

Fostering scientific collaboration for improved space weather forecasting

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and the FLARECAST and HELCATS teams



Trinity
College
Dublin

The University of Dublin



IRISH RESEARCH COUNCIL
An Chomhairle um Thaighde in Éirinn

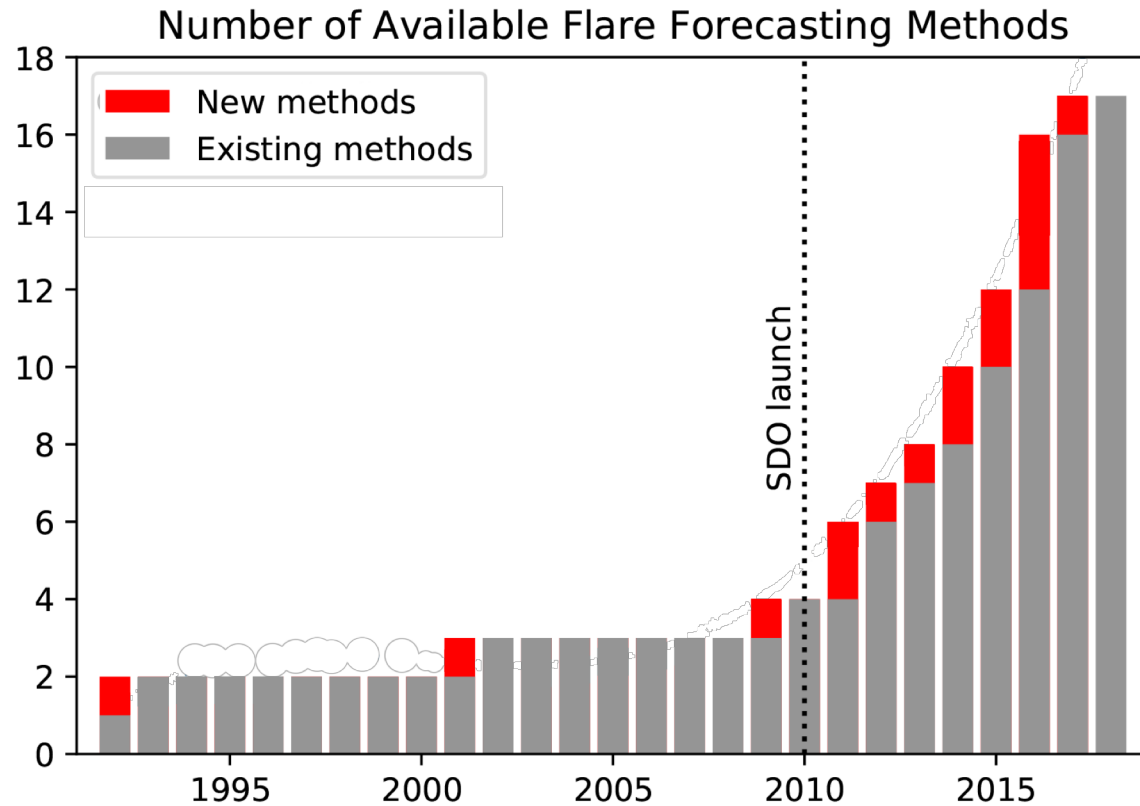


DIAS

Institiúid Ard-Léinn | Dublin Institute for
Bhaile Átha Cliath | Advanced Studies

State of the art

Lots of parallel or at least similar efforts...how do we promote collaboration and avoid replication to improve state of the art operational tools?



