

Volatility in the Evolving Cool Climate Wine Regions of Ontario

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- **Definition:** Volatility is the pace at which a climatic variable or index (temperature or precipitation) moves higher or lower over a time period, and how widely it varies or how extreme is the fluctuation

What are Extreme Climatic Events in Viticulture

- An extreme climate event is the exceedance of a threshold value by a climate variable on a particular occasion or one or more occasions within a time period for a particular crop
- Extreme events are relatively more sensitive to the variability of climate than to its average and this sensitivity is relatively greater the more extreme the event
- Extreme events can also be defined by the impact an event has on vineyard production that may involve excessive loss in yield and deterioration in quality or the destruction of the vines
 -
- Extreme events are more memorable as their impacts are more catastrophic and dramatic
- They may also form the primary climatic driver of adaptation strategies

Characterizing Extreme Events

Methods to characterize extreme events include:
percentile (90th and 10th percentile) thresholds,
duration- based indices or the tail of a weather event's
probability distribution



Georgian Bay

Grey

Lake Huron

Durham

Huron

PEC

Lake Ontario

Niagara

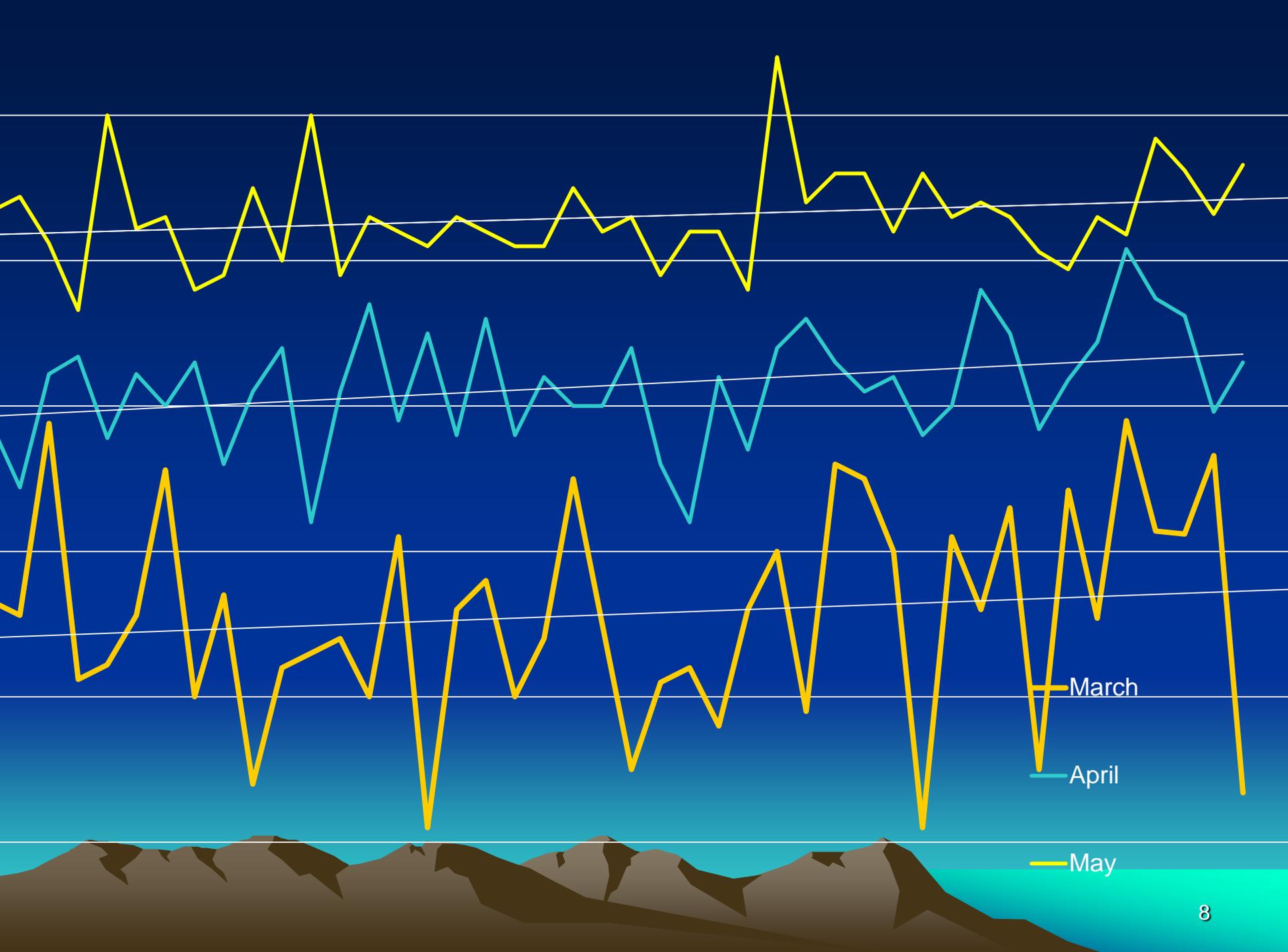
Norfolk

Lake Erie
North Shore

The Niagara Region Appellation

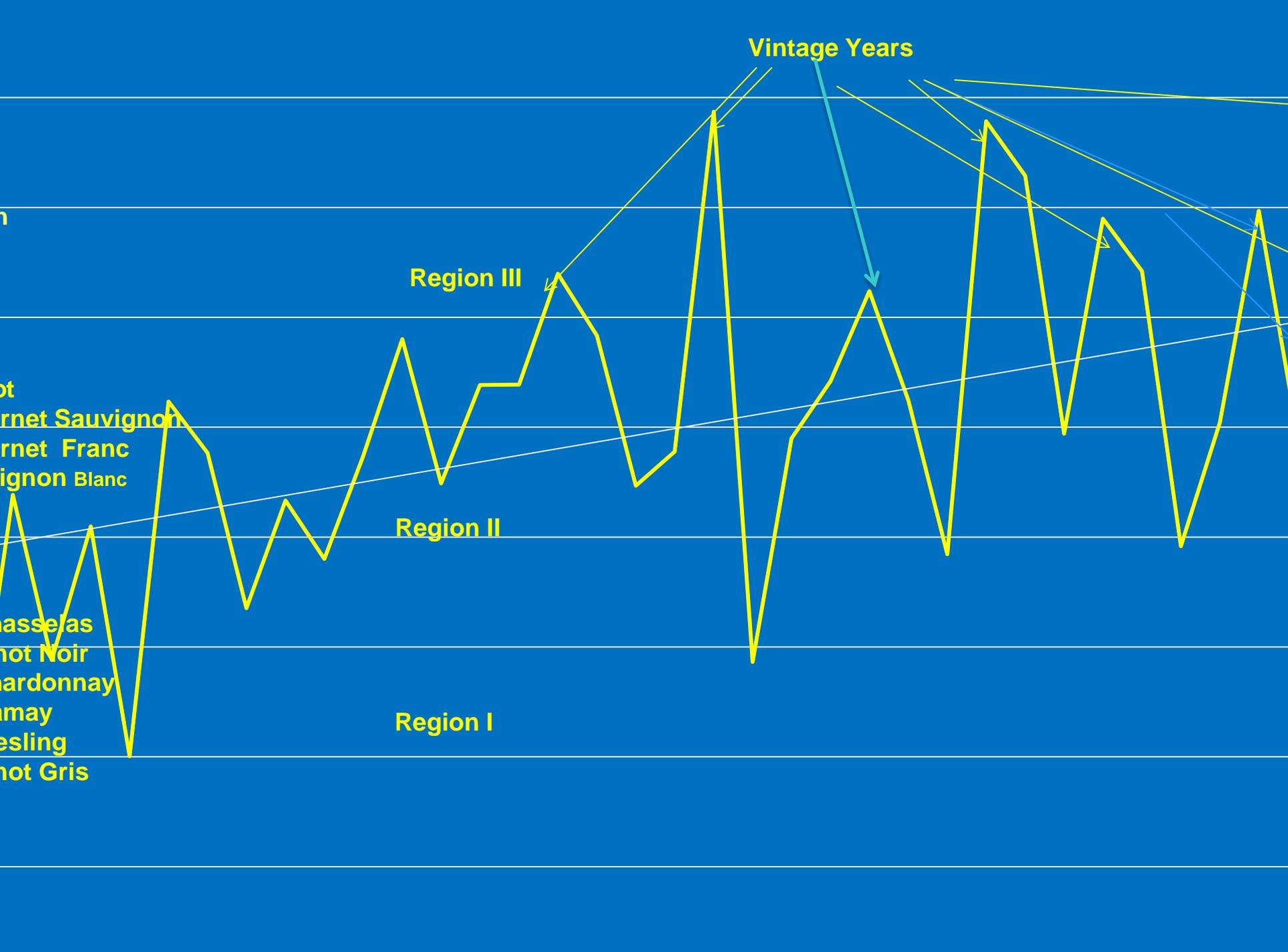


- Extreme Minimum Temperatures in Spring

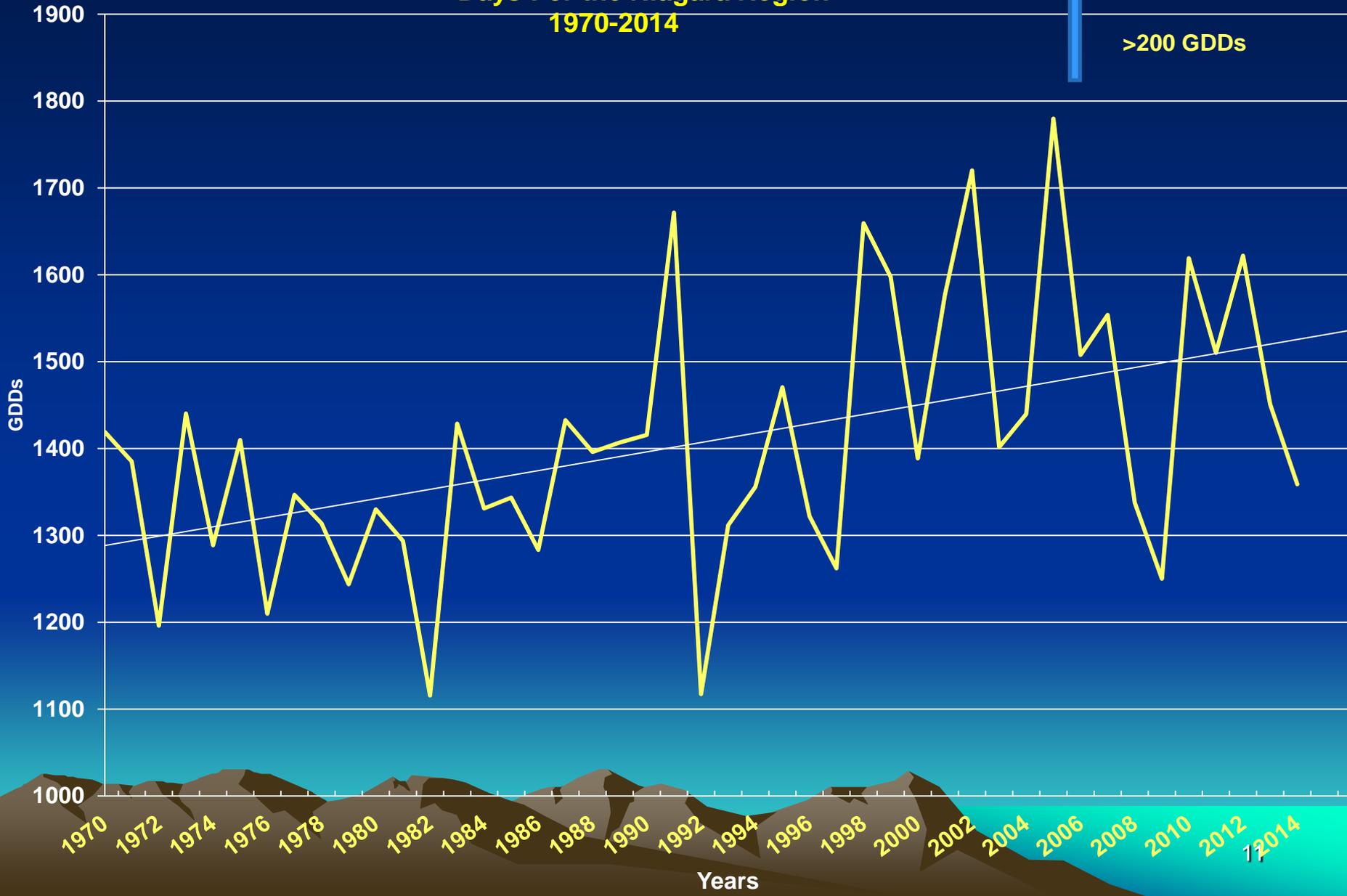


Impacts and Implications



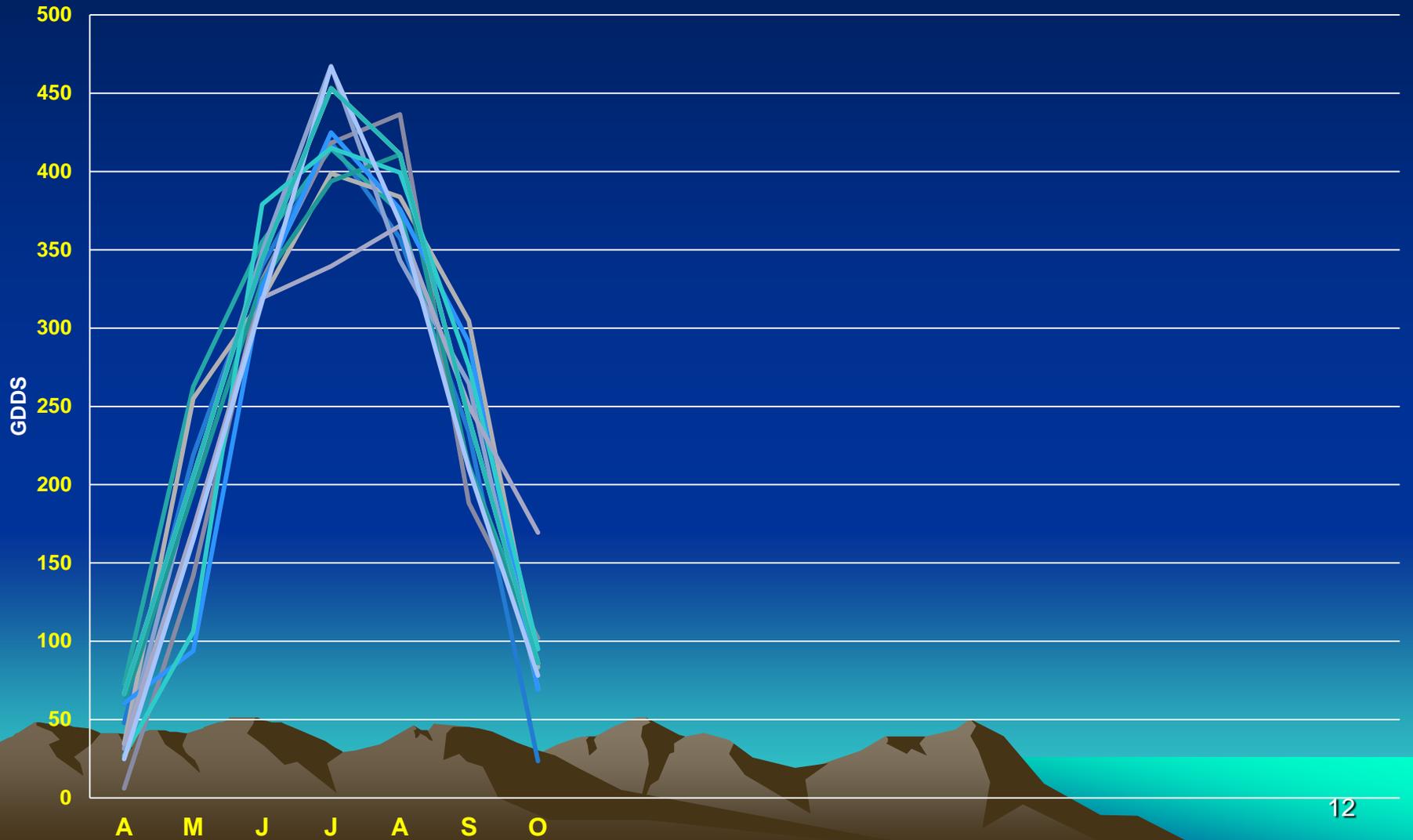


Long-Term Trends in Growing Degree Days For the Niagara Region 1970-2014

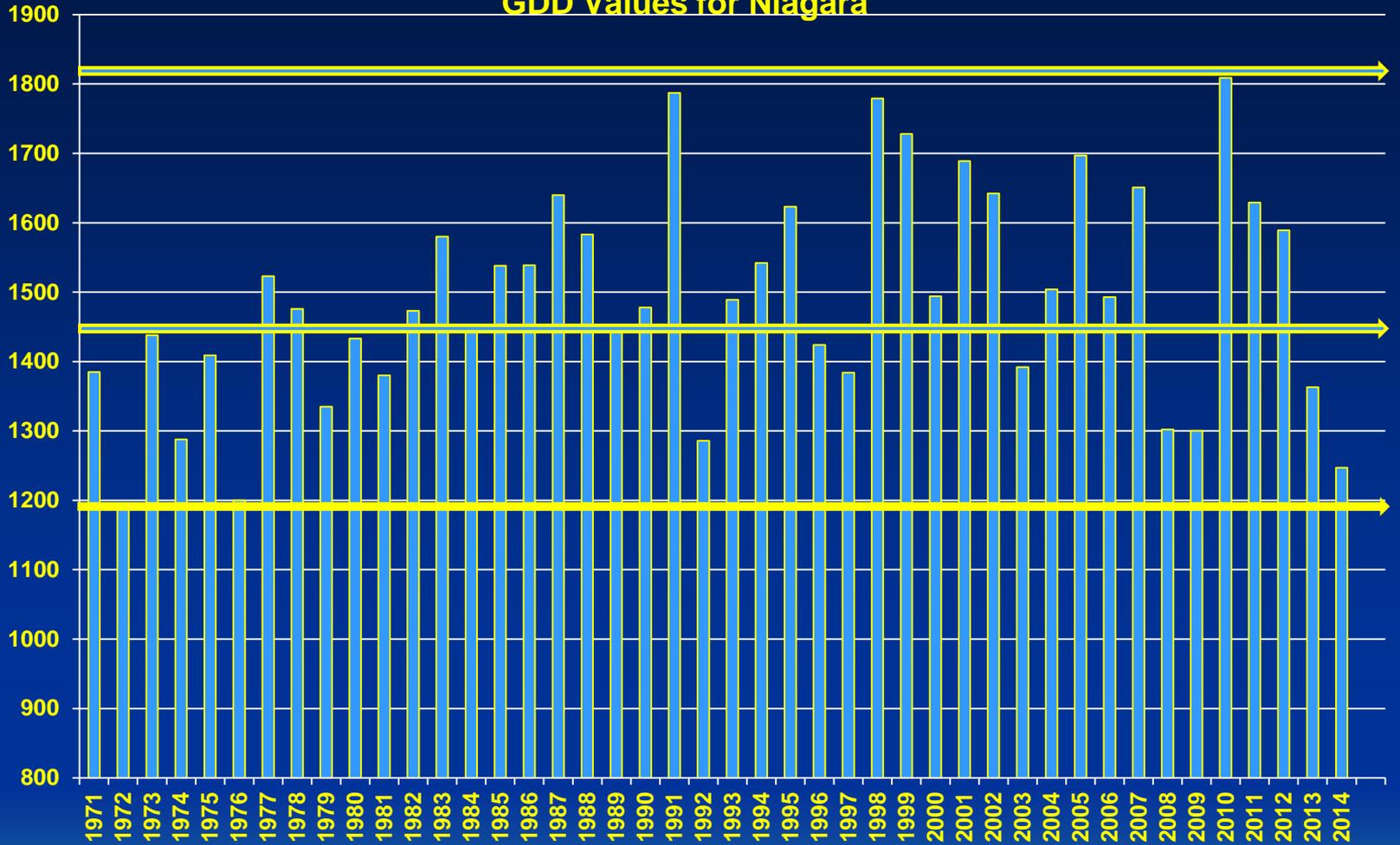


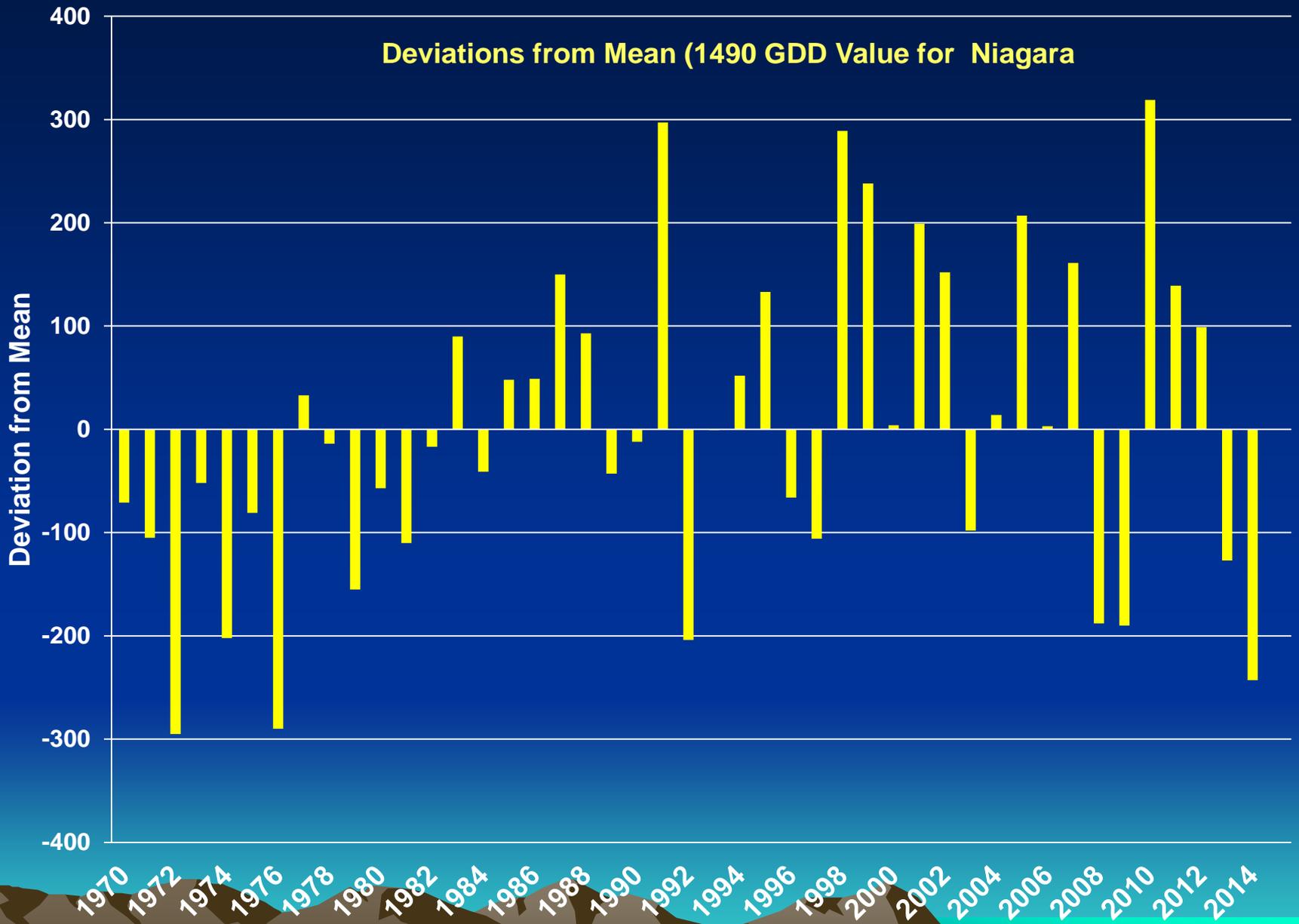
Vintage Years In Niagara

1987,1991, 1995,1998,
1999,2001,2002,2005,2007,2010,2011,2012



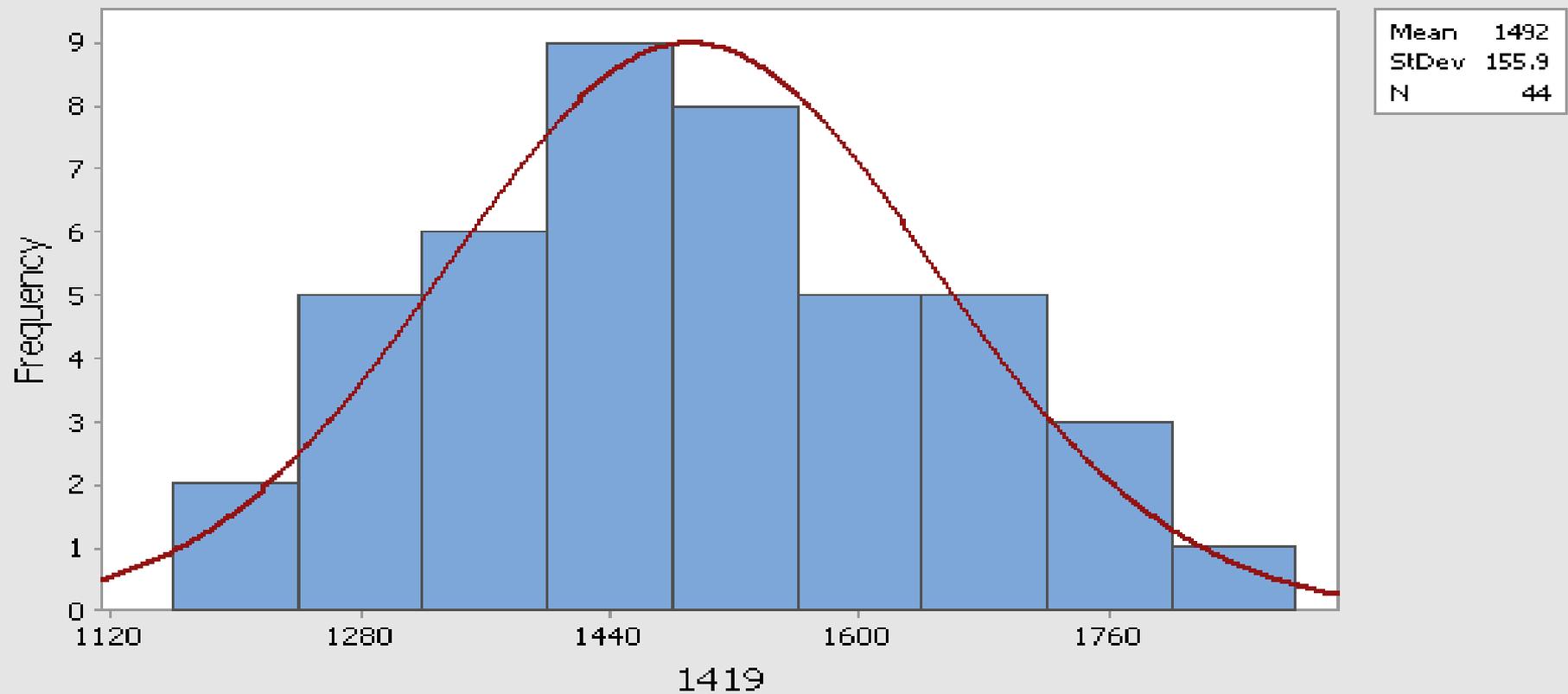
GDD Values for Niagara



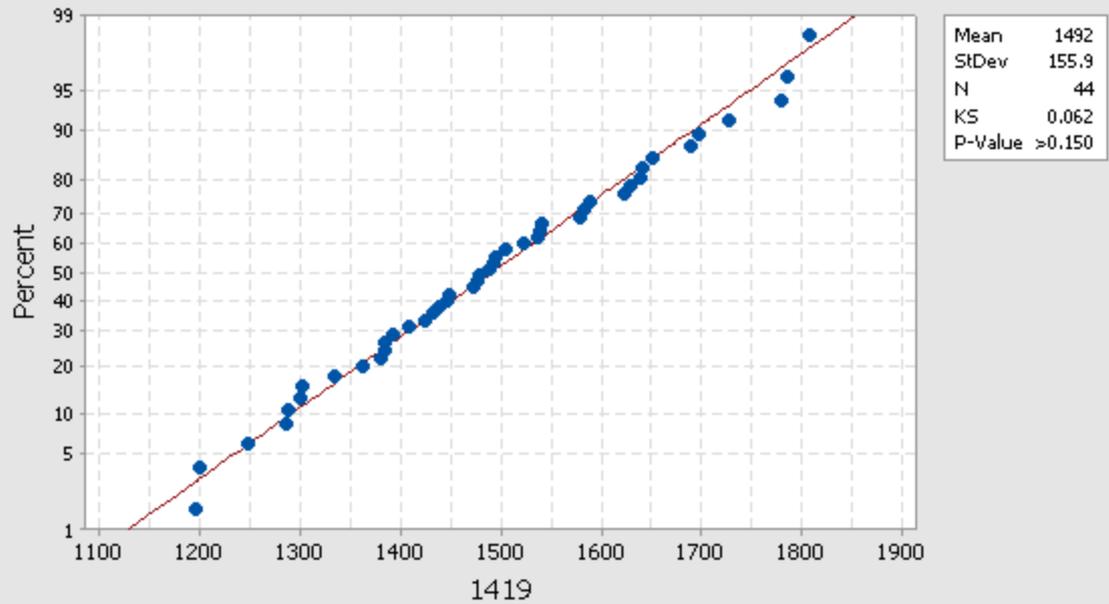


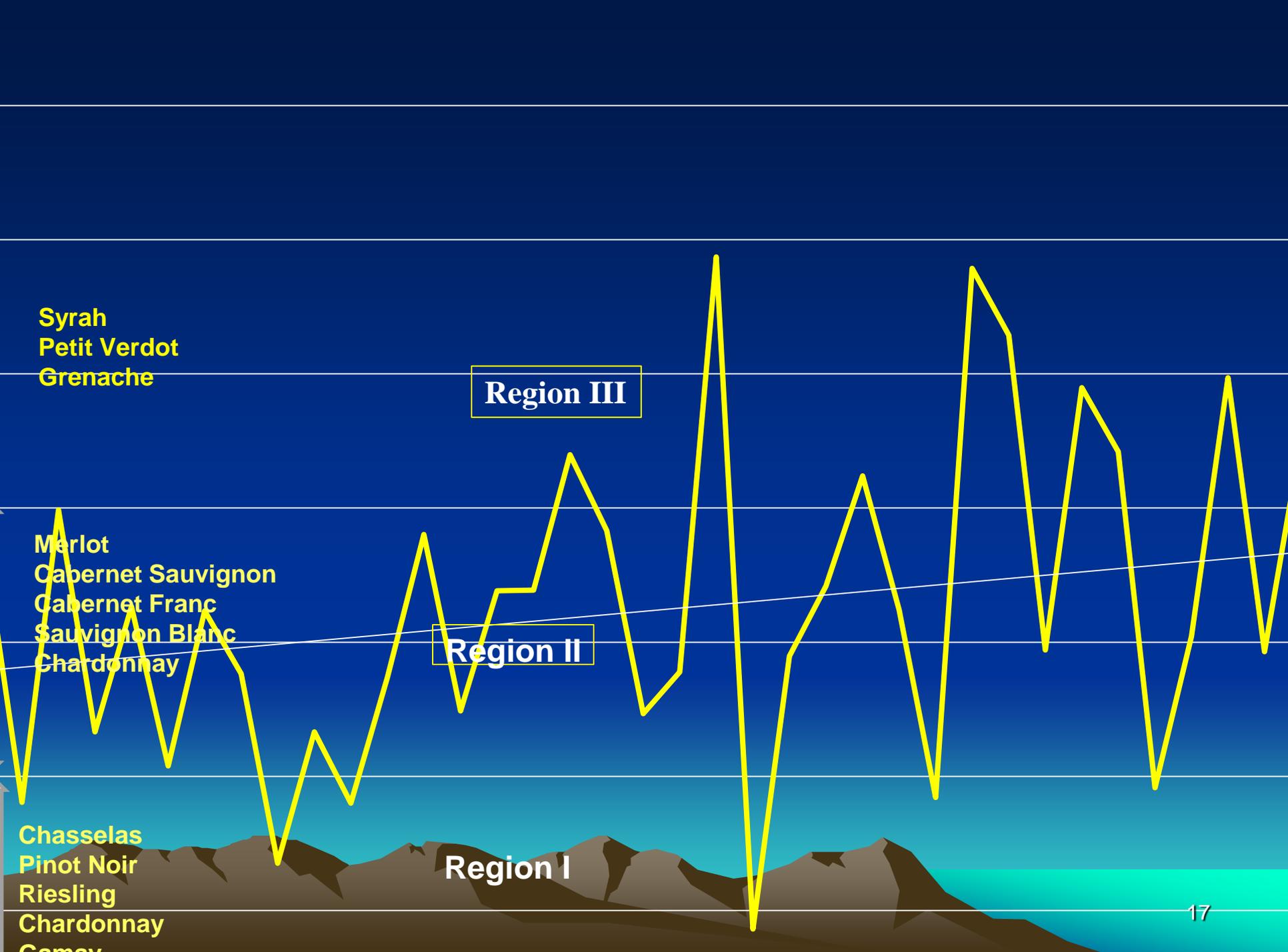
Histogram of GDD Values for Niagara Region

