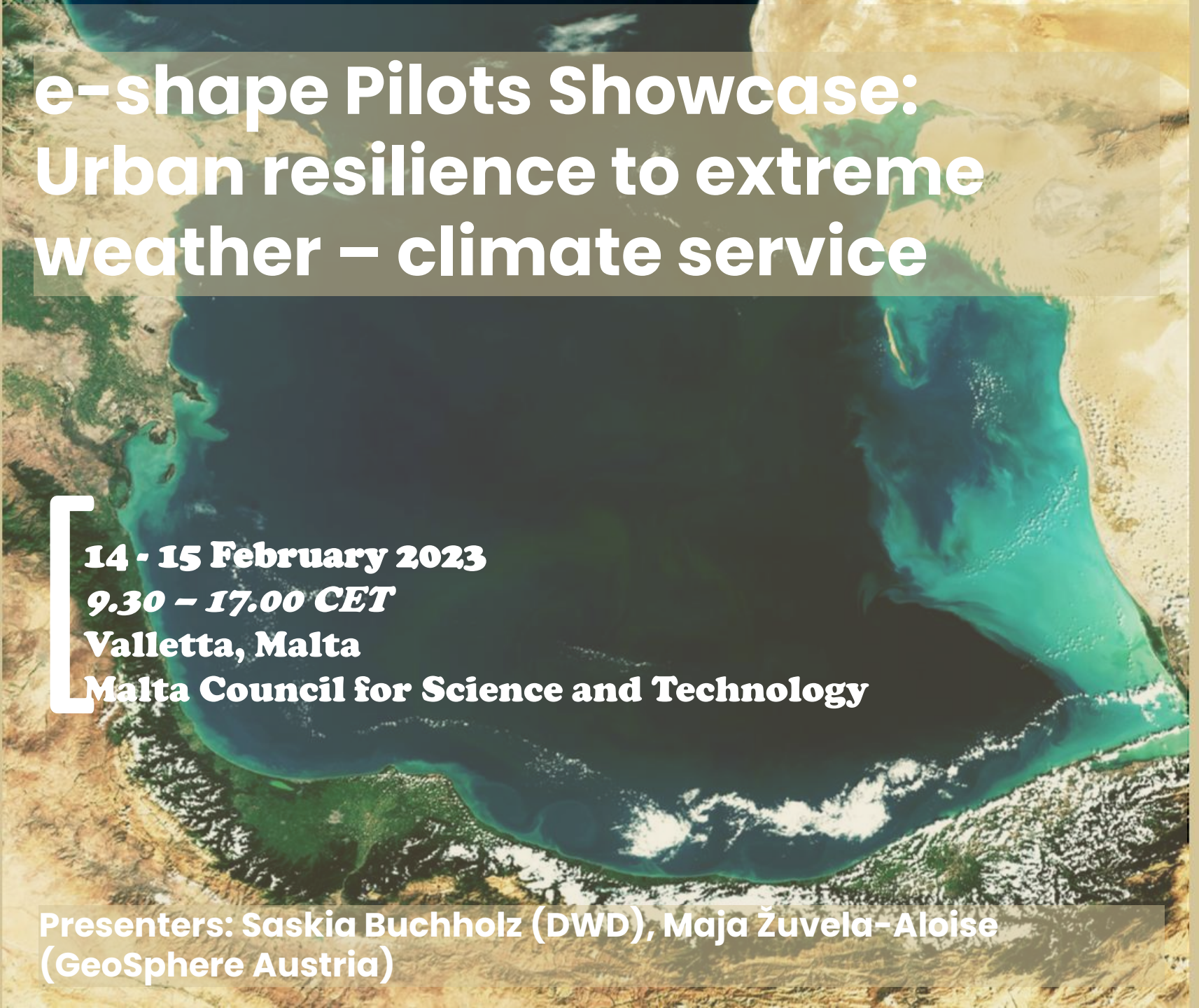


e-shape Pilots Showcase: Urban resilience to extreme weather – climate service

14 - 15 February 2023
9.30 – 17.00 CET
Valletta, Malta
Malta Council for Science and Technology

Presenters: Saskia Buchholz (DWD), Maja Žuvela-Aloise (GeoSphere Austria)

