STRENGTHENING CAPACITY IN APPLICATION OF UNMANNED AERIAL VEHICLE (UAV) AND REMOTE SENSING TECHNOLOGIES FOR VULNERABILITY ASSESSMENTS AND RESPONSE PLANNING TO ENHANCE NATIONAL FOOD SECURITY AND CLIMATE RESILIENCE IN ESWATINI

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Weather and Climate
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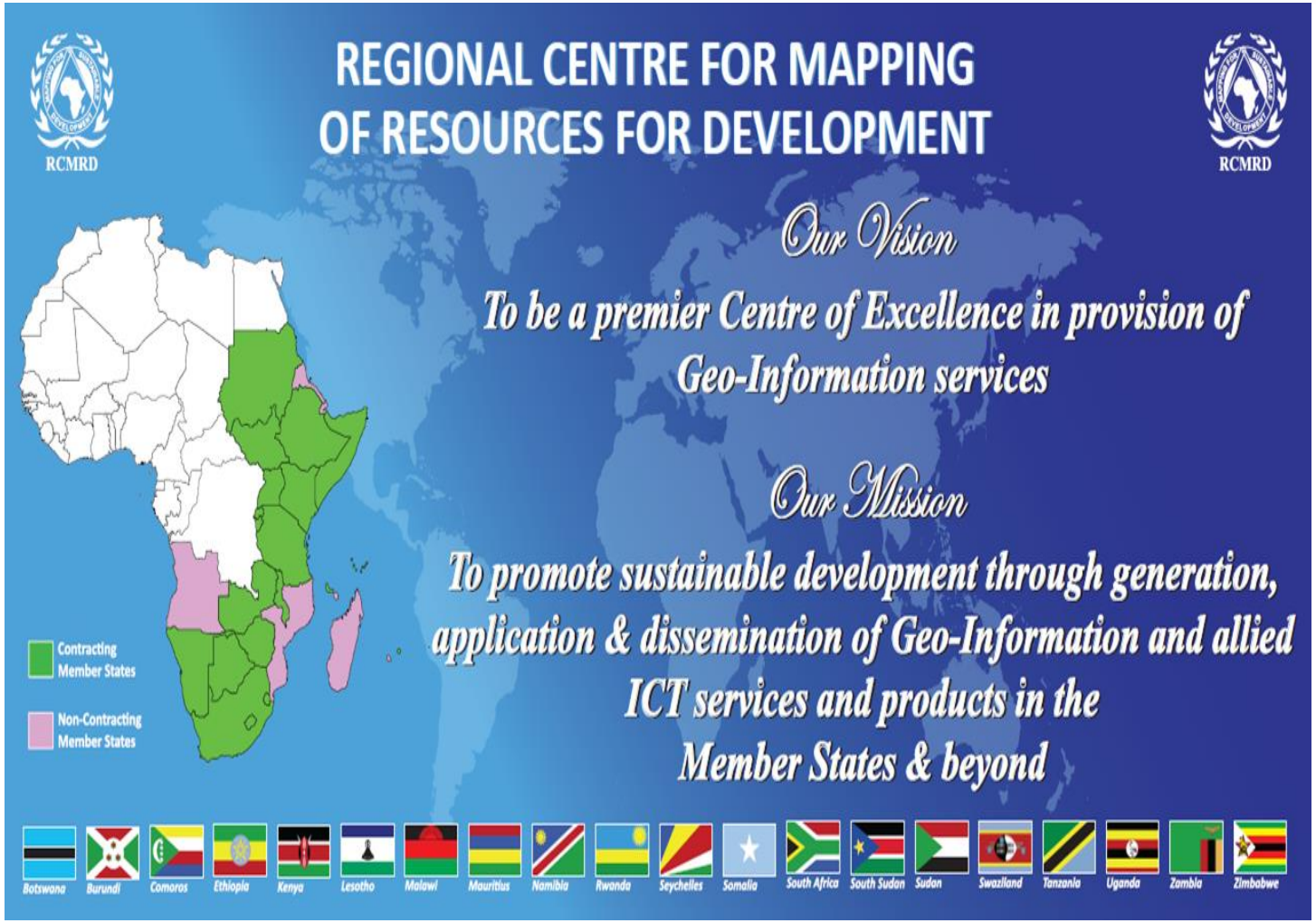
15/9/2021

