Vineyard Site Evaluation and Environmental Challenges

- Where is it possible to establish a vineyard?
  - **Will the vines survive at this site?**
    - **How will this site influence growth of the vines?**
      - How will this site affect selling the fruit/wine?

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Vineyard hazards
in Virginia and the mid-Atlantic

- Environmental
  - Cold injury (fall, winter, spring), hurricanes, soil problems, etc.
- Biotic
  - Wildlife, diseases (Viruses, Pierce's Disease, etc.)
- Anthropogenic
  - residences, 2,4-D drift, etc.
- Examples…

Spring Frost Damage:

Can affect a wide geographic area

Wildlife

Anthropomorphic: Herbicide Injury – 2,4-D

Typically affects a small, geographic area

Climate

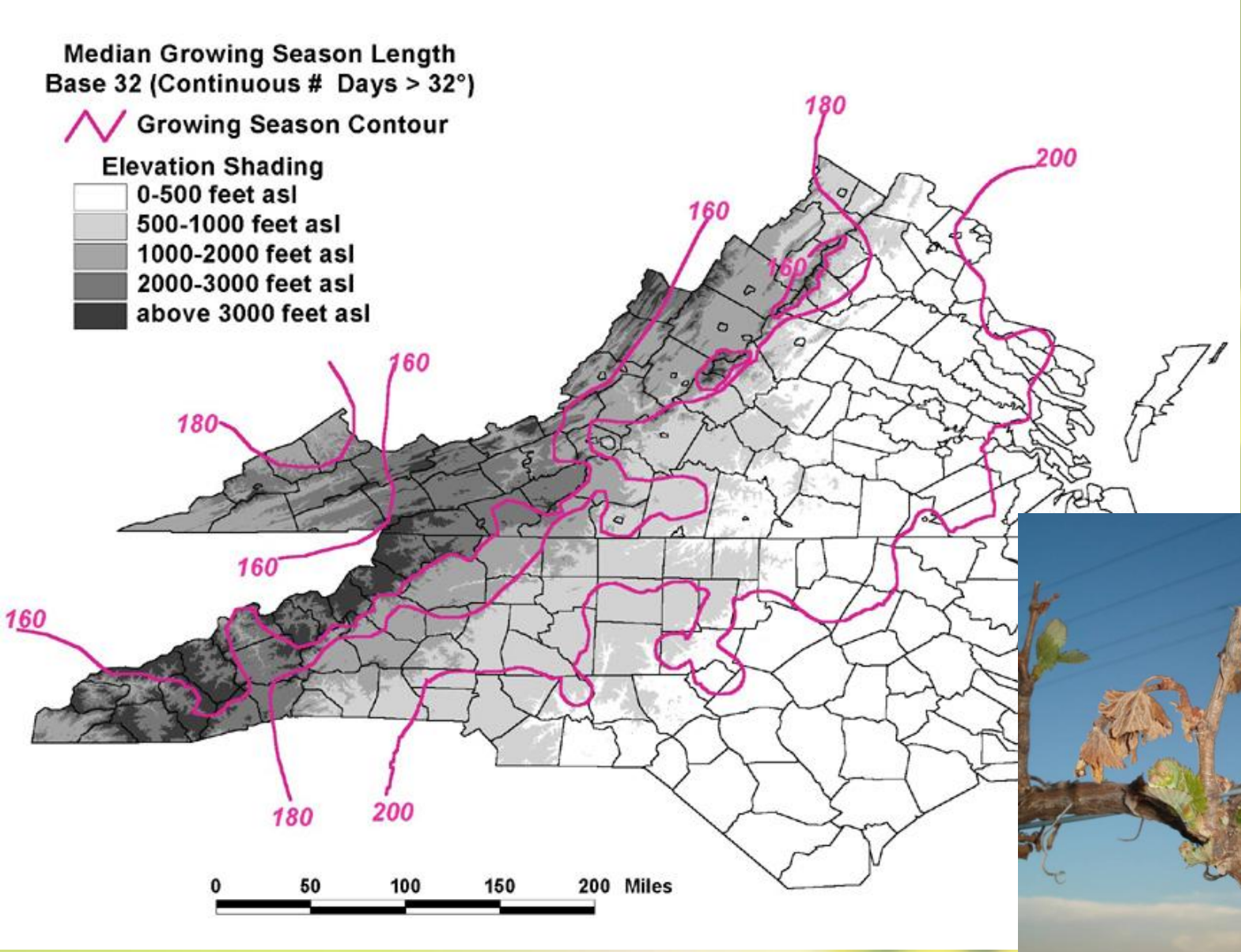
The average course of the weather at a specific location over a period of years

- **Macroclimate** refers to the prevailing climate of a large, geographic region
- **Mesoclimate,** or "local" climate is more specific, and may define the climate over a few hundred feet, such as top of a hill versus the climate found at the bottom of the same hill.
- **Microclimate** as used in viticulture, generally refers to the very specific climate in and immediately around the grapevine canopy

