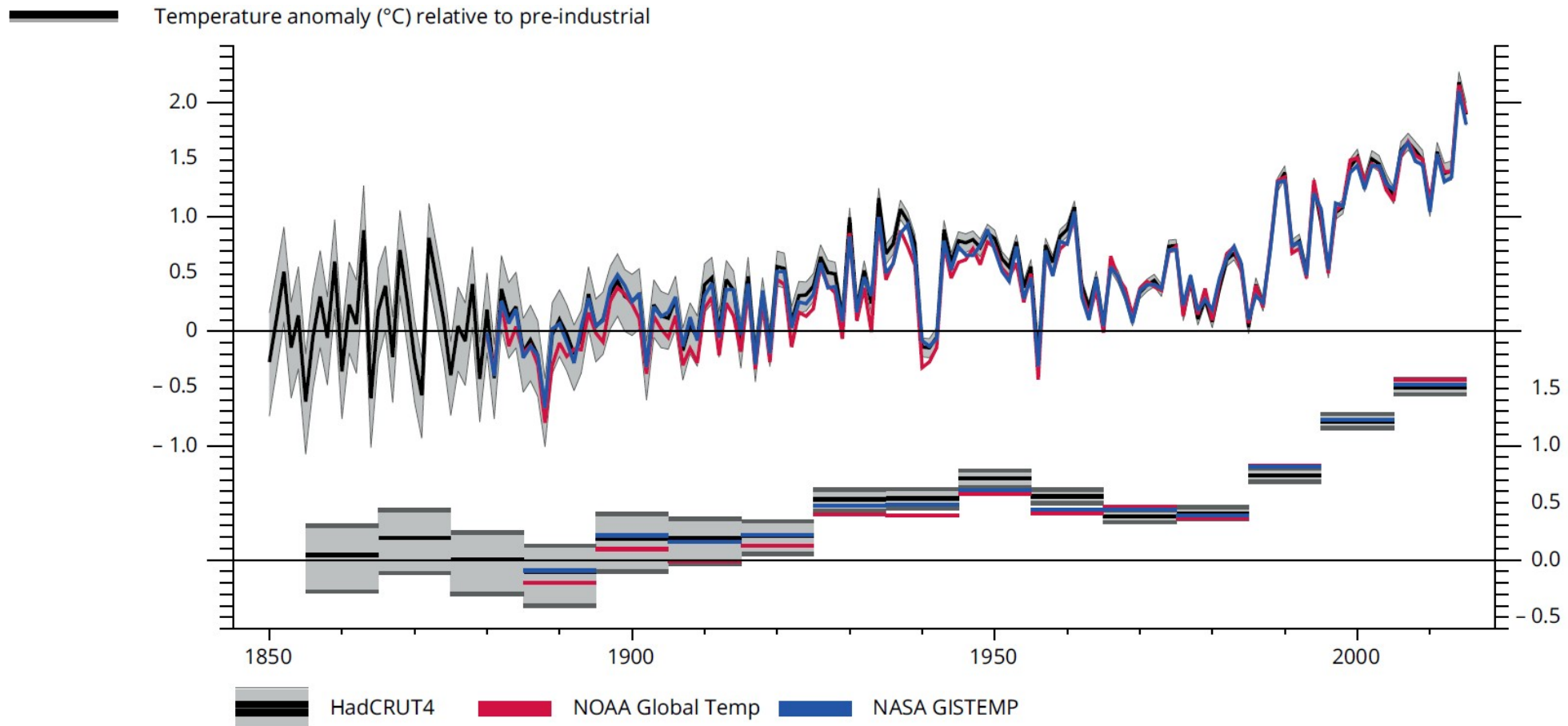


Current climate change impacts and adaptation in European agriculture

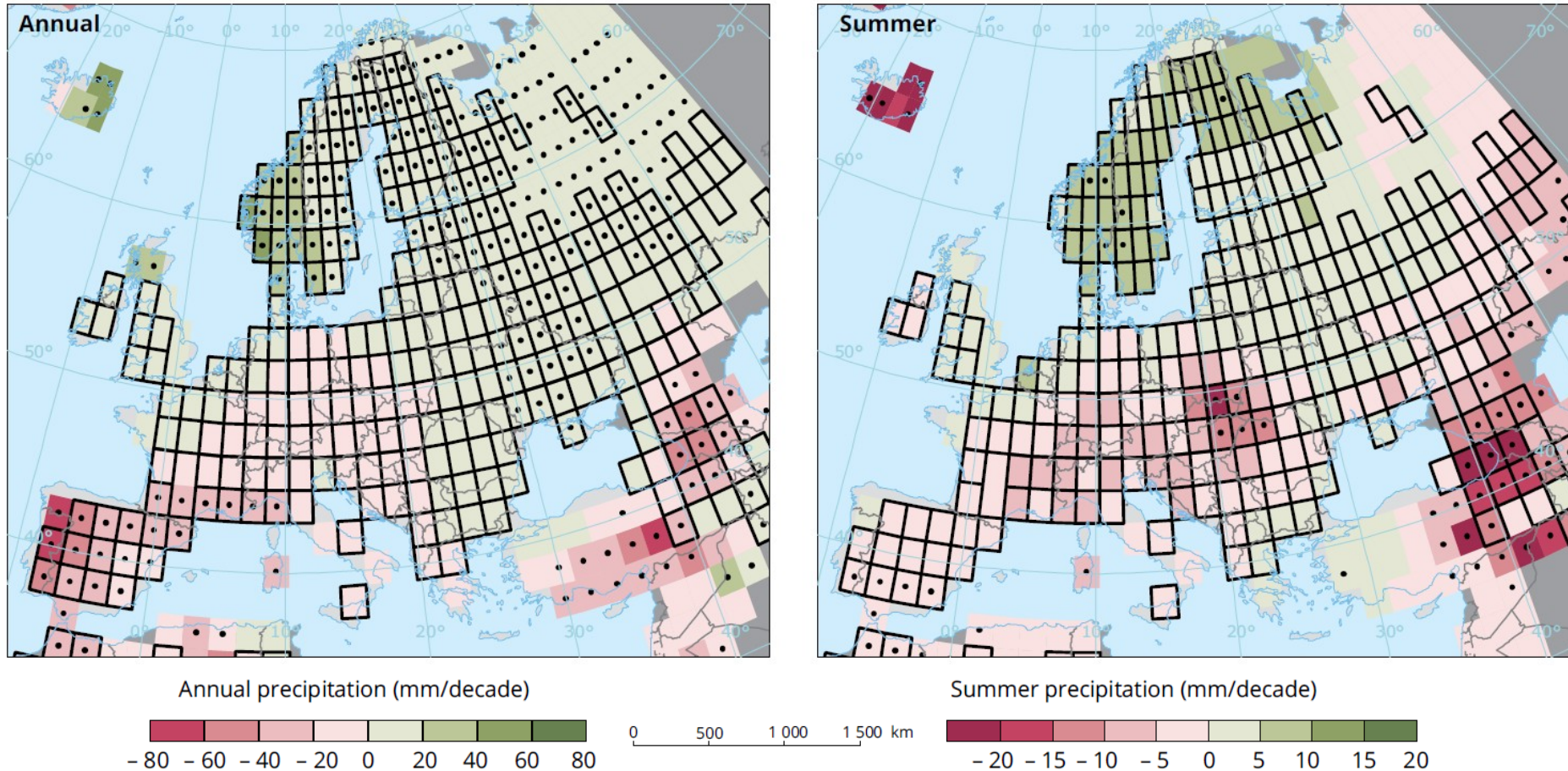
Professor Jørgen E. Olesen



