

# Climate change reshapes the drivers of false spring risk across European trees

Authors:

C. J. Chamberlain<sup>1,2</sup>, B. I. Cook<sup>3</sup>, I. Morales-Castilla<sup>4,5</sup> & E. M. Wolkovich<sup>1,2,6</sup>

*Author affiliations:*

<sup>1</sup>Arnold Arboretum of Harvard University, 1300 Centre Street, Boston, Massachusetts, USA;

<sup>2</sup>Organismic & Evolutionary Biology, Harvard University, 26 Oxford Street, Cambridge, Massachusetts, USA;

<sup>3</sup>NASA Goddard Institute for Space Studies, New York, New York, USA;

<sup>4</sup>GloCEE - Global Change Ecology and Evolution Group, Department of Life Sciences, Universidad de Alcalá, Alcalá de Henares, 28805, Spain

<sup>5</sup>Department of Environmental Science and Policy, George Mason University, Fairfax, VA 22030;

<sup>6</sup>Forest & Conservation Sciences, Faculty of Forestry, University of British Columbia, 2424 Main Mall, Vancouver, BC V6T 1Z4

\*Corresponding author: 248.953.0189; cchamberlain@g.harvard.edu

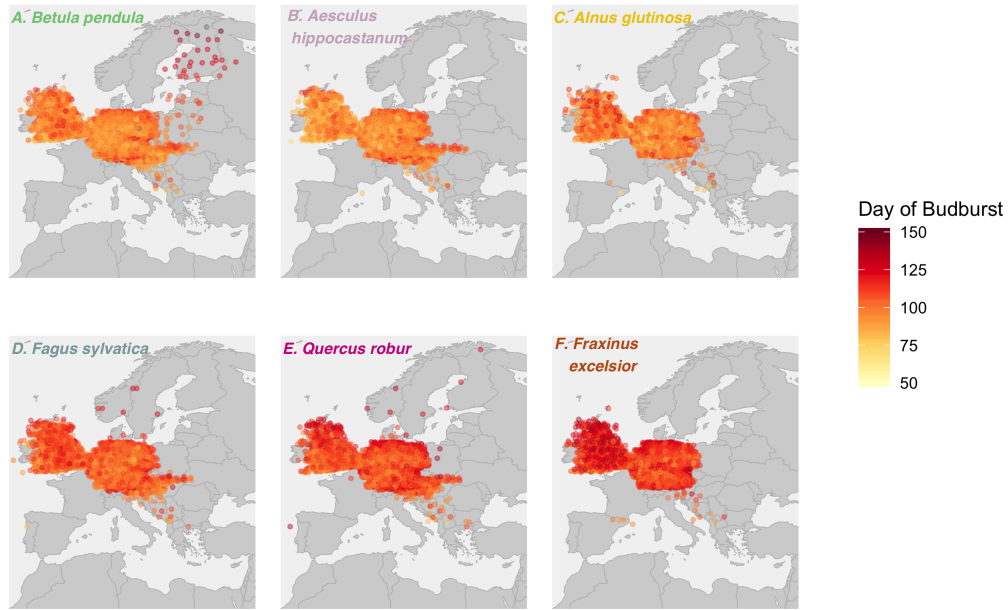


Figure 1: The average day of budburst mapped by site for each species (ordered by day of budburst starting with *Betula pendula* as the earliest budburst date to *Fraxinus excelsior*). Species names are color-coded to match figures throughout the text.

