Phytosociological Research Center
www.globalbioclimatics.org
Worldwide Bioclimatic Classification System
Prof. Dr. Salvador Rivas-Martinez
(Adapted to Synoptical Table 30/08/2017)

JOHANNESBURG CITY (SOUTH AFRICA)  Altitude: 1707 m.
Latitude: 26°13’S  Longitude: 28°4’E
Temperature observation period.: 1935–1968 (34)
Rainfall observation period....: 1951–1968 (18)

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<th>Ti</th>
<th>Mi</th>
<th>mi</th>
<th>M'i</th>
<th>m'i</th>
<th>Pi</th>
<th>EPi</th>
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<td>783.92</td>
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**BIOCLIMATIC INDICES AND DIAGNOSIS**

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<td>Diurnality index</td>
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<th>N. of Months</th>
<th>P&gt;4T</th>
<th>P:2T–4T</th>
<th>PT–2T</th>
<th>P&lt;T</th>
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<td>6</td>
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<td>3</td>
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Latitudinal Belt...: Subtropical
Continentality.....: Hyperoceanic – Low Subhyperoceanic
Bioclimate(Variant): TROPICAL PLUVISEASONAL (SUBXEROPHYTIC)
Bioclimatic Belt....: UPPER MESOTROPICAL LOW SUBHUMID
JOHANNESBURG CITY (SOUTH AFRICA) 1707 m

\[
\begin{align*}
\text{P=} & \quad 730 \quad 26^{\circ} 13\text{'}S \quad 28^{\circ} 4\text{'}E \quad 34/18 \text{ y.} \\
\text{T=} & \quad 16.3^\circ \quad \text{Ic=} \quad 10.5 \quad \text{Tp=} \quad 1952 \quad \text{Tn=} \quad 0 \\
\text{m=} & \quad 3.3^\circ \quad \text{M=} \quad 16.6^\circ \quad \text{Itc=} \quad 362 \quad \text{Io=} \quad 3.7
\end{align*}
\]

TROPICAL PLUVISEASONAL (SUBXEROPHYTIC)
UPPER MESOTROPICAL LOW SUBHUMID

WATER INDEX CARD JOHANNESBURG CITY (SOUTH AFRICA)
Altitude: 1707 m. Latitude: 26° 13’S

|  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|
| (C/mm) | T | PE | P | VR | R | RE | DF | SP | DR | HC |
| Jul. | 10.0 | 25 | 8 | -17 | 38 | 25 | 0 | 0 | 0 | -0.6 |
| Aug. | 12.7 | 39 | 5 | -34 | 5 | 39 | 0 | 0 | 0 | -0.8 |
| Sep. | 16.3 | 60 | 22 | -5 | 0 | 27 | 34 | 0 | 0 | -0.6 |
| Oct. | 18.6 | 83 | 63 | 0 | 0 | 63 | 20 | 0 | 0 | -0.2 |
| Nov. | 19.1 | 88 | 111 | 23 | 23 | 88 | 0 | 0 | 0 | 0.2 |
| Dec. | 20.0 | 101 | 111 | 10 | 34 | 101 | 0 | 0 | 0 | 0.1 |
| Jan. | 20.4 | 102 | 115 | 13 | 46 | 102 | 0 | 0 | 0 | 0.1 |
| Feb. | 20.2 | 87 | 113 | 26 | 73 | 87 | 0 | 0 | 0 | 0.3 |
| Mar. | 18.9 | 81 | 84 | 3 | 76 | 81 | 0 | 0 | 0 | 0.0 |
| Apr. | 16.0 | 56 | 66 | 10 | 86 | 56 | 0 | 0 | 0 | 0.1 |
| May. | 13.1 | 39 | 23 | 16 | 69 | 39 | 0 | 0 | 0 | -0.4 |
| Jun. | 9.9 | 23 | 9 | -14 | 55 | 23 | 0 | 0 | 0 | -0.6 |
| Year | 16.3 | 784 | 730 | * | * | 730 | 54 | 0 | 0 | * |

