meteomatics
Your Experts in Weather Data Processing.

Using MATLAB to Empower Modern Numerical Weather Forecasts

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CEO

World Class Talent in Meteorology, Data Science, Drone Development and Service Delivery

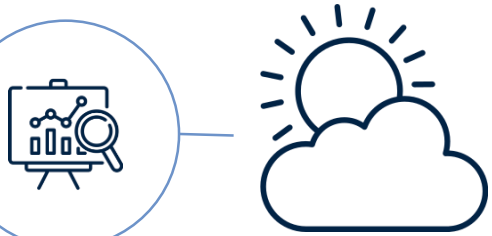
We are proud of Meteomatics' fair, hardworking, 'can-do' culture and a highly skilled multi-disciplinary team who rise to the challenge with our customers in a positive fashion. Creativity is a core skill whether it be in thinking, design, architecture or science.

Why Does Weather Matter?

It affects our daily life.

It affects our business.

It is highly variable.



Better understanding of the weather helps reducing business costs.

Better understanding of the weather improves predictive maintenance.

Better understanding of the weather reduces the impacts of natural hazards.

Key Takeaways

Weather API & MATLAB
enable us to:

... model gathered drone data

… simulate new measurement techniques

… implement physical parametrizations

… visualize meteorological data

… carry out statistical analyses

… enrich training of machine & AI learning with weather data

… give deeper insights into your weather related business

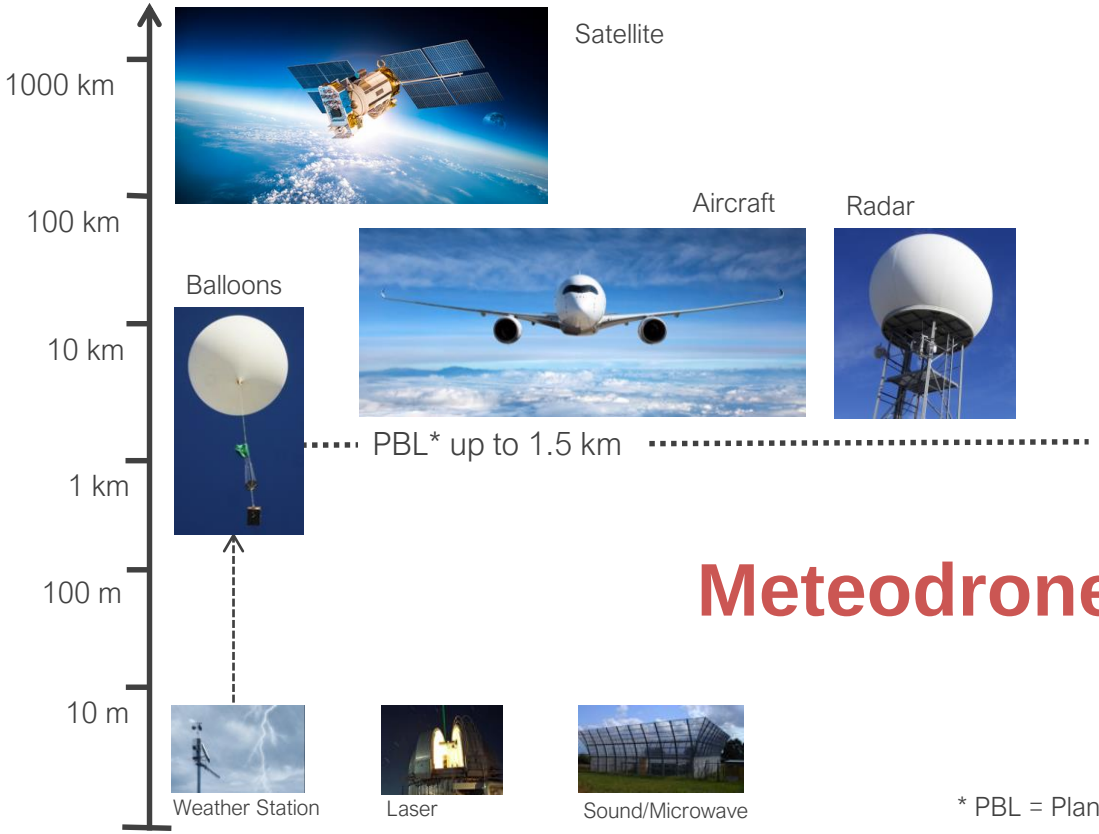
Key Challenges

- Inaccuracy of Forecasts
- Access to Historical Data
- Huge Amount of Data
- Inconsistent Data Formats

