

FP7 Project – HELCATS – WPs 5, 6 and 8

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WP6 - Initialising advanced numerical models based on the kinetic properties of STEREO/HI CMEs and CIRs

[Months: 7-36]

UPS

The primary goal of WP6 is to transform the catalogues of CMEs and CIRs observed by HI, accomplished in WP2/3 and WP5, into more advanced catalogues of simulations results of CIRs and CMEs. This advanced database will provide to the space community a set of simulation results optimised by assimilating direct images of the solar wind into ENLIL simulations. The delivery of these advanced catalogues will enhance forefront research on the ‘background’ solar wind (fast and slow solar wind) and on the spatial and temporal evolution of CIRs and CME shocks, and will provide unique material to study and interpret particle radiation measurements in the inner heliosphere. This resource will also be useful to assess the potential role of HI images for space-weather predictions and to prepare future missions (e.g. ESA’s Solar Orbiter).

UPS staff: Post-doc working on CIR and CMEs: Dr Illya Plotnikov

◄—————► Collaboration with Dusan Odstrcil

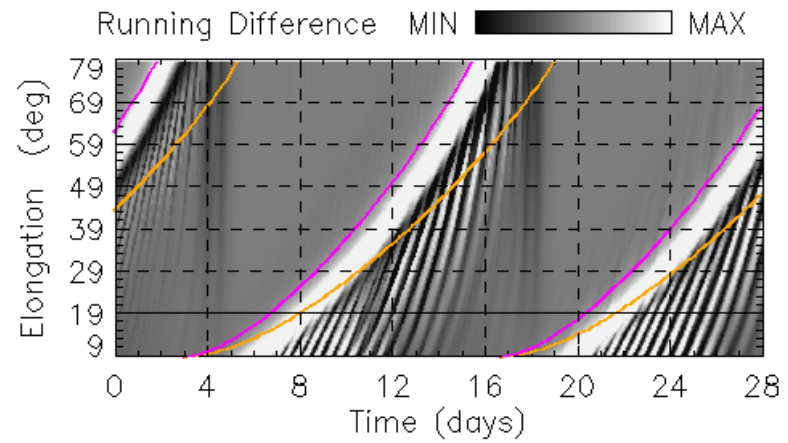
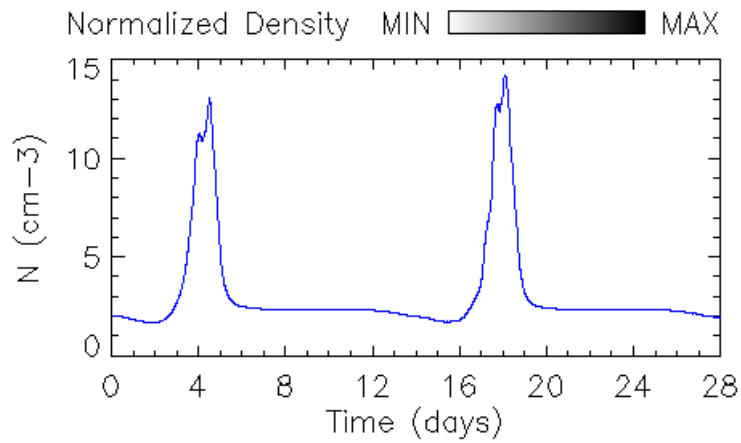
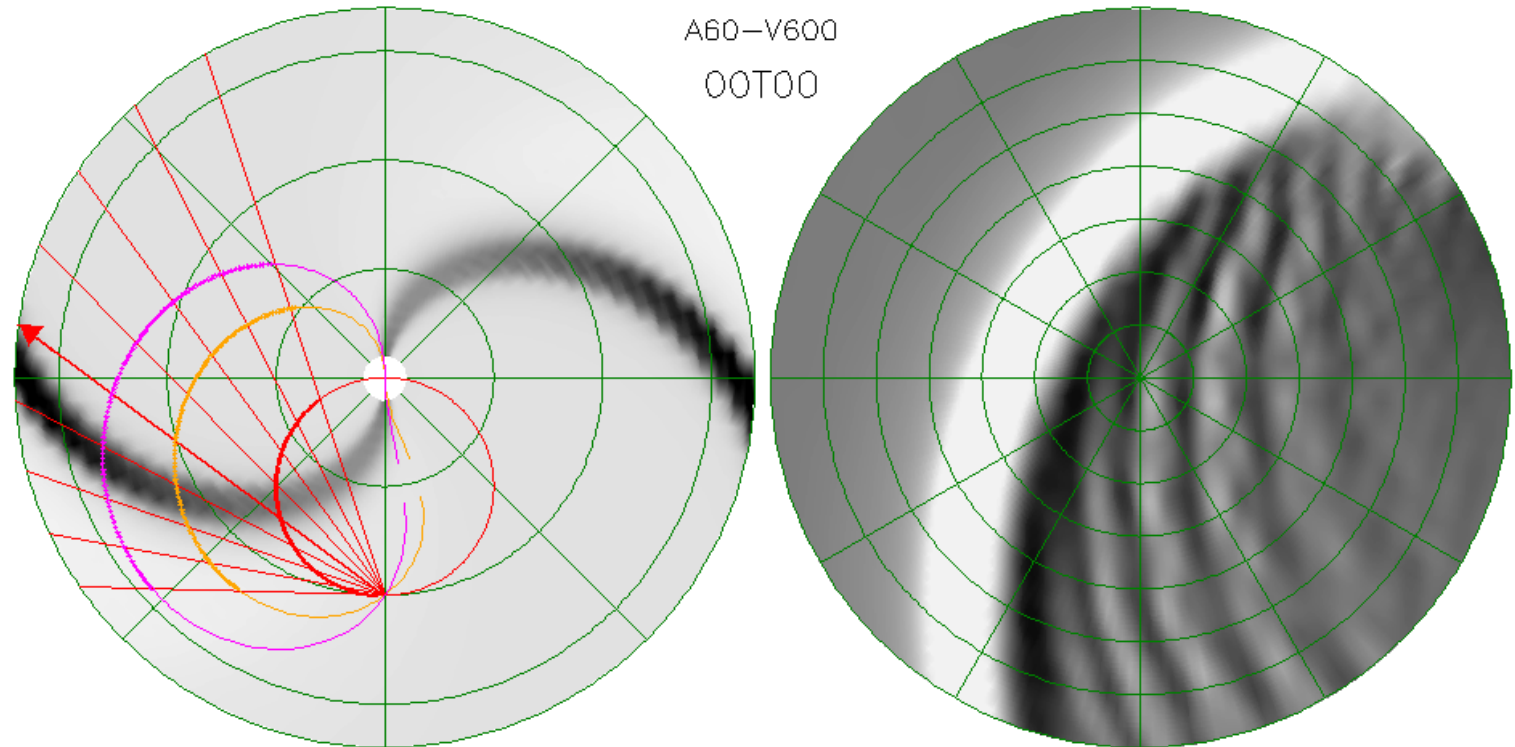
T6.1 - Assimilating HI images to model the background solar wind [Months: 7-36]

