TRANSNATIONAL DELINEATION MODEL OF CONSERVATION AND FOREST SEED TRANSFER ZONES IN CLIMATE CHANGE

(D.T1.4.2)

The objective of the project is to improve integrated environmental management capacities for the protection and sustainable use of natural heritage and resources

19th July 2019

ESTABLISH A TRANSNATIONAL MODEL FOR SEED TRANSFER AND THE SUSTAINABLE UTILIZATION AND CONSERVATION OF THE GENETIC RESOURCES OF FOREST TREES IN CLIMATE CHANGE

Introduction

Each year about 900 million seedlings of the major tree species are being produced and planted in the Central European regions. The utilisation of these seedlings is restricted to nationally defined eco-regions (seed/provenance zones). However, the effects of climate change are strongly changing the conditions within eco-regions and seedlings planted today may be maladapted in the future, once they become mature. As a result, there will be a lower stability and productivity of future forest stands which indirectly will affect the wood industry sector and thus the economy.

Climate change will disrupt the link between climate and the local adaptation of forest tree populations creating physiological stress that leads to the so-called "adaptation lag". Therefore, forest managers are confronted with the challenge of finding adapted planting materials for reforestation. As such, there has been considerable interest in developing models to aid our understanding of the limits of species distribution and their adaptive capacities in order to develop adaptive management strategies for the future. **The objective of this deliverable is to develop transnational delineation models for 7 major tree species of Europe.**

With a harmonized provenance trails dataset evaluating the adaptive performance of more than 10,000 populations of 7 major European tree species, we developed within the SUSTREE project we developed the Universal response function (URF) models. The URF models integrate both climatic and genetic factors in predicting phenotypic variation in functional traits and allow us to evaluate not only single populations growing under specific climate conditions but the overall phenotypic space expressed throughout a wide climatic spectrum. Thus, universal response functions can be used to identify either the best seed provenances for a specific site climate or the best planting site for a specific seed provenance. These URFS were used as delineation models of 7 major tree species of Europe (*Picea abies, Abies alba, Pinus sylvestris, Larix decidua, Fagus sylvatica, Quercus petraea* and *Quercus robur*) to predict the location of optimum seed sources or planting materials suitable for a given combination of the planting site and according to the different climate scenarios. The output from these delineation models was depicted as spatially explicit maps of best seed sources under the current climate (1961-90) and two climate change scenarios (RCP 4.5 and RCP 8.5).

The transnational delineation models below are based on nationally available knowledge of local adaptation and climate constraints of the six main tree species of Central Europe (*Larix decidua*, *Fagus sylvatica, Picea abies, Pinus sylvestris, Quercus petraea* and *Quercus robur*). However, due to the high interest of our transnational delineation models for optimal seed transfer in climate change

a supplementary species (*Abies alba*) was demanded by experts (foresters and conservation managers but also scientists working in similar fields) as the silver fir has also a very important value, especially in the alpine and sub-alpine regions.