Guerra et al in prep

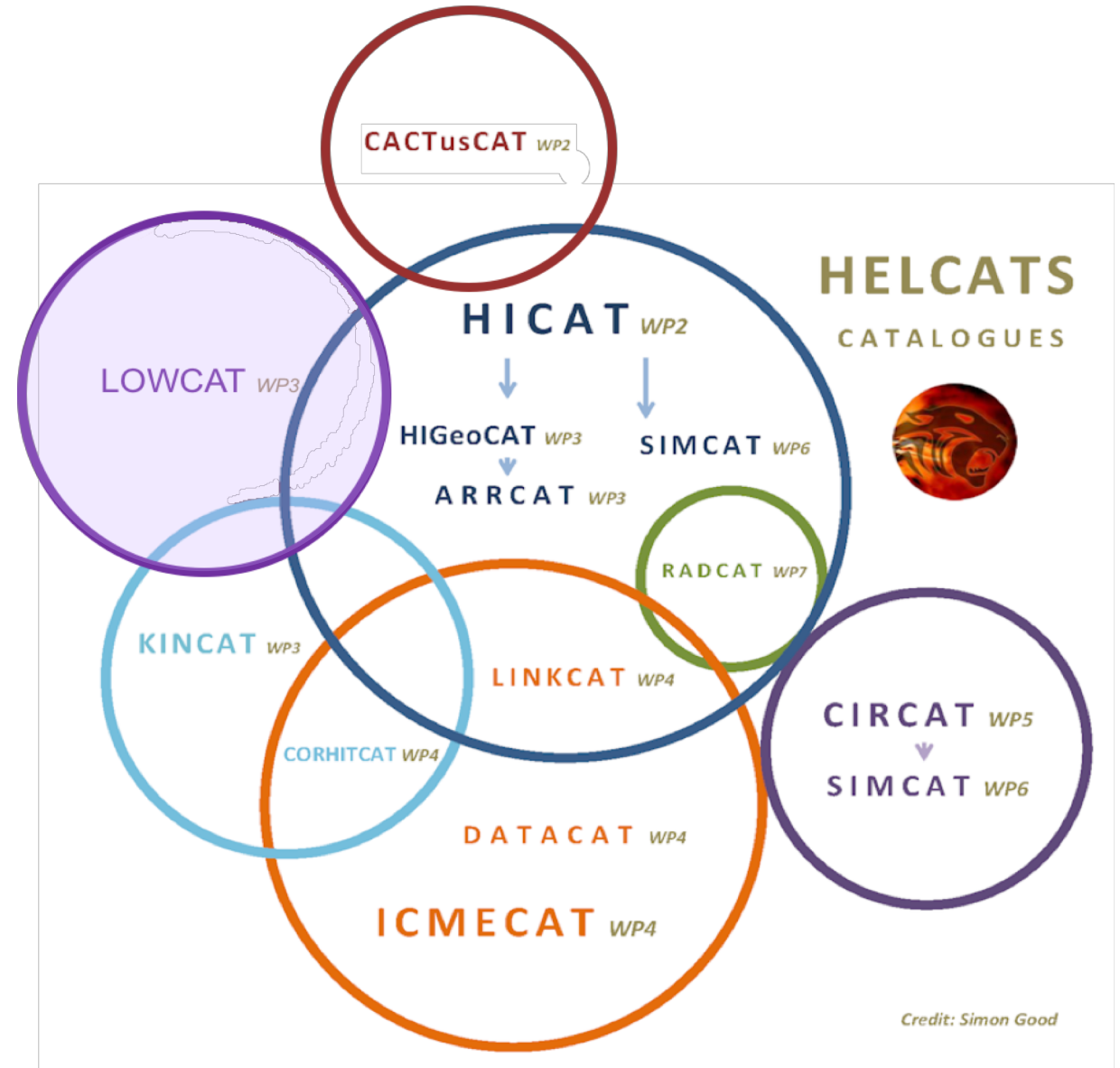
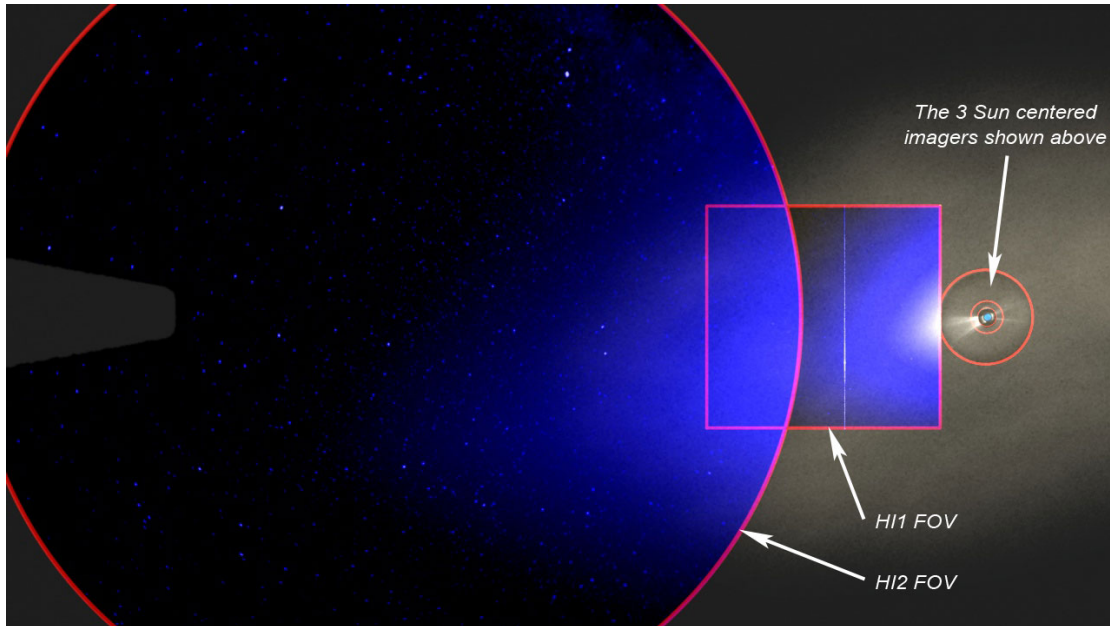
‘...no one method clearly outperformed all others.’