Normal



Probability Plot of GDD Values For Niagara Region
Normal





Syrah
Petit Verdot
Grenache

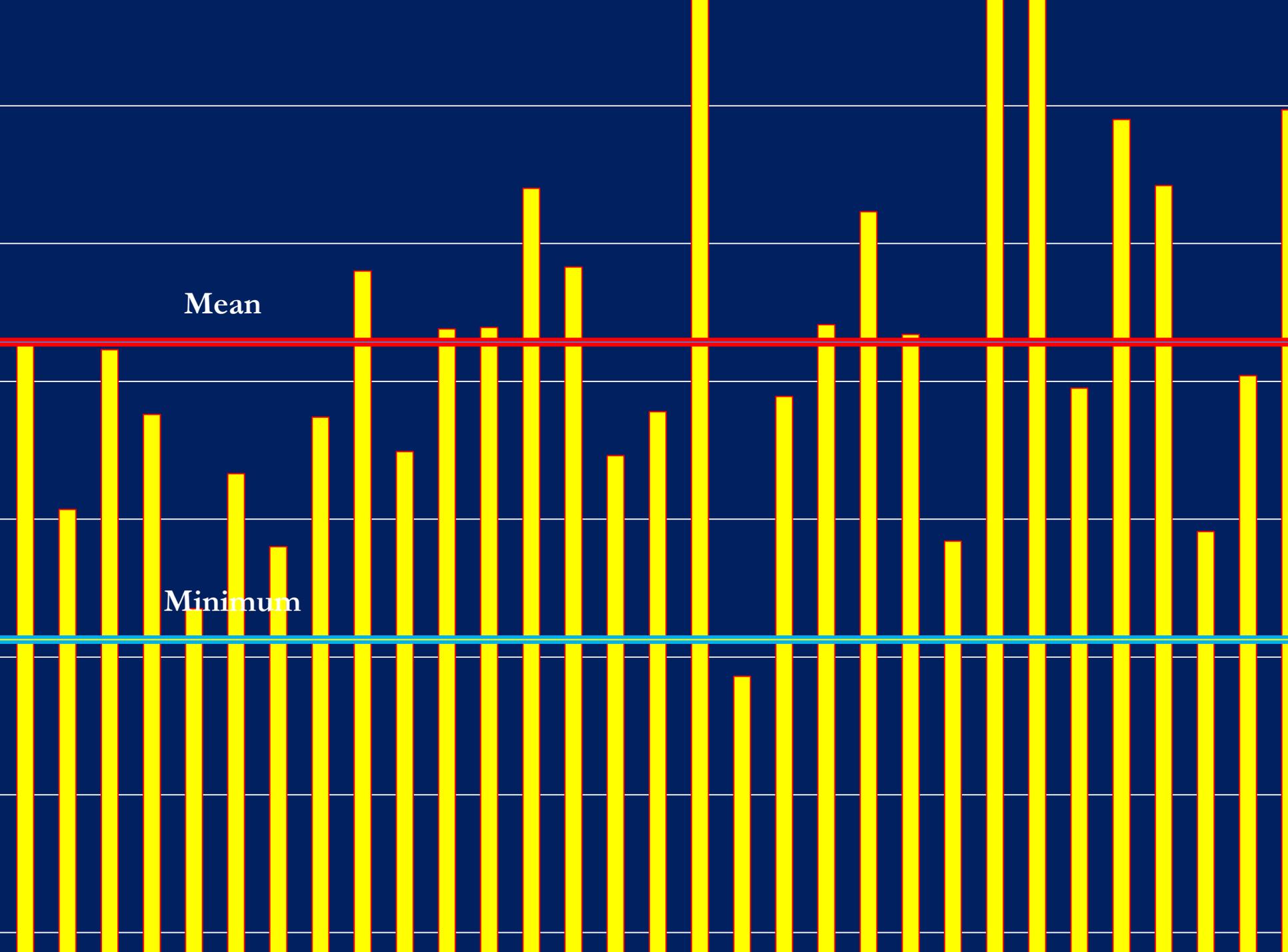
Region III

Merlot
Cabernet Sauvignon
Cabernet Franc
Sauvignon Blanc
Chardonnay

Region II

Chasselas
Pinot Noir
Riesling
Chardonnay
Gamay

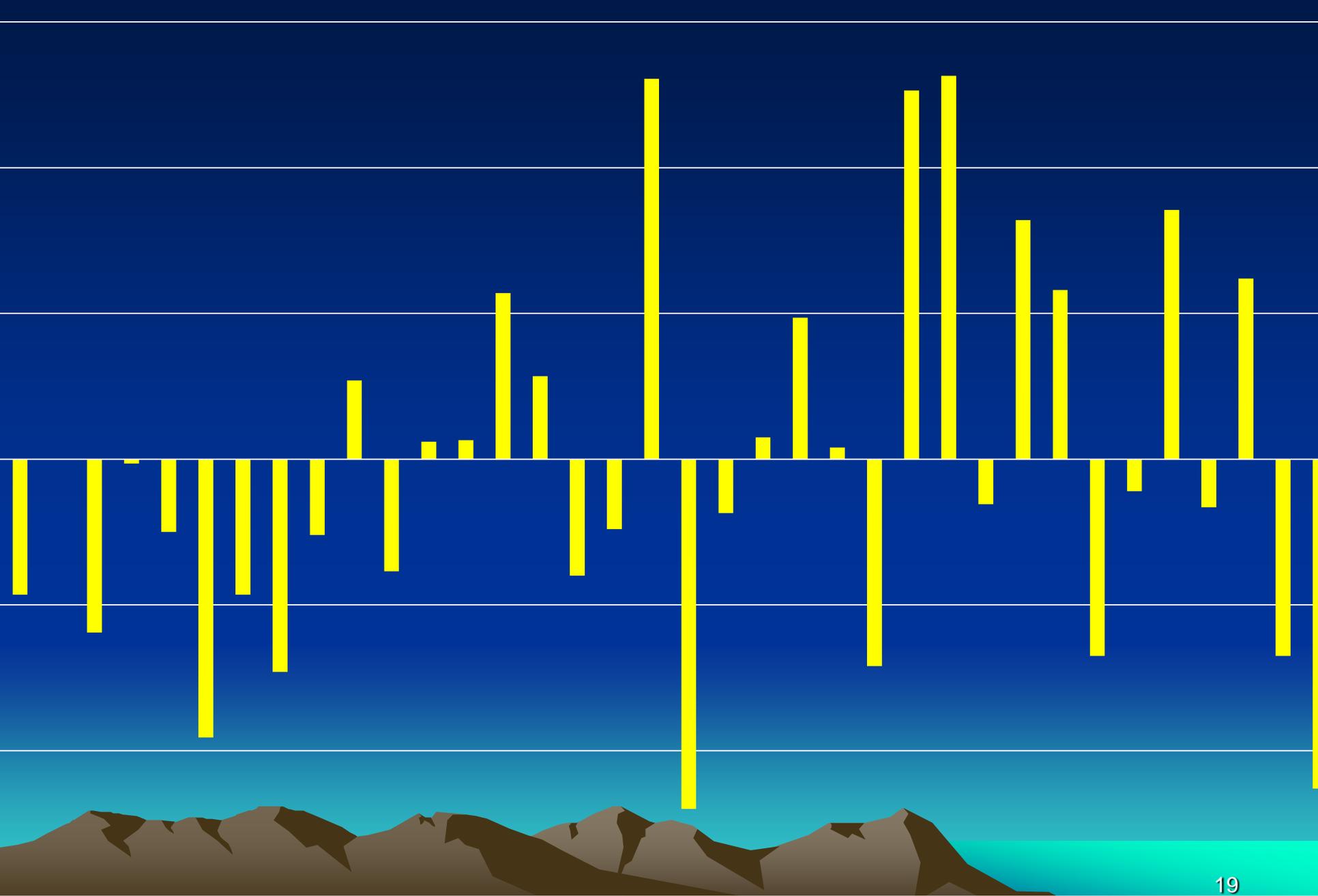
Region I



Mean

Minimum

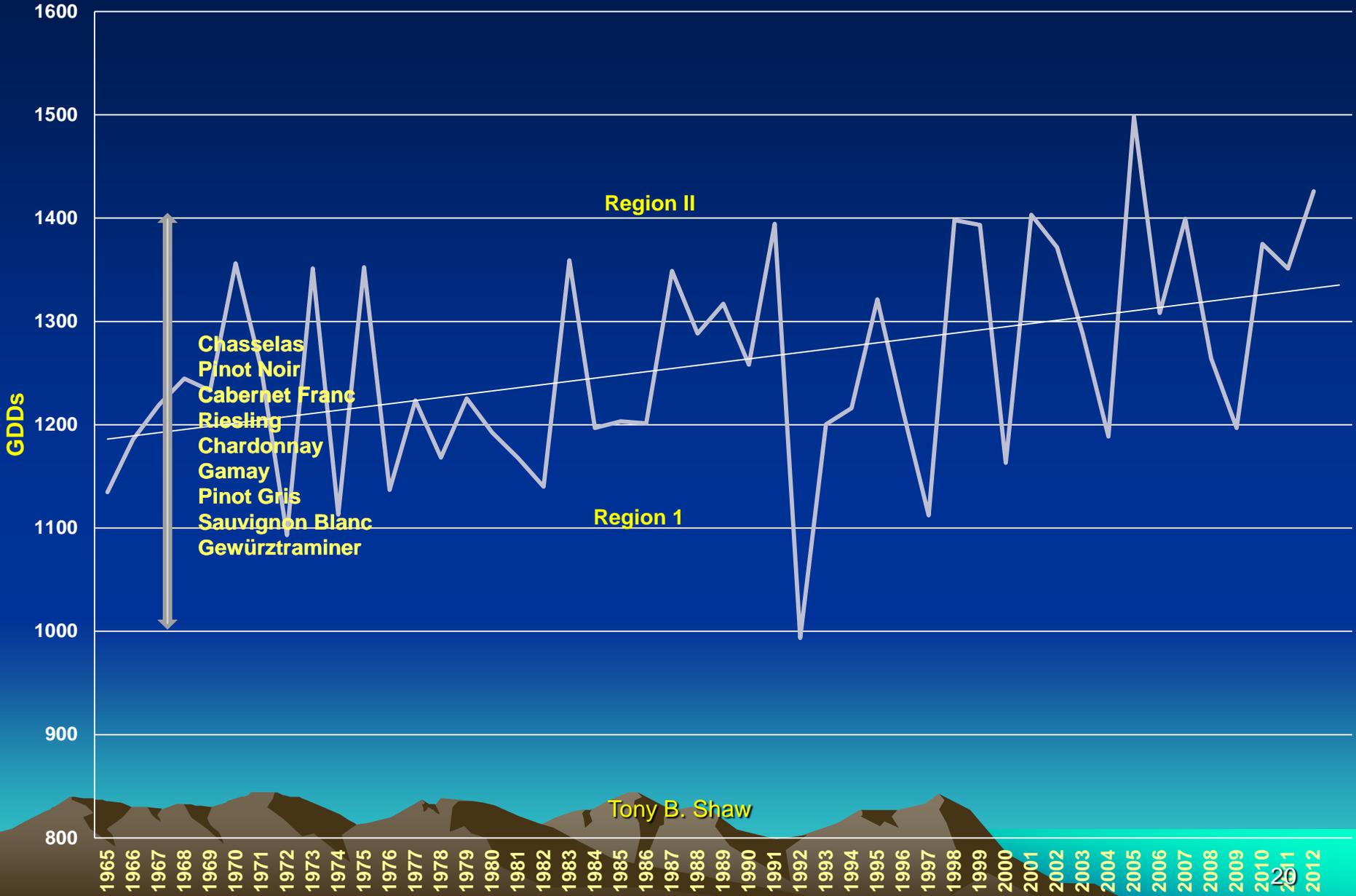
Deviations From Mean (1926) GDD value for Lake Erie North Shore



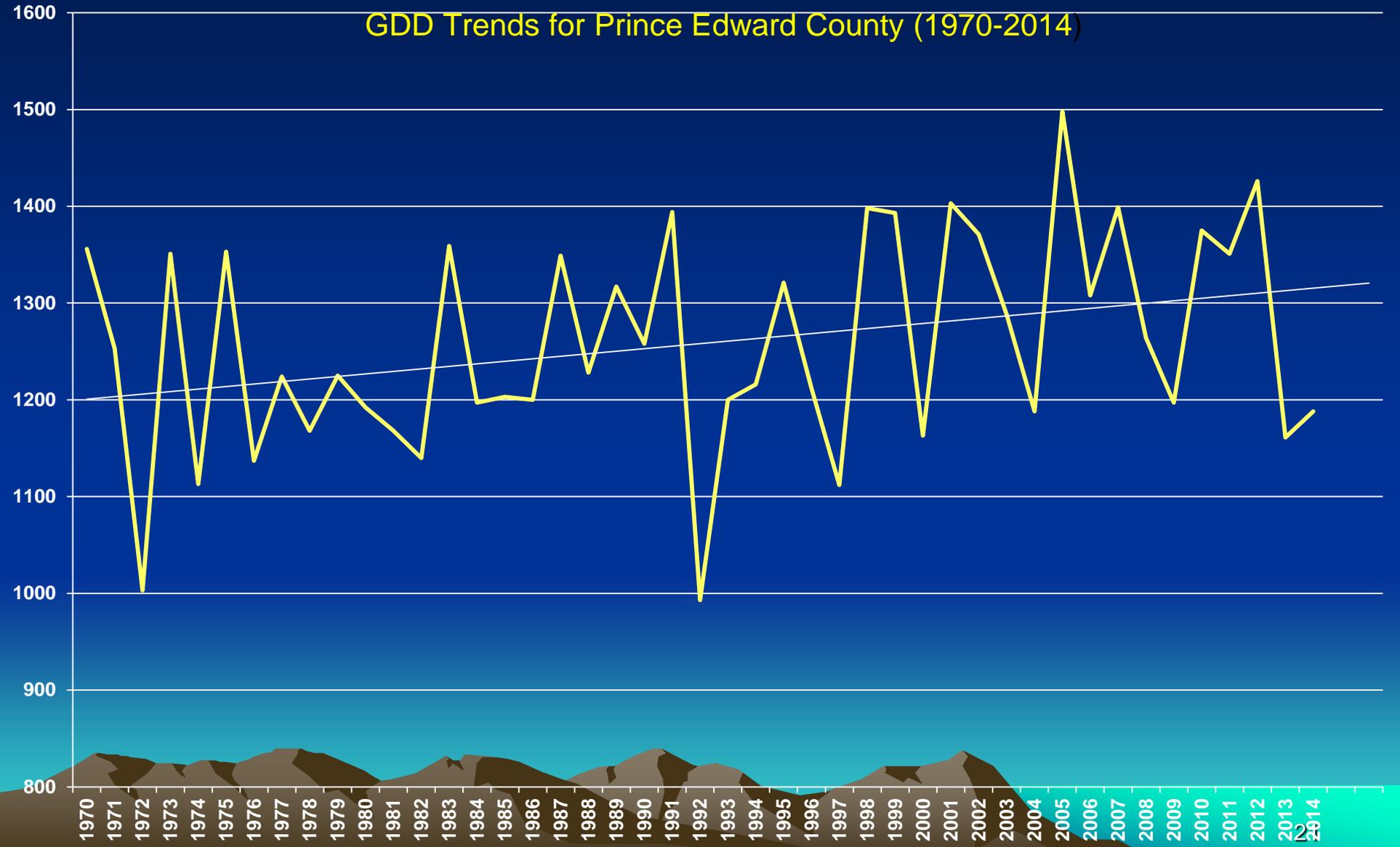
Prince Edward County 1970-2012

Mean=1258 GDDS

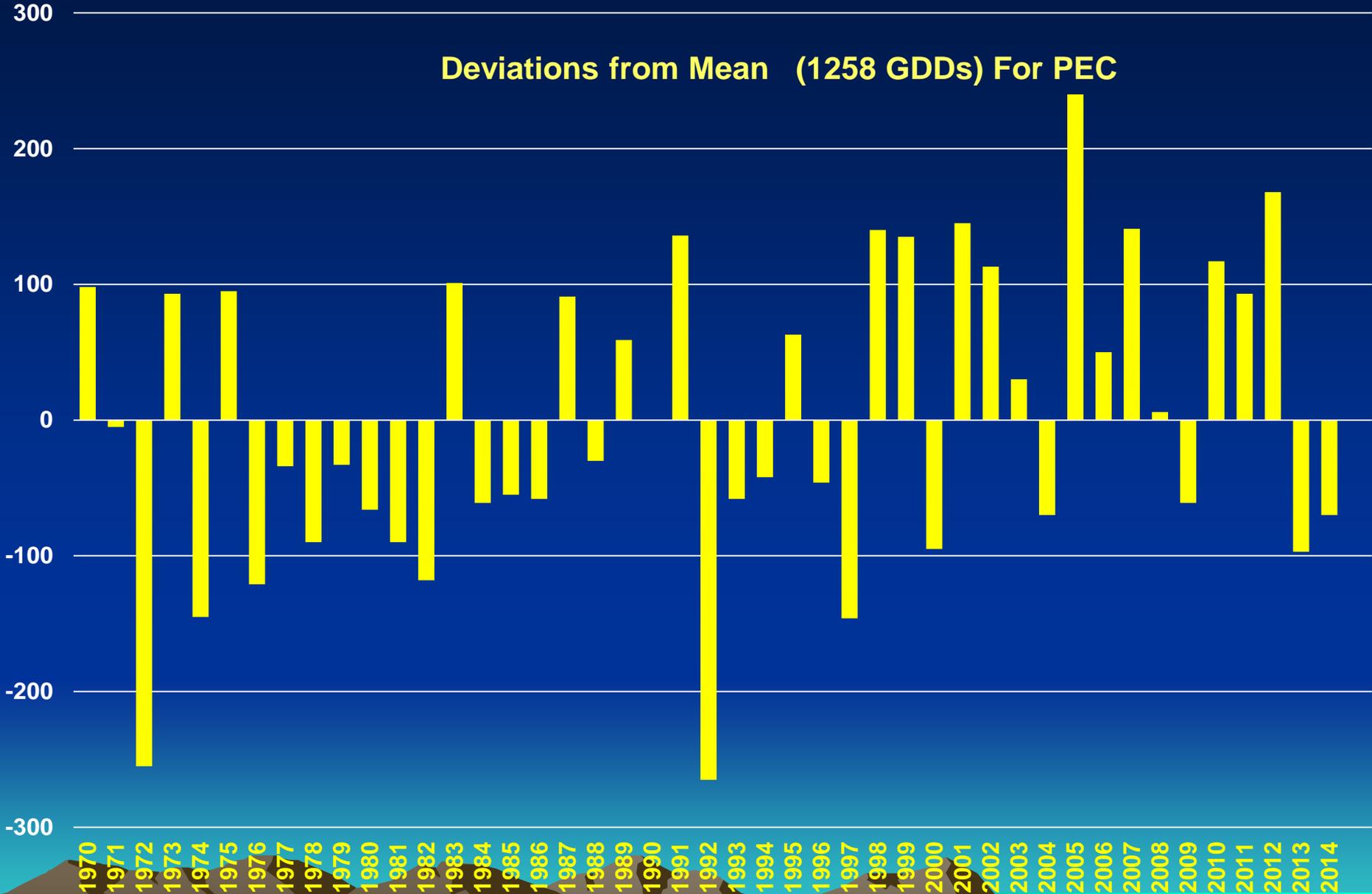
↑100 GDDs



GDD Trends for Prince Edward County (1970-2014)



