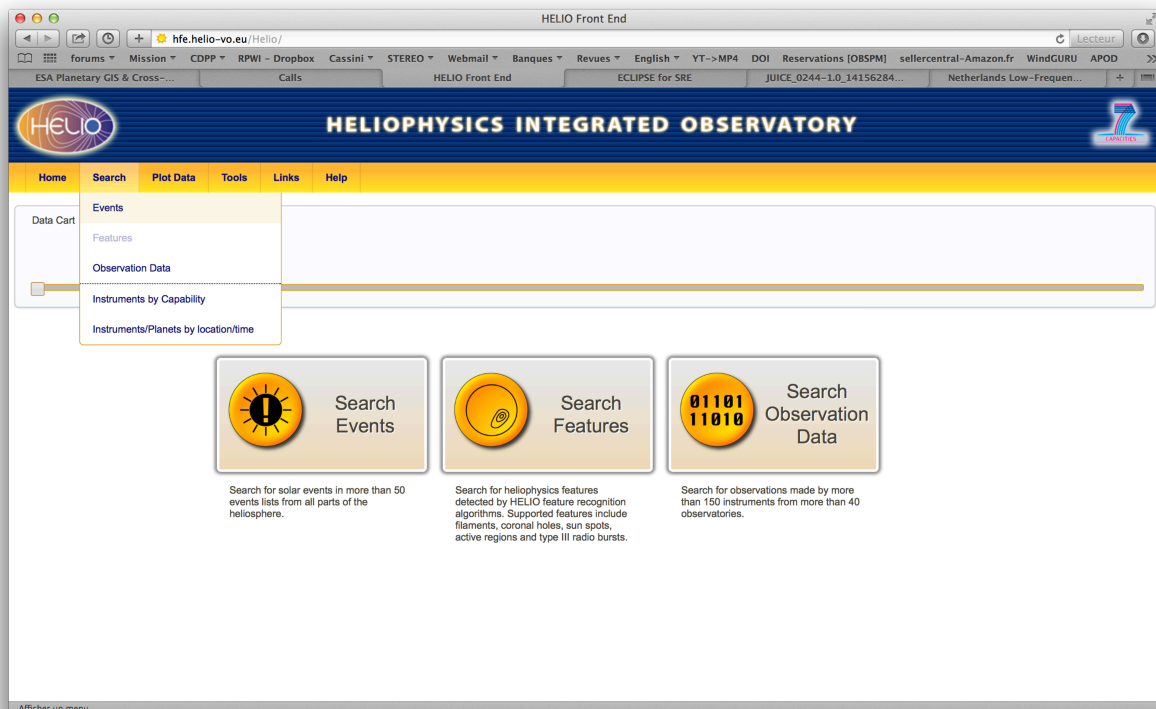


Tutorial Example - Connection of Helio Tools, AMDA/IMPEX & 3DView/IMPEX: CME impact on Venus and Earth

This tutorial gives an example of the interconnected use of HELIO Tools, AMDA/IMPEX functionality and 3DView/IMPEX functionality. The AMDA/IMPEX-, as well as the 3DView/IMPEX-part show new features in AMDA, which were implemented within the IMPEX FP7 project, i.e. the possibility of plotting simulation runs for given spacecraft side by side with observational data.

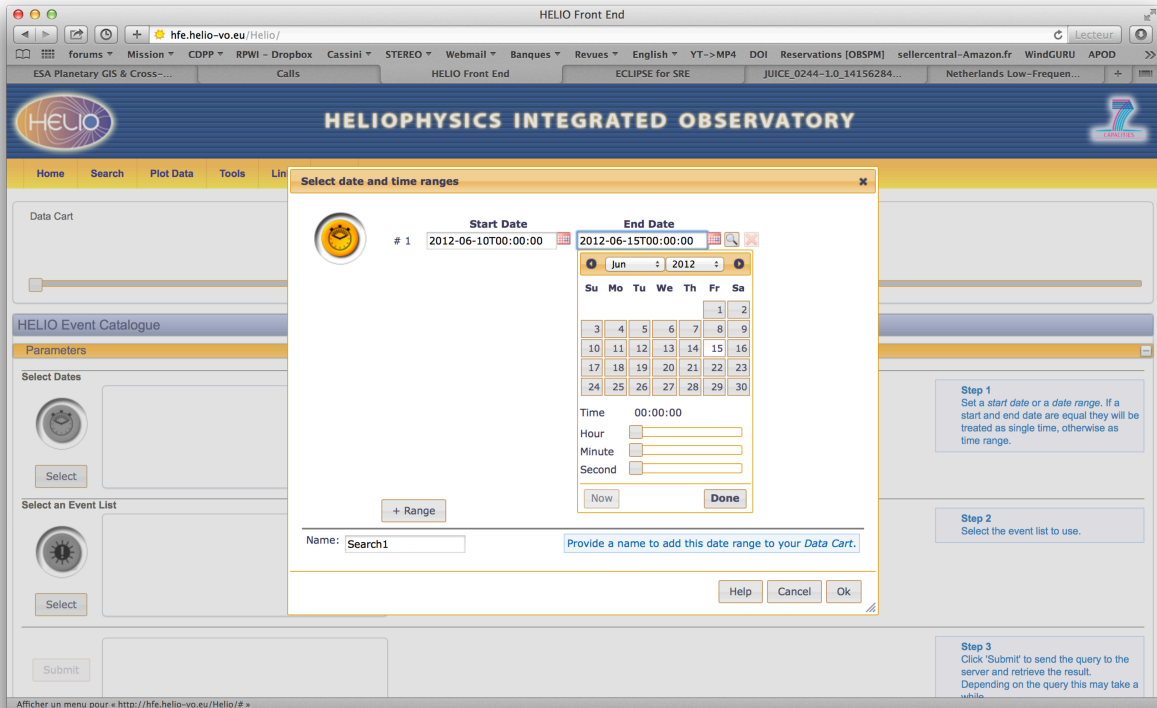
- 1) **Searching for events in Helio** → <http://hfe.helio-vo.eu/Helio/> (“Search” → “Events”)



