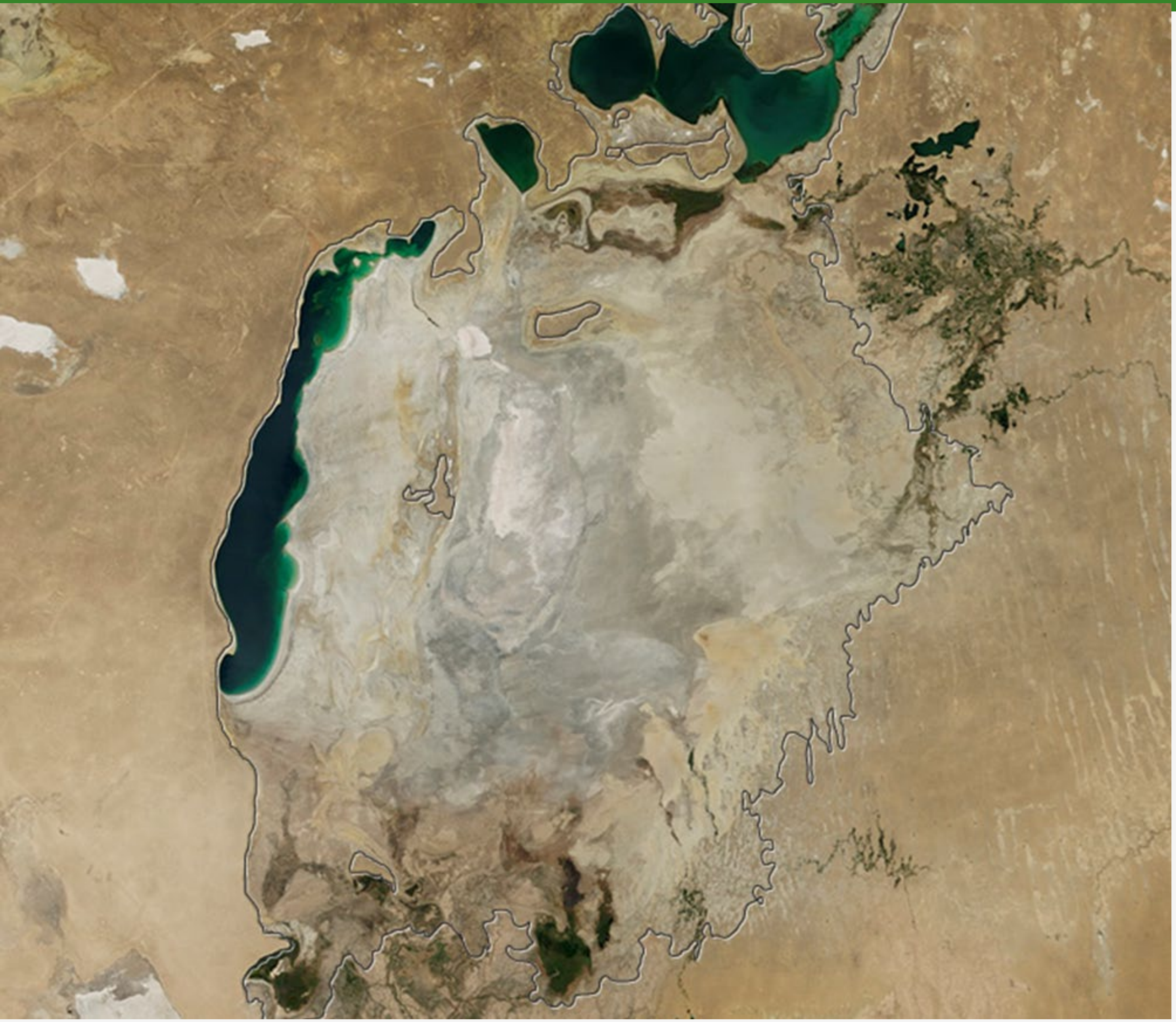
Green Central Asia

Enhancing environment, climate and water resilience

Federal Foreign Office

GREEN CAWA



Towards regular drought status bulletins for irrigation systems in Central Asia using remote sensing

