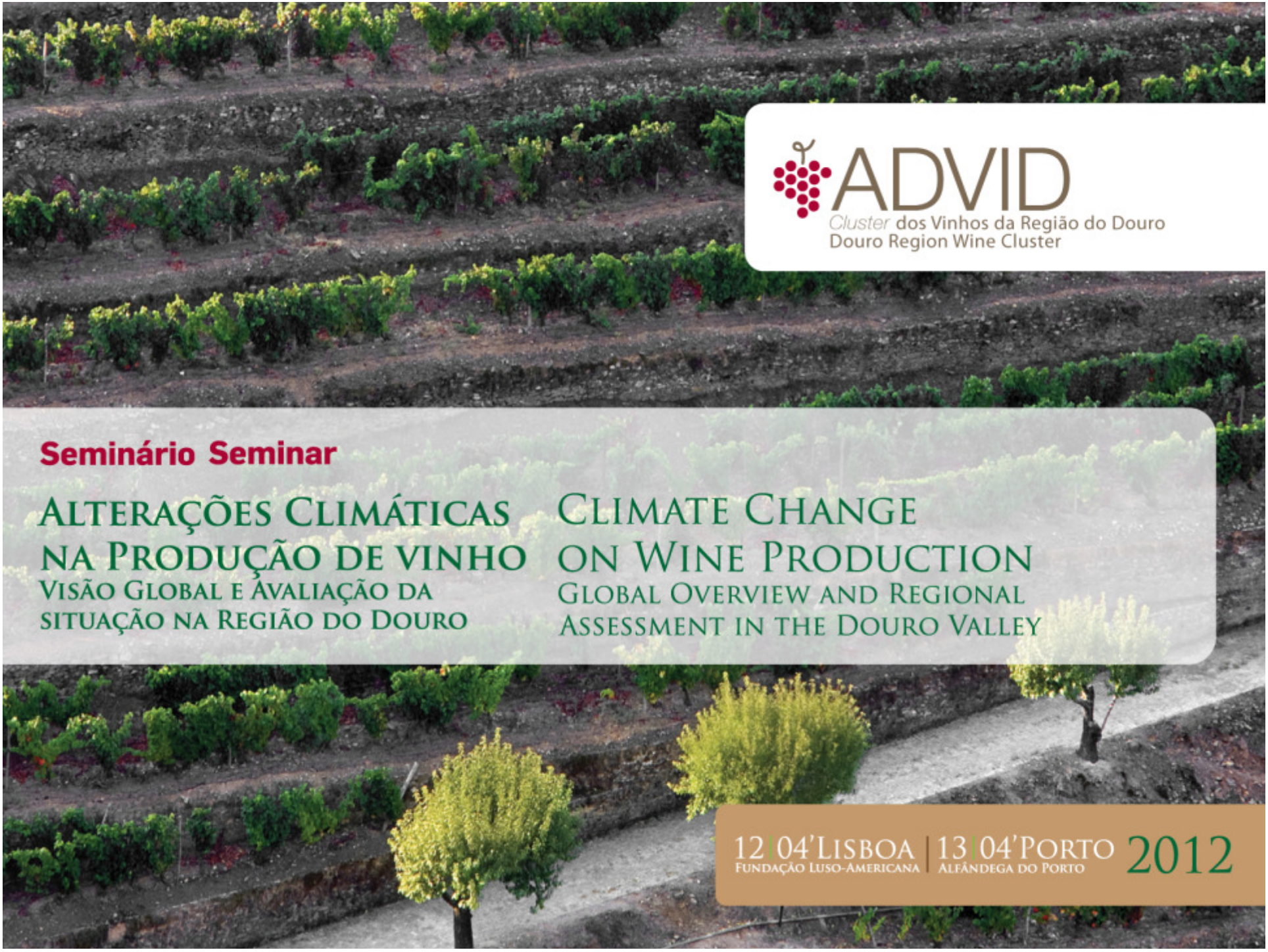


ADVID
Cluster dos Vinhos da Região do Douro
Douro Region Wine Cluster

Seminário Seminar

Alterações Climáticas na Produção de Vinho
Visão Global e Avaliação da situação na Região do Douro

Climate Change on Wine Production
Global Overview and Regional Assessment in the Douro Valley

12|04'Lisboa | Fundação Luso-Americana
13|04'Porto | Alfândega do Porto
2012

A Climate Assessment for the Douro Wine Region: An Examination for the Past, Present and Future Conditions for Wine Production

Gregory V. Jones
Department of Environmental Studies
Southern OREGON UNIVERSITY

In Collaboration with:

Association for Viticultural Development in the Douro Valley (ADVID)

