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Carbon Trading, Climate Change, Environmental Sustainability and Saving Planet Earth

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1. Introduction

The effectiveness of carbon trading (reducing CO_2 emission) to combat climate change in order to achieve greater environmental sustainability and/or saving planet Earth for prolonging the survival of future generations of the human race is examined.

2. Is CO_2 emission the most important driver of climate change?

The answer is not a resounding yes. The inconvenient truth is that CO_2 was singled out conveniently as the number one enemy of climate change by many particularly those who are not Earth scientists. Even though the present CO_2 level has reached ca. 389 ppm exceeding the highest level in 800,000 years in Antarctica ice cores (**Fig. 1**), great uncertainties exist on the effectiveness of carbon trading as a solution to the problem of climate change. Other measures with probably smaller uncertainties presented here will also be necessary.

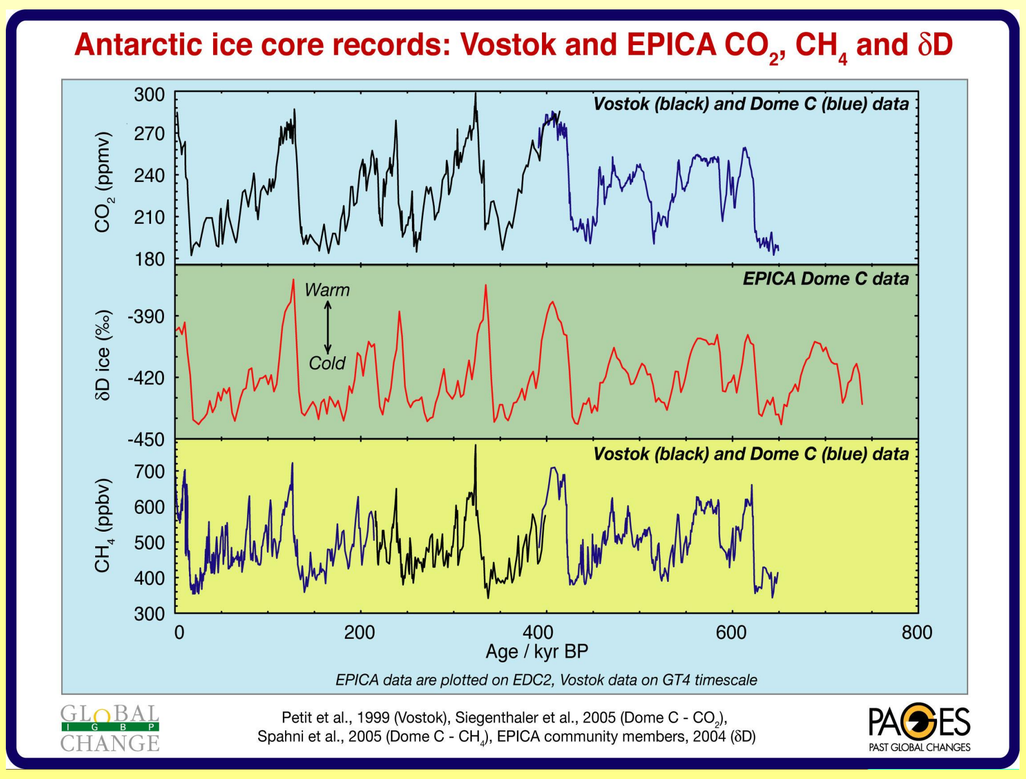

Fig. 1 CO_2, δD and CH_4 records in Vostok and EPICA ice cores.

3. Environmental sustainability as an ideal

Sustainable development was defined by Brundtland in 1987 as development that meets the needs of the present without compromising the ability of *future generations* to meet their own needs. It is however impossible to achieve because it requires Earth's natural systems to be in an overall long-term balance. Therefore we can only work towards greater sustainability. Confusion is created by the frequent misuse of the concept particularly by politicians when referring to 'economic' sustainability rather than environmental sustainability.

