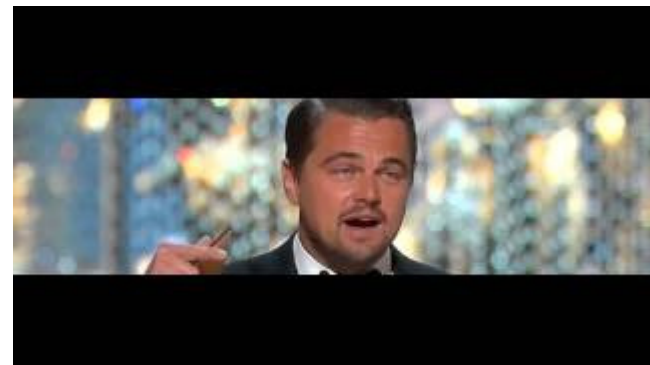
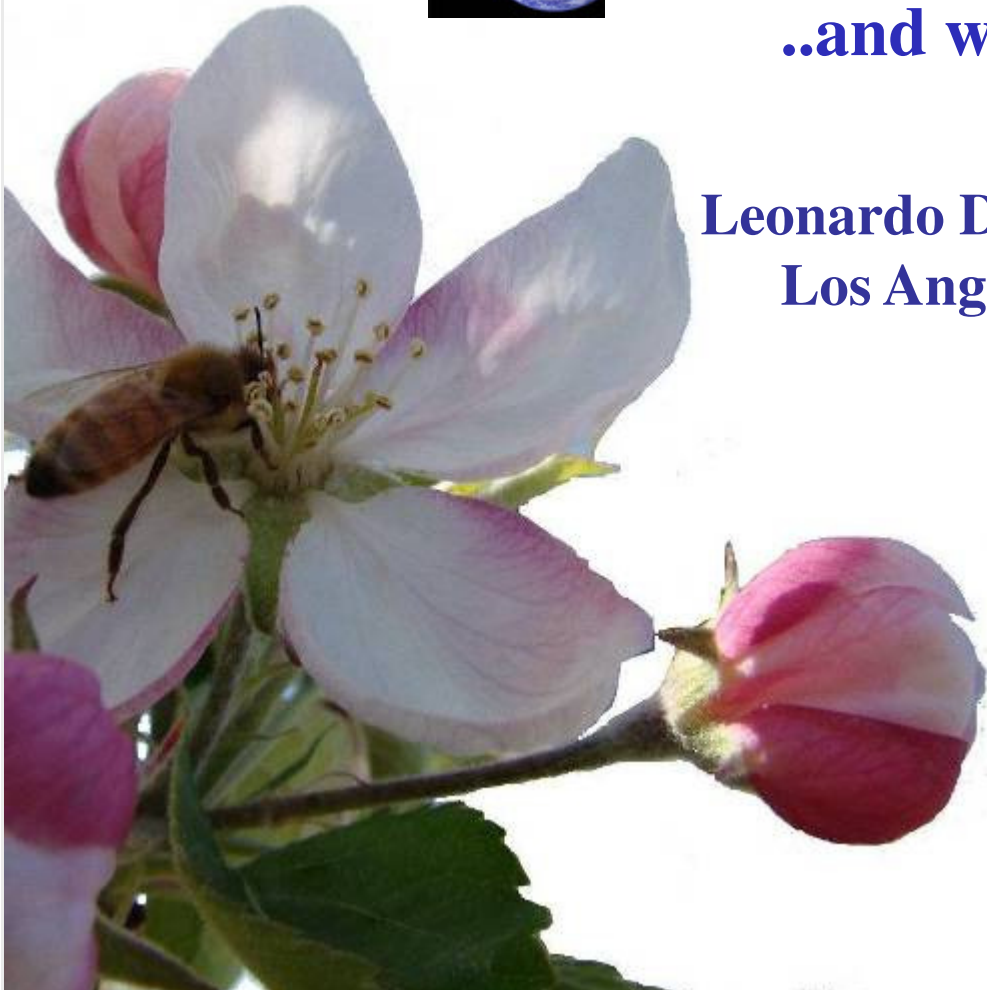




