



meteomatics

Mastering the weather challenge

Weather API

Dr. Martin Fengler

CEO

A large-scale solar farm is shown from an elevated perspective, with rows of solar panels stretching across a green field. The sun is low on the horizon, creating a golden glow and long shadows across the panels. In the background, there are rolling hills and a few industrial structures with smokestacks under a cloudy sky.

Loss of EUR 140 million per year due to bad weather forecasts

reported by the German transmission system operators

Airports spend millions per year on weather forecasts



Precise weather forecasts will be essential for autonomous driving

reported by BMW, Daimler, Audi ...



Why does weather matter?

It affects our daily life.



Better understanding weather helps reduce business costs.



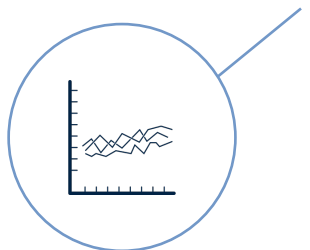
It affects our business.



Better understanding weather improves predictive maintenance.



It is highly variable.



Better understanding weather helps reduce the impacts of natural hazards.



World class talent in meteorology, data science, drone development and service delivery

40 people | 3 offices | 3 countries | global partnerships

We are proud of Meteomatics' fair, hardworking, 'can-do' culture and a highly skilled multi-disciplinary team who rise to the challenge with our customers in a positive fashion. Creativity is a core skill whether it be in thinking, design, architecture or science.



Meteomatics AG



Weather API

Worldwide parameters

Model data
Station data
Satellite data

...



Industry

Bespoke solutions

Wind power
Solar power
Hydro power

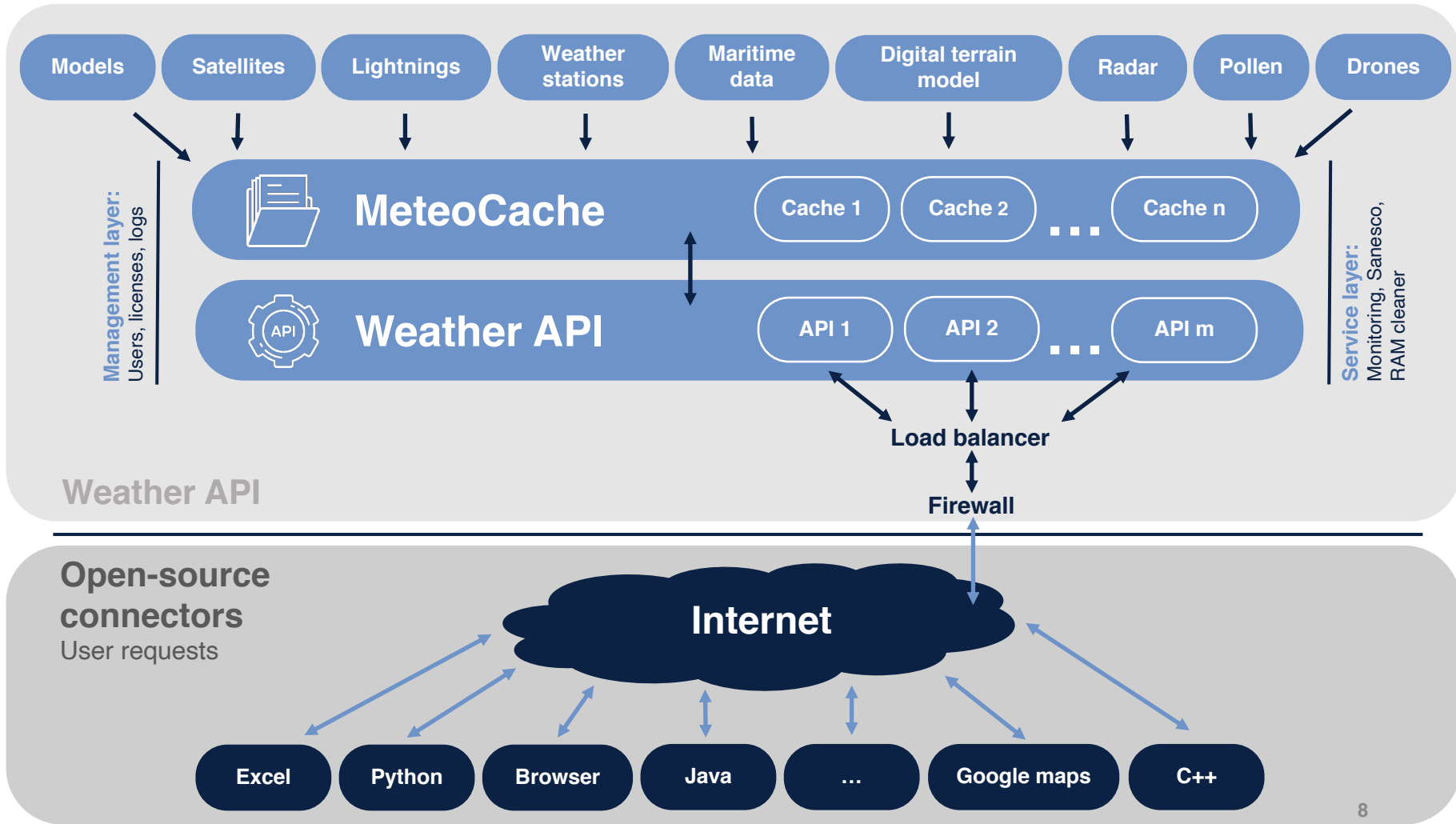
...



Meteodrone

High-resolution weather modeling

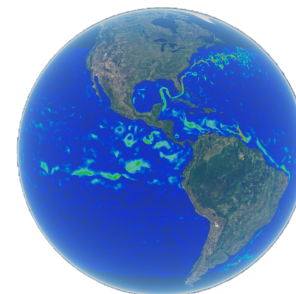
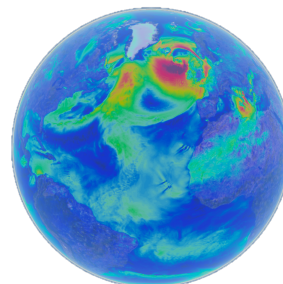
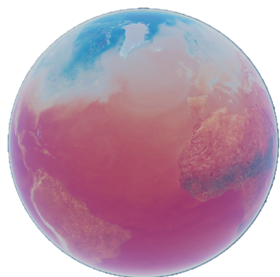
Better PBL data
Improve fog & storm forecasts
Customized solutions



Weather API – data

Historical, current & forecast data

- ✓ Global and regional weather model data from a variety of National Met Services
- ✓ Models: ECMWF, NOAA, UK MetOffice, Meteo France, Swiss1k, KNMI, FMI, Env. Canada
- ✓ Observational data of thousands of weather stations globally
- ✓ Weather data in up to 5-minute temporal resolution
- ✓ On the fly Downscaling to 90 m horizontal resolution
- ✓ Ensemble forecasts from ECMWF and GFS
- ✓ Maritime, radar & satellite data
- ✓ Worldwide coverage



Weather API – data

Forecast data

- ✓ **Global** and **regional** weather model data from a variety of National Met Services and scientific institutions
- ✓ **Models:** ECMWF, UK MetOffice, Meteo France, Swiss1k, NOAA, KNMI, FMI, Env. Canada
- ✓ Observational data of thousands of weather stations globally
- ✓ Weather data in up to **5-minute** temporal resolution
- ✓ On the fly downscaling 90 m horizontal resolution
- ✓ Up to 15 days in advance
- ✓ Seasonal forecasts up to 7 months
- ✓ Ensemble forecasts from ECMWF and GFS
- ✓ Temporal and spatial interpolation for each coordinate worldwide
- ✓ Depending on the package up to 1'000'000 accesses per day

Historical data

- ✓ Worldwide historical model data and observational data from 1979 onwards
- ✓ Basic weather parameters such as temperature, precipitation, wind, and solar radiation
- ✓ Radar precipitation data for various countries (Germany, UK, US and more), both historical and short-term forecast
- ✓ Downscaled forecast model data from various sources including ECMWF, GFS and UK MetOffice
- ✓ Ensemble forecast from ECMWF and GFS
- ✓ MOS forecast for selected weather stations and parameters

Weather API

USP



Weather data as
a single version
of truth



On the fly
calculation for
most up-to-date
forecasts



Hyperlocal
forecasts
delivering
enhanced
temporal and
spatial resolution



Variety of
formats and
connectors in
different
programming
languages



Detailed and
up-to-date
documentation



Flexible & fast
integration & use



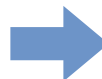
Simple one-stop
access to high
quality weather
data worldwide

Output formats

Weather forecast data through an industrial, scalable API

https://api.meteomatics.com/2018-06-04T00:00:00Z--2018-06-10T00:00:00Z:PT3H/t_2m:C/47.41,9.34/xml

```
validdate;t_2m:C
2018-06-04T00:00:00Z;16.8
2018-06-04T03:00:00Z;15.3
2018-06-04T06:00:00Z;17.2
2018-06-04T09:00:00Z;21.3
2018-06-04T12:00:00Z;23.7
2018-06-04T15:00:00Z;25.2
2018-06-04T18:00:00Z;20.6
2018-06-04T21:00:00Z;17.5
2018-06-05T00:00:00Z;17.3
2018-06-05T03:00:00Z;15.8
```



```
{
  "version": "3.0",
  "user": "meteomatics-mapsrver",
  "dateGenerated": "2018-06-04T20:00:42Z",
  "status": "OK",
  "data": [
    {
      "parameter": "t_2m:C",
      "coordinates": [
        {
          "lat": 47.4122,
          "lon": 9.34065,
          "dates": [
            {
              "date": "2018-06-04T00:00:00Z",
              "value": 16.9
            },
            {
              "date": "2018-06-04T03:00:00Z",
              "value": 15.4
            },
            {
              "date": "2018-06-04T06:00:00Z",
              "value": 17.3
            },
            {
              "date": "2018-06-04T09:00:00Z",
              "value": 21.4
            },
            {
              "date": "2018-06-04T12:00:00Z",
              "value": 23.8
            },
            {
              "date": "2018-06-04T15:00:00Z",
              "value": 25.2
            }
          ]
        }
      ]
    }
  ]
}
```



```
<?xml version="1.0" encoding="UTF-8" ?>
<meteomatics-api-response version="3.0">
  <user>meteomatics-mapsrver</user>
  <dateGenerated>2018-06-04T20:00:03Z</dateGenerated>
  <status>OK</status>
  <data>
    <parameter name="t_2m:C">
      <location lat="47.4122" lon="9.34065">
        <value date="2018-06-04T00:00:00Z">16.9</value>
        <value date="2018-06-04T03:00:00Z">15.4</value>
        <value date="2018-06-04T06:00:00Z">17.3</value>
        <value date="2018-06-04T09:00:00Z">21.4</value>
        <value date="2018-06-04T12:00:00Z">23.8</value>
        <value date="2018-06-04T15:00:00Z">25.2</value>
      </location>
    </parameter>
  </data>
</meteomatics-api-response>
```

Additional formats:

- netCDF
- PNG
- geotiff

Variety of possible integrations



Data connectors

03

Applied weather data

Thanks to worldwide available weather data you can access the for arbitrary locations.

01

Weather API



Using our Weather API gives you access to historical, current & forecast data, whereas it includes radar, satellite, model data and more.

