MAPROOM

Weighted Anomaly Standardized Precipitation (WASP)

Training Module
Malawi
June 27, 2017
Version 1.0

International Research Institute for Climate and Society
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CONTENTS

CHAPTER

ONE

WEIGHTED ANOMALY STANDARDIZED PRECIPITATION (WASP) TRAINING - MALAWI

1.1 Overview

Why was it developed?

The Weighted Anomaly Standardized Precipitation (WASP) Tool was initial created by Climate Scientist, Brad Lyon, to monitor the spatial extent of tropical drought. It has since been modified for use in malaria impact assessments.

What can the WASP tool be used for?

1. Assessing drought at national, regional and local scale
2. Assessing changes in climate risk in baseline and intervention periods within climate sensitive sectors
3. Assessing changes in climate risk in baseline and malaria intervention periods
4. Visualizing extreme climate anomalies relative to baseline periods

What can the WASP tool NOT be used for?

1. Predicting epidemics
2. Obtaining estimates or predicting actual rainfall (e.g. in mm)

1.2 Definition

To compute the WASP index, monthly rainfall departures from the long-term average (here, 1981-2010) are obtained from the global products' rainfall database and then standardized by dividing by the standard deviation of monthly precipitation. The standardized monthly anomalies are then weighted by multiplying by the fraction of the average annual rainfall for the given month. Area averages are created according to the shape files available. In this example, shape files are created by administrative boundaries at the district, regional and country level. Thus the WASP tool does not give you the actual rainfall (e.g. in mm), but rather how rainfall varies from the baseline average over time.

1.3 Interpretation

For the WASP plot, green shades indicate conditions that are wetter than the average for the baseline period brown shades indicate conditions that are drier than the average. Anomalies that are greater than 1.5 standard deviations may be considered extreme relative to the baseline period. Note some extreme anomalies may persist over multiple years. (Please refer to Figure 1.1 in the following section.)

1.4 Access

The WASP Tool in Malawi can be accessed via the Health Maproom at http://datalib.metmalawi.com:8091/maproom/Health/WASP/index.html. Here you can also find brief text and instructions on how to generate graphs for particular regions, provinces, and districts. Just for a little guidance, to generate the graph just like Figure 1.2, go into the control bar and choose the years you would like to put in as a baseline (if more than one year, separate by "-"). To select the area you are looking for also look at the drop down box under the 'Region' section (refer to Figure 1.1). Once all the conditions are set, a graph like Figure 1.2, should be generated.

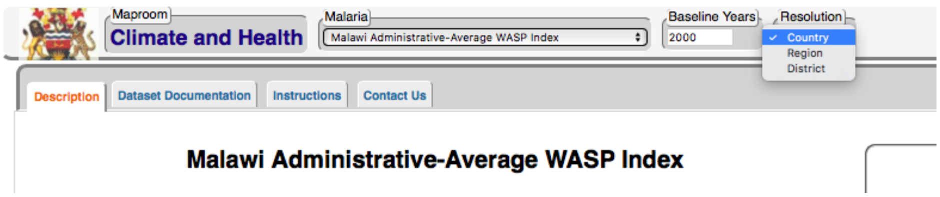

Fig. 1.1: Control Bar Setting to develop graph on Figure 1.2

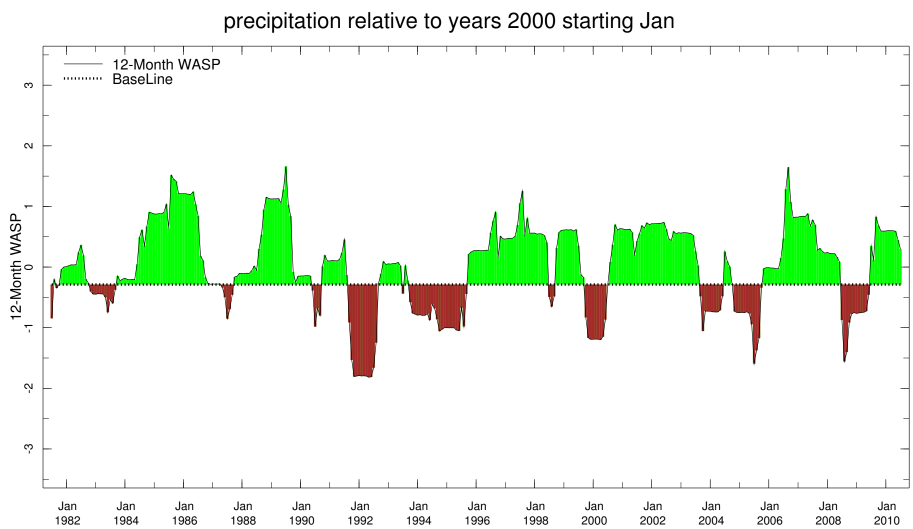

Fig. 1.2: Time series of 12-month Weighted Anomaly Standardization Precipitation (WASP) index relative to a baseline period for Malawi

