# Italian network of four permanent observatories: implementation of background data selection (BaDSfit) and 5-year analysis of the atmospheric $CO_2$ mixing ratio.

*Pamela Trisolino, Alcide di Sarra, Damiano Sferlazzo, Salvatore Piacentino, Francesco Monteleone, Tatiana Di Iorio, Francesco Apadula, Daniela Heltai, Andrea Lanza, Antonio Vocino, Luigi Caracciolo di Torchiarolo, Paolo Bonasoni, Francescopiero Calzolari, Maurizio Busetto and Paolo Cristofanelli*

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*Contacts: p.trisolino@isac.cnr.it and p.cristofanelli@isac.cnr.it*


# MEASUREMENT SITES

- **PRS - Plateau Rosa** (RSE S.p.A.)
  45°56'N 7°42'E, *3480 m a.s.l.*

- **CMN – Mt. Cimone**
  (ISAC-CNR and CAMM, Italian Air Force)
  44°12' N, 10°42' E, *2165 m a.s.l.*

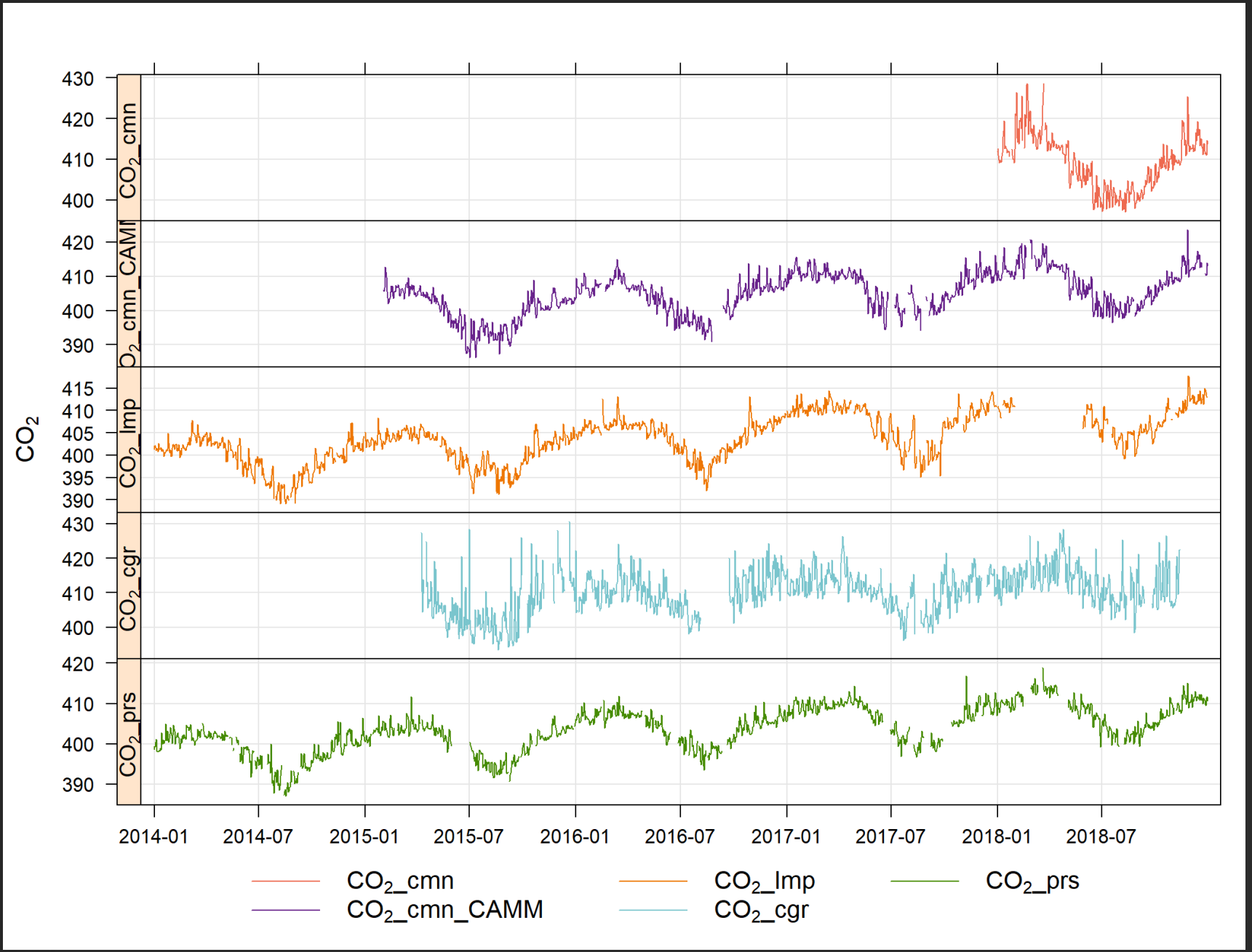
- **CGR – Capo Granitola** (ISAC–CNR)
  37° 34' N, 12° 40' E, *15 m a.s.l.*

