

# Matching Winegrape Cultivars to Nebraska Landscapes

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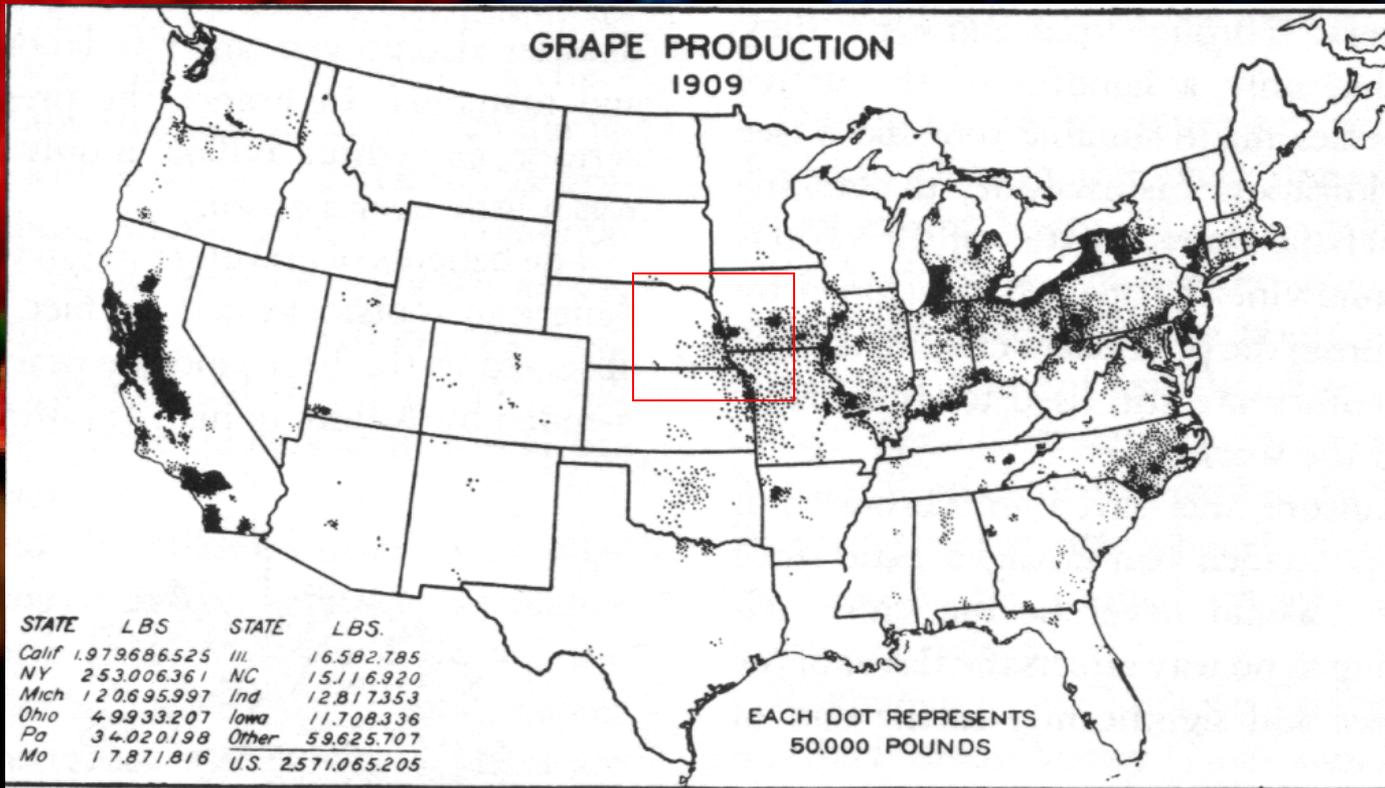
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# Matching Winegrape Cultivars to Nebraska Landscapes

Prior to the Prohibition



- ★ Grapes were grown in Nebraska prior to the Prohibition—about 5000 acres

- ★ Largely grown in the southeastern portion of the state

- ★ The viticultural knowledge of the region was lost until the Farm Winery Act (1994)

- ★ ~13 bonded wineries in Nebraska today and about 200 growers and 400 acres of vines

