

### The two studies in my thesis

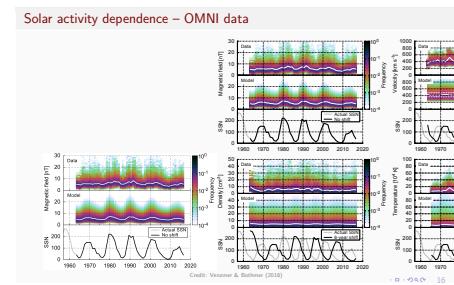
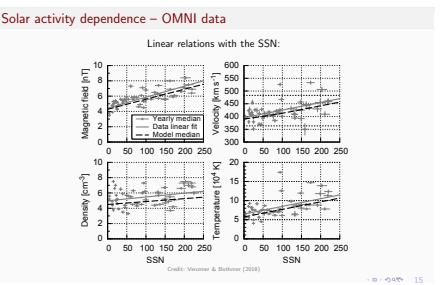
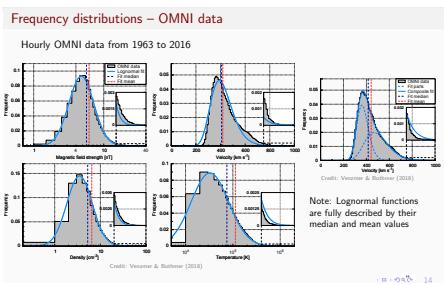
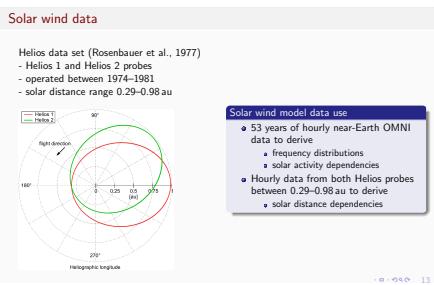
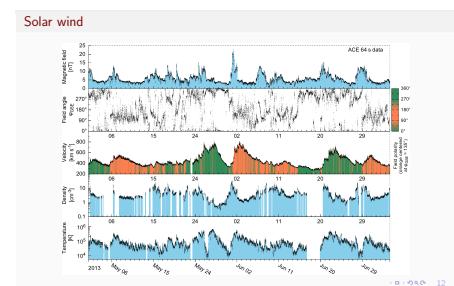
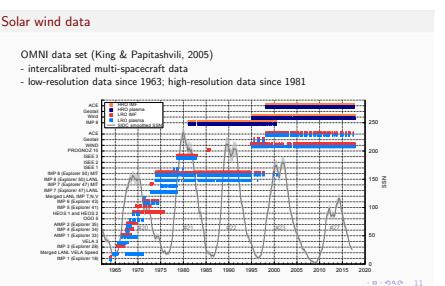
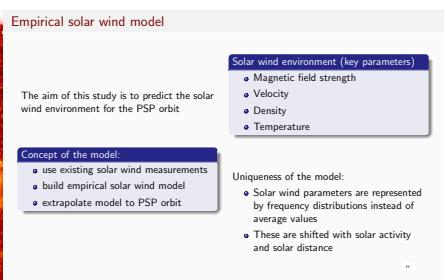
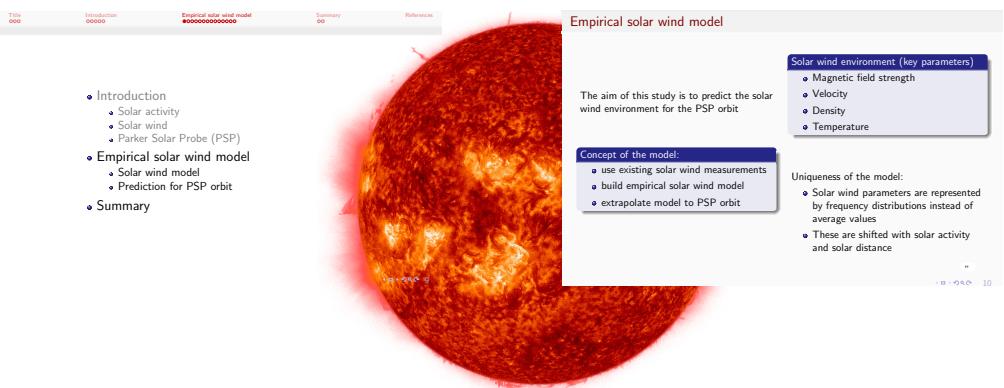
