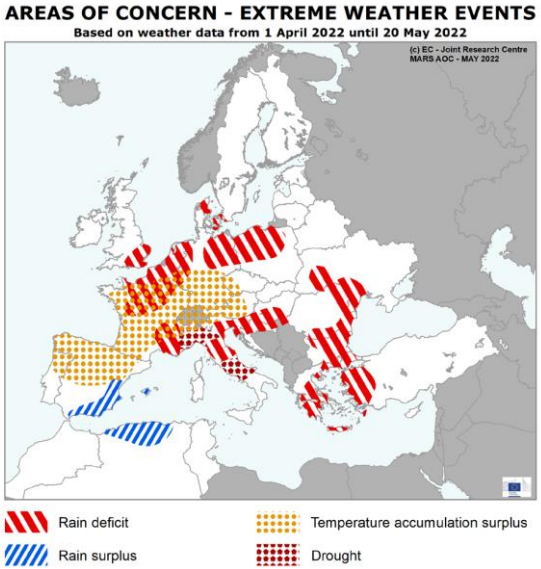
EUROPEAN CENTRAL BANK

EUROSYSTEM



Drought impacts on agriculture

16/06/2022

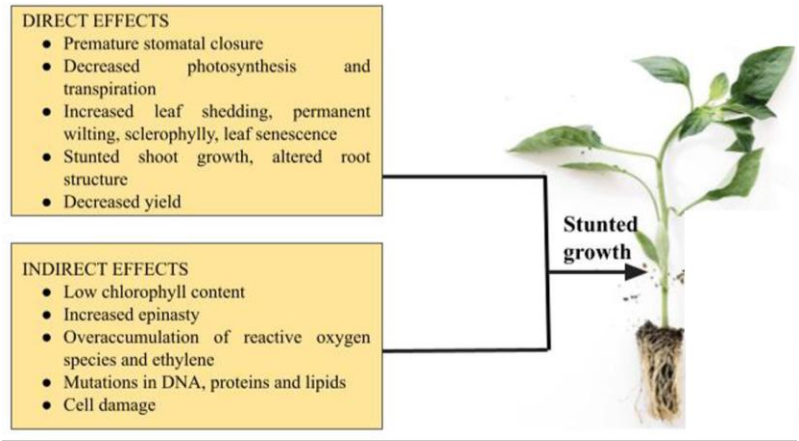
Andrej Ceglar

Presentation outline

- Impacts of drought on agriculture
- Climate change impact on agriculture
- Increasing climate resilience – the role of climate services
- Conclusions

Impacts of drought on agriculture

- Direct and indirect impacts on agriculture



Adapted from Ahluwalia et al., 2021

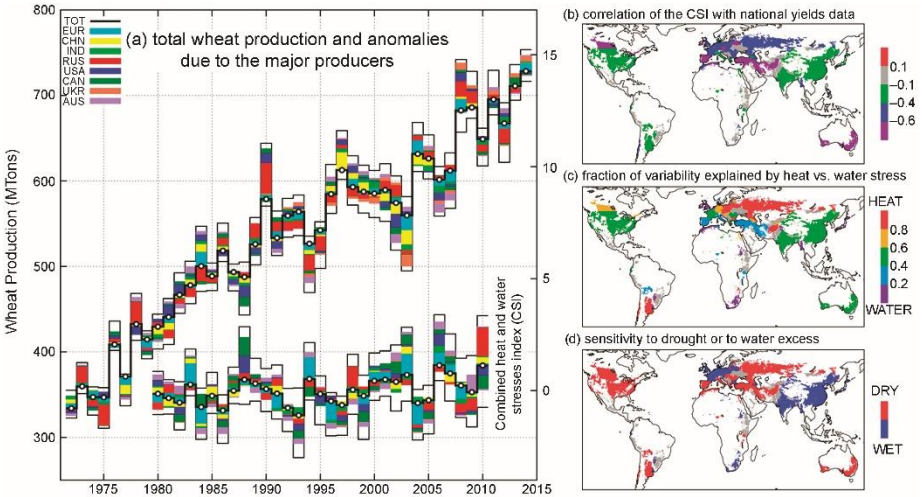
Decrease in water availability and quality, high temperatures

Decrease in yield quantity and quality
Impact on livestock
Decrease in area under cultivation
Incidence of pests and diseases
Increase in wildfire
Alter rates of carbon and nutrient cycles

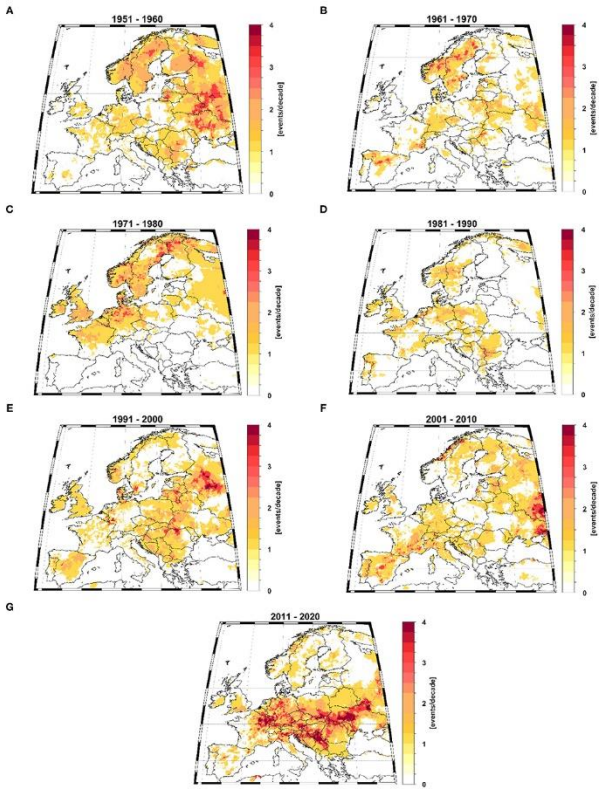
Farmers welfare
Commodity prices
Supply access
Food shortage
Land conversion

