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CS2 Temperature-related human mortality (TRM) in European regions

Contents

The Blue-Action project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 727852.

Background

ISGlobal has been interviewing many potential (both European and non-European) international end-users including international organisations, and fitting models with observational datasets (E-OBS dataset) and climate change simulations (ISIMIP2b experiment) from outside the project.

As a first step, ISGlobal gave a general overview of the objectives and methodologies of the project to scientists from outside the climate community, and explained the main characteristics of the prototype of a heat-health early warning system that is going to be created within the temperature-related mortality case study.

Secondly, ISGlobal have compiled information from previous and ongoing initiatives in the domain of heat stress and human health.
This point has been oriented towards three main areas:

- which are the main requirements in terms of climate observations and simulations for the development of a heat-health action plan?,
- which are the best statistical or epidemiological methods to fit the climate and mortality data?, and
- which is the best way to depict the information derived from the product so that it is easily understood by decision-makers and the general public?

ISGlobal found that the heat-health action plans in the United States, England and Germany are some of the most advanced operational systems available to date. The most sophisticated system is found in Germany, which is based on a human energy balance model of a human body used to compute the perceived temperature. Systems based on regionally-dependent temperature thresholds are however more widespread, such as in England, which uses temperature as the only climate variable. Most of the European countries have similar heat-health action plans, but they only provide information at the regional scale, and do not use weather or climate forecasts with lead times beyond 1 to 2 days.

Requirements of ISGlobal

In past projects, the ISGlobal team used seasonal and subseasonal forecasts of ECMWF System4 at lead times 1, 4, 8, 11, 15 and 18 days and 1 and 3 months before August 1st 2003 to predict the mortality excess in Europe for the 2003 heat wave (period 1-15 August 2003), expressing the prediction skill as a function of the above-mentioned 8 lead times (Lowe et al. 2015, 2016). Optimally, at some point during the project, ISGlobal would like to expand the work done for that paper and systematically predict all summers at different lead times and, if possible and time allows, also for winters. For ISGlobal, it was crucial that the daily time series of the forecasts were available because the ISGlobal models use the (lagged) relationships between daily climate variables and daily mortality, even if this was only used to infer at the end the overall seasonal (subseasonal) mortality exceedance.

The ISGlobal team normally works with the gridded E-OBS (regular grid) at a resolution of 0.25º, another possibility is to work 0.5º (e.g. ISIMIP). Coarser resolutions would not be however fine enough for some of the smaller European regions to work with. If the resolution is 1º, but still, regions to work with can be reformulated. The ISGlobal team has mortality data at the NUTS2 level in 16 European countries, but can

work at the NUTS1 level if necessary https://en.wikipedia.org/wiki/Nomenclature_of_Territorial_Units_for_Statistics
On this item, discussions were held as the unit of analysis depended on the climate or weather forecast service that was going to be finally used.

At that point, the essential variable we needed were daily mean 2m temperature, and would have appreciated to have either daily mean surface relative humidity or daily mean 2m dew point temperature. Other potentially useful variables considered were daily maximum and minimum 2m temperature, although they were not key if the dataset size was too big. ISGlobal was only interested in land values (need for a land-sea mask, or files could be provided with the mask already applied).

The more issuing dates of the forecasts, and the longer the time period with forecasts, the better. The ISGlobal team had mortality data for 1998-2012, so at the very least it was preferable to have access to data for this period (including hindcast). There was the possibility to be open to longer periods, and work with all the target seasons, but ISGlobal had particular interest with especially JJA (June-July-August) and, to a lesser extent, DJF (December-January-February), given that winter mortality is affected by external factors with largely independent dynamics such as the seasonal spread of infectious diseases (e.g. influenza).

ISGlobal evaluated different climate and weather services that could be used. On the one hand, seasonal (subseasonal) forecasts could be provided by WP1, but the main limitation of using them is the relatively low number of forecasts issuing dates (one per month) and stakeholders have expressed the need of a unified Pan-European service with predictions and warning beyond a few days. So ISGlobal explored alternative weather services, such as the European Centre for Medium-Range Weather Forecasts (ECMWF), which provides ensemble weather forecasts for Europe. One of the potential ECMWF products to be used was the Atmospheric model Ensemble 15-day forecast (ENS), which has been finally selected by ISGlobal as it fits the principal data requirements. More specific information is described in the next section.

