

EMRA: A Decision Support System for Monitoring, Warning and Risk Assessment of Weather Extremes for Agriculture



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EMRA: Extrême weather Monitoring and Risk assessment system

- Aim: development of an extreme weather monitoring and risk assessment system to design a decision support tool to manage weather risks in agriculture
- Duration: 02/2017-04/2020
- Budget: 1.4 Mio. €
- Project team:



- Project holder: Bundesanstalt für Landwirtschaft und Ernährung

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Motivation

- Systematic recording of extreme weather related damage in agriculture
- Contribution to close data and knowledge gaps (mid and longterm)
- Supply practice-oriented decision supports
- Development and implementation of webtools/ an APP (EMRA)
- Methods to quantify extreme weather risks
 - Past & present: historic (weather-)data & weather forecasts
 - Future: Climate projections, decadic climate prediction

Monitoring-app Decision support tool



Concept

Risk Assessment System

Designing an **interactive Information Exchange**

- System infrastructure
- Analysis routine
- Data integration

Extreme Weather Monitoring

Recording of **data on field scale**:

- Frequency
- Exposure
- Damage

...incl. metadata

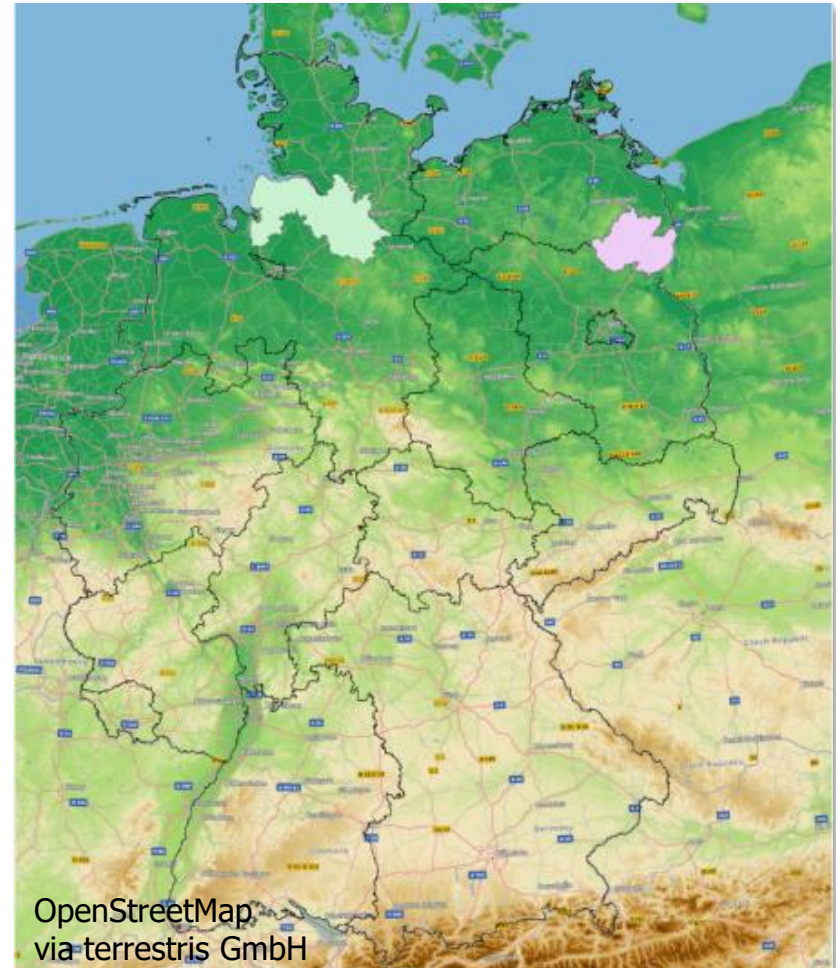
Decision Support

Providing **local and crop-specific information**

- Risk/Exposure (current and historic)
- Maps, graphs, indices and thresholds
- spacial-temporal dynamic

Stakeholder Involvement

- Test crops and regions
 - „Apple in the Altes Land“
 - „Winter wheat in the Uckermark“
- User involvement:
 - Integration of agricultural consultants and test farms
 - Nationwide online survey for farmers (30.01. - 31.12.2018) on risk (damage suffered, damage potential, measures taken) and need for advice
 - Advisory board



