Modeling the radio occultation scintillation data of FORMOSAT-3/COSMIC

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The FORMOSAT-3/COSMIC(F3/C) probes radio occultation(RO) scintillation during 2007 to 2018, which records the climatology of RO scintillation in the 24th solar cycle as S4-index calculated from the receiving GNSS L1-band amplitude fluctuation. The F3/C scintillation data distributed normally occupying both atmosphere and ionosphere within range of 0km to 870km altitudes globally, whereas the scintillation detected by receiving the GHz signal shows very weak intensity and unclear distribution pattern. Therefore, the maximum S4-index(S4max) value is being chosen to study the most intensive/probable region of the GHz occultation scintillation, and the vertical integrated S4max is highly correlated with ground-based S4-index observations. To make the F3/C S4-index more applicable, the F3CGS4 model is developed to estimate scintillation intensity a ground-based GNSS user would suffer. By collecting the single S4max from the whole profile and neglecting all the rest of the S4 data, most of the S4max are located in Sporadic-E altitude within 90km to 110km, and the developed F3CGS4 model can only calculate the most intensive/probable S4-index by given time, location, and solar activity index F10.7, but insufficient data to calculate any occurrence information.

In this study, to have a better use of the F3/C S4-index data, we develop a method that boost the amount of intense S4-index by calculating local maximum of every 5km altitude bin in every single profile. The amount of our new intense S4-index dataset is therefore drastically increase more than about 140 times comparing with the original S4max. By extracting these local maximum from more than 1.5 million F3/C RO S4 vertical profiles observed during 2007 to 2018, we can calculate the monthly and hourly occurrence of S4-index at any given location and time around the globe, which are used to update the F3CGS4 model estimating the probability of L-band S4 scintillation on the ground. We further calculate the median of converted ground-based S4 and the

occurrence under various thresholds, and find the conversion factor in various local times, seasons, and latitudes. All the derived conversion factors are all in positive values, which validates that the assumption of scintillation occurrence is proportional to their intensity. With these conversion factors, one can instantly estimate the S4 scintillation occurrence by using any real-time occultation S4-index profile data above the target location within an hour. Good agreements between our model simulations and previous ground-based observations indicate that the updated F3CGS4 model can be used to calculate ground-based S4 occurrence. The next generation of RO satellite that FORMOSAT-7/COSMIC-2(F7/C2) will be launched in late June, 2019. Early results of the F3/C2 will also be displayed comparing with the F3/C S4-index.