# A Geography of Viticulture

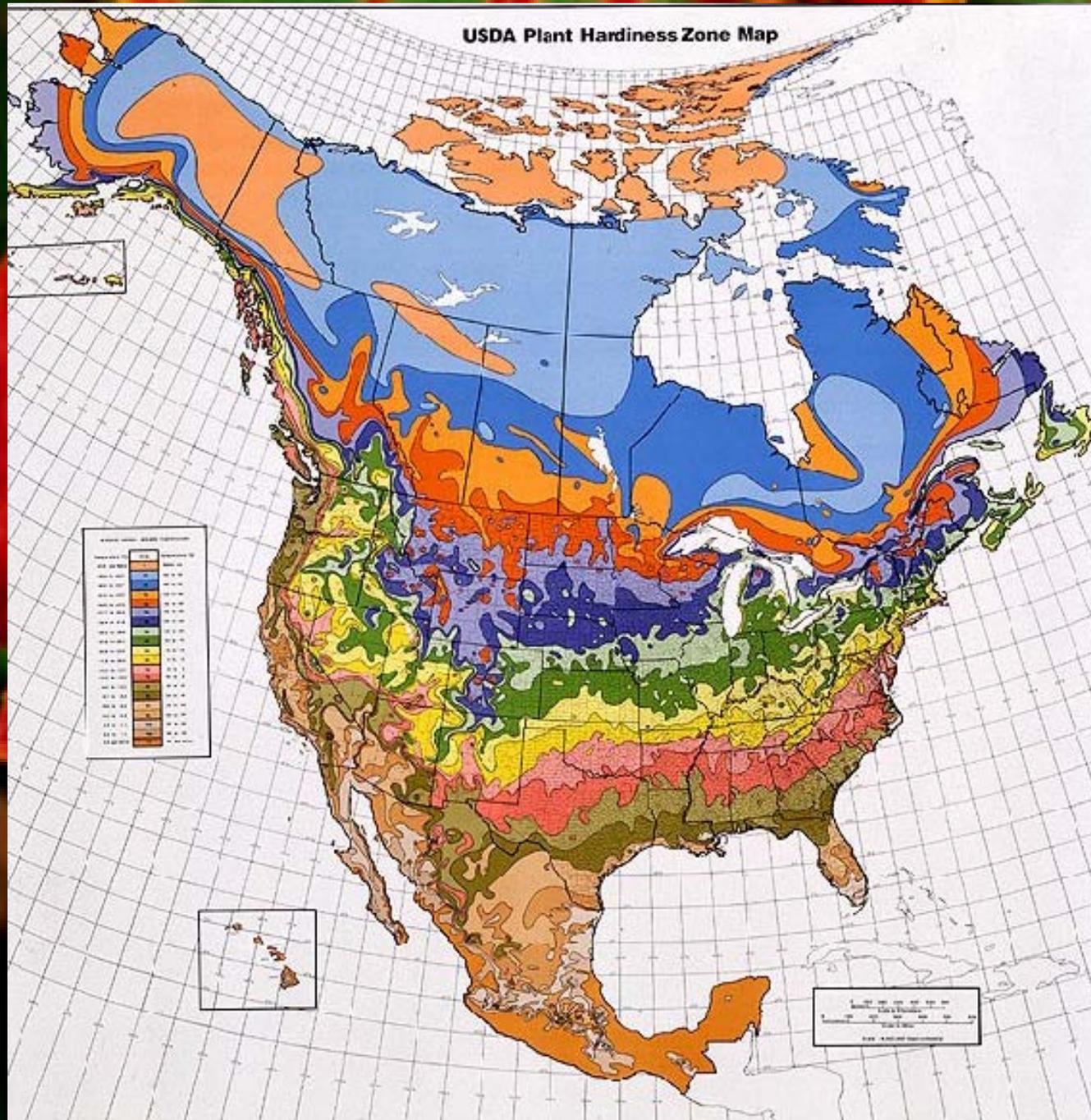
## Concept of Terroir

☀ It embraces the soil landscape and subsoil, the geology (bedrock and landforms); microclimate down to the vine, the macroclimate of the region; elevation, slope, and aspect; proximity to other features—lakes, streams, windbreaks, or the structures of man; the viticulture (variety, rootstock, pruning, and training) and enology (fermentation style, length of maceration, and refinement); and the culture (ethnicity, traditions, and beliefs) of the site.

- ☀ The combined effect of a region's geomorphic, pedologic, and climatic processes
- ☀ Defines the growing environment
- ☀ Reflects “uniqueness of place” or “sense of place”.
- ☀ Does Nebraska have terroirs? How would we recognize them?

# Objectives

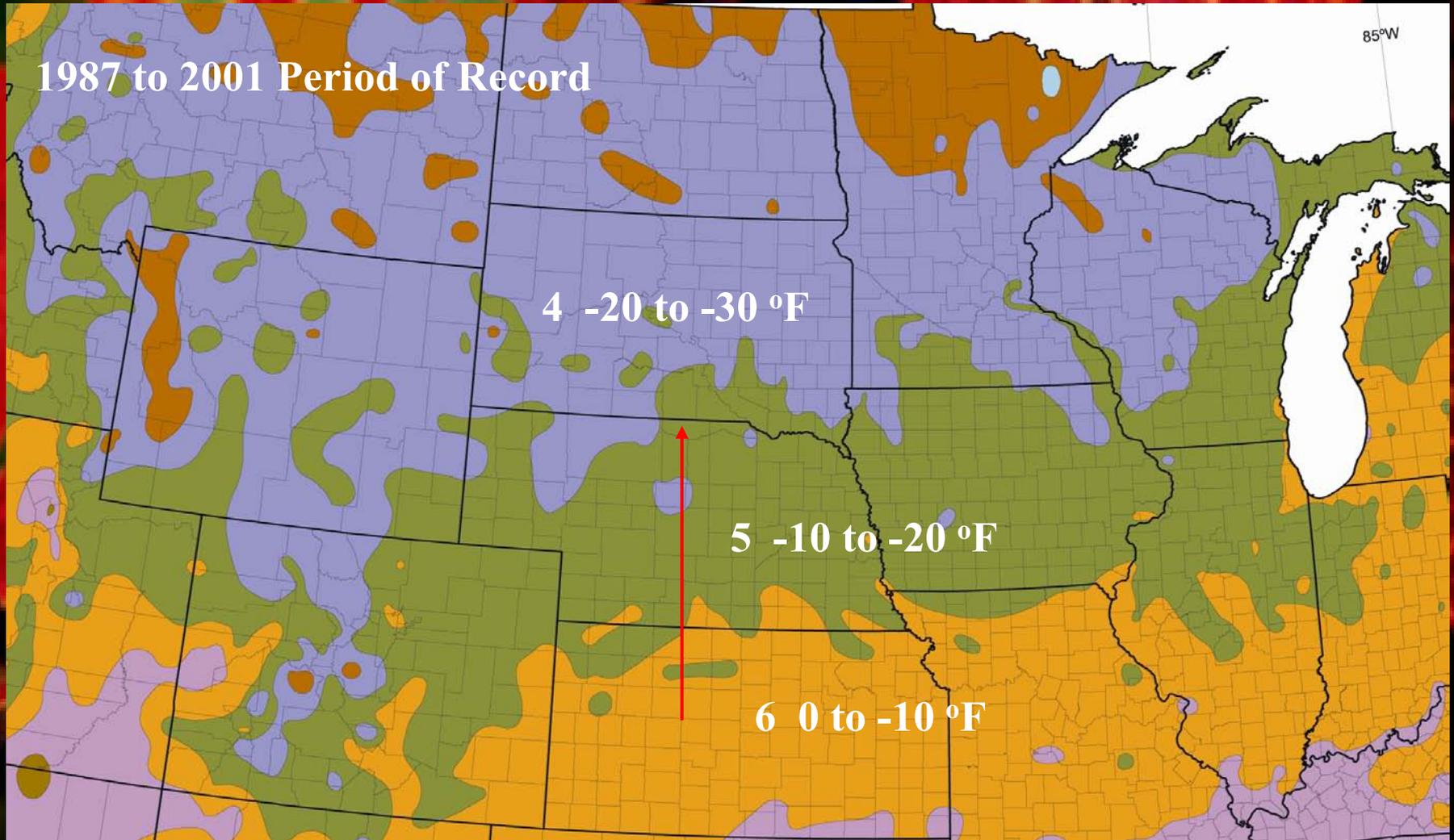
- ★ Testing the grower observations and hypotheses that Tmin extreme values are progressively becoming warmer in Nebraska through time, allowing a new window of opportunity for *V. vinifera* and French-American hybrids to be introduced and survive Nebraska winters,
- ★ Matching winegrape cultivars to the landscapes and microclimates of the Northern Great Plains through terrain-modeling of thermal climate data, and
- ★ Developing the biogeoinformatics characterizing the growing regions for winegrape cultivars that can eventually lead to the recognition of terroirs and development of American Viticultural Areas (AVAs).



# USDA Plant Hardiness Zones (Cathey, 2003)

- ☀ Plant Hardiness Zones have shifted northward from the earlier version; Tmin extreme values are becoming warmer
- ☀ Urban heat island effects are becoming evident over the past 13 years in this study
- ☀ Winter hardiness ratings for cultivars developed in other regions may not readily translate to the Great Plains

