

# 2013 intermediate report on German activities related to ISWI

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*Dr. Michael A. Danielides <sup>1,2)</sup>*

*1) Danielides Space Science Consulting, Ernst-Moritz-Arndt Str. 11, 17129 Bentzin, Germany*

*2) CAU Kiel, Leibnizstr. 11, 24118 Kiel, Germany*

*E-Mail: [michael@danielides.com](mailto:michael@danielides.com)*

Heliospheric-, solar-, near planetary environment space physics as well as space weather (SW) research is performed by several German research institutes, universities and cooperations. The following institutions involved are the Astrophysical Institute Potsdam (AIP), the Geophysical Institute Potsdam (GFZ), the Christian-Albrechts-University (CAU) of Kiel, the German Aerospace Center (DLR e.V.), the Technical University Berlin (TU-Berlin), the Technical University Braunschweig (TU-Braunschweig), the University Osnabrück (UO), the Kiepenheuer-Institute for Solar Physics (KIS), the Max-Planck Institute for Solar System Research (MPS) at Katlenburg-Lindau as well as the nearby University of Göttingen. All of these institutions are actively involved in educating and/or supervising graduate and post-graduate students. It shall be mentioned that recently the University of Cologne introduced degree classes in space physics.

## **Brief summary on the institutional activities**

In the following publicly announced activities from some of the above mentioned institutions are sketched:

The AIP is studying solar radio emission which may interfere with signals transmitted from Global Navigation Satellite Systems (GNSS). Contributions are made to the European LOFAR project by operating a national network and related data analysis.

The nearby GFZ is playing a major role in ESAs SWARM satellite project, which is generally known as the following up mission on the former CLUSTER I&II missions the CHAMP satellite mission and GRACE satellite mission. SWARM is providing a great deal of unique information on the near Earth space environment and is valuable for the understanding of the physics behind SW impacts on Earth.

The CAU of Kiel works on a broad spectrum of ISWI related topics. One focus lays on studying the role of Galactic Cosmic Rays (GCR) as an element of SW happenings. Galactic cosmic rays are high-energetic charged particles - mainly protons, doubly ionized helium as well as other fully ionized nuclei- with galactic origin. Earth is 'bombarded' permanently by those particles. CAU of Kiel is utilizing various particle detectors and investigates the change of 'cosmic particle-bombardment' with different spacial and temporal resolution and in respect of occurring solar SW events and variations of geomagnetic conditions. Also the role of interplanetary coronal mass ejections (ICMEs) in causing for-bush decreases, and co-rotating interaction regions causing recurrent decreases in the GCR intensity observed at Earth, causes SW effects. These topics are permanent study aims.

Together with the German Electron-Synchrotron (DESY – which is part of the German Helmholtz Society) and the North-West University at Potchefstroom – South Africa the study on “Installation and data acquisition of a combined neutron monitor and muon telescope on board the Polarstern and the Neumayer station” is ongoing.

Also there are ongoing negotiations regarding moving the muon monitor of the Greifswald University to Kiel.

The DLR e.V. is operating the so-called “Space Weather Application Center Ionosphere” (SWACI) at its Neustrelitz site. There are ambitions to expand – based on the SWACI activities – into an 'ionosphere prediction center'. Here the connections with several partners, such as the Space Weather European Network (SWENET), NOAA, NASA and ESA may be helpful. Also SWACI is already embedded into the ESA-SSA project and other EC FP-7 projects (e.g. ESPAS). For ISWI is one particular interesting aspect included to SWACI. Since the IHY the DLR e.V. had various (partly very successful) attempts on attracting K12 education to SW monitoring. The former “Solar & Ionosphere Monitoring Network” (SIMONE), which was a joint project of many German institutions based at Neustrelitz, has been transferred into the “Solar Flares detected by Ionospheric Effects” (SOFIE) project hosted at the DLR e.V. School\_Lab at Neustrelitz. Both the former and the new K12 outreach activity utilized an idea promoted by Stanford Solar Center – USA on passive monitoring of solar x-ray flares, which are detected as sudden ionospheric disturbances (SID) in the VLF band. There are no reports available on today's status of the SOFIE project and its nowadays outreach impact on the K12 education here in Germany.

The DLR e.V. is engaged in organizing international summer schools on SW aspects. There is especially the annual German – USA “Joint Space Weather Camp” in co-operation with University of Huntsville – Alabama – USA, the University of Rostock and the IAP in Kühlungsborn to name.

At the Center for Astronomy and Astrophysics of the Technical University of Berlin studies particle transports within the heliosphere utilizing Monte-Carlo simulations are performed.

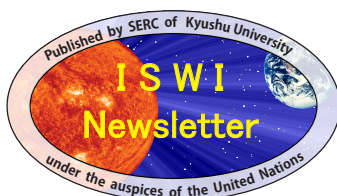
A since 13 years ongoing process is the calibration of the magnetic field data collected by CLUSTER missions at the Technical University of Braunschweig. The operation of the THEMIS-magnetometer is also located in Braunschweig.

