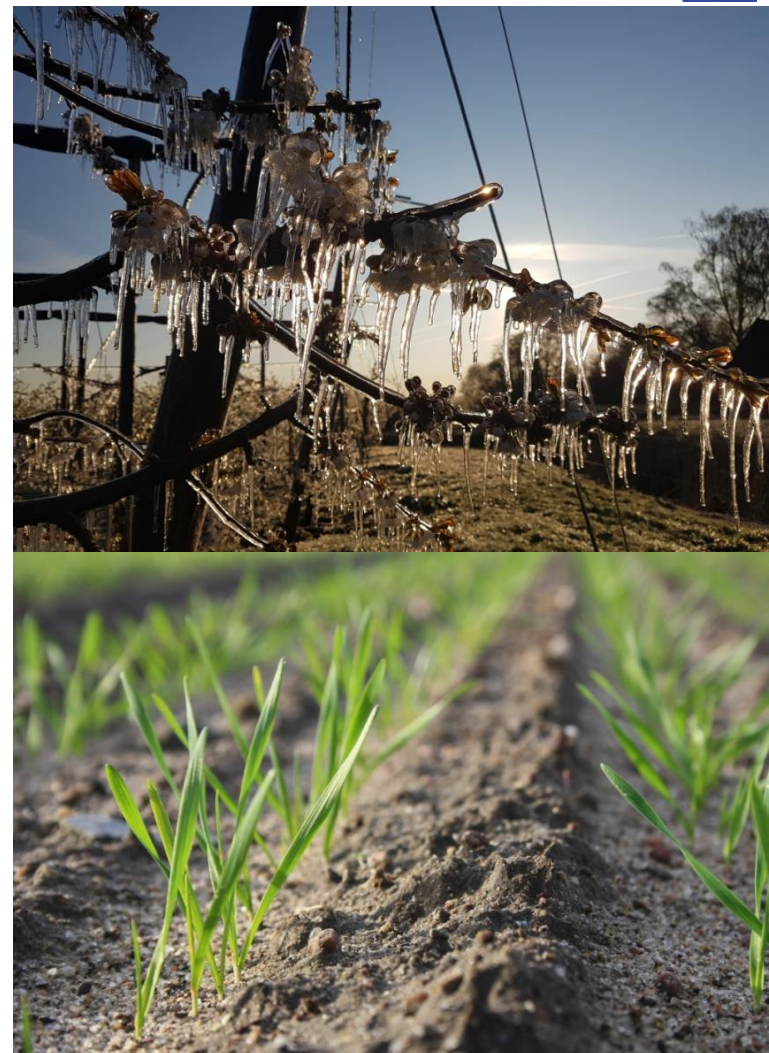# How can we develop a useful tool for **agricultural** extreme weather monitoring and risk assessment?

Juliane Kellner[1], Cathleen Frühauf[1], Sandra Krengel[2], Thorsten Ulbrich[2], Markus Möller[2], Burkhard Golla[2], Jörn Strassemeyer[2], Jan-Henrik Wiebusch[3], Joerg Hilbers[3], Detlef Deumlich[4], Dominique Niessner[4], Rolf Lessing[5], Thomas Volk[6], Michael Morgenstern[7] and Denny Schmidt[7]

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Extreme weather relevant to agriculture

→ need for tools that offer farmers crop specific and regionally relevant support

→ yield loss, e.g. 20% loss in winter wheat in 2018 compared to 2013-2017 in Germany (DBV, 2019)

...agriculturally relevant extreme weather events: https://www.agrarrelevante-extremwetterlagen.de/

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→investigated 15 crops

→16 extreme weather events, e.g. drought, heavy rain, late frost, storm, continuous rain,..

