Science Project 'Climate Neutral and Smart Cities'

Webinar

March 19 - 2024

Irena Vipavc Brvar (CESSDA/UL-ADP)
David Rayner (SND)
Arofan Gregory, Benjamin Beuster, Hilde Orten (Sikt)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

HOUSEKEEPING RULES

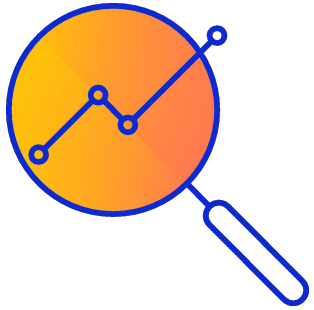
- Event will be recorded and recording and slides will be made available afterwards.
- We are using Zoom meeting mode for easier communication. However, please stay muted and keep your video off during presentations.
- You can post your questions in the chat or Q&A throughout the session.

  Please use the“hand-raise function” to indicate you would like to contribute directly.

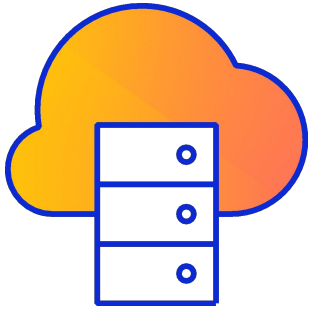
EOSC Future in a Nutshell

Ending March 2024

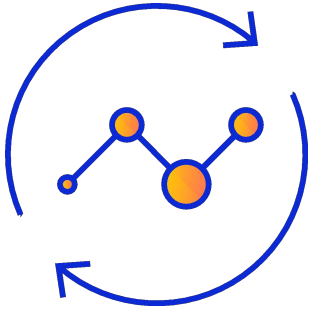
EOSC Future provides a user-friendly environment for:



Data discovery

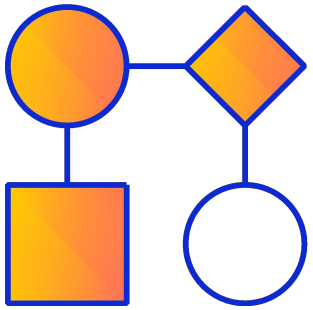


Data storage

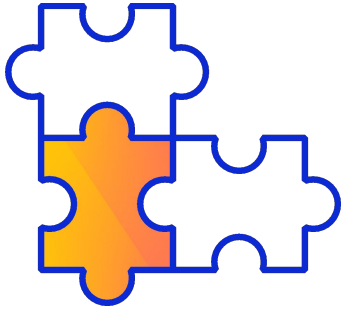


Data recomposition

Computing services



Complex workflows

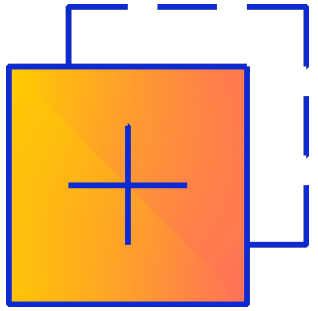


Integratable services

This way, EOSC Future wanted to help make EU research:

More innovative

More streamlined



Easier to reproduce

Science Projects

Cluster	SP number	SP Name
ENVRI	1	Impact of Climate change on Biodiversity and Ecosystems in Europe
	2	Dashboard on the State of the Environment
EOSC-Life	3	COVID-19 metadata Findability and Interoperability in EOSC
	4	Imaging Data in EOSC - COVID-19 as Demonstrator
ESCAPE	5	Understanding of Dark Matter
	6	Understanding of Extreme Universe and Gravitational waves
PaNOSC	7	Tracing bio-structures with serial crystallography
	8	Following biological processes with Small Angle Scattering
SSHOC	9	Climate Neural and Smart Cities
	10	Access Management for distributed Research Infrastructures (ARIA)

Source: MS24 / Science Projects Results

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Today's agenda

15:00 - 16:30

- Welcome and introduction, objectives
- Methods and results
  - Background and methods
  - Integrated data from different domains (social and physical sciences)
  - The importance of provenance and the prototype tool
- Utility for researchers
- FAIRness and metadata
- Forward looking - EOSC as an arena for science together- organisational interoperability
- Panel discussion with questions and answers
- Wrap up

Science Project 'Climate Neutral and Smart Cities'

Introducing the project and objectives

Irena Vipavc Brvar (CESSDA/UL-ADP)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

Do climate and air quality indices AFFECT interview responses?

Partners:

ESS ERIC : ESS HQ; Sikt

CESSDA ERIC: CESSDA MO; SND; ADP

ENVRI Consortium: IAGOS

External contributors: NILU and Met.no

Clusters:

SSHOC social sciences & humanities open cloud

ENVRI FAIR

Objectives

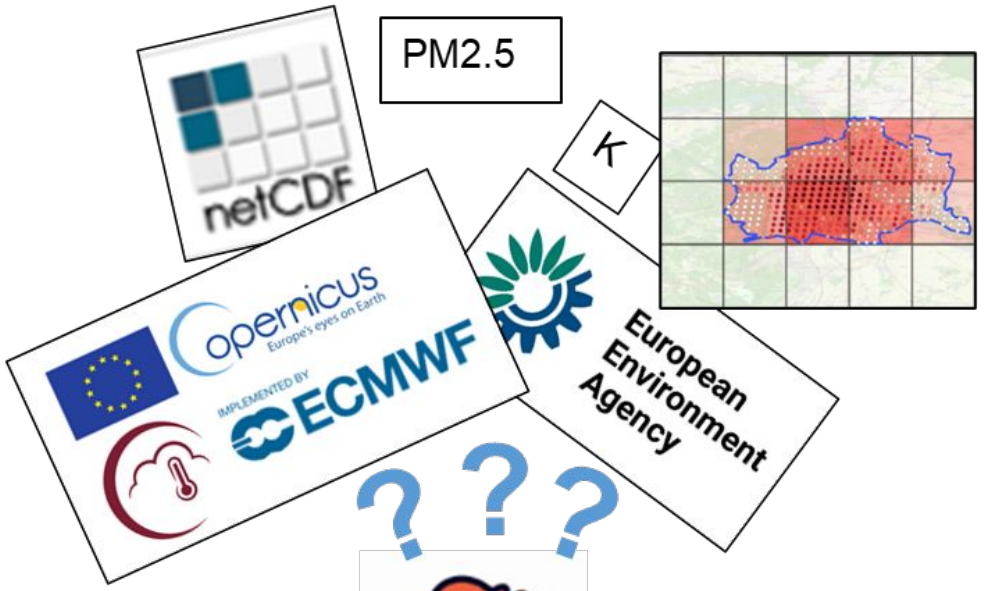
Develop solutions for interdisciplinary research based on a practical example

- Topic: European urban citizens' attitudes and values, in context of the climate and air quality in the cities they live in
- Integration of data from different research domains: Survey data and data on climate and air quality
- Collaboration between professionals from within the social science and environmental science clusters

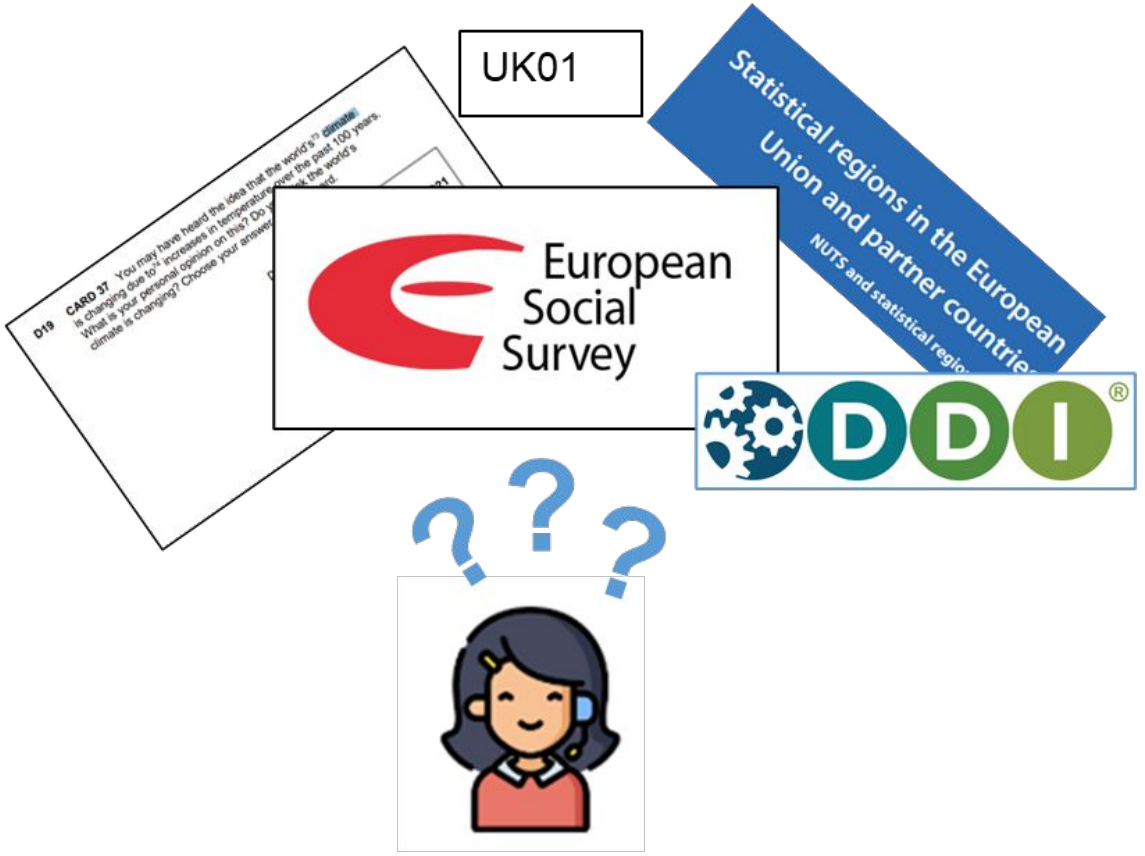
Identify requirements for metadata and systems that support interdisciplinary research

- Necessary to make detailed information about the workflows related to interdisciplinary data production transparent (provenance)
- For this purpose, tools that support human and machine access to such information are needed

Understand data from multiple domains ?



Social scientist



Environmental specialist

Science Project 'Climate Neutral and Smart Cities'

Methods and Results

David Rayner (SND)
Hilde Orten (Sikt)

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What is the research question?

Does personal experience of climate or environmental extremes influence attitudes to environmental issues, especially climate change?

- In theory, yes:
  - make impacts seem more certain,
  - more immediate,
  - more likely to affect the person themselves.

Hoffmann et al. (2022) https://doi.org/10.1038/s41558-021-01263-8

Can social scientists measure this?

Question	Affected by air pollution	Not affected by air pollution
Climate change is something that frightens me (Y/N)	53.4%	28.4%

Whitmarsh, L. (2008). https://doi.org/10.1080/13669870701552235

N=589, difference p<0.001

"The measure used for air pollution experier
respondents' own evaluation of health impa
pollution".

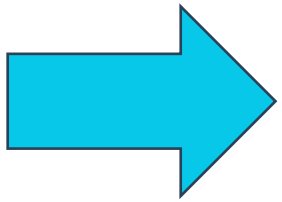
Direct experience or perception bias?

Can social scientists and natural scientists *work together* to measure this?

Combine interview or survey data about respondents' attitudes and beliefs

with

Independent meteorological or environmental monitoring data



Tag every survey response with environmental conditions of respondent's location.