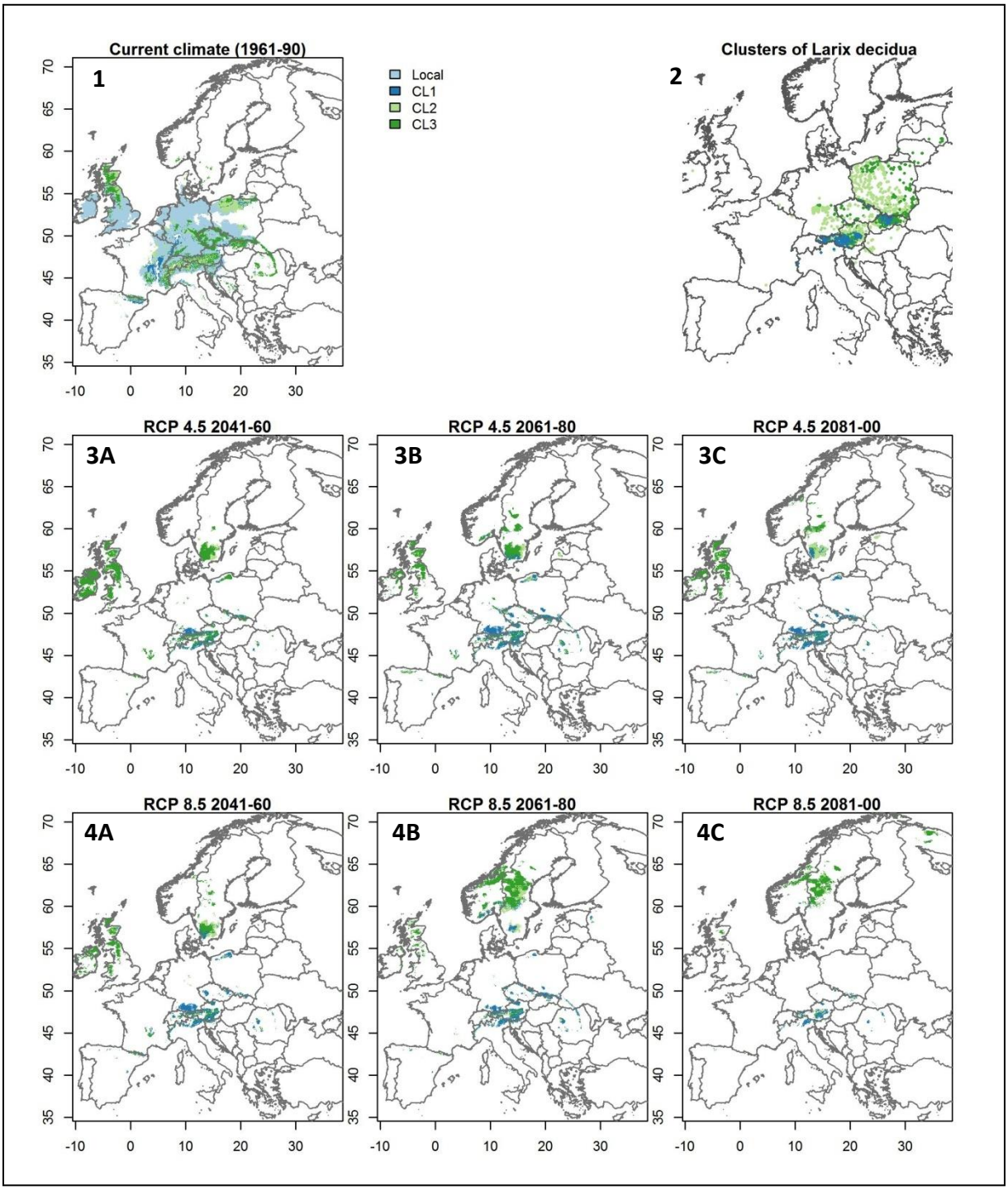
INTERPRETING THE TRANSNATIONAL MODELS FOR OPTIMAL SEED TRANSFER IN CENTRAL EUROPE

For each species, map (2) represents the geographic locations of seed sources of a species in Europe. The seed sources with similar climate have been grouped together into a cluster and have been given a unique colour code attribute. The "RCP"s stands for "Representative Concentration Pathways" which are global warming scenarios where RCP 4.5 roughly corresponds to a 2°C warming; and RCP 8.5 roughly corresponds to a warming scenario of 4-6°C.

