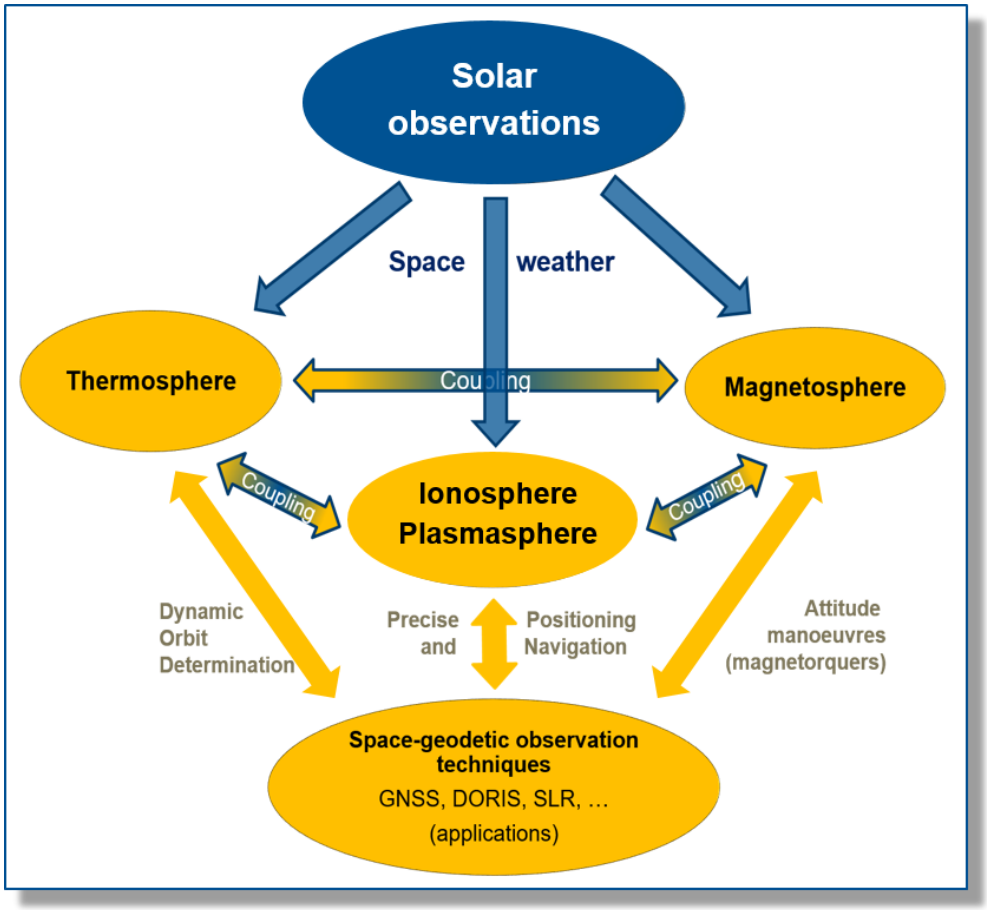
GGOS Focus Area: Geodetic Space Weather Research
Chair: M. Schmidt, Vice-Chair: E. Forootan

Present Status and Progress:

1. Due to the Corona pandemic almost all activities planned for the last year at conferences (e.g. EGU 2021) had again to be postponed, e.g. to 2022.
2. We arranged a **splinter meeting** of the FA-GSWR last year, at April 26, 2021.
3. At **EGU 2022:**
   - topics related to the FA-GSWR will be presented (in a hybrid manner) within the Session G5.1: **Ionosphere, thermosphere and space weather: monitoring and modelling**.
   - The main convener is Ehsan Forootan, Kristin Vielberg and Michael Schmidt are co-conveners.



- The session is scheduled for **Monday, May 23, 2022 from 8:30 to 11:05**. At present the session comprises altogether 15 presentations (on-site and online)

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Present Status and Progress:

4. In the last weeks or months we started with the preparation of the

   2nd International Symposium of IAG Commission 4

   which will take place from September 5 to 8, 2022 in Potsdam. This Symposium was initially scheduled for September 2020 but due to the Corona Pandemic postponed by 2 years.

Website: https://iag-commission4-symposium2022.net/

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Present Status and Progress:

4. On the website **General Information**, e.g., about the scientific content of the symposium can be found. Here some extracts:
   - … Besides positioning, another focus of the 2nd IAG Commission 4 Symposium will be on remote sensing and **modelling of the lower and upper atmosphere**.
   - This symposium will be carried out in close cooperation with the International GNSS Service (IGS), the **IAG Global Geodetic Observing System (GGOS) Focus Area "Geodetic Space Weather Research" …**
   - The Symposium will be co-sponsored by the **International Association of Geomagnetism and Aeronomy (IAGA) Inter-Division Commission on Space Weather** …
   - One **main topic** of the symposium reads: atmospheric investigations using space geodetic techniques and **space weather research**.

