Meteodrones – Assimilating 3km Soundings for Aviation Weather Forecasts

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Meteomatics
Weather Service Provider since 2012
St. Gallen, Switzerland and Berlin, Germany

Weather API
Industrial Services
Meteodrone SWISS1k

Company backbone:
- Model mix
- Model data
- Station data
- Satellite data
- Ocean data
- Soil data
- Derived parameters
- Astronomical parameters
- ...

Bespoke solutions:
- Wind power
- Solar power
- Hydro power
- Snow drift
- ...

High-resolution weather modeling:
- Better PBL data
- Improve fog & storm forecasts
- Customized solutions
Improving PBL data situation

Satellite

Aircraft

Radar

Balloons

PBL up to 1.5km

Only little data

Weather station

Laser

Sound/Microwave

Trigger for storms

Low stratus

Fog
Adding drone data

Meteodrone measuring:
- Wind speed
- Wind direction
- Temperature
- Relative humidity
- Pressure
- Experimental: Vertical wind speeds & kinematic fluxes

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PBL up to 1.5km

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Satellite
Aircraft
Radar
Balloons

1000km
100km
10km
1km
100m
10m

Weather Station
Laser
Sound/Microwave
Meteodrone „Classic“ – BVLOS approved up to 3km

Component to stay in reserved airspace

Parachute Rescue System

- > 2’000 flight hours
- > 14’000 vertical profiles

White strobe (visibility >3km)

Wind measurement using aircraft pitch & roll.
Meteodrone SSE („Severe Storms Edition“)

Technology Readiness Level 8 (of 9)
White dots indicate the drone flight track.
Data collection & distribution
Project DETAF

DETAF ("Drone Enhanced Terminal Aerodrome Forecasts")
• Operating drones in 6 locations in the vicinity of and in Zurich airport
• Feeding data in real-time into SWISS1k and send the visibility & ceiling forecasts to Skyguide

Funded by:

[SWISS] [ZURICH AIRPORT]
DETAF setup

- 10 locations
- 3 weeks
- >1,800 soundings
- >260 flight hours
- >2,800km distance

WRF model domain
DETAF setup

- 6 locations
- 3 weeks
- > 1'800 soundings
- > 260 flight hours
- > 2'800km distance
Zurich Airport Cockpit
Zurich Airport Cockpit
Increased RH downstream of the flight locations around +20%
Clouds based on Hydrometeors between 600 and 3000m MSL
26-02-2019 18Z-run: 2m temperature

- **After 22 UTC:**
  - Influence of drones visible → cooler temperature values are transported from flight locations towards south west

- Temperature was forecasted too high in this case -\( T \) in “ObsNudge”-WRF lower than without assimilation → **Improvement through assimilation**
Extended range to 3000m AGL
Extended range to 3000m AGL

Strong convective activity: Inflow into storms nearby.
High altitude tests at Jungfraujoch
Some impressions: only 1500m left to climb

Jungfraujoch High Altitude Research Station
Flight profile in Google Earth
Lab with our propeller test stand
Icing at temperatures of -14°C (hard rime)

after 180 sec.
Propeller test stand

Project SOPHIA funded by Swiss Federal Office of Civil Aviation (BV86)
Forecasting flight conditions:

- Conditions:
  1. Air temperature $< 0^\circ C$
  2. Visible humidity:
     - Relative humidity $> 95$
  3. Larger droplets -> more and quicker ice development
Icing potential at different pressure levels

Current Icing Potential: Algorithm Description and Comparison with Aircraft Observations
BEN C. BERNSTEIN, FRANK MCDONOUGH, MARCIA K. POLITOVICH, AND BARBARA G. BROWN
Research Applications Program, National Center for Atmospheric Research,* Boulder, Colorado
THOMAS P. RATVASKY AND DEAN R. MILLER
NASA Glenn Research Center, Cleveland, Ohio
CORY A. WOLFF AND GARY CUNNING
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Propeller heating in action
Towards a remotely operated platform

Remote platform „MeteoBase“.

Our future flight operation center...
MeteoBase: first field tests
Thank you ISARRA 2018!

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