SOLAR QUIET (SQ) DAILY CURRENT VARIATIONS CONTRIBUTIONS TO THE EARTH CONDUCTIVITY WITHIN SOME SOUTHERN AFRICAN COUNTRIES

By

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Introductions

The physics of the upper atmosphere as well as the solid earth is intimately connected by the science of Geomagnetism.

Geomagnetism involves the study of magnetic field's dynamics of the earth.

This field is not steady but varies with time due partly to the interaction with the solar wind.

When solar-terrestrial disturbances are not in existence or very negligible the daily variations of the geomagnetic field are called solar quiet day (Sq) variations.

Results and discussions

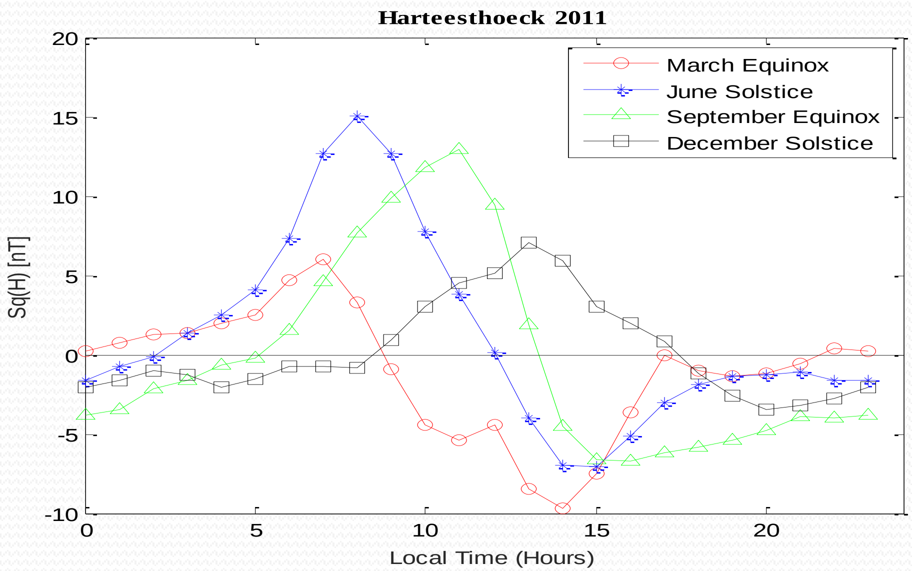

Figure 1: Showing seasonal solar quiet (Sq) current variations for Hartebeesthoek

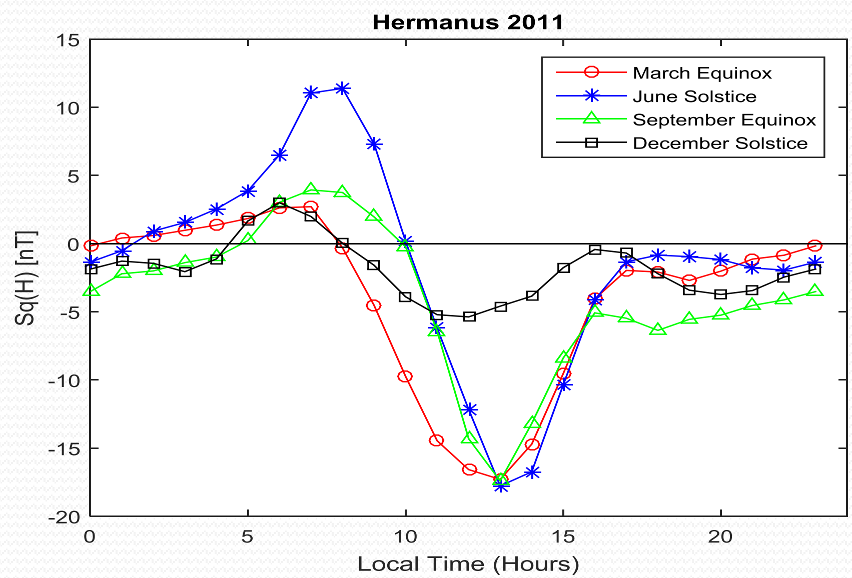

Figure 2: Showing seasonal solar quiet (Sq) current variations for Hermanus

This Sq recorded at geomagnetic observatories help in the determination of the changes in electrical conductivity within the Earth and external source current systems.