Current Data Situation

* PBL = Planetary Boundary Layer

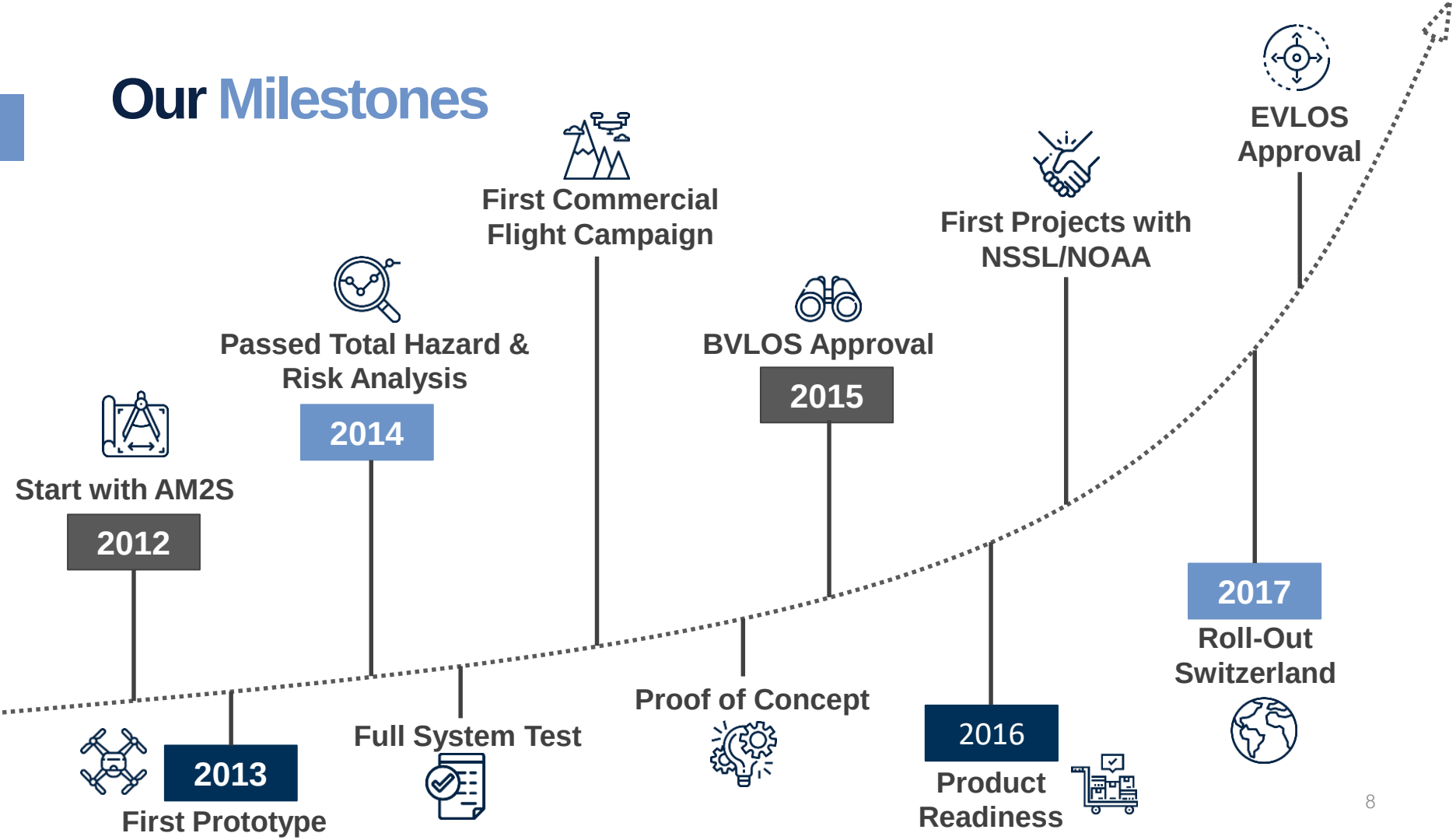
Improving Data Situation



Meteodrone

* PBL = Planetary Boundary Layer

Our Milestones




Our mobile systems allow highly flexible missions.

Meteodrone Sensors & Flight Profile

Pressure
Accuracy: 0.1 hPa
Response Time: 250 ms

Dew Point
Accuracy: 0.2 °C
Response Time: < 4 s

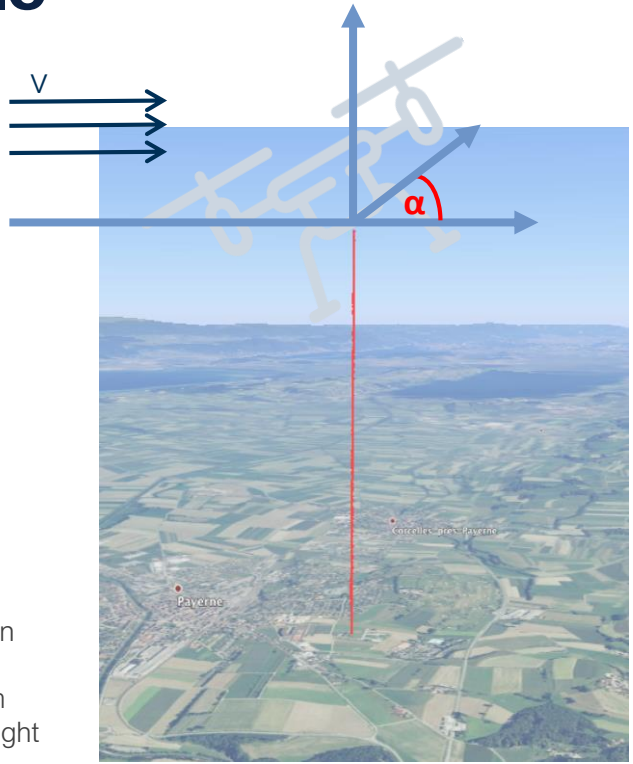
Temperature
Accuracy: 0.1 °C
Response Time: 1 s

Wind Speed & Direction
Accuracy: < 1 m/s
Response Time: 250 ms

The aircraft automatically compensates wind drag:

- Compute wind speed and direction from roll & nick angle
- Vertical flight profile up to 3'000 m
- Currently working on increasing flight altitude to 6'000 m

Relative Humidity
Accuracy: < 2 %
Response Time: < 4 s



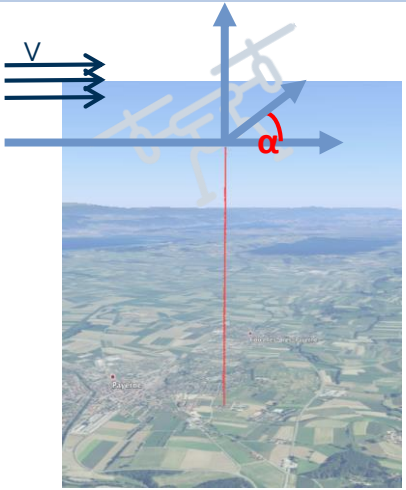
Prototyping done in MATLAB
Modelling & Simulation

Sensors are radiation-shielded and mounted in the rotor downwash.