‘For M-class flares and above... with no participating method proving substantially better than climatological forecasts.’

Barnes et al 2016,
Leka et al in prep

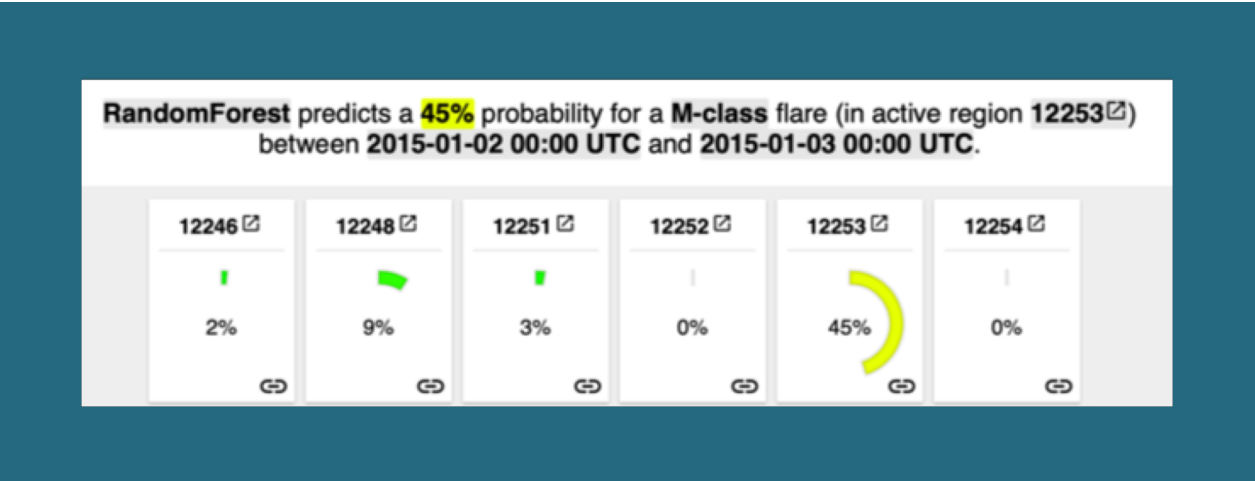
HELCATS helcats-fp7.eu

HeLiospheric Cataloguing, Analysis and Techniques Service, the definitive catalogue of CMEs imaged by STEREO/SECCHI Heliospheric Imagers.



