OTAGO POLYTECHNIC
Te Kura Matatini ki Otago

Climate Change:

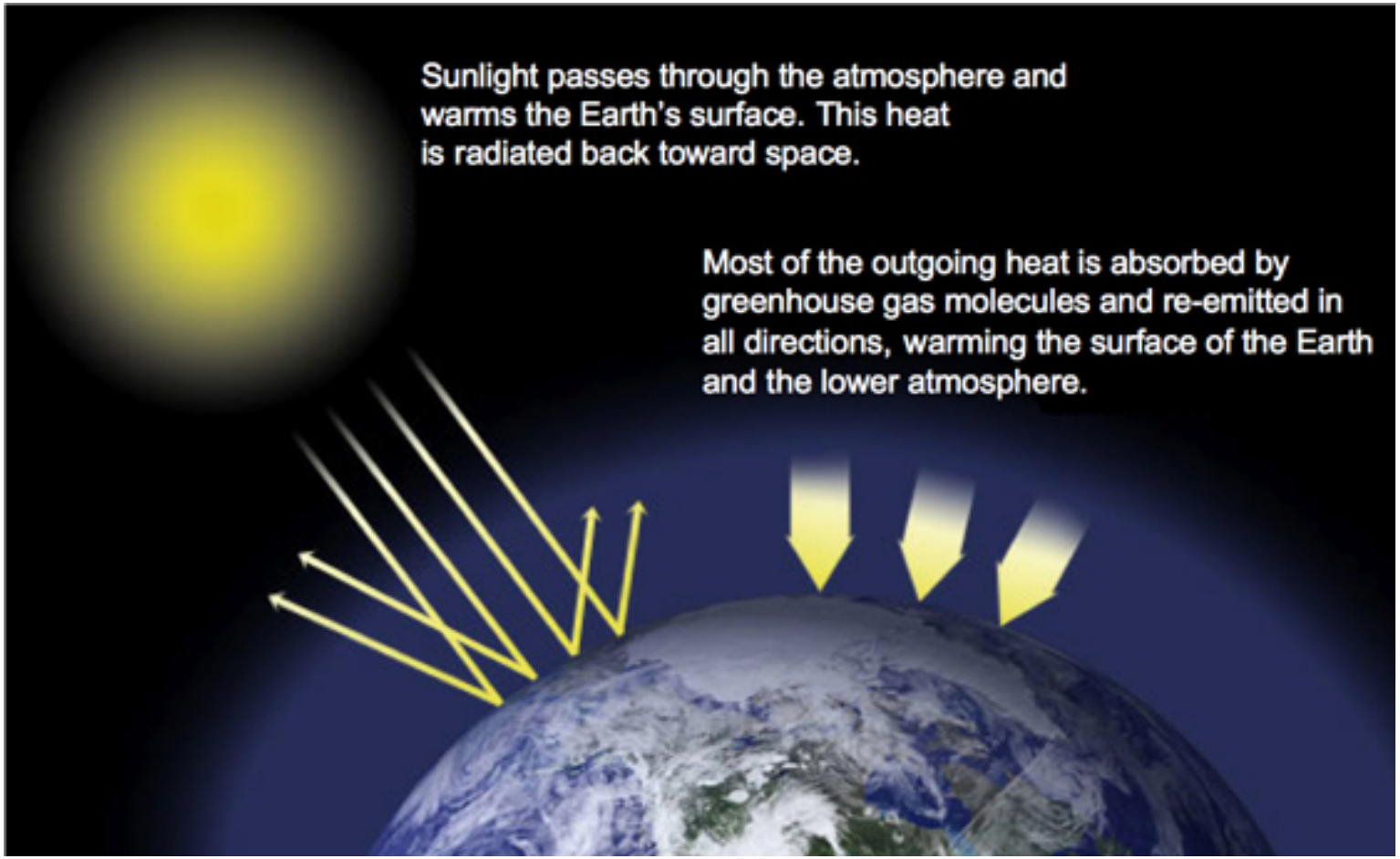
Risks and Opportunities In Nursery Production

Lisa Burton

Climate Change – What Do You See?

- What are the likely changes – globally and locally?
- How may it affect nursery production?
- What are the risks and how can you plan for uncertainty?
- Where can you find useful sources of information?
- What are some opportunities?

