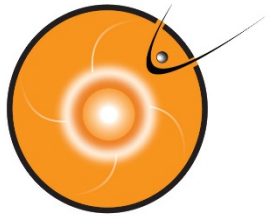
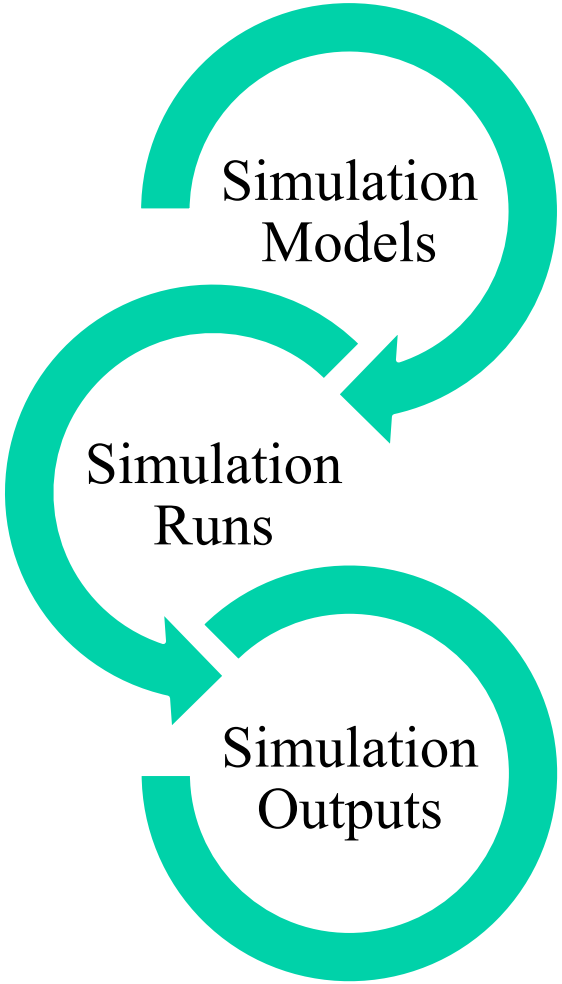


