Climate change effects on the rural north

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ENRD Workshop: The Vibrant Rural North

Kuressaare, Estonia
16.04 – 18.04.2018

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Eesti Maaülikool
Estonian University of Life Sciences

Kliima soojeneb kaelamurdva kiirusega

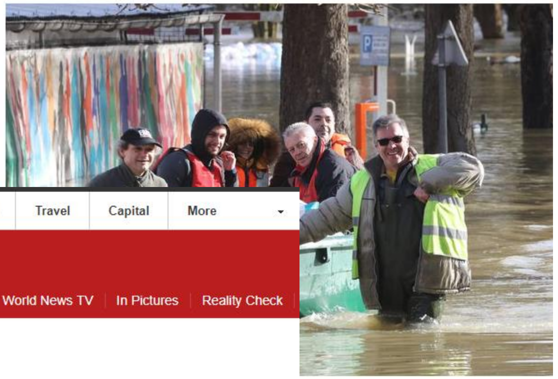
Hans Alla
toimetaja

1. veebruar 2018, 10:21

Hea koht elada: Tallinn on Läänemere ääres ainus pealinn, millele värske kliimauuring karme ilmaolusid ei ennusta

Kaur Maran
toimetaja

21. veebr



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…seisab ees oluliselt enam üleuj…
…id Newcastle'i Ülikooli teadlase…

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Climate change

21:30 11 Apr

Shifting Spring

Lindsey Chapman investigates how shifting seasons are affecting our wildlife.

We've just endured a tough winter but some records suggest that Spring now begins on average 26 days earlier than it did 10 years ago. Lindsey Chapman investigates how shifting seasons are affecting our wildlife.

Bumblebees in January, daffodils blooming early, 'thuggish-vegetation' thriving as a result of mild winters and damp summers: the seasons appear to be blurring and wildlife is becoming confused. The overall impact is 'quite staggering' according to Matthew Oates, butterfly expert from the National Trust.

Europe's cities face more extreme weather than previously thought

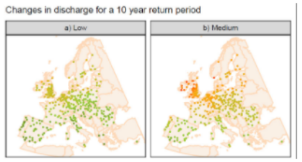
Published on: 21 February 2018

Landmark study shows the impact of flooding, droughts and heatwaves by 2050-2100 will exceed previous predictions.

The research, by **Newcastle University, UK**, has for the first time analysed changes in flooding, droughts and heatwaves for all European cities using all climate models.

Published today in the academic journal **Environmental Research Letters**, the study shows:

- a **worsening of heatwaves** for all 571 cities
- **increasing drought conditions**, particularlyin southern Europe
- **an increase in river flooding,** especially in north-western European cities
- for the worst projections, **increases in all hazards for most European cities**
- **Cork, Derry, Waterford, Wrexham, Carlisle, Glasgow, Chester and Aberdeen** could be the worst hit cities in the British Isles for river flooding
- Even in the lowest case scenario, **85% of UK cities with a river** are predicted to face increased river flooding



"The research highlights the urgent need to design and adapt our cities to cope with these future conditions"

Professor Richard Dawson, Newcastle University

Increase in 'heatwave days' for all European cities

Using projections from all available climate models (associated with the high emission scenario RCP8.5 which implies a 2.6°C to 4.8°C increase in global

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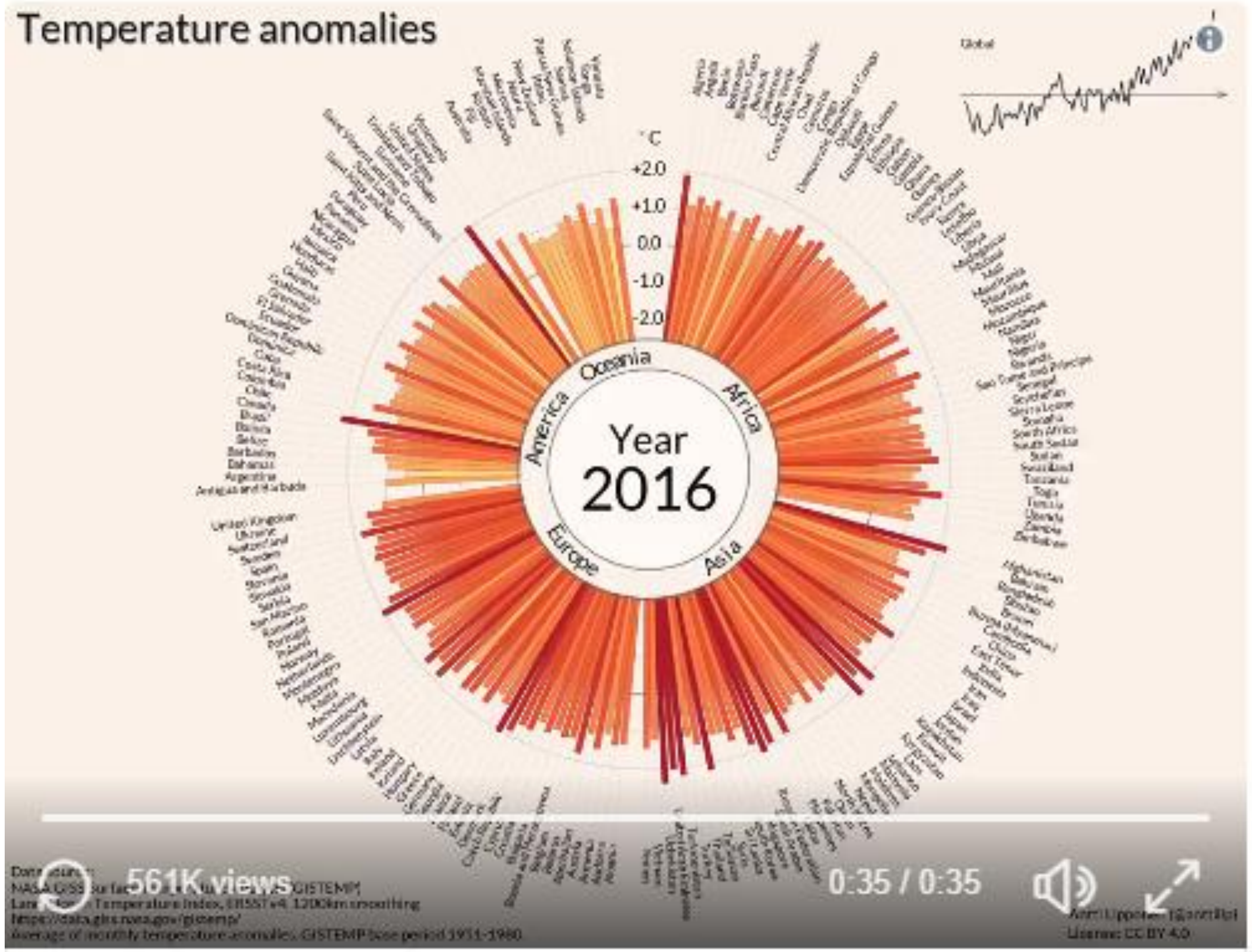
Temperature anomalies in the world 1900-2016