02

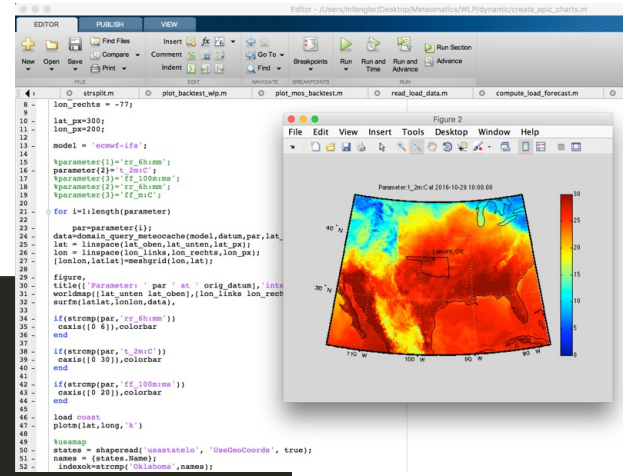
Flexible and fast integration

Variety of different connectors such as Python, Excel, Java, C++, Matlab etc.

```
import meteomatics_weather_api as api
import datetime as dt

username = 'max'
password = 'mustermann'
lat = 47.11
lon = 11.47
startdate = dt.datetime.utcnow().replace(hour=0, minute=0, second=0, microsecond=0)
enddate = startdate + dt.timedelta(days=1)
interval = dt.timedelta(hours=1)
parameters = ['air_temperature', 'relative_humidity', 'precipitation_amount_3h', 'wind_speed', 'wind_from_direction']

df = api.query_time_series(lat, lon, startdate, enddate, interval, parameters, username, password)
```



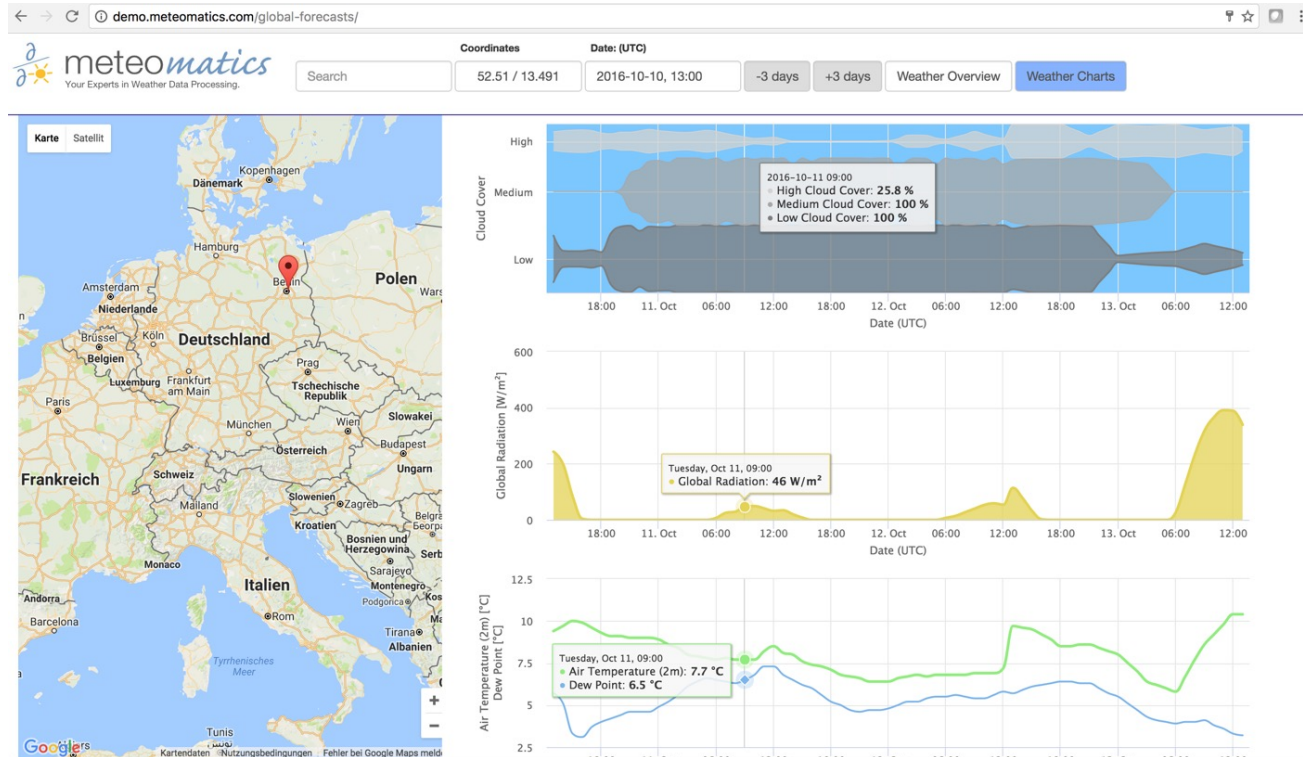
Wind power analysis

Analysis of new or potential portfolios

The screenshot shows an Excel spreadsheet titled 'meteomatics_energy_connector'. The 'Turbine model' dropdown menu is open, showing a list of power curves. A red box highlights the selected model 'ge'. A callout box with a red arrow points to the list of power curves, containing the text '> 700 power curves'.

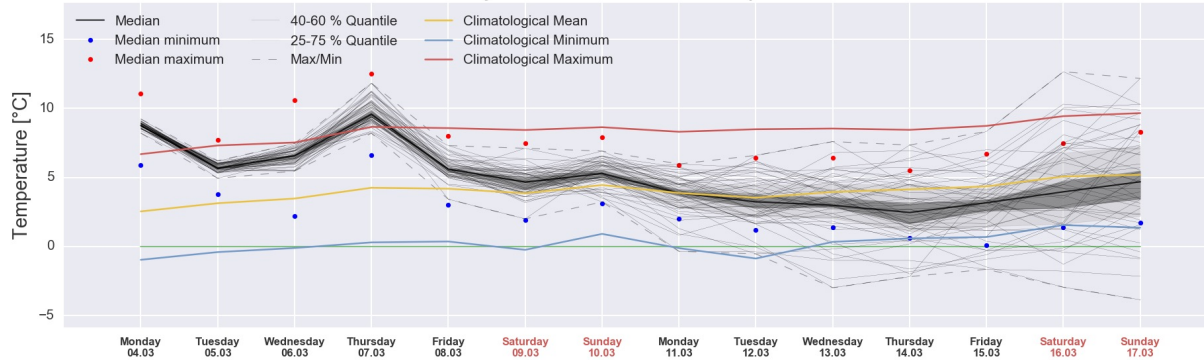
	A	B	C	D	E	F	G	H	I	J
1	Feste Werte:	50,923/10,456/-bonus_b2000	50,923	10,456	bonus_b2000_2000	100		Turbine model:	ge	
2	Start Datum:	01.09.2016 00:00	Daten beziehen							
3	End Datum:	29.09.2016 02:00	Intervall (min):	15						
4	Standort	1	2							
5	Lat	48,2569	50,797725							
6	Lon	7,800	8,9219942							
7		<input checked="" type="checkbox"/> aktiv	<input checked="" type="checkbox"/> aktiv							
8	Name Standort:	Standort #1	Standort #2							
9	Turbine model:	ge_energy_1_5sl	stus_v17_3300							
10	Hub Height [m]:	ge_energy_1_5sl								
11		ge_energy_1_5sl								
12	#####	ge_energy_1_5sl								
1507	16.09.2016 13:30:00		279,000	16.09.2016 13:30:00						
1508	16.09.2016 13:45:00		262,000	16.09.2016 13:45:00						
1509	16.09.2016 14:00:00	7,000	245,000	16.09.2016 14:00:00						
1510	16.09.2016 14:15:00	78,000	228,000	16.09.2016 14:15:00						
1511	16.09.2016 14:30:00	85,000	212,000	16.09.2016 14:30:00						
1512	16.09.2016 14:45:00	93,000	195,000	16.09.2016 14:45:00						
1513	16.09.2016 15:00:00	1,000	178,000	16.09.2016 15:00:00						
1514	16.09.2016 15:15:00	106,000	188,000	16.09.2016 15:15:00						
1515	16.09.2016 15:30:00	112,000	198,000	16.09.2016 15:30:00						
1516	16.09.2016 15:45:00	118,000	208,000	16.09.2016 15:45:00						
1517	16.09.2016 16:00:00	129,000	218,000	16.09.2016 16:00:00						
1518	16.09.2016 16:15:00	143,000	227,000	16.09.2016 16:15:00						
1519	16.09.2016 16:30:00	157,000	237,000	16.09.2016 16:30:00						
1520	16.09.2016 16:45:00	171,000	247,000	16.09.2016 16:45:00						
1521	16.09.2016 17:00:00	185,000	257,000	16.09.2016 17:00:00						
1522	16.09.2016 17:15:00	199,000	267,000	16.09.2016 17:15:00						
1523	16.09.2016 17:30:00	213,000	277,000	16.09.2016 17:30:00						
1524	16.09.2016 17:45:00	227,000	287,000	16.09.2016 17:45:00						