Deviations from Mean (1258 GDDs) For PEC



hasselas
inot Noir
hardonnay
amay
abernet Franc
iesling
ewürzraminer

Region I



Projected Changes in GDD to 2070s using the downscaled HADCM3

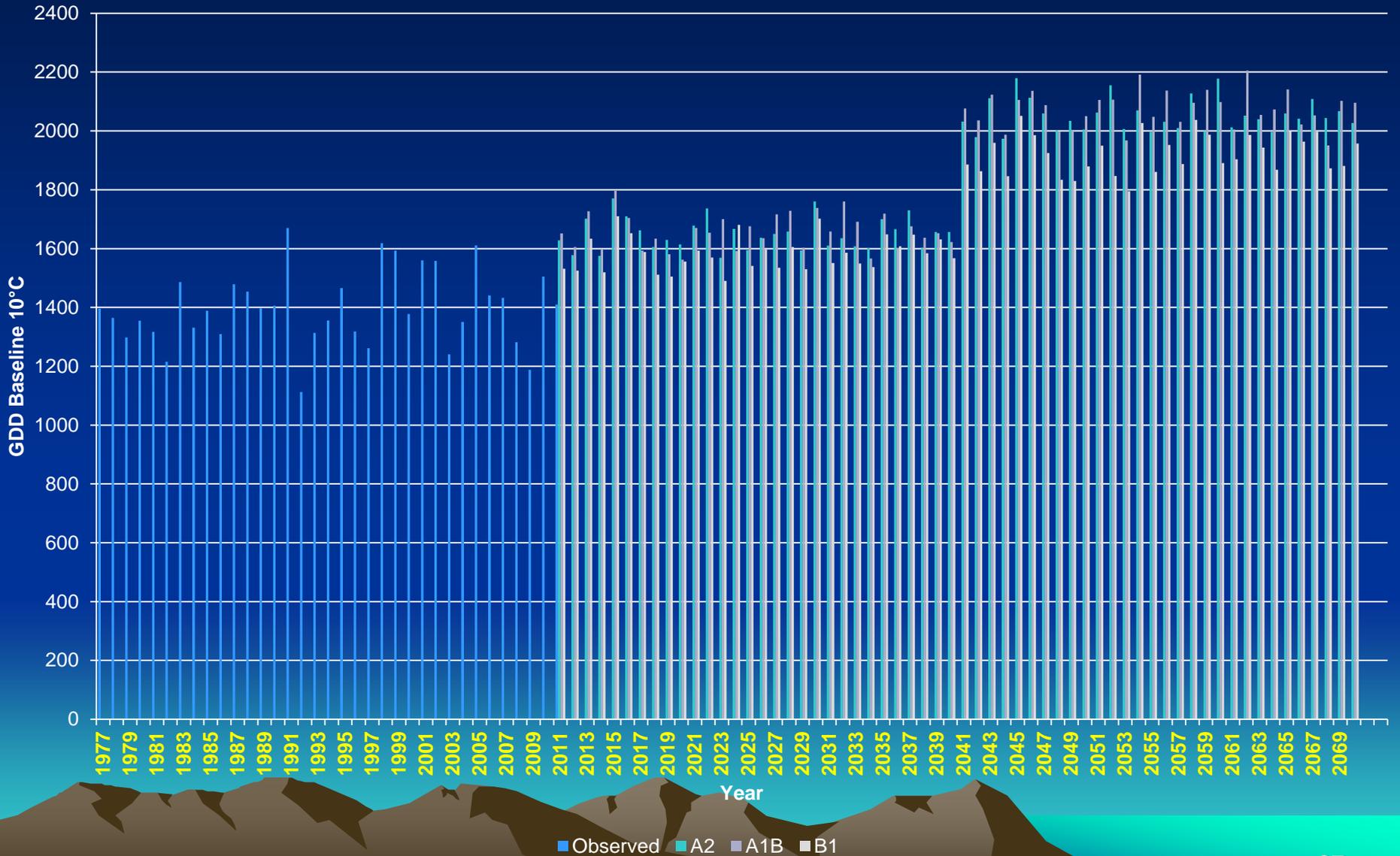
A2- Scenario- A heterogeneous world, increasing population, slower and fragmented technological change

A1B- Rapid population that peaks in mid-century and declines followed by rapid introduction of energy-efficient technologies and a balance between fossil and non-fossil fuels

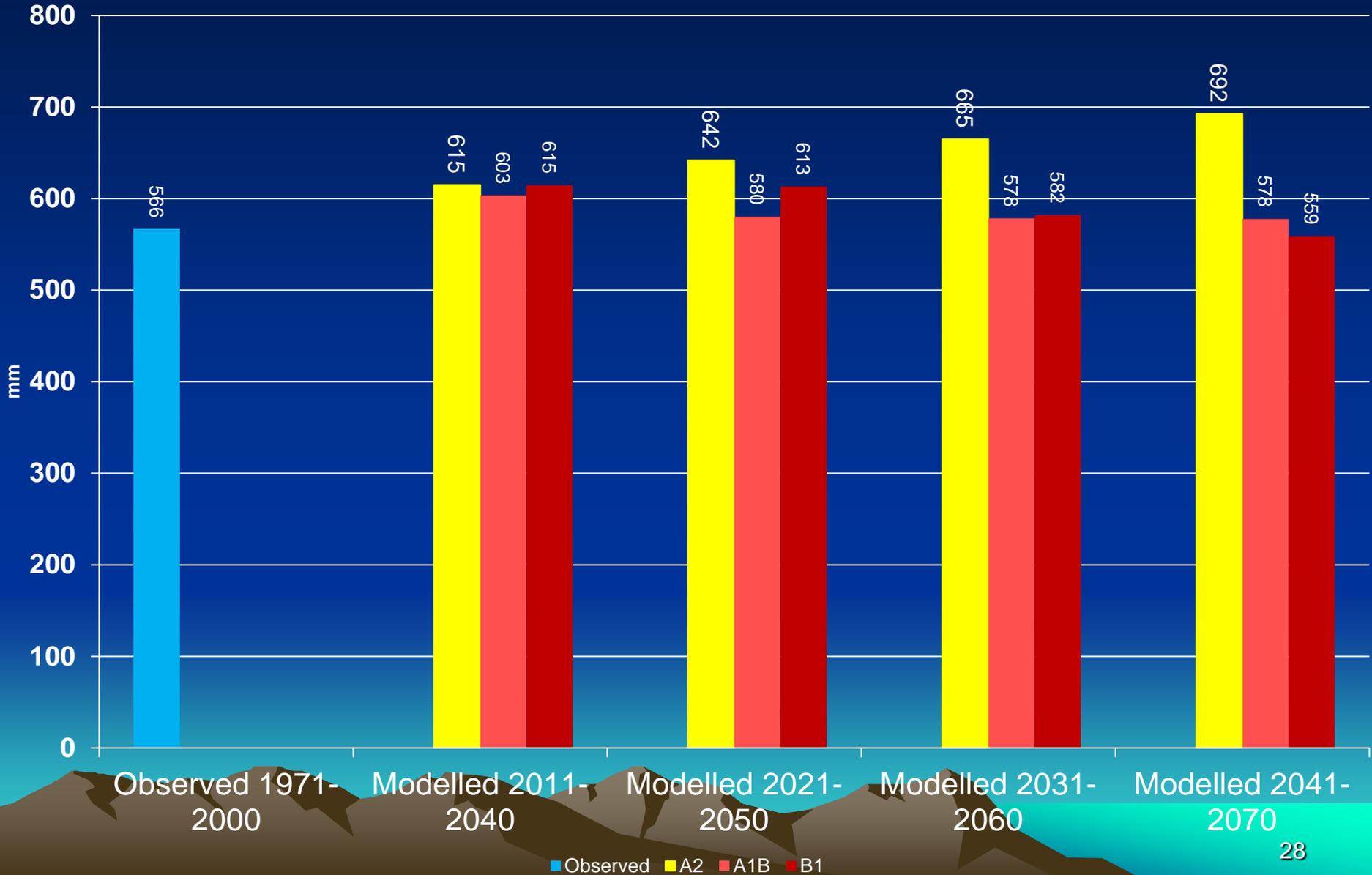
B1- A convergent world, population peaks in mid-century, and declines, global solutions and emphasis on social and environmental sustainability

Observed and Projected GDDs

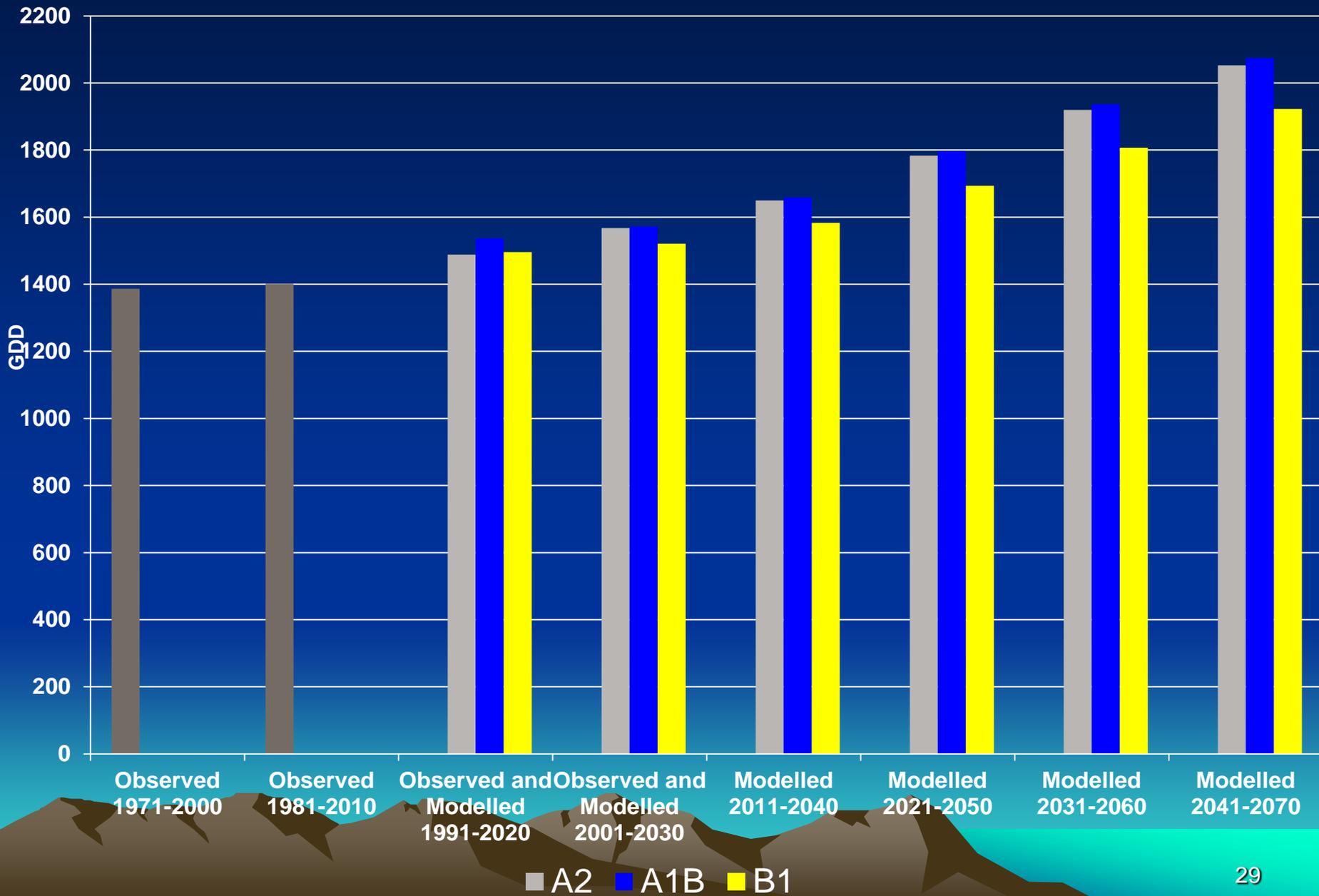
Past and Future Growing Degree Days Vineland, Ontario, Canada



Past and Projected Climate Normals Growing Season (AMJJASO) Total Precipitation Vineland, Ontario, Canada



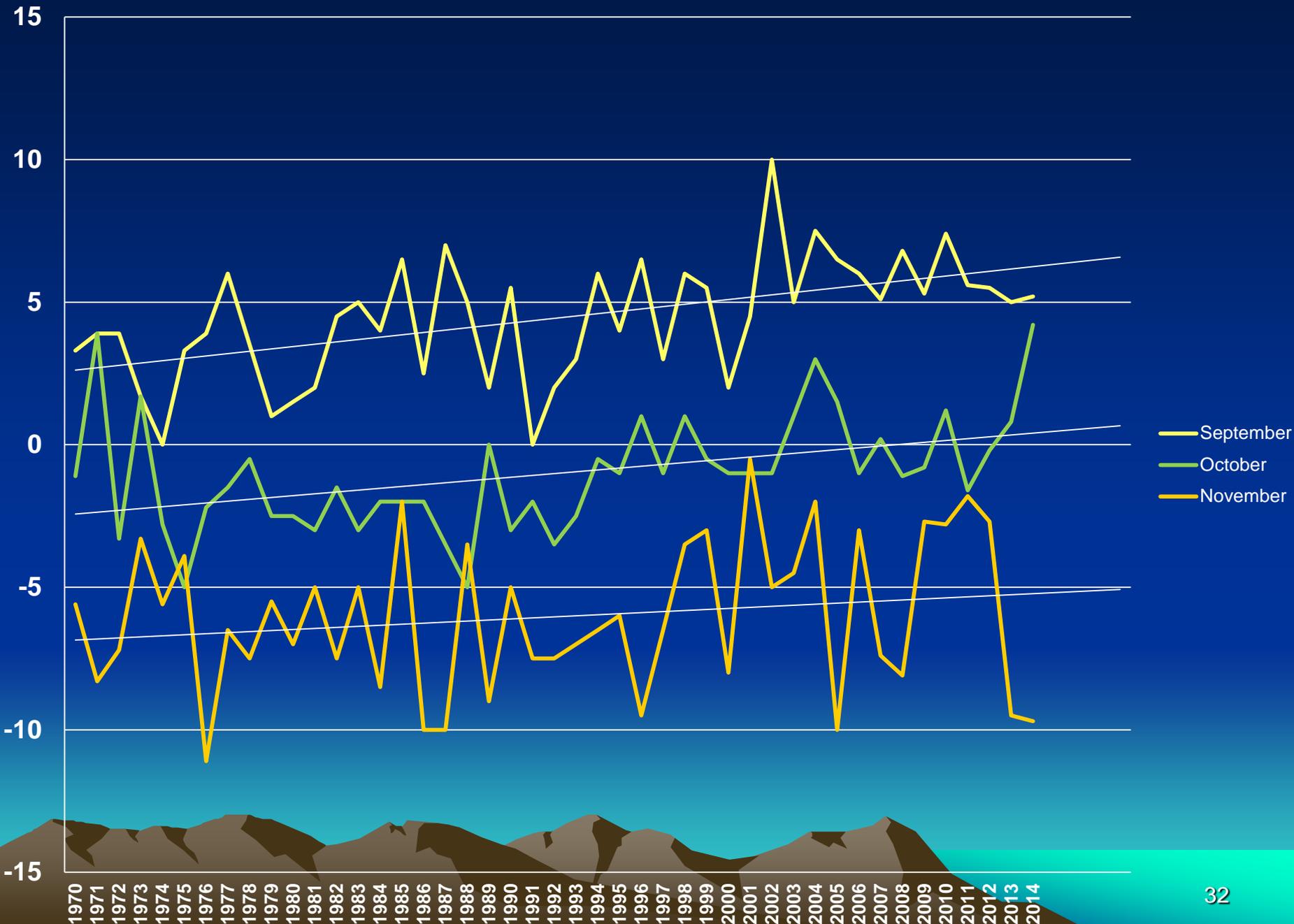
Past and Future Climate Normals Growing Degree Days Vineland, Ontario, Canada



