

# The climate of Reading

Roger Brugge

[r.brugge@reading.ac.uk](mailto:r.brugge@reading.ac.uk)

<http://www.met.reading.ac.uk/~brugge>

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# How do climate and weather differ?

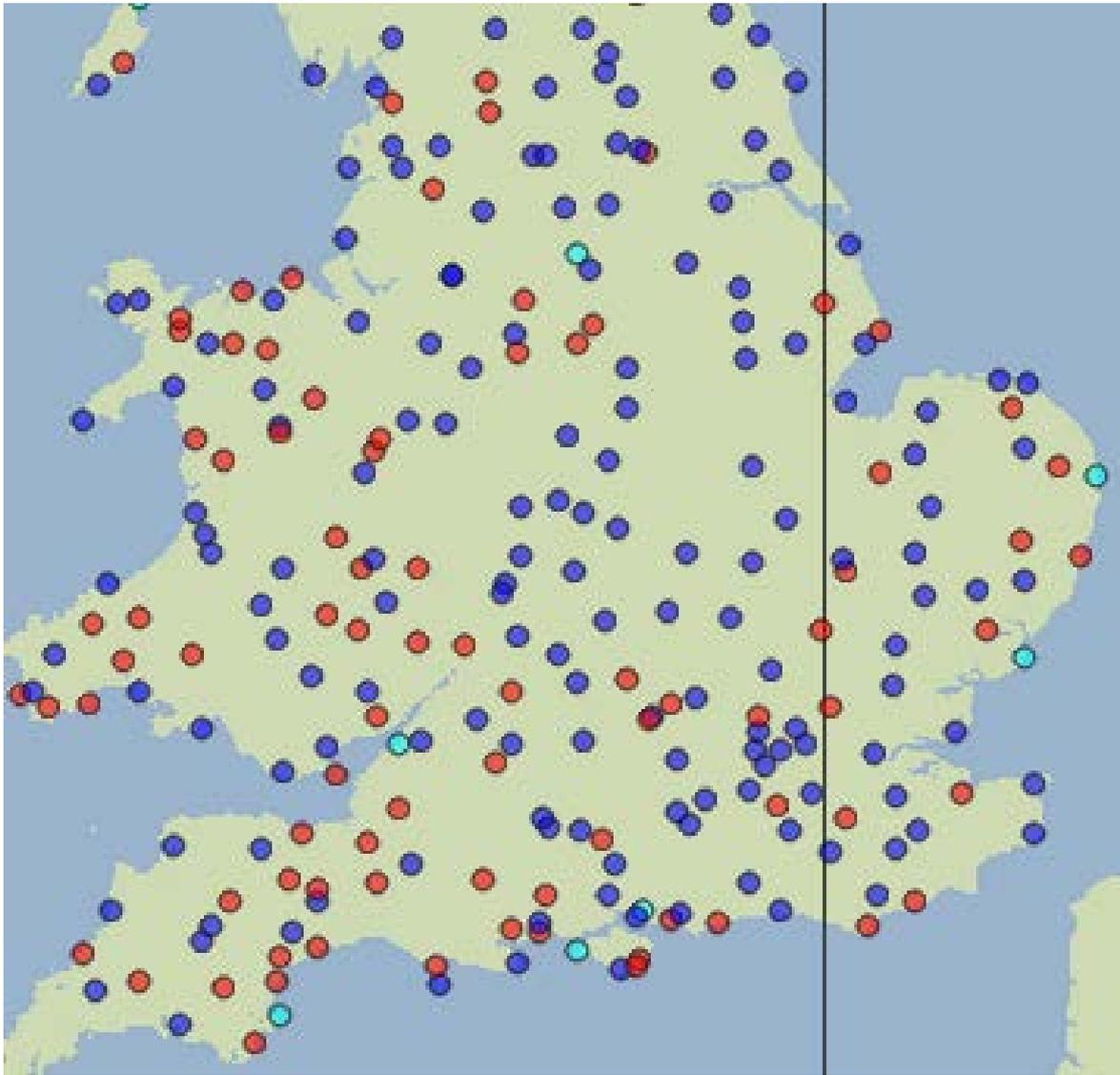
- **Weather** is the mix of events that happen each day in our atmosphere.
  - Everyday, weather events are recorded and forecast by meteorologists worldwide.

- **Climate** is the average weather pattern in a place over many years.
  - Typically climatological averages are worked out for 30-year periods

- Climate is what you expect (without a forecast), but
- Weather is what you get
- Climatology
  - Need consistency over the long-term at each site
  - Identical instruments and observing practices (automatic instruments?)
  - Identical exposure (urbanisation?)
- Long-term trends/the historical record
  - Similar to climatology, but over even longer periods
  - A pioneer in this field was Gordon Manley: ‘Climate and the British Scene’ – well worth reading if you can find a copy
  - He developed the ‘Central England Temperature series’ – a monthly temperature series back to 1659

# The weather

- How do we measure it?
  - Two categories of weather station
- Synoptic observations
  - Used for forecasting purposes
  - Observations (traditionally) every 1-3 hours
  - Eg. Heathrow Airport
- Climatological observations
  - In the UK made once daily (at 0900GMT)
  - Eg. University of Reading



Synoptic and climatological stations

Manual

Automatic

- Synoptic stations
  - Many are automatic -> continuous supply of information (very useful for severe weather events)
- Climatological stations
  - A mixture of manual and **A**utomatic **W**eather **S**tations -> with a tendency towards the latter

# Early observations in the UK

- 1337-1344: Notes on wind and rain at Oxford (a local clergyman)
- Elizabethan area onwards: a daily 'wind book' kept by the Admiralty
- Robert Hooke: 1664 records of **temperature** and pressure (MS preserved by the Royal Society)
- But early instruments were imperfect and the making of adjustments and corrections not fully understood
  - Nowadays an inspection by the MO is designed to help prevent 'drift' in thermometers, for example, and ensure instruments comply with NPL/MO standards and that observations at sites are comparable
- **Rainfall** first recorded by a Lancashire squire, Richard Towneley, of Towneley Hall (near Burnley), 1677-1704.
- During the 18<sup>th</sup> century the medical professions contributed a great deal to weather observing – with substantial contributions also from the clergy and landed gentry in the 19<sup>th</sup> century.

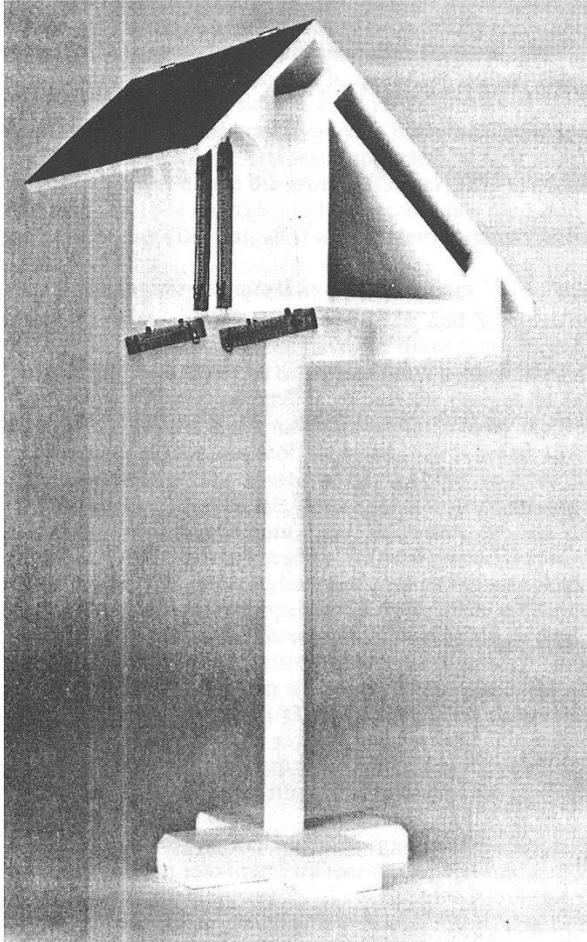
# 17th-19th century period

- 1697-1716: William Derham – Upminster rainfall record. He also used an early type of thermometer, under conditions that are not fully understood.
  - The concept of metadata (data about the data) – very important.
- 1736-1798: Thomas Barker kept meteorological records in Rutland.
- By 1799 John Dalton was assembling many of these records. He also observed rainfall at Kendal (1797-1840) – the wettest place known in those days.
- 1840: Joseph Atkinson put together the first rainfall map.
- 1860: George Symons formed the British Rainfall Organisation – the first attempt in the UK to gather data from a growing number of rainfall observers (eventually 5000-6000 in total).
- In Britain, almost all our earliest records were kept by amateurs, rather than by the state.
- Before the days of official organisations (these started to have influence from about 1850 onwards), the elements were recorded in various ways.