R = Reserve VR = Variation of the reserve RE = Real evapotranspiration DR = Drainage HC = Humidity coefficient DF = Deficit SP = Superavit

JOHANNESBURG CITY (SOUTH AFRICA)
26°13’S 28°4’E 1707 m 34/18 y.

\[
\begin{align*}
\text{T=} & \quad 16.3 \quad \text{Ic=} \quad 10.5 \quad \text{Tp=} \quad 1952 \quad \text{M=} \quad 16.6 \quad \text{Itc=} \quad 362 \\
\text{m=} & \quad 3.3 \quad \text{M=} \quad 16.6 \quad \text{Io=} \quad 3.7 \quad \text{P=} \quad 730 \quad \text{mm} \\
\text{PE=} & \quad 784 \quad \text{mm}
\end{align*}
\]

|  |  |  |  |  |
|---|---|---|---|
| Imbibing | 14 Oct. |  |
| Saturation |  |
| Reserve Use | 12 Apr. |  |
| Deficit | 4 Sep. |  |
JOHANNESBURG CITY (SOUTH AFRICA)
Latitude: 26°13'S   Longitude: 28°4'E   Altitude: 1707 m

SUMMARY OF RIVAS-MARTINEZ CLASSIFICATION

Continuity Index  
+ Type ................: A. Hyperoceanic
+ Subtype .............: 3. Subhyperoceanic
+ Variant .............: b. Low

Thermic types  
+ Latitudinal zone ....: A. Warm
+ Latitudinal belt ....: 3. Subtropical
+ Thermic type .......: A. Warm
+ Thermic subtype ....: 3. Subwarm

Bioclimatic types  
+ Macrobioclimate ......: A. TROPICAL
+ Bioclimate ...........: 4. PLUVISEASONAL
 + Bioclimatic variant :  
 + Thermic type........: 3. MESOTROPICAL
+ Thermic subtype......: a. UPPER
+ Ombrothermic type ...: 6. SUBHUMID
+ Ombrothermic subtype : b. LOW

Bioclimatic Classification ....................: Trde.Mtr.Shu

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JOHANNESBURG CITY (SOUTH AFRICA)
Latitude: 26°13'S   Longitude: 28°4'E   Altitude: 1707 m

PRECIPITATION PARAMETERS

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<thead>
<tr>
<th>Seasons</th>
<th>Winter (Tr1-W)</th>
<th>Spring (Tr2-P)</th>
<th>Summer (Tr3-S)</th>
<th>Autumn (Tr4-F)</th>
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<td>Rainfall</td>
<td>22</td>
<td>196</td>
<td>339</td>
<td>173</td>
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</table>

Seasonal rainfall rhythms:  S > P > F > W

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JOHANNESBURG CITY (SOUTH AFRICA)
Latitude: 26°13'S   Longitude: 28°4'E   Altitude: 1707 m

TEMPERATURE PARAMETERS

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<td>(Tmax)</td>
<td>20.4</td>
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<tr>
<td>Average coldest month</td>
<td>(Tmin)</td>
<td>9.9</td>
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<tr>
<td>Minimum temp. warmest</td>
<td>(Tmmax)</td>
<td>26.4</td>
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<tr>
<td>Absolute Max.temp.</td>
<td>(Tamax)</td>
<td>30.9</td>
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<tr>
<td>Absolute Min.temp.</td>
<td>(Tamin)</td>
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<td>First warmest contrasted</td>
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<td>First coldest contrasted</td>
<td>(Tcmin)</td>
<td>5.5</td>
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<tr>
<td>Dry station temperature</td>
<td>(Td)</td>
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<tr>
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<tr>
<td>dryest 3 months</td>
<td>(Tpd)</td>
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<td>coldest 1 month</td>
<td>(Tpw1)</td>
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3
### JOHANNESBURG CITY (SOUTH AFRICA)

