



TEC DERIVED FROM SOME GPS STATIONS IN NIGERIA AND COMPARISON WITH THE IRI



^{1,2}A.B. Rabiou, ³K. Groves, ^{1,4}R.B. Abdulrahim, ²R.S. Fayose

⁵J.O. Adeniyi, ⁶E.A. Ariyibi, ⁷E.O. Oyeyemi and ⁸B.I. Okere

¹NASRDA, Abuja, Nigeria; ²Space Physics Laboratory, FUTA, Nigeria;

³Space Weather Centre of Excellence, AFRL/VSBXI, USA; ⁴Centre for Satellite Technology, NASRDA, Nigeria; ⁵University of Ilorin, Nigeria;

⁶Obafemi Awolowo University, Ile-Ife, Nigeria; ⁷University of Lagos, Lagos, Nigeria; ⁸Centre for Basic Space Science, NASRDA, Nigeria

Email: bouurlarnley@gmail.com



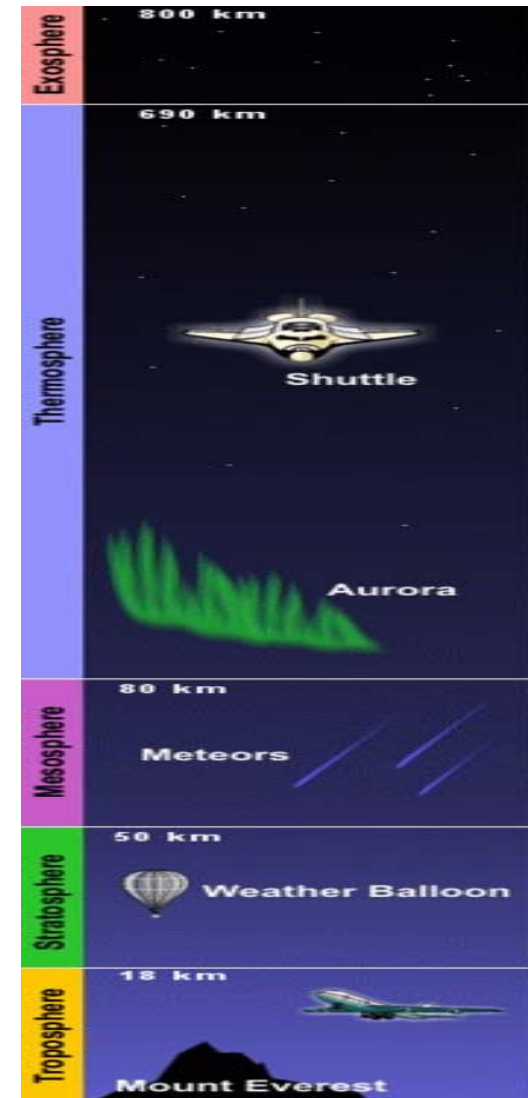
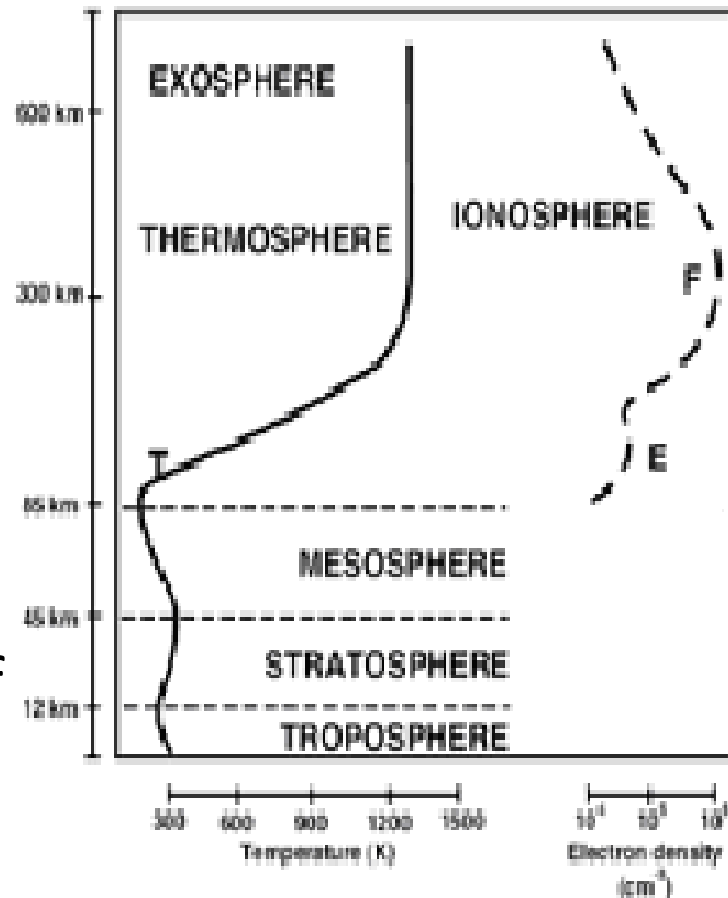
Outline

- Introduction
- Ionosphere
- TEC
- IRI model
- Objectives
- Methods
- Comparison of IRI and observed TEC
- Seasonal variations of TEC
- Conclusions



The Ionosphere

- Upper part of the earth's atmosphere where electrons exist in sufficient proportion as to affect the propagation of radio waves
- 50 km – 1000 km





Why Study The Ionosphere

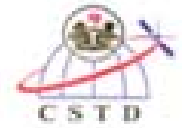


- It's the medium of transmission of radio waves
 - » long distance communication HF
 - » Earth-satellite transmission
- Home of Satellites
- Ionospheric conditions – proxy for space weather
- Imagine the economy that is tied to space region....
Multibillion USD
- Imagine the dependence of global community of space based communication... internet, data, etc