4. Unsustainable population growth

Population growth is the number one enemy working against environmental sustainability (**Fig. 2**).

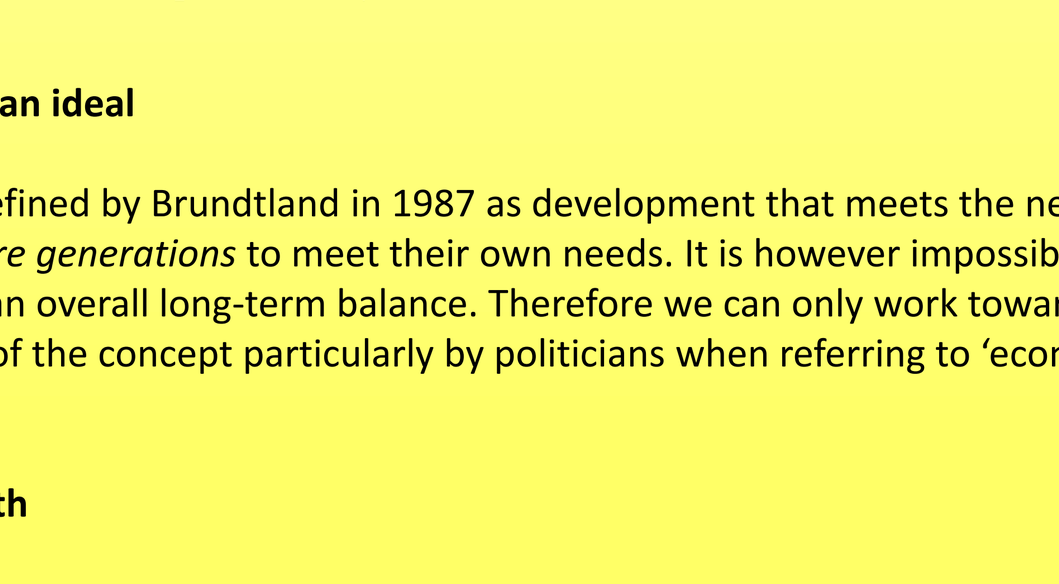

Fig. 2 Rate of population growth on Earth since 8000 B.C.

5. Consensus on climate change?

The following is believed to represent a majority view of Earth scientists:

(a) Climate has changed throughout Earth's history.
(b) Greenhouse gases are not necessarily the main driver of climate change.
(c) Astronomical variations including solar radiation, eccentricity, obliquity and precession are important.
(d) Major volcanic eruptions in the past have resulted in global cooling.
(e) Overpopulation of any organism usually leads to their demise e.g. dinosaurs.
(f) Human action has drastically changed the natural hydrological cycle through deforestation, water storage and irrigation schemes.
(g) Considerations of human forcing besides greenhouse gases including the role of changes in land use/land cover, the effect of industrial and domestic aerosols, etc. are needed to improving our understanding.

6. Supporting examples

EXAMPLE 1 Modern sea level

The South China Sea a relatively stable far-field region unaffected by glacial isostasy is used for illustration. The modern rate of sea-level change observed is difficult to explain but is slower than the projected rate of global sea-level rise of the IPCC (**Table 1**).

Source	Area studied	Years examined	Data analyzed	Rate of change
Wong et al. (2003)	Hong Kong	1954-1987	Tide gauge	Fall of 2 mm/yr
Wong et al. (2003)	Hong Kong	1987-1999	Tide gauge	Rise of 22.1 mm/yr
Wong et al. (2003)	Hong Kong	1999-2003	Tide gauge	Fall of 21 mm/yr
Wong et al. (2003)	Hong Kong	1954-2003	Tide gauge	Rise of 2.3 mm/yr
Cheng and Qi (2007)	South China Sea	1993-2000	Merged altimetry	Rise of 11.3 mm/yr
Cheng and Qi (2007)	South China Sea	2001-2005	Merged altimetry	Fall of 11.8 mm/yr

Table 1 Rates of sea-level change in Hong Kong and the South China Sea. From Yim and Ollier (2009).