Antti Lipponen

https://www.flickr.com/photos/150411108@N06/35471910724/

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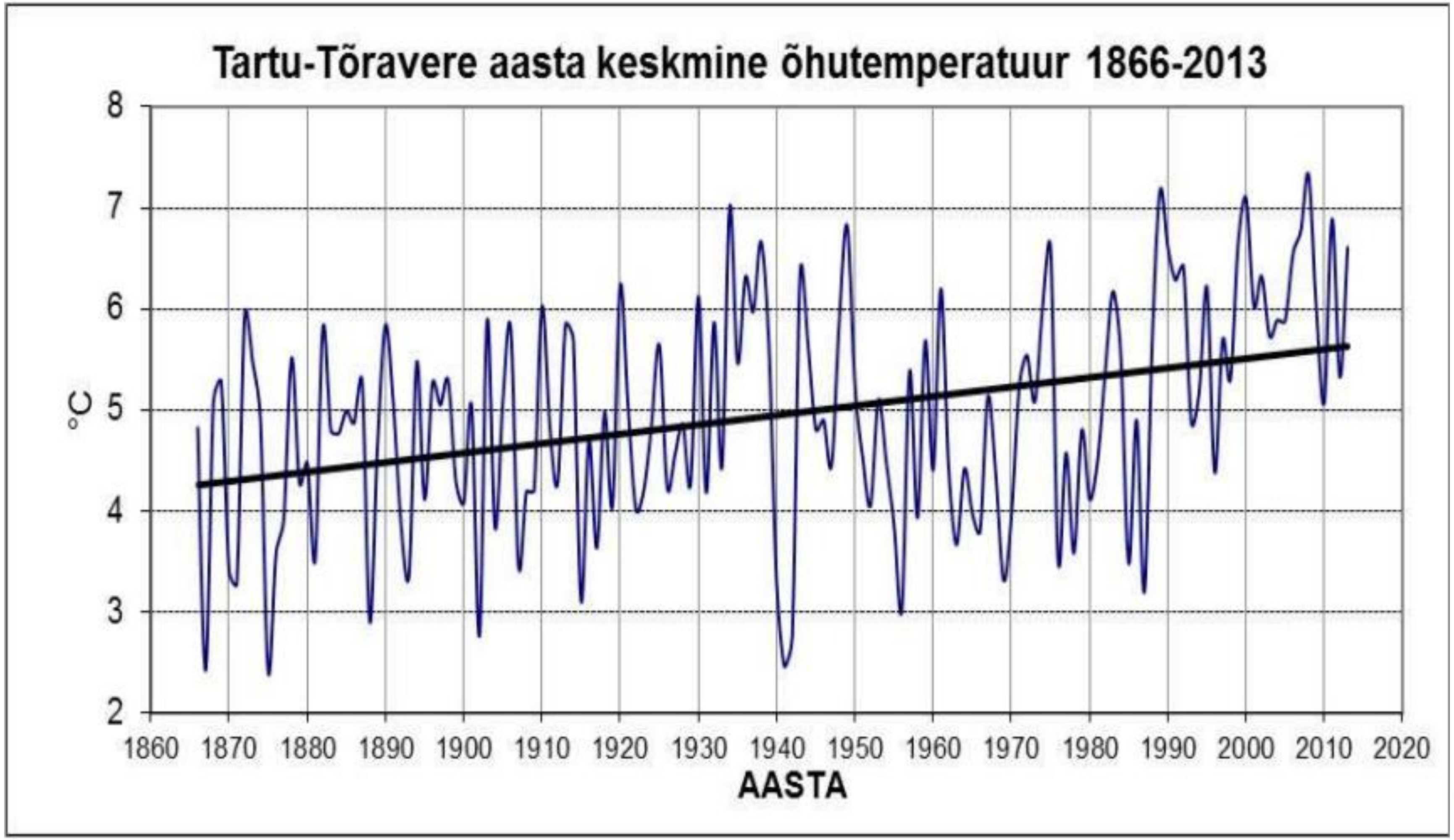
Changes in Estonia: warmer January

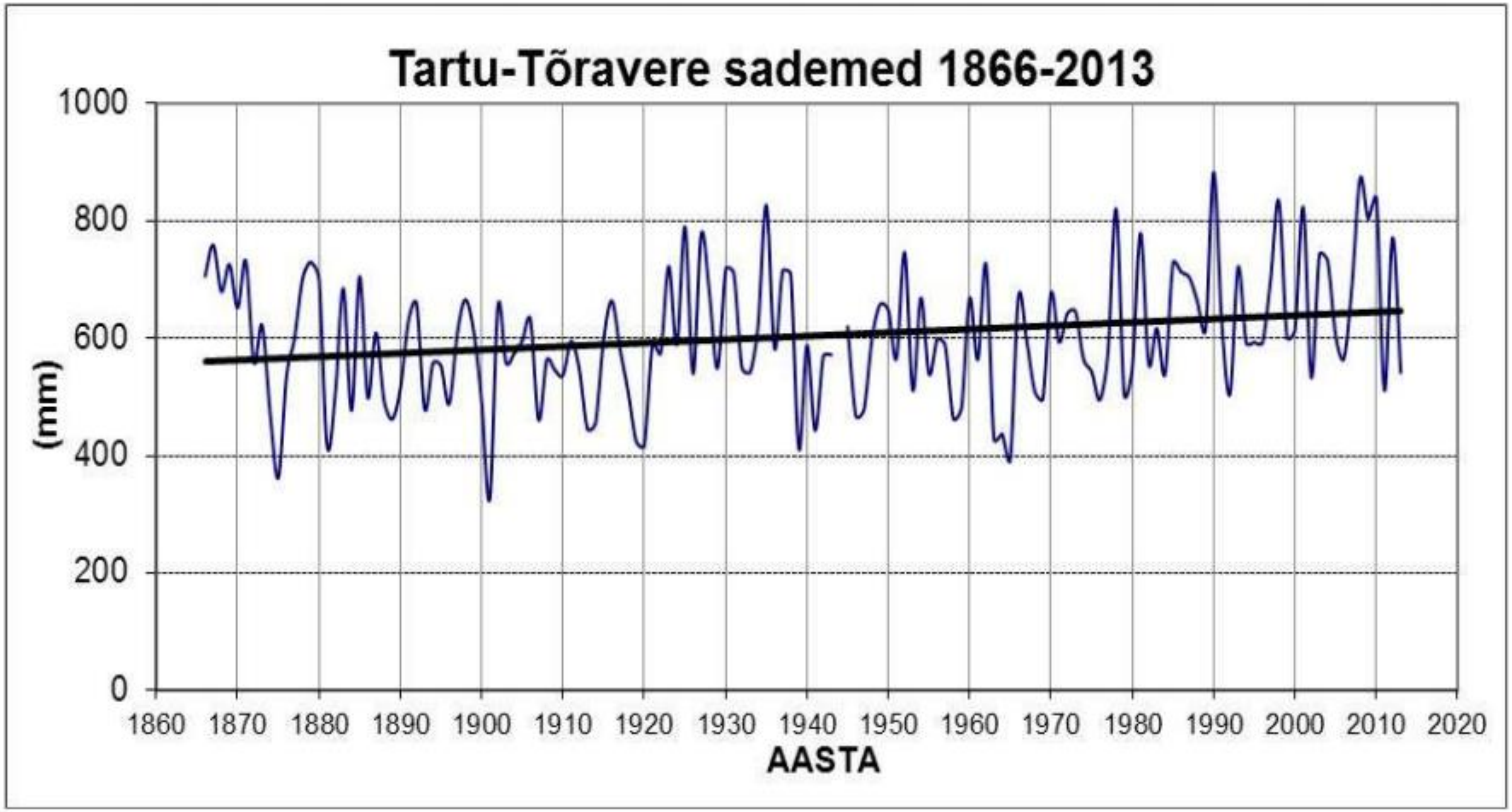


Absolute temperature change (°C) in Estonia compared to years 1971-2000

Periood / Stsenaarium	2041-2070		2071-2100	
	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Winter	2,3 °C	2,9 °C	3,1 °C	4,9 °C
Spring	2,4 °C	3,1 °C	3,4 °C	4,9 °C
Summer	1,6 °C	2,2 °C	2,2 °C	3,8 °C
Autumn	1,7 °C	2,2 °C	2,2 °C	3,6 °C
Annual average	2,0 °C	2,6 °C	2,7 °C	4,3 °C