Data sources

- European Social Survey (ESS) Social Survey data
  - 2016, fielded a rotating questionnaire module about attitudes to climate change and energy-use
- European Environmental Agency (EEA) air quality data
  - Air Pollutant concentration measurements
- European Centre for Medium Range Weather Forecasts reanalysis (ERA5)
  - combine meteorological observations with a forecast model
  - gridded dataset ~30km horizontal resolution

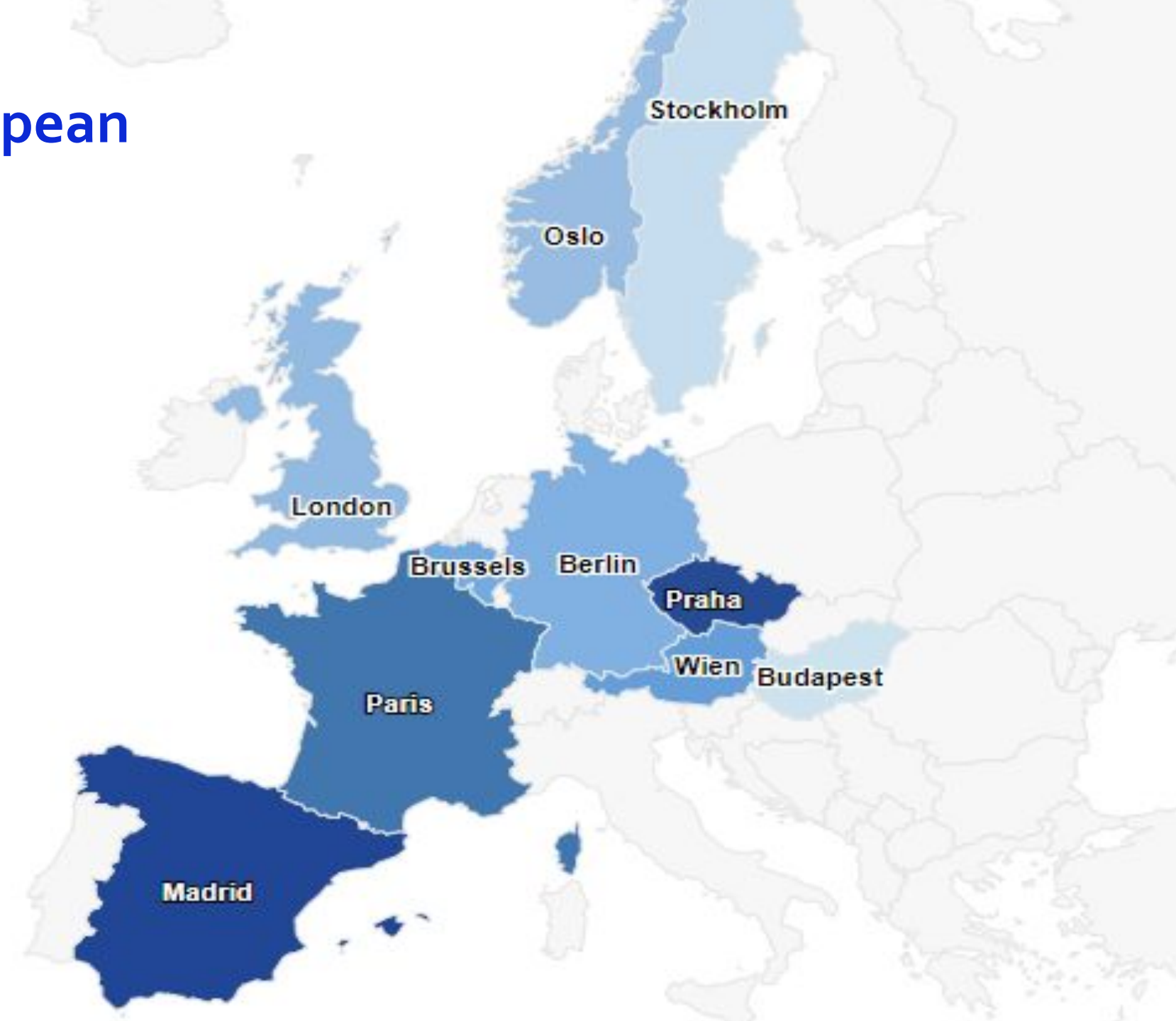
ESS data

- Biannial social survey
- Fielded every second year since 2002
- Captures attitudes, values, behaviors and beliefs
- Climate module fielded in 2016
- Data from 2016 through 2023 for 10 bigger city regions in Europe are included in the combined data file
- All ESS variables are kept in the integrated data file

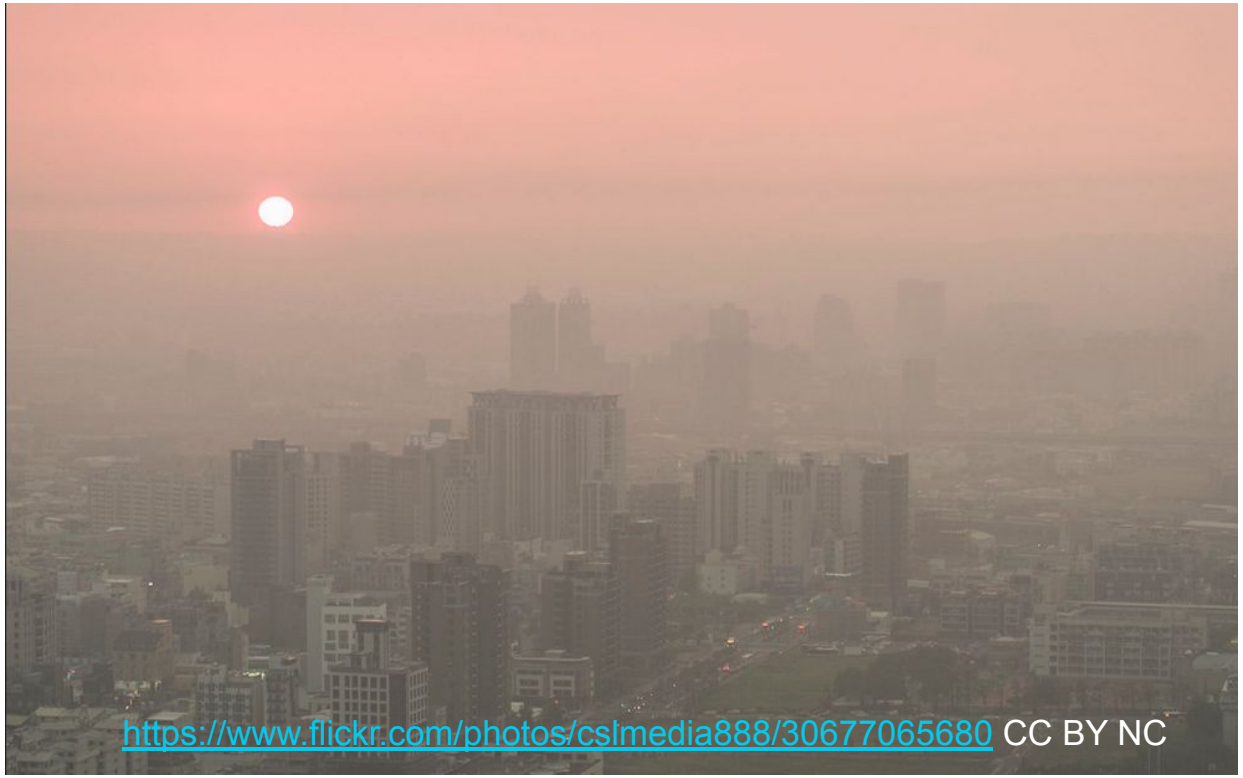
ESS questions related to climate change (from module D, 2016)

- You may have heard the idea that the world's climate is changing due to increases in temperature over the past 100 years. What is your personal opinion on this? Do you think the world's climate is changing?
- How much have you thought about climate change before today?
- Do you think that climate change is caused by natural processes, human activity, or both?
- To what extent do you feel a personal responsibility to try to reduce climate change?
- How worried are you about climate change?
- How good or bad do you think the impact of climate change will be on people across the world? Please choose a number from 0 to 10, where 0 is extremely bad and 10 is extremely good.

Data from 10 European city regions



European Environmental Agency (EEA) Air Pollution Data.

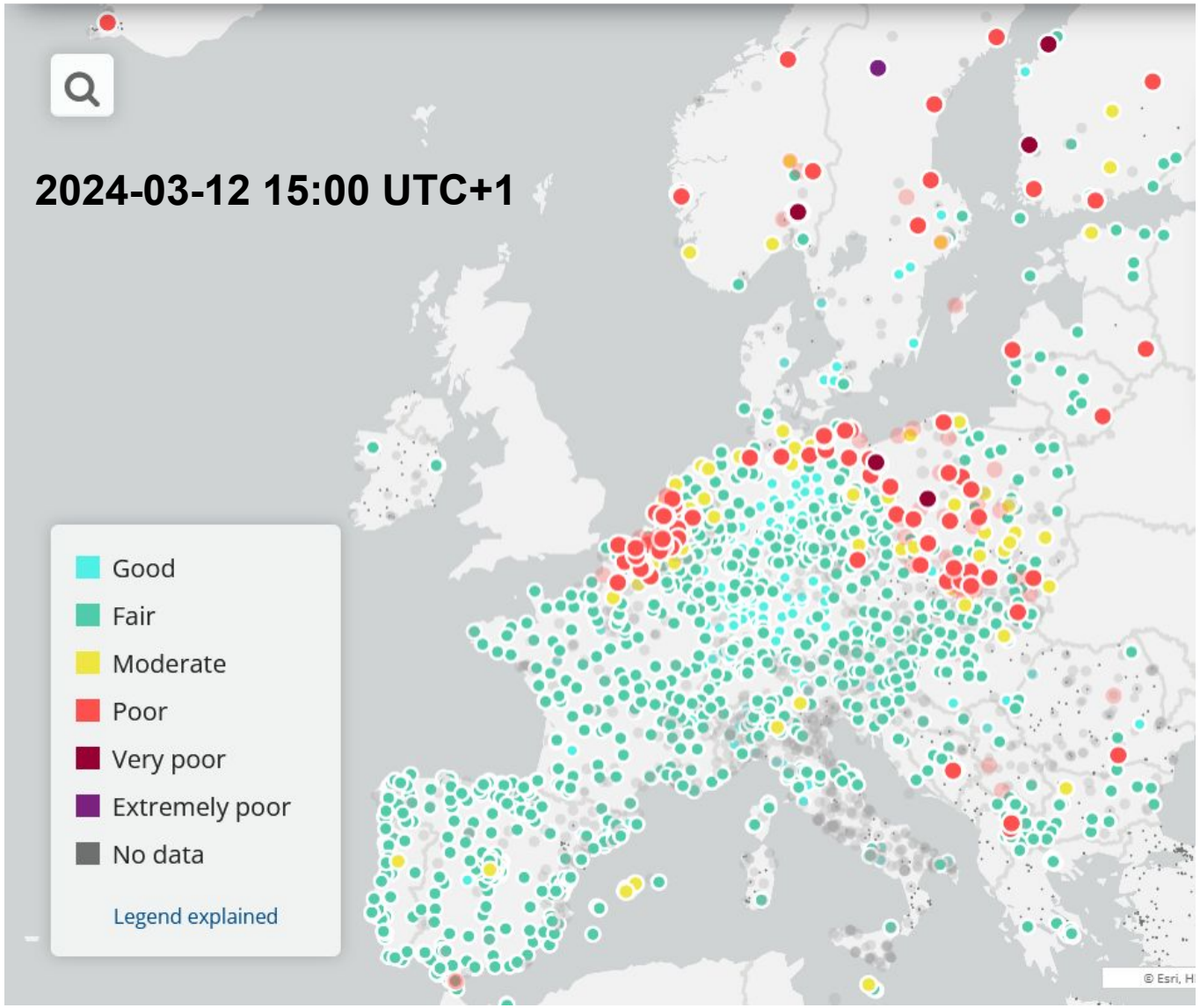


Most important Air Pollutants for human health:

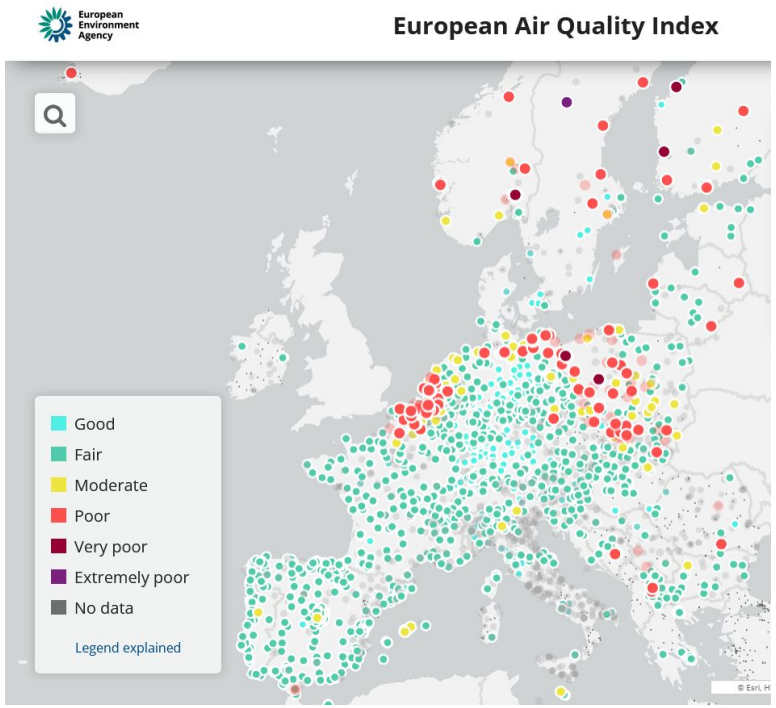
- Particulate matter (PM_{10} and $PM_{2.5}$)
- Nitrogen Dioxide (NO_2)
- Sulfur Dioxide (SO_2)
- Ozone (O_3)

