

## **Rating Guidance for Climatic Suitability**

The following questions are designed to help identify the climates suitable for the pest to establish:

(i) What is the pest's current area of distribution?

Refer to maps and summarised information in datasheets, CABI Crop Protection Compendium, EPPO PQR etc.

Record as, e.g:

- Cosmopolitan
- Pantropical
- In protected cultivation

Or by:

- Ecozone (Palearctic, Nearctic, Afrotropic, Neotropic, Australasia, Indo-Malaya, Oceania, Antarctic)
- Continent
- Country
- State

(ii) What climates occur in the pest's current area of distribution?

Examine the CABI Compendium maps of pest distribution superimposed on climate (see Appendix 1) and record as:

- Tropical
  - Rain Forest
  - Savannah
- Dry
  - Desert
  - Steppe
- Temperate
  - Warm with dry winter
  - Warm with dry summer
  - Humid with hot summer
  - Humid with cool summer
- Continental
  - Cold winter
  - Cold wet winter
  - Cold dry winter
- Polar and Mountain
  - Tundra
  - Perpetual Ice

Alternatively use:

- Köppen-Geiger Climate Zones. These have been used as a basis for the CABI Crop Protection Compendium climatic maps but have more classes and have recently been updated (Kottek *et al.*, 2006). See Appendix 2.
- World hardiness zones based on **average annual minimum temperatures** (Magarey *et al.*, 2008) from the NAPPFAST website ([www.nappfast.org/](http://www.nappfast.org/)). See Appendix 3.
- Degree day maps based on temperature accumulation above, e.g. 10°C (Baker, 2002). See Appendix 4.

(iii) Where in the PRA area are there hosts and/or suitable habitats?

Refer to question 1.15

(iv) What climates in the pest's current area of distribution occur in the PRA area where there are suitable hosts/ habitats?

Use:

- Köppen-Geiger Climate Zones (Kottek *et al.*, 2006). See Appendix 2.
- World hardiness zones based on **average annual minimum temperatures** (Magarey *et al.*, 2008). See Appendix 3.
- Degree day maps based on temperature accumulation above, e.g. 10°C (Baker, 2002). See Appendix 4.

Regional climate maps can also be used. For Europe, Metzger *et al.* (2005) provides a recent attempt to stratify European climate (see Appendix 5).

At present only a visual comparison is proposed. However, for the Köppen-Geiger Climate Zones, Appendix 2 provides maps showing the locations of the EU climate zones in the rest of the world and tables with percentages of their land surface with EU climate zones.

The match climates component of the software program CLIMEX provides algorithms for comparing climates at one location with many locations. CLIMEX procedures for comparing areas using a genetic algorithm are available and under development.

## References

- Baker, R.H.A. 2002. Predicting the limits to the potential distribution of alien crop pests. In: *Invasive Arthropods in Agriculture. Problems and Solutions*, Hallman, G.J. & Schwalbe, C.P. (Eds). pp. 207-241. Science Publishers Inc. Enfield USA.
- Kottek, M., Grieser, J., Beck C., Rudolf, B. & Rubel, F. 2006. World map of Köppen- Geiger climate classification updated. *Meteorologische Zeitschrift*, **15**: 259-263.
- Magarey, R.D., Borchert, D.M. & Schlegel, J.W. 2008. Global plant hardiness zones for phytosanitary risk analysis. *Scientia Agricola*, **65**: 54-59.
- Metzger, M.J., Bunce, R.G.H., Jongman, R.H.G., Múcher, C.A. & Watkins, J.W. 2005. A climatic stratification of the environment of Europe. *Global Ecology and Biogeography*, **14**, 549–563.
- New, M., Lister, D. Hulme, M. Makin, I. 2002. A high-resolution data set of surface climate over global land areas. *Climate Research*, **21**: 1-25.