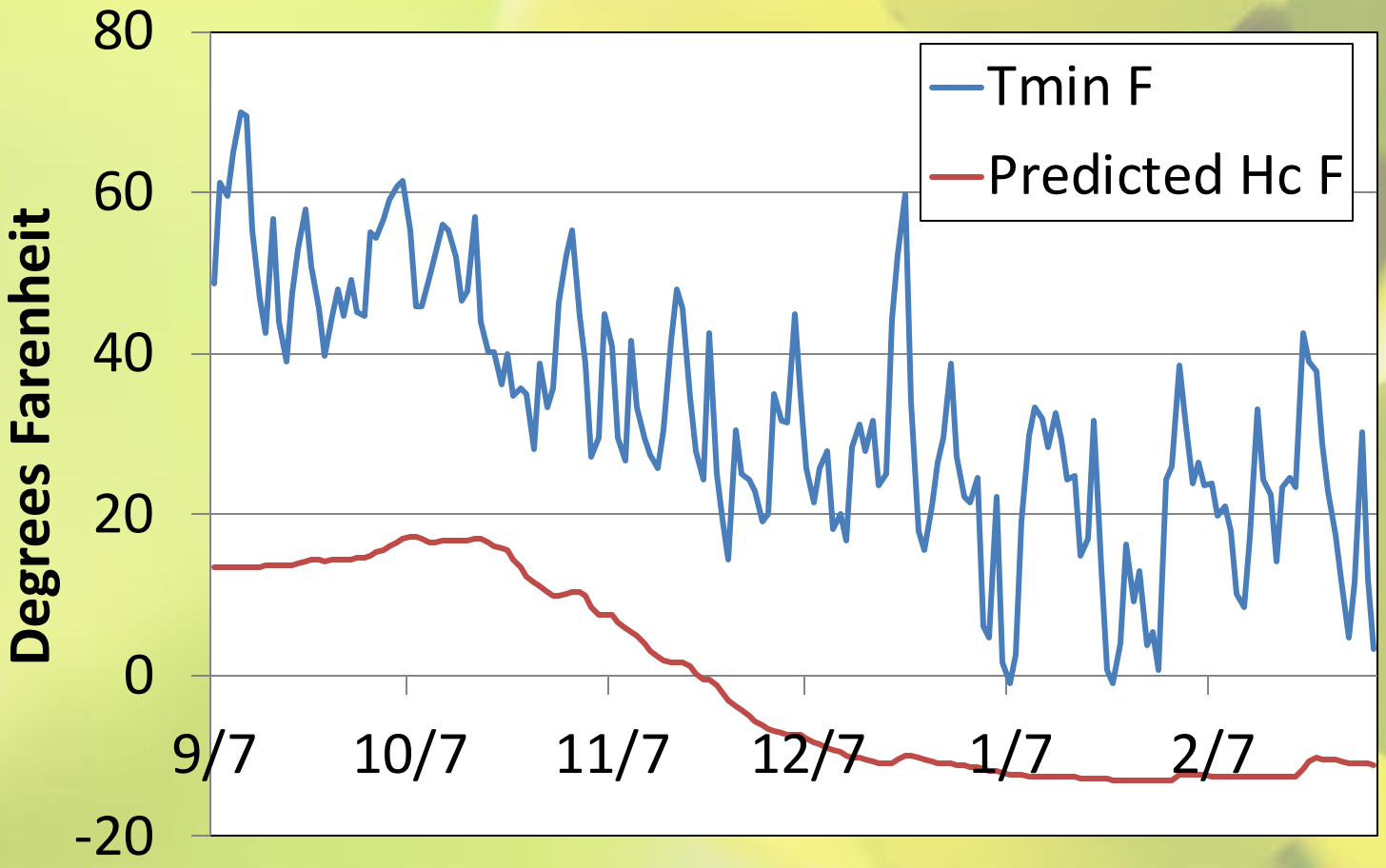
Macroclimate considerations

- Length of growing season
  - 165 days generally considered as minimum
  - 180 or more days for long-season varieties
- Frequency of low temperature extremes
  - e.g., occurrence of -5 to -10 F
- Frequency of drought or excessive rains

