The ISWAT Coronal Hole Boundary Working Team

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and Coronal Hole Boundary Working Team

Context:

This activity is part of the COSPAR initiative:

International Space Weather Action Teams (ISWAT)

which is a global hub for collaborations addressing challenges across the field of space weather

https://iswat-cospar.org/

ISWAT overview:

S: Space weather origins at the Sun	H: Heliosphere variability	G: Coupled geospace system
S1: Long-term solar variability	H1: Heliospheric magnetic field and solar wind	G1: Geomagnetic environment
S2: Ambient solar magnetic field, heating and spectral irradiance	H2: CME structure, evolution and propagation through heliosphere	G2a: Atmosphere variability
S3: Solar eruptions	H3: Radiation environment in heliosphere	G2b: Ionosphere variability
	H4: Space weather at other planets/planetary bodies	G3: Near-Earth radiation and plasma environment

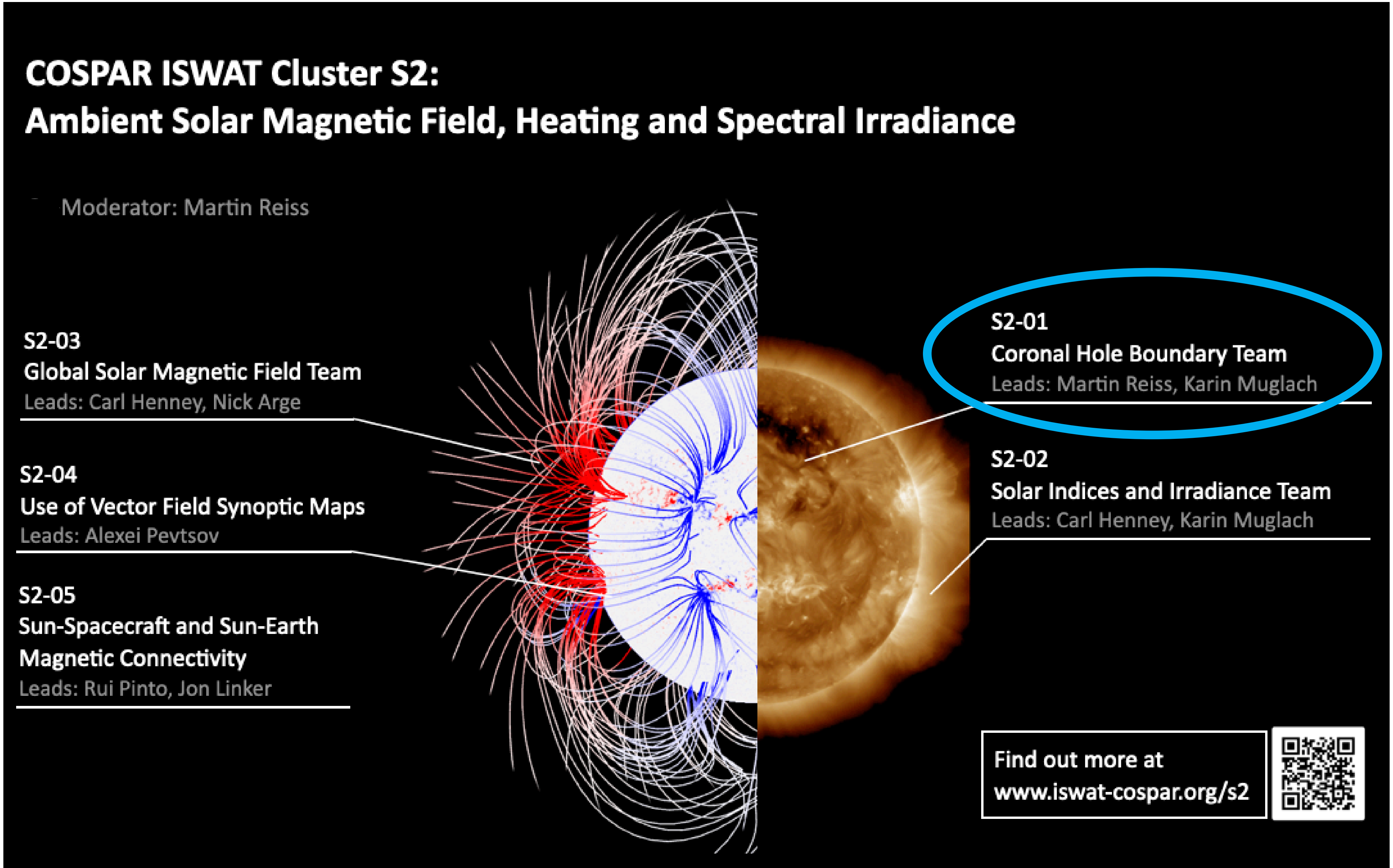
Impacts

- Climate
- Electric power systems/GICs
- Satellite/debris drag
- Navigation/ Communications
- (Aero)space assets functions
- Human Exploration

Overarching Activities:

- Assessment
- Innovative Solutions
- Information Architecture & Data Utilization
- Education & Outreach

ISWAT S2 overview:



Participants:

Team leads:

M. A. Reiss SRI, Graz, Austria
K. Muglach, NASA/GSFC, Greenbelt, MD, USA

Aug. 2019: 6 participants, from 2 institutions
Jan. 2021: 22 participants, from 12 institutions

update: Sep. 2021: 35 participants from 22 institutions

General objectives of project:

