

Development of smoke taint risk management tools for vignerons and land managers



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Why?

Smoke taint risk management tools to assist with communication, forest management (controlled burns) and viticulture and winemaking strategies to reduce smoke taint in grapes and wine



What is STAR

Smoke TAint Risk Calculator (STAR)

An interactive web-based tool that:

- predicts seasonal smoke taint risk based on grapevine growth stages
- incorporates risk factors
- integrates with planning systems for viticulture production, prescribed burns and smoke management

The Approach

The problem

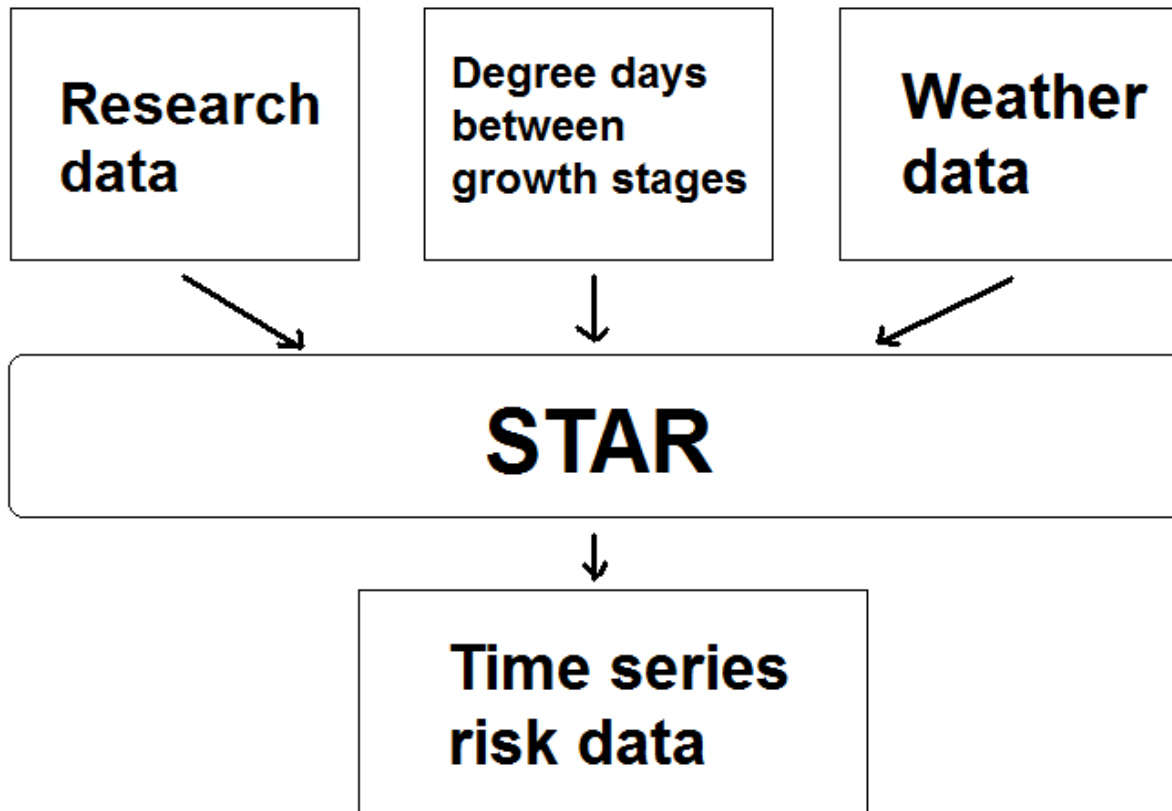


The solution

- reduce or avoid exposure to smoke during sensitive periods of grape vine growth

The Model

A time-series set of predicted growth stages. Research data can be mapped onto it to produce a time-series set of predicted smoke taint risks.



Research



Smoke applied to vines in the vineyard



Chemical analysis of smoke compounds in grapes and wine

Sensory analysis of wines



What we know

Direct link between grapevine and grape exposure to smoke and creation of taint in wine

Variation in assimilation of smoke by grapes during grapevine growth cycle

Timing of grapevine sensitivity to smoke uptake

Grapevine growth stage

Potential for smoke uptake



Shoots 10 cm in length

Low






Flowering

Low

P1

Timing of grapevine sensitivity to smoke uptake

P2		Berries pea size	Variable (low to medium)
		Beginning of bunch closure	Variable (low to medium)
		Onset of veraison to 3 days post veraison	Variable (low to medium)

Timing of grapevine sensitivity to smoke uptake

P3



From
7 days post
veraison

to

High



Harvest

Quantifying smoke taint risk

Considerations:

1. True and accurate
2. Based on smoke application to grapevines in the field and incorporating wine chemical and sensory analysis
3. Incorporate key grapevine varieties
4. Integrate a range of grapevine phenology stages

How?

Field based grapevine experiments

Varieties: Merlot, Cabernet
Sauvignon, Chardonnay,
Sauvignon Blanc

Grapevine growth stages:

Merlot - 12 growth stages over 3
years

Cab Sauv, Chardonnay, Sauv
Blanc

- 4 key growth stages in 2011/12

Smoke application:

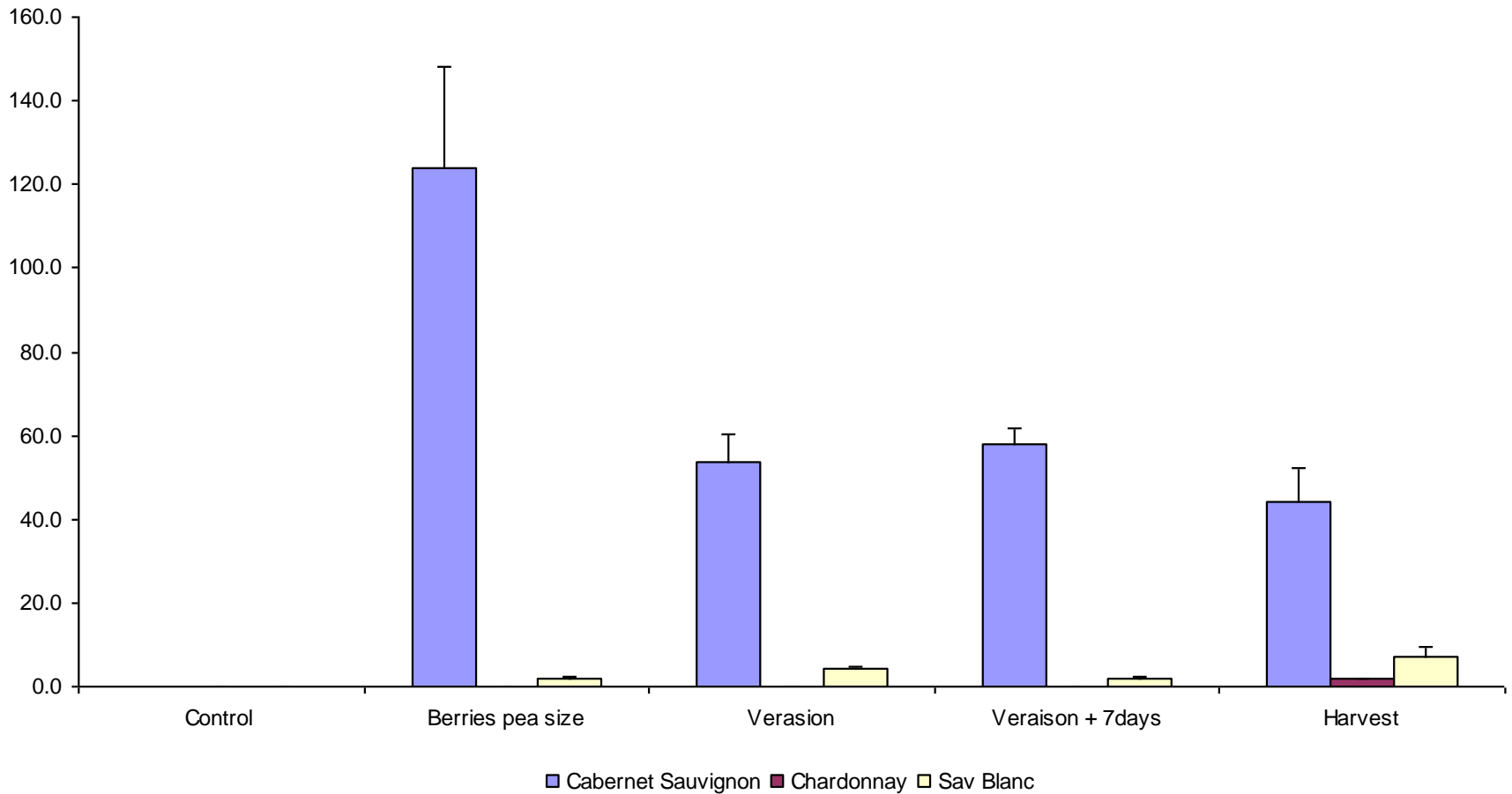
High density (30% obs/m) for 30
min duration



