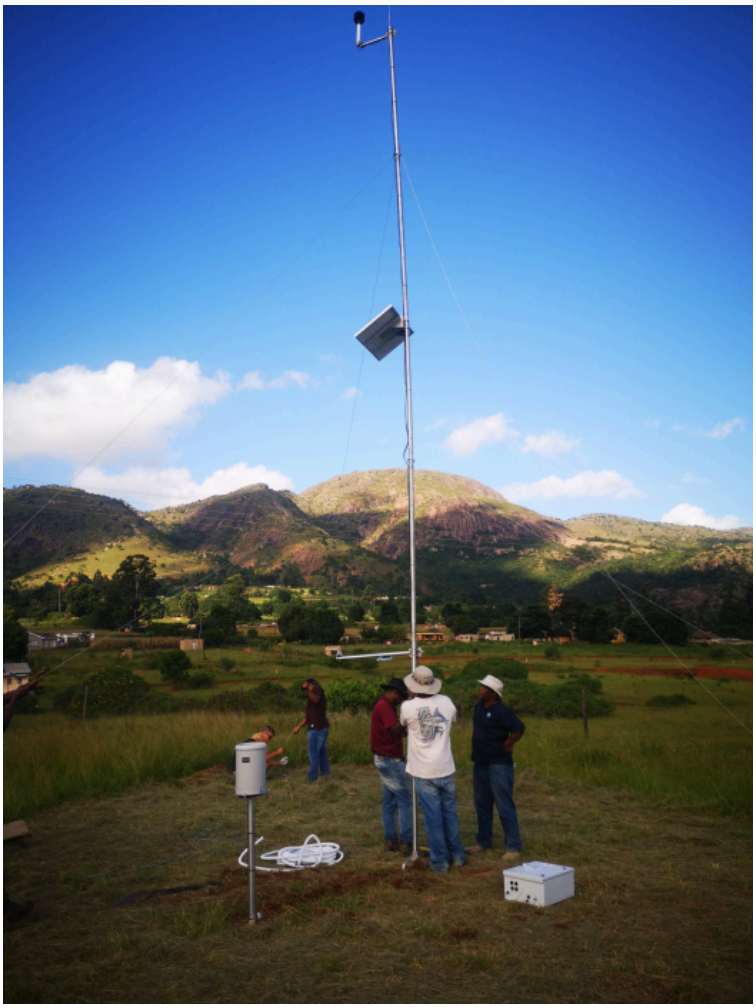
CAMPBELL SCIENTIFIC
WHEN MEASUREMENTS MATTER

The Kingdom of eSwatini: Strengthening Early Warning Systems and Climate Services

Proactively mitigating the effects of climate change



Case Study Summary

Application
Weather and climate monitoring to improve early warning systems and climate services

Location
The Kingdom of eSwatini

Products Used
WINDSONIC1-L, CMP10-L, HMP155A-L, TB4-L, SoilVUE10

Contributors
Campbell Scientific Africa

Participating Organizations
UNDP, UNEP, National Meteorological Services of eSwatini (MET)

Measured Parameters
Wind speed and direction, temperature and relative humidity, solar radiation, soil moisture and temperature, precipitation

Overview

The Kingdom of eSwatini in Southern Africa—with its agricultural-based economy and a population of less than 1.5 million—is highly vulnerable to the impacts of climate change. The country heavily relies on rain-fed agriculture and natural resources, making it susceptible to the variability of rainfall patterns and extreme climatic conditions such as droughts and floods. Studies indicate that eSwatini is experiencing an increasing frequency and severity of climate-related hazards, including droughts, floods, severe lightning, wind/hailstorms, and other extreme weather events. These events have had detrimental effects on critical sectors such as agriculture, water, tourism, health, and infrastructure, thereby impacting the country's economy negatively.

The Challenge

The National Meteorological Services of eSwatini (MET) was established to monitor weather and climate conditions and issue advisories for the safety of life and property. However, the existing early warning system (EWS) was not effective enough to generate comprehensive knowledge on climate change risks, vulnerabilities, and hazards. This limitation hinders the country from undertaking efficient planning, monitoring, mitigation, and adaptation measures to address climate change risks. Therefore, there was an urgent need to enhance eSwatini's capacity in weather and climate monitoring, data analysis, and information dissemination to improve the EWS and climate services.

The Solution

An initiative was undertaken for MET, with funding provided by the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) to install and deploy twenty automatic weather stations (AWS) in eSwatini.

Strengthening the EWS and climate services in eSwatini will contribute to the country's efforts in adapting to climate change; protecting lives, livelihoods, and the environment; and promoting sustainable development.

Deploying AWS in eSwatini

The installation sites for the AWS were meticulously chosen, with ten sites designated for UNEP and another ten for UNDP. The Campbell Scientific team encountered some unforeseen challenges but managed to complete the installation on 18 April 2020. Subsequently, an intensive one-week on-site training was conducted from 3–7 May 2020, ensuring the local team was well-equipped to maintain and use the AWS infrastructure effectively.