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german cooperation
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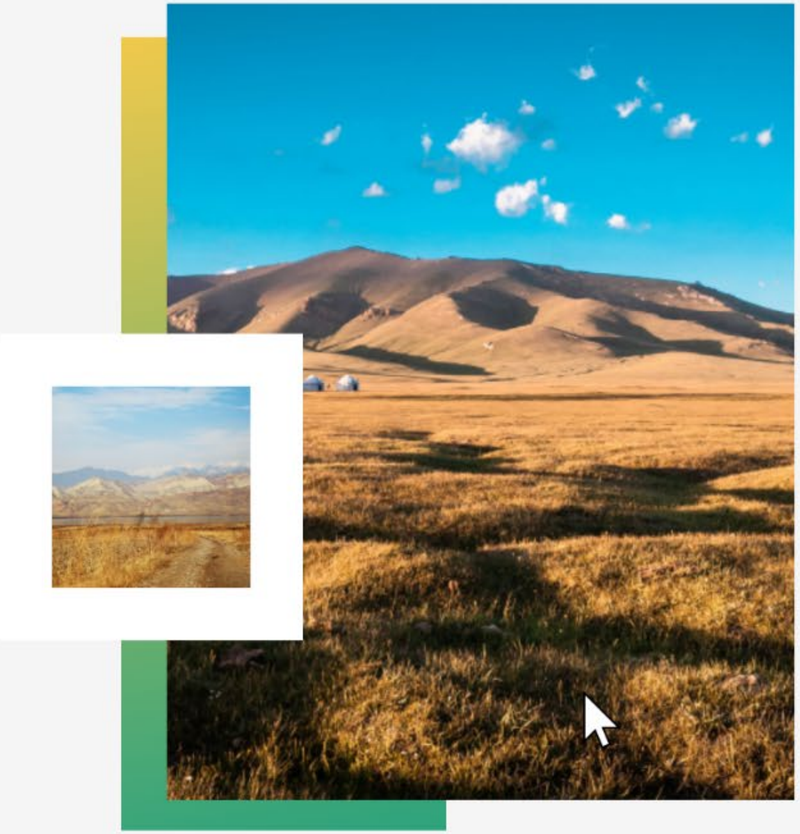

http://greencentralasia.org/en

German Initiative

Aim of 'Green Central Asia':

- to develop a political dialogue and
- consequently create better access to information and data in order
- to enable countries to assess the impact of climate change more accurately and
- to develop cooperative preventive measures.

Target group: foreign ministries and, through them, the respective institutions responsible for climate and environmental resources, including educational and research institutions

Target countries: Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan as well as Afghanistan.

One goal of the Green Central Asia Initiative is a **Drought Monitoring System** that helps to detect and manage droughts within a cropping season in the Aral Sea Basin

- 2020/2021: Specification
- 2021/2022: Implementation

The Aral Sea Basin


Aralseeboden
Photo: Pool Filmverleih/lotus Film


Numerous Reservoirs


Pamir: Abramovgletscher
Photo: K. Unger-Shayesteh


Baumwoll-, Reis-, und Getreideproduktion


Photos aus dem Archiv des Khorezm-Projekts

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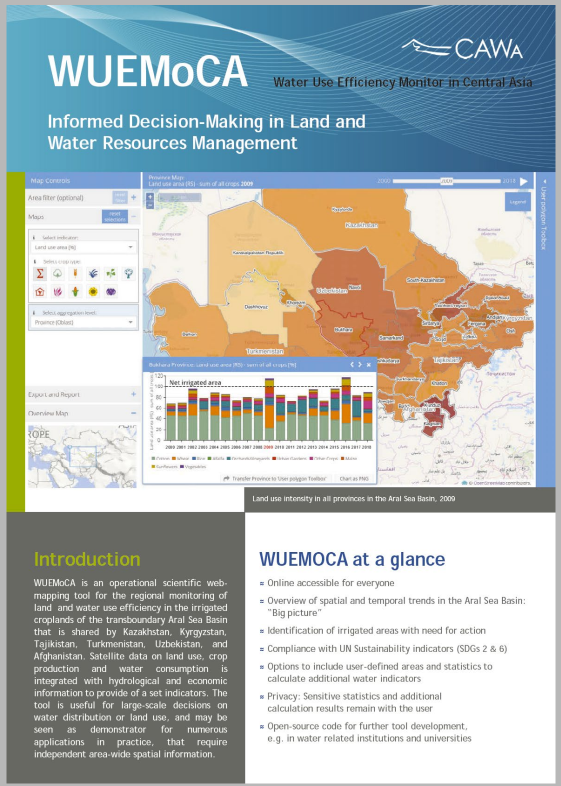
Water Use Efficiency Monitor for Central Asia WUEMoCA