Temperature over land i Europe increases rapidly



Spatial trends in precipitation

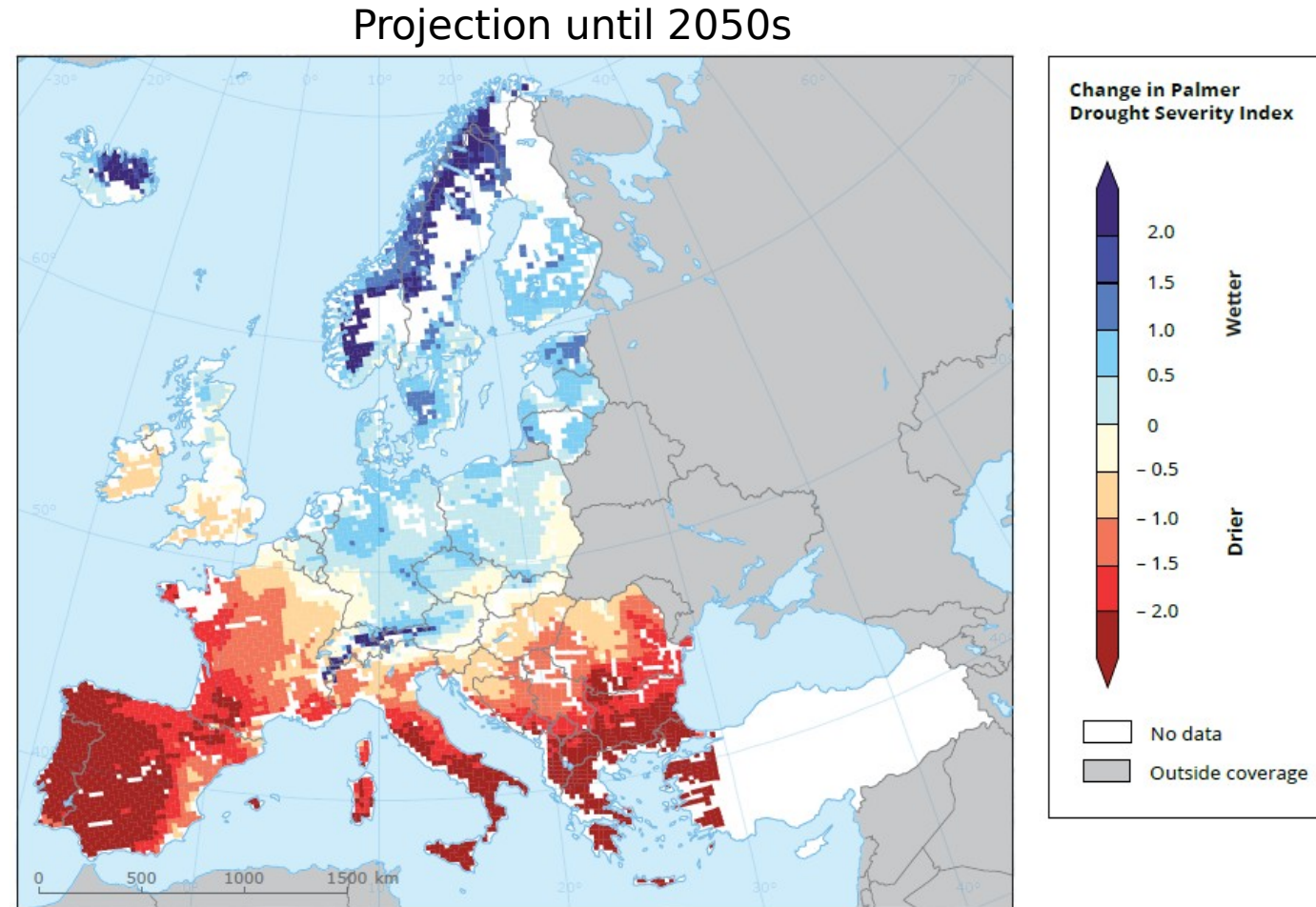
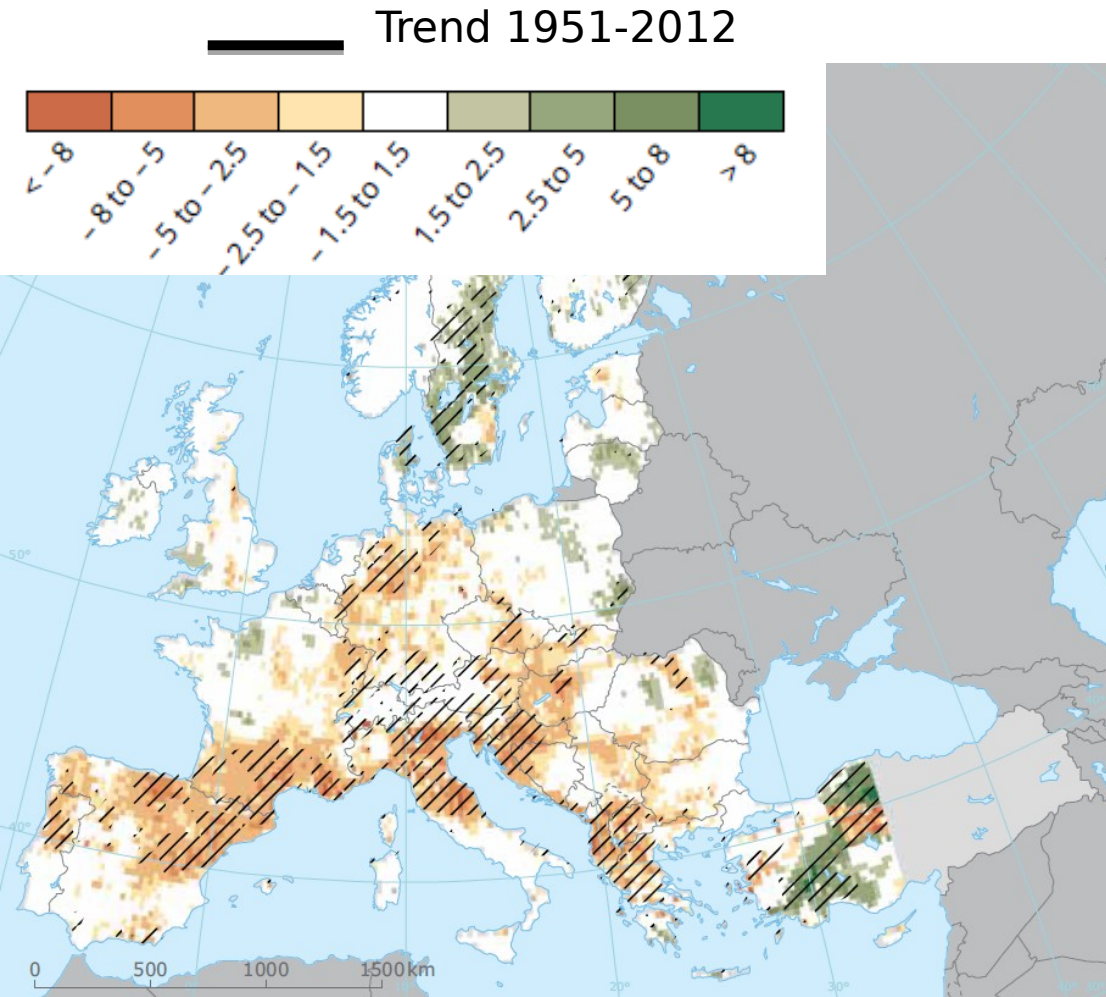