Impacts of drought on agriculture

- Droughts often co-occur with other extremes like heat waves, high vapour pressure deficit -> intensification of drought impacts



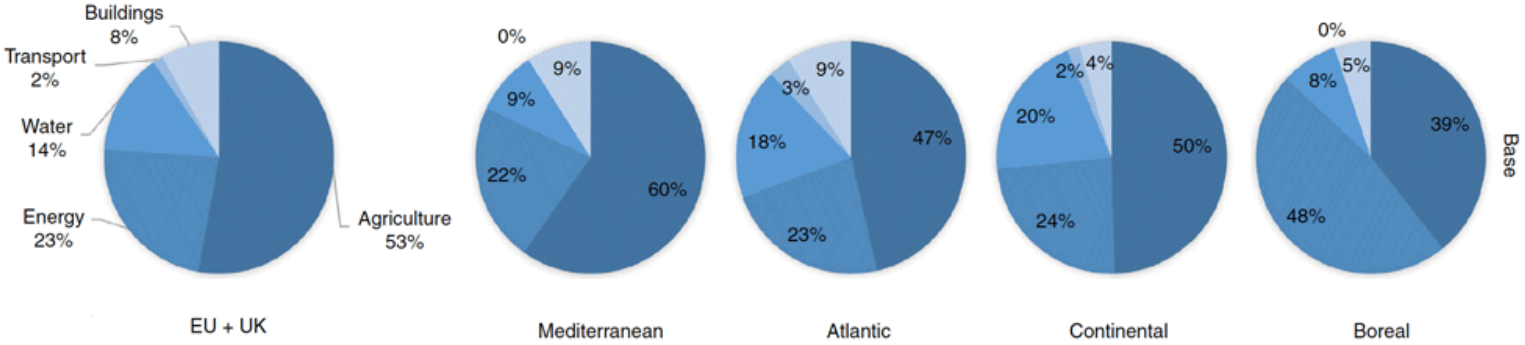
Global wheat production anomalies and Combined Stress Index (Zampieri et al., 2017)



Decadal frequency of compound hot and dry events (Ionita et al., 2021)

Impacts of drought on agriculture

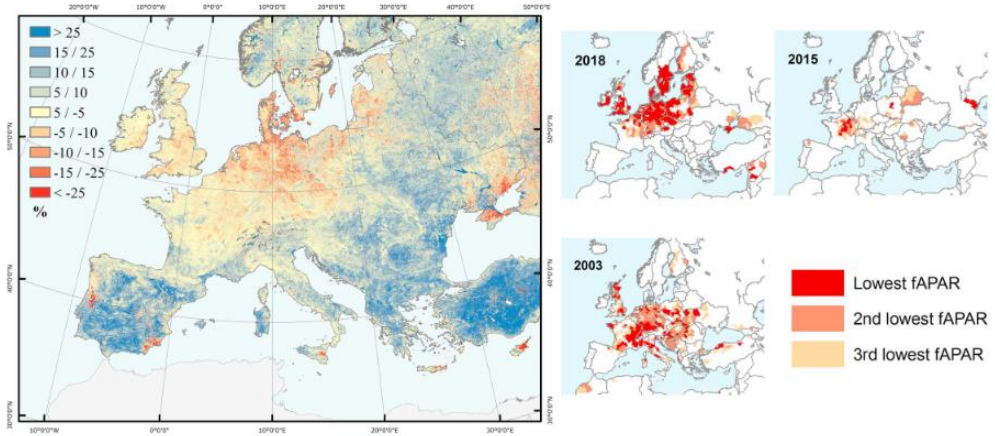
- Agriculture is the most significantly impacted sector
  - Globally, agriculture sustains 82 % of all drought impacts
  - Europe and UK experienced losses of around 9 bn €/year over the reference period (1981-2010)



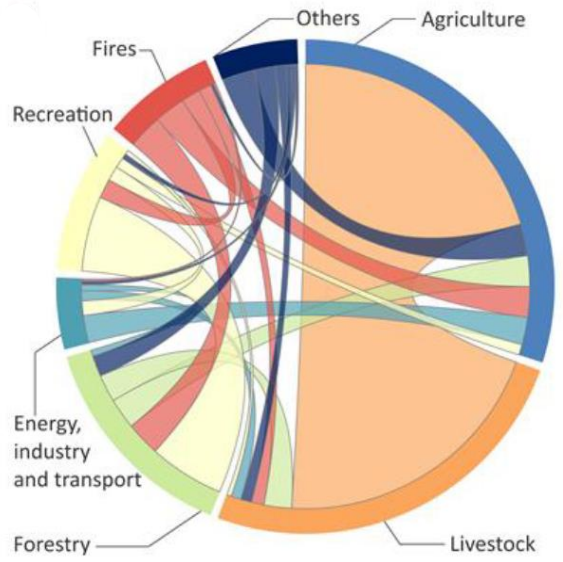
Sector shares in total drought damages in today's economy (Naumann et al., 2021)