EXAMPLE 2 Major volcanic eruptions

Based on investigations in southern China, the decline in mean annual temperature (**Table 2**) and some of the driest and wettest years on record (**Table 3**) may both be attributed to the influence major volcanic eruptions occurring over the past fifty years (see also **Paper no. NH33B-1147**).

Volcano	Month and year of eruption	Mean annual temperature during year	Mean annual temperature after 1 year	Difference from year of eruption	Mean annual temperature after 2 years	Difference from year of eruption
Agung, Indonesia	1/1963	23.3	22.9	-0.4	23.1	-0.2
El Chichón, Mexico	3/1982	22.9	23.0	+0.1	22.5	-0.4
Pinatubo, Philippines	6/1991	23.5	22.8	-0.7	23.1	-0.4

Table 2 Statistics of mean annual temperature in degrees centigrade recorded at the Hong Kong Station during, 1-year after and 2-year after the 1963 Agung, 1982 El Chichón and 1991 Pinatubo eruptions. From Yim and Ollier (2009).

Volcano	Latitude	First eruption date	Volume of materials erupted	Precipitation (mm)	Comment*
Agung, Indonesia	8°S	February 18, 1963	~1 km^3 (Rampino and Self, 1982)	901.1	Driest year
El Chichón, Mexico	17°N	March 28, 1982	~0.6 km^3 (Rampino and Self, 1984)	3247.5	2nd wettest year
Pinatubo, Philippines	15°N	June 15, 1991	~5 km^3 (Self et al., 1999)	1639.1	10th driest year

* Since the instrumental record began in 1884.

Table 3 Latitude, first eruption date, volume of materials erupted and annual precipitation at the Hong Kong Station during the 1963 Agung, 1982 El Chichón and 1991 Pinatubo eruptions. From Yim and Ollier (2009).

EXAMPLE 3 Frequency of typhoons

No evidence has been found for an increase in frequency of typhoons in the South China Sea and the northwestern Pacific since the Second World War (Huang and Yim, 2001) (**Fig. 3**). However, because of population growth, the potential for damage in the densely populated low-lying coastal regions of eastern Asia is greatly increased.

