



PROTEC-1-2014: Space Weather

Research and Innovation Action # 640216

FLARECAST: Flare Likelihood and Region Eruption Forecasting

The FLARECAST Team

via Manolis K. Georgoulis
RCAAM of the Academy of Athens





What is FLARECAST?

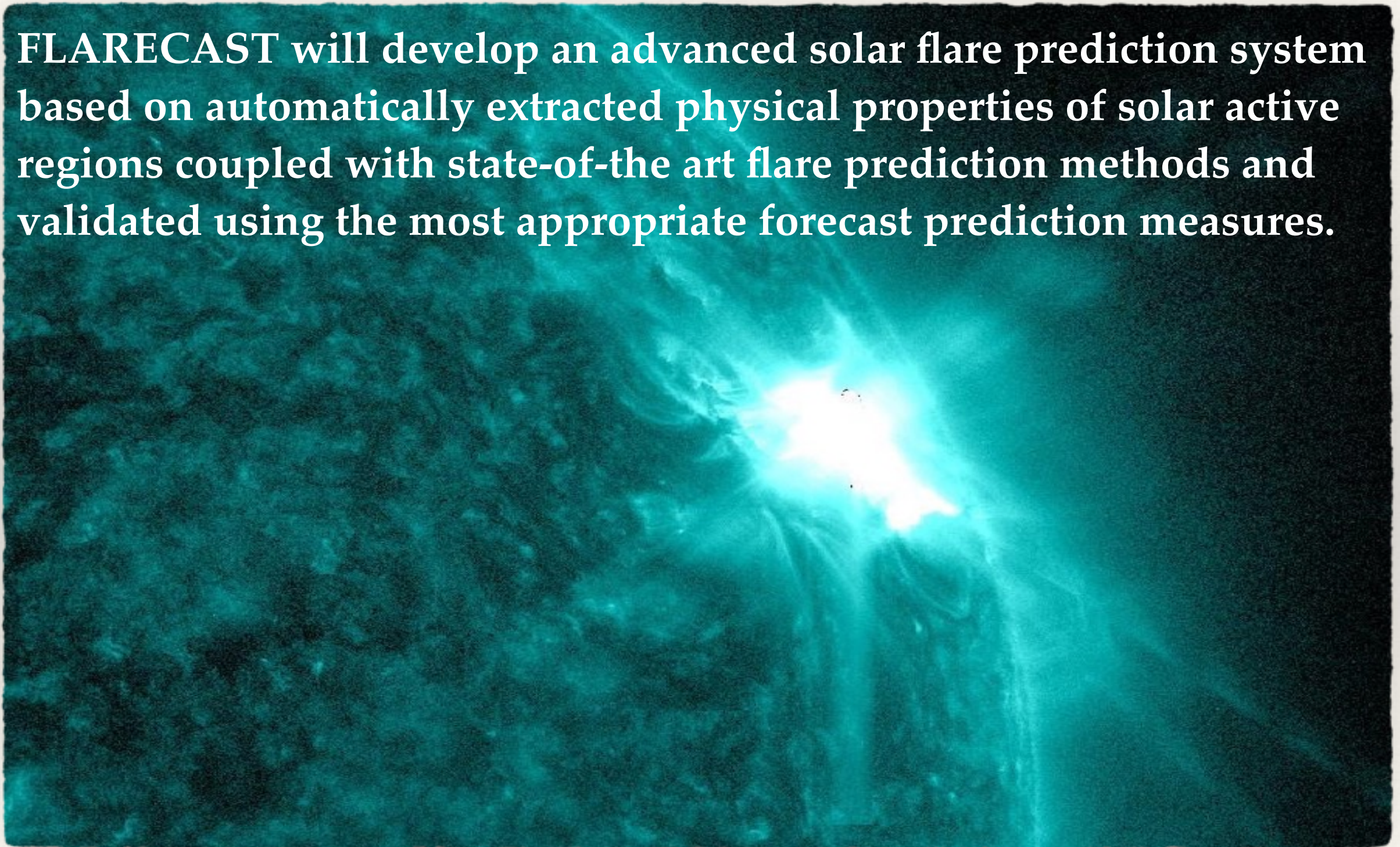


What is FLARECAST?

“It’s difficult to make predictions, especially about the future...”, Niels Bohr

What is FLARECAST?

FLARECAST will develop an advanced solar flare prediction system based on automatically extracted physical properties of solar active regions coupled with state-of-the-art flare prediction methods and validated using the most appropriate forecast prediction measures.



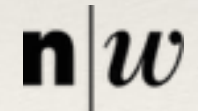
What is FLARECAST?

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From 01-01-2015 and within 36 months, FLARECAST will form the basis of the first quantitative, physically motivated and autonomous active-region monitoring and flare-forecasting system, which will be of use to space-weather researchers and forecasters in Europe and around the globe.



Who Participates?





Who Participates?