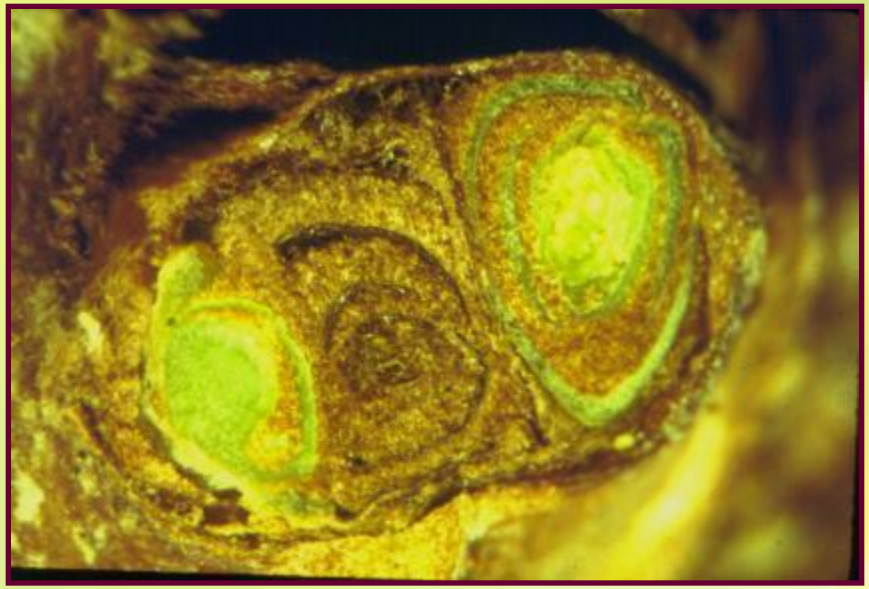
Length of Growing Season

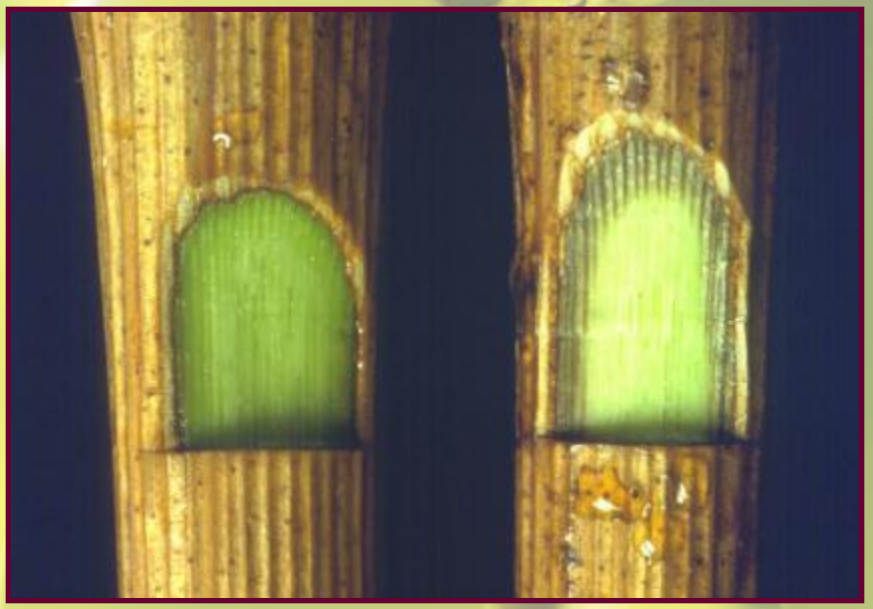


2013-14 Cold Hardiness, Winchester

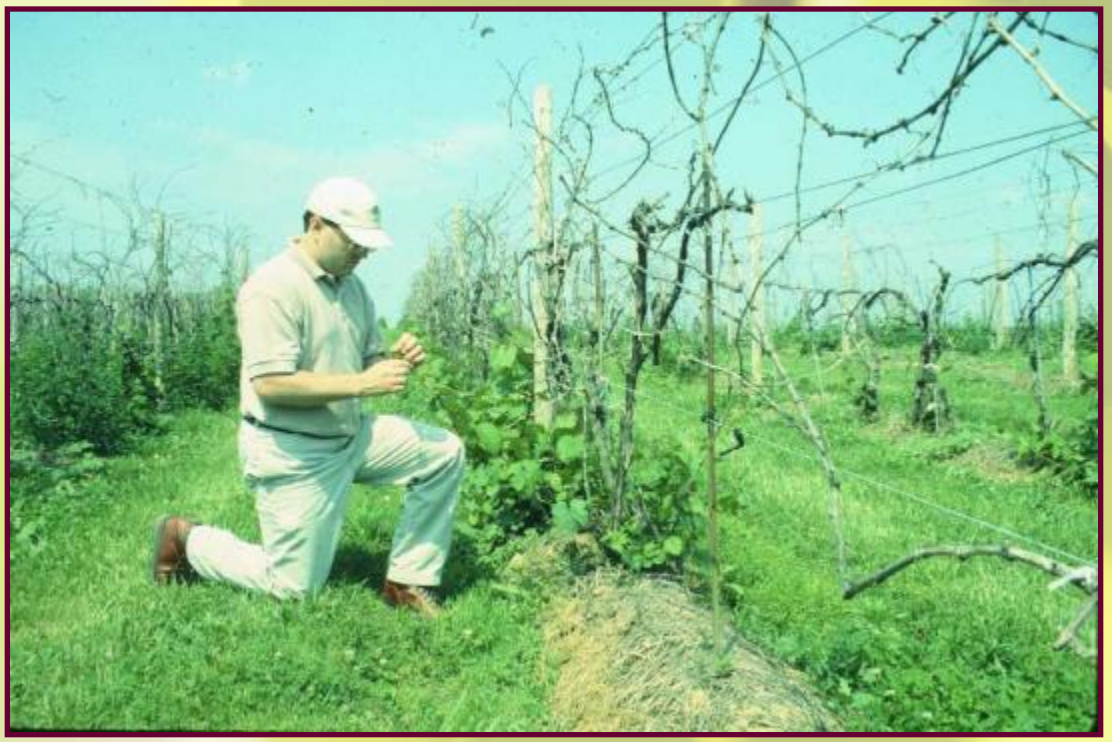


WSU Cold Hardiness Model

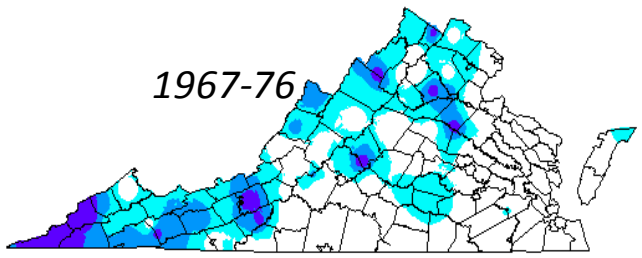


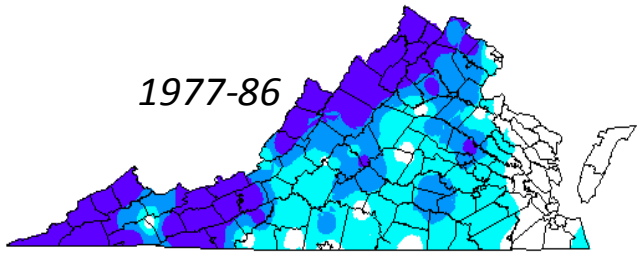


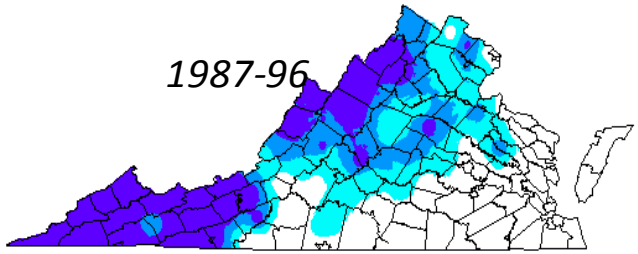
Cold Injury - Symptoms of cold injury to grapevine buds, canes, and vines



Occurrence of Minimum Winter Temperatures







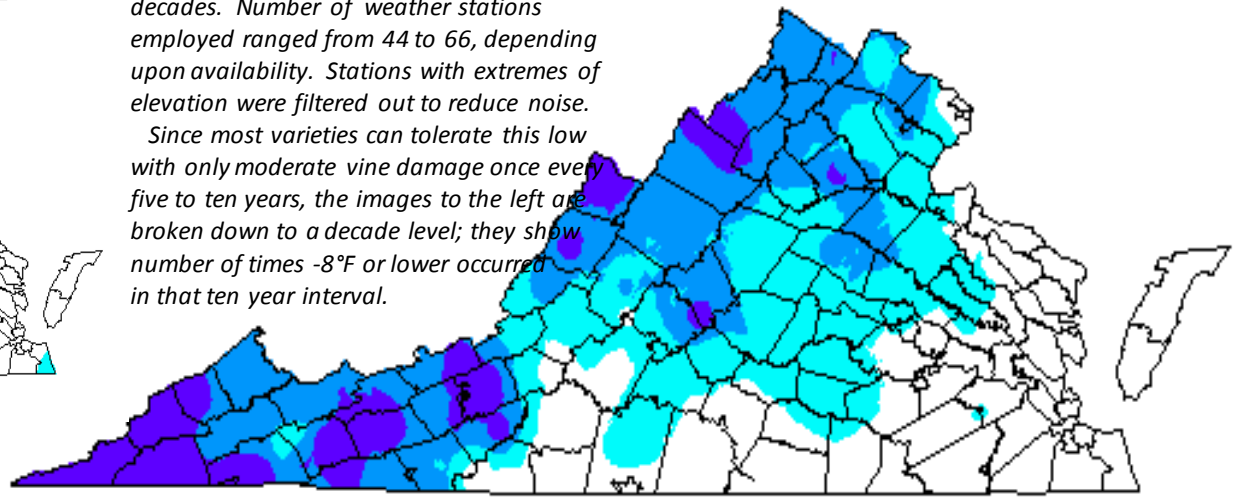
One of the chief limitations to grape production in Virginia is damage to vines resulting from severe mid-winter low temperatures. While exact damaging temperature varies with the variety and weather conditions, a conservative -8°F is considered as the critical point for this study.

The following images are a series of simple interpolations produced from temperature records of the last three decades. Number of weather stations employed ranged from 44 to 66, depending upon availability. Stations with extremes of elevation were filtered out to reduce noise.

Since most varieties can tolerate this low with only moderate vine damage once every five to ten years, the images to the left are broken down to a decade level; they show number of times -8°F or lower occurred in that ten year interval.

The image below is an average of the three decades. It is intended to identify areas where greater attention should be paid to maximizing benefits gained from cold air drainage. Extremes of elevation should be avoided in areas that average 2 or more occurrences.

Caution should be taken in interpretation of these images, as local topography and proximity to water can substantially change the occurrence of minimum temperatures at your site.



