ADM-KENYA

INTEGRATED USE OF MULTISOURCE REMOTE SENSING DATA FOR NATIONAL SCALE AGRICULTURAL DROUGHT MONITORING IN KENYA

EO for Africa Symposium

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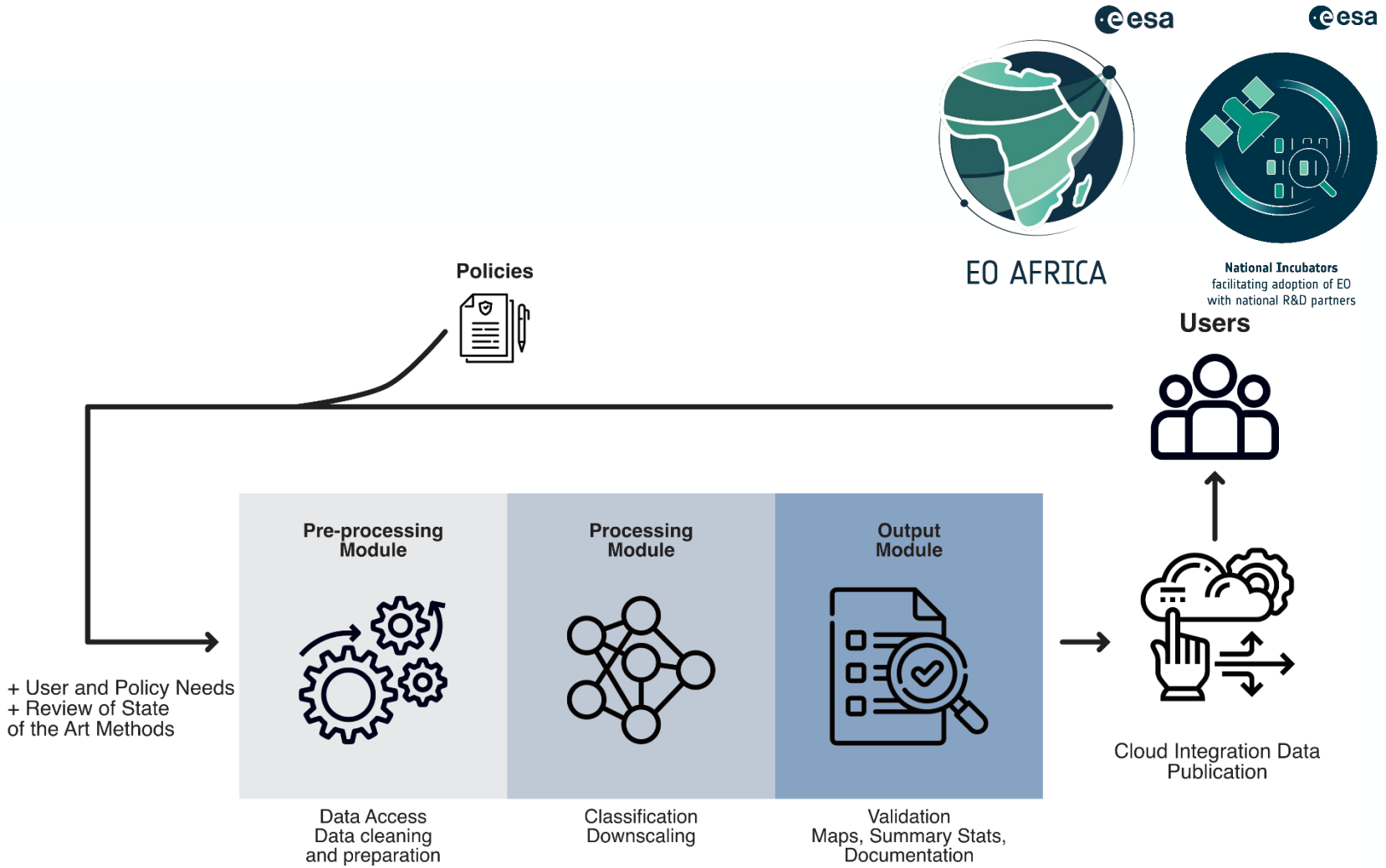
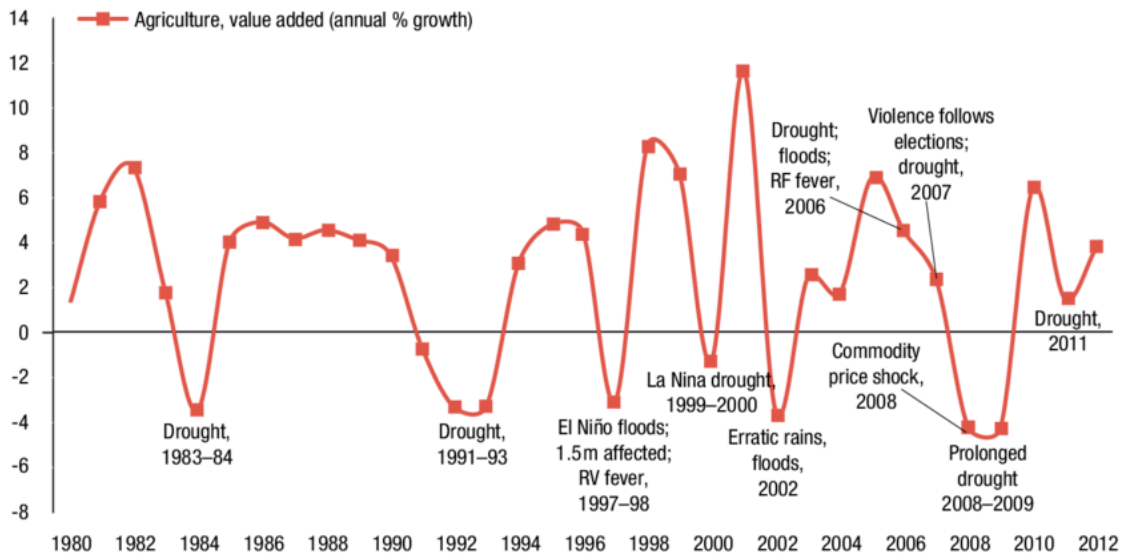
Ministry of Agriculture & Livestock Development

Overview

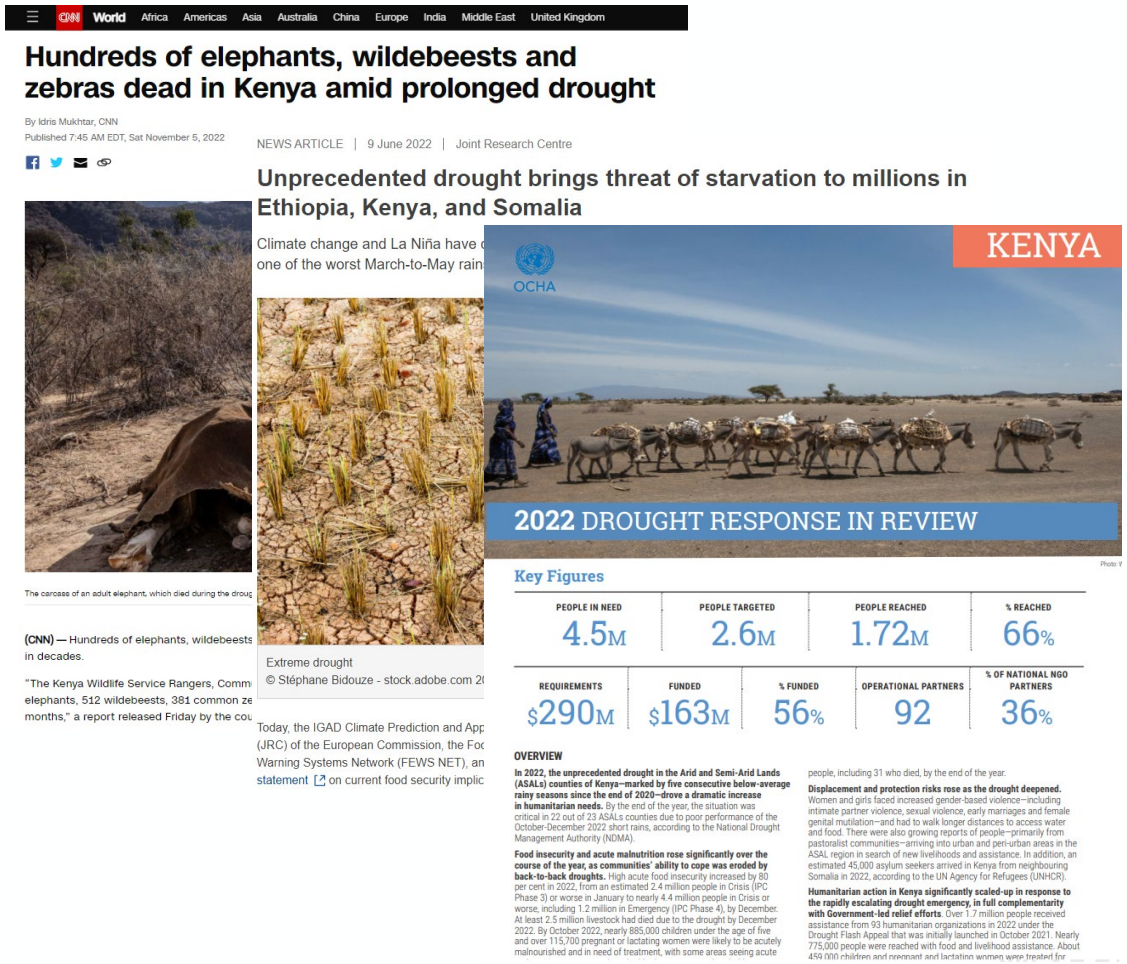
ADM-KENYA aims to co-develop solutions for monitoring **crop condition** and **cropping systems** with Earth Observation (EO) data to derive **evidence-based quantitative vegetation condition** estimates with high spatial and temporal resolution.



Why Kenya?