Proposed example:


- **Select the Time Range:**

2012-06-10T00:00:00 - 2012-06-15T00:00:00



- **Select the Event Catalogue:**

Select "SOHO/LASCO CME Event List"

and add a query parameter using the gear icon  and configure $pa_width \geq 270$

HELIO Front End

HELIOPHYSICS INTEGRATED OBSERVATORY

Home Search Plot Data Tools

Select Event List

Select criteria to restrict the list of events

Show all

Event type: CME Flare Solar Wind Particle

Location: Solar IPS Geo Planet

Obs. type: In situ Remote Both

All flare lists are shown.

Description	From	To	Type	Status	Info
GOES Soft X-ray Flare List	1975-09-01	2014-11-08	event	active	
NGDC H-alpha Flare List	1980-01-01	2010-01-31	event	static	
Kanzelhoehe Solar Observatory H-alpha Flare List	1984-01-02	2014-10-30	event	active	
SOHO/LASCO CME Event List	1996-01-11	2014-03-31	event	static	
NOAA Solar Energetic Event List	1996-01-04	2014-11-09	event	active	
NOAA GOES Solar Proton Event (SEP) List	1976-04-30	2014-09-11	event	active	
CME-related Forbush Decrease Event List	1957-	2006-	event	inactive	

Name: Provide a name to add this event list to your Data Cart.

Help Cancel Ok

Step 1: Set a start date or a date range. If a start and end date are equal they will be treated as single time, otherwise as time range.

Step 2: Select the event list to use.

Step 3: Click 'Submit' to send the query to the server and retrieve the result. Depending on the query this may take a while.

HELIO Front End

HELIOPHYSICS INTEGRATED OBSERVATORY

Home Search Plot Data Tools

Select Parameter

Parameter	Value	Description
pa	<input type="text"/>	Central position angle for the CME
pa_width	<input type="text" value="270"/>	Position angle width of the CME
v	<input type="text"/>	the linear speed obtained by fitting a straight line to the height-time measurements made at the fastest section of CMEs
v_init	<input type="text"/>	quadratic speed obtained by fitting a parabola and evaluating the speed at the initial time of the event
v_final	<input type="text"/>	quadratic speed obtained by fitting a parabola and evaluating the speed at the time of final height measurement
v_20r	<input type="text"/>	quadratic speed obtained by fitting a parabola and evaluating the speed at 20 solar radii
accel	<input type="text"/>	Acceleration is obtained from the quadratic fit to the height-time measurements
pa_measure	<input type="text"/>	The position angle at which the height-

Help Cancel Ok

Step 1: Set a start date or a date range. If a start and end date are equal they will be treated as single time, otherwise as time range.

Step 2: Select the event list to use.

Step 3: Click 'Submit' to send the query to the server and retrieve the result. Depending on the query this may take a while.


• **Submit**

You get only 1 CME in the list.

HELIO Event Catalogue


Parameters

Select Dates

 # 1 2012-06-10T00:00:00 – 2012-06-15T00:00:00

Step 1
Set a start date or a date range. If a start and end date are equal they will be treated as single time, otherwise as time range.

Select an Event List


 SOHO/LASCO CME Event List pa_width>=270

Step 2
Select the event list to use.

Data successfully loaded!

Step 3
Click 'Submit' to send the query to the server and retrieve the result. Depending on the query this may take a while.

VOTable for task 'HELIO Event Catalogue'



Hover over the toolbar buttons to get more information about what they do.

hec-soho_lasco_cme (1)

Show as table


Show 50 entries

	time_start	pa	pa_width	v	v_init	v_final	v_20r	accel	pa_measure
	2012-06-14T14:12:07	-1	360	987	997	977	983	-1.2	144

