



# Meteodrones

Improving tomorrow's low level weather forecast

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Dr. Martin Fengler

CEO

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

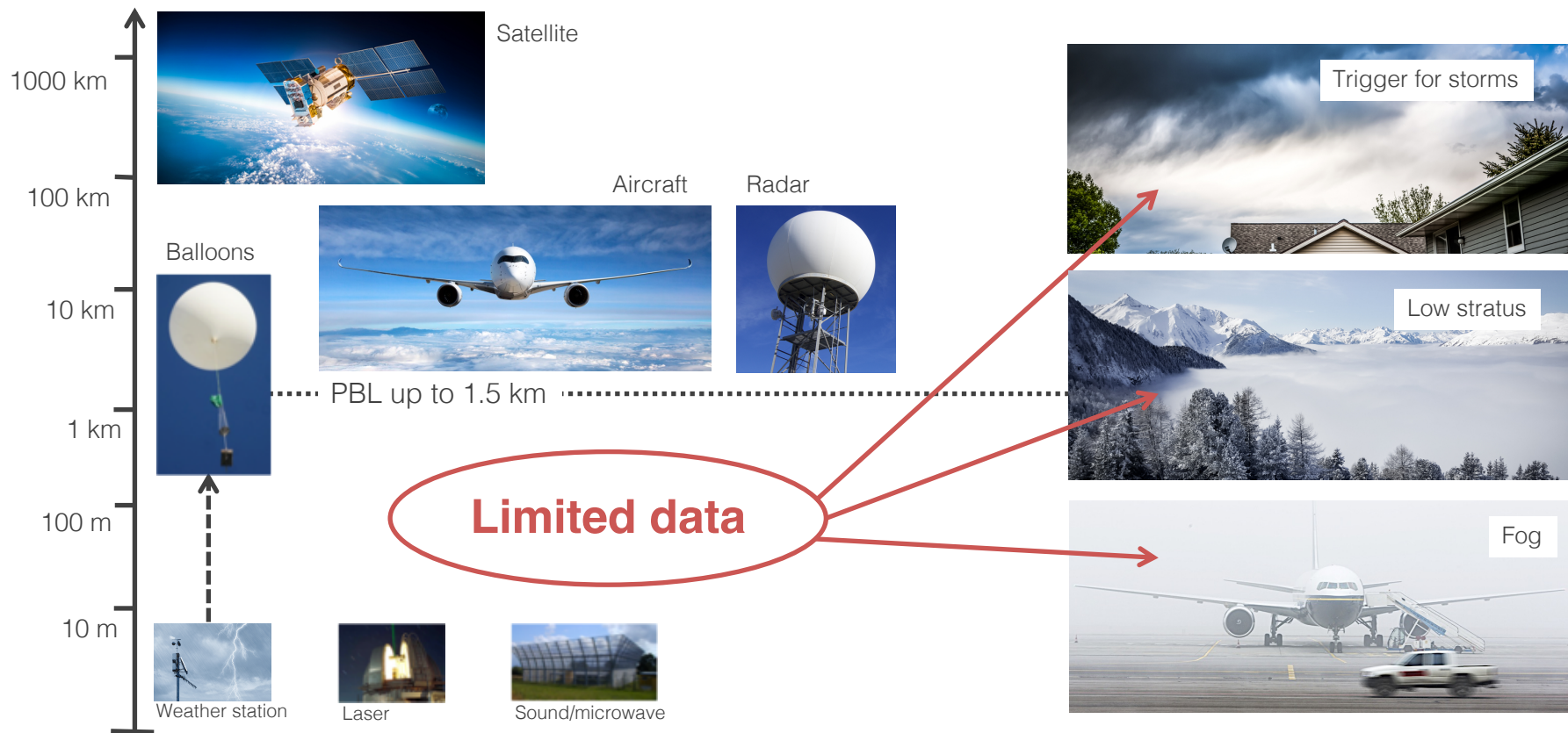
30 People | 3 Offices | 3 Countries | Global Partnerships

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.