Using SPASE at CCMC

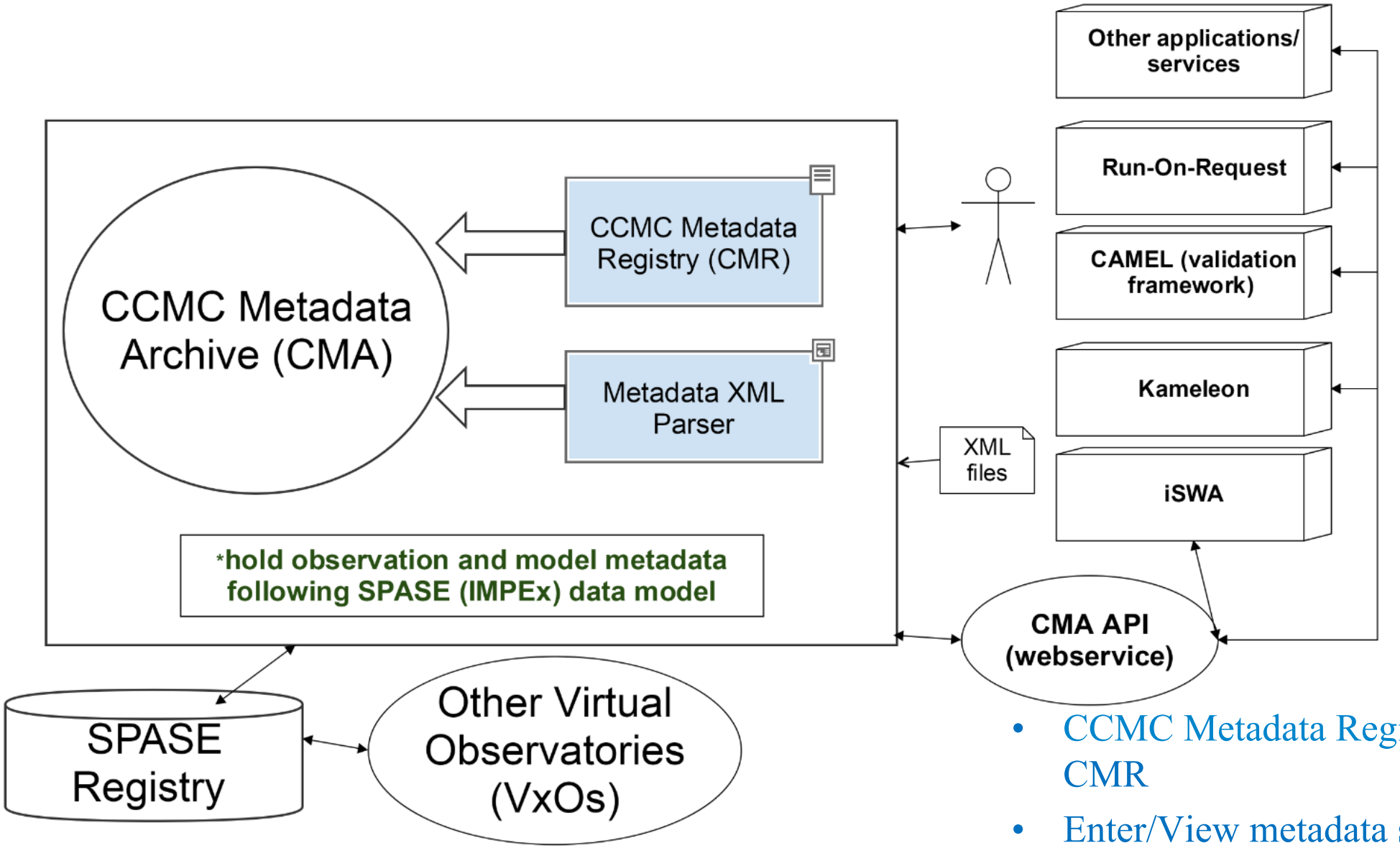
Chiu Wiegand

Model Metadata: models, runs, and output

- **<u>GOAL: Enable and Improve the use of our models for the community!</u>**
  - Centralized CCMC Metadata database store metadata on:
  - <u>Simulation Model:</u>
    - Track all model info and versions
    - Help in implementing the submission interface if input parameters are included
  - <u>Simulation Run:</u>
    - Track all runs info
    - Improve search functionality on our ROR archive
    - Before new run for a model is submitted, check database for an existing or similar run. Provide option for users to view/download a similar run instead of submitting a new run
  - <u>Simulation Outputs</u>
    - Provide API and locations to obtain run outputs for users
- **Focused on providing APIs/webservice for other applications to obtain/ exchange metadata/data**



Using metadata: models, runs, and output



- CCMC Metadata Registry: https://kauai.ccmc.g CMR
- Enter/View metadata stored in our database

Simulation Models

Simulation Model Input Form

Simulation Model Name (e.g. BATS-R-US) :

Simulation Model Full Name (if any):

Model Release/CCMC Installation date in UT (yyyy-MM-dd'T'hh:mm:ss'Z' i.e. 2014-08-08T00:00:00Z):

Model Description:

Model Version:

Change Log (if any):

Inputs Description:

WSA (v.2.2) [Add New Version]

The Wang-Sheeley-Arge model

Model Description (Edit)

The Wang-Sheeley-Arge (WSA) model has two components: the WSA Potential Field + Current Sheet (WSA PF+CS) Model and the WSA Inner Heliosphere (WSA-IH) Model.

The WSA-PF+CS model is the inner coronal component of the complete WSA model. These combine a Potential Source Surface Model with the 'Schatten' current sheet model, to produce a model of the global coronal magnetic field between the solar surface and a bounding spherical surface, typically set at 5 solar radii. The magnetic field is assumed to be radial at this outer surface. At this outer surface the model computes the solar wind speed using an empirical relationship based on the divergence of the magnetic field and the proximity of the selected open field line to the nearest coronal hole boundary, to determine the local solar wind speed. The surface magnetic field is determined from synoptic magnetogram data. Currently we download magnetograms from both Kitt Peak and Mount Wilson.

