Climate-driven forest die-off: do we understand all physiological mechanisms involved?

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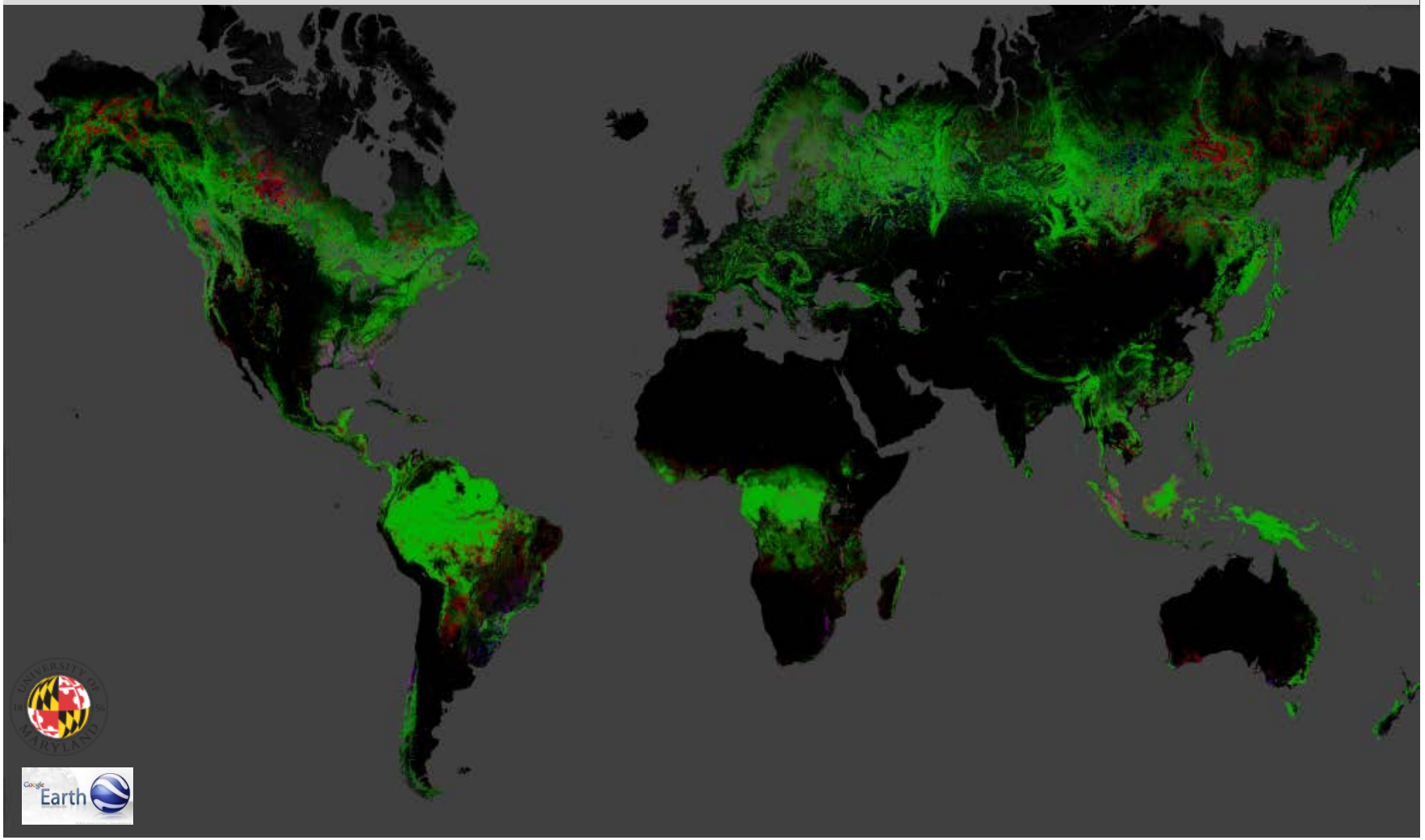
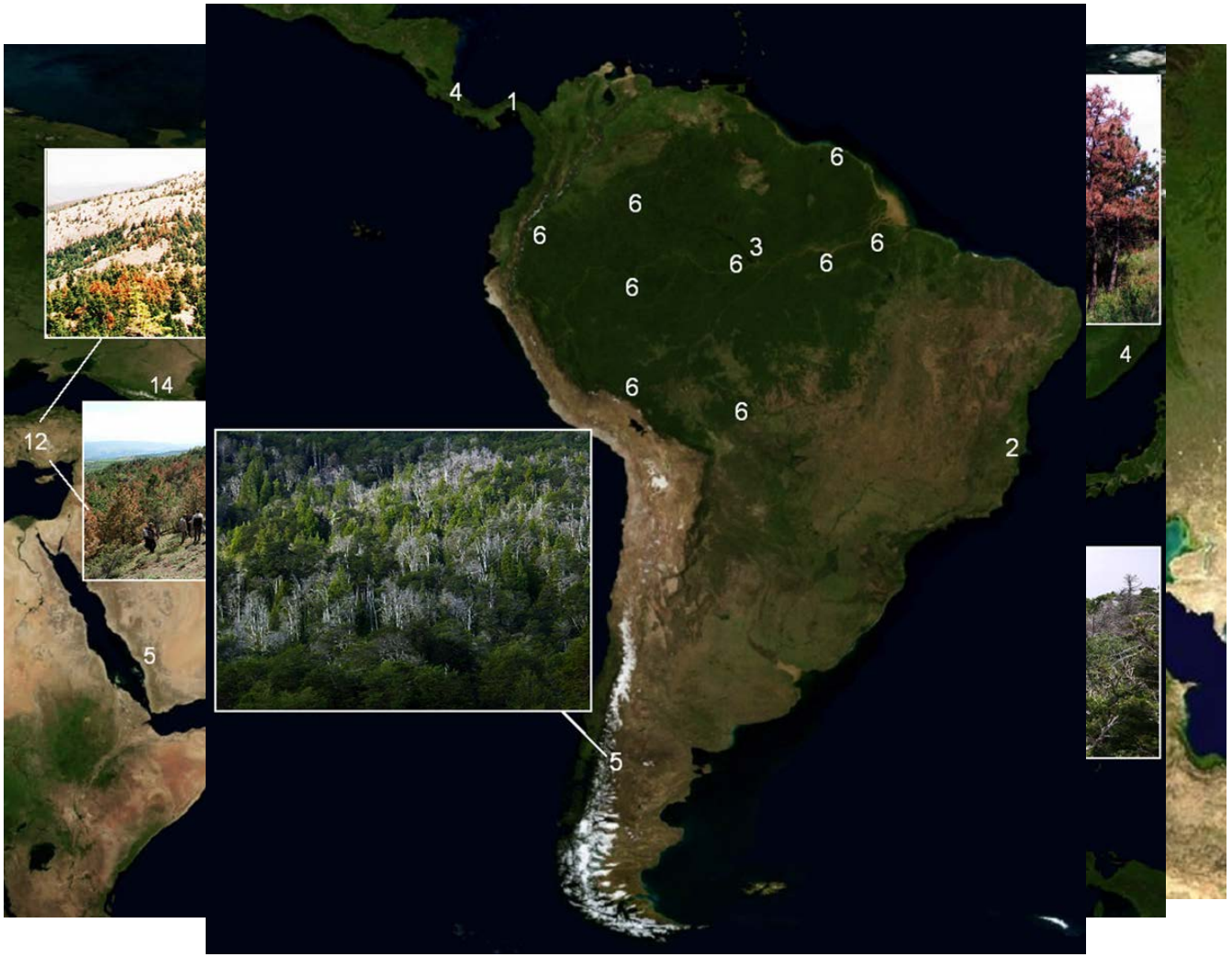
Global forest cover