UPS

D6.1 : J-maps derived from HI images and movies will be compared with synthetic J-maps and movies of CIRs derived from numerical simulations of the background solar wind (ENLIL). We will divide events in two classes: Class 1 for which a good correspondence is immediately obtained between simulated and observed height-time maps and Class 2 for which J-maps differ significantly. We will compare how well ENLIL predicts the in-situ measurements of CIRs for these two classes of events separately. We will then modify the coronal input of ENLIL of the second class of events until synthetic and observed J-maps are in good agreement. [month 24]

UPS staff: Post-doc working on CIR and CME shocks: Dr Illya Plotnikov

↔ Collaboration with Dusan Odstrcil



T6.2 - Assessing the use of HI to initialize ENLIL [Months: 7-36]**UPS**

D6.2 : A catalogue of the most accurate set of simulations of the background solar wind will then be established. This catalogue will be very useful for further simulations or for scientific users to obtain a more accurate estimate of the magnetic connectivity of spacecraft with solar events. [month 24]

UPS staff: PhD student working on slow solar wind

↔ Collaboration with Dusan Odstrcil

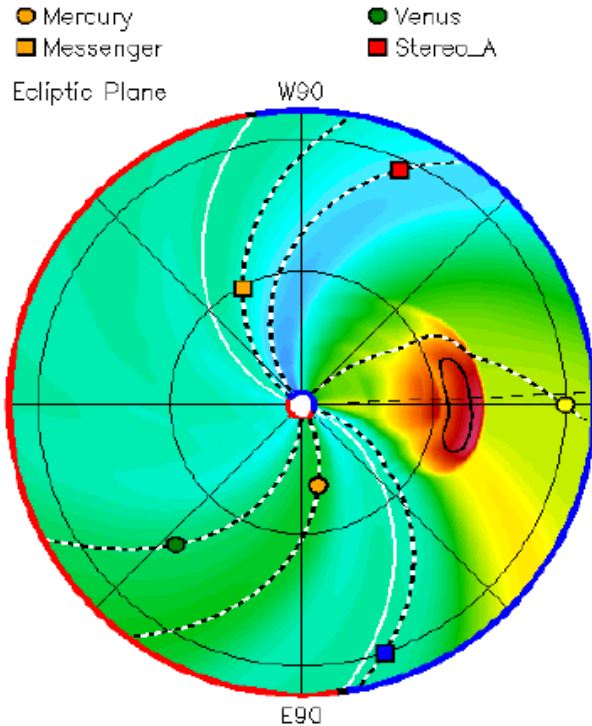
T6.3 - Continual assimilation of HI data in ENLIL and comparison with standard implementation techniques

