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Megatrends: Climate Change and Natural Resource Issues

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International Research Seminar:
"Providing adequate benefits and adapting to future megatrends"

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Seminar
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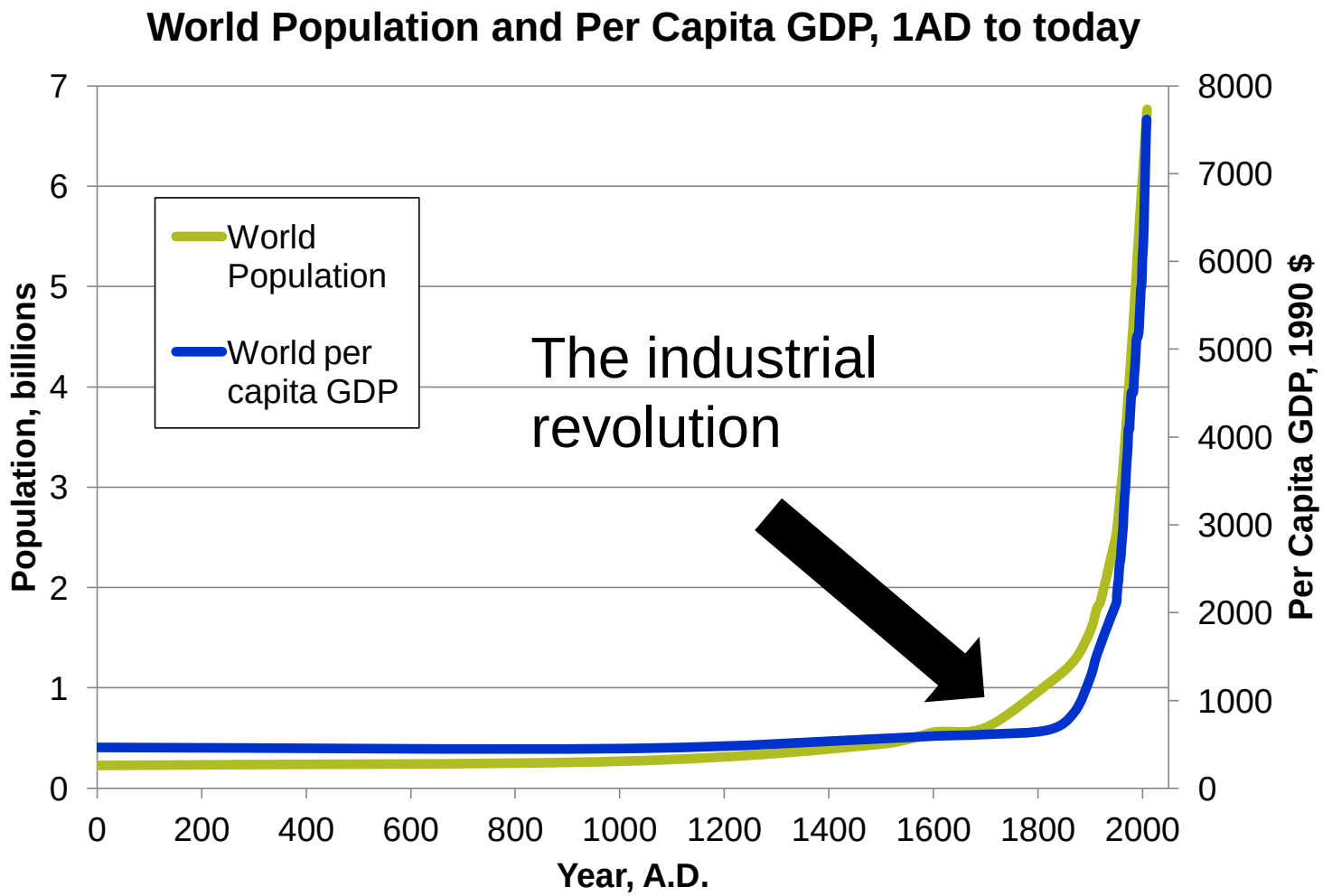
Megatrend: Climate change and natural resource limits

21st Century Megatrends?

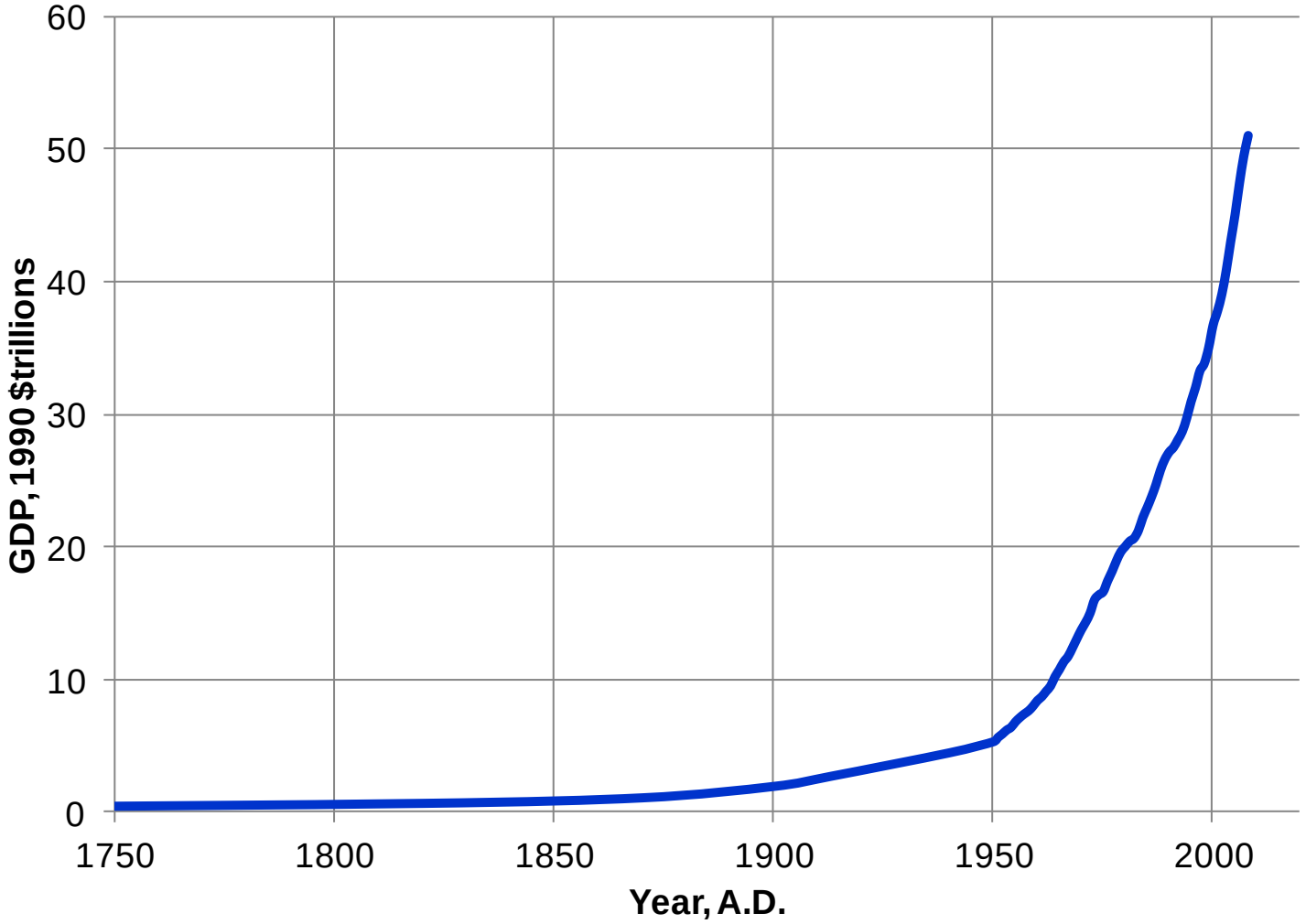
- Increasing number of extreme events and impact on global wealth from climate change, with large uncertainty
- Lower global GDP growth rates as we approach environmental and resource limits
- Societal shift towards maximizing well-being, not GDP

