Grape and Wine Roadshow

ADAPTING TO DIFFICULT VINTAGES

McLaren Vale Workshop

Middlebrook Estate, Sand Road, McLaren Vale

Tuesday, 10th September, 2013

9:00 am – 4:00 pm

09:00	-	09:10	Registration & welcome	
09:10	-	09:30	A changing environment	Darren Ray
09:30	-	09:50	Why is harvest getting earlier and what can we do about it?	Peter Dry
09:50	-	10:05	Hotter and drier in the vineyard	Peter Dry
10:05	-	10:25	Hotter and drier - processing ripe fruit	Adrian Coulter
10:25	-	10:35	Salinity and sodicity in the vineyard	Peter Dry
10:35	-	10:50	Salty juice and wine	Matt Holdstock
10:50	-	11:10	**Tea Break**	
11:10	-	11:35	Bushfires and smoke taint tasting	Adrian Coulter
11:35	-	11:55	Growing grapes in wet seasons	Peter Dry
11:55	-	12:15	Winemaking in wet seasons	Matt Holdstock
12:15	-	12:35	Efficiencies in the winery	Adrian Coulter
12:35	-	13:05	Energy use and winery wastewater	Adrian Coulter
13:05	-	13:55	**Lunch**	
13:55	-	14:45	Practical vineyard and winery group exercise	Peter Dry
14:45	-	15:45	New varieties for a changing climate tasting	Peter Dry
15:45	-	16:00	Question time	

The Australian Wine Research Institute provides its services free of charge.
Payment will secure your place in the workshop.

The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australia's grapegrowers and winemakers through their investment body, the Grape and Wine Research Development Corporation, with matching funds from the Australian government.

AWRI

The Australian Wine Research Institute

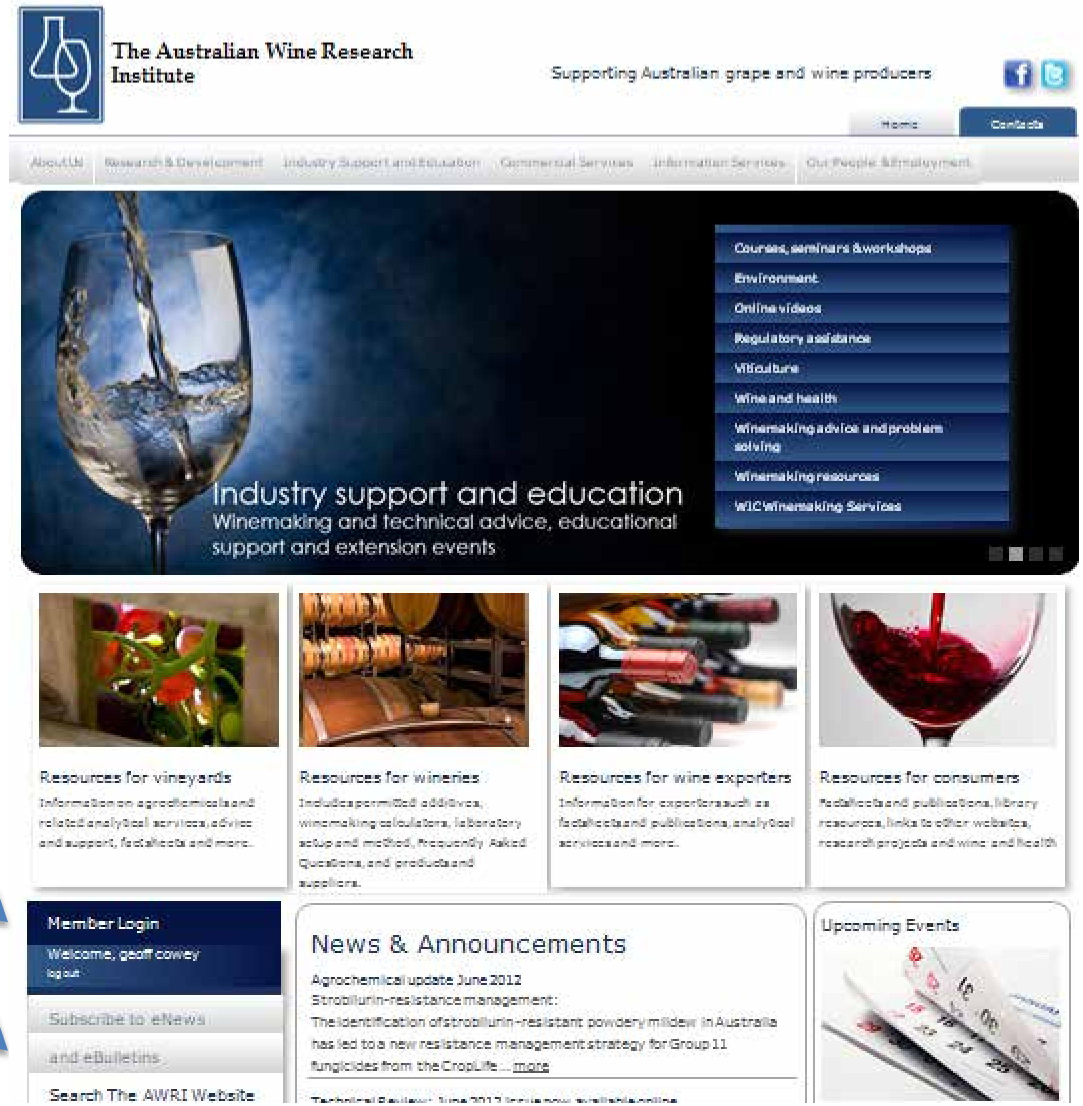
Grape and Wine Roadshow

Adapting to difficult vintages Workshop


Roadshow
Advice
Investigation
Trends,
Emergency
Response
Trials
Research
Development
Commercial
Application
Communication
Education
Technical
Review
e
eNews/eBulletin
AWITC

AWRI Subscription

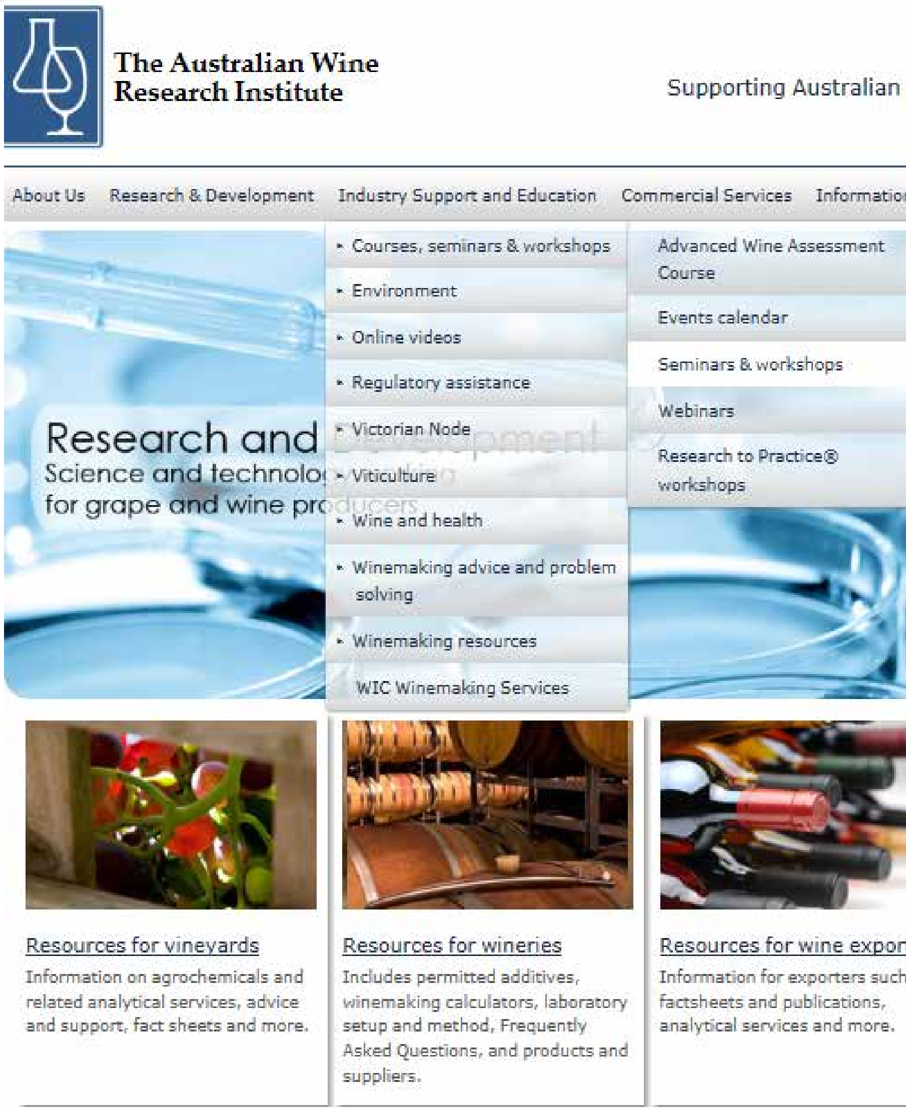
The Australian Wine Research Institute



website subscription

eNews, eBulletins

Further information



alian Wine
Institute

Acknowledgements

The Australian Wine Research Institute

Your regional association

AWRI staff and students

CSIRO – Rob Walker & team

SARDI

The University of Adelaide

BOM

Memstar Australia

Wine sector partners

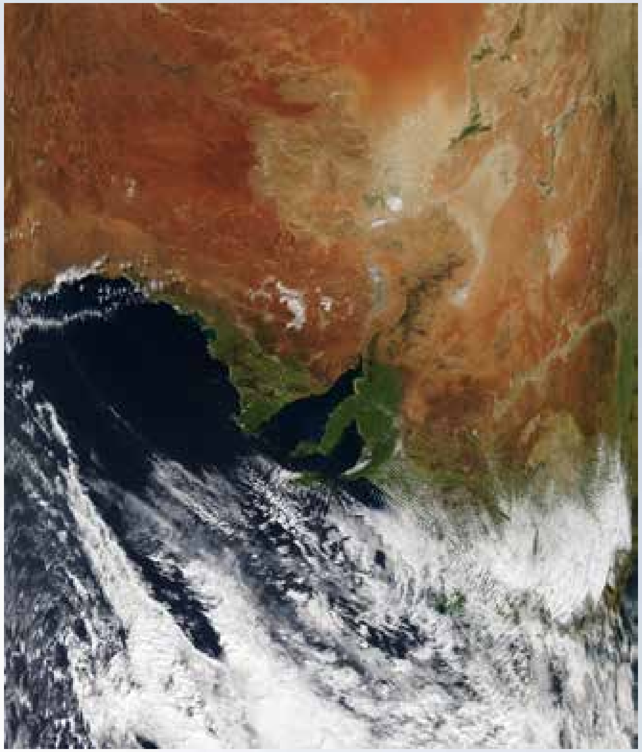
The Grape and Wine roadshow workshop program is supported by Australia's grapegrowers and winemakers through their investment agency the Grape and Wine Research and Development Corporation, with matching funds from the Australian Government.

gwrdc

GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

Australian Government
Bureau of Meteorology

Climate influences, trends and seasonal forecasting for South Australia wine regions



Darren Ray

Senior Meteorologist/Climatologist

South Australian Regional Climate Services Centre

Bureau of Meteorology

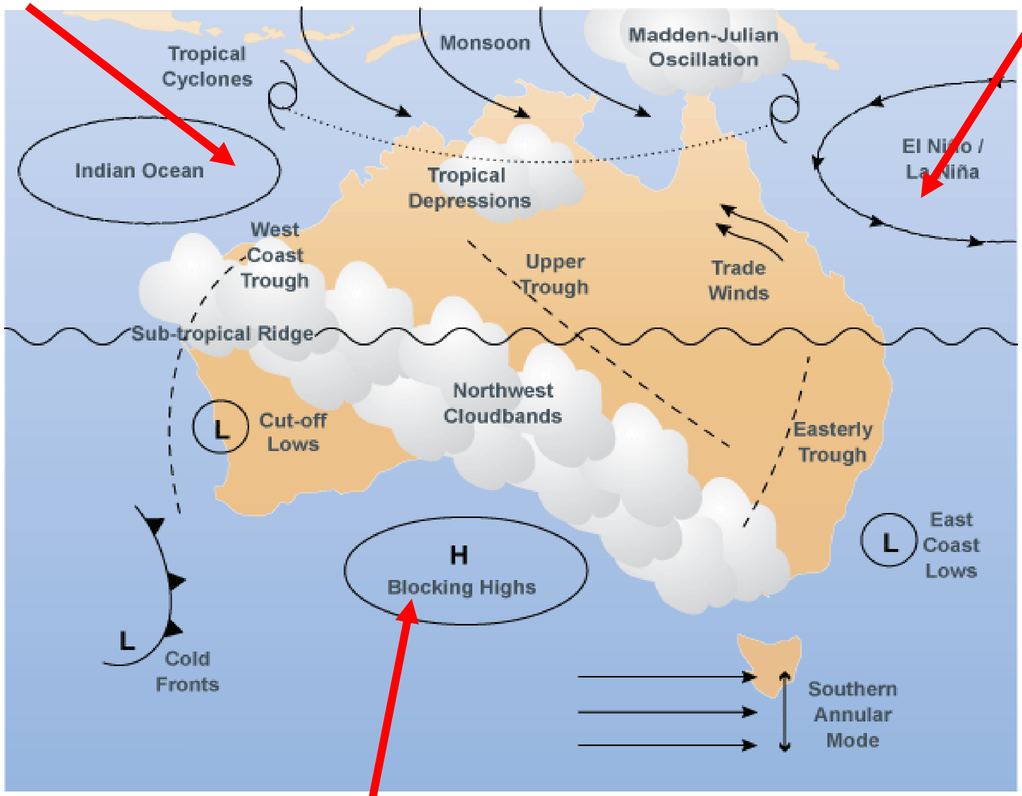
d.ray@bom.gov.au

Australian Government
Bureau of Meteorology

Major climate influences for Australia

Indian Ocean

Pacific Ocean



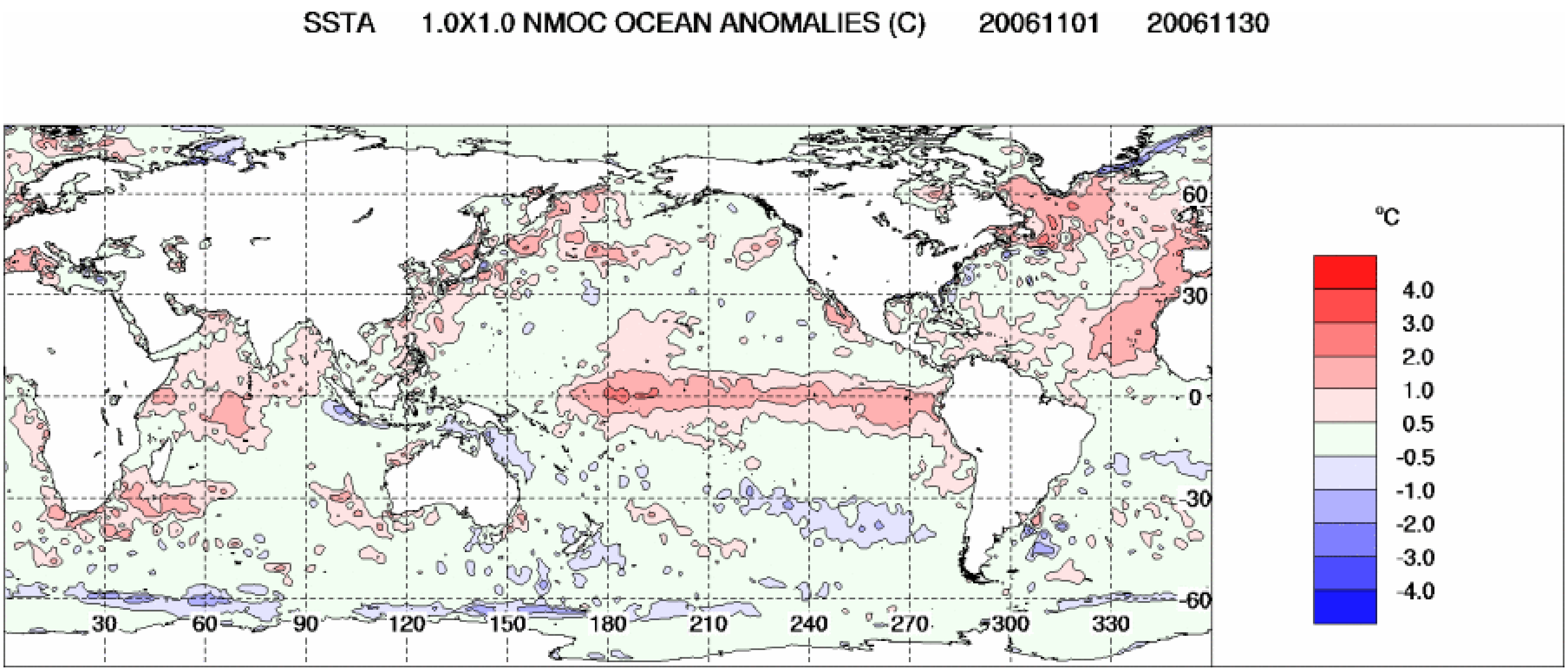
Southern Ocean

- Northwest cloud bands 1970's
- El Nino/La Nina 1980's
- Southern Annular Mode 1990's
- Indian Ocean Dipole 1999
- Madden Julian Oscillation 2000's

Still a lot of ongoing work occurring and still a long way from a complete understanding

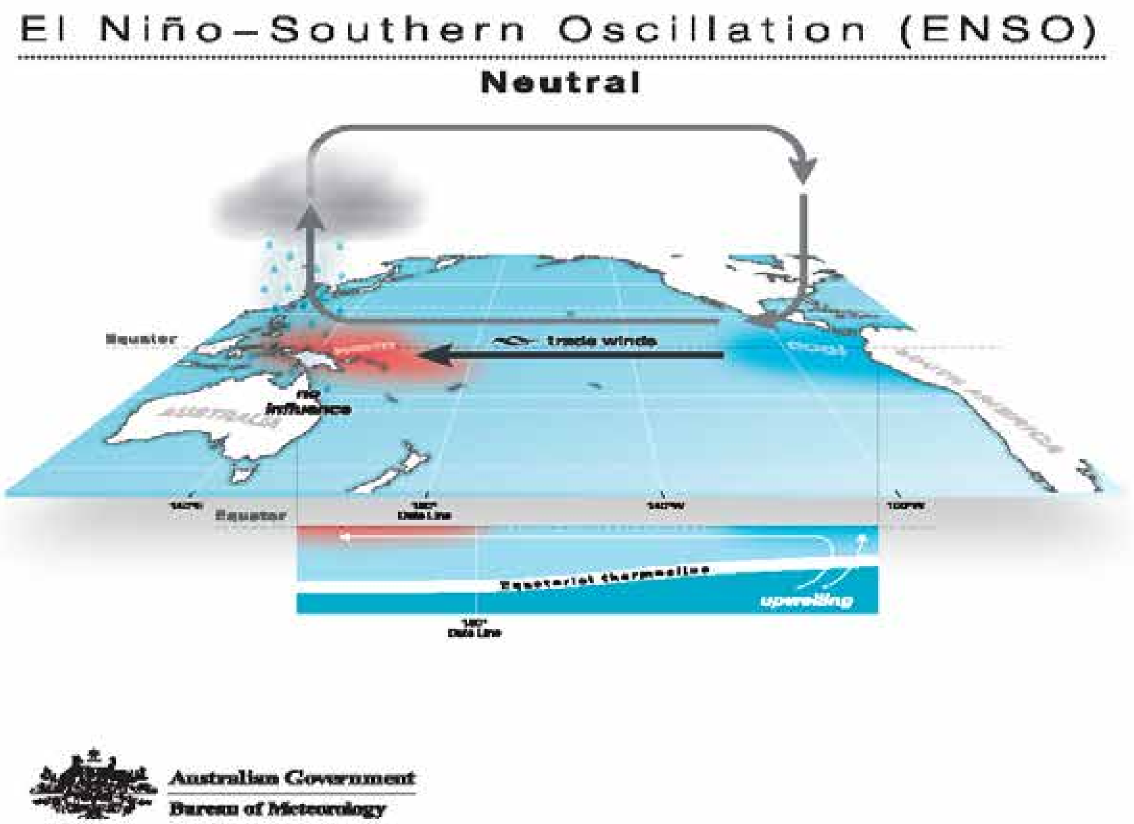
Long term predictability

- Most of the predictability past ~ 2 weeks comes from the ocean



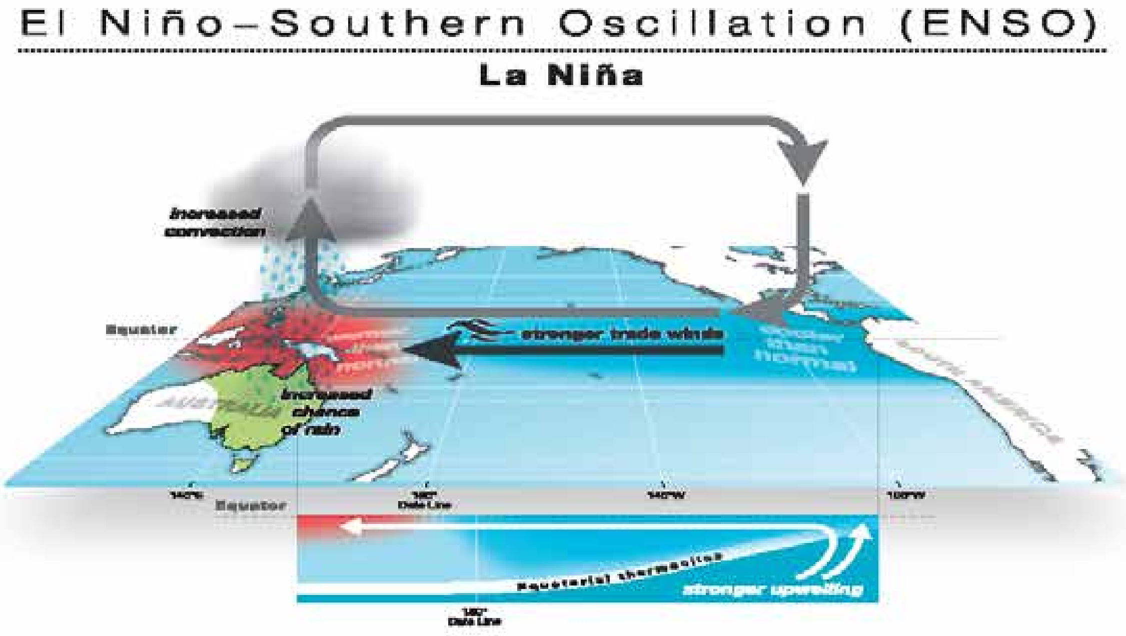
The dominant feature in ocean variability is the El Nino / La Nina (ENSO) signal

ENSO (El Niño/ La Niña cycle)



Australian Government
Bureau of Meteorology

ENSO (El Niño/ La Niña cycle)

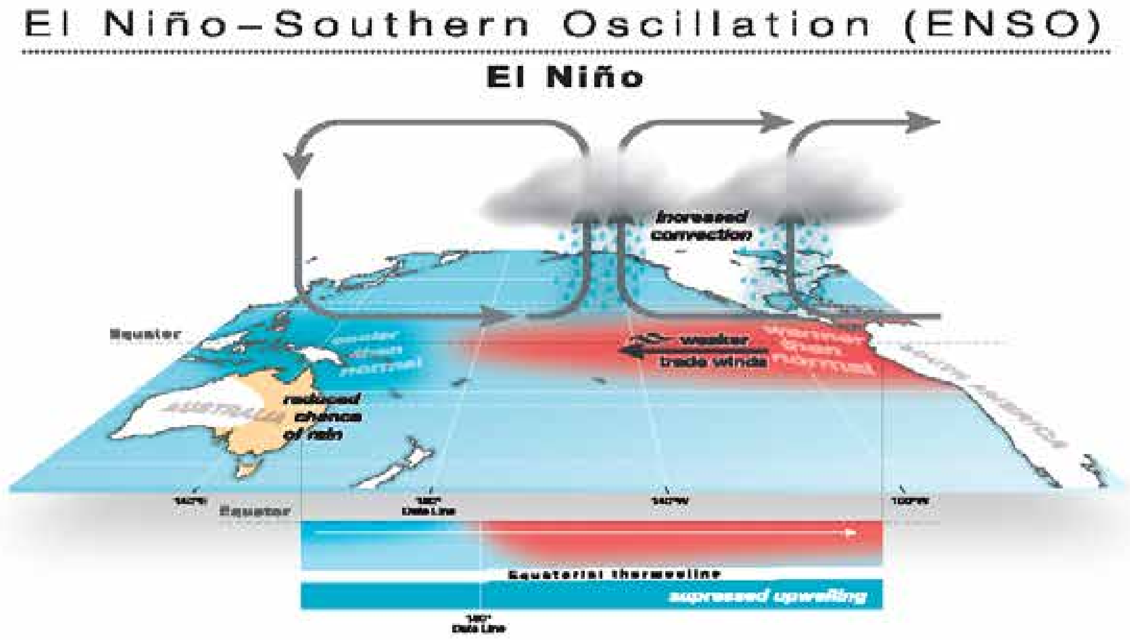


Australian Government
Bureau of Meteorology

Australian Government

Bureau of Meteorology

ENSO (El Niño/ La Niña cycle)

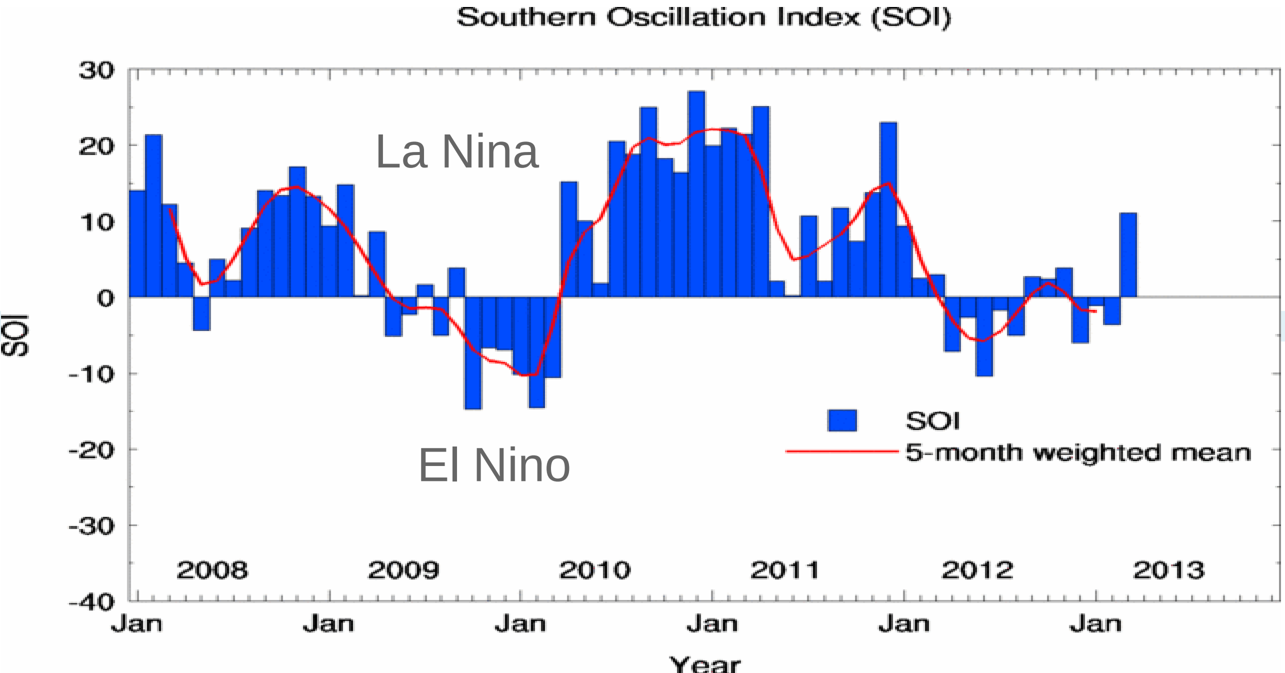


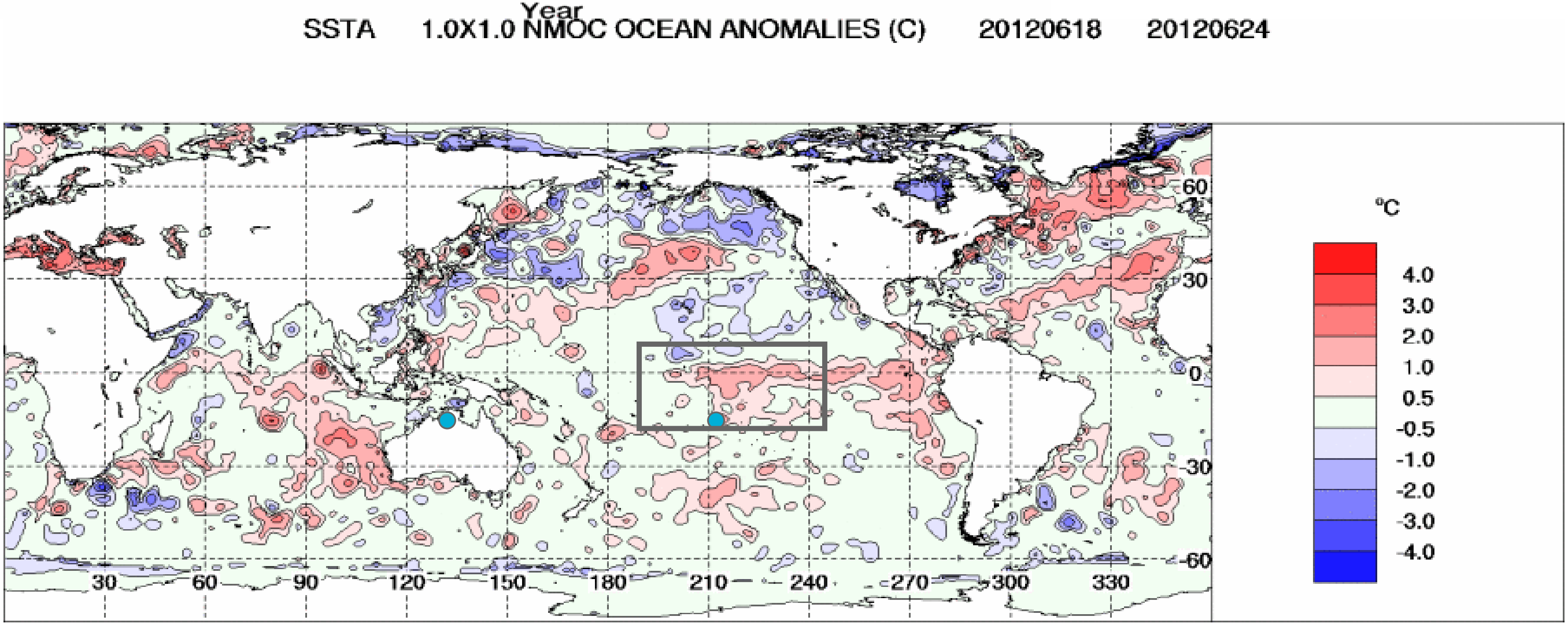
Australian Government

Bureau of Meteorology

Monitoring ENSO (El Niño/La Niña)

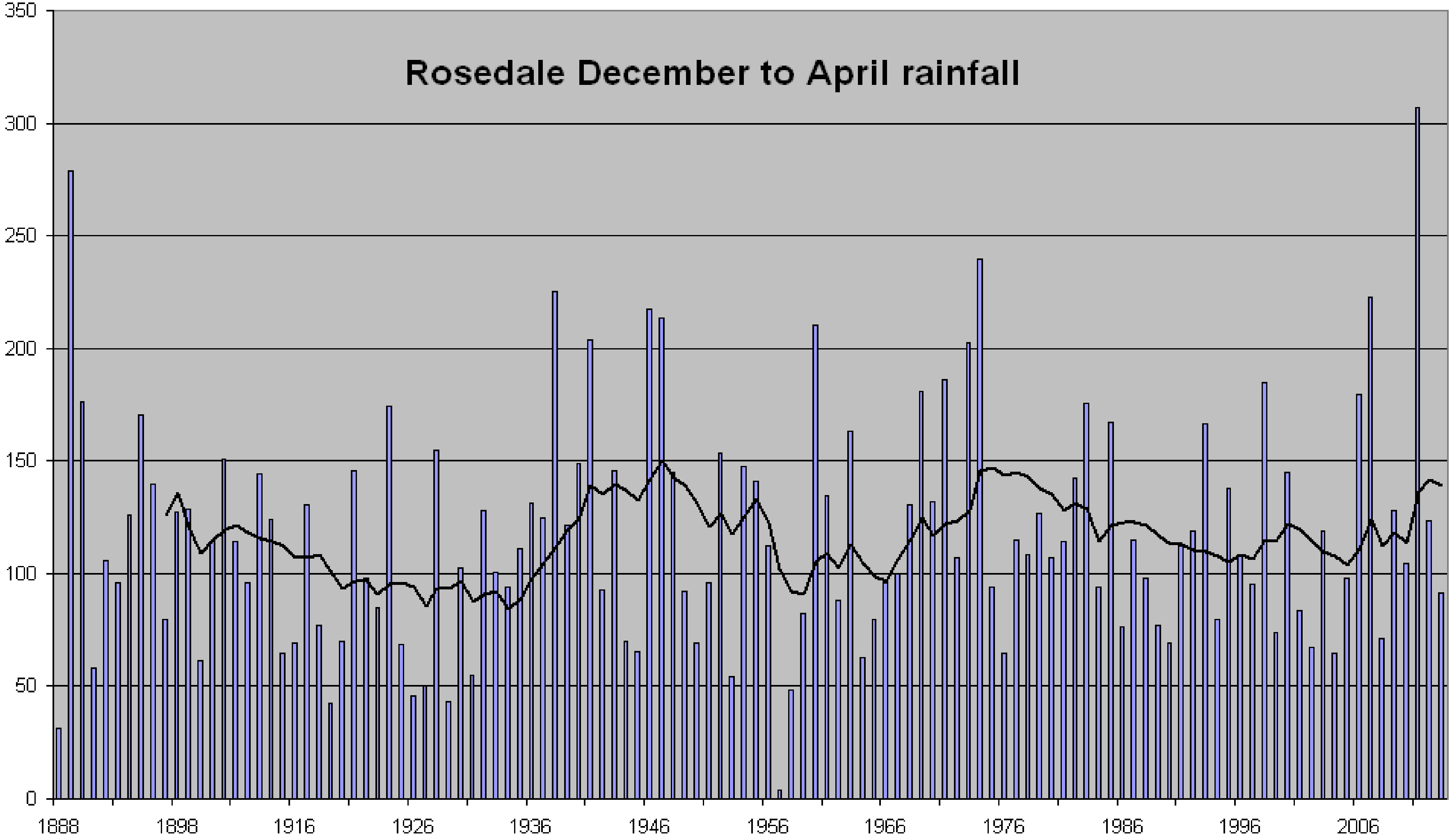
We look at SOI and ocean temperatures





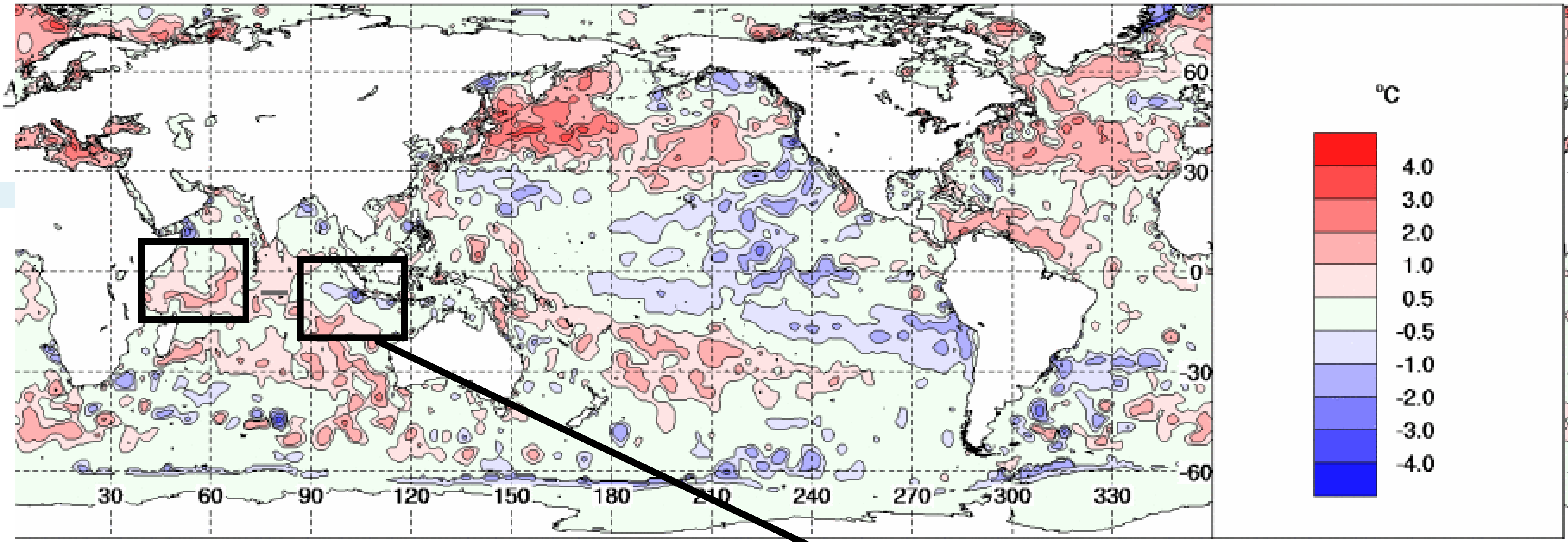
La Niña/ El Niño influence

Many of the wettest years are La Nina events



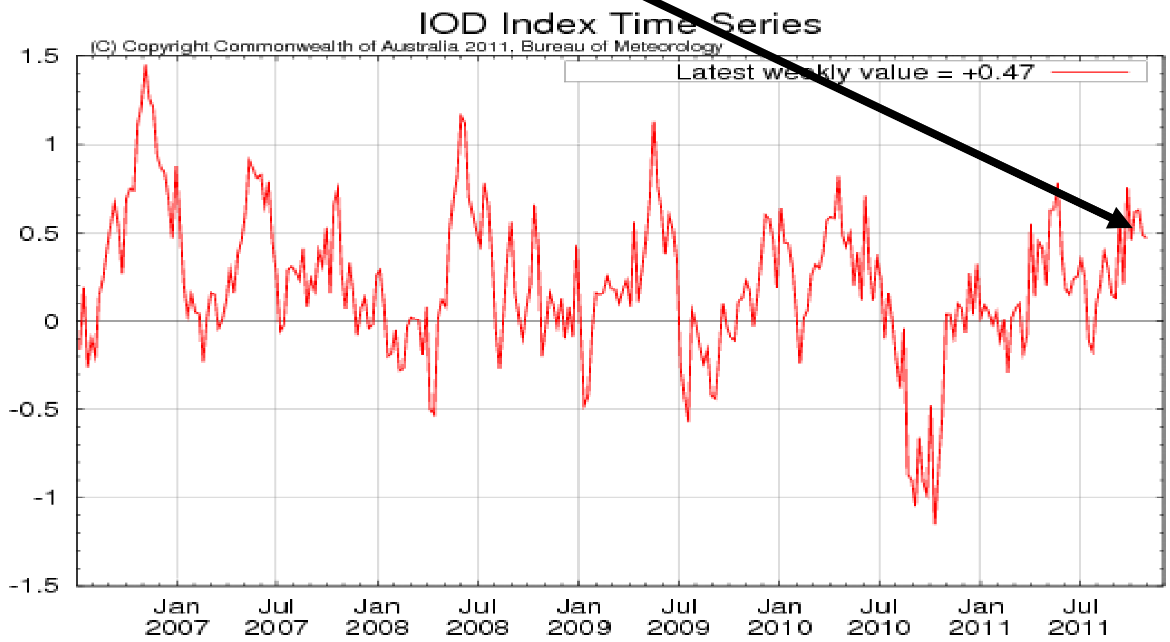
SSTA 1.0X1.0 NMOC OCEAN ANOMALIES (C) 20110905 20110911

Indian Ocean – Indian Ocean Dipole



The Indian Ocean Dipole

- influences July to November rainfall

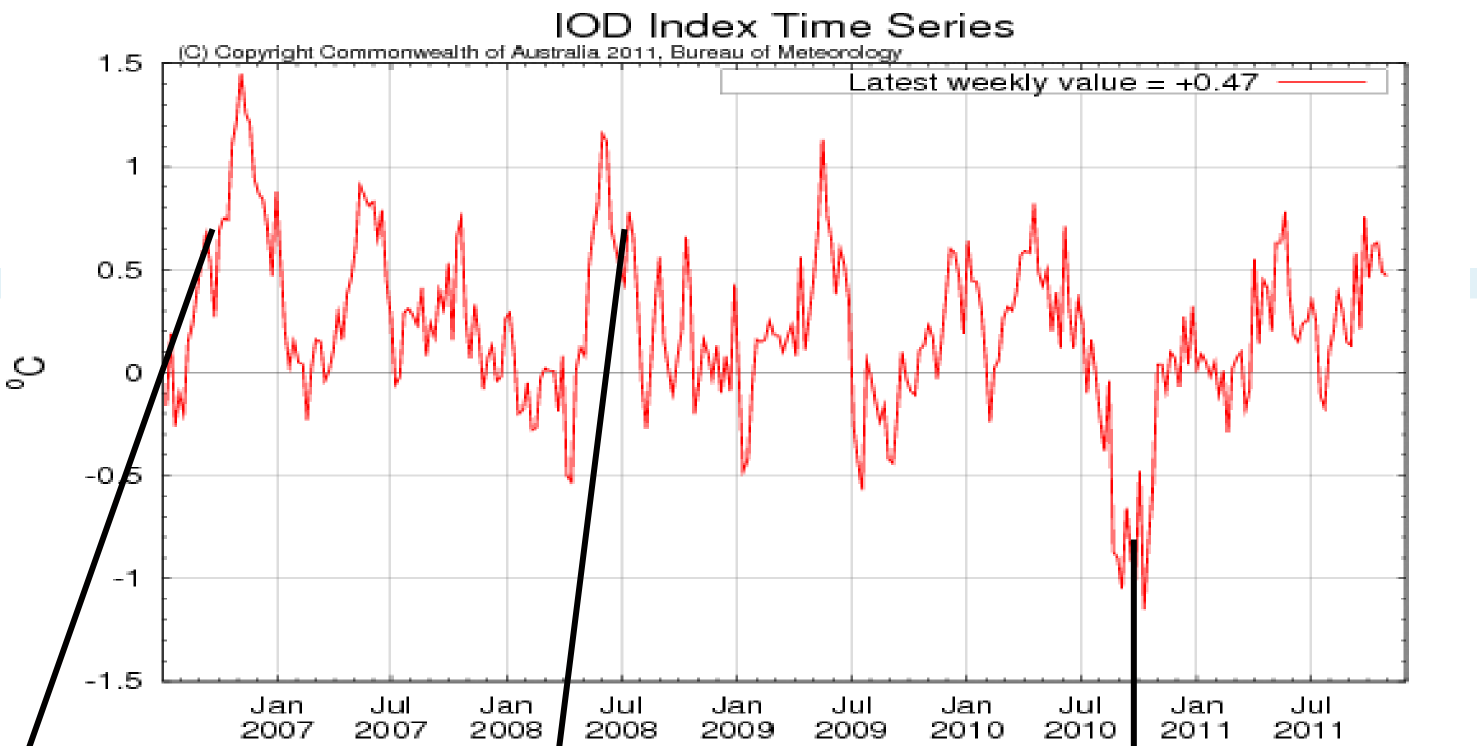


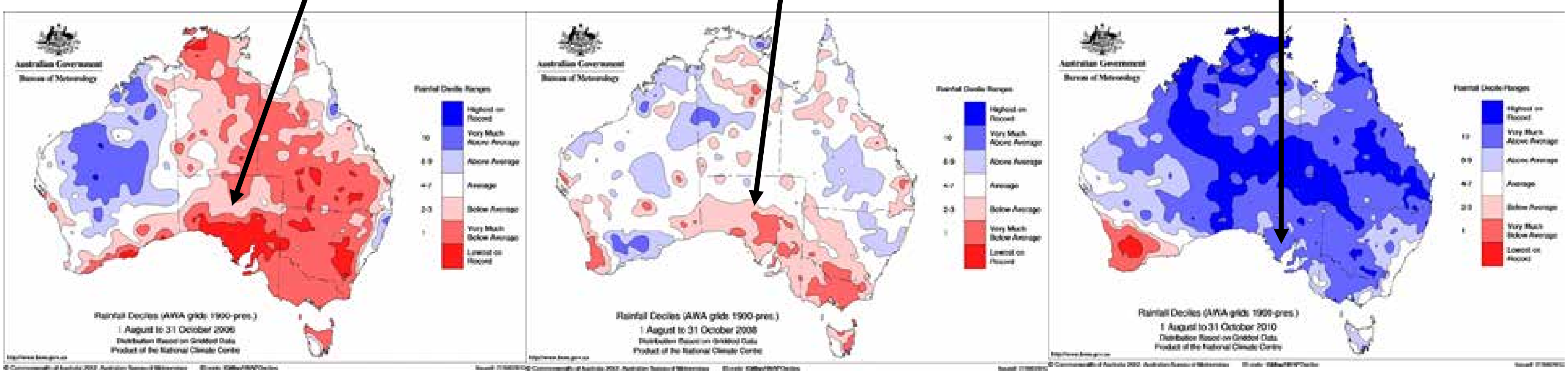
Less spring rain

More spring rain

Australian Government
Bureau of Meteorology

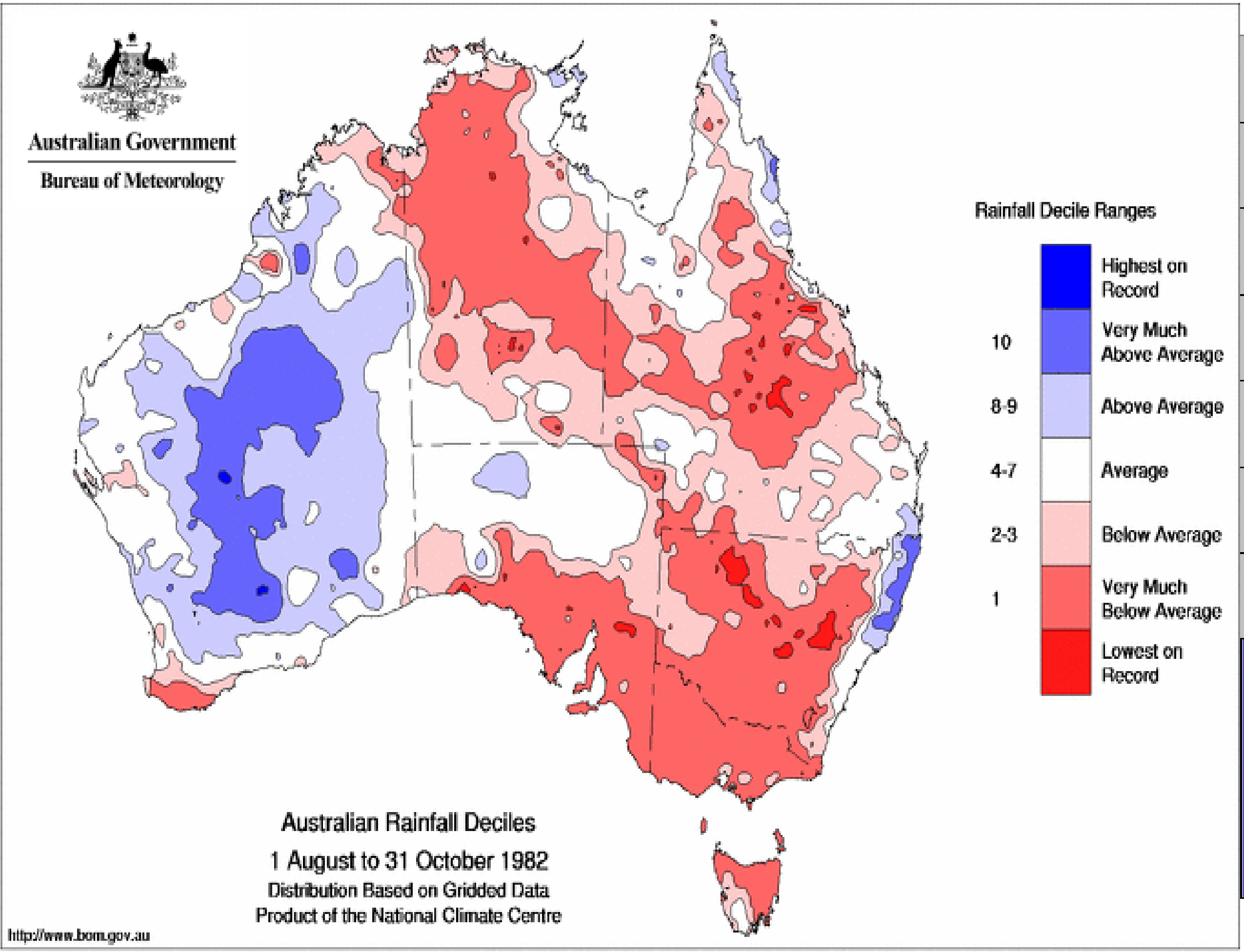
Past Indian Ocean Dipole events



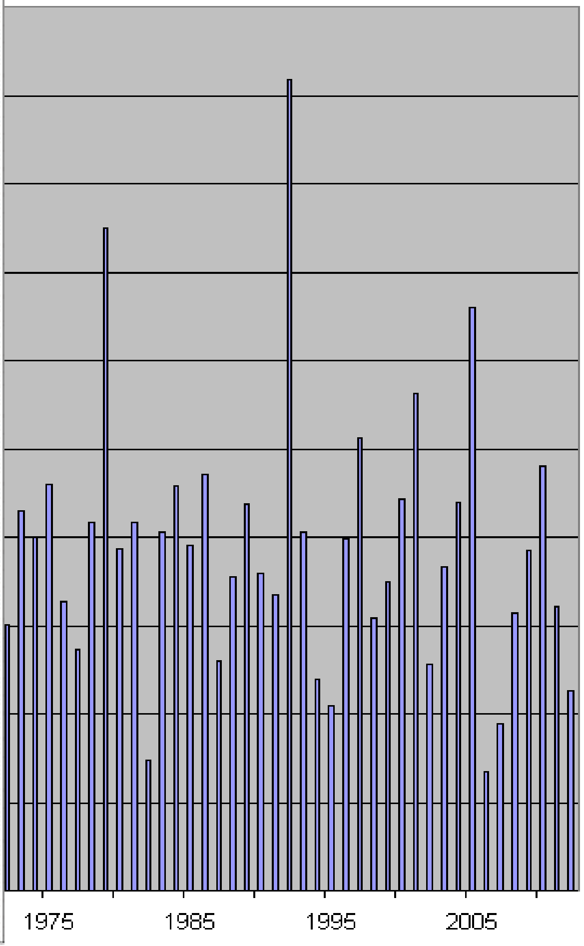


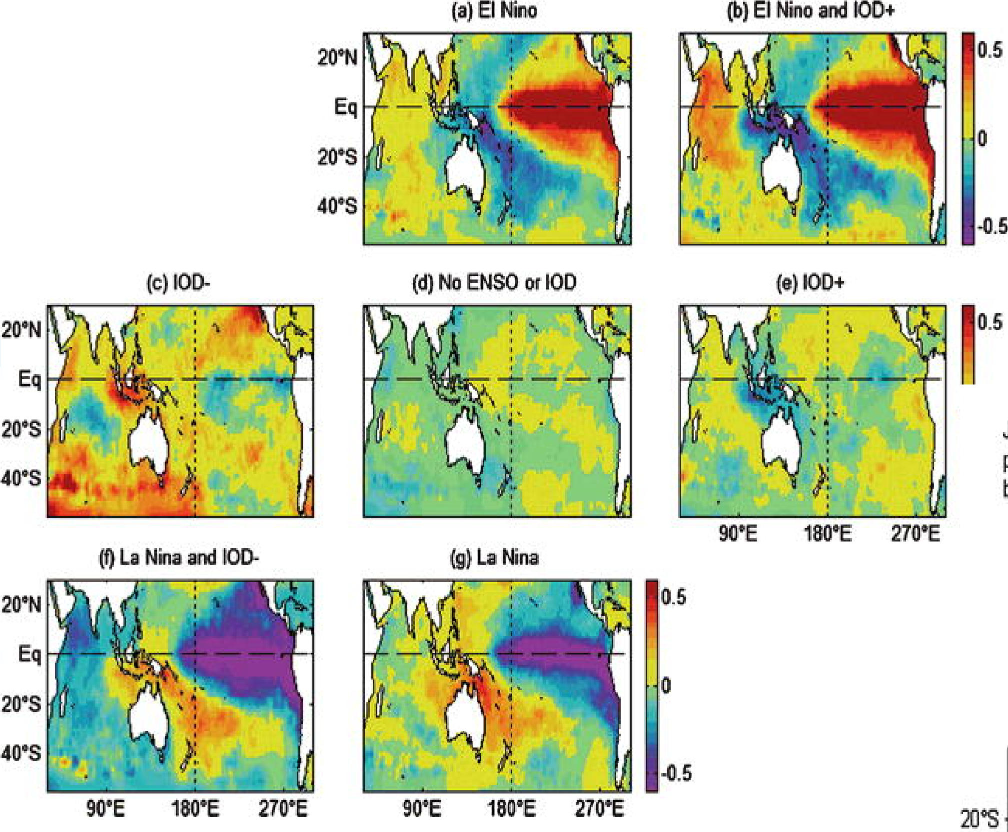
Indian Ocean Dipole influence

wet springs are often –ve IOD, dry ones +ve IOD



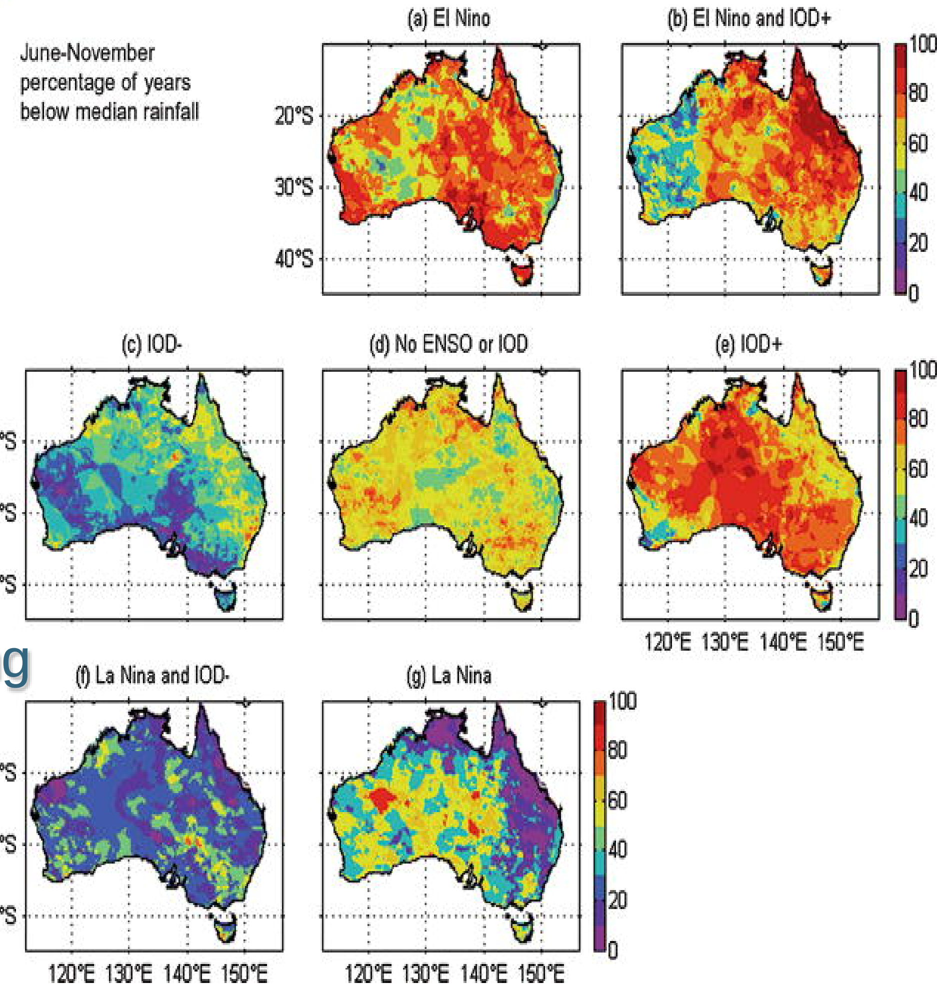
Issued: 25/01/2010





Sea surface temperatures

Resulting rainfall

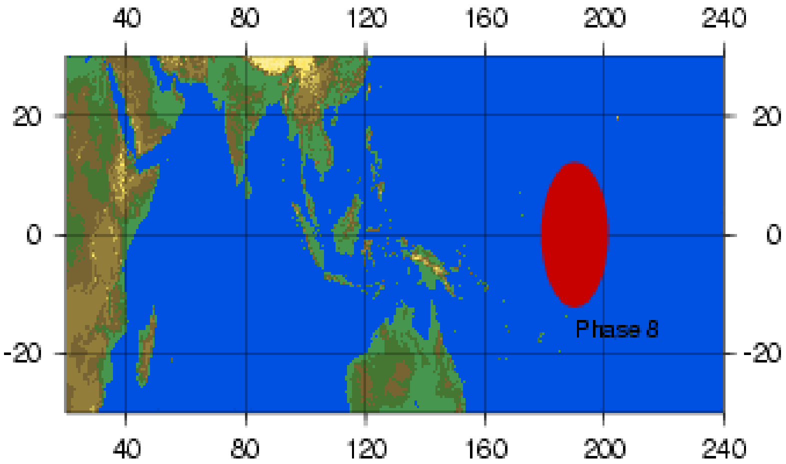


Various combinations of different phases of theses climate drivers make the picture complicated!!