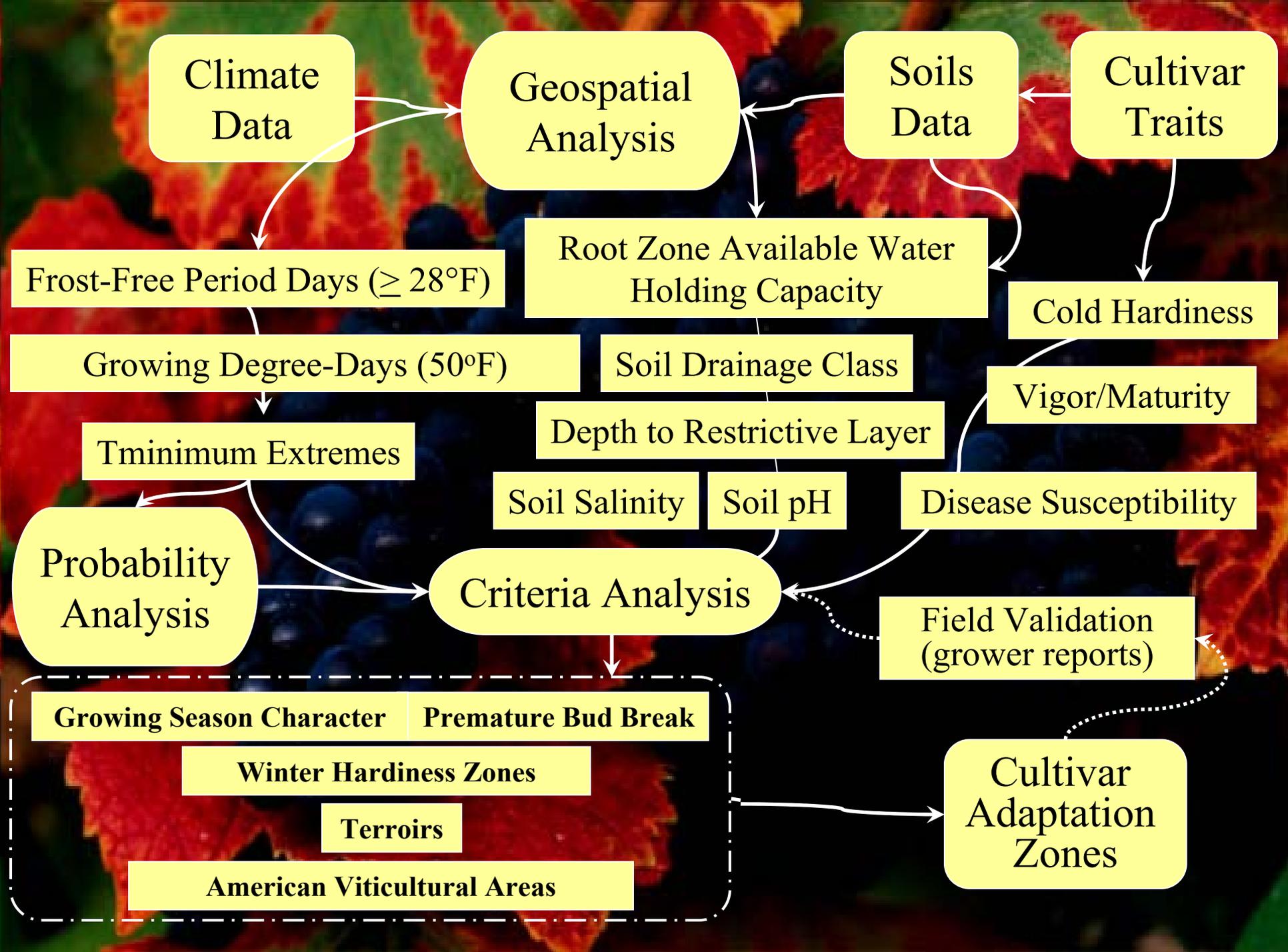
# USDA Plant Hardiness Zone Map (2003)



Cathey (2003); American Horticultural Society

## *Climate Parameters for Variety & Vineyard Site Selection*

- ✱ **Growing Degree-Days (Base 50 °F); April 1 to October 31; No upper threshold (Winkler et al., 1974); Total heat units and cumulative days**
- ✱ **Average Tminimum Extreme--Isoline of -8 °F is an ecological boundary for *Vitis vinifera*; days/decade**
- ✱ **USDA Winter Hardiness Zones--4a to 6b**
- ✱ **Mean Frost-Free Period (Base 28 °F)--Need a 165 day window**
- ✱ **Mean January Air Temperature--Isoline of 30 °F is related to Pierce's Disease**
- ✱ **Mean Annual Tmaximum <32 °F as Cumulative Days**
- ✱ **Mean Annual Number of Days of Tmaximum >90 °F**
- ✱ **Probability of 5-Consecutive Days >60 °F in January, February, or March**
- ✱ **Accumulation of GDDs (Base 32 °F) Consecutively for 1000 hrs (Bud Break)**
- ✱ **The parameters define the variety and sustainability of place, not necessarily the resulting quality and character of the wine.**



Climate Data

Geospatial Analysis

Soils Data

Cultivar Traits

Frost-Free Period Days ( $\geq 28^{\circ}\text{F}$ )

Root Zone Available Water Holding Capacity

Cold Hardiness

Growing Degree-Days ( $50^{\circ}\text{F}$ )

Soil Drainage Class

Vigor/Maturity

Tminimum Extremes

Depth to Restrictive Layer

Probability Analysis

Soil Salinity

Soil pH

Disease Susceptibility

Criteria Analysis

Field Validation (grower reports)

Growing Season Character

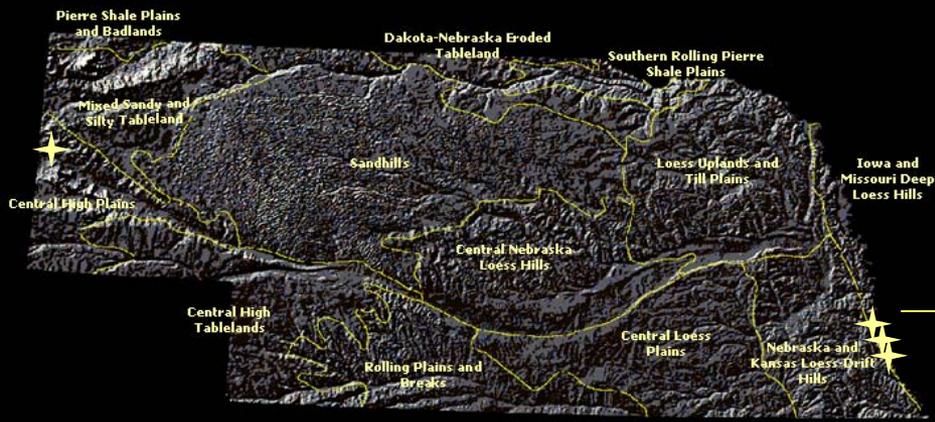
Premature Bud Break

Winter Hardiness Zones

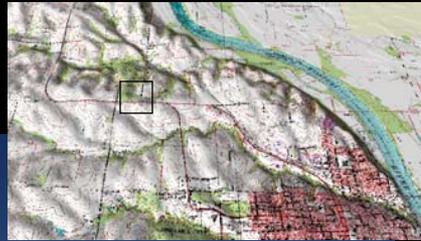
Terroirs

American Viticultural Areas

Cultivar Adaptation Zones



✦ Existing Variety Trials



*Wine quality is a function of variety, soil, climate, landscape, and vineyard management*



Data Mining  
 Geospatial Analysis

- Mapping of Varietal Adaptation
- Vineyard Suitability and Sustainability
- El Nino/La Nina Impacts
- Vineyard Management Zones
- Terroirs and AVAs

