EUMETNET SRNWP-EPS EFI/SOT

-Status review-

44th EWGLAM / 29th C-SRNWP meetings (Brussels, September 2022)

Joan Montolio Llenas

Predictability group in AEMET Catalunya

Software main features

The aim of the **EUMETNET SRNWP-EPS EFI/SOT** project is to develop a software to implement EFI and SOT indexes in LAM-EPS.

- The software is being developed in "**Python 3**" programming language.
- The software consists of **seven scripts** that perform the necessary calculus to obtain EFI and SOT.
- The different functions used by the software are defined in a **script that serves as a library**.
- A **configuration file** lets the user configure the different parameters that are involved in the EFI/SOT calculation.
- A group of scripts have been designed as "**utilities**" for the user (GRIB files tree directory / TAR GRIB copying and extraction / EFI SOT Metview plots).

Note that some of the features described above are not definitive and are susceptible to be modified.

Methodology

Most of the methodology that is being followed to calculate EFI/SOT is based on that described by Meteo-France in 2018 Laure Raynaud's article "***Detection of Severe Weather Events in a High-Resolution Ensemble Prediction System Using the Extreme Forecast Index (EFI) and Shift of Tails (SOT)***"

Main similarities with Meteo-France methodology

- **Historical LAM-EPS GRIB files** are being used to construct the model-climatology. In our case, we are working with the LAM-EPS GRIB files stored in the **ECFS SRNWP-EPS database**.
- **The lack of a long-term historical LAM-EPS database** makes it necessary to implement **relaxation techniques** in order to increase the number of data conforming the model-climatology.
- **Temporal relaxation**: definition of a **temporal window** (around the EFI/SOT calculus date and for the different years considered) where it is assumed that the meteorological data respond to the same climatology.
- For the EFI/SOT calculus year, the nearest three days are not considered as their data may be correlated to the meteorological situation of the EFI/SOT calculus date.
- **Spatial relaxation**: definition of a **neighbouring area** (centered at the grid point where EFI/SOT will be calculated) where it is assumed that the meteorological data contained within respond to the same climatology.

Methodology

Temporal relaxation

- In the configuration file the user can choose between **two options** of temporal relaxation: **“manual”** and **“automatic”**.
- **“Manual” option:** the user writes in a list the different dates that wants to be used to construct the model-climatology.
- **“Automatic” option:** the user specifies the initial year when the temporal relaxation must start its performance, as well as the length (expressed in number of days) of the temporal window to be opened forward and backward from the central date.

Spatial relaxation

- In the configuration file the user can configure the **length** (expressed in number of grid points) **of the sides** of the square-shaped neighbouring area.
- In addition, the user can decide to activate a **group of additional spatial filters**:
  I. Circular filter.
  II. Land/Sea filter.
  III. Random selection filter.
  IV. Orographical filter (in progress)

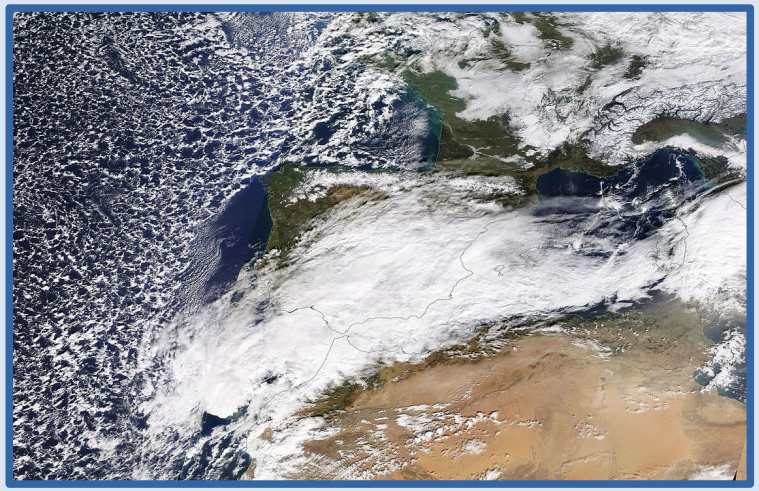
Software structure

Brief description of main Python3 scripts

01_climate_data_extraction.py	• Reads the data from the climatological GRIB files and stores it in a NumPy array. Finally, it is saved in a binary file.
02_forecast_data_extraction.py	• Reads the data from the forecast GRIB files and stores it in a NumPy array. This array is saved in a binary file.
03_y_x_subdomain_coord.py	• Transforms lon/lat coordinates of the subdomains defined by the user in the config file into the corresponding LAM-EPS y/x coordinates, saving them in a binary file.
04_climate_cdf.py	• Calculates the percentiles from the model-climate distribution. Data is stored in a NumPy array and saved in a binary file.
05_forecast_cdf.py	• Calculates the percentiles from the forecast distribution. Data is stored in a NumPy array and saved in a binary file.
06_EFI.py 07_SOT.py	• Calculate EFI and SOT indexes. For each subdomain, a GRIB file containing two messages (one for the EFI and the other for SOT) is created.

