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QWeCI

Quantifying Weather and Climate Impacts on Health in Developing Countries

D5.4.b - Historical atmospheric station data contribution for WP1.2

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Lead contractor : UNIMA, ICTP
Coordinator of deliverable :
UNIMA, ICTP with MMA
Evolution of deliverable

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Dissemination Level		
PU	Public	
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)	

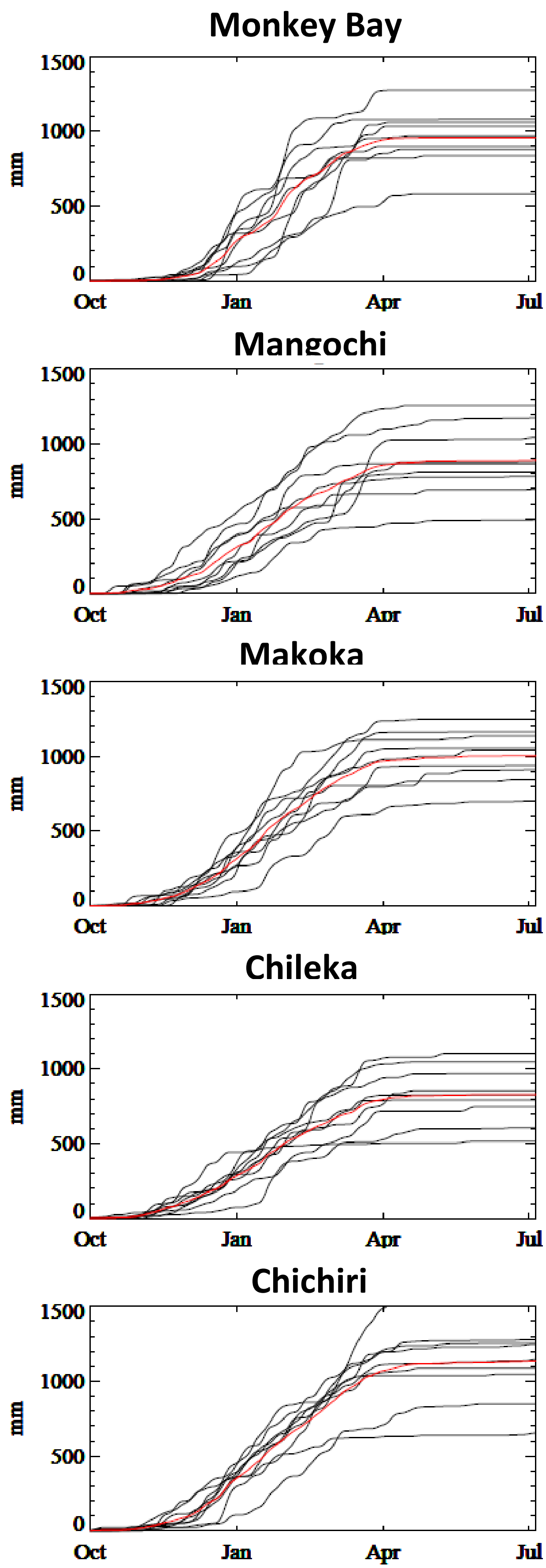
Values of daily maximum and minimum temperature and total precipitation have been obtained for five stations in the area relevant to the Malawi pilot project. The data was made available by the Department of Climate Change at the Malawi Meteorological Service (contact person: Elina Kululanga). Although the dataset does have some gaps, it constitutes the most complete available dataset of direct meteorological observations for the area. Table 1 summarizes the time periods covered for each variable at individual stations. During the November visit of ICTP and UNIMA to the partners in Malawi, agreements were made with Clement Boyce, in charge of statistics and statistical analysis at the Department of Climate Change and Meteorological Services, to update and complete the dataset as soon as possible. Specifically, a request has been made to fill in the gaps in the daily data records for the ten year period for which rainfall and health data are available. In addition longer timescale statistics will be compiled for monthly averages to cover the satellite period on 1979 onwards and coincide with the availability of reliable operational analyses.