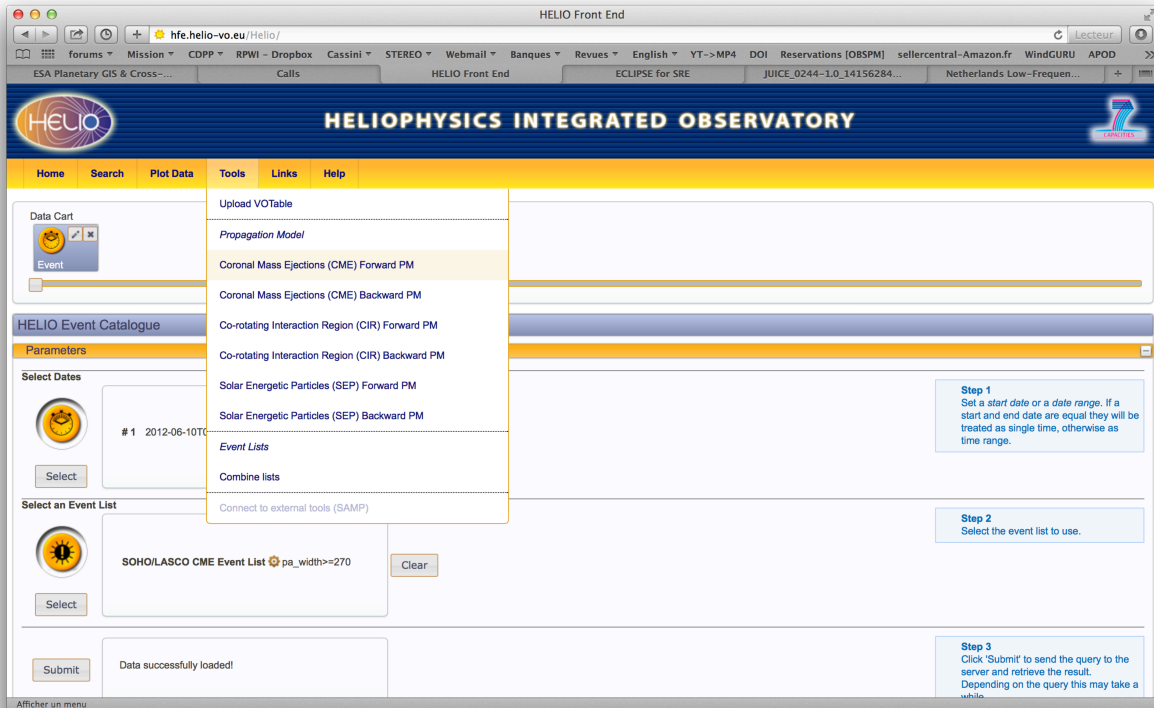
Showing 1 to 1 of 1 entries

Note down the “pa” (Position angle) and “v_final” (final velocity) parameter, for use in the next section.

2) Extraction of time range and use it as input for the Helio CME Forward PM

Select the resulting line and click on the “timer” icon  to save the time of the selected event. A item should then appear in the “Data Cart” with the name typed in the “Name” field of the pop-up frame.

In Menu “Tools” select “Coronal Mass Ejection (CME) Forward PM”



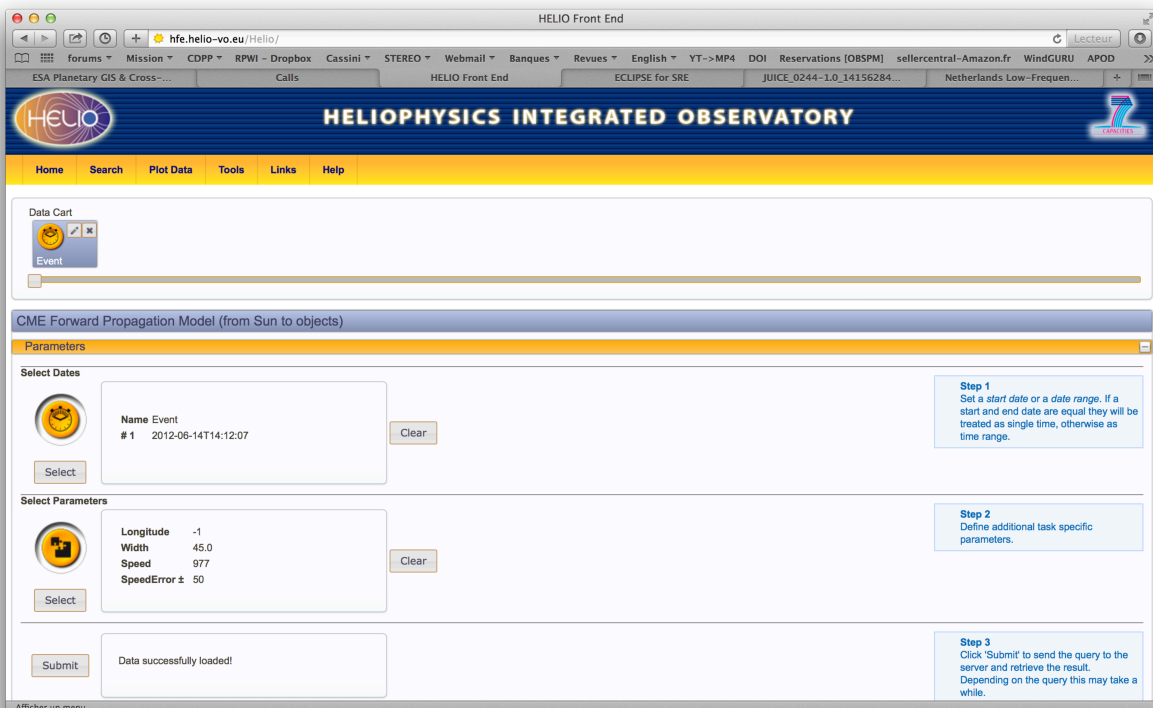
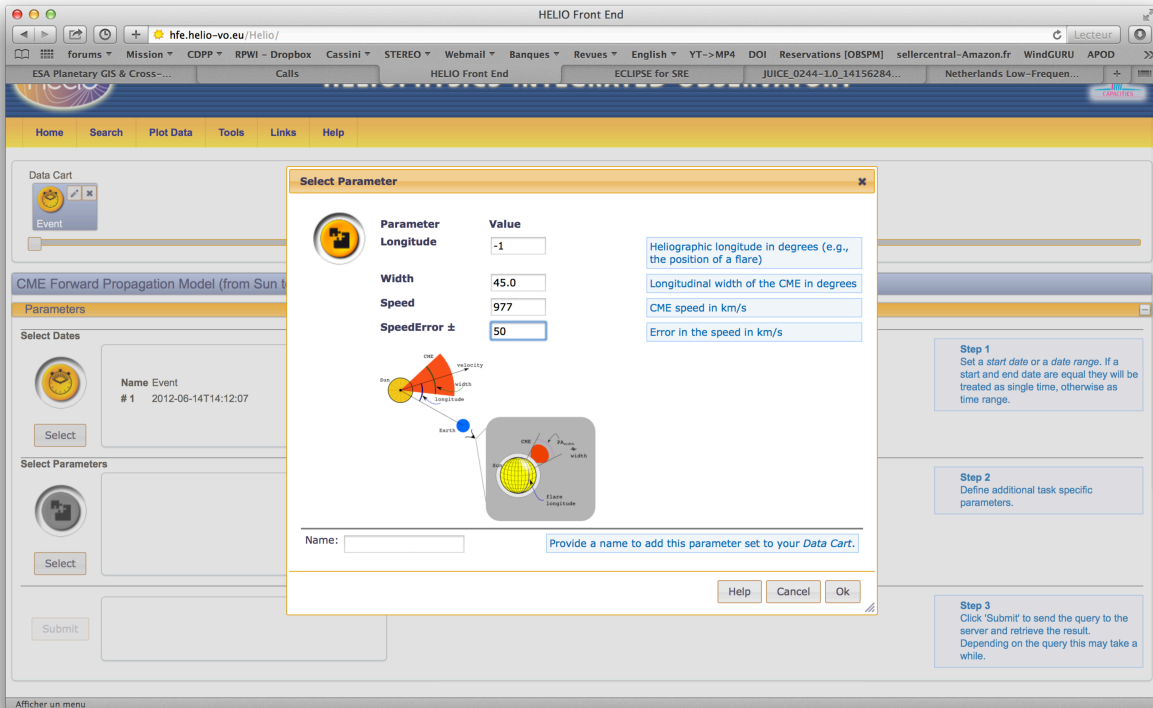
- Drag and drop extract time on grey timer (select date)
- Click on the “Puzzle” icon and fill the fields with the

