Reducing vulnerability to a changing climate in Australian temperate fruit tree industries

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Queensland Government

Horticulture is diverse

Crops	Fruit, vegetables, nuts, flowers, turf, nursery products
Location	Climates, soils, pest/disease profiles, community/social structure
Growing systems	protected cropping, open field, hydroponics,
Business structure	Small family farms to large multi-national companies
Supply/value chains	Pathway from farm-gate to consumer
Challenges	labour, water, markets, profitability, competition with imported and processed produce, pest and disease, AND climate

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Key climate change risks: warmer temperatures impacting on….

pollination success due to reduced flower viability, and changes in flowering time and bee Behaviour

winter chill, resulting in delayed and variable flowering

pest and disease pressure through changes in geographical range, generation number, activity and winter mortality

bud initiation and development

fruit quality through effects on growth/ size, colour, sunburn and storage life

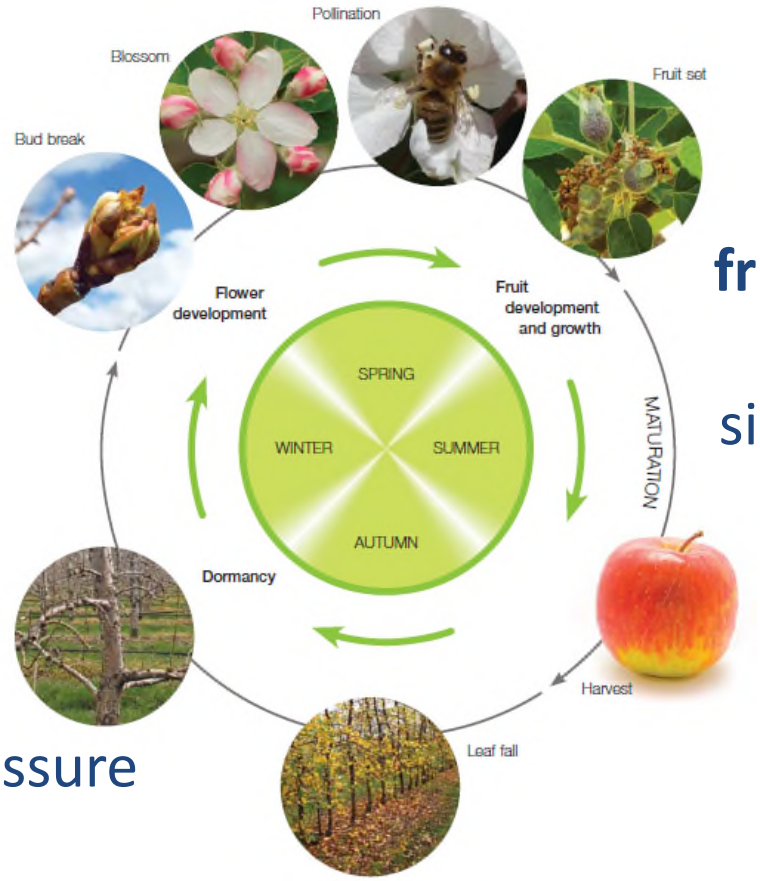
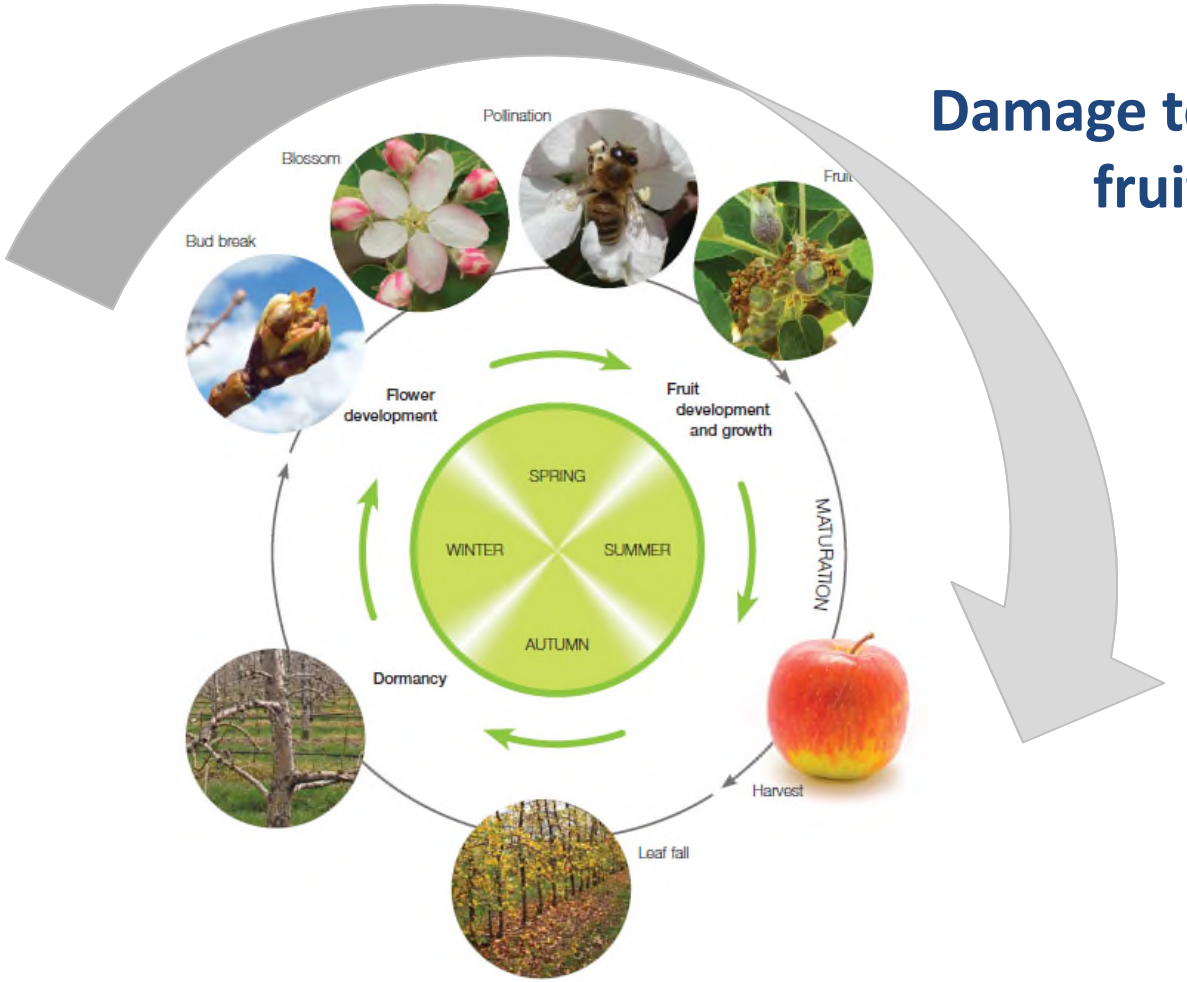


