

Climate Change and Carbon Sequestration in Soil



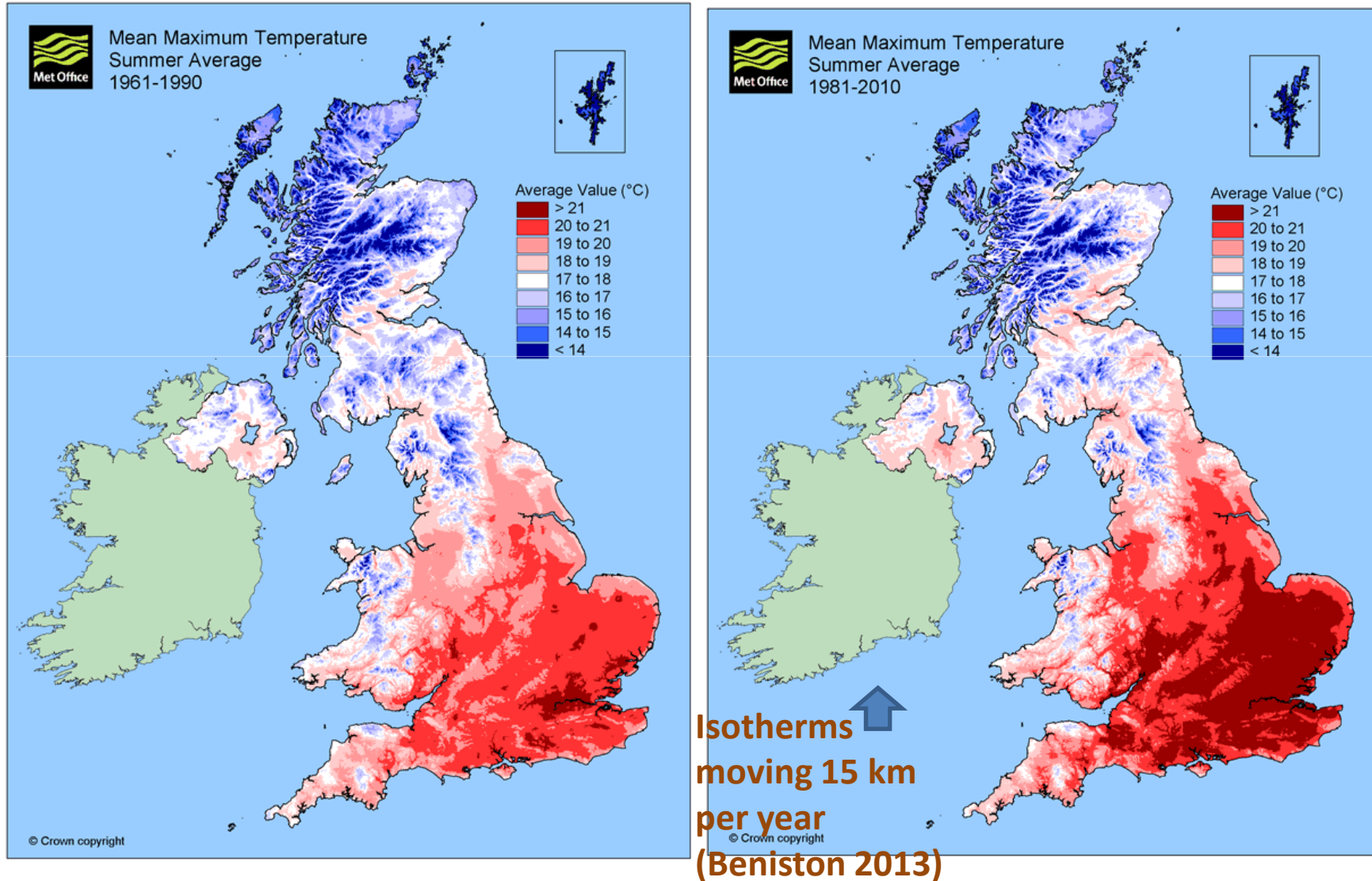
John Grace

President, Botanical Society of Scotland

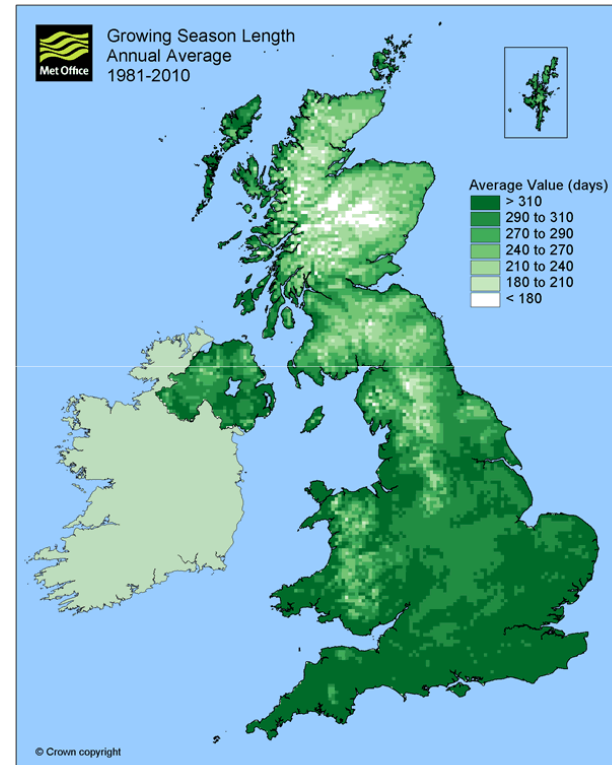
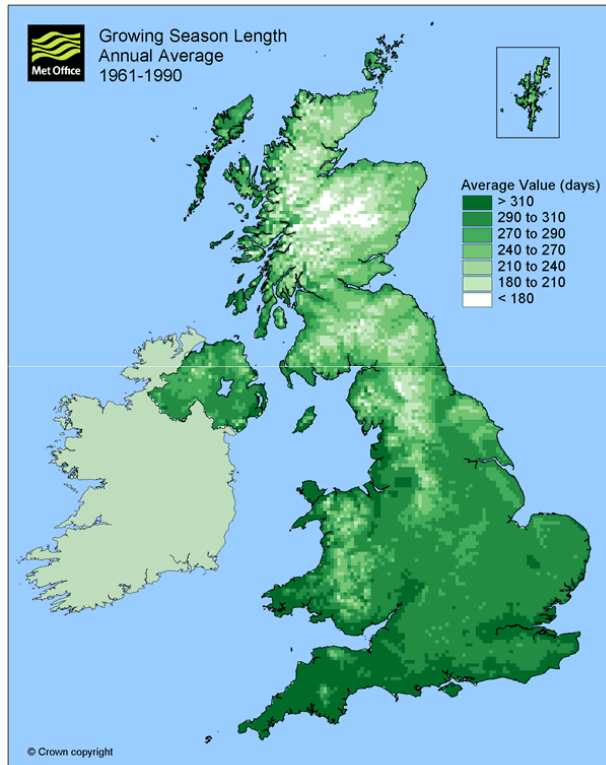
University of Edinburgh, School of GeoSciences

