



CENTRO
OSSERVAZIONI
SPAZIALI
DELLA TERRA

Space Weather – PECASUS (part of WP9)

ROMA 2

CESARONI C., ROMANO V., SPOGLI L., PERRONE L., PICA E., DI MAURO D., TOZZI R., CAFARELLA L., ALFONSI L., DE FRANCESCHI G., PEZZOPANE M., PIGNALBERI A., SCIACCA U., SCOTTO C., SABBAGH D., PIETRELLA M., BAGIACCHI P., DOMINICI G., LEPIDI S., REGI M., MARCOCCI C.,

ROMA 1

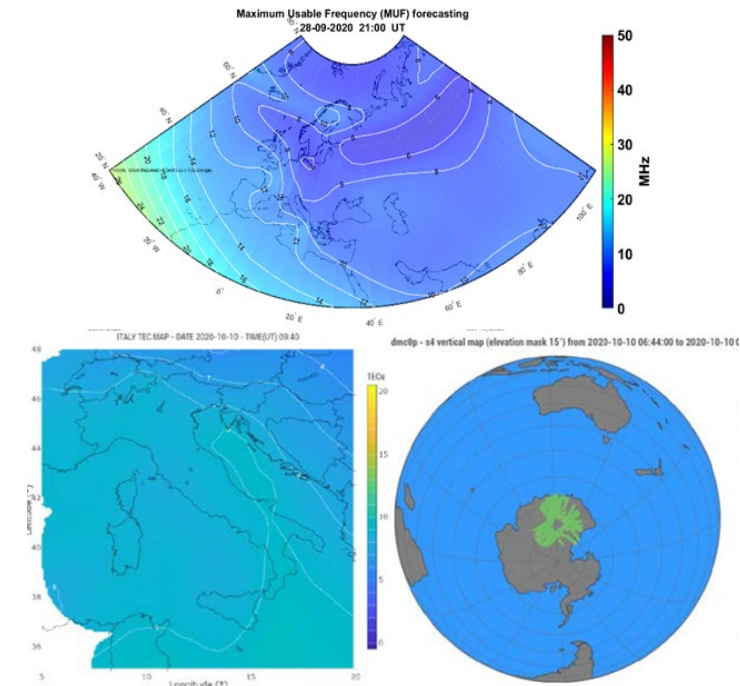
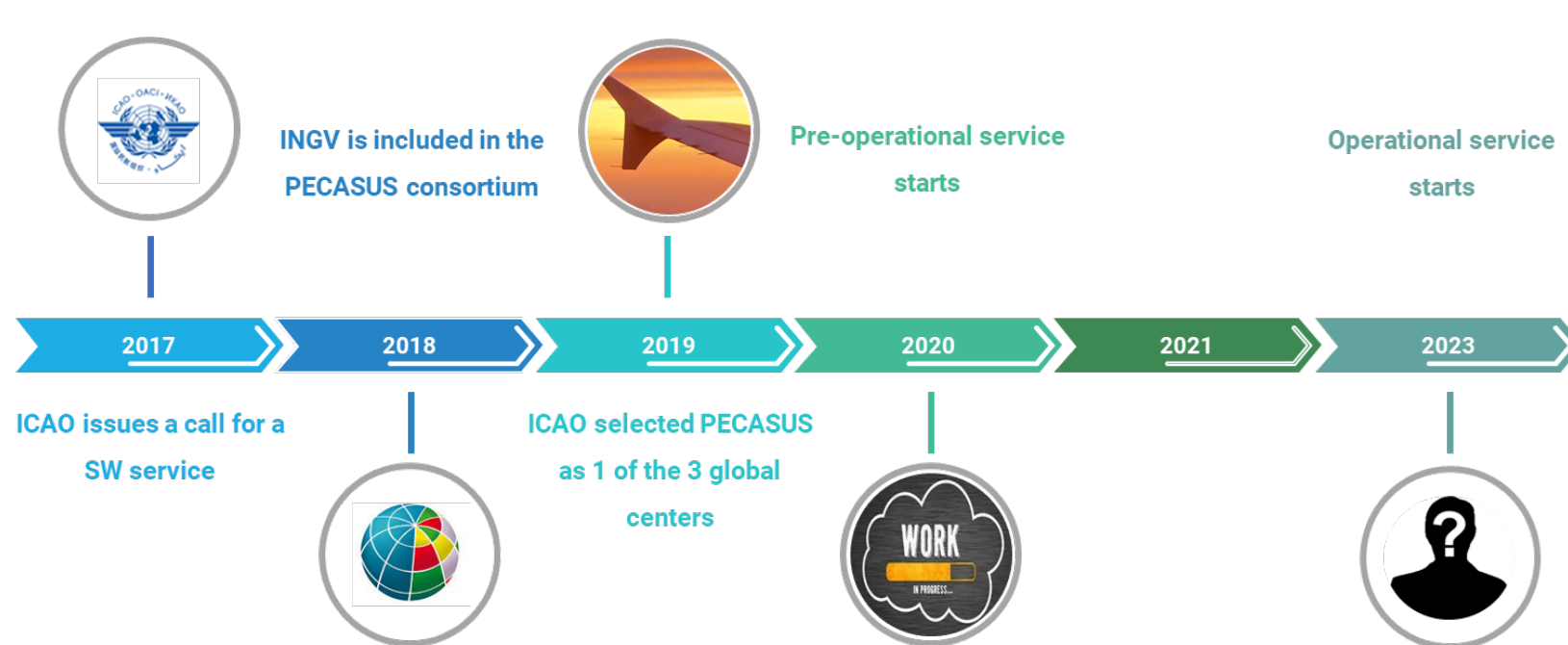
LA LONGA F., CRESCIMBENE M.,