D6.3 : The results of WP3 and 4 will provide the central axis, volume and speed of CMEs between 10 and 20 solar radii (range of inner boundary for ENLIL). These CMEs will then be injected as hydrodynamic spheres into the most accurate simulations of the background solar wind derived from WP6.1. The arrival time of the leading edge of the CMEs and the properties of the potential shocks driven ahead of them will be compared with in-situ measurements (exploiting the results of WP4.2). A catalogue of these optimised ENLIL simulations of CMEs and their shocks will then be stored for the ecliptic plane. This advanced catalogue will help studies of the origin of solar energetic particle events. [month 36]

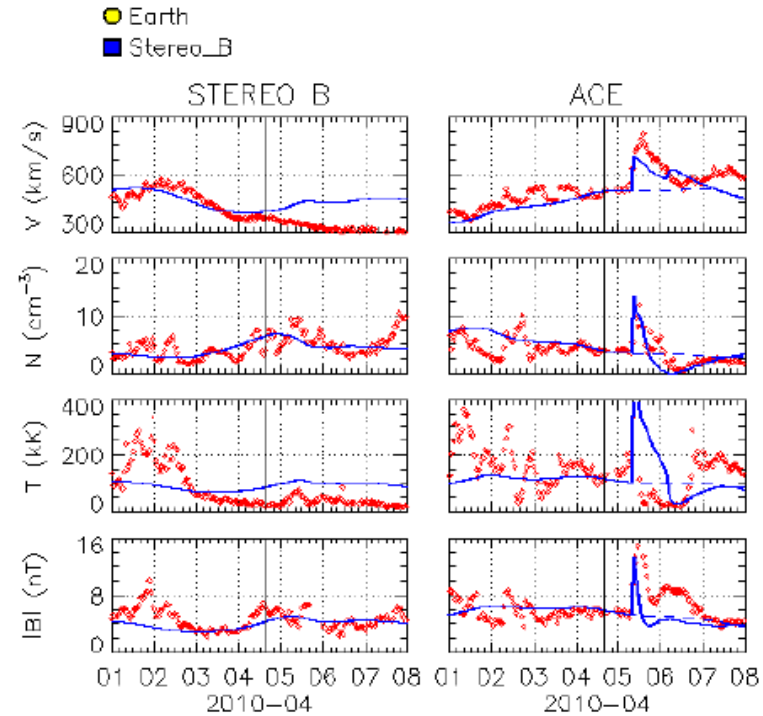
D6.4 : In Task 6.2, the CME properties are specified once at the inner boundary. The CME position, volume and speed can be updated every 40 minutes for HI-1 and 2 hours for HI-2. Medium resolution ENLIL simulations will be re-launched at every time step such that the CME position and speed remains in agreement with HI images. The results of this set of assimilated simulations will be compared with results of Task 5.2 and in-situ measurements; we will determine whether a continual assimilation of HI images provides a better forecast of CME arrival times at 1 AU. [month 36]