# Temperatures without a screen

- Why do we need a screen?
  - Need to shelter the thermometers to obtain the shade temperature. We do not want to measure temperatures in direct sunlight.
- North Wall
  - For a long time it was assumed that readings taken in the shade on a north-facing wall would be sufficiently comparable.
  - Not so – for example, on a warm March day the reading will be too low as the wall is being measured, rather than the air.
  - Hutchinson, harbourmaster of Liverpool tried to solve the problem by keeping his thermometer under a table on the roof.
- Indoors
  - 18<sup>th</sup> century – many men kept their records by reading a thermometer inside a room without a fire!
  - In 1723 the then secretary of the Royal Society recommended this!
- Later in the 18<sup>th</sup> century:
  - an interest in gardening led to better record keeping (in 1782 James Six invented his thermometer).

# Glaisher stand -> Stevenson screen



GL – thermometers mounted on a vertical board  
– needs rotating to keep out of the sun

SS, screened on all six sides. Traditionally  
wooden – now also made of plastic.

Old 'records'  
made with GL  
now tend to be  
ignored.



# AWS systems

- Automatic Weather Stations
- Electronic sensors
  - Response times of thermometers
- Advantages include:
  - Remote observations enabled
- Frequently used in UK at synoptic stations
  - Increasingly used at climatological sites

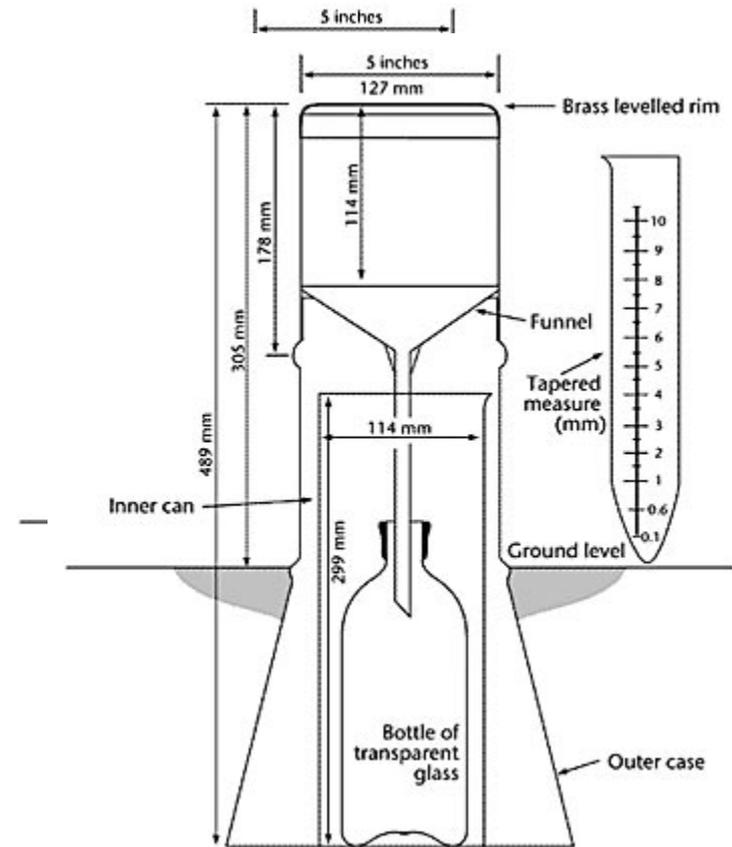


# Rainfall

- Rainfall records
  - Height and exposure important
    - Need to catch all falling rain without loss due to wind
  - Three standard gauges at Reading
    - Ground level
    - Standard exposure (rim 12 inches above ground)
    - Elevated gauge with baffles to prevent wind eddies
- Problems
  - Wind eddies reducing catch
  - Snowfall/hail
  - Evaporation

# Snowdon raingauge

10mm measuring cylinder



Design features:

Minimal evaporation through neck of funnel

Inner can maintains the temperature so water freezes less easily..

# Tipping bucket raingauge

- Traditional type used a paper chart record
- Modern types: tipping connected to a counter, ideal for an AWS
- Heated for snowmelt
  - But not always that effective
- But 0.2mm tips (not always so good for small amounts of rain – nor for knowing the times when small amounts have fallen)

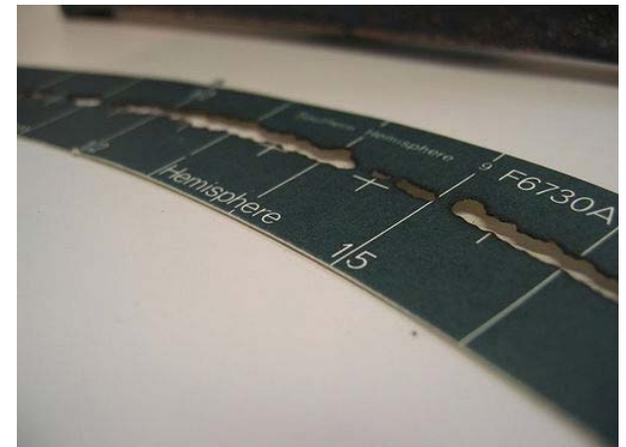


- Campbell-Stokes
  - Sun's rays focused on to a card
  - In use for over 100 years
  - Intermittent sunshine -> spreading of burns -> overestimate of sunshine
  - Burn threshold in the range 106-285 W/m<sup>2</sup>; average 170W/m<sup>2</sup>
  - WMO standard is 120W/m<sup>2</sup>

- Kipp and Zonen CSD-1 sensor solarimeter (UK standard)
  - The CSD 1 is intended for the routine measurement of sunshine duration using the WMO standard.



# Sunshine



Cannot convert from C-S to KZ readings

# The University of Reading climatological observations

## **Manual instruments used for routine climatological observations:**

- Large pattern Stevenson screen
- Wet and dry bulb, maximum and minimum thermometers,
- Thermograph and hygrograph,
- Piche evaporimeter,
- Standard rain gauge, Level ground rain gauge, Shielded rain gauge,
- Tilting Siphon rain gauge,
- Campbell-Stokes sunshine recorder,
- 5, 10, 20, 30, 50 and 100 cm earth thermometers,
- Grass, bare soil and concrete minimum thermometers,
- 2 metre run-of-wind anemometer, 10m anemometer
- British Standard evaporation tank
- Solarimeter (measuring global and diffuse radiation),
- Mercury barometer (Kew pattern), Barograph.

## **Other on-site observations include:**

- Cloud amount and type,
- Present weather,
- Visibility,
- State of ground,
- Snow depth,
- Other important weather event throughout the day (eg. thunder/hail/snow)

