15.05.2025

# Climate risk analytics with Oracle APEX? Why not? (POC)

Guido Sokolis, Timo Herwix, APEX connect 2025

code of change

Hyand

# Our key facts

Hyand

## Germany

- Brunswick
- Ratingen
- Hamburg
- Dortmund
- Cologne
- Frankfurt
- Munich
- Berlin

## Poland

- Warsaw

## Lithuania

- Vilnius
- Kaunas

## Romania

- Cluj-Napoca

## India

- Pune

850+
Employees

150+
Customers

110+
million € turnover

# Who am I? Guido

**Guido Sokolis**
Senior Consultant

- Senior Consultant at Hyand Solutions
- DevOps, APEX Developer, previous works as DWH developer 2006 - TKS
- APEX since 2017 telecommunication
- Oracle since 1998 Thyssen Krupp Steel (TKS) Datacenter
- Springer publishing author, conference speaker
- Born 1966 in Bochum

# Who am I? Timo

**Timo Herwix**
Senior Consultant

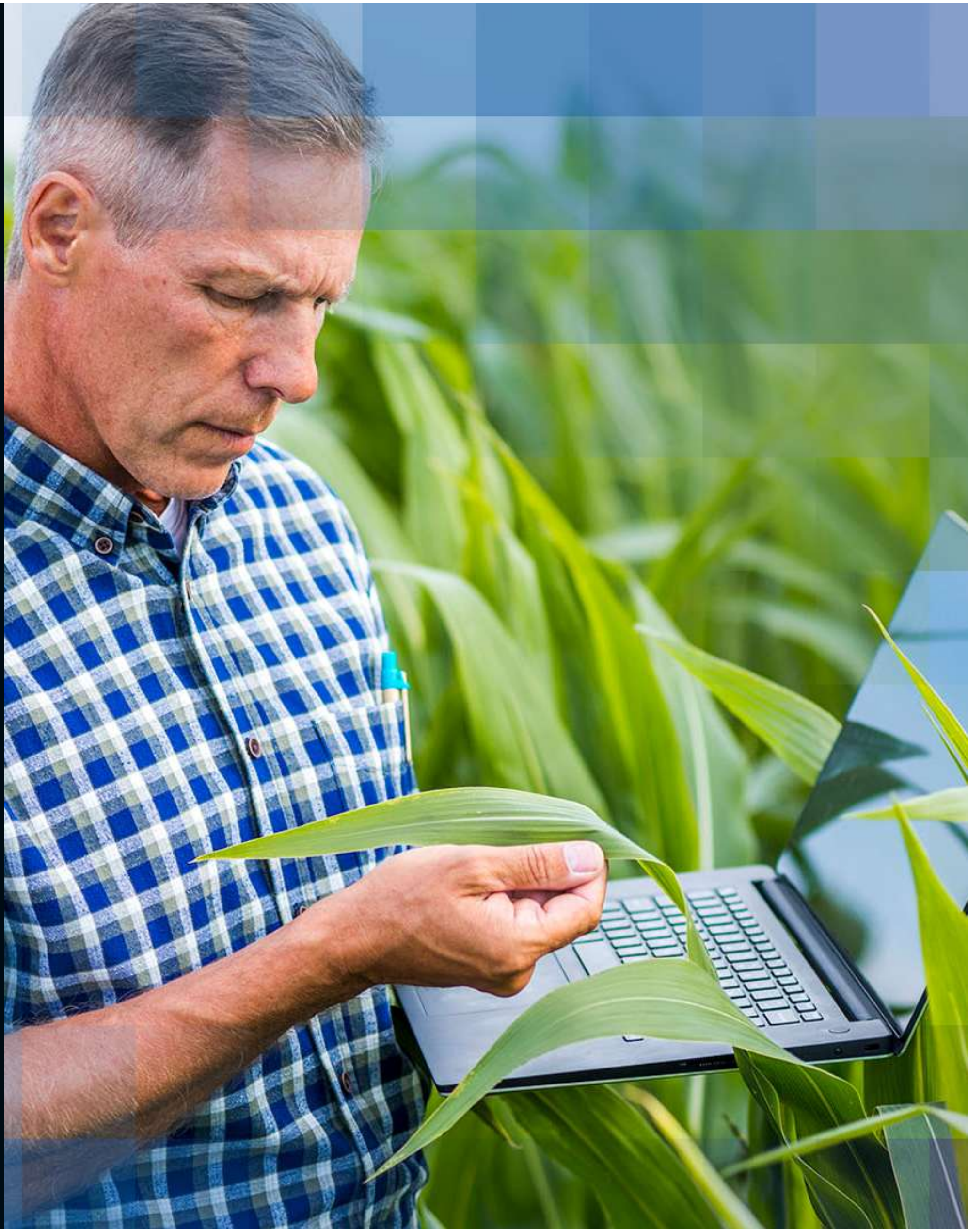
- Senior Consultant at Hyand Solutions since 2019
- Previously worked as a Data Warehouse Developer
- Oracle APEX since 2016
- Oracle Databases since 2008
- Blog author, conference speaker
- Born in 1983, two children and living in Germany

Oracle ACE Pro

# Why climate risk analysis?

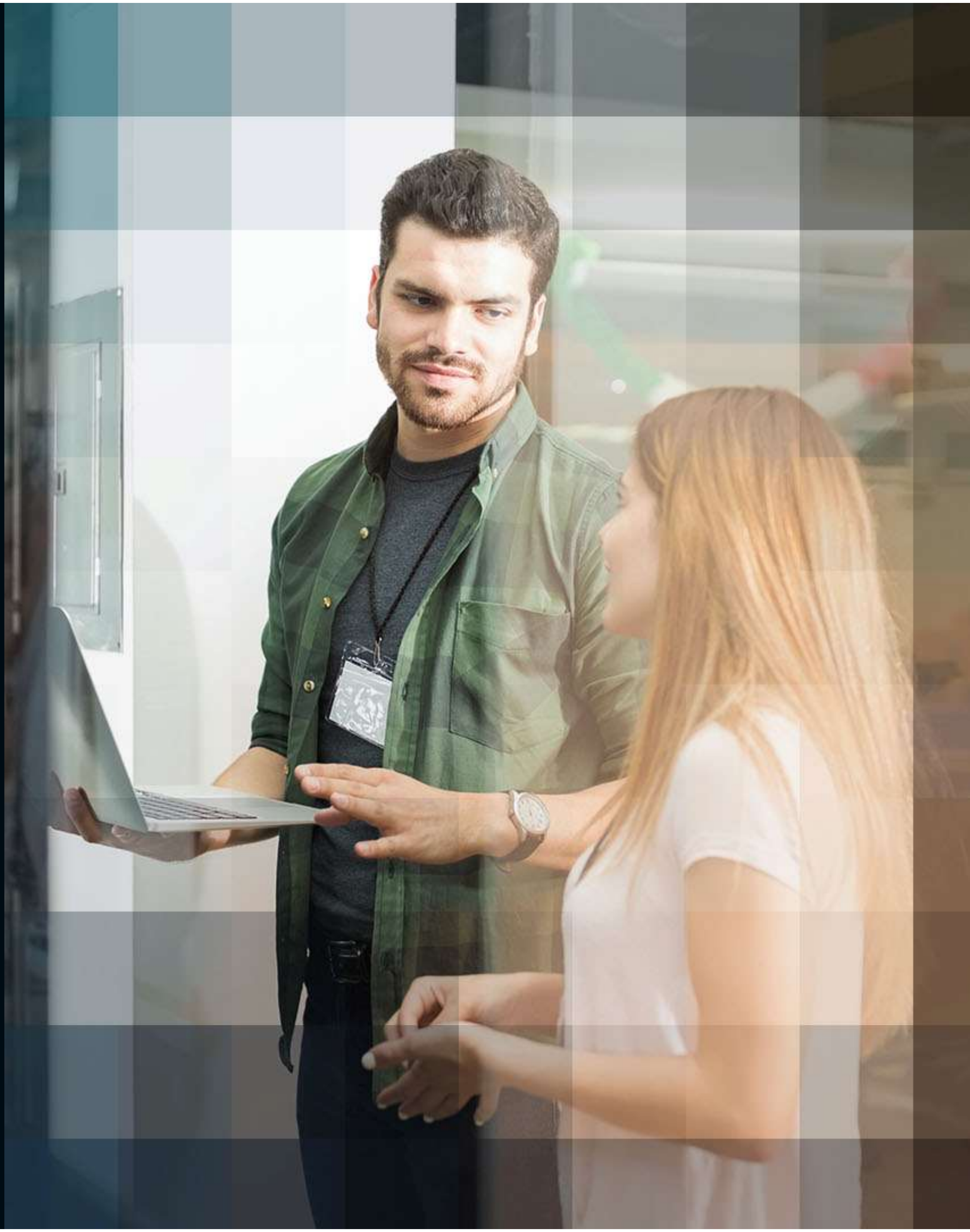
# Why climate risk analysis?

- Climate change and its consequences can no longer be ignored.
- Companies, banks, and insurance companies are increasingly having to address climate risks – whether through regulatory requirements (e.g., EU Taxonomy, CSRD) or through the need to better assess long-term business risks.
- Climate risk analyses help identify potential damage from extreme weather events, rising sea levels, or changing environmental conditions at an early stage and develop appropriate measures.



# Challenges and requirements

- Accurate climate risk analysis requires access to large, often heterogeneous data sets—historical weather data, climate projections, geographical information, and key company figures. This data must be processed, analyzed, and visualized in a comprehensible form. This poses several challenges:
  - **Data availability and quality:** Different sources with varying accuracy
  - **Scalability:** Analysis of large amounts of data and complex models
  - **Usability:** Results must be presented in a way that is understandable for decision-makers
  - **Flexibility and integration:** Integration into existing systems and workflows



# Goal of the PoC

- The code processes NetCDF/GRIB climate data, typically used by weather services.

- The data is extracted for specific cities in Germany
- and written to an Oracle Cloud database.

- This enables historical and forecast analysis of temperature/wind/rain trends.

# Proof of Concept (PoC)

- POC of a Hyand Oracle APEX ECMWF data analysis based on Copernicus weather data
- Temperature, wind, rain, etc. for the UTC+1 time zone or Longitude/Latitude
- NC/GRIB file processing via Python (import netCDF4/GRIB)
- Further processing and initial analyses with Oracle APEX
- ECMWF Data source/dataset for example:
- -> ERA5 post-processed daily statistics on single levels from 1940 to the present <-

Why Clima Risk Analysis?

# Questions from the abstract

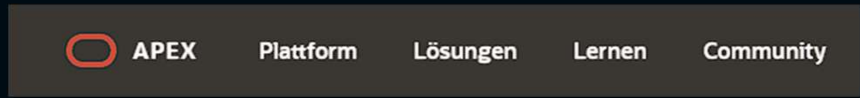
- How can we get a clear overview of all the data needed for in-depth analysis?
- Can we create real reports that businesses can use?
- What technological requirements will we have?

# Agenda

1. Why Oracle APEX?
2. Architecture and technology stack
3. Implementation with Oracle APEX
4. Climate Data Store ERA5 NC/GRIB File data generation
5. Climate Data Store
6. Processing NC/GRIB files using Python
7. Oracle APEX visualization & demo

# 1. Why Oracle APEX?

# Why Oracle APEX?




https://apex.oracle.com/de/

- Oracle APEX (Application Express) is a low-code development platform that enables the rapid and efficient creation of data-driven web applications. So why might it be a good choice for climate risk analysis?

  - **Easy development: Powerful applications can be created without in-depth coding**
  - **Strong database integration: Perfect for large data sets and SQL-based analyses**
  - **Interactive dashboards: Integrated visualization options for maps, charts, and reports**
  - **Cloud-ready: Can be deployed on-premises or in the cloud**

# Advantages of the APEX solution

✅ No complex development required– Low-Code-Approach

✅ Optimal Performance – Direct connection to the Oracle DB

✅ Flexibility – Expandable with external data sources & APIs

💡 Live-Demo

APEX visualizes temperature/wind/rain trends.

💡 custom addons

Integration of forecast data, extreme weather analyses, etc.

