# The Impacts of Tree Death on Snow Accumulation and Melt: RED PHASE


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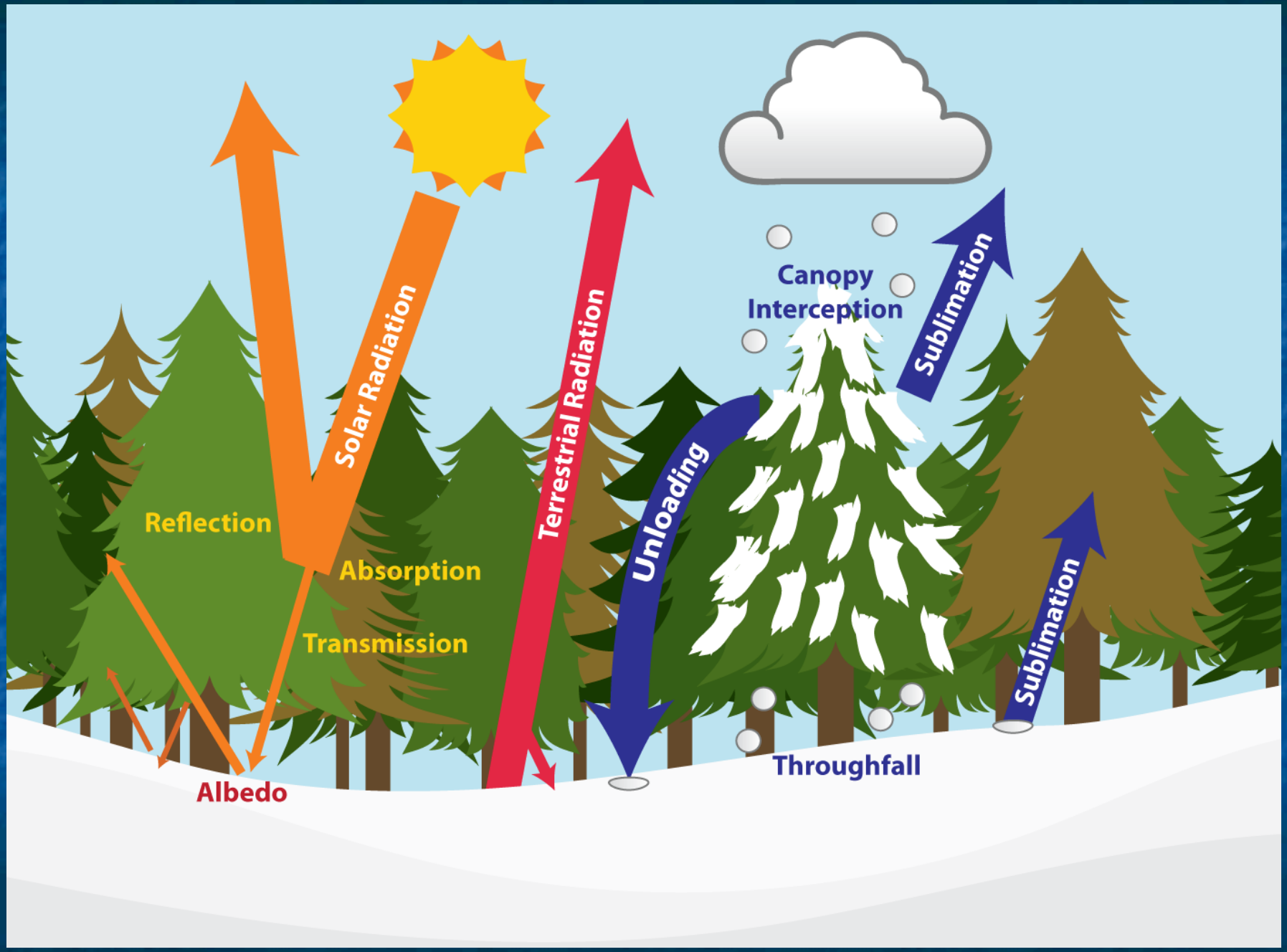
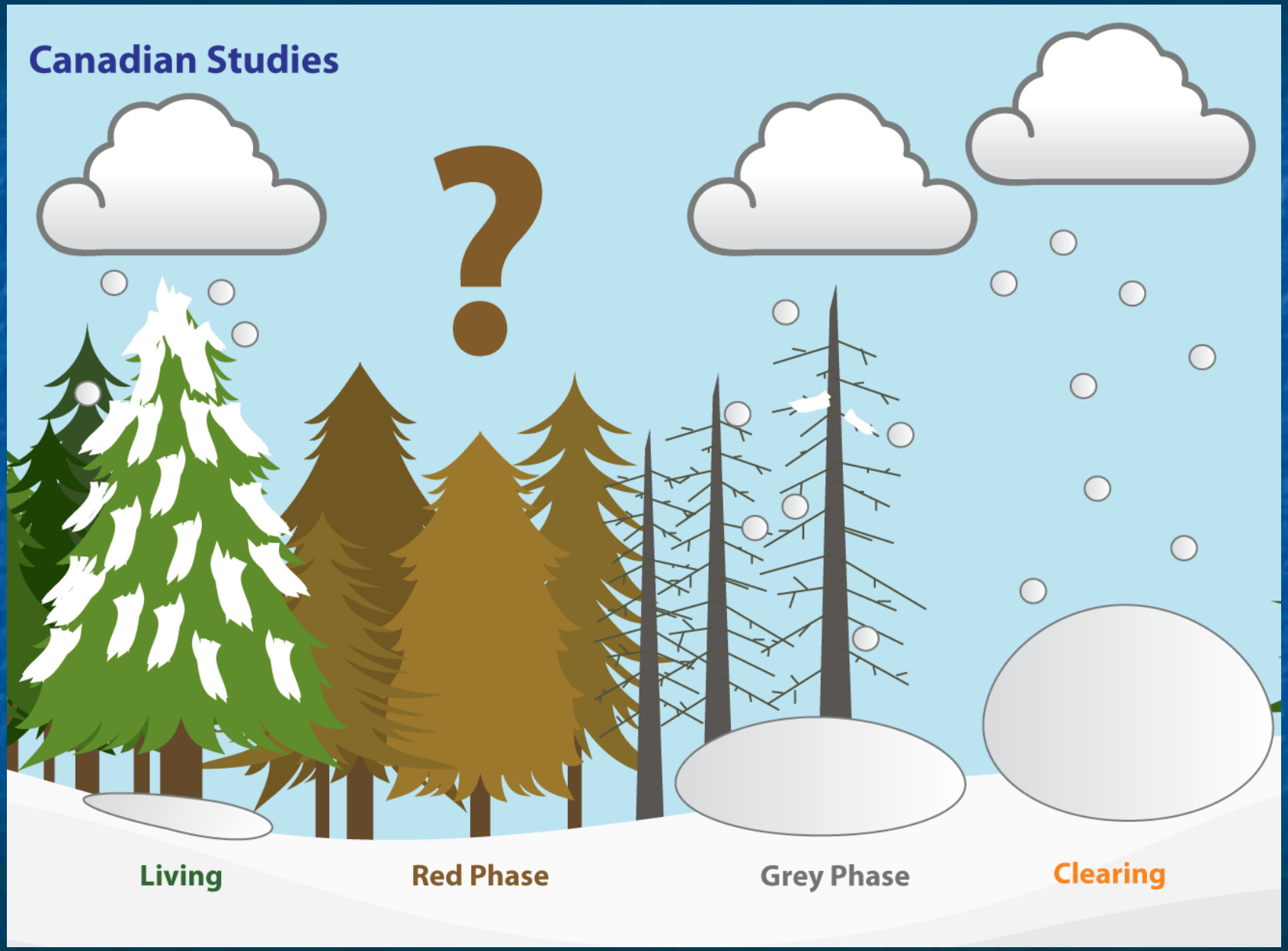

Solar Radiation
Terrestrial Radiation
Canopy
Interception
Sublimation
Unloading
Reflection
Absorption
Transmission
Sublimation
Albedo
Throughfall

