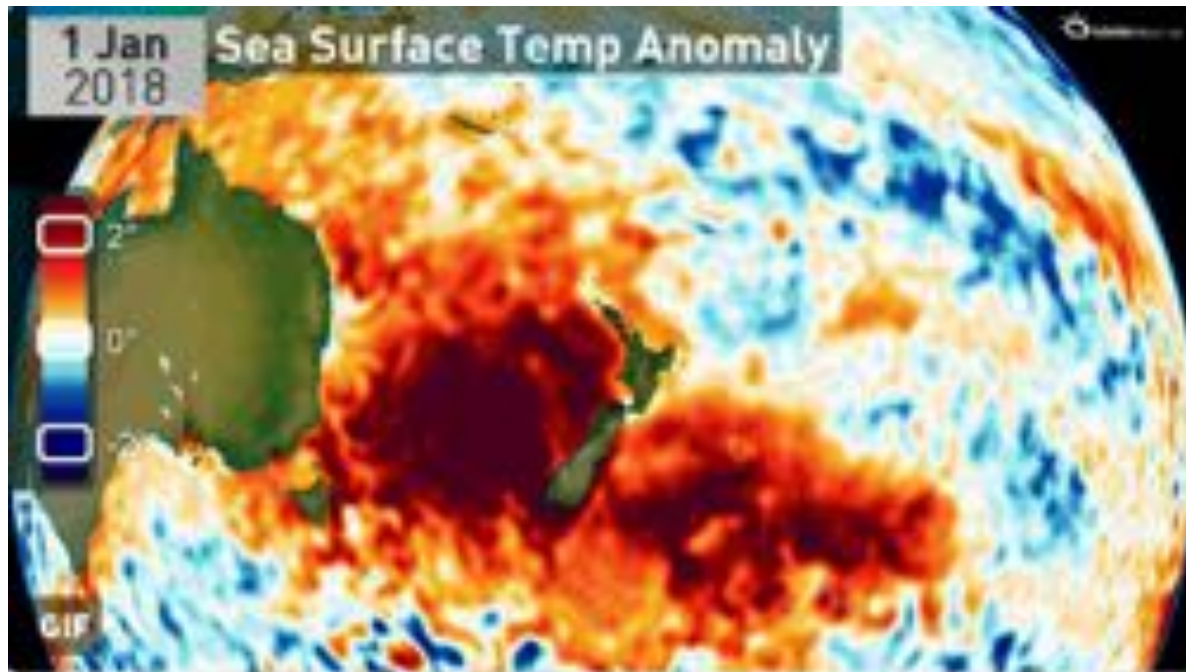


# Our Changing climate: what can we expect, what can we do?

Dr. Alex Pezza – Senior Climate Scientist, Greater Wellington Regional Council

Adjunct Research Associate – Victoria University of Wellington



**Summer 2018 was the  
hottest on record  
in New Zealand**

**(over 110 years of data in  
Masterton)**

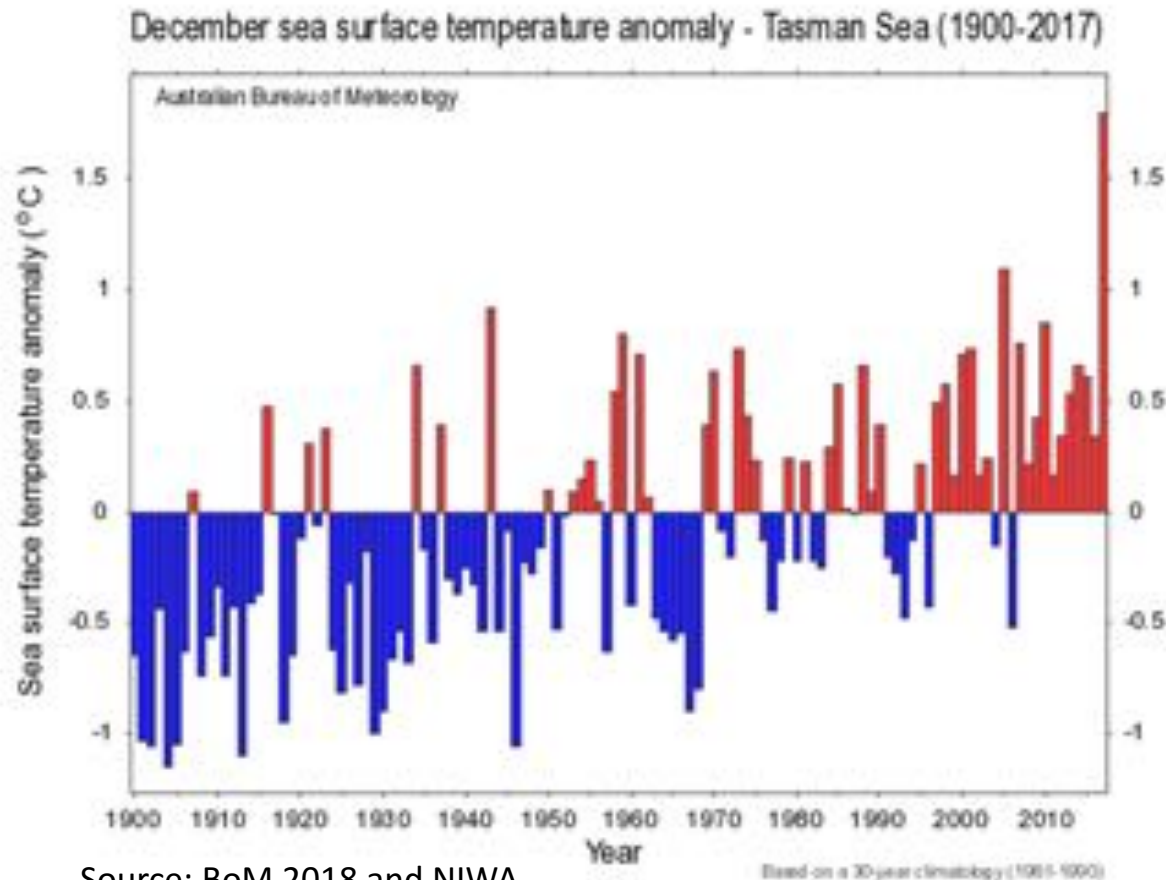
# Outline

- What the latest data is showing;
- What the scientific consensus is;
- Environmental impacts;
- Model projections;
- Some comments on CO2 uncertainties;
- Some current and future impacts on farming