## **Data are observed at 0900GMT daily**

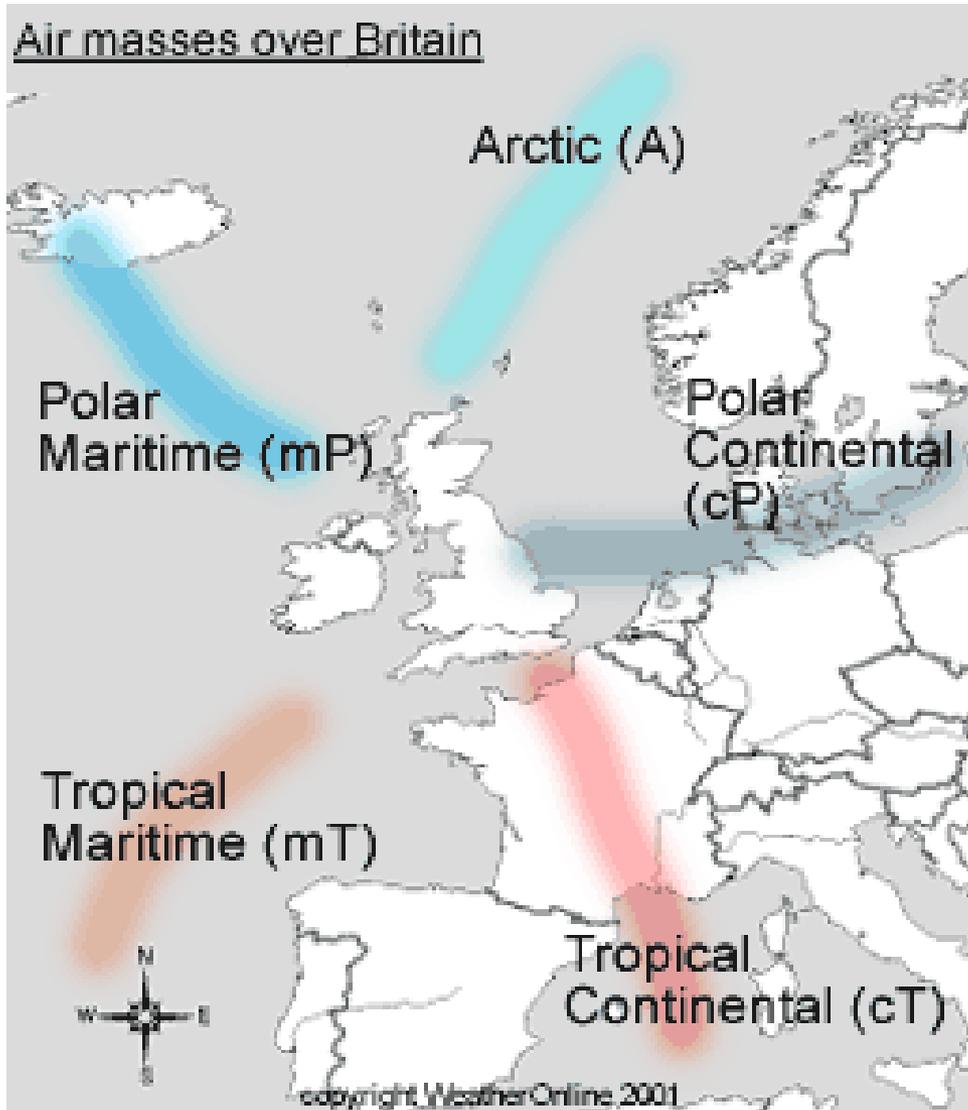
**In addition AWS instruments report a subset of these observations (hourly) to the Met Office for climatological purposes (since 2012) – air temperature and humidity, rainfall, sunshine, 10cm/30cm/100cm soil temperatures**

The station has been operating for some 100 years now with some changes in site during that time.

# British weather and climate

- A maritime climate with some continental influences
- The sea
  - smaller changes in temperature and slower to warm up/cool down than the land.
- The sea
  - movement means that ‘cold’ can replace ‘warm’ and vice-versa to some extent -> so warming/cooling in one place is difficult when compared to land
  - Winter – land colder than sea
  - Summer – land warmer than sea

# Principal air masses



Air masses – formed under areas of high pressure:  
High pressure -> slow movement of the air -> time to accumulate local 'characteristics'

## **Continental arctic (cA):**

**Extremely cold** temperatures and very little moisture. Originating over the Arctic ocean in winter; similar to cP

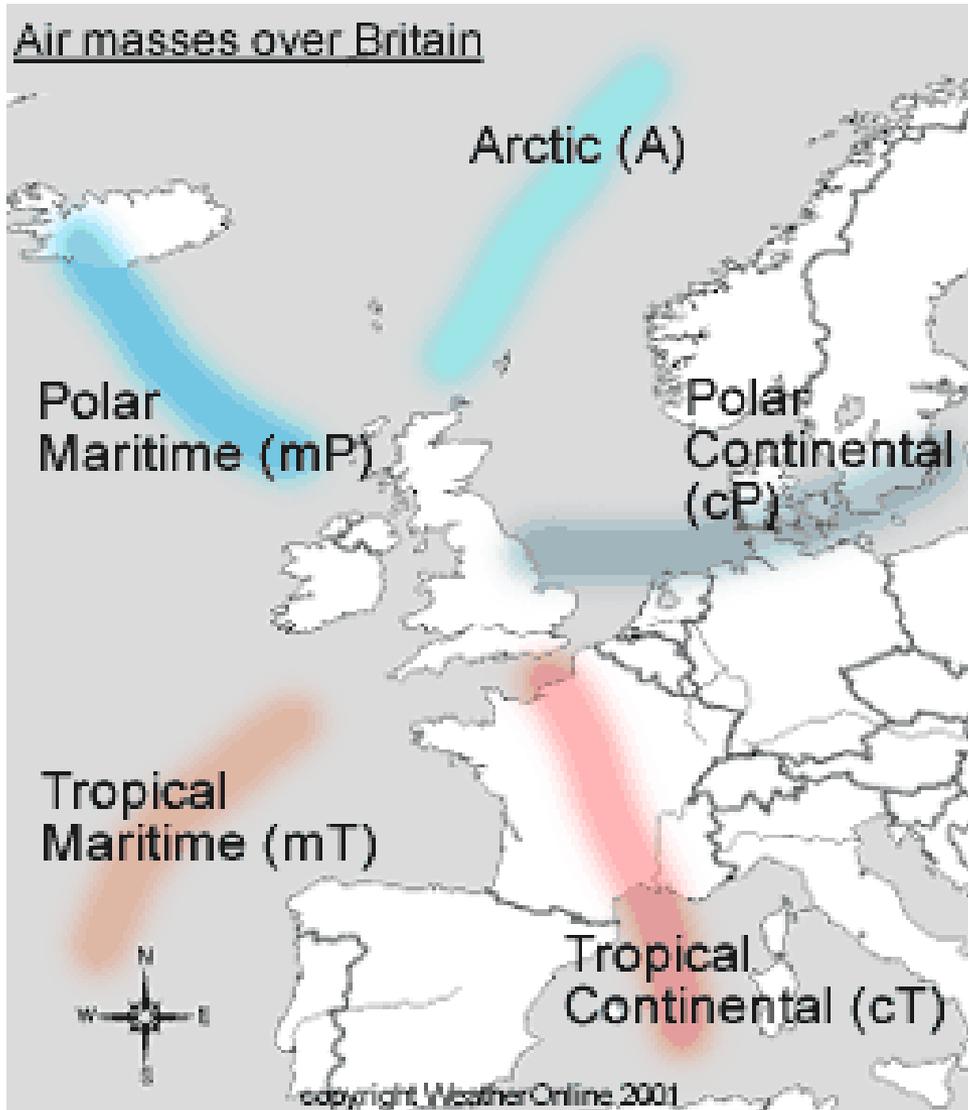
## **Maritime arctic (mA):**

From the same source region, but less dry and **less cold**; less extreme.

## **Continental polar (cP):**

**Cold and dry**, originating from high latitudes, typically as air flowing out of the polar highs. This air mass often brings the **cold, dry** and clear weather on a perfect **winter** day and also dry and **warm** weather on a pleasant day in **summer**.

# Principal air masses



## Maritime polar (mP):

**Cool** and **moist**, often originating as continental polar air over the North American land mass and is modified as it moves out over the Atlantic Ocean. Heated by the relatively warm water bodies this air mass becomes rather unstable resulting in blustery showers over the sea and windward coasts.