Data source Nr. 1

Provider: ISGlobal identified different climate and weather forecast data providers and selected the one that fulfilled the principal data requirements.

Atmospheric model Ensemble 15-day forecast (ENS) provides weather forecasts that cover lead-times up to 15 days. ENS has ensemble weather post-processed forecasts available at 00/12 UTC and with a resolution of 0.2° x 0.2° lat/long grid (20 km approx.). ISGlobal obtained a time series with the following information: coordinates, issuing date, forecast time and ensemble member. Even though daily weather data is only available since October 2006, ISGlobal is using these forecasts to create and validate the prototype of the heat-health early warning system. Indeed, considering that the mortality database is available from 1998 to 2012, these weather forecasts cover six full summers and six full winters. Moreover, ISGlobal also explores other alternatives products of ECMWF, in order to have a longer temporal domain that cover the whole mortality period and complement ENS data, such as ERA5 dataset which covers the whole 1998 to 2012 period.

Data availability: As data is not property of ISGlobal, but of ECMWF. Access can be requested to ECMWF for accessing to the forecasts (https://www.ecmwf.int/en/forecasts/accessing-forecasts/order-real-time-forecasts).

Data characteristics:

Data characteristics	Data provider ENS-ECMWF
Main variables ? Which of the variables specified in my email are available ? i.e. daily mean 2m temperature, daily mean surface relative humidity, daily mean 2m dew point temperature, daily maximum and minimum 2m temperature	All variables previously specified are available (2m mean, maximum and minimum temperature; 2m dew point temperature)
Temporal resolution:	6-hours intervals
Are daily files available?	Yes
Do we need to access to 3h or 6h files and then make the daily averages?	Daily weather forecasts can be provided (more likely to use forecasts at 00h)
Spatial resolution: Which is the maximum resolution?	0.2 degrees
Temporal domain: 1980-2016	From October 2006 onwards
Spatial domain: global?	Global

Data characteristics	Data provider ENS-ECMWF
Is it possible to have access to files showing information only for Europe?	Yes
Number of ensemble members:	51
Issuing dates:	00 UTC and 12 UTC
Model integration:	15 days
File size:	For each daily file with worldwide temperature and 15 lead times size is 8126KB, making around 5.65GB for a whole year
Data access: ftp only? Is there any other way to access to data? e.g. CMIP scripts?	Data can be downloaded by ftp after register is accepted. Register has been accepted after acknowledging that data is for the Blue-Action project.

