



Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste



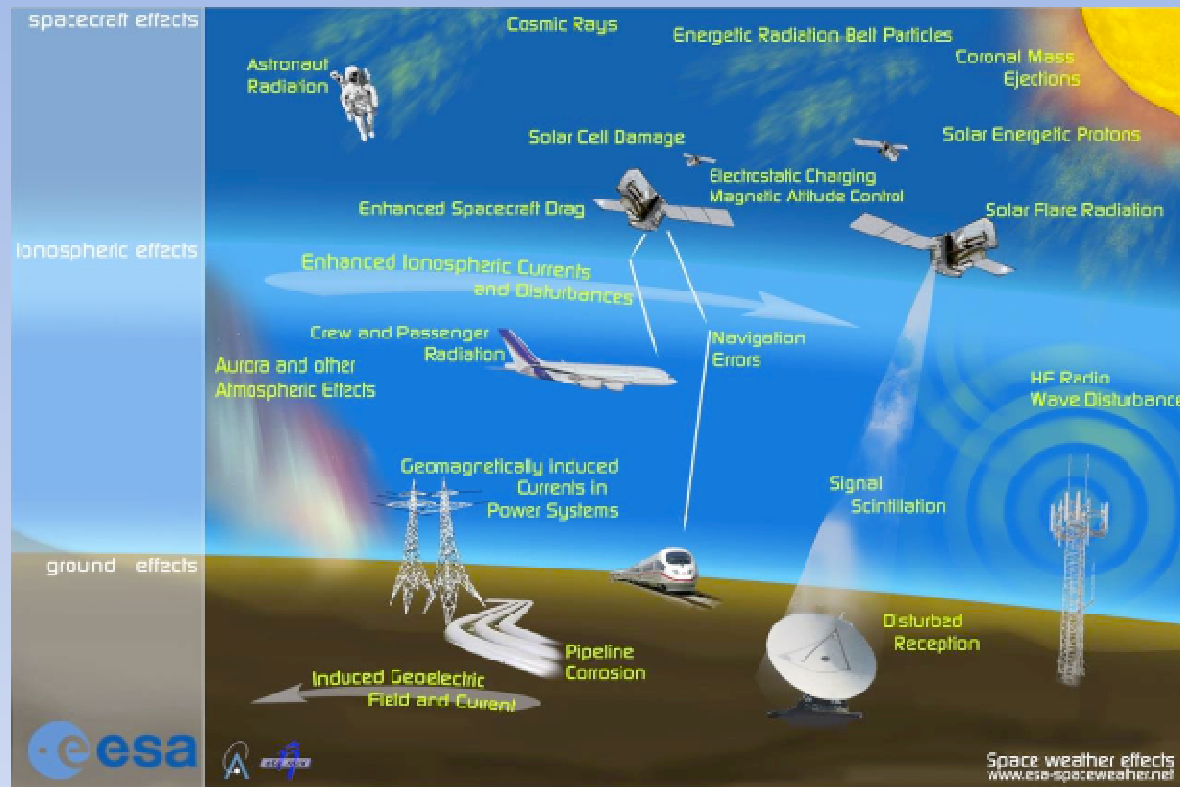
Study of the correlation between the solar activity and the geomagnetically induced currents in gas pipelines systems

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Riunione RSN3 - “Sole e Sistema Solare”, Capodimonte 18-19 ottobre 2022

Space weather



Space weather refers to the environmental conditions in Earth's magnetosphere, ionosphere and thermosphere due to the Sun and the solar wind that can influence the functioning and reliability of spaceborne and ground-based systems and services or endanger property or human health. In addition to the Sun, non-solar sources such as galactic cosmic rays can be considered as space weather since they alter space environment conditions near the Earth (ESA <https://space-env.esa.int/r-and-d/space-weather/>)

Gasdotti e sistemi di protezione catodica



I gasdotti e gli oleodotti sono strutture in acciaio adatte a contenere/trasportare liquidi/gas ad alta pressione e sono normalmente protette contro la corrosione con materiali isolanti. Eventuali superfici/punti non protetti sono soggetti a fenomeni di corrosione ove esposti ad aria o terreno umidi. Sistemi di protezione catodica vengono usati per minimizzare la corrosione mantenendo l'acciaio ad un potenziale negativo (-0.85-0.95V) rispetto al terreno.