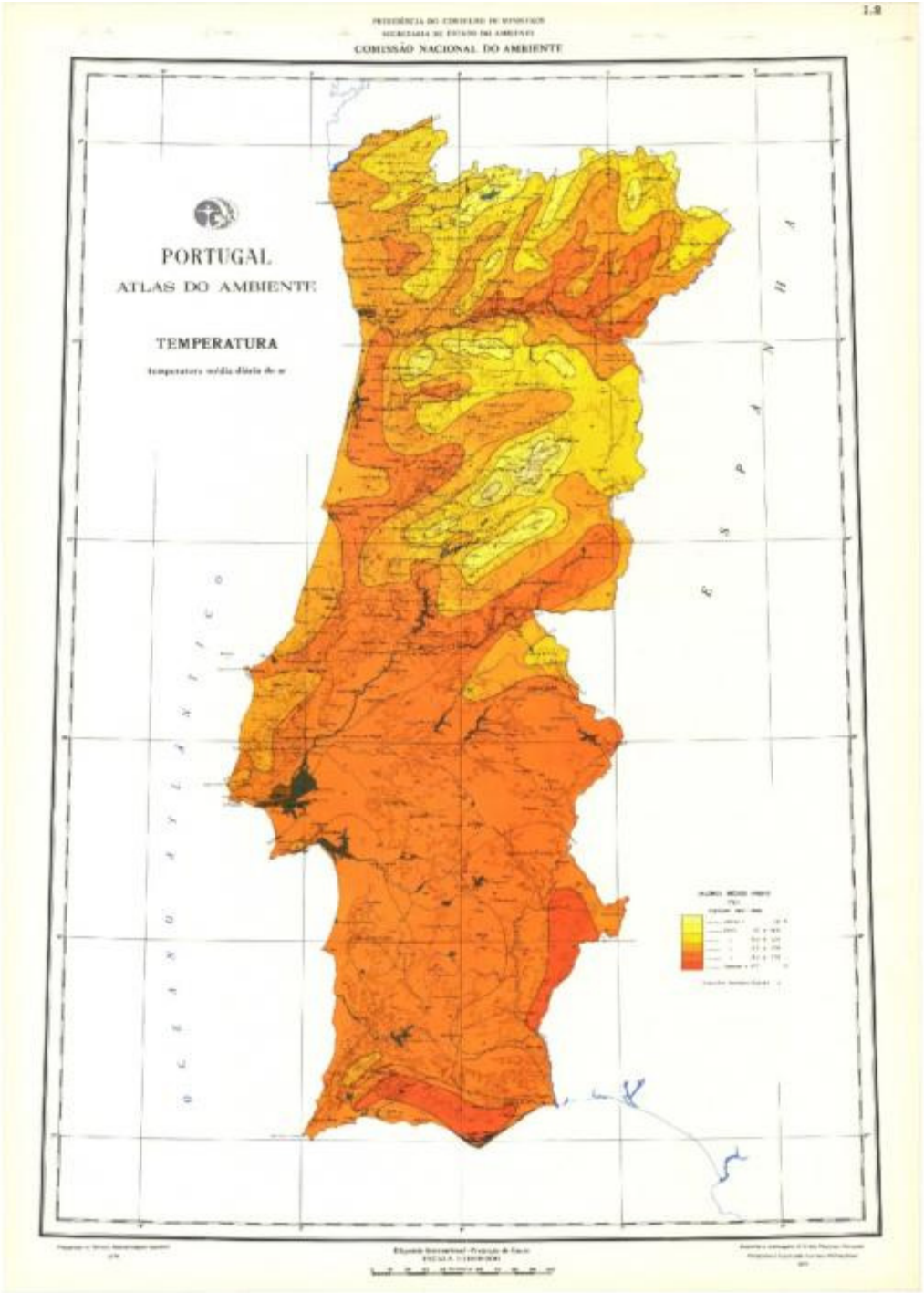
ADVID

Presentation Outline

- Overview of Climate Data for the Douro
- Overview of the:
  - Past Climate in the Douro
  - Current Climate in the Douro
  - Future Projected Climate in the Douro
- Summary and Future Developments

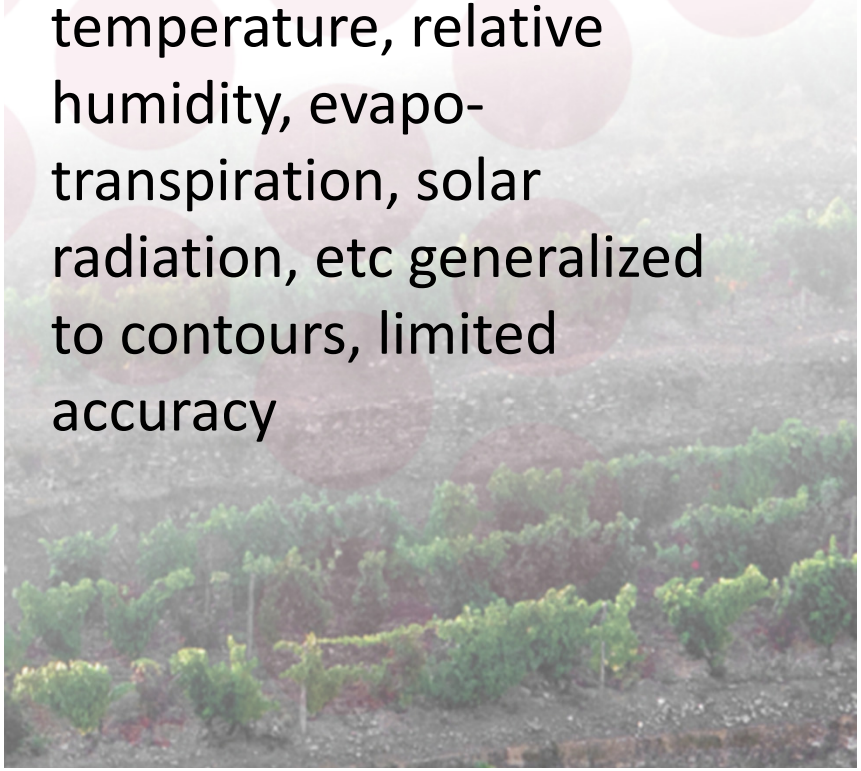
Overview of Climate Data for the Douro

- Long term station data for the region has been limited over both space and time
- Historic 1931-1960 monthly data accumulated by Ferreira (1965) and digitized to national contours by the Instituto do Ambiente (2002) and modified by others
- Limited stations with long term records for establishing characteristics and trends
  - Vila Real, Régua, Pinhão



1931-1960 Monthly National Data

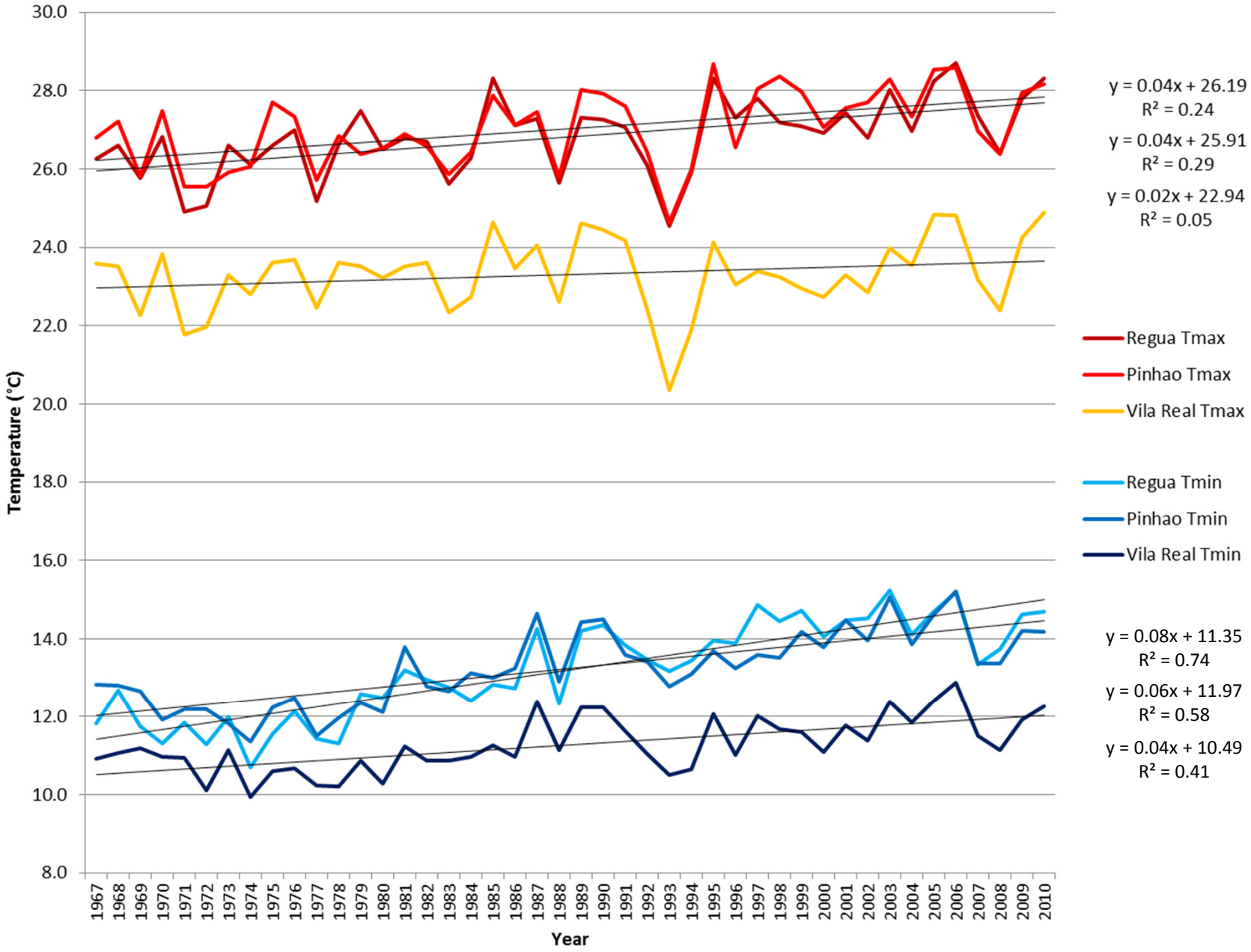
Monthly station data of annual precipitation, temperature, relative humidity, evapo-transpiration, solar radiation, etc generalized to contours, limited accuracy



