

Use of radar data for winterly weather warnings at *Deutscher Wetterdienst*

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Outline:

- **Motivation**
- Input: spatially **comprehensive observational** data → **radar data**
- **Radar products** which can be used for **winter nowcasting**
- Results of **evaluation** in winter season 2018/19
- **Summary** and outlook

Duties according to **Deutscher Wetterdienst Act (DWD Act)**:

...

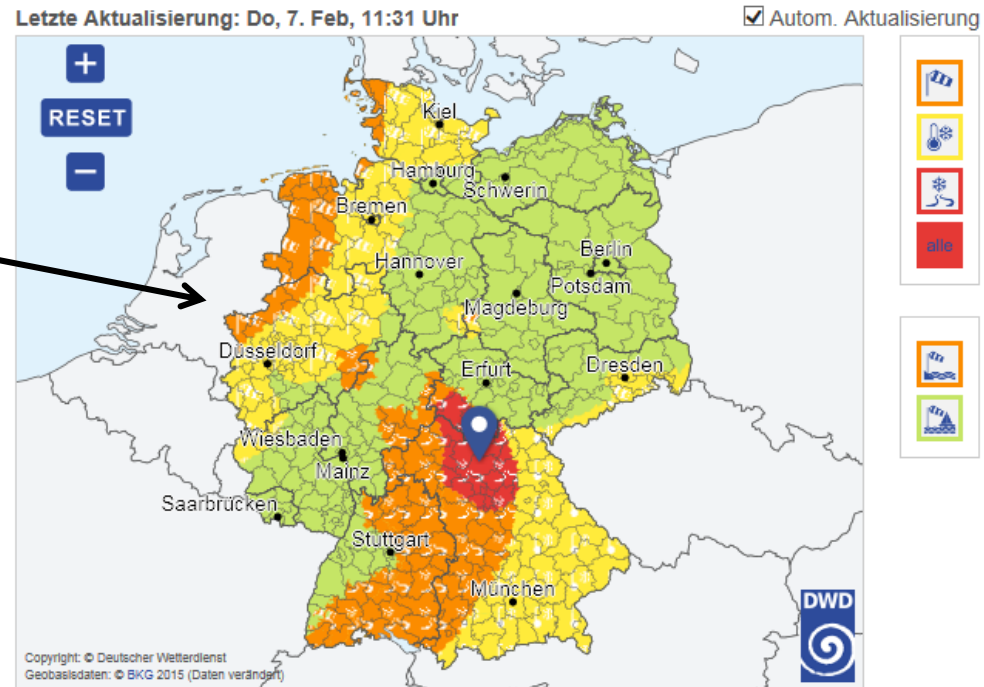
(1) ...

2. to provide **meteorological information** and services **to ensure the safety** of aviation and maritime shipping, **traffic routes** and other vital infrastructures, in particular those needed for energy supply and communication systems;
3. to **issue official warnings about weather phenomena** that
 - a) could become a **danger to public safety** and order or
 - b) are related to **imminent weather and climate events** with a high potential to cause damage;

...

Example of weather warning:

- map with coloured warning areas
- warning text



severe weather:

orange: strong wind,
local black ice

yellow: wind, frost

red: black ice

green: no warning

2 Warnungen am Punkt



Amtliche UNWETTERWARNUNG vor GLATTEIS

Do, 7. Feb, 12:00 – 17:00 Uhr

Aufgrund von gefrierendem Regen oder Sprühregen muss verbreitet mit Glatteis gerechnet werden.

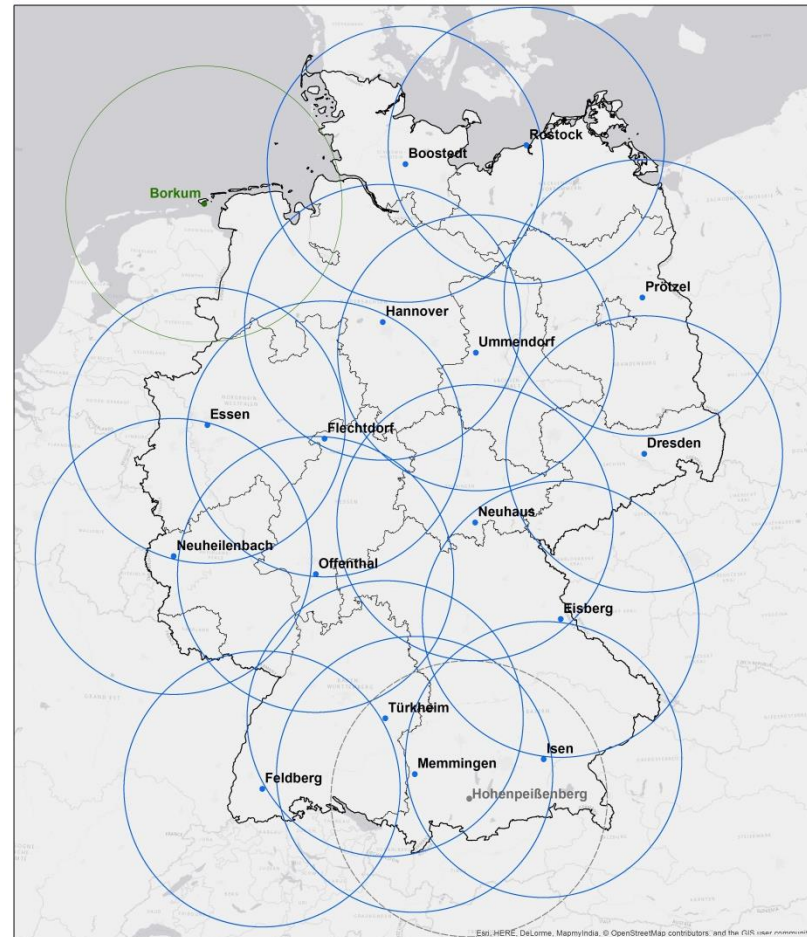
Mögliche Gefahren anzeigen ▼

requirements for data input for winterly weather warnings:

- identification of **hazardous** precipitation **type**
- identification of **hazardous ground** conditions (T_{ground})
- spatially **comprehensive observations** (at least over Germany)
- **high update rate** (e.g., 5 min) and **fast availability** (~3-5 min)

radar data for data input:

network of **17 C-band weather radars** covering Germany and parts of neighbouring countries



Legende

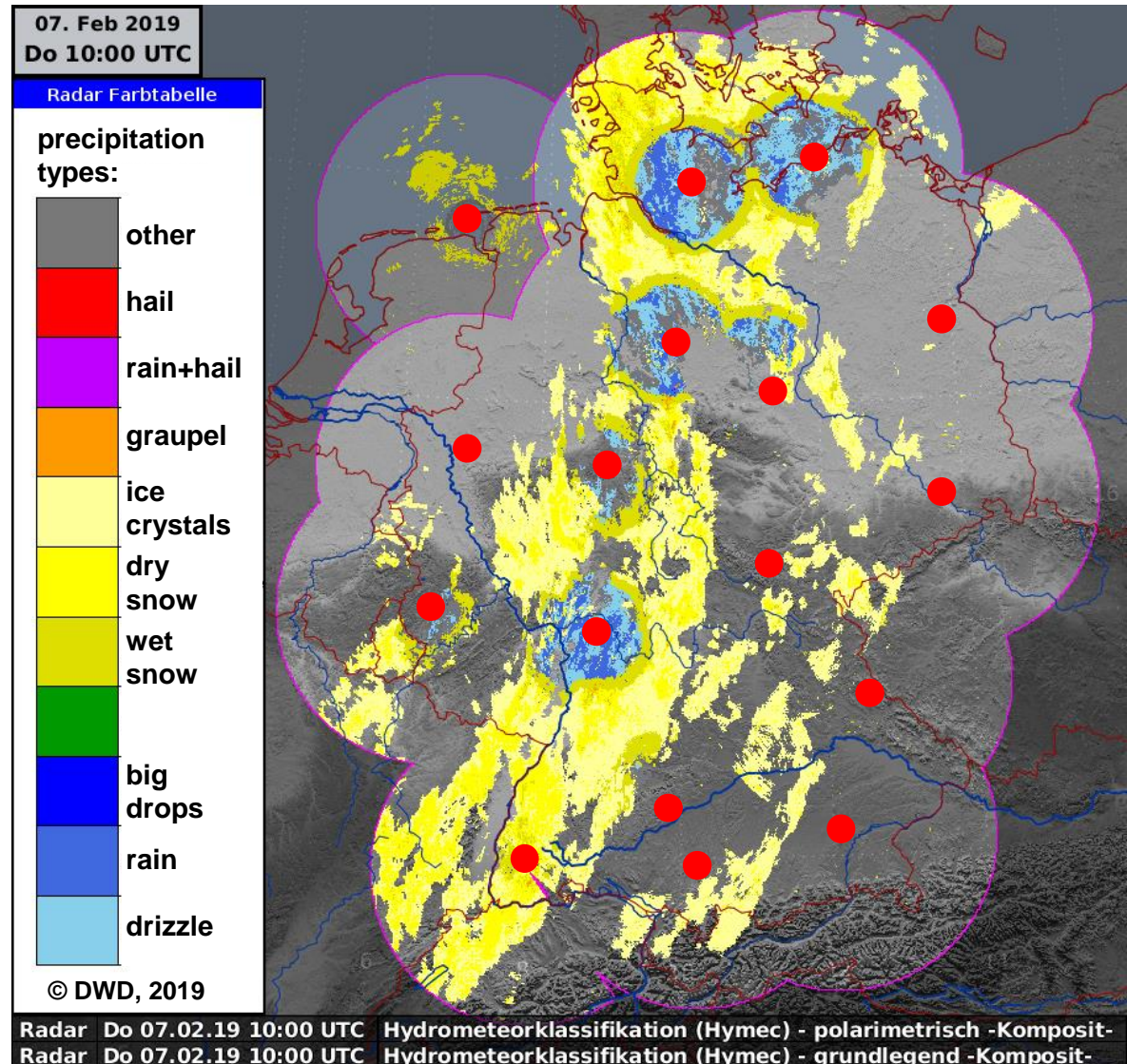
- operationelles Verbundradar
- Qualitätssicherungsradar
- Ausfallsicherungsradar (Ersatz für Radarstandort Emden)
- 150 km Abdeckungsradius

0 20 40 80 120 160
Kilometer
Maßstab 1:3.000.000
Stand: 07.03.2018 © GeoBasis-DE / BKG 2017