Figure of annual cycle: PICCC Research Fact Sheet "*Winter chill and fruit trees*"
http://www.piccc.org.au/resource/fact-sheets/670

Key climate change risks: increased incidence of extreme rain/hail events causing….



Damage to flowers, fruit and tree canopies

Figure of annual cycle: PICCC Research Fact Sheet "*Winter chill and fruit trees*"
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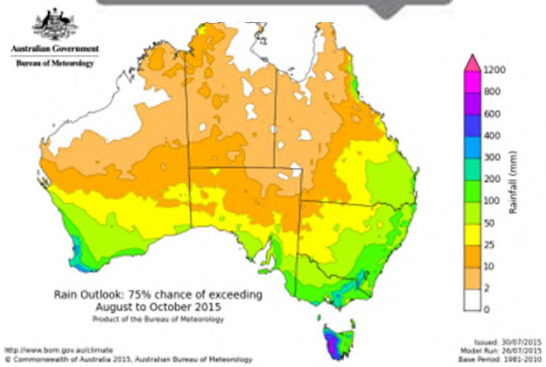
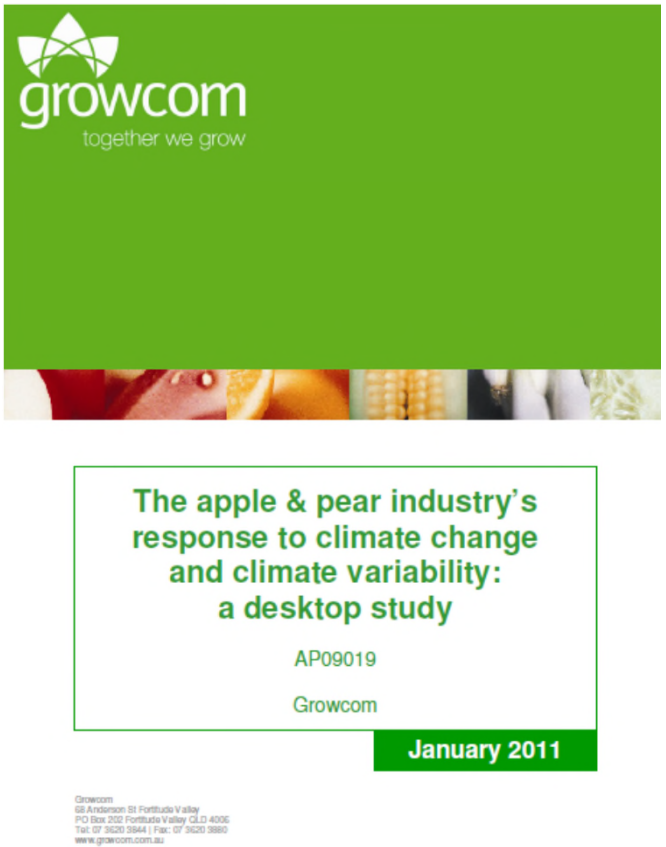
What is the capacity for adaptation?