Rabiu, 2011



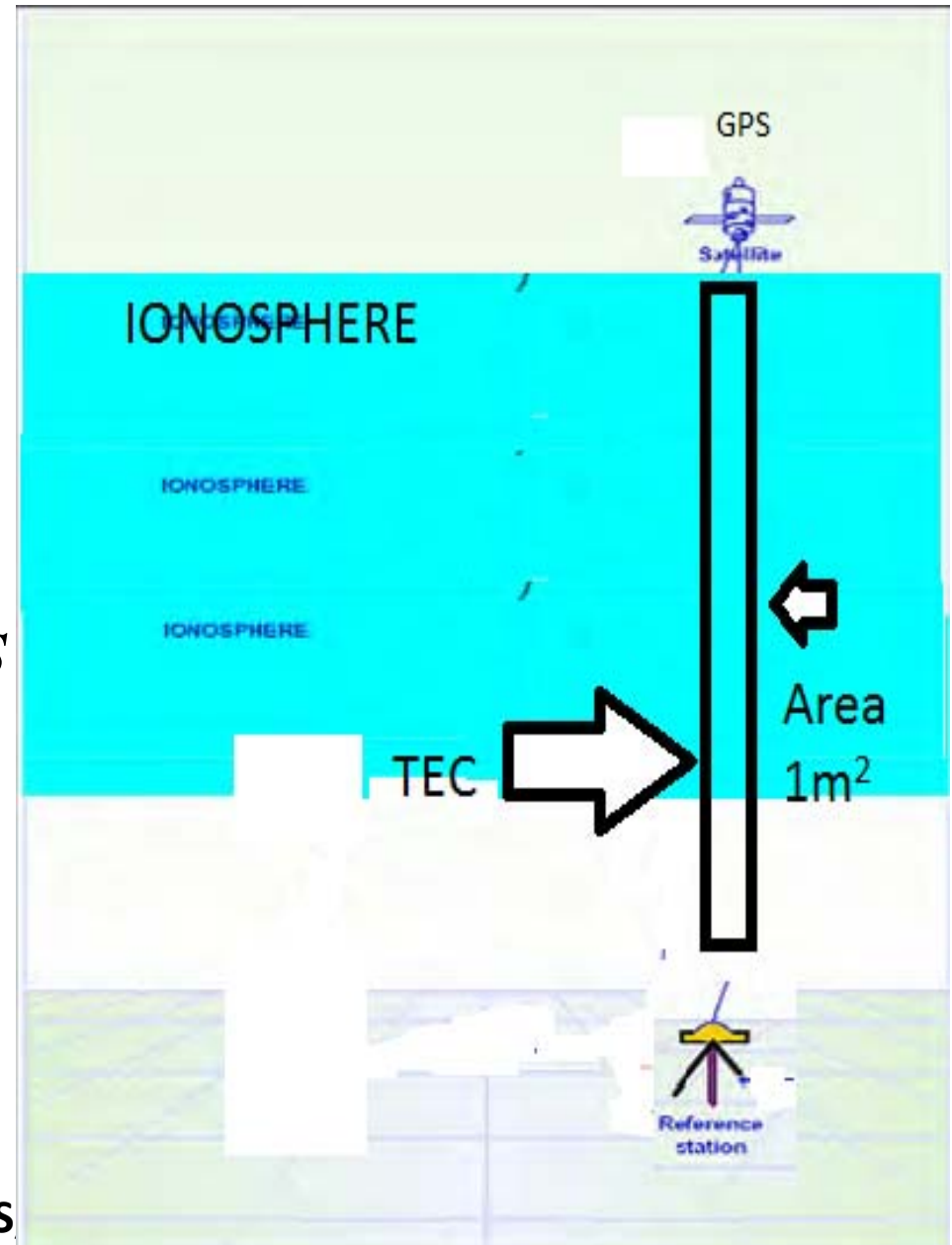
Total Electron Content (TEC)



- TEC is the number of electrons in a tube of 1m² cross section extending from the receiver to the satellite
- TEC along the signal path is given by

$$TEC = \int_{path} N_e ds$$

- Where N_e is the electron density along the signal path





TEC & Satellite-Earth Communication

- a very important parameter of the ionosphere that produces most of the effects to the signal transmitted by a Geo-positioning system satellite to the receiver on the earth
- a key parameter in the mitigation of ionospheric effects on radio systems



The IRI model

- The IRI is a model for studying the ionosphere.
- A project initiated by the Committee on Space Research (COSPAR) and the International Union of Radio Science (URSI)
- Establish an international standard for the specification of ionospheric parameters based on all worldwide available data from ground based as well as satellite observations



Objectives

- Evaluate the performance of IRI 2010 model at some Nigerian stations

This present work seek to investigate transient variations of TEC obtained from measurement at 4 Nigeria stations and compared the results with those derived from IRI model for those location.



Methods

- Obtain the IRI TEC values for the Nigerian stations
- Compare the IRI and observed values across the stations
 - » Diurnal variation
 - » Percentage deviation at all hours
 - » Seasonal variation



Locations

- Akure;
7.3°N,
5.2°E
- Lagos;3.
4°N,6.5°
E
- Nsukka;
6.8°N,7.3°E
- Ile-Ife;
7.4°N,4.
5°E