◆————→ Collaboration with Dusan Odstrcil

2010-04-04T16:00



2010-04-03T00 +1.66 days



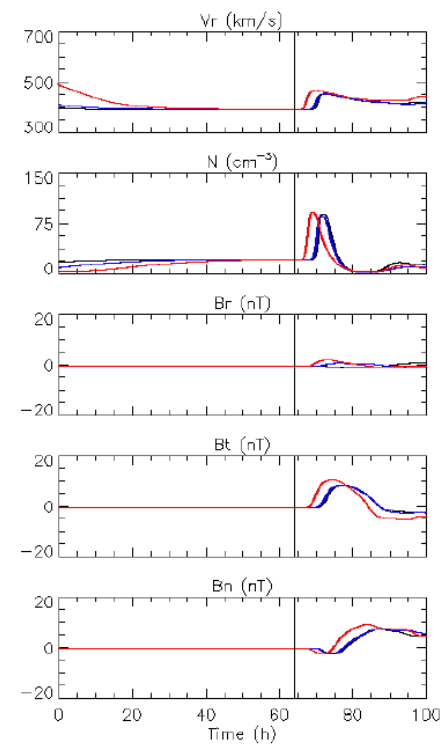
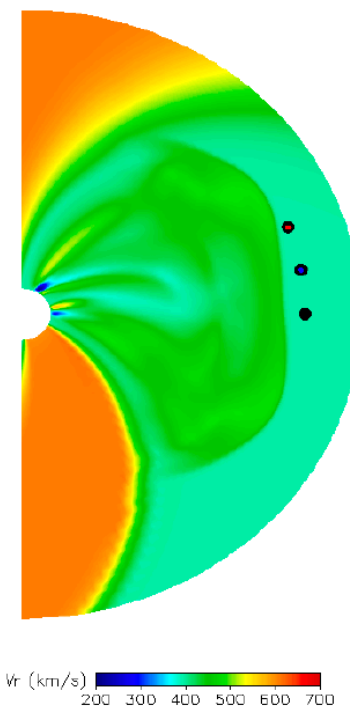
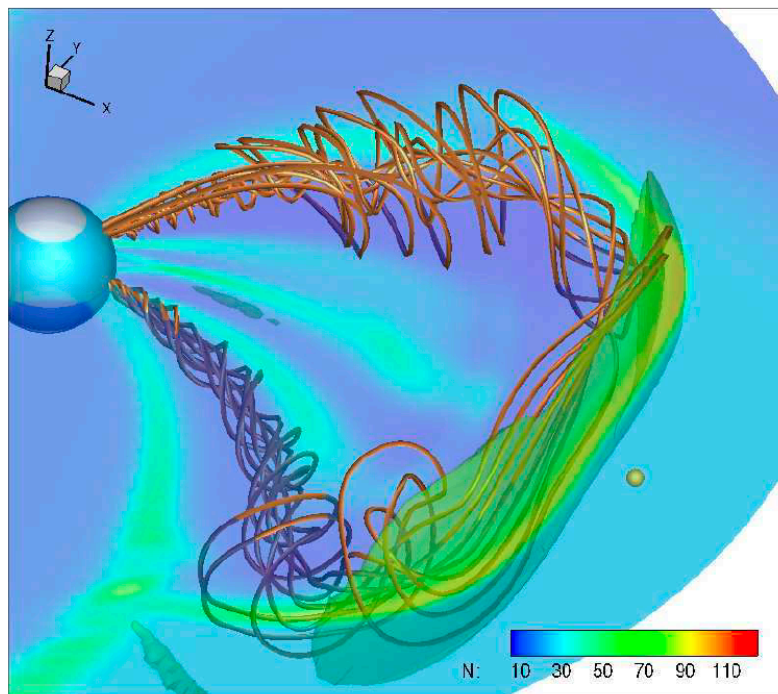
Rouillard, et al. (2011a)

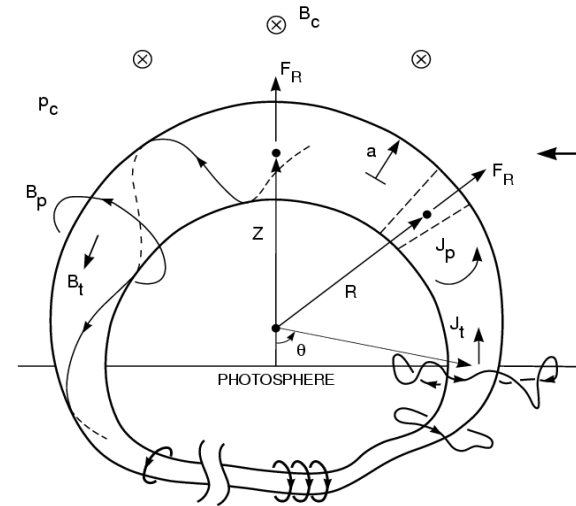
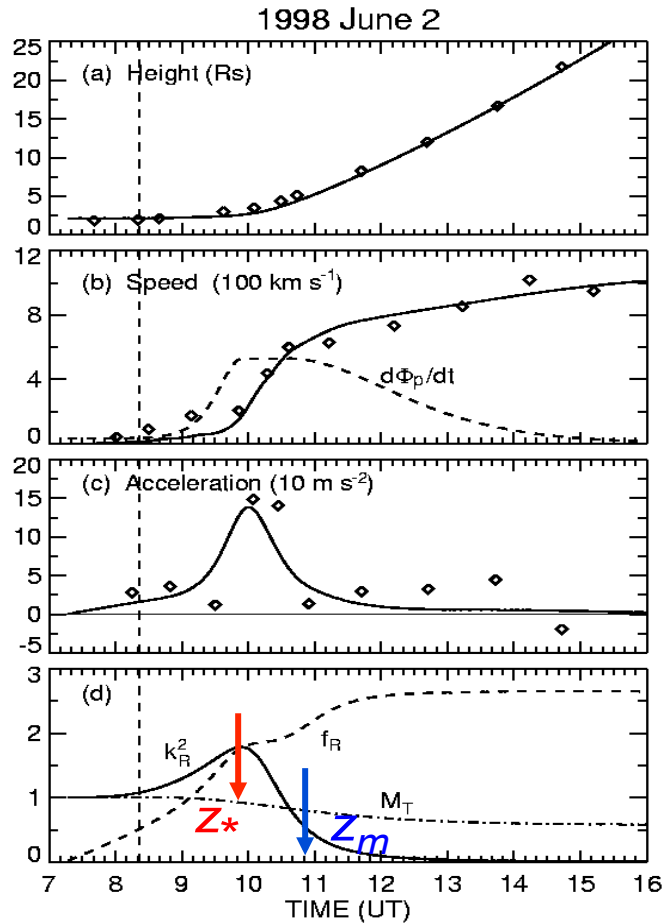
Highly asymmetric shock distribution due to local characteristic speed variations clearly observed during the 2011 March 7 event: see Wood et al. (2011)