→derived crop specific thresholds and relevant time periods

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The EMRA project

- funded by the Federal Ministry of Food & Agriculture in Germany

- February 2017 – April 2020

- partners: science, private business, advisers

The EMRA project

- **E**xtreme weather **M**onitoring and **R**isk **A**ssessment

- objectives in EMRA:
  - **extreme weather monitoring**: recording of data (frequency, exposure, damage) **→ gap filling**
  - **risk assessment**: methods for quantifying extreme weather risks (past, present, future)
  - **decision support system**:

Pilot project
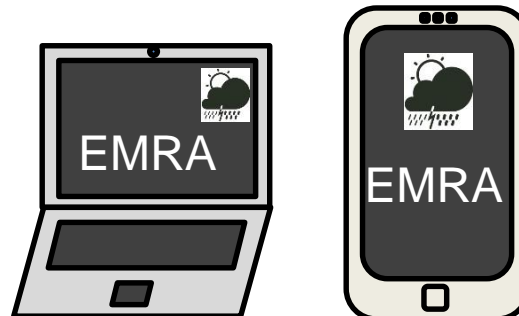
winter wheat:

→ most important cereal in Germany: 50% of cereal area (BLE, 2019)*

→ Uckermark: e.g. drought stress and severe erosion events

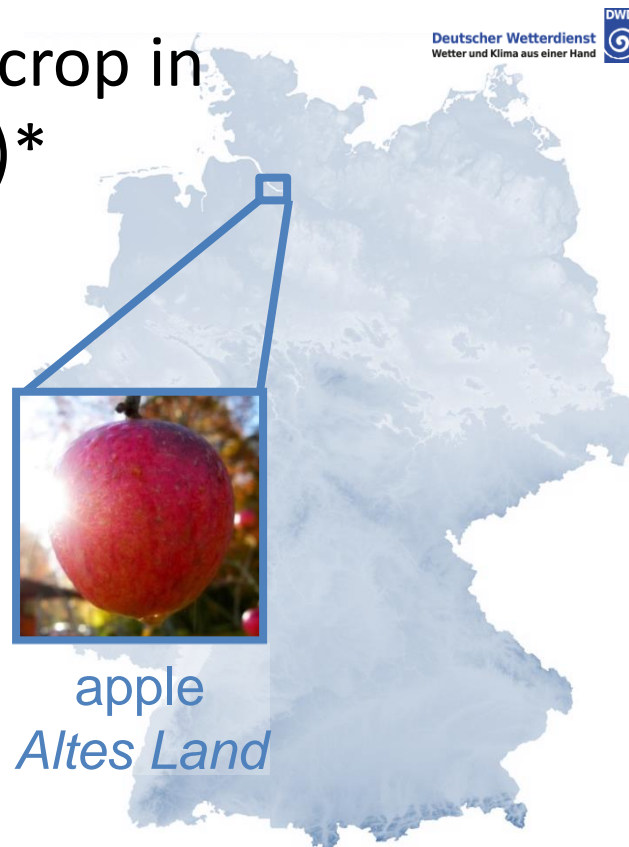winter wheat
Uckermark

*BLE = the Federal Office of Agriculture and Food in Germany

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apple:

➔ apple is the most important special crop in Germany: 75% of fruit yield (BLE, 2019)*

➔ *Altes Land* important fruit production region in Germany

apple
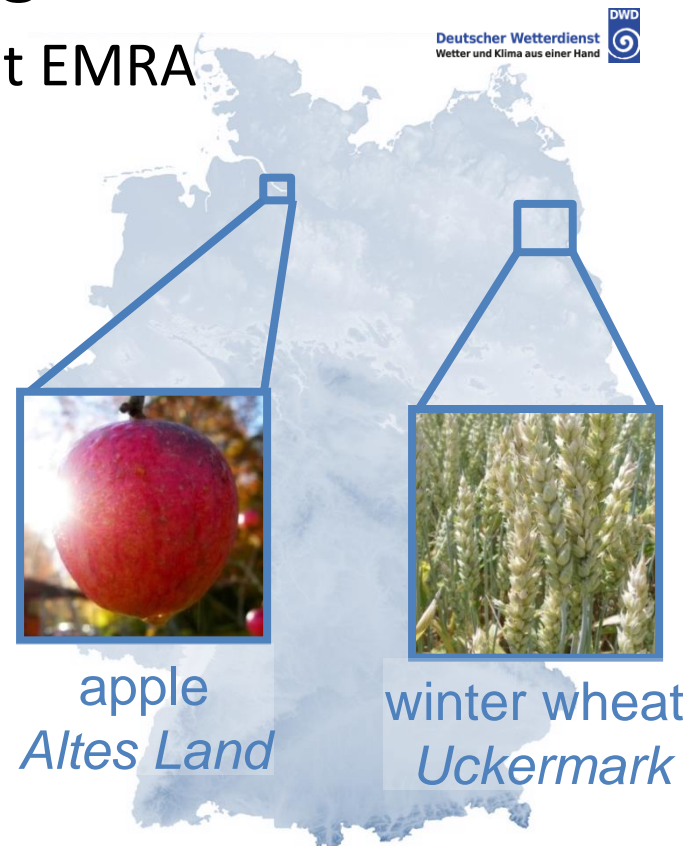*Altes Land*

*BLE = the Federal Office of Agriculture and Food in Germany

Stakeholder

- Selection of test farms in test regions:
  - close cooperation: visit farmers, present EMRA tool → continuous feedback during development process
 - monitoring data → frequency, damage