- Study and compare different automated coronal hole detection methods provided by the space weather community
- Develop strategies to quantitatively assess the spatial and temporal uncertainty of coronal hole boundary locations
- Use this information to further improve the predictive capabilities of ambient solar wind models.

close collaboration with ISWAT H1-01:

Ambient Solar Wind Validation Working Team

General objectives of project:

- Use the results of the different automated coronal hole detection methods to study magnetic connectivity of the sun with Earth or spacecrafts (e.g. PSP, SolO).

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close collaboration with ISWAT S2-05:

Sun-Spacecraft and Sun-Earth Magnetic Connectivity Team

- Provide coronal hole boundaries for WHPI studies (TBD)

New Team Activity:

Additional focus CH studies:

smaller sub teams, any CH research topic possible

- Physics of CH Boundaries: Y.-K. Ko (NRL), K. Muglach (GSFC)
- Automated CH Detection Schemes: S. Chakraborty (Virginia Tech)
- How Streamers and Other Structures Affect CH Boundaries: E. Mason (GSFC)
- Study the Interaction of fast MHD Waves with Coronal Hole Boundaries: Isabell Piantschitsch (University of the Balearic Islands, Spain)

Specific objectives of project:

- Study and compare different automated coronal hole detection methods provided by the space weather community
- Evaluate CH boundaries derived from these methods:

  - compare location of boundary (gives observed uncertainties of CH boundaries)

  - compare parameters derived from these boundaries:

