Developing New Cold Resistant Grape Varieties for a Changing Climate

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Topics

Our traditional view of vine cold hardiness

How climate change is forcing us to broaden that view

What does it mean for developing new grape varieties?

Our traditional View- Severe Mid-winter Temperatures

Hugo, MN

	1993 1994	1994 1995	1995 1996	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002	2002 2003	2003 2004	2004 2005
º C	-40	-38	-40.5	-35	-30	34.5	-34.5	-35.5	-27	-30	-34	-34
º F	-40	-36	-41	-40	-22	-30	-30	-32	-17	-23	-29	-29
	2005 2006	**2006 2007**	**2007 2008**	**2008 2009**	**2009 2010**	**2010 2011**	**2011 2012**	**2012 2013**	**2013 2014**	**2014 2015**	**2015-2016**	
º C	-32	-35	-33	-34.5	-33	-36	-30	-30	-35	-29	-32	
º F	-25	-31	-27	-30	-27	-33	-23	-23	-30	-20	-25	

Ave. minimum temperature = -34C

In 11/21 years, annual low was -35C or colder (US Zone 3b)

But there is good news.....

Our winters are warming!

FIGURE 4.5. MINNESOTA ANNUAL AVERAGE WINTER TEMPERATURES (DECEMBER – FEBRUARY). BLUE (LEFT) AND RED (RIGHT) LINES HIGHLIGHT TRENDS FOR 1895-1959 AND 1960-2013, RESPECTIVELY. DATA SOURCE: NOAA/NCDC, 2014.

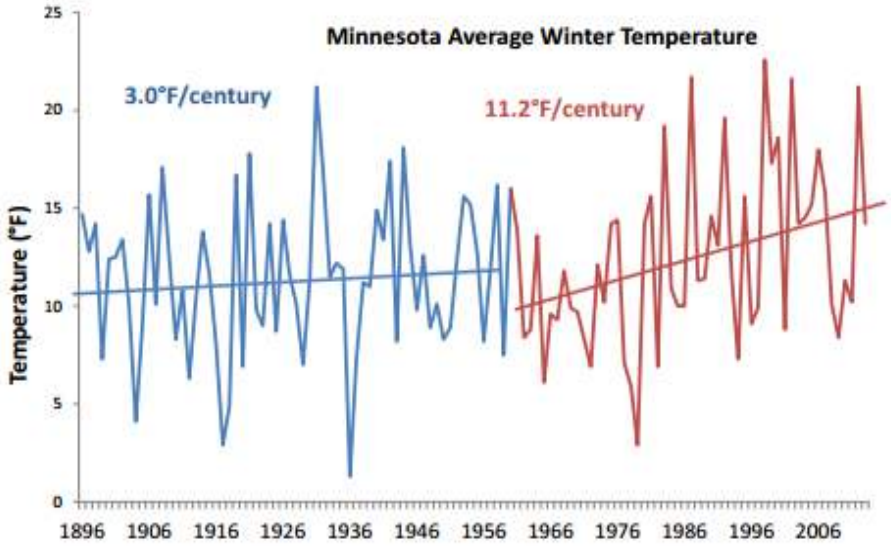
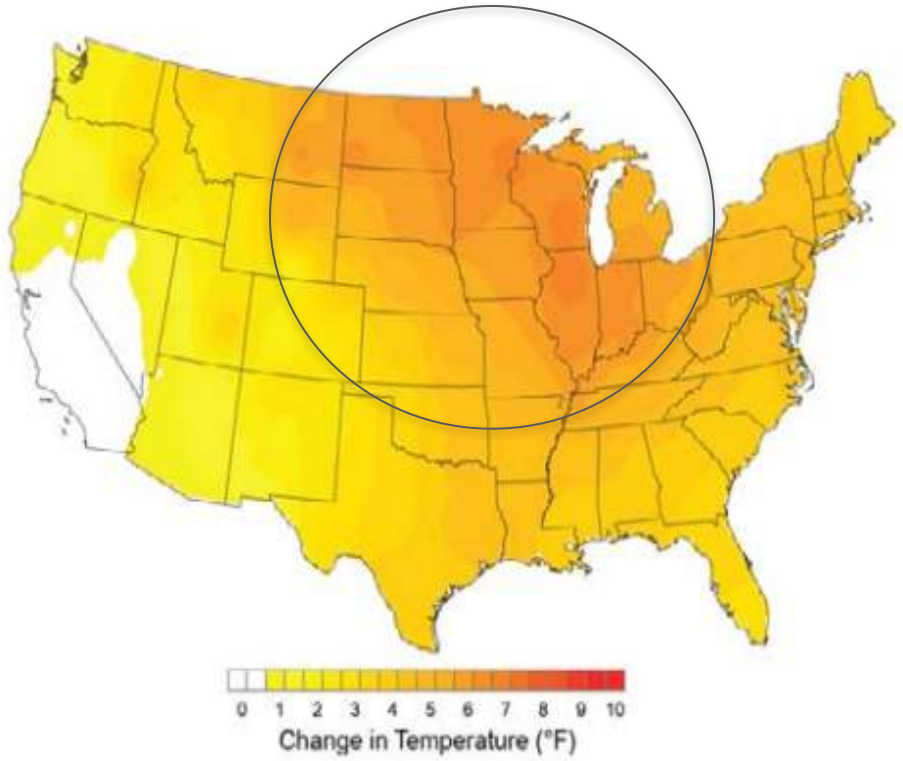


FIGURE 4.6. AVERAGE ANNUAL WINTER TEMPERATURES (°F) ACROSS THE U.S. FOR 1975-2007. TEMPERATURES ARE RISING FASTER IN WINTER THAN IN ANY OTHER SEASON, ESPECIALLY IN MINNESOTA AND THROUGHOUT THE MIDWEST REGION. FIGURE SOURCE: KARL ET AL., 2009.