A long term view of growth



Source: Maddison http://www.ggdc.net/MADDISON/oriindex.htm

World GDP since 1750



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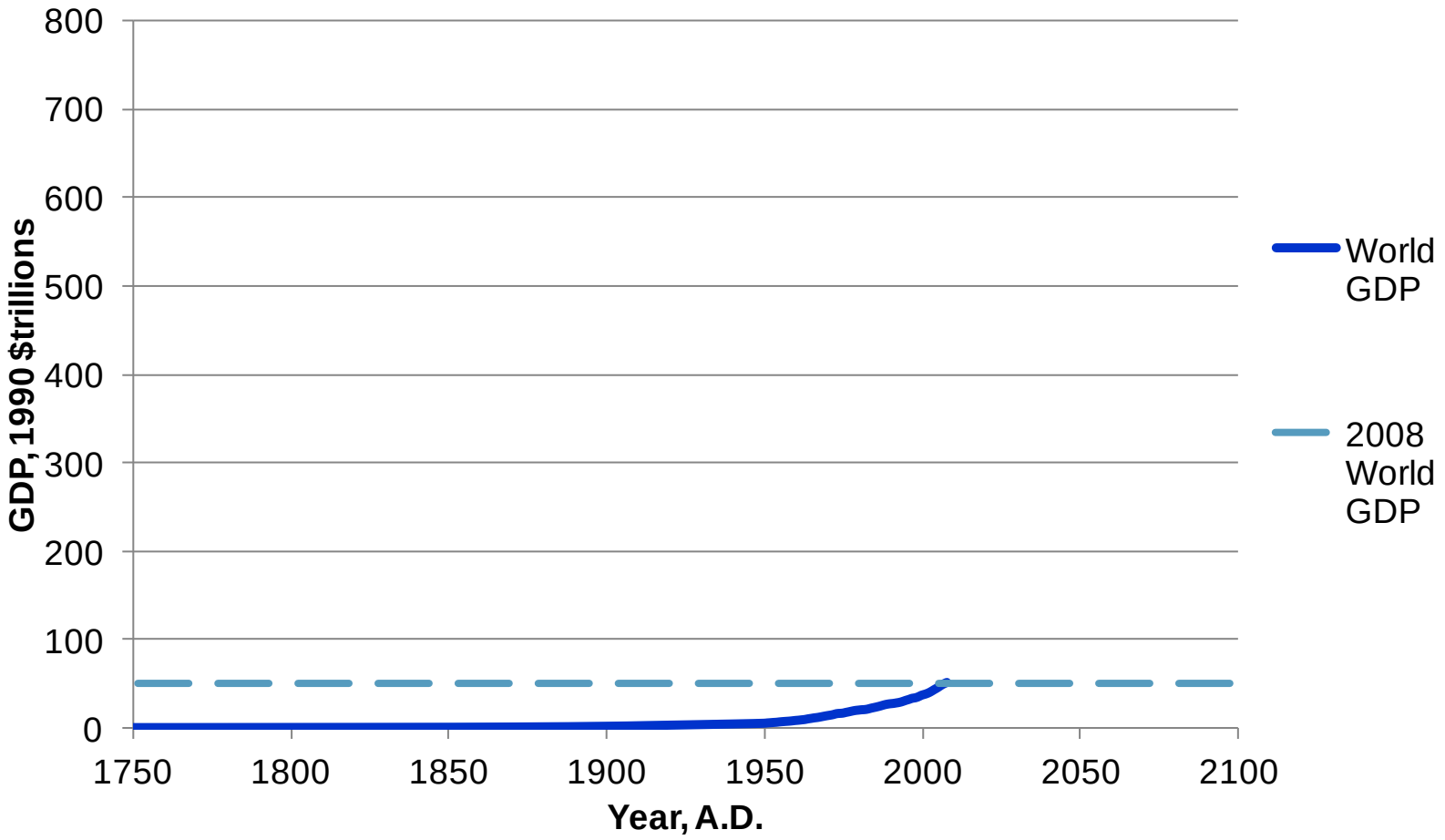
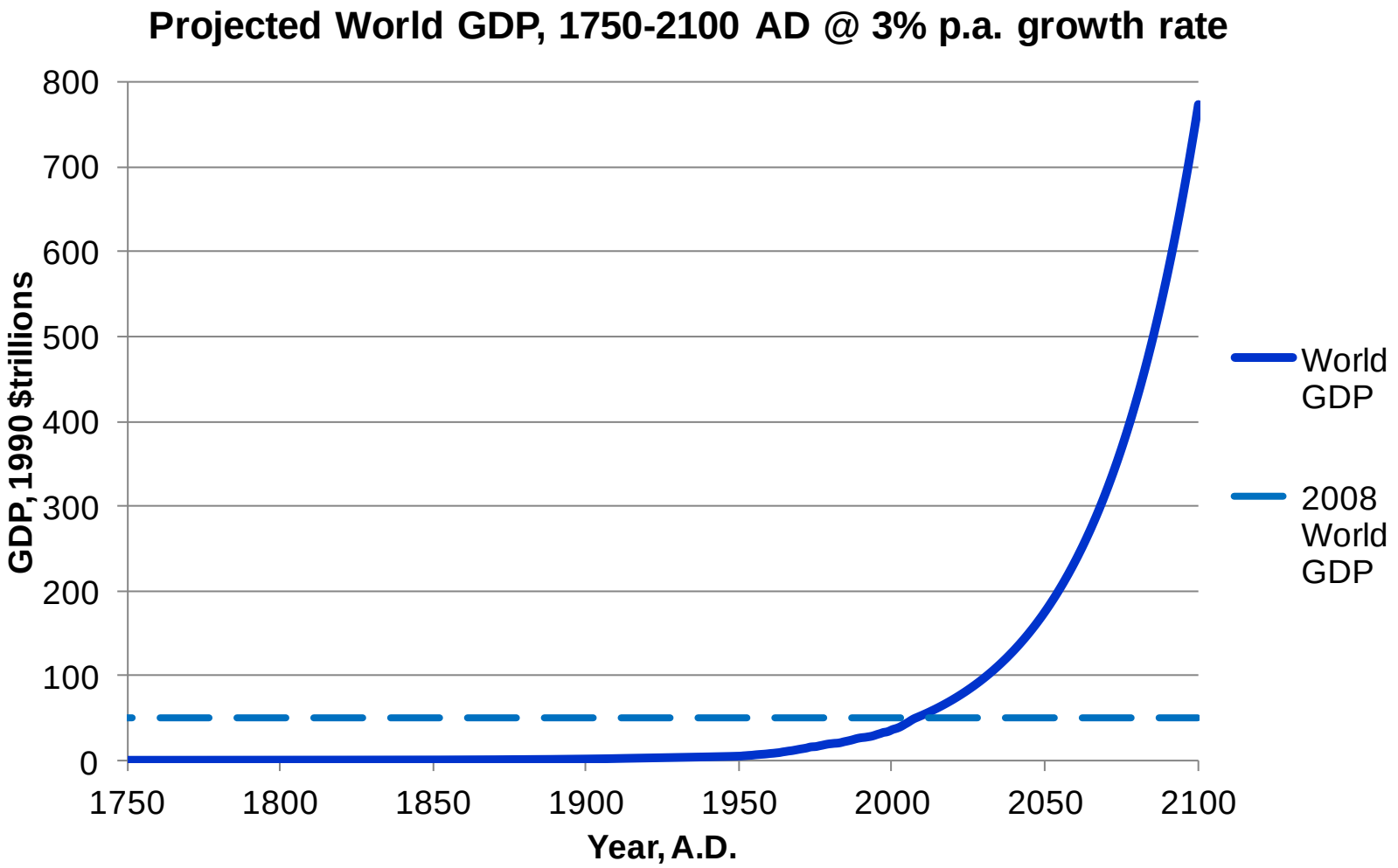
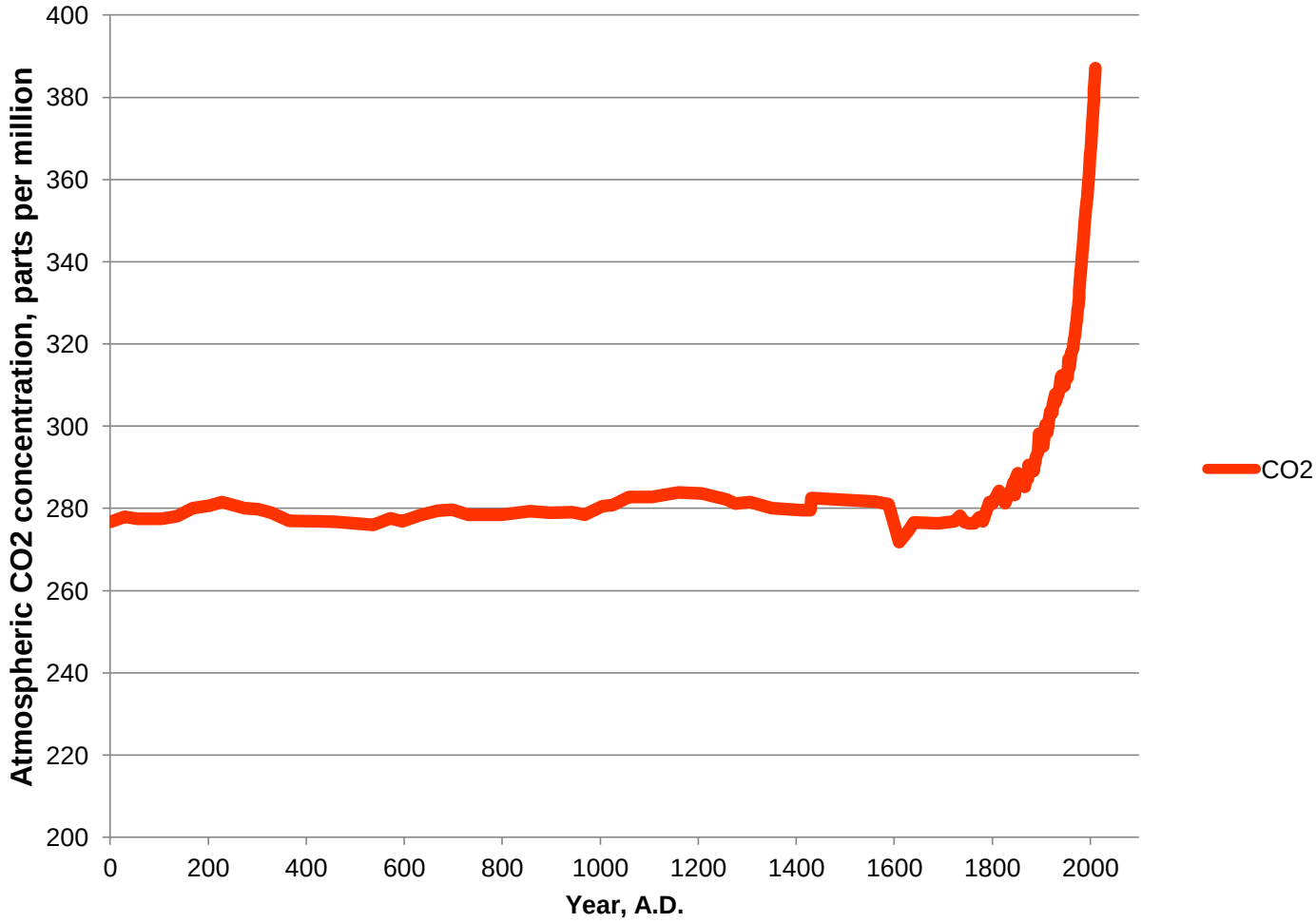


