

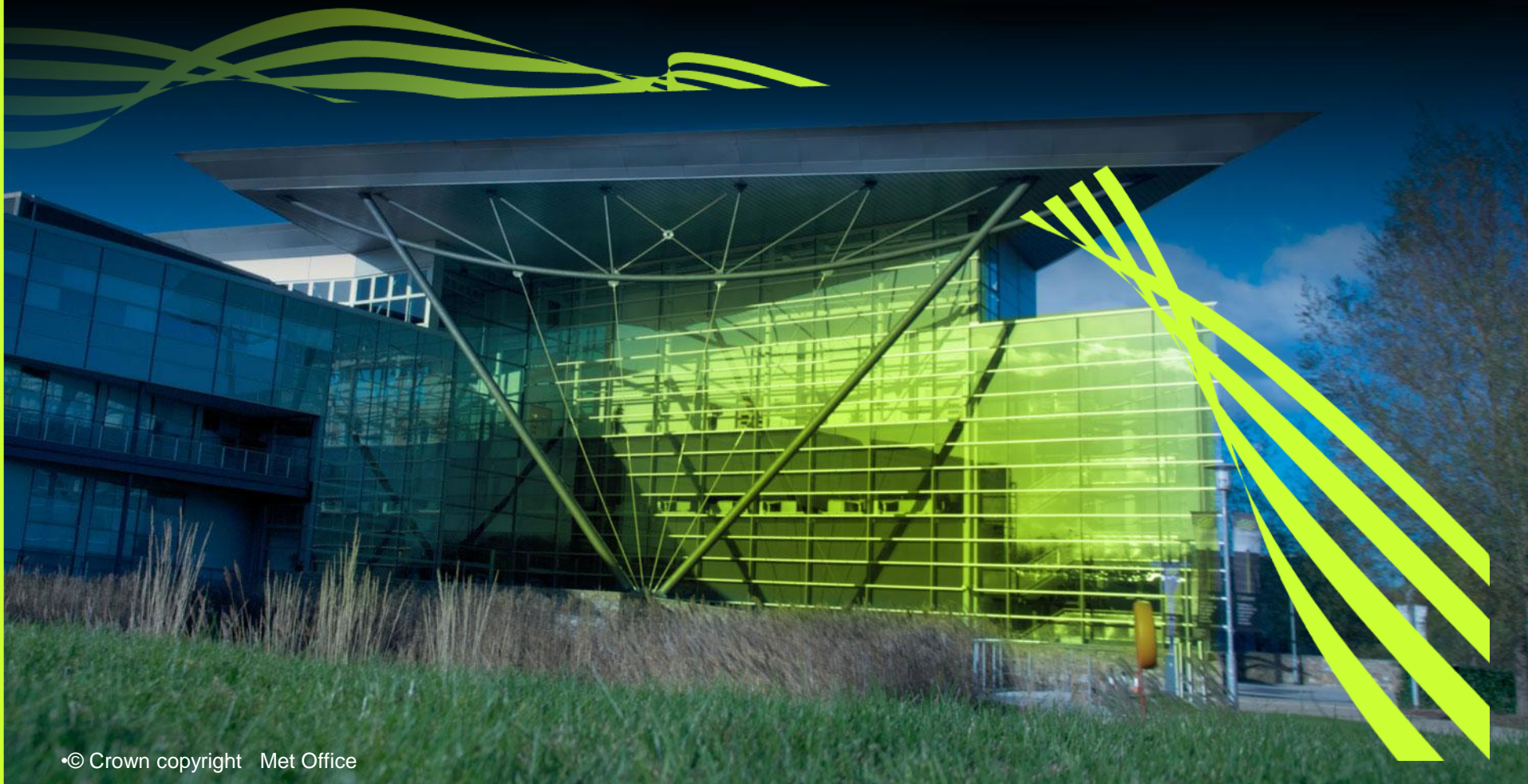


Met Office

# Influence of Weather and Climate on Forests

**Dr Deborah Hemming**

Scientific Manager, Vegetation-Climate Interactions group



## Forests and climate

### global forest distribution

Roughly 30% of the land surface is forested (42 million km<sup>2</sup>)

Different species of vegetation have adapted to varying global conditions

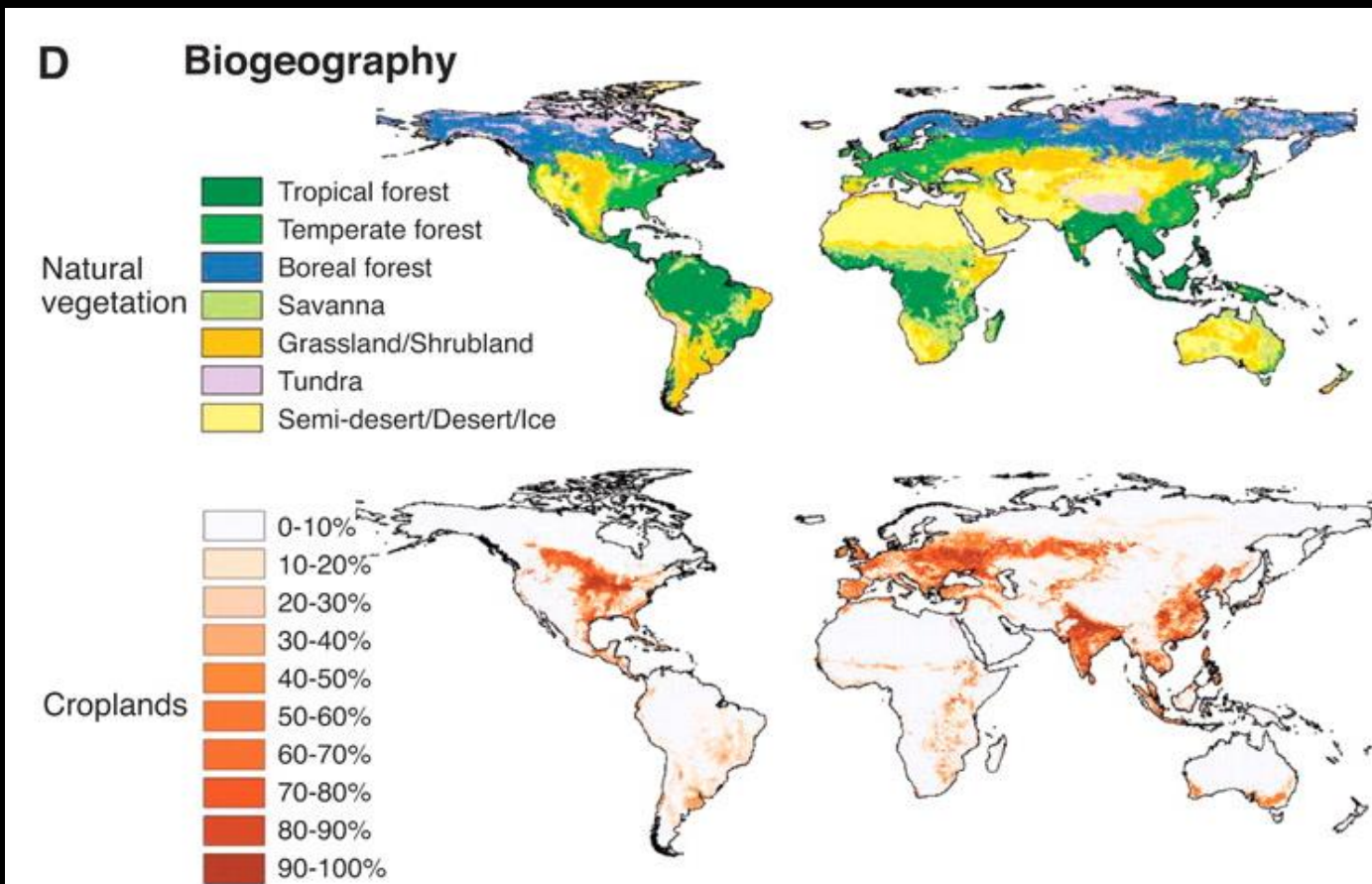
- tropical, temperate, boreal (taiga)