Australian Government
Bureau of Meteorology

Madden Julian Oscillation (Nov – April)

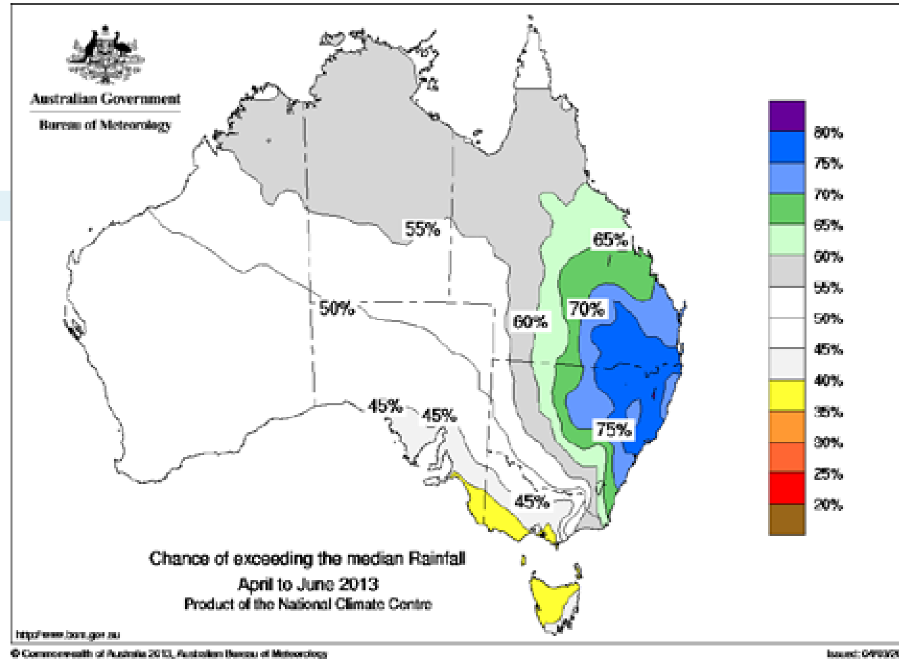
- Pulses of tropical activity moving from west to east
- ~ 30 to 60 day cycle during
- Monsoon break
- Often triggers the growing season break
- Can trigger TC activity and big rain events

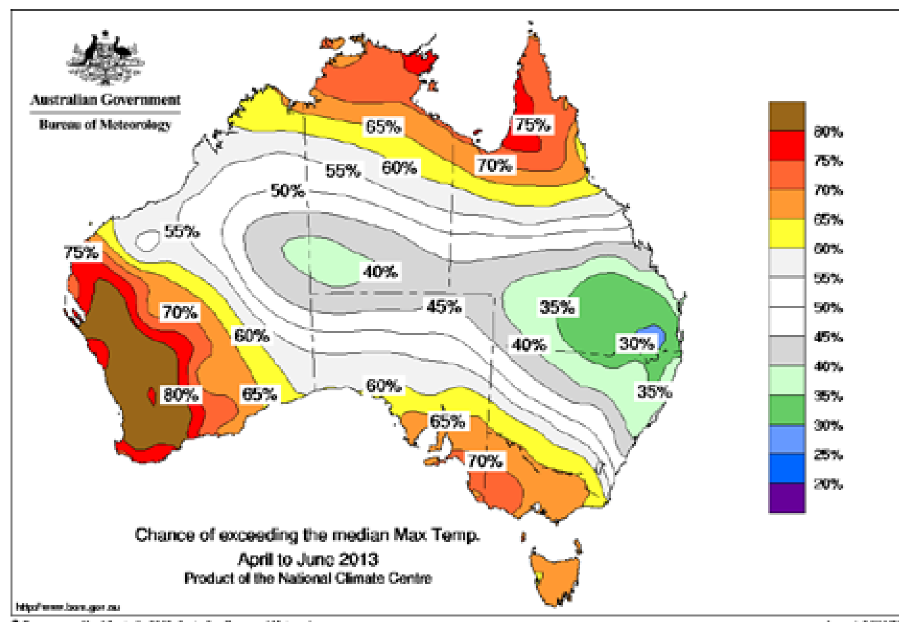


BoM Seasonal Climate Outlook

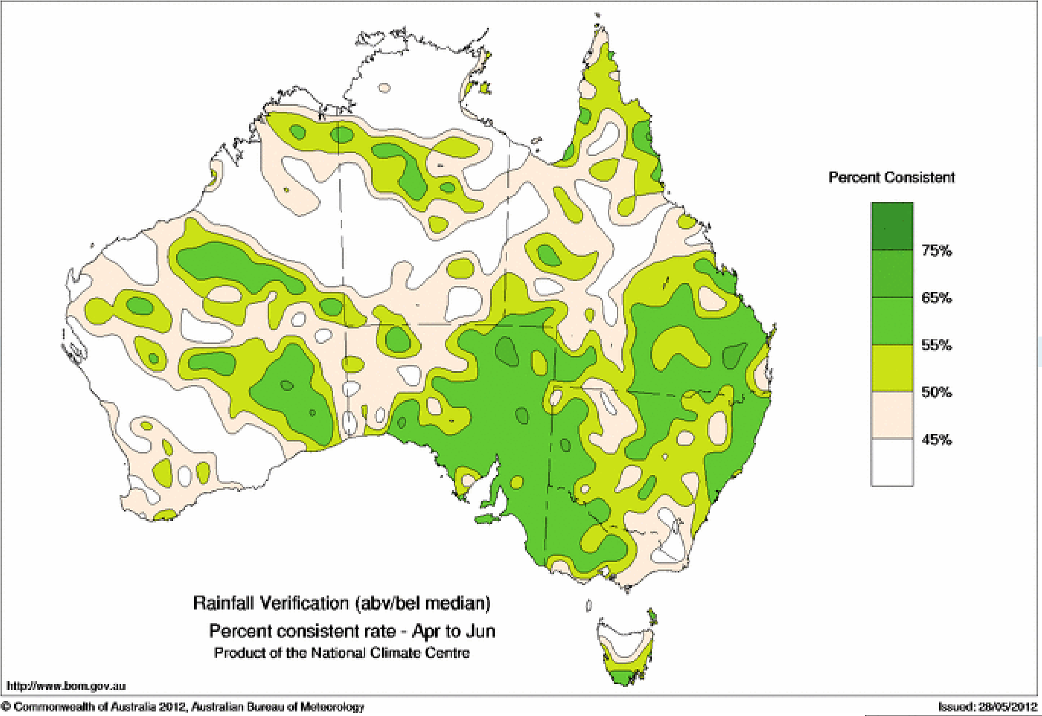
Australian Government
Bureau of Meteorology

- 3 month block updated monthly.
- Used to look for past statistical analogues in current ocean temperature patterns as the predictor.
- Skill of this method varies through the year for any location.
- It is important to keep in mind the confidence/skill maps
- From now being done using ocean/ atmosphere modelling

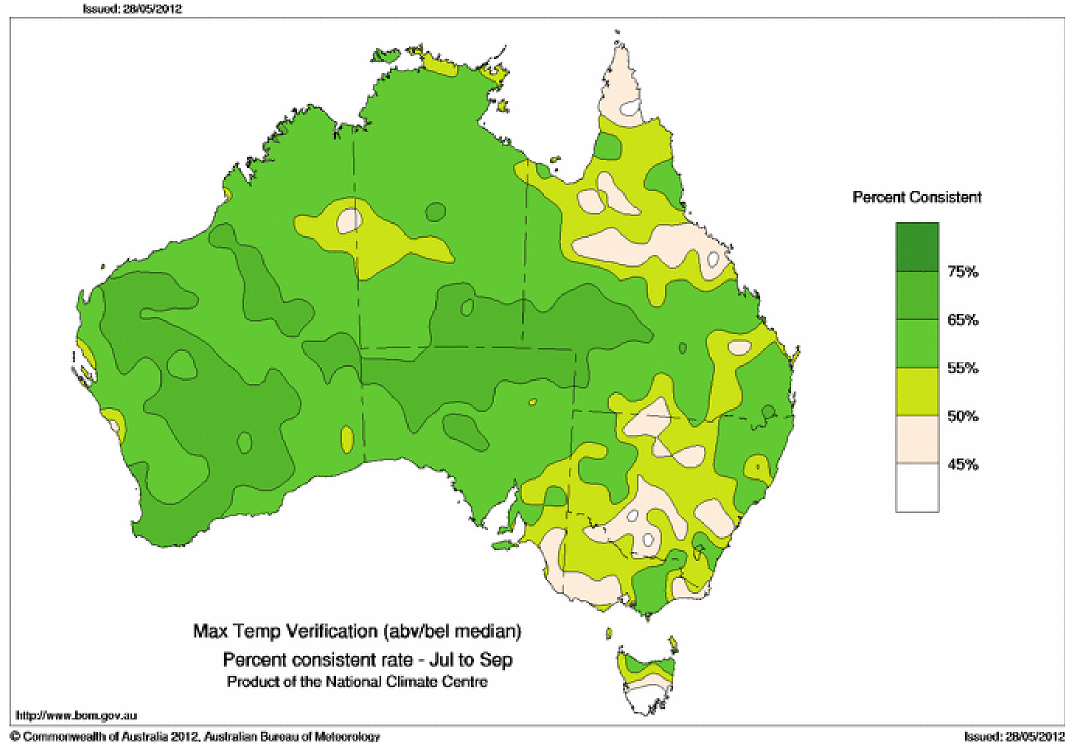




SCO skill

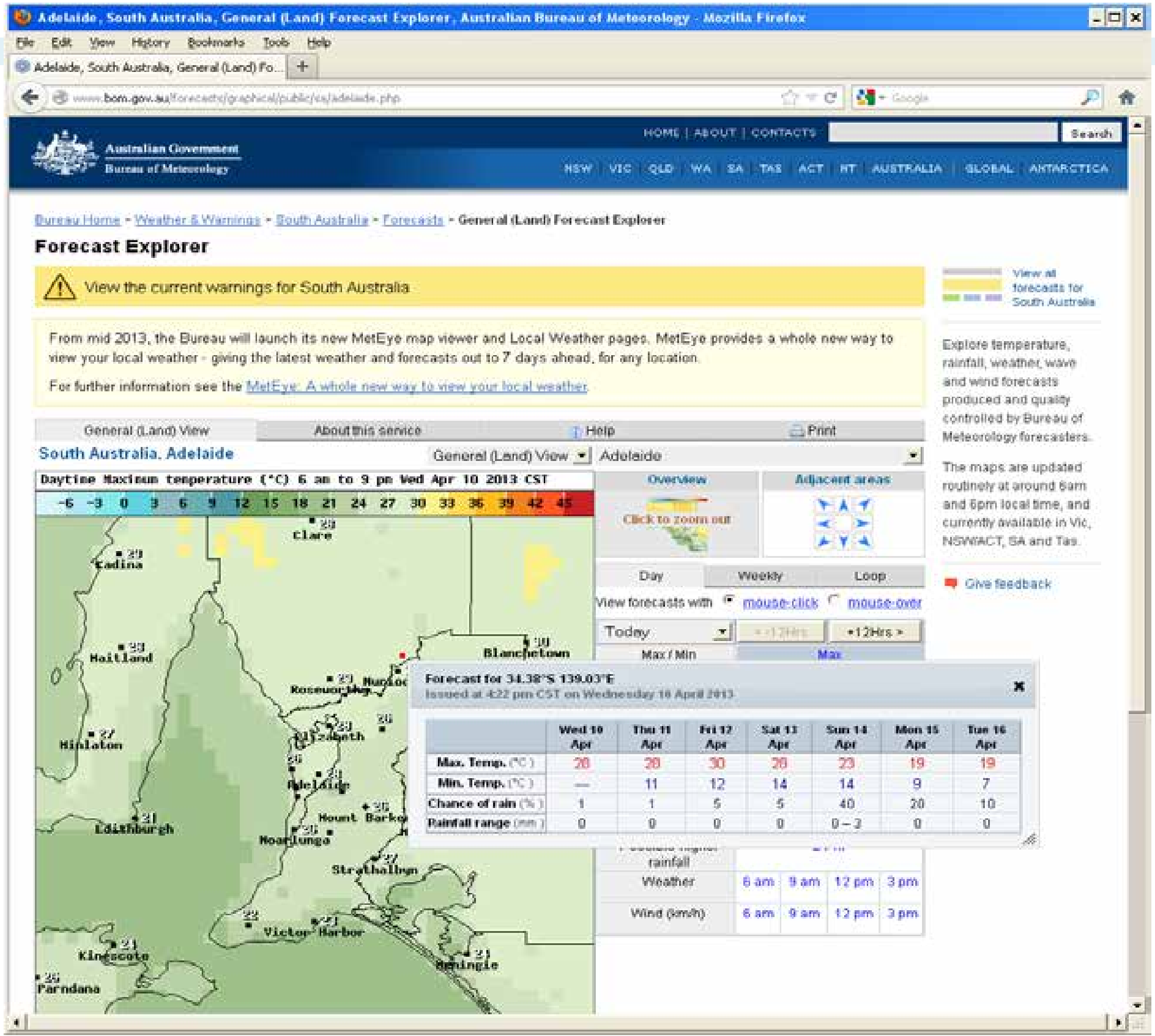


The skill of the product varies strongly through the year and for different regions



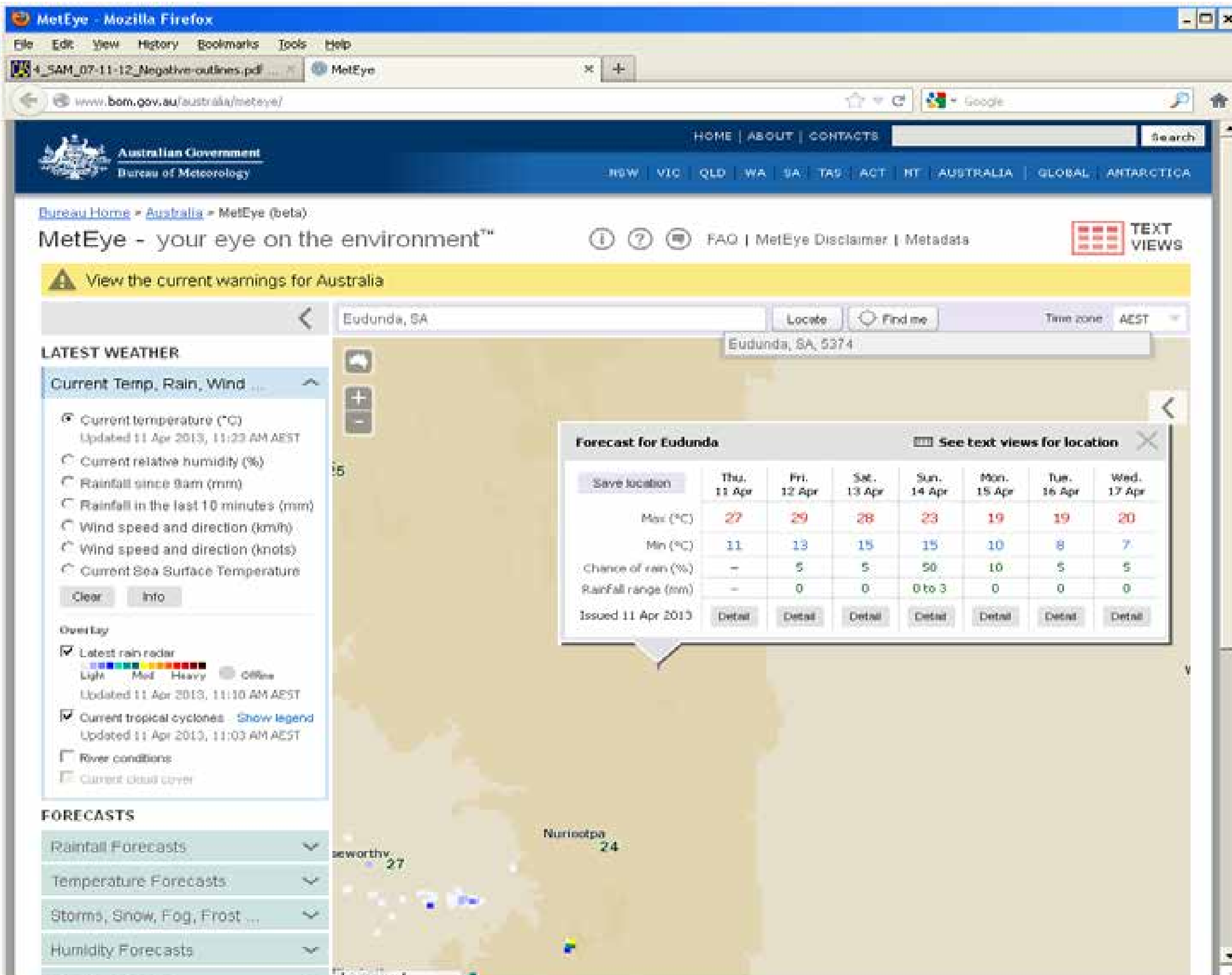
Australian Government
Bureau of Meteorology

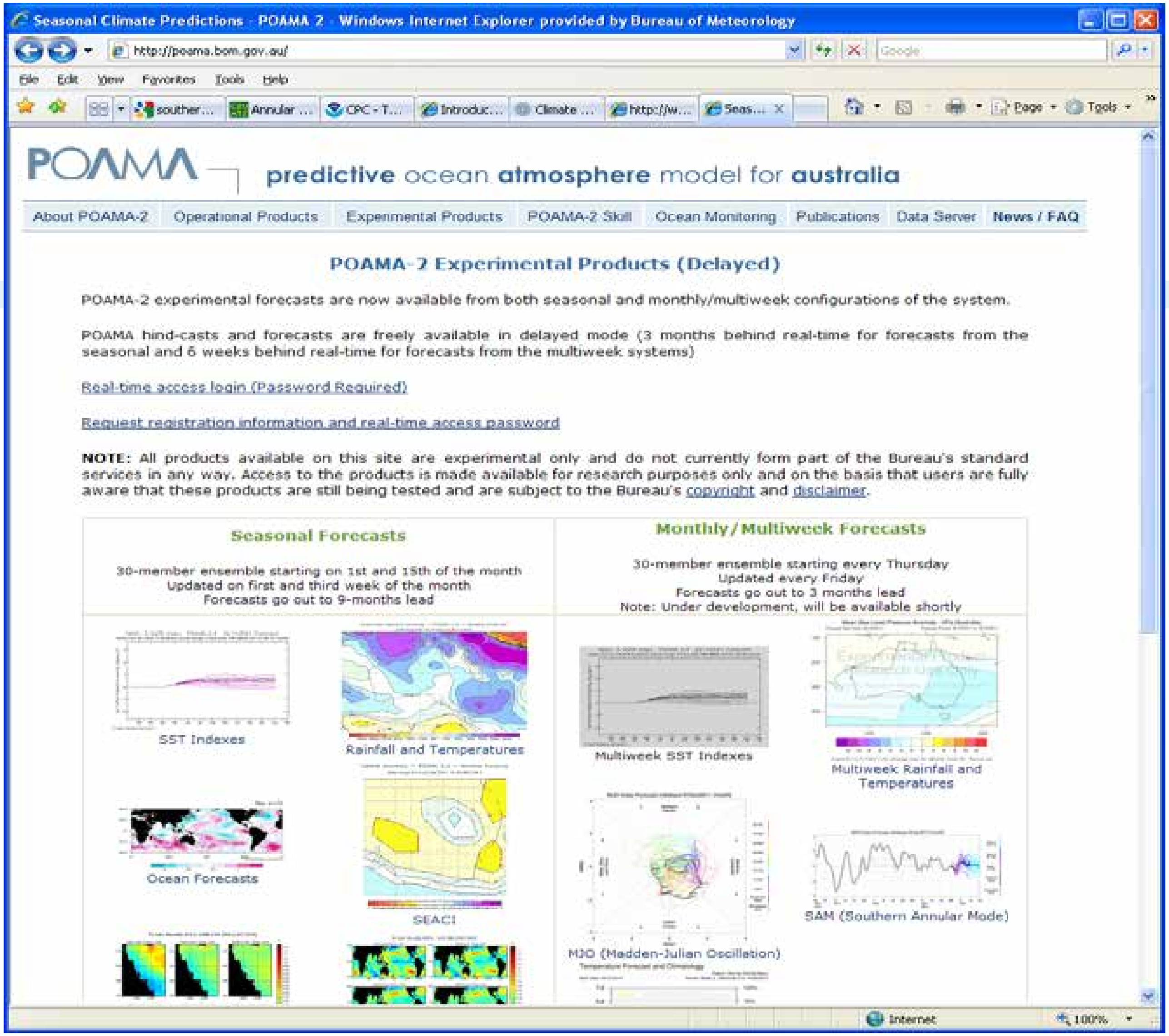
Forecast Explorer… week ahead forecasts across South Australia…



Australian Government
Bureau of Meteorology

Becoming MetEye in next few months…



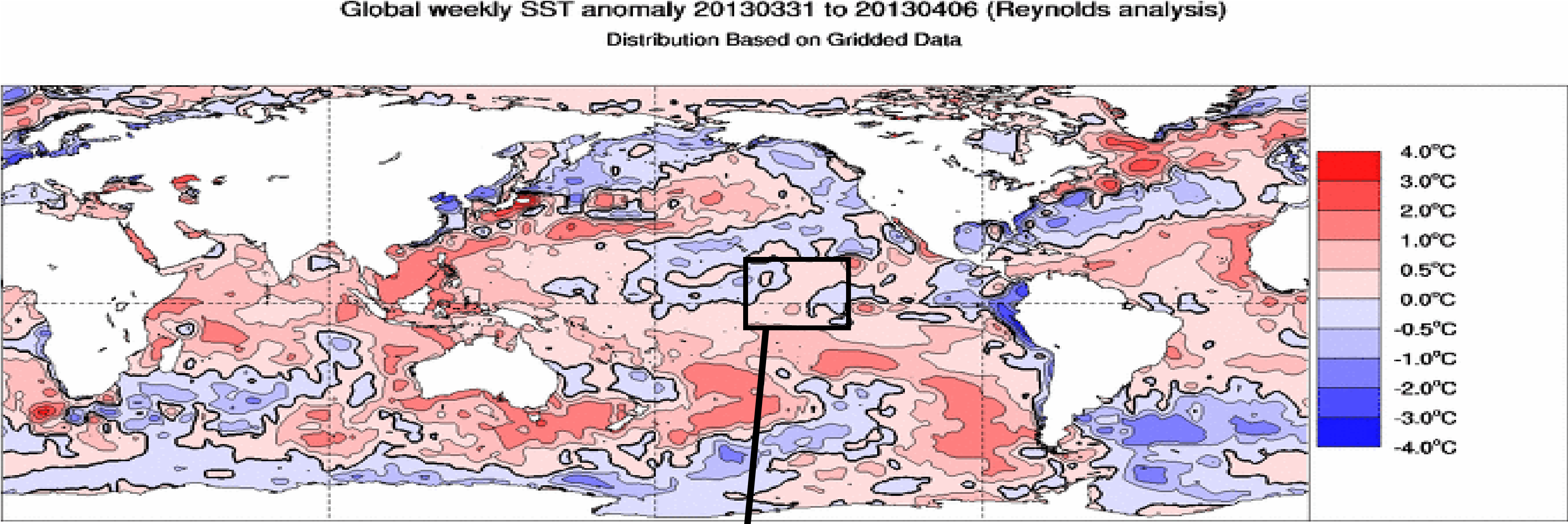


POAMA

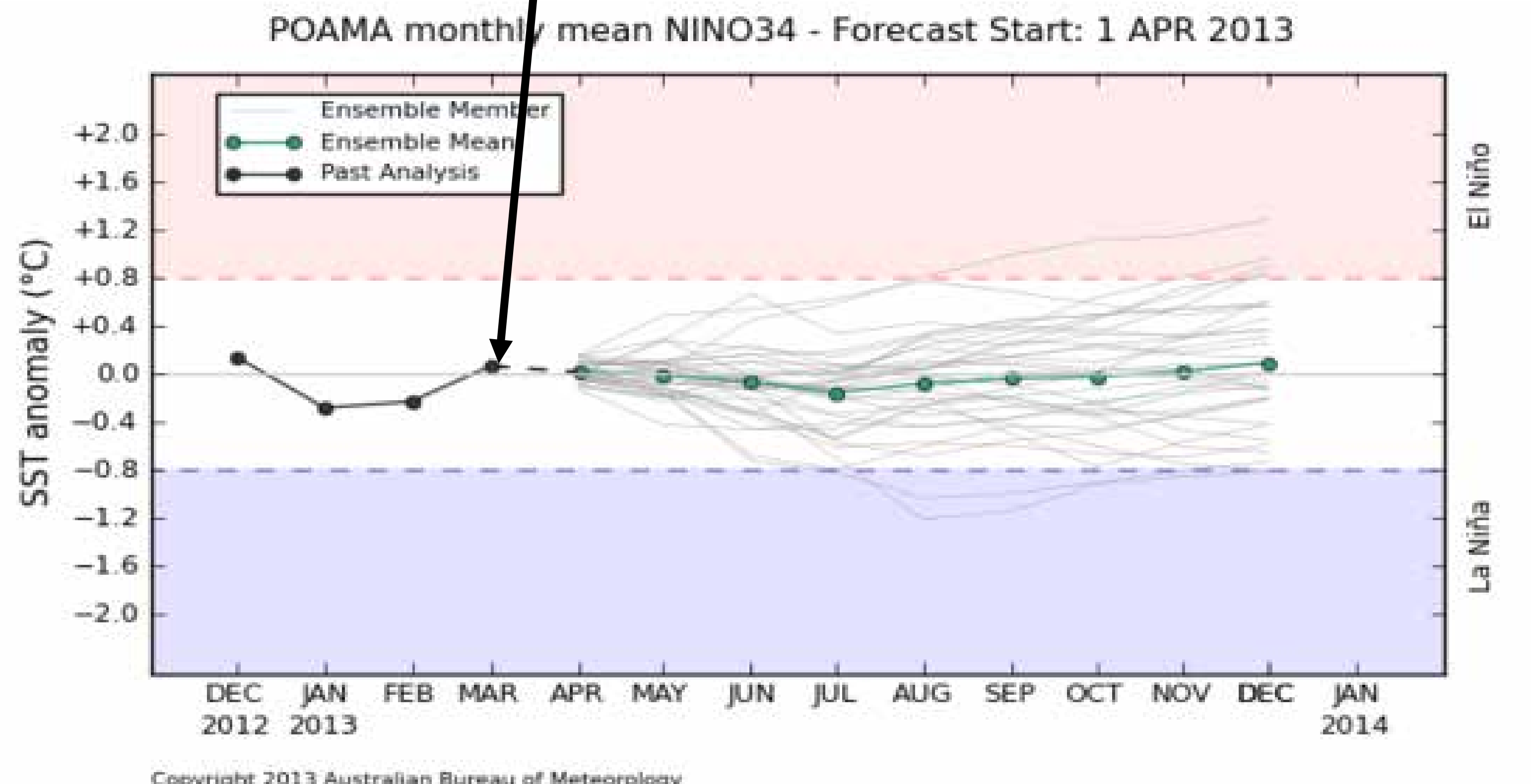
- Combines ocean computer model forecasts with weather model forecasts out months ahead.
- Other international centres have similar models

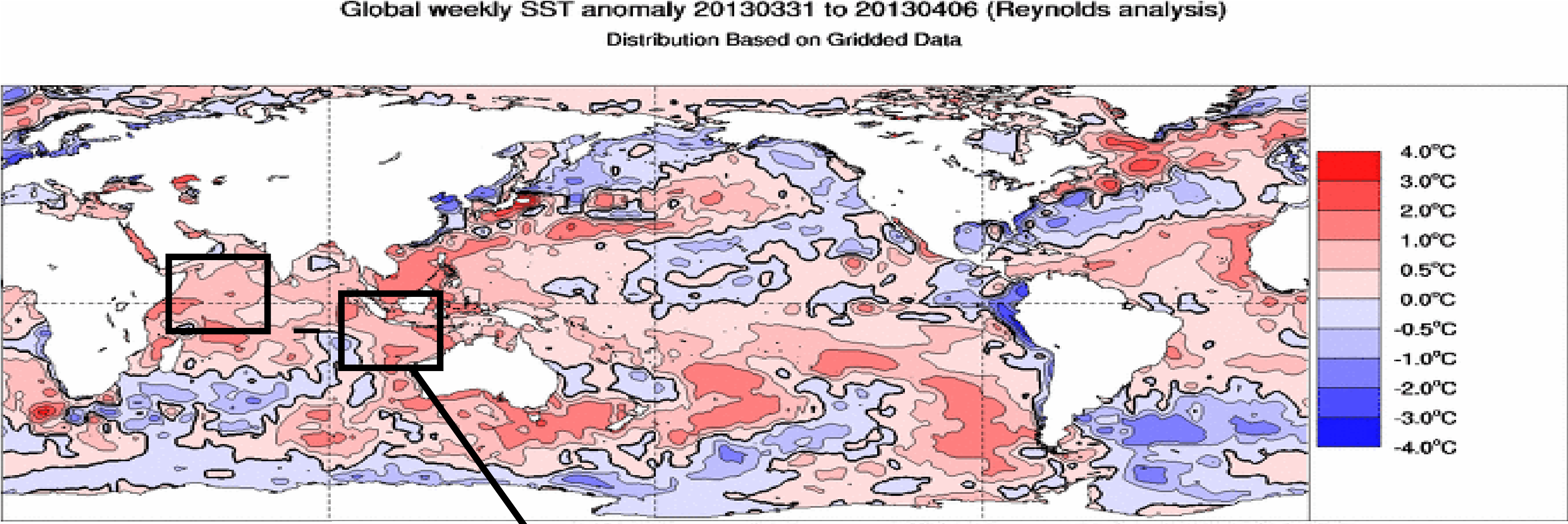
Available for experimental use:

http://poama.bom.gov.au/realtime/poama2.shtml



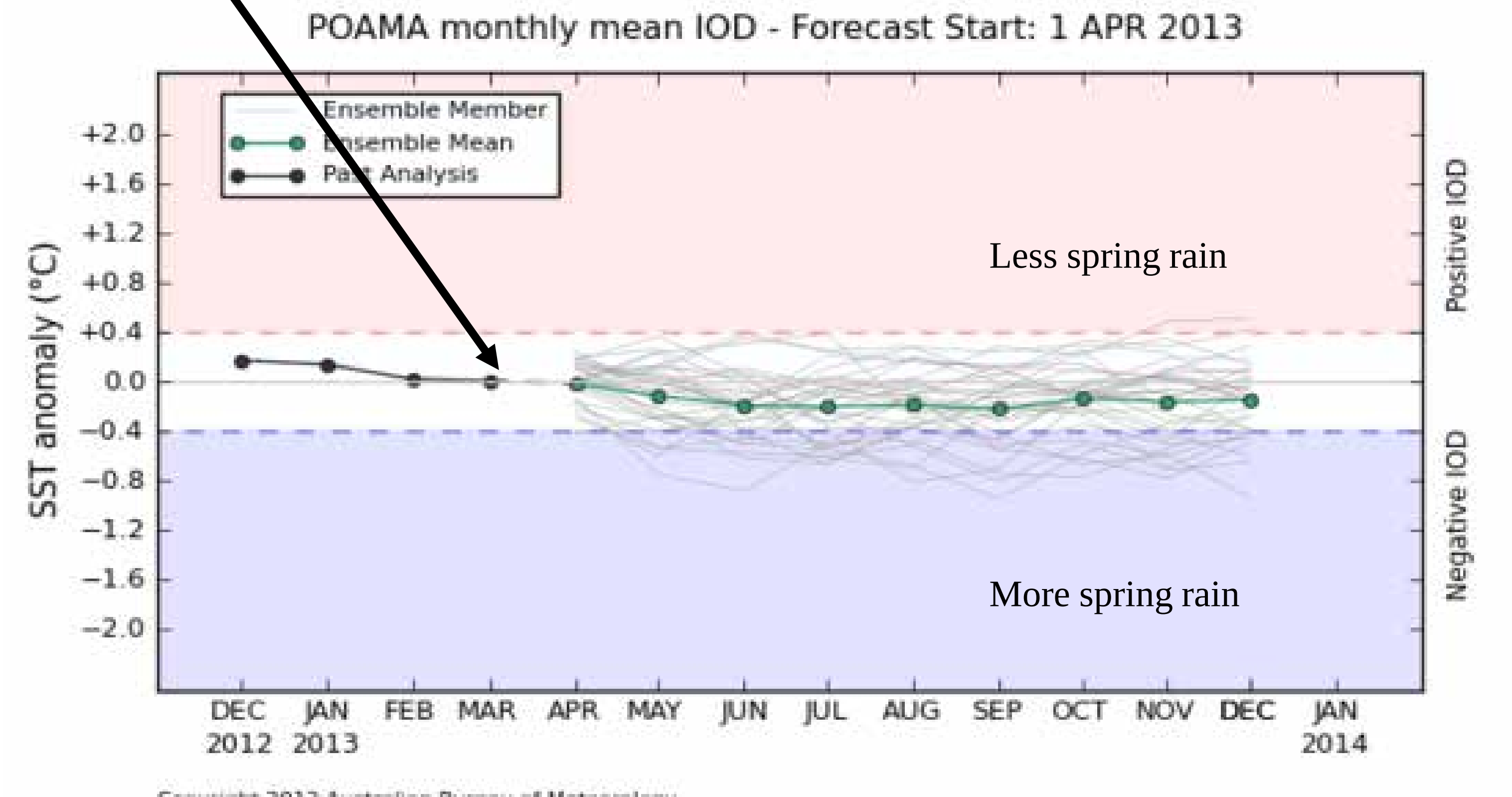
Neutral ENSO is forecast for the coming spring/summer in 2013



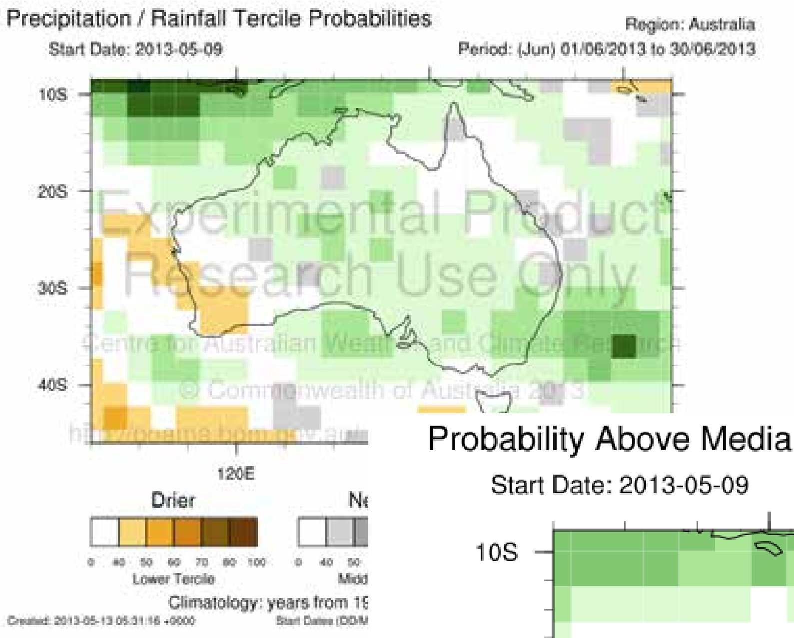


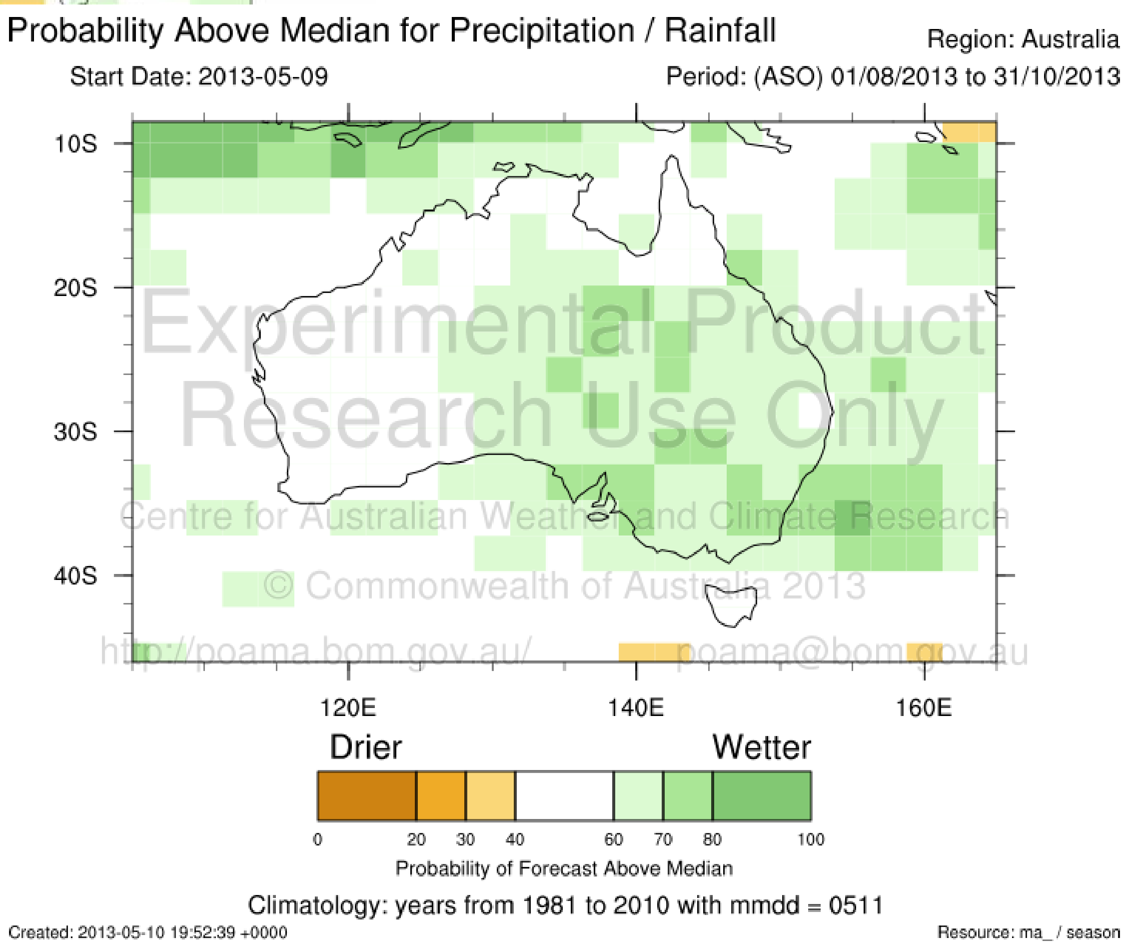
The Indian Ocean Dipole outlook for July to November 2013 :

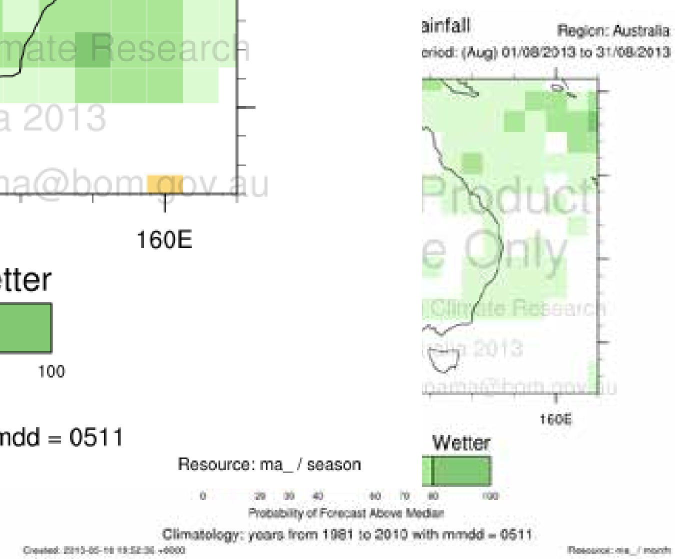
neutral to weak –ve phase



POAMA dynamic model outlooks offer more timescales and information…



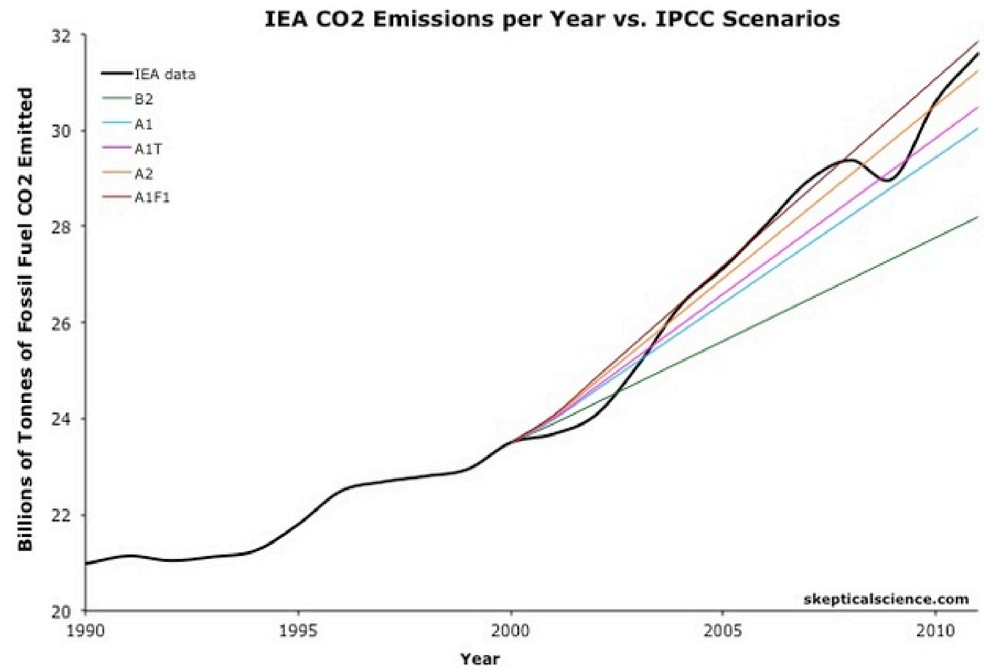


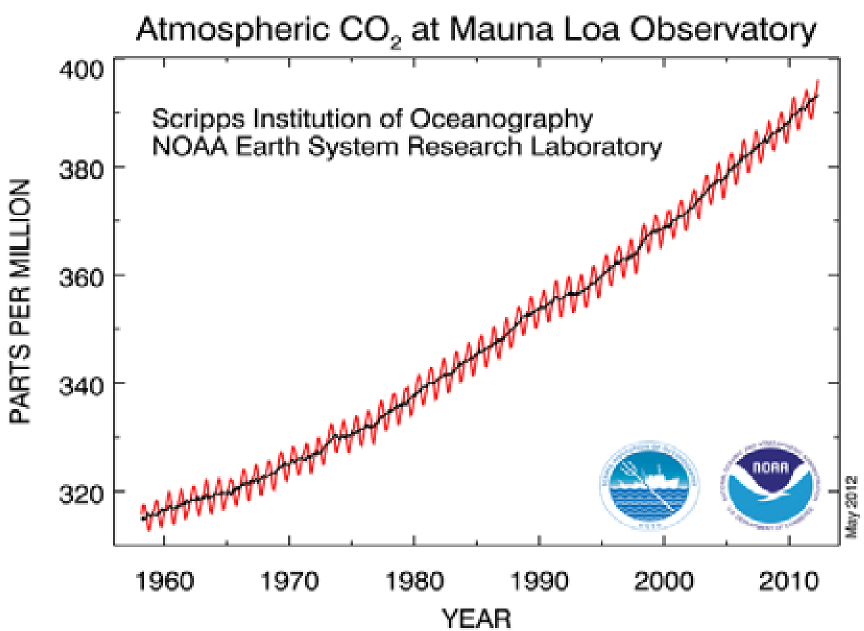


Slightly wetter for winter, and spring

Australian Government
Bureau of Meteorology

- Highest annual Co2 emissions in 2011
- Largest increase in emissions occurred in 2010





Greenhouse gas levels continue to strongly increase.

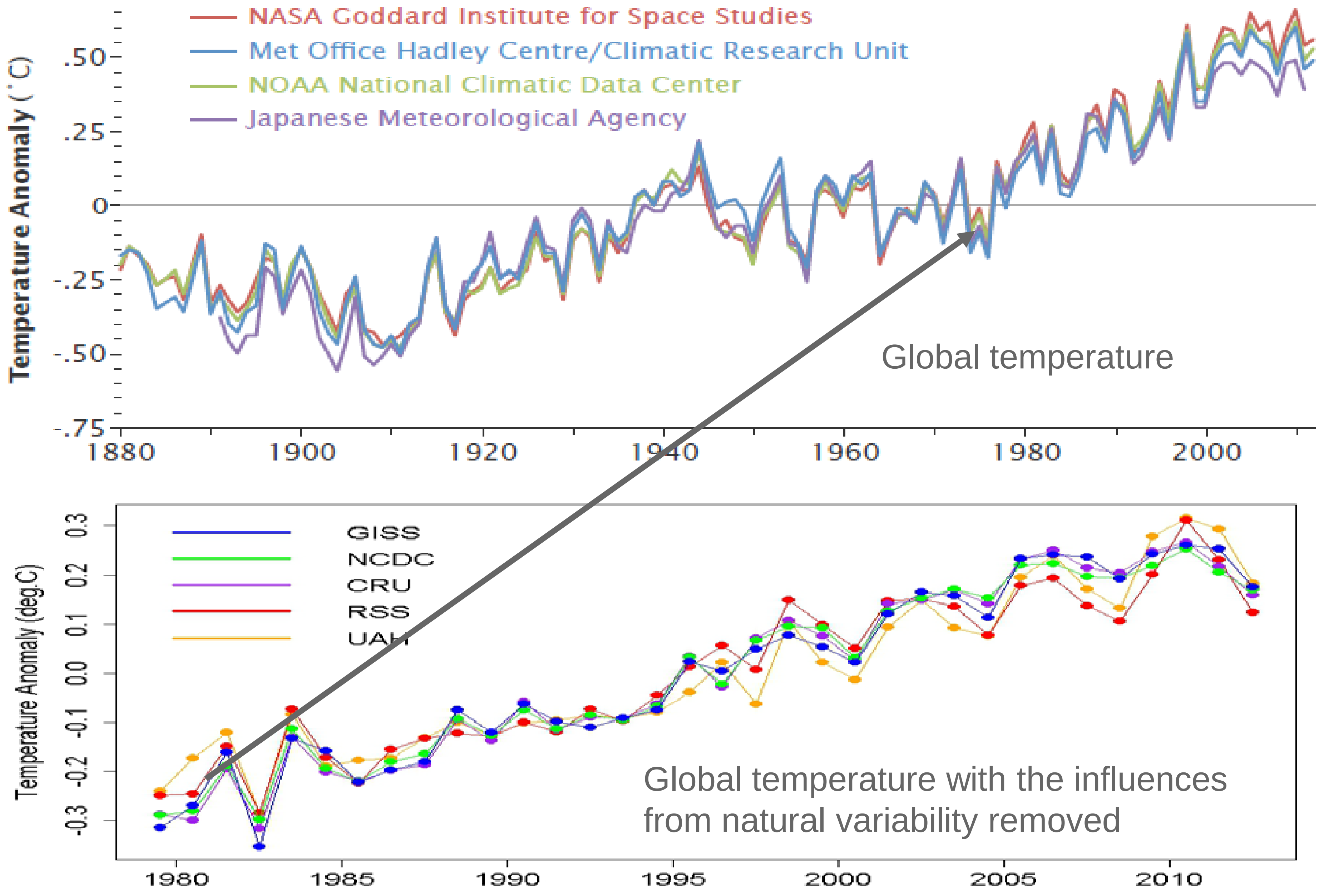
CO_2 now at 400ppm for the first time in at least 3 million years.

Australian Government
Bureau of Meteorology

What is it doing?

