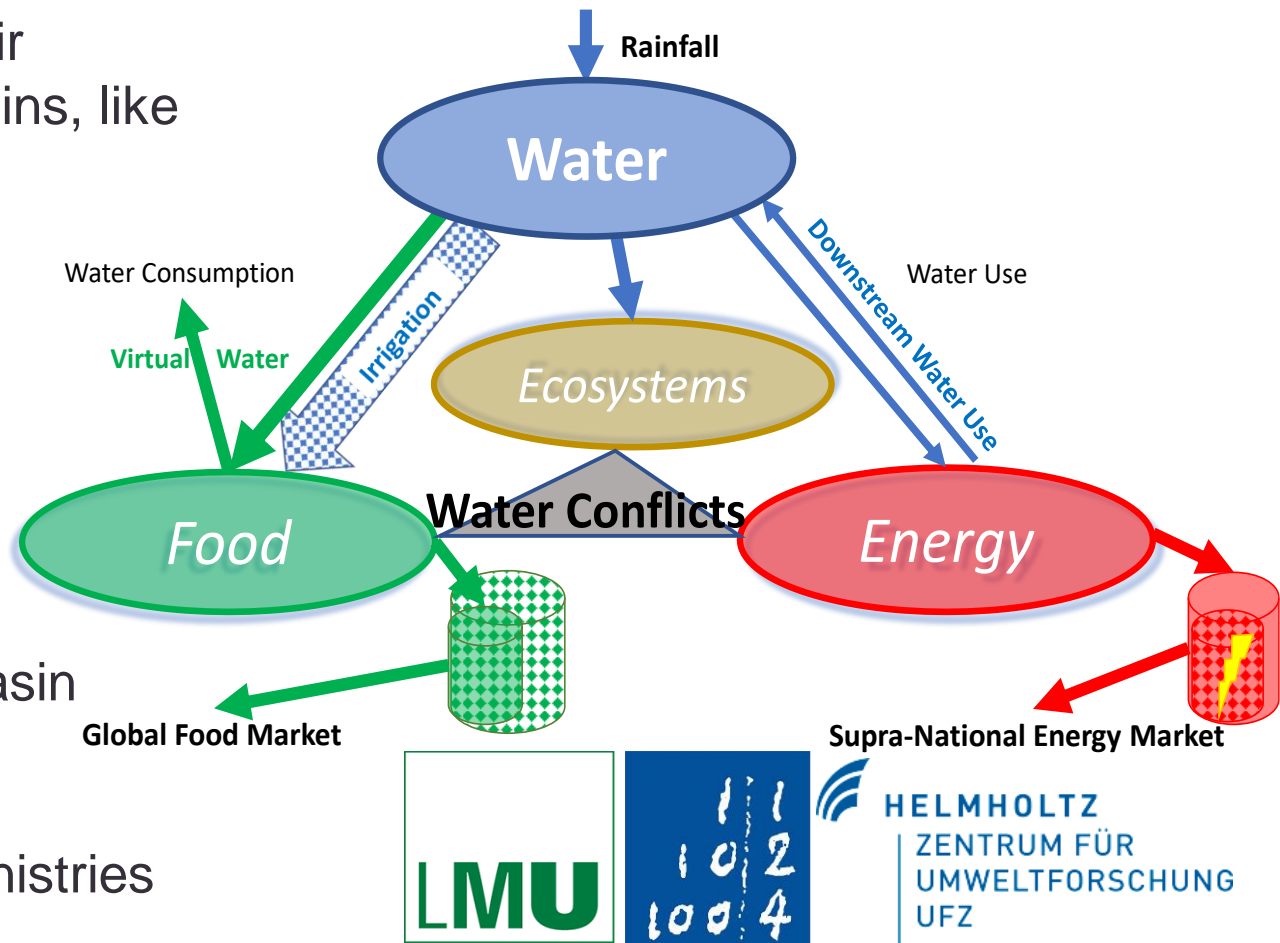
ViWA aims at improving practical understanding of efficiency and sustainability in agricultural water use. On the global, regional and local scale!

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 assessed?

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.