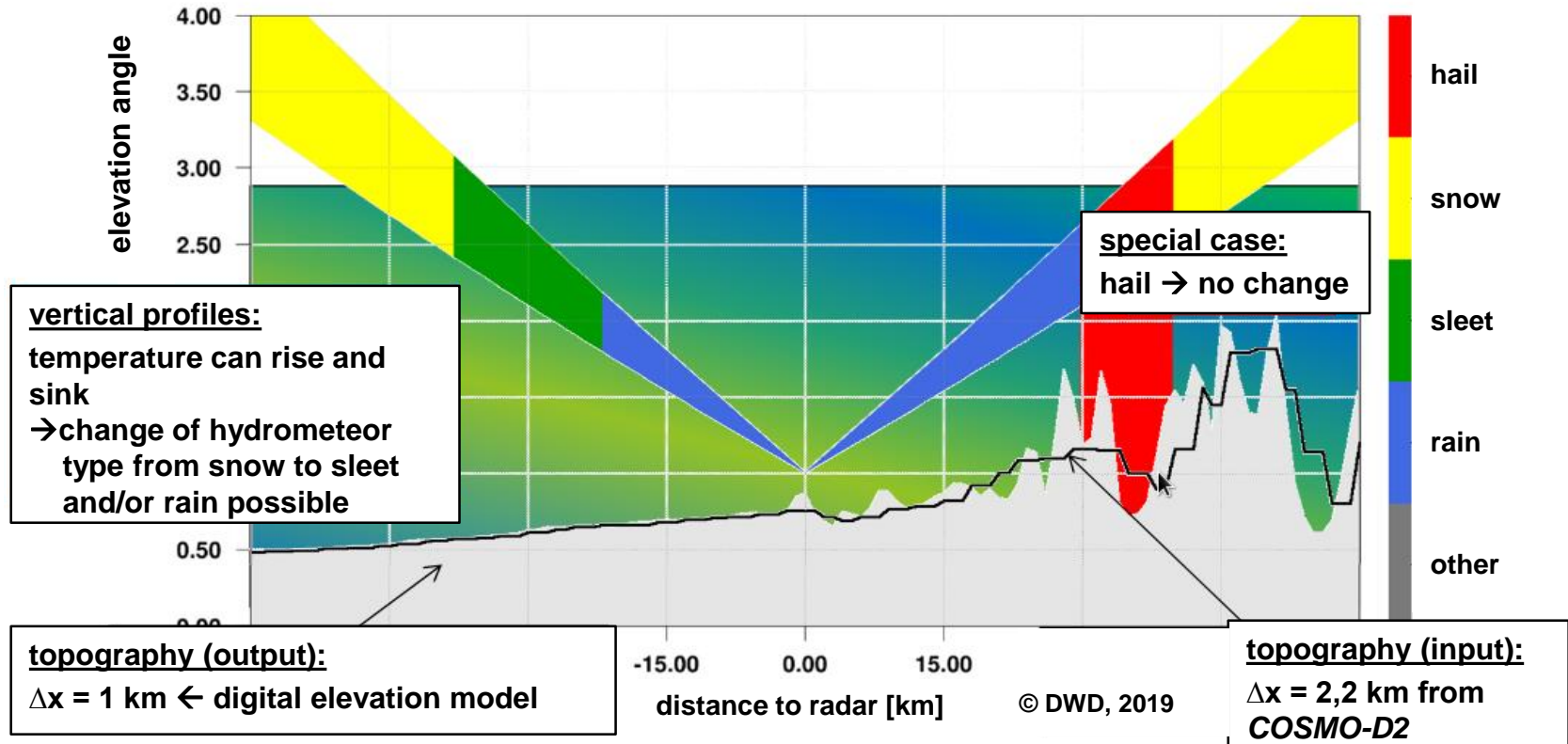
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radar hydrometeor types
on radar beam height:

● weather radar sites



extrapolation of radar hydrometeor types from radar beam height to ground:



extrapolation of radar hydrometeor types from radar beam height to ground:

- **NASMA** („nose analysis based on snow melting area“) algorithm
- **basis: hydrometeor classification on radar beam height**
- use of **vertical profiles** (*NWP*) of temperature, humidity and pressure
- **adaption to 2m temperatures** (observations)
- result: **hydrometeor types in 2m height**
- analysis and forecasts up to +2 hours
 - optical flow **displacement**,
 - $T_{2m} +$ *humidity* of **model output statistic** of *NWP* and observation **predictors**