The Natural Greenhouse Effect



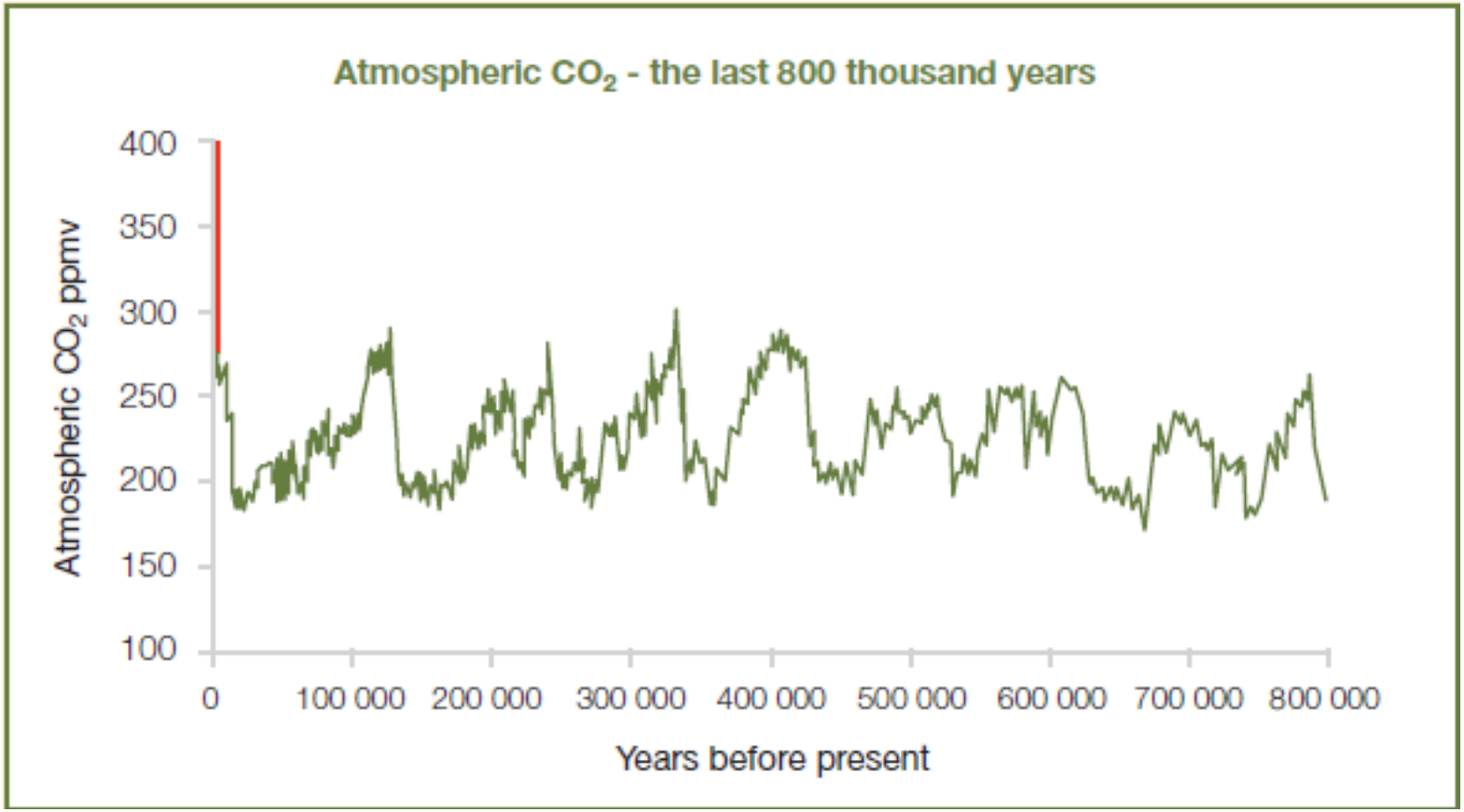
Source: http://climate.nasa.gov/causes/

The Natural Greenhouse Effect

- About 1% of the earth's lower atmosphere is composed of **greenhouse gases**: mainly
  - water vapour
  - carbon dioxide
  - methane
  - nitrous oxide

- The average global earth surface temperature is 15 C^0 due to our atmosphere
- Without the natural greenhouse effect our world would be cold and uninhabitable

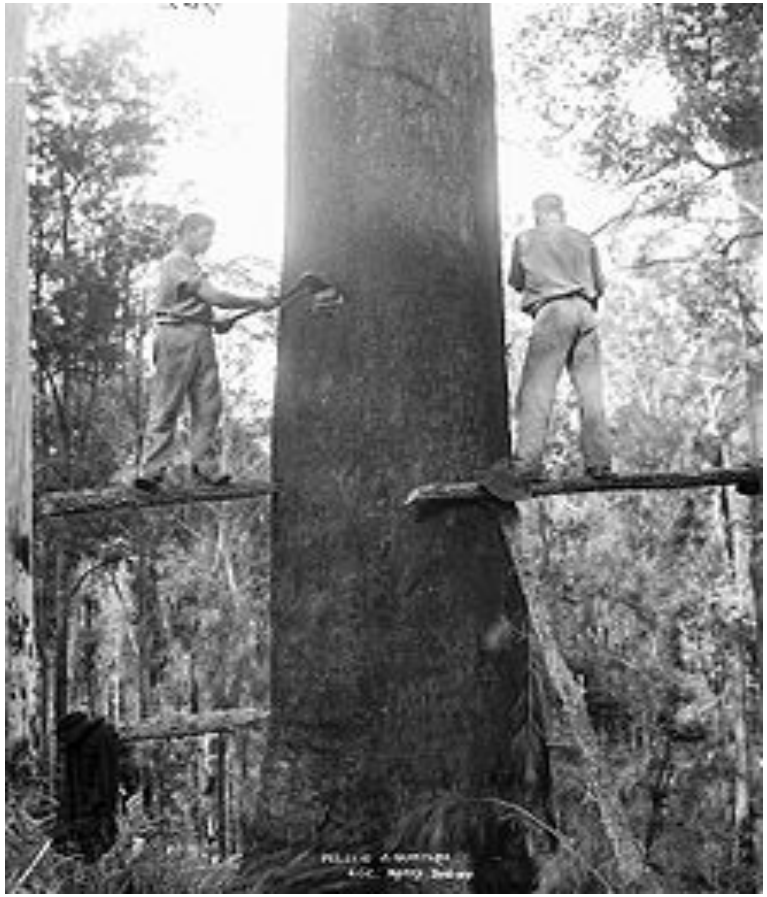
Level Of CO_2 Is Now Higher Than It Has Been In The Past 800,000 Years



Human Activities Create Change

- Some people might pine for the good old days…

It Is *Extremely Likely* That We Are The Dominant Cause Of Warming Since The Mid 20th Century



Global Effects - Says Who?