**”Climate change is real and the most urgent threat to the entire species ..and will seriously affect us all”**

**Leonardo Dicaprio, Oscar Award winner,  
Los Angeles, 29 February 2016.**



# Substitution of lack of winter chill by more forcing in spring

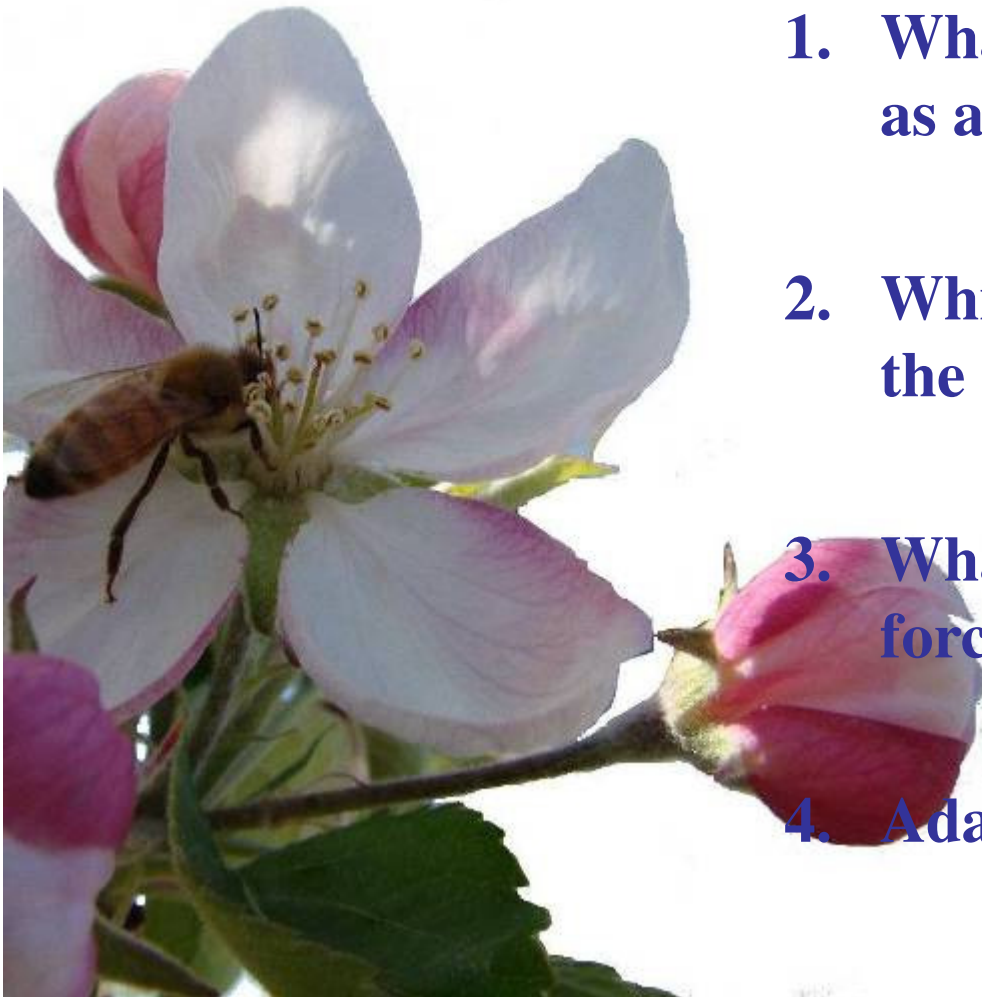
Heiko Kaufmann, Achim Kunz, Michael Blanke, University of Bonn



# **Substitution of lack of winter chill by more forcing in spring**

**M. Blanke et al., University of Bonn**

- 1. What is Chilling and lack of chilling  
as a consequence of climate change**
- 2. Which fruit crops are affected in  
the med climate/temperate zone**
- 3. What is forcing and how can more  
forcing in spring substitute ?**
- 4. Adaptation strategies**



# **1 Consequences of (lack of) chilling (= cold temperature during the winter) Effects of climate change**



# 1 What is Chilling

**Fruit trees require a cool period for flowering the next year (chilling)**

## **Lack of chilling**

- retarded bud break
- Retarded flowering
- Prolonged flowering
- Delayed fruit set
- Acrotony
- **Apical dominance-vertical branch**
- Flatter fruit
- Long pedicel (fruit stalk)
- Uneven ripening, several picks
- Lower yield



# 1 Lack of Chilling

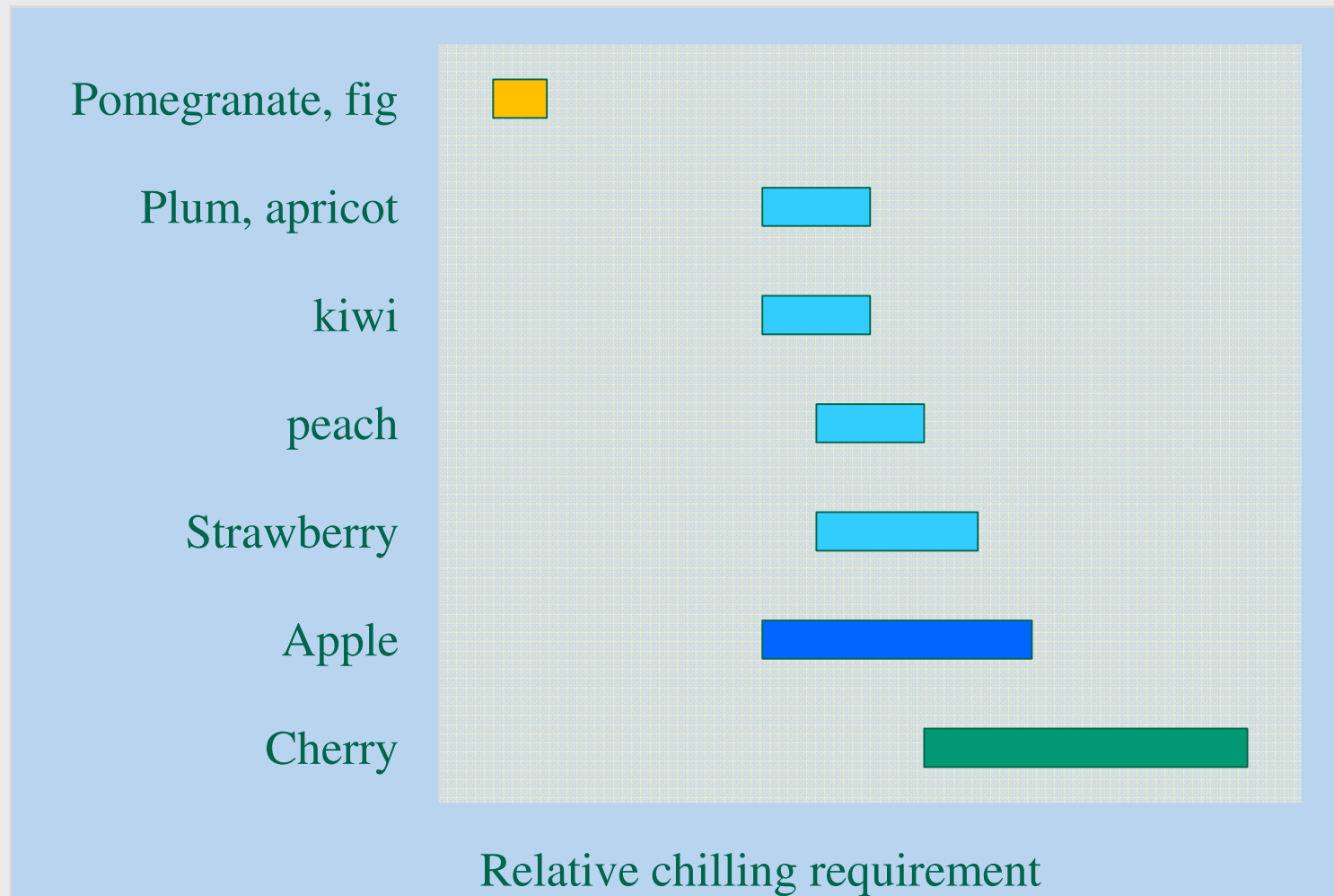
**Fruit trees require a cool period for flowering the next year (chilling)**