Longitude: -1 (from previous result)

Width: 45

Speed: 977 (from previous result)

SpeedError ± 50



→ CME hits Earth, Venus, Pluto, Voyager1, New Horizons, Rosetta (see screenshot)

You can save the resulting table using the « VOT » floppy disk icon. This will create a VOTable file and download it for local use.

Note down the ETA_min (minimum Estimated Time of Arrival) and ETA_max (maximum Estimated Time of Arrival) for use in the next section.

Plots for task 'CME Forward Propagation Model (from Sun to objects)'

VOTable for task 'CME Forward Propagation Model (from Sun to objects)'

SHEBA CME propagation model (17)

Show as table | Show as plot

Hide missed objects

Show 50 entries

time_start	long_hg	long_hci	long_width	v	v_err	target_obj	r_hci	HitOrMiss	ETA	ETA_min	ETA_max	Dt	Dt_min	Dt_max
2012-06-14T16:12:07.000	-1	186.89	45	977	50	VENUS	0.727	1	2012-06-15T23:11:14.400	2012-06-15T21:40:43.660	2012-06-16T00:51:30.981	1.29	1.23	1.36
2012-06-14T16:12:07.000	-1	186.89	45	977	50	EARTH	1.016	1	2012-06-16T11:31:01.515	2012-06-16T09:24:29.767	2012-06-16T13:51:12.223	1.8	1.72	1.9
2012-06-14T16:12:07.000	-1	186.89	45	977	50	PLUTO	32.25	1	2012-08-08T19:03:43.089	2012-08-06T02:39:28.362	2012-08-11T18:24:49.114	55.12	52.44	58.09
2012-06-14T16:12:07.000	-1	186.89	45	977	50	VOYAGER1	120.89	1	2013-01-19T00:00:00.000	2013-01-08T00:00:00.000	2013-01-31T00:00:00.000	218	207	230
2012-06-14T16:12:07.000	-1	186.89	45	977	50	NEWHORIZONS	23.4	1	2012-07-27T00:00:00.000	2012-07-25T00:00:00.000	2012-07-29T00:00:00.000	42	40	44
2012-06-14T16:12:07.000	-1	186.89	45	977	50	ROSETTA	5.25	1	2012-06-24T00:00:00.000	2012-06-24T00:00:00.000	2012-06-25T00:00:00.000	9	9	10

Showing 1 to 6 of 6 entries (filtered from 17 total entries)

First Previous 1 Next Last

3) Plotting data in AMDA - Comparison of model data with in-situ data →

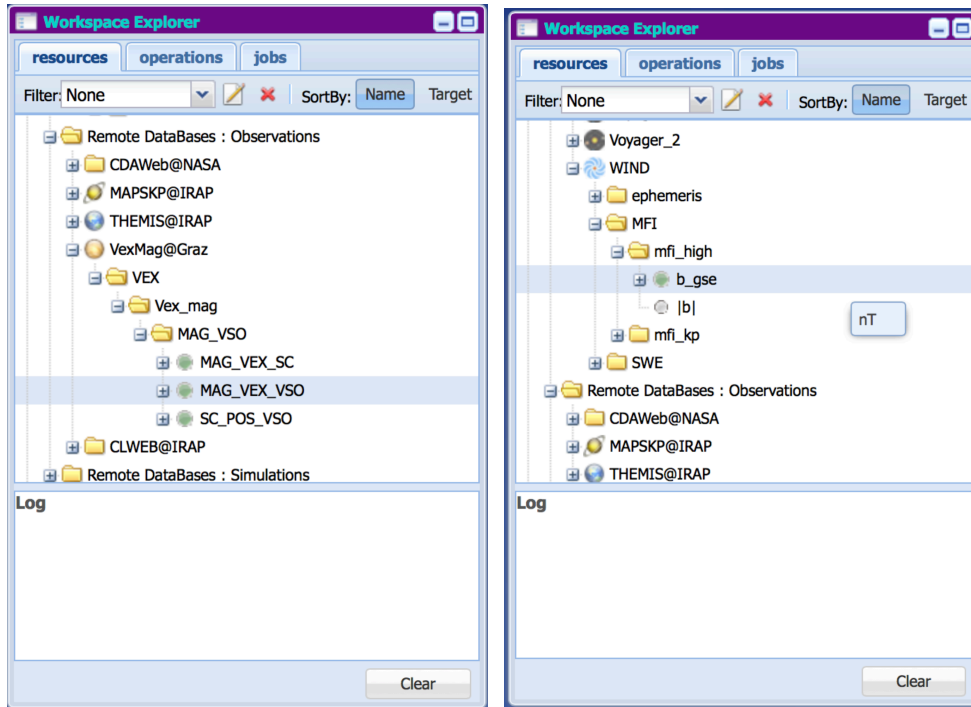
<http://amda.cdpp.eu/>

Ask for a guest account to the organizers.