- → **German Water Initiative in Central Asia** 2009-2019 (https://www.cawa-project.net/)
- → **Decision-support tool** for identifying irrigated areas of the Aral Sea Basin with need for action in water management (water scarcity, land degradation and abandonment)
- → **Source of new data**: Integrates satellite RS technology (MODIS), i.e. for land use mapping crop yield estimations and evapotranspiration modelling
- → **Database** for administrative boundaries, water distribution units, regular grid cells and user zones

https://wuemoca.geo.uni-halle.de/app/



https://www.cawa-project.net/news-detail/news/wuemoca-brochure-broshjura/

Example: Detect unused (fallow) land

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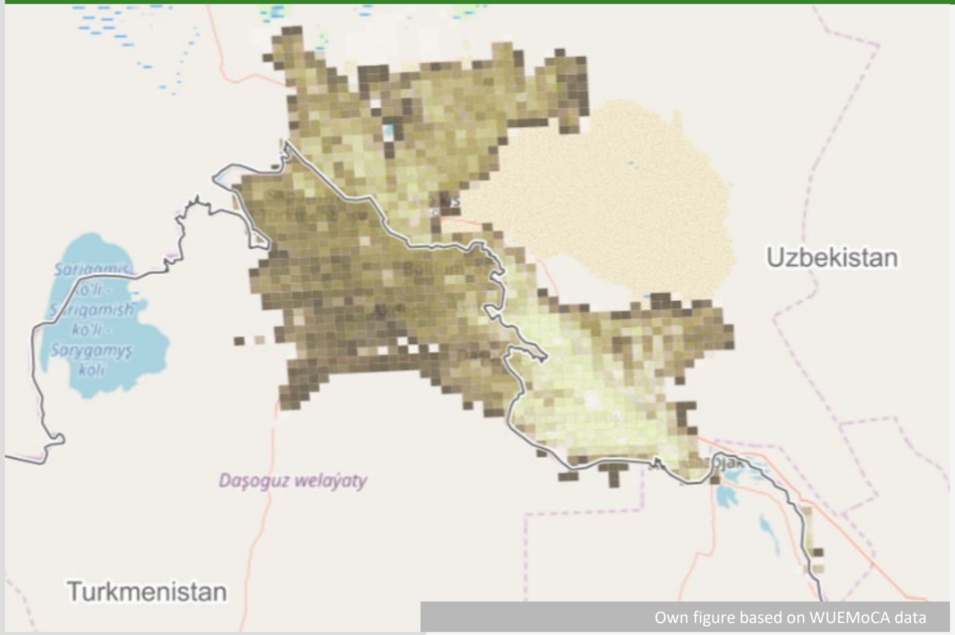
GEO ECOLOGY

Own figure based on WUEMoCA data

Detect parts of the irrigated cropland in the Aral Sea Basin that is unused within one or more cropping years (fallow).

Indicators: Temporarily unused irrigated land, fallow land frequency



Own figure based on WUEMoCA data

⇒ **Decisions** about the use of unproductive land: planting alternative crops (e.g. agroforestry), abandon land, invest in irrigation and drainage infrastructure, etc.

The figures show the **Amu Darya Delta**. Dark and bright cells in raster refer to mainly unused and heavily irrigated areas, respectively.

Top: Drought year 2008

Down: Water rich year 2010

Specification phase for a drought monitoring system in the Aral Sea Basin

Who are the users? Scientific / administrative bodies that aim to prepare decision support and political dialogue