e-shape

An event co-organised by

Xjenza

The Malta Council for Science & Technology

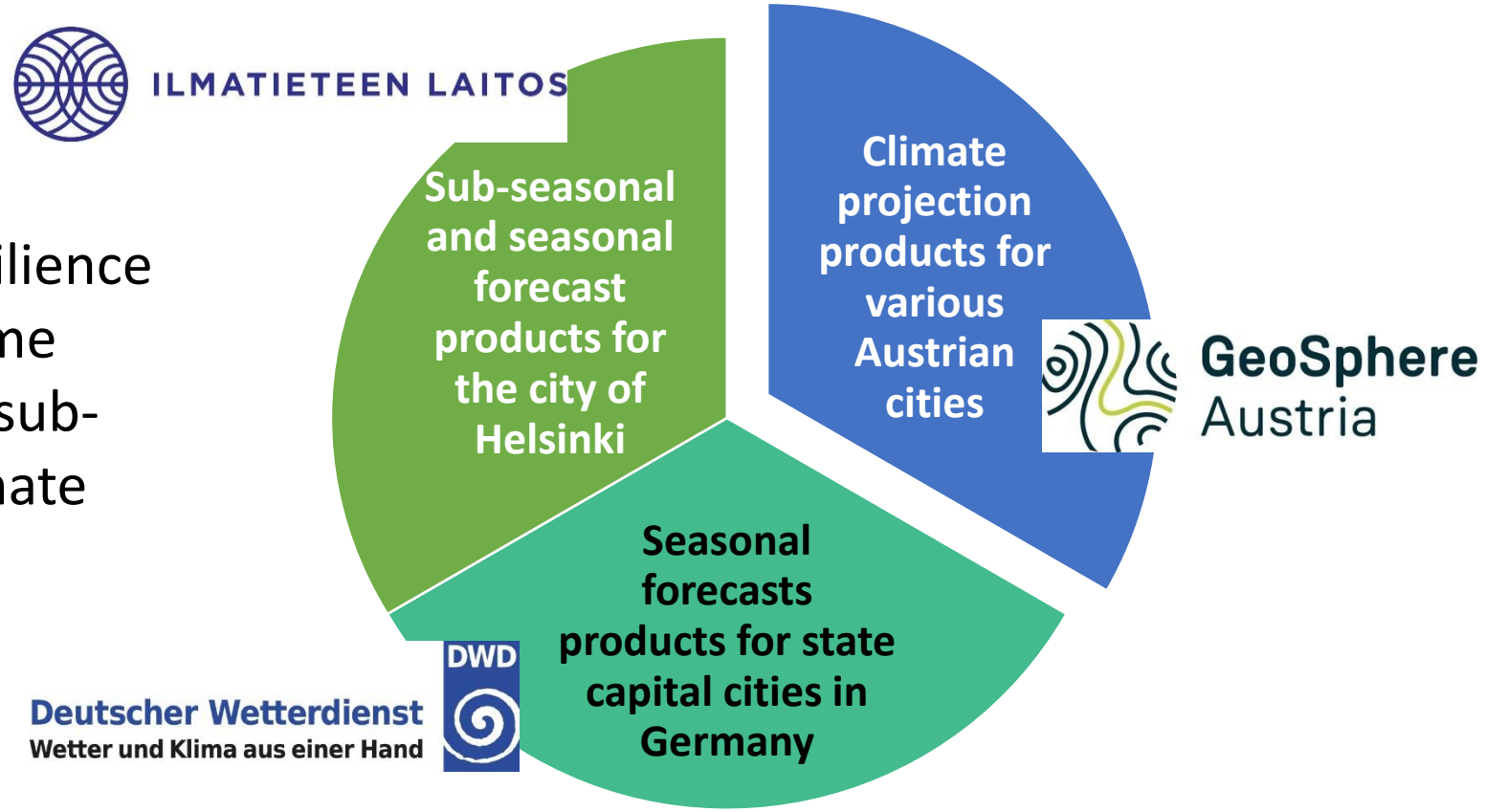
eurisy
ACTING COLLECTIVELY TO BRIDGE SPACE AND SOCIETY

e-shape

Pilot Overview

S7 Climate showcase
P2 Urban resilience to extreme weather

Goal: strengthen urban resilience and preparedness to extreme weather and climate using sub-seasonal, seasonal and climate projection data



FMI – **Sub-seasonal and seasonal predictions for winter street maintenance activities in Helsinki**

Otto Hyvärinen, Andrea Vajda, Mika Rantanen, Andreas Tack, Markus Mellin
Finnish Meteorological Institute

- Serving City of Helsinki authorities
  - in planning their activities,
  - improving winter safety and
  - optimizing maintenance costs
- Winter street maintenance activities include
  - snow removal from streets,
  - street sanding,
  - cleaning streets of sand and grit in spring

https://pixabay.com/photos/car-under-snow-winter-helsinki-car-5994674/

DWD – **Seasonal climate forecast products for German state capital cities**

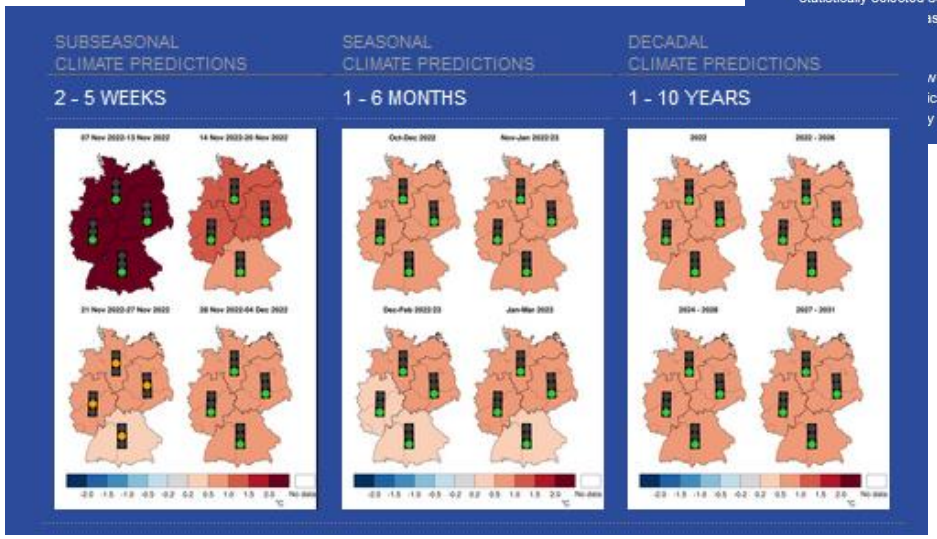
Saskia Buchholz, Andreas Paxian, Birgit Mannig, Amelie Hoff
Deutscher Wetterdienst