- Less heat is being measured escaping to space

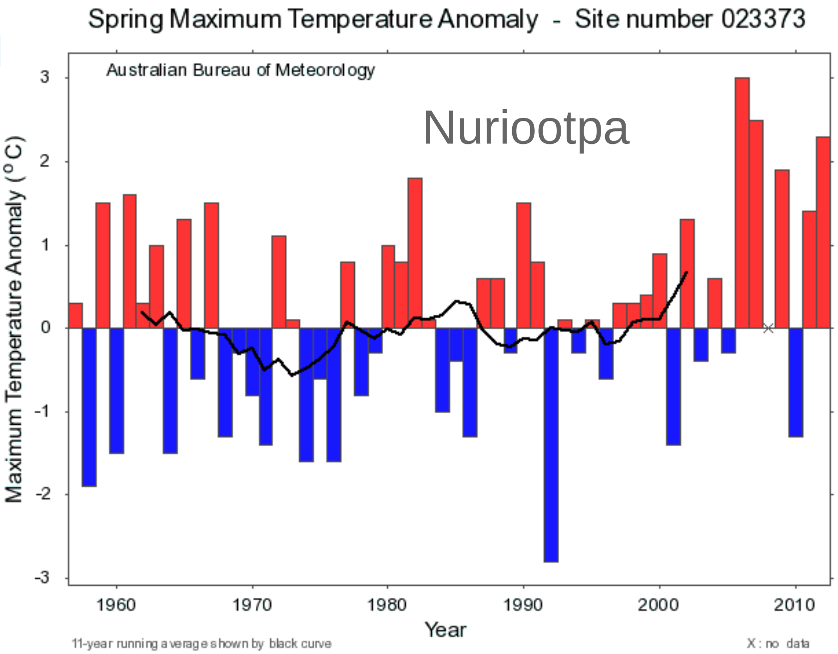
- More heat is being measured coming back to the surface (~ 2 watts/square metre)



Arctic, glacier and ice sheet melt, and sea level rise

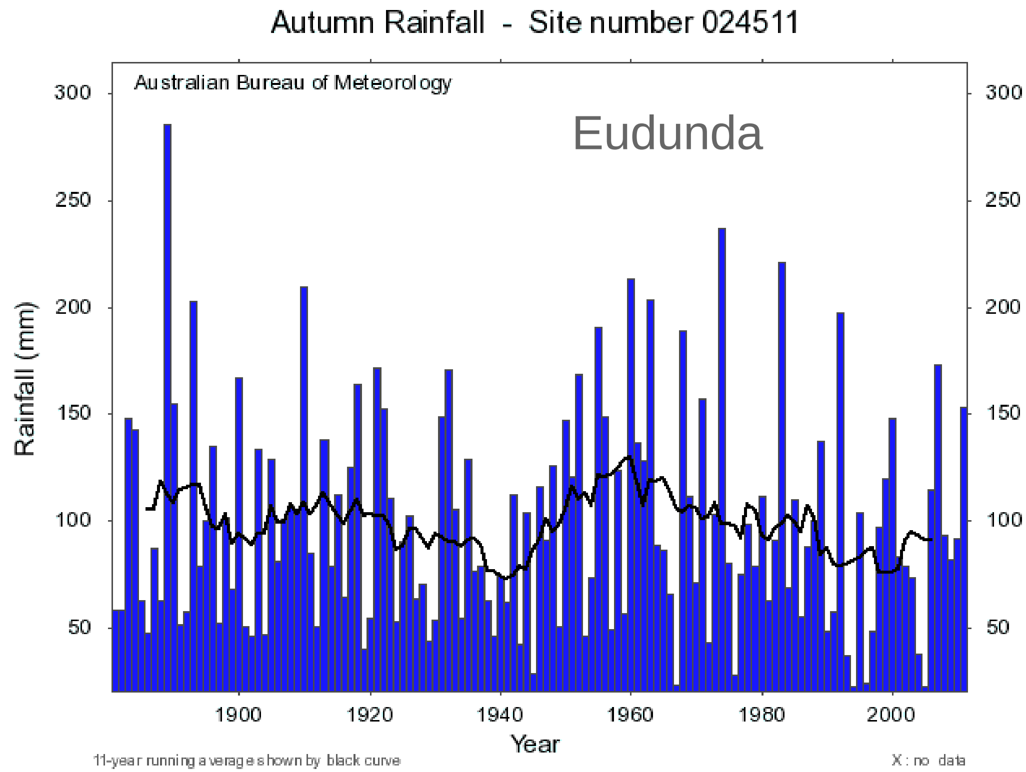
Climate trends and changes

Australian Government
Bureau of Meteorology



Warming by ~ 1.0C, particularly at night and in spring

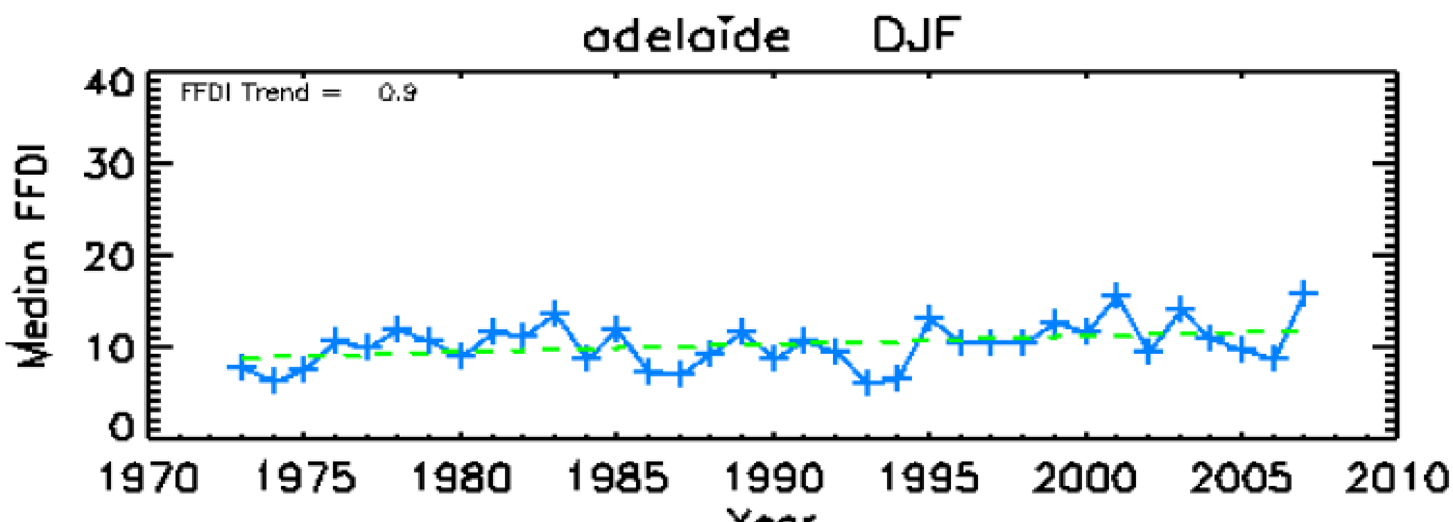
Changes in rainfall seasonality – decreasing autumn rainfall



Bushfire

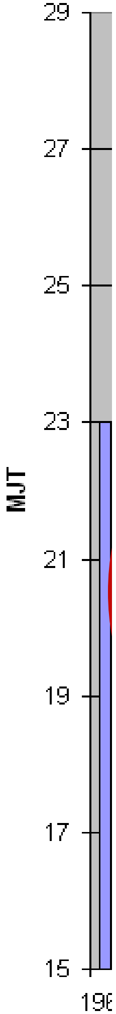
Australian Government
Bureau of Meteorology

- Fire seasons starting earlier and finishing later...
- Increased number of extreme fire weather days



Mean January temperature has increased by ~ 1^{o}C

Australian Government
Bureau of Meteorology



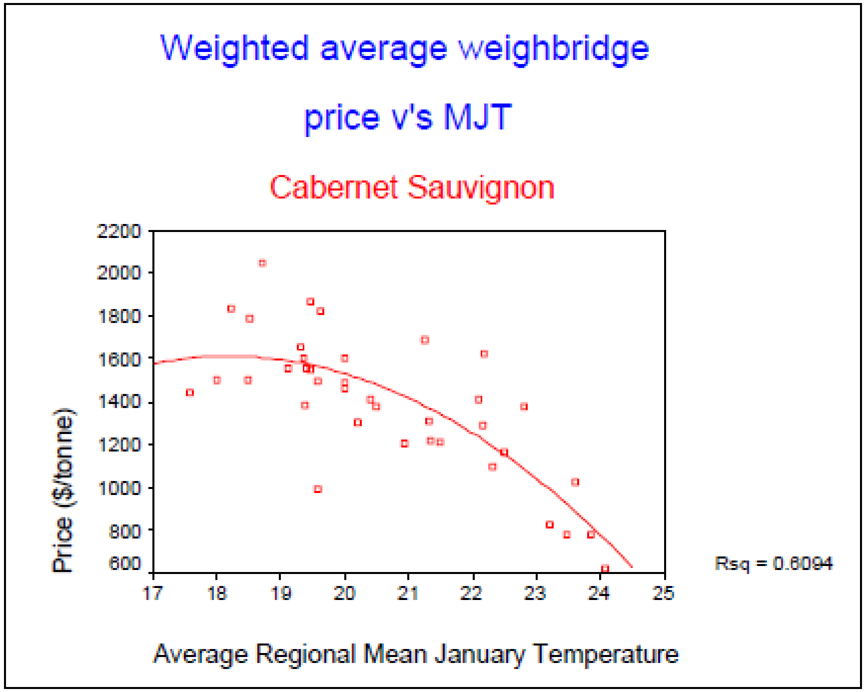
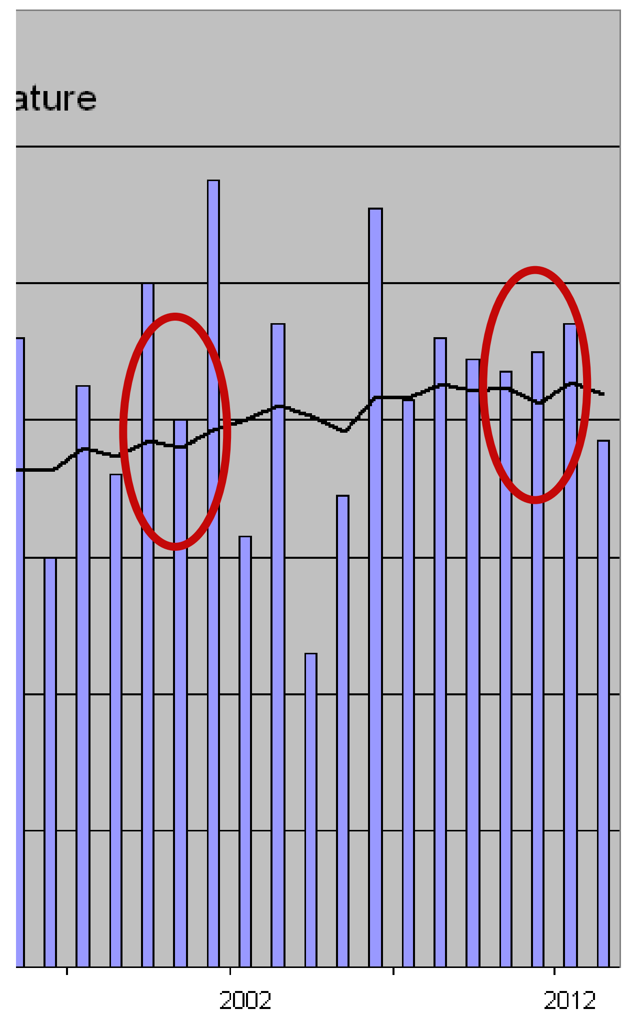


Figure 3 Scatterplot of Weighted average weighbridge price per tonne (1999-2003) for Cabernet Sauvignon compared to the Average regional Mean January temperature.



Cooler Januaries are often La Nina events

Australian Government
Bureau of Meteorology

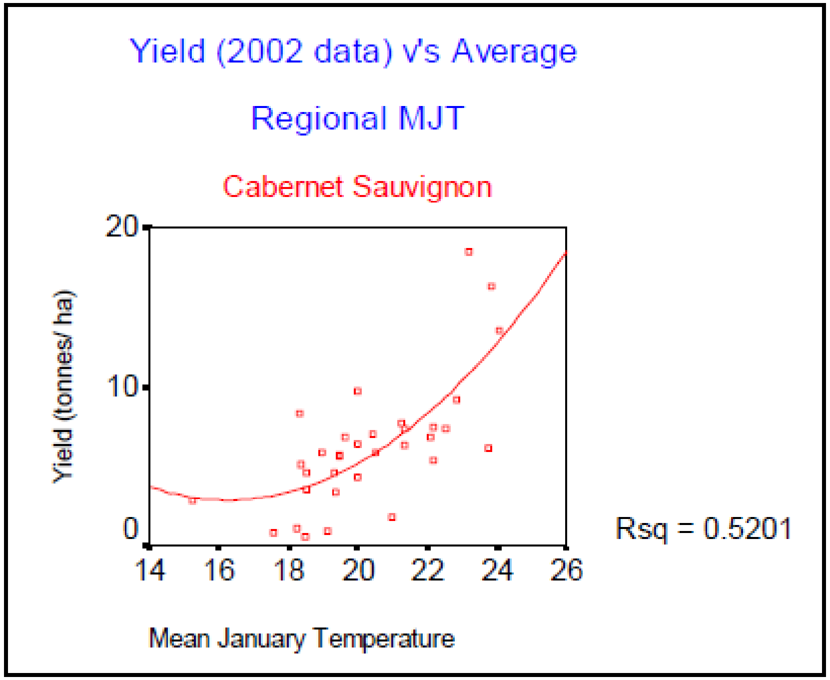


Figure 6 Yield (tonnes per hectare) for Cabernet Sauvignon as it varies with MJT.

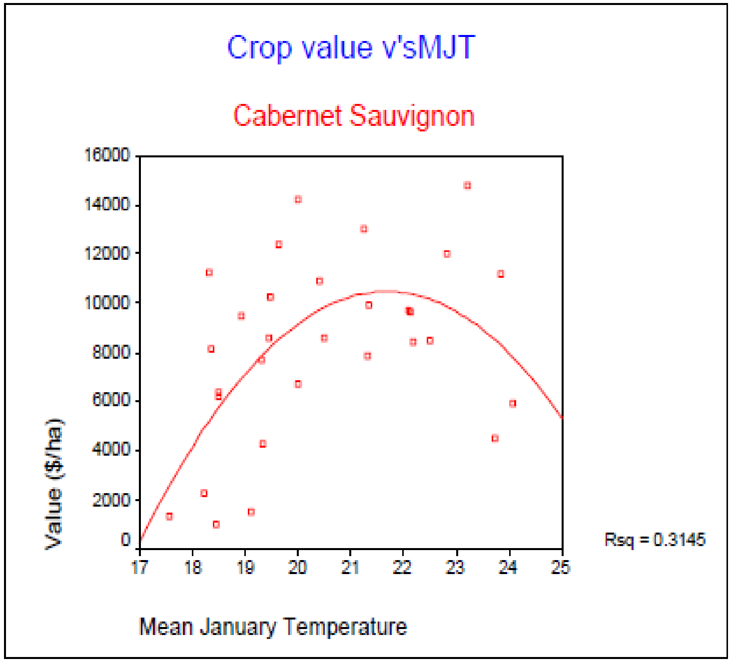


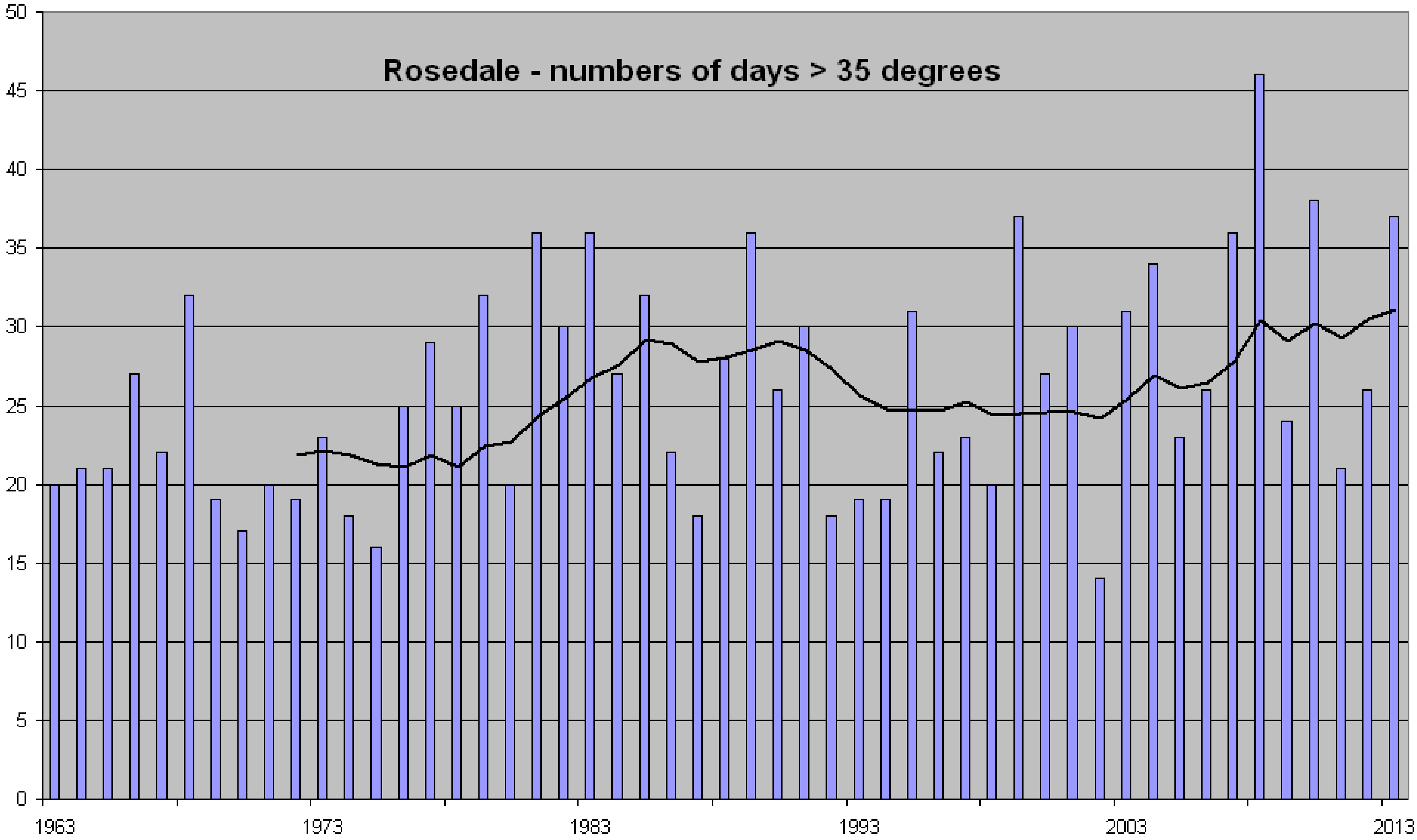
Figure 7 Value ($/tonne) for Cabernet Sauvignon as it varies with MJT.

Impact on Australian Viticulture from Greenhouse Induced Temperature Change

Webb, L.B.,[1,2] P.H. Whetton[1] and E.W.R Barlow[2]

Australian Government

Bureau of Meteorology



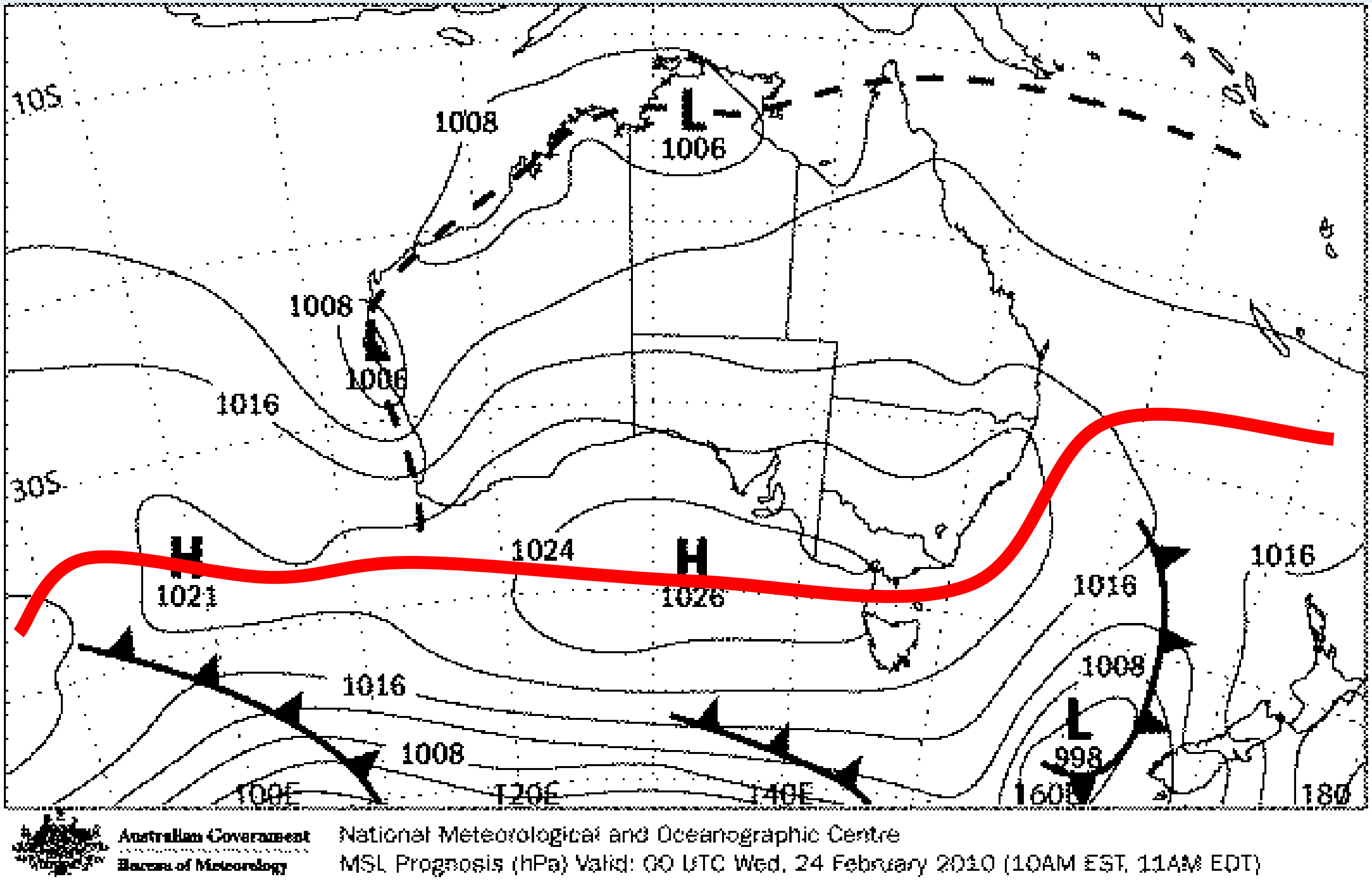
The Big Dry – 1996 to 2010

Not from natural variability

Strong April- June drying trend

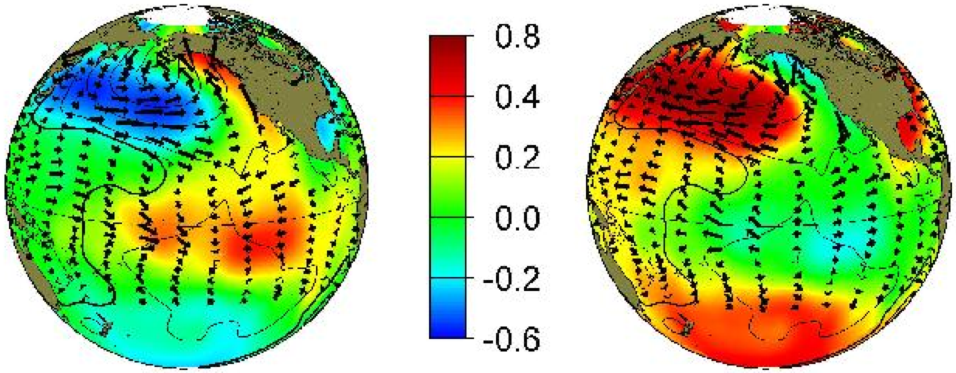
Linked to stronger high pressure systems

Changes consistent with atmospheric circulation changes from global warming

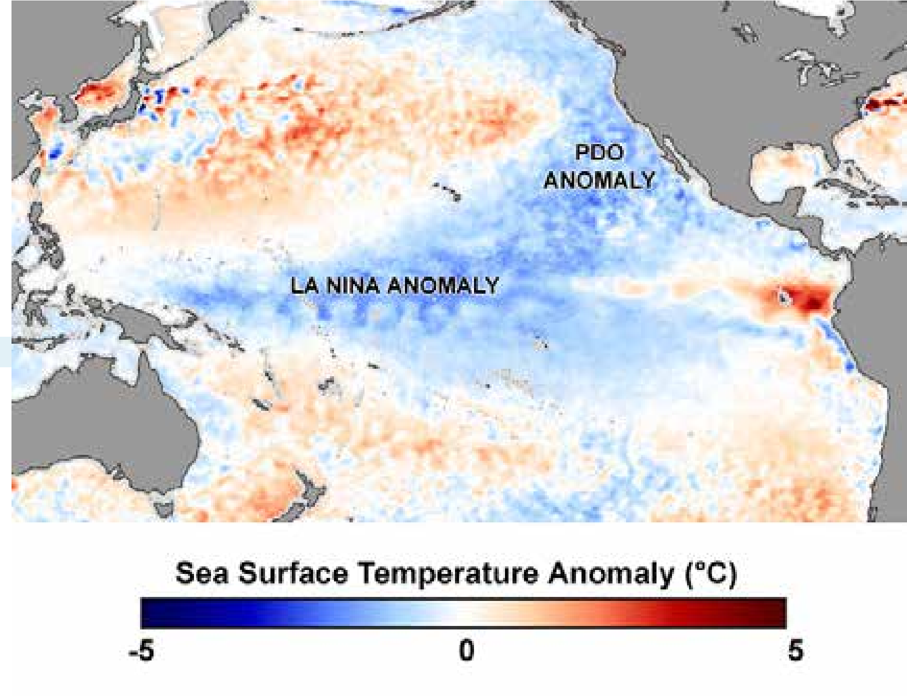


More or less El Nino's and La Nina's ????

Pacific Decadal Oscillation



warm phase cool phase



Real or noise?

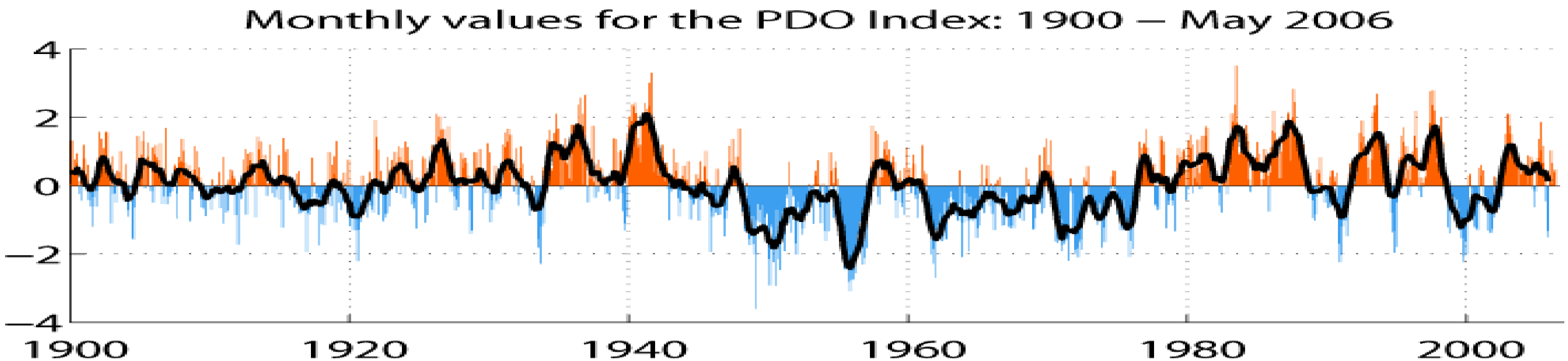
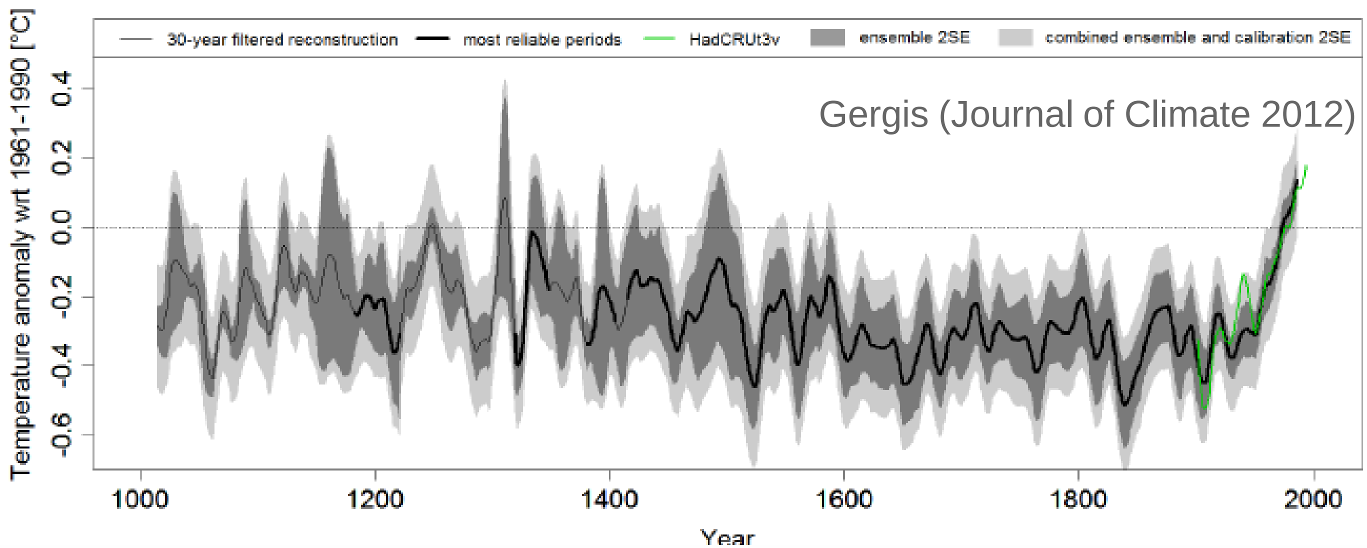


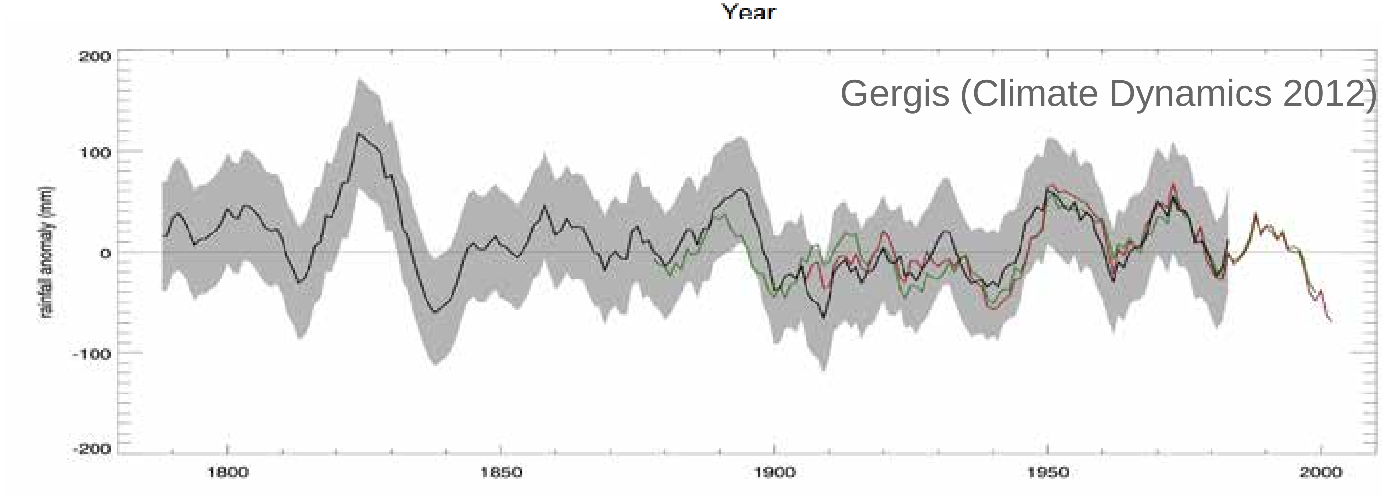
Figure source: Climate Impacts Group

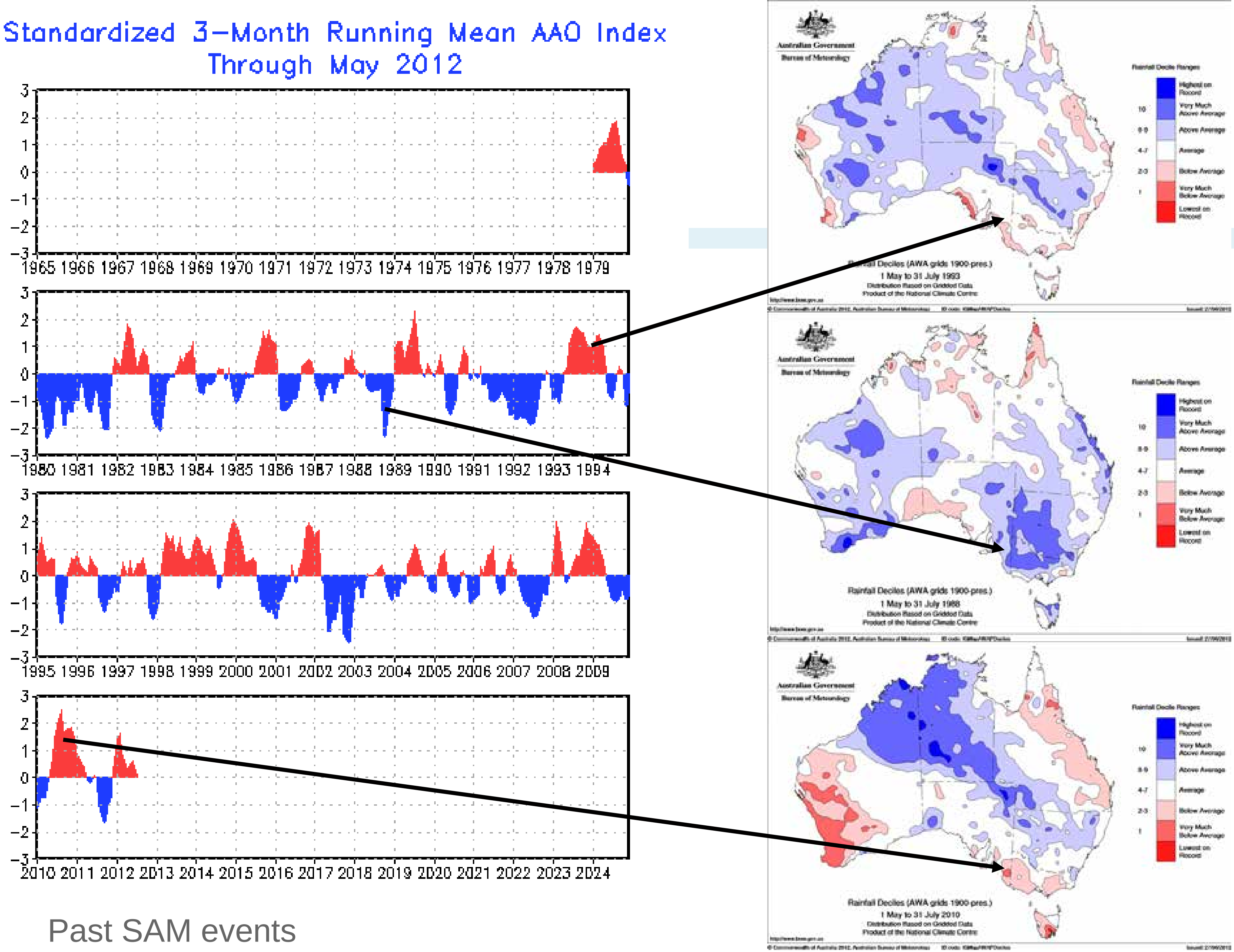
Paleoclimate records for Australia

Current temperatures are the warmest in at least 600 years, possibly 1000 years.



The Big Dry (1996 – 2009) was most likely unprecedented since European settlement





Past SAM events

Australian Government

Bureau of Meteorology

Thank you

d.ray@bom.gov.au

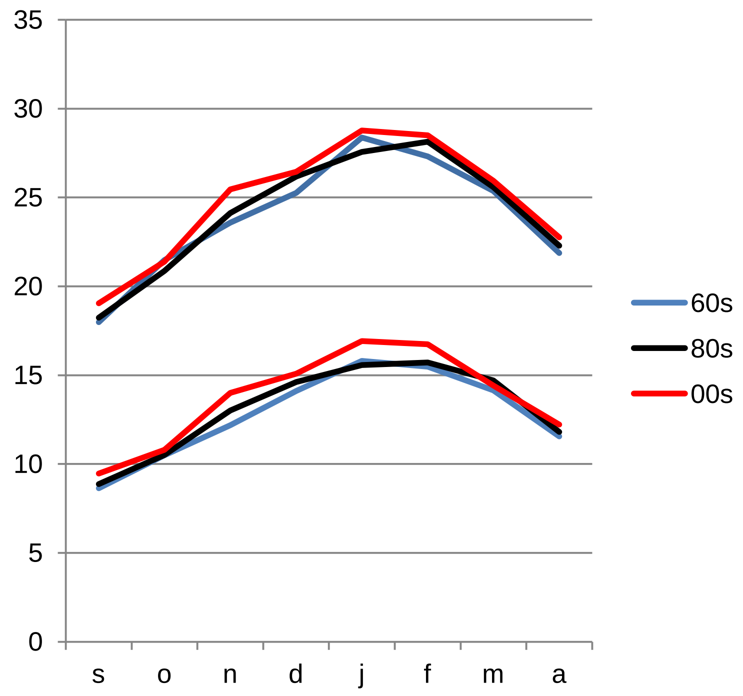
Why is harvest getting earlier and what can we do about it?

Introduction

- In your region, is it warmer now than it was 50 years ago?

McLaren Vale*

Mean daily max and min temps



Mean growing season temp °C

60s 18.3
80s 18.6
00s 19.3

* Adelaide Airport

Introduction

The Australian Wine
Research Institute

- Is harvest earlier than it used to be?
- **Since early 1980s, harvest advanced by about 8 days per decade in southern Aust, Europe…**
- Regional differences

Climate warming and earlier harvest

The Australian Wine Research Institute

- Day of year of maturity (DOYm) at sites with long term data: common period 1985-2009

Location	Variety	Days advanced per decade
Mornington Pen	Pinot Noir	16
Eden Valley	Shiraz	4
Central Vic	Shiraz	8 to 13
Margaret R	Shiraz	8

Source: Webb et al. (2012) Nature Climate Change

Introduction

- What has caused earlier harvest?
- What are the implications for style and quality?

Climate warming and earlier harvest

The Australian Wine
Research Institute

- Main drivers
  - **Increased growing season average temperature**
  - Decreased soil water content

Climate warming and earlier harvest

The Australian Wine
Research Institute

- Main drivers
  - Increased growing season average temperature
  - Decreased soil water content

Warmer soil

Increased ABA production by roots

Lower yield

Direct effect on ripening

Switch off shoot growth

Climate warming and earlier harvest

The Australian Wine Research Institute

- Day of year of maturity (DOYm) at sites with long term data: common period 1985-2009 (Webb et al. 2012)
- Main drivers
  - Increased growing season average temp
  - Decreased soil water content
- Minor drivers
  - Lower yield
  - Changes in management practices

Climate warming and earlier maturity

The Australian Wine Research Institute

- Earlier maturity due to:
  - shorter ripening period?
  - or earlier onset of ripening?
    - (no change in duration of ripening period)
  - or combination of both?

A. Regional effect on phenology

The Australian Wine Research Institute

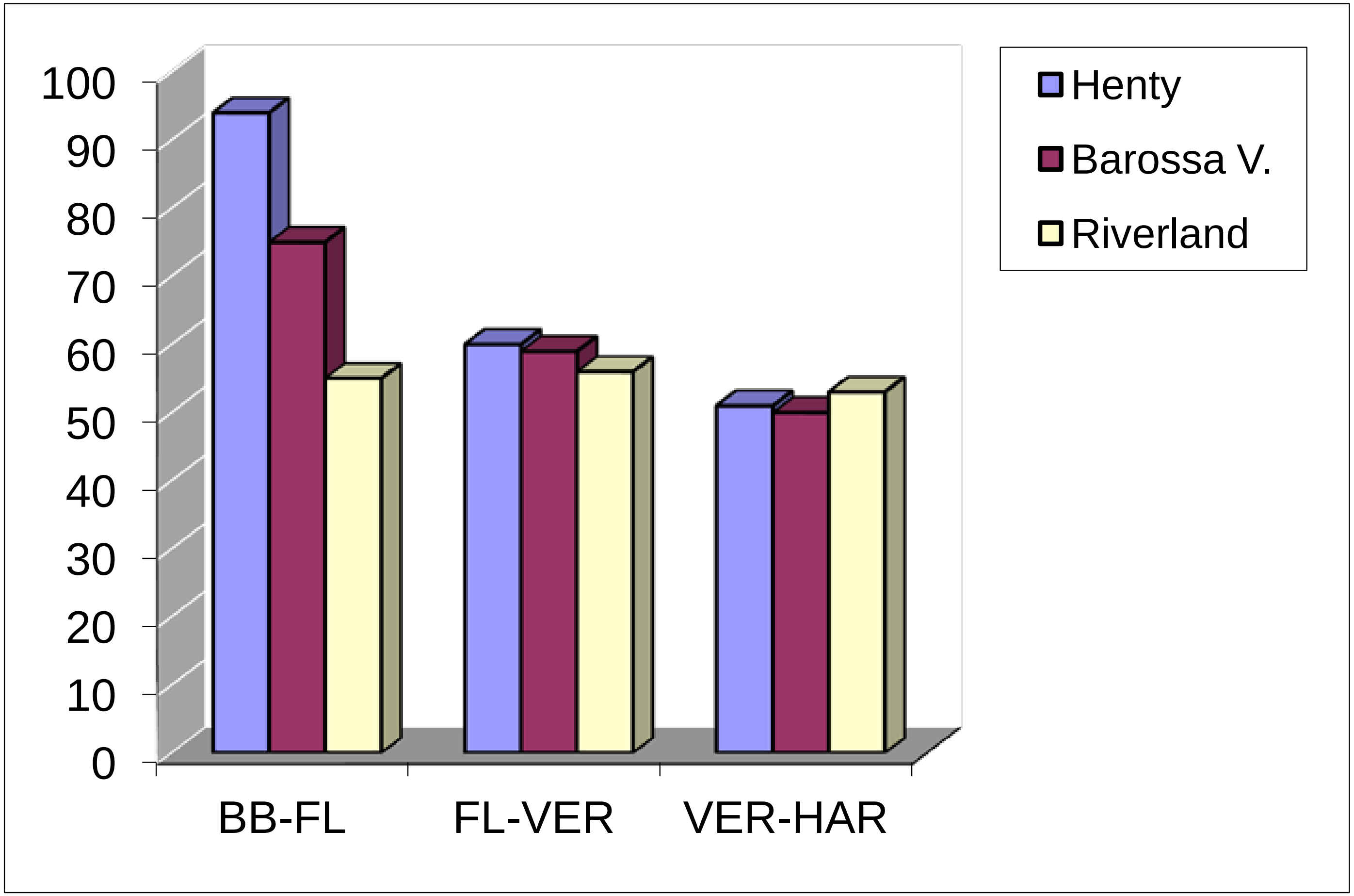
- Riverland, Barossa Valley, Henty (sthn Vic)
- what is order of harvest for same variety?

Regional effect on phenology

- Riverland then Barossa then Henty
- Is it due to longer ripening period?
- NO

Effect of climate on average duration (days) of phenological stages of Riesling

The Australian Wine Research Institute



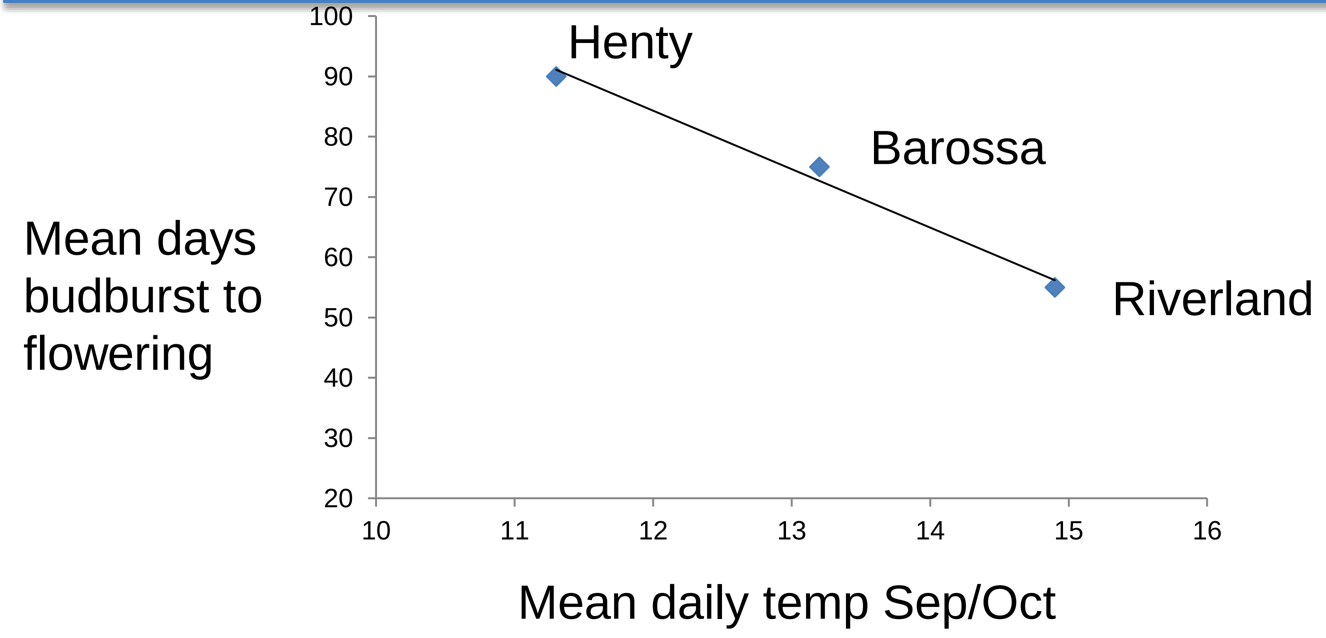
Source: Heinze, R. (1977) Proc. 3rd Aust. Wine Ind. Tech. Conf.pp. 18-25

Regional effect on phenology

The Australian Wine Research Institute

- What is cause of differences in duration of BB to FL?

Earlier flowering causes earlier onset of ripening



B. Seasonal effect on phenology

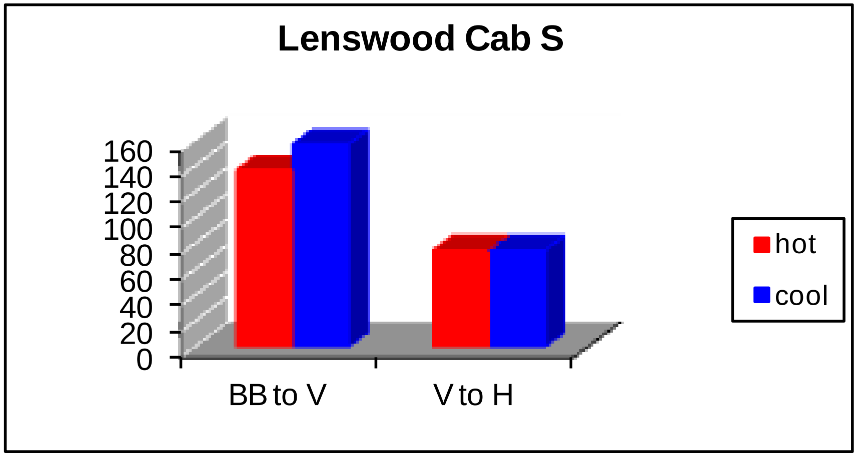
The Australian Wine Research Institute

- Harvest in cool seasons is generally later than in a hot season
  - e.g. harvest in Riverland, Coonawarra, Adelaide Hills was on average **10 days later in 2002** (cool) than 2001 (hot)

Seasonal effect on phenology

The Australian Wine Research Institute

- Was the ripening period longer in 2002 than 2001? NO



Cooler spring in 2001/02\
 than 2000/01

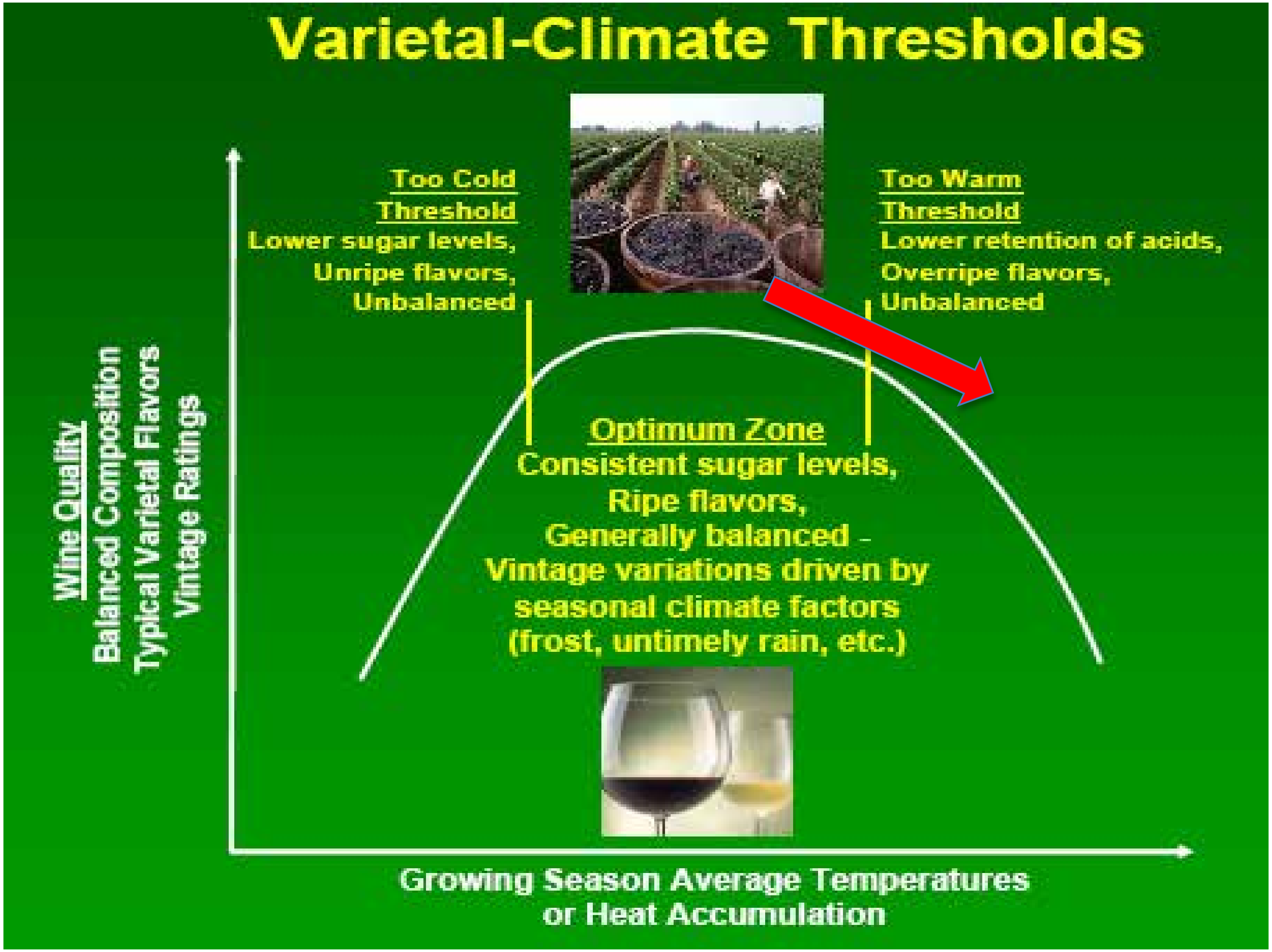
Earlier flowering causes earlier onset of ripening

Climate warming and earlier maturity

- Earlier maturity due to:
  - shorter ripening period
  - or earlier onset of ripening
  - or ….?
- **Earlier onset of ripening** for Chard, Cab S and Shir in Riverland, Barossa and Coonawarra (Sadras and Petrie 2011 Aust J Grape and Wine Res 17, 199-205)
  - Associated with higher temperature in spring

What are the implications for earlier onset of ripening on fruit and wine quality?