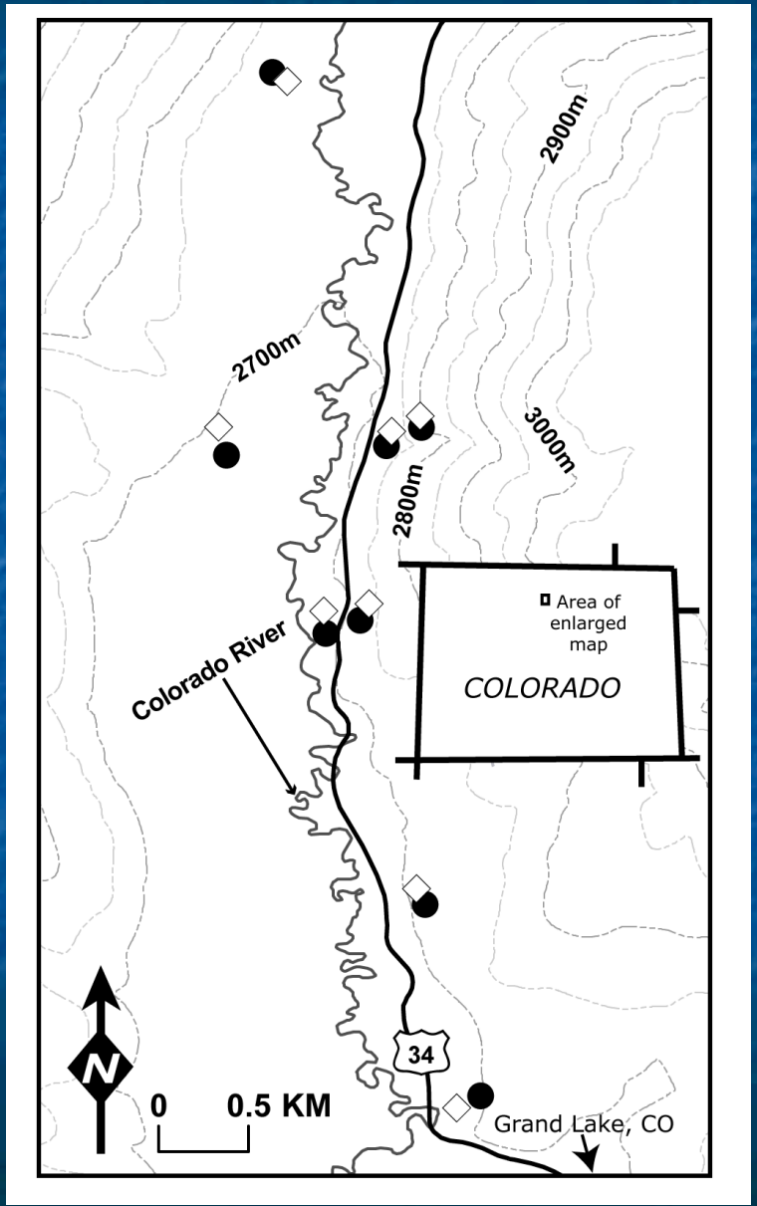
# Other MPB Snow Studies:



# Colorado River Field Work

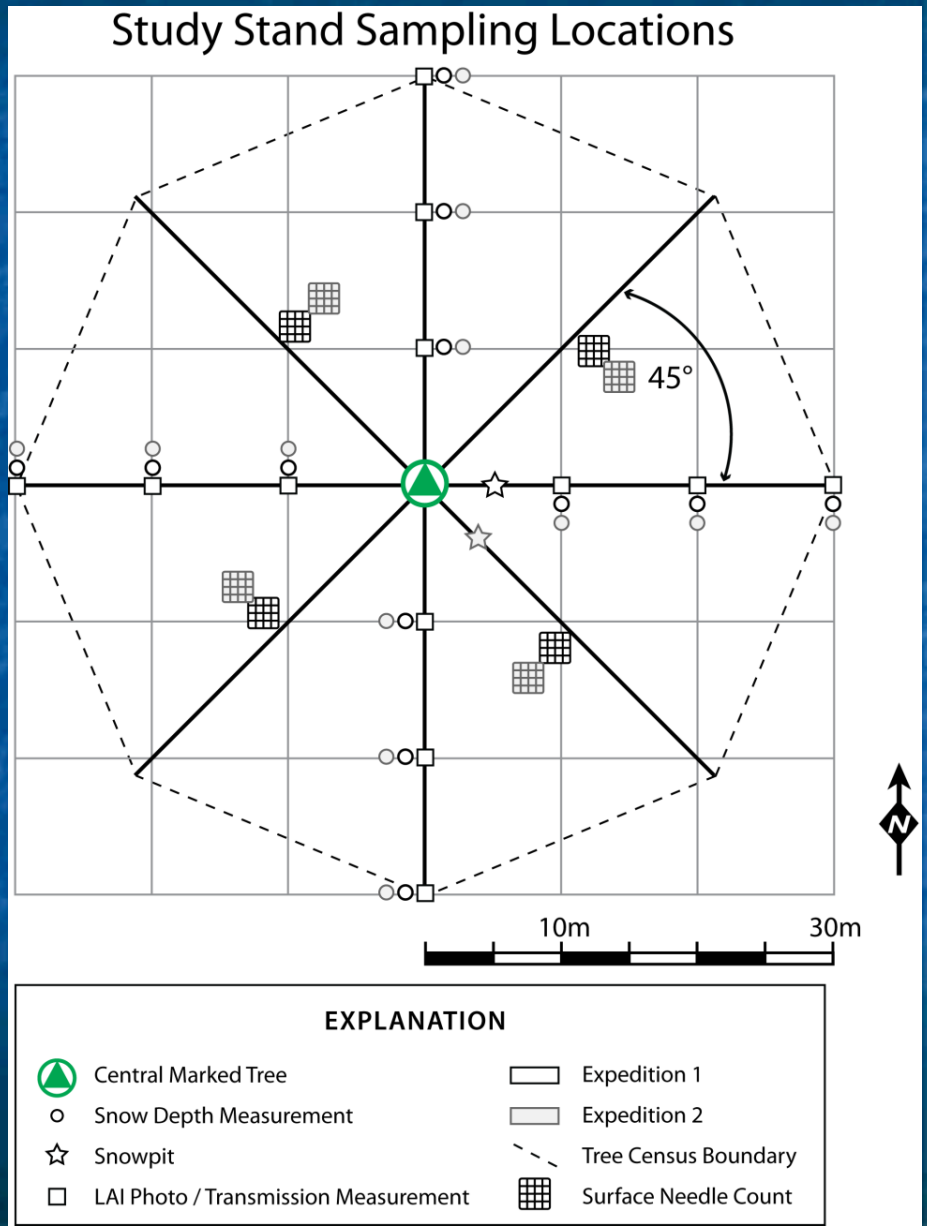
**WINTER 2009**

- Compare snow and meteorological properties beneath similar living and RED dead tree stands.
- The site pairs themselves range in slope, aspect, and elevation
- Within site pairs:
  - Location (<200m apart)
  - Elevation (<15m apart)
  - Slope (<10° difference)
  - Aspect (<45° difference)
  - Modeled radiation



# Colorado River Field Work

- Snow Properties:
  - Snow Depth
  - Snow Density
  - Snow Temperature
  - Snow Cover
- Forest Properties:
  - Stand Census
    - DBH
    - Species
    - Trees/hectare
  - Canopy Transmission
  - Death Stage