- Seasonal climate forecast products for city authorities
  - decrease the vulnerability of urban population to hazardous weather events and risks caused by climate variability (e.g., for periods of anomalous high temperatures, so that preventive measures can be taken in the occupational health and safety sectors)
  - provide the scientific basis for midterm planning decisions (decadal climate predictions)
- Use of the German Climate Forecast System Version (GCFS) Version 2.1
  - hindcasts: 30 ensemble members, forecasts: 50 ensemble members
  - ECMWF Atos BullSequana XH2000, Bologna Italy, post-pocressing DWD HPC architecture
- Increase of the GCFS spatial resolution to 5km x 5km via a statistical down-scaling approach called EPISODES

e-shape

www.dwd.de/climatepredictions

The e-shape pilot is accessible
via the "Basic Climate Predictions" and
"Seasonal Climate Predictions“, as well
As “Decadal Climate Predictions”



This is the website of the Deutscher Wetterdienst (DWD) for
consistent selection of available climate predictions and corr
different timescales (weeks, seasons, years) and varying s
Germany, Europe, World). All climate predictions on this web
improved continuously.

The climate prediction products on this website are based or
because there is no method that provides equally successfu
and regions. For some constellations, we therefore offer mo
climate prediction products for Germany in the winter half-ye
statistically selected seasonal climate predictions are used (
ıses, we will always explicitly mention t

ween basic, expert and - as a compleme
ics below. Background information is av
y feedback you may have on the websi

User Selection

Prediction Period (Month):
The seasonal climate prediction runs from the 1st of each month and is calculated for the next six months

Start of Prediction (Year):
The start year of the prediction can be selected

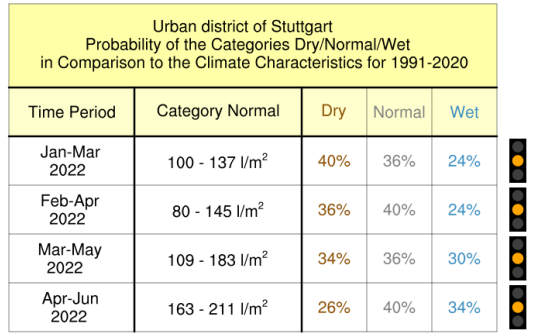
Region:
The predictions are available for different German regions, as well as for the capitals of the German federal states and Aschaffenburg

Variable:
temperature and precipitation

Type of Visualisation:
map, time series or table

Prediction Type:
ensemble mean prediction or probabilistic prediction

Data provision: ESGF Node at DWD, project ClimatePredictionsDE



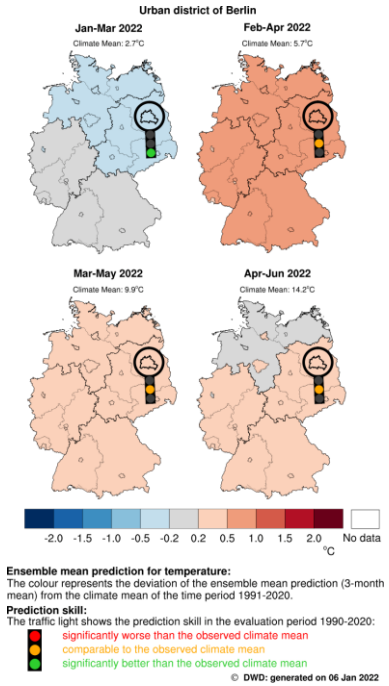
Urban district of Stuttgart
Probability of the Categories Dry/Normal/Wet
in Comparison to the Climate Characteristics for 1991-2020

Time Period	Category Normal	Dry	Normal	Wet
Jan-Mar 2022	100 - 137 l/m²	40%	36%	24%
Feb-Apr 2022	80 - 145 l/m²	36%	40%	24%
Mar-May 2022	109 - 183 l/m²	34%	36%	30%
Apr-Jun 2022	163 - 211 l/m²	26%	40%	34%

Probabilistic prediction for precipitation:
The table represents the probabilities of the three categories (Dry/Normal/ Wet) of the climate prediction (3-month sum) in comparison to the climate characteristics for the time period 1991-2020.

Prediction skill:
The traffic light shows the prediction skill in the evaluation period 1990-2020:
significantly worse than the observed climate mean
comparable to the observed climate mean
significantly better than the observed climate mean

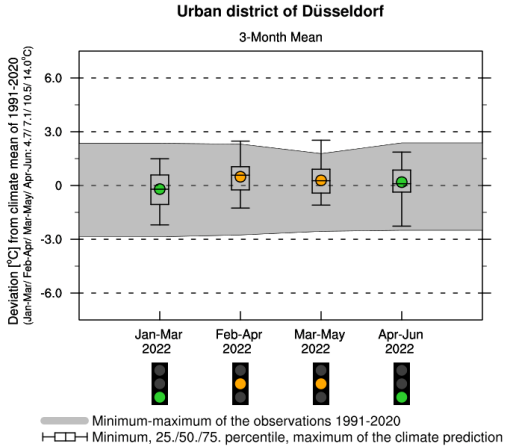
© DWD: generated on 07 Jan 2022



Ensemble mean prediction for temperature:
The colour represents the deviation of the ensemble mean prediction (3-month mean) from the climate mean of the time period 1991-2020.