- **LMP – Lampedusa** (ENEA)
  35° 31' N, 12° 38' E, *45 m a.s.l.*

**Dataset:**

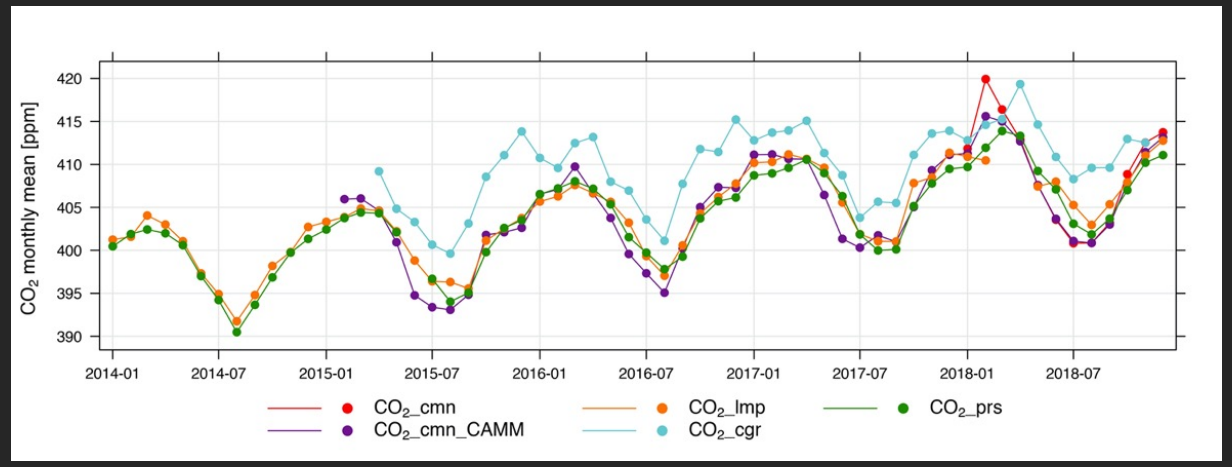
| PRS | CMN - ISAC | CMN-CAMM | CGR | LMP |
|---|---|---|---|---|
| 2014-2018 | 2018 | 2015-2018 | 2015-2018 | 2014-2018 |