Climate Station Analysis

- Only Vila Real, Régua, and Pinhão have qualified, moderately long-term station data
- Covers 1967-2010 for Tmax, Tmin, and Precipitation
- Conducted extensive quality assessment of the data
- Used the CCl/CLIVAR/JCOMM Expert Team (ET) on Climate Change Detection and Indices (ETCCDI) tools to test for:
  - Outliers (unrealistic values, bad data points, etc.)
  - Homogeneity (station moves, changes, etc.)
- Calculated 27 average and extreme climate parameters and indices for understanding climate structure and trends for each station

Growing Season Average Temperatures



Climate Extreme Indices

ID	Indicator name	Units	Régua Trend	Vila Real Trend	Pinhão Trend	Average Trend
FD0	Frost days	Days	-18.7		-11.4	-15.1
CSDI	Cold spell duration indicator	Days	-16.8		-10.5	-13.6
SU25	Summer days	Days	25.6		20.7	23.1
ST35	Stress days	Days	18.6		16.1	17.3
TR20	Tropical nights	Days	13.4	6.1	9.5	9.7
TN10p	Cool nights	Days	-19.8	-5.8	-13.4	-13.0
TN90p	Warm nights	Days	18.9	9.3	12.0	13.4
TX90p	Warm days	Days	7.9		6.5	7.2
TXx	Max Tmax	°C	2.2		2.5	2.3
TNx	Max Tmin	°C	4.3	2.9	3.3	3.5
TNn	Min Tmin	°C	1.9	1.2	2.2	1.8
DTR	Diurnal temperature range	°C	-1.9	-0.6	-1.0	-1.2

- General characteristics: higher minimum and maximum temperatures, increase in extreme temperatures, fewer cold events and not as cold, more heat stress events, and a lower diurnal temperature range

Spatial Climate Data Products

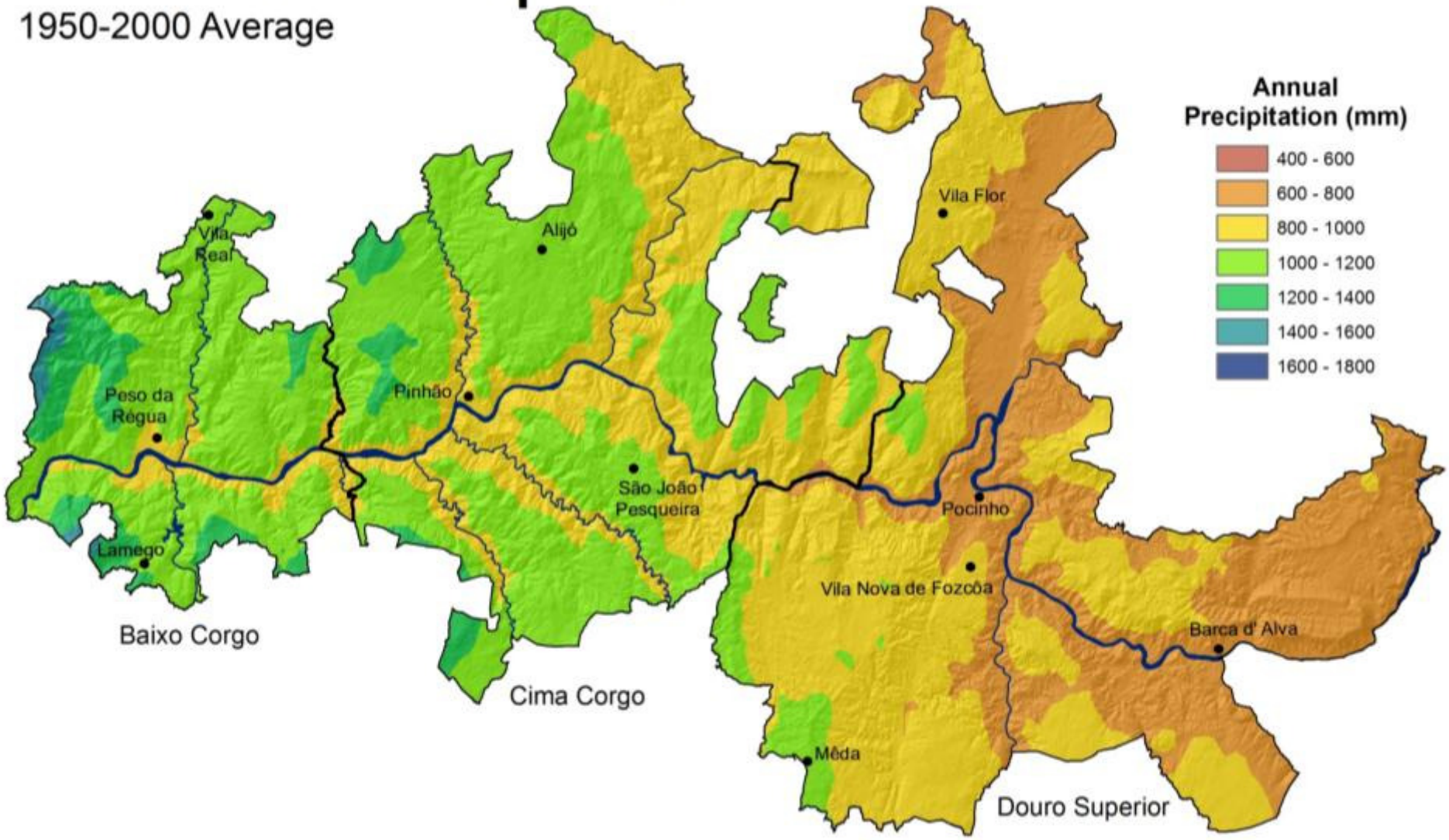
- Understanding the climate structure in wine regions helps define/understand cultivar suitability, along with wine style, production and quality potential
- Station data issues … station location is generally not representative of vineyard locations
- However interpolation of stations using topography, known horizontal and vertical atmospheric patterns, and latitude and longitude can generate tremendous improvement in spatial climate data and understanding
- Many new spatial climate data products are now available, or being developed, at resolutions that are useful for viticulture