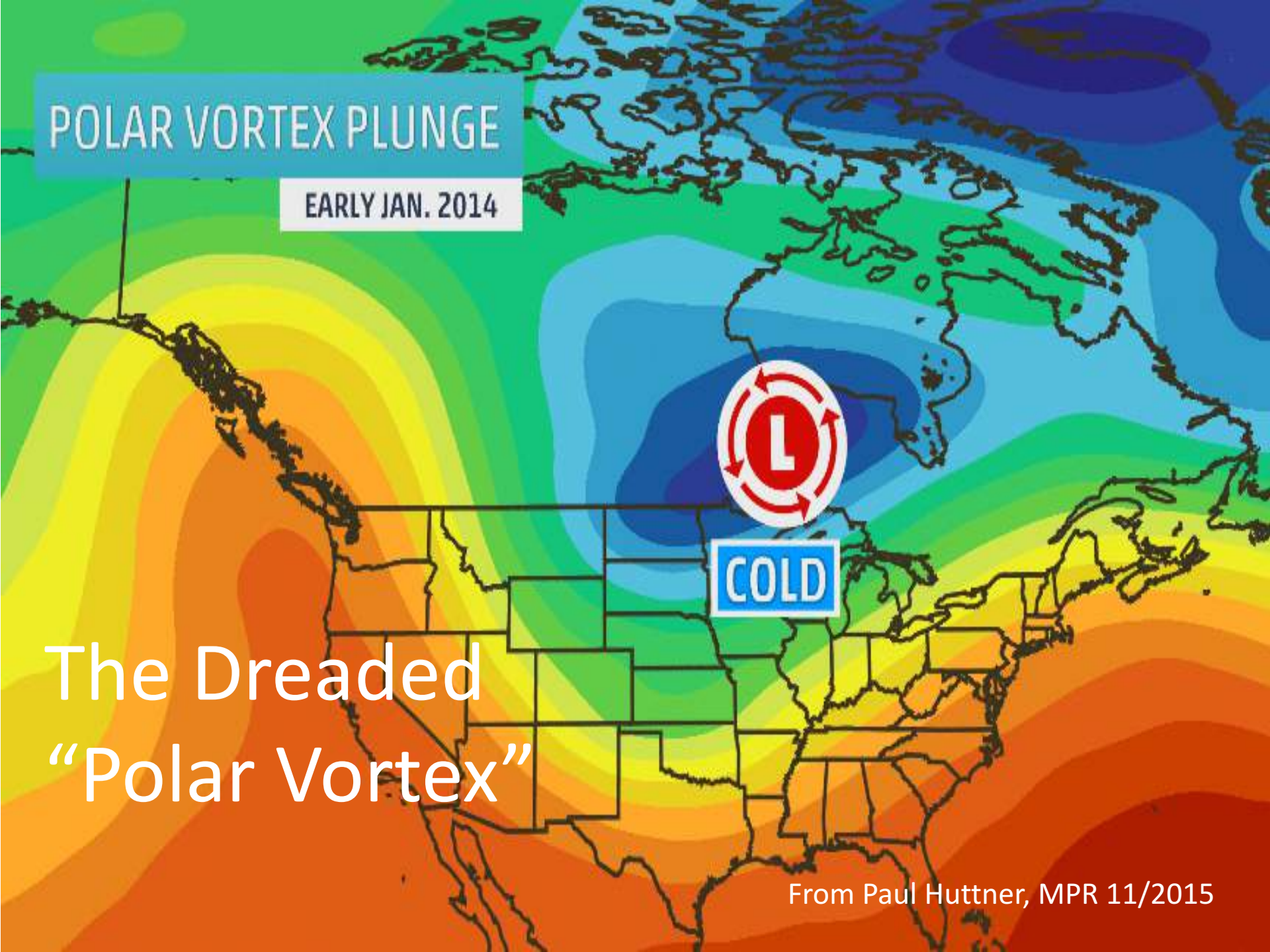
- Midwest: Winters +1 to +3 degrees C vs. 1975
- Minnesota: Winters warming at the rate of 6 C/century since 1960!
- Greatest warming is **in winter, at night**!

From Paul Huttner, MPR 11/2015

Source: NOAA/NCDC

While they may not occur as often as in the past,

Extreme mid-winter temperatures are still a problem.



The Dreaded "Polar Vortex"

