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Space Weather activities in Austria (update for 2021)

presenter: Manuela Temmer
University of Graz (on behalf of the Austrian Space Weather Community)

Space Weather services from Austria

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Space Weather is an important issue of global matter and global efforts but needs also coordinated collaboration on a national level. The *University of Graz* and its Kanzelhöhe Observatory for Solar and Environmental Research (KSO) is ISES member and regional Space Weather warning center of Austria (**weltraumwetter.at/spaceweather.at**).

The *Conrad Observatory (ZAMG)* just recently submitted to the FFG a proposal outlining plans to consolidate and expand on Space Weather efforts in Austria and create a national data portal. The consortium behind the proposal is made up of **8 national partners**, with both research groups and industries affected by space weather contributing.

Picture shows the start of coordinated efforts in 2015 (meeting at KSO).

1. Österr. Weltraumwetter Workshop at KSO

Furthermore, a proposal to establish a crisis management plan for Austria in the case of failure of the electrical power supply and their IT-systems caused by solar storms was submitted to the FFG by *Joanneum Research Graz*. The consortium consists of **7 national partners**.

The Austrian Space Weather Community is growing!

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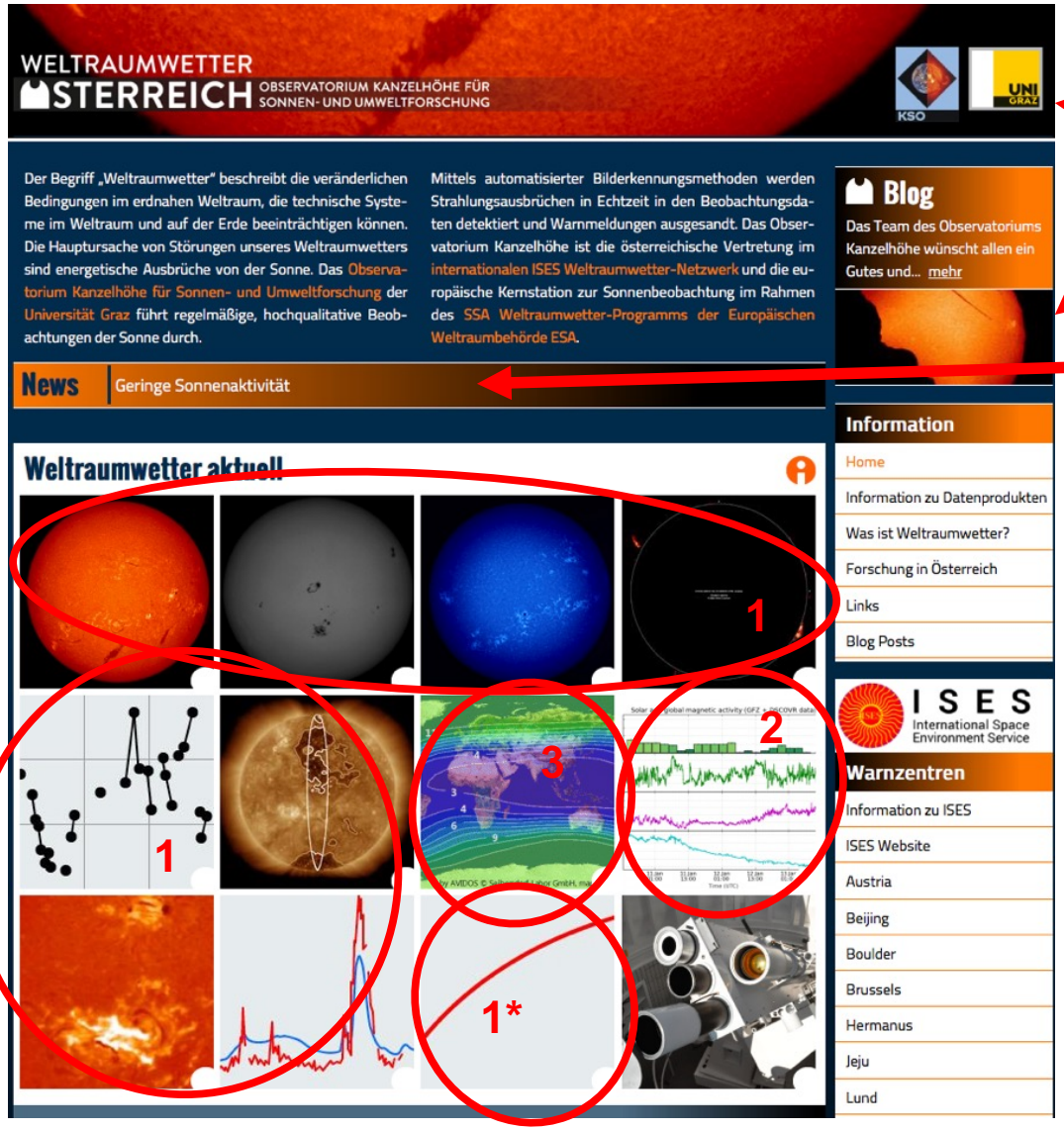
Weltraumwetter.at / Spaceweather.at