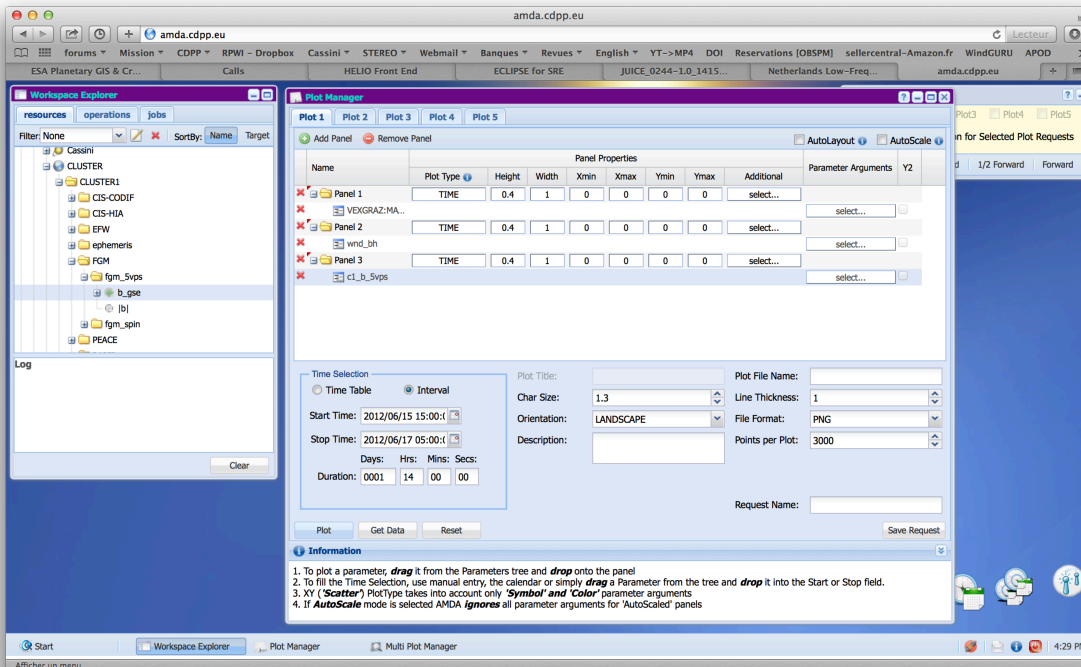
a) Verification of CME impacts on Venus and Earth:

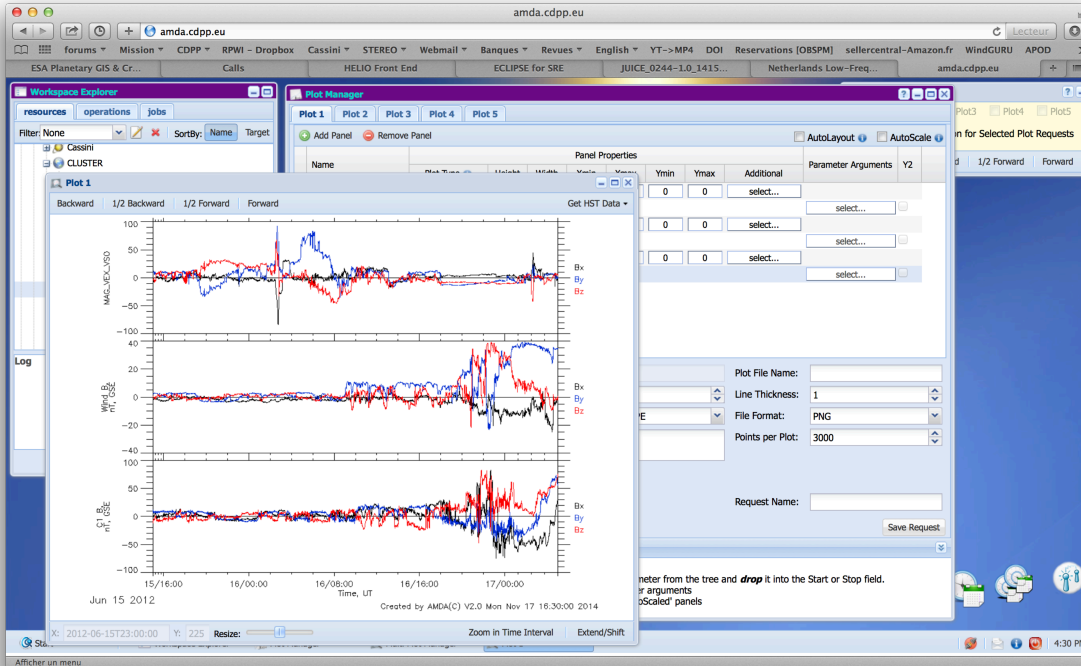
- Open the “Plotting Data” in AMDA:
Use the time range as received via HELIO and extend it properly (± 6 hours), i.e. the CME impacts at Venus and Earth should be visible :
Begin: 2012/06/15 15:00:00
End: 2012/06/17 05:00:00
- The following parameters may be selected (see screenshot below):
 - VEXMAG data: Remote Data (Observations)/ VexMag@Graz/ VEX/ Vex_mag/ MAG_VSO/ MAG_VEX_VSO (use drag and drop to add parameter in Plot Manager window)

