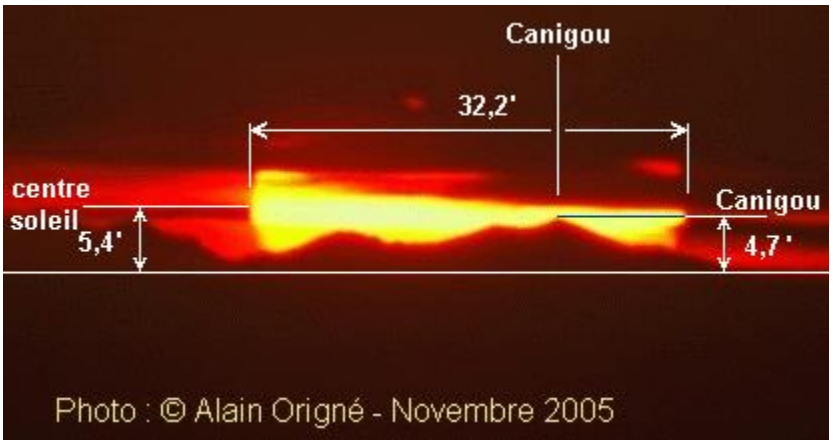
A SPECTACULAR CANIGOU SUNSET



This superb Canigou Sunset Picture taken from Allauch on Nov 1st 2005 was subsequently published on this very interesting dedicated site (*http://canigou.allauch.free.fr/Refract_atm.htm*) covering a number of aspects related to such events.

This document analyses all the environment of this Picture. Special attention is devoted to the nearby Canigou Atmospheric Refraction and to the far-away Sun Astronomical Refraction, both showing up at very low heights. In particular, being ***under the Observer's Astronomical Horizon*** the Sun needs special care to check whether it reasonably fits to the standard Astronomical Refraction estimates applicable to such low heights.

Although its Refraction numerical results significantly depart from the ones obtained through the "Standard Atmosphere" usual computations (namely: Horizon Dip, Atmospheric Elevation and Sun Refraction) this Author's document is quite interesting.

1 - ***WGS84 Ellipsoid* data, 3D computations. The "Astronomical Horizon" (AH) is perpendicular to the Local Vertical.**

1.1 - ***Allauch Notre Dame du Château***: N43°20'12"/E005°29'10", AMSL+310m, EGM08+48.9m, WGS84+360m
1.2 - ***Pic du Canigou***: N42°31'08" / E002°27'24", AMSL+2,784m, EGM08+52.2m, WGS84+2,836m
1.3 - From 1.1 and 1.2 we get for the ***unrefracted straight line between Allauch (A) and Canigou (C)***:
1.3.1 - Straight-in Distance ***D = 142.3 NM***, Departure Azimuth **250.86595°**, ***Canigou height -38.62' under AH.***
Ellipsoid radius at ***Allauch* 6385.770 km** and Geometrical ***Unrefracted Horizon Dip: UHD = -33.87' under AH.***
1.3.2 - ***UHD*** Refraction of the Horizon: 33.87 * 0.08 = 2.71', hence ***Refracted Horizon Dip = -31.16' under AH.***
1.3.3 - **Atmospheric Vertical elevation *Ve*** from ***Allauch (A)*** to ***Pic du Canigou (C)***: ***Ve = D* (0.18/2) = +12.80'**
Hence ***Refracted (C)*** is at -38.62' + 12.80 = ***-25.82' under AH.***
Hence ***Refracted (C)* 5.34' above the Allauch Refracted Maritime Horizon (RMH)**.

2 - **Astronomical data from *VSOP09A*, *IAU 2006 (P03)* Precession and *IAU 2000A* Nutation**

2.1 - Since it shows at 0.7' height above ***Refracted (C)*** the ***Refracted Sun is at -25.12' under the Local Horizon***.
Since it shows 6.4' left of ***Refracted (C)*** the ***Refracted Sun Azimuth is at 250.76°***.
2.2 - Astronomical data then indicate that:
At *UT = 16h30m52.0s*, Sun geocentric/topocentric height at -1°03.14' / -1°03.29' with Azimuth at 250.76°.
2.3 - From 2.1 and 2.2, with 63.29'-25.12' = 38.17' , the ***Sun Center observed Refraction is at -38.2'***

3 - **On-site Weather data from *https://weatherspark.com/* for Nov 1st, 2005 16h30m UT**

3.1 - At the sea-level ***Marseille Airport (LFML / MRS)*** for that evening: QNH 1020 mb, Temp = +18.3 °C
3.2 - For nearby ***Allauch*** (310 m MSL), we retain: **P = QFE = 983 mb, Θ = +16°C**.

4 - Computation of the Sun Refraction (*Sun Center height at -25.12' below the Local Horizon*)

4.1 - We should remember that the ***Standard Refraction Tables*** dispersion is close to 1' at the Horizon. For h=0° and 1013.25mb/10°C the ***1981 Éphémérides Nautiques (EN)*** indicate ***-33.8'*** while the ***1983 NAL*** gives ***-34.6'*** .

4.2 - The refraction **Daily Correction Factor (DCF) "μ"** is equal to **$(P/P_o)*(273+T_o)/(273+\Theta)$.** Hence for both **EN** and **NAL**: *(983/1010)*(283/289) =* μ *=0.953*. With h = -25.12' the ***Augmented Standard Refraction Tables*** yield:

- For the ***NAL***: ***R'_a(NAL) = -38.0' +/- 2', a difference of 0.2' with the observed value at -38'2.***
- For the ***EN*** : ***R'_a(EN) = -36.8' +/-2', a difference of 1.4' with the observed value at -38.2'*.**

NOTE 1 - From 310 m MSL we have [far] exceeded any practical limit to observe a crisp refracted maritime horizon. The ***Pic du Canigou*** refracted summit had to be used as a relay. ***Alternately a vertical theodolite could have been and still could be used***.

NOTE 2 - While our no-Refraction geometrical computations all agree *we observe some* ***significant differences*** between the initial document http://canigou.allauch.free.fr/Refract_atm.htm *and our results here-above*, with the most important ones being:
(2a) *Refracted horizon dip*: for an Altitude of 310m we compute -31.16' (*1.77* $\sqrt{h}m$) while the Author seems to use -33.1'.
(2b) *Sun Refraction (True Sun - Refracted Sun)*: we observe -38.2' while the Author seems to observe -33.1'.
(2c) *Pic du Canigou Vertical Elevation due to the Atmospheric Refraction*: we compute +12.8' while the Author uses +7.5'.
Our "(2c/2b)" ratio is 0.33. Without some ***careful additional checks*** it seems a bit difficult to fully accept the Author's value at 0.22 as well as his (2a), (2b) and (2c) values here-above. ***Again, a vertical theodolite would be the final judge here.***

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