AC

FICELI P., SENSALE G.

General Description (Objectives)

Since 2018, INGV is part of the PECASUS consortium (www.pecasus.eu) that is devoted to the provision of a Space Weather service to support the civil aviation. PECASUS has been designated by the International Civil Aviation Organization (ICAO) as one the four global center capable of providing a 24/7 service including radiation, HF and GNSS related products. Since 7 November 2019 the service is fully available and INGV contributes by providing products on HF and GNSS domain.



Progress Description

With respect to 2021 the following goals have been reached:

Infrastructures

- Installation of new GNSS receivers for ionospheric scintillation monitoring (Thule, Malindi-BSC, Abuja...)
- Progress on the installation of a new AIS ionosonde in the Broglia Space Center (installation scheduled in June 2023)
- Progress on the installation of a new digisonde in Gibilmanna (to be installed during summer)
- Progress on the installation of a new AIS ionosonde in Lerici (site selected)

Products

- Improvement of the Total Electron Content forecasting algorithm (paper submitted)
- Development of a new algorithm producing 3D electron density maps over Italy/Europe based on IRI-UP ingesting ionosondes and TEC maps

INGV contribution to ESA Space Weather Service Network Development and Pre-Operation (SWESNET)

Carlo Scotto and the SWESNET team



• General Description

Background

Under the ESA Space Situational Awareness (SSA) Programme (2009 – 2019) work began to develop a system to monitor, predict and disseminate Space Weather information and alerts.

The SSA programme successfully demonstrated the feasibility of providing reliable space weather information via a distributed network of federated service providers. On conclusion of the SSA programme the SSA Space Weather Service Network is able to provide ~1500 users with access to 29 prototype services, built upon more than 200 individual Space Weather data products.