# Data overview (2014 – 2018) – daily average values

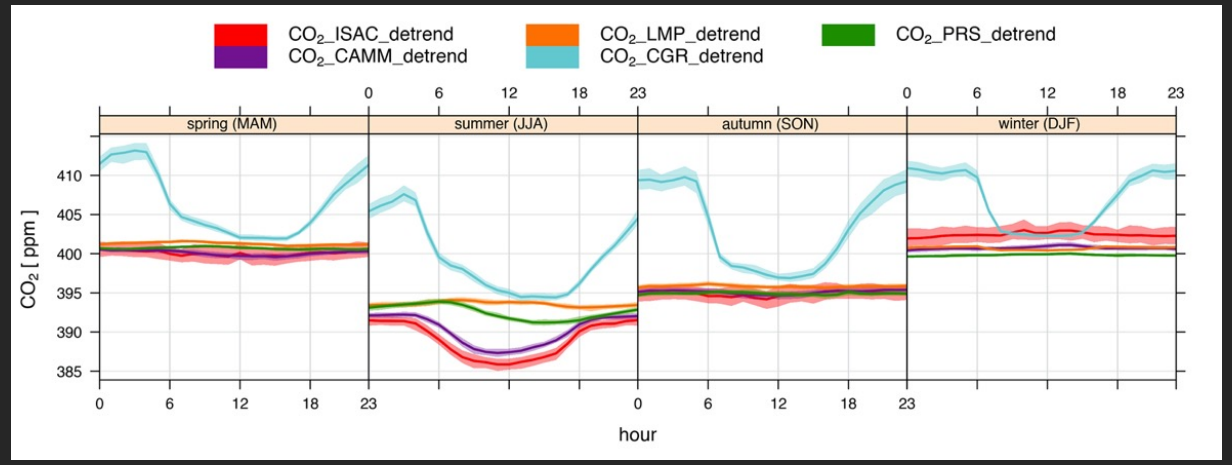


# Data overview (2014 – 2018)

## Monthly values

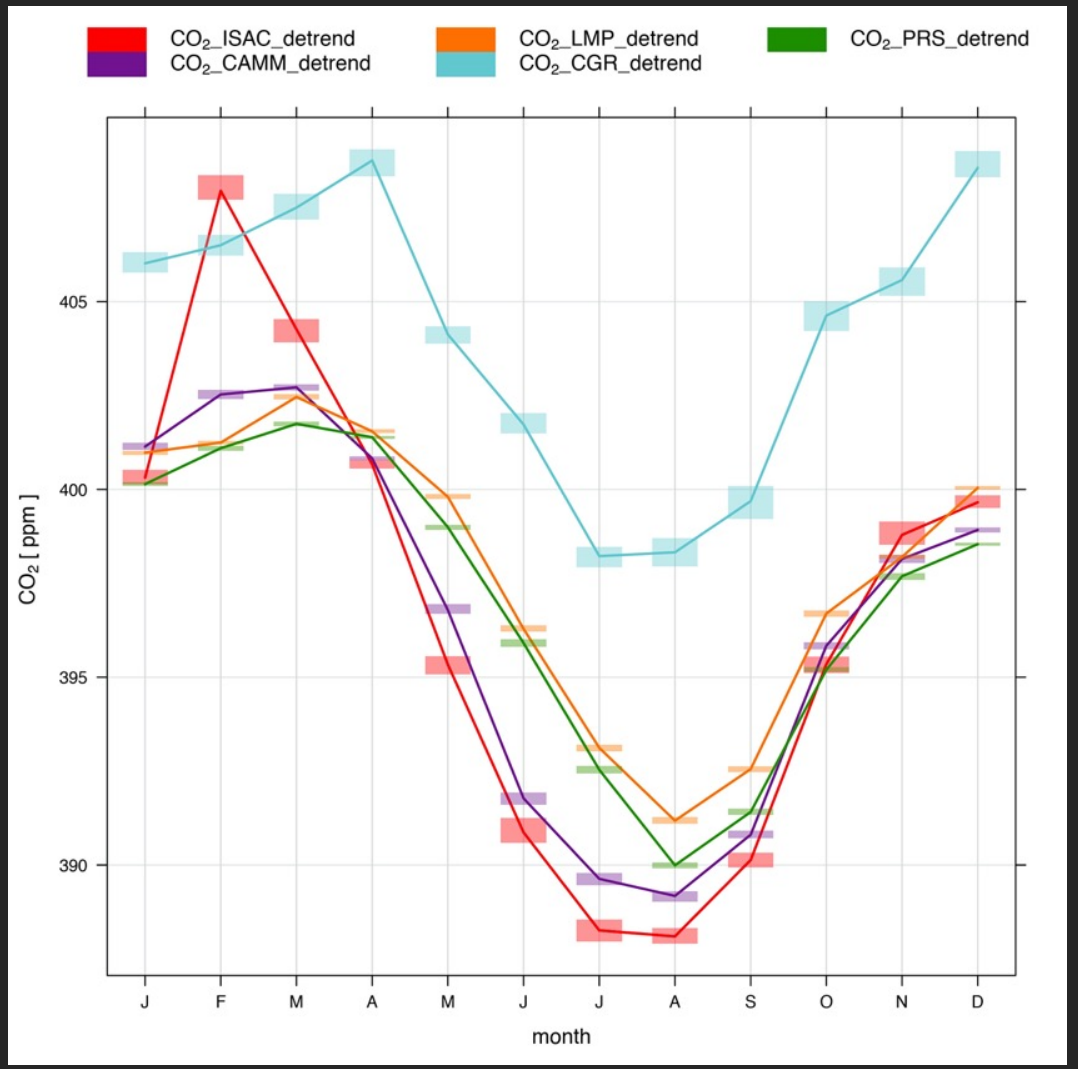



## Diurnal variations




Diurnal wind breezes at CMN and CGR

## Annual cycle

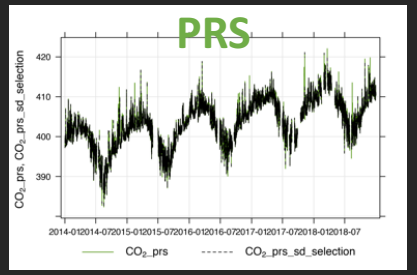


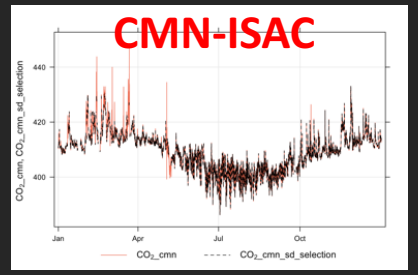

*Trisolino et al. (2019) – submitted paper*

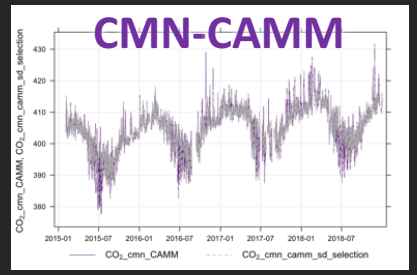
# Background data selection for Italian stations (*BaDSfit*)

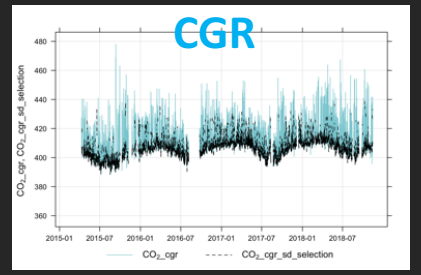
## *BaDSfit* consists of 3 steps:

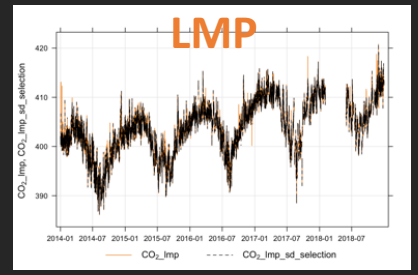
1) Selection of data with hourly $CO_2$ standard deviation (calculated from 1-min mean values) **< 1 ppm**
   a. calculate a running median on 504 hours (21 days) with the selection;
   b. calculate the average difference between consecutive hourly mean values (defined as the "S" parameter).