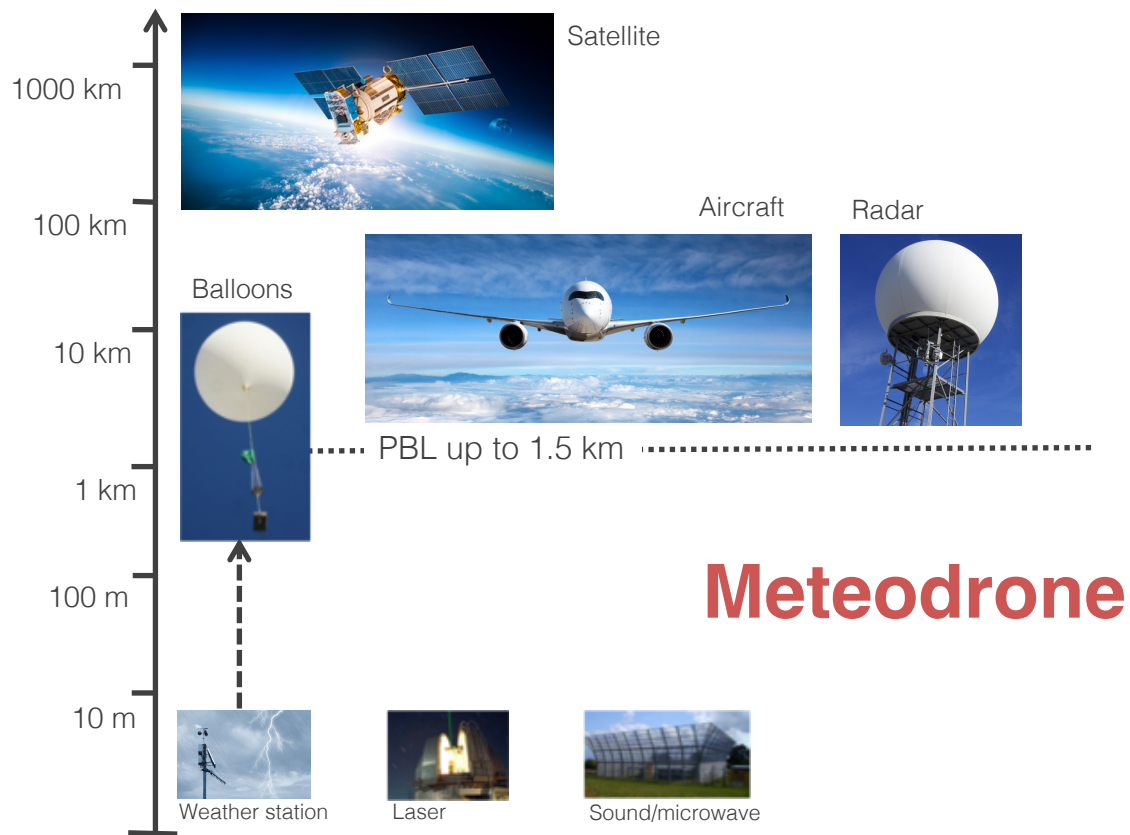




# Current data situation



# Improving data situation





# Meteodrone Classic – BVLOS approved



**> 2'000 flight hours**  
under BVLOS conditions

**> 14'000 vertical profiles**

**> 1'500 Swiss1k model runs**

**Several patents filed & awarded**



**Fully  
automated**



**Customized  
to your needs**

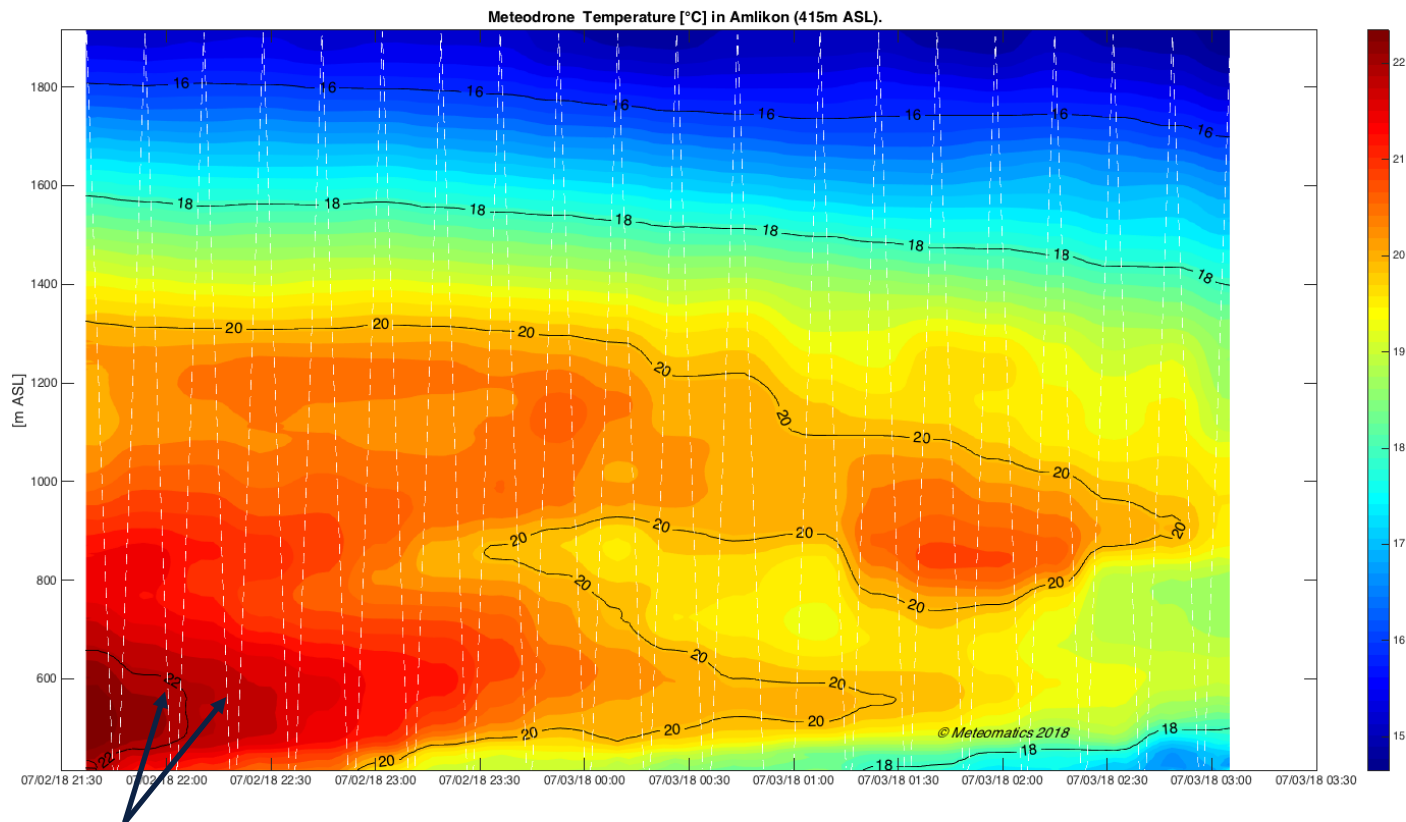


**New dimension  
in precision**



**Maximum  
flexibility**

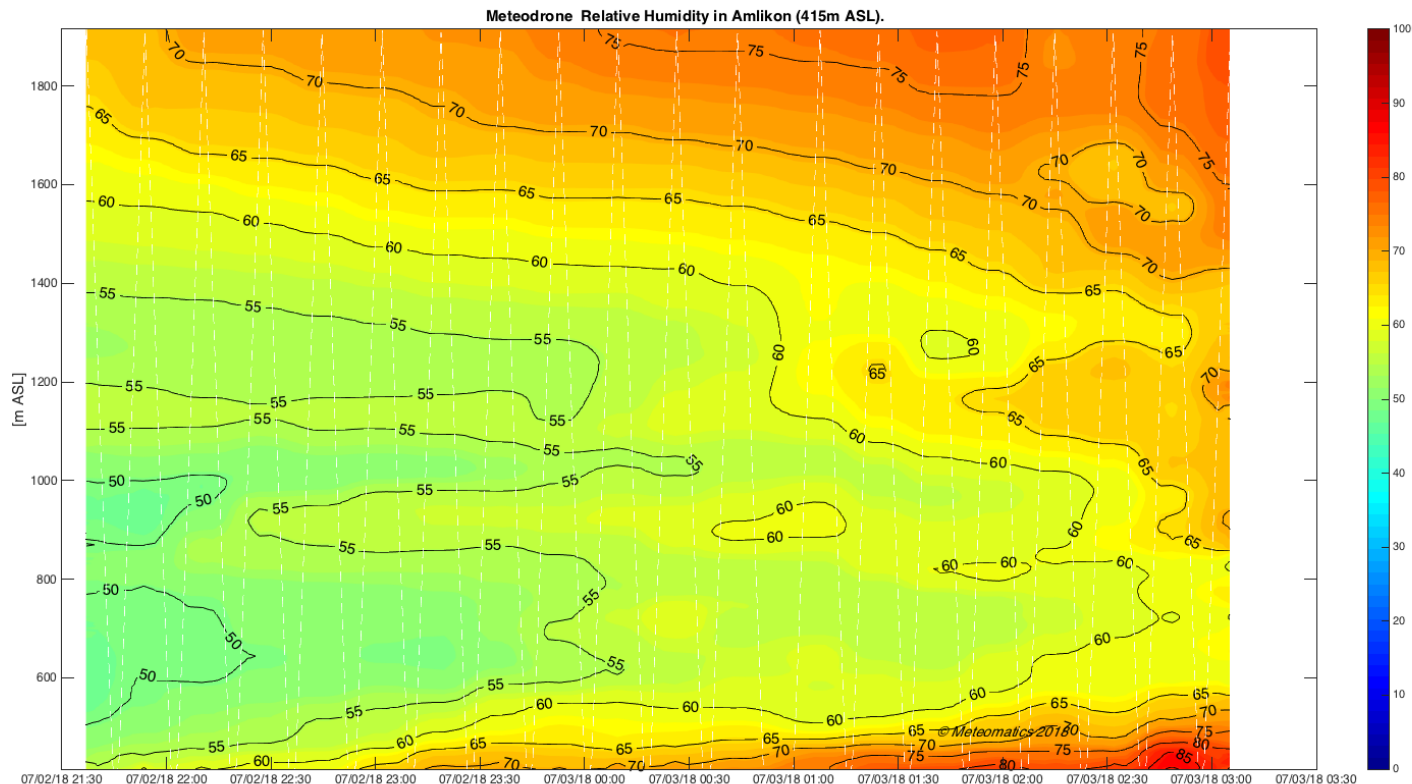