## **Lack of chilling**

- retarded bud break
- Retarded flowering
- Prolonged flowering
- Delayed fruit set
- Acrotony
- Apical dominance-vertical branches
- Long pedicel (fruit stalk)
- Flat fruit
- Uneven ripening, several picks
- Lower yield



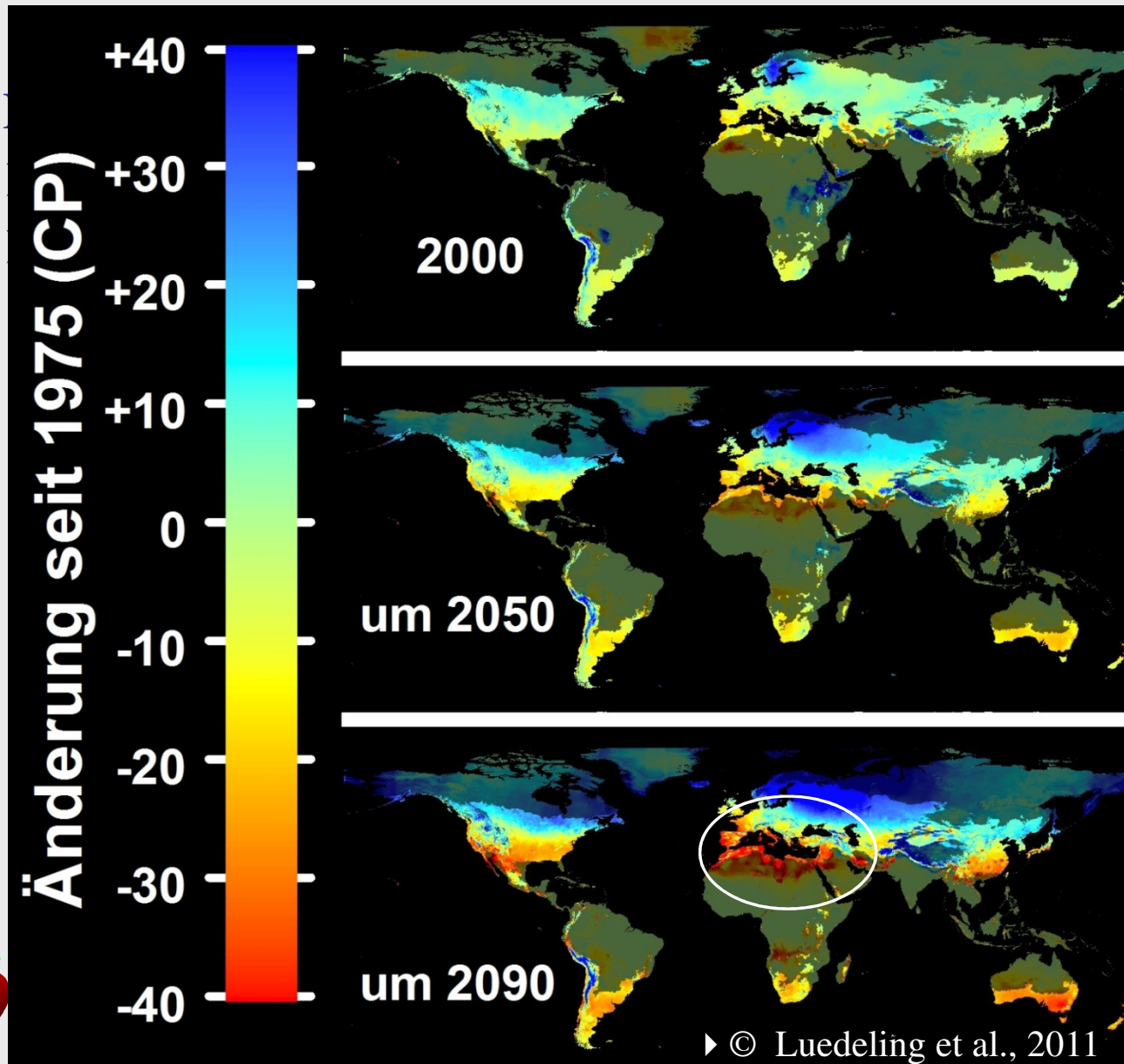
## 2 Which fruit crops are most affected ?