Website: https://iag-commission4-symposium2022.net/

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Present Status and Progress:

4. Further steps:
   - Two weeks ago we setup a first draft of the **session plan** for the 4 days (September 5 to 8, 2022) of the symposium
   - The **2nd Announcement** of the 2nd IAG Commission 4 Symposium with all necessary information will be published and presented soon
   - The **abstract submission** deadline will be **June 18, 2022**

   The **Local Organizing Committee** (LOC) is composed of Robert Heinkelmann (Chair), Anja Böhmer and Harald Schuh.

   The **Scientific Organizing Committee** (SOC) consists at present of 16 members. Among them are Ehsan Forootan and Michael Schmidt

   Furthermore, we invited 2 scientists (Stefan Lotz, Laure Lefevre) from **IAGA** to become members of the SOC

   This way we plan to **extend the scientific collaboration between IAG and IAGA** in terms of the topic **Space Weather**; we will set up a discussion round

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Present Status and Progress:

5. First draft of the **session plan** of the **28th General Assembly of the IUGG** in Berlin from July 11 to 20, 2023. Several sessions will be dedicated to **Geodetic Remote Sensing** including Atmosphere Modeling and Space Weather Research. Website: https://www.iugg2023berlin.org/
6. Based on the results of the **Fifth National Space Weather Workshop** held from September 21 to 23, 2021, online, a document was prepared by the **German space weather expert community** (e.g. from BKG, DLR, GFZ, DGFI-TUM) that includes recommendations for enhancing the German space weather capabilities and capacities in a coordinated approach.

Empfehlungen zum Ausbau der deutschen Weltraumwetter-Fähigkeiten und Kapazitäten in einem koordinierten Ansatz

In the next days or weeks this 13-page document – written in German – will be officially addressed to the **German Federal Government**

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Joint Study Group (JSG) and Joint Working Groups (JWG) related to the FA-GSWR:

- **JSG 1 (JSG T.27, ICCT)**: **Coupling processes between magnetosphere, thermosphere and ionosphere**
  - Chair: Andres Calabia Aibar (China), Vice-Chair: Munawar Shah (Pakistan),
  - 11 group members
- **JWG 1**: **Electron density modelling**.
  - Chair: Fabricio dos Santos Prol (Germany; Finland), Vice-Chair: Alberto Garcia-Rigo (Spain)
  - 18 group members
  - Fabricio dos Santos Prol moved from DLR (German Aerospace Center) in Neustrelitz Germany to the Finnish Geospatial Research Institute

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Joint Study Group (JSG) and Joint Working Groups (JWG) related to the FA-GSWR:

- **JWG 2: Improvement of thermosphere models**
  - Chair: Christian Siemes (The Netherlands), Vice-Chair: Kristin Vielberg (Germany)
  - 9 group members
- **JWG 3**: **Improved understanding of space weather events and their monitoring by satellite missions**.
  - Chair: Haixia Lyu (China), Vice-Chair: Benedikt Soja (Switzerland)
  - 11 group members
  - Haixia Lyu (China) took over the Chair from Alberto Garcia-Rigo (Spain)

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JWG 1 Electron density modelling: Present Status and Progress:

- Three **new 3D global electron density models** have been developed by the group members:
  - 1st **plasmaspheric** model using tomography and LEO satellites (Prol et al. 2022);
  - 2nd **climatological** model that describes the electron density from 50 km up to 20,000 km (Hoque et al. 2022);
  - 3rd **High-resolution** 3D electron density **tomography** using ~2700 GNSS receiver stations (Prol et al. 2021).
- **Advances** have been made in the development of a **simulated database** to perform the evaluations. Now the simulation is capable of:
  - Reproducing **pseudoranges** with **1m** accuracy in **L1** and **2m** in **ion-free**;
  - Reproducing **carrier-phase** with **1m** accuracy in **L1** and **0.2m** in **ion-free**;
  - Reproducing **Doppler-Shift** with **0.2m/s** accuracy in **L1** and **ion-free**;