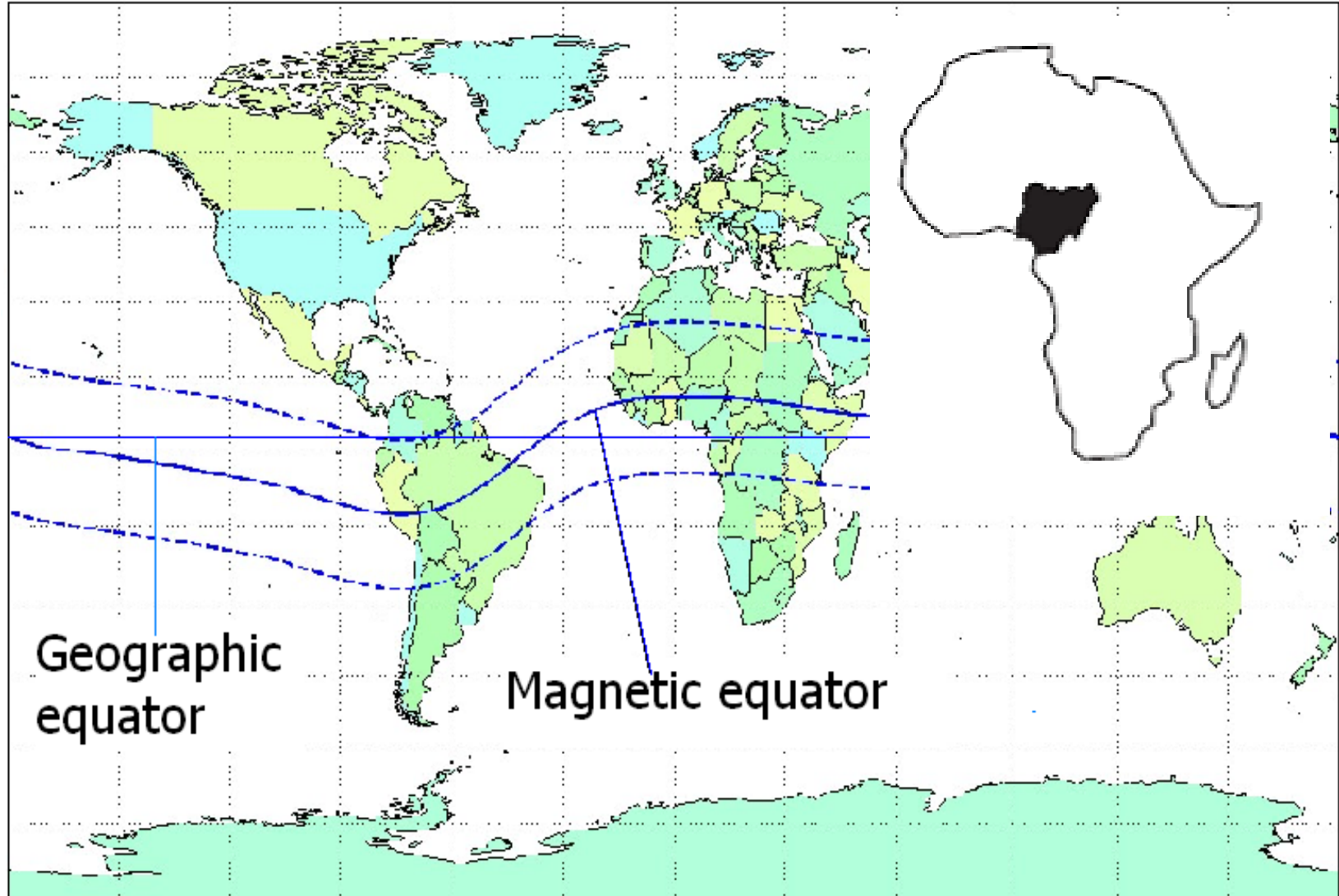
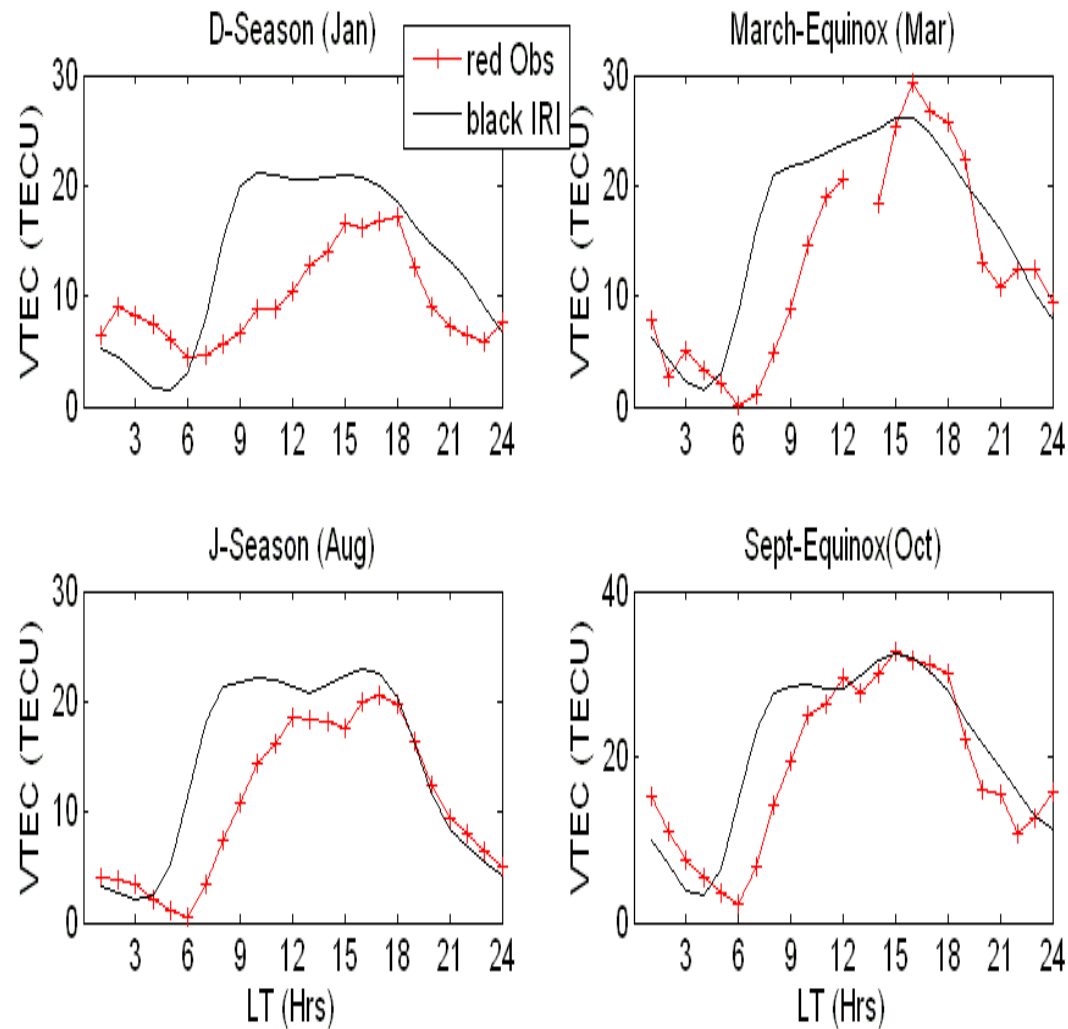


Fig. 1. Relative positions of the magnetic and geographic equators
UN Int'l Meeting on the Applications of GNSS, 12 - 16 Dec 2011, Vienna, Austria

