# Geomagnetic Tools for Space Weather Monitoring

Stolle, C; Matzka, J; Korte, M; Linthe, H-J; Park, J; Kervalishvili, G; Rauberg, J; Lühr, H

Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences
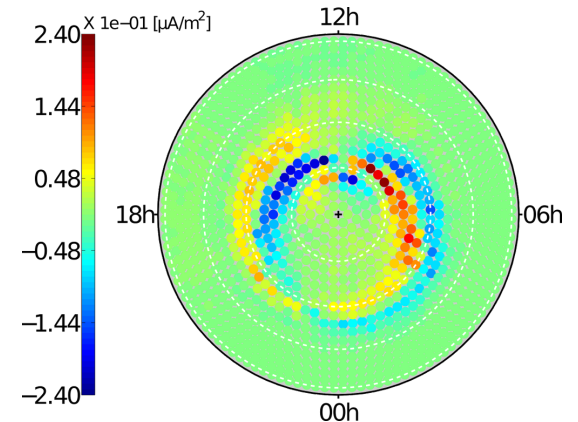Contact: cstolle@gfz-potsdam.de

Objectives:

- Magnetic variations provide **real time observations** of ionospheric and magnetospheric currents, describe the **geomagnetic activity** state of the Sun-Earth system

- Space Weather capabilities from **ground magnetic observatories** and the **Swarm satellite** constellation mission