- The Intergovernmental Panel on Climate Change (IPCC) **Fifth Assessment Report 2014**
- Established by the United Nations and World Meteorological Society
- Produces reports every 5-7 years
- A global report – around 700 authors
- 195 governments are members of IPCC

Global Effects of Climate Change

- Increased air temperatures
- Longer periods of drought in some areas
- Longer, more intense heat waves
- Increased frequency of wildfires

Source: http://climate.nasa.gov/evidence

Global Effects of Climate Change

- Increase in the number, duration and frequency of tropical storms
- Oceans are warming leading to loss of sea ice
- Global sea level rose 10-25 cm in the last century

Global Effects of Climate Change

- "The global redistribution of our planets' species is widely recognised as a fingerprint of climate change"

- In a study of 329 plant and animal species, 84% had shifted their ranges towards the cooler poles, or to higher altitudes

New Zealand tree fuchsia

Effects Of Climate Change – South Africa

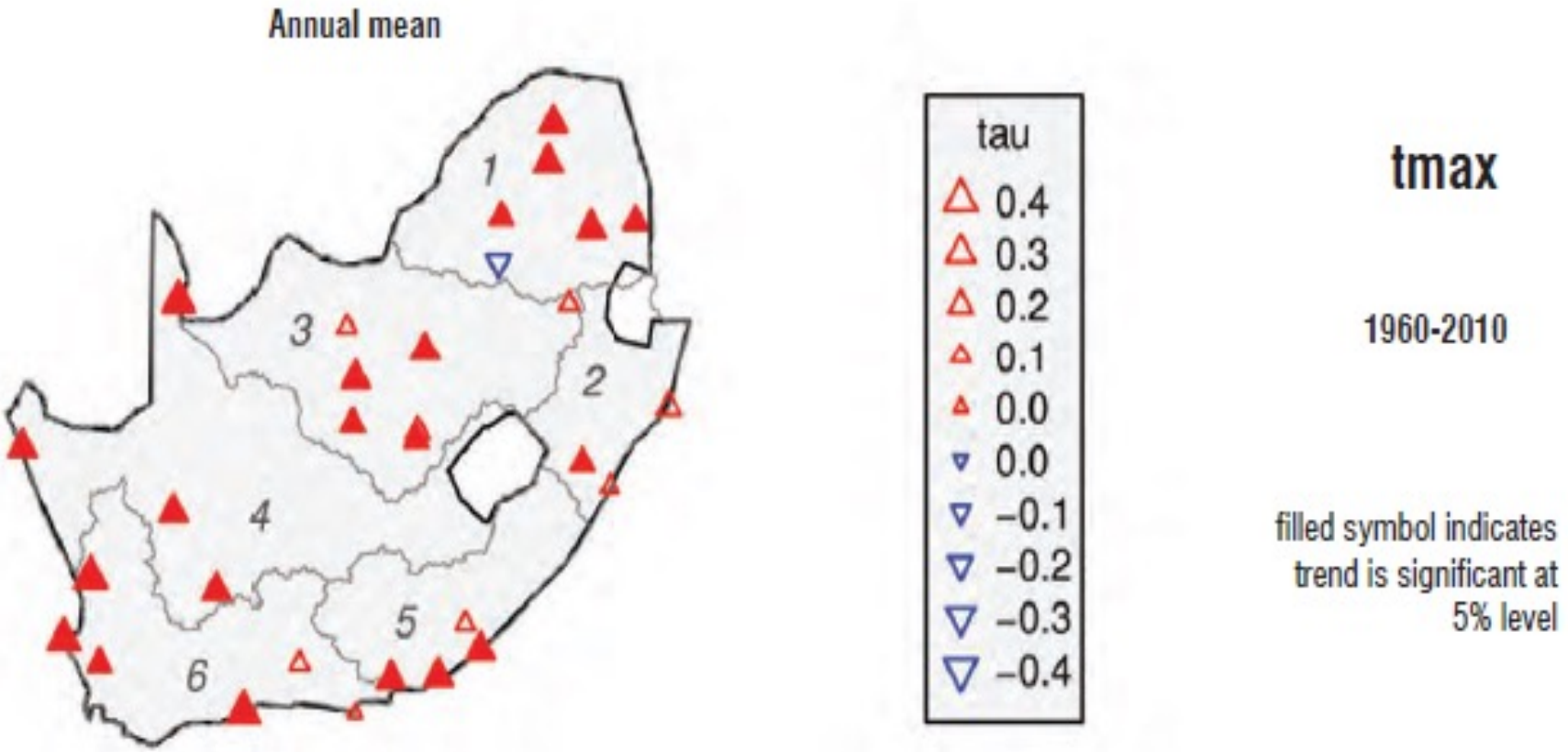
- The climate will not change uniformly across the globe as greenhouse gases increase”

Risk Management #1 Know your risks

Effects Of Climate Change On Temperature – South Africa

- Over the last 5 decades, mean annual temperatures have increased by more than 1.5 times the observed global average of 0.65^0C
- Maximum and minimum temperatures have been increasing annually across the country, with the exception of the central interior
- Temperature increases of more than 4^0C are projected under scenarios, where emissions remain high, for the central & northern interior regions over 2080-2100
- The coastal regions are expected to experience the least amount of warming

Trends In Annual Mean Daily Maximum Temperatures (MacKellar et al.)