WorldClim Database

- Uses monthly averages of climate as measured at weather stations from a large number of global, regional, national, and local sources for 1950-2000
- Interpolates these data using the thin-plate smoothing spline algorithm implemented in ANUSPLIN
- 30 arc second spatial resolution (0.86 km^2 at the equator, ~1 km for the mid-latitudes)
- Strong cross validation and uncertainty assessment
- Further assessed for appropriate use in the Douro; correlates highly with 1931-1960 and 1967-2010 station data and ENSEMBLES E-OBS data (25 km resolution) for the region

Annual Precipitation

1950-2000 Average



WorldClim 1 km Database
Hijmans et al. (2005)

0 5 10 20 30 40 50 Kilometers

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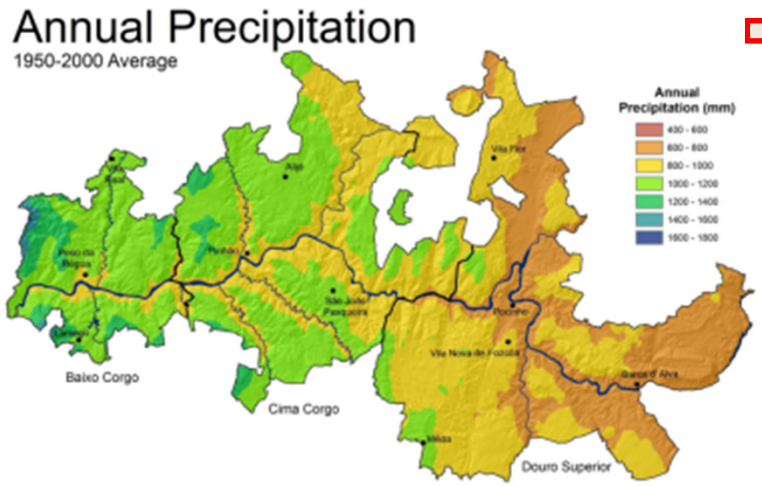
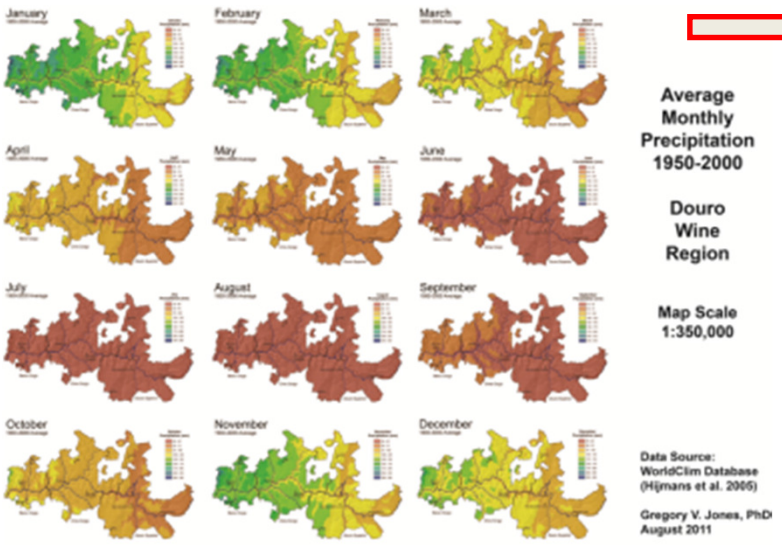
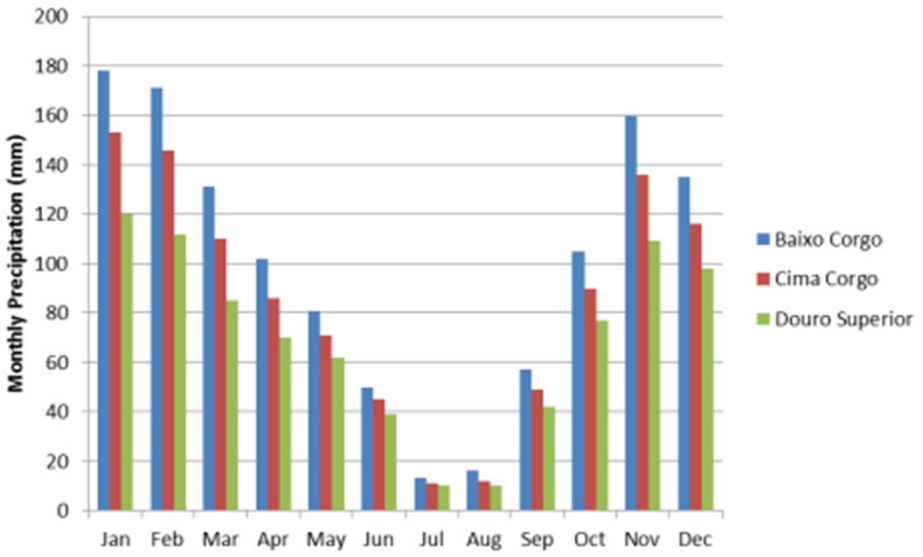
August 2011

With gridded climate data one can assess not only the visual spatial characteristics of climate parameters, but also summarize the statistical properties both within and between regions



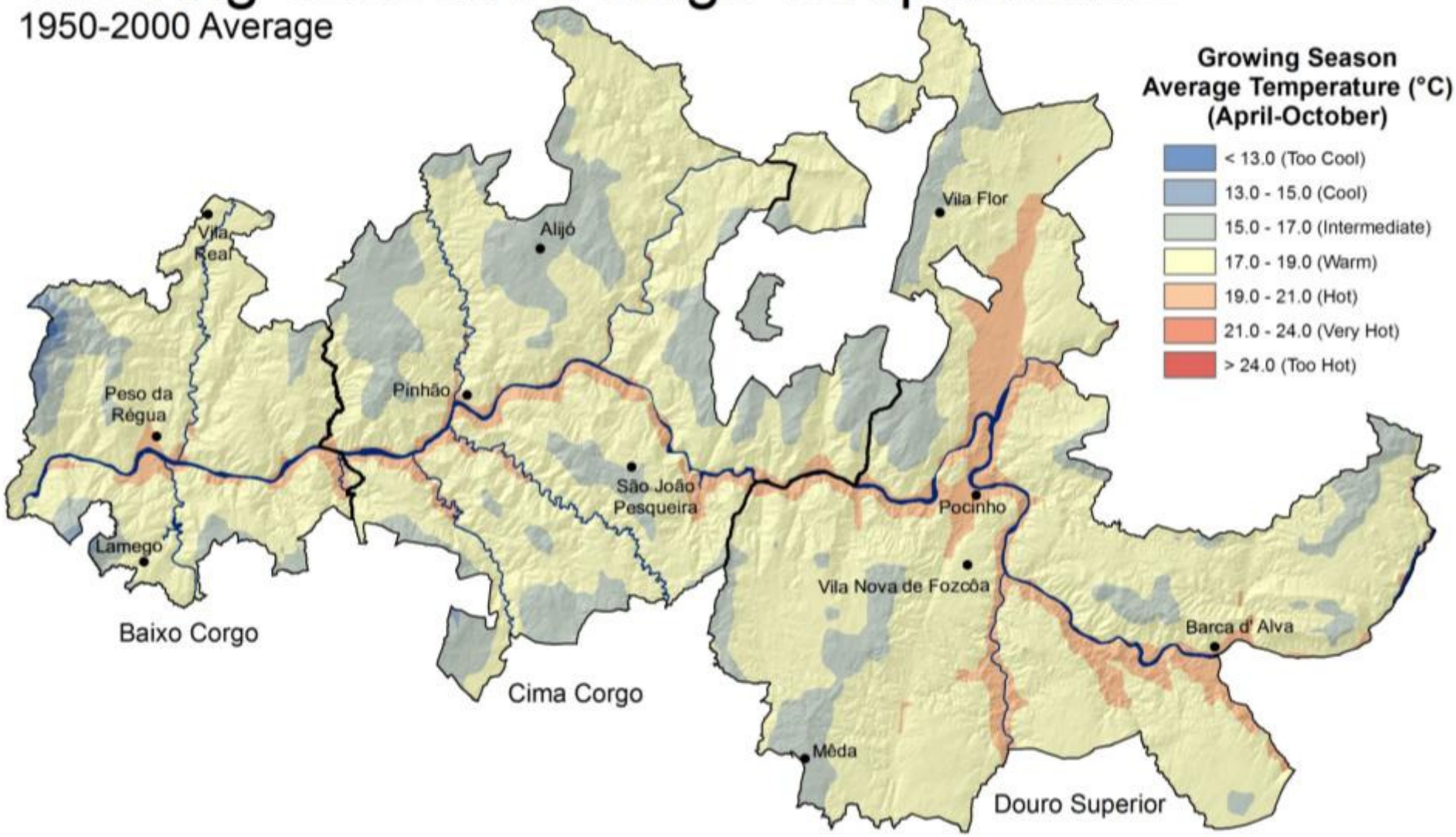
Annual Precipitation Statistics					
	Min	25%	Median	75%	Max
Baixo Corgo	971	1128	1190	1282	1625
Cima Corgo	778	938	1026	1089	1314
Douro Superior	643	776	832	927	1123