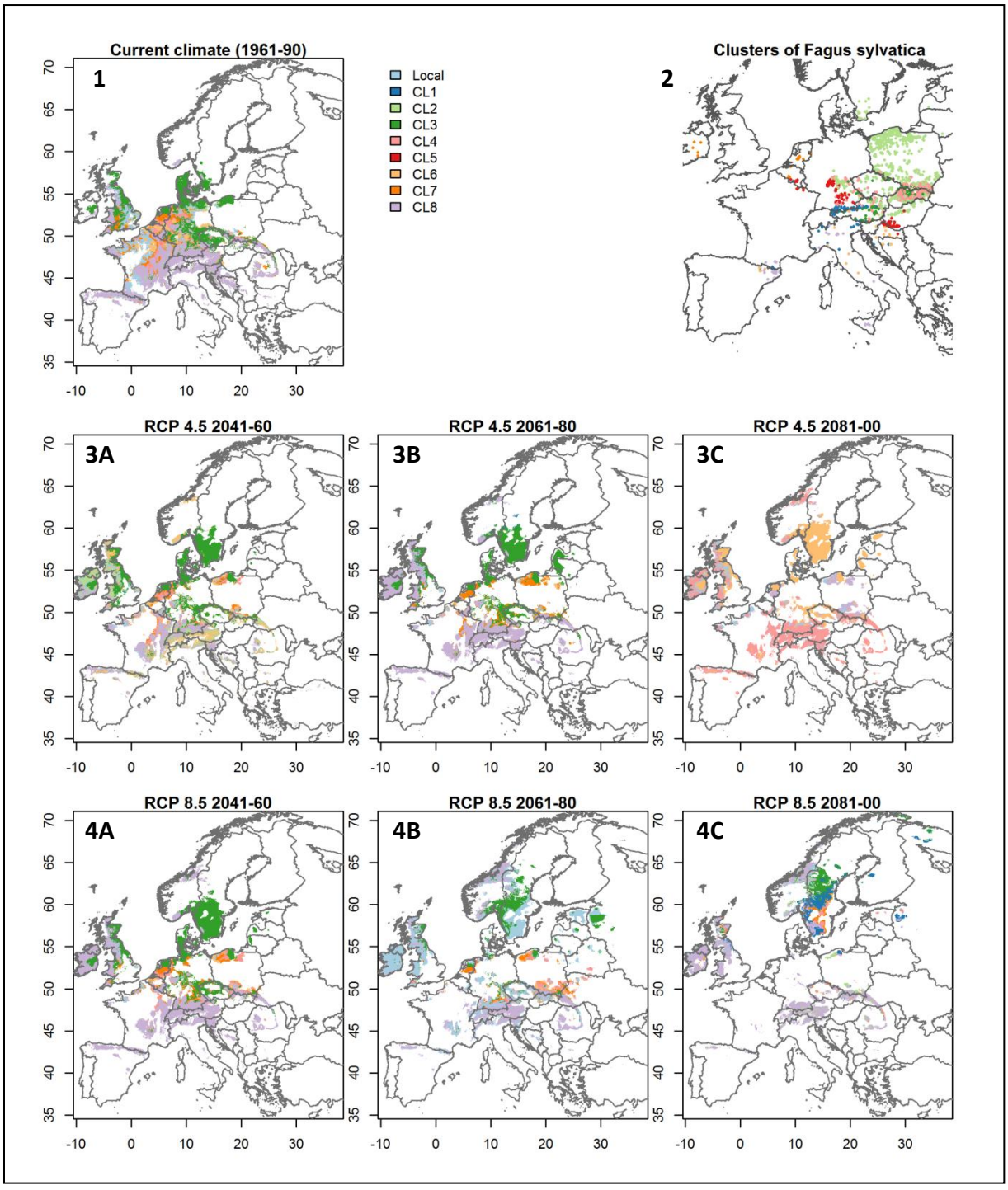
Maps 1, 3A, 3B, 3C and 4A, 4B, 4C within each model depicts the locations in Europe, when planted with a seed source cluster (from map 2) will have best performance in terms of tree height.

The maps of best seed source performances are given for (1) current climate i.e. 1961-1990 and three future time frames 3A, 3B, 3C and 4A, 4B, 4C which denotes the following years 2041-2060; 2061-2080; and 2081-2100.