Agricultural Production shocks
1980–2012 (D'Alessandro et al., 2015)



World Africa Americas Asia Australia China Europe India Middle East United Kingdom

Hundreds of elephants, wildebeests and zebras dead in Kenya amid prolonged drought

By Idris Mukhtar, CNN
Published 7:45 AM EDT, Sat November 5, 2022

The carcass of an adult elephant, which died during the droug

(CNN) — Hundreds of elephants, wildebeests
in decades.

"The Kenya Wildlife Service Rangers, Comm
elephants, 512 wildebeests, 381 common ze
months," a report released Friday by the cou

NEWS ARTICLE | 9 June 2022 | Joint Research Centre

Unprecedented drought brings threat of starvation to millions in Ethiopia, Kenya, and Somalia

Climate change and La Niña have
one of the worst March-to-May rain

Extreme drought
© Stéphane Bidouze - stock.adobe.com

Today, the IGAD Climate Prediction and App
(JRC) of the European Commission, the Foo
Warning Systems Network (FEWS NET), an
statement on current food security implic

KENYA

OCHA

2022 DROUGHT RESPONSE IN REVIEW

Key Figures

PEOPLE IN NEED	PEOPLE TARGETED	PEOPLE REACHED	% REACHED
4.5M	2.6M	1.72M	66%

REQUIREMENTS	FUNDED	% FUNDED	OPERATIONAL PARTNERS	% OF NATIONAL NGO PARTNERS
$290M	$163M	56%	92	36%

OVERVIEW

In 2022, the unprecedented drought in the Arid and Semi-Arid Lands (ASALs) counties of Kenya—marked by five consecutive below-average rainy seasons since the end of 2020—drove a dramatic increase in humanitarian needs. By the end of the year, the situation was critical in 22 out of 23 ASALs counties due to poor performance of the October-December 2022 short rains, according to the National Drought Management Authority (NDMA).

Food insecurity and acute malnutrition rose significantly over the course of the year, as communities' ability to cope was eroded by back-to-back droughts. High acute food insecurity increased by 80 per cent in 2022, from an estimated 2.4 million people in Crisis (IPC Phase 3) or worse in January to nearly 4.4 million people in Crisis or worse, including 1.2 million in Emergency (IPC Phase 4), by December. At least 2.5 million livestock had died due to the drought by December 2022. By October 2022, nearly 885,000 children under the age of five and over 115,700 pregnant or lactating women were likely to be acutely malnourished and in need of treatment, with some areas seeing acute

people, including 31 who died, by the end of the year.

Displacement and protection risks rose as the drought deepened. Women and girls faced increased gender-based violence—including intimate partner violence, sexual violence, early marriages and female genital mutilation—and had to walk longer distances to access water and food. There were also growing reports of people—primarily from pastoralist communities—arriving into urban and peri-urban areas in the ASAL region in search of new livelihoods and assistance. In addition, an estimated 45,000 asylum seekers arrived in Kenya from neighbouring Somalia in 2022, according to the UN Agency for Refugees (UNHCR).

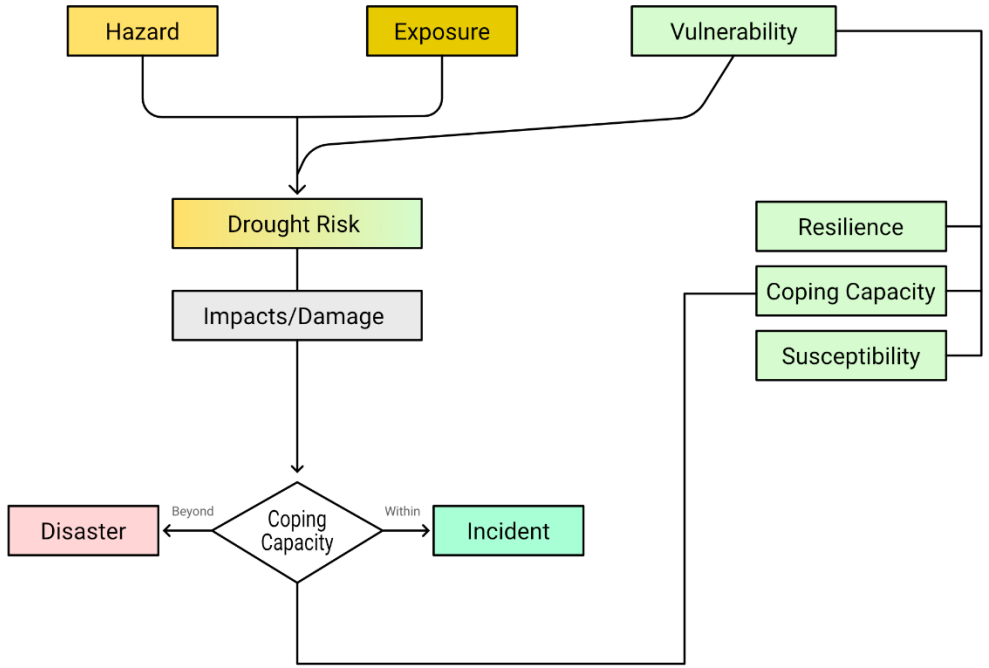
Humanitarian action in Kenya significantly scaled-up in response to the rapidly escalating drought emergency, in full complementarity with Government-led relief efforts. Over 1.7 million people received assistance from 93 humanitarian organizations in 2022 under the Drought Flash Appeal that was initially launched in October 2021. Nearly 775,000 people were reached with food and livelihood assistance. About 459,000 children and pregnant and lactating women were treated for

ADM-Kenya Solution

- **Drought assessment**: Improving currently used drought assessment methods with the use of new datasets (such as Sentinel-3) and develop methods for high resolution drought monitoring (Sentinel-2).

- **Mapping of cropping systems**: Drought information is linked to products that are relevant to drought impact as different cropping practices can affect the susceptibility and vulnerability to drought.

- **Validation of the approaches**: Many drought assessment practices currently do not include validation schemes. We collected in-situ reference data, as well as combined available data for validation.



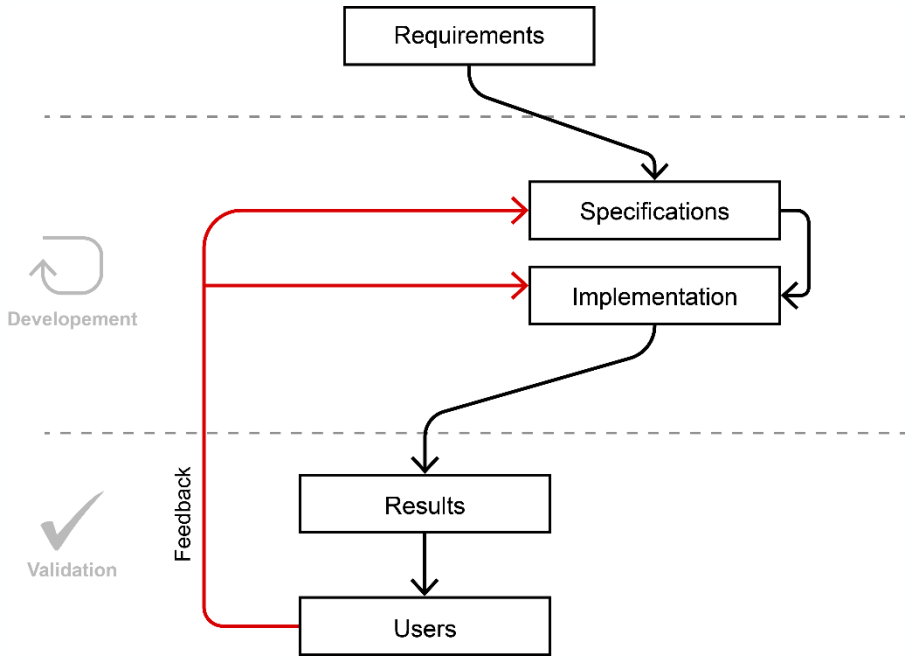
Assessing Drought Risk by Integrating Hazard, Vulnerability, and Exposure Components (adapted from Global Risk Identification Programme (2010))

Validation overview

- **Direct validation:** This involves comparing satellite-derived products with in-situ data (such as field data collected in 2023).