Growing Season Average Temperatures

1950-2000 Average



WorldClim 1 km Database
Hijmans et al. (2005)

0 5 10 20 30 40 50 Kilometers

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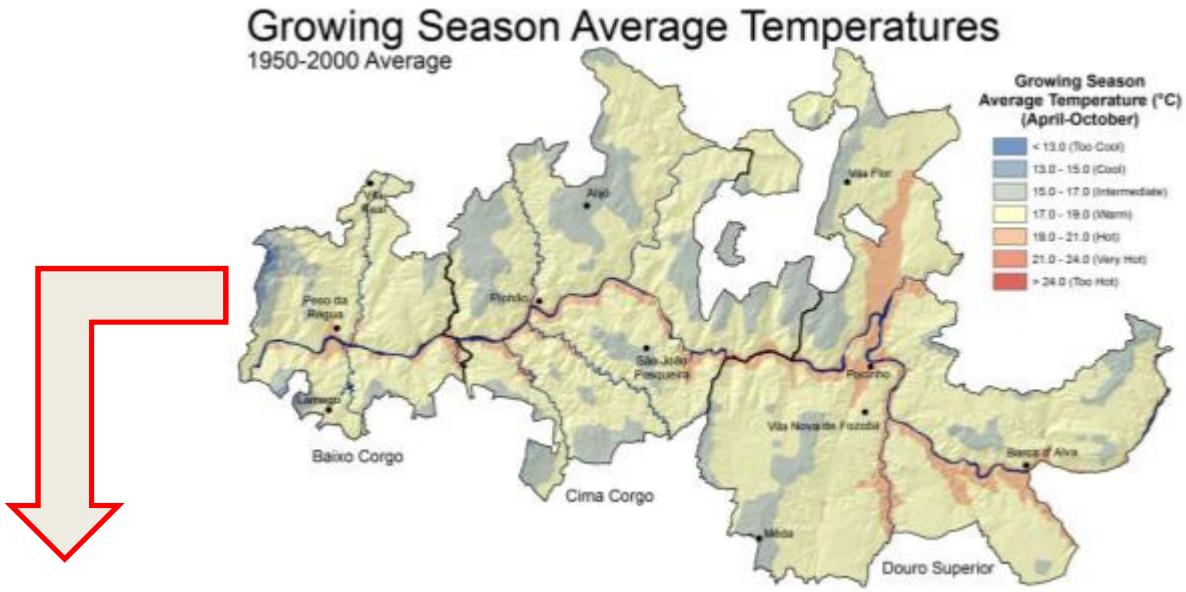
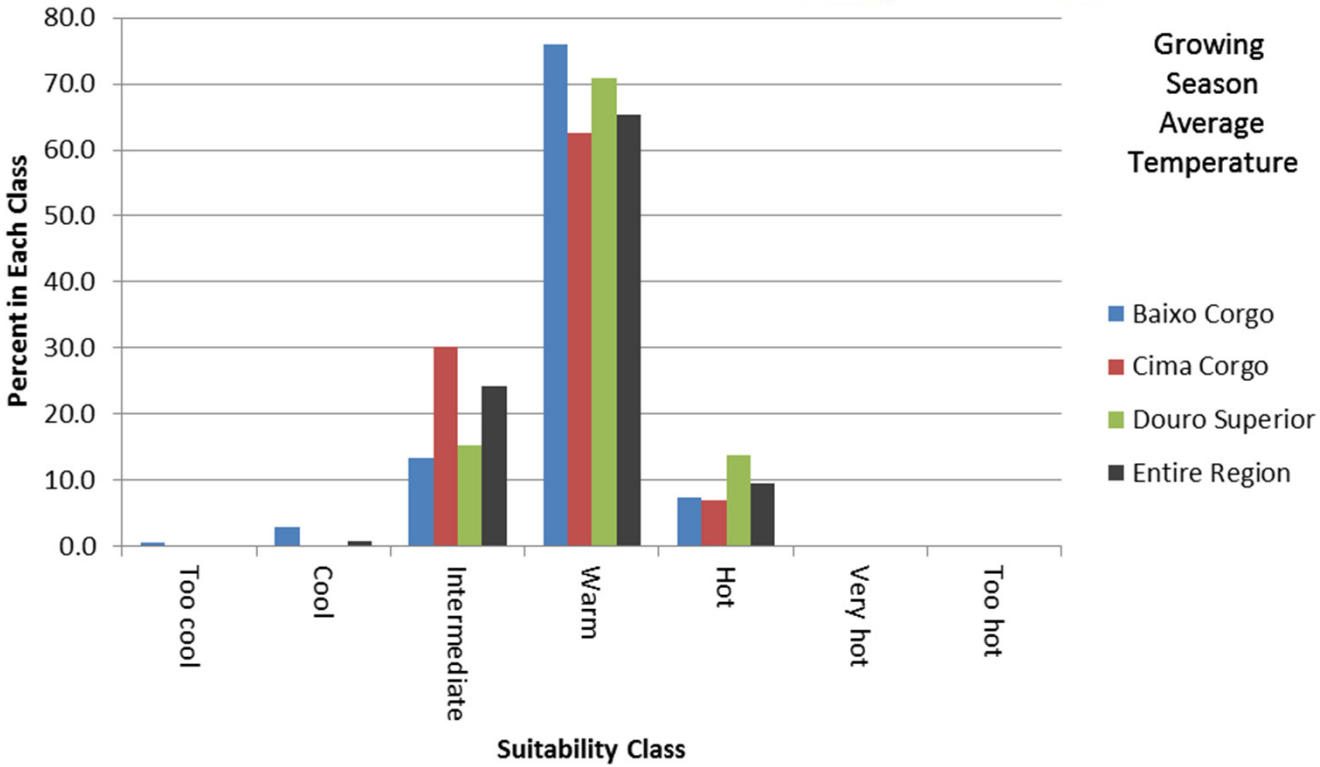
August 2011

