

Can we detect rapid altitudinal shift in tree species distribution related to recent global changes ?

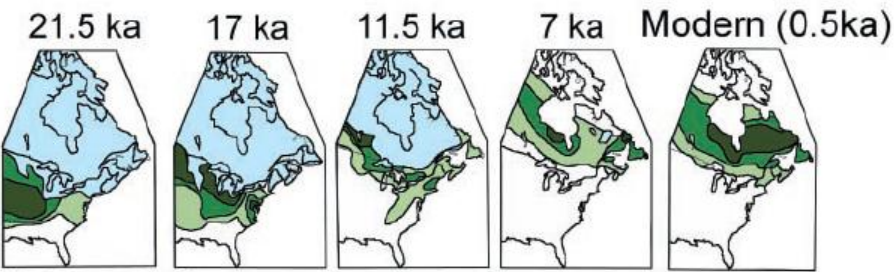
Tours 2012

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Impact of past climate changes on tree species distribution

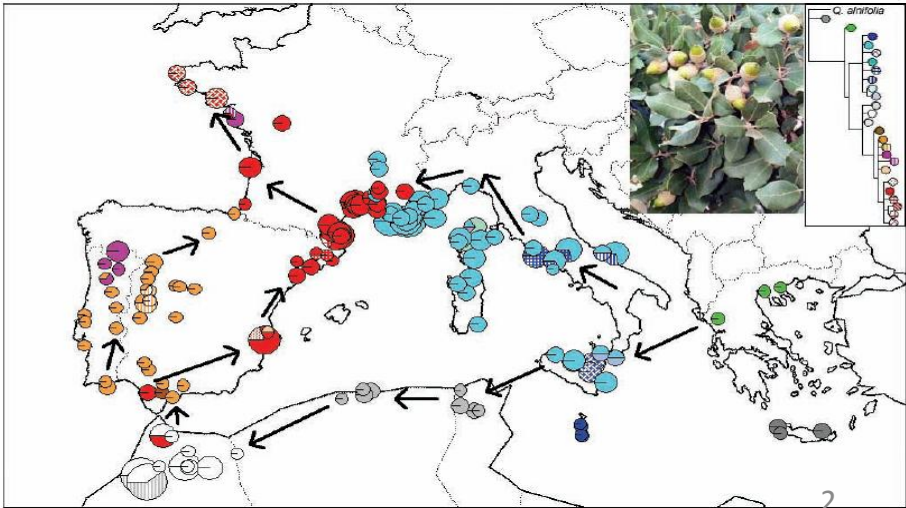


A. Spruce Pollen

Davis and Shaw (2008)