Variables	Max. Temperature	Min. Temperature	Total Rainfall
Station names			
Mangochi 14°27′S, 35°16′E	01/00 to 09/08	01/00 to 09/08	01/00 to 04/09
Monkey Bay 14° 4' 60 S, 34° 55' 0 E	01/00 to 03/05	01/00 to 03/05	01/00 to 04/09
Mokoka tbc	01/00 to 04/05	01/00 to 04/05	01/00 to 04/09
Chichiri 15°47′10″S, 35°0′21″E	01/00 to 01/05	01/00 to 01/05	01/00 to 04/09
Chileka 15° 41' 0" S, 34° 56' 0" E	01/00 to 01/05	01/00 to 02/05	01/00 to 04/09

Table 1) Available time periods for individual variables and stations.

Figures 1 shows some very preliminary analyses of the Malawi station data. The left column in figures 1 shows time series of cumulative precipitation derived from daily means. Thin black lines represent individual years while the thick red line represents the mean over all years. Cumulative precipitation is often used as a threshold value to define the onset of the wet season. For example, one could define a very simple onset date to be the date at which a threshold of 100mm of rain is attained. In general the onset over the 10 years occurs on average in mid November. The variability between the stations of the average onset date is around one week, as expected considering the proximity of the stations. The stations to the south such as Chichiri in Blantyre have a mean onset slightly later than the stations to the north (e.g. Mangochi), consistence with the simple picture of the southerly progression of the rainbelt during the onset period of the rains in Malawi.

The variability from year to year in onset date at each station is much more marked, with a variability of approximately two weeks, but with the onset occurring as late as January in one extreme year. Looking at the CDF values on the 1st April to give the seasonal total precipitation, it is seen that the variation from the driest to the wettest years within the 10 year period is around a factor of two at most of the stations. A more robust analysis of the inter-annual variability will be possible when a longer dataset of monthly rainfall data is provided in early 2011 from the Malawian meteorological agency.