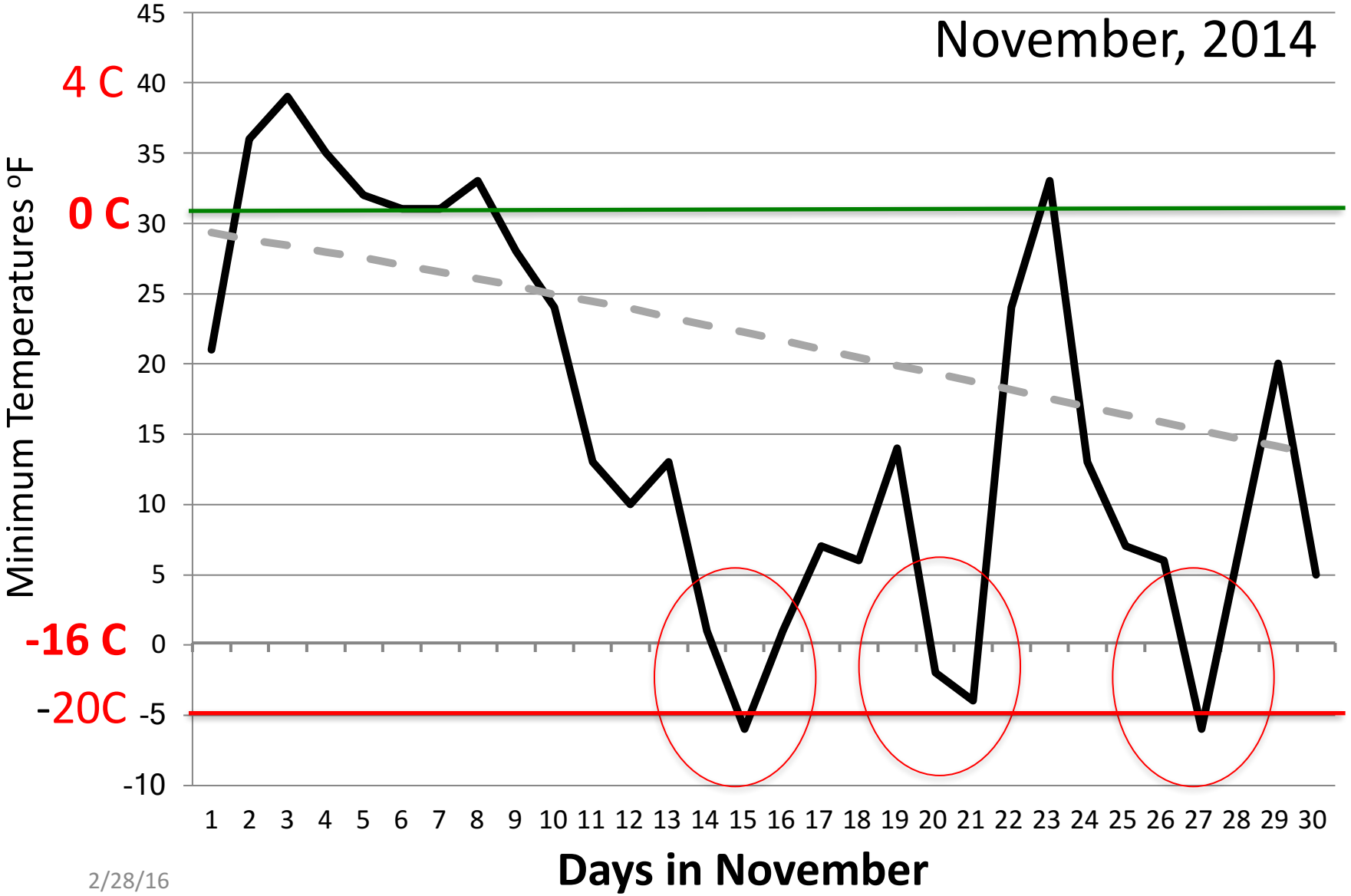
From Paul Huttner, MPR 11/2015

Our “New” Grapegrowing Problems

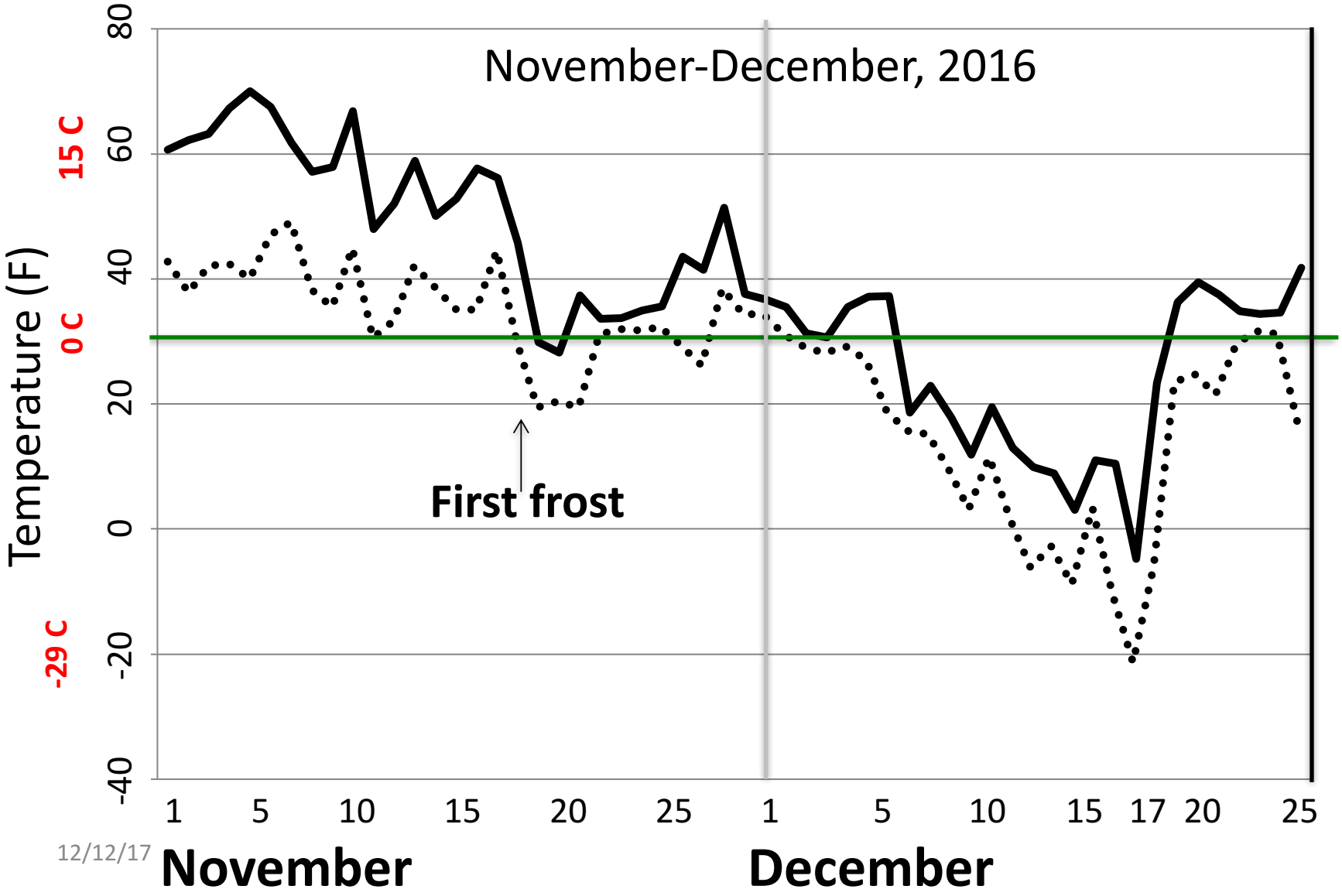
Thanks to climate change,
Now we also have to worry more about...

Extreme cold temperatures in early winter
Extreme warm temperatures in late winter
Late spring freezes
Heavy and untimely rainfall