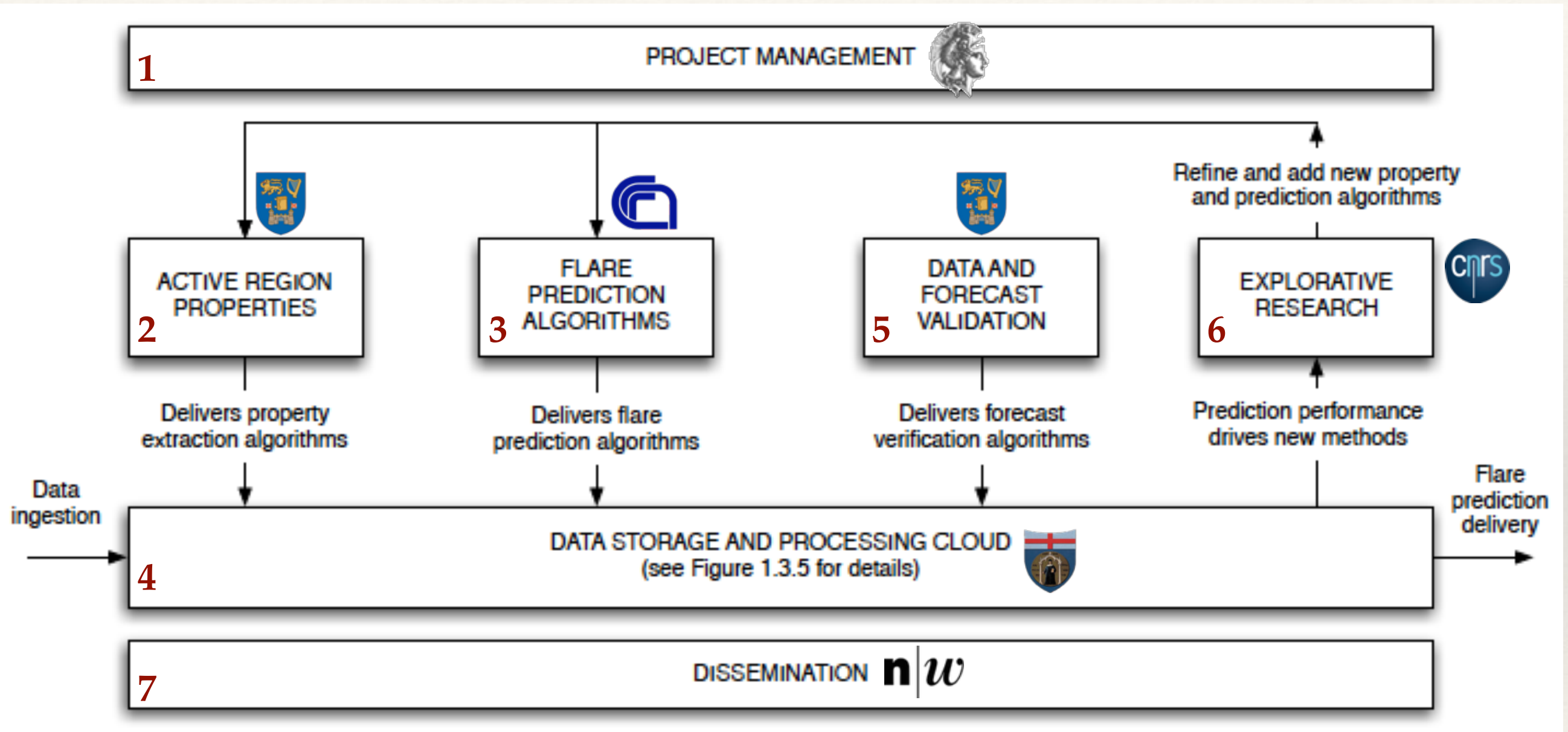




Description of Action

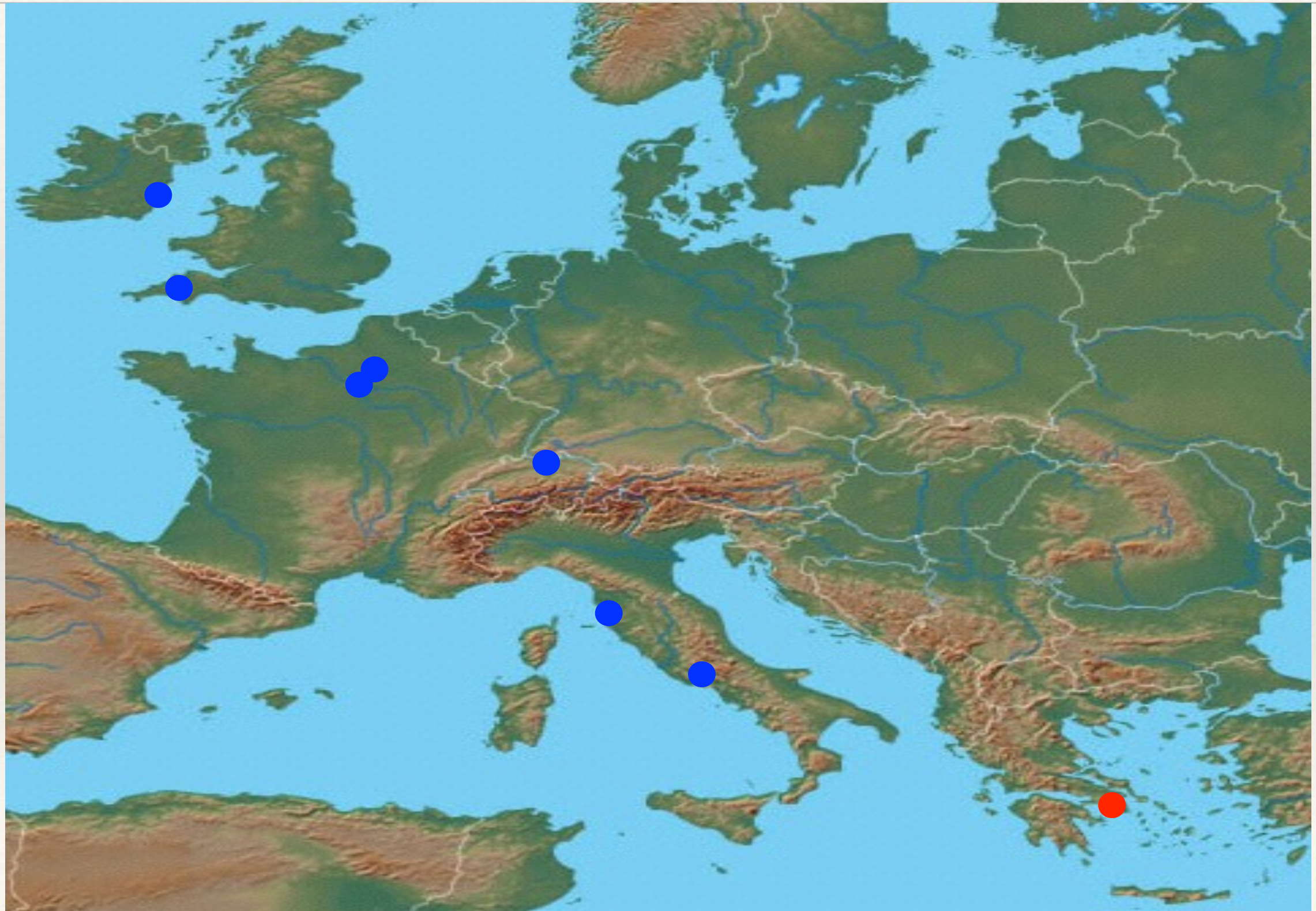
- ❖ WT1: Project Management
- ❖ WT2: Active Region Predictors of Flare Activity
- ❖ WT3: Flare Prediction Algorithms
- ❖ WT4: Data Storage and Processing Cloud
- ❖ WT5: Data and Forecast Validation
- ❖ WT6: Explorative Research
- ❖ WT7: Dissemination

