Estimating Precipitable Water Vapour with Geodetic Receivers

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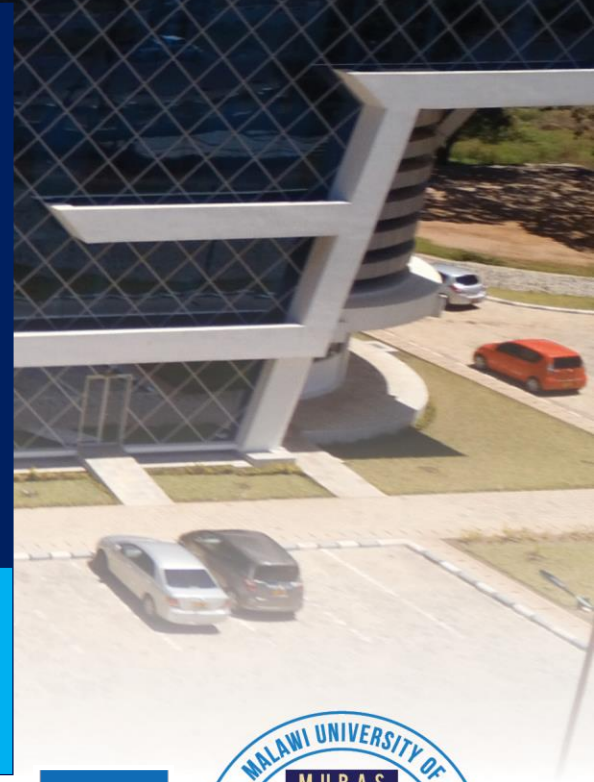

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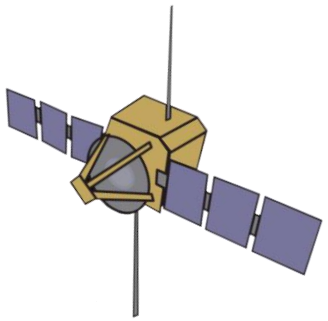
Agenda

- Motivation
- Objectives
- Approach
- Sample Results
- Summary



Motivation

- Geodetic receivers are a valuable resource
  - In the retrieval of water vapour from GNSS measurements

- Modern geodetic receivers
  - Improved tracking capability
  - Satellite-based estimation and reliability

- However, Malawi is still behind
  - On using geodetic receivers in climatological studies

Objectives

- **Precipitable water vapour estimation**
  - **GPS (Global Positioning System) measurements**
  - **GLONASS (Globalnaya Navigazionnaya Sputnikovaya Sistema, or Global Navigation Satellite System)**
- **Existing geodetic datasets assessment for**
  - **Potential application in climatological studies**

Approach

Datasets

PREParedness for East African Countries through Seismic Resilience Engineering (PREPARE) — 1