New Problem #1:
Extreme cold temperatures in late fall/early winter

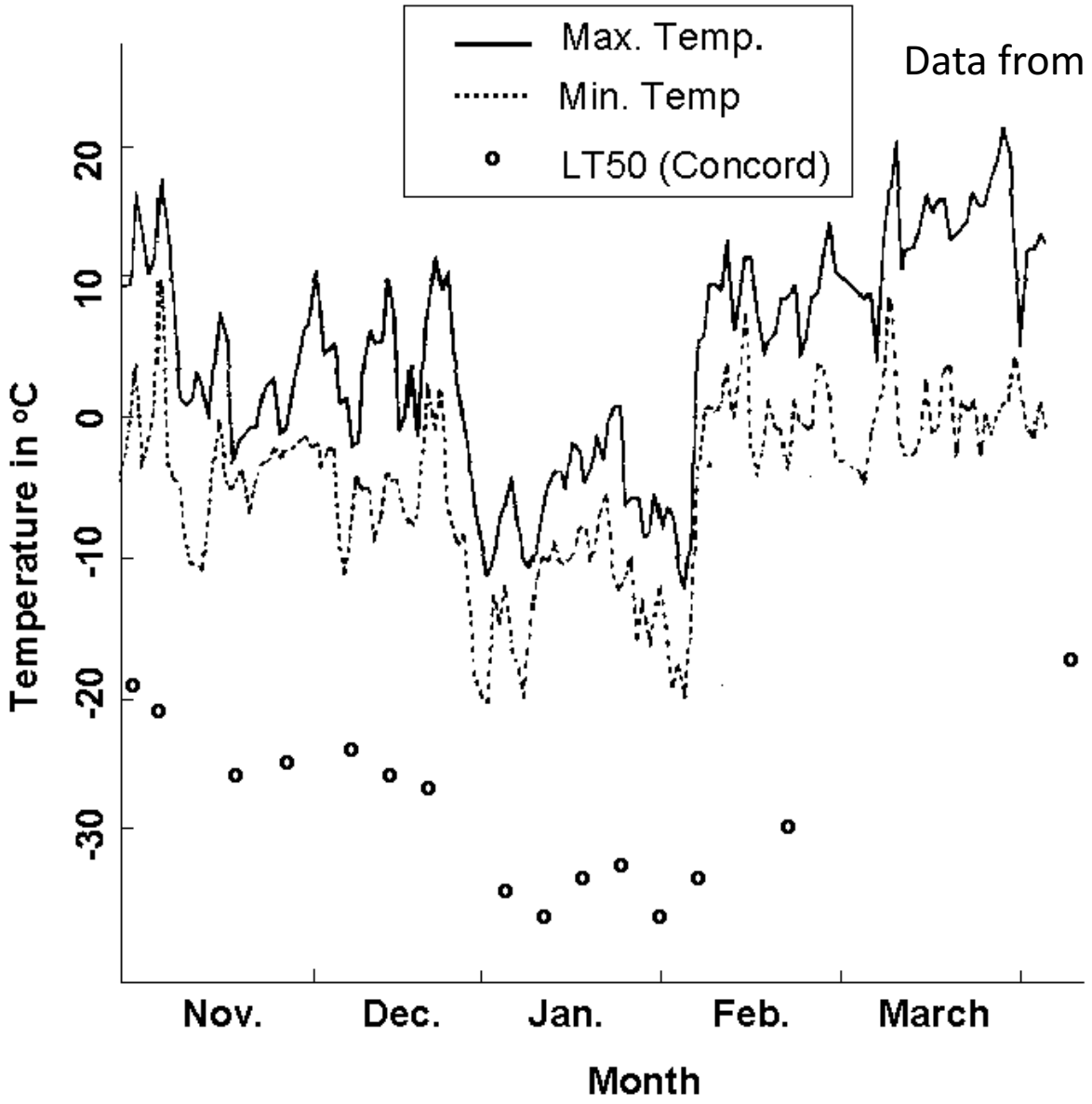


New Problem #1:
Extreme cold temperatures in late fall/early winter



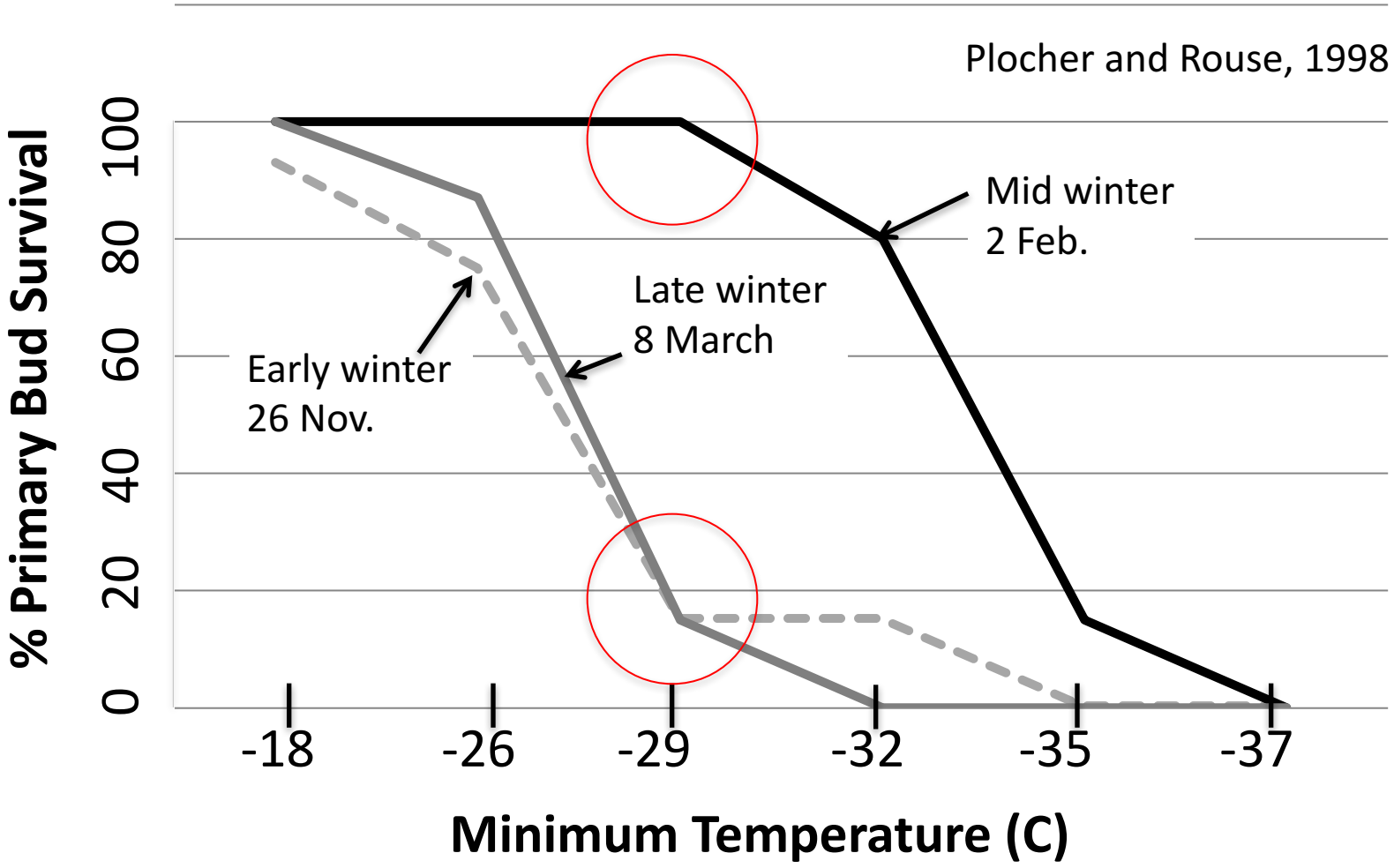
And why is this scenario bad for our vines?

Cold acclimation is a slow, gradual process



Data from Proebsting, 1982