Modelling & Simulation of Meteodrone

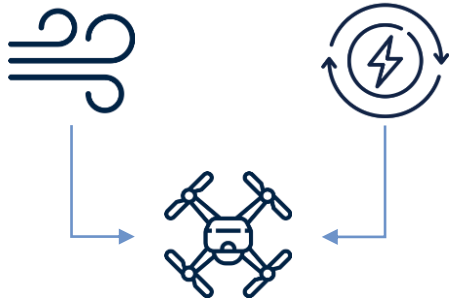
Input

- Roll and Pitch angle
- Power Consumption



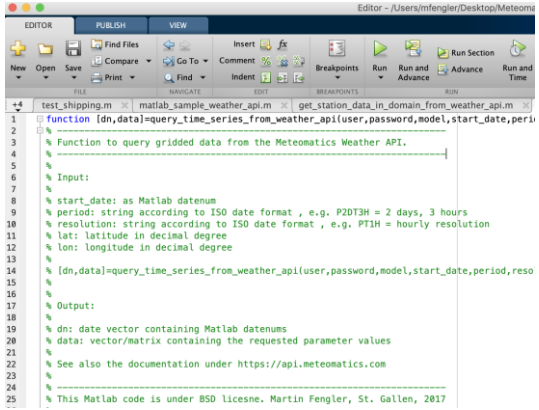
Drone Model

- Physics based
- Automatic wind drag compensation
- Comparison to wind tunnel and outside conditions
- Postprocessing and calibration
- MATLAB / C++
- Deployed on ARM Processor



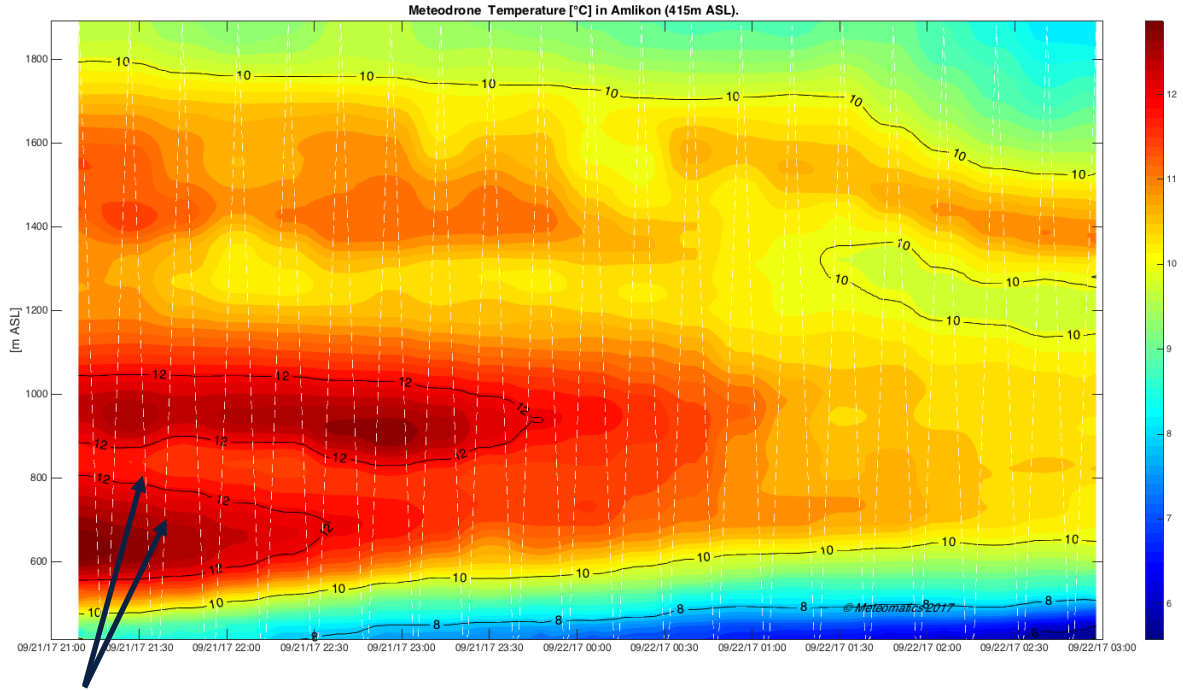
Share Results

- Send data in real-time to ground station
- Post-processing / WRF model-input
- Weather API