Model Inputs Description

Photospheric Synoptic Magnetograms produced by either the National Solar Observatory or the GONG network.

Model Outputs Description

Images displaying wind speed at outer boundary of the models Current Sheet Component; Wind speed and IMF polarity timelines at L1.

Simulation Type: ***Empirical***

Temporal Dependence: ***false***

Regions:

Heliosphere.Inner
Sun.Corona

Contacts (Add Contact) :

- Currently our database has 53 models info
- Part of CCMC model onboarding process: Obtain metadata about their models

Simulation Runs: WSA 2.2 real-time runs

- Step 1: Enter Model Run template: spase://CCMC/SimulationRun/WSA/v.2.2/TEMPLATE

List of Run Input Parameters (Add Input Parameter) :

Name	Description	Caveats	InputTable URL	Properties
All settings for WSA model	All input settings for WSA model			Add Property to this InputParameter

Name	Description	Caveats	Units	Value	Min	Max
OBSER	Observatory where input data is coming from			gong		
FILELIST	FILELIST (example: mrbql170714t1504c2192_014)					
CARROT	Carr. Rot. of leading edge of map					
PROVERS	WSA version #			WSA_V2.2		
MAPTYPE	Type of Map			DU		
RADOUT	Outer boundary radius (Rs)			21.5		
RADINT	Interface radius (Rs)			2.49		
RADSS	Source Surface radius (Rs)			2.51		
GRID	Uniform grid res., del(Lat)=del(Long) (deg)			2.5		
SPHHAR	Number of spherical harmonics			72		
VELEQN	Velocity Equation			240.0+(675.0/(1.0+fexp)**(1.0/4.5))*((1.0-0.8*math.exp(1.0-(arc_ft_bd[i]/2.8)**(1.25))/math.exp(1.0)))**3.0		
MAPNAME	MAPNAME					
MAPDATE	UT Date of this map (i.e. of last contributor)					
MAPTIME	UT Time of this map (i.e. of last contributor)					
pre_filename	intermediate output file generated by the model run					
syn_filename	intermediate output file generated by the model run					
int_filename	intermediate output file generated by the model run					
wsa_filename	intermediate output file generated by the model run					
vel_filename	intermediate output file generated by the model run					
mrbqs_filename	input file					
CARRLONG	Longitude of leading edge of map					

Step 2: Create a ‘database_record_file’ per run

- Parser will parse the ‘database_record_file’
- Send it to CMR
- CMR will create the SimulationRun metadata for that run
- Currently, we have 30K+ runs info from WSA near real-time run since 2006

```
ModelName=WSA
ModelVersion=WSA_V2.2
RORID=N/A
RunDescription=WSA realtime run
RunSubmissionTime=  2018-04-14T20:14:00
RunStartTime=  2018-04-14T20:14:00
RunEndTime=  2018-04-14T20:14:00
RunCompletionTime= N/A
procs= 1
cluster= hilox1.cluster
RunSubmitterFirstName= Peter
RunSubmitterMiddleName= J
RunSubmitterLastName= MacNeice
RunSubmitterOrganizationName= NASA/CCMC
RunSubmitterEmail= Peter.J.MacNeice@nasa.gov
SimulationStartTime= 2018-04-14T20:14:00
SimulationEndTime= 2018-04-14T20:14:00
SimulationTimeStep=N/A
LikelihoodRating=N/A
Keywords=N/A
ParentSpaseResourceID=spase://CCMC/SimulationModel/WSA/v.2.2
TemplateRunInfoID=spase://CCMC/SimulationRun/WSA/v.2.2/TEMPLATE
Property.OBSER= gong
Property.FILELIST=  mrbql180414t2014c2203_358
Property.CARROT  = 2203
Property.CARRLONG= 358
Property.PROVERS = WSA_V2.2
Property.MAPTYPE = DU
Property.RADOUT  = 21.50 / Outer boundary radius (Rs)
Property.RADINT  = Not available
Property.RADSS   = 2.50 / Source Surface radius (Rs)
Property.GRID    = 2.50 / Uniform grid res., del(Lat)=del(Long) (deg)
Property.SPHHAR  = 72 / Number of spherical harmonics
Property.VELEQN  = 240.0+(675.0/(1.0+fexp)^(1.0/4.5))*((1.0-0.8*exp(1.0-(arc_ft_bd/2.8)^(1.25))/exp(1.0)))^3.0
Property.MAPNAME = 2203_358
Property.MAPDATE = 2018-04-14
Property.MAPTIME = 20:14
Property.pre_filename = /gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/DATA/PRE
Property.syn_filename = /gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/DATA/SYN
Property.int_filename = /gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/DATA/WSA
Property.wsa_filename = /gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/DATA/WSA
Property.vel_filename = /gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/DATA/WSA
Property.mrbqs_filename = /gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/observation/solar/gong/QR/bqs
```

