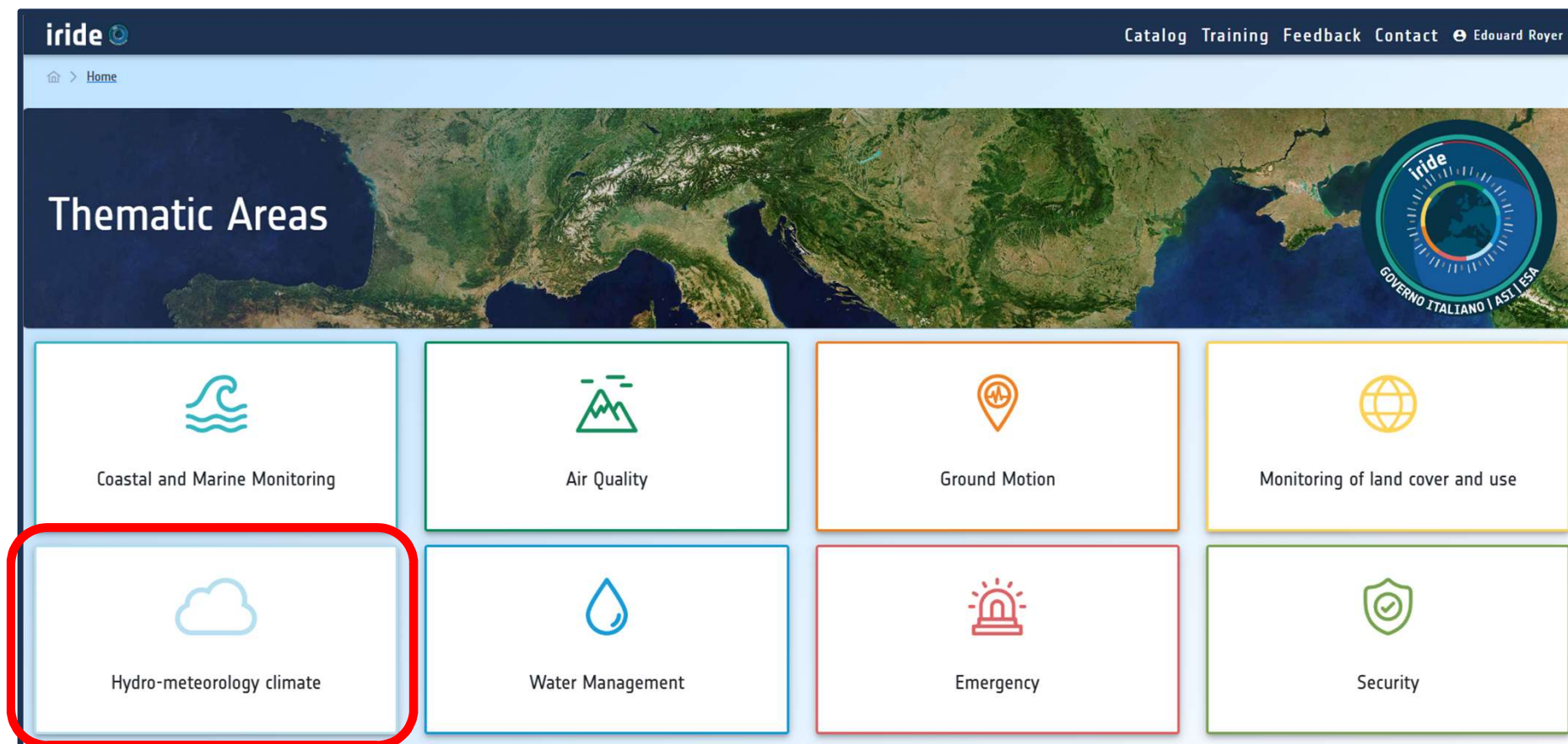


S5 – Hydro-meteorology climate



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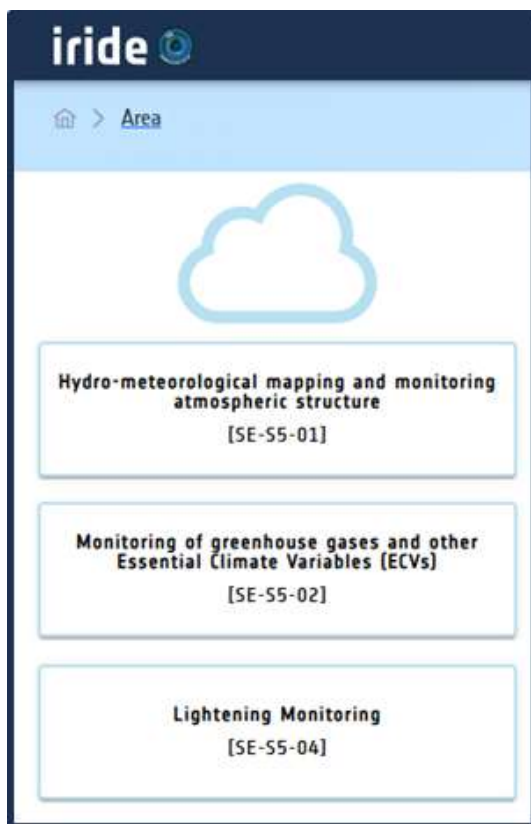
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S5 – Hydro-meteorology climate



Servizi mirati a fornire prodotti derivati da satellite utili per **attività operative nazionali e regionali legate al monitoraggio idro-meteorologico e alle previsioni meteorologiche**

Perché i servizi IRIDE ?

- Servizi integrati che combinano dati satellitari, in-situ e intelligenza artificiale per **migliorare le capacità di monitoraggio attuale** in termini di frequenza temporale, dettaglio spaziale ed accuratezza a livello nazionale