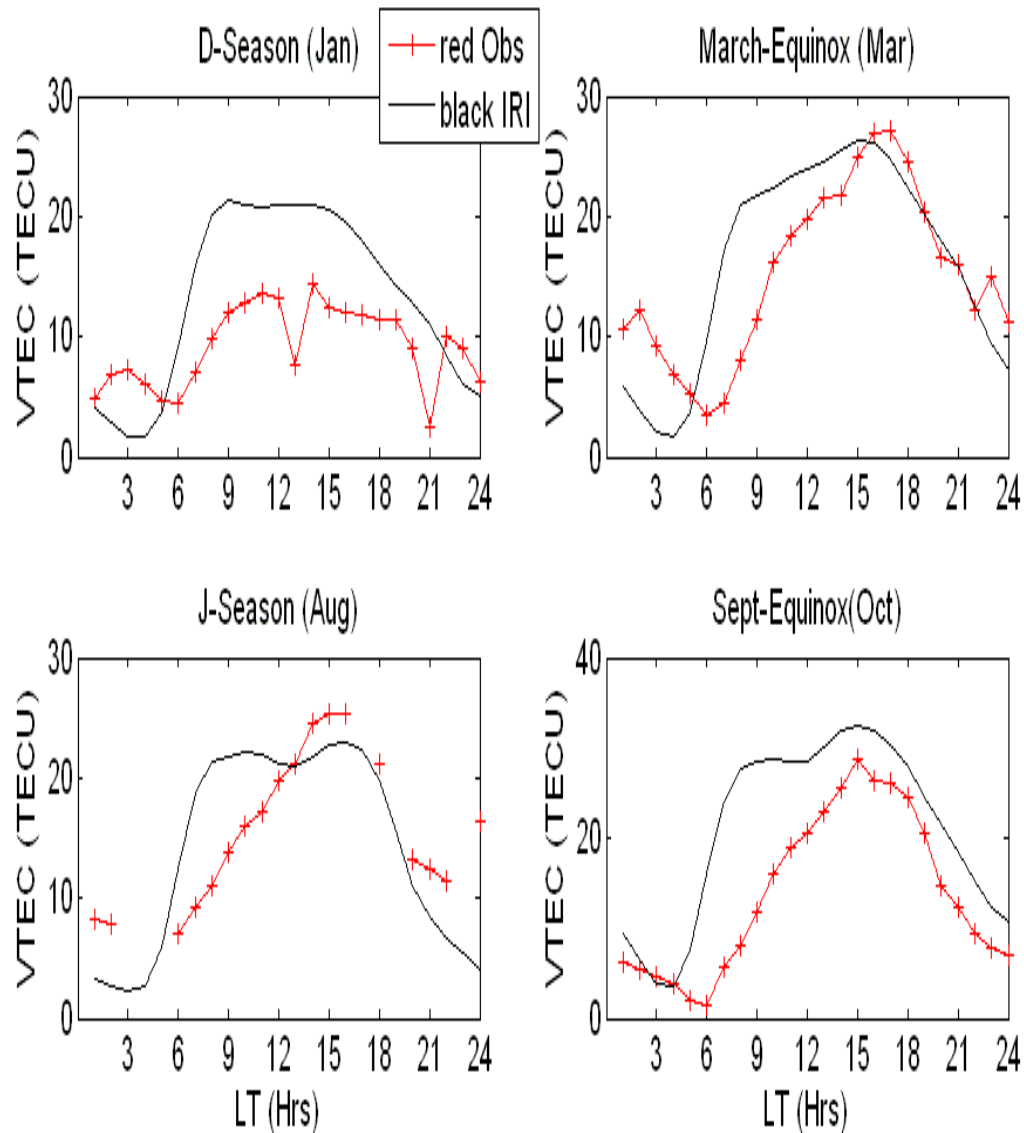


Comparison of IRI and observed TEC



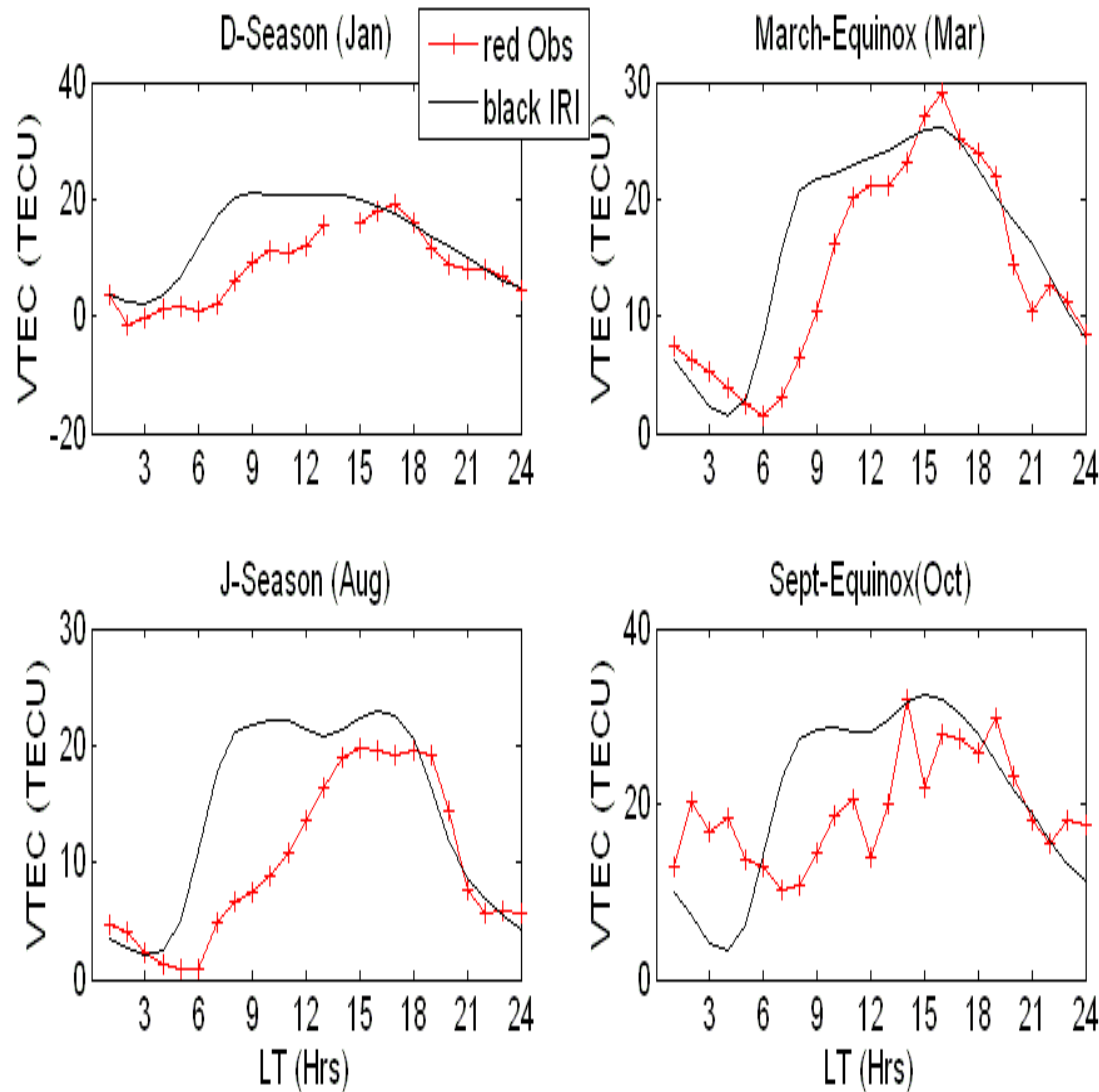
IRI & Observed TEC at Akure

The IRI Under-estimate and over estimate the values of TEC at different times of all the seasons considered.