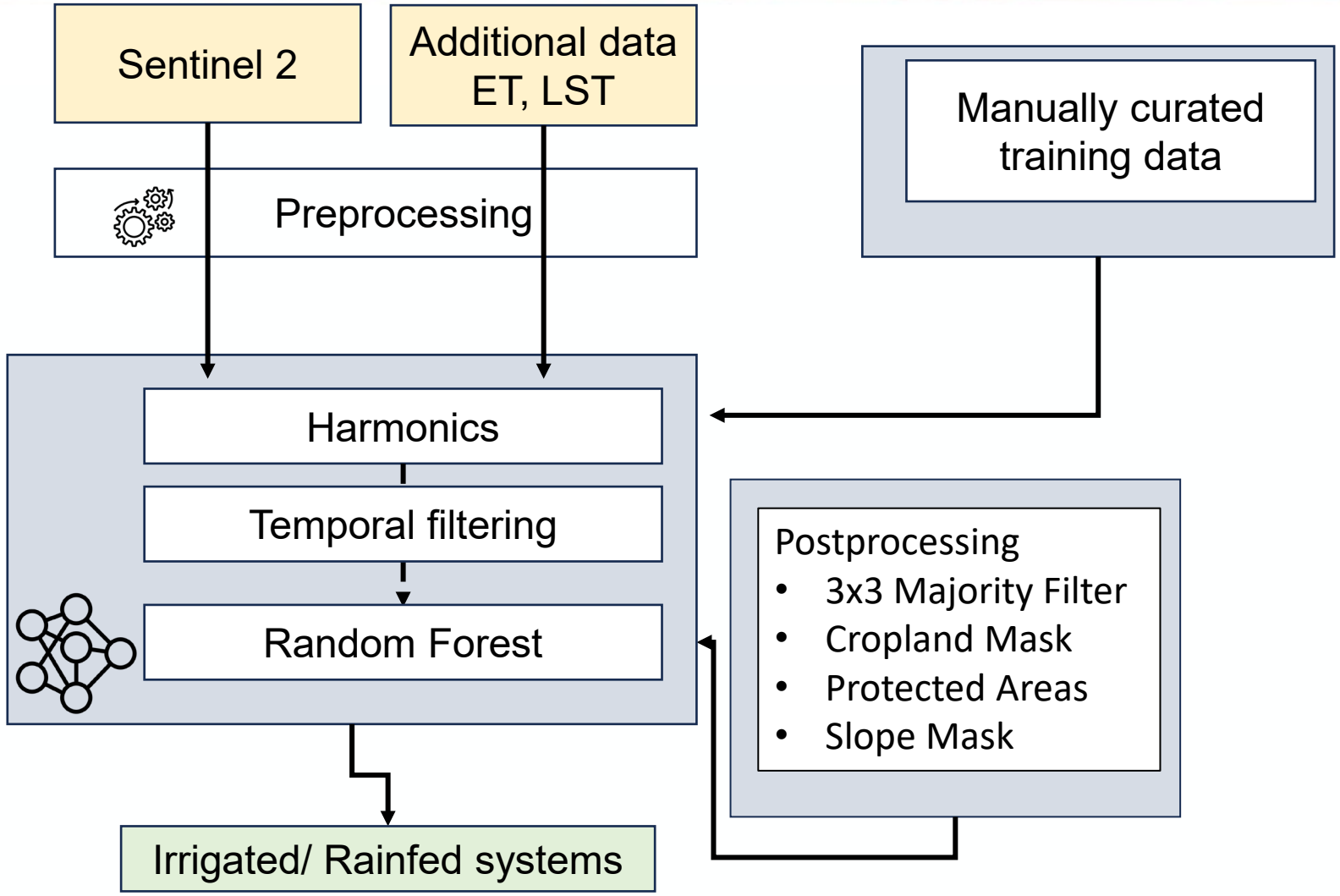
- **Intercomparison with other datasets:** assessments of temporal and spatial consistency with similar datasets or other appropriate reference data.

- **User-based validation:** Consolidation of the feedback and evaluations from end-users. Questionnaires with specific questions on accuracy and overall usefulness of the product (1-5 scale, 1 = highest confidence, 5 = lowest confidence).



User Validation Process

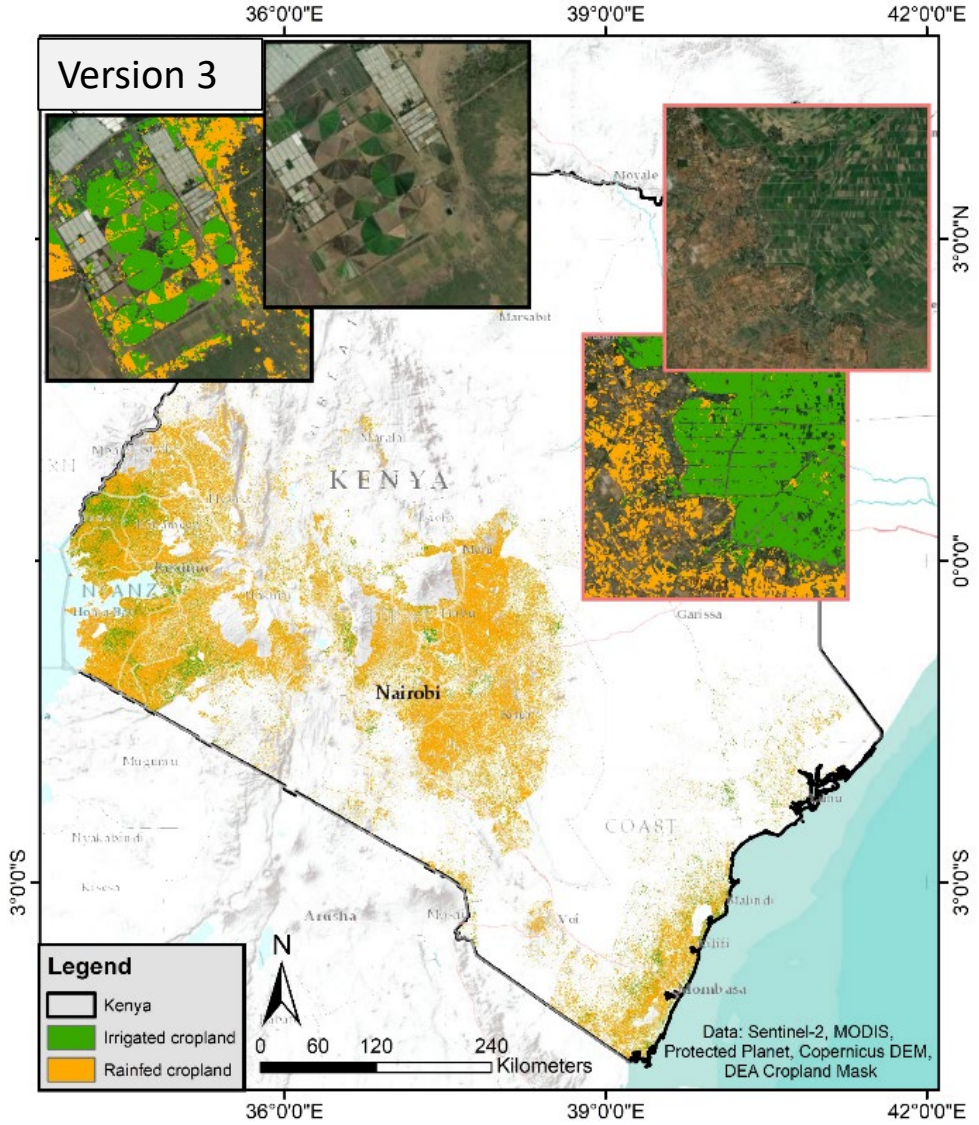
Irrigation Systems mapping



Workflow of the product farming systems

Irrigation Systems mapping

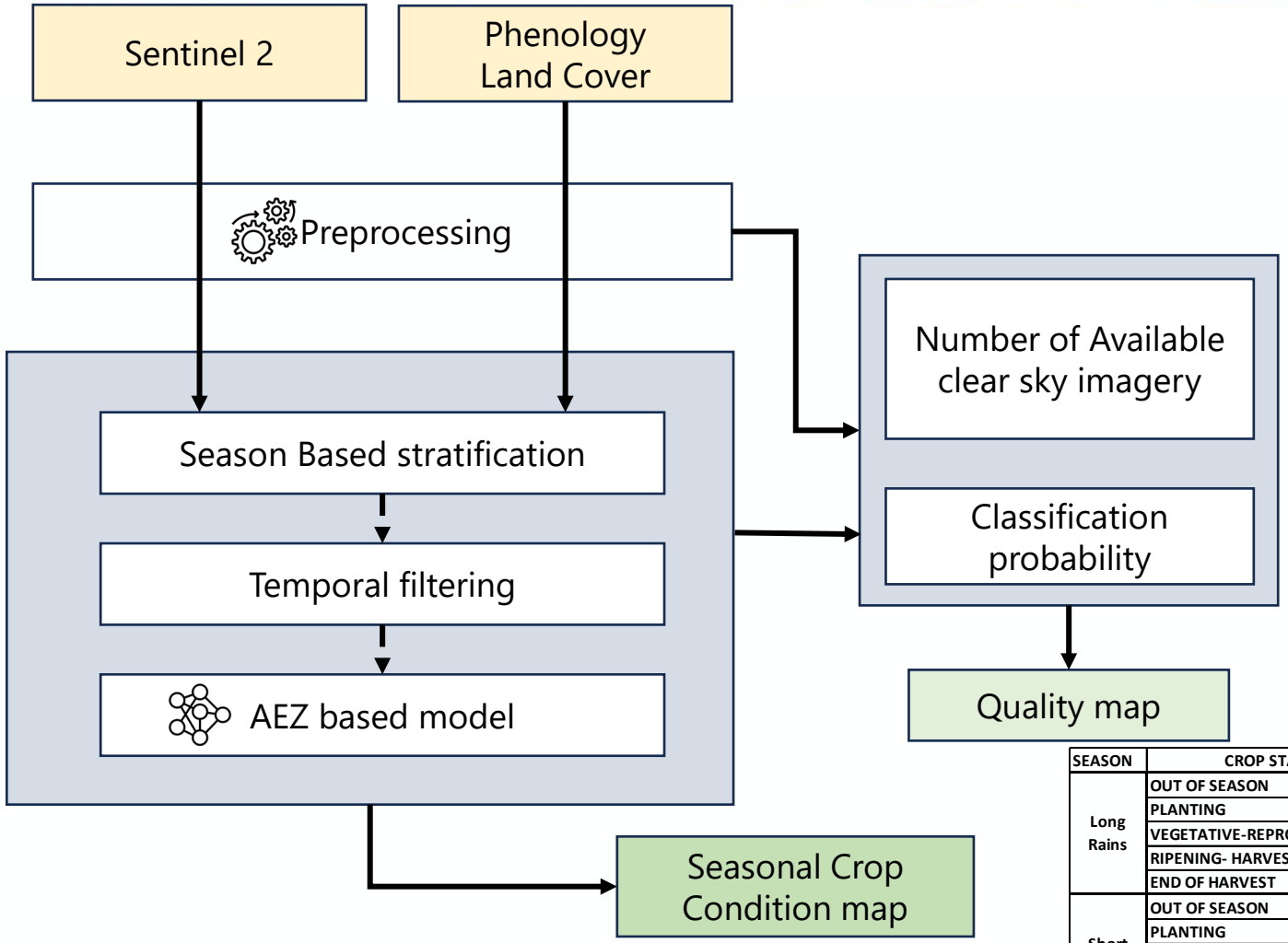
		REFERENCE			
		Irrigated	Rainfed	TOT	*User's accuracy (%)*
PREDICTION	Irrigated	**107,353**	2,714	**110,067**	*97.53*
	Rainfed	1,785	**99,693**	**101478**	*98.24*
	TOT	**109,138**	**102,407**	***Total Samples:* 211,545** ***Overall Accuracy:* 97.87%**	
	Producers Accuracy (%)	*98.36*	*97.35*		