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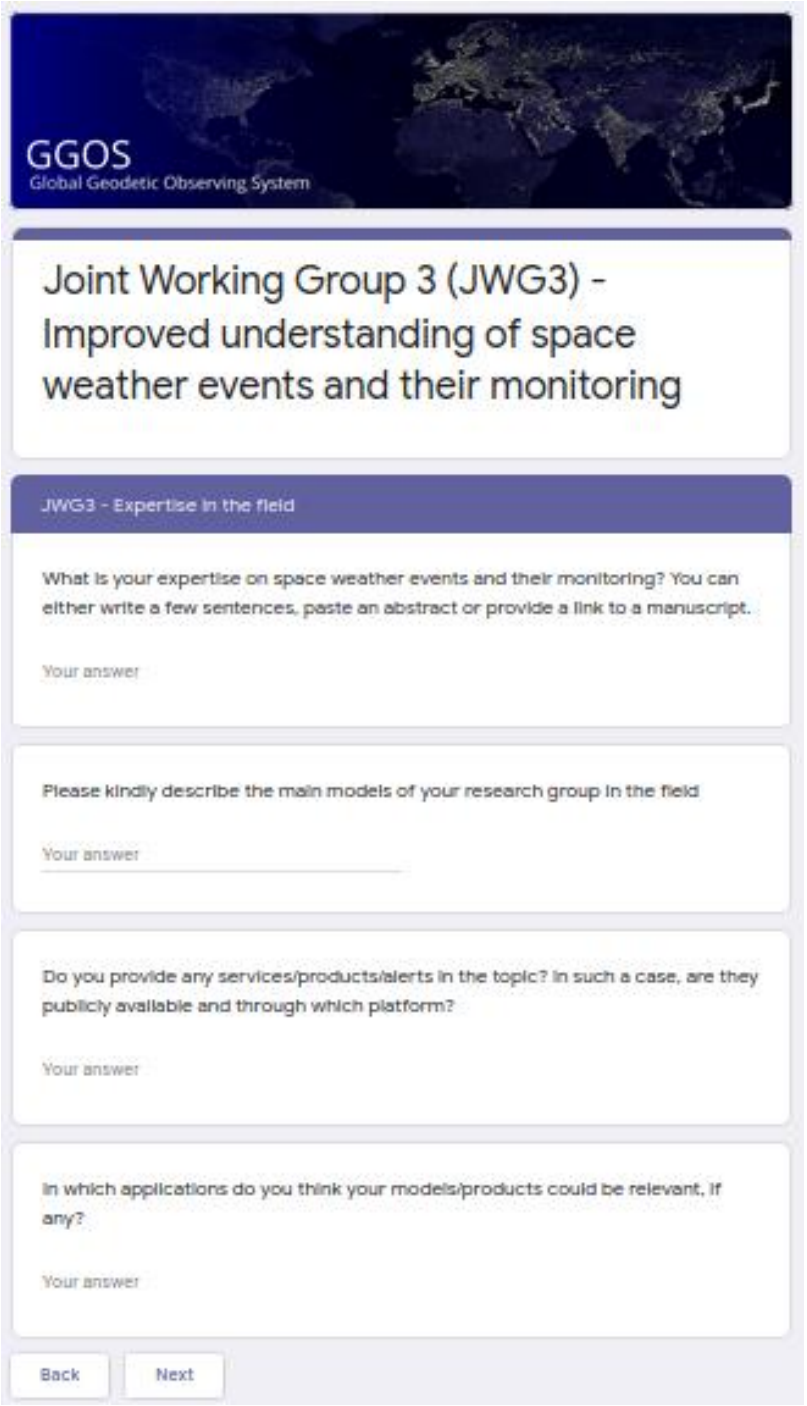
JWG 3: Improved understanding of space weather events and their monitoring by satellite missions: Present Status and Progress:

1. **Google Form Survey** to gather feedback from JWG3 members

JWG3 – Google Form Survey



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JWG 3: Improved understanding of space weather events and their monitoring by satellite missions: Present Status and Progress:

1. **Google Form Survey** to gather feedback from JWG3 members
2. **Selection** of a set of **historical representative space weather events** to be analyzed
3. **Identification of Space Weather (SW) data sources** accessible by the team members
4. **Teleconference with JWG1** on collaboration
5. **Collection** of progress on **selected storm scenarios** within the group for collaboration with JWG1
6. **Analysis of the correlation** between SW products and perturbed ionospheric electron density/TEC
7. **Identification of the main parameters** that could be useful to improve real time determination as well as prediction of ionospheric/plasmaspheric TEC and electron density estimates, in case of extreme solar weather conditions.

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JWG 3: Improved understanding of space weather events and their monitoring by satellite missions: Future Plans:

1. **Improving (near) real time determination** of the electron density within the ionosphere and plasmasphere to detect space weather events in **collaboration with JWG1**.

2. **Combination of measurements** and estimates derived **from space geodetic observation techniques and from solar spacecraft missions** by conducting extensive simulations, combining different data sets and testing different algorithms.

3. **Comparison and validation** using external data, in particular data from spacecraft.