# Data findings from observations

- No models, direct observations via meteorological stations or satellites

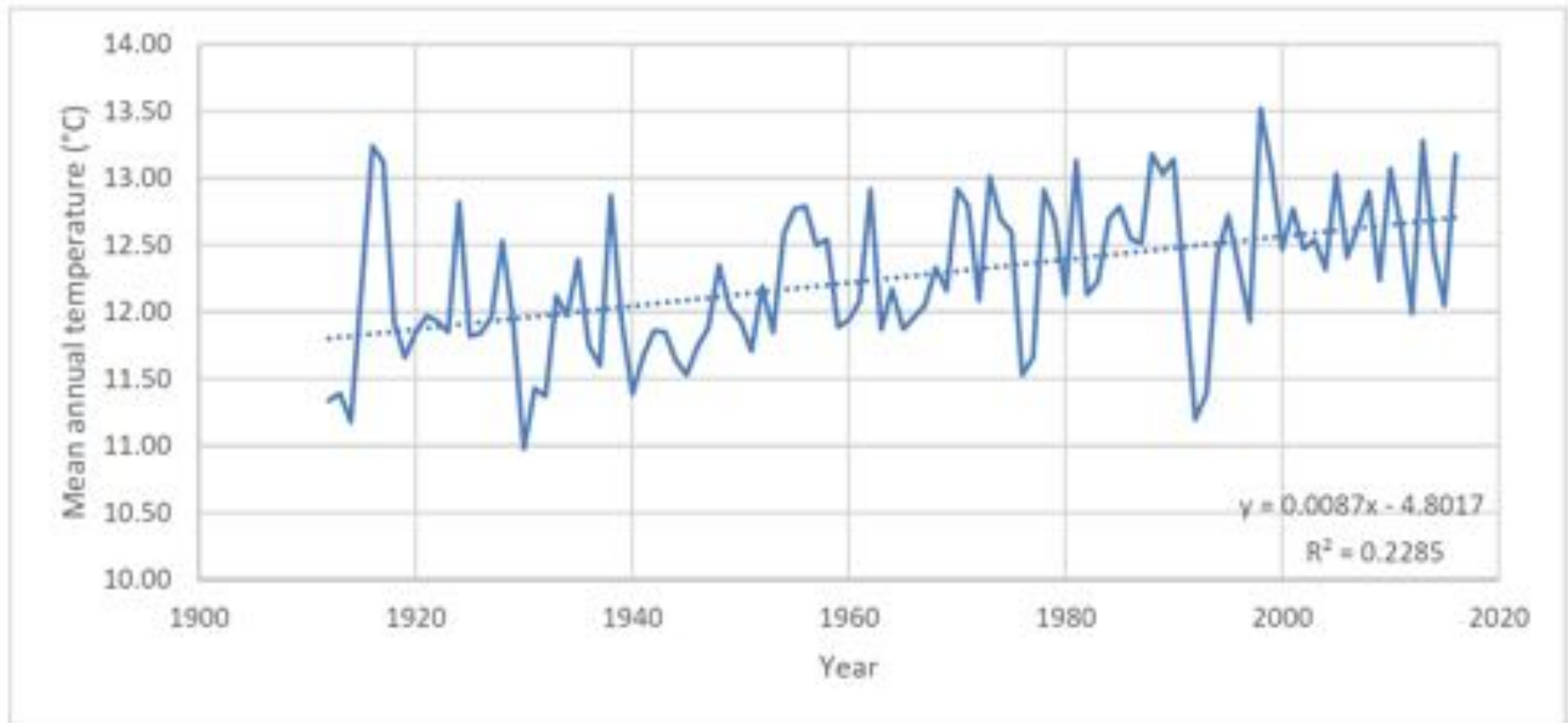
# The Tasman Sea has never been so warm!



**Warmer water = more energy for storms and sea level rise**  
**93% of 'excess' heat from global warming is stored deep in the oceans**

