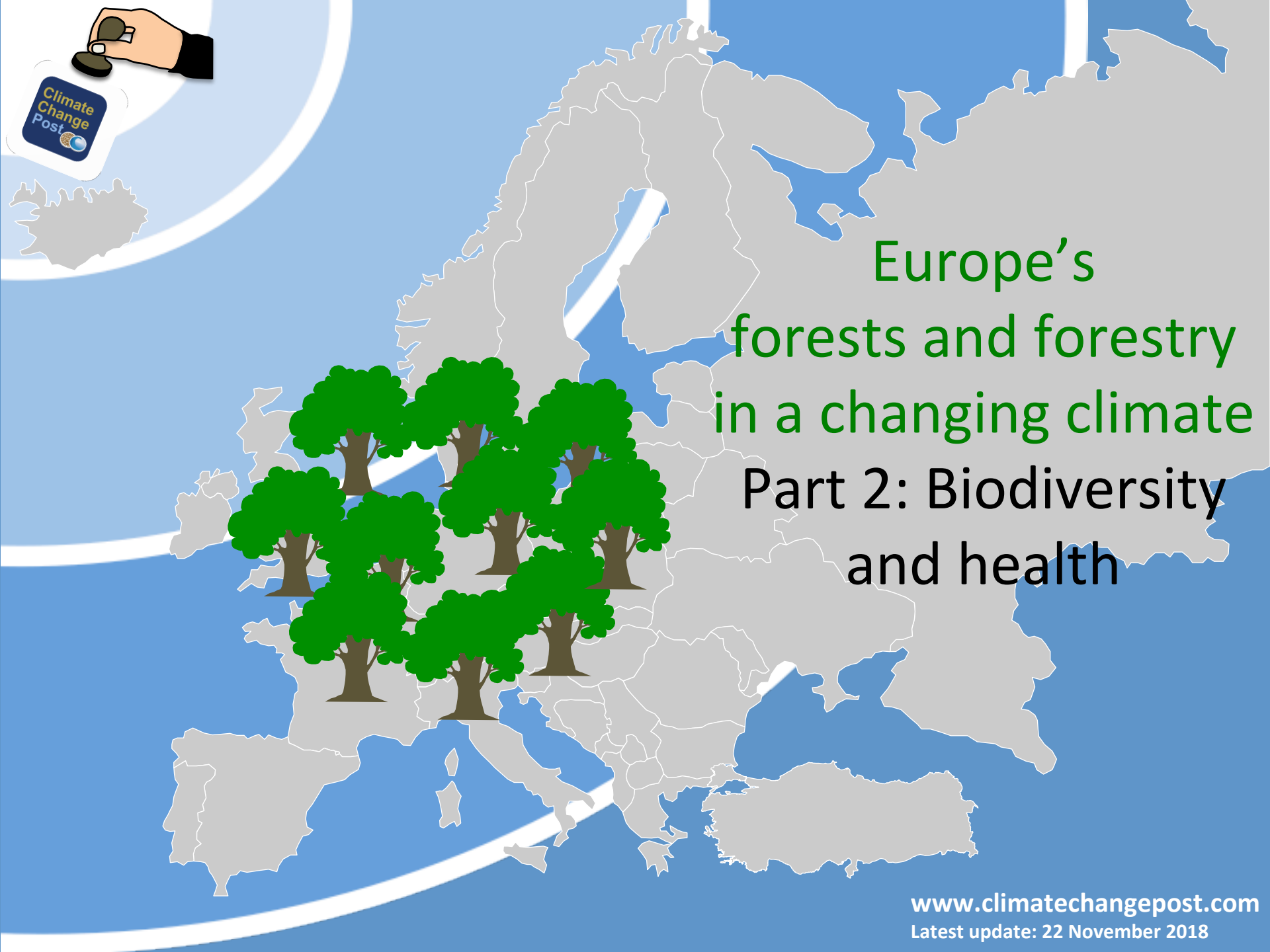


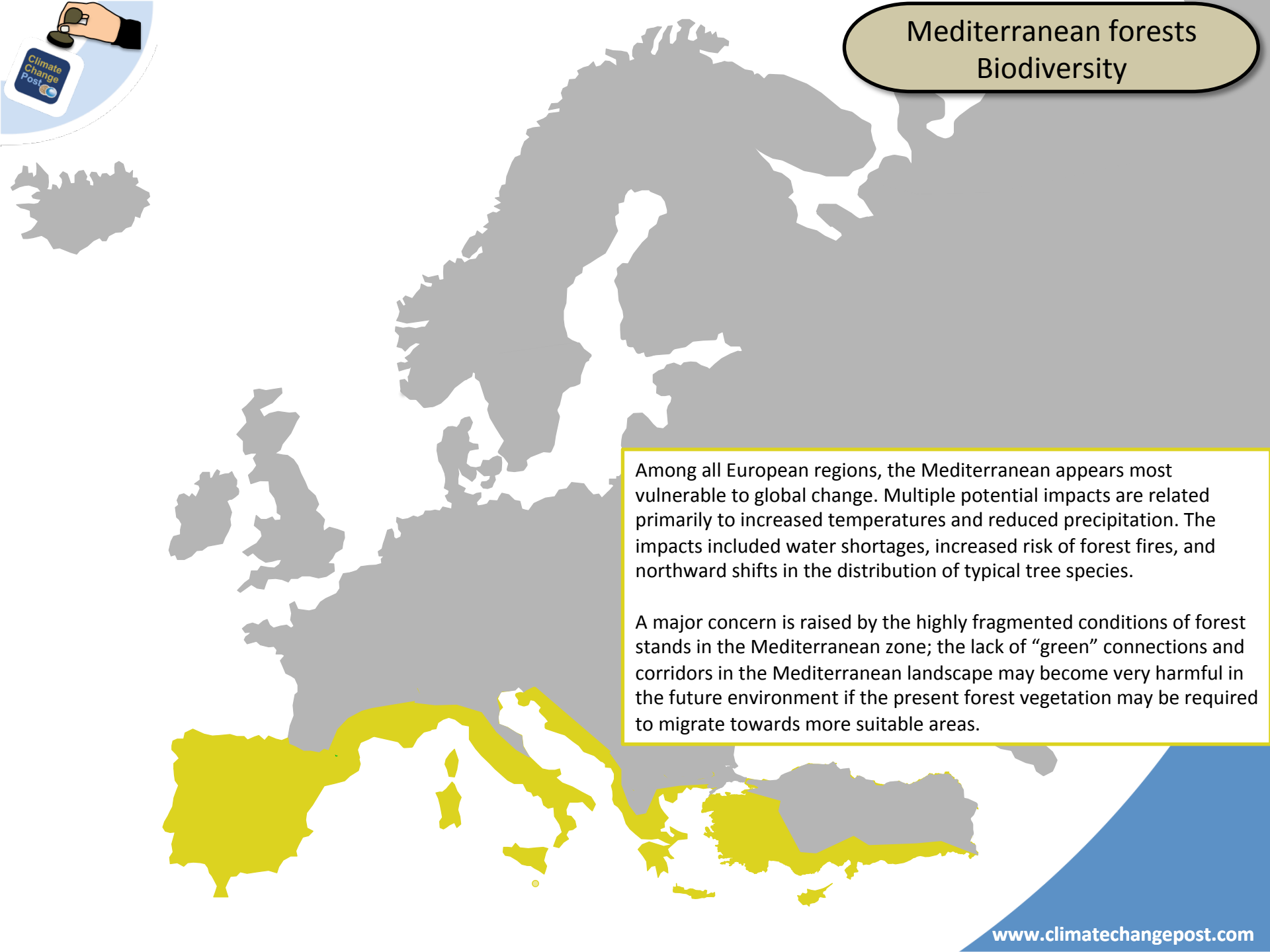
Europe's forests and forestry in a changing climate

