

The solar wind's geomagnetic impact and its Sun-Earth evolution
Predictive models for space weather and for the Parker Solar Probe orbit

PhD defense by
Malte Venzmer

PhD student:
Within the doctoral program PrePhys,
Georg-August University School of Science
(GAUSS)

Institute for Astrophysics
Georg-August-Universität Göttingen

Thursday, 1 November 2018, 14:00
Seminarraum Astrophysik (SR 17, F 05.104)

Geographic impact of the solar wind

Solar wind model

Summary

References

Contents

The solar wind's geomagnetic impact and its Sun-Earth evolution
Predictive models for space weather and for the Parker Solar Probe orbit

Geomagnetic impact of the solar wind – Predictive models for space weather

- Brief summary

Solar wind model – Predictions for the Parker Solar Probe orbit

- Intro
- Parker Solar Probe
- Solar wind model
- Prediction for PSP orbit

Geomagnetic impact of the solar wind

Solar wind – solar system bodies

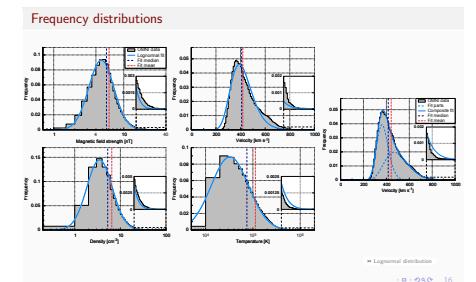
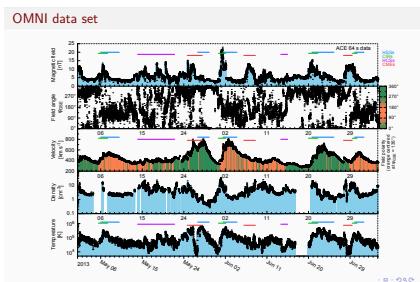
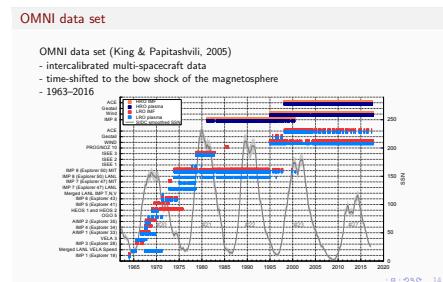
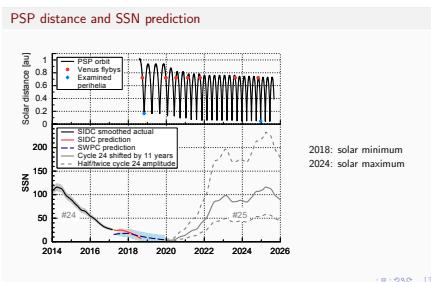
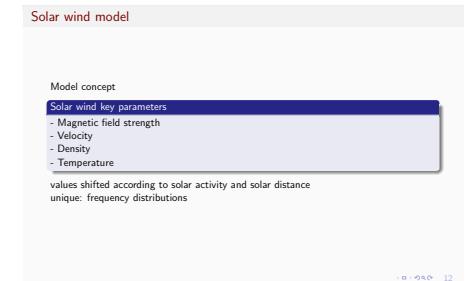
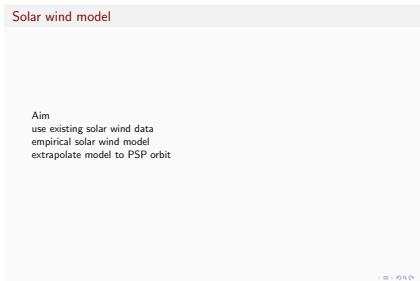
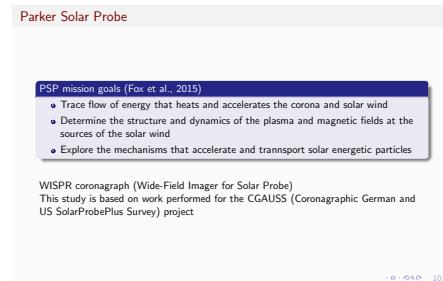
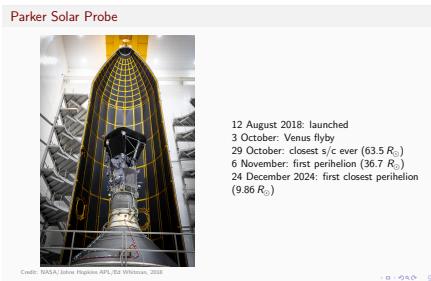
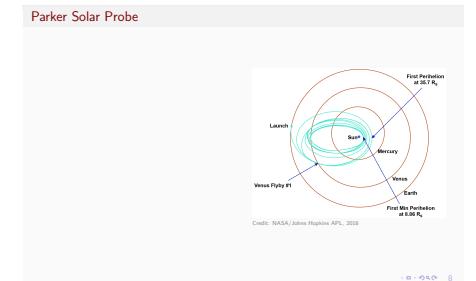
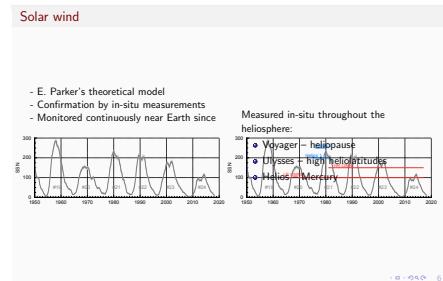
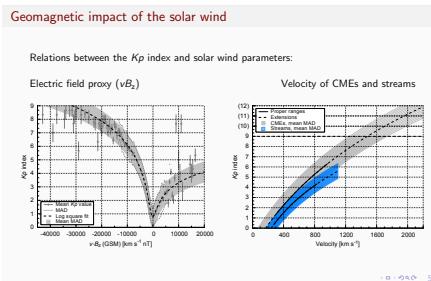
CMEs – geomagnetic storms – effects

