Table of Content

1	Intr	oduction	1
	1.1	Motivation	1
	1.2	Statement of Problem	4
	1.3	Hypotheses	5
	1.4	Objectives	5
		1.4.1 General Objective	5
		1.4.2 Specific Objectives	6
	1.5	Contributions	6
	1.6	Outlines	7
2	Effe	cts of the 12 May 2021 Geomagnetic Storm on Georeferencing Preci-	
	sion		8
	2.1	Introduction	8
	2.2	Materials and Methods	12
		2.2.1 Estimation of the Ionospheric Total Electron Content	12
		2.2.2 ROT and ROTI	13
		2.2.3 Apparent Position Variation Using Precise Point Positioning	14
		2.2.4 Geophysical and Geomagnetic Conditions	14
		2.2.5 Possible Earthquakes Perturbations	15
	2.3	Results	15
	2.4	Discussion and Main Conclusions	22
		2.4.1 12 May 2021 Geomagnetic Storm	22
		2.4.2 The 27 March 2017 and 5 August 2019 Geomagnetic Storms	25
		2.4.3 Ionospheric Effects	25
		2.4.4 Positioning Errors	26
3	Iono	ospheric Behavior During the 10 June 2021 Annular Solar Eclipse and	
	Its 1	Impact on GNSS Precise Point Positioning	29
	3.1	Introduction	29
	3.2	Materials and Methods	33
		3.2.1 Estimation of the Ionospheric Total Electron Content	33
		3.2.2 ROT and ROTI	34
		3.2.3 Low Earth Orbit Satellite Measurements and Ionospheric Data	35
		3.2.4 Apparent Position Variation Using Kinematic Precise Point Positioning	36
		3.2.5 Geomagnetic and Geophysical Conditions	36

3.3	Results	38
	3.3.1 Ionospheric Behavior and TEC Maps	38
	3.3.2 ROTI and GNSS Precise Point Positioning Accuracy Maps	42
	3.3.3 Ionospheric Behavior and GNSS Positioning Errors by Region	45
3.4	Discussion	49
	3.4.1 Ionospheric Behavior	49
	3.4.2 Ionospheric Impacts on GNSS Positioning Errors	53
3.5	Conclusions	55
3.6	Supplementary Materials	56
Conclu	sions	57
Conclu Bibliog	sions raphy	57 60
Conclu Bibliog	sions raphy	57 60 76
Conclu Bibliog Annex	sions raphy es ex A. Geomagnetic Conditions During Solar Cycle 25 up to the 306th Day of	57 60 76
Conclu Bibliog Annex Ann	sions raphy es ex A. Geomagnetic Conditions During Solar Cycle 25 up to the 306th Day of the Year 2022	57 60 76 76
Conclu Bibliog Annex Ann	sions raphy es ex A. Geomagnetic Conditions During Solar Cycle 25 up to the 306th Day of the Year 2022	57 60 76 76