WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Malawi Automatic Weather Stations data exchange

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World Meteorological Organization
Organisation météorologique mondiale

Manned stations on GTS

- 23 stations making 2 observations per day (few of them 4 obs/day)
- Very few data where received by NWP Centres.
- Some GTS problems resolved
- AWS on OSCAR → more back dots
- More data received, but
  - Most of the stations are not making pressure observation
  - Number of observations per day are not enough and not regular

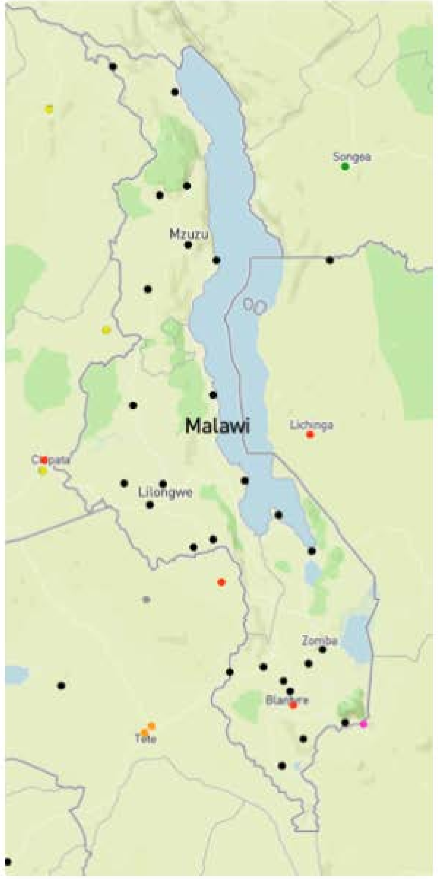
Songea
Mzuzu
Malawi
Lichinga
Chipata
Lilongwe
Zomba
Blantyre
Tete

Fig.1 2021/02

● a lack of data

● one observation only

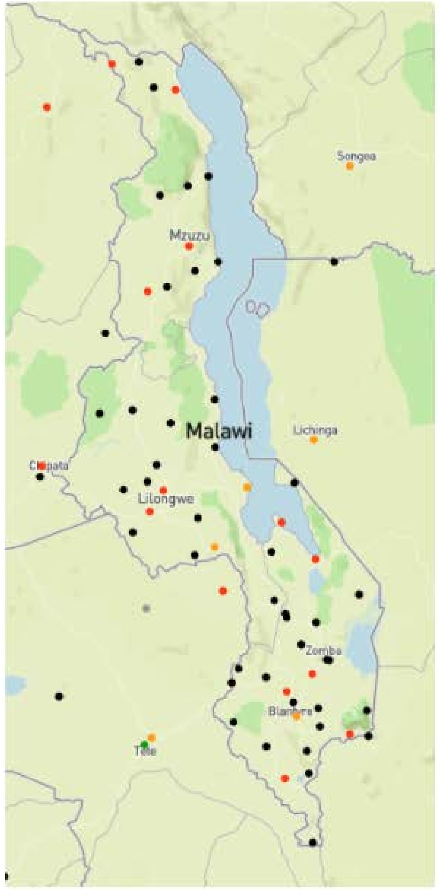
Songea
Mzuzu
Malawi
Lichinga
Chipata
Lilongwe
Zomba
Blantyre
Tete

Fig. 2 2021/05

● a lack of data

● one observation only

● two observations

Problem statement

Malawi NMHS manages 44 Campbell Scientific automatic weather stations (AWS), providing data through a GSM connection and internet.

These are the issues related to the AWS data:

- transmission problems
  - SIM card has been disabled
  - GSM signal is too weak
- AWS data are used only locally and not exchanged internationally
- Campbell Scientific software cannot produce BUFR. The WIGOS station identifier (WSI) cannot be encoded in SYNOP, therefore BUFR is required
- data are received on a PC in Blantyre at DCCMS headquarters, which constitute a single point of failure and is not sufficient to guarantee the required continuity and resilience of the transmission

Project objectives

- Continous and reliable provision of hourly real-time data from 44 stations to WMO NWP Centers in BUFR format through GTS and WIS 2.0 Message Queuing Protocols.
- Optimization of the acquisition system for cloud services for sustainability purposes.
- Development of a turn-key solution to be delivered to other Countries.