SAGS, Dunblane, June 20th 2015

Climate change: getting warmer all the time



Change in the length of the growing season



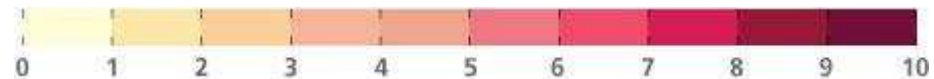
<http://www.metoffice.gov.uk/public/weather/climate/>

UK Climate Change 'Predictions' under 'high' emission scenarios, by the year 2050

Change in
Summer Mean Temperature, °C



Change in
Winter Mean Temperature, °C

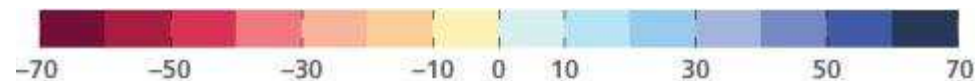


UK Climate Change 'Predictions' under 'high' emission scenarios, by the year 2050

Change in
Summer Rainfall (%)



Change in
Winter Rainfall (%)



Also..more variability, more extremes

Very hot episodes (heatwaves)

Storms (threat to buildings, crops)

Floods (threat to soil and crops)

Droughts (threat to crops)

Extreme spring weather is a threat



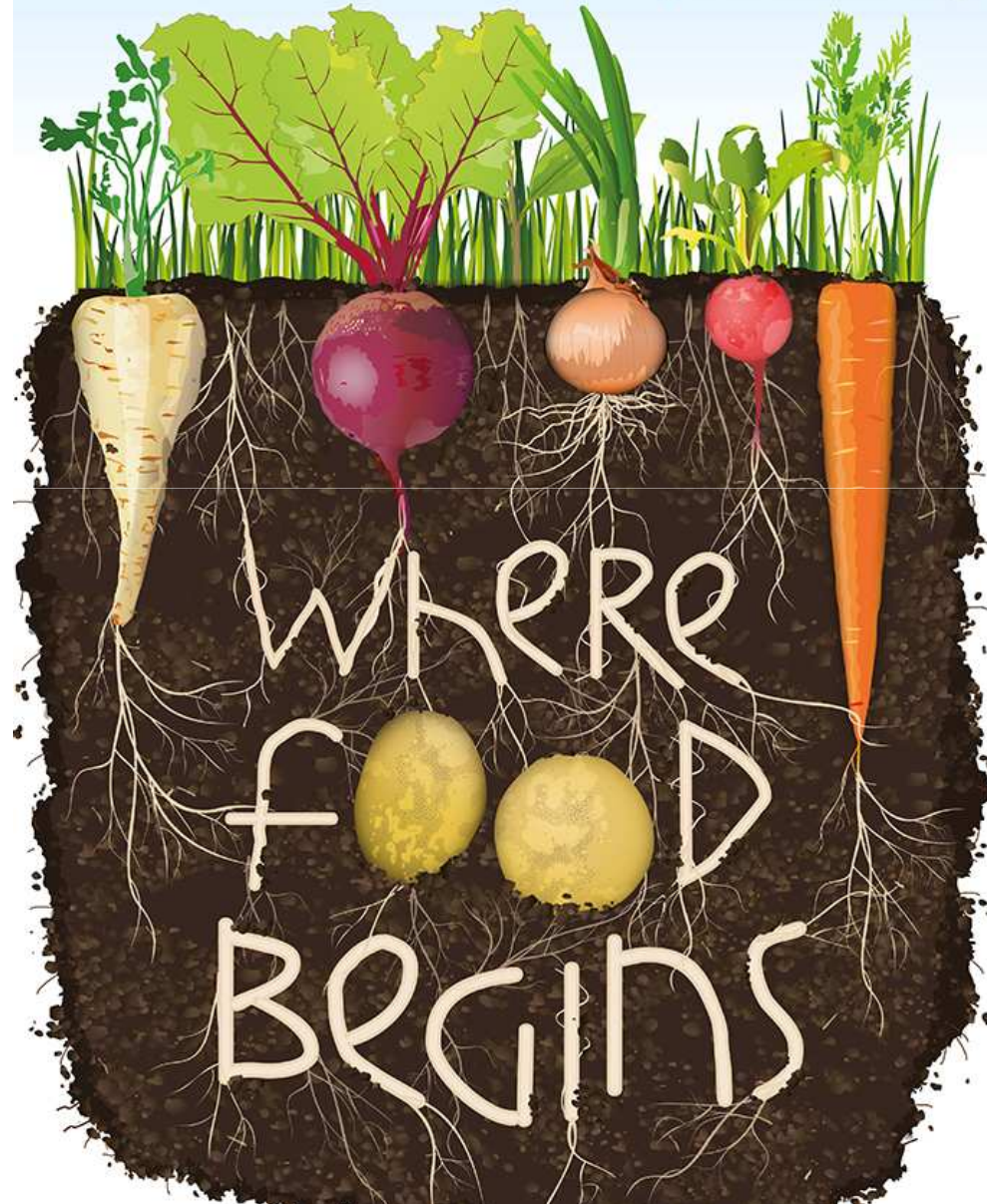
2015

International
Year of Soils



Food and Agriculture
Organization of the
United Nations

World Soil Day
5 December



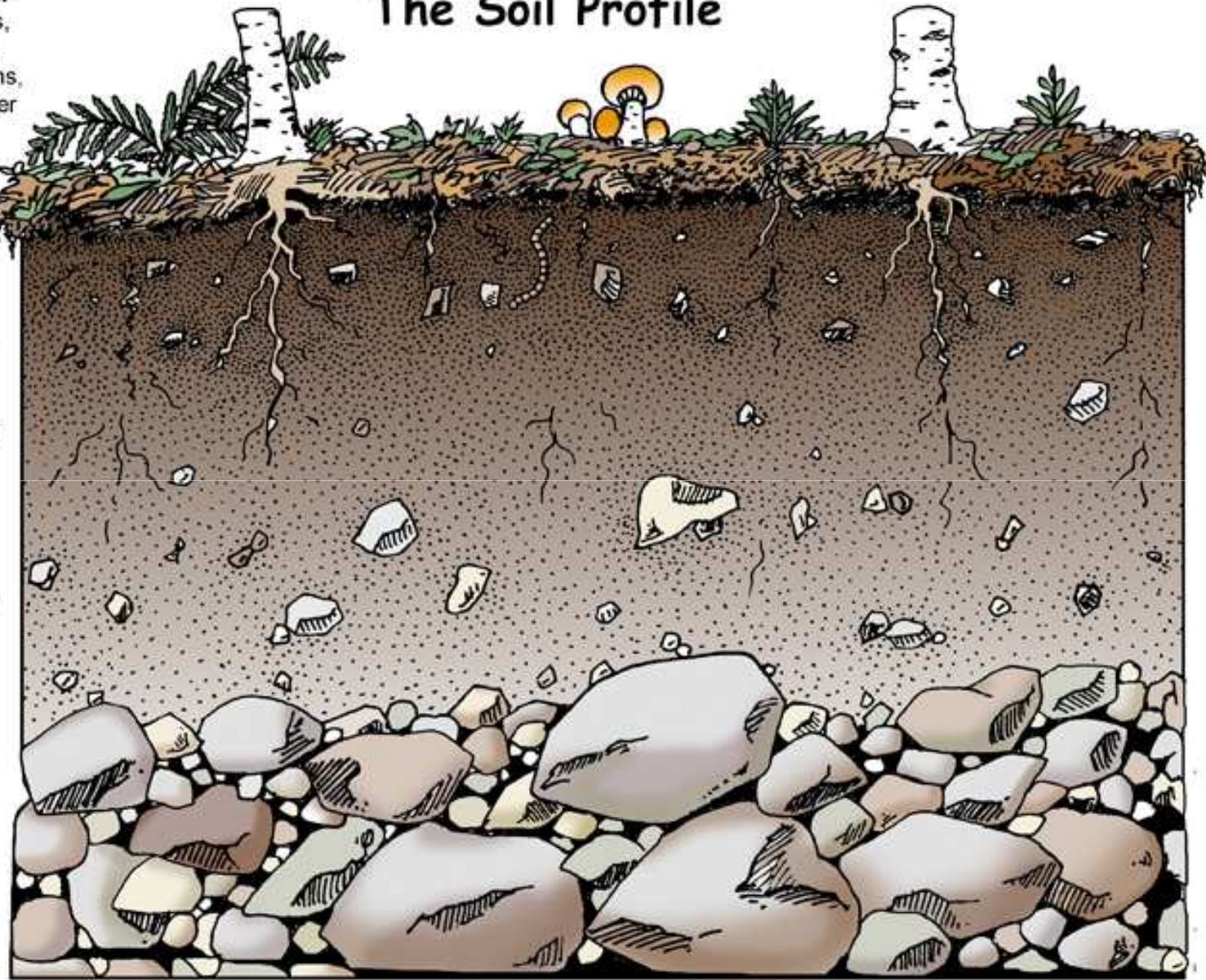
The Soil Profile

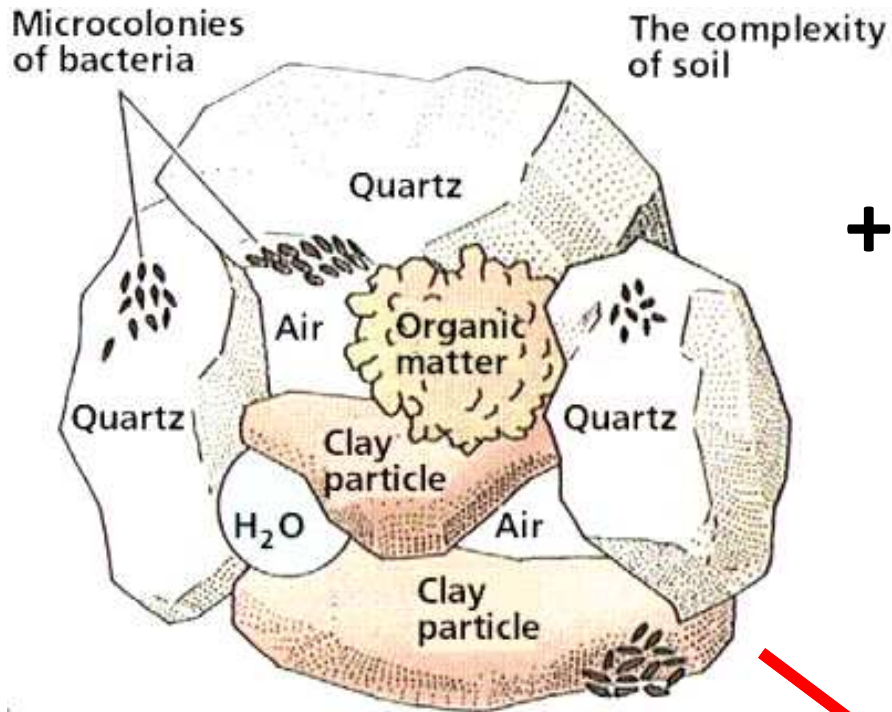
Surface Litter
leaves, branches,
animal scats &
bodies, mushrooms,
other rotting matter