# Masterton is already 1C hotter

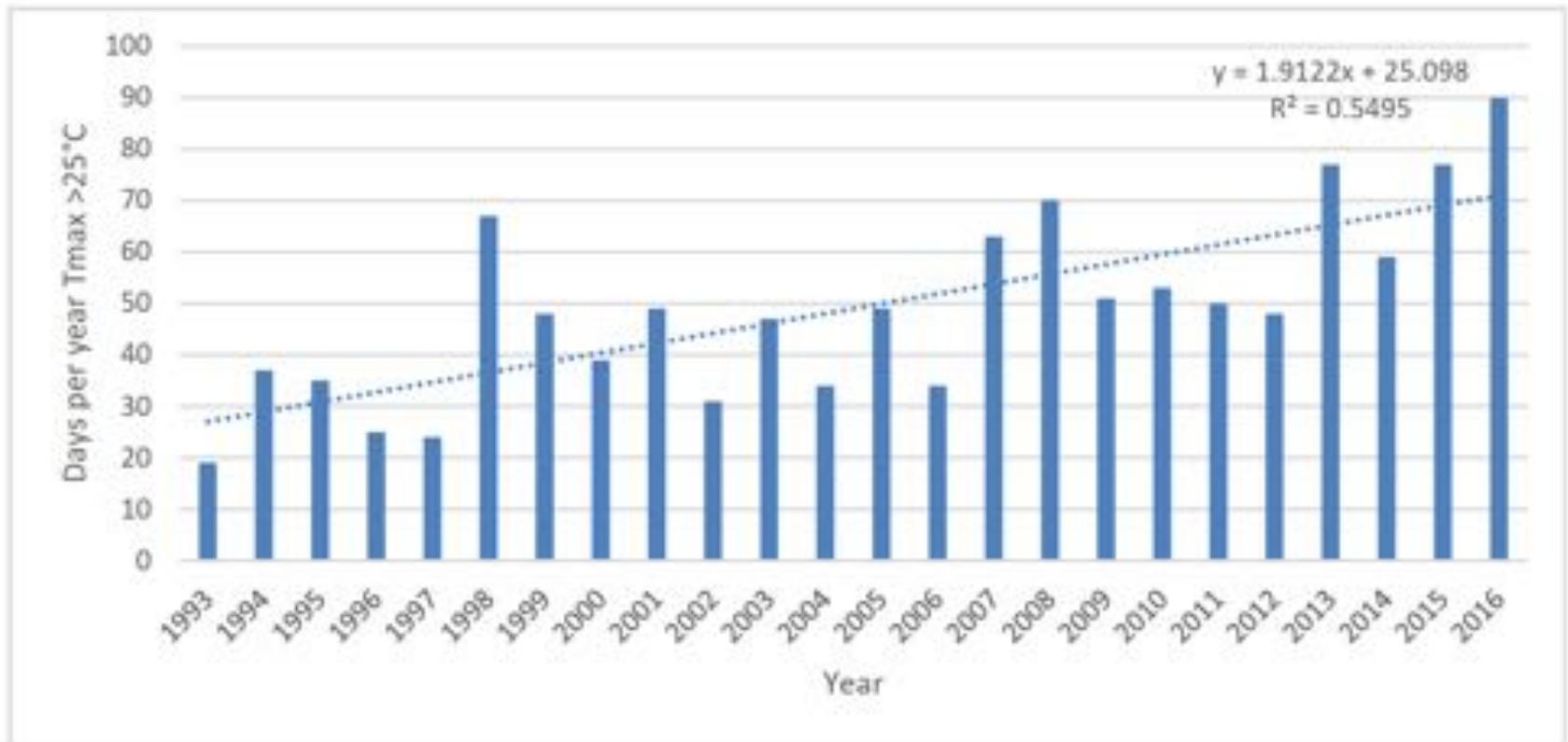
105 years of data, 95% confidence



Source: NIWA/GWRC 2017

# Masterton already getting plus 2 hot days/year

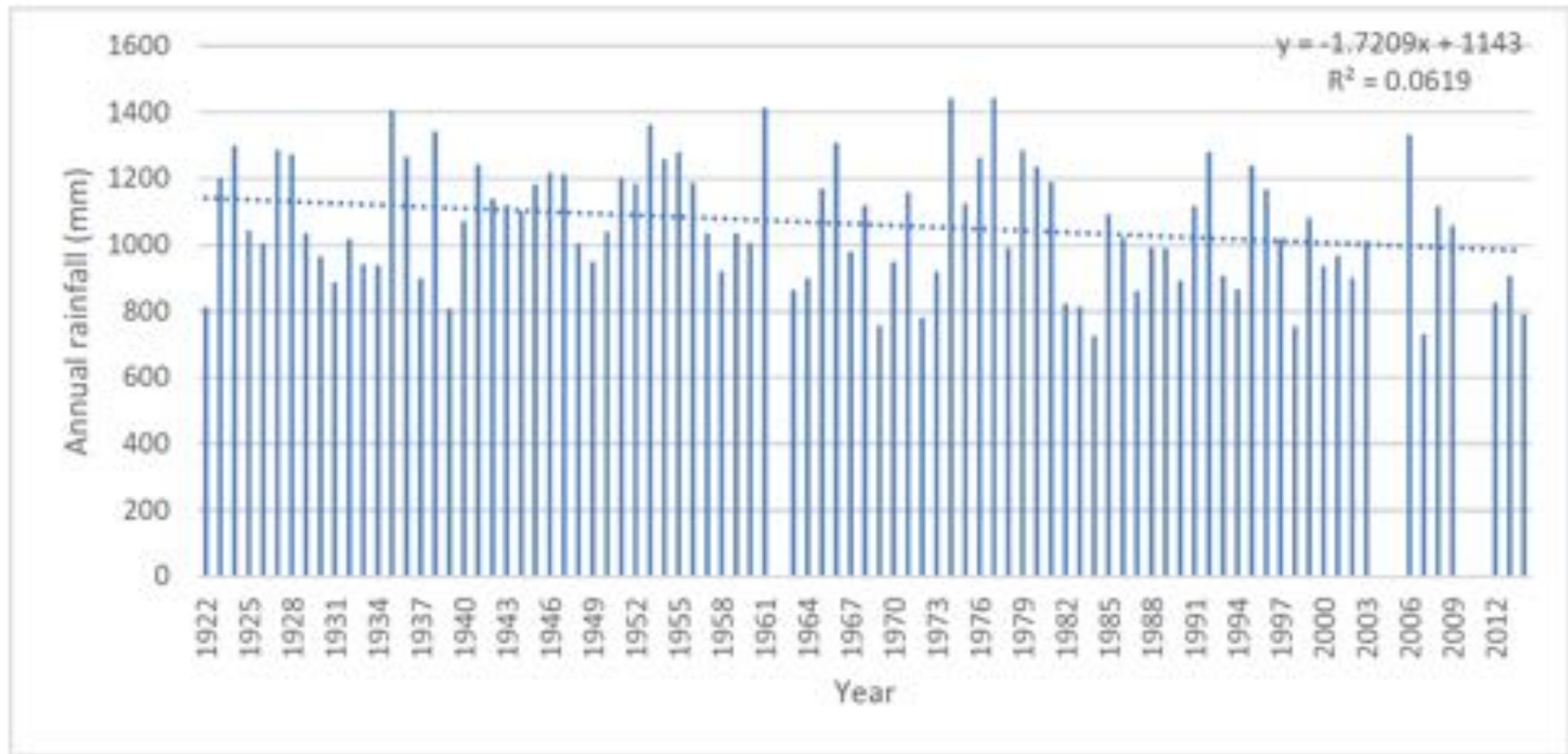
## 24 years of data, 95% confidence



Source: NIWA/GWRC 2017

# Masterton already about 13% drier

95 years of data, 95% confidence



Source: NIWA/GWRC 2017

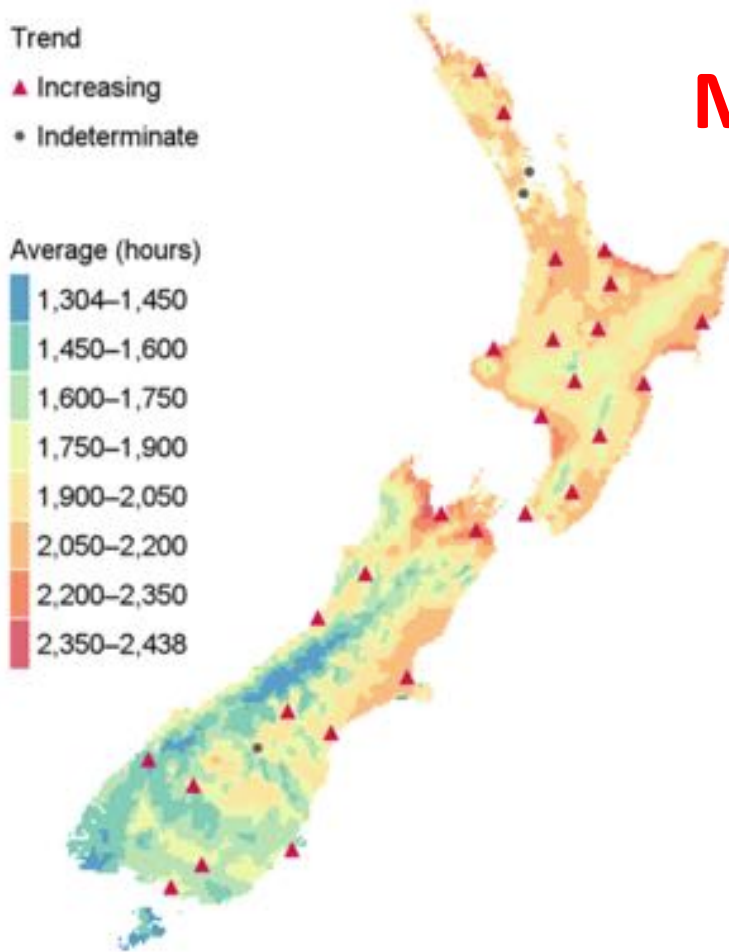
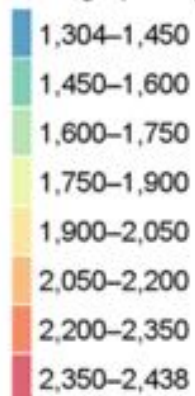


## Annual average sunshine hours and sunshine hours trends, 1972–2016

Trend

- ▲ Increasing
- Indeterminate

Average (hours)



# More sunshine hours

45 years of data  
95% confidence

Source: NIWA/MFE 2017



# Scientific consensus

- What the majority of climate scientists agree is happening to our atmosphere

# What we know from climate science

1. The climate is changing and sea level is rising, no matter where you are
2. It's getting warmer (more energy, more extremes – **storms getting wetter, droughts getting drier**)
3. Projections starting to materialise, model confidence is increasing
4. There will be substantial impacts on the environment and human activities, **and this is already happening**
5. Worst impacts can be avoided in the long-term, but only if CO2 emissions are significantly reduced in the next few decades
6. Last time CO2 was so high was about **25 Mi years ago**

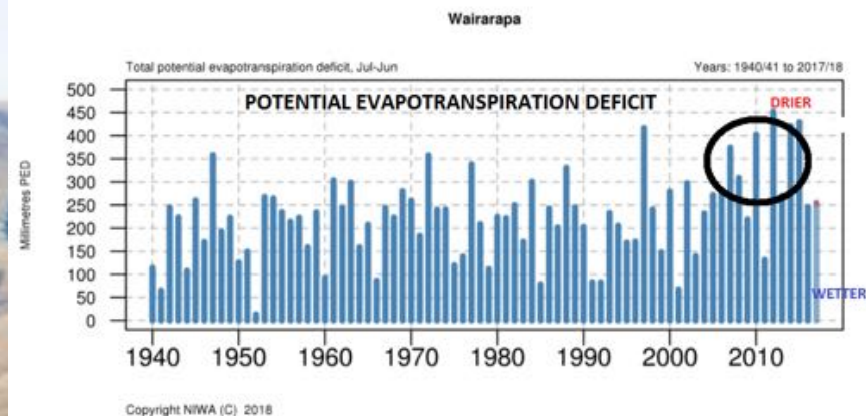
# Scientific consensus

- Even if you don't believe in the model projections, we know that **25 Mi years ago** the world was a very different place!
- We will need to change and adapt (people/societies/businesses/scientists/farmers/countries, etc)

# Environmental impacts

- Most of the impacts already happening agree with the predictions based on climate models

# Droughts – Despite a couple of humid years they're becoming more frequent in the Wairarapa



Wairarapa in drought, 2013

**Bushfires** – some models projecting increase of up to 700%



Quoine ridge beech forest decades after a bushfire, showing slow recovery  
Hutt water supply collection area (circa 1990s)