Climate change poses risks to current systems

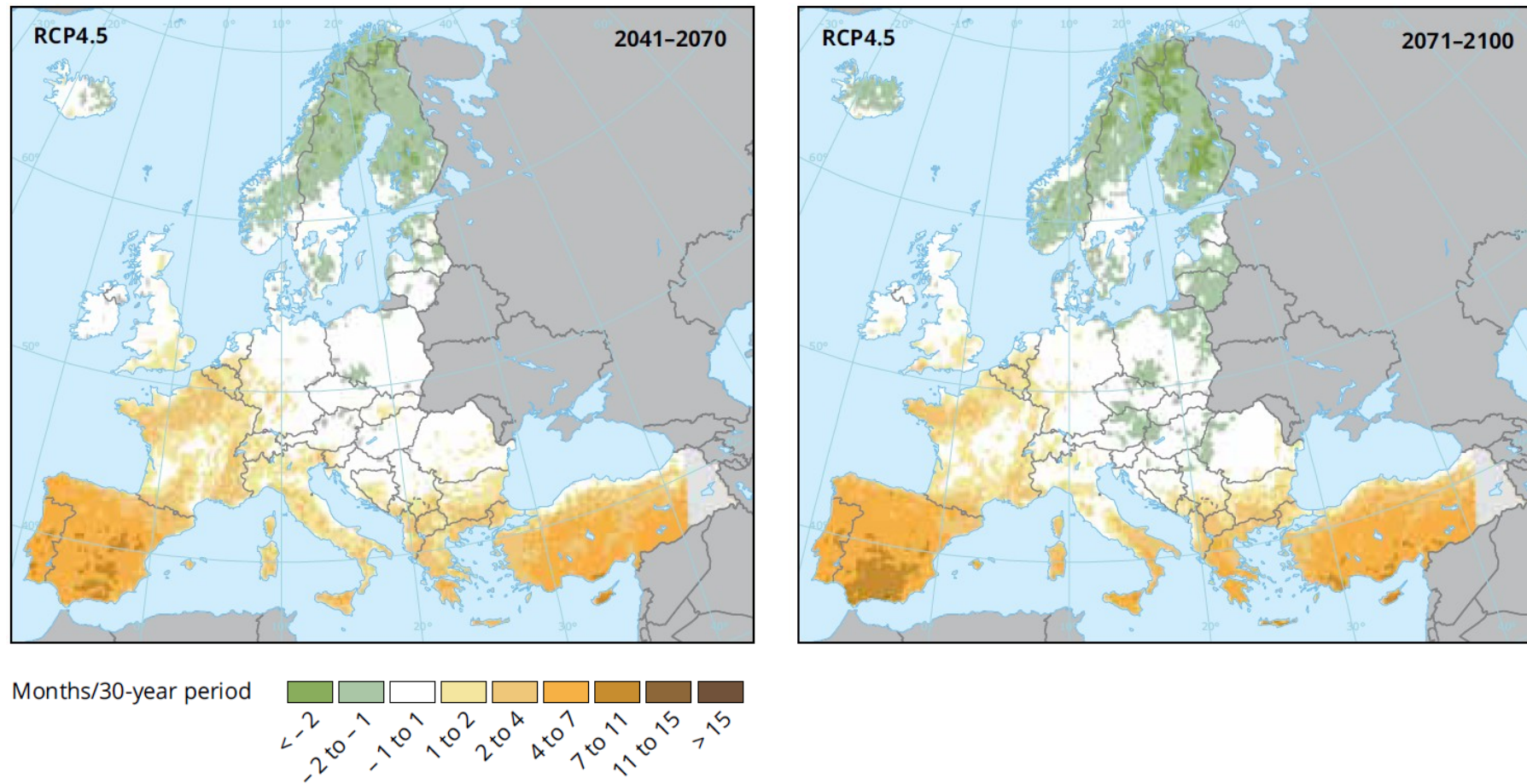
- Risks to production systems are mostly related to extreme events and new biotic interactions
 - Heat waves
 - Frost, snow, ice
 - Droughts
 - Intense or long lasting rainfall (floods)
 - Storms
 - Pest and diseases
- Climate change increases
 - Frequency of extreme events
 - Inter-annual variability