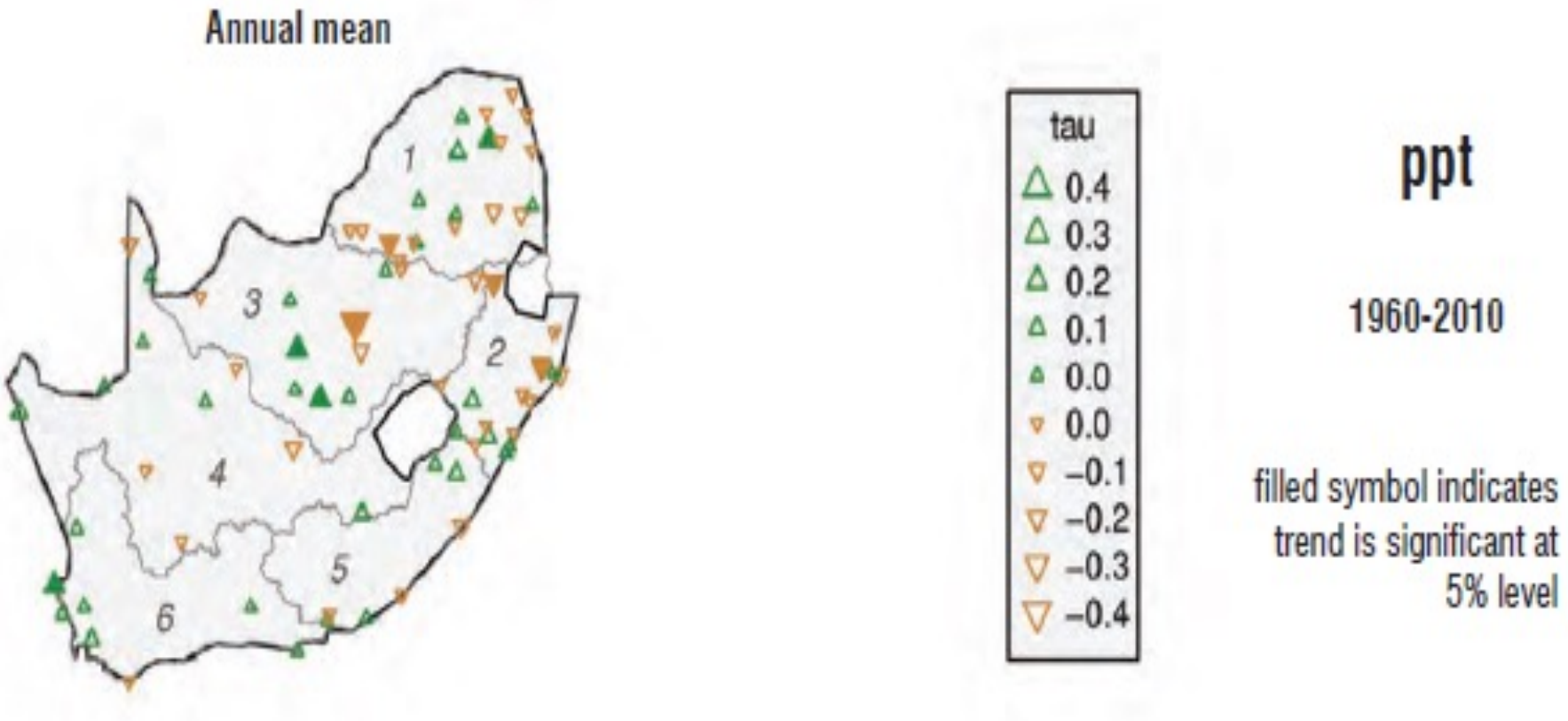


Red triangles show an increase in Mean Daily Max. Temp 1960-2010

Effects Of Climate Change On Rainfall – South Africa

- There is less autumn rainfall and fewer days with rain in the central and north-eastern parts of the country
- Spring and summer rainfall has increased in Southern Drakensberg region.
- Unlike temperature, there is more uncertainty about future rainfall trends
- Current models project rainfall to **reduce** in Limpopo and SW Cape while it will **increase** in the central interior extending to the southeast coast in the far future. Increases are projected to occur in spring and summer.

Trends In Annual Mean Rainfall



Green triangles show an increase in Annual Mean Rainfall 1960-2010

Effects Of Climate Change On Biodiversity – South Africa

- South Africa covers less than 1% of the world's land surface area and is home to:
- **nearly 10% of the world's plant species**
- About 7% of the world's vertebrates
- And 5% of all known insect diversity

