A new Space Weather Observatory in Tamanrasset

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CRAAG

Centre de Recherche Astronomie Astrophysique et Géophysique

Created in 1980 fusion of two institutions: the Algiers Observatory (1856) and the IMPGA (1930)

- **Three main areas of research**
- **Seismology**
- **Geophysics**
- **Astrophysics**

Astrophysics CRAAG

- Stellar and High Energy Astrophysics Division
  - Asteroseismology
  - High energy Astrophysics
  - Stellar variability
  - Data Analysis
- Solar Physics Division
  - Solar Activity studies
  - Helioseismology
  - Ionospheric research
  - High angular solar resolution


CRAAG
Algiers Observatory

Algiers Observatory

(Historic)

1846 : First observations in Astronomy started in Kouba (Algiers)

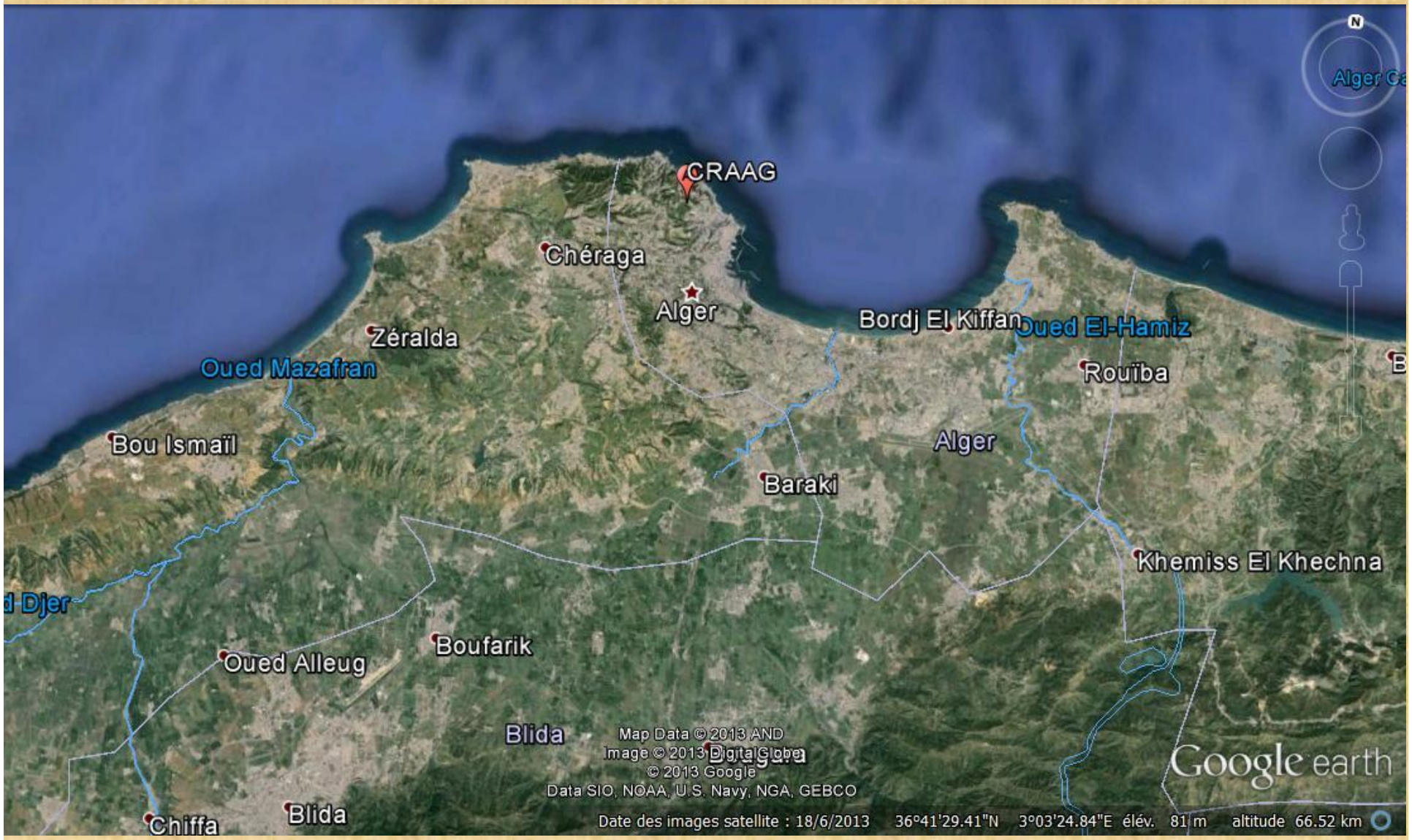
1880: Construction of the Observatory in Bouzareah: Highest point in Algiers

ÅIt is one of the first Observatory in the African continent

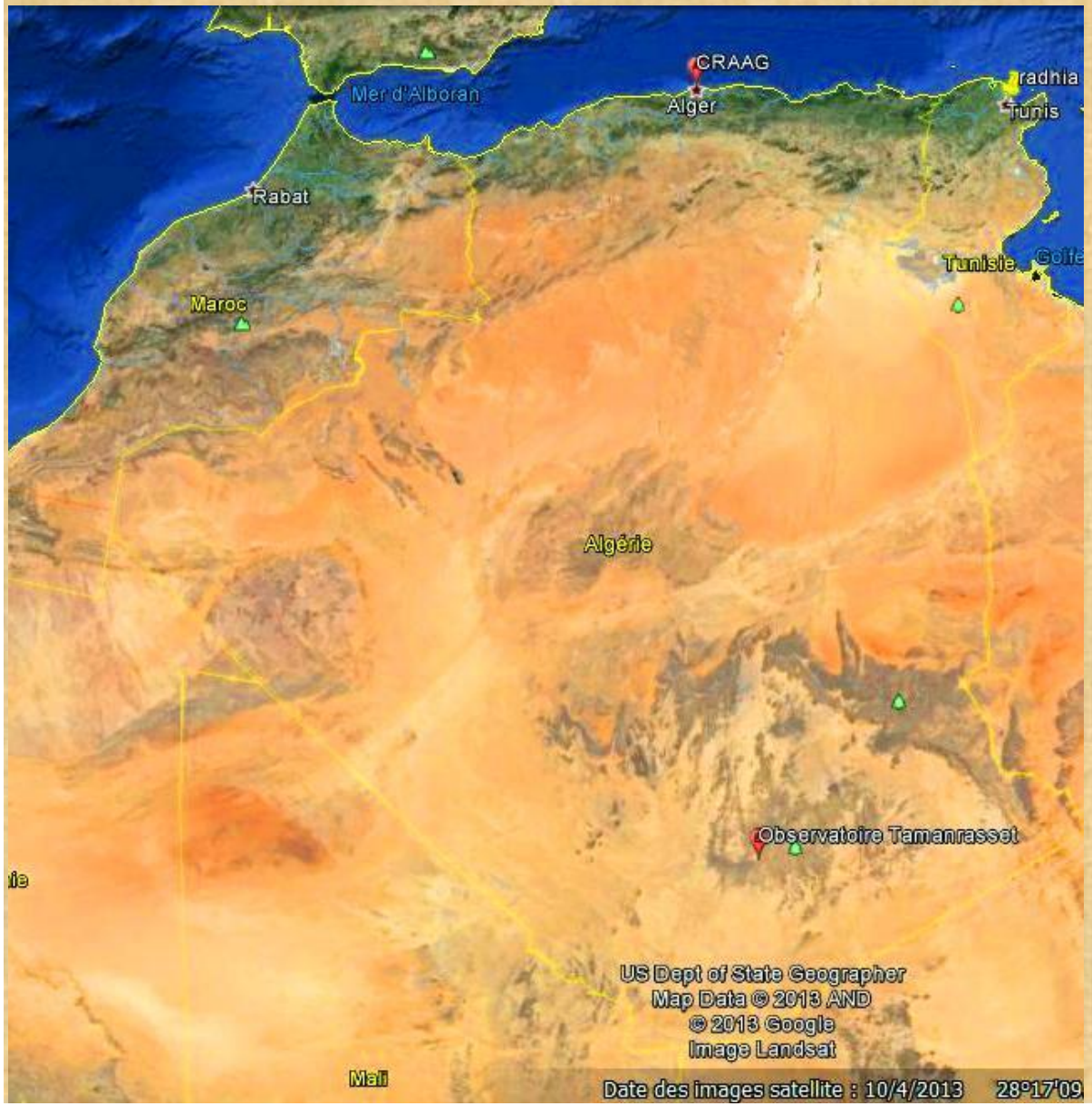
ÅFour instruments :