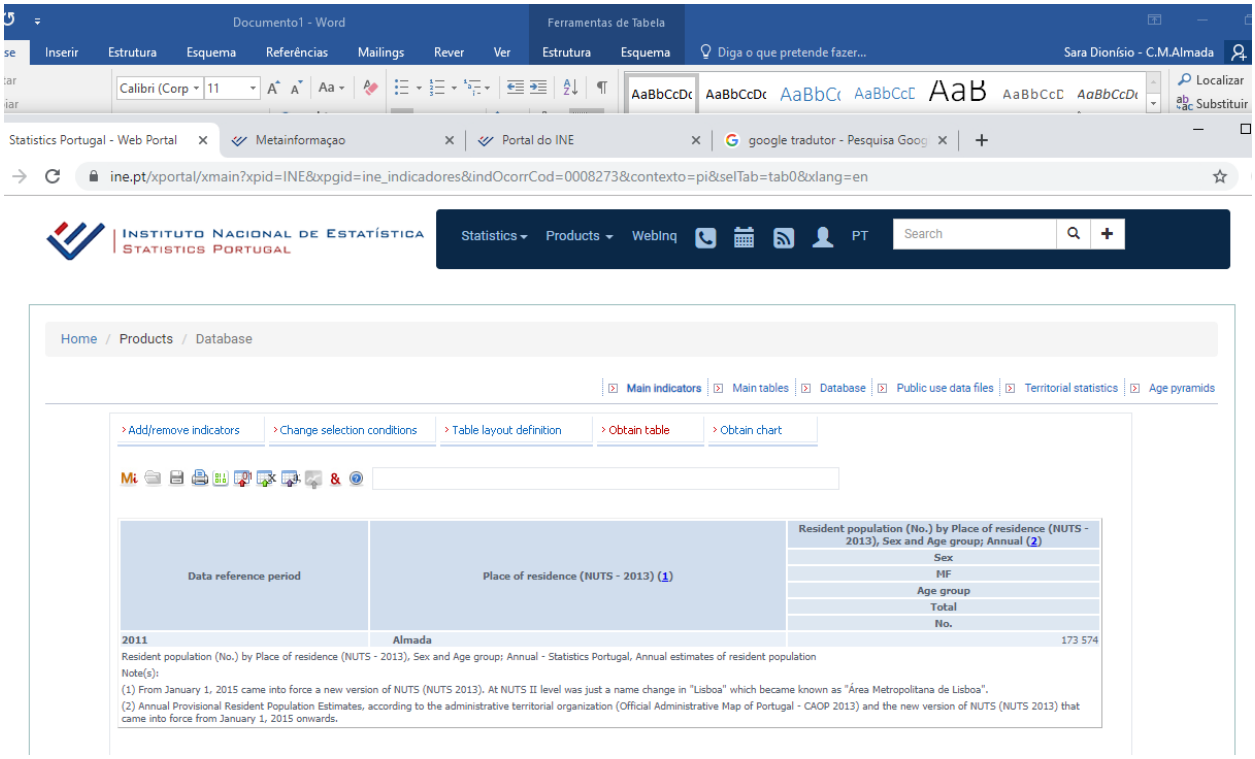
Data source Nr. 2

Provider: Statistics Portugal (Instituto Nacional de Statistica)

What has been provided: Data on Resident population (No.) by Place of residence (NUTS - 2013), Sex and Age group; Annual - Statistics Portugal, Annual estimates of resident population

Repository links:

- https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008273&contexto=pi&selTab=tab0&xlang=en
- https://www.ine.pt/bddXplorer/htdocs/minfo.jsp?var_cd=0008273&lingua=EN
- http://smi.ine.pt/Indicador/Detalhes/12153?LANG=EN