- Start of WP6, we officially start on month 7 but will start immediately (meeting with Dusan in Boston/Washington start of June)

- We will start with modeling of the background solar for several Carrington Rotations

- We start injecting CMEs into ENLIL from month 12





Chen-Kunkel Model permet de définir les props des CMEs à 10 rayons solaires
 > Intégration des forces régissant la dynamique des CMEs une fois l'énergie injectée

Space-Weather Tool:

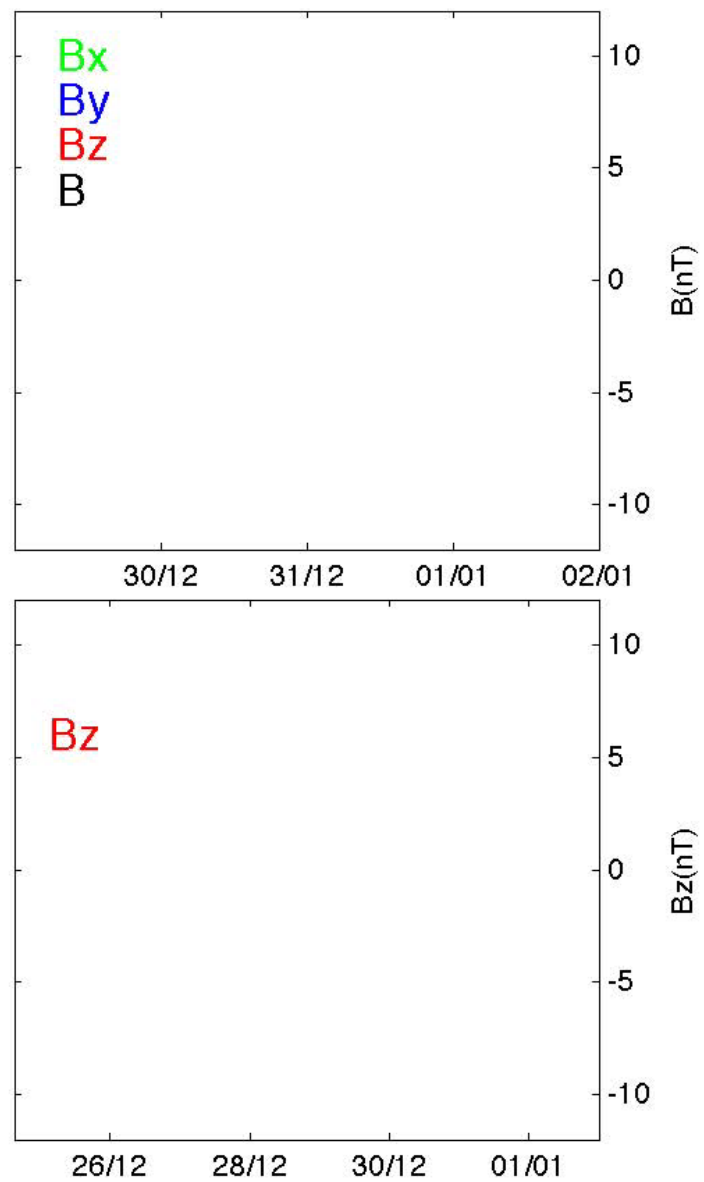
Collaboration with Valbona Kunkel (post-doc at IRAP from June to November 2013).