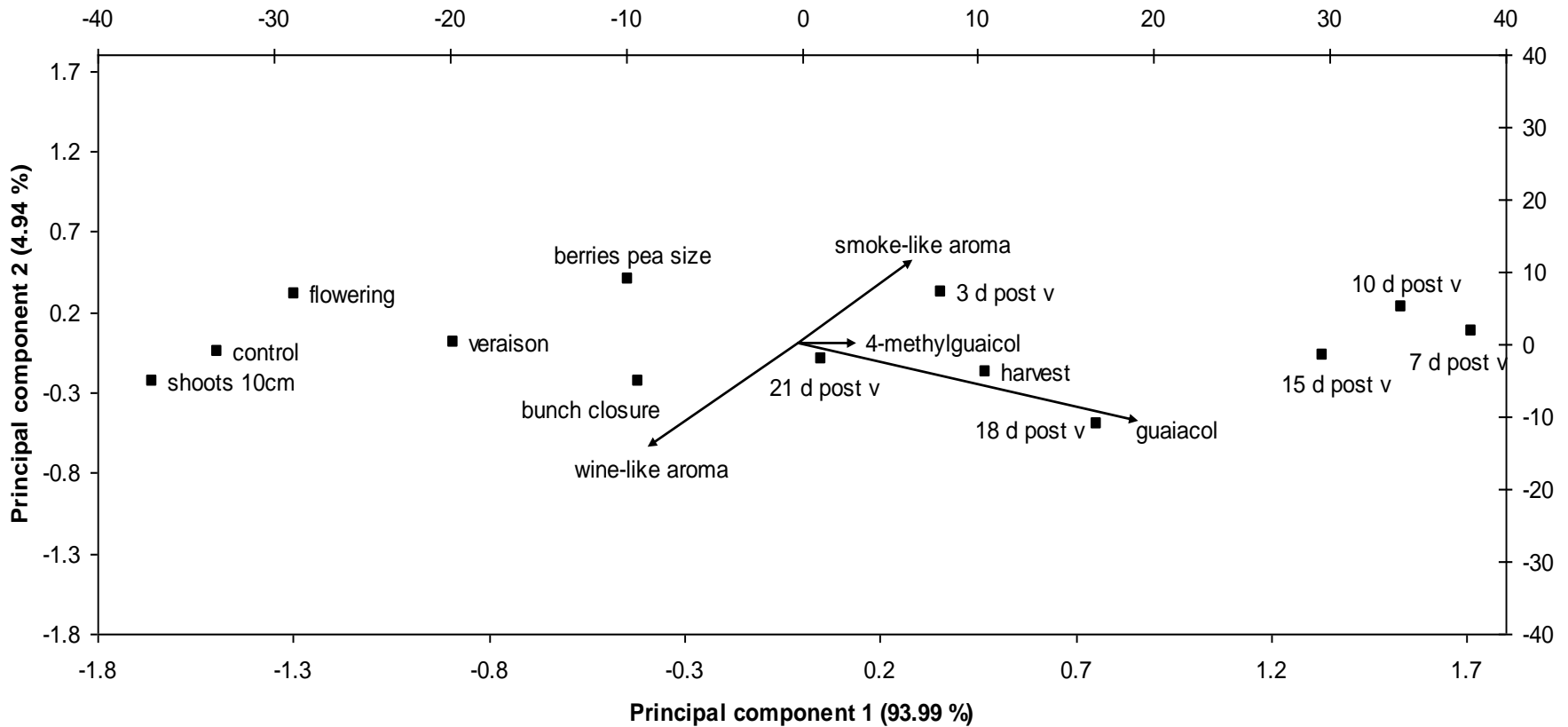
Developing smoke taint risk factors

1. Chemical analysis (GS-MS) of smoke compounds (G, 4MG) in wine
2. Sensory analysis (QDA) of wines by trained panels for 'smoke-like' aromas and 'wine-like' aromas
3. All data collated and analysed by PCA to develop numerical indices as seasonal risk factors for susceptibility of smoke taint in wine
4. PCA data and chemical analysis data compiled to develop smoke taint risk factors for STAR