Climate Change
Future Impacts On Biomes

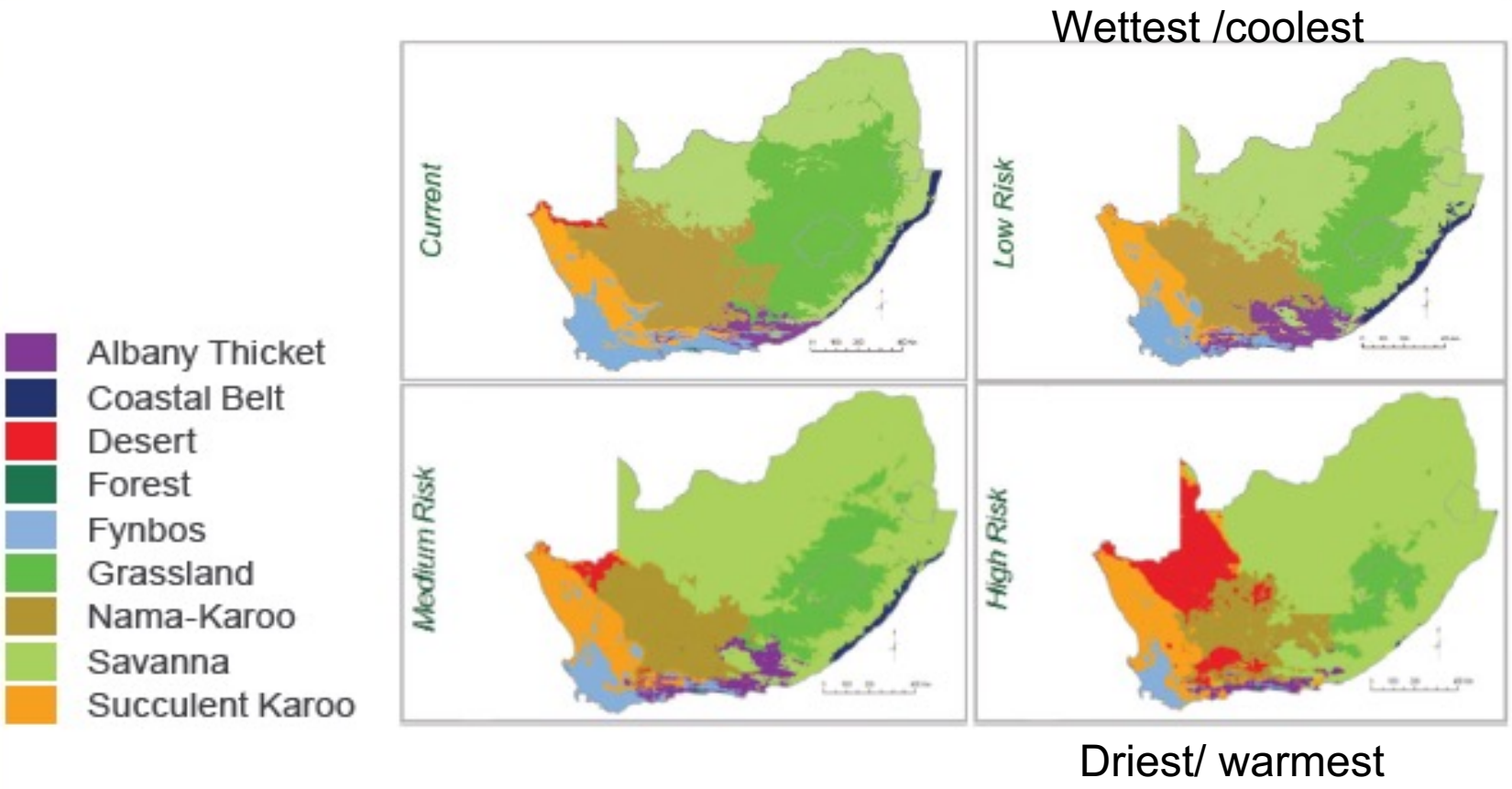


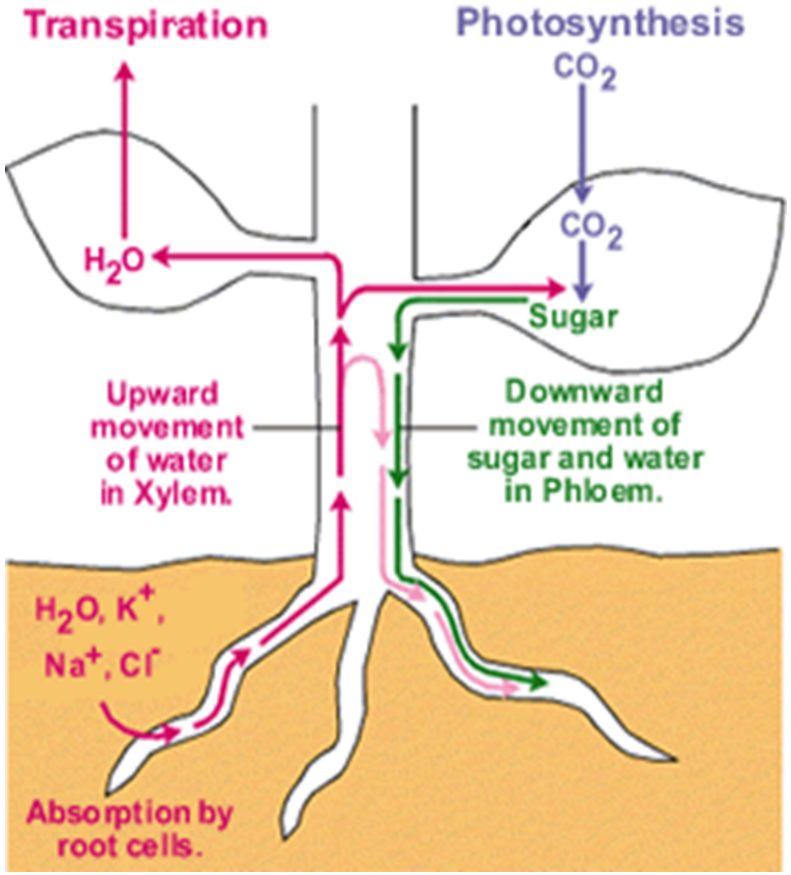
Figure 2. Projections of biome shifts under low, medium and high risk climate scenarios until approximately 2050.

How Might These Changes Affect My Nursery ?