Effetti GIC su gasdotti ed oleodotti

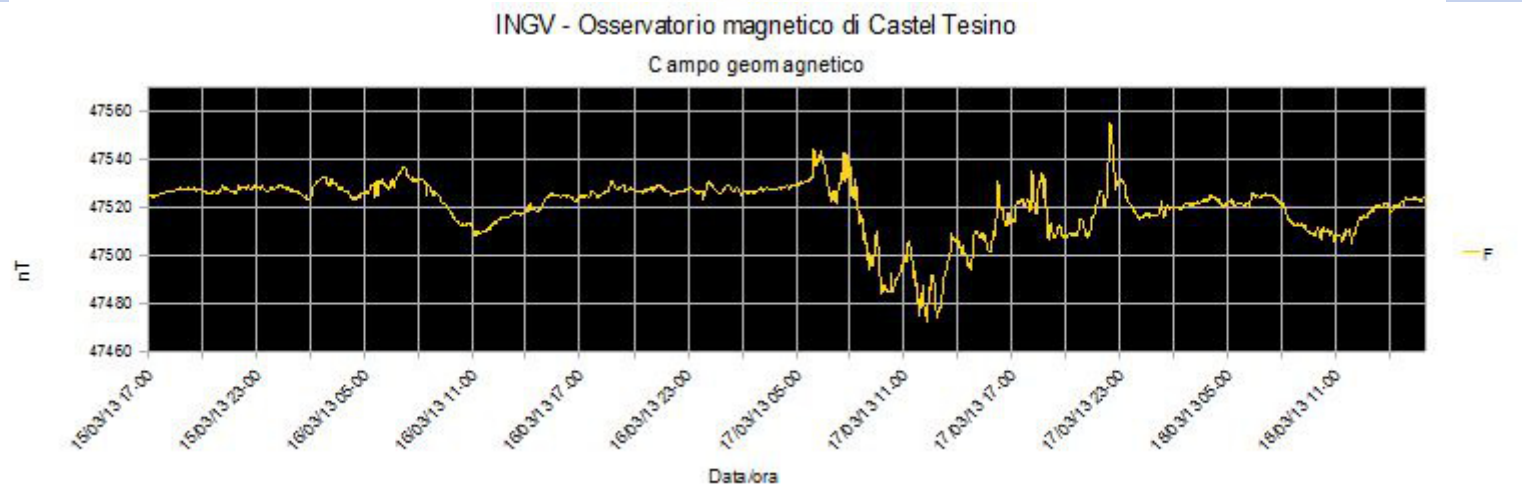
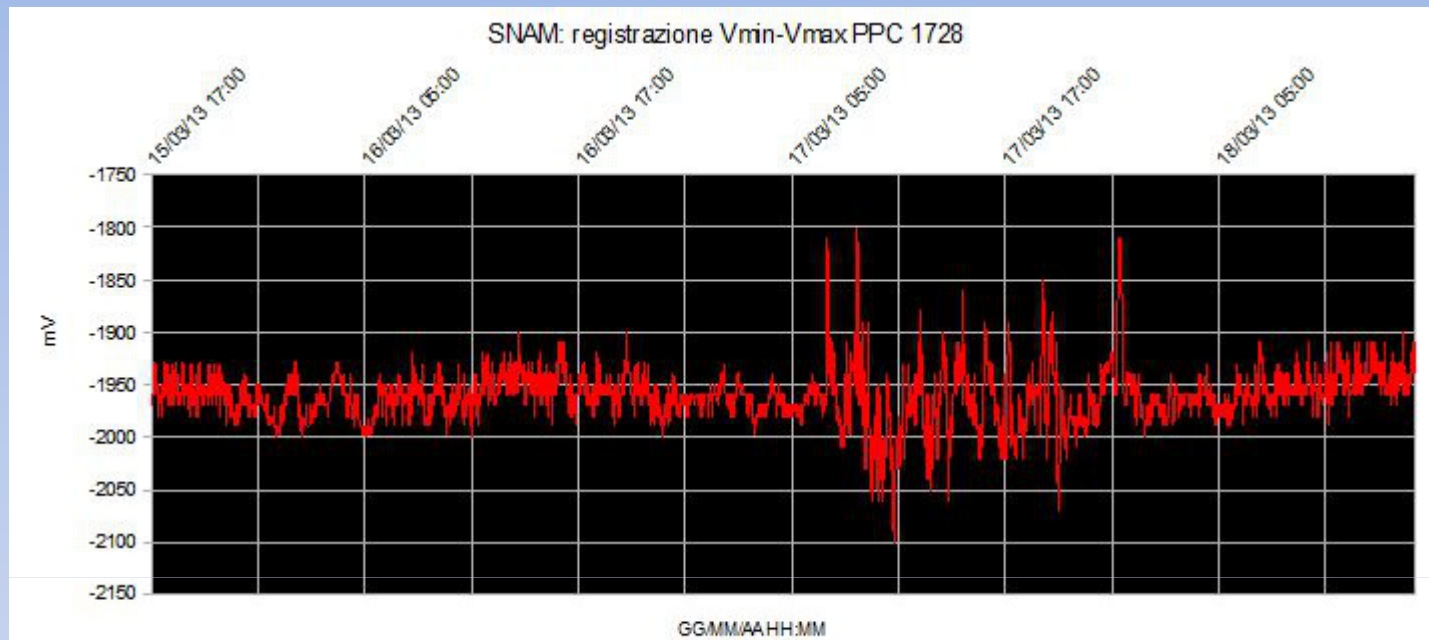
Correnti geomagnetiche indotte possono causare sbalzi nella **differenza di potenziale condotta/suolo**, aumentando la possibilità di corrosione durante le tempeste geomagnetiche [1][2][3] [4][5] e modificando i valori del potenziale di protezione catodica della struttura. Questi effetti sono normalmente **più rilevanti a latitudini elevate** [8], ma sono rilevabili anche alle **medie latitudini** [9][10].