Relevant Extreme Weather Events

Online survey

Ranking of extreme weather events, that induced loss in crop yield and quality

Cropping farms* (n=143)

Rank	1	2	3	4	5	6	7	8	9
Extremes	drought	heat	heavy rain	hail	continual rain	spring frost	winter frost	storm	early frost
Ø rank	2,2	3,5	3,8	4,4	4,6	5,2	5,3	5,6	7,6
St. dev	1,8	2,1	1,9	2,4	2,6	2,0	2,5	2,2	1,6
n	134	117	115	119	111	109	106	101	89

Fruit growing farms* (n=54)

Rank	1	2	3		4	5		6	7
Extremes	hail	spring frost	continual rain	storm	heat	drought	heavy rain	early frost	winter frost
Ø rank	2,2	2,7	4,3	4,3	4,5	5,1	5,1	6,8	4,3
St. dev	1,7	1,9	2,2	2,3	2,3	2,1	2,0	2,2	2,3
n	45	43	39	36	38	34	33	30	36

* All farms with exclusively cropping or fruit growing, survey period: 30.01.-14.08.2018

Extreme weather in agriculture...

May result in...

- Hail ([hail damage](#))
- Continual rain ([waterlogging](#))
- Heavy rain ([erosion](#))
- Storm ([wind damage](#))
- Drought ([drought damage](#))
- Heat / Solar radiation ([apple sun burn](#))
- Frost ([winter killing](#))

Hail



Water logging



Erosion

Foto: Niessner

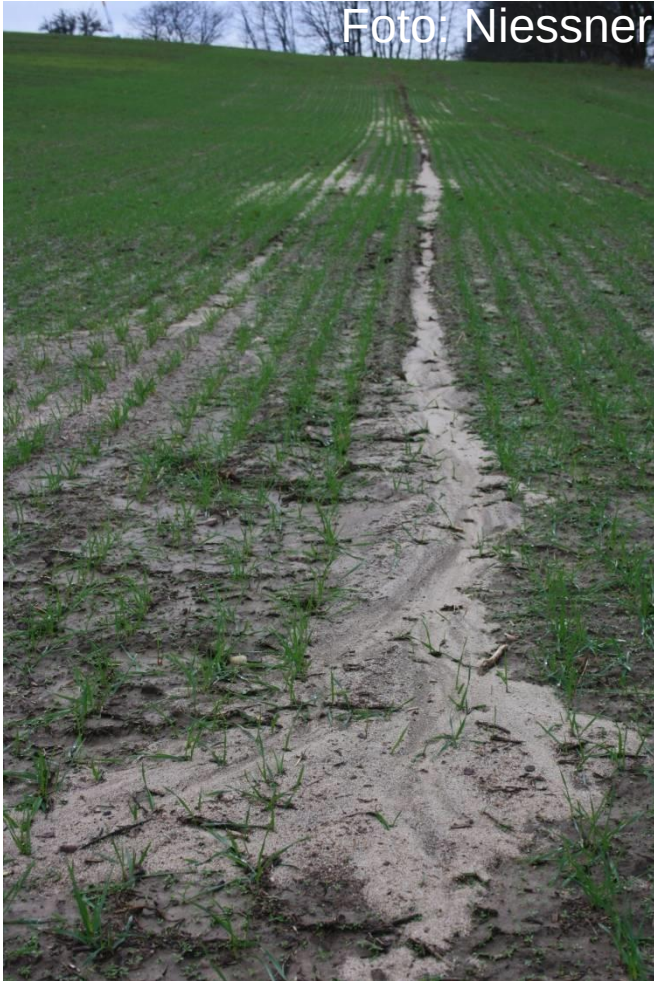


Foto: Deumlich



Wind damage



Drought damage



Foto: Wiebusch



Foto: Niessner



Foto: Niessner

Apple sun burn



Frost (-blanketing)



Extreme weather in agriculture...

May result in...

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- Storm ([wind damage](#))
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- Heat / Solar radiation ([apple sun burn](#))
- Frost ([winter damage](#))

And depends on ...

- Intensity/strength of weather (Min T, Max T, P^{DSum} , ...)
- crop/variety
- Phenological phase (~time)
- Cultivation system
- Local factors (soil, topography, etc.)