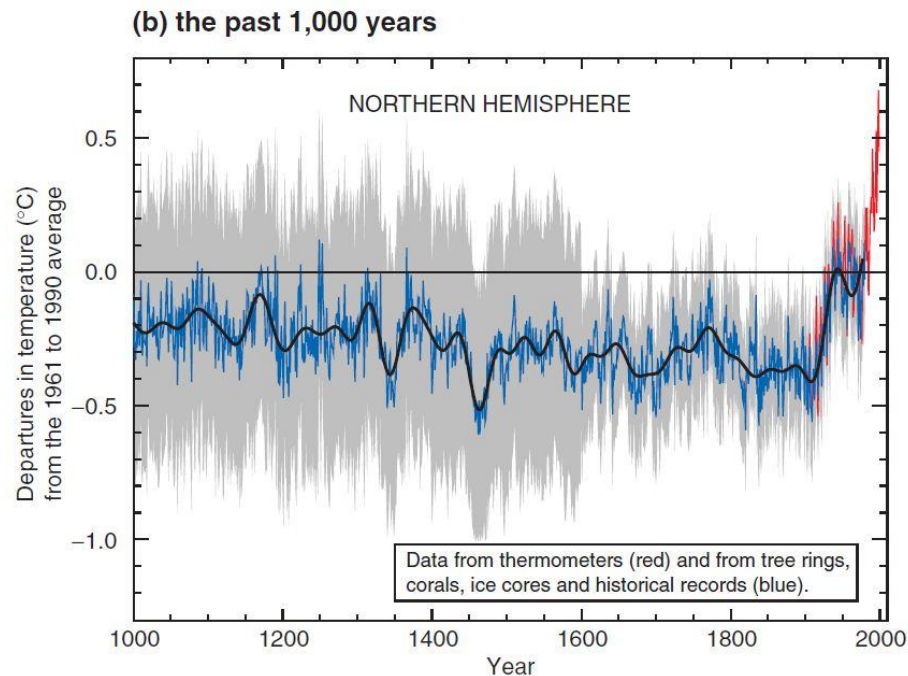


Petit *et al.* (2005)



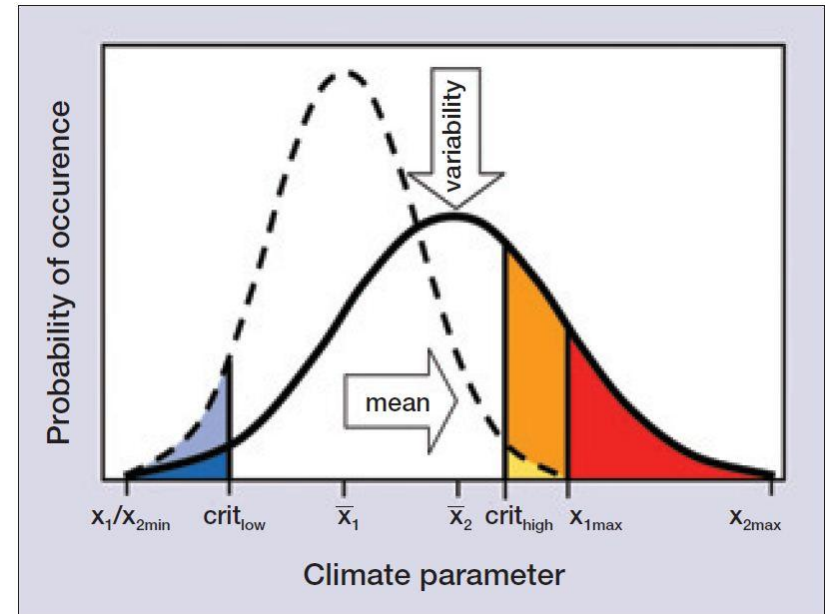
Current and futur climate change

Current climate change > Past climate change



IPCC (2001)

More and more intense and frequent ECE.



Jentsch *et al.* (2007)

Will tree species be able to cope with the current climate change ?

Will they be able to **migrate** to find more favorable climatic conditions?

Will they be able to **adapt** themselves to new environmental conditions?

Will tree species be able to cope with the current climate change ?

Will they be able to **migrate** to find more favorable climatic conditions?