Variations occurred in all hours of the day in all the stations.

This was found to be mild at night but not zero due to currents flowing within the magnetosphere such as ring currents.

Across all the stations, highest seasonal Sq current was recorded during the months of June with an exception of Maputo region which has nearly triple peaks, with highest during December.

The maximum value occurred during the June solstice in Hartebeesthoek region and minimum in March equinox in Maputo region.

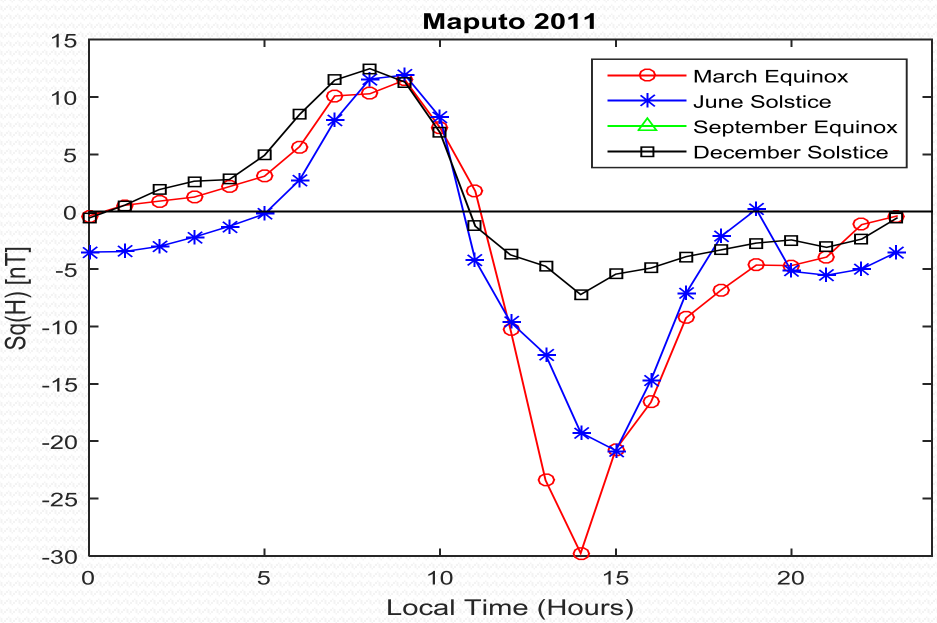

Figure 3: Showing seasonal solar quiet (Sq) current variations for Maputo regions