# Nebraska Research Initiative

# Climate Comparison of Major Vineyards in Nebraska

1971 to 2000 Normals

<b>Weather Station</b>	<b>FFP (28°F)</b>	<b>Days &lt;-10°F</b>	<b>Tmin Extreme</b>	<b>Abs Tmin</b>	<b>GDD (50°F)</b>
<b>Cuthills Vineyard Osmond</b>	<b>166</b>	<b>8.4</b>	<b>-21.0</b>	<b>-28</b>	<b>3249</b>
<b>Geo. Spencer Kearney 4 NE</b>	<b>177</b>	<b>3.8</b>	<b>-14.4</b>	<b>-30</b>	<b>3325</b>
<b>James Arthur Vineyard Lincoln AP</b>	<b>183</b>	<b>4.0</b>	<b>-15.2</b>	<b>-22</b>	<b>3605</b>
<b>Blue Valley Vineyard Crete</b>	<b>190</b>	<b>2.8</b>	<b>-14.5</b>	<b>-25</b>	<b>3714</b>
<b>Lovers Leap Vineyard Crawford</b>	<b>153</b>	<b>4.3</b>	<b>-17.5</b>	<b>-33</b>	<b>2742</b>
<b>Geneva Research Farm Geneva, NY</b>	<b>198</b>	<b>0.5</b>	<b>-7.2</b>	<b>-16</b>	<b>2485</b>

# Nebraska Research Initiative

# Changes in Thermal Regime

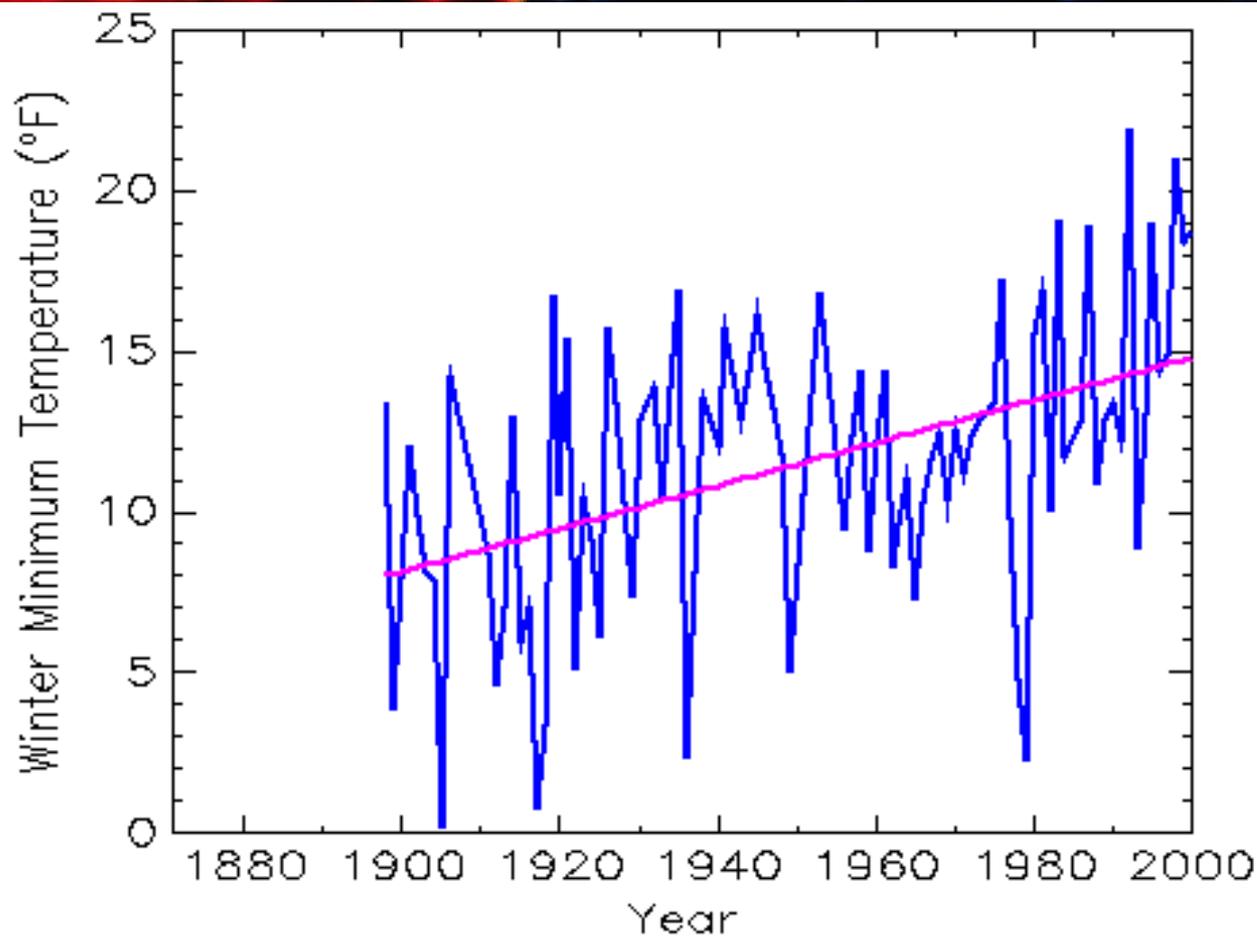
Comparison of the Past 10 Years and the Total  
Length of Record

<b>Weather Station</b>	<b>Record</b>	<b>FFP (28°F)</b>	<b>Days &lt;-10°F days/y</b>	<b>Tmin Extreme</b>	<b>Days &gt;95°F</b>	<b>GDD (50°F)</b>
<b>Nebraska City</b>	<b>1994-2003</b>	<b>206</b>	<b>1.7</b>	<b>-10.6</b>	<b>5.1</b>	<b>3440</b>
<b>Nebraska City</b>	<b>1961-2003</b>	<b>202</b>	<b>3.0</b>	<b>-12.4</b>	<b>10.0</b>	<b>3477</b>
<b>Pawnee City</b>	<b>1994-2003</b>	<b>196</b>	<b>2.0</b>	<b>-13.3</b>	<b>14.6</b>	<b>3752</b>
<b>Pawnee City</b>	<b>1903-2003</b>	<b>191</b>	<b>2.5</b>	<b>-13.3</b>	<b>24.6</b>	<b>3934</b>
<b>Red Cloud</b>	<b>1994-2003</b>	<b>175</b>	<b>1.8</b>	<b>-9.6</b>	<b>27.8</b>	<b>3476</b>
<b>Red Cloud</b>	<b>1948-2003</b>	<b>174</b>	<b>3.5</b>	<b>-14.2</b>	<b>28.7</b>	<b>3549</b>
<b>Superior</b>	<b>1994-2003</b>	<b>195</b>	<b>0.5</b>	<b>-8.2</b>	<b>29.8</b>	<b>4008</b>
<b>Superior</b>	<b>1964-2003</b>	<b>193</b>	<b>1.7</b>	<b>-11.0</b>	<b>23.3</b>	<b>3842</b>