# 2. Architecture and technology stack

# Architecture and technology stack (components)

- **Oracle SQL & PL/SQL:**
  Storage and query of climate data.
- **SQL*Plus**
  inserts with integration in Python code: For incremental and efficient data insertion into the database.
- **Oracle APEX:**
  Web-based application for analysis and visualization.
- **Oracle Database:**
  For storing and processing climate data.
- **Geospatial data & mapping:**
  Integration with Oracle Spatial & Google Maps API is possible.

# Data sources & interfaces

- **NetCDF/GRIB data:** The code reads climate data (temperature at 2 m altitude) from an .nc rain -> grib file.
- **Oracle Cloud Database:** Stores time, temperature, wind, rain for area based on latitude, and longitude area.
- **Dynamic city selection:** The user can select which cities to analyze by entering data in the console.

```
hre Wahl (Nummer): 7

erfügbare Städte mit Koordinaten:
. München (Lat: 48, Lon: 11.5)
. Frankfurt (Lat: 50, Lon: 8.5)
. Düsseldorf (Lat: 51.5, Lon: 6)
. Berlin (Lat: 52.5, Lon: 13.25)
. Dresden (Lat: 51, Lon: 13.5)
. Hamburg (Lat: 53, Lon: 9.75)
ählen Sie die Städte aus, die Sie laden möchten (z.B. 1,3,5 oder 'a' für alle): a
```

# APEX-Integration

- **Creation of an APEX dashboard** with interactive charts and maps.
- **Integration of PL/SQL reports** to display temperature, wind, rain profiles and trends.
- **Extension to include live data** queries from external APIs (e.g., Copernicus or DWD).

# 3. Implementation with Oracle APEX

# Implementation with Oracle APEX

**Steps for APEX integration:**

1. Building an APEX dashboard with interactive charts and maps
2. Integrating PL/SQL reports to display temperature/rain/wind data and trends
3. Data preparation with SQL and PL/SQL → aggregation by time and calculation of risk indicators are possible.
4. Frontend with Oracle APEX → interactive dashboards and map visualizations

# Technical implementation with APEX

**SQL queries for charts:**

1. Grouping by year, city, and minimum, maximum, and/or average temperature.
2. PL/SQL procedures to optimize data aggregation

**Dynamic Actions & APEX Components :**

➢ Enable interactive customization of the display

**Data update:**

➢ Possible automated updates from the NetCDF/GRIB analysis

# 4. Climate Data Store
# ERA5 NC/GRIB File data generation

Possibilities of APEX visualizations

NC/GRIB Files

# What kind of format?

- ✓ NetCDF/GRIB (Network Common Data Form) files serve as a standardized format for storing climate data in multidimensional arrays.
- ✓ These arrays allow access to specific elements based on dimensions such as latitude (lat), longitude (lon), altitude, time, and others.
- ✓ Supported by a range of software libraries and data formats, NetCDF/GRIB files simplify the creation, retrieval, and sharing of scientific data in an array-centric manner.
- ✓ NetCDF/GRIB files are extremely versatile and efficient for storing and sharing large datasets with multiple dimensions such as time, latitude, longitude, altitude, and various other parameters.

```
Wählen Sie die Datei für die u-Komponente:

Verfügbare NetCDF-Dateien:
1. nc/10m_u_component_of_wind_stream-oper_daily-mean.nc
2. nc/10m_v_component_of_wind_0_daily-mean.nc
3. nc/10m_win_u_jan_until_april_daily-mean.nc
4. nc/10m_win_u_mai_until_aug_daily-mean.nc
5. nc/10m_win_v_jan_until_apr_daily-mean.nc
6. nc/10m_win_v_jan_until_april_daily-mean.nc
7. nc/10m_win_v_mai_until_aug_daily-mean.nc
8. nc/2mtemp_2023.nc
9. nc/3529dd0379f6306da8bb934d9708080f.nc
10. nc/69c889d181e037544acfe0c1319d3a6f.nc
11. nc/7b0aaed86d21d53fafd11c7f2cd559d5.nc
12. nc/886c7deb5420884f938ad00ff9f3a404.nc
13. nc/925a58d695ace35afde8eabcaaf29510.nc
14. nc/cb9c9800dd90ecd2656f680be194bb90.nc
15. nc/d765d899120c40892b7b29c86e81188b.nc
16. nc/e0fe1e78f16fe76dcd0c92086374d14d.nc
17. nc/f7b353125a76f1bbb67ddc0e30172fe9.nc
18. nc/rainwater_2024.nc
Ihre Wahl (Nummer): 4

Wählen Sie die Datei für die v-Komponente:

Verfügbare NetCDF-Dateien:
1. nc/10m_u_component_of_wind_stream-oper_daily-mean.nc
2. nc/10m_v_component_of_wind_0_daily-mean.nc
3. nc/10m_win_u_jan_until_april_daily-mean.nc
4. nc/10m_win_u_mai_until_aug_daily-mean.nc
5. nc/10m_win_v_jan_until_apr_daily-mean.nc
6. nc/10m_win_v_jan_until_april_daily-mean.nc
7. nc/10m_win_v_mai_until_aug_daily-mean.nc
8. nc/2mtemp_2023.nc
9. nc/3529dd0379f6306da8bb934d9708080f.nc
10. nc/69c889d181e037544acfe0c1319d3a6f.nc
11. nc/7b0aaed86d21d53fafd11c7f2cd559d5.nc
12. nc/886c7deb5420884f938ad00ff9f3a404.nc
13. nc/925a58d695ace35afde8eabcaaf29510.nc
14. nc/cb9c9800dd90ecd2656f680be194bb90.nc
```

# Advantages and applications of the formats (NC/GRIB)

**Interoperability & platform independence:**

- ✓ Seamless integration into different software environments and programming languages.
- ✓ Compatibility with HDF5 (since version 4.0, 2008) improves data management.

**Efficient data management:**

- ✓ Flexible storage of large data sets in multidimensional arrays.
- ✓ Easy data access and extraction, supported by tools

**Areas of application:**

- ✓ Climatology, atmospheric sciences, oceanography, geosciences.

NC Files

# Example on the website in Python

[How to convert NetCDF to CSV - Copernicus Knowledge Base - ECMWF Confluence Wiki]

## First option : Python Script

The first option is to use a python script (below). The script allows you to covert data from NetCDF in two different ways, as explained in the workflow below:

- Retrieve data with the CDS API and store as a netCDF4 file in the working directory.
- Extract the variable from the NetCDF file and get the dimensions (i.e. time, latitudes and longitudes)
- Extract each time as a 2D pandas DataFrame and write it to the CSV file
- Write the data as a table with 4 columns: time, latitude, longitude, value

**Python source code example for ERA5 single level data** Quelle reduzieren

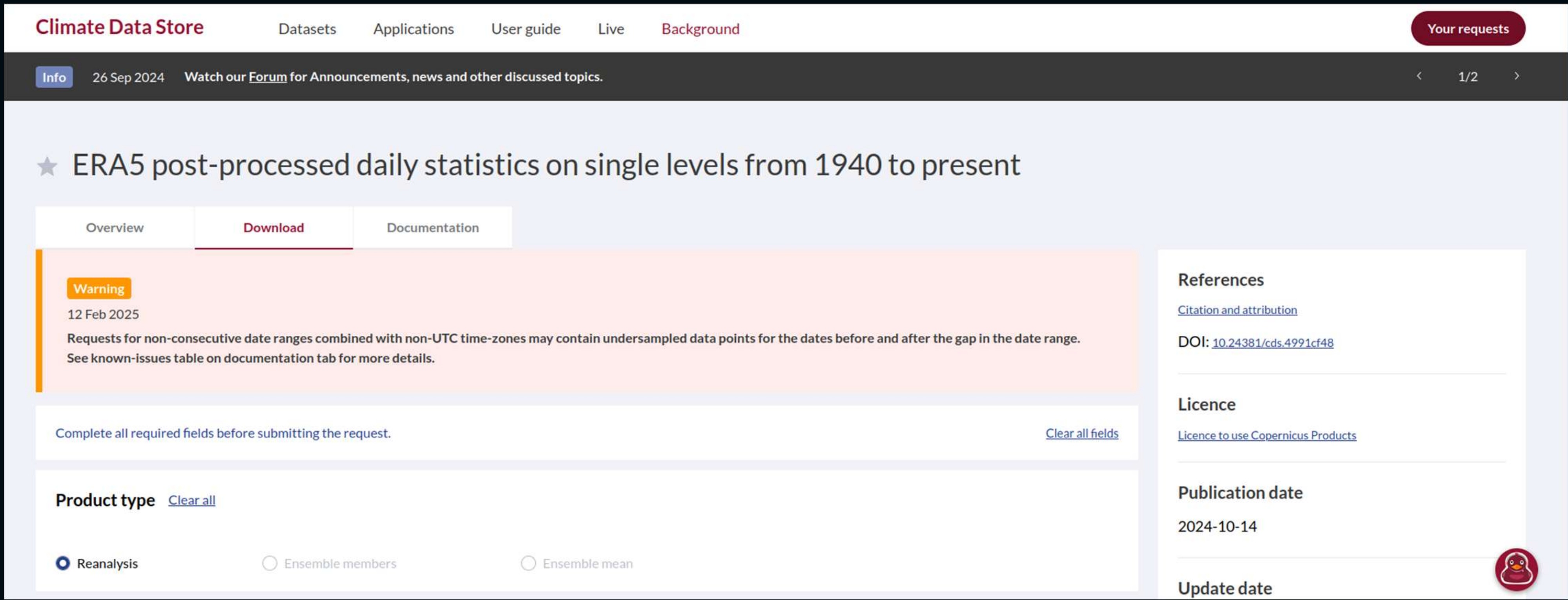
```
#!/usr/bin/python3

import cdsapi
import netCDF4
from netCDF4 import num2date
import numpy as np
import os
import pandas as pd

# Retrieve data and store as netCDF4 file
c = cdsapi.Client()
file_location = './t2m.nc'
c.retrieve(
    'reanalysis-era5-single-levels',
    {
        'product_type':'reanalysis',
        'variable':'2m_temperature',  # 't2m'
        'year':'2019',
        'month':'06',
        'day':[
            '24','25'
        ],
```

# 5. Climate Data Store

NC data generation for further processing

Climate Data Store

# Data query reanalysis Demo Live



# Data query reanalysis request

Climate Data Store | Datasets | Applications | User guide | Live | Background | Your requests

ERA5 post-processed daily statistics on single levels from 1940 to present | 2025-04-10 12:32:58pm | 2025-04-10 03:34:08pm | Complete 03:01:10 | Download Expired

Details

| Your request | |
|---|---|
| **Request ID** | e02d9f04-c2eb-4461-a8d7-37bb8d8ce991 Open request form |
| **Product type** | Reanalysis |
| **Variable** | 10m u-component of wind, 10m v-component of wind |
| **Year** | 2024 |
| **Month** | September, October, November, December |
| **Day** | 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31 |

# Data query reanalysis request API format

## API request

Please go to the documentation page for information as to how to use the CDS API.