Global forest cover



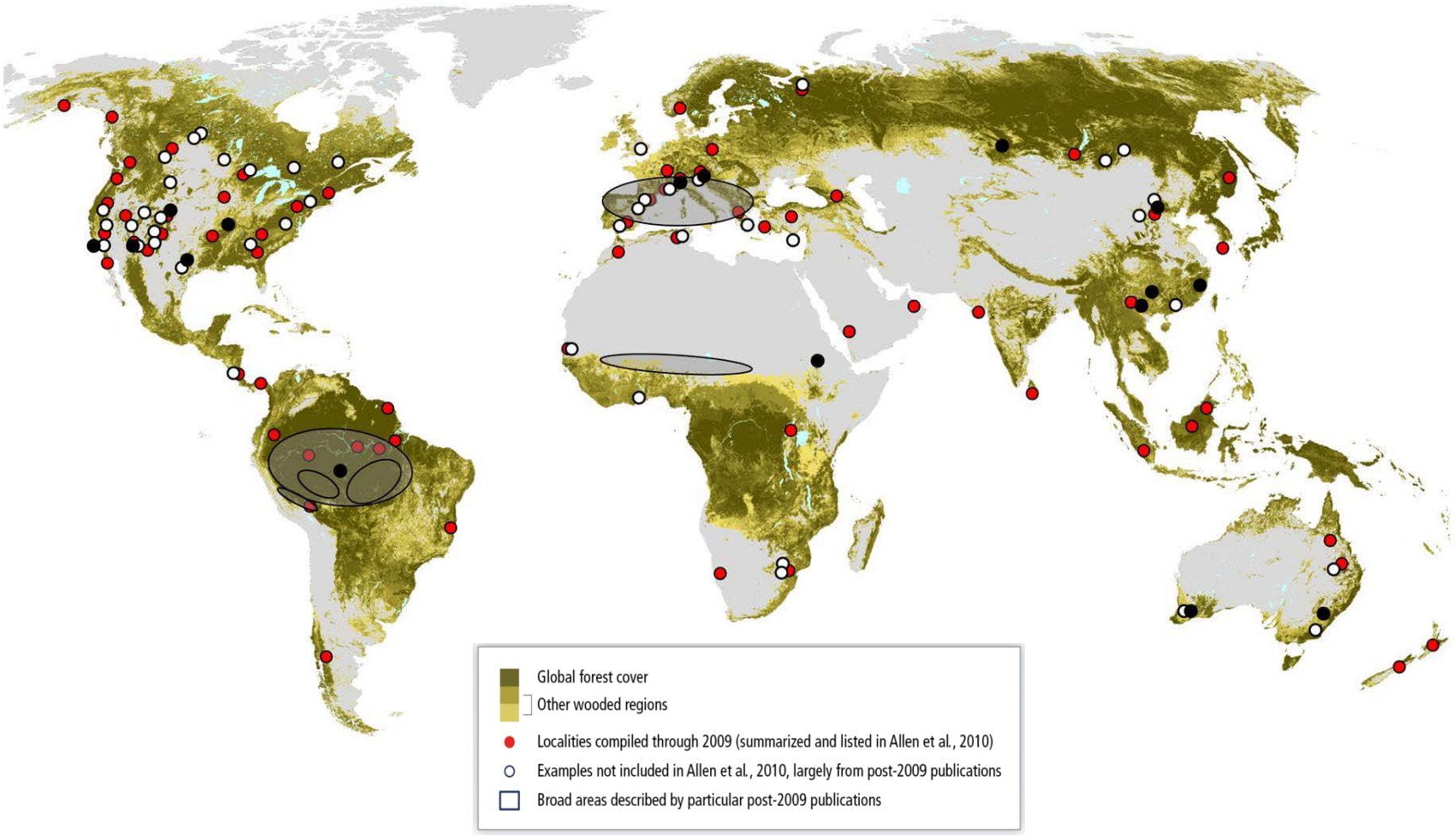
Hansen et al. (2013), Science

Increased forest die-off has been linked to drought and elevated temperatures



Allen et al. (2010), Forest Ecology and Management