# Changes in Thermal Regime

U.S. Historical Climatology Network

Crete, NE



☀ Steeper slope to the trendline of winter minimum temperatures

☀ Allows over-wintering of grape pests and diseases

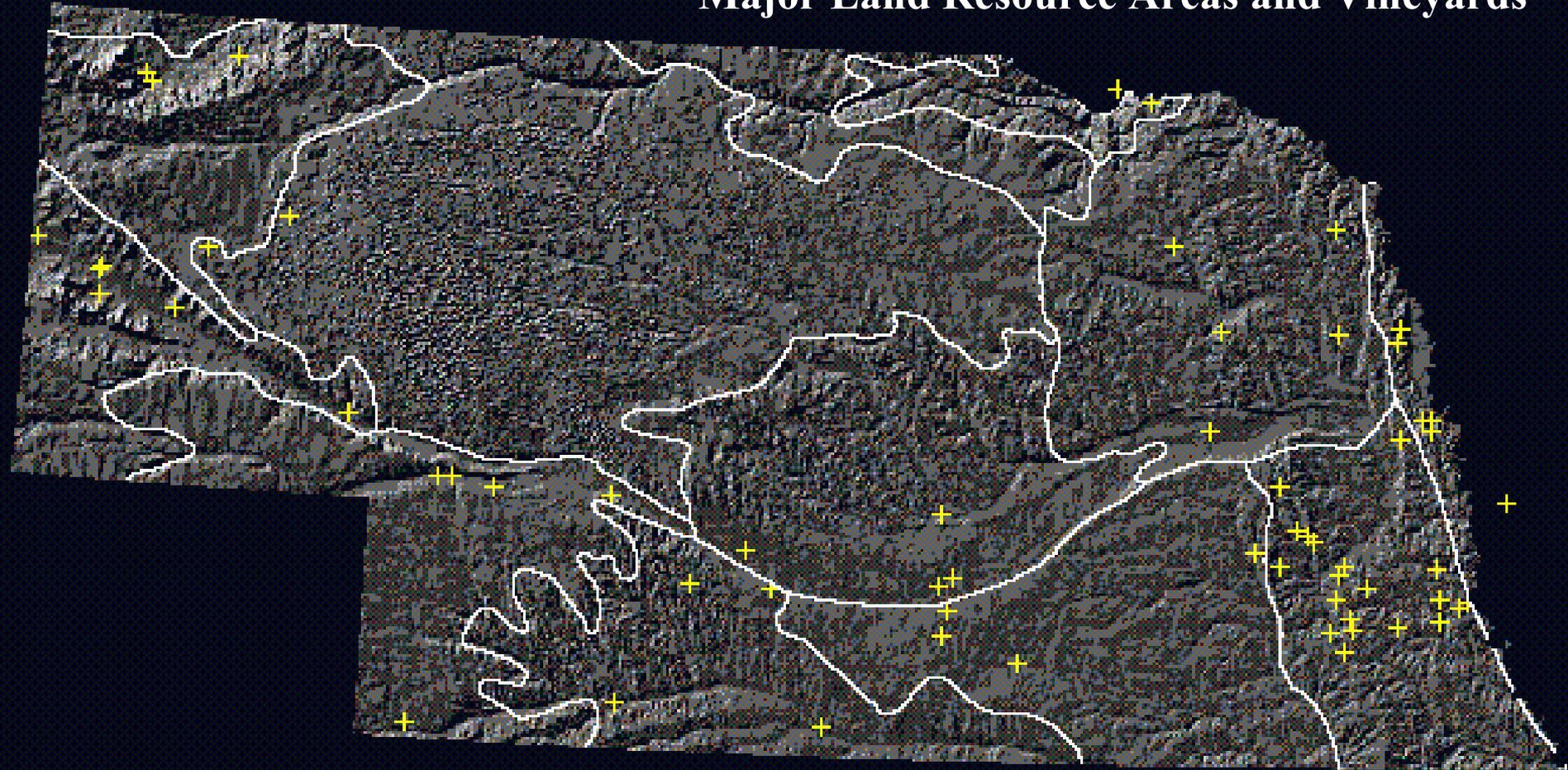
☀ Promoting earlier budbreak and frost damage in spring

Doane College



# The Working Hypothesis

## Major Land Resource Areas and Vineyards



MLRAs as an ecological framework for terroirs and AVAs

# Nebraska Research Initiative

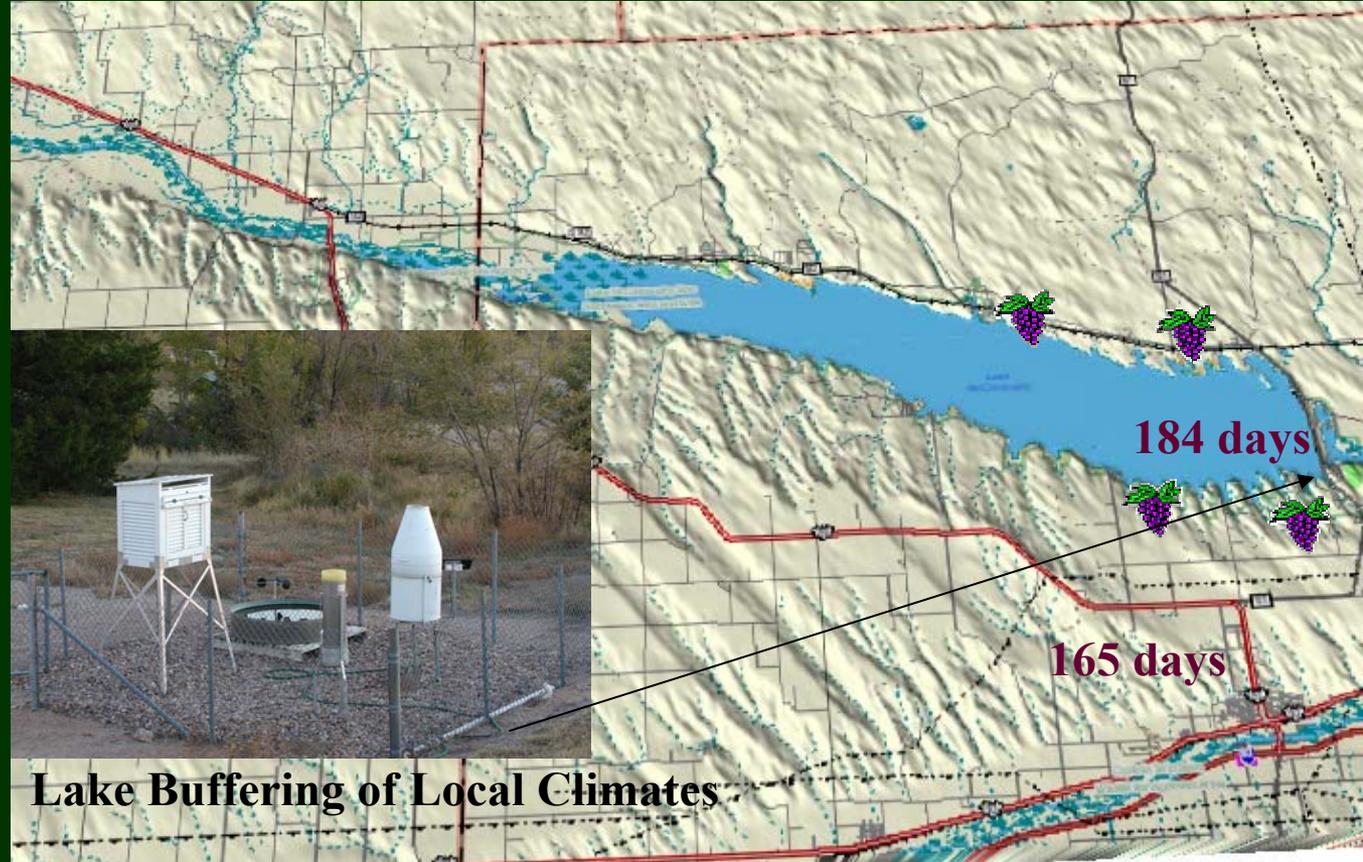
# A Geography of Viticulture

## Finding New Vineyard Sites with Extended Growing Seasons

**A Finger Lakes Model  
for the Northern High  
Plains**

**Lake McConaughy**

**Vineyards in this  
region would have an  
extended growing  
season and total GDDs  
comparable to the  
Finger Lakes region,  
but the Tminimum  
extreme averages -12°F  
at Kingsley Dam. The  
surrounding weather  
stations average -17°F.**



**The lake buffering slows spring warm-up and premature  
budbreak, and reduces impact of late spring frosts.**

# Nebraska Research Initiative

# Winterhardiness

If Tminimum Extreme  
is Higher than ...

