



09/05/2022 Audizioni INAF

Comprehensive spAce wEather Studies for the **ASPIS** prototype Realization

Monica Laurenza (INAF/IAPS)

Project Prime:



Project Partners:



UNIVERSITÀ DEGLI STUDI DELL'AQUILA







Università

di Catania



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Scientific Context

Understanding of basic processes of plasma physics from the Sun to the Earth and planets at the base of Space Weather (SWE) is an unanimously recognized primary interest both for making significant advances in SWE Science and for realising a quality leap in our capabilities to predict SWE effects and ensure effective mitigation.

- Fundamental scientific questions remain open
- The scientific community has so far suffered from a fragmented scientific approach
- Urgent need to reinforce the interactions and synergies among the SWE Italian groups and unify Italian resources (ASI roadmap, Plainaki et al., 2020)



CAESAR overview

CAESAR rallies a great part of the Space Weather (SWE) Italian community and tackles **all the relevant aspects of SWE science.** It will realize the **prototype** of the scientific data centre for Space Weather of the Italian Space Agency (ASI) called **ASPIS** (ASI SPace Weather InfraStructure).





CAESAR is supported by ASI and INAF through the ASI-INAF agreement n. 2020-35-HH.0

CAESAR approach

CAESAR adopts an unprecedented, comprehensive, multidisciplinary and integrated approach, encompassing the **whole chain of phenomena from the Sun to the Earth up to planetary environments.**

Geoeffective event











Widespread event



CAESAR will select a number of wellobserved "**target SWE events**" (geoeffective, widespread), exhibiting extreme SWE characteristics from several perspectives, for detailed case studies.

CAESAR investigations will synergistically exploit different products, that will be made available in ASPIS.

CAESAR objectives

1) Advance the understanding of the origin and evolution of SWE phenomena;

2) provide novel and longstanding data, codes and models;

3) design, implement and populate with such products the ASPIS prototype in a flexible userfriendly infrastructure;

4) pave the way to future advanced SWE forecasting capabilities;

5) ensure efficient dissemination and foster future studies.



CAESAR team

CAESAR brings together 11 Italian institutions, with complementary recognised expertise

| | Institution | Leader | N° of people |
|--------------------|----------------------------|----------------------------|--------------|
| | INAF (prime) | Monica Laurenza (PI) | 24 |
| 84 | INGV | Fabio Giannattasio | 8 |
| | INFN | Valeria Di Felice | 3 |
| Participants | UNIAQ | Ermanno Pietropaolo | 6 |
| 12.28 FTE | UNICAL | Fabio Lepreti | 7 |
| | UNICT | Francesca Zuccarello | 3 |
| | UNIGE | Cristina Campi | 2 |
| | UNIPG | Bruna Bertucci | 5 |
| +12 AdR, 14.36 FIE | UNITOV | Dario Del Moro (Deputy PI) | 15 |
| | UNITN | Roberto Battiston | 2 |
| | ASI and other Institutions | | 8 |



Executive board: A. Milillo, C. Plainaki, G. Sindoni, M. Giardino, G Polenta

CAESAR INAF team

24 INAF researchers are involved in the project, 4.55 FTE



CAESAR Work Breakdown Structure (WBS)





WBS NODE 1000









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ASPIS prototype high level architecture





Functionalities

| roduct ingestion |
|----------------------------------|
| Airroring: synchronised |
| Airroring: bulk static |
| cheduled computation |
| Data Conversion |
| Aetadata mapping |
| tandard Visualisation: GUI |
| tandard Query: GUI |
| Download: GUI |
| IRT visualisation: GUI |
| On demand computation |
| Advanced Visualisation: ASPIS.py |
| Advanced Query: ASPIS.py |
| ownload: ASPIS.py |
| Computation: ASPIS.py |
| Viki: documentation |
| |



CAESAR fundings

| Description | Funding source | Total Cost (kEuro) | Justification |
|-------------------------|----------------|--------------------|--|
| | | | |
| Mannowar | ASI | 470,3 | |
| Maripower | COFIN | 768,5 | Research activity |
| External Major Products | ASI | 12,5 | Hardware for performing demanding computations |
| External Services | ASI | 122,0 | ASPIS prototype |
| Travels | ASI | 136,8 | Present the CAESAR progress and results and advertise the ASPIS prototype |
| Miscellaneous | ASI | 17,9 | Publish scientific results and material for dissemination |
| | COFIN | 14,9 | Publish scientific results |
| | ASI | 759,5 | |
| TOTAL | COFIN | 783,4 | |
| | ASI+COFIN | 1542,9 | |

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CAESAR fundings per Institution

Total project fundings





INAF fundings

| Description | Funding source | Total Cost (kEuro) |
|-------------------------|----------------|--------------------|
| Mannautor | ASI | 168,0 |
| Manpower | COFIN | 245,3 |
| External Major Products | ASI | 2,6 |
| External Services | ASI | 39,0 |
| Travels | ASI | 44,0 |
| Miscollanoous | ASI | 6,5 |
| Miscelidrieous | COFIN | 3,5 |
| | ASI | 260,2 |
| TOTAL | COFIN | 248,8 |
| | ASI+COFIN | 509,0 |