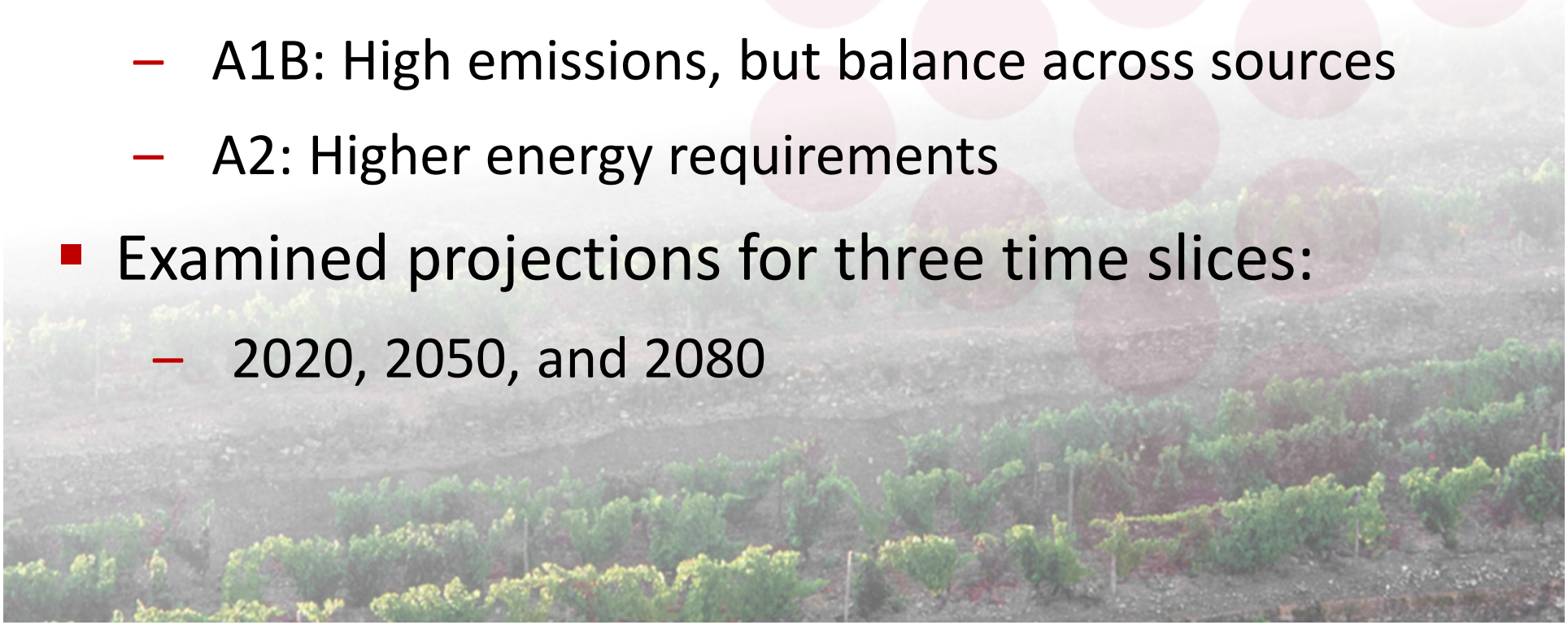
Again, with gridded climate data one can assess not only the visual spatial characteristics of climate parameters, but also summarize the area of each region that falls within certain categories of climate suitability



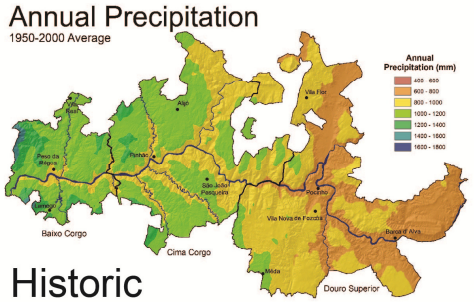


Future Projected Climate for the Douro

- Used downscaled GCM output from the HADCM3 climate model (1km resolution = WorldClim)
- For three future emission scenarios:
  - B2: Lower energy requirements
  - A1B: High emissions, but balance across sources
  - A2: Higher energy requirements
- Examined projections for three time slices:
  - 2020, 2050, and 2080

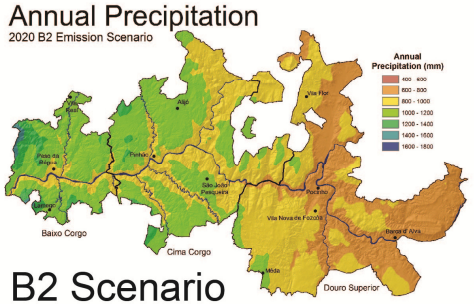


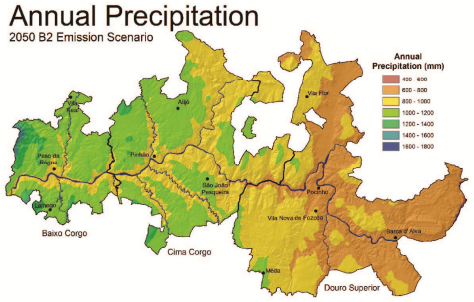
Douro Wine Region
Annual Precipitation
1950-2000 and
2020, 2050, and 2080
for B2, A1B, and A2 Emission Scenarios

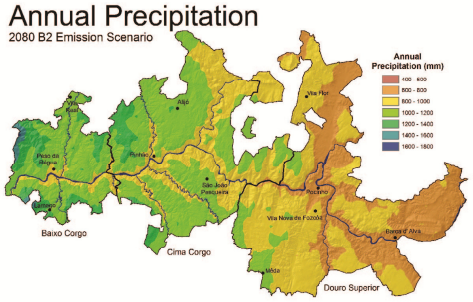


Historic

Region	Annual Precipitation (mm)
Baixo Corgo	1190
Cima Corgo	1026
Douro Superior	832