Amlikon 21. – 22.09.17

Temperature

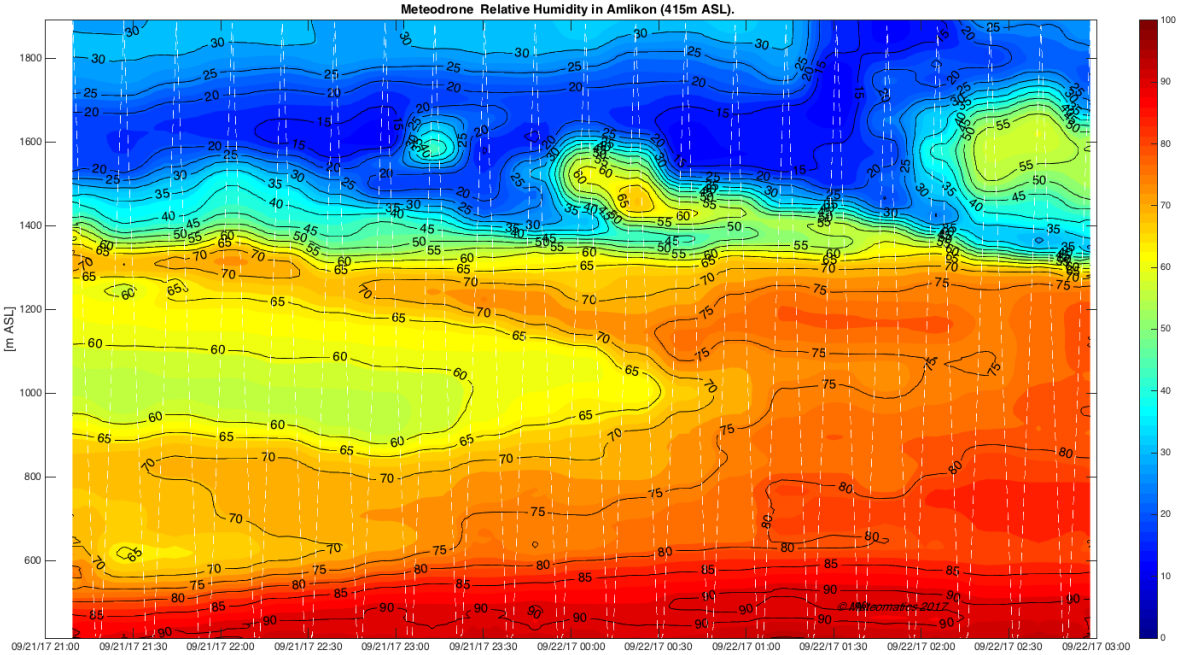


White dots indicate the drone flight track.