apple
Altes Land

winter wheat
Uckermark

Stakeholder

online survey (Jan-Dec 2018)
preliminary results: three most relevant extreme weather events were

winter wheat		relevant period	threshold
1.	drought	October-July	Soil moisture < 50%PAW
2.	heat	May-June	Tmax > 30°C
3.	heavy rainfall	June-August	precipitation: > 20 mm/d

Möller et al., 2017, CATENA(150)

dynamized, using phenological data*

thresholds provided, but adjustable by end-user

apple orchards		relevant period	threshold
1.	hail	January- December	Yes/No
2.	late frost	October-July	tight cluster stage: Tmin <-7°C pink stage: Tmin < -2°C full flowering: Tmin < 0°C
3.	continuous rain	March-October	precipitation: > 10mm/d
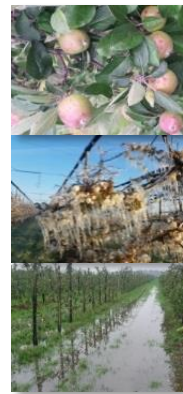
- essential data for EMRA
  - **past**: climate data (1991-2019)
    - characterization of region
  - **present**: weather forecast (7 days)
    - warnings
  - **future**: climate projection until 2100
    - future development
- daily update
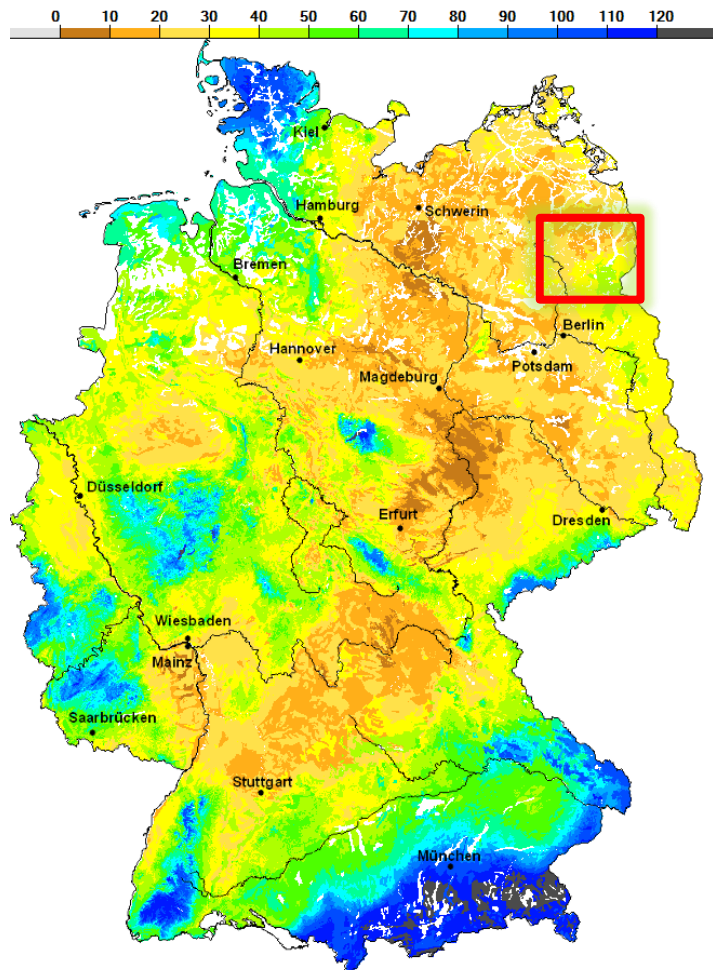- 1x1 km grid