## Continental tropical (cT):

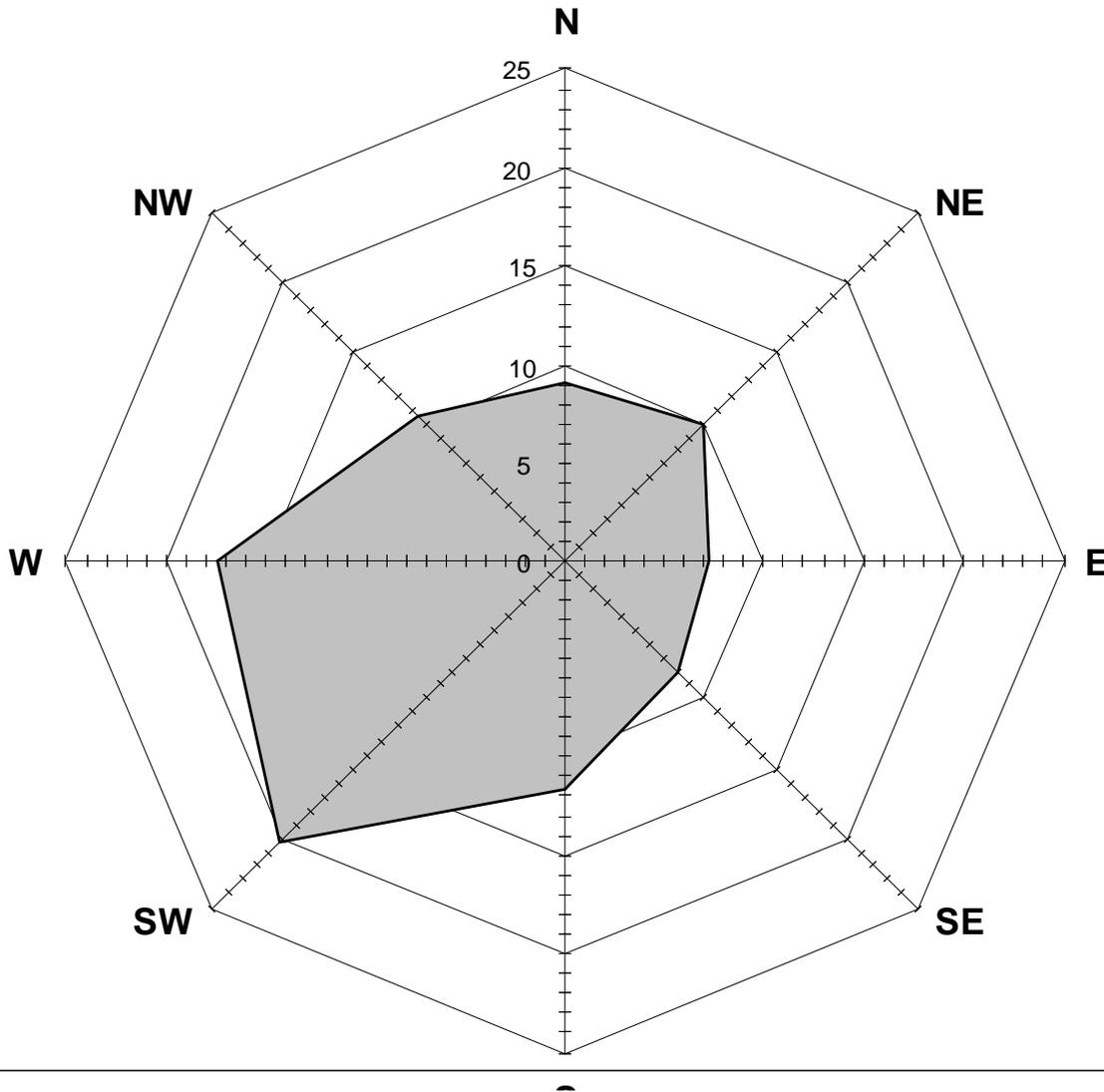
**Hot and very dry**, originating from the arid and desert regions during **summer**. The least common air mass to affect the British weather. However, approaching from the south and south-east in **summer** it can bring **record heat** to southeast Britain, particularly in late-summer.

## Maritime tropical (mT).

**Mild and damp** in **winter**, **very warm** and muggy during **summer**. Originating from the Azores this air mass approaches the British Isles from the west, leading to overcast skies with prolonged rain for the western half of the country and to many clouds, sometimes broken with drizzle for the eastern half. In **summer** tropical maritime air often produces **warm** weather with abundant sunshine in the southeast.

# Wind direction

Average wind direction across the British Isles (percentage)