</> **Hide API request code**

```
import cdsapi

dataset = "derived-era5-single-levels-daily-statistics"
request = {
    "product_type": "reanalysis",
    "variable": [
        "10m_u_component_of_wind",
        "10m_v_component_of_wind"
    ],
    "year": "2024",
    "month": [
        "09", "10", "11",
        "12"
    ],
    "day": [
        "01", "02", "03",
        "04", "05", "06",
        "07", "08", "09",
        "10", "11", "12",
```

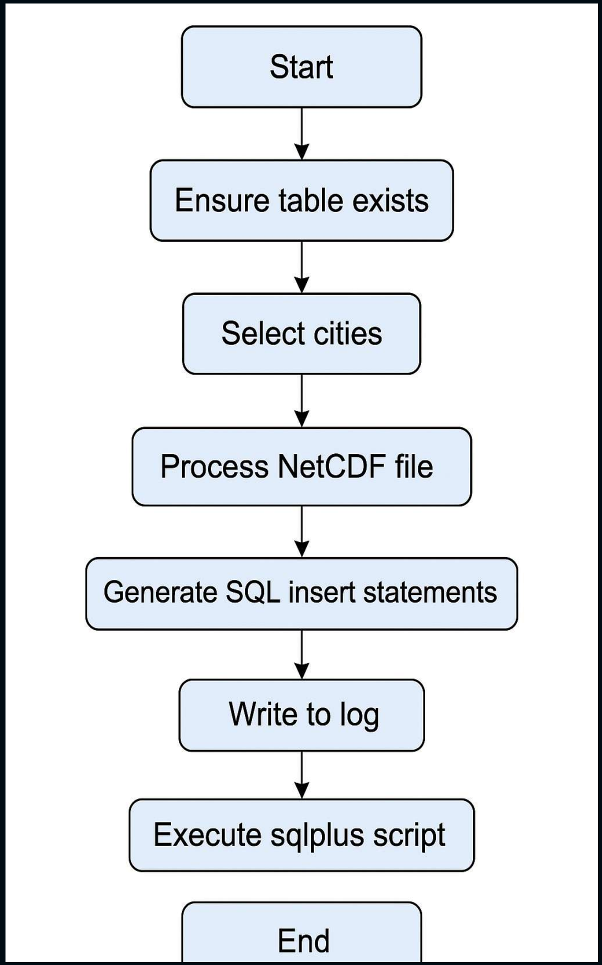
### Request validation

Request size

- Product type ✓
- Variable ✓
- Year ✓
- Month ✓
- Day ✓
- Daily statistic ✓
- Time zone ✓
- Frequency ✓
- Geographical area
  - Whole available region
  - Sub-region extraction

# 6. Processing NC/GRIB files using Python

Simplified representation of the processing of NC/GRIB files with Python V3.12 as a flowchart based on Copernicus weather data



Here is the call to process the NC files:

U and V files for month ranges and year
to generate a table with corresponding values.

```
[opc@climate-data ECMWF]$ python3.12 wind_daten_2024_QX.py
Bitte geben Sie den Namen der Tabelle an: Wind_Daten_POC_2024
Bitte geben Sie das Jahr an (z.B. 2020): 2024
Bitte geben Sie den Monatseingabebereich ein (z.B. 5-8): 5-8

Wählen Sie die Datei für die u-Komponente:

Verfügbare NetCDF-Dateien:
1. nc/10m_u_component_of_wind_stream-oper_daily-mean.nc
2. nc/10m_v_component_of_wind_0_daily-mean.nc
3. nc/10m_win_u_jan_until_april_daily-mean.nc
4. nc/10m_win_u_mai_until_aug_daily-mean.nc
5. nc/10m_win_v_jan_until_apr_daily-mean.nc
6. nc/10m_win_v_jan_until_april_daily-mean.nc
7. nc/10m_win_v_mai_until_aug_daily-mean.nc
8. nc/2mtemp_2023.nc
9. nc/3529dd0379f6306da8bb934d9708080f.nc
10. nc/69c889d181e037544acfe0c1319d3a6f.nc
11. nc/7b0aaed86d21d53fafd11c7f2cd559d5.nc
12. nc/886c7deb5420884f938ad00ff9f3a404.nc
13. nc/925a58d695ace35afde8eabcaaf29510.nc
14. nc/cb9c9800dd90ecd2656f680be194bb90.nc
15. nc/d765d899120c40892b7b29c86e81188b.nc
16. nc/e0fe1e78f16fe76dcd0c92086374d14d.nc
17. nc/f7b353125a76f1bbb67ddc0e30172fe9.nc
18. nc/rainwater_2024.nc
Ihre Wahl (Nummer): 4

Wählen Sie die Datei für die v-Komponente:

Verfügbare NetCDF-Dateien:
1. nc/10m_u_component_of_wind_stream-oper_daily-mean.nc
2. nc/10m_v_component_of_wind_0_daily-mean.nc
3. nc/10m_win_u_jan_until_april_daily-mean.nc
4. nc/10m_win_u_mai_until_aug_daily-mean.nc
5. nc/10m_win_v_jan_until_apr_daily-mean.nc
6. nc/10m_win_v_jan_until_april_daily-mean.nc
7. nc/10m_win_v_mai_until_aug_daily-mean.nc
8. nc/2mtemp_2023.nc
9. nc/3529dd0379f6306da8bb934d9708080f.nc
10. nc/69c889d181e037544acfe0c1319d3a6f.nc
11. nc/7b0aaed86d21d53fafd11c7f2cd559d5.nc
12. nc/886c7deb5420884f938ad00ff9f3a404.nc
13. nc/925a58d695ace35afde8eabcaaf29510.nc
14. nc/cb9c9800dd90ecd2656f680be194bb90.nc
15. nc/d765d899120c40892b7b29c86e81188b.nc
16. nc/e0fe1e78f16fe76dcd0c92086374d14d.nc
17. nc/f7b353125a76f1bbb67ddc0e30172fe9.nc
18. nc/rainwater_2024.nc
Ihre Wahl (Nummer): 7
```

```
:hre Wahl (Nummer): 7

'erfügbare Städte mit Koordinaten:
.. München (Lat: 48, Lon: 11.5)
:. Frankfurt (Lat: 50, Lon: 8.5)
:. Düsseldorf (Lat: 51.5, Lon: 6)
!. Berlin (Lat: 52.5, Lon: 13.25)
;. Dresden (Lat: 51, Lon: 13.5)
;. Hamburg (Lat: 53, Lon: 9.75)
'ählen Sie die Städte aus, die Sie laden möchten (z.B. 1,3,5 oder 'a' für alle): a
```

- ➢ Wind data has a U and V component, north, south, and west, east.
- ➢ In the Python script, both components are combined to determine the wind rose direction.

```
========================================
Analyse der kombinierten u- und v-Komponenten
Zielkoordinaten: lat=51.5, lon=6
Verwendete Indizes: lat index = 154, lon index = 24
Gitter-Koordinaten: lat = 51.5, lon = 6.0
Es werden alle Daten bis zum Monat 3 ausgegeben.

Zeit: 2025-01-01 00:00 -> Wind: 29.86 km/h, Richtung: 221.8° (SW) ↗
Zeit: 2025-01-02 00:00 -> Wind: 11.61 km/h, Richtung: 264.6° (W) →
Zeit: 2025-01-03 00:00 -> Wind: 16.03 km/h, Richtung: 256.6° (W) →
Zeit: 2025-01-04 00:00 -> Wind: 8.06 km/h, Richtung: 210.3° (SW) ↗
Zeit: 2025-01-05 00:00 -> Wind: 14.38 km/h, Richtung: 183.8° (S) ↑
Zeit: 2025-01-06 00:00 -> Wind: 29.00 km/h, Richtung: 213.4° (SW) ↗
Zeit: 2025-01-07 00:00 -> Wind: 20.36 km/h, Richtung: 228.4° (SW) ↗
Zeit: 2025-01-08 00:00 -> Wind: 9.49 km/h, Richtung: 218.6° (SW) ↗
Zeit: 2025-01-09 00:00 -> Wind: 8.46 km/h, Richtung: 325.5° (NW) ↘
Zeit: 2025-01-10 00:00 -> Wind: 14.51 km/h, Richtung: 248.6° (W) →
Zeit: 2025-01-11 00:00 -> Wind: 8.00 km/h, Richtung: 272.8° (W) →
Zeit: 2025-01-12 00:00 -> Wind: 6.29 km/h, Richtung: 312.2° (NW) ↘
Zeit: 2025-01-13 00:00 -> Wind: 5.98 km/h, Richtung: 161.8° (S) ↑
Zeit: 2025-01-14 00:00 -> Wind: 10.36 km/h, Richtung: 221.0° (SW) ↗
Zeit: 2025-01-15 00:00 -> Wind: 4.57 km/h, Richtung: 266.5° (W) →
Zeit: 2025-01-16 00:00 -> Wind: 6.42 km/h, Richtung: 140.2° (SE) ↖
Zeit: 2025-01-17 00:00 -> Wind: 4.11 km/h, Richtung: 138.2° (SE) ↖
Zeit: 2025-01-18 00:00 -> Wind: 7.12 km/h, Richtung: 90.5° (E) ←
Zeit: 2025-01-19 00:00 -> Wind: 1.46 km/h, Richtung: 221.7° (SW) ↗
Fehler bei SQL-Ausführung: Fehler beim Ausführen von sqlplus:
```

Here is the call to process the NC files:

U and V files for month ranges and year
to generate a table with corresponding values

Import done ☺

Spalten | Daten | Model | Constraints | Zugriffsberechtigungen | Statistiken | Trigger | Flashback | Abhängigkeiten | Details | Partitionen | Indizes | SQL

Sortieren... | Filter:

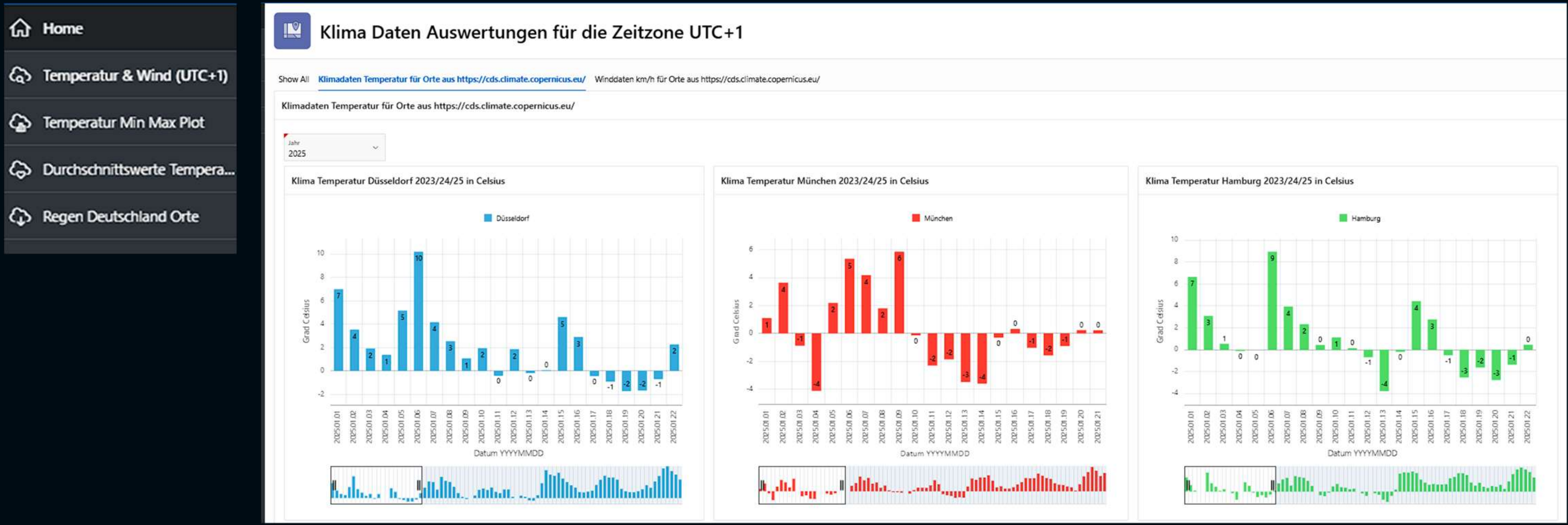
| | ZEIT | GESCHWINDIGKEIT_KMH | RICHTUNG_GRAD | RICHTUNG_LABEL | PFEIL | ORT |
|---|---|---|---|---|---|---|
| 1 | 01.05.24 | 8,62 | 128,3 | SE | NW | München |
| 2 | 01.05.24 | 8,23 | 66,9 | NE | SW | Frankfurt |
| 3 | 01.05.24 | 15,15 | 85,9 | E | W | Hamburg |
| 4 | 01.05.24 | 17,29 | 112,6 | SE | NW | Berlin |
| 5 | 01.05.24 | 21,13 | 134,5 | SE | NW | Dresden |
| 6 | 01.05.24 | 7,44 | 16,2 | N | S | Düsseldorf |
| 7 | 02.05.24 | 5,49 | 204,6 | SW | NE | München |
| 8 | 02.05.24 | 3,08 | 154 | SE | NW | Frankfurt |
| 9 | 02.05.24 | 18,04 | 92,9 | E | W | Hamburg |
| 10 | 02.05.24 | 18,1 | 110,8 | E | W | Berlin |
| 11 | 02.05.24 | 22,03 | 132,5 | SE | NW | Dresden |
| 12 | 02.05.24 | 1,4 | 345,8 | N | S | Düsseldorf |
| 13 | 03.05.24 | 12,74 | 265,5 | W | E | München |
| 14 | 03.05.24 | 13,17 | 238,3 | SW | NE | Frankfurt |
| 15 | 03.05.24 | 7,24 | 202 | S | N | Hamburg |
| 16 | 03.05.24 | 7,38 | 172,4 | S | N | Berlin |
| 17 | 03.05.24 | 8,04 | 249,1 | W | E | Dresden |
| 18 | 03.05.24 | 14,74 | 229 | SW | NE | Düsseldorf |
| 19 | 04.05.24 | 4,98 | 111 | E | W | München |
| 20 | 04.05.24 | 6,5 | 142,1 | SE | NW | Frankfurt |
| 21 | 04.05.24 | 4,18 | 208 | SW | NE | Hamburg |
| 22 | 04.05.24 | 4,8 | 290 | W | E | Berlin |
| 23 | 04.05.24 | 2,4 | 236,7 | SW | NE | Dresden |
| 24 | 04.05.24 | 7,79 | 146,1 | SE | NW | Düsseldorf |
| 25 | 05.05.24 | 6,47 | 244,2 | SW | NE | München |
| 26 | 05.05.24 | 9,17 | 221 | SW | NE | Frankfurt |
| 27 | 05.05.24 | 11,36 | 229,5 | SW | NE | Hamburg |
| 28 | 05.05.24 | 8,09 | 216,8 | SW | NE | Berlin |
| 29 | 05.05.24 | 9,29 | 218 | SW | NE | Dresden |
| 30 | 05.05.24 | 6,05 | 253,6 | W | E | Düsseldorf |
| 31 | 06.05.24 | 4,25 | 259,6 | W | E | München |
| 32 | 06.05.24 | 6,75 | 219,6 | SW | NE | Frankfurt |
| 33 | 06.05.24 | 4,5 | 331,1 | NW | SE | Hamburg |

```
Transaktion mit COMMIT abgeschlossen.

Alle Daten von 2024 im Zeitraum von Monat 5 bis 8 wurden verarbeitet und in die Tabelle Wind_Daten_POC_2024 übertragen.
```