## Coastal inundation



Kapiti Coast at high tide 24<sup>th</sup> July 2016



## Extreme vulnerability of infrastructure



Track damage after a June 2013 storm just north of Wellington

# Spring storms cause chaos across New Zealand to end November

JAMES PAUL

Last updated 05:33, December 1 2017

## SEVERE THUNDERSTORMS

Hail stones can cause severe damage to crops

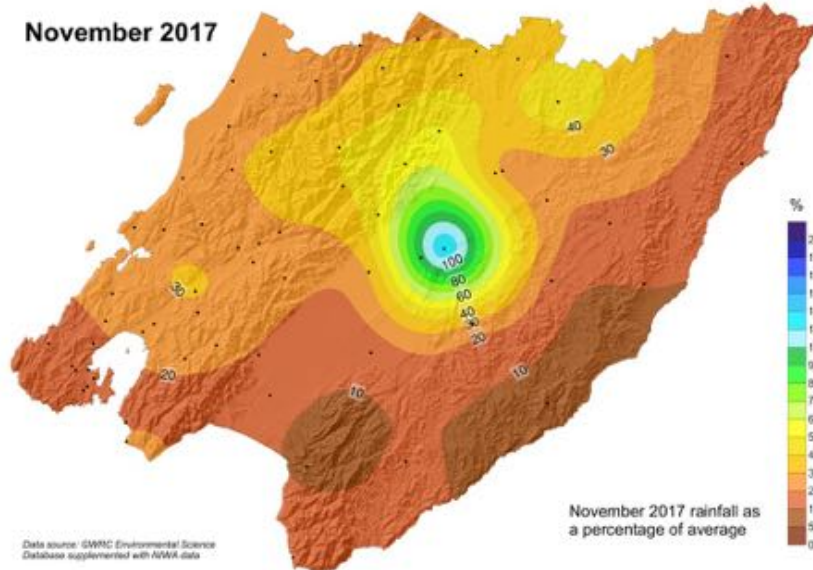


27 NOV 2017

Rain Radar - Wellington



November 2017



Data source: GWRC Environmental Science  
Database supplemented with NIWA data

November 2017 rainfall as  
a percentage of average

# Projections from climate models

- Figures show high emissions future for 2040 and 2090 (average of 6 models);
- 2040 = 2031-2050 and 2090 = 2081-2100;
- Vigorous emission reduction could cap the warming by half for 2090, but very little difference for mid-century because of cumulative CO2 effect

# What part of the region will be hit the hardest?

Wind storms/coastal inundation: west coast;

Heat/drought/severe thunderstorms: Wairarapa

## Wairarapa projections:

- **2040**: 1C additional warming (+30 hot days/year)
- **2090**: 3C additional warming (+80 hot days/year)
- **2040**: 5% drier (normal year would look like a drought year of today)
- **2090**: 10% drier (normal year would be worse than the worst drought we have ever had)

# Reality check – summer 2018 for Masterton

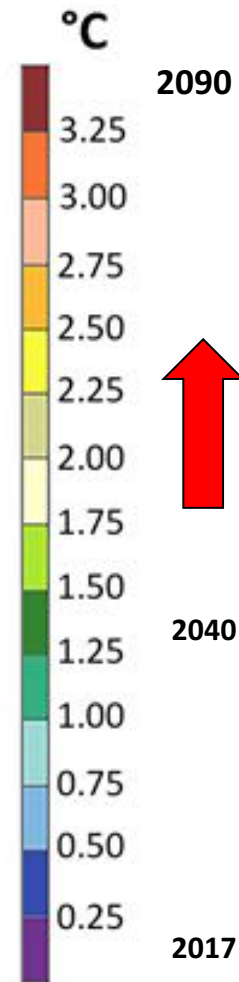
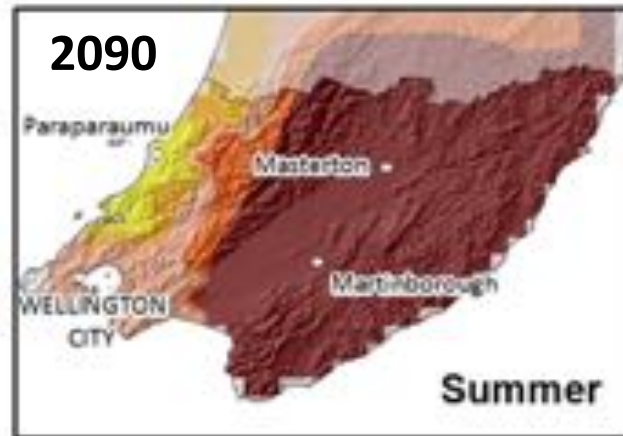
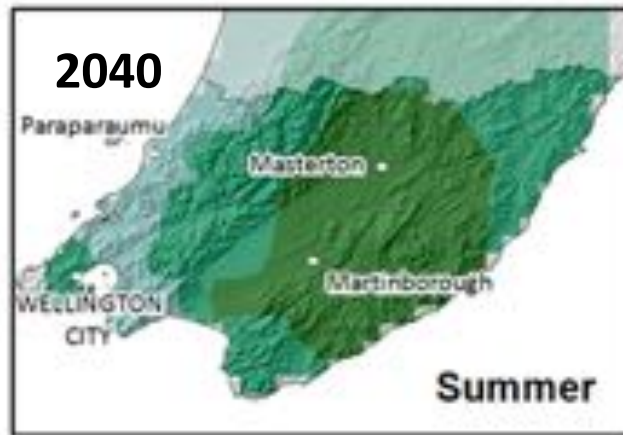
- Hottest summer on record, 3.2°C above average (**highest for NZ**)
- Might become the new 'normal' by 2090 (high emissions scenario)
- High rainfall didn't match – wet La Niña/climate variability
- **73 hot days so far** (Oct to Sep)
- **Historical average 49**
- **2090 high emissions prediction: 130**
- **Still need another 57 hot days until September to equal 2090 prediction for average year!!**

## NIWA CLIMATE CHANGE VIDEO

<http://www.gw.govt.nz/climate-change/>

# DAYTIME MAX TEMP

Wairarapa warms much more



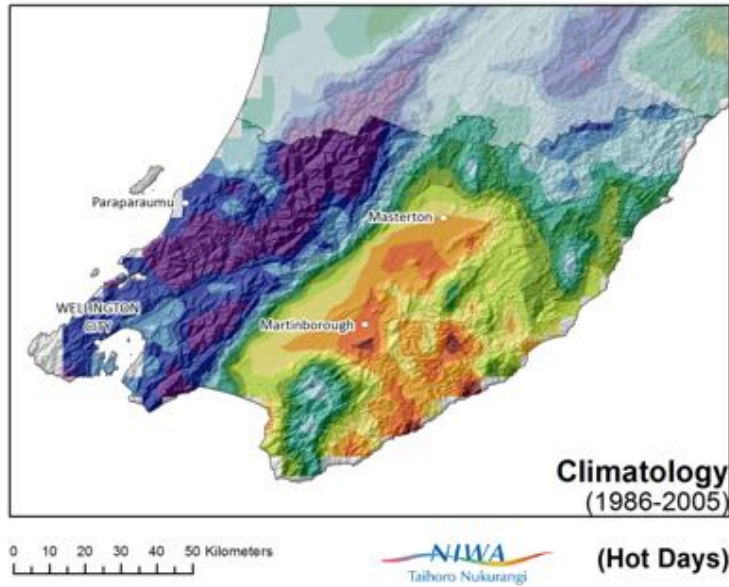
**Warming  
Relative to present**

Source: NIWA 2017 (average of 6 models)