Decision Support Tools

Weather data

Temp. (Min Max,...)
Precip. (sum, intens.)
...

Phenological phase

Agricultural indicators

Field capacity
Evapotranspiration
...

Geodata

Soil type
Erodability
Slope
...

Damage monitoring

Historic damages
Damage potential

Decision support tools

- field-specific → smallest possible scale
- crop-specific → thresholds
- customizable → cultivation system, variety, thresholds, period
- comparative → field vs. farm or region

User

Cultivation System

Crop/Variety

Show:

- historic damage
- Current weather and forecasts
- Indicators, maps, Graphs, thresholds
- Management recommendations

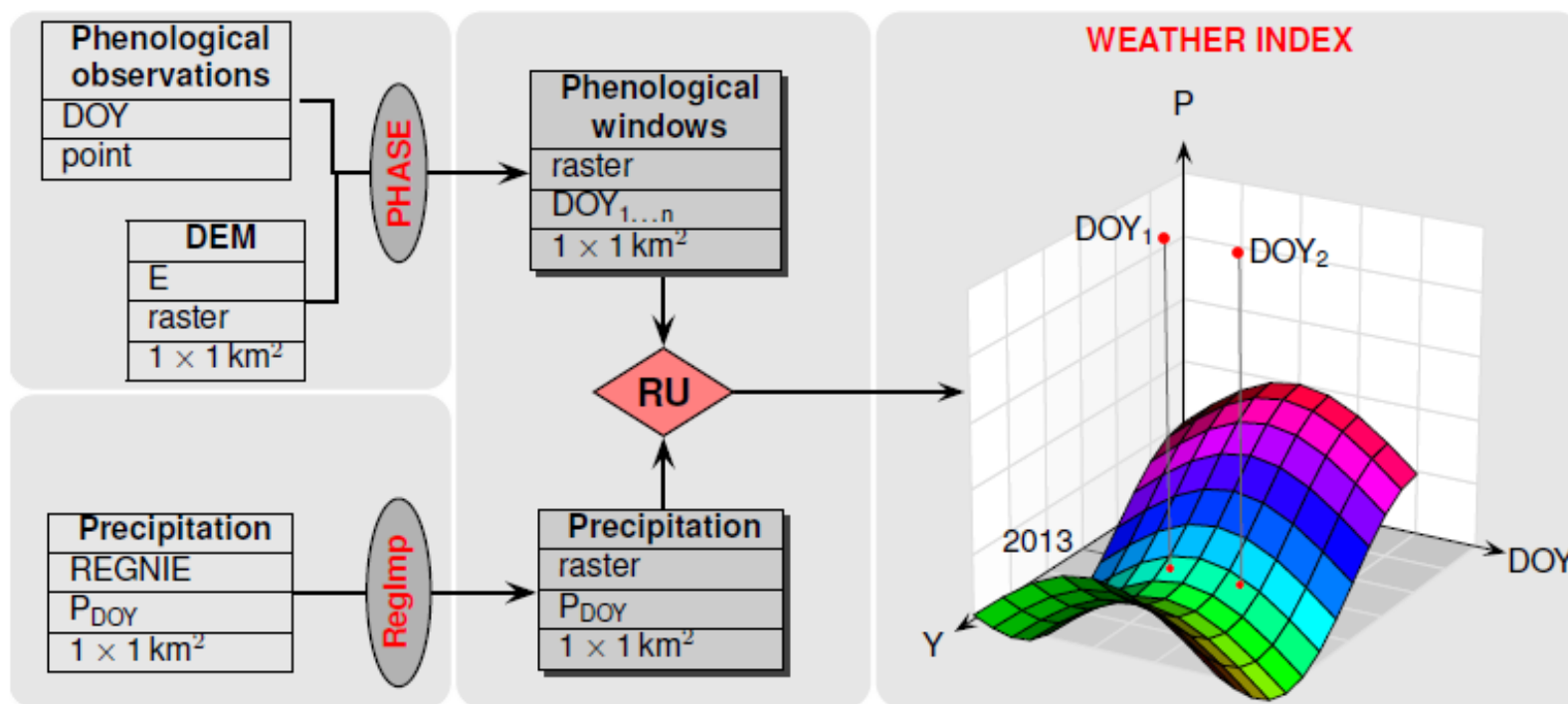
Support decisions on:

- long-term risks
 - Hail nets, frost-protection, irrigation
- mid-term risks
 - Choice of crop/Variety, plowing
- acute measures
 - Erosion breaks

Decision Support Tool

Phenologic phase-specific dynamic indices

Flow chart for dynamic modeling of weather indices



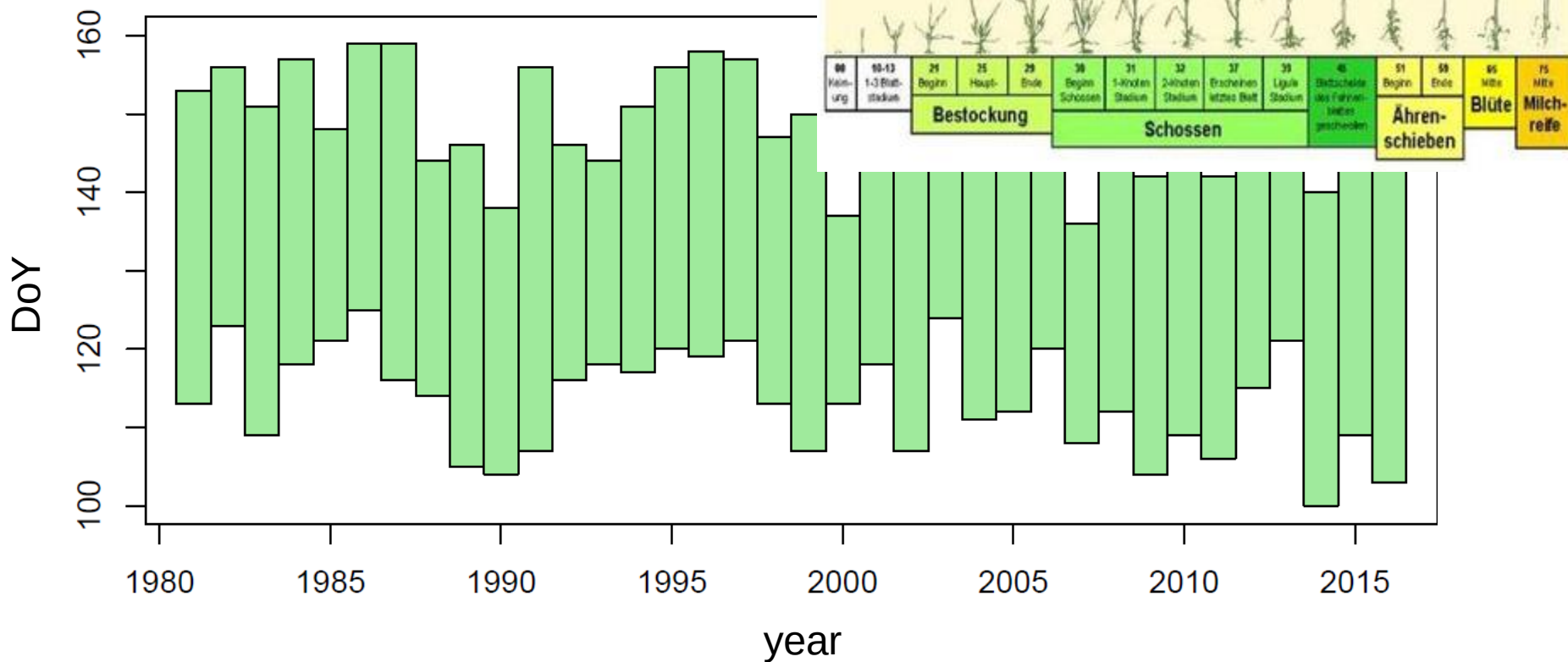
RU – Raster unit (f.e.: field, farm, county) | *DoY*– Day of Year |
P- Precipitation | *Y*– Year | DEM – digital elevation model