Projected World GDP 1750-2100 AD – the conventional view

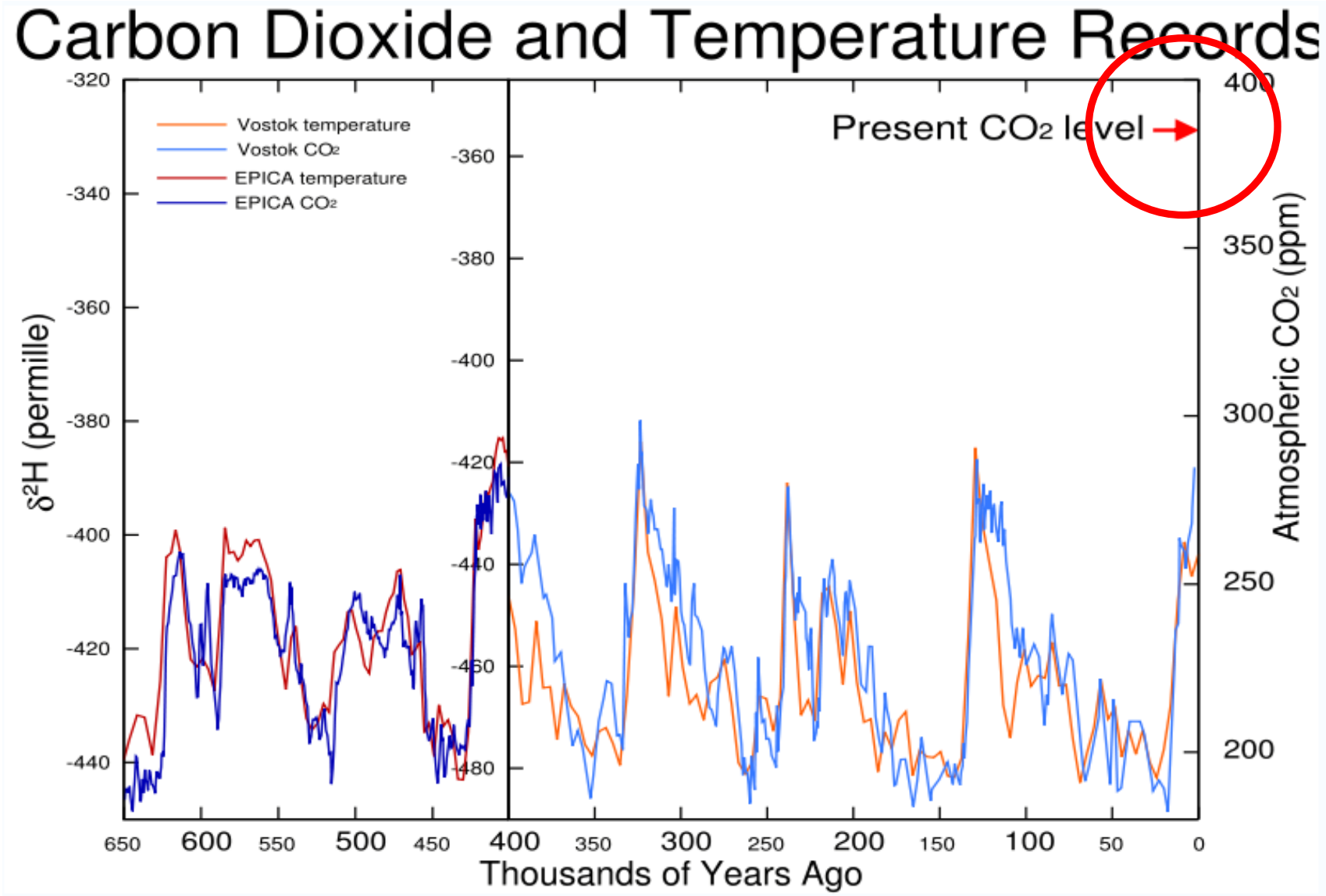


Atmospheric carbon dioxide 1-2012AD

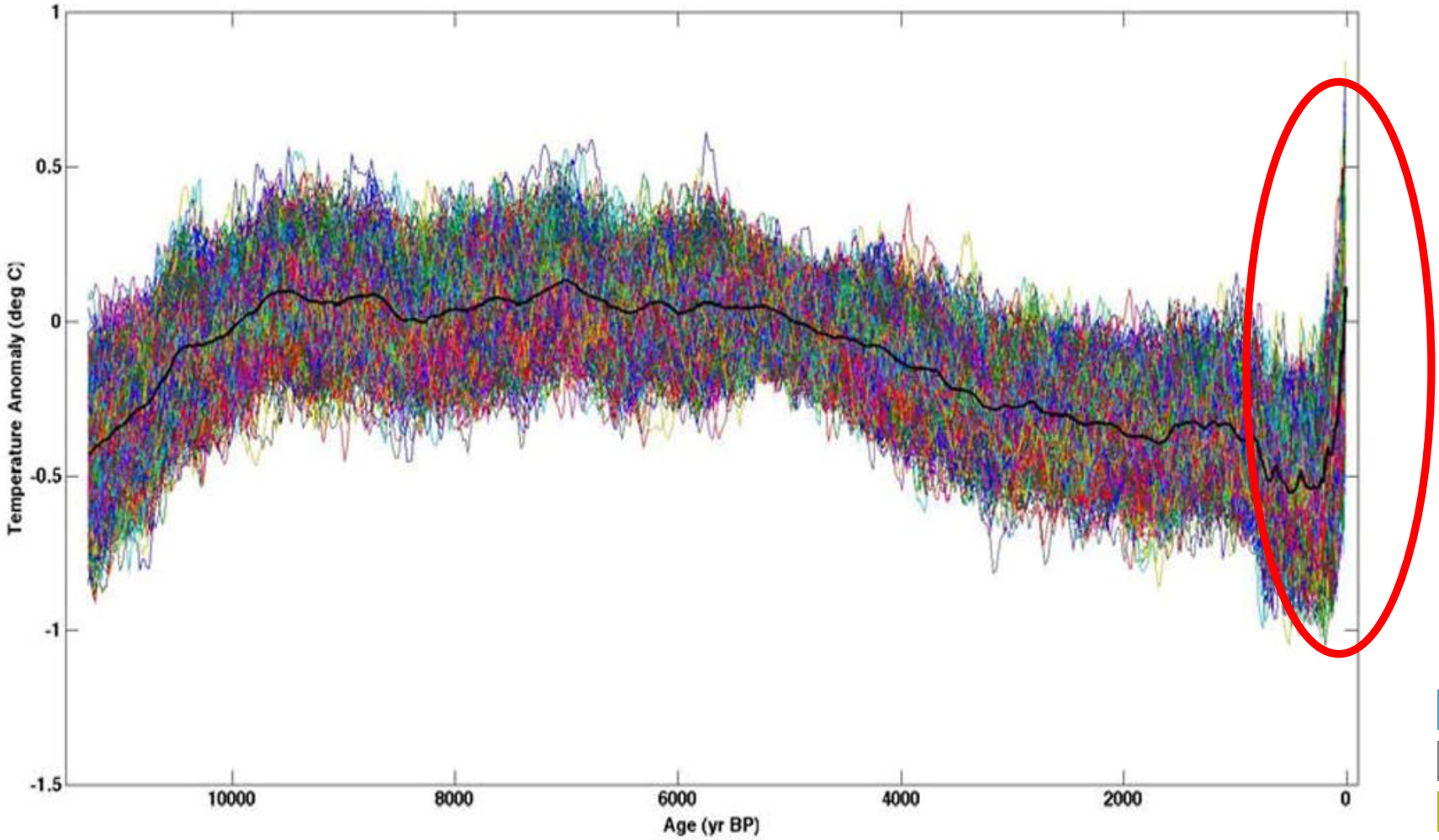


Source: Scripps Institution of Oceanography (SIO) CO2 Program http://scrippsco2.ucsd.edu R. F. Keeling, S. C. Piper, A. F. Bollenbacher and S. J. Walker