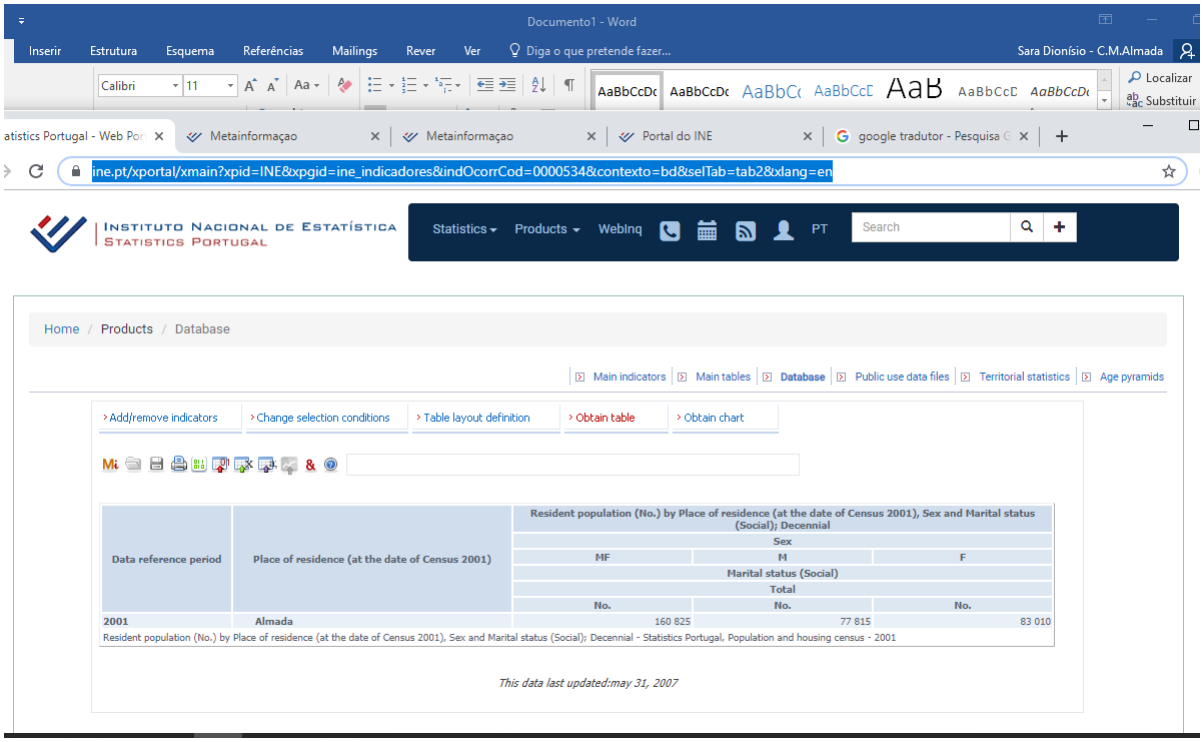
Data source Nr. 3

Provider: Statistics Portugal (Instituto Nacional de Statistica)

What has been provided: Number of inhabitants of Almada in Census 2001. More in details: Resident population (No.) by Place of residence (at the date of Census 2001), Sex and Marital status (Social); Decennial.

Repository links:

- https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0000534&contexto=bd&selTab=tab2&xlang=en
- https://www.ine.pt/bddXplorer/htdocs/minfo.jsp?var_cd=0000534&lingua=EN



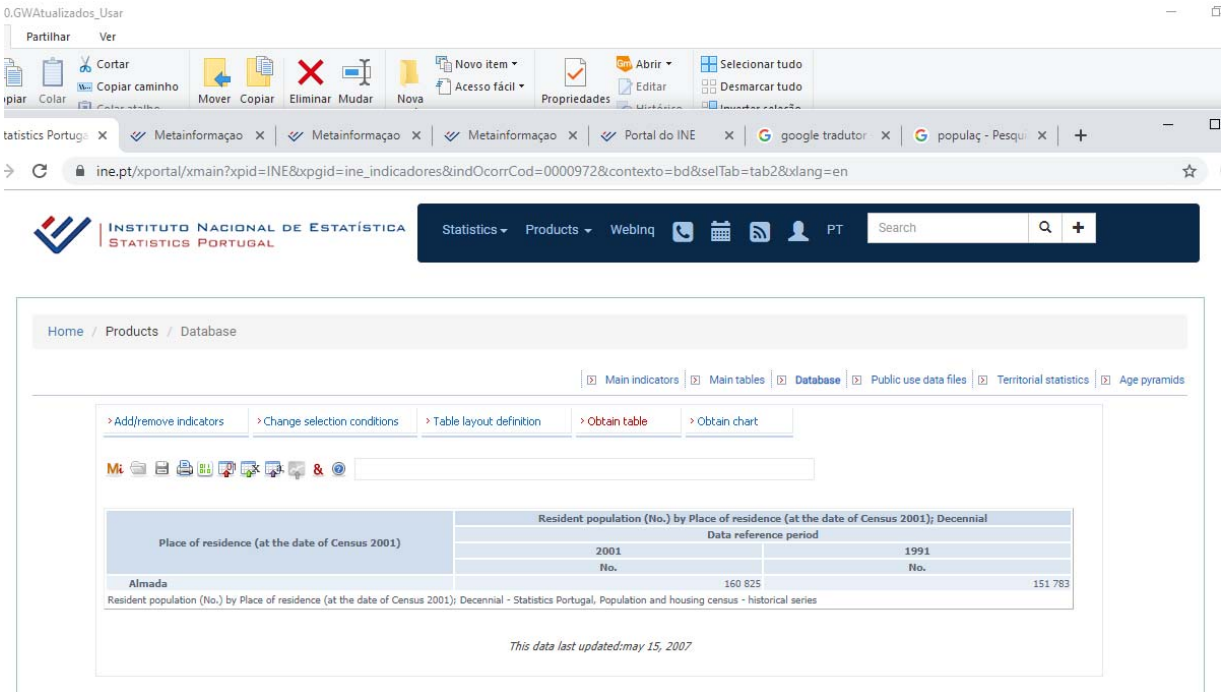
Data source Nr. 4

Provider: Statistics Portugal (Instituto Nacional de Statistica)

What has been provided: Number of inhabitants of Almada in Census 1991. In details: Resident population (No.) by Place of residence (at the date of Census 2001); Decennial

Repository links:

- https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0000972&contexto=bd&selTab=tab2&xlang=en
- https://www.ine.pt/bddXplorer/htdocs/minfo.jsp?var_cd=0000972&lingua=EN