Impacts of drought on agriculture

- Drought in central-northern Europe in 2018: unique concurrent spring and summer climatic anomalies



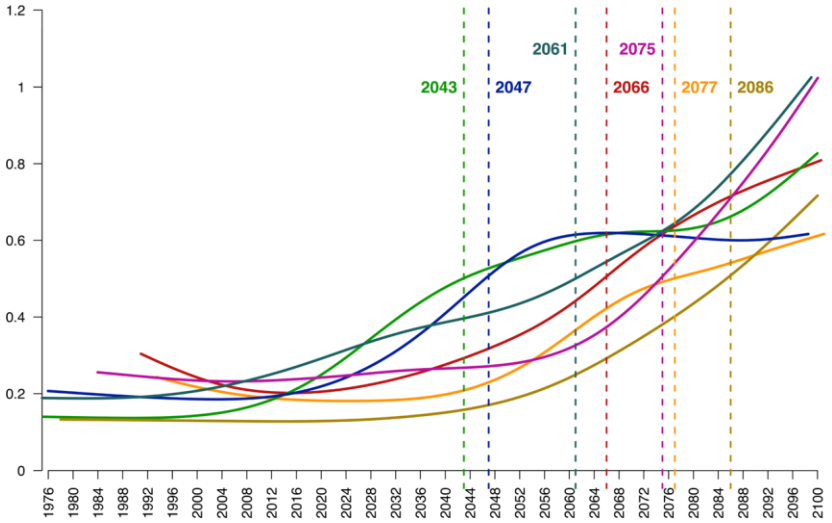
Anomalies of fhe fAPAR from March to August 2018 (Toreti et al., 2019)



Drought impacts in Germany 2018 based on media reports
(De Brito and Kuhlicke, 2021)

Climate change impact on agriculture

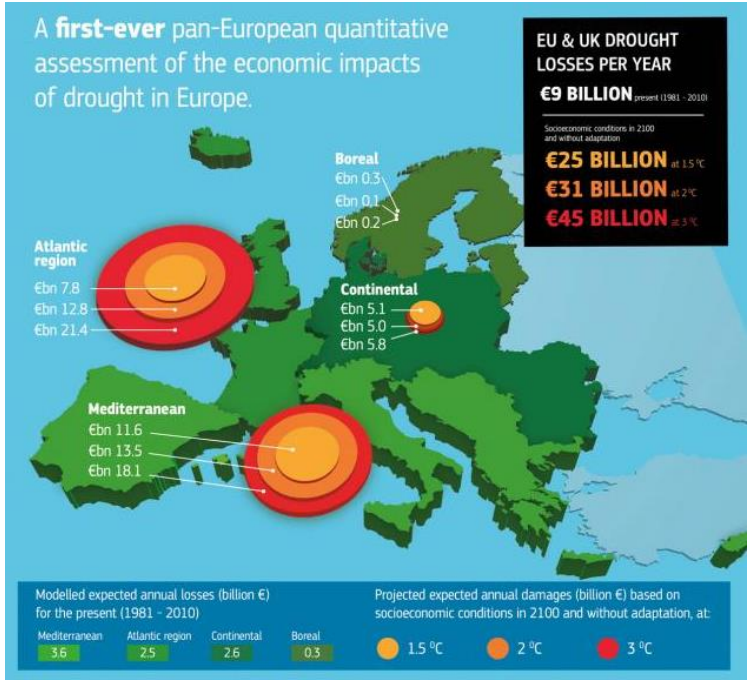
- 2018-like droughts could become a common occurrence as early as 2043
- Projections show a decrease in the frequency of occurrence and spatial extension of anomalous wet conditions over southern Europe
- Climate change adaptation strategies for agriculture in Europe cannot count on recurrent water seesaws



Estimated frequency of occurrence of the 2018-like drought events in central Europe (Toreti et al., 2019)