Drought and heat induced forest die-off

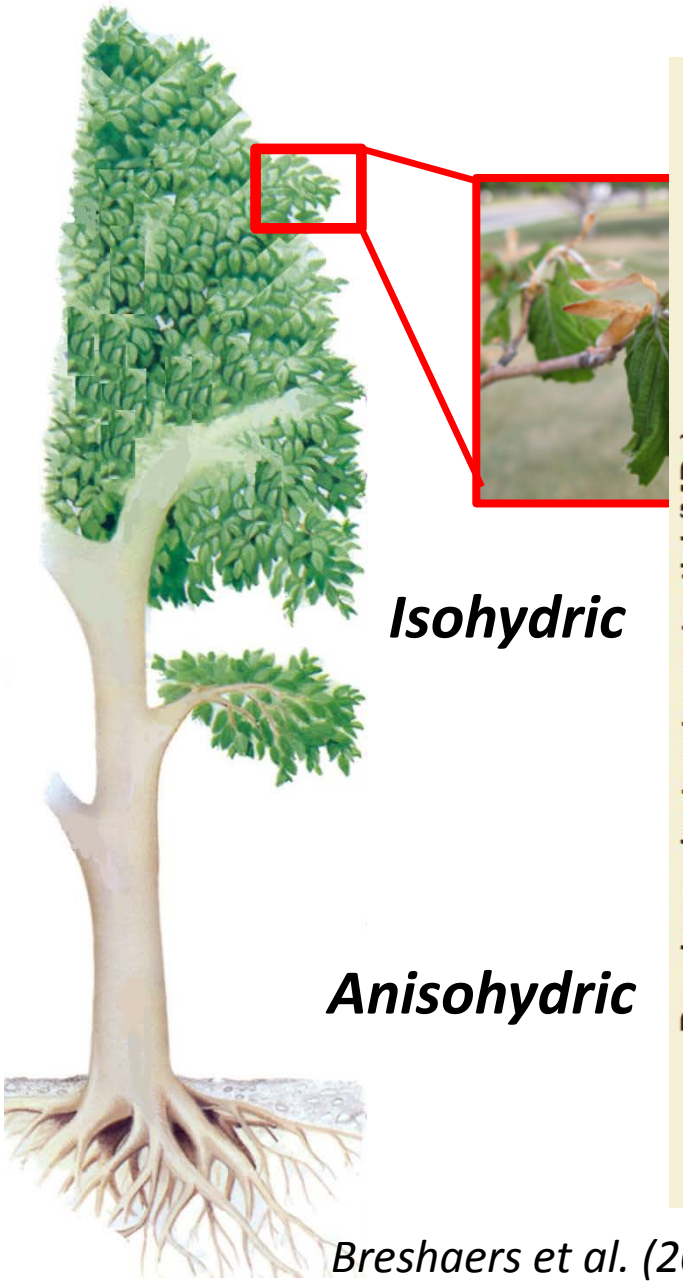


Allen et al. (2015), Ecosphere

Why do some trees die while others don´t?

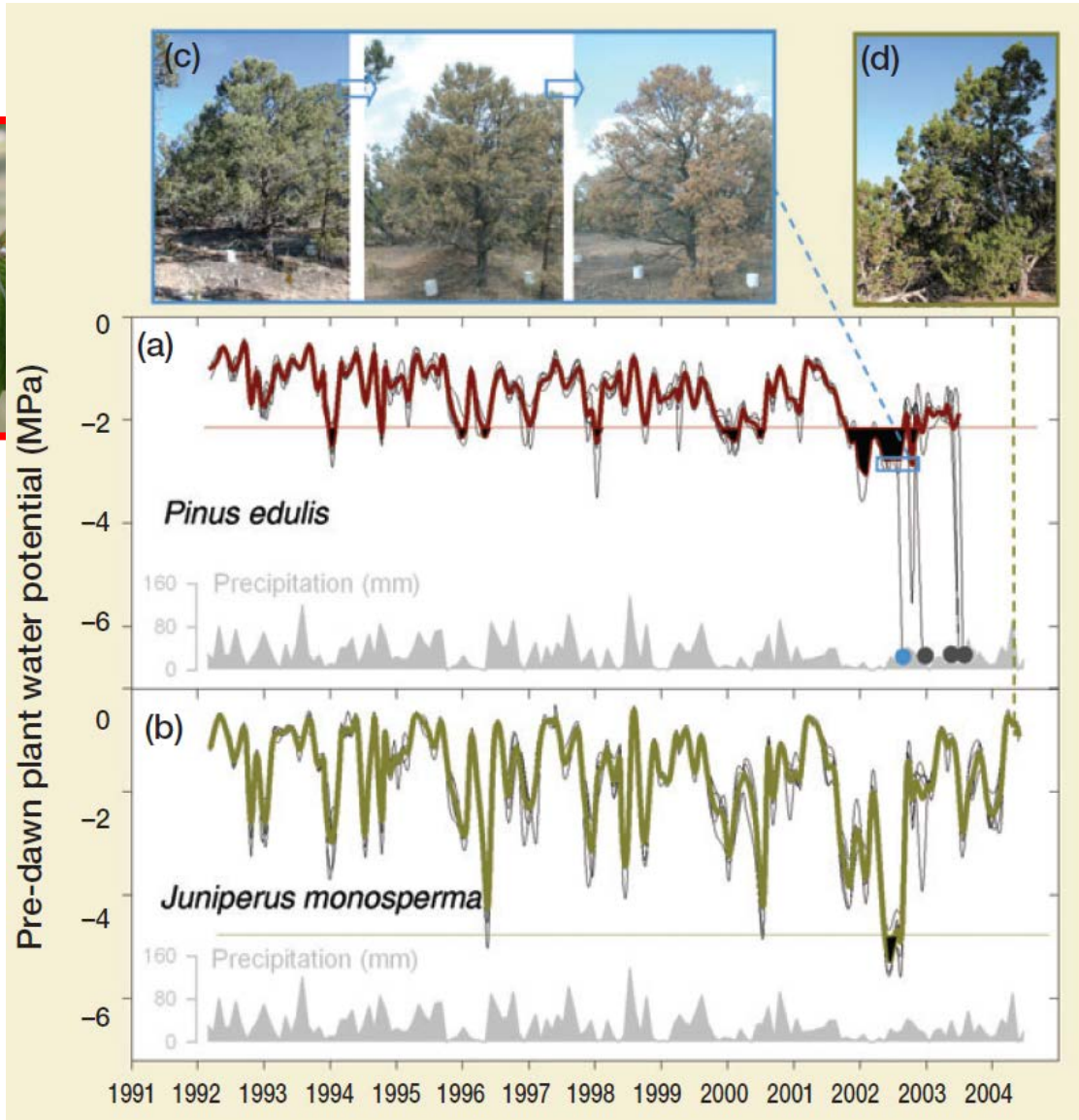
Breshaers et al. (2009), front ecol environ

