



Grant agreement no. 243964

QWeCI

Quantifying Weather and Climate Impacts on Health in Developing Countries

D1.2a: Database with gridded climate and remote sensed data and observed meteorological data

Start date of project: 1st February 2010

Duration: 42 months

Lead contractor: UoC
Coordinator of deliverable: Prof. Dr. Andreas H. Fink
 Dr. Volker Ermert

Evolution of deliverable

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Deliverable accepted :	M18

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Dissemination Level		
PU	Public	PU
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Introduction

The QWeCI project aims to identify relationships between atmospheric variables and the occurrence of diseases like malaria and the Rift Valley Fever. This deliverable reports on the construction of an atmospheric database, which will provide access to climate-driver variables for various work packages of the QWeCI project. Key variables of the investigated diseases including rainfall amounts, temperature, and humidity are entered into the database.

The status at the ground level of the Earth's atmosphere is usually represented by automatic and manual observations. These observations are carried out regularly, for example, every three hours or even every hour by weather stations (usually called a synoptic station) typically measuring a number of characteristics of the atmosphere. These include observations from instruments for example thermometers or barometers as well as visual observations of clouds, the visibility, the state of the ground, and the present and past weather conditions. According to the **World Meteorological Organization (WMO) Resolution 40 (Cg-XII)** of the **World Weather Watch Program** atmospheric observations are exchanged worldwide via the **Global Telecommunication System (GTS)** by means of predefined reports. These reports include, for example, 3-hourly **SYNOP** (code format 12 of the WMO) and monthly **CLIMAT** (code format 71) messages, and hourly **METAR** (code format 15) reports from airports.

Besides surface station datasets, quality-controlled satellite observations are available since the late 1970s. Satellites are, for instance, used to quantify the distribution of precipitation around the globe over many years. Such products are based on microwave or infrared data, which are calibrated by using precipitation amounts from gauges.

Atmospheric re-analyses are also added to the database. Re-analyses improve operational analyses and provide a consistent analysis of the atmosphere. Such systems are based on data assimilation techniques using a frozen version of an atmospheric model and use as much as possible original observations. For example, in addition to standard observations, the **European Centre for Medium-range Weather Forecasts (ECMWF) 40 Year Re-Analysis (ERA-40)** product made use of data from past field experiments such as the 1974 **Atlantic Tropical Experiment** of the **Global Atmospheric Research Program (GATE)**. The **ECMWF Interim Re-Analysis (ERA-Interim)** is the latest global atmospheric reanalysis produced by the ECMWF.

Structure of the atmospheric database

The atmospheric database of the QWeCI project can be entered via a web portal (see <http://qweci.uni-koeln.de>; Figure 1), which is integrated into the web-based Java framework of work package 5.1. In the first step, short profiles are presented of different datasets, which reveals information in terms of the name and the originator of the data, the data content, as well as regarding the covered period (Figure 2). Subsequently, the user can either enter particular metadata, visit the original provider of the data, or is able to directly download data files (Figures 3-5).



QWeCI
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on health in developing countries

University of Cologne
Institute of Geophysics and Meteorology

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One of the most dramatic and immediate **impacts of climate variation** is that on **diseases**, especially the **vector-borne diseases** that disproportionately affect the poorest people in Africa. Although we can clearly see that, for example, an El Nino event triggers Rift Valley Fever epidemics, we remain poor at understanding why particular areas are vulnerable and how this will change in coming decades, since **climate change** is likely to cause entirely **new global disease distributions**. This applies to most vector-borne diseases. At the same time, we do not know currently the limit of **predictability of the specific climate drivers** for vector-borne disease using state-of-the-art **seasonal forecast models**, and how to best use these to produce skilful **infection-rate predictions** on seasonal timescales. The QWeCI project thus aims to understand at a more fundamental level the climate drivers of the vector-borne diseases of **malaria, Rift Valley Fever**, and certain **tick-borne diseases**, which all have major human and livestock **health** and implications in Africa, in order to assist with their short-term management and make projections of their future likely impacts.