Visualization done in MATLAB

Amlikon 21. – 22.09.17

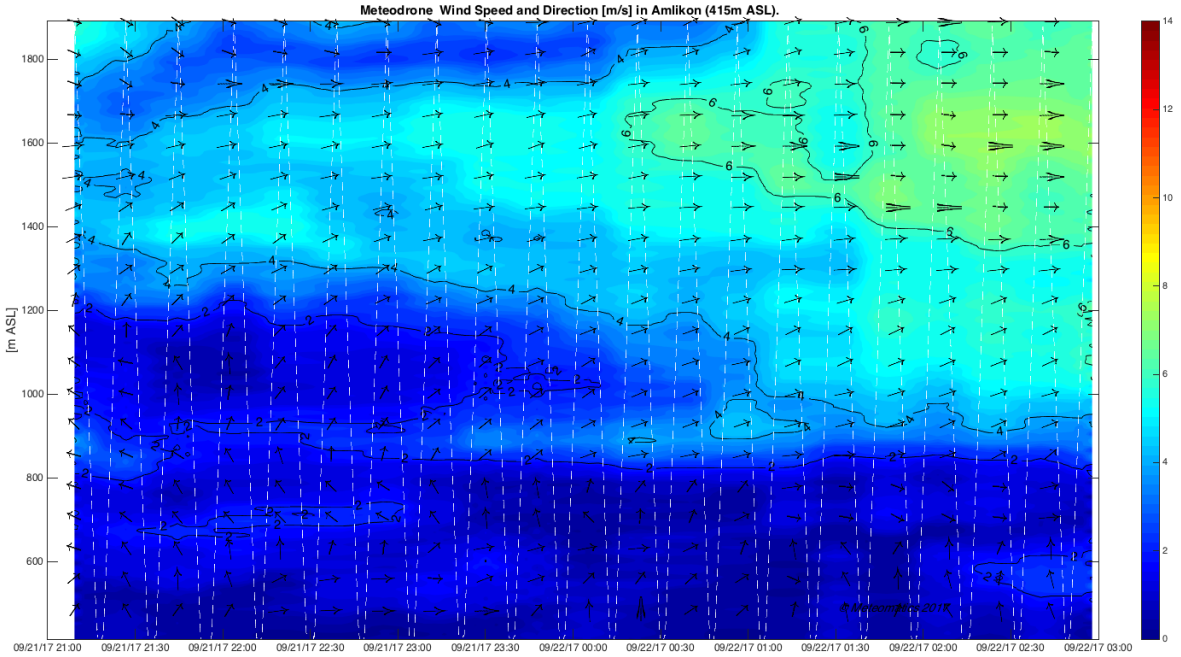
Relative Humidity



Visualization done in MATLAB

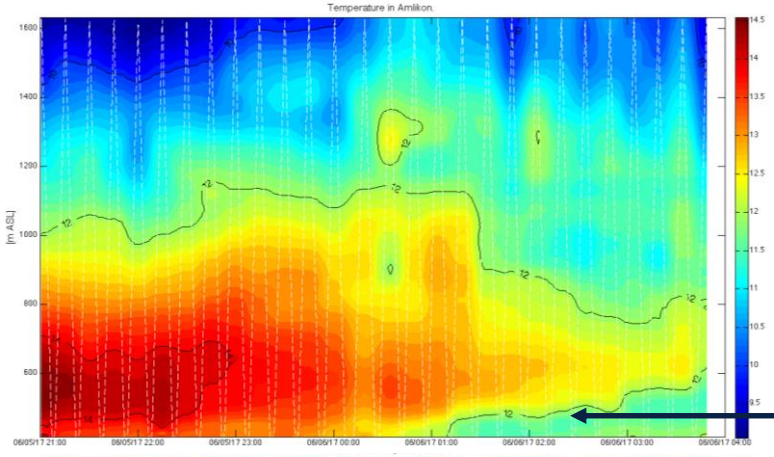
Amlikon 21. – 22.09.17

Wind Speed & Direction



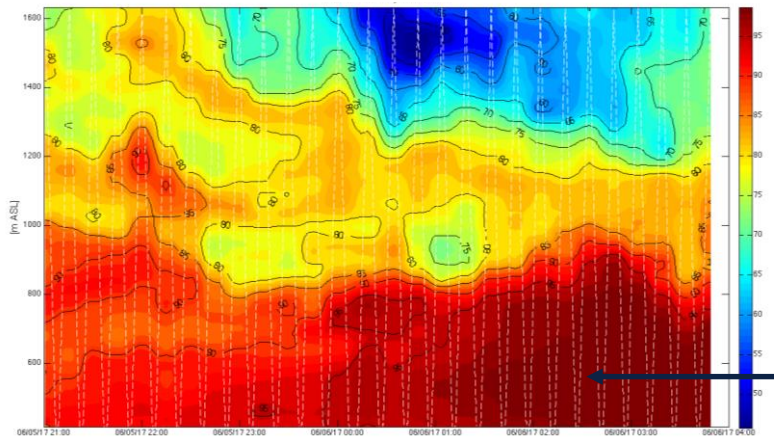
Visualization done in MATLAB

Amlikon 05. – 06.06.17



Temperature

Ground Inversion



Relative Humidity

100% RH

Shallow Fog:
Up to 150 m

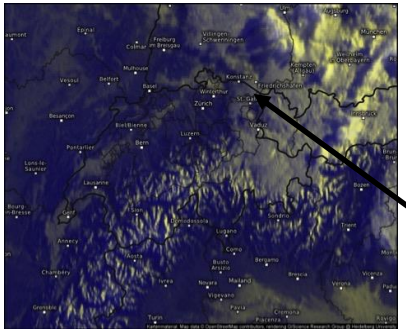

Fully automated
Customized to your needs
New dimension in precision
Maximum flexibility

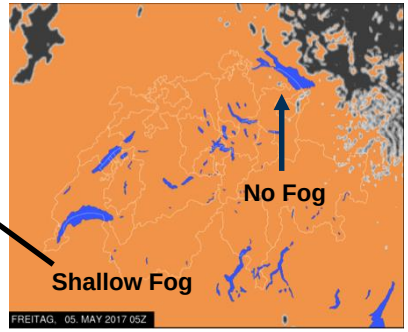
Morning Fog at Lake Constance 05.04.17, 7 am & 8 am

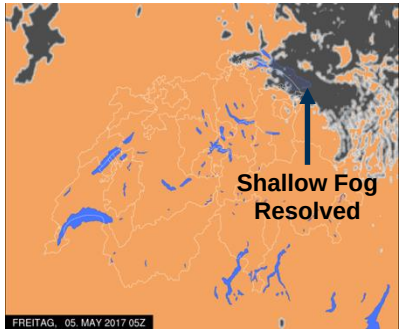
Satellite Cloud Cover

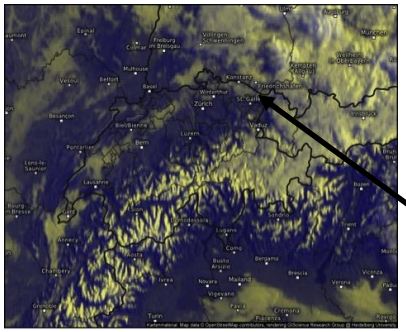
Swiss1k **Without** Meteodrone Data

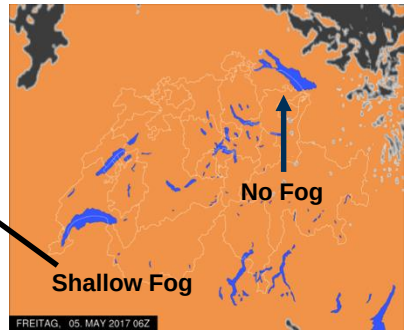
Swiss1k **With** Meteodrone Data

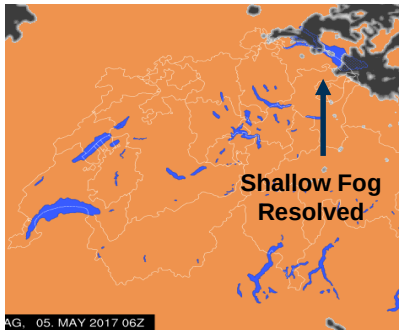








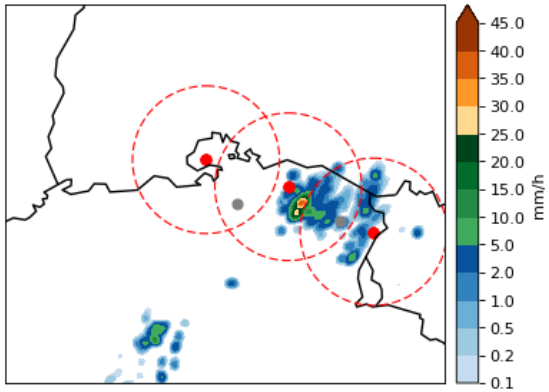




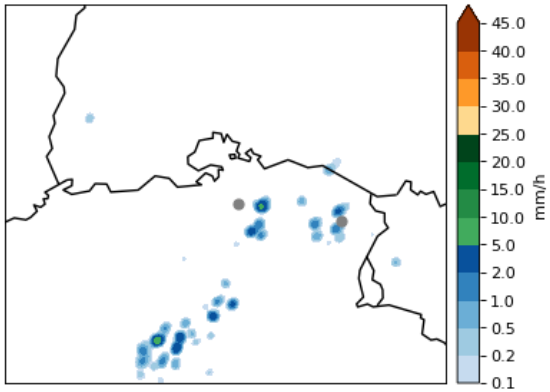
Meteodrones in Schaffhausen, Amlikon and Marbach until 5 am