Importance of prediction of onset/magnitude

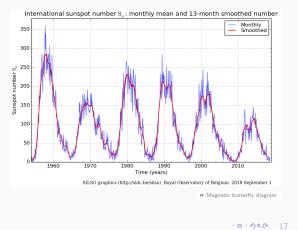
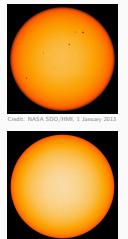
The study addresses; deriving predictive models

Geomagnetic impact of the solar wind

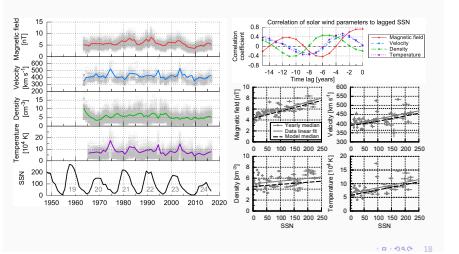
- K_p index
- Coupling mechanisms
- Reconnection at magnetopause



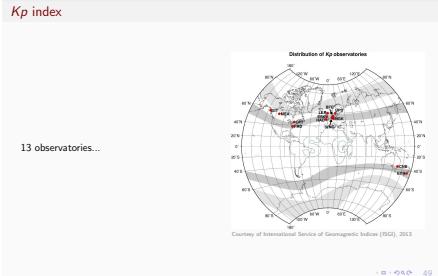
Solar activity



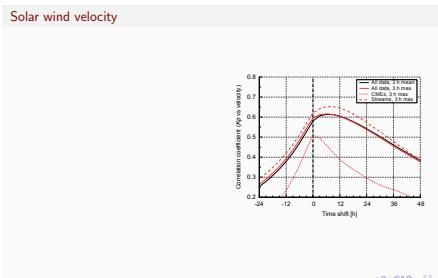
Solar activity



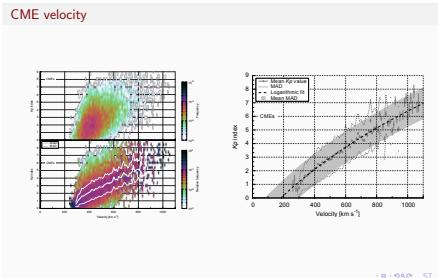
Kp index



Solar wind velocity



CME velocity



Results

Predictive Kp models based on relations with

- solar wind electric field proxy (vB_2)
- velocity of CME-associated flows (v_{CME})
- velocity of solar wind streams (v_{stream})