# Snow Density

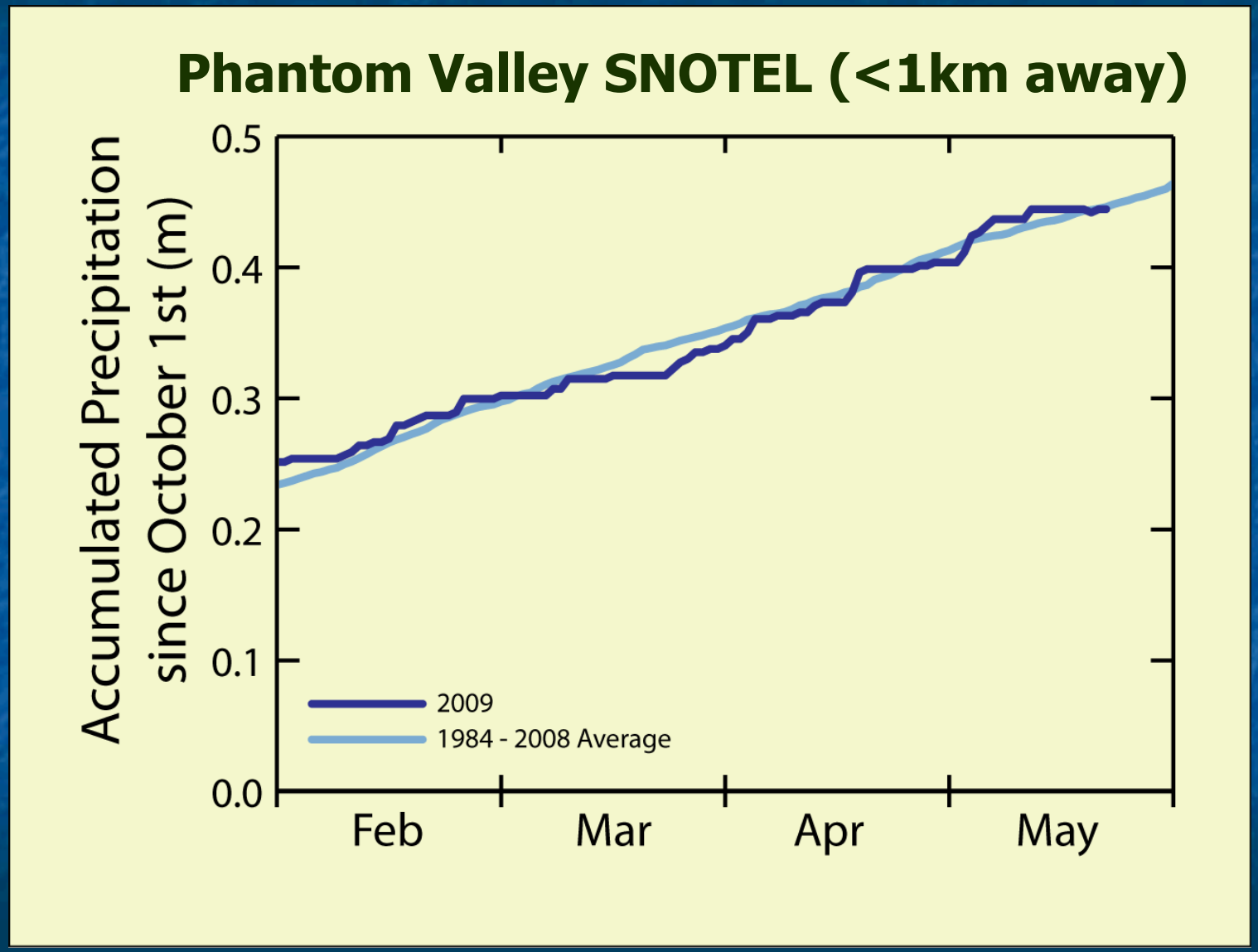
# Snow Depth

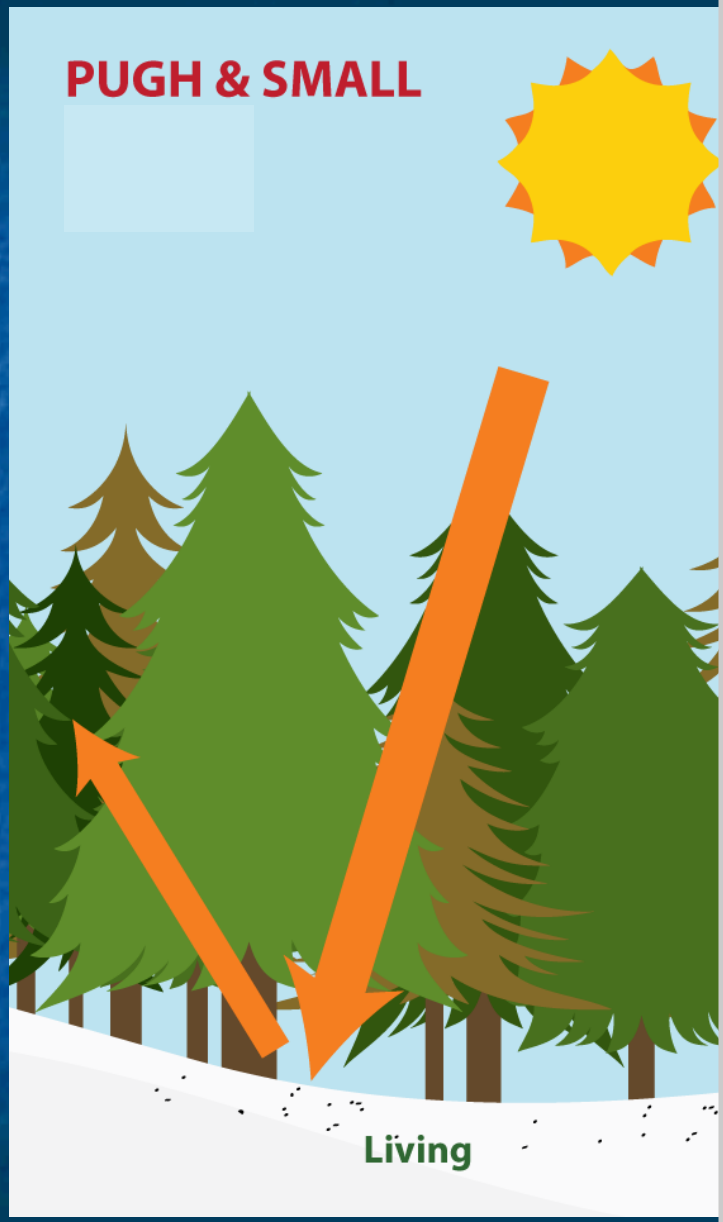
By their powers combined….