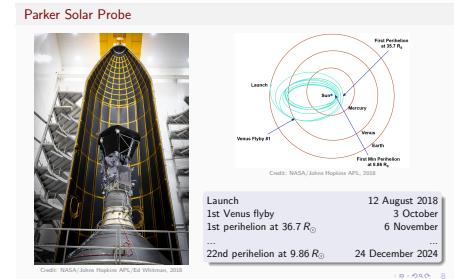
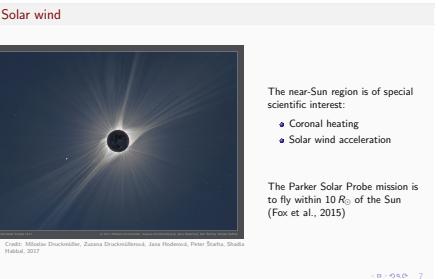
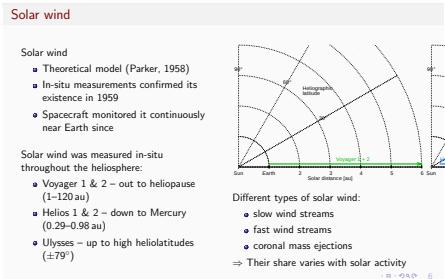
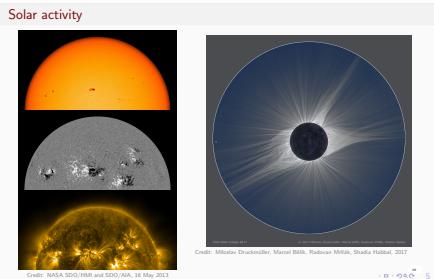
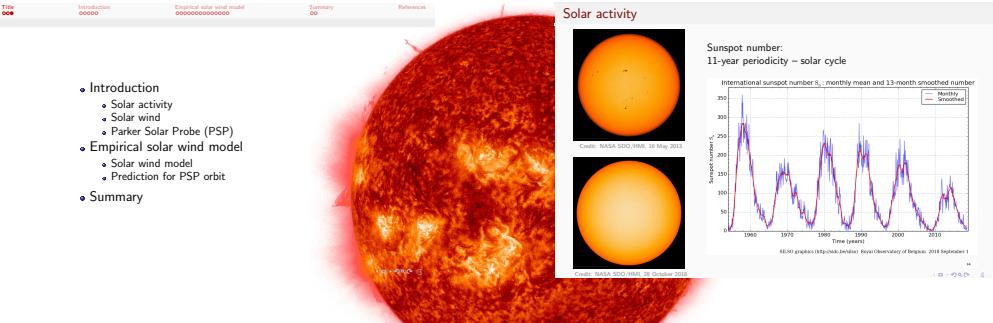
**The solar wind's geomagnetic impact and its Sun–Earth evolution**  
Predictive models for space weather and for the Parker Solar Probe orbit