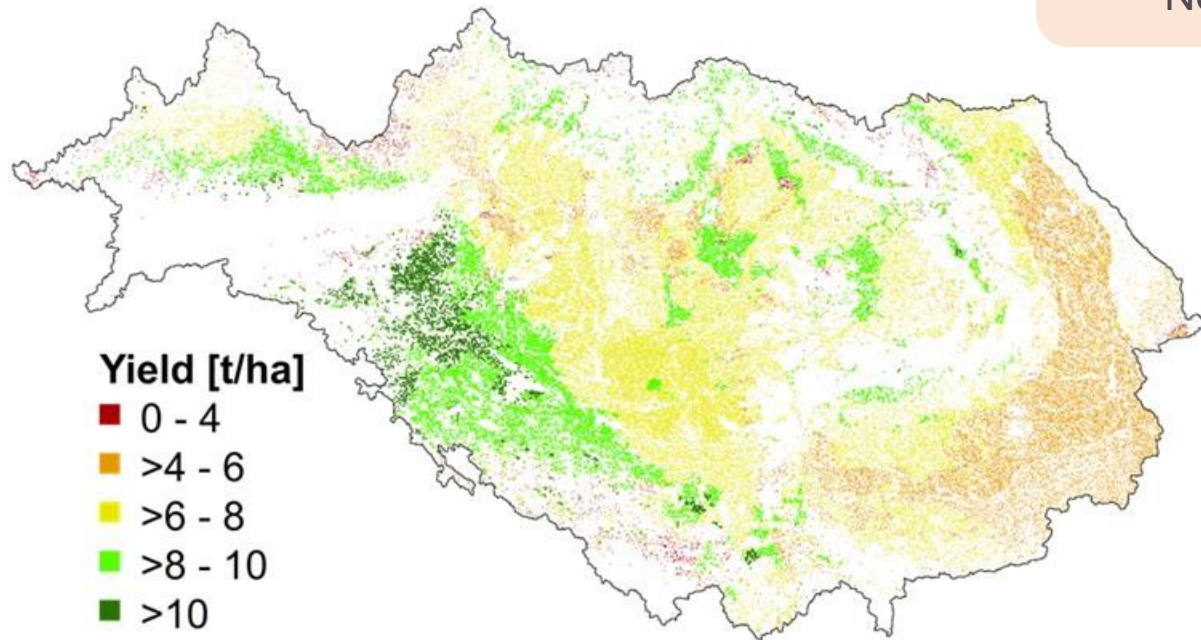
Use Case: expansion of irrigation in the Danube basin

- the case of maize
- Lower Danube Countries push for expansion
- ICPDR uses our simulations to inform national Ministries

Taking maize as an example: actual situation yield + AWUE

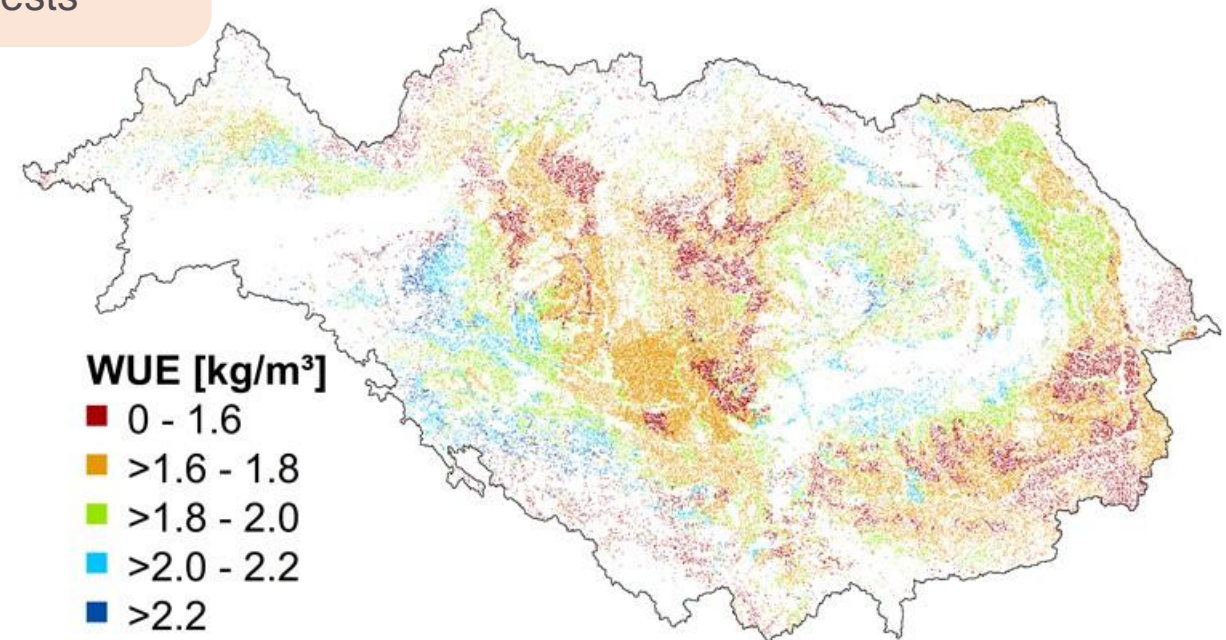
Mean actual yield (2015-2018)