National level: hydromet and other services, universities

Regional l.: CAREC, IFAS

International l.: WMO, GWP, UNCCD, UNDRR, IDMP …

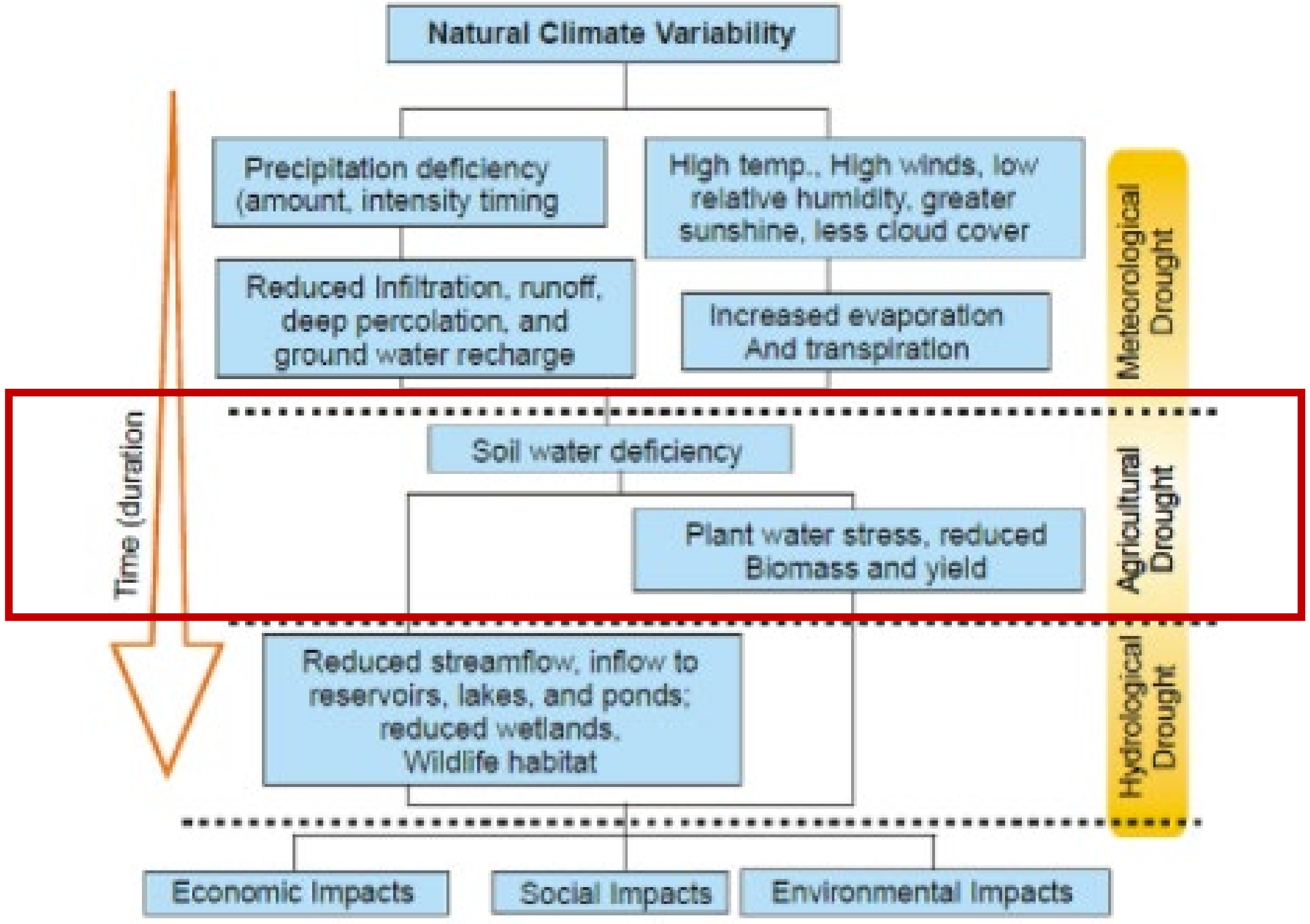
What are the key requirements?

1. Detect droughts „in time“ (after two weeks)
2. Describe droughts: Where, how long, how strong?

What are possible recommendations by the users in drought situations?

- Temporarily exclude fields from water supply
- Change water distribution/allocation
- Support of national planning (subsidies)
- ….

Scientific background: drought concept



Indicators

Reduced vegetation growth

Reduced relative water consumption

Scientific drought detection and monitoring
Indicators from satellite data

Normalized Difference Vegetation Index (NDVI): Index values for greenness and density of vegetation, ratio of red to infrared radiation.

Evaporative Stress Index (ESI): Ratio of actual evapotranspiration (AET) to potential ET (PET), showing water use relative to demand, e.g., S-SEBI model.