**Geomagnetic impact of the solar wind**  
I derived relations to predict geomagnetic activity from

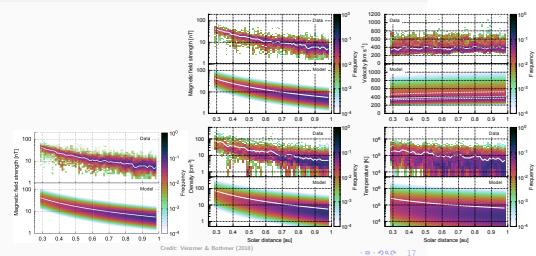
- Solar wind electric field
- Velocity of coronal mass ejections
- Velocity of solar wind streams

**Empirical solar wind model**  
I use existing solar wind data to derive

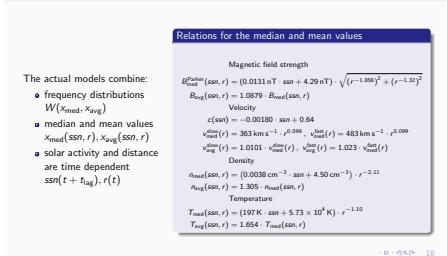
- Solar wind model for the inner heliosphere
- Extrapolation to the near-Sun region
- Prediction for Parker Solar Probe orbit



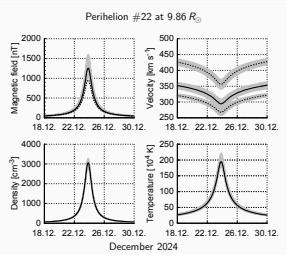
## Solar distance dependence – Helios data



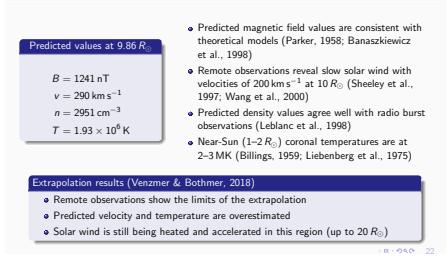
## Final model



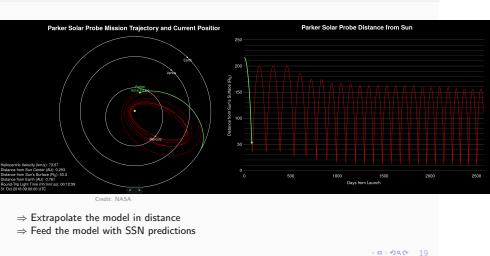
## Prediction for PSP orbit



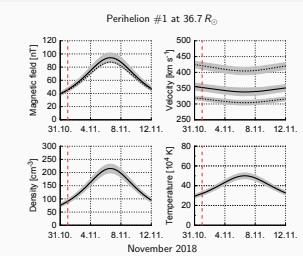
## Comparison with other studies



## Prediction for PSP orbit



## Prediction for PSP orbit



## Outlook

- Possible modifications to model (e.g., flux conservation)
- Refine model with additional solar wind data from Mercury probes and the upcoming Solar Orbiter mission
- The predictions can be used as a reference for the first measurements made by PSP
- The PSP measurements can be used to validate the extrapolations

Thank you!



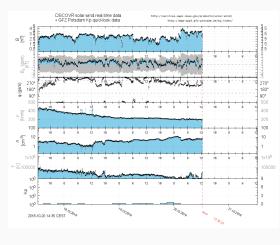
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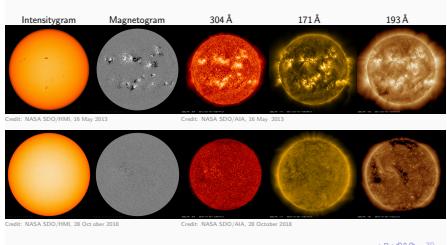
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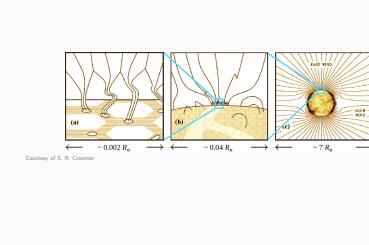
## Solar wind