- The shape and strength of the geomagnetic **main field** determines the **location and strengths of ionospheric current** systems
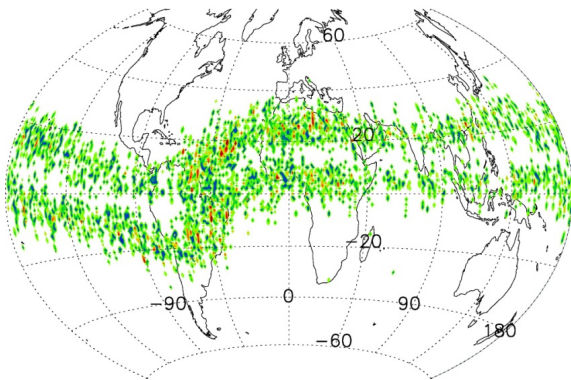
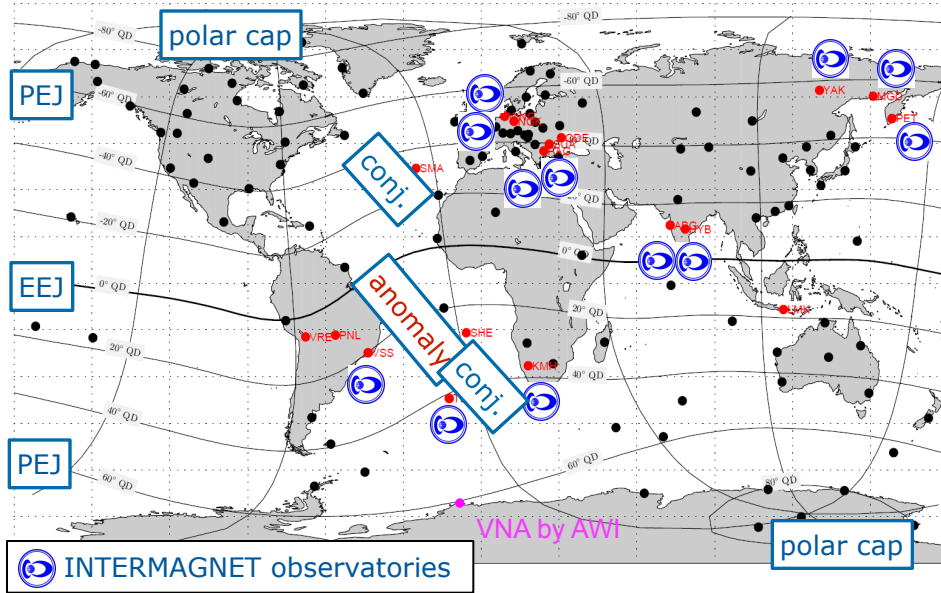**Nr. of detected equatorial plasma irregularities from 9 years of magnetic CHAMP satellite data**
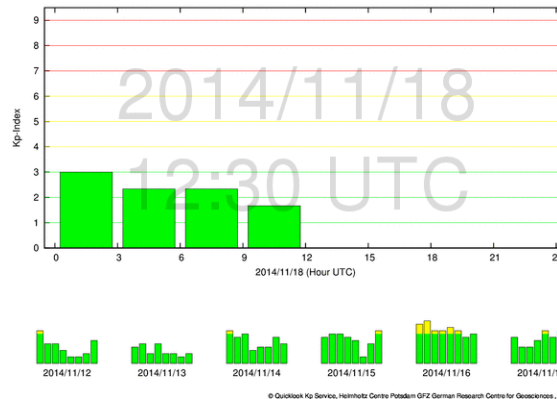
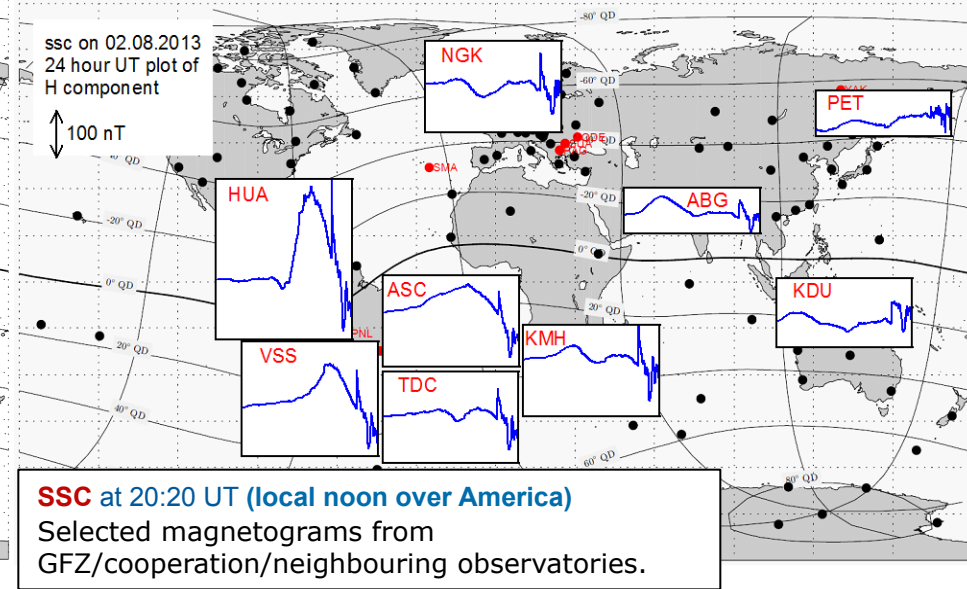**Real time Kp index from ground magnetic observatories produced at and available from GFZ Potsdam**