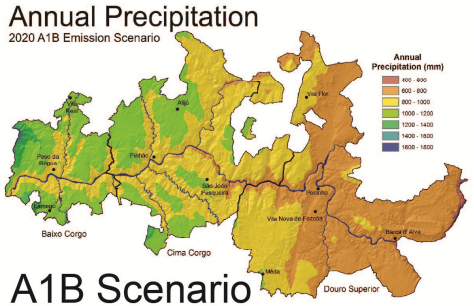


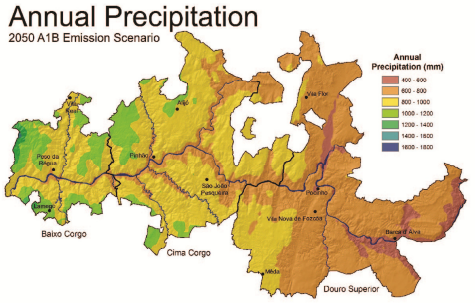


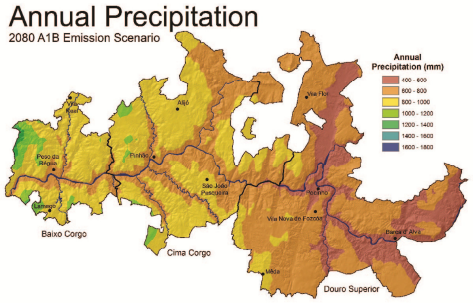
B2 Scenario

Projected Changes From 1950-2000

Region	B2 2020 (%)	B2 2050 (%)	B2 2080 (%)
Baixo Corgo	-1.2	-2.2	1.4
Cima Corgo	-1.1	-2.1	1.6
Douro Superior	-1.5	-2.4	1.0

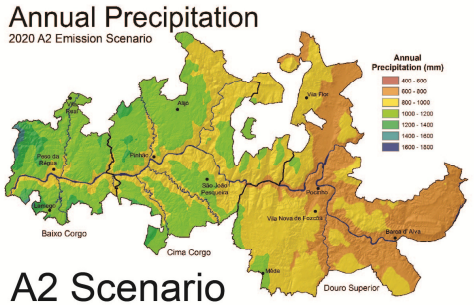


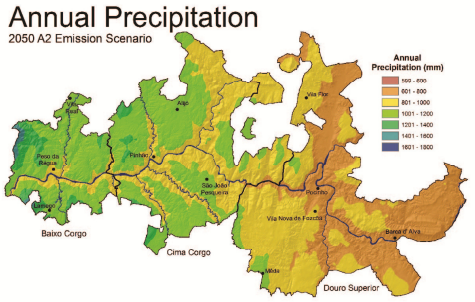


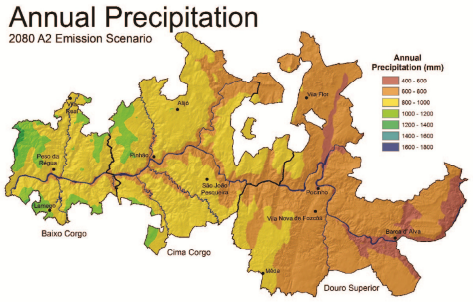


A1B Scenario

Region	A1B 2020 (%)	A1B 2050 (%)	A1B 2080 (%)
Baixo Corgo	-6.2	-13.2	-18.8
Cima Corgo	-6.3	-13.8	-19.5
Douro Superior	-7.2	-15.3	-21.6







A2 Scenario

Region	A2 2020 (%)	A2 2050 (%)	A2 2080 (%)
Baixo Corgo	-0.8	-0.5	-15.3
Cima Corgo	-1.1	-0.9	-15.7
Douro Superior	-1.4	-1.3	-16.8

Map Scale
1:350,000

Data Source:
WorldClim Database
(Hijmans et al. 2005)

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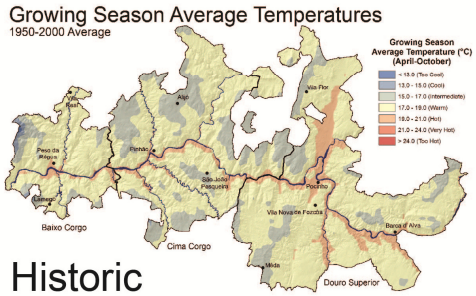
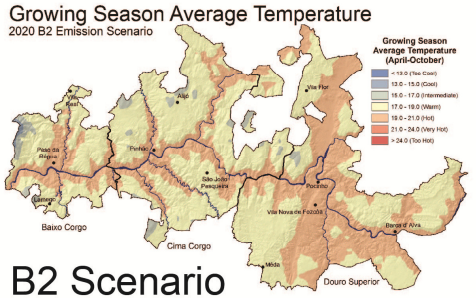
August 2011

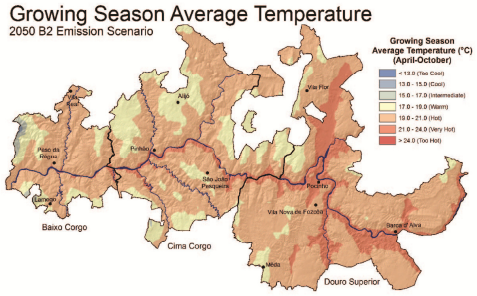
Douro Wine Region
Growing Season Average Temperatures 1950-2000 and 2020, 2050, and 2080 for B2, A1B, and A2 Emission Scenarios

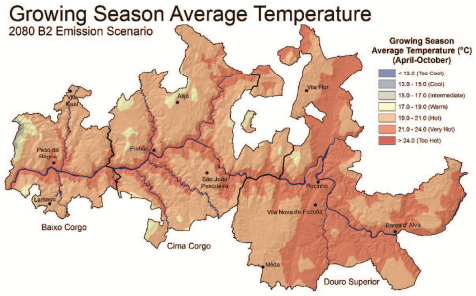


Historic

Region	Median Temperature (°C)
Baixo Corgo	17.5
Cima Corgo	17.5
Douro Superior	18.0



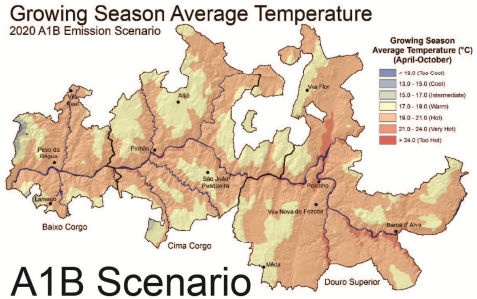


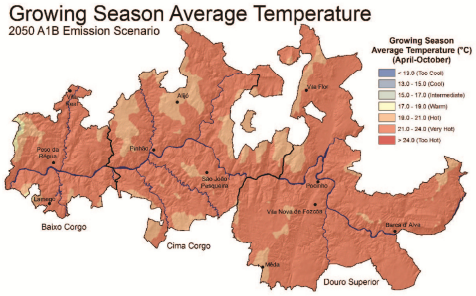


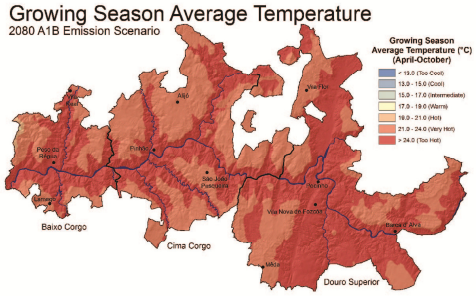
B2 Scenario

Projected Changes From 1950-2000

Region	B2 2020 (°C)	B2 2050 (°C)	B2 2080 (°C)
Baixo Corgo	0.8	1.8	2.5
Cima Corgo	1.0	2.0	2.9
Douro Superior	1.0	2.2	3.1

