What is climate change and what are its implications?

View towards the Tanqua Karoo – October 2006

Emma Archer, Gamkaskloof, October 13-17th, 2008

Outline

- What is climate change?
- What are the global predictions?
- What might be predicted for South Africa?
- What are the possible implications for the Western Cape?

People often talk about climate change as

Source: www.solcomhouse.com/_borders/Global_Warming.gif

- **GLOBAL WARMING**

- - this is both right and wrong – why?

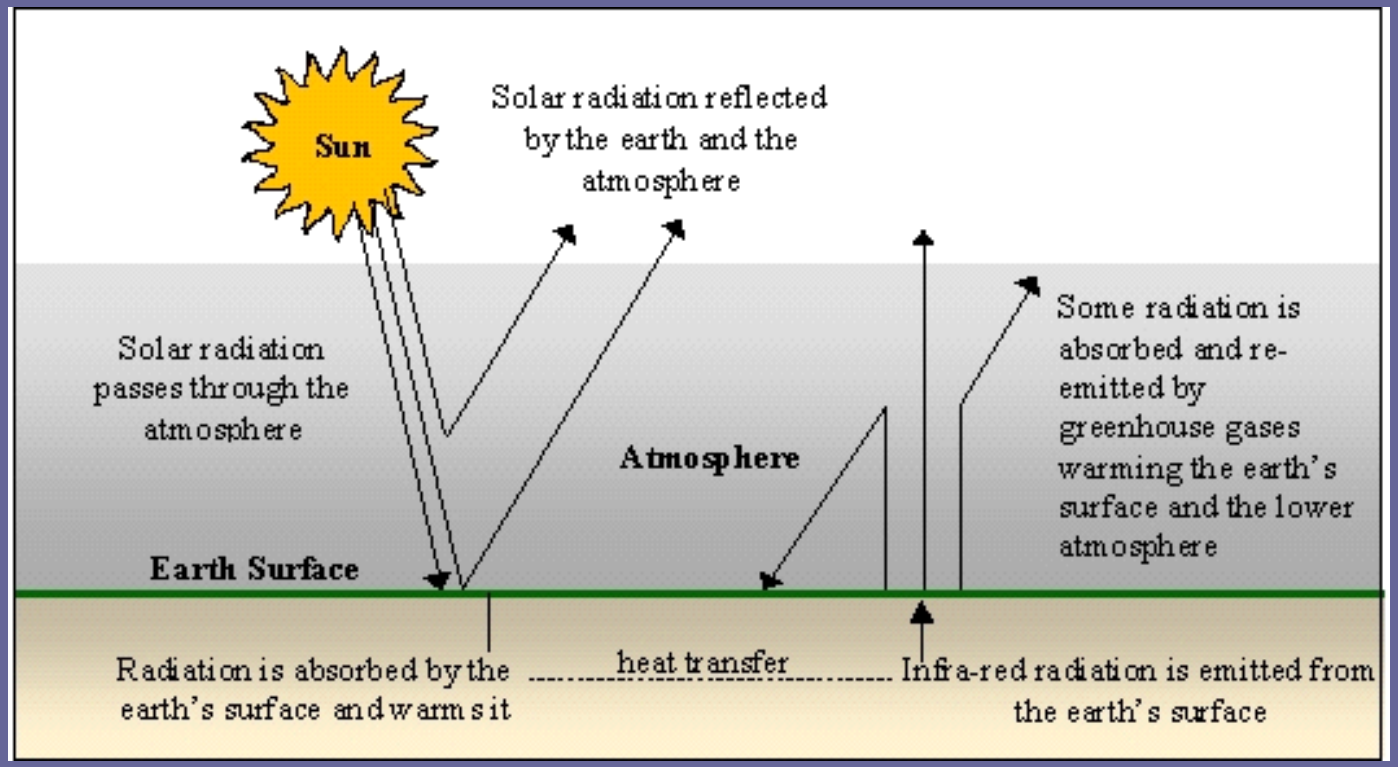
- Climate change not new
- Earth –significant variations in climate during estim 5 billion years of life
  - E.g. Ice ages; parts of earth under glaciers
- Particular concern today – warming of the earth's climate – occurring more rapidly than any previous climate changes that earth has experienced
- Unlike previous climate changes – this global warming has a clear **man-made** component

Global warming & the greenhouse effect

- Earth's atmosphere consists of
  - Nitrogen
  - Oxygen
  - Small amount of 'greenhouse gases':
    - Including water vapor, carbon dioxide, methane and nitrous oxide

→ The greenhouse effect → actually a vital atmospheric process, without which the planet couldn't sustain life