Data for arbitrary locations

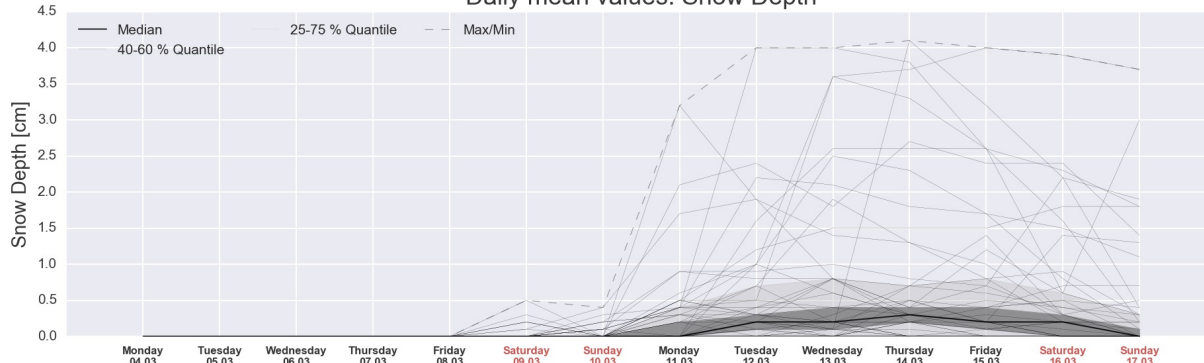


ECMWF 15 days ensemble data

Ensemble prediction 15 Days: Hamburg
Daily mean values: 2m Temperature

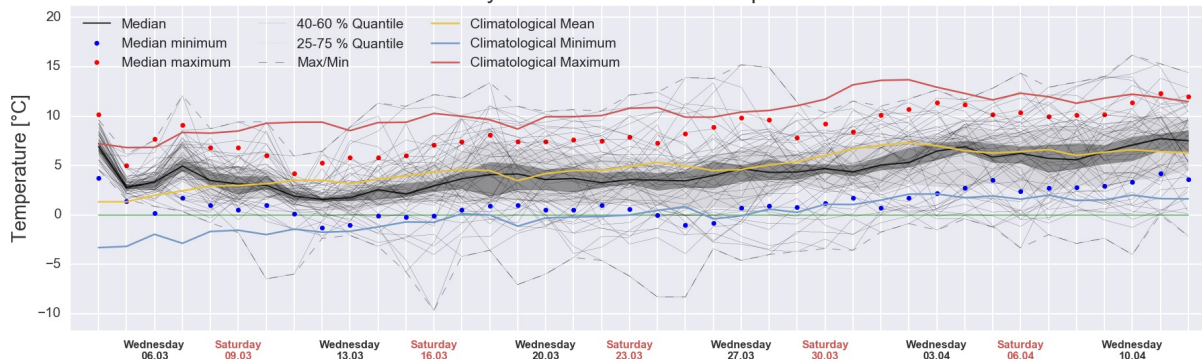


Ensemble prediction 15 Days: Hamburg
Daily mean values: Snow Depth

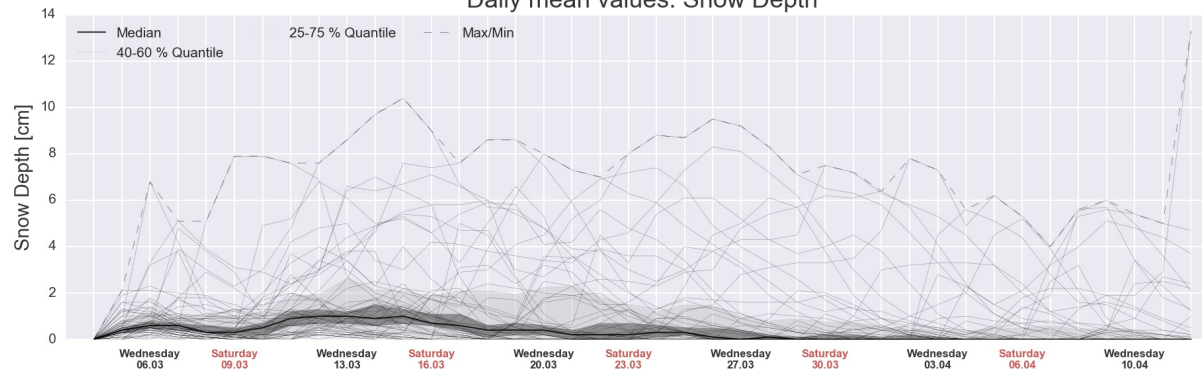


ECMWF 46 days ensemble data

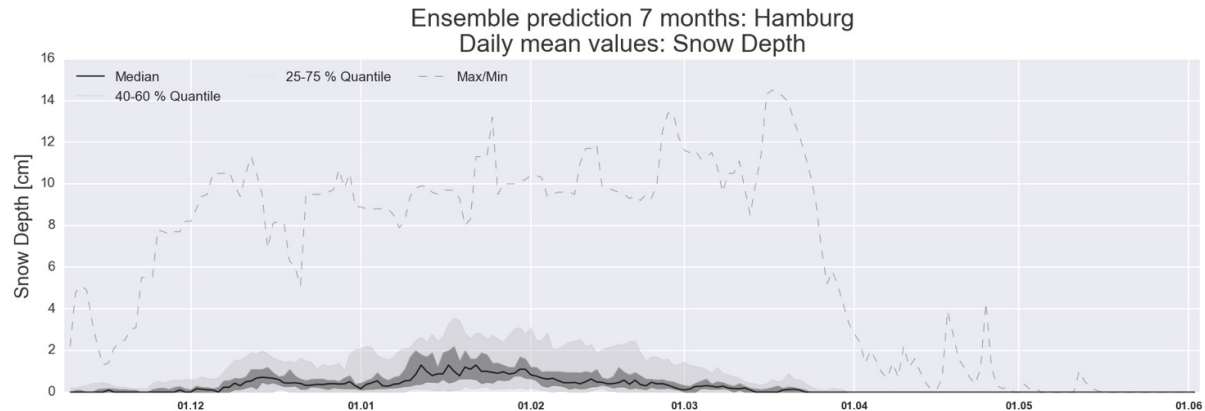
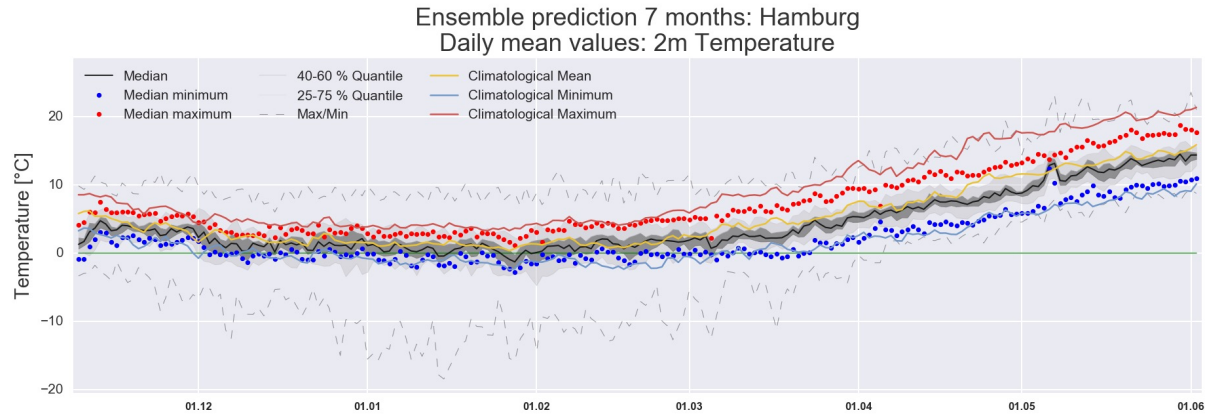
Ensemble prediction 46 Days: Weißenhorn
Daily mean values: 2m Temperature



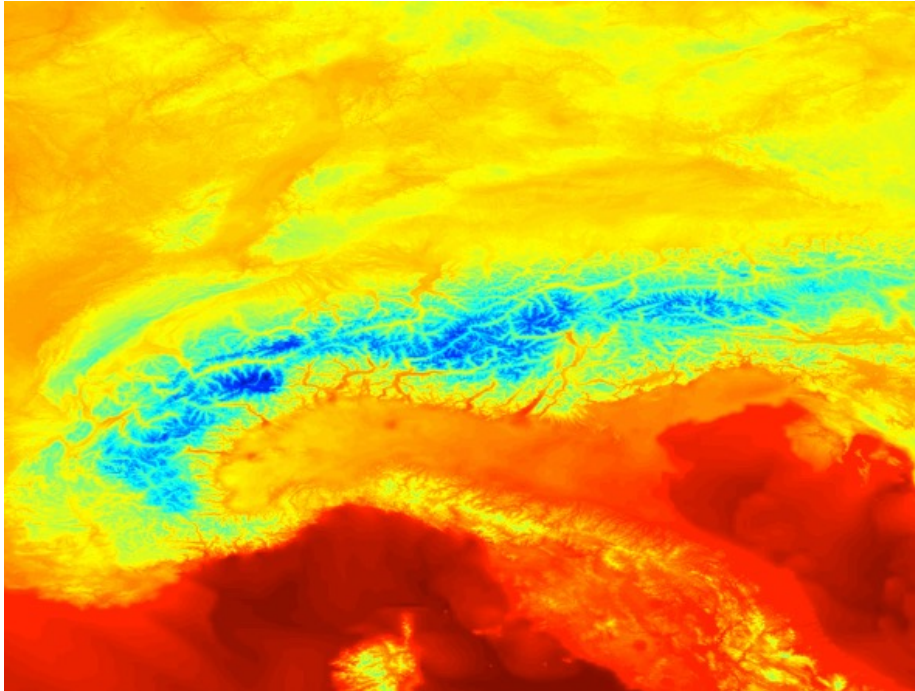
Ensemble prediction 46 Days: Weißenhorn
Daily mean values: Snow Depth



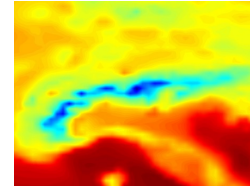
Seasonal forecasts for 7 months



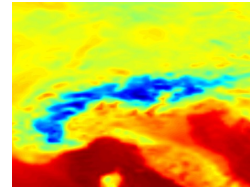
Downscaling weather data on the fly



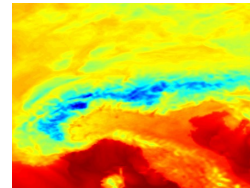
Meteomatics API 90 m (!)



GFS 0.25° = ca. 20-25 km

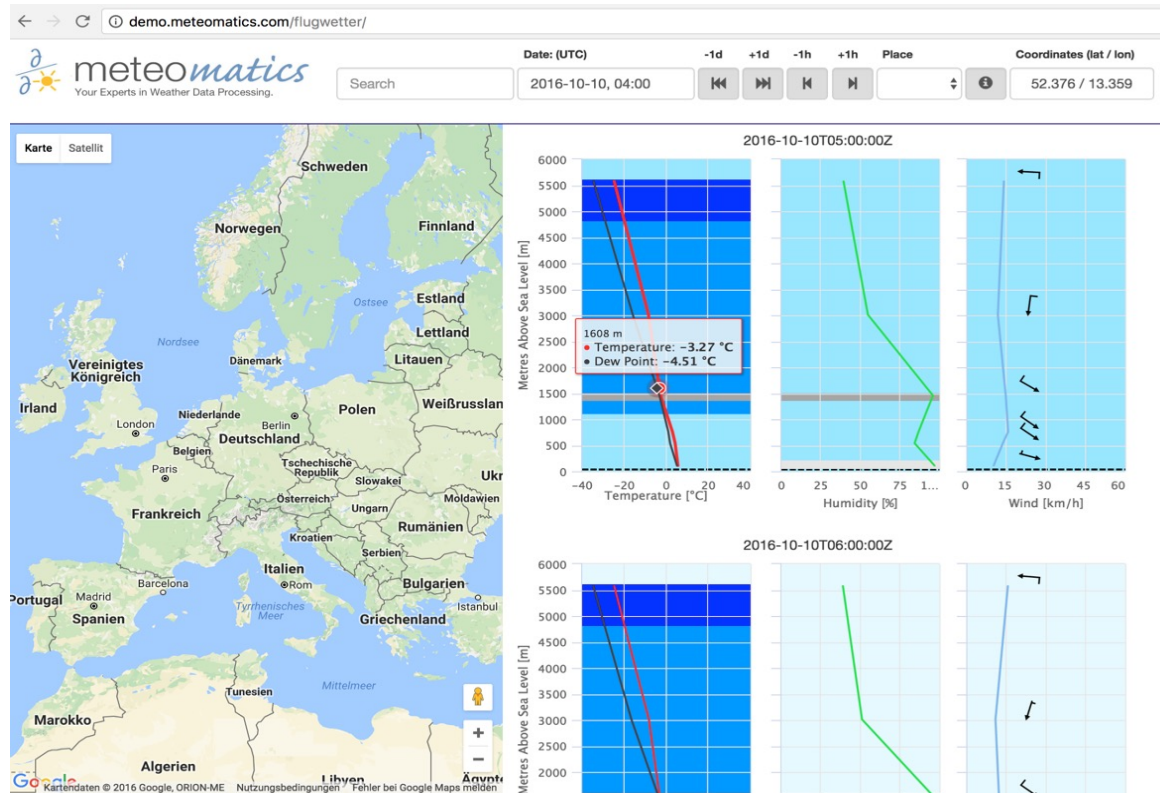


ECMWF 0.1° = ca. 8-10 km



UK MetOffice ca. 4 km

Upper air level data for arbitrary locations



Industry-specific solutions

Agricultural parameters

Leaf wetness
Frost warning
Moisture stress index
Soil temperature 5/15/50/150 cm



Rime index
Moon light index
Grassland fire index
Growing degree days (basis 10°C)

Wave period 1st moment
Period of total swell
Direction of first swell
Drift (speed & direction)



Maritime parameters

Wave height (mean/max)
Wave direction
Direction of wind waves
Direction of total swell

Industry-specific solutions

Automotive industry

Visibility
Wind
Temperature in 90 m resolution
Nowcasting



Storm & hail forecasts
En route weather conditions
Slippery road indicator
Freezing rain
Black ice

Multiple atmospheric layers
Cloud cover
Turbulence
Solar inclination
En route flight weather forecast



Aviation

Visibility
Wind & gusts
Fan blade icing
Icing conditions

Industry-specific parameters

Insurance

Lightning data
Hail information
Storm data
Hurricane tracks



Drought indices
Flash floods
Extreme weather
Ocean wave heights
Climatological values

Are you interested in another
industry sector?



We have many more
parameters for you !