Part 2: Biodiversity and health

www.climatechangepost.com
Latest update: 22 November 2018


Biodiversity

Mediterranean forests Biodiversity

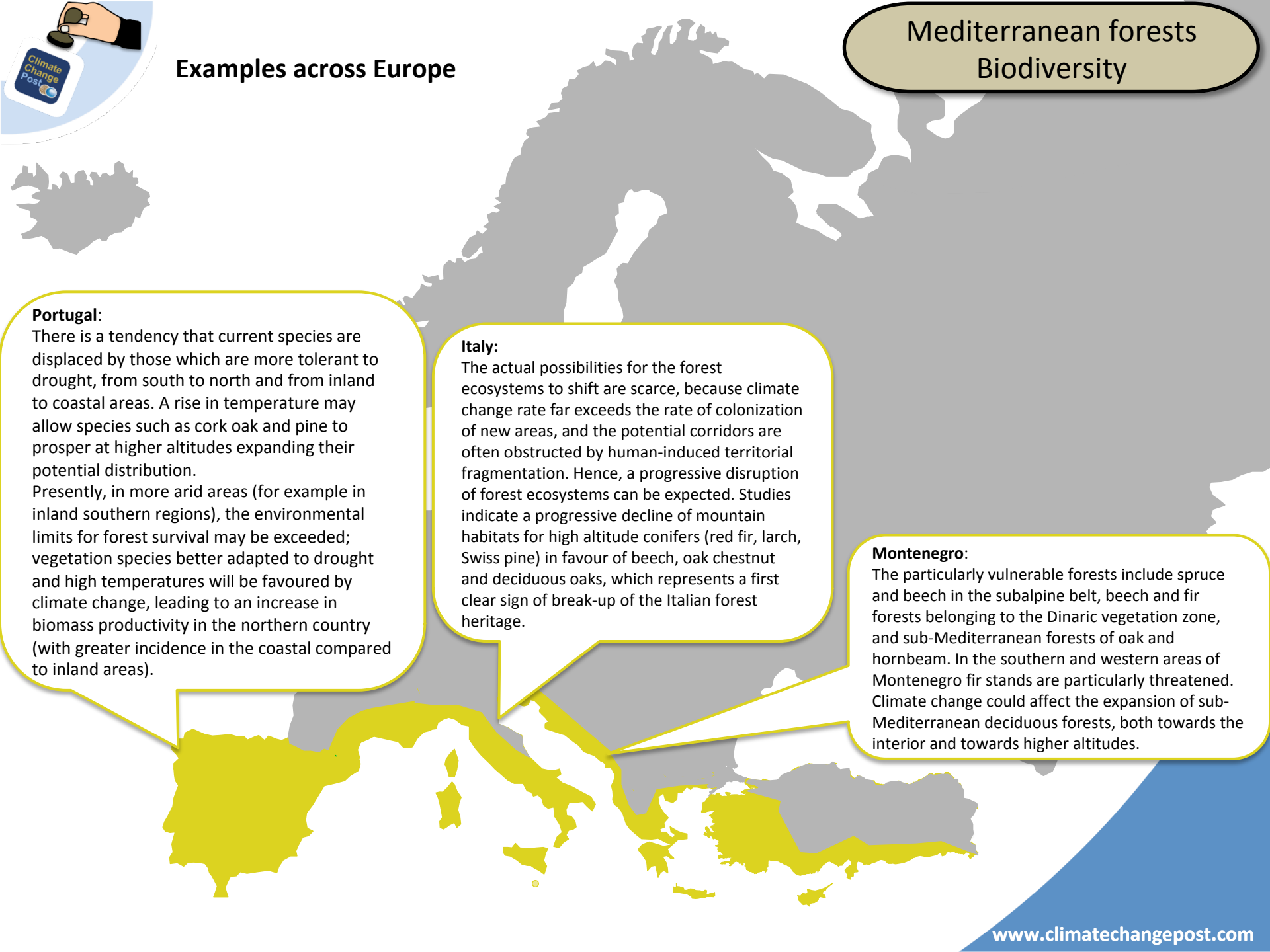


Among all European regions, the Mediterranean appears most vulnerable to global change. Multiple potential impacts are related primarily to increased temperatures and reduced precipitation. The impacts included water shortages, increased risk of forest fires, and northward shifts in the distribution of typical tree species.

A major concern is raised by the highly fragmented conditions of forest stands in the Mediterranean zone; the lack of “green” connections and corridors in the Mediterranean landscape may become very harmful in the future environment if the present forest vegetation may be required to migrate towards more suitable areas.