**Appendix 1 CABI Crop Protection Compendium Pest Distribution and Climate Maps**

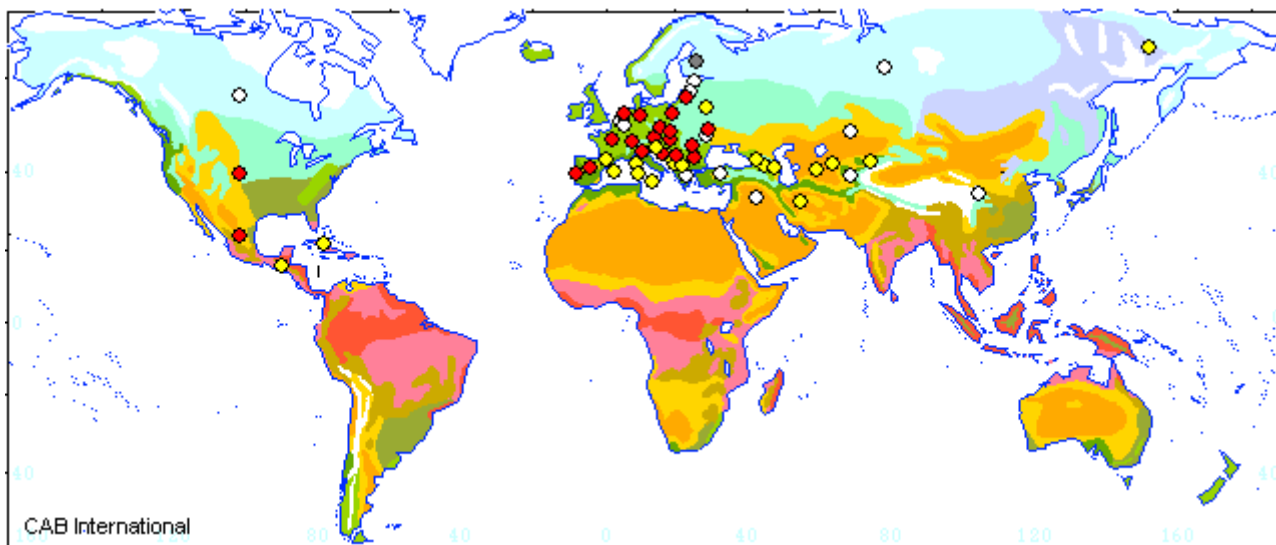


Fig 1a CABI Compendium World Map: Pest Distribution and Climate

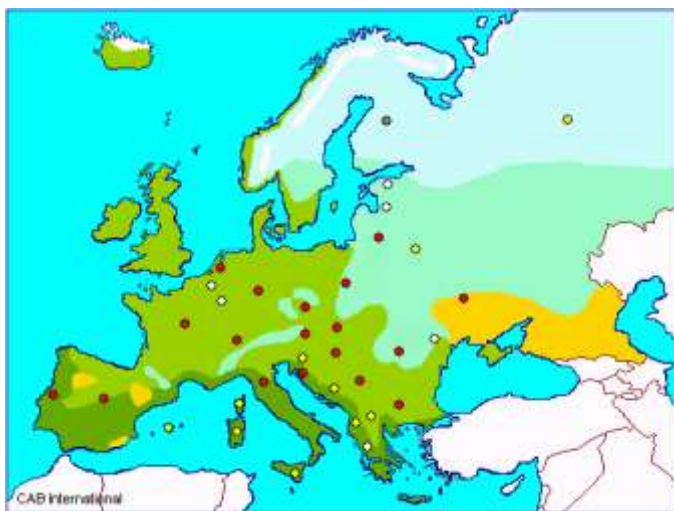


Fig 1b CABI Compendium European Map: Pest Distribution and Climate

**Tropical climates**

- Rain forest
- Savannah

**Dry climates**

- Desert
- Steppe

**Temperate climates**

- Warm with dry winter
- Warm with dry summer
- Humid with hot summer
- Humid with cool summer

**Continental climates**

- Cold winter
- Cold, wet winter
- Cold, dry winter

**Polar & mountain climates**

- Tundra
- Perpetual frost

## Appendix 2 Köppen-Geiger Climate Classification

The global Köppen-Geiger climate zones (Kottek *et al.*, 2006) take into account average minimum winter temperatures and summer maxima (as well as rainfall amount and pattern) and can therefore be considered to be more useful for predicting the potential distribution based on climate for insects than, e.g. hardiness zones (Appendix 3) that only take winter minima into account. However, Figure 2B shows that, for instance, apart from Tibet and the extreme north-west of China, only two EU Köppen-Geiger climate zones (“Bsk”: arid main climate, steppe precipitation, cool arid temperature and “Esk”: warm temperate main climate, fully humid precipitation, hot summer temperature) are found in China because, in locations with summer temperatures comparable to those in Europe, the winters in China are very much colder. Recent invasions have shown that many Chinese species from outside these Köppen-Geiger climate zones can establish in the EU, showing that the severity of the winter is often not important for pest establishment.

Tables 1 and 2 show the percentage of the EU Köppen-Geiger Climate Zones in the EU members states and other countries of the world

### A Tropical humid

- Af Tropical wet
  - No dry season
- Am Tropical monsoonal
  - Short dry season; heavy monsoonal rains in other months
- Aw Tropical savanna
  - Winter dry season

### B Dry

- BWh Subtropical desert
  - Low-latitude desert
- BSh Subtropical steppe
  - Low-latitude dry
- BWk Mid-latitude desert
  - Mid-latitude desert
- BSk Mid-latitude steppe
  - Mid-latitude dry

### C Mild Mid-Latitude

- Csa Mediterranean
  - Mild with dry, hot summer
- Csb Mediterranean
  - Mild with dry, warm summer
- Cfa Humid subtropical
  - Mild with no dry season, hot summer
- Cwa Humid subtropical
  - Mild with dry winter, hot summer
- Cfb Marine west coast
  - Mild with no dry season, warm summer
- Cfc Marine west coast
  - Mild with no dry season, cool summer

### D Severe Mid-Latitude

- Dfa Humid continental
  - Humid with severe winter, no dry season, hot summer
- Dfb Humid continental
  - Humid with severe winter, no dry season, warm summer
- Dwa Humid continental
  - Humid with severe, dry winter, hot summer
- Dwb Humid continental
  - Humid with severe, dry winter, warm summer
- Dfc Subarctic

- Severe winter, no dry season, cool summer
- Dfd Subarctic
  - Severe, very cold winter, no dry season, cool summer
- Dwc Subarctic
  - Severe, dry winter, cool summer
- Dwd Subarctic
  - Severe, very cold and dry winter, cool summer

**E polar**

- ET Tundra
  - Polar tundra, no true summer
- EF Ice Cap
  - Perennial ice

**H Highland**

Code	Main Climate	Precipitation	Temperatures
Bsk	Arid	steppe	cool arid
BSh	Arid	steppe	hot arid
Cfa	Warm temperate	fully humid	hot summer
Cfb	Warm temperate	fully humid	warm summer
Cfc	Warm temperate	fully humid	cool summer
Csa	Warm temperate	dry summer	hot summer
Csb	Warm temperate	dry summer	warm summer
Dfb	Snow	fully humid	warm summer
Dfc	Snow	fully humid	cool summer
ET	Polar tundra		

Table 1 Köppen-Geiger climate zones in the EU

COUNTRY	Bsk	BSh	Cfa	Cfb	Cfc	Csa	Csb	Dfb	Dfc
Austria	0.0%	0.0%	0.0%	48.6%	0.0%	0.0%	0.0%	32.4%	18.9%
Belgium	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bulgaria	0.0%	0.0%	46.8%	40.4%	0.0%	0.0%	0.0%	12.8%	0.0%
Cyprus	0.0%	50.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%
Czech Republic	0.0%	0.0%	0.0%	82.5%	0.0%	0.0%	0.0%	17.5%	0.0%
Denmark	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Estonia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
Finland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.8%	89.2%
France	0.0%	0.0%	0.4%	90.1%	0.8%	3.2%	4.3%	0.0%	1.2%
Germany	0.0%	0.0%	0.0%	99.5%	0.0%	0.0%	0.0%	0.5%	0.0%
Greece	0.0%	1.9%	7.7%	11.5%	0.0%	65.4%	13.5%	0.0%	0.0%
Hungary	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ireland	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Italy	0.0%	0.0%	24.0%	33.1%	0.0%	32.2%	6.6%	0.8%	3.3%
Latvia	0.0%	0.0%	0.0%	5.7%	0.0%	0.0%	0.0%	94.3%	0.0%
Lithuania	0.0%	0.0%	0.0%	2.6%	0.0%	0.0%	0.0%	97.4%	0.0%
Luxembourg	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Malta	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Netherlands	0.0%	5.6%	0.0%	94.4%	0.0%	0.0%	0.0%	0.0%	0.0%
Poland	0.0%	0.0%	0.0%	68.1%	0.0%	0.0%	0.0%	31.9%	0.0%
Portugal	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%
Romania	0.0%	0.0%	24.1%	23.2%	0.0%	0.0%	0.0%	50.9%	1.8%
Slovakia	0.0%	0.0%	0.0%	34.6%	0.0%	0.0%	0.0%	61.5%	3.8%
Slovenia	0.0%	0.0%	0.0%	88.9%	0.0%	0.0%	0.0%	0.0%	11.1%
Spain	7.4%	0.0%	3.2%	18.9%	0.0%	42.6%	26.9%	0.0%	0.0%
Sweden	0.0%	0.0%	0.0%	11.8%	0.0%	0.0%	0.0%	17.9%	70.3%
United Kingdom	0.0%	0.0%	0.0%	91.8%	8.2%	0.0%	0.0%	0.0%	0.0%
TOTAL EU	0.7%	0.2%	4.0%	46.2%	0.6%	8.8%	4.7%	14.7%	20.1%