Power forecasts



Solar power forecasts

- Radiation
- Solar inclination
- Effective cloud cover
- Downscaled temperature



Wind power forecasts

- Wind speed
- Wind angle
- Turbine type
- Generator capacity



Hydro power forecasts

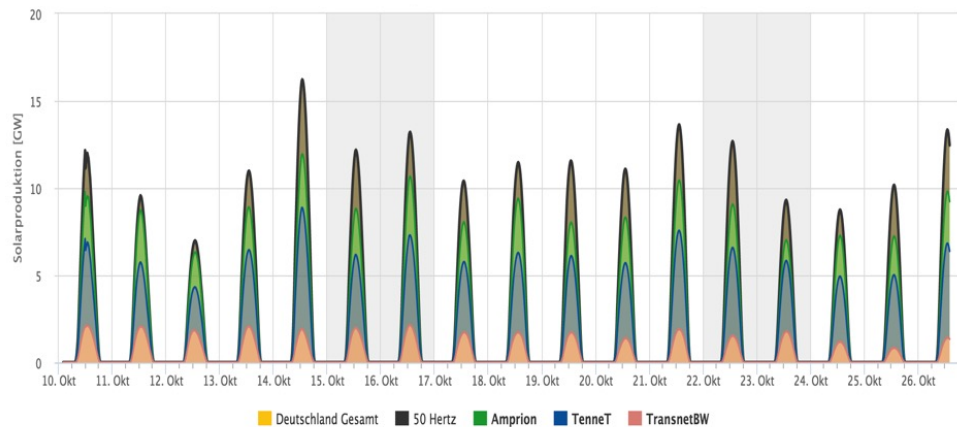
- Radiation
- Evaporation
- Temperature
- Radar & precipitation data

Solar power forecasts



Solar power forecasts

- Radiation
- Solar inclination
- Effective cloud cover
- Downscaled temperature
- Direct & diffuse radiation



Solar Power Forecast by Meteomatics

Wind power forecasts

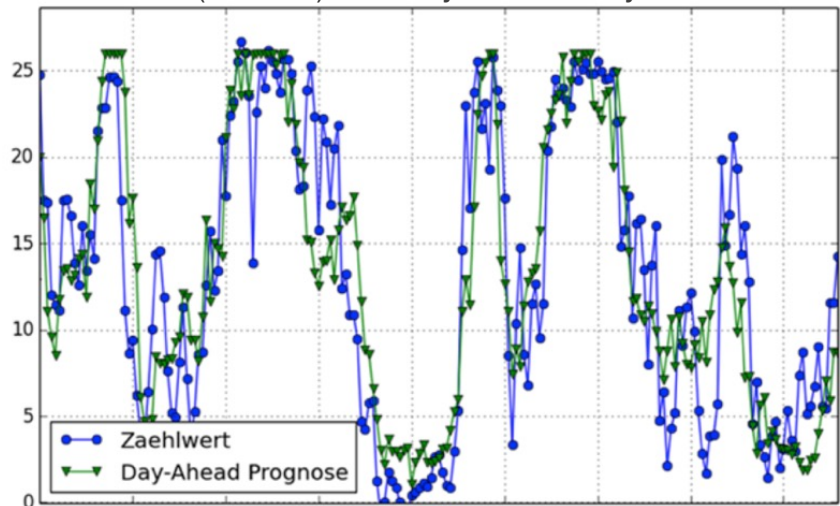


Mix the forecast of the different models!

Choose your own:

- Generator capacity
- Hub height
- Turbine type
- ...

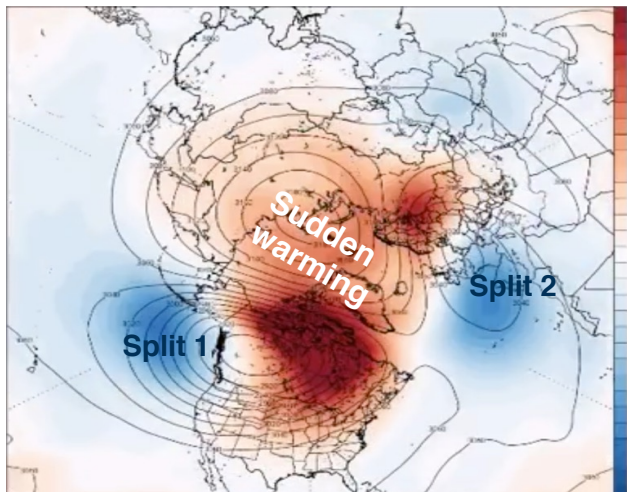
Wind farm (nRMSE): intraday < 8 % & day ahead < 10 %



Wind power forecasts

- Wind speed
- Wind angle
- Turbine type
- Generator capacity

Stratospheric polar vortex index (SPV)



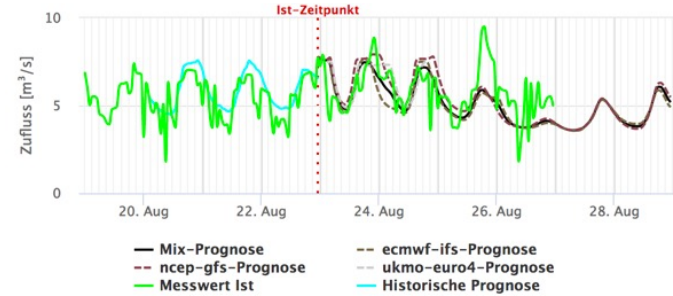
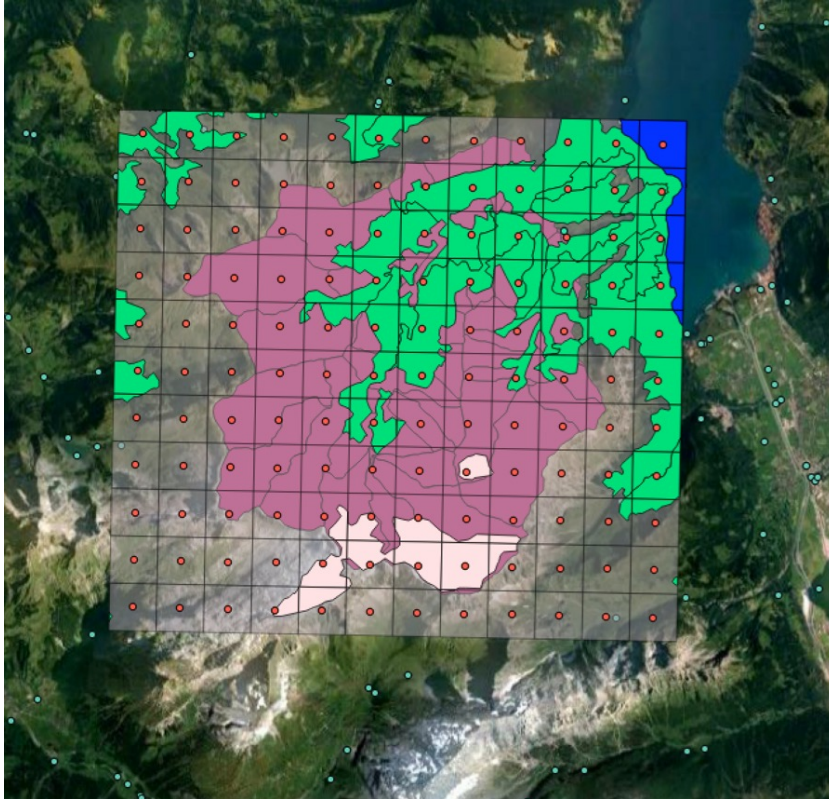
The SPV-index allows the monitoring of the stratospheric vortex strength and warns of possible cold outbreaks at mid-latitudes during the northern winter.



Historical and forecast data:

- ECMWF ERA-5, IFS and extended-range EC46 model output
- Range: 60°N – 90°N around the globe
- Levels: 200hPa, 50hPa, and 10hPa
- Parameter: mean wind speed