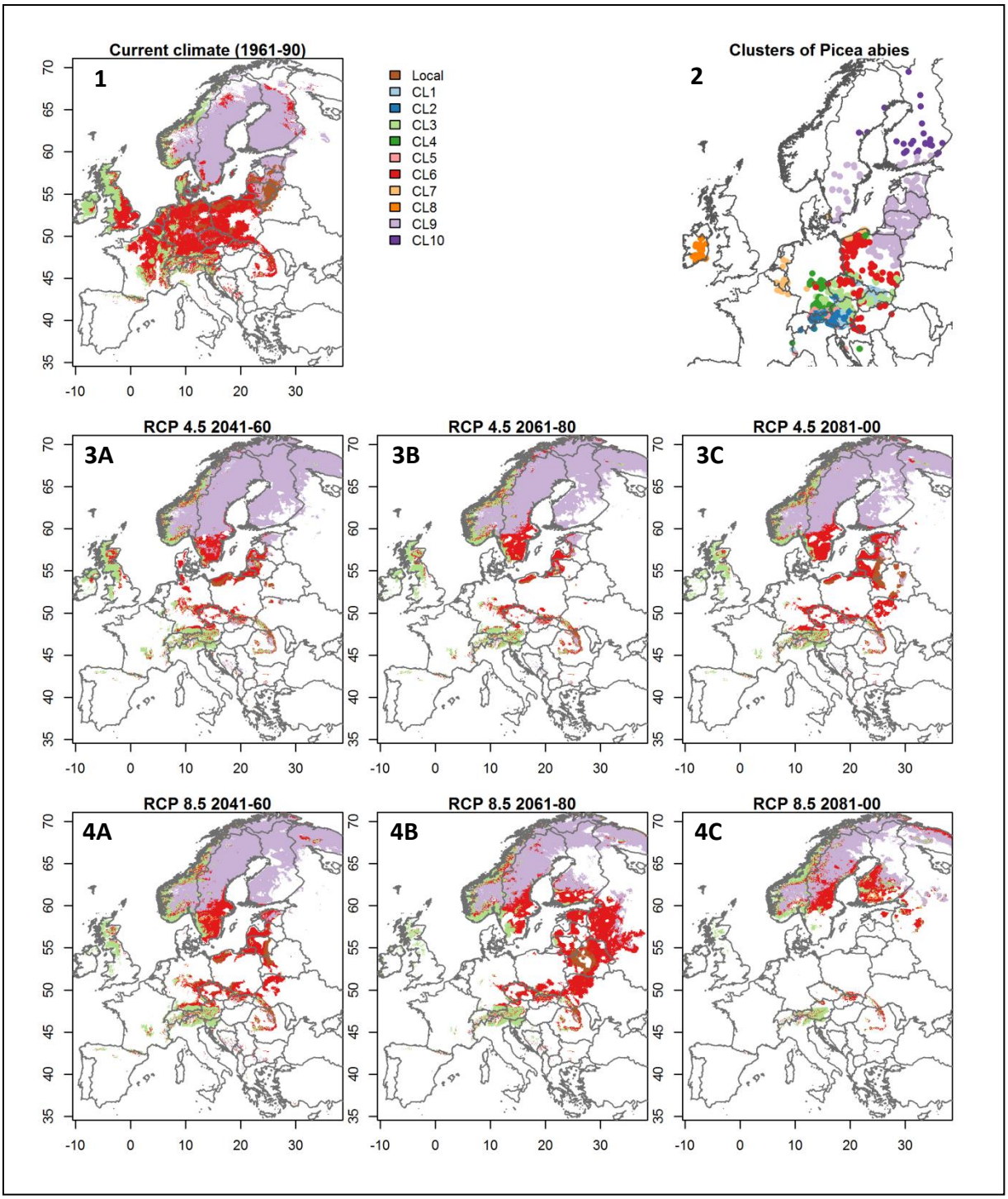
Larix deciduas (European larch)