gSREPS EFI/SOT test: Philomena storm

Philomena is the name of an extra-tropical storm that **hit the Iberian Peninsula during the first days of January 2021**. It produced **extreme snowfalls** in several regions, as well as **heavy rains** and a noticeable **drop of temperatures**.



Satellite image of Philomena storm over Iberian Peninsula (08/01/2021)

gSREPS EFI/SOT test: Philomena storm

As Philomena episode produced extreme weather events, it is a good choice as a benchmark where testing the EFI/SOT software. So, an EFI/SOT test has been performed to see how the software works.

- **LAM-EPS:** gSREPS
- **EFI/SOT forecast day:** 9 January 2021
- **Meteorological variables:** 24h-AccPcp / 24h-AccSnw / T2mMax / T2mMin
- **Model-climatology dates:** 1 to 31 December 2020
- **Square-neighbourhood dimensions:** 21x21
- **Circular filter:** YES
- **Random filter:** YES
- **Land-Sea filter:** YES (for temperatures) and NO (for precipitation and snow).
- **Orographical filter:** NO

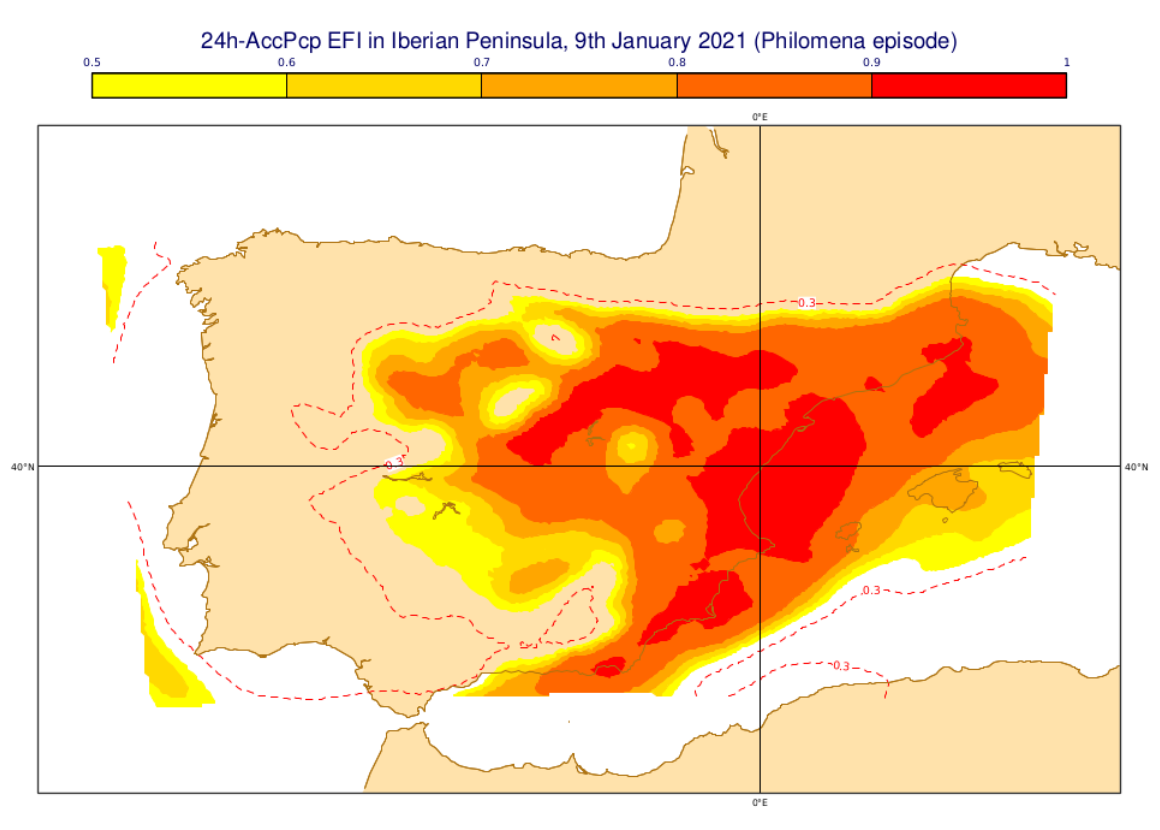
GRIB files from gSREPS...