- **Algoritmi avanzati e strumenti di validazione** ad alta risoluzione permettono analisi accurate per fulmini, clima e meteo, utili a istituzioni e gestori del rischio
- Intelligenza artificiale e tecniche di data fusion per il **monitoraggio continuo dei gas serra e di variabili climatiche essenziali**

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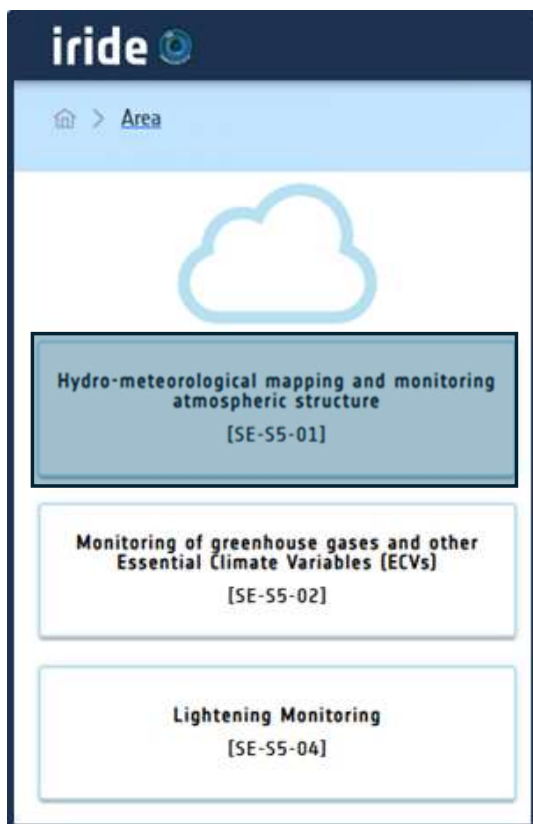


Hydro-meteorological mapping and monitoring atmospheric structure

Il servizio fornisce prodotti di previsione stagionale, basati su dati di Osservazione della Terra (OT) integrati con misure da reti di stazioni a terra, allo scopo di supportare il monitoraggio degli oceani, le previsioni metereologiche e servizi idro-meteo.