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**

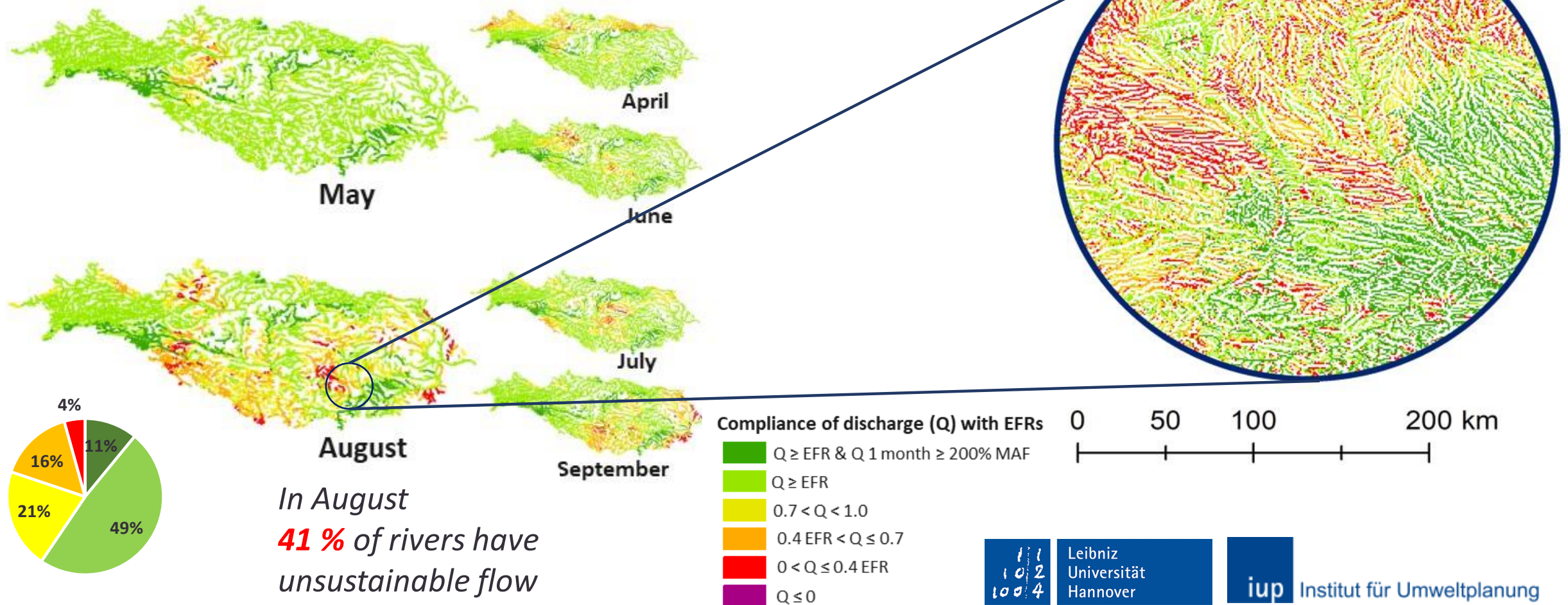


mean WUE maize : **1.8 kg/m³**

Taking maize as an example: actual situation

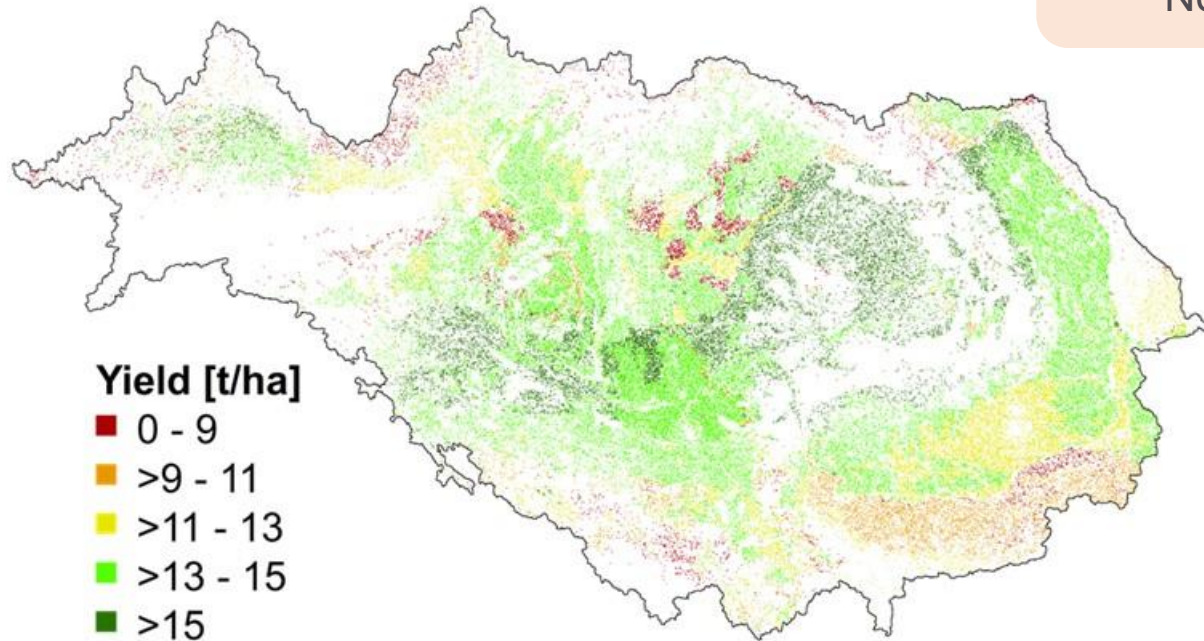
Ecological Sustainability Assessment