**Topsoil Layer
(or humus)**
rotting organic
matter from litter
layer and
minerals from
weathering rocks

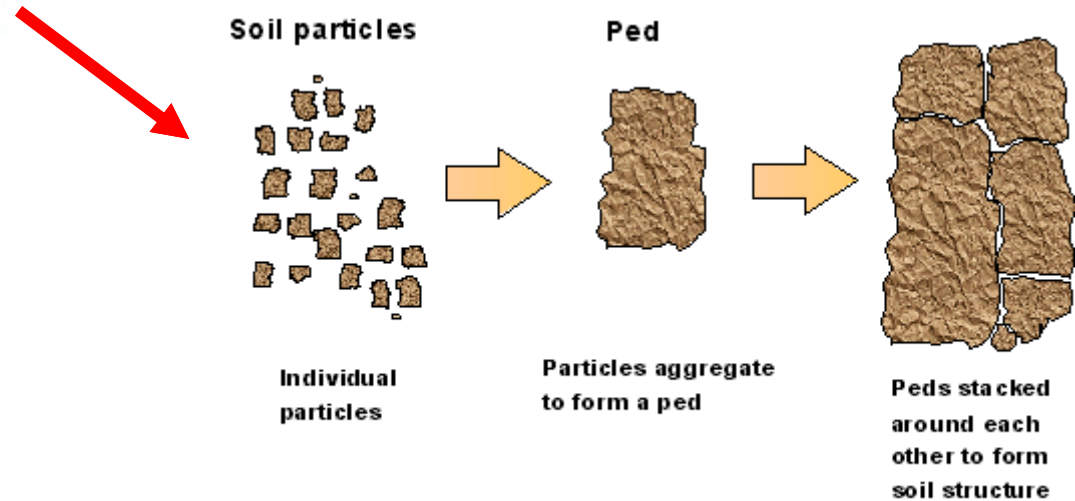
Subsoil
crumbling rock,
sand, clay, gravel
and silt

**Parent
Material**
actual bedrock
underlying the
soil layers

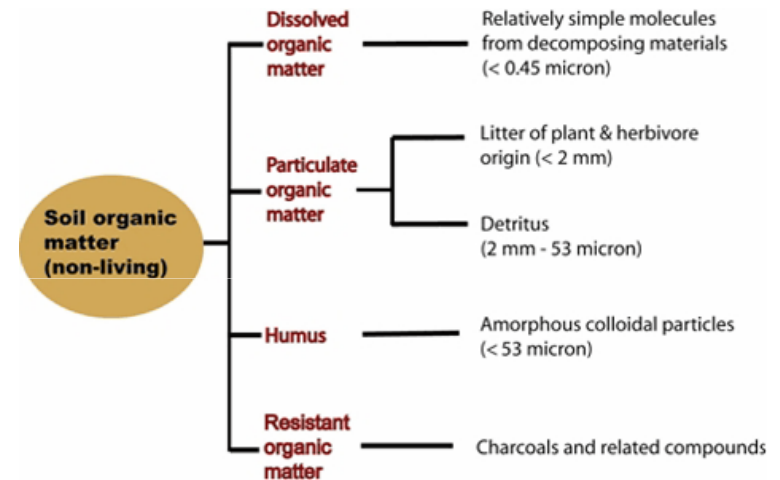
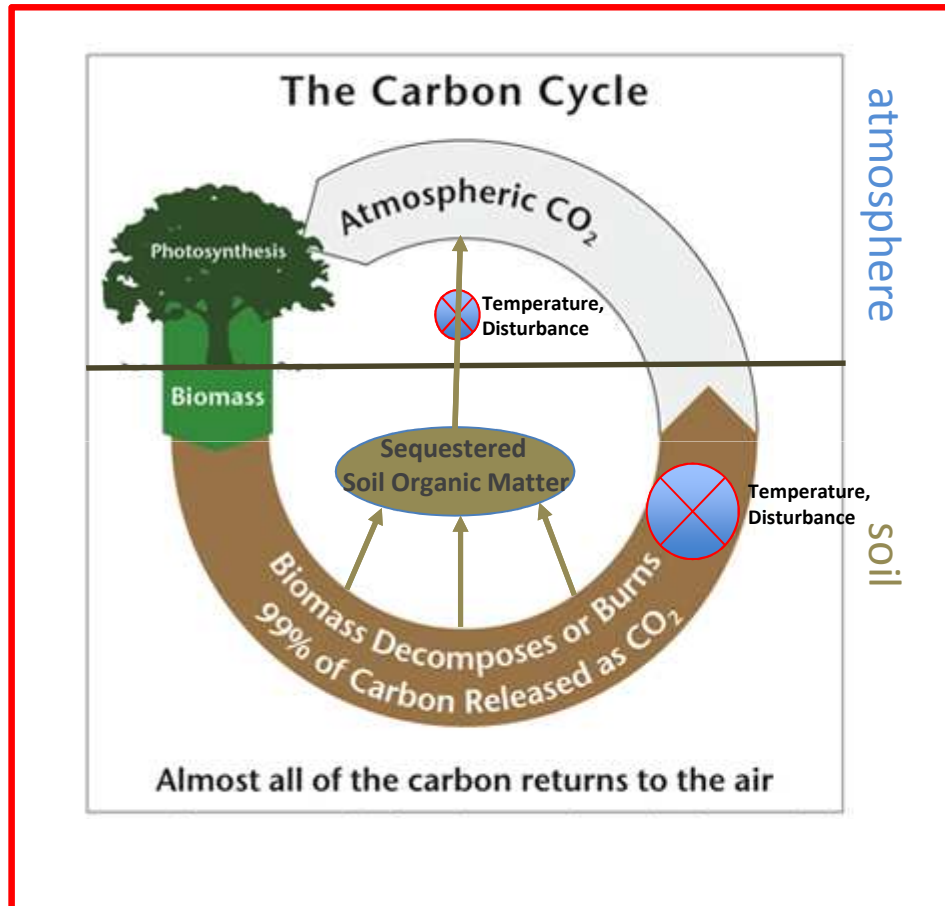