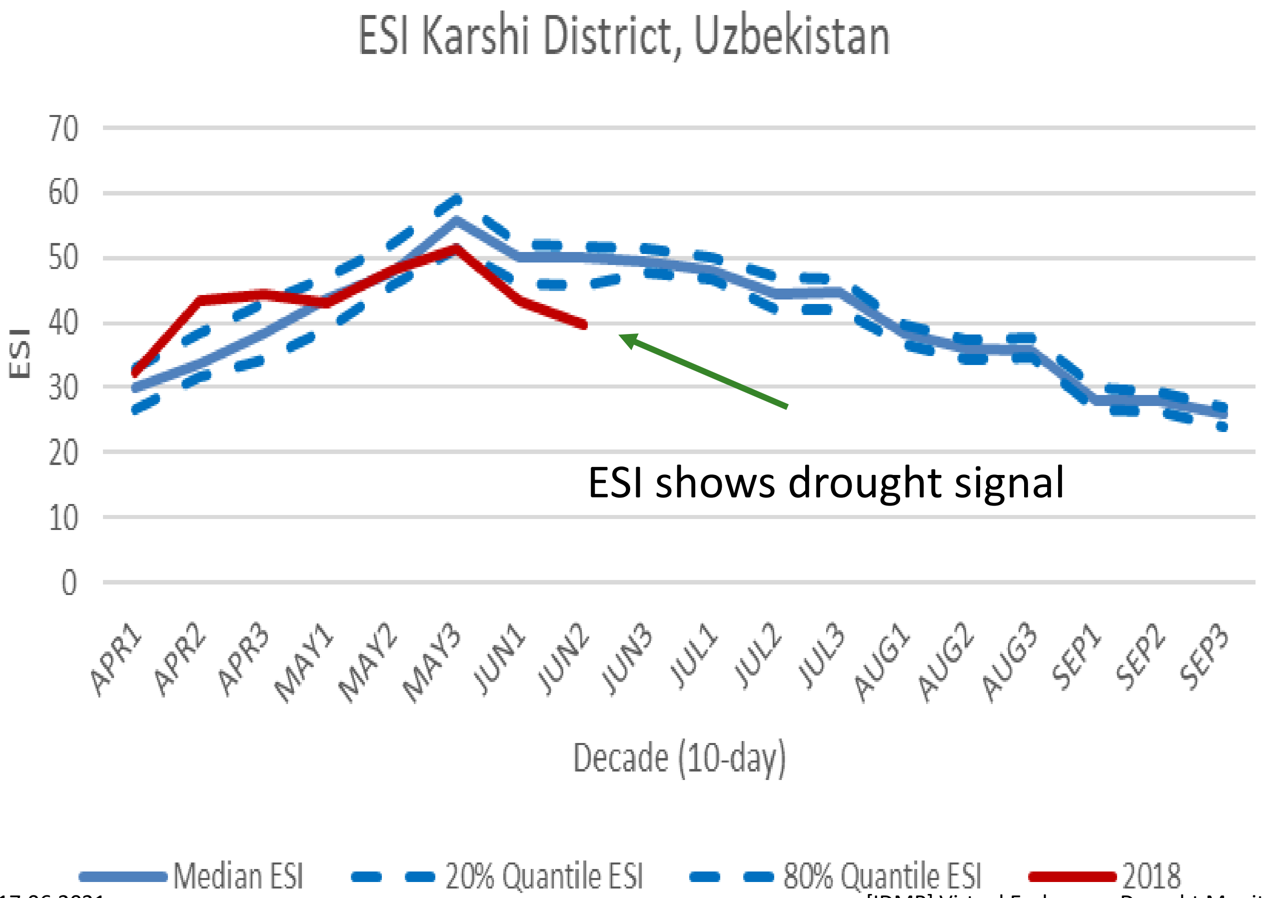
Indicators

Reduced vegetation growth

Reduced relative water consumption

Combination of the indicators shows strength and duration of a drought.