Eesti tuleviku kliimastsenaariumid aastani 2100, Luhamaa jt 2015

Changes in Estonia: more precipitation Oct-March

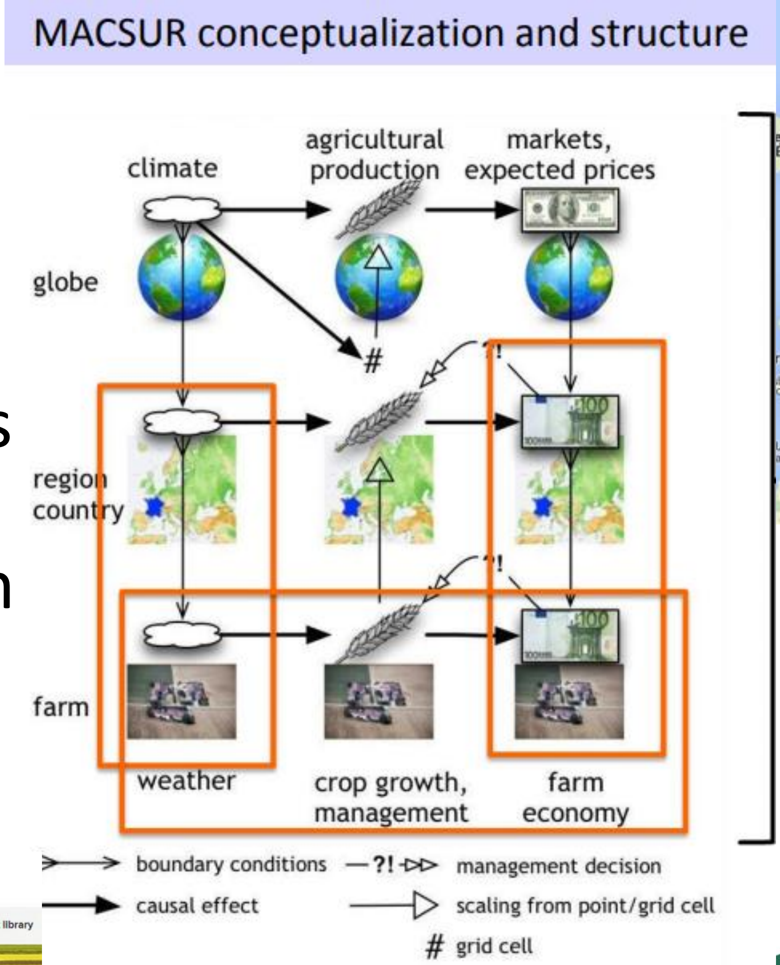


Average amount of precipitation compared to years 1971-2000

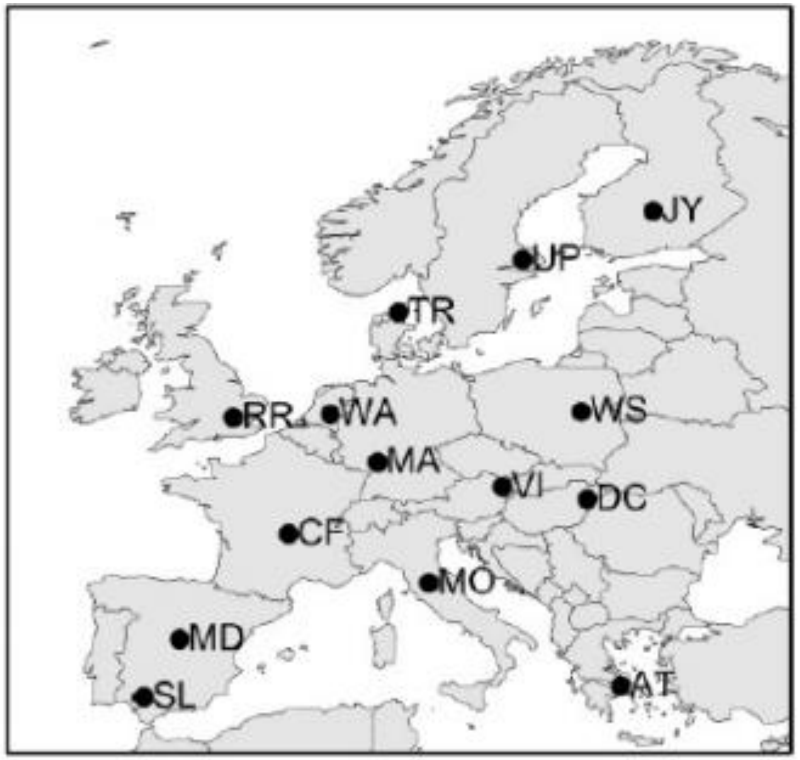
Periood / Stsenaarium	2041-2070		2071-2100	
	RCP4.5	RCP8.5	RCP4.5	RCP8.5
Winter	9%	15%	16%	22%
Spring	10%	16%	21%	24%
Summer	11%	18%	15%	19%
Autumn	10%	8%	11%	12%
Annual average	10%	14%	16%	19%

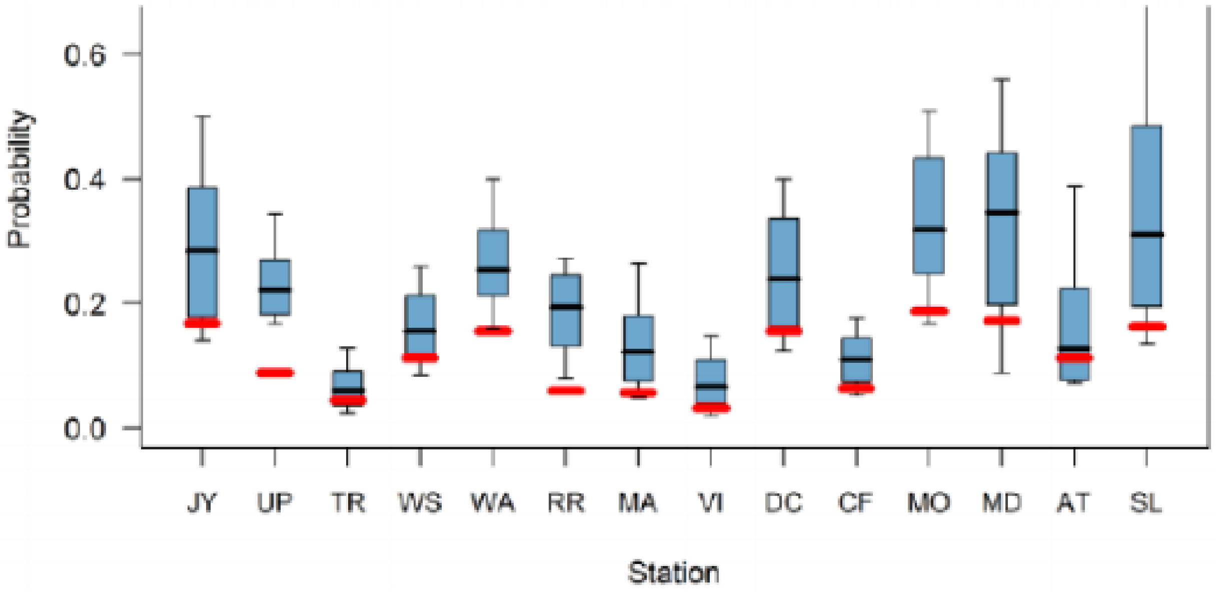
https://www.macsur.eu/

- Integration and improvement of models
- Case studies
- To find the risks and consequences related to adaptation and mitigation to the climate change in agriculture



Probabilities of occurrence of adverse events from sowing to maturity causing major threats for wheat production are projected to increase all over Europe under climate change