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CAESAR duration & status

CAESAR Kick-off 21st December 2021 End 20th January 2024

During the first 4 months since the start of the project activities have focused on:

- Preliminary data analysis for the identification of target SWE events (intense flares, major SEP events, geo-effective CMEs, strong geomagntic storms); models set up
- Collection of product specification information, start of metadata mapping and wiki docs, ASPIS design
- CAESAR Web Page



NODE 1000 Activity Planning

| NODO 1000 | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Milestones: RAs and Final Meeting | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP0.1: Progress Reports – Del001 \ Del006 Publications-Del005 | | | | | | | | | | | | | | | | | | | | • | | | | | |
| All WPs: Identification of candidate SWE events | | | | | | | | | | | | | | | | | | | | | | | | | |
| All WPs: compile the Product Specs template, return to WP2320 | | | | | | | | | | | | | | | | | | | | | | | | | |
| HL-WPs: Review and combine lists of SWE events | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP0.1: Target SWE events selection | | | | | | | | | | | | | | | | | | | | | | | | | |
| Models development\set up | | | | | | | | | | | | | | | | | | | | | | | | | |
| All WPs: Study of selected SWE events | | | | | | | | | | | | | | | | | | | |) | | | | | |
| All WPs: Consolidation of results and dissemination | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |

CÆSĄR

NODE 2000 Activity Planning

| NODO 2000 | | | | ~ | | | | | | | | | | | | | | | | | | | | |
|---|-----|----------------------|---------------------------|-------------------------|---------------------|------------------------|---------------------------|------------------------|-----------------|-------------------|------------------|----------------|----------------|-------------|---------|----|--------|-------|------|--------|--------|------|-------|----|
| month | 1 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Milestones: RAs and Final Meeting | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2310: prepare the product specs template | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2110: Define DB system requirements, ASPIS pilot design | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2320: Prepare the metadata map, Wiki- site design and population | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2210: API basic set design and realization | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2220: GUI pilot design and realization | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2120: Implementation of empty DB | | | < | | | | | | | | | | | | | | | | | | | | | |
| WP2130: Pilot ASPIS database populated with products | | | | | | | | | | | | | | | | | | | | | _ | | | |
| CÆSAR | | Del0 Del0 Del0 | 02:Re)03: A)04.1: | quire SPIS [Tech | emer Data Spe | nts Dc Mod cs of | oc (So Iel sp pilot | cient ecs; prote | ., Fur otype | nctior e; Pilc | nal, S ot Imp | ysten oleme | n req entat | is) tion | \prec | S | tart o | t the | exte | rnal s | servic | e co | ntrac | :† |

NODE 2000 Activity Planning

| NODO 2000 | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|-----|-------|--------|--------|--------|-------|-------|-------|-------|--------|-------|----|----|----|----|----|----|----|----|----|----|----|
| month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Milestones: RAs and Final Meeting | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP 2230: ASPIS.py basic library design and realization | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2330: Wiki-site design and population | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2110, WP2120: Advanced ASPIS and ASPIS.Py design & realization | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2210: API advanced set design & realization | | | | | | | | | | | | (| | | | | | | | | | | | | |
| WP2220: Web GUI advanced design & realization | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2210, WP2220, WP2230: API, Web GUI, ASPIS.py docs | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP2130: Advanced ASPIS database populated with data | | | • | | | | | | | | | | | | | | | | | | | | | | |
| RA | | | | Del | 004.2 | : Tec | h Spe | ecs of | the o | adva | incec | d ASP | IS pro | ototy | be | | | | | | | | | | |
| GÆSAR | | | | Del | 004.3 | : Finc | al Imp | leme | ntati | on of | the / | ASPIS | prot | otype | Э | | | | | | | | | | |

NODE 3000 Activity Planning

| NODE 3000 | | | | - | ~ | | | | | | | | | | | | | | | | | | | | |
|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| Milestones: RAs and Final Meeting | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP3100:Design and realization of the CAESAR website | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP3100: Continuous updates to Website | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP3200: Educational and outreach activity | , | | | | | | | | | | | | | | | | | | | | | | | | |
| WP3200: Dissemination, Press and communication activity | | | | | | | | | | | | | | | | | | | | | | | | | |
| WP3300: organization of the Final Workshop | | | | | | | | | | | | | | | | | | | | | | | | | |



First Results

NODE 1000

- Catalogues of flares, SEPs, geoeffective CMEs;
- 3 publications submitted or in preparation

NODE 2000

- Product Specification Template (ProSpecT)
- Preliminary ASPIS design

NODE 3000

<u>CAESAR Web site</u>



Expected results at the end of the project

- Publications and reports
- Prototype deployed in ASI SSDC:
 - More than 100 products
 - Ready to ingest new additional product types
 - Real-time monitoring
- Final Workshop

Reinforce the interactions and synergies among the SWE Italian groups in a strongly collaborative environment.





Conclusions

- CAESAR is an ambitious project dedicated to Space Weather, which is an unanimously recognized primary interest in the international context

- CAESAR involves a wide team coordinated by INAF

- CAESAR has a multidisciplinary scientific approach and technological aspects

- The scientific value of the project would be fully capitalized in the context of **long -term strategy**, including fundings and personnel recruitment plan to ensure the INAF lead in the Space Weather field.