Vines tolerate much colder temps at mid-winter



New Problem #2:
Extreme warm temperatures in late winter

From Paul Huttner, MPR 11/2015

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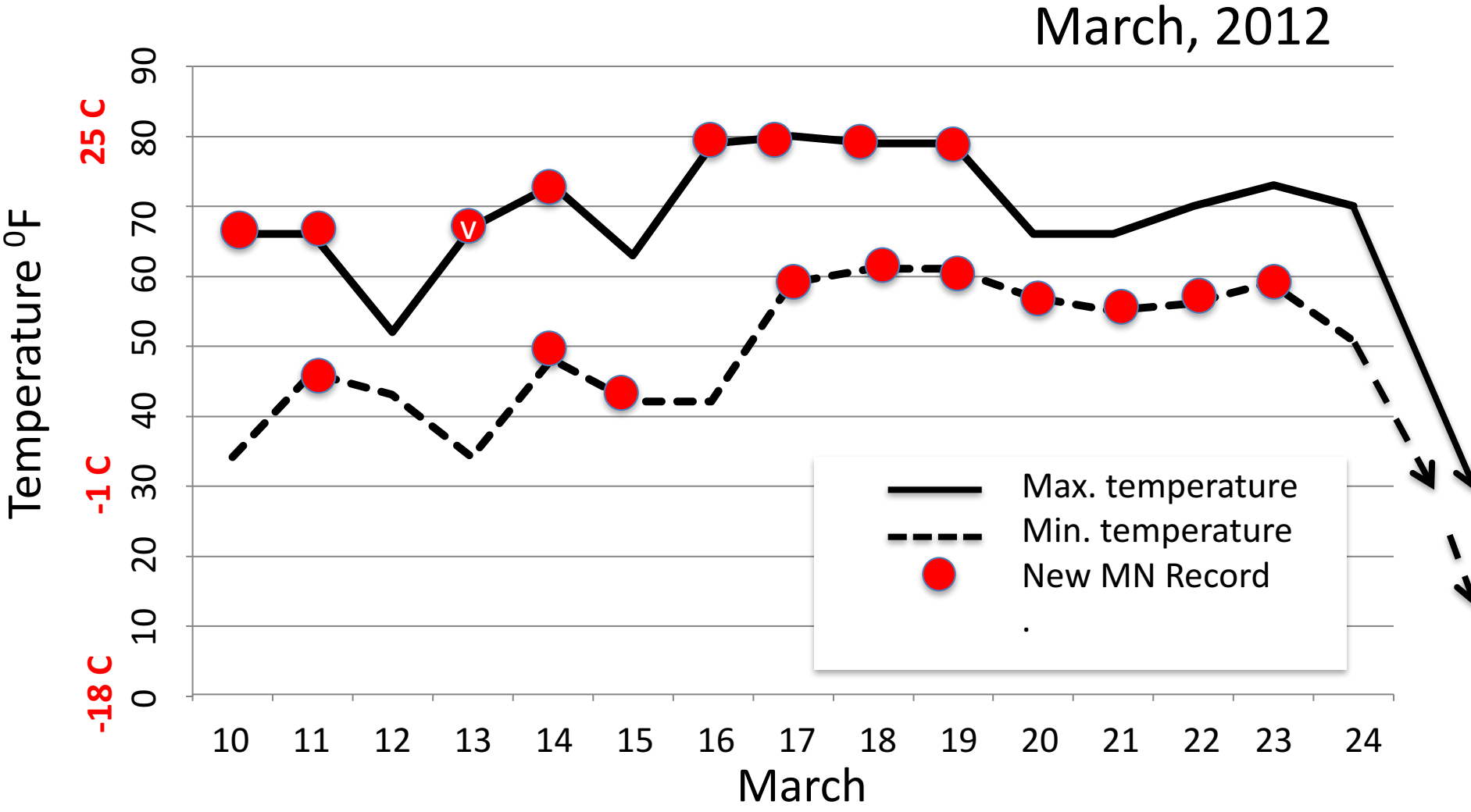
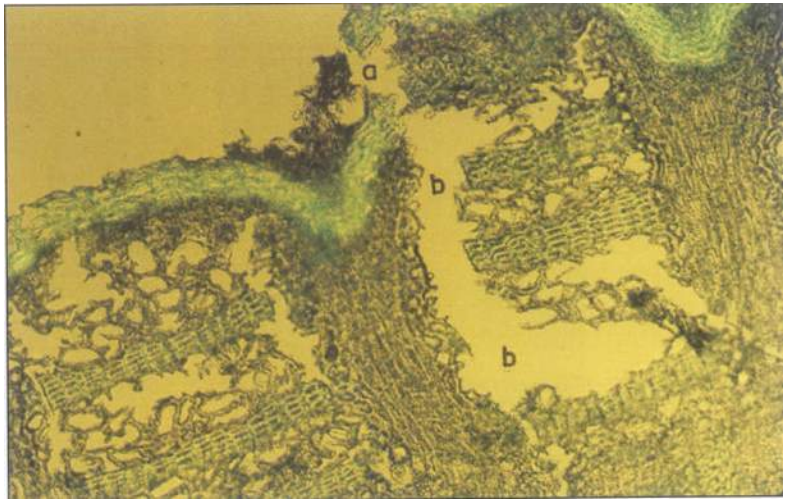
Extreme warm temperatures in late winter