About RCMRD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OF RESOURCES FOR DEVELOPMENT
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Our Vision
To be a premier Centre of Excellence in provision of Geo-Information services
Our Mission
To promote sustainable development through generation, application & dissemination of Geo-Information and allied ICT services and products in the Member States & beyond
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Kenya
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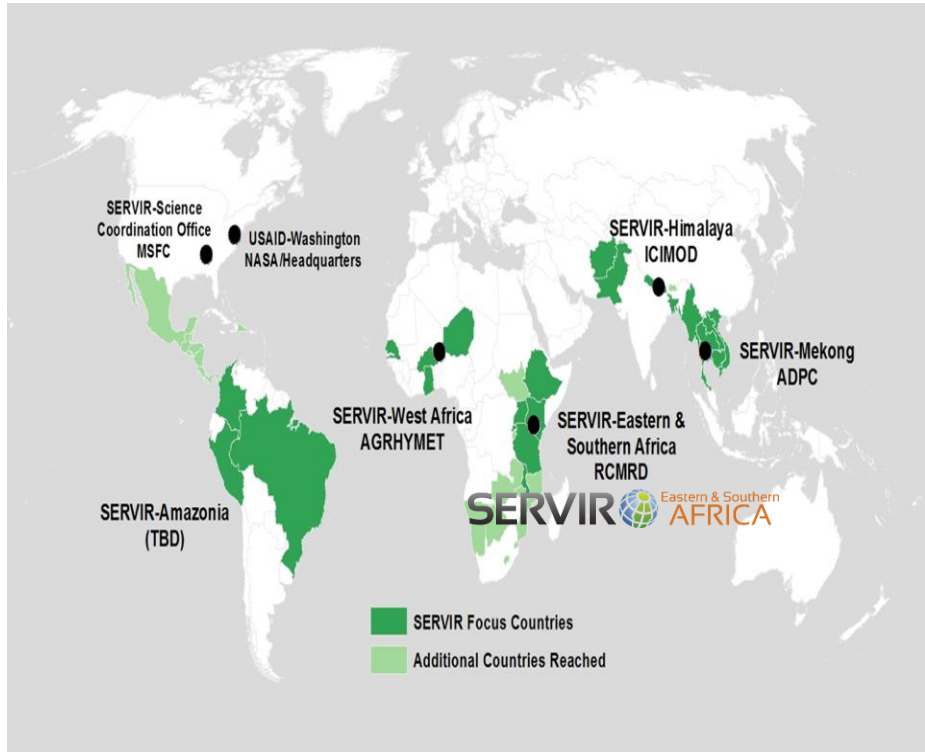
Zimbabwe


SERVIR-Science Coordination Office MSFC
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Additional Countries Reached

Objective and Expected Outcomes

Objective:

To strengthen the capacity of national entities in the Kingdom of Eswatini in the use of Unmanned Aerial Vehicles and Remote Sensing (RS) technologies for vulnerability assessments and climate resilience in the agriculture sector.

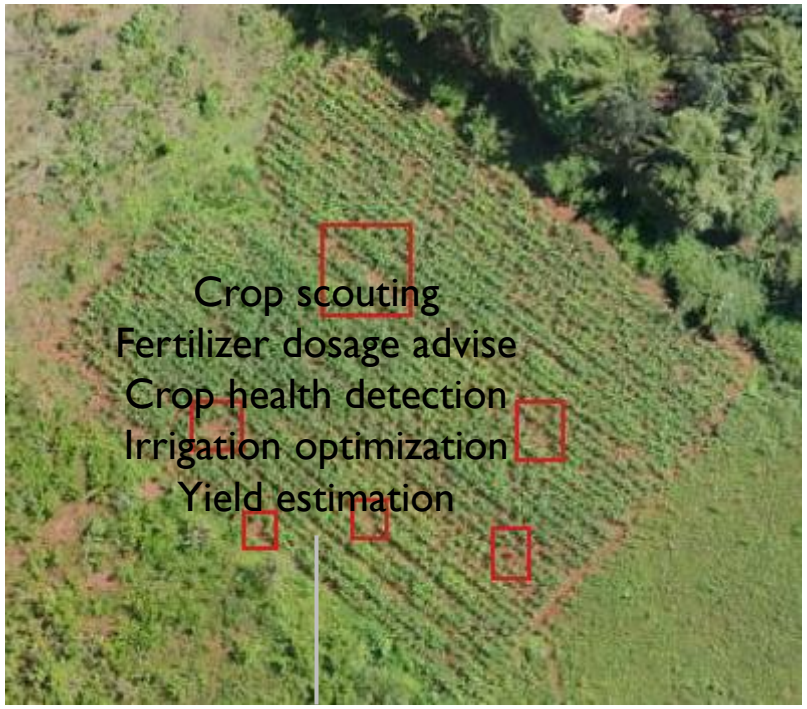
Expected Outcomes

i. Enhanced capacity of national stakeholders, including the National Disaster Management Agency, on the application of UAV technology and remotely sensed imagery for crop monitoring and provision of timely early warning data to farmers

ii. Availability of baseline dataset based on pilot application of UAV and remote sensing in the agricultural sector, and

iii. Improved readiness to seek Global Climate Fund (GCF) funding for up-scaling of technologies