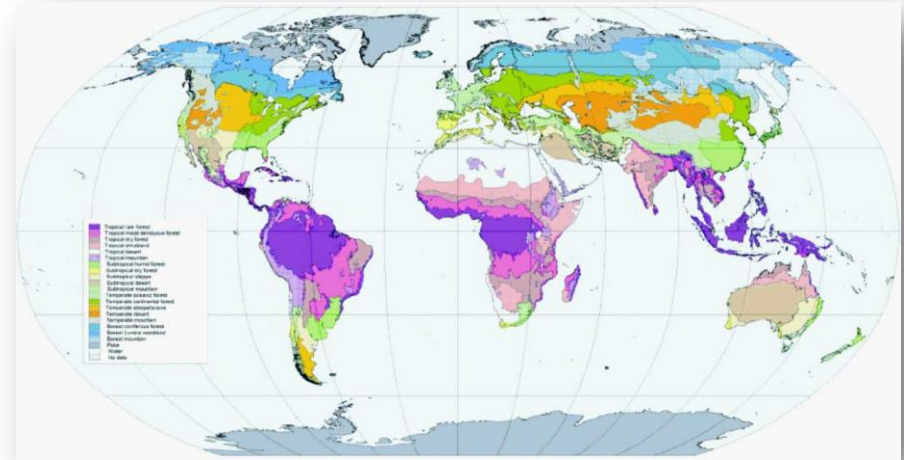
# Forests and climate

## global vegetation distribution

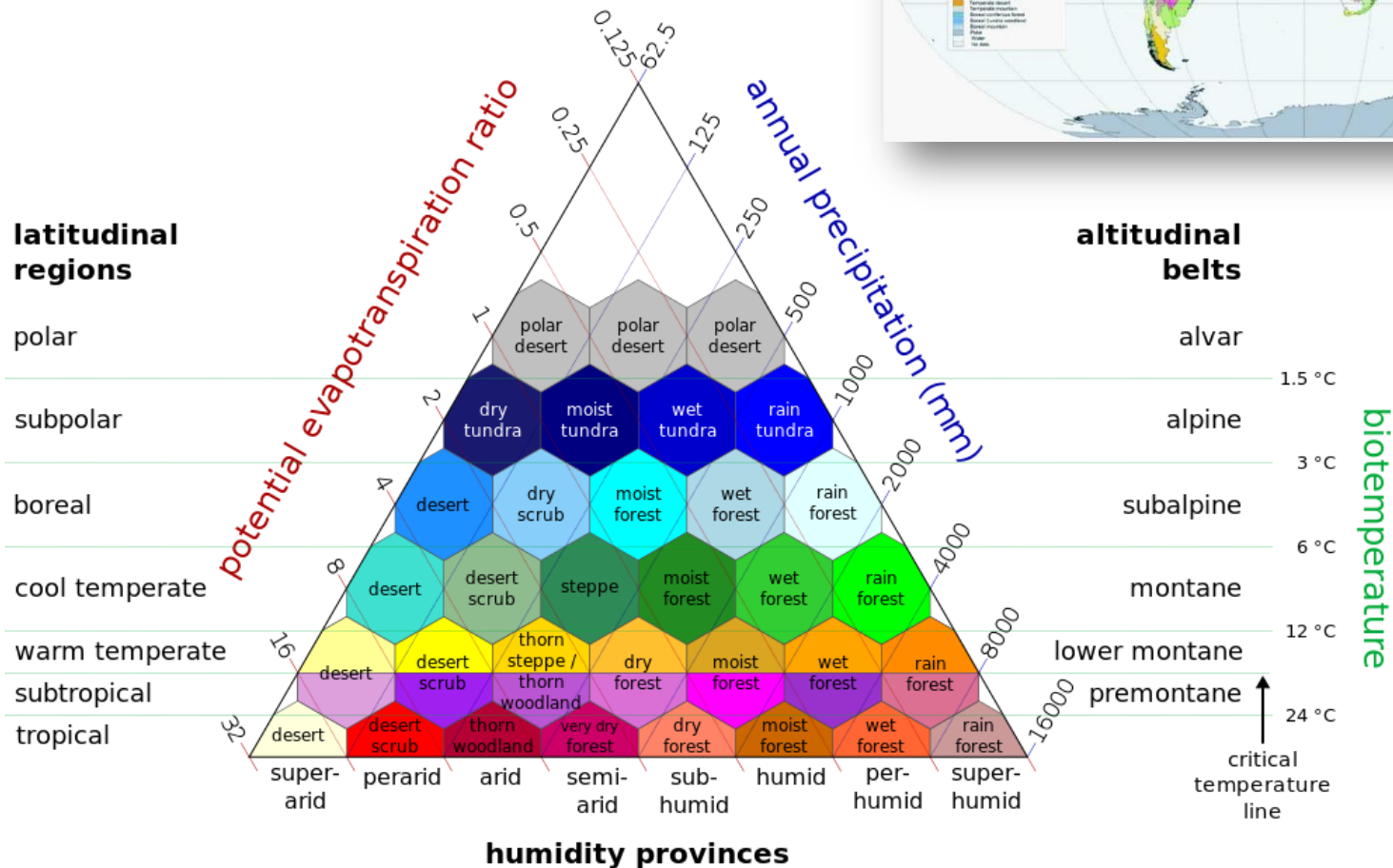
Climate and human land-use change are key influences on vegetation distribution







### Holdridge Life Zones classification



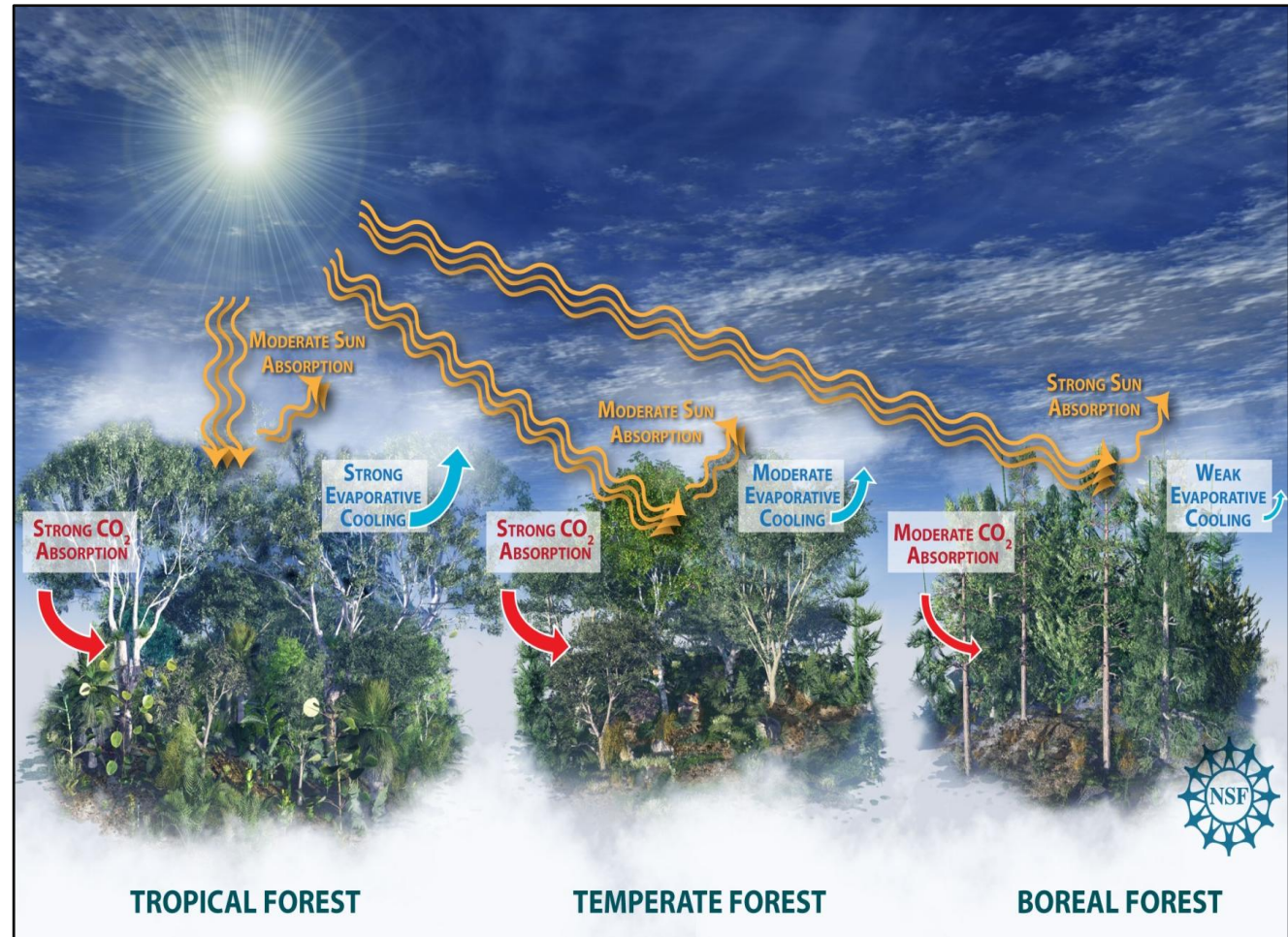
# Forests play an integral role in the Earth's climate

## Forests influence climate and weather mainly through

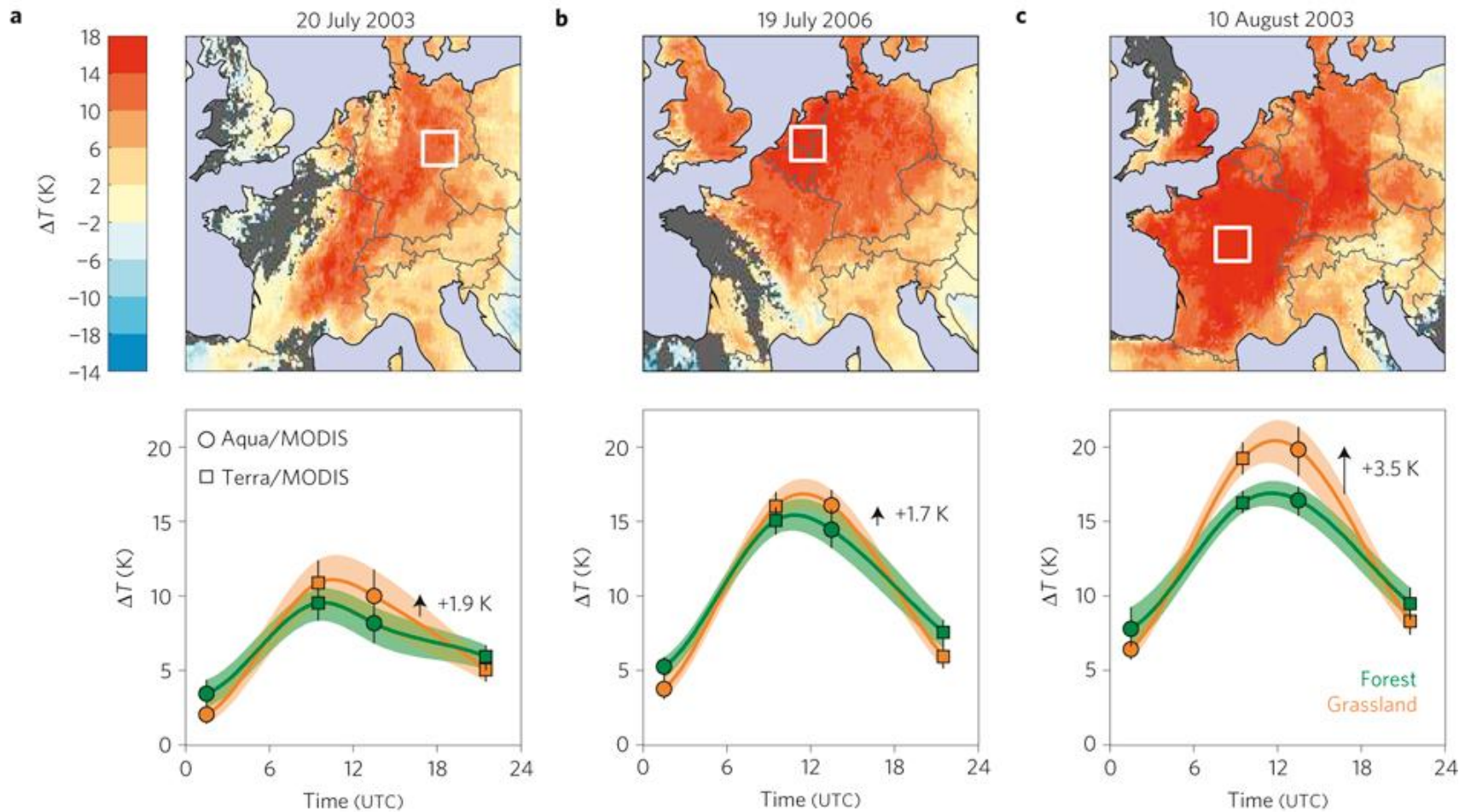
- Albedo
- Evapotranspiration
- Aerodynamic roughness
- CO<sub>2</sub> uptake & release