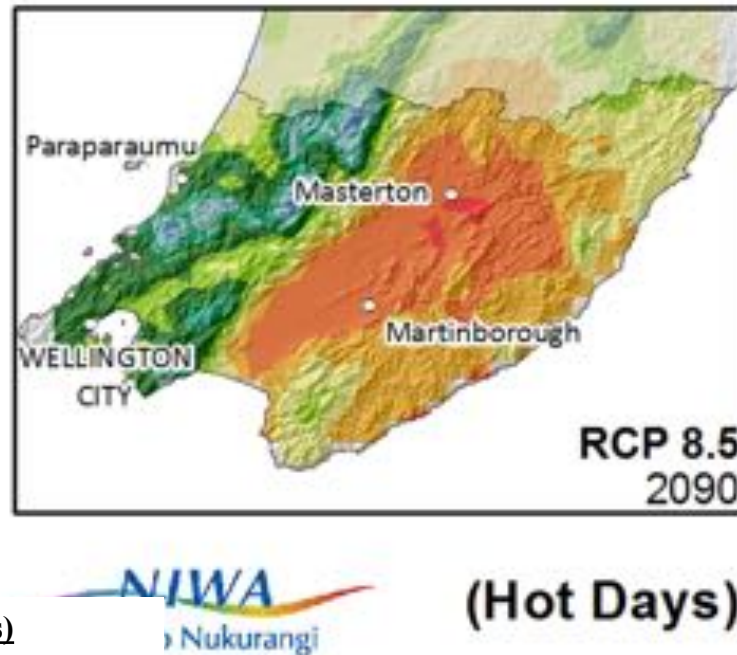
# HOT DAYS

## CURRENT



Source: NIWA 2017 (average of 6 models)

## 2090 CHANGES



Increase days/year

80  
70  
60  
50  
40  
30  
20  
15  
10  
5  
0

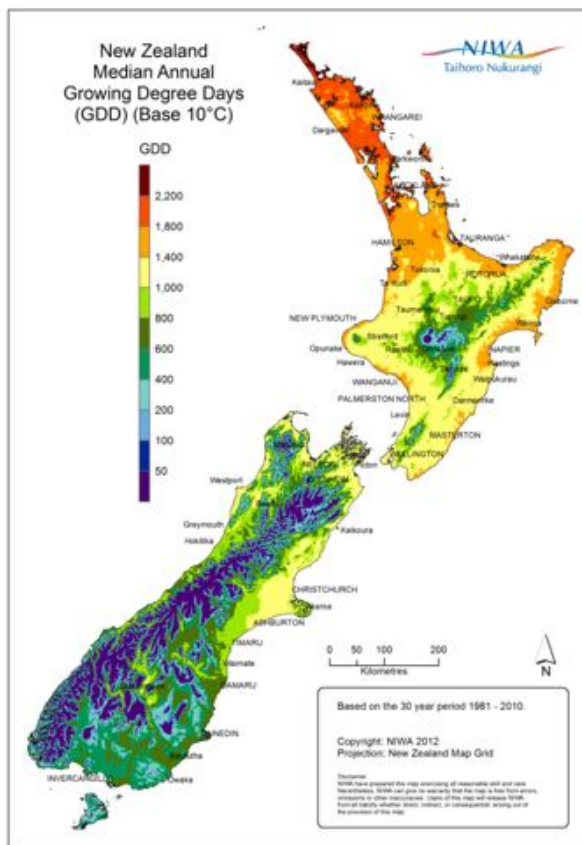
More bushfires, water restrictions, stress on crops and animals

Water demand to increase by 15% mid-century and 33% late century due to heat alone