1.5 Choosing the Baseline Year(s)

As year-to-year variability in rainfall is high and can have a considerable impact on short-term changes in malaria transmission in some regions, the choice of baseline year(s) for malaria impact assessment may significantly affect the assessment. See Figure 1.3.

Figure 1.3 shows that if the baseline year (or period) was unusually favorable or unfavourable (e.g. wet or dry; warm or cool) for the particular malaria outcome, then achieving change relative to that baseline year (or period) may be confounded. For example, if interventions follow an unusually high (e.g. wet and/or warm) baseline year and malaria incidence declines, it may be tempting to attribute all of the decline in malaria outcomes to the interventions – thereby and inadvertently, overestimating their effectiveness.

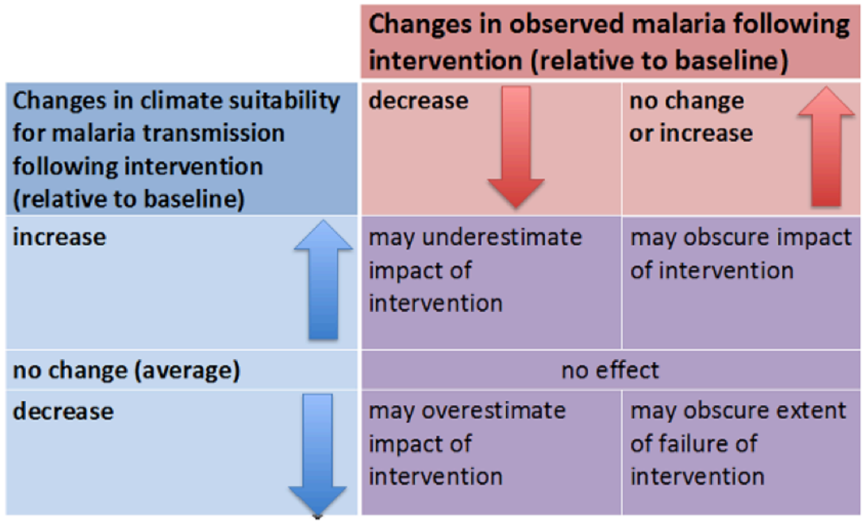

Fig. 1.3: Possible impacts of climate suitability for malaria transmission on efforts to reduce malaria incidences.

However, as the climate varies over time, it is likely that malaria incidence will at some point reverse, and cases may increase as a result of a more favourable climate. If climate is not factored into the equation, then the increase in case numbers may be inappropriately attributed to programme failure or other factors.

1.6 Case Study - Tanzania

Tanzania is located in Eastern Africa. It has a very varied geography – extending from the Indian Ocean coastline in the East - to the humid Lake Victoria region in the West. Most of the country has a tropical climate with cooler regions, limited to the highland areas associated with Malawi's volcanic mountain range (including Kilimanjaro) in the northwest and the highland plateau in the south central region.

In Tanzania, the relationship between malaria and climate is significant and varies across the country. Climatically, temperature is extremely important in highland areas in the northwest and south central regions, whereas rainfall can be significant across the entire country, but especially in the central semi-arid regions.

Central to malaria interventions and impact assessments is the concept of a baseline year or baseline period against which changes in outcomes can be measured. For example, if the climate risk for malaria in the baseline period was unusually severe then achieving change relative to that baseline is relatively easy. Using the WASP tool, it is possible to explore changes in rainfall integrated over time and over a specified region for both a baseline and intervention period. Where temperature is not a constraint to malaria transmission, this tool may provide a good estimate of climate risk for malaria. Figure 1.2 shows a WASP calculation for Tanzania using the baseline period of 1995-1999, and an intervention period of 2000-2010. Figure 1.4 expands the analysis to the whole country.

The 1995-1999 baseline is used in this instance as it keeps into consideration the rainfall conditions of Tanzania associated with 1997/98 El Niño that resulted in flooding.