The greenhouse effect



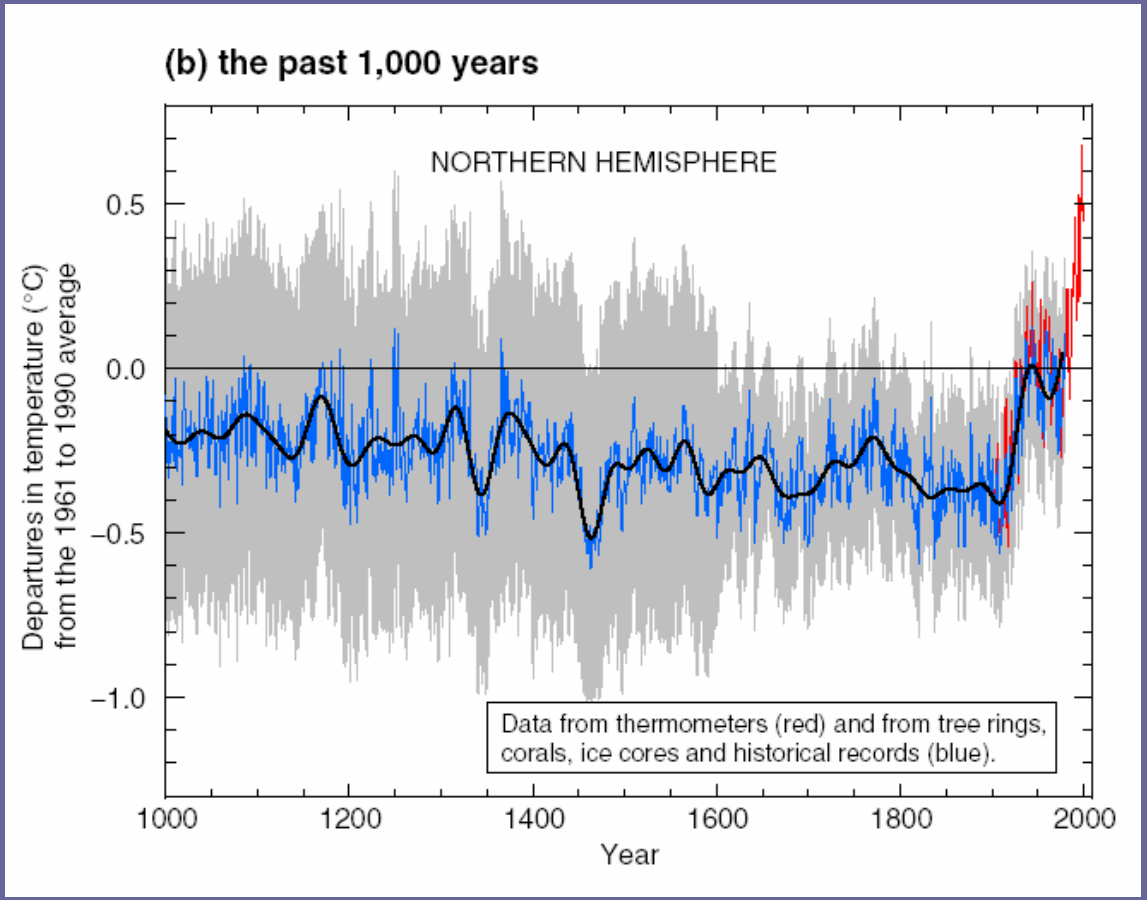
Source: Adapted in part from IPCC. 1990. *Climate change: The IPCC scientific assessment.* Houghton, Jenkins, and Ephraums, eds. Cambridge, UK: Cambridge University Press, pp. xiv.

- Greenhouse gases ~ act like panes of glass in a greenhouse
  - Allow short wave energy to pass through them
  - Trap longer-wave heat radiation that is radiated back to the atmosphere from the earth's surface (changes to atmosphere – radiative forcing)

Humans & the enhanced greenhouse effect

- Human activity has begun to alter the composition of the earth's atmosphere
  - Nothing like this ever before experienced…
- By-products of industrialization
  - E.g. CO_2 from fossil fuel combustion (coal, oil etc)
  - Have AUGMENTED the amount of greenhouse gases in the atmosphere
- Known as enhanced greenhouse effect
  - Increase in greenhouse gases traps additional heat energy within the atmosphere → predicted to have range of effects on the planet's climate

So far – collective picture of a warming world



- **Global average surface temperature has increased over 20th century by about 0.6 C**

- Temperatures have risen during past 4 decades in lowest 8 kilometres of atmosphere
    - Satellite & weather balloon measurements
- Global average sea level has risen & ocean heat content has increased
  - Tide gauge data: global average sea level rose 0.1-0.2 meters during 20th C
- Snow cover and ice extent have decreased
  - *Satellites:* decreases of about 10% in extent of snow cover since 1960s
  - Widespread retreat of mountain glaciers in non-polar regions during 20th century
  - Northern Hemisphere spring & summer sea-ice extent decreased by 10-15% since 1950s
  - Possible 40% decline in Arctic sea-ice thickness late summer – early autumn in recent decades
      - Slower decline in winter sea-ice thickness