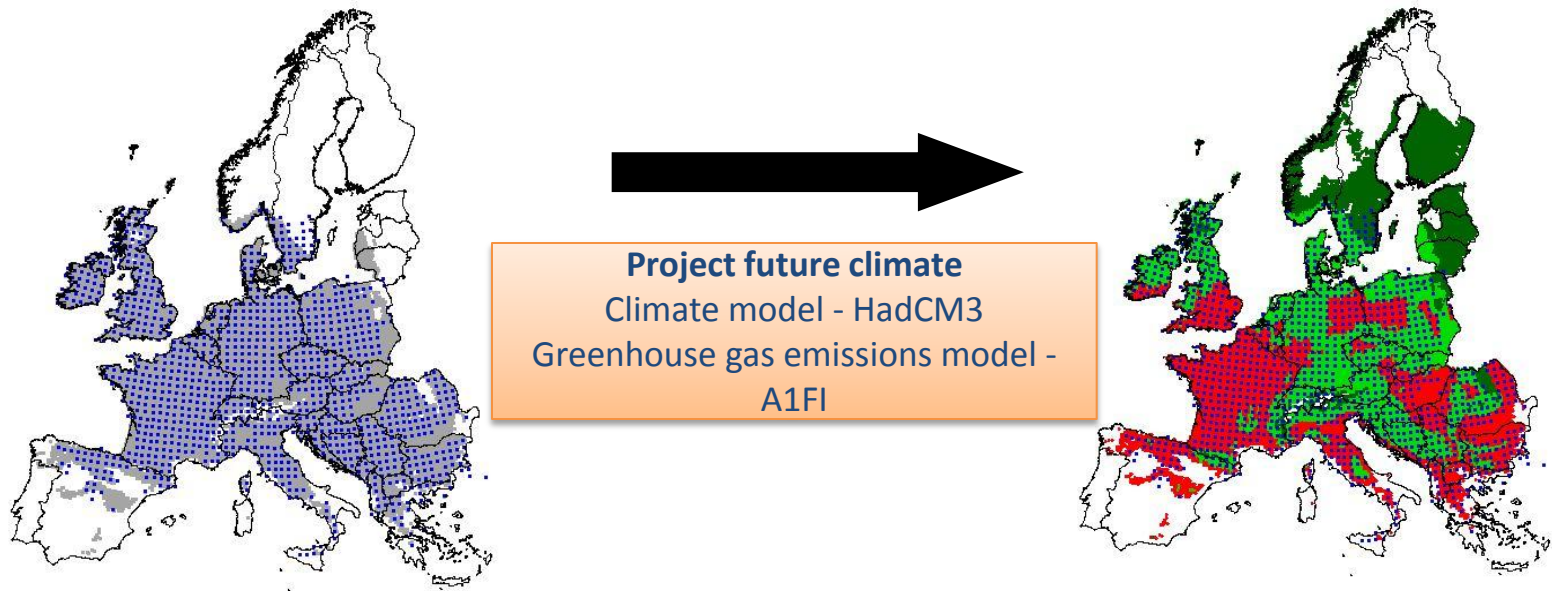
Extirpation

Colonisation

Will they be able to **adapt** themselves to new environmental conditions?

Model of bioclimatic niche shift

Example of *Quercus petraea*



Current distribution
BIOMOD simulation

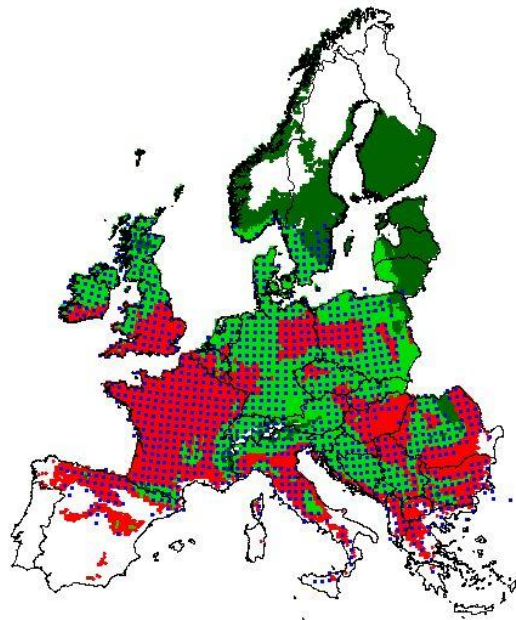
- **Observation**
- Simulation

Future distribution: 2080
BIOMOD simulation

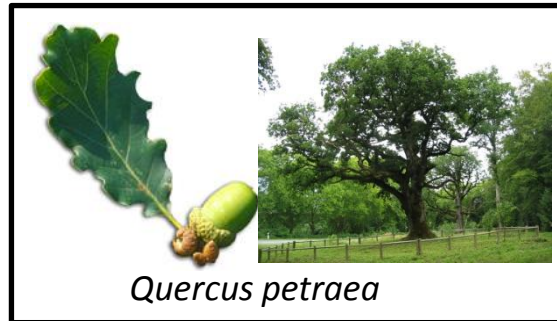
- **Habitat loss**
- **Stable habitat**
- **Habitat gain**