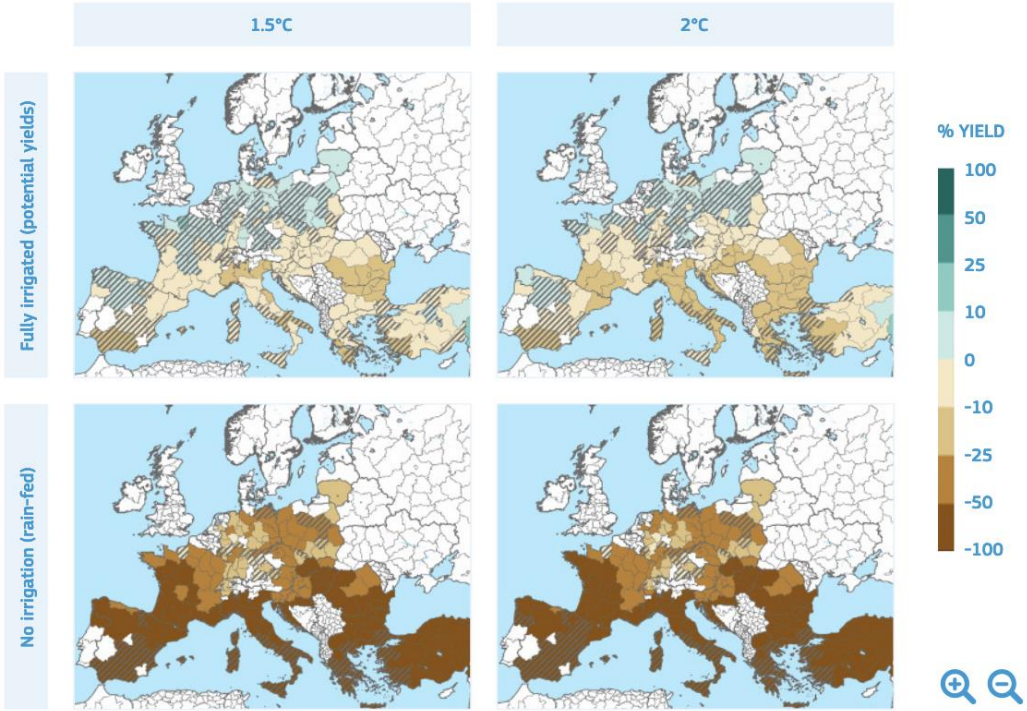
Climate change impact on agriculture

- PESETA IV: better understand the implications of climate change for the EU (Feyen et al., 2021)



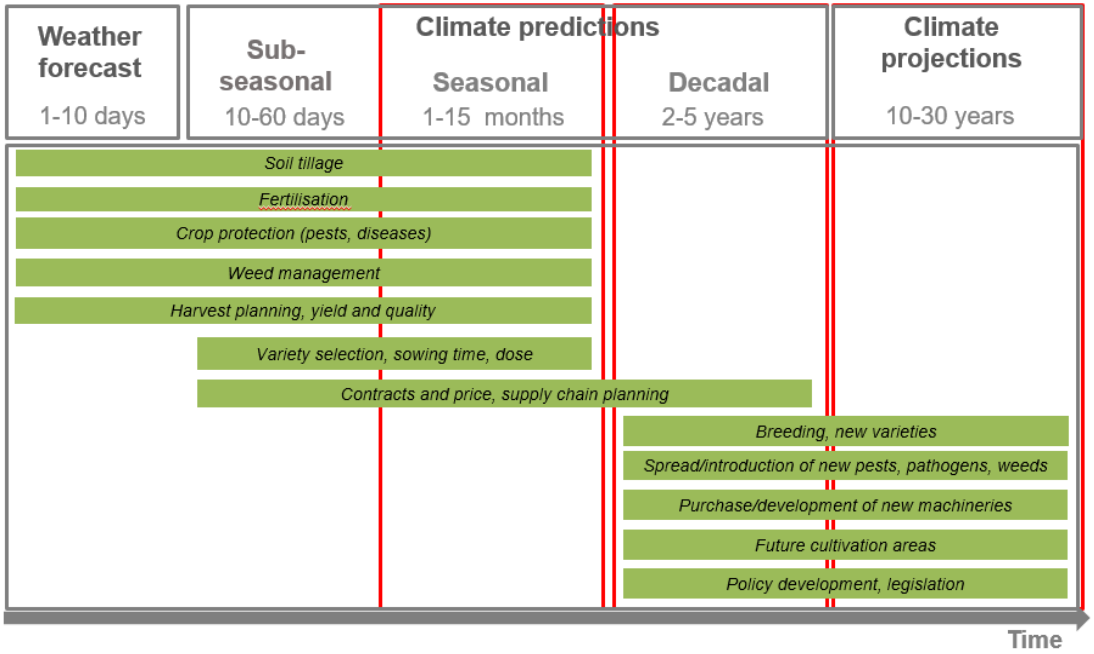
Climate change impact on agriculture

- Without adaptation, climate change will substantially lower grain maize and wheat yields in southern Europe, and to a lesser extent grain maize in northern Europe
- Climate change could further restrict the water available for irrigation
- Complex interaction between CO2 fertilization effect and extreme climate events