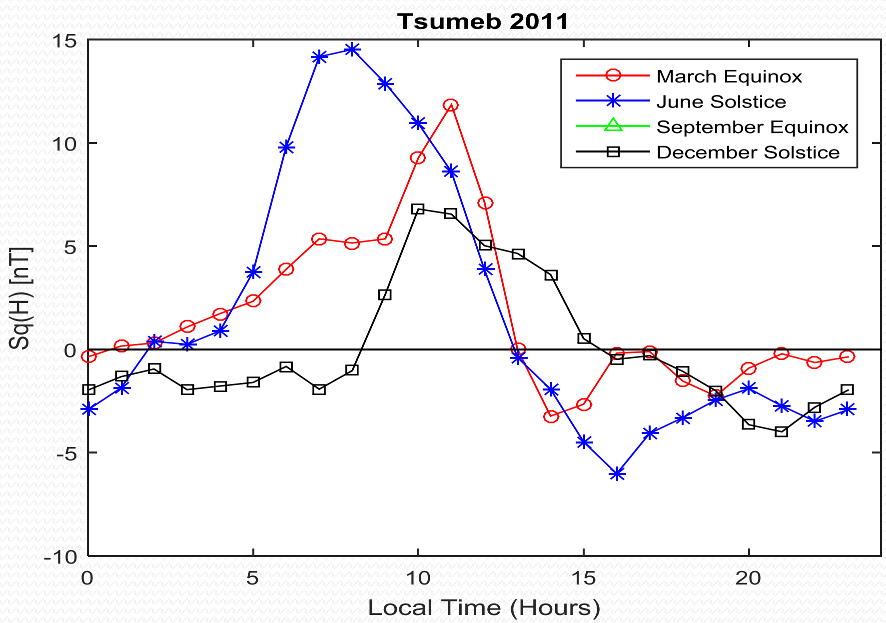

Figure 4: Showing seasonal solar quiet (Sq) current variations for Tsumeb regions

Results and discussions cont.

It was also seen that the variations in both the external and internal currents is a dawn to dusk phenomenon.

They follow the same phase and amplitude in all the regions.

The external and internal currents variations exhibit the same pattern in all the stations.

The external and internal currents variations show opposite patterns to each other.

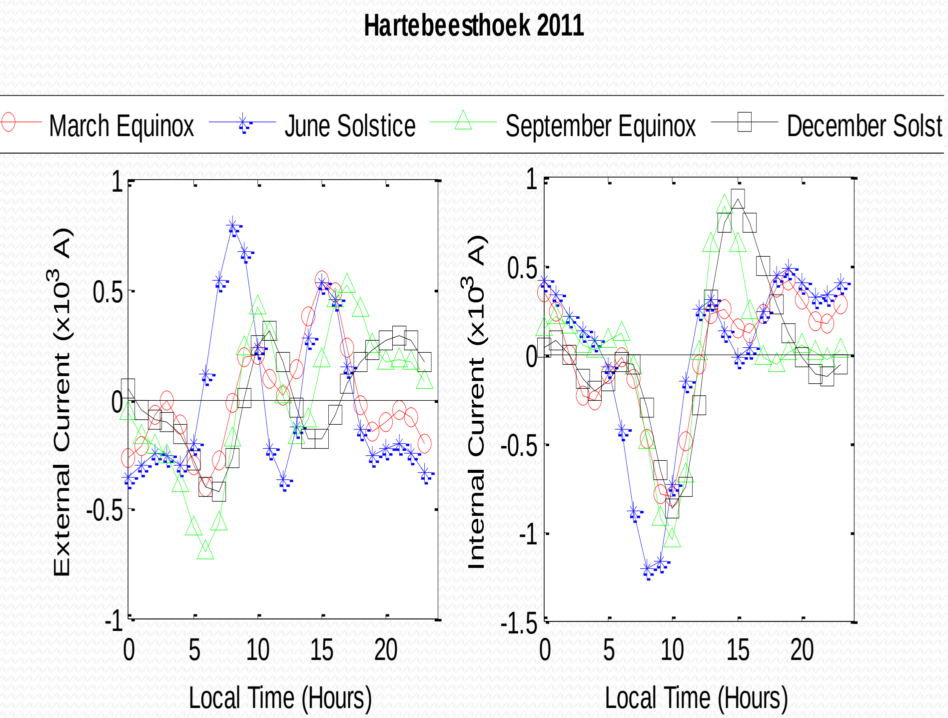

Figure 5: Showing separated seasonal external and internal current variations for Hartebeesthoek regions