1. Is there evidence of a shift in tree species altitudinal distribution over one single decade ?

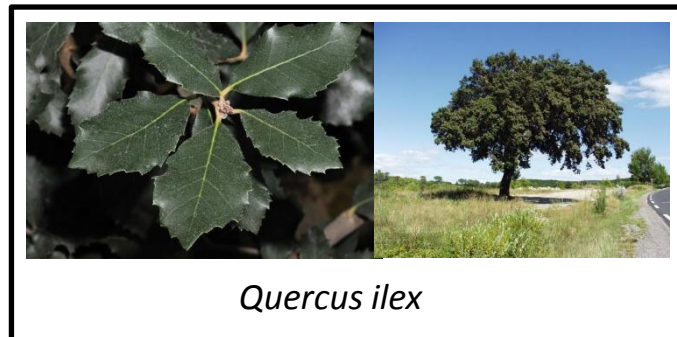
2. Are the responses to global change of the same magnitude between species and mountain ranges ?



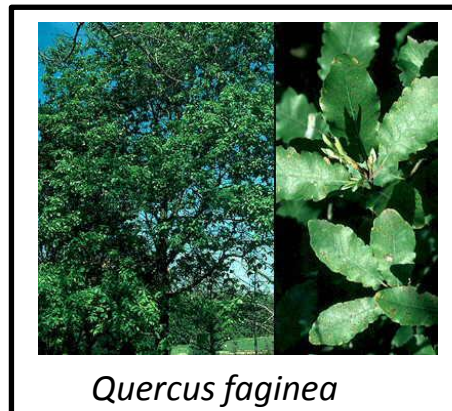
○ Temperate species



○ Mediterranean species



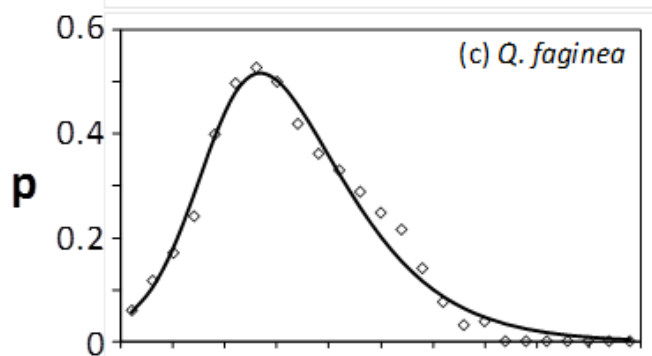
○ Sub-mediterranean species



Data of presence/ absence from two successive surveys separated by 10 years (1990 and 2000).