# Amlikon 01. – 02.07.18: temperature



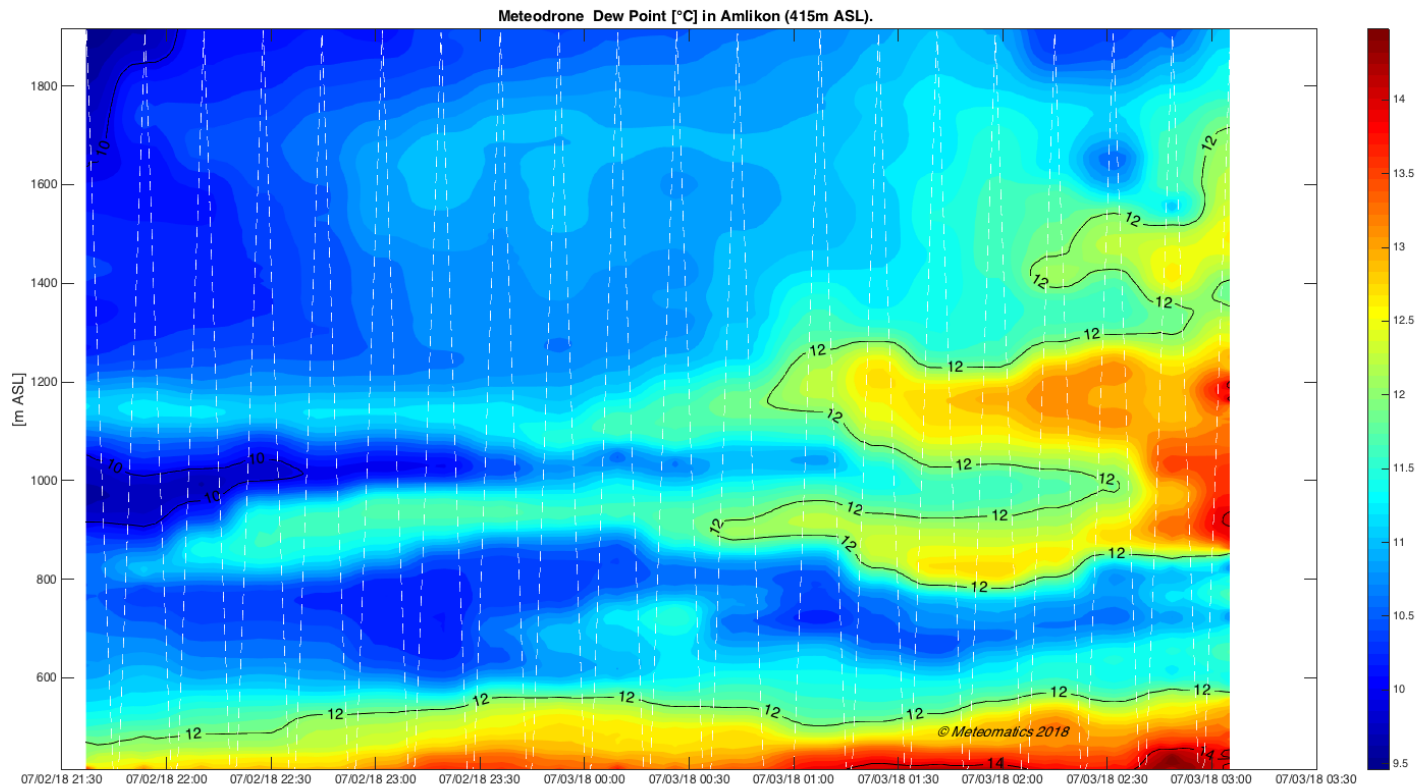
White dots indicate the drone flight track.



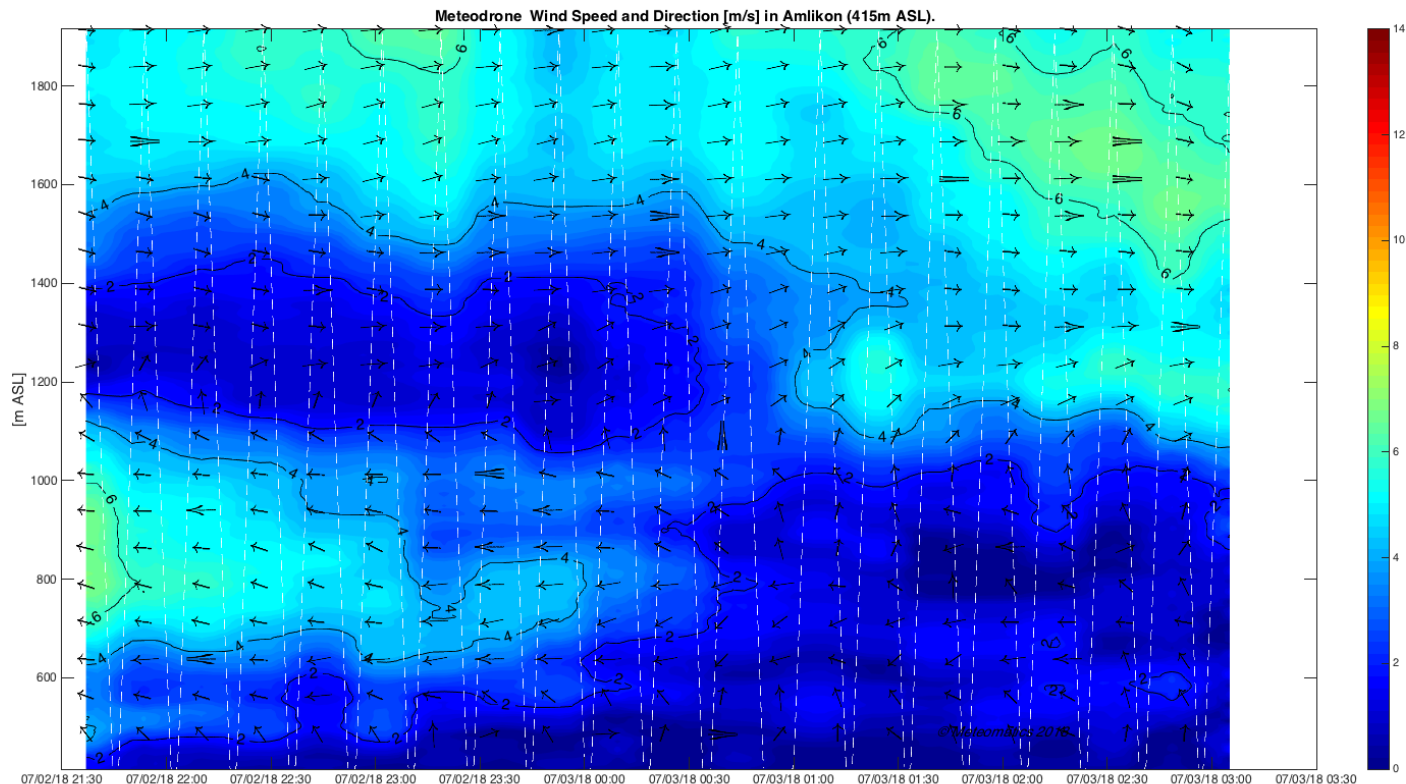
# Amlikon 01. – 02.07.18: relative humidity



# Amlikon 01. – 02.07.18: dew point temperature



# Amlikon 01. – 02.07.18: wind speed and direction



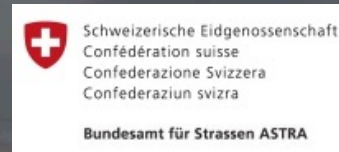


# Project DETAF

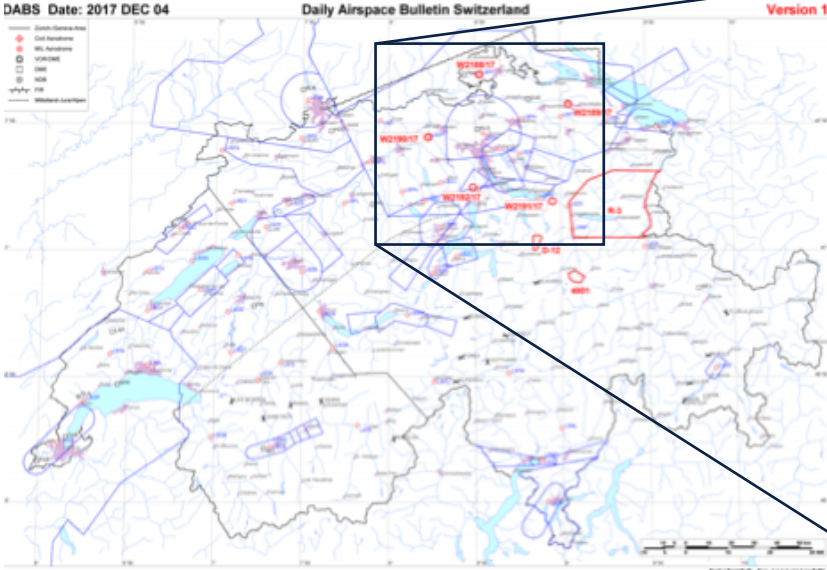
## DETAf (Drone Enhanced Terminal Aerodrome Forecasts)