Status quo - 2017



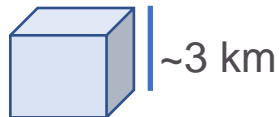
What happens, if large-scale irrigation is introduced? yield + AWUE

Mean potential yield (2015-2018)



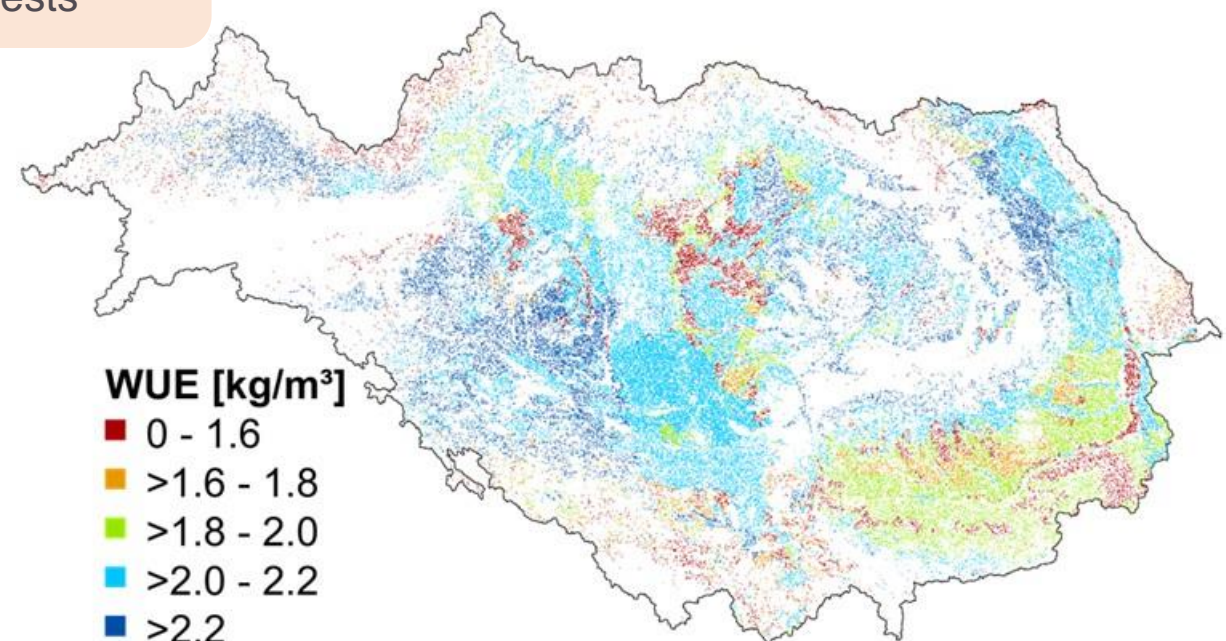
Modelled maize yield: **13.4 t/ha**
Total production: **77.8 Mio t**