## Chemical exchanges can also be important

biogenic volatile organic compounds (BVOCs) react to produce aerosols which can reflect solar radiation and act as cloud condensation nuclei



# Influence of forests on heatwaves in Europe...







Modelling the forest ↔ weather / climate interactions



# Climate / Earth System Model characteristics

**Mathematical equations of thermodynamics, fluid flow, gas properties, energy transfer, atmospheric chemistry, plant physiology...**

1,000,000 lines of code

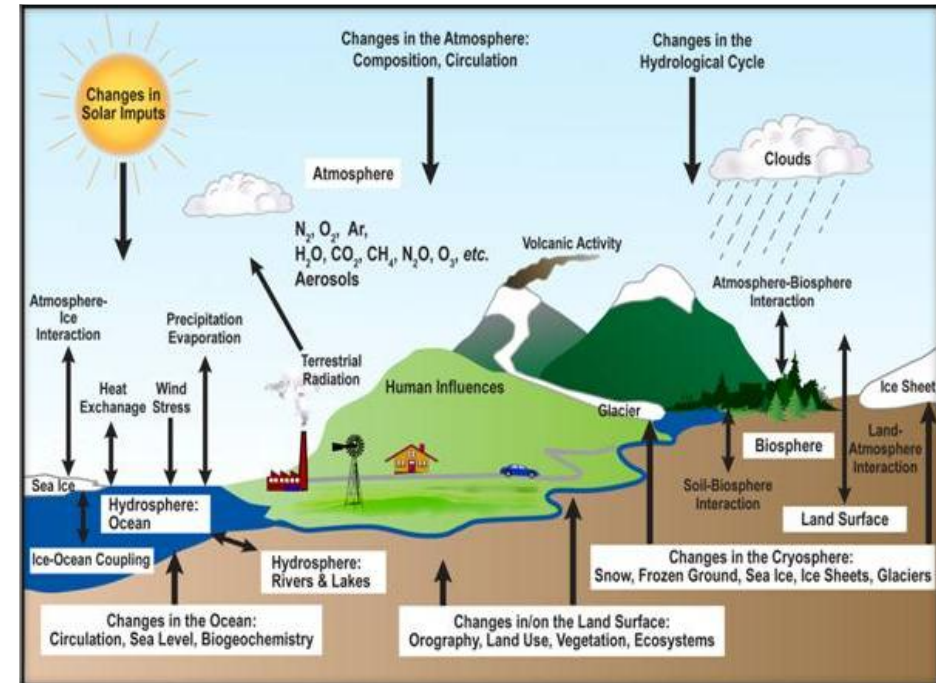
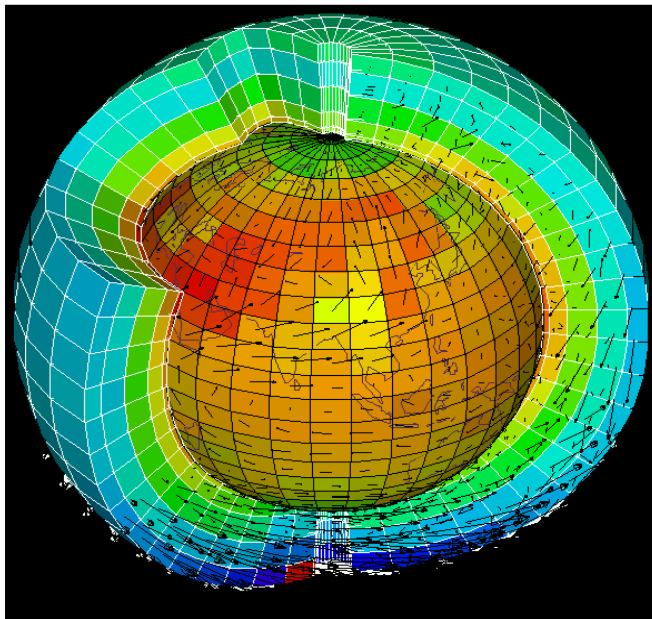
200 output variables

Approx 15,000 grid points

20-40 layers in atmosphere and ocean

30 minute time-step

250 years of simulation requires 1-6 months of real time



```

set msg "$msg \nVegetation param scheme can only be used with JULES boundary\
layer and Hydrology. \nCorrect this and reconsider associated ancillary files."
}
}
set jules {get_variable_value JULES}
set atm_vn {get_variable_value ATMOS_SR($index)}

if { $index=="3" } {
  set j_vn {"9B" "9C" "1A"}
} elseif { $index=="8" } {
  set j_vn {"8A"}
} elseif { $index=="19" } {
  set j_vn {"1B" "2B"}
}

set match "FALSE"
foreach scheme $j_vn {
  if { $scheme == $atm_vn } {
    set match "TRUE"
    set j_vn $scheme
    break
  }
}

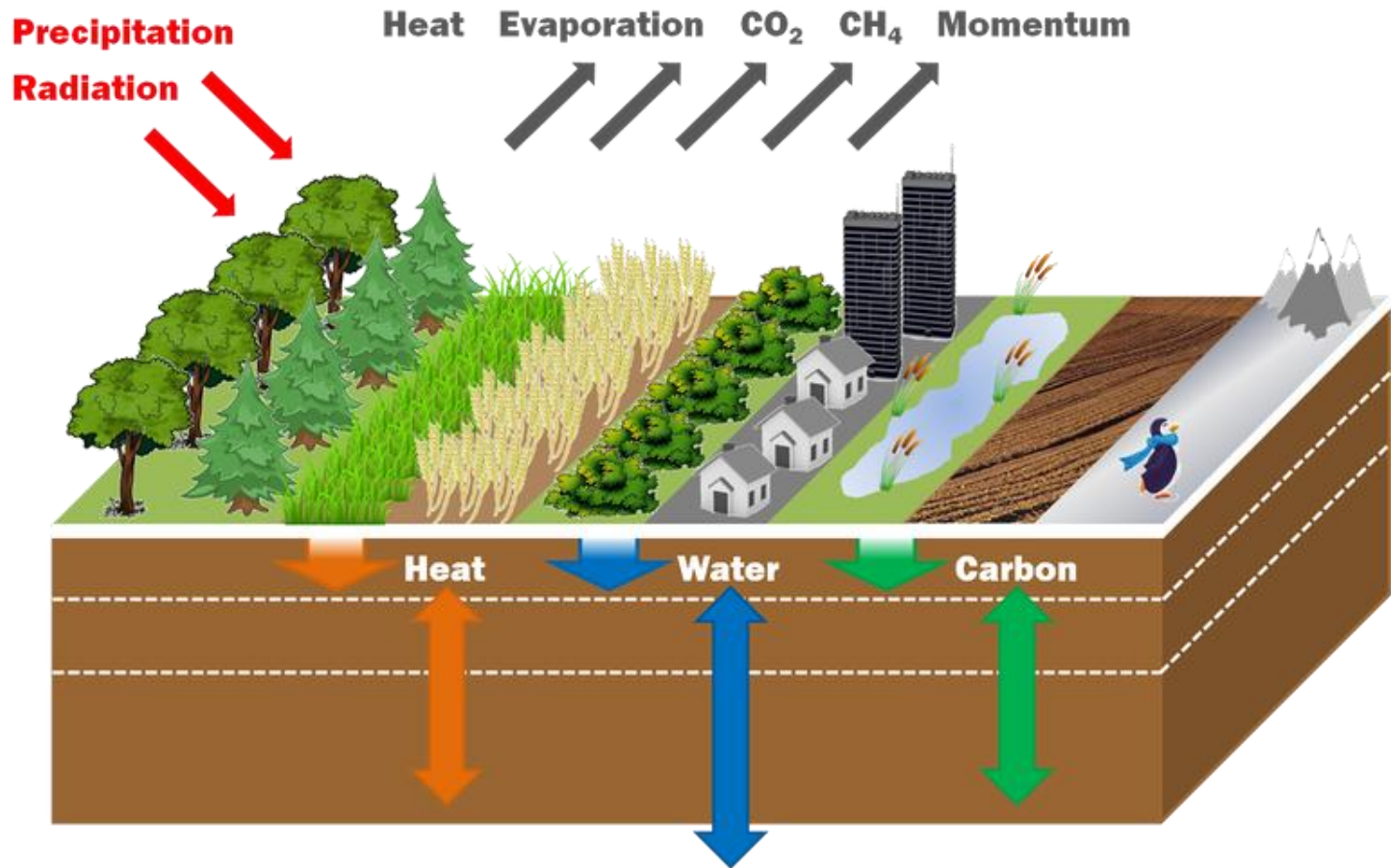
if { $jules=="T" && $match=="FALSE" } {
  set msg "JULES Land Surface Model is currently in use.\n
Please select version $j_vn."
  set retval 1
} elseif { $jules=="F" && $match=="TRUE" } {
  set msg "Version <$atm_vn> is only appropriate when JULES Land Surface Model is in use.\n
Please select an alternative."
  set retval 1
}