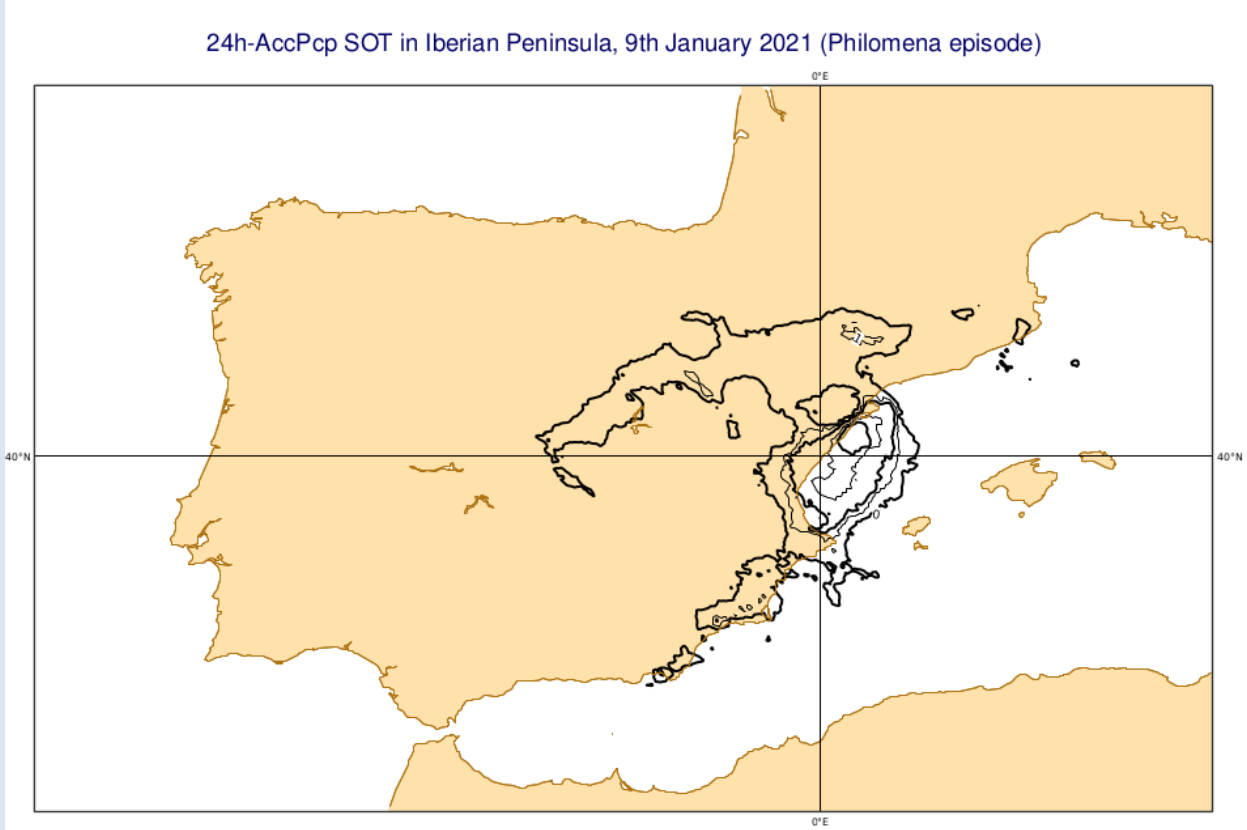
...code developed in Python3...

...and executed in ECMWF ATOS HPC

gSREPS EFI/SOT test: Philomena storm

24h-AccPcp EFI and SOT (9th January 2021)