The Australian Wine Research Institute

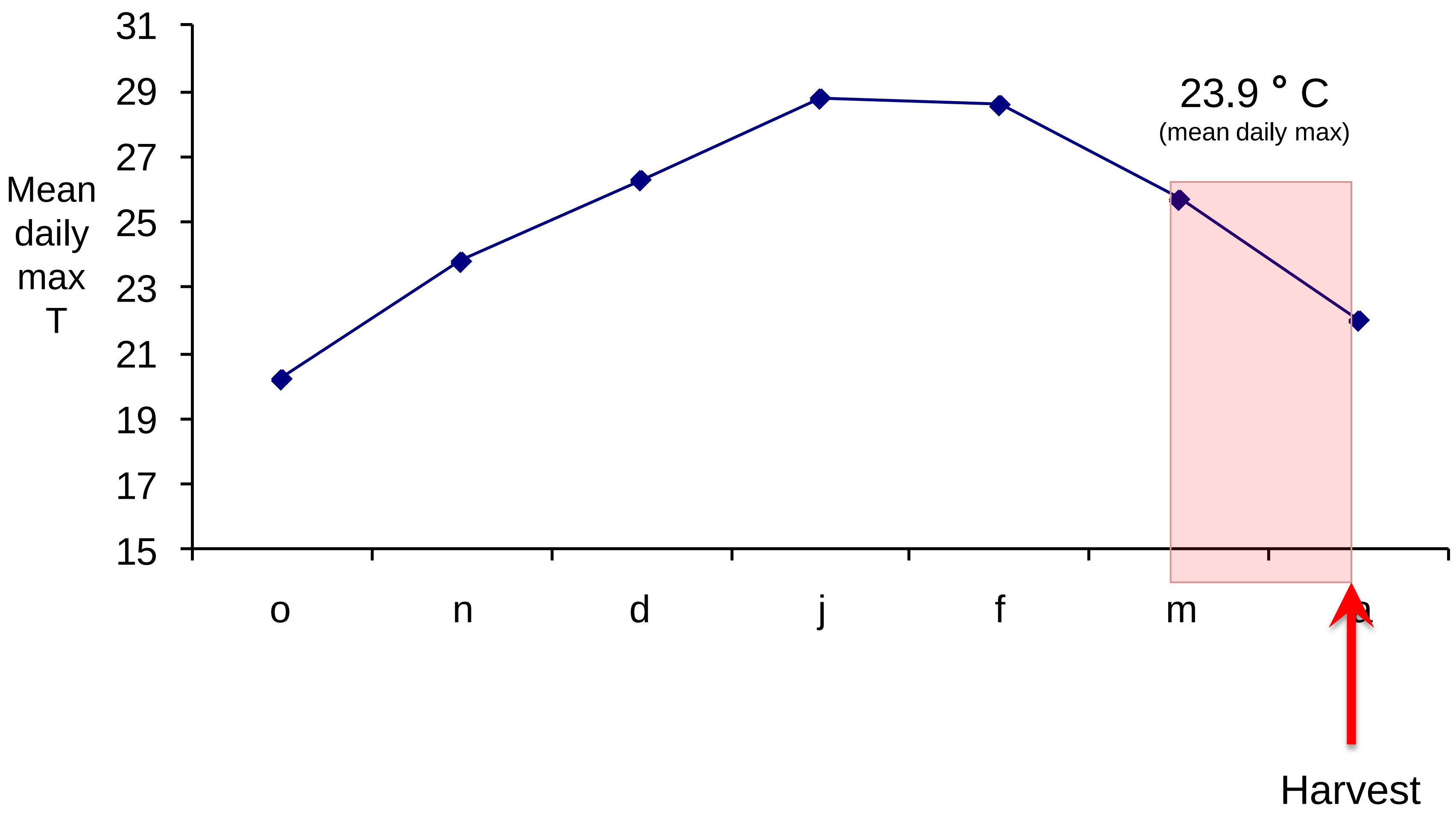


Source: Greg Jones

Quality implications of earlier onset of ripening

The Australian Wine
Research Institute

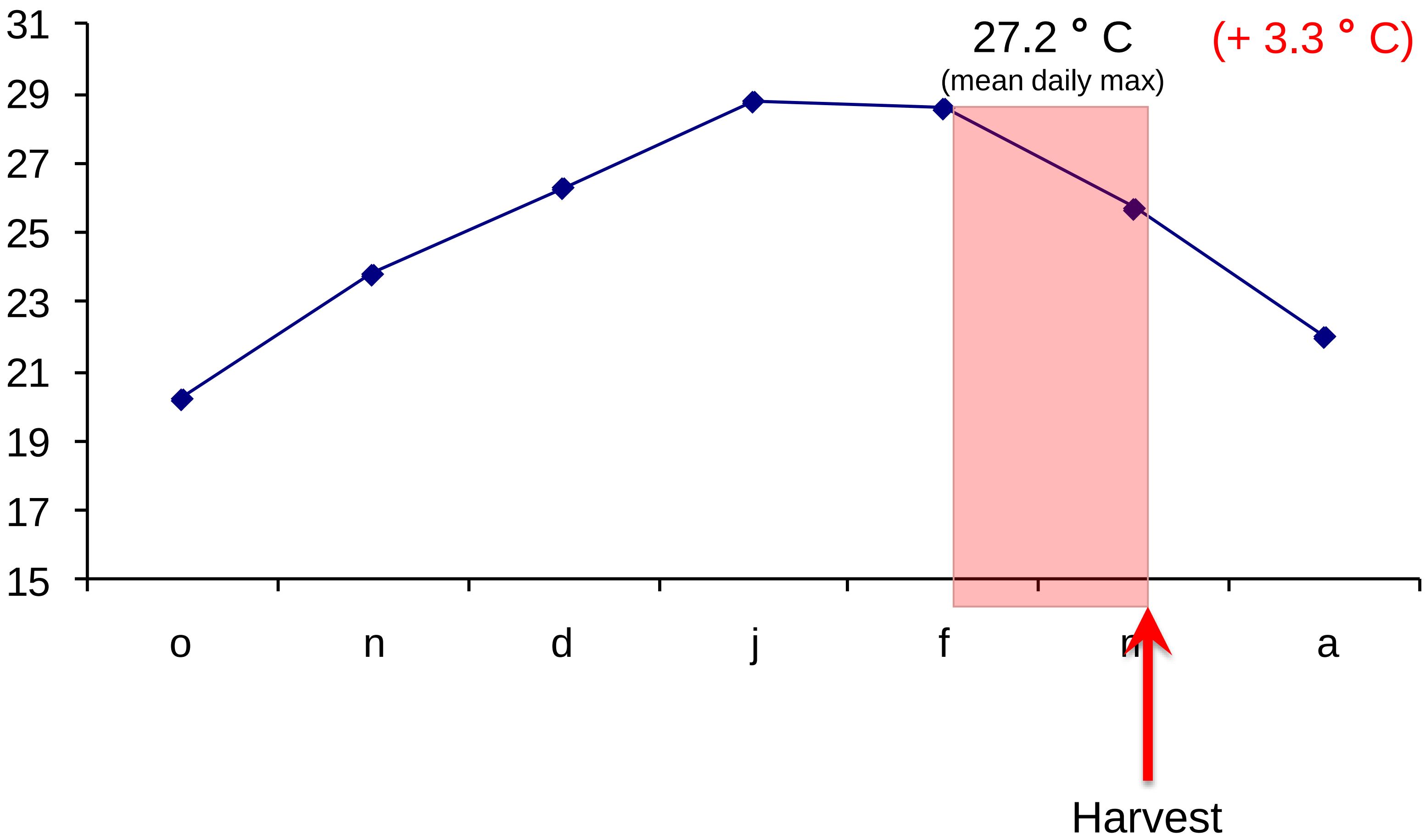
Example: Coonawarra Cabernet Sauvignon



Quality implications of earlier onset of ripening

The Australian Wine Research Institute

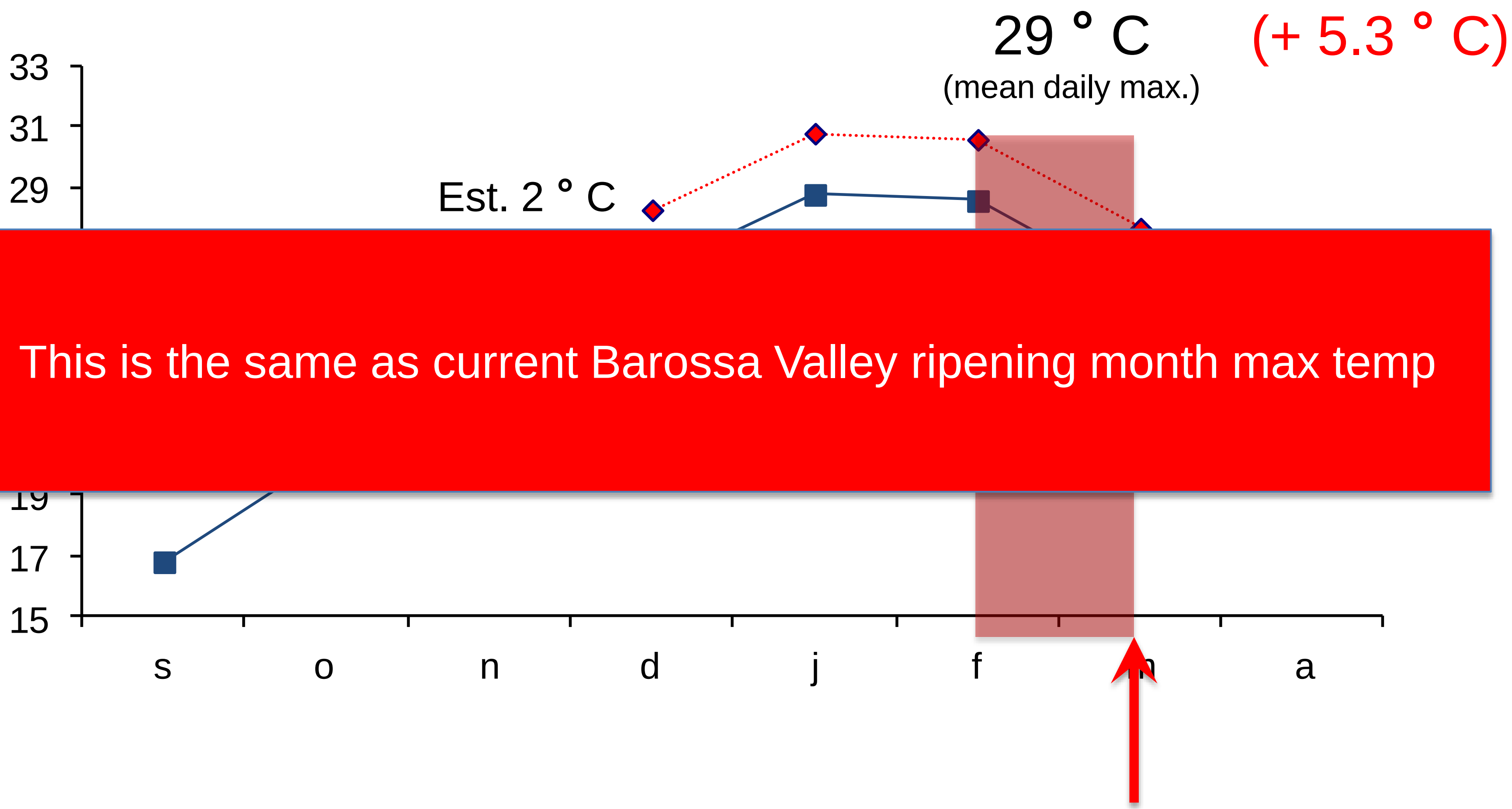
Example: Coonawarra Cabernet Sauvignon



Quality implications of earlier onset of ripening

The Australian Wine Research Institute

Example: Coonawarra Cabernet Sauvignon



This is the same as current Barossa Valley ripening month max temp

Conclusions

- It is warmer than it was in the past and likely to keep getting warmer
- This has lead to earlier harvest
  - due to increased temperature
  - and possibly decreased soil water content
- Earlier harvest is mainly due to earlier flowering
- Earlier harvest means a warmer ripening period with implications for fruit composition and wine style

What can you do about it?

The Australian Wine Research Institute

- For existing plantings:
  - Slow down onset of ripening
    - Increase yield to slow down sugar ripening?
    - Reduce leaf area “ “ “
    - Irrigation management to offset soil drying
    - Delay flowering?

What can you do about it?

- Slow down onset of ripening
  - Reduce leaf area by leaf removal or shoot trimming pre-veraison: up to 20 days delay
  - Anti-transpirant foliar spray

Dry, P.R. (2013) Can the production of low alcohol wines start in the vineyard? Wine and Vitic. J., 28(2): 40-43

What can you do about it?

- Delay flowering
  - Prune after budburst

What can you do about it?

The Australian Wine Research Institute

- For existing plantings:
  - Slow down onset of ripening
    - Increase yield to slow down sugar ripening?
    - Reduce leaf area
    - Irrigation management to offset soil drying
    - Delay flowering?
- New plantings
  - Varieties better adapted to hotter and drier climate
  - Later ripening varieties
  - Rootstocks with less sensitivity to soil drying
- Move to a cooler region

Hotter and Drier in the Vineyard

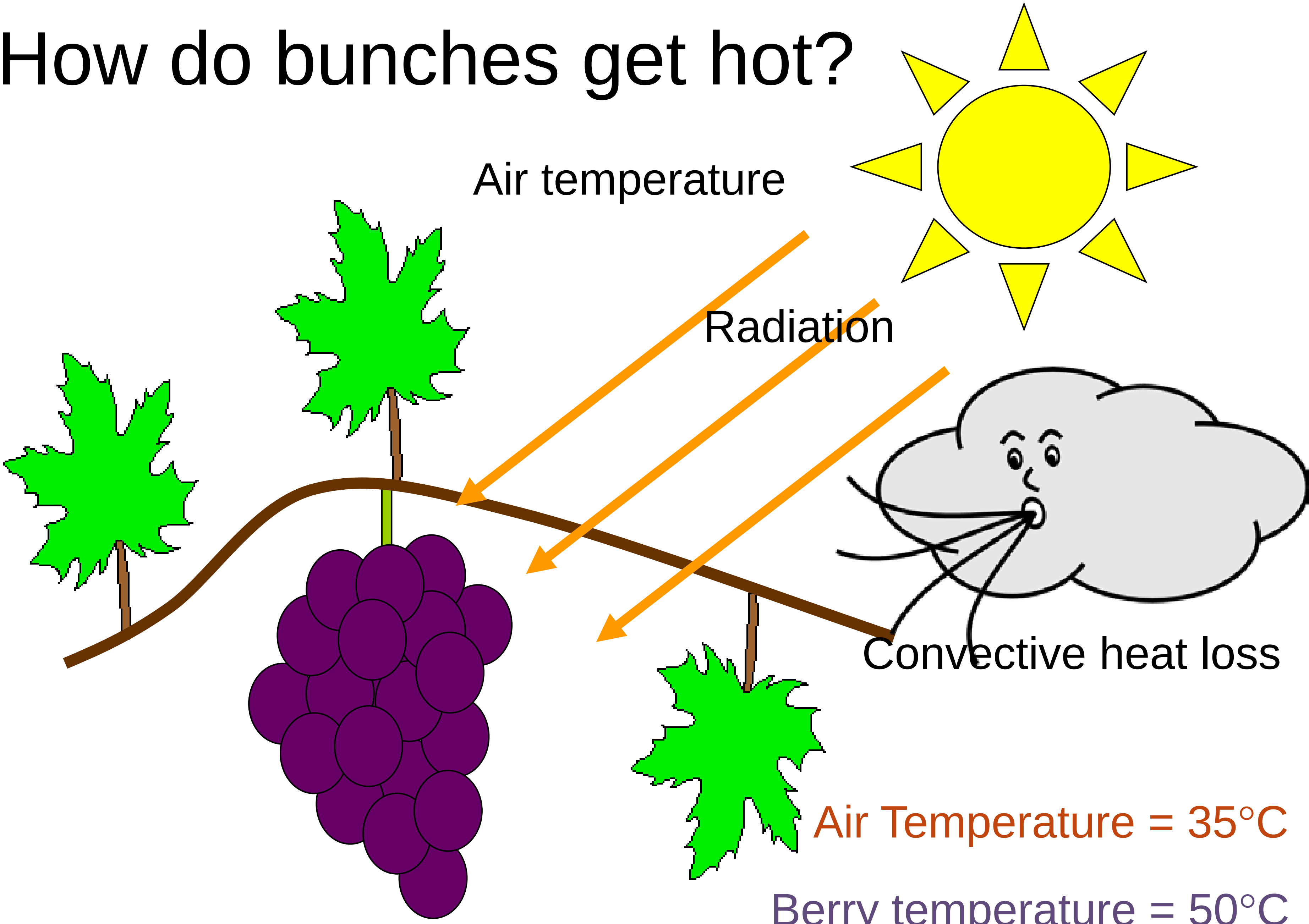
The Australian Wine
Research Institute

Likely changes in future

The Australian Wine Research Institute

- Earlier harvest
  - Increased ripening temperature
- Compression of the growing season
- Increased risk of heatwaves
  - ↑ bunch damage
- Increased risk of drought
  - ↓ shoot vigour
  - ↑ basal leaf defoliation
  - ↓ natural protection of bunches (↑ exposure)

How do bunches get hot?



Effects of bunch overexposure

The Australian Wine Research Institute

Overexposure → losses in both productivity and wine quality

Physical damage

- sunburn browning = skin injury
- ↑ bitterness
- invasion by 2 ° bunch rots

‘Chemical’ damage

- may occur in the absence of any physical symptoms

Management strategies to protect bunches from extreme heat

The Australian Wine Research Institute

↓ bunch exposure

↑ cooling

Management strategies to protect bunches from extreme heat

The Australian Wine Research Institute

1. Aim = minimise exposure

In established vineyards:

- Pruning
- Nutrition
- Irrigation

increase shoot vigour and promote canopy development

- Canopy management
- Artificial shading
- Vineyard floor management
- Chemical sprays

minimise bunch exposure to radiation, particularly in the afternoon

Management strategies to protect bunches from extreme heat

The Australian Wine
Research Institute

1. Aim = minimise exposure

In new vineyards:

- New varieties and rootstocks — increase shoot vigour and promote canopy development
- Row orientation — minimise bunch exposure to radiation, particularly in the afternoon

Management strategies to protect bunches from extreme heat

The Australian Wine Research Institute

2. Aim = decrease vine and bunch temperature
   - Irrigation
   - Sprinkler cooling
   - Artificial shading

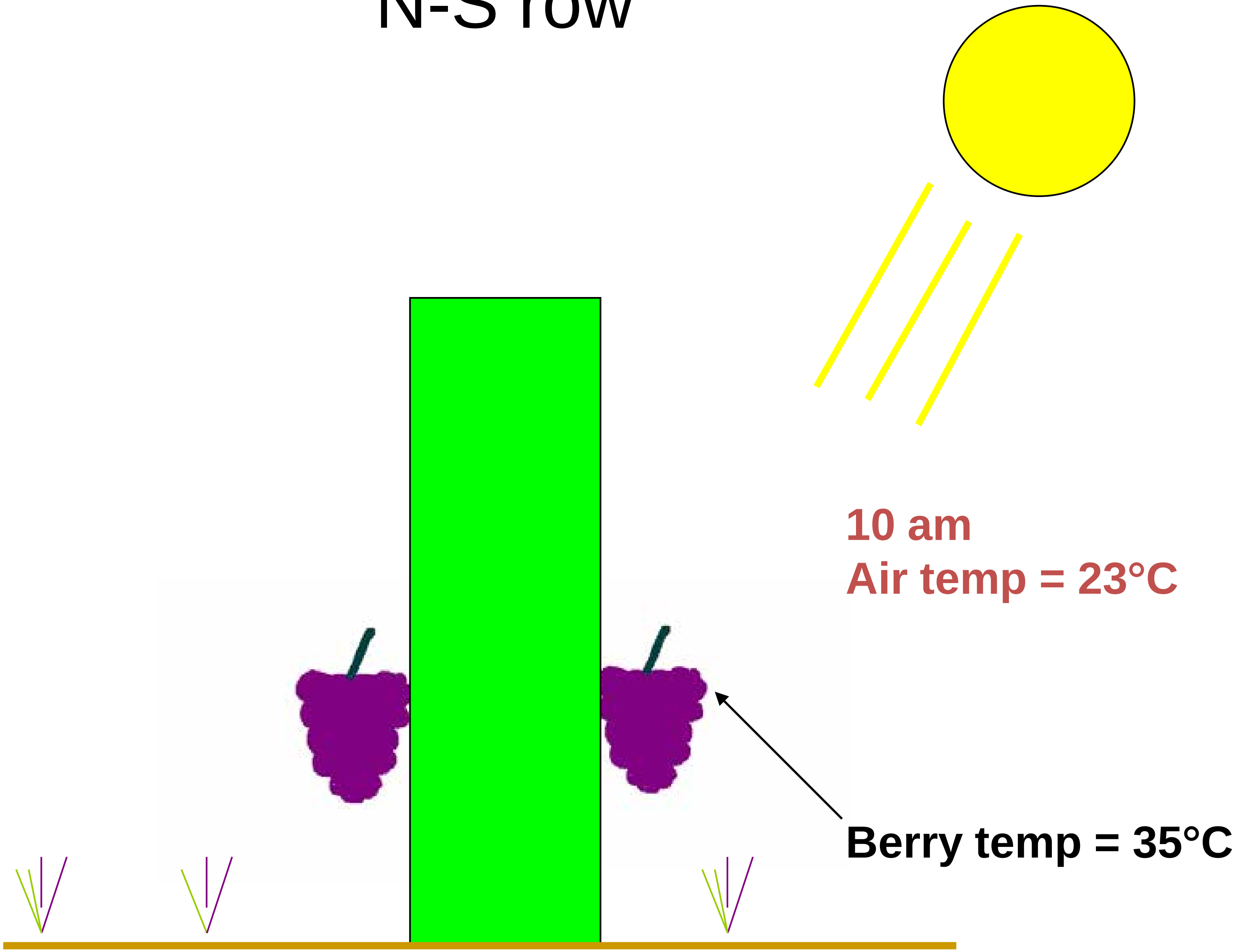
New vineyards: Row orientation

North-South rows are common in Australia:

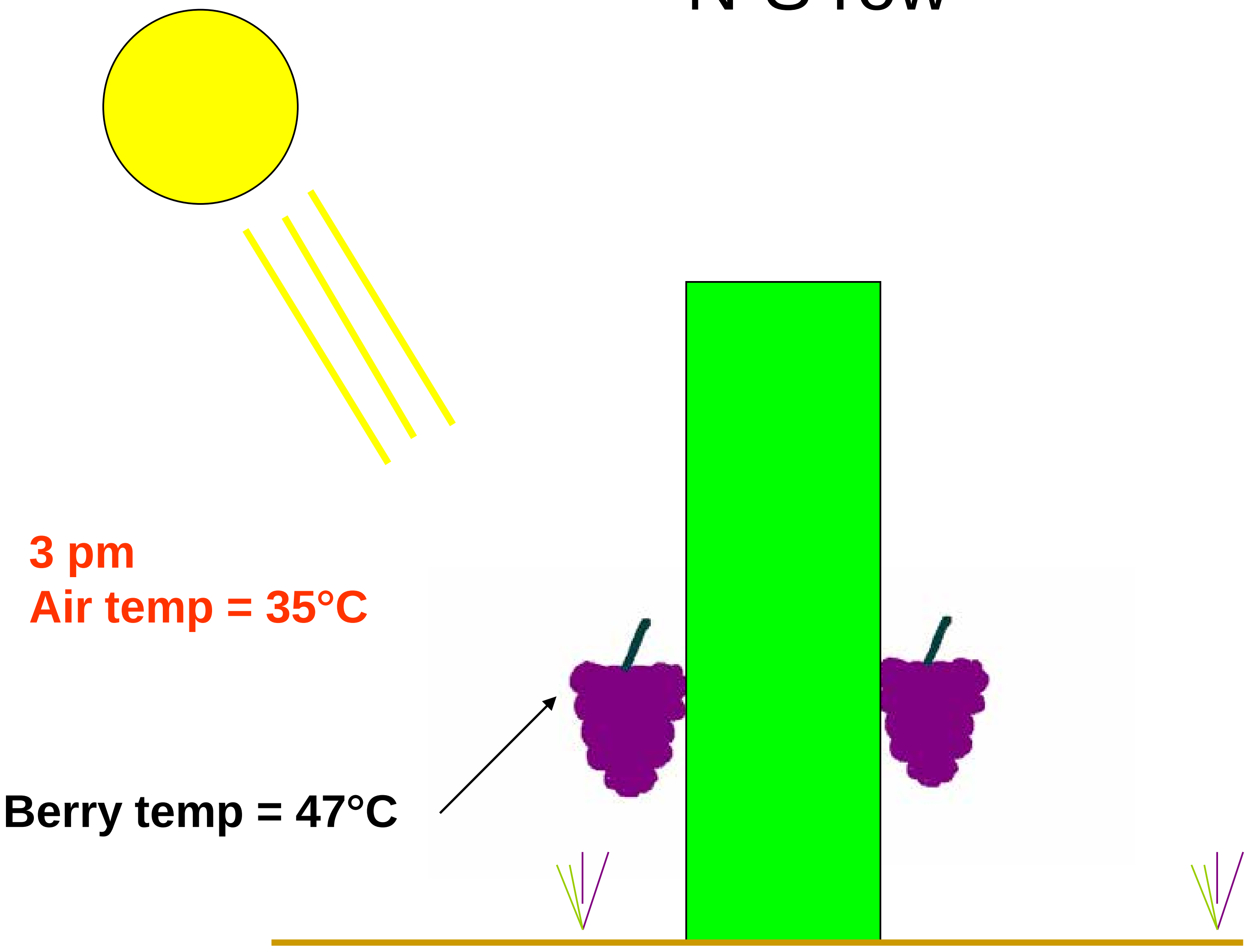
BUT thermal properties of bunches on W side are very different to those on E side

In sunny climates, the choice of row orientation should take into consideration **protection of bunches from over-exposure**

N-S row



N-S row



New vineyards: Row orientation

The Australian Wine Research Institute

In 2009: most bunch damage on N-S rows, particularly with VSP

In a cool climate vineyard:

- 40% bunch damage on N-S rows,
- only 10% on E-W (Webb et al. 2009)

Row orientation:

Recommendation:

Protect bunches during the hottest part of the day

- Consider **E-W or NW-SE*** row orientation for VSP and other trellis systems with vertical canopy face

*NE-SW in northern hemisphere

Nutrition

Ensure adequate nutrition:

- post harvest for strong growth in spring
- early season
- ID & rectify any deficiencies that may restrict growth or cause defoliation

Irrigation management

The Australian Wine Research Institute

Aims:

- Develop strong canopy early in the season
  - Keep in mind potential ↑ demand for water later in the season
- Maintain a good canopy cover until late in the season

Irrigation management

In 2007 to 2009 most bunch damage occurred where water was limited prior to heatwaves due to:

- drought or
- 'severe' deficit irrigation

Negative effects of high temperature event (40-45 ° C) are more severe for water-stressed vines than well-watered controls (Edwards et al. 2011)

Irrigation management

The Australian Wine
Research Institute

Irrigation affects the vineyard microclimate

Transpirational cooling is ***critical***

- Active transpiration must occur ***prior*** to heat event
  (Edwards et al. 2011)

Considerations:

- **Need good water supply**
  - **particularly from set to veraison**
  - **and during heat waves**

Irrigation management

The Australian Wine Research Institute

Recommendations:

- Apply adequate irrigation pre-veraison to achieve good canopy cover
- If heat event forecast, cease deficit irrigation, apply irrigation to refill soil profile

These require good water supply & appropriate infrastructure

Canopy management: training system

The Australian Wine Research Institute

In 2009 vineyards with sprawling, non-positioned canopies had least heat damage (Webb et al.)

- VSP trellis had most heat damage

  Particularly in cool regions (with a high proportion of VSP trellis and bunchzone leaf removal)

Canopy management: training system

The Australian Wine Research Institute

What do you do if you have VSP and north-south rows in sunny climate?

Canopy management: training system

The Australian Wine Research Institute

Full lift on both W and E sides of N-S row

Foliage wire lift to first position only on W side: both wires lifted on E side

Canopy management: bunchzone leaf removal

The Australian Wine Research Institute

- Either avoid altogether
- Or if necessary, do only on E side of N-S rows

W side

Artificial shading

The Australian Wine Research Institute

Applicable to winegrape vineyards?

Tablegrape vineyard near Mildura

Vineyard floor management

The Australian Wine Research Institute

In 2009 vineyards with bare soil had most heat damage (Webb et al.)

Recommendation:

Permanent sward

Mown sward thrown undervine

Chemical sprays

‘sun protection agents’ or ‘sunscreens’

- particle film technology (PFT) products based on:
  - processed and refined kaolin (Surround®, Screen®)
  - calcium carbonate crystals (Parasol®)

applied as a foliar/bunch spray claimed:

- reduce visible radiation, reflect UV and infrared
- Australian research: reduced leaf temperature, no effect on yield, increased juice sugar and acids

Seek clarification from winery regarding their use

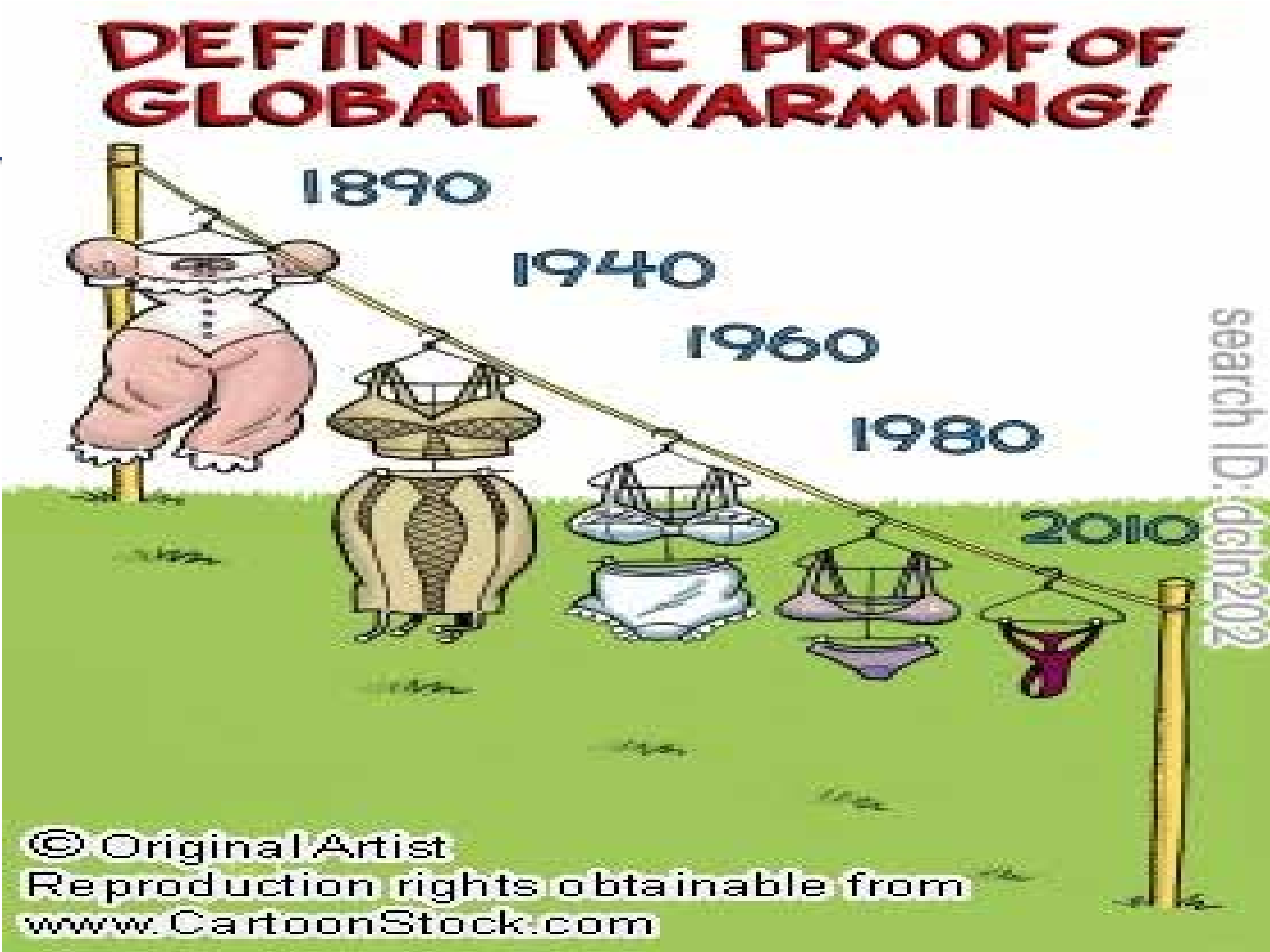
Conclusions

The Australian Wine Research Institute

- Excessive bunch exposure has implications for grape composition and wine quality
- Maintain bunches with some degree of shading
- The degree of bunch exposure can be manipulated in both existing and new vineyards
- New technologies such as particle film and anti-transpirants may be considered
- Many existing winegrape varieties are adaptable

  BUT alternative varieties can offer greater heat and drought tolerance

Hotter and drier & Processing ripe fruit


DEFINITIVE PROOF OF GLOBAL WARMING!
1890
1940
1960
1980
2010
search ID: dcln202
© Original Artist
Reproduction rights obtainable from
www.CartoonStock.com

What is a heatwave?

The Australian Wine Research Institute

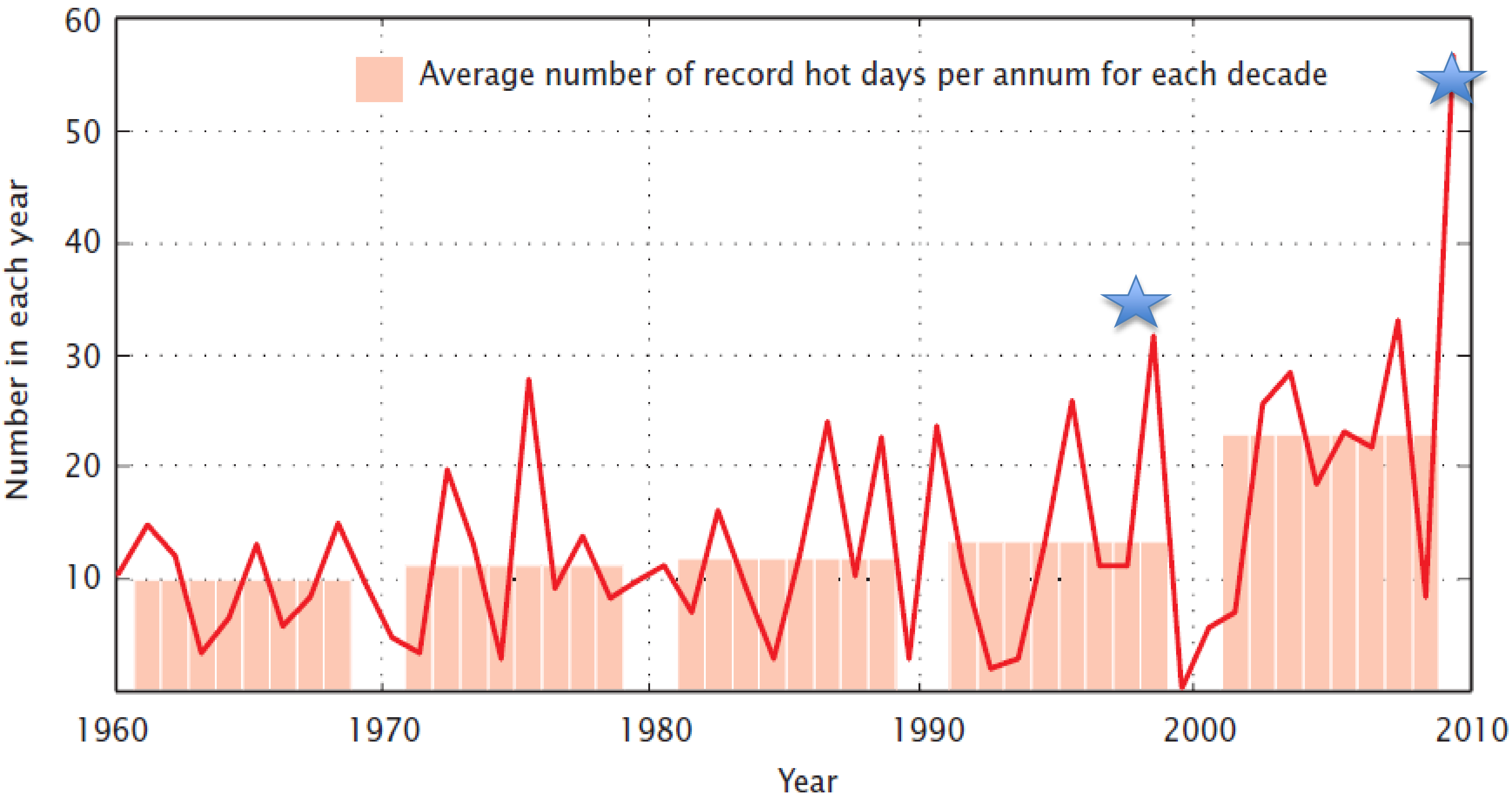
What is a heat wave?

The Australian Wine Research Institute

- No international definition ~ a string of unusually hot days
- South Australian BOM definition
  - five consecutive days max. day time temperature > 35 degrees ^{o}C
  - three consecutive days max. day time temperature > 40 degrees ^{o}C
  - Adelaide region experiences a heatwave every three years
  - usually in the summer months December to February

2000-2010 Australia's warmest decade on record

The Australian Wine Research Institute



CSIRO 2012 State of the Climate

Heatwaves in recent times

The Australian Wine Research Institute

2008 - Adelaide^{o}C

35.4 (March 03)
35.7 (March 04)
37.9 (March 05)
38.5 (March 06)
39.0 (March 07)
39.8 (March 08)
40.2 (March 09)
40.0 (March 10)
38.4 (March 11)
39.2 (March 12)
39.7 (March 13)
38.6 (March 14)
38.3 (March 15)
39.9 (March 16)
40.5 (March 17)

2009 - Adelaide^{o}C

36.6 (January 26)
43.2 (January 27)
45.7 (January 28)
43.4 (January 29)
43.1 (January 30)
41.1 (January 31)
40.6 (February 1)
38.8 (February 2)
36.3 (February 3)
33.0 (February 4)
35.6 (February 5)
43.9 (February 6)
41.5 (February 7)

36.7 (November 8)
36.7 (November 9)
36.7 (November 10)
36.7 (November 11)
36.7 (November 12)
36.7 (November 13)
36.7 (November 14)
36.7 (November 15)
36.7 (November 16)
36.7 (November 17)
36.7 (November 18)

2013 - Adelaide^{o}C

Jan, Feb, March

Night time temps

23.0 (March 04)
22.8 (March 05)
23.6 (March 06)
24.6 (March 07)
25.9 (March 08)
24.8 (March 09)
21.6 (March 10)
22.0 (March 11)
26.1 (March 12)
19.1 (March 13)

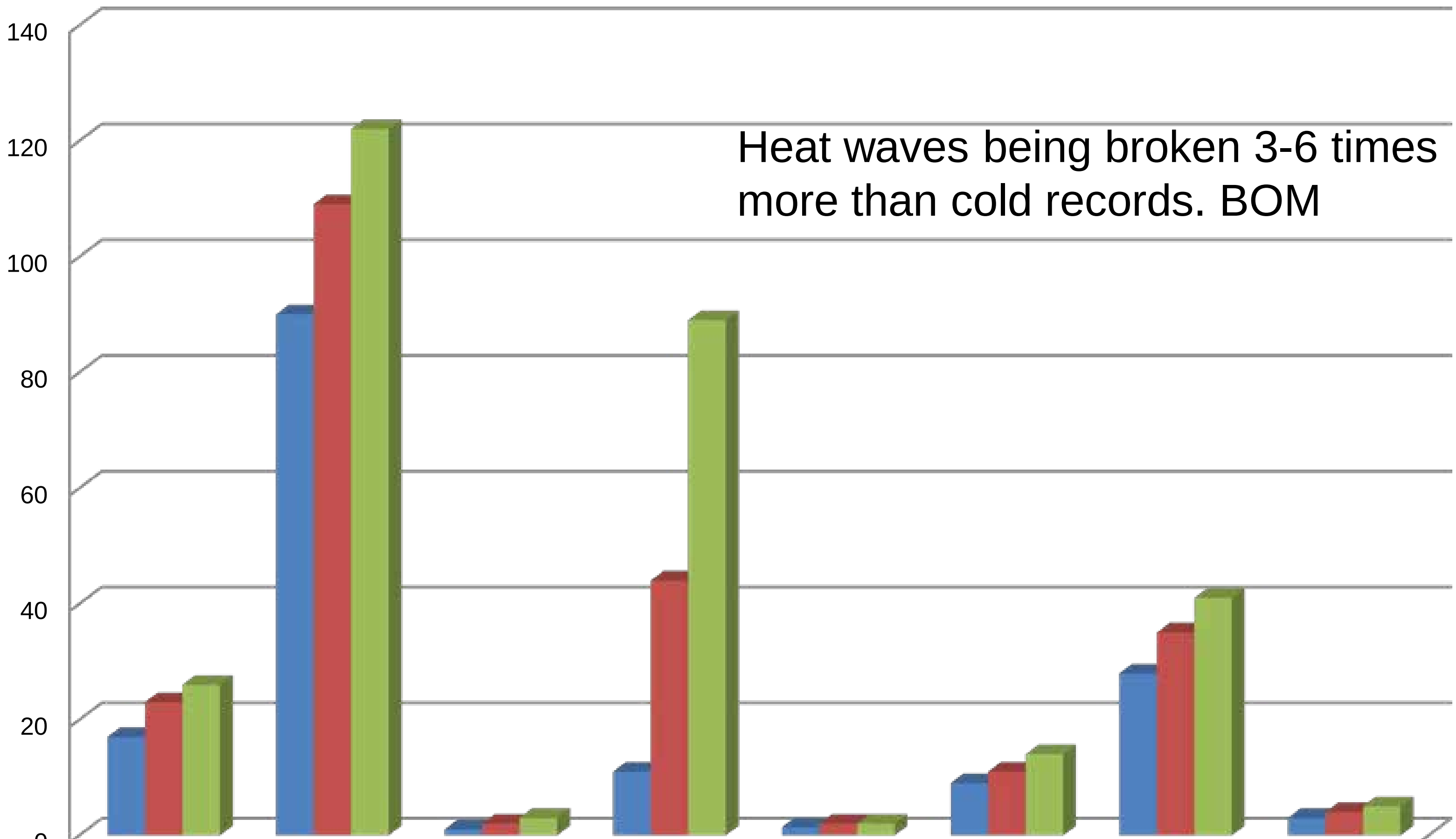
www.bom.gov.au

Future heatwaves forecast

The Australian Wine Research Institute

CSIRO 2011 State of the Climate

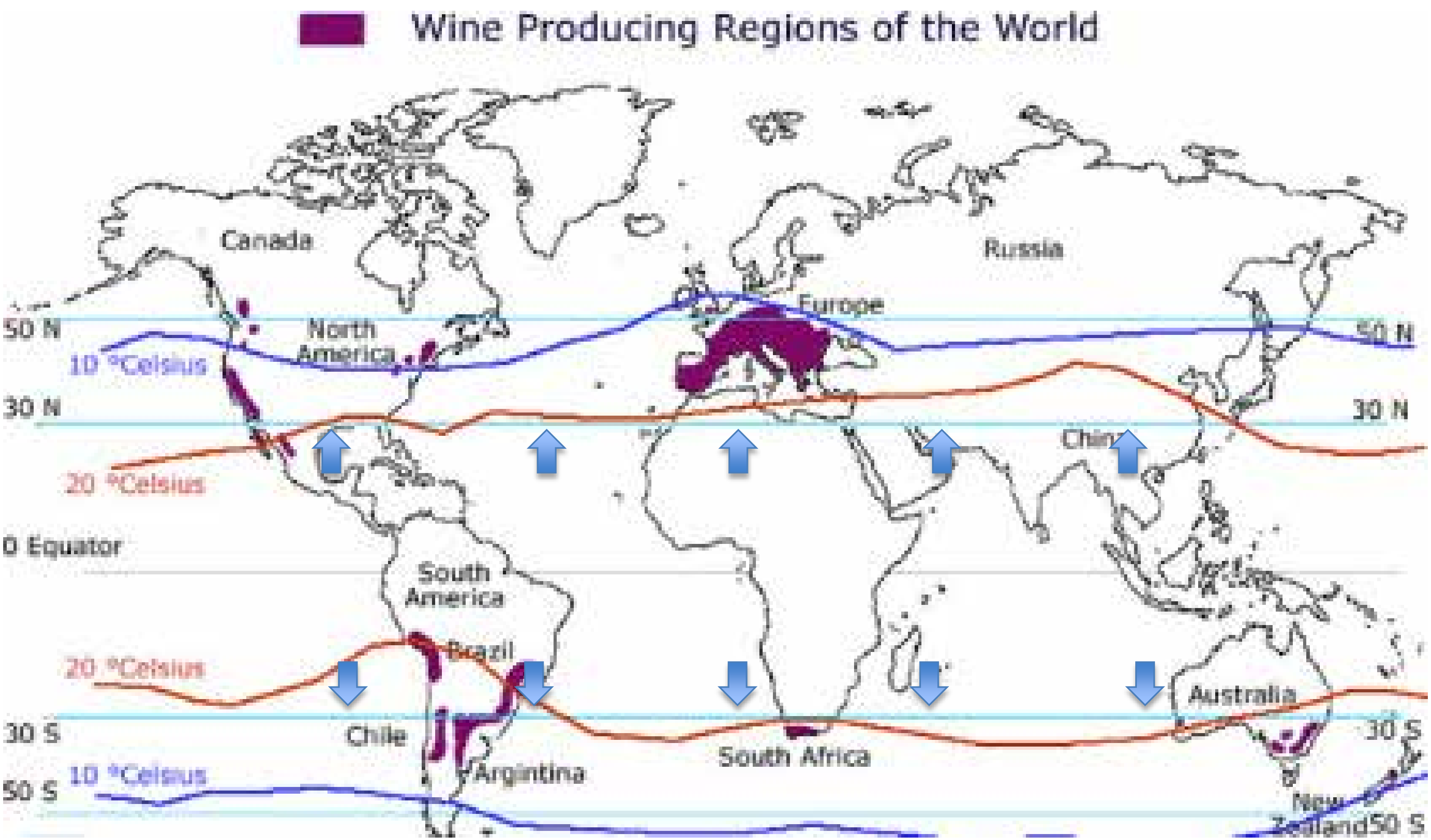
No. of days >35ºC

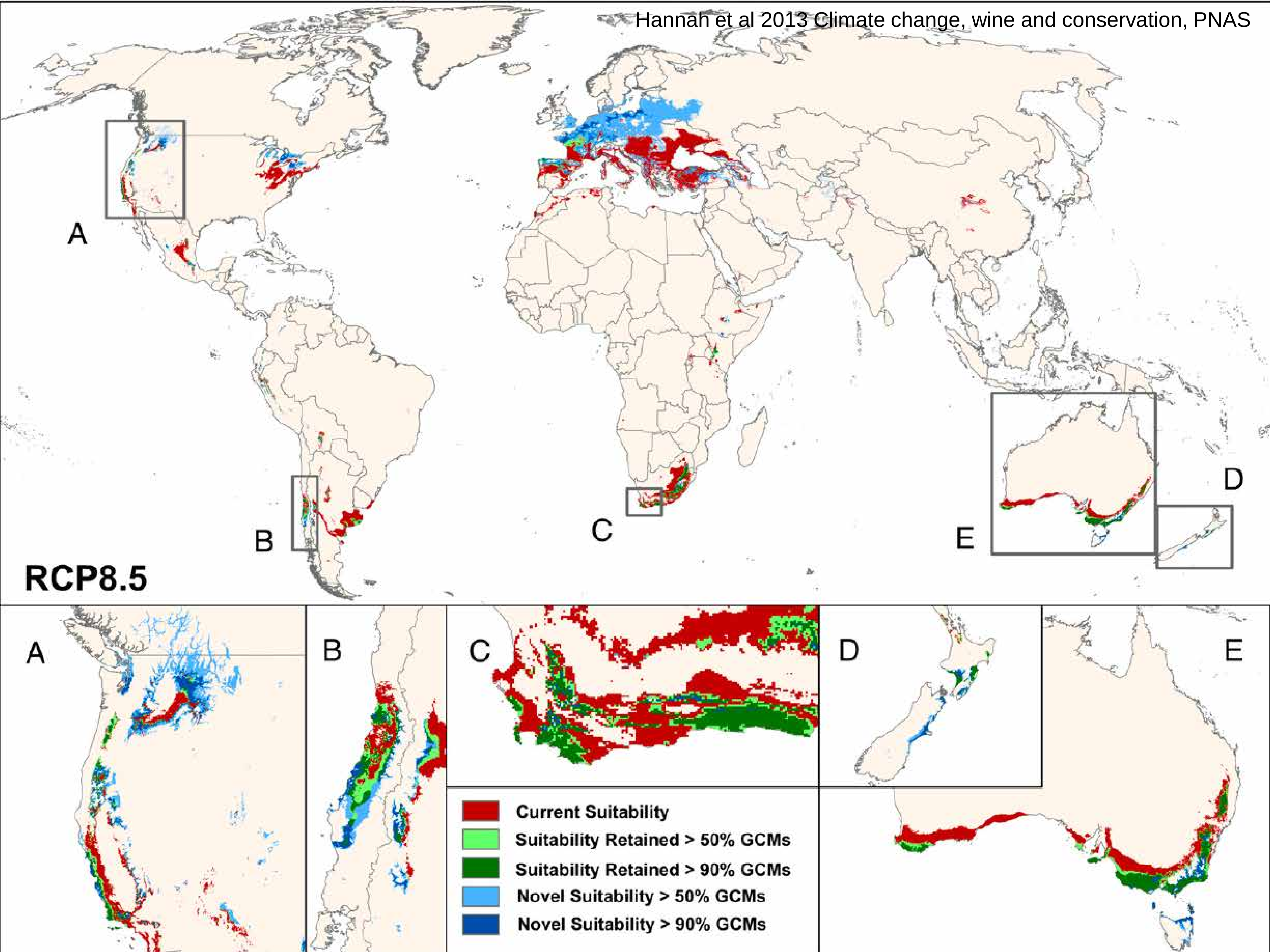


	Adelaide	Alice Springs	Brisbane	Darwin	Hobart	Melbourne	Perth	Sydney
Present Ave (1971-2000)	17	90	1	11	1.4	9	28	3
2030 (Mid emissions)	23	109	2	44	2	11	35	4
2070 (low emissions)	26	122	3	89	2	14	41	5

Changes to wine producing regions

The Australian Wine
Research Institute




Hannah et al 2013 Climate change, wine and conservation, PNAS
A
B
C
D
E
RCP8.5
A
B
C
D
E
Current Suitability
Suitability Retained > 50% GCMs
Suitability Retained > 90% GCMs
Novel Suitability > 50% GCMs
Novel Suitability > 90% GCMs

Compressed Vintages

The Australian Wine Research Institute

January → February → March → April → May

White harvest | White harvest | Red harvest | Red harvest | Red harvest

Whites to barrel | Red pressed to barrel | Red pressed to barrel

January → February → March → April

White harvest | White harvest

Red harvest | Red harvest | Red harvest

Whites to barrel | Red pressed to barrel | Red pressed to barrel

Compressed Vintage impacts

- Increased vineyard assessment – maturity/botrytis can be rapid

- Prioritisation of fruit parcels
  - small volume premium versus large volume lower quality
  - do you harvest
  - consider costs of post ferment steps such as VA/alcohol removal by RO, or MOX

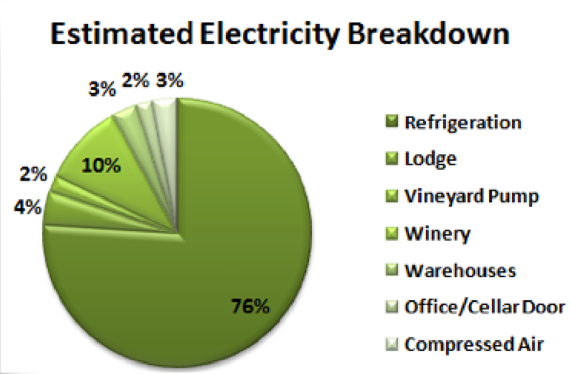
- Delays due to
  - time from picking to processing
  - time in queues or trying to sell fruit from winery to winery