Scientific drought detection and monitoring
Indicators from satellite data



Indicators

Water consumption

Observation within statistical percentiles of the indicators during the past 10 years

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Ruleset for the analysis of the two indicators (NDVI, ESI, and DSI)

0. DSI [t=k] = WL-ESI [t=k] + WL-NDVI [t=k]

Indikator	APR1	APR2	APR3	MAY1	MAY2	MAY3	JUN1	JUN2
WL_ESI	0	-1	-1	-1	0	0	0	1
WL_NDVI	0	0	-1	-1	-1	-1	0	0
DSI	0	-1	-2	-2	-1	-1	0	0
Duration	0	1	2	3	4	5	0	0
Sum(DSI)	0	-1	-3	-5	-6	-7	0	0
Severity	0	<1	=1	>1	=1	<1	0	0
Surplus	0	0	0	0	0	0	0	1
Class								

1. Classification of Water surplus
If WL_ESI >=1 **Water surplus** = 1

- Water surplus
- No drought
- Initial mild drought
- Initial severe drought
- Mid-term mild drought
- Mid-term severe drought
- Long mild drought
- Long severe drought

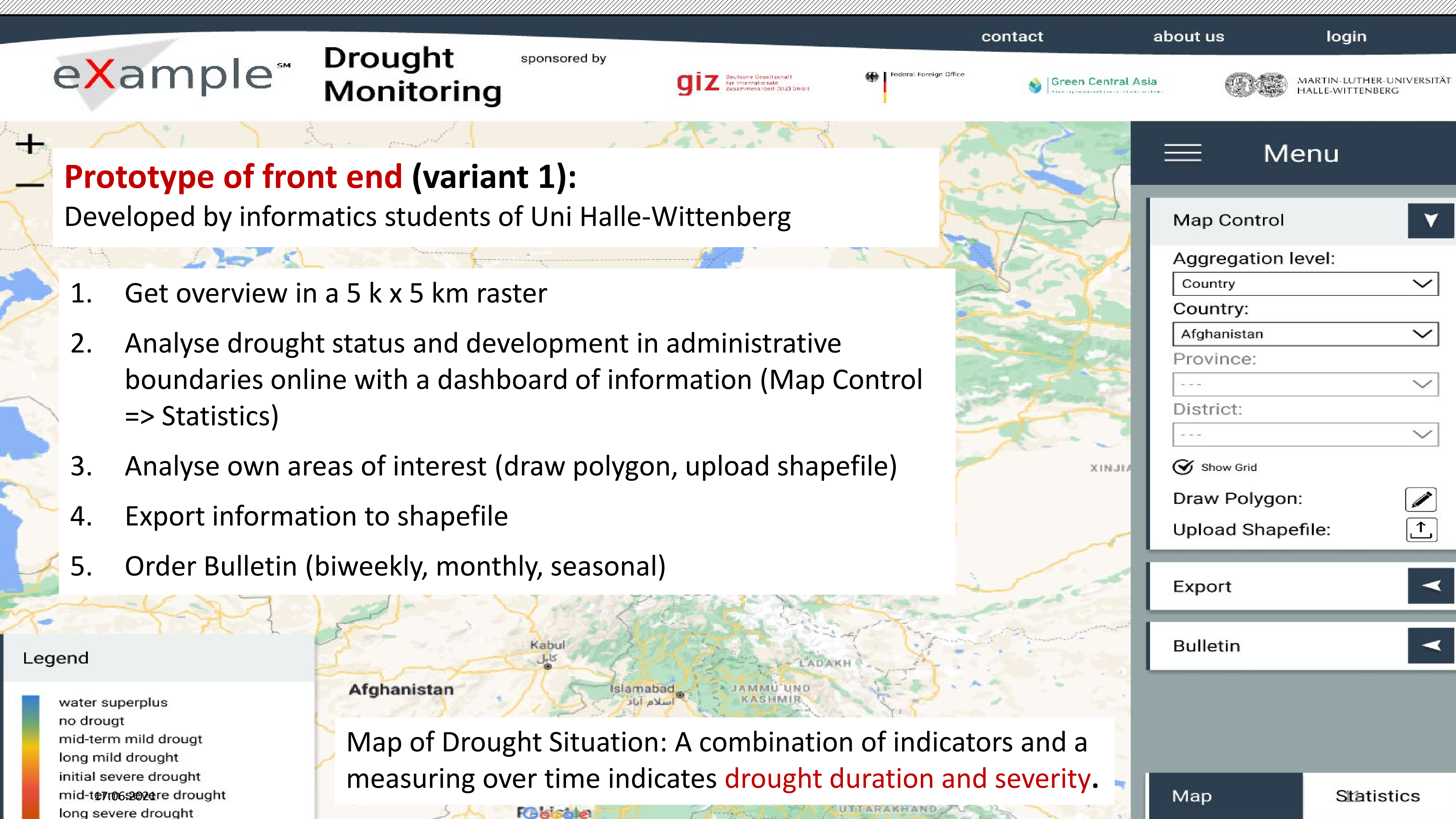
2. Classification of drought duration
Duration: of drought situation in 10day intervals
If DSI >= 0 => duration = 0, if DSI < 0 duration++
if duration < 1 => „no drought“
if 1<= duration <=2 = > „initial drought“
if 2<= duration <= 3 = > „mid-term drought“
if duration > 3 => „long-term drought“