**Latitude:** 26°13’S  **Longitude:** 28°4’E  **Altitude:** 1707 m

#### SEASONAL PARAMETERS

<table>
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<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
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<td><strong>Dryest semester</strong>...<strong>(Smd)</strong></td>
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<td><strong>Dryest 4 months</strong>...<strong>(Cmd)</strong></td>
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<td><strong>HiperAgelid</strong>...<strong>(all&gt;0)</strong></td>
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#### OMBROTHERMIC PARAMETERS

**Latitude:** 26°13’S  **Longitude:** 28°4’E  **Altitude:** 1707 m

- **Annual aridity index**...**(Iar):** 1.07
- **Mediterranean index of January**...**(Im1):** 0.89
- **Mediterranean index of January & February**...**(Im2):** 0.83
- **Mediterranean index of December to February**...**(Im3):** 0.85

<table>
<thead>
<tr>
<th>Months</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
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<tr>
<td><strong>Pp</strong>(x10)</td>
<td>1110</td>
<td>1150</td>
<td>1130</td>
<td>840</td>
<td>660</td>
<td>230</td>
<td>90</td>
<td>80</td>
<td>50</td>
<td>220</td>
<td>630</td>
<td>1110</td>
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<tr>
<td><strong>Tp</strong></td>
<td>200</td>
<td>204</td>
<td>202</td>
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<td>100</td>
<td>127</td>
<td>163</td>
<td>186</td>
<td>191</td>
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<td><strong>Io (Iom)</strong></td>
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<td>5.64</td>
<td>5.59</td>
<td>4.44</td>
<td>4.13</td>
<td>1.76</td>
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<td>0.80</td>
<td>0.39</td>
<td>1.35</td>
<td>3.39</td>
<td>5.81</td>
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#### Aridity Value Index (AVI)

- **[10xPP/TP=IO]:** 7300/1952=3.74  **There is No Yearly Aridity**

<table>
<thead>
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<th>Months</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
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<th>Oct</th>
<th>Nov</th>
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<tr>
<td><strong>Pp</strong> [P*10]</td>
<td>1110</td>
<td>1150</td>
<td>1130</td>
<td>840</td>
<td>660</td>
<td>230</td>
<td>90</td>
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<td>220</td>
<td>630</td>
<td>1110</td>
</tr>
<tr>
<td><strong>Tp</strong> [T*10]</td>
<td>200</td>
<td>204</td>
<td>202</td>
<td>189</td>
<td>160</td>
<td>131</td>
<td>99</td>
<td>100</td>
<td>127</td>
<td>163</td>
<td>186</td>
<td>191</td>
</tr>
<tr>
<td><strong>Io (Iom)</strong></td>
<td>555</td>
<td>564</td>
<td>559</td>
<td>444</td>
<td>413</td>
<td>176</td>
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<td>339</td>
<td>581</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Summer</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pp / Tp</strong></td>
<td>3390 / 606</td>
<td>1730 / 480</td>
<td>220 / 326</td>
<td>1960 / 540</td>
</tr>
<tr>
<td><strong>Io (Iosm)</strong></td>
<td>5.594</td>
<td>3.604</td>
<td>0.675</td>
<td>3.630</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semesters</th>
<th>December-May</th>
<th>June-November</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pp / Tp</strong></td>
<td>5120 / 1086</td>
<td>2180 / 866</td>
</tr>
<tr>
<td><strong>Io (Iosm)</strong></td>
<td>4.715</td>
<td>2.517</td>
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</tbody>
</table>