- Orchard re-location
- Variety selection
- Plant Growth Regulators
- Improved within season forecasting
- Netting
- Evaporative cooling
- Spray-on protectants



How is the Apple and Pear Industry responding to these risks and reducing vulnerability to the changing climate?



A desktop study investigating:

- regional climate change projections for 2030,
- potential impacts on apple and pear production,
- possible adaptation strategies,
- priority areas for further research and development

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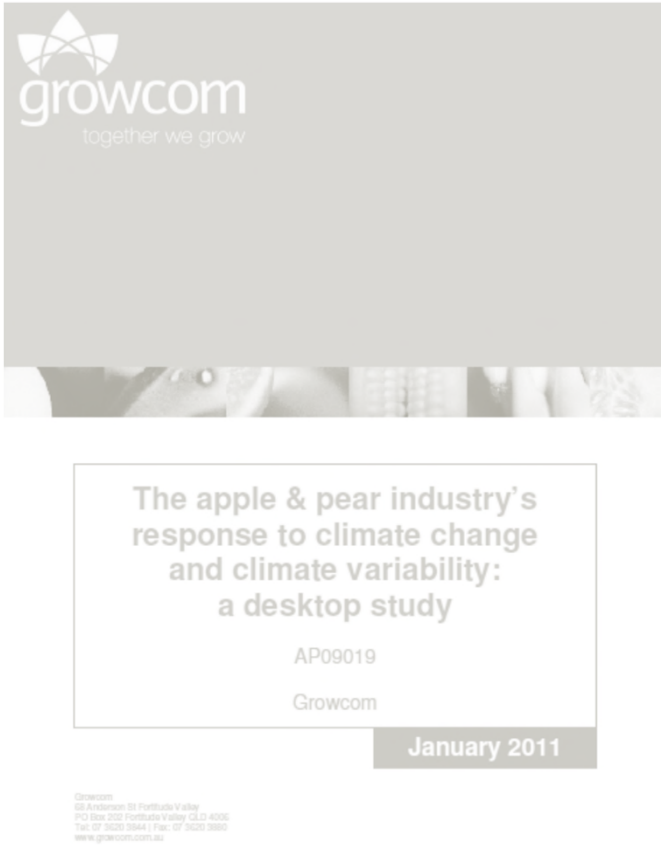

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apal

Horticulture Innovation Australia

Understanding apple and pear production systems in a changing climate

AND

Australian Government
Department of Agriculture and Water Resources

Crossing the threshold: adaptation tipping points for Australian fruit trees

How will reduced winter chill impact on productivity of different varieties of apple and pear?

How much chill is enough? Need to define **chill requirements** for different varieties of apple and pear.

Lowest

Sundowner™
Manchurian Crab Apple

RS103-110
Granny Smith
Pink Lady™
Kalei
Gala, Fuji, Red Delicious

Highest

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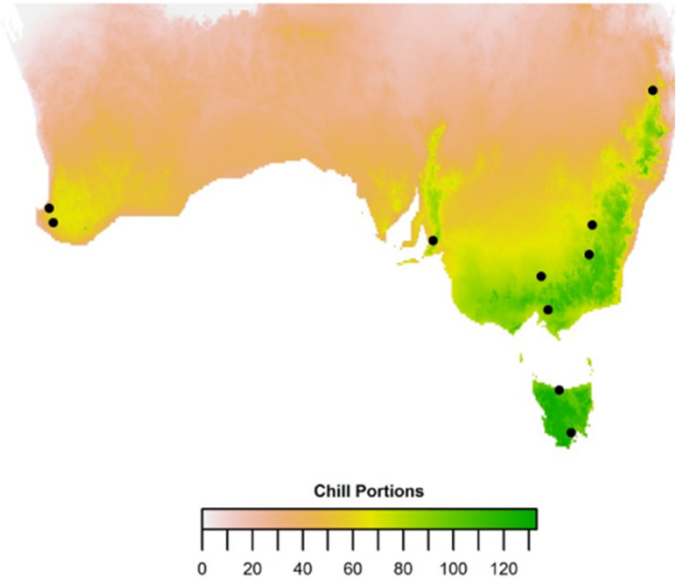

Map courtesy of Dr Rebecca Darbyshire

How will reduced winter chill impact on productivity of different varieties of apple and pear?

How will reduced winter chill impact on flowering? A climate analogue approach.