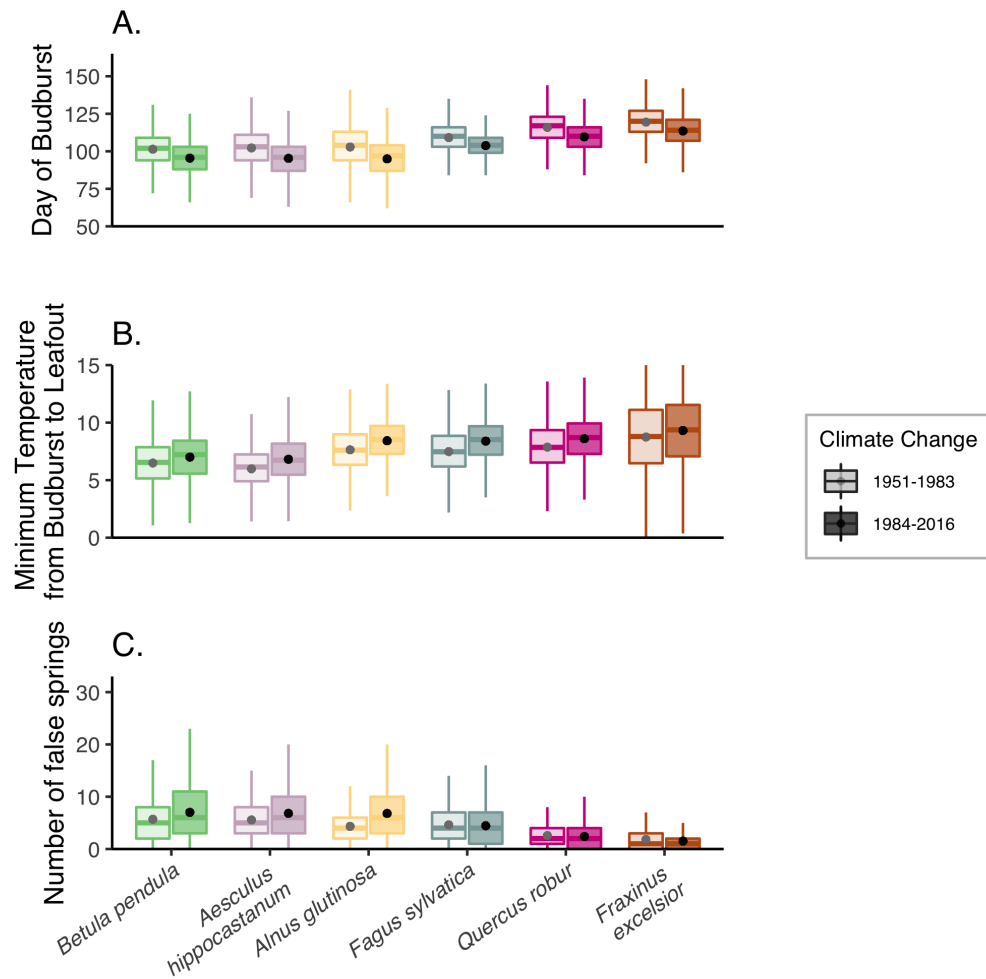


Figure 2: Day of budburst (A.), minimum temperatures between budburst and leafout (B.) and number of false springs (C.) before and after 1983 across species for all sites. Box and whisker plots show the 25th and 75th percentiles (i.e., the interquartile range) with notches indicating 95% uncertainty intervals. Dots and error bars overlaid on the box and whisker plots represent the model regression outputs (Tables S3-S5). Error bars from the model regressions indicate 98% uncertainty intervals but, given the number of sites, are quite small and thus not easily visible (see Tables S3-S5). Species are ordered by day of budburst and are color-coded to match the other figures.

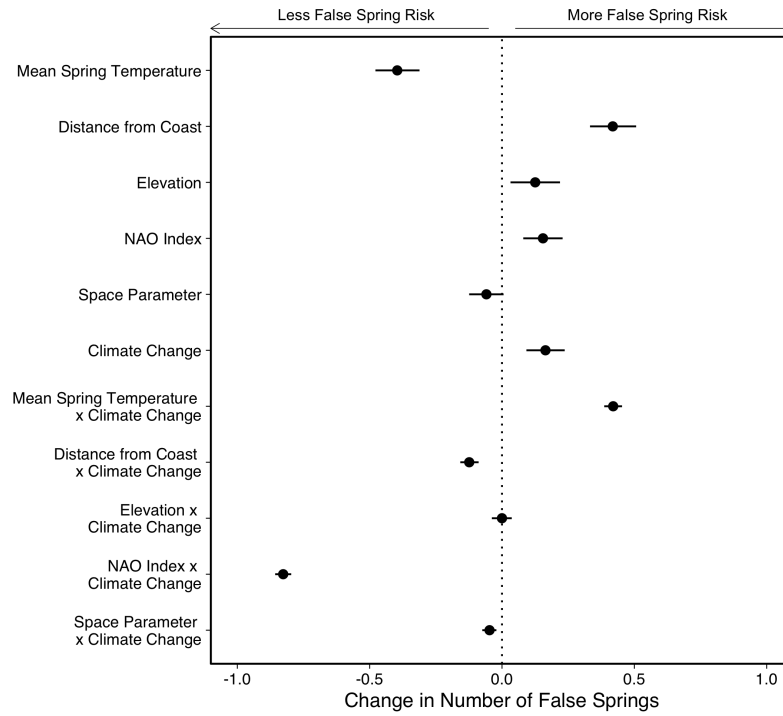


Figure 3: Effects of species, climatic and geographical predictors on false spring risk. More positive values indicate an increased probability of a false spring whereas more negative values suggest a lower probability of a false spring. Dots and lines show means and 98% uncertainty intervals. There were 582,211 zeros and 172,877 ones for false springs in the data. See Table S6 for full model output.