1. **La lunette méridienne de Gautier**
2. **La Lunette Coudé de Loewy**
3. **LôAstrographe de Gautier**
4. **Le télescope de Foucault**

Algiers Observatory



Research Unit In Tamanrasset



Algeria: 16 in superficies

Algeria =3,7 France

Alger
Tamanrasset=2000Km
Alger Mali =2400Km

Space Weather in Algeria

Thru the ISWI (International Space Weather Initiative) the CRAAG participate to several research programs:

1. **AMBER**: One magnetic station in Medea (100 km south of Algiers)
2. **AWESOME**: One VLF station near Algiers
3. **INTERMAGNET**: One magnetic station in Tamanrasset (1900 Km south of Algiers)
4. **GPS_Africa**: one GPS station International GNSS Service in Tamanrasset

Tamanrasset host also a long range seismic station through the GEOSCOPE program

Scientific Needs

- Complete ignorance of ionospheric conditions in southern Algeria
- Very few data
- Proximity to the equatorial electrojet

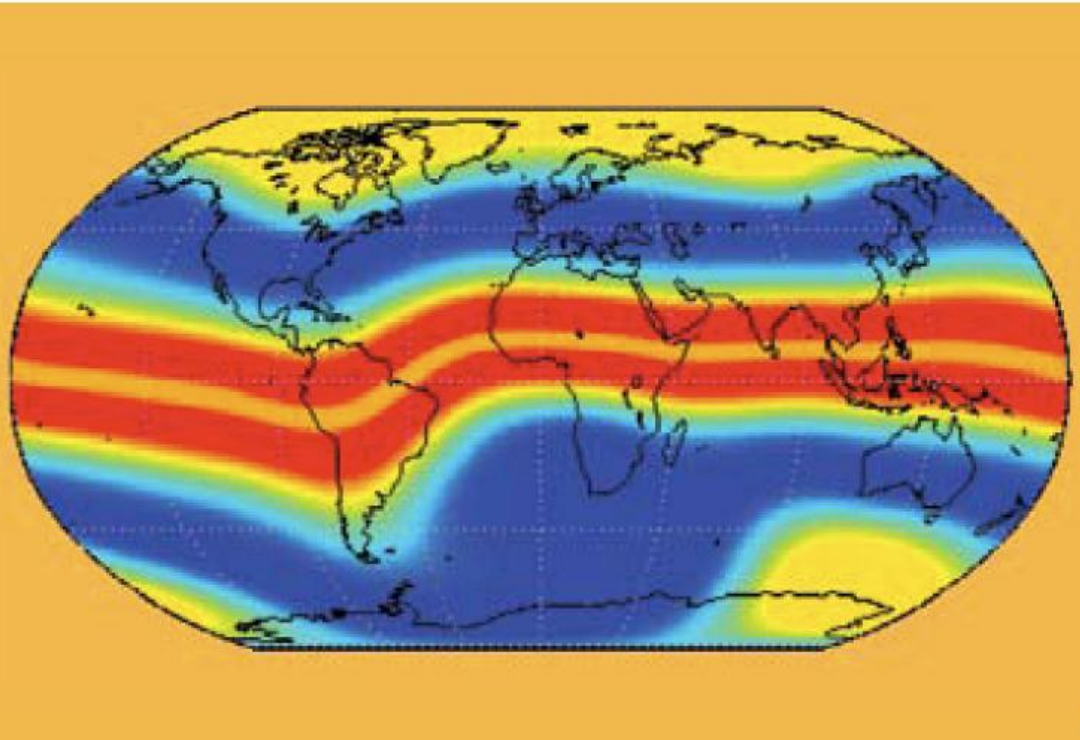


FIGURE 1 Scintillation map showing the frequency of disturbances at solar maximum. Scintillation is most intense and most frequent in two bands surrounding the magnetic equator, up to 100 days per year. At poleward latitudes, it is less frequent and it is least frequent at mid-latitude, a few to ten days per year.

Inside GNSS January 2009

New Space Weather station in Tamanrasset

We have decide to install different instruments to follow up the activity of the sun as well as the ionosphere:

- Flare patrol telescope
- 10.7cm Radio Flux monitor.
- Radio spectrometer
- Digital Ionosonde
- TEC and scintillation Monitors
- VLF receiver

These instruments will complete the other instruments already in place. The data will be completed with satellite data