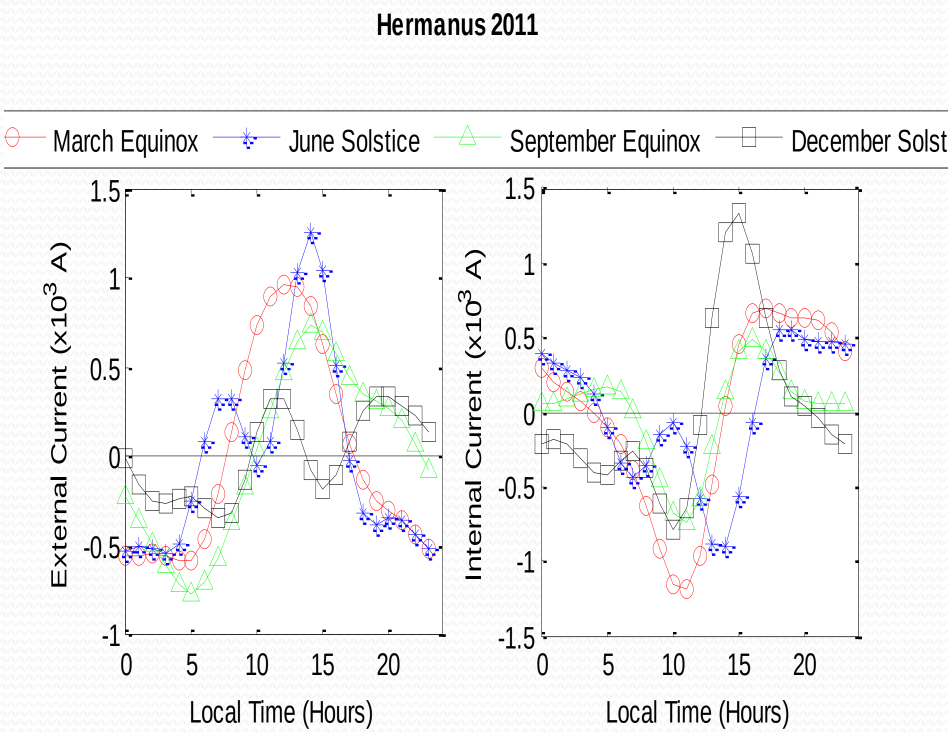

Figure 6: Showing separated seasonal external and internal current variations for Hermanus regions

We observed in the seasonal external Sq current an equinoxial maximum with a value of 2.1×10^3 A in March within the Maputo region.

A solsticial minimum in June with a value of 0.75×10^3 A in the Hartebeesthoek region.

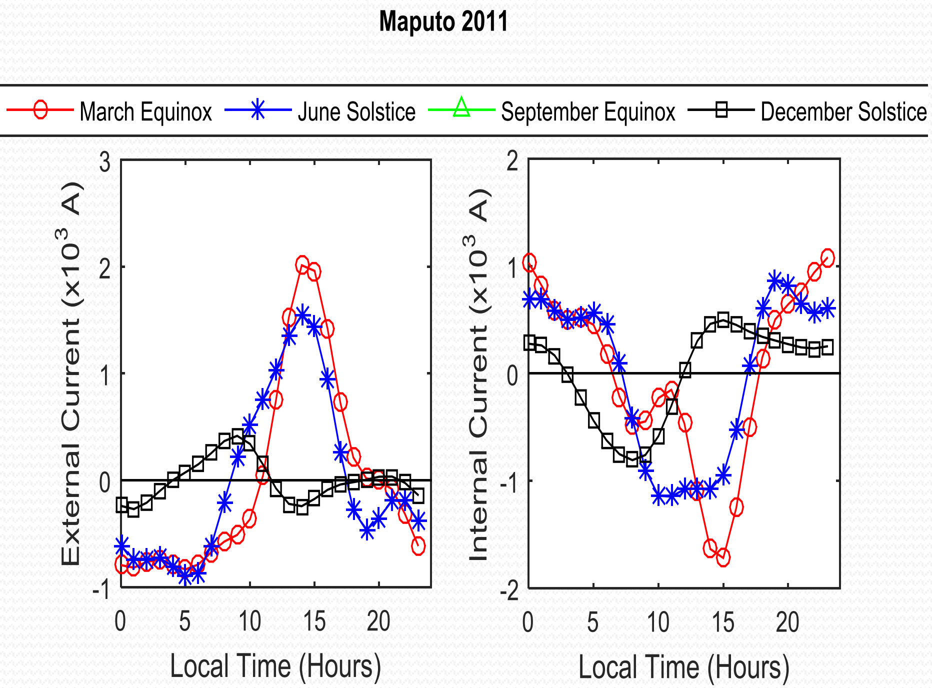

Figure 7: Showing separated seasonal external and internal current variations for Maputo regions

The seasonal external Sq current system pattern is seen to be same to that of the seasonal Sq current system;

This thereby proves that the source of Sq current system is external to the earth.