Prediction skill:
The traffic light shows the prediction skill in the evaluation period 1990-2020:
significantly worse than the observed climate mean
comparable to the observed climate mean
significantly better than the observed climate mean

© DWD: generated on 06 Jan 2022



Ensemble mean prediction for temperature:
The coloured dots represent the deviation of the ensemble mean prediction (3-month mean) from the climate mean of the time period 1991-2020. The box-whisker represent the distribution of the prediction ensemble. The area in gray shows the spread of the observations in the time period 1991-2020.

Prediction skill:
The traffic light shows the prediction skill in the evaluation period 1990-2020:
significantly worse than the observed climate mean
comparable to the observed climate mean
significantly better than the observed climate mean

© DWD: generated on 06 Jan 2022

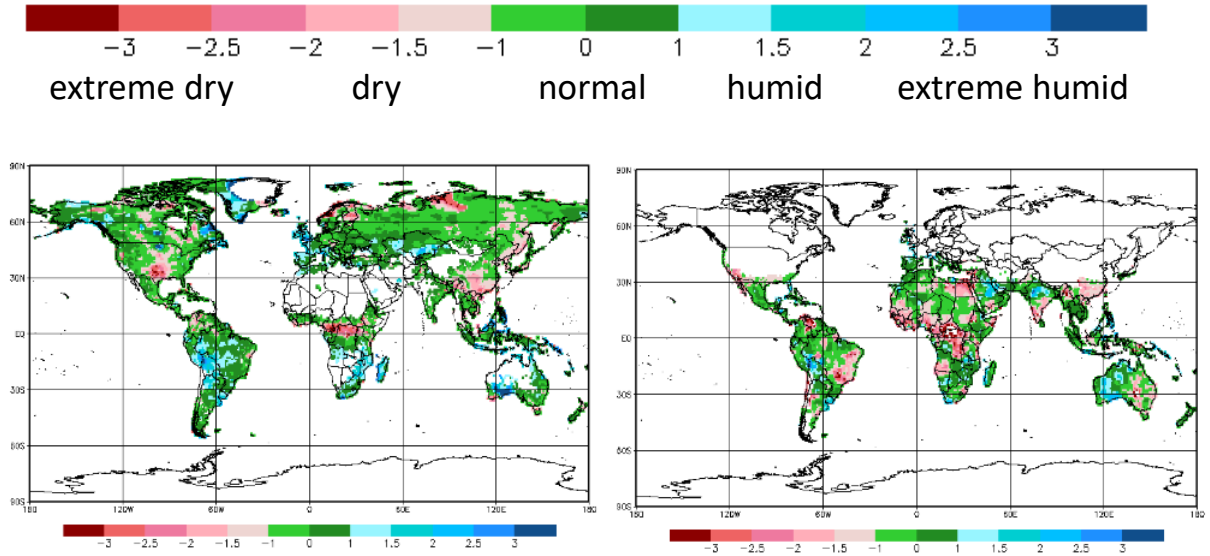
Outlook to planned extensions

Interactive presentation and selection of combined maps and time series for basic climate predictions

Further user-oriented products (e.g. drought and heat extreme values)

- SPI: Standardized Precipitation Index, not in very arid regions
  [McKee et al. 1993]

- SPEI: Standardized Precipitation Evapotraspiration Index, not in cold regions
  [Vicente-Serrano et al. 2010]