Thunderstorms in St.Gallen 29. – 30.05.17

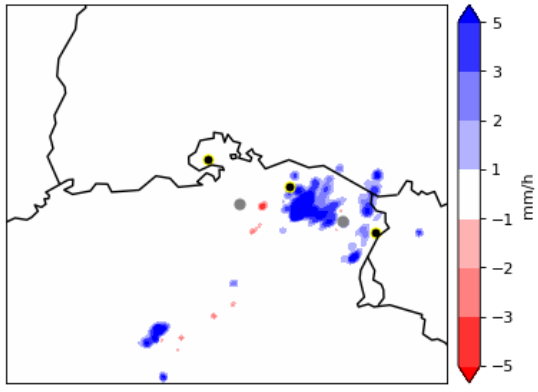
With Meteodrone
29.05.17



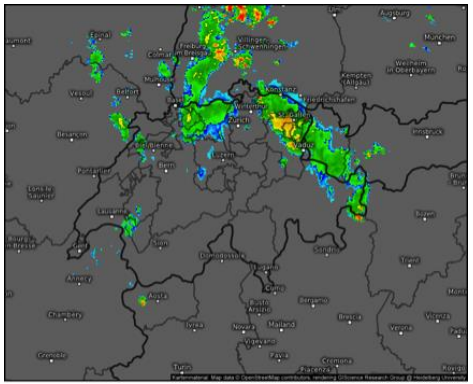
Without Meteodrone
29.05.17



Difference
29.05.17



Swiss1k was the only model to capture these storm cells and forecasted them 23 hours ahead!

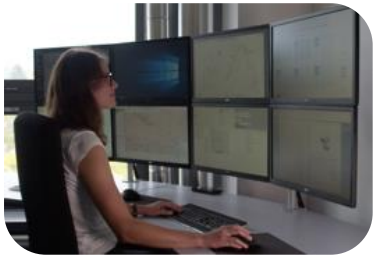


Swiss1k Workflow

Primary Data and Control Link

Secondary Data and Control Link

Ground Station



Control Center

Meteodrone Data

Customer

API

FTP/E-Mail

Production

Model Output, GRIB/NETCDF

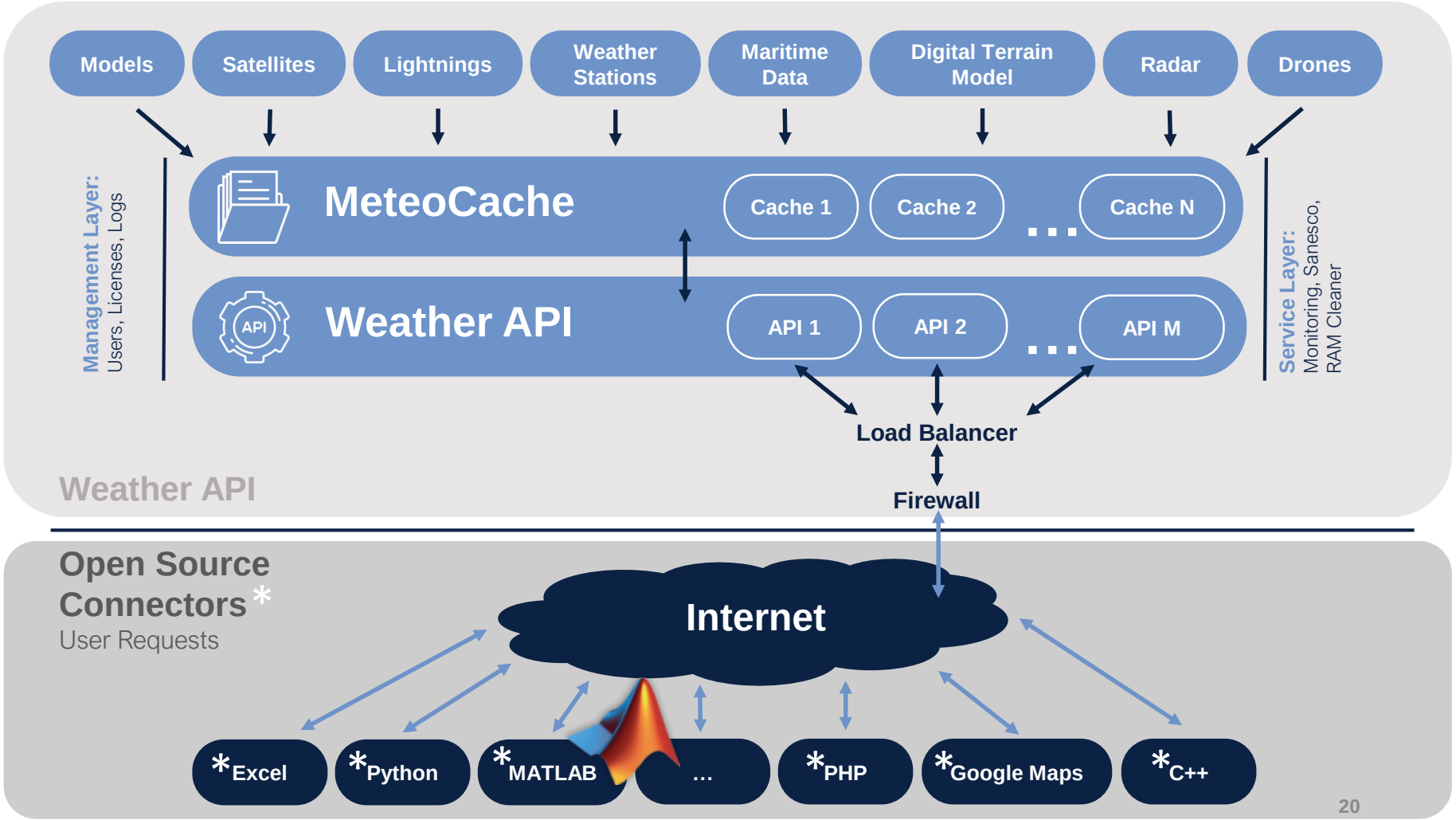
WRF

Sea & Lake Surface Temperature

Satellite Information

Weather Station

ECMWF


Models
Satellites
Lightnings
Weather Stations
Maritime Data
Digital Terrain Model
Radar
Drones
Management Layer:
Users, Licenses, Logs
MeteoCache
Cache 1
Cache 2
Cache N
Weather API
API 1
API 2
API M
Service Layer:
Monitoring, Sanesco, RAM Cleaner
Load Balancer
Firewall
Weather API
Open Source Connectors*
User Requests
Internet
*Excel
*Python
*MATLAB
...
*PHP
*Google Maps
*C++