Increasing climate resilience: the role of climate services

- MEDGOLD project – turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems

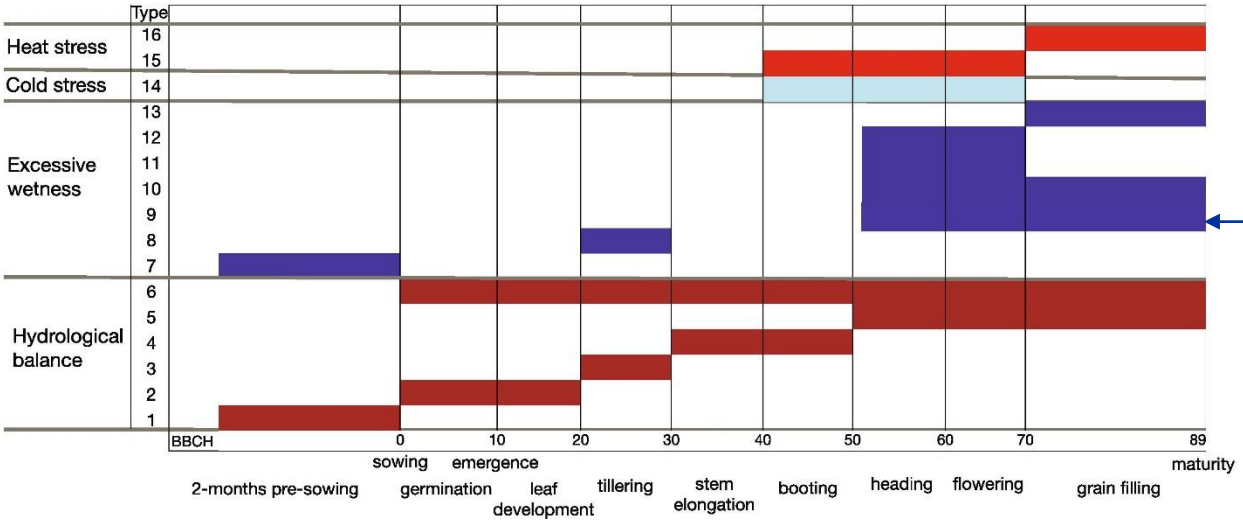


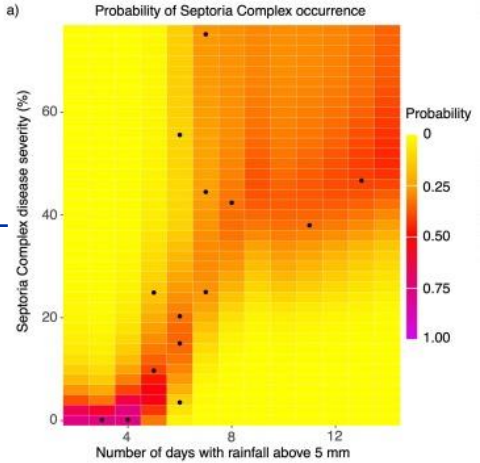
Risk assessment and actions that can be taken based on climate data on different time scales (MEDGOLD)

#Co-production
#inclusive
#collaborative
#flexible
#decision-driven
#process-based

Increasing climate resilience: the role of climate services

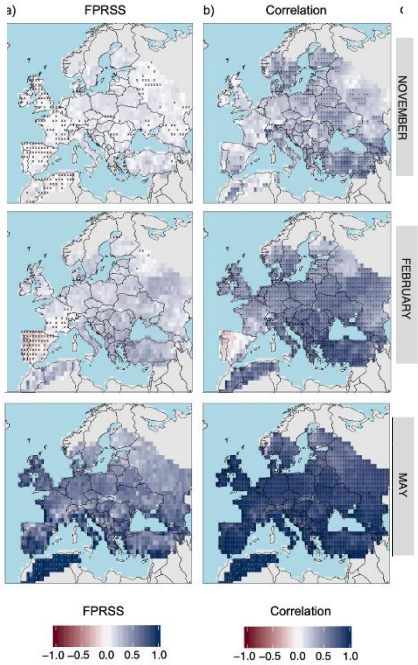
- Dynamical approach to target phenological phases of crop growth most sensitive to drought, heat stress, wet conditions and cold stress





Different types of agroclimatic indicators to characterize wheat growing season (Ceglar et al., 2020)

Increasing climate resilience: the role of climate services



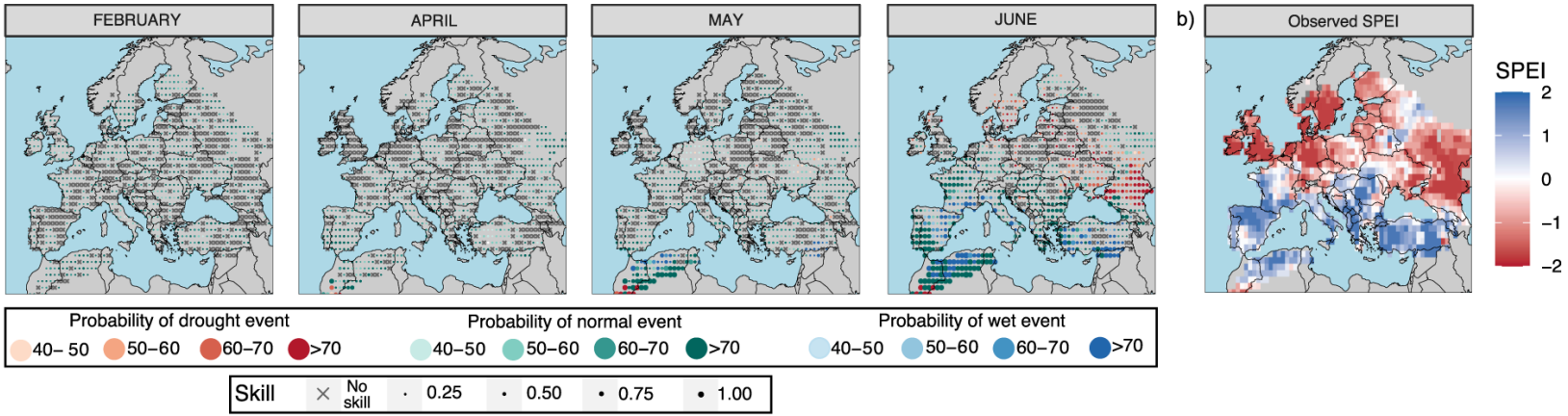
Prediction of flowering period for winter wheat in Europe
(Ceglar and Toreti, 2021)

- Seasonal forecasts
  - flowering time can be reliably predicted already at the beginning of the growing season in central and eastern Europe
  - regionally skillful and reliable predictions of drought events during the sensitive periods of wheat flowering and grain filling can be made already at the end of winter

Share of arable land where seasonal prediction of different drought indicators (*y*-axis) is skillful