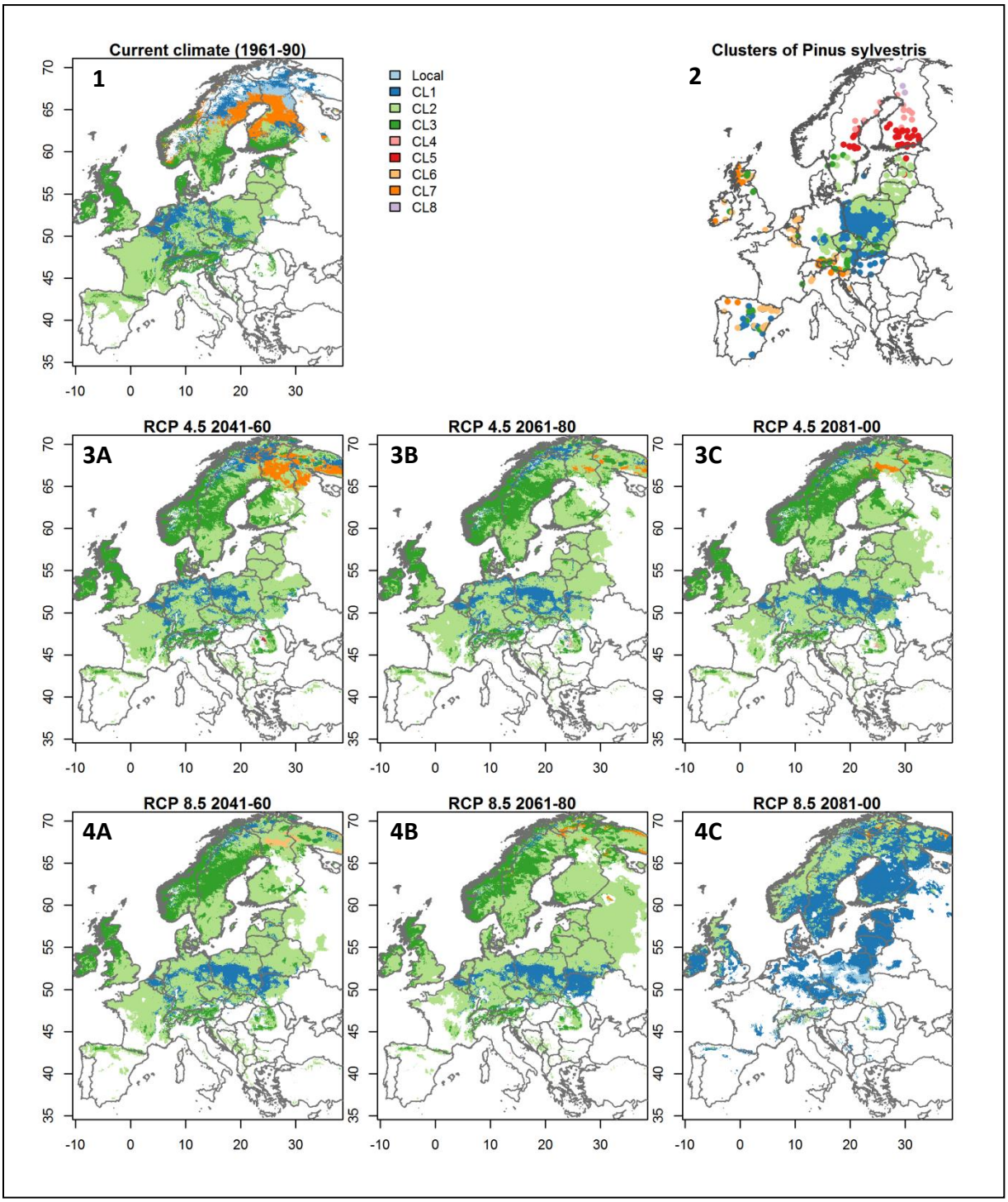
Fagus sylvatica (European beech)