Overall Structure of Work Tasks



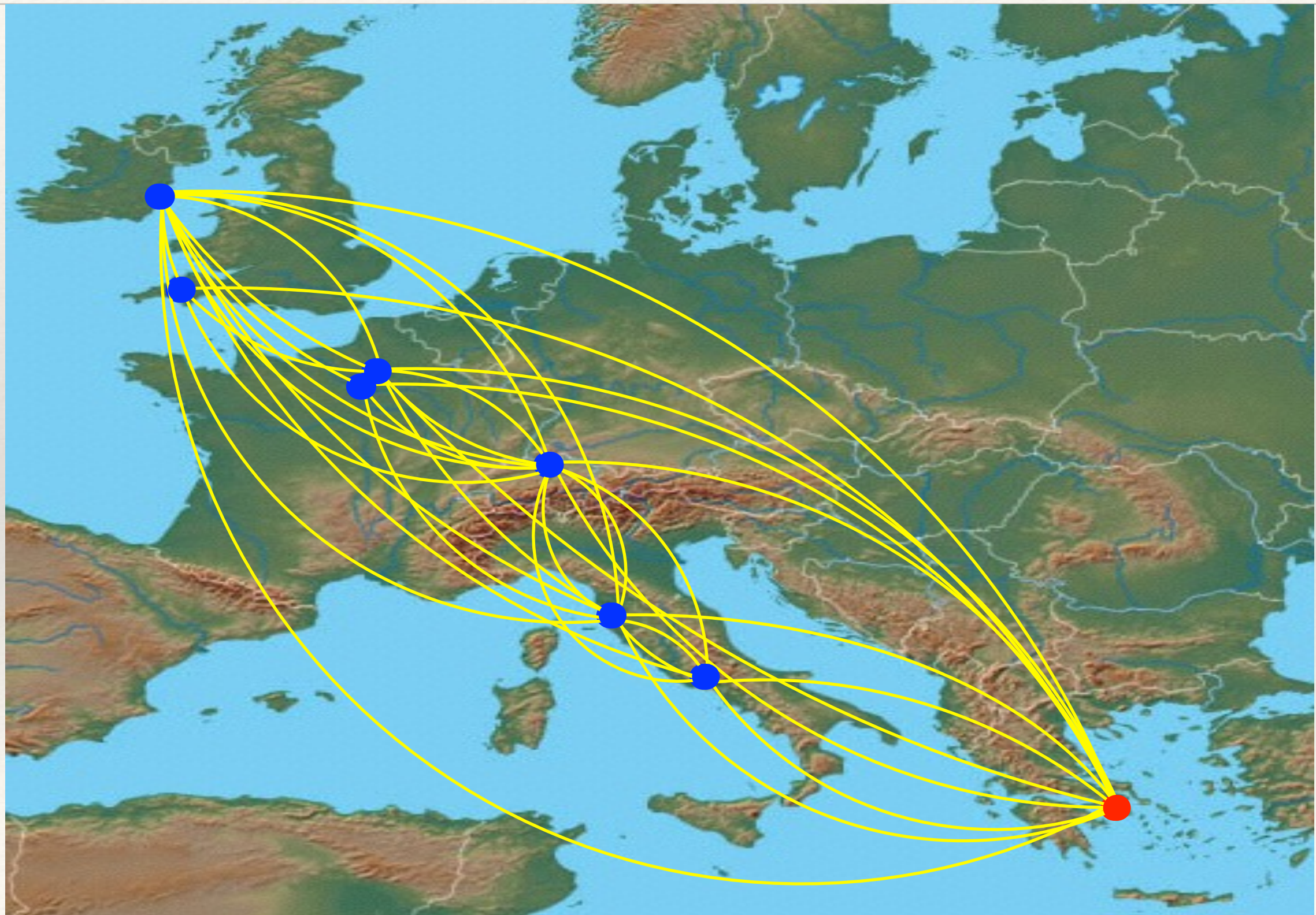


Work Fusion and Project Management (WT1)



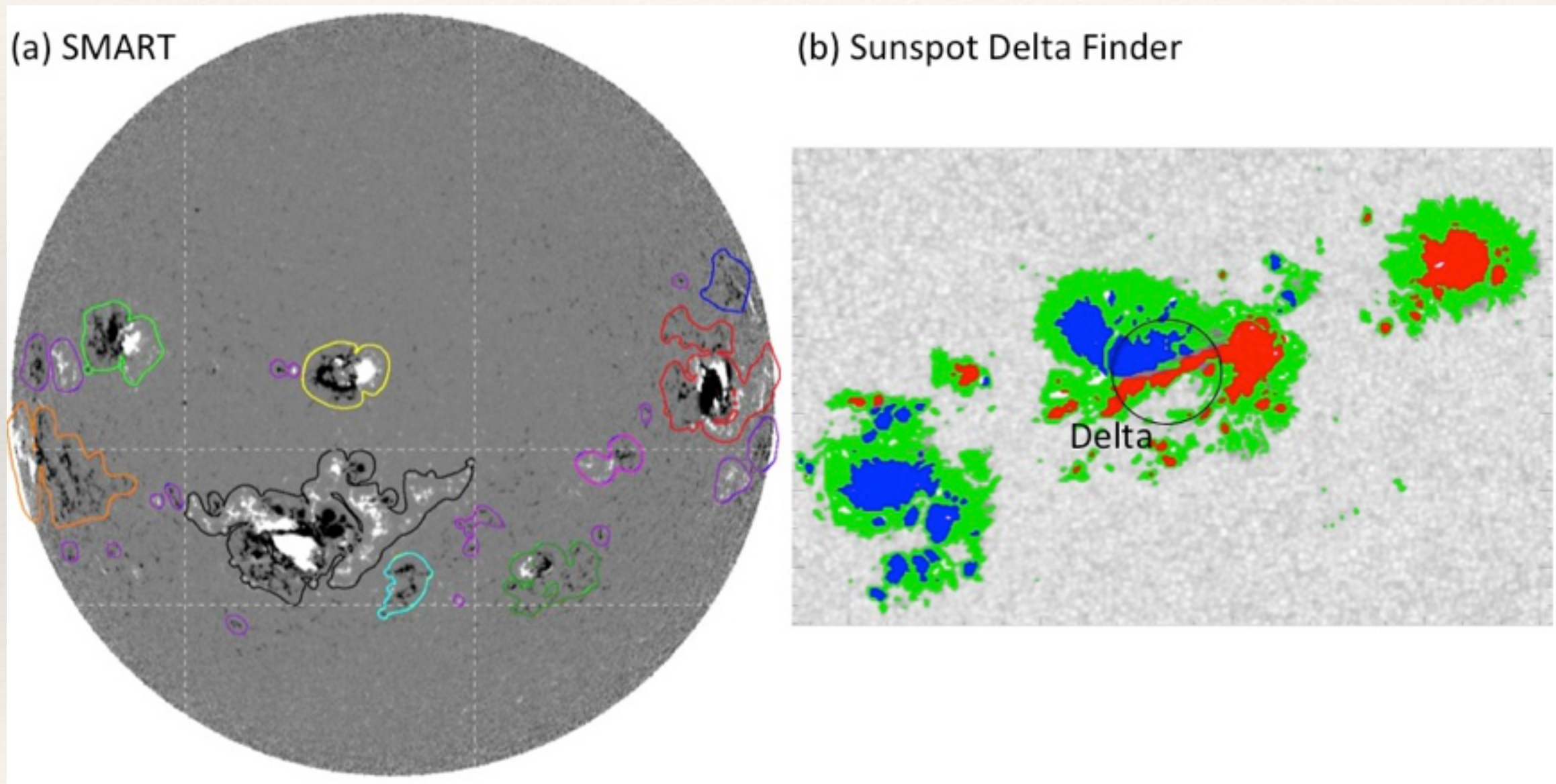


Work Fusion and Project Management (WT1)