Agrometeorological data

- measured parameters
  - temperature
  - precipitation
  - wind speed
  - solar radiation
  - ...
- simulated parameters
  - soil moisture*   →   DWD-model: *AMBAV*
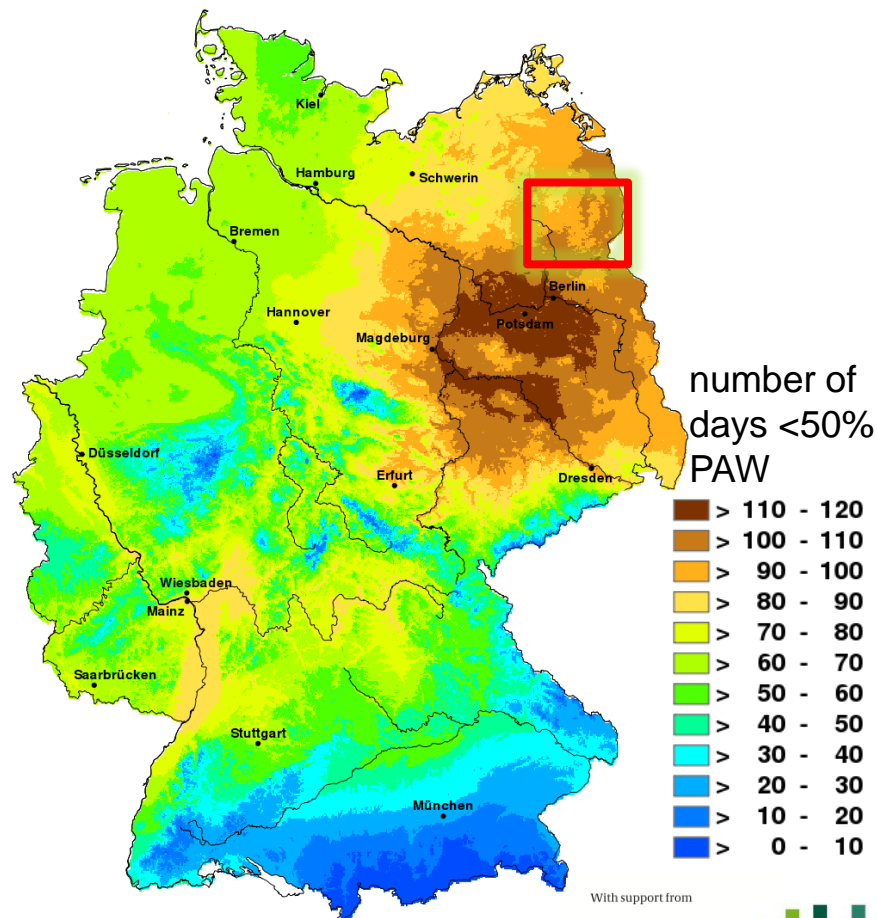 - leaf temperature*
  - apple skin temperature*

*https://www.dwd.de/EN/climate_environment/consultancy/agriculture/agrometeorological_models.html

Example drought stress

simulated soil moisture [%PAW]
Jan-Dec 2018 with *AMBAV* for winter wheat

potential drought risk between
1961-1990

number of
days <50%
PAW

> 110 - 120
> 100 - 110
> 90 - 100
> 80 - 90
> 70 - 80
> 60 - 70
> 50 - 60
> 40 - 50
> 30 - 40
> 20 - 30
> 10 - 20
> 0 - 10

Geobasisdaten © Bundesamt für Kartographie und Geodäsie (www.bkg.bund.de)