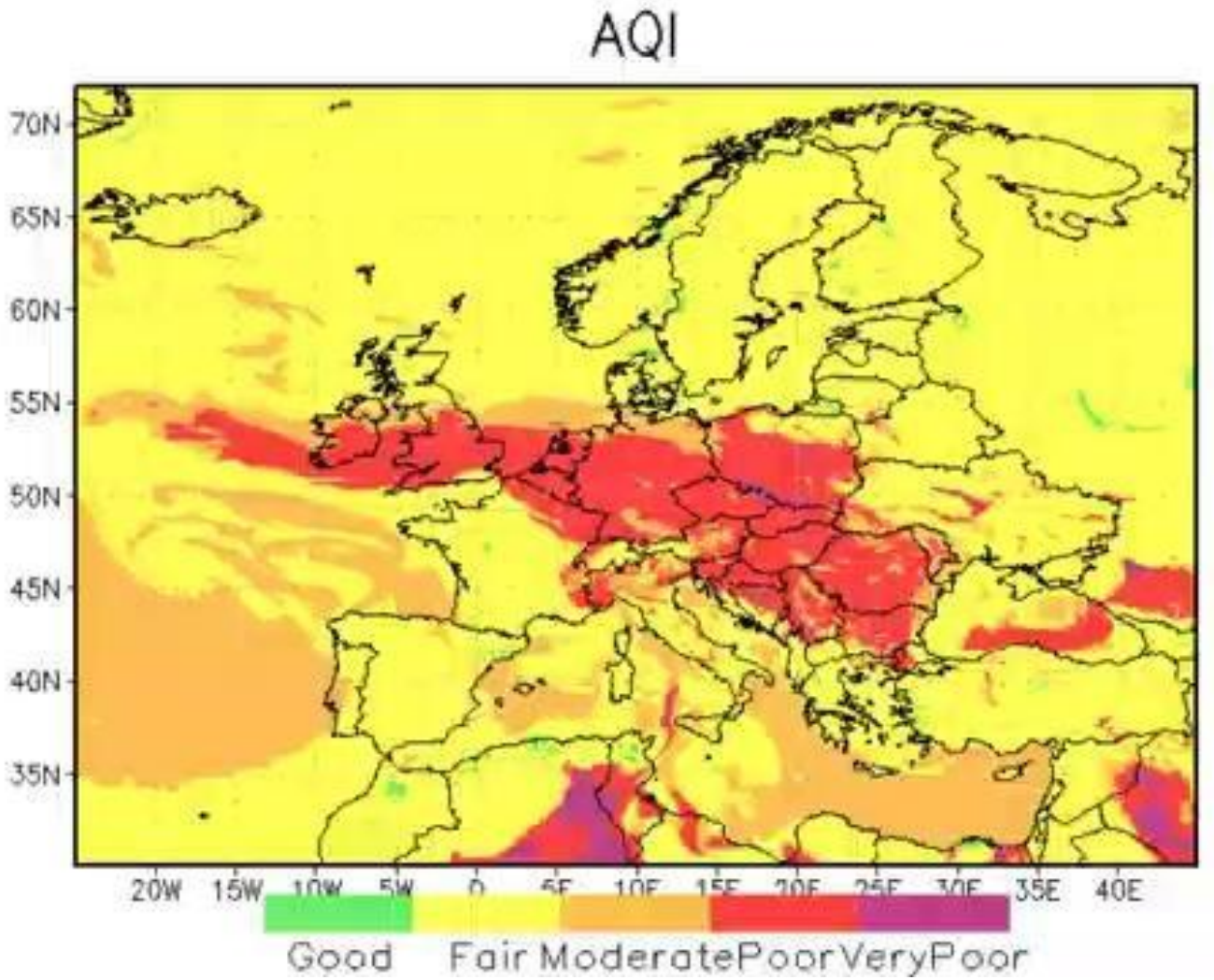
European Air Quality Index (AQI)

- Composite index.
- Worst concentration re impacts on human health.
- Calculated from European Environmental Agency (EEA) air quality data.

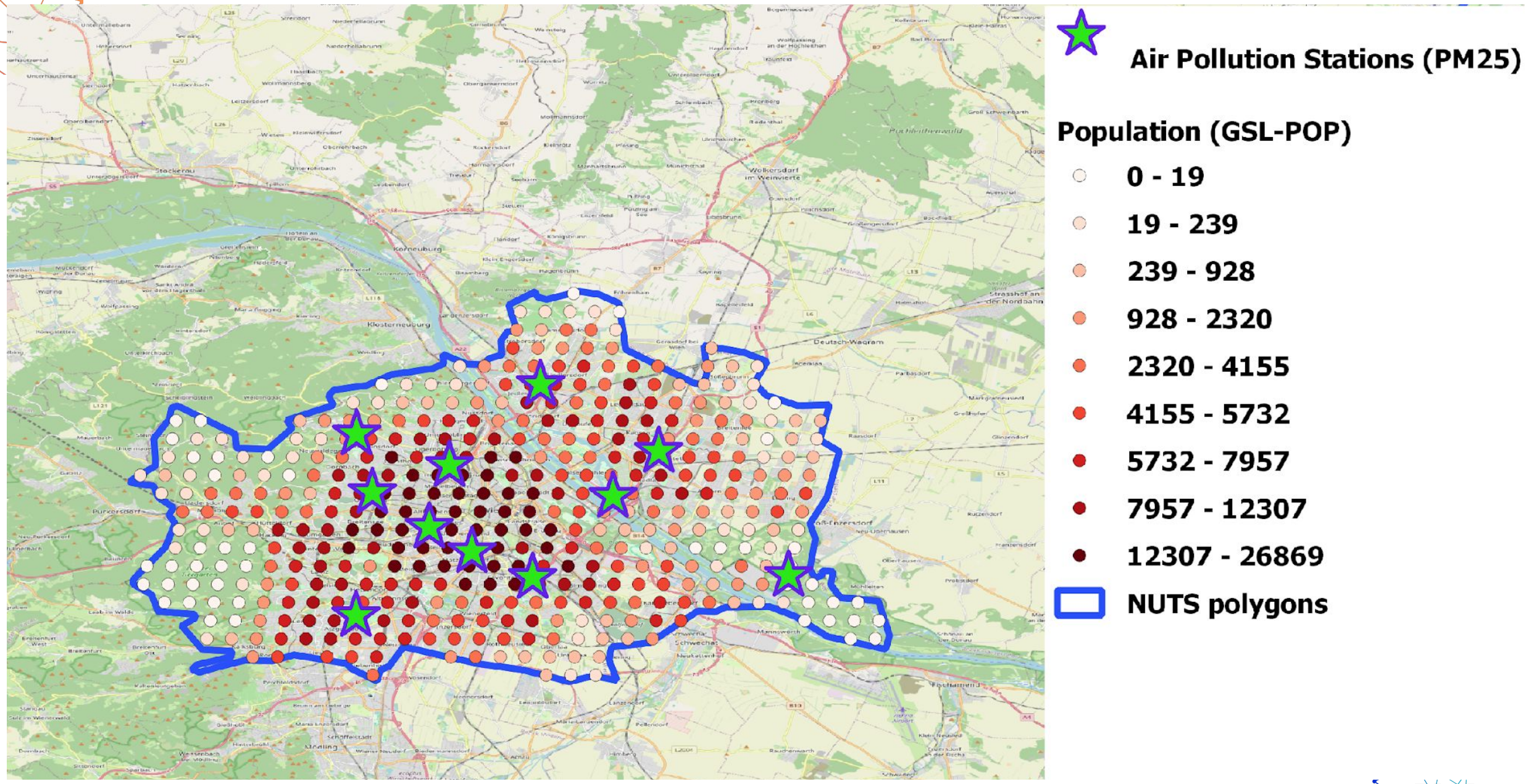


https://airindex.eea.europa.eu/AQI/index.html

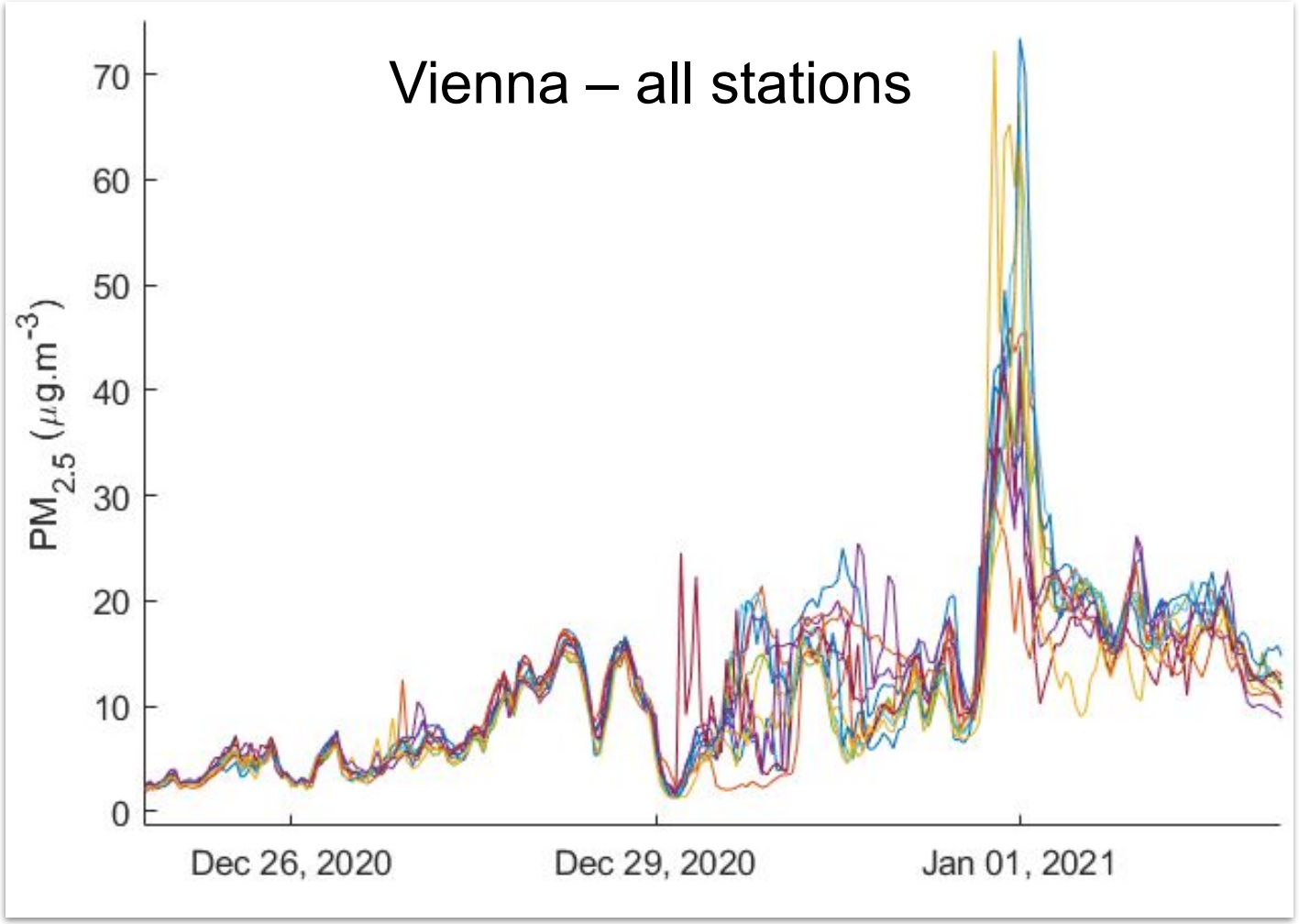




https://silam.fmi.fi/aqforecast.html
Used with permission.


Air Pollution Stations (PM25)
Population (GSL-POP)
0 - 19
19 - 239
239 - 928
928 - 2320
2320 - 4155
4155 - 5732
5732 - 7957
7957 - 12307
12307 - 26869
NUTS polygons

Air Pollution – individual monitoring stations



Issues

- No historical European Air Quality Index (AQI) data!
  - Need to re-calculate it using pollutant concentrations.
- Designed for single point in space/time.
  - Effect of the worst air pollutant.
  - No standard way to calculate regional average.
  - No standard way to calculate temporal average.
  - No standard way to average at all!!

Meteorological data – ERA5

- European Center for Medium-Range Weather Forecasts (ECMWF) reanalysis database (ERA5)
- combine observational data and outputs from numerical modelling
- spatially-complete, physically consistent datasets
- 31 km temporal resolution and hourly timestep

Meteorological variables used:

- Temperature (air temperature at 2m height)
- Total precipitation (rain + snow)
- Wind gust (max wind gust at 10m height)

https://pulse.climate.copernicus.eu/

Climate Pulse BETA version

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

IMPLEMENTED BY ECMWF

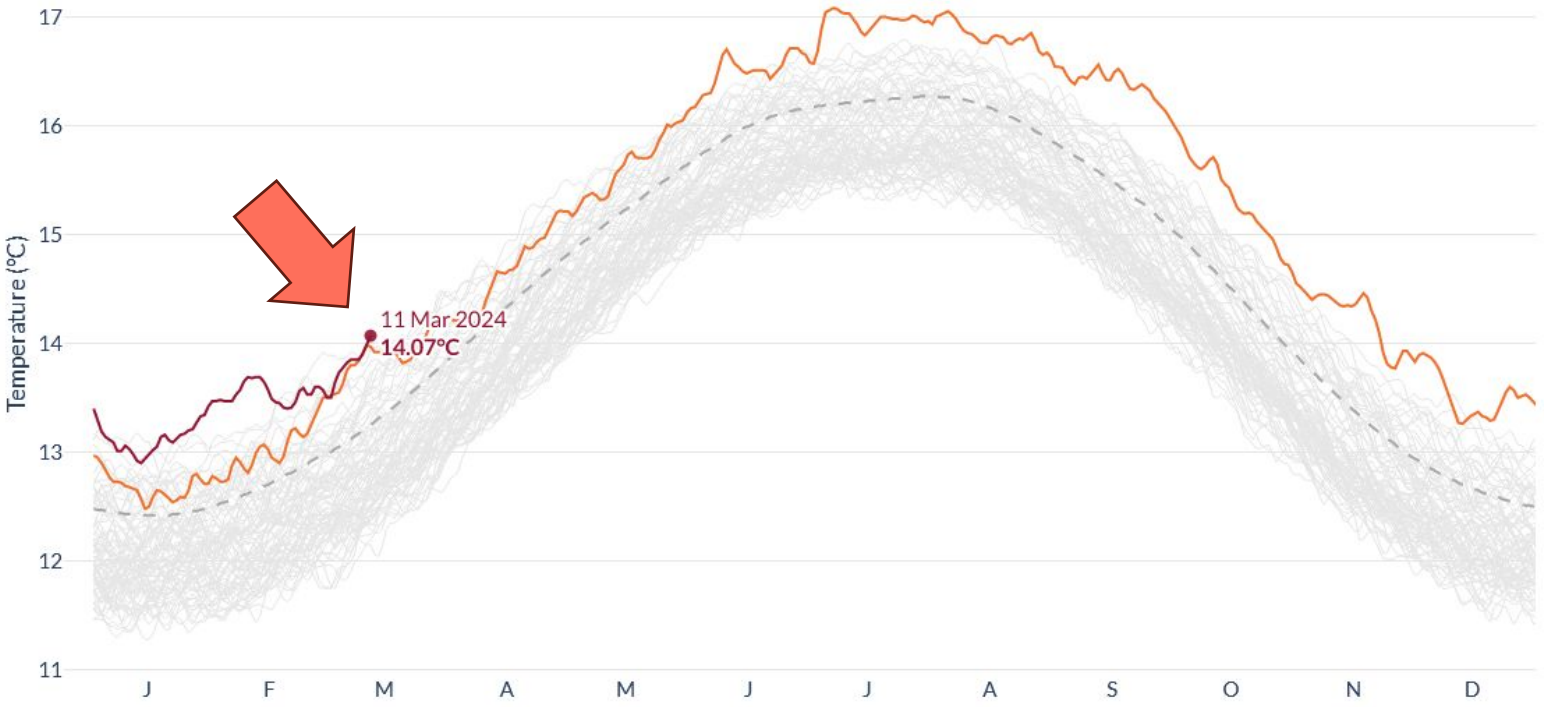
Climate Change Service

Absolute values | Anomalies

Surface air temperature

ERA5 1940-2024 (global mean)