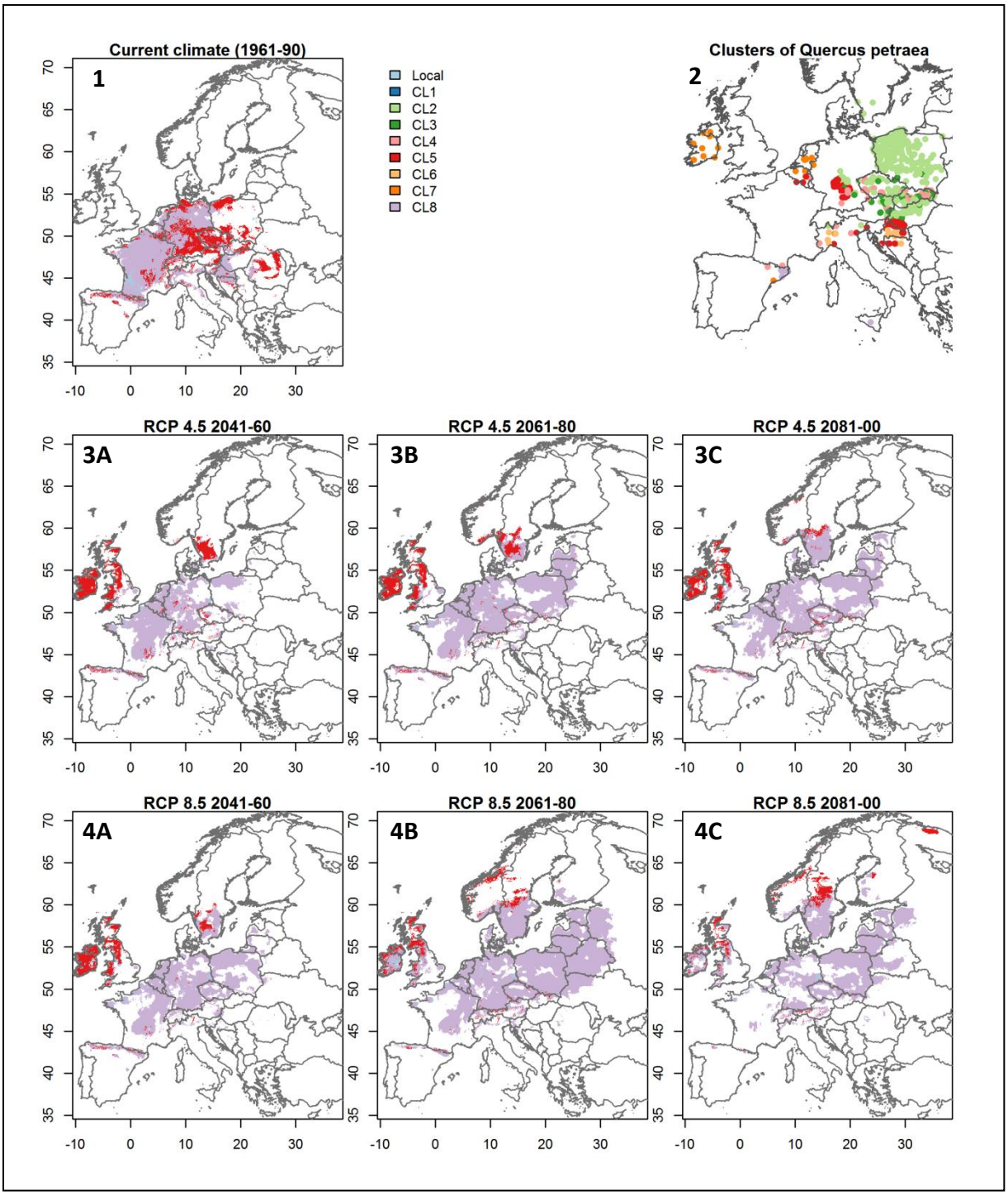
Picea abies (Norway spruce)