Malawi Continuously Operating Reference Stations (CORS) — 2

Processing Strategy

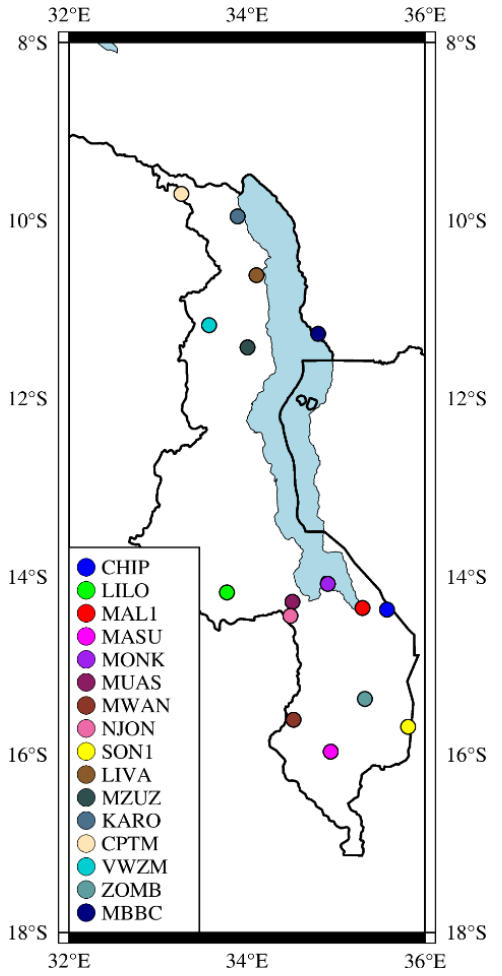
- GPS
- GPS + GLONASS

1

Least Squares

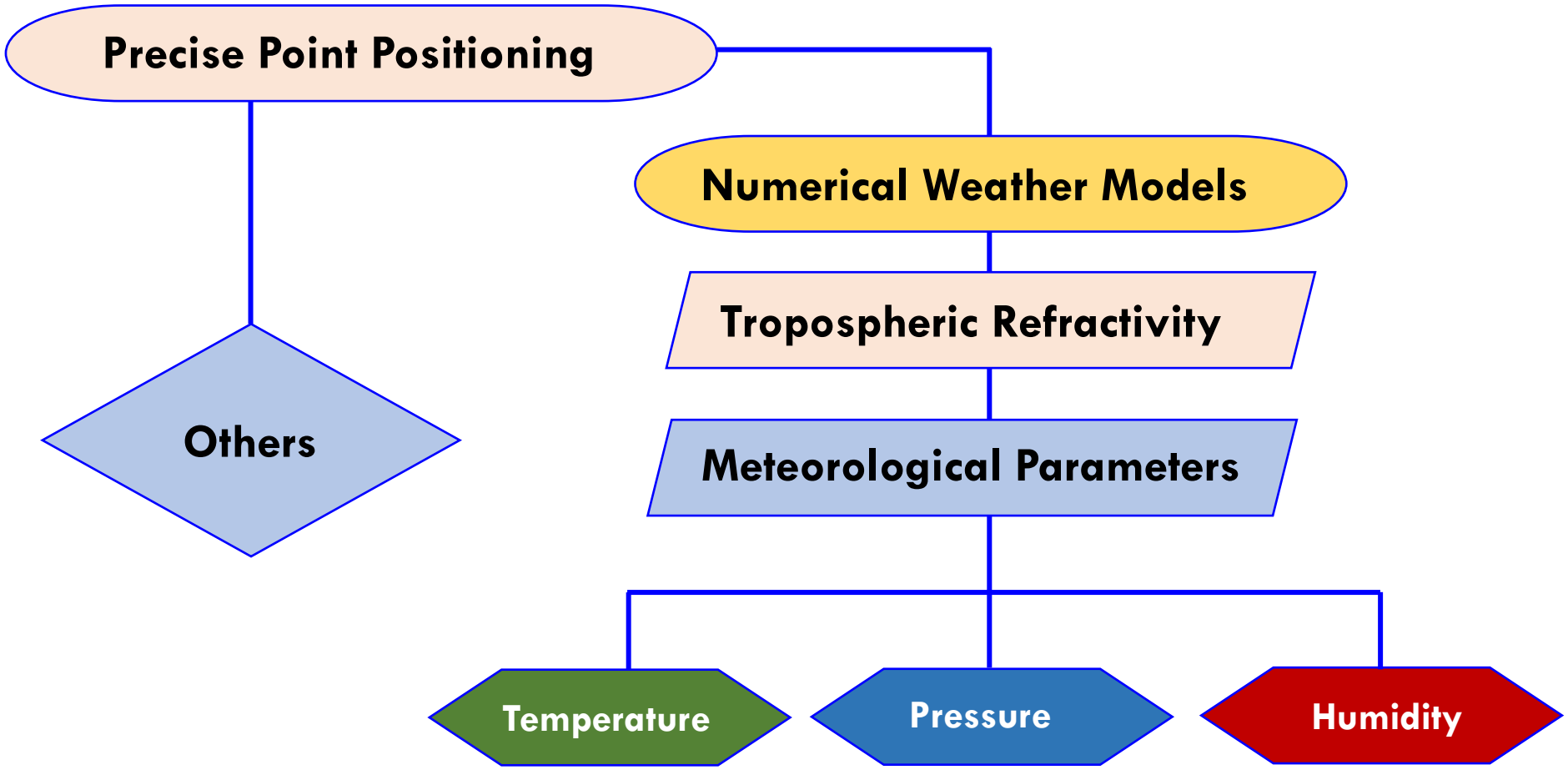
2

— Precipitable Water Vapour
— Pressure
— Temperature
— Humidity



PWV Estimation