# AGRICULTURAL IMPACTS Growing Degree Days (10C) BY 2090

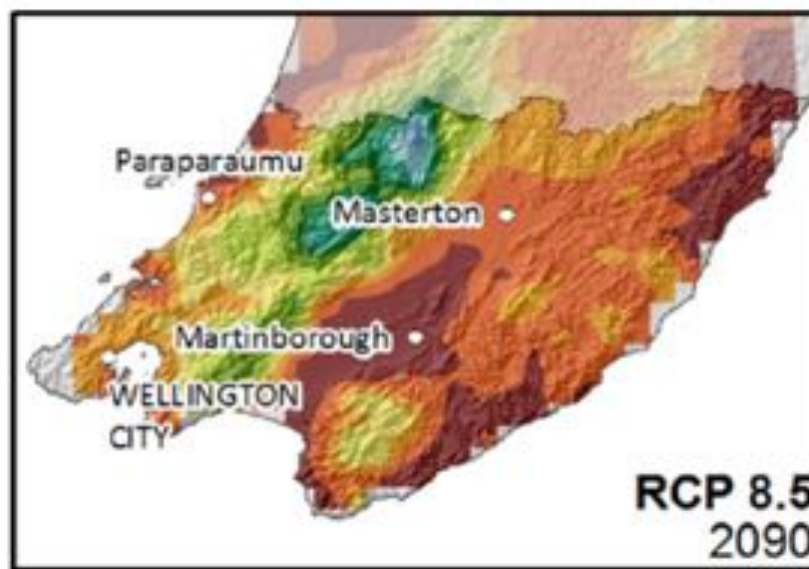
## Hours available for plants to grow

Present day

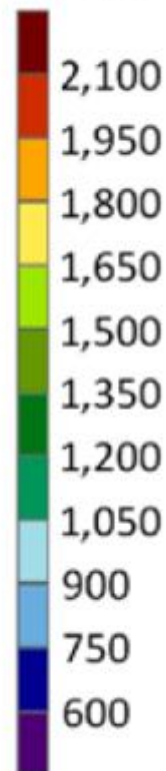


Wairarapa may look like Northland

By 2090

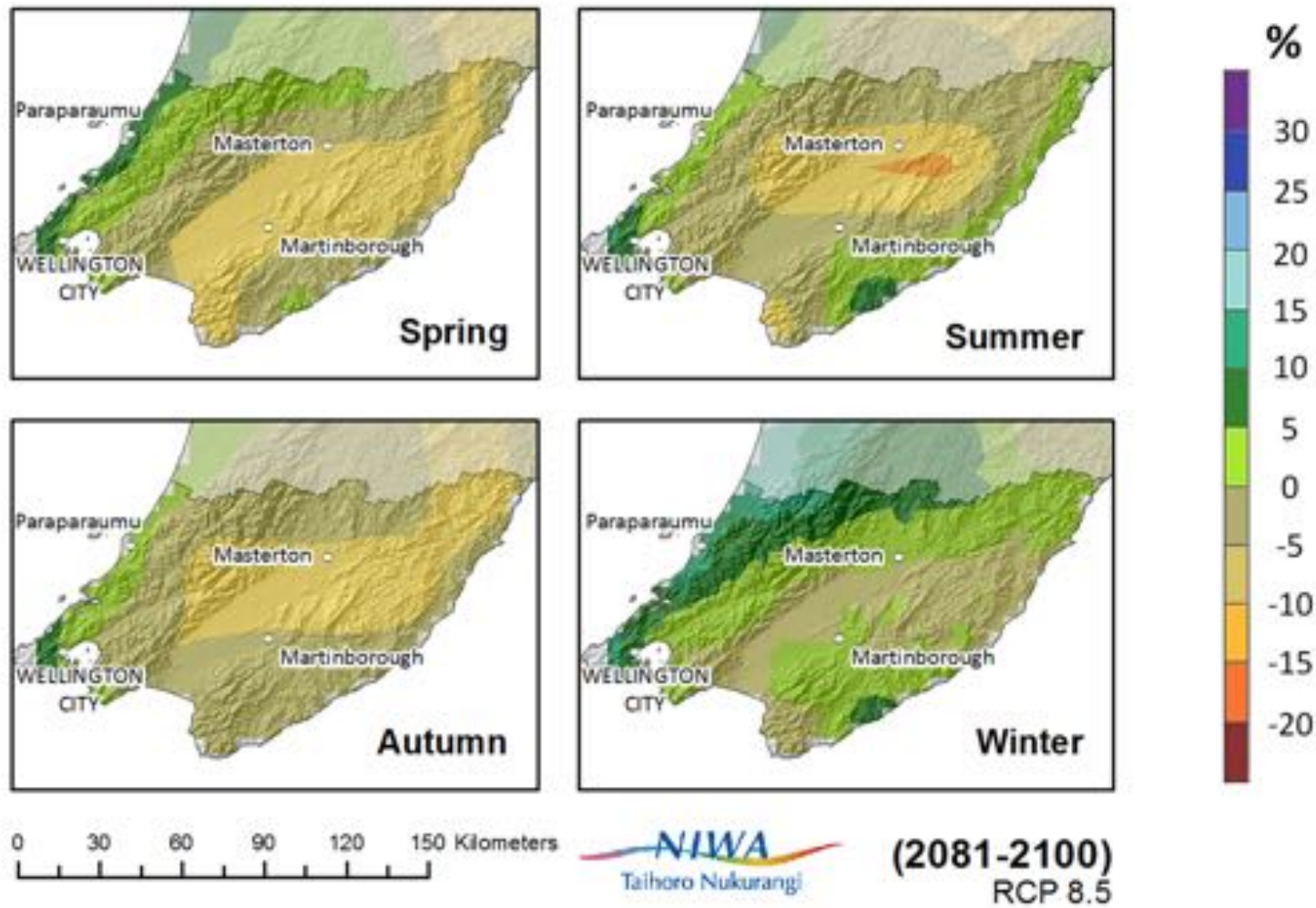


GDD



## RAINFALL CHANGES BY 2090 (in %)

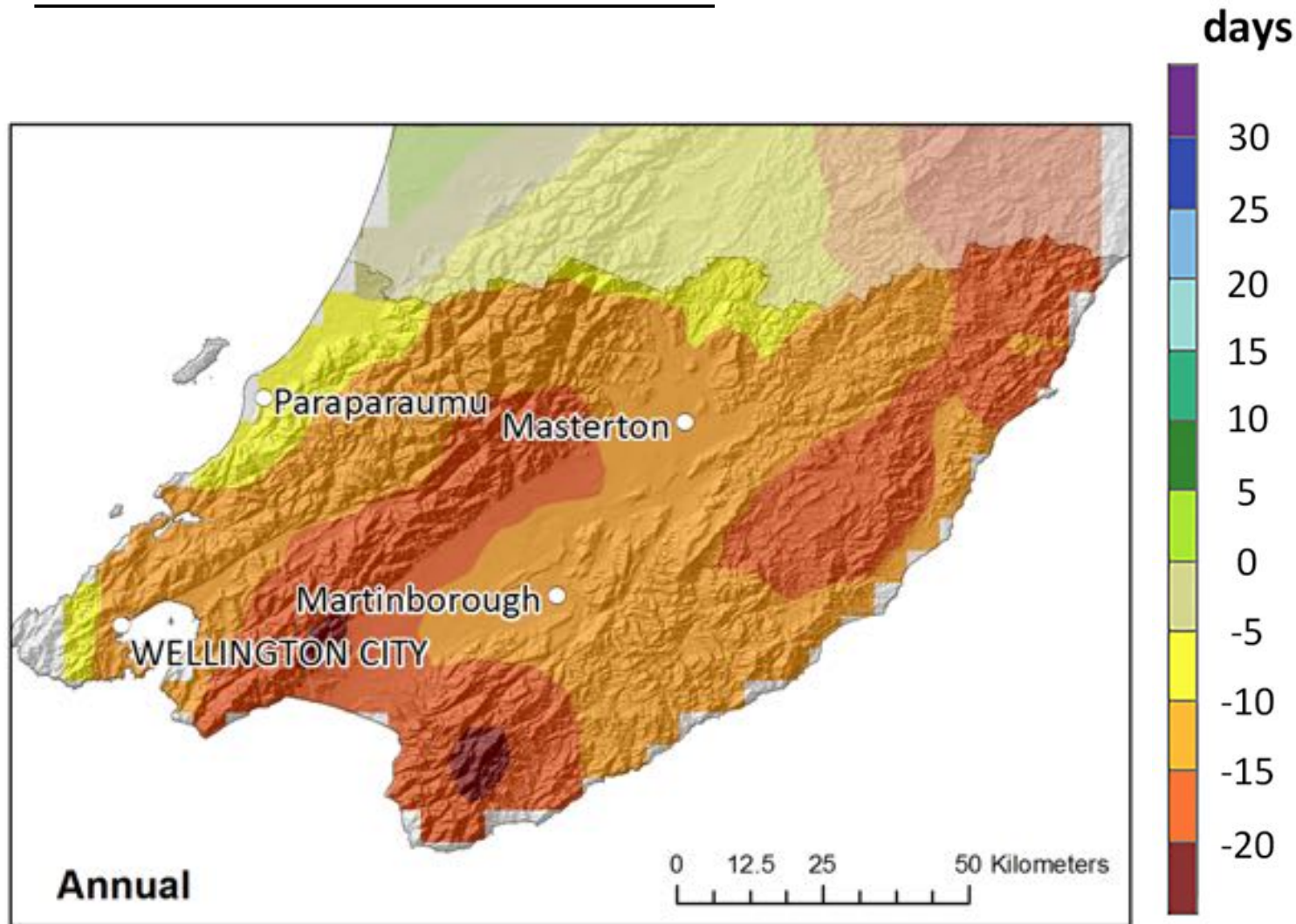
More variable than temperature, usually drier inland (little consensus)



Source: NIWA 2017 (average of 6 models)