Inoltre include la possibilità di integrazione di modelli numerici e previsionali al fine di effettuare una comparazione automatica con dati OT ed in situ, relativamente a:

- Rianalisi atmosferica
- Proiezioni climatiche ad alta risoluzione
- Previsioni metereologiche
- Previsioni stagionali



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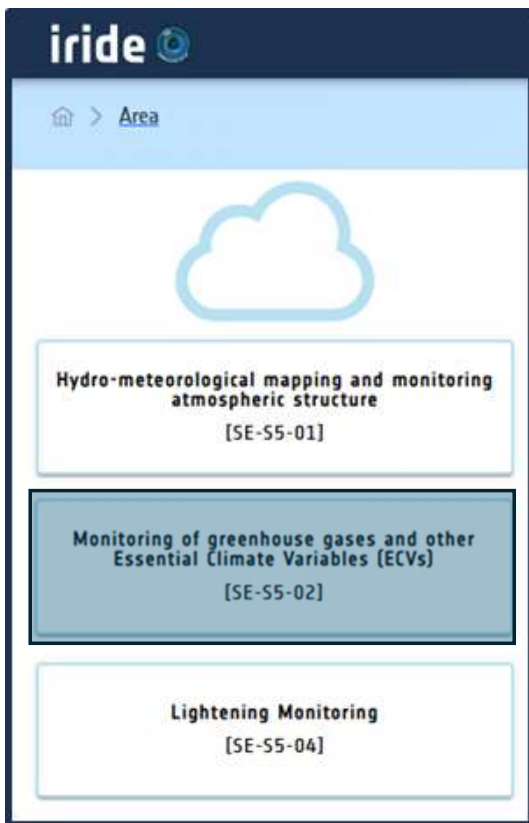
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Monitoring of greenhouse gases and other Essential Climate Variables (ECVs)



Il servizio ha l'obiettivo di supportare il monitoraggio continuo delle Variabili Climatiche Essenziali (EVC) e della concentrazione di gas serra (GHG).

Una serie di prodotti ECV e GHG, vengono generati mediante la fusione di dati provenienti da differenti sensori satellitari di Osservazione della Terra, incluso IRIDE Platino. Tale fusione permette di ottenere prodotti ad alta risoluzione spaziale e temporale, su tutto il territorio nazionale.

Tecniche di intelligenza artificiale, permettono di ottenere prodotti di temperatura superficiale a super risoluzione.

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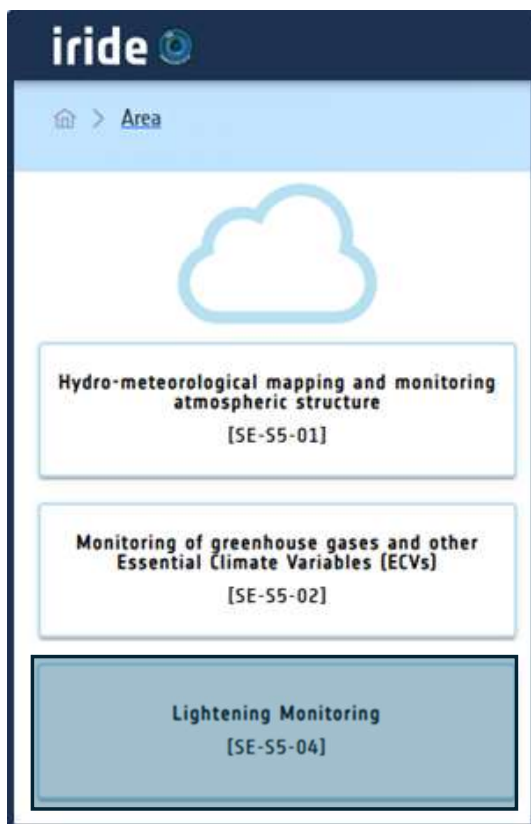
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Lightening Monitoring



Obiettivo del servizio è di fornire mappe di occorrenza di fulmini ad alta risoluzione spaziale (c.ca 2km) e temporale (ogni 10'), a supporto del monitoraggio dei fulmini e le previsioni a breve termine.

Tali mappe sono basate sulla combinazione di dati provenienti dalla rete LAMPINET (dell'Aeronautica Militare) e dati satellitari Meteosat Third Generation (MTG) mediante un algoritmo di intelligenza artificiale.