new portal covering ALL key players aimed for 2021+!



Kanzelhöhe Solar Observatory (UNI Graz) – ISES RWC for Austria

Public outreach

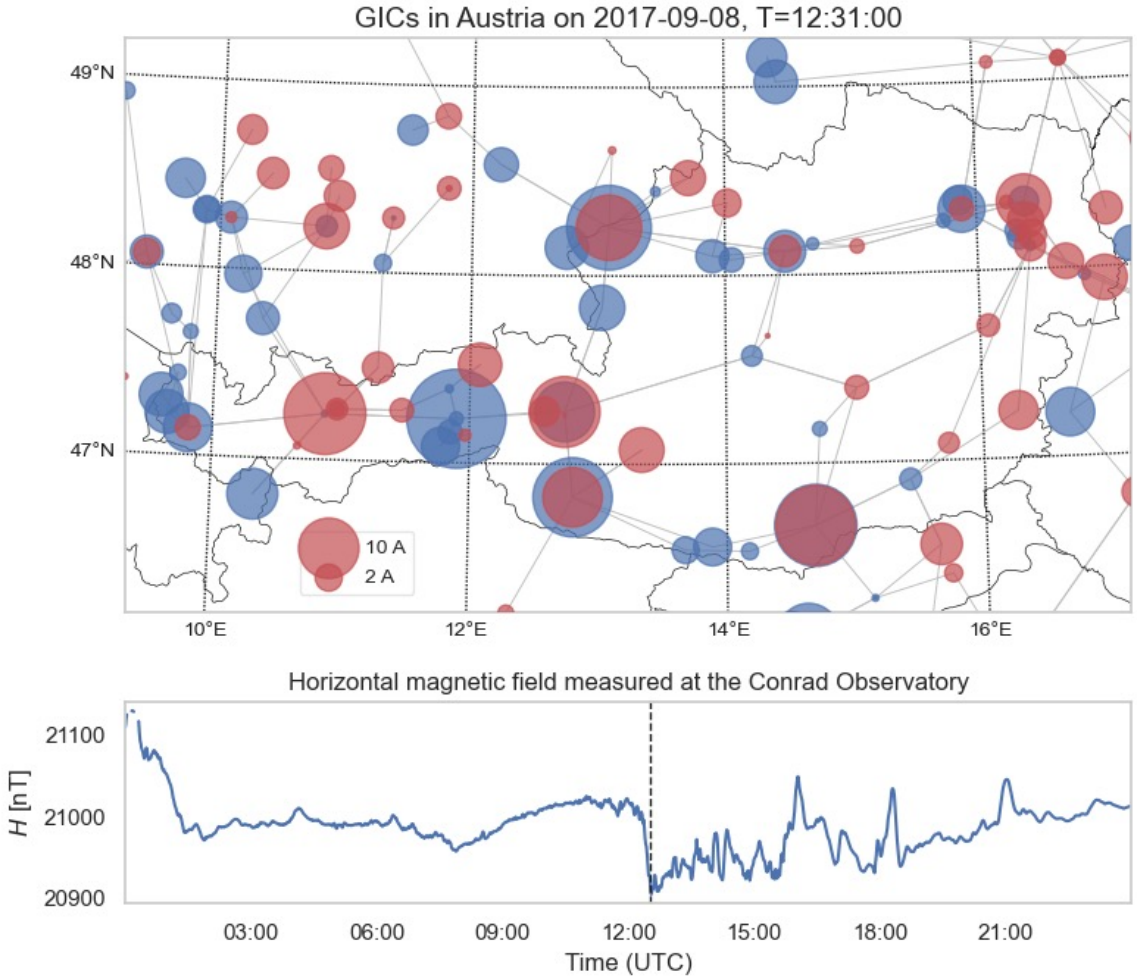
Alerts (based on automatic flare detection at KSO)

Space Weather (research, services, satellites) in Austria:

- University of Graz **1**
- Conrad Observatory **2**
- Seibersdorf Laboratories **3**
- IWF Graz / Space Research Institute

- [University of Zagreb] **1***

Conrad Observatory/ZAMG
Geomagnetically induced Currents in Austria



Geomagnetic Observatory part of the „Zentralanstalt für Meteorologie und Geodynamik“

Real-time *H* measurements

Currently working on forecasting local GICs from incoming solar wind data using deep learning.