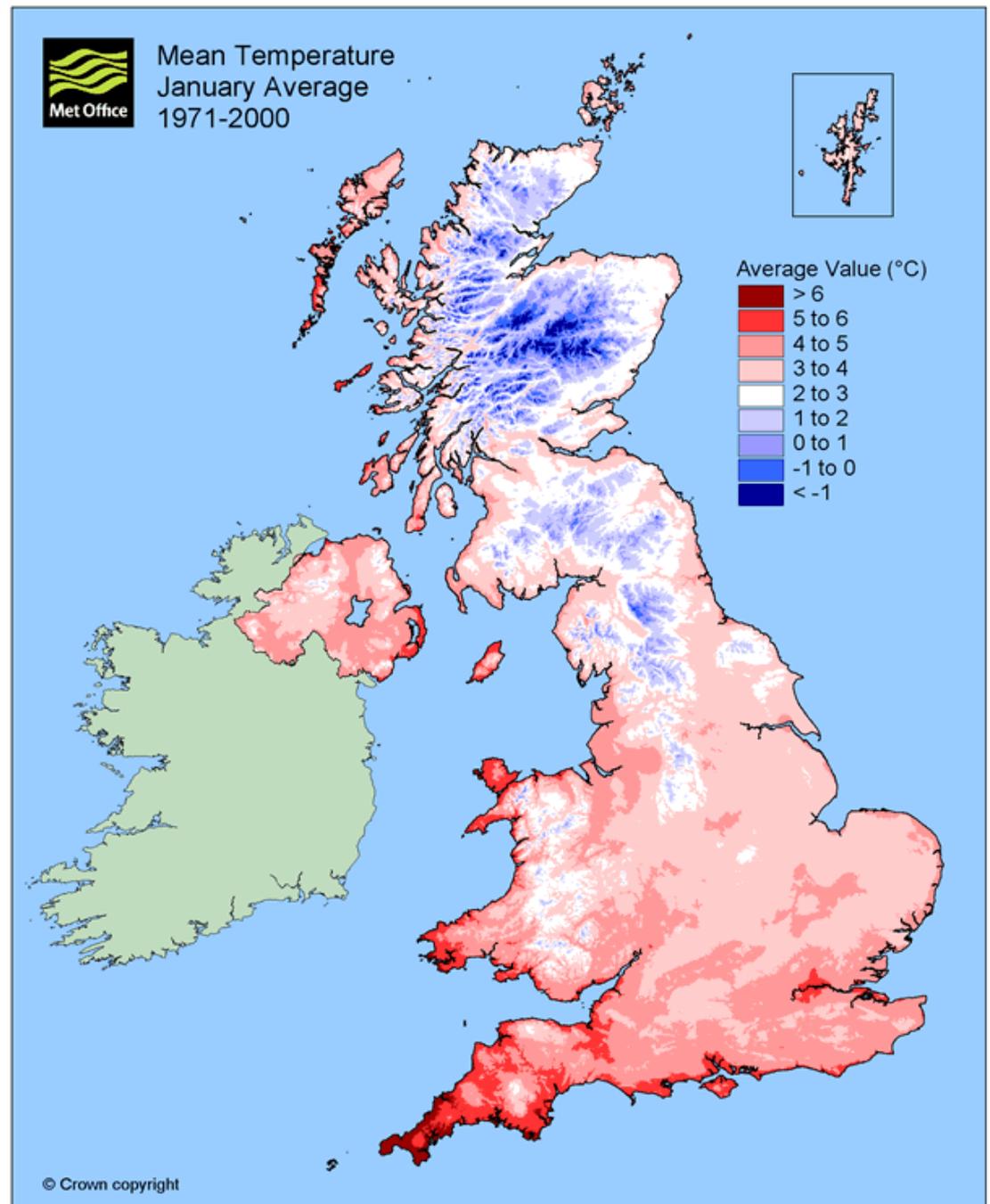


Data for 2008-2010; SW quadrant dominates – but the NE also contributes

-> large maritime influence

# UK climate - winter

- Temperature
  - west: milder due to sea
  - north: colder
- Palms in Scilly



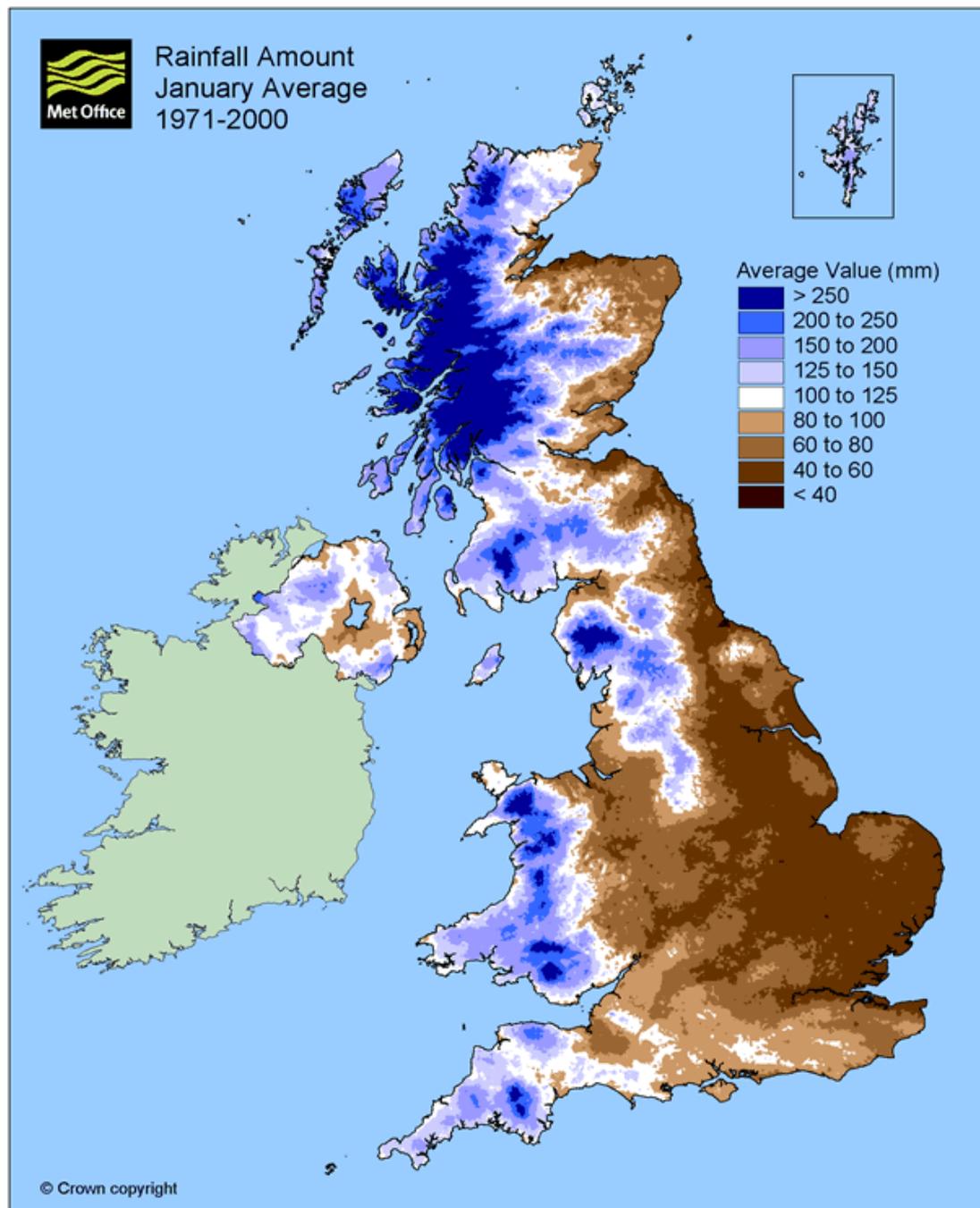
# UK climate - winter

- Rainfall

- hills: wet

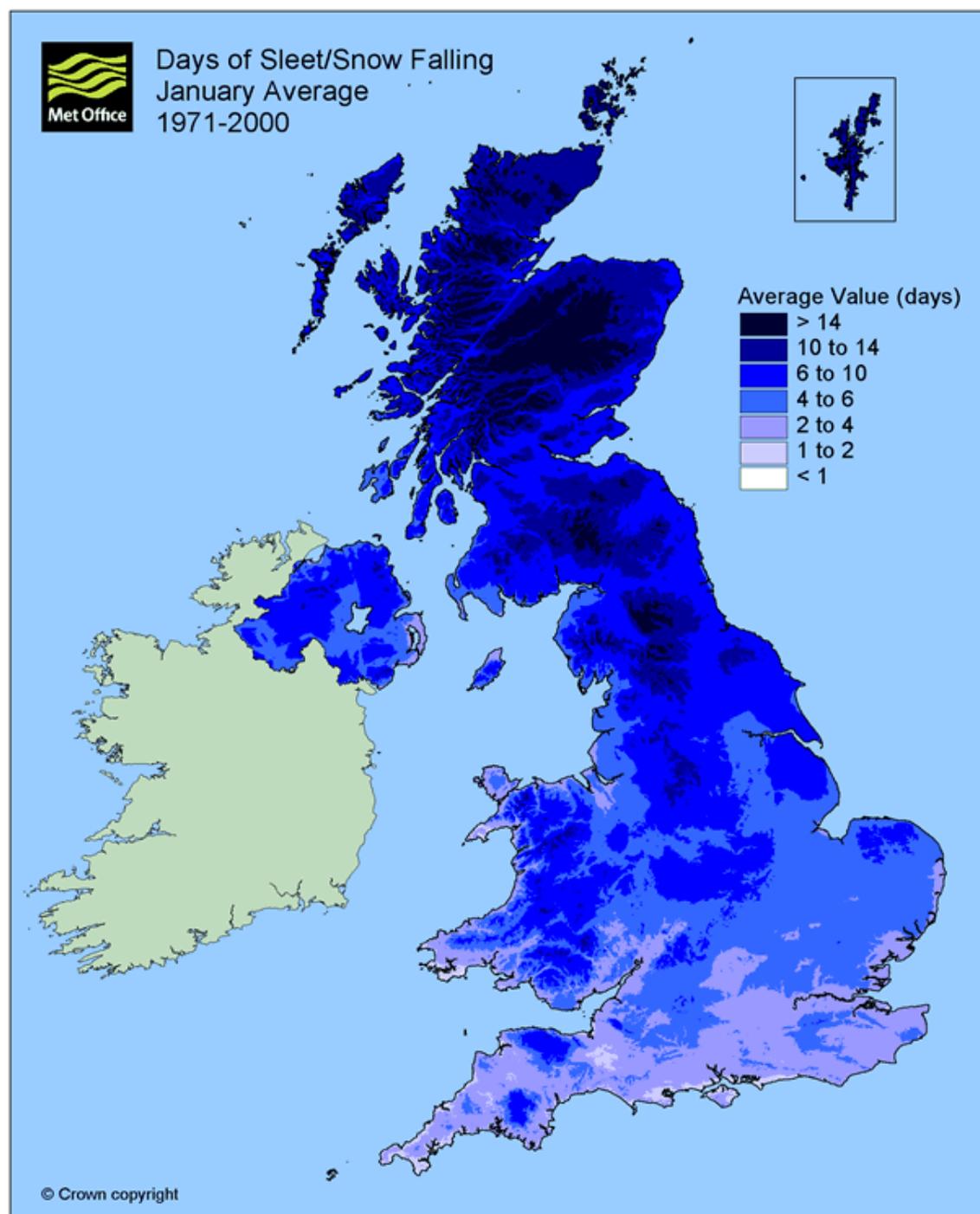
- east: dry

Dry winter ->  
water recharge  
problems in SE



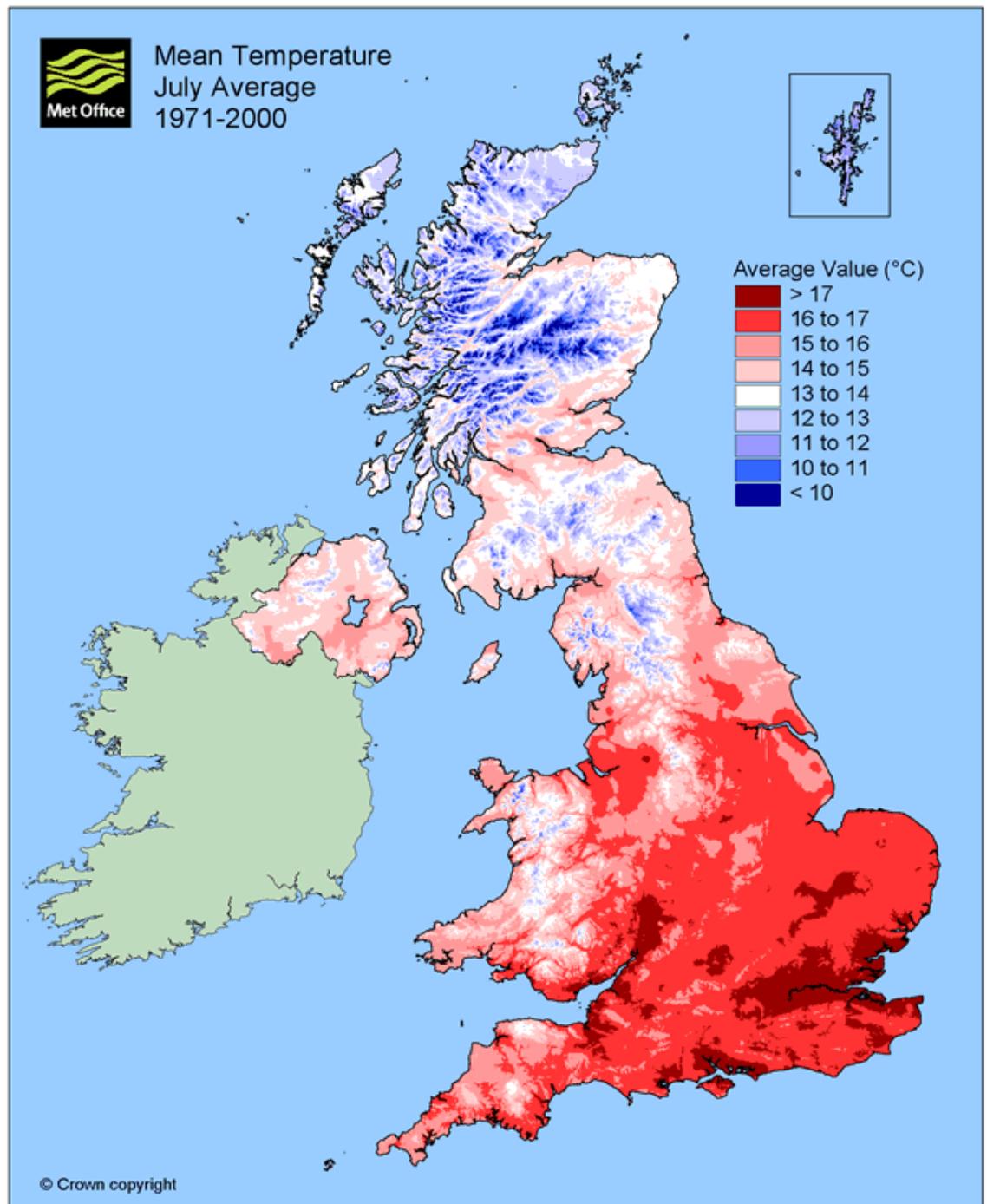