Quantifying Weather & Climate Impacts
on health in developing countries

The main specific tasks of Cologne's QWeCI team are as follows:

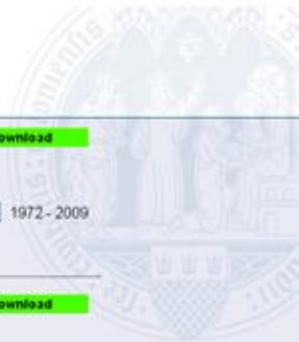
- ▶ Formation of an **atmospheric data** base with health relevant data sets.
- ▶ Development of an **integrated decision support framework** for health impacts of climate and weather, i.e. the construction of decision support systems, information systems, and monitoring tools.

Figure 1: Web portal of the UoC regarding QWeCI available at <http://qweci.uni-koeln.de>.

Detailed metadata is provided for each dataset according to the **ISO 19139** geographic information metadata eXtensible Markup Language (**XML**) schema implementation. This catalog is divided into various categories consisting amongst others of an abstract, resource overview, content information, graphical overview, lineage, resource constraints, data quality, and distribution information (Figure 4 & 5). All this information is provided by the web portal and is in addition available by an XML file.

A link is provided for the originator of the datasets. Here the user might be able to access the original data, download recent data updates, to find different versions of the dataset and additive information. Note that the original data files have been frequently processed in order to provide end-user friendly file formats such as **Comma-Separated Values (CSV)** or the **Network Common Data Format (NetCDF)**.

The datasets of the QWeCI atmospheric database can be either downloaded from a public accessible **FTP (File Transmitting Protocol)** server of the UoC computer centre (free access via <ftp://ftp.uni-koeln.de/institute/qweci>) or via a password protected FTP service of the UoC QWeCI server (restricted access via <ftp://qweci.uni-koeln.de>). Downloadable are the data files, example graphics of the data, the XML file of the dataset, as well as supporting files (Figure 3).



QWeCI
Atmospheric database
Multi Agency Systems
HEWS
Disease Operation System
MT for standing water
MT for near real time disease incidence




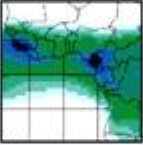
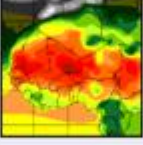
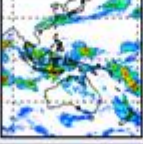
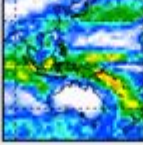

	GSOD Federal climate complex Global Surface summary of Day version 7 - Originator: National Climatic Data Center (NCDC), USA Daily meteorological observations from Africa - Period: 1972 - 2009 - Type: Station time series derived from SYNOP and METAR reports - Metadata Free access - Download
	GHCN Global Historical Climatology Network version 2 - Originator: National Climatic Data Center (NCDC), USA Monthly rainfall, temperature, and pressure data from Africa - Period: 1849 - 2009 - Type: Station time series derived from CLIMAT reports - Metadata Free access - Download
	GMet Historical Meteorological time series from Ghana - Originator: Ghana Meteorological Services Department Daily & monthly station observations from Ghana - Period: 1959 - 2009 - Type: Rainfall, temperature, relative humidity, and evapotranspiration time series - Metadata Restricted access - Download
	ERA-40 ECMWF 40 year Re-Analysis - Originator: European Centre for Medium-Range Weather Forecasts Daily data from Africa on a 1° x 1° latitude-longitude grid - Period: 1957 - 2002 - Type: Reanalysed temperatures, precipitation, evaporation, solar radiation, and wind - Metadata Restricted access - Download
	ERA-Interim ECMWF Interim Re-Analysis - Originator: European Centre for Medium-Range Weather Forecasts Daily data from Africa on a 1° x 1° latitude-longitude grid - Period: 1988 - 2010 - Type: Reanalysed temperatures, precipitation, evaporation, solar radiation, and wind - Metadata Restricted access - Download
	GPCP v1.1 1dd Global Precipitation Climatology Project 1° daily (version 1.1) - Originator: NASA Goddard Space Flight Center Satellite-gauge precipitation estimate - Period: 1996 - 2009 - Type: Daily precipitation on a 18deg, x 18deg, longitude-latitude grid - Metadata Free access - Download
	GPCP v2.1 Global Precipitation Climatology Project 2.5° monthly (version 2.1) - Originator: NASA Goddard Space Flight Center Satellite-gauge precipitation estimate - Period: 1978 - 2009 - Type: Monthly precipitation on a 2.58deg, x 2.58deg, longitude-latitude grid - Metadata Free access - Download
	SYNOP Synoptic reports from the DWD archive - Originator: German National Weather Service (DWD) 3 & 6-hourly synoptic messages from Africa - Period: 1966 - 2007 - Type: Station reports from the SYNOP code distributed by the GTS - Metadata Restricted access - Download