Mediterranean forests Biodiversity

Examples across Europe

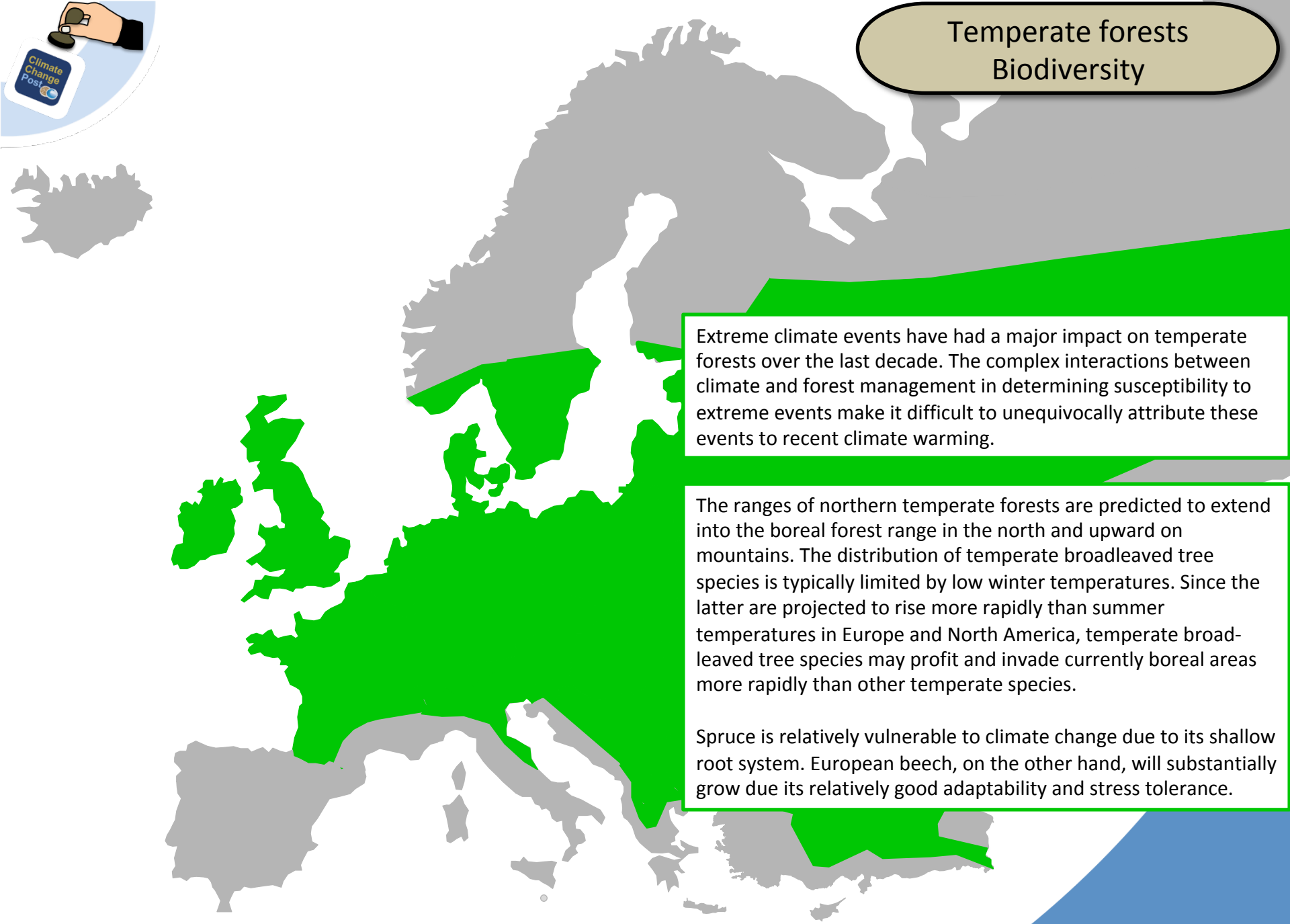


Portugal:
There is a tendency that current species are displaced by those which are more tolerant to drought, from south to north and from inland to coastal areas. A rise in temperature may allow species such as cork oak and pine to prosper at higher altitudes expanding their potential distribution.
Presently, in more arid areas (for example in inland southern regions), the environmental limits for forest survival may be exceeded; vegetation species better adapted to drought and high temperatures will be favoured by climate change, leading to an increase in biomass productivity in the northern country (with greater incidence in the coastal compared to inland areas).

