# Metadata template for Learning Resources (V1.0)

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| Collector: Angela Aragon-Angel  Revision Date: 17/12/2024  Version: v1.0 |
| Title  GNSS contributions to Space Weather monitoring: gAGE/UPC Real-Time products for Precise Navigation, Ionosphere and Space Weather Monitoring |
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| Subject  Global Navigation Satellite Systems (GNSS), Space Weather, Ionospheric Modelling, Positioning and Navigation, Ionospheric Scintillation, Real Time Monitoring |
| Description  The Space Weather Prediction Center (SWPC) at the National Oceanic and Atmospheric Administration (NOAA), just published a new on the last October 25th issuing a “revised prediction for solar activity during Solar Cycle 25 that concludes solar activity will increase more quickly and peak at a higher level than that predicted by an expert panel in December 2019. The updated prediction now calls for Solar Cycle 25 to peak between January and October of 2024, with a maximum sunspot number between 137 and 173”.  In that context, this training offers a tutorial on two main hot topics on GNSS positioning in two consecutive sessions or lessons: Galileo High Accuracy Service and Ionospheric Scintillation.  First session: The Galileo High Accuracy Positioning Service (HAS) will offer free-of-charge real-time improved user positioning performances down to a decimetre level, with multiple constellations of the GNSS. The Service Level 1 (SL1) of Galileo HAS is based on a Precise Point Positioning (PPP) user algorithm, and SL2 is enhanced with ionospheric corrections for Fast-PPP navigation, both with ambiguity fixing capabilities. An overview of the ionospheric model developed by gAGE/UPC for Galileo HAS SL2, and other associated products, will be presented in this second part of the tutorial.  Second session: Scintillation is one the major limitations in achieving high-accuracy GNSS positioning, especially at low latitudes, where severe scintillation frequently occurs. Scintillation is currently monitored with specialized Ionospheric Scintillation Monitoring Receivers (ISMRs), but only a few tens of ISMRs are available and their data are provided just at a few locations and for short periods of time. In this tutorial, we will present a new technique developed by gAGE/UPC to monitor scintillation with conventional multi-frequency geodetic receivers operating at 1 Hz. This technique opens the door to use the huge databases available from permanent GNSS networks (such as the EUREF, IGS or others) for scintillation studies. |
| Abstract  This tutorial covers two key topics in GNSS positioning and its applications: The Galileo High Accuracy Service (HAS) and ionospheric scintillation. Galileo HAS offers real-time decimeter-level accuracy using GNSS constellations, with Service Level 2 enhanced by ionospheric corrections. In this regard, the tutorial describes a tool able to provide ionospheric corrections fulfilling the requirements of the Galileo HAS. Additionally, in the second session of the tutorial a novel technique that enables monitoring scintillation using conventional GNSS receivers will be introduced, expanding the potential for scintillation research across large GNSS networks.  The real time tools described in this tutorial are the result of the participation of the gAGE/UPC research group in several contracts awarded by the European Space Agency. |
| Learning Outcomes  It is expected at the end of the training that attendees:  • Familiarize with the Galileo High Accuracy Service (HAS), including its Service Levels (SL1 and SL2), requirements, and benefits from the user point of view.  • Practical application of the Galileo High Accuracy service (HAS): use of practical examples to achieve enhanced GNSS positioning accuracy using Galileo HAS, including a comparative for different type of navigation solutions.  • Updated Knowledge on the impact of Solar Activity on the ionosphere using GNSS.  • Understanding Ionospheric Scintillation: An introduction into the ionospheric scintillation, one of the key challenges in GNSS positioning. The training covers techniques for monitoring scintillation, with a focus on its impacts at low latitudes, where it is more frequent and intense.  • New Techniques for Scintillation Monitoring in real-time: Participants will be introduced to real-time techniques developed by gAGE/UPC that use conventional geodetic GNSS receivers for monitoring scintillation in a global scale. |
| Target audience  Since the tutorial covers a wide range of topics in fields of geodesy, cartography, GNSS, It Is addressed to professionals in such field with some experience. Also, postdocs and JRFs In those specifics areas. |
| Date created  May/2024. |
| Type  Live presentation with audience. |
| Format  Microsoft PPT presentation. |
| Publisher  UPC |
| Contributor/s  Research group of Astronomy and GEomatics (gAGE) of UPC. |
| Location (URL)  https://github.com/SpaceSUITE-ReactiveResponseCourses/GNSS-Contributions-to-Space-Weather |
| Language  English. |
| Source/s  Research papers from gAGE to be found at: https://gage.upc.edu/en/publications/peer-reviewed-papers-on-gnss |
| License  CC-BY-SA. |
| Duration  4 hours. |
| EQF level  EQF 7 & 8. |
| Table Of Contents   * First 2-hour tutorial: Real-Time Central Processing Facility for High Accuracy Navigation (IONO4HAS) * Second 2-hour tutorial: World-wide ionospheric scintillation monitoring in real time using non-specialized receivers. |
| Workload  Amount of time students are expected to invest in order to meet the defined learning outcomes, quantified using ECTS (European Credit Transfer and Accumulation System) credits. |
| Training Program  GNSS Training Program. |
| Prerequisites  Basic knowledge in GNSS systems (Single Point Positioning and Precise Point Positioning Techniques). |
| Type of assessment  NA. |
| Certification  Certification of attendance. |
| Title of the micro-credential  NA. |
| Microcredential awarding body  NA. |
| Relation/s (BoK)  NA. |
| BoK Links  NA. |