```



# JULES Joint UK Land Environment Simulator

Met Office tiled land-surface scheme

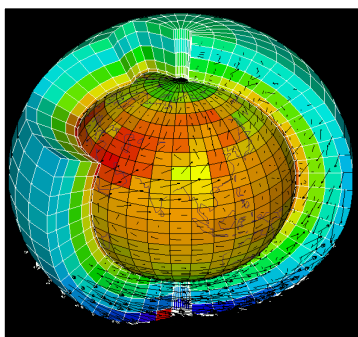
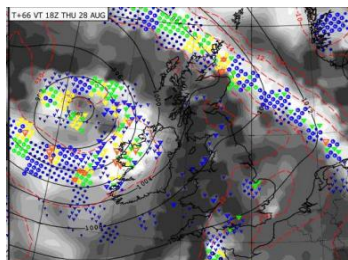


5 PFTs: Broadleaf, needleleaf, C3 grass, C4 grass, and shrubs  
4 non-vegetated tiles: Urban, inland water, bare soil, land ice

# Vegetation-climate interactions

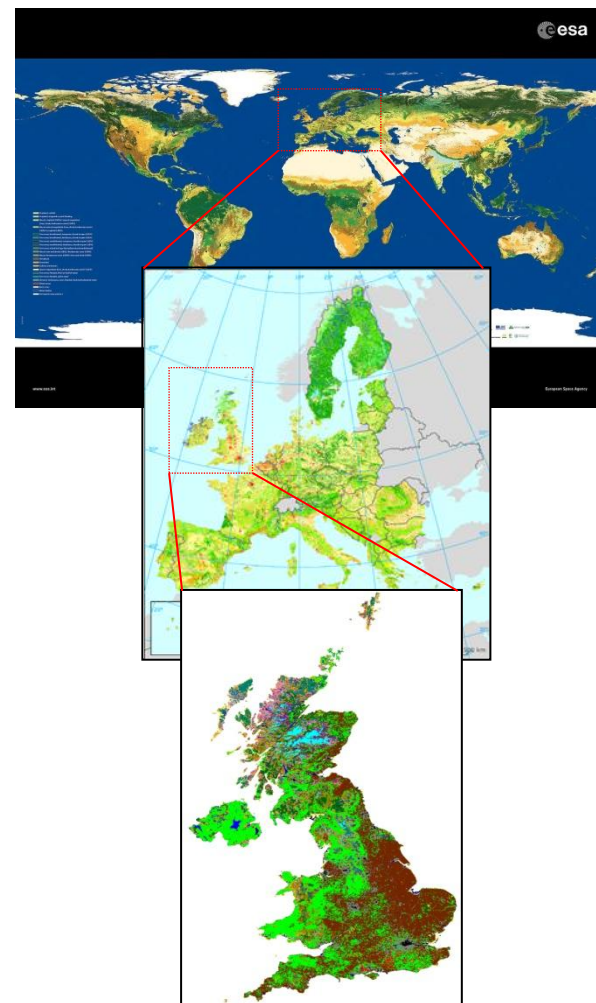
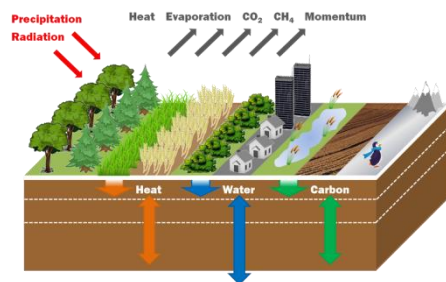
## Met Office modelling capability