Italy:
The actual possibilities for the forest ecosystems to shift are scarce, because climate change rate far exceeds the rate of colonization of new areas, and the potential corridors are often obstructed by human-induced territorial fragmentation. Hence, a progressive disruption of forest ecosystems can be expected. Studies indicate a progressive decline of mountain habitats for high altitude conifers (red fir, larch, Swiss pine) in favour of beech, oak chestnut and deciduous oaks, which represents a first clear sign of break-up of the Italian forest heritage.

Montenegro:
The particularly vulnerable forests include spruce and beech in the subalpine belt, beech and fir forests belonging to the Dinaric vegetation zone, and sub-Mediterranean forests of oak and hornbeam. In the southern and western areas of Montenegro fir stands are particularly threatened. Climate change could affect the expansion of sub-Mediterranean deciduous forests, both towards the interior and towards higher altitudes.

Temperate forests Biodiversity

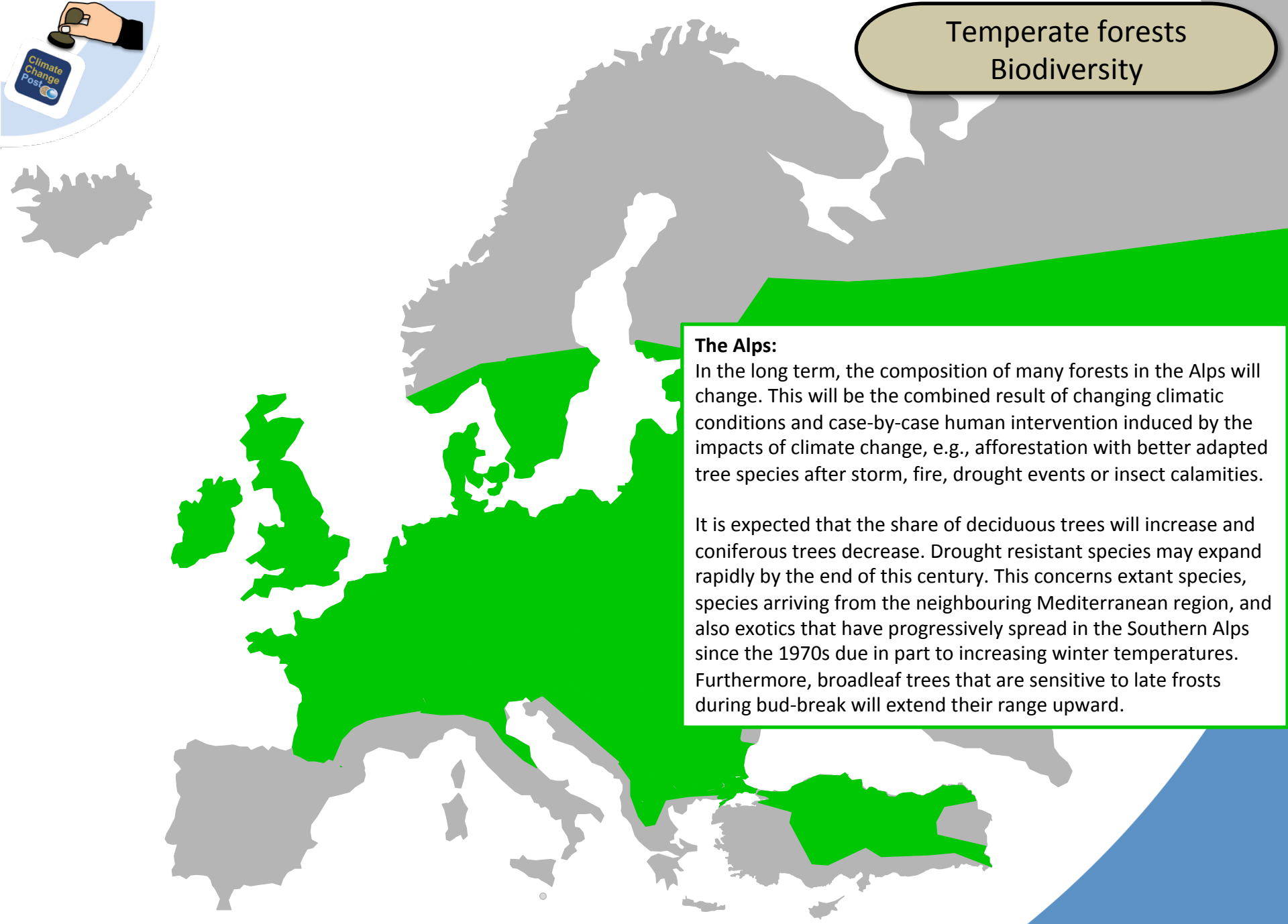


Extreme climate events have had a major impact on temperate forests over the last decade. The complex interactions between climate and forest management in determining susceptibility to extreme events make it difficult to unequivocally attribute these events to recent climate warming.

