



ADVID

Cluster dos Vinhos da Região do Douro  
Douro Region Wine Cluster

# VITICULTURAL ZONING IN EUROPE: CLIMATE CHANGE CHALLENGES

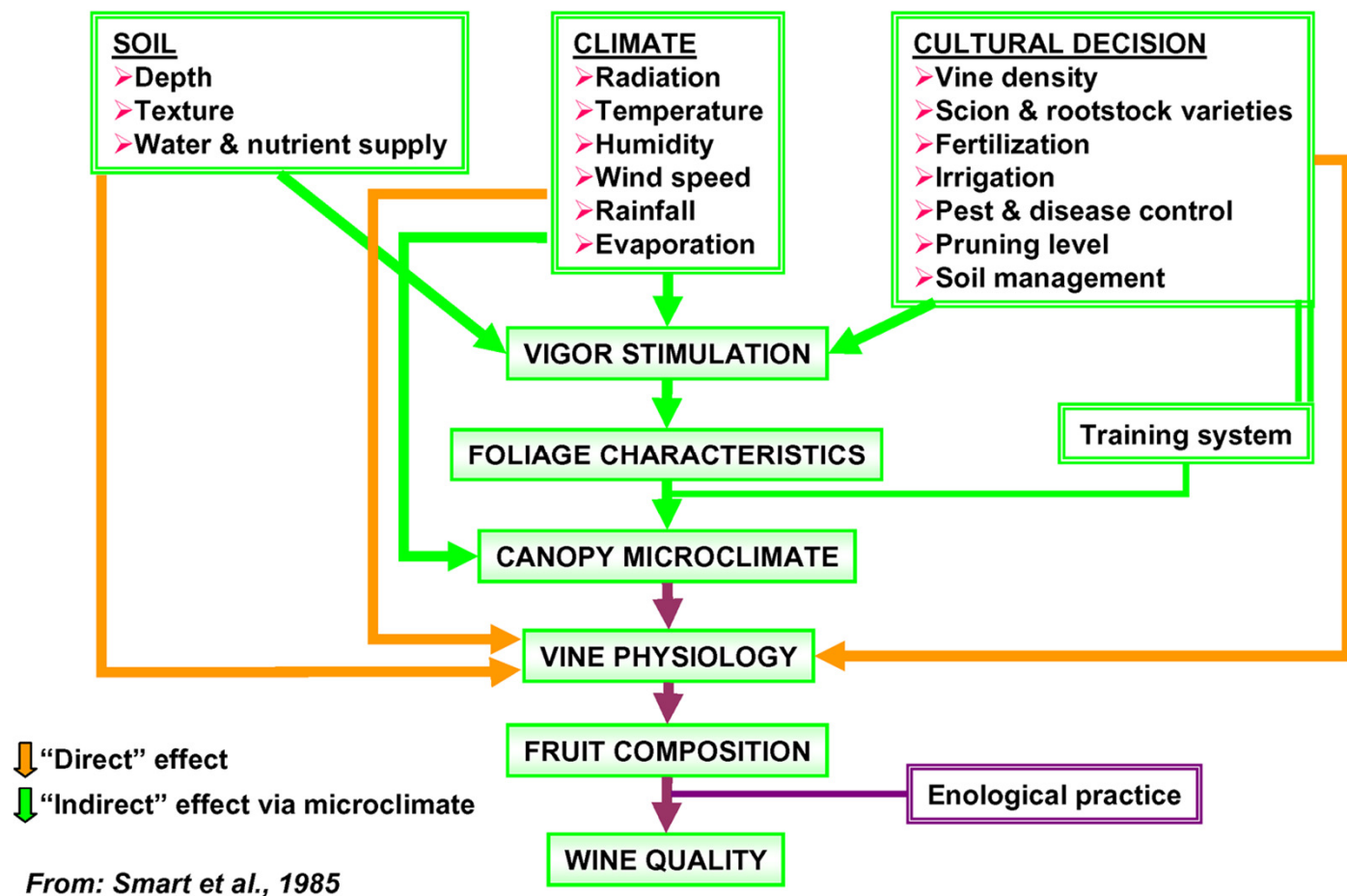
JOÃO ANDRADE SANTOS

12 | 04' LISBOA | 13 | 04' PORTO 2012  
FUNDAÇÃO LUSO-AMERICANA | ALFÂNDEGA DO PORTO

# Introduction



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Climatic forcing ...

# Methods for viticultural zoning



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## ■ 15 **bioclimatic** indices

### ■ 4 fundamental indices

## ■ Key references:

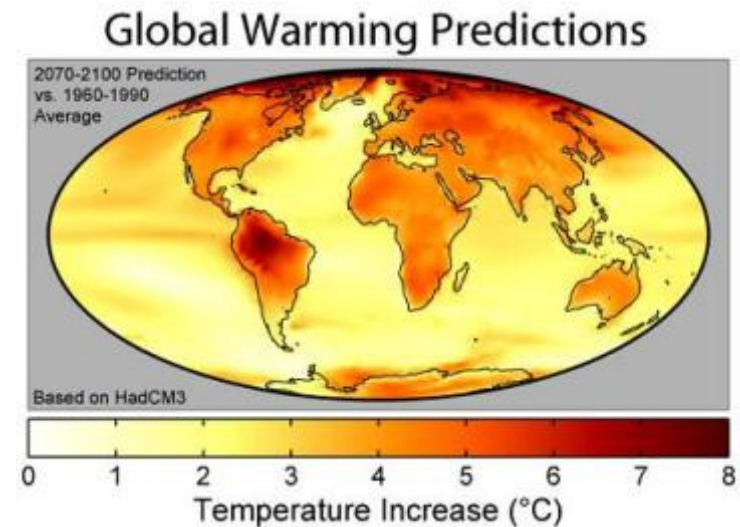
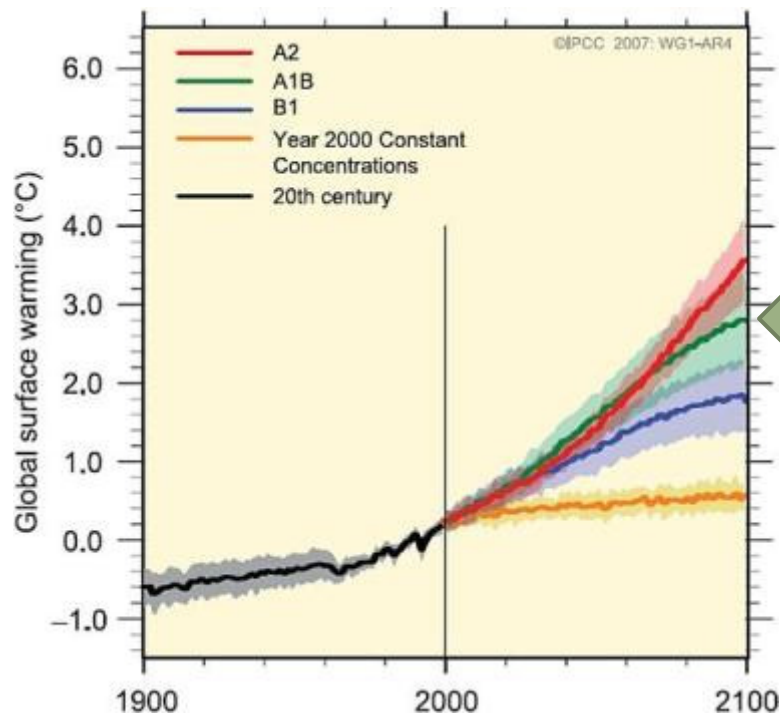
- Santos JA, Malheiro AC, Pinto JG, Jones GV (2012). Macroclimate and viticultural zoning in Europe: observed trends and atmospheric forcing. *Clim Res* 51: 89-103 (doi: 10.3354/cr01056)
- Malheiro AC, Santos JA, Fraga H, Pinto JG (2010) Climate change scenarios applied to viticultural zoning in Europe. *Clim Res* 43:163-177
- Santos JA, Malheiro AC, Karremann MK, Pinto JG (2011) Statistical modelling of grapevine yield in the Port Wine region under present and future climate conditions. *Int J Biometeorol* 55:119-131
- Jones GV, Duff AA, Hall A, Myers JW (2010) Spatial analysis of climate winegrape growing regions in the Western United States. *Am J Enol Vitic* 61:313-326