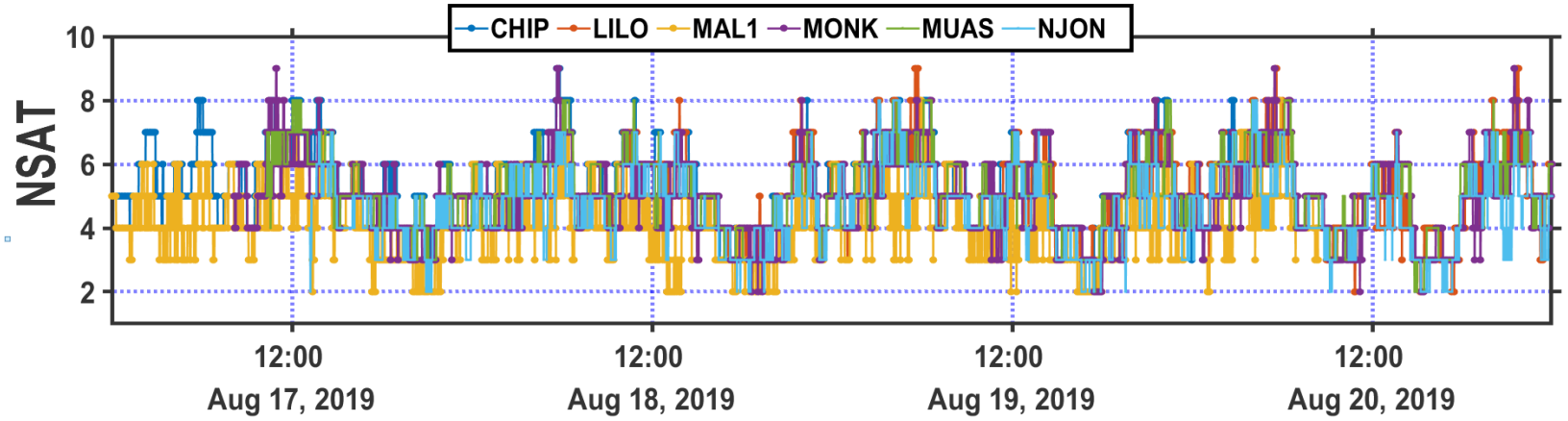
Approach



Sample Results

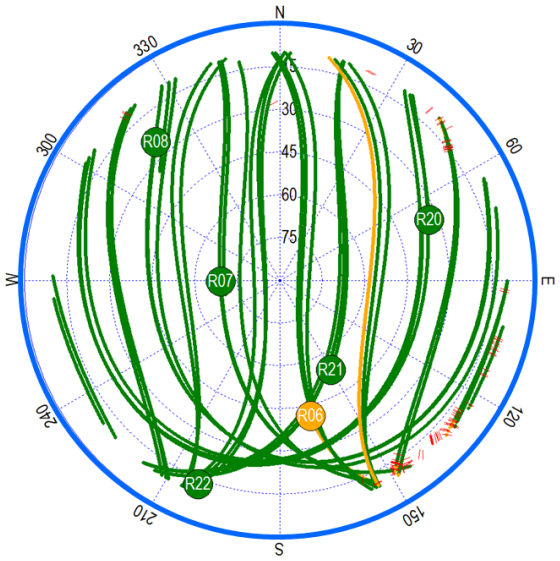
Observation Availability

Number of Satellites (NSAT): GLONASS



NSAT: < 10 (GLONASS)

SkyPlot @ CHIP



GLONASS

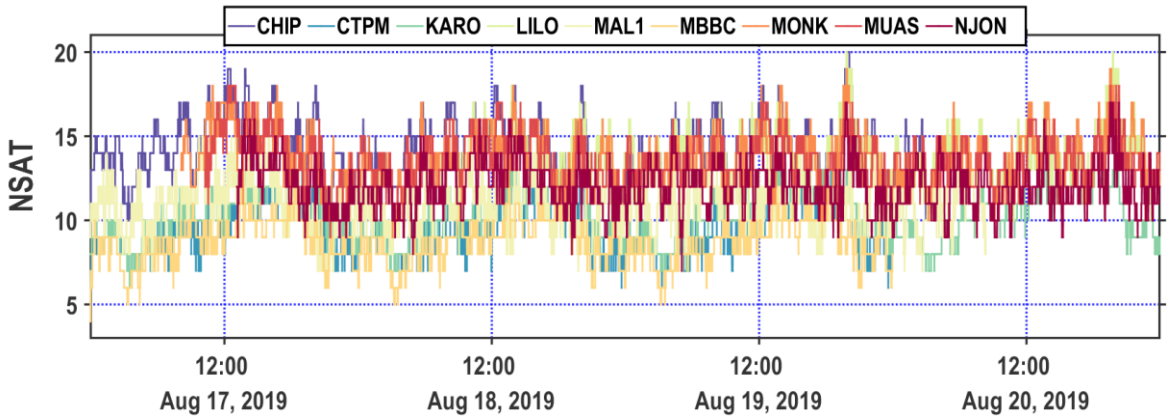
Satellite Availability on 17th August 2019

