

Focus Area on Geodetic Space Weather Research – Current Status

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Space Weather

- **Space weather** is a very **up-to-date** and **interdisciplinary** field of research.
- It describes **physical processes** in space mainly caused by the Sun's **radiation** of energy and **plasma** release.
- There are multiple **manifestations** of **space weather**, e.g., the variations of the Earth magnetic field, the polar lights as well as the variations of the **ionosphere** and **thermosphere** (due to coupled processes)..
- The **most extreme known space weather event** happened at September 1, 1859 – the **Carrington storm**.
- Prominent recent events are the **Halloween storm** at October 28 – 30, 2003, the **Bastille Day Event** at July 14, 2000 or the **St. Patrick's storm** at March 17, 2015.
- The **strength** of these events, their **impacts** on modern society and the possibility of much stronger **future events** have brought several countries to recognize the necessity
 - of studying these **impacts scientifically**,
 - to establish space weather data centers and **space weather services**.

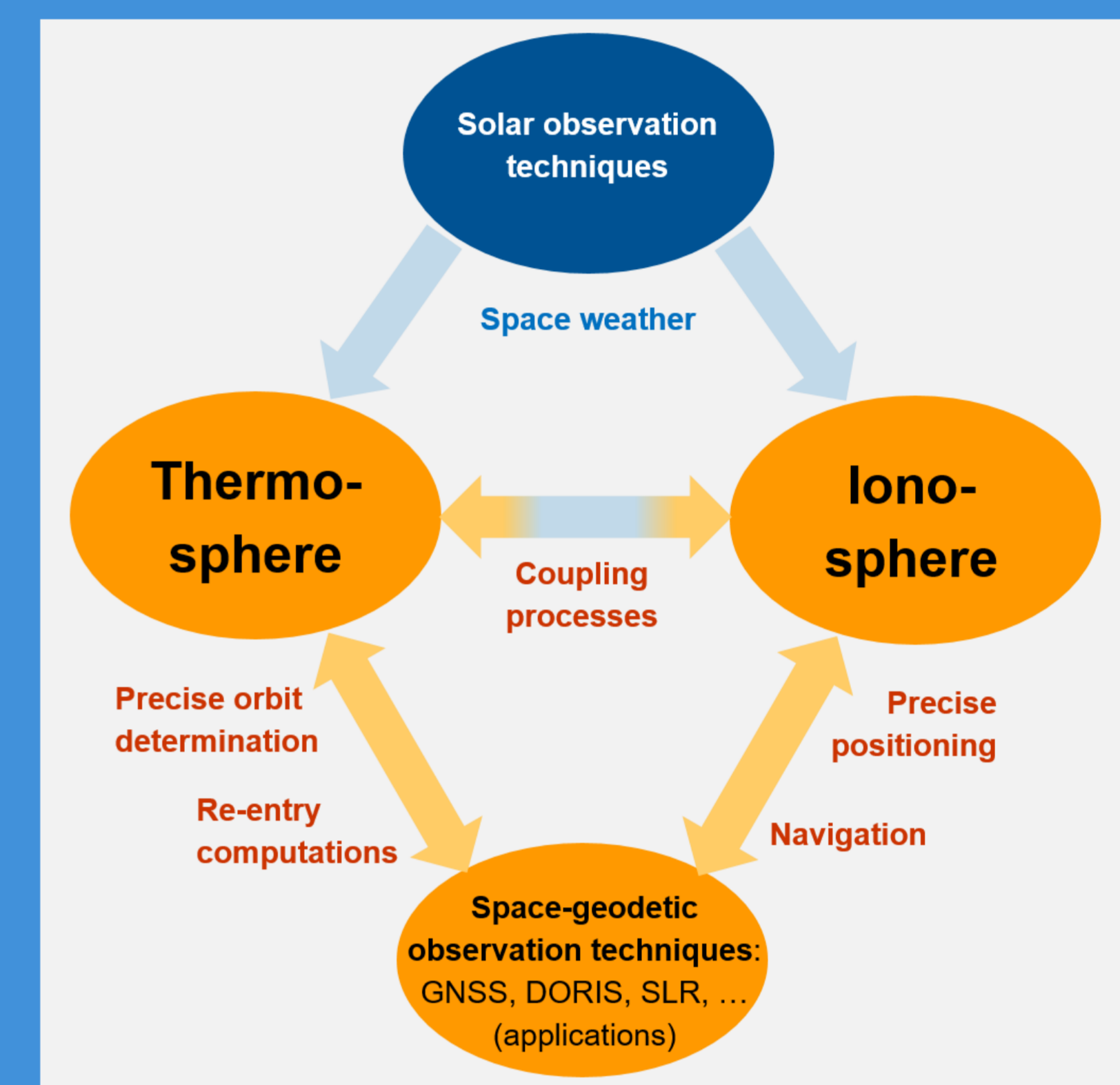


Figure 1: Structure of the FA-GSWR illustrated by a diamond. The orange parts can mainly be covered by geodesy (space-geodetic measurement techniques and evaluation methods); for the blue parts interdisciplinary studies and investigations have to be performed.