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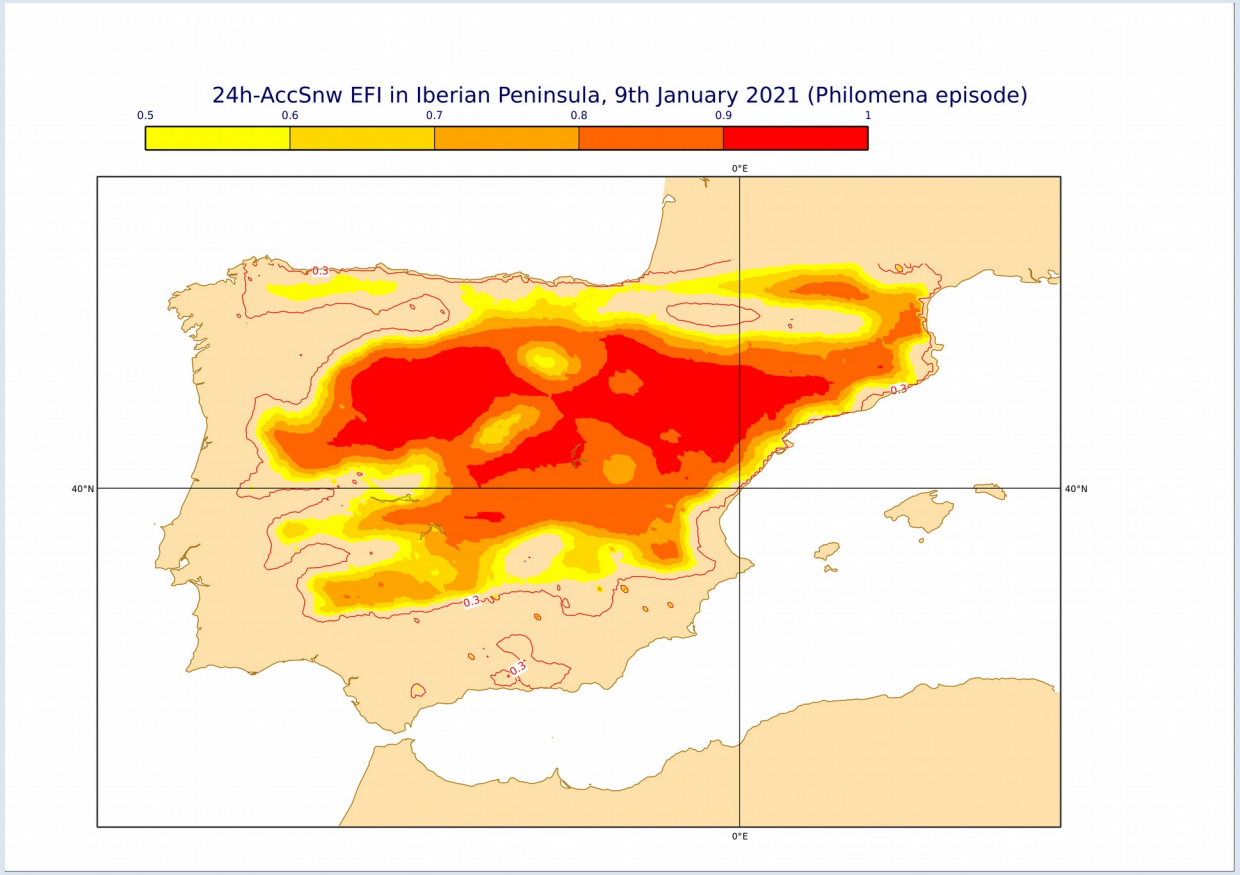
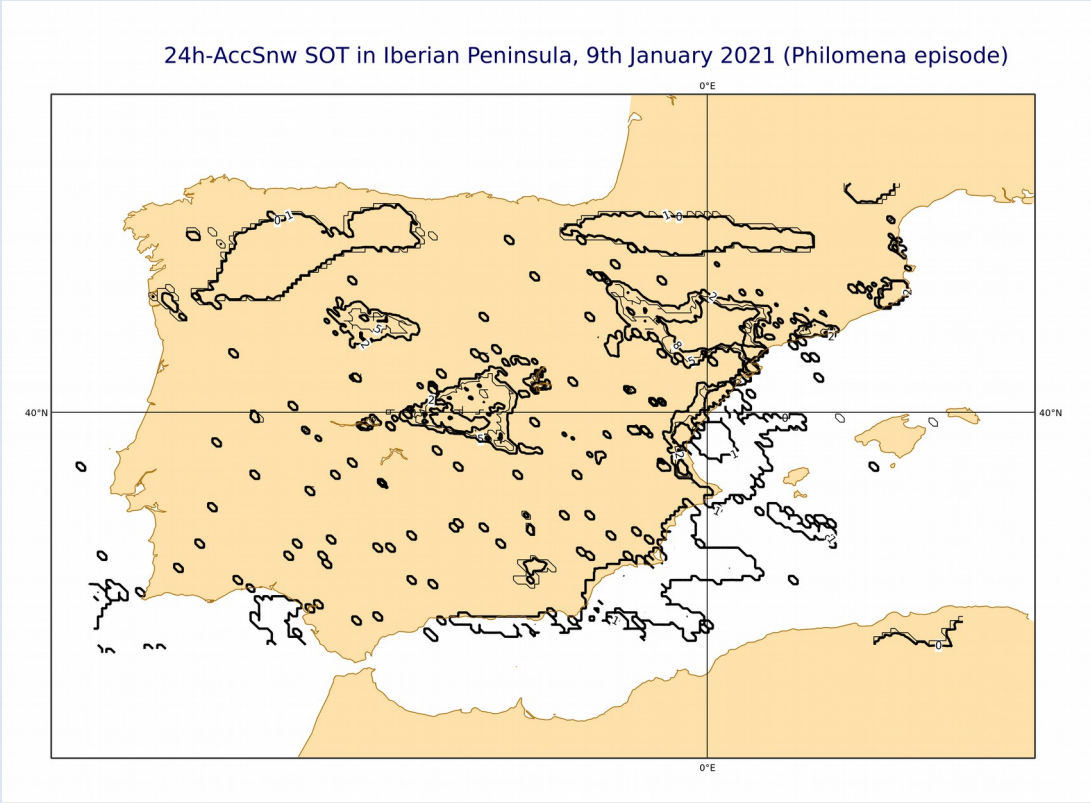
gSREPS EFI/SOT test: Philomena storm

