What are we looking for in a flare forecasting roadmap?

FLARECAST First Stakeholders Workshop

Manolis K. Georgoulis

Project Coordinator, FLARECAST

RCAAM of the Academy of Athens

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Aim and outline: a FLARECAST-speared R&D roadmap

The aim of this discussion is to formulate an R&D roadmap for solar flare prediction.

The FLARECAST service can probably serve as the starting point or a reference.

Prioritize needs to those that can be implemented in the nominal FLARECAST duration and those that can be considered in future improvements

- Make best use of day 1 deliberations
- Implement another four (4) groups of diverse expertize
- Distribute a number of roadmap-related questions
- Discuss a subset (or all) of them in a free-form style, with a rapporteur collecting notes
- Summarize everything at the end, aiming to discuss questions that have been left unaddressed

Rationale of the roadmap effort
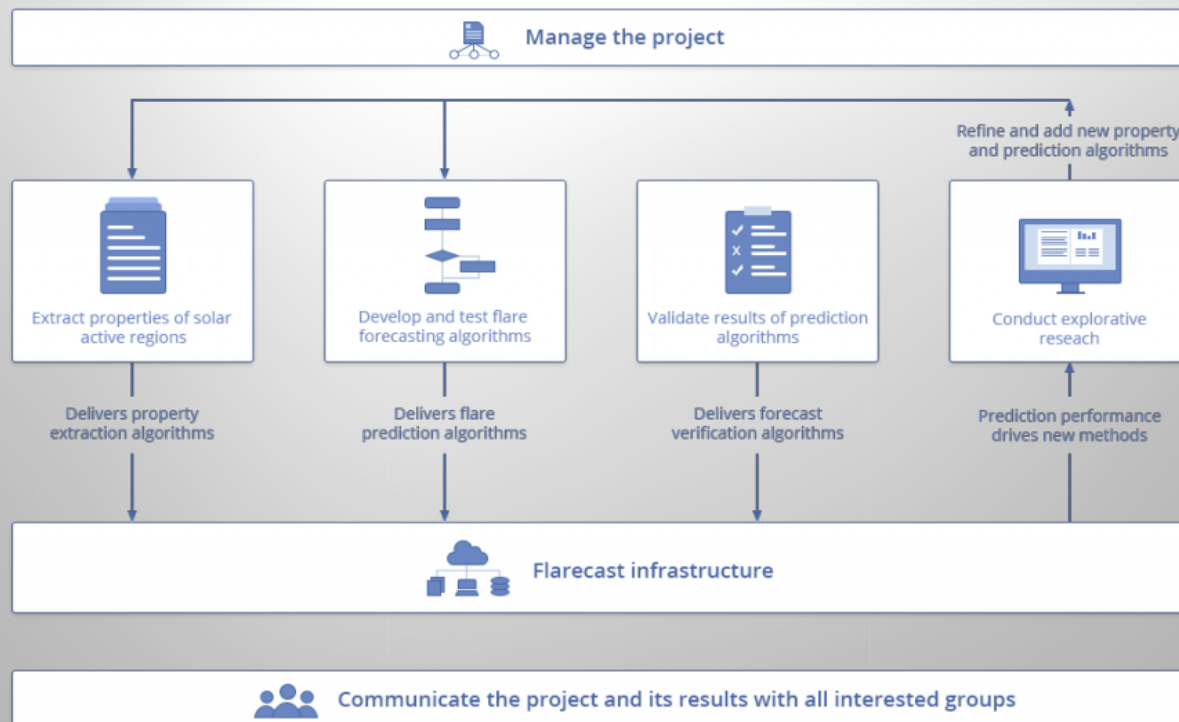
- FLARECAST features a highly modular architecture that facilitates expansion. Databases are public and compelling, ~240 TB.