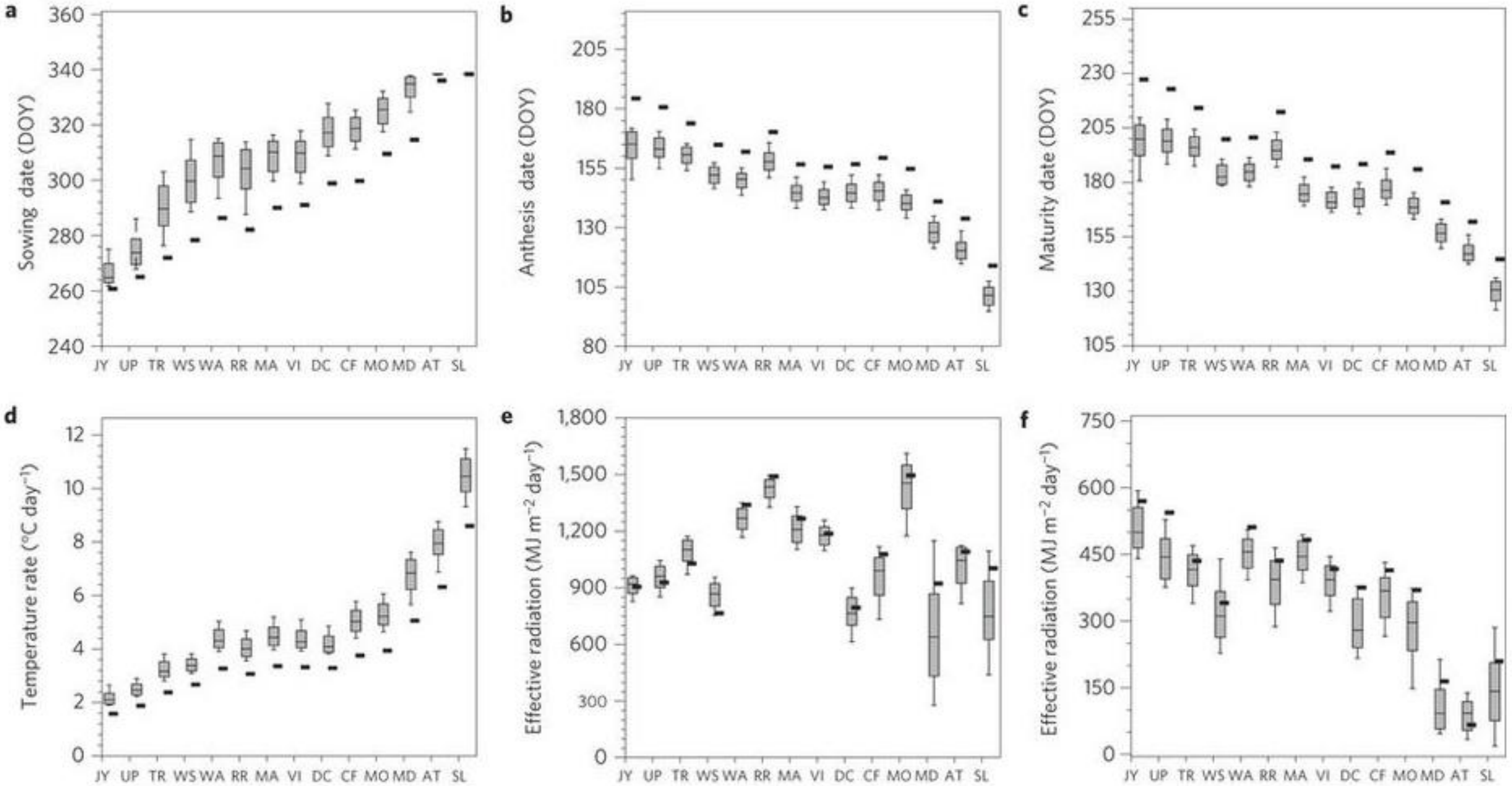




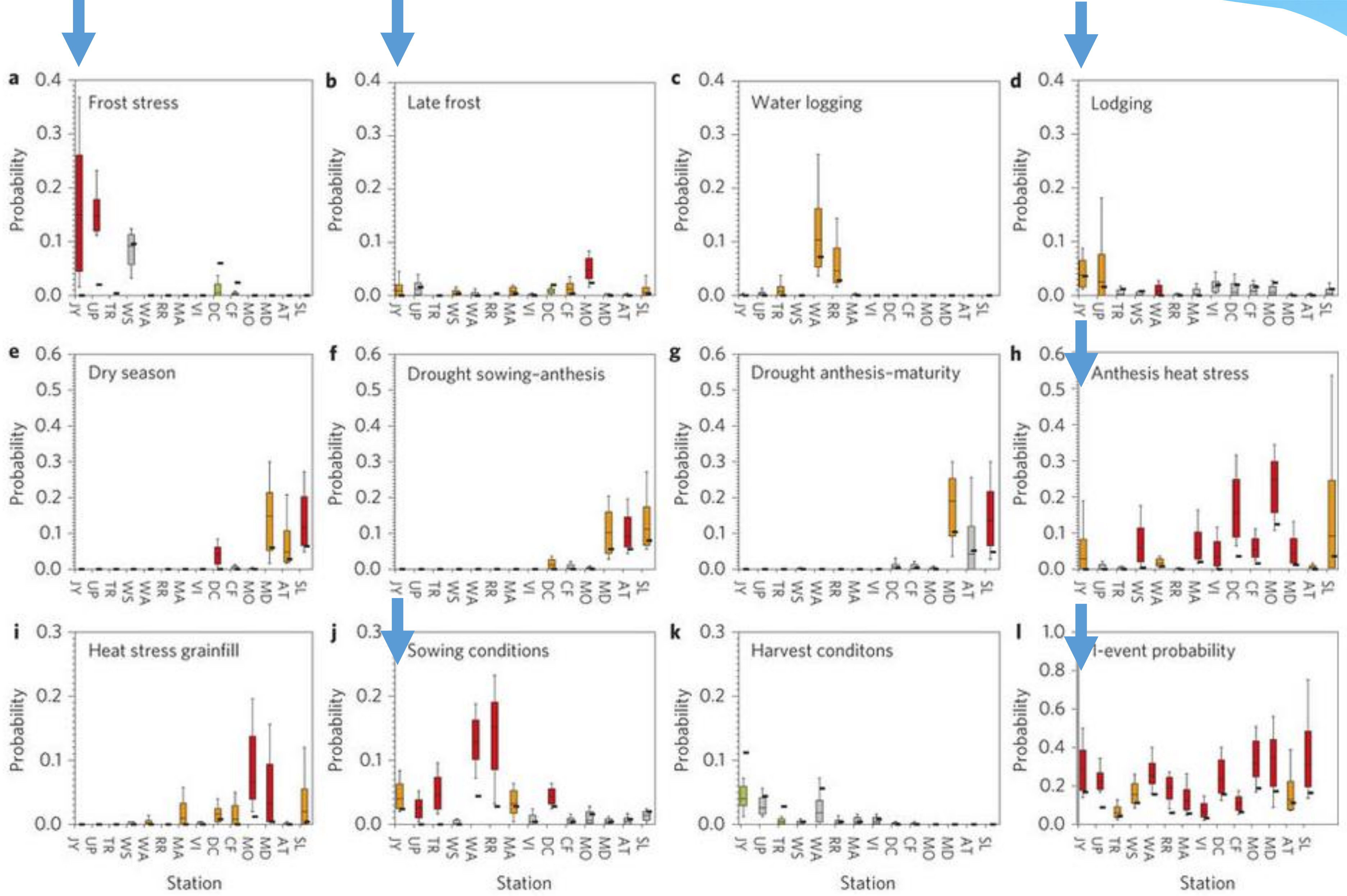
Trnka et al 2014

JY= Jyvasküla
UP= Uppsala

1981-2010 (-) versus 2060 (box)



Trnka et al 2014


a
Frost stress
b
Late frost
c
Water logging
d
Lodging
e
Dry season
f
Drought sowing-anthesis
g
Drought anthesis-maturity
h
Anthesis heat stress
i
Heat stress grainfill
j
Sowing conditions
k
Harvest conditons
l
i-event probability
Probability
Station
JY UP TR WS WA RR MA VI DC CF MO MD AT SL

Europ. J. Agronomy 34 (2011) 96–112

Contents lists available at ScienceDirect

European Journal of Agronomy

journal homepage: www.elsevier.com/locate/eja

Review

Impacts and adaptation of European crop production systems to climate change

J.E. Olesen[a,*], M. Trnka[b], K.C. Kersebaum[c], A.O. Skjelvåg[d], B. Seguin[e], P. Peltonen-Sainio[f], F. Rossi[g], J. Kozyra[h], F. Micale[i]

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[b] Mendel University of Agriculture and Forestry, Inst. of Agriculture Systems and Bioclimatology, Brno, Czech Republic
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[e] INRA, MICCES, Centre d'Avignon, Avignon, France
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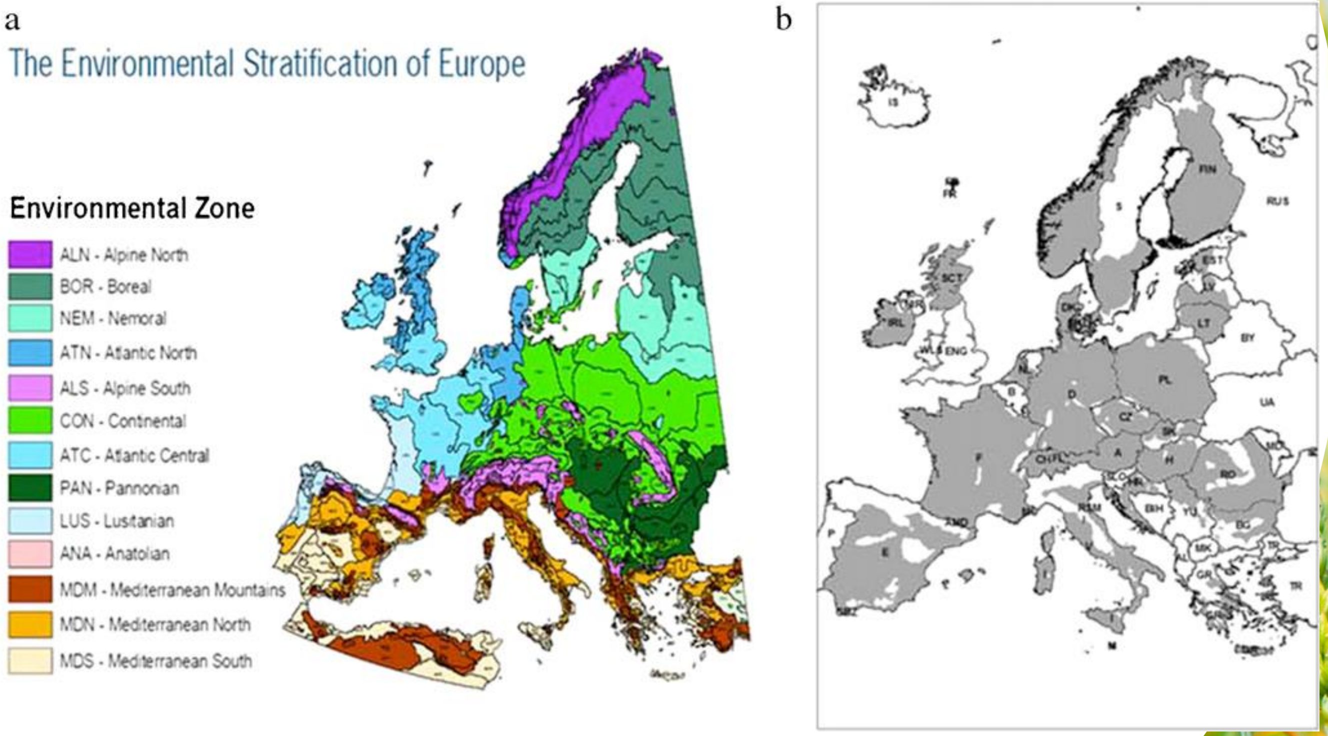
[h] Institute of Soil Science and Plant Cultivation, State Research Institute, Pulawy, Poland
[i] European Commission, JRC Ispra, Ispra, Italy