Conclusions to date…

STATEMENT BY THE MINISTER OF ENVIRONMENTAL AFFAIRS AND TOURISM, MARTHINUS VAN SCHALKWYK, FRIDAY 2 FEBRUARY 2007

The IPCC report clearly outlines the unequivocal (clear and unambiguous) link between human activity and identified global climate change. Based on vastly improved data, analyses, modeling and understanding of climate change developed over the past six years, the report indicates that global temperatures and sea levels will continue to rise, and unless urgent action is taken, could rise dramatically by the end of the 21st Century.

The clock is thus ticking and time is running out for us to avoid major climate change with its attendant real and serious threats to our economies and people's livelihoods, health, food security, and damage to our ecosystems.

- **What about the future ?**

Predictions for the globe

By 2099..

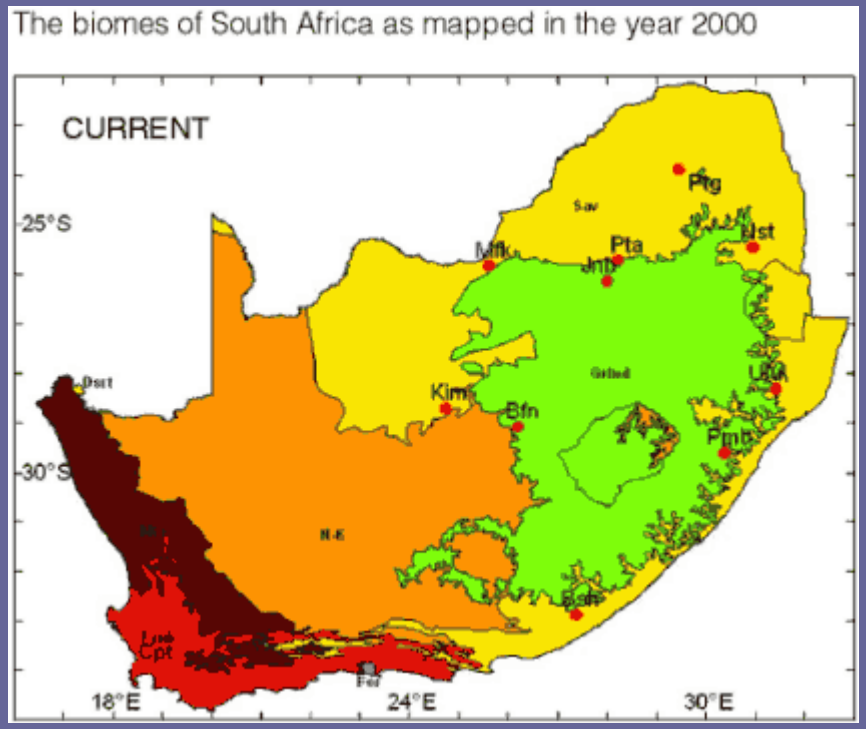
- *'Best case' scenario* – global T increase by 1.8 C (could be as low as 1.1 C) & sea level rise by as much as 0.38 m
- Under *'business as usual' scenario* – global T increase by 4 C (could be as much as 6.4 C) & sea level rise by as much as 0.59 m
  - Note – won't just wake up in 2099 and find these changes – are already occurring…..

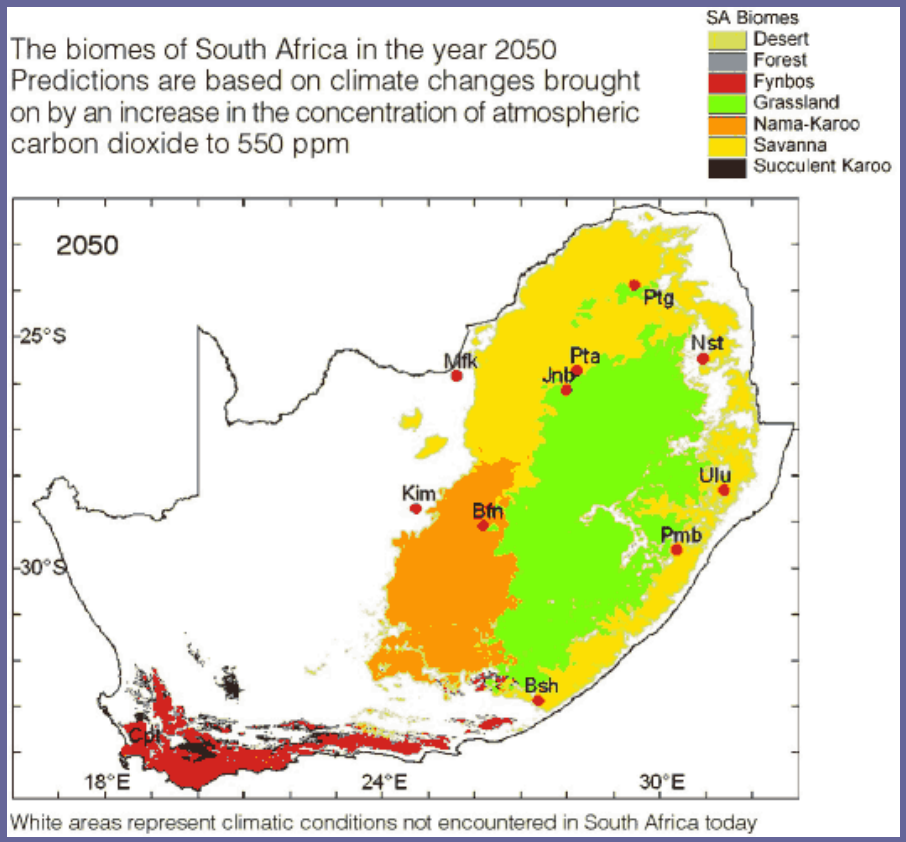
Predictions for South Africa (tentative)