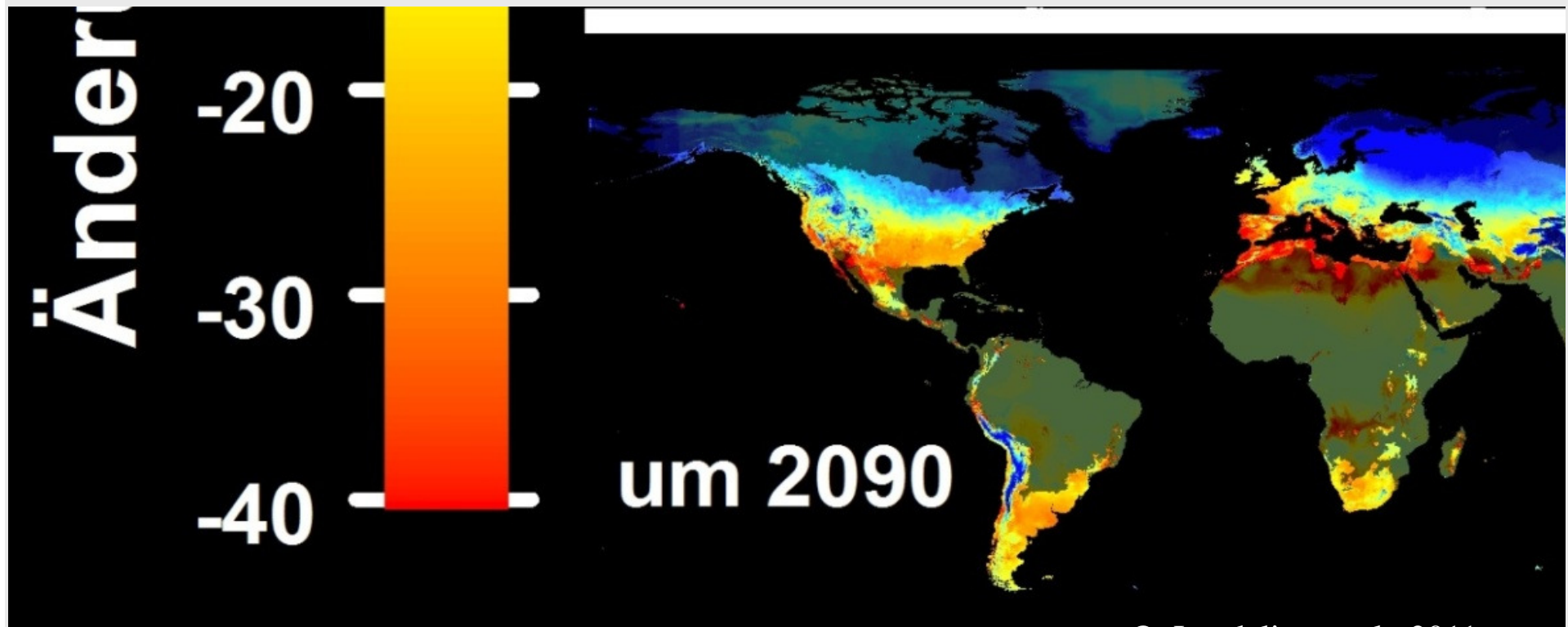
► Apple and cherry => large chilling requirement of all fruit crops, then kiwi & plum



