CORRECTION OF CYCLE SLIPS IN STAND-ALONE GPS RECEIVER DATA FOR PHASE SCINTLLATION INDEX EVALUATION

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Abstract:

Within the framework of the European Space Weather Pilot Project, intensive efforts are being deployed to assess and map ionospheric scintillation events on a global scale. This paper is concerned with the derivation and calibration of scintillation indices from GPS data available on a worldwide scale. More specifically, it addresses the problem of detecting and correcting the phase data from stand alone GPS receivers for cycle slips that usually occur during intense scintillation events.Cycle slips are receiver induced artefacts that are produced in the following manner. When a GPS receiver gets locked on a satellite, the relative phase (between 0 and 2p) of the received signal is measured and an integer counter is initialised. At any subsequent epoch, a new relative phase measurement is obtained and accumulated to the preceding values. The counter is incremented by one unit each time the cumulative phase changes from 2p to 0. Thus, at each epoch, the cumulative phase (in cycles) is the sum of the current relative phase plus the integer count. If, by accident, the phase lock loop of the receiver loses track of the signal, then the integer count is reinitialised. The measured cumulative phase then presents a discontinuity called cycle slip. Such cycle slips usually occur when bad propagation conditions are encountered resulting e.g. from the occurrence of intense ionospheric scintillation events in equatorial or auroral regions or from the presence of obstacles in the vicinity of the receiving antennas.If GPS data contaminated by cycle slips are used to derive phase scintillation indices, like sf , then large errors are usually observed in the results. It is thus a matter of concern to remove cycle slips from the raw data in order to derive reliable indices. Although algorithms exist for editing GPS phase data, most of them make use of the single or double difference scheme and are thus impracticable for stand-alone receiver data. In the present paper, the problem of detecting and correcting cycle slips in the phase measurements of a dual frequency stand-alone GPS receiver is investigated. Using a few illustrative examples, it is shown that a post-processing algorithm can be effective for correcting cycle slips. However, the reliability of the proposed still method remains to be assessed by extensive use in a variety of circumstances representative of common GPS receiver configurations.