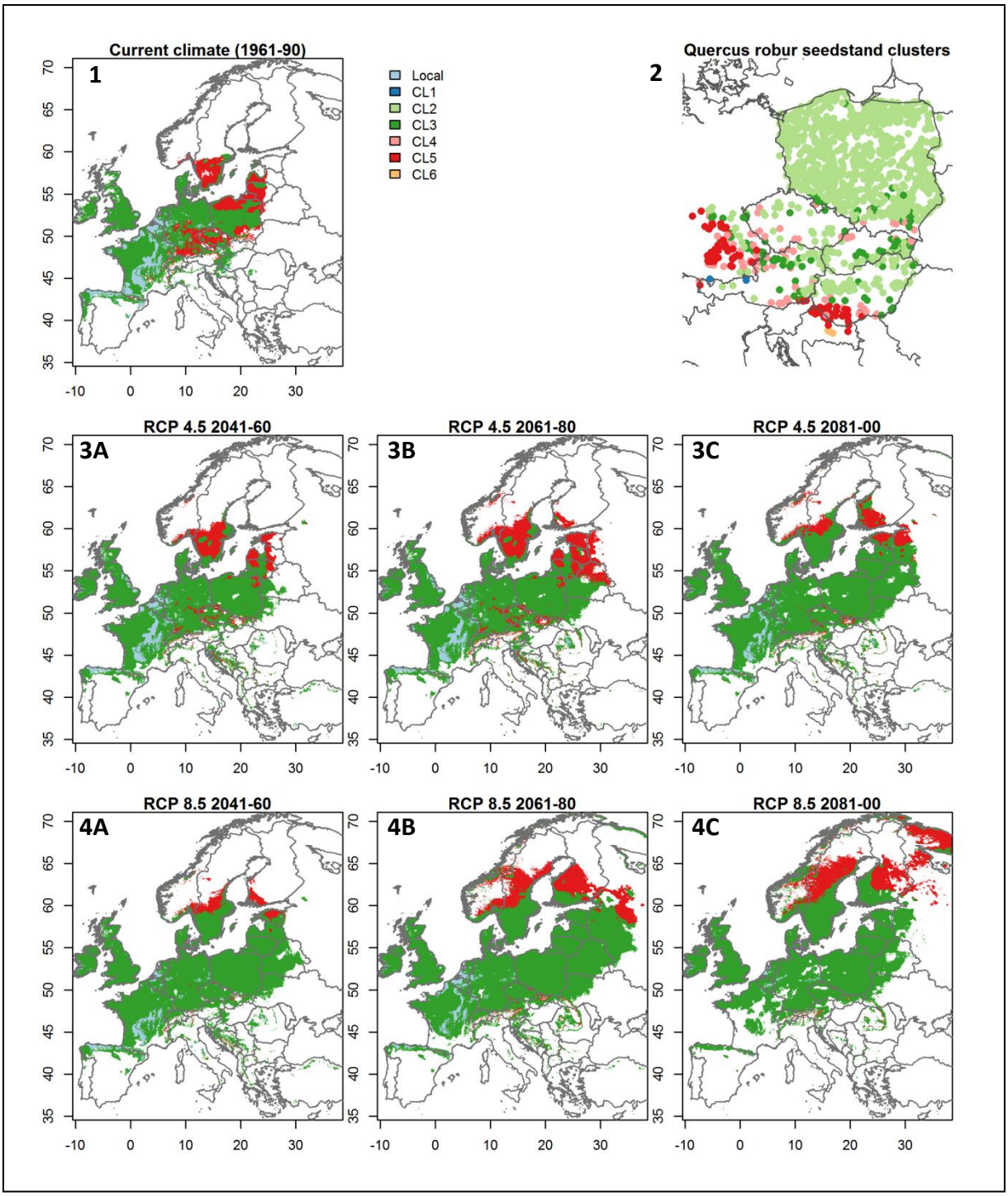
Pinus sylvestris (Scots pine)



Quercus Petraea (Sessile oak)



Quercus robur (English oak)



Abies alba (Silver fir)