Main System Components

The AWS installations in eSwatini relied on a range of cutting-edge components to gather accurate and reliable weather data. The key components included a data logger and various sensors.

The CR1000X Datalogger is a low-powered device designed to measure sensors, analyze data, and store the data securely. The data logger provided a solid foundation for data collection and analysis throughout the AWS network.

Several high-quality sensors were used to measure various weather parameters, including the following:

- Gill WindSonic1 and WindObserver are ultrasonic sensors used for wind speed and direction measurements. The innovative design minimized maintenance costs and ensured precise readings.
- The HMP155A-L is a reliable sensor for measuring relative humidity (RH) and temperature. Its accurate readings made it ideal for a wide range of applications.
- The CMP10-L is an ISO first-class pyranometer that monitors solar radiation. It played a crucial role in assessing solar resource availability and performance.
- The SoilVue™10 is a sensor designed to measure soil moisture and temperature accurately. Multiple sensors provided valuable insights into soil conditions and helped the MET personnel understand the environmental dynamics.
- Several TB4-L tipping bucket rain gauges were used to accurately measure precipitation. These gauges were carefully sited and mounted to ensure accurate and reliable measurements.

Installation Procedure

The installation process followed a well-defined procedure to ensure optimal performance and longevity of the AWS infrastructure. Here is an overview of the key steps involved:

1. **Layout:** A comprehensive layout plan was devised to determine the optimal positioning of the sensors at each installation site. Factors such as wind exposure, obstructions, and thermal radiation were carefully considered.
2. **Wind Speed and Direction:** The Gill WindSonic1 and WindObserver sensors were installed in accordance with Environmental Protection Agency (EPA) guidelines at specified heights and locations to capture accurate wind data.
3. **Temperature and Relative Humidity:** The HMP155A-L sensors were positioned to avoid thermal radiation and ensure proper ventilation while being situated away from obstructions that could influence readings.
4. **Solar Radiation:** The CMP10-L sensors were mounted to minimize shading and positioned on the northernmost side of the weather stations to reduce interference from other structures.
5. **Soil Moisture and Temperature:** The installation of SoilVue 10 sensors involved careful site selection, considering soil properties and minimizing disturbances to the surrounding soil.
6. **Precipitation:** The TB4-L rain gauges were sited on level ground with short grass or gravel, and they were carefully positioned to avoid splashing and ensure accurate rainfall measurements.

The Benefits

By addressing these needs and strengthening eSwatini's EWS and climate services, the project brought numerous benefits to the country. These include:

- **Enhanced Resilience:** With improved monitoring, forecasting, and early warning capabilities, eSwatini is better equipped to respond and adapt to climate-related hazards. This increased resilience will help safeguard lives, protect infrastructure, and reduce the economic impact of extreme weather events.
- **Sustainable Development:** This project aligns with eSwatini's sustainable development goals by supporting sustainable agricultural practices, water resource management, and environmental conservation. This, in turn, contributes to food security, poverty alleviation, and the preservation of eSwatini's natural resources.
- **Capacity Building and Knowledge Transfer:** The project involved capacity-building activities to strengthen the skills and expertise of eSwatini's meteorological and climate professionals. This knowledge transfer empowered local institutions to independently monitor, analyze, and disseminate weather and climate information. By building local capabilities, the project fosters sustainable development and ensures the long-term sustainability of the EWS and climate services in eSwatini.
- **Effective Communication and Alert Systems:** The implementation of a Common Alerting Protocol (CAP) and the development of national alert systems and protocols will enhance the dissemination of early warning information. By adopting internationally recognized standards, such as CAP, the project will improve communication with key stakeholders and the public, raising awareness and facilitating prompt responses to impending disasters.
- **Climate Modeling and Projections:** The project improved weather and climate modeling capabilities, enabling the production of seasonal forecasts and climate projections. This information is vital for the agricultural sector, helping farmers make informed decisions about planting, harvesting, and managing water resources. Additionally, decision-makers in various sectors can use these projections to develop effective climate change adaptation strategies.

The successful AWS deployment in eSwatini marks a significant milestone in weather monitoring and forecasting capabilities. The comprehensive installation process, coupled with diligent testing and troubleshooting, has paved the way for accurate and reliable weather data collection.

View online at: www.campbellsci.com/eswatini-early-warning-systems

Campbell Scientific, Inc. | 815 W 1800 N | Logan, UT 84321-1784 | (435) 227-9120 | www.campbellsci.com
AUSTRALIA | BRAZIL | CANADA | CHINA | COSTA RICA | FRANCE | GERMANY | INDIA | SOUTH AFRICA | SPAIN | THAILAND | UK | USA