Hydro power forecasts



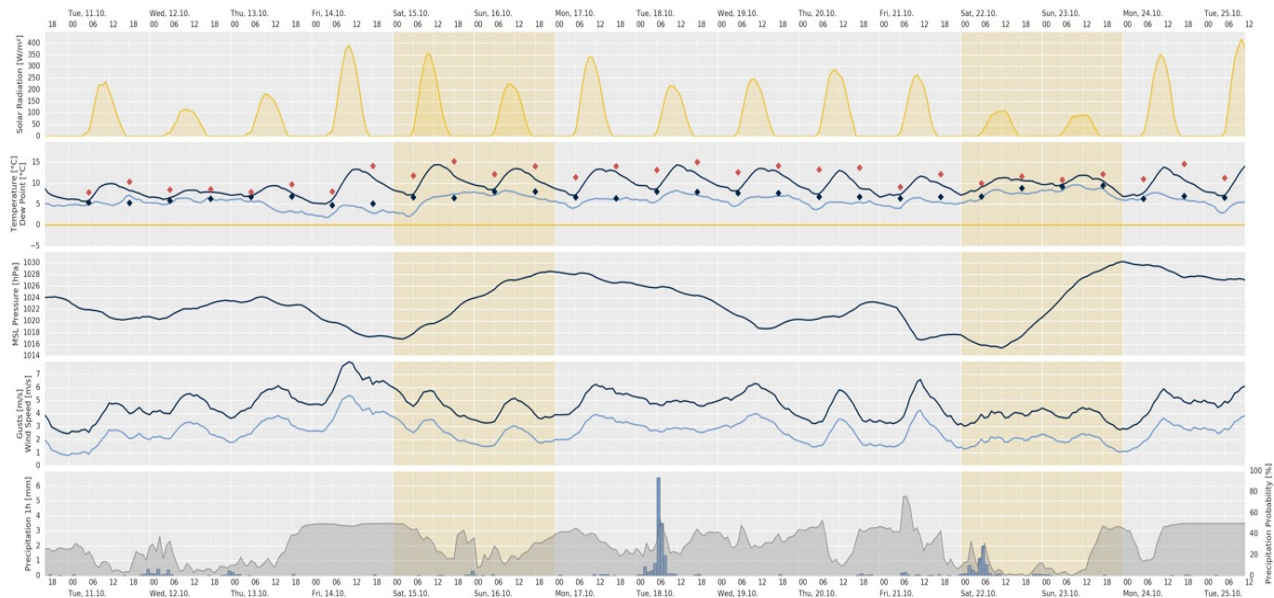
Hydro power forecasts

- Radiation
- Evaporation
- Temperature
- Radar & precipitation data

Own station forecasts

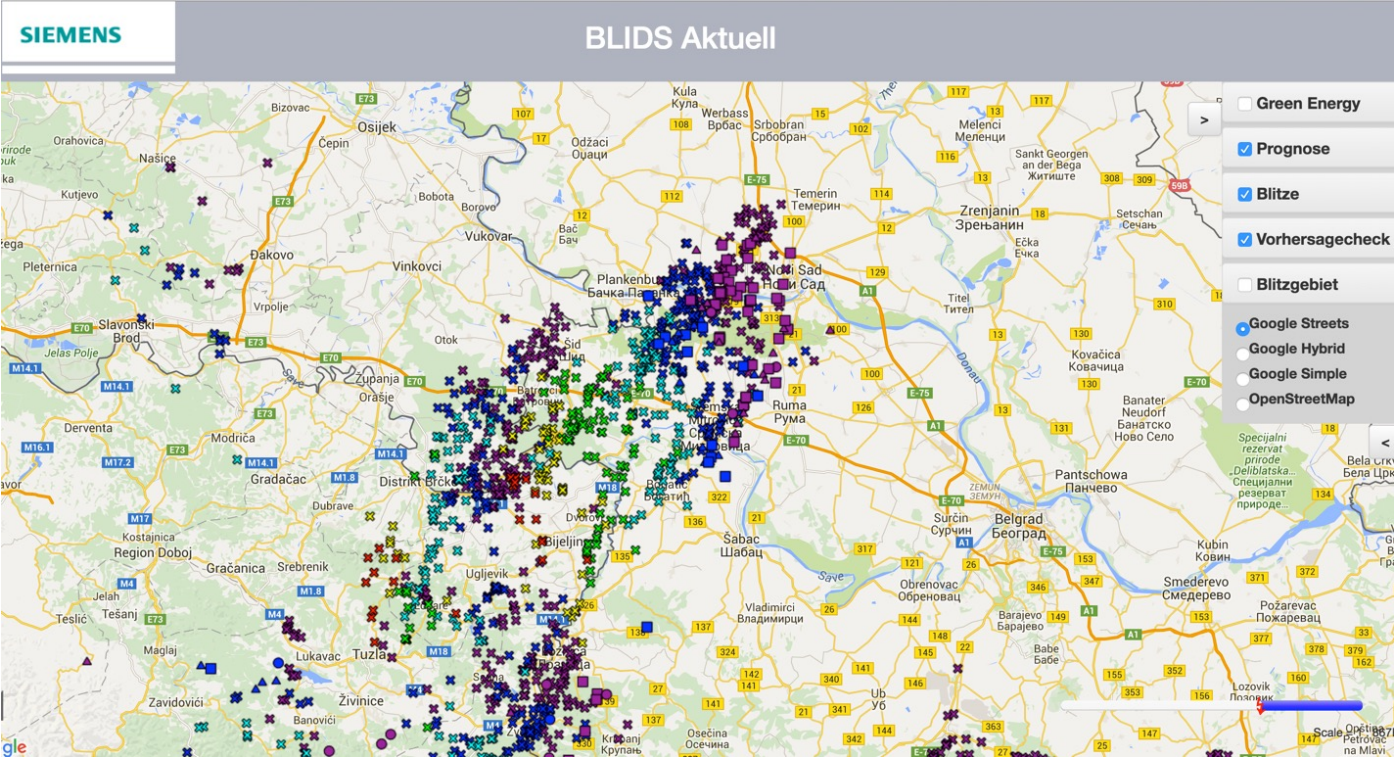
Build your own „MOS“/model

dresden-nossener-bruecke
(generated at 2016-10-11 05Z)

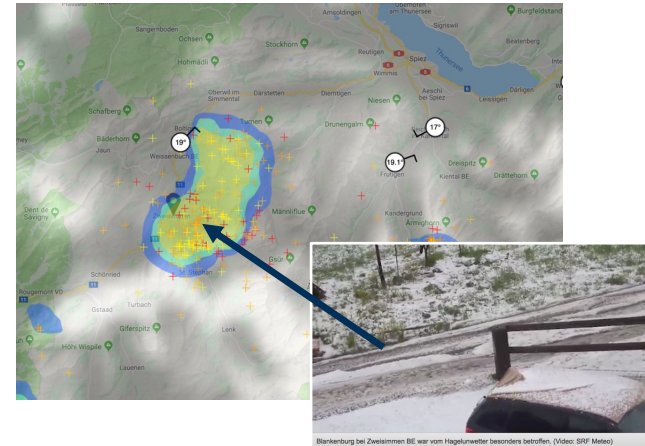
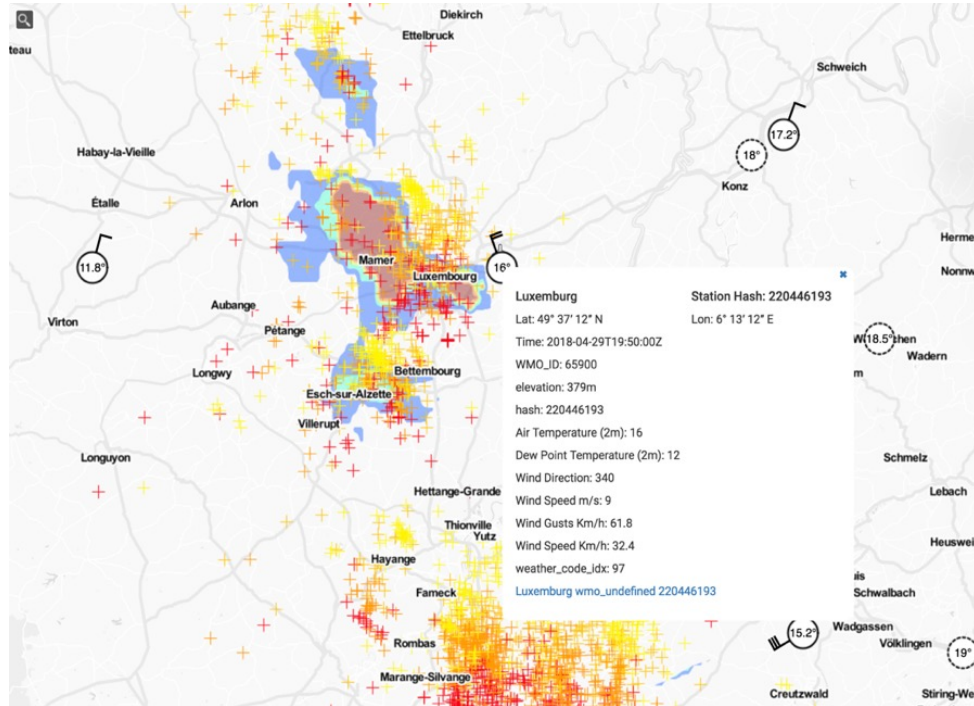


Temperature error MAE intraday/ day ahead: 0.8 °C - 1.0 °C

Real-time lightning forecasts



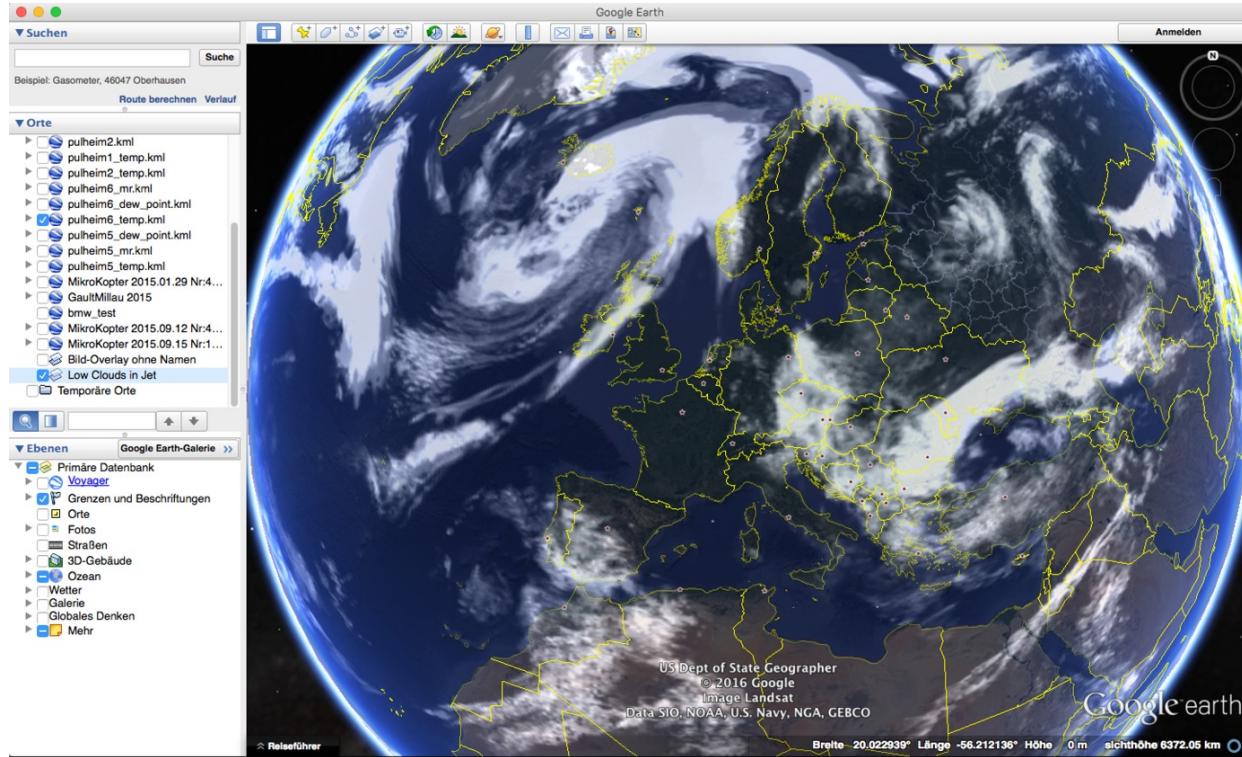
Radar, hail & lightning data (WMS/WFS layer)



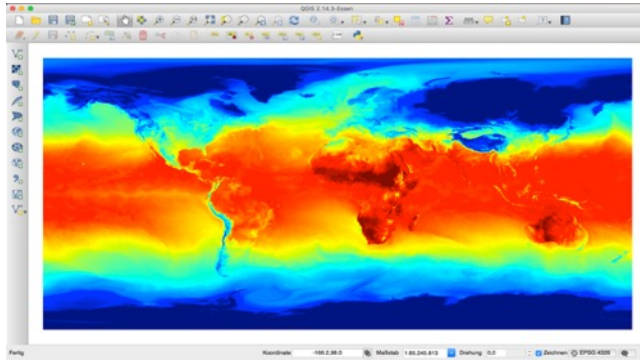
For insurances, it is highly important to get precise data on:

- Historical lightning & hail events
- Storm data
- Rain & flood data

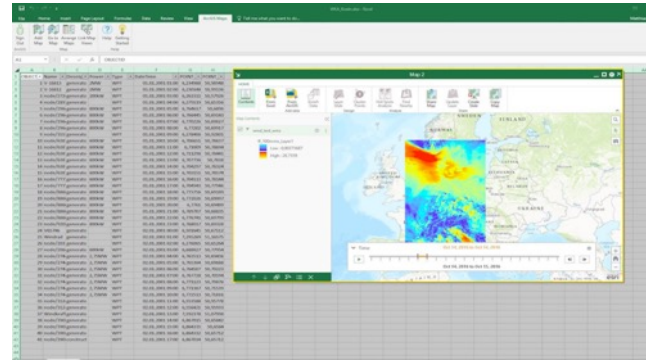
Support of WMS: integration into Google Earth