Data source Nr. 5

Provider: Statistics Portugal (Instituto Nacional de Statistica)

What has been provided: Annual estimates (1991 to 2017). In details: Resident population (No.) by Place of residence (NUTS - 2013), Sex and Age group (By life cycles); Annual + Resident population (No.) by Place of residence (NUTS - 2002), Sex and Age group; Annual

Repository links:

- https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0003182&contexto=bd&selTab=tab2&xlang=en
- https://www.ine.pt/bddXplorer/htdocs/minfo.jsp?var_cd=0003182&lingua=EN
- https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008272&contexto=bd&selTab=tab2
- https://www.ine.pt/bddXplorer/htdocs/minfo.jsp?var_cd=0008272&lingua=EN

Data source Nr. 6

Provider: City Council Almada

What has been provided: CM Almada Internal Study “The population - volume, structure and distribution - in the county of Almada, in 2031 from the application of the cohort-survival model” (pdf) (Draft version, in Portuguese). The document used in the Blue-Action Project was a draft version, developed by the City Council for the Master Plan Revision.

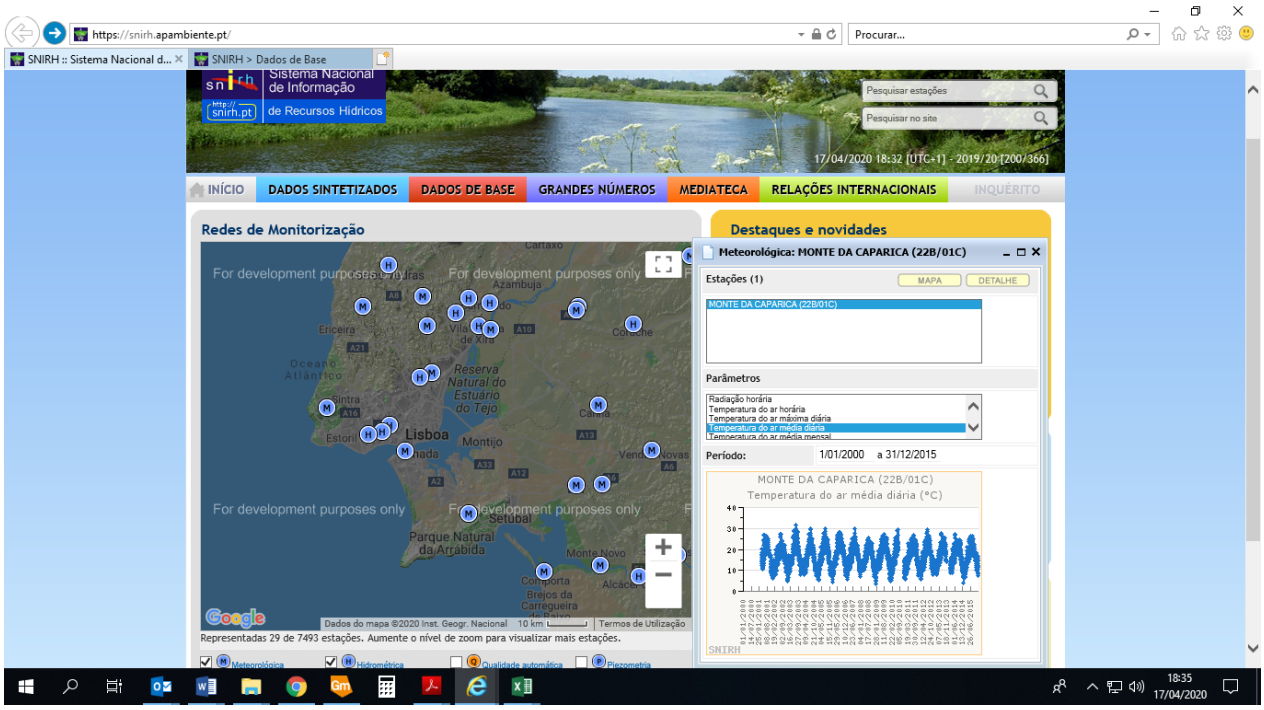
Link to DOI: https://zenodo.org/record/3763224#.XqGcCykzbiw

Data source Nr. 7

Provider: City Council Almada

What has been provided: Temperature data of Daily mean temperature from 2000 to 2015. Daily mean temperature includes 24 hours of observations (hourly temperature, 09:00-09:00 UTC)

Repository links: https://snirh.apambiente.pt/



Data source Nr. 8

Provider: City Council Almada

What has been provided: Limits of Almada's civil parish (Georeferenced data). Shapefile with the limits of Almada's civil parish. For the 2011 Censuses, the Census Cartographic Base (BGRI 2011) was used as a necessary and inseparable dissemination product of census information.