Injury  
Hazard

Suitable  
Varieties

0°F

Very Low

classic Vinifera

-5°F

Low

northern Vinifera

-10°F

Moderate

hardy Vinifera/  
moderately hardy  
hybrids

-15°F

High

hardy hybrids/most  
American cultivars

<-20°F

Very High

very hardy American  
cultivars/hybrids  
(Swenson cultivars)

# Length of Growing Season

Frost-Free Period  
(Consecutive Days  
between 28°F)

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Suitability for Grapes

> 180 days

Excellent (most late season)

171 to 180

Good (mid- to late-season)

161 to 170

Satisfactory (mid- and early)

151 to 160

Marginal (only early)

< 150 days

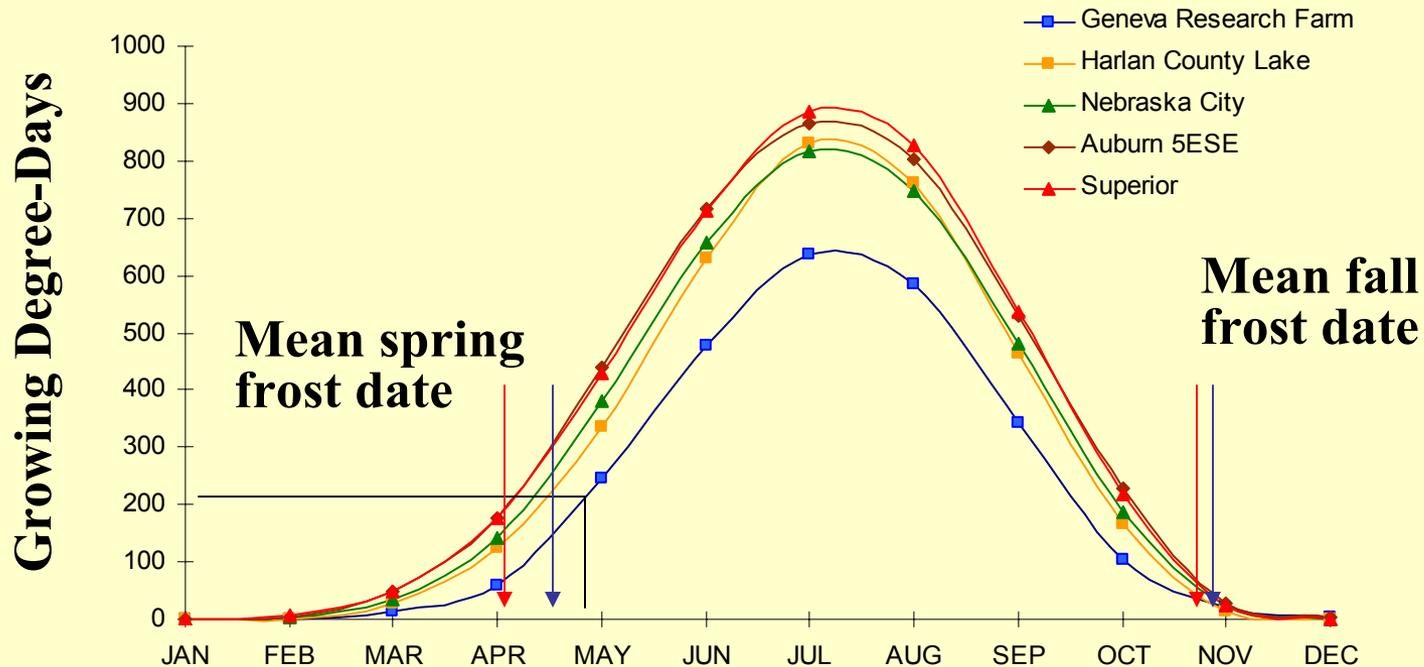
Unacceptable

# Winterhardness is the key to varietal selection the Northern Great Plains

At the Panhandle Research and Extension Center (1971-2000)

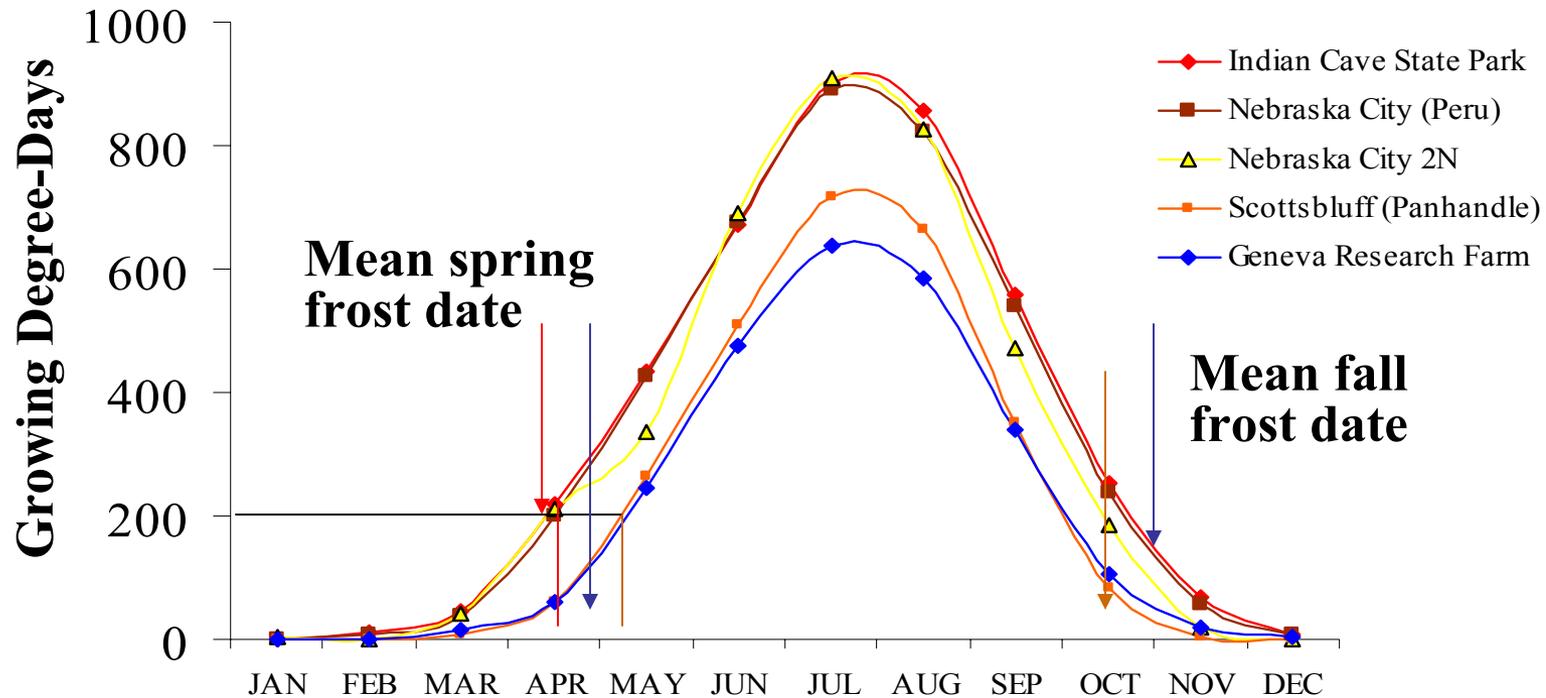
FFP (28°F)	Days <-10°F	Tmin Extreme	Abs Tmin	GDDs (50°F)
163 d	5.0 d	-19.7°F	-42°F	2819