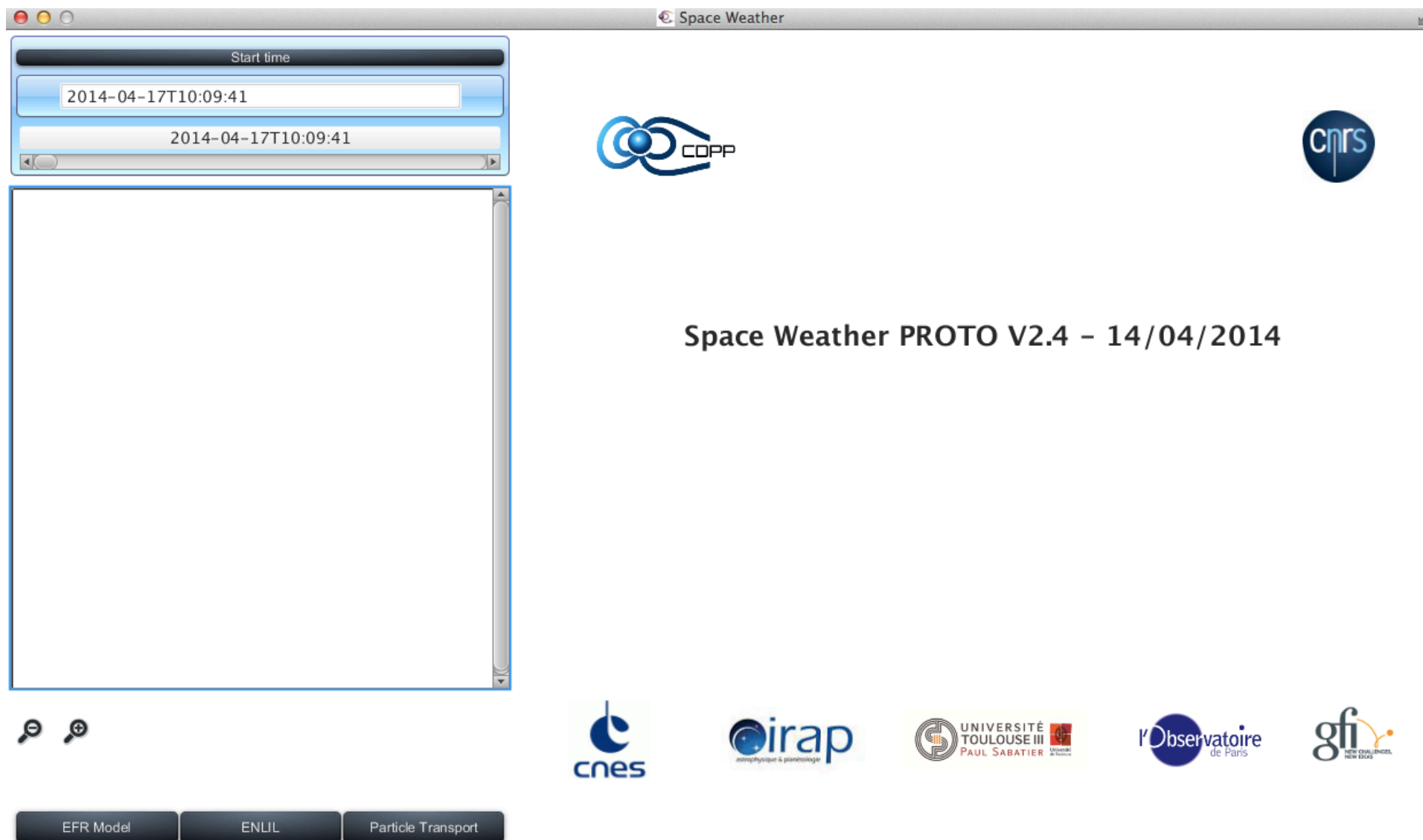
- Scientific tool but can be used for space-weather forecasting.
- Integration of real-time measurements and images.
- Delivered by GFI informatique end of May 2014.
- Tests June-September 2014: Anthony Bourdelle (ISAE-SUPAERO student)
- Delivery in October 2014

Integration of HELCATS events as the project develops 2015-2017

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The screenshot shows a web browser window titled "Space Weather". On the left, there is a sidebar with a "Start time" section containing two input fields, both with the value "2014-04-17T10:09:41". Below these is a large empty rectangular area. At the bottom of the sidebar are zoom in and zoom out icons, and three buttons: "EFR Model", "ENLIL", and "Particle Transport".

Logos for CDPP and CNRS are visible in the top right area of the interface.

Centered text reads: **Space Weather PROTO V2.4 - 14/04/2014**

Logos for CNES, airap, UNIVERSITÉ TOULOUSE III PAUL SABATIER, l'Observatoire de Paris, and gfi are visible in the bottom right area of the interface.