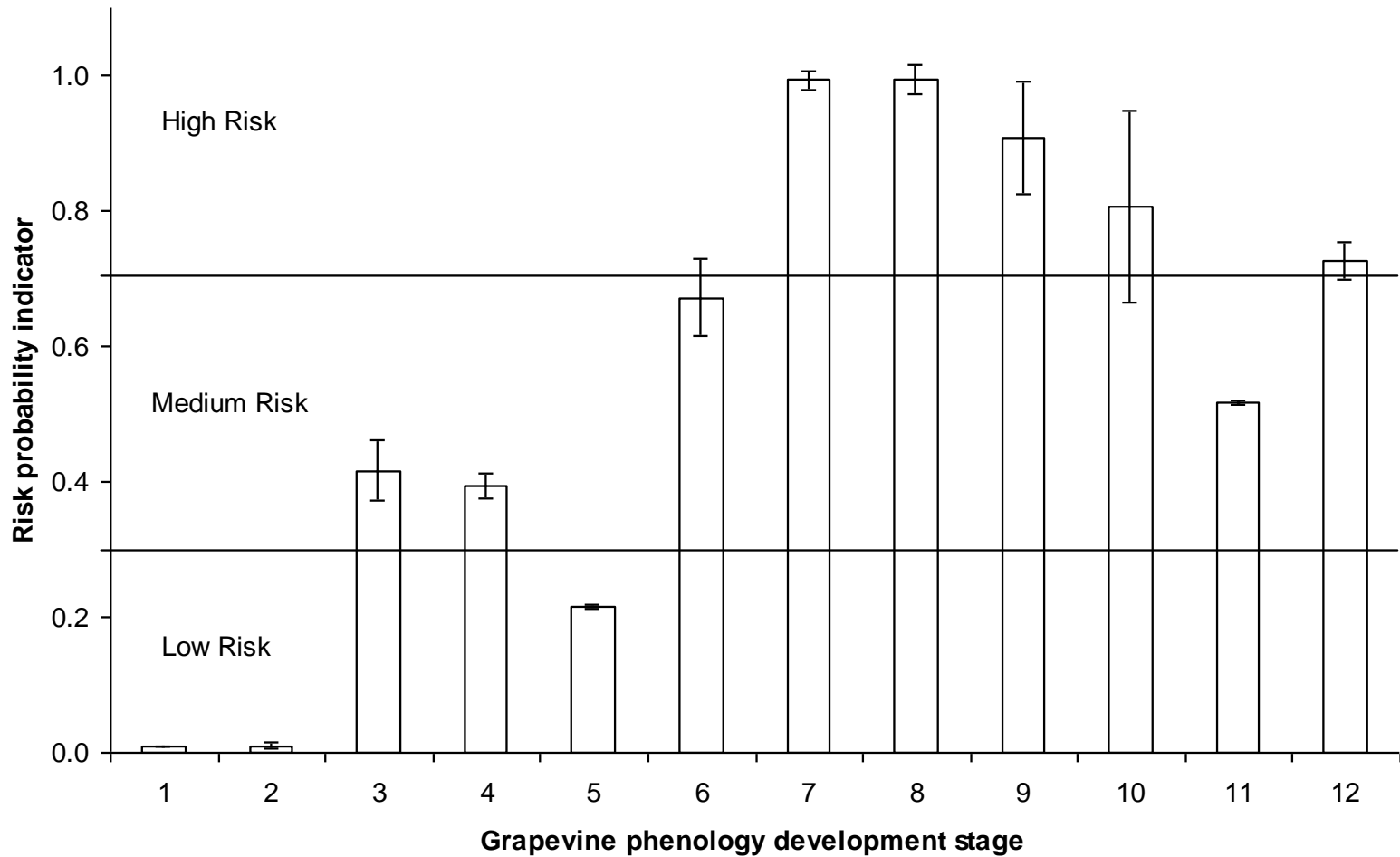
Guaiacol in wines



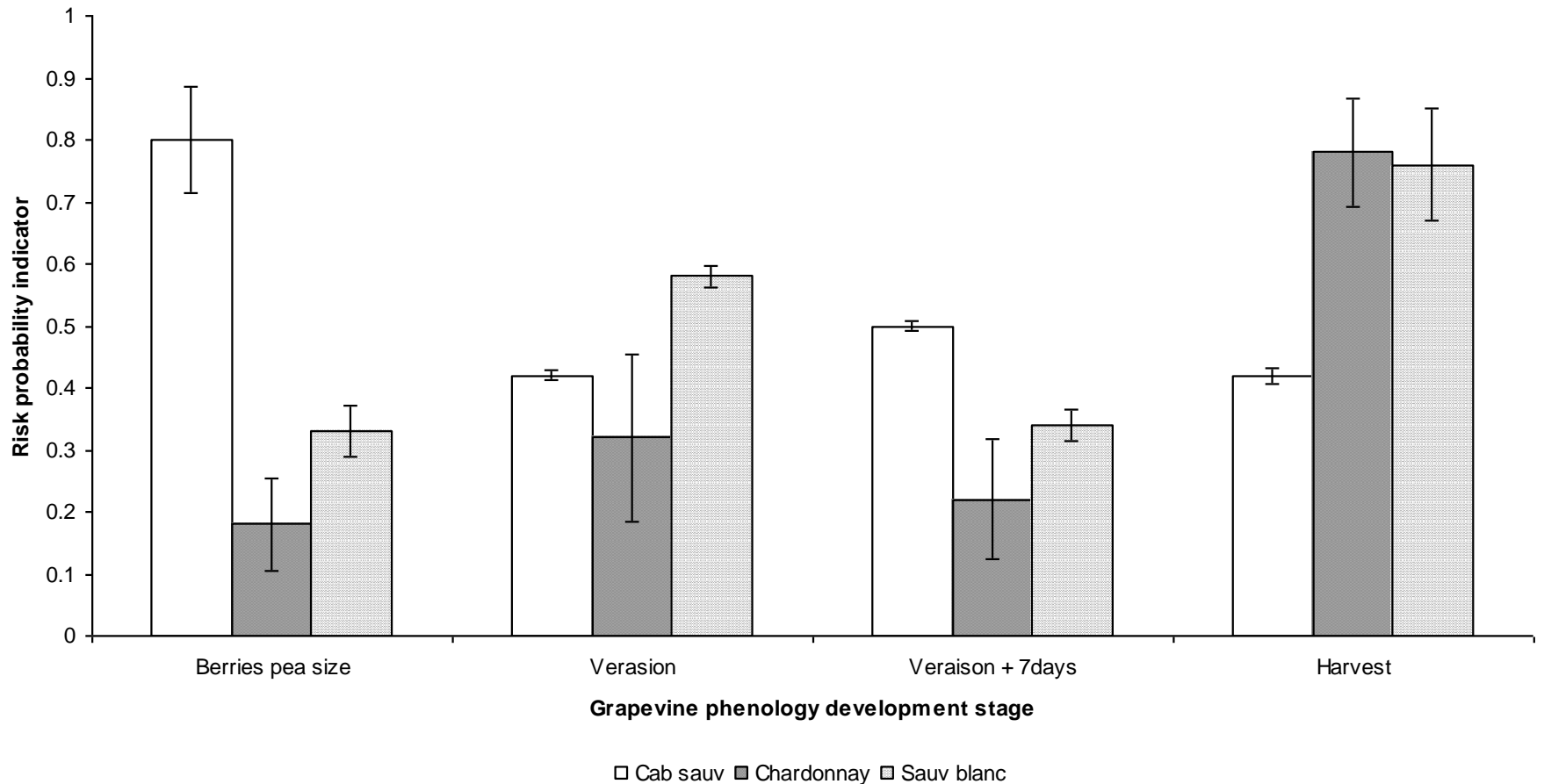
Principal component analysis for Merlot



Smoke taint risk probability for Merlot



Smoke taint risk probability for Cabernet Sauvignon, Chardonnay and Sauvignon Blanc



Predicting grapevine growth stage

Model based on observes historic vineyard phenology records

Use measurements of time between growth stages from previous seasons

But previous seasons had different weather?

Refer to historical weather data between the times of measurement, to determine degree days (cumulative heat) between growth stages

Use this data with the Parker et al. Grapevine Flowering Veraison Phenology Model:

- Degree days
- Base temperature 0°C
- Model start day-of-year 242 days (break of dormancy)



Estimating timing of grapevine growth stages

Grapevine growth and development is driven by temperature

Growth stages vary with variety and weather (ie season, region and site variation)

Historical vineyard phenology records

Grapevine phenology data collected:

Vineyards: 20 +

Regions: 5 (Great Southern, Pemberton, Margaret River, Geographe, Swan Districts)

Varieties: 5 (Merlot, Chardonnay, Cabernet Sauvignon, Sauvignon Blanc, Shiraz, Pinot Noir, Verdhele)

Seasons: Up to 40 years

Growth stages: Up to 12 including: budburst, flowering, fruit set, bunch closure, veraison, ripening, harvest, harvest Baume)

Rootstock: Own roots



What drives STAR?

Growing Degree Days

GROWTH STAGE	E-L stage	Merlot	Cabernet Sauvignon	Chardonnay	Sauvignon Blanc	Shiraz	Pinot Noir
Bud burst	EL4	192	394	175	380	342	266
Shoots 10cm/5 leaves separated	EL12	NA	835	565	826	701	NA
Flowering begins	EL19	1220	1236	1090	1312	1255	1097
Full Bloom/50% cap fall	EL23	1285	1337	1177	1444	1348	1203
Flowering ends, 80% cap fall	EL25	1386	1471	1294	1547	1462	1341
Fruit set/berries pea size	EL31	1652	1972	1730	1871	1983	NA
Bunch closure	EL32	1999	2105	1689	1984	2013	1641
Veraison	EL35	2815	2614	2471	2573	2561	2636
Veraison + 3 days		2874	2678	2531	2635	2623	2696
Veraison + 7 days		2953	2763	2611	2721	2709	2772
Veraison + 10 days		3014	2826	2671	2783	2773	3832
Harvest	EL38	3754	4031	3425	3366	3718	3281

Smoke taint risk factors

GROWTH STAGE	E-L stage	Merlot	Cabernet Sauvignon	Chardonnay	Sauvignon Blanc
Bud burst	EL4	0.00	0.00	0.00	0.00
Shoots 10cm/5 leaves separated	EL12	0.01	0.01	0.01	0.01
Full Bloom/50% cap fall	EL23	0.01	0.01	0.01	0.01
Fruit set/berries pea size	EL31	0.40	0.80	0.18	0.33
Bunch closure	EL32	0.40	0.80	0.18	0.33
Veraison	EL35	0.30	0.42	0.32	0.58
Veraison + 3 days		0.70	0.42	0.32	0.58
Veraison + 7 days		1.00	0.50	0.22	0.34
Veraison + 10 days		1.00	0.50	0.22	0.34
Berries intermediate brix	EL36	0.9	0.50	0.22	0.34
Berries intermediate brix + 3 days		0.8	0.50	0.22	0.34
Berries not quite ripe	EL37	0.50	0.50	0.22	0.34
Harvest	EL38	0.70	0.42	0.78	0.76