FLARECAST flarecast.eu

Flare Likelihood And Region Eruption
foreCASTing, a flare forecasting system with ML
and real-time verification and large database of
AR photospheric magnetic field properties



Data Source	Property Group
SWPC catalogues	NOAA Solar Region Summary properties
	GOES soft X-ray flare events
Line-of-sight magnetograms	SMART-derived properties (area, flux, field strength, R value, WLsg, etc.)
	Effective connected magnetic field strength, B_{eff}
	Fractal and multifractal parameters
	Fourier and CWT power spectral indices
	Decay index
	Magnetic polarity inversion line properties
	3D magnetic null point
	Ising energy
	Magnetic helicity injection rate proxy
Vector magnetograms	SHARP properties
	Magnetic helicity injection rate
	Magnetic energy injection rate
	Non-neutralized currents
	Diverging/converging/shear flows
Intensity images	Flow field properties

Research to operations

But how is this
useful for
forecasters?!

Research to operations

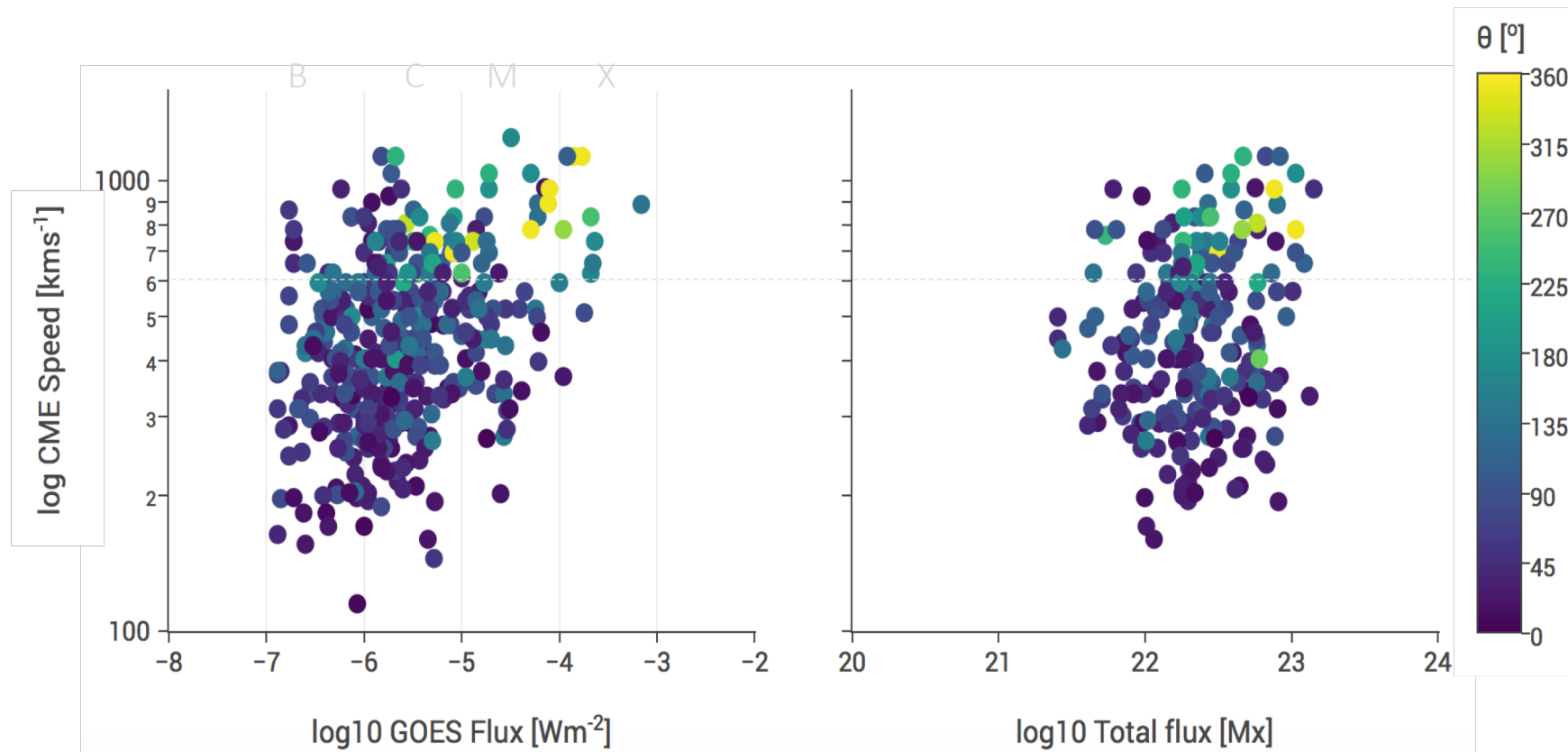
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CME
warning!