3. Classification of severity
Severity requires DSI < 0 and
a) **Severity Factor**: 1.5 & b) **Sum(DSI):** Sum of DSI from start of drought
If Duration = 0 then Severity = „no drought“
Severity = |Sum(DSI)|/Duration*Severity Factor
If Severity < 1 => „mild drought“
If Severity >=1 => „severe drought“

Prototype of front end (variant 1):

Developed by informatics students of Uni Halle-Wittenberg

1. Get overview in a 5 k x 5 km raster
2. Analyse drought status and development in administrative boundaries online with a dashboard of information (Map Control => Statistics)
3. Analyse own areas of interest (draw polygon, upload shapefile)
4. Export information to shapefile
5. Order Bulletin (biweekly, monthly, seasonal)



Map of Drought Situation: A combination of indicators and a measuring over time indicates drought duration and severity.

eXample℠ Drought Monitoring

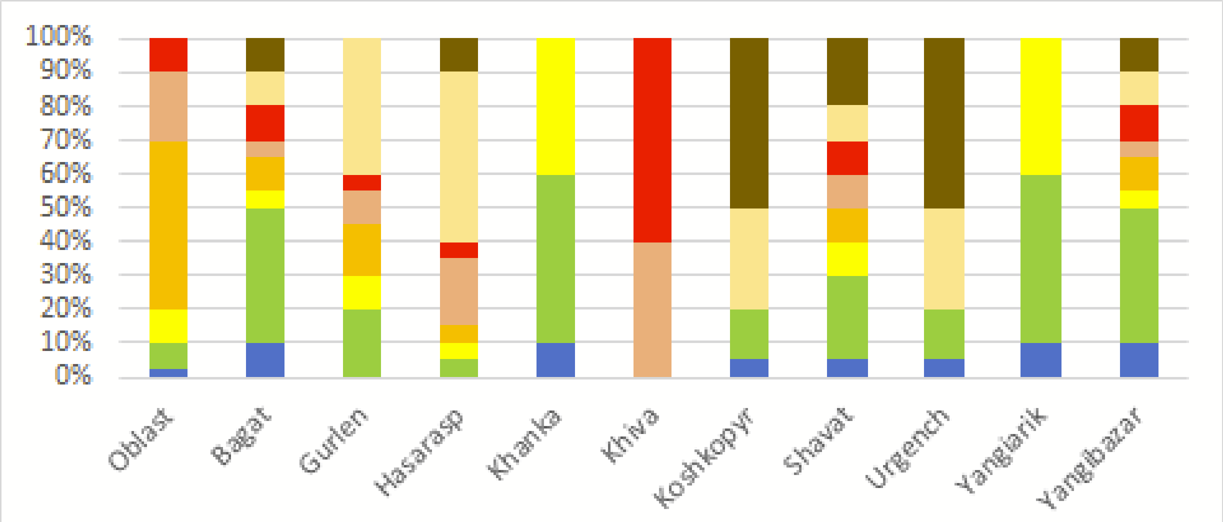
sponsored by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH · Federal Foreign Office · Green Central Asia · MARTIN-LUTHER-UNIVERSITÄT HALLE-WITTENBERG

Kasachstan

Bulletin

1. Definitions used in the drought monitor
2. Maps (5 km * 5km grids with administrative boundaries of interest)
3. List areas with need for action
4. Tables and graphs