Table 2 Proportion of Köppen-Geiger climate zones in EU member states

COUNTRY	BSk	BSh	Cfa	Cfb	Cfc	Csa	Csb	Dfb	Dfc
Afghanistan	62.2%	0.0%	4.5%	4.5%	0.0%	26.1%	1.8%	0.9%	0.0%
Albania	0.0%	0.0%	0.0%	8.3%	0.0%	41.7%	41.7%	8.3%	0.0%
Algeria	51.6%	0.0%	0.0%	0.0%	0.0%	48.4%	0.0%	0.0%	0.0%
Angola	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Antarctica	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Argentina	34.9%	0.0%	40.6%	13.1%	1.9%	0.1%	9.3%	0.0%	0.0%
Armenia	9.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	90.9%	0.0%
Australia	33.1%	0.0%	27.7%	24.0%	0.0%	6.1%	9.0%	0.0%	0.0%
Azerbaijan	35.7%	0.0%	26.2%	0.0%	0.0%	16.7%	0.0%	21.4%	0.0%
Bangladesh	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Belarus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
Belize	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Benin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bhutan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bolivia	75.0%	0.0%	3.3%	20.0%	1.7%	0.0%	0.0%	0.0%	0.0%
Bosnia & Herzegovina	0.0%	0.0%	4.5%	90.9%	0.0%	0.0%	0.0%	4.5%	0.0%
Botswana	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Brazil	0.0%	0.0%	86.8%	13.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Brunei	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Burkina Faso	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Burundi	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cambodia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cameroon	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canada	1.1%	0.0%	0.0%	0.9%	0.2%	0.0%	0.1%	20.0%	77.7%
Cape Verde	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Central African Republic	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Chad	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Chile	6.3%	0.0%	0.0%	27.1%	34.0%	0.0%	32.6%	0.0%	0.0%
China	36.9%	0.0%	58.5%	0.4%	0.0%	0.0%	0.0%	1.5%	2.7%
Colombia	0.0%	0.0%	0.0%	93.9%	0.0%	0.0%	6.1%	0.0%	0.0%
Comoros	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Congo	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Congo, DRC	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cook Is.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Costa Rica	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cote d'Ivoire	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Croatia	0.0%	0.0%	3.6%	92.9%	0.0%	0.0%	3.6%	0.0%	0.0%
Cuba	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Djibouti	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dominican Republic	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ecuador	0.0%	0.0%	0.0%	87.0%	0.0%	0.0%	13.0%	0.0%	0.0%
Egypt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
El Salvador	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Equatorial Guinea	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Eritrea	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ethiopia	3.1%	0.0%	0.0%	96.9%	0.0%	0.0%	0.0%	0.0%	0.0%
Falkland Is.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Faroe Is.	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
Fiji	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
French Guiana	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
French Polynesia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
French Southern & Antarctic Lands	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gabon	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Georgia	0.0%	0.0%	25.0%	14.3%	0.0%	0.0%	0.0%	57.1%	3.6%
Ghana	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Greenland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Guadeloupe	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Guatemala	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Guinea	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Guinea-Bissau	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Guyana	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Haiti	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Honduras	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iceland	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
India	0.0%	0.0%	0.0%	4.5%	0.0%	91.0%	0.0%	1.8%	2.7%
Indonesia	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Iran	63.7%	0.0%	0.8%	0.0%	0.0%	35.4%	0.0%	0.0%	0.0%
Iraq	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
Israel	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%

Jamaica	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Japan	0.0%	0.0%	60.9%	1.9%	0.0%	0.0%	0.0%	35.3%	1.9%
Jordan	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kazakhstan	52.7%	0.0%	0.0%	0.0%	0.0%	1.8%	0.0%	42.8%	2.6%
Kenya	0.0%	0.0%	0.0%	90.9%	0.0%	0.0%	9.1%	0.0%	0.0%
Kiribati	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kuwait	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kyrgyzstan	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.0%	50.0%
Laos	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lebanon	0.0%	0.0%	0.0%	0.0%	0.0%	75.0%	25.0%	0.0%	0.0%
Lesotho	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Liberia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Libya	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
Macedonia	0.0%	0.0%	18.2%	72.7%	0.0%	0.0%	9.1%	0.0%	0.0%
Madagascar	0.0%	0.0%	58.3%	41.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Malawi	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Malaysia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mali	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mauritania	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mauritius	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mexico	55.2%	0.0%	5.5%	4.4%	0.0%	22.7%	12.2%	0.0%	0.0%
Moldova	0.0%	0.0%	0.0%	62.5%	0.0%	0.0%	0.0%	37.5%	0.0%
Mongolia	98.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.8%
Morocco	36.8%	0.0%	0.0%	0.0%	0.0%	63.2%	0.0%	0.0%	0.0%
Mozambique	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Myanmar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Namibia	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Nepal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
New Caledonia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
New Zealand	0.0%	0.0%	0.0%	87.4%	12.6%	0.0%	0.0%	0.0%	0.0%
Nicaragua	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Niger	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Nigeria	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North Korea	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
Norway	0.0%	0.0%	0.0%	7.6%	4.3%	0.0%	0.0%	5.2%	82.9%
Oman	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pakistan	32.8%	0.0%	20.7%	5.2%	0.0%	5.2%	1.7%	13.8%	20.7%
Panama	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Papua Guinea	New	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Paraguay	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Peru	26.6%	0.0%	0.0%	68.8%	4.7%	0.0%	0.0%	0.0%	0.0%
Philippines	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Puerto Rico	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%