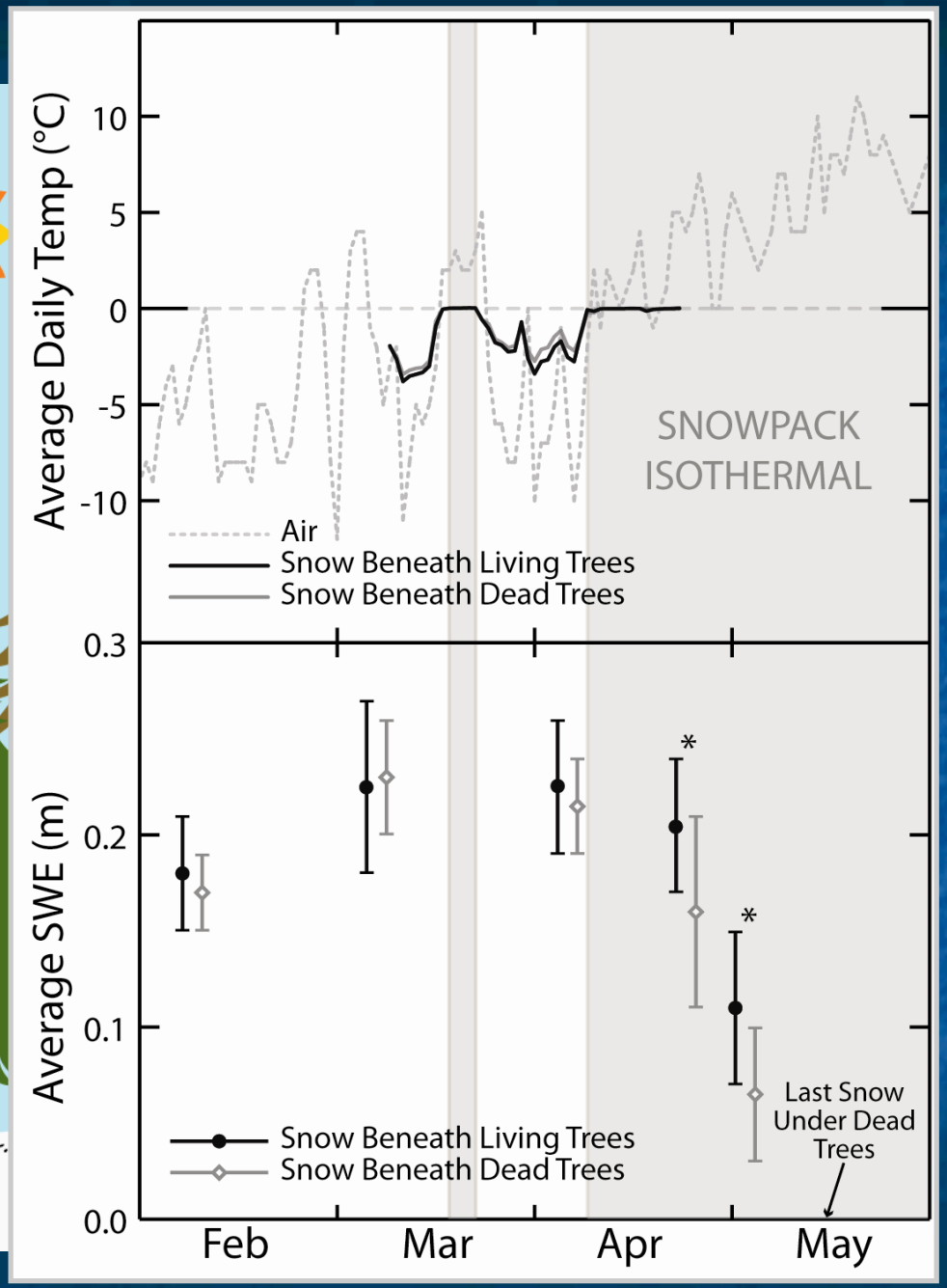
**SNOW WATER EQUIVALENT (SWE)**

= how much liquid water is in the snowpack

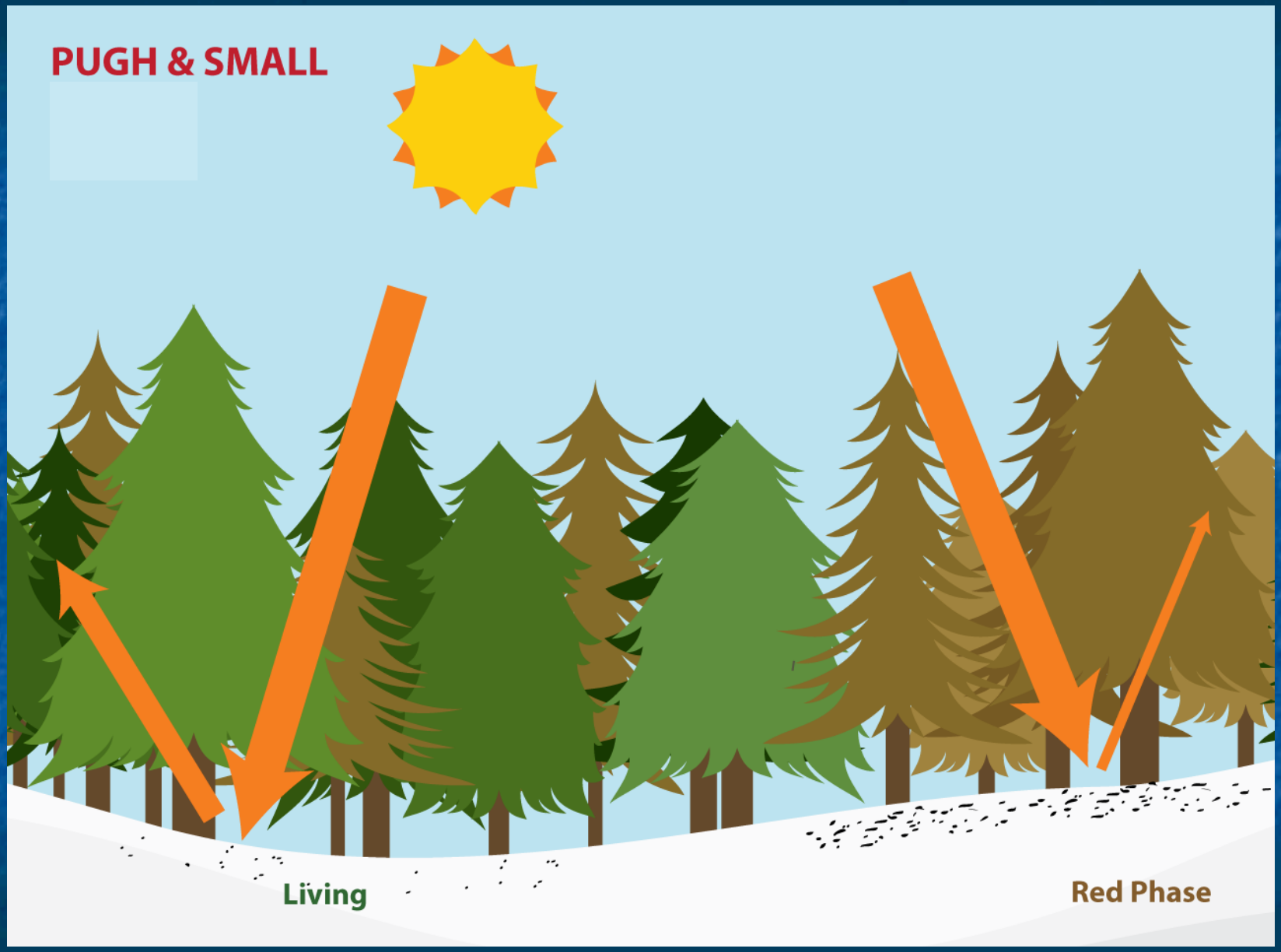
# 2009 Snow Year



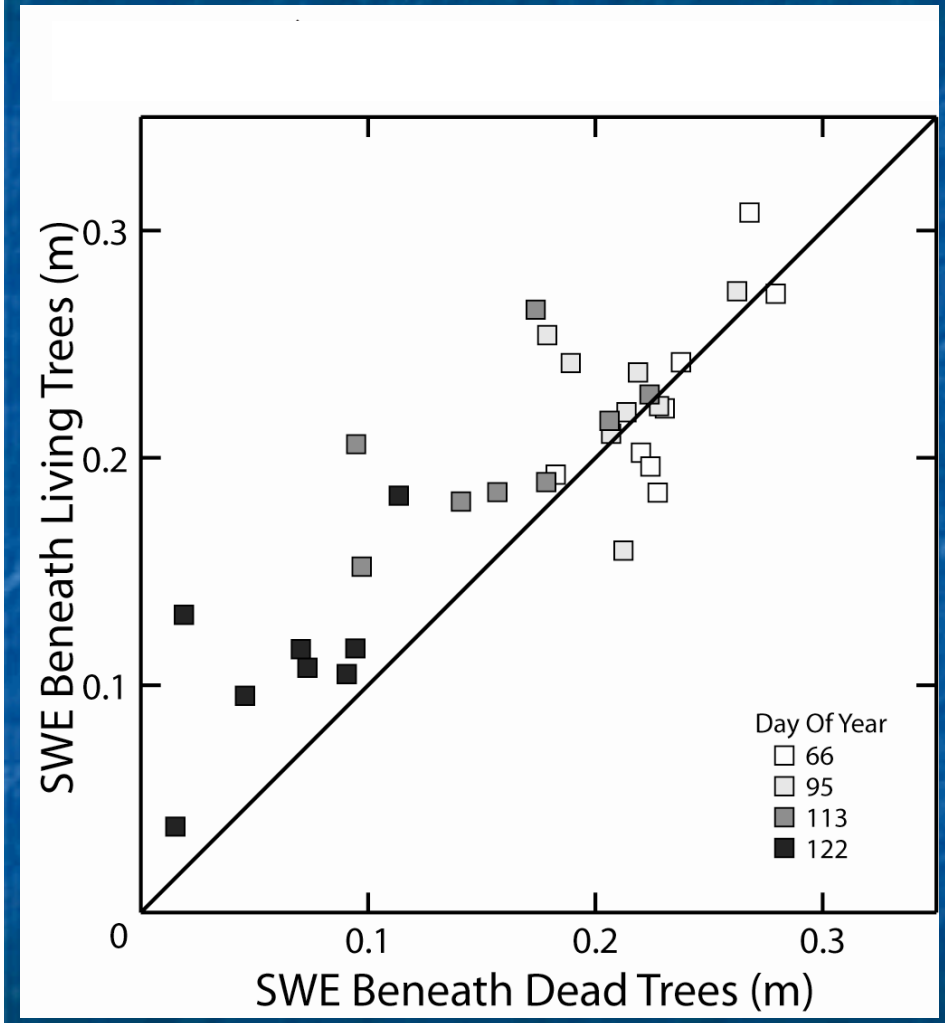


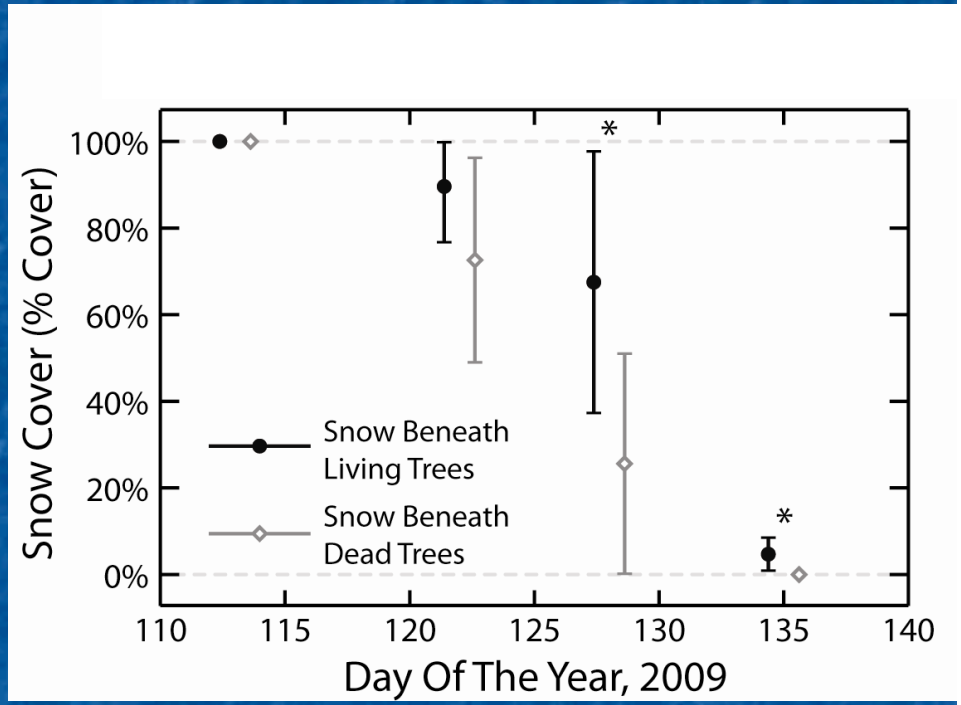




Similar accumulation under living and red phase dead

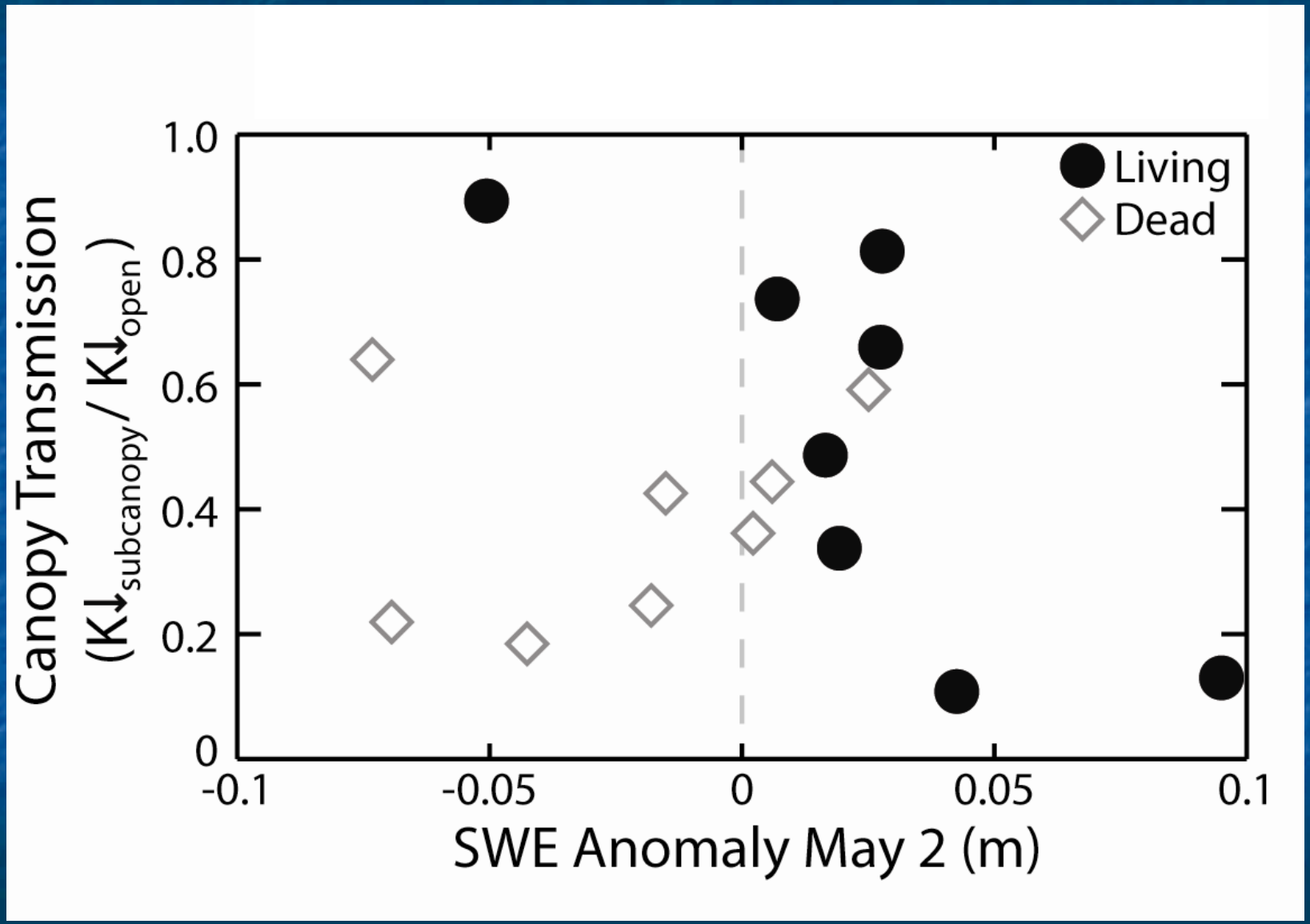



Earlier depletion under red phase dead stands


SWE Beneath Living Trees (m)
SWE Beneath Dead Trees (m)
0