Farming Systems for Kenya: Version 3 – updated training data, updated cropland mask, additional protected areas mask, ET, LST

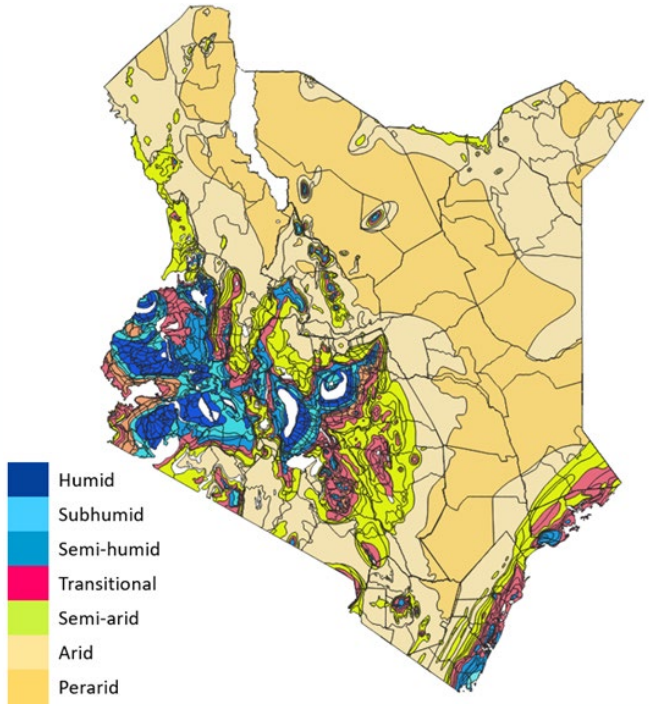
Schwarz et al., 2024

High Resolution Crop Condition



Workflow of the crop condition mapping

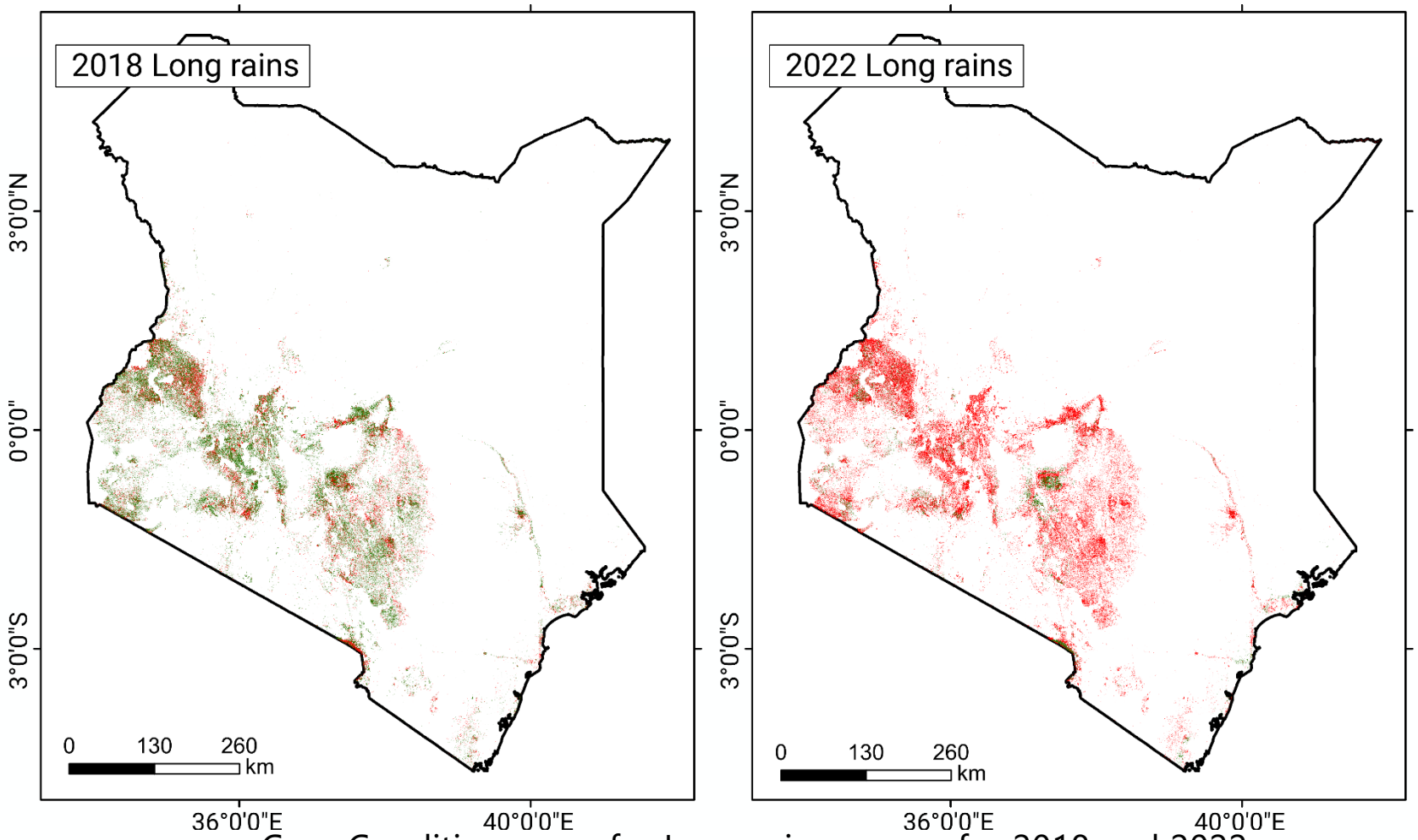
Agro-ecological Zones (AEZ). Source: RCMRD



Maize crop calendar. Source: Ministry of Agriculture

SEASON	CROP STAGE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Long Rains	OUT OF SEASON												
	PLANTING												
	VEGETATIVE-REPRODUCTIVE												
	RIPENING- HARVEST												
	END OF HARVEST												
Short Rains	OUT OF SEASON												
	PLANTING												
	VEGETATIVE-REPRODUCTIVE												
	RIPENING- HARVEST												
	END OF HARVEST												

High Resolution Crop Condition



Crop Condition maps for Long rains season for 2018 and 2022.
(Data: Sentinel-2, AEZ, ESA World Cover v2)

Accuracy metrics (%)

AEZs	Long rains	Short rains
Humid	*68*	*67*
SubHumid	*68*	*65*
Semi-Humid	*63*	*67*
Transitional	*64*	*69*
Semi-Arid	*80*	*78*
Arid	*78*	*85*
PerArid	*70*	*66*