13 observatories... 13 48 61

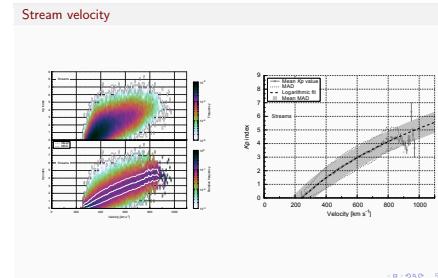
Kp index



Solar wind velocity



Stream velocity



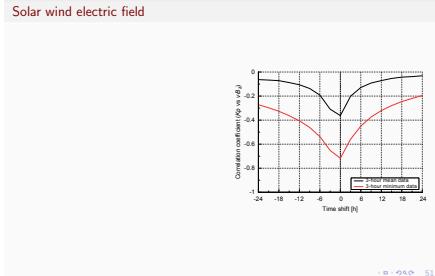
Conclusions

- The processing of 3-hour extrema of high time resolution data captures short-term geoeffective magnetic features that are neglected when averaging over 3-hour intervals
- The isolated treatment of CMEs and streams is beneficial to the prediction accuracy of Kp
- The prediction models perform well for their limited input information

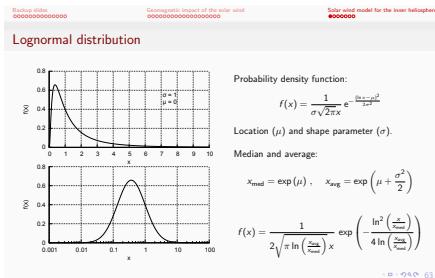
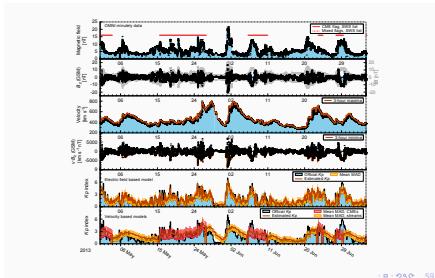
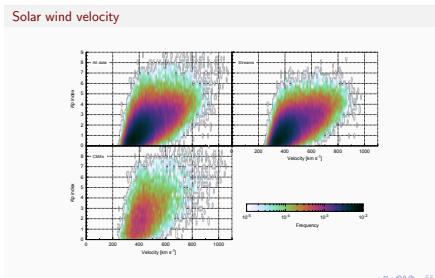
■ Prediction performance

13 48 62

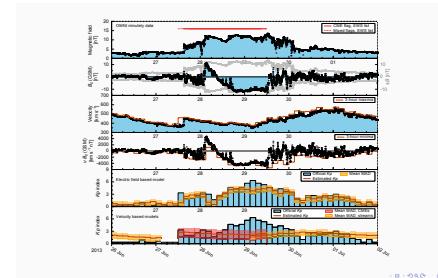
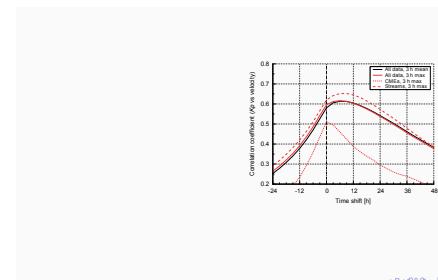
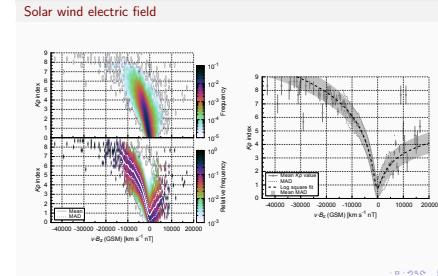
Solar wind electric field



Solar wind velocity



Solar wind electric field



Sun-Earth evolution of the solar wind

Solar wind measured in-situ throughout the heliosphere – except near-Sun

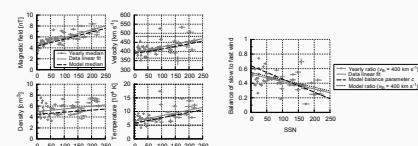
13 48 63

Sun–Earth evolution of the solar wind

special scientific interest:
coronal heating
solar wind acceleration

65

Solar activity



66

Sun–Earth evolution of the solar wind Aims

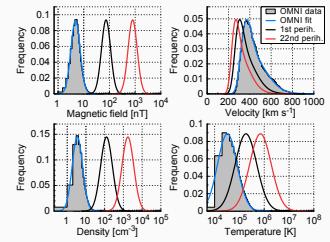
Solar wind model for the inner heliosphere and prediction of the near-Sun environment for the PSP orbit

67

combine models, extrapolation

68

PSP perihelia prediction



69