Observed and Projected Extreme Minimum Temperatures

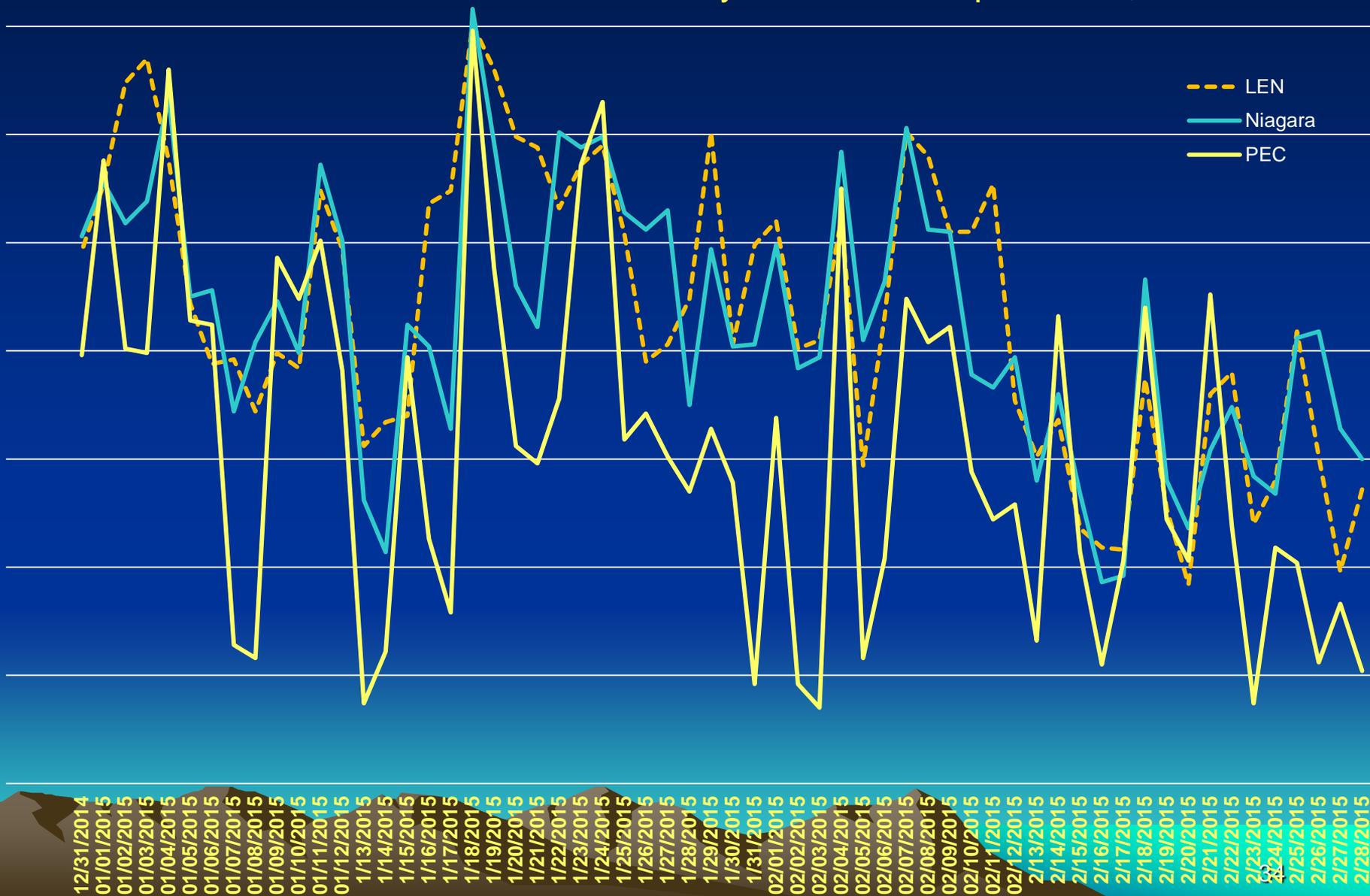
- Extreme Minimum Temperatures in Fall

Vineland's Lowest Fall Minimum Temperatures

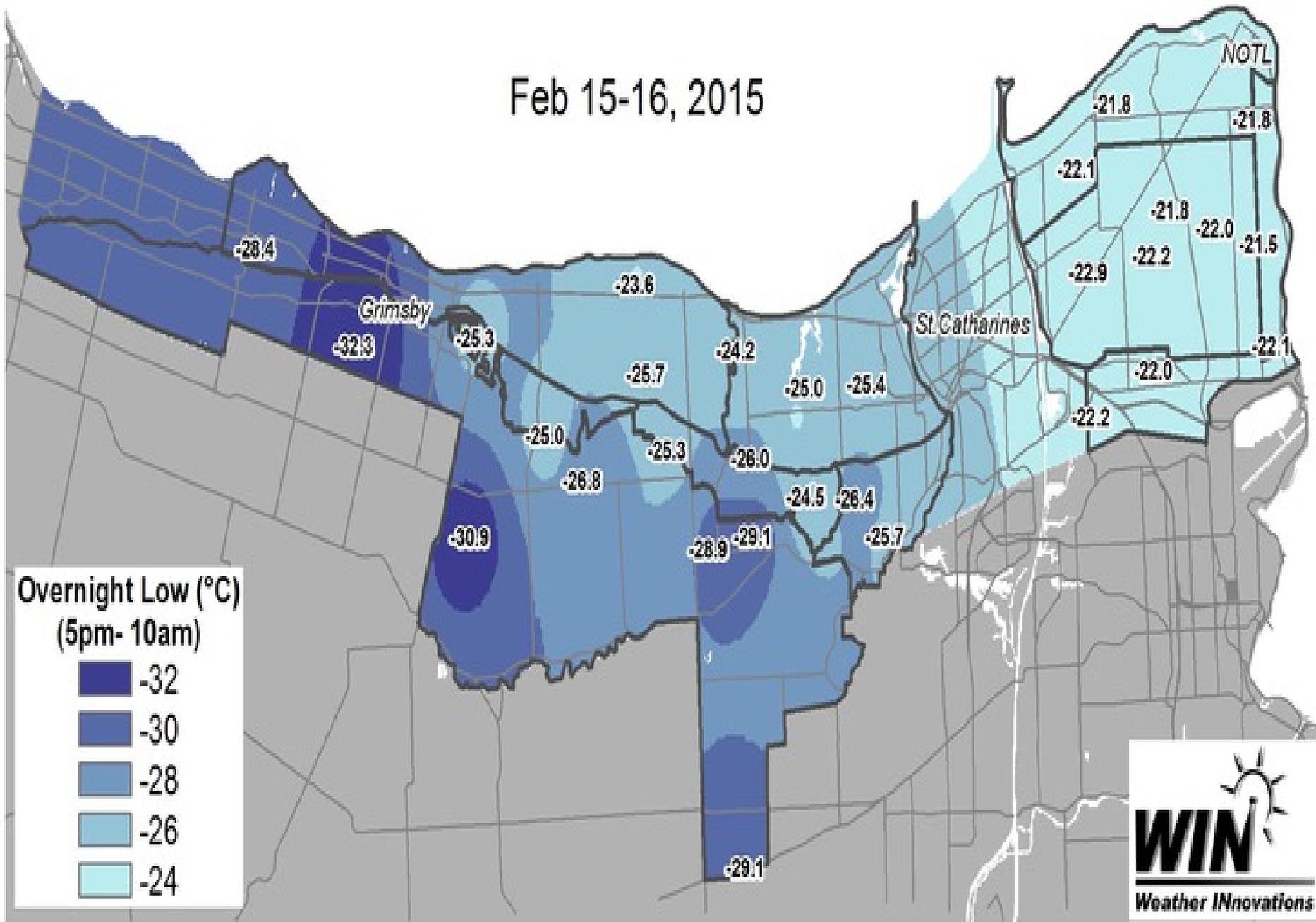


Extreme Minimum Temperatures in Winter/ 2015

Short-Term Volatility in Winter Temperatures, J/F 2015



Feb 15-16, 2015

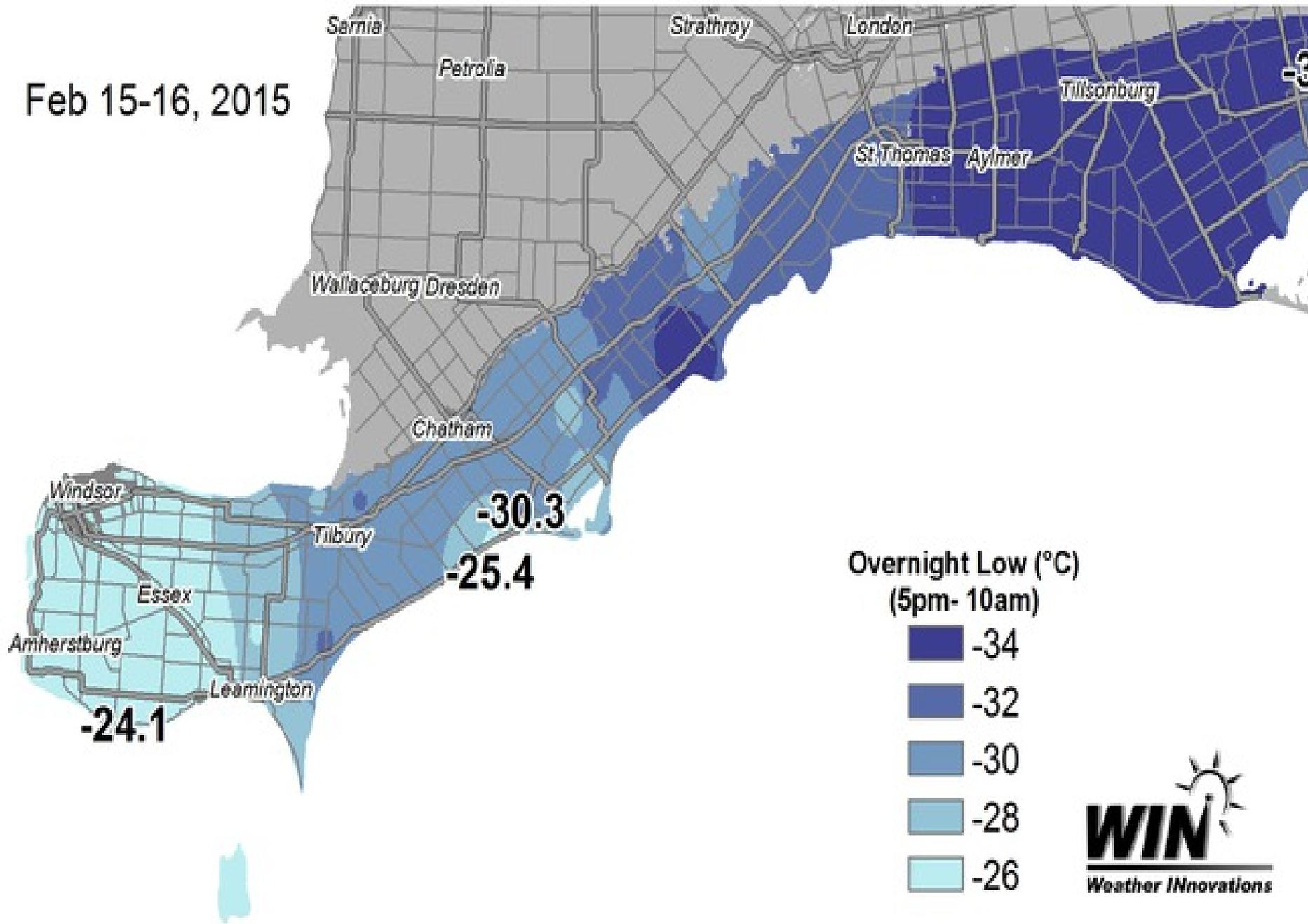


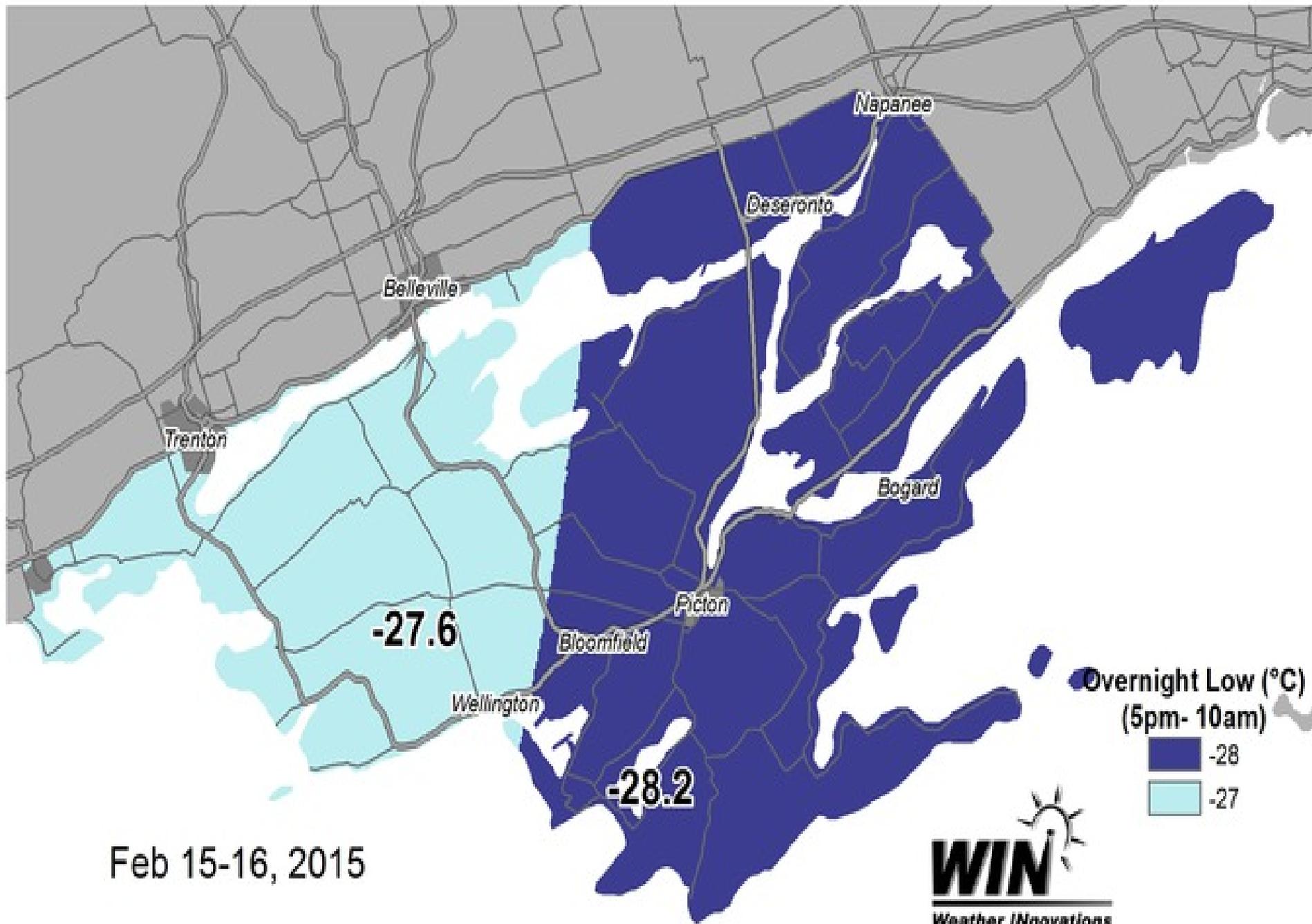
Overnight Low (°C)
(5pm - 10am)