Unmanned Areas Vehicles in Agriculture



Soil testing & and evaluation of historic maps

Gap filling

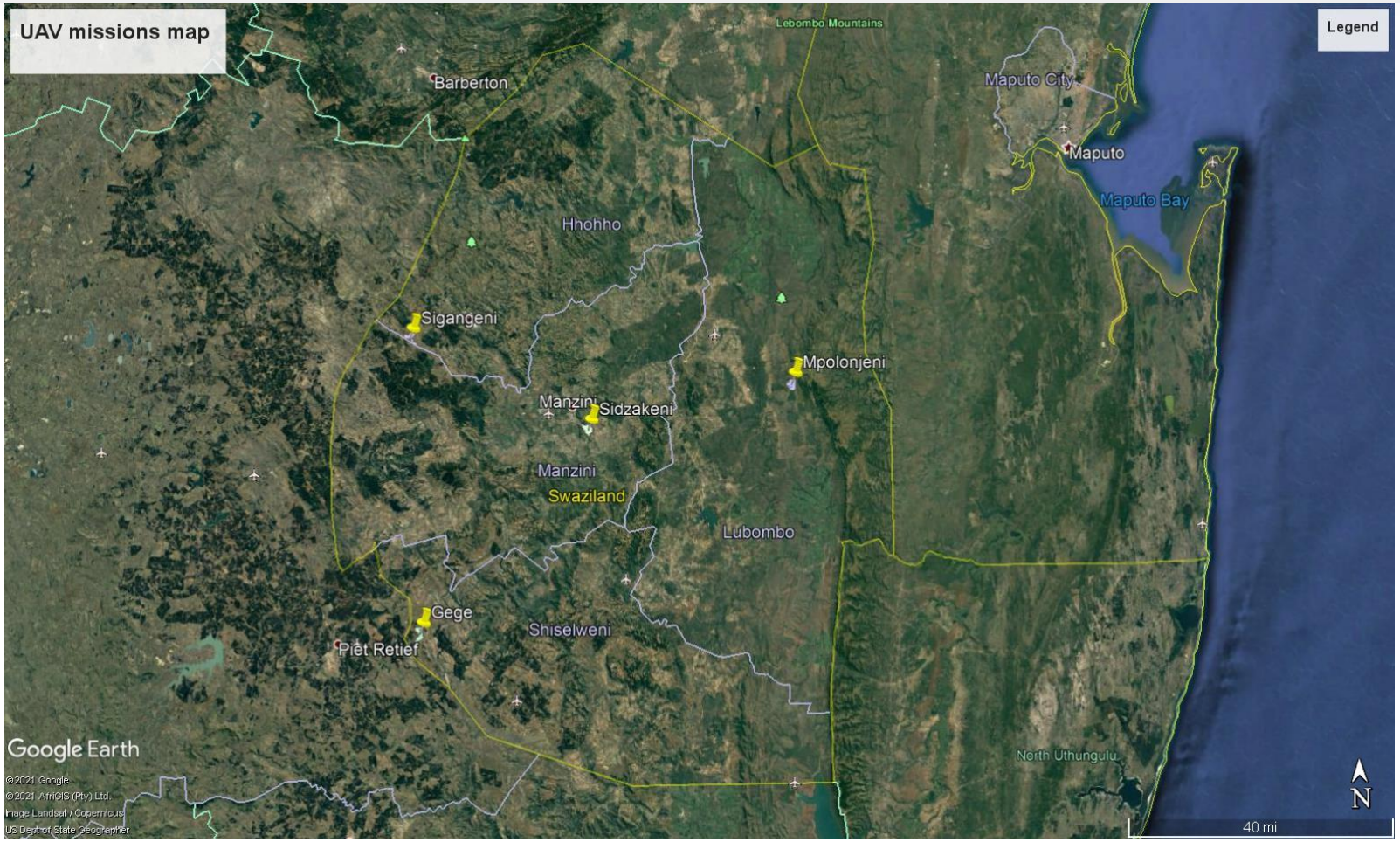
From elevation maps

Review season maps and plan for next season

Buy seed & equipment	Soil mapping	Plant	Emergence stage	Growth stage	Harvest stage	Drainage repair	Planning for next season

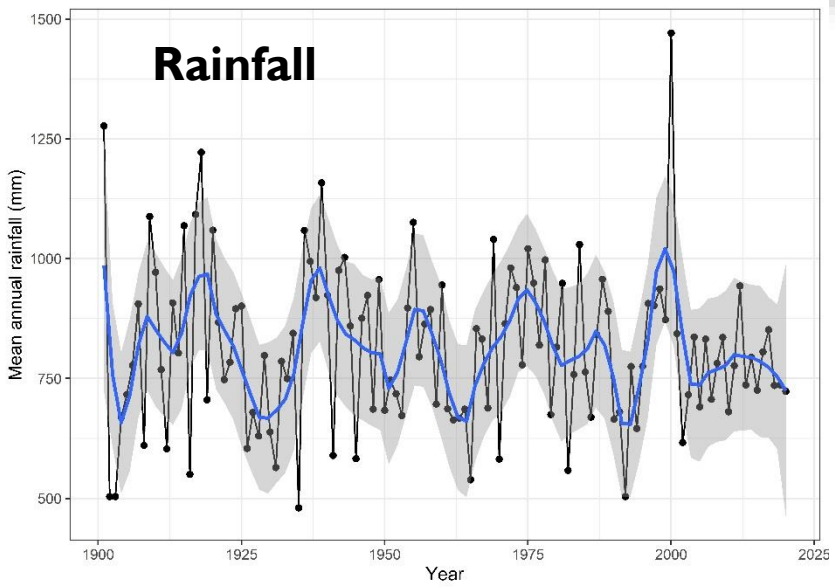
Mon 1 Mon 2 Mon 3 Mon 4 Mon 5 Mon 6 Mon 7 Mon 8 Mon 9 Mon 10 Mon 11 Mon 12