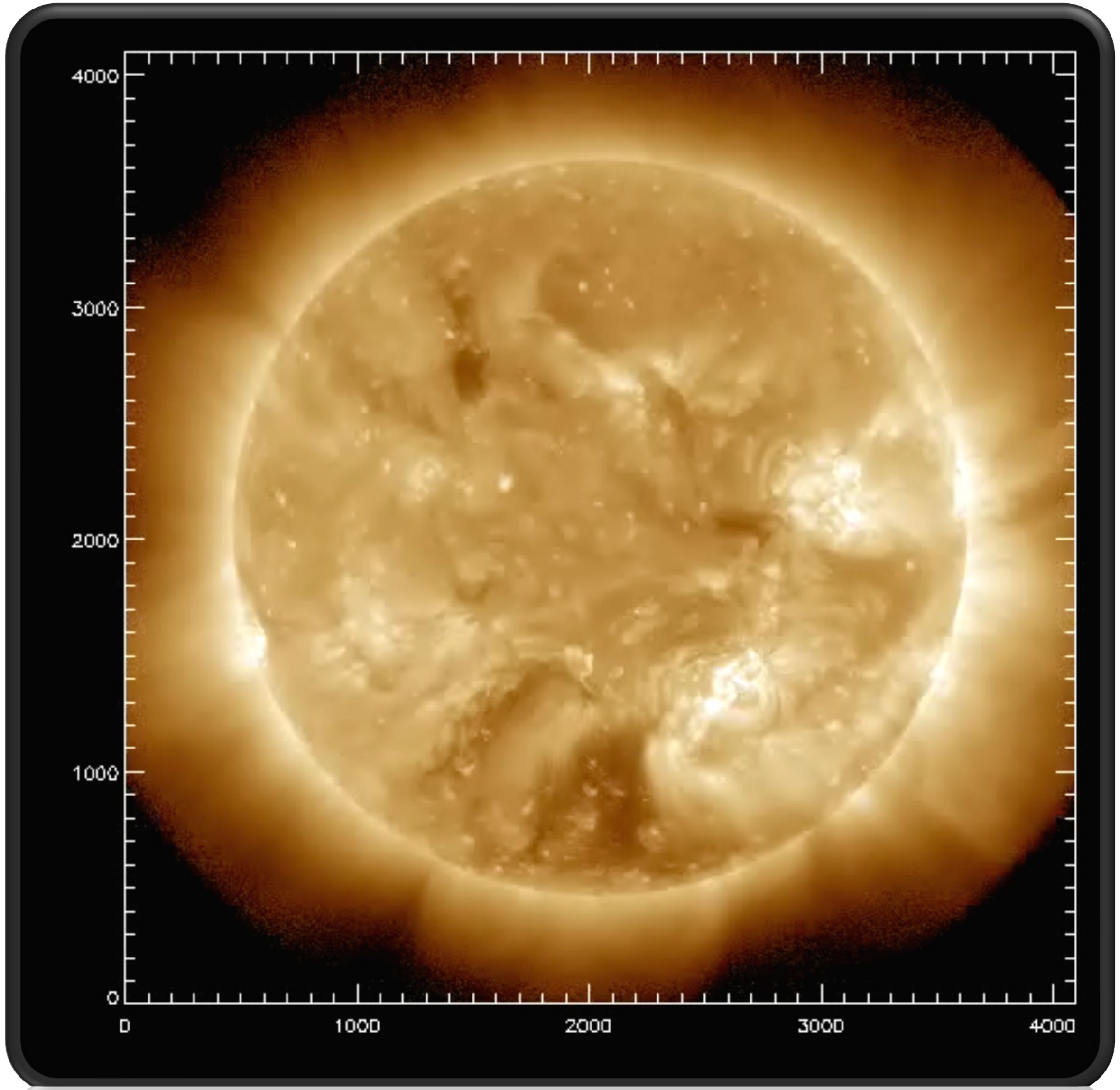
    e.g. average coronal intensity inside the CH, average photospheric signed magnetic flux in CH, average unsigned flux in CH

Participating methods:
(preliminary list)

ASSA	Korean Space Weather Center	Hong et al. (2012)
CHARM	NOAA	Krista & Gallagher (2009)
CHIMERA	Trinity College Dublin	Garton et al. (2018)
CHORTLE	Southwest Research Institute	Lowder et al. (2014)
CNN193	Moscow State University	Illarionov & Tlatov (2018)
Multi-CNN	University of Graz	Jarolim et al. (2021)
SPoCA	Royal Observatory of Belgium	Verbeeck et al. (2014)
SYNCH	University of Oulu	Hamada et al. (2018)
TH35	Space Research Institute	Reiss et al. (2016)
CHMAP	Predictive Science Inc.	Caplan et al. (2016)
ACWE	New Mexico State University	
CHIPS	Virginia Tech.	