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Scheme of EMRA
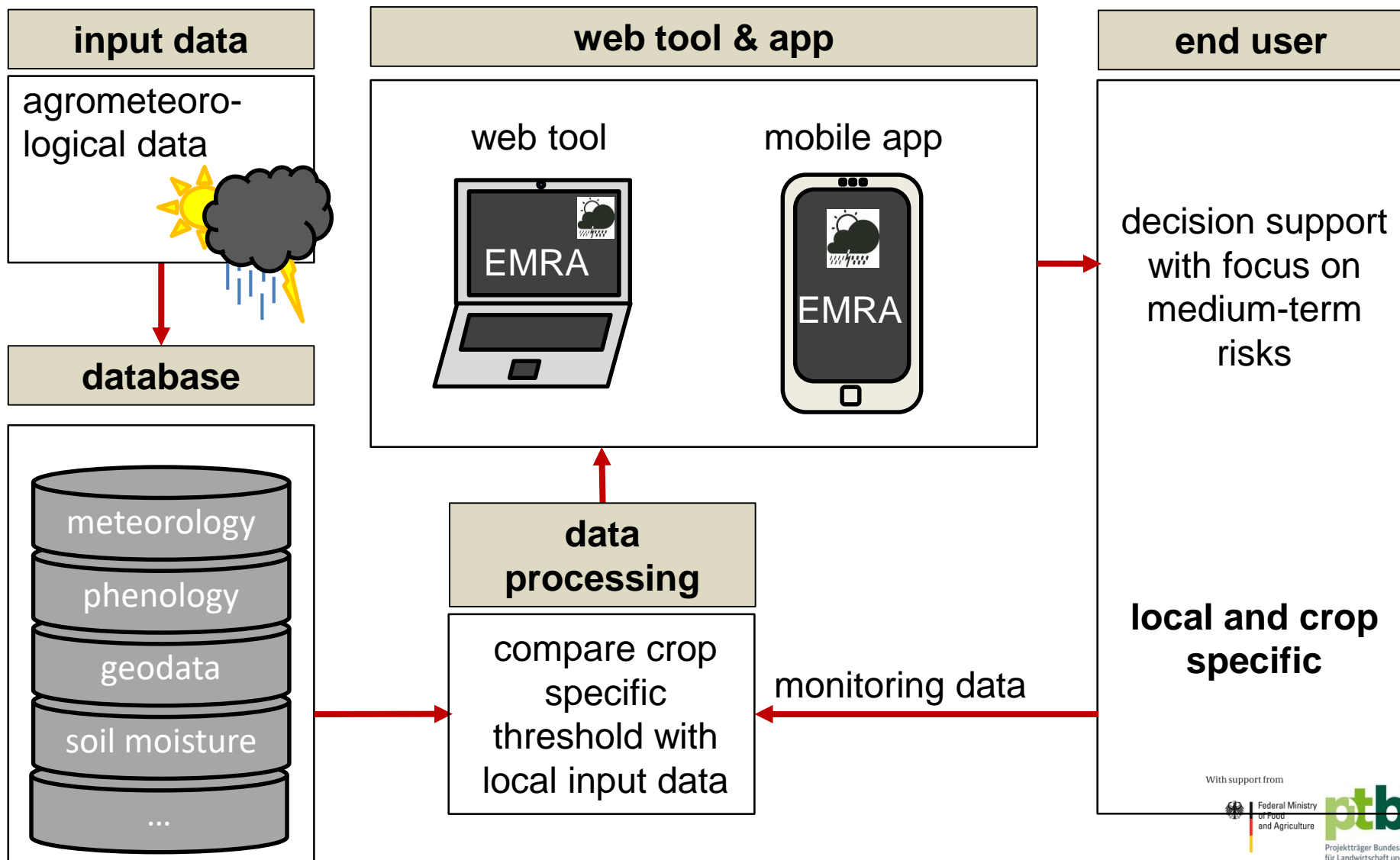
- extend to nation-scale
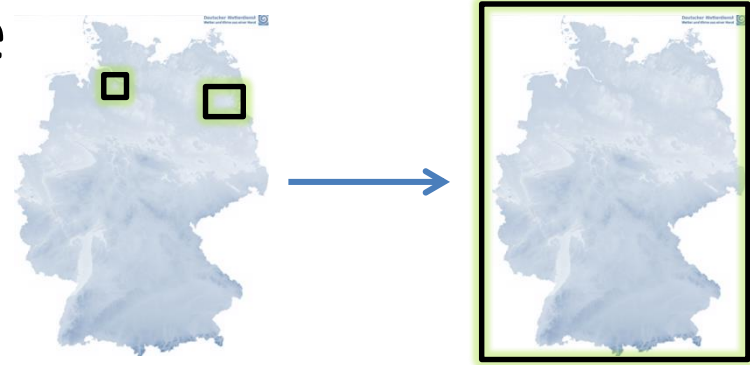
- add further crops

- advice

  drought → irrigation

  hail → hail netting

Conclusion

*How can we develop a useful tool for **agricultural** extreme weather monitoring and risk assessment?*

- identify crop-specific relevant extreme weather events

- (medium-term) support for extreme weather management

- close cooperation between scientists and farmers/orchadists, including feedback

Thank you very much!

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