+ Soil + Soil solution + Soil biota



Simplified diagram of soil carbon sequestration



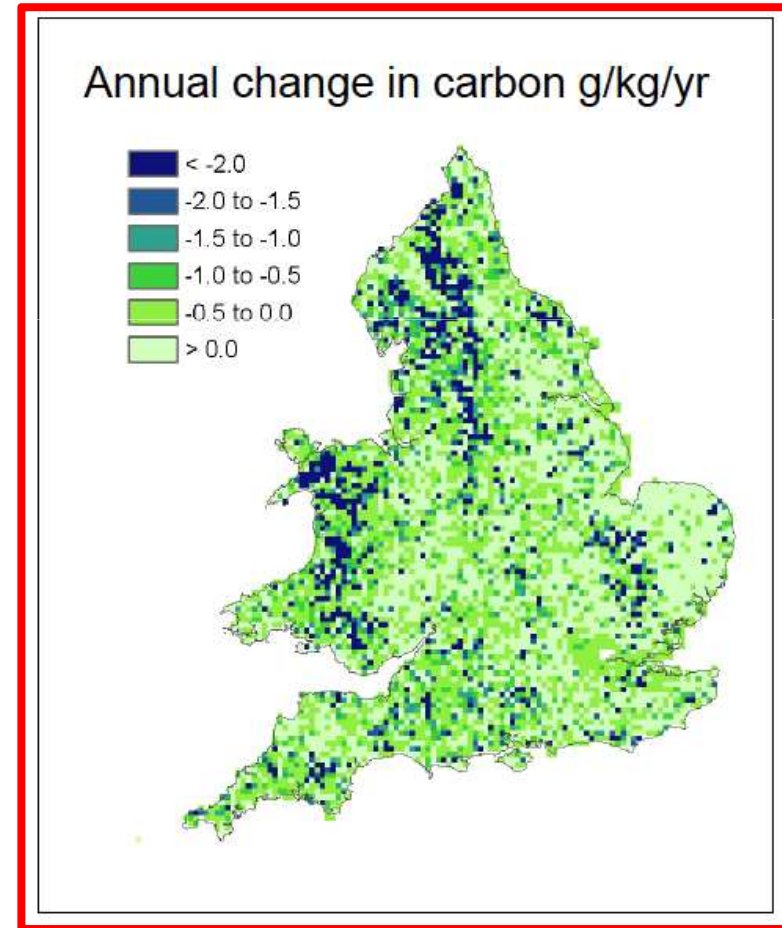
NB Scottish soils store over 50% of the UK's soil carbon and are expected to play a significant role in mitigating greenhouse gas emissions. Mostly the peatlands.

Soil carbon may be declining

(5 km samples from 1978-2003)



Pat Bellamy



Bellamy et al. *Nature* (2005), 437, 245-248.

Major Report: The State of Scotland's Soil 2011

www.sepa.org.uk/land/land_publications.aspx

- **loss of organic matter** - refers to a reduction of organic matter in soils. Organic matter is important in its own right as a direct loss no matter how small, but also because the scale of loss may lead to a reduction in the capacity of different soils to deliver their functions;

- **soil sealing** - the permanent covering of the soil surface with an impermeable material;

- **contamination** – an effect caused by the addition of a substance or substances to soil that causes a deterioration in the ability of a soil to perform key functions and often has a negative impact on soil, water or air;

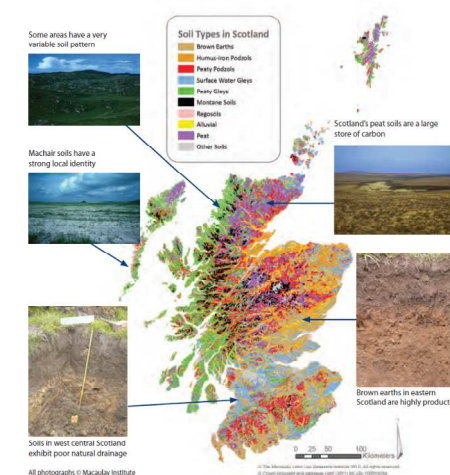
- **change in soil biodiversity** – either a change in the diversity itself or on the ability of soil biodiversity to perform its functions;

- **erosion and landslides** - soil erosion, i.e. the movement of soil particles, becomes of concern when the rate exceeds “natural” or “background” rates that can be considered as broadly equal to the rate of formation of new soil material by weathering processes. Landslides are mass movements of rock, earth or debris down a slope;