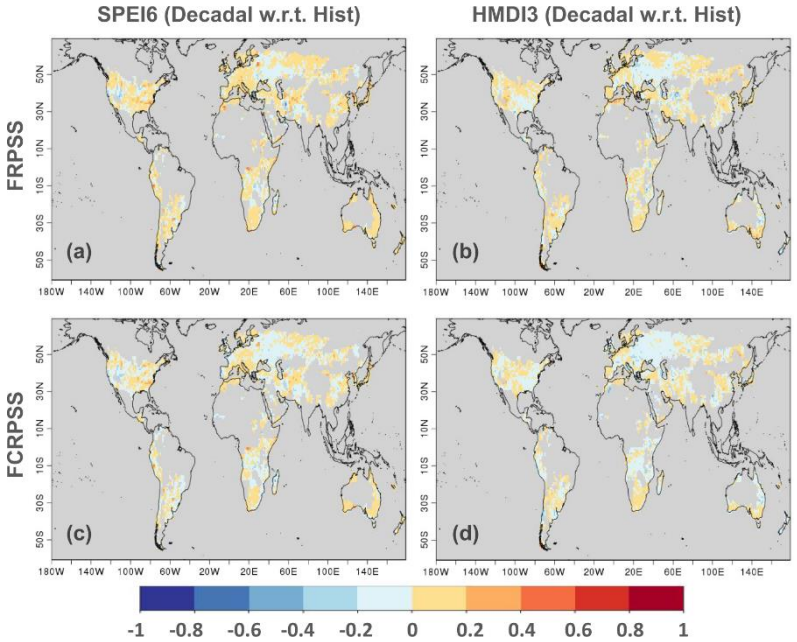
Increasing climate resilience: the role of climate services

- Prediction of drought between wheat heading and maturity in 2018

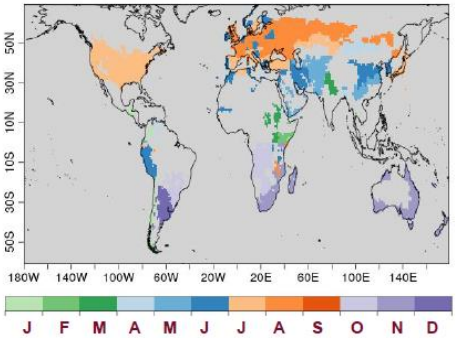


Increasing climate resilience: the role of climate services

- Decadal climate predictions are skilfull in several global wheat growing seasons



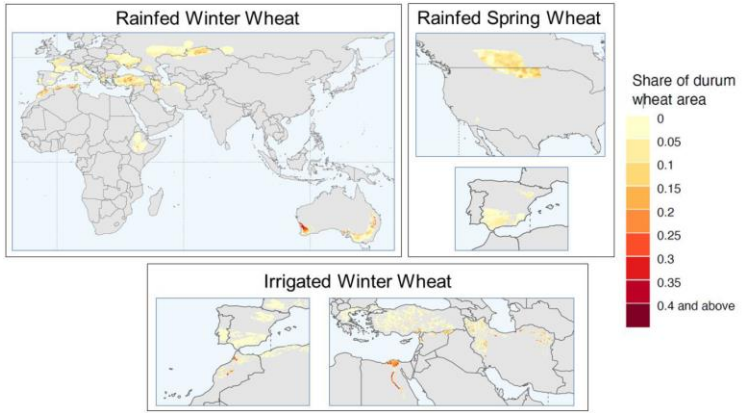
Skill of decadal predictions of SPEI6 and HMDI3 (Solaraju-Murali et al., 2021)

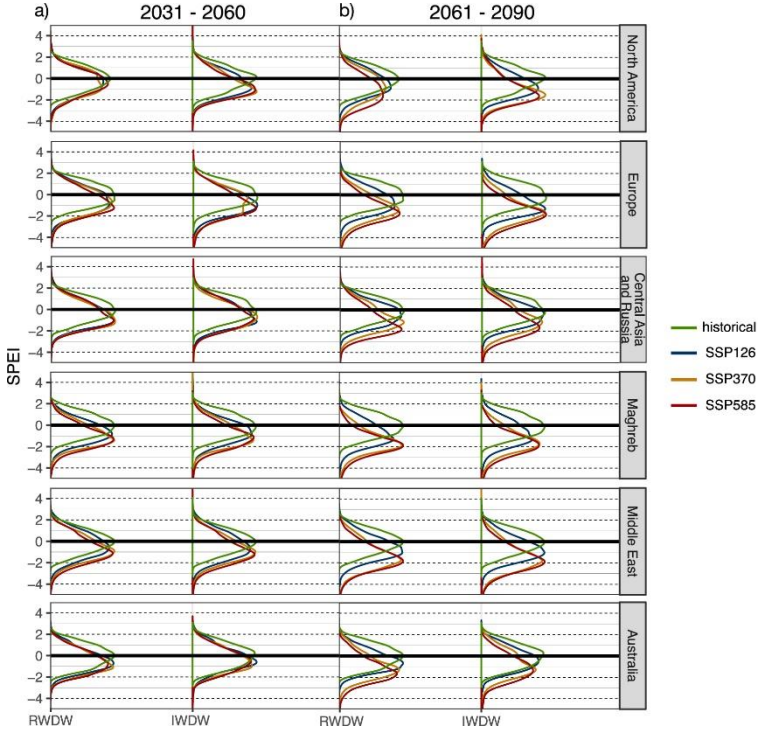


Winter wheat harvest month

Increasing climate resilience: the role of climate services

- Climate change projections – assessment of climatic suitability for durum wheat growth globally

