

Space Weather in Morocco

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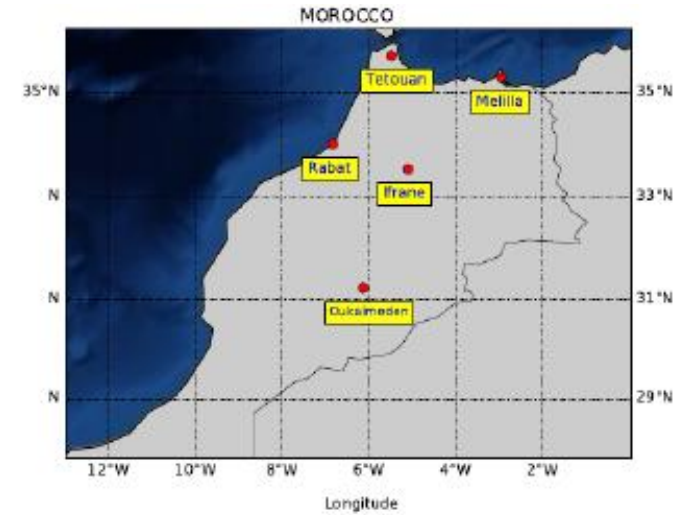
Fabry-Perot interferometer



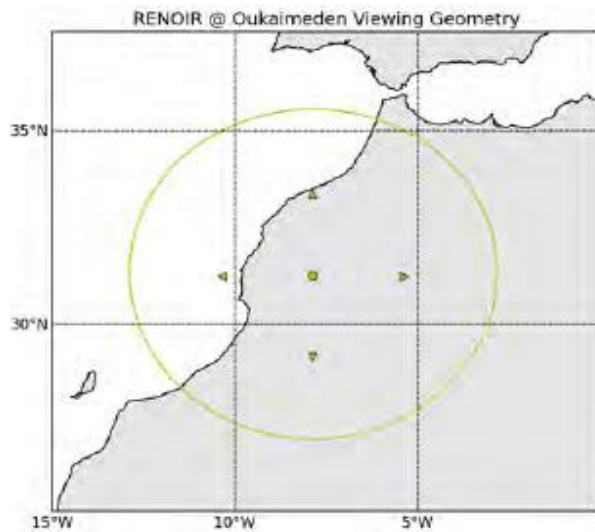
Wide angle Camera



GPS Stations in Morocco



RENOIR Network



<http://airglow.ece.illinois.edu/>

Scientific achievements

- * Measurement of winds, temperature and ionospheric irregularities at 250 km of altitude.
- * Thermospheric winds and temperature establishment; **Climatology, seasonality, solar cycle dependence, effect of geomagnetic storm.**
- * Tidal and gravity wave signatures
- * Climatologies of EPBs over Africa
- * **Response of the thermosphere to geomagnetic storms.**