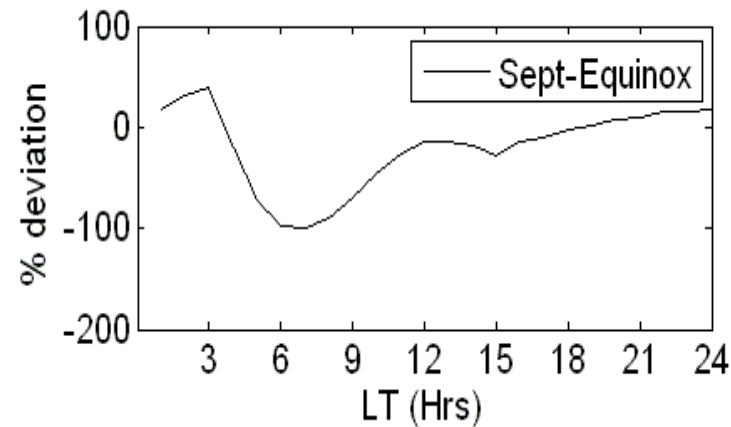
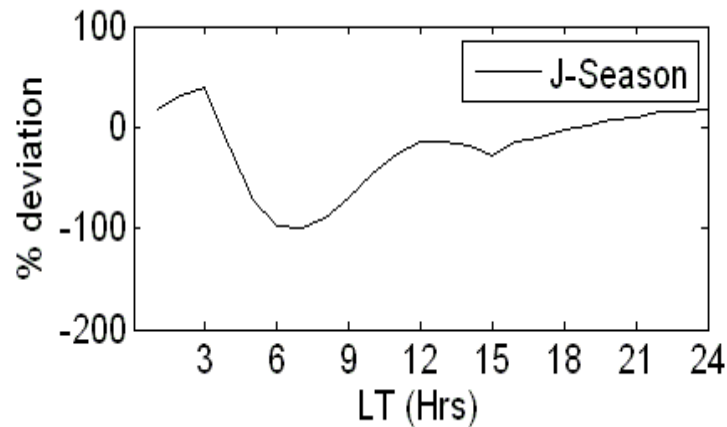
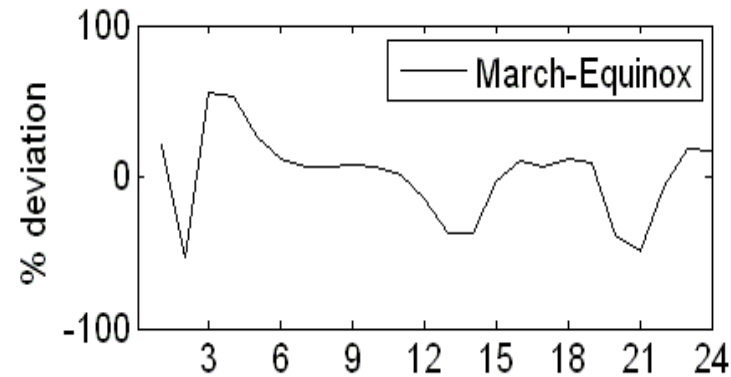
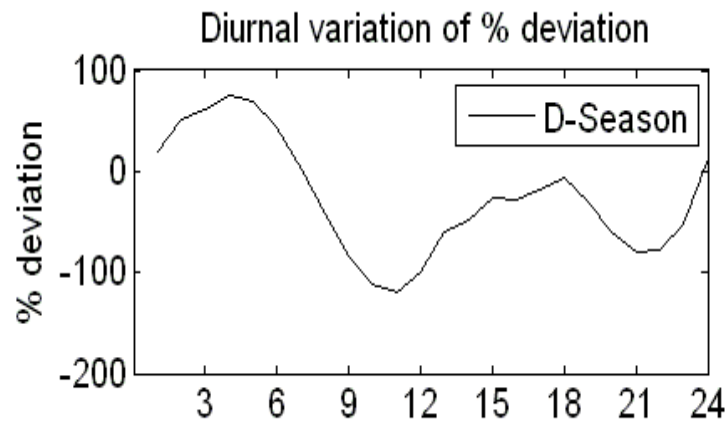
IRI & Observed TEC at Nsukka

The IRI Under-estimate and over estimate the values of TEC at different times of all the seasons considered.