Figure 2: Short profiles of the datasets as presented by the web-based Java framework.

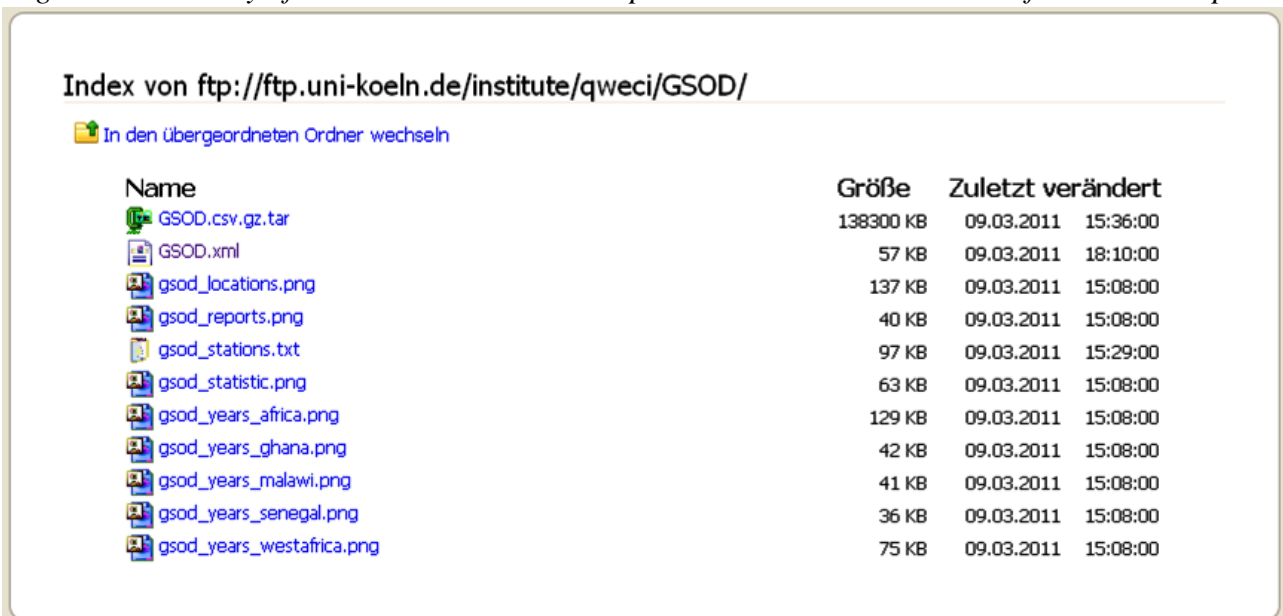
Datasets

In the following, datasets are presented, which were already entered into the atmospheric database. The alpha version of the atmospheric database includes altogether eight different datasets:

- GSOD: Federal climate complex Global Surface summary of Day version 7

The federal climate complex **Global Surface summary of Day (GSOD)** dataset is produced and regularly updated by the **National Climatic Data Center (NCDC)**. In the dataset a subset of the global surface summary of day data was extracted for Africa. The daily entries of GSOD include 18 surface meteorological elements, which were derived from SYNOP and METAR reports. The historical time series are generally available for 1973 to the present. Some stations in Africa reveal data back to before 1900. The variables included in the dataset differ from station to station, they include mean temperature, mean dew point, mean sea level pressure, mean station pressure, mean visibility, mean wind speed, maximum sustained wind speed, maximum wind gust, maximum temperature, minimum temperature, precipitation amount, snow depth, as well as an indicator for the occurrence of fog, rain or drizzle, snow or ice pellets, hail, thunder and tornado/funnel clouds of a particular day.