- Operating drones in 6 locations in the vicinity of and at Zurich airport
- Feeding data in real-time into Swiss1k
- Sending visibility & ceiling forecasts to Skyguide

Funded by:

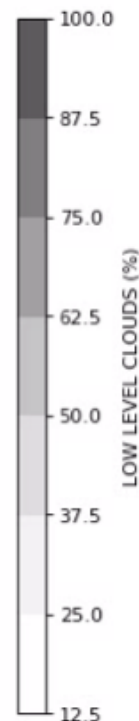
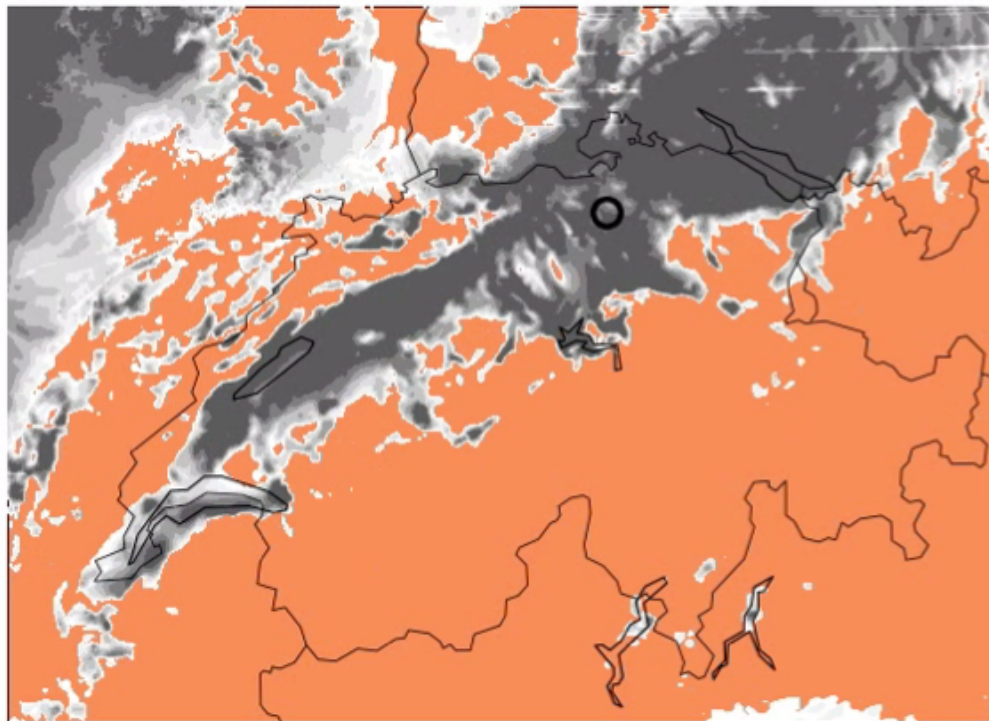