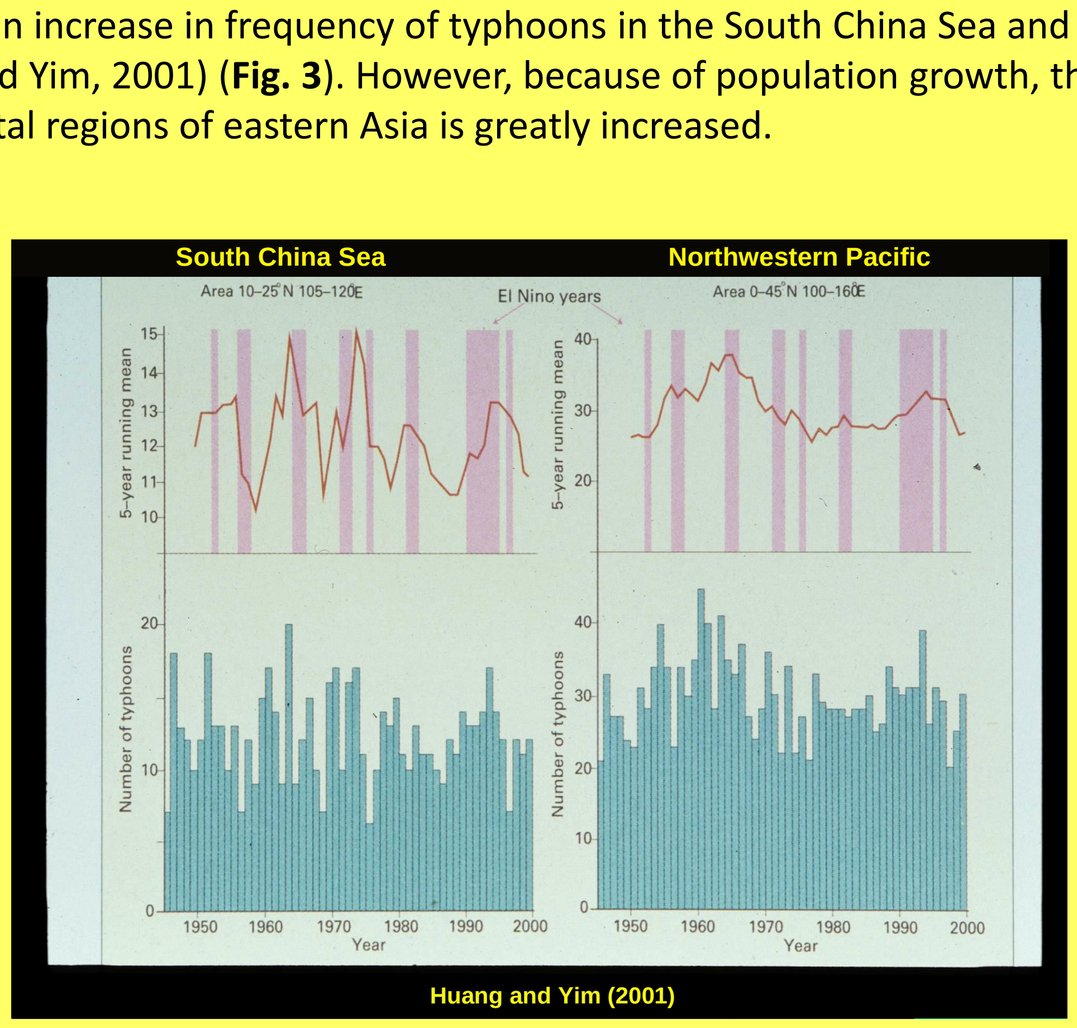

Fig. 3 Frequency of typhoons in the South China Sea and the northwestern Pacific and the occurrence of El Niño years (highlighted in pink). El Niño years can be seen to be marked by declines in the 5-year running means.

7. Waste generation

A major problem in exacerbating the problem of greenhouse gases is that we are nowhere near recycling 100% of the waste we generate. Great energy savings can be made through recycling (**Table 4**) but we are behind both in replenishing renewable resources at the rate they are being consumed and in recycling waste generated from non-renewable resources.

Product	Energy savings
Aluminum cans	206
Carpets	106
Copper wire	83
Low-density polyethylene	56
Polyethylene terephthalate	53
High-density polyethylene	51
Persnal computers	43
Newspaper	16
Corrugated cardboard	15
Phone books	11
Office paper	10
Glass	2
Magazines	1

Note: 1 million Btu equals nearly the same energy as in 8 US gallons of petrol.

Table 4 Comparison of energy savings in the United States in millions of Btu/tonne when products are manufactured using the maximum percentage of recycled materials, compared with virgin materials alone. After Zeller, Jr. (2008).

8. Way forward

In order to achieve greater environmental sustainability for our future generations' action will be needed in many areas. The International Year of Planet Earth of UNESCO (**Fig. 4**) is aimed at a more prosperous society based on the recommendations of Earth scientists on ten major themes. Carbon trading should not be the only concern as the interactions between human action, natural forces and our environment are still far from being clearly understood.

Action needed on reducing the human footprint (**Fig. 5**) besides carbon trading in order to prolong human survival into the future should include:

(a) Reducing population growth.
(b) Reducing the human impact on the natural hydrological cycle.
(c) Reducing energy consumption.
(d) Reducing wastes by recycling.
(e) Reducing pollution including industrial and domestic aerosols.
(f) Better education including the true meaning of environmental sustainability.
(g) Changing the undesirable effects created by the global economy.