Water saving vs. non water-saving trees



Isohydric

Anisohydric



Breshaers et al. (2009), front ecol environ

Carbon starvation due reduced carbon uptake

Climate extreme e.g. drought

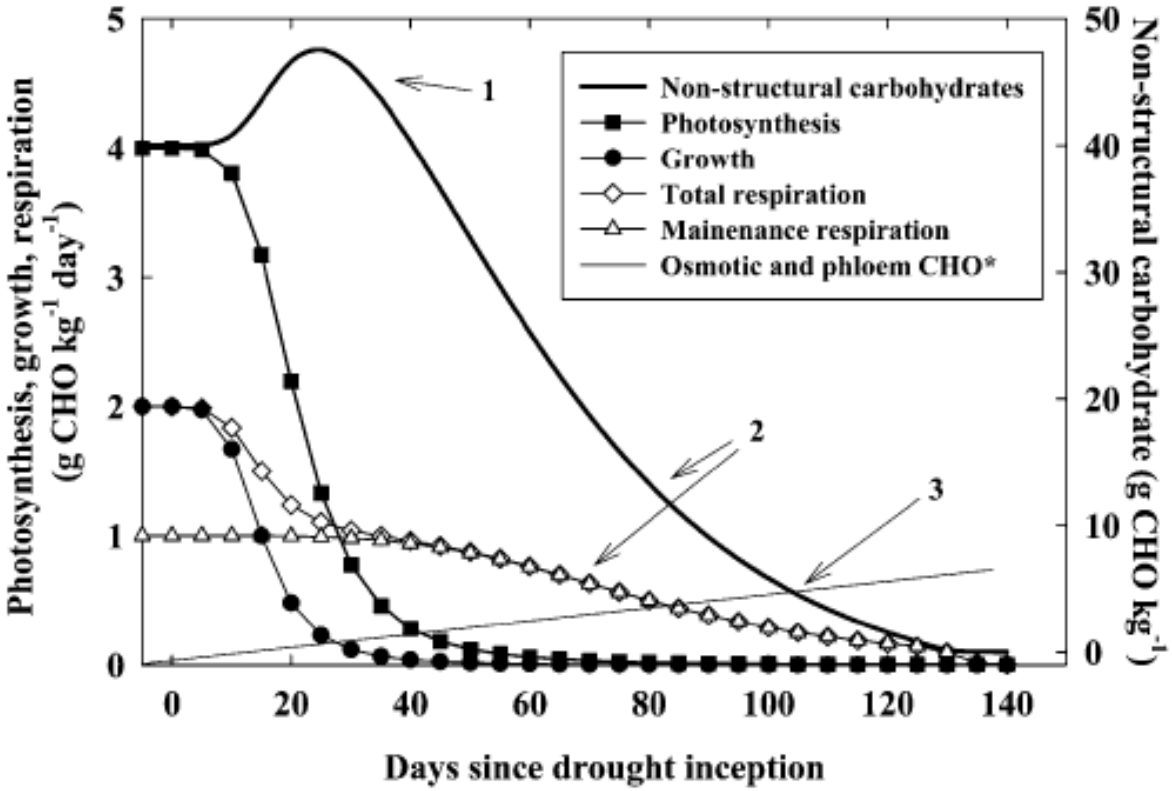
Stomata close

Photosynthesis reduced