Risk profile for Merlot



Weather station
PEMBERTON

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Chardonnay	<input type="text" value="25%"/>	<input type="checkbox"/>
Cabernet Sauvignon	<input type="text" value="25%"/>	<input type="checkbox"/>
Sauvignon Blanc	<input type="text" value="25%"/>	<input type="checkbox"/>

Future weather: Average
 All possibilities Choose

Temperature offset from weather station: 0.0 °C

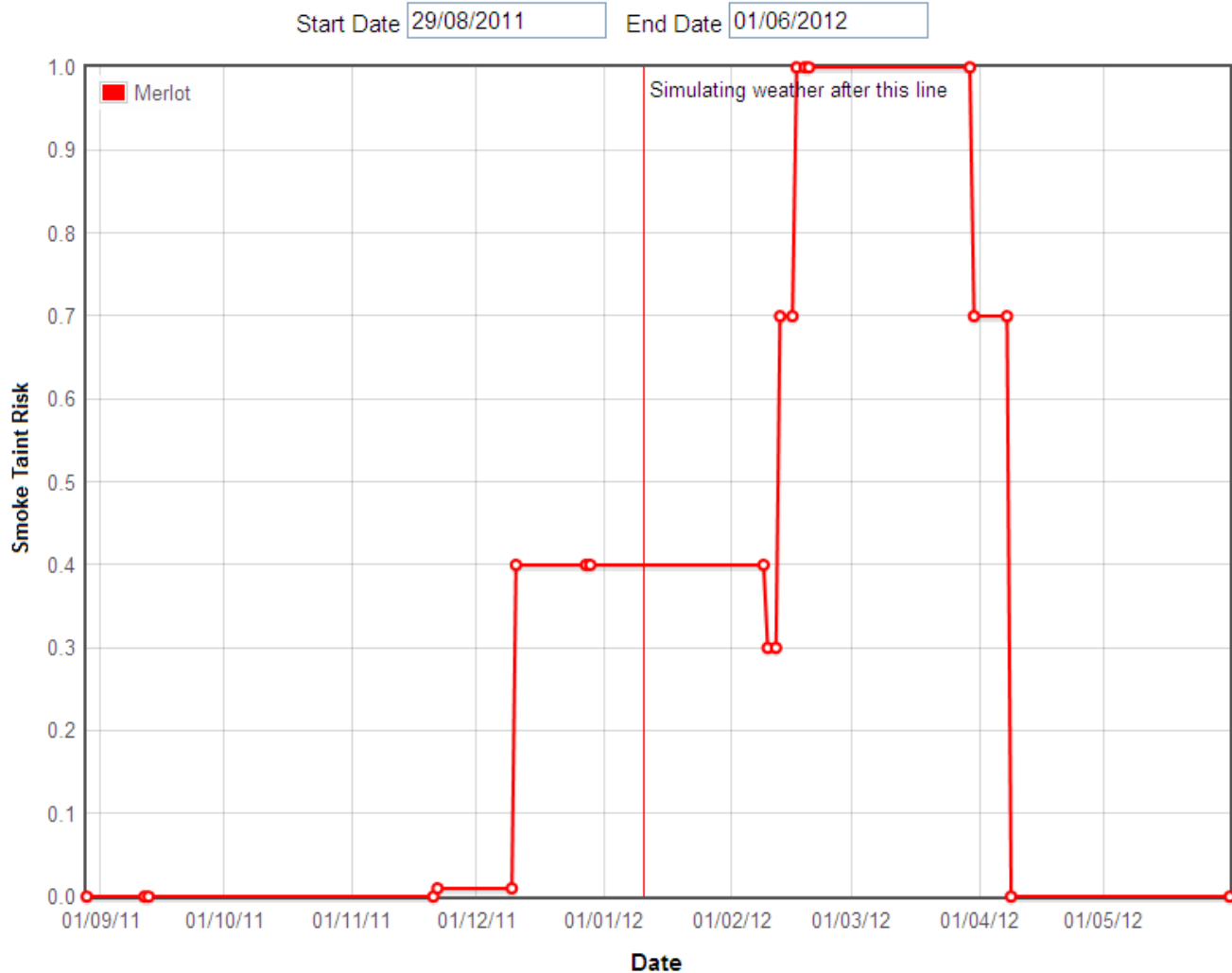
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Data set updated.



Select region and weather station

Weather station
PEMBERTON

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	25%	<input checked="" type="checkbox"/>
Chardonnay	25%	<input type="checkbox"/>
Cabernet Sauvignon	25%	<input type="checkbox"/>
Sauvignon Blanc	25%	<input type="checkbox"/>

Future weather: Average
 All possibilities Choose

Temperature offset from weather station: 0.0 °C

Simulate weather after:
11/01/2012

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Data set updated.

Weather station locator ✕

recorded; for your privacy no other geographic information is sent to DAFWA.

Station: **PEMBERTON**
 Latitude: **-34.44940185546875**
 Longitude: **116.04280090332031**

Map Satellite

01/04/12 01/05/12

Map data ©2012 Google, Whereis(R), Sensis Pty Ltd - [Terms of Use](#) [Report a map error](#)

McAfee

Select varieties



Weather station
MARGARET RIVER POST ...

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	25%	<input checked="" type="checkbox"/>
Chardonnay	25%	<input checked="" type="checkbox"/>
Cabernet Sauvignon	25%	<input checked="" type="checkbox"/>
Sauvignon Blanc	25%	<input checked="" type="checkbox"/>

Future weather: Average
 All possibilities Choose

Temperature offset from weather station: 0.0 °C

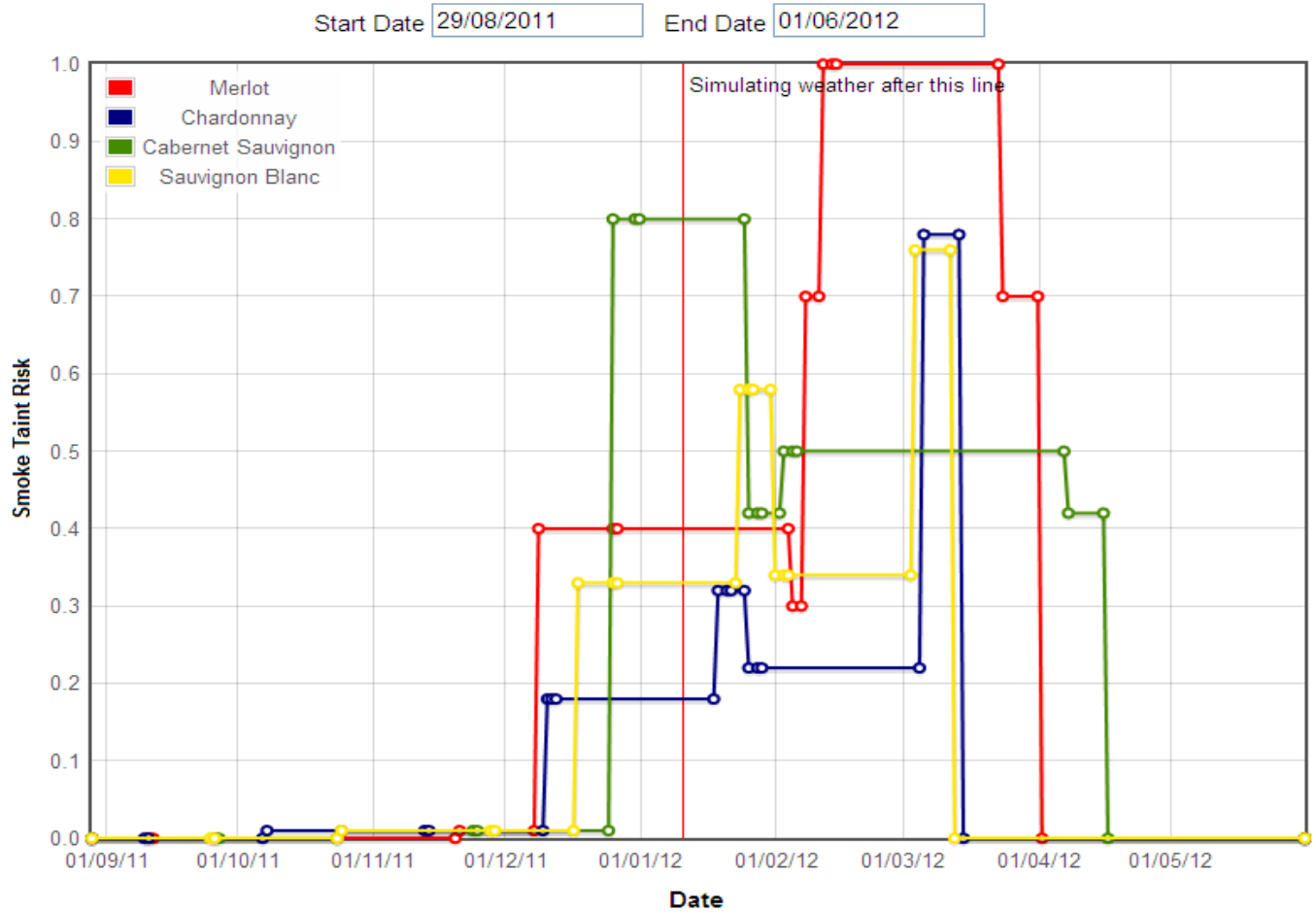
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Charting lines unstacked.



