

## Rule set used to define agroecological zones (AEZ) for Sub-Saharan Africa – 2009

### **Major Climate Divisions:**

Temperature zones are one of the governing factors in the selection of what crops can be cultivated in what areas. The major climate divisions, as defined for the Global Agroecological Zones (GAEZ) project (FAO/IIASA 2002), represent major latitudinal thermal (or temperature) shifts and are defined as follows:

**Tropics:** mean monthly temperature adjusted to sea-level<sup>1</sup> greater than 18° C for ALL months

**Sub-tropics:** mean monthly temperature adjusted to sea-level less than 18° C for 1 or more months

**Temperate:** mean monthly temperature adjusted to sea-level less than 5° C for 1 or more months – *not applicable for Africa*

**Boreal:** mean monthly temperature adjusted to sea level less than 5° C for all months – *not applicable for Africa*

In creating the revised AEZ surface for Africa, we used monthly average minimum and maximum temperature data at a resolution of 0.00833dd (approximately 1x1km) from WorldClim (2009) and SRTM30 elevation data also at a resolution of 0.00833dd (CGIAR-CSI 2007). Mean monthly temperature adjusted to sea level was calculated for each cell as follows:

$$(tmin\_m + tmax\_m) / 2 + (0.55 * elevation / 100)$$

where *m* represents individual months

The monthly data were then analyzed and the climate regions identified according to the above definitions. In the database the climate zone classes are:

0 = boreal / 1 = tropical / 2 = subtropical / 3 = temperate  
where only 1 and 2 are applicable for Africa.

### **Moisture zones**

Moisture zones are identified using the *length of growing period (LGP)* concept which identifies the time with both moisture and temperature are conducive to crop growth. Length of growing period is defined as the period during the year when average temperatures are greater than or equal to 5°C (Tmean >=5° C) and precipitation plus moisture stored in the soil exceed half the potential evapotranspiration (P>0.5PET). A normal growing period is defined as one when there is an excess of precipitation over pet (i.e. a humid period). Such a period meets the full evapotranspiration demands of crops and replenishes the moisture definite of the soil profile. An intermediate growing period is defined as one in which precipitation does not normally exceed PET but does

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<sup>1</sup> Temperature was adjusted to sea level using a normal lapse rate of 0.55° C per every 100meters of elevation change. This was done in order to obtain unfragmented geographical areas.

for part of the year. No growing period is when temperatures are not conducive to crop growth or P never exceeds PET (FAO 1978).

Determining LGP is a difficult process that requires extensive calculations based on precipitation, evapotranspiration and soil moisture holding capacity. It also requires an understanding of the moisture requirements of specific crops since the growing period for many extends beyond the rainy season. Coarse resolution LGP data is available as part of IIASA/FAO's initial GAEZ project (IIASA/FAO 2001). For this project the moisture zones were defined using LGP data at a resolution of 0.08333dd (approximately 10x10km) (Fischer 2009). *This length of growing period data was provided via personal communication from IIASA (Fischer 2009) and is not yet available for distribution.*

The specific moisture zone classes are:

**Arid:** less than 70 days length of growing period (LGP)

**Semi-arid:** 70-180 days LGP

**Sub-humid:** 180-270 days LGP

**Humid:** >270 days LGP

#### **Highland / Lowland (i.e. Cool / Warm)**

The major climate and thermal zones provide a broad understanding of the agroecologies of Africa but it is equally as important to take into account the effect that changes in elevation have on crops. Certain plants thrive in cooler climates and could possibly be adapted to the highland regions of the tropics but for the most part higher altitudes produce adverse conditions that can restrict agriculture.

For IIASA/FAO's GAEZ project the cool/warm distinction is determined using temperatures during the growing season. This requires using daily mean temperature data in conjunction with the start and end dates of the growing season for each cell. Since these data were not available at a resolution of 0.00833dd we used elevation data as a proxy measure of the cool/warm zones.

The SRTM30 elevation data was first classified into 3 zones as follows:

1: -50 – 800m

2: 800 – 1200m

3: >1200m

Different cutoff values were used for the tropics and subtropics since it takes a greater elevation change for the temperature in the tropics to drop into what is considered a cool zone. For the tropics areas with greater than 1,200m elevation were classified as cool; for the subtropics areas with greater than 800m elevation were classified as cool.

The cool/warm assigned classes are:

0 = Cold/Boreal (*not applicable for Africa*)

1 = Cool

2 = Warm

Each cell was classified as cool or warm using the following criteria:

Climate	Elevation	Cool/Warm
0	1-3	0
1	3	1
1	<3	2
2	>=2	1
2	1	2
3	1-3	1

**Final AEZ classification:**

The major climates, moisture zones and warm/cool surfaces were combined together and each cell was classified into Agroecological Zones classes using the following three digit combinations:

Climate	Temperature/ elevation	Humidity
Temperate : 1	Warm : 1	Arid : 1
Subtropic : 2	Cool: 2	Semiarid: 2
Tropic: 3	No distinction: 0	Subhumid : 3
Boreal : 4		Humid : 4

The final classes are:

- 101 Temperate / arid
- 102 Temperate / Semi-arid
- 103 Temperate / sub-humid
- 104 Temperate / humid
- 211 Subtropic - warm / arid
- 212 Subtropic - warm / semiarid
- 213 Subtropic - warm / subhumid
- 214 Subtropic - warm / humid
- 221 Subtropic - cool / arid
- 222 Subtropic - cool / semiarid
- 223 Subtropic - cool / subhumid
- 224 Subtropic - cool / humid
- 311 Tropic - warm / arid
- 312 Tropic - warm / semiarid
- 313 Tropic - warm / subhumid
- 314 Tropic - warm / humid
- 321 Tropic - cool / arid
- 322 Tropic - cool / semiarid
- 323 Tropic - cool / subhumid
- 324 Tropic - cool / humid
- 400 Boreal

**Sources:**

Report on Agro-Ecological Zones Project. Vol 1. Methodology and Results for Africa. FAO. World Soil Resources Report #48. 1978. FAO: Rome.

Fischer, G., H. van Velthuis, M. Shah, F. Nachtergaele. 2002. *Global Agro-ecological Assessment for Agriculture in the 21<sup>st</sup> Century: Methodology and Results*. IIASA: Austria & FAO: Rome.

Fischer, G. 2009. *Length of Growing Period Data*. Personal communication. Data not available for distribution.

WorldClim climate and elevation data downloaded from web. January, 2009.  
<http://www.worldclim.org/current.htm>.