- WIND-MFI data: Local Data/WIND/MFI/mfi_high/b_gse
- CLUSTER1-FGM data: Local Data/fgm_5vps/b_gse



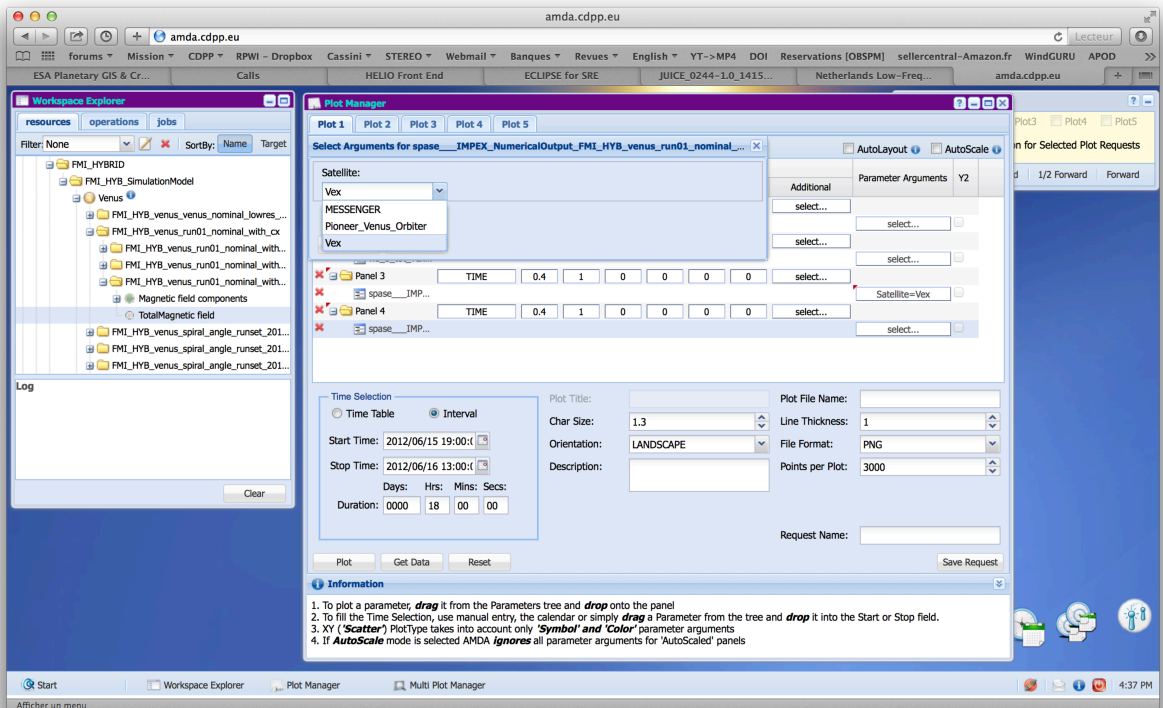
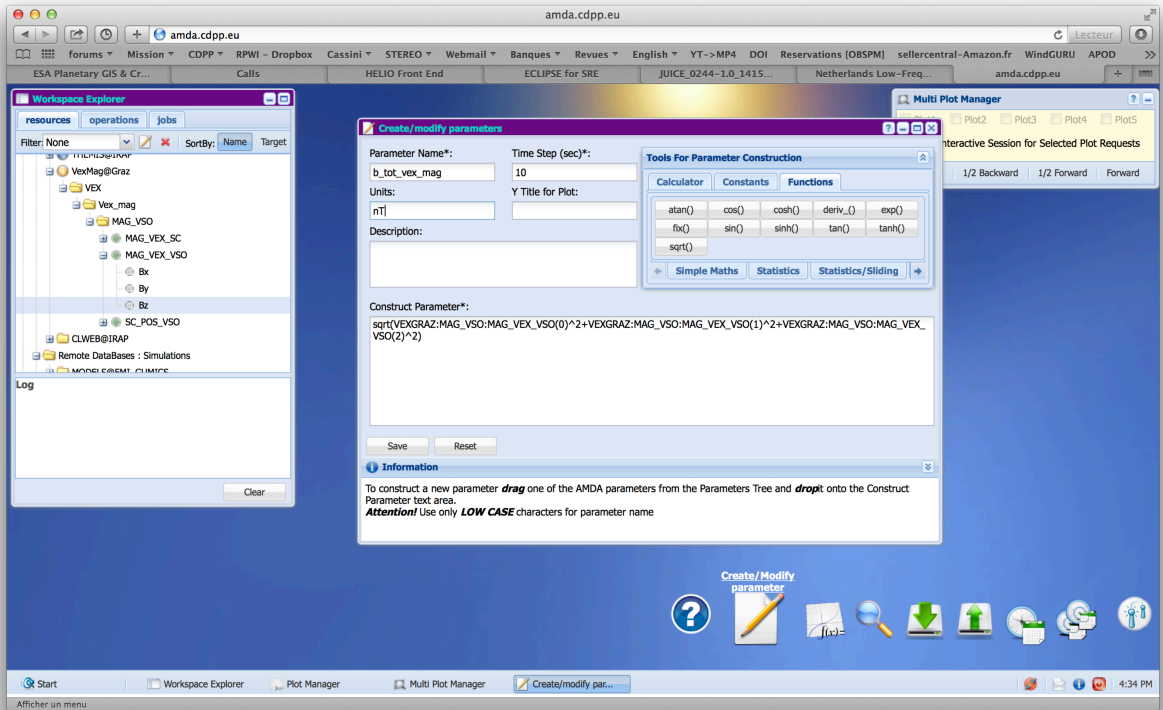
- Plot the data (see screenshot below). One can zoom into different time intervals to get a more detailed view on the data at Venus and Earth.