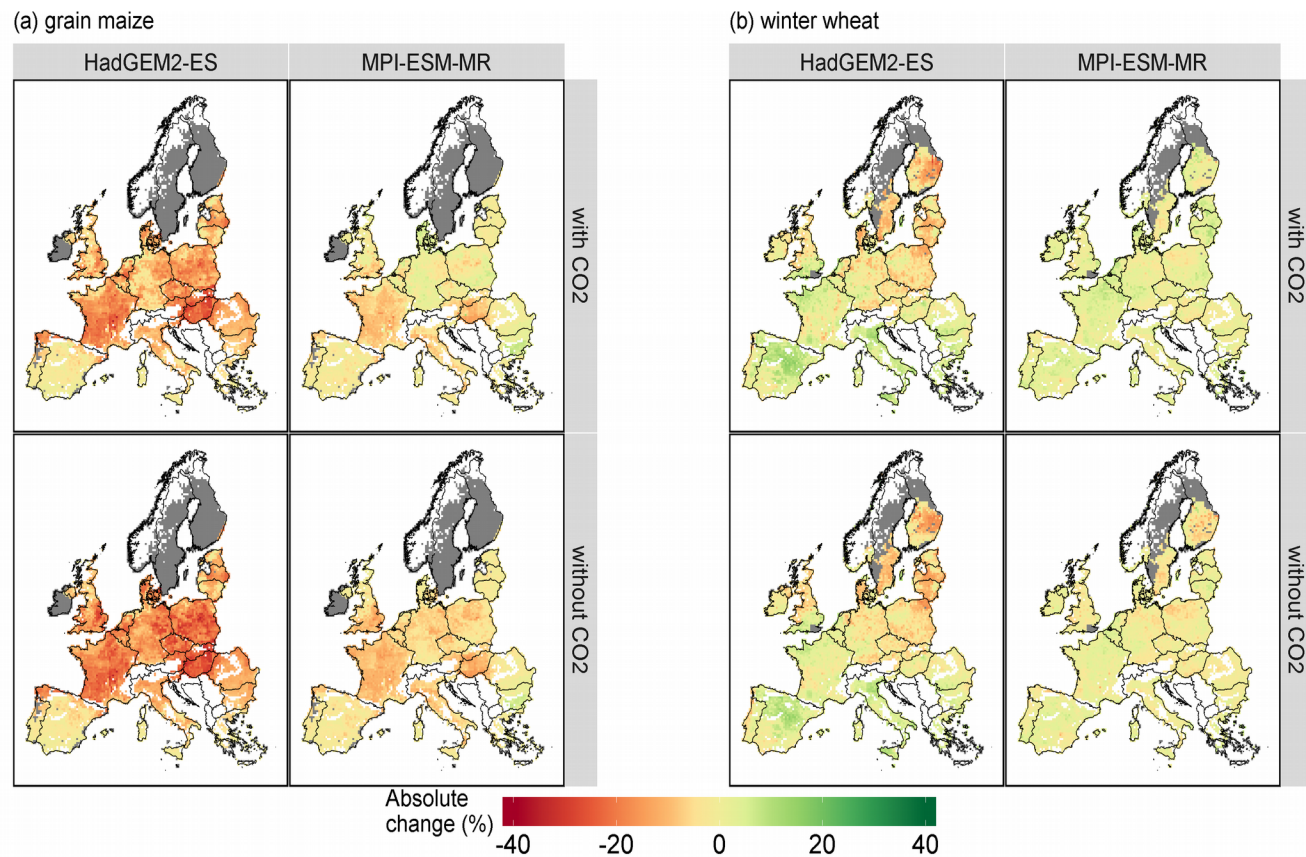
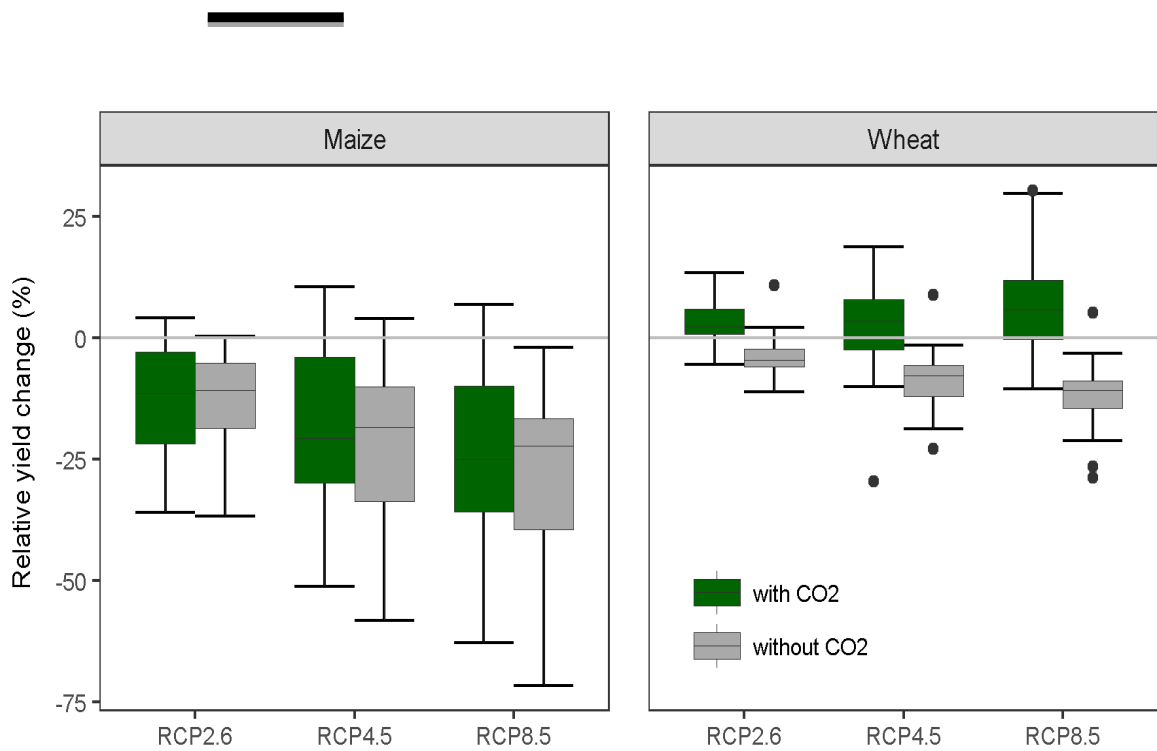
Trends in summer soil moisture