# DETAf setup



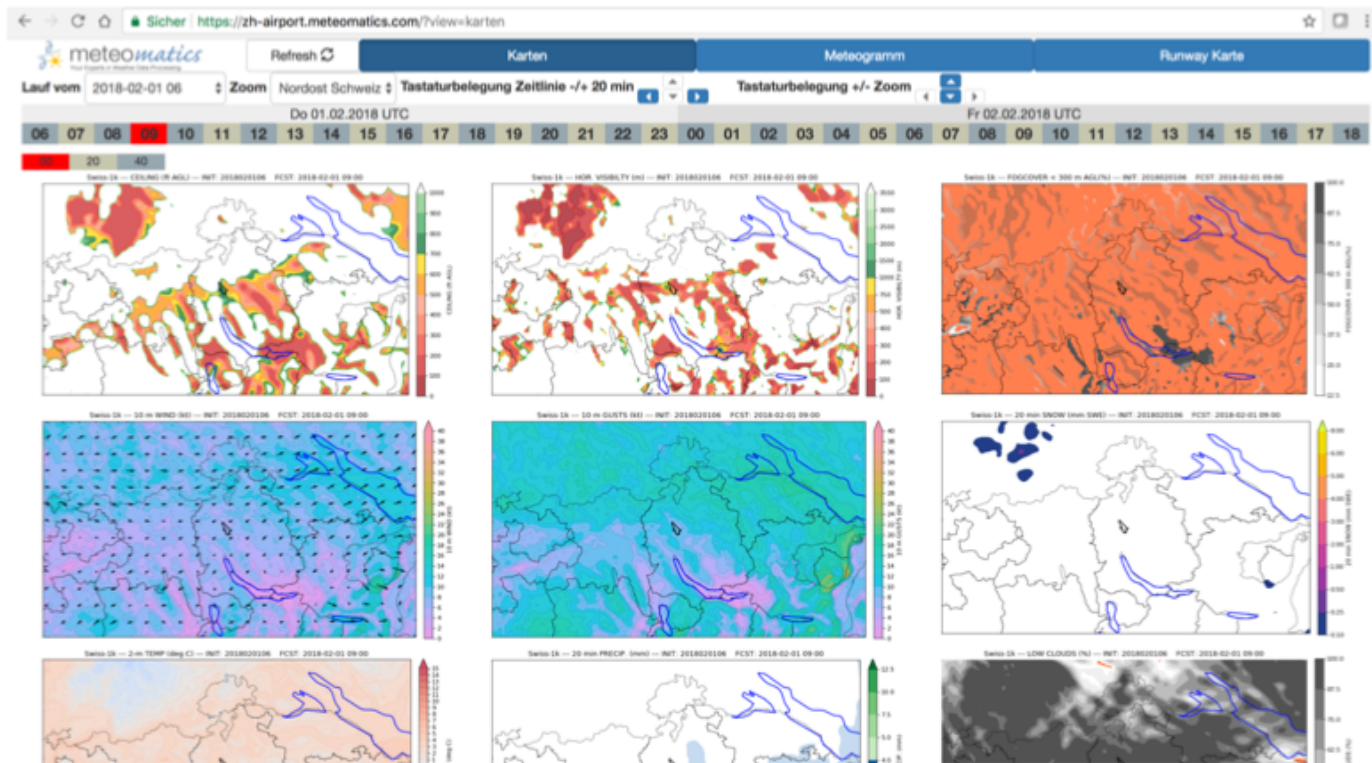
# Swiss1k – fog & low clouds

Swiss-1k --- LOW LEVEL CLOUDS (%) --- INIT: 2017120618 FCST: 2017-12-06 18:40

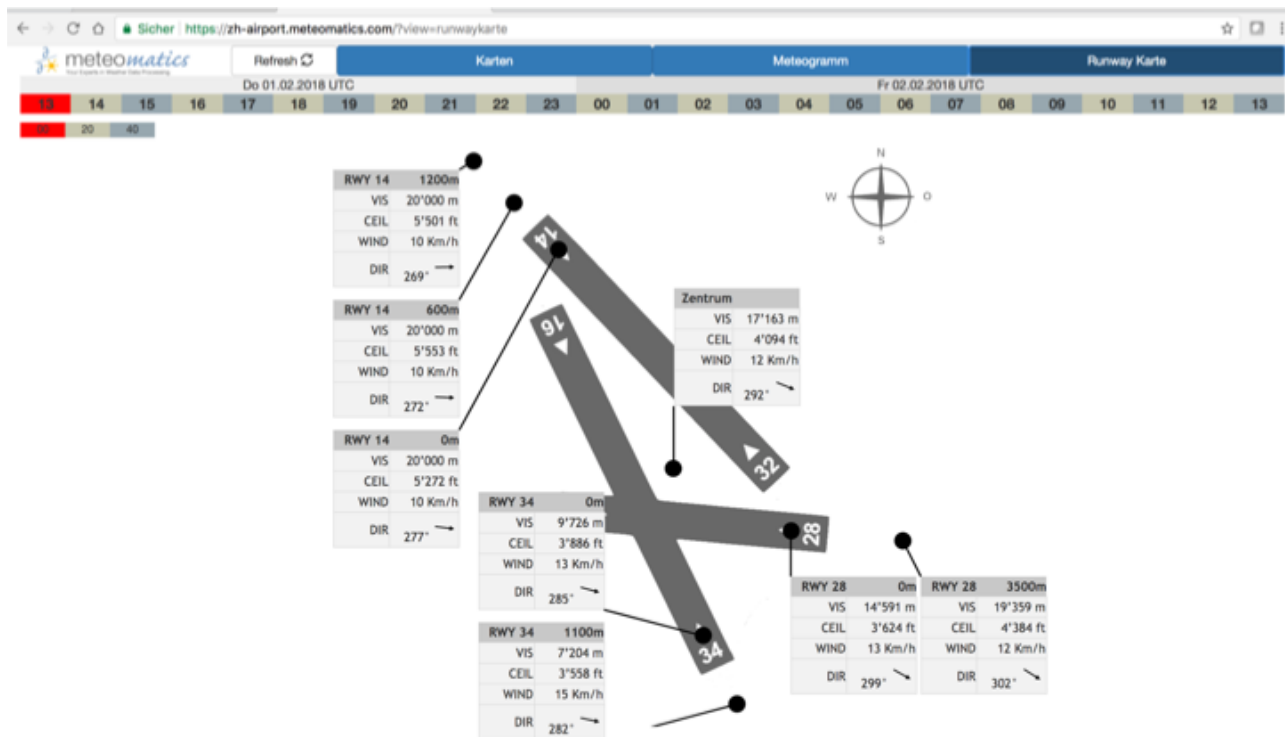




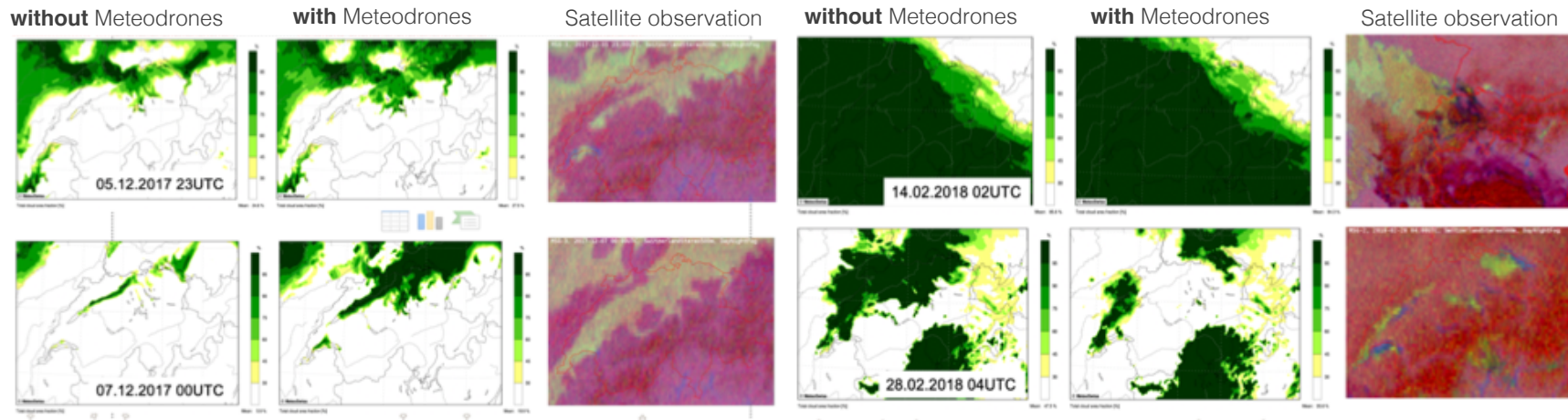
# Zurich airport cockpit



# Zurich airport runway chart



# MeteoSwiss tests



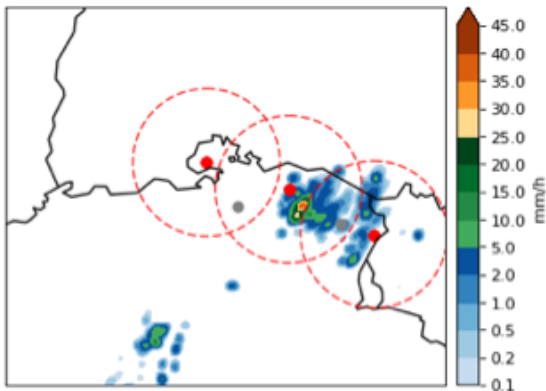
Date	Weather Situation	Impact on COSMO Cloud Analysis
2017-12-05	High pressure system, low Large-Scale Forcing	Positive
2017-12-06	High pressure system, low LSF	Strongly Positive
2018-02-13	Border of high pressure system, medium LSF	Neutral
2018-02-14	Border of high pressure system, medium LSF	Neutral
2018-02-15	Frontal passage, strong LSF	Neutral
2018-02-26	Border of high pressure system, medium LSF	Neutral
2018-02-27	High pressure system, low LSF	Strongly Positive

## Conclusion

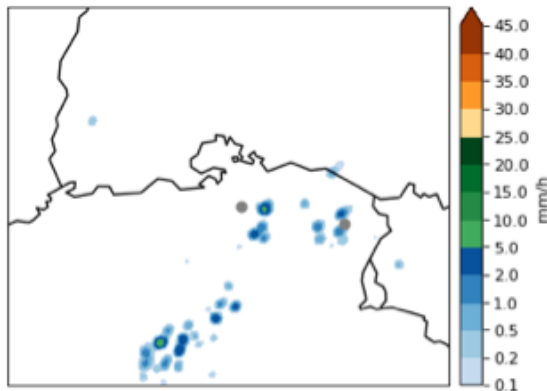
- Meteodrone profiles have a very positive impact on COSMO analyses
- It demonstrates the importance of PBL T and RH observations in fog situations
- Most positive impact found in cases of weak large-scale forcing