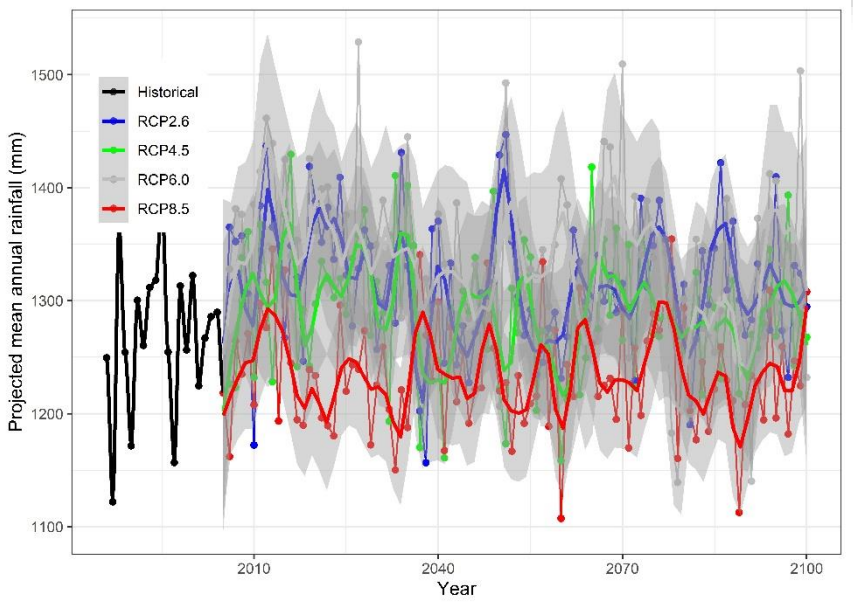
Fieldwork planning and mission execution

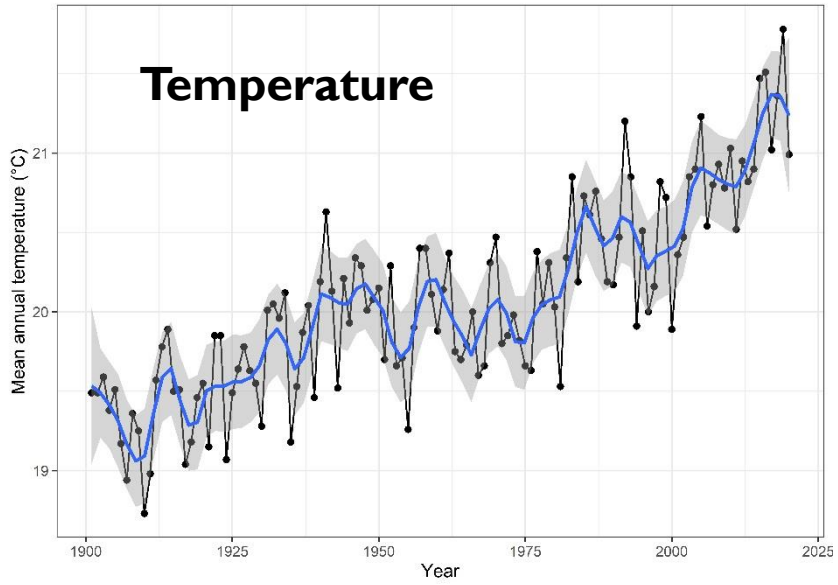


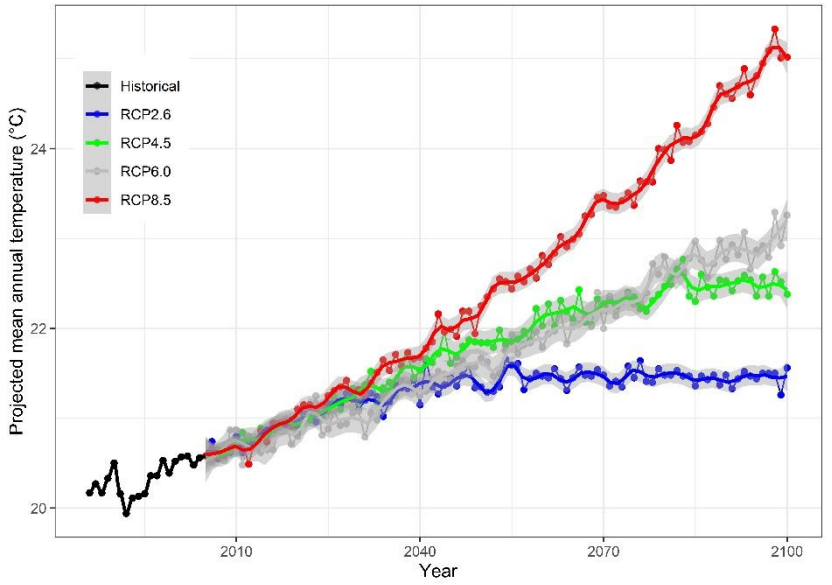
Four sites: Sigangeni, Sidzakeni, Manjoleni and Gege. A total of 20.3Km^2 mapped using WingtraOne Fixed drone from the Kenya Red Cross Society and 5km^2 using DJI Phantom 4 and Matrice drones from NDMA