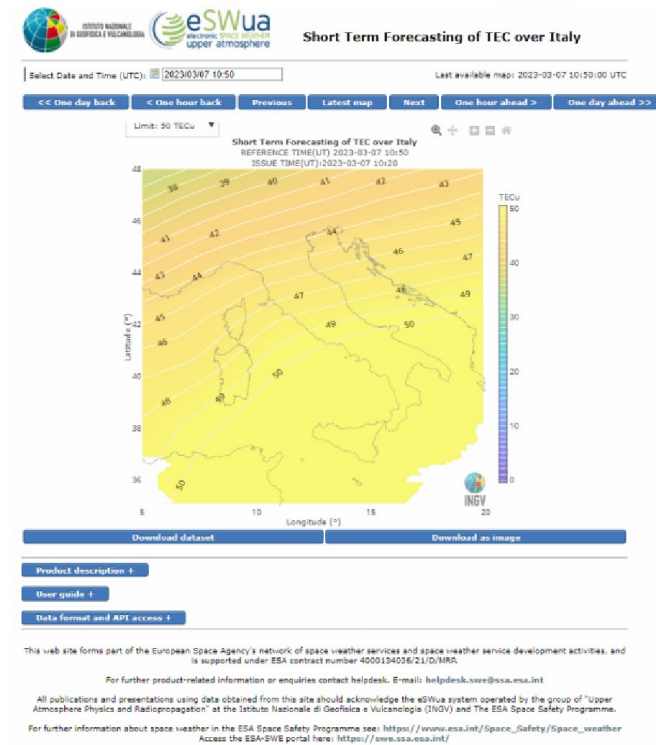
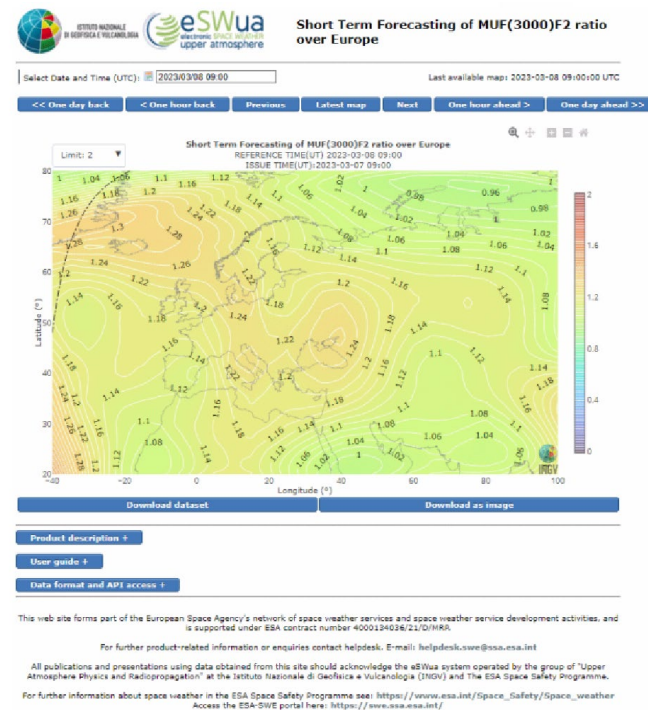
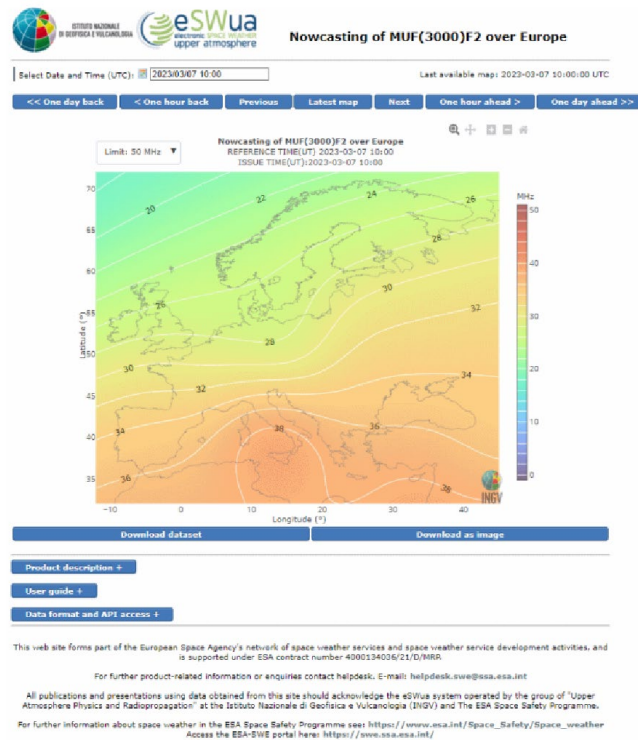
New Program

Development in S2P Period 1 will increase the ESA Member States ability to protect critical infrastructure and mitigate the impacts of Space Weather on affected systems, with an emphasis on improved forecasting capabilities and increasing the robustness of the underlying service provision system.