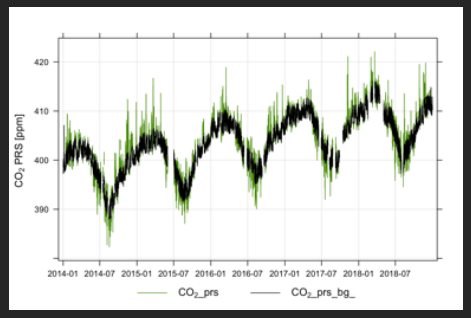



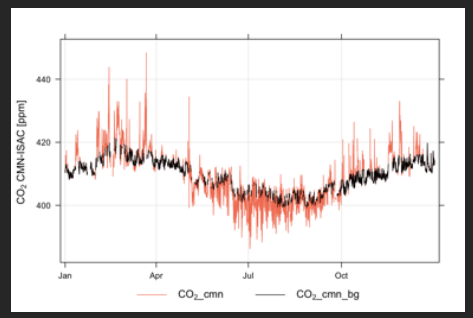



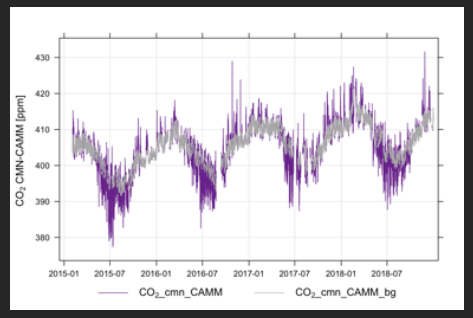



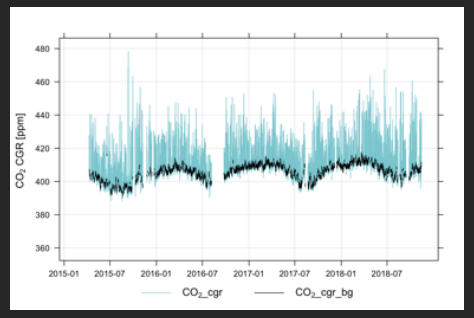

2) Selection of data for which the difference **(ΔC)** between retained hourly values and running median (504-hours) is **< n*S**, where *n* is an adjustable parameter
3) Selection of data for which the difference **($\delta$C)** between and the hourly mean values ( $\sigma$ < 1 ppm) and the corresponding 48-hours running mean calculated with retained values of previous step, is **< n*S**

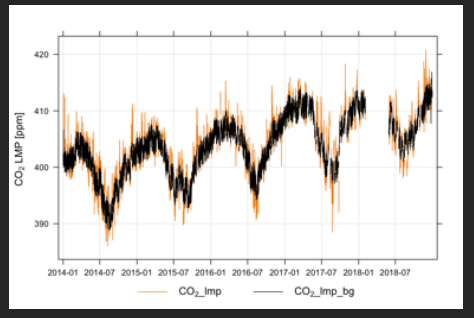
All data points with $|\delta C| > n*S$ are flagged as "not background"