- Questionnaire in 2007



Climate related factors limiting crop production

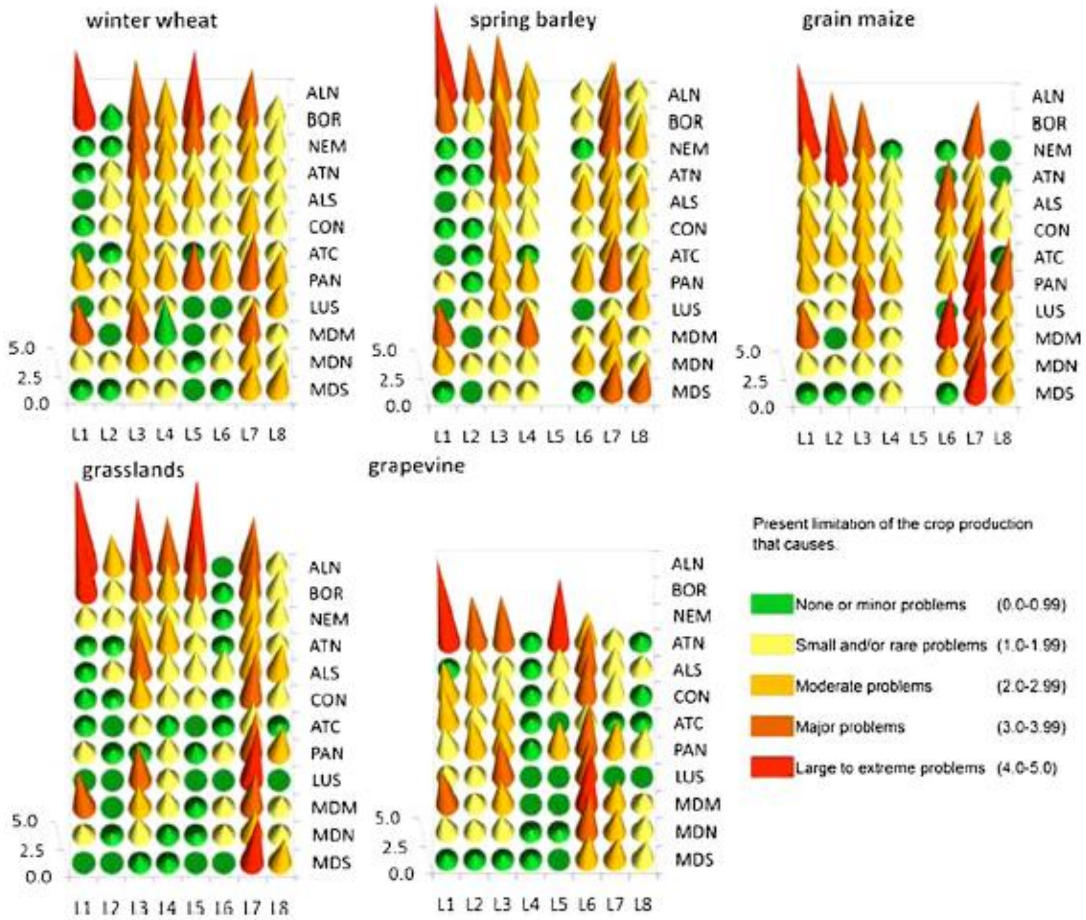
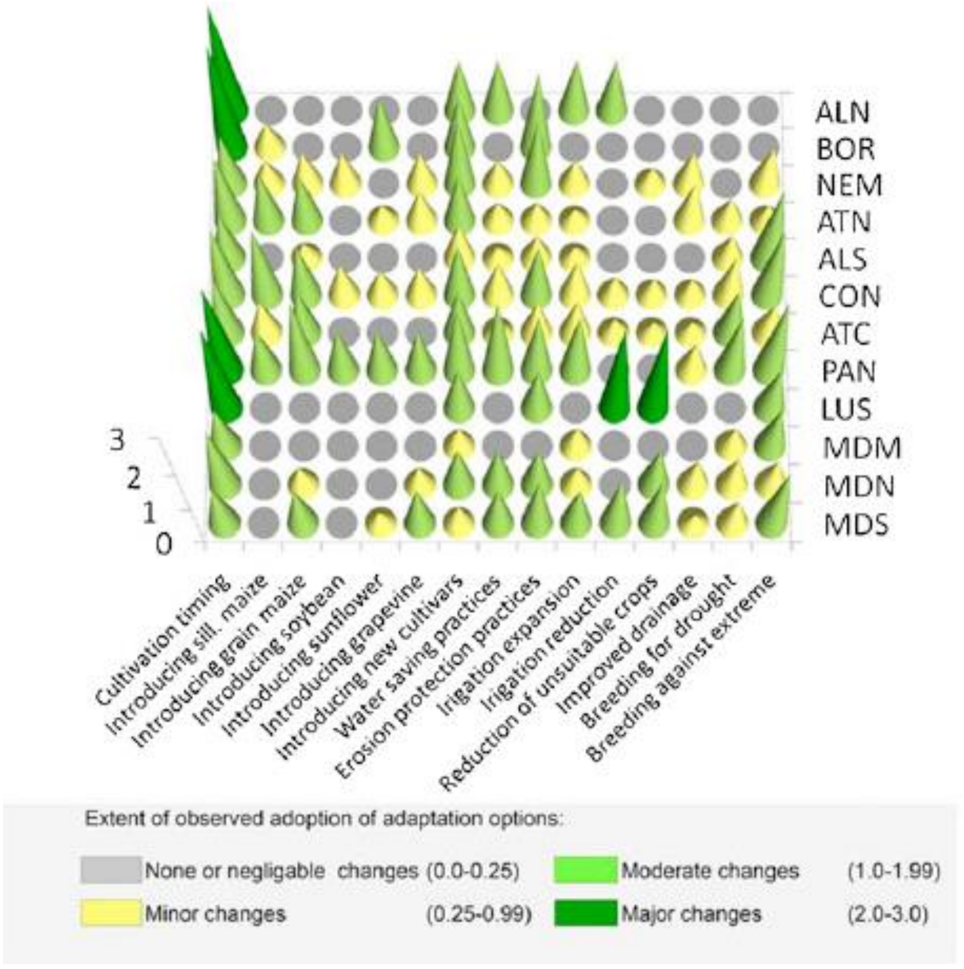


Fig. 4. Present limitation of crop production by climate factors for five selected crops over the individual European environmental zones. Legend: L1 length of the growing season; L2 occurrence of late/early frosts; L3 rain during sowing/harvesting; L4 occurrence of floods; L5 crop damage during winter; L6 crop damage by hail; L7 occurrence of drought; L8 heat stress.

L1 – length of growing season
L2 – occurence of late/early frost
L3 – rain during sowing/harvesting
L4 – floods
L5 – winter damage
L6 – hail damage
L7 – drought
L8 – heat stress

Adaptation strategy for year 2050



Cultivation time

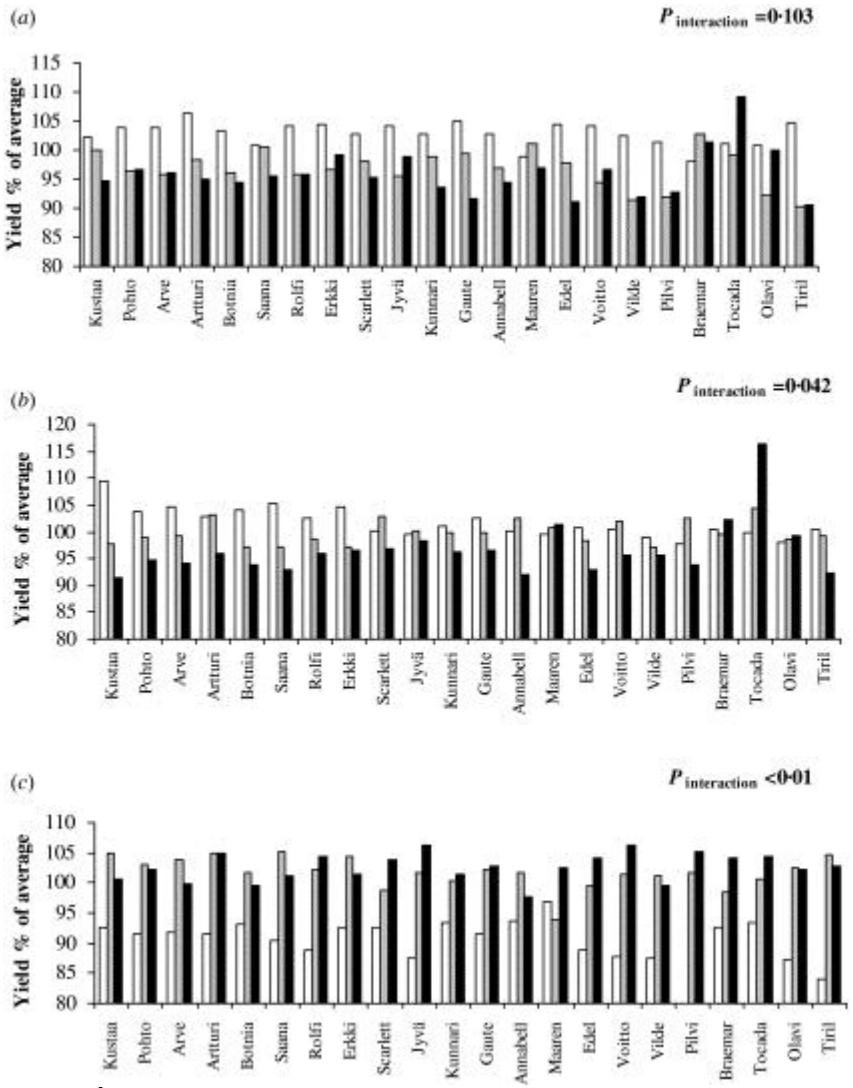
New crops and varieties

Adaptation strategy in Estonia: 1991-2000 versus 2012- 2017

- Wheat, rape seed, potato
  - More varieties
  - More winter crops
  - More pathogens and diseases (and pesticides)
  - Changed sowing and harvesting times
  - Changed cultivation times
- Novel crops
  - Soybean, hemp, buckwheat, winter barley, triticale