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Servizi a supporto della mappatura e monitoraggio dell'atmosfera e dell'oceano

Giusy Fedele, CMCC
giusy.fedele@cmcc.it

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Hydro-meteorological mapping
and monitoring atmospheric
structure

[SE-S5-01]

Monitoring of greenhouse gases
and other Essential Climate
Variables (ECVs)

[SE-S5-02]

Lightening Monitoring

[SE-S5-04]

Hydro-meteorology climate

In this thematic area, IRIDE's geospatial services are geared towards furnishing satellite-derived products useful to national and regional hydro-meteorological monitoring and weather forecasting activities. These products offer valuable information crucial for verifying forecasts and facilitating the provision of climate services.

IRIDE's geospatial services for this application domain support:

- The mapping and monitoring of hydro-meteorological atmospheric structure
- The monitoring of greenhouse gases and other essential climate variables (ECVs)
- The lightning monitoring

In this presentation we focus on S5-01 and S5-04:

These services aim at providing **satellite-based products** useful for national and regional operational activities related to **hydro-meteorological monitoring and forecasting**, ranging from short-term (weather), seasonal, and climate scales.

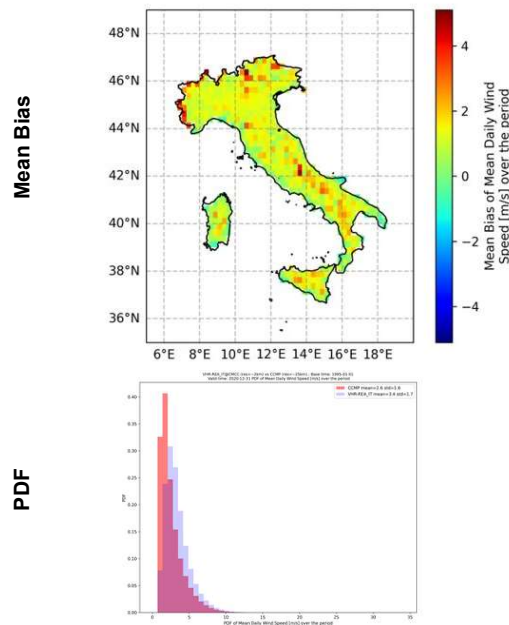
These products will provide valuable information for forecast verification, lightning monitoring and for supporting the delivery of climate services.

Validation of **Atmospheric Reanalysis** and **Climate Projections** against EO derived, in situ and gridded observational data

Validation Reports: Error metrics (i.e., RMSE, Mean Bias) and Diagnostics (i.e., Mean Field, PDF, Corr.)

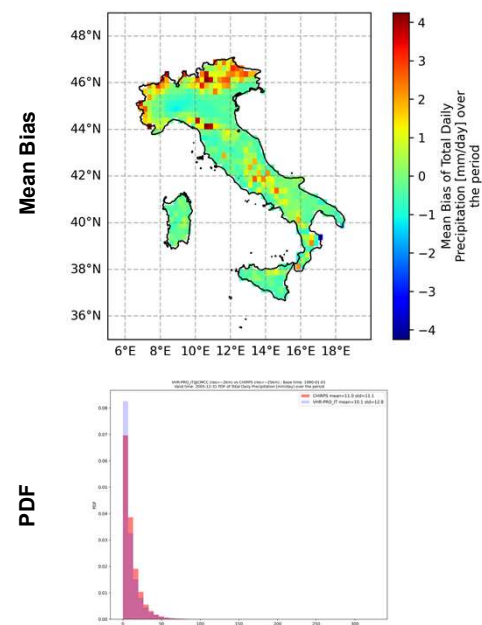
VHR-REA@IT against CCMP (Daily Mean Wind Speed) VHR-PRO@IT against CHIRPS (Total Daily Precipitation)

VHR-REA_IT@CMCC (res=-2km) vs CCMP (res=-25km) : Base time: 1995-01-01
Valid time: 2020-12-31 Mean Bias of Mean Daily Wind Speed [m/s] over the period



