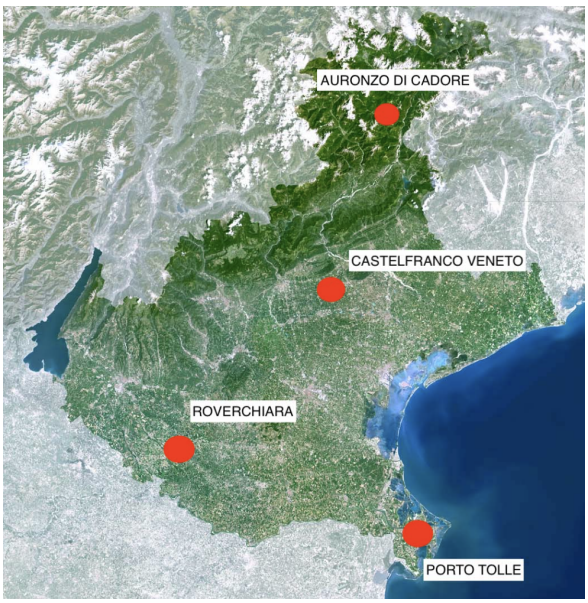
P05 - Bayesian Analysis of ARPAV time series on temperatures and precipitations

ARPAV (Agenzia Regionale per la iPrevenzione e Protezione Ambientale del Veneto) is an agency widespread over the territory that collects and analyzes environmental data. Some of the measurement points are quite old and ve a very long time serie (for example in Cavanis, Venice, daily measurements are available since 1900).

The aim of the project is to analyze the data available in three stations from 1993 to 2021, where the environment is quite different, and study the evolution over time. The stations are located in:

- Auronzo di Cadore (Lat: 46°33′33″ N, Long: 12°25′28″ E, Alt over sea level: 887 m);
- Castelfranco Veneto (Lat: 45°40′00″ N, Long: 11°55′00″ E, Alt over sea level: 46 m);
- Porto Tolle (Lat: 44°56′58″ N, Long: 12°19′28″ E, Alt over sea level: -22 m);
- Roverchiara (Lat: 45°16′10″ N, Long: 11°14′41″ E, Alt over sea level: 20 m).



Part 0

Study the evolution over time of the min, max and average temperatures computed over one month.

Part 1

Analysis of the evolution of the annual average of the min, max and daily averate temperature over time (1993 - 2021):

- study the trend of the annual averages and compare them with a constant value or a rising trend (for instance linear or quadratic)
- perform an analysis using a Bayesian linear regression with JAGS or STAN
- perform the same analysis uwing a constant regression
- perform a Bayesian hypothesis test comparing the two results
- do you see correlations between data measured at different stations ?

Part 2
Analysis of the evolution of the annual difference of the min, max and daily averate temperature over time (1993 - 2021):

- assuming you found an increasing trend in the temperature, compute it considering 4-years intervals and compare the results with those shown in SNPA (Sistema Nazionale per la Protezione Ambiente) in [1].
- perform an analysis using a Bayesian linear regression with JAGS or STAN

Part 3
Using the `forecast` R package [2], which provides methods and tools for displaying and analysing univariate time series, analyze the data. The library contains also the ARIMA (Autoregressive Integrated Moving Average), which allows to perform the equivalent of a linear regression in time series, where data is not stationary. Analyze your data and try to predict the evolution in the next years (average the data over multiple years, if needed).

Bibliography

[1] `https://www.snpambiente.it/wp-content/uploads/2021/06/Rapporto-SNPA-21_2021.pdf`

[2] `https://cran.r-project.org/web/packages/forecast/index.html`