# Thunderstorms in St.Gallen 29. – 30.05.17

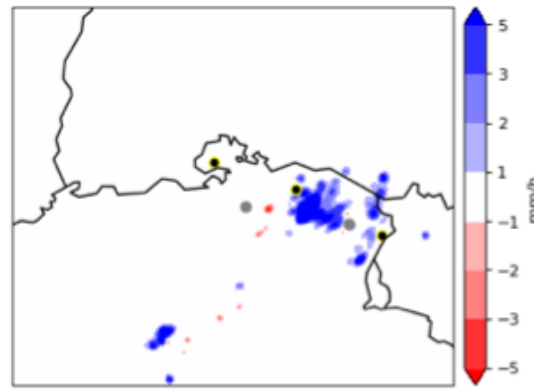
with Meteodrone  
29.05.17



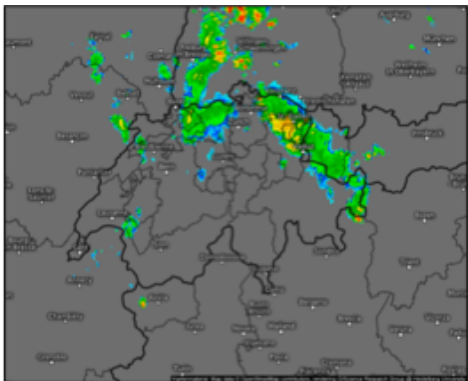
without Meteodrone  
29.05.17



Difference  
29.05.17

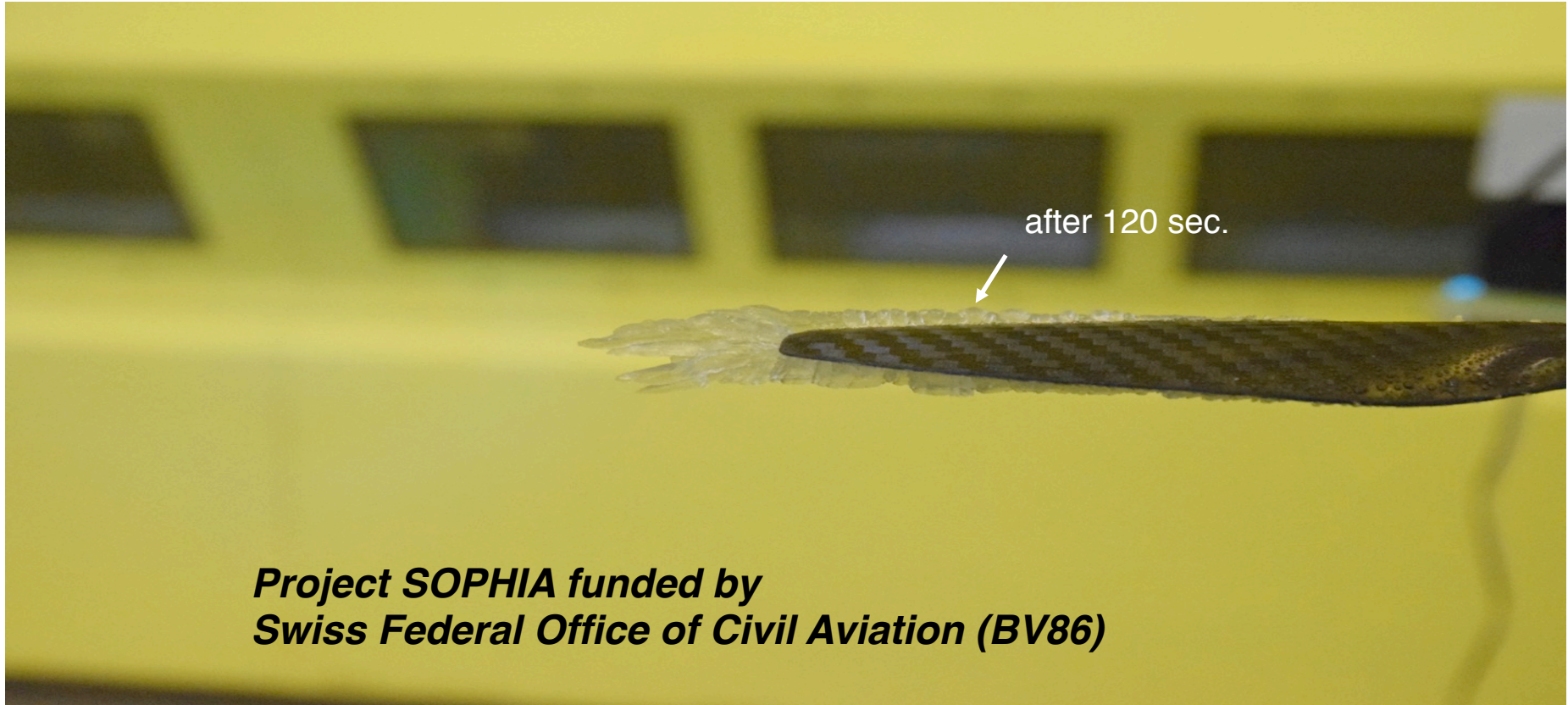


Swiss1k was the only model to capture these storm cells and forecasted them 23 hours ahead!





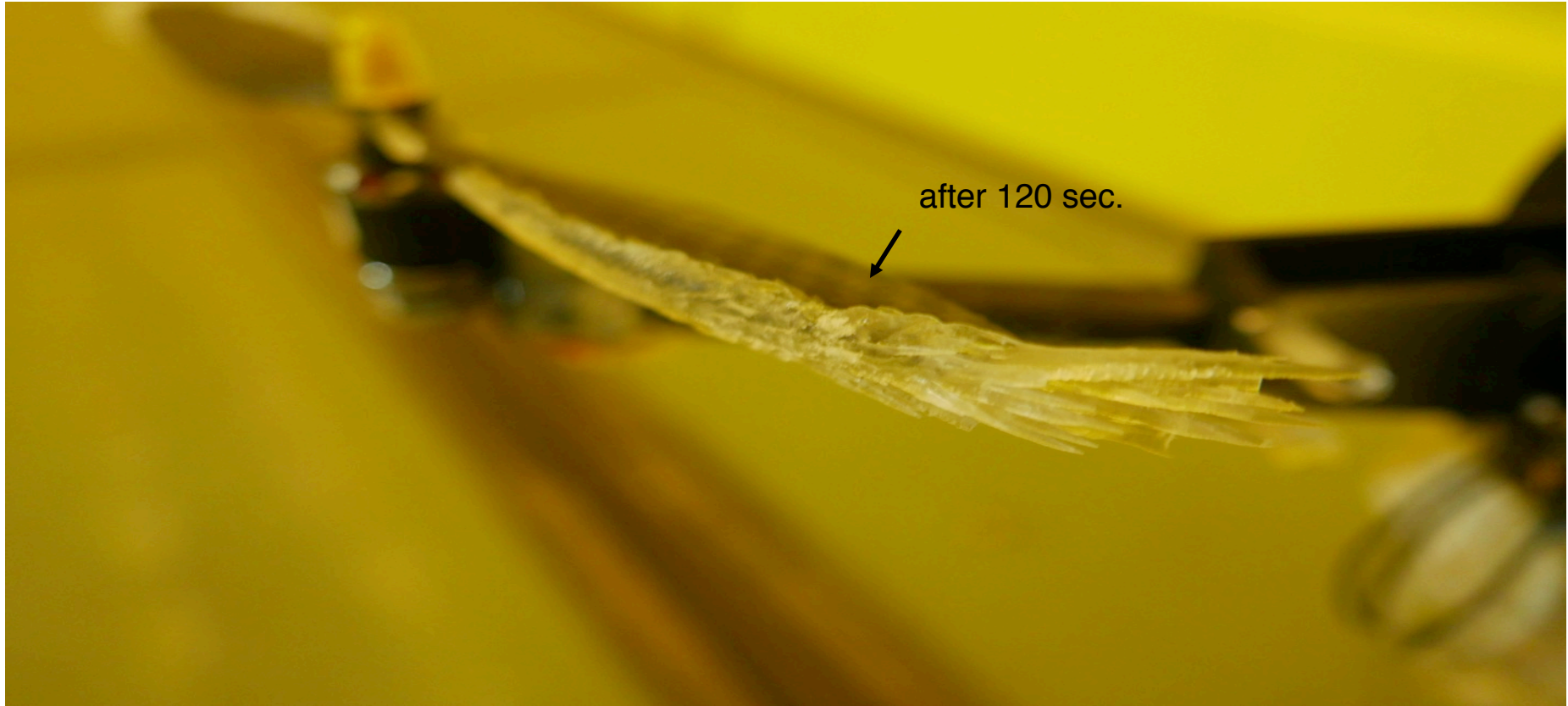
**Clear ice ( $-2^{\circ}\text{C}$ ,  $\text{MVD}=20\mu\text{m}$ ,  $\text{LWC}=0.6\text{g}/\text{m}^3$ )**