# Methods for climate change projections



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Climate models for regional projections ...

# Atmospheric Modelling & Downscaling

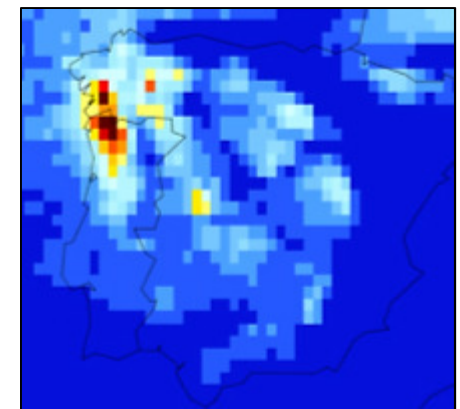
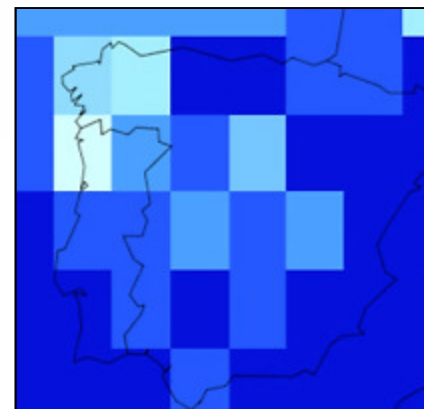
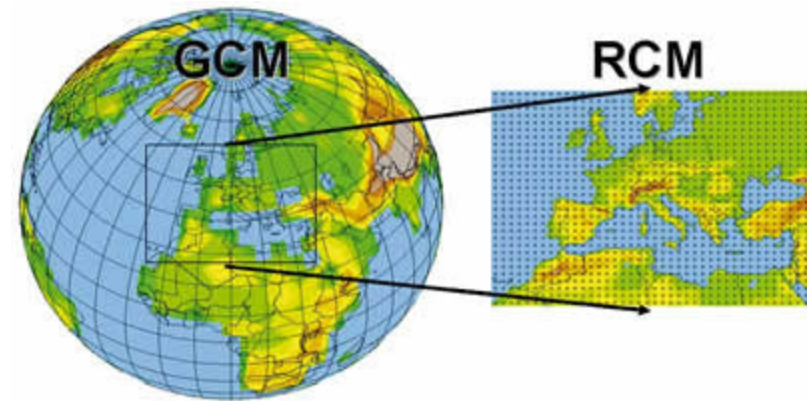
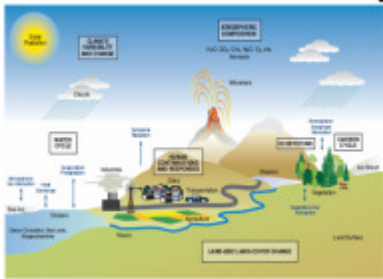


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## Schematic for Global Atmospheric Model

Horizontal Grid (Latitude-Longitude)

Vertical Grid (Height or Pressure)

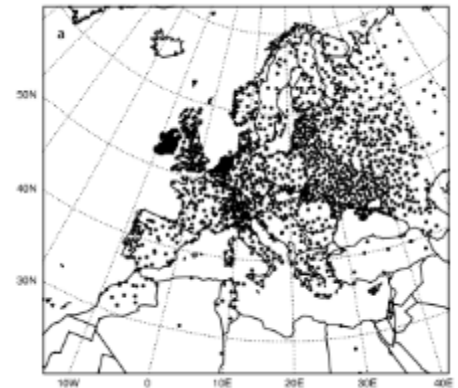


# Data



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- Climatic variables for bioclimatic indices: daily TG, TN, TX & RR
- 1<sup>st</sup> part: viticultural zoning for current climates:
  - **Station-based** dataset E-OBS (ECA&D)
  - Grid: 0.25° latitude x longitude (~25 km)
  - Baseline period: 1950-2010
- 2<sup>nd</sup> part: viticultural zoning for future climates:
  - Ensemble of 16 **simulated** datasets from 15 RCMs
  - Grid: 0.25° latitude x 0.25° longitude
  - 1961-2000 (model validation/calibration)
  - 2011-2070 – A1B emission scenario (ensemble projections)