Sharing science

FLARECAST Work Package 6: Explorative Research



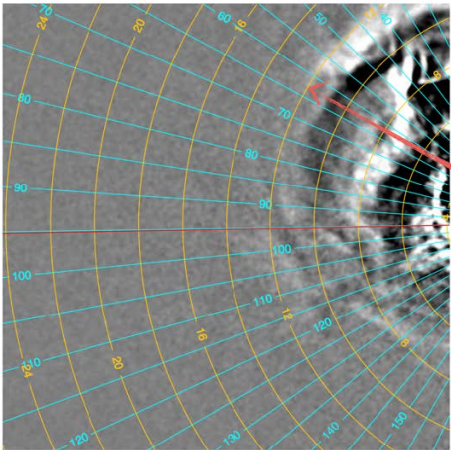
Open data

All catalogues freely available
online with release notes...and
friendly colleagues!

HI-1A

2010-02-14 23:29UT

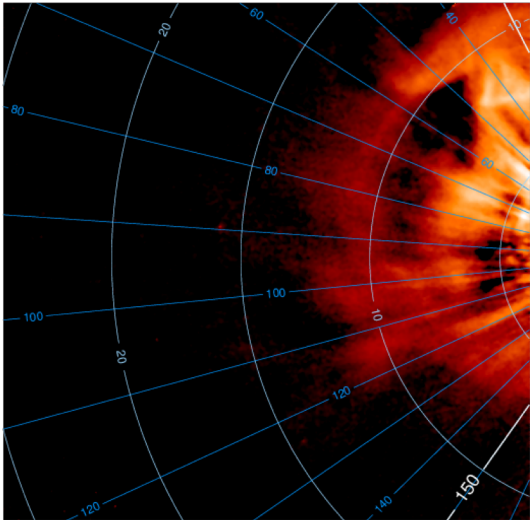
Spacecraft Longitude (HEE): 65.08°



Earth PA: 95.17°
Current Image: 20100214_232901_14h1A.fits
Previous Image: 20100214_224901_14h1A.fits