Change in frequency of extreme drought under moderate climate change

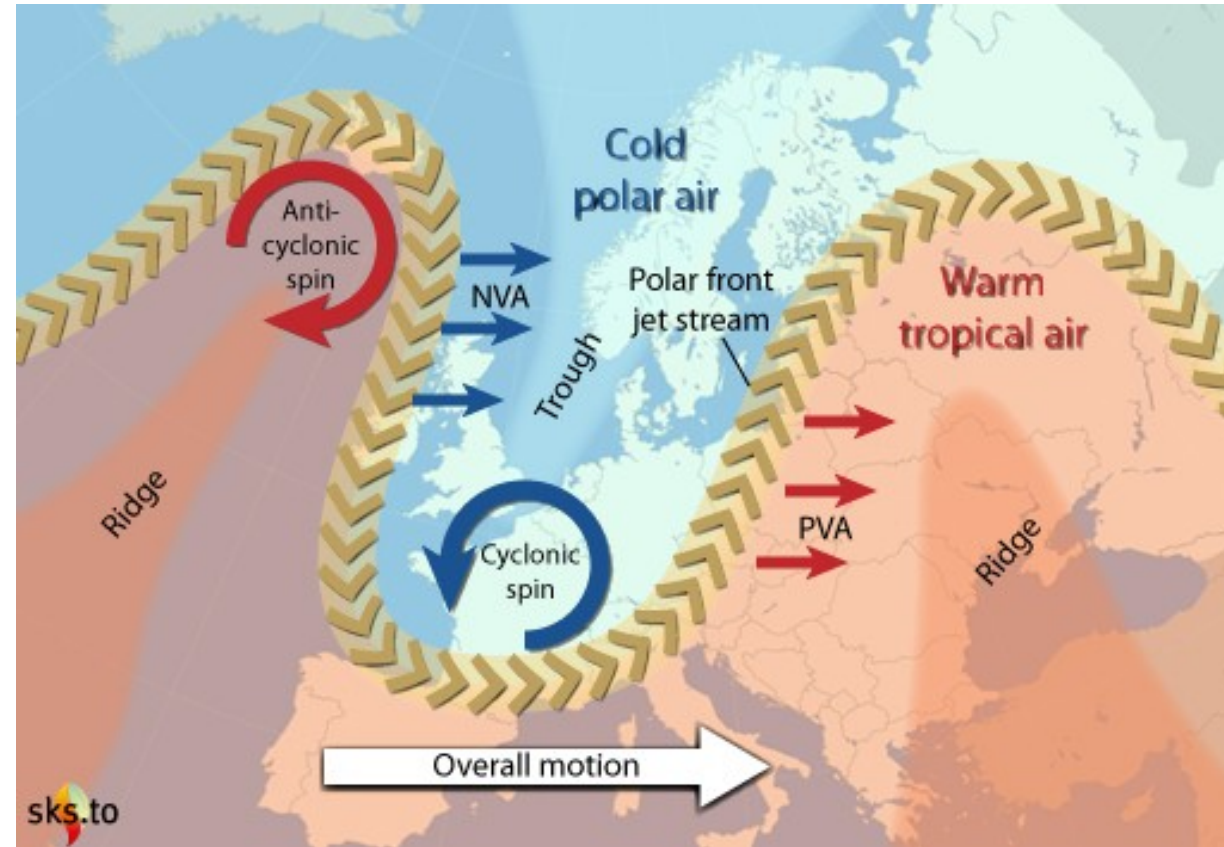


Drought is the major threat for cereals under climate change in Europe (2050s)