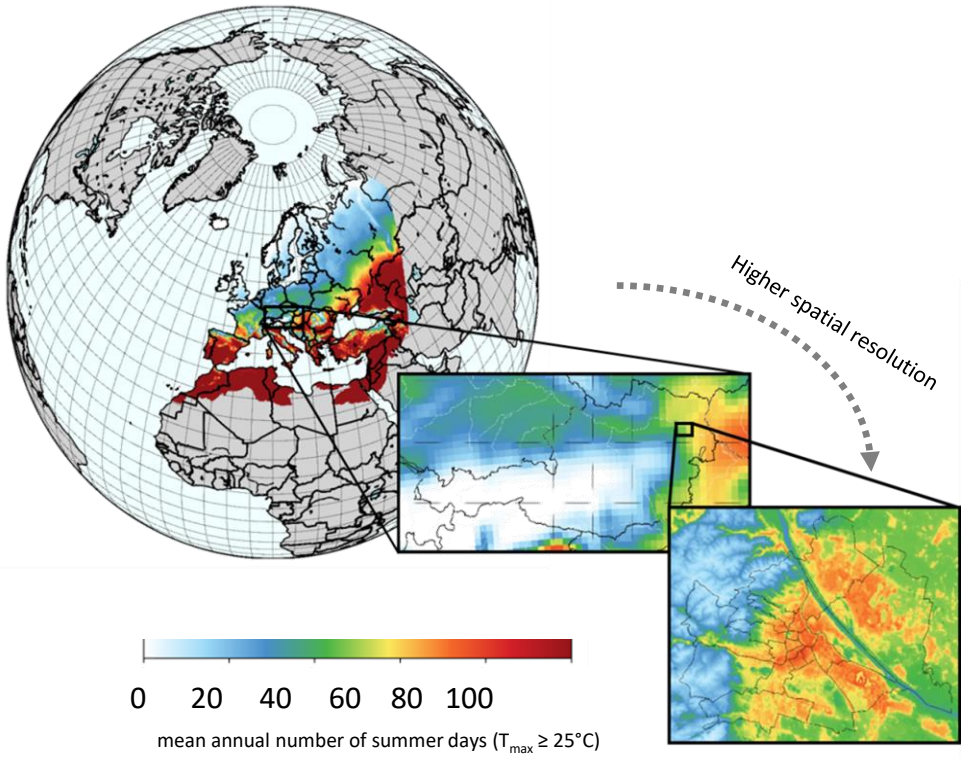
Ziese et al. 2014

GeoSphere Austria – Future climate projection of heat indices for major cities in Austria

Michael Avian, Sandro Oswald, **Maja Žuvela-Aloise**, Chris Schubert

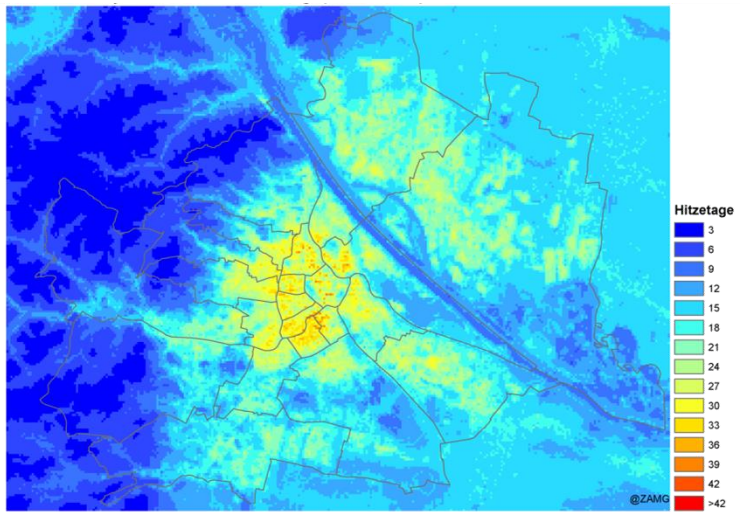
GeoSphere Austria *– Bundesanstalt für Geologie, Geophysik, Klimatologie und Meteorologie, Vienna, Austria*

- Climate scenarios on city-scale based on urban climate model simulations and climate projections from global (GCM) and regional climate model (RCM) outputs
- Product: High spatial resolution maps of heat indices including Climate Change and Urban Heat Island information
- Data are used as input for urban development plans, risk management, environmental protection
- Stakeholders: city administrations

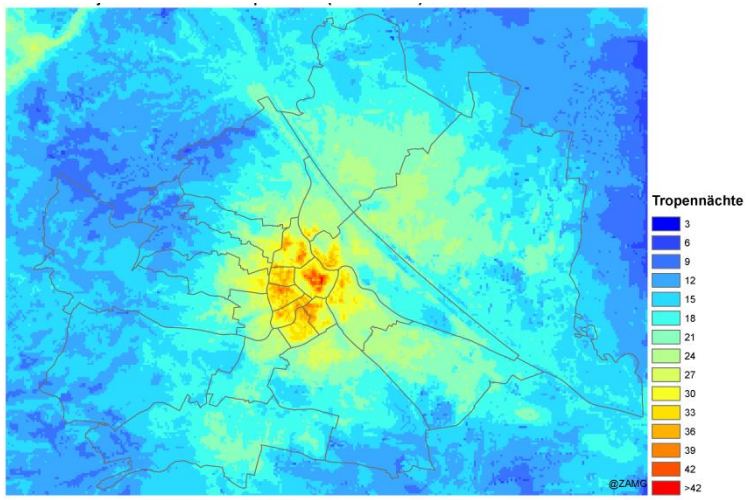


Pilot case developed for Vienna:

- Input EO data: Urban Atlas, Copernicus Land Monitoring Services, Land Information System Austria
- Input GCM/RCM data: EURO-CORDEX, IPCC RCP4.5 and RCP8.5
- Time period: 2011 - 2100
- Climate indices maps with 100 m horizontal resolution:
  - Mean annual number of summer days ($T_{max} \geq 25°C$), hot days ($T_{max} \geq 30°C$), tropical nights ($T_{min} \geq 20°C$)



*Mean annual number of **hot days** for the time period 1991 -2020*



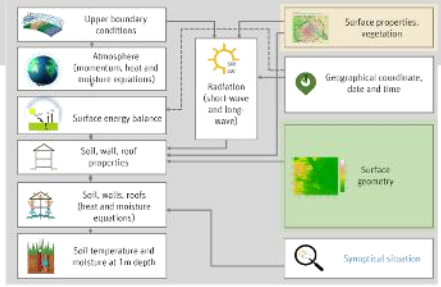
*Mean annual number of **tropical nights** for the time period 1991 -2020*