Eswatini Climate Risk profile





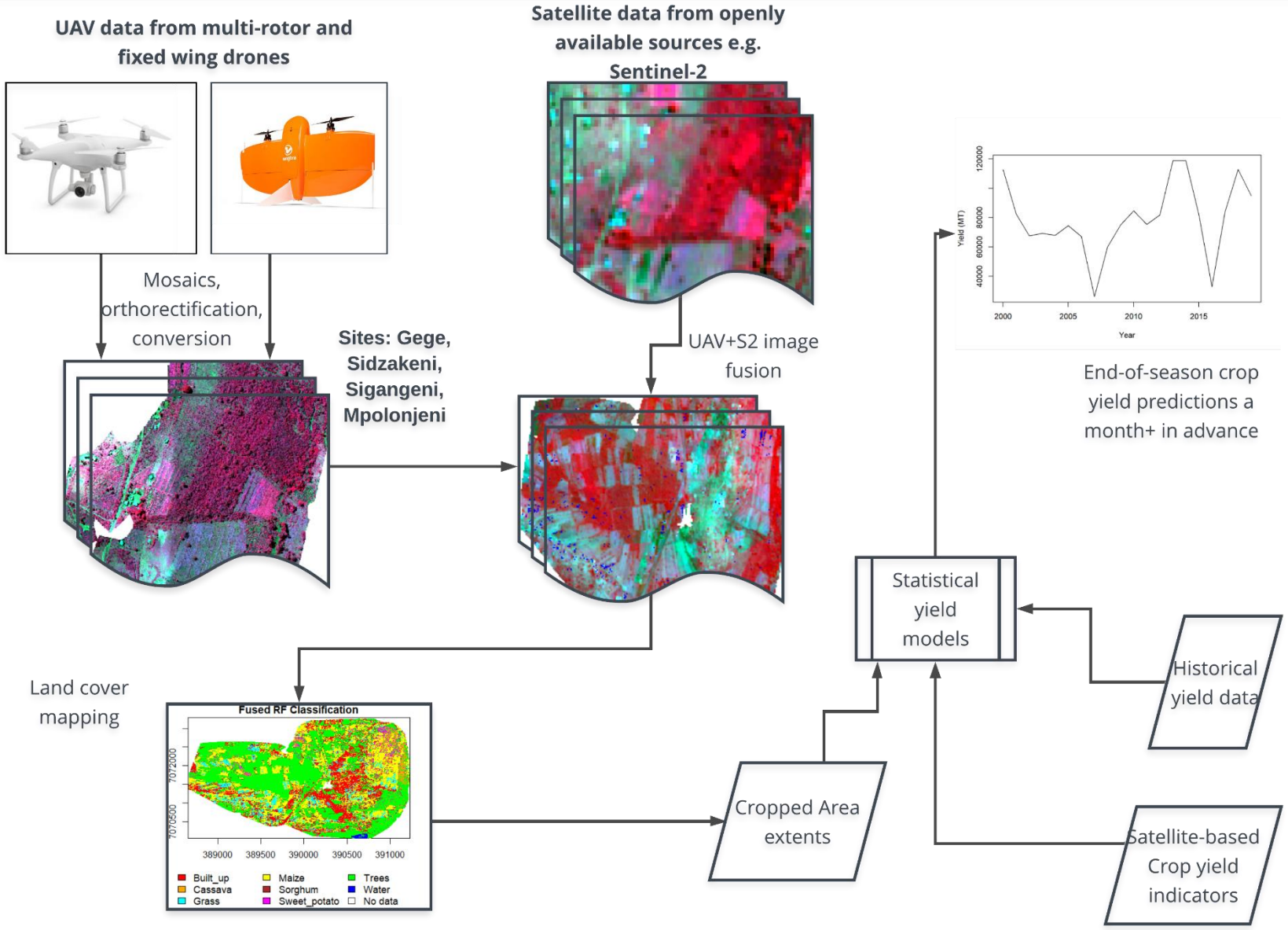




Key trends:

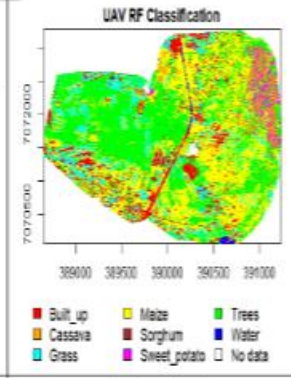
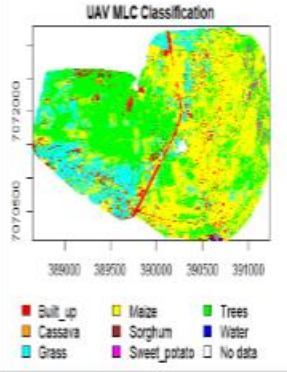
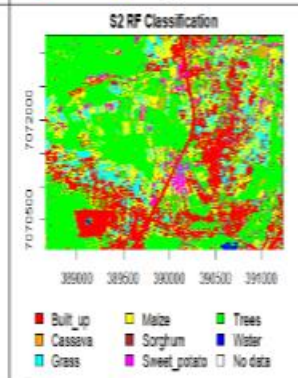
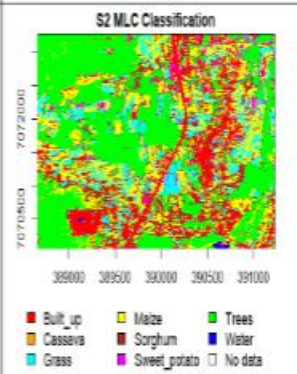
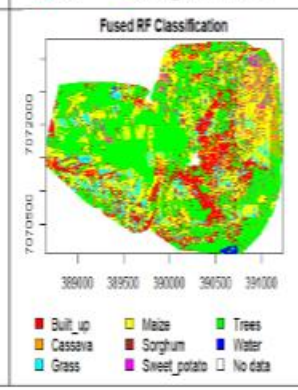
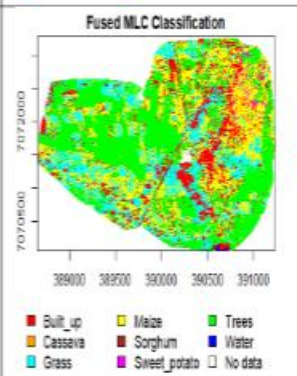
- Consistent temperature extremes showing warming in the last 2 decades
- Increase in the frequency of very hot days (>34°C mean maxTemp)
- Significant warming trends between 2000-2010
- High interannual variability in total rainfall– general pattern points to a decreasing trend in rainy days
- Increased average dry spells length
- Concerns for increased drought severity and frequency, as well as flash floods from intense rainfall events

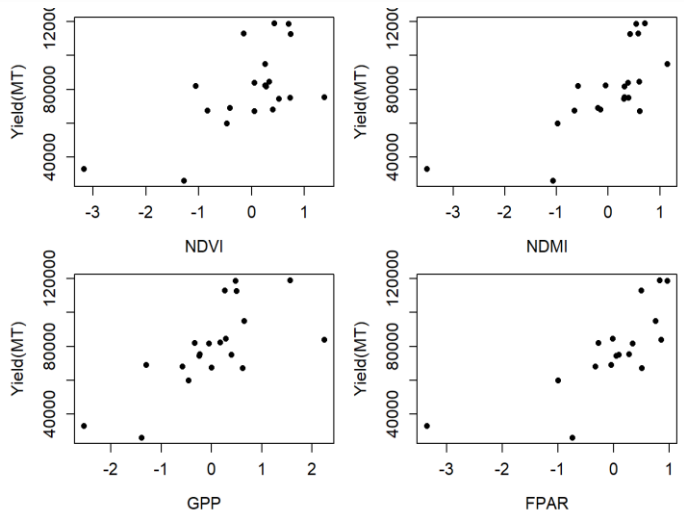
Case study: Product development

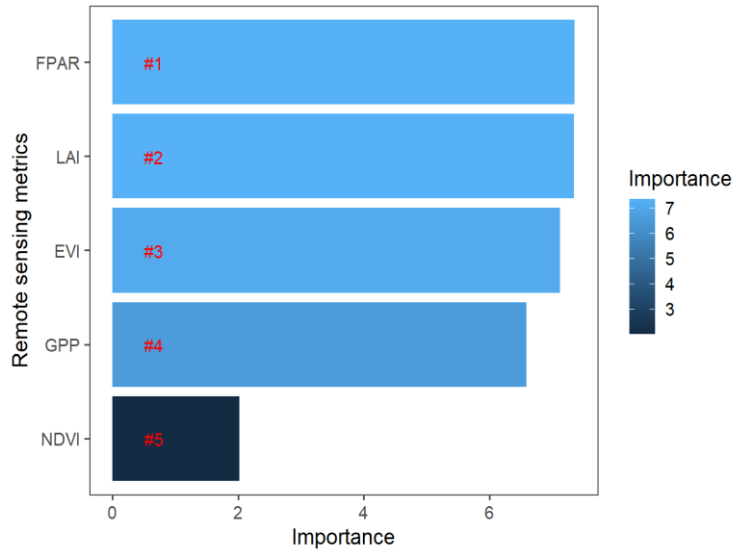


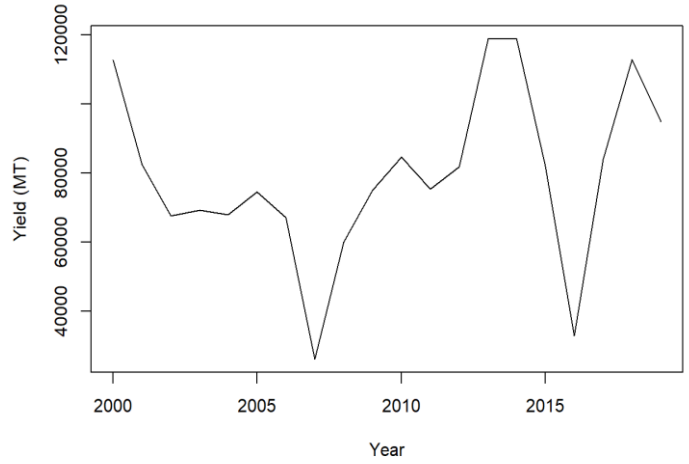
- Development of Standard Operating Procedures for use of drones by NDMA
- Framework for data collection, analysis and product development using UAV/drone imagery and satellite data (freely available medium resolution data from Sentinel-2 and MODIS)
- Improvement of climate data-merging station data from the Dept. of Met services with satellite-rainfall data to improve consistency and spatial coverage
- Cropped area mapping and yield modeling/prediction
- Early warning systems and tools
- Gender analysis
- Capacity building