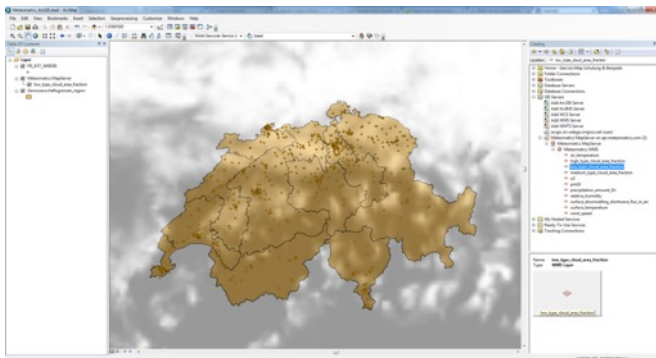
Integration into ESRI & QGIS



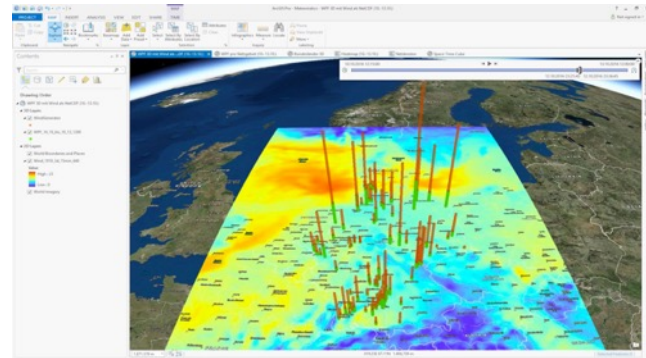
QGIS



ArcGIS for Office

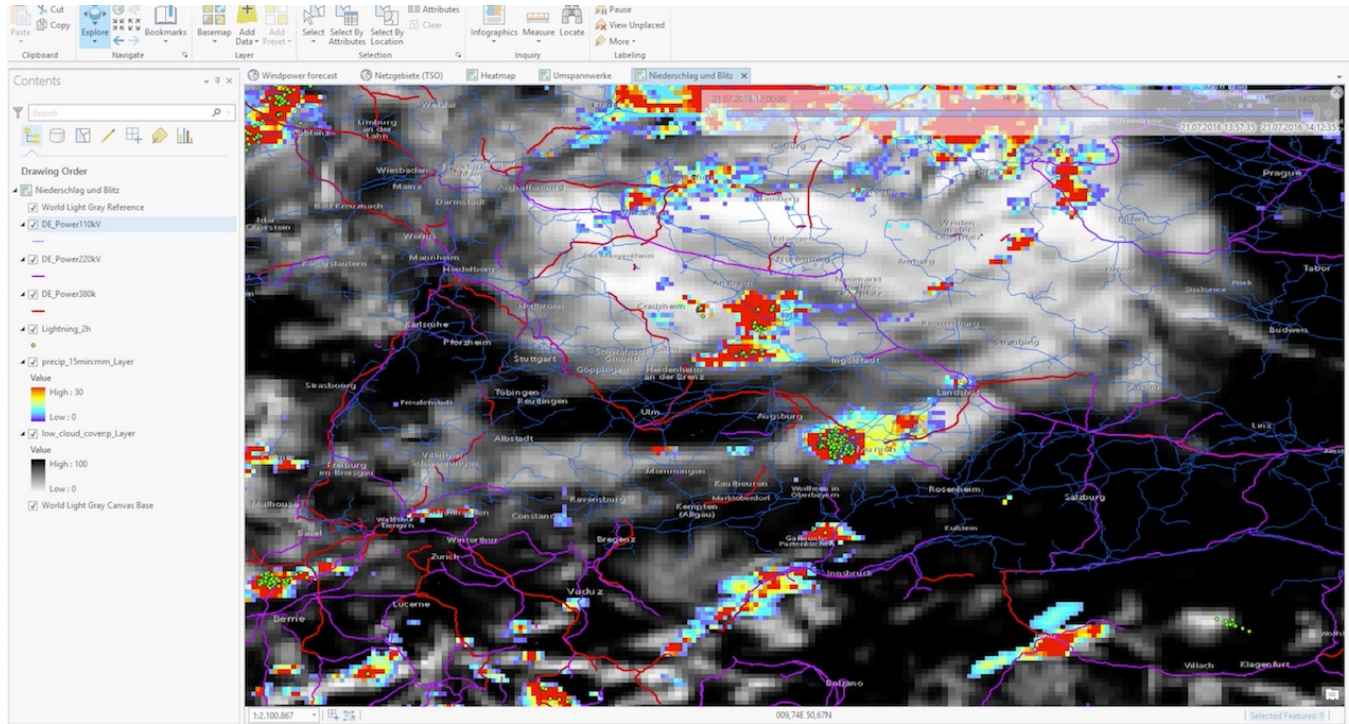


ArcGIS



ArcGIS Pro

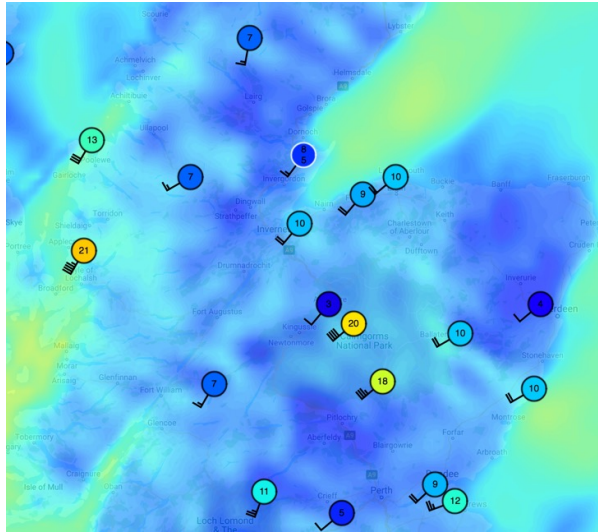
Integration into ESRI (ArcGIS)



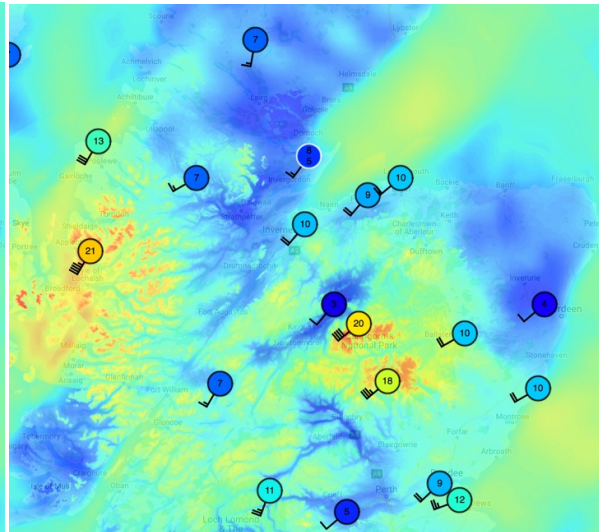
Multi-layer representation
for a transmission system
operator (TSO)

- Cloud layer (satellite images), radar images, lightning data
- Historical & current data, nowcasting 2 hours ahead, weather model data up to 10 days
- Overlay with power line network

Reanalysis mode



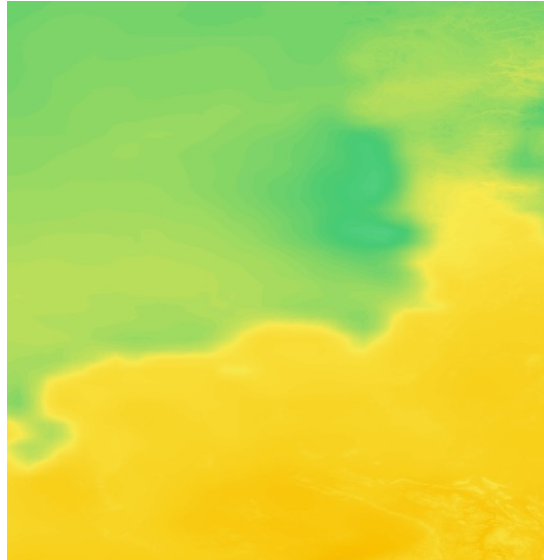
without calibration



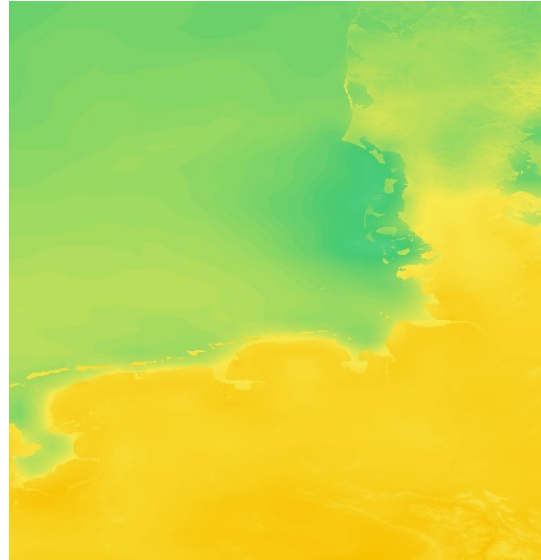
with calibration

**High-resolution model output
is calibrated against weather
station data.**

Coastal Downscaling



without downscaling



with downscaling

Coarse model resolution fails to identify islands in the sea as land which impacts the forecast negatively. Correcting for this gives a more realistic forecasts for the coastal area!

Weather texts for any location

Wetter St.Gallen

Dienstag 30.10. 2018

Heute kann es zeitweise stark regnen. Die Sonne scheint nur eine Stunde. Es ist sehr kühl mit Temperaturen zwischen 2°C und 7°C. Über den ganzen Tag weht ein schwacher Wind aus Südwesten. Bei Einbruch der Nacht gibt es freie Sicht auf Sterne und Planeten, in der zweiten Nachthälfte wird es leicht bewölkt.

Weather Zürich

Tuesday 30.10. 2018

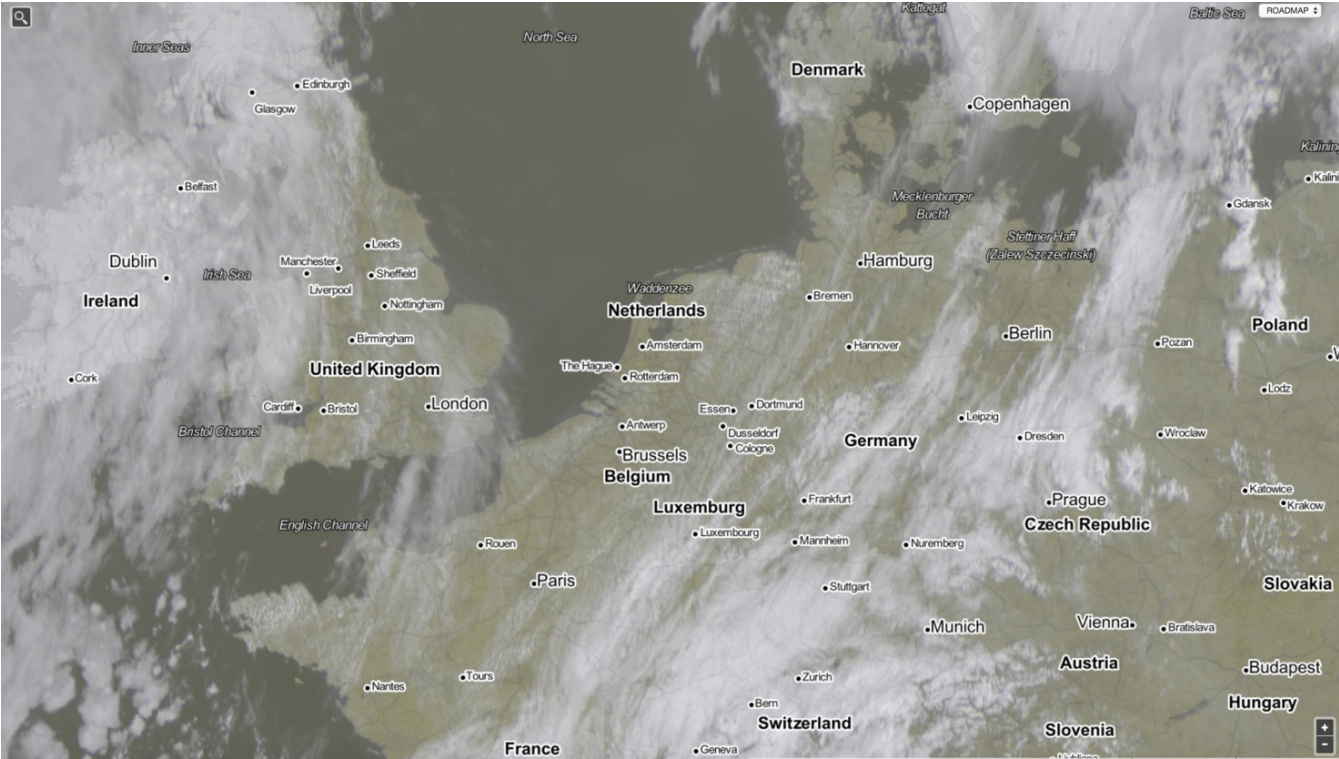
Today after daybreak rain will be falling. In the afternoon rain showers are expected. It stays very cool with temperatures between 3°C and 8°C. In the morning there is a light southwesterly breeze which converts to a gentle southerly wind. During nighttime it is cloudless.