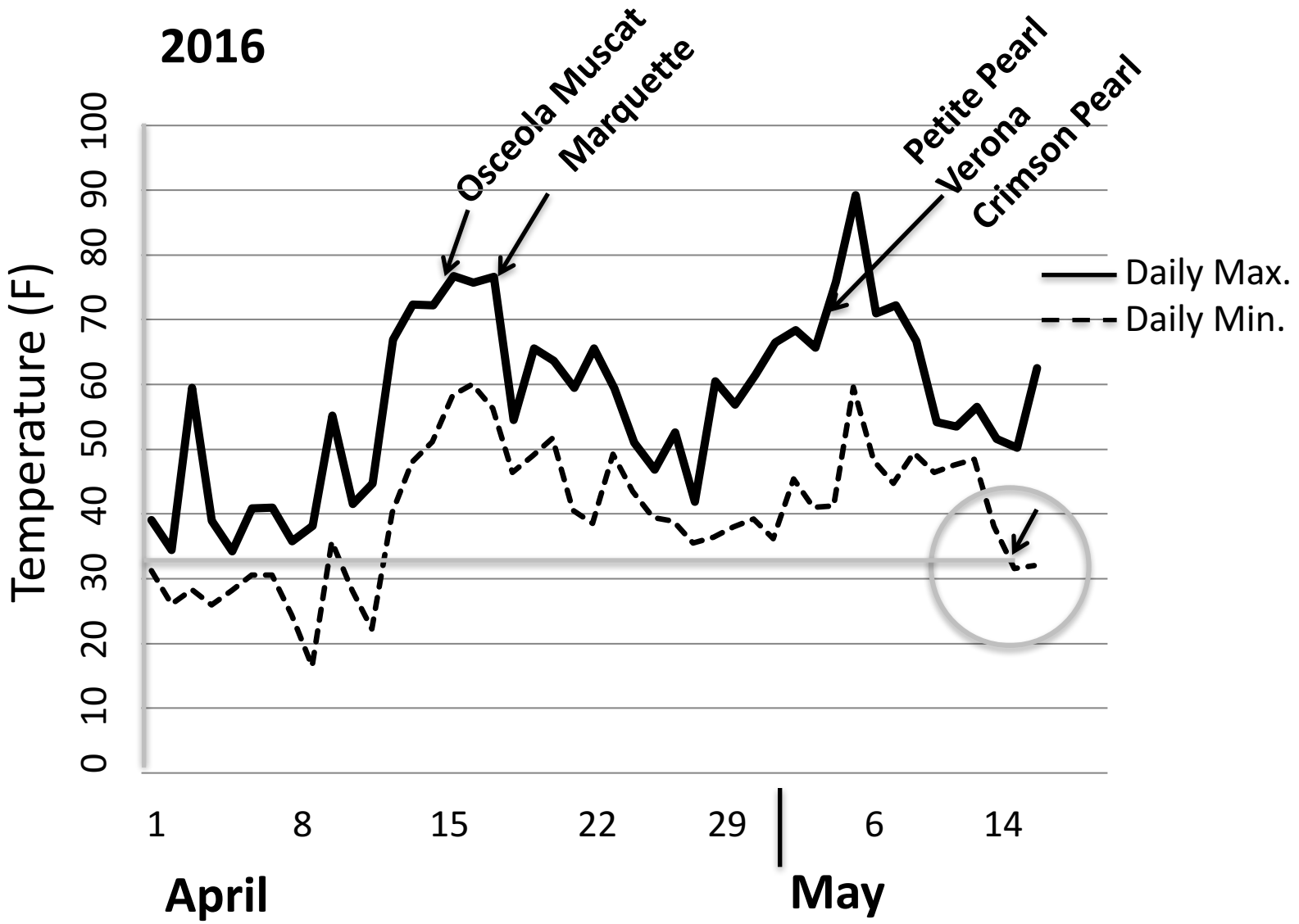


Wonderful for people

Bad for Vines



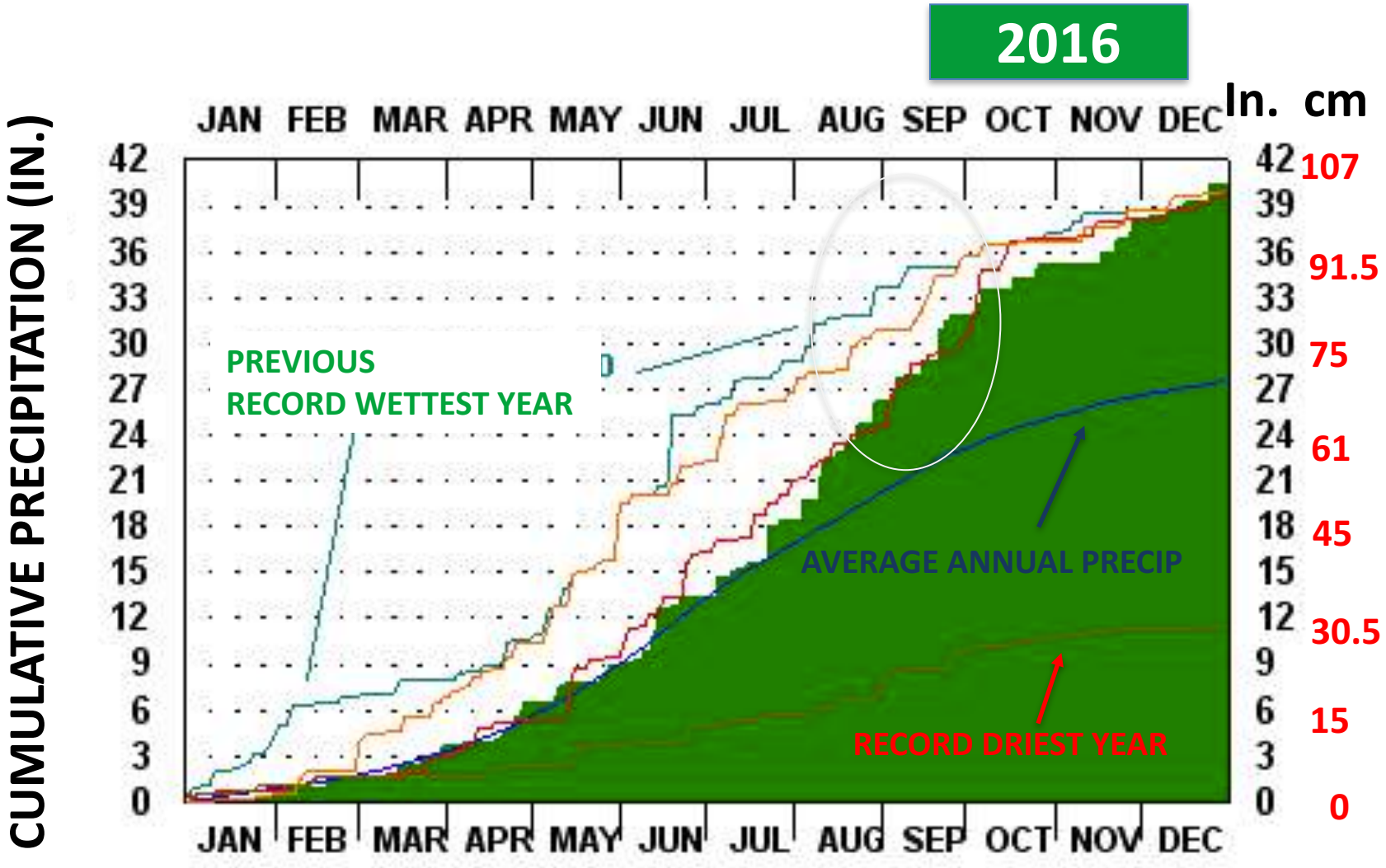
New Problem #3- Late spring frost



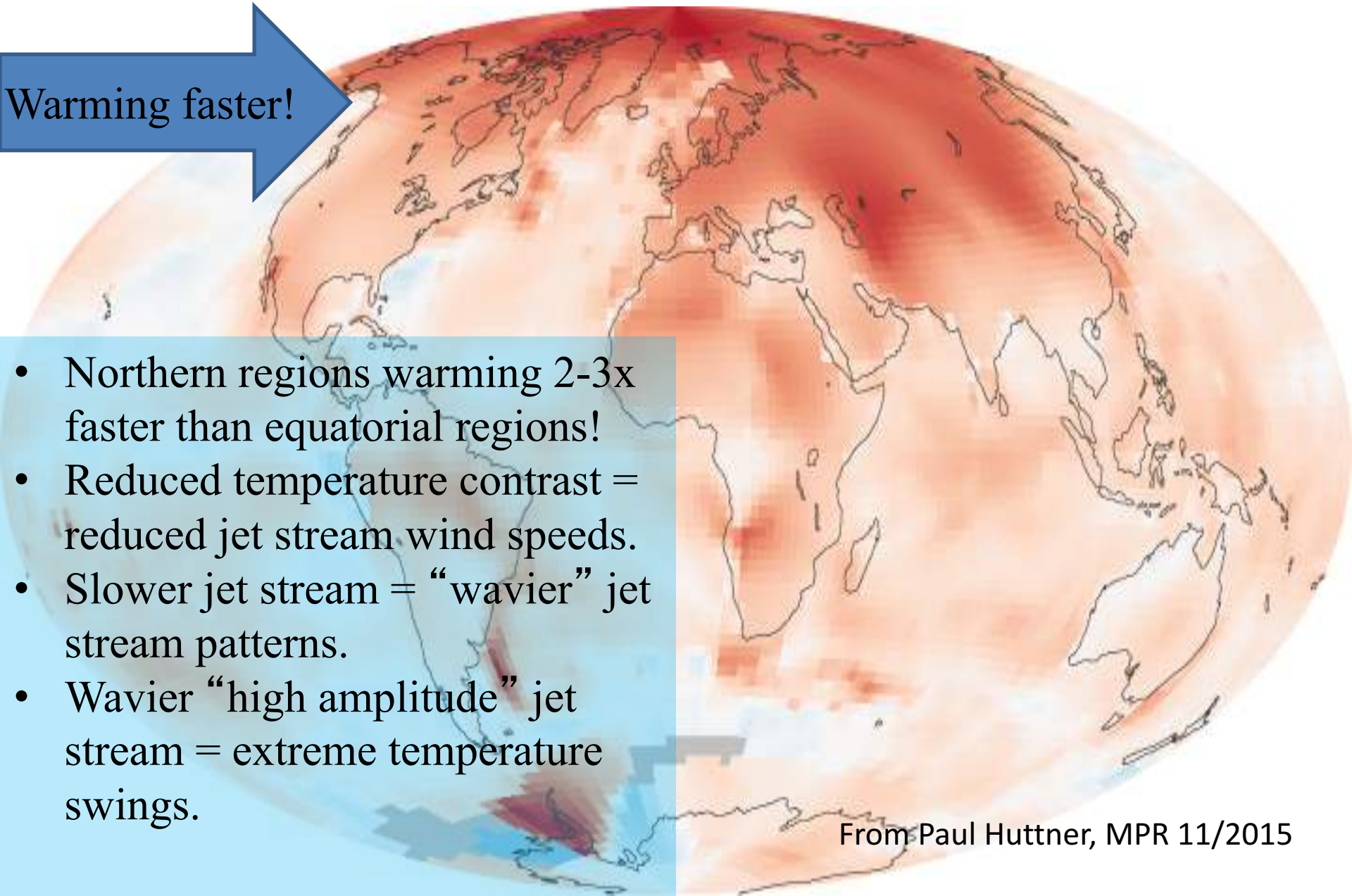
Variety ‘Marquette’ after 14 May freeze

Variety ‘Petite Pearl’ after 14 May freeze

New Problem #4-Heavy and untimely rainfall



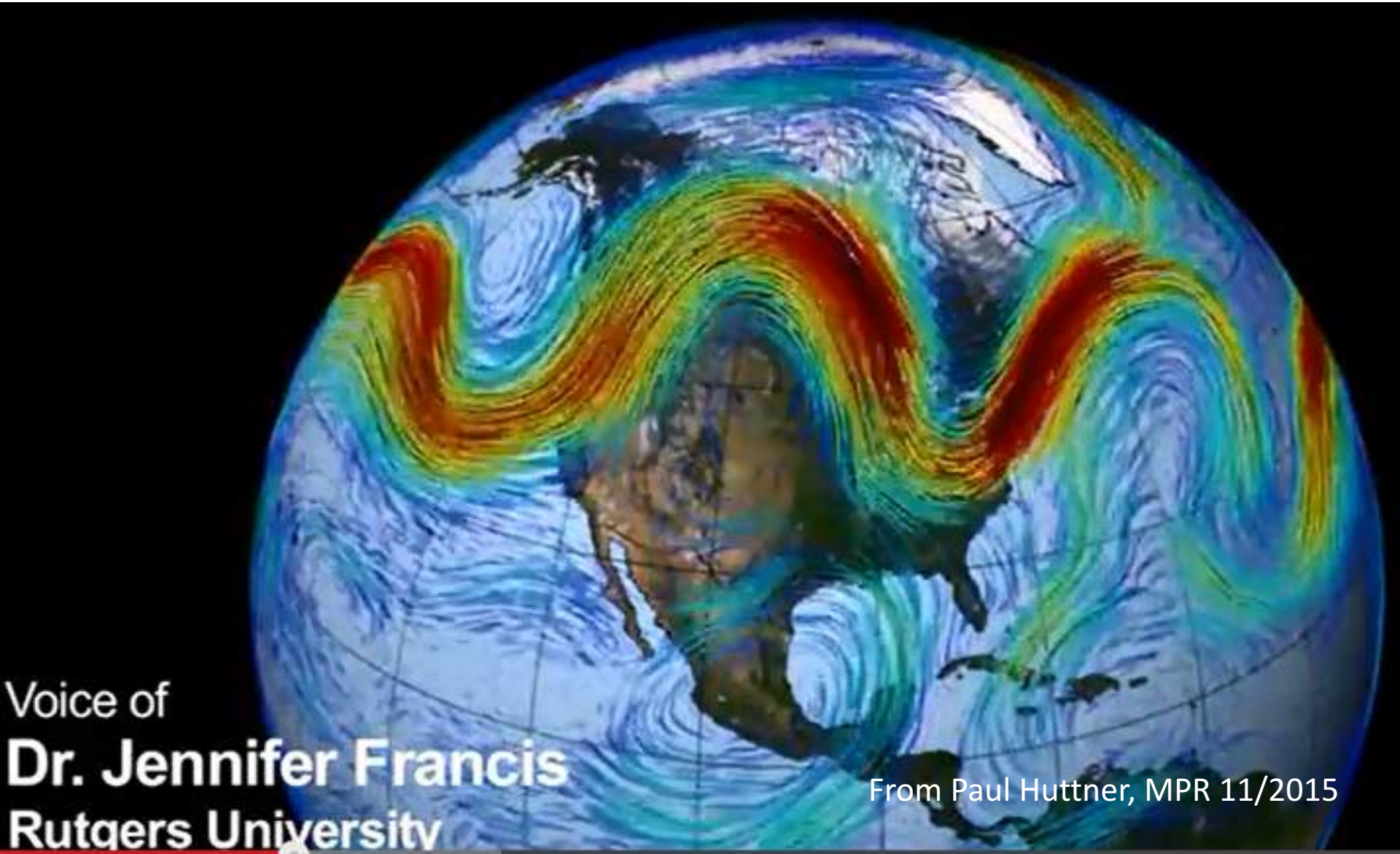
Arctic Amplification



- Northern regions warming 2-3x faster than equatorial regions!
- Reduced temperature contrast = reduced jet stream wind speeds.
- Slower jet stream = “wavier” jet stream patterns.
- Wavier “high amplitude” jet stream = extreme temperature swings.

From Paul Huttner, MPR 11/2015

Arctic Amplification



From Paul Huttner, MPR 11/2015

So What Can We Do?

As a grower:
Good site selection
Good matching of variety to local climate
Good vine management
New frost avoidance technology

As a Grape Breeder:
Focus development of new grape varieties on these new challenges associated with climate change

“A Climate Change-Resistant Grape”

Midwinter hardiness > -35C

Early fruit and wood ripening to withstand late fall/early winter cold

Holds dormancy during late winter warm spells