Case study: Stanthorpe, QLD

1. *How will flowering and productivity of apple and pear trees be impacted by reduced winter chill in Stanthorpe in 2030?*

2. *What can growers do to adapt?*

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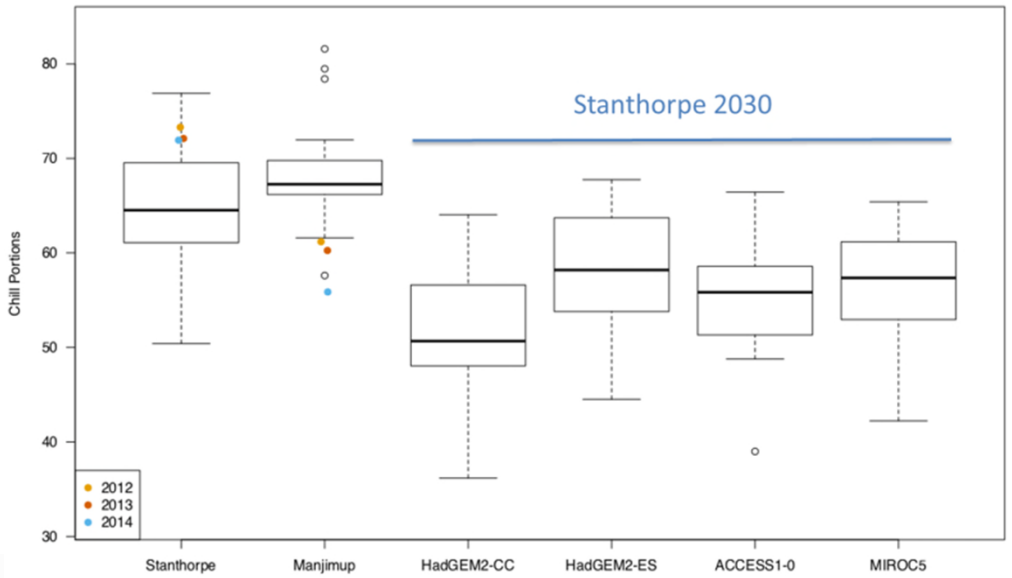
Manjimup, Western Australia 34.24 ºS, 116.14 ºE

Present

Stanthorpe, Queensland 28.62 ºS, 151.96 ºE

2030



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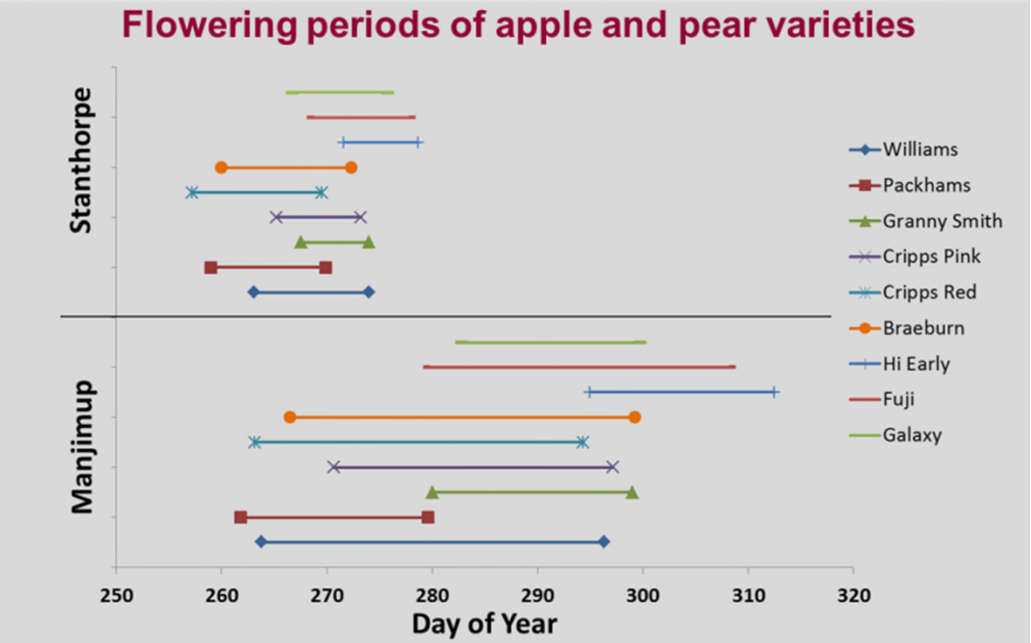

More variable and protracted pattern of flowering in Manjimup, but,
no evidence for loss in productivity.

How will reduced winter chill impact on productivity of different varieties of apple and pear?

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Case study: Stanthorpe, QLD

1. *How will flowering and productivity of apple and pear trees be impacted by reduced winter chill in Stanthorpe in 2030?*

2. *What can growers do to adapt?*

50% of Manjimup growers are using dormancy-breaking sprays on some varieties.

No clear differences in plantings of new varieties.

How will reduced winter chill impact on productivity of different varieties of apple and pear?

How will reduced winter chill impact on flowering? A climate analogue approach.