The ranges of northern temperate forests are predicted to extend into the boreal forest range in the north and upward on mountains. The distribution of temperate broadleaved tree species is typically limited by low winter temperatures. Since the latter are projected to rise more rapidly than summer temperatures in Europe and North America, temperate broad-leaved tree species may profit and invade currently boreal areas more rapidly than other temperate species.

Spruce is relatively vulnerable to climate change due to its shallow root system. European beech, on the other hand, will substantially grow due its relatively good adaptability and stress tolerance.

Temperate forests Biodiversity



The Alps:
In the long term, the composition of many forests in the Alps will change. This will be the combined result of changing climatic conditions and case-by-case human intervention induced by the impacts of climate change, e.g., afforestation with better adapted tree species after storm, fire, drought events or insect calamities.

It is expected that the share of deciduous trees will increase and coniferous trees decrease. Drought resistant species may expand rapidly by the end of this century. This concerns extant species, species arriving from the neighbouring Mediterranean region, and also exotics that have progressively spread in the Southern Alps since the 1970s due in part to increasing winter temperatures. Furthermore, broadleaf trees that are sensitive to late frosts during bud-break will extend their range upward.

Temperate forests Biodiversity

Examples across Europe

UK: Temperate deciduous forests and temperate/boreal mixed forests will expand and temperate conifer and boreal evergreen forests will reduce. Under a high end scenario of climate change, the area of temperate conifer forest is restricted to the highlands of Scotland.

Denmark: A majority of existing tree species that thrive well today are expected to persist in Denmark, except for Norway spruce.

Estonia: No drastic changes are expected in the species composition of Estonian forests over the next 100-200 years. The intra-species genome diversity provides additional flexibility to handle the results of a warming climate during the next century.

Poland: Oak production will either remain the same as now or will increase. Future production of beech seems uncertain and might decline, while spruce production is likely to increase.

The Netherlands: So far no doom scenarios are foreseen.

Slovakia: The proportion of Norway Spruce in total composition of forests is expected to decrease from the current 27% to less than half this percentage due to climate change.

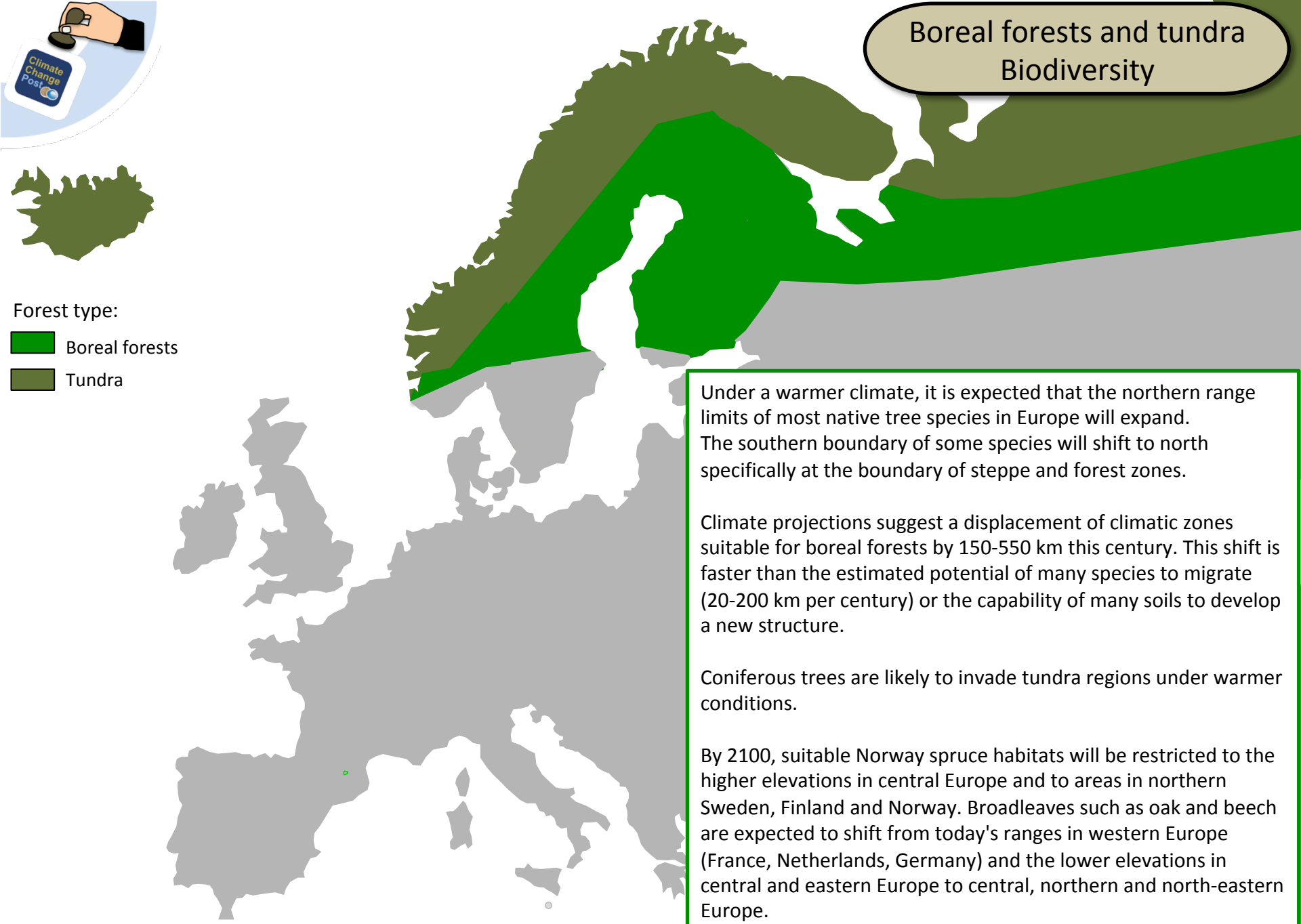
Alps: Adaptation to forthcoming climate changes might not require a shift in tree species composition in the Alps of Germany and Austria. The genetic variability of most common tree species is probably large enough to accommodate the mean changes in temperature and precipitation.