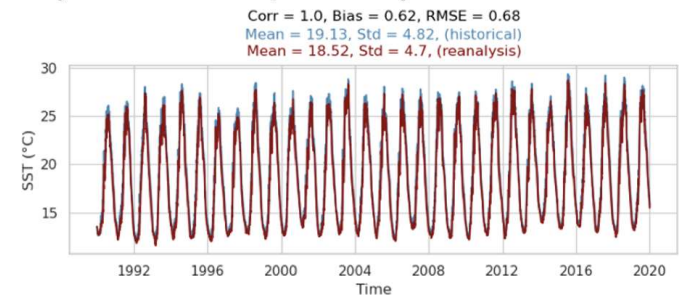
Atmospheric Reanalysis

VHR-PRO_IT@CMCC (res=-2km) vs CHIRPS (res=-25km) : Base time: 1990-01-01
Valid time: 2005-12-31 Mean Bias of Total Daily Precipitation [mm/day] over the period

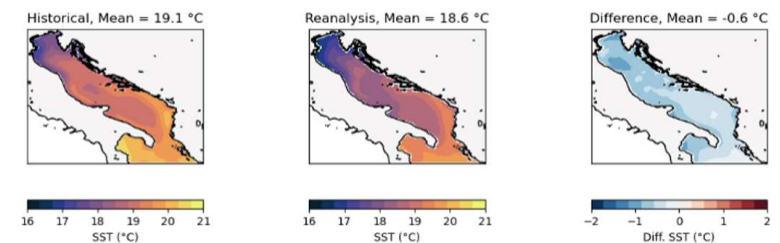


Atmospheric Climate Projection

Daily Mean Sea Surface Temperature averaged over the whole Adriatic Sea



Mean Sea Surface Temperature maps averaged over the integrated period (from 01/1990 to 12/2019)



Marine Climate Projection

HYDRO-METEOROLOGY CLIMATE

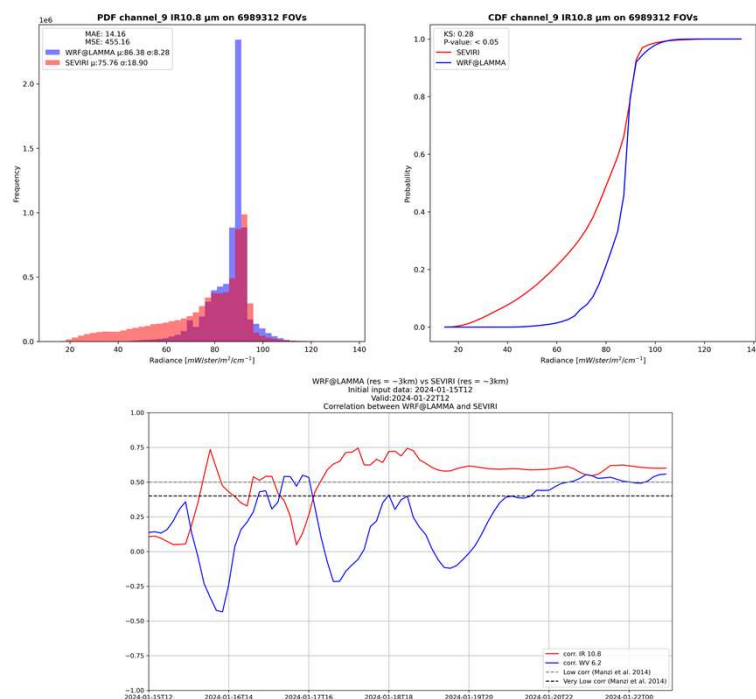
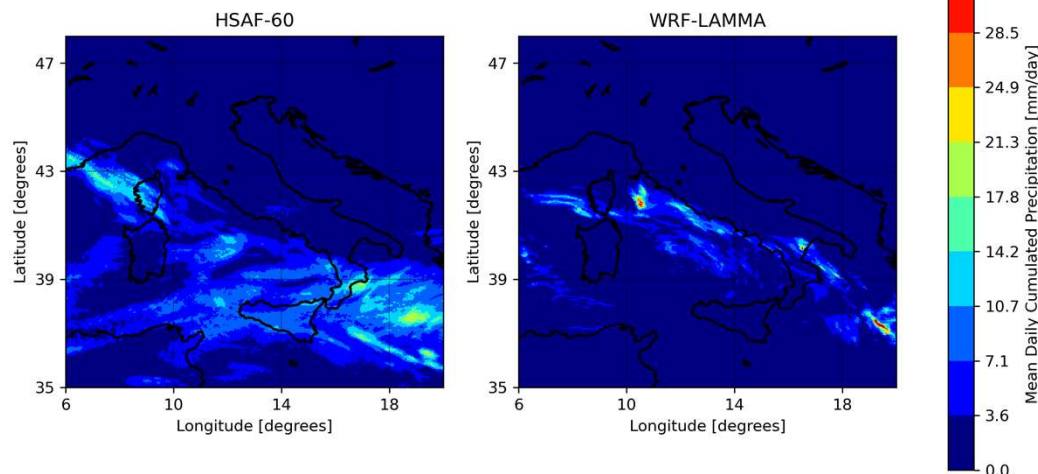
Validation of **weather forecasts** outputs from NWP model (i.e., WRF, BOLAM, MOLOCH) provided by different Italian Institutions against EO data (MSG, MTG, HSAF)