CME “quality” : Good

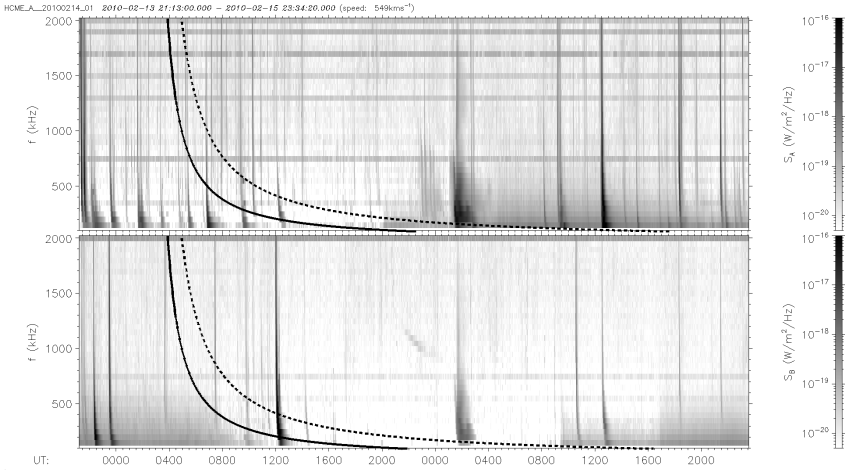
STEREO/HI-1A
2010-02-14 22:49UT



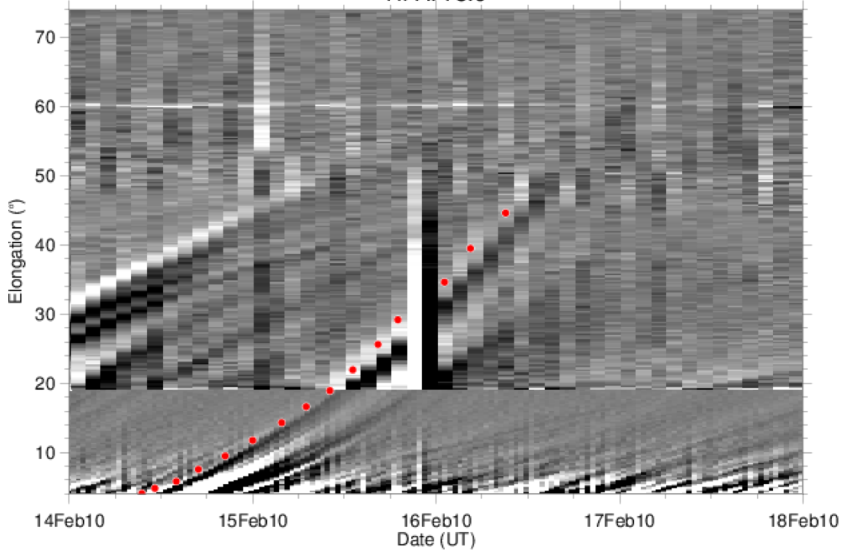
HCME_A_20100214_01

Background subtracted (1-day background)

Types of Fitting	HEEQ Longitude [deg]	HEEQ Latitude [deg]	Speed [kms-1]	Carrington Longitude [deg]	Phi [deg]	Launch [UTC]
Fixed-Phi	35	3	517±3	208	30±0	2010-02-14 00:27
Self-Similar Expansion	45	0	549±3	217	20±1	2010-02-14 02:01
Harmonic-Mean	55	-2	575±3	226	10±2	2010-02-14 02:46



HI-A: 75.0



figshare

doi.org/10.6084/m9.figshare.4970222.v2

Open code

Entire FLARECAST codebase available- back-end infrastructure to property algorithms!



Project	Description
 Download	Download scripts, Access layer for HMI files and staging area
 Feature Extraction	Algorithms for Feature Extraction, Read and write access layer for Property Database
 Flare Prediction	Algorithms for Flare prediction, Read and write access layer for Prediction Config and Prediction Database
 FLARECAST Datamodel	Definition and implementation of FC data model
 FLARECAST Infrastructure	Computing Infrastructure for the FLARECAST project
 Sandbox	Sandbox for various experiments.