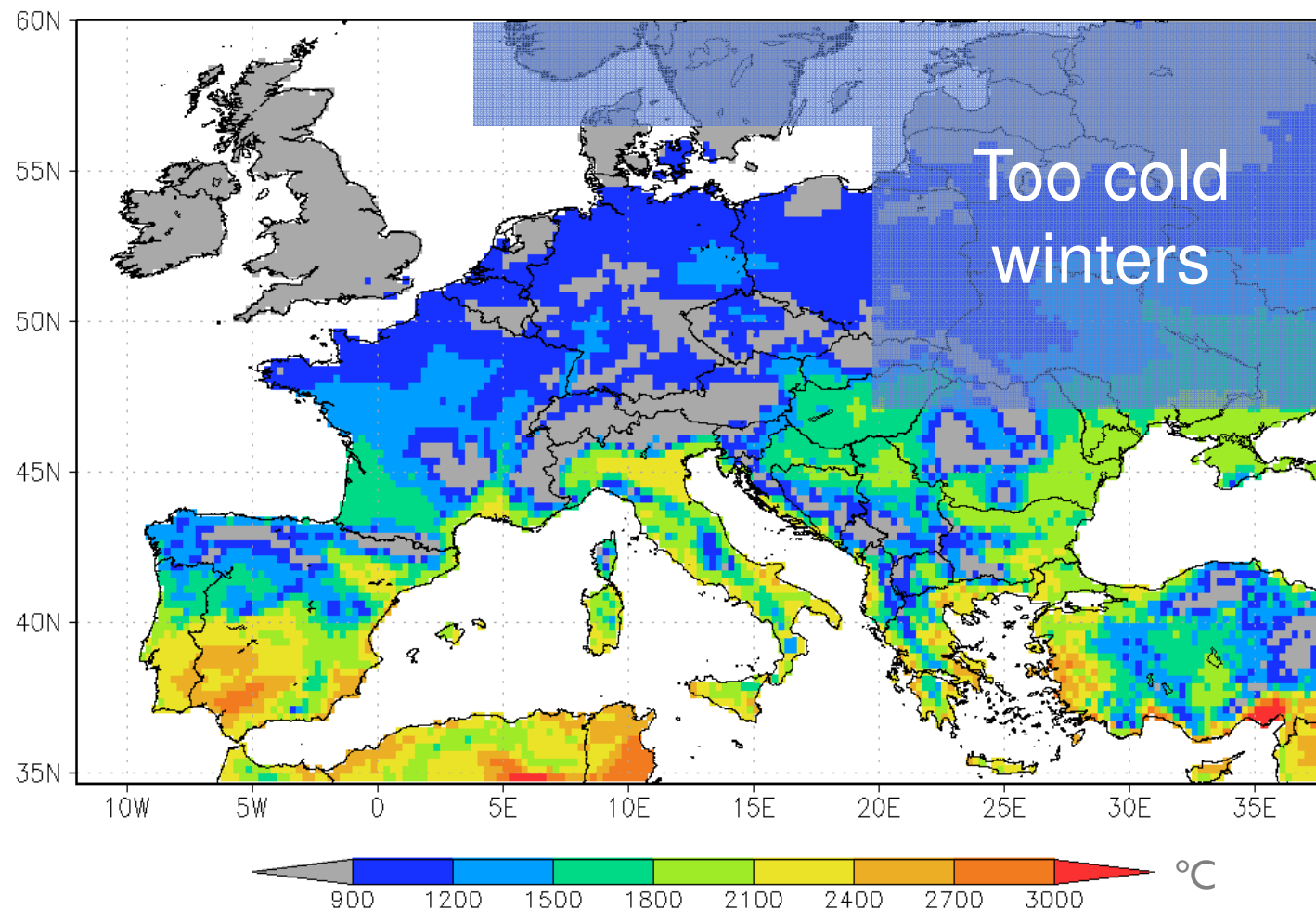
Results...

# Huglin Index (OBS)

degree-day index (Thermal & radiative basic requirements)



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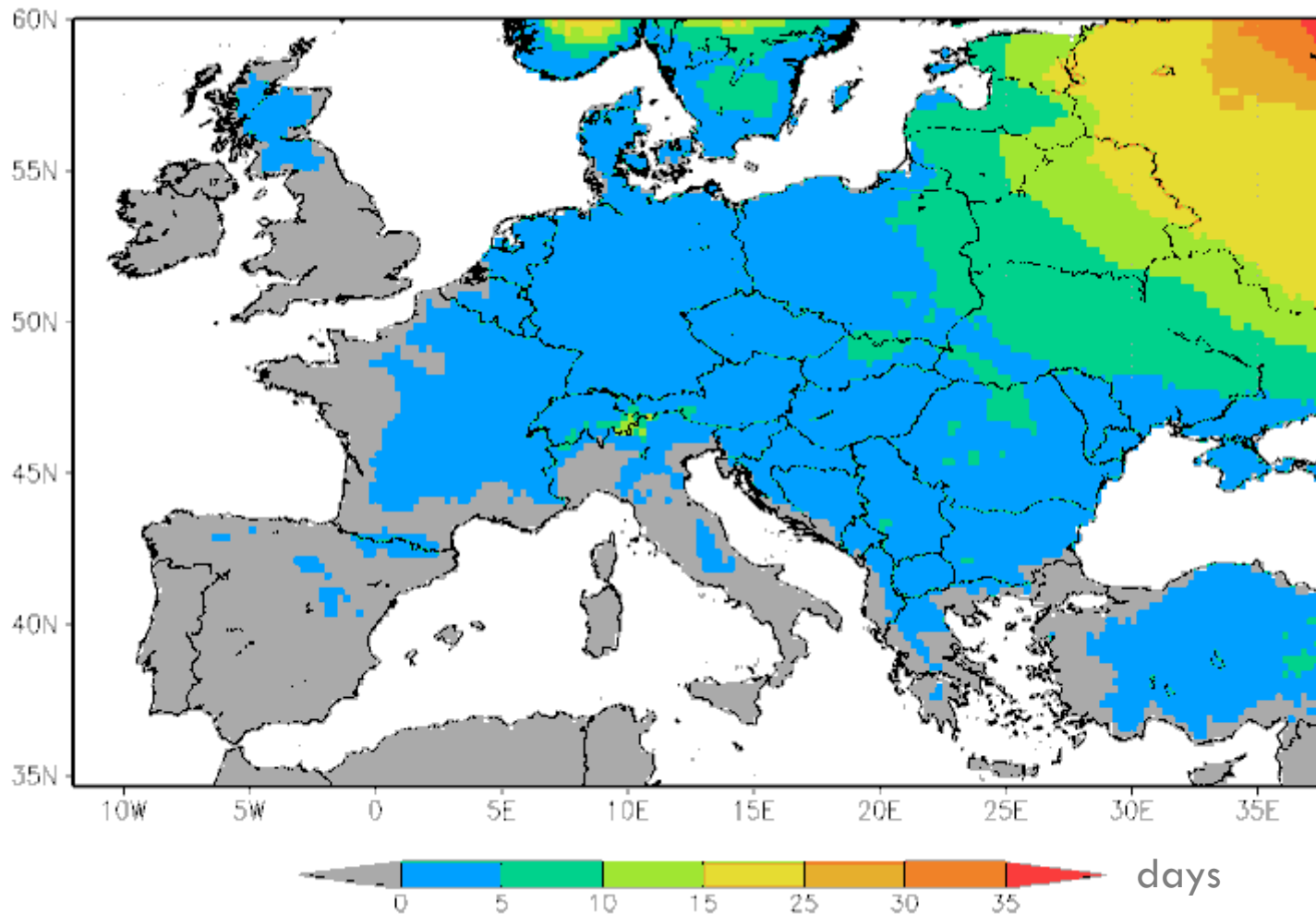
Suitability widely depends on grapevine variety: early-late cultivars