Compressed Vintage impacts

The Australian Wine Research Institute

- Access to
  - harvesters
  - trucks
  - grape bins

- Capacity
  - tank and fermenter space – can vary from 1 to 5 uses each/vintage
    – contract winemaking or storage options
    – other vessels used for fermentation
  - refrigeration – cooling fruit, cooling hot ferments
    – consider a second unit
  - electricity usage



http://www.lowcarbonaustralia.com.au/where-we-work/tamburlaine-wines.aspx

Hope for the best but prepare for the worst

The Australian Wine Research Institute

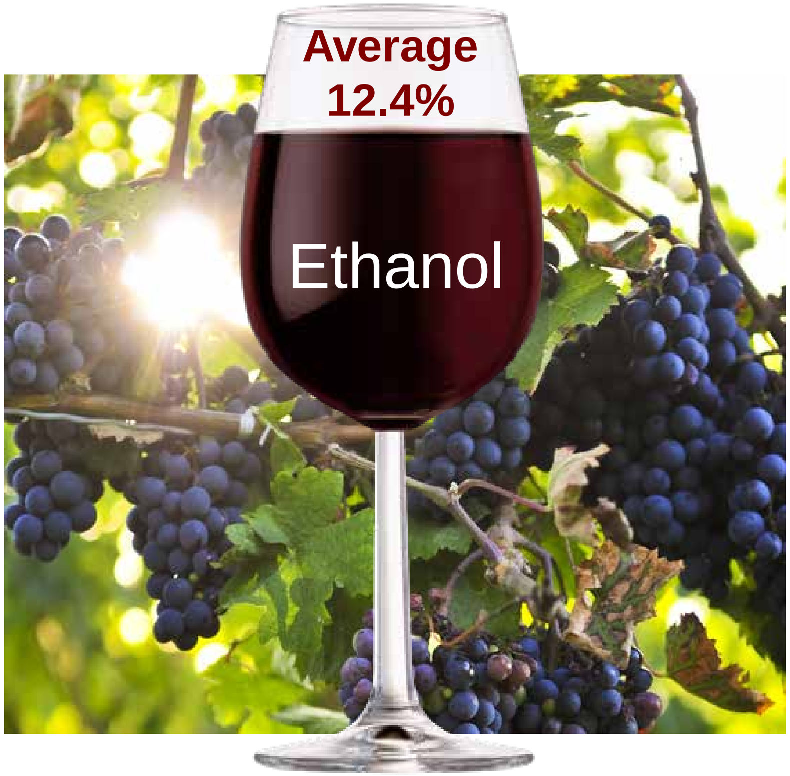
- Spread your vineyards and varieties over the region
  - mitigate any localised rainfall, frost or heat effects
- Red : white fruit ratio
  - related impacts of a compressed vintage
- Pre-vintage planning
  - order winemaking materials for the whole vintage
  - have a botrytis kit handy
  - have enough hoses to do more than one operation at a time
- Staffing
  - working 3 months worth in 6 weeks – the stress factor
  - greater time spent selecting fruit parcels and additional preferment operations
  - surplus at the end of harvest

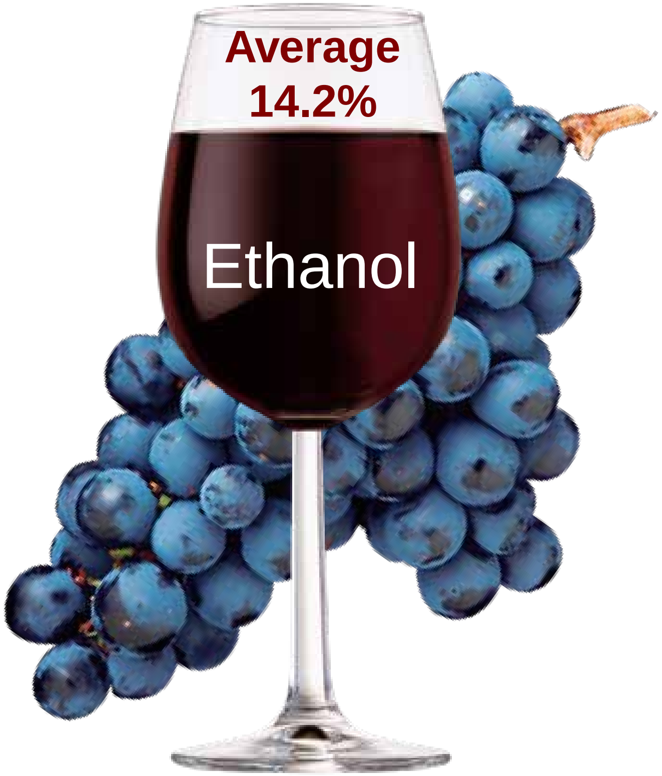
Implications of a warmer climate

The Australian Wine Research Institute

- Longer hang time on the vines
- Higher sugar levels in grapes
- Higher ethanol levels in wine
- Consumer preference for ripeness

- Greater fruit flavour complexity
- Riper fruit flavours and fruitier wines
- Softer tannins and silkier wines
- Full-bodied wines

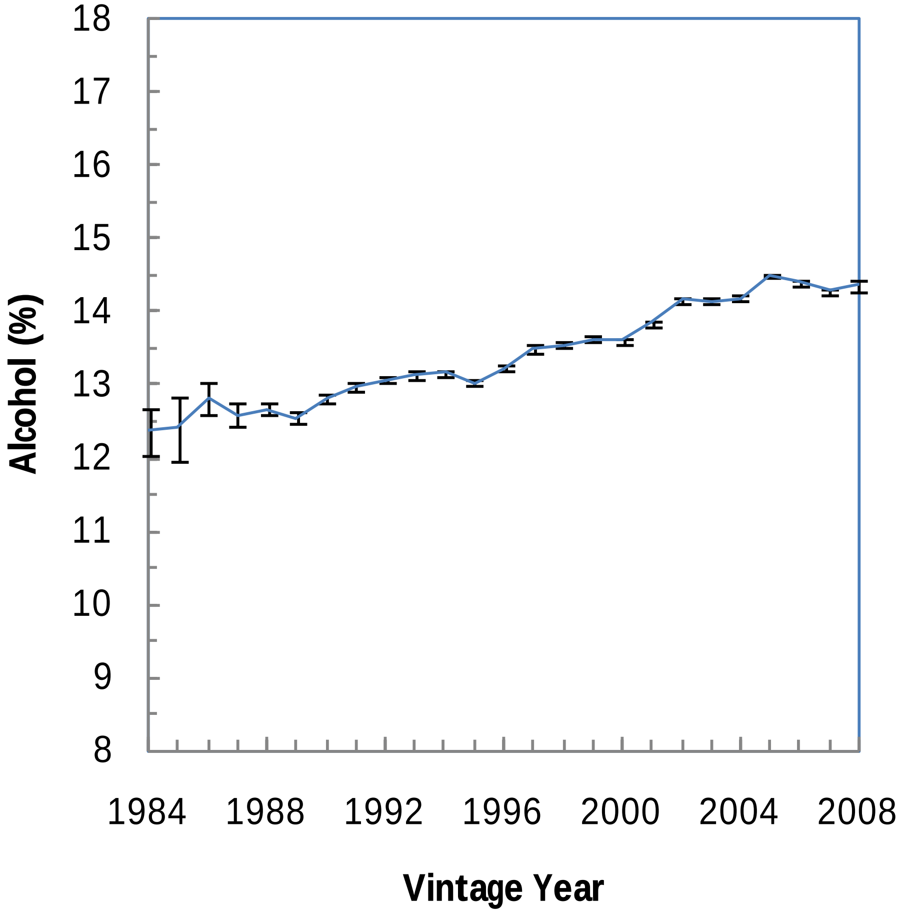


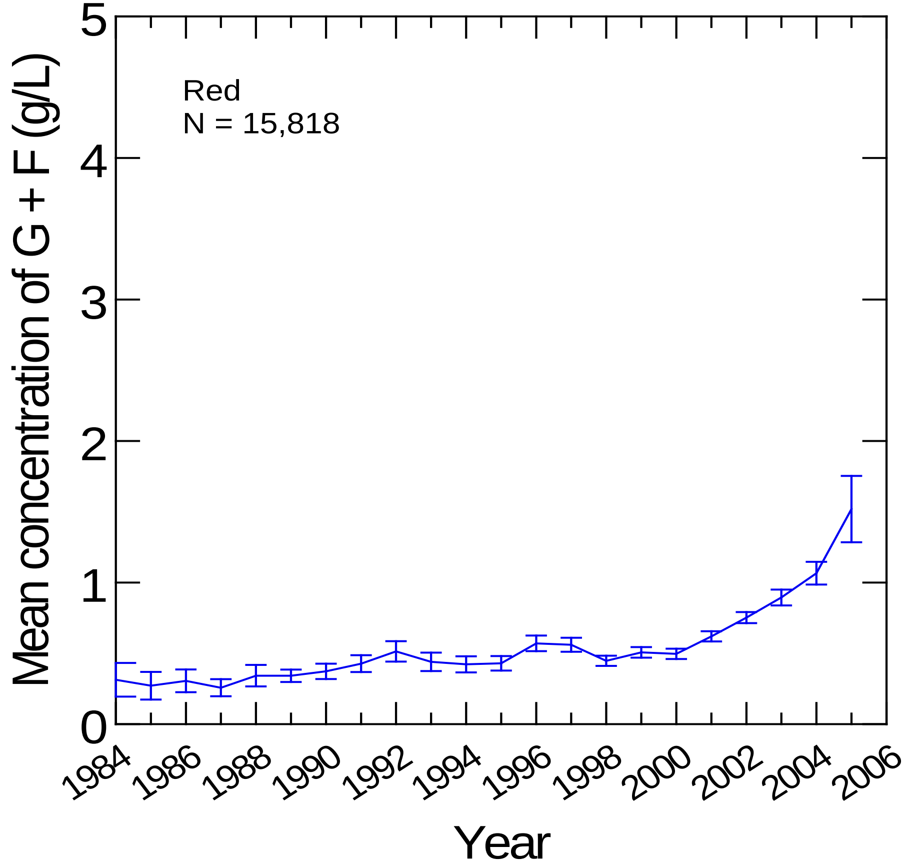


Trending higher alcohol levels

The Australian Wine Research Institute

Australian red wines



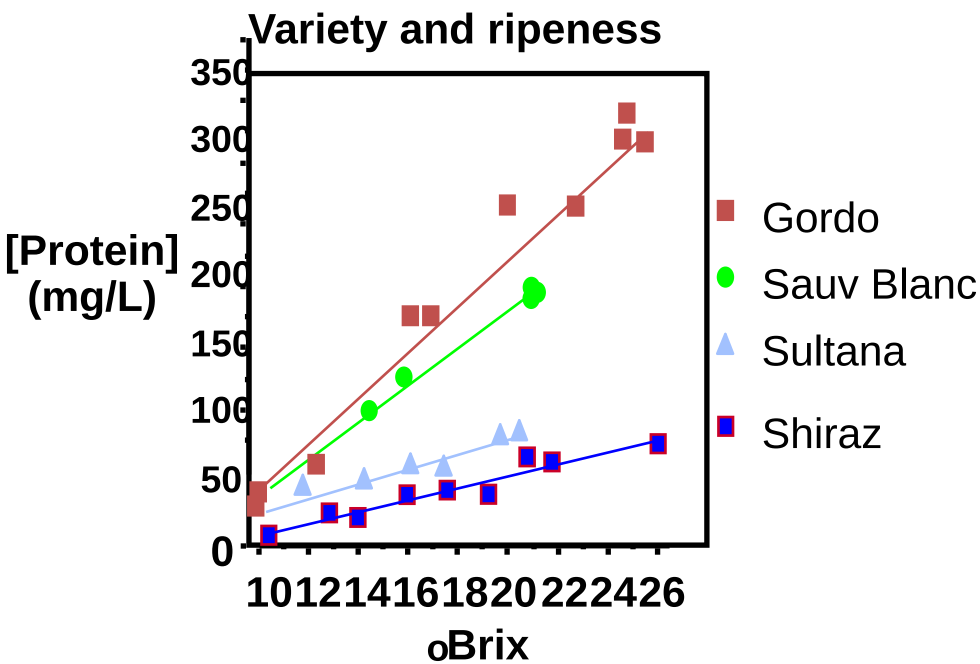


Grape compositional changes

- Dehydration increases solids and pectin
  - vintage pectin tests
  - more pectin enzyme required?
  - more settling time required?

- Increased protein
  - perform bentonite trials
  - don't just add same amount of bentonite as last year

- Overipe fruit
  - high sugar
  - decreased acidity, high pH
  - low malic acid



AWRI, Waters and Pocock

Grape and juice handling

The Australian Wine Research Institute

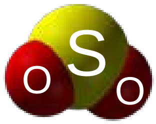
Temperature

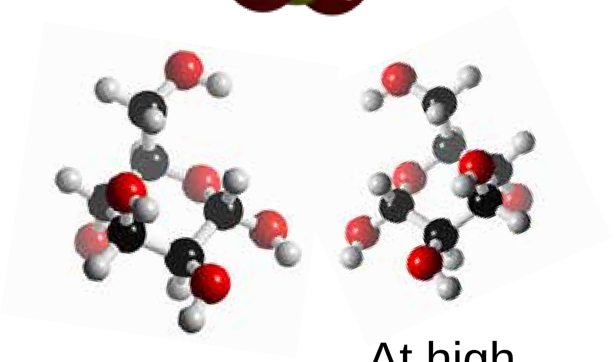
cooling

pH

acid adjust

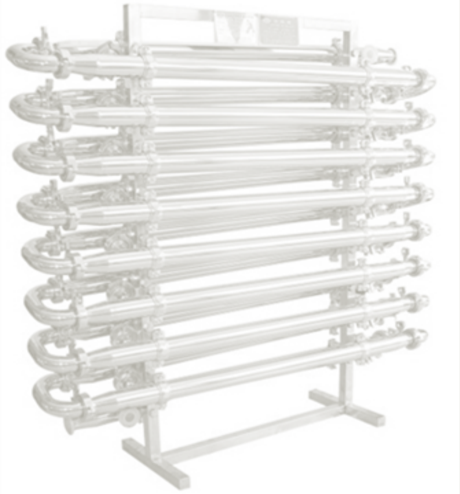
SO_2 binds weakly to glucose





At high [sugar] binding becomes significant

Juice transfer



- Processing dehydrated and shriveled fruit
  - lower yields
  - blockages of must lines and heat exchangers
  - processing delays & increased oxidation risks

- Actions
  - isolate free run and use to push grapes through hopper
  - avoid long distance pumping
  - chill in tank
  - add larger amounts of SO_2

Grape compositional changes

Glucose to fructose ratio

Saccharomyces are more ‘glucophilic’

than ‘fructophilic’

Start of ferment (ripe fruit) ~ 0.7-1.1

Start of ferment (over-ripe fruit) ~ <1.0

End of ferment (<1 Baume) ~ 0.1

Heat waves in 2008 caused

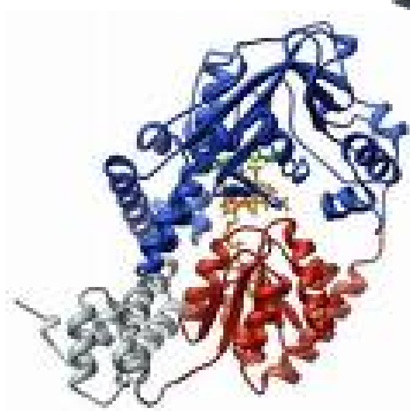
large number of stuck ferments

Typical analysis

Brix	27-32
Alcohol (% v/v)	14-17
Glucose + fructose (g/L)	47
pH	3.80
Acetic acid (g/L)	1.90
Malic acid (g/L)	<0.05

Native microorganisms

- Increased toxins
- Depleted nutrients



SO_2

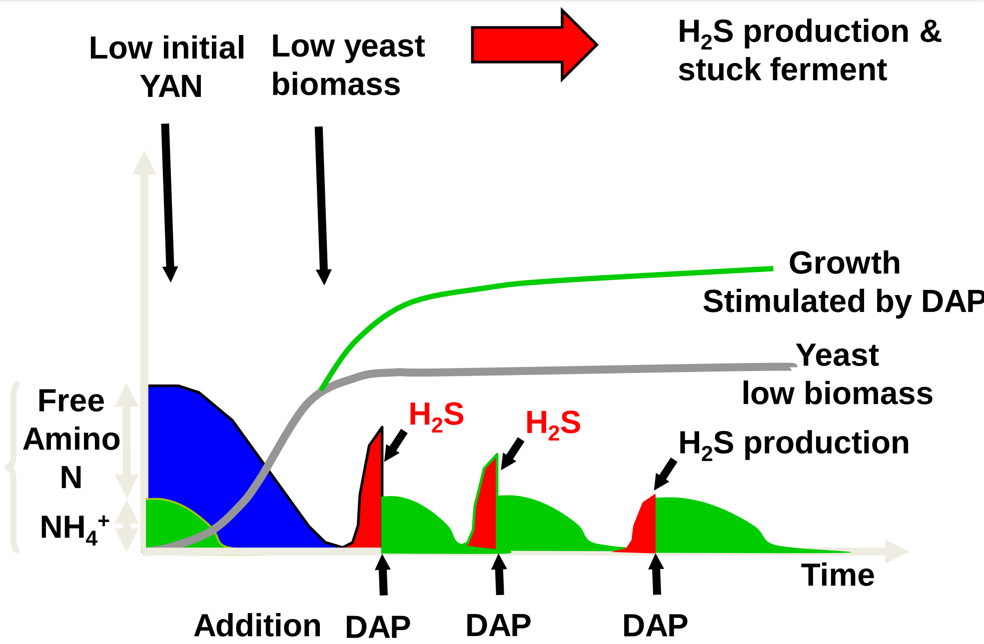
- Cover bins to
  - heat/light
- Clean grape bins between loads

- Lysozyme
  - Kills LAB, but not yeast, AAB

Measure YAN

The Australian Wine Research Institute

Yeast nutrients depleted or insufficient for ripe fruit



Maximum YAN demand:
Mean = 400 mg/L
Range = 330 – 470 mg/L

Minimum YAN requirement
Whites – approx. 150 mg/L
Reds – approx. 100 mg/L

Optimum flavour/prevent H2S
Whites – approx. 250–350 mg/L
Reds – approx. 250 mg/L

Yeast rehydration

The Australian Wine Research Institute

- Re-hydration medium:
  - Mineral water/rain water/clean tap water (remove Chlorine)
  - Mineral water with grape sugar
  - Diluted preservative-free (SO_2) grape juice (sterile)
  - Proprietary nutrients (inactive yeast) for difficult musts
- Temperature - 38-40 ° C
- Stand 15-20 min
- Lower temp/Add grape juice
- Stand 15-20 min, repeat
- Add to tank at similar temperature

Correct

Incorrect

Yeast storage ~4ºC

The Australian Wine Research Institute

Yeast stress – to high sugar and high ethanol levels

Aeration

Yeast scale-up

1.5-2x inoculum

Procedure for 1000 L of ferment

Stage	Function	Cumulative volume
1. Preparation of rescue culture		20 L

1. Preparation of rescue culture — 20 L

5L hydrated yeast

10L Grape juice (no SO_2) or 15L water (no Cl)
5L water + 3Kg GJC (2Kg sucrose)
15g DAP
150mg *Cerevit* or *Maurivit*

2. Acclimatisation and aerate

Step	Proportion of ferment	
1	50%	40 L
2	75%	80 L
3	88%	160 L
4	94%	320 L

3. Inoculate problem ferment — 1020 L

The Australian Wine Research Institute

Blending

- Grape musts high in sugar can be blended with low strength juice (LSJ) or condensate within regulations
- Integrity laws dictate a dilution less than 15% of volume for authenticity, unless LSJ or condensate is derived from the same variety as the wine or blend to which it is added
- Added water, such as fining agents is limited to 7% v/v
- These additions can lower alcohol concentration by 1% v/v

The Australian Wine Research Institute

Fermentation design to ferment less alcohol

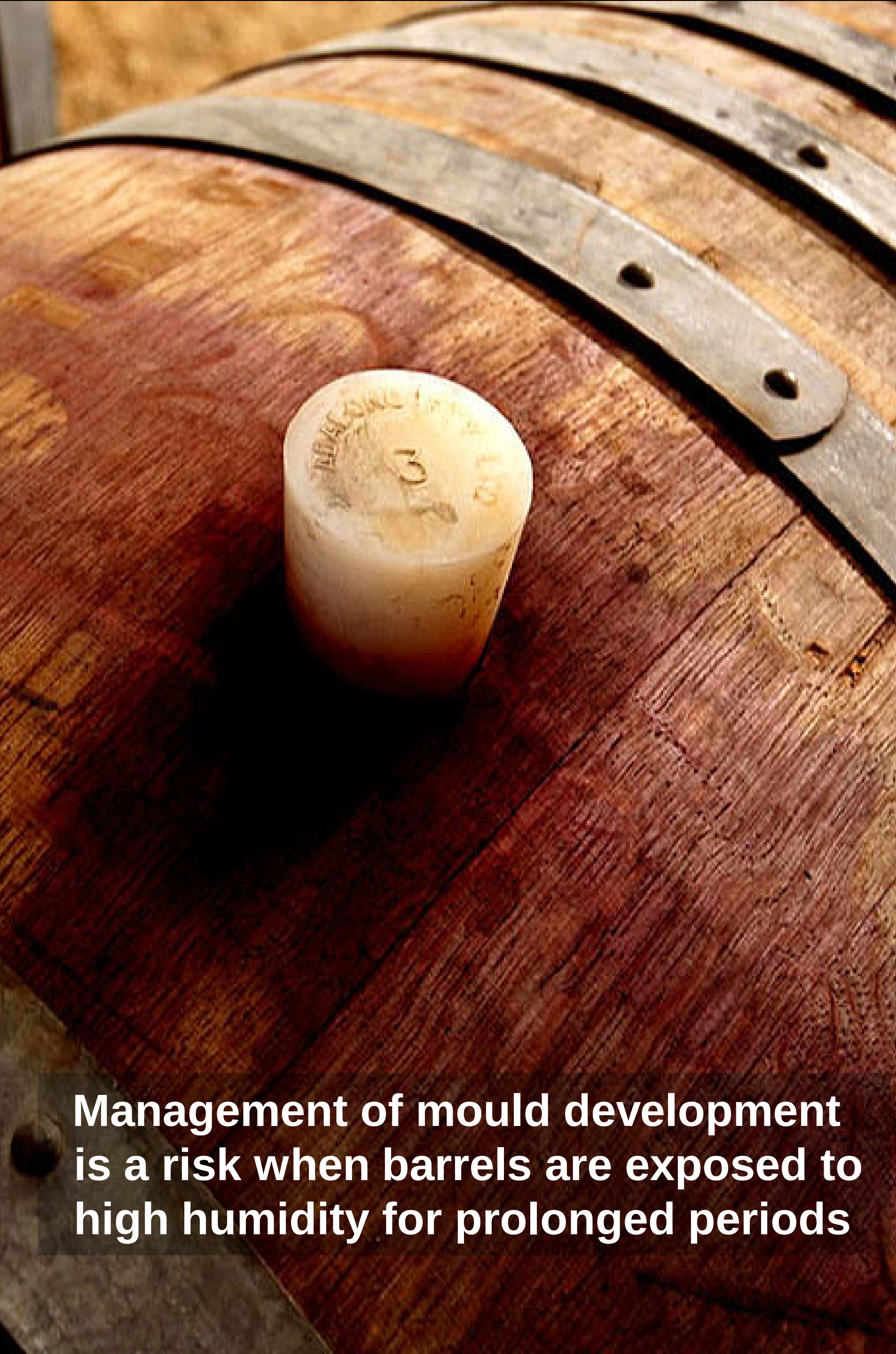
Scientific studies have yet to establish the degree to which these factors modify alcohol levels and wine flavour

- There is evidence that aeration and higher fermentation temperatures decrease alcohol levels
- Tank type and design have been indicated as important factors
- Open top fermenters reported to give lower alcohol after fermentation

The Australian Wine Research Institute

Physical removal of alcohol

- Membrane-based systems
  - reverse osmosis
  - perstraction
- Vacuum distillation
- Spinning cone separation
  - **These provide effective and precise control of alcohol reduction**
  - **EU approved 2010**
- Sometimes other sensory compounds may also be removed, impacting wine quality
  - **To address this… totally de-alcoholise a small parcel, then back blend to achieve desired alcohol concentration whilst minimising quality losses**
- More peer-reviewed research needed on potential side-effects of de-alcoholisation technologies



Loss of alcohol by evaporation

- During barrel maturation, both water and ethanol evaporate
- Ethanol concentration slowly increases in dry cellars as water evaporates faster than ethanol in this environment
- Conversely, in cellars with a relative humidity over 70%, ethanol concentration slowly decreases over time
- Alcohol was reported to drop by 0.2% v/v when barrels were stored for 12 months at 15ºC with relative humidity over 90%

Alcohol management summary

The Australian Wine Research Institute

- Heatwaves will be more common & harvest will trend earlier
- Manage increased solids, pectins and grape proteins
- Control native microorganisms
- SO_2 and pH management
- Nitrogen supplement
- Blend musts with LSJ
- Yeast selection, propagation acclimatisation
- Sanitation
- Reduce alcohol content with engineering technologies

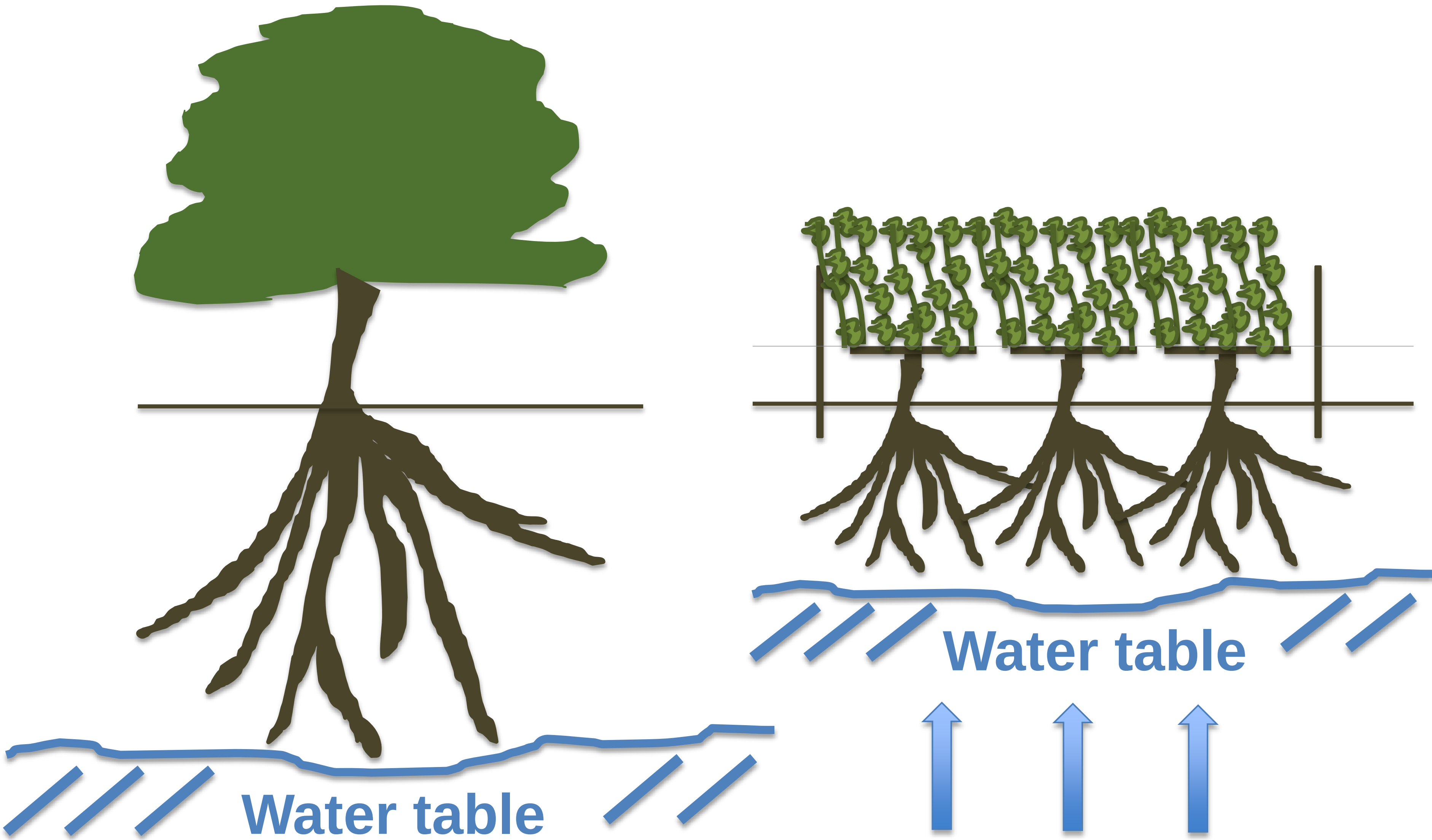
What’s the problem with salt in the vineyard?

What is salinity?

- What is salinity?
- Why is it a problem?
- How can we manage it in the vineyard?

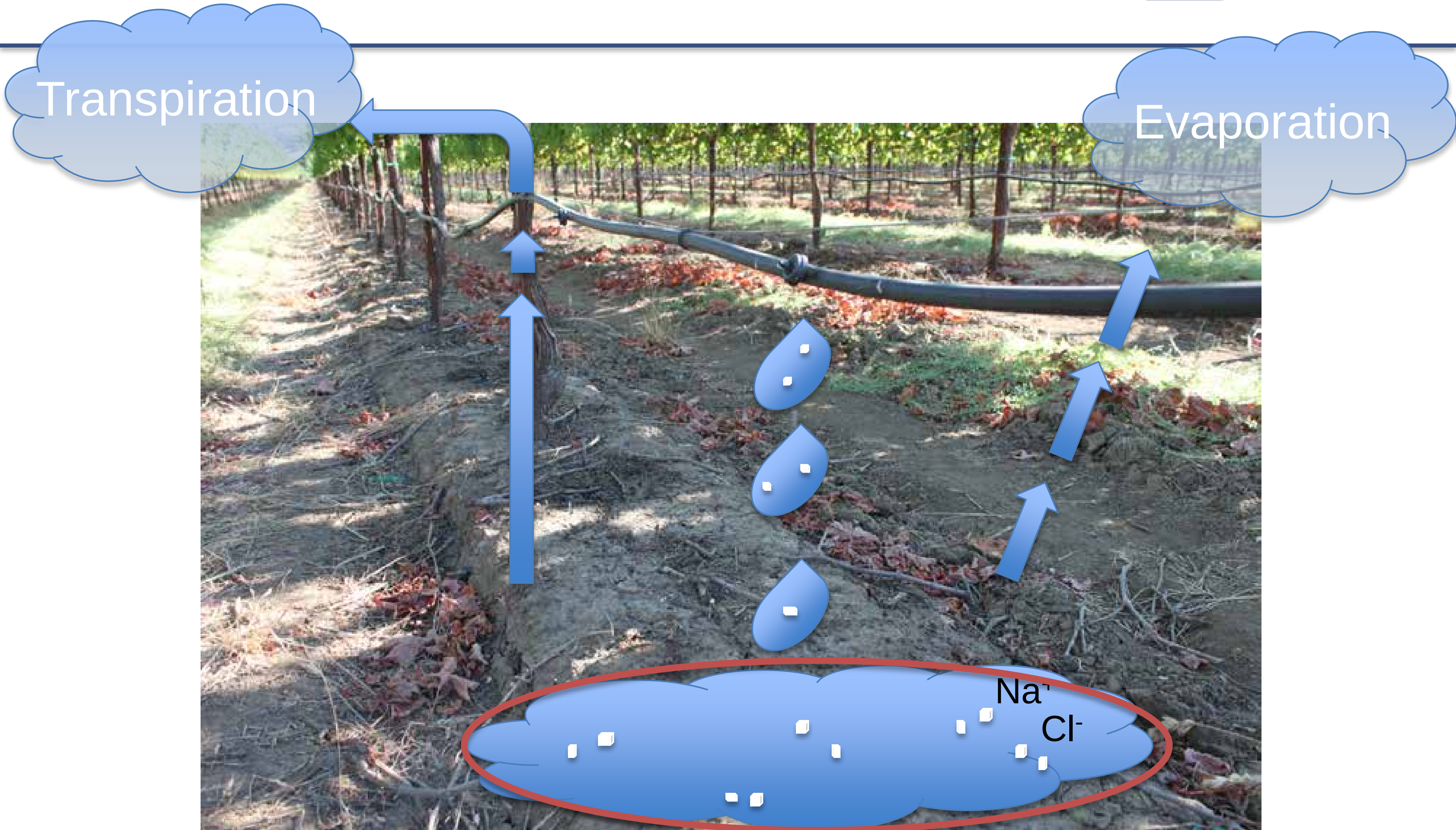
Dryland Salinity

The Australian Wine Research Institute



Irrigation brings salts with it

The Australian Wine
Research Institute

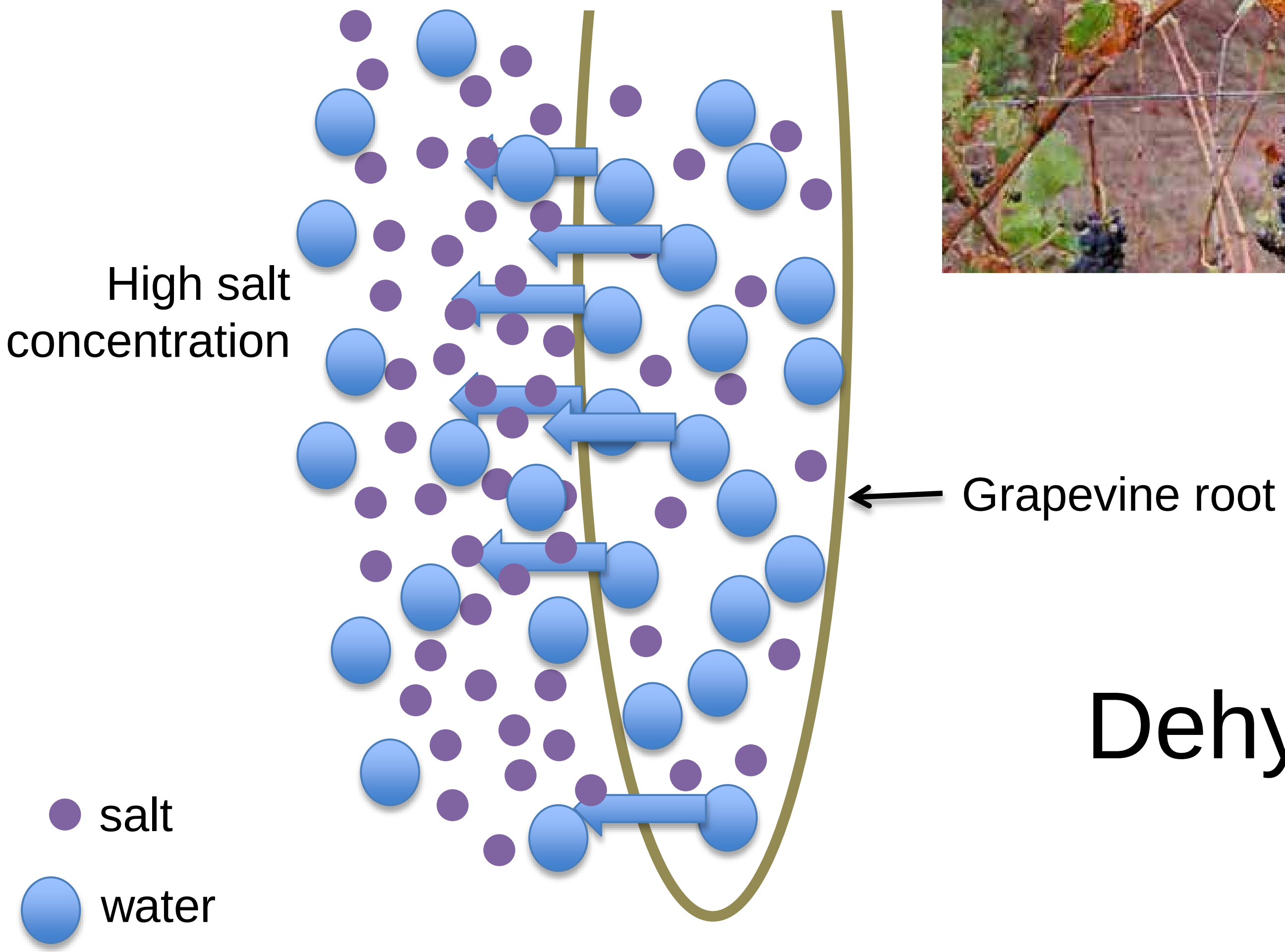


Salt symptoms in the vineyard

The Australian Wine
Research Institute

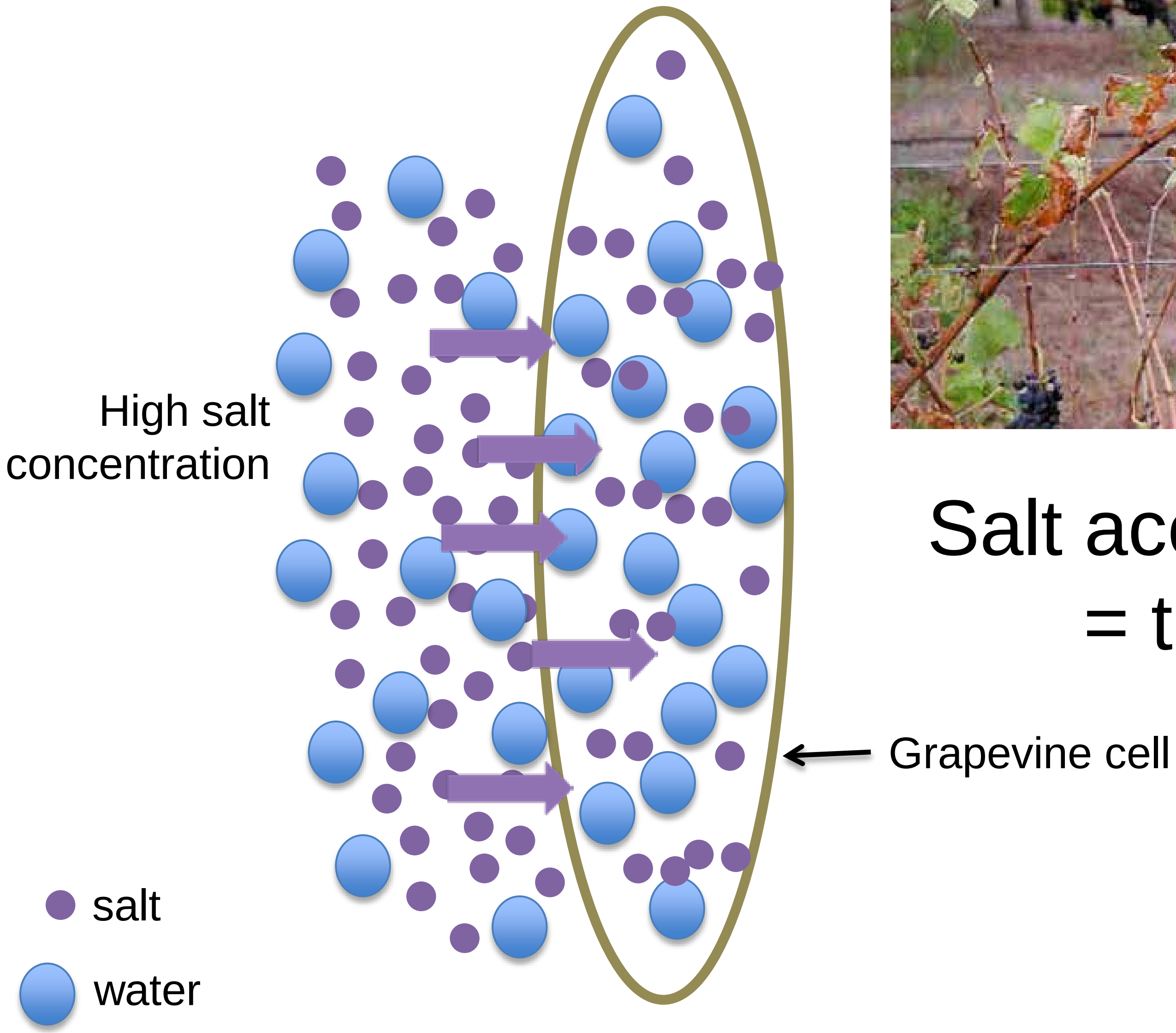
- Leaf burn
- Poor vegetative growth (stunted shoots)
- Poor flowering/fruit set → reduced yield
- High levels of sodium and chloride in grape juice

Salt - the osmotic effect



Dehydration

Salt - the toxic effect



Salt accumulation
= toxicity

Units for salt & salinity measurement

The Australian Wine
Research Institute

- Standard unit for electrical conductivity (EC) is decisiemens/metre (dS/m)

1 dS/m = 1000 EC units

= 640 milligrams/litre, or ppm total dissolved salts

Effect of saline irrigation water

The Australian Wine Research Institute

Water salinity (dS/m)
0.3
0.4

Effect of saline irrigation water

The Australian Wine Research Institute

Water salinity (dS/m)	Irrigation (ML/ha)
0.3	5
0.4	6

Effect of saline irrigation water

The Australian Wine Research Institute

Water salinity (dS/m)	Irrigation (ML/ha)	Salt (tonnes)
0.3	5	0.96
0.4	6	1.54

Effect of saline irrigation water

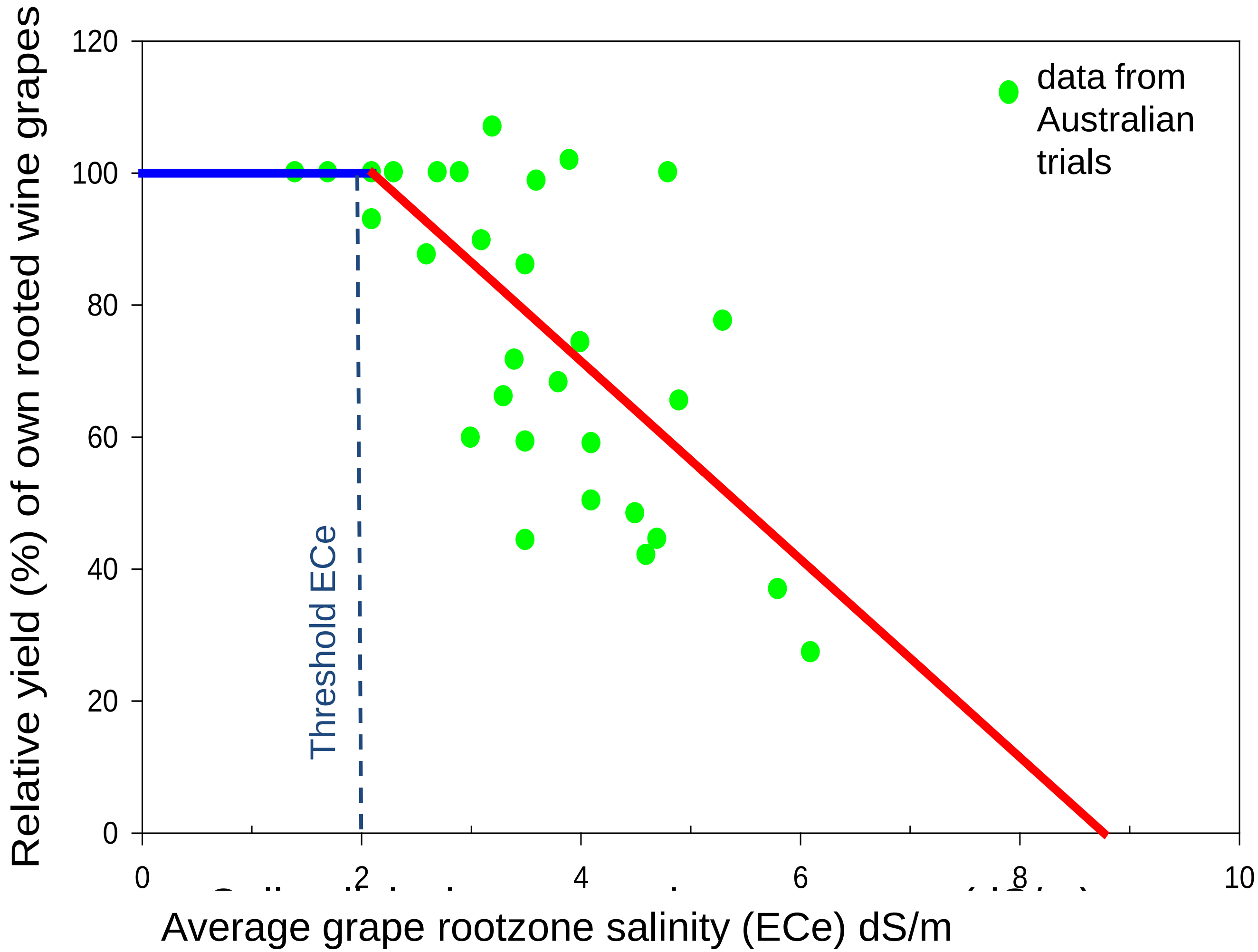
The Australian Wine Research Institute

Water salinity (dS/m)	Irrigation (ML/ha)	Salt (tonnes)	
0.3	5	0.96	
0.4	6	1.54	+ 60%




Grapevine salt tolerance

The Australian Wine
Research Institute



Varietal tolerance / sensitivity

The Australian Wine Research Institute

Sensitivity	Varieties	ECe at which yield declines (dS/m)	ECsw at which yield declines (dS/m)
Sensitive to moderately sensitive	**Scion**: Sultana, Shiraz, Chardonnay **Rootstock**: 1202C, 5BB Kober, 5C Teleki, SO4	2.2	3.6
Moderately **tolerant** to tolerant	**Rootstock**: Ramsey, 1103 Paulsen, Ruggeri 140, Schwarzmann, 101-14, Rupestris St George.	3.3	6.6

ECe – EC of soil extract
ECsw – EC of soil water

Modified from Zhang et al. 2002

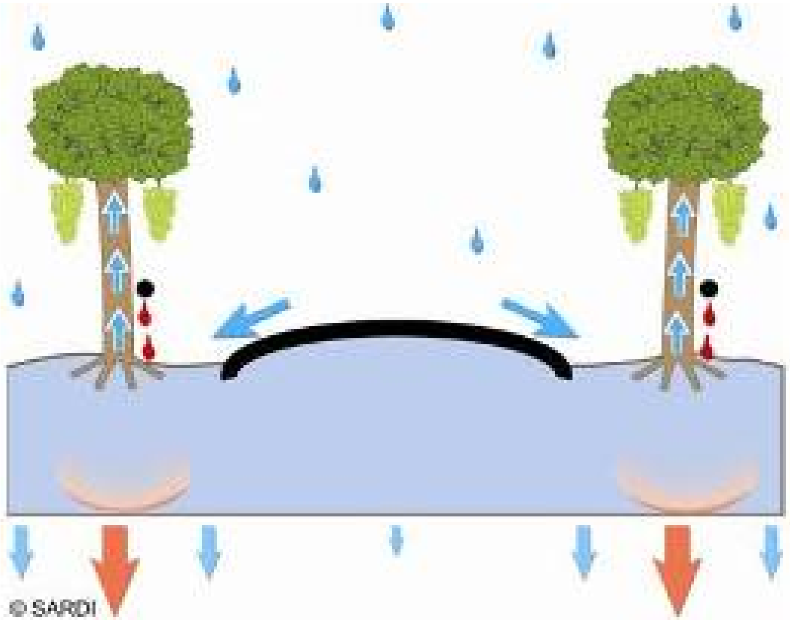
How to manage salinity

The Australian Wine Research Institute

Monitoring – soil & petiole data

Winter flushing

Rainfall diversion

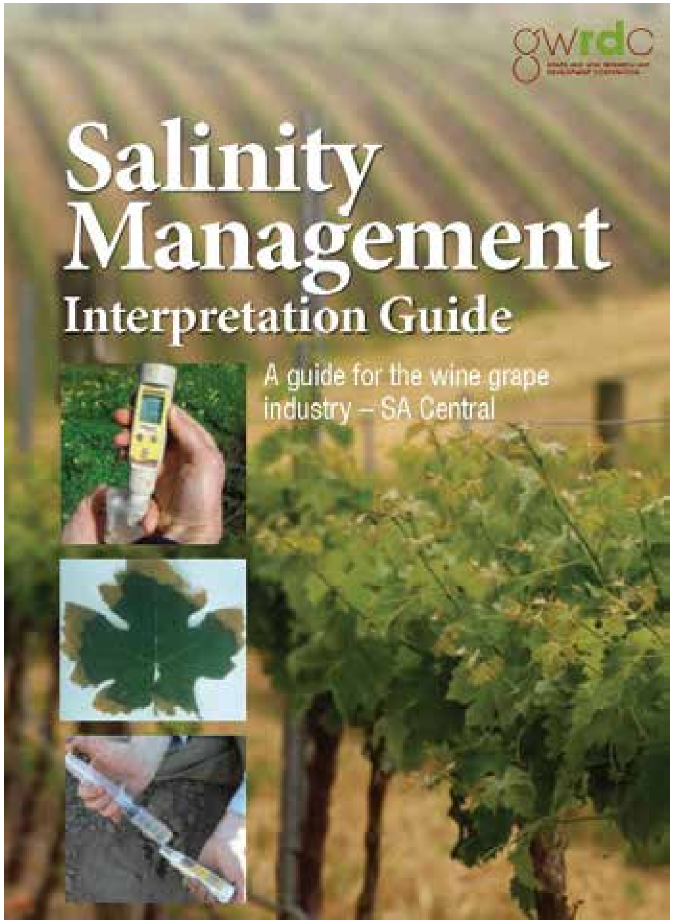


How to manage salinity

The Australian Wine
Research Institute

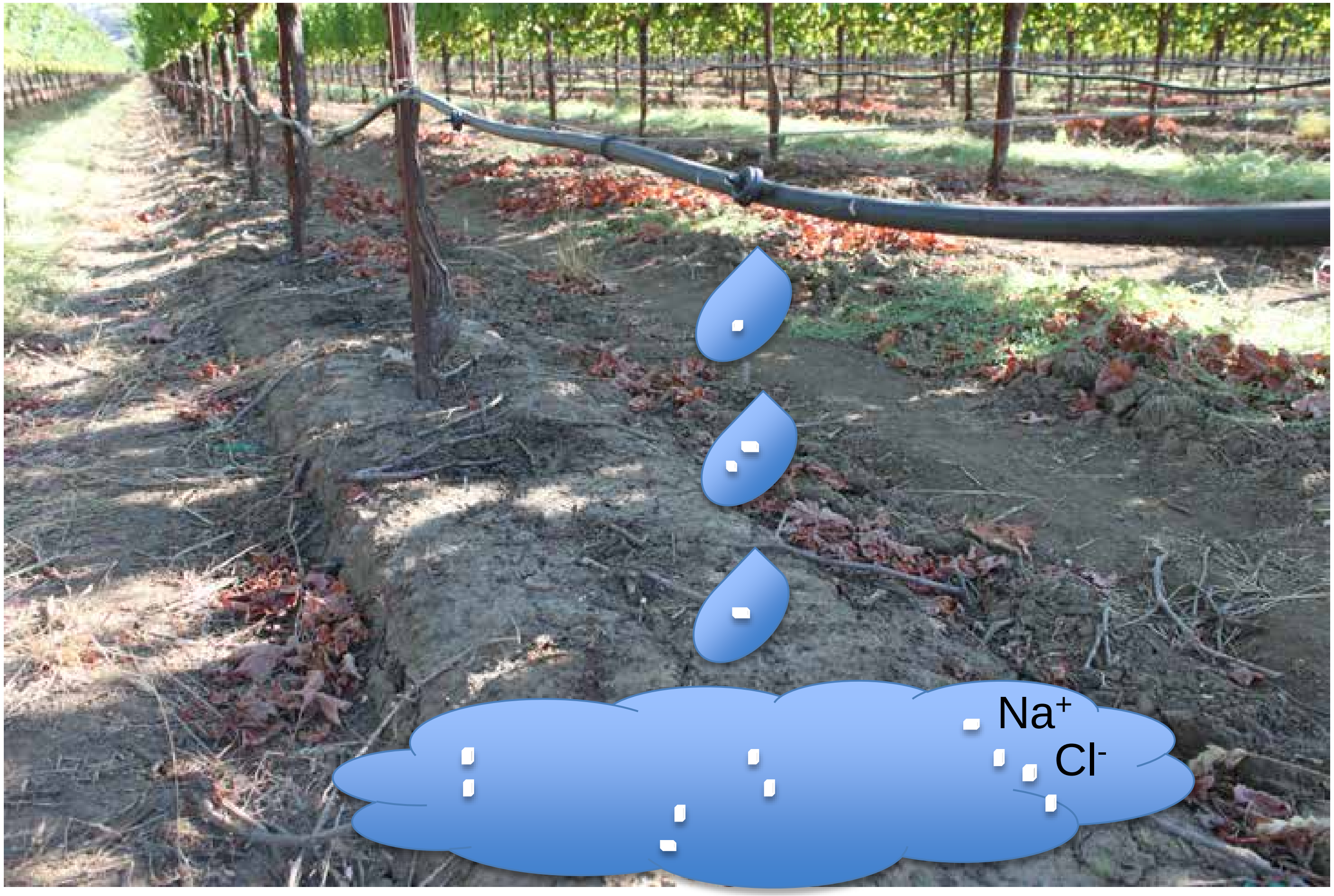
Monitoring
Winter flushing
Modify water quality
Modify irrigation quantity / regime

Variety / rootstock choice



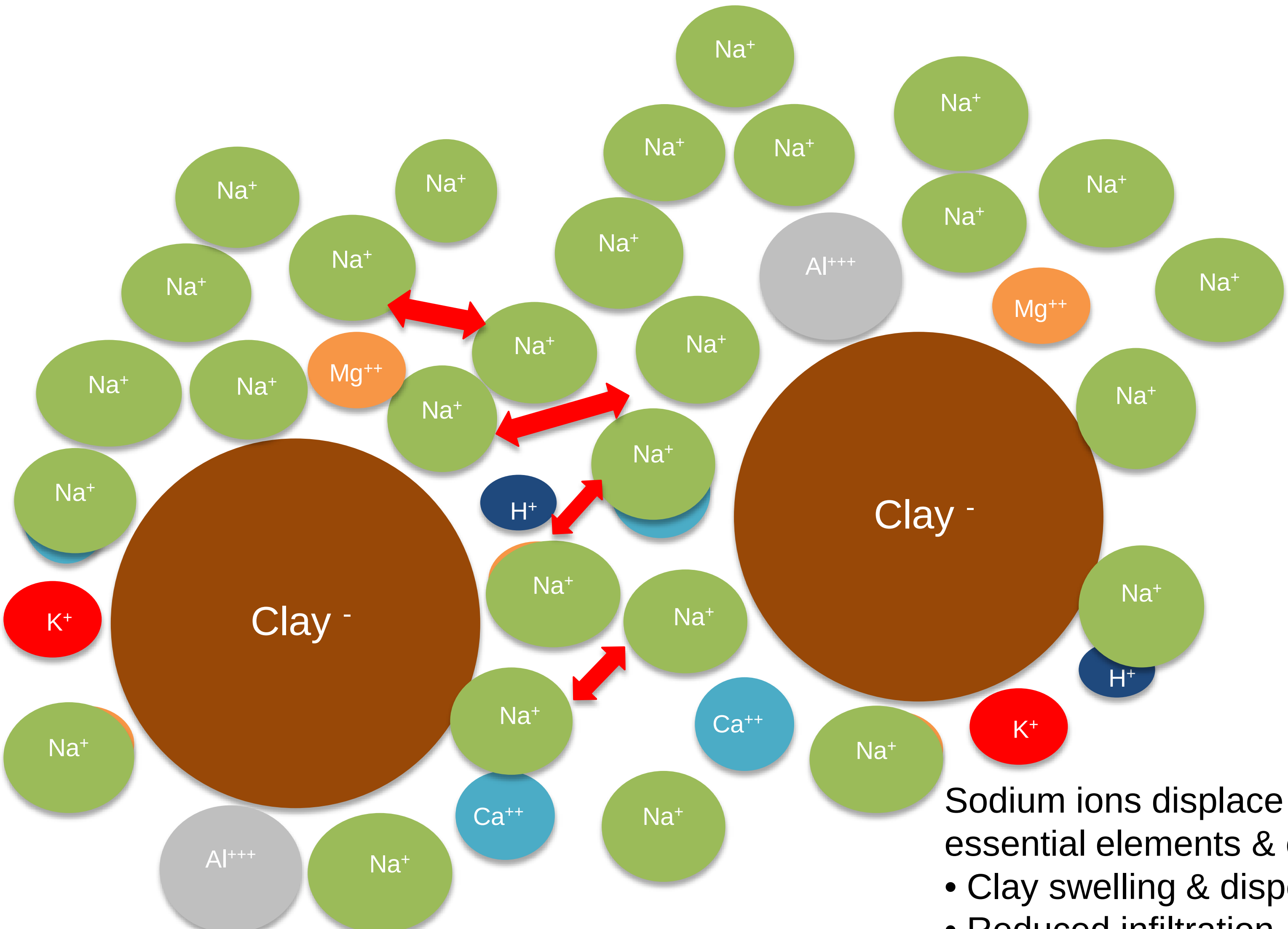
Sodicity

The Australian Wine Research Institute



Excessive sodium affects soil structure and vine health

Sodicity



Sodium ions displace other essential elements & cause:

- Clay swelling & dispersion
- Reduced infiltration
- Decreased hydraulic conductivity
- Surface crusting

The problem with sodicity

The Australian Wine Research Institute

↑ salinity

Sodicity

Poor soil structure

(clay dispersal, waterlogging, surface crusting)

↓ effectiveness of leaching

Take home messages

The Australian Wine Research Institute

- Grapevine production is affected by salinity
  - Osmotic effect
  - Toxic effect
- Sodicity is associated with salinity and may require separate management
- Management tools include monitoring, winter leaching & variety/rootstock selection

- References on AWRI website

Acknowledgements

The Australian Wine Research Institute

- AWRI
  - Sensory team — Leigh Francis, Brooke Travis, Patricia Osidacz
  - IDS — Mardi Longbottom, Geoff Cowey
- Water and Vine Series — Tapas Biswas, John Bourne, Mike McCarthy and Pichu Rengasamy
- SARDI — Tim Pitt
- CSIRO — Rob Walker and team
- Memstar Australia — David Wollan, Roger Mills

GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australia's grapegrowers and winemakers through their investment body, the Grape and Wine Research Development Corporation, with matching funds from the Australian government.