Data: ERA5 • Credit: C3S/ECMWF



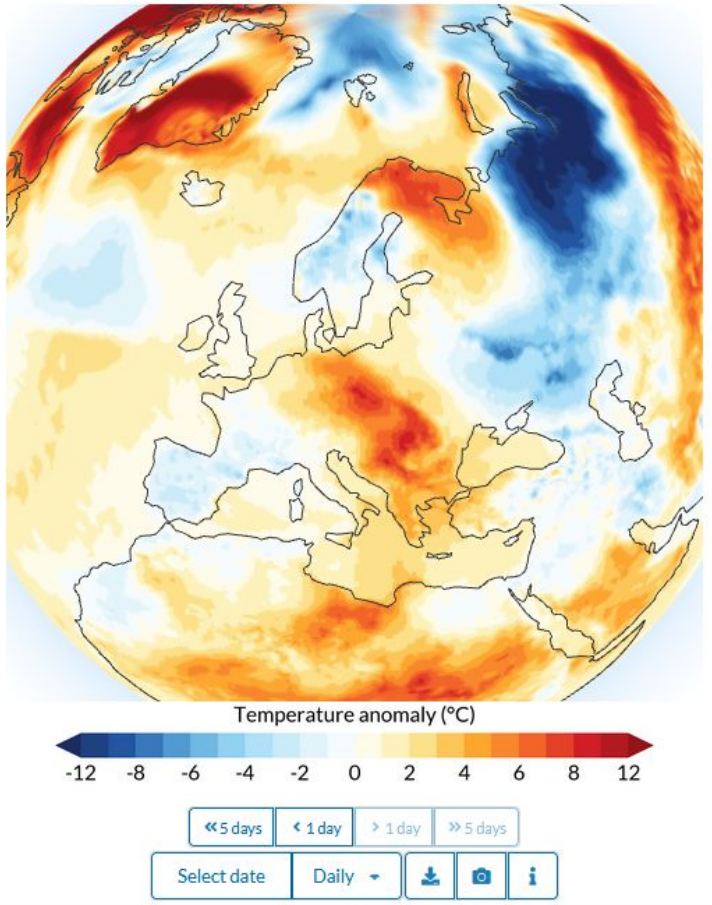
+ Add years to compare with 2024

Absolute values | Anomalies

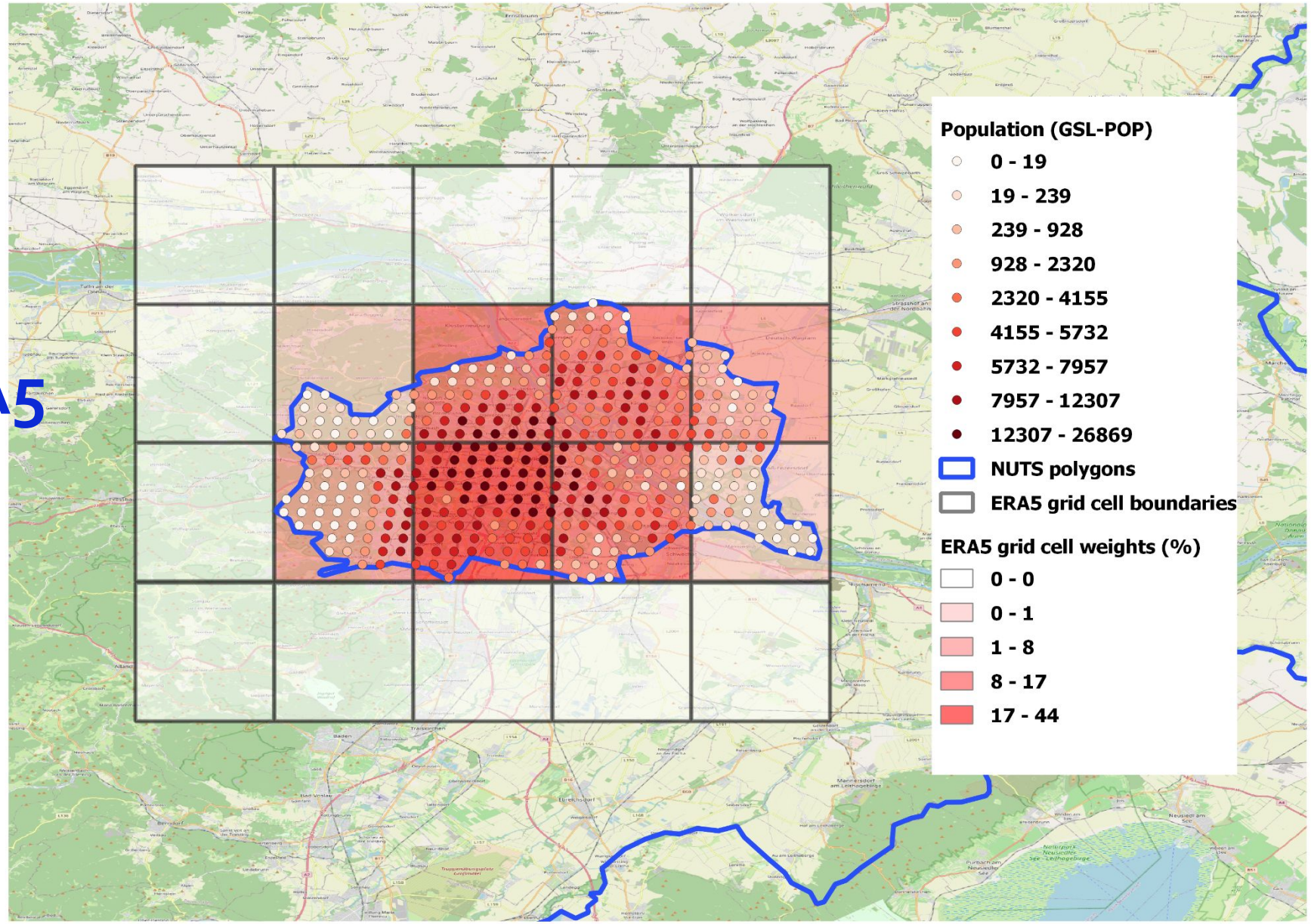
Surface air temperature

Daily mean anomaly - 11 March 2024

Data: ERA5 • Credit: C3S/ECMWF



Geographic averaging of ERA5 climate data.



Temporal considerations

An extended period of anomalous weather is probably required to increase environmental concern, but as events become more distant in the past, their impact recedes.

We characterize regional conditions in specific time-slots

- relative to the dates of the interviews. 7, 30, 90, 365 day before (climate)
- relative to the dates of the interviews. 2,7, 30, 365 day before (air pollution)

Table 6: The full list of air quality indices in the dataset[21].

Index	Index Label
aqiwdpm10	Worst air quality index level PM10, date
aqiwdpm2_5	Worst air quality index level PM2.5, date
aqiwdso2	Worst air quality index level SO2, date
aqiwdno2	Worst air quality index level NO2, date
aqiwdo3	
aqiwd	
ndyprwpm10	Number of days with 'poor' air quality level or worse on PM10, week before the date
ndyprwpm2_5	Number of days with 'poor' air quality level or worse on PM2.5, week before the date
ndyprwso2	Number of days with 'poor' air quality level or worse on SO2, week before the date
ndyprwno2	Number of days with 'poor' air quality level or worse on NO2, week before the date
ndyprwo3	Number of days with 'poor' air quality level or worse on O3, week before the date
ndyprw	Number of days with 'Poor' air quality level or worse on one or more pollutant indicators, week before the date

Table 4: The full list of climate indices in the dataset[19].

Index	Index Label
tmpdca	Temperature in degrees Celsius, date average
tmpdcmx	Temperature in degrees Celsius, date maximum
tmpdcmn	Temperature in degrees Celsius, date minimum
tmpdcaw	Temperature in degrees Celsius, week average before the date
tmpdcam	Temperature in degrees Celsius, month average before the date
tmpdca3m	Temperature in degrees Celsius, three months average before the date
tmpdcay	Temperature in degrees Celsius, year average before the date
tmpdcacm	Temperature in degrees Celsius, calendar month average
tmpdcamb	Temperature in degrees Celsius, multi-year calendar month averages, baseline 1991 - 2020
tmp95pacmb	Temperature in degrees Celsius, multi-year calendar month 95th percentiles, baseline 1991 - 2020
tmpanod	Temperature anomaly date
tmpanocm	Temperature anomaly calendar month

Science Project 'Climate Neutral and Smart Cities'

Provenance

Benjamin Beuster (Sikt)

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How Can We Describe the Data Integration Process and Variable Computation?

Process Model

DDICDILibrary

Fully qualified package name: DDICDIModels::DDICDILibrary

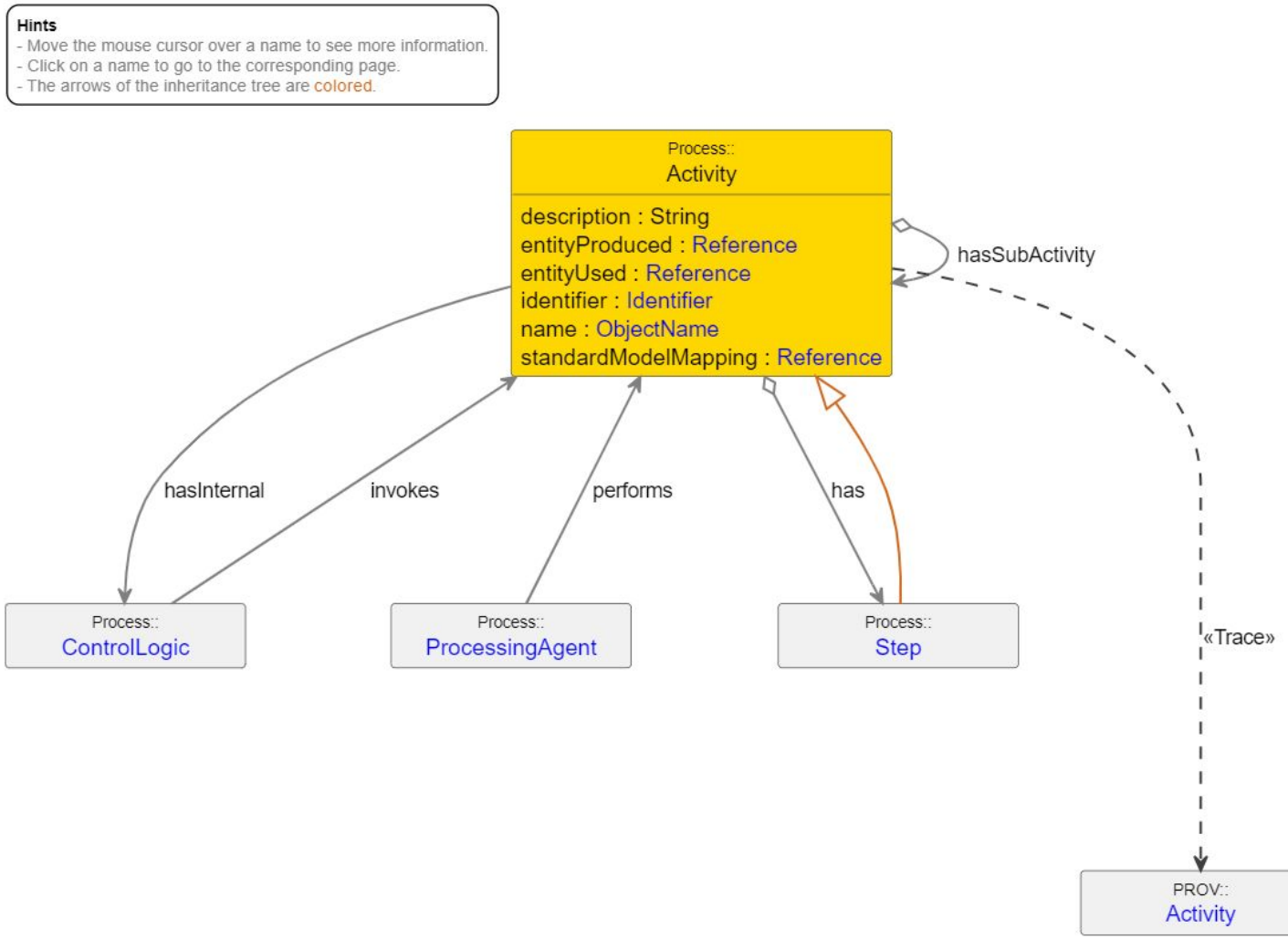
This package contains the classes, datatypes, and their definitions for all of the DDI-CDI model packages, as described below.