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

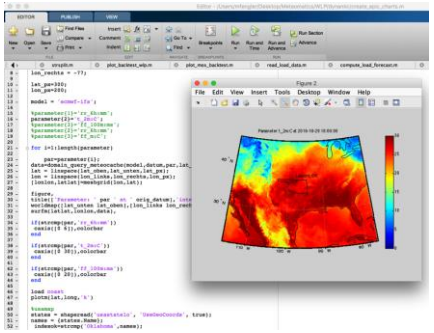
Variety of formats and connectors in different programming languages

Detailed and up-to-date documentation

Flexible & fast integration & usage

Simple one-stop access to high quality weather data worldwide

Variety of Possible Integrations



Golang

Google Earth

Google Sheets

php

python

MATLAB

ArcGIS

Weather API

tableau

QGIS

CESIUMJS

Qlik

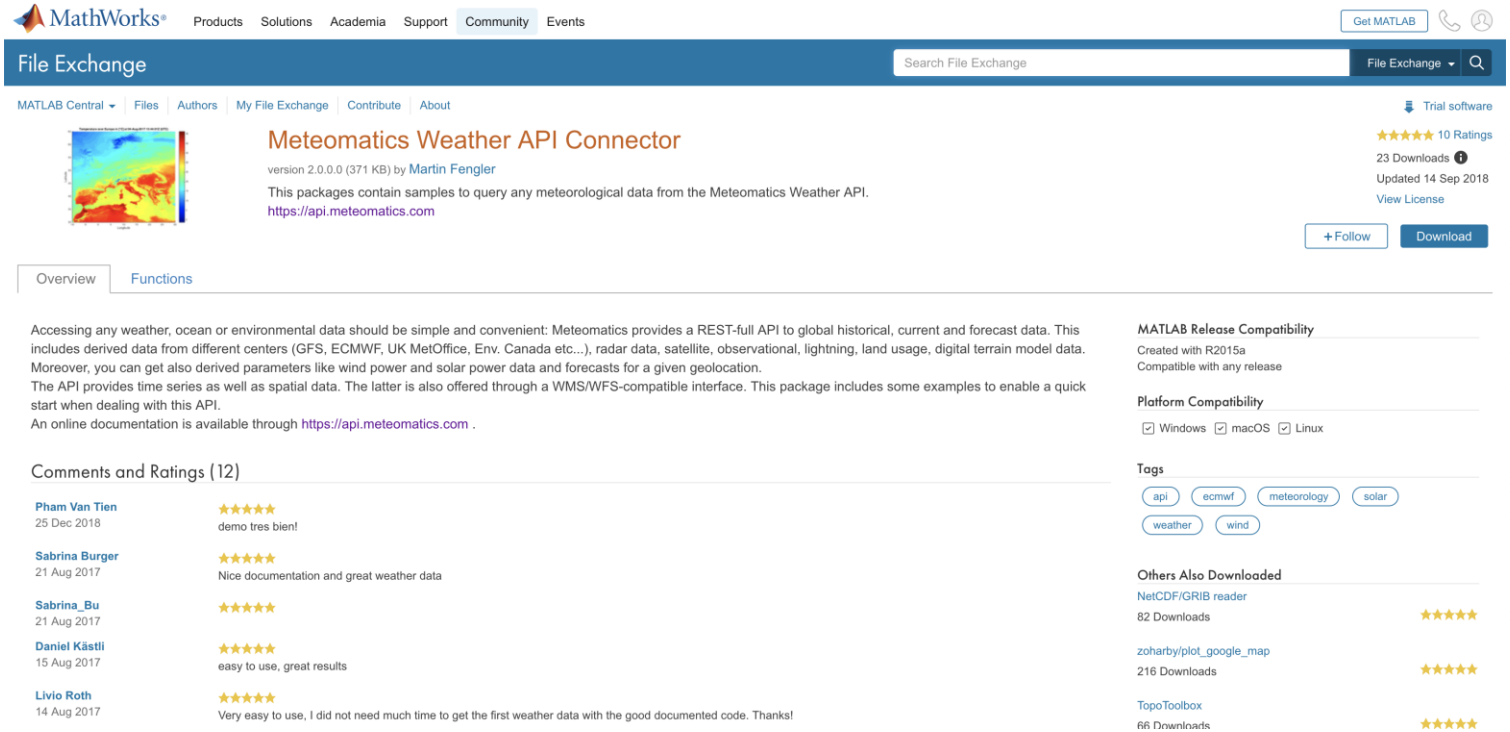
Power BI

R

JS

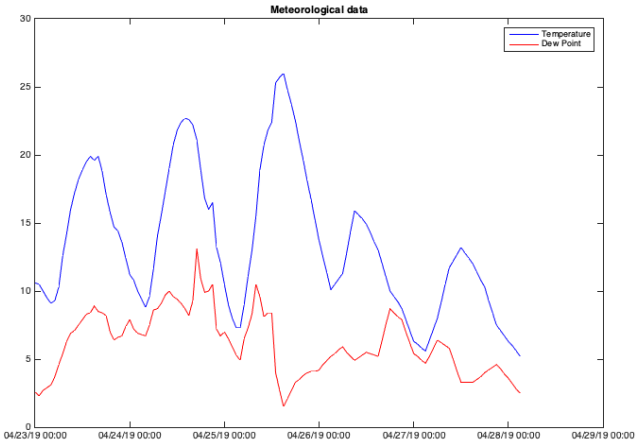
Java

Weather API in MATLAB File Exchange



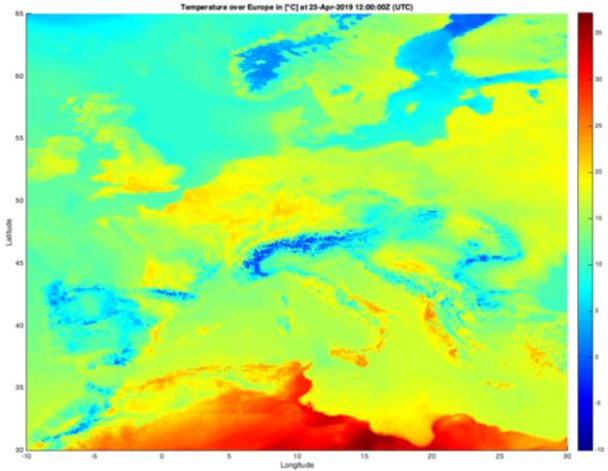
Weather API in MATLAB

```
% ------------------------------------------------------------------
% Sample to query weather data at a certain location time series
% ------------------------------------------------------------------

lat    = 50.123;
lon    = 10.843;

start_date  = floor(now);  % Could be anything like a datenum
period      = 'P5DT3H15M'; % period of 5 days, 3 hours, 15 min
resolution  = 'PT1H';      % 1h resolution

parameters = 't_2m:C,d_2m:C';  % Temperature and Dew Point at 2m

[dn,data]=time_series_query_meteocache(user,password,'mix',start_date,period,resolution,parameters,lat,lon);
```

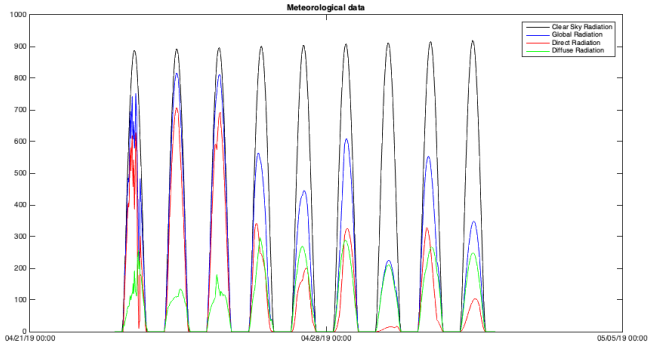


Weather API in MATLAB

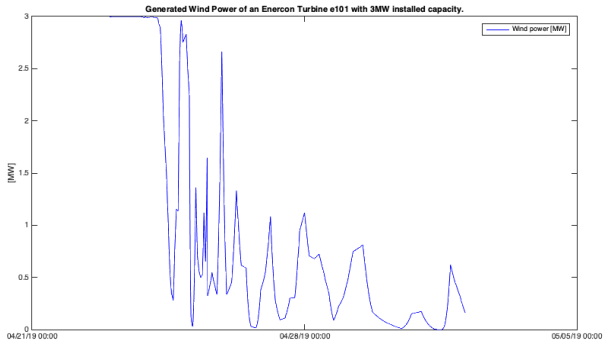