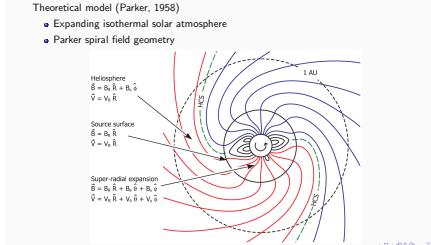
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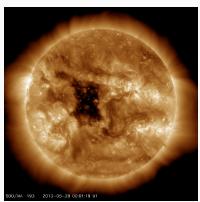
## Solar magnetic field



## Solar magnetic field

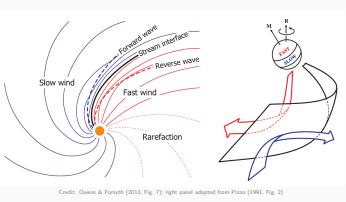


## Slow and fast solar wind



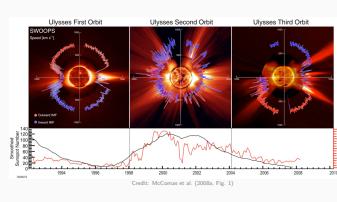
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## Slow and fast solar wind



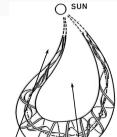
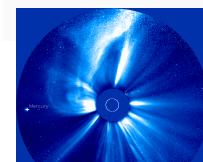
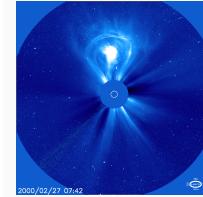
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## Solar activity



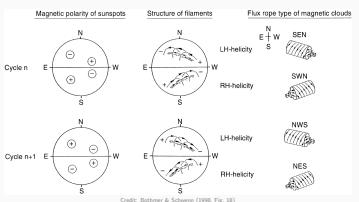
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## Coronal mass ejections



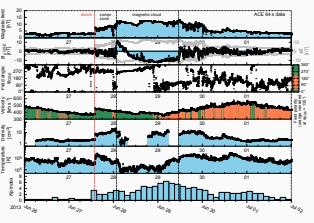
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## CME orientation



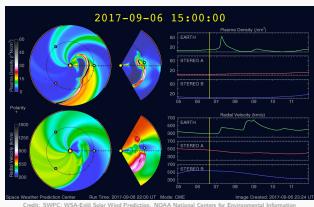
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## In-situ CMEs



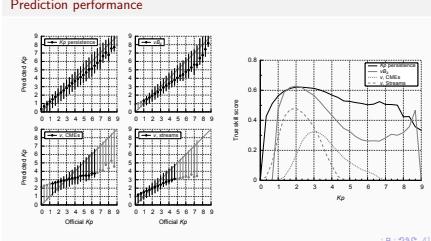
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## Solar wind and CME forecast



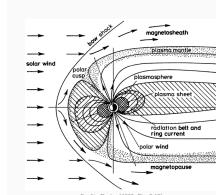
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## Prediction performance

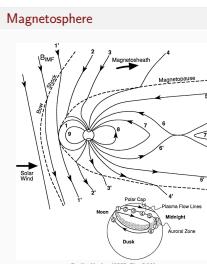


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## Magnetosphere



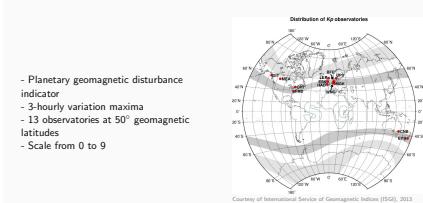
## Magnetosphere



- Factors that influence the reconnection flux rate:
  - Velocity
  - Turbulence
  - Compression
  - Induction

42

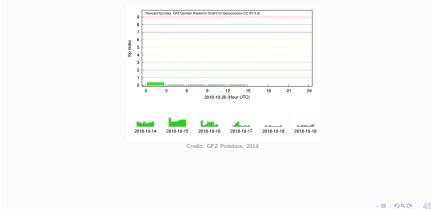
## Kp index



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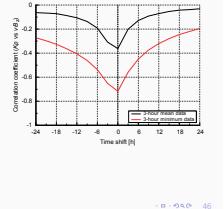
## Kp index