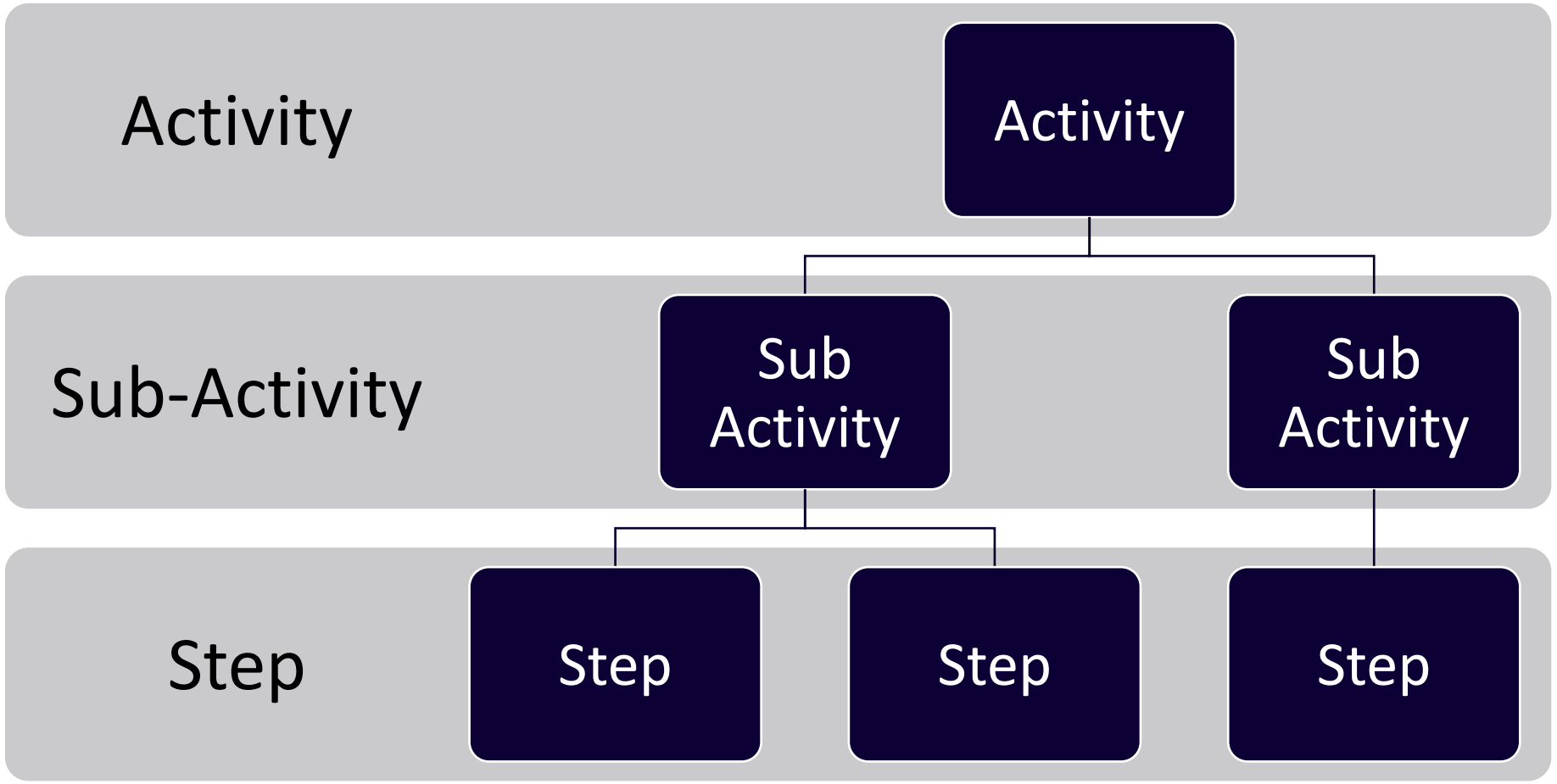
- Classes
  - Agents
    - Agent
    - Organization
  - Process
    - Activity
    - ControlLogic
    - DeterministicImperative
    - Parameter
    - ProcessingAgent
    - ProductionEnvironment
    - Sequence
    - Step

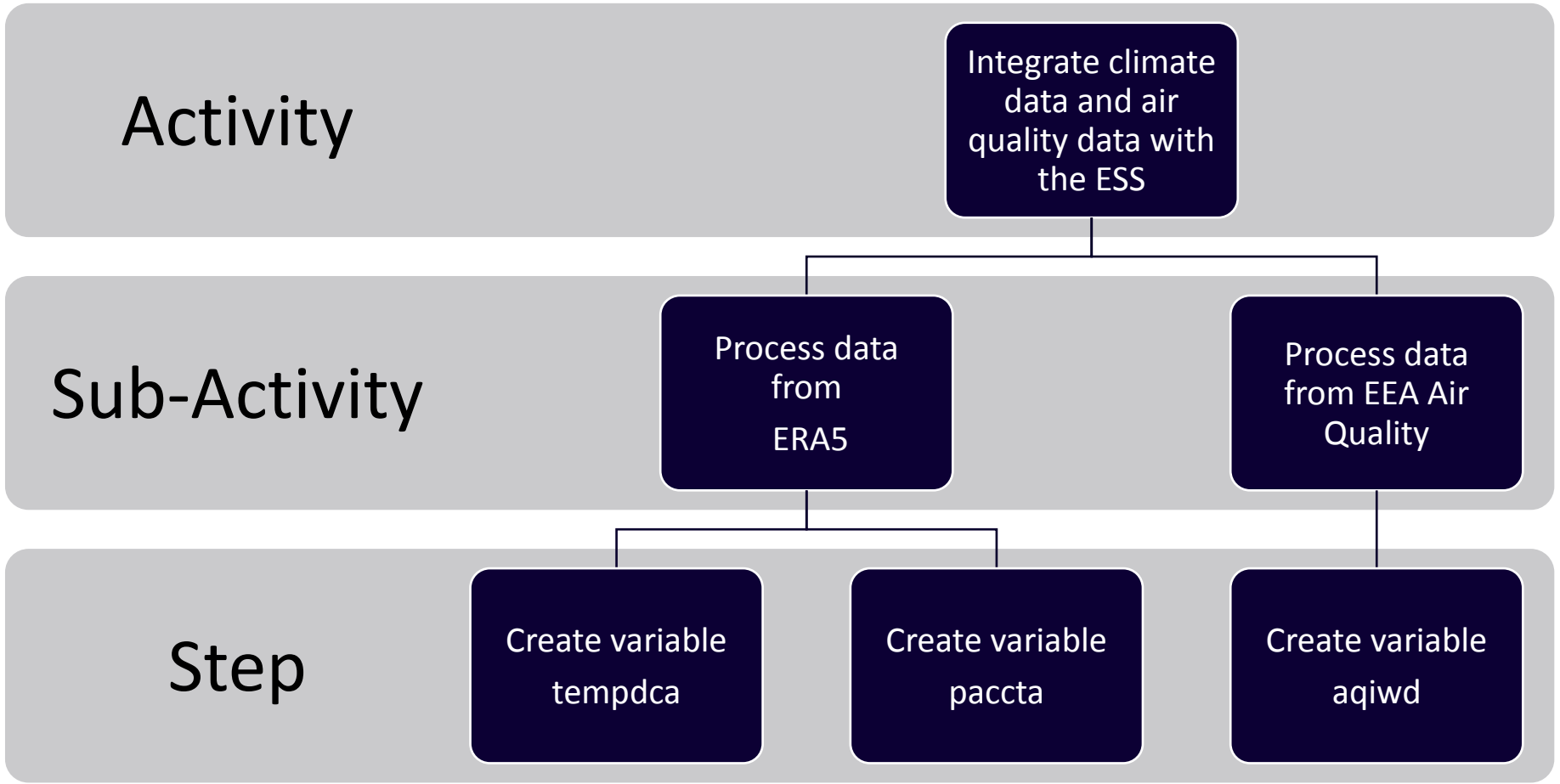
Subset of Process Model

Activity

UML Diagram: Class Activity in Context



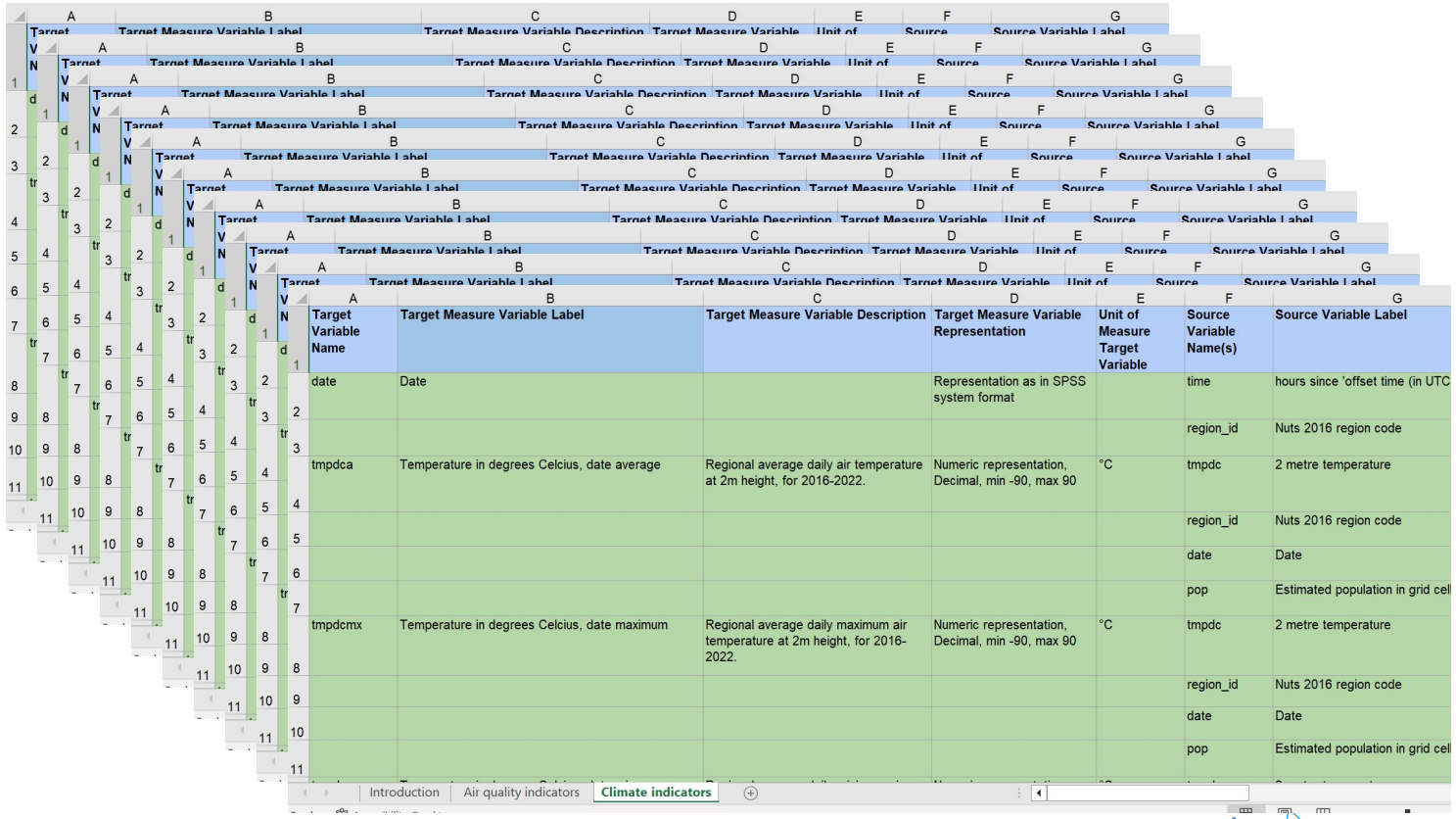

Activity
Activity
Sub-Activity
Sub Activity
Sub Activity
Step
Step
Step
Step


Activity
Integrate climate data and air quality data with the ESS
Sub-Activity
Process data from ERA5
Process data from EEA Air Quality
Step
Create variable tempdca
Create variable paccta
Create variable aqiwd

How to generate the DDI-CDI metadata?