VALIDATION REPORT

Error metrics (i.e., RMSE, Mean Bias) and Diagnostics (i.e., Mean Field, Clustering, PDF, Contingency Table)

RADIATIVE TRANSFER MODEL - RTTOV
It allows the conversion from Meteorological Variables to Radiance

WRF@LAMMA (res= ~3km) against HSAF60 (res= ~3km)
Initial input data: 2024-01-10T00
Valid: 2024-01-13T00
Mean daily cumulated precipitation over the period

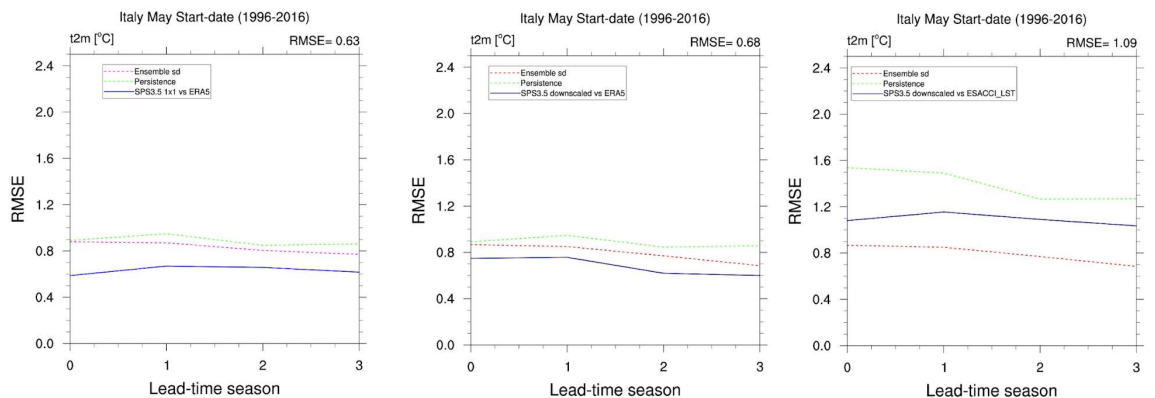


HYDRO-METEOROLOGY CLIMATE

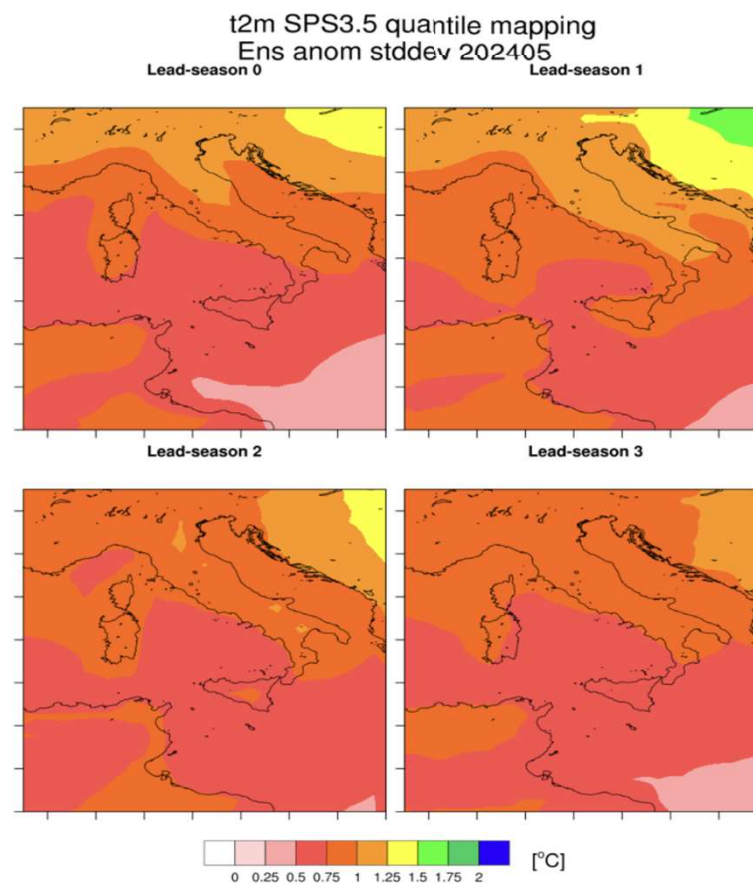
Seasonal forecasts at higher spatial resolution geospatial products and validation report.

**GEOSPATIAL PRODUCTS AT ~25 km resolution
monthly delivered**

**VALIDATION REPORT – seasonal downscaled
forecasts validated against EO-derived data.**



**EXTREME EVENTS INDICATORS based on 2m Air
Temperature and Precipitation (by October '25)**