Quicklook Kp



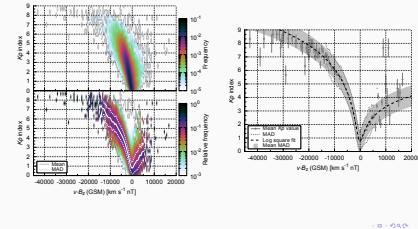
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## Solar wind electric field



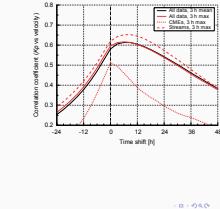
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## Solar wind electric field



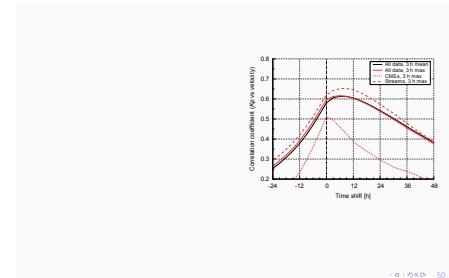
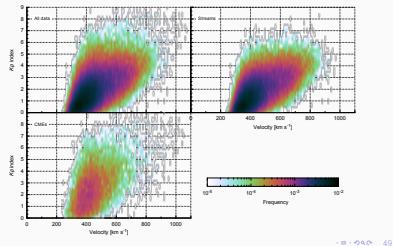
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## Solar wind velocity

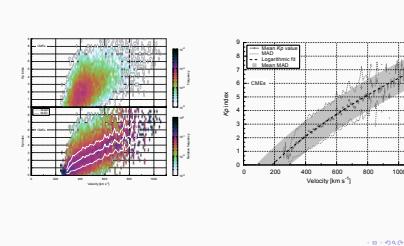


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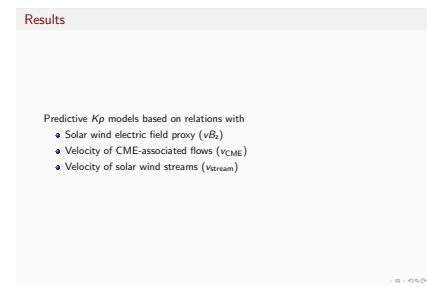
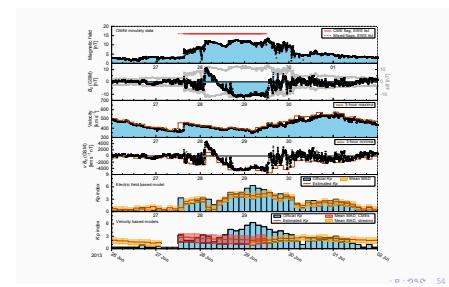
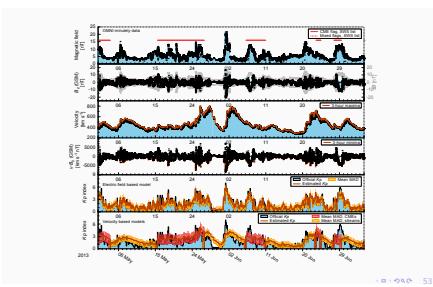
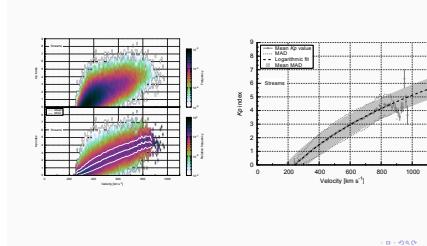
## Solar wind velocity