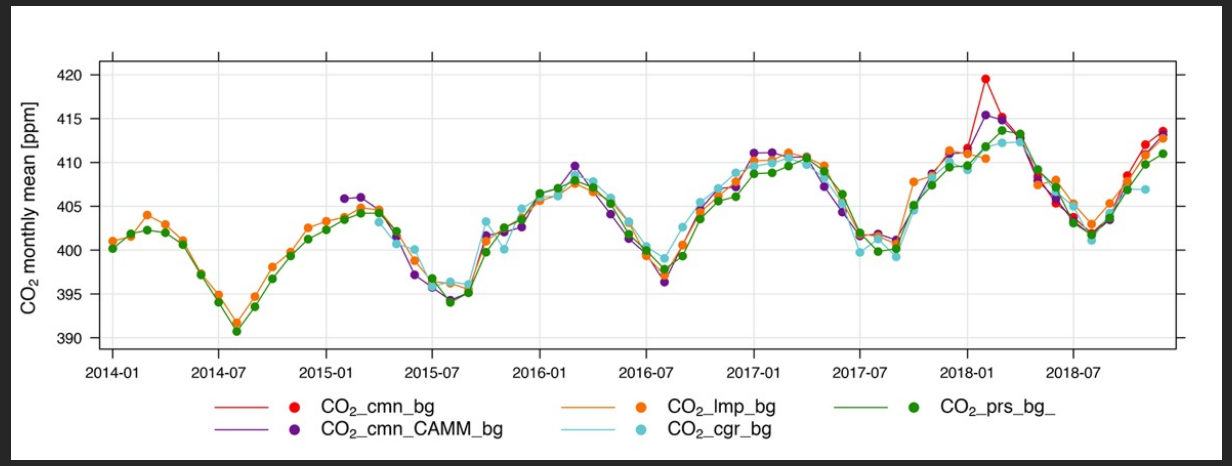




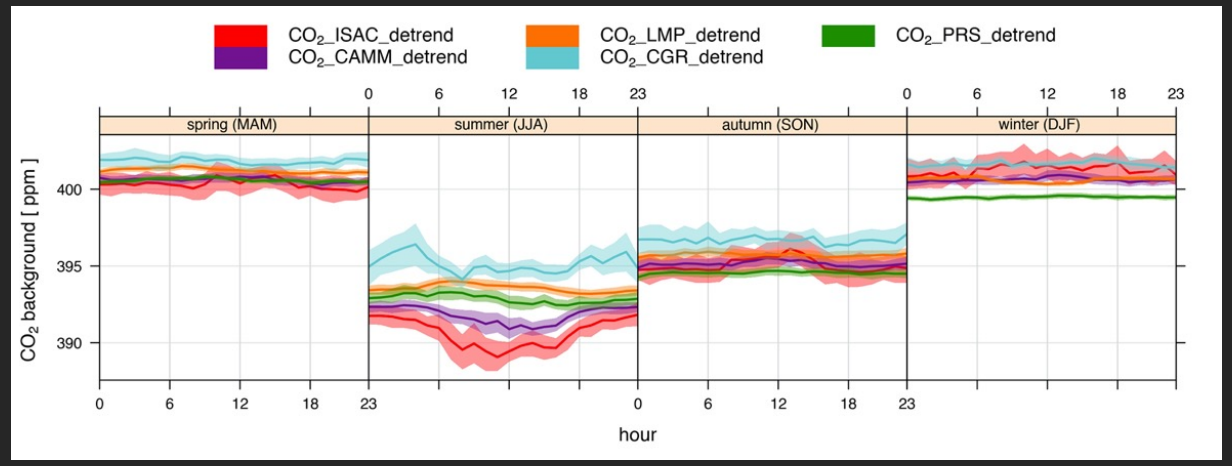


# Selection results

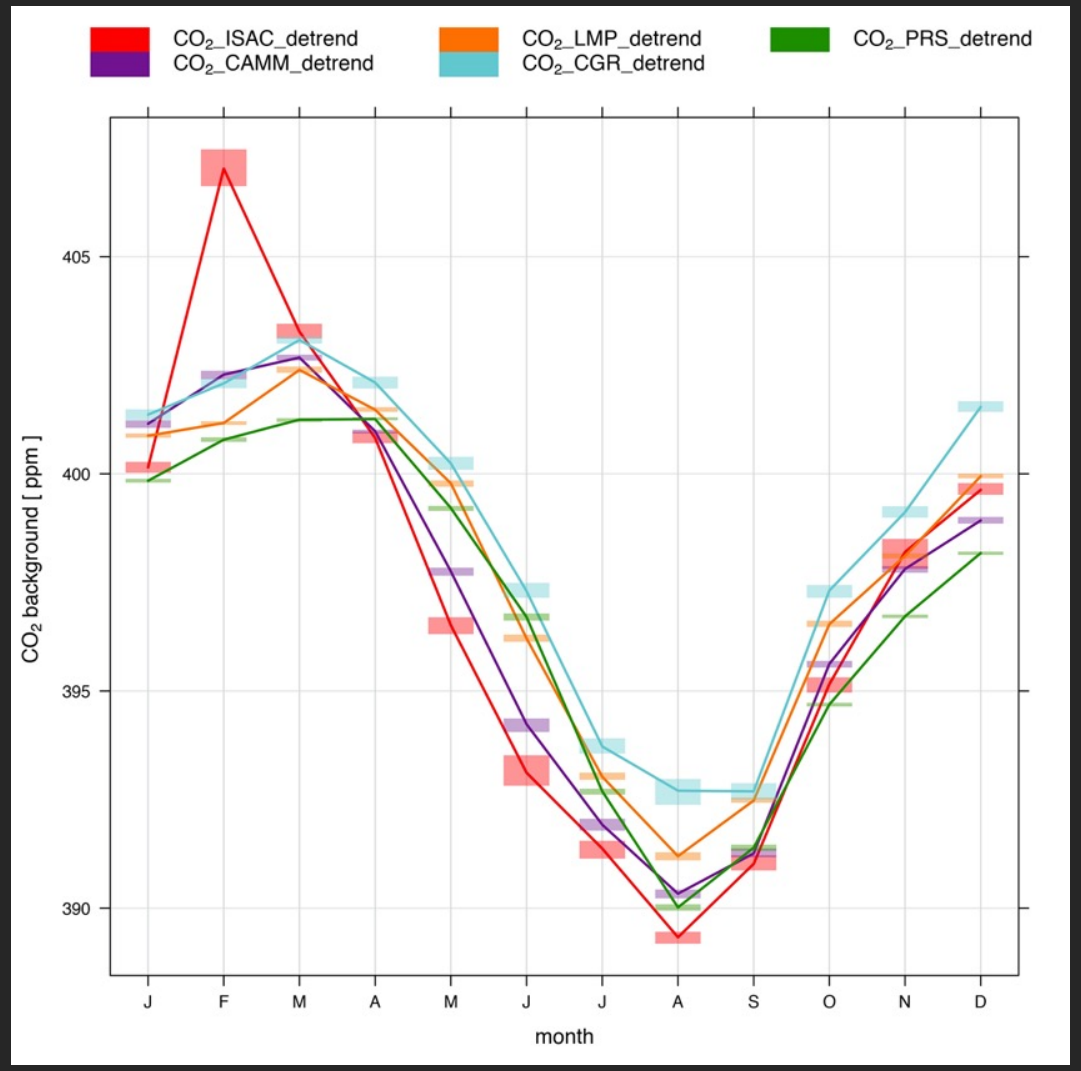
## Monthly values




## Diurnal variations




## Annual cycle




*Trisolino et al. (2019) – submitted paper*

# SUMMARY

Dataset from the **Italian network of GHG atmospheric observatories** are presented for the period 2014-2018.

These observatories are managed by **different Institutions** with different strategies for air sampling, calibration, data quality checks, and flagging.

**A procedure to select background observations (*BaDSfit*) was implemented** and the interannual, seasonal, and diurnal of $CO_2$ variability was investigated.

Considering original dataset:

- a low average diurnal amplitude (less than 1 ppm) characterizes PRS and LMP during all seasons;
- a significant diurnal cycle is evident at CMN during vegetative months (vertical transport of air-masses depleted in $CO_2$ due to vegetation photosynthesis);
- a significant diurnal cycle is evident at CGR (due to the transport of air-masses affected by anthropogenic emissions during night-time).