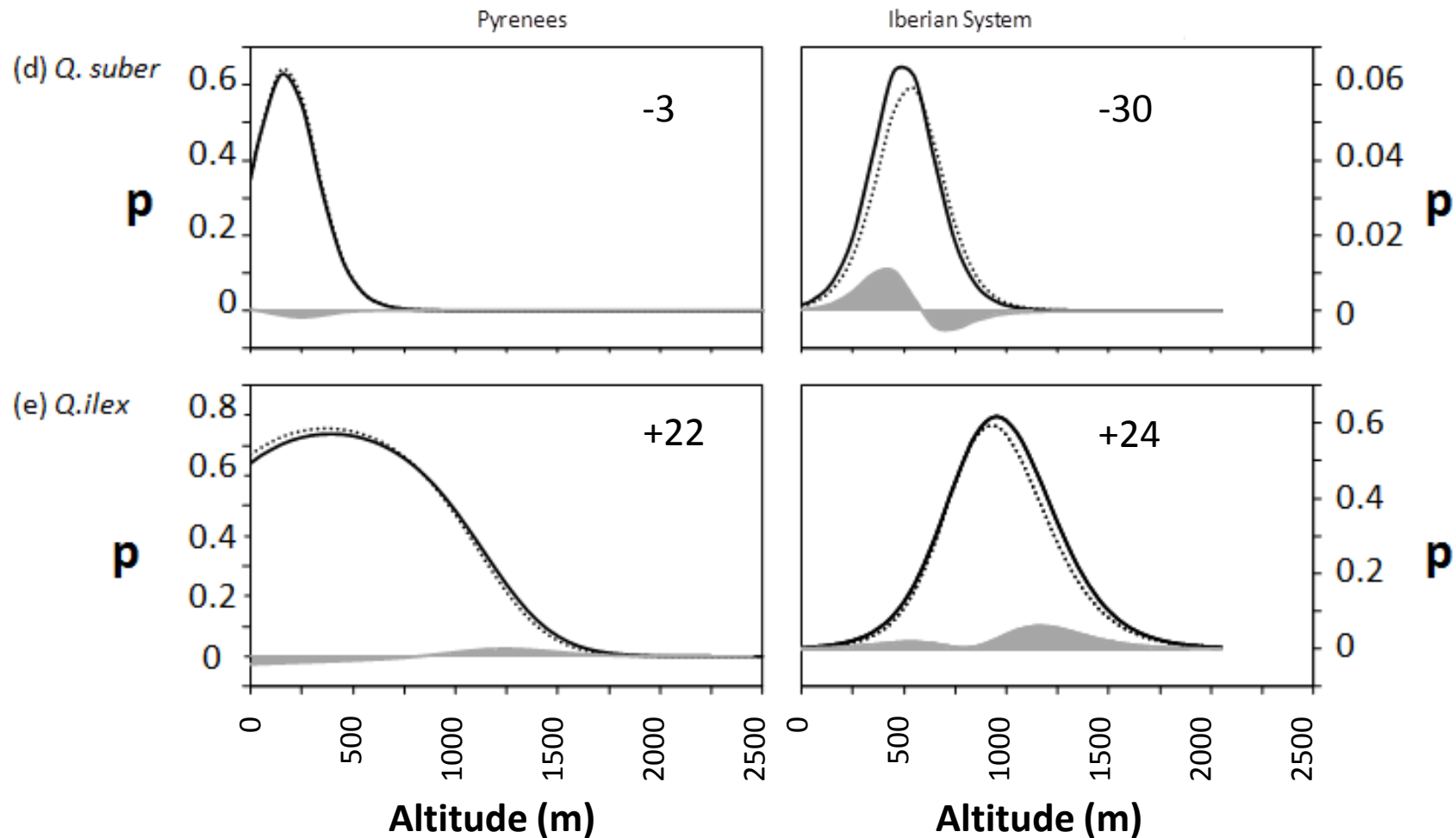
Probability of occurrence by altitudinal class



Determination of optimum altitude
($alt_{opt, 1990}$ ou $alt_{opt, 2000}$)

