# Species differences in budburst responses in woody plants of North America

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## Introduction

1. Plant phenology is changing with climate change:
   (a) Timing of spring bb is changing with anthropogenic climate change
   (b) But changes are not uniform with some regions experiencing greater warming than others.
   (c) Responses are also species specific and highly variable
   (d) Budburst in forest communities is the product of species differences as well as geographic variability in environmental cues.
   (e) Understanding the relative importance of these different drivers of budburst is needed to understand and predict future changes in spring phenology—and their ultimate impacts on growing season length, carbon cycle, species interactions
2. Cues that shape bb
   (a) For woody plants, we do know there are three important environmental cues for bb:
      i. Forcing: spring temperatures
      ii. Photoperiod/daylength
      iii. Chilling: winter length and temperatures
   (b) But these cues interact—forcing can offset low chilling—photoperiod offsets weak forcing (Heide1993, Chuine2000, Caffarra2011, Flynn2018 )
   (c) The consistency and strength of these interactions across populations remains unclear.
3. Cues can vary geographically and temporally—likely to create differences in community dynamics and species composition.
   (a) Increasing winter and spring temperatures = faster accumulation of chilling and forcing (Guy2014)—associated with earlier budburst in many temperate plant species.
   (b) Could create novel niche space early in growing season—facilitating spp invasions or novel community assemblages
   (c) Will also reduce fitness in spp with strong photoperiod cues = limited in their ability to advance (Korner2010) = different competitive landscape later in the growing season

(d) Differences in species cue responses are likely to shape the diversity and persistence of species across forest communities.

4. Variation in bb phenology across species in a community

   (a) To date, most work has been devoted to understanding how environmental cues shape phenology and what drives the high species level variation in budburst

   (b) Timing of bb in a forest community can span several weeks—species fill different temporal niche

   (c) e.g. understory spp tend to bb earlier than canopy species, likely reflecting overarching differences in traits.

   (d) But differences in budburst responses are likely to also exist across a species ranges.

5. Across a species spatial distribution—differences in cues and therefore in spp responses/bb

   (a) Species with large latitudinal distributions experience differences in cues—e.g. photoperiod cues

   (b) Budburst across diff pop = result of local selective pressures—abiotic (local envirt) and biotic (competition and herbivory)

   (c) But few studies have explored how cue use may differ across spatial gradient for the same forest communities and the role of local environments and biotic communities in shaping budburst across North America.

6. In this study we:

   (a) Combined results from two growth chamber studies of woody plant phenological cues

   (b) Data from four populations, from eastern to western North America and a range of 4-6° latitude

   (c) Allows us to detect general trends in how bb of N Am. deciduous forest communities respond to forcing, chilling, photoperiod

   (d) But also community specific responses—detect differences between Western and Eastern forest communities, and at different latitudes

   (e) And trends across different functional groups, exploring differences between shrub and tree species.