Le condotte SNAM sono protette catodicamente da Impianti a Corrente Impressa, detti anche **Posti di Protezione Catodica (PPC)**, i cui valori di protezione (potenziale della struttura) vengono monitorati e registrati tramite **telecontrollo**.

Una **prima indagine**, effettuata in collaborazione tra **SNAM** ed **INAF-Osservatorio Astronomico di Trieste**, che ha permesso di evidenziare gli effetti di tempeste geomagnetiche causate da eventi solari, misurati e registrati dal sistema di protezione catodica a servizio del gasdotto SNAM. Si sono considerati indici Dst dell'archivio del **World Data Center for Geomagnetism, Kyoto** e i dati geomagnetici registrati dall'**Osservatorio Magnetico INGV di Castel Tesino (TN)**.

Il giorno 15 marzo 2013 si è verificato un **flare di classe M1**, accompagnato da una **CME** che ha colpito la magnetosfera terrestre il 17 marzo alle 06.01 UTC, come indicato da un impulso di 48 nT registrato dal magnetometro di Boulder (Colorado), generando una **tempesta geomagnetica di media entità (Kp=6)**.

Evento solare dd. 15 marzo 2013 (brillamento di classe M1 + CME)



Project aim, deliverables and milestones

The main **scientific goal** of the project will be the identification and characterization of the properties of the solar conditions which can produce Space Weather events potentially harmful for a gas pipeline system at our latitude. Then a detailed description of the suitable conditions for the occurrence of the geomagnetic disturbances which may affect the pipelines systems will be reported in a published paper.

On the basis of these properties we will develop a **prototype of a smartphone application** to send alerts in case of potentially dangerous events for gas pipeline systems at different latitudes on Earth due to the solar activity. This application will be dedicated to potential users who work in the sector of the management and monitoring of gas pipelines.

M1.1 Identification of a list of significant potential variations registered along the SNAM pipeline and the corresponding geomagnetic events (T0+6M)

D1.1 Report containing the results reached during the first year of activity (T0+12M)

D1.2 Publication of a case study in a peer review journal (T0+12M)

M1.2 Identification of the properties of Space Weather events potentially harmful for a gas pipeline system at our latitude (T0+12M)

D1.3 Publication of a paper in a peer review journal describing the method for the identification of the solar conditions suitable for the occurrence of the geomagnetic disturbances which may affect the pipeline systems at different latitudes (T0+22M)

M1.2 Prototype of an Application for smartphone useful for alert in case of potentially dangerous events for a pipeline system located at a selected latitude (T0+24M).

D1.4 Final report containing the results reached during the whole project (T0+24M)

Bibliografia

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Main project activities

- Comparison between the **reported anomalies** in the SNAM pipeline **potential variations** and the **geomagnetic variations** measured along the pipeline
- Correlation of the highlighted **potential variations** registered along the SNAM pipeline with some global **geomagnetic indices**
- Check the correspondence of the **reported anomalies** with major solar events, like **CMEs** and the associated **flares**.
- Investigation over some properties of those **CMEs**, such as **speed, acceleration, polar angle, angular width, and mass**, using data acquired by the LASCO onboard the Solar and Heliospheric Observatory (SOHO), measured SEPs (ACE and STEREO measurements) and type-II radio bursts (publicly available radio data NOAA, e-Callisto)
- Comparison of the recorded anomalies of the **potential variations** with several parameters describing the solar activity in order to search for quantifiable correlations with the conditions of the solar atmosphere suitable for the occurrence of Space Weather events using data taken by space and ground-based telescopes dedicated to solar monitoring (such as **sunspot number and their areas** measured by the Catania Solar Telescope , **HMI data, emissions at several wavelengths**, radio, EUV and X ranges)
- Development of a **prototype of a smartphone application** to send alerts in case of potentially dangerous events for gas pipeline systems at different latitudes on Earth due to the solar activity