# $T_{min} < -17^{\circ}\text{C}$ (OBS)

Lower lethal limit for grapevine



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**Important  
limitation to  
winegrape  
growth in  
northern and  
eastern  
Europe**

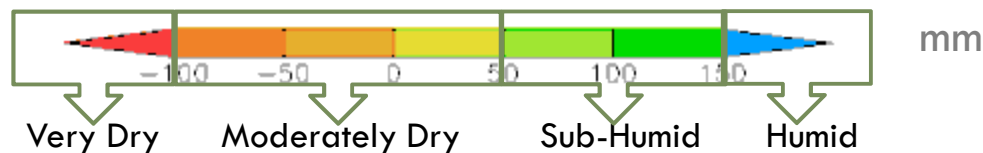
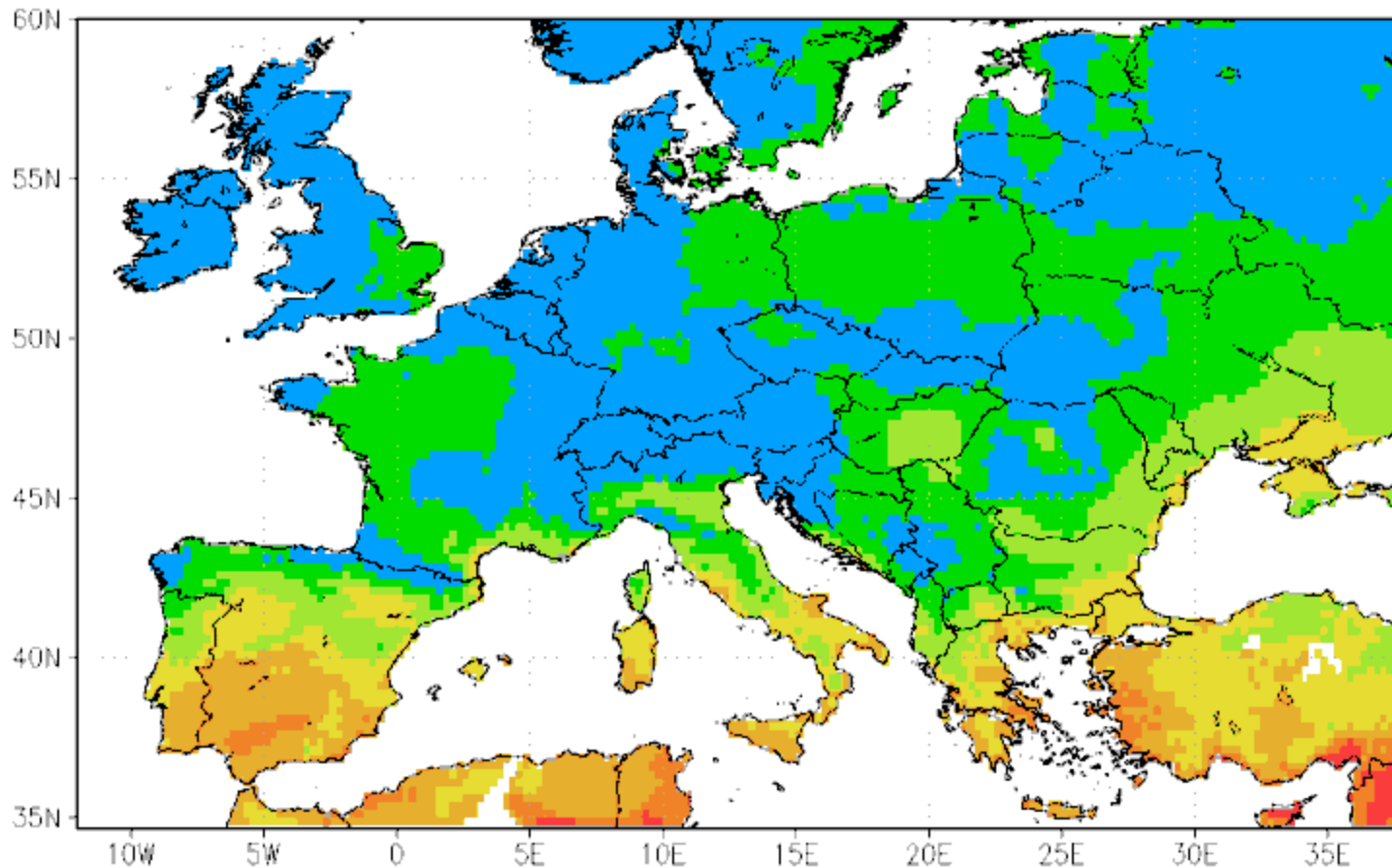


# Dryness Index (OBS)

Potential soil water balance (water stress assessment)