For each class of the subset, we have created a dedicated table

- Classes
  - Agents
    - Agent
    - Organization
  - Process
    - Activity
    - ControlLogic
    - DeterministicImperative
    - Parameter
    - ProcessingAgent
    - ProductionEnvironment
    - Sequence
    - Step



Target Variable Name	Target Measure Variable Label	Target Measure Variable Description	Target Measure Variable Representation	Unit of Measure Target Variable	Source Variable Name(s)	Source Variable Label
date	Date		Representation as in SPSS system format		time	hours since 'offset time (in UTC
					region_id	Nuts 2016 region code
tmpdca	Temperature in degrees Celcius, date average	Regional average daily air temperature at 2m height, for 2016-2022.	Numeric representation, Decimal, min -90, max 90	°C	tmpdc	2 metre temperature
					region_id	Nuts 2016 region code
					date	Date
					pop	Estimated population in grid cel
tmpdcmx	Temperature in degrees Celcius, date maximum	Regional average daily maximum air temperature at 2m height, for 2016-2022.	Numeric representation, Decimal, min -90, max 90	°C	tmpdc	2 metre temperature
					region_id	Nuts 2016 region code
					date	Date
					pop	Estimated population in grid cel

Introduction | Air quality indicators | Climate indicators

Tour of the tool

https://eosc-provenance.sikt.no/#

European Social Survey

ESS Labs Process Search

Go

Contents

CDI-Workflow description of the EOSC Future WP6 Task 3, Science Project 9 'Climate Neutral and Smart Cities'

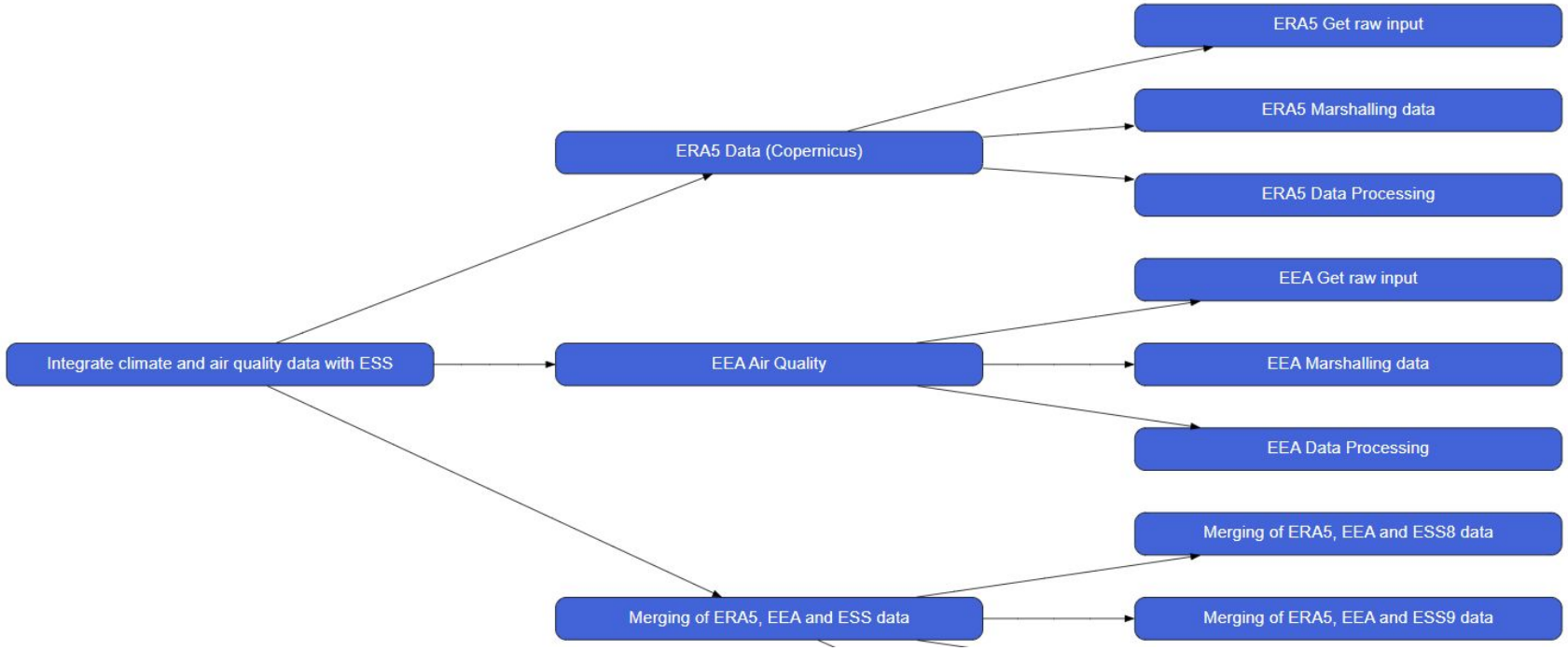
Main Process Sequence

Description: Main Sequence of the process

Processing Agent: EOSC project team at Sikt - Norwegian Agency for Shared Services in Education and Research
Purpose: Integrate climate data from ERA5 and air quality data from the EEA with the ESS survey data
Production Environment: Sikt - Norwegian Agency for Shared Services in Education and Research acting as a participant of SP9

Overview Diagram of the Process Activities (in sequential order)

Note: *Move the mouse cursor over an activity to see more information. Click on an activity to go to the corresponding page.*



Integrate climate and air quality data with ESS

Process Activity

Description: Integrate climate data from Copernicus ERA5 and air quality data from the European Environmental Agency (EEA) with data from the European Social Survey (ESS) for Berlin, Oslo, Stockholm, Brussels, London, Paris, Vienna, Prague, Budapest, and Madrid

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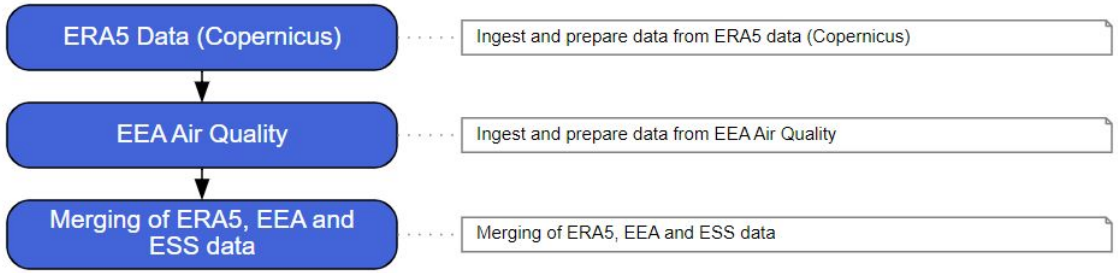
Diagram of the Process Sub-Activities (in sequential order)

Note: *Click on a sub-activity to go to the corresponding page.*



ERA5 Data (Copernicus)¶

Process Activity

Description: Ingest and prepare data from ERA5 data (Copernicus)

Diagram of the Process Activity

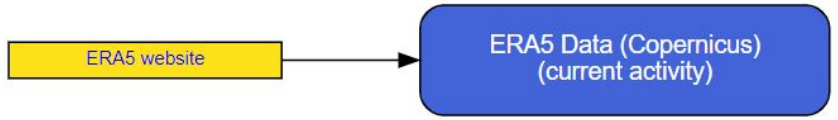
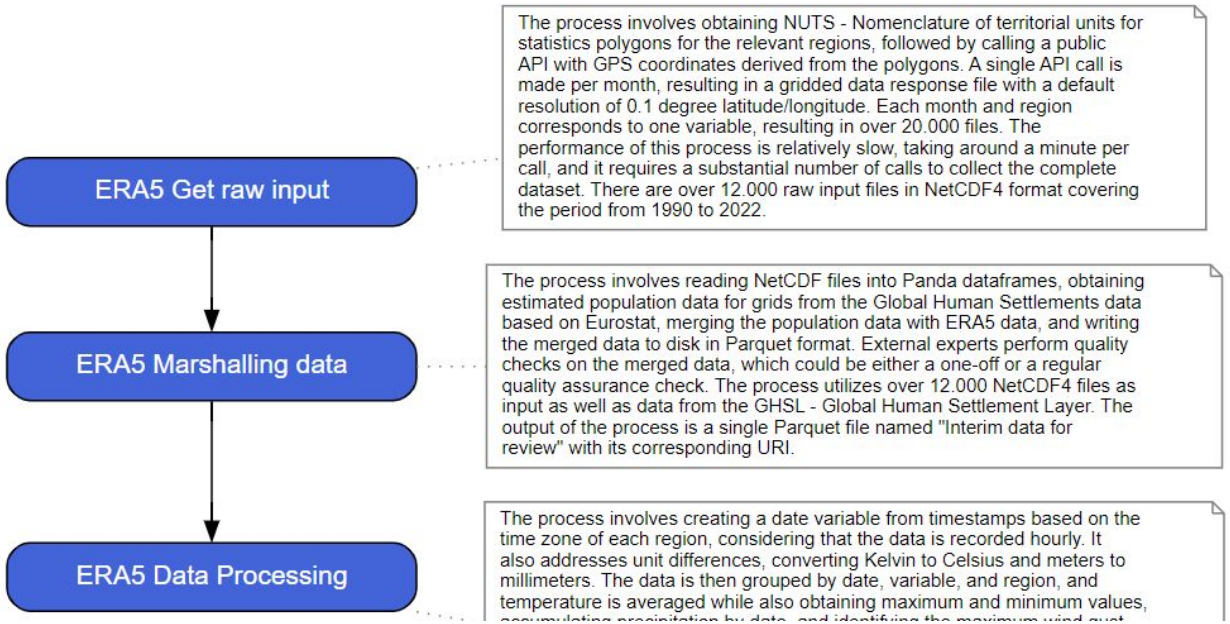


Diagram of the Process Sub-Activities (in sequential order)

Note: *Click on a sub-activity to go to the corresponding page.*



ERA5 Get raw input ¶

Process Activity

Description: The process involves obtaining NUTS - Nomenclature of territorial units for statistics polygons for the relevant regions, followed by calling a public API with GPS coordinates derived from the polygons. A single API call is made per month, resulting in a gridded data response file with a default resolution of 0.1 degree latitude/longitude. Each month and region corresponds to one variable, resulting in over 20.000 files. The performance of this process is relatively slow, taking around a minute per call, and it requires a substantial number of calls to collect the complete dataset. There are over 12.000 raw input files in NetCDF4 format covering the period from 1990 to 2022.

Diagram of the Process Activity

https://gisco-services.ec.europa.eu/distribution/v2/nuts/geojson/NUTS_RG_01M_2016_4326_LEVL_1.geojson

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ERA5 Marshalling data

Process Activity

Description: The process involves reading NetCDF files into Panda dataframes, obtaining estimated population data for grids from the Global Human Settlements data based on Eurostat, merging the population data with ERA5 data, and writing the merged data to disk in Parquet format. External experts perform quality checks on the merged data, which could be either a one-off or a regular quality assurance check. The process utilizes over 12.000 NetCDF4 files as input as well as data from the GHSL - Global Human Settlement Layer. The output of the process is a single Parquet file named “Interim data for review” with its corresponding URI.

Diagram of the Process Activity

European Social Survey

ESS Labs Process Search

Go

Contents

ERA5 Data Processing

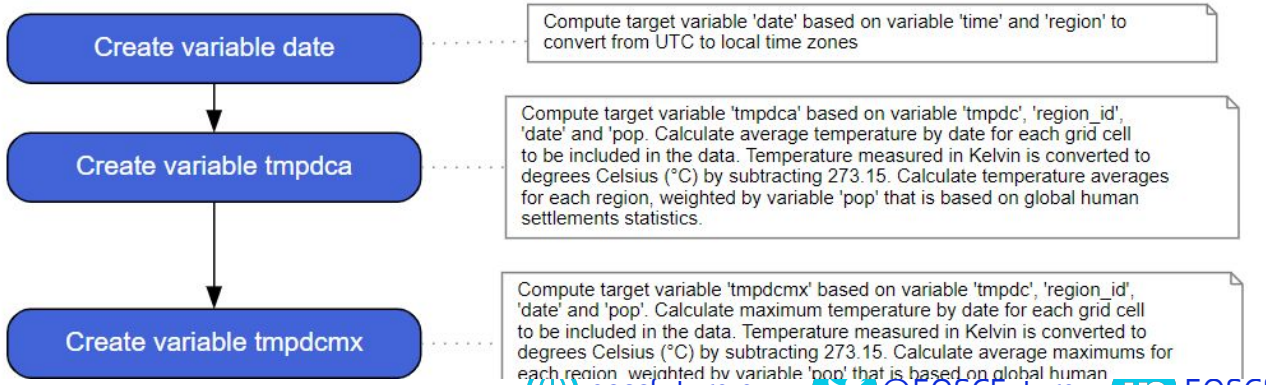
Process Activity

Description: The process involves creating a date variable from timestamps based on the time zone of each region, considering that the data is recorded hourly. It also addresses unit differences, converting Kelvin to Celsius and meters to millimeters. The data is then grouped by date, variable, and region, and temperature is averaged while also obtaining maximum and minimum values, accumulating precipitation by date, and identifying the maximum wind gust value. Moving averages are calculated for variables using different time windows (7-day, 30-day, 90-day, 365-day). Baseline values for temperature, precipitation, wind gust, and deviations from the baseline (anomalies) are determined based on the period from 1991 to 2020. Data older than 2015 is removed, and a group-by operation is performed, collapsing the data by region using population-weighted averages. It is important to note that the ERA5 data may contain imputed and missing values. In memory, each row corresponds to a region, with mesh-blocks aggregated per day to calculate region-level values by taking the average of all variables weighted by the population of each block. The resulting data is stored to disk in CSV, SAV, or other suitable formats, as the data size remains manageable.