Plants respond to changes in:

- temperature
- water
- light
- carbon dioxide
- nutrients

which have a significant impact on growth and reproduction



Changes in Temperature

- Heat stress damages, and in extreme cases, kills plants
- It is a function of intensity, duration and rate of increase in temperature
- High day temperatures have direct and indirect damaging effects on plants
- High soil temperatures can reduce seedling emergence and also damage the reproductive development of many crop species

Changes in Temperature

- Plants take up an enormous amount of water – much more than an animal of a similar size
- Almost 99% of the water taken in by the roots is released from the leaves in a process called transpiration, through stomata openings
- Increasing temperatures, increases transpiration; the rate of water evaporation doubles for every 10^0C rise = increased risk of cell death

Stomata In Leaf Surface

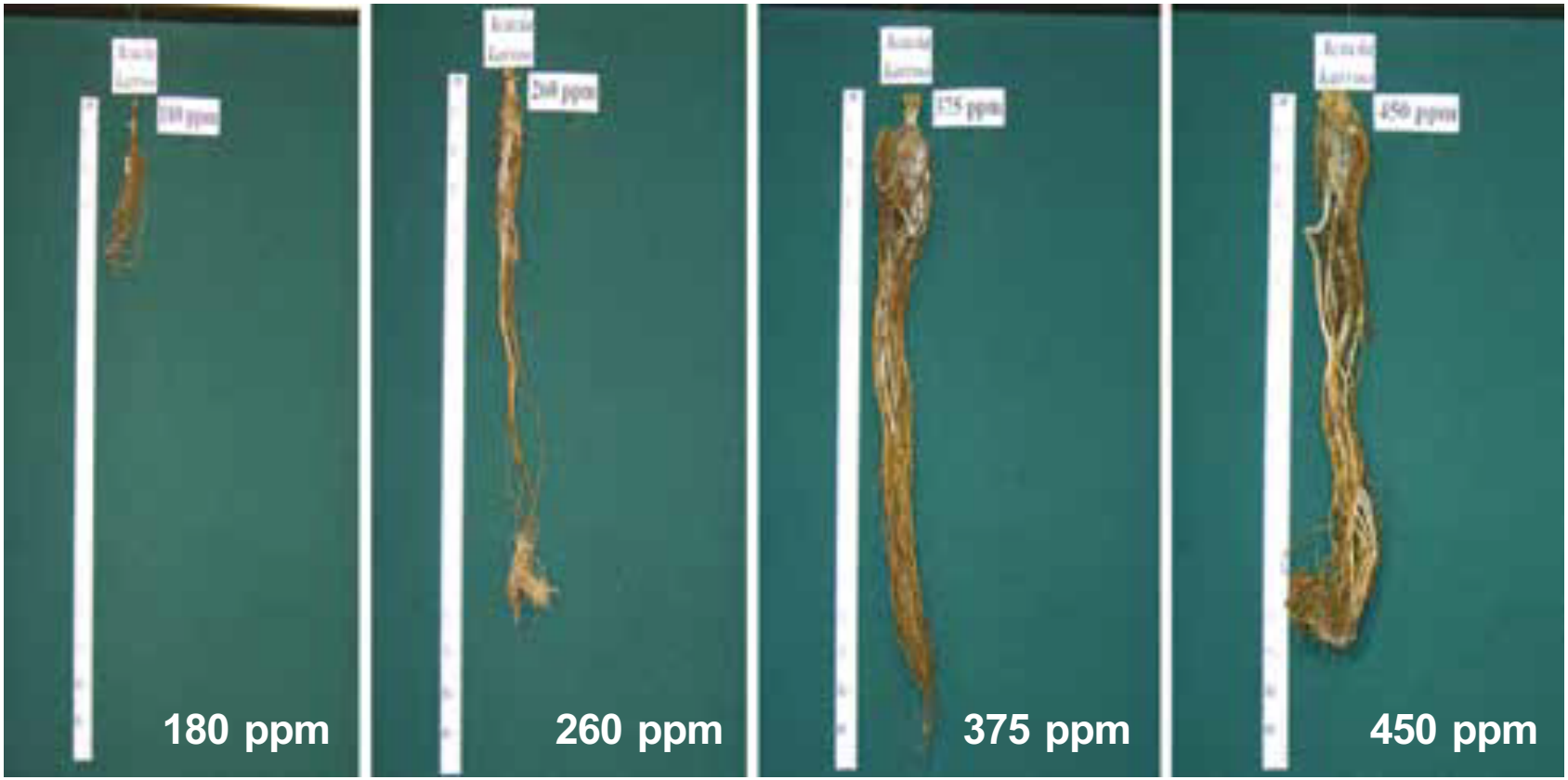
Photo Source:

https://oceanacidificationblog.wordpress.com/2014/11/06/stomata/

Changes in Temperature

- Temperatures higher than 30^0C to 35^0C can lead to stomata closing. This stops carbon dioxide entering the leaf, photosynthesis is decreased = decreased food reserves for growth
- An increase in temperature results in an increase in respiration = decreased food reserves for growth
- Root initiation in cuttings is temperature driven but root growth after that is very dependent on available carbohydrates; low food reserves = poor root growth

Changes in Carbon Dioxide



Increased CO2 = increased growth

Bond & Midgley, 2012

How Might Increased CO^2 Affect My Nursery ?

- Increased carbon dioxide levels increase some plants' growth – less need for artificial CO^2 enrichment
- Increased levels mean plants will use less water when growing
- In urban areas demand for plants may increase due to urban greening and carbon credit schemes
- Nurseries growing for ecological restoration work need to ensure their plant mix is 'future proofed' i.e. climate adjusted provenancing
- Increased demand for seed resources and restoration work as biodiversity under pressure

How Might Increased Temperatures Affect My Nursery ?