### 3 Climate change: Prediction of lack of chill worldwide



### 3 Climate change: Prediction of lack of chill for the med

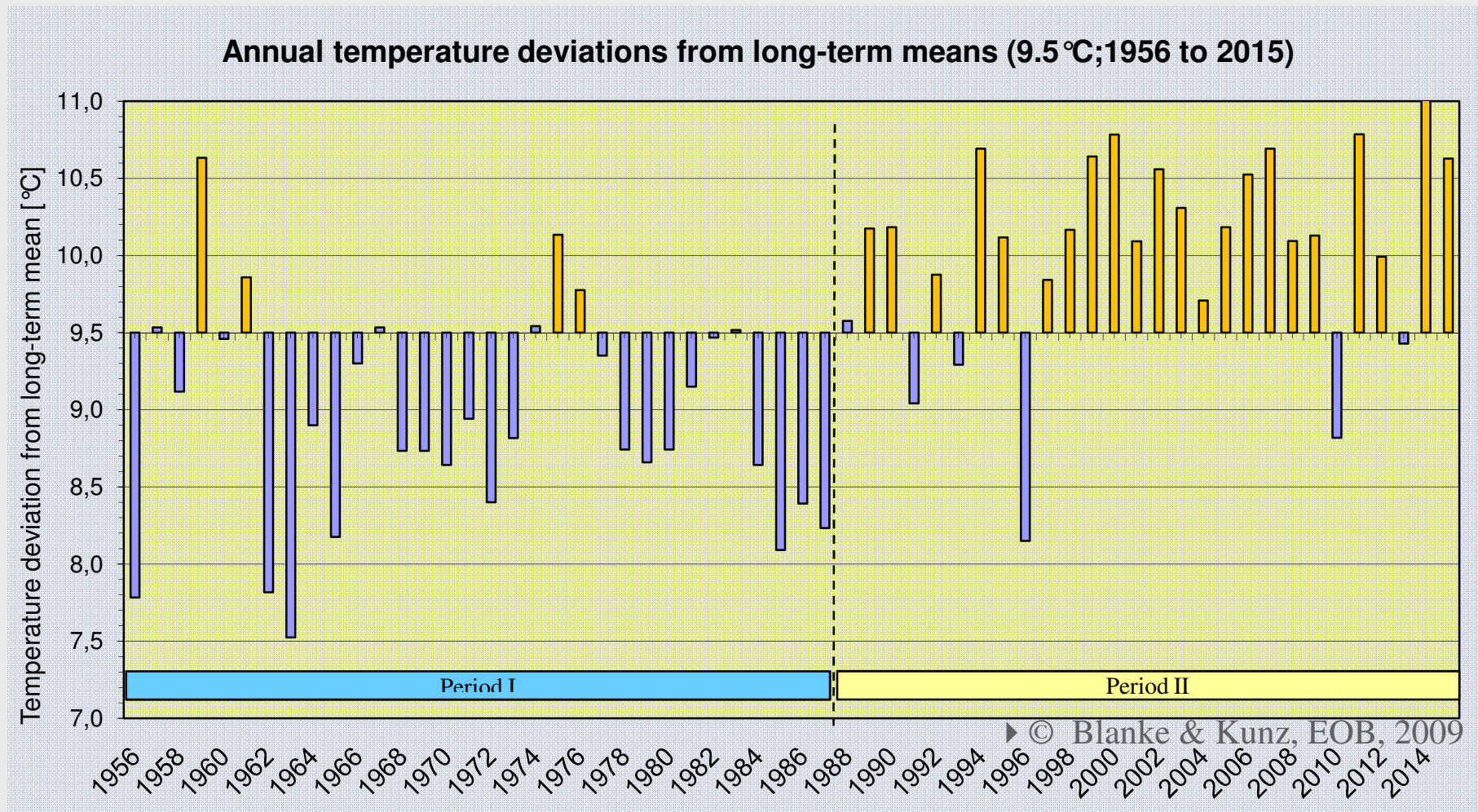


► © Luedeling et al., 2011

- The md and the med islands are particularly prone to lack of chilling



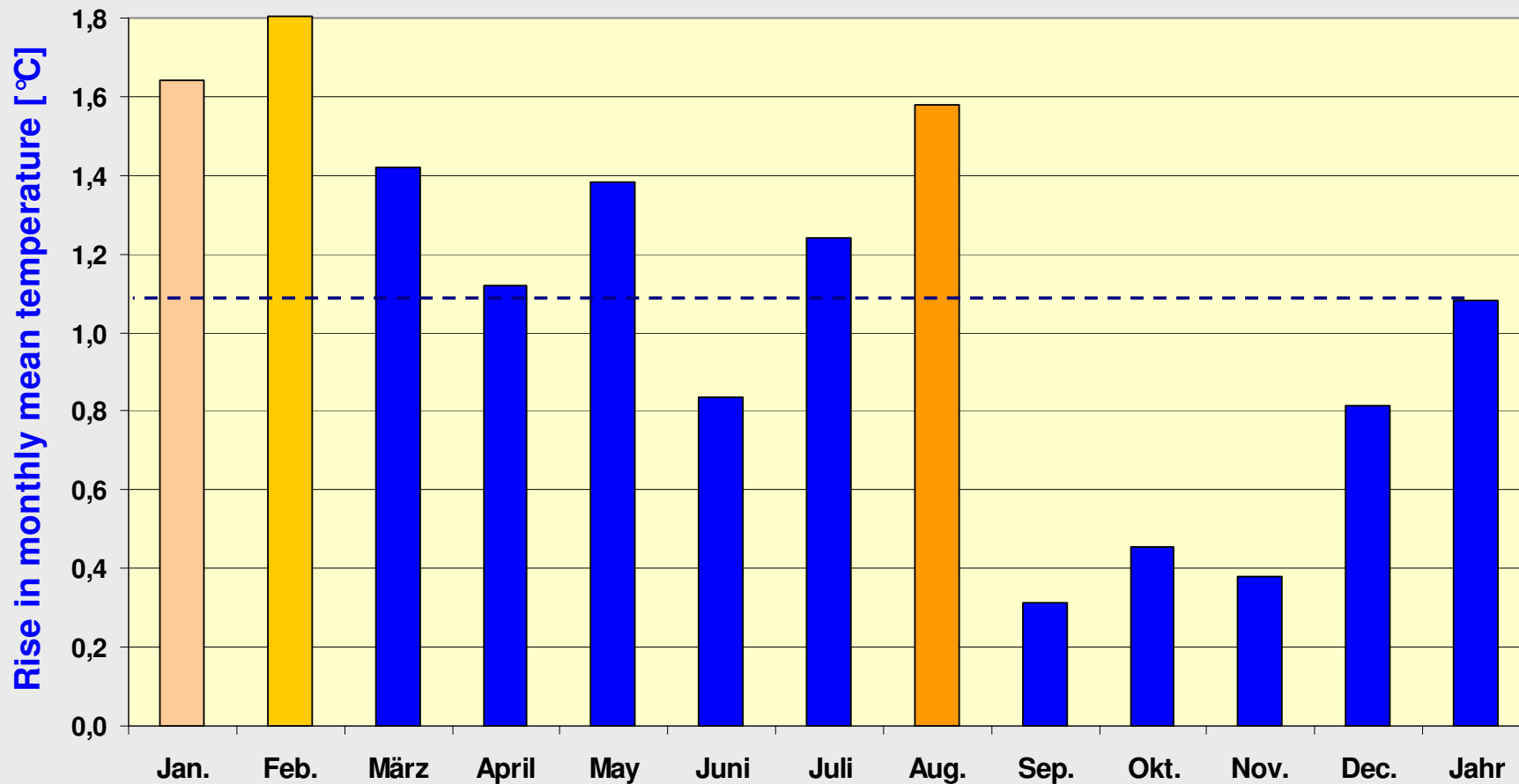
## Temperature variations from long term mean @ Klein-Altendorf/Bonn