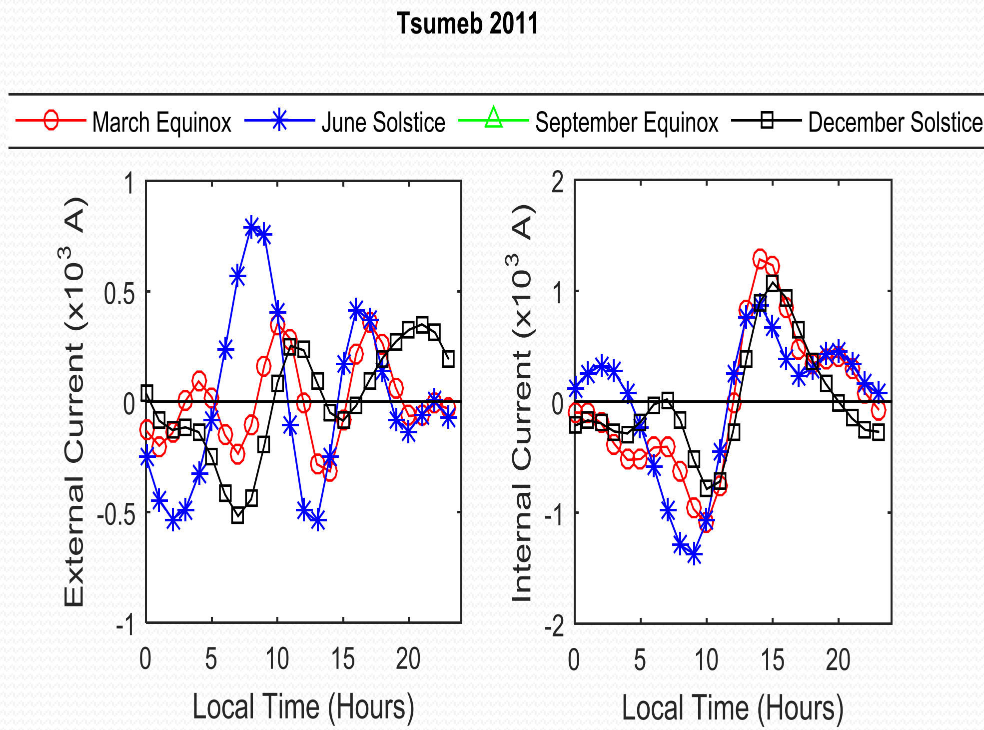

Figure 8 Showing separated seasonal external and internal current variations for Tsumeb regions

Results and discussions cont.

The highest electrical conductivity value of 0.498 Sm^{-1} at the depth of 1052.8 Km was found in Hartebeesthoek.

The Tsumeb station has the lowest electrical conductivity value of 0.187 Sm^{-1} at the depth of 1269.5 Km.

Our study at shallow depth, is smaller than the East African conductivity-depth profile upto a depth of about 600 and 650 km.

Here, it intersected with that of Maputo and Hartebeesthoek profiles indicating likely similar material constituents within this depth range.