Slovenia: In the second half of this century higher temperatures favour growth of European beech, in contrast to drought-induced growth reductions in both silver fir and Norway spruce conifers, especially at low elevations.

Hungary: The appearance of plant species of southern character, such as eastern hornbeam, Turkey oak, Hungarian oak is expected. The most disadvantageous climatic changes may be experienced by lowland coniferous stands as we already can see in the black pine forests of the Balaton hills.

Bulgaria: At lower elevations drought-sensitive species such as Norway spruce will probably be replaced by more drought-tolerant species such as Scots pine and black pine, and forest diversity will decrease.

Boreal forests and tundra Biodiversity



Under a warmer climate, it is expected that the northern range limits of most native tree species in Europe will expand.
The southern boundary of some species will shift to north specifically at the boundary of steppe and forest zones.

Climate projections suggest a displacement of climatic zones suitable for boreal forests by 150-550 km this century. This shift is faster than the estimated potential of many species to migrate (20-200 km per century) or the capability of many soils to develop a new structure.

Coniferous trees are likely to invade tundra regions under warmer conditions.

By 2100, suitable Norway spruce habitats will be restricted to the higher elevations in central Europe and to areas in northern Sweden, Finland and Norway. Broadleaves such as oak and beech are expected to shift from today's ranges in western Europe (France, Netherlands, Germany) and the lower elevations in central and eastern Europe to central, northern and north-eastern Europe.

Boreal forests and tundra Biodiversity

Examples across Europe


Health

Temperate forests
Health of forest ecosystems

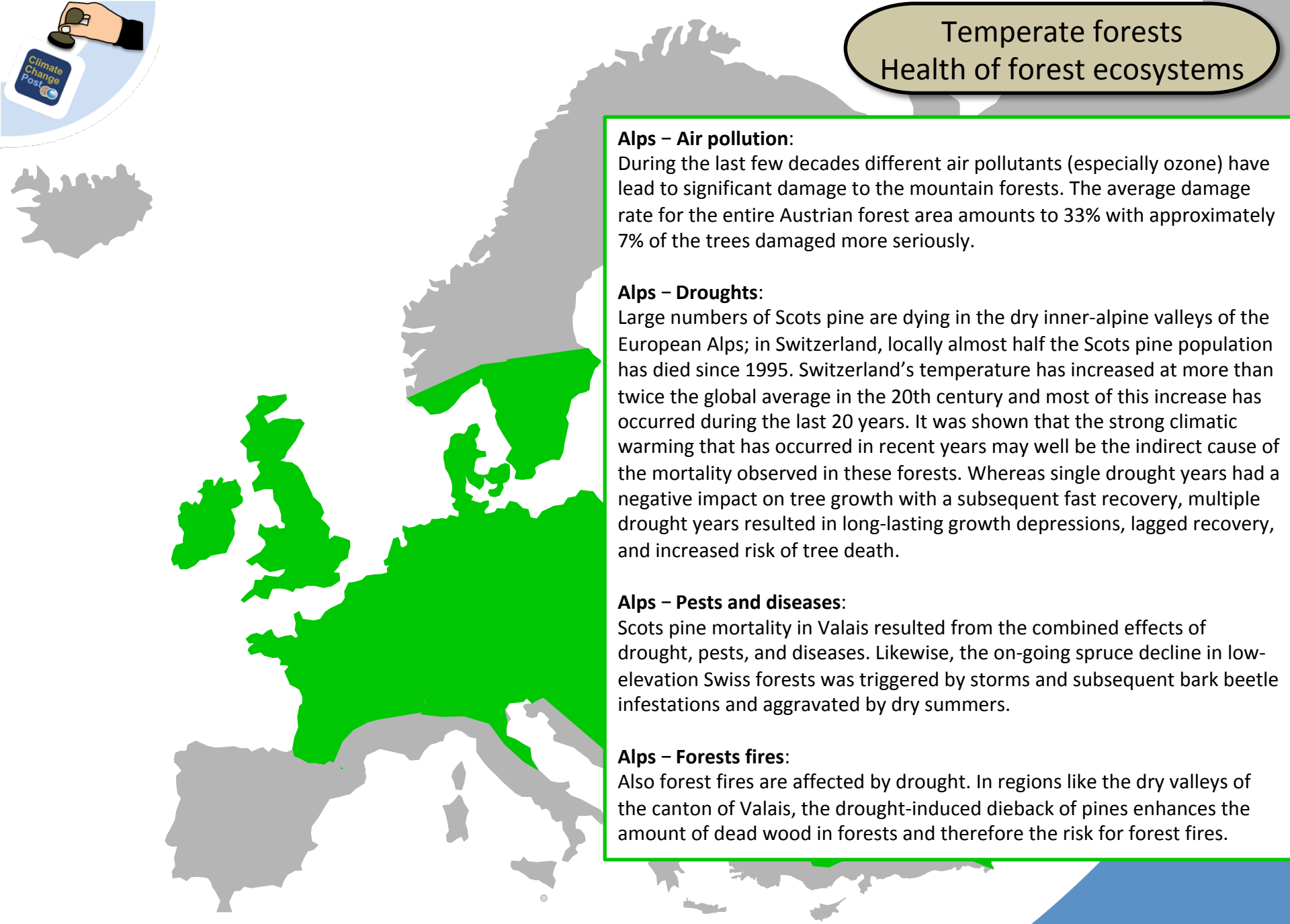
The impact of the summer of 2003 to German forests:
In the year 2004, 72% of all trees exhibited distinct crown transparency or were rated as “in stage of alert”. This was the highest level of recorded damage since the beginning of forest damage inventories. For the first time, the main reason for this high level of damage is not thought to be pollution, but the weather conditions in the hot and dry “record summer” of 2003, and its side- and after-effects. These are