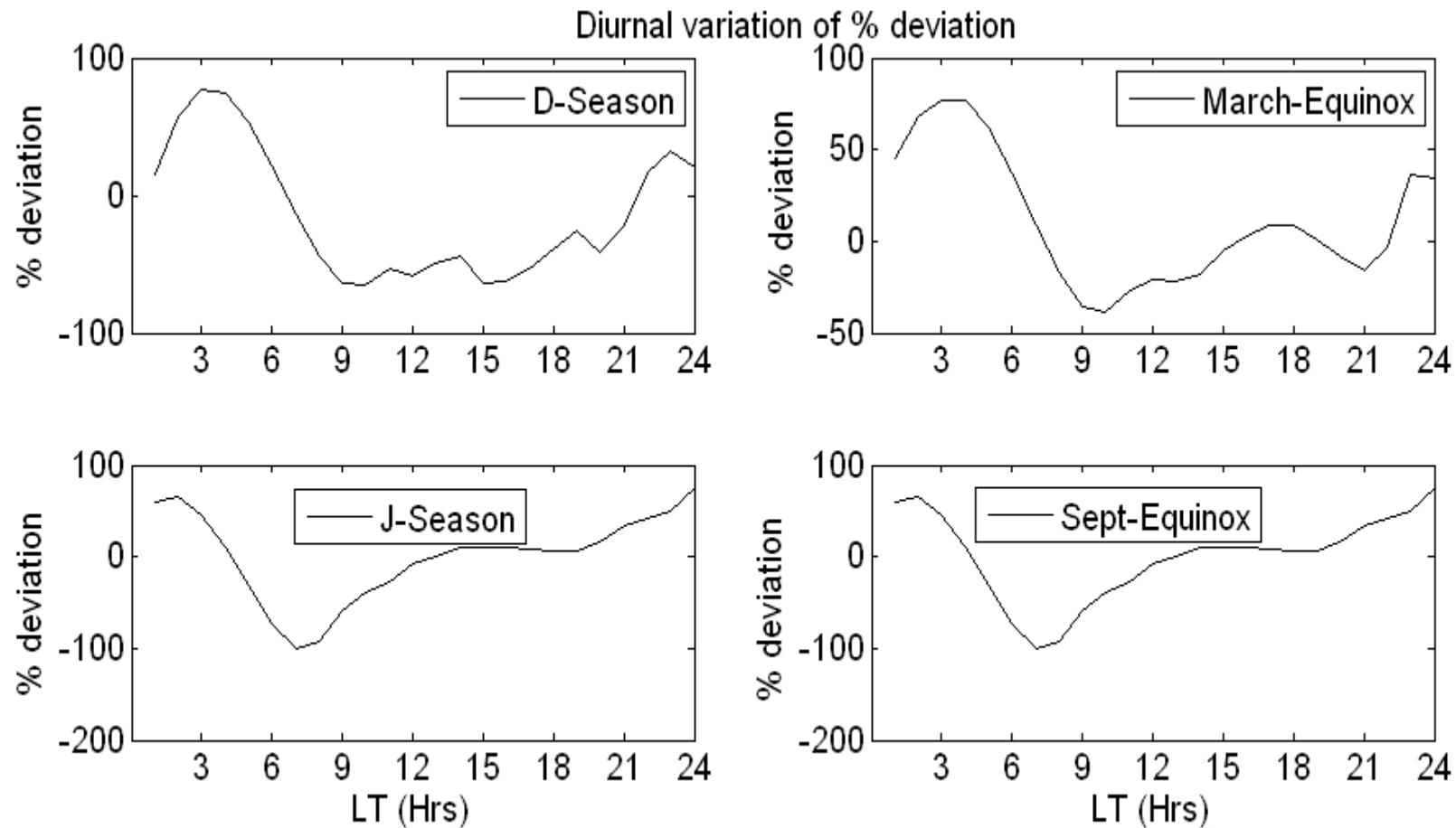
IRI & Observed TEC at Ile-Ife

The IRI Under-estimate and over estimate the values of TEC at different times of all the seasons considered.



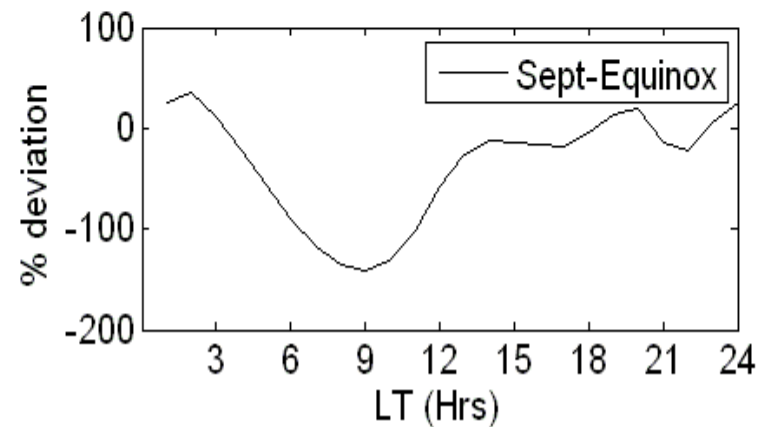
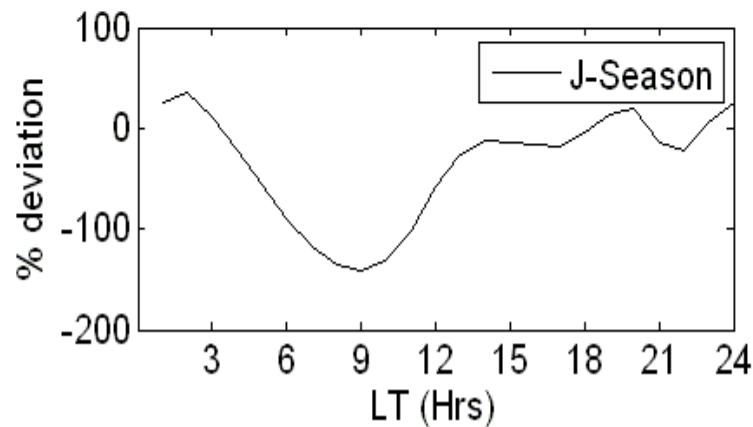
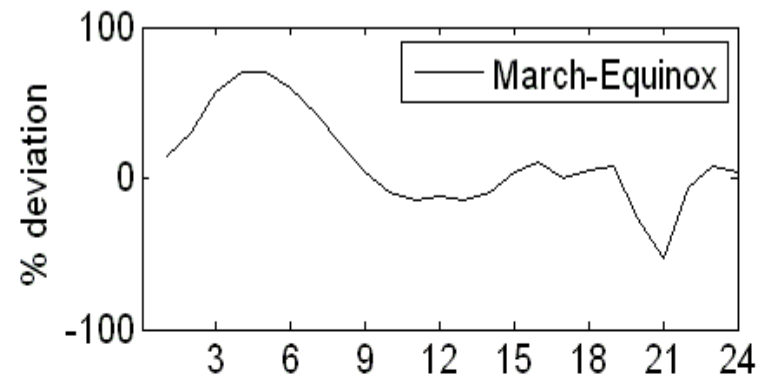
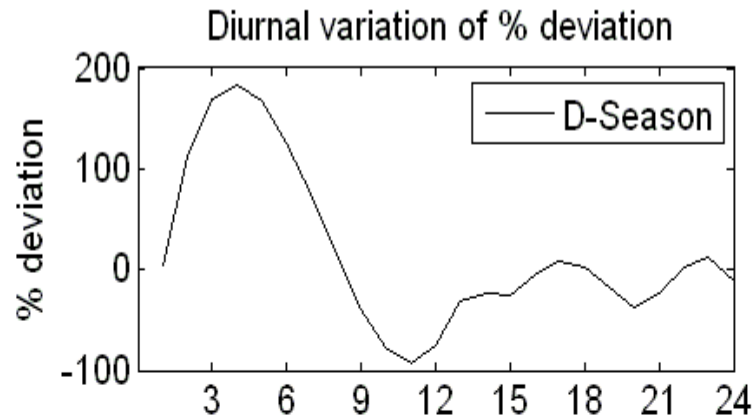
% deviation of IRI from observed TEC at Akure

✓ IRI -2010 Model gives poor prediction during 0200-0600 hrs LT when compared with predictions at other times and the Δ TEC having values greater than 50% during all seasons.