0.1
0.2
0.3
Day Of Year
66
95
113
122


Snow Cover (% Cover)
100%
80%
60%
40%
20%
0%
110
115
120
125
130
135
140
Day Of The Year, 2009
Snow Beneath Living Trees
Snow Beneath Dead Trees
*
*

# Canopy Transmission




No consistent differences

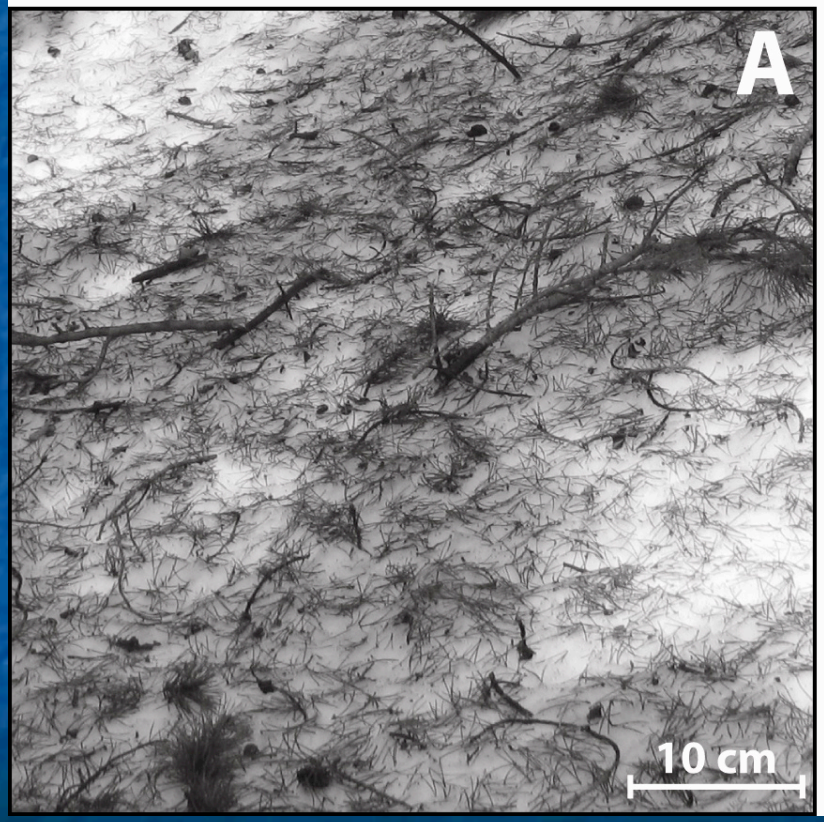
# Additionally…

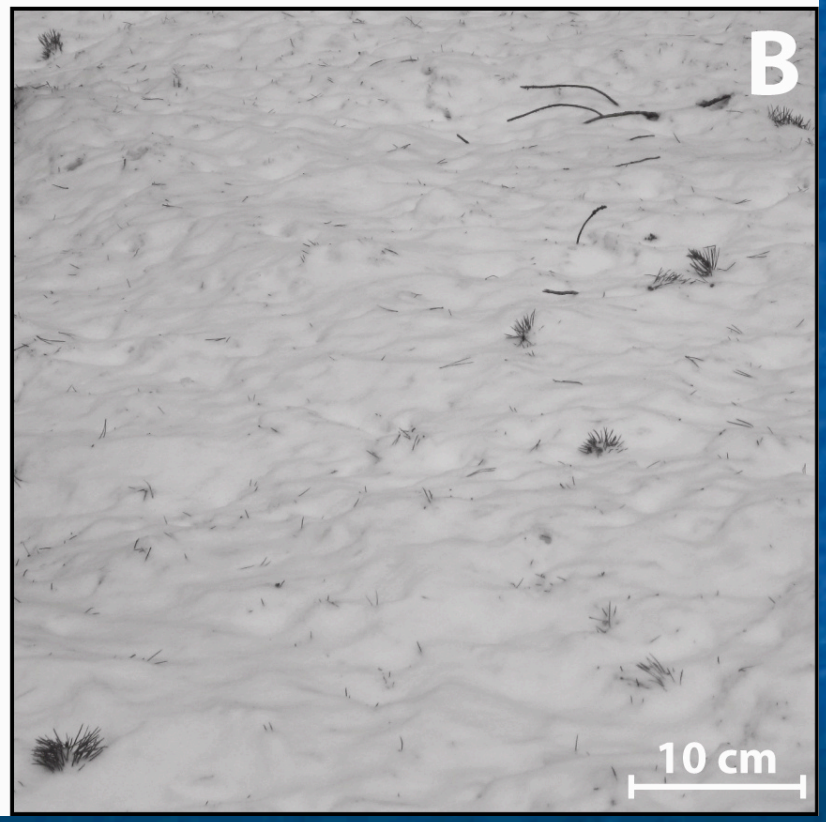
- **Similar amounts accumulated under dead and living stands**
- **Both living and dead stands became isothermal on the same date**