AWRI
The Australian Wine Research Institute

Salty juice and wine

Geoff Cowey
Senior Oenologist
Industry Development and Support
geoff.cowey@awri.com.au

Queries to AWRI Support Services

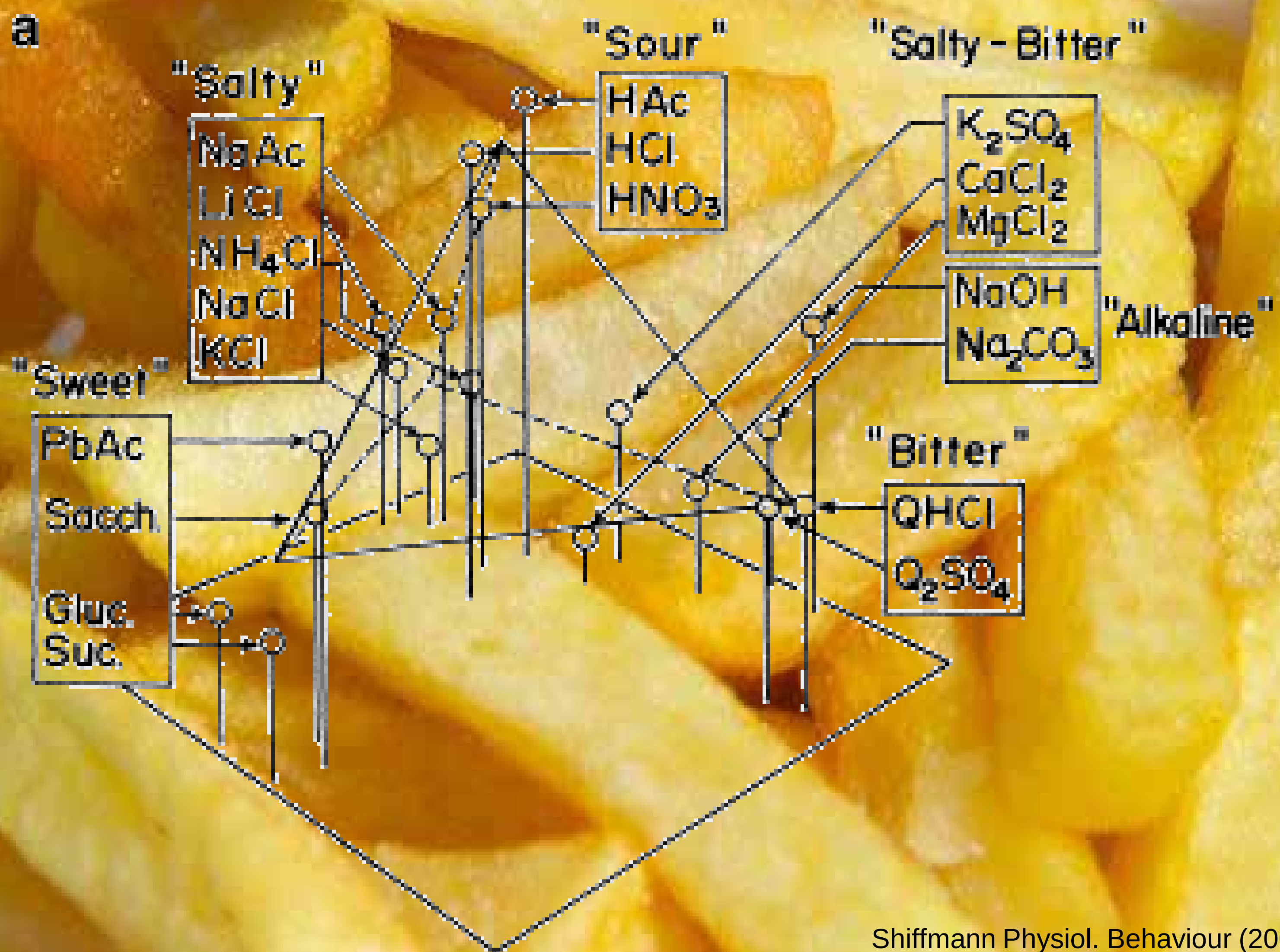
The Australian Wine Research Institute

- What is salt and how do you measure it? – sodium, chloride, or sodium chloride?
- What are the legal levels of salt for export?
- What are the legal levels for salt in grapes imposed by wineries?
- How do you measure in vines, grapes, juice and wine?
- How does salt affect wine balance?
- How can you remove salt?
- How can you prevent excessive salt levels in wine?

What is salt?

Manu Feildel
My Kitchen Rules

The Australian Wine Research Institute



Shiffmann Physiol. Behaviour (2000)

Salty taste

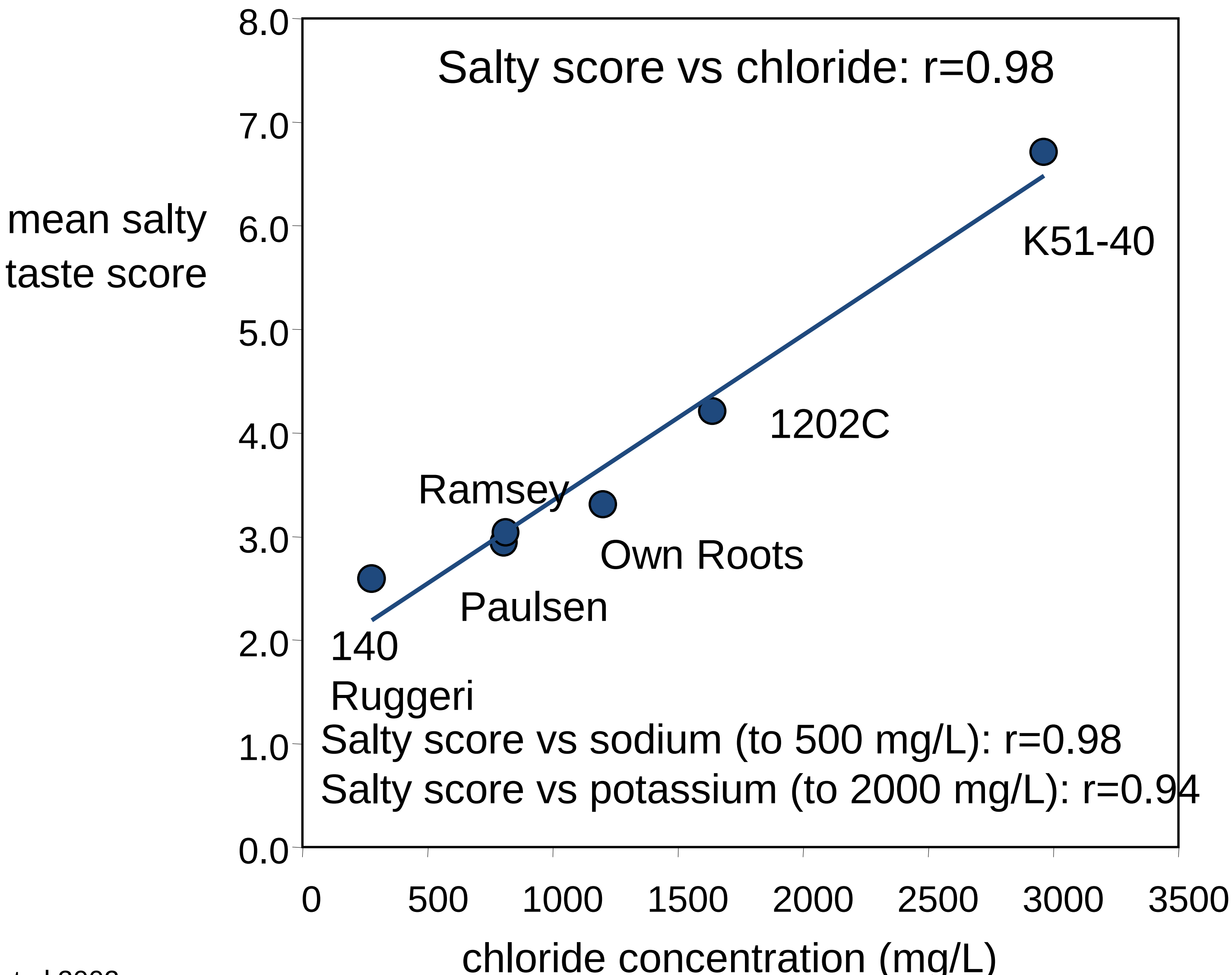
- SALT = the concentration of soluble salts in ionic form in water bodies, soils and landscapes

  - main salts: Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, SO_4^{2-}, $C0_3^{2-}$, $HC0_3^-$ but usually Cl^- and Na^+ predominate

- Saltiness perception – cations > anions
  - $Na^+ > K^+$ @Mg^{2+} @Ca^{2+}

Chloride Vs Sodium and salty taste

The Australian Wine Research Institute



Walker et al 2002

Units for salt & salinity measurement

The Australian Wine Research Institute

- Standard unit for electrical conductivity (EC) is decisiemens/metre (dS/m)

1 dS/m = 1000 EC units

= 640 milligrams/litre, or ppm total dissolved salts

- Units & legal levels in Australia
  - 1000 mg/L soluble chlorides expressed as Sodium Chloride (NaCl) (Food standards Code 4.5.1)
  - 606 mg/L Chloride ion (Cl^-)

Thresholds

The Australian Wine Research Institute

- Detection thresholds in water
  - Sodium chloride 224 mg/L
    - In drinking water, ~250 mg/L NaCl can be easily tasted, but ‘become accustomed’ to this level (World Health Organisation)
  - Potassium chloride 926 mg/L

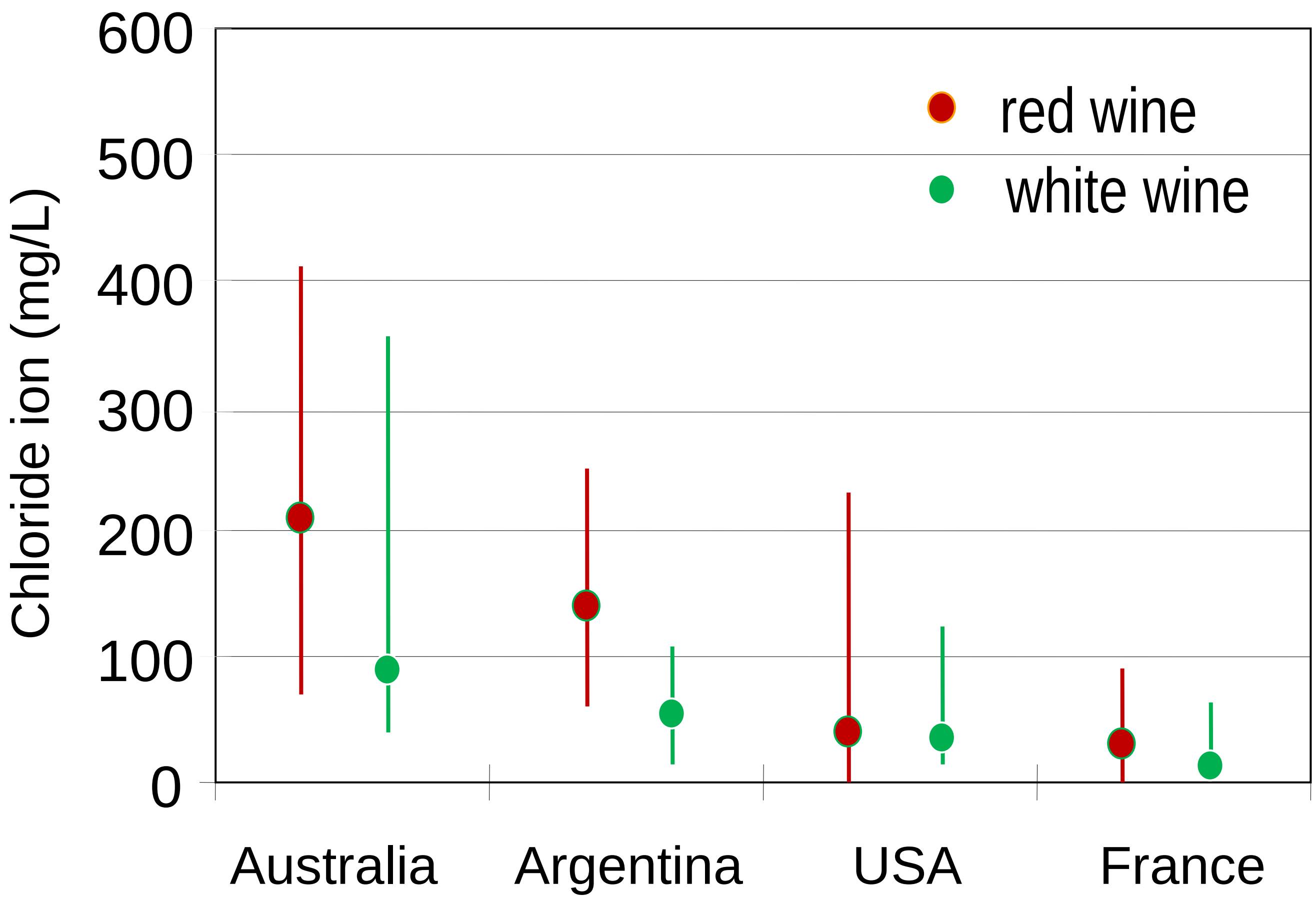
- Detection thresholds in juice and wine

NaCl (Bastian 2010)	(AWRI 2012)
§ White and red juice: 420 and 1550 mg/L	
§ White and red wine: 570 and 520 mg/L	455 and 1156 mg/L
§ Recognition thresholds 2670-4790 mg/L	
KCl	(AWRI 2012)
§ White and red wine:	750 and 1156 mg/L

Chloride levels in wine

The Australian Wine Research Institute

(Kauffman, 1996)



Chloride distribution in wine

The Australian Wine Research Institute

- Six red wines, multiple regions

Low / Med / High chloride
No / Low / High sodium
Med / High potassium

Wine	Cl^- mg/L	Na^+ mg/L	K^+ mg/L	Cl^- as NaCl mg/L	Na^+ as NaCl mg/L	Max % Cl^- bound to Na mg/L
08 PN	115	20	542	190	51	27
08 CAB	91	0	1004	150	0	0
08 GSM	789	151	1186	1301	384	30
08 SHZ	728	164	1121	1200	417	55
07 SHZ	291	104	1539	480	264	96
07 SHZ	279	174	539	460	442	35

Salt levels from juice to wine

The Australian Wine Research Institute

- Walker 2010
  - Salt levels in white juice = salt levels in white wine
    - Critical juice level =607 mg/L
  - Salt levels in red juice = 1.7 x salt levels in red wine
    - Critical juice level =356 mg/L

Legal and tolerance levels for salt

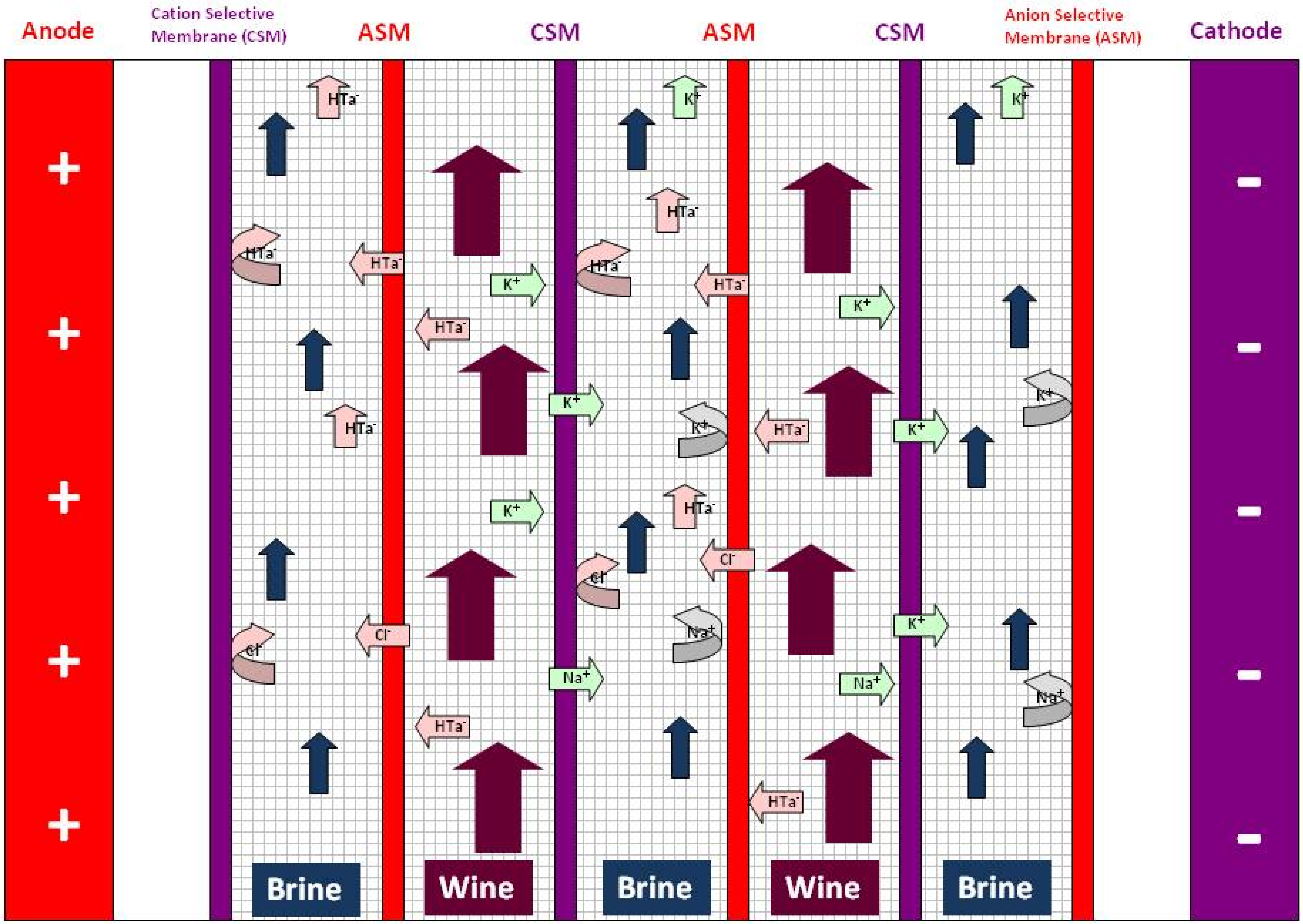
The Australian Wine Research Institute

Country	Tolerance
Argentina	Chloride (expressed as sodium chloride) - 600 mg/L
Australia (wine produced in Australia)	Chloride (expressed as sodium chloride) - 1 g/L 1000 mg/L Chloride ion equivalent 607 mg/L of Cl^- Chloride ion in white juice 607 mg/L of Cl^- Chloride ion in red juice 356 mg/L of Cl^-
Canada — Ontario	Sodium - 500 mg/L
Canada — Quebec	Sodium - 500 mg/L
South Africa	Sodium - 100 mg/L
Switzerland	Sodium - 60 mg/kg
Lebanon	Sodium (expressed as sodium chloride) - 500 mg/L

Salt management options in winery

The Australian Wine Research Institute

- Blending options
- Setting maximum chloride levels for incoming fruit/juice
- Decreased skin contact time with red ferments
- Electrodialysis

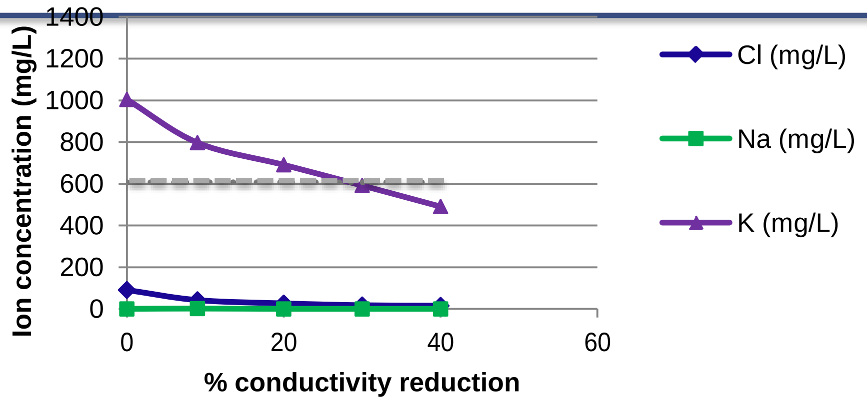


Anode
Cation Selective Membrane (CSM)
ASM
CSM
ASM
CSM
Anion Selective Membrane (ASM)
Cathode
+
-
HTa-
K+
Cl-
Na+
Brine
Wine
Brine
Wine
Brine

Effective in reducing [Cl], [Na] & [K]

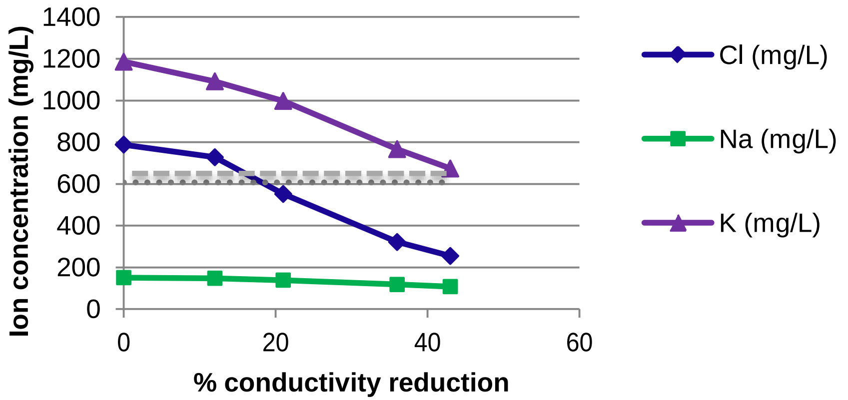
The Australian Wine Research Institute

Cabernet Sauvignon

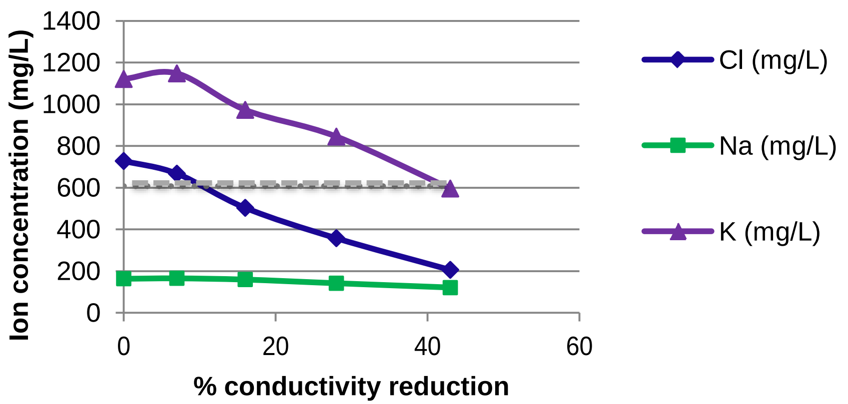


Maximum allowed chloride concentration

Grenache Shiraz blend



Shiraz



ED will reduce other salts

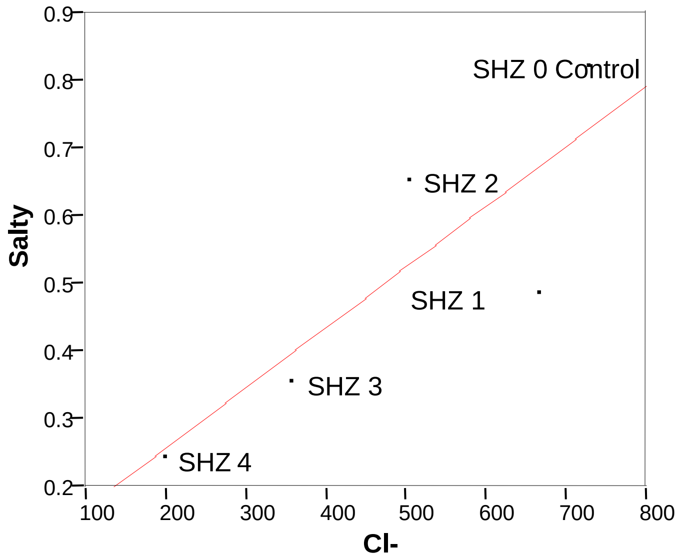
The Australian Wine Research Institute

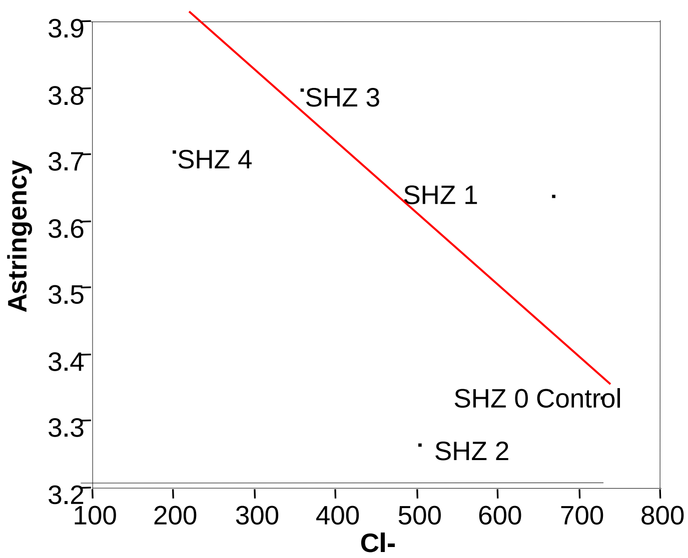
2008 Shiraz

	Cl as NaCl (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Cu (mg/L)	Fe (mg/L)	S04 (mg/L)	PO4 (mg/L)	pH	TA (g/L)
Control	1200	164	1121	46	0.3	1.3	600	780	3.55	6.4
40%	340	121	596	26	0.3	0.9	530	640	3.44	6.1
Δ	**860**	**43**	**525**	**20**	**0**	**0.4**	**70**	**140**	**0.11**	0.3

- 40% reduction in conductivity is excessive; common is 20%
- Non- selective - reduction in other cations and anions will occur
- No reduction in quality, but may impact on wine style

Saltiness and astringency



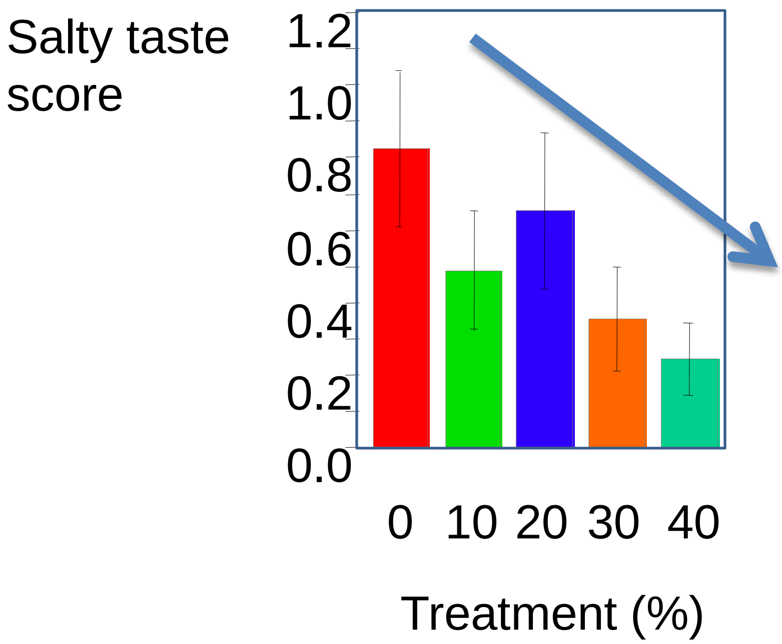


2008 Shiraz >1200 mg/L NaCl

- Linear sensory relationship for Salty
- Mean Salt taste levels <1.0 out of 9.0
- More salt, less astringency
- No ‘perceived sensory difference’ between
  control (1200 mg/L) and 20% reduced sample (830 mg/L)

Shiraz - Mean values for salty taste

The Australian Wine Research Institute



Decrease salty taste rating with increased ED treatment

Take home messages

The Australian Wine Research Institute

- Measured as Chloride ion, but expressed as Sodium Chloride
- Some countries have specifications for sodium also
- Chloride levels in juice = chloride levels in white wine
  = 1.7x chloride levels in red wine
- Some salt needed for sensory balance
  - Sodium and potassium chloride ions involved
  - Sweet spot
  - Adaptation
- Management options include grape intake maximum levels, blending or electrodialysis removal

Acknowledgements

The Australian Wine Research Institute

- AWRI
  - Sensory team: Leigh Francis, Brooke Travis, Patricia Osidacz
  - IDS: Mardi Longbottom, Geoff Cowey
- Water and Vine Series: Tapas Biswas, John Bourne, Mike McCarthy and Pichu Rengasamy
- CSIRO
  - Dr Rob Walker and team
- Memstar Australia
  - David Wollan, Roger Mills
- Australian wine sector partners

gwrdc
GRAPE AND WINE RESEARCH AND DEVELOPMENT CORPORATION

The Australian Wine Research Institute, a member of the Wine Innovation Cluster in Adelaide, is supported by Australia's grapegrowers and winemakers through their investment body, the Grape and Wine Research Development Corporation, with matching funds from the Australian government.

A W R I

The Australian Wine Research Institute

Smoke taint

Smoke taint team:
Dr Yoji Hayasaka, Gayle Baldock, Mango Parker, Patricia Osidacz, Dr David Jeffery, Dr Jason Geue, Dr James Kennedy, Adrian Coulter, Con Simos, Dr Cory Black, Kevin Pardon, Dr Leigh Francis, Dr Markus Herderich

Major smoke events

The Australian Wine Research Institute

- **2003**
- **2006/2007**
- **2009**
- **2013**

Bushfires, Controlled Burns & Smoke Taint in Wine

- Loss of grapes/wine: 40% of Victorian production affected in 2009
- Legal disputes
- Potential losses
  - unnecessary harvesting
  - dropping of clean grapes
  - wine loss, production & testing costs
  - brand damage, shelf space lost

Smoke marker compounds

- Guaiacol and methylguaiacol
  - Major components of smoke formed by burning wood
  - During 2003-2008, these were successful markers for smoke taint exposure in grapes
  - High concentrations in smoke affected grape samples (70-300mg/kg)
  - Other off-flavour compounds present?
  - Limited use as markers in wine
  - Guaiacol (10-100µg/L) and methylguaiacol (1-20µg/L) also come from oak

The 2009 Experience

- In **grapes** from Victoria guaiacol was often low
- "My grapes had no guaiacol but after alcoholic fermentation I could smell smoke in the wine"
- "My wine seemed ok until it finished Malo then it tasted like I licked an ashtray"
- 95% of 700 grape samples sent to AWRI for guaiacol analysis in 2009 had below 5 µg/kg
- Need for robust measures to detect smoke exposure

Key AWRI research objective

The Australian Wine
Research Institute

- Develop assays for the measurement of smoke exposure in grapes prior to winemaking
- This will enable winemakers to make critical decisions early (when to harvest, whether to purchase grapes or bulk wine etc)
- It will also allow winemakers to quantify the effect of different amelioration process to reduce the taint

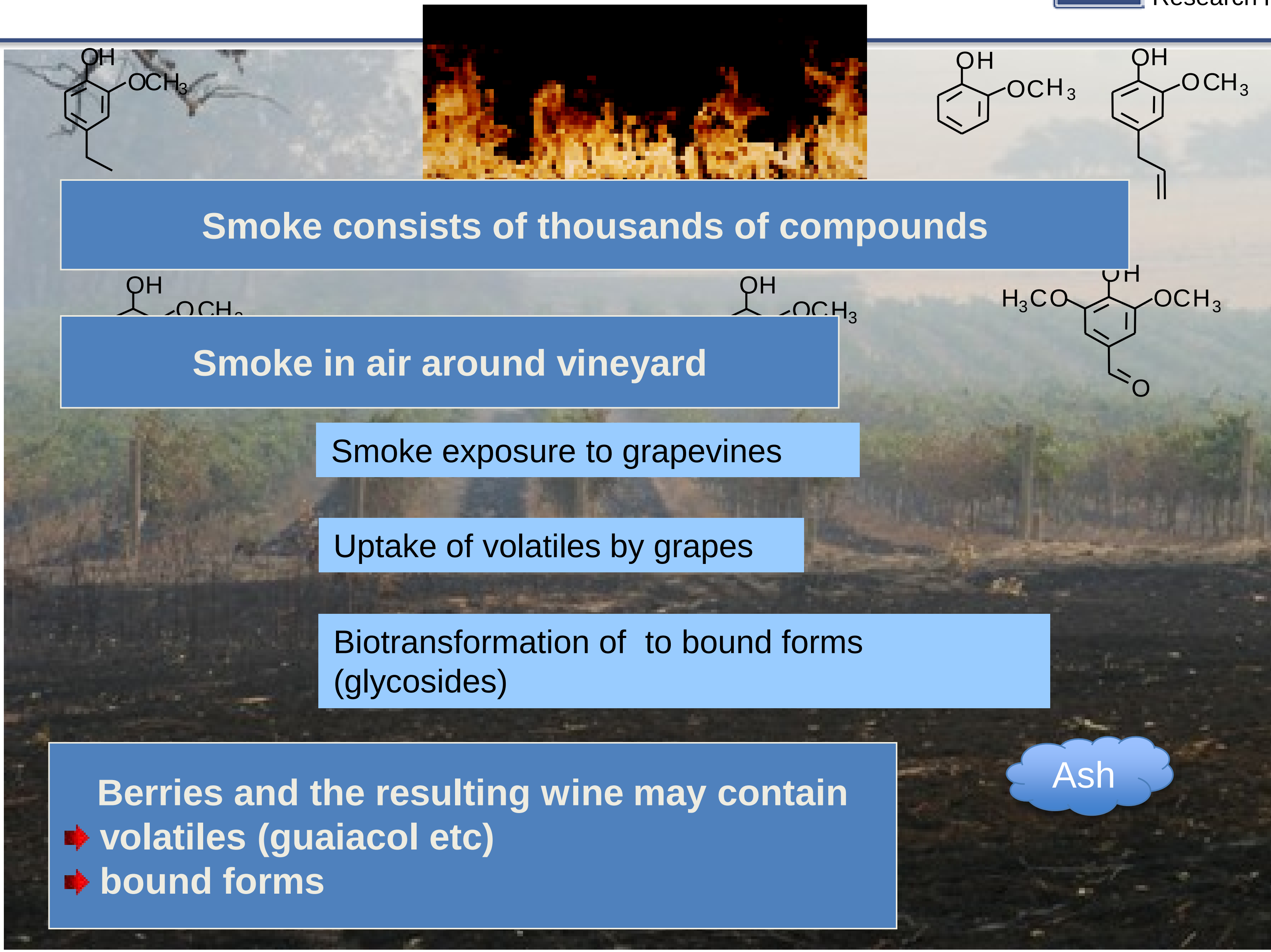
Yarra Valley vineyard 2009 (Photo supplied by Chris Bevin from Constellation Wines Australia)

Controlled burn – air sampling

The Australian Wine Research Institute

Fires, smoke and grapes

The Australian Wine
Research Institute



Smoke consists of thousands of compounds

Smoke in air around vineyard

Smoke exposure to grapevines

Uptake of volatiles by grapes

Biotransformation of to bound forms
(glycosides)

Berries and the resulting wine may contain
- **volatiles (guaiacol etc)**
- **bound forms**

Ash

New Measurements

The Australian Wine Research Institute

- We identified over 50 compounds in smoke exposed samples, and to cut a long story short:

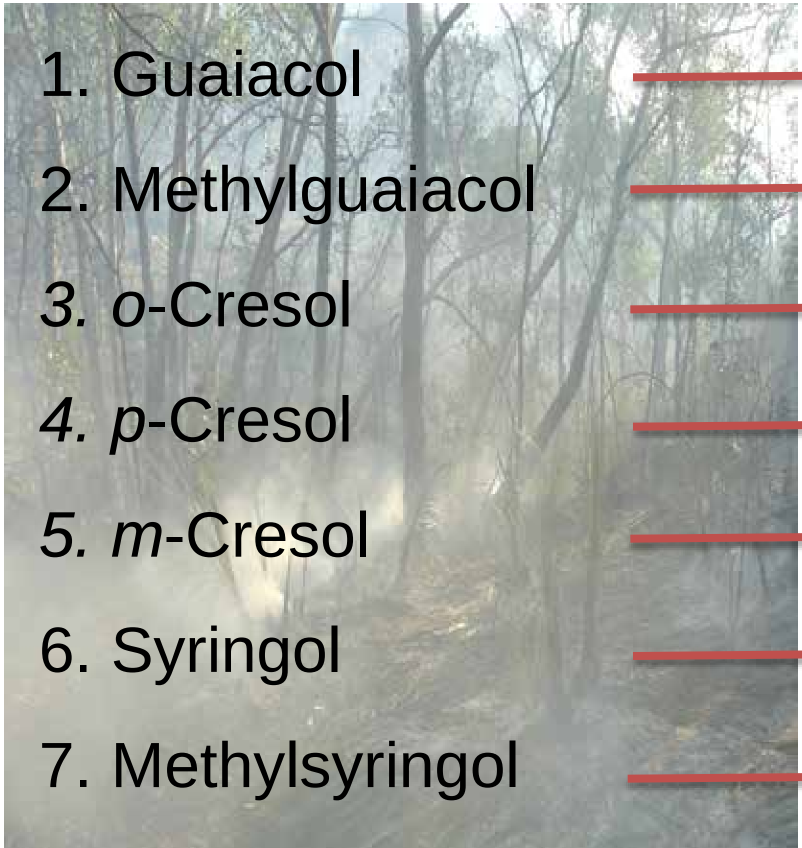
- New analysis of ‘free’ volatile smoke compounds
- New analysis of ‘bound’ smoke compounds

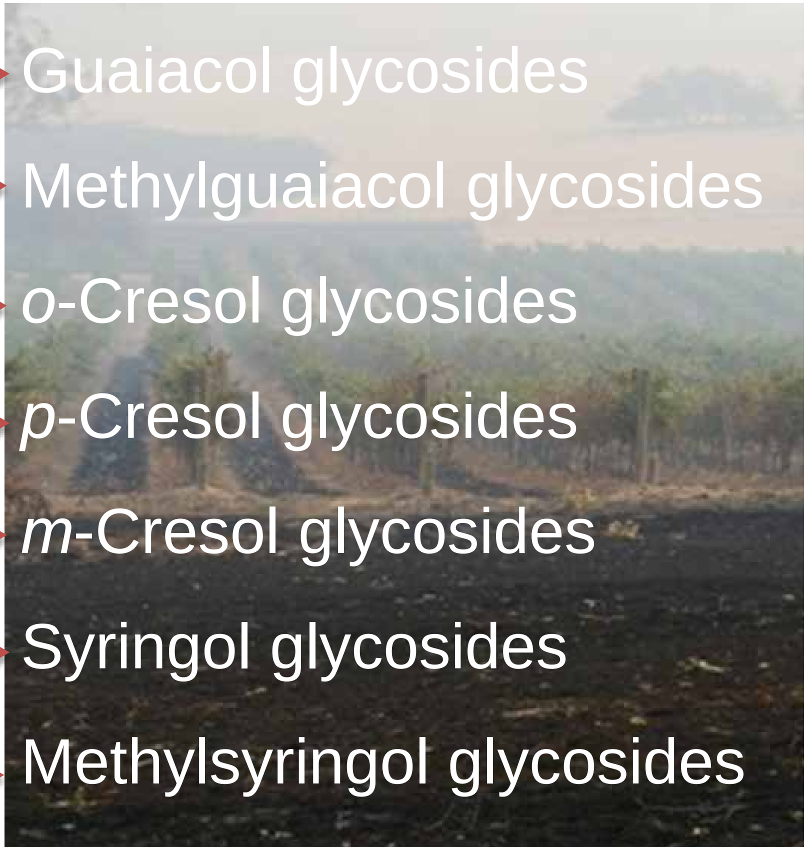
Smoke compounds

The Australian Wine Research Institute

The volatile phenols are taken up by the grapevine and glycosylated to give the corresponding glycosides

Volatile phenols → Glycosides





1. Guaiacol → Guaiacol glycosides
2. Methylguaiacol → Methylguaiacol glycosides
3. *o*-Cresol → *o*-Cresol glycosides
4. *p*-Cresol → *p*-Cresol glycosides
5. *m*-Cresol → *m*-Cresol glycosides
6. Syringol → Syringol glycosides
7. Methylsyringol → Methylsyringol glycosides

Background levels

The Australian Wine
Research Institute

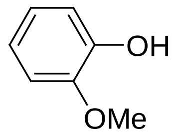
- 2010/2011 – survey of background levels
- Variety dependent
- Glycosides much higher than volatiles

Note:

- Glycosides hydrolyse back to volatile forms
  - During fermentation (enzyme hydrolysis)
  - During storage (acid hydrolysis)

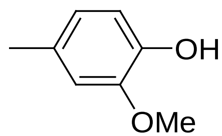
Volatile phenols

Guaiacol



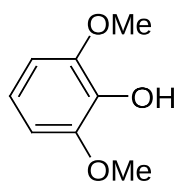
'smoky', 'sweet smoke', 'smoky bacon'

4-Methylguaiacol



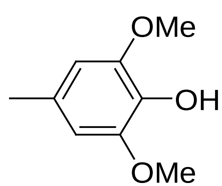
'smoky', 'spicy'

Syringol



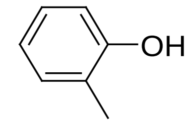
'smoky', 'charry'
(Weaker odorant)

4-Methylsyringol



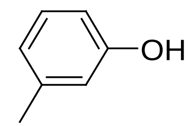
'smoky', 'charry'
(Weaker odorant)

o-Cresol



'phenol', 'plastic'

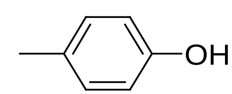
m-Cresol



'smoky, phenolic', 'smoky bandaid', 'faecal, plastic'

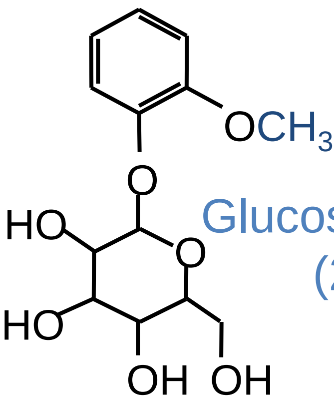
p-Cresol

'faecal, horse stable-like', 'medicinal'

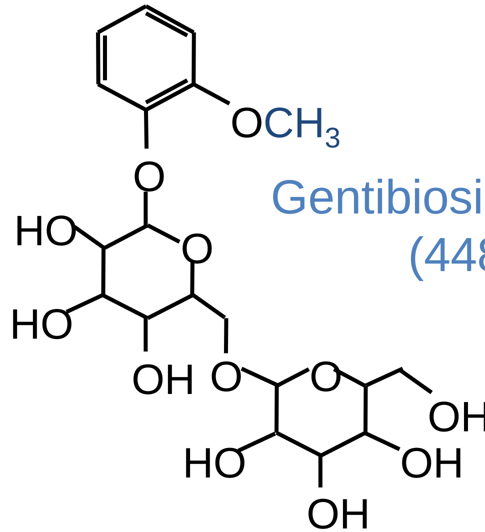


Seven bound forms of guaiacol (glycosides)

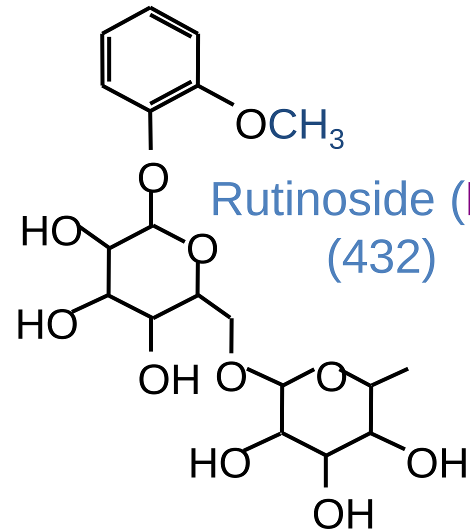
The Australian Wine Research Institute



Glucoside (**MG**)
(286)

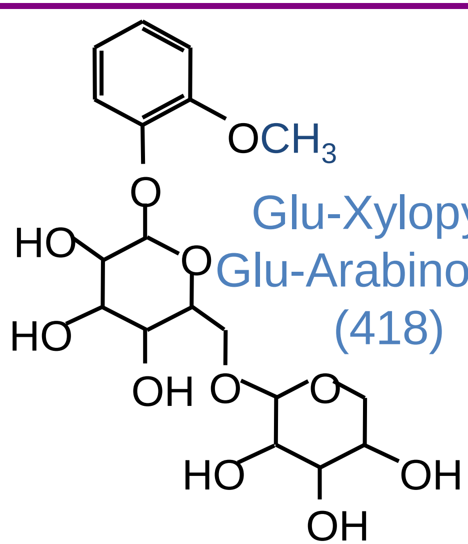


Gentibioside (**GG**)
(448)

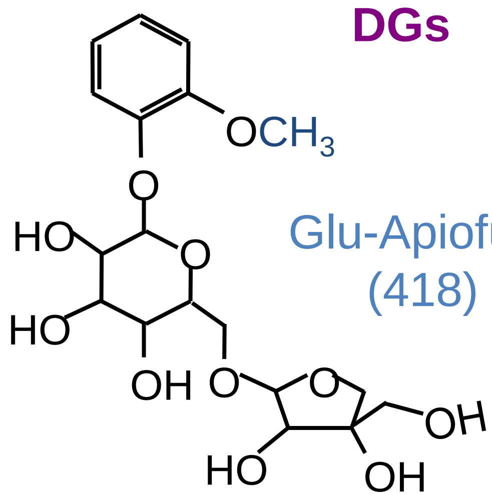


Rutinoside (**RG**)
(432)

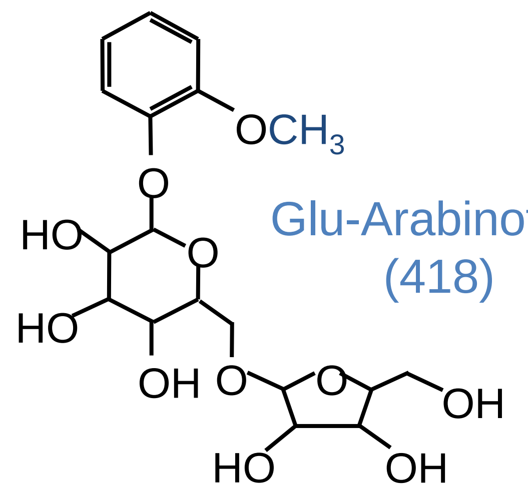
DGs



Glu-Xylopyra
Glu-Arabinopyra
(418)



Glu-Apiofura
(418)



Glu-Arabinofura
(418)

Sensory thresholds

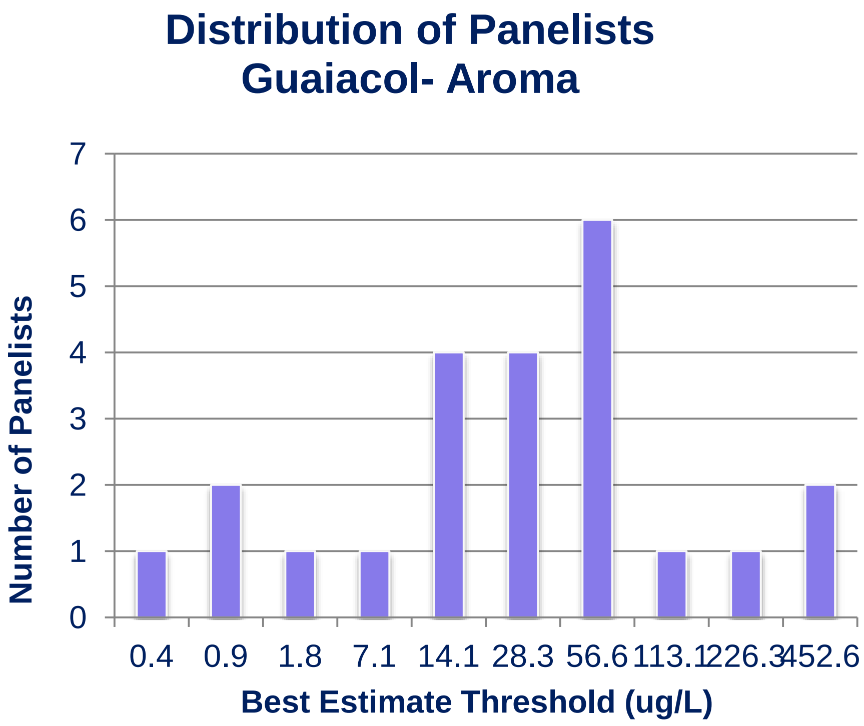
The Australian Wine Research Institute

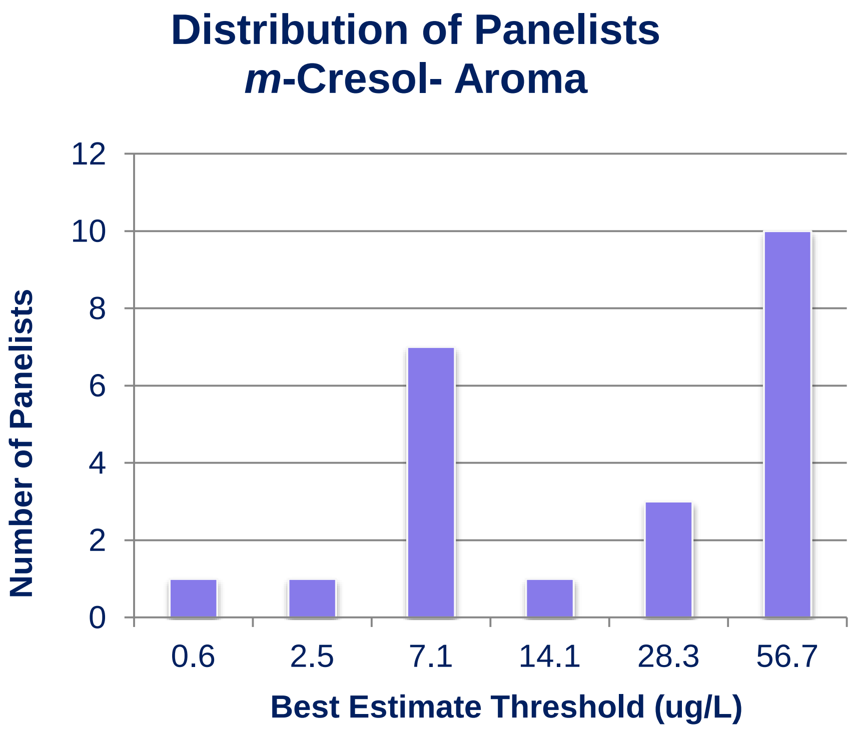
- in commercial neutral Merlot wine

Compound	Threshold
Guaiacol aroma	23 µg/L
Guaiacol taste	27 µg/L
m-Cresol aroma	20 µg/L
o-Cresol aroma	62 µg/L
p-Cresol aroma	64 µg/L

Thresholds vary across tasters

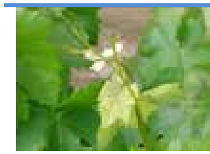
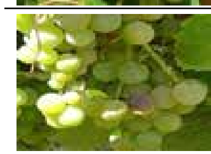
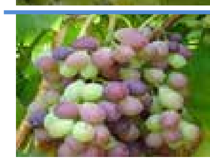
The Australian Wine Research Institute





Key periods of grapevine sensitivity

The Australian Wine Research Institute

Period		Grapevine growth stage	Potential for smoke uptake
Period 1		Shoots 10 cm in length	Low
		Flowering	
Period 2		Berries pea size	Variable (low to medium)
		Beginning of bunch closure	
		Onset of veraison to 3 days post veraison	
Period 3	 	From 7 days post veraison to Harvest	High

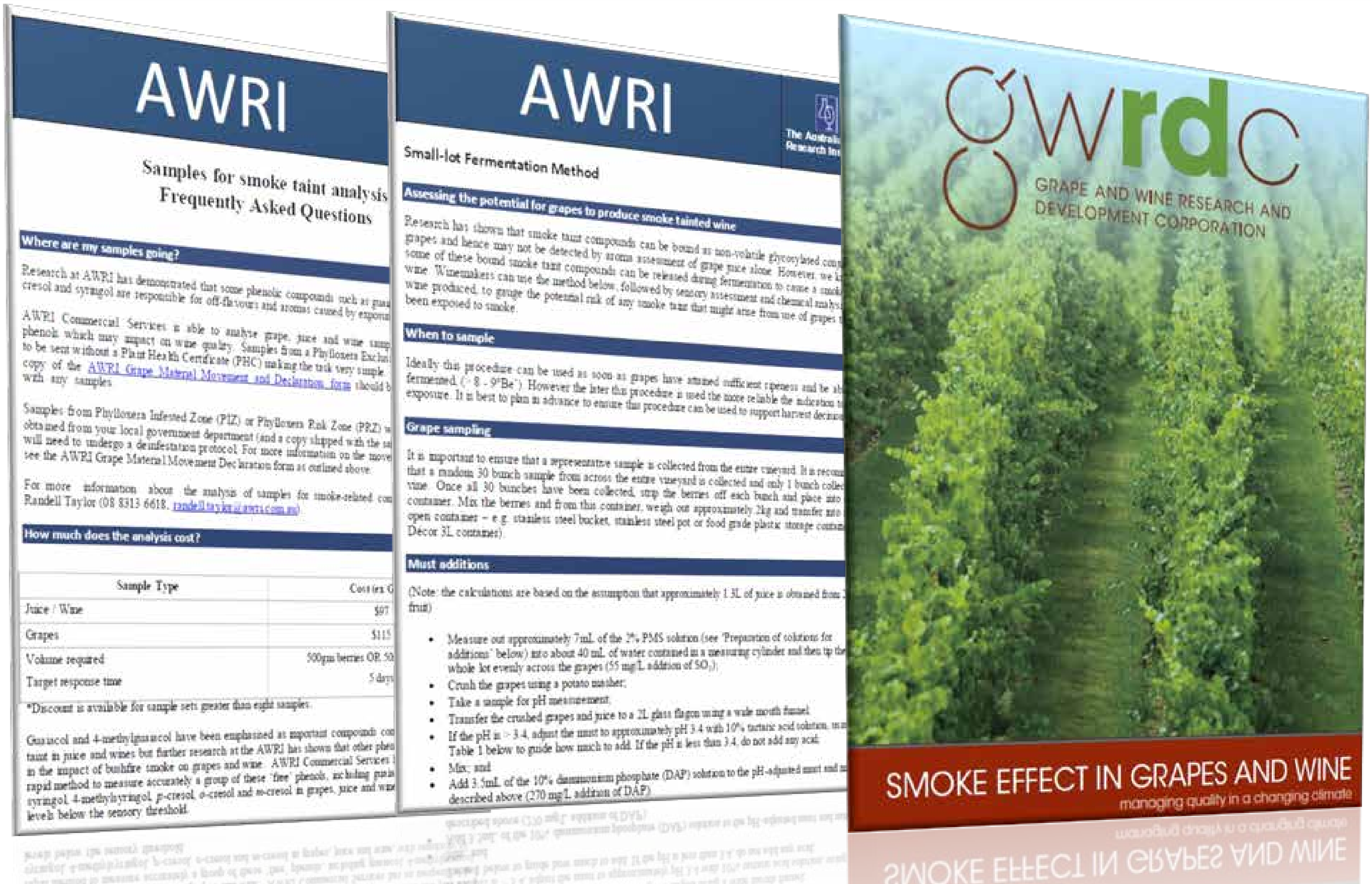
Kennison K.R., Wilkinson, K.L., Pollnitz, A.P., Williams, H.G. and Gibberd, M.R. (**2011**). Effect of smoke application to field-grown Merlot grapevines at key phenological growth stages on wine sensory and chemical properties. Australian Journal of Grape and Wine Research 17(2), S5-S12.