FFG funded GEOMAGICA project partners: Austrian Power Grid, British Geological Survey, TU Graz, ...

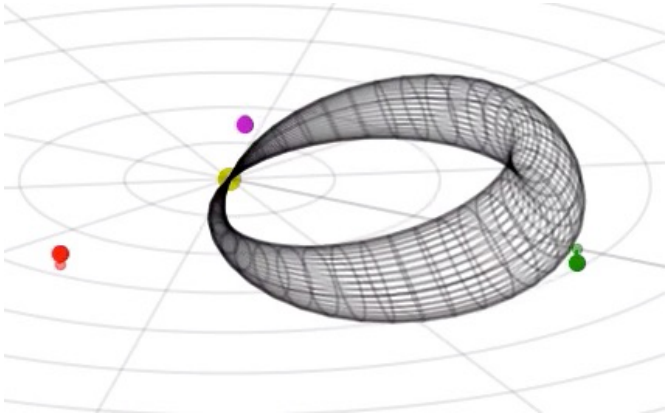
For more details see:
https://www.conrad-observatory.at/index.php/data-en/daily-magnetogram

ZAMG

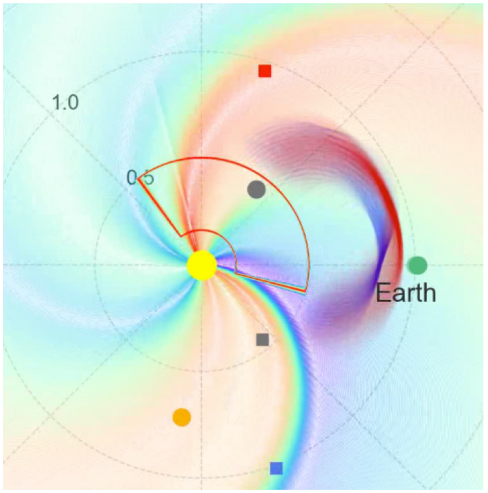
ÖAW IWF

IWF/OEAW SPACE WEATHER ACTIVITIES

Hardware & data analysis & theory contribution to ongoing and future space missions for studying space weather sciences



- Research topics:
  - Solar wind and CME modeling, prediction and verification
  - Solar wind- Earth's/planets' magnetosphere interaction



- Science/Hardware contribution to space weather missions
  - Space weather Monitoring (**ESA SSA program**)
    > GEO-KOMPSAT-2A mission (operating since Jan 2019): SOSMAG (Service Oriented Spacecraft Magnetometer)
    >Lagrange mission L5 (planning): magnetometer, CME propagation models
  - Space weather Science:
    Solar Orbiter (Launch 2020), SMILE (Solar wind Magnetosphere Ionosphere Link Explorer) (Launch 2022)

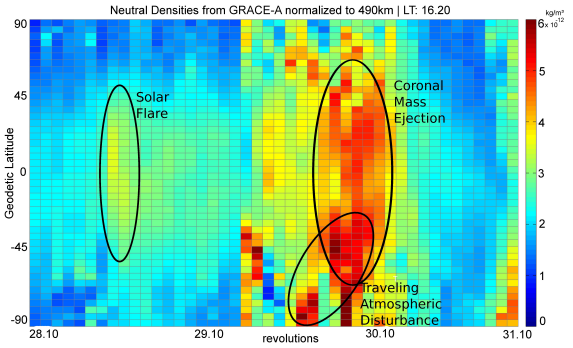
Graz University of Technology

Institute of Geodesy
Working Group „**Theoretical Geodesy and Satellite Geodesy**“

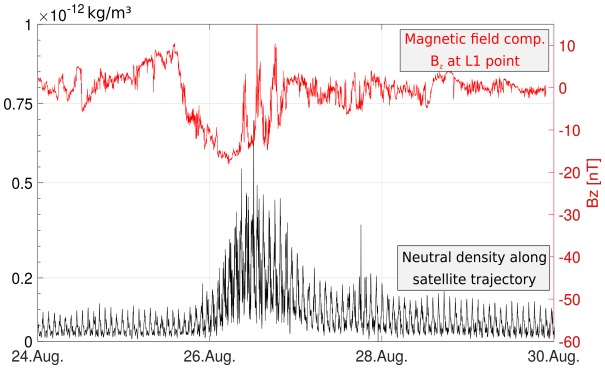
Space Weather:

The research is accomplished in the framework of the ASAP FFG-Project SWEETS (PN: 878876)

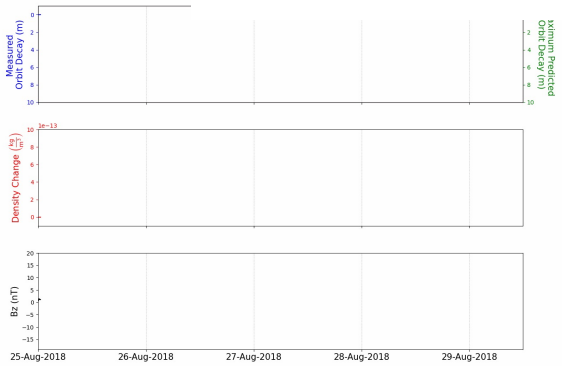
- Estimation of thermospheric densities from kinematic satellite orbits and on-board accelerometer measurements
- Exploring thermospheric variations triggered by solar events like solar flares and coronal mass ejections
- Interaction with interplanetary- and geomagnetic field based on satellite and terrestrial observations
- Forecast of thermospheric densities and satellite orbit decays based on interplanetary observations at the L1 point.



Correlation studies



Forecasting orbit decays



Cooperations:

- University of Graz, Institute of Physics
- Austrian Academy of Sciences, Space Research Institute

Graz University of Technology

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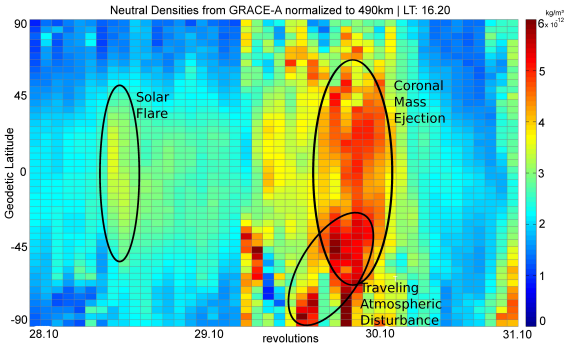

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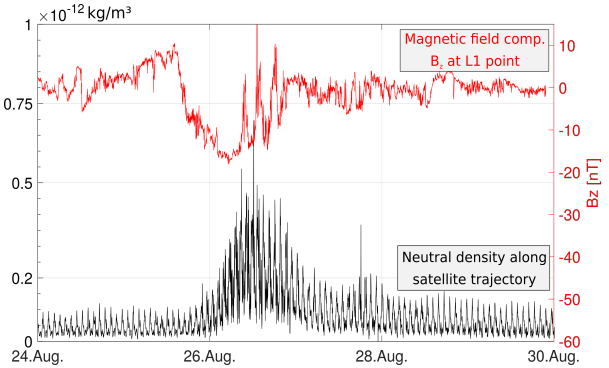

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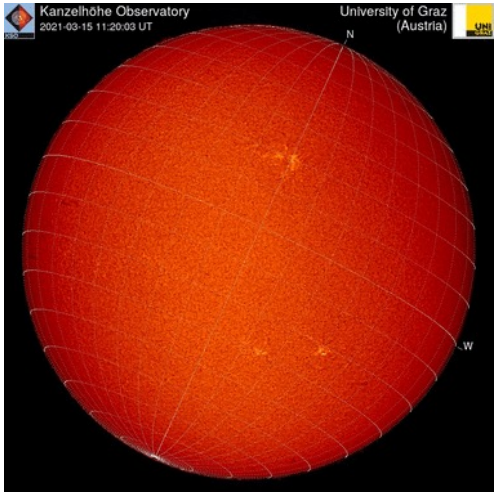
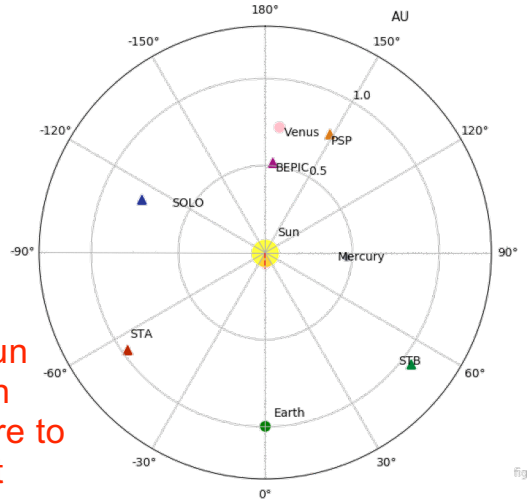