# UK climate - winter

- Snowfall
  - Most in the north and over high ground
  - Many falls are slight (couple of cm)



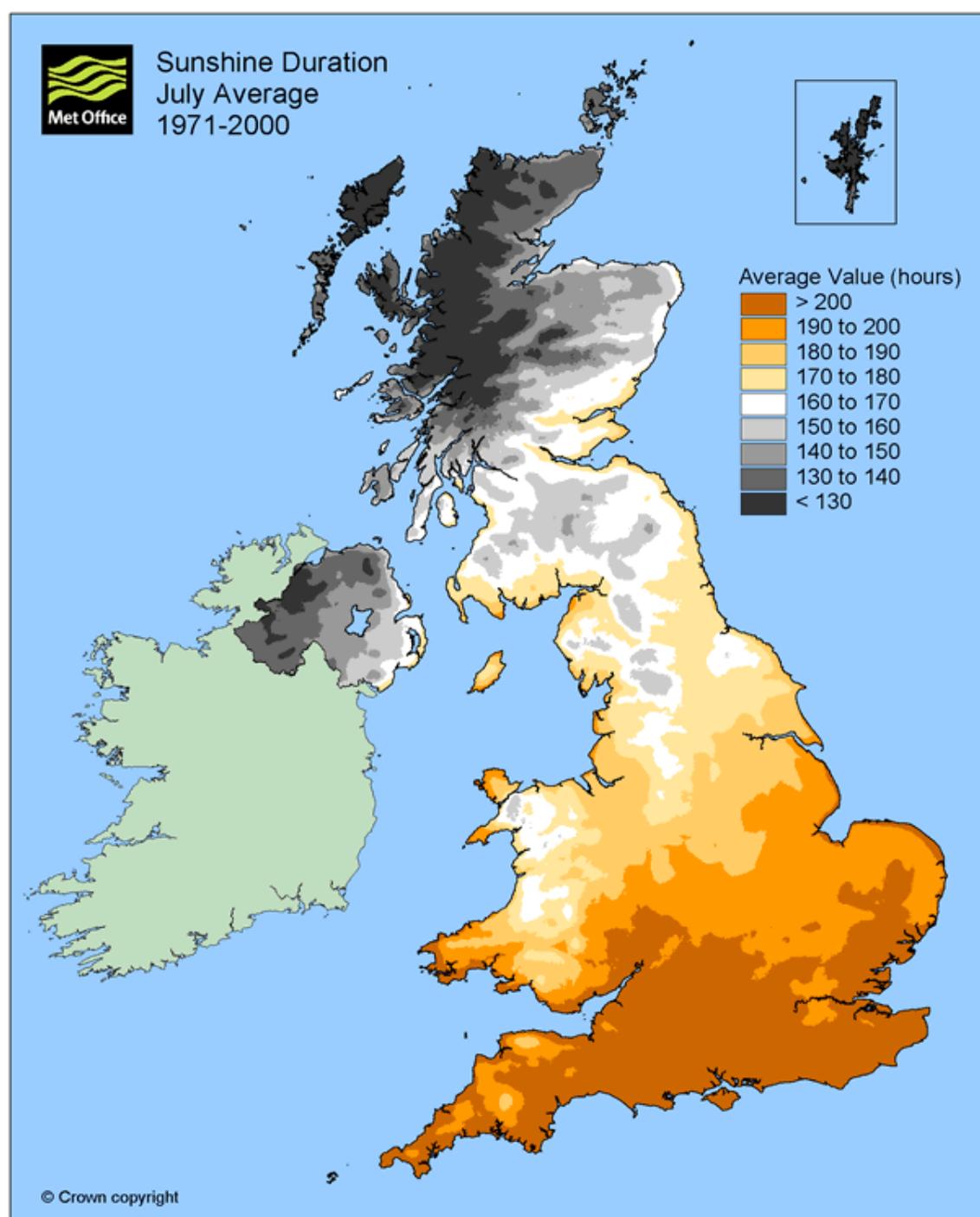
# UK climate - summer

- Temperature
  - Southeast:  
warm due to  
continent
  - Northwest:  
cool due to sea



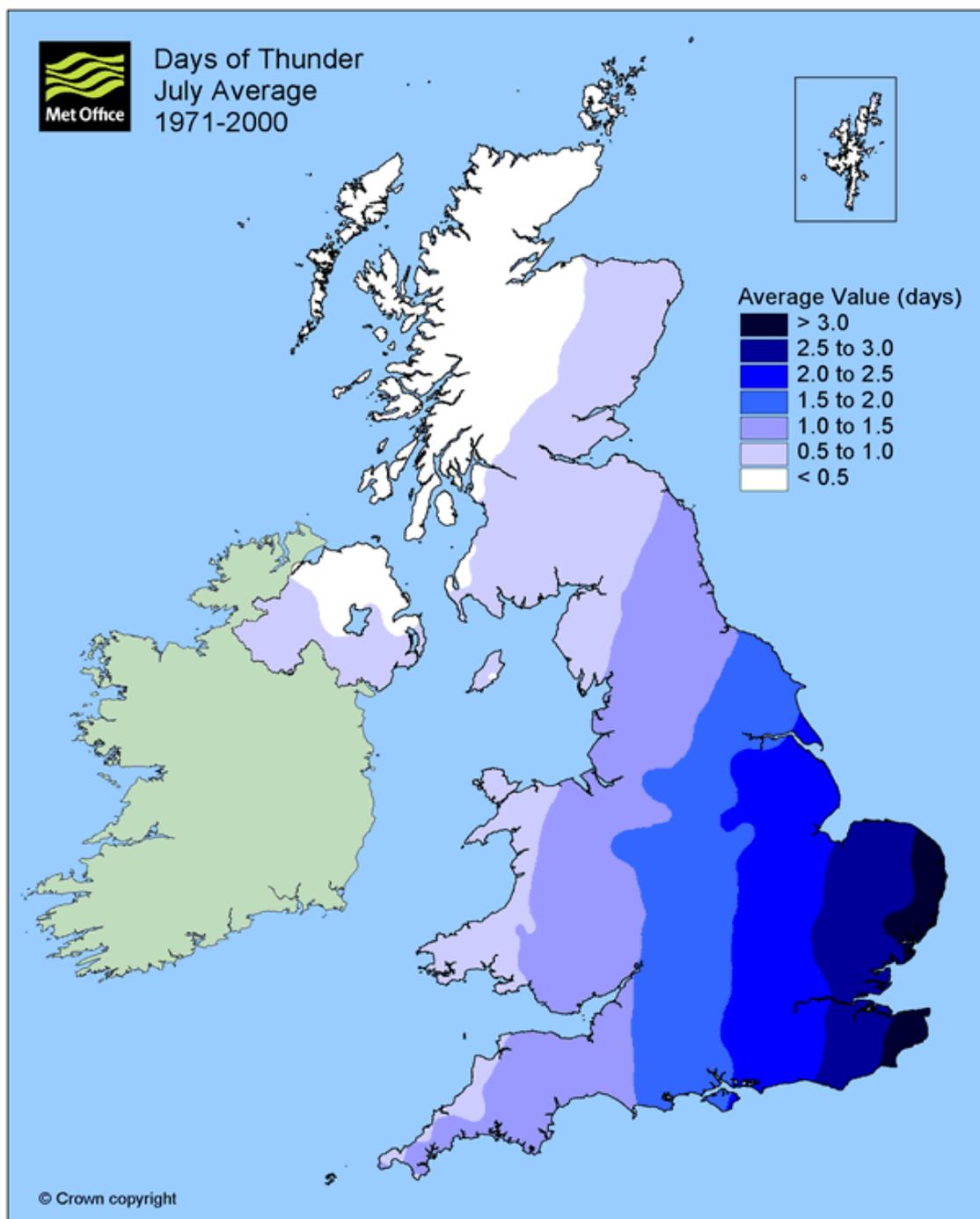
# UK climate - summer

- Sunshine
  - South: sunny
  - North: relatively dull (partly due to hills and cloud – Dundee sunny)
  - But the south can also be wet in summer