Diagram of the Process Activity

Diagram of the Process Sub-Activities (in sequential order)

Note: *Click on a sub-activity to go to the corresponding page.*



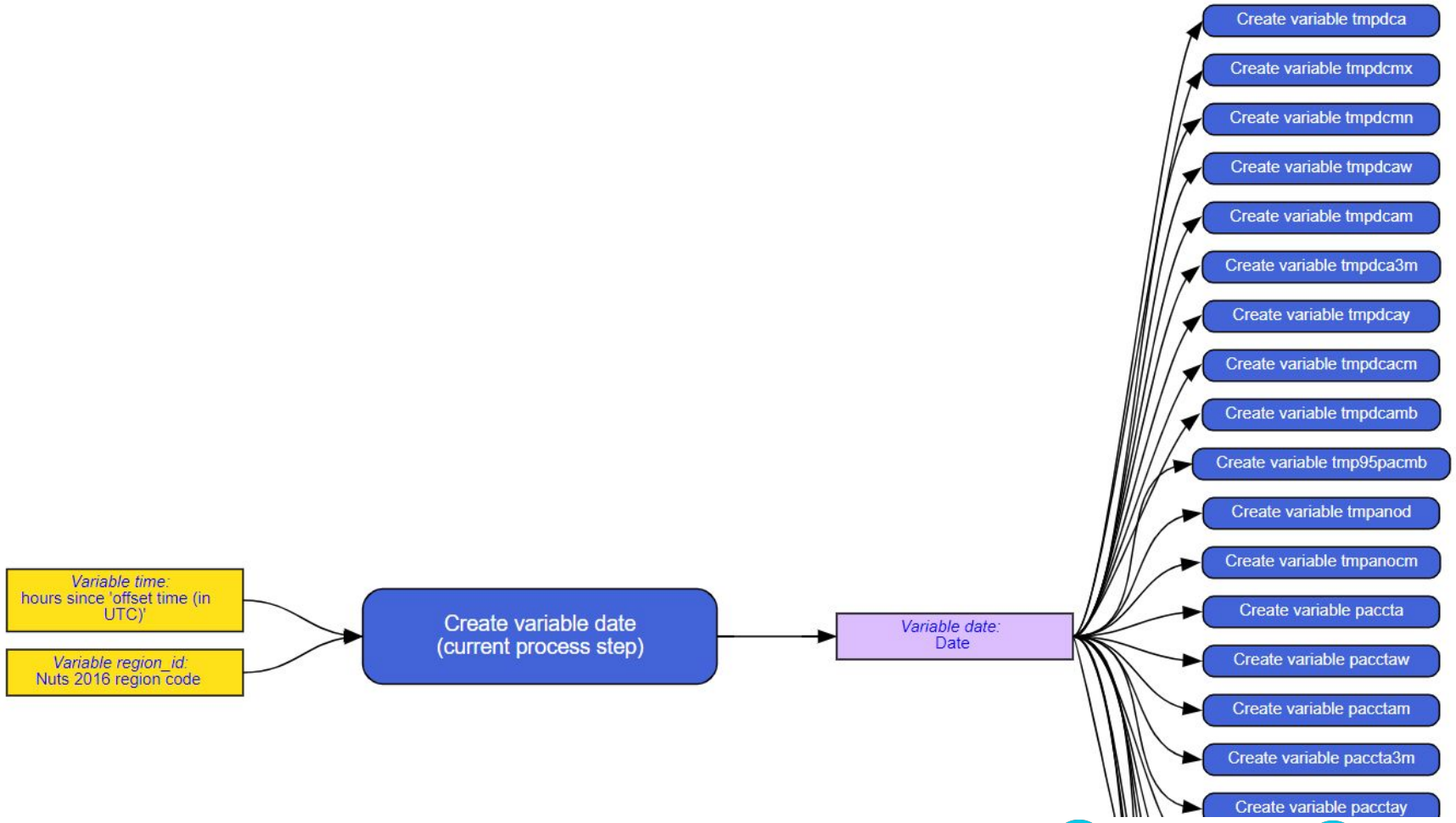
Create variable date ¶

Process Step

Description Compute target variable ‘date’ based on variable ‘time’ and ‘region’ to convert from UTC to local time zones

This step uses a script written in Python3.

Diagram of the Process Step



Create variable tmpdca

Process Step

Description Compute target variable 'tmpdca' based on variable 'tmpdc', 'region_id', 'date' and 'pop. Calculate average temperature by date for each grid cell to be included in the data. Temperature measured in Kelvin is converted to degrees Celsius (°C) by subtracting 273.15. Calculate temperature averages for each region, weighted by variable 'pop' that is based on global human settlements statistics.

This step uses a script written in Python3.

Diagram of the Process Step

Hint: *Move the mouse cursor over a parameter to see more information. Click on a parameter or a related step to go to the corresponding page.*

Legend: Input parameter — used by → Process step — produces → Output parameter

https://github.com/sikt-no/ess-labs-data-sp9/blob/master/era5-prepare.py#L41

Files

master

Go to file

- .gitignore
- README.md
- config_RENAME_ME.py
- eea-download.py
- eea-prepare.py
- era5-download.py
- era5-prepare.py
- merge.py
- requirements.in
- requirements.txt
- utils.py

ess-labs-data-sp9 / era5-prepare.py

Code | Blame | 265 lines (214 loc) · 8.16 KB

```
14  def create_date_column(df):
28      df["tmpdc"] = df["tmpdc"] - 273.15  # kelvin to celcius
29      df["pac"] = (df["pac"] * 1000).round(2)  # meters to millimeters
30      return df
31
32
33  def groupby_date(df_in: pd.DataFrame) -> pd.DataFrame:
34      """
35      Calculate grid-based daily values
36      """
37      daily_grouper = df_in.groupby(["region", "grid_id", "date"])
38      df = pd.DataFrame(
39          {
40              "pop": daily_grouper["pop"].first(),
41              "tmpdca": daily_grouper["tmpdc"].mean(numeric_only=True),
42              "tmpdcmx": daily_grouper["tmpdc"].max(),
43              "tmpdcmn": daily_grouper["tmpdc"].min(),
44              "paccta": daily_grouper["pac"].sum(),
45              "iwg10mx": daily_grouper["iwg10"].max(),
46          }
47      )
48      return df
49
```

Create variable tmpdca

Process Step

Description Compute target variable 'tmpdca' based on variable 'tmpdc', 'region_id', 'date' and 'pop. Calculate average temperature by date for each grid cell to be included in the data. Temperature measured in Kelvin is converted to degrees Celsius (°C) by subtracting 273.15. Calculate temperature averages for each region, weighted by variable 'pop' that is based on global human settlements statistics.

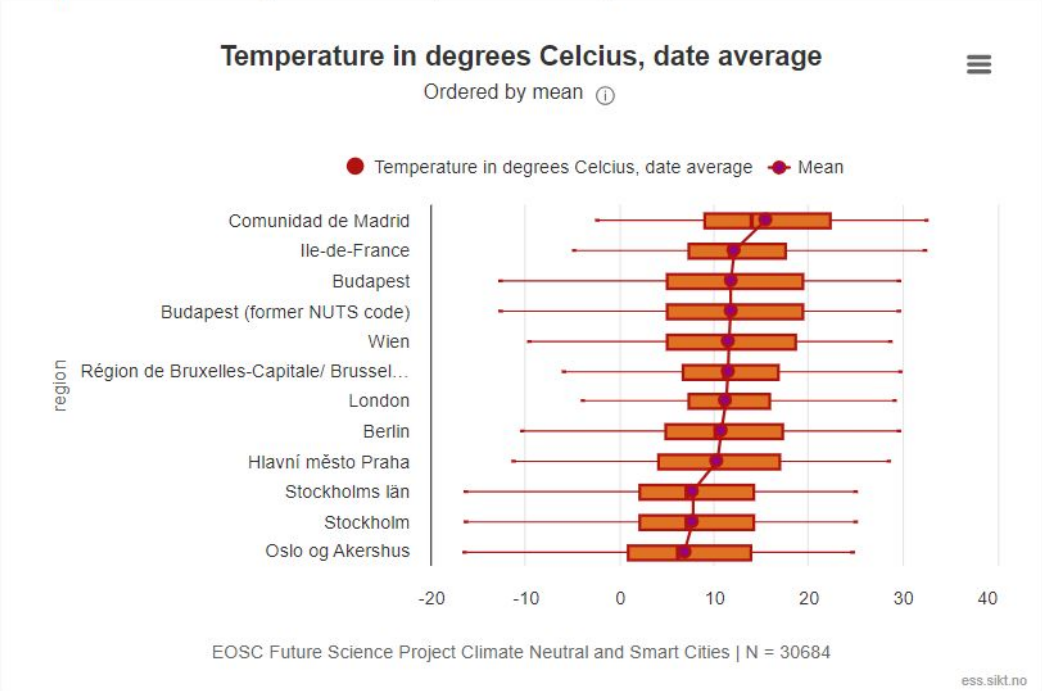
This step uses a script written in Python3.

Diagram of the Process Step

Hint: *Move the mouse cursor over a parameter to see more information. Click on a parameter or a related step to go to the corresponding page.*

Legend: Input parameter — used by → Process step — produces → Output parameter

tmpdca - Temperature in degrees Celcius, date average



Detailed variable information

tmpdca - Temperature in degrees Celcius, date average

Low	Q1	Median	Q3	High	Mean
-16.5	4.8	10.5	16.8	32.4	10.7

Note:
Regional average daily air temperature at 2m height, for 2016-2022. Unit of measure: °C

Process description ↗

Accreditation

Tool Developer: Joachim Wackerow

Thank you!

https://eosc-provenance.sikt.no/#
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benjamin.beuster@sikt.no
joachim.wackerow@posteo.de

Science Project 'Climate Neutral and Smart Cities'

Utility

David Rayner (SND)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

Feasibility Use-Case

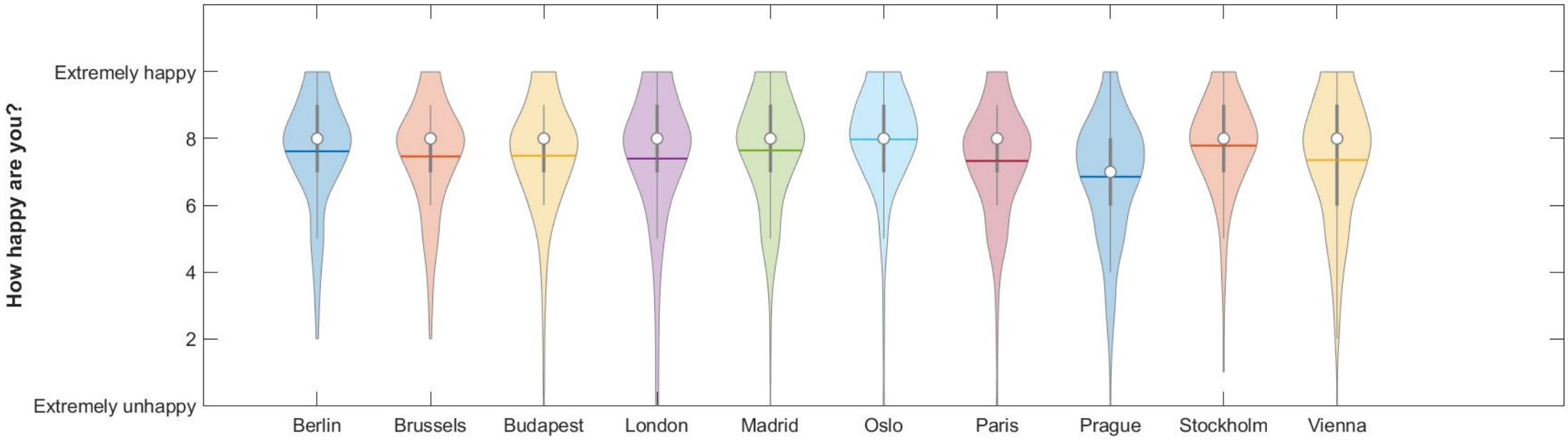
“ Its limitations are many but hint at a multitude of analytical opportunities. ”

“ For each 1 degree increase in this (for the calendar month of interview) there is a 7% rise in the likelihood of the respondent reporting worry about climate change. This is only significant at p<.1 (actually p=.051). ”

Climate and Air Quality Data in Attitudinal Research: A Feasibility Use-Case, 2023, Eric Harrison. https://zenodo.org/records/10581886

Does recent rainfall affect happiness?

How happy are you?