Total irrigation water: **29 Gm³**

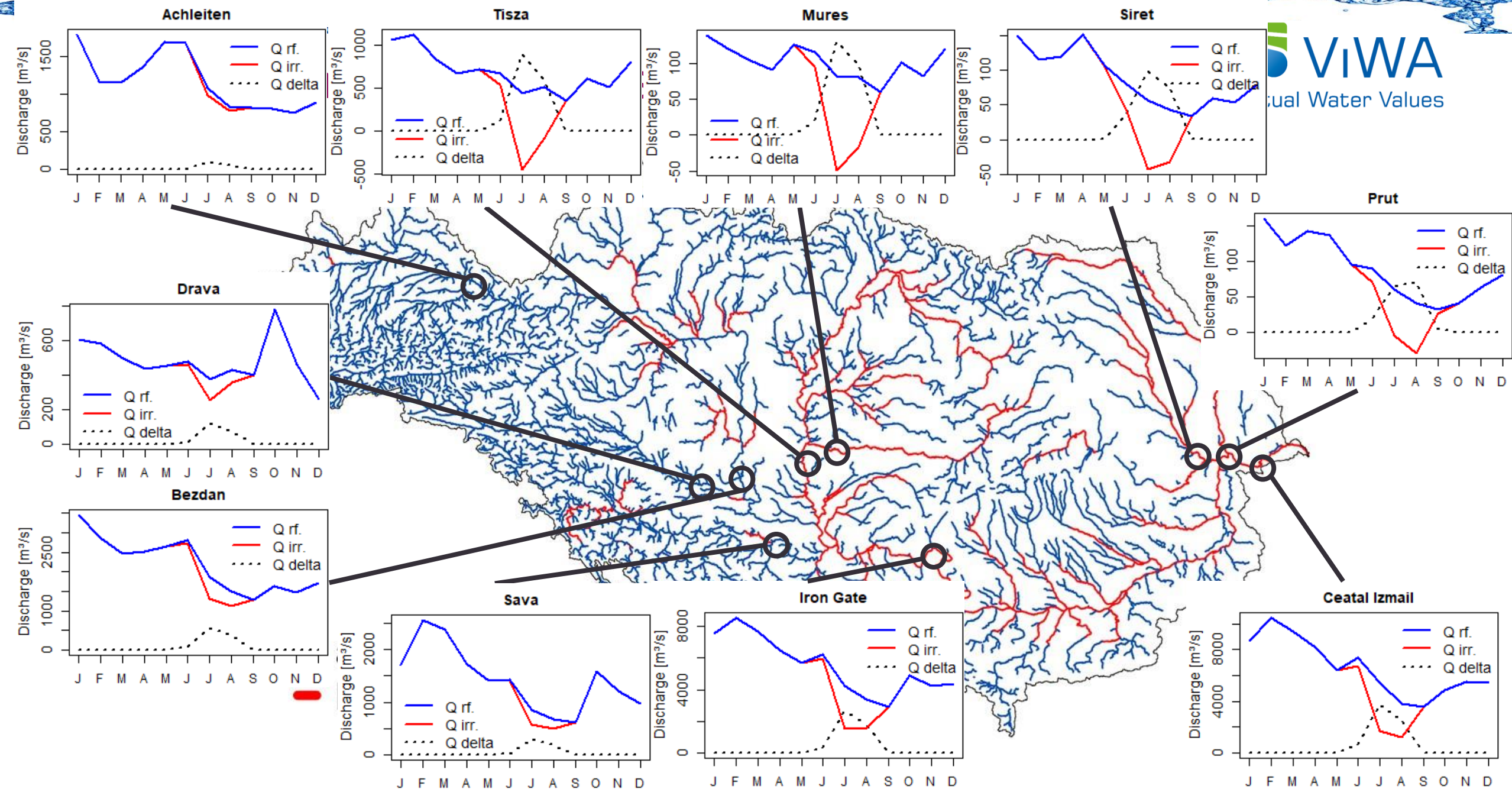


Full irrigation,
Full fertilization,
No pests