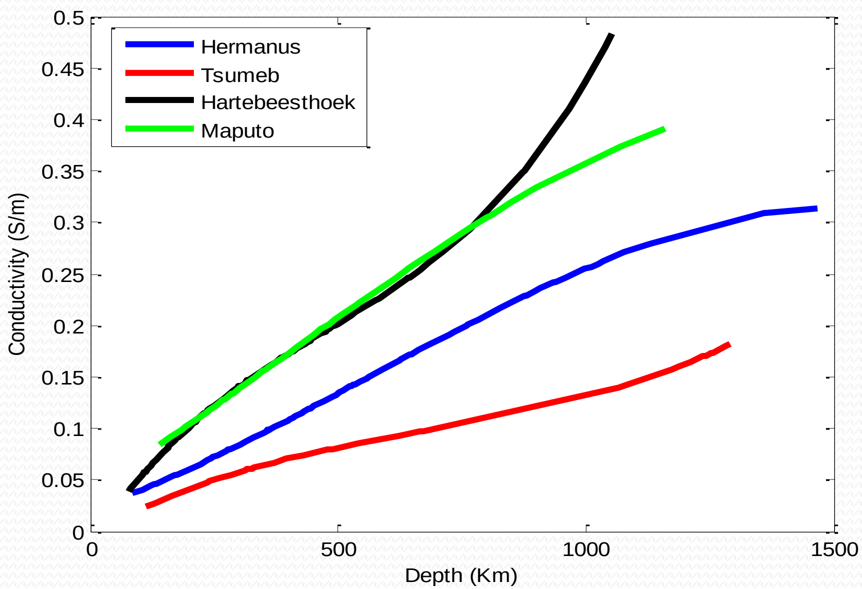

Figure 9: Mantle electrical conductivity-depth profile of the four geomagnetic South African stations

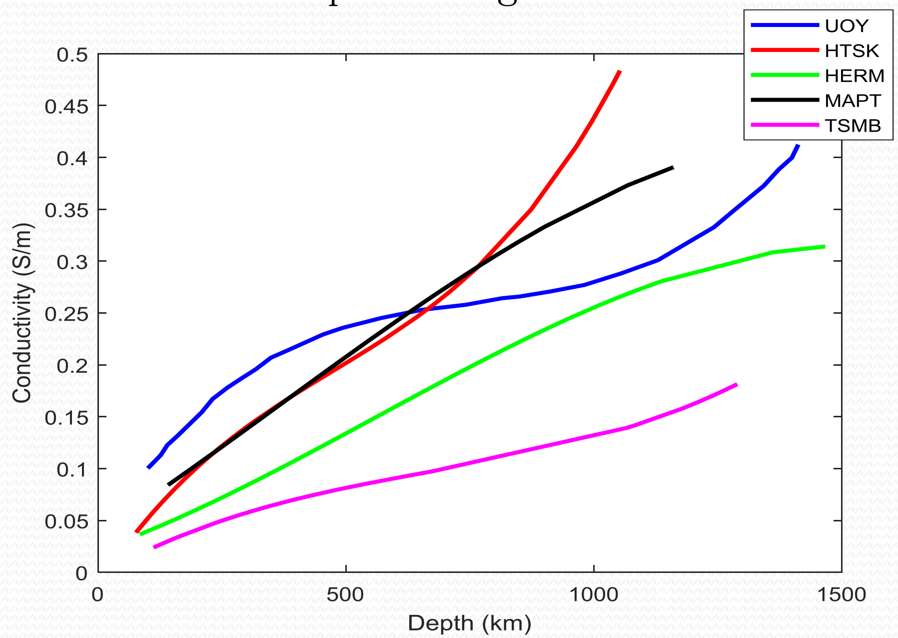

Figure 10: Present profiles (HTSK, HERM, MAPT, and TSMB) compared with UOY: Ugbor et al., 2016

Conclusions

Since the seasonal external Sq current system pattern is the same to that of the seasonal Sq current variation.

It thereby agrees with the works of Schuster (1889, 1908) who proved that the source of Sq current system is external to the earth.

Also, an increase in the electrical conductivity starting from the crust down to the earth's mantle within the were seen from all the profiles.

Therefore, this agrees with the global model for electrical conductivity profile.

These findings could be attributed to the mantle compositions of that area, the closer to the equator of the area and the oceanic effect.

The results of the conductivity-depth profiles of our study show similar trends and compares well with previous researches done in East African region.

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