dev.flarecast.eu/stash/projects

R2O

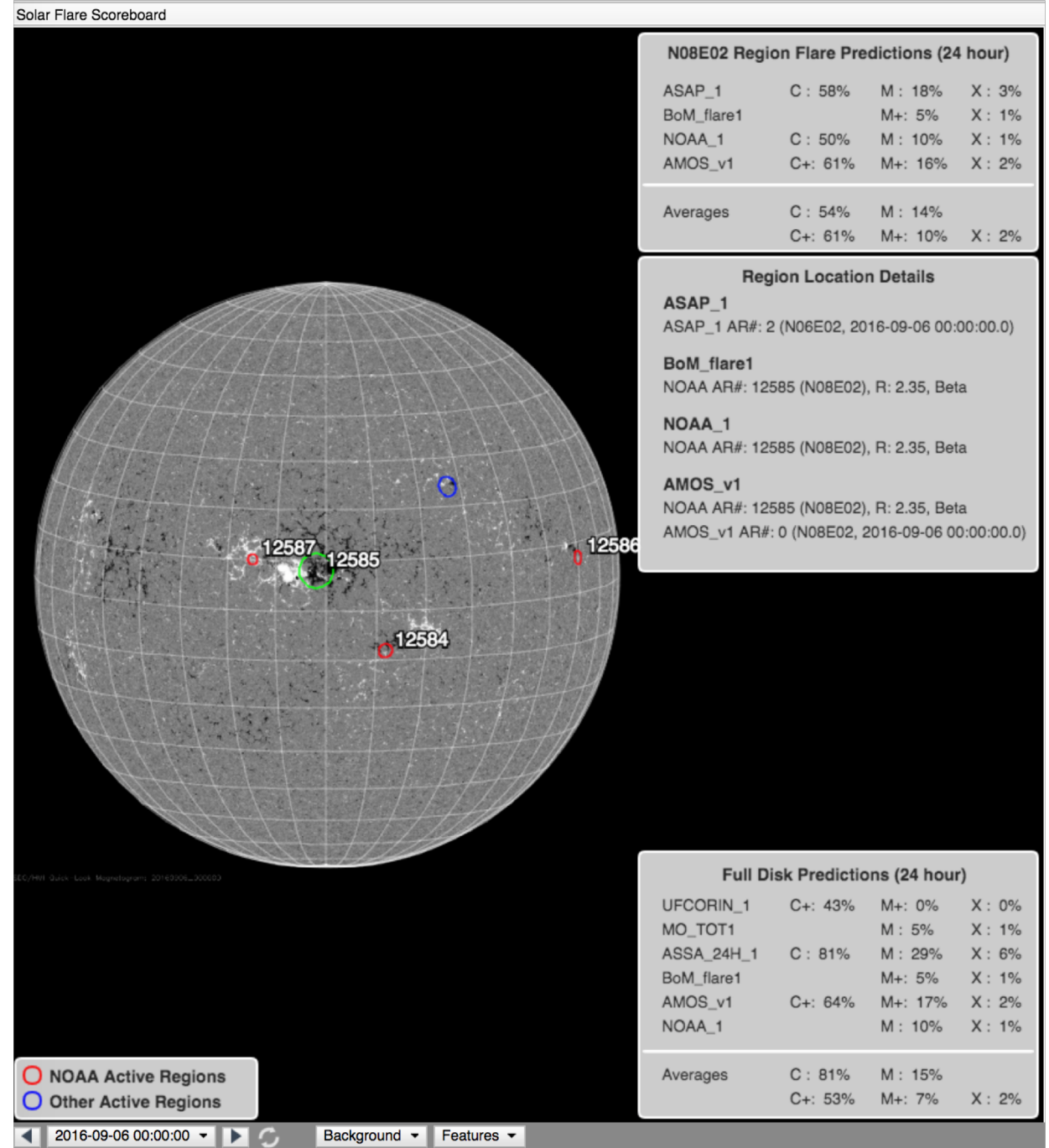
Community embracing
benchmarking activities to
compare predictions, e.g.,