Space Weather
START : SUN
CR2118 STEREO-A 195A

Start time

2012-01-06T04:02:00

0 24 48 72 hr

0 0.3 0.6 1 AU

EFR Model
ENLIL
Particle Transport

Longitude : 339.6 - Latitude : -85.3 - Value : 62

CME Long. ...	Longitude	Central ...	Footpoin...	Footpoin...
89.8	107.58	106.63	108.53	
	Latitude	1	1	1

Start Time	Ellipticity	Aspect Ratio	Hel	Z0	Central Axis Tilt	Footpoint Separation	HAE Central Axis	
Start : SUN	2012-01-06T00:00:00	1	1.1	-1	1	0	1.9	160

Poloidal Flux Injection defined

Background Corona defined

Automatic comp... ...

Rot. angle

End Time	BZmin RTN	BZmin GSM	Vmax	Ptot	DSTmin	HAE
End : Time t						

EFR Interface
J-Map/Kinematics
Poloidal Flux Injection
Solar Wind Interface
Table of Arrival Times

AMDA at END time
MEDOC at tSUN
3-D Movies of EFR
Wight-light SIMU

Start time
START : SUN
CR2118 STEREO-A 195A

0
24
48
72 hr

0
0.3
0.6
1 AU

90°
START : SUN
CR2118 STEREO-A 195A

-90°
Longitude : 339.6 - Latitude : -85.3 - Value : 62

	Central ...	Footpoint...	Footpoint...
CME Long. ...	Longitude	107.58	106.63
	Latitude	1	1

Start Time	Ellipticity	Aspect Ratio	Hel	Z0	Central Axis Tilt	Footpoint Separation	HAE	Central Axis
Start : SUN	2012-01-06T00:00:00	1	1.1	-1	1	0	1.9	160

Poloïdal Flux Injection defined
Automatic comp... ...
Rot. angle

Background Corona defined

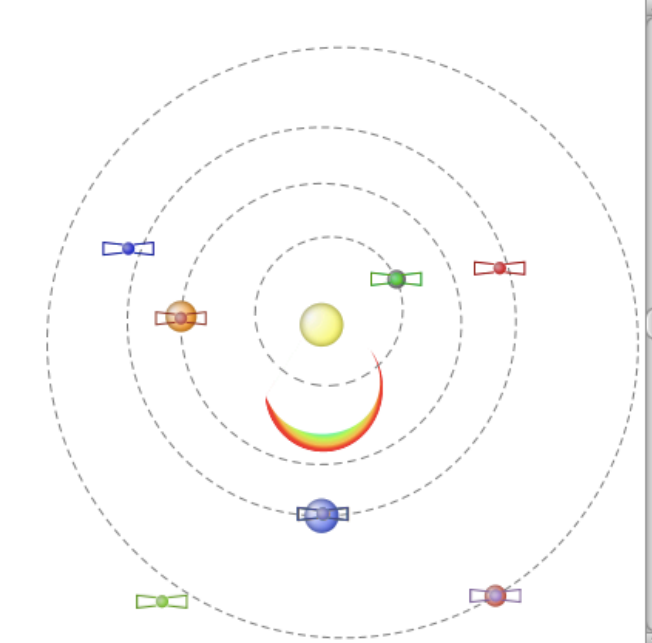
End Time	BZmin RTN	BZmin GSM	Vmax	Ptot	DSTmin	HAE
End :	Time t					

EFR Model
ENLIL
Particle Transport

EFR Interface
J-Map/Kinematics
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AMDA at END time
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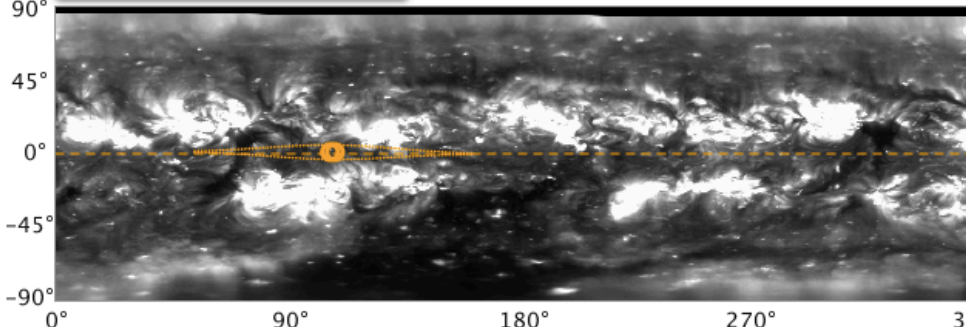
Start time
START : SUN
CR2118 STEREO-A 195A



0 24 48 72 hr

0 0.3 0.6 1 AU

90°
CR2118 STEREO-A 195A



-90°
0° 90° 180° 270° 360°

Longitude : 339.6 - Latitude : -85.3 - Value : 62

	Central ...	Footpoint...	Footpoint...
Longitude	107.58	106.63	108.53
Latitude	1	1	1

	Start Time	Ellipticity	Aspect Ratio	Hel	Z0	Central Axis Tilt	Footpoint Separation	HAE Central Axis
Start : SUN	2012-01-06T00:00:00	1	1.1	-1	1	0	1.9	160

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Background Corona defined

Automatic comp... ...