Sample Results

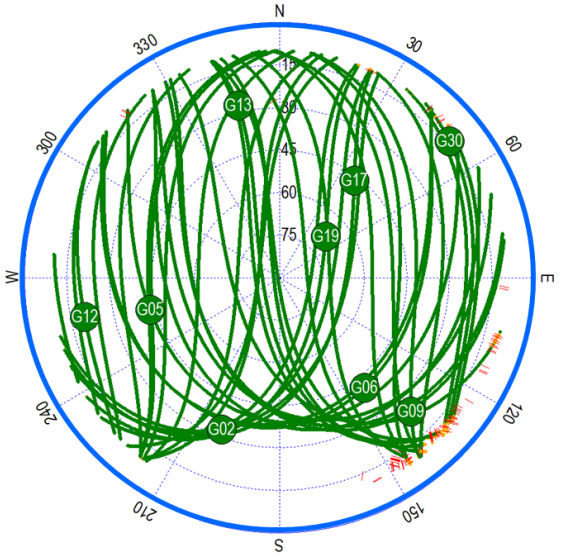
Observation Availability

NSAT: Increased (GPS + GLONASS)

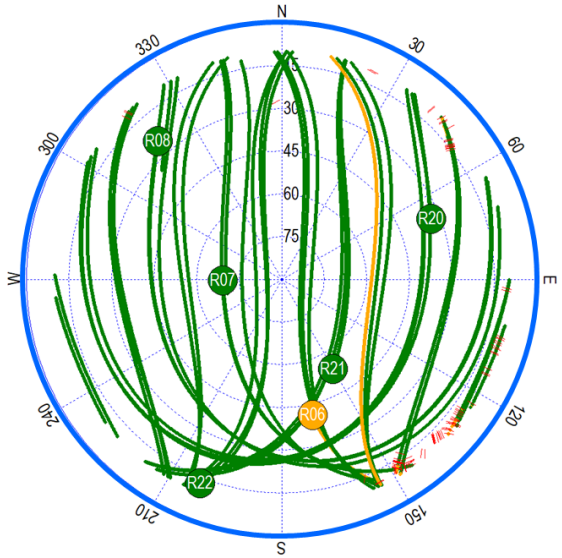
Number of Satellites (NSAT): GPS + GLONASS