Temperature versus CO_2 concentration

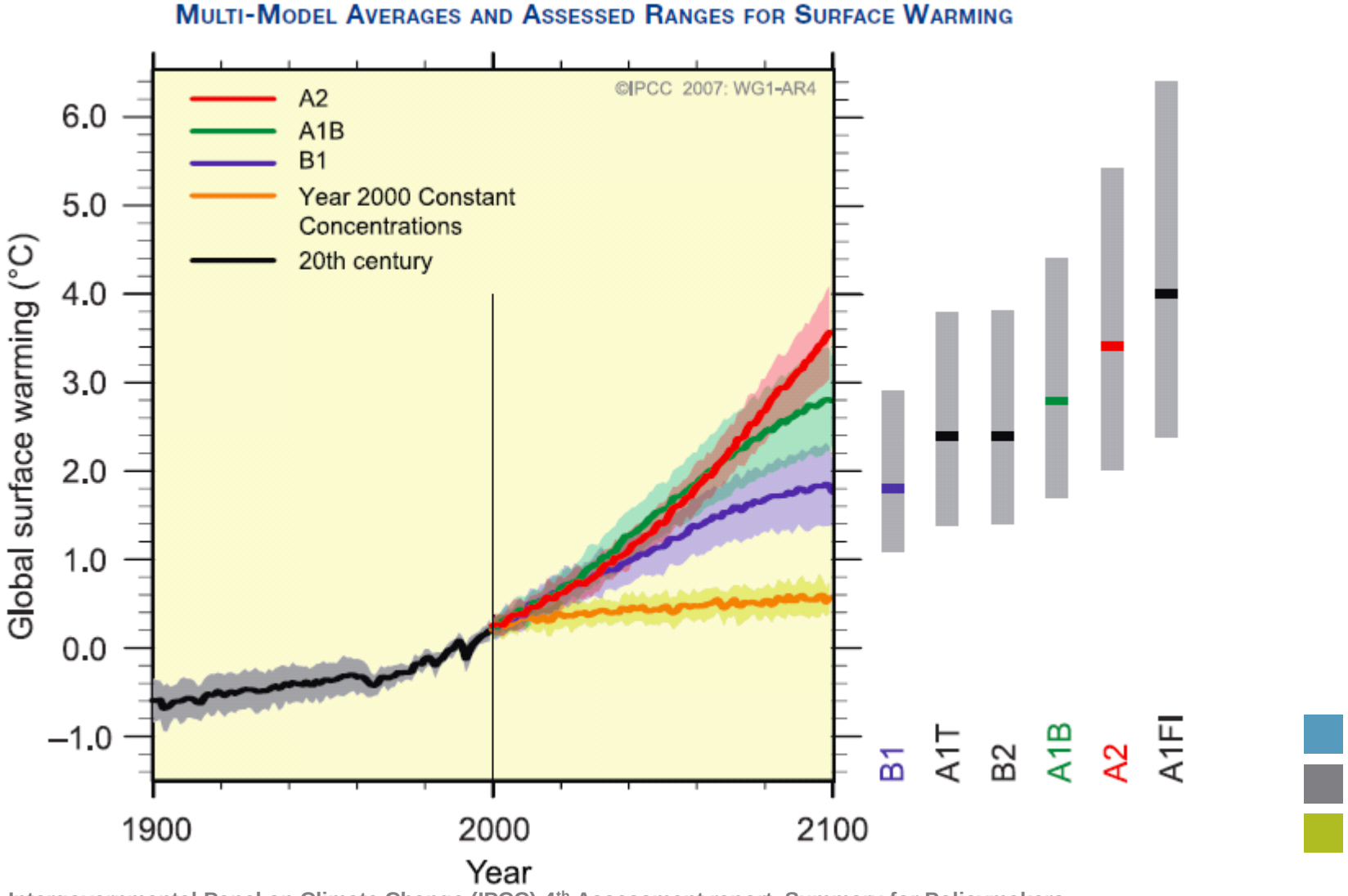


Global temperature for last 11,000 years



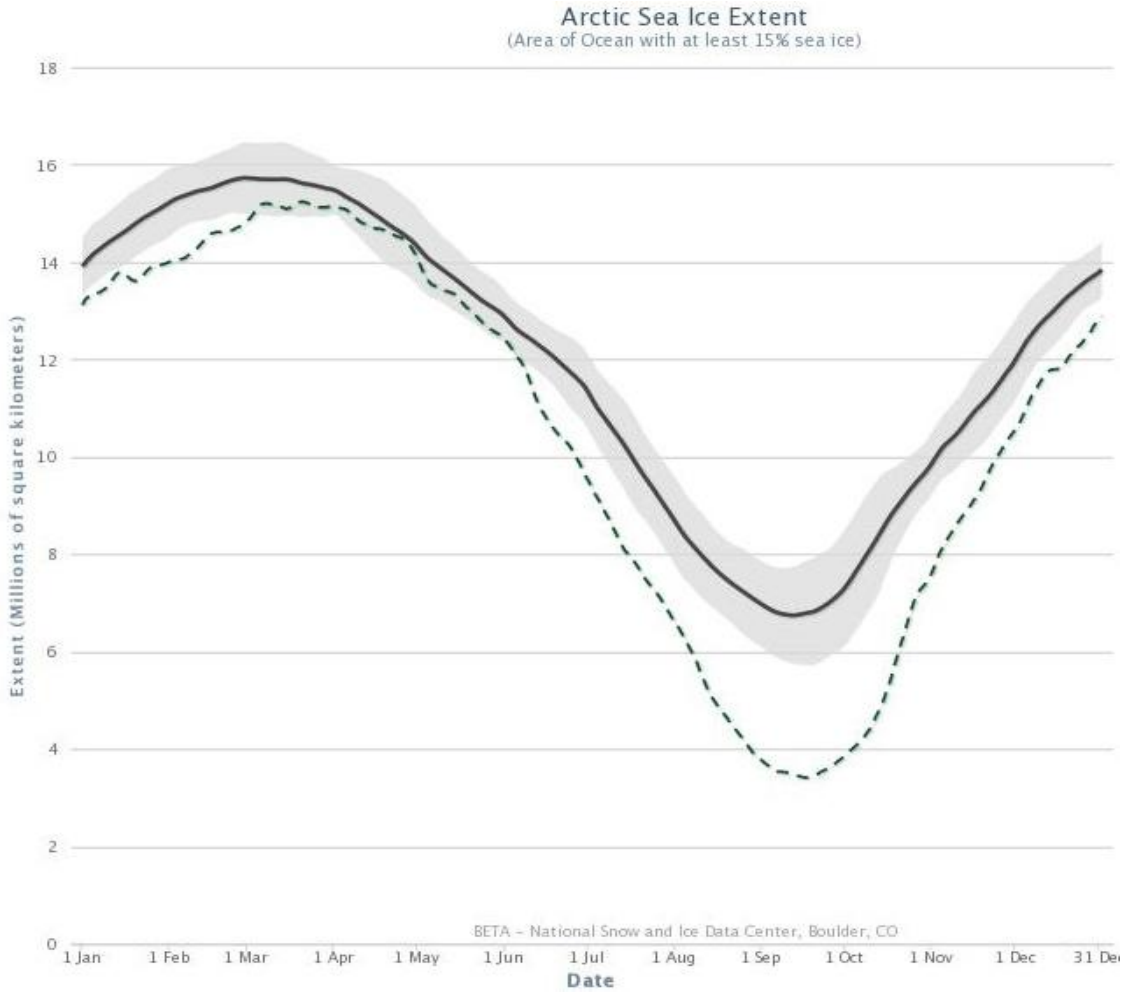
http://www.sciencemag.org/content/339/6124/1198 *DOI: 10.1126/science.1228026* A Reconstruction of Regional and Global Temperature for the Past 11,300 Years, Shaun A. Marcott, Jeremy D. Shakun, Peter U. Clark, Alan C. Mix

Temperature Rises by 2100



Source: Intergovernmental Panel on Climate Change (IPCC) 4th Assessment report, Summary for Policymakers

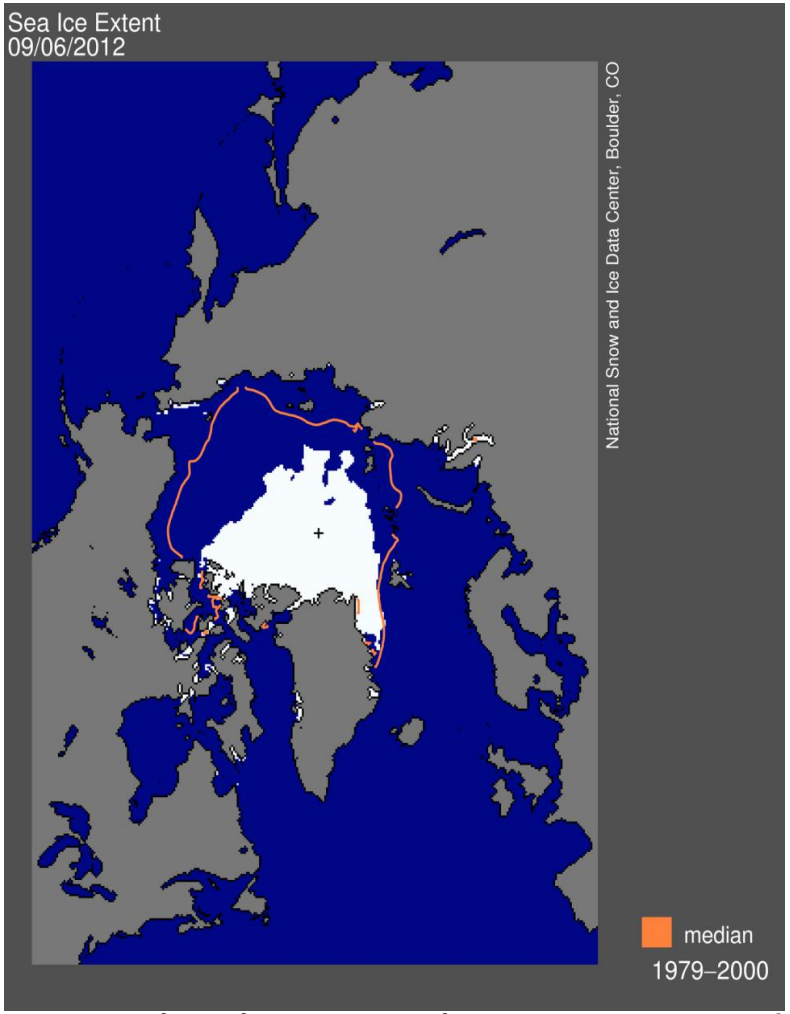
Climate Change Impact Today – Caused by 0.8°C Warming: Arctic sea ice melting



- Continuous line is average from 1979-2000 Average (shaded area is +- 2 Std. deviations)
- Dotted line is the 2012 sea ice extent

Source: National Snow and Ice Data Center http://nsidc.org/

Arctic summer sea ice area breaks 2007 record low



- Arctic sea ice is melting much faster than projected in the 2007 IPCC report
- As ice melts, open water absorbs more heat from the sun
- This may be starting to affect weather patterns

Source: National Snow and Ice Data Center http://nsidc.org/

Impacts of Climate Change

Examples:

- **More weather extremes:**
  - Heatwaves
  - Droughts
  - Intense rainfall events
  - Storms
- **Expansion of deserts**
- **Decreasing crop yields**
- **Sea level rise**