Other data and facilities

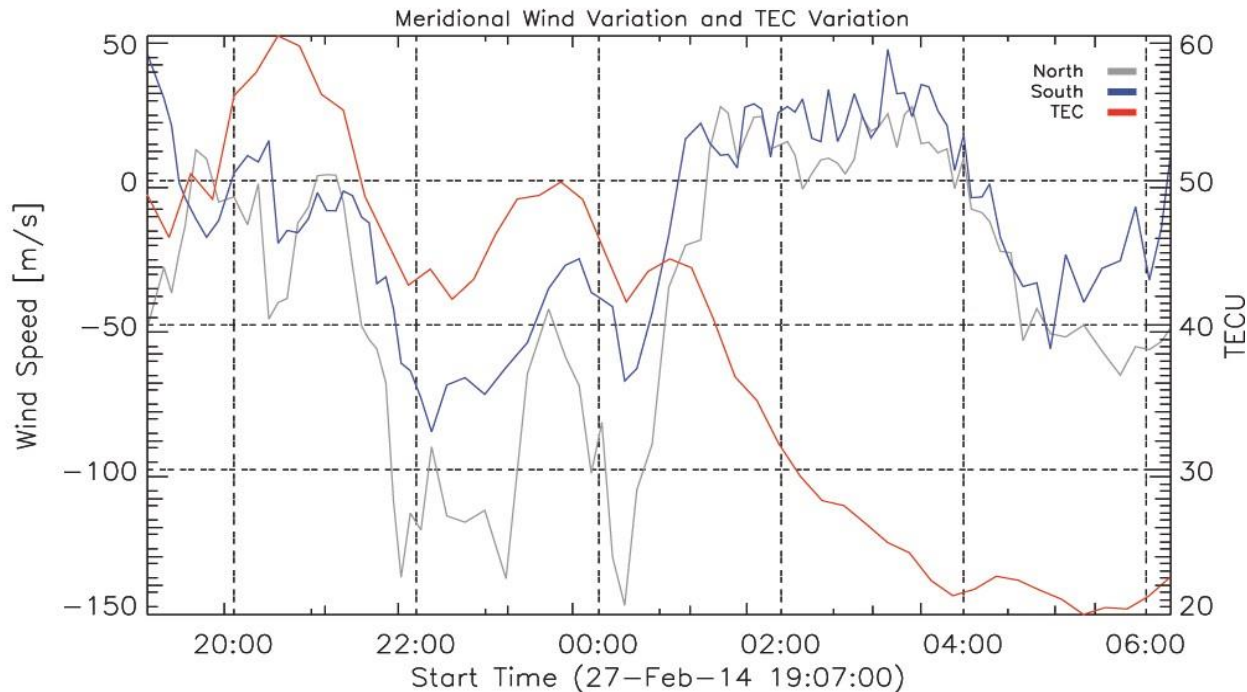
- * Measurements of TEC: GPS station at Oukaimeden, and other stations in Morocco. **Climatology, seasonality, solar cycle dependence, effect of geomagnetic storm.**
- * Use of satellite data, SWARM.
- * Comparison to empirical and physics based models: HWM14, NRLMSIS-00, TIE-GCM and GITM

The RENOIR Network

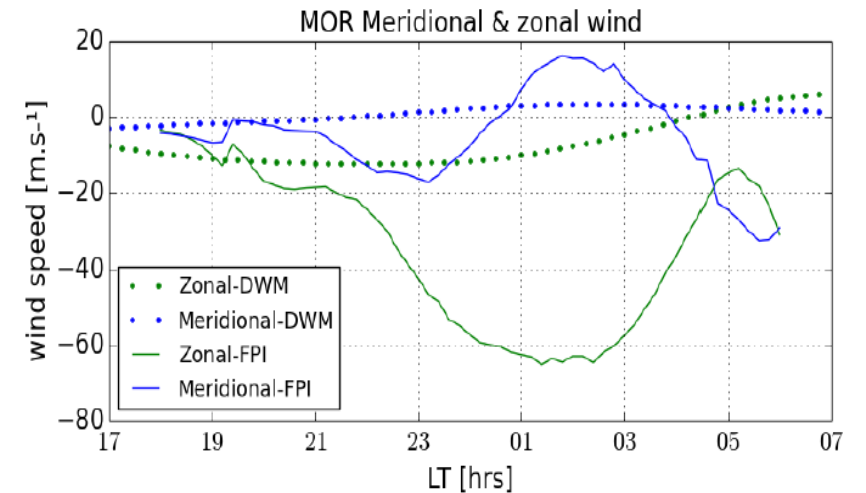
- * Study of latitudinal and longitudinal effects and differences for various phenomena
- * Increased coverage to understand storm-time response.
- * Four FPIs installed in Ethiopia, Nigeria, Ivory Coast and South Africa allowing comparisons within Africa for the first time
- * Added coincident data from satellite observations and GPS measurements.

Scientific achievements; storm time study

Multi-aperture, case of 27 Feb 2014



statistical study



59 % TAD induced circulation.