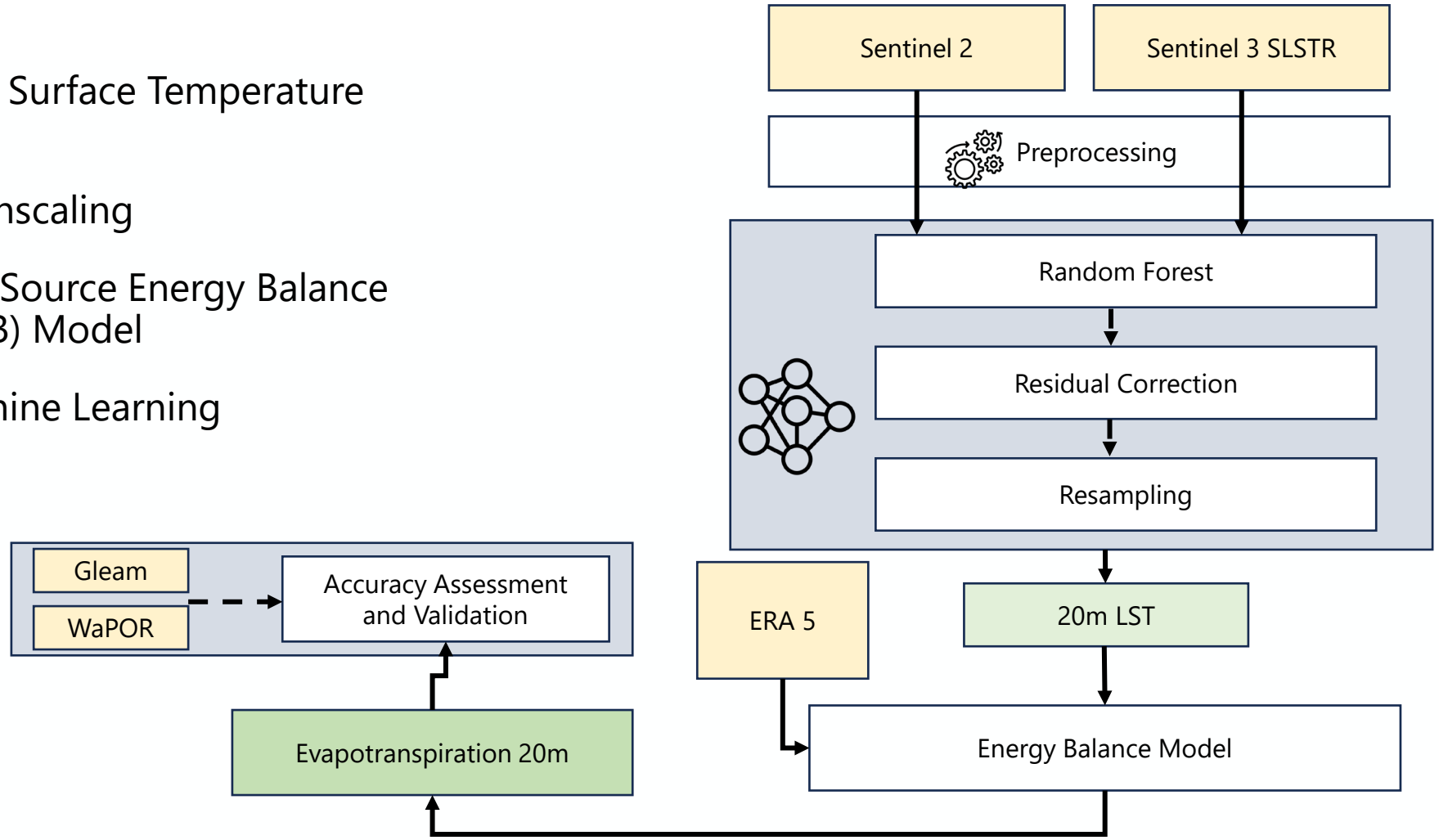
Crop Condition

- Affected
- Unaffected

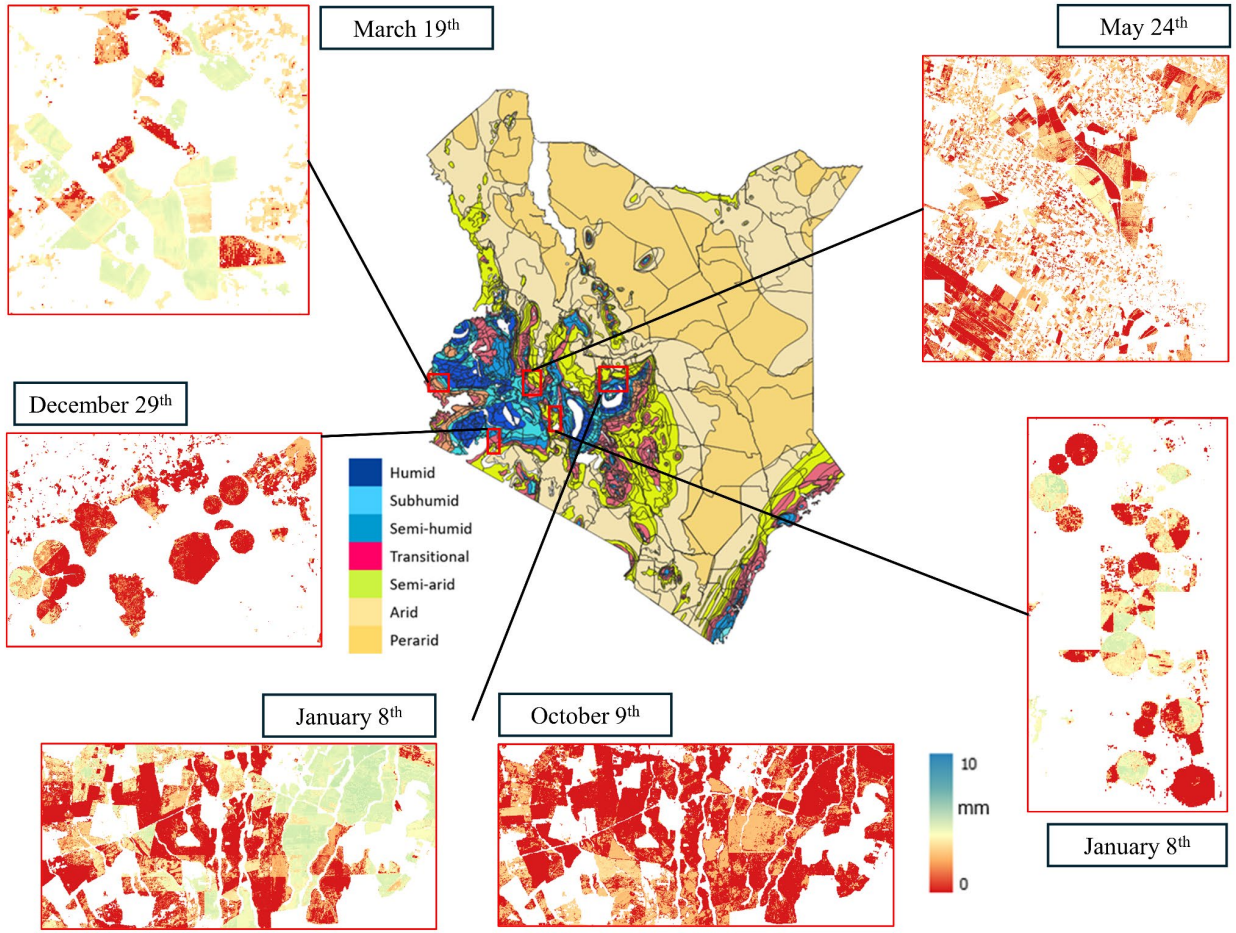
Mirmazloumi et al., 2024 (in preparation)

Downscaled Evapotranspiration

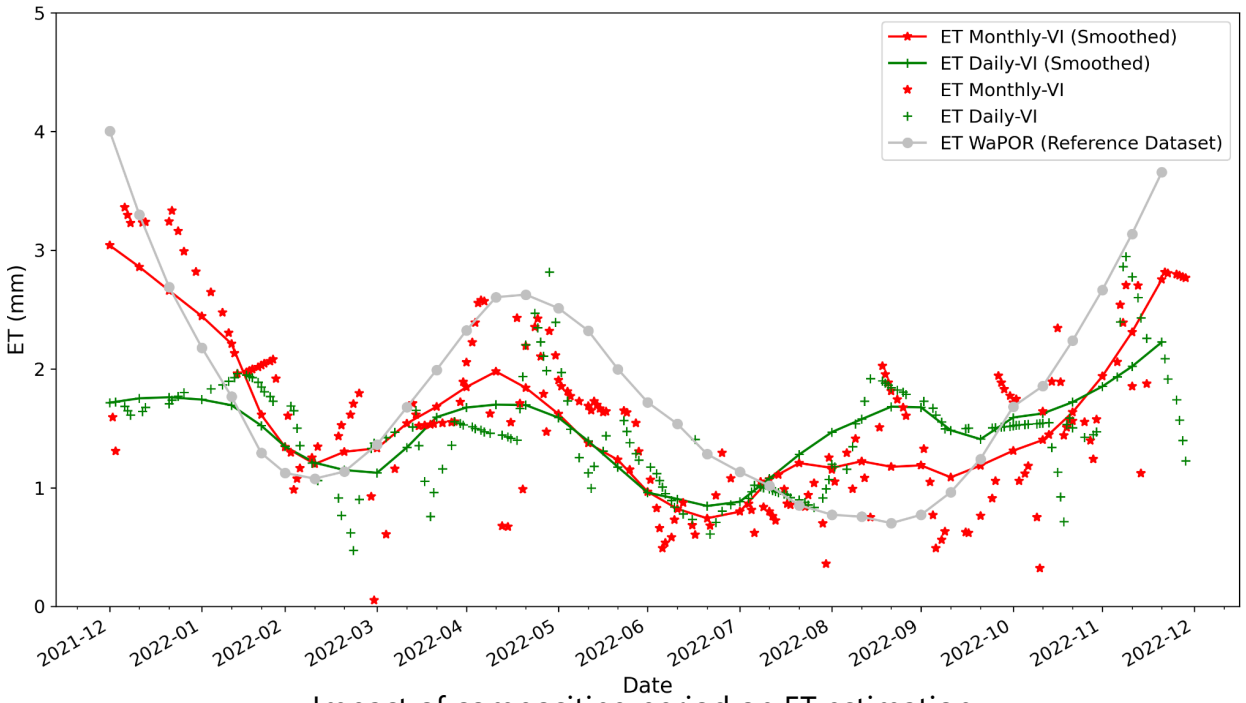
- Land Surface Temperature (LST)
- Downscaling
- Two-Source Energy Balance (TSEB) Model
- Machine Learning



Downscaled Evapotranspiration



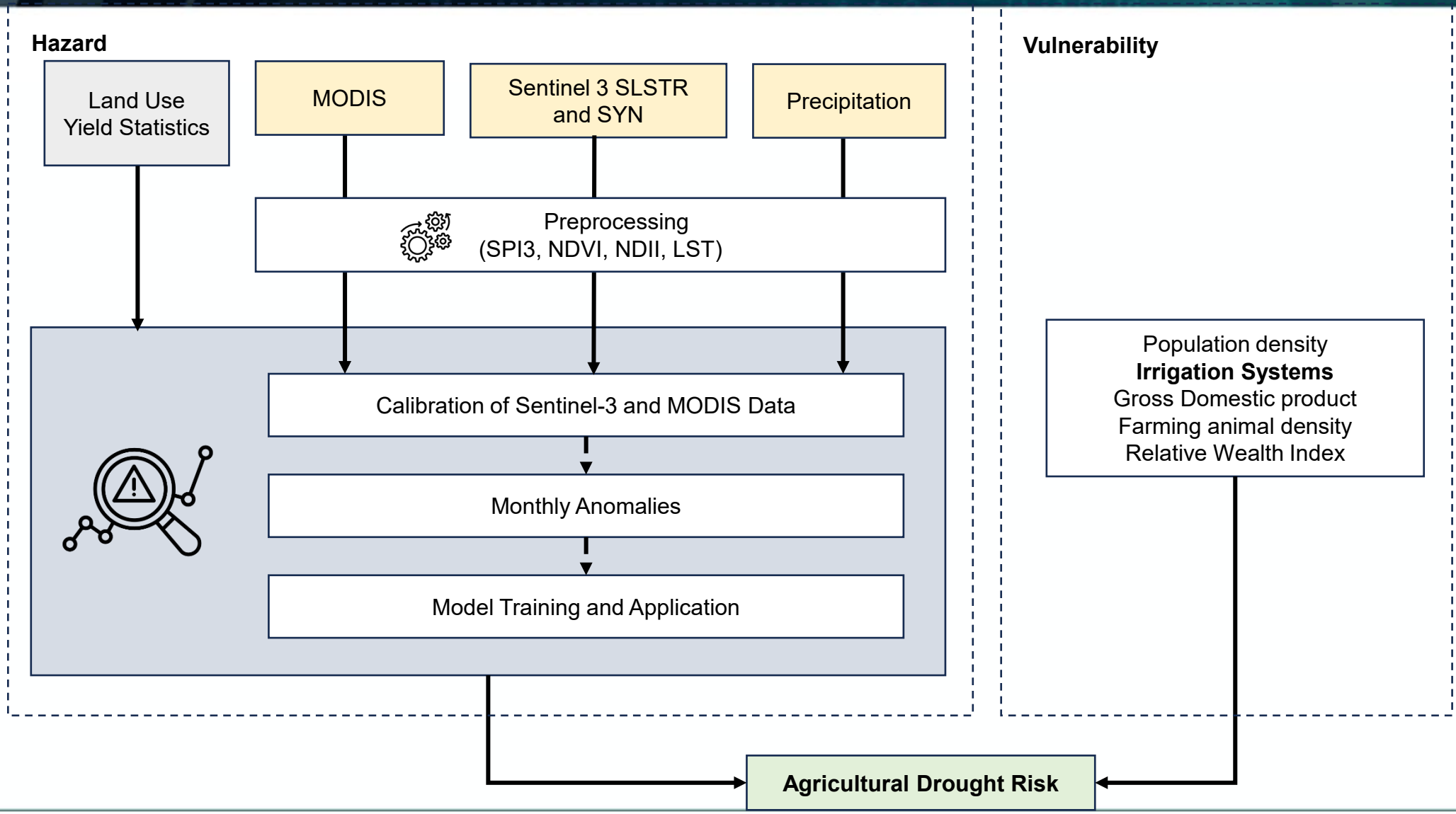
Examples of ET estimation for different time steps/areas