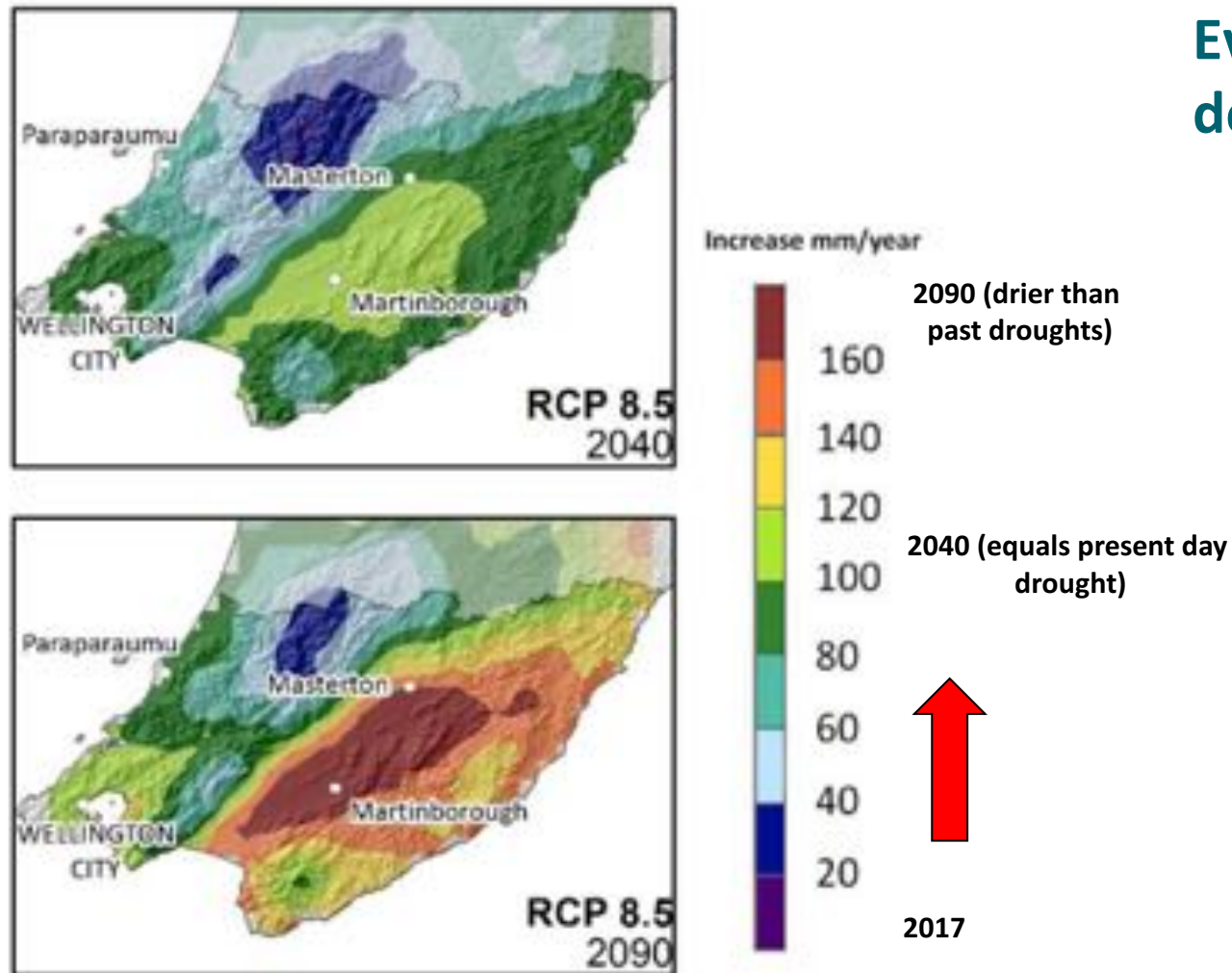
## RAIN DAYS CHANGES BY 2090



Source: NIWA 2017 (average of 6 models)

# DROUGHT INCREASES

## Potential Evapotranspiration deficit (PED)



*PED - the amount of rainfall needed to keep pasture growing at optimum levels*

Drying  
Relative to present

Source: NIWA 2017 ( average of 6 models )

# Water Sources - changes by 2090

Natural river flows already decreasing

Model consensus: Less water for abstraction except on western catchments

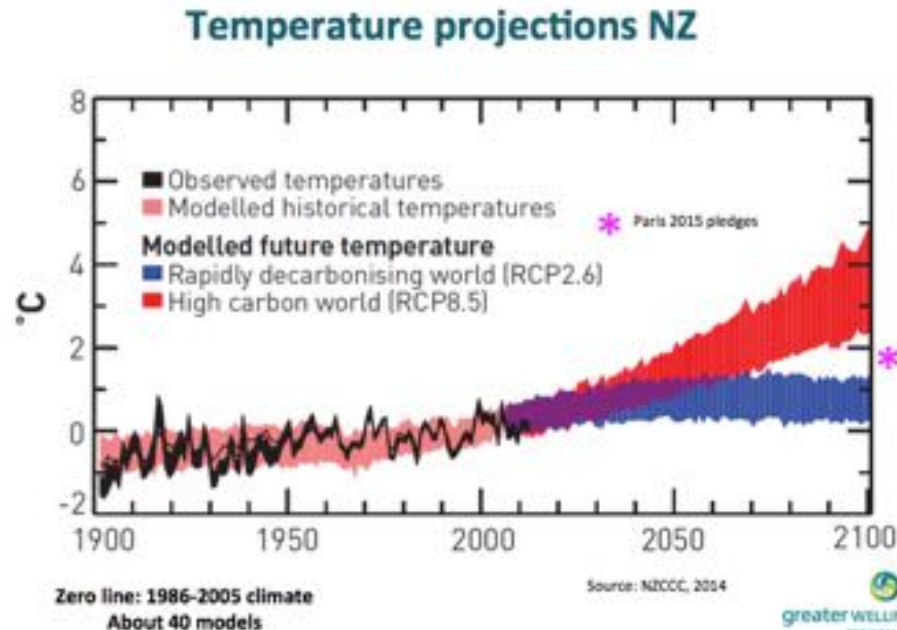
Minimum flows in particular expected to drop another 20% by mid century



Source: NIWA 2017

# CO2 uncertainties

- Models cannot predict what future emissions will be;
- Must work with a range of uncertainty

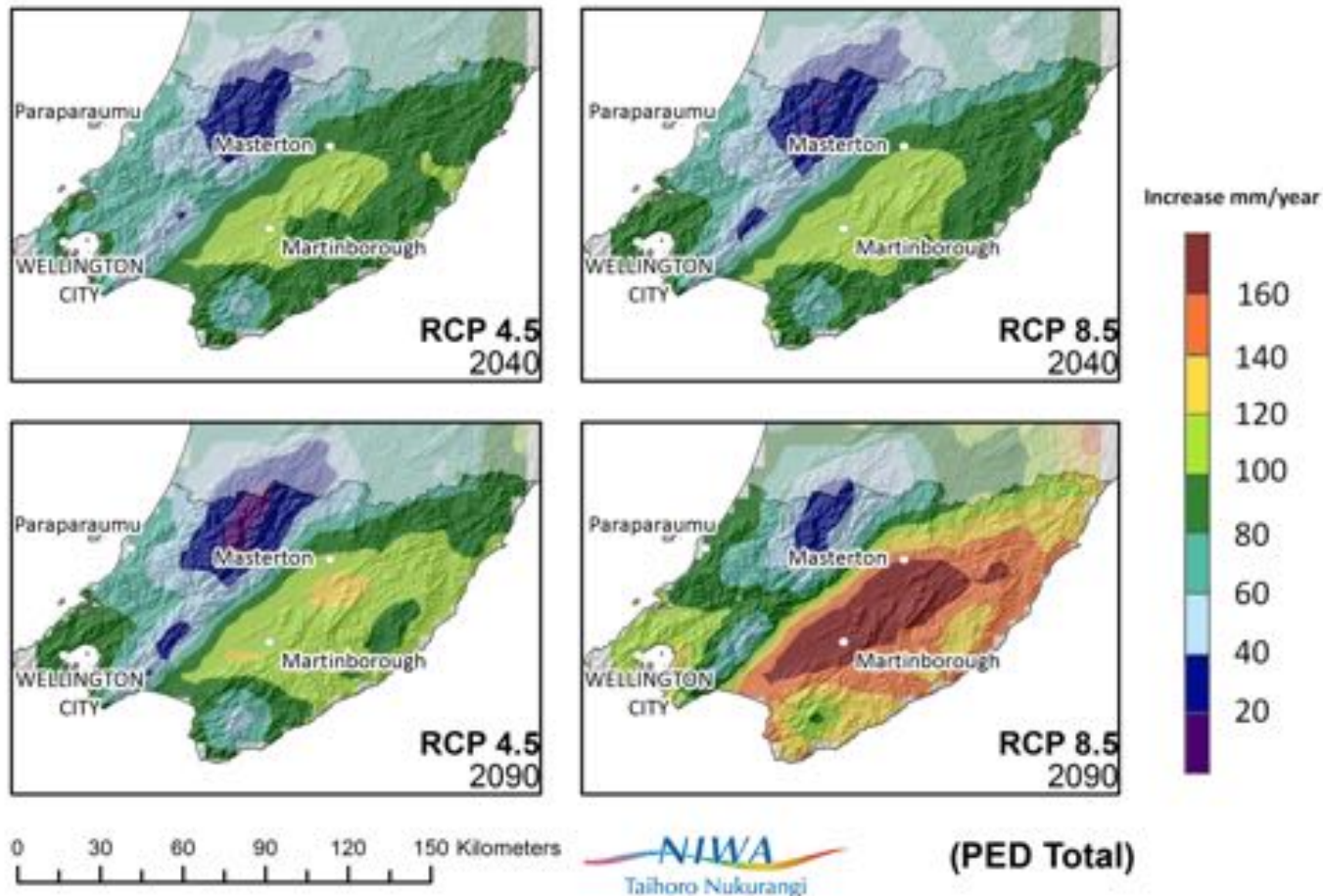




# Key regional impacts and CO2 uncertainty:

REGIONAL DROUGHT CHANGES (PED) BY 2090 (RCP 4.5 and 8.5)