Late budbreak and slow growth to avoid late spring freezes

Thick skins to resist splitting during wet conditions and all the predators of September

What's in the future?

Hardier

The lesson from the Polar Vortex winter was that we still have to strive for greater mid-winter hardiness.

What's in the future?

Back to the drawing board!

Backcross the best red wine selections with super hardy selections.

Super Hardy (-40) Parents	X	Hardy/High Quality Parents
MN 1094		Verona, TP 2-3-51
DM 8521-1		Crimson Pearl, PP, Verona, TP 1-1-12
ES 10-18-06		Crimson Pearl, PP, Verona, TP 1-1-12

Inter-cross the best red wine selections and hope that some of the seedlings show **heterosis** for winter hardiness **and** bring some good wine quality too.

Example: TP 1-1-12 x Petite Pearl

What's in the future?

Hardier

T.P. B-5-16

Virtually no injury from the Polar Vortex winter, the November 2014 subzero cold spell or the May, 2016 frost.

Vigorous, healthy vine

130g cluster with double wings and long stem.

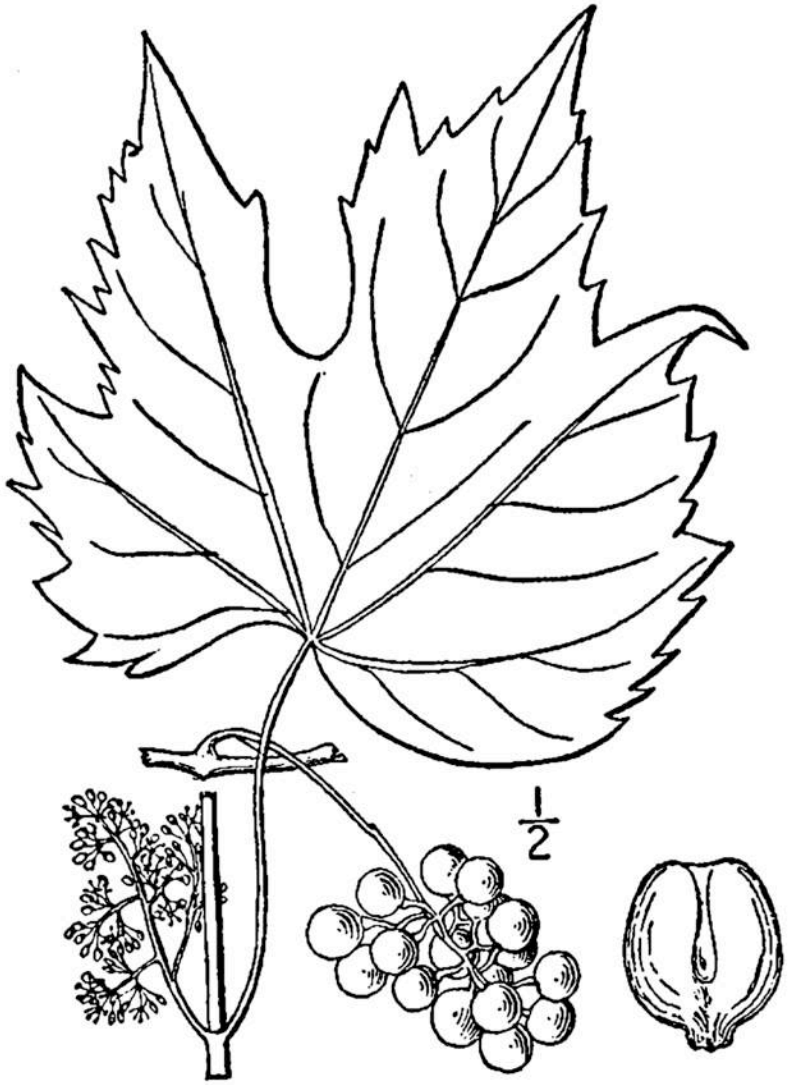
Wine: Dense color; fruity and smoky; moderate tannin about like the PP; very soft palate and soft finish.