- direct damage through drought and radiation;
- damage through increased ozone content of the air, as a consequence of intensive solar radiation;
- the spread of calamities as a consequence of the mild winter in 2003;
- prior damages through direct weather impacts.

Drought stress
The heat wave in the summer of 2003 shows how strongly yield potential can be threatened by drought stress. Drought and high temperatures led to a near total depletion of the water reserves in forest soils available to plants.

Long term effects
Damages through extreme weather conditions such as in the year 2003 can continue to have an effect over more than 10 years, and can lead to changes in growth trends in the long term, beyond actual reduced growth rates. In 2003, the connection between drought, heat and risk of pest infestation became also apparent. An explosive propagation of pests, particularly bark beetles and nun moths, was a consequence of high temperatures and decreased vitality of forests in 2003.

Temperate forests
Health of forest ecosystems



Alps – Air pollution:
During the last few decades different air pollutants (especially ozone) have lead to significant damage to the mountain forests. The average damage rate for the entire Austrian forest area amounts to 33% with approximately 7% of the trees damaged more seriously.

Alps – Droughts:
Large numbers of Scots pine are dying in the dry inner-alpine valleys of the European Alps; in Switzerland, locally almost half the Scots pine population has died since 1995. Switzerland's temperature has increased at more than twice the global average in the 20th century and most of this increase has occurred during the last 20 years. It was shown that the strong climatic warming that has occurred in recent years may well be the indirect cause of the mortality observed in these forests. Whereas single drought years had a negative impact on tree growth with a subsequent fast recovery, multiple drought years resulted in long-lasting growth depressions, lagged recovery, and increased risk of tree death.

Alps – Pests and diseases:
Scots pine mortality in Valais resulted from the combined effects of drought, pests, and diseases. Likewise, the on-going spruce decline in low-elevation Swiss forests was triggered by storms and subsequent bark beetle infestations and aggravated by dry summers.

Alps – Forests fires:
Also forest fires are affected by drought. In regions like the dry valleys of the canton of Valais, the drought-induced dieback of pines enhances the amount of dead wood in forests and therefore the risk for forest fires.

Temperate forests
Health of forest ecosystems

Pests
Climate change could change the behaviour of relatively unimportant pests, which can cause large damages in the future. Even small oscillations in temperature might have extensive impacts on forests. Besides the changes in distribution sites of pests, climate change also influences the number of realized generations within one year. If warming prolongs vegetation period, the number of generations of several species is expected to be higher to the north and in higher altitudes.