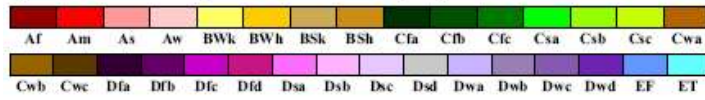
Qatar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Reunion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Russia	0.7%	0.0%	0.8%	0.1%	0.0%	0.0%	0.0%	20.8%	77.7%
Rwanda	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sao Tome & Principe	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Saudi Arabia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Senegal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Serbia & Montenegro	0.0%	0.0%	16.3%	72.1%	0.0%	0.0%	0.0%	11.6%	0.0%
Sierra Leone	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Solomon Is.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somalia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
South Africa	59.1%	0.0%	11.7%	22.8%	0.0%	2.3%	4.1%	0.0%	0.0%
South Georgia & the South Sandwich Is.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
South Korea	0.0%	0.0%	85.7%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%
Sri Lanka	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
St. Vincent & the Grenadines	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sudan	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Suriname	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Svalbard	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Swaziland	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Switzerland	0.0%	0.0%	0.0%	75.0%	0.0%	0.0%	0.0%	0.0%	25.0%
Syria	34.2%	0.0%	0.0%	0.0%	0.0%	63.2%	2.6%	0.0%	0.0%
Tajikistan	41.7%	0.0%	0.0%	0.0%	0.0%	58.3%	0.0%	0.0%	0.0%
Tanzania	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Thailand	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
The Bahamas	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
The Gambia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Timor Leste	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Togo	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Trinidad & Tobago	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tunisia	31.3%	0.0%	0.0%	0.0%	0.0%	68.8%	0.0%	0.0%	0.0%
Turkey	2.2%	0.0%	1.8%	12.7%	0.0%	42.9%	28.7%	11.6%	0.0%
Turkmenistan	98.0%	0.0%	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%	0.0%
Uganda	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ukraine	0.0%	0.0%	8.4%	4.7%	0.0%	0.0%	0.0%	86.5%	0.4%
United Arab Emirates	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
United States	27.3%	0.0%	10.5%	2.2%	0.4%	1.7%	7.9%	22.9%	27.2%
Uruguay	0.0%	0.0%	97.1%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%
Uzbekistan	55.0%	0.0%	0.0%	0.0%	0.0%	43.3%	1.7%	0.0%	0.0%
Vanuatu	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Venezuela	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Vietnam	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Virgin Is.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
West Bank	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
Western Sahara	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Yemen	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Zambia	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Zimbabwe	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 2 Percentage of EU Köppen-Geiger climate zones in other countries of the world

## World Map of Köppen–Geiger Climate Classification

updated with CRU TS 2.1 temperature and VASCLimOv1.1 precipitation data 1951 to 2000



### Main climates

- A: equatorial
- B: arid
- C: warm temperate
- D: snow
- E: polar

### Precipitation

- W: desert
- S: steppe
- f: fully humid
- s: summer dry
- w: winter dry
- m: monsoonal

### Temperature

- h: hot arid
- k: cold arid
- a: hot summer
- b: warm summer
- c: cool summer
- d: extremely continental
- F: polar frost
- T: polar tundra

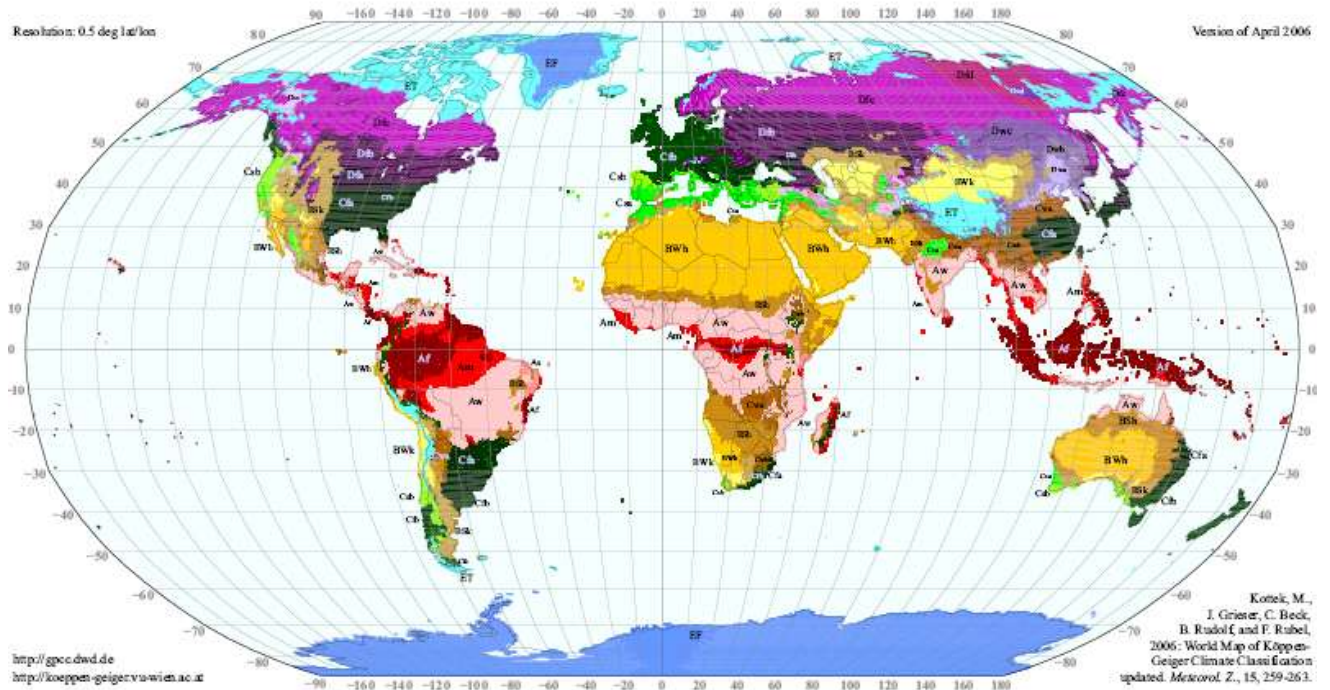


Fig 2a The updated Köppen-Geiger Climate Classification (Kottek et al 2006)