- One of the project's core objectives is "to engage with space weather end users and inform policy makers and the public"

- It would further justify public investment if this infrastructure was exploited even after the project's nominal duration

Exeter, UK, 13 January 2017

How to make it work

FLARECAST

- Ask what kind of information can be included in the service during the nominal project duration
- Ask what kind of service could conceivably be added to further exploit the infrastructure and databases
- Assess a possible timeline for these improvements in priority, assuming that funding is available
- Create a concise document describing this plan that could be conceivably utilized by scientific and stakeholder communities in the future
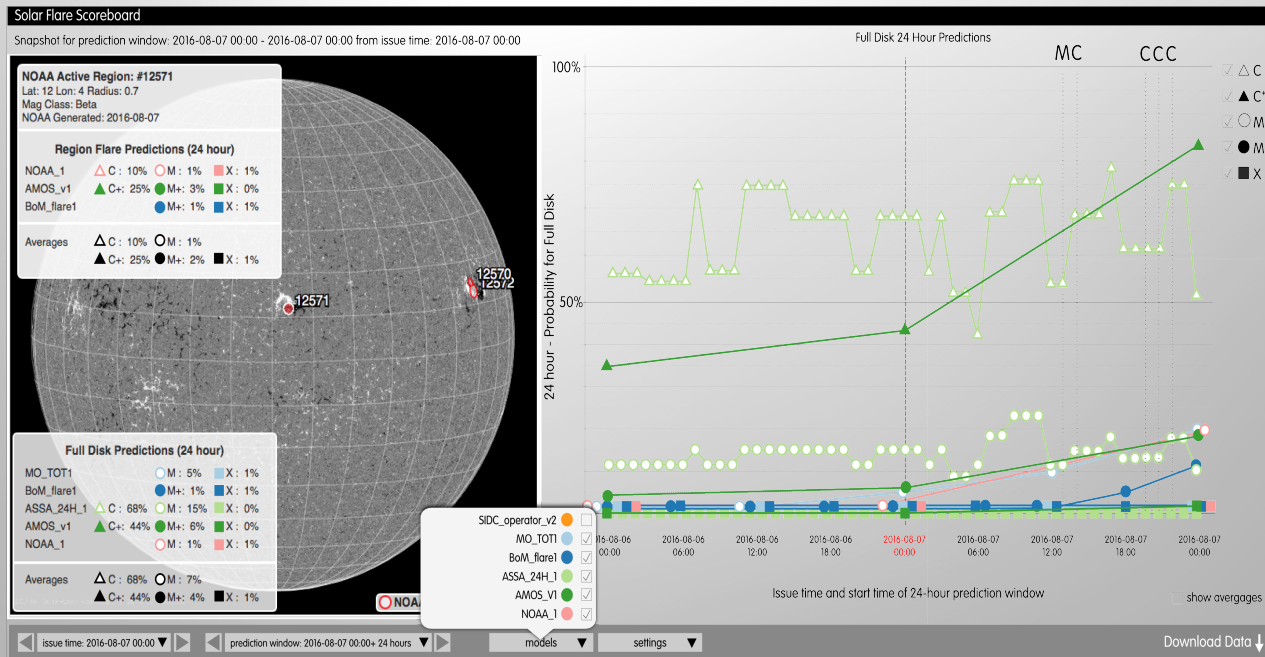
Existing FLARECAST service planning

Full-Sun view   Solar x-ray flux   Major flare risk %   Grade flare risk (color coded)
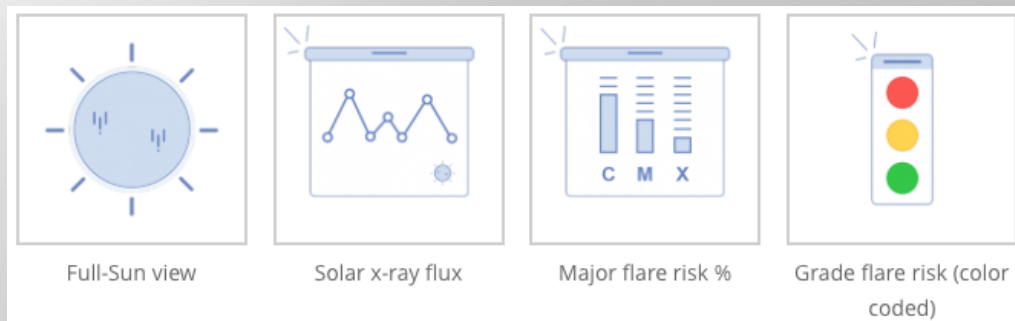
(in addition to flare probs.)