FLARECAST under the hood. WT2

WT2: Active Region Predictors of Flare Activity

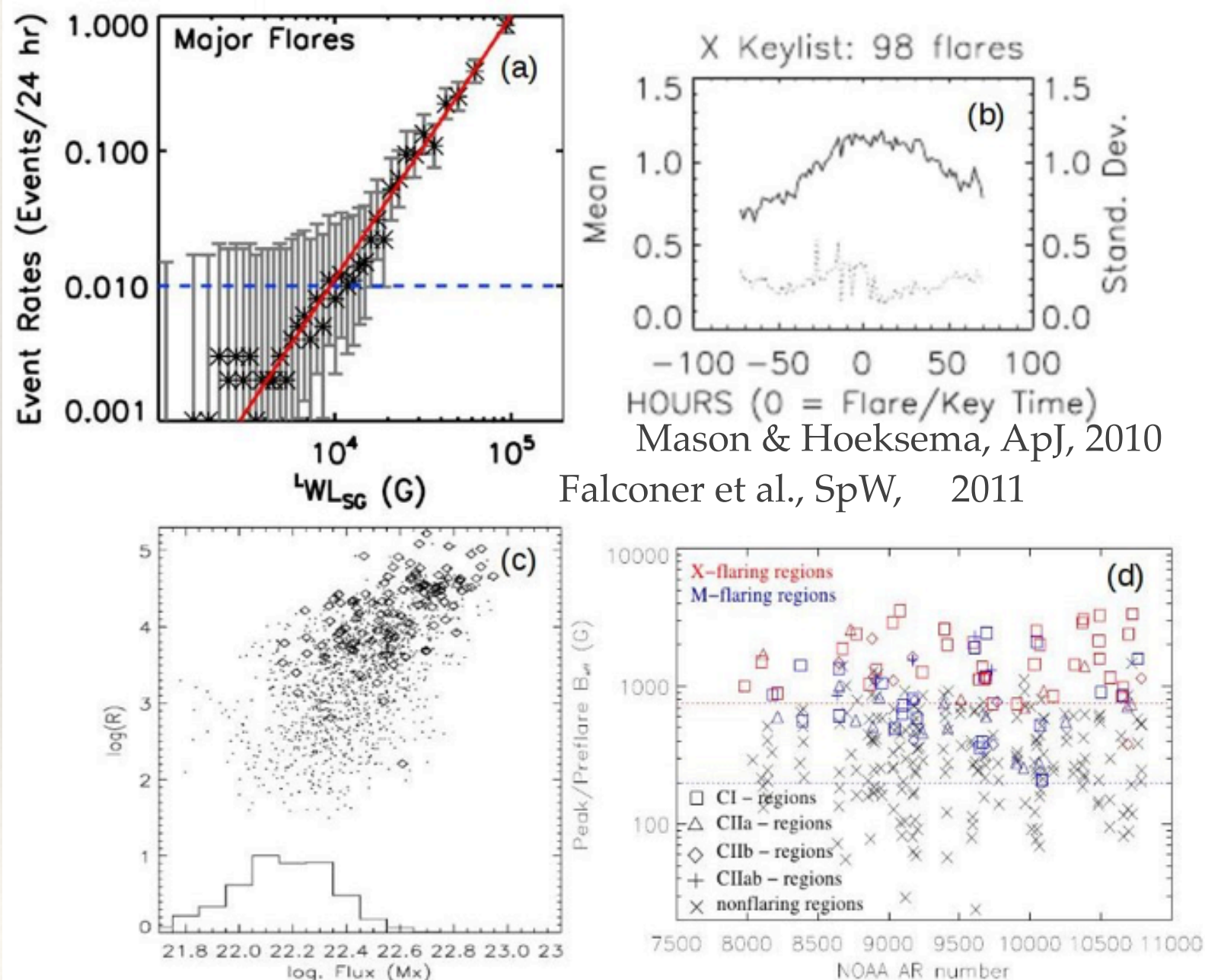


Properties that have to do with active-region size, flux, morphology (McIntosh class, PIL, gradients, electric currents, proxies of free energy & helicity, etc.)



FLARECAST under the hood. WT3

WT3: Flare Prediction Algorithms



Mason & Hoeksema, ApJ, 2010
Falconer et al., SpW, 2011

Schrijver, ApJ, 2007

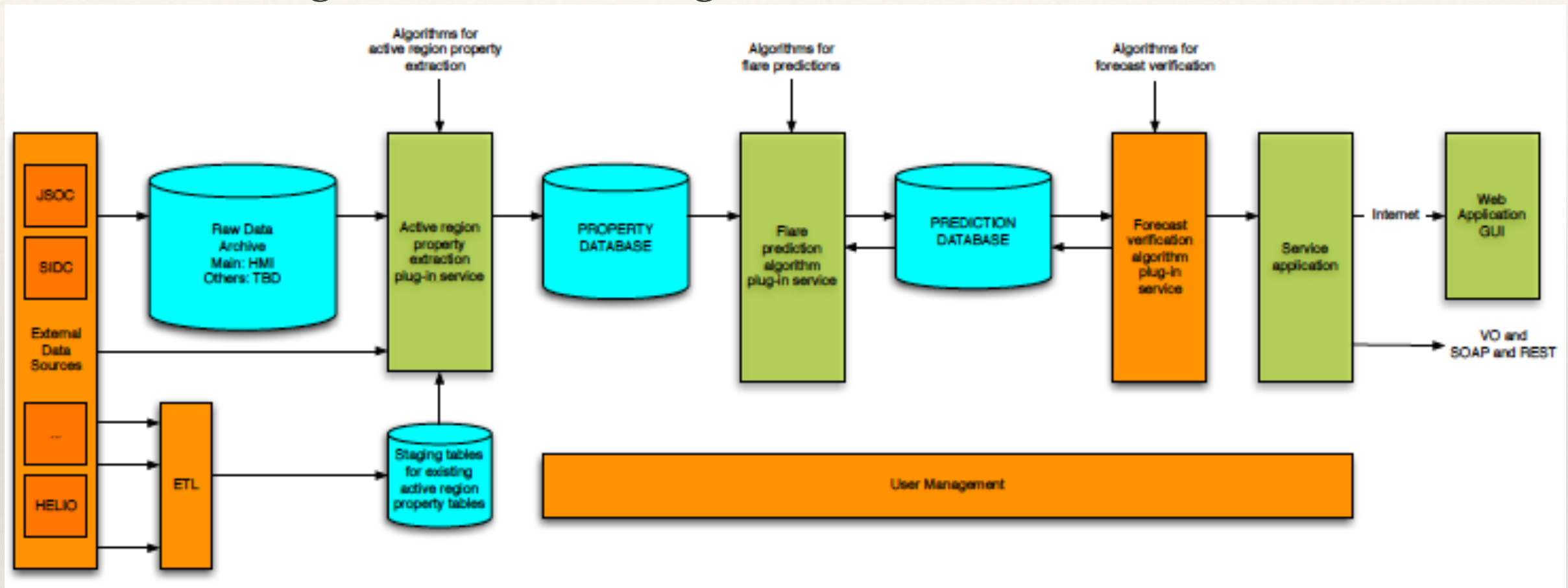
Georgoulis & Rust, ApJ, 2007

FLARECAST will utilize the best published flare prediction algorithms aiming to see which of them, or which combinations of them, can notably improve our forecast capability

For a presentation of [existing solar flare prediction methods](#), see MKG's presentation @ Fri 14:30 on *Solar Storms Splinter*