Land use / vegetation characterisation



Earth System Modelling

JULES land surface modelling

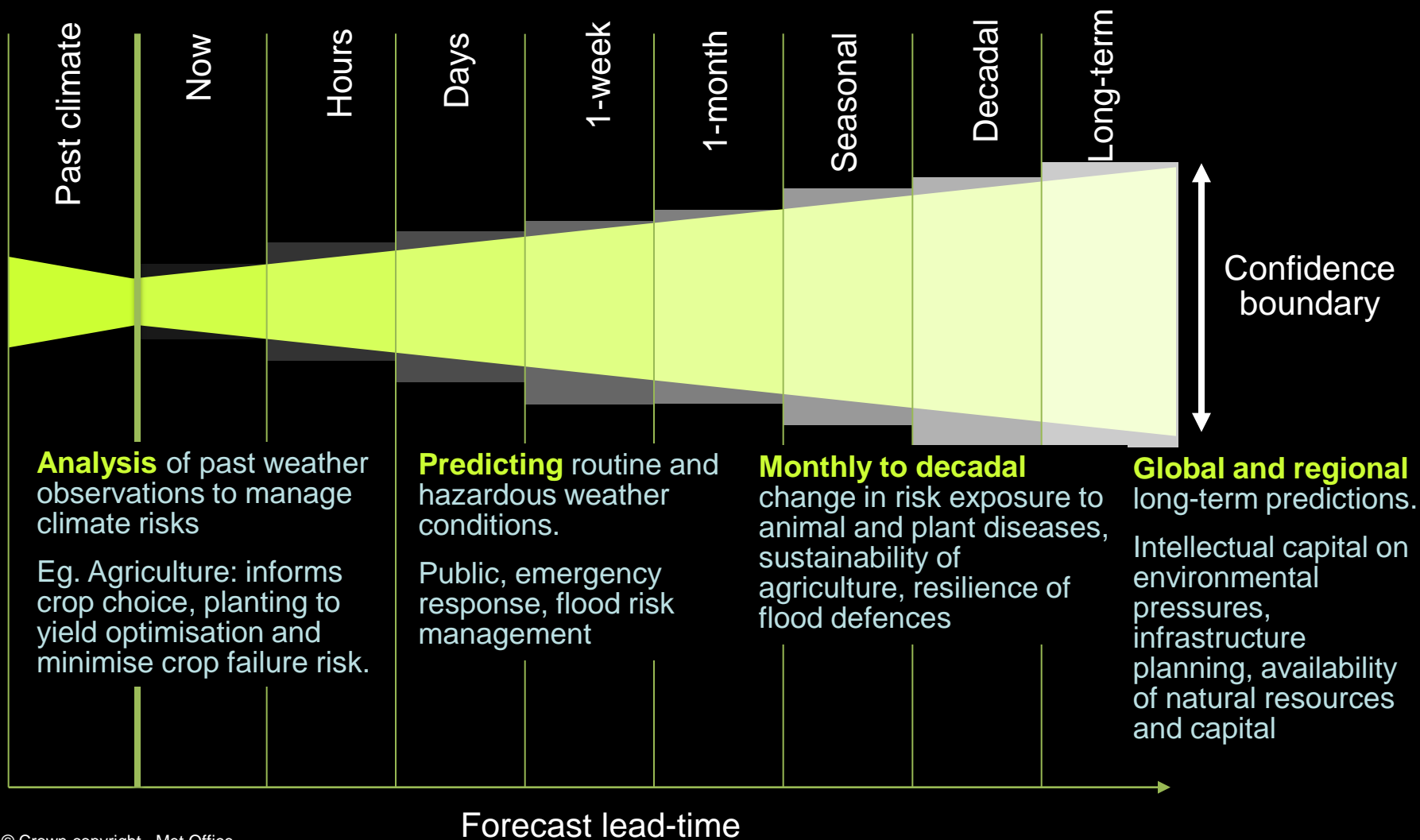


Dispersion modelling



# Seamless prediction

support to decision making on all timescales

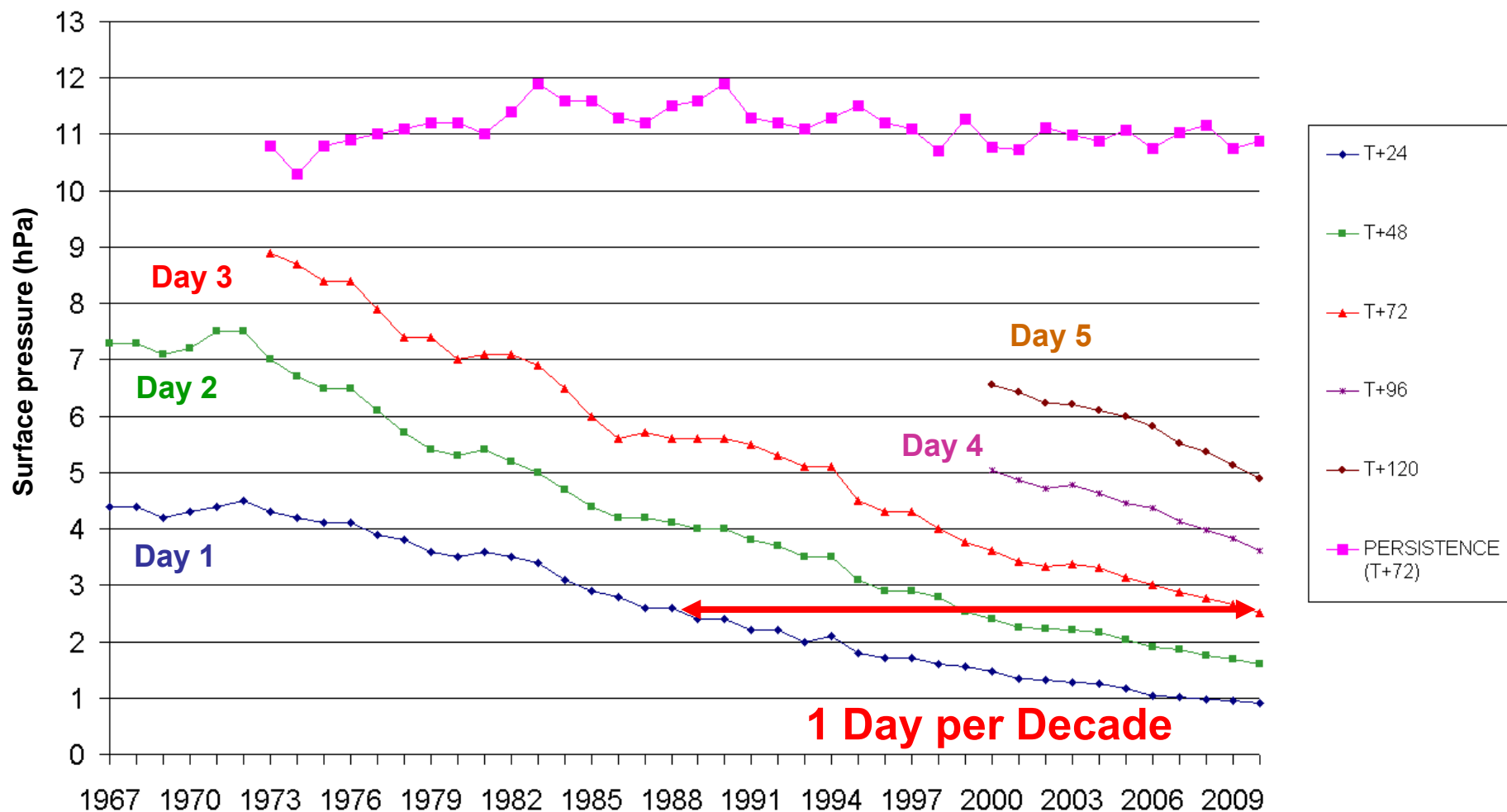






# World-leading weather forecast accuracy

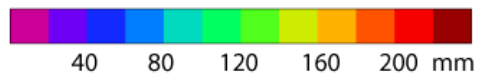
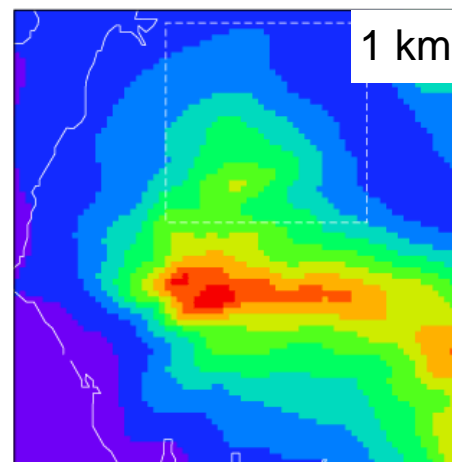
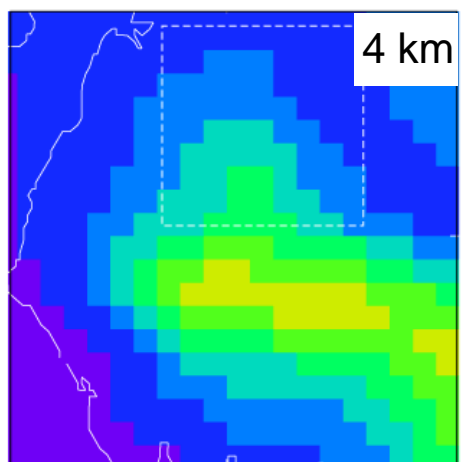
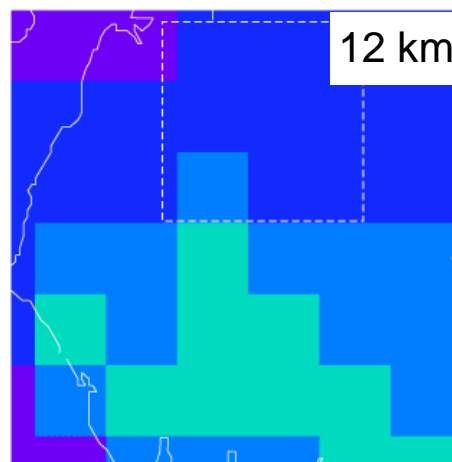
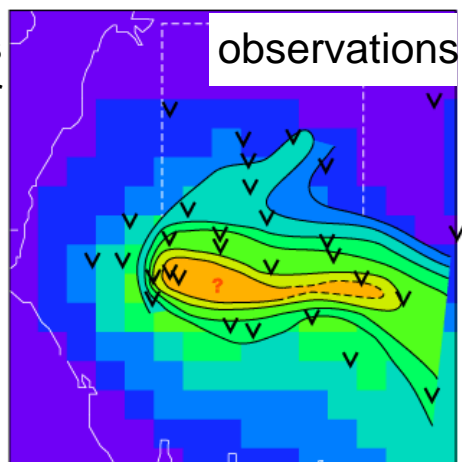
RMSE surface pressure over NE Atlantic



# Increased resolution - precipitation forecasting

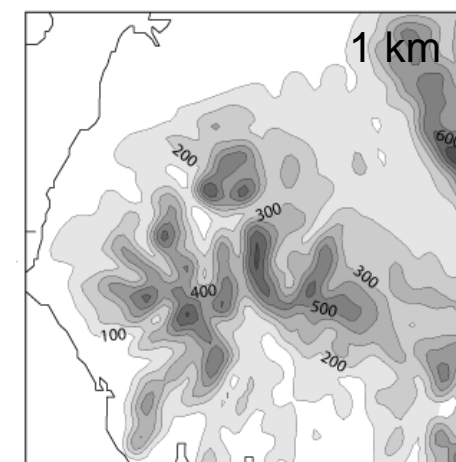
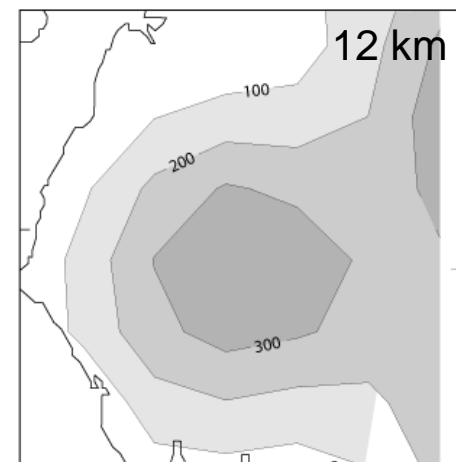
Carlisle Flood 2005

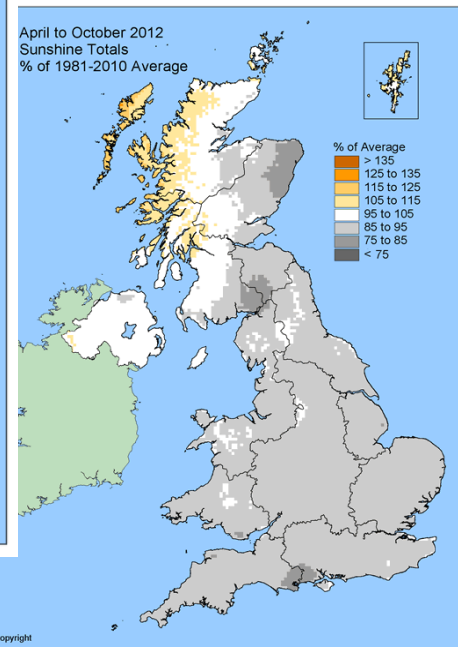
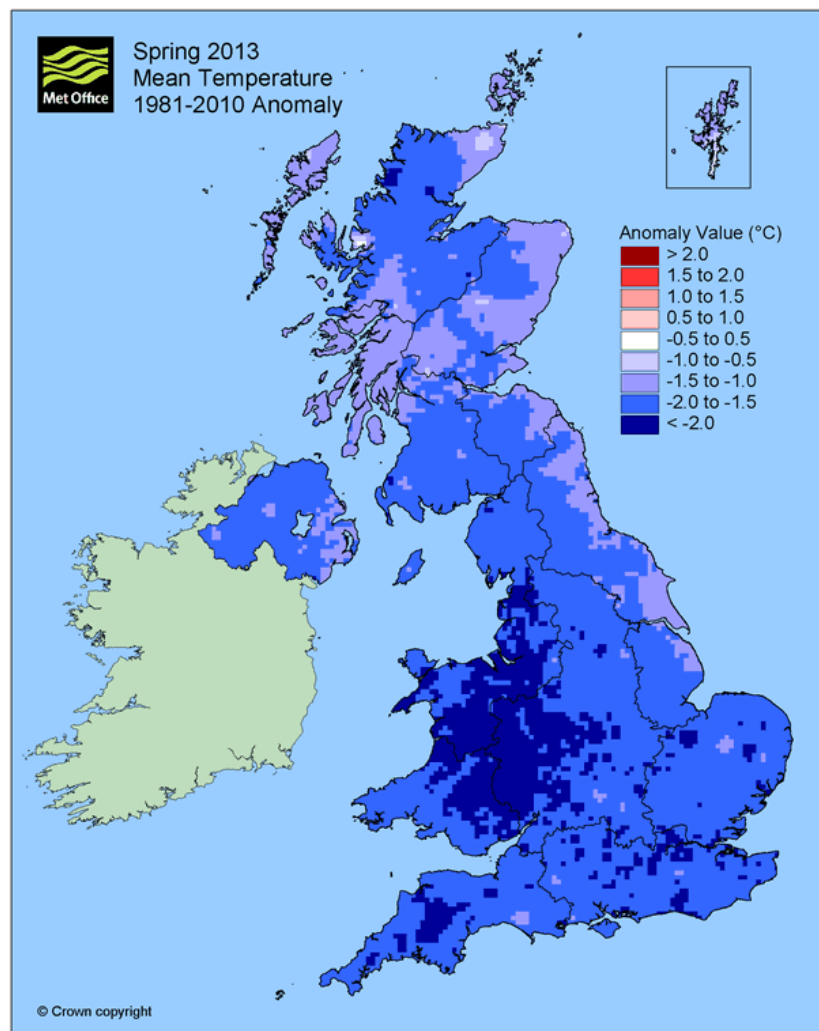
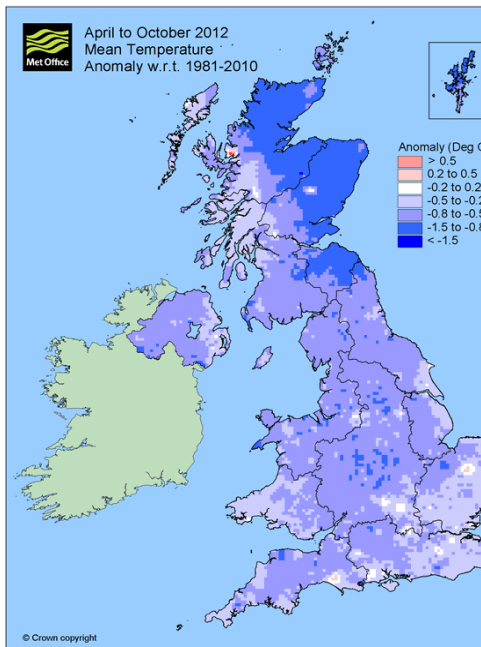
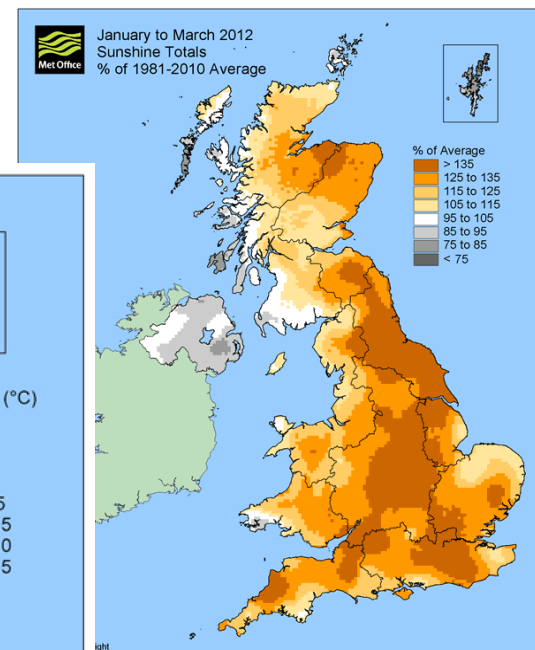
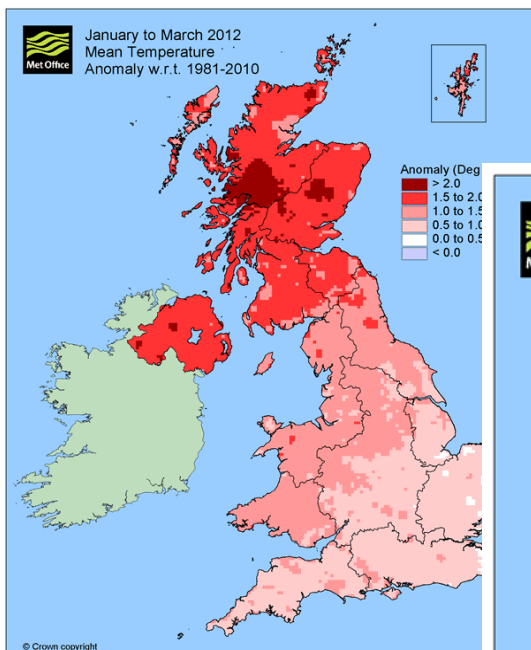
Rain gauges  
and radar