Other roadmap-type efforts currently in progress

FLARECAST

NASA / CCMC Flare Forecasting Scoreboard

- Excellent resource for future <u>ensemble</u> flare forecasting efforts

- Other efforts for an integrated, whole-system Sun-to-Earth space-weather prediction system (e.g., PSTEP, etc.)

Envisioned discussion structure

❑ The leader moderates and stimulates the discussion but he/she lets the discussion orient according to the group's interests

❑ A list of general, potentially interesting questions exist and each group is left to resonate, moderated by the leader, to the questions that seem more crucial

❑ The more discussion points covered the better, but this is not a race. The point is to have something sound stemming from the collective, group thinking

❑ The group is most welcome to introduce and discuss questions that may have been overlooked and are absent from the provided list of questions

Indicative discussion directions[1]:
added value by the nominal project duration

❑ What additional information (e.g., for the benefit of Stakeholder communities) can be included in a flare prediction service – what part of it could be implemented in the course of FLARECAST?

Low-hanging fruit, if any

Indicative discussion directions[2]:
added value beyond the nominal project duration

❑ Can we test the possible flare-prediction capability of new physical models / data analysis techniques?

❑ Can this be streamlined by means of a testbed, such as the FLARECAST infrastructure?

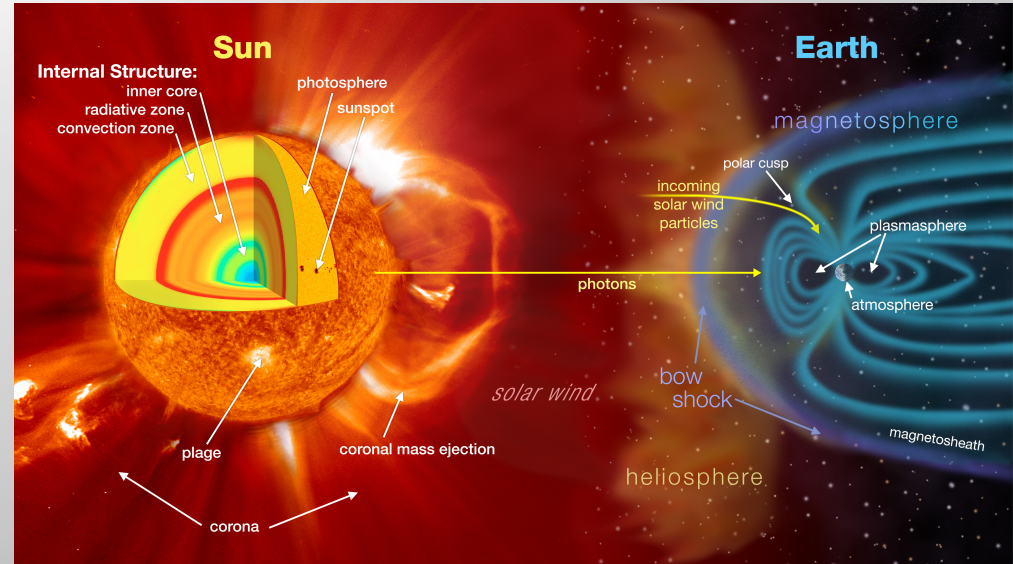# Indicative discussion directions[3]: prioritization and a potential timeline
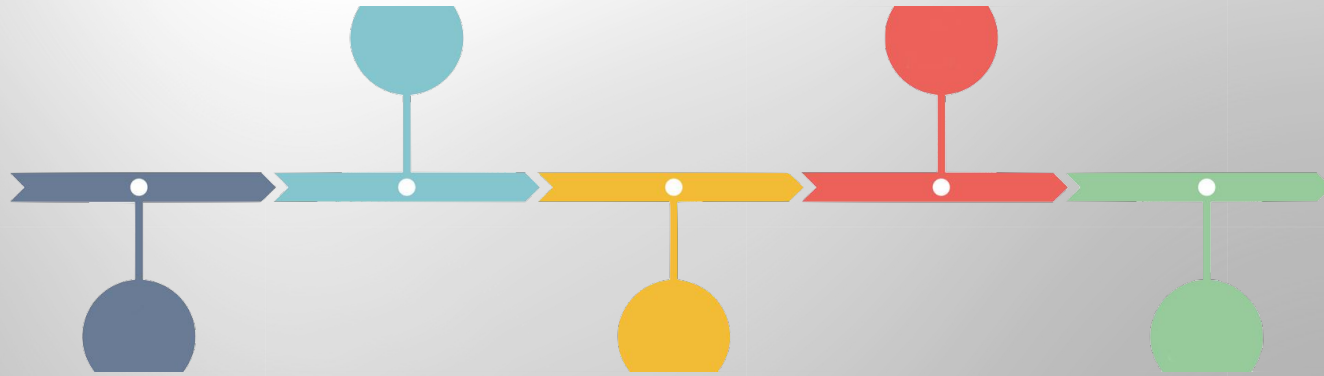
❑ Can we prioritize future needs and assign a time-tag to them?
    ❑ 3 – 5 years
    ❑ > 5 years