CCMC Metadata Registry (CMR)

Go to:

- CMR Home
- Enter Metadata
- View Metadata

Log out

Search SimulationRun

Parent Resource ID : spase://CCMC/SimulationModel/WSA/v.2.2

Start search date in format (e.g. 2017-01-31) : 2018-03-17

End search date in format (e.g. 2017-06-30) : 2018-04-16

search

See All SimulationRun Templates

List of Simulation Runs:

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180317t0614c2201_015

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180317t1204c2201_012

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180317t1814c2201_008

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180317t2004c2201_007

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180317t2204c2201_006

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180318t0614c2201_002

spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180318t1204c2202_358

WSA/v.2.2/mrbqs180317t1204c2201_012 [Add New Version]

Run Description (Edit)

WSA realtime run

Simulation Time:

Simulation Start Time: 2018-03-17T12:04:00Z
Simulation End Time: 2018-03-17T12:04:00Z
Time Step in second:
Simulation Time Description:
Simulation Time Caveats:

Likelihood Rating:

Temporal Dependence: ***false***

Regions:

Heliosphere.Inner
Sun.Corona

Contacts (Add Contact) :

Peter.MacNeice, ModelUser (Edit)

List of Run Input Parameters (Add Input Parameter) :

Name	Description	Caveats	InputTable URL	
All settings for WSA model	All input settings for WSA model			Add Property to this InputParameter

Name	Description	Caveats	Units	Value
OBSER	Observatory where input data is coming from			gong
FILELIST	FILELIST (example: mrbql170714t1504c2192_014)			mrbql180317t1204c2201_012
CARROT	Carr. Rot. of leading edge of map			2201
PROVERS	WSA version #			WSA_V2.2
MAPTYPE	Type of Map			DU
RADOUT	Outer boundary radius (Rs)			21.50 / Outer boundary radius (Rs)
RADINT	Interface radius (Rs)			Not available
RADSS	Source Surface radius (Rs)			2.50 / Source Surface radius (Rs)
GRID	Uniform grid res., del(Lat)=del(Long) (deg)			2.50 / Uniform grid res., del(Lat)del(Long) (deg)
SPHHAR	Number of spherical harmonics			72 / Number of spherical harmonics
VELEQN	Velocity Equation			240.0+(675.0/(1.0+fexp)^(1.0/4.5))*((1.0-0.8*exp(1.0-(arc_ft_bd/2.8)^(1.25))/exp(1.0)))^3.0
MAPNAME	MAPNAME			2201_012
MAPDATE	UT Date of this map (i.e. of last contributor)			2018-03-17
MAPTIME	UT Time of this map (i.e. of last contributor)			12:04
pre_filename	intermediate output file generated by the model run			/gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/D
syn_filename	intermediate output file generated by the model run			/gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/D
int_filename	intermediate output file generated by the model run			/gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/D
wsa_filename	intermediate output file generated by the model run			/gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/D
vel_filename	intermediate output file generated by the model run			/gpfs/fs1/Data/ccmc/RT_DATA_TREE_ROOT/ccmc_rt_data_tree/model/solar/WSA_SUB2.2/D

WSA 2.2 Real-time Runs Search Interface via API

Search the real time Wang-Sheeley-Arge (WSA) model simulations database

Specify search parameters of interest to you (synoptic map date or Carrington Rotation/longitude, run outer boundary radius) for the near real time WSA 2.2 simulation(s) in our database.