Large uncertainty about regional effects – hence adaptation is difficult to plan

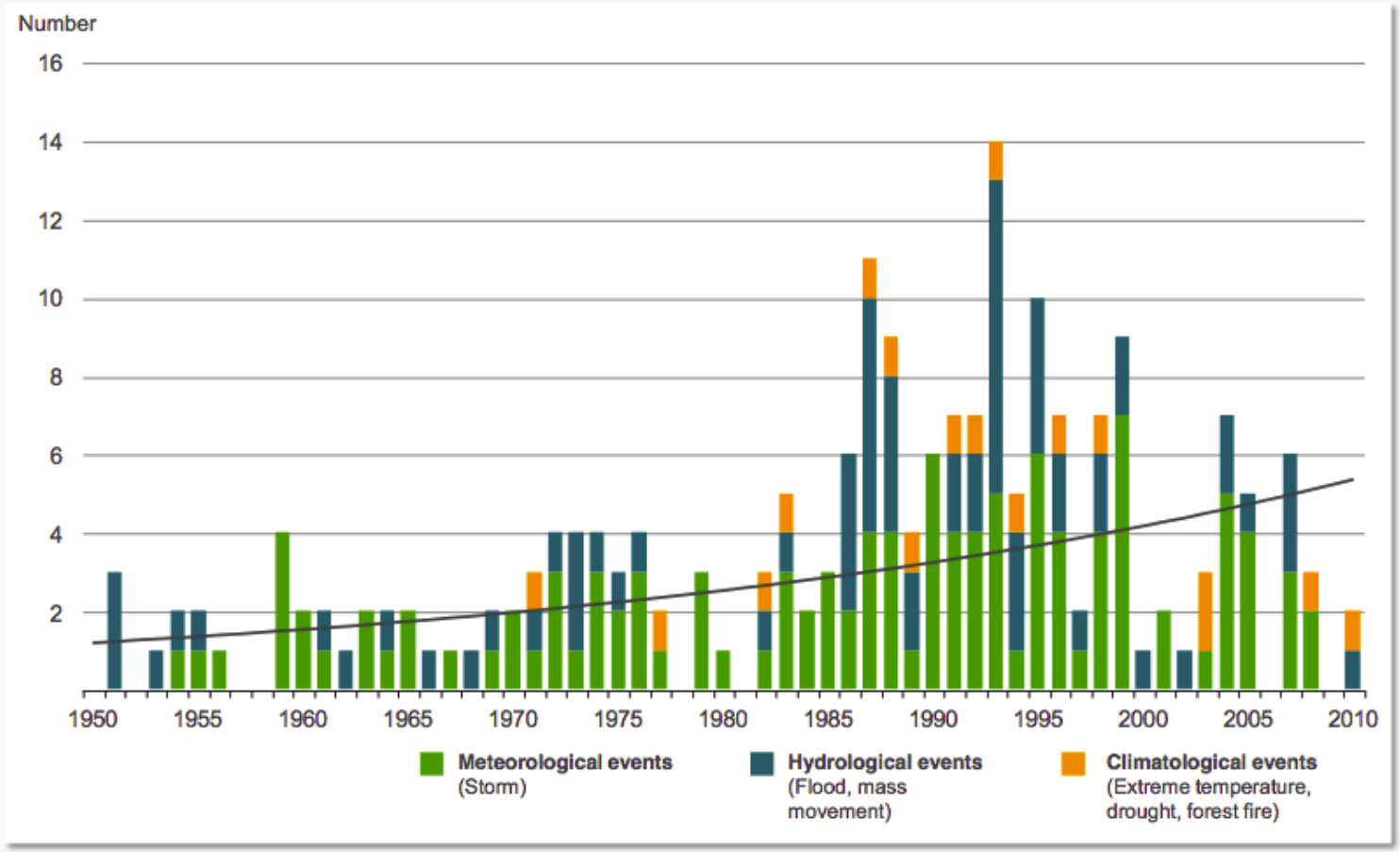
Climate Change is already having an impact

NatCatSERVICE

Great weather catastrophes worldwide 1950 – 2010

Number of events with trend

Munich RE



Energy is the “Master Resource”

Road transport

Aviation

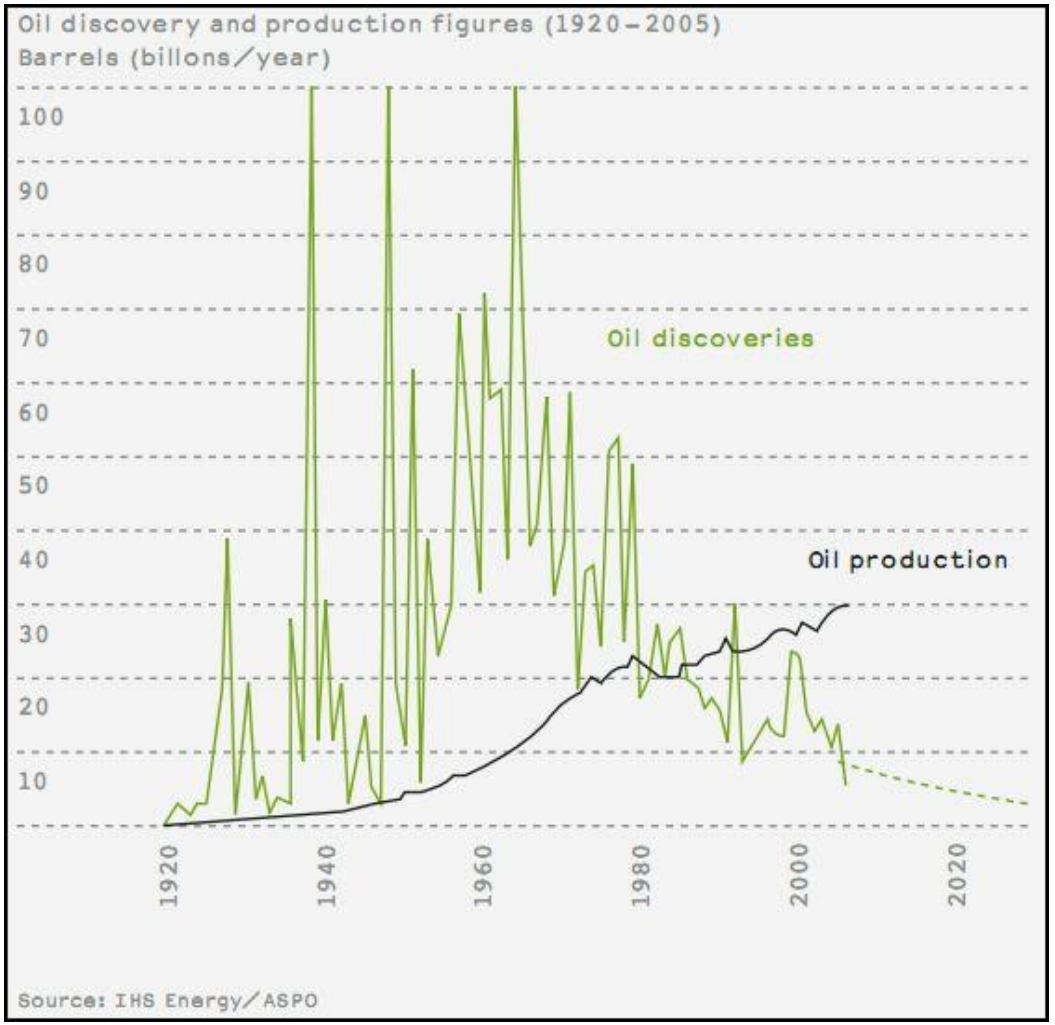
Heating and lighting

Construction

Mining

Food production

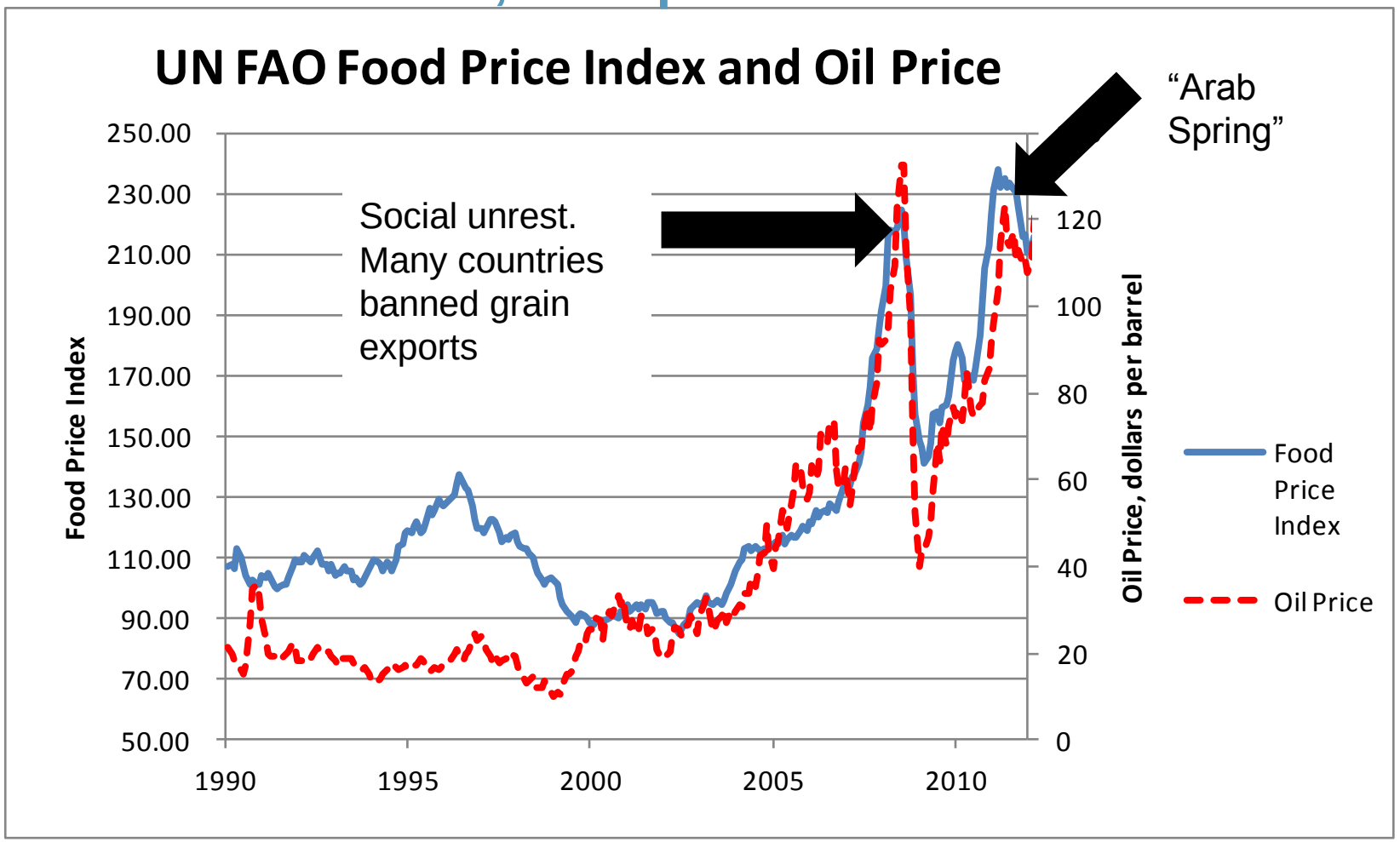
Oil is our most important energy source .. but discoveries peaked in the 1960s