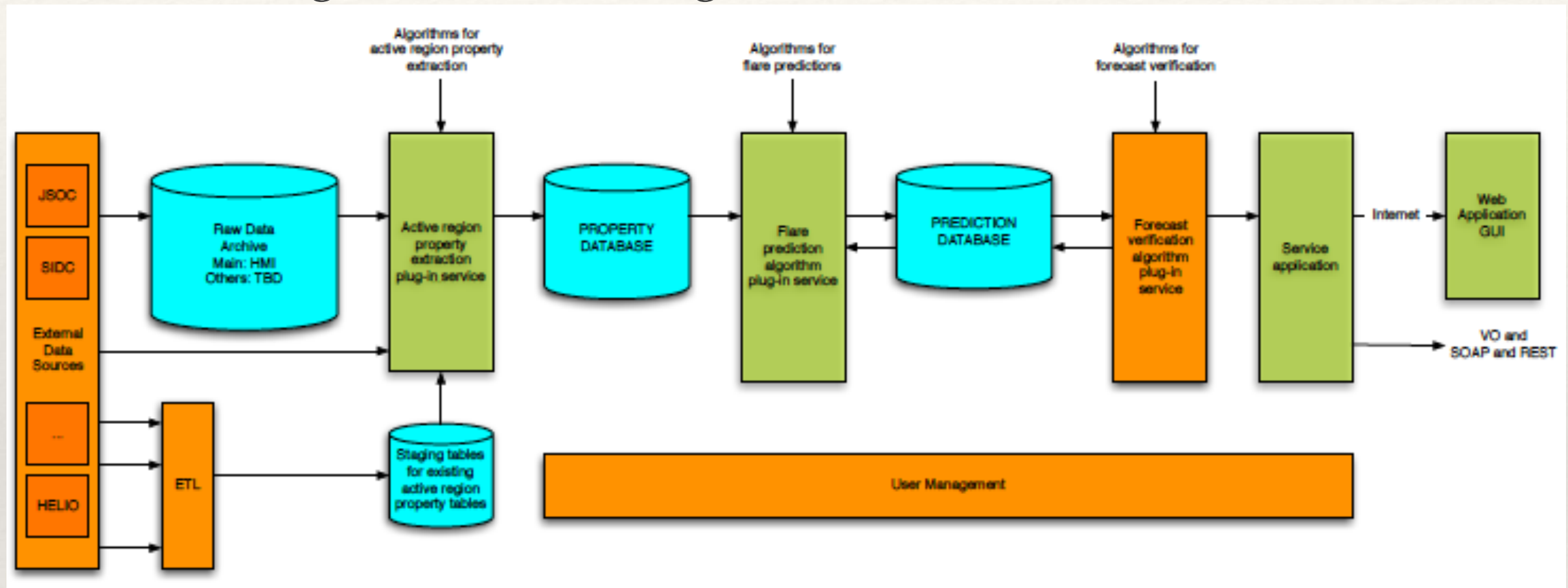
FLARECAST under the hood. WT4

WT4: Data Storage and Processing Cloud

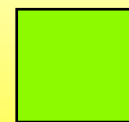


FLARECAST under the hood. WT4

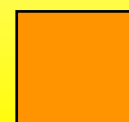
WT4: Data Storage and Processing Cloud



HESPE Databases



HESPE Services



Modules to be designed



HESPE: High-Energy Solar Physics Data in Europe

www.hespe.eu





FLARECAST under the hood. WT5

WT5: Data and Forecast Validation

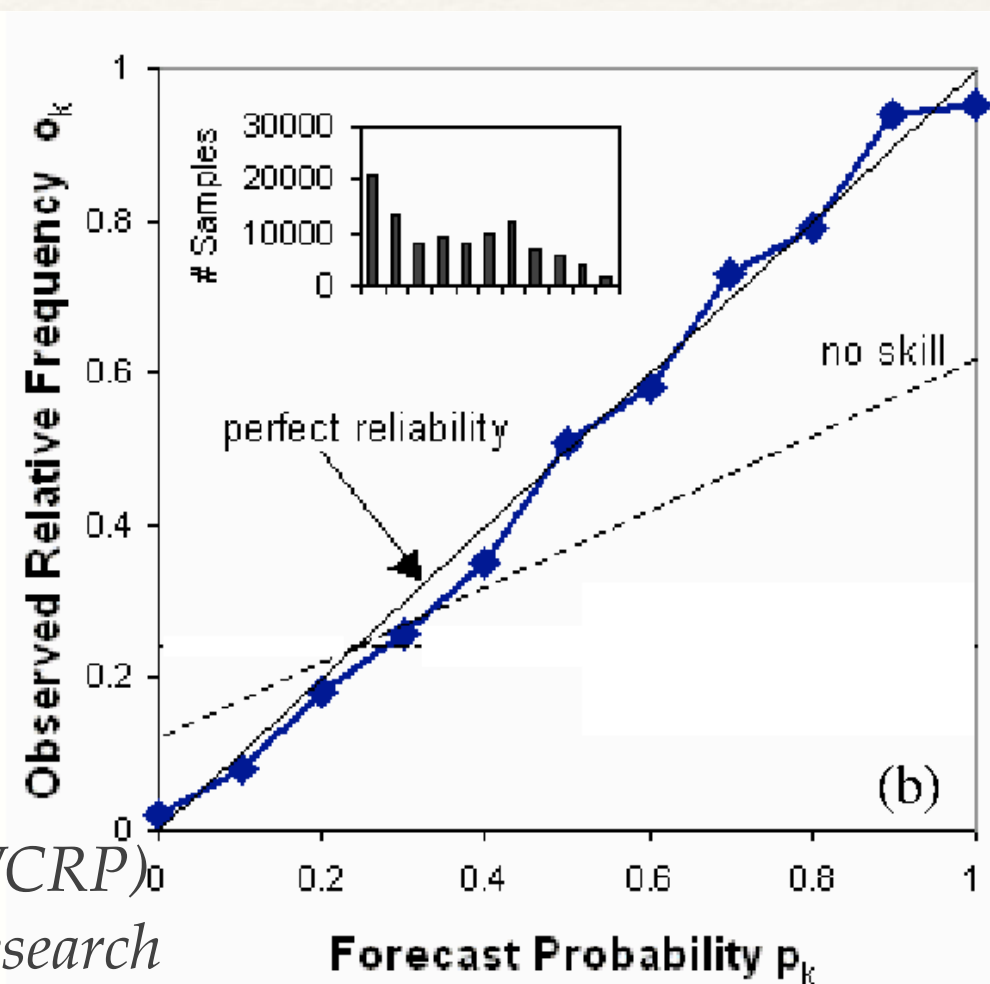
FLARECAST under the hood. WT5

WT5: Data and Forecast Validation Dichotomous Forecasting (Yes/No)

Probabilistic Forecasting

		Predicted		TOTAL
		YES	NO	
Observed	YES	F_{11} (hits)	F_{12} (misses)	N_{observed}
	NO	F_{21} (false alarms)	F_{22} (correct negatives)	
	TOTAL	$N_{\text{predicted}}$		

(a)



For a presentation on [applicable validation techniques](#), see MKG's presentation @ Thu 14:30 on SWE Metrics Splinter

Source: World Climate Research Programme (WCRP)
Joint Working Group on Forecast Verification Research

