iPATH
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Description

iPATH is a physics-based model (MHD and particle transport) that predicts SEP time profiles and event fluences at Earth. The CME-triggered Module uses measured CME parameters and simulates particle acceleration from the CME shock to Earth. The Flare-triggered Module does the same with hypothetical CME speeds when no CME measurements are available.

Inputs

Flare-triggered Module

Flare Class and Location: From DONKI once entered into the database

CME-triggered Module

CME Speed, Width, and Location: From DONKI once M2M analyzes the CME and enters it into the database

Both Modules

Solar Wind Parameters: From ACE/MAG at a 1 minute cadence and ACE/SWEPAM at a 20 min cadence

Outputs

SEP Time Profile: For integral energies of >10 MeV and >100 MeV

Event Fluence: At differential energies ranging from 0.1-1000 MeV

Lag Time

Flare-triggered Module

Inputs: Few minutes for flare information being entered into DONKI.

Run Time: About 30 minutes

CME-triggered Module

Inputs: About 45 minutes for CME parameters to be entered into DONKI (if M2M staffed, about 8-16 hours if not staffed)

Run Time: About 30 minutes

Interpretation and Caveats

CME Speed: In the Flare-triggered Module, iPATH uses a hypothetical CME speed of $V_{CME} = 2.4 \times 10^4 \, F_{SXR}^{0.3}$, where F_{SXR} is the flare magnitude. For the hypothetical CME width, iPath uses $W_{CME} = max(V_{CME}/25 + 60, 140)$.

High Energy Particle Onset: Due to particle acceleration occuring in the low corona and iPATH's inner boundary being 10 solar radii, the onset of higher energy particles is less accurate than those of lower energies

Perpendicular Diffusion: Since iPATH includes perpendicular diffusion of particles across interplanetary magnetic field lines, parameters such as CME width are less significant

Background Solar Wind: Every 8 hours, iPATH uses the latest solar wind parameters from ACE/MAG and ACE/SWEPAM to simulate a steady-state solar wind background to be used in future runs

Triggers: iPATH checks the DONKI database for a new flare, new CME, or updated CME every 15 minutes and runs if a new entry is found

DONKI Flares: An automated code within DONKI creates entries for any flare above M5 and uses M5 as the peak magnitude as a filler until someone from M2M updates it. So it's possible iPath uses an incorrect flare magnitude.

Event: An "event" in iPATH terms is the entire simulated time profile – about 40 hours of results with no flux threshold applied

Additional Links

iSWA Data Tree (No link yet)   CCMC Model Description (No link yet)

Validation

	Categorical				Start Time	End Time	Max Peak Intensity			Intensity Time Profile		
	H	FAR	TSS	HSS	ME	ME	MLE	MALE	R	MLE	MALE	R
Flare-triggered Module >10	1.00	0.55	0.00	0.00	-1.58	21.52	0.36	0.99	0.61	0.27	0.65	0.21
Flare-triggered Module >100	1.00	0.18	0.00	0.00	-2.00	9.23	0.69	1.28	1.74	0.06	1.08	0.55
CME-triggered Module >10	0.90	0.31	0.57	0.31	-3.56	24.79	-0.49	1.76	0.26	-0.31	0.87	0.26
CME-triggered Module >100	0.67	0.60	0.29	0.22	-1.74	4.55	0.11	1.74	1.74	-0.14	1.91	0.34