From 2009 cross of
T.P. 1-1-12 x Petite Pearl

What's in the future?

Later budbreak

Introducing tendency for slow spring growth from *Vitis cinerea* and *Vitis palmata*



What's in the future?

Later budbreak

T.P. 3-1-3-N

First selection for spring freeze resistance, after the severe freeze of 17 May, 2009

Slow growth after budbreak;

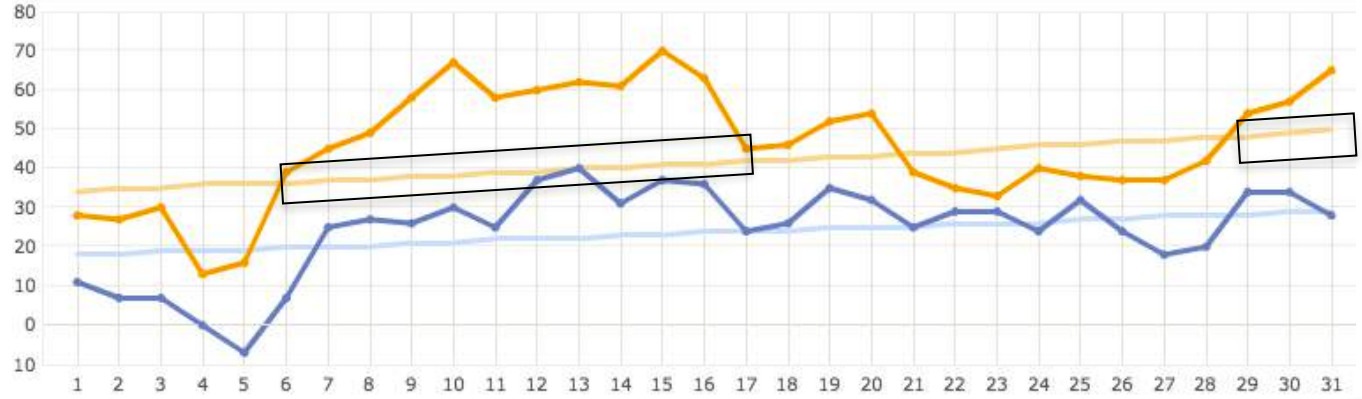
Slow spring growth derives from its pollen parent, *Vitis palmata*.

Big cluster, Ave.= 180g (120-300g)

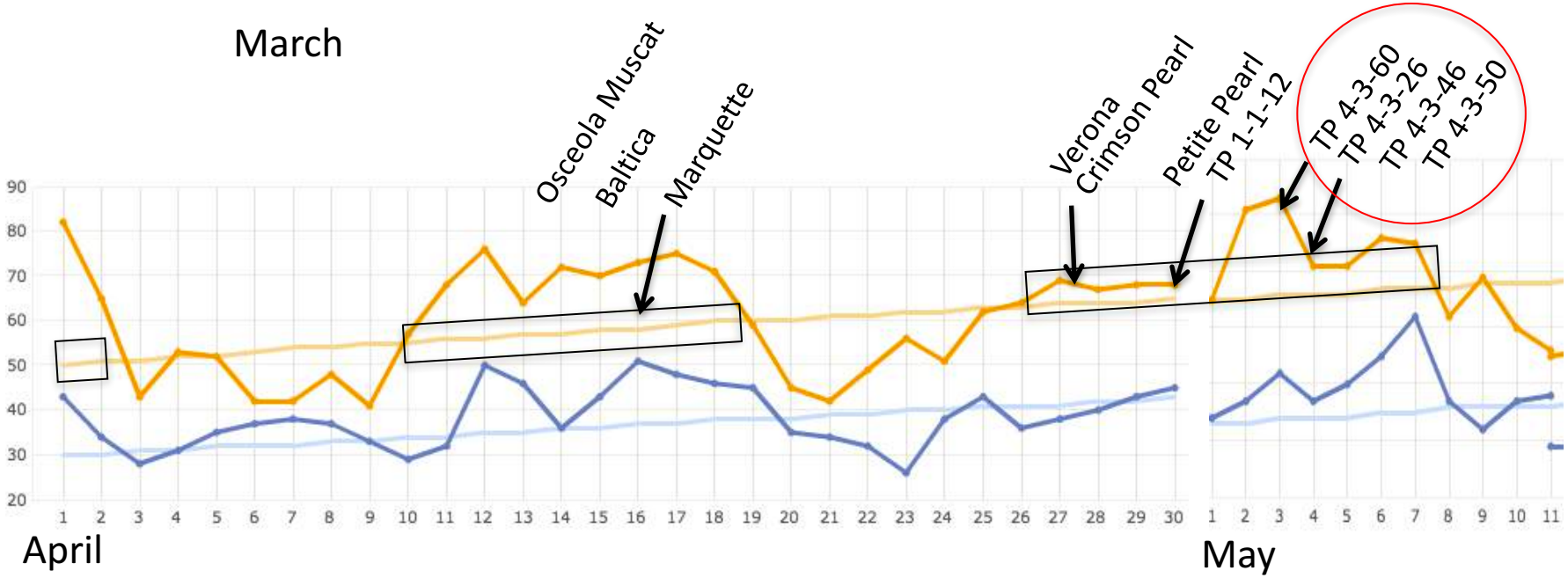
Use for a breeding parent

2006 cross of
E.S. 10-18-06 x Vitis palmata

Spring 2015 budbreak



March



April

May

What's in the future?

Later budbreak

T.P. 4-3-60

From a new second generation of seedlings bred for late budbreak.

One of 4 selected for late budbreak in 2015. 4-5 days later than Petite Pearl.

Also a "blue tag" vine. Matures wood very early. Vigorous and healthy.

Ripens fruit in early October; good harvest parameters.

First wine samples produced in 2015; "woody/earthy over fruit, floral overtones, a little Zin-like; consistent flavors end to end; some tannin.

T.P. 4-3-60

2012 T.P. 3-1-3-N x Petite Pearl

What's in the Future?

Thick Skins

Provide natural resistance to splitting, bird and insect predation.

TP 2-3-51 has skins twice as thick as other selections.

In 100 seedlings from **Petite Pearl x TP 2-3-51,** 1 in 8 inherited thick skins.

During the record wet fall of 2016, no splitting, no bird damage, no insect damage.

T.P. 2-3-51
ES. 10-18-06 x Regent

What's in the future?

Better Wine Quality

T.P. B 3-40

First fruit and micro wine in 2013

Rated highly for soft tannins, ripe plum nose and flavor, and long finish; described as "syrah-like"

Early ripening

Winter hardiness still needs to be proven

2009 cross of
T.P. 1-1-12 x Golubok

In Summary

Broaden our view of winter hardiness.

When selecting varieties, ask questions about:

-performance during early and late winter, as well as mid-winter.

-spring frost susceptibility.

-how it is affected by excessive and untimely rainfall.

We need to develop new sustainable varieties that meet all these future challenges

31 July-2 August, 2018

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2012- Neubrandenburg, Germany/Szczecin, Poland

2015-Nebraska City, Nebraska, USA

2018- Malmo/Copenhagen