"Discoveries of new deposits peaked in the 1960s and 1970s. Now a number of countries in addition to the UK and the USA, for instance, have reached their production limits. The quantity of oil being pumped out of the earth exceeds new discoveries."

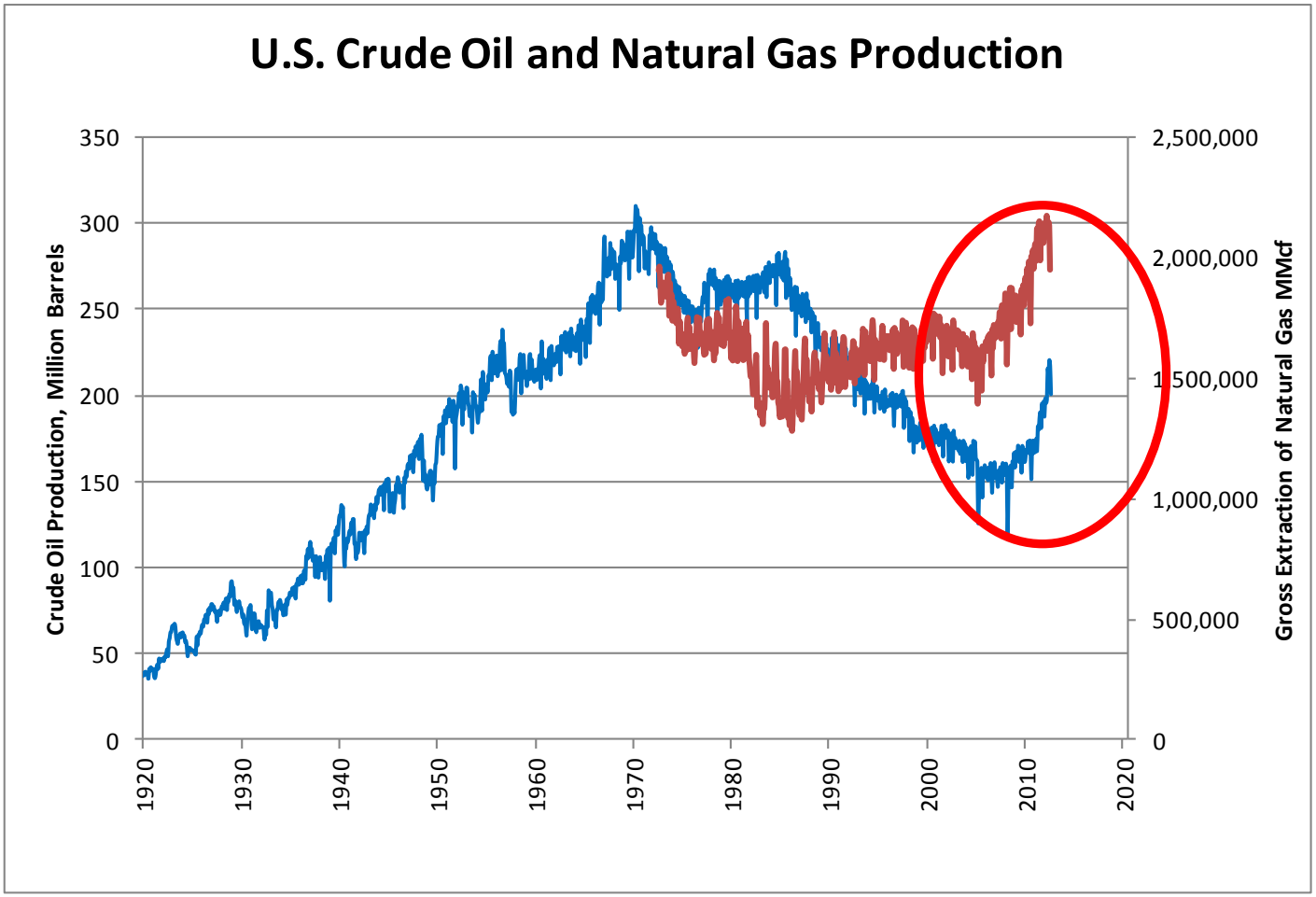
Source: Munich Re Foundation 2009 Report page 28
http://www.munichre-foundation.org/StiftungsWebsite/Publications/2009report_Publication_summary.htm

Link between oil, food prices and civil unrest?

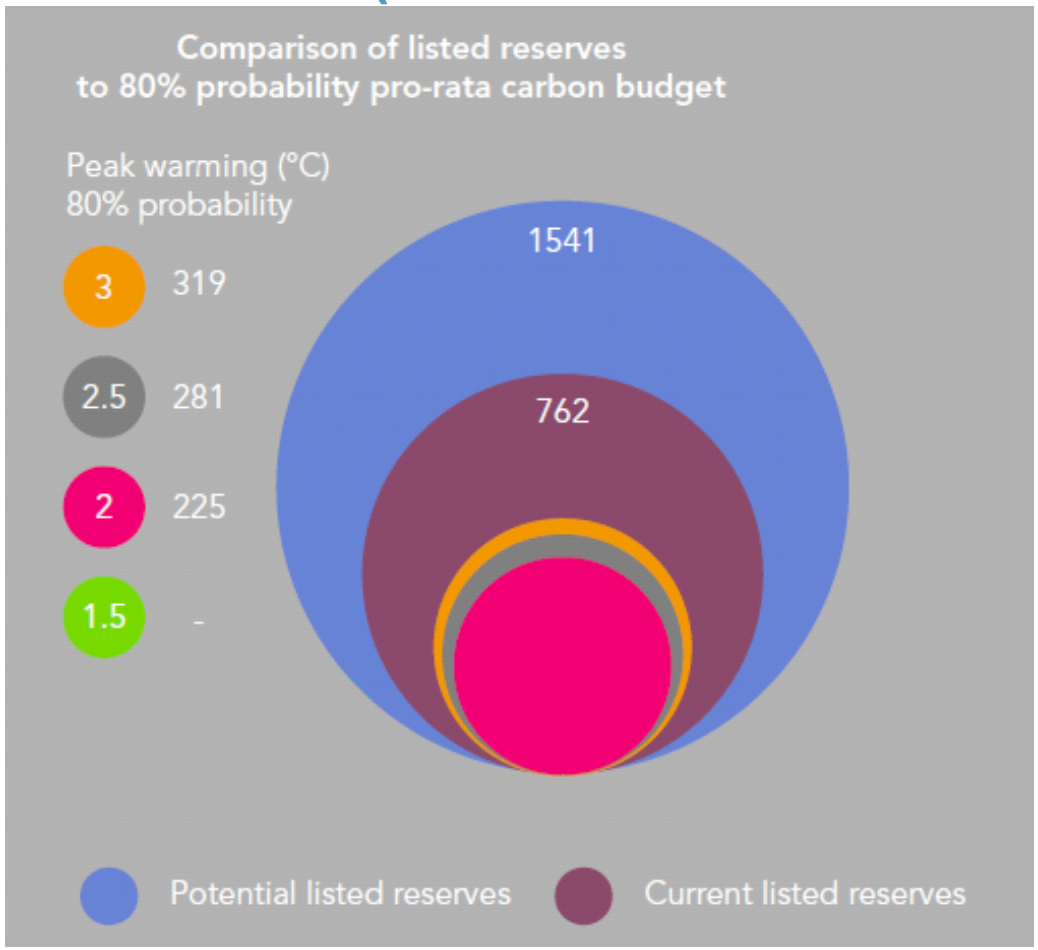


Sources: http://www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/
http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=rbrte&f=m

In the short term higher energy prices can stimulate increased oil & gas production



But in the long term, can new fossil fuel reserves be used? (The "Carbon Bubble")