INGV contributes to the new program with 6 Space Weather products

- Progress description

The products have been accepted by ESA with the Acceptance test (March 2023) and will be deployed in the new ESA Portal with **portal release 3.7** (July 2023).



Screenshots of some INGV Space Weather products as they are accepted for deployment on ESA portal.

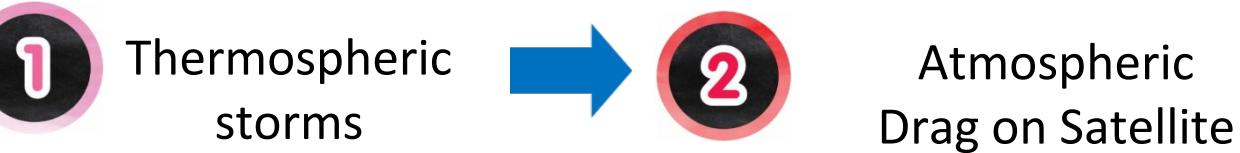
THERmospheric parameters from IONospheric observations

THERION

L. Perrone, C. Scotto, D. Sabbagh



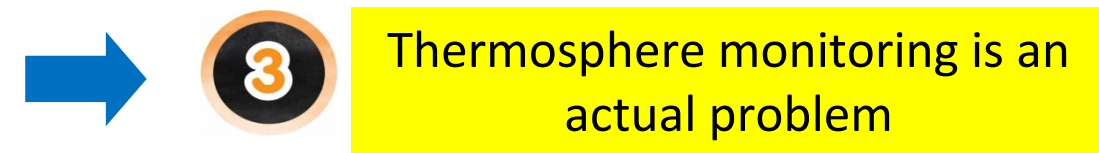
GENERAL DESCRIPTION AND PROGRESS



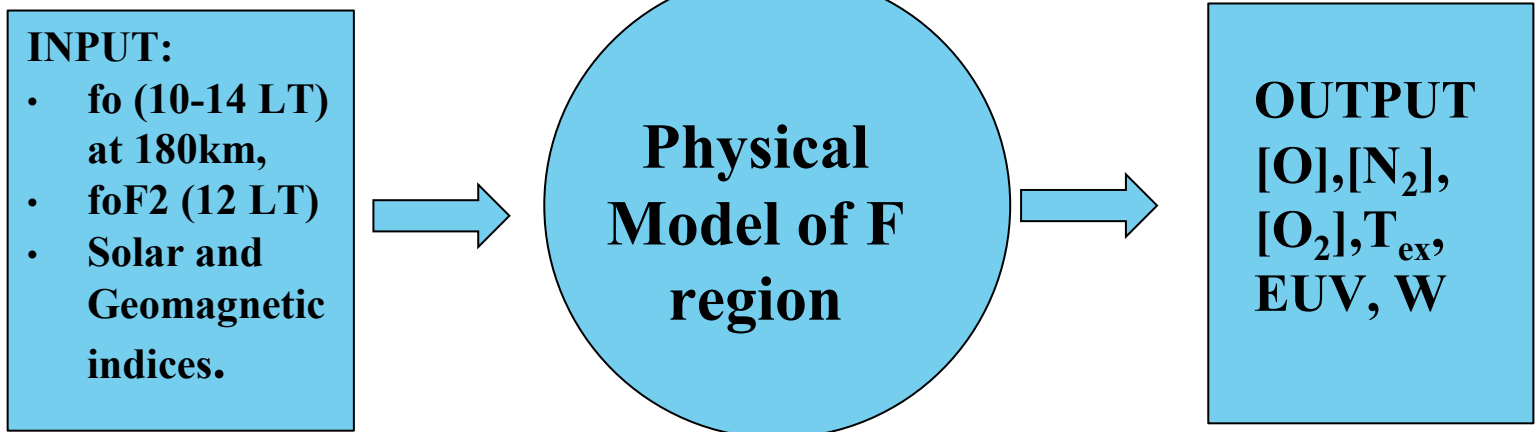
The increase of neutral density occurring during thermospheric storms determines an increase in air drag that leads to a stronger drag of low orbiting satellites, that can determine the loss of satellites (e.g. STARLINK satellites) necessitating a recalculation of their orbits



Direct observations of the thermosphere are technically very complicated and expensive. The idea is to retrieve the main thermospheric parameters from ionosonde observations.