rainfall in 48 hours

## Model Orography









Relevant science and services





# Fire Severity Index

If a fire starts, how difficult will it be to control, how quickly will it spread, what damage is it likely to do to vegetation and underlying soil



## Initial Spread Index

Expected rate of fire spread

Combines the effects of wind speed and Fine Fuel Moisture Code (soil moisture index) without the influence of variable quantities of fuel

## Build Up Index

Total amount of fuel available for combustion

Tend to get higher BUI in autumn than spring

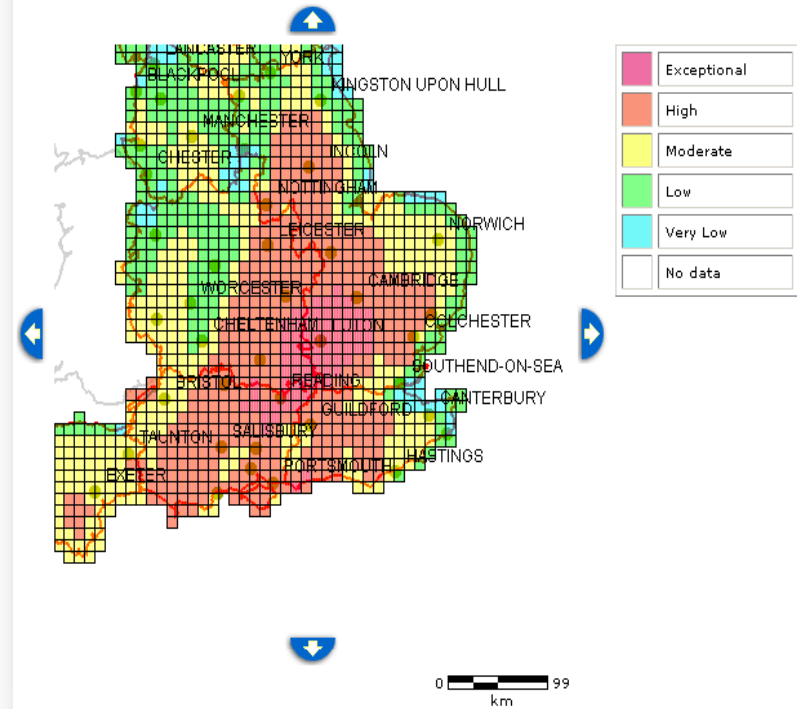
## Fire Severity Index

Show the Met Office Fire Severity Index for...

Date selected to view the Fire Severity Index **18/07/2005**

You can select the Fire Severity Index for today **or** you can see the forecast Fire Severity Index by selecting a date in the next 5 days

Please note these maps must not be used as a walking guide



# Operational pollen forecast

## Daily observations of pollen counts


- March to September

## Observations delivered as operational forecast process

## Part of wider European Aeroallergen Network

## Select pollen sites have been running for many decades

- Several from 1960's  
- Longest from 1953 (Cardiff)

**Pollen forecast**

Pollen forecasts are available on the weather map and provide people with vital information to help reduce the impact of pollen on their health. This year the pollen forecast is sponsored by Benadryl.

Different types of pollen are released throughout the year which can generate hay fever and other allergies. These symptoms can have a serious impact on the well-being of some people.

[Information on how to manage your hay fever symptoms](#)

**Pollen season**

The pollen count season is normally March to August. However, it can start as early as January and end as late as November.

The pollen season separates into three main sections:

1. Tree pollen - late March to mid-May
2. Grass pollen - mid-May to July
3. Weed pollen - end of June to September

Our [pollen calendar](#) has a detailed breakdown of the different types of pollen and their peak times within a season.

**How can the Met Office help?**

In count monitoring network in the UK and produce pollen forecasts up to five days ahead from our network, our weather data and expertise from organisations such as the [National Institute for Research in Dairies](#) at the University of Worcester and [Pollen-UK](#) to produce forecasts which help allergy and hay fever sufferers through the most difficult time of the year.

Europe-wide study, hay fever sufferers are recording their symptoms online through the [European Allergy Network \(EAN\)](#) Patient's Hayfever Diary.

Patients can compare them with concentrations of pollen in the air, to help identify which pollen types are most likely to be causing their symptoms. Look back at pollen levels from previous seasons and read the latest pollen news. This will significantly aid research into pollen and hay fever.

[Pollen-UK](#)

**Hay fever**

Minimise exposure and ease your hay fever symptoms

**Health forecasting**

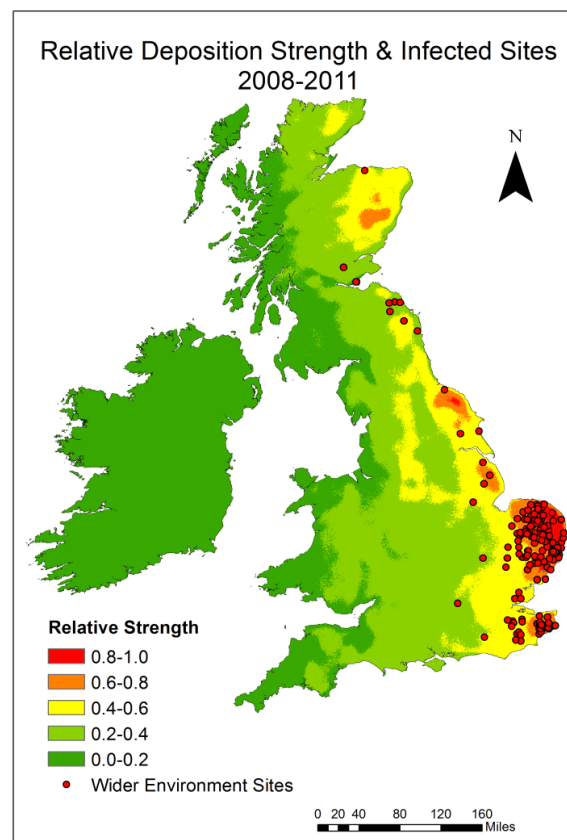
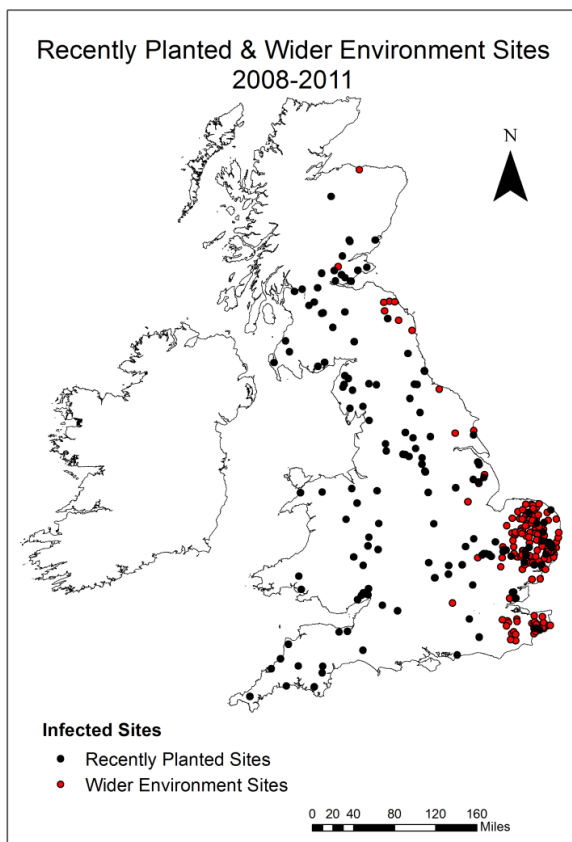