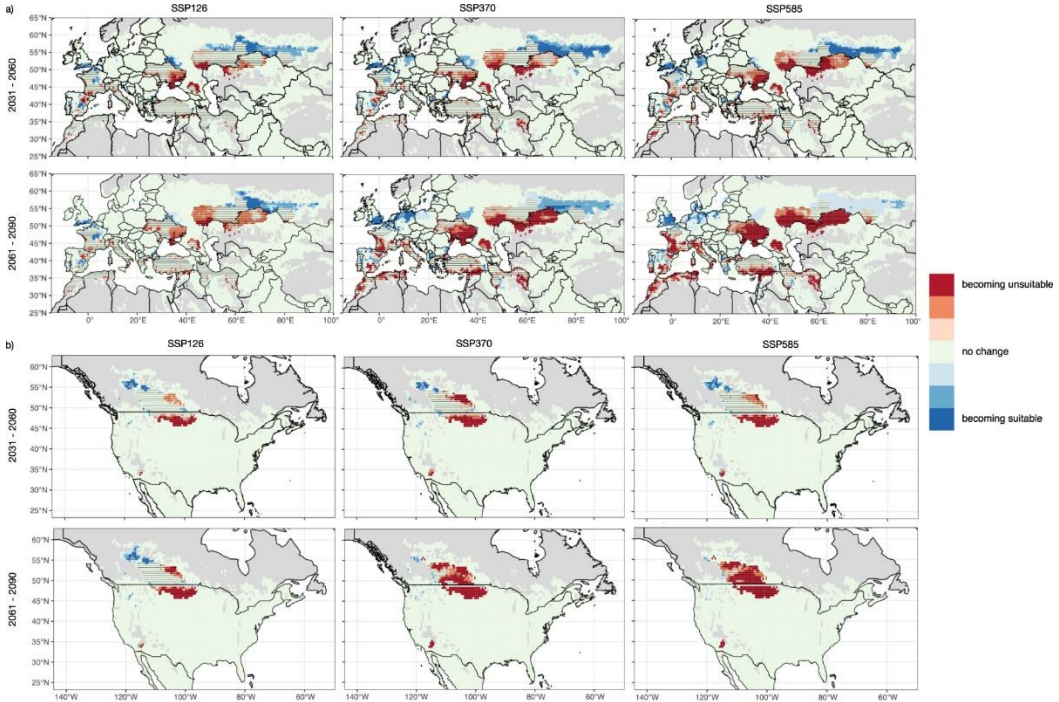


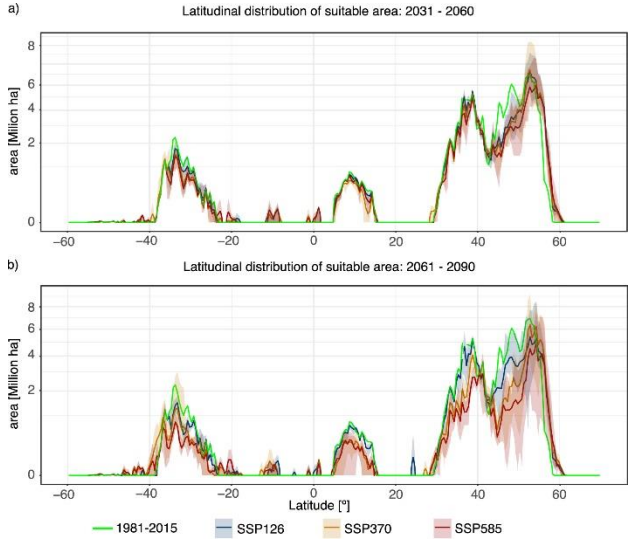


Change in drought patterns in durum wheat growing areas (Ceglar et al., 2021)

Increasing climate resilience: the role of climate services

- Development of ML-based framework to derive climatic suitability model

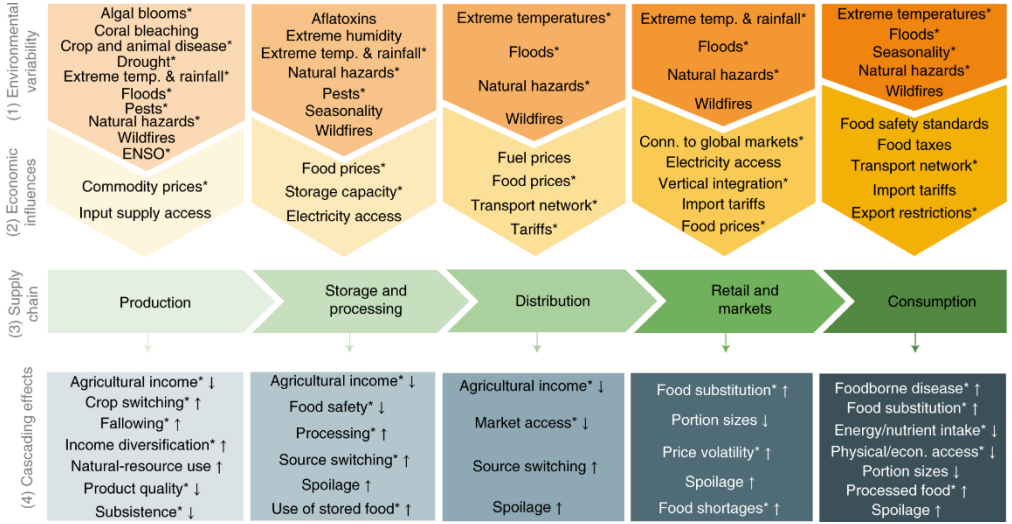




Changing climatic suitability for durum wheat growth in the future

Increasing climate resilience: the role of climate services

- Moving production to emerging suitable area could provide an effective global adaptation
- Sustainable changes in value food chain due to interlinkages
- Dynamic approach to adaptation