NASA CCMC scoreboards for

- CMEs
- SEPs
- Flares
- IMF Bz

and ILWS teams

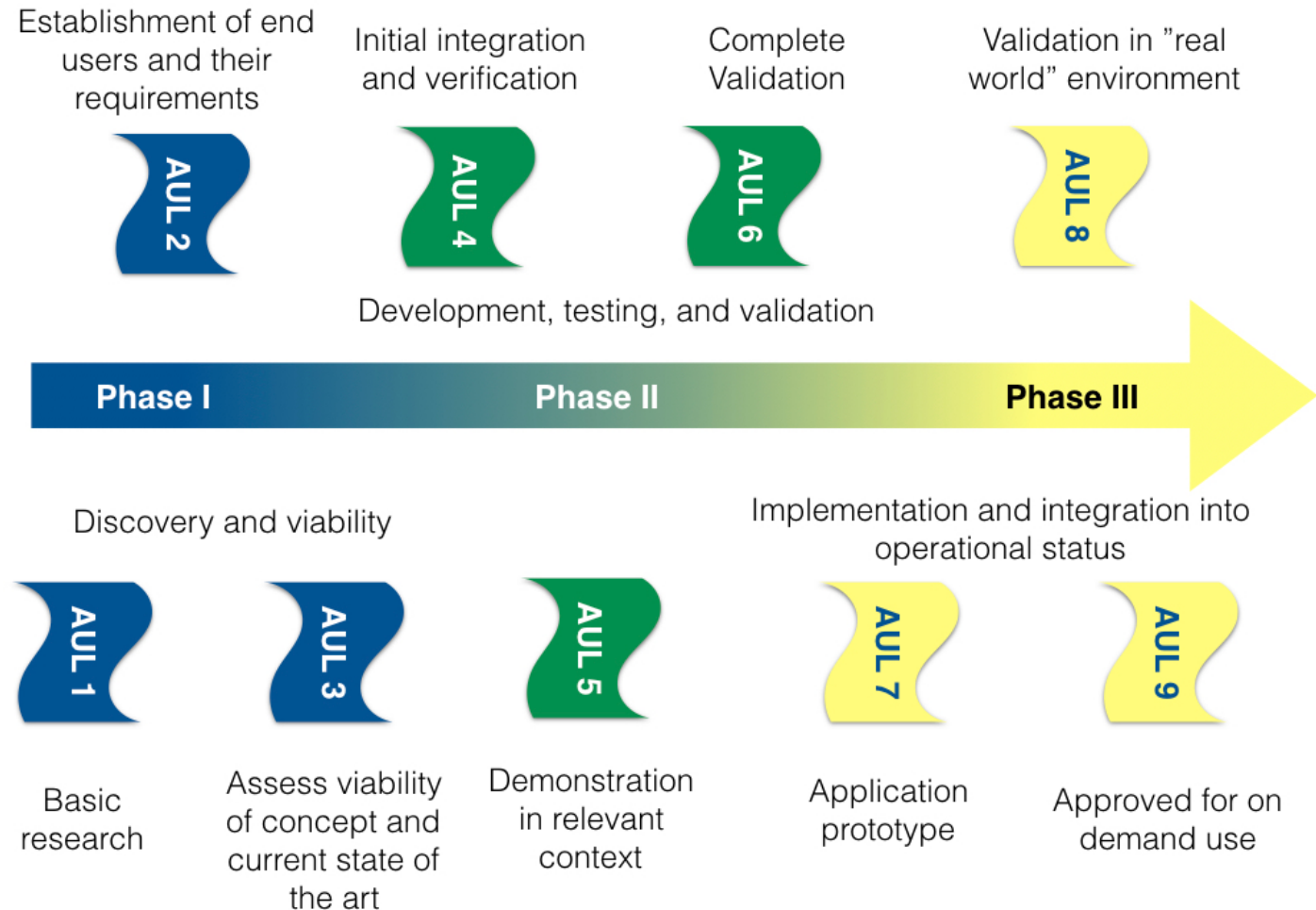
ccmc.gsfc.nasa.gov/challenges



Application Usability Levels

AULS developed specifically for space weather to track development progress

- Assessing viability
- Best practices for communicating and working with users



Halford et al- see poster session!

Who are your users?

Developers

Forecasters

Policy

Researchers

solar helio
magneto iono
geo

Industry

aviation power
marine space

General public

The times they are a changing

- Community benchmarking efforts are helping us identify what is state-of-the-art.
- Embracing open science encourages interdisciplinary collaborations to improve state-of-the-art.
- bit.ly/helcats-flarecast



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