Impact of compositing period on ET estimation

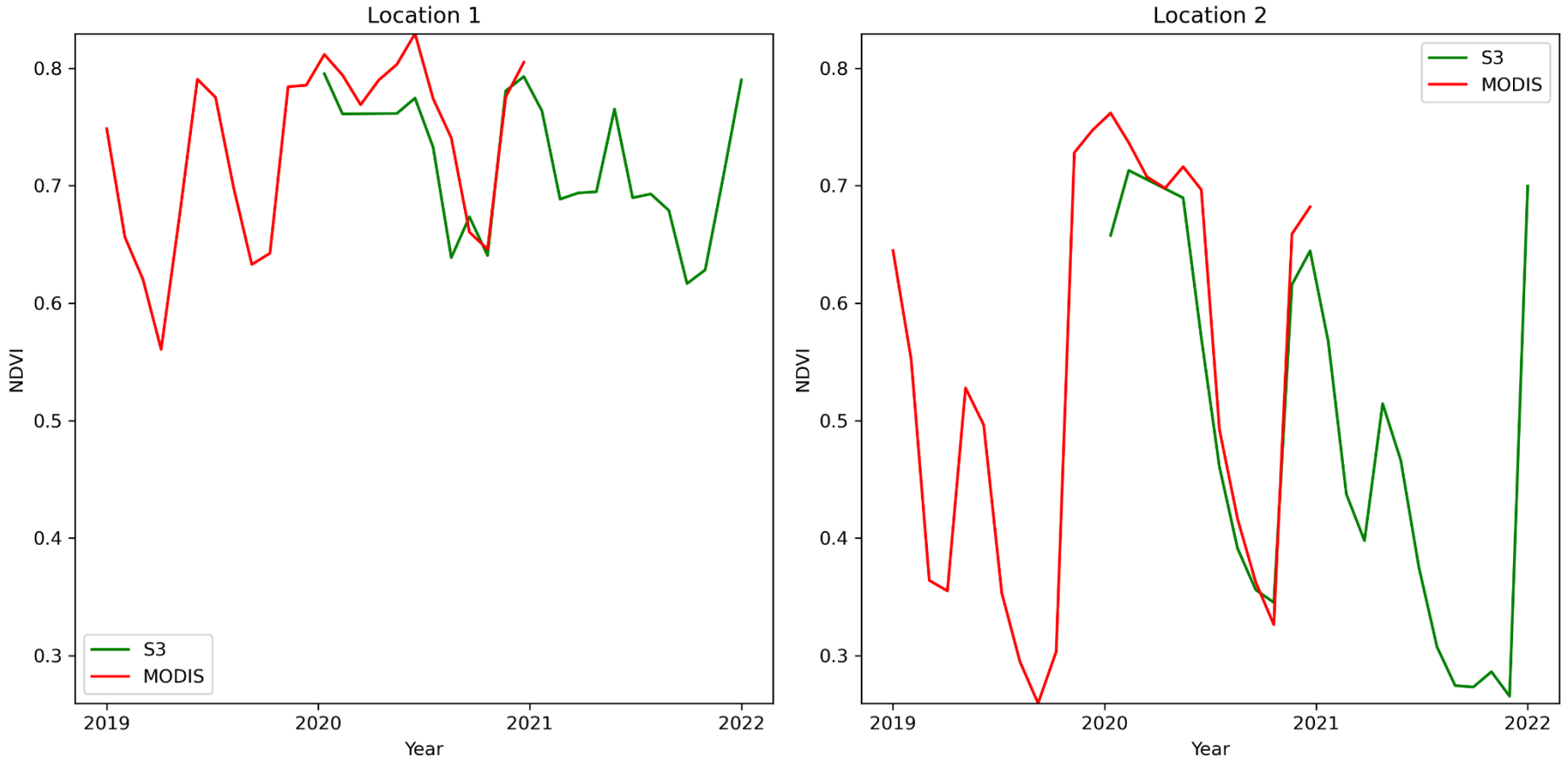
Mirmazloumi et al., 2024 (in preparation)

Spatially transferable National scale Drought Risk assessment



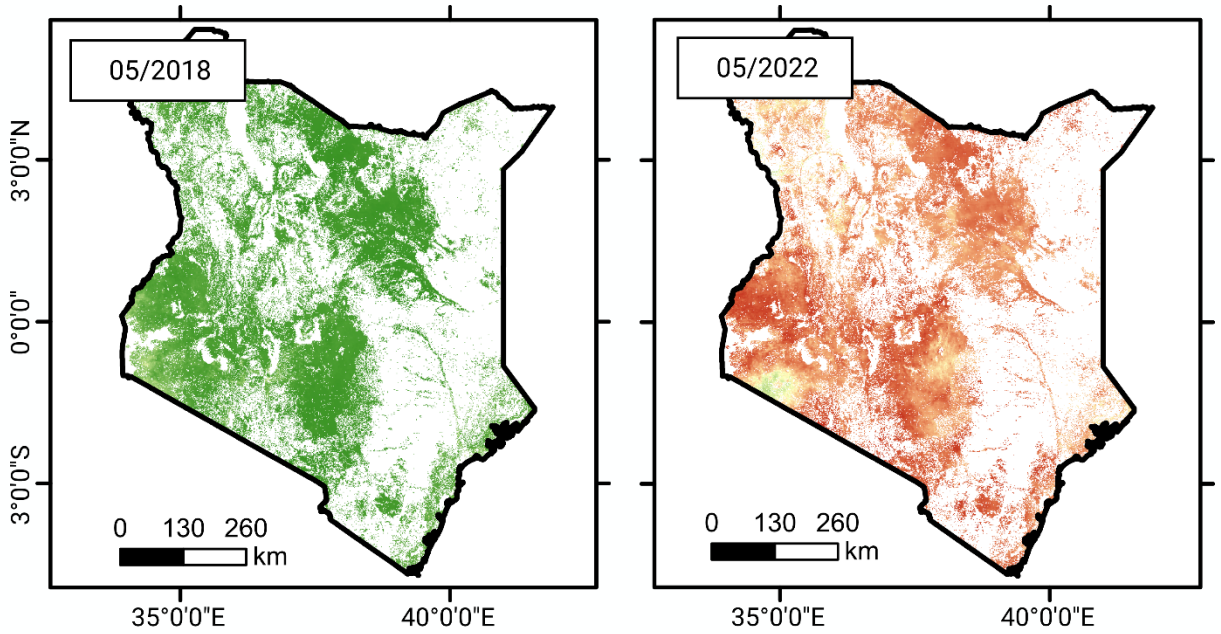
Spatially transferable National scale Drought Risk assessment