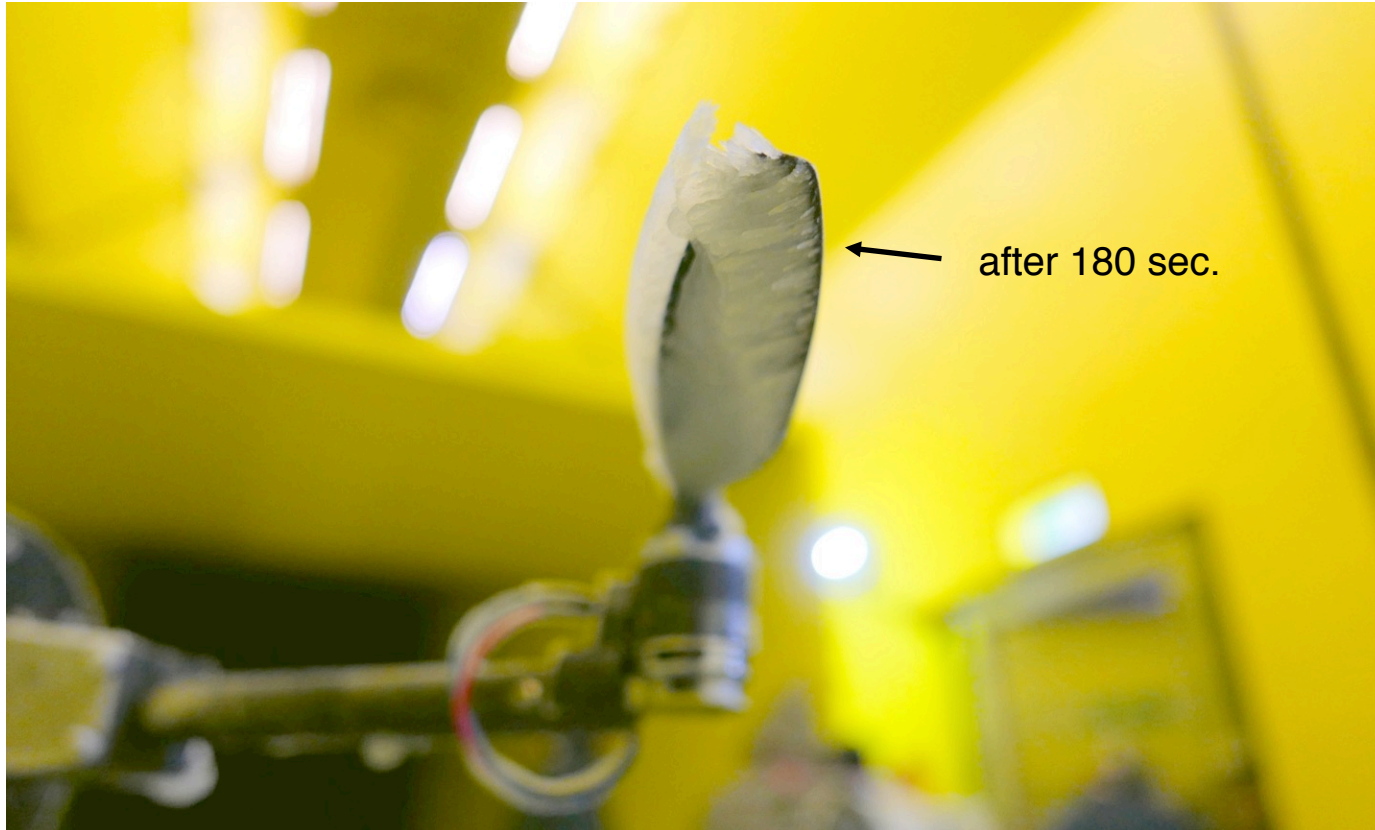
***Project SOPHIA funded by  
Swiss Federal Office of Civil Aviation (BV86)***