$$\text{Shift} = alt_{opt, 2000} - alt_{opt, 1990}$$

Mediterranean species



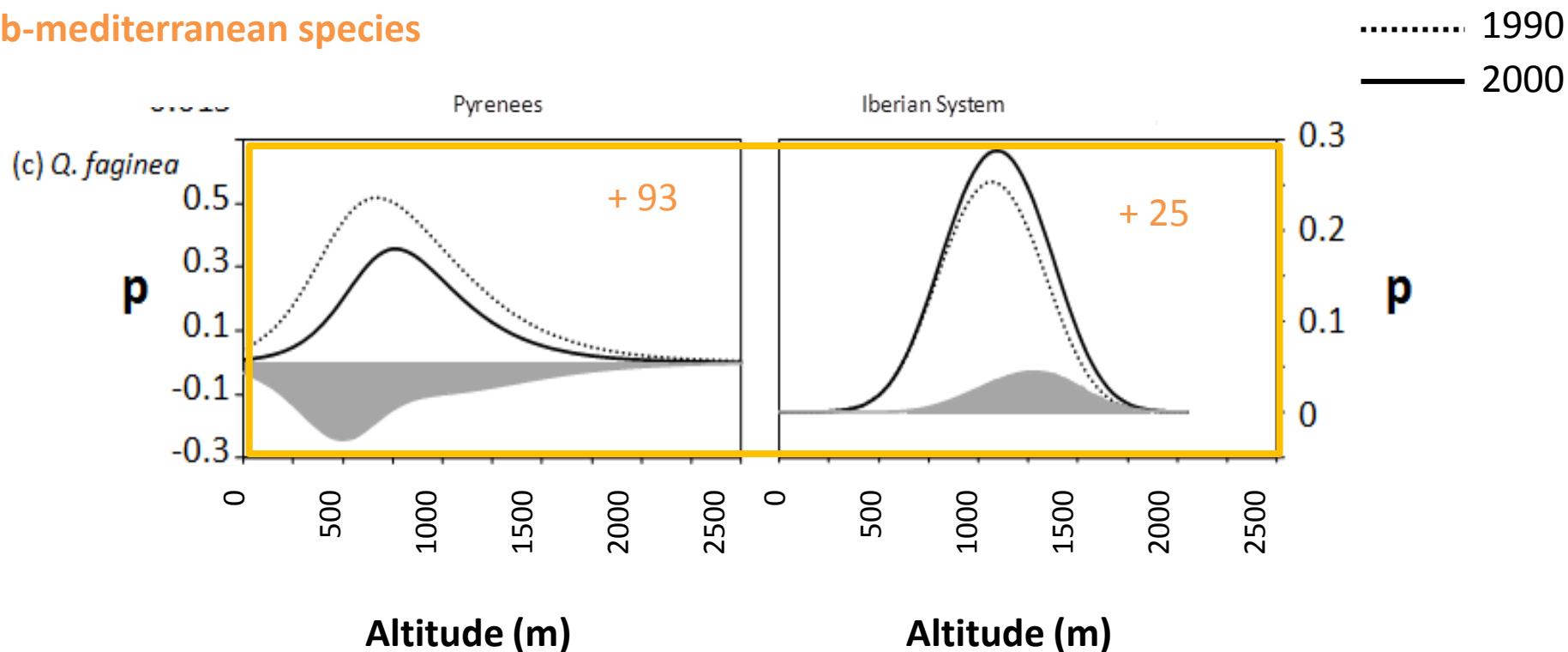
..... 1990
 ——— 2000

➔ No altitudinal shift.

Mediterranean species

- Models predicted maintenance or expansion of mediterranean oaks until 2020 then strong extirpations by 2080. (Benito-Garzon *et al.* 2008)
- The mean annual temperature plays an important role in mediterranean oak's distribution. (Olano *et al.* 2012)
- Biotic factors and land use changes could explain the limitation of expansion of these two species. (Urbieto *et al.* 2008)