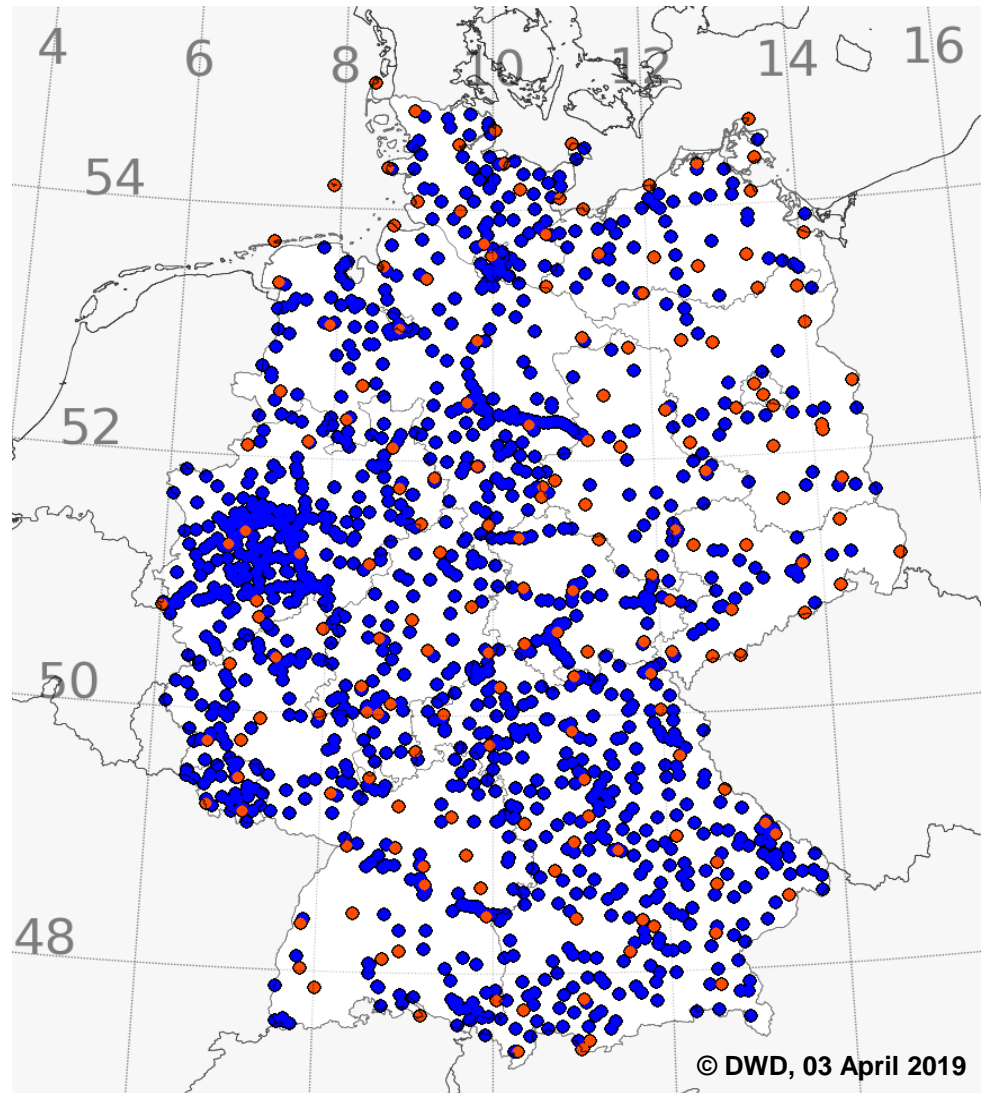


use of road stations for
observation data near ground:

network of

~200 *SYNOP* stations ●+

~1300 *SWIS* stations ●



evaluation of analysed precipitation types in winter season 2018/19:

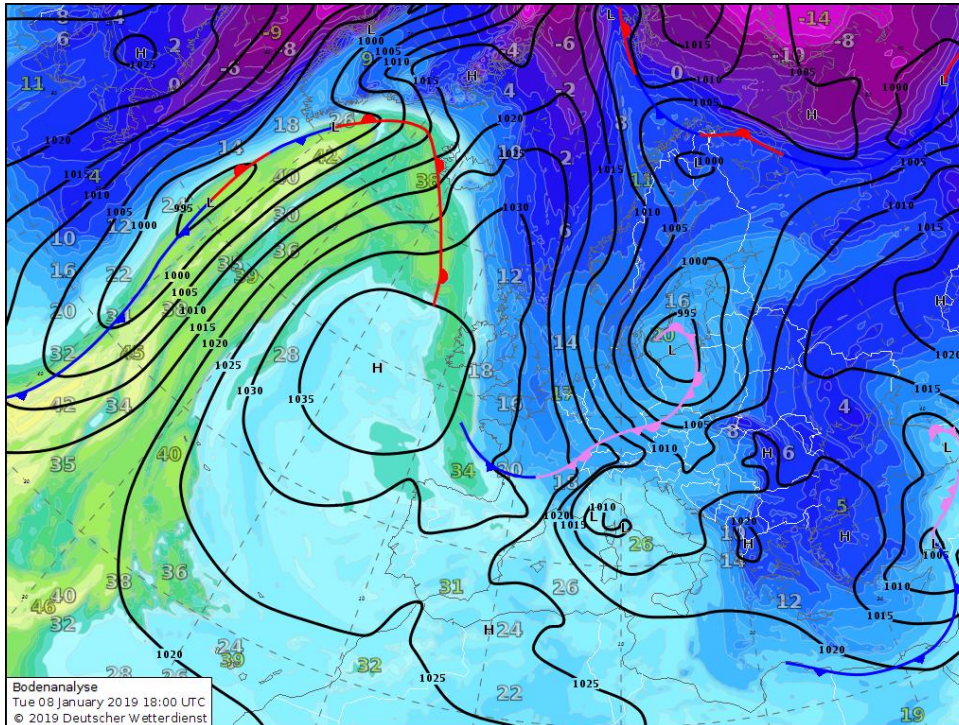
- evaluation of ~20 case studies
- classification into different **weather situations**:
 - **front passages**: Warm front and cold front
 - **post frontal** situations / convective situations
 - *Föhn* events etc.
- comparison of **precipitation type analysis** with ground **weather observations** and **NWP** output (*COSMO-D2*)

two cases of season 2018/19:

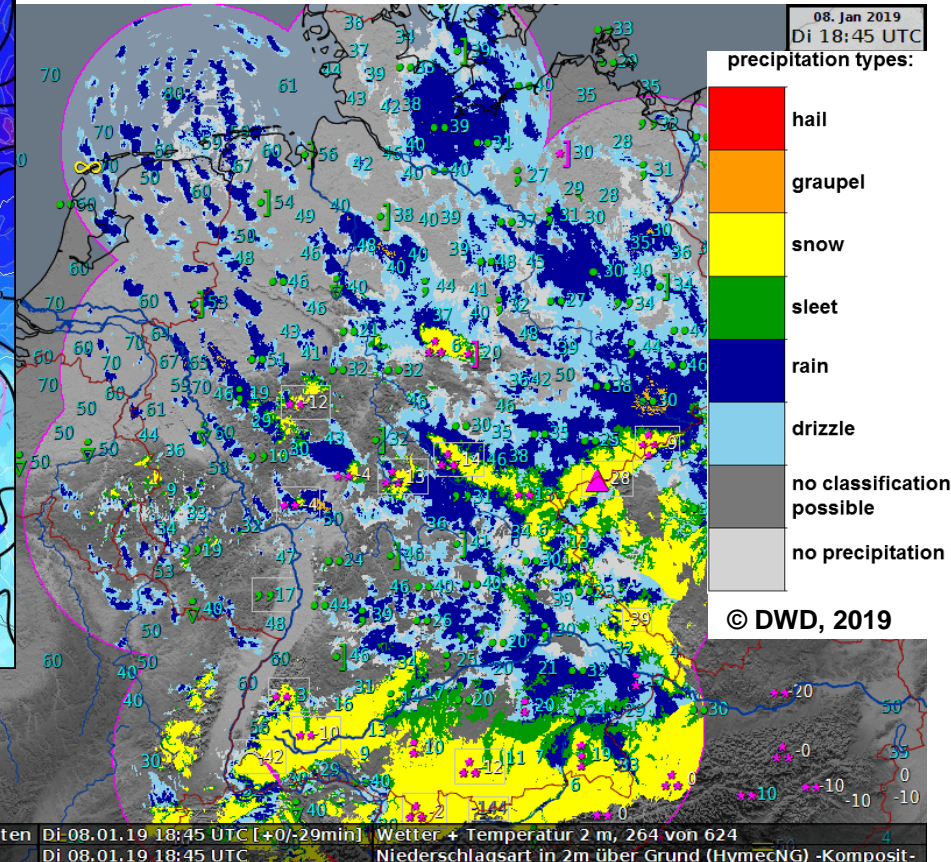
- **well-mixed** troposphere
 - case study 1 of **08 January 2019**
- **front** passage
 - case study 2 of **07 February 2019**

Case study 08 January 2019

precipitation type analysis in 2m msl and ground observations (ww + T_{2m})

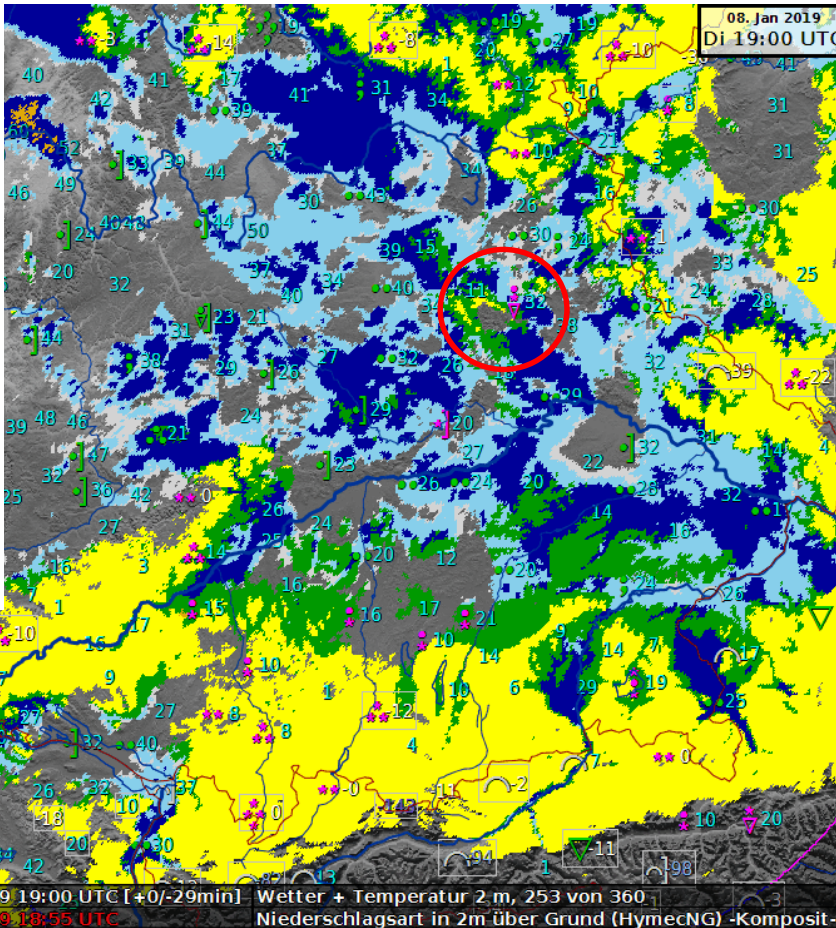


analysis 08 January 2019, 18.00 UTC



Case study 08 January 2019

precipitation types:



Southern Germany:

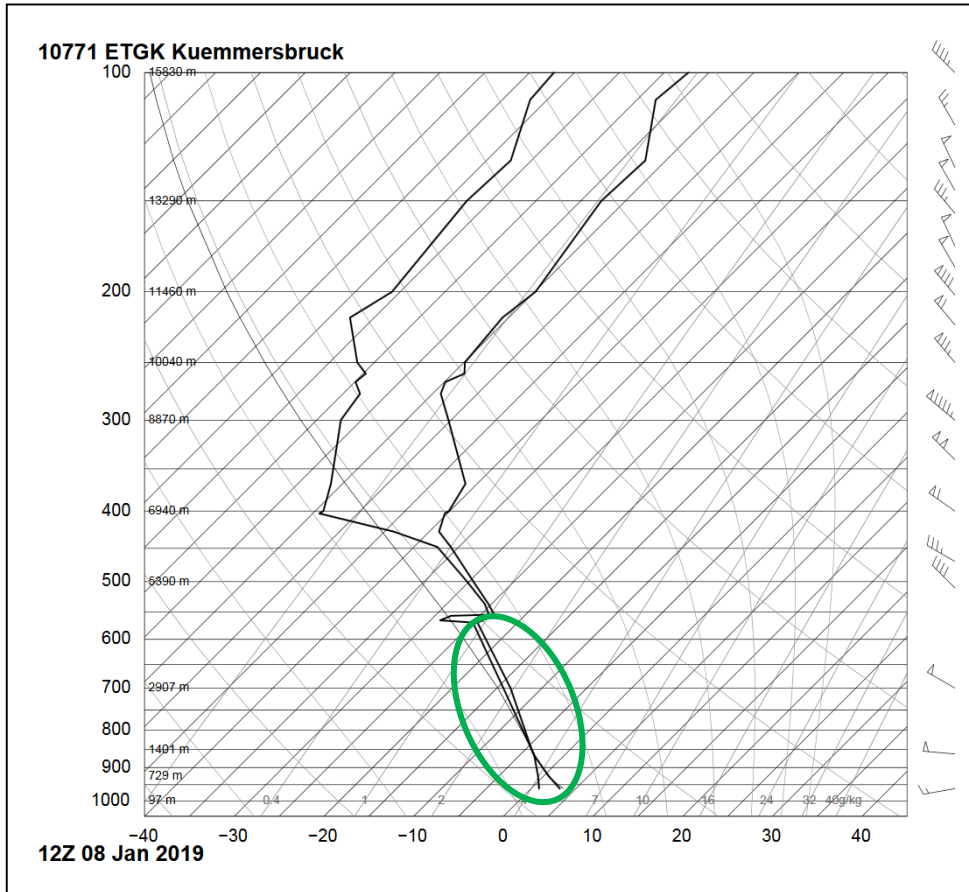
observed precipitation types are
well represented

in precipitation type **analysis** in 2m

→ *High-Rhine valley, Lake Constance and river valleys (e.g., Danube, Inn, Salzach):*
rain

→ **snow line is ~ 600 m msl**
e.g., *Franconian alb* (red circle)

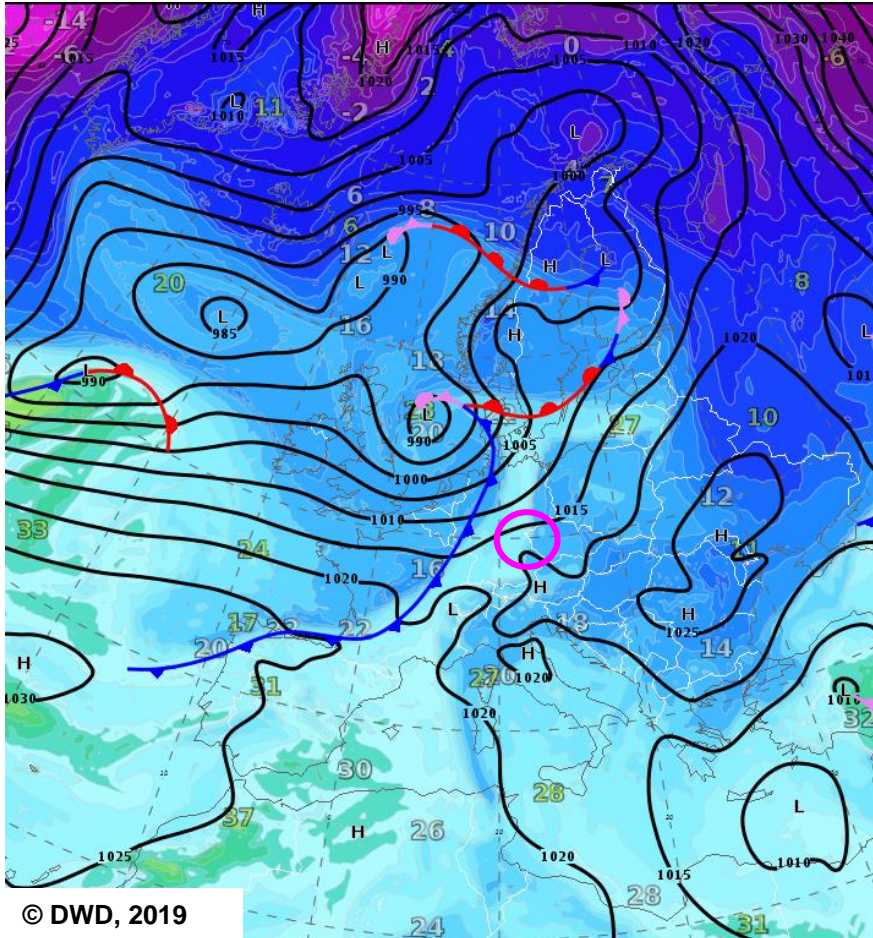
Case study 08 January 2019



Radiosonde ascent of *Kümmersbruck*:

Verticale profiles show **well-mixed**
lower **troposphere** without inversions

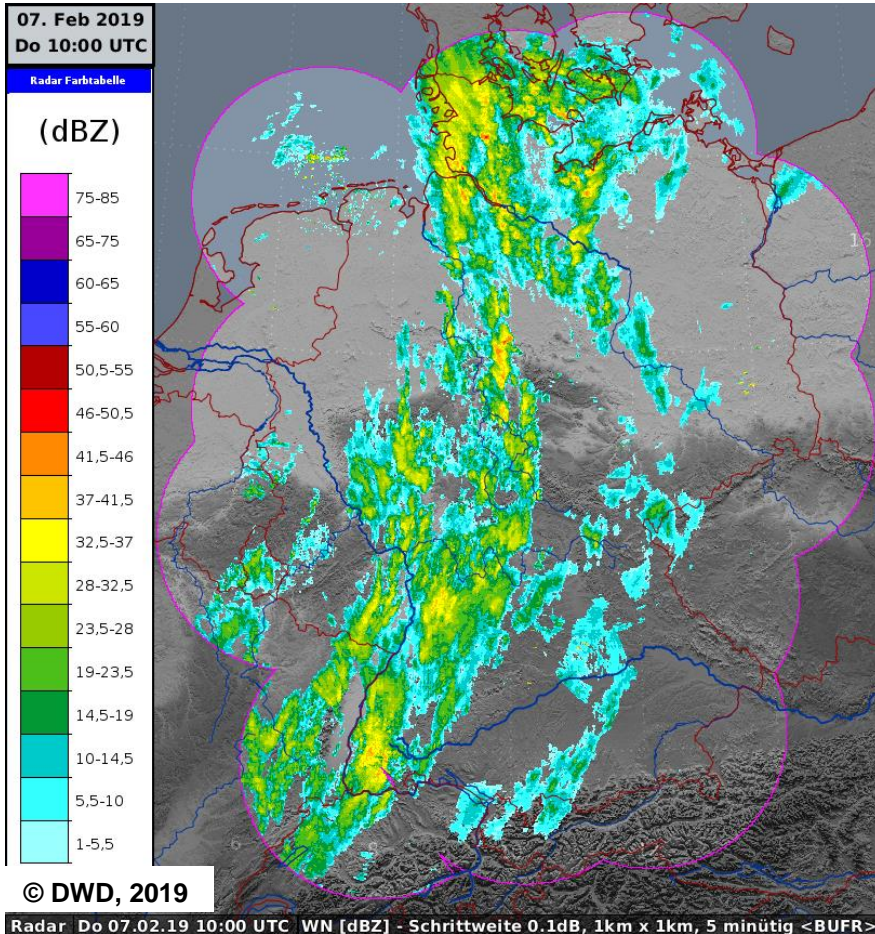
Case study 07 February 2019



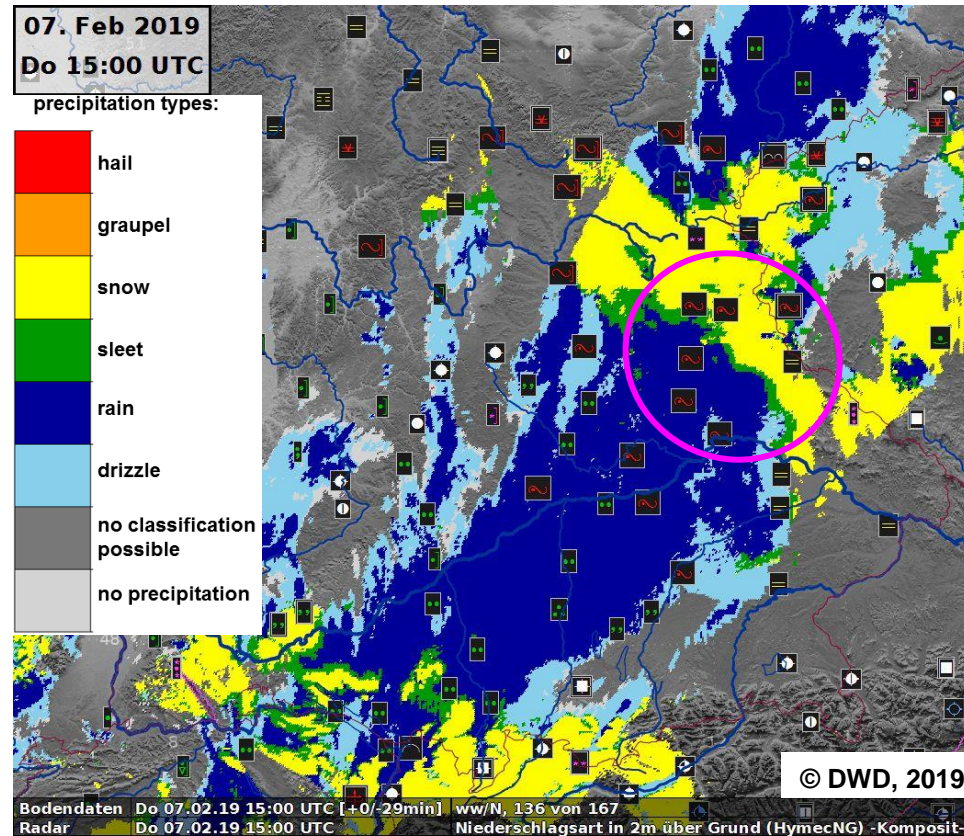
Black ice in *Oberpfalz* region
(*Eastern Bavaria*).