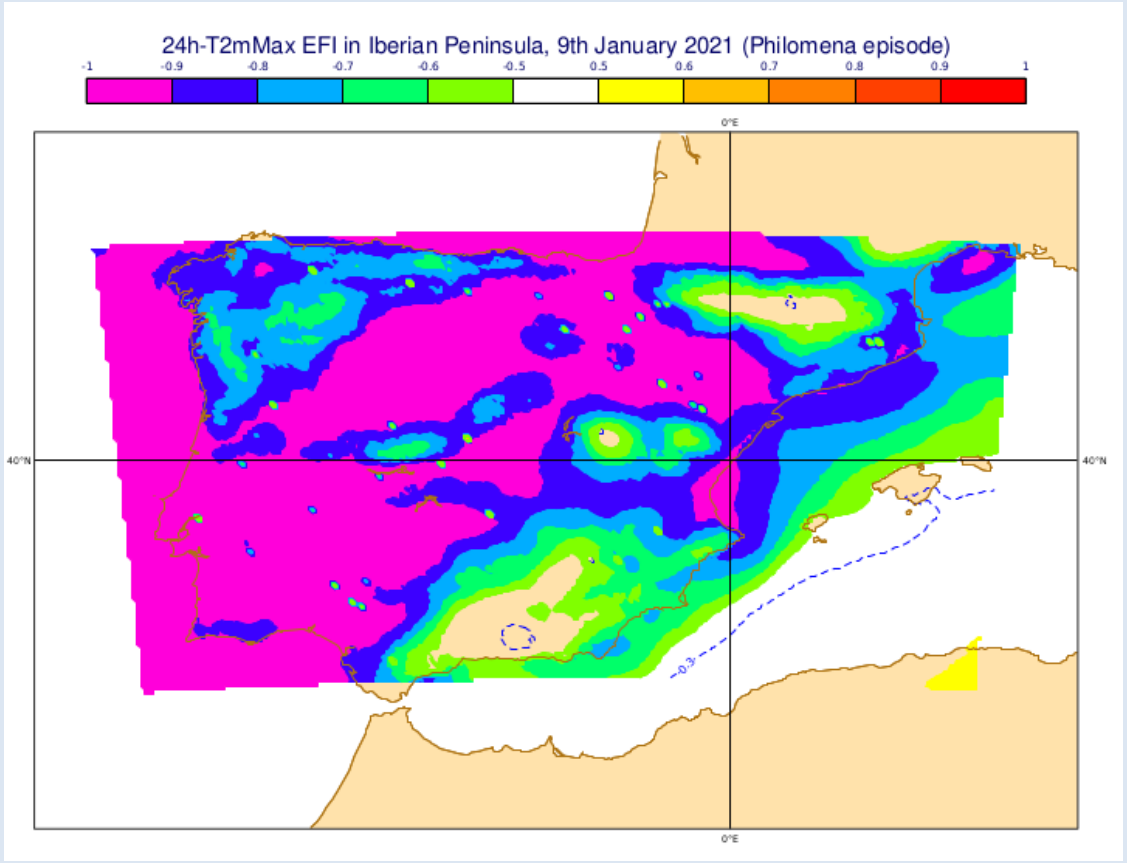
24h-AccSnw EFI and SOT (9th January 2021)