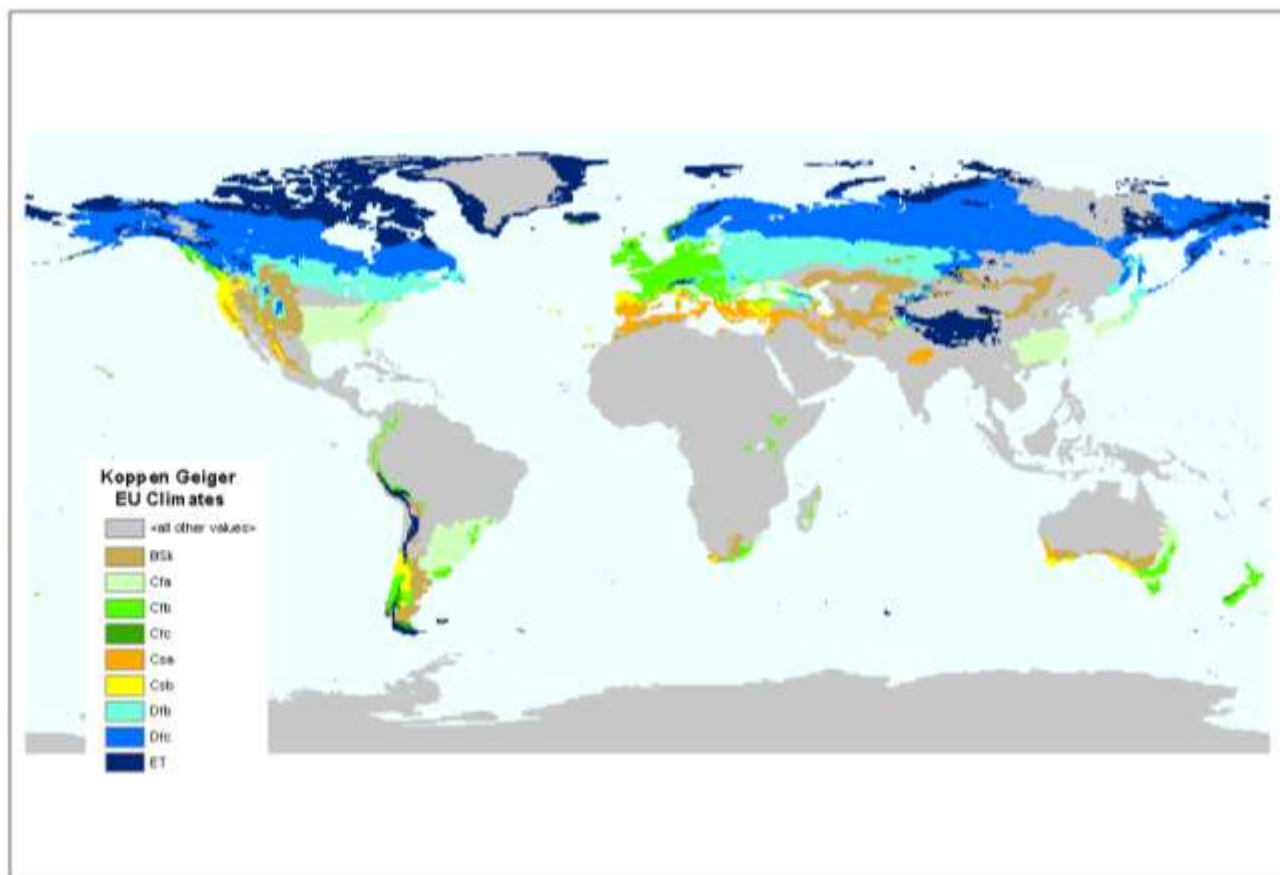


Fig 2b The updated Köppen-Geiger Climate Classification (Kottek et al 2006) showing only the distribution of climates that occur in the EU

### Appendix 3 World Hardiness Zones

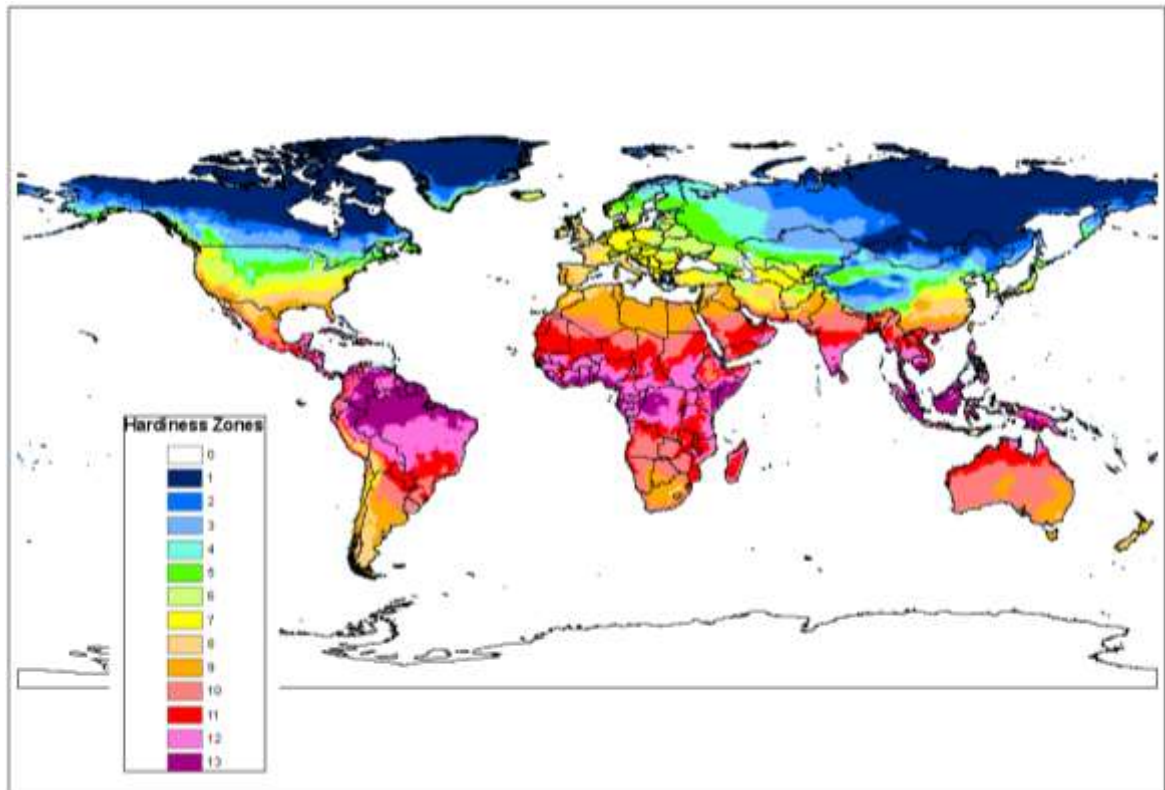


Fig 3a World Hardiness Zones updated by Magarey et al (2008)