2 x 2 Contingency Table

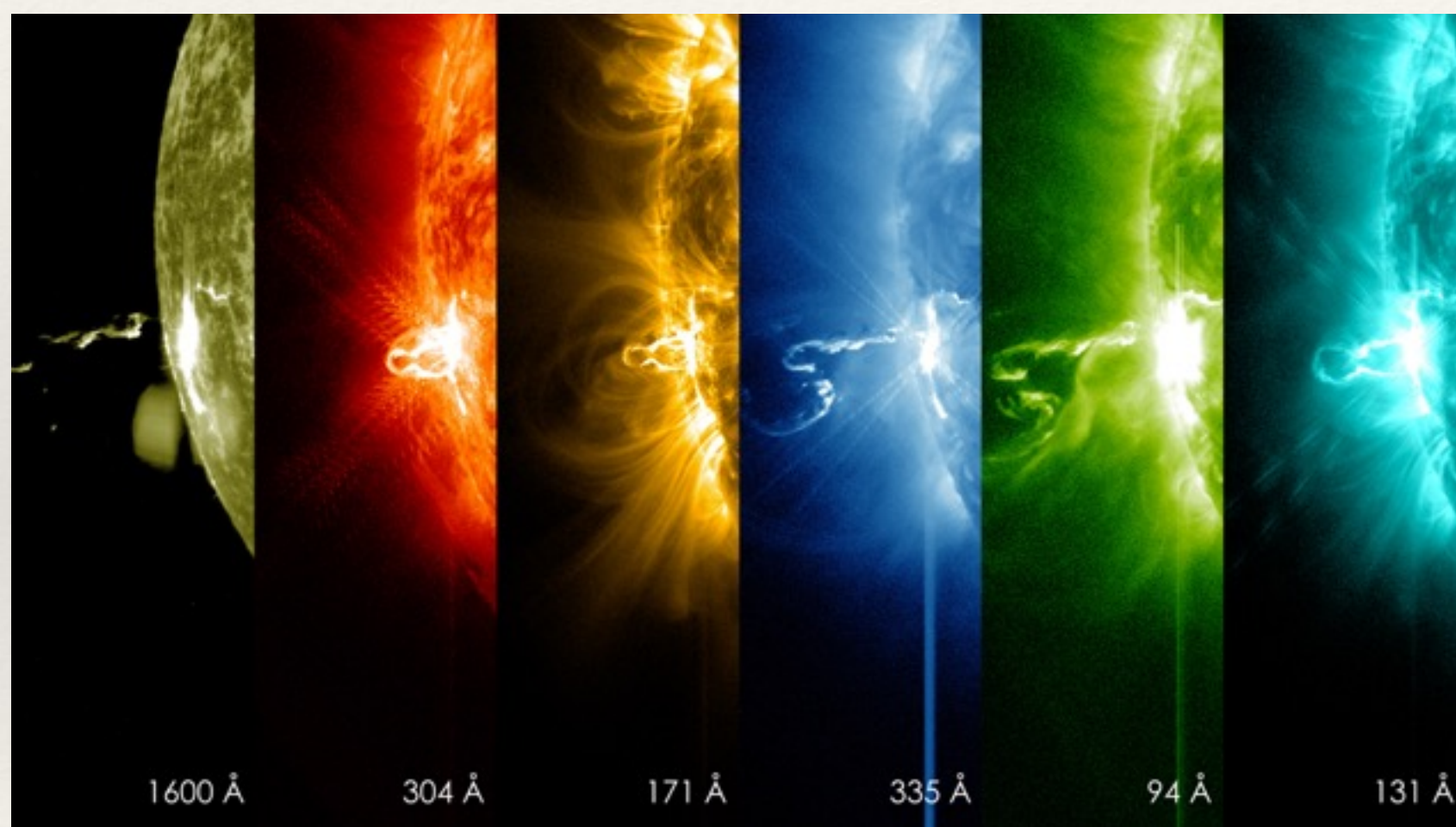
Reliability Diagram

Skill Score:

$$SS(p, o) = 1 - \frac{MSE(p, o)}{MSE(< o >, o)}$$

FLARECAST under the hood. WT6

WT6: Explorative Research



Source: www.tumblr.com

- Identify new, potentially promising flare predictors
- Thoroughly understand and quantify the pre-eruption state
- Link flare to CMEs based on pre-eruption properties
- Lay the foundations of offering a possible CME prediction, as well