Figure 3: Directory of the GSOD dataset on the public accessible FTP server of the UoC computer



Name	Größe	Zuletzt verändert
GSOD.csv.gz.tar	138300 KB	09.03.2011 15:36:00
GSOD.xml	57 KB	09.03.2011 18:10:00
gsod_locations.png	137 KB	09.03.2011 15:08:00
gsod_reports.png	40 KB	09.03.2011 15:08:00
gsod_stations.txt	97 KB	09.03.2011 15:29:00
gsod_statistic.png	63 KB	09.03.2011 15:08:00
gsod_years_africa.png	129 KB	09.03.2011 15:08:00
gsod_years_ghana.png	42 KB	09.03.2011 15:08:00
gsod_years_malawi.png	41 KB	09.03.2011 15:08:00
gsod_years_senegal.png	36 KB	09.03.2011 15:08:00
gsod_years_westafrica.png	75 KB	09.03.2011 15:08:00

centre (downloadable via <ftp://ftp.uni-koeln.de/institute/qweci/GSOD/>).

- GHCN: Global Historical Climatology Network version 2

The global historical climatology network (GHCN) monthly data is produced and regularly updated by the NCDC. Here a subset of the global GHCN version 2 dataset was extracted for Africa. The GHCN database contains monthly historical mean, maximum and minimum temperatures, precipitation amounts, and pressure data for synoptic weather stations, which were mostly gathered from CLIMAT reports. The period of record varies from station to station; some of the stations in Africa extend back to the 19th century.

- GMet: Historical Meteorological time series from Ghana

The Ghana dataset contains both daily and monthly data of several synoptic weather stations as well as hydro-meteorological stations from Ghana. Daily data include minimum and maximum

temperatures, precipitation amounts, as well as sunshine duration. The period of record varies from station to station and includes various data gaps. For most stations data is available between 1960 and 2008.

The screenshot displays the metadata for the GMet dataset. At the top, it identifies the project as 'QWeCI' (Quantifying Weather & Climate Impacts) from the University of Cologne, Institute of Geophysics and Meteorology. The main heading is 'Atmospheric Database → Metadata: GMet'. The 'Short Profile' section includes a bar chart showing data trends and a 'Restricted access' button. The 'Abstract' section provides the following details:

- GMet**: Historical Meteorological time series from Ghana
- Originator**: Ghana Meteorological Services Department
- Abstract**: The Ghana database contains both daily and monthly data of several synoptic weather stations as well as hydrometeorological stations from Ghana. Daily data include minimum and maximum temperatures, precipitation amounts, as well as the sunshine duration.
- Keywords**: precipitation, minimum and maximum temperatures, relative humidity, sunshine duration, potential evapotranspiration, Africa, Ghana
- Contact**: Roderick van der Linden
- Organisation**: Institute of Geophysics and Meteorology, University of Cologne
- email**: r.van-der-linden@uni-koeln.de
- Update**: -
- Note**: There might be an update of the data set. The update depends on the accessibility of the data from KNUST.

Below the abstract, there are several expandable menu items: Resource overview, Content information, Graphical overview, Lineage, Resource constraints, Data quality, and Distribution information.

Figure 4: Metadata of the GMet dataset with the extended 'Short Profile' and 'Abstract' sections.

- ERA-40: ECMWF 40 year Re-Analysis

ERA-40 covers the period from September 1957 to August 2002. The three dimensional variational technique was applied using the T159L60 version of the Integrated Forecasting System to produce the analyses every six hours and forecasts each three hours. The analysis involved comprehensive use of satellite data, starting from the early vertical temperature profile radiometer data in 1972, then later including data from various satellites. Cloud motion winds were used from 1979 onwards. ERA-40 makes also use of data from past field experiments such as GATE. The QWeCI database contains a subset of the ERA-40 data. Only daily mean and daily accumulated surface variables were added to the database. For the height of 2 m included are the daily mean temperature, maximum and minimum daily temperature and relative humidity. The dataset furthermore comprehends the zonal and meridional wind component, skin temperature, ground temperature and soil moisture below surface, evaporation, total precipitation, and incoming solar radiation.