Water surplus
No drought
Initial mild drought | Initial severe drought
Mid-term mild drought | Mid-term severe drought
Long mild drought | Long severe drought



Menu

Statistic Controls

Export

Bulletin

Region:
Afghanistan

Period *
monthly

Firstname *
Jane

Lastname *
Doe

Institution *
example(gmbh)

E-mail *
example@mail.com

i accept the terms of use.*

Send email

Map | Statistics

Conclusions

→ Scientific tools such as remote sensing technology can contribute to identify, monitor and combat droughts

→ Steps towards a remote sensing based operational drought montoring tool planned in GCA:

1. Specification (in agreement with potential users)
2. Implementation
3. Test and Application (with users)
4. Dissemination (policy dialogue)

→ Identify pathways to implementation and use of such information requires collaboration among all stakeholders

Outlook:
Drought forecast system in the irrigated Aral Sea Basin / Central Asia

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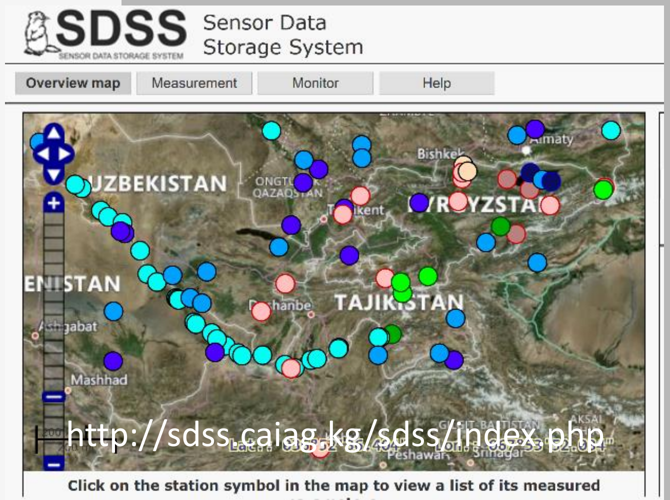
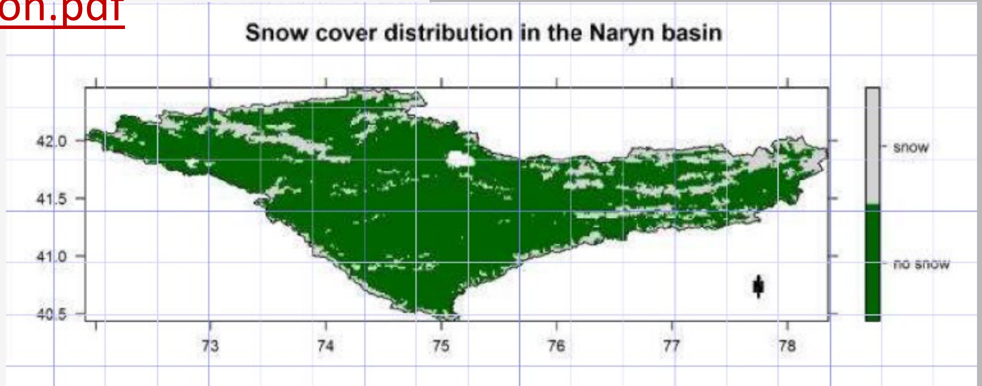
GEO ECOLOGY

1. **Bring our partners and other stakeholders together**:
   national: hydromets, ministries for emergency situations ..
   Regional: CAREC, IFAS, …)
   international (GWP, WMO, UNCCD, UNDRR, ICBA, …)
2. **Define information demand**/contribution of hydromets and other stakeholders
3. **Integrate scientific tools about water availability, artificial reservoirs / management options and water user system** (MODSNOW, SDSS, WUEMoCA, GCA drought monitor)
4. Present results on **learning platform** for different users



http://sdss.caiag.kg/sdss/index.php

https://www.cawa-project.net/fileadmin/cawa/00_home/Flyer_November17-Webversion.pdf



Gafurov, A., Lüdtke, S., Unger-Shayesteh, K. *et al.* **MODSNOW-Tool**: an operational tool for daily snow cover monitoring using MODIS data. *Environ Earth Sci* **75,** 1078 (2016). https://doi.org/10.1007/s12665-016-5869-x

=> **Drought Management Center** for Central Asia?

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