```
% ------------------------------------------------------------------
% Sample to Query a domain for temperature
% ------------------------------------------------------------------

% Define corners of a rectangular domain in decimal degrees
lat_top     =   65;
lon_left    =  -10;
lat_bottom  =   30;
lon_right   =   30;

% Define Pixel resolution
lat_px = 300;
lon_px = 600;

% Create Lat/Lon grid for visualization
lat = linspace(lat_bottom,lat_top,lat_px);
lon = linspace(lon_left,lon_right,lon_px);
[lons,lats] = meshgrid(lon,lat);
lats = flipud(lats);

% Set date
validdate = floor(now)+0.5; % datenum(2016,12,24,15,35,0);

parameter = 't_2m:C';

% Query the grid:
data=domain_query_meteocache(user,password,'mix',validdate,parameter,lat_top,lon_left,lat_bottom,lon_right,lon_px,lat_px);

figure, surf(lons,lats,data,'EdgeColor','none')
```



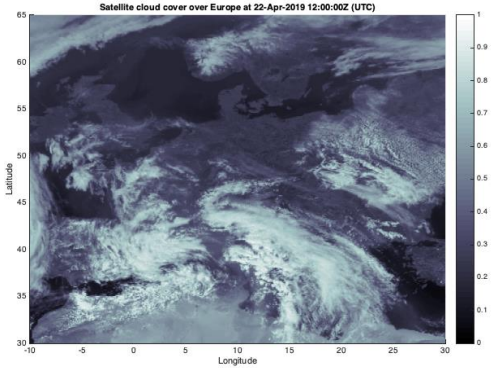
Weather API in MATLAB



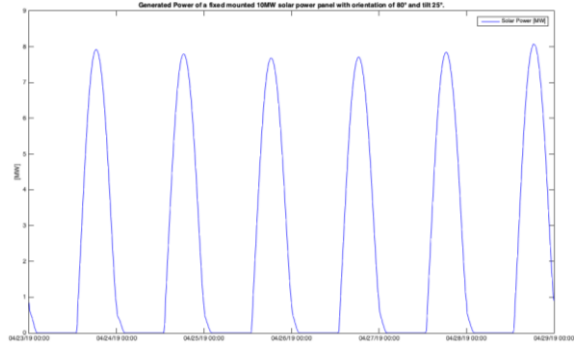
Global, diffuse, direct and clear sky radiation



Wind Power



MSG Satellite Data



Solar Power

Key Takeaways

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… visualize meteorological data

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… give deeper insights into your weather related business

Thank You

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