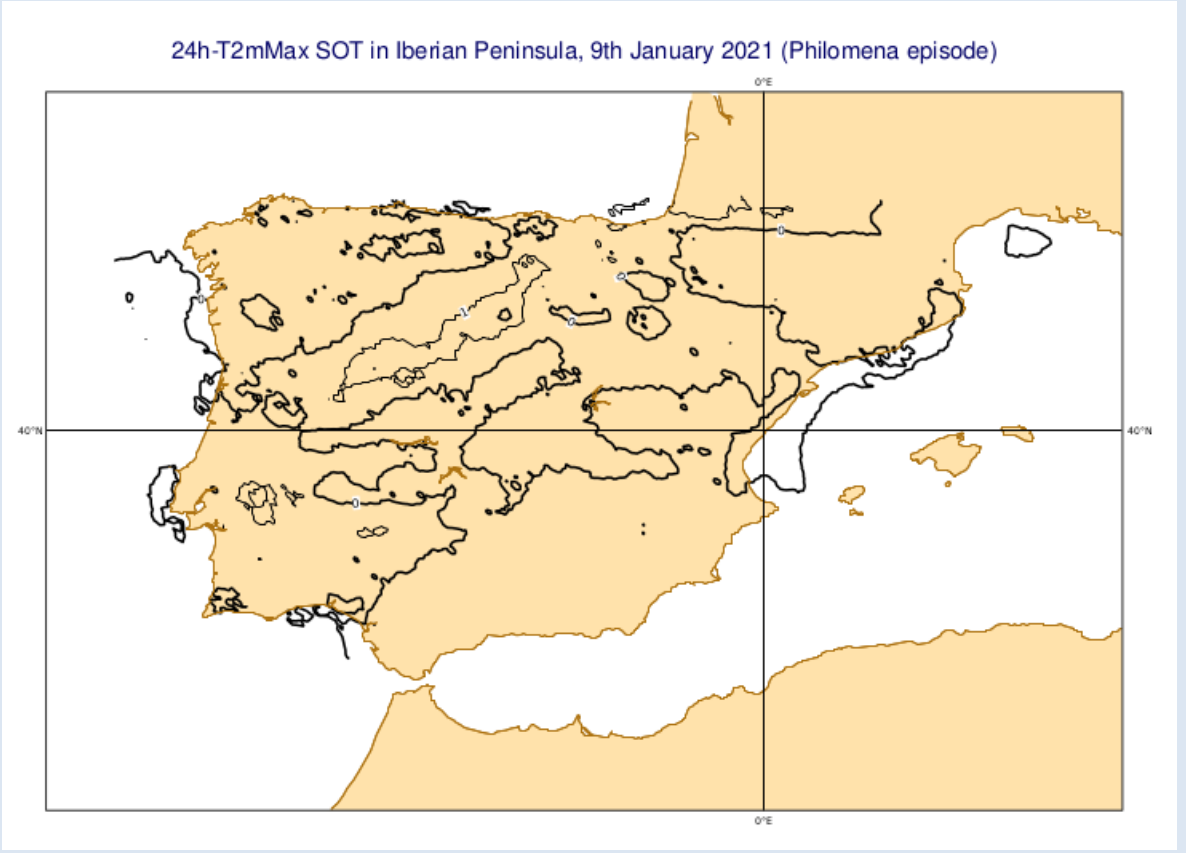




gSREPS EFI/SOT test: Philomena storm

24h-T2mMax EFI and SOT (9th January 2021)