=> Period I 1956-1987 without, period II from 1988 with temperature rise



**Temperature difference between period II (1988-2007) versus  
period I (1958-1987); annual mean - - -**



► © Blanke & Kunz, EOB, 2009

**=> Strongest temperature rise at Bonn: January, February, August**



## 4 Chilling research at Univ. Bonn

### Experimental design

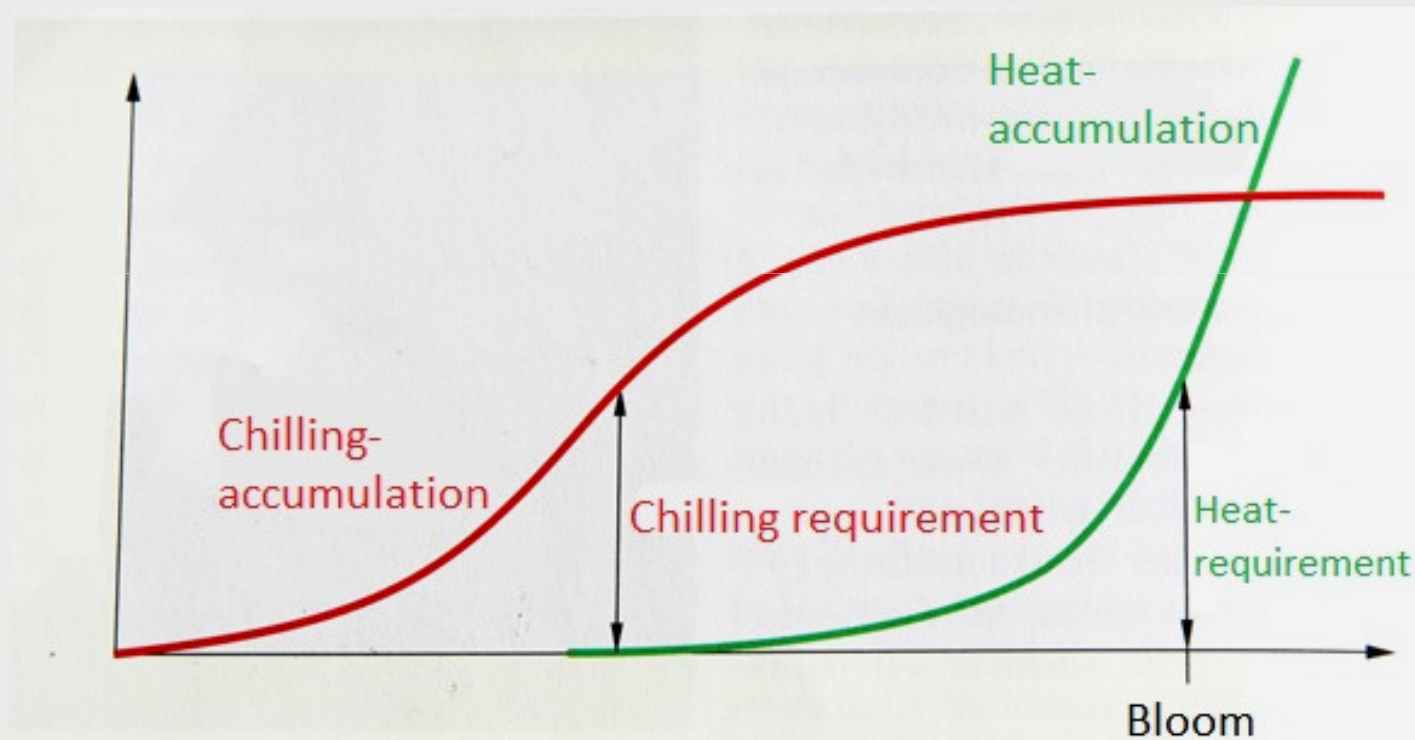
- Cherry trees with chilling requirement (CH)
  - 500, 1000 and 1500 CH
  
- Transport from/to 3 temperature sites
  - Field outside for chilling
  - unheated greenhouse
  - Heated greenhouse for forcing
  
- Modelling for each treatment and variety
  - Based on chilling hours ( $0 - 7.2^{\circ}\text{C}$ )