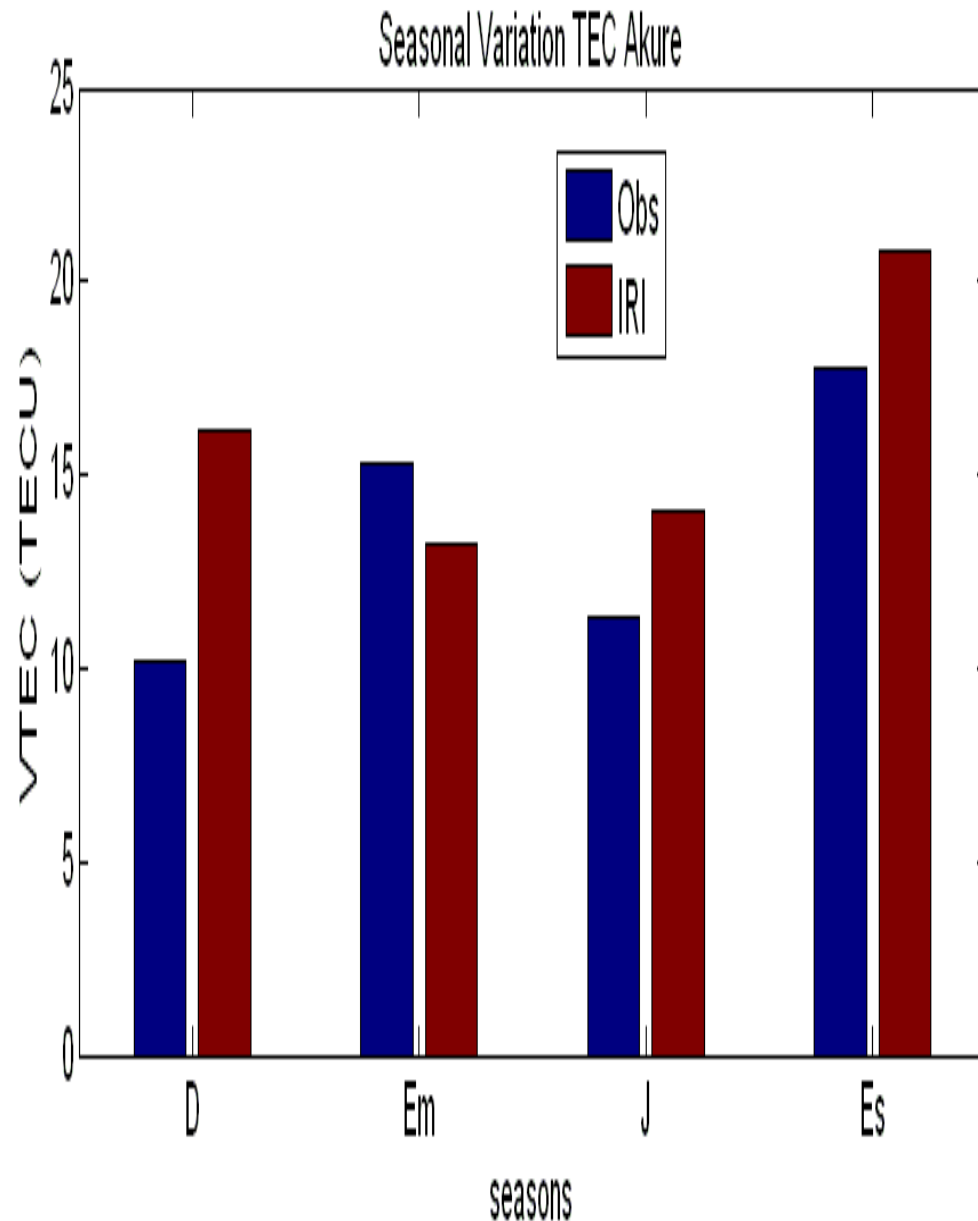
% deviation of IRI from observed TEC at Nsukka

✓ IRI -2010 Model gives poor prediction during 0200-0600 hrs LT when compared with predictions at other times and the Δ TEC having values greater than 50% during all seasons.