Future weather average

Weather station

Pemberton

Start Date

End Date

Hide variety list

Reset %

Variety	% of total	Plot?
Merlot	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Chardonnay	<input type="text" value="25%"/>	<input type="checkbox"/>
Cabernet Sauvignon	<input type="text" value="25%"/>	<input type="checkbox"/>
Sauvignon Blanc	<input type="text" value="25%"/>	<input type="checkbox"/>

Future weather: Average

All possibilities Choose



Temperature offset from weather station: 0.0 °C



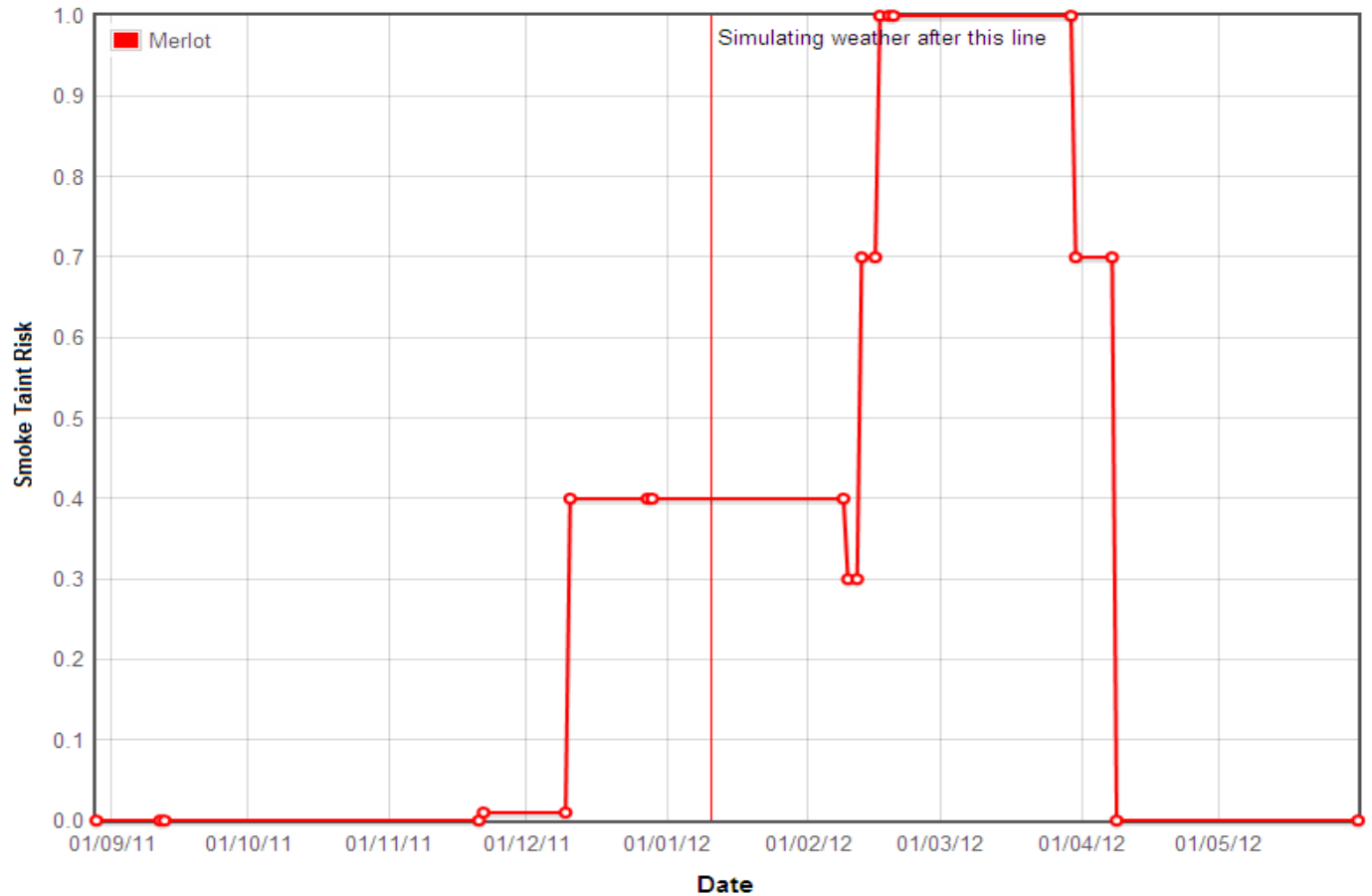
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Charting lines unstacked.



Future weather very hot

Weather station
Pemberton

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	25%	<input checked="" type="checkbox"/>
Chardonnay	25%	<input type="checkbox"/>
Cabernet Sauvignon	25%	<input type="checkbox"/>
Sauvignon Blanc	25%	<input type="checkbox"/>