Recent progress concerns the assimilation of the neutral density measurements from satellite to obtain more accurate determination of thermospheric parameters





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Lithosphere-Atmosphere- Ionosphere Coupling (LAIC)

(part of WP9)

G. CIANCHINI, M. CALCARA, S. D'ARCANGELO, D. DI MAURO, A. IPPOLITO, A. NARDI, L. PERRONE, C. SCOTTO, D. SABBAGH, MAURIZIO SOLDANI [ROMA2] | A. DE SANTIS [ASS. INGV] | A. PISCINI [ONT]

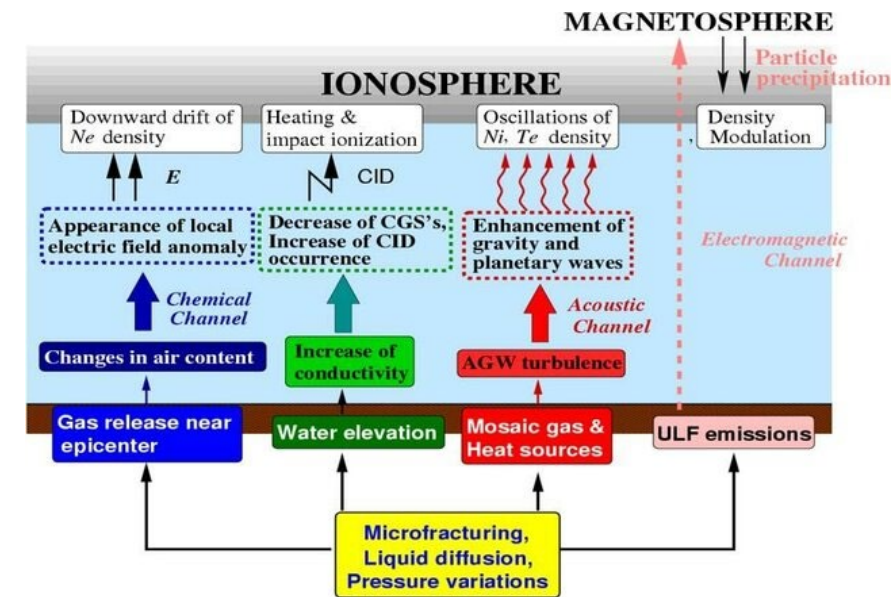
General Description (Objectives)

Ancillary Seismic Data. Products for characterizing the hazard source areas: Temporal/Spatial variations of seismicity through plots of cumulative number of earthquakes (EQs), b-value and G-R distribution; Revised Accelerated Moment Release (R-AMR).

Other Ancillary Data. Ground-based magnetic & ionosonde data. Plots of found anomalies in geomagnetic field parameters, including total intensity, horizontal and vertical components, and their temporal changes, observed prior to seismic events. Plot of empirical relationships between ionospheric anomalies and magnitude M.

Satellite Data. ULF (Ultra-Low Frequency) and ELF (Extremely Low Frequency) analysis of magnetic and electron density data. Geomagnetic variations within the ULF and ELF ranges have been linked to seismic activity. These low-frequency electromagnetic emissions can be generated by pre-earthquake processes such as rock deformation and frictional sliding, and specialised instruments are employed for their monitoring.

Currently, the products are generated on demand for INGV users.