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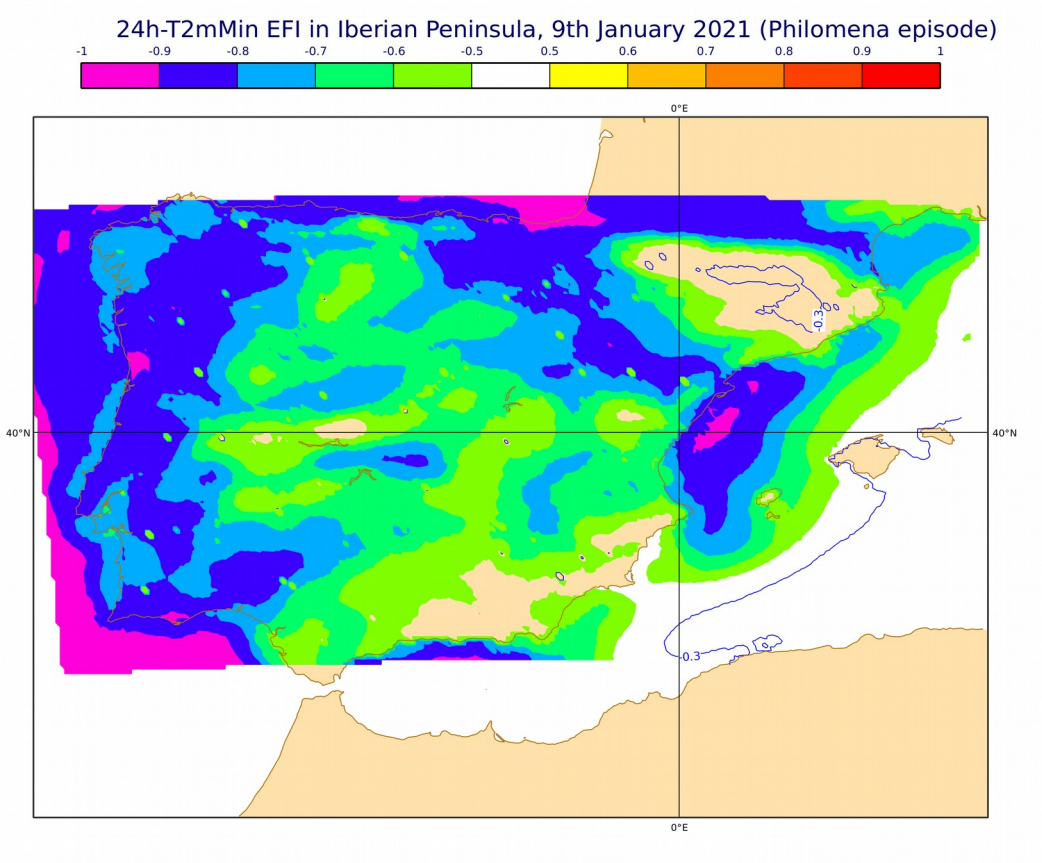
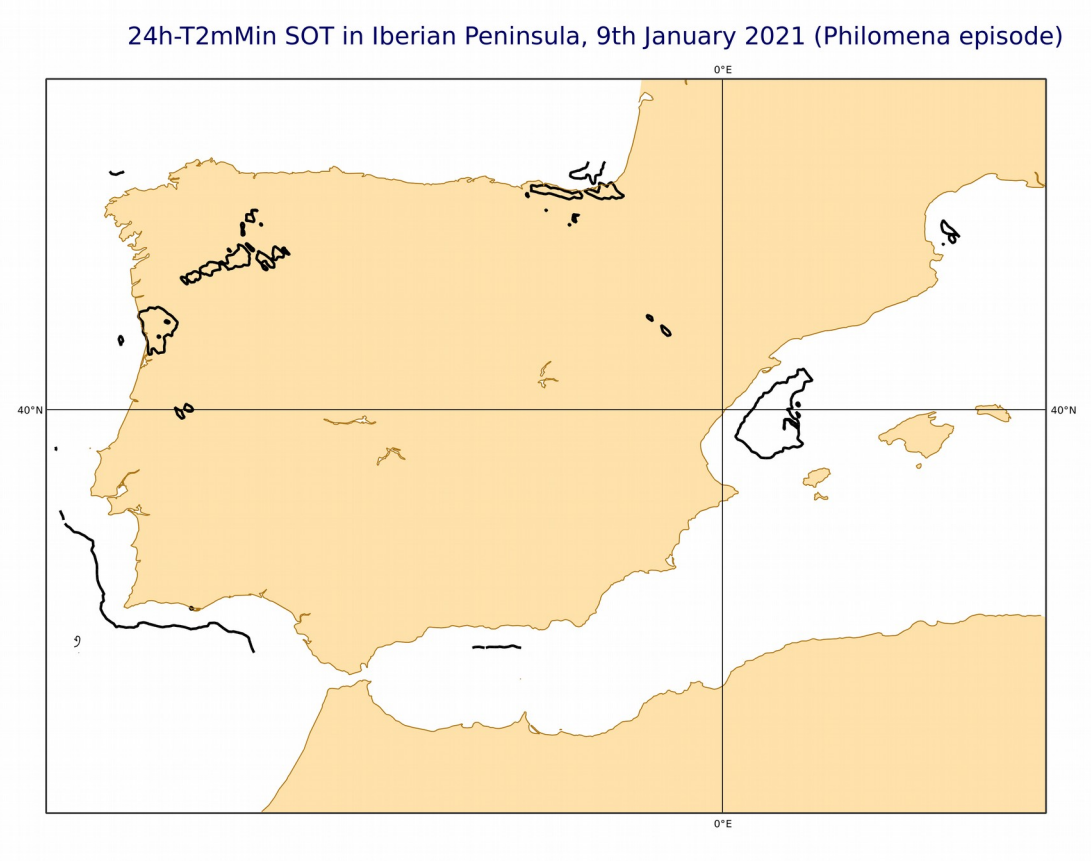
gSREPS EFI/SOT test: Philomena storm