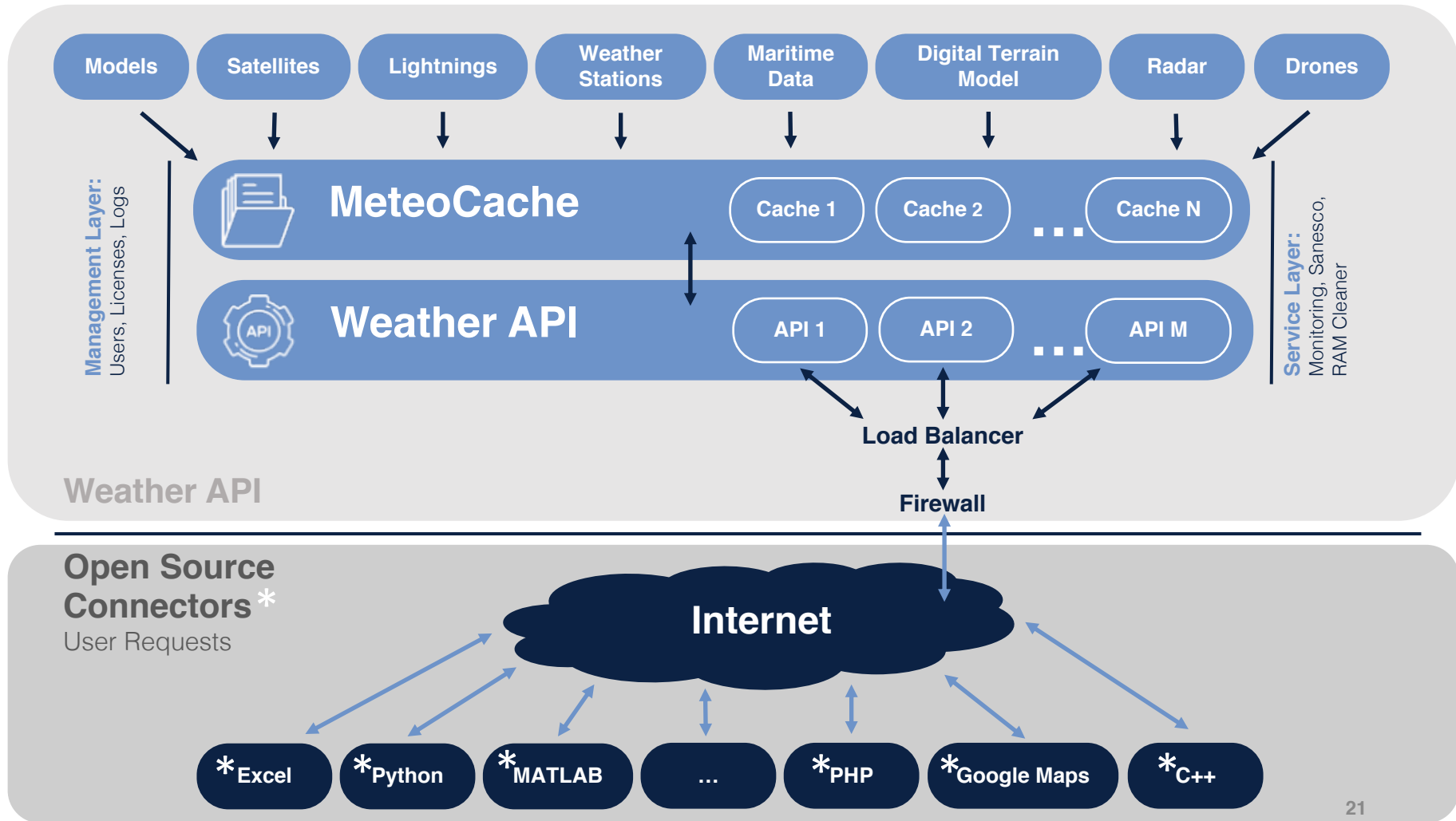


**Extreme clear ice amount (-5°C, MVD=30 $\mu$ m, LWC=1.25g/m<sup>3</sup>)**



**Icing at the downside of the propeller (-10°C, MVD=25 $\mu$ m, LWC=1.4g/m<sup>3</sup>)**

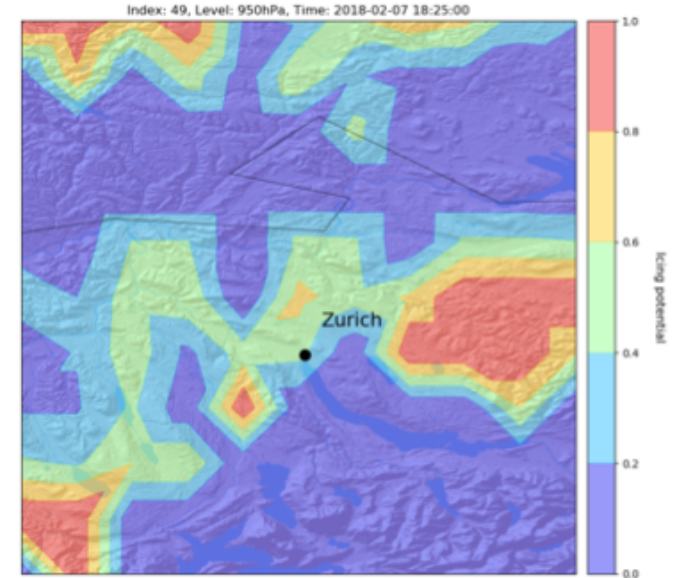




# Icing Index Method & Description

## Current Icing Potential: Algorithm Description and Comparison with Aircraft Observations

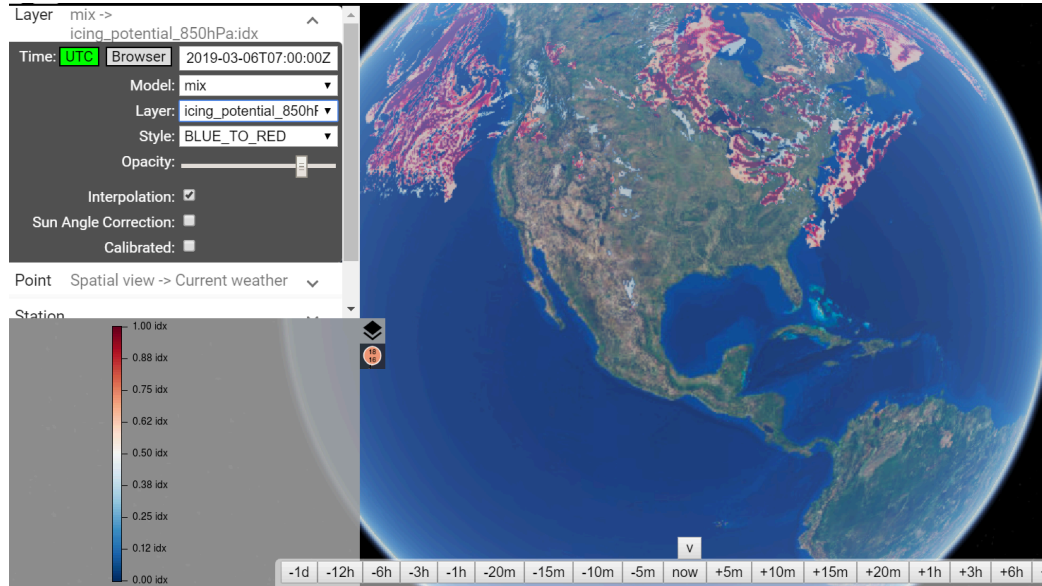
BEN C. BERNSTEIN, FRANK MCDONOUGH, MARCIA K. POLITOVICH, AND BARBARA G. BROWN  
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CORY A. WOLFF AND GARY CUNNING  
*Research Applications Program, National Center for Atmospheric Research,\* Boulder, Colorado*



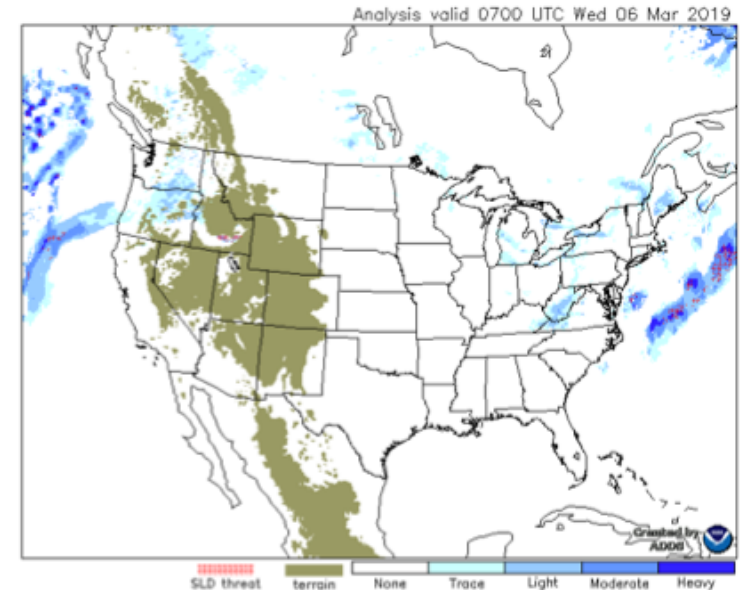
Index	Description
0.0-0.2	No icing
0.2-0.4	Traces
0.4-0.6	Light
0.6-0.8	Moderate
0.8-1.0	Heavy

# 850hPa/5'000ft

- Icing potential index over North America, 06 Mar 2019, 07:00 (nowcast) from Meteomatics (left) and NOAA (right). 850hPa respectively 5000ft.



Icing severity at 5000 ft. MSL





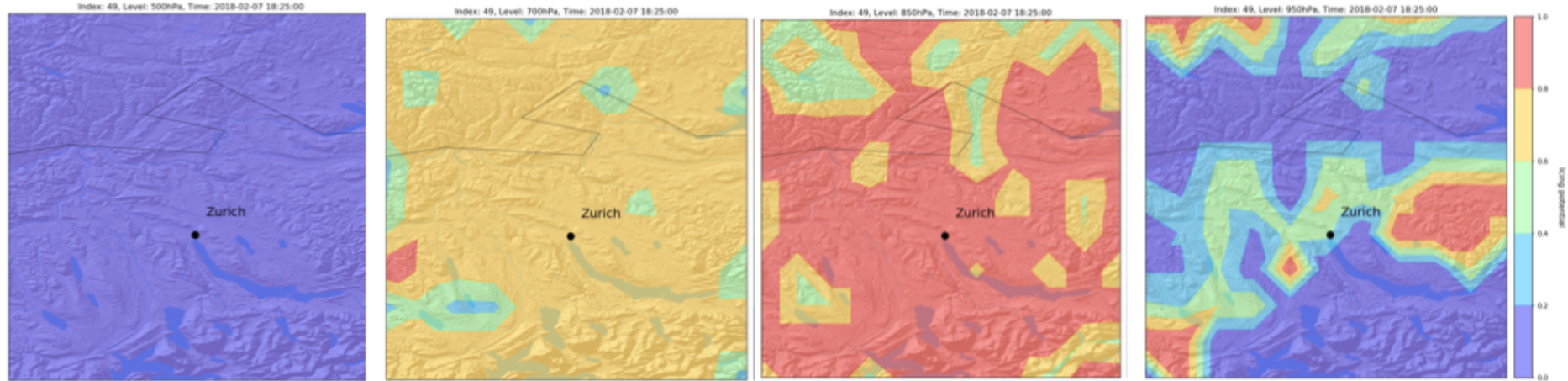
## Example 1: Icing during approach

ECCAIRSNUMBER	Location name	Date and Time	Flight Phase
xxxxxxx	Near LSZH (Zurich) Route: LEPA (Mallorca)- LSZH	xxxxxx	Approach

- Description of event: ATIS LSZH stated "moderate icing in approach". Ice build up on ice indicator of about 7mm.
- Icing Predictability: Heavy icing potential around LSZH airport between 700hPa-950hPa (3000m-500m altitude). Icing during approach of LSZH could be predicted.

# Example 1: Icing during approach

Icing potential at 500hPa, 700hPa, 850hPa, 950hPa at time of icing occurrence (18:25). Ca. 110km\*75km Grid around LSZH.



- No icing at 500hPa
- Moderate icing at 700hPa
- Heavy icing at 850hPa
- Light to heavy icing at 950hPa

## Icing events summary

- Ca. 90% of 20 investigated events have been classified as icing incidents
- For most icing events the API predicts moderate to heavy icing potential in the area.
- For some icing events the location is not specified well enough, this makes validation more difficult.
- Icing might be underestimated due to a lack of supercooled liquid water content or too high temperatures or too low relative humidity in the model.

# Contact us



## Your contact

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