Case study: Cropland mapping and yield prediction

Image Type	RF	MLC
UAV multi-spectral image 88-95% accuracy for maize		
Sentinel-2 multispectral image 64-79% accuracy for maize		
PCA-fused multi-spectral image 85-95% accuracy for maize		



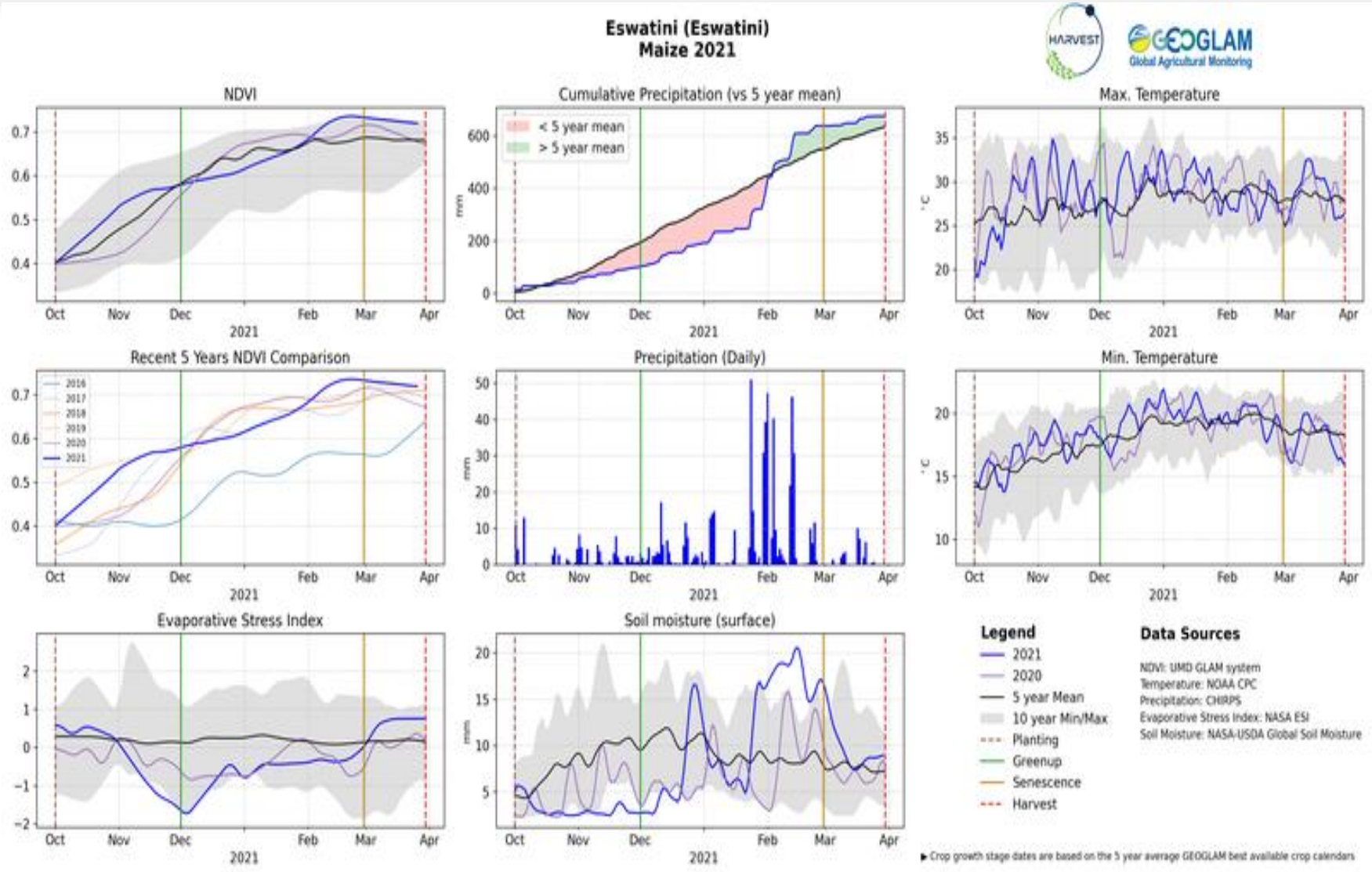




Models: Random Forest, Support Vector Machine and Linear regression

From the framework and the statistical model used, 2020 maize yield was predicted to be **92,500 T** compared to the reported yield which was **87,000 T (~6% error).** It was possible to predict the yield by using MODIS variables collected between January and March 2020.