**→ both received similar amounts of solar energy**

**So why did snow under dead stands melt out earlier?**

# Snow Surface Albedo

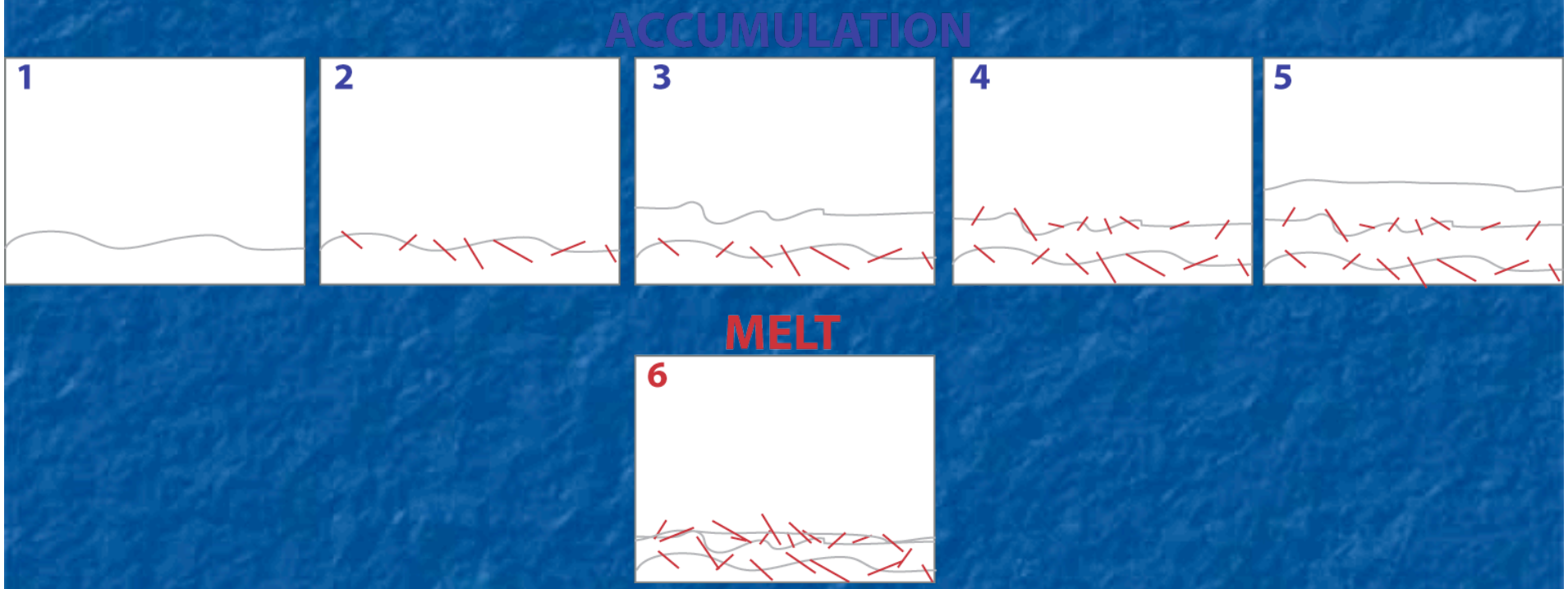


Living Stand 1/17/2010

Dead Stand 1/17/2010

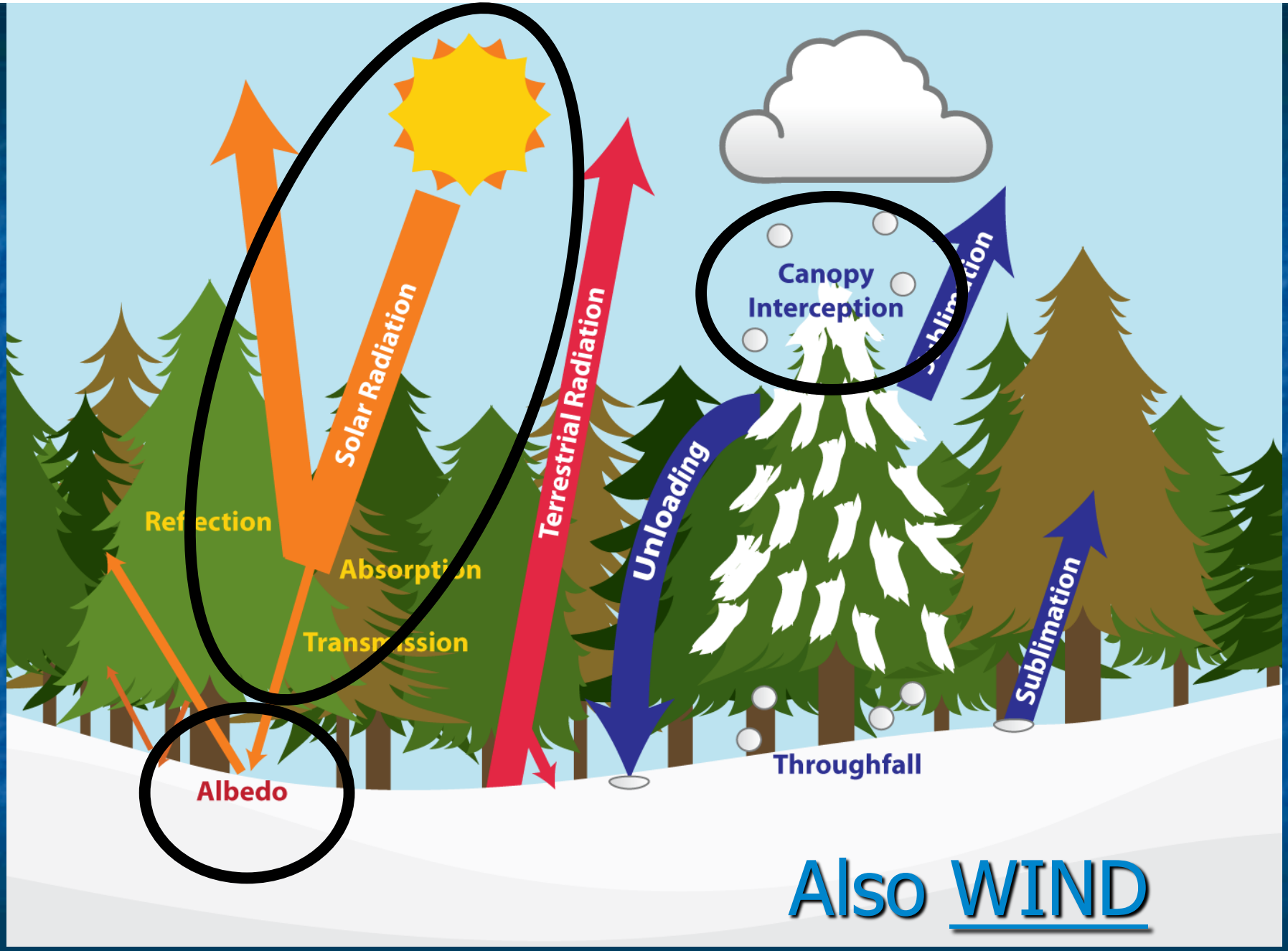