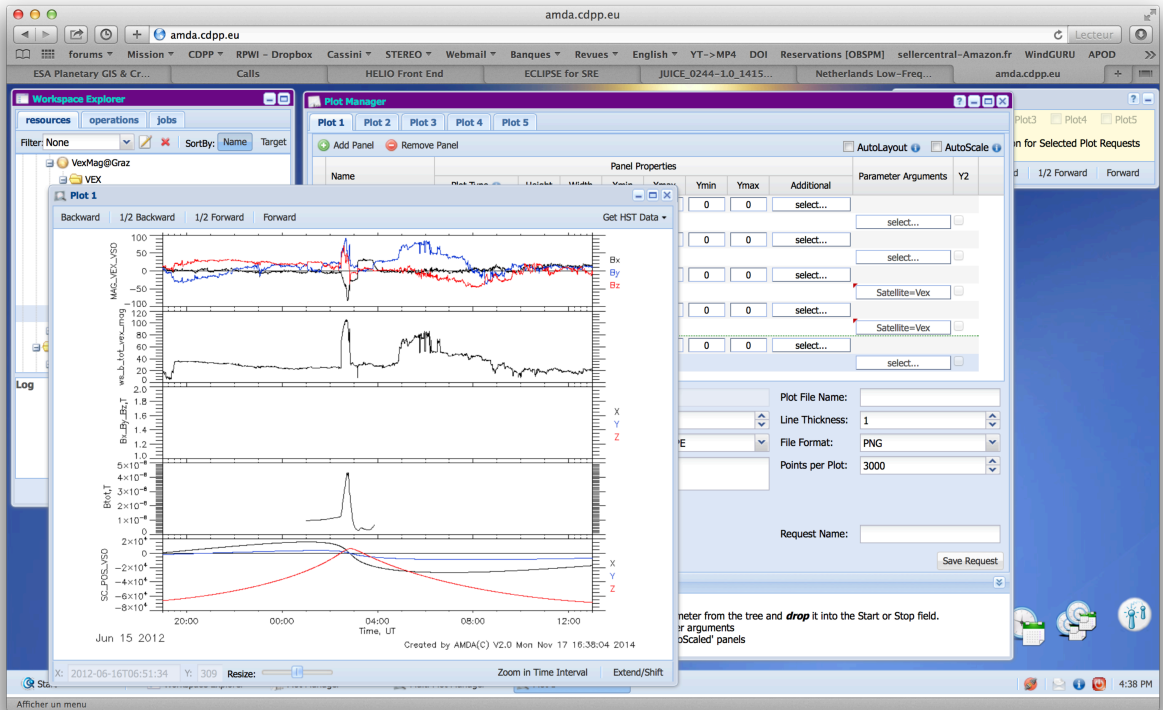




b) The Venus Impact:

- Prepare another plot via the Plot Manager for the time interval of the CME impact at Venus (e.g. 2012/06/15 19:00:00 - 2012/06/16 13:00:00).
- Compare observational data by VEX MAG with FMI HYB simulation run data (please be aware that the FMI HYB simulation runs are by now only for quiet solar wind conditions. The runs are within a range around Venus of $x=[-3,3]$, $y=[-4,4]$, $z=[-4,4]$ Venus radii). Use the following data:
 - VEXMAG data: Remote Data (Observations)/ VexMag@Graz/ VEX/ Vex_mag/ MAG_VSO/ MAG_VEX_VSO
 - Via Create/Modify parameter one can also create the absolute value of the observed magnetic field (see screenshot below)
 - Select B_tot of one of the FMI HYB simulation runs for Venus under (Remote Data (Simulations))
 - VEXMAG ephemeris data: Remote Data (Observations)/ VexMag@Graz/ VEX/ Vex_mag/ MAG_VSO/ SC_POS_VSO
- Plot the data. One can now zoom into the region, where the FMI HYB simulation run is plotted (see screenshot below).

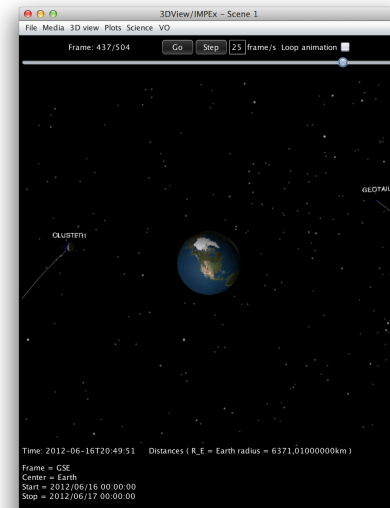
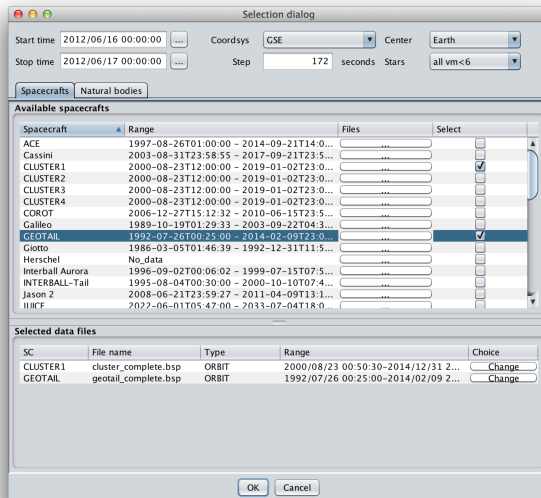