Growth reduced

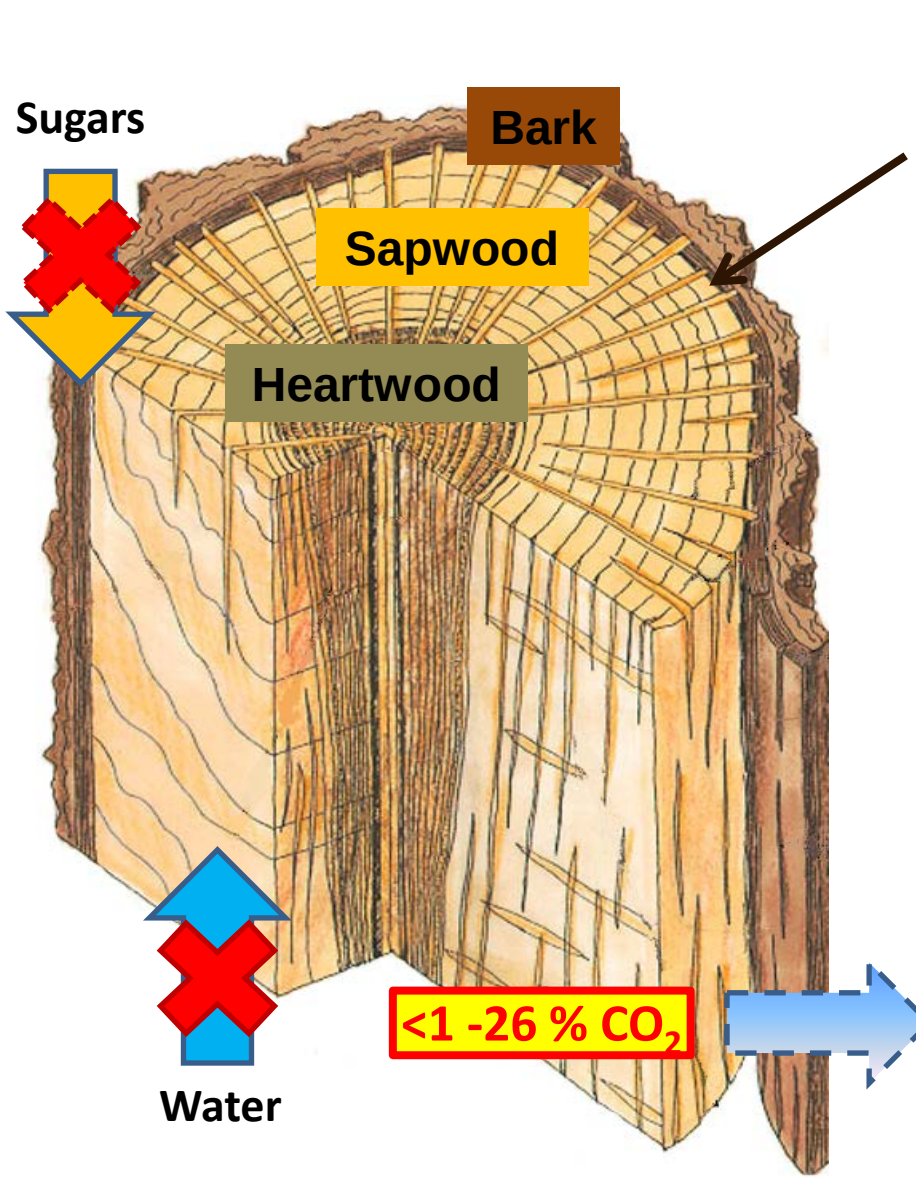
Use of storage compounds

Respiration stops



McDowell et al. (2011), Plant physiology

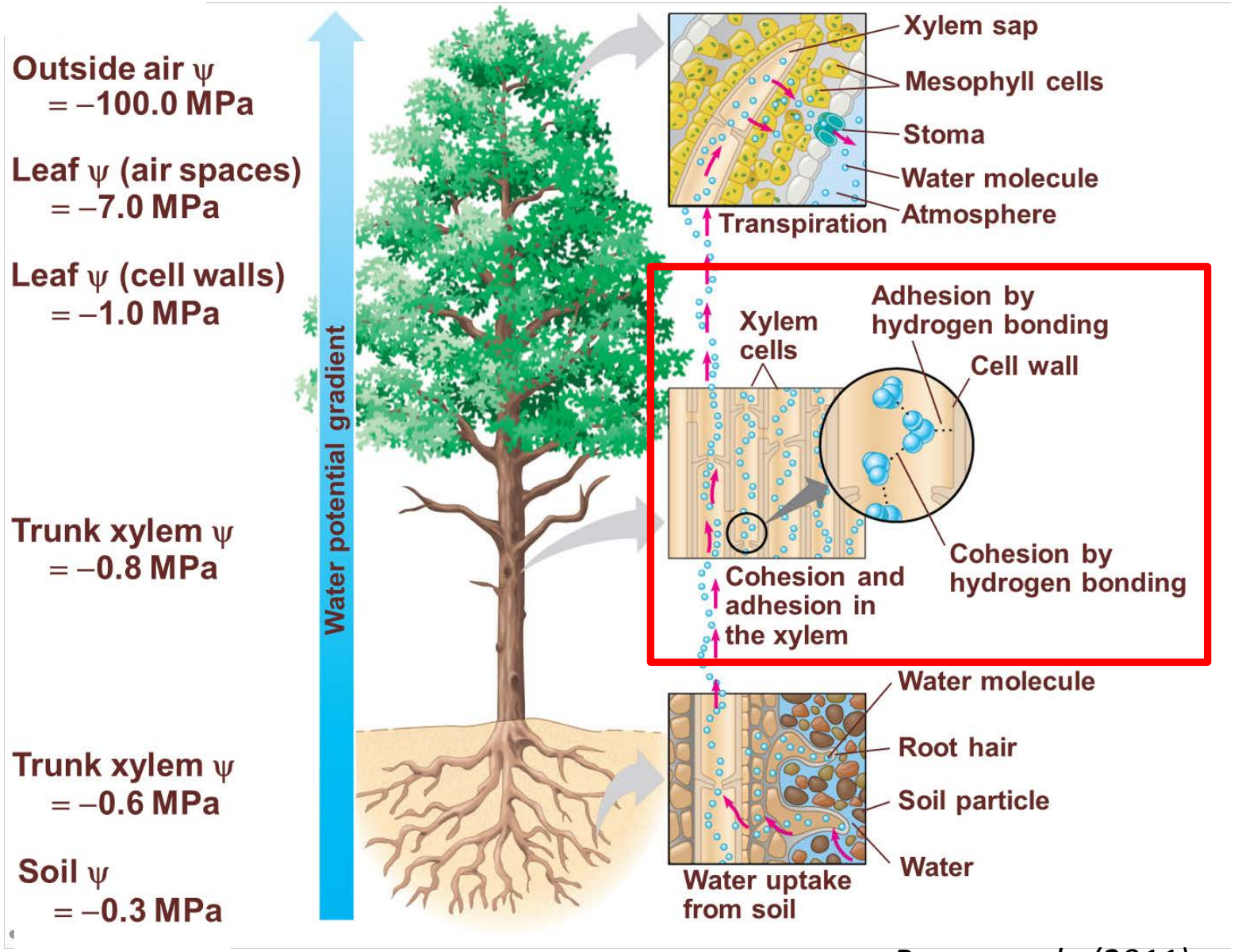
Tree stems and branches can still photosynthesize under drought



