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Role of the external drivers in the occurrence of low-latitude ionospheric scintillation revealed by multi-scale analysis

L. Spogli[1,5*], M. Piersanti[2,6], C. Cesaroni[1], M. Materassi[3], A. Cicone[4,10,11], L. Alfonsi[1], V. Romano[1,5] and R.G. Ezquer[7,8,9]

(1) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
(2) National Institute for Nuclear Physics, University of Tor Vergata, Rome, Italy
(3) National Research Council, Institute for Complex Systems ISC-CNR, Italy
(4) Department of Information Engineering, Computer Science and Mathematics, University of L'Aquila, Italy
(5) SpacEarth Technology, Rome, Italy
(6) Consorzio Area di Ricerca in Astrogeofisica. L'Aquila, Italy
(7) Laboratorio de Ionósfera, Departemento de Física, FACET, Universidad Nacional de Tucúman, Tucúman, Argentina
(8) CIASUR, Facultad Regional Tucúman, Universidad Tecnológica Nacional, Tucúman, Argentina
(9) Consejo Nacional de Investigaciones Cientifíca y Técnicas, Buenos Aires, Argentina
(10) Istituto Nazionale di Alta Matematica, Rome, Italy
(11) Gran Sasso Science Institute, L'Aquila, Italy

In the low latitude ionosphere, the formation of Equatorial Plasma Bubbles presents a regular behavior under quiet conditions of the geospace. The ionospheric irregularities embedded in the plasma bubbles may lead to amplitude scintillation of Global Navigation Satellite Systems signals. Solar events disturb the regular behavior of the magnetosphere-ionosphere system, leading to an intensification or a suppression of such ionospheric irregularities producing scintillations. During the same storm, inhibition and intensification of the ionospheric scintillations can both occur, depending on the local time of the storm arrival and on the storm features. Electric fields penetrating from the auroral latitudes and disturbing the ionospheric electrodynamics are commonly highlighted as the principal responsible for the inhibited/enhanced scintillations. Beside this mechanism, the disturbance dynamo is the concurrent key-physical phenomenon, being due to variations of the thermospheric winds induced by heating convecting from high towards equatorial latitudes and disturbing the electrodynamics of the Equatorial Electrojet [1]. In the present work, we analyze the scintillation over San Miguel de Tucumán (Argentina), located under the southern crest of the Equatorial Ionospheric Anomaly, focusing on the multi-scale variability and on the causal relationship between forcing factors from the geospace and the ionospheric response.

In the specific, we provide the time scale-dependency of the amplitude scintillation index under both disturbed and quiet geomagnetic conditions. In fact, one of the most important aspects of the radio amplitude scintillation is its scale-dependent behavior, emerging from the small-scale properties of the plasma medium, resulting into different statistical properties of the sampled signal.

The aim is to compare such multiscale picture with the corresponding picture derived from geomagnetic indices and Interplanetary Magnetic Field parameters to catch potential similarities. To the scope, we adopt a recently introduced data analysis technique called "Adaptive Local Iterative Filtering (ALIF)" [2]. ALIF is able to efficiently decompose nonstationary signals into components, here called Intrinsic Mode Components (IMCs) [3]. We identified resonant modes in the x component of the Interplanetary Electric Field as responsible for frequency components in the amplitude scintillation index time evolution, hence modulating the intensification/suppression of the scintillation itself.

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