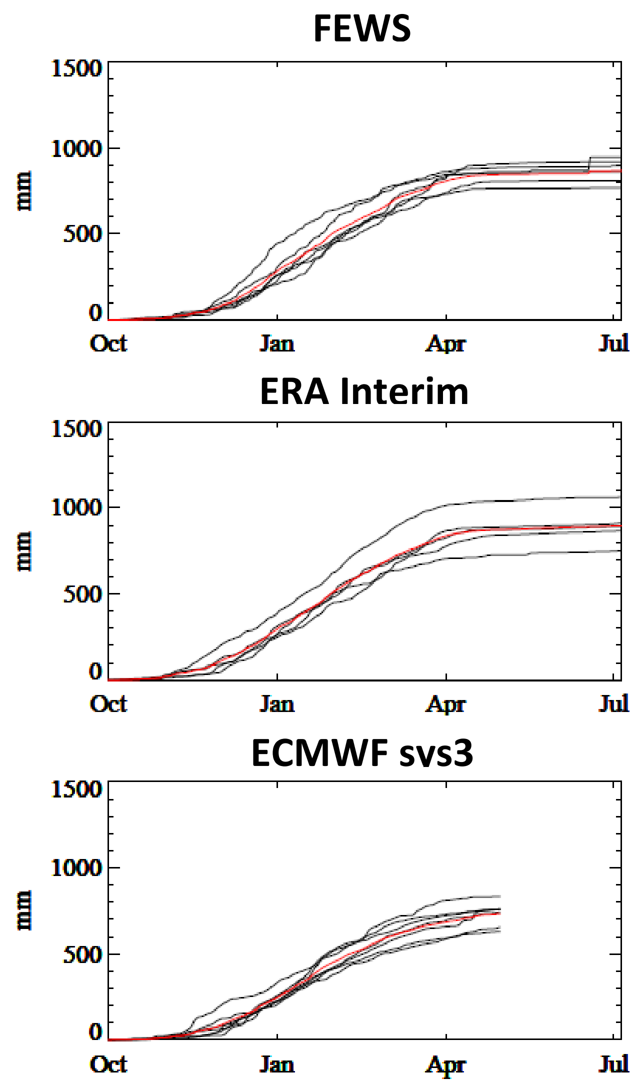


Figure 1: Left column: Black lines represent the CDF of rainfall for each years from 2000-2009 for the Malawi station data, while the red line shown the mean for the period. Right column gives a comparison “all Malawi” rainfall from a satellite retrieval (FEWS), short range 24 hour weather forecasts made from a daily reanalysis (ECMWF ERA-Interim) and the ECMWF system 3 operational seasonal forecast. See main text for further details

In the right column of figure 1 a very crude comparison is made to "all Malawi" rainfall CDFs from a satellite product, a model reanalysis product and the operational seasonal forecast product of ECMWF. The Satellite product is the FEWS RFE v2.0 retrieval, (which will shortly be compared to alternatives such as TRMM, GPCP and CMORPH). The model reanalysis is the ERA interim product of ECMWF, in which the rainfall produced in short 24 hour forecasts starting from the Interim analysis at 00Z each day are averaged over the period in question. The seasonal forecasts are derived from SYSTEM 3 version of the ECMWF operational system initialized on the 1st October each year. System 3 has been operational since 2006, however a catalogue of hindcast integrations are available from 1960 from the EU FP6 project ENSEMBLES which are used here. This analysis will be repeated with the state-of-the-art system 4 of ECMWF when the hindcast integrations become available during 2011.

It should be emphasized that these are (approximate) "all Malawi" simple averages for a box of 32° to 36°E in longitude and 8° to 18°S in latitude, and as regional averages can not be directly compared to individual stations. With more stations available in the future more robust comparison may be possible using kriging techniques to grid the station data. Nevertheless, this simple comparison does show that the area averaged cumulative distributions roughly reproduce the mean onset dates in the station data. Also cumulative precipitation amounts are fairly similar in April between the station data and the reanalysis and Satellite "observations" products. In comparison the seasonal forecast product would appear to have a dry bias in this region which, if confirmed with a more in-depth analysis, will be corrected by bias-correction techniques in WP3 of QWeCI. As expected, year to year variations in individual stations are obviously significantly larger than those of the averages over the national territory.

The binned values of total precipitation are given in figure 2. These are obtained by multiplying the daily precipitation intensity histogram (number of occurrences) by the value of the bin (mm/day). The resulting value is the total amount of precipitation, in the relevant period, associated with days of a given precipitation intensity. This type of plot statistically qualifies the character of the prevailing precipitative event. For example, comparing the histogram for Monkey Bay (fig. 2, top row left), with the other stations below it is clear that, in this area, a larger amount of precipitation is associated with intense events. This is also clear by the large 'steps' in the cumulative precipitation plots on the left. As expected, the histogram derived from the FEWS observational data set (fig. 2, right column, top row) is similar in shape to the ones obtained from the station data. It should be noted that the histograms of daily precipitation intensity in fig. 2 are calculated using grid points separately and not an area average which would be of little significance. Instead the histograms derived from the ERA interim reanalysis and from the ECMWF seasonal forecast data show the common statistical biases of simulated output. In particular, a comparatively large proportion of the total precipitation comes in the form of light rain with few intense events. This is generally associated with an excessive number of wet days in the simulations. These two forms of bias have compensating effects on the cumulative precipitation which results in the model data fitting observations well.

This preliminary analysis is restricted to rainfall due to the shorter record of station temperature data currently available to the consortium and the greater importance of the rainfall in driving the interannual fluctuations in disease incidence in this region. The station data will receive more analysis within the work of themes 1 and 3 of QWeCI.