- Interior warming
- Increased variability of precipitation (explain)
- Drier western South Africa away from mountains
- Increased frequency of extreme events

- W.Cape - Planning should be for a minimum of 1 deg warming by the late 2030s compared to the second half of the 20th century (Hewitson & Johnston 2007)

Climate change impacts on terrestrial ecosystems in South Africa





Source: South African National Biodiversity Institute report: '**The Heat is On**'

http://www.nbi.ac.za/climrep/

Whats happening in the western Cape?

- *Western Cape Climate Change Response Strategy:*

  http://www.wc-climatechange-response.org.za

  – *Question: what are the existing challenges, before we even think about climate change ?*

Western Cape projections – Midgley *et al* 2005, Hewitson & Johnston 2007 material used – both accessible via http://www.wc-climatechange-response.org.za

- *Midgley et al 2005:*
  - 'The future climate of the Western Cape is likely to be one that is warmer and drier than at present, according to a number of current model projections'
  - 'A future that is warmer and possibly drier, will encompass a range of consequences that will affect the economy'.

Projections for the Western Cape…

‘Projections for the Western Cape are for a drying trend from west to east, with a weakening of winter rainfall, possibly slightly more summer rainfall (mainly in the east of the province), a shift to more irregular rainfall of possibly greater intensity, and rising mean, minimum and maximum temperatures everywhere.’

Midgley *et al* 2005

Precipitation projections - summary

- General drying in all seasons in SW province areas
- Shorter winter rainfall season (what do we see now?)
- Serious drying in winter (what do we see now?)
- Decreased runoff

Hewitson & Johnston 2007

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Autumn rainfall specifics

- Decrease autumn rainfall over most of SW province
  - Agricultural areas of Swartland, Ruêns & SW Cape wine region may be affected

Hewitson & Johnston 2007

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Winter rainfall specifics

- Winter rainfall decreases over entire province
  - Greatest in SW and SE of province
- Implications for dams and agriculture (conservation?)
- Trend indicative of fewer frontal systems making landfall (MacKellar *et al* – Journal of Arid Envs)
- Increased wind speeds for winter – will increase evaporation (irrigation implications?)

Hewitson & Johnston 2007

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Temperature projections - summary

- Warming increases from SW to NE
- Most pronounced in spring & summer months
- Consistency with recent preliminary work for GCBC – Tanqua Karoo mnimum temperatures… ?
- December-Jan-Feb – moderate to strong warming over whole province – more pronounced away from coast.
- Sept-Oct-Nov – moderate to strong warming from SW to NE in spring (flowering? conservation?)

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Wind (velocity) summary

- Mild-moderate increases summer, spring & autumn
- NB – moderate to strong increases in winter
- Accompanied with corresponding drying – fire risk and evapo potential increased

Hewitson & Johnston 2007

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Stress factors

- Increase in veld fire risk
- Temperature impacts on crop activities
- Reduced soil moisture (increase in T, decrease in average precipitation)
- Possible (not robust) increases in frequency of extreme events

Hewitson & Johnston 2007

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Where is this area vulnerable?

- *Some thoughts to start* →
  - Water resources
  - Agriculture (tomorrow's presentation)
  - Rivers, wetlands & estuaries
  - Coastal impacts
    - (e.g. sea level, saltwater intrusion into coastal aquifers, extreme storm events, coastal erosion)
  - Biodiversity
    - E.g. high altitude areas, high altitude marshes, increased fire risk, estuaries
  - Effects on alien invasive species?
  - Fire danger & fire frequency
  - Livelihoods