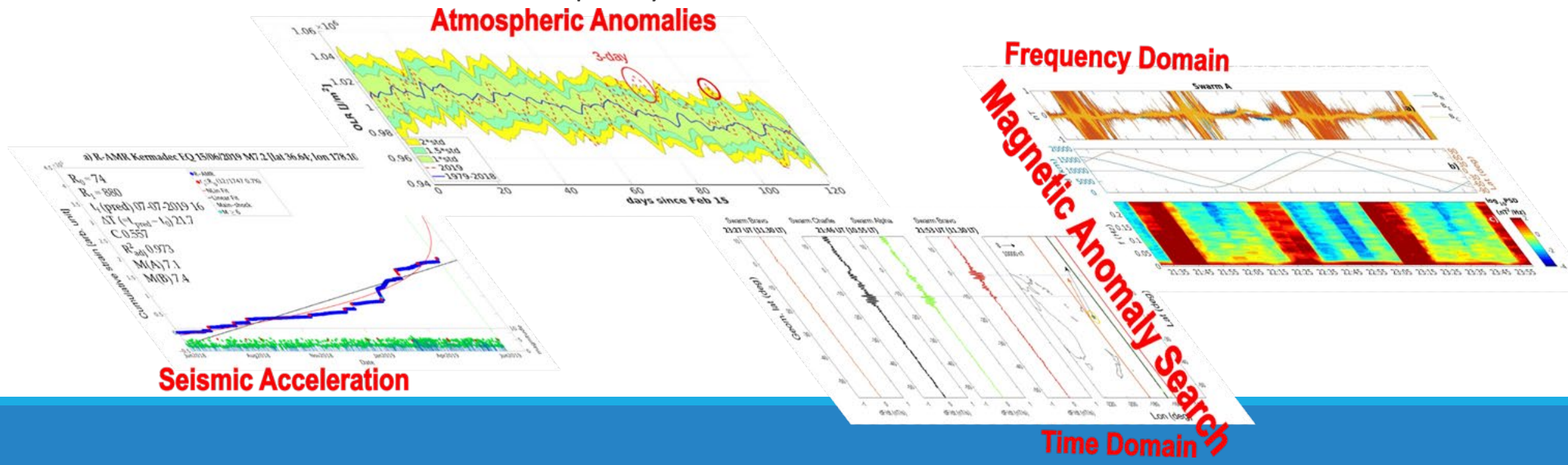
Schematic illustration of the lithosphere-atmosphere-ionosphere coupling (LAIC)
Credit: M.Hayakawa

Progress Description

Ancillary. Ground-based magnetic, GNSS & ionosonde data: Introduction of *new ionospheric anomalies* (e.g. TEC) possibly related to more recent earthquakes to improve the empirical relationship.

Atmospheric Data: Intercomparison of gas and atmospheric data and their time delay of appearance.

Satellite data: Anomalies in time and frequency Domains.





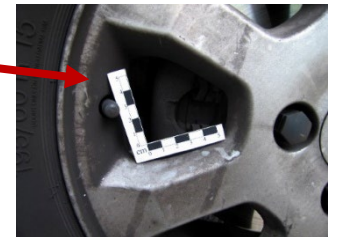
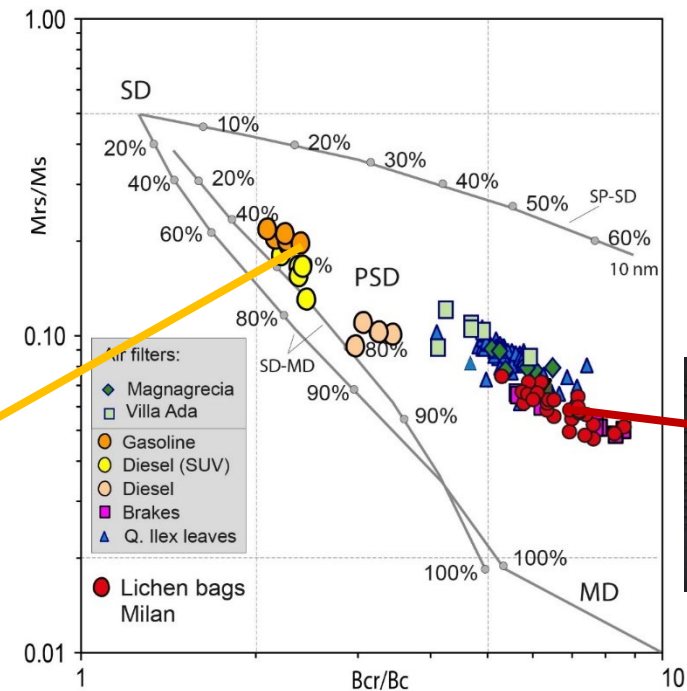
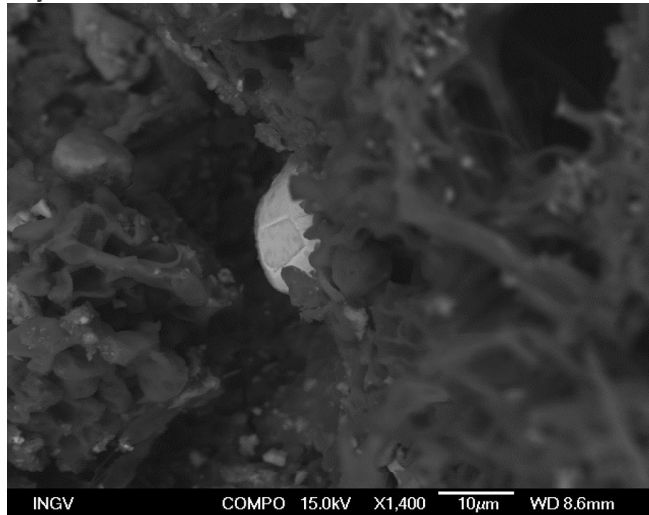
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Magnetic Methods for the Source Apportionment of PM