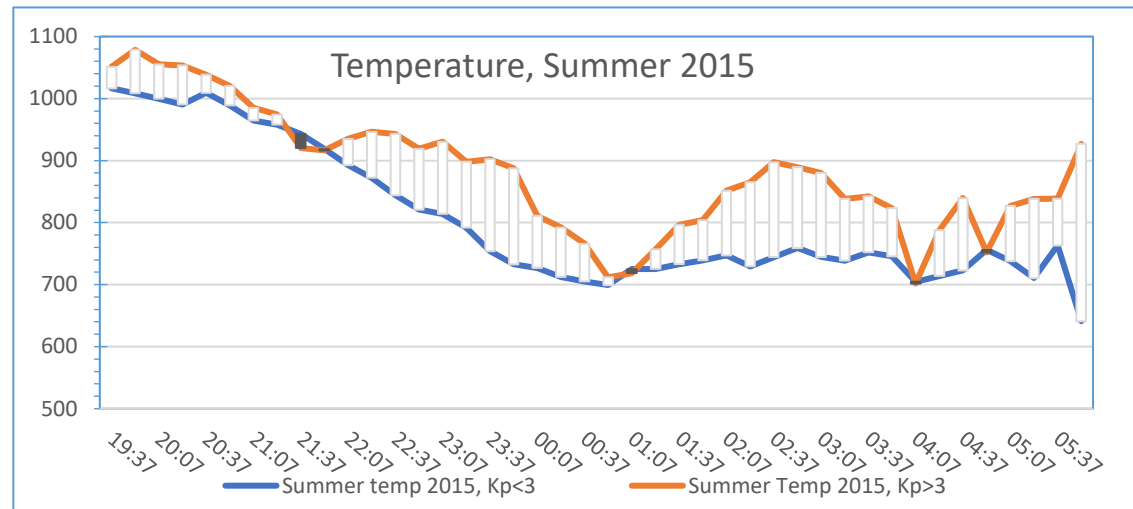
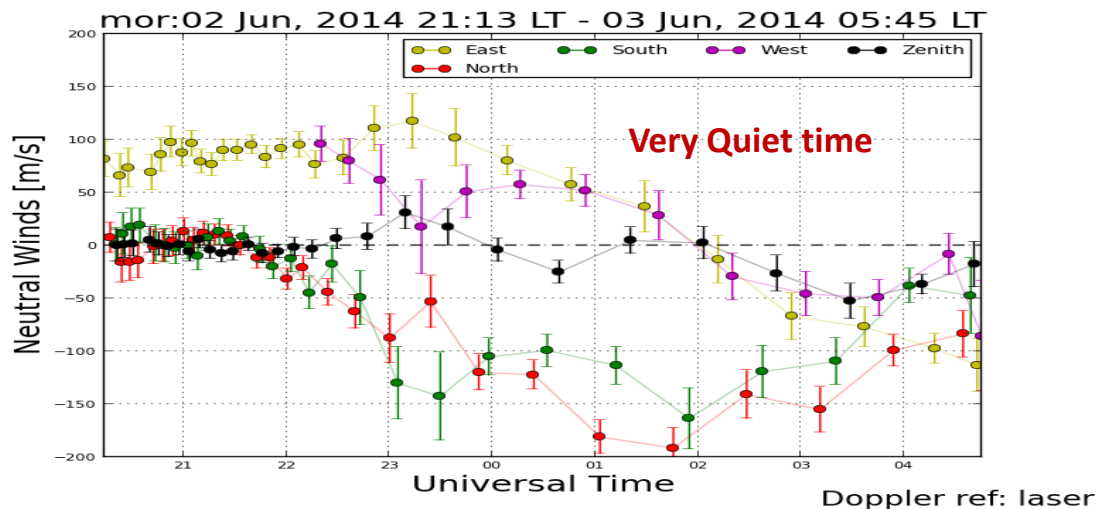
33 % slight difference with quiet night.

8 % transequatorial wind during the whole the night.

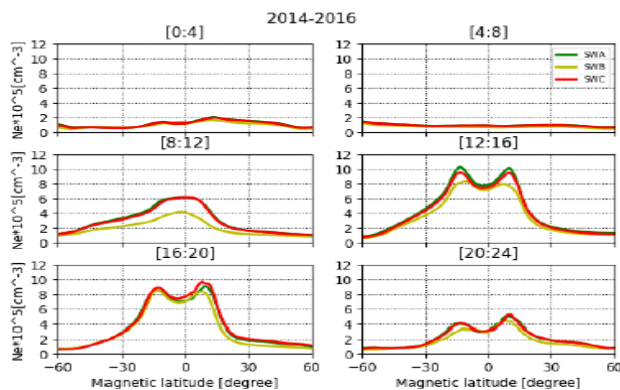
- * First TAD coming from the north **lasted for about 4 hours**; $V(\text{TAD}) = 550 \text{ m/s}$
- * Second TAD trans-equatorial was captured around 00 LT, **lasted for 3,5 hours**.
- * Equatorward flow \rightarrow TID raises the HmF2 pick where **decrease NmF** \rightarrow migration to thermospheric regions of **increased mean molecular mass** \rightarrow **TAD effect**.
- * Plasma drift = Zonal wind \rightarrow Storm dynamo fully developed.