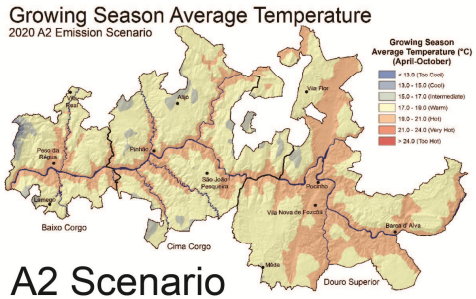


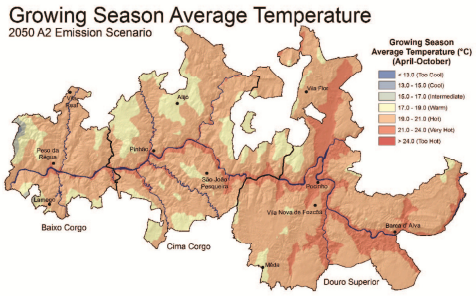


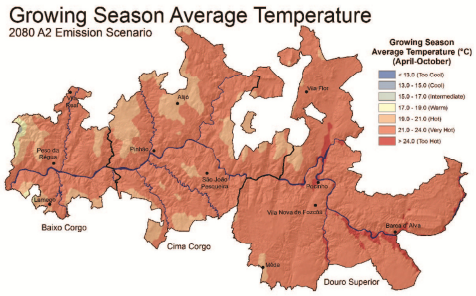


A1B Scenario

Region	A1B 2020 (°C)	A1B 2050 (°C)	A1B 2080 (°C)
Baixo Corgo	1.7	4.1	6.4
Cima Corgo	1.7	4.1	6.4
Douro Superior	1.8	4.3	6.6







A2 Scenario

Region	A2 2020 (°C)	A2 2050 (°C)	A2 2080 (°C)
Baixo Corgo	0.6	1.9	3.7
Cima Corgo	0.8	2.1	4.2
Douro Superior	0.8	2.3	4.6

Map Scale 1:350,000

Data Source: WorldClim Database (Hijmans et al. 2005)

Gregory V. Jones, PhD
August 2011

Summary and Future Developments

- General station trends in the Douro Wine Region show:
  - Higher minimum and maximum temperatures
  - Increases in extreme temperatures
  - Fewer cold events and not as cold
  - More heat stress events
  - A lower diurnal temperature range
- Gridded spatial climate products give a sound representation of Douro Wine Region climate structure, better than typical station comparisons

Summary and Future Developments

- Future projections for the Douro Wine Region, over three different emission scenarios, indicate a range of growing season warming of:
  - 0.8-1.8°C by 2020
  - 1.8-4.3°C by 2050
  - 2.5-6.6°C by 2080
- A range of annual precipitation decreases of:
  - 0-7% by 2020
  - 0-15% by 2050
  - 0-22% by 2080
- With a greater reduction in precipitation during the growing season than during the winter

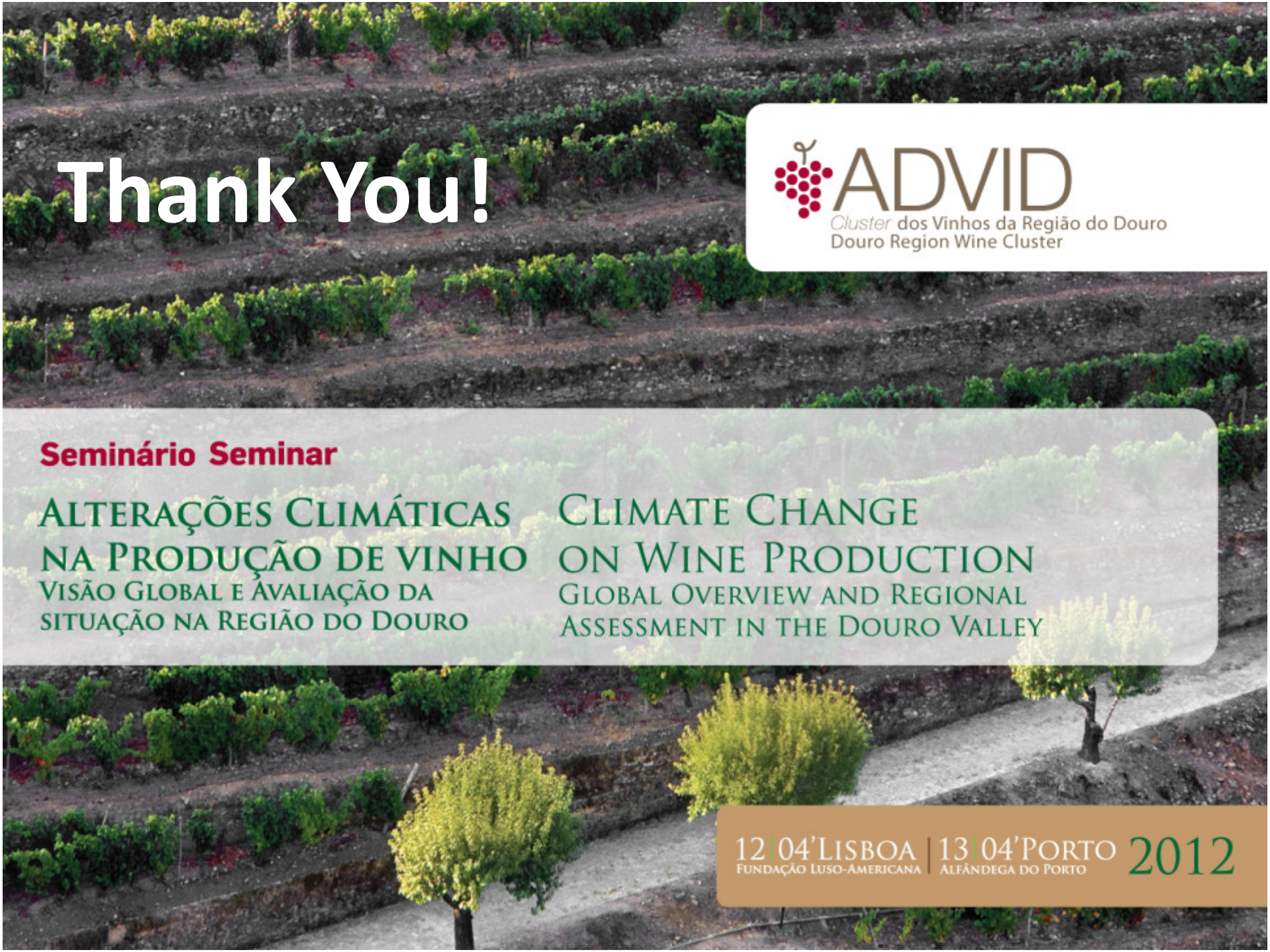
Summary and Future Developments

Douro Wine Region

- Already warm and dry with heat and water stress in most years, small changes in climate may push regional climate thresholds sooner than other regions
- Large genetic potential and adaptive capacity
- Large landscape potential and adaptive capacity

Future Work

- Continue to develop the understanding of spatial climate structure and range of observed and projected changes
- Further develop plant, production, and quality models
- Assist ADVID, growers, producers with strategies to reduce vulnerability and increase adaptive capacity


Thank You!
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