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Project team

Name	Agency
Mr Rodrick G. WALUSA	Department of Climate Change & Meteorological Services, Malawi
Mr Amos D MTONYA	Department of Climate Change & Meteorological Services, Malawi
Mr Hussein MILANZI	Department of Climate Change & Meteorological Services, Malawi
Ms Christa FERREIRA	South African Weather Service

Name	Company
Isak Lombard	Netsys
Johan Visagie	Campbell Scientific
Mauritz de Beer	Campbell Scientific
Rob Costello	Amazon
Philippe Jegou	Amazon

WMO Secretariat
Enrico Fucile
Timo Proescholdt
Xiaoxia Chen

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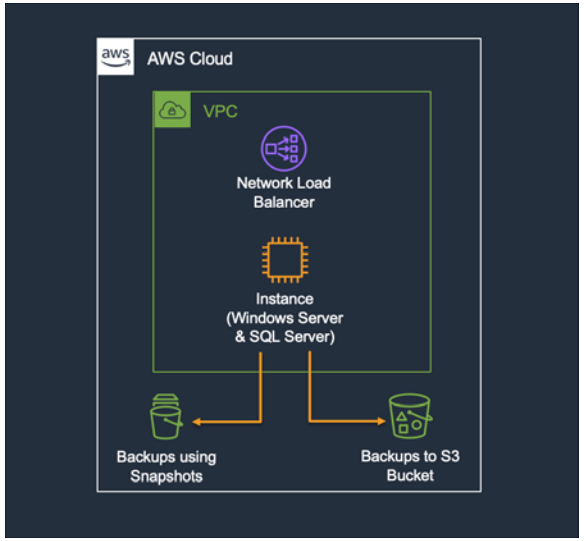
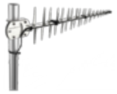
Project costs


aws
AWS Cloud
VPC
Network Load Balancer
Instance (Windows Server & SQL Server)
Backups using Snapshots
Backups to S3 Bucket

- Amazon services one year around $10K (**first year provided for free by Amazon**)
- Implementation of Campbell Sci. software on Amazon cloud service provided at no cost by Campbell Sci.
- Implementation of BUFR production provided by Campbell Sci. at no cost.
- Cost of WIS2 type transmission to be determined and to replace GTS costs in the longer term.



Cost of improving GSM reception around $6000

- Training for IT staff in Malawi to be provided by the Secretariat and Amazon (no cost for DCCMS Malawi)

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Project plan

May 2021

Registration of 44 AWSs on OSCAR/surface

Setup of cloud environment

- Amazon cloud environment (EC2 Windows + SQL Server, S3)
- AMQP broker (service from cloudAMQP)

June 2021

Installation and configuration of Campbell software on Amazon cloud

- LoggerNet
- LNDB

July 2021

Introductory training session for DCCMS staff

August 2021

Development and configuration of ASCII to BUFR software by Campbell

Start WIS2 data exchange for a subset of stations

September-October 2021

ECMWF and DWD to monitor data quality

November 2021

BUFR data from all AWS on GTS

Q4 2021

Maintenance of stations

- new antennas
- replace batteries

Q1 2022

Development of a BUFR conversion module (WMO Secretariat)