Indicative discussion directions[4]: an integrated service (flares, CMEs, SEPs) in the future?

☐ A next-gen, integrated inner-heliospheric modeling encompassing flares, SEPs, CMEs?

☐ Would you like to see a discussion forum identifying and prompting for specific improvements of the FLARECAST service in the future?

Indicative discussion directions[5]: consistent awareness and information to public, gov & industry

❑ How can we best serve public awareness needs by keeping the public updated?

❑ How can we best serve government & industry needs, keeping these sectors updated?

Indicative discussion directions[6]: what would you like to see reported in performance verification?

❑ Are existing validation methods sufficient, or do they need refinement now or in the future?

❑ Which of these techniques are mature enough to use in FLARECAST?

Indicative discussion directions[7]: what should we be discussing in the next Stakeholders WS?

❑ We are committed to organizing a Second Stakeholders workshop toward the expiration of the project. Based on the discussion here, what would you expect to be discussed during the second workshop?

Key: exploitation of day-1 discussions

- ❏ **The User is the key!**

  Critical aspects of flare forecasting depend on the User's specific needs

- ❏ **Thresholds & impacts**

  - Cost : Loss function of capital importance
  - Find relevant thresholds for possible impacts

- ❏ **Communication and translation**

  - Translate thresholds to impacts in Users' "language"
  - Simplify to standard formats and terminology

- ❏ **Verification & accuracy**

  - Definition of "accuracy", e.g., full-disk forecasting vs. active-region forecasting
  - Event occurrence vs. impact occurrence
  - Confidence in forecast: skill relying on hits, misses, false alarms, all clear

Key: exploitation of day-1 discussions (cont'd)

❑ Timeliness

- Planning vs. execution: scaled confidence
- 3 – 7 days forecast window based on system or mission – latency also desirable in some cases

❑ Education & Training

Willingness to be educated: SWx impacts; development of pertinent thresholds

WITH THIS DISCUSSION IN MIND, LET US TRY TO SEE IF WE CAN PUT DOWN SOME NUMBERS FOR THE ROADMAP

Breakout II team composition

FLARECAST

Group A	Group B	Group C	Group D
Lucie Green (Science Expert)	Graham Barnes (Science Expert)	Misha Balikhin (Science Expert)	Neal Hurlbert (Science Expert)
Klaus Sievers	Colin Hord	Bryn Jones	Kevin Morgan
Kent Miller	Simon Machin	Mark McGachy (rapporteur)	Trevor McMaster
Mark Allen	Yousaf Butt	Roberto Destefanis	Tamitha Skov
Alan Grant	Andrew Sibley (rapporteur)	Klaus Börger	Alessia Morris
Bob Gunby	Nicole Vilmer	Michael Jagger	Marc Troller
David Pearson (rapporteur)	Manolis Georgoulis	David Jackson	Marianna Korsos
Robertus Erdelyi	Shaun Bloomfield	Hanna Sathiapal	Chloe Guennou (rapporteur)
Michele Piana	David Bennett	Anna Maria Massone	Marco Soldati
Sophie Murray		Luc Dame	Fraser Lott

Summarizer: Robertus Erdelyi

- Diverse expertise in each group; scientists coordinating the discussion

- Each group features a rapporteur

- There is a general summarizer

Met Office