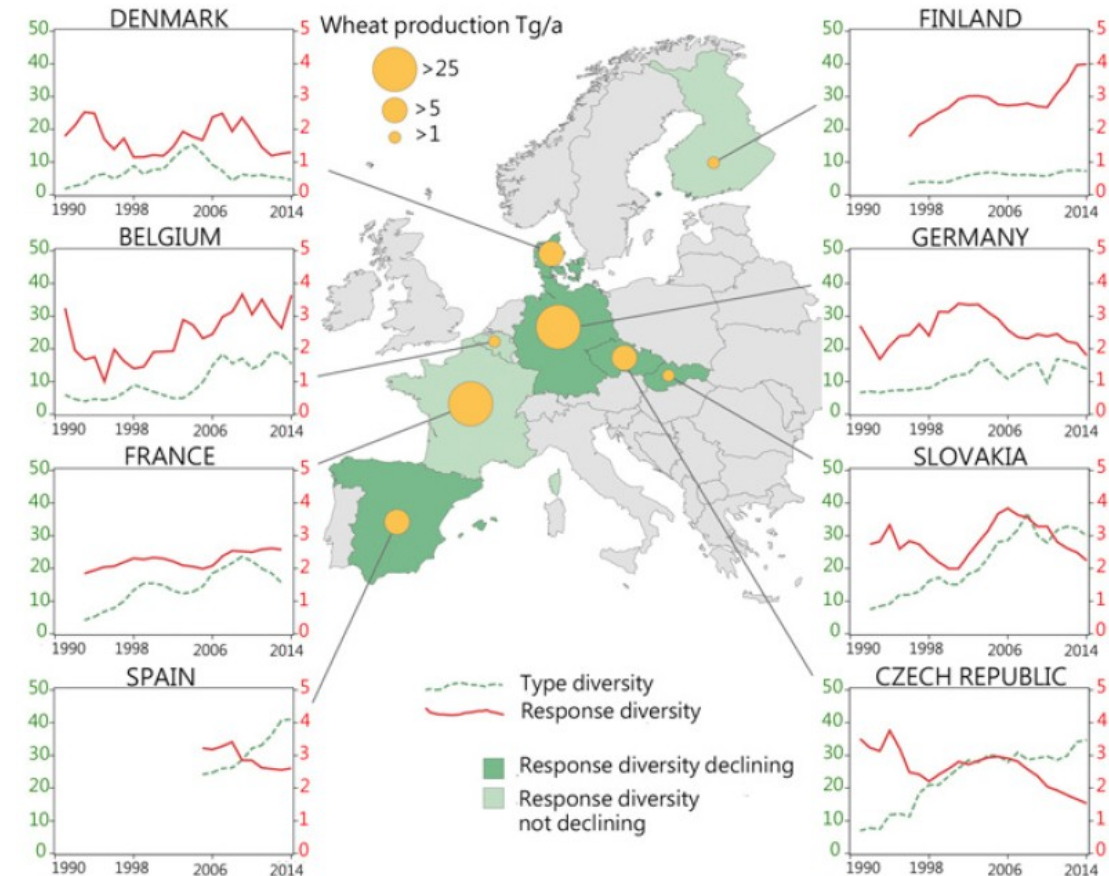
Changes in the jet stream determines variability

- The jet stream determines the flow of cyclones at mid and high latitudes
- The suitable climate (varying dry and wet conditions in Nordic climate) is determined by this flow of cyclones
- Warming reduces temperature difference between arctic and mid-latitude temperatures
- This weakens the jet stream, possibly resulting in more stable locking of the jet stream

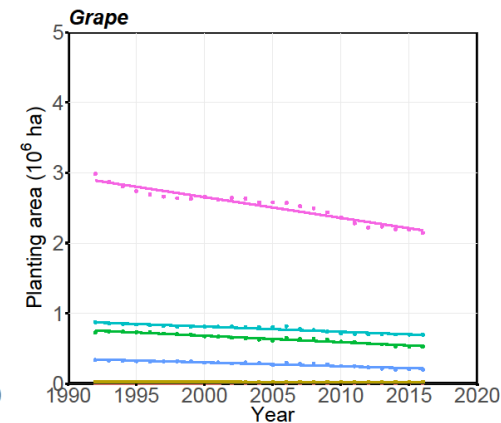
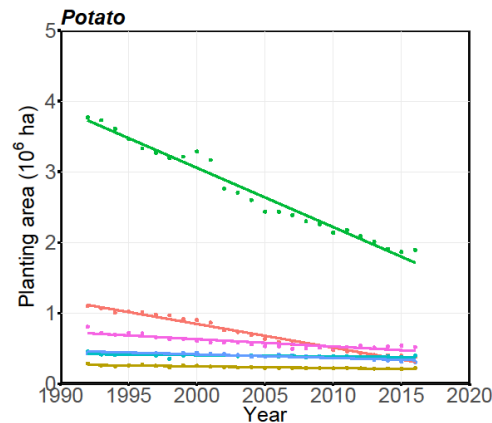
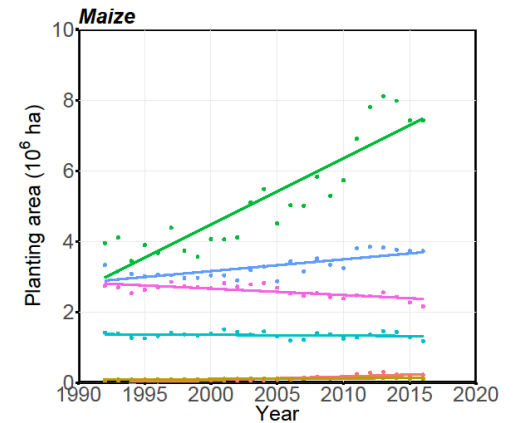
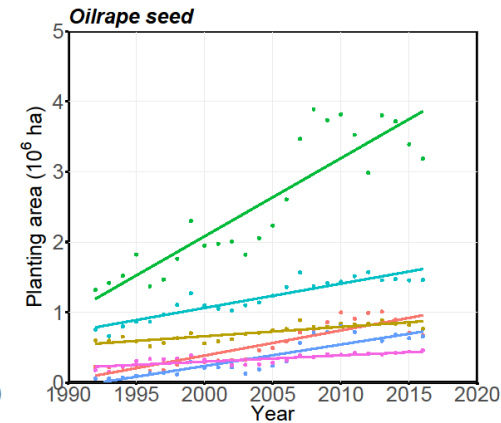
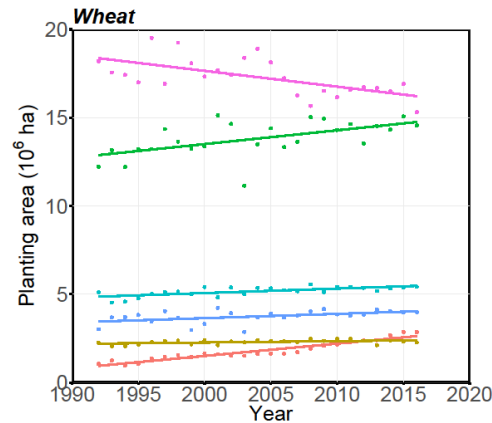
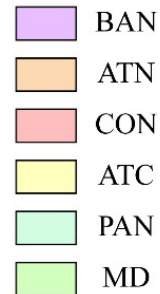
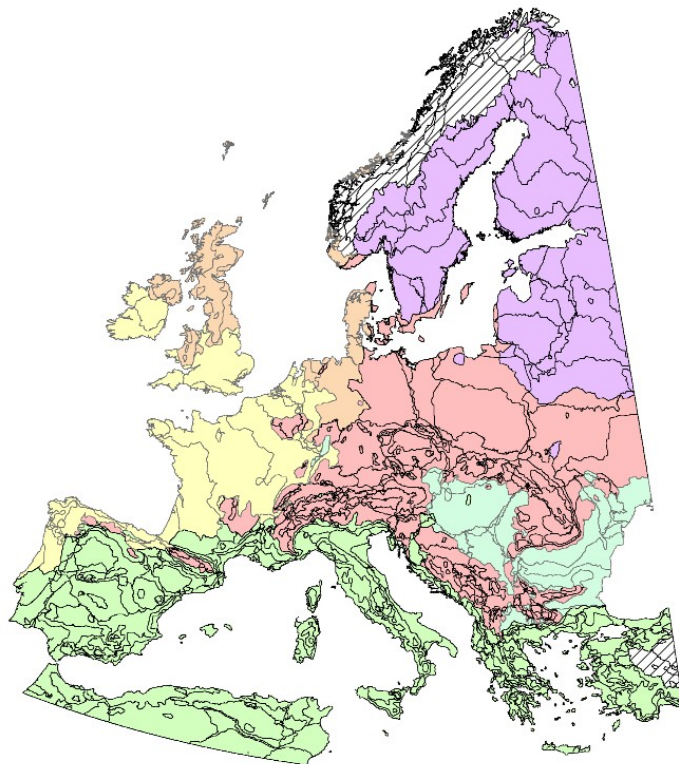