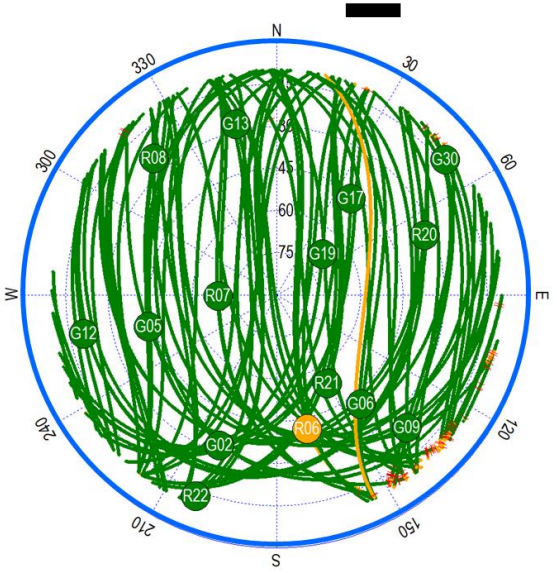
SkyPlot @ CHIP



GPS



GLONASS



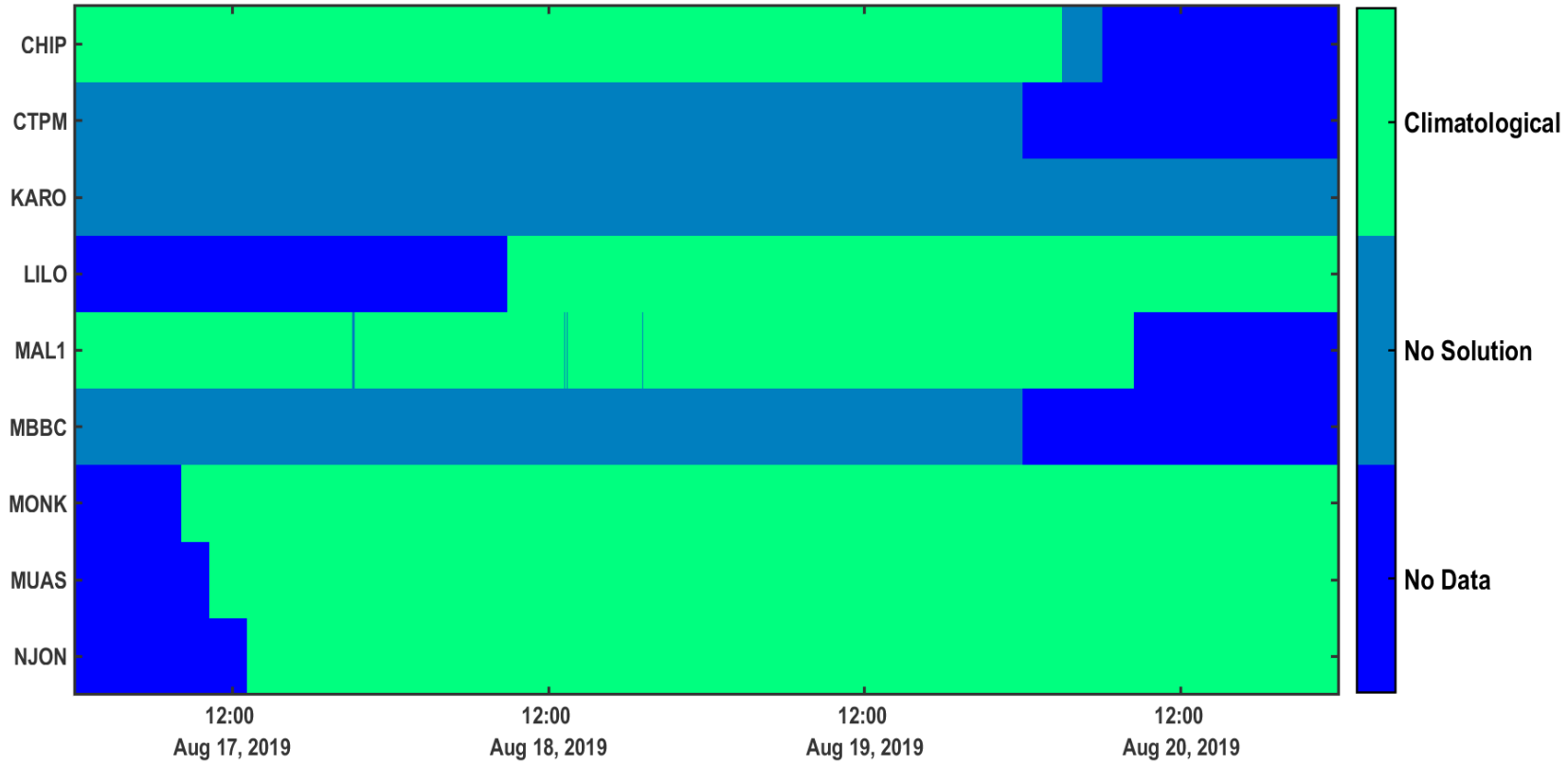
GPS + GLONASS

Satellite Availability on 17th August 2019

Sample Results

Processing Status of Meteorological Parameters

Satellite System: GLONASS



Climatological:

— For estimating the Meteorological Parameters

No Solution:

— Execution not successful

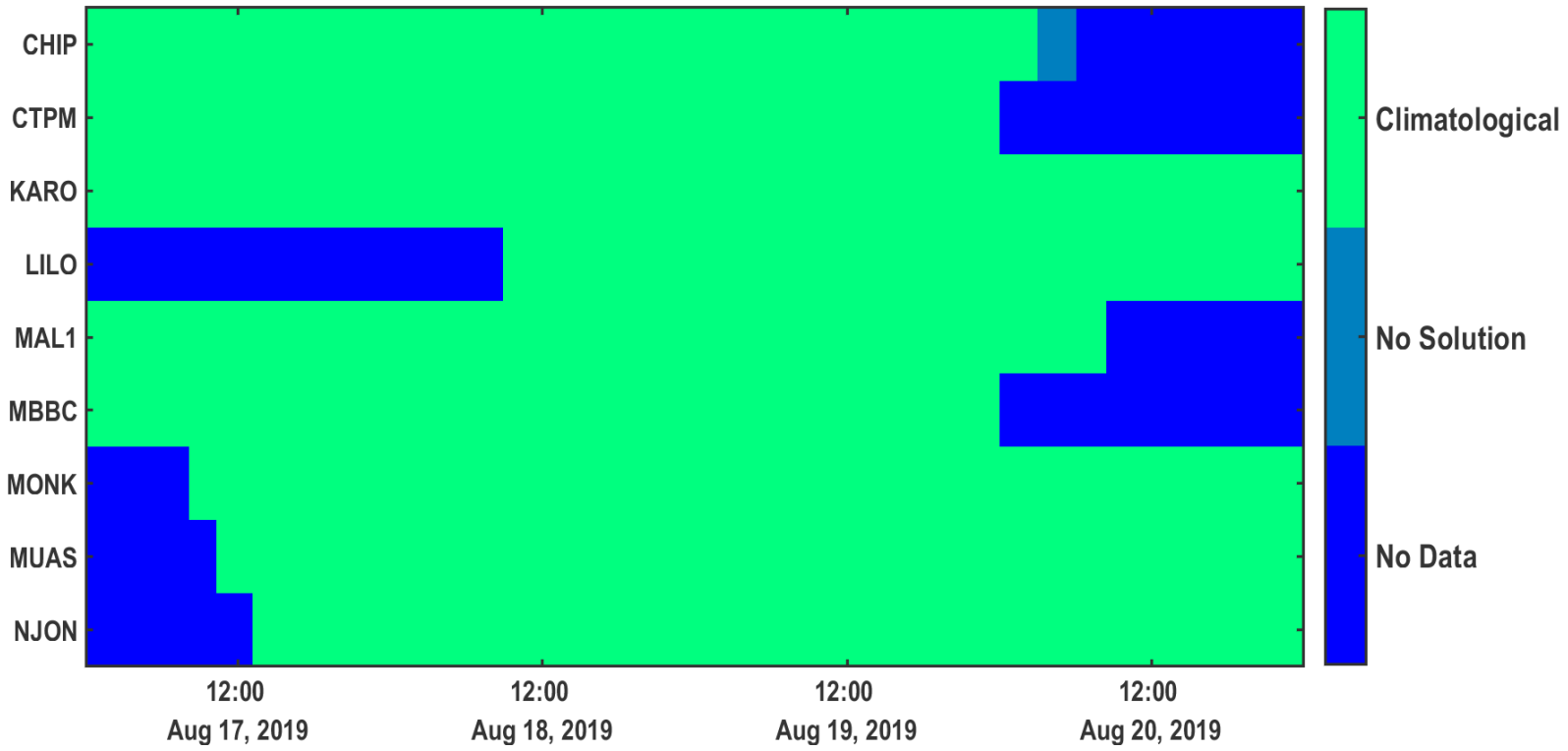
No Data:

— No dataset for estimation

Sample Results

Processing Status of Meteorological Parameters

Satellite System: GPS + GLONASS



Climatological:

— For estimating the Meteorological Parameters

No Solution:

— Execution not successful

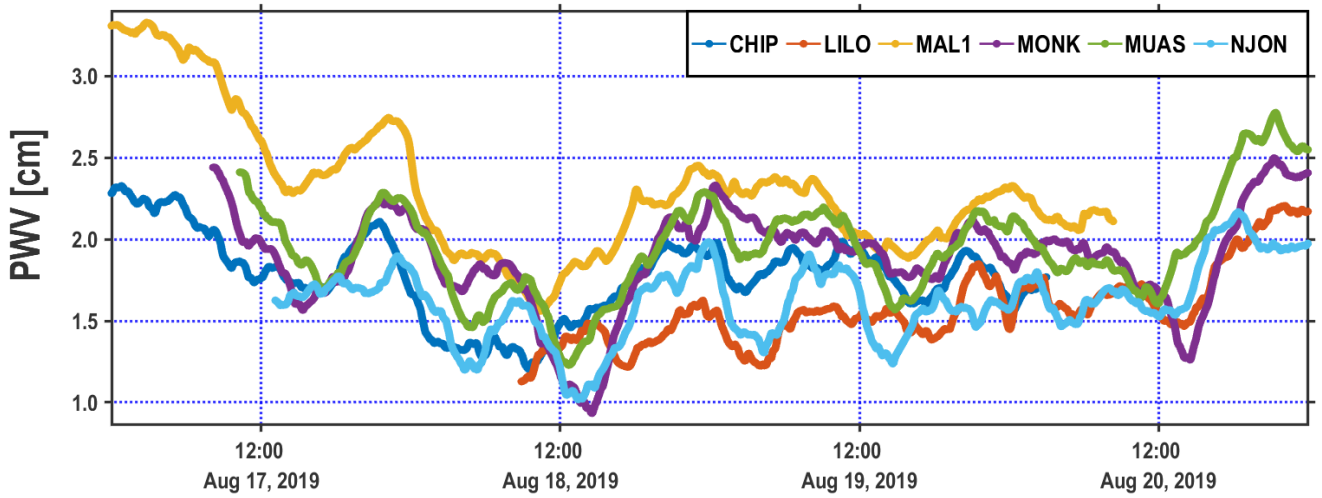
No Data:

— No dataset for estimation

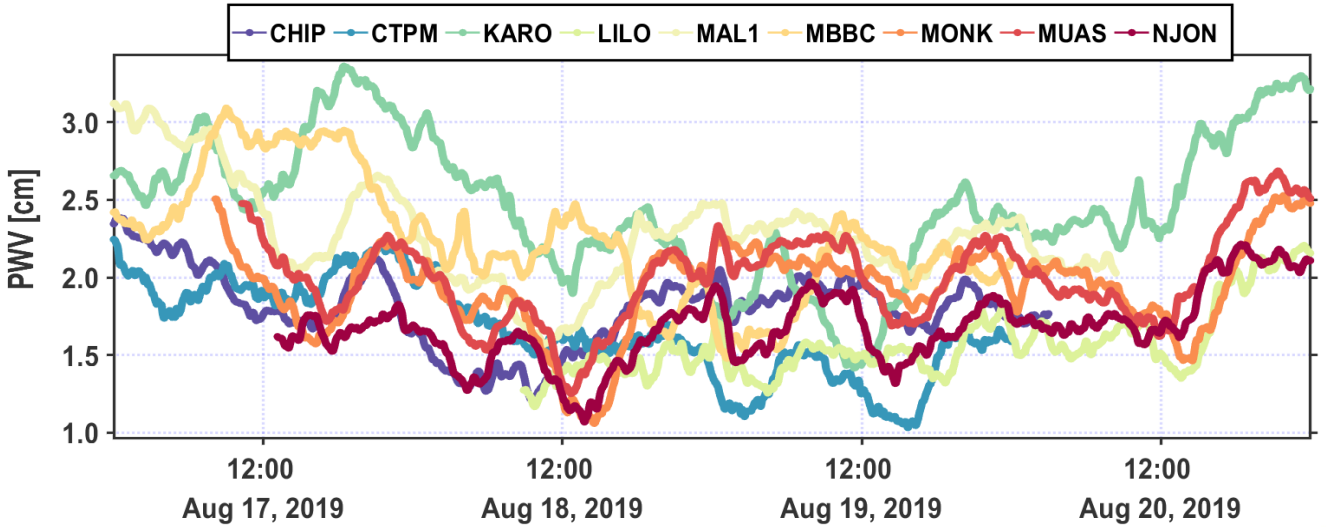
Precipitable Water Vapour (PWV)