# Airborne pest & disease risk

Ash dieback - *Chalara fraxinea* spore deposition

Collaboration between Met Office Dispersion team and Cambridge University Dept of Plant Science

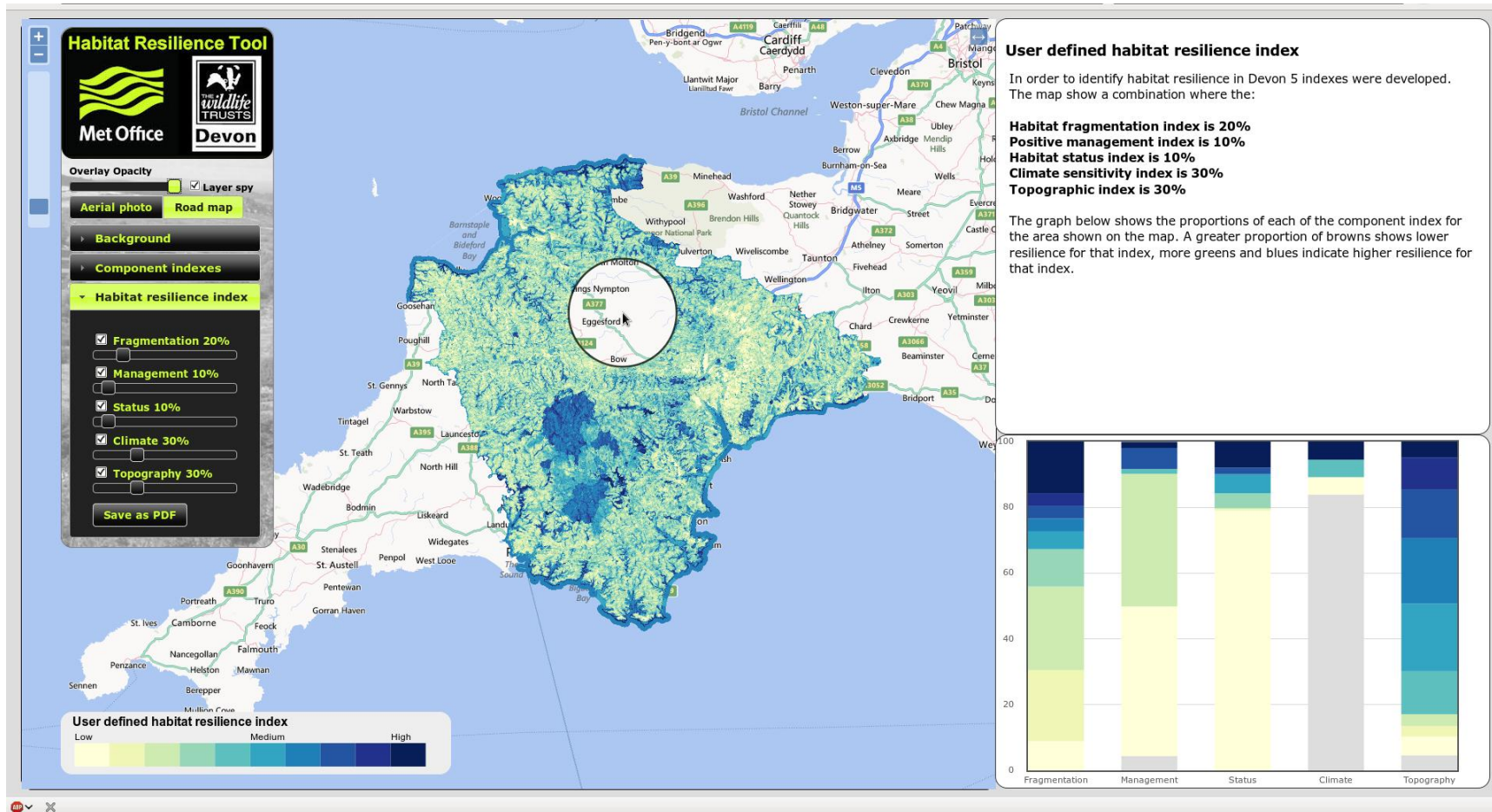


Spore deposition from the continent explains UK wider environment infections better than proximity to recently planted sites

# Habitat resilience to climate & other factors

Devon Wildlife Trust – resilience of Devon habitats

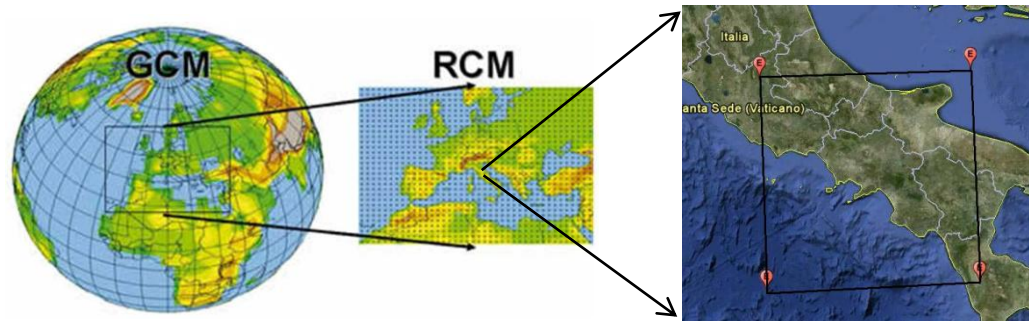
*Collaboration between Met Office Vegetation-Climate Interactions group and DWT*



# Europe forest change effects on climate & water balance

## Deforestation scenario in Italy

*Collaboration between Met Office Vegetation-Climate Interactions group and CMCC Italy*

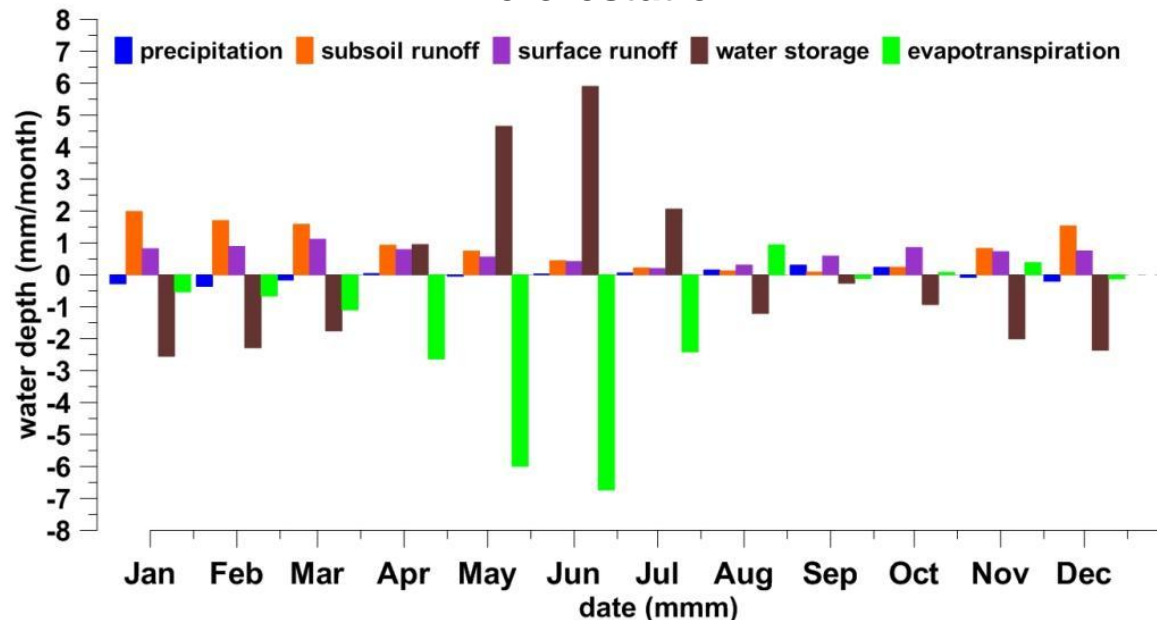


Investigated effects of three forest change scenarios:

afforestation  
deforestation  
current land cover

Analysed changes in climate & water balance for the 2015-2045 period compared to the 1971-2000

## Deforestation





## ***DECC/DEFRA Hadley Centre Climate Programme research*** **Global Modelled Net Primary Productivity**

Report & publications for HCCP

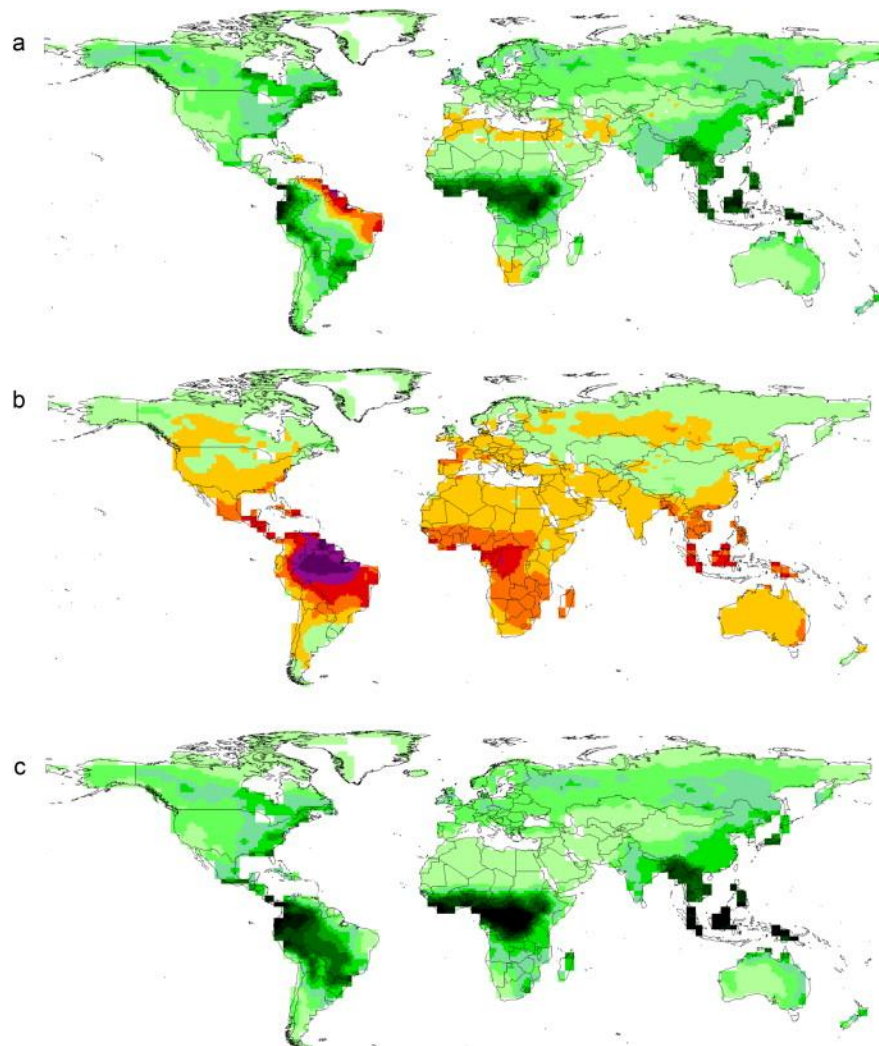
Sensitivities and Uncertainties in modelled  
Net Primary Productivity (NPP) to doubled  
atmospheric CO<sub>2</sub>