Decision Support Tool

Phenologic phase-specific dynamic indice

Beginning and end of the winter wheat phenol
in the county *Uckermark*

Phenological phases of wheat

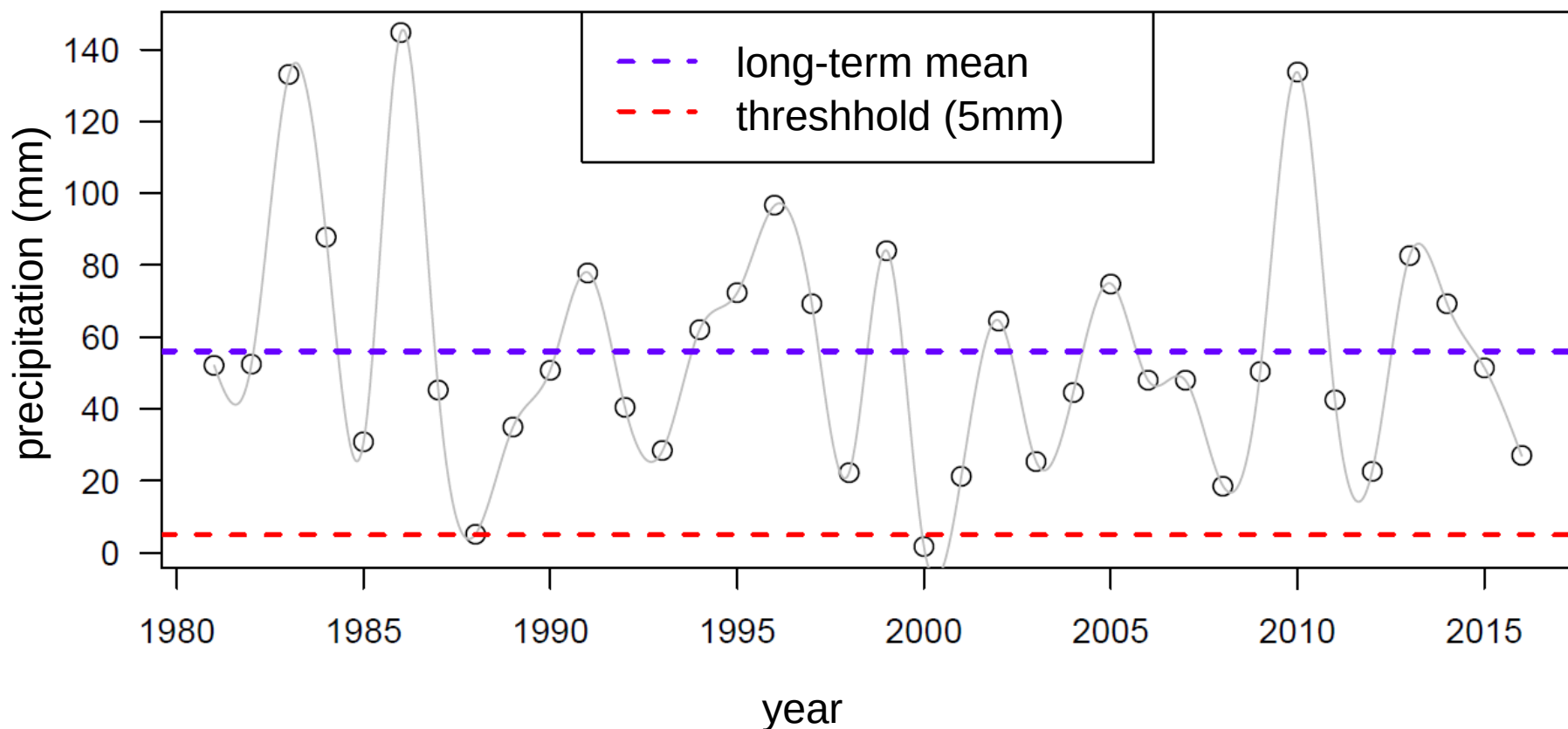


DoY- Day of year

Decision Support Tool

Phenologic phase-specific dynamic indices

Time series of phenological phase-specific sums of precipitation for the county *Uckermark* between 1981 and 2016



Conclusion and Outlook

Conclsions

- High risk of loss due to weather extremes
- Lack of data to assess extreme weather risks and damage
- Relevance of extreme weather events depends on crop, location, phenologic phase
- Decision support tools for practitioners have to factor that in

Ongoing work and next steps

- Implementing the monitoring tools
- Implementing the interactive information exchange → linking of geodata
- Development of analysis routines to provide field-specific decision support
- Testing the webtool and app with agricultural consultants and test farms
- Concept for continuation of EMRA

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Thank you for the attention!



Foto: Niessner