- 32
- 30
- 28
- 26
- 24



Feb 15-16, 2015

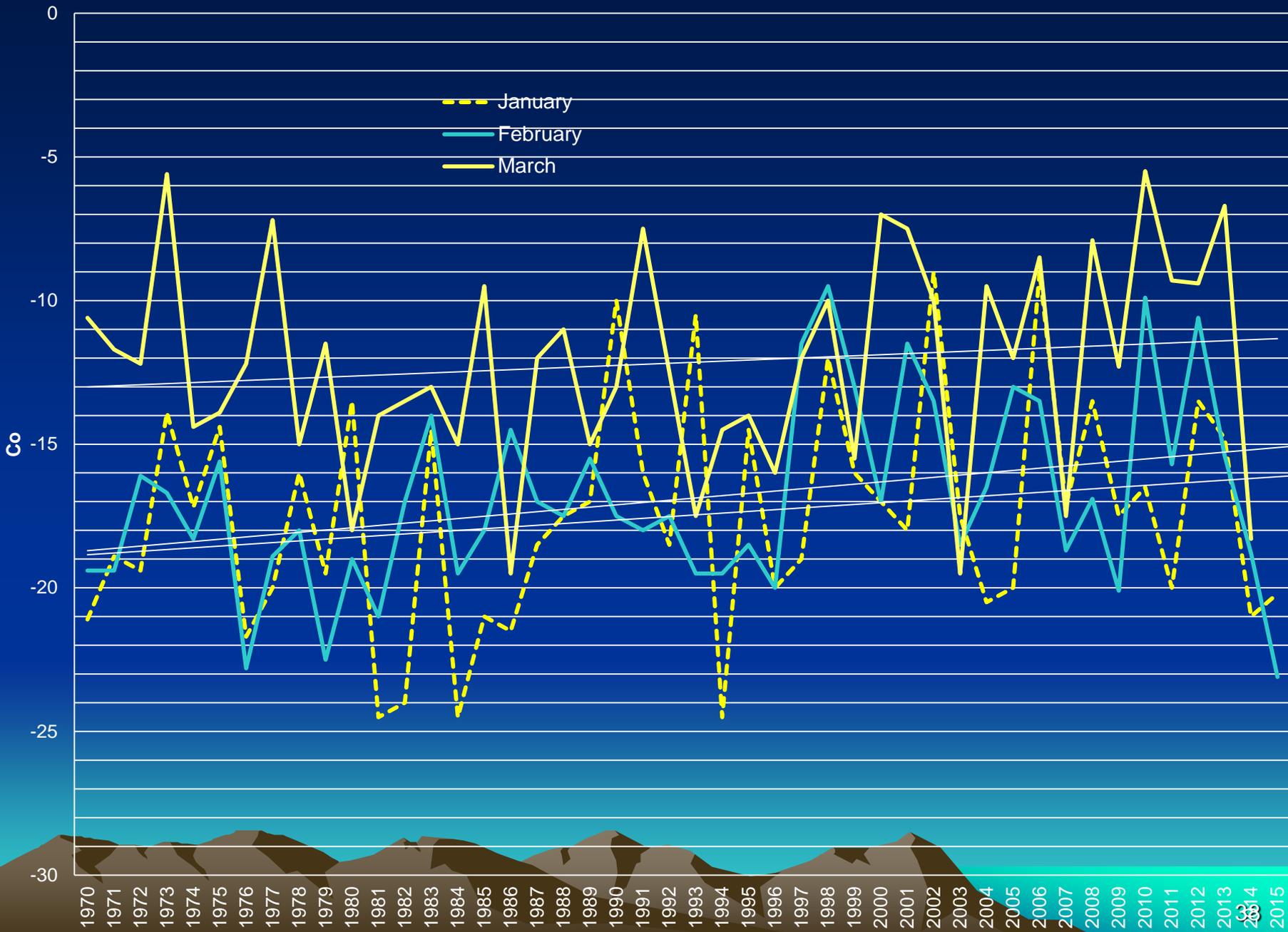




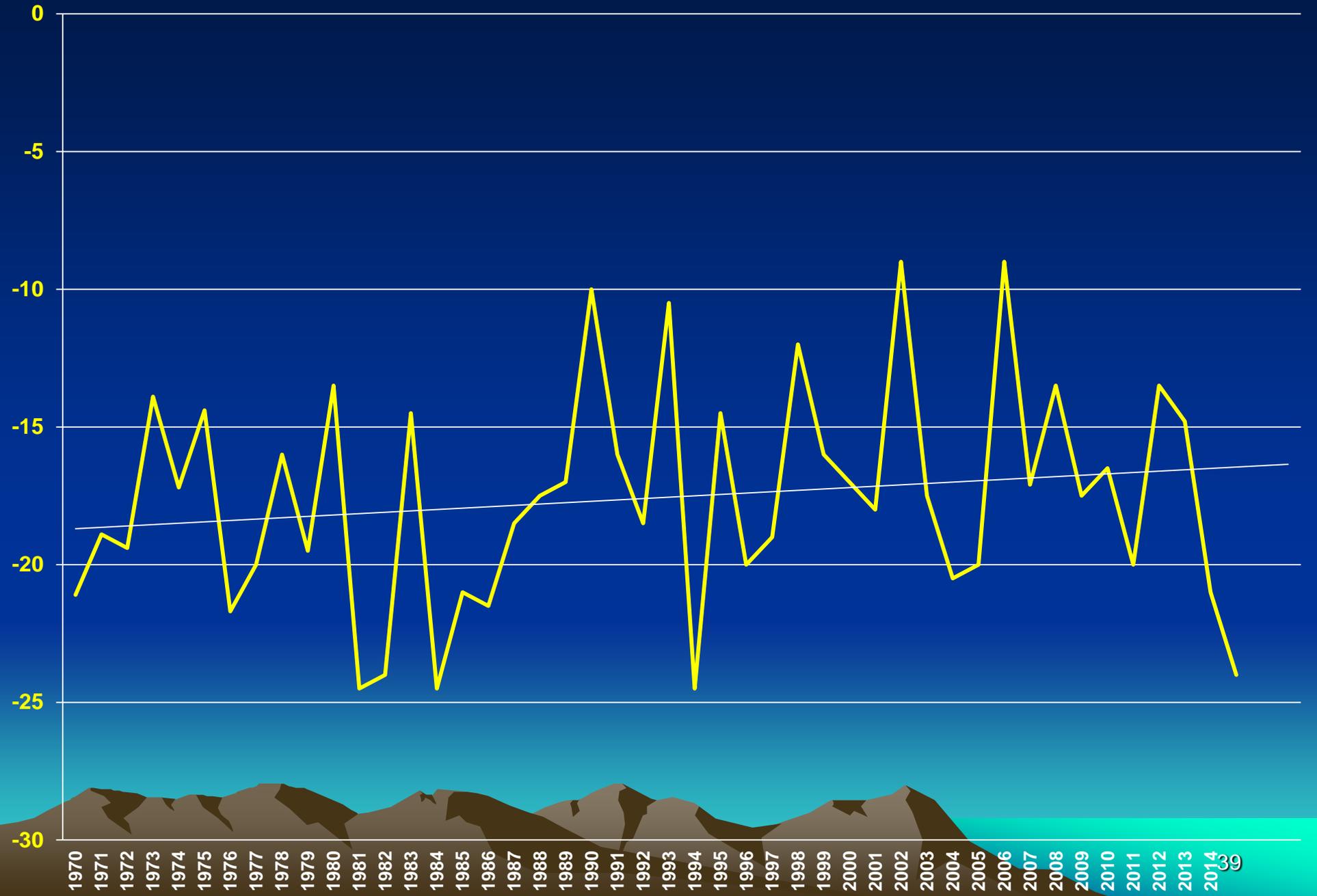
Feb 15-16, 2015



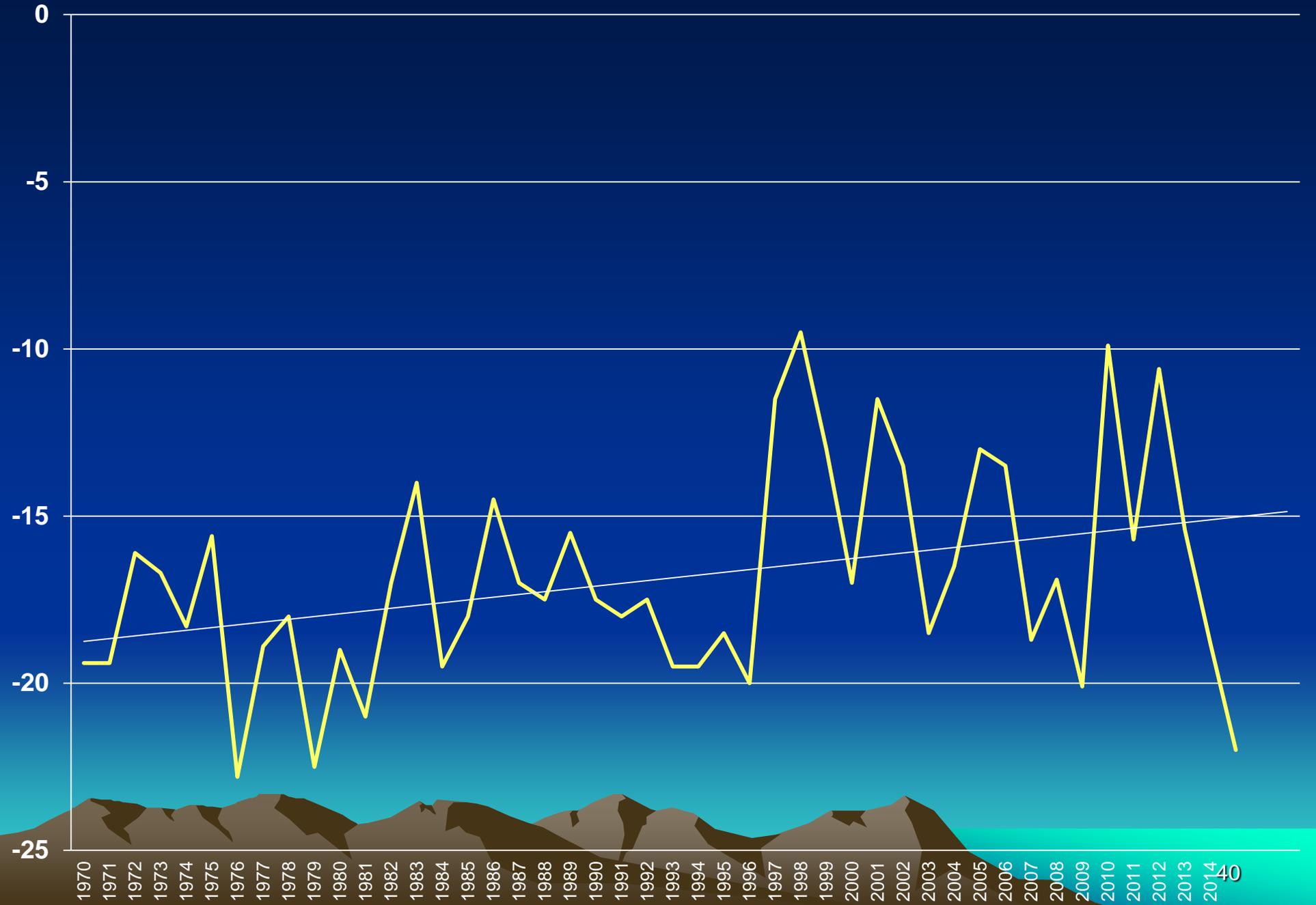
Lowest Monthly Temperatures, 1970-2015, Vineland



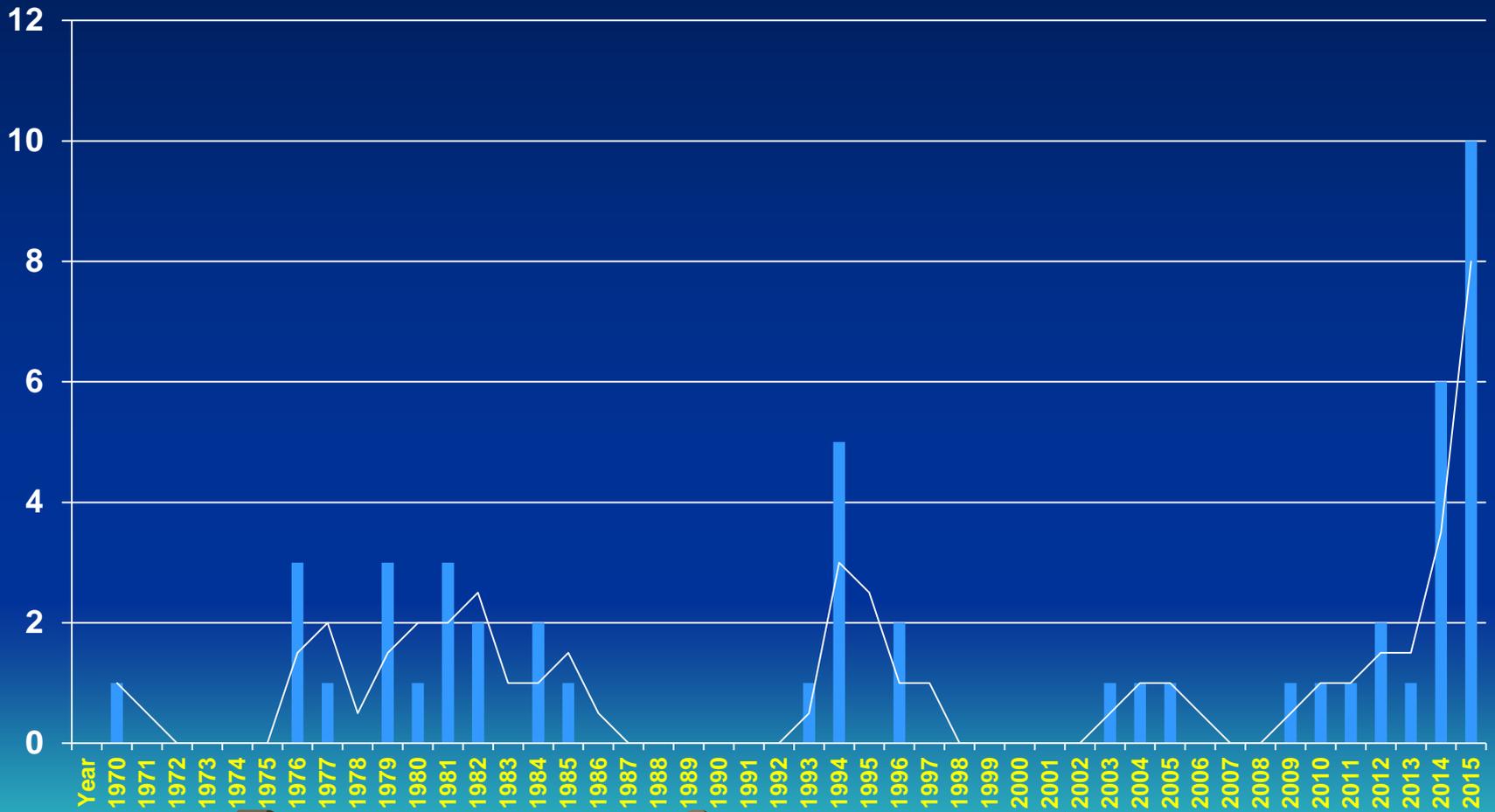
Trends in the Lowest Temperatures for January at Vineland



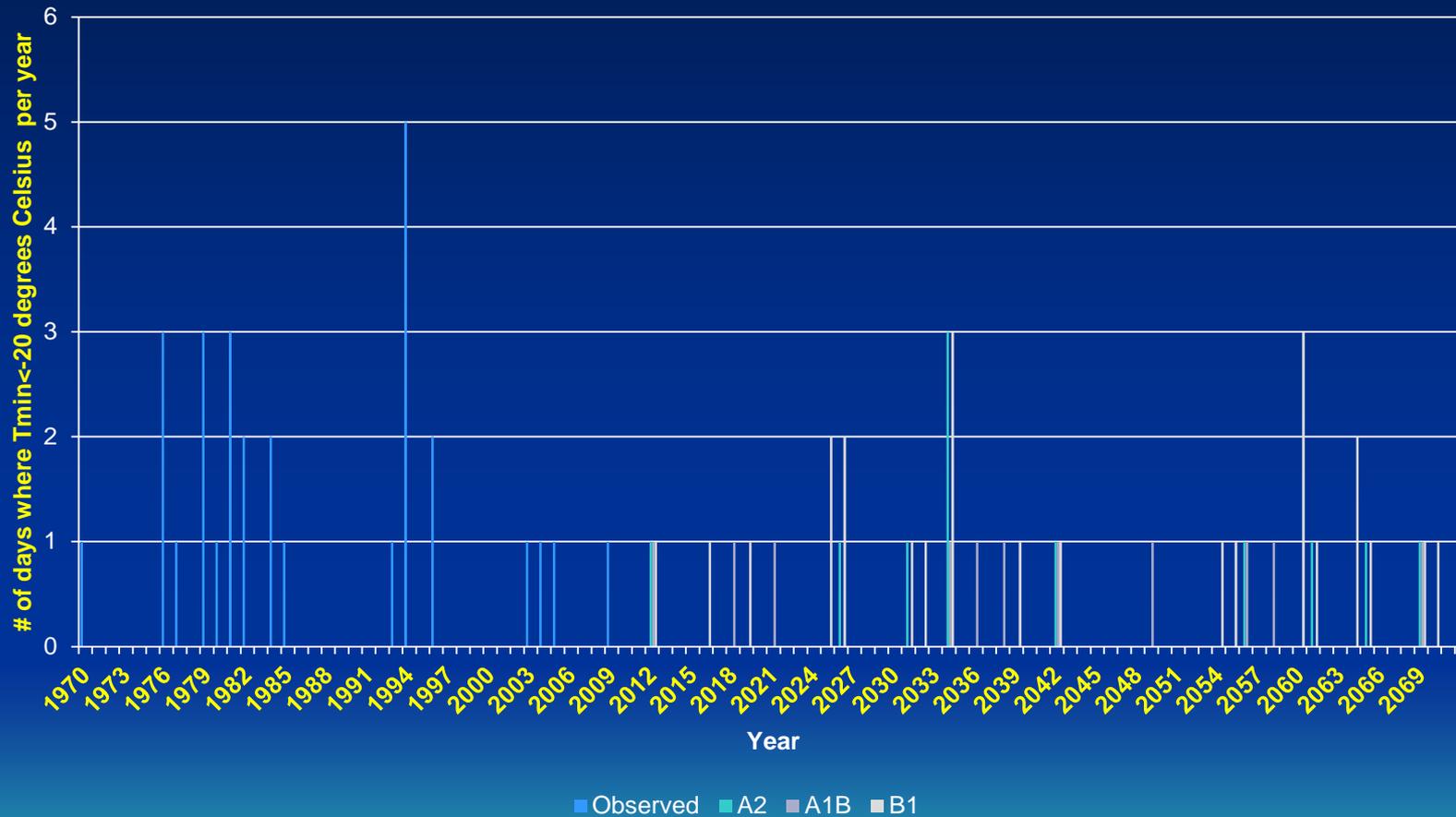
Trends in Lowest Temperatures for February at Vineland



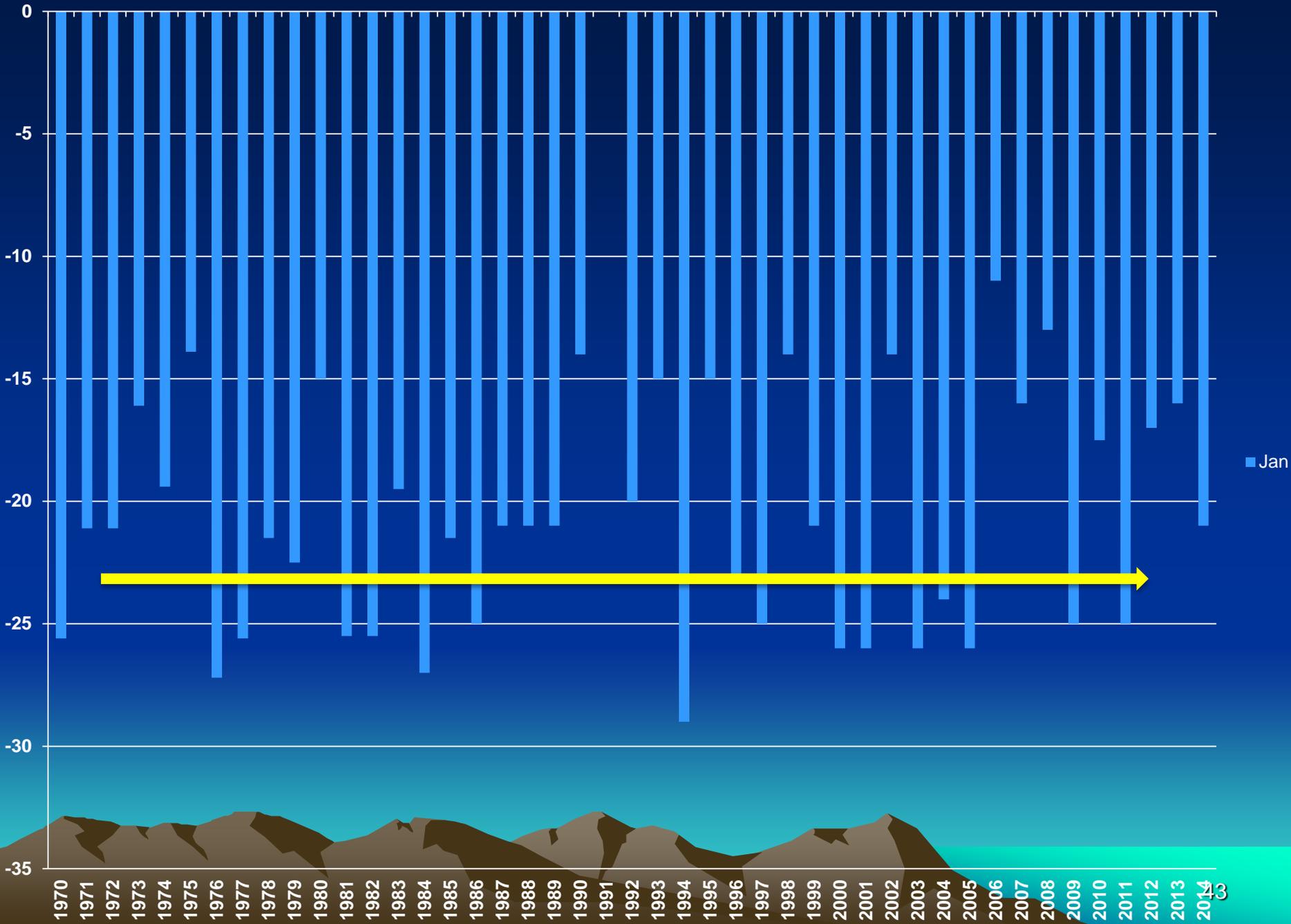
Frequency Of -20C for Vineland, 1970-2015