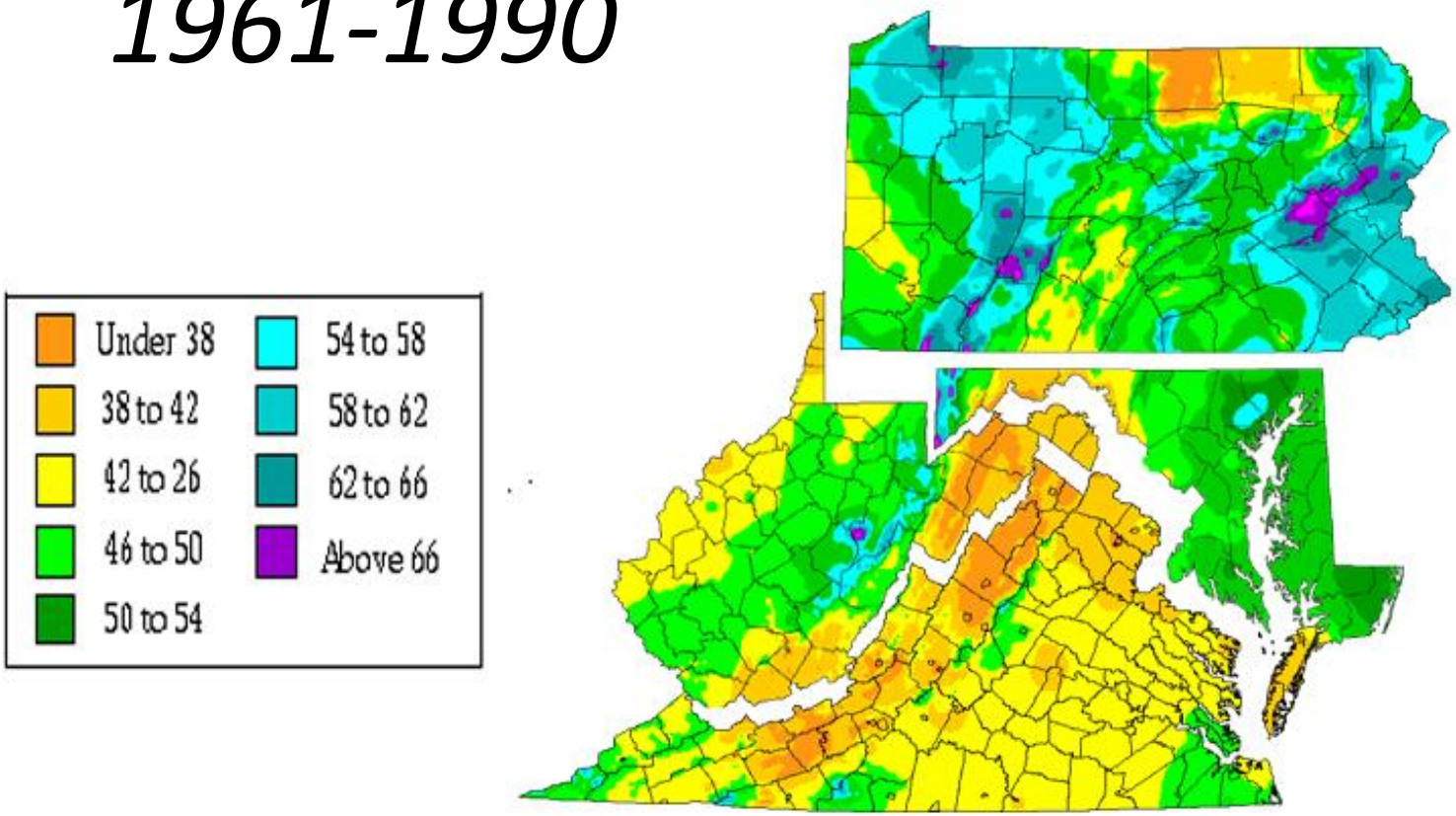
Average Occurrence of -8°F/decade, 1967-96

Macroclimate considerations

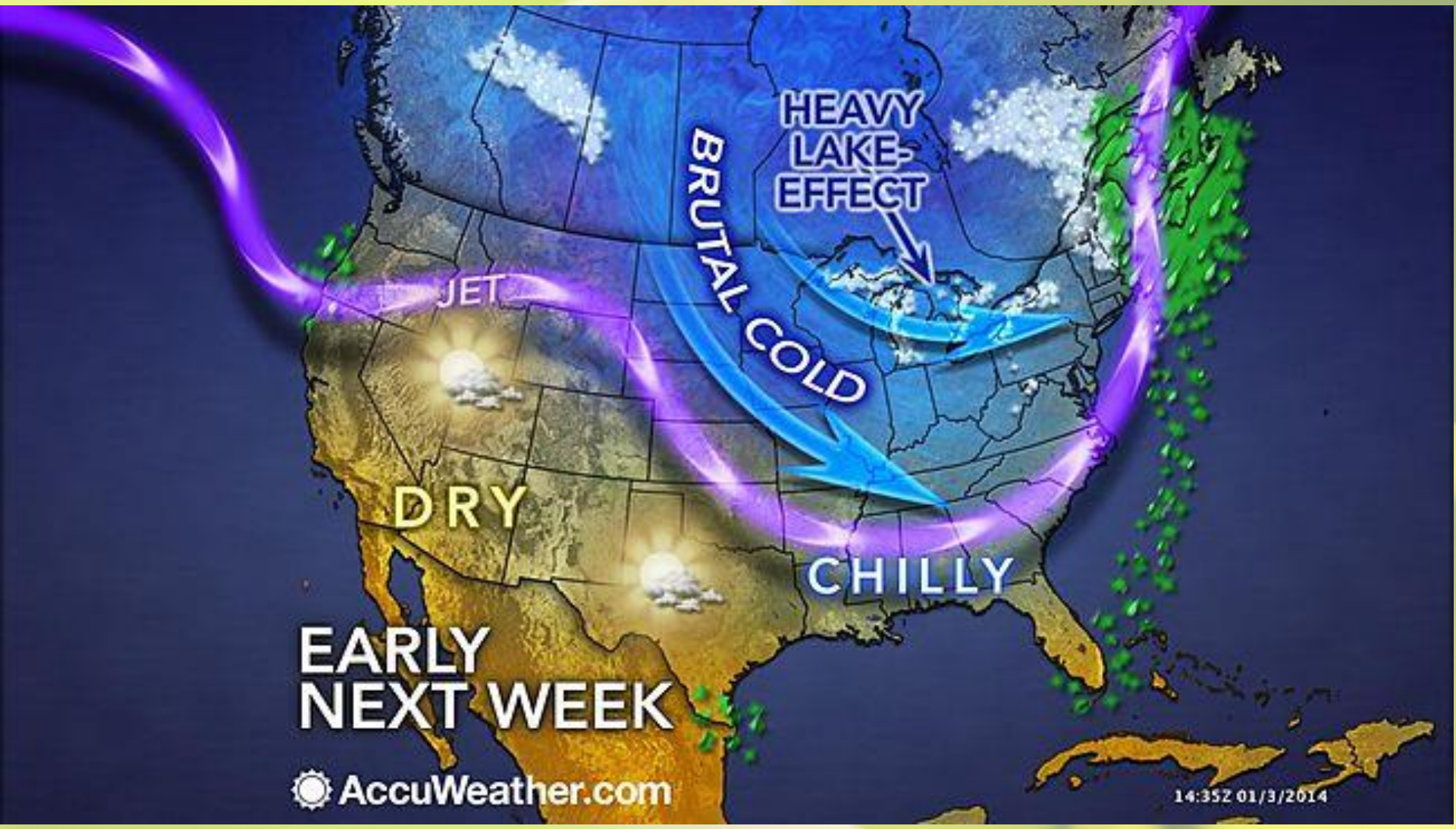
- Length of growing season
  - 165 days generally considered as minimum
  - 180 or more days for long-season varieties
- Frequency of low temperature extremes
  - e.g., occurrence of -5 to -10 F
- Frequency of drought or excessive rains

