Climate change and crop phenology

Robert Hijmans, University of California, Davis
Katherine Pope, University of California Cooperative Extension
Elise Hellwig, University of California, Davis
Phenology  [fi-nol-uh-jee]

The study of **environmentally influenced regular events** in the lifecycle of organisms

**Examples**
- Leaves emerging in the spring
- Bird migration
- Plants blooming

**Environmental factors**
- Temperature (heat or cold accumulation)
- Photoperiod (day length)
Northern Hemisphere Temperatures last ~ 1000 years:

- Medieval Warm Period
- Little Ice Age
Apple bloom in Europe

Golden delicious

Legave et al. (2013) Intl J Biomet
California tree crop phenology and climate (change)

• **Warm winter can delay spring phenology**
  Winter chill needed to wake up

• **Warm spring can advance spring phenology**
  Need warm weather to come out

• **Warm spring advances harvest**
  Fruits and nuts mature faster
Data

Almond:
Chico (4 varieties), 1933 — ; 1983 — (5 varieties)
Modesto (7 varieties), 1983 —
Shafter (7 varieties), 1996 —

Prune: Parlier and Winters, 1998 —

Walnut: Davis (7 varieties), 1954 —
Walnut leaf-out

Leaf-out timing, ‘Payne’ walnuts, Davis, CA

Pope (2013) Glob Chang Biol
'Chandler' Walnut Harvest Day

$R^2 = 0.146$

Harvest Day (Julian Day)

Year

'Improved French' Prune Bloom Day

$R^2 = 0.412$
'Improved French' Prune Bloom Date by Monthly Mean Temperature

- **January**
- **February**
- **March**
- **April**

Bloom Day (Julian) vs. Temperature (degrees C)