# 7. Oracle APEX Visualization

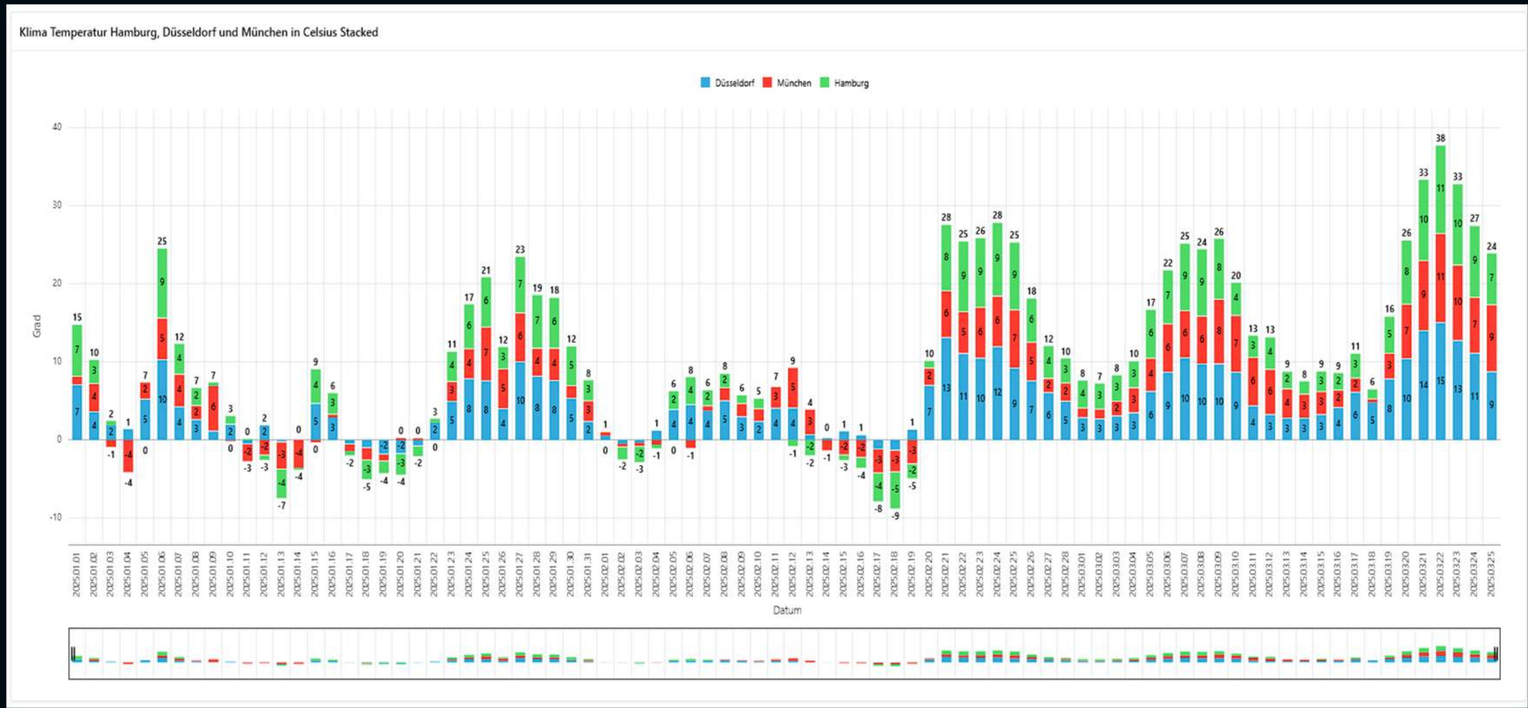
Möglichkeiten von APEX Visualisierungen

# Climate data temperature in degrees Celsius for locations from https://cds.climate.copernicus.eu/



Oracle APEX Visualization Temperature

# Climate data temperature in degrees Celsius for locations from https://cds.climate.copernicus.eu/

Oracle APEX Visualization Temperature

# Climate data temperature in degrees Celsius for locations from https://cds.climate.copernicus.eu/

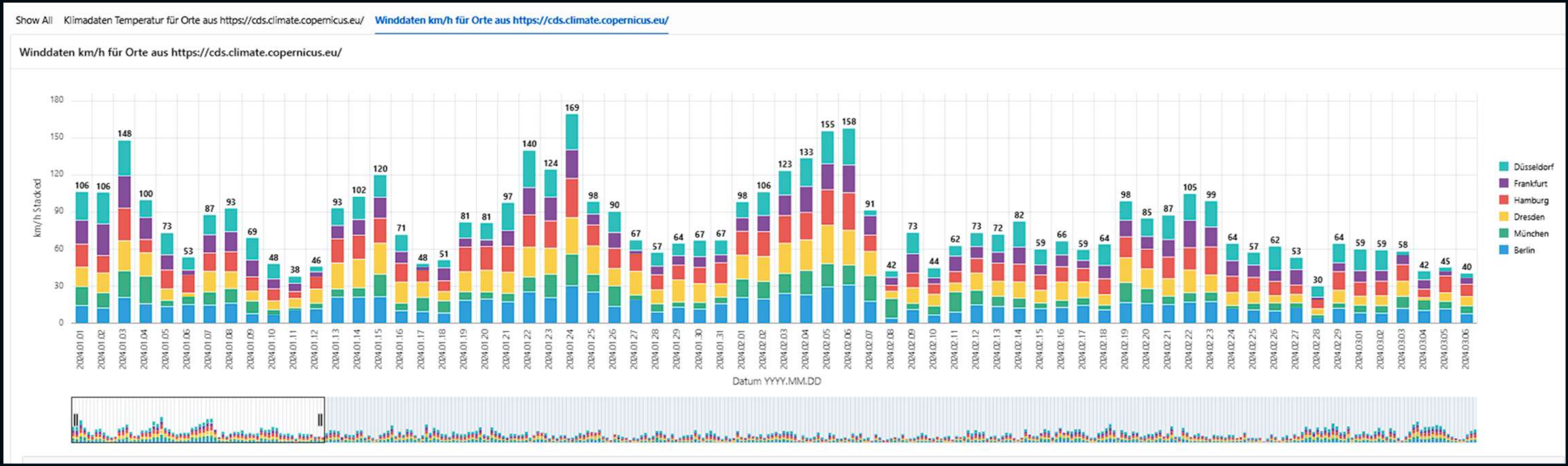
Go Rows 5 Actions

1 - 5 of 3,792

| Ort | Zeit | Jahr | Breitengrad | Längengrad | Temperatur in Grad C |
|---|---|---|---|---|---|
| Düsseldorf | 2023.01.01 | 2023 | 51.5 | 6 | 13.232019042968773 |
| Hamburg | 2023.01.01 | 2023 | 53 | 10 | 13.107751464843773 |
| München | 2023.01.01 | 2023 | 48 | 11.5 | 8.356286621093773 |
| Düsseldorf | 2023.01.02 | 2023 | 51.5 | 6 | 10.080773925781273 |
| München | 2023.01.02 | 2023 | 48 | 11.5 | 8.023645019531273 |