Average Annual Precipitation

1961-1990



Arctic Vortex



Factors that affect meso- or local climate

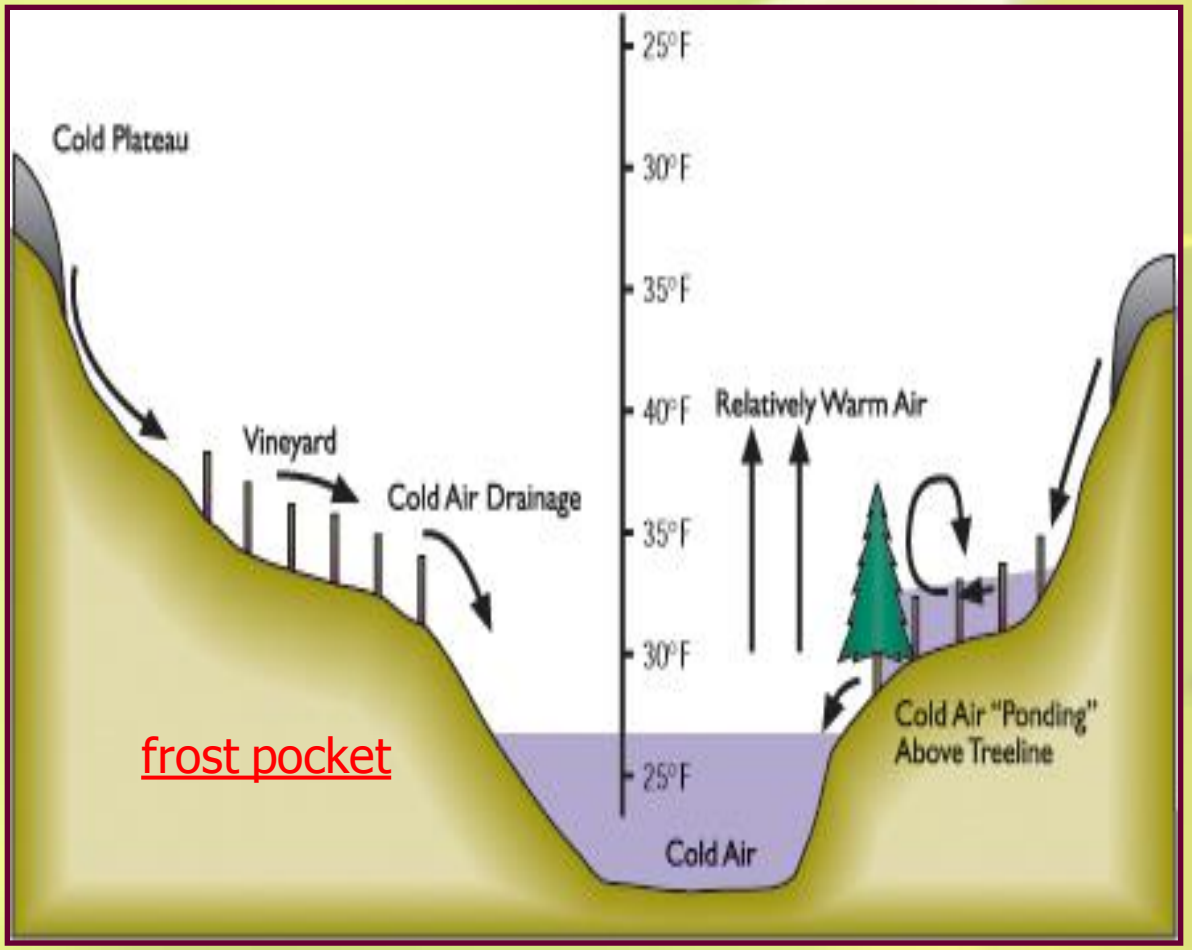
- Elevation
  - Absolute (feet above sea level)
  - Relative (to surrounding topography)
- Slope
  - change in elevation with horizontal displacement
- Aspect
  - the compass direction that a slope faces

Absolute and Relative Elevation

- Air temperature decreases with increased elevation
  - environmental lapse rate ~ 3F/1000 feet
  - sets upper limit (~ 1800' in northern VA) for grapes

- Cold air "ponds" in low areas during radiational cooling
  - displaces warm air up, creating thermal inversion
  - Frost events of cold injury events

Relative Elevation and Slope



Vineyard Site Selection

Authors: Tony K. Wolf and John D. Boyer, Professor of Viticulture and Lecturer, Virginia Tech

Publication Number 463-020, December 2003

Slope

Degree of Slope will influence:

- air movement
- water movement
- possible erosion

Direction of Slope:

N, S, E, W

- affects angle of sunlight
- total heat balance
- prevailing wind

- Slopes > 15%
  - introduce unique problems but can be used if row orientation is altered.
  - erosion concerns

Aspect is the compass direction that an inclined parcel of land faces. Does it matter?