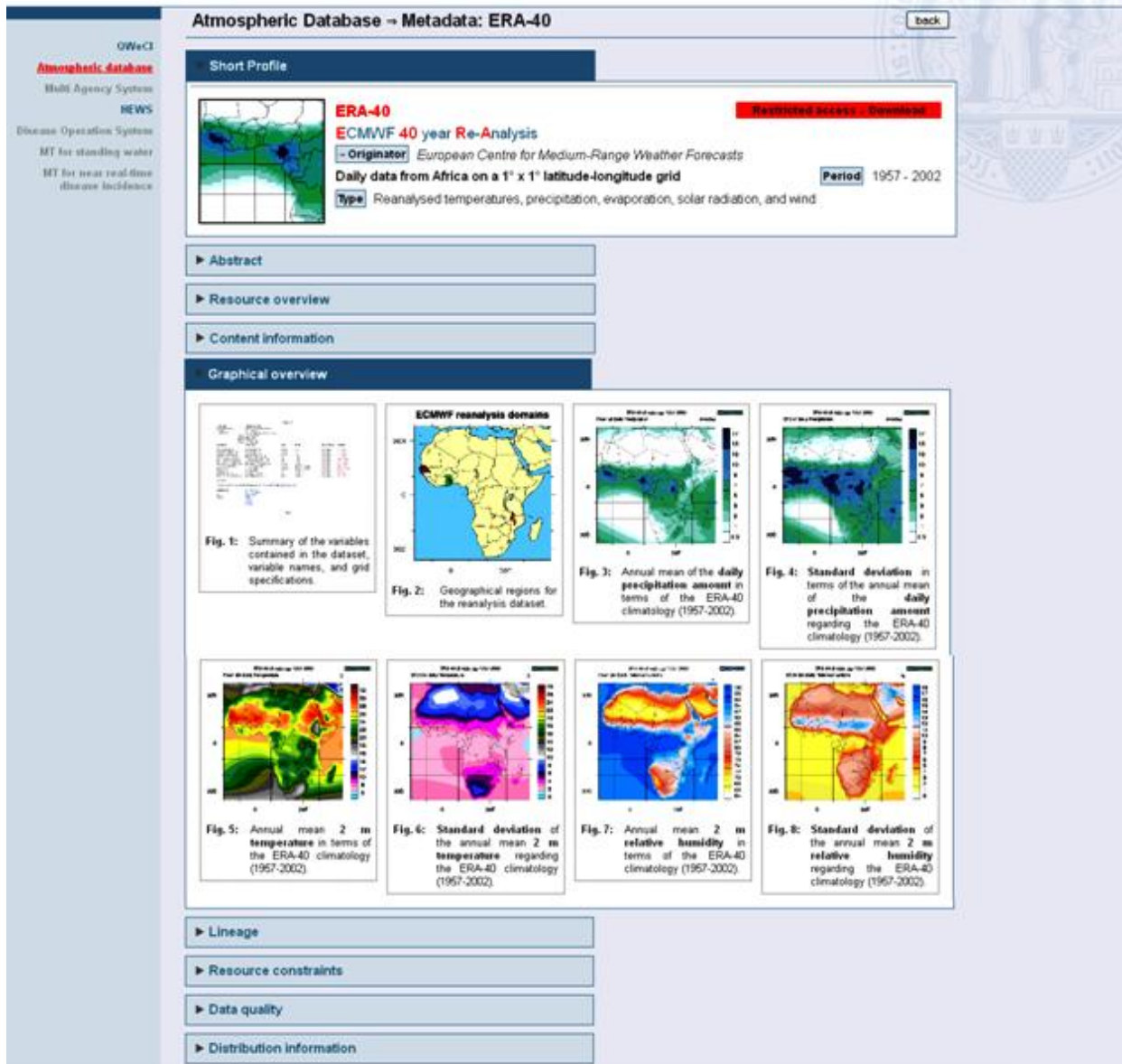


Figure 5: Metadata of the ERA-40 dataset with the extended 'Short Profile' and 'Graphical overview' sections.

