# A PCA based study of the TEC over a single station

F. Azpilicueta[(1)], B. Nava*[(2)], and C. Brunini [(1)]
(1) CONICET-Universidad Nacional de la Plata, La Plata, Argentina, http://www.fcaglp.unlp.edu.ar/
(2) The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, https://www.ictp.it

## Extended Abstract

The study long series of the Total Electron Content (TEC) over a single station with the Principal Components Analysis (PCA) technique is relatively new. The usual approach for this type of studies consists on applying Fourier Transforms [1, 2], analyzing the dominant frequencies and subsequently interpreting and associating them to the physical processes that could be the causes, for example the solar cycle.

In this contribution we have followed a different approach with the goal of understanding what new insights can PCA [3] provide when it's applied to series of TEC determinations over a set of GNSS stations. Each station data series consists on hourly mean values spanning over more than a 11-year period (more than solar cycle) and covering all of the periodic geometrical configurations of the Sun - Earth system (annual variation of the distance, annual movement of the sub-solar point, etc.).

The results show that the first component alone is enough to explain approximately 90% of the total variance of the series. This component can be associated to the local noon period of the TEC daily pattern. The temporal behavior of the related coefficients is dominated by the variation of the solar EUV flux, mainly due to the 11 year solar cycle and secondly due to the annual relative movement of the sub-solar point and the annual change of the Sun-Earth distance. Interesting to mention is that overlapped to the previous signals, the first coefficient also shows a semi-annual signal related to the so-called semi-annual anomaly, which is not present in the EUV flux.

Finally, the addition of the second and third components helps to reproduce as much as 96% of the total variance. In general the second component could be related to minor corrections (w.r.t. the first component) during the local morning/evening and the third component to small corrections during local evening/morning depending on the station.

## References

1. T. L. Gulyaeva, F. Arikan, M. Hernández Pajares, I. Stanislawska (2013), "GIM-TEC adaptive ionospheric weather assessment and forecast system", JASTP, 102, 329–340, http://dx.doi.org/10.1016/j.jastp.2013.06.011.
2. G. Crowley, I. Azeem, A. Reynolds, T. M. Duly, P. McBride, C. Winkler, and D. Hunton (2016), "Analysis of traveling ionospheric disturbances (TIDs) in GPS TEC launched by the 2011 Tohoku earthquake", Radio Sci., 51, 507–514, doi:10.1002/2015RS005907.
3. R.W. Preisendorfer (1988), "Principal component analysis in meteorology and oceanography", Developments in Atmospheric Science, Ed. C. D. Mobley, 7, Elsevier, 1988, 111-143.

Key words: TEC, ionosphere, PCA, LPIM