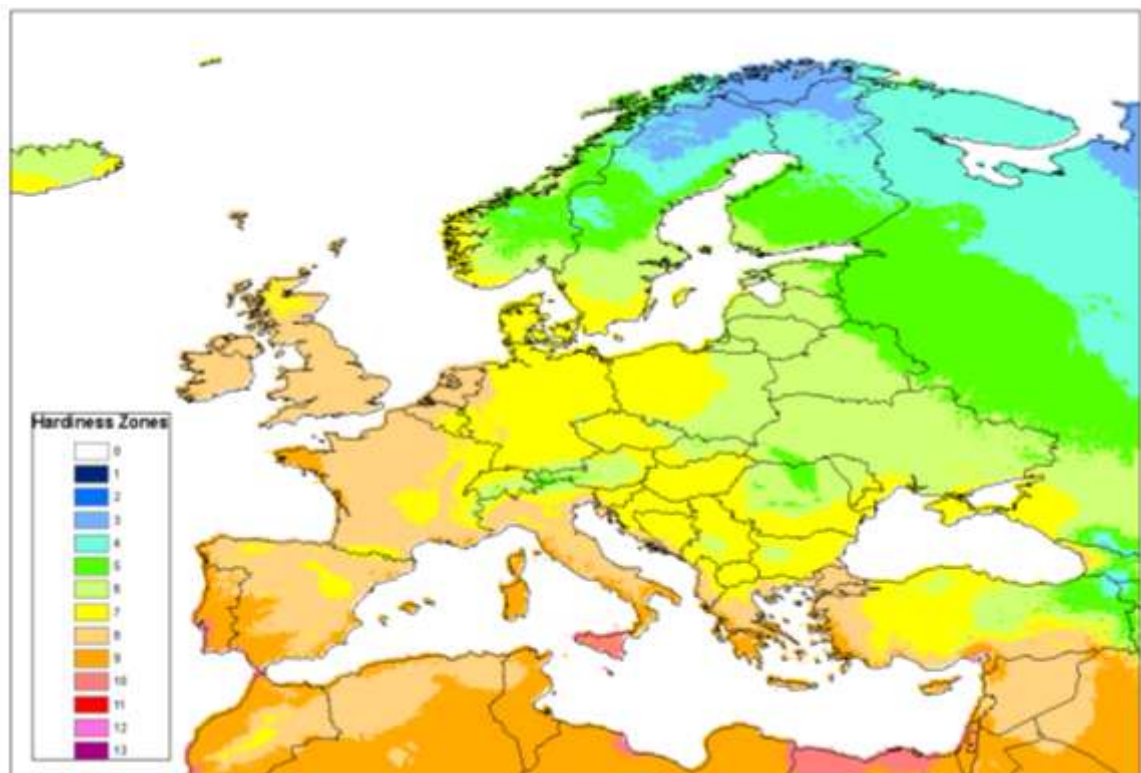


Fig 3b European Hardiness Zones updated by Magarey et al (2008)

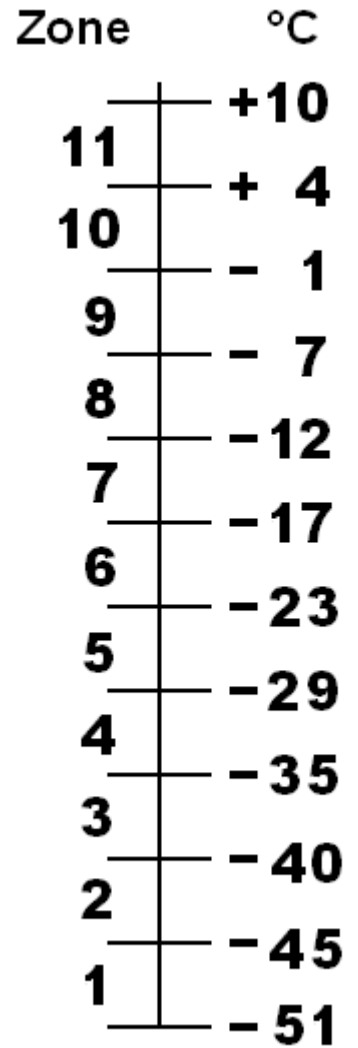
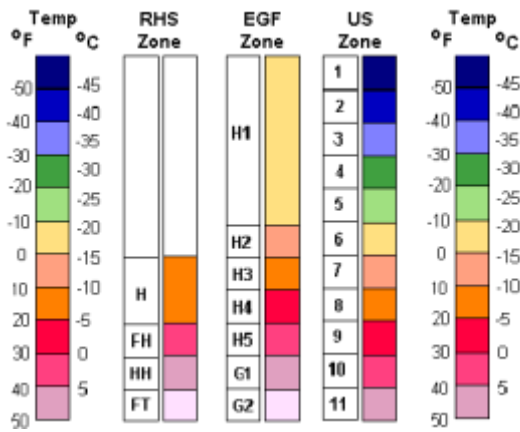


Fig 3c A comparison of different world hardiness zones with the classification (2008)