30,000 random points -> generate sensor offset

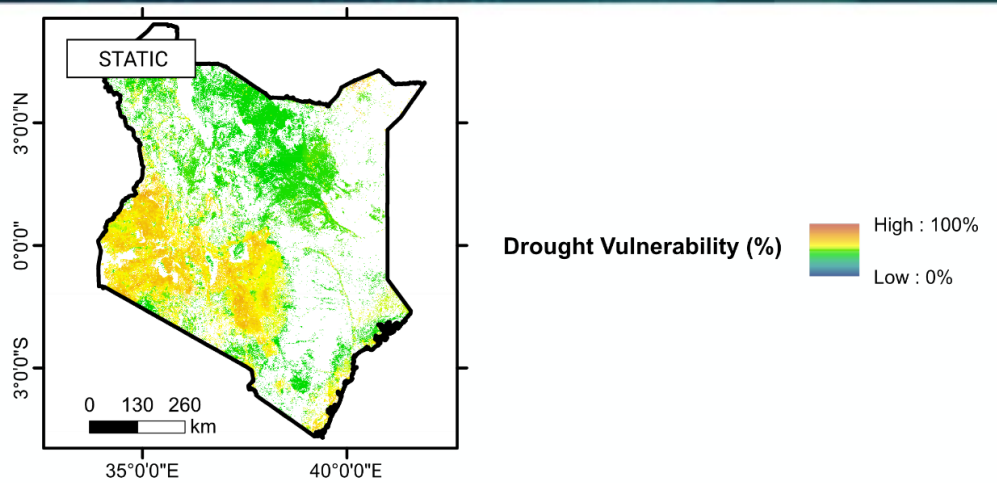


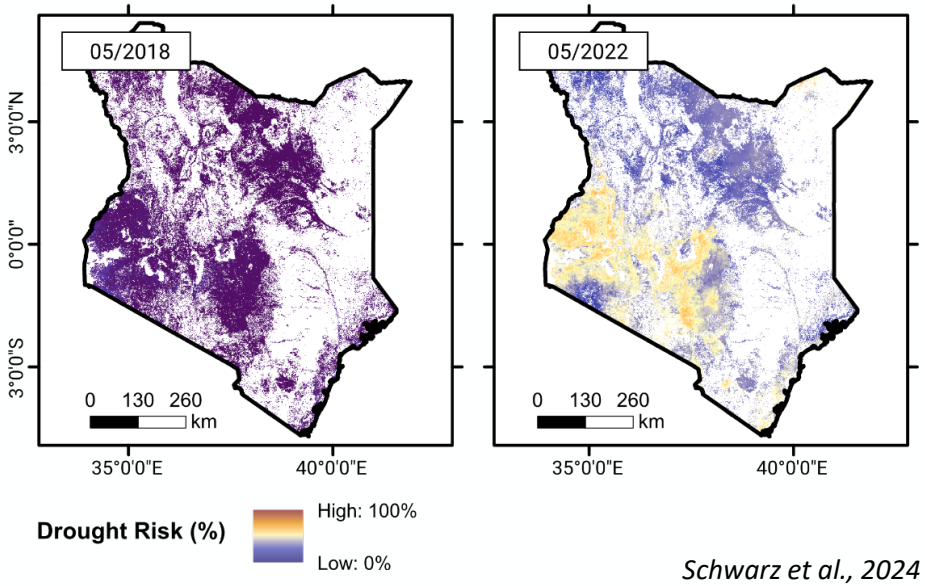
Comparison between MODIS and Sentinel-3

Spatially transferable National scale Drought Risk assessment



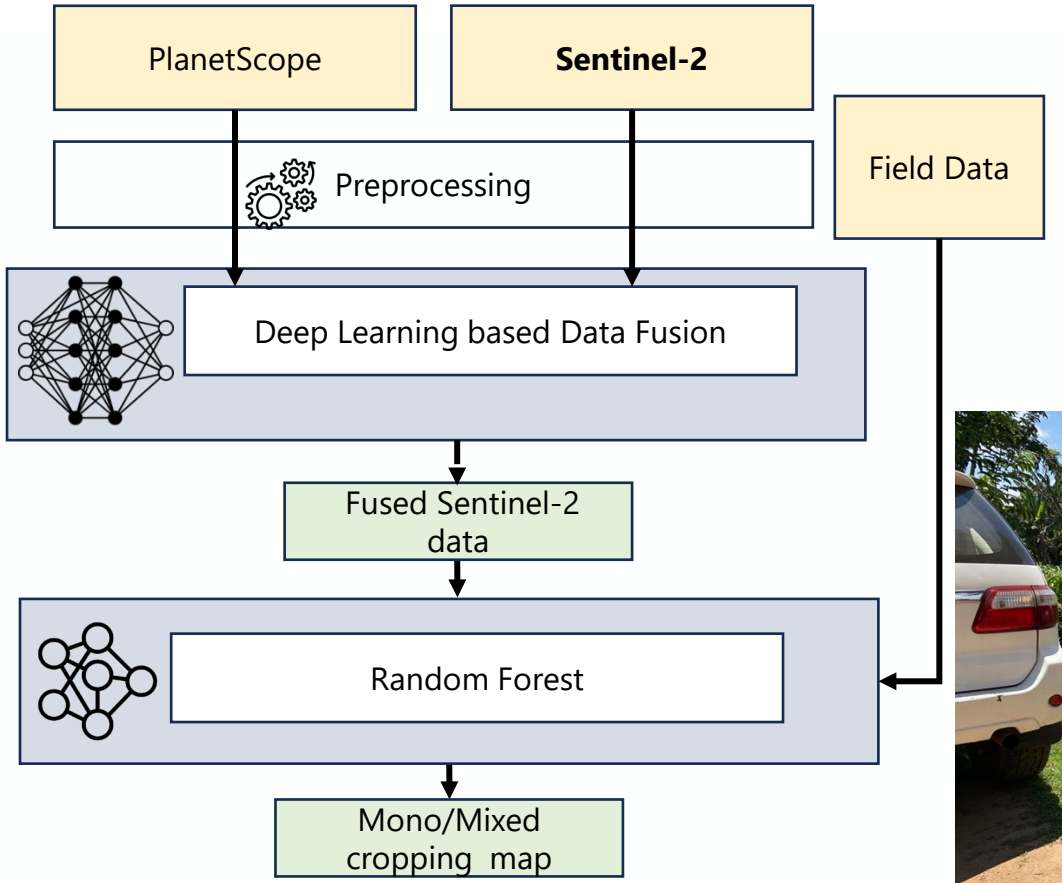
Drought Hazard, Risk and vulnerability for May 2018 and May 2022
(Data: FAOSTAT, Copernicus Land Cover, MODIS, Sentinel-3, TAMSAT)



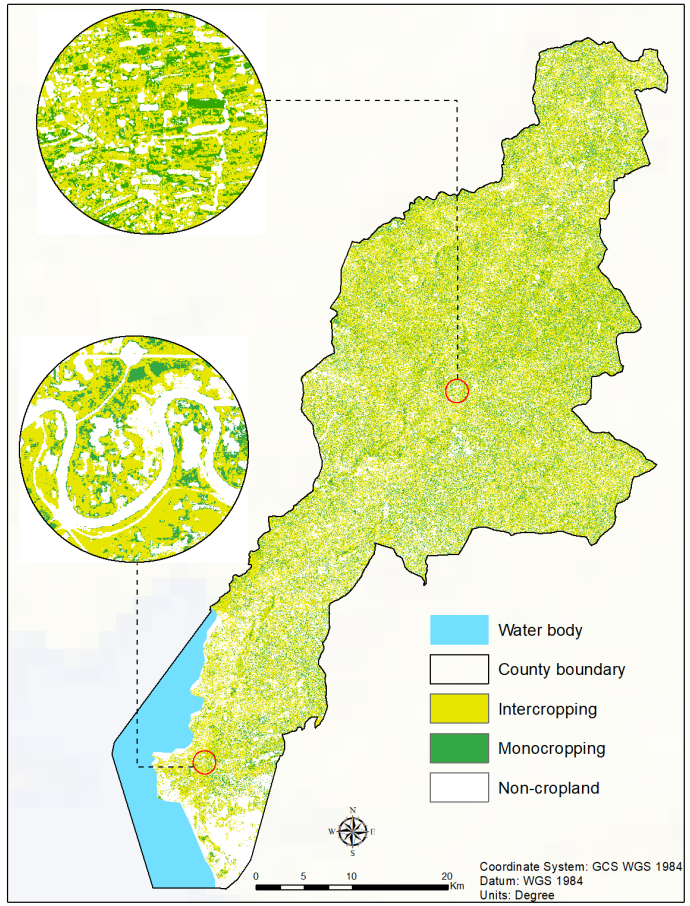


Schwarz et al., 2024 (in preparation)

Crop systems: Mono/Mixed cropping mapping



Field data collection (September 2023)



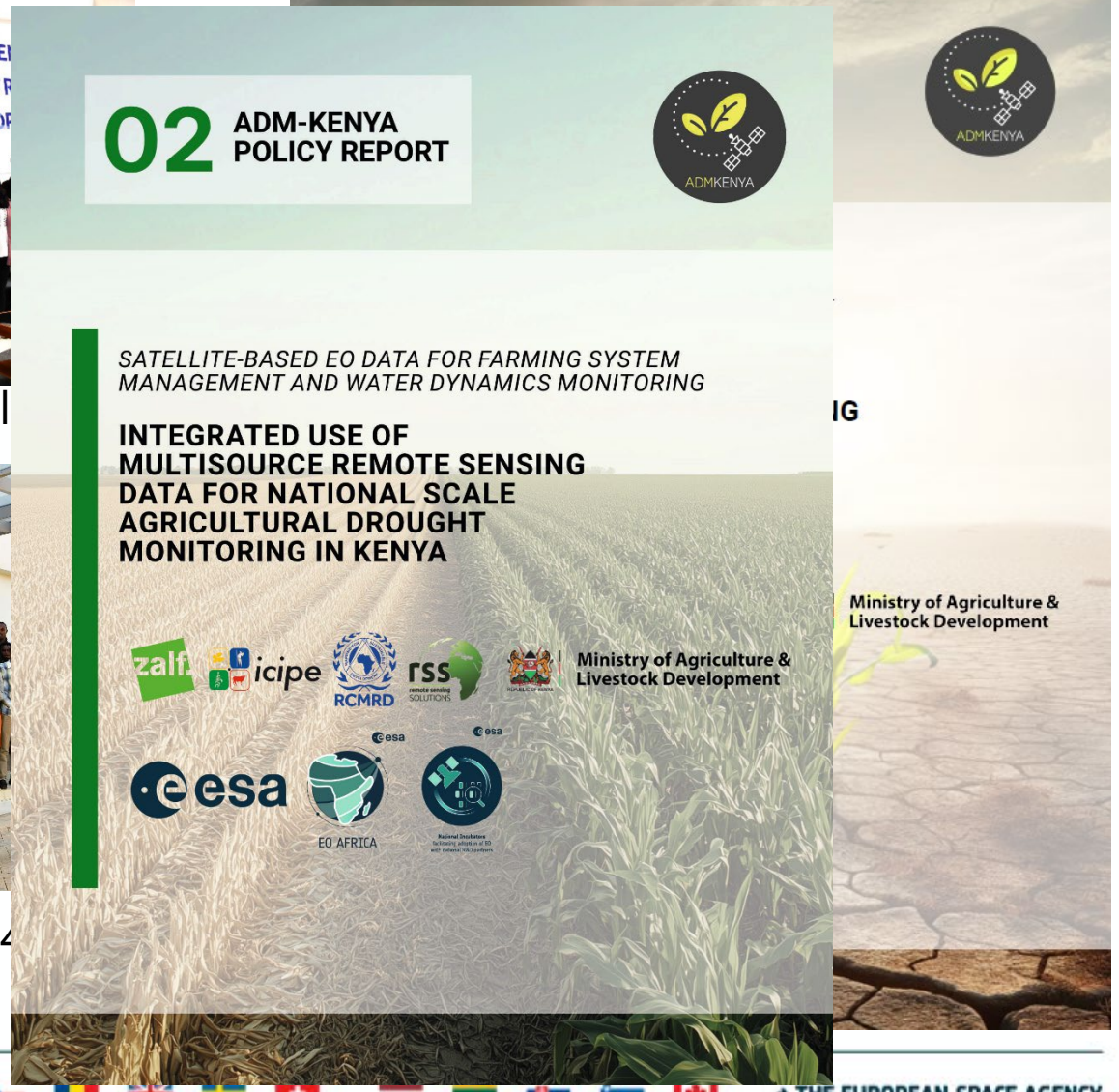
Kyalo et al., 2024 (in preparation)