4) Visualization within 3DView: IMPEX functionality within 3DView - The CME impact at Earth (Cluster1 & Geotail)



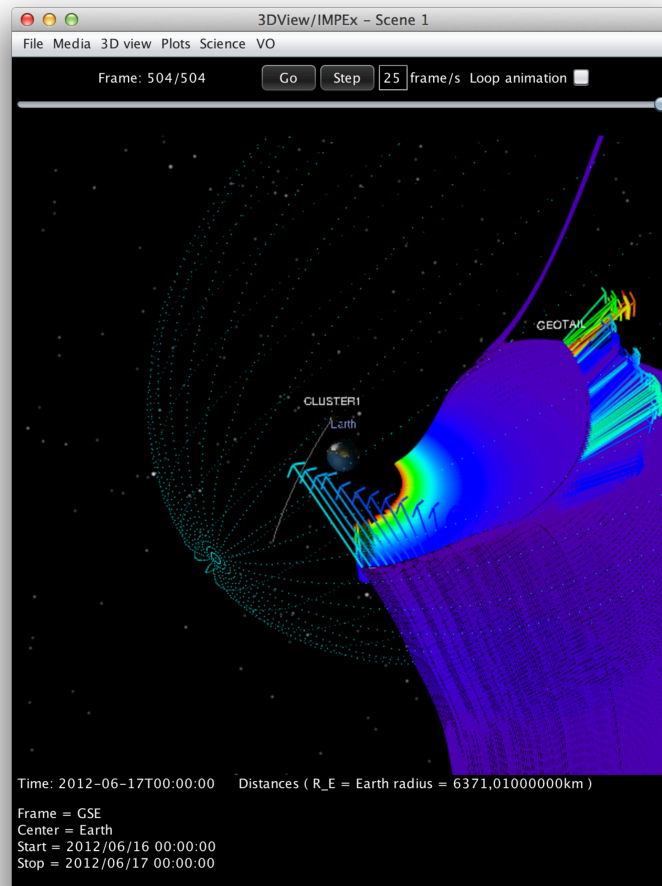
1. Download and open 3DView (<http://3dview.cdpp.eu/>)
2. File → New. Open File → Manage Scene within the new scene window and choose
 - a. Time range: Start = 2012/06/16 00:00:00 & Stop = 2012/06/17 00:00:00
 - b. Choose Cluster1 & Geotail and start scene



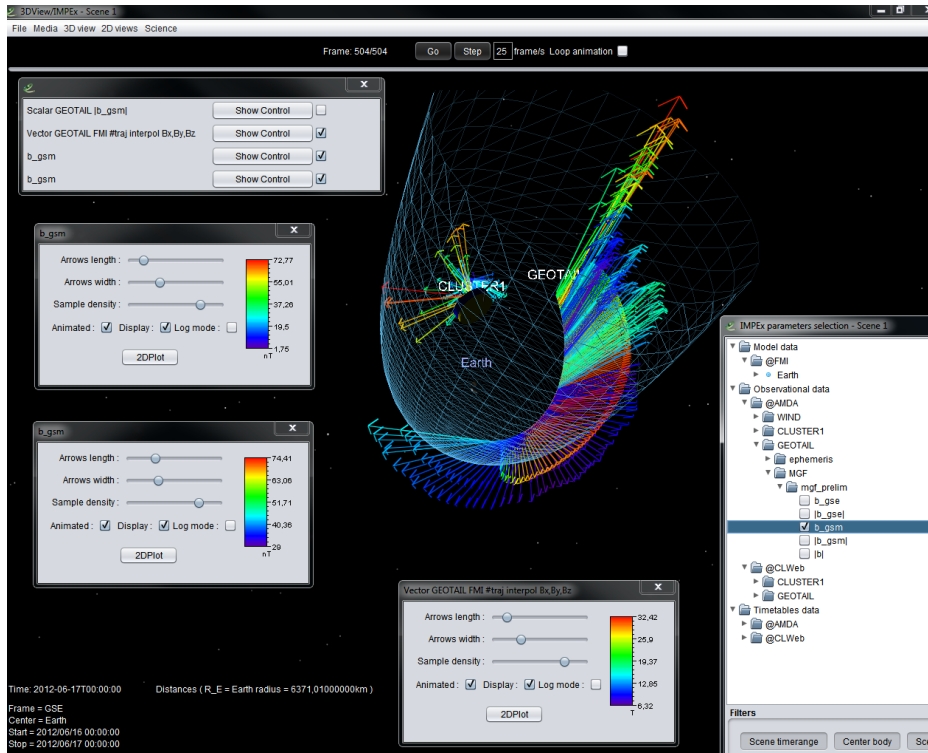
3. Load Data : VO menu → IMPEX
 - a. Models of magnetospheric frontiers → Earth/MAGNETOPAUSE/Shue et al 1997, - then “Add Selected data to 3Dscene”
 - b. Model data → FMI → Earth → GUMICS_Earth_run_000001 → 3DCubes →

FieldLine → GSE → Magnetic field component → #Field Line Bx,By,Bz,
- select “Geotail” in the spacecraft list (and ckeck corresponding radio button)
- then “Add Selected data to 3Dscene”

- c. Observational data → AMDA → Geotail → MGF → mgf_preliminary → b_gse
- and “Add selected data to 3DScene”



- d. One may additionally add Cluster1 data in the same way as described above
4. The different parameters can be manipulated via Scientific Control Panels (see screenshot below). One can get to the control panels via Science → Science data controls. Additionally further spacecrafts can be added via File → Manage Scene. Further data can also be added in the same way as described above.



5. Within the science control one can also add a 2DPlot by clicking on “2Dplot” on the respective Science Control Panel (see second screenshot)