As mentioned before Fig 1.3 depicts the major interventions that occurred in Tanzania from 2000-2010. From the graph we can also observe the impact of the first medium - term strategic plan for 2002-2007 that was implemented by NMCP, as well as the second medium - term strategic pan for 2008-2013 which pushed for an even higher malaria intervention coverage for the national population (Smithson et al, 2015).

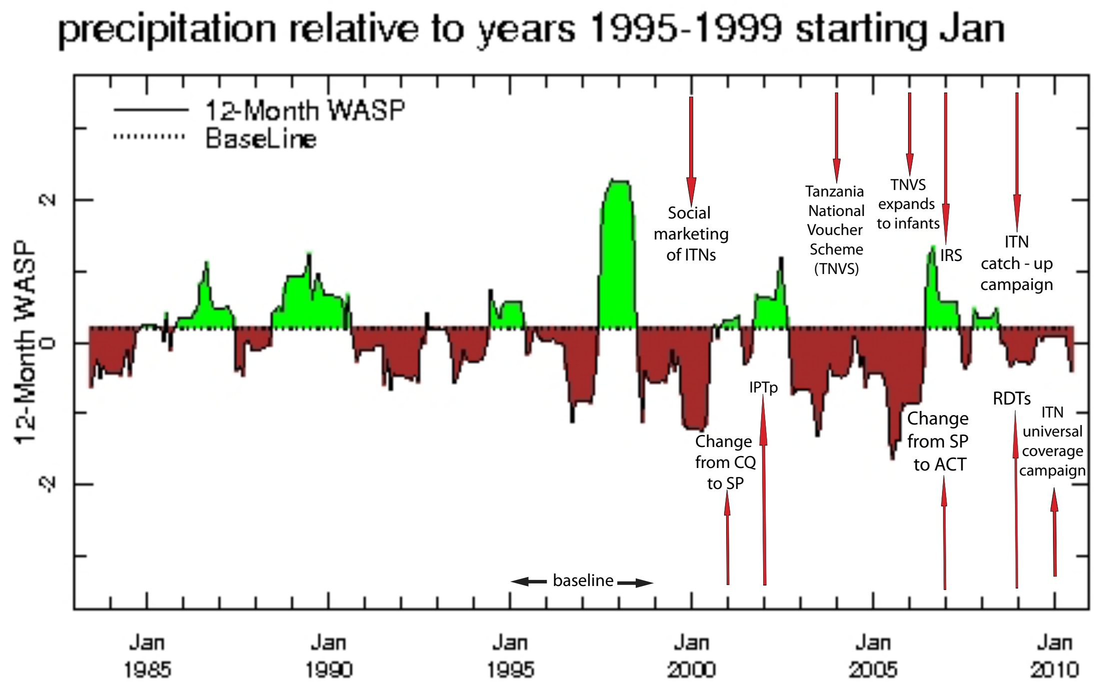

Fig. 1.4: National analysis of rainfall in Tanzania. The WASP tool indicates that the intervention years of 2000-2010 included major droughts (2000, 2004-2006) while the baseline period of 1995-1999 included the major 1997/98 El Niño

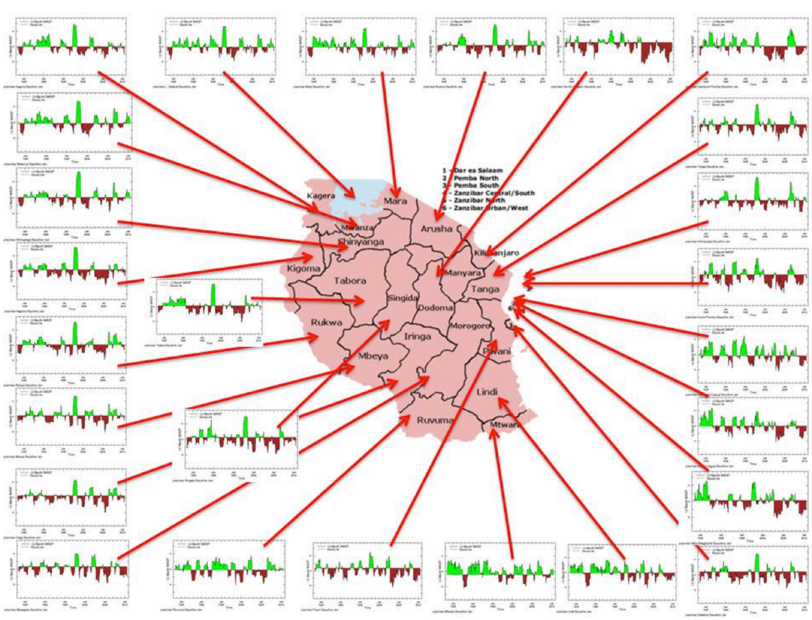

Fig. 1.5: Similar analyses for all provinces in Tanzania – showing at a glance how rainfall anomalies in the period of 1983-2010 vary in both space and time