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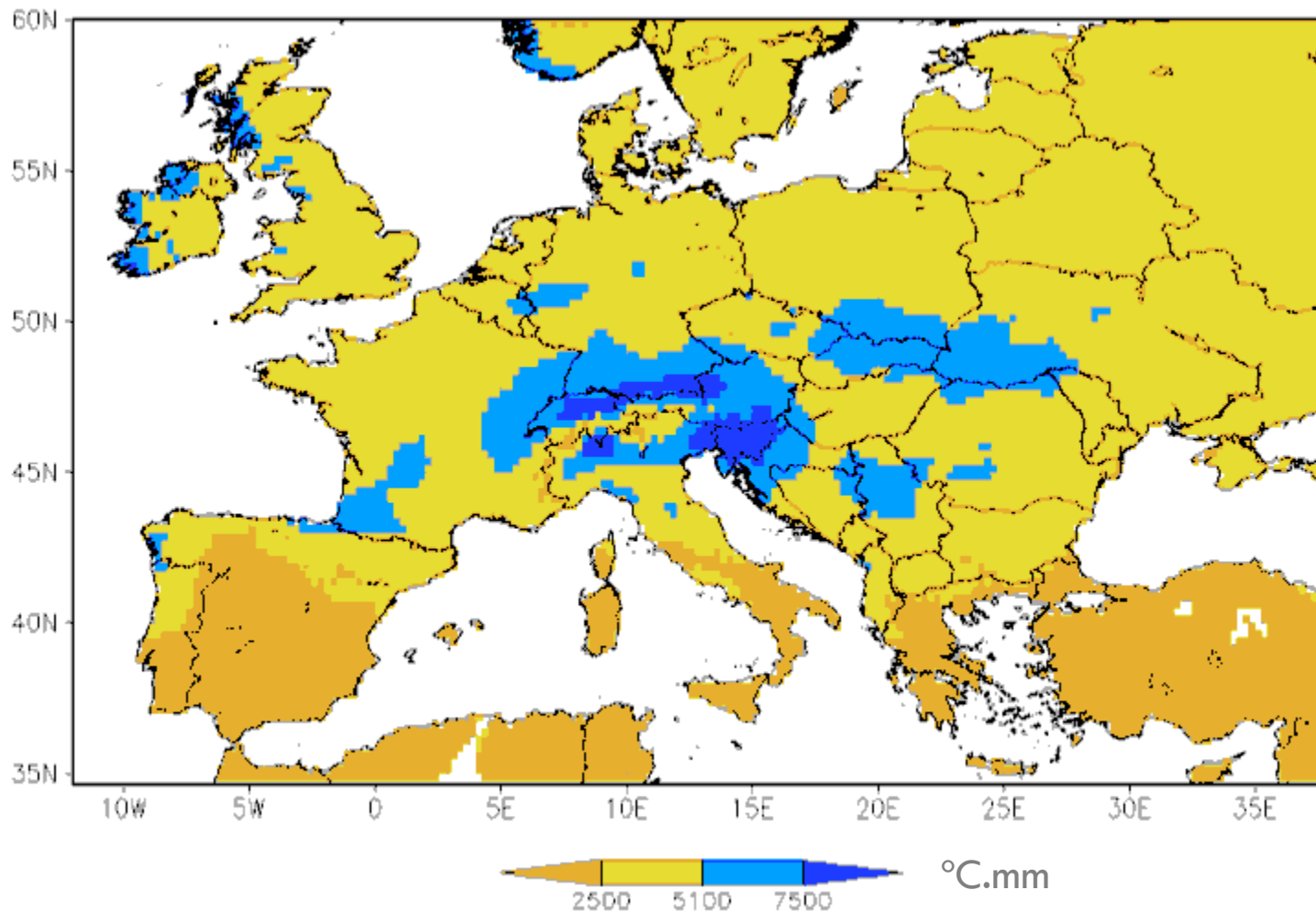
**Moderate**  
limitation to  
winegrape  
growth in  
some  
**southern**  
**regions**

# Hydrothermic Index (OBS)

Excessive precipitation/humidity levels



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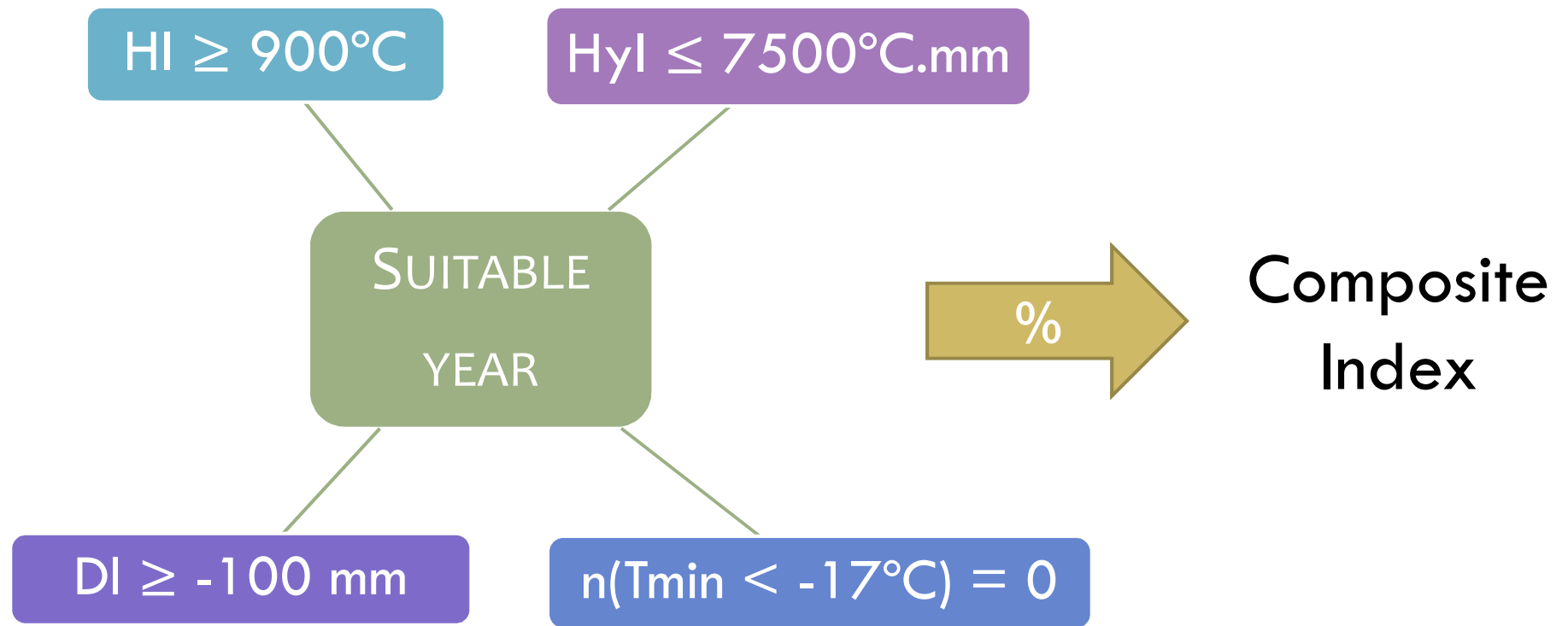