Olesen et al *in writing process*

Barley yield depending on rain and sowing date



Rain for 1 month before sowing (mm/month),

- Low: 1·1–23·1 mm
- Moderate: 23·2–40·7 mm
- High (extreme): 40·8–112·9 mm

Delay of sowing (sowing date)

- Low: 25 April–12 May
- Moderate: 13–19 May
- High (extreme): 20 May–6 June

Rain during 3–7 weeks after sowing (rain sum mm/period)

- Low: 2·3–39·4 mm
- Moderate: 39·5–63·3 mm
- High (extreme): 63·4–176·7 mm

Hakala et al 2012

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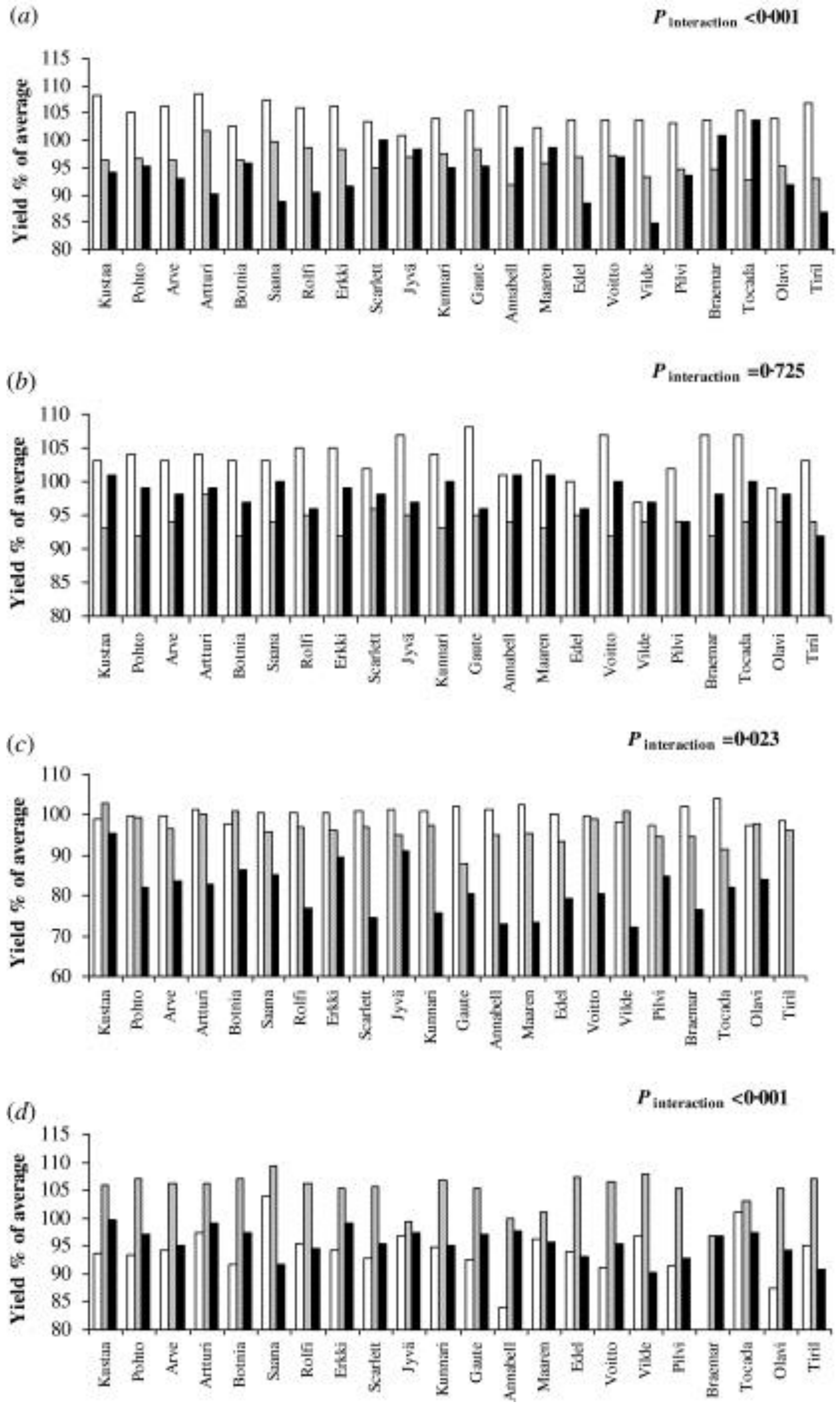


Temperatures during 3rd and 4th weeks after sowing (average temp)

- Low: 6·3–11·6 °C
- Moderate: 11·6–13·7 °C
- High (extreme): 13·8–19·1°C

Temperature sum accumulation rates during the period of 2 weeks before heading (temperature sum)

- Low: 63–135 °C d
- Moderate: 136–159 °C d
- High (extreme): 160–237 °C d

Very high temperatures (maximum day temperatures 28°C or higher) during the period of 7 days before and 14 days after heading (duration)

- Low: 0–2 d
- Moderate: 3–5 d
- High (extreme): more than 6 d

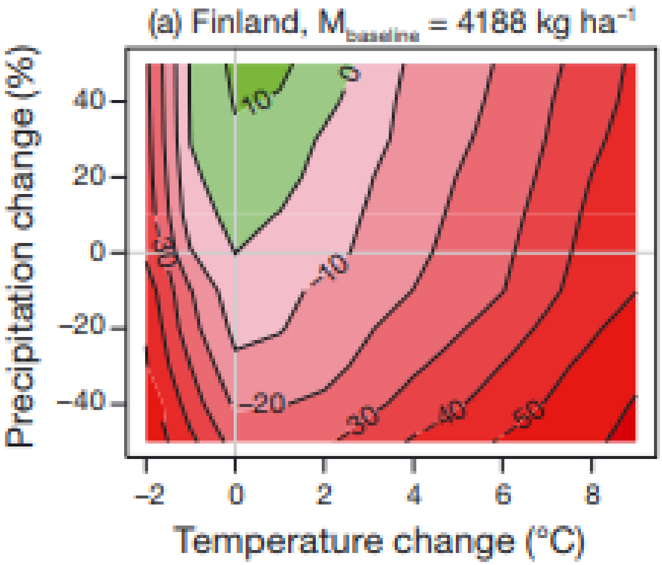
Temperature sum accumulation rate during the period of grain filling (heading to yellow ripeness) (°C d/day during the period)

- Low: 5·2–10·2
- Moderate: 10·3–11·5 d
- High (extreme): 11·6–16·6°C d/day

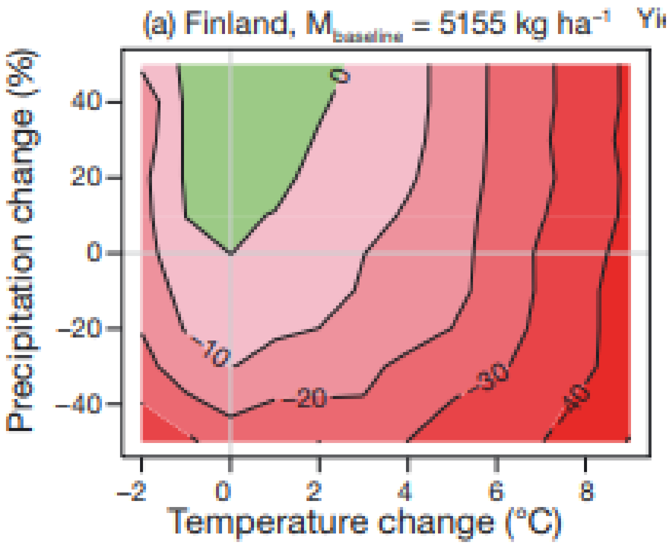
Wheat yield change prognosis in Finland 26 models combined

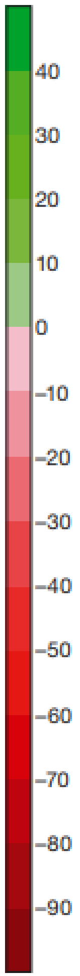
Change in yield (%)

