Total Electron Content Monitoring
Complemented with Crowdsourced GNSS Observations

G. Kłopotek, B. Soja, M. Awadaljeed, L. Crocetti, M. Rothacher, L. See, R. Weinacker, T. Sturn, I. McCallum, and V. Navarro

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Application of machine learning technology for GNSS IoT data fusion

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Camaliot - Goals

• GNSS IoT Data
  - Investigate alternative sources of GNSS observations
  - **Collection of GNSS community data**

• GNSS Big Data Processing
  - Framework for an automated, robust and scalable GNSS processing
  - Fusion of indices and models with huge and heterogeneous data sets of various quality

• Science Use Cases
  - Troposphere – Earth Weather
  - Ionosphere – Space Weather
Camaliot - Crowdsourcing Campaign

- Started March 17, 2022
- Android app with 35k+ installations
- 11k+ registered users
- Over 55 billion GNSS observations collected so far
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Camaliot Functional SW Architecture
Development of a self-contained SW running on Kubernetes and communicating with GSSC

- File/Stream Ingestion
- Data/Stream Processing
- Real-time Data Enrichment
- Data offload/aggregation
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Machine Learning For Spatial Interpolation and Forecasting

Example: Data fusion for the spatial modelling of ZWD

Distribution of training and test stations for all available stations (2019)

Talk by Laura Crocetti
G1.3: Fri, 27 May, 09:45
GNSS IoT Data Collection & Exploration
Exploring smartphone-based observations with dedicated measurement campaigns

Smartphones for STEC:
- Observations in the vicinity of the AGNES ETH2 station
- Geometry-free (L1/L5) combination for STEC
- Observations in the RINEX-3 format (Geo++ RINEX Logger)
- Investigating “raw” satellite-specific STEC time series for smartphones and ETH2

Platform for horizontal/vertical smartphone orientation during measurements
Examples of STEC time series from Xiaomi Mi8 (green) and ETH2 (red)
GNSS IoT Data Collection & Exploration
Examples of STEC time series from Xiaomi Mi8 (green) and ETH2 (red)

- STEC from Xiaomi Mi8 aligned (offset) manually to STEC from ETH2
GNSS Community Data
Examples of STEC time series from crowdsourced observations (as acquired from the Camaliot app)

- Observations uploaded by the users
- Geometry-free (L1/L5) combination for STEC
- Observations in the RINEX-3 format (Camaliot RINEX Converter)
- Investigating “raw” satellite-specific STEC aligned to the IONEX-based STEC time series (GIM from IGS)
GNSS Community Data

Examples of STEC time series from crowdsourced observations (as acquired from the Camaliot app)

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Summary

Camaliot Project:

- Collection of GNSS community data during the dedicated crowdsourcing campaign
- Development of the GNSS big data processing framework for the ML-based data fusion at scale

Smartphone-based GNSS observations:

- With the potential to be exploited for ionospheric monitoring (to a certain extent)
- Quality much lower compared to the conventional GNSS observations
- Frequent occurrence of observation gaps and cycle slips
- Dedicated screening and preprocessing stages needed to extract reliable ionospheric information

Visit [www.camaliot.org](http://www.camaliot.org) for more!

Try out the Camaliot App today!
THANK YOU FOR YOUR ATTENTION!

klopotek@ethz.ch