- Review use of greenhouses
- Identify ways of cooling plants that are energy efficient

- Increase shading by use of natural plantings/ shade materials
- Increase technical knowledge to deal with new pests & diseases
- Grow crops that fit your conditions
- Shorter time span to crop maturity may be an opportunity

How Might Less Water Affect My Nursery ?

- Improve irrigation efficiency
- Improve water storage and water recycling

- Grow more drought tolerant crops
- Conserve soil moisture with mulches
- Increased demand for drought tolerant garden plants is an opportunity
- Give wise water advice to your customers

Tools And Resources

- United Kingdom Resources

  Decision-making for adaptation

  www.ukcip.org.uk

- Adaptation Wizard and Adapt ME toolkit– online tools to help you adapt to climate change

- Numerous carbon footprint calculators of use to the nursery industry e.g. Food & Trees For Africa

  http://www.trees.co.za/carbon-offset/carbon-calculator.html

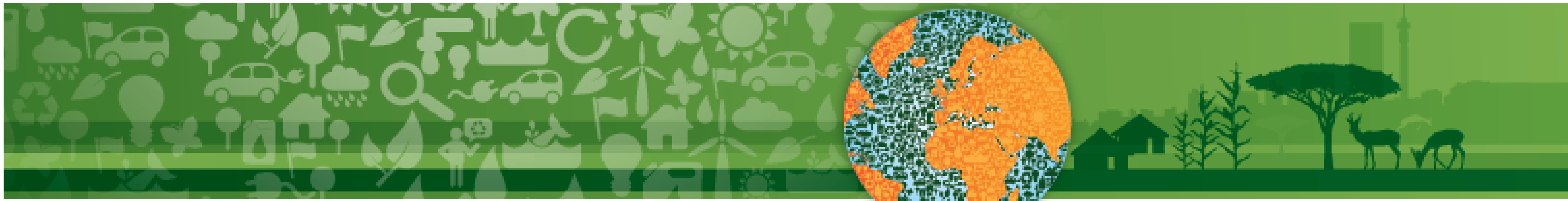
Tools And Resources – South Africa

Green economy for Sustainable Development

https://www.environment.gov.za/branches/climatechange_airquality

ITAS Fact sheet series on climate change

http://www.sanbi.org/biodiversity-science/state-biodiversity/climate-change-and-bioadaptation-division/ltas



le 1. Rainfall projections for each of South Africa's six hydrological zones.

cenario	Limpopo/Olifants/ Inkomati	Pongola-Uzimkulu	Vaal	Orange	Mzimvubu-Tsitsikamma	Breede-Gouritz/ Berg
warmer/ wetter	spring and summer	spring	spring and summer	in all seasons	in all seasons	autumn, winter and spring
warmer/ drier	summer, spring and autumn	spring and strongly summer and autumn	summer and spring and strongly autumn	summer, autumn and spring	in all seasons, strongly summer and autumn	in all seasons, strongly in the west
hotter/ wetter	Strongly spring and summer	Strongly spring	spring and summer	in all seasons	Strongly in all seasons	autumn, winter and spring
hotter/ drier	Strongly summer, spring and autumn	spring and strongly summer and autumn	summer and spring and strongly autumn	summer, autumn and spring	all seasons, strongly in summer and autumn	all seasons, strongly in the west

Projected climate futures for South Africa (2015–2035, 2040–2060 and 2070–2090)

uth Africa's climate future up to 2050 and beyond can be described using r fundamental climate scenarios at national scale, with different degrees change and likelihood that capture the impacts of global mitigation and passing of time.

warmer (<3°C above 1961–2000) and wetter with greater frequency of extreme rainfall events.

warmer (<3°C above 1961–2000) and drier, with an increase in the frequency of drought events and somewhat greater frequency of extreme rainfall events.

hotter (>3°C above 1961–2000) and wetter with substantially greater frequency of extreme rainfall events.

hotter (>3°C above 1961–2000) and drier, with a substantial increase in the frequency of drought events and greater frequency of extreme rainfall events.

ective international mitigation responses would reduce the likelihood of narios 3 and 4, and increase the likelihood of scenarios 1 and 2 during this tury. In both wetter and drier futures a higher frequency of flooding and ught extremes could be expected, with the range of extremes significantly eased under unconstrained emissions scenarios. Table 1 gives rainfall jections for these scenarios for South Africa's six hydrological zones.

Climate change projections for South Africa up to 2050 and beyond project warming as high as 5–8°C over the South African interior, and somewhat less over coastal regions, under an unmitigated global emissions scenario. A general pattern of a risk of drier conditions to the west and south of the country and a risk of wetter conditions over the east of the country has been projected, but many of the projected changes are within the range of historical natural variability. These rainfall projections are associated with a high degree of uncertainty.

Global climate model ensembles summarised for South Africa suggest a significant benefit from effective mitigation responses (global CO_2e stabilisation at between 450 and 500 ppm) relative to unconstrained emission pathways by as early as mid-century. Effective global mitigation efforts would halve median warming at the regional level from just under 2°C to about 1°C by as early as 2050, and would reduce the risk of high regional warming and extreme changes in rainfall.

Even under effective international mitigation responses, significant socio-economic implications are expected for vulnerable groups and communities in South Africa under both wetter and drier climate futures. These implications would largely be felt through impacts on water resources, such as changes in water resource availability and a higher frequency of natural disasters (flooding and drought), with cross-sectoral effects on human settlements, disaster risk management and food security.