Bloemen et al. (2014), Trees

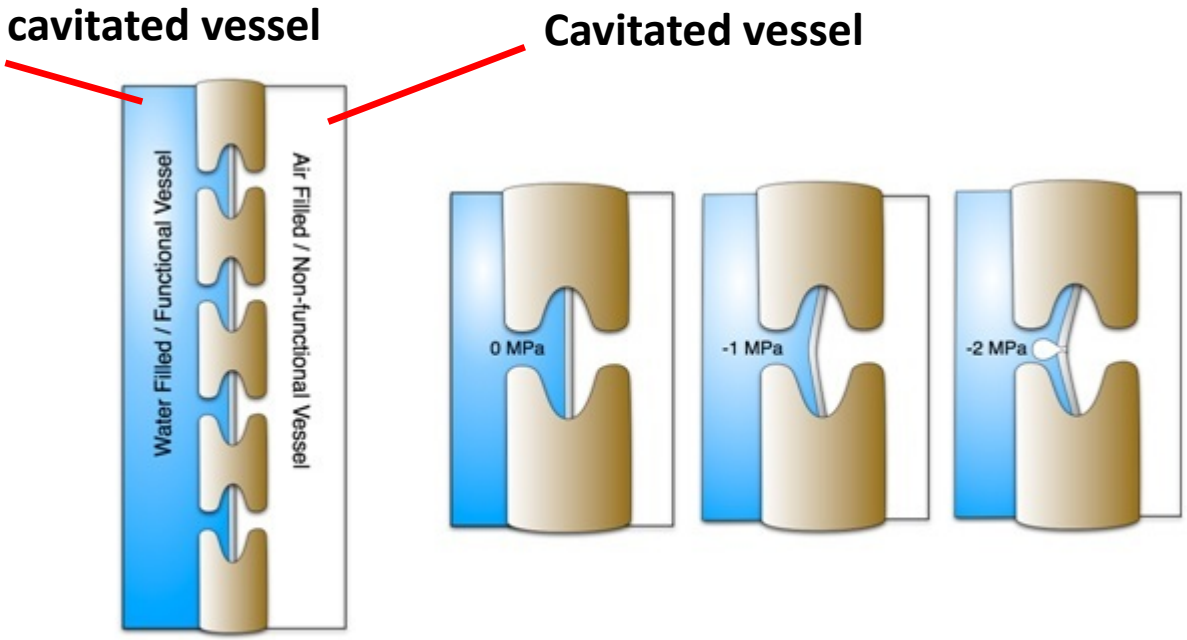
Bloemen et al. (2014), Naturwissenschaffen

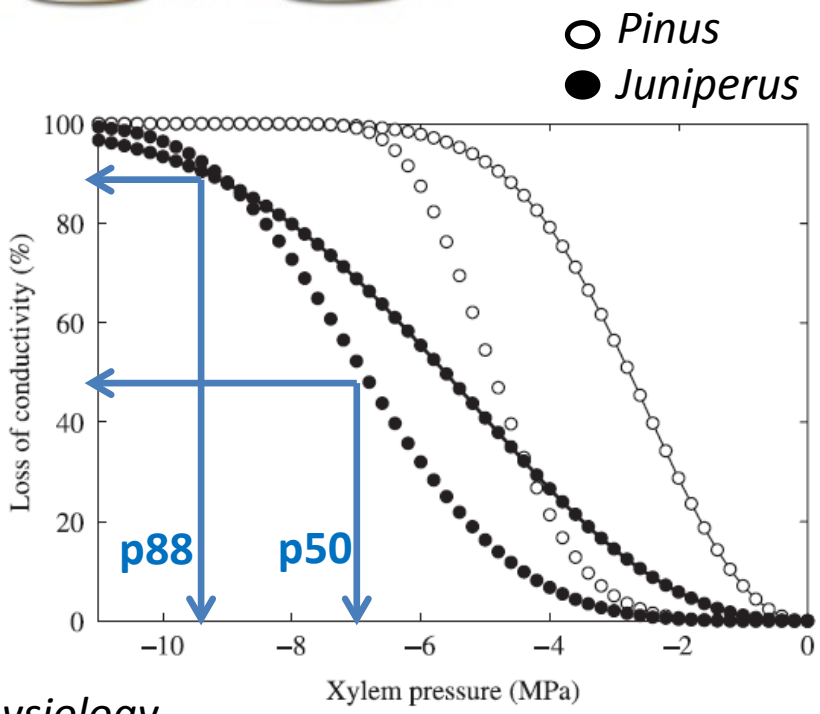
Water transport in trees occur along a water potential gradient