Lightning Monitoring

The service S5-04 consists of providing **georeferenced lightning monitoring maps** covering the Italian Territory with a **~2 km x 2 km resolution** with a **10 min time frequency**. Data are provided as WMTS and netcdf data in order to be used in several applications.

By leveraging on **Artificial Intelligence** and **Satellite data**, it is developed a Neural Network capable of **identifying convection areas with potential for lightning activity**.

Lightning monitoring is crucial for several sectors, such as energy, aviation, weather services, and telecommunication.



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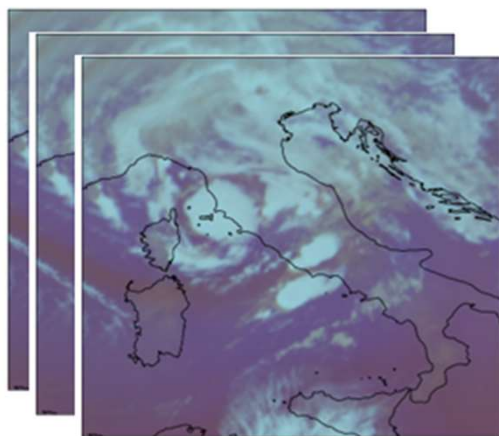
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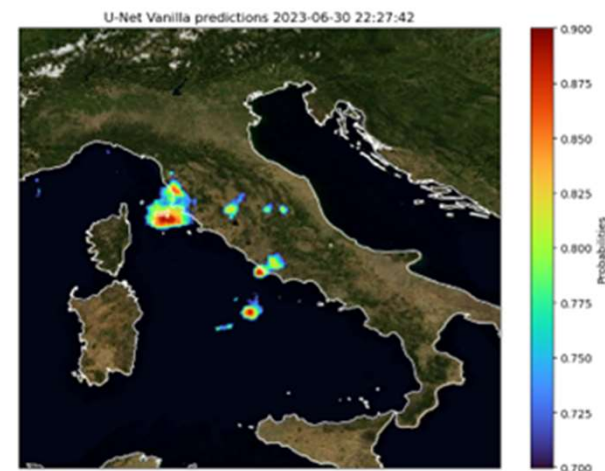
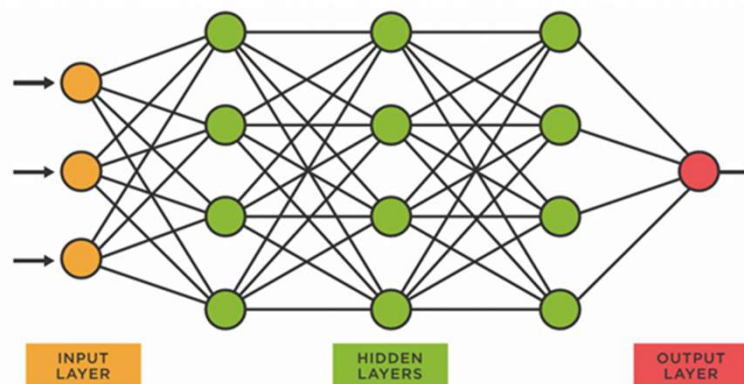
S5-04