Past and Future Extreme Cold Days Vineland, Ontario, Canada



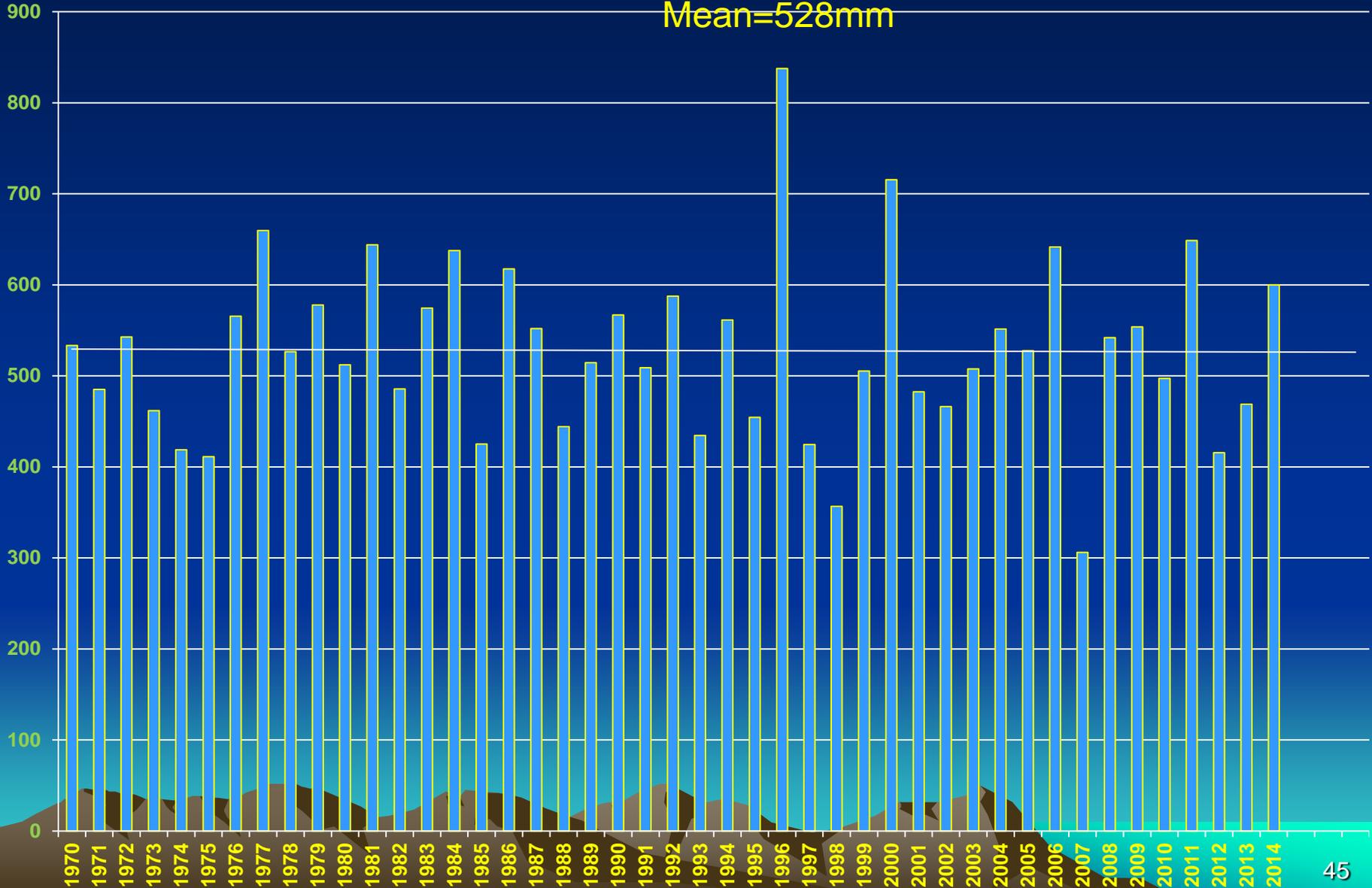
January (Potentially Damaging Minimum Temperatures (Welland))



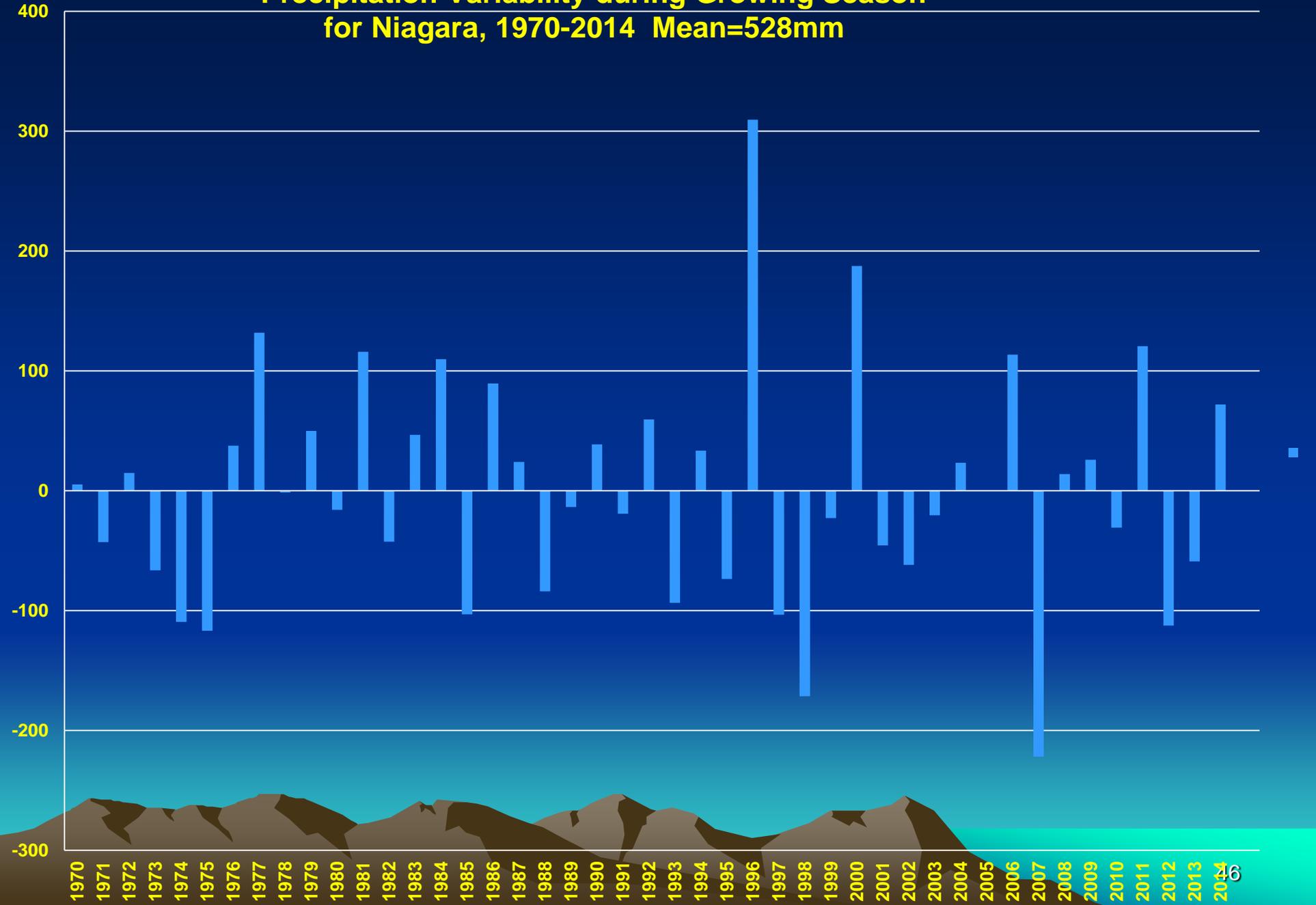
Observed and Predicted Growing Season Precipitation

Growing Season Precipitation for Niagara, 1970-2014

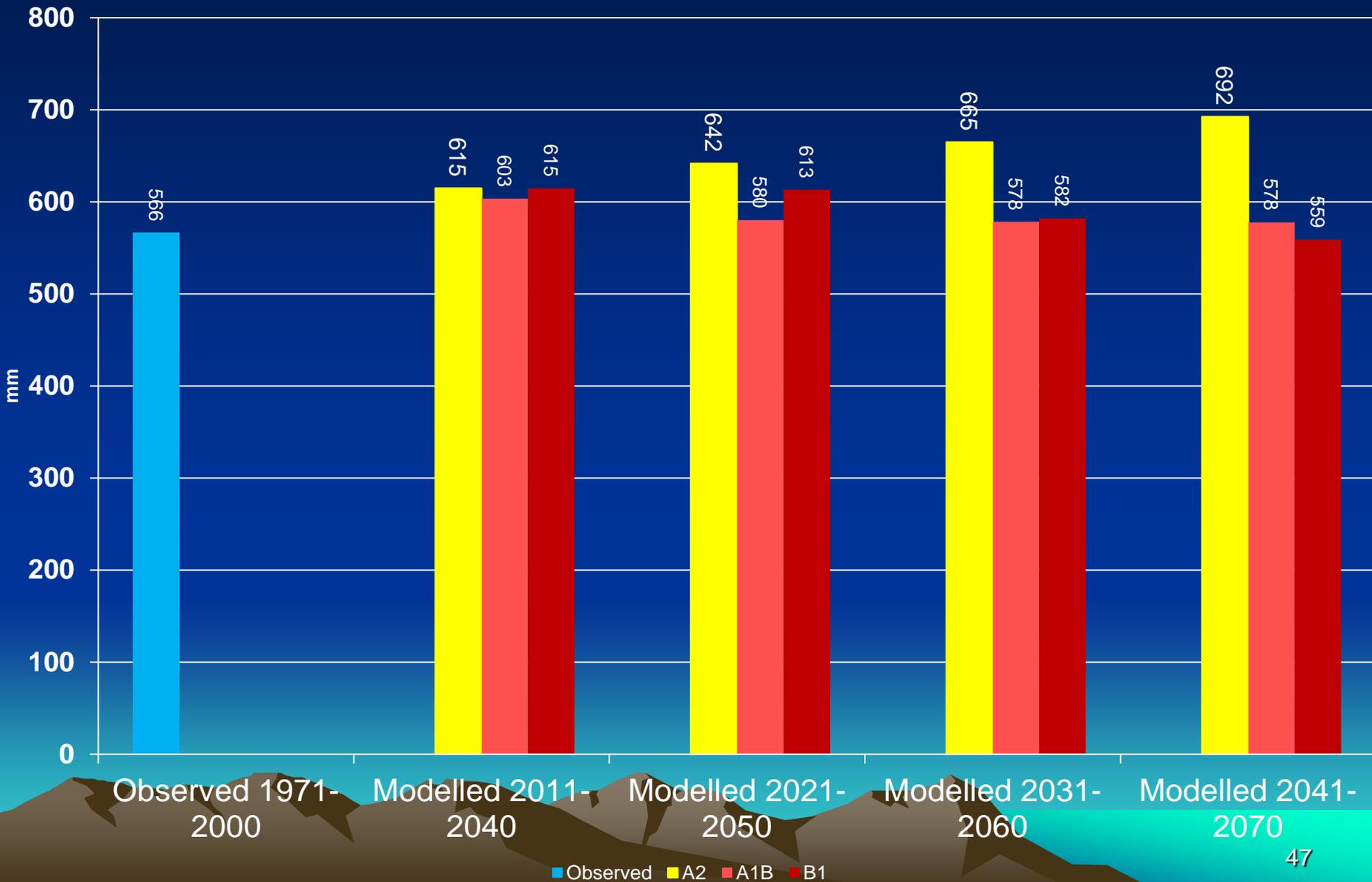
Mean=528mm



Precipitation Variability during Growing Season for Niagara, 1970-2014 Mean=528mm

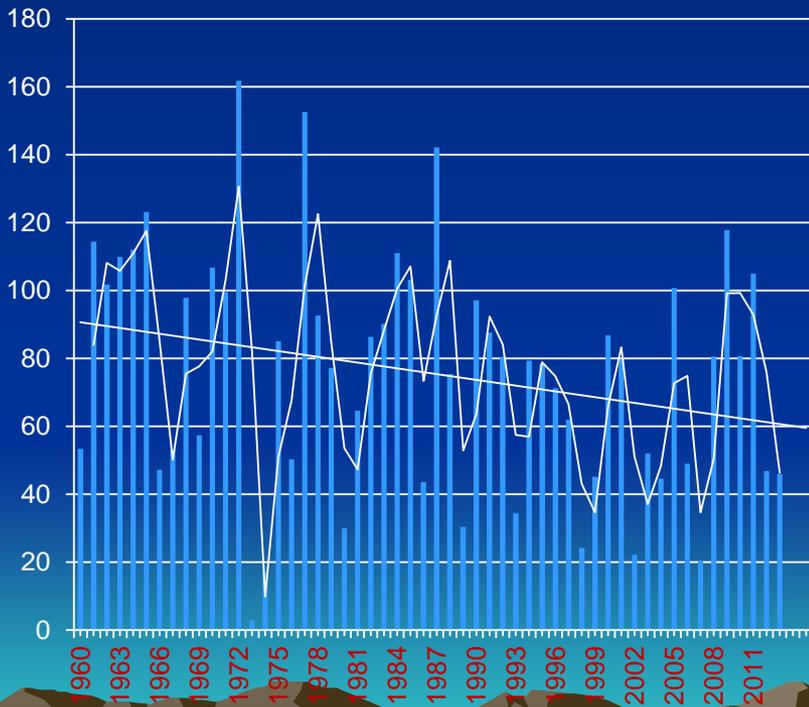


Past and Projected Climate Normals Growing Season (AMJJASO) Total Precipitation Vineland, Ontario, Canada

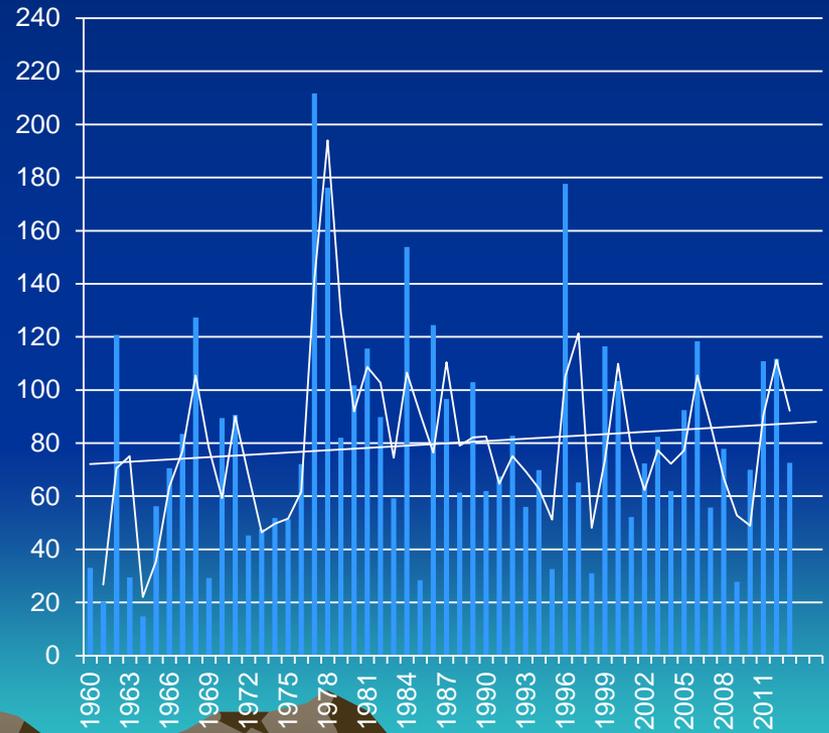


Precipitation During Veraison to Harvest

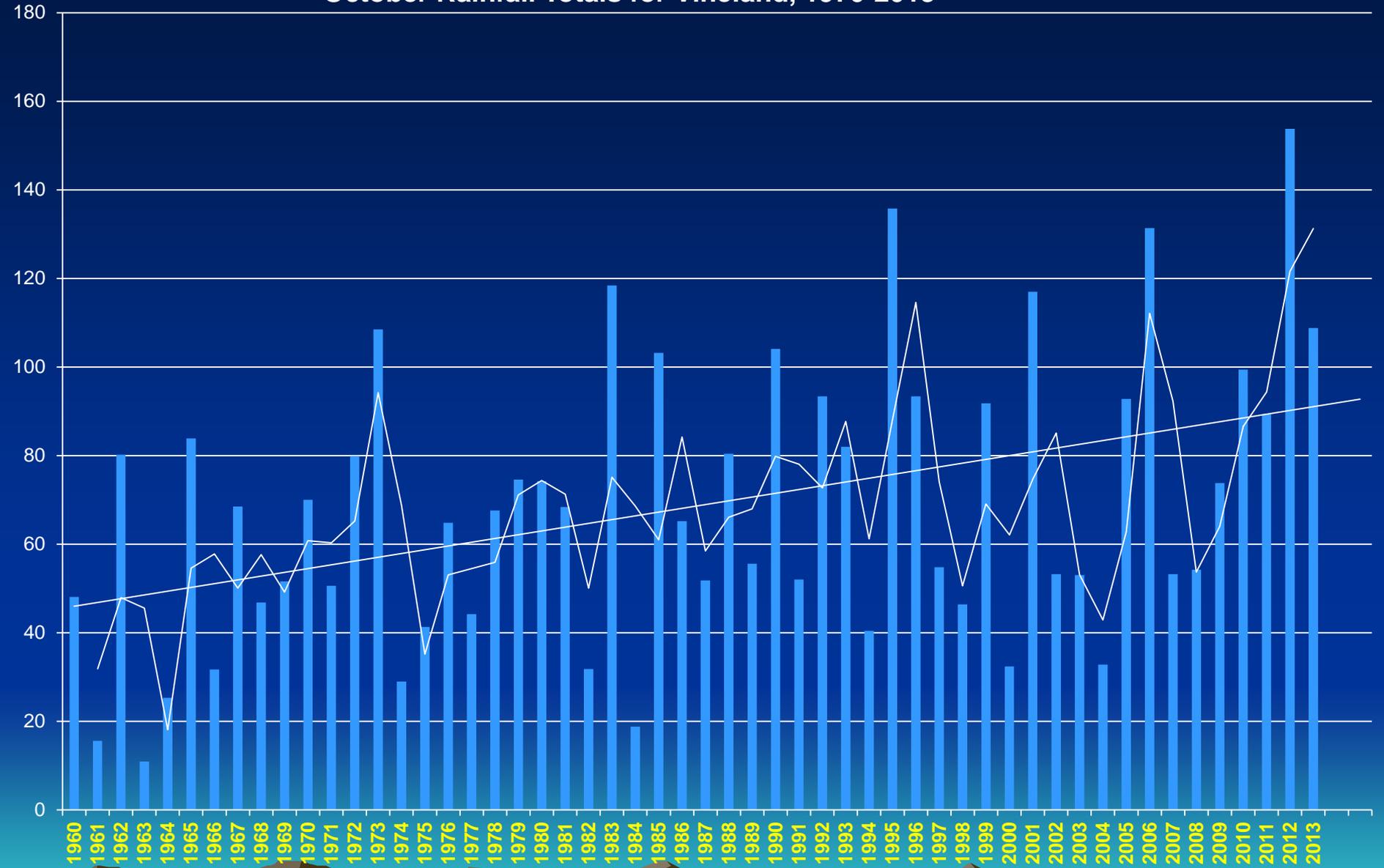
August Rainfall Totals for Vineland 1970-2013