1.6.1 Case Study Conclusion & Summary

The WASP tool, using regularly updated ENACTS rainfall products for Tanzania, provides high quality climate information for pre- and post-intervention efforts at different spatial scales (e.g. district, province, country).

From the results, it is clear that the baseline period included the 1997/98 El Niño, when epidemics of malaria were widespread in Tanzania.

In contrast, drought persisted in Tanzania through much of the intervention period of 2000-2010. However, major scale-up of interventions occurred post 2005 – after the most severe droughts had occurred (2000, 2003, 2005). If 1995-1999 is used as a baseline, there is a high risk that impact assessments for the period of 2000-2010 will overestimate the impact of interventions if climate is not taken into account.

In Tanzania the relationship between malaria and rainfall is significant and varies across the country with (1) temperature important in highland areas in the northwest and south central regions and (2) rainfall playing a significant role across the country especially in the semi-arid regions. In these regions, analysis of malaria and climate must be undertaken at multiple scales to account for local complexity.

1.7 Exercise 1 using Figure 1.3 - Tanzania

Q1. Which choice of baseline has the highest risk of overestimating the impact of interventions during the 2000-2010 period?

Q2. Which baseline would you choose to evaluate the impact of the interventions?

Q3. Was 2000 an unusually dry or wet year compared to the entire time series?

Q4. Which was the wettest year in the time series (BONUS: What teleconnection was it associated?)

1.7.1 Exercise 1 - Answers

A1: 1995-1999

A2:

A3: Dry

A4: 1997, El Niño

1.8 Exercise 2 - Malawi and Baseline Years

Malawi is located south of the equator, mostly hilly and mountainous, and has a tropical climate or sub-tropical at high altitudes. Malawi has a hot and rainy season from mid-November to April, and a relatively cool, dry winter season from mid-May to mid-August. Before the rainy season, from September to November, the temperature rises to the point of reaching the highest levels of the year. Temperatures vary with altitude: above a thousand metres (3,300 feet). However, in the far south there is a flat region, hot and humid due to the low altitude. In most of the country, annual precipitation is between 800 and 1,300 millimetres (31 and 51 inches), and is more abundant in the north, especially in March and April are very rainy, but also in the southern slopes of Mount Mulanje, where it even exceeds 2,000 mm (79 in) per year.

Please perform the following exercises:

E1. Generate the WASP figure for the Chitipa district in Malawi using 1995-1999 as a baseline period, starting in Jan (see Figure 1.6).

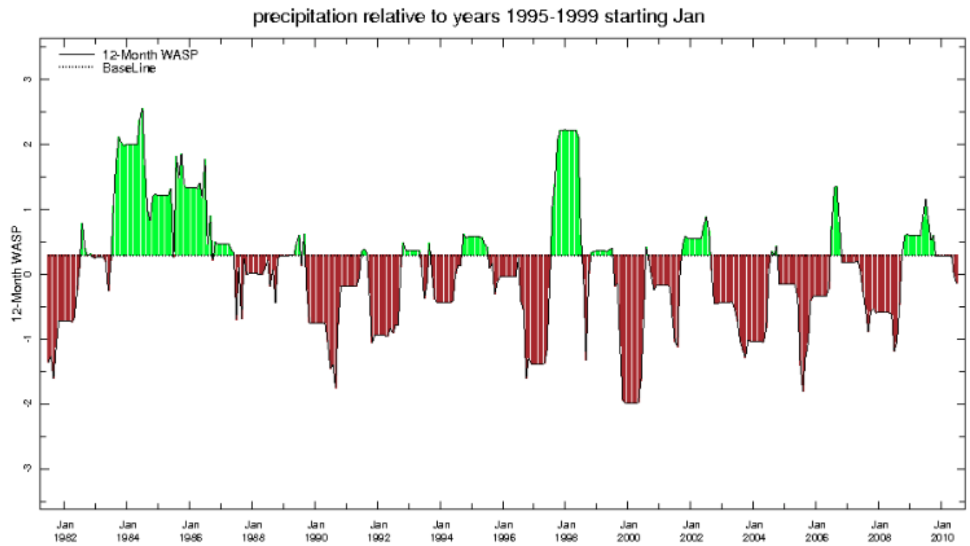

Fig. 1.6: WASP precipitation relative to years 1995-1999 starting Jan (baseline period) for the Chitipa district in Malawi