Future weather: Very hot
 All possibilities Choose

Temperature offset from weather station: 0.0 °C

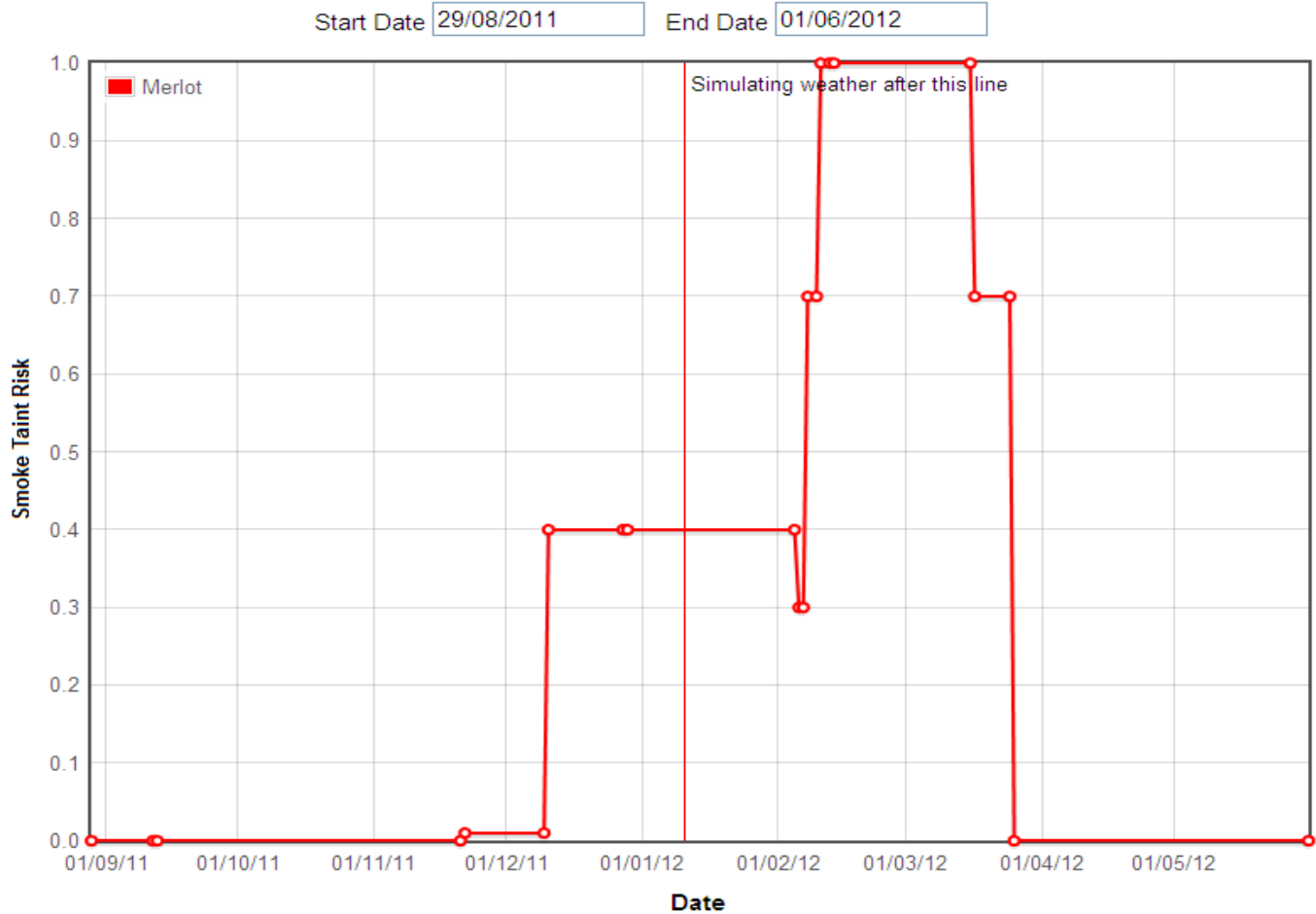
Simulate weather after:
11/01/2012

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Data set updated.



Future weather very cold

Start Date End Date

Weather station

Pemberton

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Chardonnay	<input type="text" value="25%"/>	<input type="checkbox"/>
Cabernet Sauvignon	<input type="text" value="25%"/>	<input type="checkbox"/>
Sauvignon Blanc	<input type="text" value="25%"/>	<input type="checkbox"/>

Future weather: Very cold

All possibilities Choose

Temperature offset from weather station: -1 °C

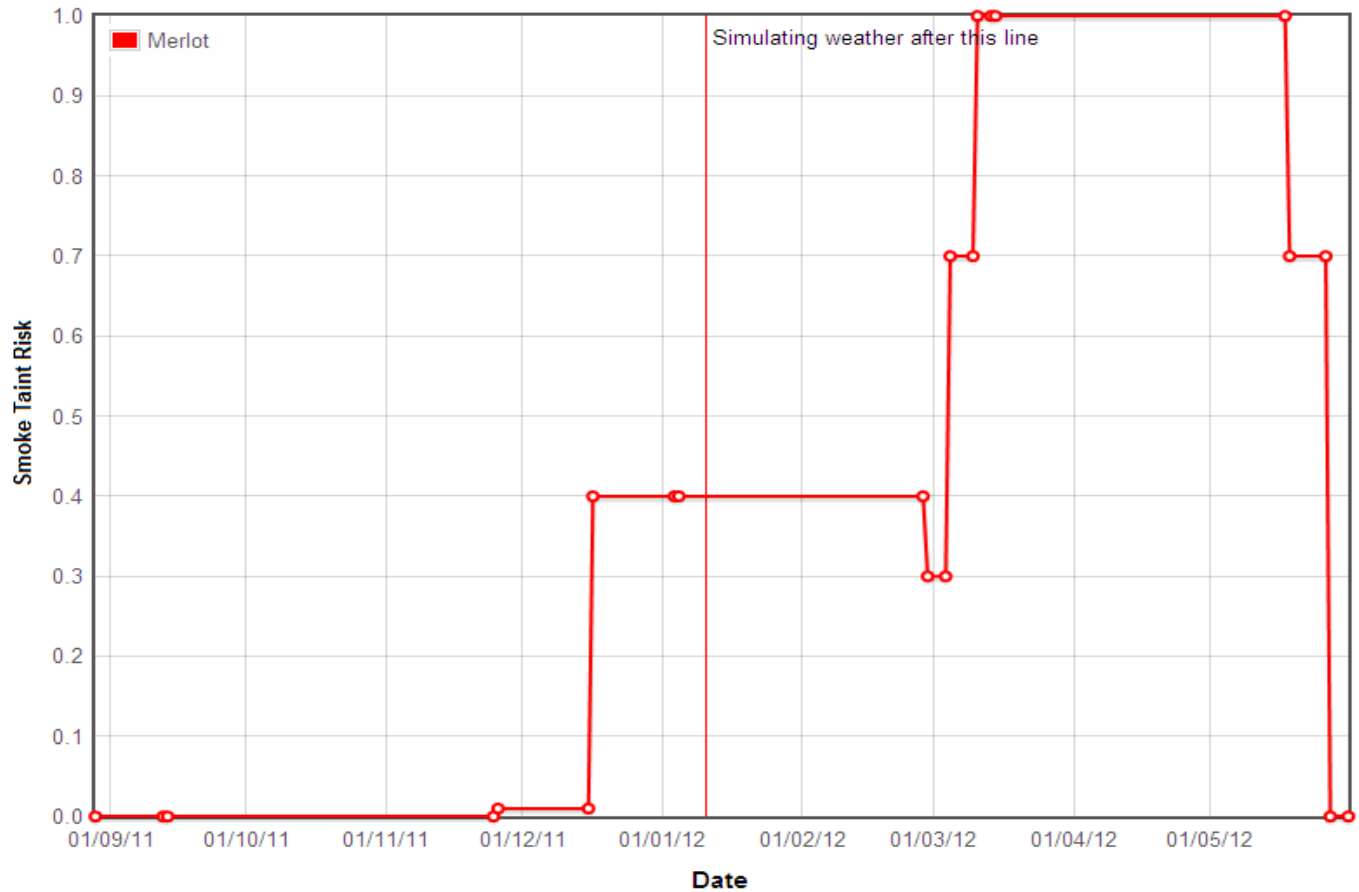
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Data set updated.



Multiple varieties individual risks

Start Date End Date

Weather station

Pemberton

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Chardonnay	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Cabernet Sauvignon	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Sauvignon Blanc	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>