The Kiepenheuer-Institut für Sonnenphysik (KIS) conducts experimental and theoretical investigations of physical processes on and within the Sun. KIS operates the German solar telescopes at Teide Observatory on Tenerife (Spain) where most of the scientific observations are performed. KIS still operates the old solar observatory on the Schauinsland mountain near Freiburg, in particular for training and public outreach purposes.

Researchers at the University Osnabrück are constantly enhancing their Atmospheric Ionization Model Osnabrück (AIMOS). It is an up to 3-D numerical model of ionization due to precipitating particles and useful for computing, e.g., ionospheric ionizations, mapping particle fluxes as well as modeling quiet conditions and times of enhanced solar particle-bombardment. Utilizing AIMOS for ISWI related studies and education would be beneficial.

Solar research at the University of Göttingen is basically scientific data analysis in the framework of solar heliosphere missions. For future solar missions the university is contributing developments to both NASA and ESA. The university is also involved with SW EC FP-7 projects (e.g. AFFECTS).

The research at the MPS is directed at the generation and extrapolation of solar magnetic fields, the source regions for space weather, using a nonlinear force-free magnetic field extrapolation model. To better understand solar causes of SW processes, MHD simulation studies are performed using data of the Solar Dynamic Observatory (SDO). Solar energetic particles observed by the STEREO mission using IMPACT are tracked down from Sun to Earth, where they become geo-effective. During solar maximum the studies are extended. Extreme ultraviolet (EUV) observations from the two STEREO spacecrafts and SDO are used to identify the sites of solar energetic particles (SEPs) measured by particle detectors on STEREO and ACE spacecrafts. SW impacts of SEPs on Earth depend on their generation process, whether they are generated in a flare or further out in the solar corona.



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## Public Outreach, schools and other activities

Following are present or recent activities related to ISWI in Germany listed:

- The ISWI-Germany website is currently offline due technical matters at [www.aef-ev.de](http://www.aef-ev.de). The new ISWI-Germany website will be located at <http://www.iswi-germany.de> from the beginning of October 2013.
- The annual spring meeting of the German Physics Society and the AEF is hosting regularly a session on SW and ISWI. In 2013 Prof. M.-B. Kallenrode and Mr. T. Bayer were invited speakers.
- A group of SW experts and radio amateurs have founded the InFlaMo project (<http://www.inflamo.org>), which utilizes similar methods as the Standford Solar Center – USA monitoring SID. The projects aim is to cover a global meridian from high to low latitudes, having already stations from Finland till South Africa under construction. A generalized understanding of ionospheric reaction on SW impacts is one special aim beside the obvious outreach character of the project.
- The group 'International Space Weather Initiative (ISWI) followers forum' was set up at the social network <http://www.linkedin.com> and is moderated by Dr. Danielides as a part of Germanies participation to promote ISWI.
- SW is promoted more generally in the press. Local newspapers are speculating on aurora visibility in northern Germany during solar maximum.
- A questionnaire to the German physics sections related to SW (e.g. ET-Physics, Plasma-Physics, Numerical-Physics, etc.) was distributed and new results of ISWI related activities within Germany are implemented in this report. Among the many answers Prof. Karl-Heinz Glaßmeier provided (in private communication) a very helpful comment: "... there is the impression that SW is mainly seen in connection with solar activities. It is regrettable that the internal dynamics of Earth magnetosphere is often underestimated and therefor not as much investigated. ...".

In general it was obvious that the German physics community is not aware on the existents of ISWI despite the fact that there are sessions on meetings in Germany devoted to ISWI and SW.

- The results of a former German research program on 'Geomagnetic Variations' including palaeo-magnetospheres and space climatology might be of interest for the ISWI community: Glassmeier, K. H., H. Soffel, J. W. Negendank (Eds.), *Geomagnetic Variations, Space-Time Structure, Processes, and Effects on System Earth*, Springer Verlag, Heidelberg, 2009.
- Dr. Danielides was granted by the EISCAT Association personal EISCAT measurement time, which lead to the following presentation: M. Danielides, M. Rietveld, M. Kosch, A. Senior, N. Jakowski, *A Case-Study: Correlation of GNSS Distortions and the Aurora During Increasing Solar Activity*, DPG Jahrestagung (Fachverband ET) Stuttgart, 12.-16. March, 2012, Germany.

*Disclaimer: This report was prepared on for the author available and generally known information only. If activities are not mentioned, then those have not been brought to the authors attention and therefore could not have been included. If your activities are missing or incorrect represented please contact Dr. Michael Danielides via E-Mail ([michael@danielides.com](mailto:michael@danielides.com)) and the correction will be included to the next German ISWI report.*