Explorative research involves all partner and WTs



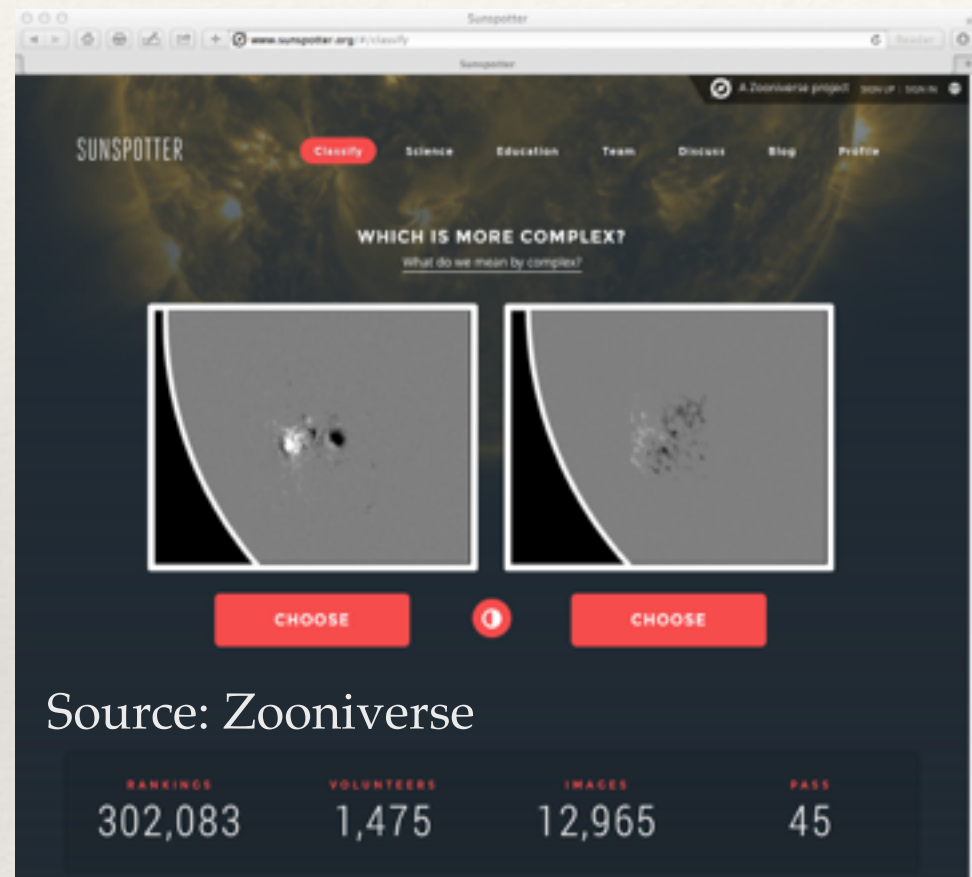
FLARECAST under the hood. WT7

WT7: Dissemination



FLARECAST under the hood. WT7

WT7: Dissemination



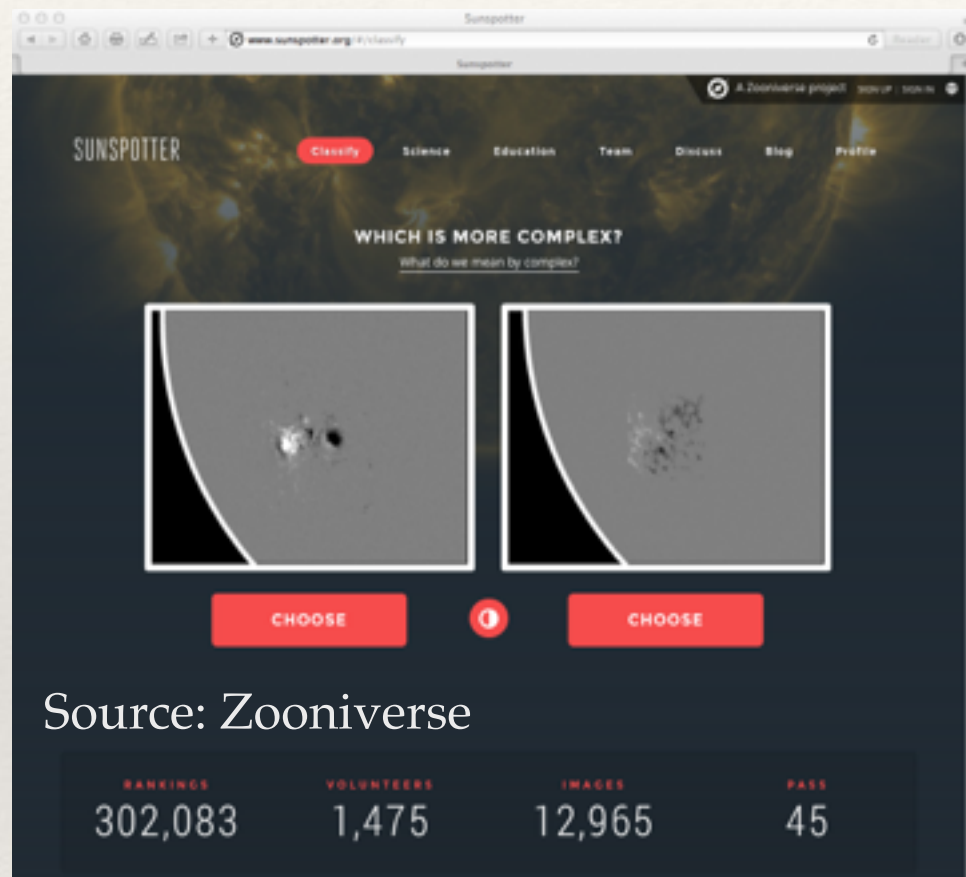
Source: Zooniverse

Public (user friendly interfaces, EPO, press releases, education kits, popular movies)



FLARECAST under the hood. WT7

WT7: Dissemination



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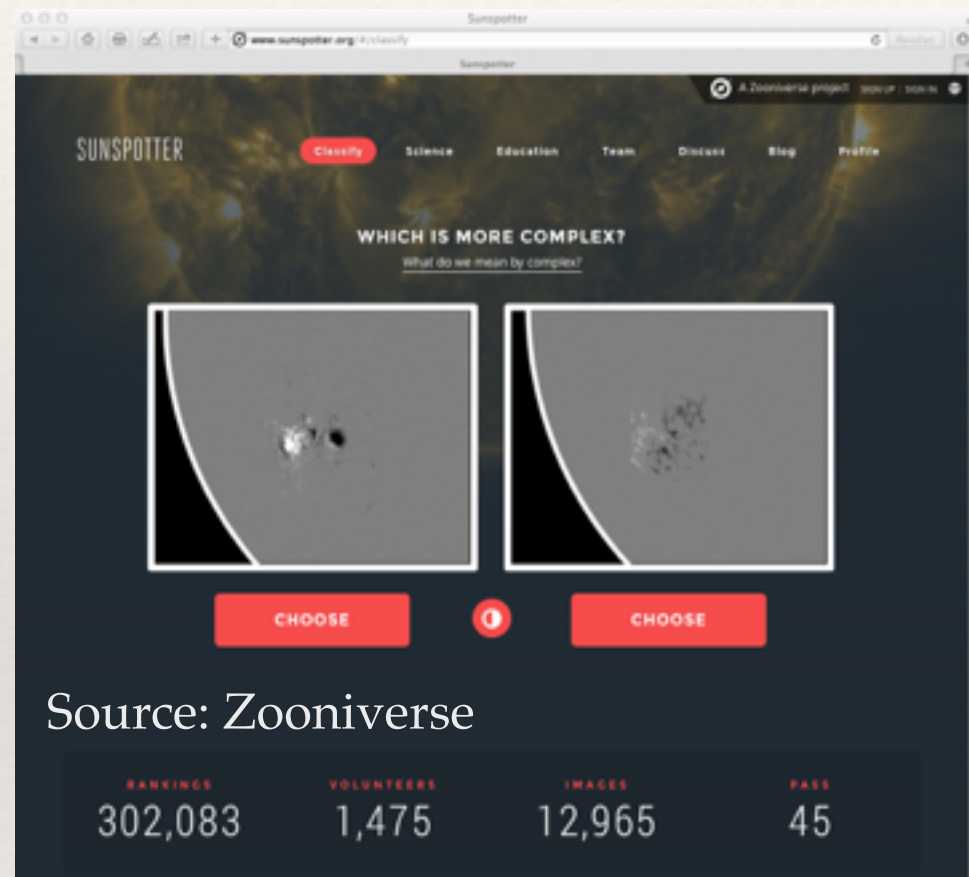
Source: *Nature* cover, Nov 4, 1869



Academic reporting & publications

FLARECAST under the hood. WT7

WT7: Dissemination



Source: Zooniverse

Public (user friendly interfaces, EPO, press releases, education kits, popular movies)