E2. Generate the WASP figure for the Chitipa district in Malawi using 2000 as the baseline period, starting in Jan (see Figure 1.7).

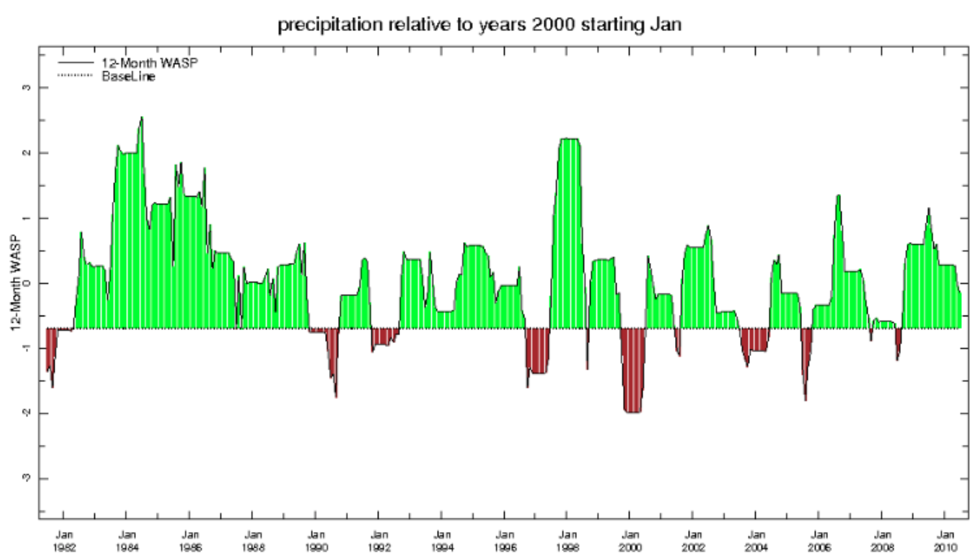

Fig. 1.7: WASP precipitation relative to year 2000 starting Jan (baseline period) for the Chitipa district in Malawi

From Figure 1.7 the user can see that the year 2000 was a dry year for Chitipa district.

1.9 Quiz

Please answer the following questions:

Q1. WASP stands for Weighted Average Standardized Precipitation. (T/F)

Q2. Rainfall variability is MOST likely to confound malaria impact assessments in: a) semi-arid regions b) highland regions c) humid regions

Q3. If climate suitability for malaria is higher in the baseline year(s) than in the intervention period, malaria impact assessments may overestimate the impact of interventions. (Y/N)

Q4. The WASP tool can be used to predict rainfall related to epidemics. (T/F)

Q5. The WASP tool can be used for impact assessments for climate sensitive outcomes other than malaria. (T/F)

Q6. The WASP tool can be used to describe anomalies in rainfall amount in mm. (T/F)

1.9.1 Quiz - Answers

A1: True, WASP stands for Weighted Average Standardized Precipitation.

A2: a) rainfall variability plays a significant role across the entire country, but especially in the semi-arid regions.

A3: True, per Figure 1.5, if climate suitability for malaria is higher in the baseline year(s) than in the intervention period, malaria impact assessment may overestimate the impact of interventions.

A4: False, as mentioned previously, the WASP tool CANNOT be used to predict rainfall nor can it be used to predict epidemics.

A5: True, the WASP tool can be used for impact assessments for climate sensitive outcomes and sectors related to agriculture, energy, biodiversity, etc.

A6: False, the WASP tool describes anomalies in rainfall as in index and not as a metric units.

1.10 Summary & Additional Uses of WASP

WASP is a simple tool for use in malaria impact assessment and possible outcomes. It enables the user to assess whether rainfall during a baseline and intervention period is likely to have (1) overestimated or underestimated the impact of the intervention or (2) obscured the extent of the success or failure of the intervention.

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