EURO-CORDEX - Coordinated Downscaling Experiment - European Domain

Methodology

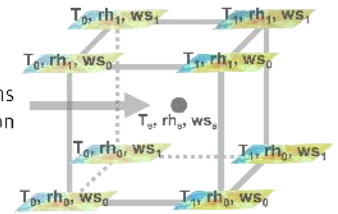
DYNAMICAL PART: MUKLIMO_3 SIMULATIONS

Digital Elevation Model
Copernicus layer (Urban Atlas etc.)
Land use table
1-D vertical profiles

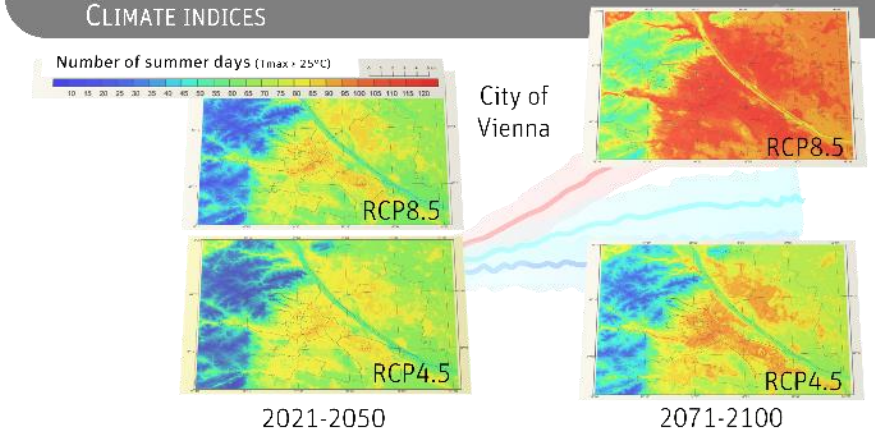


STATISTICAL PART: CUBOID METHOD

Daily measurements of meteorological stations
Trilinear interpolation

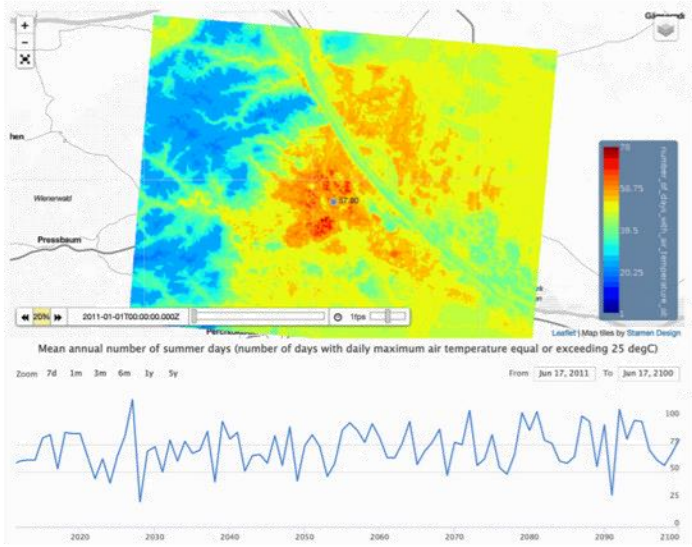


POST-PROCESSING: CLIMATE INDICES

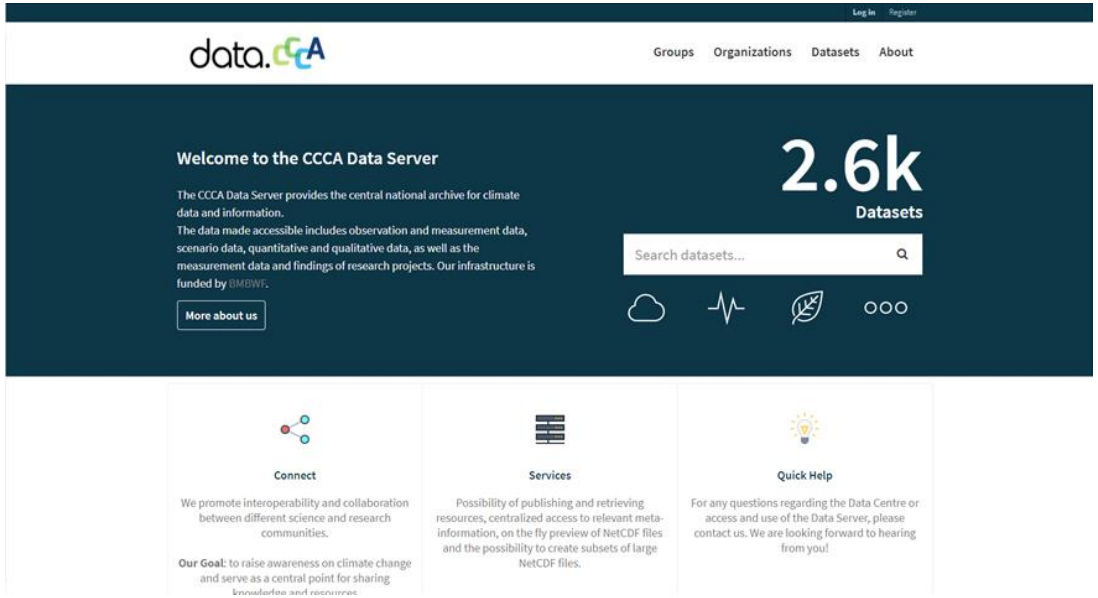


CASE STUDIES: MAJOR CITIES IN AUSTRIA

DATA SERVER WITH VISUALIZATION



Data access



- Data available at Climate Change Center Austria (CCCA) Data Server (data.ccca.ac.at)
- Data download in netcdf Format
- Export of metadata, citation and version tracking
- Visualization of maps and timeseries