Declining resilience of European wheat

- Climate change increases variability in temperature and rainfall
- Adaptation to such changes requires increasing resilience
- Resilience may be achieved with greater varietal response diversity
- Analysis of >100.000 observations of yield from European variety trials
- Results show declining diversity and lower resilience
- Need for greater focus on diversity and resilience through breeding and variety choice

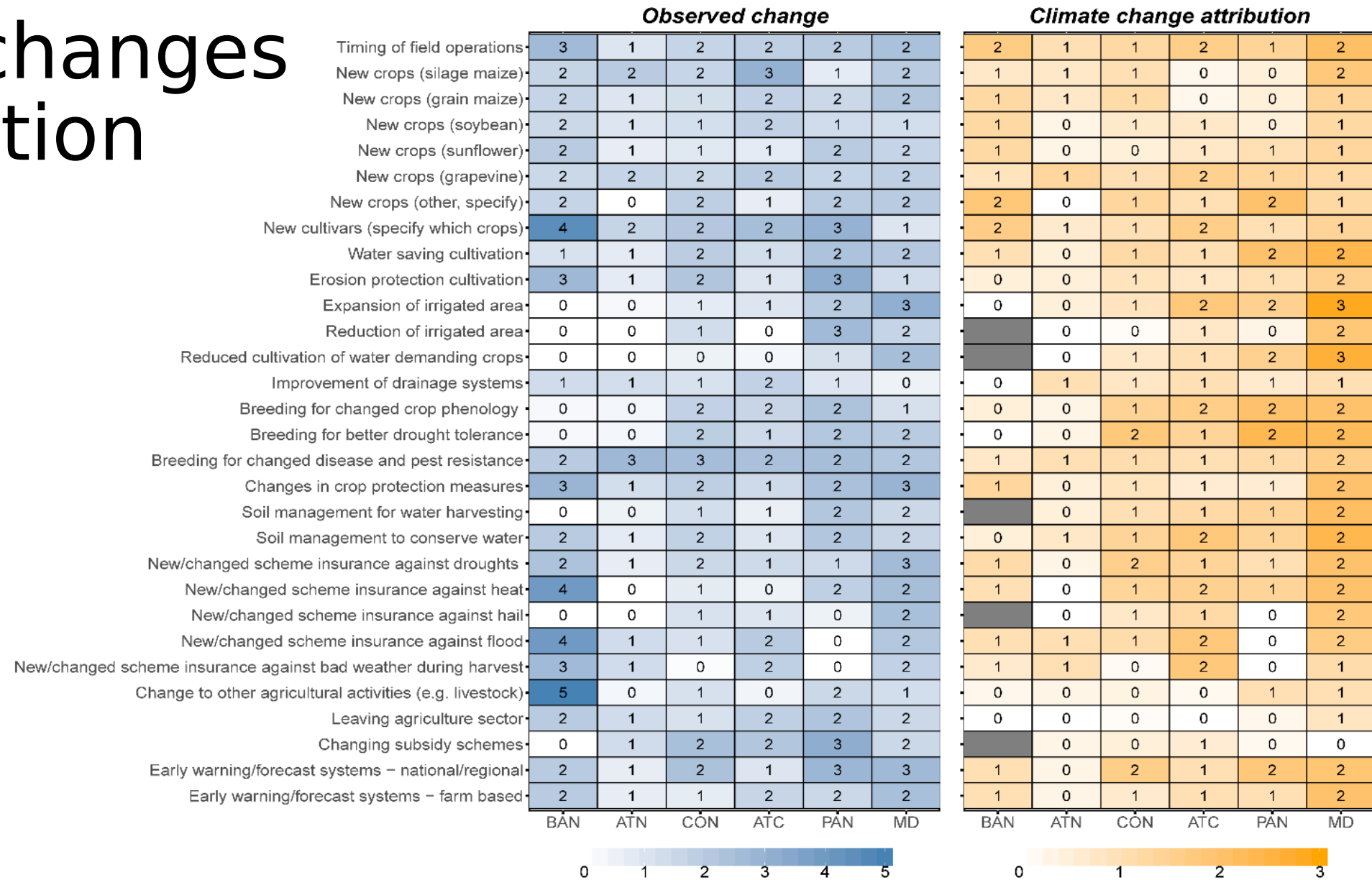


Survey of impacts and adaptation in European crops



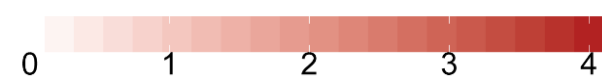
— BAN — ATN — CON — ATC — PAN — MD

Observed changes and attribution

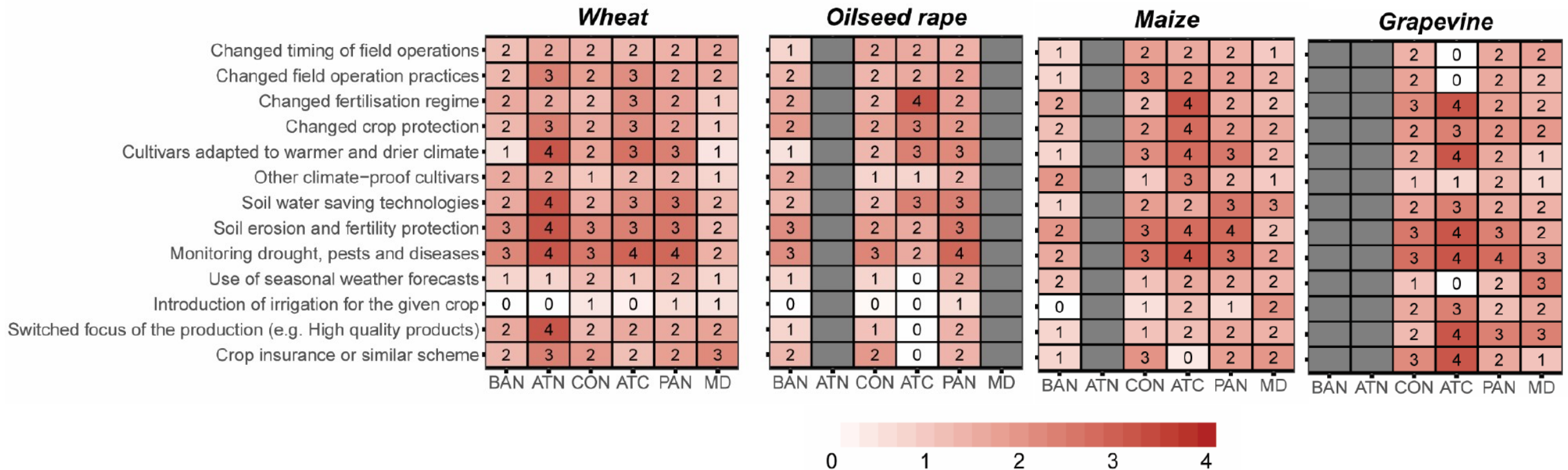


Planned adaptations

Changed timing of field operations	2	1	2	2	2	1
Changed field operation practices	2	2	3	2	2	2
Changed fertilisation regime	2	1	2	2	2	2
Changed crop protection	3	2	3	2	2	2
Cultivars adapted to warmer and drier climate	3	2	3	3	3	1
Other climate-proof cultivars	2	2	3	2	2	1
Soil water saving technologies	2	2	3	2	3	2
Soil erosion and fertility protection	3	4	3	4	4	2
Monitoring drought, pests and diseases	3	3	3	4	4	2
Use of seasonal weather forecasts	4	0	2	1	2	2
Introduction of irrigation for the given crop	4	1	2	1	1	3
Switched focus of the production (e.g. High quality products)	2	2	2	3	2	3
Crop insurance or similar scheme	4	2	2	3	2	3
New (warm season) crops	2	2	1	3	0	4
Crop rotations for better water use	1	4	2	2	2	4