User engagement and other activities

User needs assessment workshop (February 2023)

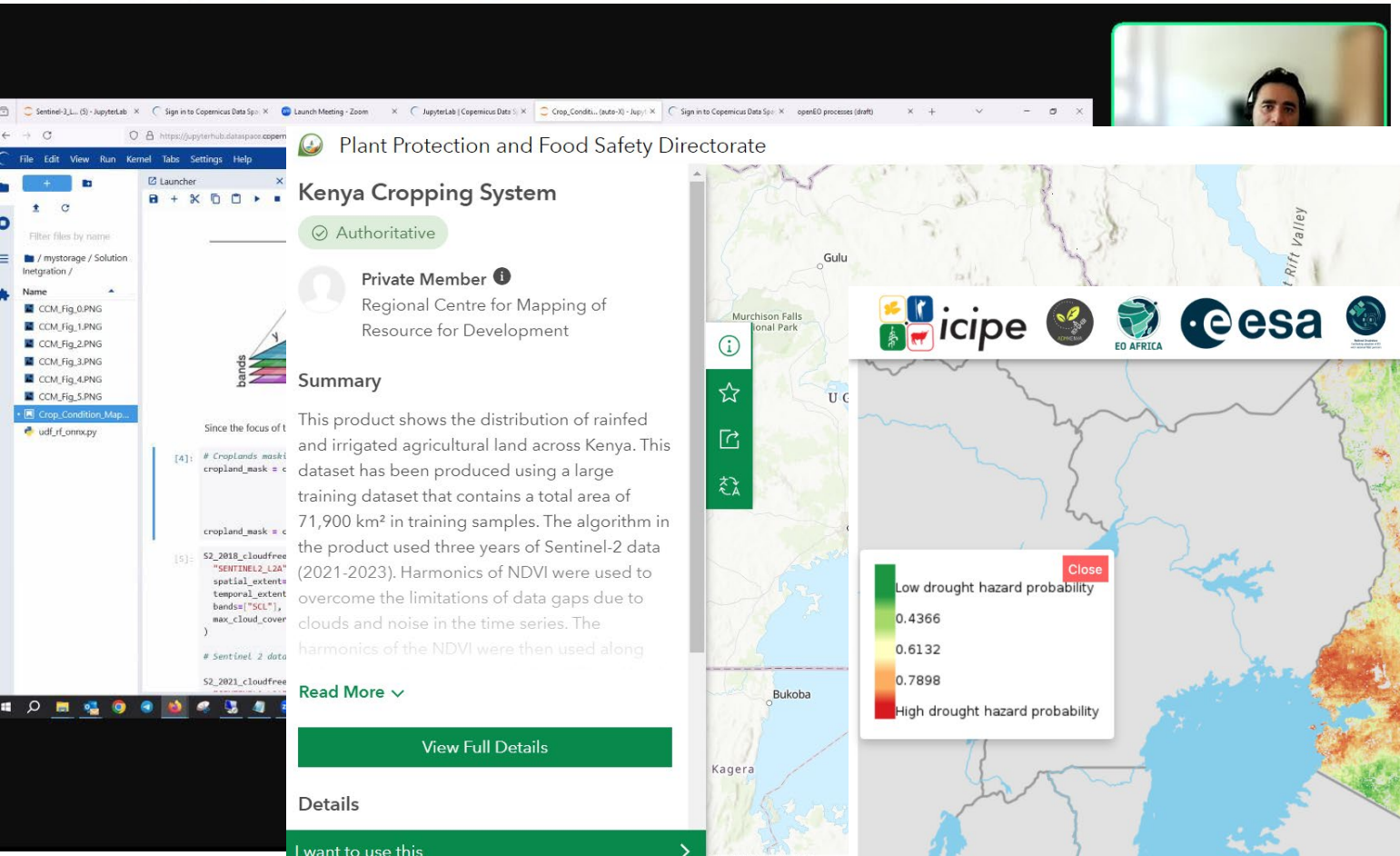
Validation meeting (Jul

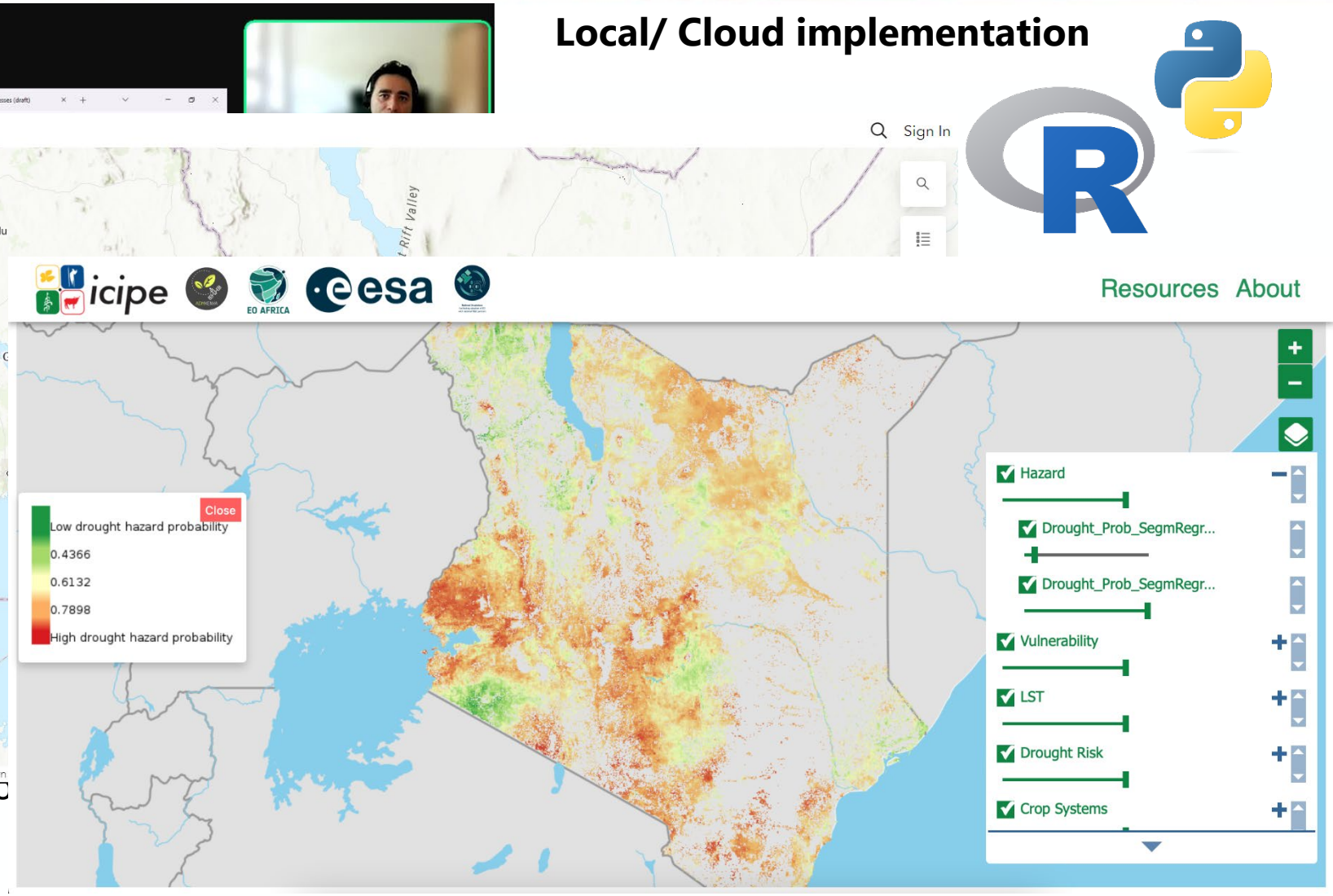
Workshop (May 202



Solution integration

Local/ Cloud implementation





https://dataspace.copernicus.eu/analyse/apis/c

Save the date: Second User Webinar

EO AFRICA

HOME ABOUT RESULTS CONSORTIUM

On **October 2nd, 2024**, the ADM-Kenya team will host the second user webinar. The webinar will present the results of EO Africa ADM-Kenya p developing solutions for agricultural drought monitoring using Earth Observation (EO) time-series data. The session will start with a brief over a recap of key takeaways and major insights. We will then focus on the methodologies behind the products, including crop condition assessm downscaled evapotranspiration and cropping systems assessment. After a short break, we will present case studies illustrating successful im of these methodologies.

Registration is open:

Webinar registration

Time: 2nd October 13:00 – 16:00 CEST

Agenda:

13:00: Brief Overview of the EO Africa ADM-Kenya Project
13:15: Key Takeaways from the Project, Recap of the major insights and learnings
14:00: Focus on Methodologies Behind the Products and data needs
14:45: Break
15:00: Case Studies: Illustrating Successful Implementations/Integration
15:45: Discussion

More information:
Web: https://www.admkenya.eu
Mail: contact@admkenya.eu

Ministry of Agriculture & Livestock Development

→ THE EUROPEAN SPACE AGENCY