11 December 2012:  
700 chilling hours (CH)

## 5 Modelling **chilling** and **forcing**

### ► Flower initiation



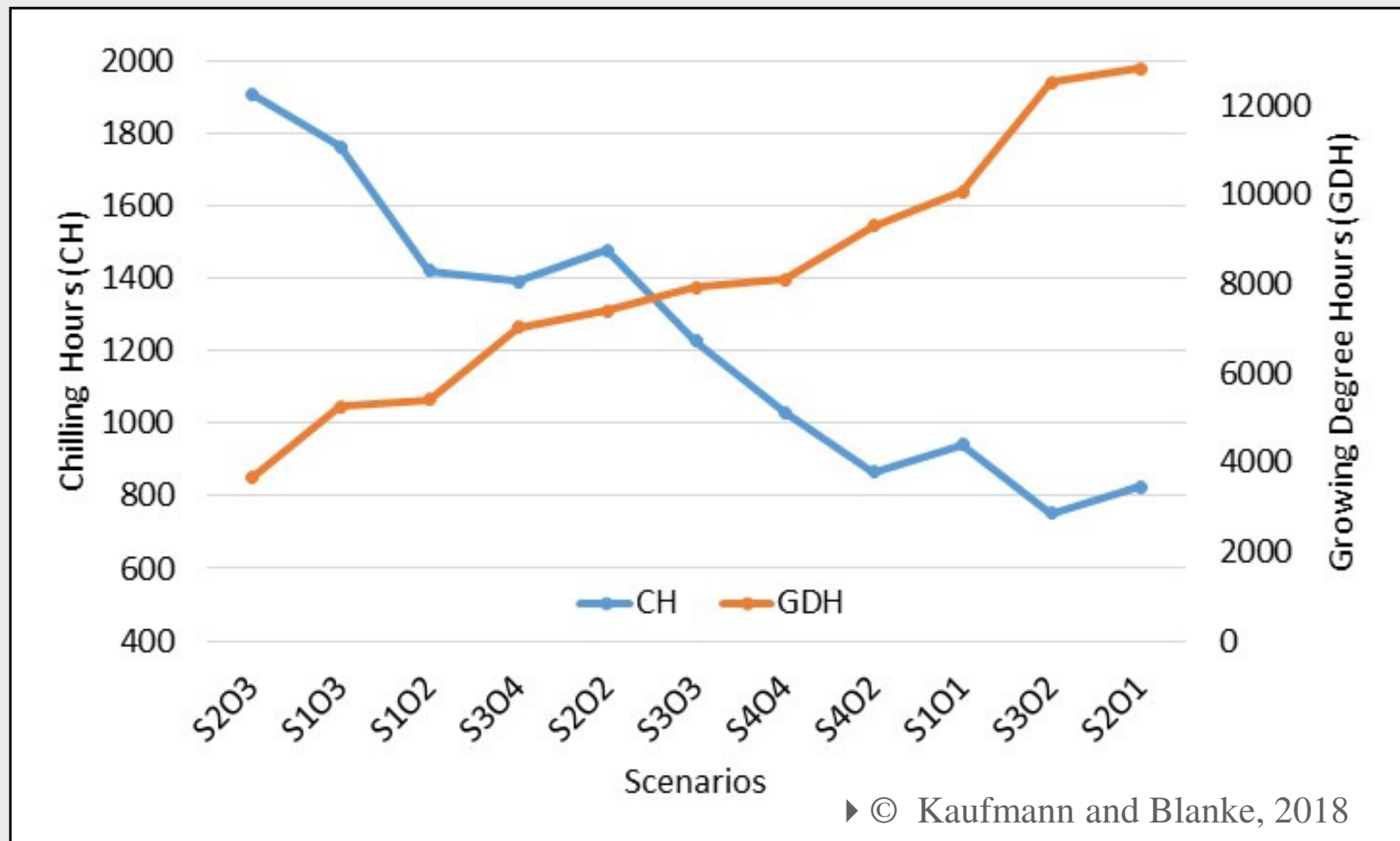
=> **Forcing (heat)** can partially substitute **chilling**

© Gebauer, Luedeling, Blanke, 2015



## 5 Modelling chilling and forcing

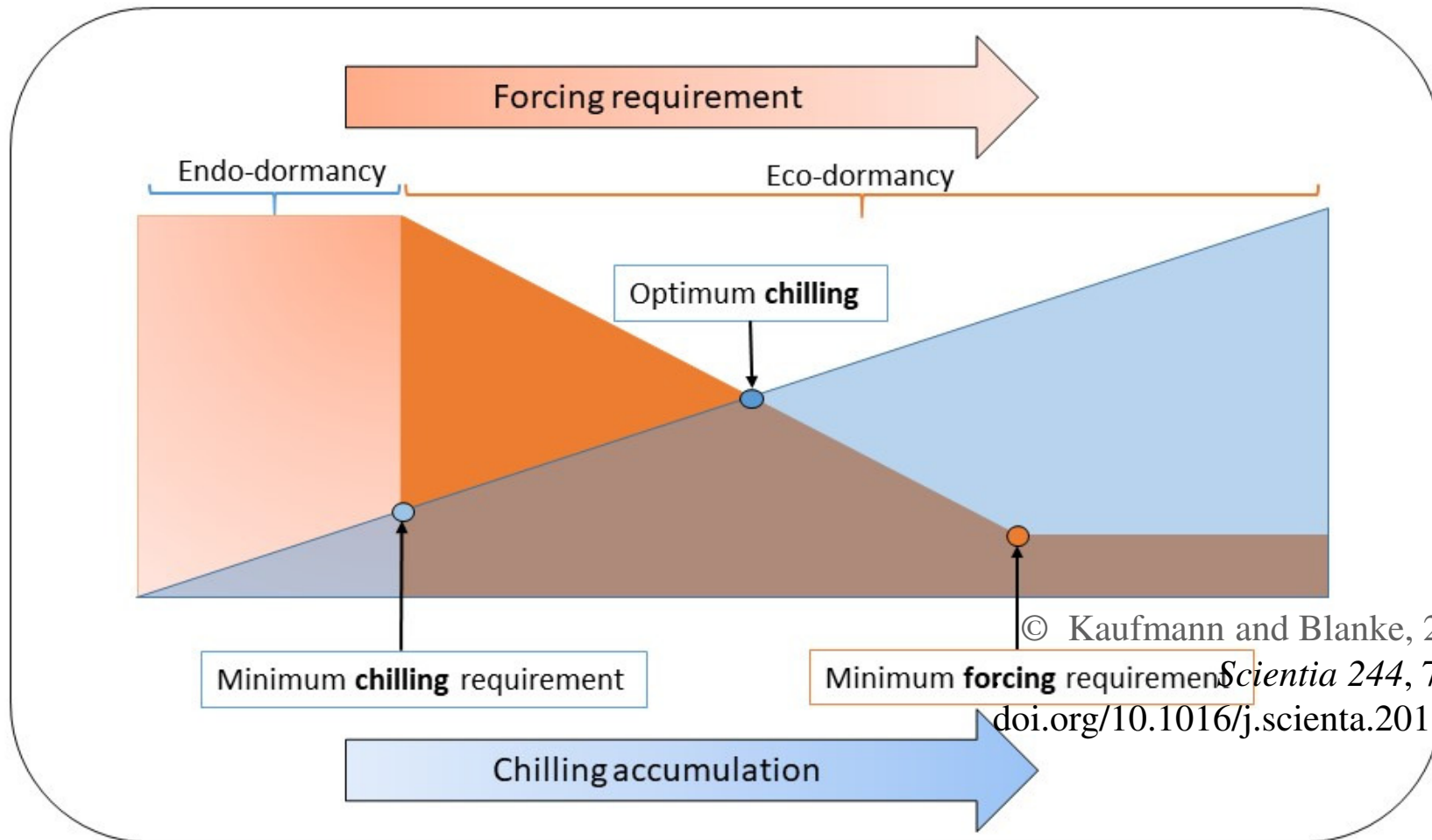
### ► Flower initiation



=> **Forcing (heat)** can  
partially substitute **chilling**



## 5 Modelling chilling and forcing



© Kaufmann and Blanke, 2018 .