WINKLER[ROMA2]

General Description (Objectives)

- Anthropogenic airborne particulate matter (PM) may contain relevant concentration of magnetic particles
- Rock magnetism methods can be applied to the validation and source apportionment of PM
- Magnetic analyses can contribute to data integration between air and ground-based observations
- Type of measurements: magnetic susceptibility, hysteresis properties, correlations with third party chemical analyses
- Spatial resolution: any scale (depending on the selection of samples/sampling)
- Temporal coverage: daily (PM filters), monthly (transplanted lichens), seasonal (leaves), multiannual (native lichens)
- Refresh time: depending on aims and projects
- Availability: on demand, research based



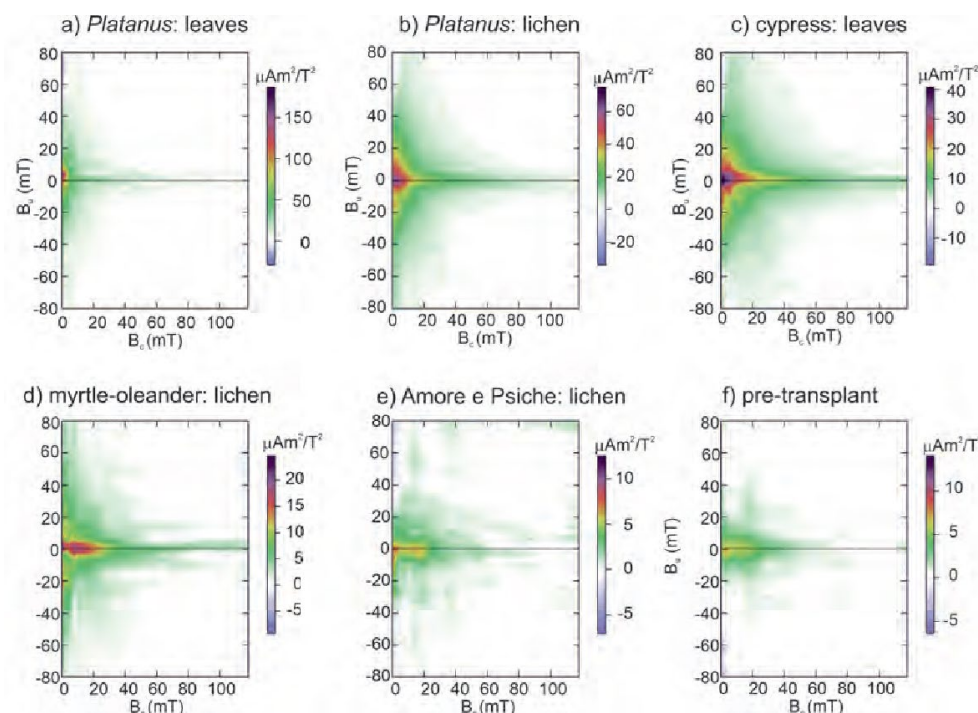
Progress Description

Projects and Cooperations that are potentially interesting: both about Cultural Heritage