From Sun through Heliosphere to Impact



Animation info
Date: 15 Mar 2021
Time: 15:39 h
Transit time: 0.0 h
Speed, v: 998km/s
Distance: 0.09 AU

DBM results
CME arrival (at Earth)
Date: 17 Mar 2021
Time: 17:21 h
Transit time: 49.71 h
Speed at target: 635 km/s
Distance (target): 1.0 AU

Input parameters
CME date: 15 Mar 2021
CME time: 15:39 h
Drag, γ: 0.2 $\times 10^{-7} km^{-1}$
SW speed, w: 450 km/s
Radial dist., R_0: 20 r_{Sun}
CME init. speed, v_0: 1000 km/s
CME half-width, λ: 30.0 deg
CME long., ϕ_{CME}: 0.0 deg
Target: Earth

figure generated with DBEMv3

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- Kanzelhöhe Observatory is ESA Expert Service Group for **Solar Weather** (real-time flare alerts and filament detection) – kso.ac.at
- ISES member and regional Space Weather warning center of Austria
- Institute of Physics is ESA Expert Service Group for **Heliospheric Weather** (CME propagation, solar wind forecast) - swe.uni-graz.at
- Together with the Technical University of Graz (TU Graz), the goal to become an ESA Expert Service Group for **Ionospheric Weather** is on track (short-term forecast and nowcast of satellite orbit decays due to thermospheric density enhancement is funded by the FFG-ASAP project SWEETS)
- iSWAT-COSPAR member – join the international Space Weather Action Teams under https://www.iswat-cospar.org

https://avidos.seibersdorf-laboratories.at/avidos.html

SEIBERSDORF LABORATORIES

Space Weather at Seibersdorf Laboratories

Research & Services

Radiation exposure at aviation altitudes

- Galactic Cosmic Rays (GCR), Solar Energetic Particles (SEP)
- **AVIDOS** (aviation dosimetry) service for:
  - International Civil Aviation Organization (**ICAO**) via **PECASUS** - Partnership of Excellence for Civil Aviation Space weather User Services
  - European Space Agency - **ESA** Space Weather Service Network
  - Airlines

Radiation detectors

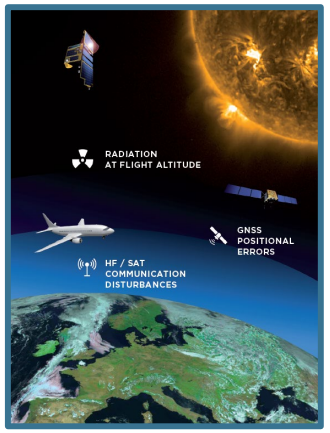
- Tissue Equivalent Proportional Counter (**TEPC**) for
  - International Space Station (**ISS**)
  - On-board aircraft and terrestrial measurements

Space radiation dose modeling

- Monte Carlo simulation techniques (**FLUKA, Geant4**)

Radiation Hardness Assurance for space applications

- **Accredited testing** services of space electronics



https://www.seibersdorf-laboratories.at/en/products/ionizing-radiation/dosimetry/aircrew-dosimetry-service

https://www.seibersdorf-laboratories.at/en/products/ionizing-radiation/radiation-hardness-assurance

DI Dr. Peter Beck, DI Dr. Marcin Latocha
DI Dr. Michael Wind, DI Christoph Tscherne,
Lukas Huber

Summary

Space Weather is an important issue of global matter and global efforts but needs also coordinated collaboration on a national level.

- Austria currently covers 4 out of 5 service domains from the ESA/SSA Expert Service Centers on *Solar Weather, *Heliospheric Weather, *Space Radiation, and *Ionospheric Weather
- We aim to deepen our national collaboration on Space Weather with industrial partners and “end-users” (FFG project SWAP submitted)
- We aim to bring our current internet presentation to the next level supporting industrial partners **spaceweather.at/weltraumwetter.at**
- We aim to develop a crisis management plan for Austria (FFG project ELSON submitted)
- We aim to create a national roadmap for the future strategic development and promotion of space weather research (funding is needed!).