Case study: Stanthorpe, QLD

1. *How will flowering and productivity of apple and pear trees be impacted by reduced winter chill in Stanthorpe in 2030?*

2. *What can growers do to adapt?*

→ More variable and protracted pattern of flowering across most varieties

How can the timing and quality of flowering impact productivity?

How will reduced winter chill impact on productivity of different varieties of apple and pear?

How will reduced winter chill impact on flowering? A climate analogue approach.

Case study: Stanthorpe, QLD

1. *How will flowering and productivity of apple and pear trees be impacted by reduced winter chill in Stanthorpe in 2030?* → More variable and protracted pattern of flowering across most varieties, but, with no clear negative impact on productivity.

2. *What can growers do to adapt?* → Use of dormancy-breaking sprays. No clear need to shift to different varieties.

How will the increased frequency of extreme heat events impact on the incidence of fruit sunburn?

Darbyshire et al. 2015. *New Zealand Journal of Crop and Horticultural Science*. http://dx.doi.org/10.1080/01140671.2015.1034731

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Define the fruit surface temperatures that lead to sunburn (variety specific)

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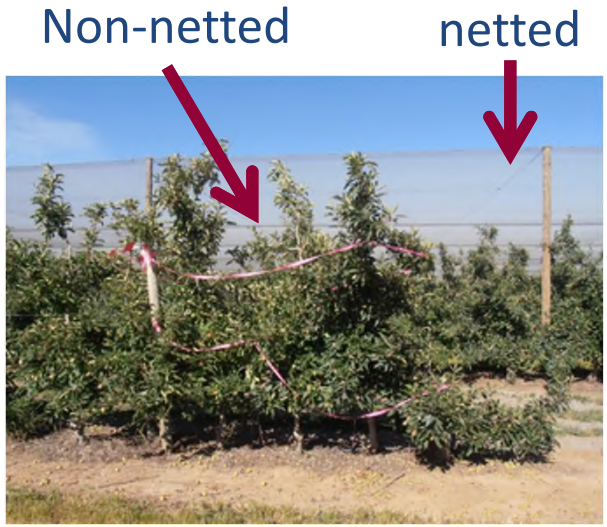

Define the air temperatures, with and without netting, that result in fruit surface temperatures above these thresholds

Define the fruit surface temperatures that lead to sunburn (variety specific)

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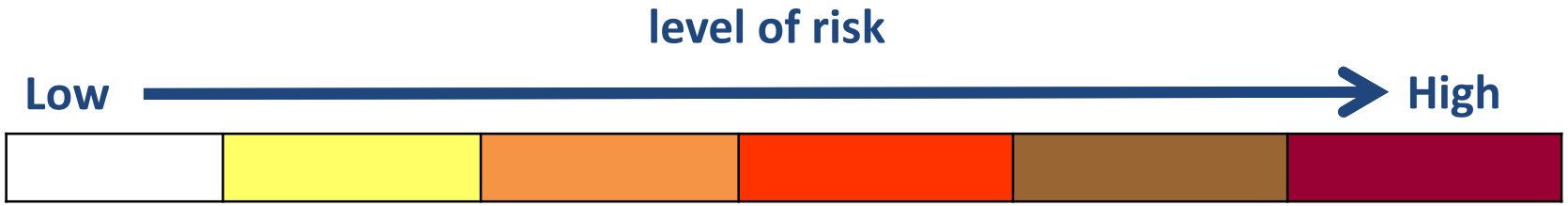
How will the increased frequency of extreme heat events impact on the incidence of fruit sunburn?

Number of potential sunburn days in January, Young NSW [median (10th to 90th percentile)]

	1995	2030	2050	2090
Non-netted	9.0 (1.2 to 16.0)	13.3 (2.6 to 20.2)	15.4 (3.8 to 22.7)	17.8 (5.8 to 24.9)
Netted	2.0 (0.0 to 5.9)	3.9 (0.0 to 9.0)	5.4 (0.5 to 11.5)	7.8 (1.1 to 14.2)



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What are the industry and on-farm benefits from this research and extension?

Scale of benefit	Description of benefits
Broad	Improved industry knowledge around climate change, how it might impact productivity and profitability, and the capacity of growers to adapt Making climate change information meaningful
Long-term planning	Transition to lower chill varieties or crops Change farm location Diversification
Medium-term planning	Installation of netting, evaporative cooling systems Varietal mix- which varieties to plant/graft? Information on varietal chill requirements and sunburn risk supports decisions around varietal choice
Short term in-season decision making	Use of plant growth regulators to break dormancy, or improve fruit quality during hot conditions Irrigation scheduling Crop load and canopy management

What are the industry and on-farm benefits from this research and extension?