CHIOMA: Cultural Heritage Investigations and Observations: a Multidisciplinary Approach - cooperations with ONT (Buongiorno, Costanzo, Musacchio, Silvestri), OV (Marotta), Accademia Nazionale dei Lincei, Parco Archeologico del Colosseo, Collezione Peggy Guggenheim, UNSAM Buenos Aires, Università di Siena

DTC Lazio: Centro di Eccellenza Regione Lazio per lo sviluppo e l'applicazione di tecnologie nel settore dei Beni e delle Attività culturali e per attività di alta formazione

Instrumental development: a new vibrating sample magnetometer through PON GRINT funds: LAKESHORE 8400



Characterization on forest fire and (burnt areas) (part of WP9)

S. Amici ONT



General Description

Mapping fire activity

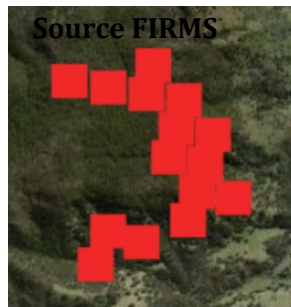
- ~3.4 % of the Earth's vegetated area burns annually, with resulting large scale effects (Giglio et.al. 2018)
- Since 2006 INGV has been involved in developing science for wildfire characterization
- Adapted to a range of data deployed by a variety of space sensors such as multispectral, hyperspectral and thermal sensors at multiple scale to characterize wildfires and their impact on vegetation and soil erosion.



General Description (Objectives)

- Enhance fire mapping by using high resolution (optical –TIR) space data)
- **Develop a module to provide maps of active fires at higher resolution from (1Km to 30m)**
- The data are accessed through diverse type of providers
- Develop burned areas/ severity products
- Spectral library

Bush fire Australia



VIRSS 350m



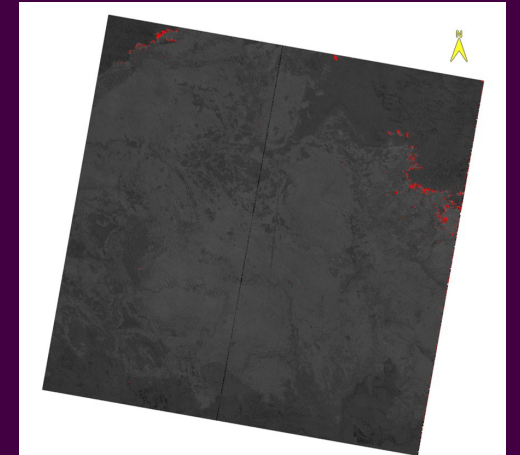
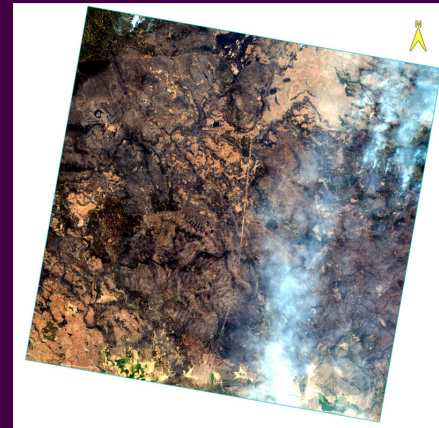
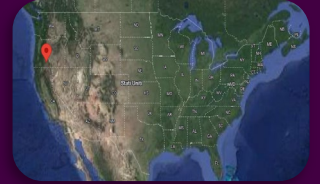
PRISMA 30m



Progress Description

- 2021-2022 Feasibility demonstration : it is possible to use PRISMA (SWIR) data for active fire characterization
- 2021-2022 Development of a prototype: Forest Fire Front
- 2023- To study the thresholds to be used in different ecosystems
- 2023 – 2025 To integrate the FFF into the PNRR - MEET project
- Burned areas TBC

Bootleg Fire, Oregon, Fremont-Winema National Forest



■ FFF



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DI GEOFISICA E VULCANOLOGIA

Thank you!



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Characterization of forest fire and burnt area (part of WP9)

ONT

S. AMICI