24h-T2mMin EFI and SOT (9th January 2021)

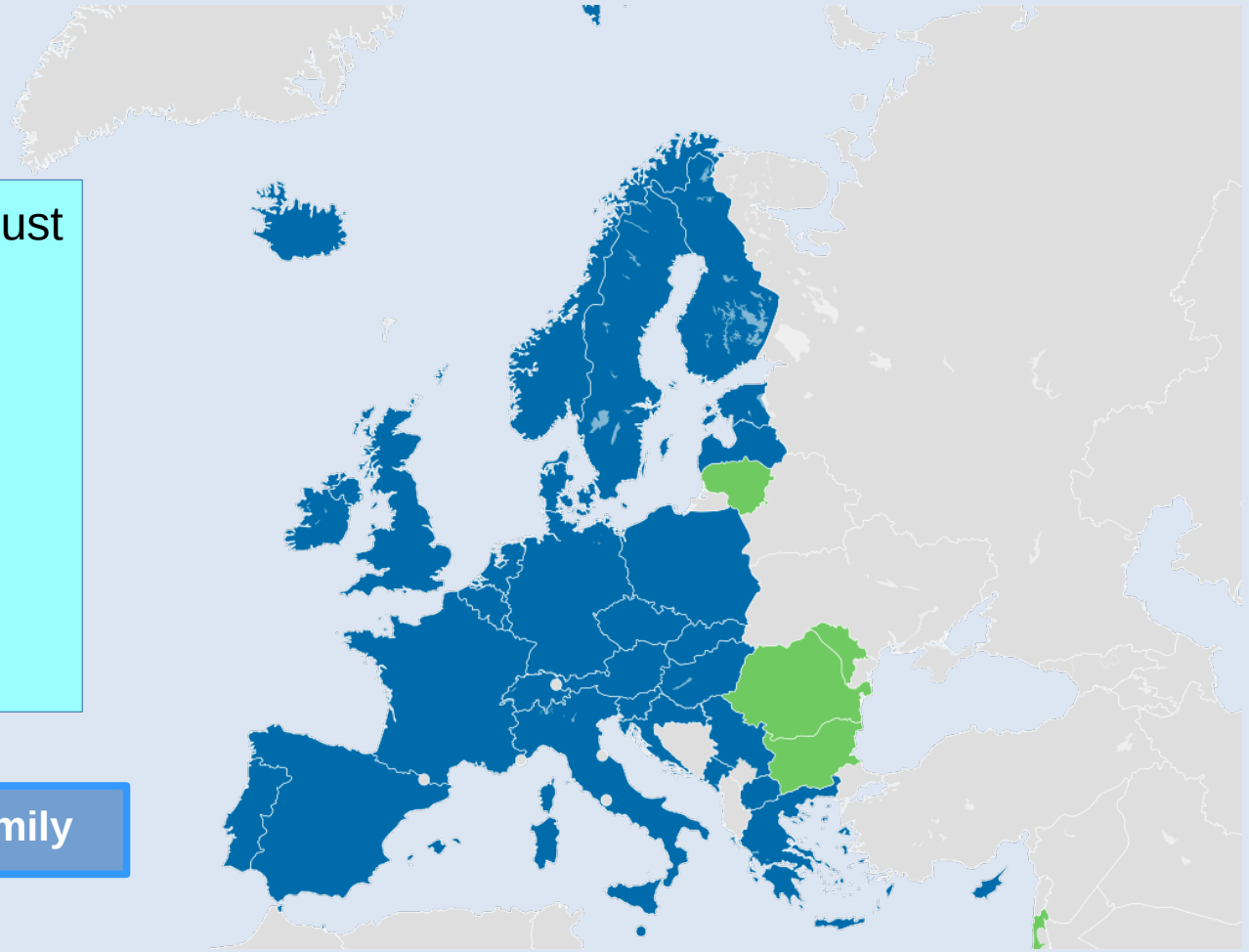




Next steps

- Start implementing EFI/SOT for 24h-10mMaxWindGust and 24h-T2mMean using gSREPS GRIB files.
- Once checked that software works fine for all the interested meteorological variables, we will start working with GRIB files from different EUMETNET members LAM-EPS such as MFArome-EPS / IT-EPS / IREPS / COMEPS and so on.

Our final target is to bring EFI/SOT to the EUMETNET family



THANK YOU VERY MUCH FOR YOUR ATTENTION!!

If you want to consult any doubt or question, please, do not hesitate to send an e-mail at *srnwpeps_efi@aemet.es*