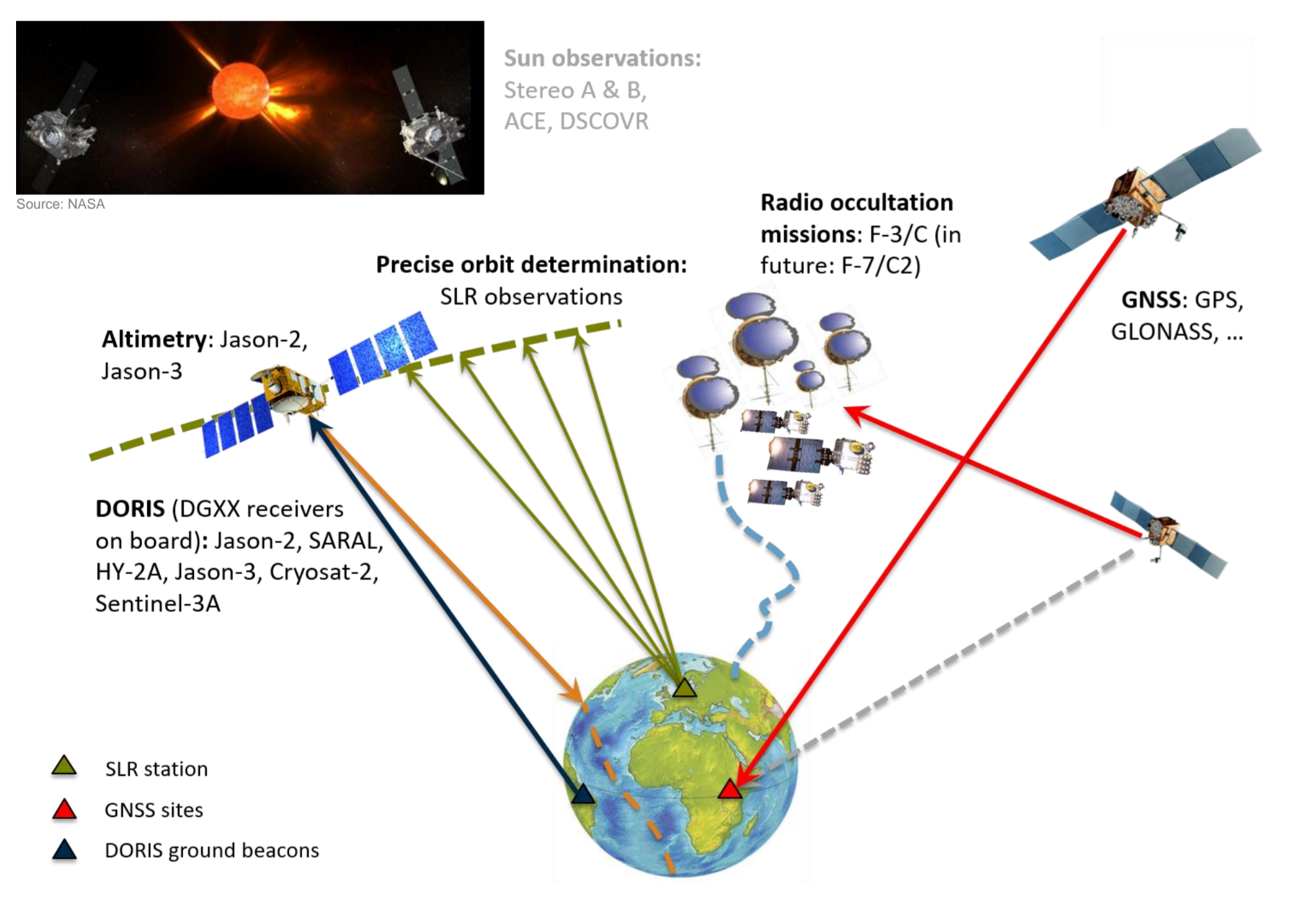


Figure 2: Space-geodetic observation techniques for monitoring and modelling the thermosphere-ionosphere system. Sun observations from solar missions will be used to forecast space weather events.

Geodetic Monitoring

- Figure 1 illustrates the **structure** of the Focus Area on Geodetic Space Weather Research (FA-GSWR) as a rhombus
- **Satellite Geodesy** deals for a long time with the ionosphere (PPP) and the thermosphere (POD)
- **Thermospheric drag** is the most important force acting on Low-Earth Orbiting (LEO) satellites and objects in the re-entry stage
- Figure 2 gives an overview about the space-geodetic observation techniques which provide valuable information about the **coupled thermosphere-ionosphere (TIC)** system
- The **properties of the upper atmosphere** have a strong impact on the execution of **fundamental geodetic tasks** such as positioning and gravity field modelling
- Geodesy has a long history and large experience in developing sophisticated **analysis techniques** and **modelling approaches**

Objectives of the FA-GSWR

The **main objectives** are:

- improvement of **precise point positioning** and **navigation** by developing high-precision and high-resolution models of the electron density (**PPP**)
- improvement of **precise orbit determination** by developing high-precision and high-resolution **thermospheric drag models (POD)**
- Study of the **coupled processes** between thermosphere and ionosphere (**TIC**)

Joint Study Groups (JSG) and Joint Working Groups (JWG)

For the **realization** of the objectives one **new GGOS JSG** and three **new GGOS JWGs** will be installed:

- JSG 1: Improved **understanding** of the **coupled processes** (implemented within IAG ICCT and joint with GGOS); chair person: Andres Calabia Aibar
- JWG 1: **Electron density modelling** (joint with IAG Com. 4); chair person: Fabricio dos Santos Prol
- JWG 2: **Thermosphere modelling** including physics-based realisations of the coupled thermosphere-ionosphere processes (joint with IAG Com. 4); chair position: still vacant
- JWG 3: Improved **understanding** of **space weather events** and their **monitoring** by **satellite missions** (joint with IAG Com. 4); chair position still vacant

Essential Geodetic Variables (EGV)

- Since main geodetic tasks are depending on the properties of the upper atmosphere, the **electron density** and the **neutral density** are the most important EGVs from the view of the FA-GSWR.