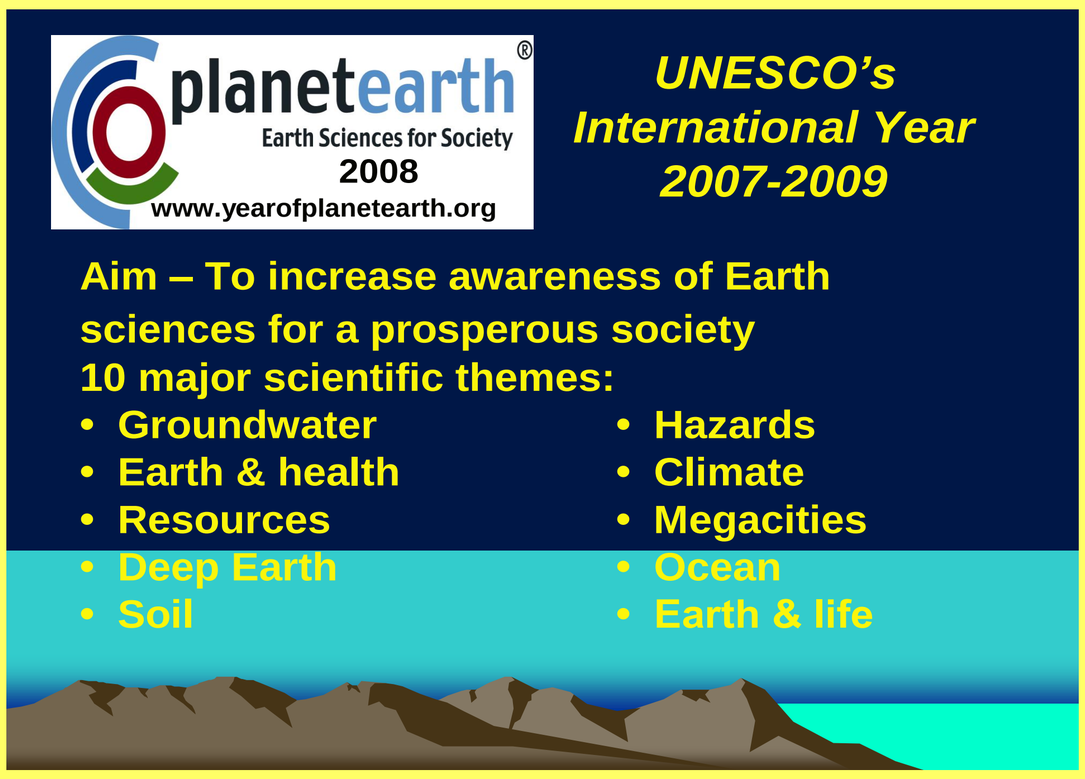

Fig. 4 The ten major science theme of the International Year of Planet Earth 2007-2009.

Fig. 5 The human footprint on planet Earth must be reduced if future generations are to survive.

9. Conclusions

It is important to recognize that humans are not on this planet for promoting economic growth and overpopulation. If future generations are to survive, the human race MUST learn to achieve a more balanced existence without destroying the environment that sustains us. In view of the uncertainties on the causes of climate change, considerations must be given to reducing other anthropogenic forcings in addition to the emission of greenhouse gases.

10. Acknowledgements

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11. References

Cheng X, Qi Y (2007). *Global and Planetary Cha*nge 57: 371-382.
Huang G, Yim WW-S (2001). *Pages News* 9/2: 7-8.
Rampino MR, Self S (1982). *Quaternary Resea*rch 18: 127-143.
Rampino MR, Self S (1984). *Scientific American* 250: 34-43.
Self S, Zhao J, Holasek RE et al. (1999). Http://pubs.usgs.gov/pinatubo/self/index.html.
Wong WT, Li KW, Yeung KH (2003). *Hong Kong Meteorological Society Bulletin* 13/1-2: 24-40.
Yim WW-S, Ollier CD (2009). *Quaternary Sciences* 29/2: 190-198.
Zeller Jr T (2008). *National Geographic* 2008/1: 82-87.