Pearson ed. (2011)

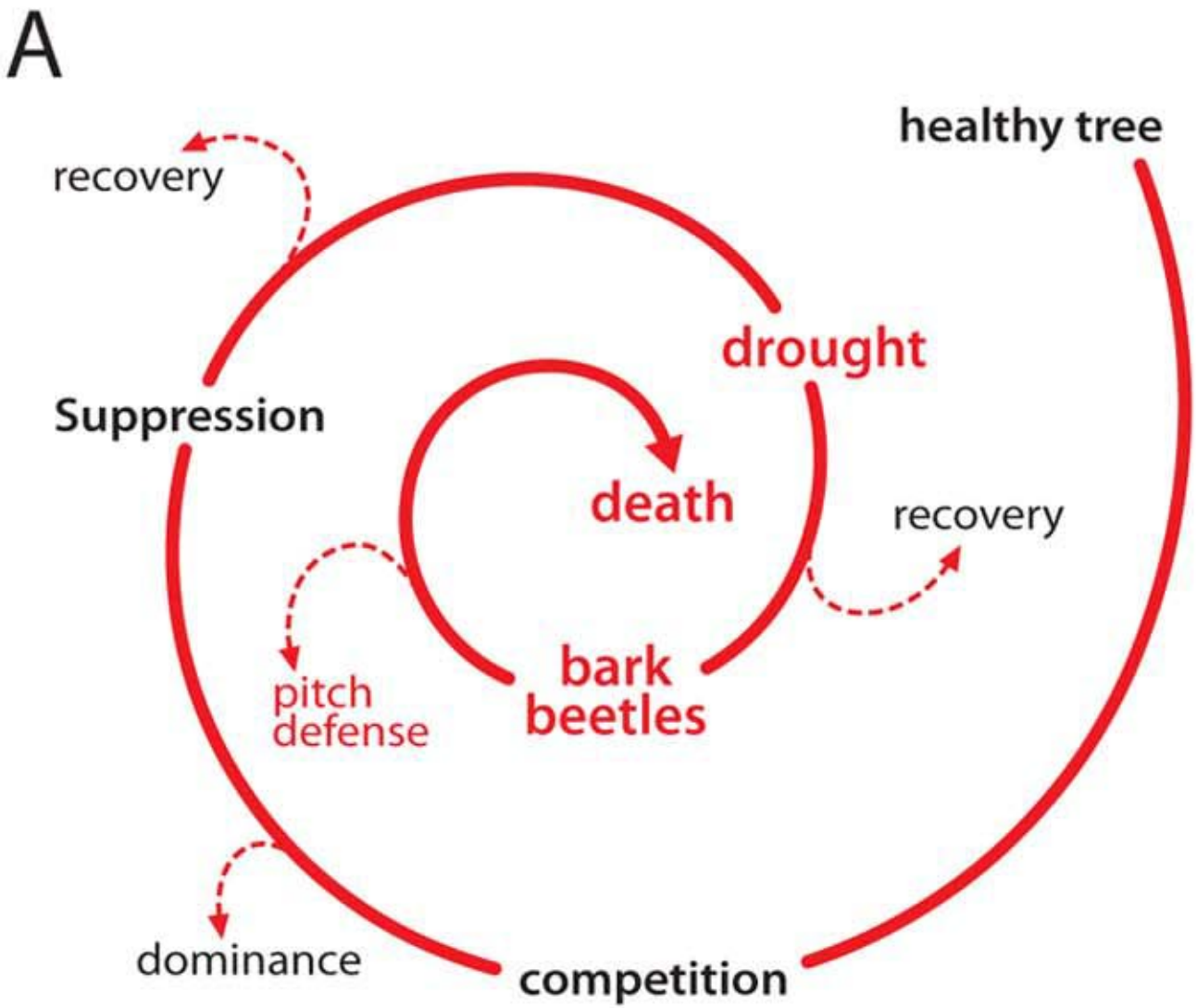
Very negative water potentials lead to hydraulic failure





McDowell et al. (2011), Plant physiology

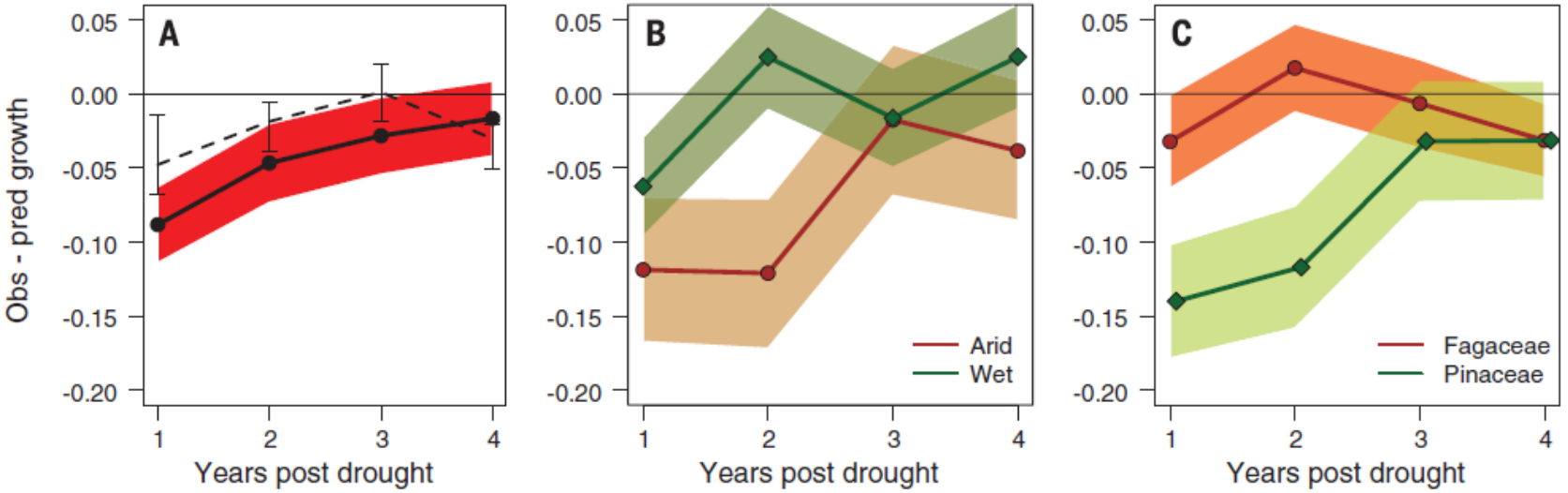
Interaction of multiple stressors complicate forest die-off analysis