Q2 2022

Final configuration operational

44 stations available on WIS2 and GTS

Training

Q3 2022

Potential deployment in other countries

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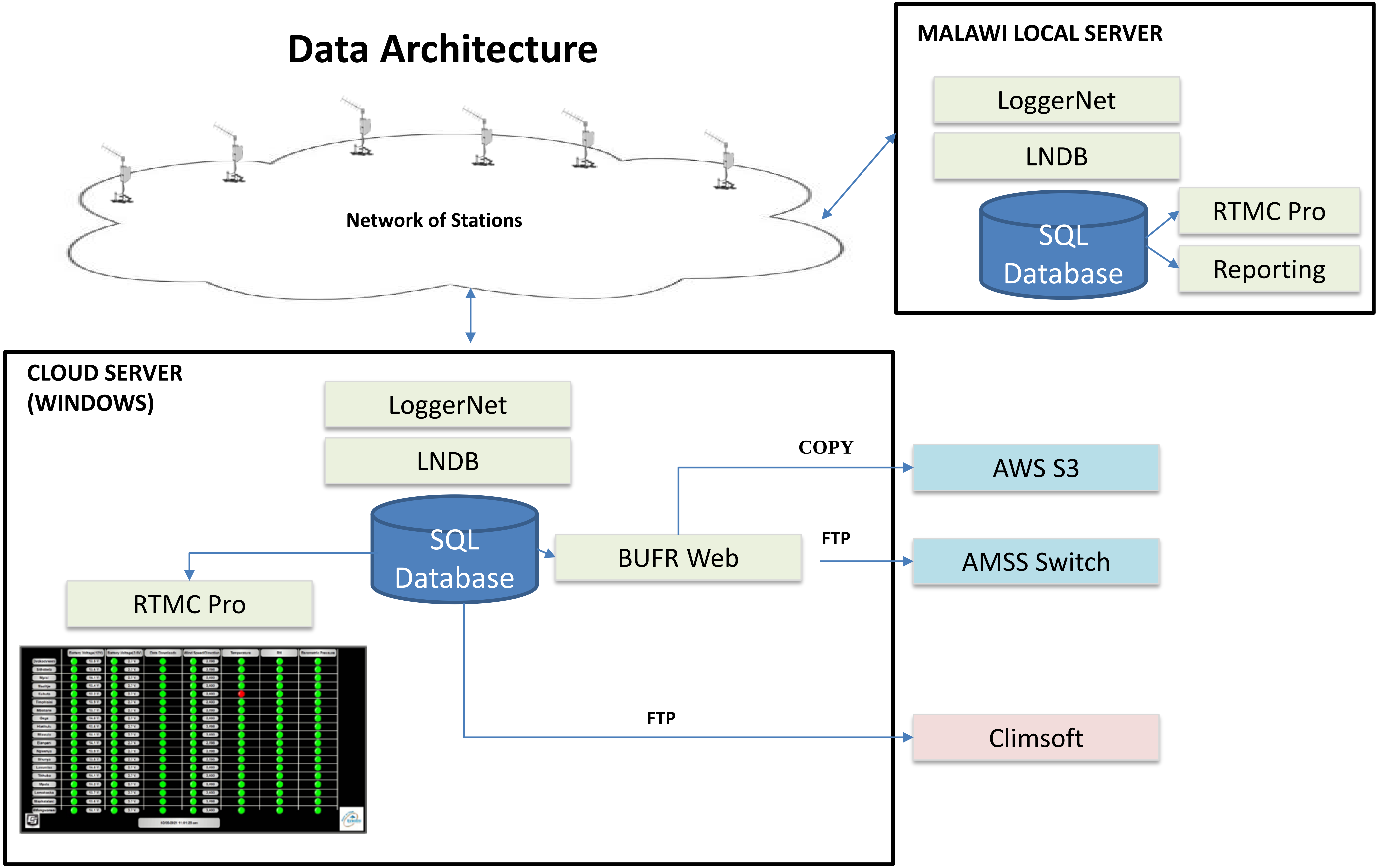
Data Architecture



Network of Stations

MALAWI LOCAL SERVER

LoggerNet

LNDB

SQL Database

RTMC Pro

Reporting

CLOUD SERVER (WINDOWS)