Perturbed physics ensemble of 224 different model  
runs – HadCM3 model

Average changes in NPP ( $\text{kg cm}^{-2} \text{ yr}^{-1}$ ) between  
pre-industrial and doubled  $[\text{CO}_2]$  for:

- (a) Both climate and CO<sub>2</sub> fertilisation effects**
- (b) Climate effect only**
- (c) CO<sub>2</sub> 'fertilisation' effect only**

Hemming, D., R. Betts, et al. (2011). "Sensitivity and uncertainty of modelled terrestrial net primary productivity to doubled CO<sub>2</sub> and associated climate change for a relatively large perturbed physics ensemble." *Agricultural and Forest Meteorology*.



# Potential influence of climate change on forest productivity

Tropical forest productivity – multiple global models compared

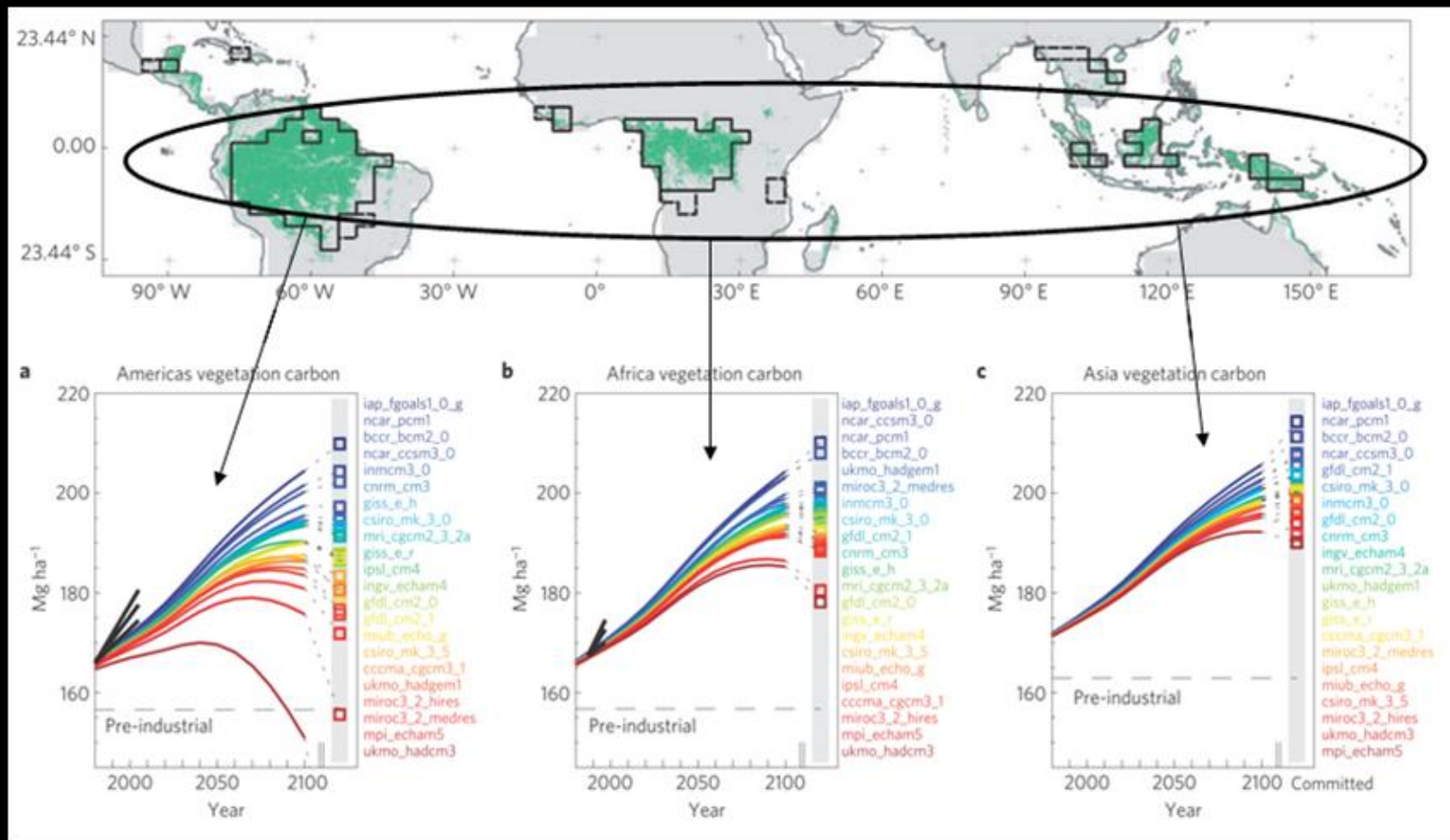


Figure taken from Huntingford et al (2013)



# Citizen Science – WOW Weather Observation Website

user generated observations

<http://wow.metoffice.gov.uk/>

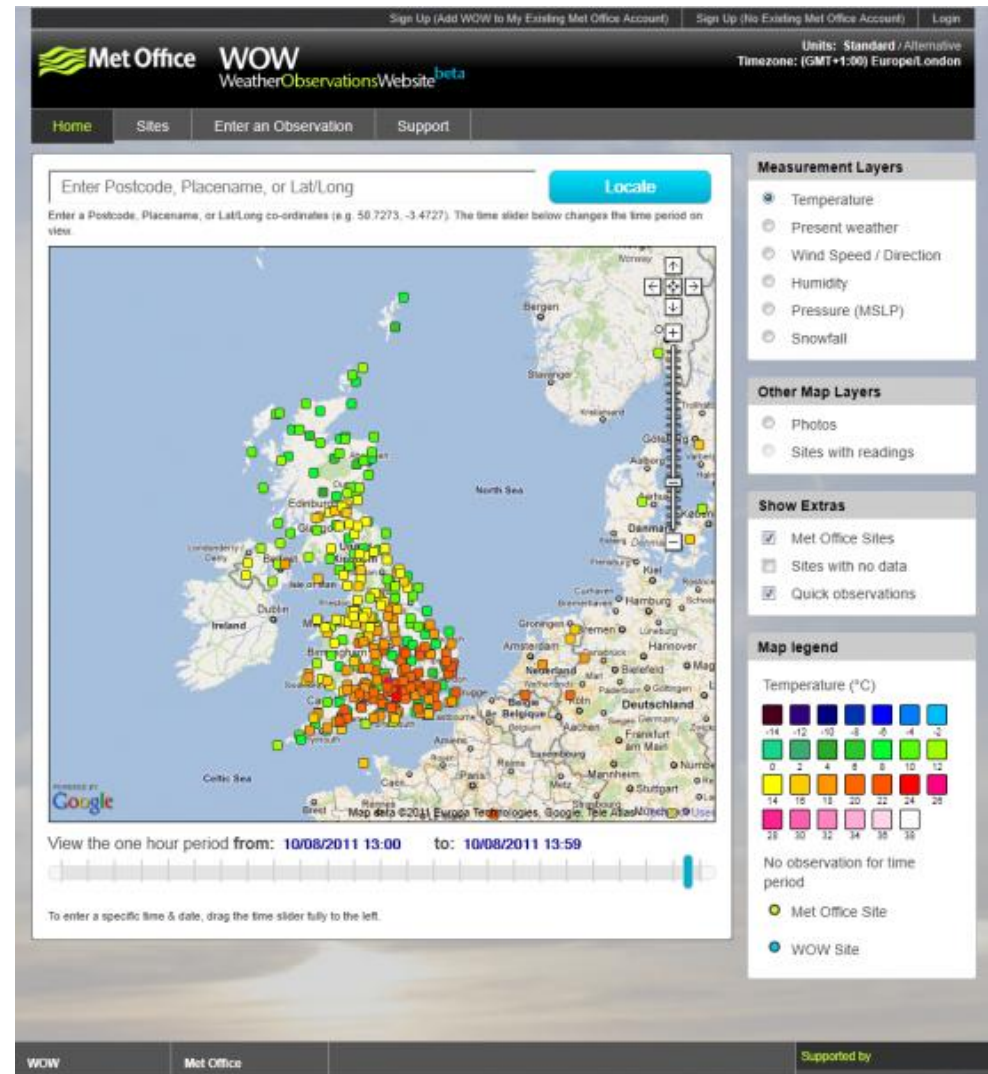
## More than 145 million observations submitted since launch June 2011

- Over 4 million observations being received every month
- Over 3500 separate observation sites created
- Over 625,000 visits to the website from 183 different countries
- Hosted externally on “Google Cloud” technology, offering the main benefits of off-site resilience, and ease of scalability

Google have identified WOW as the most sophisticated use of their API that they are aware of to date

Provides real time information for weather forecasters in the UK, particularly in periods of extreme weather

Looking to extend WOW to other weather / climate related services





Thanks for listening, any questions?