Future weather: Average
 All possibilities Choose



Temperature offset from weather station: 0 °C



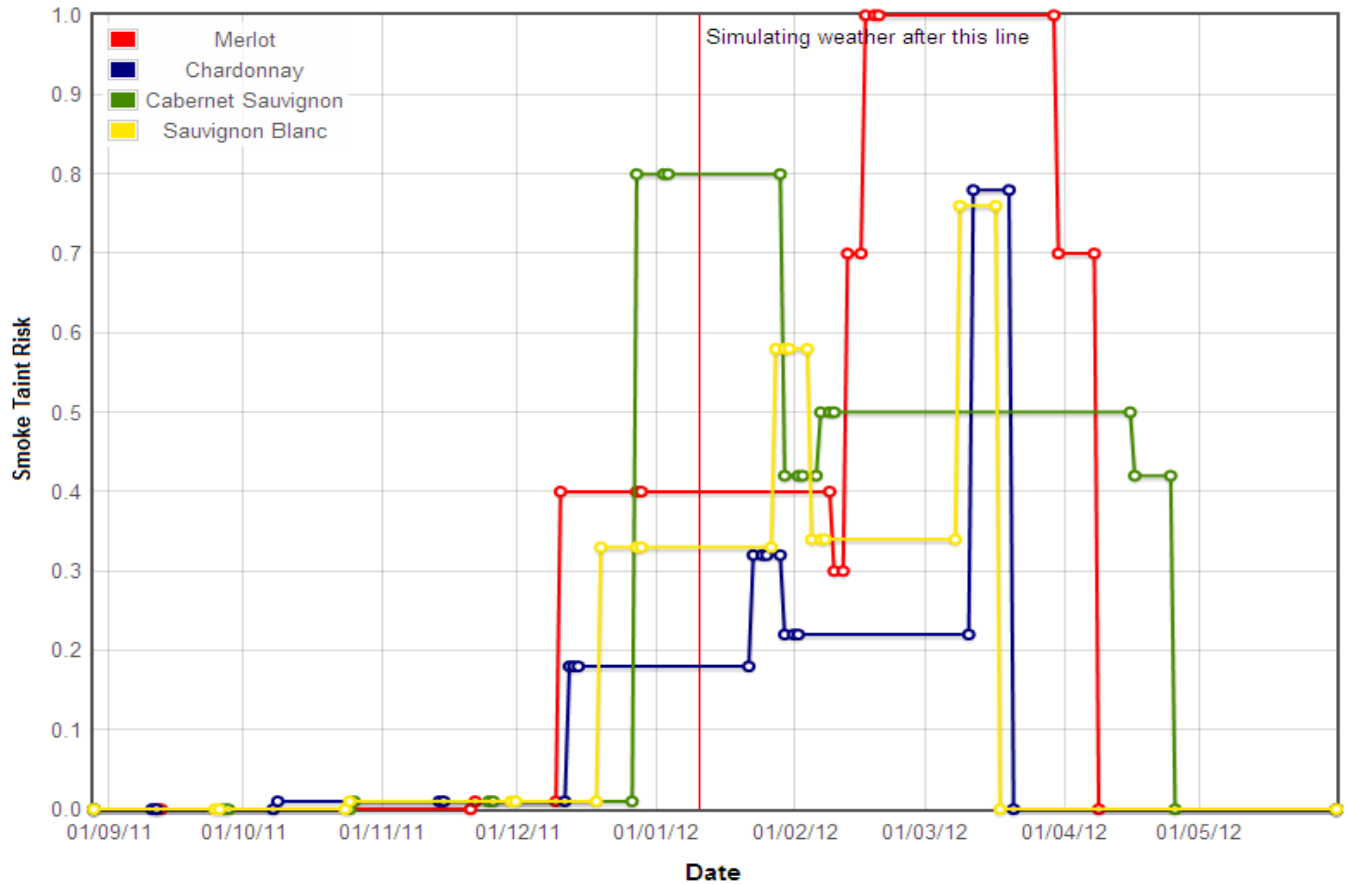
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Data set updated.



Multiple varieties stacked risk

Weather station

Pemberton

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Chardonnay	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Cabernet Sauvignon	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Sauvignon Blanc	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>

Future weather: Average

All possibilities Choose



Temperature offset from weather station: 0 °C



Simulate weather after:

Show chart legend

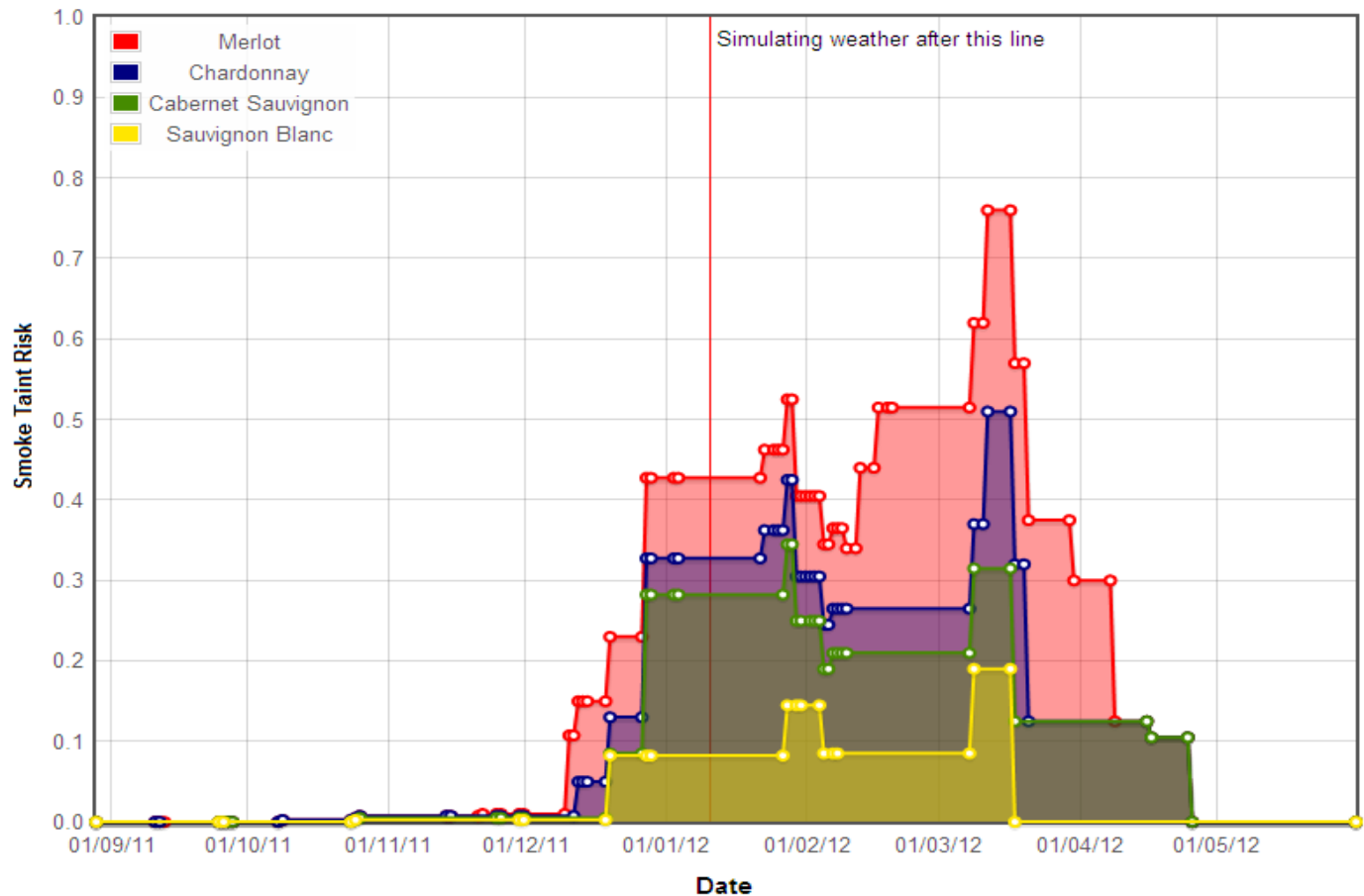
Individual
 Stacked
 Total

Show chart data in a table

Stacking chart lines.

Start Date

End Date



Multiple varieties total risk

Weather station

Pemberton

Start Date

End Date

Hide variety list

Reset %

Variety	% of total	Plot?
Merlot	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Chardonnay	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Cabernet Sauvignon	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>
Sauvignon Blanc	<input type="text" value="25%"/>	<input checked="" type="checkbox"/>