Parameter	Aspect			
	North	**South**	**East**	**West**
Time of bud-break	Retarded	Advanced	Retarded	Advanced
Daily maximum vine temperature	Less	Greater	Less	Greater
Speed of foliage drying in morning	-	-	Advanced	Retarded
Radiant heating of fruit	Less	Greater	Less	Greater
Radiant heating of vines in winter	Less	Greater	Less	Greater
Minimum winter air temperatures	Lower	Higher	-	-
Length of growing season	Shorter	Longer	-	-

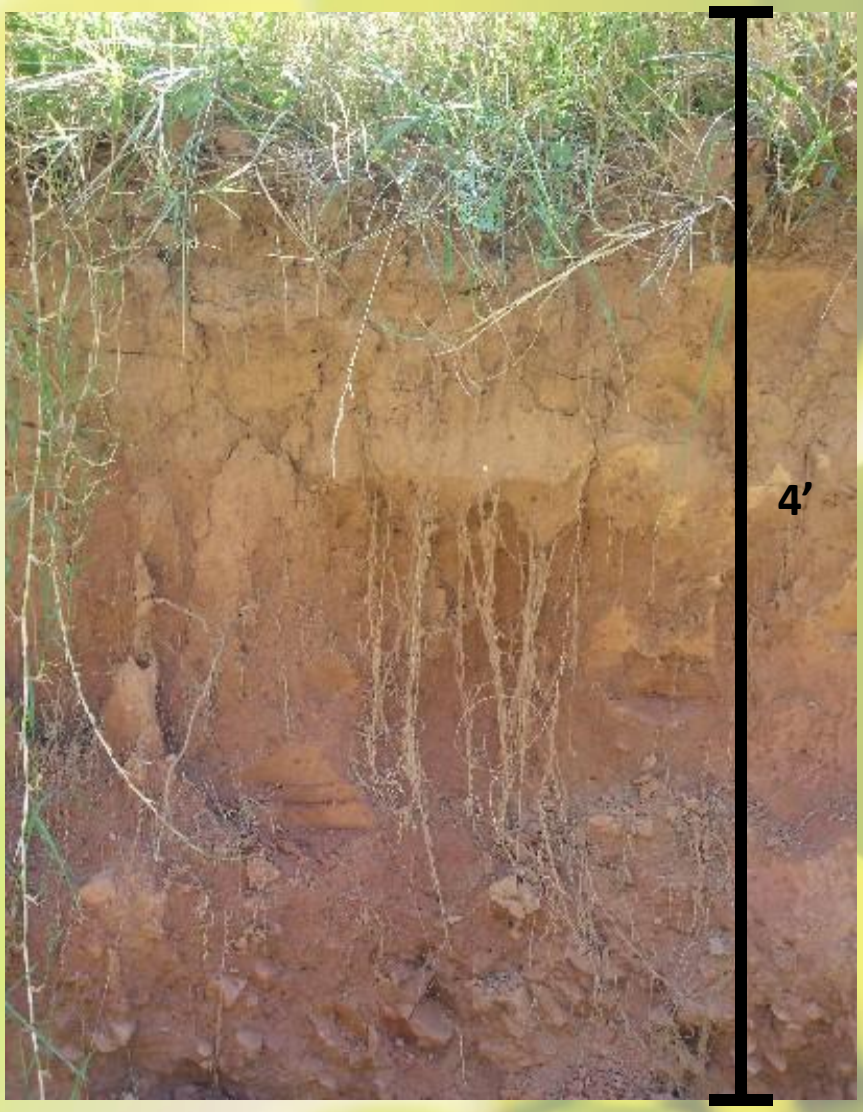
Soils

- SOIL STRUCTURE
- SOIL TEXTURE
- DEPTH–soil depth before reaching an impermeable layer. Shallower soils limit root development
- **WATER HOLDING CAPACITY**

- TEST soil before planting for **pH**, **organic matter (O.M.),** P, K, Mg, B, Zn, Ca, Al, Mn, Cu, and Fe; and amend as needed

Soil (water)

- Texture
  - % sand, silt, clay
- Organic matter
- Structure
- Depth
- Color
- Compaction
- Roots
- Rocks
- Standing water