**Moderate**  
limitation to  
winegrape  
growth in  
**blue areas**  
(risk of downy  
mildew disease  
and pests)

# Composite Index (OBS)



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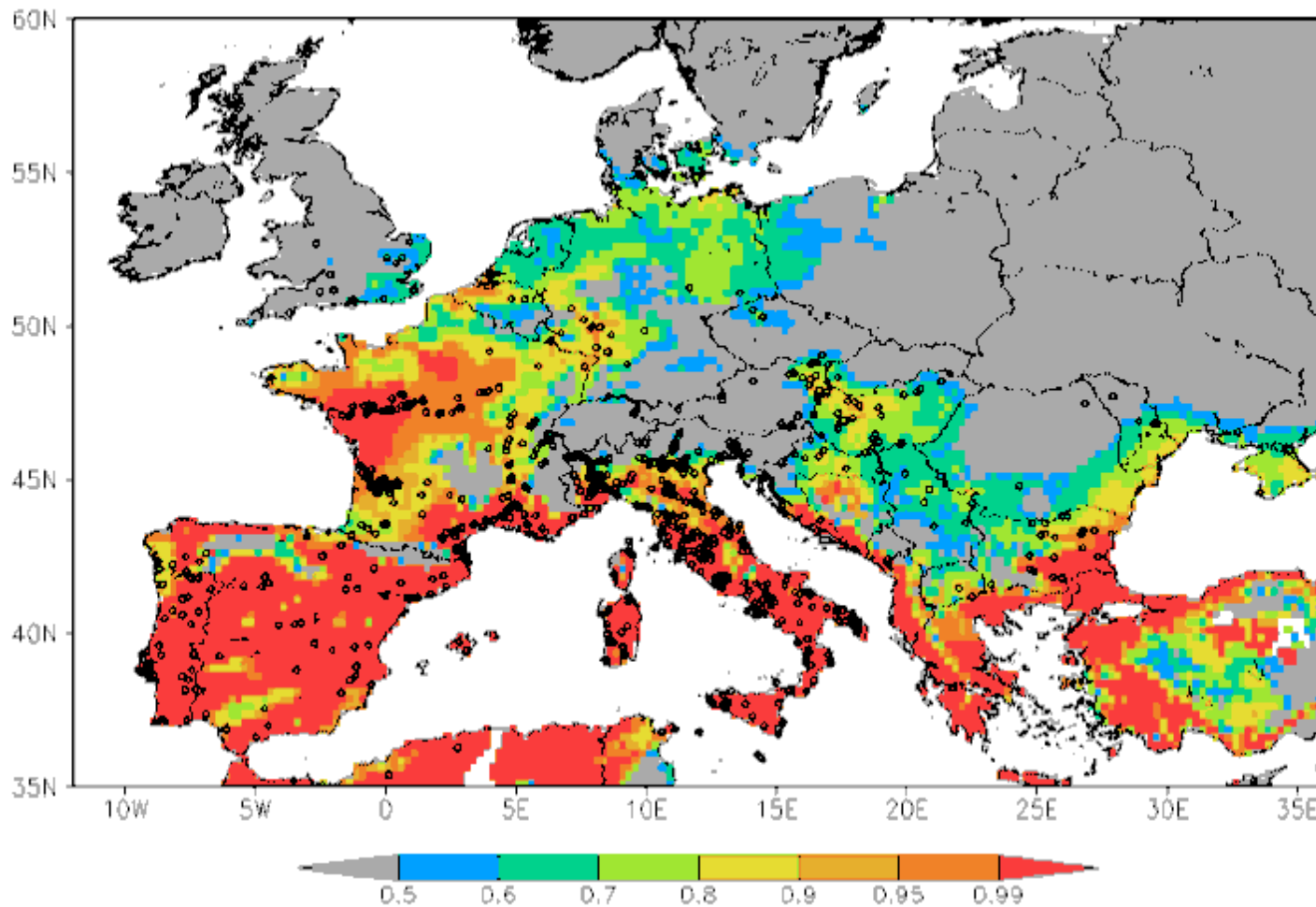


**Suitable climate: Compl > 50%**

# Composite Index (OBS: 1980-2010)



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Composite Index allows a **realistic** viticultural zoning in Europe