Scientific achievements

Importance of the coupling with lower altitudes

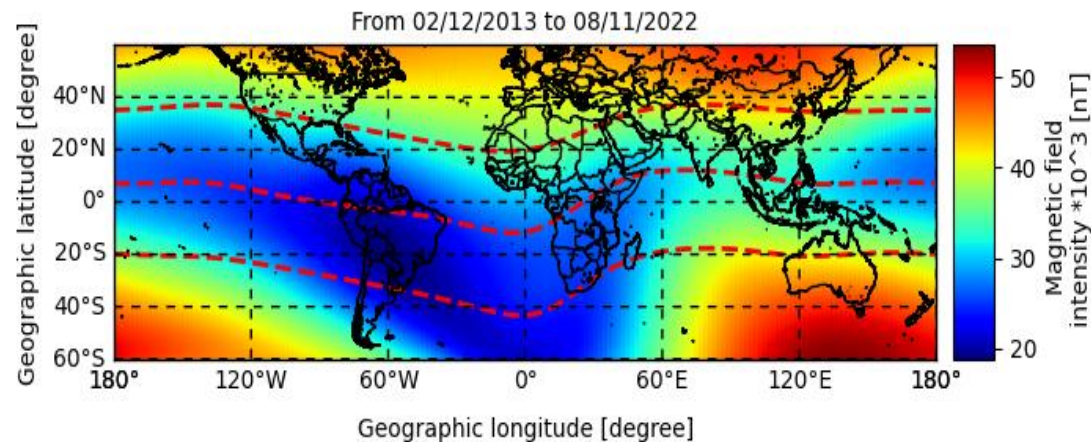


Effect of thermospheric winds on the EAI



- * Symmetrical EIA crests; weak wind speeds or converging/diverging winds with about the same velocity in both hemispheres.
- * EIA crests for transequatorial winds.

Longitudinal effect of the Equatorial Ionization Anomaly



Team and current interests

The Team

4 professors
3 Ph.D thesis defended.
3 Ph.D students
Toubkal project success.
22 publications

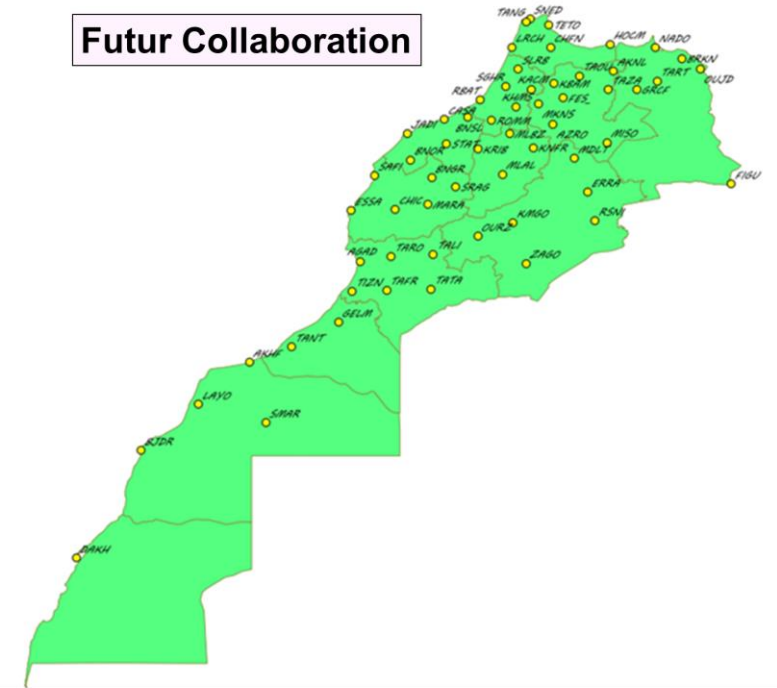
The Interest

- In depth exploration of previous studies.
- RENOIR data available again.
- Ionosphere/Thermosphere Coupling.
- A future collaboration : Mapping Morocco with 60 GPS stations
- IMCP project participation.

3 Thesis

- 1: Improvement of operational risks forecasting capabilities of existing SW warning systems.
- 2: Study of thermospheric wind and temperature trends as a function of solar and geomagnetic activities.
- 3: Study of solar events effect on the Thermosphere/Ionosphere coupling: use of satellite and in situ measurements.

Future Collaboration



GNS network in Morocco ANCFCC (Agence Nationale de la Conservation Foncière, du Cadastre et de la Cartographie)

International Meridian Circle Project