And an additional benefit that's hard to quantify…

Increased awareness leads to increased levels of daily observation out in the orchard which has many benefits

- Early warning of changes in variety performance

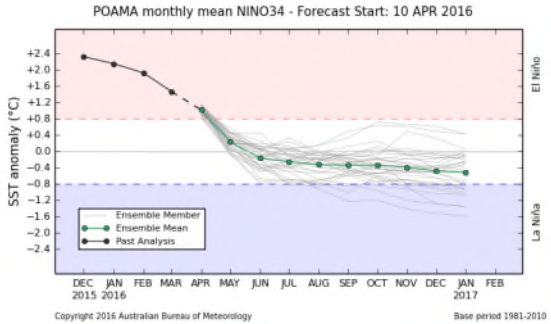
- Improved level of response to climate variability
- Improved collective knowledge (local and national) and ability to adapt
- And hopefully…more data sets for research in the longer term

Where are the research, development and extension gaps? Part 1

Regional climate projections

(www.climatechangeinAustralia.gov.au)

Multi-week to seasonal forecasts



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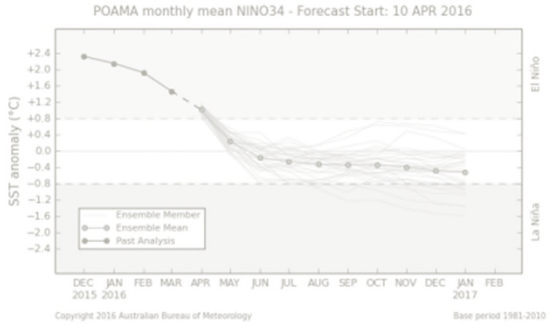

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Metrics for horticultural crops