Auroral field-aligned currents derived from Swarm-A magnetic data (NH, local summer)

ESWW11, Session 9, Poster 30-e
Stolle et al., Geomagnetic Tools for Space Weather Monitoring
Contact: cstolle@gfz-potsdam.de

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ | ASSOCIATION

GFZ network of geomagnetic observatories

Stations of GFZ and cooperation partners
Station of the German AWI

Potential of a global network to detect sudden commencements
(strong amplitudes on dayside)

ssc on 02.08.2013
24 hour UT plot of H component

100 nT

SSC at 20:20 UT **(local noon over America)**
Selected magnetograms from GFZ/cooperation/neighbouring observatories.

Global coverage
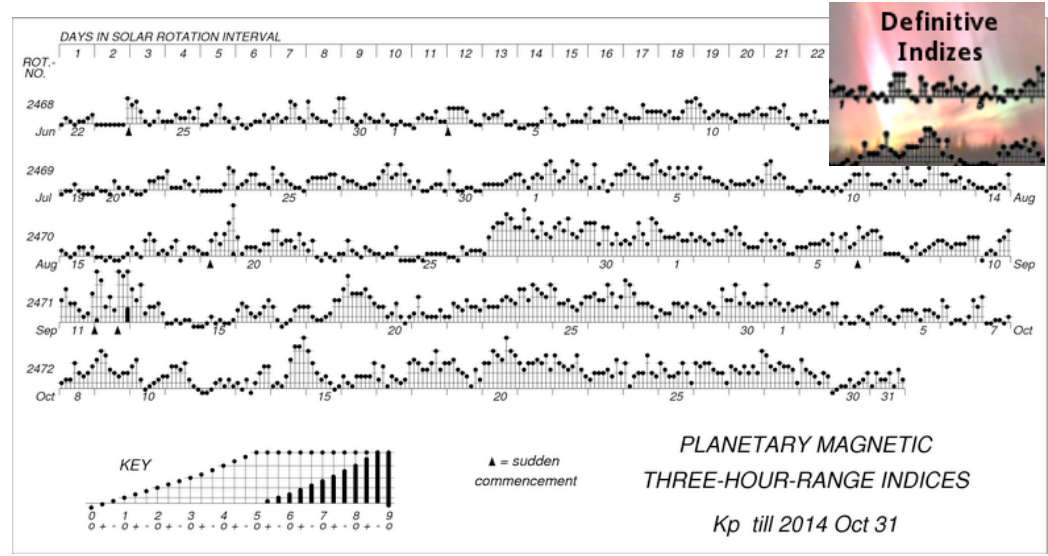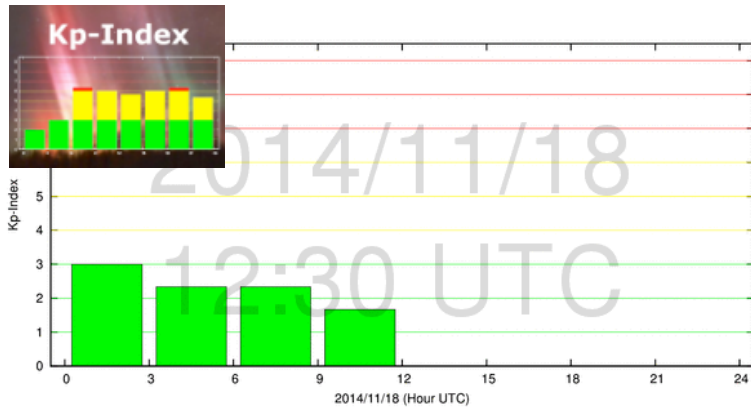**with emphasis, e.g., on the South Atlantic Anomaly**

Magnetic storm starts few hours after SSC: severe geo-magnetic variation, plasma gradients and degrading GPS etc.

Potential for near-real time predictions of local magnetic variations during magnetic storms
Example TDC
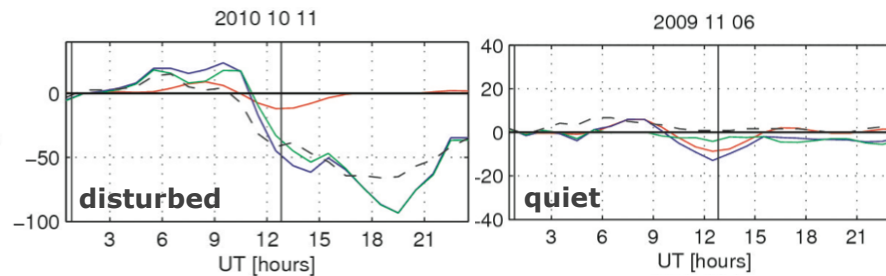
Dst provides longitudinal average!

— Real time observations
— Empirical local Sq model
— Observation – model
- - - Dst-index (reduced to TDC latitude)

ESWW11, Session 9, Poster 30-e
Stolle et al., Geomagnetic Tools for Space Weather Monitoring
Contact: cstolle@gfz-potsdam.de

Kp index service for IAGA
and the International Service of Geomagnetic Indices

Real time Kp Index calculated from NRT geomagnetic data.

Definitive Kp index calculated from K-values supplied by the contributing observatories.

The Kp index is currently reviewed for being part of the ESA SSA programme.

ESWW11, Session 9, Poster 30-e
Stolle et al., Geomagnetic Tools for Space Weather Monitoring
Contact: cstolle@gfz-potsdam.de

The Swarm satellite constellation mission
LEO-satellites for Space Weather Environment analyses and alerts