# UK climate - summer

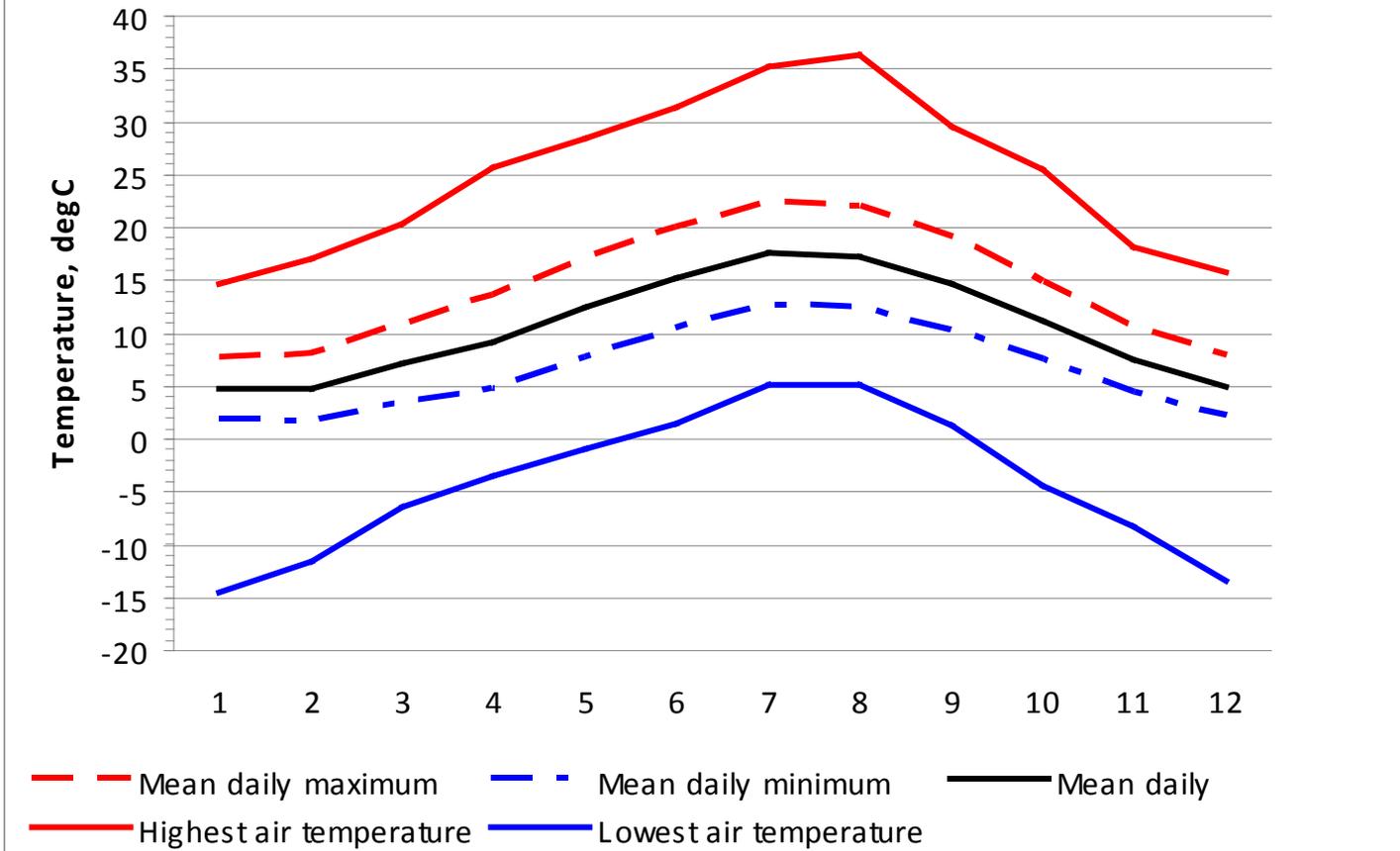
- Thunder
  - More likely in the SE due to extra warmth
  - Often t'storms can be tracked through France to the UK



# Climate of Reading and East Berkshire

- Note in the previous slides how close Reading is to the
  - Hot/warm
  - Dry/wet boundary
  - Sunny south