SEARCH RUNS BY DATE OR CARRINGTON ROTATION

Display runs for a certain date interval or for a selected Carrington Rotation / Longitude* (CR range is 2137–).

BY CARRINGTON ROTATION
Display all runs for selected Carrington Rotation / Longitude.

CR: 2157

lon: whole Carrington Rotation

BY DATE INTERVAL
Display all runs for dates between start and end date (range is 05/31/1976 - 01/30/2015)

START year: choose start year

START month: choose start month

START day: choose start day

END year: choose end year

Search results for Wang-Sheeley-Arge (WSA) model simulations

Runs with **Carrington Rotation=2157** and **observatory=GONG**.
Go back to search simulations by other parameters.

Carrington Rotation	Center Longitude	Start Time	Observatory	Model	Version	Run output link
2157	317	2014-11-10T00:14:00Z	gong	WSA	v.2.2	View run output
2157	316	2014-11-10T01:04:00Z	gong	WSA	v.2.2	View run output
2157	315	2014-11-10T03:04:00Z	gong	WSA	v.2.2	View run output
2157	314	2014-11-10T06:04:00Z	gong	WSA	v.2.2	View run output
2157	313	2014-11-10T07:04:00Z	gong	WSA	v.2.2	View run output
2157	312	2014-11-10T09:04:00Z	gong	WSA	v.2.2	View run output
2157	311	2014-11-10T10:14:00Z	gong	WSA	v.2.2	View run output
2157	310	2014-11-10T13:14:00Z	gong	WSA	v.2.2	View run output
2157	309	2014-11-10T14:14:00Z	gong	WSA	v.2.2	View run output
2157	308	2014-11-10T16:04:00Z	gong	WSA	v.2.2	View run output
2157	307	2014-11-10T19:14:00Z	gong	WSA	v.2.2	View run output
2157	306	2014-11-10T20:04:00Z	gong	WSA	v.2.2	View run output
2157	305	2014-11-10T21:14:00Z	gong	WSA	v.2.2	View run output
2157	304	2014-11-10T23:04:00Z	gong	WSA	v.2.2	View run output
2157	303	2014-11-11T02:14:00Z	gong	WSA	v.2.2	View run output
2157	302	2014-11-11T04:14:00Z	gong	WSA	v.2.2	View run output
2157	301	2014-11-11T05:04:00Z	gong	WSA	v.2.2	View run output
2157	300	2014-11-11T07:14:00Z	gong	WSA	v.2.2	View run output
2157	299	2014-11-11T09:14:00Z	gong	WSA	v.2.2	View run output
2157	297	2014-11-11T13:04:00Z	gong	WSA	v.2.2	View run output
2157	296	2014-11-11T14:14:00Z	gong	WSA	v.2.2	View run output

Simulation Output: WSA 2.2 real-time run output (VEL)

- Step 1: create a template NumericalOutput
  - spase://CCMC/NumericalOutput/ WSA/ v.2.2/RT/21.5Rs/VEL/ GONG/ TEMPLATE
- Step 2: iSWA Data File Parser during processing:
  - Send filename to CMR
  - CMR create NumericalOutput for that output file
  - CMR sends the SPASE ID back
  - iSWA process the file:
    - Move it to iSWA data tree
    - Store the file location and SPASE ID in database

NumericalOutput [Create Copy]

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/TEMPLATE (Edit)

Data Set Release Date in UT:

Data Set Description

Coronal magnetic field magnitude and solar wind speed output at RADOUT=21.5 Rs from WSA 2.2 real-time run at CCMC

Simulation Product: ***2DCuts***

Measurement Type:

MagneticField

Processing Level: ***Raw***

Simulated Regions:

Sun
Sun.Corona

Temporal Description (Add/Edit) :

Spectral Range (Add/Edit) :

Link to Parent Spase Resource(s) (example: SimulationRun) (Add) :

spase://CCMC/SimulationModel/WSA/v.2.2

Simulated Instrument(s) (Add) :

Access Information (Add Access) :