Data to be used:

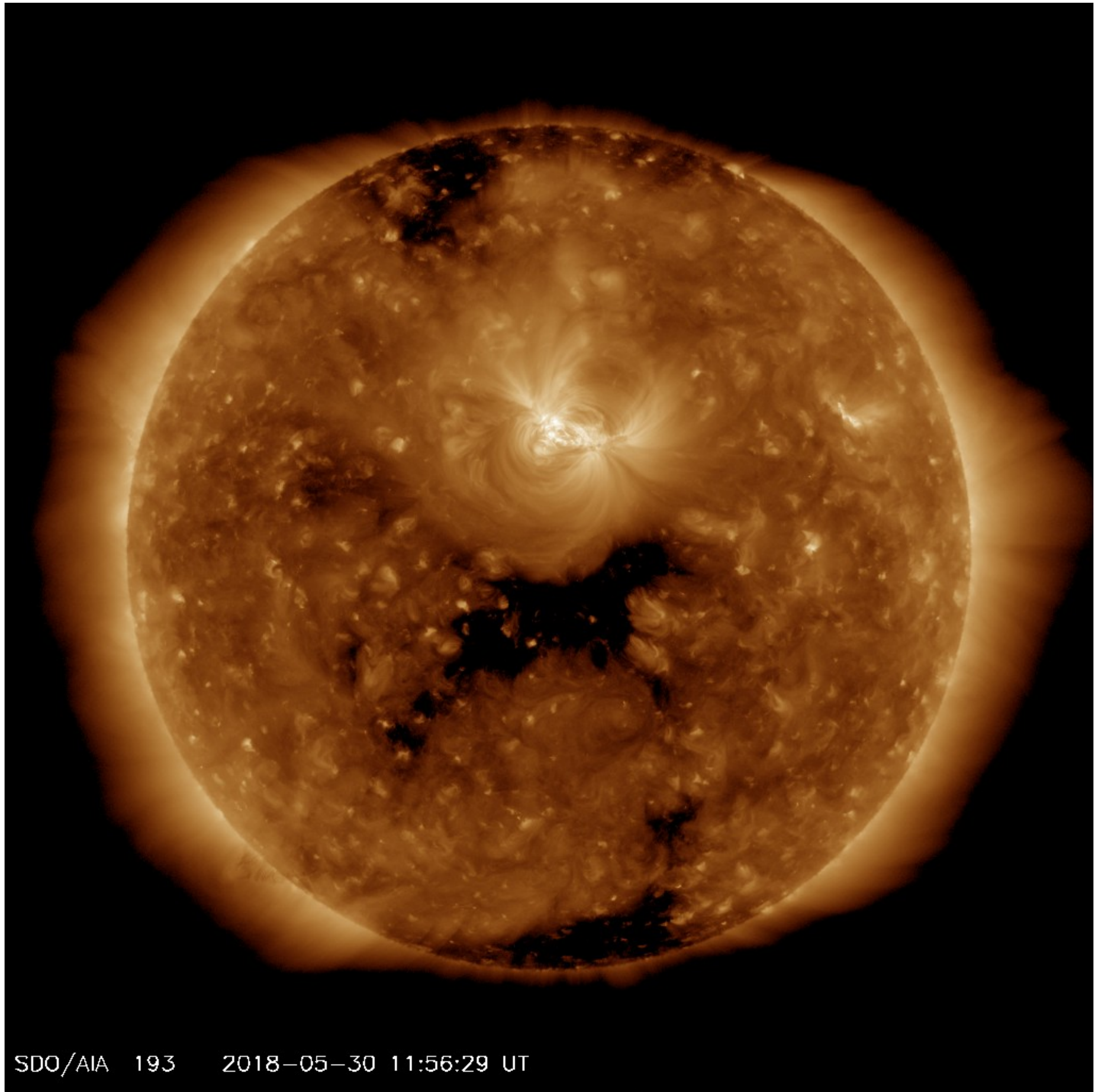
SDO/AIA and SDO/HMI



- 29 full disk images were selected (2014-2019)
- all AIA EUV channels and HMI LOS magnetograms can be used
- AIA 193 A shown here as example