Flare Patrol Telescope

Three solar telescopes of the CHAIN project

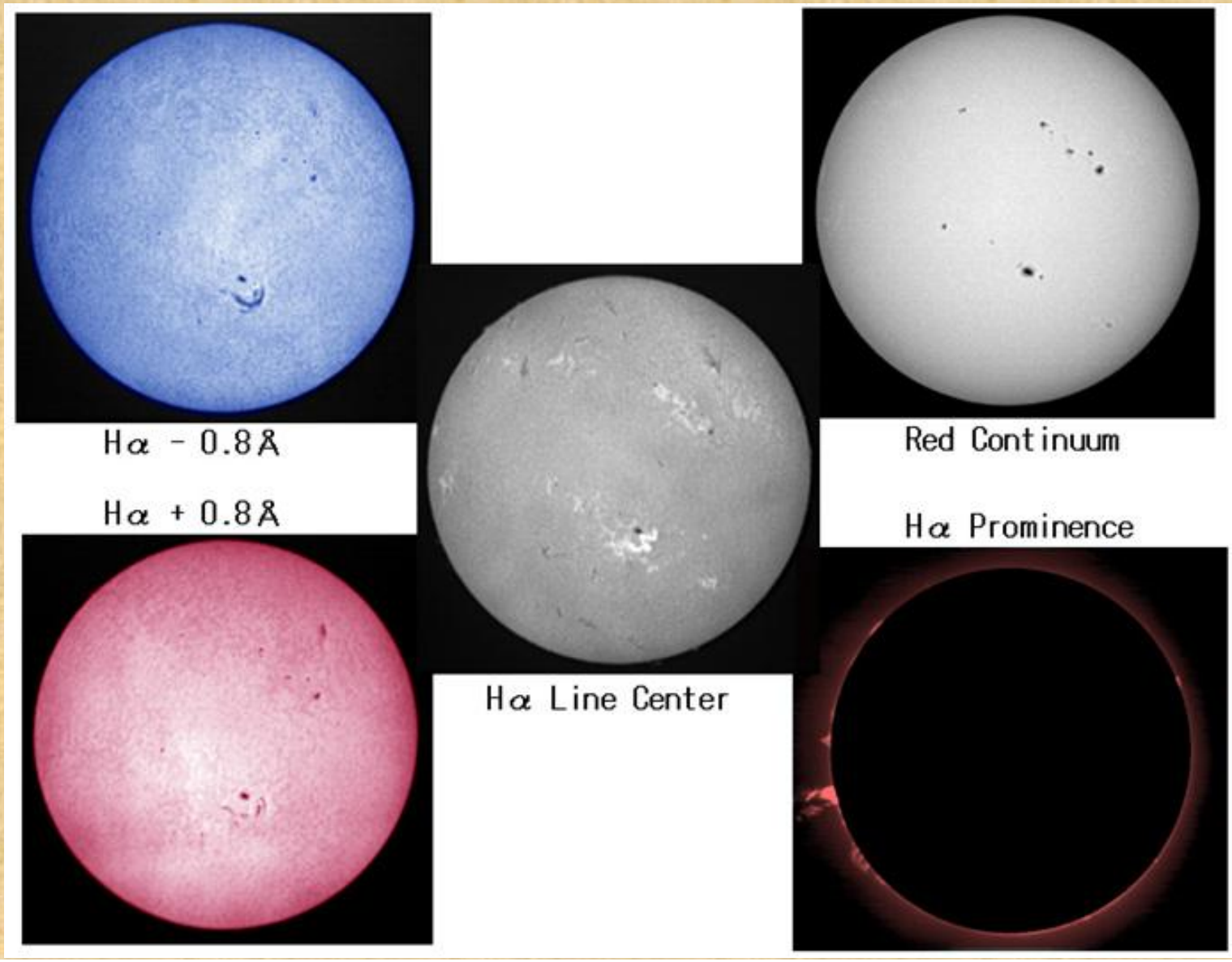
"SMART" at Hida Obs. (Japan)

"FMT" at National Ica Univ. (Peru)

"FMT" at King Saud Univ. (Saudi Arabia)

- Similar to the FMT Hida Observatory in Japan (in 1992, Peru in 2009, Saudi Arabia)
- Multiple refractors to observe the full disk sun at different wavelengths around H-alpha absorption line and in different modes
- 1 arsec resolution with high rate of acquisition.
- Synoptic observations and the three-dimensional velocity field of moving features.

FMT Sample



Flare Patrol Telescope

Specifications:

3 Refractors D 10mm, F:1600mm	Ha	6562.8/0.3 A
	Ha -0.8 A	6562.0/0.3 Å
	Ha +0.8 A	6563.6/0.3 Å
1 Refractor + Filter Wheel D 10mm, F:1600mm	Continuum	6100.0/60 Å
	Calcium II K line	3933.0/2.0 Å
	Helium D3	5875.6 /0.4 Å
	H Alpha	6562.8/0.8 Å
1 Refractor 2xfocals	H alpha	6562.8/0.3 Å
Tracking telescope		

CDD Cameras

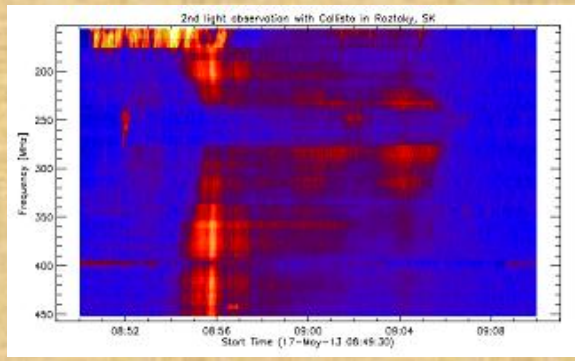
Resolution 4 MPix 12bit

A frame rate of 7 frames/sec:

- Frame selection
- Record a flare event

Others instruments

1. **10.7cm Radio Flux monitor.**
   Measure 10.7cm radio flux (synoptic)
2. **Radio spectrometer**: diagnostics of solar activity, such as solar flares and CMEs, instrument type CALISTO
3. **Digital Ionosonde**: with 4 receivers: capability to measure ionospheric Doppler drift.
4. **TEC and scintillation Monitors** measure of the TEC and the scintillation of the GPS signal with network of GPS
5. **VLF receiver**: measurement of the D layer of the Ionosphere.



F10.7 CM RADIO EMISSIONS

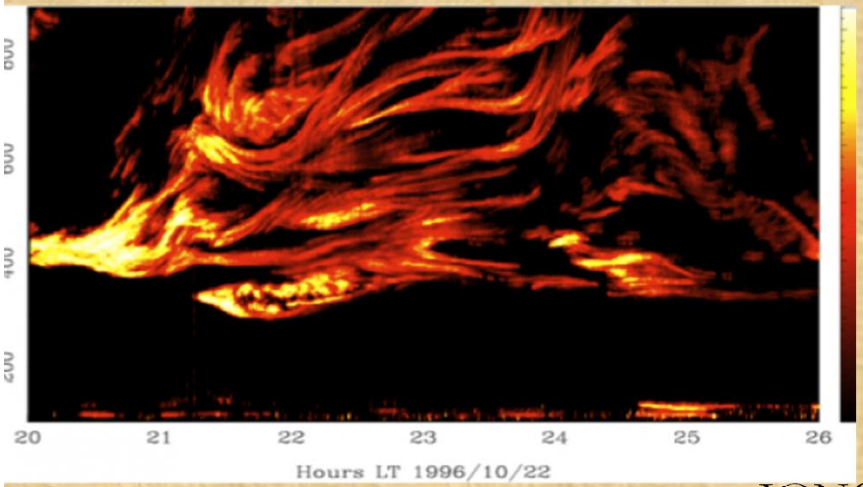
F10.7 CM RADIO EMISSIONS

The solar radio flux at 10.7 cm (2800 MHz) is an excellent indicator of solar activity The F10.7 correlates well with the sunspot number as well as a number of UltraViolet (UV) and visible solar irradiance records.

The F10.7 has been measured consistently since 1947, first at Ottawa, and then at the Penticton Radio Observatory in British Columbia.

Reported in “solar flux units”, (s.f.u.), the F10.7 can vary from below 50 s.f.u., to above 300 s.f.u., over the course of a solar cycle.