ESA's Earth Explorer Mission
Launched on 22/11/2013

https://earth.esa.int/swarm

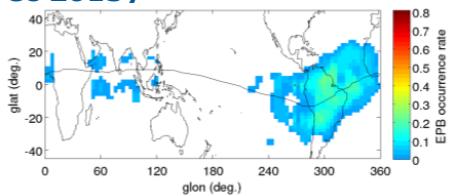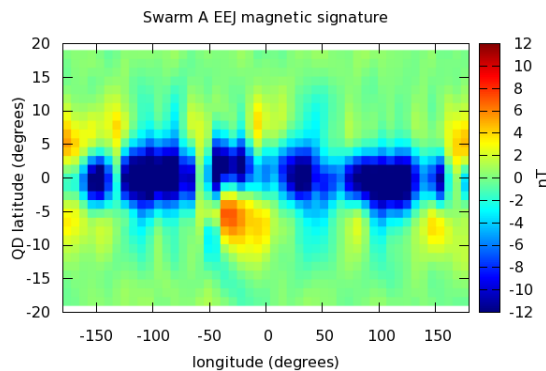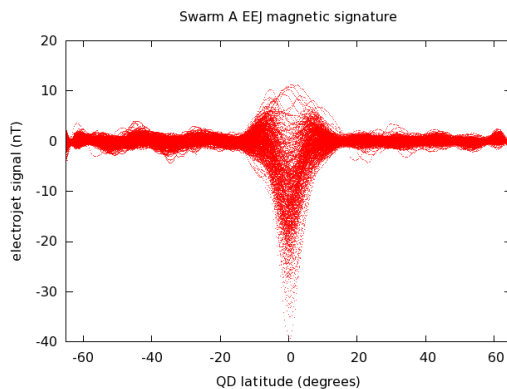## Equatorial plasma irregularities

Champ magnetic signatures (8 years)
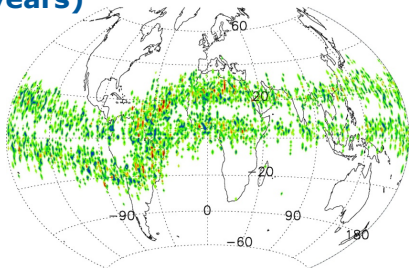
Swarm magnetic signatures (Dec 2013)

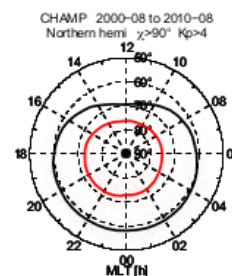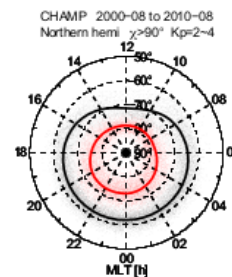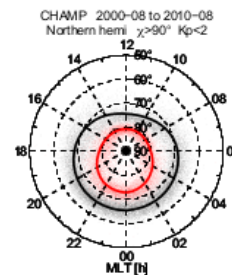## Magnetic signatures of the Equatorial Electrojet from the Swarm mission

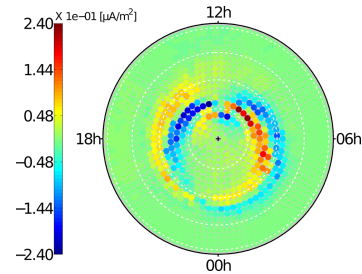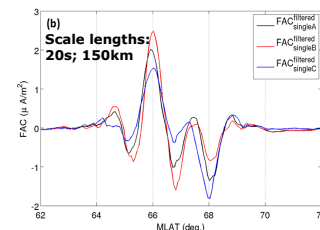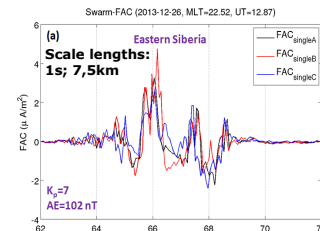Swarm A EEJ magnetic signature

Swarm A EEJ magnetic signature

Courtesy of P. Alken

Auroral field aligned currents and oval boundaries

CHAMP 2000-08 to 2010-08 Northern hemi χ>90° Kp<2

CHAMP 2000-08 to 2010-08 Northern hemi χ>90° Kp=2~4

CHAMP 2000-08 to 2010-08 Northern hemi χ>90° Kp>4

Swarm-FAC (2013-12-26, MLT=22.52, UT=12.87)

CHAMP model of auroral boundaries
(Xiong et al., angeo-2014)

Swarm auroral field-aligned currents

ESWW11, Session 9, Poster 30-e
Stolle et al., Geomagnetic Tools for Space Weather Monitoring
Contact: cstolle@gfz-potsdam.de

GFZ Helmholtz Centre POTSDAM

HELMHOLTZ | ASSOCIATION