Left: with CO2 reduction, right: high emissions scenario



Source: NIWA /GWRC2017

# Farming for the Future

- Even if we reduce emissions, the climate has already changed enough to cause substantial changes to crops, and will continue to do so for decades to come, before it re-stabilises
- If we get prepared now we'll be much better off ✓
- Resilience planning required to counter and adjust for a new regime

### **Lloyds Of London Global 360<sup>o</sup> Risk Profile:**

Climate Change - Not business as usual, consequences are uncertain, water scarcity, food production, mass migration, greater increase in severe weather events, flood and inundation 20% to 30% year on year claims increase predicted

Cyber security - data protection and intelligent security required

### **Rabobank:**

Future of Farming As our world population grows and lives longer, we rely on farmers to enable a sustainable food supply. But farmers everywhere face various food production challenges that make it difficult to live up to their potential and produce more with less environmental impact. Global food production is expected to double by 2050

Courtesy of Venture Southland

# Potential impacts for farming

- Wairarapa temperatures of the future may look like Hawkes Bay by 2040 and Northland by 2090, but much drier;
- Potentially extensive implications (urban, rural and environmental)
- We'll continue to have hot/cold, dry/wet individual years (climate variability);
- Potential for growing new crops and shifting current crops;
- New technologies
- New agriculture, tourism and business opportunities, but enormous pressure on water demand for irrigation

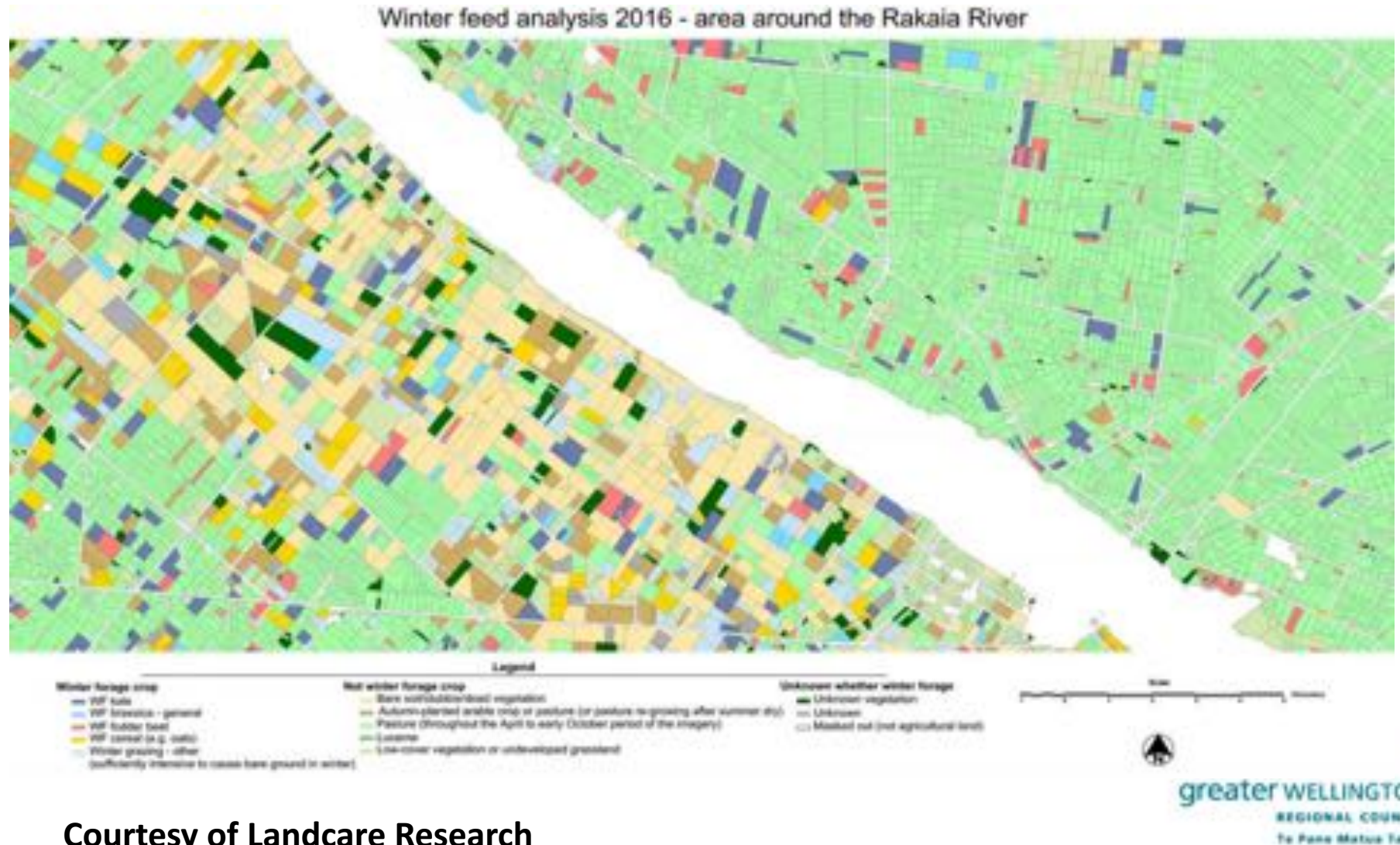
## Potential good news

- CO2 fertilizing effect may increase crops resistance to drought
- New satellite application tools become increasingly available (and cheaper)
- Possible to launch your dedicated satellite sensor at low cost





# New satellite applications for agriculture



Courtesy of Landcare Research

## Take away message

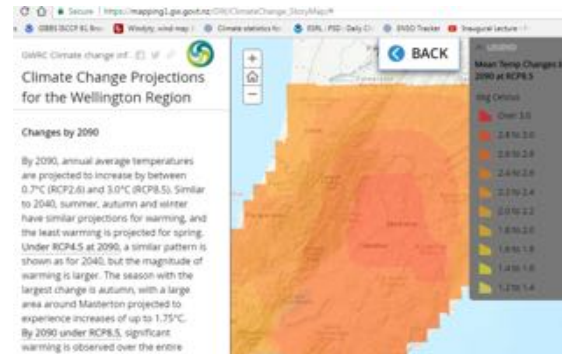
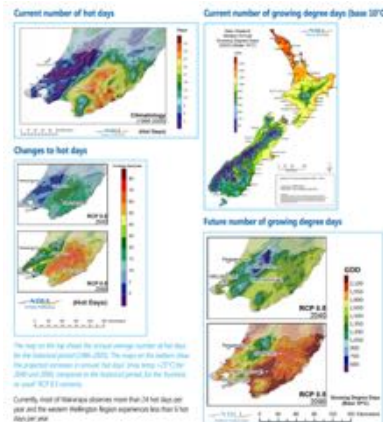
- There's a lot of information (and misinformation) out there;
- Focus on what the early signs are telling us (farmers know a lot about how nature is responding!);
- Recent report for MFE: farming is the single most prepared sector for climate change in NZ!
- Embrace change, be innovative: try to anticipate changes by seeing where nature is heading
- The future climate might be better or worse than the projections, but those who embrace change and innovate today will be better off in all scenarios ✓



# GWRC climate change tools online

[www.gw.govt.nz/climate-change/](http://www.gw.govt.nz/climate-change/)

- Full NIWA report for GWRC;
- Video and stakeholder six-page summary;
- Interactive climate change maps online



# Thanks very much

[www.gw.govt.nz/climate-change](http://www.gw.govt.nz/climate-change)

**‘we can’t stop or choose the change,  
but we can fully control how we react to it’**