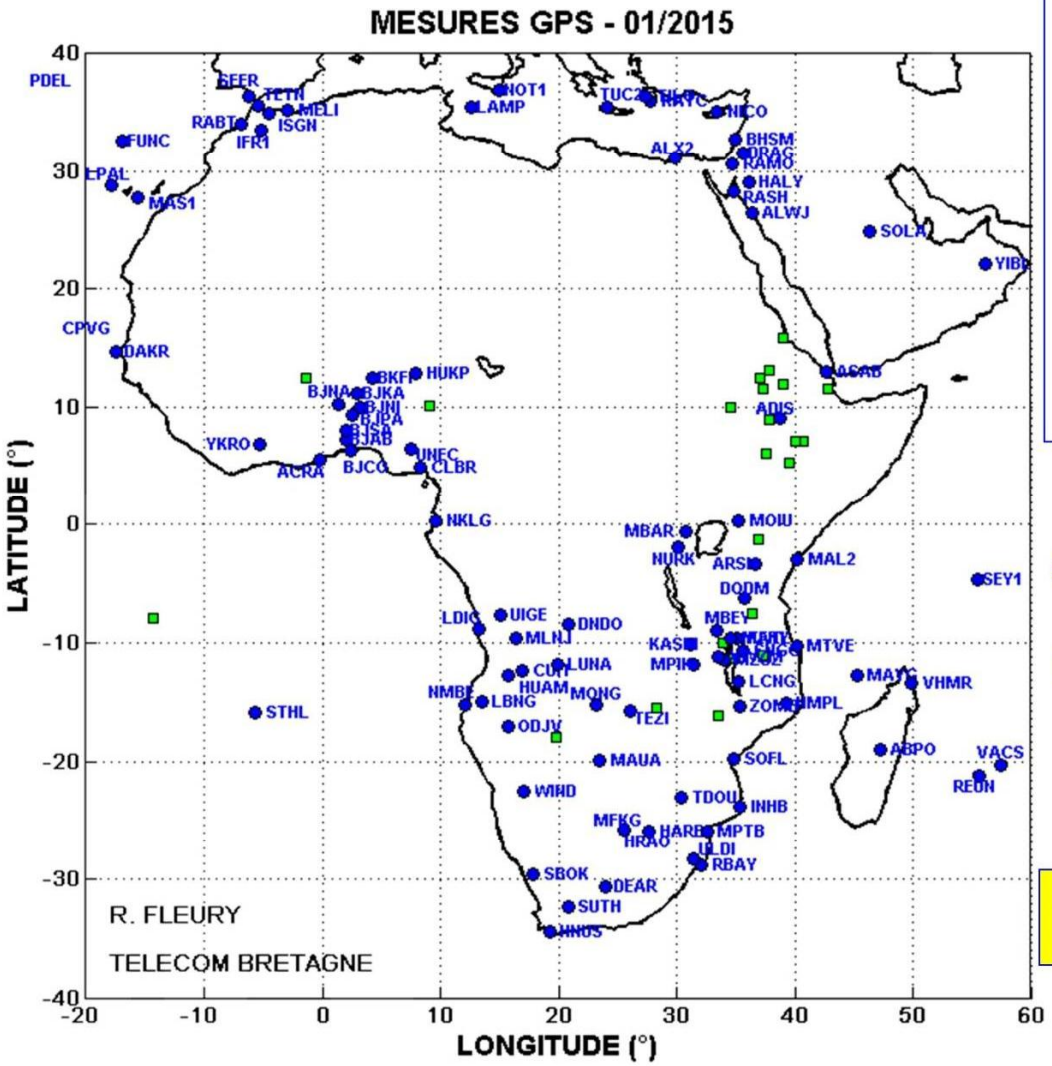
IONOSPHERIC SCINTILLATION



IONOSPHERIC SCINTILLATION

Ionospheric scintillation is the rapid modification of radio waves caused by small scale structures in the ionosphere. Severe scintillation conditions can prevent a GPS receiver from locking on to the signal and can make it impossible to calculate a position. Less severe scintillation conditions can reduce the accuracy and the confidence of positioning results.