Lightning Monitoring

SEVIRI@MSG



Convolutional Neural
Network (CNN)



Lightning probabilistic detection

Spatial resolution	3 km
Temporal frequency	15 minutes

Lightning Monitoring - Some results 1/2



*The provided example of results displays the product over a zoomed-in area within the proposed domain.

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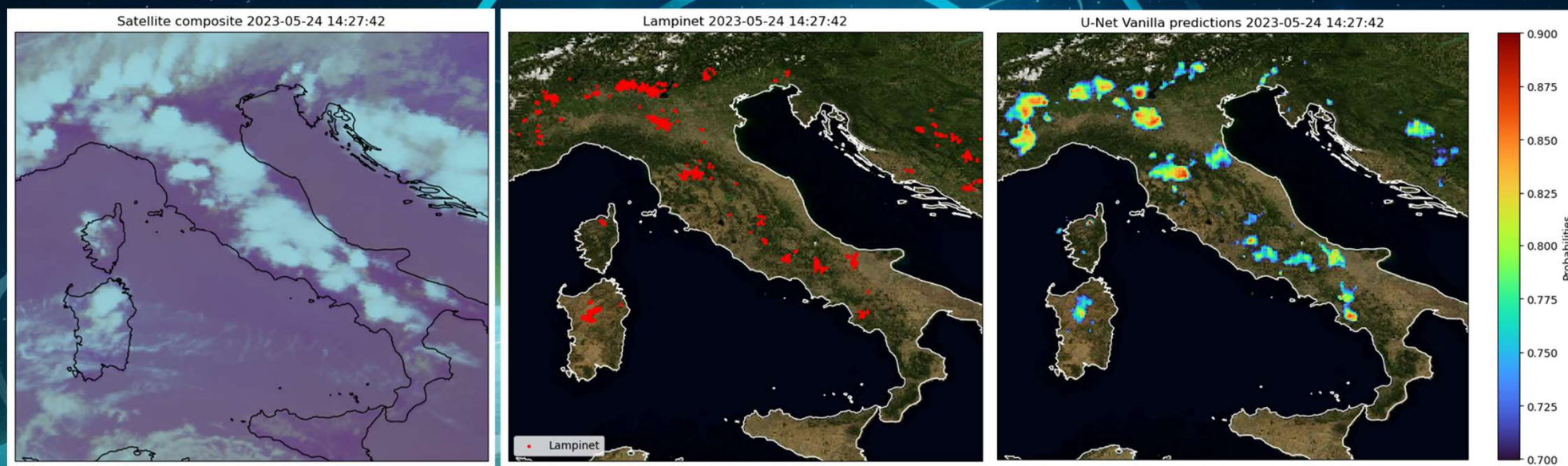
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Lightning Monitoring - Some results 2/2



*The provided example of results displays the product over a zoomed-in area within the proposed domain.

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Lightning Monitoring - Improving current methodology



Product	Description	Spatial resolution	AOI	Temporal resolution	Update frequency
Lightning Monitoring	Daily products (maps and data with lightning position) at 10 min frequency over Italian peninsula.	~ 2 km	Italian Peninsula	10 min	Daily

EO DATA

Meteosat Second Generation (MSG):

-Radiance Channels (IR3.9, WV6.2, WV7.3, IR10.8)

Meteosat Third Generation MTG:

-Radiance Channels (IR3.8, WV6.3, WV7.3, IR10.5)

-Lightning Imager

LIGHTNING IN SITU DATA

Lampinet

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