Mean potential WUE (2015-2018)



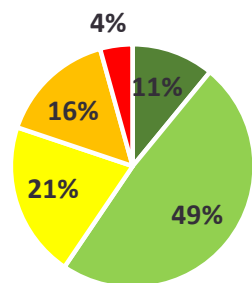
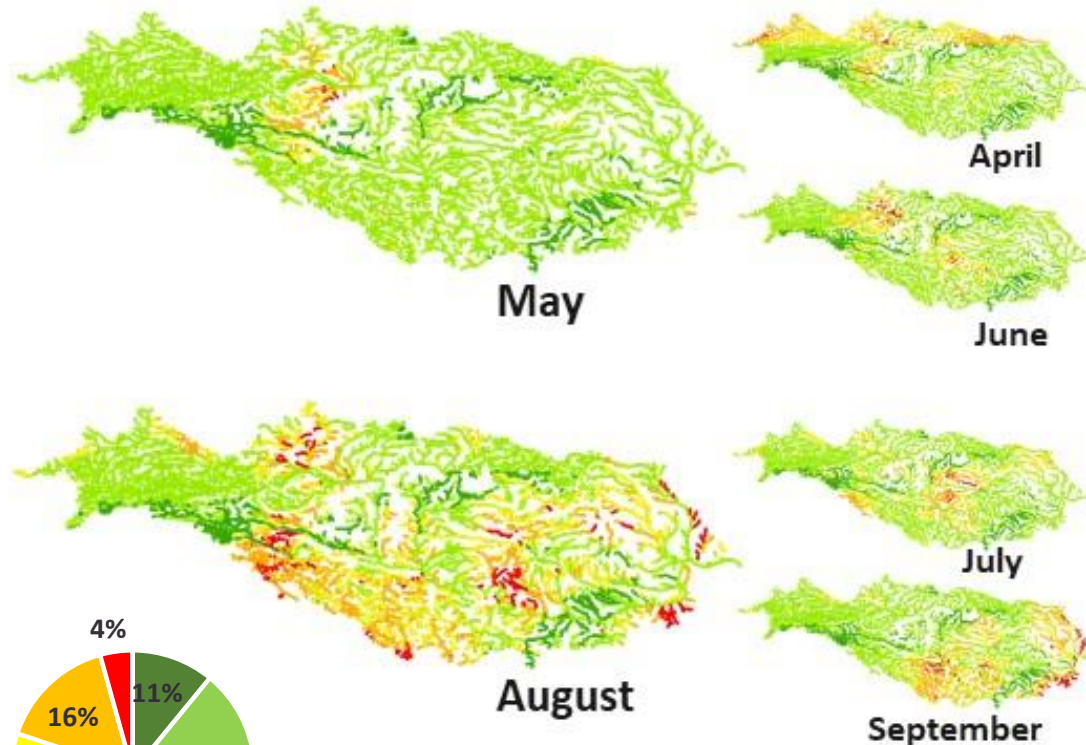
mean WUE maize: **2.1 kg/m³**