Rot. angle

	End Time	BZmin RTN	BZmin GSM	Vmax	Ptot	DSTmin	HAE
End :	Time t						

EFR Model

ENLIL

Particle Transport

[EFR Interface](#)
[J-Map/Kinematics](#)
[Poloïdal Flux Injection](#)
[Solar Wind Interface](#)
[Table of Arrival Times](#)

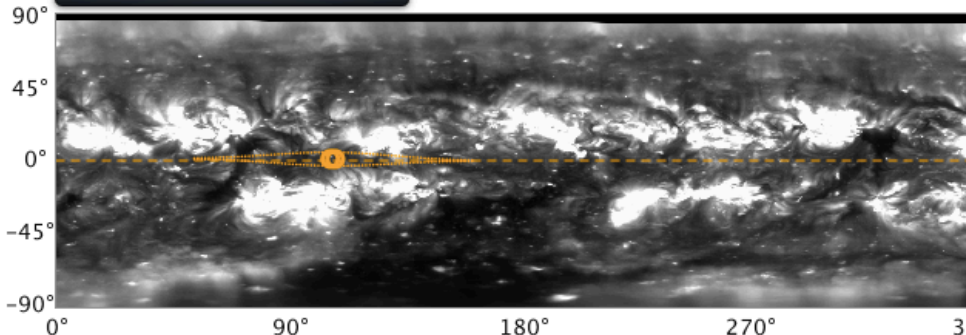
[AMDA at END time](#)
[MEDOC at tSUN](#)
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[Wight-light SIMU](#)

Start time

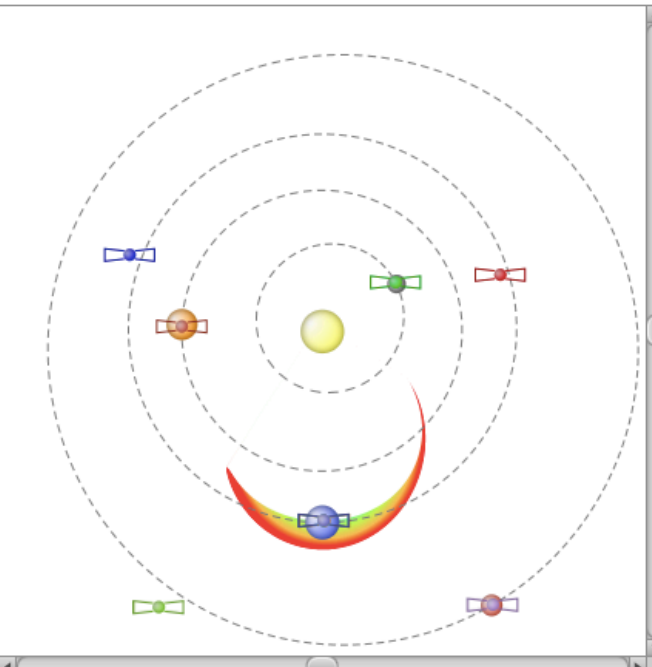
2012-01-06T00:00:00

2012-01-09T00:02:00

START : SUN CR2118 STEREO-A 195A



- MERCURY
- VENUS
- EARTH
- MARS
- JUPITER
- SATURN
- URANUS
- NEPTUNE
- MESSENGER
- VEX



0 24 48 72 hr

0 0.3 0.6 1 AU

	CME Long. ...	Longitude	Footpoint...	Footpoint...
	108.1	107.58	106.63	108.53
		Latitude	1	1

	Start Time	Ellipticity	Aspect Ratio	Hel	Z0	Central Axis Tilt	Footpoint Separation	HAE Central Axis
Start : SUN	2012-01-06T00:00:00	1	1.1	-1	1	0	1.9	160

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Automatic comp... ...

Background Corona defined

Rot. angle

	End Time	BZmin RTN	BZmin GSM	Vmax	Ptot	DSTmin	HAE
End :	Time t						

EFR Model ENLIL Particle Transport

EFR Interface J-Map/Kinematics Poloïdal Flux Injection Solar Wind Interface Table of Arrival Times

AMDA at END time MEDOC at tSUN 3-D Movies of EFR Wight-light SIMU

