A model to estimate the L-band amplitude scintillation index from Swarm faceplate electron density measurements

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• There has been a growing interest in using Swarm data as a proxy for the GNSS scintillation activity.

• This in view also to exploit present and future LEO missions to model the effect of small-scale irregularities on L-band signals in the critical areas.

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GPS SCINTILLATION AND SWARM

Scintillation caused GPS signal interruption of Swarm
[Xiong et al., 2016; 2018]
• Inspired by WAM, we have the capability to **model the S4 index based on Swarm FP**
  
  • Significantly longer dataset w.r.t. DE2 (sol max conditions only)
  • Swarm carries other instruments which assist the interpretation and validation
  • More ground-based observations are now available for model validation

• The 16 Hz sampling rate, combined with the Swarm orbital features, allows modelling the effect of spatial scales with scale size of ~ 500 m along the Swarm flight direction (roughly N-S), which are slightly above the Fresnel’s scale relevant for L-band scintillations (few hundreds of metres) affecting the propagation of GNSS signals.
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S4 from Swarm is validated against S4 from GNSS receivers.

→ eSWua GNSS scintillation network (7+ low latitude stations) Sep 2021 – Apr 2023

Tatsuhiro Yokoyama (2017)
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Swarm A – ESWUA GNSS CONJUNCTIONS 09.2021-04.2023

SwarmA - 20-Oct-2021 11:50 --> 13-Apr-2023 17:02 -- L0=500 [m]
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SWARM A- MALINDI (KENYA) CONJUNCTIONS
01.07.2023- 31.01.2024
REMARCHES

- We developed a **Swarm amplitude scintillation index (S4)** for measuring irregularities that affect L-band Global Navigation Satellite Systems (GNSS) signals.

- Such an index from Swarm measurements is important for filling ground-based GNSS scintillation **measurement gaps**.

- We **validate** the model inputs and outputs using Swarm’s conjunctions with GNSS and ionosondes.

- This S4 data product has the potential to be used for **space weather applications** and for near real-time specification of the ionosphere.

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Swarm 10 Year Anniversary & Science Conference 2024