# Growing Degree-Days and Bud Break



**These four Nebraska locations occur within the proposed Vinifera Triangle and compared with the Geneva Experiment Station (NY). In the Vinifera Triangle, the spring warm-up is nearly 3-weeks faster than in the Finger Lakes region.**

# Growing Degree-Days and Bud Break— Field Trials



These four Nebraska cultivar trials are compared with the Geneva Experiment Station (NY).

# Winegrape Adaptation Zones

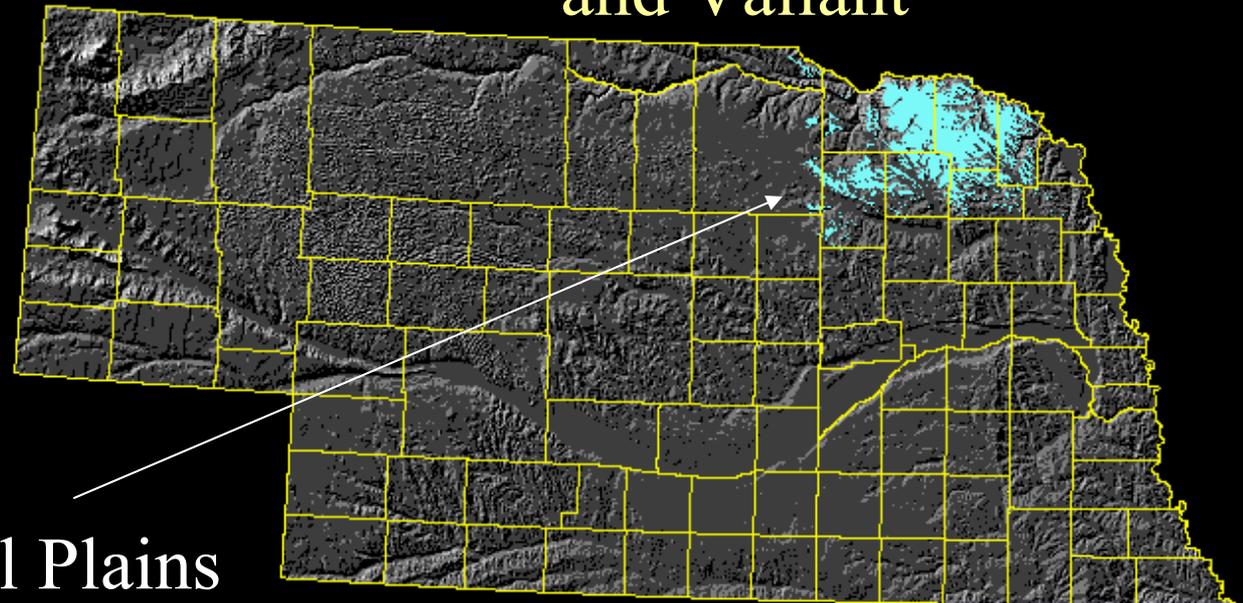
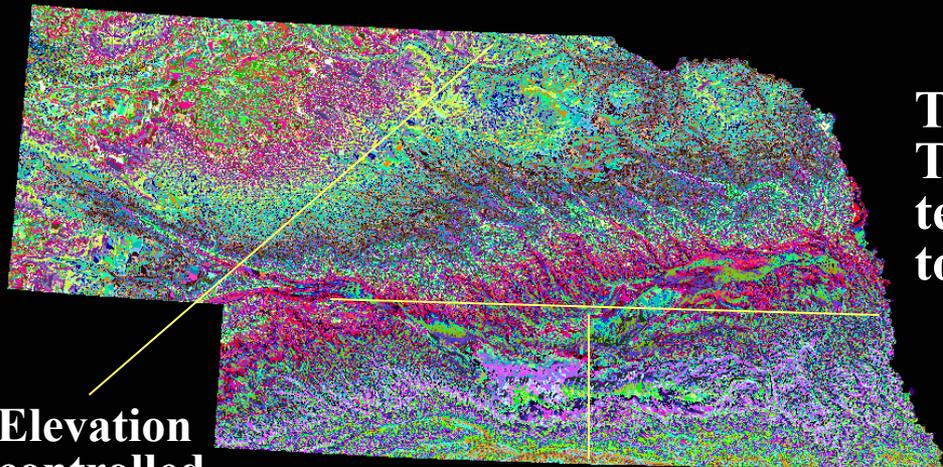
The raw terrain surface of  
T<sub>minimum</sub> extreme  
temperatures based upon 1971  
to 2000 normals.