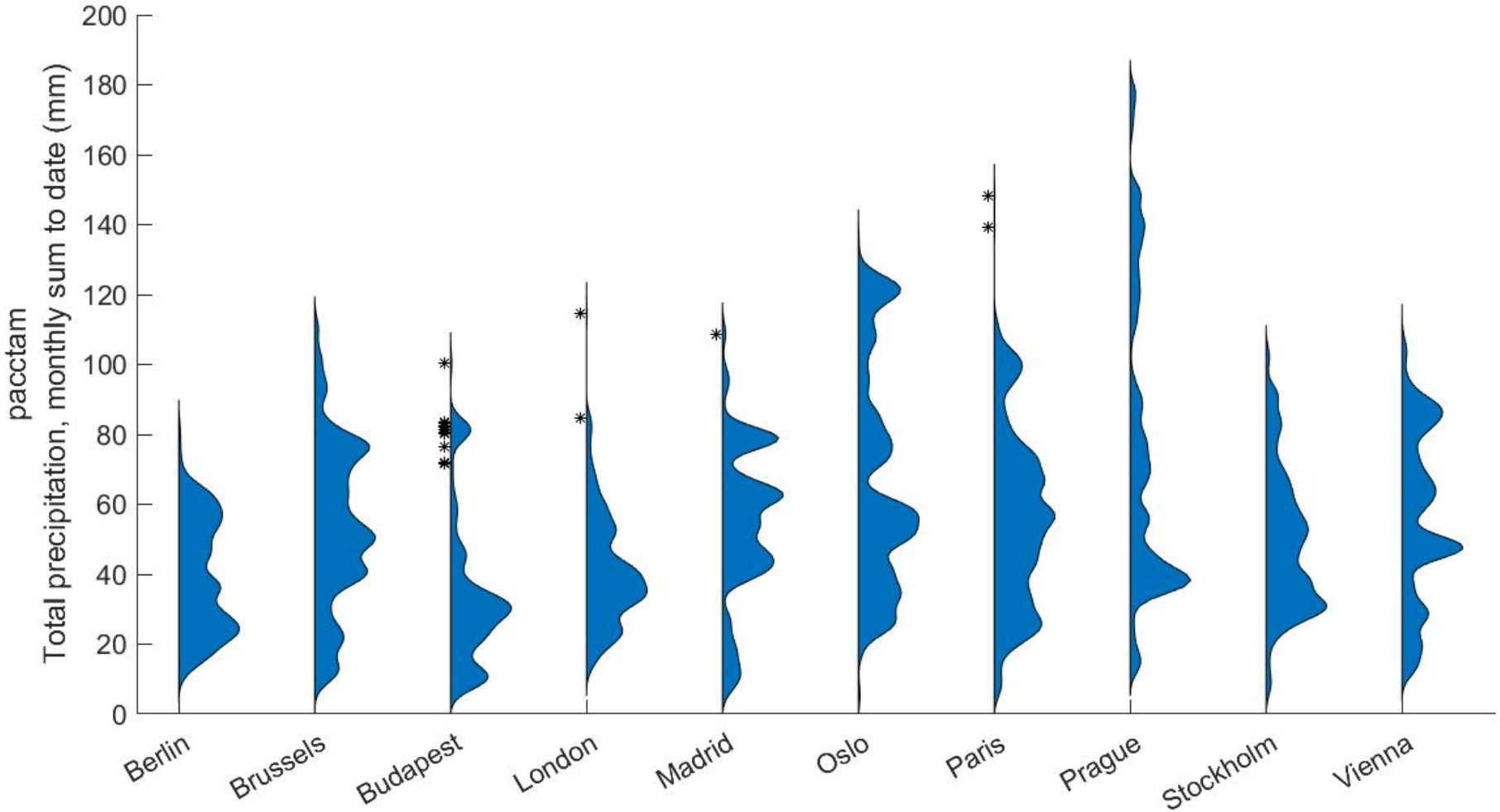
Which variables to use?

paccta	Total precipitation average, date
pacctaw	Total precipitation, weekly sum to date.
pacctam	Total precipitation, monthly sum to date.
paccta3m	Total precipitation, three-monthly sum to date.
pacctay	Total precipitation, yearly sum to date.
pacctcm	Total precipitation, calendar month
pacctmb	Total precipitation, multi-year calendar month averages, baseline 1991 - 2020
paccdcm	Total precipitation, calendar month relative to normal.

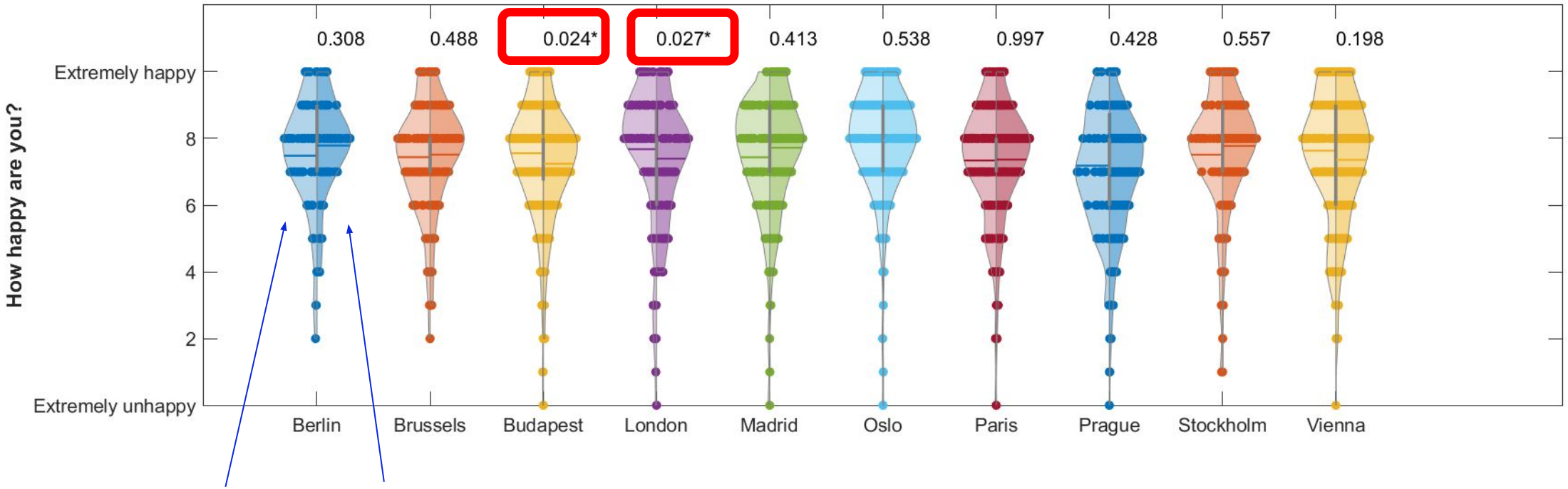
Which variables to use?

paccta	Total precipitation average, date
pacctaw	Total precipitation, weekly sum to date
pacctam	Total precipitation, monthly sum to date.
paccta3m	Total precipitation, three-monthly sum to date.
pacctay	Total precipitation, yearly sum to date.
pacctcm	Total precipitation, calendar month
pacctmb	Total precipitation, multi-year calendar month averages, baseline 1991 - 2020
paccdcm	Total precipitation, calendar month relative to normal.

Precipitation, month before interview.



Happiness and precipitation anomaly?



Less than 50% of normal for the month.

25% more than normal for the month.

Total precipitation, monthly sum to date.

Science Project 'Climate Neutral and Smart Cities'

FAIRness and metadata

Arofan Gregory (Sikt)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

FAIRness and Metadata

- Why FAIR? What are we trying to achieve?
- What does FAIRness require?
- What did we learn in the project?

FAIR is about Better Research

- FAIR is about enabling researchers to work more efficiently
  - Climate change is a complex problem requiring multi-disciplinary study
  - Access to data in a practical way is a key enabler
- Researchers are not the end goal!
  - "Grand challenges" like climate change demand good policy
  - Good policy requires an understanding of social attitudes
- By making access to needed data easier, across domains, we can make this happen
  - We must consider practical aspects!
  - Unfamiliar climate and environment data needs to be comprehensible to social researchers

FAIR is about Metadata

- To share data, we need good metadata
- In cross-domain scenarios, the need for metadata increases
  - Complete information about variables and data structures
  - Detailed provenance/processing metadata (especially!)
- Metadata needs to be in standard, useful formats
  - These often exist *within* domains (DDI for social science, NetCDF for climate data, etc.)
  - Domain standards are not directly useful outside their domains
  - Provenance metadata is usually absent, making data harder to reuse and harder to *trust*

What Did We Learn?

- The metadata exists for all of the data sets, but…
  - In practical terms, the data is too complex to be used directly in available forms
  - It was not in standards accessible to social scientists (for climate and environment data)
  - Presentation of the information was lacking!
- Provenance/process information
  - There is no single standard (there are several)
  - Other "provenance browser" applications exist (public health, economics, etc.)
  - None provide this information in an open standard, as required by FAIR

Science Project 'Climate Neutral and Smart Cities'

Looking forward

Arofan Gregory (Sikt)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

Realizing the Promise of EOSC

- EOSC aims at supporting efficient reuse of resources and services for all European research
  - The use of standards for metadata is being address (e.g., the EOSC Interoperability Framework)
  - Many useful services have been/are being developed
  - Some aspects of legal and organizational interoperability are being highlighted
- Most progress is on the technical side (so far)
  - Technical challenges are difficult but…
  - They are better understood than legal/organizational ones

Interoperability for Cross-Domain Research

- In "Climate Neutral and Smart Cities" we explored the practical aspects of doing cross-domain research
- There are different levels of collaboration:
  - Scientific: how do we study the problem? What data do we need?
  - Data/metadata systems: how can we access and use the data?
  - Organisational/legal: how can we work together? Where does support for such work come from?
- These levels are inter-related

Scientific Collaboration

- Need experts from different domains
  - Scientists are intellectually curious and easily engaged
  - You need the *right* experts for the research question/data
- Competing priorities set by individual's institutions
  - Are resources available for scientific collaboration?
  - Is there an existing process for supporting such projects?
- Our experience was generally positive
  - Possible, but not as easy as it could be
  - Did not feel like a "normal" project - could EOSC help establish a "normal" process for such research?

Data/Metadata Systems

- Data sources were available and usable
  - Metadata existed, often in standard form, but…
  - Not fully "FAIR" for cross-domain purposes
- Emphasized the need for better provenance/process metadata
- Explored ways to present needed metadata for cross-domain use
- Identified need for agreed *cross-domain* standards
  - As part of EOSC Interoperability Framework
  - WorldFAIR Cross-Domain Interoperability Framework (CDIF)
  - Others?
- Lessons learned can provide input to further work within EOSC and more broadly

Organisational/Legal Collaboration

- Legal considerations between data infrastructures were minor
  - Data all public and free
  - Commercial use the only consideration
  - No questions about legal liability
- Organisational collaboration more complicated
  - Infrastructures expect to serve their user communities with their data
  - Systems do not anticipate need for other infrastructures to use their data on a large scale (target for use is researchers)
  - Collaborations between infrastructures currently unsupported
- Prioritising "high-value" collaborations is ad hoc
  - What are the important research questions which need cross-domain data?
  - Which infrastructures should serve which research communities?
- EOSC could help provide solutions

Inter-Dependencies and Issues

- Scientific collaborations are the key
  - Provide requirements for data and metadata systems
  - Drive prioritization of data infrastructure collaborations
- Detailed provenance helps
  - To provide transparency
  - To promote trust
- Ideally, all three levels work together. But how best to do this?
- Current EOSC project funding is emphasizing *scientific impact*
  - Is this enough?
  - Should we explore support for cross-domain research at the scientific and organizational levels more?
  - Would need to answer questions around structure and process as well as just resources

Science Project 'Climate Neutral and Smart Cities'

Q&A and Panel discussion

Moderator: Irena Vipavc Brvar (CESSDA/UL-ADP)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

Science Project 'Climate Neutral and Smart Cities'

Wrap-up

Hilde Orten (Sikt)

The EOSC Future project is co-funded by the European Union Horizon Programme call INFRAEOSC-03-2020, Grant Agreement 101017536

Contributors

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- Hannah Clark (IAGOS)
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SSHOC
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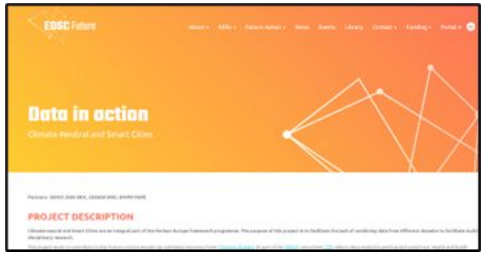
ENVRI community

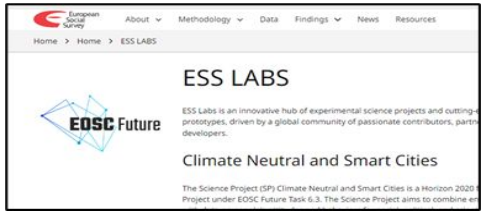
Where to find the project deliverables?

- EOSC Portal/Marketplace: https://marketplace.eosc-portal.eu/
  - **ESS Labs** added **as a service**

- EOSC Future web page: https://eoscfuture.eu/data/climate-neutral-and-smart-cities/

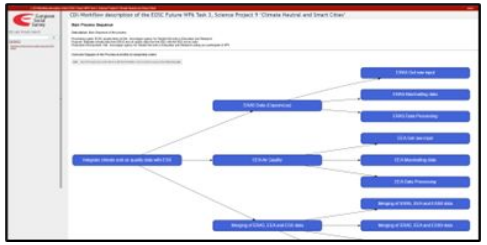


- ESS Labs page: https://www.europeansocialsurvey.org/esslabs/
  - Contains links to **all project deliverables**



- Data access in the ESS Data Portal: https://ess.sikt.no/en/study/71586b4f-ef66-4b90-aed7-e7e7ad7406ce

- Provenance description application prototype: https://eosc-provenance.sikt.no/



Papers

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Orten H, Rayner D, Stavestrand E, Alfredsson I, Lace I, Vipavc Brvar I, Dolinar M, Wackerow J, Clark H (2023) Climate and Air Quality Indices for the European Social Survey. ARPHA Preprints. https://doi.org/10.3897/arphapreprints.e114675

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Thank you very much for attending the webinar and for your contributions!

Best wishes from the EOSC Future 'Climate-neutral and Smart Cities' project team