Crop rotations for better nutrient use	3	4	2	4	2	4
Expansion of irrigation systems	2	1	2	2	2	4
Improvement of irrigation systems	2	2	2	2	2	4
Regulation of water rights for irrigation	1	2	2	2	4	2
Microclimate modification	1	1	1	1	2	
Landscape changes (e.g. hedgerows, buffer strips)	2	2	2	2	2	4
Revised environmental regulations	3	2	2	3	2	4
Revised subsidy schemes	3	2	3	2	2	4
Increased storage capacity	1	2	2	3	2	3
Leaving the agriculture sector	0	0	0	1	0	0
	BAN	ATN	CON	ATC	PAN	MD



Planned adaptations



Challenges to current resource and environmental management

- Changes in climatic suitability will lead to changes in land use, greatly affecting production in agriculture and forestry, but also the quality of nature, the environment, groundwater and surface water systems.
- Future resource management needs to meet many conflicting goals.



Greater focus on adaptation to climate change is needed

- Planning of adaptation to climate change is essential where
 - There are long lead times before new technologies, materials or management schemes can be implemented
 - Involvement of several actors or institutions is required
- Examples of need for action on adaptation
 - Land use planning and management, e.g. related to drainage soils and water resources for irrigation
 - Enhanced focus on water/irrigation use efficiency
 - Use of genetic resources of plants and animals
 - Management and prevention of diseases