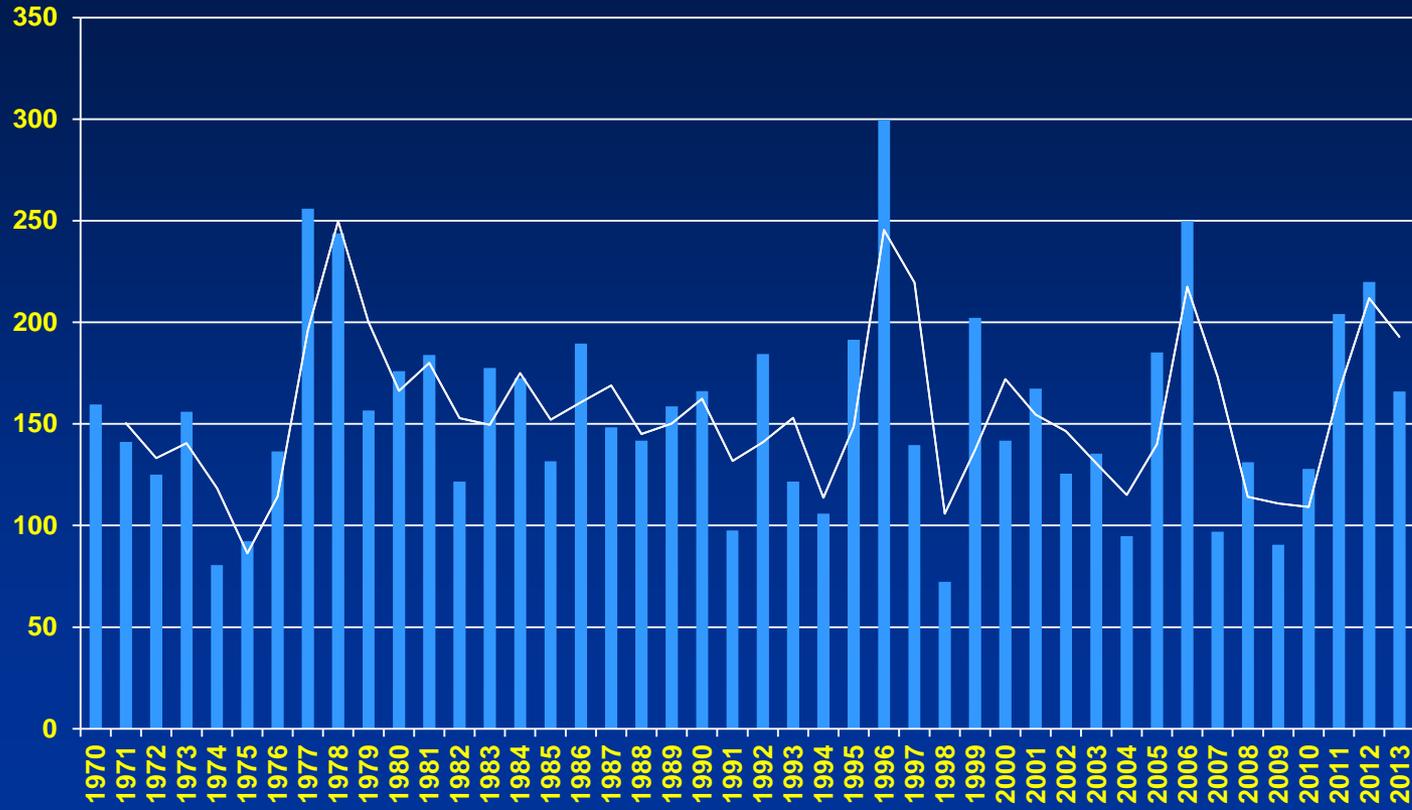
September Rainfall Totals for Vineland 1970-2013



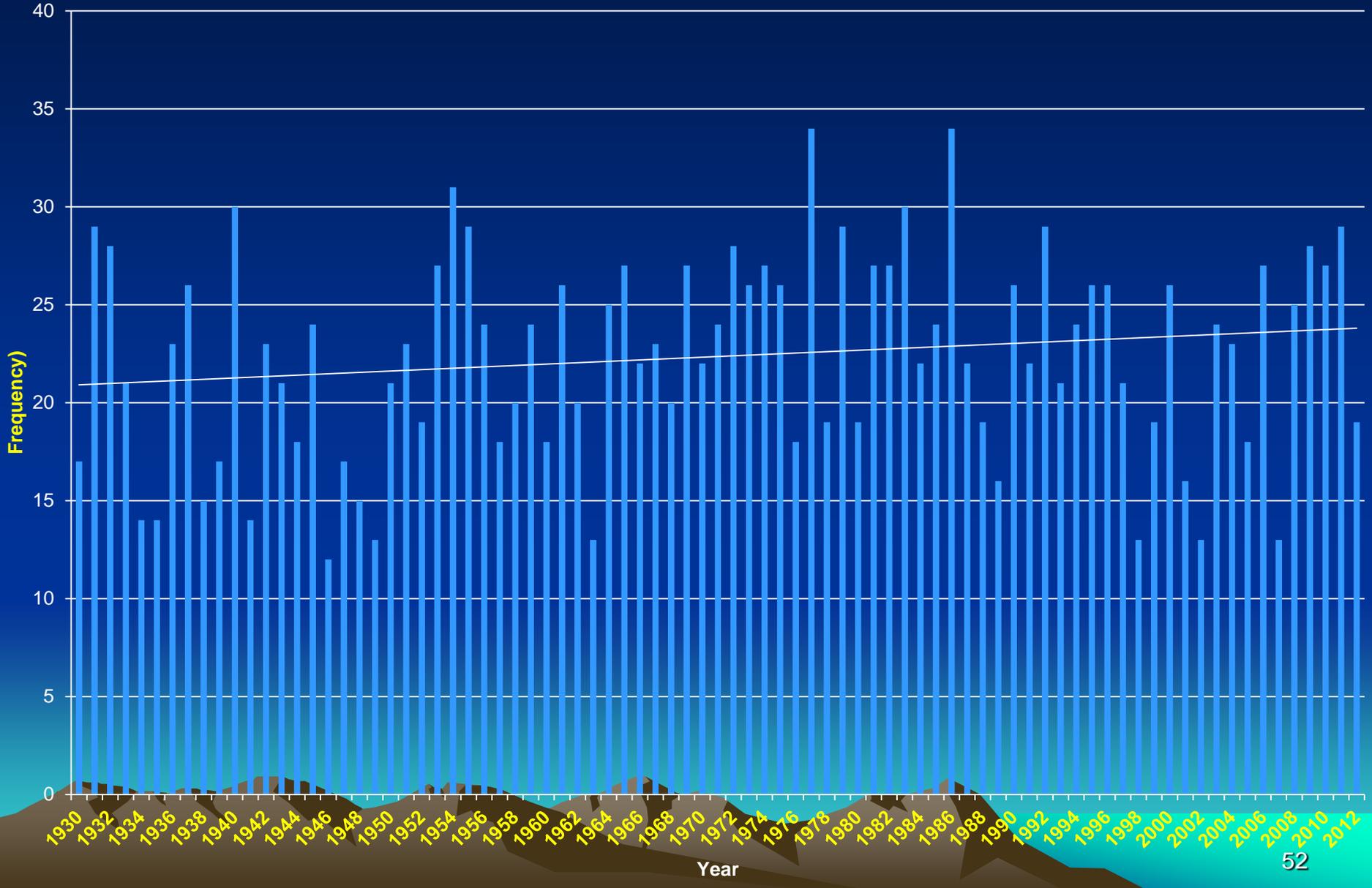
October Rainfall Totals for Vineland, 1970-2013



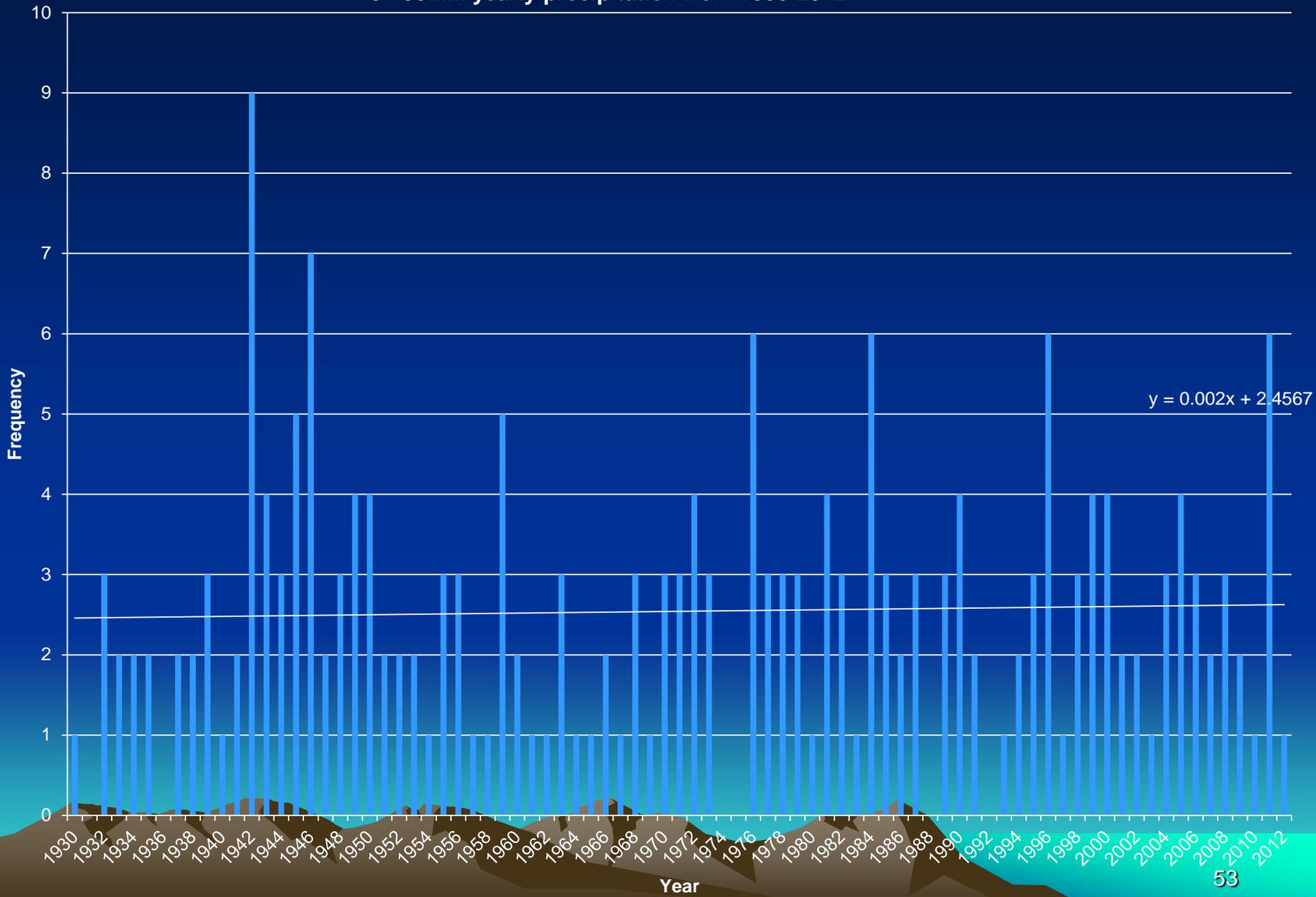
Precipitation Totals for Sept and Oct (mm)



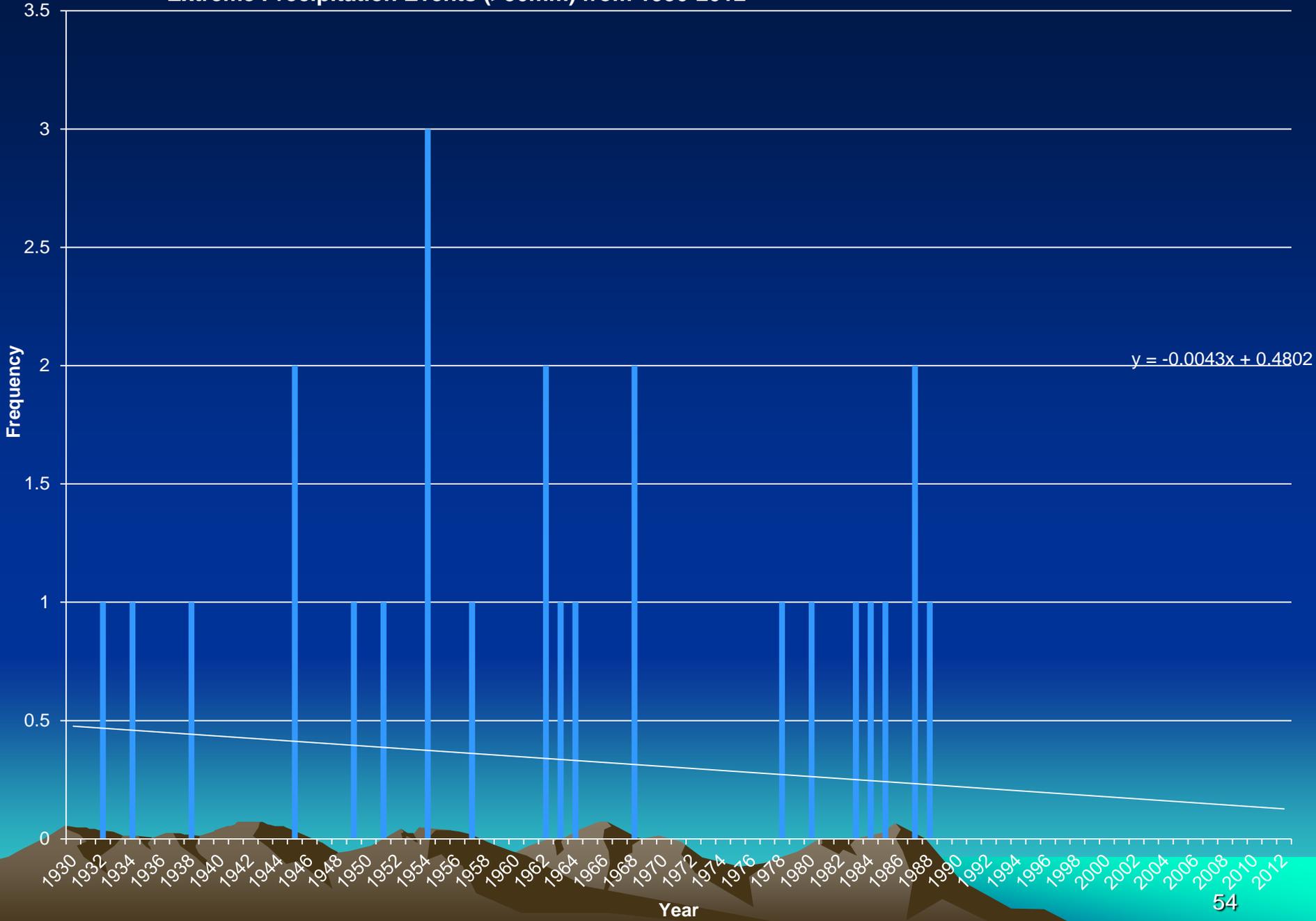
11-30mm yearly precipitation from 1930-2012



31-50mm yearly precipitation from 1930-2012



Extreme Precipitation Events (>50mm) from 1930-2012



- **IMPLICATIONS**

- A trend towards warmer winters, BUT
- Winter damage could actually increase in Ontario's wine regions due an increase in the frequency of warm freeze-thaw events followed by cold snaps
- Warmer growing seasons and an evolution of the climate and possible expansion into new areas. However,
- More volatility in growing season conditions leading to a greater degree of variability in vintages



Climate Change

- **Viticulture Practices In a Variable Climate With Extremes**

Perception of future climatic risks is important because wine growers will not invest unless they understand that their agricultural systems is highly vulnerable.

- **Diversify the range of cold-resistant varieties**
- **Site selection to optimize growing season potentials and reduce freeze damage**
- **Invest in freeze protection technologies**
- **Invest in crop insurance**
- **Investments in weather forecasting systems at the micro-level**
If a warmer growing season becomes the norm, long-term water management technologies should be planned
-

Climate Change

Conclusions

- **Potential benefits are not clearly evident**
- **The changes may be imperceptible to most people**
- **More controversial, are the uncertainties**
- **Even more controversial: What strategies should we adopt over the long-term?**



Thank You



Observed and Projected Extreme Minimum Temperatures