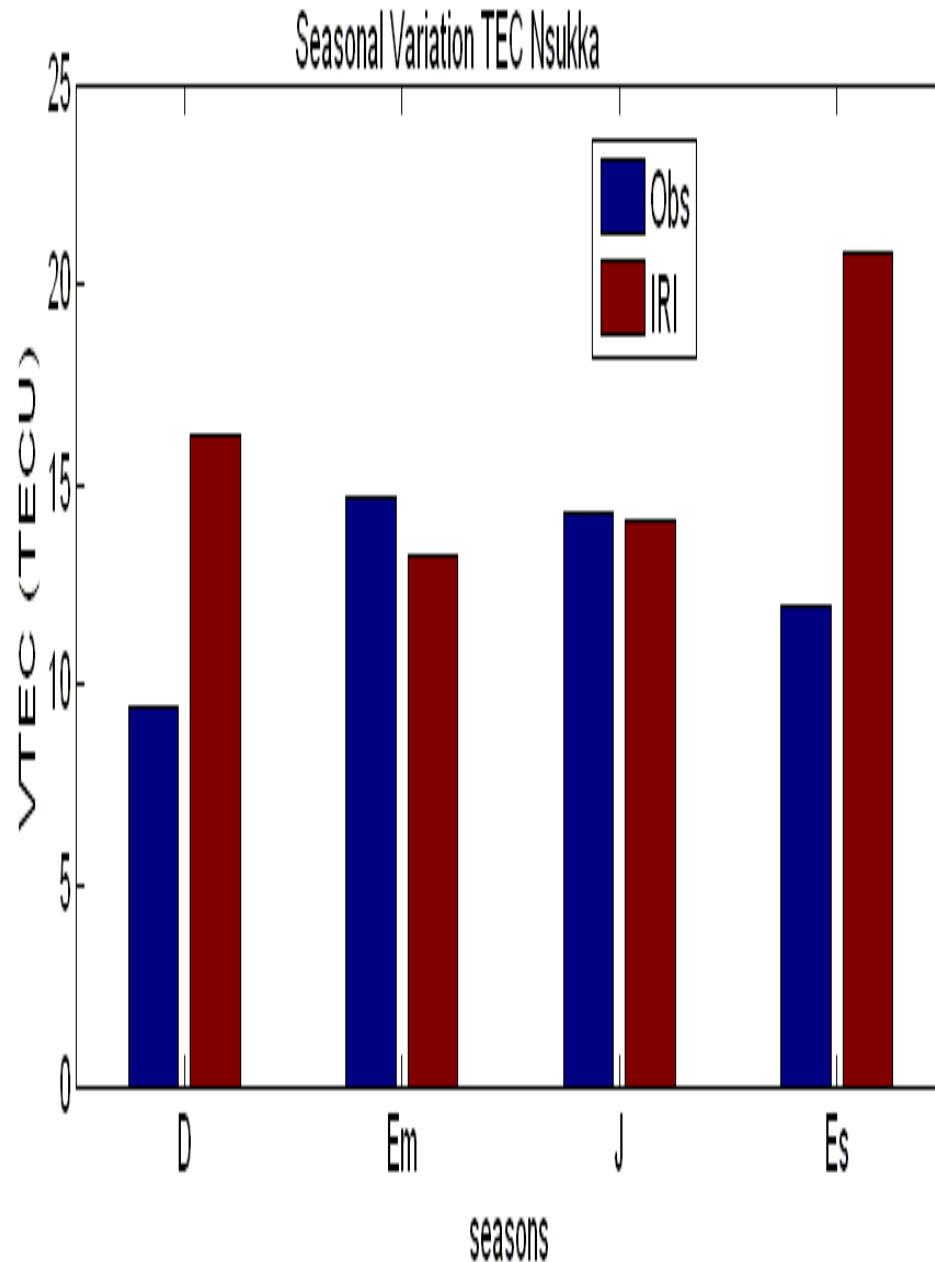
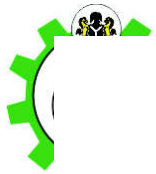
% deviation of IRI from observed TEC at Ile-Ife

- ✓ IRI -2010 Model gives poor prediction during 0200-0600 hrs LT when compared with predictions at other times and the Δ TEC having values greater than 50% during all seasons.



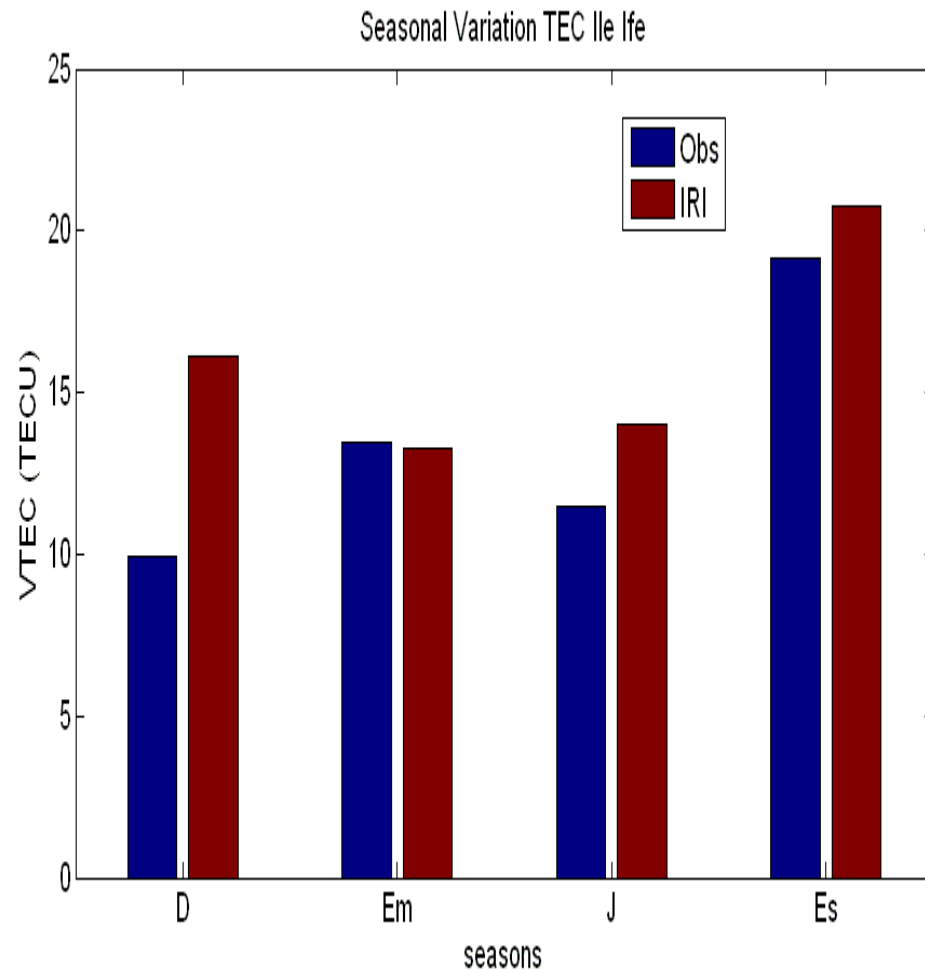
□ The Results show that IRI -2010 predictions does not have the same variation pattern as the observed values

□ There are still discrepancies between the observed values and IRI – 2010 Predictions



□ The Results show that IRI -2010 predictions does not have the same variation pattern as the observed values

□ There are still discrepancies between the observed values and IRI – 2010 Predictions



□ The Results show that IRI -2010 predictions does not have the same variation pattern as the observed values

□ IRI and Observed TEC maximize at Sept Equinox



Conclusions

- IRI and Observed TEC have maximum values at Sept Equinox
- The IRI Underestimate and over estimate the values of TEC at different times of the March Equinox, D- and J- seasons considered.
- Measured TEC were compared with those predicted by the International Reference Ionosphere (IRI). It was observed that IRI TEC is not in accord with those measured at about all local times.
- IRI -2010 Model gives poor prediction during 0200-0600 hrs LT when compared with predictions at other times and the TEC



Conclusion

- Hence, the need to improve on IRI model 2010 as a universal model for Ionospheric studies.



THANK YOU