# Reading temperatures, 1981-2010



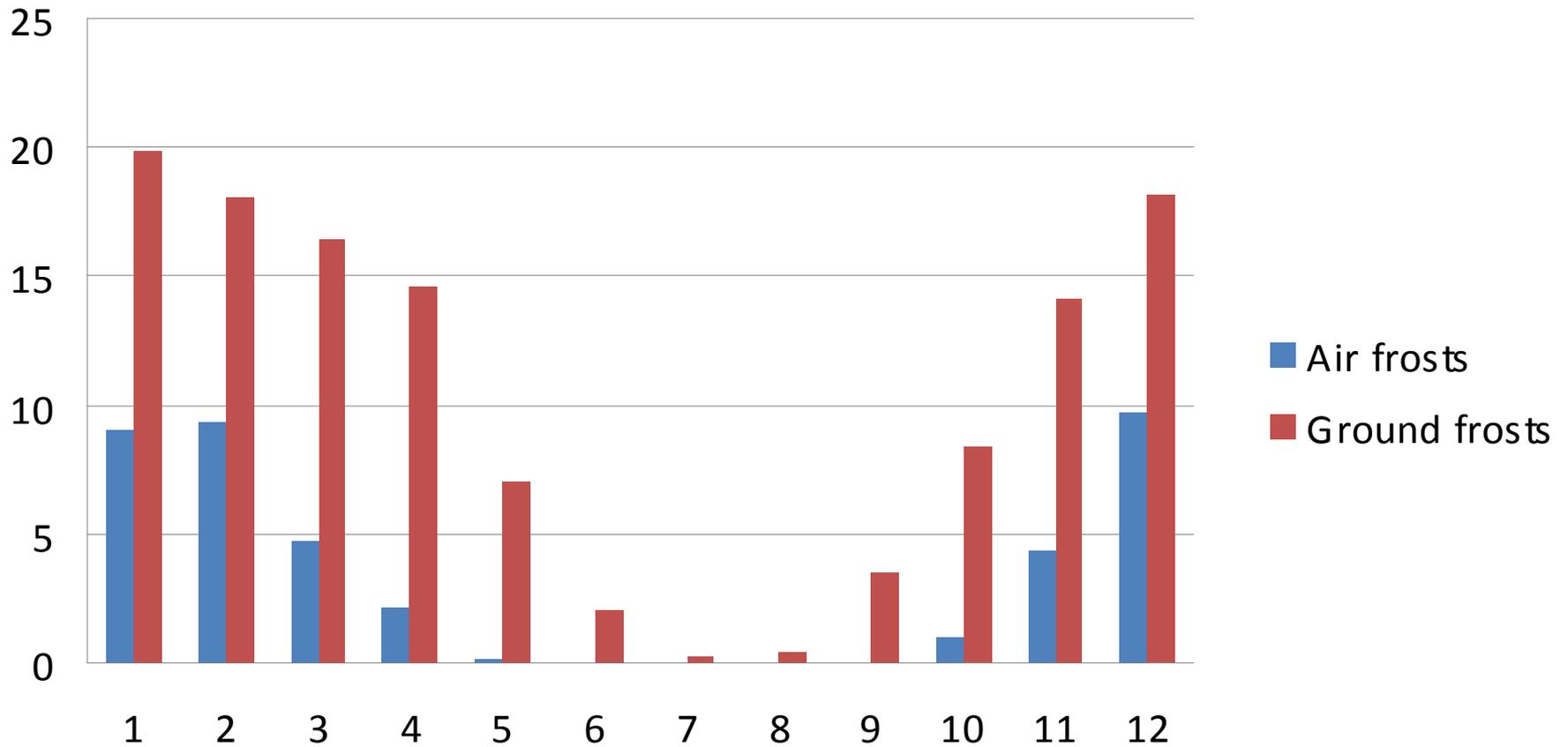
**Monthly: 21.1C July 2006**

**-1.1C February 1986**

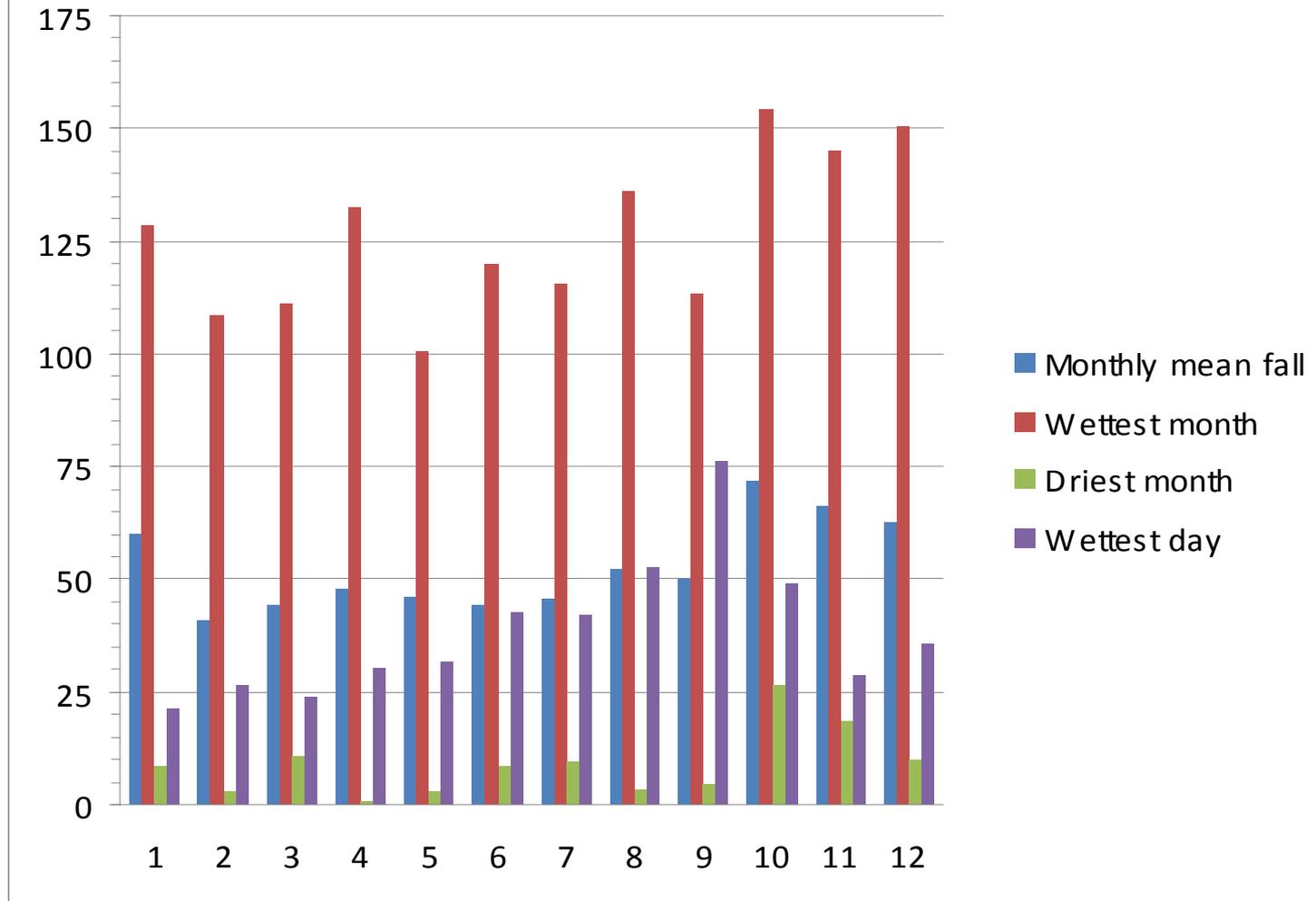
**Daily: 36.4C August 2003;**

**-14.5C January 1982**

# Number of frosts each month, 1981-2010



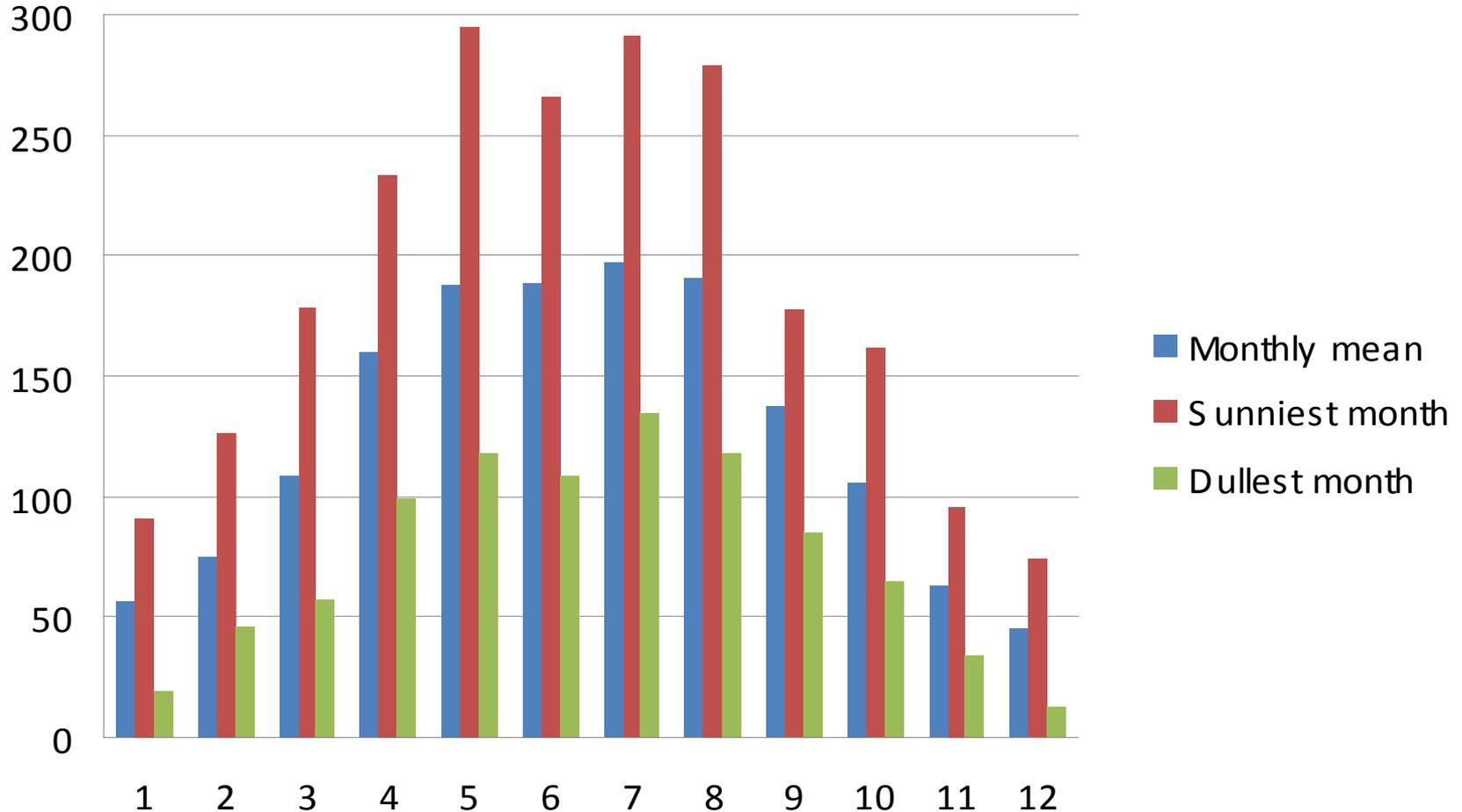
# Monthly rainfall at Reading, mm



**Annual mean 635.4mm; (852mm in 2000, 463mm in 1990)**

**154.5mm October 1987; 0.9mm April 2007; 76.3mm daily max fall in Sept 1992**

# Monthly sunshine at Reading, hrs



**Annual mean 1522h; (1810h in 2003, 1338h in 1992)**

**295.1h May 1989; 13.0h December 2010; 15.5h daily max amount May 1985**

# Weather types in Maidenhead, 1989-2008