First part of study:

Select and analyse one CH

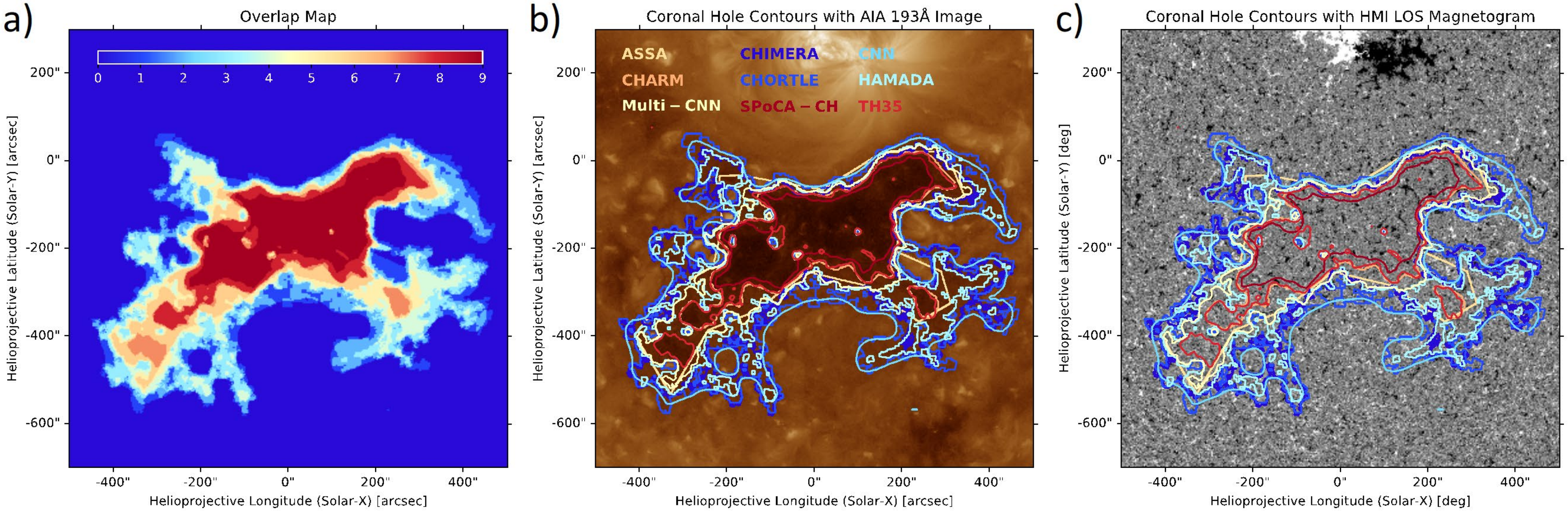


2018-05-30 ~12.00 UT

2 polar CHs

1 low-latitude CH close to disk center

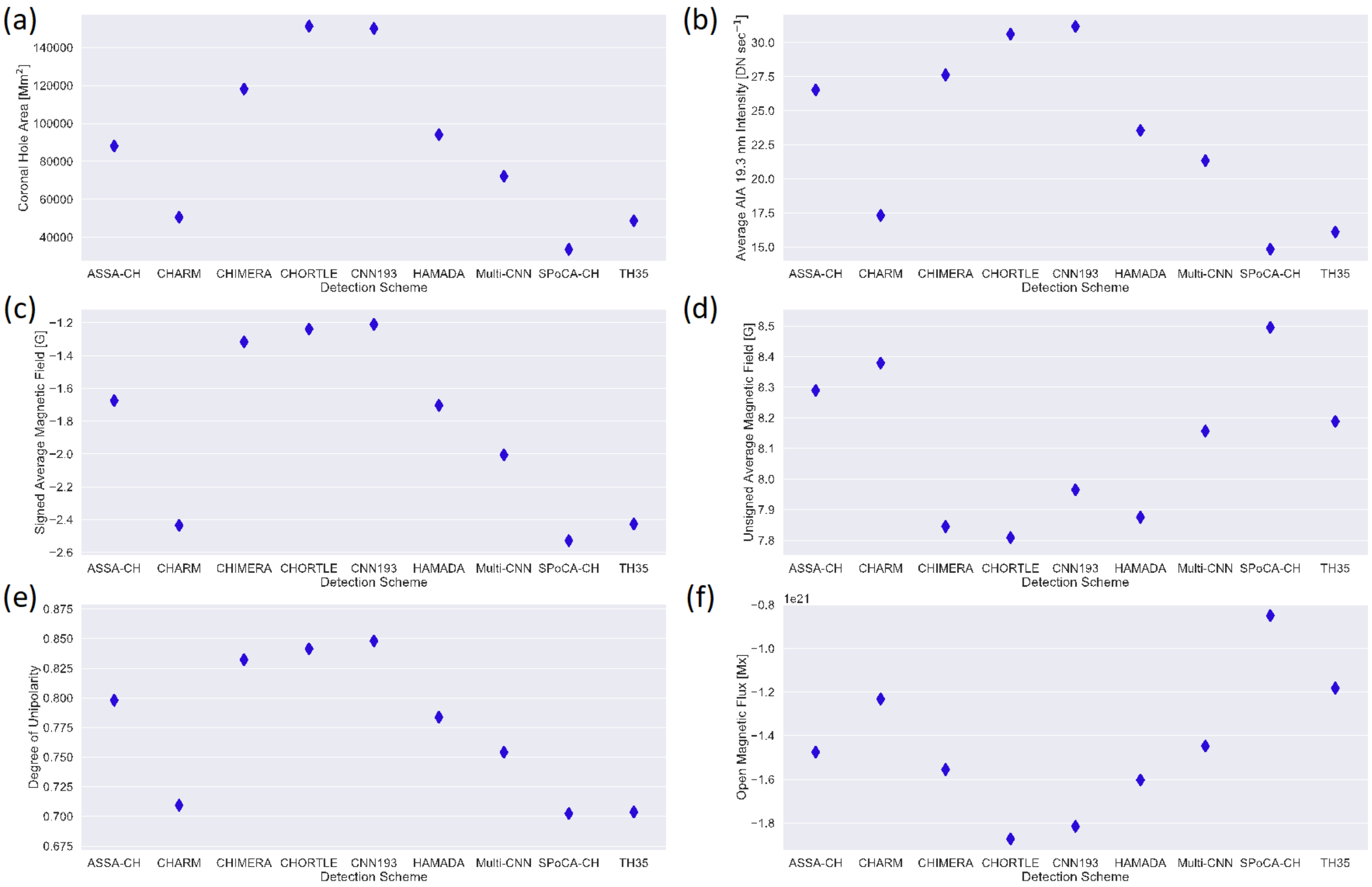
First part of study:



Final result: comparison of 9 methods with contour overlays:

a) Probability map, b) contour on AIA 193 A, c) contours on HMI magnetogram

First part of study:



Final result: comparison of 9 methods CH parameters:

a) CH area

b) AIA 193 av. brightness

c) av. signed magnetic flux

d) av. unsigned magn. flux

e) unipolarity

f) open flux estimate

Reiss et al. 2021, ApJ 913, #28

Next part of study:

- Apply all methods to all CHs
- Evaluate CH boundaries derived from these methods:

  compare location of boundary and compare parameters derived from these boundaries:

currently 13 participating methods,

+ 2 updated methods

Future plans:

- Use global synoptic EUV maps (e.g. Carrington maps, ADAPT) to identify CHs
- Use coronal models to get boundaries of open flux (e.g. PFSS, others) and compare location of modelled and observed CH boundaries
- Include time dependence

Future plans:

Everyone is welcome to participate!

Check out: https://iswat-cospar.org/S2-01

Contact us: M.A. Reiss, K. Muglach