## CME velocity



## Stream velocity

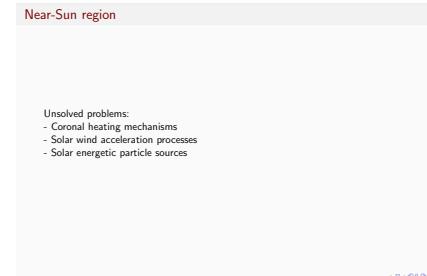
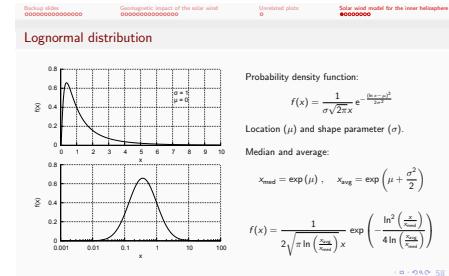


## Conclusions

- 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  $K_p$
- The prediction models perform well for their limited input information

► Prediction performance

## Solar wind



## Parker Solar Probe

Parker Solar Probe mission to fly within  $10 R_\odot$  of the Sun

Primary goals are to investigate (Fox et al., 2015):

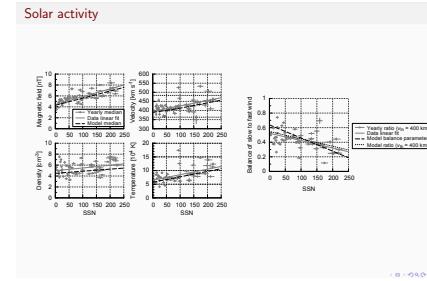
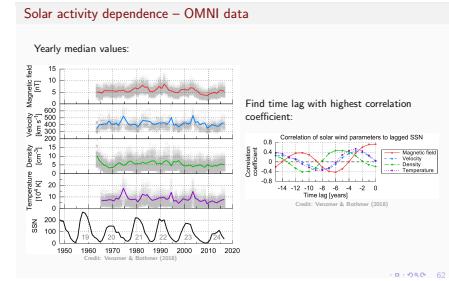
- the flow of energy that heats and accelerates the solar wind
- the structure and dynamics at the sources of the solar wind
- the mechanisms that accelerate solar energetic particles

### Scientific instruments

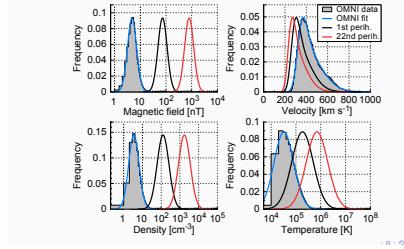
- FIELDS – Electromagnetic Fields Investigation
- ISIIS – Integrated Science Investigation of the Sun
- SWEAP – Solar Wind Electrons Alphas and Protons Investigation
- WISPR – Wide-Field Imager for Solar Probe

► Prediction performance

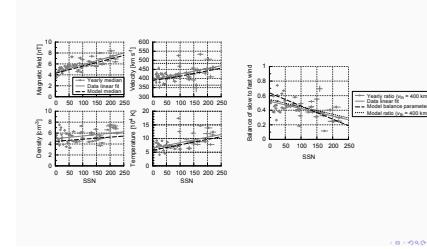
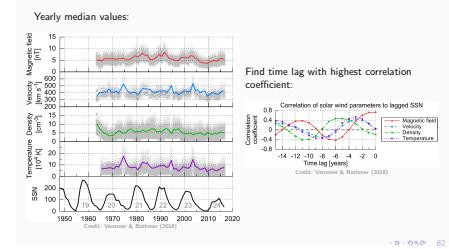
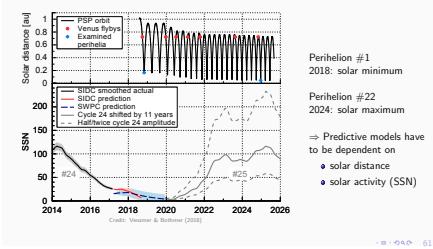
## PSP distance and solar activity



## PSP perihelia prediction



► Prediction performance



### Solar wind