Critical time:7days post-veraison ® Harvest

- Repeated or prolonged exposure can potentially have a cumulative negative effect on resultant wine quality.
- Best time for testing grapes: as close to harvest date as possible (2 weeks before planned date)
- Vineyard sampling plan important
- Sending samples intersate
- Sensory - laboratory-scale ferments (‘bucket ferments’)

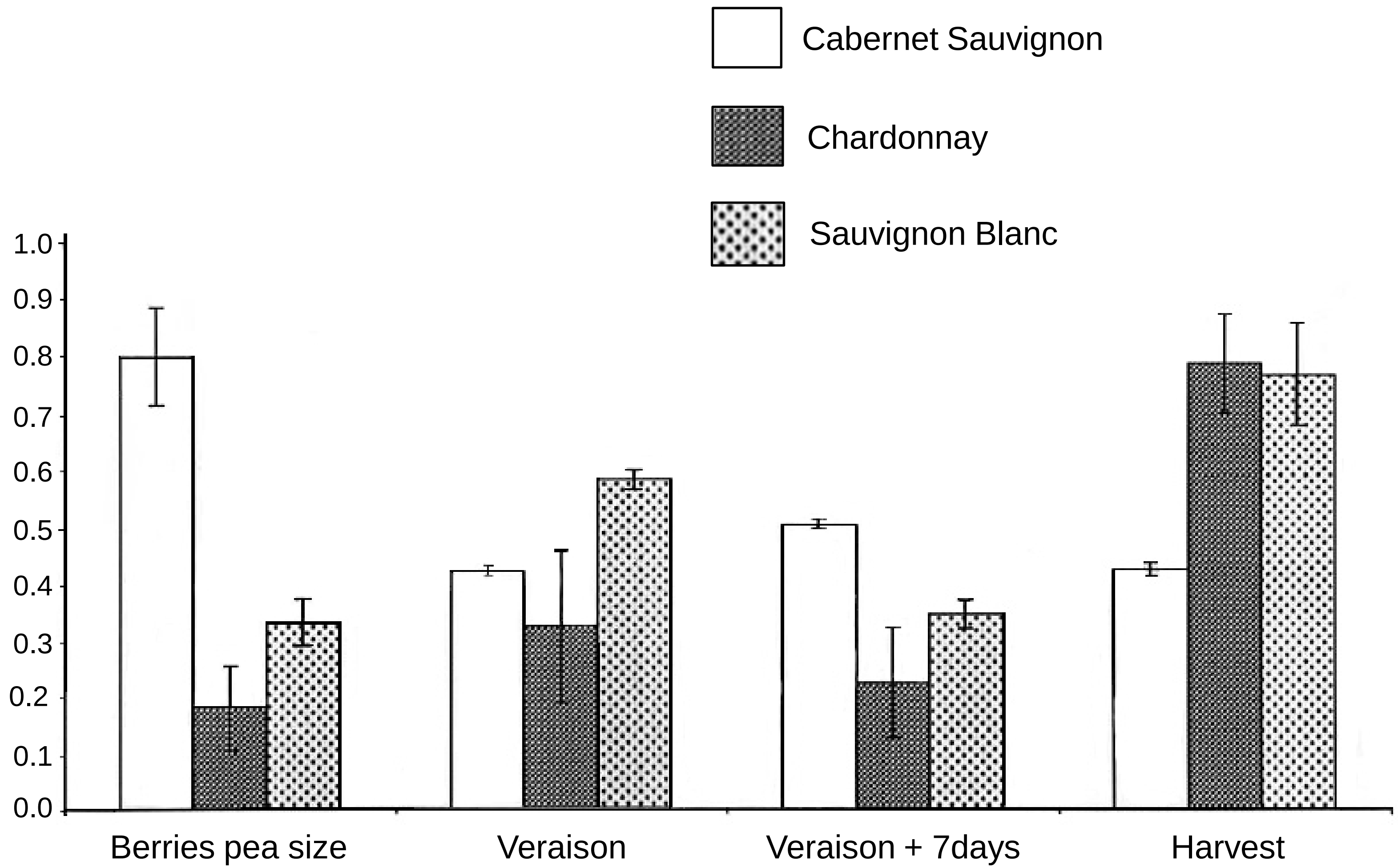
Details: AWRI & GWRDC websites

The Australian Wine Research Institute



Smoke taint risk probability

The Australian Wine Research Institute



Ref: DAF WA

Ameliorating smoke taint

The Australian Wine Research Institute

Technique	Details
Hand harvest fruit	Minimise breaking or rupturing of the skins as long as possible[1,2]
Exclude leaf material	Grapevine leaf material can contribute smoke related characteristics when in contact with fruit and juice[1,2]
Keep fruit cool	Fruit processed at 10ºC had less extraction of smoke-related compounds compared to fruit processed at 25ºC[1,2]
Whole bunch press	Has been shown to reduce the extraction of smoke derived compounds in whites[1,3]

Refs: [1]Simos 2008, [2]Whiting and Krstic 2007, [3]Ulrich 2009

Ameliorating smoke taint

The Australian Wine Research Institute

Technique	Details
Separate press fractions	Smoke characters could be minimised in the first 400L/t when combined with fruit cooling; free-run juice can contain less smoke characters[1,2,3]
Consider addition of oak chips and tannin	Have been found to reduce intensity of smoke effect through increased wine complexity[4]
Reverse osmosis of wine	Has been found to be effective in smoke effect reduction however smoke-related characteristics found to return in the wine over time[5]
Market wine for immediate consumption	Evolution of smoke related characteristics can occur in bottle over time as wine ages therefore early consumption is recommended[1,3,5]

Refs: [1]Simos 2008, [2]Whiting and Krstic 2007, [3]Ulrich 2009, [4]Ristic 2011, [5]Fudge et al 2011.

Tasting: smoke taint compound spikes

The Australian Wine Research Institute

- Bottled wine spiked with compounds
- Aroma only (but can taste if you want to)
- First glass is control (no spike)

Tasting: smoke taint compound spikes

The Australian Wine Research Institute

Wine 1

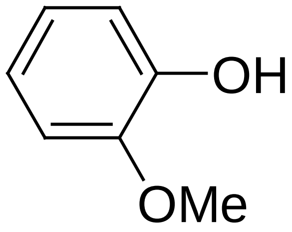
Base wine control:

2012 Pinot Noir

Wine 2

The Australian Wine
Research Institute

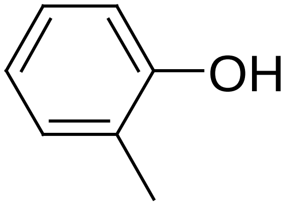
Guaiacol at 50µg/L



- Chemical name: 2-methoxyphenol
- Aroma threshold = 23µg/L in red wine
- Taste threshold= 27µg/L in red wine
- ‘Smoky’, ‘sweet smoke’, ‘smoky bacon’
- Can come from oak (up to 100µg/L)

Wine 3

o-cresol at 150µg/L

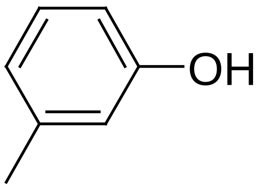


- Chemical name: (2-methylphenol)
- Aroma threshold = 62µg/L in red wine
- 'phenol'
- Can come from oak (low concentrations)

Wine 4

The Australian Wine Research Institute

m-cresol at 100µg/L

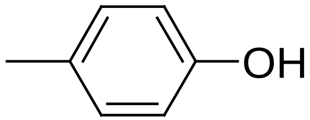


- Chemical name: 3-methylphenol
- Aroma threshold = 19µg/L in red wine
- ‘smoky, phenolic’ ‘smoky bandaid’, ‘faecal, plastic’
- Low concentrations can come from oak

Wine 5

The Australian Wine Research Institute

p-cresol at 150µg/L

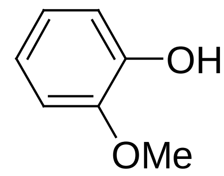


- Chemical name: 4-methylphenol
- Aroma threshold = 64µg/L in red wine
- 'faecal, horse stable-like', 'medicinal', 'medicine, phenol, smoke'
- Low concentrations from oak

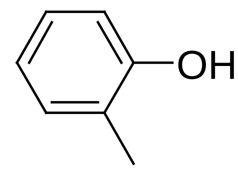
Wine 6

Mixture:

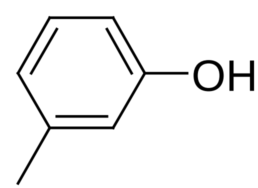
Guaiacol: 25 µg/L



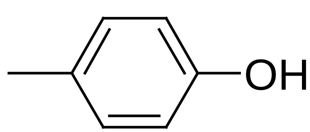
o-cresol: 15 µg/L



m-cresol: 10 µg/L



p-cresol: 15 µg/L



Further information

The Australian Wine Research Institute

- AWRI website – references
  http://www.awri.com.au/industry_support/winemaking_resources/smoke-taint-information-and-ordering-page/
- AWRI website – general information:
  http://www.awri.com.au/information_services/current-topics/smoke-taint/
- GWRDC website - Factsheets & other resources:
  http://www.gwrdc.com.au/resource_categories/smoke-taint/

Growing grapes in wet seasons

The Australian Wine Research Institute

Photo: Jan O'Connor

What's in the future?

Ø increased incidence of high intensity rainfall events

→ increased risk of berry splitting
→ increased risk of bunch rot
→ increased risk of flooding

Ø higher temperatures
→ increased risk of some non-Botrytis bunch rots

Bunch rots: know your enemy

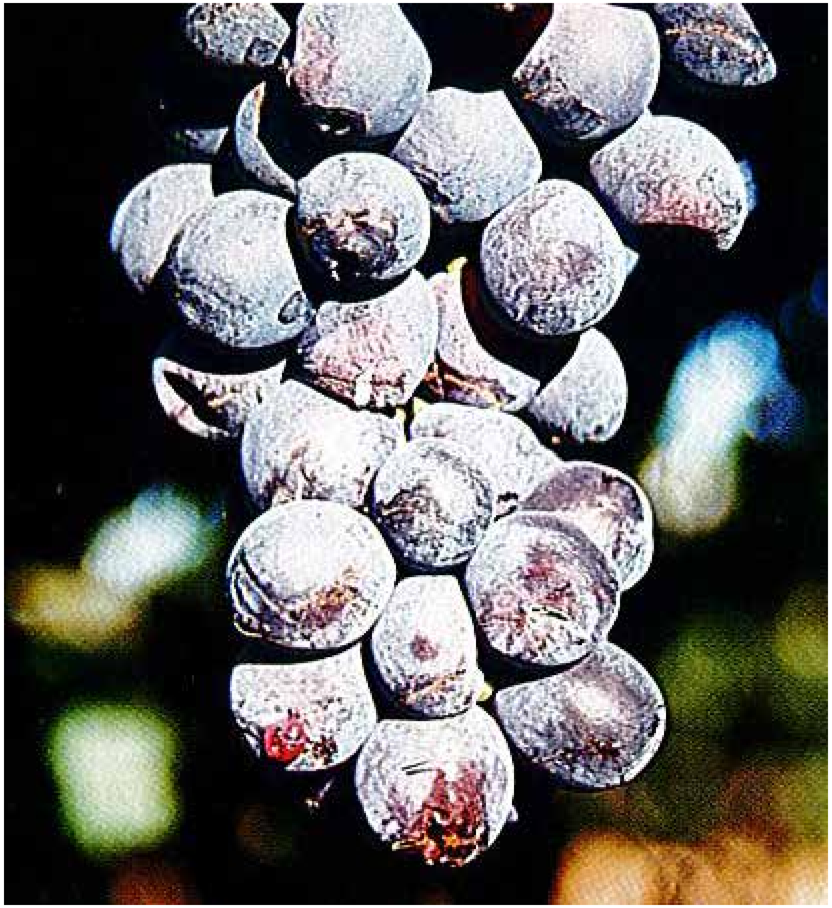
The Australian Wine Research Institute

- ***Botrytis***
- other bunch rot-causing fungi e.g.
  - *Alternaria*
  - *Aspergillus* (black mould)
  - *Cladosporium* (sour rot)
  - *Colletotrichum* (ripe rot)
  - *Greeneria* (bitter rot)
  - *Penicillium* (blue mould)
  - *Rhizopus* (sour rot)
  - Sooty mould (grows on mealybug honeydew)

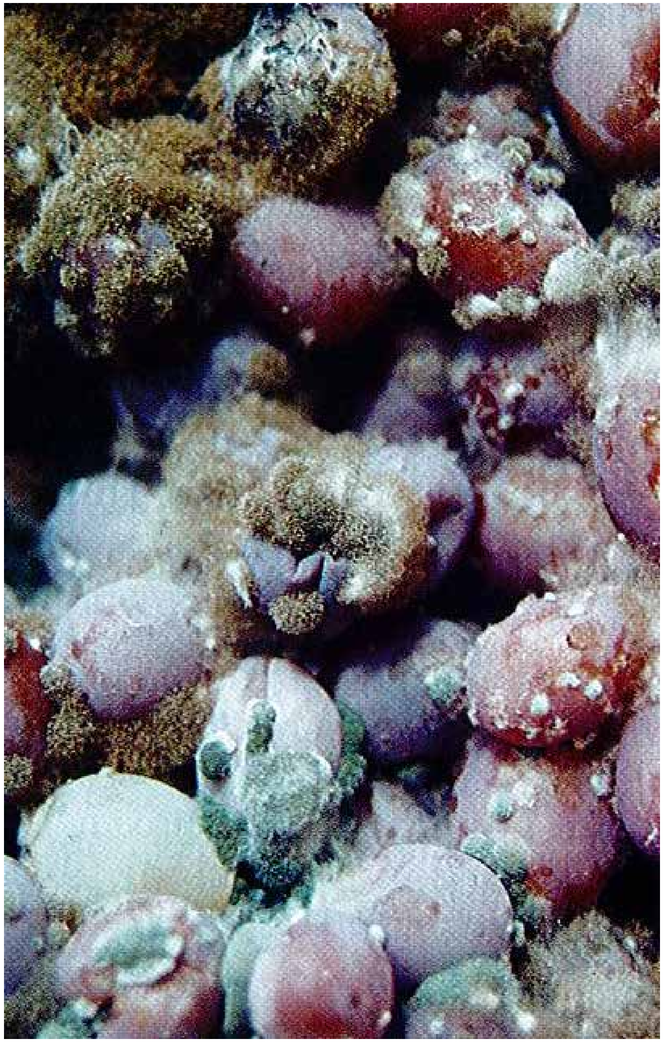
Bunch rot fungi

The Australian Wine Research Institute

Sour rot



Penicillium + Botrytis



Source: Nicholas et al. (1994)

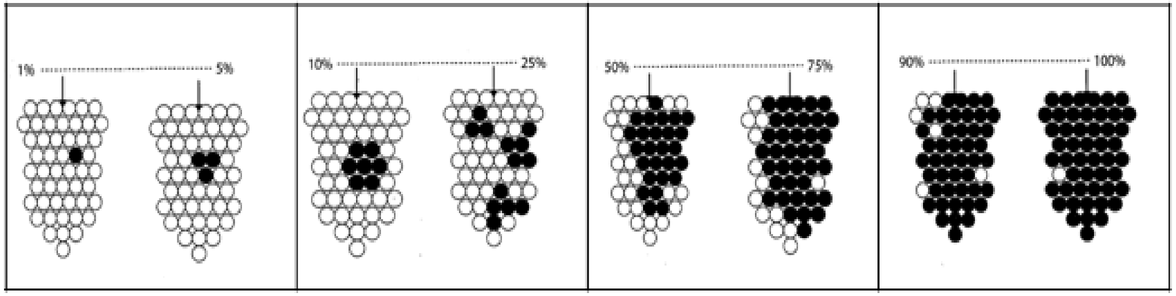
Botrytis assessment

The Australian Wine Research Institute

- **Incidence** relates to the number of bunches with the presence or absence of symptoms

- **Severity** relates to the percentage of the bunch infected.

  Wineries typically evaluate severity (% infected).



Source: R. Emmett

Rejection levels on fruit with Botrytis will vary from winery to winery and variety to variety - 3-5% is the limit that is widely used.

Bunch rot fungi

- **Chemical control** mainly applies to Botrytis
  - need to ensure that Botrytis is the problem before using fungicides

- **Non-chemical control** methods for Botrytis **also apply to non-Botrytis fungi**
  - so will focus on Botrytis in this presentation

Botrytis bunch rot: how does it develop?

The Australian Wine Research Institute

Botrytis spores

+ Favourable environmental conditions

+ Susceptible fruit

Photo: David Braybrook

Botrytis spores

The Australian Wine Research Institute

- A common environmental fungus
- High spore numbers in wet weather
- Carryover from previous season
- Spread by wind, insects …

Photo: Rob Beresford

Favourable environmental conditions

The Australian Wine Research Institute

For development and spread

- Free water → infection
- High humidity → spore production
- Mild temperatures (optimum temp: 18 - 21ºC)

Weather x dense canopy x wet midrows x …

Susceptible fruit

The Australian Wine Research Institute

Flower infection in spring (latent)

Infection of ripening berry via injury

Infection of ripening berry directly (wet)

Botrytis bunch rot: how does it develop?

Infection of ripening berry directly

- Berry cuticle an effective barrier
- Wetness → spore germination and infection
- Natural openings
- Susceptible varieties – tight bunches, thin skins

Botrytis bunch rot: how does it develop?

Infection of ripening berry via injury

• Wetness not required

• Caused by other fungi (e.g. powdery mildew), insects (e.g. LBAM), bird peck etc

• Susceptible varieties

– thin skins split easily

– tight bunches → berry to berry contact

• **Invasion by other bunch rot fungi**

Control methods

The Australian Wine Research Institute

1. Opening up the canopy to produce well-exposed/well-aerated bunches

- Ø directly by various canopy management procedures
- Ø indirectly by control of shoot vigour

2. Loosen bunches
3. Choose right variety
4. Nitrogen nutrition
5. Reduce berry injury
6. Chemical control

Photo: P Dry

Canopy management

The Australian Wine Research Institute

Includes:

- Ø training systems
- Ø shoot thinning,
- Ø shoot trimming
- Ø leaf and lateral removal in the bunch zone

Photos: P Dry

Why is bunch looseness important?

The Australian Wine Research Institute

- Bunch architecture plays a major role in determining bunch rot incidence
- The looser the bunch, the greater the airflow and the lower the risk of berry-to-berry spread of the fungus
- Compact bunches have more chance of berries bursting
- Cuticle is also thinner where berries touch

How to make bunches looser?

The Australian Wine Research Institute

A. Choose the right clone

2 different clones of Pinot Noir

Photo: P Dry

How to make bunches looser?

The Australian Wine Research Institute

B. Retain more nodes at pruning

C. Removal of basal leaves before fruitset

D. Anti-transpirant foliar spray

(C and D: reduce fruit set)

E. Deficit irrigation strategies

F. Horizontal bunch cutting

Variety selection

- Some varieties are more tolerant of bunch rot infection than others
- due to either loose bunches
- or thick skinned berries that are less prone to splitting
- or a combination of both

Petit Manseng

N nutrition

- Plant tissues high in N are most susceptible to infection by Botrytis.

- Excessive N supply will result in increased shoot vigour and dense canopy.

- Carefully monitor vine N status by tissue analysis and avoid over-fertilization.

Reduce berry injury

The Australian Wine
Research Institute

- Reduce berry damage by controlling powdery, light brown apple moth and other pests

- Lift foliage wires with care

- Protect bunches from sunburn

Chemical control of Botrytis

The Australian Wine Research Institute

Timing of protective fungicides after flowering

- pre-bunch closure
  - a critical spray in many regions
- veraison
  - at high risk sites
  - before berries become increasingly susceptible
- pre-harvest
  - if Botrytis risk is high but severity is still low

Chemical control –
Pre-bunch closure

The Australian Wine Research Institute

- Switch – 60 days withholding period
- Captan – 30 days “
- Iprodione (Rovral) – 7 days “

Consult winery and follow resistance management guidelines

Chemical control – **Pre-harvest**

The Australian Wine Research Institute

- Iprodione (Rovral)
- Hydrogen peroxide + peroxyacetic acid – Peratec (suppression)
- Potassium metabisulphite (KMS) – discuss with your winery
- Eco-protector – potassium soap

Take home messages - Botrytis

The Australian Wine Research Institute

- Needs an integrated approach
- Don’t view Botrytis as unmanageable – all the little things make a difference!
- Don’t expect that any one activity will be enough
- Be pro-active in assessing incidence, severity and distribution of Botrytis
- Consider the influence of site, season and management factors on the potential infection and spread of Botrytis

Flooding

The Australian Wine Research Institute

Photo: R Muhlack

Flooding

The Australian Wine Research Institute

- Duration and timing of flood is importan
  - e.g. well drained soil + few days → minimal impact
- Waterlogged roots die

  - but flooded vineyards can return to production in following season
- Observations from 2011 season

  drain surface water to speed recovery

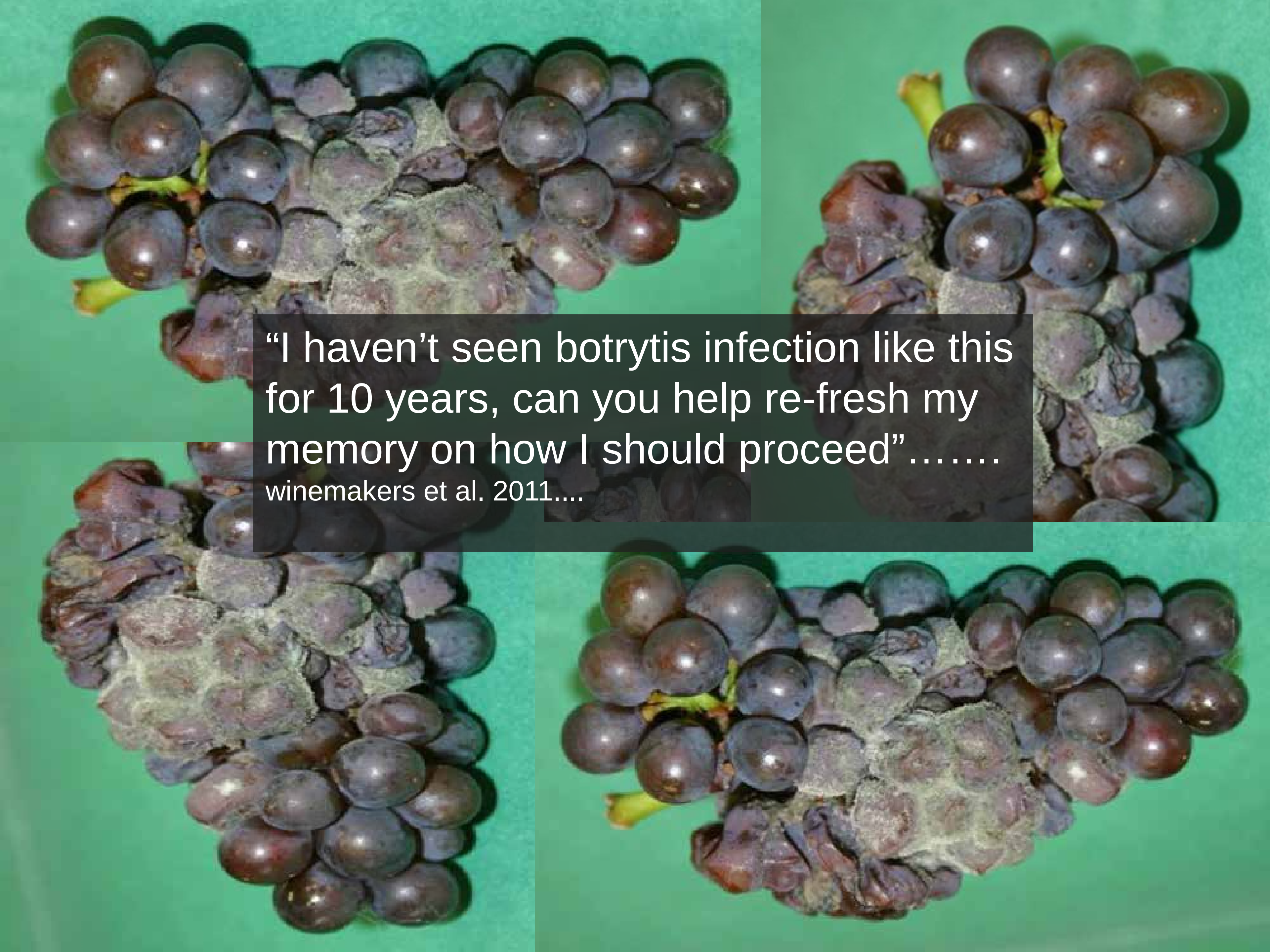
  may be reduced yield and increased vigour in following season

  possible leaching of nutrients and increased disease

Further information: http://www.gwrdc.com.au/?s=flood

Winemaking in wet seasons

St George QLD, January 2011


“I haven’t seen botrytis infection like this for 10 years, can you help re-fresh my memory on how I should proceed”…….
winemakers et al. 2011....

Learning's from this presentation

Botrytis – Winemaking implications

Laccase and browning

Information resources

Testing for laccase

Filterability issues with Botrytis

Toowoomba QLD, January 2011

Floods

The Australian Wine Research Institute

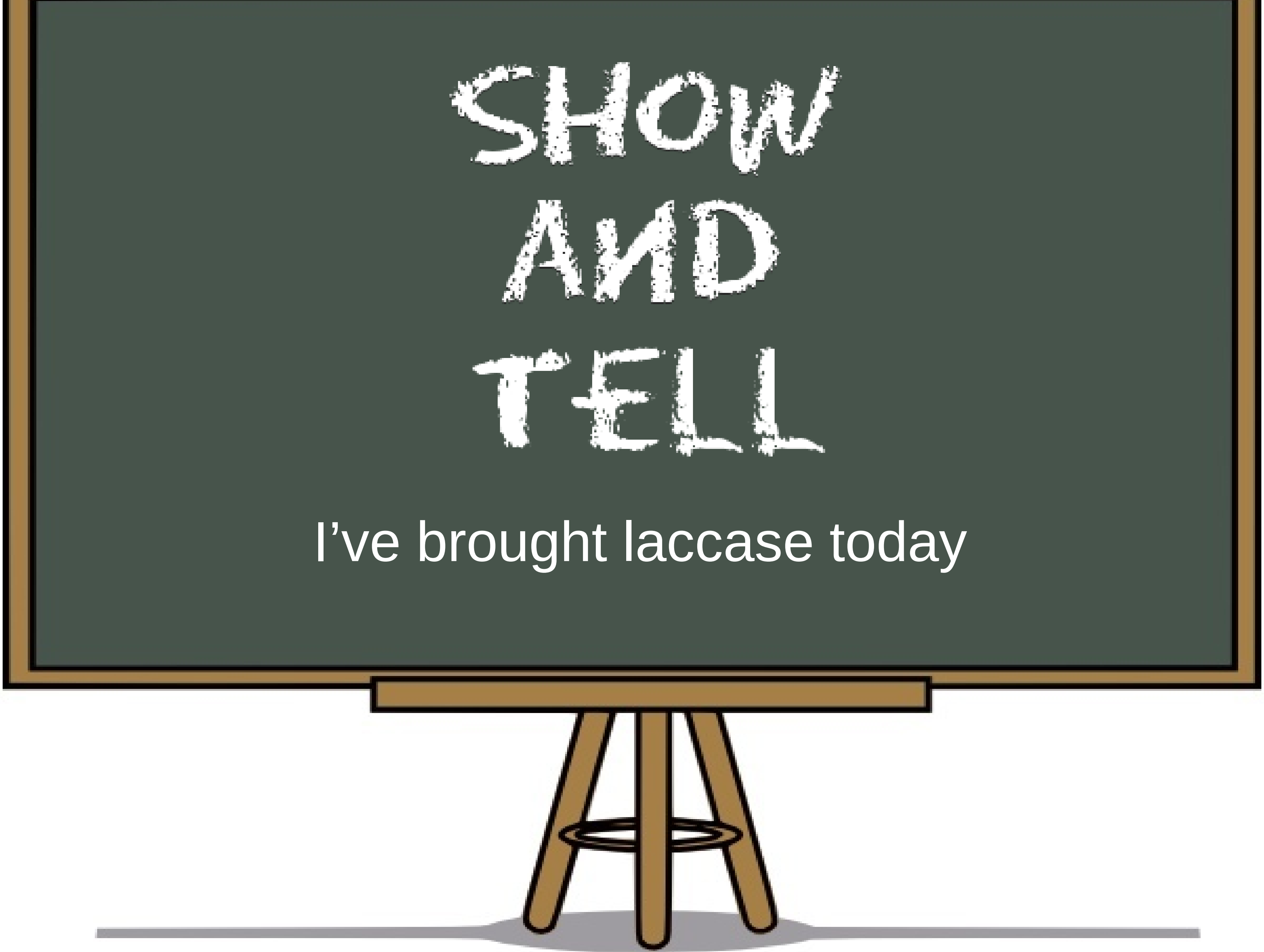
St George QLD, + many other areas in 2011- March 2010, January 2011, February 2012

NSW and Victoria - March 2012

Many areas of QLD - February 2013

Floods

- Pollution of vineyards
- Submerged vineyards
- Vines can be killed
- Submerged wineries
- Dry goods damaged
- Access to winery
- Can introduce TCA type contamination
- Follow on effects for following vintage
- Delayed ripening of some varieties… "This cool summer has put us about four weeks behind, which means we will run out of time to ripen our cabernet sauvignon," Ewen Mcpherson Symphony Hill 2011


SHOW
AND
TELL
I’ve brought laccase today

What is Laccase?

The Australian Wine Research Institute

Main issue associated with Botrytis

Laccase is an oxidative enzyme which comes from Botrytis

Differs from tyrosinase or polyphenoloxidase

Laccase cannot be controlled using SO_2, **BUT** SO_2 is still important

Testing for laccase activity is important

How potent is laccase?

The Australian Wine Research Institute

Demonstration - In this glass 5 mg/L of 'laccase' has been added, the other glass is a control. We will monitor these glasses during the afternoon to watch how quickly and how active the laccase enzyme is in the presence of oxygen.

Laccase added at: 9:00am today

Dealing with mouldy grapes

Biggest impact on reducing rot damage will be at harvest

Separate healthy fruit from infected bunches

Affected fruit should be hand separated before machine harvest

Hand sorting (& sorting tables) - discard juice from sorting table run-off

Winemaking impacts

In wet and humid seasons, added disease pressures will impact your winemaking:

- Yield losses
- Quality (depending on the impact/severity)

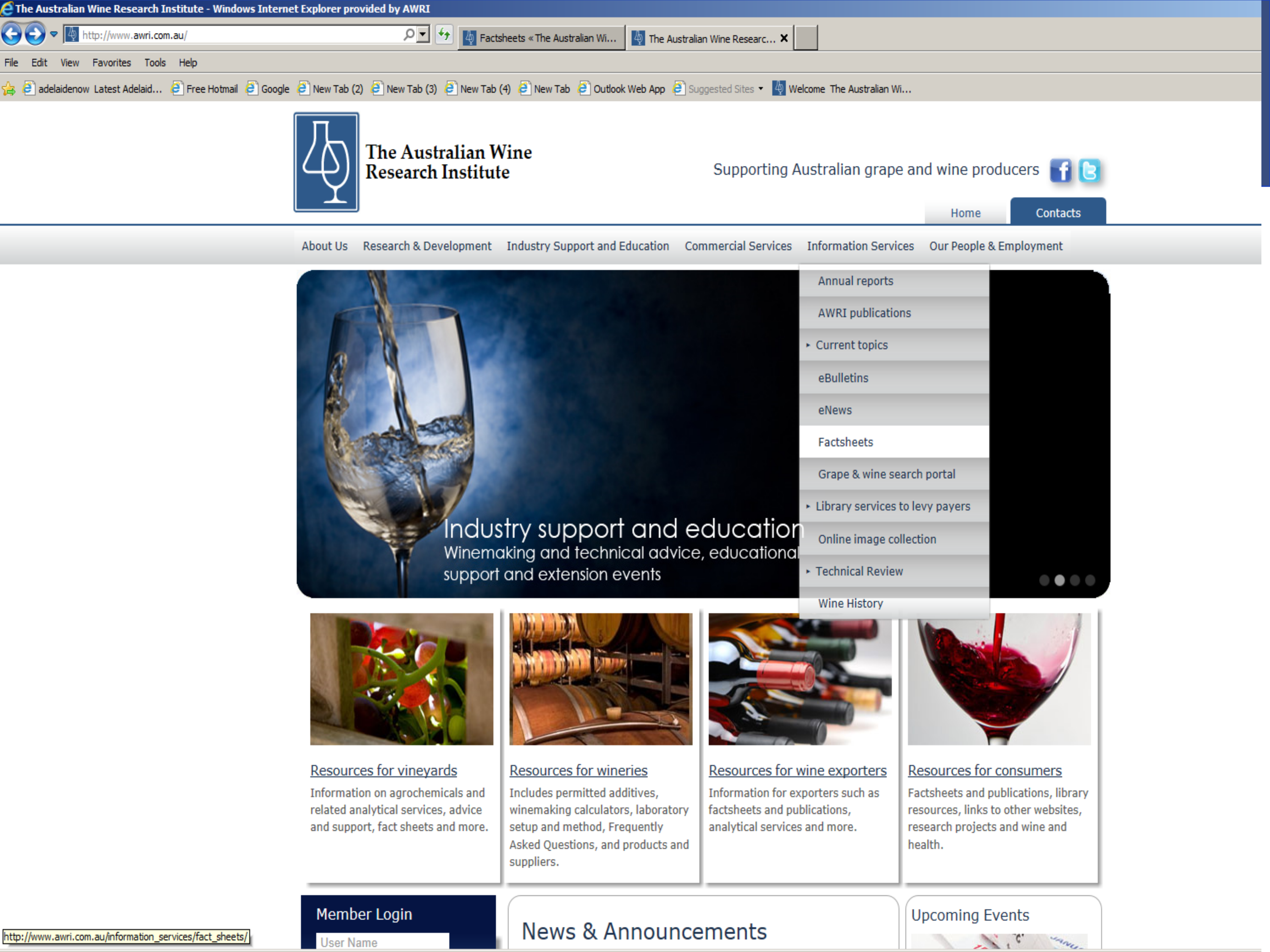
You will observe

- Changes in must composition
- Loss of primary fruit flavours
- Introduction of undesirable characters and taints
- Oxidative enzymes (browning & premature ageing)

- Create large populations of moulds, yeast and bacteria

Where can you get help from?

- Call AWRI's Winemaking and Extension Services
- Visit the AWRI website
  - eBulletin's, FAQ's
  - Factsheets
- Articles/presentations
- AWRI library
- ASVO proceedings



The Australian Wine Research Institute - Windows Internet Explorer provided by AWRI
http://www.awri.com.au/
Factsheets « The Australian Wi...
The Australian Wine Researc...
File Edit View Favorites Tools Help
adelaidenow Latest Adelaid... Free Hotmail Google New Tab (2) New Tab (3) New Tab (4) New Tab Outlook Web App Suggested Sites Welcome The Australian Wi...
The Australian Wine Research Institute
Supporting Australian grape and wine producers
Home
Contacts
About Us
Research & Development
Industry Support and Education
Commercial Services
Information Services
Our People & Employment
Annual reports
AWRI publications
Current topics
eBulletins
eNews
Factsheets
Grape & wine search portal
Library services to levy payers
Online image collection
Technical Review
Wine History
Industry support and education
Winemaking and technical advice, educational support and extension events
Resources for vineyards
Information on agrochemicals and related analytical services, advice and support, fact sheets and more.
Resources for wineries
Includes permitted additives, winemaking calculators, laboratory setup and method, Frequently Asked Questions, and products and suppliers.
Resources for wine exporters
Information for exporters such as factsheets and publications, analytical services and more.
Resources for consumers
Factsheets and publications, library resources, links to other websites, research projects and wine and health.
Member Login
User Name
News & Announcements
Upcoming Events
http://www.awri.com.au/information_services/fact_sheets/

http://www.awri.com.au/information_services/fact_sheets/ | Factsheets « The Australian Wi... | Factsheets « The Australian ...

File Edit View Favorites Tools Help

adelaidenow Latest Adelaid... | Free Hotmail | Google | New Tab (2) | New Tab (3) | New Tab (4) | New Tab | Outlook Web App | Suggested Sites | Welcome The Australian Wi...

The Australian Wine Research Institute

Supporting Australian grape and wine producers

Home | Contacts

About Us | Research & Development | Industry Support and Education | Commercial Services | Information Services | Our People & Employment

- Annual reports
- AWRI publications
- Current topics
- eBulletins
- eNews
- Factsheets
- Grape & wine search portal
- Library services to levy payers
- Online image collection
- Technical Review
- Wine History

Member Login

User Name

forgotten your password | sign up

Subscribe to eNews and eBulletins

Search The AWRI website

Information Services > Factsheets

Factsheets

The following Fact Sheets have been issued from the AWRI. For further information, contact the Communications Manager.

- Application of spectroscopy for non-destructive 'inbottle' measurement of wine composition and quality (pdf)
- Chemical control options for six spotted mite on Western Australian wine grapes (pdf)
- Eucalyptus character in wine (pdf)
- Extension activities (pdf)
- Identify cost savings with an Energy Audit (pdf)
- Improving refrigeration and heat transfer (pdf)
- Introducing BevScan – a new tool for non-destructive wine analysis and classification (pdf)
- In-bottle measurement of variable bottle oxidation (pdf)
- Managing botrytis infected fruit (pdf)
- Measuring red wine colour using the Modified Somers assay (pdf)
- Measuring tannins in grapes and red wine using the MCP (methyl cellulose precipitable) tannin assay (pdf)
- Measuring total anthocyanins (colour) in red grape berries (pdf)
- Near infrared spectroscopy in the Australian grape and wine sector (pdf)
- New calculator for conversion of dissolved oxygen (DO) to total package oxygen (TPO) fact sheet (pdf)
- Oxygen transmission rate of wine packaging (pdf)
- Quick facts – the AWRI (pdf)

http://www.awri.com.au/wp-content/uploads/managing_botrytis_infected_fruit_fact_sheet.pdf

Compositional changes

The Australian Wine Research Institute

	Clean	Botrytis	Sour Rot	
° Brix	18.5	21	16	↓ (Usually)
TA (g/L)	8.0	6.5	5.0	↓
Gluconic Acid (g/L)	0.5	1-5	>0.5	↑
Acetic Acid (g/L)	0	1.1	>1.5	↑
Glycerol (g/L)	trace	1-10	trace	↑
Ethanol (%)	0	0-trace	>0.2	↑
Laccase (µg/mL)	0-trace	0.1-8	trace - 0.5	↑
Glucan (mg/L)	0	247	65	↑

http://www.oardc.ohio-state.edu/grapeweb/OGEN/09252006/FruitRotWineStability.pdf

Important winemaking changes – sulfur dioxide

The Australian Wine Research Institute

More will be required to control the much larger populations of yeast and bacteria present

- Additions in picking bins will be higher
- Further adjustments at winery will be required

SO_2 consumption (binding) increases in diseased fruit due to presence of gluconic acid

Remember SO_2 **will not inhibit** laccase activity

SO_2 can interfere with laccase testing

Important winemaking changes – Pre-ferment treatment

Keep fruit and must as cool as possible

Whole bunch press whites (where possible)

More separate press fractions will be required.

Cold soaking is not advisable for reds

Reds require a quick commencement of primary fermentation with strong vigorous culture

Keeping processes **anaerobic** is very important

Important winemaking changes – Additional finings

The Australian Wine Research Institute

Whites will require fining (bentonite 0.5-1.0 g/L physically removes solids and takes laccase with it)

- cold settle, fined, racked x2 x3 or until juice is completely clean of mould character

Reds will benefit from tannin addition 200-500 mg/L– phenolics will bind laccase

- warning this will change wine structure.
- bentonite can also assist in removing mouldy taint.

Important winemaking changes – Fermentation considerations

Whites will be highly clarified

- addition of some solids will avoid slow or sluggish ferments
- residual copper levels can inhibit fermentation the following year

YAN will be depleted due to higher than normal microorganism populations

- YAN concentrations range from 50 to 450 mg/L in Australia with 100 to 200 mg/L being common.

Reds should be inoculated quickly

Important winemaking changes – Laccase testing

The Australian Wine Research Institute

Testing is very important

Whites	Reds
Intake (juice)	Intake (juice)
After cold settling (juice)	Post ferment (wine)
After bentonite fining (juice)	After pasteurisation (wine)
After pasteurisation (juice or wine)	

Can be done qualitatively or quantitatively

Simple qualitative test for laccase activity

The Australian Wine Research Institute

- Pour two glasses of the wine with watch-glasses and add 60 mg/L total SO_2
- Put one in fridge (as control) & the other on bench overnight.