# Needle Litter Layer



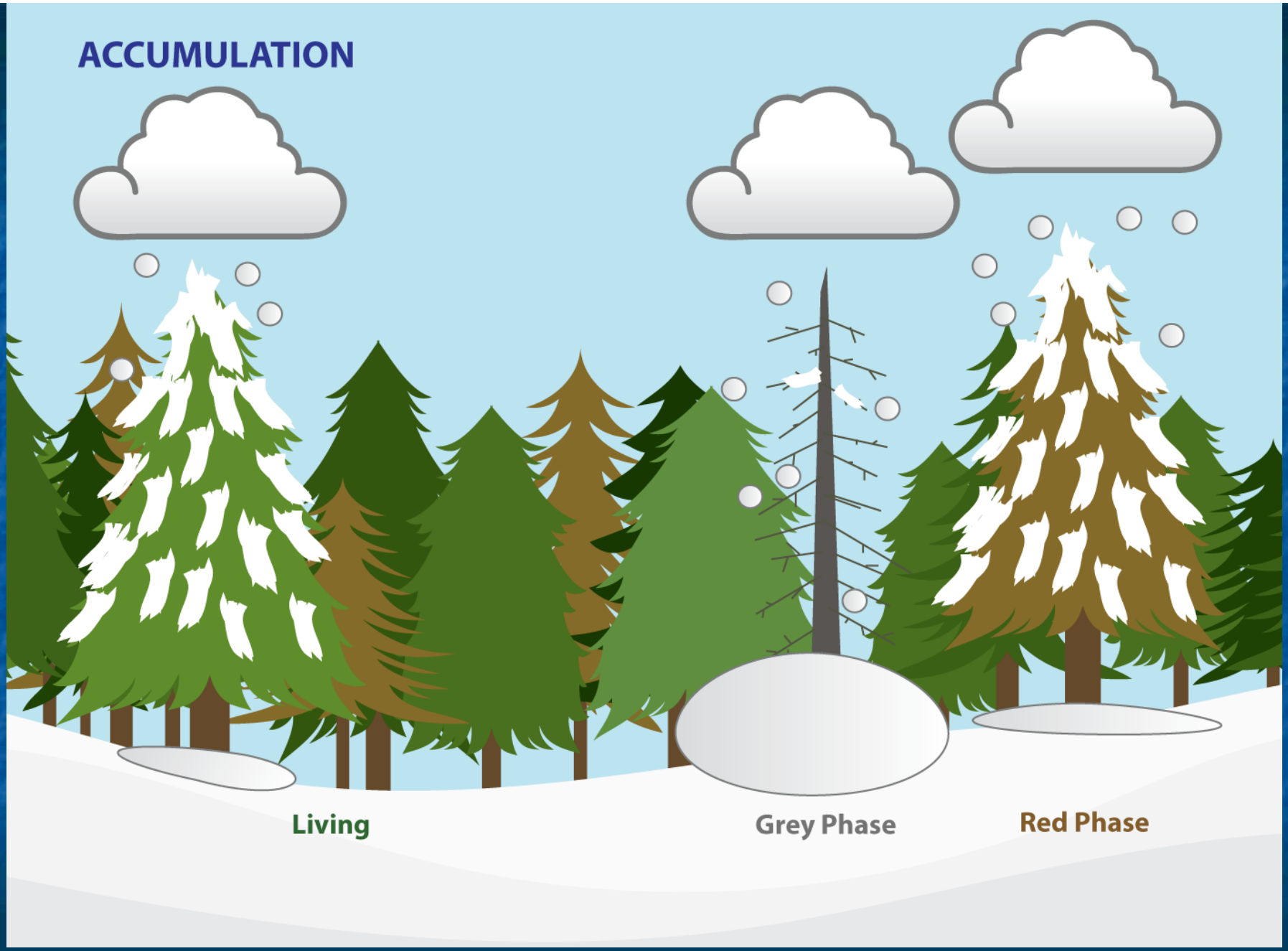
# Conceptual Model

**Key Concept:**

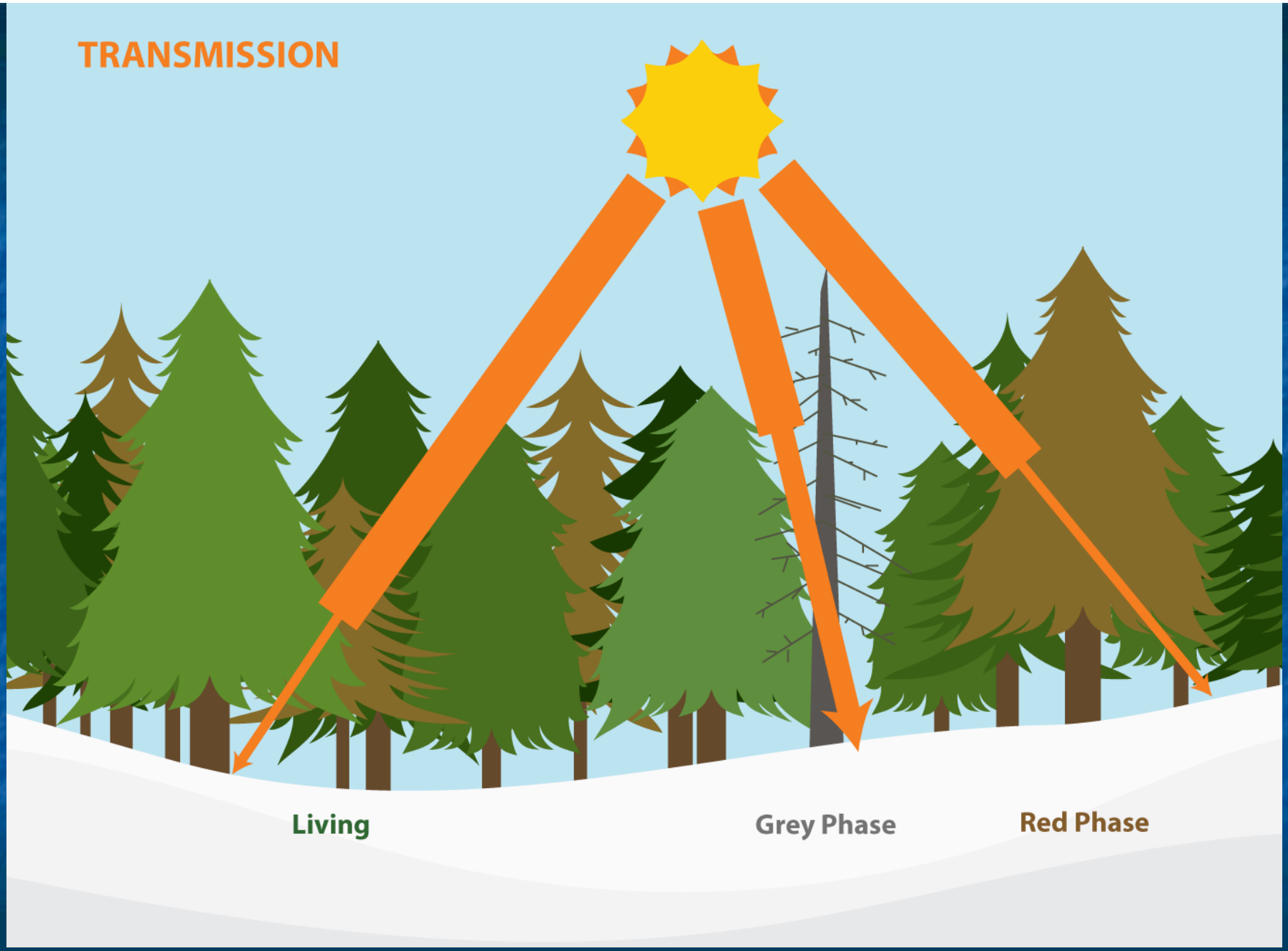
Accumulation and melt vary with death stage!


Solar Radiation
Terrestrial Radiation
Canopy
Interception
Unloading
Reflection
Absorption
Transmission
Albedo
Throughfall
Sublimation