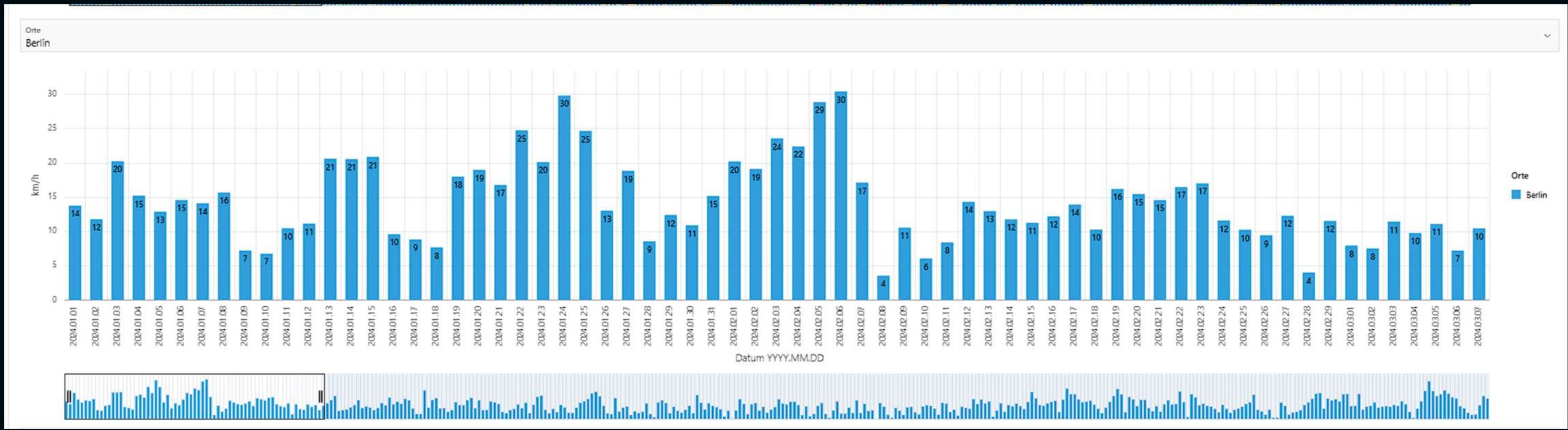
1 - 5 of 3,792

# Climate Wind Hamburg, Düsseldorf and Munich... for Month Year Stacked



Oracle APEX Visualization Wind

# Climate Wind Hamburg, Düsseldorf and Munich… for Month Year Stacked (locations)



Oracle APEX Visualization Wind

# Climate Wind Hamburg, Düsseldorf and Munich… for Month Year Stacked (locations)

**Baseline Wind Daten für Orte**

Go Rows 10 Actions

6 inactive settings

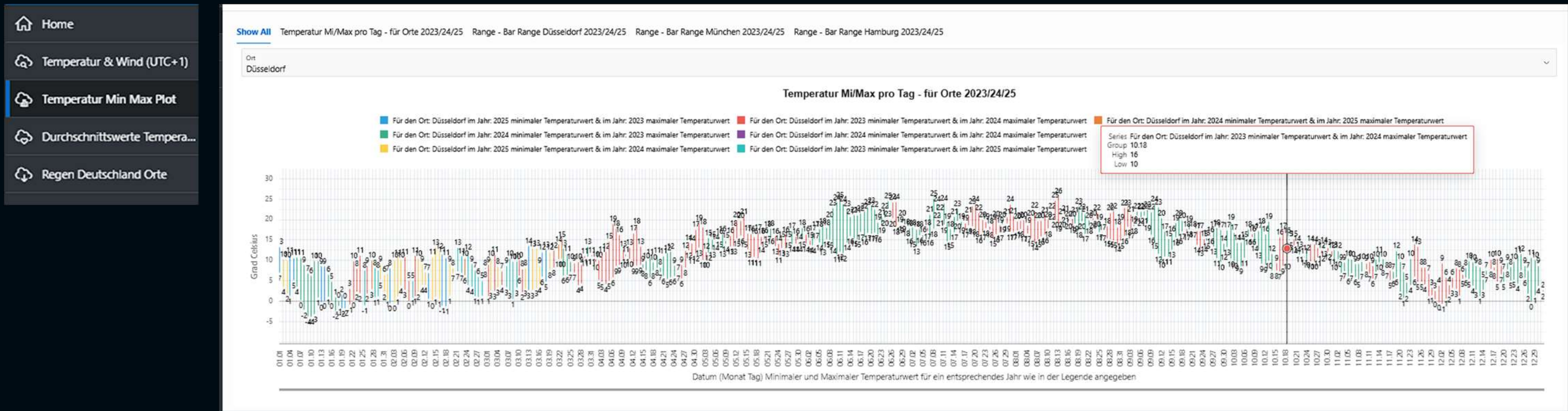
1 - 10 of 2.196

| Zeit | Ort | Geschwindigkeit km/h | Richtung Grad | Richtung Label | Windrose Pfeil in Richtung |
|---|---|---|---|---|---|
| 2024.12.31 | Düsseldorf | 19.76 | 209 | SW | NE |
| 2024.12.31 | Berlin | 16 | 230.8 | SW | NE |
| 2024.12.31 | Dresden | 13.71 | 218.6 | SW | NE |
| 2024.12.31 | Frankfurt | 10.96 | 212.9 | SW | NE |
| 2024.12.31 | München | 6.19 | 196.6 | S | N |
| 2024.12.31 | Hamburg | 20.84 | 224.9 | SW | NE |
| 2024.12.30 | Berlin | 17.85 | 236.4 | SW | NE |
| 2024.12.30 | Düsseldorf | 17.18 | 214.4 | SW | NE |
| 2024.12.30 | Dresden | 12.95 | 235 | SW | NE |
| 2024.12.30 | Frankfurt | 6.97 | 208.3 | SW | NE |