Access URL: https://iswa.gsfc.nasa.gov/iswa_data_tree/model/solar/WSA_2_2_RT/VEL_GONG/ (Edit)
Access URL Name: ISWA DATA TREE
Repository ID: spase://CCMC/Repository/NASA/GSFC/CCMC/ISWA
Availability: online
AccessRights: OPEN
Format: FITS
Encoding: None

WSA 2.2 real-time run outputs on iSWA data tree

- **https://iswa.gsfc.nasa.gov/iswa_data_tree/model/solar/WSA_2_2_RT/VEL_GONG/**
- 33K+ run outputs are available going back to 2006

Secure | https://iswa.gsfc.nasa.gov/iswa_data_tree/model/solar/WSA_2_2_RT/VEL_GONG/

Index of /iswa_data_tree/model/solar/WSA_2_2_RT/VEL_GONG

Name	Last modified	Size	Description
Parent Directory		-	
2006/	2018-04-18 20:26	-	
2007/	2018-04-19 13:51	-	
2008/	2018-04-19 13:54	-	
2009/	2018-04-19 13:54	-	
2010/	2018-04-19 13:54	-	
2011/	2018-04-19 14:12	-	
2012/	2018-04-19 14:52	-	
2013/	2018-04-19 13:48	-	
2014/	2018-04-19 13:38	-	
2015/	2018-04-19 13:39	-	
2016/	2018-04-19 13:48	-	
2017/	2018-04-19 13:45	-	
2018/	2018-04-19 14:46	-	

Index of /iswa_data_tree/model/solar/WSA_2_2_RT/VEL_GONG/2018/04

Name	Last modified	Size	Description
Parent Directory		-	
vel_2202_011.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_012.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_015.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_023.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_024.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_029.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_032.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_036.00_01_gong.fits	2018-04-18 20:33	84K	
vel_2202_042.00_01_gong.fits	2018-04-18 20:33	84K	

WSA v.2.2 Run Outputs Metadata

Search NumericalOutput

Parent Resource ID : spase://CCMC/SimulationModel/WSA/v.2.2

Start search date in format (e.g. 2017-01-31) : 2018-03-27

End search date in format (e.g. 2017-06-30) : 2018-04-26

search

List of NumericalOutputs:

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_236.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_235.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_234.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_230.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_227.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_223.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_222.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_220.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_217.00_01_gong.fits

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_213.00_01_gong.fits

NumericalOutput

spase://CCMC/NumericalOutput/WSA/v.2.2/RT/21.5Rs/VEL/GONG/vel_2202_236.00_01_gong.fits

Data Set Release Date in UT:

Data Set Description

Coronal magnetic field magnitude and solar wind speed output at RADOUT=21.5 Rs from WSA 2.2 real-time run at CCMC

Simulation Product: ***2DCuts***

Measurement Type:

MagneticField

Processing Level: ***Raw***

Simulated Regions:

Sun
Sun.Corona

Temporal Description :

Start Date: *2018-03-27T18:04:00Z*
Stop Date:

Spectral Range :

Link to Parent Spase Resource(s) (example: SimulationRun) :

spase://CCMC/SimulationModel/WSA/v.2.2
spase://CCMC/SimulationRun/WSA/v.2.2/mrbqs180327t1804c2202_236

Simulated Instrument(s) :

Access Information :

Access URL: https://iswa.gsfc.nasa.gov/iswa_data_tree/model/solar/WSA_2_2_RT/VEL_GONG/2018/03/vel_2202_236.00_01_gong.fits
Access URL Name: ISWA DATA TREE
Repository ID: spase://CCMC/Repository/NASA/GSFC/CCMC/ISWA
Availability: online
AccessRights: OPEN
Format: FITS
Encoding: None

Future Work

- Link to SPASE registry on Github
- Provide additional APIs to help in Model Info page, submission interfaces, search runs/outputs interfaces, provide metadata for other CCMC systems (iSWA, CAMEL, etc.)
- SimulationRun and NumericalOutput/DisplayOutput: part of Run-On-Request Next Gen
  - WSA 2.2 Real-time run is the first example
  - Need to extend to other ROR models replacing our existing ROR database
- Extend/Improve current metadata model for complex/future cases
  - Example: chain of model or a modeling framework
- Metadata to describe a space weather event (discussion this afternoon)