Sub-mediterranean species



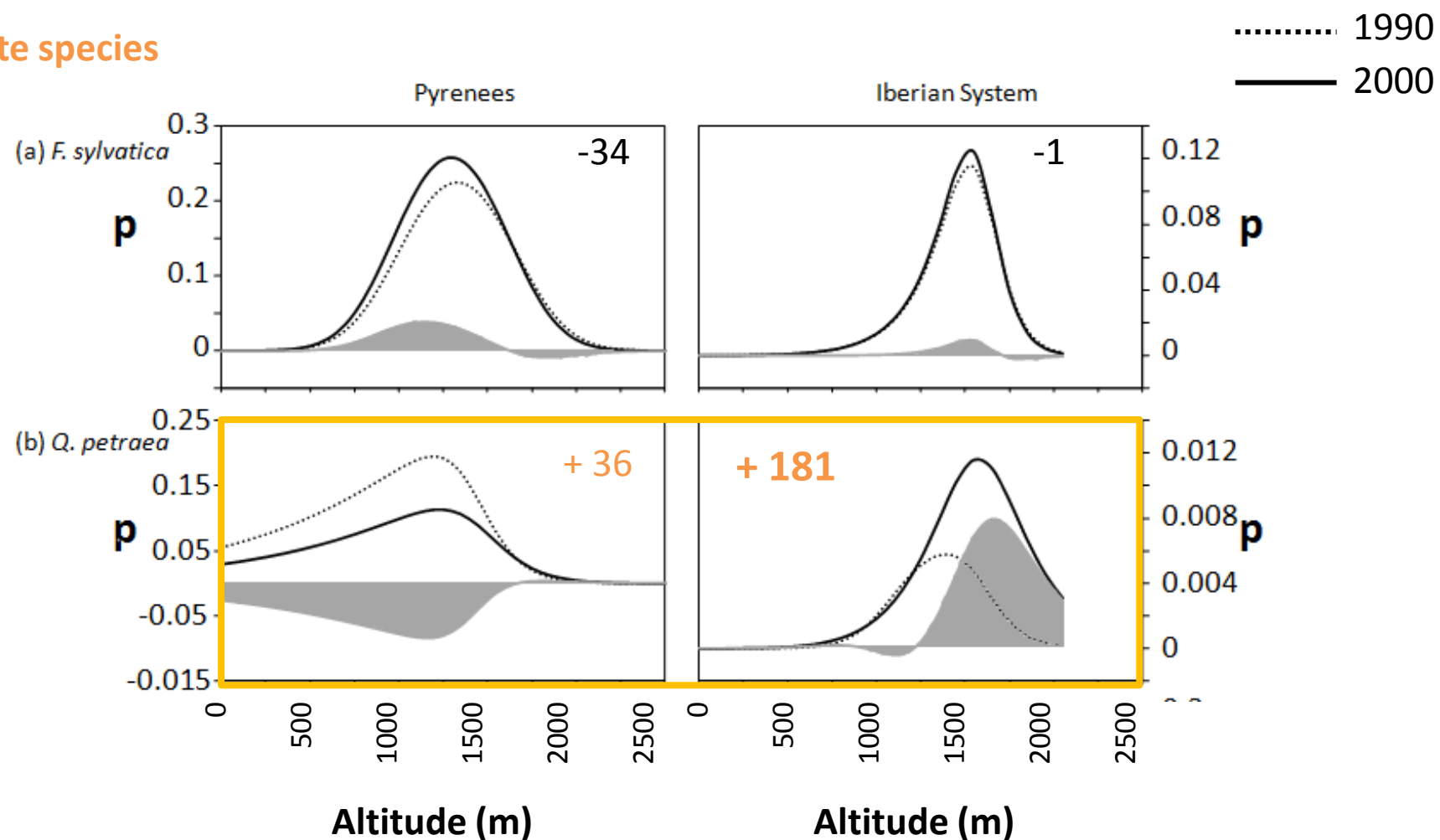
- Extirpation at lower altitudes in the Pyrenees Mountains.

→ Species sensitive to drought (Purves *et al.* 2007)

→ Role of land use change (Nogues-Bravo *et al.* 2008)

➔ Shrinkage of submediterranean area with high probability of upward shift until 2080. (Benito-Garzon *et al.* 2008)