LoggerNet

LNDB

SQL Database

RTMC Pro

BUFR Web

COPY

AWS S3

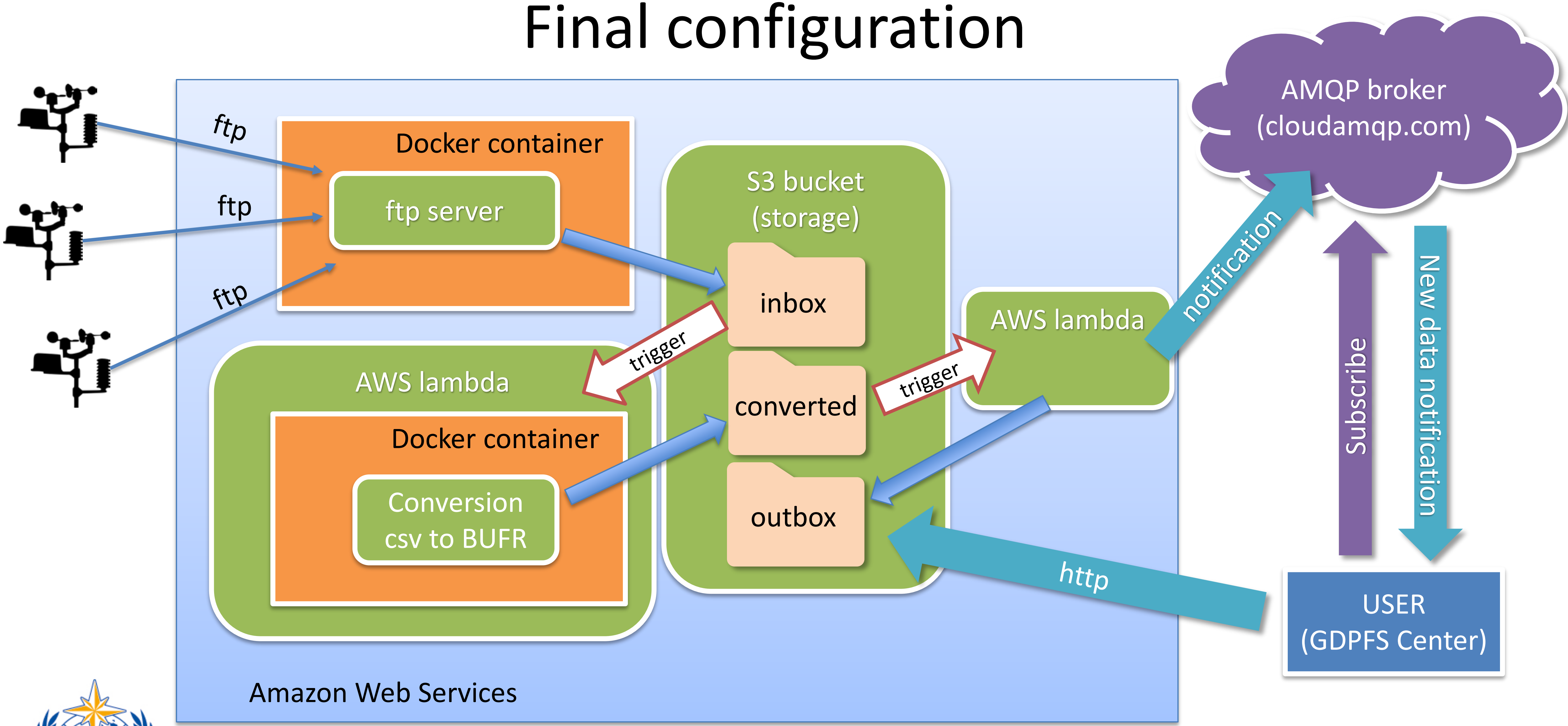
FTP

AMSS Switch

FTP

Climsoft

Final configuration


ftp
ftp
ftp
Docker container
ftp server
S3 bucket
(storage)
inbox
converted
outbox
trigger
trigger
AWS lambda
Docker container
Conversion
csv to BUFR
AWS lambda
notification
AMQP broker
(cloudamqp.com)
Subscribe
New data notification
http
USER
(GDPFS Center)
Amazon Web Services

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Costs

Current configuration

Service	Yearly cost
EC2 Windows + MS SQLServer	~ $10000
S3 storage + Lambda	<$100
AMQP (cloudAMQP.com)	$600

Final configuration

Service	Yearly cost
AWS Fargate (docker container) + Elastic Load Balancing + Elastic container registry	~ $1600
S3 storage + Lambda	<$100
AMQP (cloudAMQP.com)	$600

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WIS 2 Principles in the project

Principle 1. Web technologies and leverages industry best practices and open standards.	MQTT, http, docker
Principle 2. Uniform Resource Locators (URL) to identify resources.	URL to access the data
Principle 6. open standard messaging protocols.	Using MQTT with a publish-subscribe pattern
Principle 8. direct data exchange between provider and consumer	Users (DWD, ECMWF) accessing data directly published by DCCMS Malawi.
Principle 9. phase out the use of routing tables and bulletin headers	routing tables and bulletin headers are not used in this case

Project data standards

- BUFR to be exchanged on the GTS and WIS2
- Conversion from ASCII format to BUFR to be implemented using ecCodes and provided as a python script and in a docker container.
- Training on BUFR will be provided by the Secretariat to DCCMS Malawi.

Project metadata standards

- No search metadata uses
- Data will be published on WIS as all GTS data

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Data discovery

- No data discovery implemented in the project

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Data exchange

- Exchange of BUFR data through GTS and WIS2 protocols.

Input to WIS2

- Important to foster adoption of cloud services to provide turn-key solutions.
- BUFR presents a barrier that is extremely difficult to address. More tools and training needed to support BUFR data exchange.
- Difficulties are encounterd in data exchange from the station to the acquisition centre at national level. Support to improve national exchange is required.
- Internet availability and costs can be a limitation in LDCs.
- Observing station manifacturers provide closed solutions to access data from the stations. Open standards would be helpful at that level.

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Thank you
Merci

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