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Precise orbit determination using GPS observations of all three-frequencies

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The new third frequency is widely believed to be capable to improve the performance of GNSS precise positioning. Nowadays, there are 10 BLOCK IIF GPS satellites transmitting signals of all three frequencies, which provides an opportunity to investigate the nature of biases among the signals of different frequencies and to access the impact of the third-frequency observations on the quality of products such as satellite orbits and clocks. In this study, two groups of independent ionosphere-free (IF) combinations formed by observables of the three frequencies, i.e L1/L2 and L1/L5, were adopted for the precise orbits determination and the related bias investigation. Using data of the MGEX network over three months, precise orbit determination is carried out using two above-mentioned IF combinations with range biases as determined parameters for accessing the impacts of the third-frequency data. Meanwhile, in order to analyze the phase bias between the two combined IF combinations, not only the residuals but also the estimated satellite orbits and clocks were compared with that derived from the standard IF combination of L1 and L2. Finally, the performance of ambiguity resolution for the new third frequency is also investigated. We detected the existence of a phase shift of 0.5 cycles on L5 observations from some special type of receivers to a group of GPS BLOCK IIF satellites. Special handling must be taken into consideration for reliable ambiguity resolution of the IF combination of L1 and L5.
Keywords: Precise orbit determination; Three frequencies; Phase bias; Code bias;