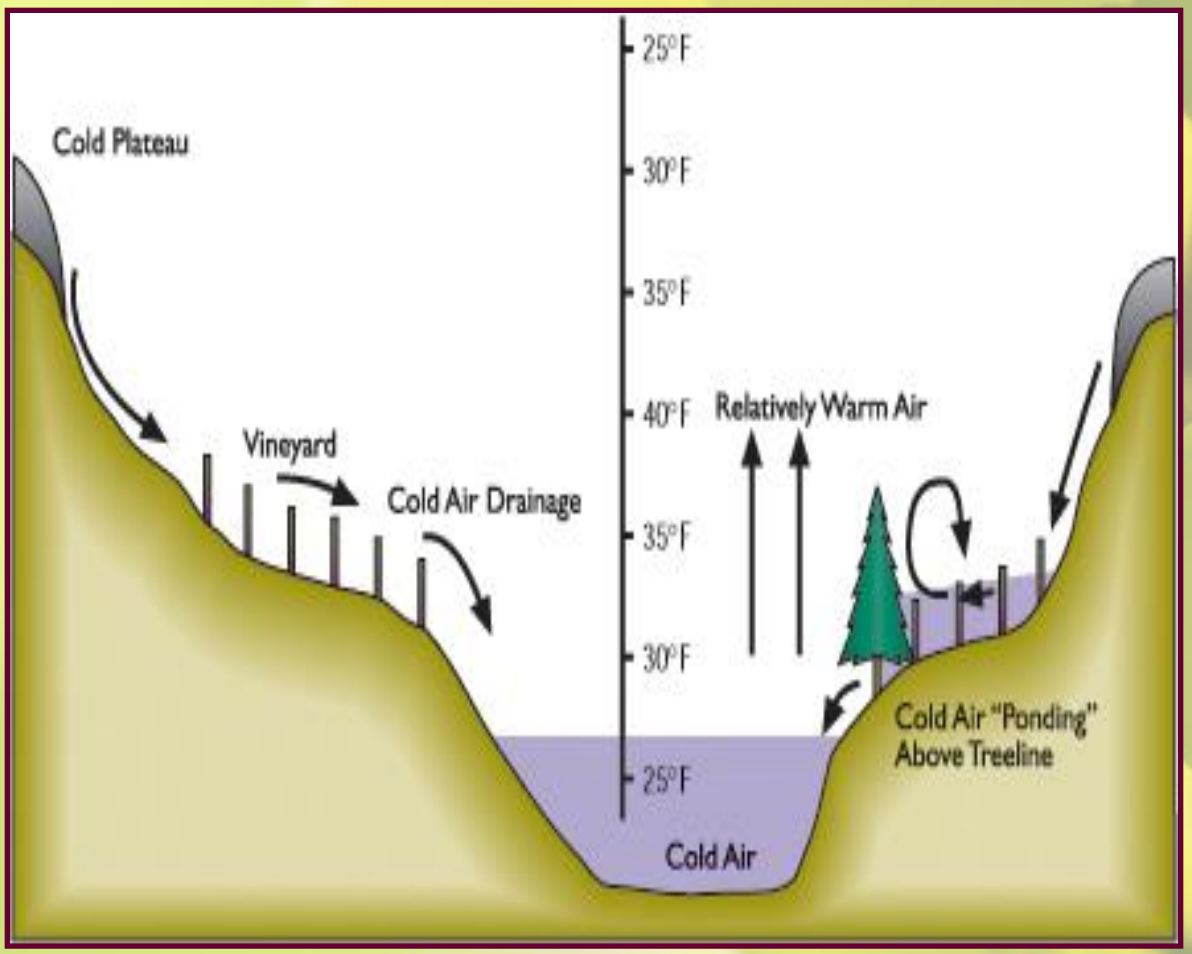


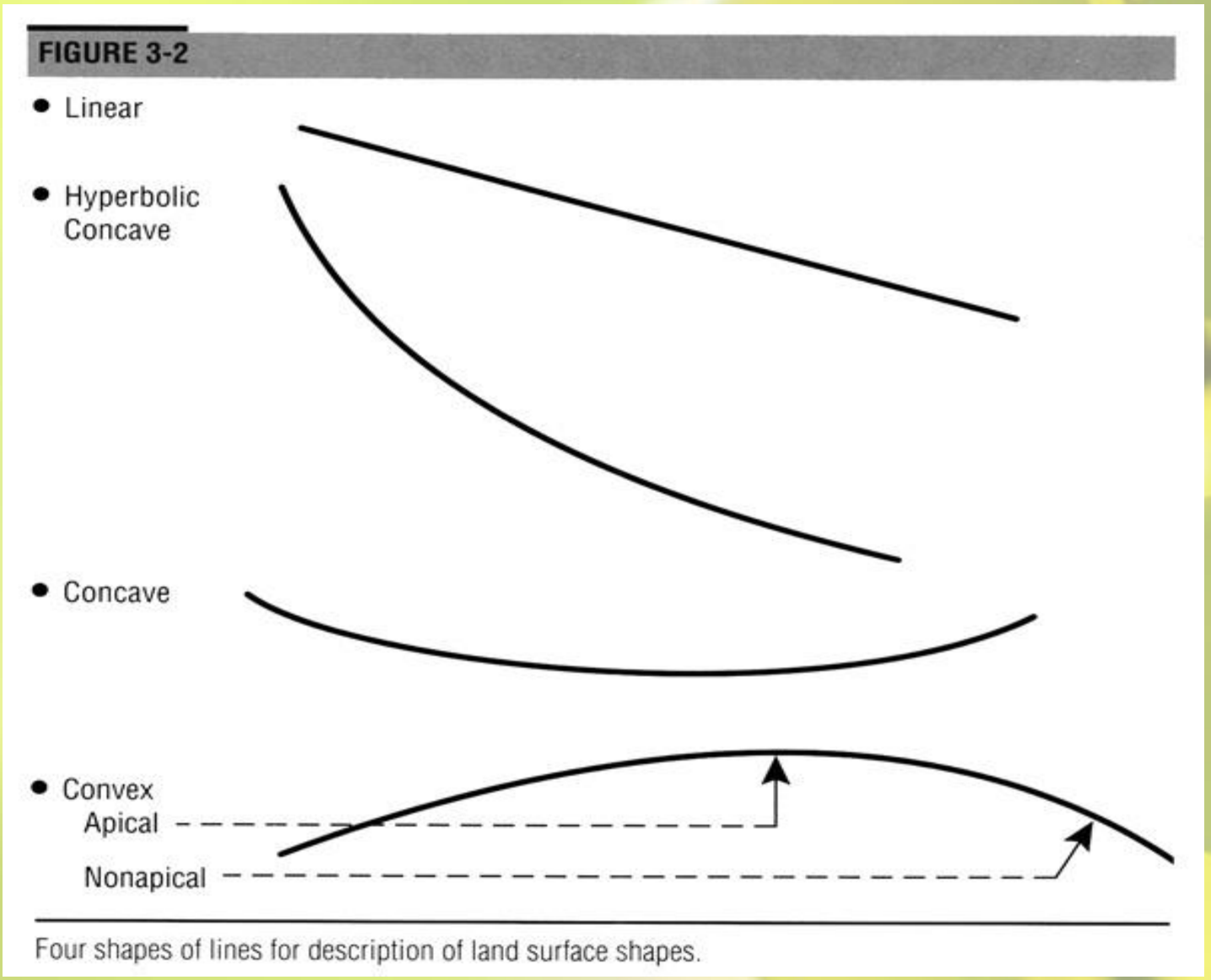
Soil Assessment

Backhoe

Soil Auger

Where would one find deep soil – where would one find shallow soil?