Also WIND




**Hypothesis**: Similar amount under red, more under grey

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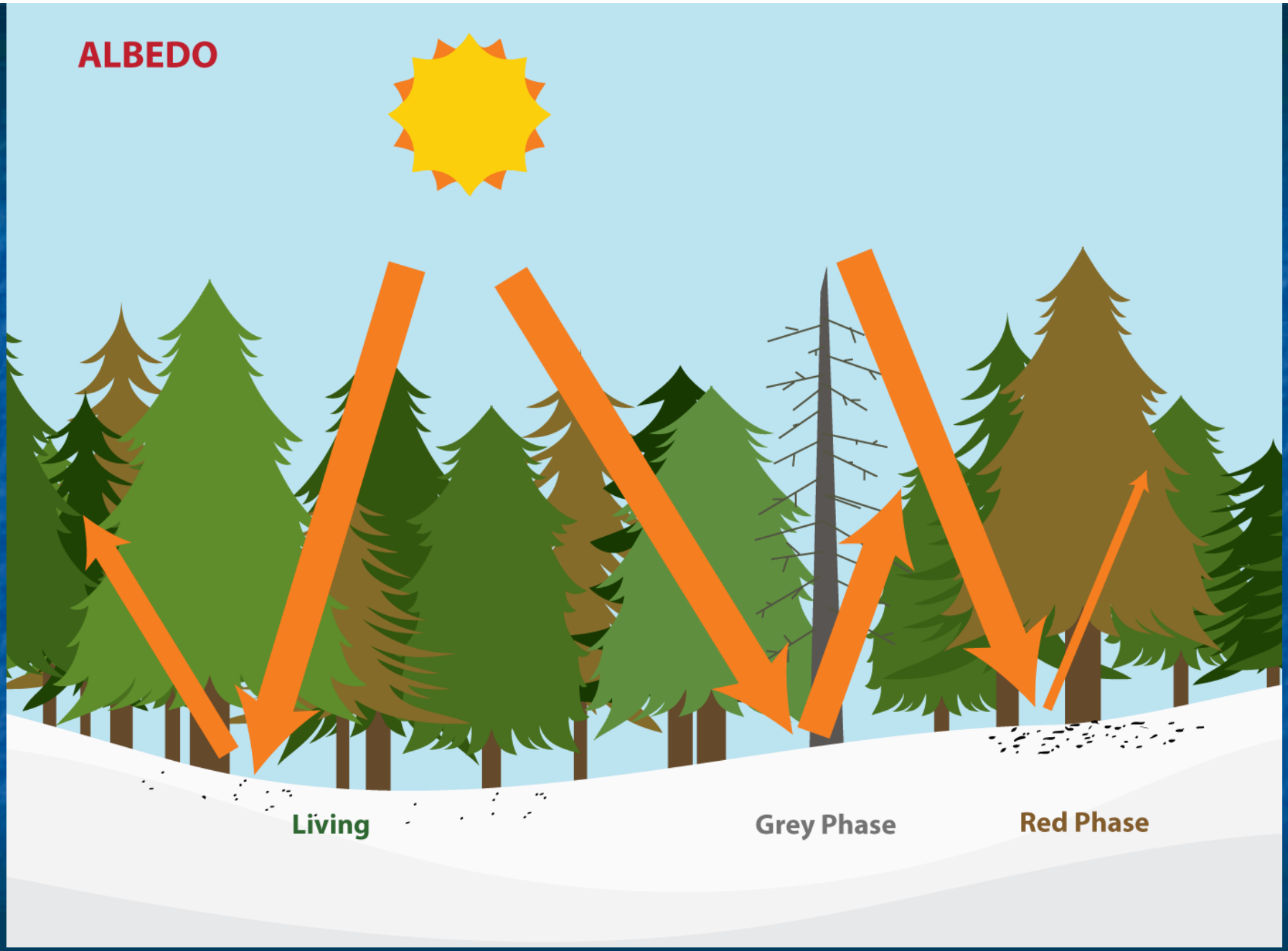
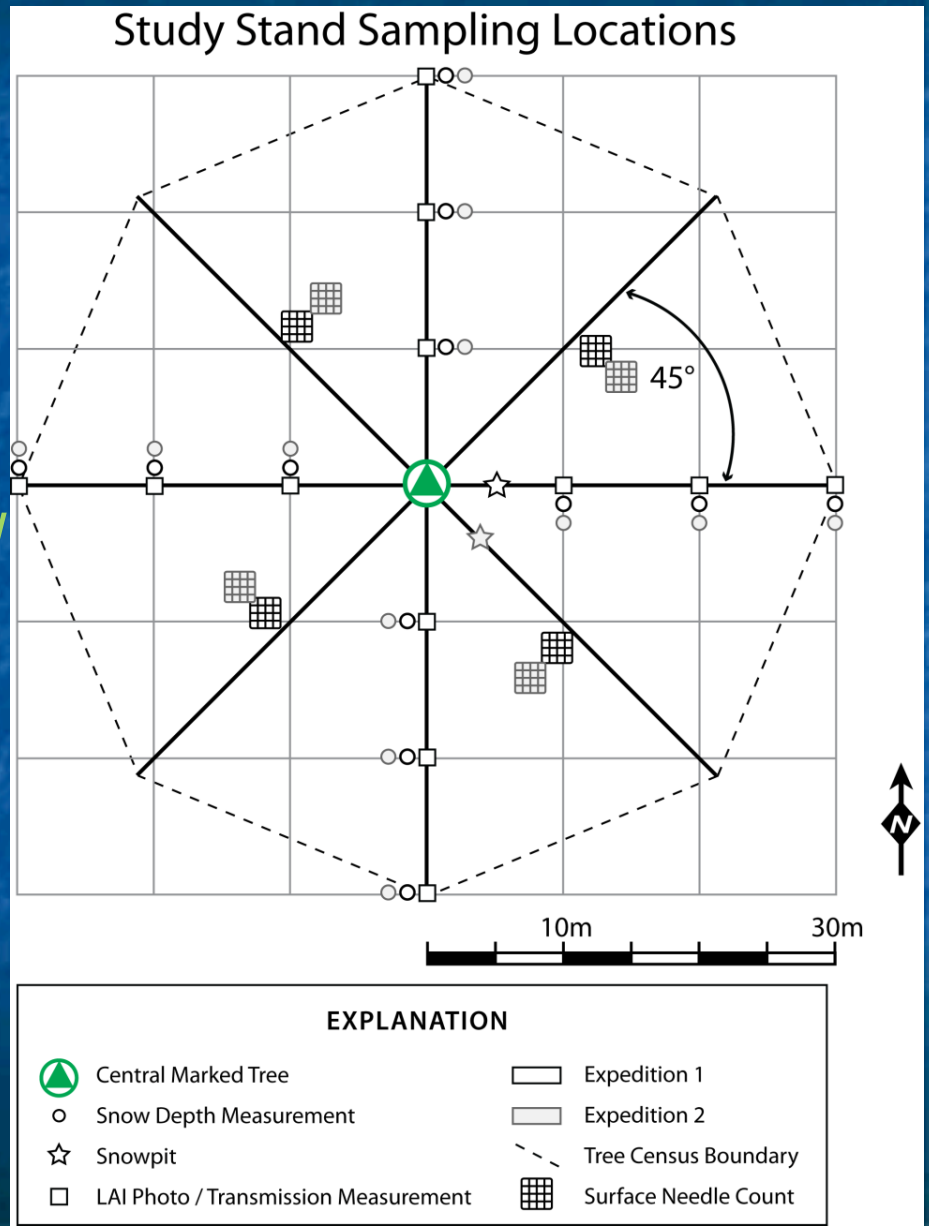
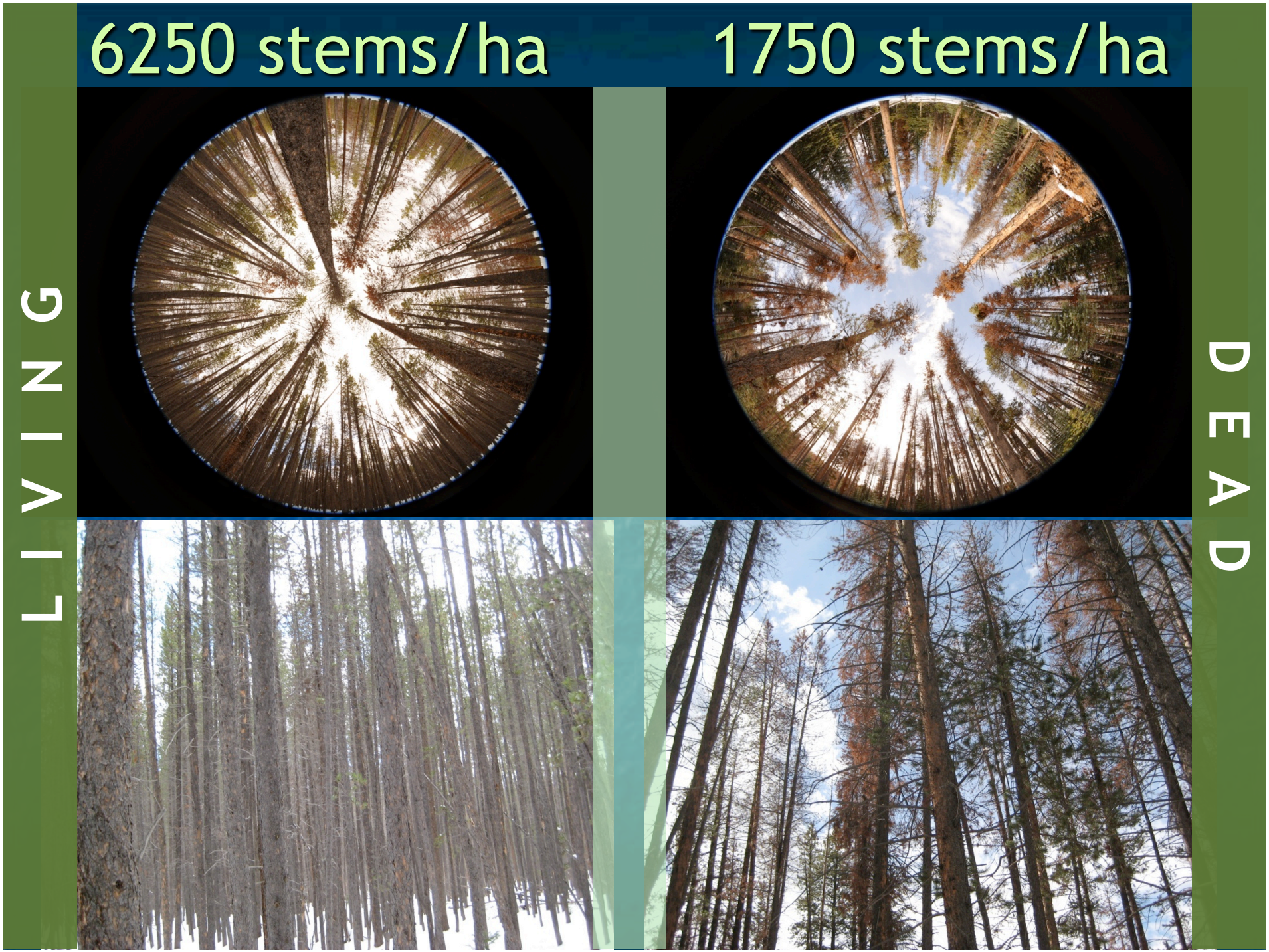



**Hypothesis**: Lower albedo under red, higher under grey

# Colorado River Field Work

- Snow Properties:
  - Snow Depth
  - Snow Density
  - Snow Temperature
  - Snow Surface Albedo *NEW
  - Snow Surface Needle Count *NEW
  - Snow Cover
- Forest Properties:
  - Stand Census (DBH, species, etc)
  - Canopy Transmission
  - Leaf Area Index *NEW
  - Death Stage

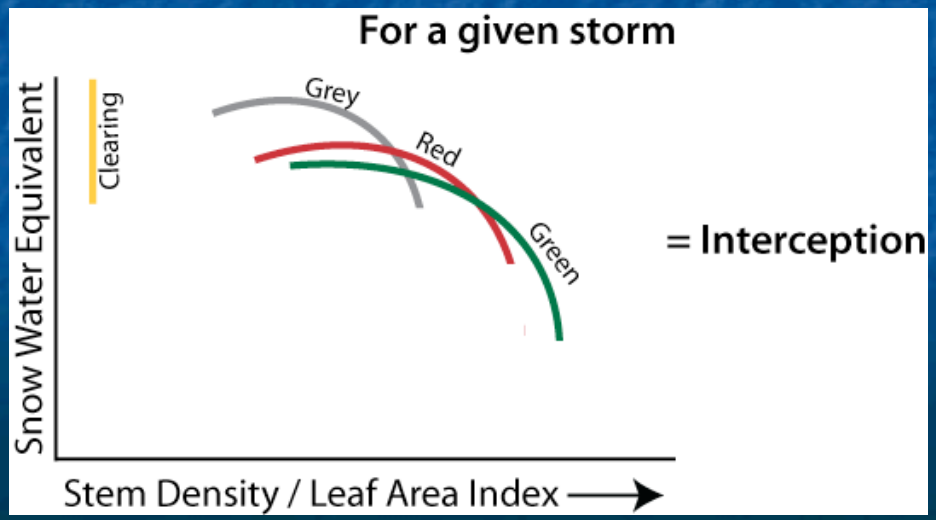



6250 stems/ha
1750 stems/ha
LIVING
DEAD

# Colorado River Field Work

## Continuing Work

- Longitudinal Record of **LEAF AREA INDEX** will allow:
  - Quantification of canopy reduction
  - Determination of intra-stand variability
  - Coupling of overhead canopy with ground measurements
  - → Glimpse at point scale within stand



# Colorado River Field Work

- Take Home Messages -
  - Tree death does alter snow processes!
  - Dominant accumulation and melt regimes change with death stage
  - **RED PHASE**: Similar accumulation, faster melt under dead (albedo)
  - **GREY PHASE**: More accumulation under dead, melt depends on magnitude of snow accumulation
    - Low snow year → Earlier depletion data (spring melt energy dominates low accumulation)
    - High snow year → Same or later depletion date (large quantity of accumulation means it takes longer to melt out)

Research submitted to *Hydrological Processes* in Aug 2009