Source: *Nature* cover, Nov 4, 1869



Academic reporting & publications



Source: 123BRF

Informing and reporting to the European Commission, industry and governments



FLARECAST ambition



FLARECAST ambition



FLARECAST ambition



FLARE PREDICTORS



CATEGORICAL / PROBABILISTIC &
MACHINE-LEARNING TECHNIQUES

FLARECAST ambition



FLARE PREDICTORS

FREEDOM OF CHOICE

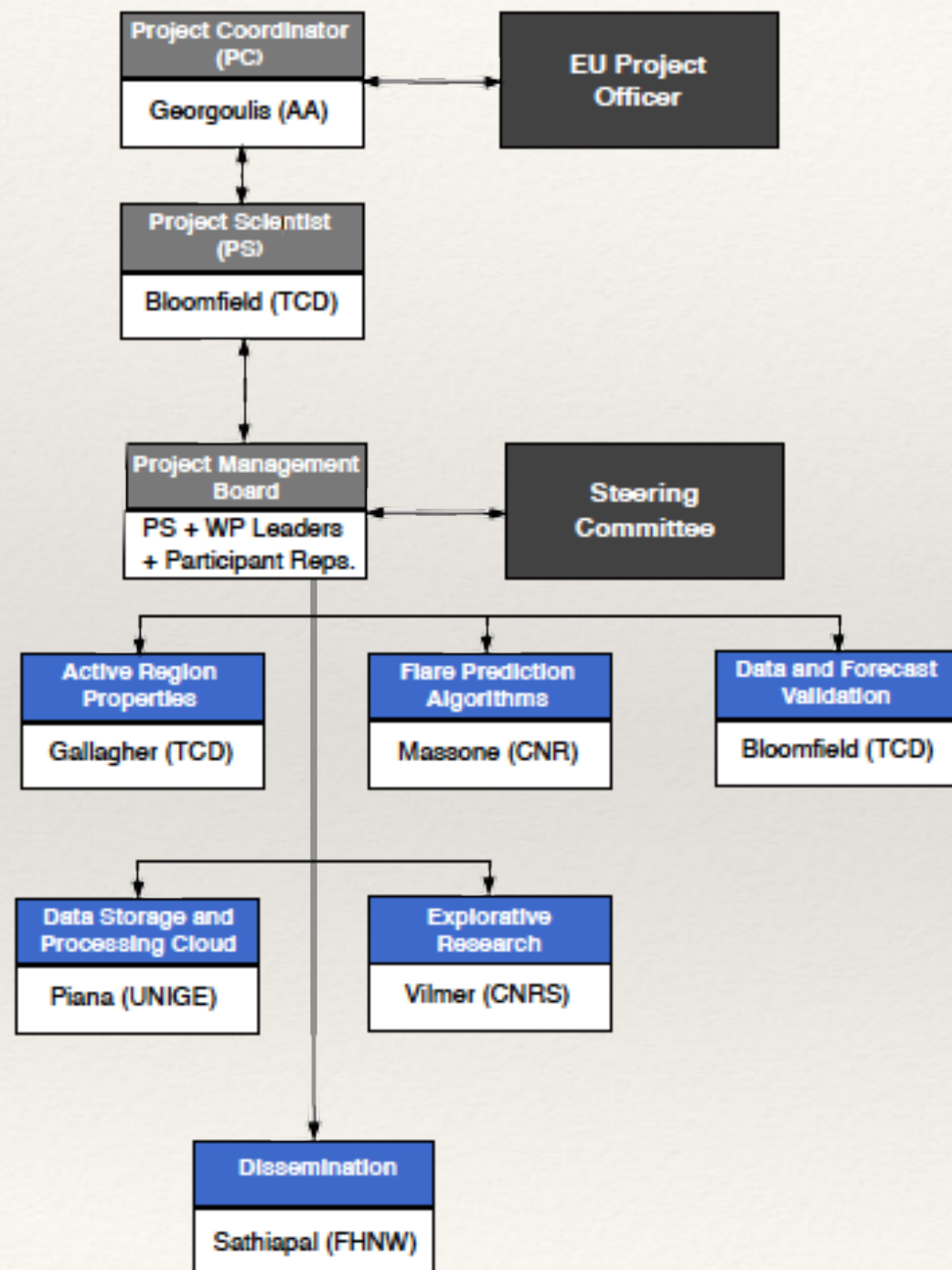
BY THE END USER



CATEGORICAL / PROBABILISTIC &
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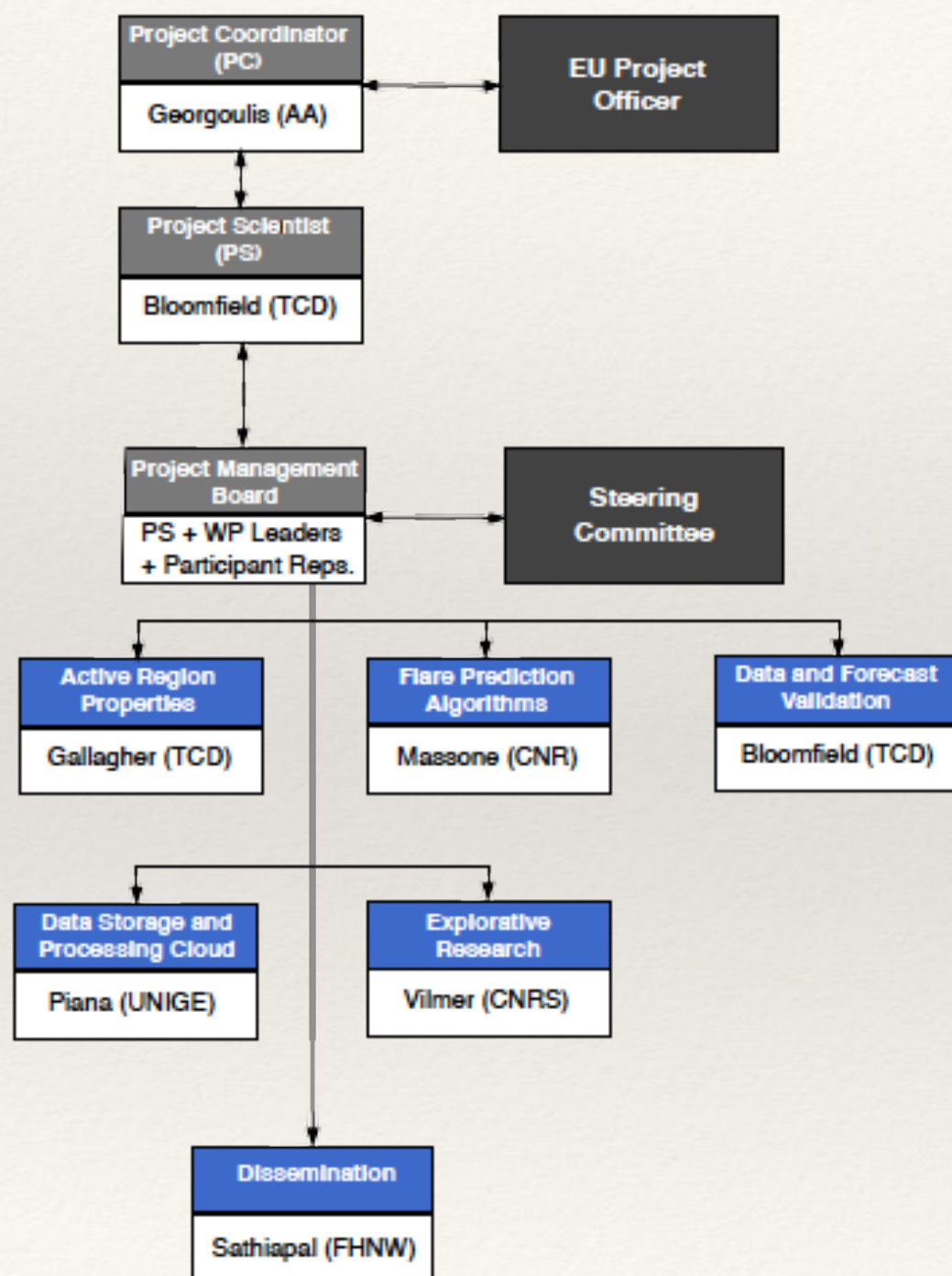


The FLARECAST team





The FLARECAST team



Name	Affiliation	Role
* M. K. Georgoulis	AA	Project Coordinator
* D. S. Bloomfield	TCD	Project Scientist
* P. Gallagher	TCD	WT2 leader
* A. M. Massone	CNR	WT3 leader
* M. Piana	UNIGE	WT4 leader
* D. S. Bloomfield	TCD	WT5 leader
* N. Vilmer & * E. Pariat	CNRS	WT6 leader
* H. Sathiapal	FHNW	WT7 leader
* F. Baudin	UPSud	Local group leader
* A. Csillaghy	FHNW	Local group leader
* D. Jackson	MET OFFICE	Local group leader

+ EC Project Officer + Steering Committee +
+ local group members + students & post-docs



Conclusion

- ❖ FLARECAST: a new Horizon 2020 project focused on solar flare prediction
- ❖ Not only solar physicists are involved: technologists, programmers, and archivers will play an integral role
- ❖ A link to operations has also been foreseen, via the UK Met Office. We seek to make sure that the FLARECAST outcome comply with operational standards, definitions, P&Ps



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KICKING-OFF IN THE NEXT MONTHS. PLEASE STAY TUNED!