Sample Results

- GLONASS:
  - PWV time series



- GPS + GLONASS:
  - PWV time series



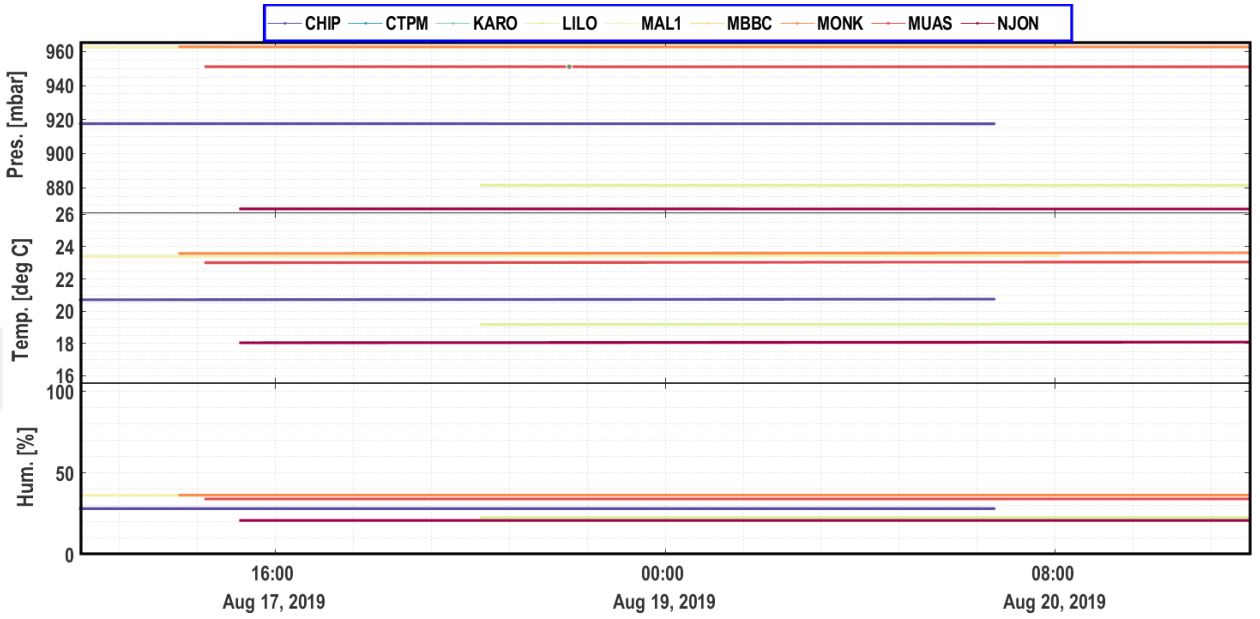
Sample Results

Pressure — Temperature — Humidity

GLONASS

For example

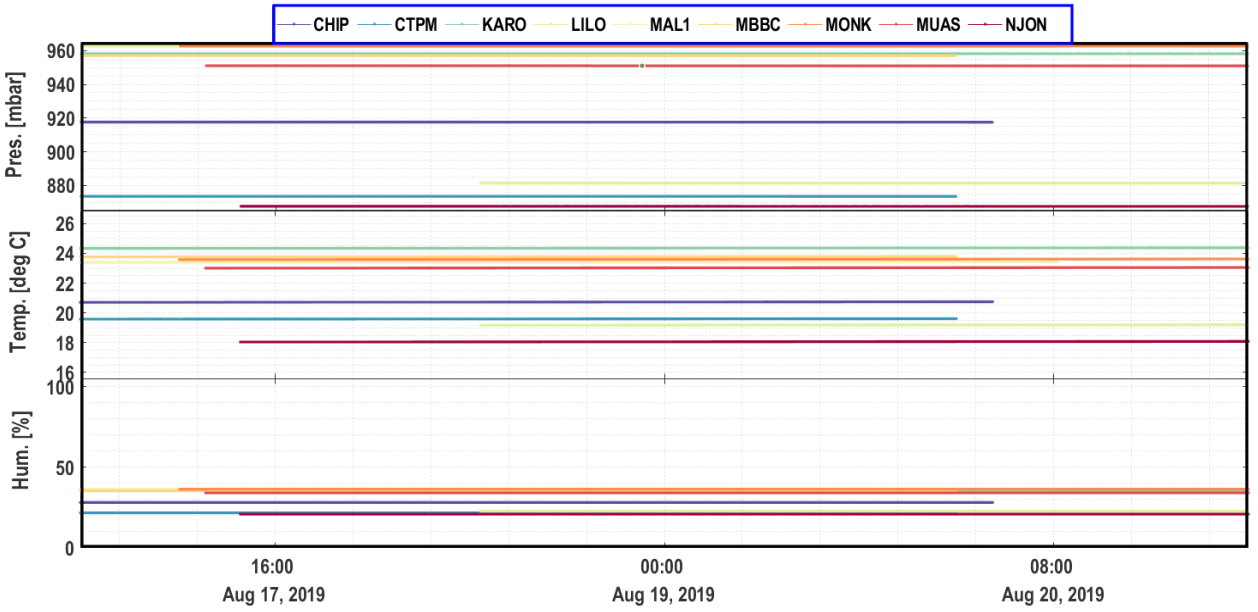
- NJON : lowest pressure (< 800 mbar)
- NJON : 18° C
- NJON : 20 % of water vapour



GPS + GLONASS

For example

- KARO : pressure (~ 955 mbar)
- KARO : ~ 24° C
- KARO : 40 % of water vapour



Summary

Summary

- **Evaluated the satellite availability**
  - CORS
  - PREPARE survey stations

  - The NSAT increases when GPS satellites are added to GLONASS
  - Limited number of CORS and duration of availability
  - PREPARE survey marks: limited during the experiment

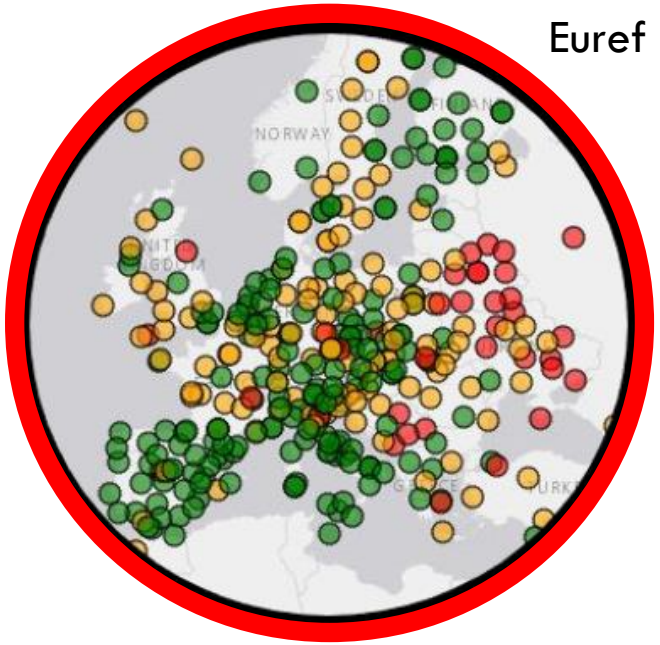
- **Assessed the meteorological parameters**
  - GPS
  - GPS + GLONASS satellites

  - The quality of estimated parameters improves with increase in the NSAT

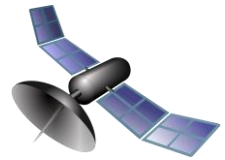
- **Does the Malawi CORS Network Qualify for Climatological Application?**

CORS in the World

Global — CORS



Euref — Europe



National Geodetic Survey — USA

trigNet — South Africa

corsNet — Australia

Geodetic Equipment and Radiosonde

A Broad Spectrum of Applications

- Dataset for Computer-Based Weather Prediction Models
- Forecasting
  - Storm
  - Aviation
  - Weather
  - Marine
- Input for Air Pollution Models

THANK YOU

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