GPS stations available on the web-2015



Increase of GNSS stations in Africa

~50 to ~150

2010 to 2015

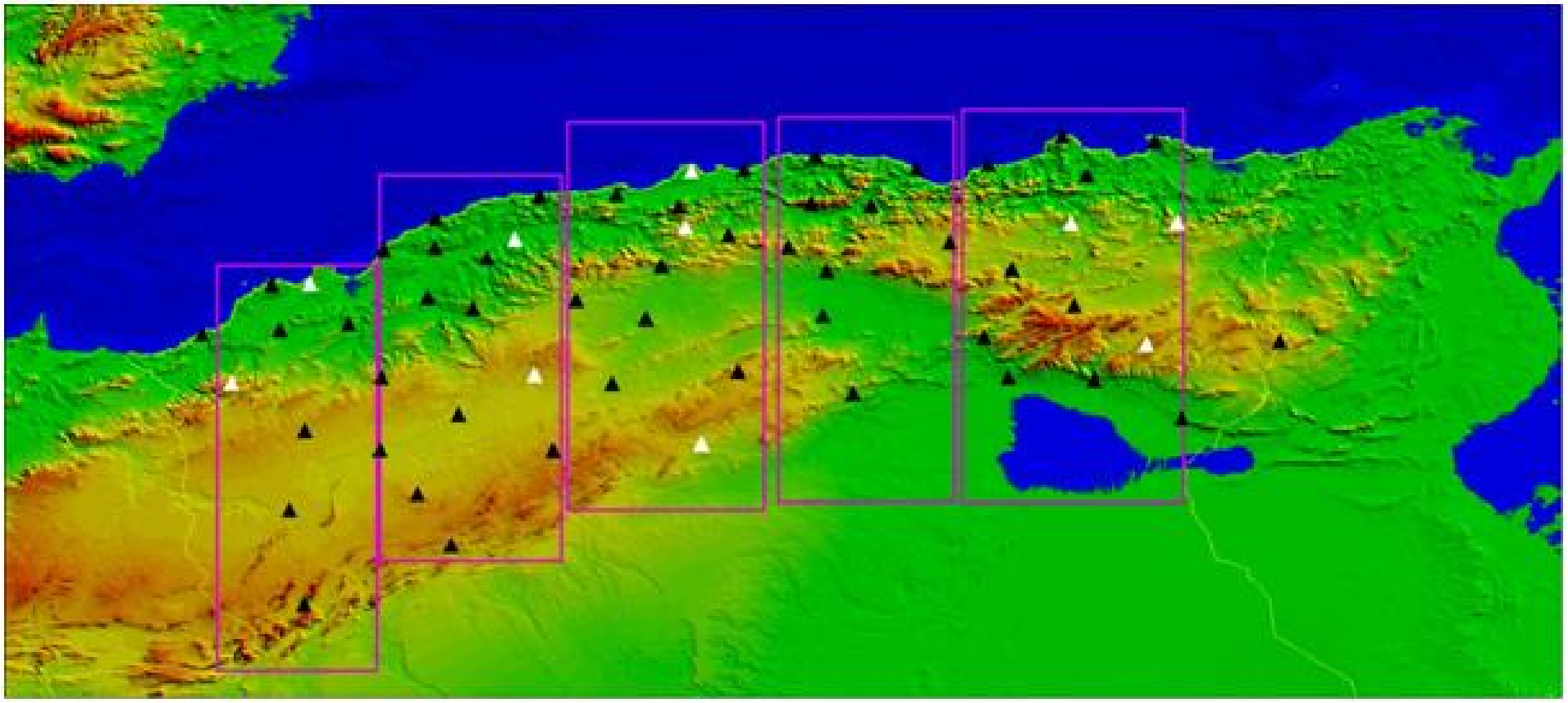
Mainly due to GEODESY

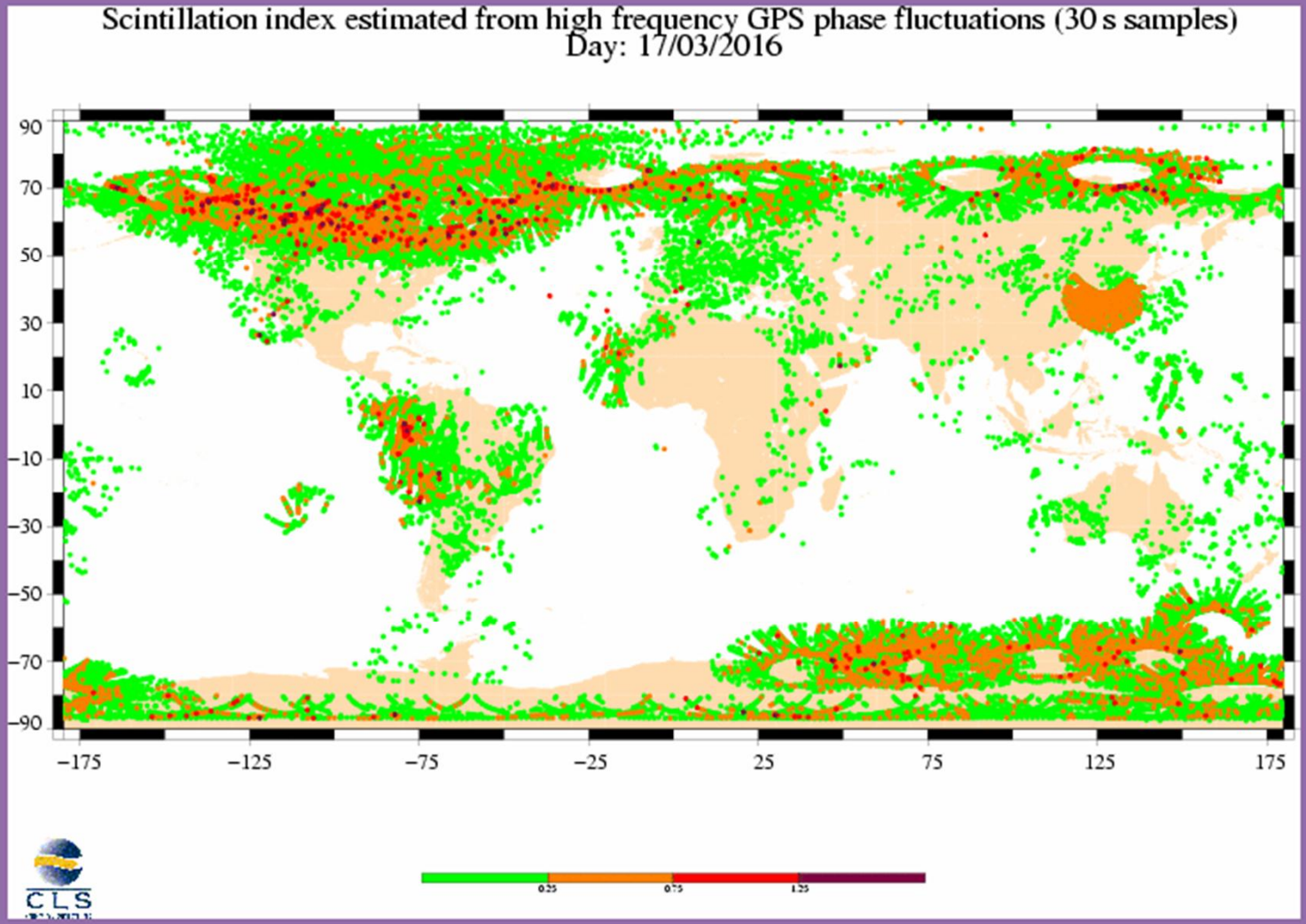
Many other GPS networks
Algeria (~60), Burkina Faso (~10),
Egypt (~ 10), Morocco (~25)
Rwanda(~10), South Africa (~60)
DRC (~15) > 200
=> Work of AGS