Frontenac, St. Croix,  
Lacrosse, Prairie Star,  
and Valiant

Elevation  
controlled

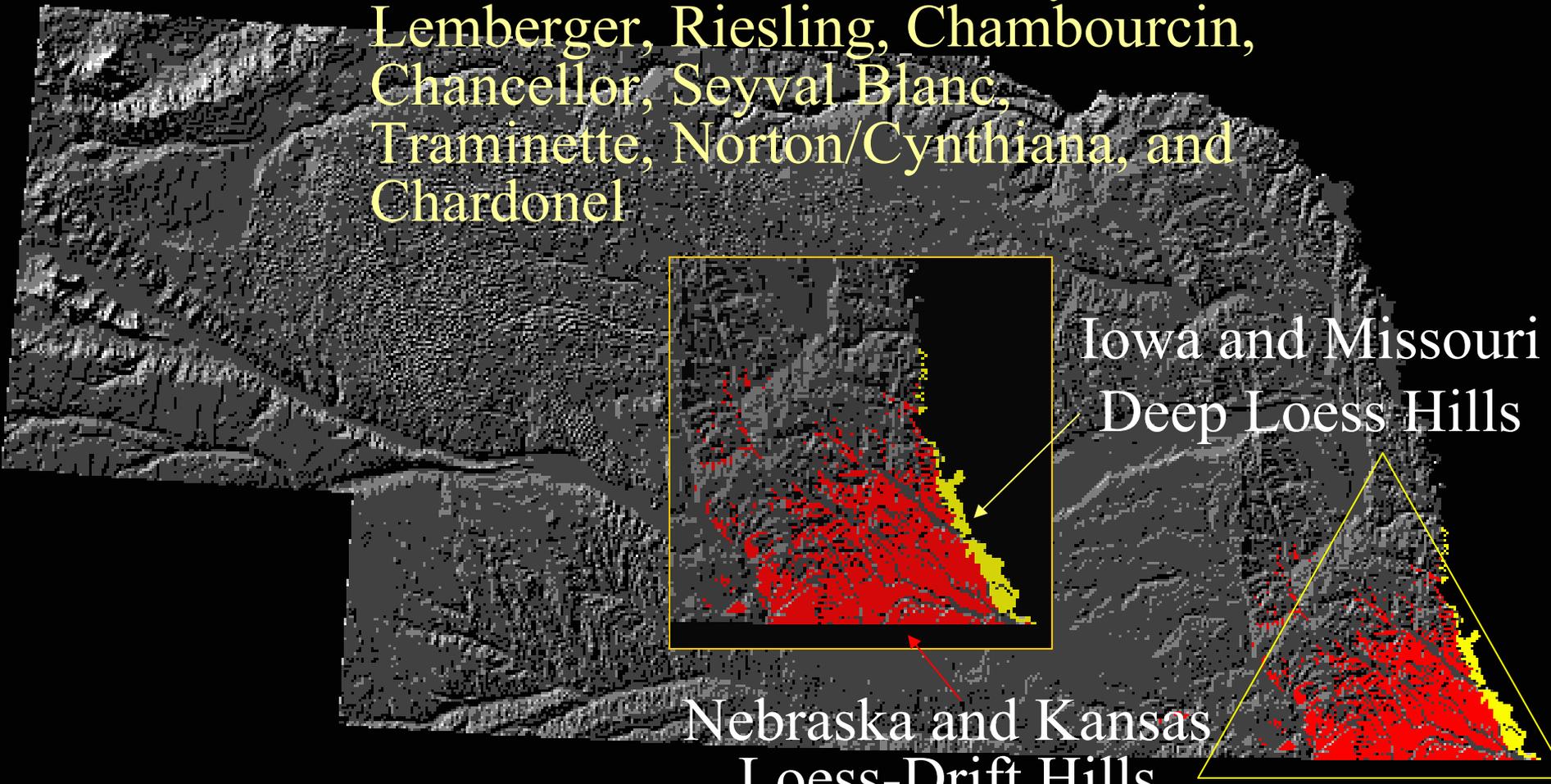
Latitude controlled

Nebraska Loess  
Uplands and Till Plains



# Vinifera Triangle in Nebraska

Cabernet Franc, Chardonnay,  
Lemberger, Riesling, Chambourcin,  
Chancellor, Seyval Blanc,  
Traminette, Norton/Cynthiana, and  
Chardonel



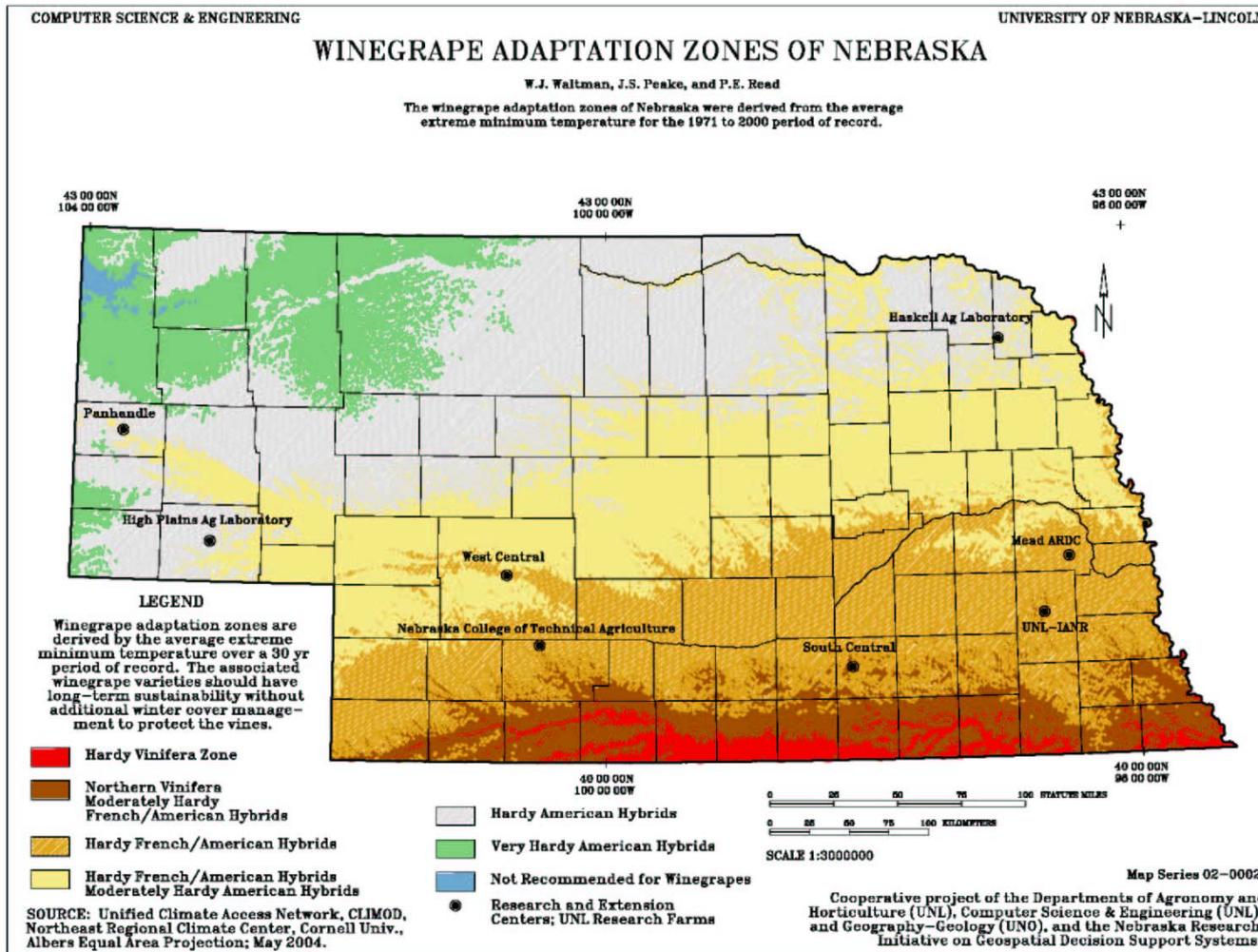
Iowa and Missouri  
Deep Loess Hills

The image shows a topographic map of the central United States, specifically the region around the Vinifera Triangle in Nebraska. The map is rendered in grayscale, showing the terrain's elevation. A yellow triangle highlights the Vinifera Triangle region. An inset map provides a closer look at this triangle, showing a red and yellow shaded area. Arrows point from the text labels to the corresponding regions on the map.

Nebraska and Kansas  
Loess-Drift Hills

# Summary and Conclusions

## Maps of “genotype x environment”



☀ Trends toward warming of T<sub>minimum</sub> extremes in the past 10 years in southeast and southcentral Nebraska

☀ Lengthening of frost-free period in the Republican River Valley

☀ Although a warming trend allows introduction of more vinifera and French/ American hybrids that will survive, pre-mature budbreak limits consistent harvests