Allen et al. (2015), Ecosphere

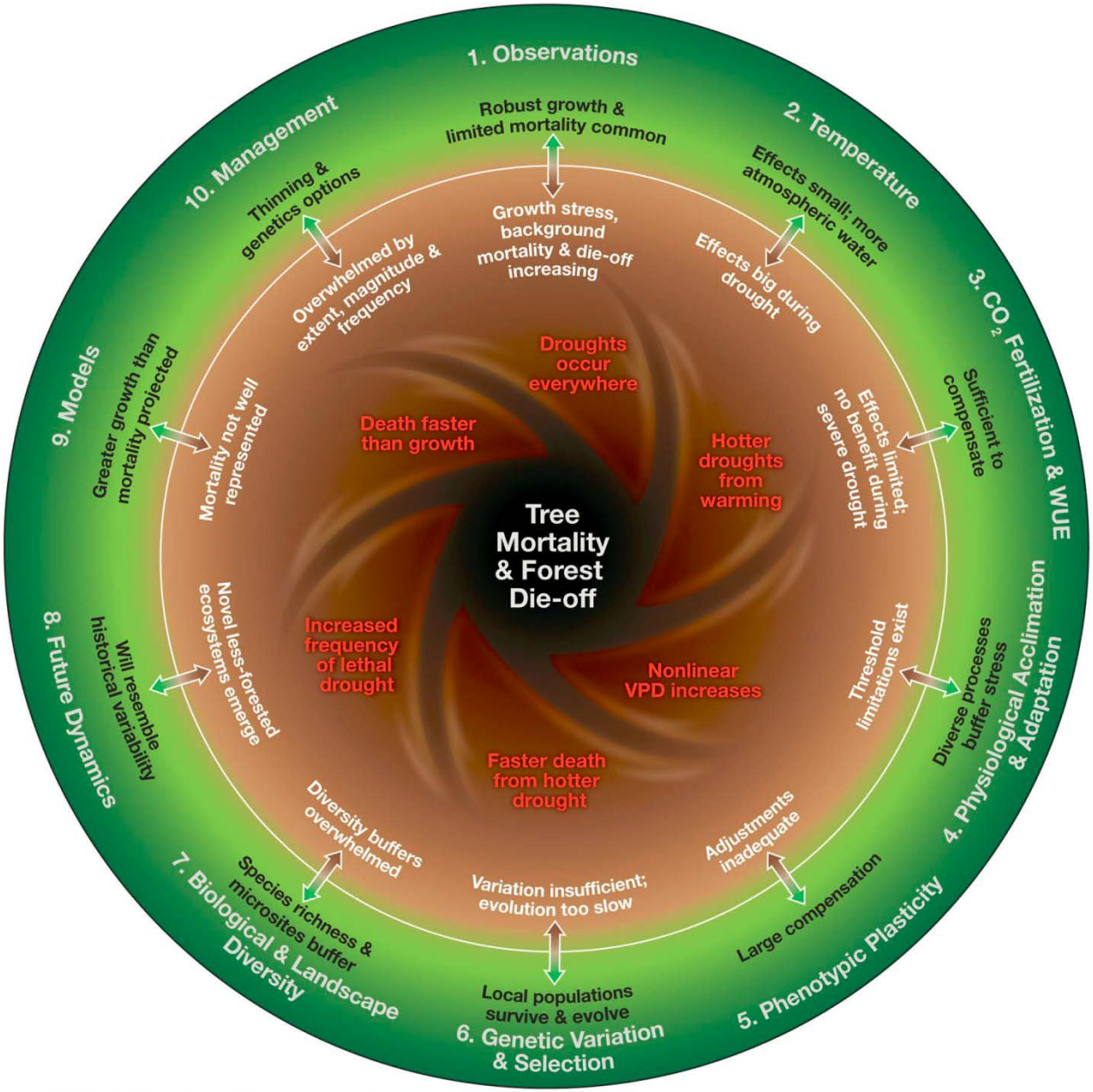
Climate extremes legacy effect complicate forest die-off analysis

Tree ring analysis for 1338 sites, up to 4 years after a drought event occurred



Legacy effects persists for over 3 to 4 years

Anderegg et al. (2015), Science



Allen et al. (2015), Ecosphere

Conclusions

- **Major knowledge gaps:**
  - **Is forest die-off increasing globally?**
  - **Why do some trees survive and others don´t ?**
  - **What is the lethal mortality treshold?**

- **Need for a global forest die-off monitoring network**