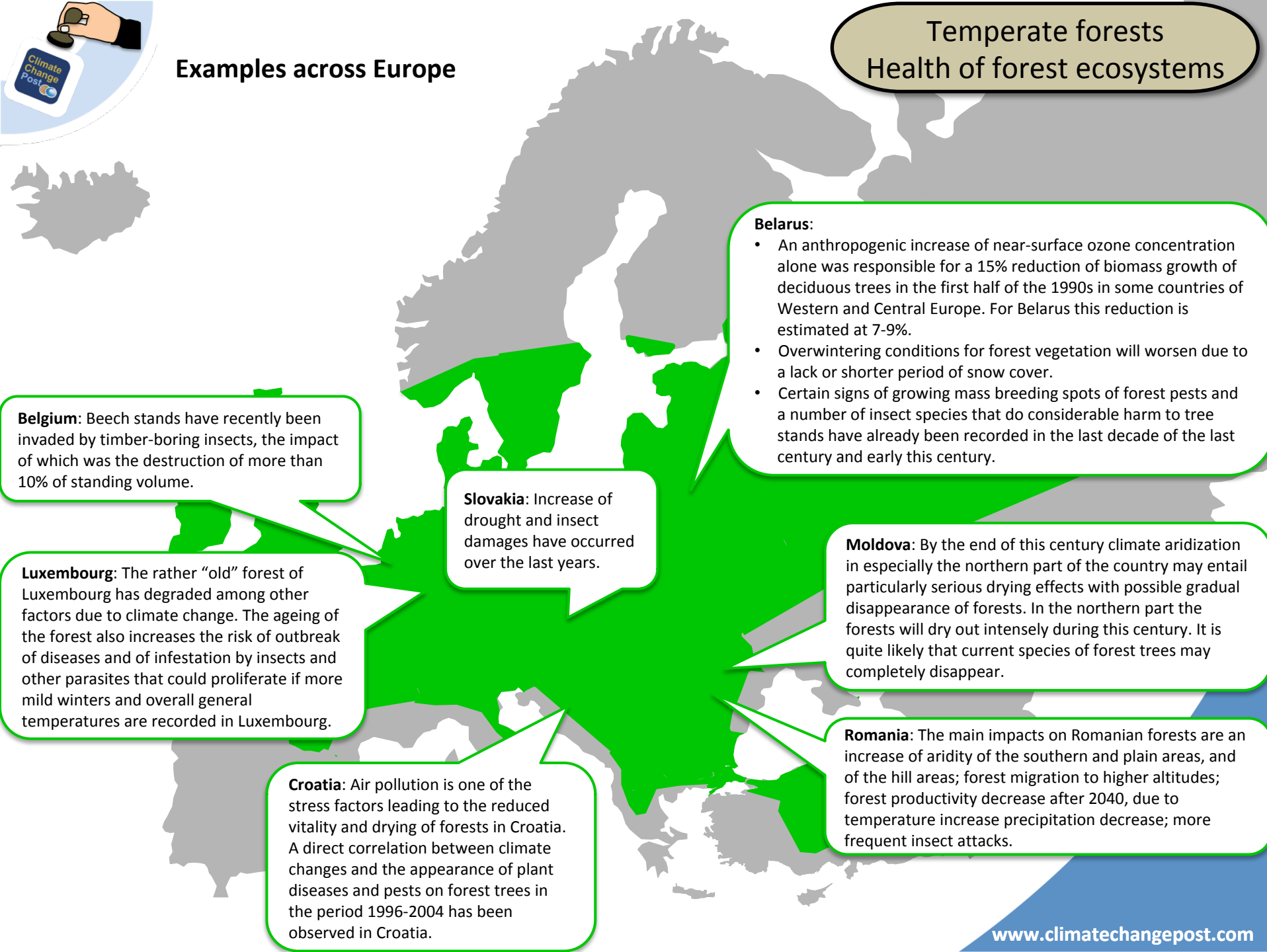
Drought stress
Particularly in **Central Europe**, an increased water scarcity interacting with climate-sensitive pest dynamics has been recognized as the most significant climate change-related threat to forests.
The occurrence of bark beetles in fir and spruce forests is most indicative after dry periods when physiologically weakened trees become easily accessible to bark beetles as secondary pests.

Wind throw
Forest stands damaged by wind are especially important precursors to outbreaks as they quickly provide large quantities of optimal breeding material. Thus a projected increase in the windstorm frequency could also escalate the bark beetle threat to forests in the future.

Heat stress
Spruce bark beetle is the most important forest insect pest in Europe whose development is strictly regulated by air temperature. More frequent heat waves increase the spruce susceptibility to bark beetle attacks.

Temperate forests
Health of forest ecosystems

Examples across Europe



Belarus:

- An anthropogenic increase of near-surface ozone concentration alone was responsible for a 15% reduction of biomass growth of deciduous trees in the first half of the 1990s in some countries of Western and Central Europe. For Belarus this reduction is estimated at 7-9%.
- Overwintering conditions for forest vegetation will worsen due to a lack or shorter period of snow cover.
- Certain signs of growing mass breeding spots of forest pests and a number of insect species that do considerable harm to tree stands have already been recorded in the last decade of the last century and early this century.

Belgium: Beech stands have recently been invaded by timber-boring insects, the impact of which was the destruction of more than 10% of standing volume.

Slovakia: Increase of drought and insect damages have occurred over the last years.

Luxembourg: The rather "old" forest of Luxembourg has degraded among other factors due to climate change. The ageing of the forest also increases the risk of outbreak of diseases and of infestation by insects and other parasites that could proliferate if more mild winters and overall general temperatures are recorded in Luxembourg.

Moldova: By the end of this century climate aridization in especially the northern part of the country may entail particularly serious drying effects with possible gradual disappearance of forests. In the northern part the forests will dry out intensely during this century. It is quite likely that current species of forest trees may completely disappear.

Romania: The main impacts on Romanian forests are an increase of aridity of the southern and plain areas, and of the hill areas; forest migration to higher altitudes; forest productivity decrease after 2040, due to temperature increase precipitation decrease; more frequent insect attacks.

Croatia: Air pollution is one of the stress factors leading to the reduced vitality and drying of forests in Croatia. A direct correlation between climate changes and the appearance of plant diseases and pests on forest trees in the period 1996-2004 has been observed in Croatia.

Boreal forests and tundra
Health of forest ecosystems

For the forests in northern Europe, the combination of raised mean temperature and a higher frequency of extreme events will have negative effects that could ultimately be of greater importance than the positive outcomes of a warmer climate. The boreal forests, for example, may be severely affected by summer dry spells and droughts, making trees more susceptible to frost damage, wind throw, storms and attacks by pests and diseases.

Insect pests will benefit from increased temperatures and the longer growing season. This may increase the number of insect generations each year. An increase in minimum temperatures in the winter could facilitate the spread of pest species in Scandinavia from south to north.


Climate
Change
Post