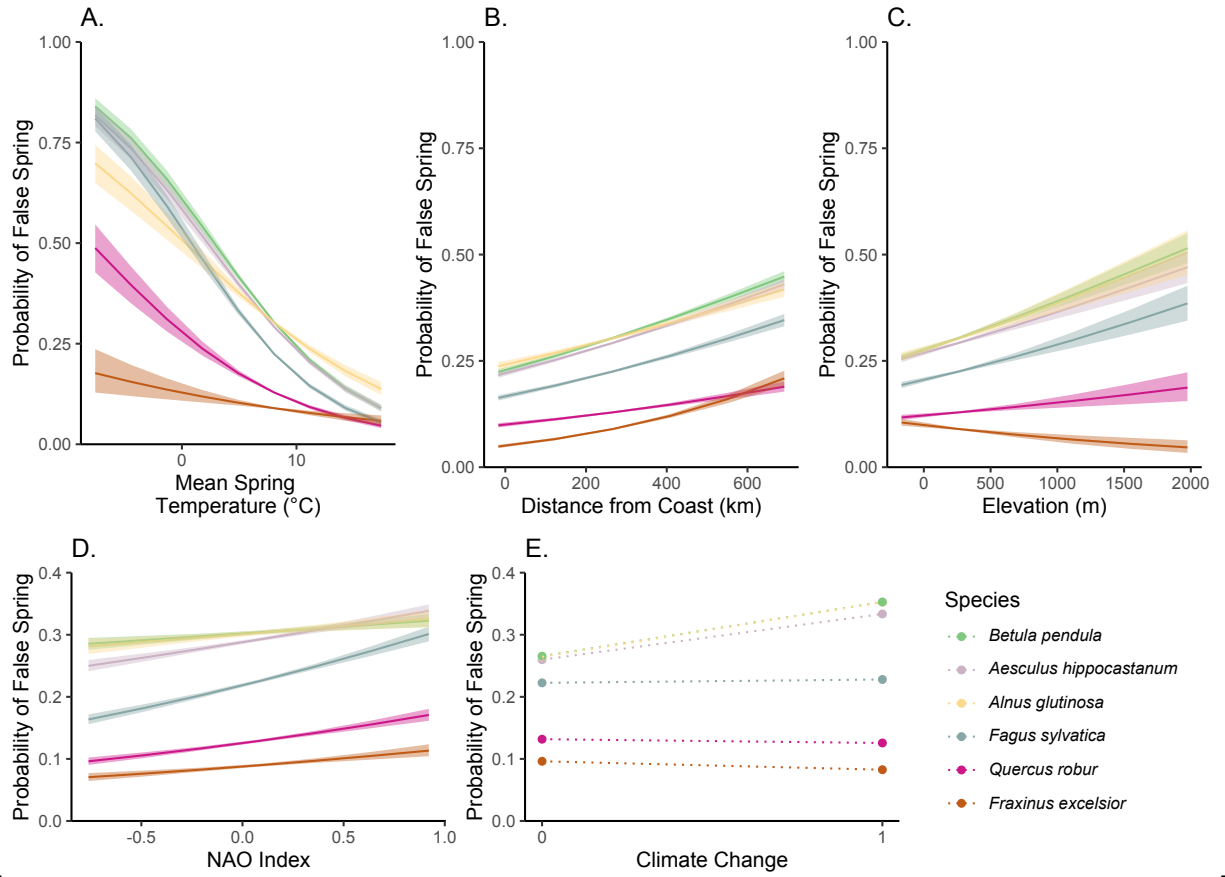


Figure 4: Species-level variation across geographic and spatial predictors (i.e., mean spring temperature (A.), distance from the coast (B.), elevation (C.), and NAO index (D.)). Lines and shading are the mean and 98% uncertainty intervals for each species. To reflect the raw data, we converted the model output back to the original scale for the x-axis in each panel. See Table S6 for full model output.