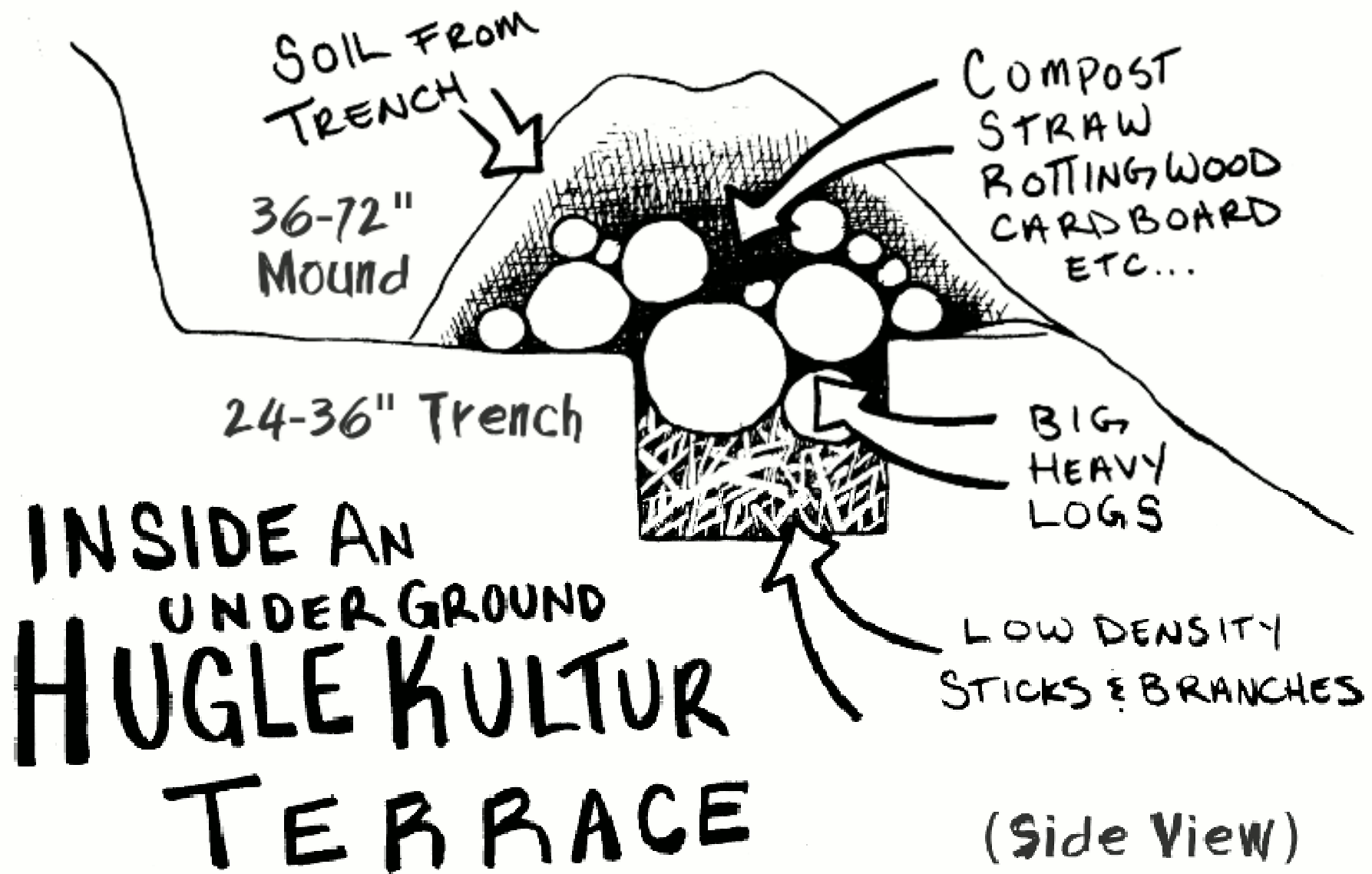
- **soil compaction** - generally refers to the loss of porosity through mechanical damage to soil and can affect both topsoil and subsoil. Compaction occurs when an external stress exceeds the mechanical stability of soil.



Karen Dobbie, SEPA







Allotments are the most
climate-friendly and
biodiversity-friendly ways
to produce food.

A photograph of a community garden. In the foreground, there are several raised garden beds. One is a wooden bed with green plants, and another is a metal barrel filled with straw. A wooden bench sits in the middle ground. In the background, there is a greenhouse with a solar panel on its roof, and several colorful tiny houses (yellow, blue, brown) built on a hillside. The text "Many thanks for listening. Any questions?" is overlaid in the center in a bold, dark blue font.