Spring wheat



Winter wheat

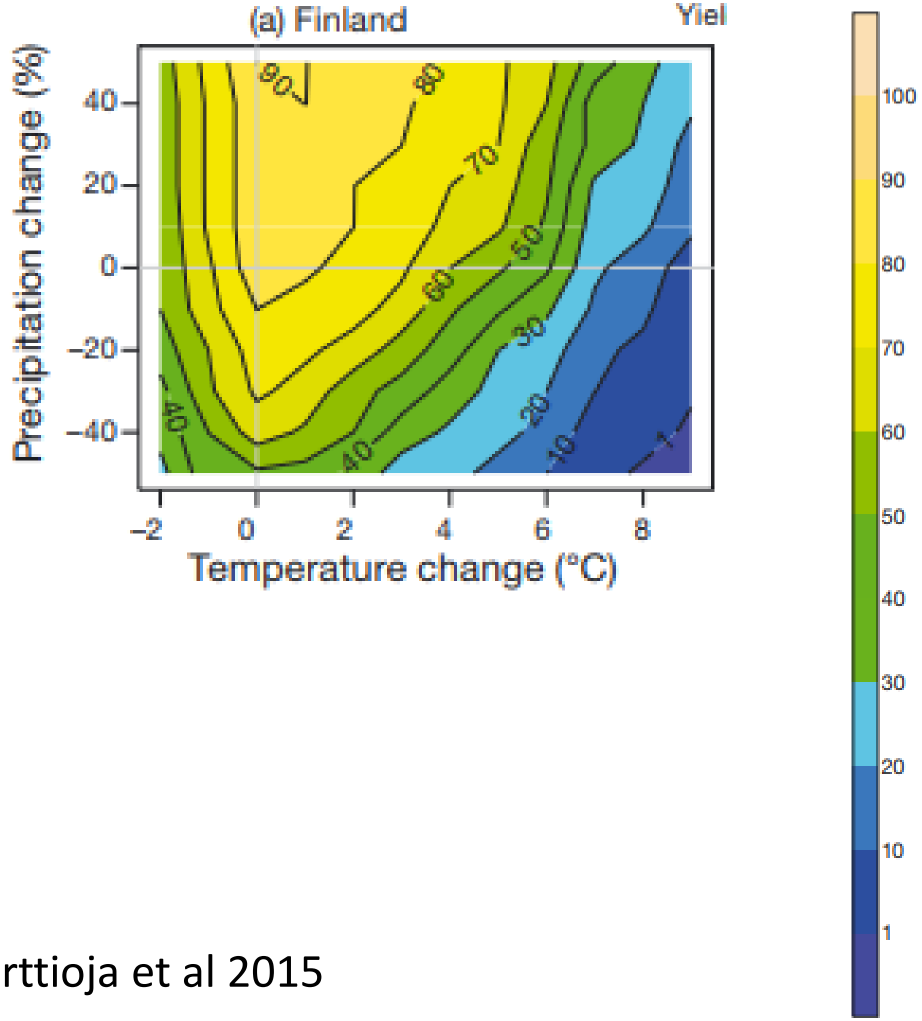




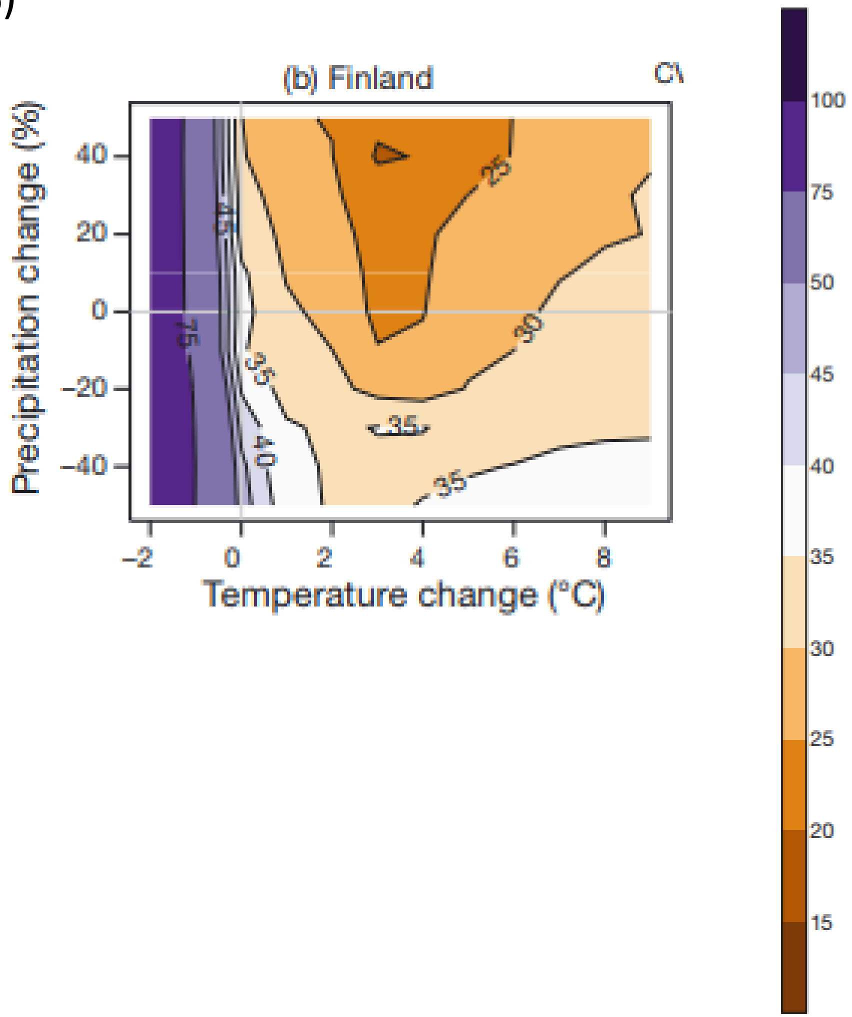
Pirttioja et al 2015

Spring wheat yield stability and variance

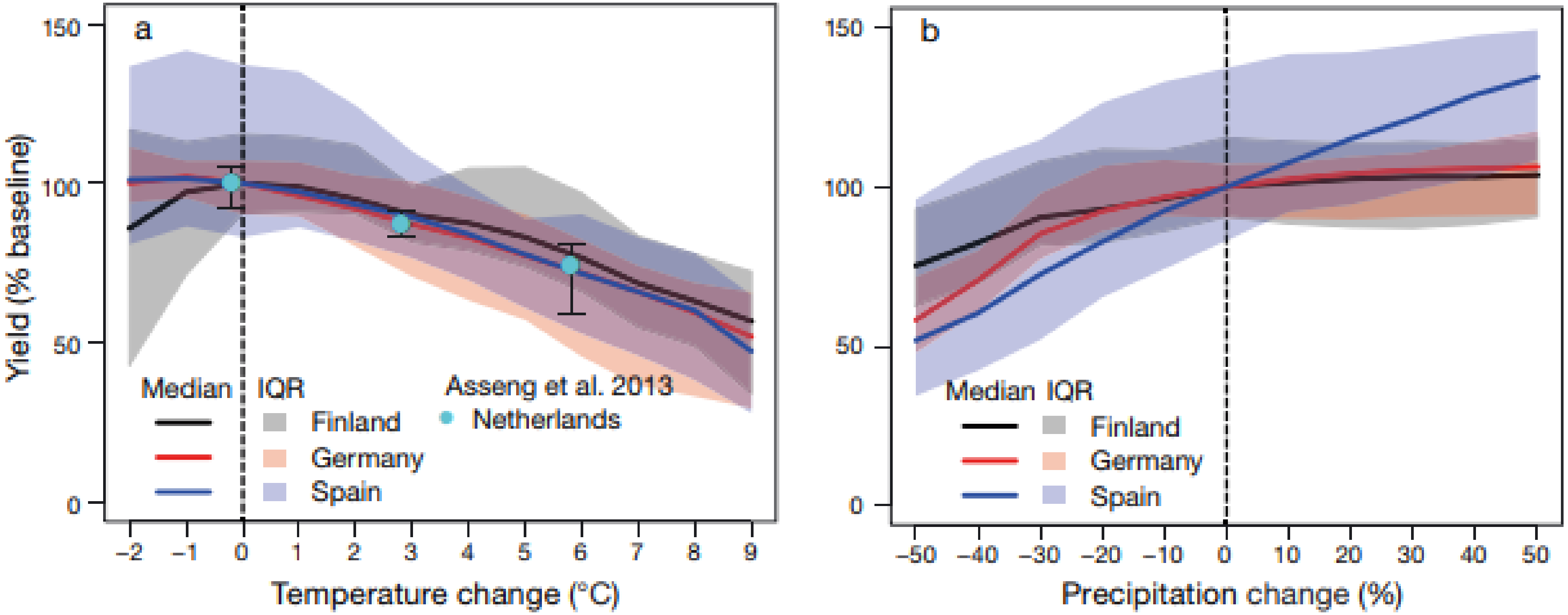
Yield stability (%)



Yield variance (%)



Pirttioja et al 2015



Pirttioja et al 2015

Wheat yield potential

- Wheat yield potential may rise by 59-109% by year 2050 thanks to genetics and breeding:
- Improvement in light conversion efficiency, extended duration of grain filling resulting in a higher harvest index, and optimal phenology.