Taking maize as an example: actual situation

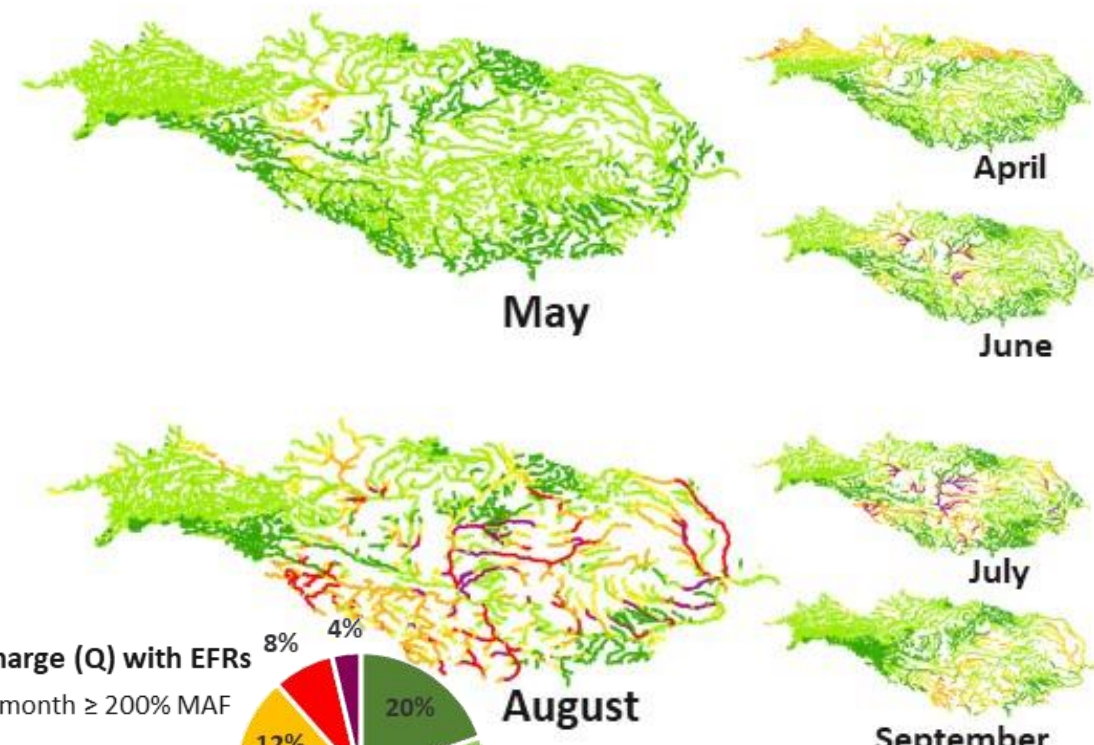
Ecological Sustainability Assessment

Status quo - 2017

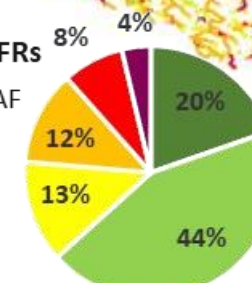
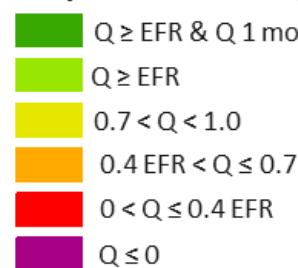


In August
41 % of rivers have
unsustainable flow

Maize irrigation - 2017



Compliance of discharge (Q) with EFRs



In August
4 % of rivers have
"negative" flow

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 Computable Equilibrium 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



**Dept. of Geography,
University of Munich**

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



**Institute for Environmental
Planning, University of Hanover**

Prof. Dr. Christina von Haaren



**VISTA Geoscience Remote
Sensing GmbH, Munich**

Dr. Heike Bach
Philipp Klug



**Institute for the World
Economy, Kiel**

Dr. Ruth Delzeit
Prof. Dr. Gernot Klepper



An institution of Helmholtz-Zentrum Geesthacht
**Helmholtz-Zentrum Geesthacht, Climate
Service Center Germany, Hamburg**

Prof. Dr. Daniela Jacob
Dr. Susanne Pfeiffer



**Helmholtz Center for
Environmental Research (UFZ),
Leipzig**

Prof. Dr. Sabine Attinger



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

Prof. Dr. Dieter Kranzlmüller
Dr. Jens Weissmüller

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)



in the framework program FONA
(Research for Sustainability)



Funded by