Future weather: Average

All possibilities Choose



Temperature offset from weather station: 0 °C



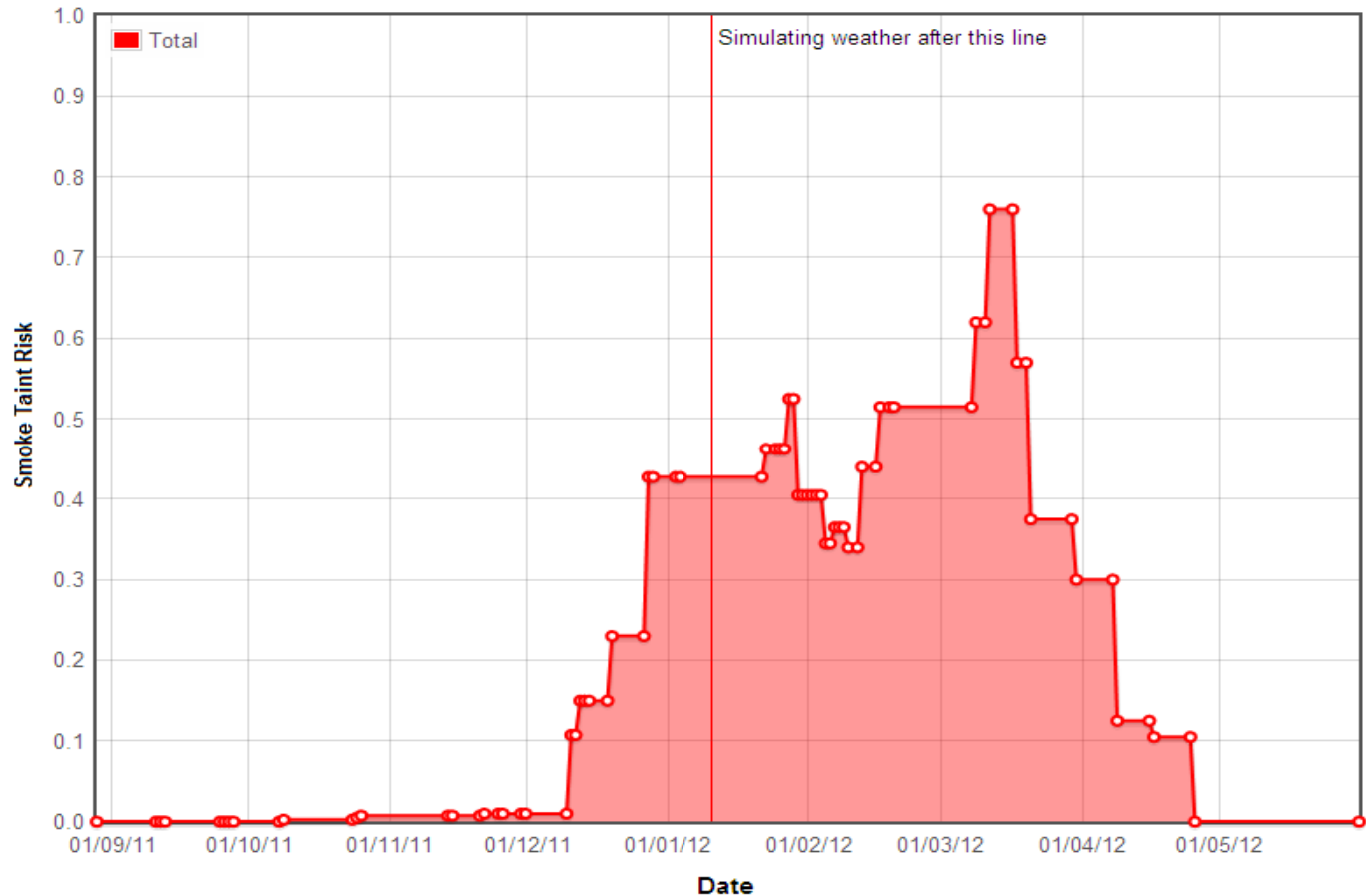
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Charting total risk only.



Future weather all possibilities

Weather station
Pemberton

Hide variety list Reset %

Variety	% of total	Plot?
Merlot	25%	<input checked="" type="checkbox"/>
Chardonnay	25%	<input checked="" type="checkbox"/>
Cabernet Sauvignon	25%	<input checked="" type="checkbox"/>
Sauvignon Blanc	25%	<input checked="" type="checkbox"/>

Future weather:
 All possibilities Choose

Temperature offset from weather station: 0 °C

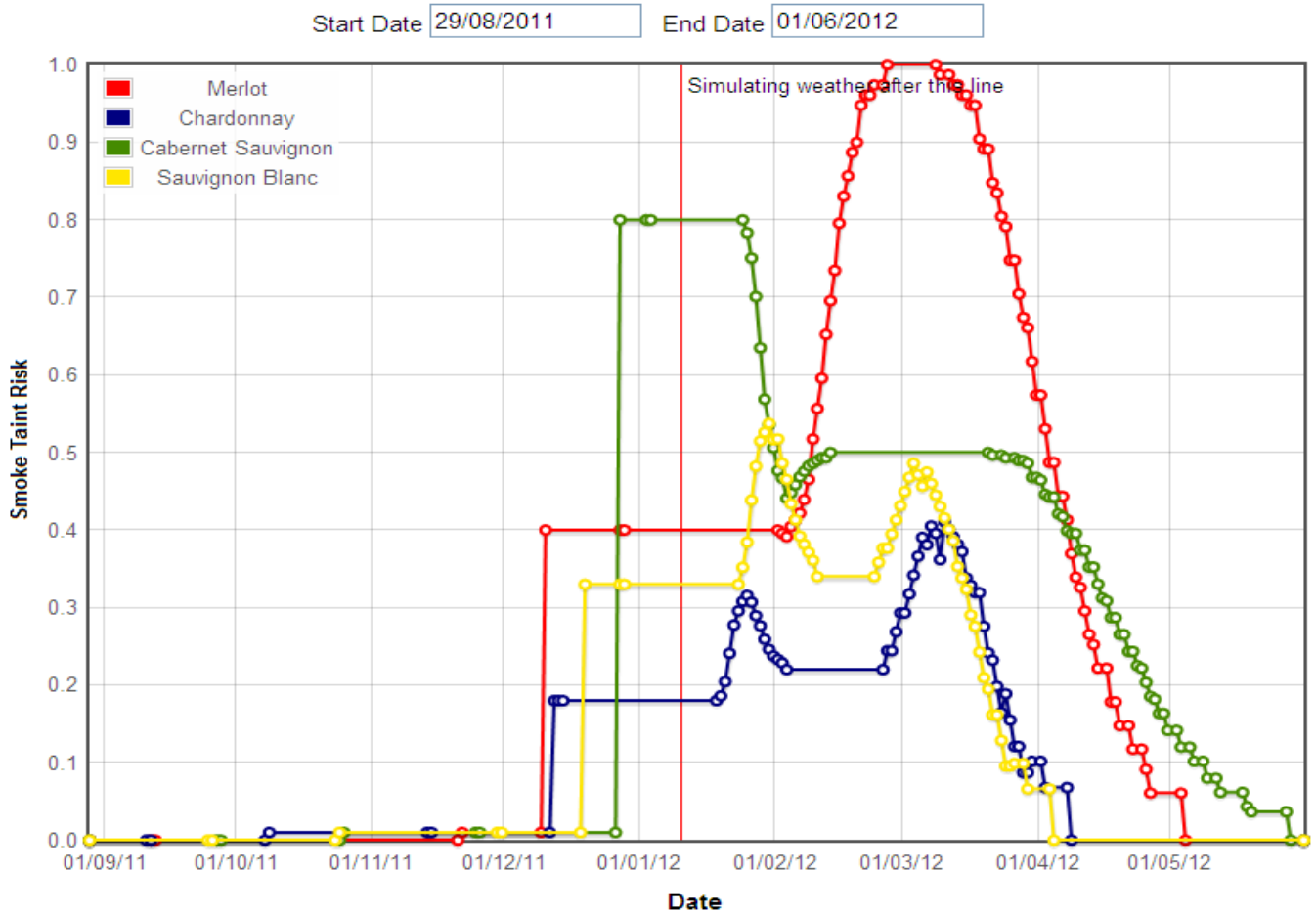
Simulate weather after:

Show chart legend

Individual
 Stacked
 Total

Show chart data in a table

Data set updated.



Summary

STAR will automatically simulate grape growth stages, and from that predict a time series of likely smoke taint risk

It can be used for any weather station in South-Western WA

It can use real weather data where available, and predict using simulated weather of any decile (or an average of all deciles)

It can simulate the effects of an average temperature difference between a vineyard and its closest weather station, and

It uses a sensible default date range, and allows selection of any date range (1 year max).

Future work

STAR accessible on external website (July/August 2012)

National workshops to demonstrate STAR and other information in toolkit (September 2012)

Improve robustness, applicability and update STAR model

- include weather data for other Australian wine growing regions
- continue research with other varieties
- historical phenology data from more vineyards and regions
- include other risk factors (eg rootstocks)

Acknowledgements



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Our environment, our future



WINE
INDUSTRY
ASSOCIATION
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Thank you

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Or find me during the symposium