*Scientia* 244, 75-81.

[doi.org/10.1016/j.scienta.2018.09.02](https://doi.org/10.1016/j.scienta.2018.09.02)

## Conclusion – Effects of warmer climate

1) Chilling need for flowering in fruit crops, followed by forcing (heat)

2) Warmer winters reduce chilling

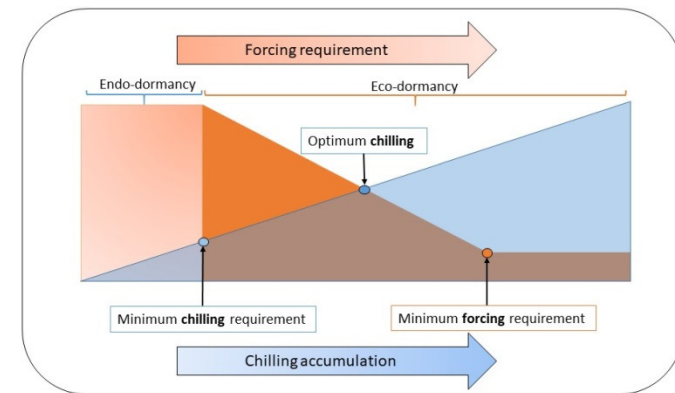
3) Lack of chilling

- Lack of flowering, acrotony, ...

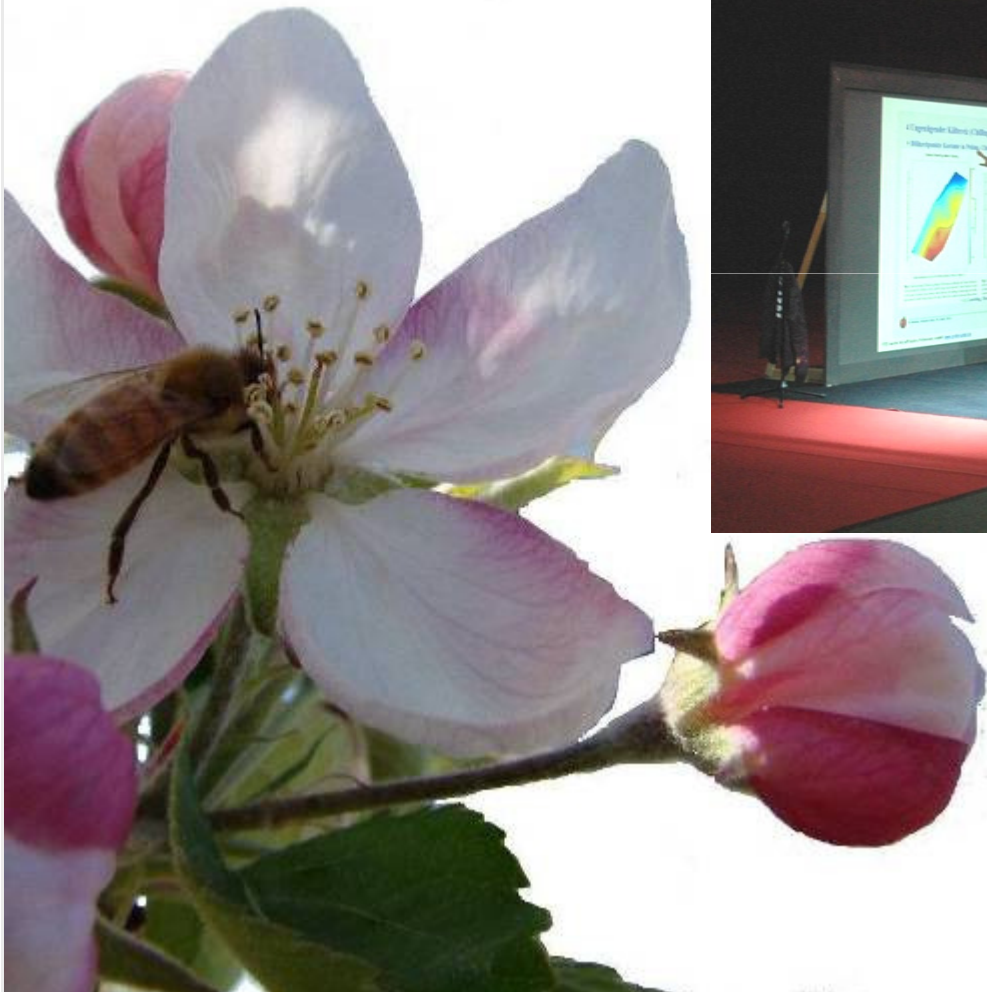
4) Up to 50% of lack of chilling can be substituted by more forcing in spring depending on.

- Variety, winter, location .....

More research and collaboration is needed



## There is passion behind it: 2 science slams at Bonn theatres



**The faces behind the team  
thank you for your attention**