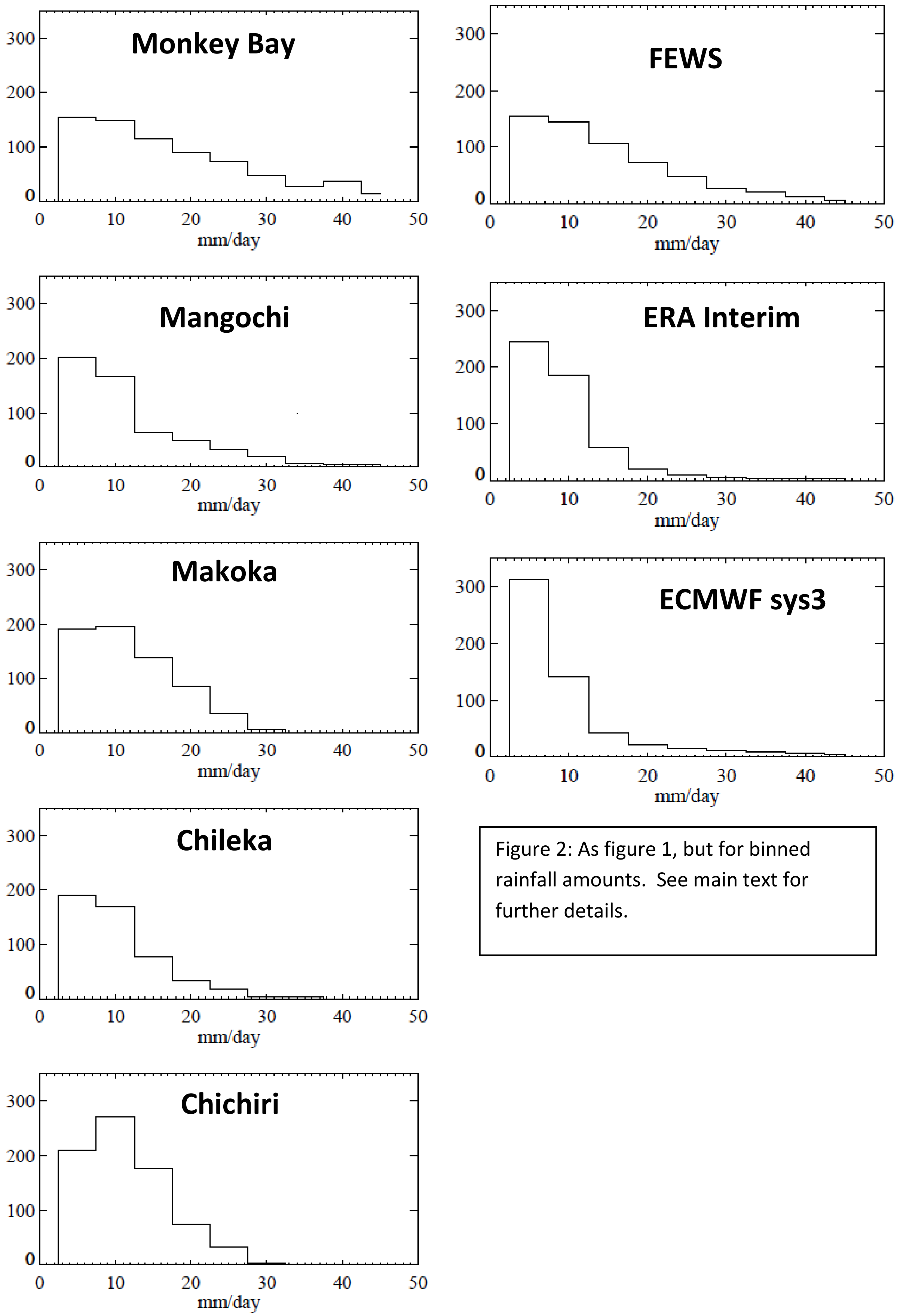


Figure 2: As figure 1, but for binned rainfall amounts. See main text for further details.