BGRI 2011 consists of a Geographic Information System (GIS) made up of a digital base with several "layers" (layers of geographic information), including the Official Administrative Charter of Portugal , containing updated information on the administrative and statistical delimitation; that is, the division of parishes into statistical census sections and these into statistical subsections.

Repository links: http://mapas.ine.pt/download/index2011.phtml

Data source Nr. 9

Provider: Statistics Portugal (Instituto Nacional de Statistica)
What has been provided: Daily counts of all-cause mortality are property of the city Council of Almada.

The daily counts of all-cause mortality used in the project are not property of the City Council of Almada. This data is compiled by the Central Government entity "Instituto Nacional de Statistica". This entity made available this information to the City Council specifically for the Blue-Action Project and based on an request of the City Council. At the time, the "National Statistics of Portugal" indicated that the data's property rights had the fowling conditions.

Property Rights: The information is provided by the Instituto Nacional de Statistica, I.P. it is its exclusive responsibility and all rights are reserved according to the Industrial Property code - DL nº 36/2003 of 5 March and the Copyright and Related Rights code - Law nº 50/2004 of 24 August. Access to information does not give the user property rights. The use of information for other purposes, in addition to the normal right to quote, **requires prior authorization from the Institute of the source in the following terms**. Source: National Institute of Statistics, I.P. - Portugal, http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_ped_informacao_list

Data source Nr. 10

Provider: City Council Almada
What has been provided: Weather station metadata (pdf)

Weather station name	Monte da Caparica
Station Code	22B/01C
Latitude and longitude coordinates	38.660921, -9.202774
Source	Portuguese Environment Agency, National Water Resources Information System (https://snirh.apambiente.pt)
Type of data:	Non validated values

Repository links:

- https://snirh.apambiente.pt/snirh/_dadosbase/site/janela.php?obj_janela=INFO_PARAMETROS&tp_lista=I
- https://snirh.apambiente.pt/snirh/_dadosbase/site/simplex.php?OBJINFO=INFO&FILTRA_BACIA=17&FILTRA_COVER=920123704&FILTRA_SITE=920685506

Dataset Nr. 1: Calibration of the temperature-related mortality model, based on historical weather data already provided for Almada

Provider: ISGlobal

Provided to: City Council of Almada

Description: ISGlobal conducted some specific analysis for the city Council of Almada. The calibration of the model using Almada historical data has been made available to Almada. The main figures are shown in the derivable D5.8: https://zenodo.org/record/3559472#.XjKZxDJKjiw

Repository: The data set is available in open access on Zenodo, DOI: https://zenodo.org/record/3763171

Dataset Nr. 2: Heat-health early warning system for the city of Almada

Provider: ISGlobal

Provided to: City Council of Almada

Description: ISGlobal conducted some specific analysis for the city Council of Almada. This is the Heat-health early warning system for the city of Almada, where climate (seasonal/subseasonal/weather) forecasts will be selected by interpolation or from the nearest grid-cell point to Almada city.

This data set is still work in progress. It will be disclosed in open-access as soon as the work is finalized.

References

Lowe, R., Ballester, J., Creswick, J., Robine, J.-M., Herrmann, F. R., & Rodó, X. (2015). *Evaluating the Performance of a Climate-Driven Mortality Model during Heat Waves and Cold Spells in Europe*. International Journal of Environmental Research and Public Health, 12(2), 1279–1294. https://doi.org/10.3390/ijerph120201279

Lowe, R., García-Díez, M., Ballester, J., Creswick, J., Robine, J.-M., Herrmann, F. R., & Rodó, X. (2016). *Evaluation of an Early-Warning System for Heat Wave-Related Mortality in Europe: Implications for Sub-seasonal to Seasonal Forecasting and Climate Services*. International Journal of Environmental Research and Public Health, 13(2), 206. https://doi.org/10.3390/ijerph13020206