Original Research

Designing high-yielding wheat ideotypes for a changing climate

Mikhail A. Semenov, Pierre Stratonovitch

First published: 18 September 2013 Full publication history

DOI: 10.1002/fes3.34 View/save citation

Case studies: Northern Savo, Finland

- Observed climate change
  - longer growing period, higher mean temperatures, more total rain
  - greater variability, summer droughts, less snow cover, feed quality losses, wet conditions more frequent ⇒ soil compaction by machines
- adaptation in cultivars, fertilization, pest mngmt., farm machinery, drought risk mngmt, silage storage, crop rotations, sowing dates
- Increasing grass growth benefits dairy and beef
  - limited by EU N directive, greening rules; national land buying regulations
- Increase in yield potential of cereals and oilseeds is uncertain: more frequent summer droughts, daylight
- Positive market development and more flexible and encouraging policies (N, land) needed for adaptation

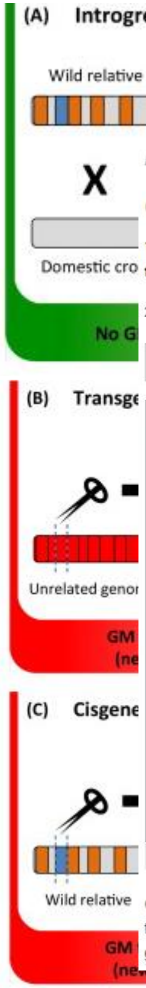
Opportunity in breeding?

Trends in Plant Science
Volume 20, Issue 7, July 2015, Pages 426–434

Review

Feasibility of new breeding techniques for organic farming

Martin Marchman Andersen[1], Xavier Landes[1], Wen Xiang[2], Artem Anyshchenko[2], Janus Falhof[3], Jeppe Thulin Østerberg[3], Lene Irene Olsen[3], Anna Kristina Edenbrandt[4], Suzanne Elizabeth Vedel[4],



NATURE | EDITORIAL

Gene editing in legal limbo in Europe

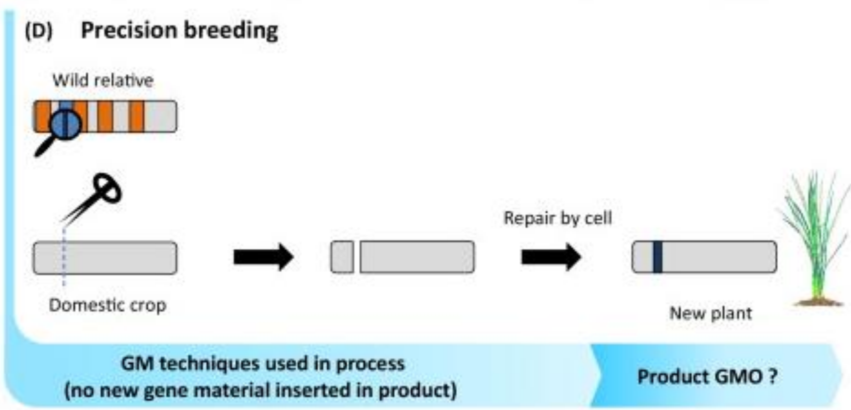
The European Union is dragging its feet on gene-editing rules and scientists should push the issue.

22 February 2017

PDF | Rights & Permissions

Germany and other countries in Europe are wrestling with how to regulate gene-edited plants.

Germany is having trouble deciding whether plants that are gene-edited should be regulated as if they were genetically modified (GM). Confused? You're not alone: the issue has split the German government and has left scientists across Europe in limbo.



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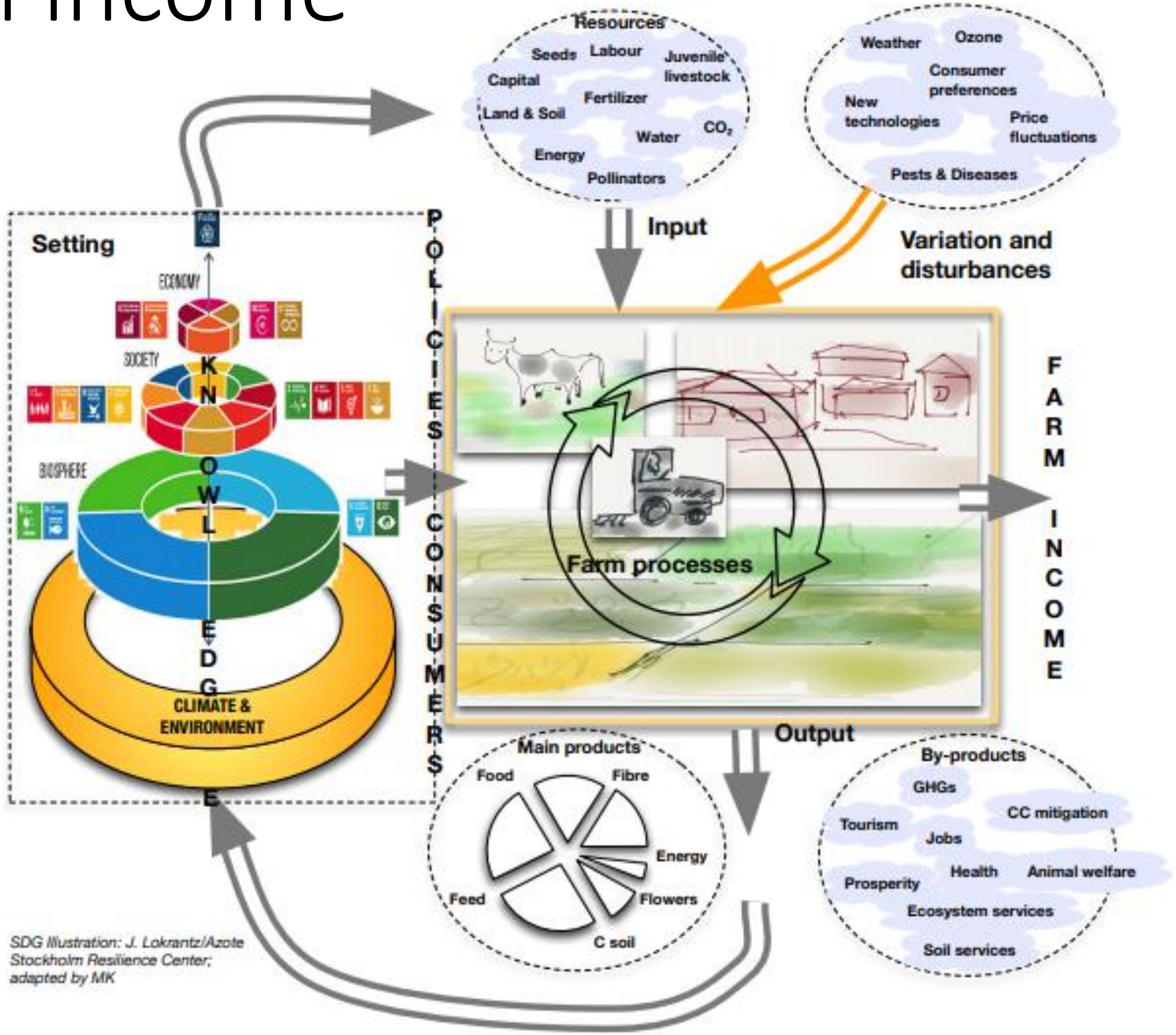
NEWS · 19 JANUARY 2018

European court suggests relaxed gene-editing rules

Judicial opinion says restrictive regulations may not apply to plants and animals bred using CRISPR technique.

Cell PRESS
Trends in Plant Science 2015 20, 426-434DOI: (10.1016/j.tplants.2015.04.011)

Whole system is complex: inputs, outputs, settings and farm income



Köchy et al 2017

Summary

- The climate change will impact the life of a farmer: more opportunities (if temperature raise is less than 2 degrees and there will be more rain) and more risks. Need for a smart farmer.
  - Novel crops and varietes
  - Crop rotations and caring for soil is important
- The opportunites for rural life may lie in the development of bioeconomy and improving the valorization of local produce.

Eesti Teadusagentuur Estonian Research Council
Maaeluministeerium
Keskkonnaministeerium
Majandus- ja Kommunikatsiooniministeerium

Uus projekt: Lisandväärtuse tõstmine ja toorme tõhusam kasutamine Eesti biomajanduses ja selle sektorites

1. märts 2018 – 28. veebruar 2021

TTÜ
Tartu Ülikool
Eesti Maaülikool Estonian University of Life Sciences

Thank you!

Chair of Crop Science and Plant Biology

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