Necessity TO SHARE

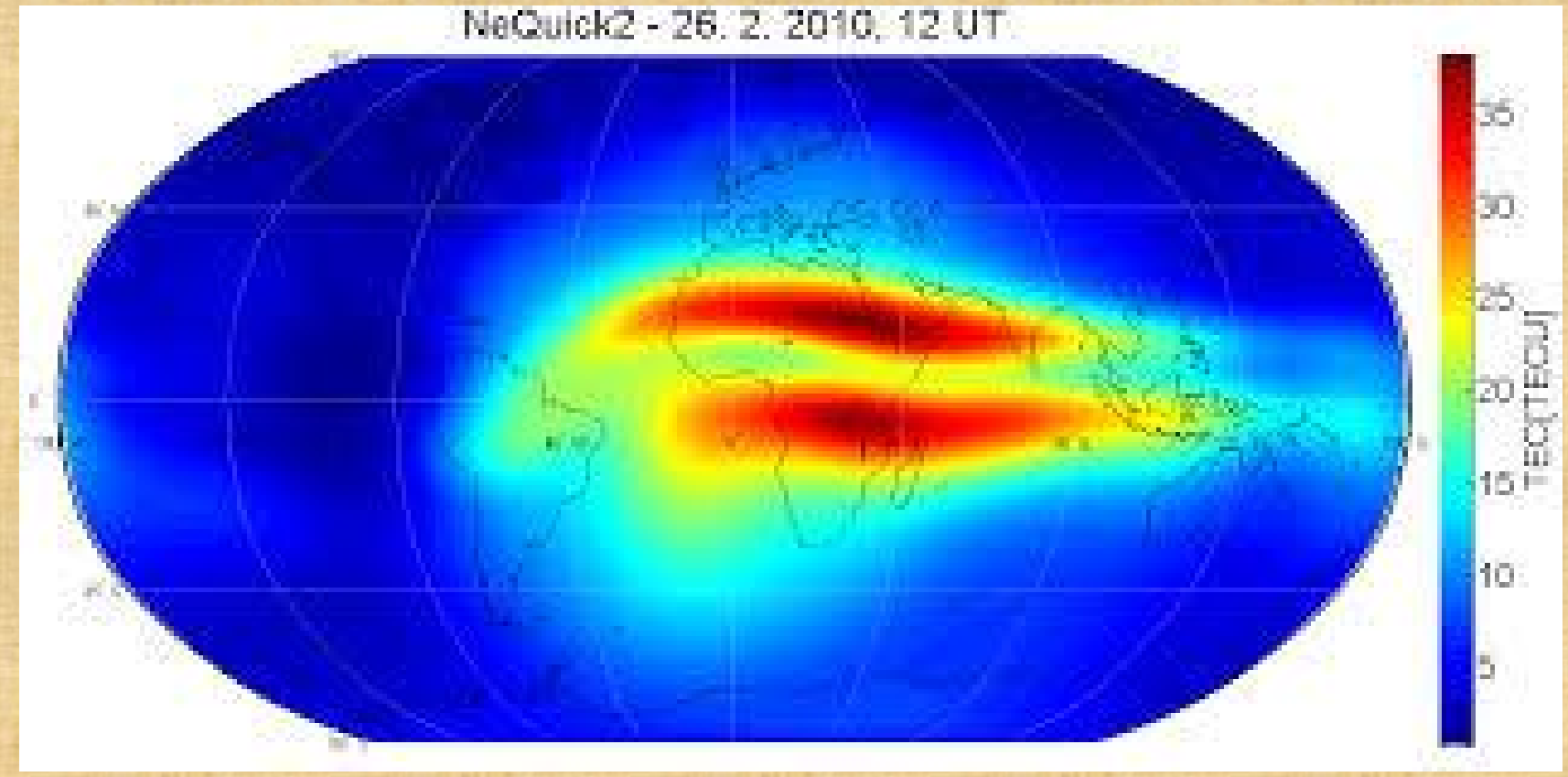
From Amory-Mazaudier
June 2016

Permanent GPS Network : REGAT CRAAG

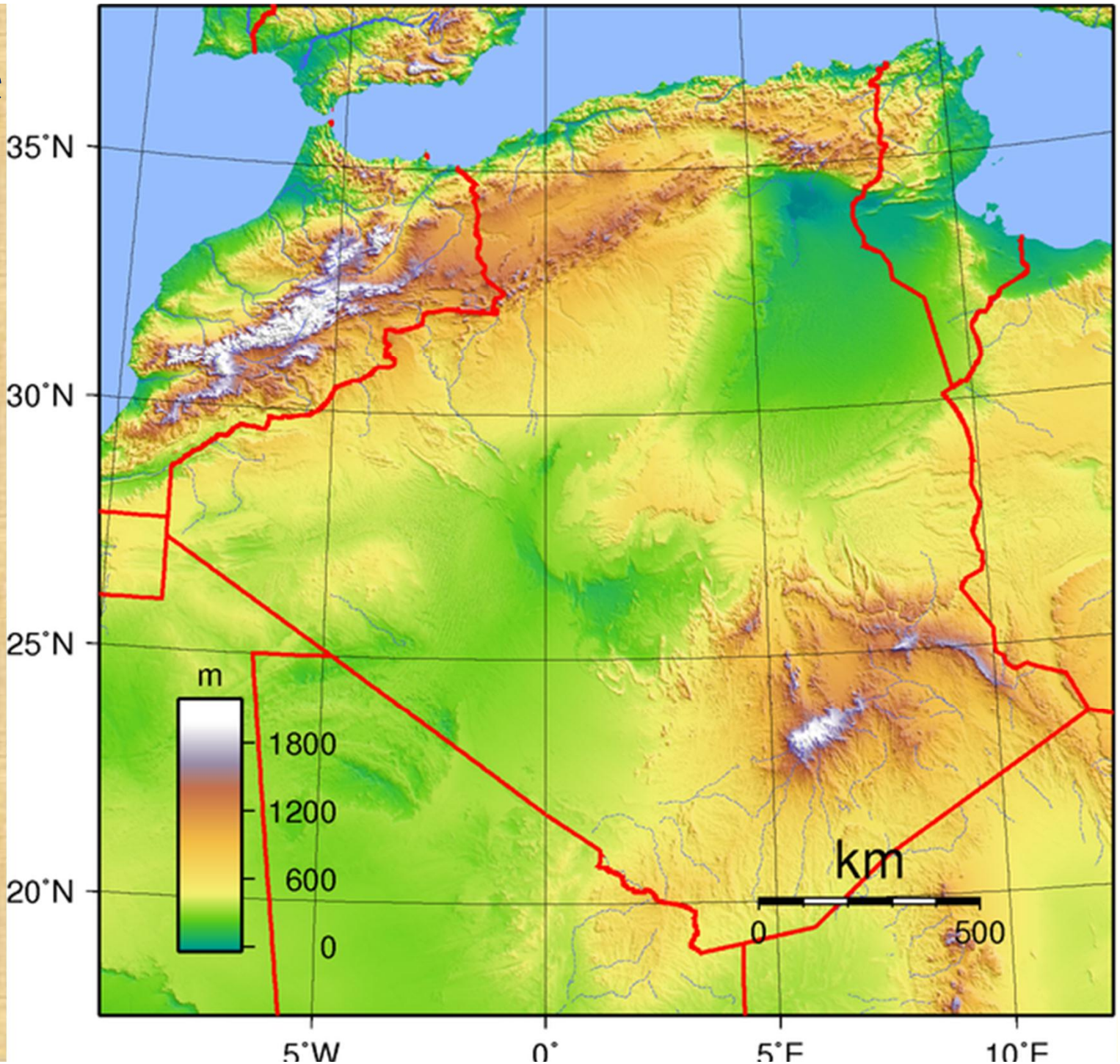


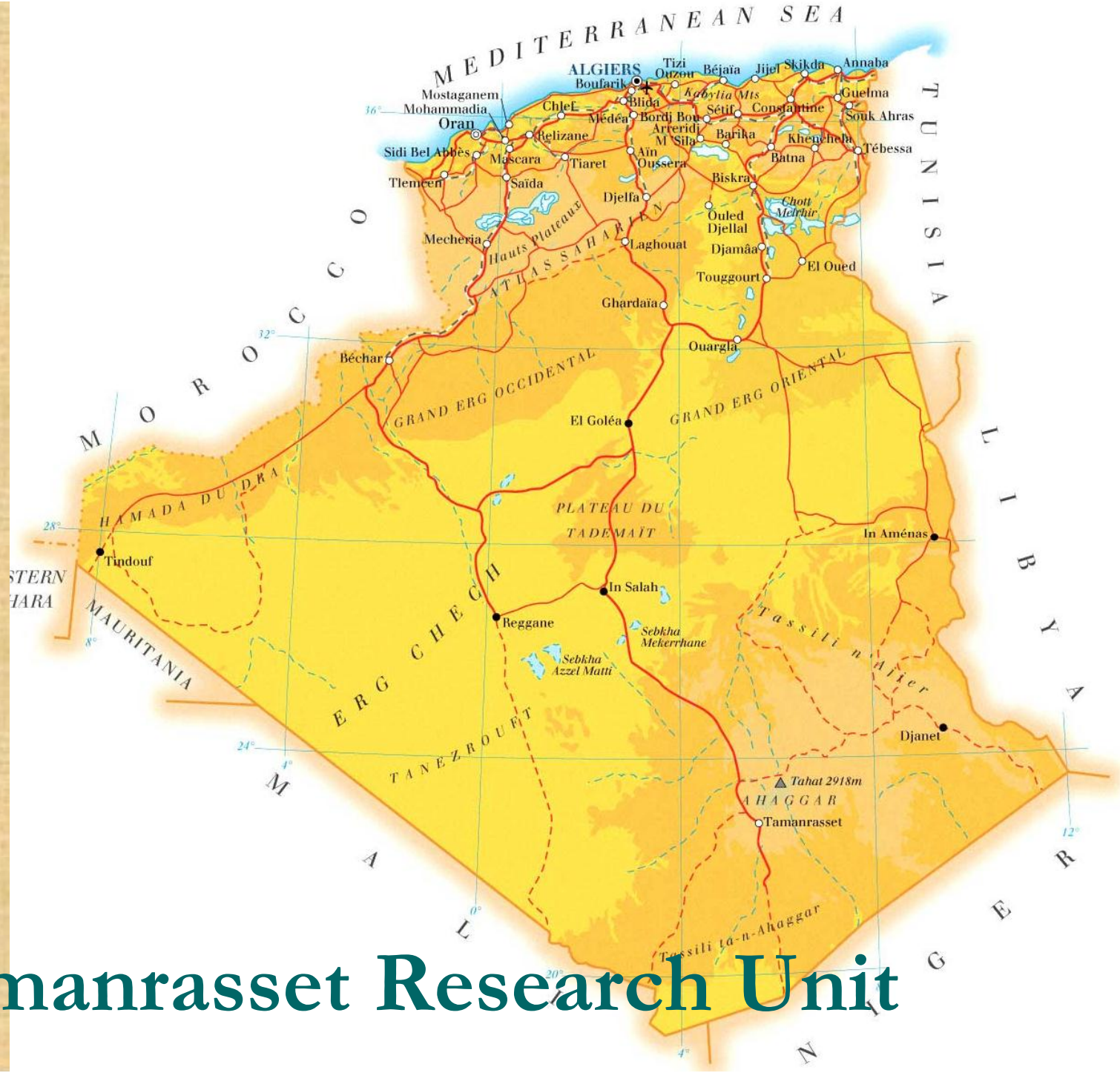

Scintillation index estimated from high frequency GPS phase fluctuations (30 s samples)
Day: 17/03/2016
90
70
50
30
10
−10
−30
−50
−70
−90
−175
−125
−75
−25
25
75
125
175
0.25
0.75
1.25
CLS