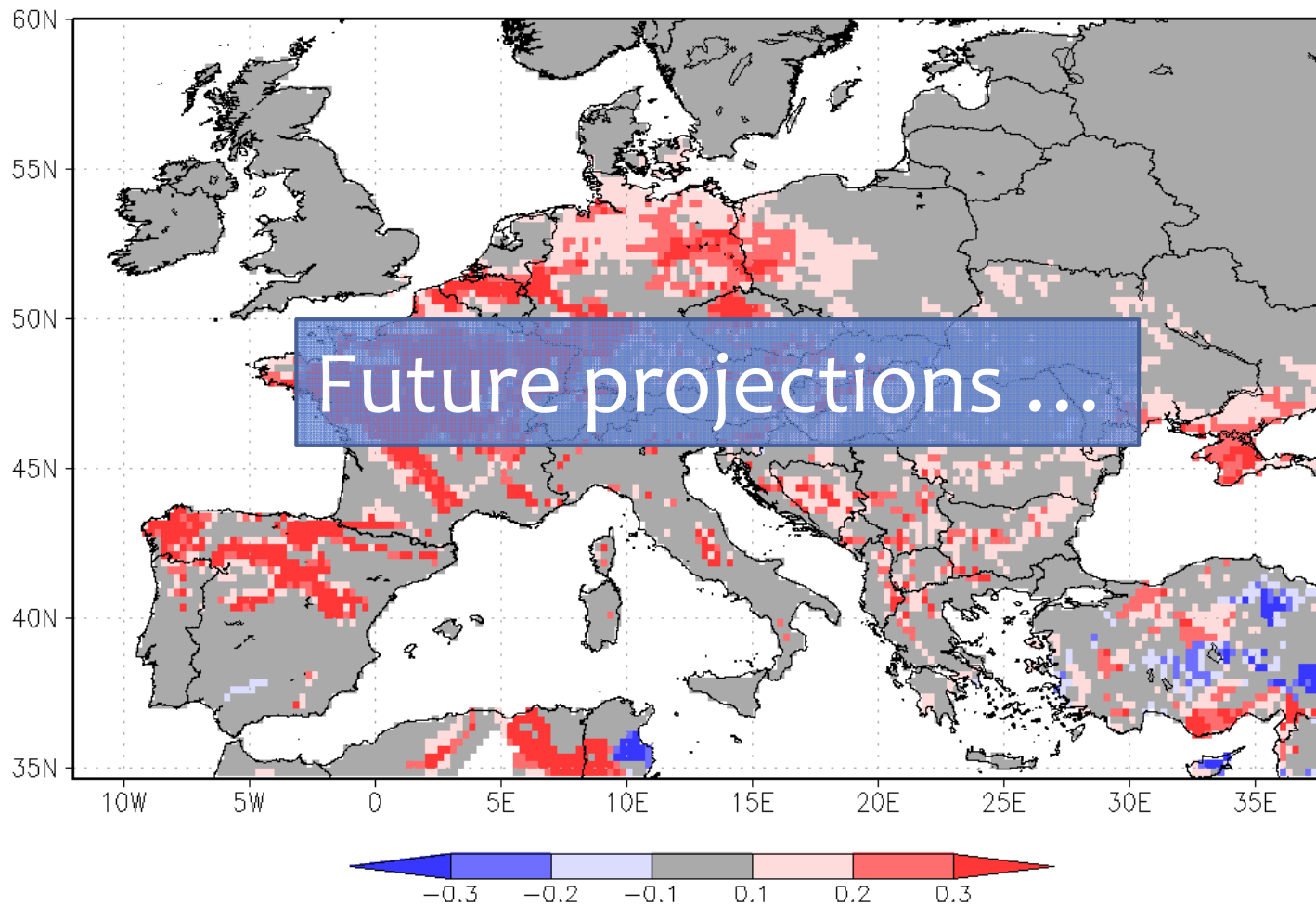


# Differences in the Composite Index (OBS)

1980/2010 – 1950/1979



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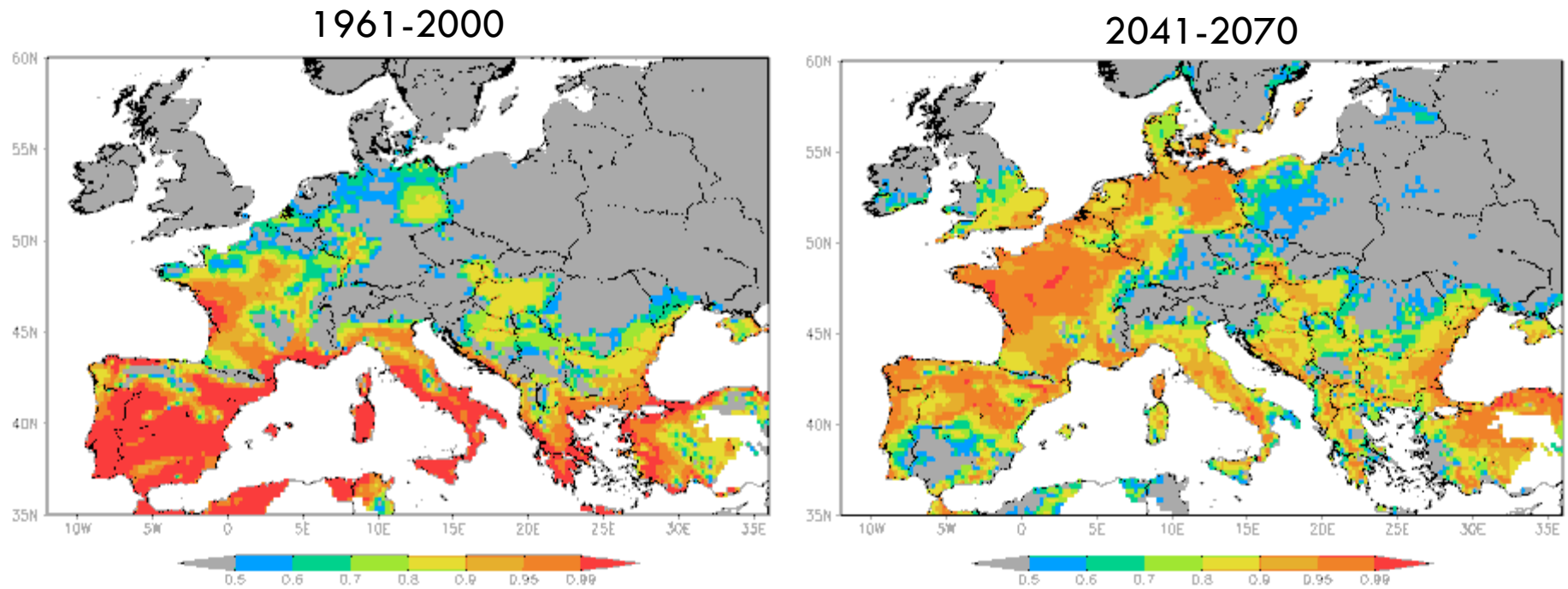


**Recent-past  
increase in  
climate  
suitability  
for viticulture**

# Composite Index



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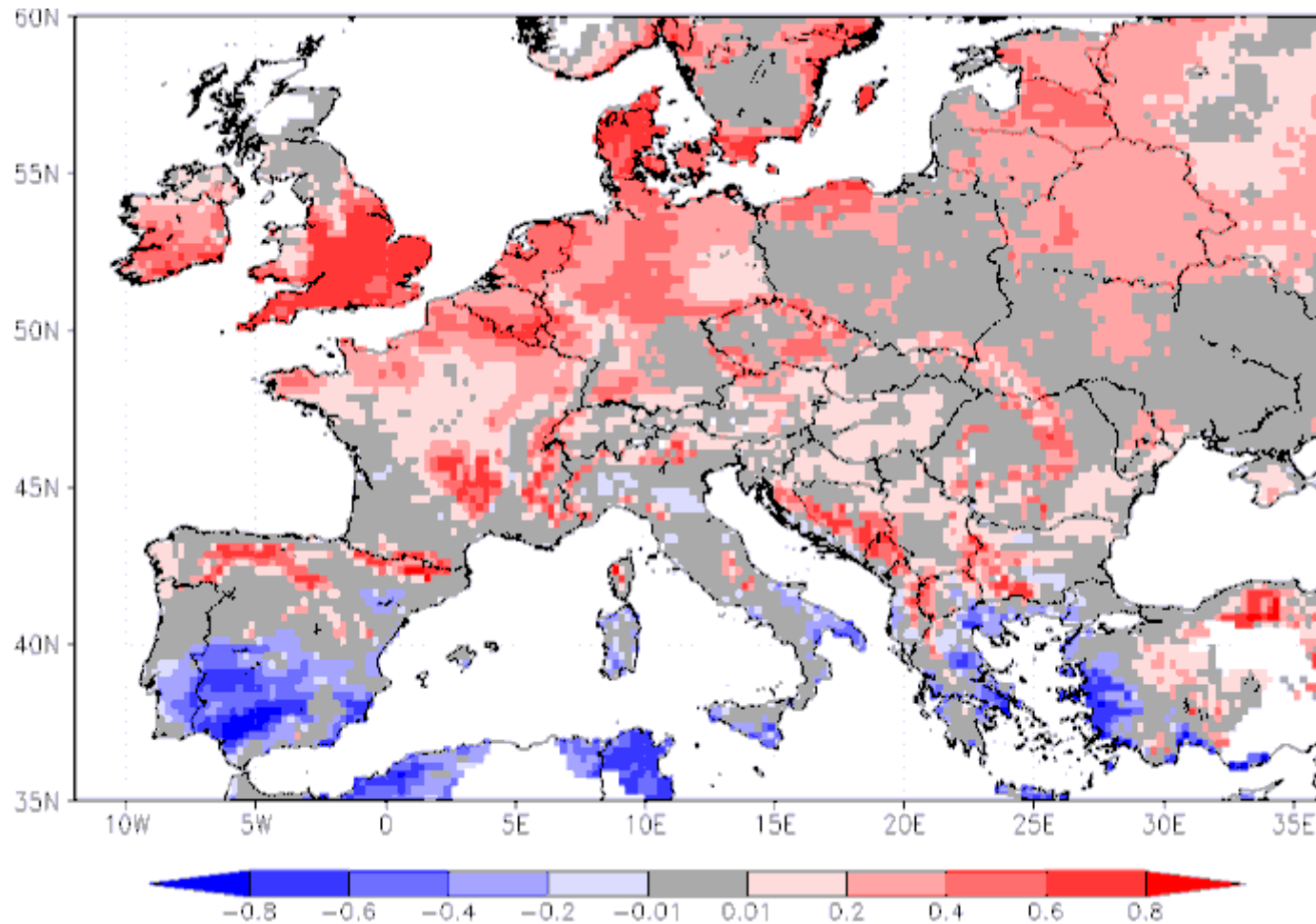
**Northward displacement of the “optimal regions”  
and reduction in their extension**