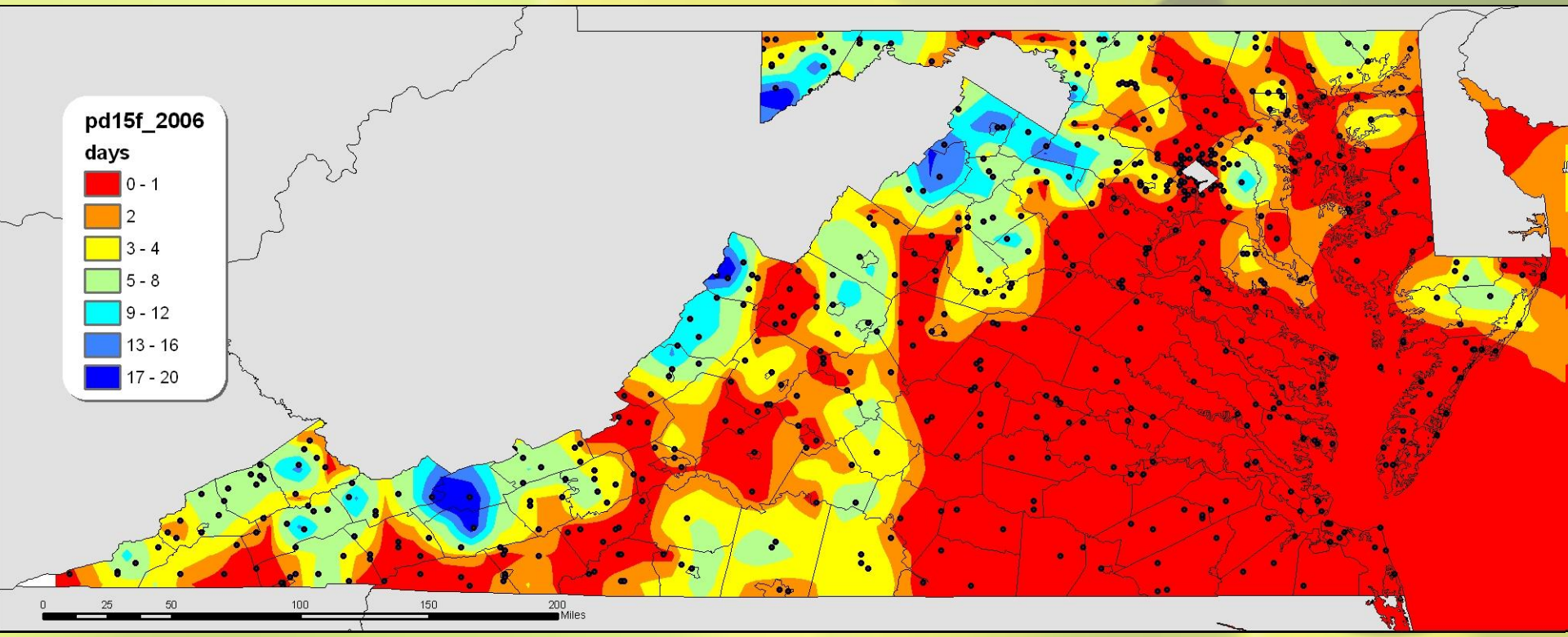


NRCS
http://soils.usda.gov/technical/manual/contents/chapter3.html

Site Selection and Pest Management

- Proximity to wooded areas
  - Vertebrate pests
  - Wild grape vines
- Minimum temperatures
  - Pierces disease
  - Crown gall
- Wind
  - Pro: rapid drying of canopy
  - Con: shoot breakage and spray drift
- Shade
  - Slows canopy drying
- Neighbors
  - Drift to their property
  - Drift from their property

PD: Yearly risk maps



Figures from Anna Wallingford (VT)

Online Resources

-

GRAPE & WINE QUALITY
EASTERN U.S. INITIATIVE

http://vmdev.cgit.vt.edu/vineyards/

http://websoilsurvey.nrcs.usda.gov

Limiting Factors

- Climate: cold injury, unpredictable rainfall, heat, drought
- Relative topography – cold injury
- Forests and pests
- Location hard to access

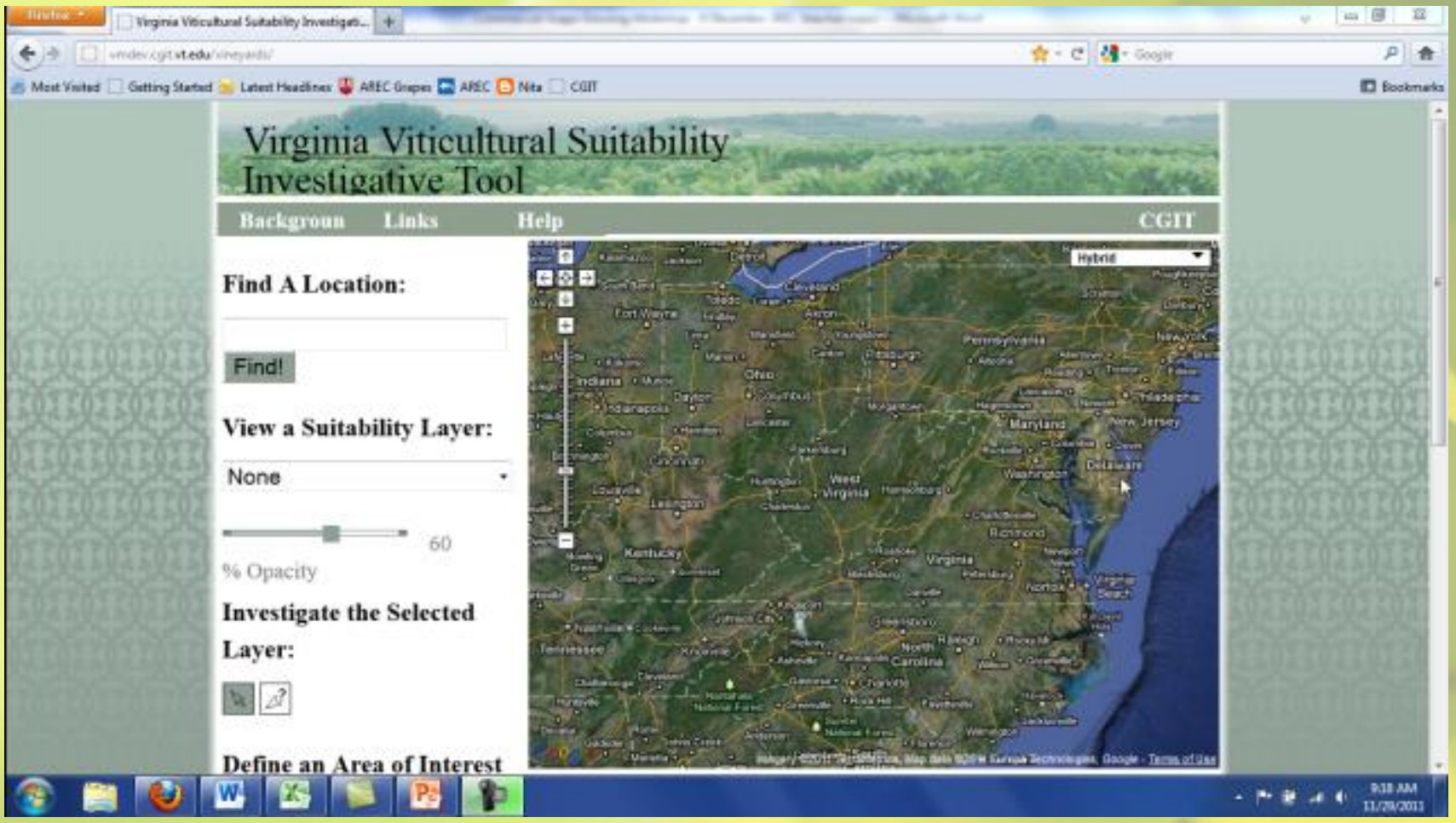
Checklist of physical features in site selection

Climate considered separately

- Relative elevation
- Absolute elevation
- Soil hydrology (internal and surface drainage)
- Land use (forest vs. pasture; rockiness)
- Proximity to sensitive areas (e.g., schools)
- Proximity to biotic and abiotic hazards
- Other soil features (depth, OM, pH, etc.)
- Slope
- Aspect

CONCLUSIONS

- **Relative Topography** is most important vineyard feature in the mid-Atlantic region – frost potential , impacts length of growing season and frequency of low temperature extremes.
- **Plant available soil moisture** is the most important feature of soil.
- attempt to **minimize** risks (mistakes)


Virginia Viticultural Suitability Investigative Tool
Backgroun
Links
Help
CGIT
Find A Location:
Find!
View a Suitability Layer:
None
60
% Opacity
Investigate the Selected Layer:
Define an Area of Interest
Hybrid