Analysis 07 February 2019, 18.00 UTC

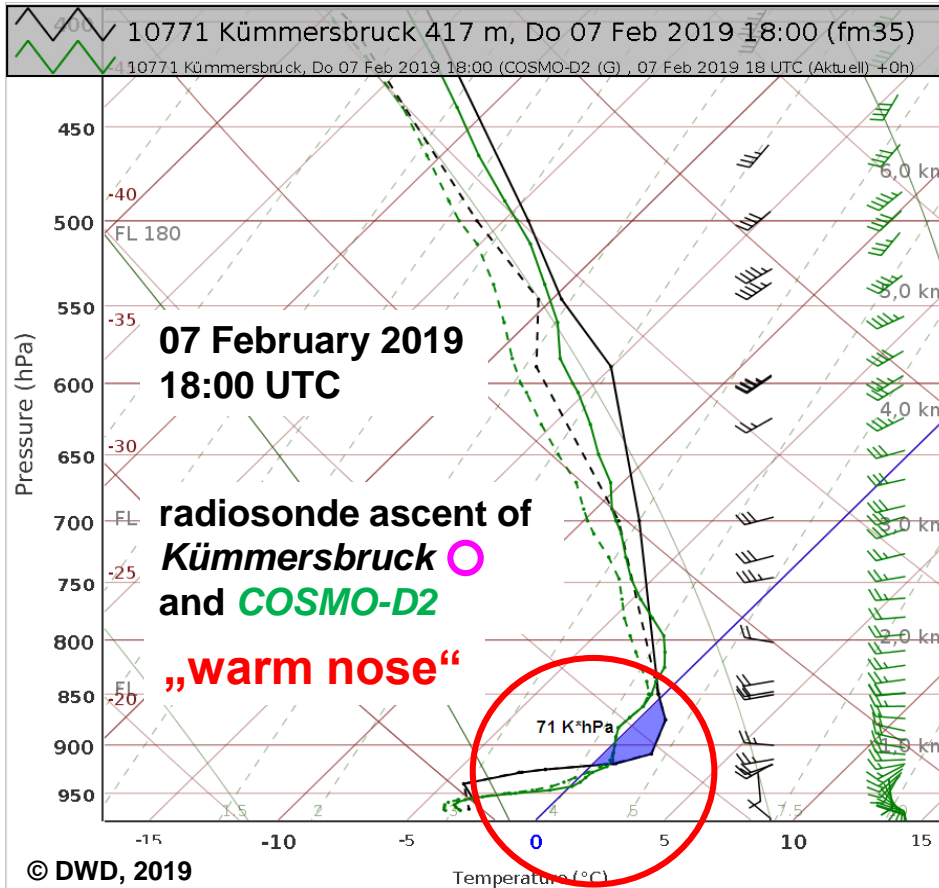
Case study 07 February 2019



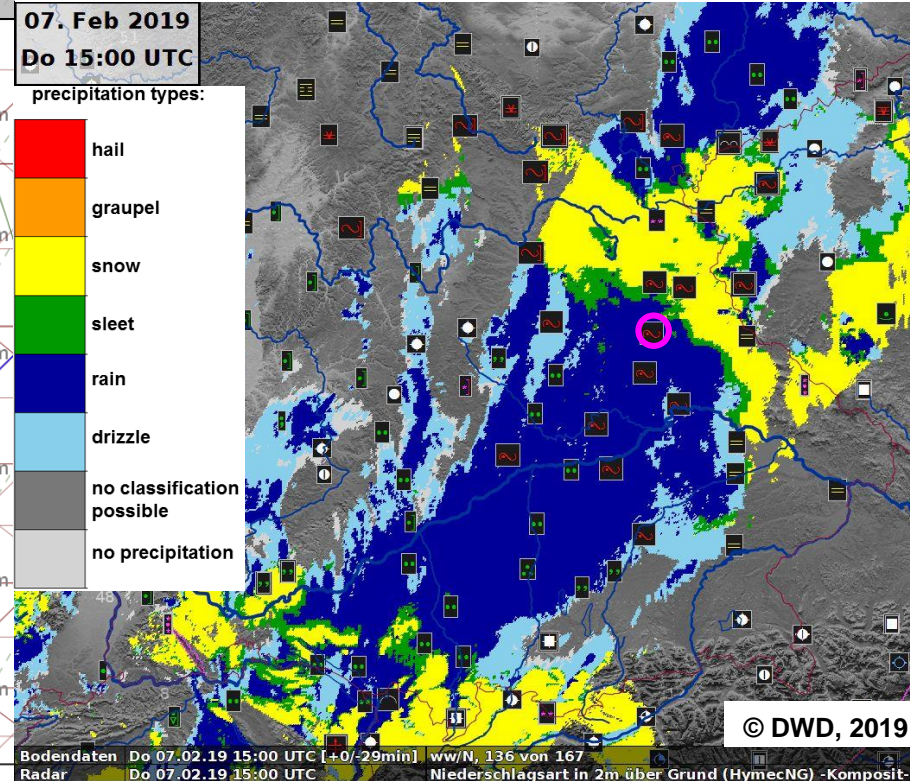
black ice in *Oberpfalz* region (Eastern Bavaria)



Case study 07 February 2019



black ice in Oberpfalz region (Eastern Bavaria)



Nowcasting of winterly precipitation:

- promising results of **adapted hydrometeor classification algorithm**
- classification is very **sensitive** to accurate **vertical profiles of T, f, p**

Outlook:

- adding **further** radar data → **melting layer height derived from radar data**
- use of **additional ground observations** (e.g., of neighbouring countries)
- use of **3D-observations (?)** → e.g., *radiosonde, AMDAR, ...*

Questions



Map with *MOS* forecast points

~4500 - 5000
forecast points