# Differences in the Composite Index

## 2041/2070 – 1961/2000



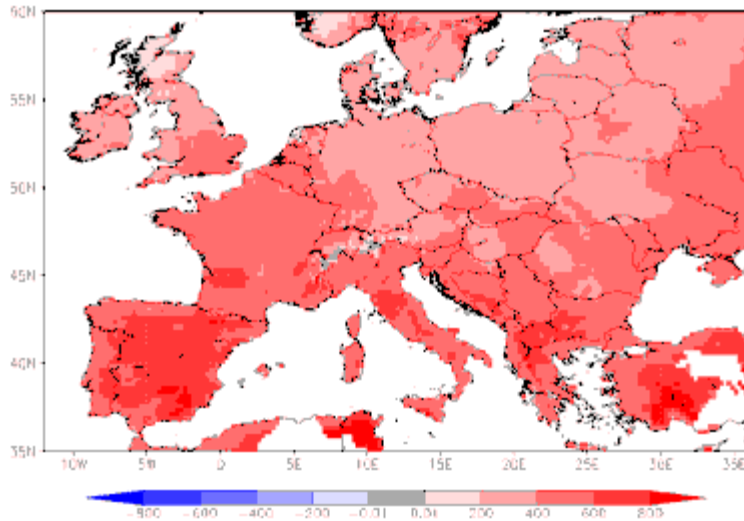
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# Main contributors to projected changes

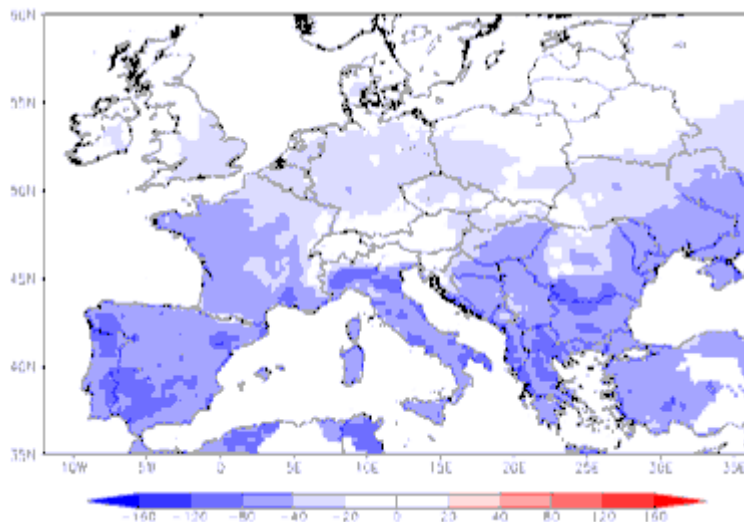


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Change in HI (A1B)

Significant  
**warming** of the  
growing season



Change in DI (A1B)

Significant  
**drying** of the  
growing season

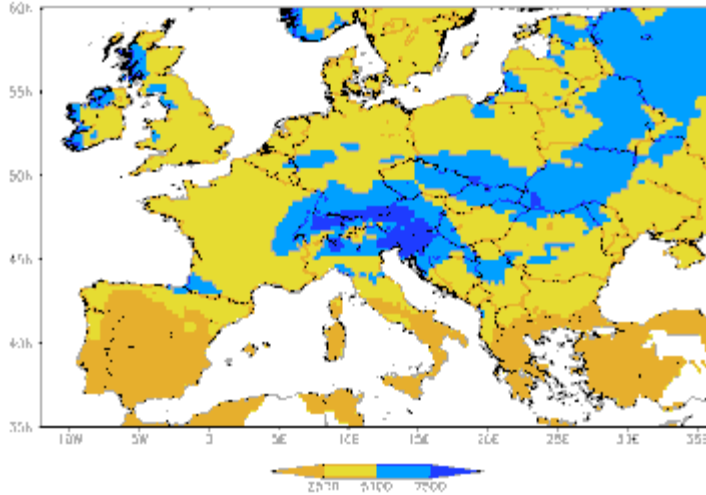


# Main climate change risks



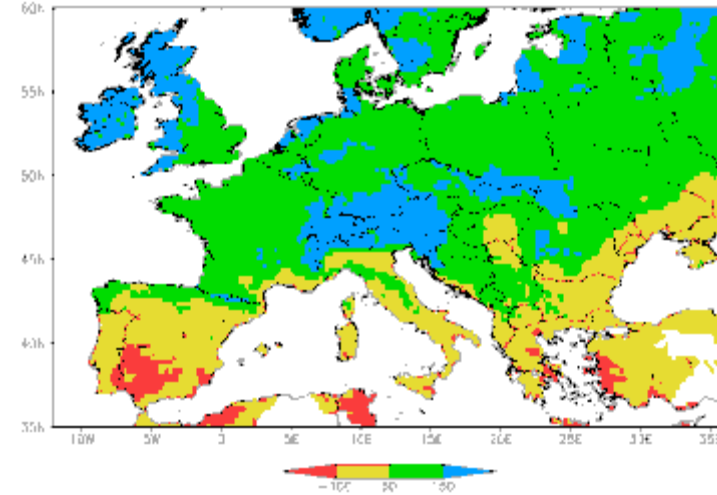
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Hyl – A1B (2041-2070)



pests & diseases

DI – A1B (2041-2070)



water stress

# Adaptation/mitigation measures



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## Short-term measures:

Irrigation

Changes in agricultural practices and  
in soil management

Plant protection against water &  
thermal stresses

More effective control of pests &  
diseases

Fertilization

## Long-term measures:

Selection of suitable grapevine  
varieties

Changes in the vineyards microclimate  
(e.g. solar exposure, altitude, vine  
density)

Genetic breeding

Thank you!