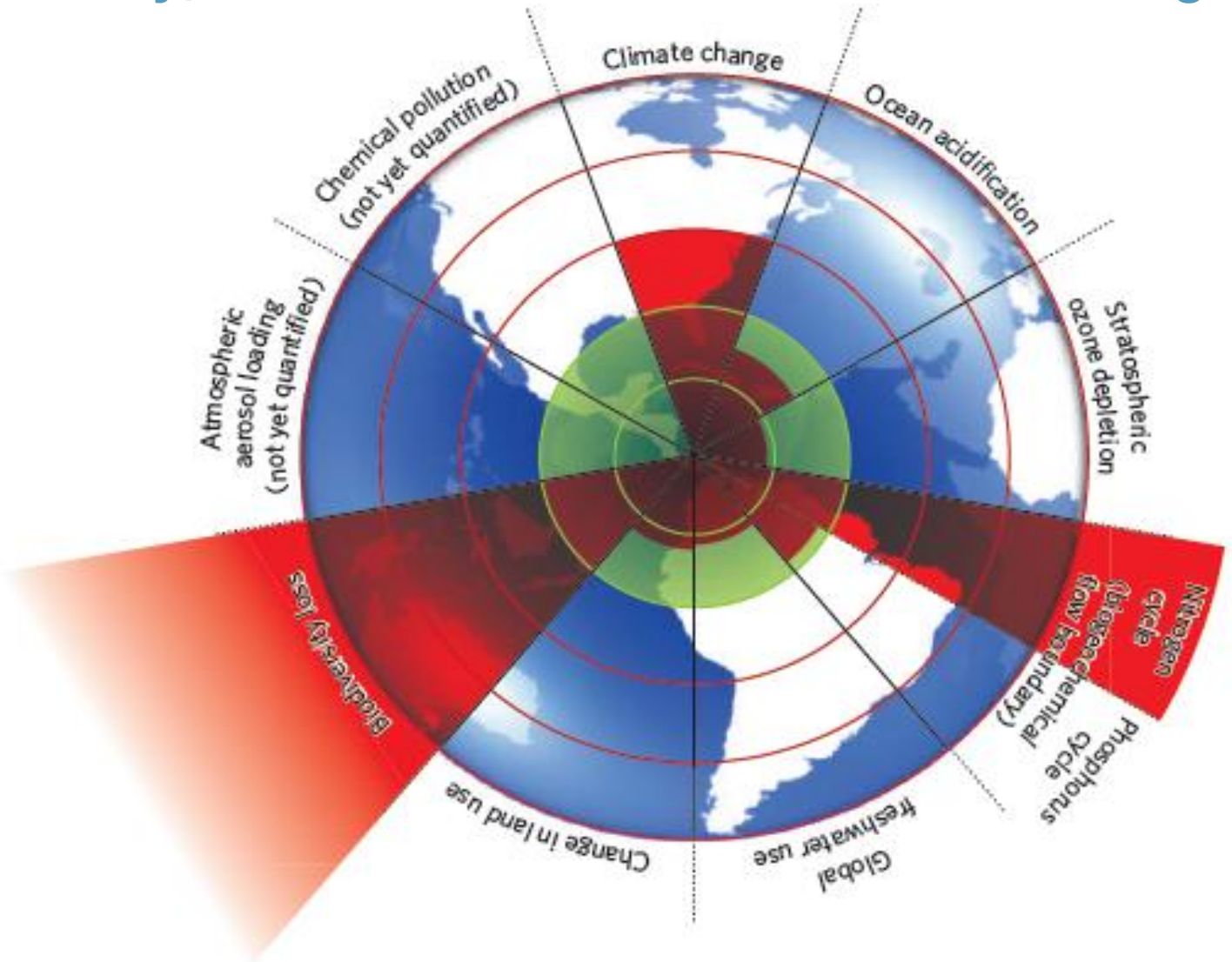
- There are more fossil fuel reserves than can safely be burnt
- If reserves can't be burnt, what are they worth? - "Carbon bubble"
- Stranded assets from shift to renewable energy

Source: http://www.carbontracker.org/wastedcapital

Energy Limits - Summary

- **Modern economies rely on liquid fuel for transport**
- **Large reserves of unconventional fossil fuel exist: tar sands, tight oil, shale gas – but very risky for the climate**
- **Huge renewable energy potential, but hard to realise it:**
  - Diffuse energy sources, concentration difficult
  - Massive investment needed
  - Lock-in to existing infrastructure/stranded assets
- **What will be the impact on energy prices and economic growth?**

In reality, a number of environmental limits to growth



From Rockstrom et al "A safe operating space for humanity", Nature 2009
http://www.nature.com/nature/journal/v461/n7263/full/461472a.html

Examples of other resource limits

- Overfishing
- Soil erosion
- Phosphorus for farming

State of the Planet: What do the Scientists say?

Planet Under Pressure conference

http://www.planetunderpressure2012.net/

London, March 2012 – 3000 delegates, many world class Natural and Social scientists

State of the Planet Declaration:

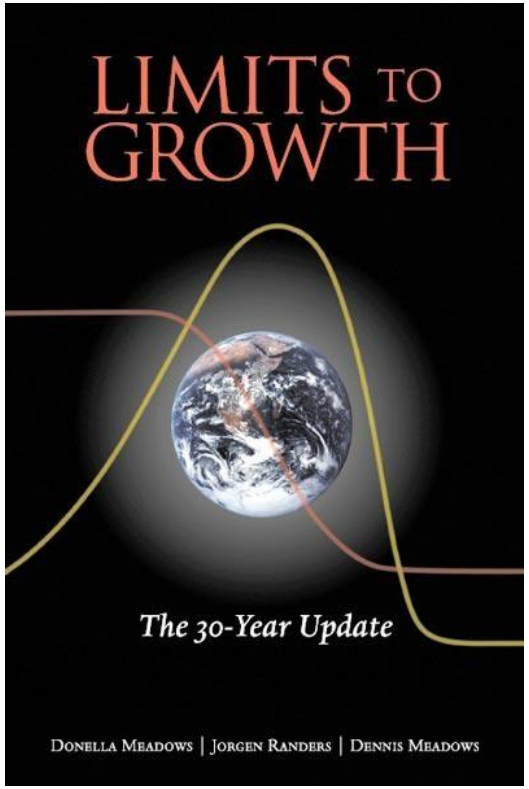
"1. Research now demonstrates that the continued functioning of the Earth system as it has supported the well-being of human civilization in recent centuries is at risk…"

The Anthropocene Age

See 'The Economist' – 26 May 2011
http://www.economist.com/node/18744401

"Humans are reshaping the planet on a geological scale."

"Limits to Growth"



- Endless physical growth in a finite world is not possible.
- If growth in consumption is not contained, humanity will exceed the carrying capacity of the Earth.
- Exceeding the carrying capacity of the Earth carries risk.

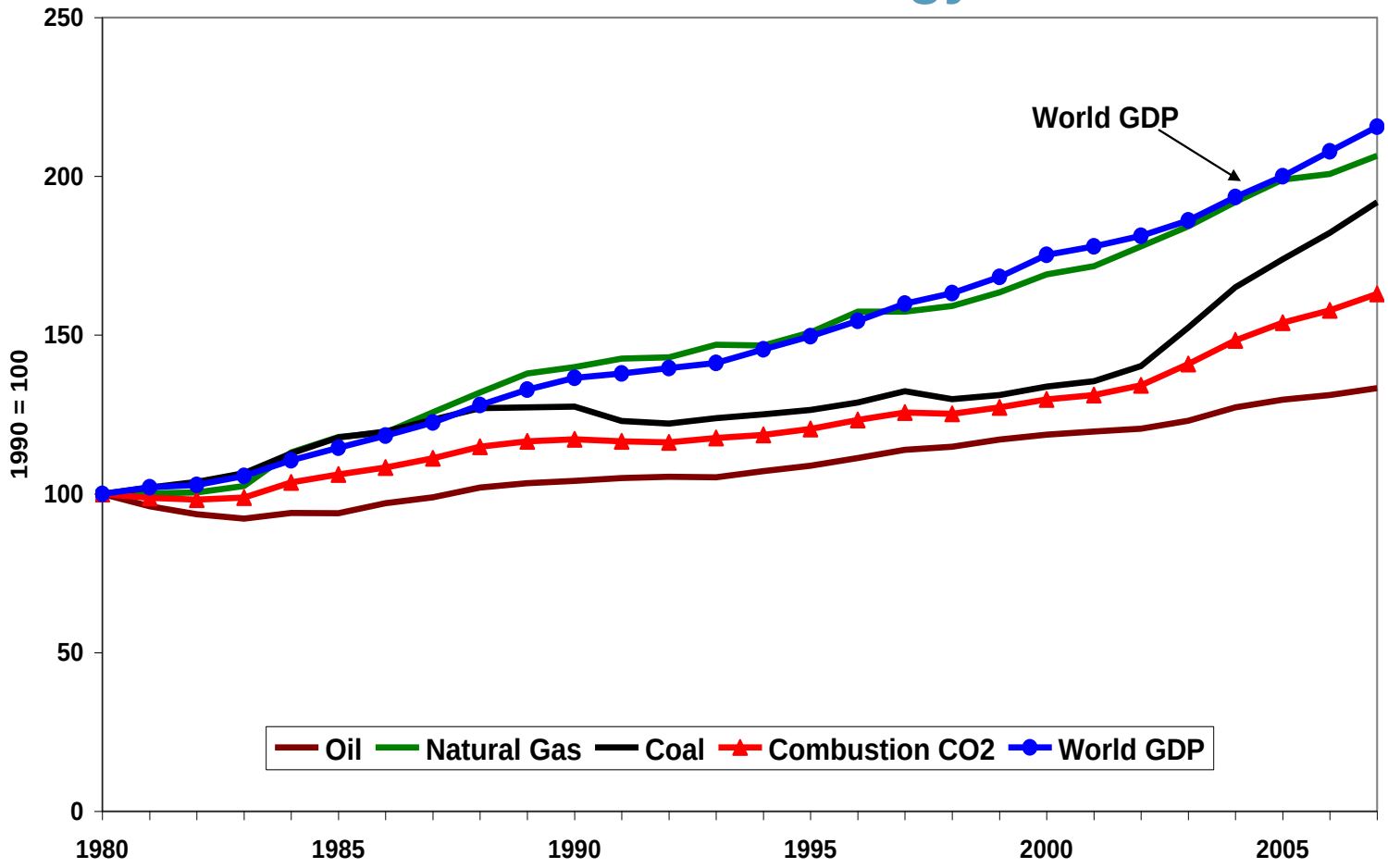
The original 1972 study was updated in 2004

Can technology solve our problems through "green" economic growth ?