<http://theseedsite.co.uk/hardiness.html>

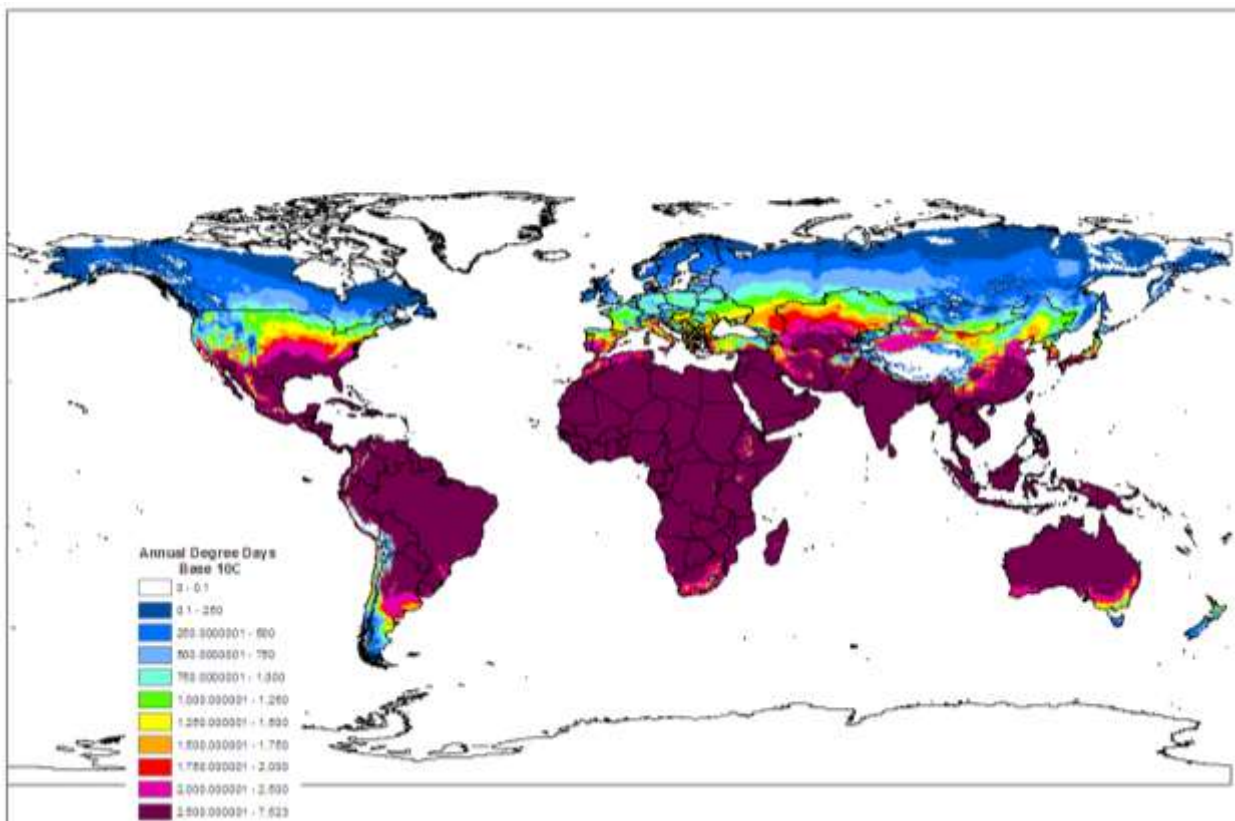
A history of hardiness zone in the USA is provided here:

<http://www.garden.bsewall.com/topics/hardiness/history.html>

## Appendix 4 Global Maps of Temperature Accumulation (Degree Days) based on 10°C

Some key points to take into account:

- The 30 year average Climatic Research Unit (CRU) global dataset of climatic data from 1861-90 constructed by New *et al.* (2002) is the common standard for global PRA climatic assessments but there are more recent gridded climatic data from CRU that can also be used. For Europe, the EU Joint Research Centre at Ispra<sup>1</sup> provides 25 x 25 km interpolated data that can be used to explore the potential distribution within Europe based on degree day accumulations.
- The 10 minute latitude-longitude resolution of the 1861-90 dataset provides grid cells of different dimensions depending on latitude, e.g. approximately 17 x 17 km in northern Italy. Each grid cell provides one value for accumulated temperatures at mean altitude irrespective of the complexity of the terrain. In mountainous areas, temperatures are likely to vary significantly within each grid cell according to the altitude, slope, aspect, presence of water bodies and even the concavity and convexity of the landscape. Farmers may exploit the terrain to maximise production, e.g. by utilising south facing slopes with good cool air drainage. Grid cell data in mountainous areas are thus not likely to give values for maximum and minimum temperatures that are representative of temperature conditions in areas where crops are grown.
- Annual degree days derived from the global 10 minute latitude-longitude 1861-90 database are based on monthly summaries and are therefore much more inaccurate than degree day accumulations calculated from daily measurements, e.g. by the JRC, that directly represent the diurnal variability of weather conditions.



<sup>1</sup> <http://mars.jrc.ec.europa.eu/mars/About-us/AGRI4CAST/Data-distribution>

Fig 4a Global Map of Temperature Accumulation (Degree Days) based on a threshold of 10°C using 1861-90 monthly average maximum and minimum temperatures taken from the 10 minute latitude and longitude Climatic Research Unit database (New *et al.*, 2002).