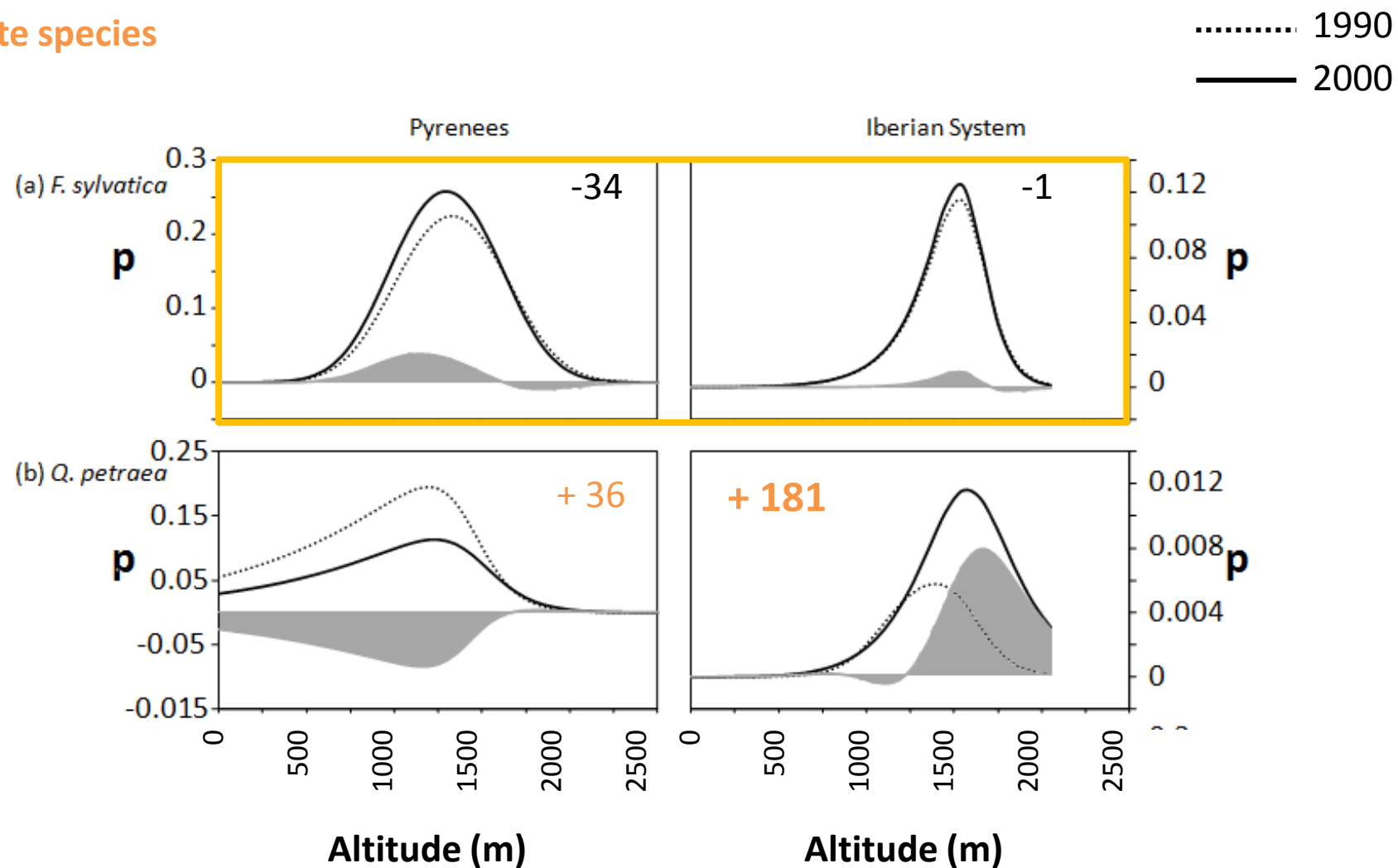
Temperate species



-In Spain, species located at the south limit of its distribution.

- Models predicted a large reduction of its bioclimatic envelop until 2080. (Benito-Garzon *et al.* 2008)

Temperate species



-Movements toward lower altitudes in the Pyrenees and no displacement in Iberian System.
--> Opposite results to those in the literature.

→ The persistence of *F. sylvatica* in these mountains resulted of past upward shifts. (Penuelas ¹⁴ et

- **Rapid upward shifts** of tree species distribution detected in 10 years (Objective 1).
- Relationship between the amplitude of movements and the species location within their distribution area. (Objective 2).

PERSPECTIVES

- Study of the change in species coexistence at regeneration stage.