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On the use of ScintPi monitors in research, education, and citizen science applications

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ScintPi is a series of ionospheric scintillation and total electron content (TEC) monitors developed at the University of Texas at Dallas [1,2]. The development was motivated by the need of low-cost instruments for distributed observations of the geospace and for educational and citizen science initiatives related to space sciences and space weather. ScintPi can be described as a low-cost monitor that is easy to install and maintain. It was developed using commercial off-the-shelf GNSS receivers and single-board computers (Raspberry Pi). In this talk we will briefly describe the three versions of ScintPi that have been developed and their differences. We will then show examples of measurements made by ScintPi and comparisons of their measurements with those made by collocated commercial GNSS scintillation and TEC monitors. We will discuss the main strengths and potential weaknesses of the monitors. Next, we will present examples of research studies using ScintPi. These studies include investigations of scintillation at the boundary between low and mid latitudes during varying geophysical conditions [3,4]. Examples also include results related to the detection of solar radio bursts using measurements made by distributed ScintPi monitors [5]. With respect to education, we will present examples and results of the use of ScintPi to expand the breadth of skills of undergraduate students [6]. Finally, we will discuss the opportunities of the use of ScintPi by citizens willing to contribute to advancing experimental setup for observations and understanding of space weather.

1. Rodrigues, F. S., and Moraes, A. O., ScintPi: A Low-cost, easy-to-build GPS ionospheric scintillation monitor for DASI Studies of space weather, education, and citizen science initiatives, Earth and Space Science, 6, 1547–1560. https://doi.org/10.1029/2019EA000588, 2019.

2. Gomez Socola, J. and F. S. Rodrigues, ScintPi 2.0 and 3.0: low-cost GNSS-based monitors of ionospheric scintillation and total electron content, Earth Planets Space 74, 185, https://doi.org/10.1186/s40623-022-01743-x, 2022.

3. Gomez Socola, J., Sousasantos, J., Rodrigues, F. S., Brum, C.G.M., Terra, P., Moraes, A.O., Eastes, R., On the quiet-time occurrence rates, severity and origin of L-band ionospheric scintillations observed from low-to-mid latitude sites located in Puerto Rico, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 250, 106123, ISSN 1364-6826, https://doi.org/10.1016/j.jastp.2023.106123, 2023.

4. Sousasantos, J., Gomez Socola, J., Rodrigues, F.S. et al., Severe L-band scintillation over low-to-mid latitudes caused by an extreme equatorial plasma bubble: joint observations from ground-based monitors and GOLD, Earth Planets Space, 75, 41, https://doi.org/10.1186/s40623-023-01797-5, 2023.

5. Wright, I. G., Rodrigues, F. S., Gomez Socola, J., Moraes, A. O., Monico, J. F. G., Sojka, J., Scherliess, L., Layne, D., Paulino, I., Buriti, R. A., Brum, C. G. M., Terra, P., Deshpande, K., Vaggu, P. R., Erickson, P. J., Frissell, N. A., Makela, J. J. and D. Scipión, On the detection of a solar radio burst event that occurred on 28 August 2022 and its effect on GNSS signals as observed by ionospheric scintillation monitors distributed over the American sector, J. Space Weather Space Clim., 13, 28, DOI: 10.1051/swsc/2023027, 2023.

6. Wright, I. G., Solanki, I., Desai, A., Socola, J. G. and F. S. Rodrigues, Student-led design, development and tests of an autonomous, low-cost platform for distributed space weather observations, J. Space Weather Space Clim., 13, 12. https://doi.org/10.1051/ swsc/2023010, 2023.