Temps Lausanne

Mardi 30.10. 2018

Aujourd'hui après le lever du soleil on attend de la pluie. Dans l'après-midi le ciel sera bien dégagé et ensoleillé. Le soleil brillera presque 3 heures. Il reste très frais avec températures entre 2°C et 10°C. Après le lever du soleil un vent frais soufflera du sud-ouest en s'affaiblissant durant la journée. Il y aura des rafales. Dans la première moitié de la nuit les étoiles seront visibles, après minuit le ciel se voilera progressivement.

Real-time satellite images



Integration into Tableau

The screenshot displays the Tableau Desktop interface. The main view is a satellite map of Europe, titled "Satellite view". The interface includes a top toolbar, a left sidebar with a "Daten" (Data) pane, and a right sidebar with a "Zeig es mir!" (Show me!) pane.

Dimensions (Dimensionen):

- Customer
 - Customer Name
 - Segment
- Order
 - Order Date
 - Order ID
 - Ship Date
 - Ship Mode
- Location
 - Country
 - State
 - City
 - Postal Code
- Product

Measures (Kennzahlen):

- Discount
- Profit
- Profit Ratio
- Quantity
- Sales
- Anzahl der Datensätze
- Breitengrad (generiert)
- Längengrad (generiert)

Sätze (Views):

- Top Customers by Profit

Parameter:

- Profit Bin Size
- Top Customers

Right Sidebar (Zeig es mir!):

Für Symbolkarten versuchen Sie

- 1 Geo **Dimension**
- 0 oder mehrere **Dimensionen**
- 0 bis 2 **Kennzahlen**

Kann räumliche Kennzahl statt geografischer Dimension verwenden

Integration into Google Spreadsheet

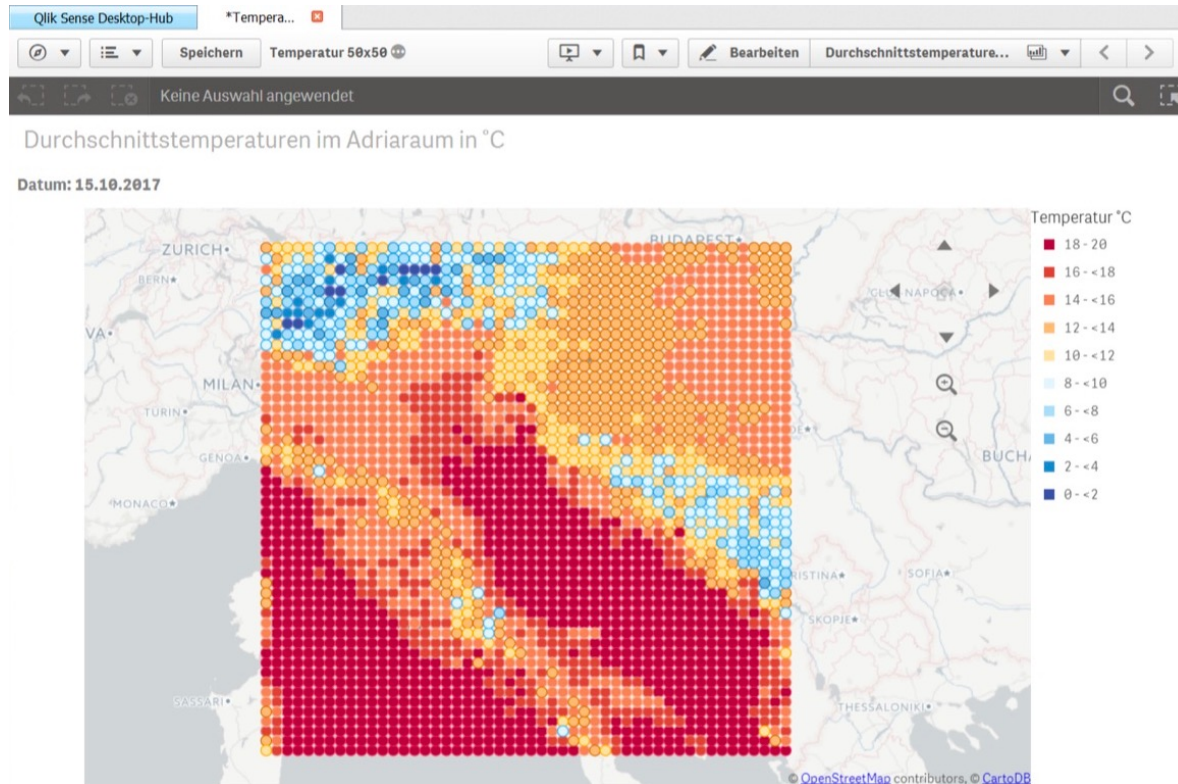
The screenshot shows a Google Spreadsheet titled "Meteomatics Weather API". The "Call Weather API" add-on is highlighted in the top menu. The spreadsheet contains the following configuration parameters:

Parameter	Value
Start date:	2018-07-27T00:00:00Z
End date:	2018-07-29T00:00:00Z
Location Latitude:	50,211
Location Longitude:	10,232
User:	google-community
Password:	*****
Parameter list:	t_2m:C
validdate:	t_2m:C

The chart displays the temperature data for "t_2m:C" over time. The x-axis represents time from 2018-07-27 to 2018-07-29, and the y-axis represents temperature in degrees Celsius, ranging from 15 to 35. The chart shows a clear diurnal cycle with peaks around 30°C and troughs around 17°C.

Time	Temperature (t_2m:C)
2018-07-27T00:00:00Z	18.3
2018-07-27T01:00:00Z	17.6
2018-07-27T02:00:00Z	17.1
2018-07-27T03:00:00Z	18.6
2018-07-27T04:00:00Z	21.2
2018-07-27T05:00:00Z	24.5
2018-07-27T06:00:00Z	27
2018-07-27T07:00:00Z	28.7
2018-07-27T08:00:00Z	29.9
2018-07-27T09:00:00Z	30.4
2018-07-27T10:00:00Z	30.6
2018-07-27T11:00:00Z	30.6
2018-07-27T12:00:00Z	30.9
2018-07-27T13:00:00Z	30.6
2018-07-27T14:00:00Z	30.9
2018-07-27T15:00:00Z	30.6
2018-07-27T16:00:00Z	30.4
2018-07-27T17:00:00Z	29.6
2018-07-27T18:00:00Z	26.3
2018-07-27T19:00:00Z	24.1
2018-07-27T20:00:00Z	22

Integration into Qlik



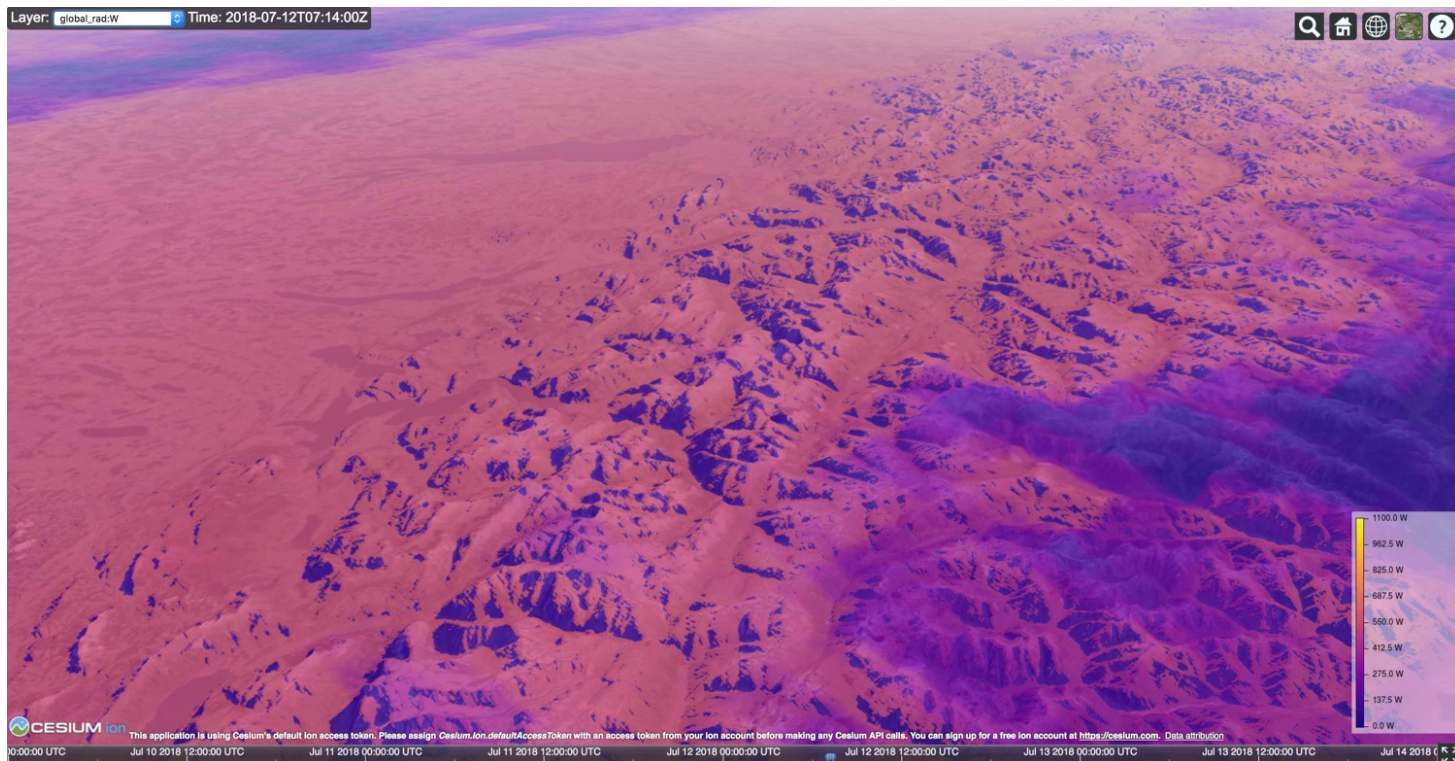
Integration into Power BI

The screenshot displays the Power BI Query Editor interface for a query named "output". The main area shows a table with the following data:

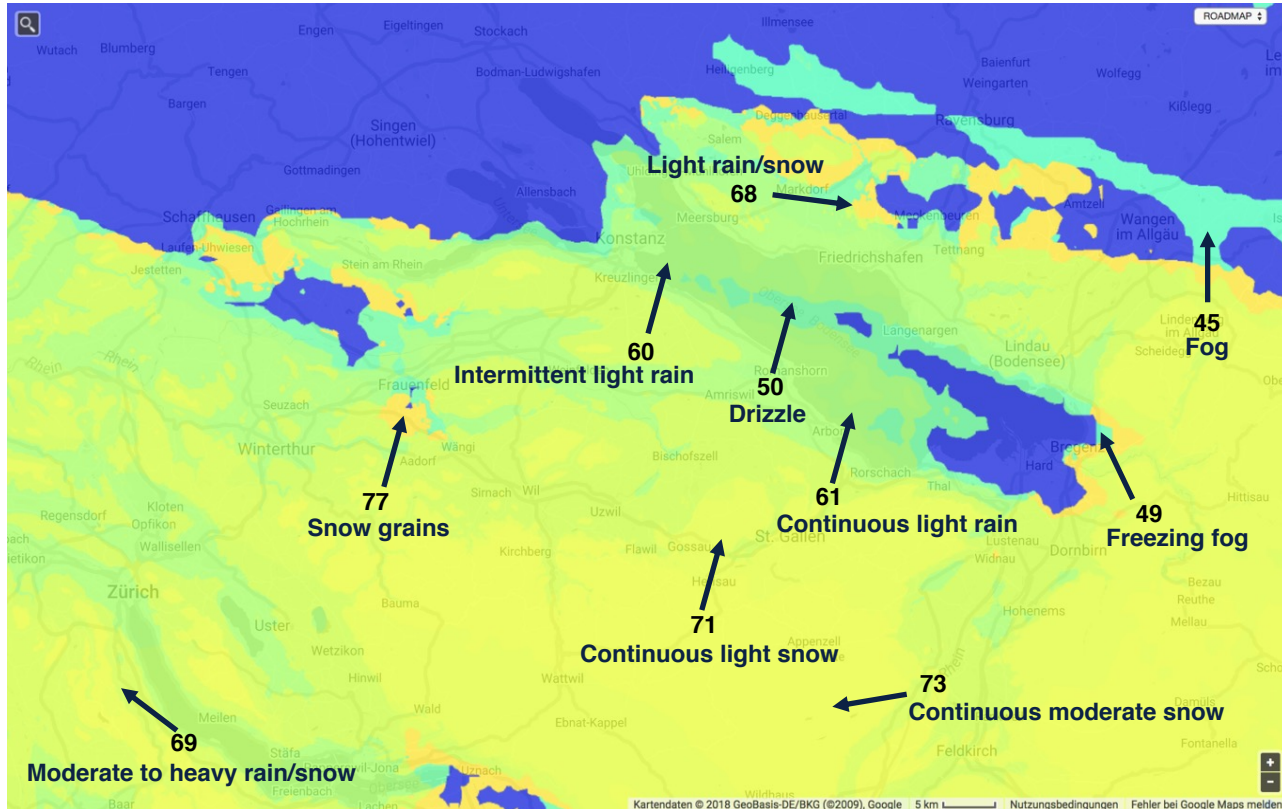
	Date	Parameter	1.2 Value
1	01.01.2017 00:00:00	t_2m.C	3.6
2	01.01.2017 01:00:00	t_2m.C	-0.6
3	01.01.2017 02:00:00	t_2m.C	2.1
4	01.01.2017 03:00:00	t_2m.C	1.7
5	01.01.2017 04:00:00	t_2m.C	2.5
6	01.01.2017 05:00:00	t_2m.C	3.3
7	01.01.2017 06:00:00	t_2m.C	3.4
8	01.01.2017 07:00:00	t_2m.C	3.5
9	01.01.2017 08:00:00	t_2m.C	4.3
10	01.01.2017 09:00:00	t_2m.C	5.6
11	01.01.2017 10:00:00	t_2m.C	6.4
12	01.01.2017 11:00:00	t_2m.C	7
13	01.01.2017 12:00:00	t_2m.C	7.3
14	01.01.2017 13:00:00	t_2m.C	7
15	01.01.2017 14:00:00	t_2m.C	6.2
16	01.01.2017 15:00:00	t_2m.C	4.9
17	01.01.2017 16:00:00	t_2m.C	4.7
18	01.01.2017 17:00:00	t_2m.C	4.8
19	01.01.2017 18:00:00	t_2m.C	4.6
20	01.01.2017 19:00:00	t_2m.C	4.1
21	01.01.2017 20:00:00	t_2m.C	3.8
22	01.01.2017 21:00:00	t_2m.C	3.4
23	01.01.2017 22:00:00	t_2m.C	3.2
24	01.01.2017 23:00:00	t_2m.C	3.1
25	02.01.2017 00:00:00	t_2m.C	3
26	02.01.2017 01:00:00	t_2m.C	-1.7
27	02.01.2017 02:00:00	t_2m.C	0.4
28	02.01.2017 03:00:00	t_2m.C	0.9
29	02.01.2017 04:00:00	t_2m.C	1.5
30	02.01.2017 05:00:00	t_2m.C	2.1
31	02.01.2017 06:00:00	t_2m.C	2.1
32	02.01.2017 07:00:00	t_2m.C	2.2

The interface includes a ribbon with options like "Data", "Transform", "Add Column", "View", and "Help". The "Query Settings" pane on the right shows the "PROPERTIES" section with "Name" set to "output" and the "APPLIED STEPS" section with "Source" and "Navigation" steps. The bottom status bar indicates "3 COLUMNS, 99+ ROWS" and "PREVIEW DOWNLOADED AT 09:06".

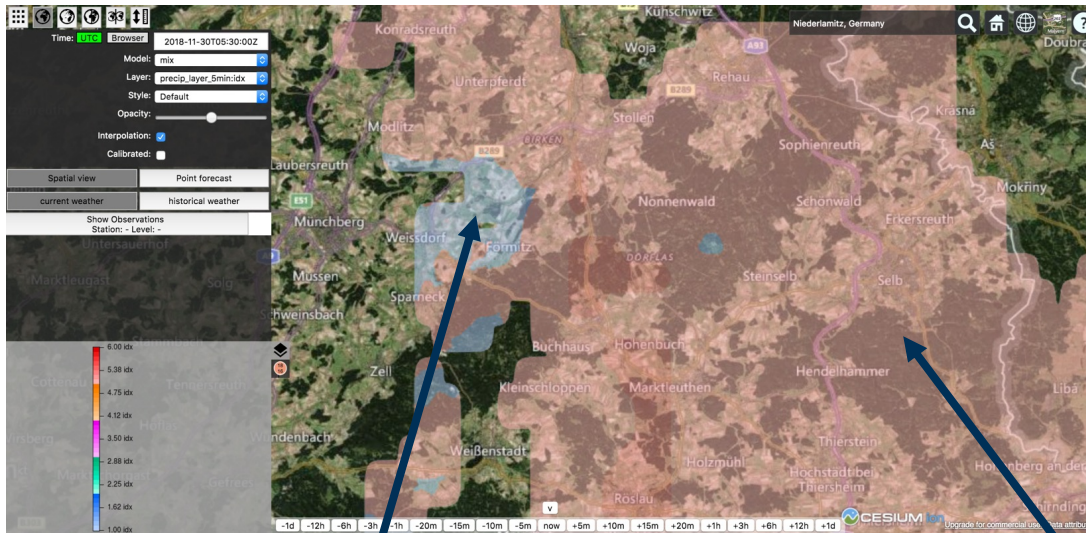
Integration into CesiumJS



The weather code (ww) on the fly



Hyperlocal forecasting freezing rain



Rain

Freezing rain

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Frankenpost

Suche...

Region Deutschland & Welt Meine Themen Sport Leben Anzeigen Abo Vorteilswelt Mehr

Topthemen: Neue B15-Ampel • Hofer Kaufhof wird Hotel • Hilfe für Nachbarn • Benefiz-Ball • Stromtrasse durch die Region • Gerch

Anzeige

Länderspiegel

Glätteis: 30 Unfälle im Raum Wunsiedel

Zahlreiche glättebedingte Verkehrsunfälle beschäftigten am Freitagmorgen Polizei, Rettungsdienst und Feuerwehr. Bei Kirchenlamitz wurde ein Verkehrsteilnehmer schwer verletzt, in Rehau trug ein Fußgänger Kopfverletzungen davon.

Verlesen

Seit den frühen Morgenstunden führte der feuchte Niederschlag besonders im Landkreis Wunsiedel zu zahlreichen Verkehrsunfällen. Rund 30 Mal mussten Polizei sowie Hilfsdienste zu Unfällen ausrücken.

Bei einem Unfall auf der Kreisstraße bei Kirchenlamitz erlitt ein Beteiligter schwere Verletzungen und kam in ein Krankenhaus.

In Rehau stürzte ein Fußgänger und erlitt Kopfverletzungen.

Die Polizei appelliert gerade in den Wintermonaten zu vorsichtiger und witterungsangepasster Fahrweise. Winterrüstung, insbesondere Winterreifen, sollte mittlerweile an den Fahrzeugen Standard sein.

Anzeige

Autor

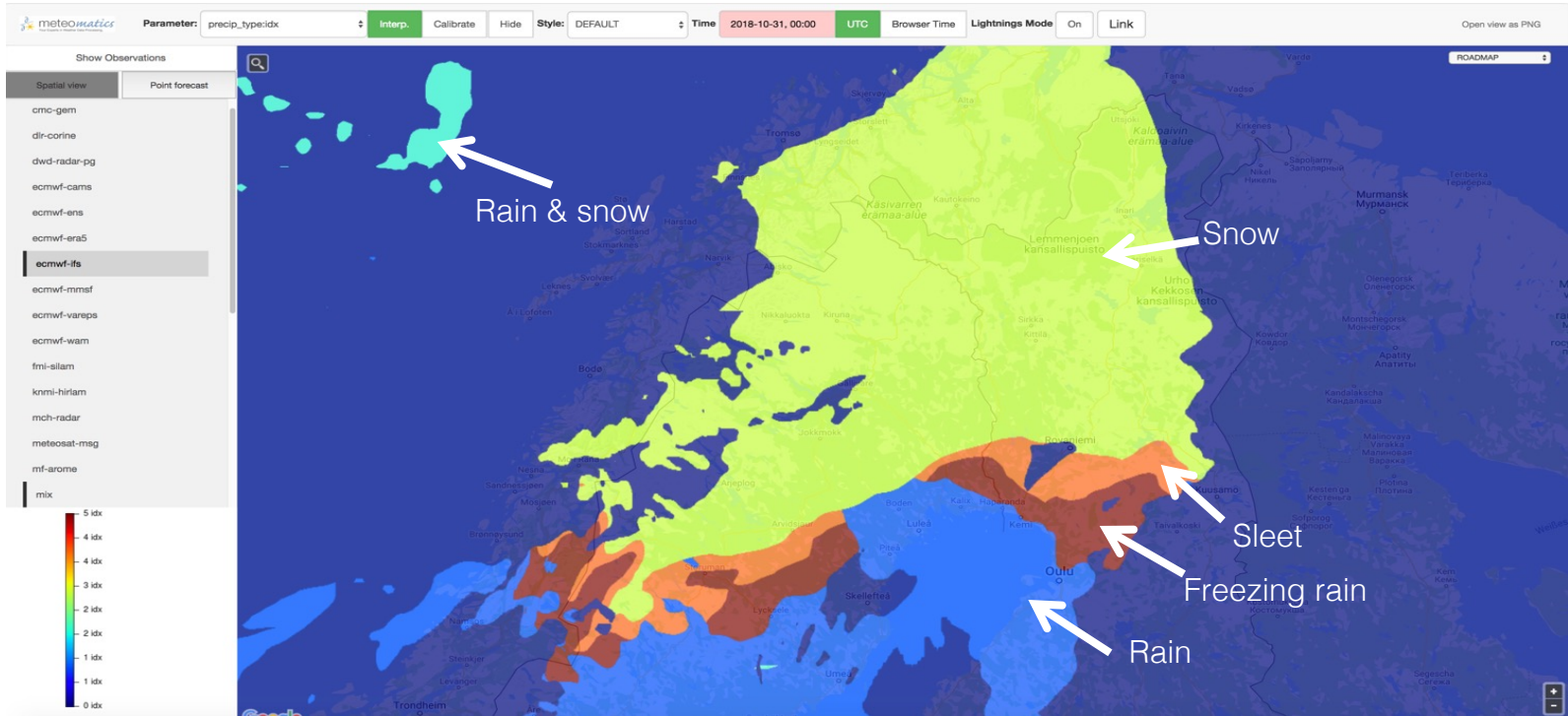
Redaktion

Kontakt zum Autor

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Precipitation types on the fly






Weather widgets

St.Gallen locate me

Wednesday  7 °C 12 °C	Thursday  7 °C 16 °C	Friday  10 °C 19 °C
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London

Wednesday 13 °C 11 °C 
Thursday 21 °C 14 °C 
Friday 23 °C 14 °C 

locate me

Homepage weather

9	27	28	1. März	2	3	4	5
 -0°C – 12°C	 -0°C – 6°C	 -1°C – 5°C	 3°C – 8°C	 -1°C – 13°C	 4°C – 14°C	 1°C – 6°C	
10	6	7	8	9	10	11	12
 -1°C – 5°C	 -2°C – 8°C	 2°C – 6°C					
11	13	14	15	16	17	18	19

Calendar integration into iCal & iPhone

Contact us



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