- Need to completely decouple economic growth from resource use & environmental impacts
- But evidence shows this has not happened so far

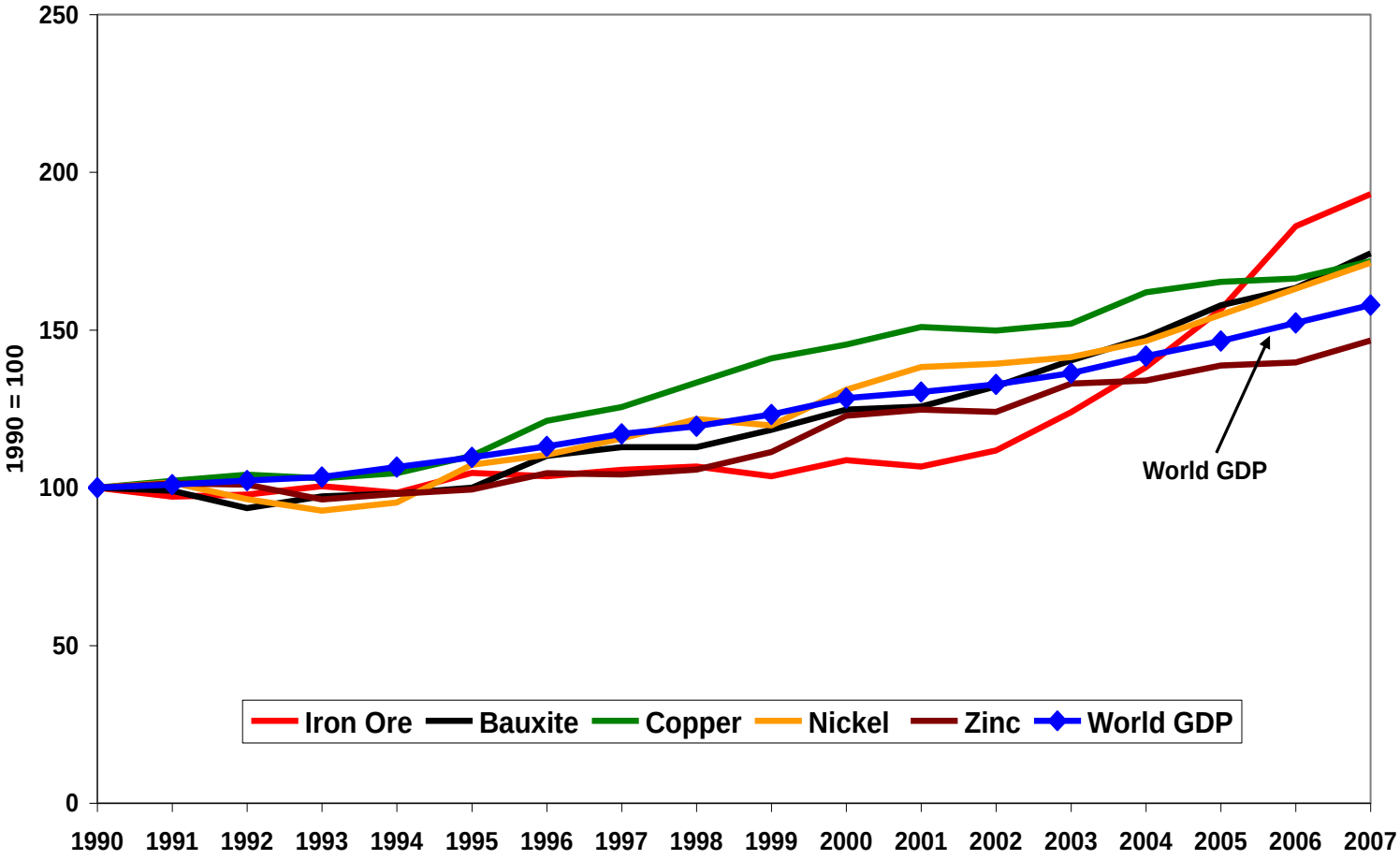
- Data suggests that it is not prudent to rely only on technology
- Efficiency gains can lead to higher energy consumption not lower (Jevons paradox)
- Deep structural changes to economy may be necessary

World GDP correlated with energy use ...



Jackson, T. (2009) *Prosperity Without Growth? Economics for a Finite Planet*, Routledge, London, UK.

... and Resource Use



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Implications of resource and environmental limits

- **The past is not a guide to the future**
  - May be slower GDP growth rates
  - Plan for transition required
- **Possible shift from consumption to investment**
  - Damage from climate change needs to be repaired
  - Clean energy will take massive investment to develop
- **Societal shift towards maximizing well-being instead of wealth ?**

Problems with GDP as a measure of success

- UK's first report on well-being in July 2012
- British Prime Minister David Cameron on GDP

  "We'll continue to measure GDP as we've always done, but it is high time we admitted that, taken on its own, GDP is an incomplete way of measuring a country's progress."

Cameron: 'Happiness cannot be captured on spreadsheet'

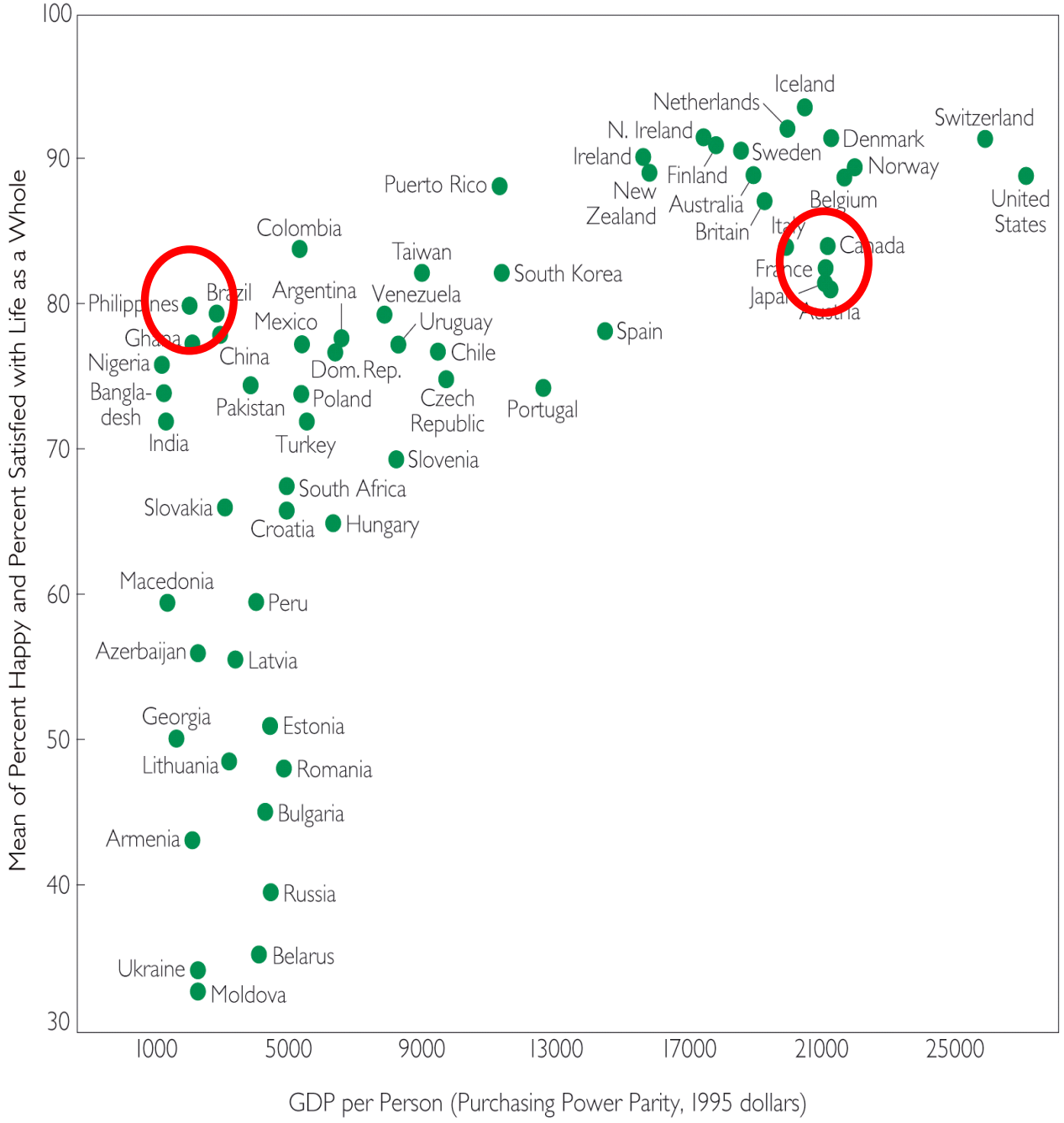
- Sarkozy/Stiglitz Commission on the Measurement of Economic Performance and Social Progress

- Former US senator Robert Kennedy in 1968:
  - "GDP measures everything except that which makes life worthwhile"

What is economic growth for?

- Developed countries have reaped enormous benefits from economic growth.
- Less developed countries need to grow their economies for basic needs: housing, sanitation, healthcare, education.
- But, once material needs are met, increasing GDP has relatively small effect on life satisfaction.

GDP versus happiness



% of people content
versus
GDP per person at PPP

Source: Jackson, T. (2009) Prosperity without growth? Economics for a finite planet,
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Summary

- Global economic growth may slow during the 21st Century due to physical limits from climate change and resources
- New technology is necessary but not sufficient
- Provided material needs are met, slower growth need not mean reduced well-being

Q&A