Global TEC from GPS



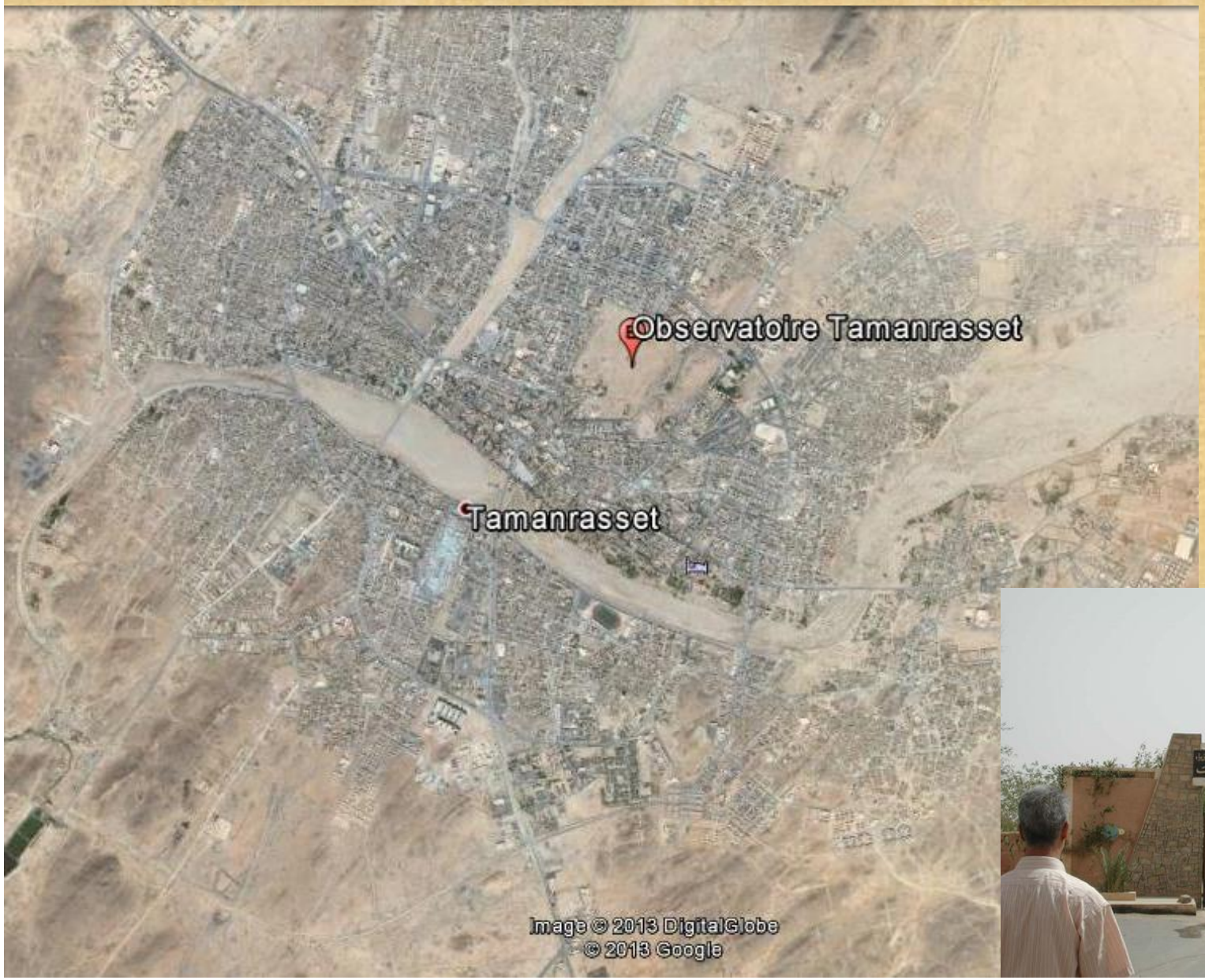
Altitude



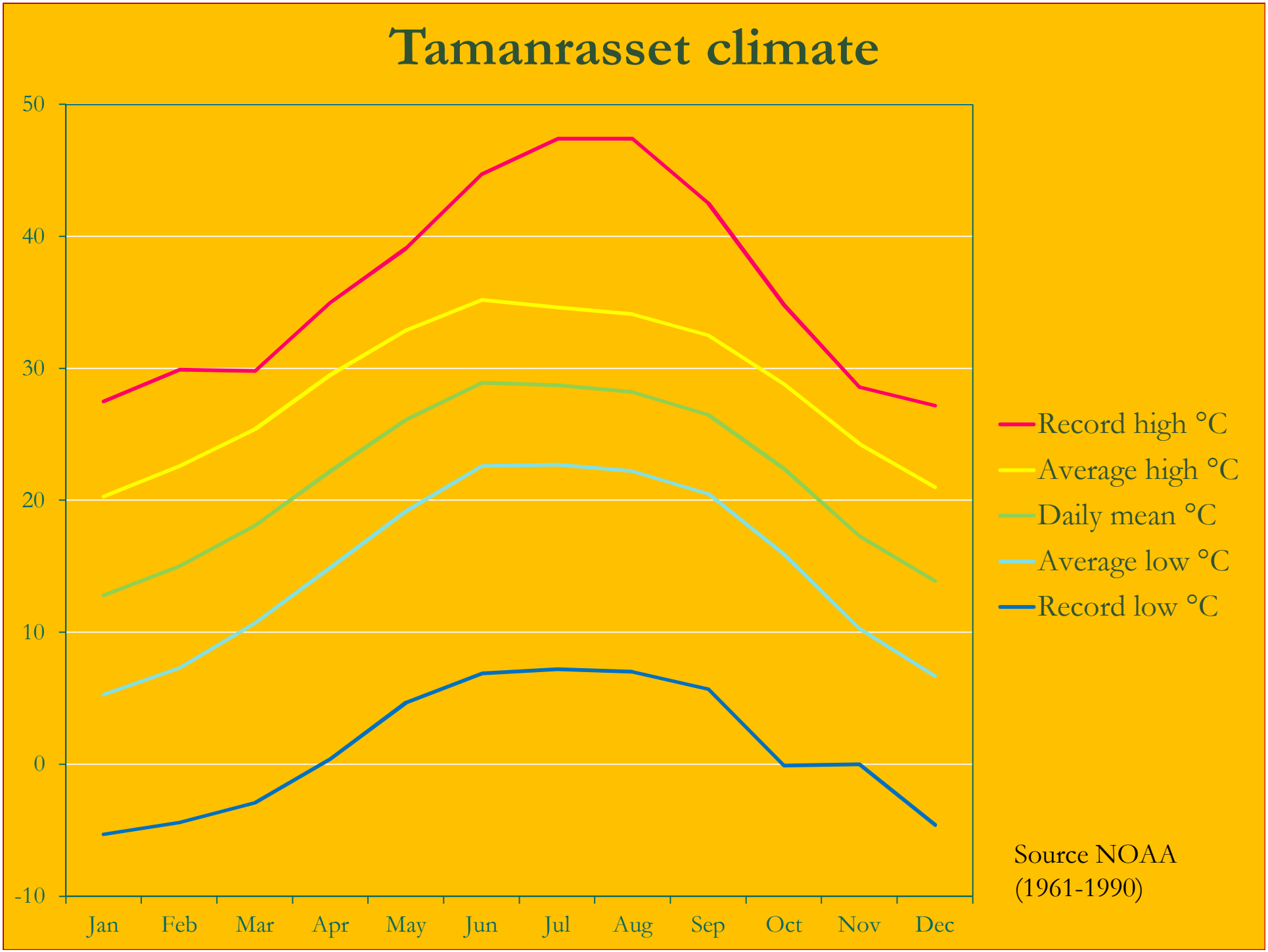


Tamanrasset Research Unit

City of Tamanrasset -CRAAG

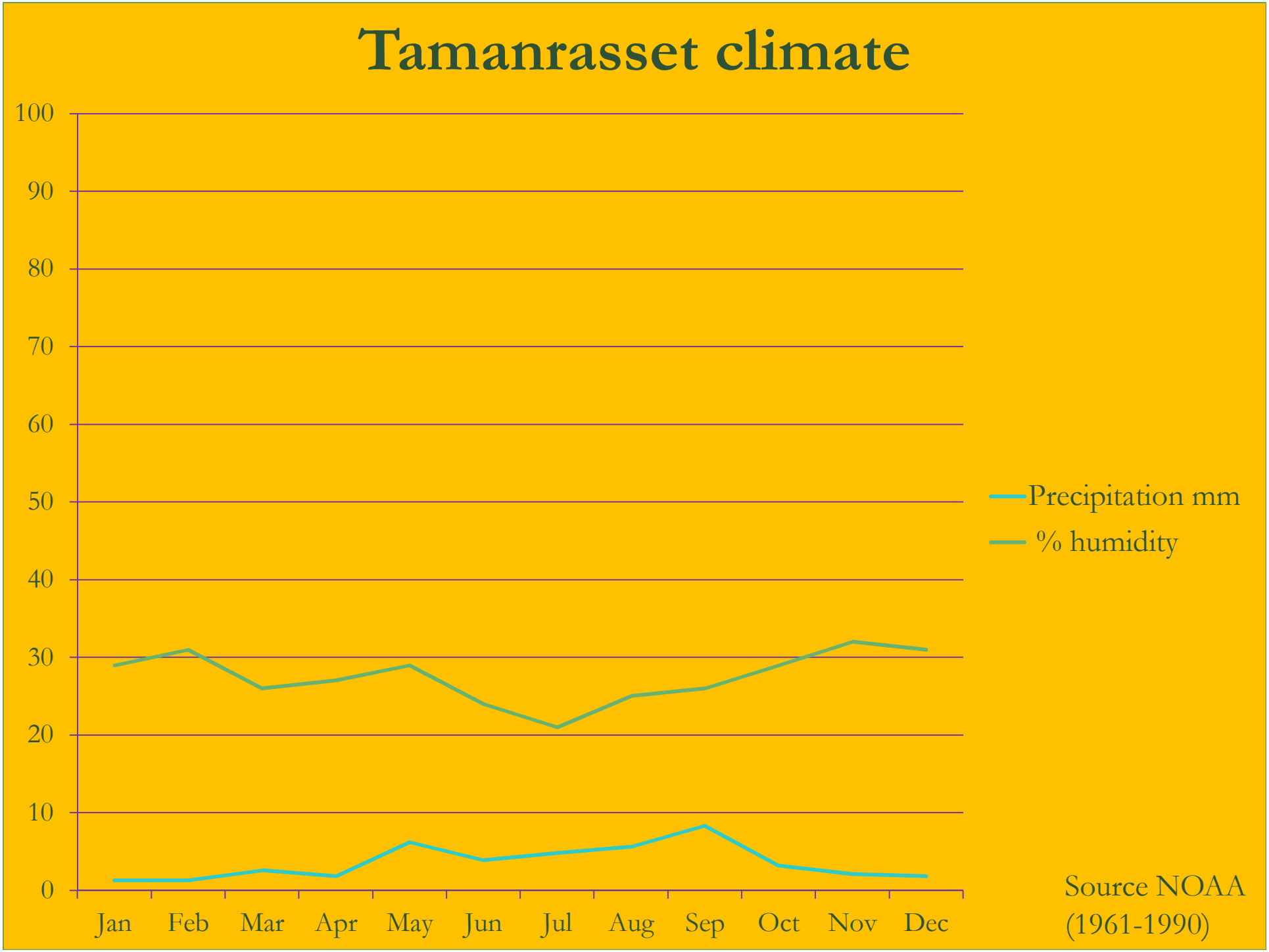


Tamanrasset climate



Source NOAA
(1961-1990)

Tamanrasset climate



Source NOAA
(1961-1990)

New site Assekrem 2.728 m
80 km from Tam

Assekrem

Thank you