Conclusions and linkages

er the last five decades significant changes in climate have been served in South Africa. Mean annual temperatures have increased about 1.5 times the observed global average of 0.65°C, and hot and d extremes have increased and decreased respectively in frequency. almost all hydrological zones there has been a tendency towards uced rainfall for the autumn months, though annual rainfall has not nged significantly. Instead there has been an overall reduction in the nber of rainy days, implying a tendency towards an increase in the nsity of rainfall events and increased dry spell duration.

FACTSHEET SERIES PRODUCED BY

SANBI, DEA and GIZ in consultations with relevant sector stakeholders

OTHER FACTSHEETS IN THIS SERIES:

- LTAS Phase 1 Methodology
- Climate Change and the Water Sector
- Climate Change and the Agriculture Sector
- Climate Change and Human Health
- Climate Change and Marine Fisheries
- Climate Change and Biodiversity

Photos by Gigi Laidler

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CLIMATE TRENDS AND SCENARIOS

Climate and Impacts Factsheet Series, Factsheet 2 of 7

THE LONG-TERM ADAPTATION SCENARIOS FLAGSHIP RESEARCH PROGRAMME (LTAS) FOR SOUTH AFRICA

The LTAS aims to respond to the South African National Climate Change Response White Paper (NCCRP, para 8.8) by developing national and sub-national adaptation scenarios for South Africa under plausible future climate conditions and development pathways. This will be used to inform key decisions in future development and adaptation planning.

The first phase, completed in June 2013, developed a consensus view of climate change trends and projections for South Africa. It summarised key climate change impacts and potential response options identified for primary sectors, namely water, agriculture and forestry, human health, marine fisheries, and biodiversity.

The second phase will use an integrated assessment approach and model to develop adaptation scenarios for future climate conditions using the information, data and models from Phase 1 and inputs from a range of stakeholder consultations and task-team workshops.

The Climate and Impacts Factsheet Series has been developed to communicate key messages emerging from LTAS Phase 1, and to complement the LTAS Phase 1 technical reports and the summary for policy-makers.

This factsheet has been developed specifically to provide policy- and decision-makers, researchers, practitioners and civil society with up-to-date information on observed climate trends and projected climate scenarios over the short- (2015–2035), medium- (2040–2060) and long-term (2070–2090) for South Africa. For further details see the LTAS Phase 1 full technical report entitled *Climate Trends and Scenarios for South Africa.*

1. Introduction

The climate trends and scenarios work done in LTAS Phase 1 is the most significant step thus far in consolidating relevant data for South African climate change modelling (see Box 1). The process engaged with local and international climate modellers to develop a consensus set of climate scenarios for South Africa representing different future global emissions pathways. This included downscaling global climate models from the fourth and fifth assessment reports (AR4 and AR5) of the Intergovernmen Panel on Climate Change (IPCC); and exploring short-term scenarios the time period 2015 to 2035 (centred on ~2025), in addition to the medi and long term scenarios previously explored (centred on ~2050 and ~20 respectively). The process also compared observed climate trends South Africa from 1960 to 2010 to modelled trends for the same peri to begin identifying possible strengths and weaknesses in the curr modelling approaches. Due to the variety of emissions scenarios employ by climate modellers in the projections, the LTAS process has attempt to gather these into two main groups, namely unmitigated (unconstrain and mitigated (constrained) future energy pathways (see Box 1, final bul

BOX 1. PROGRESSION OF WORK ON CLIMATE CHANGE SCENARIOS FOR SOUTH AFRICA

- 1990s: The South African Country Studies Programme developed a series of climate projections (including a simple interpolation of global climate models and statistically downscaled projections) in preparation for South Africa's Initial National Communication for submission to the United Nations Framework Convention on Climate Change (UNFCCC).
- 2003, South Africa's Initial National Communication: The overall view was that South Africa faced a considerably drier and warmer future by mid-century, with some indication of an increased risk of intense rainfall events.
- 2003–2007: Modeling approaches developed extensively internationally, including improved representation of oceanic influences on global and regional climates. In South Africa and the broader region, downscaling methods were applied far more extensively than before.
- 2007, Fourth Assessment Report (AR4) of the IPCC: High levels of uncertainty relating to rainfall projections in the summer rainfall regions of South Africa, while the winter rainfall region continued to show a higher likelihood of drying than wetting by mid- to end-century.
- 2011, South Africa's Second National Communication: Statistical downscaling of AR4 results showed a far higher likelihood of increased rainfall over the summer rainfall eastern regions of South Africa, however, the impacts of rising temperature would lead to a net decrease in water availability in many (but not all) regions.

The project is part of the International Climate Initiative (ICI), which is supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Saf

environmental affairs
Department: Environmental Affairs
REPUBLIC OF SOUTH AFRICA

giz

SANBI
Biodiversity for Life

Future Focused Opportunities

FEED THE WORLD

- The world population has now reached 7 billion and is expected to reach **9 billion by 2050**
- Some countries' food production will decrease due to climate change, further increasing world food demand
- More plant production and new crops will be needed to meet this challenge

Future Focused Opportunities

GREEN YOURSELF

- Educate yourself and plan how to sustain your business into the future
- Educate your customers and your community - consumer awareness of the value of plants is your best advantage
- Investigate industry standards and policies on climate change and sustainability

Future Focused Opportunities

GREEN THE WORLD

- Carbon dioxide removing, food creating, habitat enhancing:

  PLANTS, are a huge part of the solution

- If any group can position themselves as having an answer to saving the planet, it's plant propagators!
- This puts us at the **forefront of leadership** on the most significant global issue of our age!
- WHAT ACTION DO YOU INTEND TO TAKE?


Thanks!
Sponsors: Southern Africa
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