Quantitative laccase testing

- Kits are available commerically
- Simple to use – can use in the field
- “Laccase activity” is based on the rate at which laccase enzyme oxidises Syryngaldazine to a purple colour
- Interpretation can be difficult

AWRI is currently validating a new laccase method

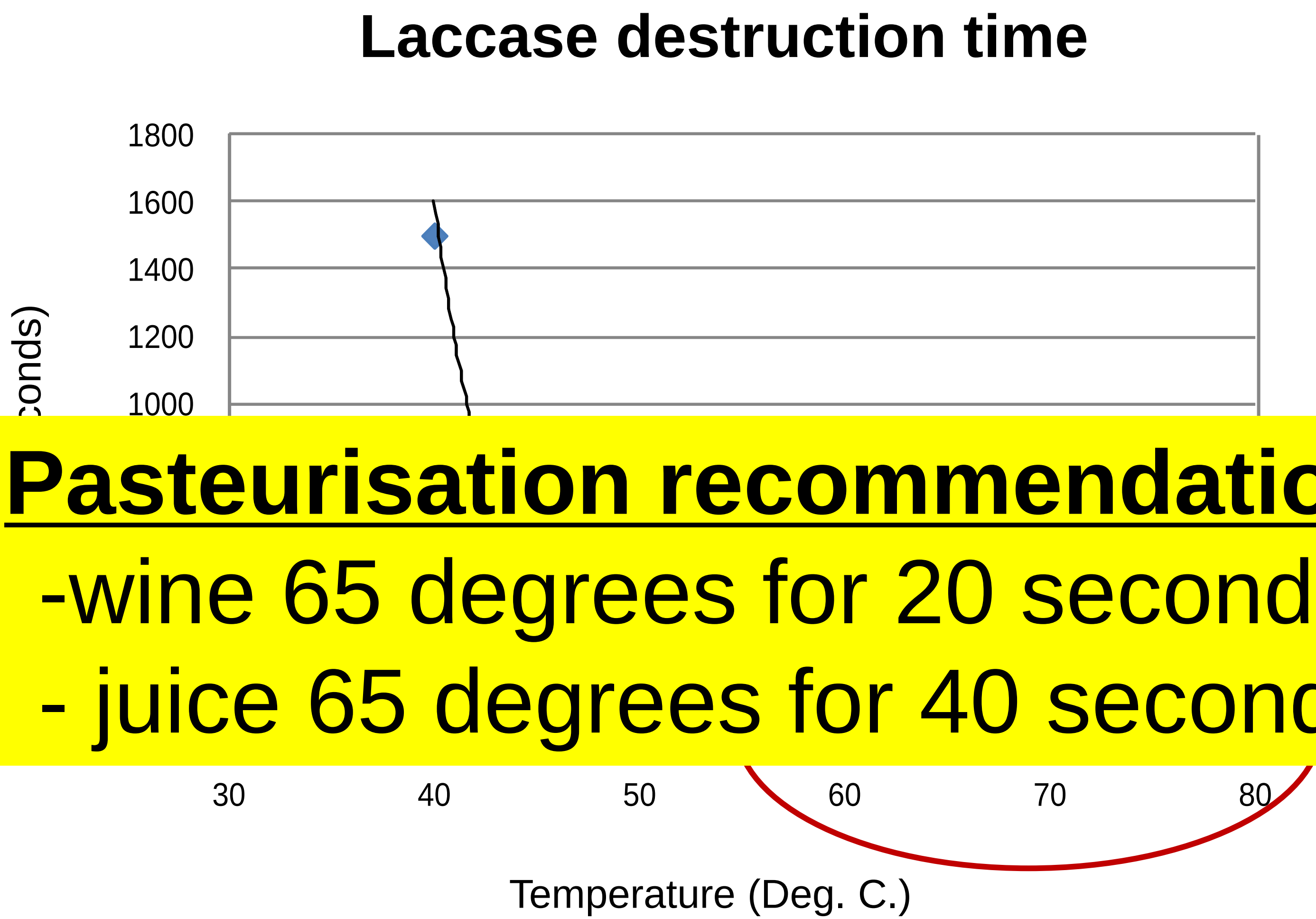
The Australian Wine Research Institute

- Decolourisation can be difficult in intense reds

- Traditionally pink colour charts have been used

Laccase inactivation (pasteurise)

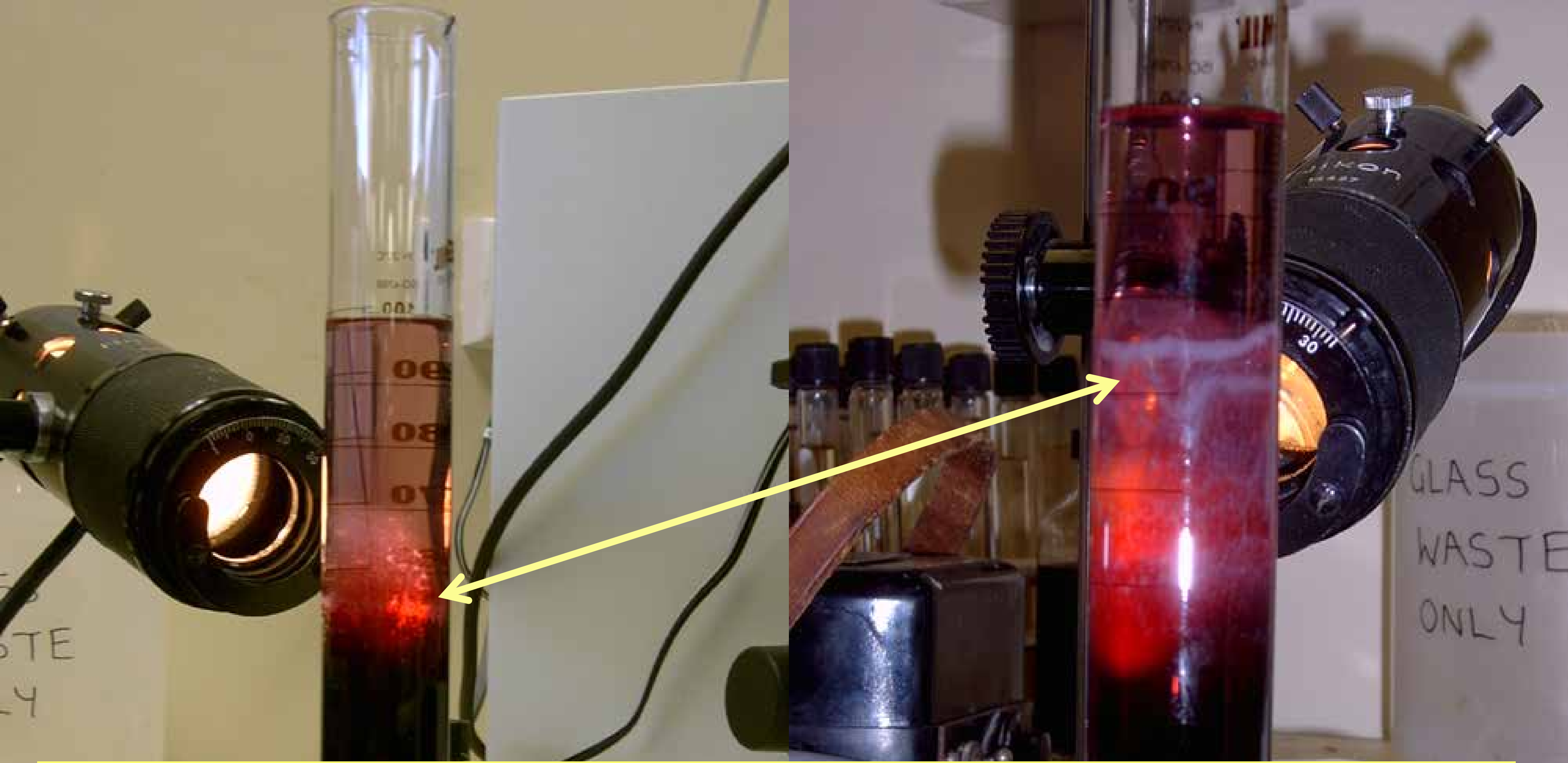
The Australian Wine Research Institute



<u>Pasteurisation recommendations</u>

-wine 65 degrees for 20 seconds

- juice 65 degrees for 40 seconds

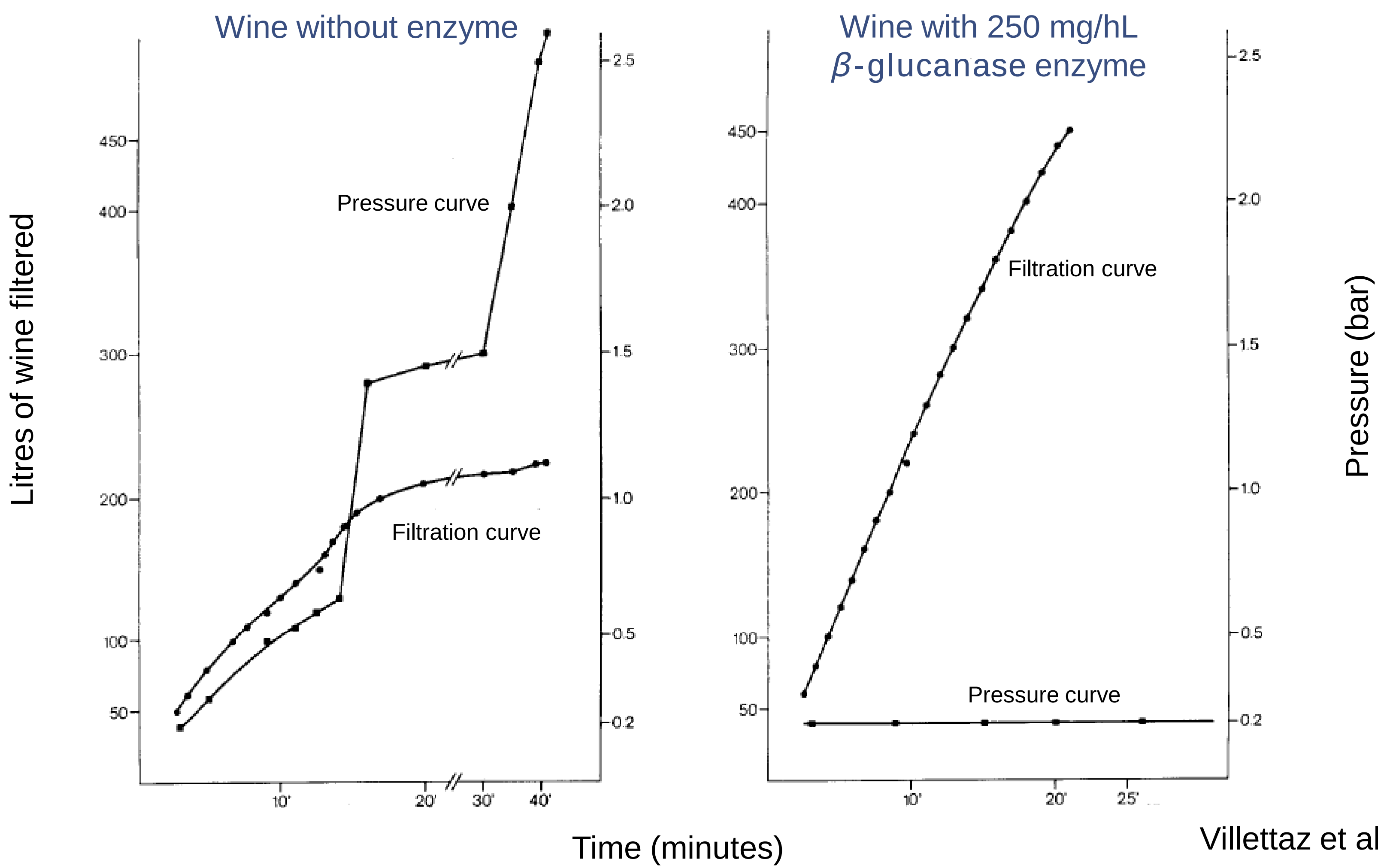


With Botrytis often comes β-Glucans. These are polysaccharides which will reduce filterability

Post-fermentation (Botrytis –affected)

The Australian Wine Research Institute

- Can treat with beta glucanase enzyme (e.g. glucanex)



Villettaz et al (1984)

Simple test

Polysaccharides

Polysaccharides originate from the grape (such as pectins) and from Botrytis infection, are released by yeast during fermentation and during lees contact, and are also released by some bacteria. Polysaccharides can form colloidal hazes in wines which make clarification and filtration difficult. Since polysaccharides form gelatinous aggregates when mixed with alcohol solutions, the simple test described below may be used to determine if polysaccharides are present in a haze.

Alcohol precipitation test for polysaccharides

To a test tube containing 10 mL of wine, add 5 mL of 96% v/v ethanol and mix thoroughly. The formation of white filaments is indicative of the presence of polysaccharides.

If filaments do not form, but a haze develops upon mixing, the following more sensitive test may be performed.

After mixing the 10 mL of wine with 10 mL of 96% v/v ethanol, allow the mixture to stand for 30 minutes and then centrifuge, decant and discard the supernatant. Redissolve the deposit in 2 mL of water and add 1 mL of 96% v/v ethanol. The formation of filaments is indicative of polysaccharides.

- Courses, seminars & workshops
- Environment
- Online videos
- Regulatory assistance
- Victorian Node
- Viticulture
- Wine and health
- Winemaking advice and problem solving
- Winemaking resources
  - Additives & processing aids
  - Frequently asked questions
  - Laboratory establishment
  - Laboratory methods

Amorphous deposits

Amorphous material can be loosely defined as particles that, under magnification, have no specific shape or morphology. The common types of deposits that can be found in wine, and fall into this category are:

- Protein
- Polysaccharides
  - Caramel
- Red pigments
- Polyphenolics
- Metal hazes
  - Copper
  - Iron

Efficiencies in the winery

The Australian Wine Research Institute

Efficiency gains in the winery

The Australian Wine Research Institute

Efficiency gains can be achieved in….

- Energy
- Refrigeration
- Water useage
- Waste management

Refrigeration

The Australian Wine
Research Institute

- Refrigeration accounts for 50 – 70% of a wineries total electricity use

- Cooling is widely used:
  - Must cooling
  - Juice clarification
  - Fermentation
  - Cold stabilisation
  - Wine storage (tank insulation)
  - Space cooling

Cellar efficiencies

The Australian Wine Research Institute

Cold stabilisation

Cellar techniques for cold stabilisation

- Chilling and holding for a number of days/weeks (slow stabilisation)
  - Spontaneous, primary nucleation, long process that produces large crystals due to slow growth
- Contact seeding (rapid stabilisation in hours)
  - Fast homogeneous secondary nucleation, induced by massive quantities of small exogenous crystals. Rate is increased due to significantly increasing the surface area
  - Typical rate 2-4 g/L
  - CTS systems available ($$$)
- Electrodialysis (Ion exchange resins)
  - Ions K^+ and HT^- are removed until certain conductivity is reached as determined by the conductivity test

Cellar techniques for cold stabilisation

The Australian Wine Research Institute

- Use of crystallisation inhibitors such as
  - Metatartaric acid (Maximum level allowed: 100 mg/L.)
  - Soluble mannoprotein fractions
    - Claristar
  - Carboxyl methyl cellulose (Maximum level allowed: 100 mg/L.)
    - *Cellstab*
- ~~These techniques are rarely used~~

CMC – Carboxylmethylcellulose

- CMC is a polysaccharide
- Used in the food industry for a number of years
- Authorised for use by OIV in 2008/2009
- Approved for use in Australian Wine Industry in November 2011
  - Identification E466 in STD 1.3.1

CMC – How does it work?

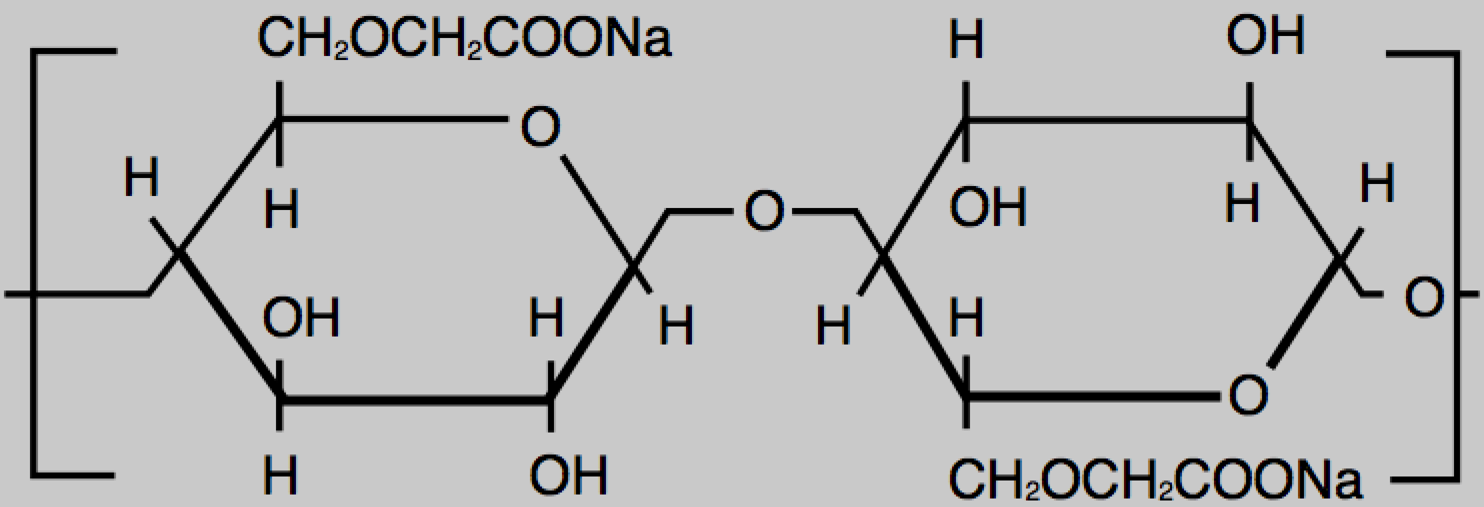
- CMC is a crystallisation inhibitor

- Put simply - it prevents crystals from growing via its electrosatatic attraction between the –ve of CM groups and the +ve surface charge of KHT crystal

- The strength of the attraction is related to charge distribution on the surfaces – different CMC's will have variable effectiveness

CMC – How does it work?

The Australian Wine Research Institute



Reproduced from Wilkes et al. 2012

- OIV recommends CMC polymer length between 17 and 300 kilodaltons (governs viscosity) and degree of substitution 0.6 – 0.95 (governs solubility) Bowyer, P. Moine, V. Gouty, C. Marsh, R. Battaglene, T. CMC: a new potassium bitartrate stabilisation tool.. *Australian & New Zealand Grapegrower & Winemaker* (558) : 65-68 ; 2010.

CMC – Why use it?

The Australian Wine Research Institute

- Has appeal - its cheap and efficient
  - ~1 cent/L ($100 per 10,000L)
  - Traditional cold stabilising using a diesel generator to run cooling system: 10,000L ~$4000
- Can save $ in refrigeration costs = efficiency and energy saving
- Uptake appears to be slow??
- No chemical reactions, no change in pH, TA or sensory
- Can be a powder or more common a solution of X %. Dissolve in a little wine, add and mix in.
- Minimal electricity required when mixing

CMC – Important notes and limitations

The Australian Wine Research Institute

Limitations

- CMC is not suitable for Rose or Red wines (will affect colour)
- Wine must be protein free
- Must be used after fining but before final filtration
- No additions can occur after addition
- Potential to affect filterability
- Not effective against Calcium tartrate precipitation
- Maximum dosage of 100 mg/L
- Tends not to work on wines that are grossly unstable
- Not allowed for certified biodynamic wines

Juice clarification

Juice clarification

- White juice is often clarified before fermentation to ~1% solids
  - As a guide

NTU	% solids
100-200	6
10-15	3-3.5
5	1

Howard, C. What's new in winery toys? New technology for SME wineries.. *Wine & Viticulture Journal* 27 5 : 29–31, 33 ; 2012.

- Can be done via a number of ways
  - Natural settling (natural fermentation can interfere)
  - Cold settling (decreasing temperature)
  - Enzymes, bentonite and gelatine will assist
  - Filtration in combination with natural clarification
  - Centrifugation (mechanical)
  - Flotation

Juice clarification by Flotation

- Solid – liquid separation technology
- Used in mining, sewerage treatment, food and beverage industry
- Introduced to wine industry in 1970's
- Technology has improved and interest is gaining

Flotation

"Flotation is a technique that involves the use of gas particles to carry solids to the surface of the grape juice. Much of the suspended pulp becomes attached to the bubbles due to the surface tension and then floats upwards toward the surface where it can be collected." Rachel Gore. Wine Network Consulting

Clarification using Flotation

The Australian Wine Research Institute

Step 1: Pectic enzymes added at press

Step 2: Juice pumped to tank

Step 3: Gelatine/bentonite added with compressed nitrogen/air using flotation equipment

Step 4: Wine left in tank for solids to float ~1-4 hours

Step 6: Pump clean juice from below

Ready for inoculation with minimal temperature change required

Juice clarification by Flotation - Benefits

The Australian Wine
Research Institute

- Chilling requirements reduced
- Reduces clarification time for white juice
- Can be done in a matter of hours rather than days
- Reduces settling tank requirement – space and cleaning (water)
- Quality improved through preservation of aromatics
- Can get better clarification than traditional settling
- Performed closer to fermentation temperature

- Winequip
  - Juclas Easyfloat systems for 1000L up to 50,000L and beyond)
  - Easyfloat 50 - $5500
  - Easyfloat 300- $11,500

Other areas for efficiency gains

- High impact and/or low cost improvements can be achieved
  - Refrigeration control
  - Process heating
  - Filtration
  - Waste heat recovery
  - Hot water generation
  - Air compressor performance
  - Lighting – natural light
  - Waste water treatment
  - Water saving

Further information: http://www.awri.com.au/industry_support/environment/

Other resources

The Australian Wine Research Institute

- AWRI website
- http://www.awri.com.au/industry_support/environment/
- Case study – Taylors Wines
- http://www.taylorswines.com.au/sustainability/environment
- Case Study – Cape Mentelle
- http://www.wfa.org.au/resources/5/PDF_Resources/Resources/Winery%20Energy%20Management%20CMV%20Final%20Report.pdf
- Sinclairs Gully Winery – Adelaide Hills
- http://www.sinclairsgully.com/environment.html
- Winemakers Federation of Australia
- http://www.wfa.org.au/environmental_sustainability.aspx
- GWRDC
- http://www.gwrdc.com.au/wp-content/uploads/2012/09/2011-FS-Improving-Winery-Refrigeration.pdf

Take home message

- Efficiencies can be gained
- CMC is a low cost alternative with efficiency benefits
- Aim for high impact and low cost efficiency gains
- Look at the whole process
- Consult information resources out there. Numerous available.

Energy and Water

Increasing efficiency &
recycling

Energy Efficiency

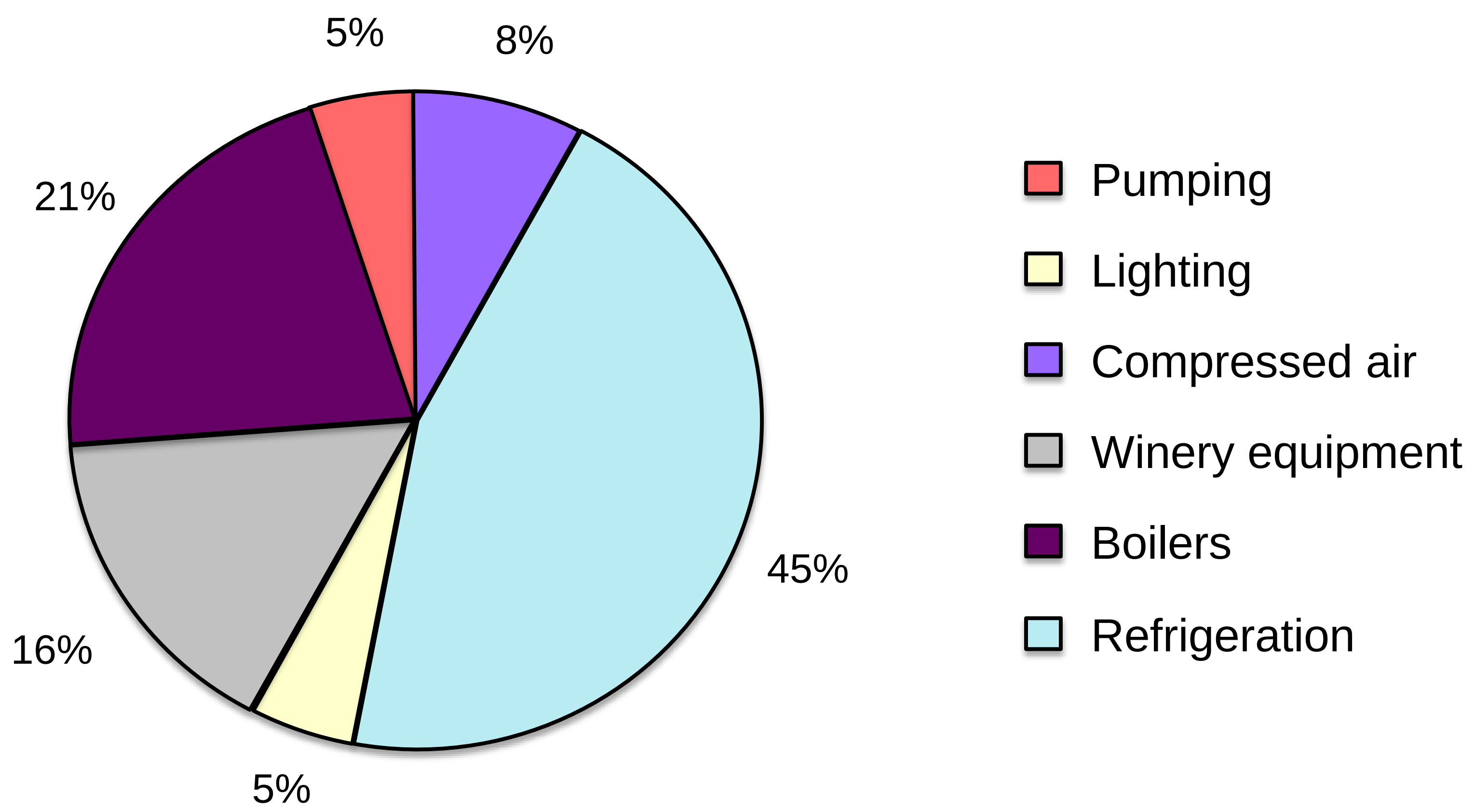
- Increased energy efficiency has multiple benefits:
  - lowering carbon pollution
  - improving energy security, and
  - Better able to cope with rising energy prices

- The International Energy Agency suggests that energy efficiency could deliver 65 per cent of all the global greenhouse gas abatement needed to reach the agreed target

AWRI Energy Audits

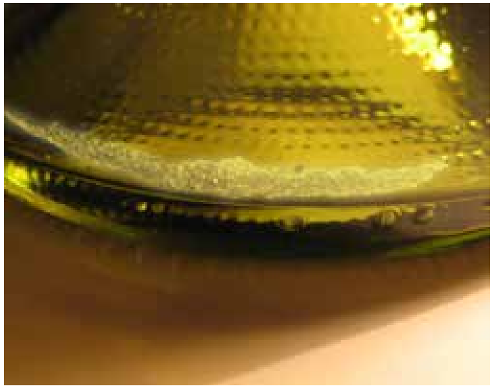
The Australian Wine
Research Institute

- Process areas where energy efficiency improvements can be found



Winery refrigeration uses

The Australian Wine Research Institute



Cold stabilisation

Must chilling

Fermentation, storage, cold settling

Space cooling

Refrigeration issues

The Australian Wine Research Institute

- Cost
  - Typically 50-70% winery electricity use

- Environmental
  - Ozone layer depletion.
  - Global warming.

Environmental impacts of refrigerants

ASHRAE[1] #	Name (group)	Ozone depleting potential (ODP)[2]	Global Warming Potential (GWP100, kg CO_2e/kg)[3]
R717	Ammonia	0	<1
R12	Dichlorodifluoromethane (CFC)	1	10,900
R22	Chlorodifluoromethane (HCFC)	0.055	1,810
R134a	1,1,1,2-Tetrafluoroethane (HFC)	0	1,430
R290	Propane (HC)	0	20
R744	Carbon dioxide	0	1

1. American Society of Heating, Refrigerating and Air-Conditioning Engineers.
2. Ozone Depleting Potential: Index of a substance's ability to deplete stratospheric ozone.
3. Global Warming Potential: Index of a substance's ability to contribute to global warming. Environmental impacts from ASHRAE (2009).

Improvement Opportunities

- low-cost improvement opportunities:
  - generally associated with changes in operating practices

- higher-cost improvement opportunities
  - often involve more significant refrigeration plant/winery modifications

Turning off refrigeration when not in use

The Australian Wine
Research Institute

- If cooling is not required for a significant period of time:
  - turn refrigeration plant off, or change the temperature settings so that it runs infrequently

- Brine systems: evaporation (usually ethanol) needs to be managed
  - maintain brine at maximum of ~ 10ºC

Turning off refrigeration when not in use

PLANT SHUT-DOWN EXAMPLE

Cooling was not required at one small winery for approximately 4 months each year. The winery's packaged chiller had usually been left on during this period. One year, the chiller was switched off during this period, reducing annual winery electricity consumption by approximately 20%.

Temperature rationalisation

The Australian Wine Research Institute

- Example: dry goods that don't need to be stored cold should not be stored in a refrigerated product warehouse
  - energy requirement to cool materials
  - increased traffic leads to heat gains

- Method for wineries to estimate potential savings from storing wine at warmer temperatures is provided at awri.com

Night-time grape harvesting

The Australian Wine
Research Institute

- harvest at night when it is cool:
  - reduced heat energy in the grapes, which otherwise may have needed to be removed by refrigeration at the winery

Night-time cooling

- off-peak night-time electricity is often considerably cheaper than peak electricity
  - Cool at night (off-peak tariff) rather than during the day
  - Wine stored in insulated tanks may be able to be maintained within an acceptable temperature range by night-time cooling alone.

Brine temperature

The Australian Wine Research Institute

- Warmer brine temperatures Þ considerable improvements in refrigeration plant coefficient of performance
- Fermentation, bulk wine storage: acceptable cooling rates can often still be achieved using warmer brine
- The required brine temperature is dictated by the lowest temperature operation on the brine reticulation loop.
  - Scheduling to limit the amount of time very low brine temperatures have to be used
    - e.g. all cold stabilisation operations could be scheduled to occur in specific periods in the year instead of intermittently throughout the year.

Alternatives to cold stabilising

The Australian Wine Research Institute

- Crystallisation inhibitors
  - e.g. carboxymethylcellulose, mannoproteins
- Electrodialysis
  - Removes potassium

http://www.memstar.com.au/modules/mastop_publish/?tac=electrodialysis

- Contact process

Product heat exchange

- means of recovering useful energy
- e.g.: pre-cooling wine for cold-stabilisation with wine finishing cold stabilisation using a plate heat exchanger
- involves increased planning

Maintenance

The Australian Wine Research Institute

- Equipment should be properly maintained to ensure efficient operation
- Condensers should be kept clean to maintain their effectiveness
- Bulky equipment like grape bins should not be left in a position where they can obstruct condenser air flow

Boiler savings

The Australian Wine Research Institute

Boiler economisers for waste heat recovery and reduced fuel consumption

- Boiler flue gases are often rejected to the stack at temperatures >100°C higher than the temperature of the generated water or steam.
- By recovering flue waste heat, an economiser can reduce fuel requirements by as much as 5-10% and pay for itself in less than 4 years.

Winery example

Lamborghini Condensating Boiler from Travhotec (www.travhotec.com.au)

Winemaker comments:

- “Not big footprint, compact.
- Waste heat in the discharge air is perculated against incoming water in a ~2m column.
- Estimated winery will save ~ 33% gas requirements.
- When we upgrade other boilers we will head in this direction”.
- Works very well”

- Courses, seminars & workshops
  - Advanced Wine Assessment Course
  - Events calendar
  - Seminars & workshops
  - Webinars
  - Research to Practice® workshops
- Environment
- Online videos
- Regulatory assistance
- Victorian Node
- Viticulture
- Wine and health
- Winemaking advice and problem solving
- Winemaking resources*
- WIC Winemaking Services

Member Login

Industry Support and Education > Environment > Boiler economisers for waste heat recovery and reduced fuel consumption

Boiler economisers for waste heat recovery and reduced fuel consumption

Key Points

- A feedwater economiser reduces steam boiler fuel requirements by transferring heat from the flue gas to incoming feedwater.
- A feedwater economiser is appropriate when insufficient heat transfer surface area exists within the boiler to remove combustion heat.
- Boilers that exceed 980 kWth and that are significantly loaded throughout the year are potential candidates for an economiser retrofit.

Background

Boiler flue gases are often rejected to the stack at temperatures in excess of 100°C higher than the temperature of the generated water or steam. In some cases, boiler efficiency can be increased by 1% for every 20°C reduction in flue gas temperature. In such cases, by recovering flue waste heat an economiser can reduce fuel requirements by as much as 5-10% and pay for itself in less than 4 years.

Initial Stack Temp (C)	Recoverable Heat (kW)			
	Boiler Thermal Output (kW)			
	500	1000	2000	4000
200	15.08	40.18	90.37	190.76

Compressed air

The Australian Wine
Research Institute

- Typical production facility: 10% of the total electricity consumed on site is used to generate compressed air.

- Leaks can be significant source of wasted energy, sometimes wasting as much as 20-30% of a compressors output

Compressed air

The Australian Wine Research Institute

- Leaks occur most often at joints and connections
- Stopping leaks can be as simple as tightening a connection or as complex as replacing faulty equipment, such as:
  - filters and regulators
  - couplings
  - Fittings
  - Hoses
  - Joints
  - Valves
  - Condensate traps

Wastewater in the winemaking process

The Australian Wine Research Institute

- Significant quantities of wastewater are generated from the following actives:

  - Cleaning (tanks, barrels, paved areas etc)
  - Non- recycled vacuum gland seals (pumps)
  - Storm water runoff
  - ‘Push’ activities related to wine transfers
  - Wine spillages and waste streams such as tank lees and centrifuge solids.

- It may be helpful to complete a winery wastewater audit to identify areas for improvement (see awri.com)

Cleaner Production

- The core concepts behind cleaner production are:
  - **Avoid** – eliminate waste streams where possible by adopting different processes, technologies, or strategies.
  - **Reduce** – limit the amount of waste being produced; this might mean sweeping hard surfaces, rather than hosing them down.
  - **Reuse** – Can the waste be reused, for example recirculating cooling water through vacuum pumps.
  - **Recycle** – can the waste be recycled for another purpose, for example using truck wash down water to clean paved areas

‘Treat the source – not the symptom’

- Opportunities in the winery:
  - Recycling cleaning chemicals
  - Reusing vacuum gland seal water
  - Smarter transfer operations
  - Reuse of crusher push water
  - Ice pigging
  - Cross flow lees filtration

Establish a caustic recycling system

The Australian Wine
Research Institute

- Establish a central storage tank to hold the caustic cleaning chemical.
- Draw the required amount of caustic solution from the central holding tank into a movable container.
- Transport the mobile container to the tank and use it to clean the tank in the normal manner.
- Empty the used cleaning solution back into the mobile tank.
- Empty the mobile tank back into the main storage tank.

Caustic solution storage tanks

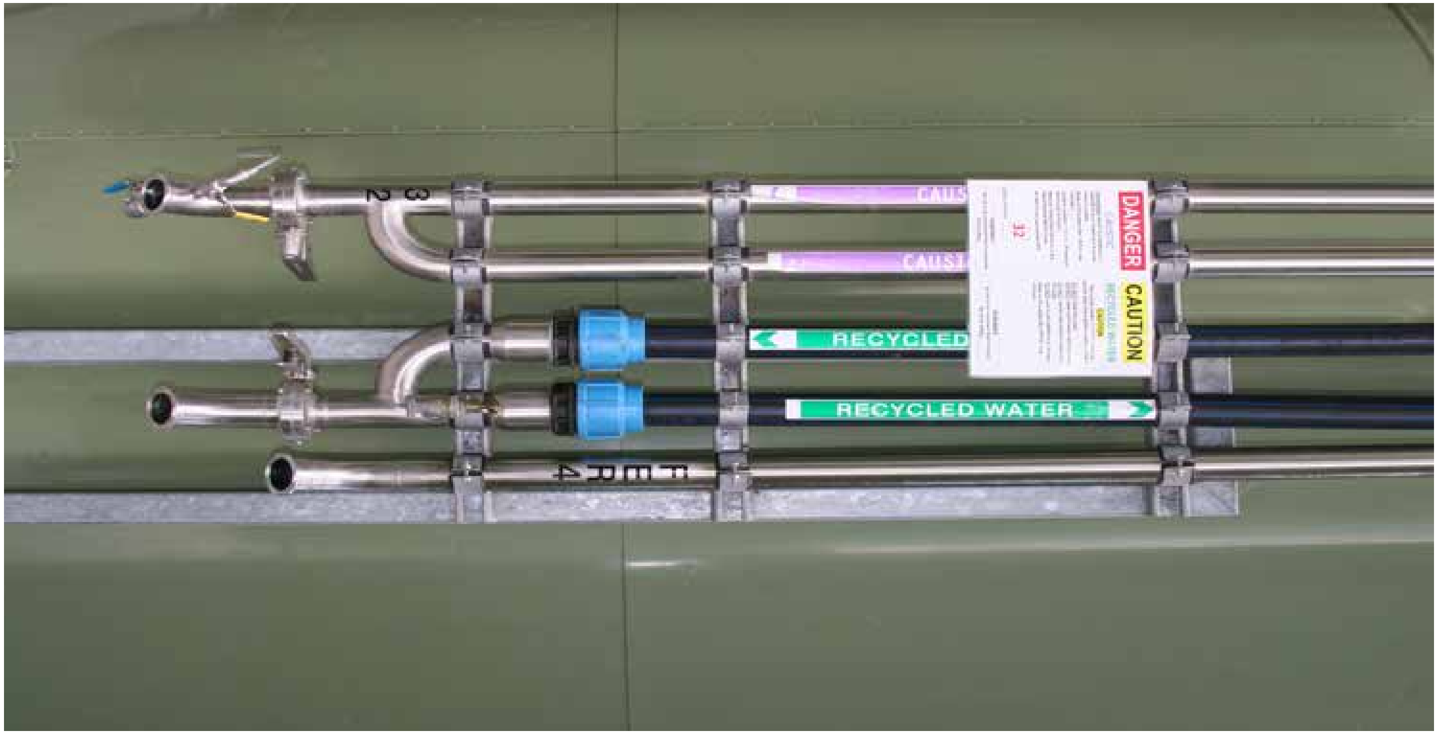
Establish a caustic recycling system

- Main storage tank: monitor at regular intervals to ensure caustic concentration remains adequate.
  - Additional doses of caustic material will need to be added to maintain effectiveness.
- As the salt level builds up, the tank will eventually need to be emptied. This can be done by:
  - Disposal into the winery waste treatment facility;
  - Disposal at a waste processing facility (about $140 per kL);
  - Disposal into an evaporation pond or basin.

Establish a caustic recycling system

The Australian Wine Research Institute

- In some cases (e.g. limited access areas) , it may be more effective to fit fixed caustic delivery lines throughout the winery



Fixed Caustic and Cleaning Water lines for recycling

Cost of chemicals vs water treatment cost

The Australian Wine Research Institute

- The cost of cleaning chemicals is a big factor in choice
  - but it is also important to evaluate the cost of treatment.

The cost of purchase & treatment, assuming no recycling of the cleaning agent.

Cleaning agent	Approx. concentration required to remove residues (kg/kL)	Cost to purchase cleaning agent ($/kg)	Cost to treat 1kL residual cleaning solution* ($)
NaOH (93%)	0.4	2.95	$32.20
KOH (40%)/NaOH (10%)	1.5	2.98	$19.50
Na_2CO_3 (60%)	0.4	2.95	$14.60

* Based on treatment of sodium and/or potassium content only

Reducing the use of cleaning agents

- Chemical use could be reduced significantly if processes were planned more effectively
  - often tanks or barrels are left empty for significant periods of time before they are cleaned - tartrate deposits become harder to remove over time.
  - Þ Clean tanks as soon as the must or wine has been transferred

Must transfers

The Australian Wine
Research Institute

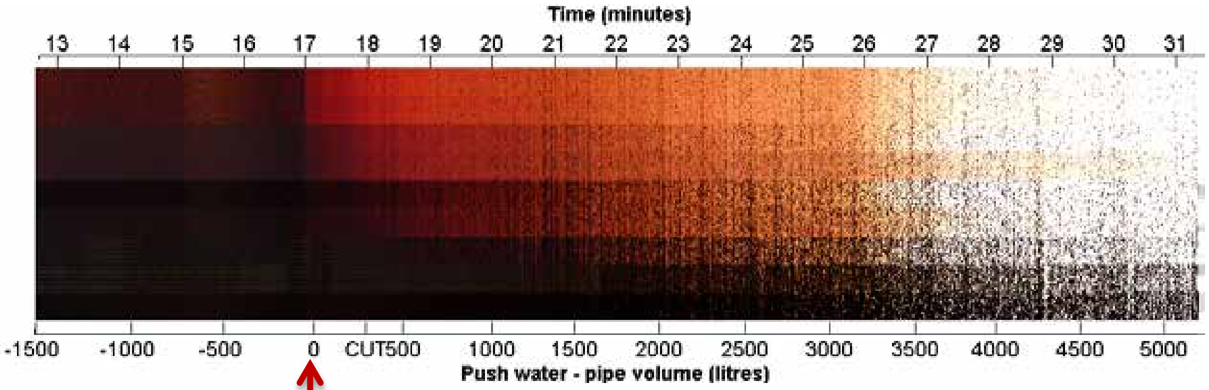
Experimental work has shown that up to 1.6 pipe volumes can be needed to effectively flush a must transfer pipe.

Ref: Forsyth. K; O'Brien V. (2011) Winery Wastewater Management & Recycling. Research to Practice. The AWRI.

Red must push water experiment

The Australian Wine Research Institute

Must line showing solids material within must pipe after 3055 litres of water have been added.



<u>Bottom scale:</u>
water pumped in to push the must - volume of the pipe (4000 litres)

Zero point = one pipe volume of water has been pumped in

Þ transfer of must is a potentially large contributor to winery wastewater, both in terms of loading and volume

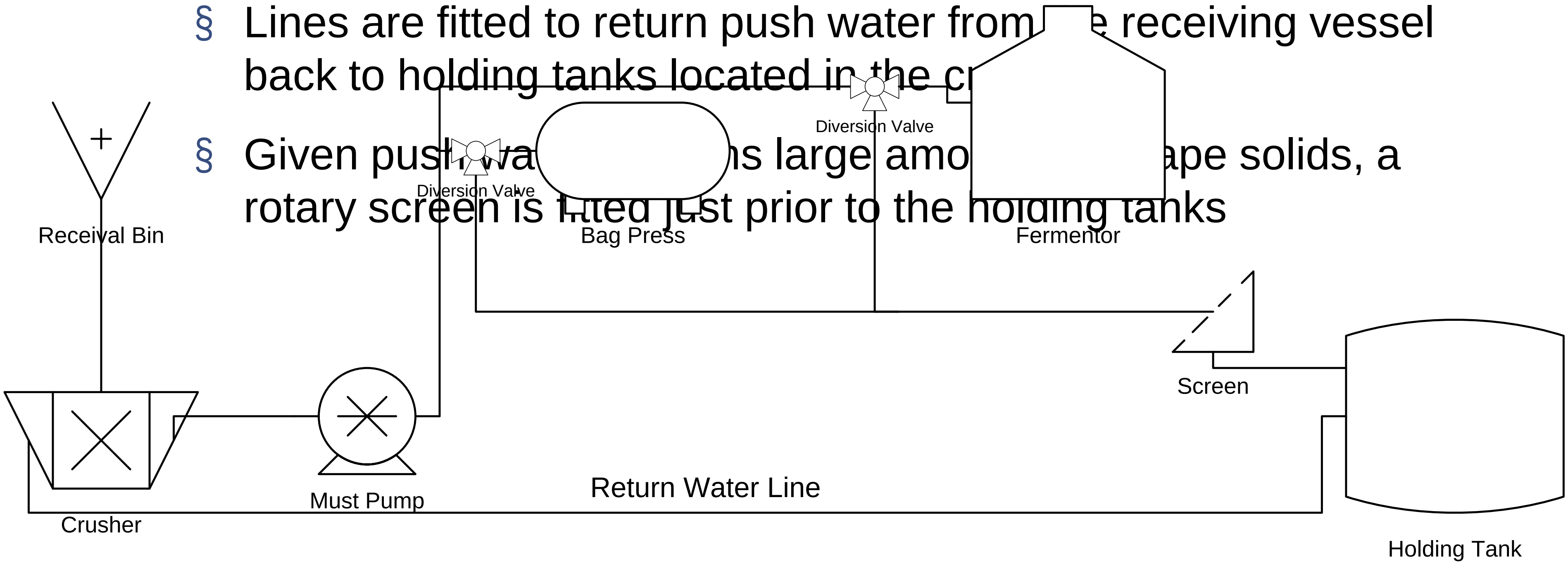
Must Transfers

- Possible options to reduce the impact
  - separating pigs
  - recycling of must push water

Recycling Crusher Push Water

The Australian Wine Research Institute

- Number of variations, but the general principle is the same:
  - Lines are fitted to return push water from e receiving vessel back to holding tanks located in the cr
  - Given push wa ns large amo ape solids, a rotary screen is fitted just prior to the holding tanks



  - More sophisticated versions also employ tanks to hold caustic cleaning solutions.

Rotary screen

The Australian Wine
Research Institute

- The rotary screens are only able to remove large solids so the holding tanks need to be emptied regularly.

Pigging winery pipes

The Australian Wine Research Institute

- Pigging involves pumping a solid object through a pipe.
  - 'pigs' provide a physical barrier between the contents within the pipe
  - Limited in wine industry due to changing diameters within a pipe run

- But there are many economic and environmental benefits:
  - improved product recovery
  - reduced BOD and potassium in wastewater
  - increased water recyclability
  - reduced water consumption

The physical scraping of pigs can also increase cleaning efficacy compared to chemical washing alone.

Scourer pig

The Australian Wine Research Institute

- Due to the changing size of winery pipes, use of solid pigs is very limited.
- Recent research has focused on semi-solid pigs, capable of deforming; allowing them to operate in different sized pipes.

Ice pigs

- very effective semi-solid pigs, made up of a high-solid content (>80%) ice slurry
- exploit the beneficial physical properties of a solid, whilst retaining versatile flow characteristics of a fluid.
- ice pigging doesn’t require specialised high-tolerance pipe work, valves, or in-line pig launchers and catchers.
- Ice pigs can traverse drastic pipe diameter changes, butterfly valves, pumps, manifolds and nozzles whilst retaining integrity.

Ice pigging

- Contamination from water pushing accounts for large proportion of total winery waste contributions and water use

- CSIRO found that of the total winery output, the large crusher push water accounts for (on average) 39.3% of COD.

- A perfectly performing pigging operation has the potential to reduce this to almost zero, whilst also reducing wastewater volumes, product dilution and potable water use substantially

Ref: Kumar, Anu. Winery Waste Water generation, treatment and disposal: A survey of Austalian Practice. Adelaide : CSIRO, 2009.

Ice pigging

The Australian Wine Research Institute

- Value to wineries:
  - heightened efficacy and lower chemical requirement than the current practice of chemical washing alone (or even with scourer pigs).

- Ice pigs are very effective at cleaning hard deposits and bio-films
  - effectively represent a new breakthrough in ‘clean in place’ technology capable of physically abrading inaccessible and previously unpiggable plant.

Ice pigging

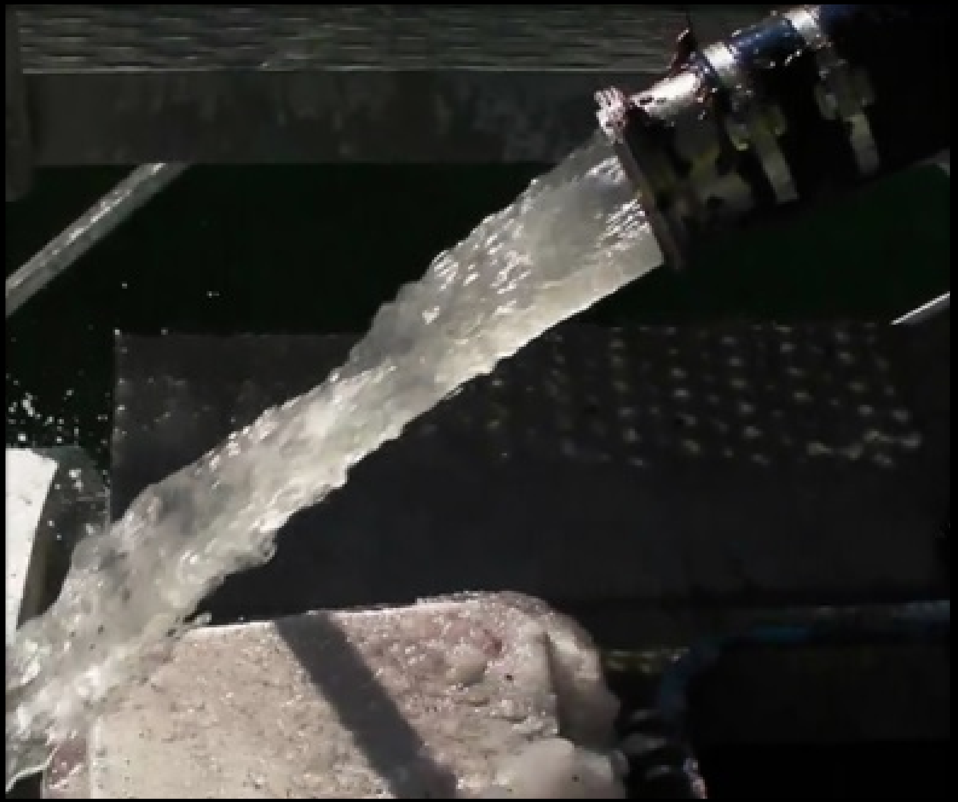
- 2009: feasibility studies found ice pigging equipment was too costly, time consuming & used too much salt for practical applications in wineries

- 2011: A new prototype ice pigging machine was designed to be capable of producing ice pigs:
  - with higher ice fraction (83.7% vs 60% ice by weight)
  - from delivered and stored ice cubes (vs. purchasing a slurry ice machine)
  - in shorter times (20 minutes vs. 8 hours per pig)
  - with less additive (1% vs 4.75% concentration)
  - with various types of additive complementary to winery products and processes (ethanol, potassium carbonate, caustic, organic solutions, acids, bases, gels, biocides, solid particles, etc.).

2011 Vintage trial

The Australian Wine Research Institute

An ice pig



Push water following an ice pig

Further information

The Australian Wine Research Institute

- Improving Winery Refrigeration Efficiency (AWRI website) http://www.awri.com.au/wp-content/uploads/ImprovingRefrigerationEfficiency.pdf
- Winery A Case Study: http://www.awri.com.au/wp-content/uploads/WineryA-CaseStudyReport.pdf
- Winery B Case Study 1: http://www.awri.com.au/wp-content/uploads/WineryB-CaseStudyReport1.pdf
- Winery B Case Study 2: http://www.awri.com.au/wp-content/uploads/WineryB-CaseStudyReport2.pdf
- Environment fact sheets http://www.awri.com.au/industry_support/environment/environment-fact-sheets-3/
  - Identify cost savings with an Energy Audit
  - Improving refrigeration and heat transfer
  - Real energy solutions
- Boiler economisers for waste heat recovery and reduced fuel consumption: http://www.awri.com.au/industry_support/environment/boiler-economisers-for-waste-heat-recovery-and-reduced-fuel-consumption/
- Efficient compressed air use: http://www.awri.com.au/industry_support/environment/efficient-compressed-air-use/
- US Climate Change Science Program (2008) http://www.climatescience.gov/Library/sap/sap2-4/final-report/

New varieties
for a changing climate

Why consider new varieties?

The Australian Wine
Research Institute

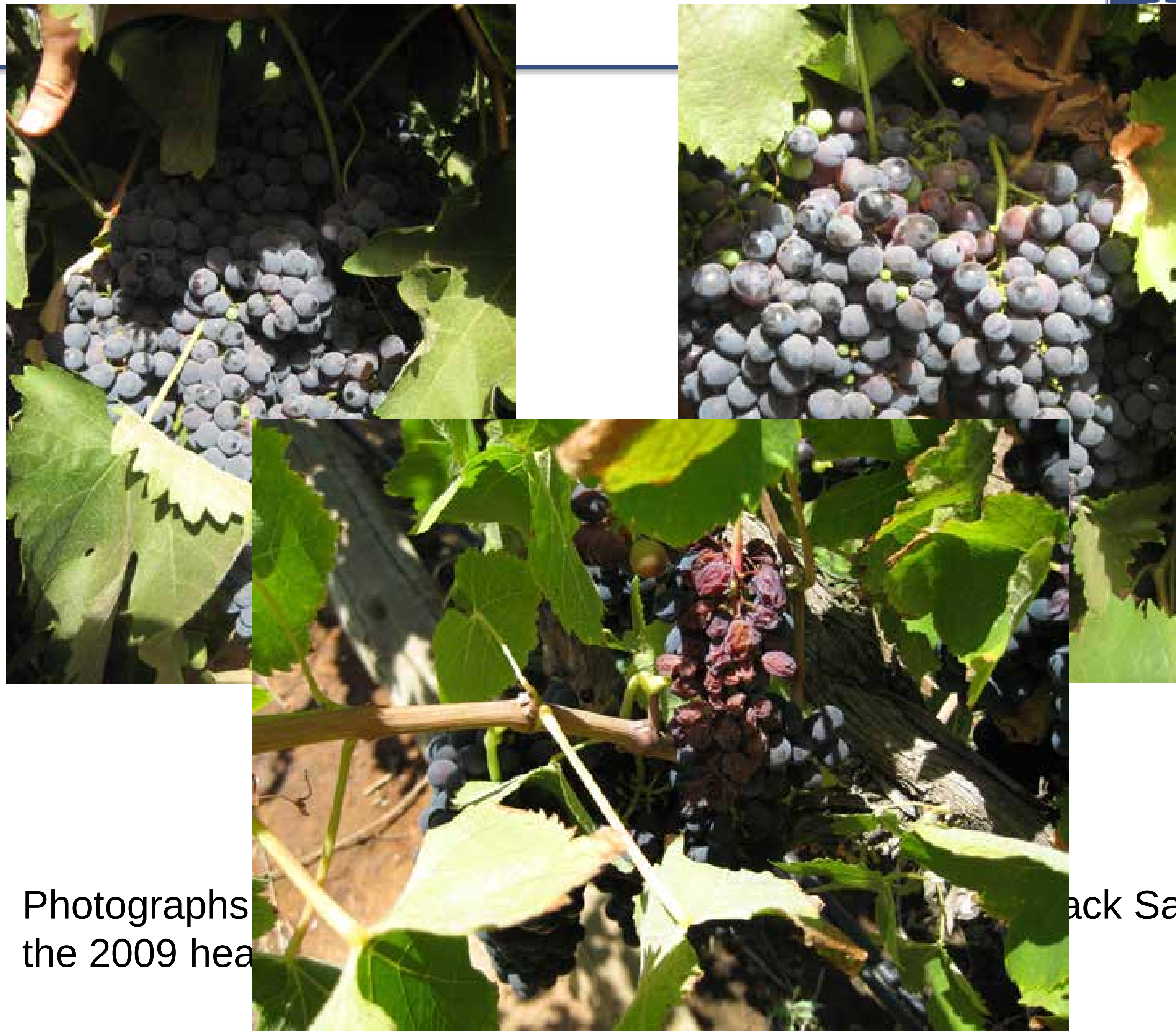
- **Better climatic adaptation**
- More flavours
- More wine styles
- Lower alcohol wines
- Point of interest

New Varieties: why?

- Better suited to climatic conditions: present and future
  - e.g. drought and heat tolerance

Negroamaro

Nero d'Avola



Photographs ... ack Saturday' of
the 2009 hea...

The Australian Wine
Research Institute

New Varieties: why?

- Increased incidence of drought events predicted for the future

New Varieties: why?

The Australian Wine Research Institute

- Where can we find varieties with drought and heat tolerance?

New Varieties: why?

The Australian Wine Research Institute

- Greater range of flavours
- More suited to Asian market
  - e.g. Fiano, Lagrein, Montepulciano, Petit Manseng, Tannat, Verdejo …

New Varieties: why?

The Australian Wine
Research Institute

- White wines with texture, savouriness, minerality
  - e.g. Fiano, Greco, Gruener Veltliner, Pecorino, Vermentino…..

New Varieties: why?

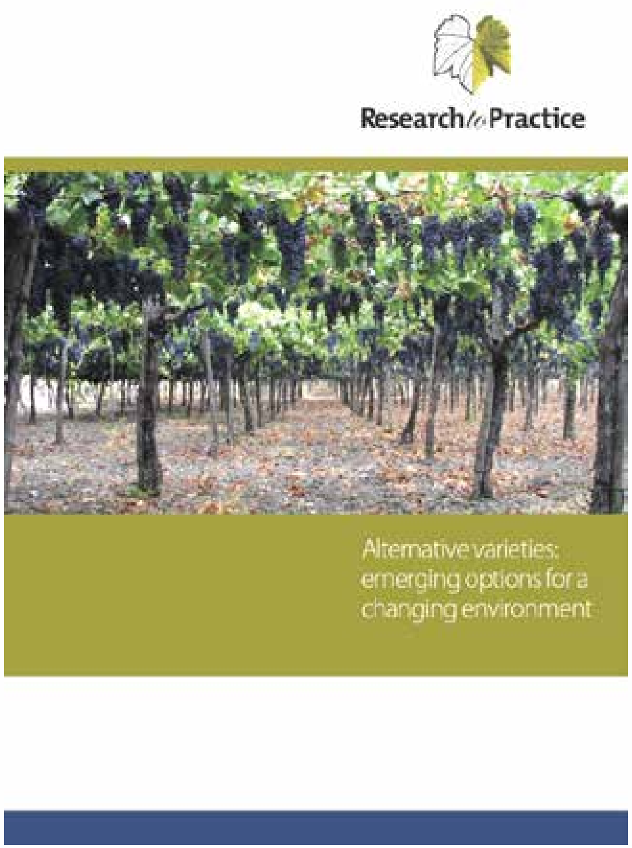
The Australian Wine
Research Institute

- More suited to lower alcohol wines?
  - good flavour at relatively low Brix
- More suited to new wine styles
  - Different markets/ changing tastes
    - e.g. Prosecco

New Varieties: why?

- Point of interest/difference
  - Regional level, e.g. Strange Bird Wine Trail, Granite Belt
  - Company level

AWRI Alternative Varieties program



For more information contact
Marcel Essling
marcel.essling@awri.com.au

New Varieties

The Australian Wine
Research Institute

- Consumer interest
- Wine show performance

- Tasting