ROT1 estimation by dual-frequency GPS receiver measurements with code bias multipath correction during magnetic storms

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Science Goal
Qualitatively understand the high-latitude ionospheric irregularities occurrence rate during the geomagnetic storms by dual-frequency GPS receiver with code noise multipath correction.

Rate of TEC index (ROTI)

\[ \text{ROTI} = \frac{TEC(t + \delta t) - TEC(t)}{\delta t} \]

PROS:
- only need 1Hz data rate for TEC irregularities.
- S4 and \( \phi_4 \) need data sampled at higher frequency (20 Hz or higher).

S4 and ROTI are highly dependent!

Kernel Density Estimation

\[ \text{Normalized Prob. Density} = \frac{1}{\text{BH 10-min. std. V.S. ROTI}} \]

The occurrence rate of TEC irregularities is more sensitive to BH and BD fluctuations.

Summary
- The CNM algorithm can mitigate the multipath and other error terms in the GPS range equation, better estimating the slant TEC and TEC fluctuations along the path.
- It can be further used to evaluate the scintillation activity with cheaper computing cost and open the possibility of using dense networks of inexpensive GNSS TEC monitors.

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