**Many thanks for
listening. Any
questions?**



Czech
Republic



Finland



Germany



Malta



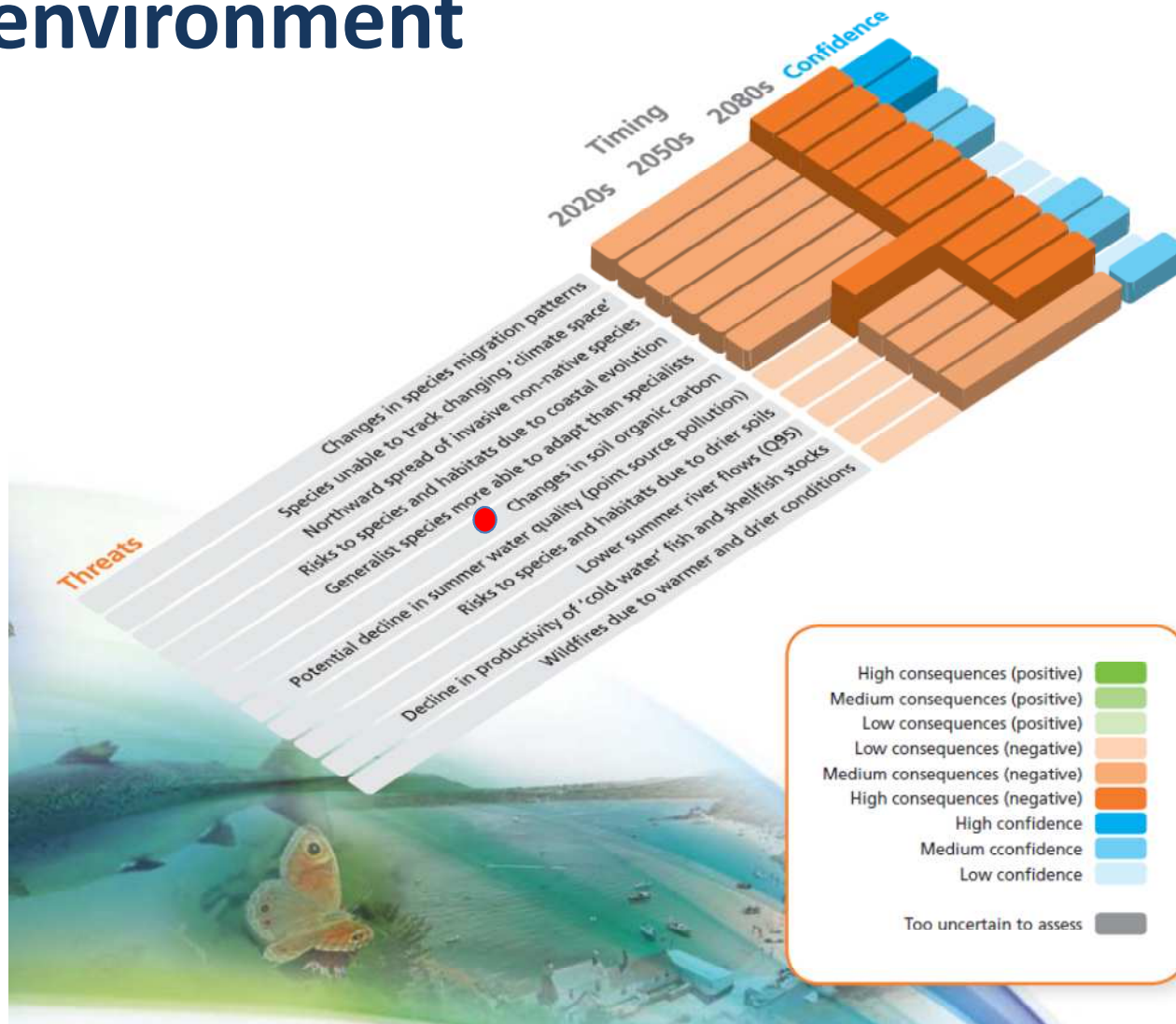
Philippines



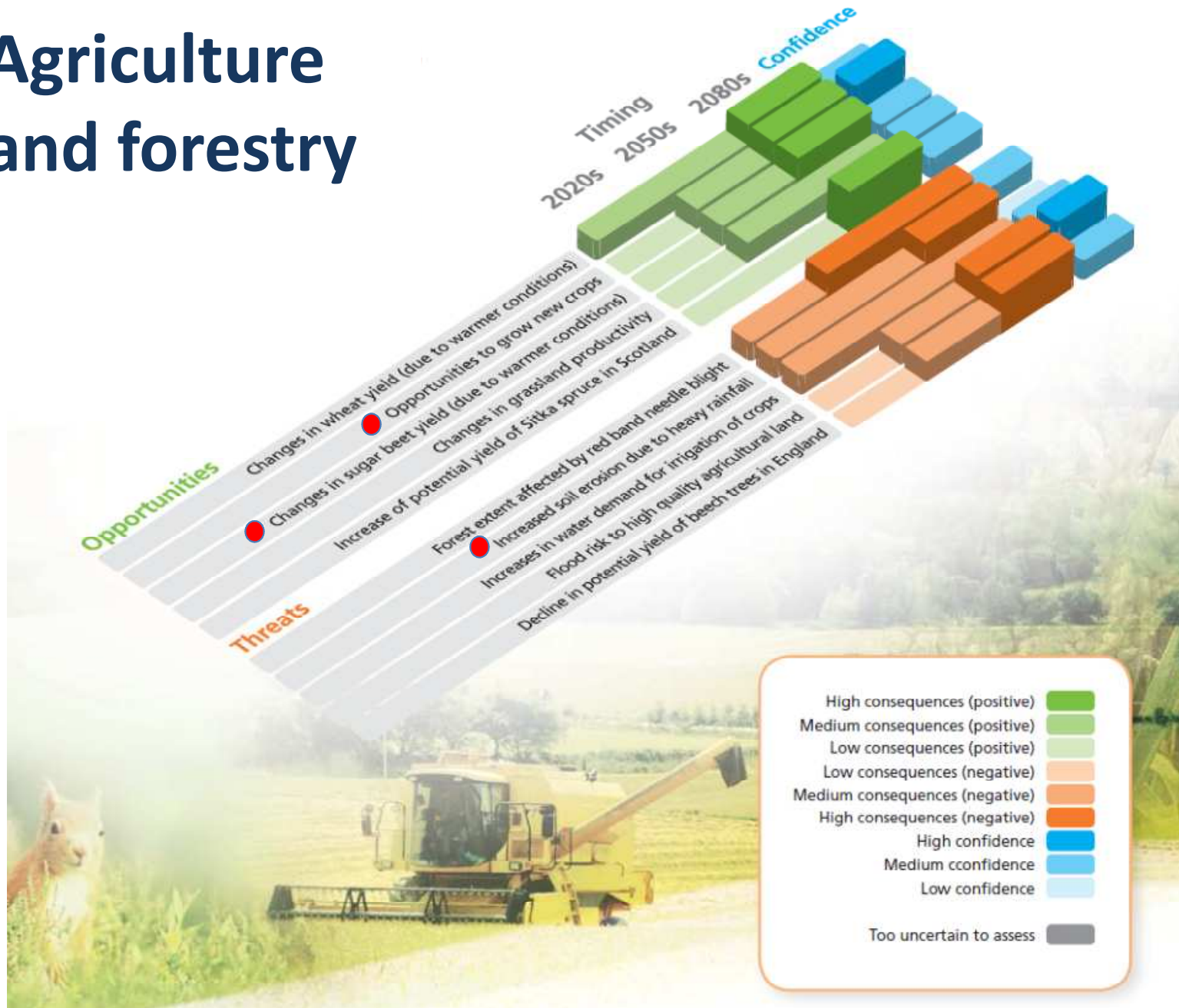
Russia

Summary of the Key Findings from the UK Climate Change Risk Assessment 2012

The natural environment



Agriculture and forestry



the Guardian June 9 2015

Scotland misses carbon target for fourth year in a row

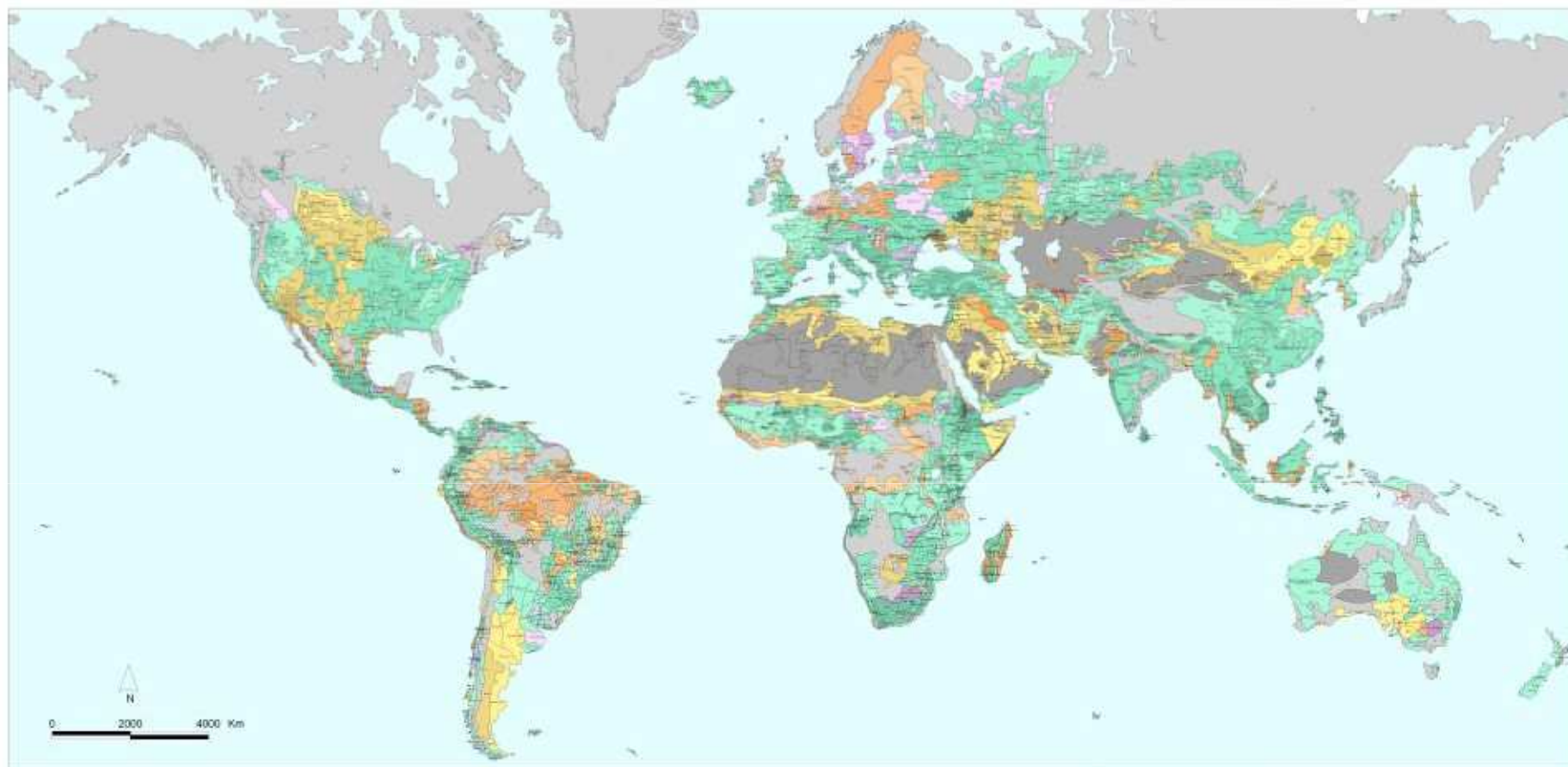
Co-leader of Scottish Greens says Holyrood has 'failed spectacularly' as annual figures show target missed by 2m tonnes equivalent of CO₂

Target: 80% reduction by 2050 (42% by 2020)



Wind power delivers 9.2% of UK's electricity

GLOBAL ASSESSMENT OF THE STATUS OF HUMAN-INDUCED SOIL DEGRADATION (1990)



DEGRADATION SEVERITY (Extent + Degree)

Water erosion

- Loss of topsoil
- Terrain deformation/
mass movement

Low
 Medium
 High
 Very high

Wind erosion

- Loss of topsoil
- Terrain deformation/
Overblowing

Low
 Medium
 High
 Very high

Chemical deterioration

- Loss of nutrients/
organic matter
- Salinization/alkalinization
- Acidification
- Pollution

Low
 Medium
 High
 Very high

Physical deterioration

- Compaction/crusting
- Waterlogging
- Subsidence of organic soils

Low
 Medium
 High
 Very high

Stable terrain

- Stable under
natural conditions
- Stable without vegetation
- Stabilized by human
intervention

Stable

Other

- Non used wasteland
- Ocean, inland water



A note about
biochar

Biochar
works in
some soils