winter chill

growing degree days

Biological thresholds

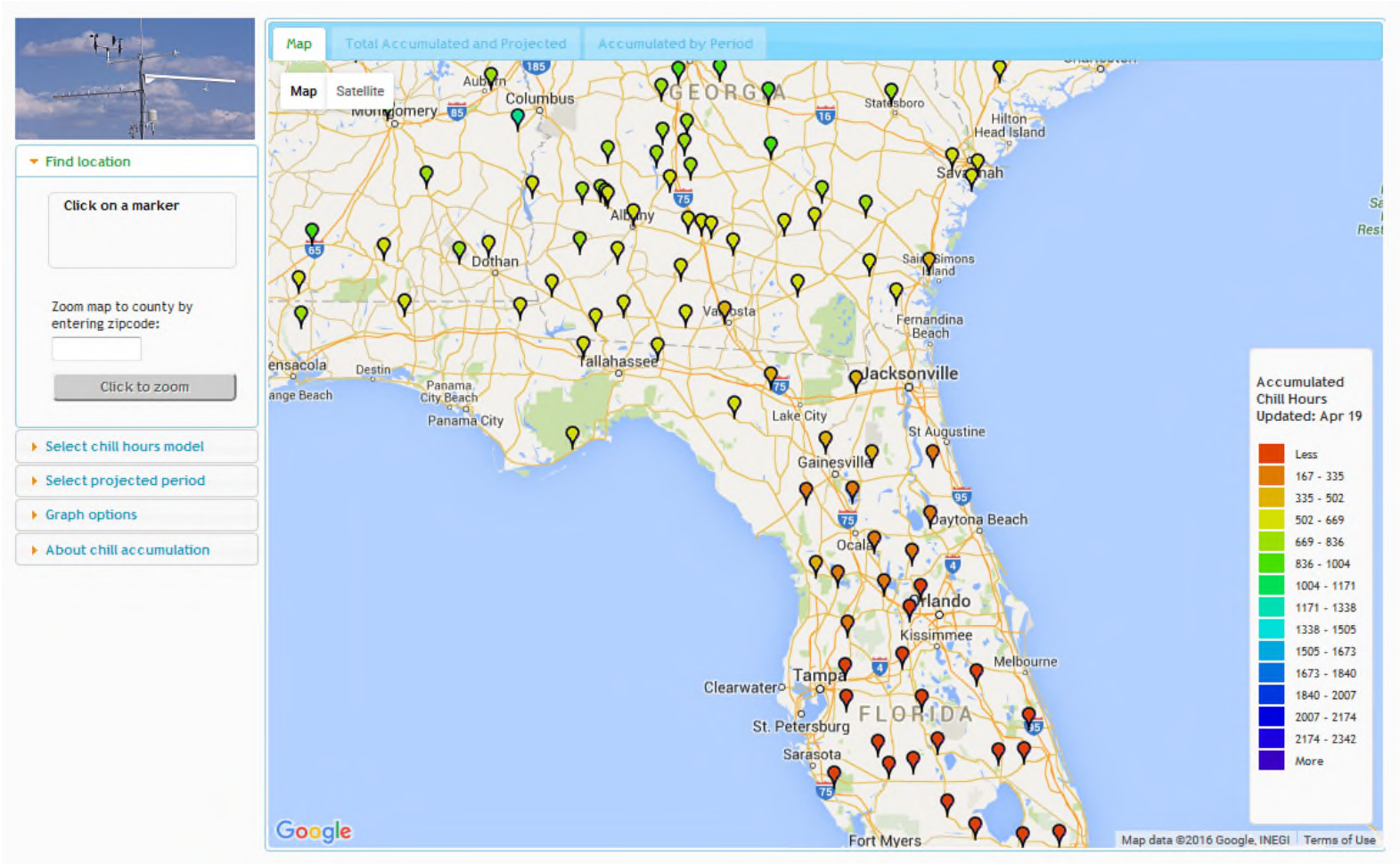
Chill requirements

Fruit surface temperatures for sunburn

Pest and disease development

On-farm decision making: in-season and longer term

Example: a tool that can provide useful metrics for horticultural crops



http://agroclimate.org/tools/Chill-Hours-Calculator/

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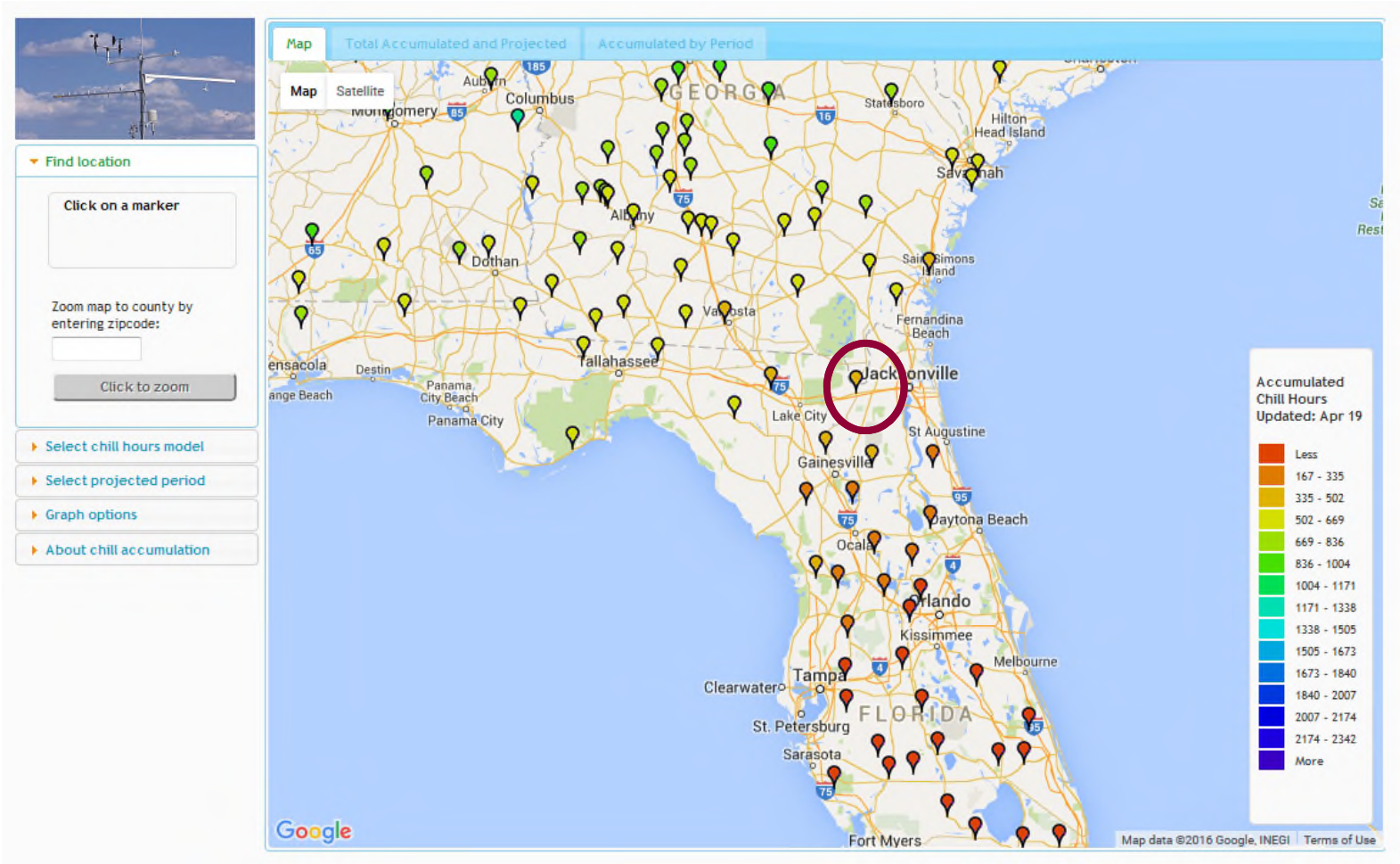