Pilot webpage

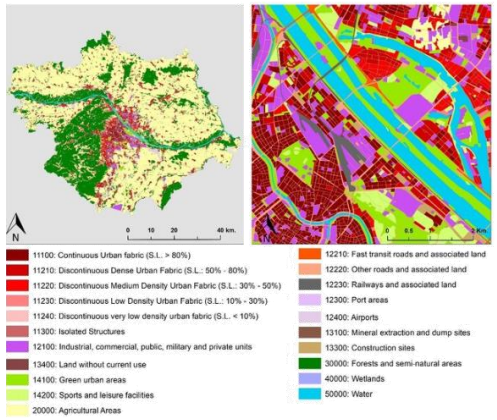
- More information available on pilot webpage: https://e-shape.egitlab.zamg.ac.at/e-shape/
- Method and input data description
- Climate change signals and links to data download

Land use and land cover

Classification to distinguish between urban areas, vegetation, bare soil and water

1 Urban Atlas

The Land Use (LU) classification of the Urban Atlas (UA) was merged with information obtained from the local municipal authority, including nearby districts, to statistically analyze the LU characteristics. These classification were used to characterize each LU class's basic urban features such as the fraction of buildings, streets, vegetation and bare soil (see below).



2 LISA

In addition, data from the Land Information System Austria (LISA) were used, which covered huge areas of Austria with a 1 m resolution. LISA provides extensive land cover data derived from satellite pictures from 2014 to 2016 and includes eleven distinct land cover types, such as buildings, steets, trees, annual crops, and cobblestone sidewalks.

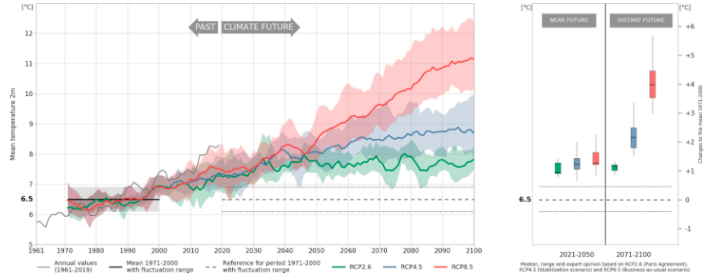
Climate projections

Representative concentration pathways

1 EURO-CORDEX

The World Climate Research Programme launched the Coordinated Regional Downscaling Experiment (CORDEX) with the goal of supporting, coordinating, and improving regional climate scenarios through global collaboration. The EURO-CORDEX research project for Europe aggregated future climate forecasts through Regional Climate Models (RCMs) at 50 and 12.5km spatial resolution based on RCPs as established in the Intergovernmental Panel on Climate Change's Fifth Assessment Report. These models give data on key meteorological characteristics through 2100 under various climate change scenarios.

We used model outputs from three different RCMs combined with six Global Climate Models at the 12.5km spatial resolution under RCP4.5 and RCP8.5 for the time period 2011-2100 to estimate possible future urban climate scenarios from the EURO-CORDEX model database. RCP4.5 is a scenario in which CO_2 emissions peak by 2040, whereas RCP8.5 represents a more extreme scenario in which CO_2 emissions continue to climb until 2100.

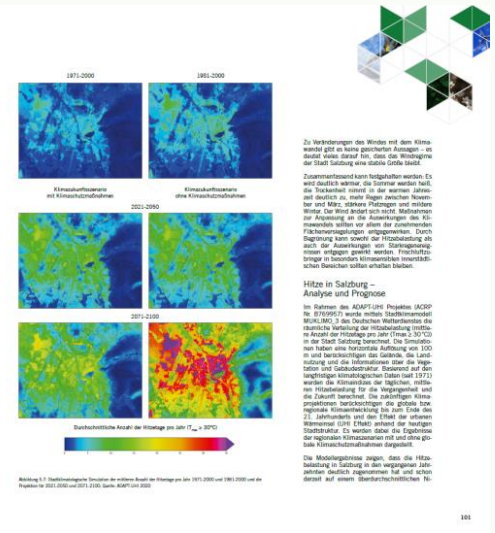


Past observed (1961–2019) and future projected (5-year running mean regional climate model simulations for scenarios RCP2.6, RCP4.5, and RCP8.5 in the period 1970–2100) annual mean temperatures for Austria (left) and climate change signal compared to the 1971–2000 period (right). Shaded hues represent the bandwidth per scenario provided by the various climate models, whereas solid lines represent the model median. Source: Olefs et al. (2021)

Applications in Austrian cities

Salzburg:

- Assessment of urban climate conditions for the new spatial development concept (REK-Räumliche Entwicklungskonzept)
- Evaluation of climatological measurements, modelling of cold air outflow and urban heat load, as well as future scenarios



https://www.stadt-salzburg.at/rek-grundlagenbericht/

Innsbruck:

- Urban climate analysis in scope of the Action plan 2020/21 of the Innsbruck climate change adaptation strategy
- Climate assessment and urban climate modelling with MUKLIMO_3 model

https://www.ibkinfo.at/stadtklimaanalyse

Development of Climate Services for urban areas

01 Urban Climate Assessment
measurements, modelling

02 Future Climate and Urban Development
regional climate scenarios, urban climate modelling

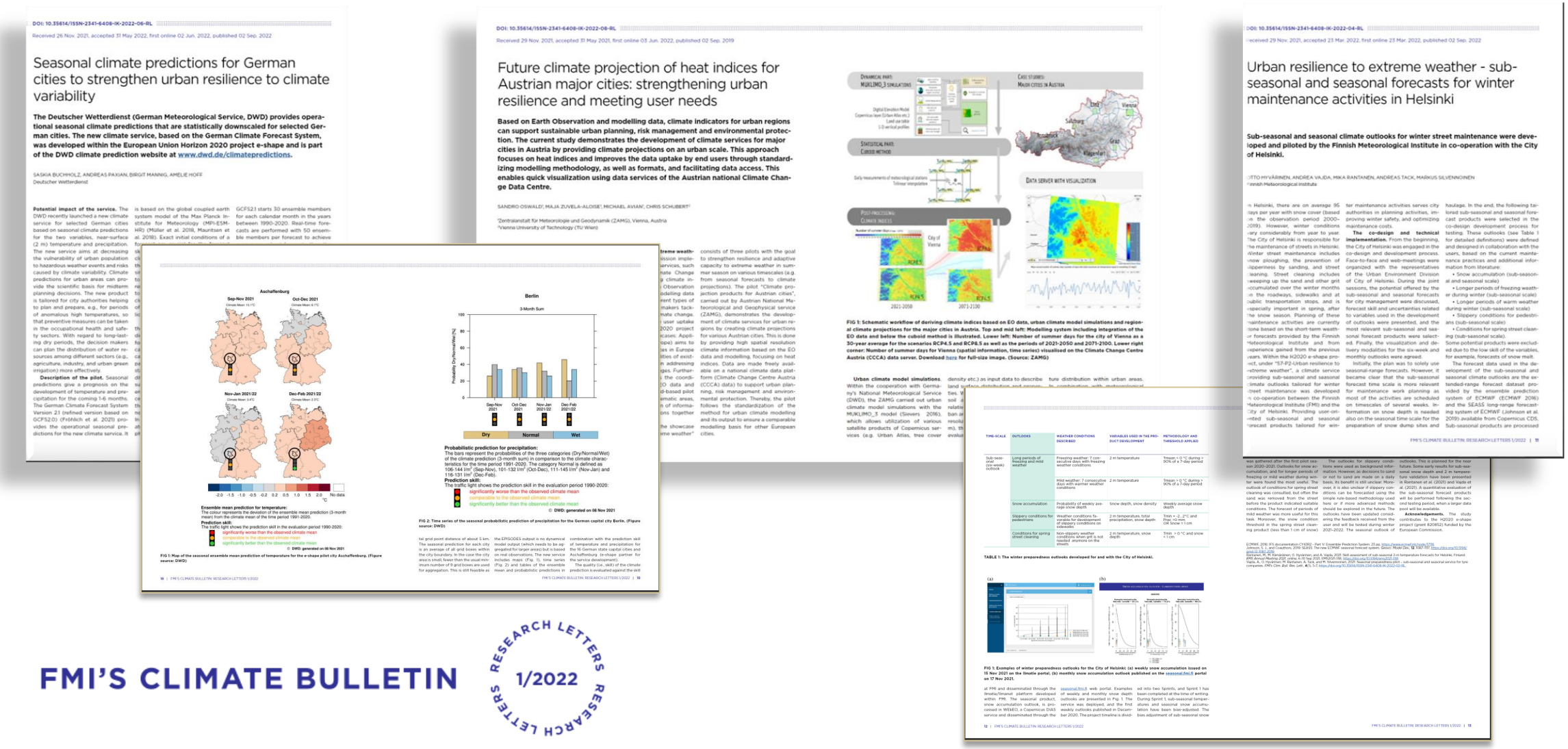
03 High-resolution Climatological and Environmental Analysis
measurements, modelling, thermal and wind comfort, fresh air circulation, environmental impact assessments

04 Basis for Decision-Making Process and Urban Planning
climate analysis maps, solar potential, urban planning guidelines

05 Weather Forecast for urban areas
heat waves and extremes, thermal comfort

06 Consulting
Stakeholders, knowledge transfer

Pilot publications: Research Letters - e-shape special issue



Seasonal climate predictions for German cities to strengthen urban resilience to climate variability

Future climate projection of heat indices for Austrian major cities: strengthening urban resilience and meeting user needs

Urban resilience to extreme weather - sub-seasonal and seasonal forecasts for winter maintenance activities in Helsinki

FMI'S CLIMATE BULLETIN

RESEARCH LETTERS 1/2022

https://issuu.com/fmi-ik/docs/rl-e-shape_special_issue-1-2022

e-shape

Thank you!

www.e-shape.eu