1 - 10 of 2.196

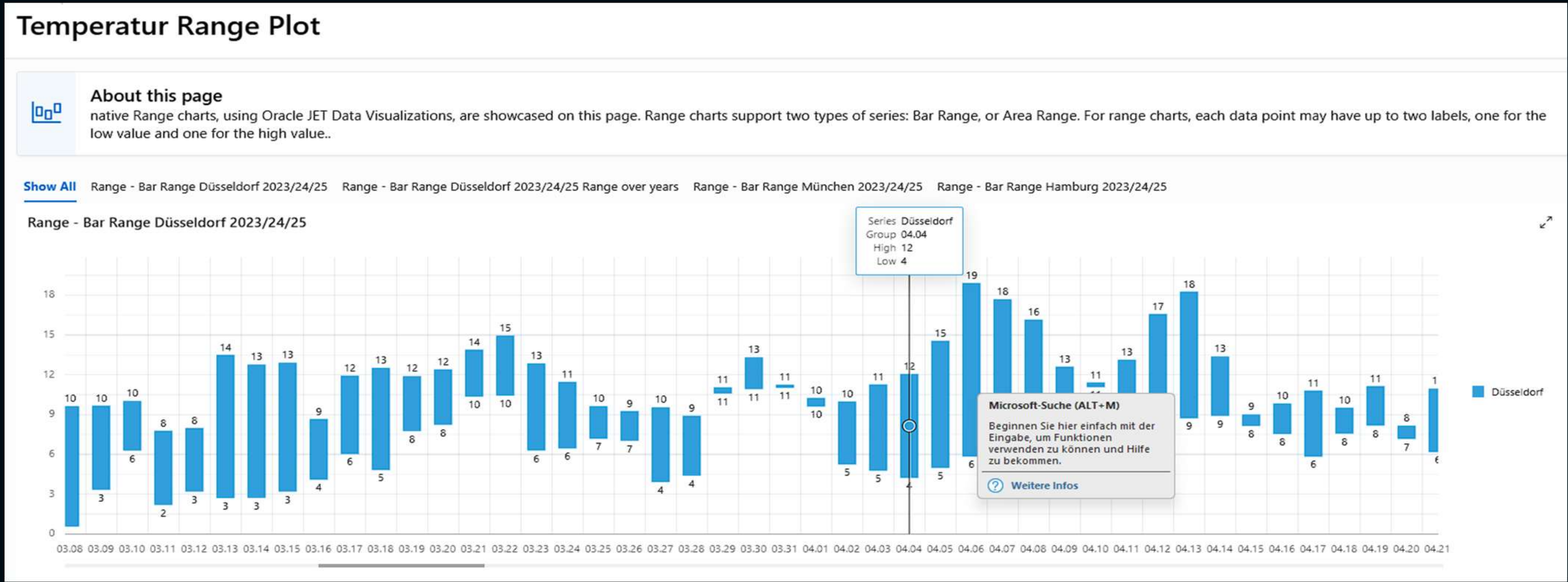
Oracle APEX Visualisierung

# Climate Temperature Hamburg, Düsseldorf and Munich Max Min for month over 3 years

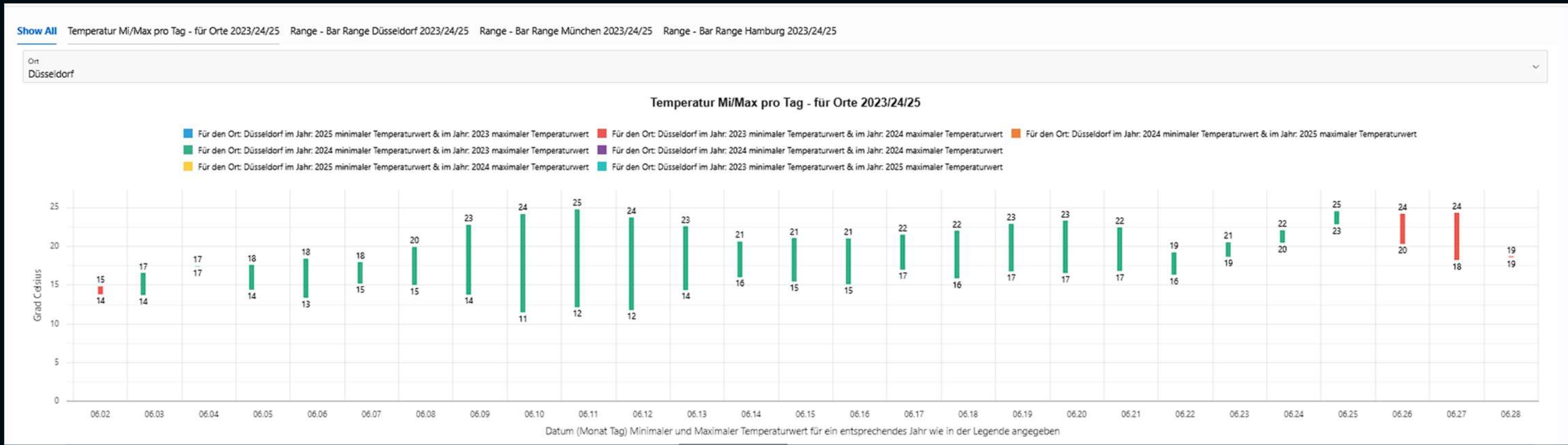


Oracle APEX Visualisierung

# Temperatur Range für Orte – Jet Engine Zoom in

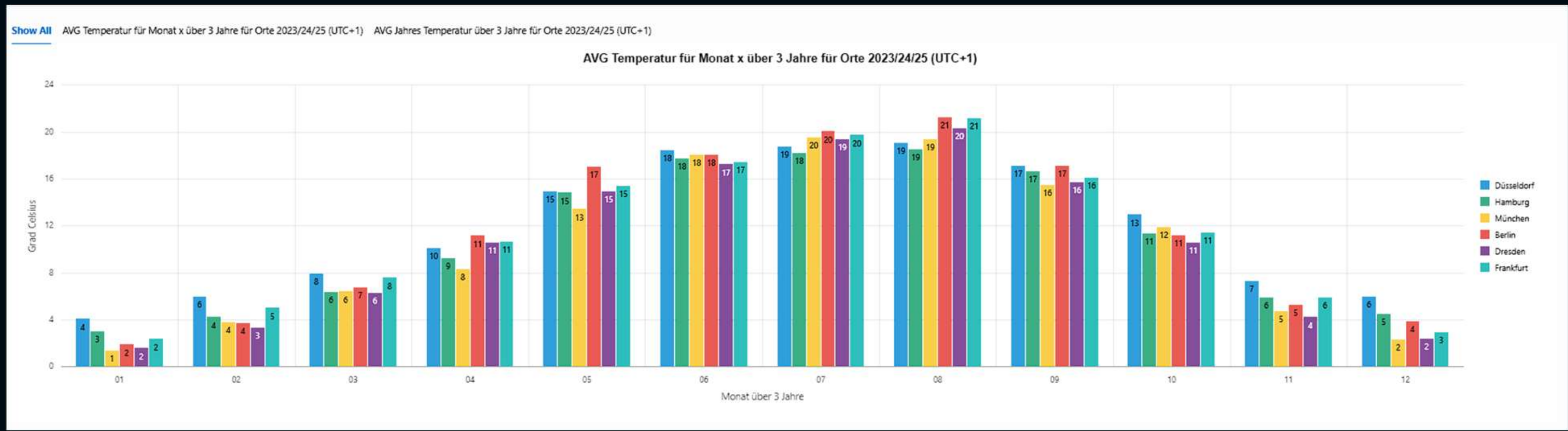


# Climate Temperature Hamburg, Düsseldorf and Munich Max Min km/h for month over 3 years (Zoom)

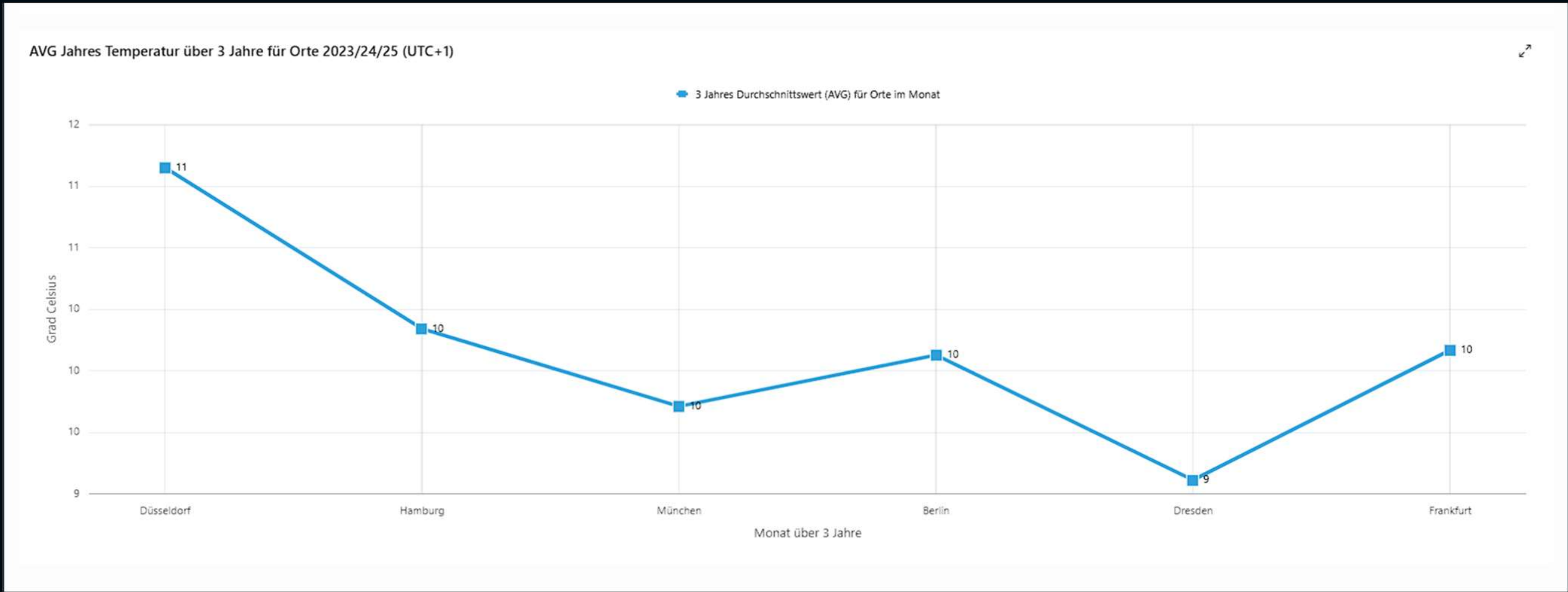


Oracle APEX Visualisierung

# Climate Temperature Average AVG Max Min for Month X over 3 years

# Climate Temperature Average AVG over 3 years for location X



# Baseline wind data for locations

## Baseline Wind Daten für Orte

Rows 10 | Actions

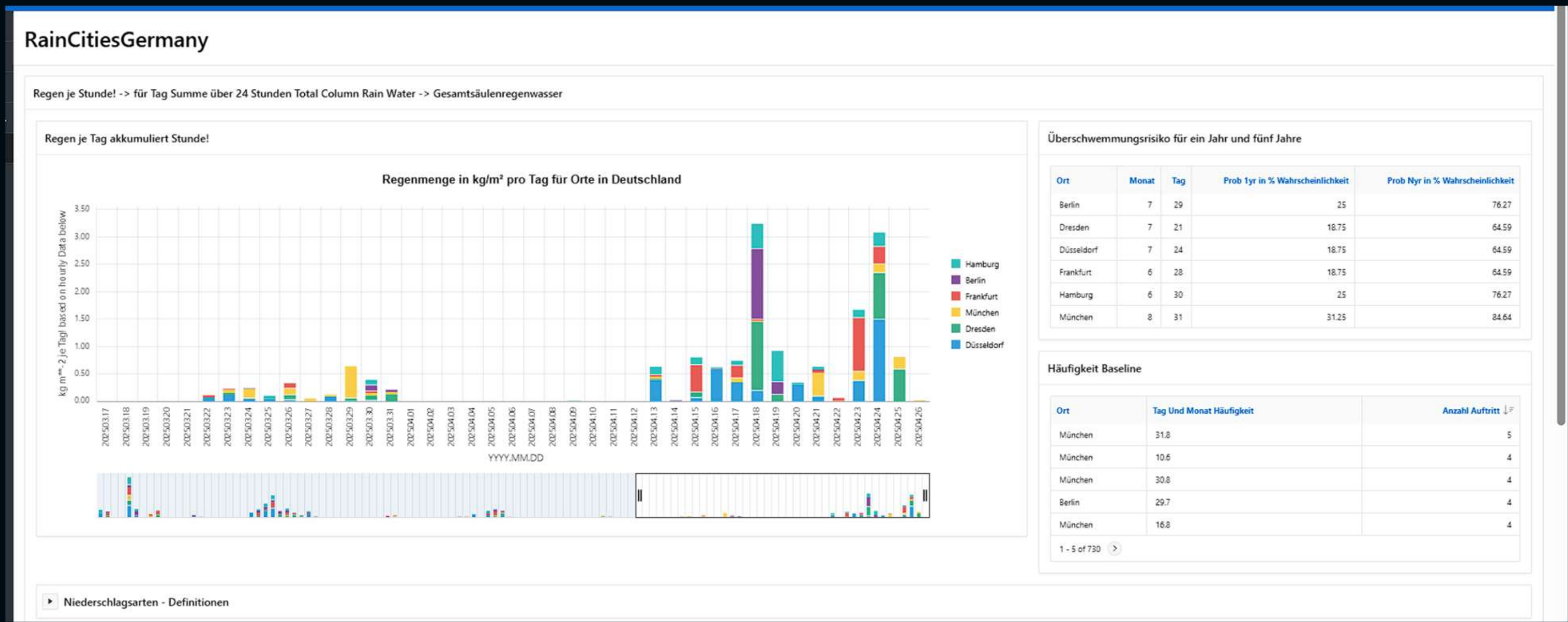
Ort = 'Berlin' | Ort = 'Dresden' | Ort = 'Düsseldorf' | Ort = 'Frankfurt' | Ort = 'Hamburg' | Ort = 'München'

1 - 10 of 2,196

| Zeit | Ort | Geschwindigkeit km/h | Richtung Grad | Richtung Label | Windrose Pfeil in Richtung |
|---|---|---|---|---|---|
| 2024.12.31 | Düsseldorf | 19.76 | 209 | SW | NE |
| 2024.12.31 | Berlin | 16 | 230.8 | SW | NE |
| 2024.12.31 | Dresden | 13.71 | 218.6 | SW | NE |
| 2024.12.31 | Frankfurt | 10.96 | 212.9 | SW | NE |
| 2024.12.31 | München | 6.19 | 196.6 | S | N |
| 2024.12.31 | Hamburg | 20.84 | 224.9 | SW | NE |
| 2024.12.30 | Berlin | 17.85 | 236.4 | SW | NE |
| 2024.12.30 | Düsseldorf | 17.18 | 214.4 | SW | NE |
| 2024.12.30 | Dresden | 12.95 | 235 | SW | NE |
| 2024.12.30 | Frankfurt | 6.97 | 208.3 | SW | NE |

1 - 10 of 2,196

# Baseline Wind data for locations

Oracle APEX Visualisierung

# Baseline Wind data for locations

Überschwemmungsrisiko für ein Jahr und fünf Jahre

| Ort | Monat | Tag | Prob 1yr in % Wahrscheinlichkeit | Prob Nyr in % Wahrscheinlichkeit |
|---|---|---|---|---|
| Berlin | 7 | 29 | 25 | 76.27 |
| Dresden | 7 | 21 | 18.75 | 64.59 |
| Düsseldorf | 7 | 24 | 18.75 | 64.59 |
| Frankfurt | 6 | 28 | 18.75 | 64.59 |
| Hamburg | 6 | 30 | 25 | 76.27 |
| München | 8 | 31 | 31.25 | 84.64 |

Häufigkeit Baseline

| Ort | Tag Und Monat Häufigkeit | Anzahl Auftritt |
|---|---|---|
| München | 31.8 | 5 |
| München | 10.6 | 4 |
| München | 30.8 | 4 |
| Berlin | 29.7 | 4 |
| München | 16.8 | 4 |

1 - 5 of 730

Niederschlagsarten - Definitionen

Convective precipitation -> Konvektiver Niederschlag

Convective rain rate -> Konvektive Regenrate

Instantaneous large-scale surface precipitation fraction -> Momentaner großflächiger Niederschlagsanteil

Large scale rain rate -> Großflächige Regenrate

Large-scale precipitation -> Großflächiger Niederschlag

Large-scale precipitation fraction -> Großflächiger Niederschlagsanteil

Maximum total precipitation rate since previous post-processing -> Maximale Gesamtniederschlagsrate seit der letzten Nachbearbeitung

Minimum total precipitation rate since previous post-processing -> Minimale Gesamtniederschlagsrate seit der letzten Nachbearbeitung

Precipitation type -> Niederschlagsart

Total column rain water -> Gesamtsäulenregenwasser

Total precipitation -> Gesamtniederschlag

# POC Risk rain calculation example

I am interested in knowing how many years such an event occurred (on this exact calendar day).

$$p_{1yr} = \frac{\text{Anzahl Jahre mit Ereignis an diesem Tag}}{\text{Anzahl Jahre insgesamt}}$$

This is the empirical proportion of years in which this day was an exceeded day

extrapolation over several years

To estimate the probability that this event will occur at least once within nnn years, I use the opposite probability

-

$$P(\text{kein Ereignis in } n \text{ Jahren}) = (1 - p_{1yr})^n,$$

$$p_{nyr} = 1 - (1 - p_{1yr})^n.$$

This assumes that the annual events run independently and with constant probability per year

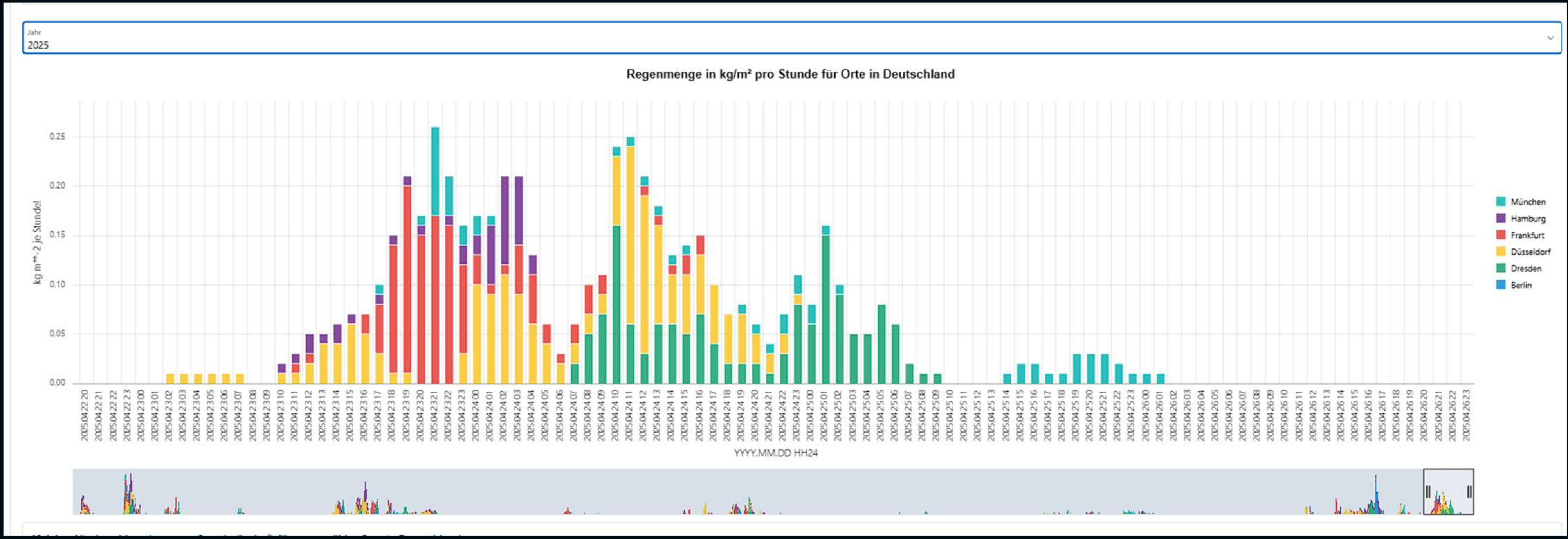
```
Example with prob_1yr = 0.75, N = 5 Jahre:

prob_nyr = 1 - (1 - 0.75)^5
         = 1 - (0.25)^5
         = 1 - 0.0009765625
         ≈ 0.999 (also 99.9%)
```

This means: It is virtually certain that the event will occur at least once in 5 years.
-> The further I look into the future, the more likely the event is to occur, i.e., 10 years, etc.

What does 100% mean?
If prob_1yr = 1 (the event occurs every year), then:
prob_nyr = 1 - (1 - 1)^N = 1 - 0 = 1 → 100%
If prob_1yr = 0 (never happens), then:
prob_nyr = 1 - (1 - 0)^N = 1 - 1 = 0 → 0%

Oracle APEX Visualisierung

# Rain data for cities



# 9. Oracle APEX Visualization Demo

Simple APEX visualization options
based on existing temperature and wind data for locations in the time zone (UTC+1)

# Conclusion and discussion

- ➢ Is Oracle APEX an alternative for climate risk analysis?
- ➢ Next steps & optimization potential!