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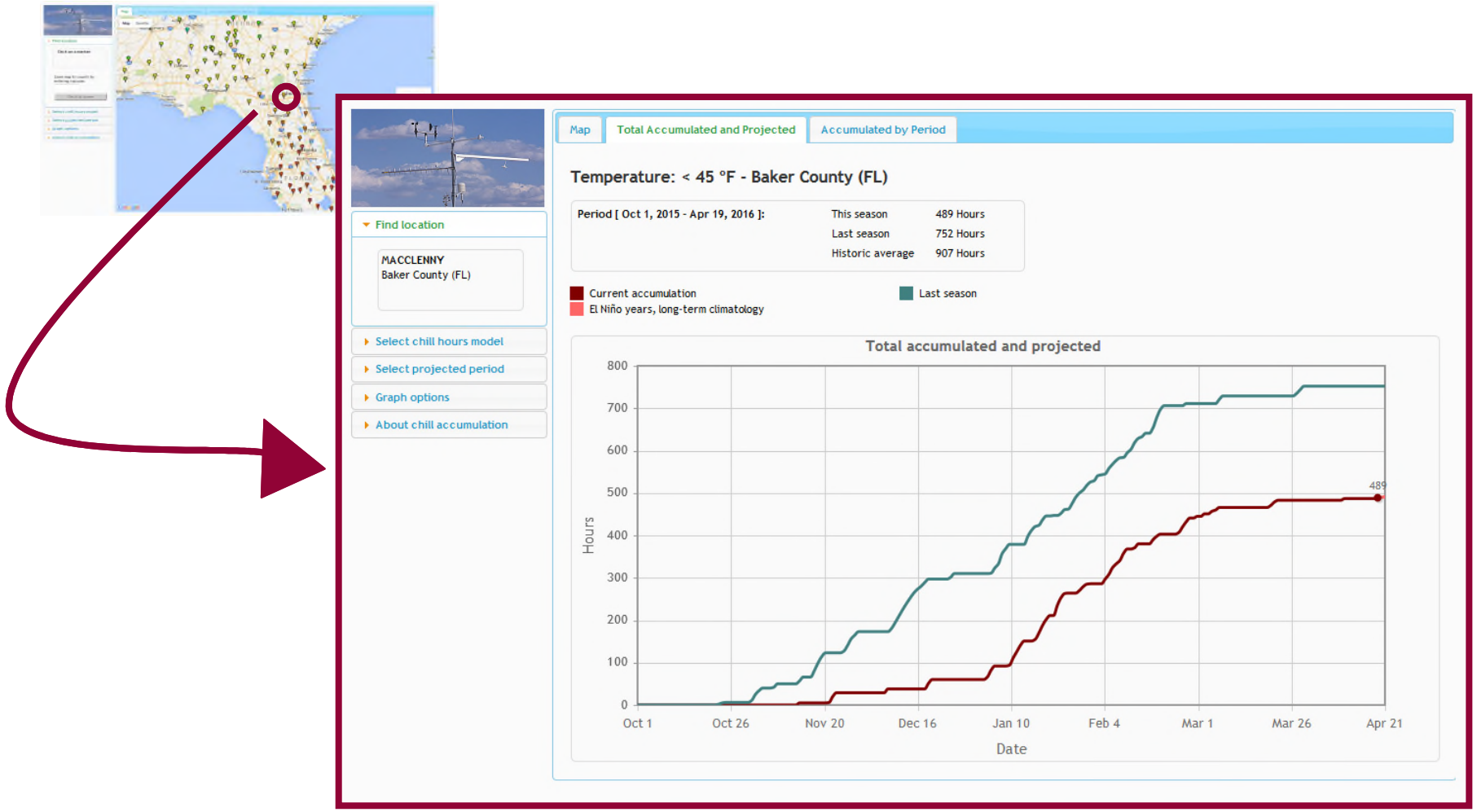

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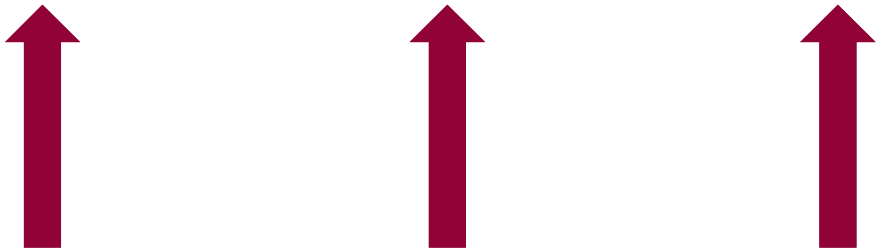
Where are the research, development and extension gaps? Part 2

Some other desirable industry outcomes…

Orchard practice guidelines for **managing extreme heat** (tree canopy structure, use of evaporative cooling, netting types, irrigation, nutrition etc.)

Orchard practice guidelines for **optimising post harvest fruit quality** in warm to hot summer/autumn conditions (pre and post harvest management)



Delivery requires a mix of basic and applied research, extension and communication

Project Team and funding organisations

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Department of Economic Development, Jobs, Transport & Resources Victoria
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