Entry points for environmental variability in food supply chains (Davis et al., 2020)

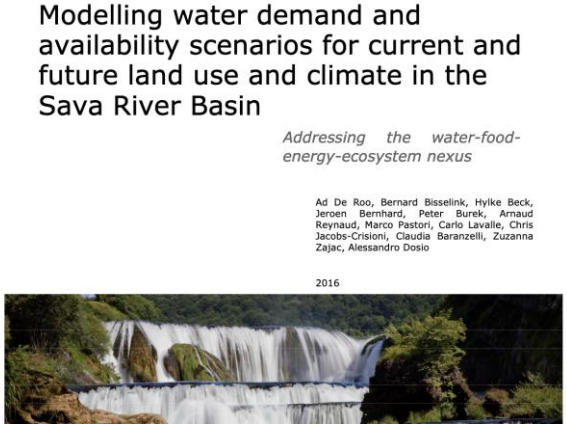
Increasing climate resilience: the role of climate services

- Integrated approach – WEFE nexus an approach that integrates management and governance across the multiple sectors of food, energy, water, and ecosystems

  - more intense irrigated agriculture has the potential to increase crop yields considerably, but there are not sufficient water resources available to realise this

  - If irrigation would be increased drastically, other sectors would be negatively influenced, such as the energy sector, navigation and the environment

  - Climate adaptation measures need to go hand in hand with water resource management policy measures, and the integrated effects should be studied



Conclusions

- Drought impacts crop production and livestock with knock-on effect throughout the whole economy
- Concurrent climatic extremes can exacerbate environmental and societal impacts
- Climate change will increase damage caused by droughts
- Important role of mitigation and adaptation
- Climate services codesign with end users, explore a range of times scales to support decision making in entire food chain

Thank you for your attention

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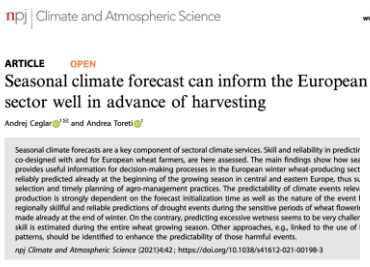
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ARTICLE OPEN

Seasonal climate forecast can inform the European agricultural sector well in advance of harvesting

Andrej Ceglar and Andrea Toreti

Seasonal climate forecasts are a key component of sectoral climate services. Skill and reliability in predictin co-designed with and for European wheat farmers, are here assessed. The main findings show how se provides useful information for decision-making processes in the European winter wheat-producing sect reliably predicted already at the beginning of the growing season in central and eastern Europe, thus s selection and timely planning of agro-management practices. The predictability of climate events relev production is strongly dependent on the forecast initialization time as well as the nature of the event regionally skillful and reliable predictions of drought events during the sensitive periods of wheat floweri made already at the end of winter. On the contrary, predicting excessive wetness seems to be very challe skill is estimated during the entire wheat growing season. Other approaches, e.g., linked to the use of patterns, should be identified to enhance the predictability of those harmful events.

npj Climate and Atmospheric Science (2021)4:42 ; https://doi.org/10.1038/s41612-021-00198-3


Climate Services 20 (2020) 100197

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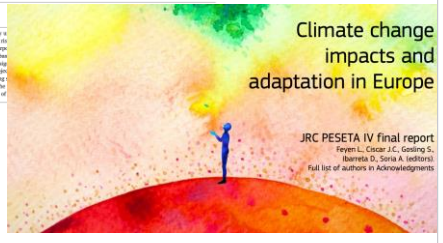
journal homepage: www.elsevier.com/locate/cliser

Clisagri: An R package for agro-climate services

A. Ceglar, A. Toreti, M. Zampieri, V. Manstretta, T. Bettati, M. Bratu

ARTICLE INFO

ABSTRACT




ENVIRONMENTAL RESEARCH LETTERS

LETTER

Global loss of climatically suitable areas for durum wheat growth in the future

Andrej Ceglar, Andrea Toreti, Matteo Zampieri and Conxita Royo

Earth's Future

RESEARCH ARTICLE

Observed Northward Migration of Agro-Climate Zones in Europe Will Further Accelerate Under Climate Change

A. Ceglar, M. Zampieri, A. Toreti and F. Dentener

Abstract This study focuses on the northward shift of homogeneous agro-climate zones in Europe analyzed for the observed past and projected climate conditions for the next decades. Statistical cluster analysis is used to derive eight main agro-climatic zones driven by two agro-meteorological indicators, namely, active temperature sum and thermal growing season length. The northward shift of

Earth's Future

RESEARCH ARTICLE

The Exceptional 2018 European Water Seesaw Calls for Action on Adaptation

Andrea Toreti, Alan Belward, Ignacio Perez-Dominguez, Gustavo Naumann, Jürg Luterbacher, Ottmar Cronie, Lorenzo Seguini, Giacinto Manfron, Raul Lopez-Lozano, Bettina Baruth, Maurits van den Berg, Frank Dentener, Andrej Ceglar, Thomas Chatzopoulos, and Matteo Zampieri

Abstract Temperature and precipitation are the most important factors responsible for agricultural productivity variations. In 2018 spring/summer growing season, Europe experienced concurrent anomalies of both. Drought conditions in central and northern Europe caused yield reductions up to 50% for the main crops, yet wet conditions in southern Europe saw yield gains up to 34%, both with respect to the previous