Target group:

- ➢ Decision-makers & analysts in risk analysis & sustainability
- ➢ APEX developers & IT architects

# What´s Next?!?

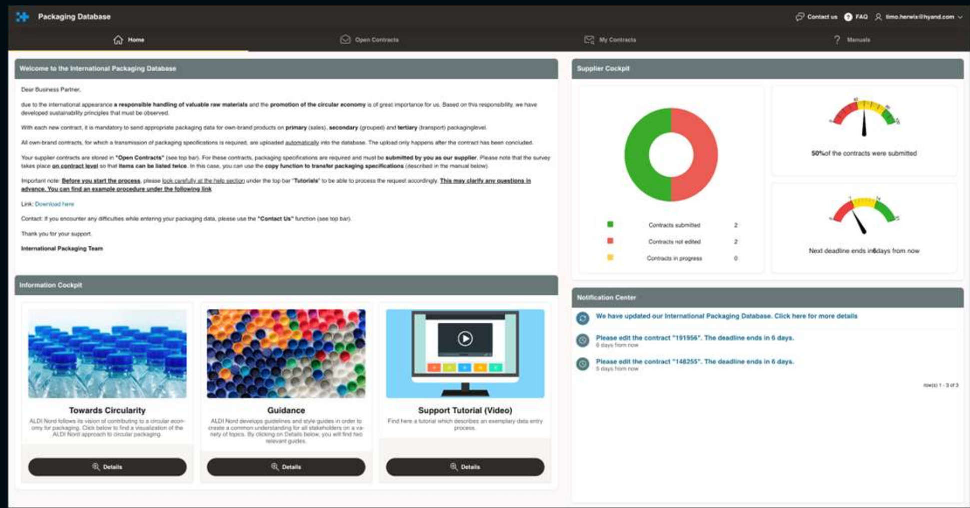
- Start a project promptly and discuss with experts exactly which KPIs are required.
- Looking into the future:
  - What will the data be like in 2050?
  - Can we calculate that with AI possibilities?
- Provision of a platform for companies that are hosted by us
- Provision of APIs for companies

# Solution 1: Packaging Database

Many trading companies have received political guidelines for packaging reduction.

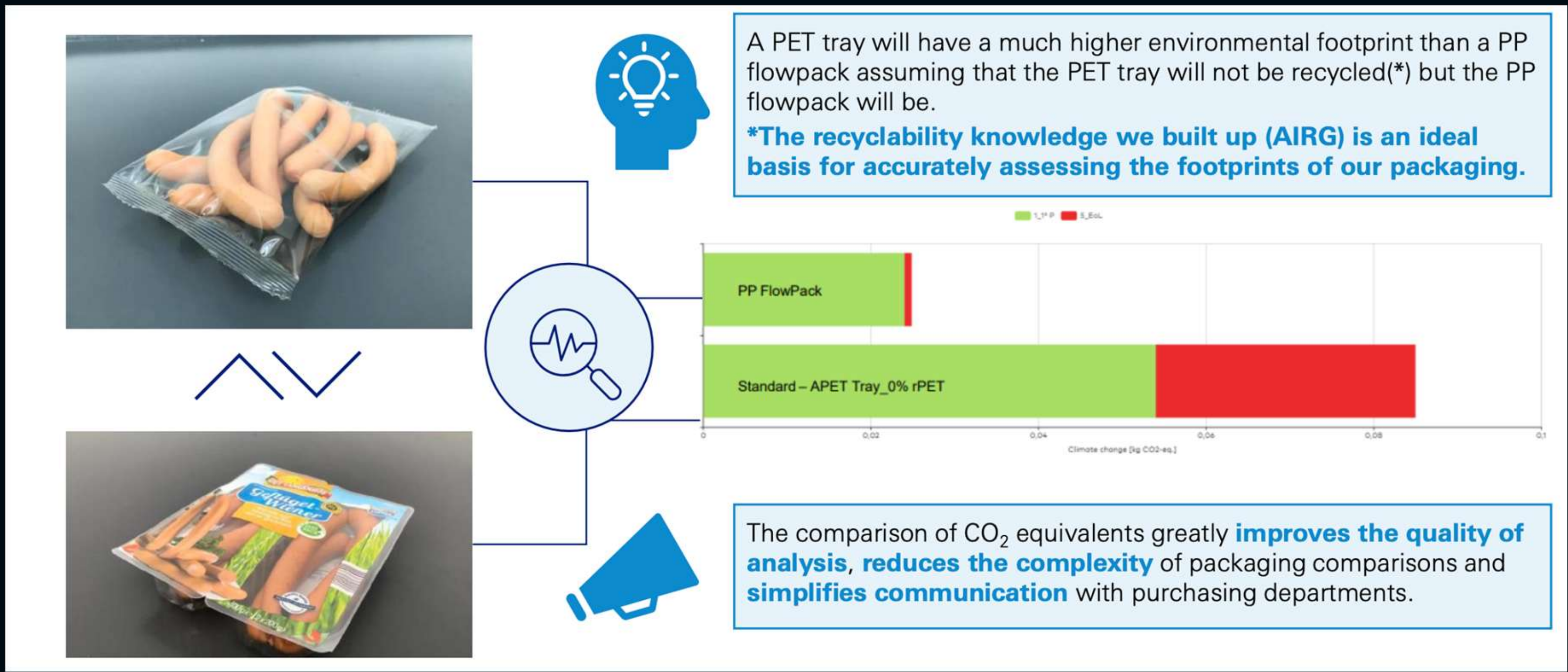
To do this, they need a large amount of data, which must be collected directly from suppliers. The data is then evaluated and appropriate measures are taken as a result.

The goal is reducing packaging material and using more recyclable materials.

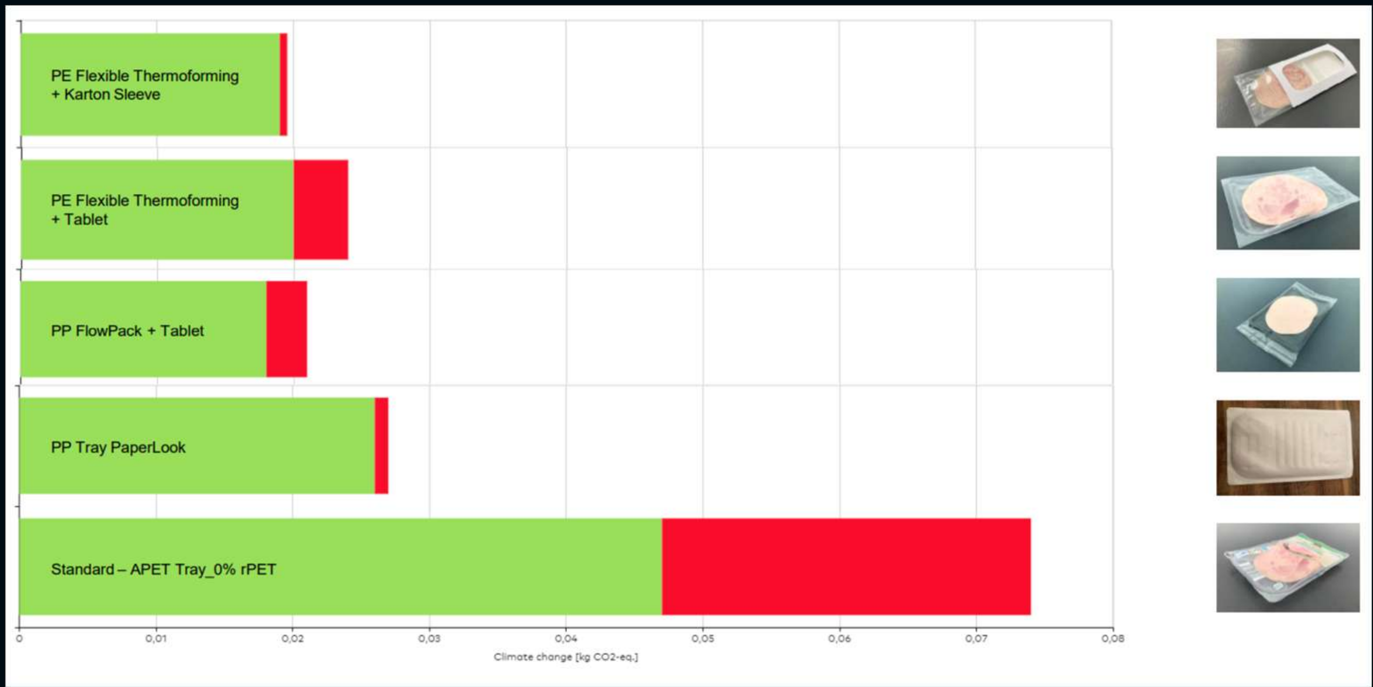



*EU-Packaging and Packaging Waste Regulation (PPWR)

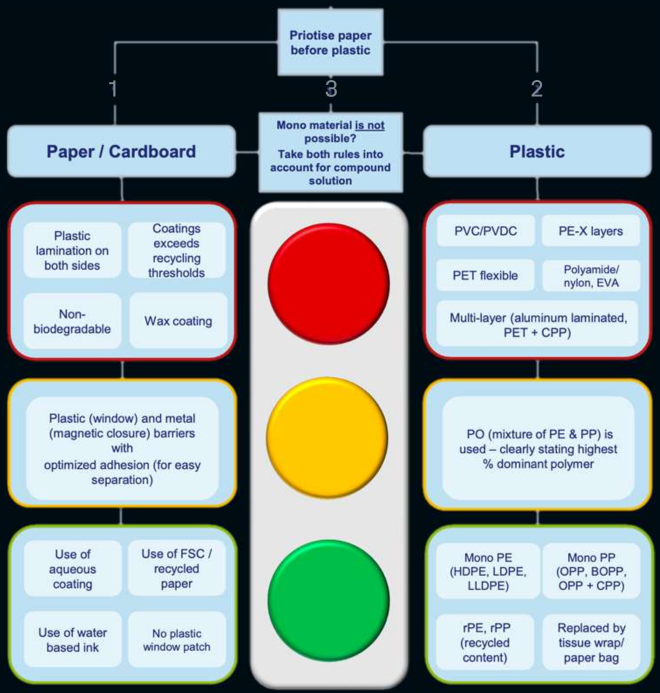
# Sustainable Packaging at a Glance
# PP flowpack versus PET tray



# Sustainable Packaging at a Glance
# Comparison of packaging for cold meats



# Sustainable Packaging at a Glance
## Recyclability



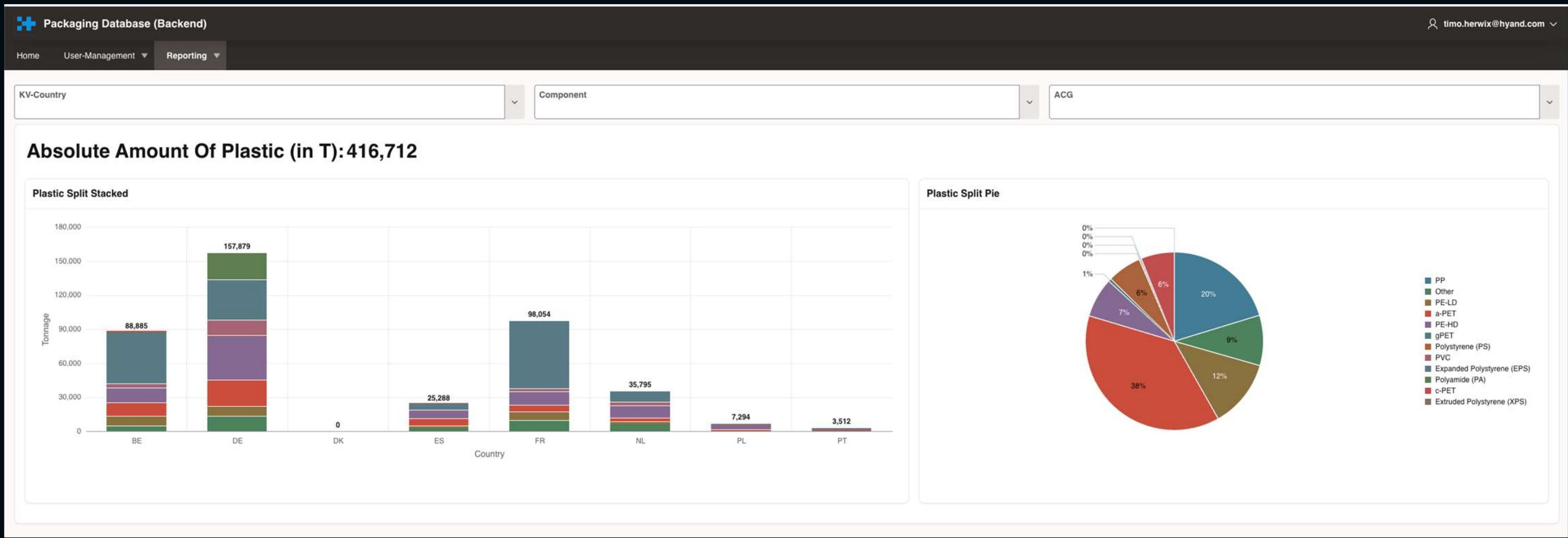

| | |
|---|---|
| **Article name** | **Suppenfleisch, 500g** |
| **Number of components** | 4 |
| **Total weight** | 27.75 g |
| **Komponenten** | |
| **Tray** | |
| **Function** | Main component |
| **Weight** | 23 |
| **Material** | PP |
| **Color** | Transparent |
| **Foil/Film/Flow-Pack** | |
| **Function** | Closure |
| **Weight** | 2.89 |
| **Material** | a-PET/EVOH/PE-HD/PP/PA |
| **Color** | Transparent |
| **Label** | |
| **Function** | Decoration |
| **Weight** | 1.04 g |
| **Material** | Paper |
| **Absorbent Pad** | |
| **Function** | Decoration |
| **Weight** | 0,82 g |
| **Material** | PP |