- ERA-Interim: ECMWF Interim Re-Analysis

ERA-Interim is the latest global atmospheric reanalysis produced by the ECMWF, covering dates from 01 January 1989 onward to present. The ERA-Interim project is conducted in part to prepare for a new atmospheric reanalysis to replace ERA-40, which will extend back to the early part of the 20th century. Like for ERA-40 only a subset of the dataset was extracted for the QWeCI atmospheric database. Analogous to ERA-40 only surface variables are included.

- GPCP v1.1 1dd: Global Precipitation Climatology Project 1° daily (version 1.1)

GPCP was established to quantify the distribution of precipitation around the globe over many years. In support of this work an international group of precipitation experts developed and produced the GPCP Version 1.1 satellite-gauge **One-Degree Daily (1DD)** combined precipitation

dataset. The 1DD product provides precipitation estimates on a 1-degree grid over the entire globe at 1-day (daily) for the period October 1996 - present. The 1DD product is consistent with the Version 2 monthly product in the sense that the 1DD approximately sum to the monthly satellite-gauge estimate. All precipitation products are produced by optimally merging estimates computed from microwave, infrared, and sounder data observed by the international constellation of precipitation-related satellites, and precipitation gauge analyses.

- GPCP v2.1: Global Precipitation Climatology Project 2.5° monthly (version 2.1)

The GPCP 2.5-degree version 2 monthly product covers the period January 1979 to the present, with a delay of two to three months for data reception and processing. All precipitation products are produced by optimally merging estimates computed from microwave, infrared, and sounder data observed by the international constellation of precipitation-related satellites, and precipitation gauge analyses. The precipitation gauge analysis used in the GPCP satellite-gauge is created by the Global Precipitation Climatology Centre.

- SYNOP: Synoptic reports from the DWD (German Weather Service) archive

The SYNOP dataset includes meteorological messages, which are based on data exchanged under the WMO World Weather Watch Program according to WMO Resolution 40 (Cg-XII). The archive includes data from SYNOP messages as distributed by weather stations. The data was provided by the archive from the German Weather Service (DWD). A subset of the SYNOP dataset available in the DWD archive was extracted for Africa for the WMO block numbers 60, 61, 62, 63, 64, and 65. Included in the synoptic reports are atmospheric variables such as air temperature, dew-point temperature, atmospheric pressure, wind speed, the precipitation amount, present and past weather, cloud observations, etc. The archive contains data from 1966 to 2010 and is most complete since about 2000. For example, on average for each weather station contained in the dataset, more than four synoptic messages are available per day in 2009.

Future prospects

In the near future, further datasets will be added to the atmospheric database. It is planned to add an additional datasets including station observations. The **Met Office Integrated Data Archive System (MIDAS)** Land Surface Stations data will supplement the SYNOP and GSOD datasets. Satellite rainfall estimates of the **Tropical Rainfall Measuring Mission (TRMM)** in terms of Version 6 of the 3B42 and 3B43 algorithms will amend the GPCP SG precipitation estimates. Further re-analysis data will be provided in terms of the **NCEP/NCAR Re-Analysis 1 (NCEP-1)**. NCEP-1 is a joint product from the **National Centers for Environmental Prediction (NCEP)** and the **National Center for Atmospheric Research (NCAR)**. Regarding the pilot areas of the QWeCI project, historical time series from Senegal and Malawi will be added to the database. Due to data restrictions only a small subset of the available historical time series will be accessible from the two countries.

The atmospheric database will be used for the assessment of ERA-Interim products for the three target countries (D1.2b; M24). One problem is related to the fact, that long-term historical observations are missing for Senegal and Malawi. This problem can be partly compensated by means of the SYNOP, GSOD, MIDAS, and GHCN datasets.

The atmospheric database was released on M15 as the alpha version (D1.2a). The next updated beta version of the database will contain additional datasets. It is planned to add other functionalities like a search function for further versions of the database. From a technical point of view such features are relatively easy to include since the database is incorporated into the web-based Java framework of work package 5.1. It is foreseen to complete the final version of the atmospheric database, which is ready for transfer into the AMMA database, at M26 of the QWeCI project (D1.2c).