### JOHANNESBURG CITY (SOUTH AFRICA)

**Latitude:** 26°13’S  **Longitude:** 28°4’E  **Altitude:** 1707 m

**Aridity Value Index (AVI)**

**[10xPP/TP=IO]:** 7300/1952=3.74  **There is No Yearly Aridity**

<table>
<thead>
<tr>
<th>Months</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pp</strong> [P*10]</td>
<td>1110</td>
<td>1150</td>
<td>1130</td>
<td>840</td>
<td>660</td>
<td>230</td>
<td>90</td>
<td>80</td>
<td>50</td>
<td>220</td>
<td>630</td>
<td>1110</td>
</tr>
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<td>202</td>
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<td>1730 / 480</td>
<td>220 / 326</td>
<td>1960 / 540</td>
</tr>
<tr>
<td><strong>Io (Iosm)</strong></td>
<td>559</td>
<td>360</td>
<td>67</td>
<td>363</td>
</tr>
</tbody>
</table>

|-------------|---------------------|-----------------------|---------------------|------------------------|------------------------|
JOHANNESBURG CITY (SOUTH AFRICA)
Latitude: 26°13’S   Longitude: 28°4’E   Altitude: 1707 m

BIOCLIMATIC INDICES I

CI of Supan (1884) [Tmax−Tmin] .................(Sp): 10.50
CI of Gorezinski (1920) [1.7*Sp/sin(Lat)+20.4] ....: 20.01
CI of Conrad (1946) [1.7*Sp/sin(Lat+10)+14] ......: 16.21
   + Hyperoceanic (−20<CI<20)
CI of Currey (1974) [CI=Sp/(1+Lat/3)] .............: 1.08
   + Oceanic (0.6<CI<1.1)
Rainfall Index of Lang (1925) [R=P/T] ..............: 44.88
   + Semiarid (60<R>40)
Aridity Index of Martonne (1926) [Ia=P/(T+10)] ...: 27.79
   + Subhumid (30>Ia>20)
I of Emberger (1930) [Q=100*P/(Tmmax²−Tmmin²)] ...: 106.40
   + Humid (Q>90)
I of Dantin & Revenga (1940) [DR=100*T/P] ........: 2.23
   + Semiarid (3>DR>2)
Aridity Index of UNEP [I=P/PE] ....................: 0.93
   + Humid (I>0.65)
Potencial Erosion I of Fournier (1960) [K=Pi²/P] ...: 18.12
   + Very low (K<60)

JOHANNESBURG CITY (SOUTH AFRICA)
Latitude: 26°13’S   Longitude: 28°4’E   Altitude: 1707 m

BIOCLIMATIC INDICES II

Bioclimatic classification of Gaussen & Bagnouls (1957)
   + Climate ......: A. Warm and temperate warm
   + Region ......: 3. Termoxeroteric (Mediterranean warm)
   + Thermic type: 3. Macro−mesothermic

Thornthwaite (1948)

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>P−E ratio</td>
<td>0.48</td>
<td>0.47</td>
<td>0.35</td>
<td>0.29</td>
<td>0.10</td>
<td>0.04</td>
<td>0.03</td>
<td>0.02</td>
<td>0.09</td>
<td>0.26</td>
<td>0.48</td>
</tr>
<tr>
<td>T−E ratio</td>
<td>9.18</td>
<td>9.09</td>
<td>8.50</td>
<td>7.20</td>
<td>5.90</td>
<td>4.45</td>
<td>4.50</td>
<td>5.71</td>
<td>7.33</td>
<td>8.37</td>
<td>8.60</td>
</tr>
</tbody>
</table>

Precipitation-effectiveness: 30.82  Temperature-efficiency ....: 87.84

Moisture Index [MI=100*(P−PE)/PE] ......................: -6.88
   + CI.Subhumid dry (-33.3<MI<0)
Index of dryness [DI=100*d/PE] ....................: 6.88
   + No deficit (0<DI<16.7)
Index of humidity [HI=100*s/PE] ....................: 0.00
   + No surplus (0<HI<10)
Potential Evapotranspiration PE ....................: 783.92
   + Second mesothermic (712<PE<855)