$$R = \frac{(23 * 1) + (2.89 * 0) + (1.04 * 0.5) + (0.82 * 0.5)}{27.75} * 100 = \mathbf{86.23\%}$$

# Achievements

- From 2020 to 2022, we have already achieved a reduction of more than 80,000 tons of packaging material in our supply chain.
- In the 2023 financial year, around 75% of our packaging was recyclable. The recyclability of packaging is a prerequisite for producing valuable secondary raw materials that can ideally be reused for packaging.
- Our recycled content in plastic packaging was around 15% in the 2023 financial year.

# Achievements



+200.000
Articles
since 2022

+300
Articles
per day

+10.000
User

+500
Accesses per
day

24/7

Hyand

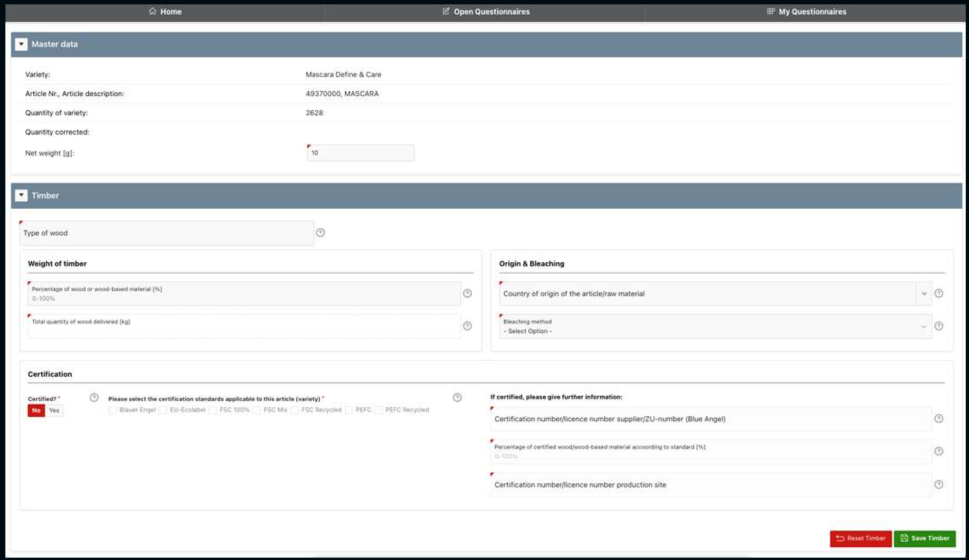
# Solution 2: Sustainability Database

A lot of trading companies can no longer avoid the topic of „Sustainability“.

Sustainability is based on clear strategies, ethically correct and legally compliant behavior and efficient organizations.

The selection of focus areas and corporate responsibility programs provides a clear path.

The goal is to enable safe and responsible consumption without a guilty conscience.




*EU Deforestation Regulation (EUDR)

# Reporting

## CERTIFIED SUSTAINABLE FISH AND SEAFOOD PRODUCTS

**Share of own-brand products certified with the MSC, ASC, GLOBALG.A.P. or EU organic logo as a proportion of the total number of fish and seafood products, broken down by certification standard only online (in per cent)**

In 2022, around 60 per cent of our own-brand fish and seafood products were certified with one of the following sustainability standards: the largest portion was attributable to the MSC certification standard (around 62 per cent), followed by ASC certification (around 29 per cent), GLOBALG.A.P. certification (around 12 per cent) and products with the EU organic logo (around 3 per cent).

| | 2020 | 2021 | 2022 |
|---|---|---|---|
| Belgium/Luxembourg[1] | 74.3 | 76.8 | **81.4** |
| Denmark | 88.9 | 71.6 | **71.6[2]** |
| France | 54.1 | 57.2 | **57.5** |
| Germany | 85.8 | 83.9 | **78.4** |
| Netherlands | 80.6 | 73.7 | **74.4** |
| Poland | 42.2 | 73.5 | **54.0** |
| Portugal | 51.0 | 49.5 | **43.6** |
| Spain | 37.8 | 29.9 | **24.9** |
| | **60.0** | **59.8** | **60.3** |

## CERTIFIED SUSTAINABLE COTTON

**Share of sustainable cotton as a proportion of the total volume of cotton in the clothing and home textiles product groups from the standard and special-buy product ranges, broken down by certification standard only online (in per cent)**

| | 2020 | 2021 | 2022 |
|---|---|---|---|
| Belgium/Luxembourg[1] | 74.7 | 88.9 | **91.2** |
| Denmark | 63.7 | 88.9 | **93.6** |
| France | 52.1 | 71.9 | **74.1** |
| Germany | 64.9 | 85.1 | **92.4** |
| Netherlands | 49.5 | 69.3 | **89.2** |
| Poland | 64.8 | 89.3 | **93.3** |
| Portugal | 76.4 | 89.4 | **92.3** |
| Spain | 68.7 | 65.0 | **95.8** |
| | **64.1** | **82.0** | **90.6** |

## FSC®- OR PEFC™-CERTIFIED PRODUCTS

**Share of own-brand products certified according to FSC ® or PEFC™ as a proportion of the total number of own-brand products from the standard and special-buy product ranges with elements made of wood, board, paper, cellulose-based viscose and non-woven fabric, as well as bamboo, broken down by certification standard only online (in per cent)**

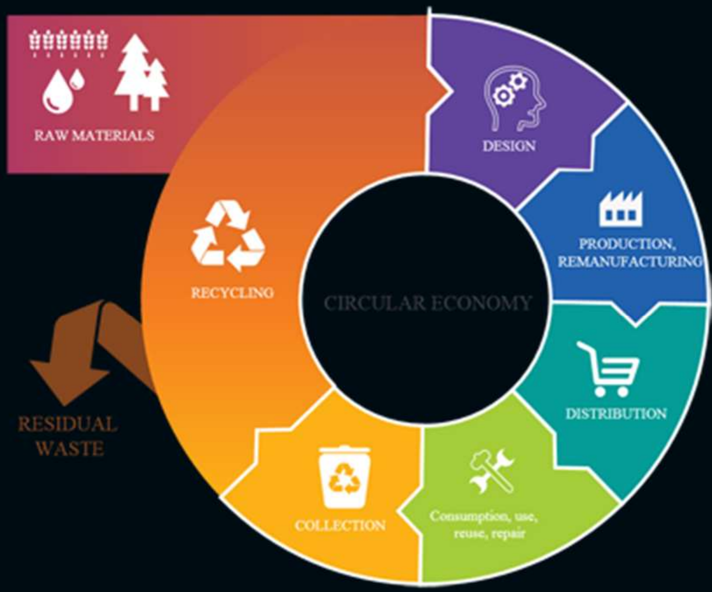
FSC® 100%, FSC® MIX and PEFC™ are considered to be certification standards. In 2022, the largest portion was attributable to FSC® 100% certification (around 50 per cent followed by FSC® MIX certification (around 36 per cent), and PEFC™ certification (around 14 per cent).

| | 2020 | 2021 | 2022 |
|---|---|---|---|
| Belgium/Luxembourg[1] | 97.2 | 94.3 | **97.0** |
| Denmark | 95.0 | 92.5 | **93.2[2]** |
| France | 92.6 | 87.9 | **89.2** |
| Germany | 95.2 | 94.2 | **94.1** |
| Netherlands | 90.7 | 86.3 | **87.7** |
| Poland | 89.8 | 94.0 | **89.9** |
| Portugal | 96.7 | 95.2 | **93.3** |
| Spain | 97.5 | 97.9 | **96.0** |
| | **93.2** | **92.6** | **92.1** |

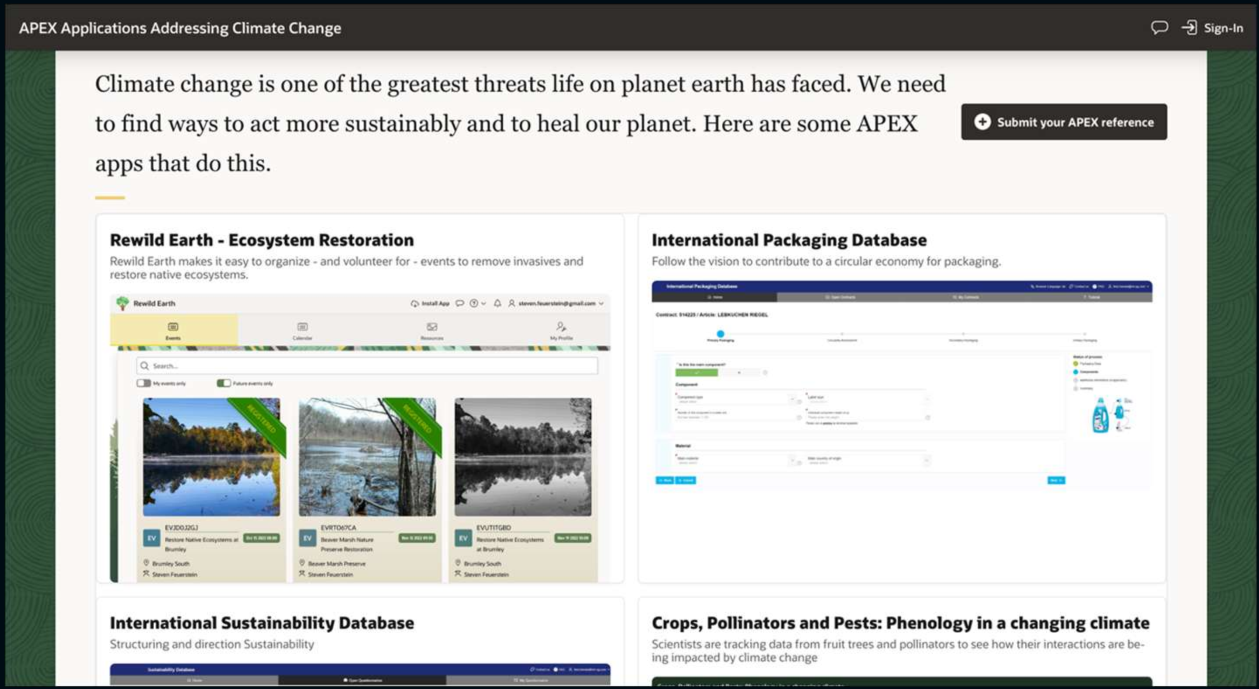
# Looking to the future

Human Rights


Circularity eco design



# sustainability-apex.org



# Are you interested?

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