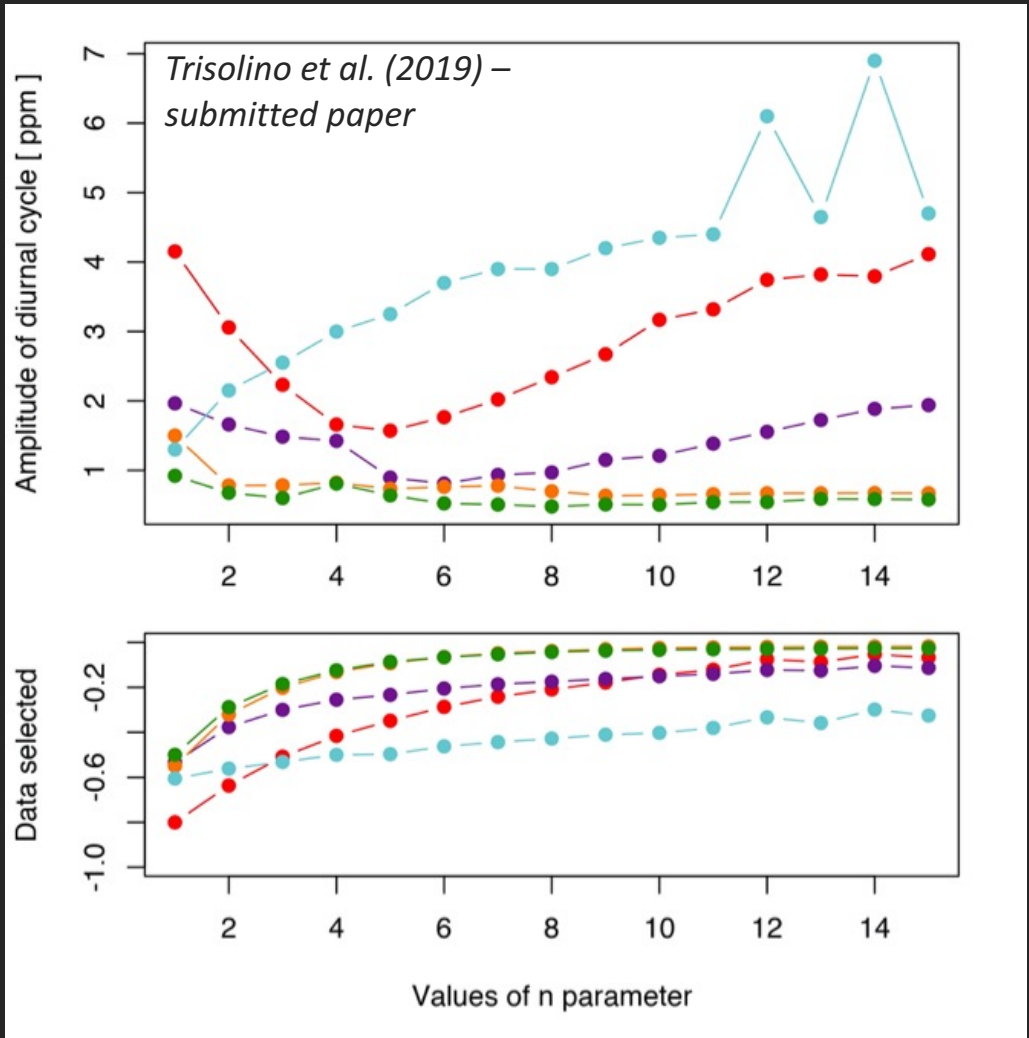
Considering background data:

- The *BaDSfit* algorithm leads to identify as non-background conditions about **4%** of the data **at LMP**, **7% at PRS**, **19% at CMN** and **61% at CGR**.
- A **more coherent diurnal and seasonal evolution** among the various datasets was obtained after *BaDSfit* application.

**These results suggest that the adopted algorithm is capable of identifying background conditions and allows the separation of local/regional scale from large scale phenomena in the $CO_2$ time series**

# Supplementary material

# Sensitivity study of *n* parameter




On the top:

the **median values of the $CO_2$ diurnal cycle amplitudes** (calculated over the whole dataset) as a function of "n" parameter

On the bottom:

the **fraction of data discharged** as a function of "n" parameter because defined as "not background".

| Selection | PRS<br>n=6<br>S=0.36 | CMN-ISAC<br>n=5<br>S=0.52 | CMN-CAMM<br>n=7<br>S=0.36 | CGR<br>n=1<br>S=1.43 | LMP<br>n=8<br>S=0.30 |
|---|---|---|---|---|---|
| Original dataset | 0.78 | 4.47 | 3.77 | 8.90 | 0.58 |
| Background dataset | 0.52 (7%) | 1.57 (35%) | 0.92 (19%) | 1.30 (61%) | 0.70 (4%) |

Color legend: **PRS**, **CMN-ISAC**, **CMN-CAMM**, **CGR** and **LMP**.

*For PRS, CMN-ISAC and CMN-CAMM only data from May to September are considered.*