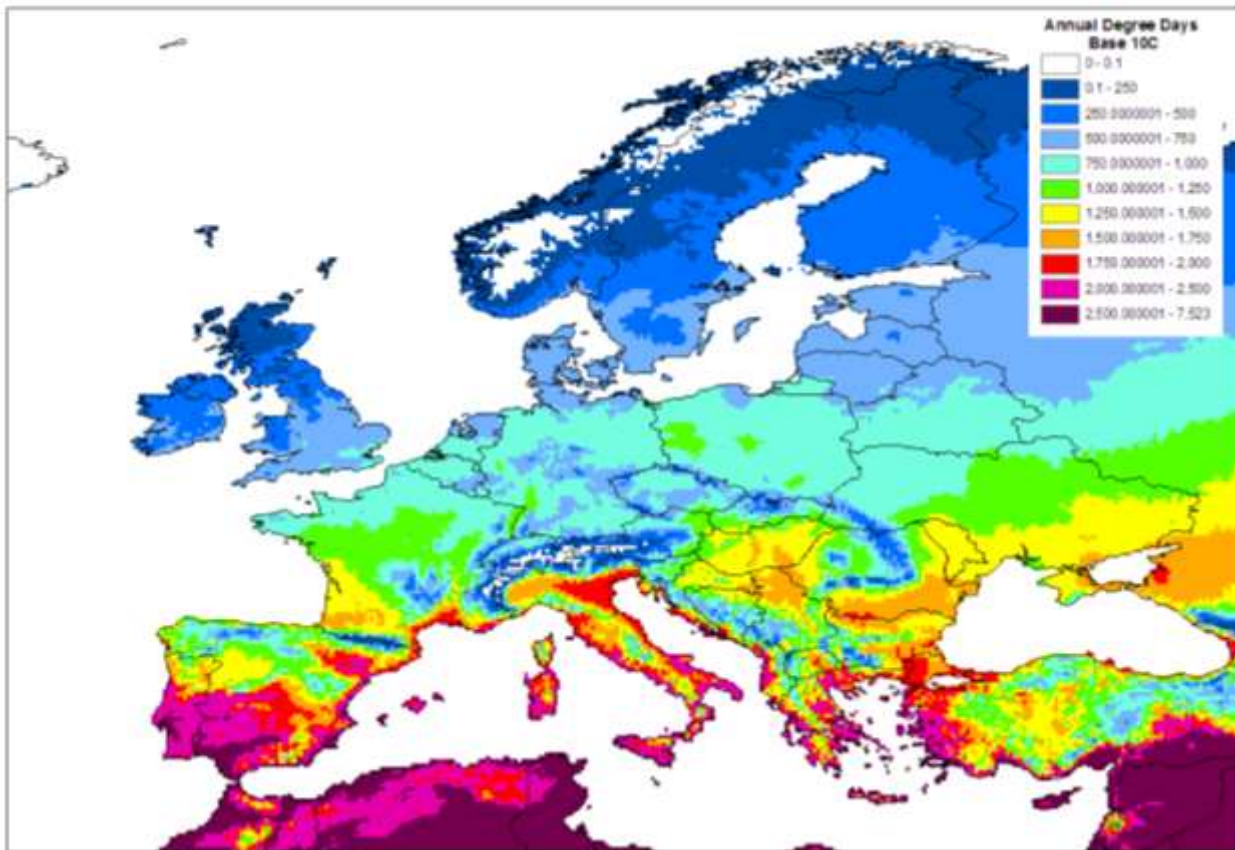


Fig 4b European Map of Temperature Accumulation (Degree Days) based on a threshold of 10°C using 1861-90 monthly average maximum and minimum temperatures taken from the 10 minute latitude and longitude Climatic Research Unit database (New *et al.*, 2002).



## Appendix 5 Europe Climatic Classification (Metzger et al 2005)

Alpine North  
Alpine South  
Anatolian  
Atlantic Central  
Atlantic North  
Boreal  
Continental  
Lusitanian  
Mediterranean Mountains  
Mediterranean North  
Mediterranean South  
Nemoral  
Pannonian

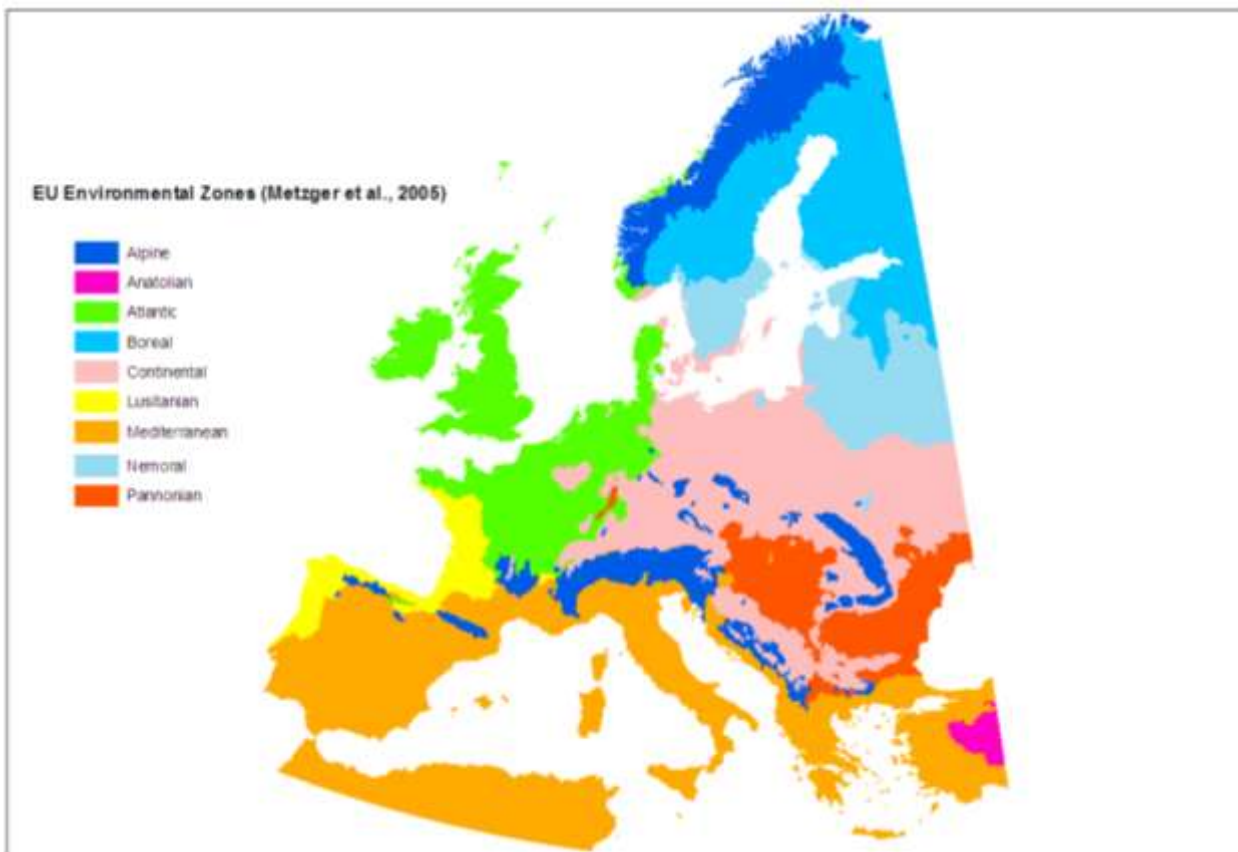


Fig 5 European climatic stratification of the environment of Europe (Metzger et al., 2005)