Early Warning Systems for agricultural monitoring



Early warning indicators

Using satellite-derived crop health monitoring indicators (rainfall, NDVI, soil moisture, evapotranspiration, and temperature) to track conditions across the growing season and forecast expected end of season yields using machine learning techniques that leverage UAV and Satellite data

Gender Analysis

- Women make up 53%of the population in a country with 63%of the population living in poverty;
- Female-headed households as having higher poverty incidence at 67%when compared to their male counterparts at 59% (Eswatini household oncome and expenditure survey 2009/10).
- Eswatini women generally have lower economic status than men (2013-2014 Labor Force Survey) indicates that male earnings are 67%higher than those of women.
- Female labour participation rate at only 45% and women participation in the labour force is lower in all the regions as well as across rural and urban areas
- HIV incidence among girls and women aged 15-24 years is high, almost 5X that of men
- Women least involved in Digital for Agriculture technologies
- Gender disaggregated data remains scarce in the country but progress has been made to improve the collection
- Between 2011-2016, there was a decline (41 to 28%) among female professionals in agricultural research agencies
- COVID-19 affected women significantly, especially when lockdowns prevented movement of produce from rural farms to markets e.g., from Shiselweni to Manzini

Challenges and opportunities

Major challenges

- COVID-19 restrictions– delayed fieldwork to collect UAV data
- Political activities during the data analysis period– delays getting response from the country partners
- Technological problems– DJI drone from NDMA developed image capture problems while the fixed-wing WingtraOne drone had problems with acceleration– overcame both by deploying DJI Matrice 200 and bypassing acceleration problem for the WingtraOne
- Unable to get in-situ yield data from the Min of Agr.– used publicly available yield data from FAOSTAT

Opportunities

- A committed partner in NDMA and the NDE (Dept. of Meteorological services)
- Dedicated support from CTCN during key stages: planning, stakeholder engagement, fieldwork and product development
- Opportunities via CTCN to network with global partners through webinars
- Opportunities for resource mobilization through the TA mechanism
- Coordinated and facilitated a "Drones in SERVIR" session during the SERVIR 2021 (March 2021) highlighting the Eswatini TA and other drone services across the SERVIR Global network

CTCN value proposition: *The pilot approach is an innovative pathway to a gradually accelerated operationalization of innovations. This enables identification of appropriate technologies, possible challenges and solutions before operationalization.*

Next steps

Eswatini Observer

10 National News

NDMA ENGAGES IN DRONE USE TRAINING

...exercise meant for vulnerability assessment accross the country

BY SIFISO NHLABATSI
Mbabane

THE National Disaster Management Agency has hosted experts to capacitate the agency on drones and remote sensing technology for vulnerability assessment and response planning processes.

According to a statement released by NDMA Communications Manager Wandile Mavuso the agency through assistance from the Climate Technology Centre and Network (CTCN, hosted technical experts from the Regional Centre for Mapping and Resource Development (RCMRD) and Kenya Red Cross Society to strengthen the NDMA's capacity in the application of Unmanned Aerial Vehicle (drones) and remote sensing technology for vulnerability assessments and response planning to enhance national food security and climate resilience.

This training according to NDMA started on 31 March and will end tomorrow.

Mavuso explained that the overall objective was to strengthen Eswatini's climate resilience, disaster risk reduction and vulnerability assessments in the agricultural sector by building capacity on access to an application of meteorological data, UAV technology and remotely sensed imagery for crop monitoring and early warning systems.

"The technical assistance aims to enhance the capacity of national stakeholders, including the NDMA, on the application of meteorological data, UAV technology and remotely sensed imagery for crop monitoring and provision of timely early warning data to farmers through various training workshops, make available a set of baseline data for agricultural indicators in support of vulnerability assessments and decision-making" Mavuso stated.

Officers from NDMA posing for a group photo.

An officer manning a drone.

Officers inspecting one of the drones

Another objective of the training according to NDMA is to improve the country's readiness to seek GCF funding for up-scaling of technologies.

The technical assistance according to NDMA is expected to strengthen the country's capacity to identify, plan for and respond to climate-induced vulnerabilities and food insecurity situation in the country.

"The exercise of drone use is being carried out in all four regions of the country and is expected to last for two weeks" part of the statement from Mavuso reads.

Mavuso said the technical assistance is expected to strengthen the country's capacity to identify, plan for and respond to climate-induced vulnerabilities and food insecurity situation in the country.

He said the total project cost approximately E2 million for more effective data management and decision making around vulnerability assessment, food security and response, and enhance the use of climate information to increase resilience to broader climate change impacts and shocks for the 200 000 persons experiencing acute food insecurity in the country.

Mavuso said the drones may provide regular field overviews and crop assessment for faster response such as exact planning of pests and disease treatments, and yield higher outcomes compared to conventional methods of assessment related to time, accuracy, safety, costs and yield maximisation.

1. In-person training covering main components: SoPs, demo flight planning, drone operations and product development (discussions and preparations ongoing)
2. Compile a Green Climate Fund proposal for scale up of the pilot technologies
3. Project close out: October, tentative.

THANK YOU!