Ulf-Peter Hoppe

Earth on the Edge: Science for a Sustainable Planet – Melbourne, 28 juni – 7 juli 2011

NGFs Geilo Symposium, 9 september 2011
Partnership of Science and Society: A great Challenge

Reiko Kuroda

ICSU Vice-President for External Relations
Professor of the University of Tokyo (Chemistry/Biology)
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Gas Hydrates Stability Zone and BSR

(a) Schematic of gas hydrates stability field &
(b) Marine seismics for gas hydrates studies

Indian Scenario

- 1900 Trillion cubic meter of methane within gas hydrates
- 1,500 times the country's current gas reserves
- 10% gas-hydrates can meet our energy demand for a century

Sain & Ojha, Memoir, GSI, 2009
9 Union Lectures (fremragende!)

Dr. Greg Ayers
Bureau of Meteorology, Melbourne, AUSTRALIA
Environmental Observations as a Basis for Environmental Intelligence

Prof. Markus Rothacher
Institute of Geodesy and Photogrammetry, ETH Zurich, SWITZERLAND
The Challenge in Earth Observation: From the Fast Response to Catastrophic Events to the Reliable Detection of Very Small Trends
Sea level will continue to rise in the future.

Historical tide gauges
Satellite altimetry

Semi-empirical model projections
Sea level projections
IPCC 2007

Nicholls & Cazenave, Science, 2010
Dr. David Vaughan

British Antarctic Survey, Cambridge, UNITED KINGDOM

The Hidden History of Ice Sheets: The Secret to Predicting Sea-level Rise

Why is it so hard to predict ice-sheet change?

#5 – It’s the boundary conditions

Boundary conditions report card

- Atmospheric – 8/10 (Keep it up)
- Ocean-ice heat flux – 5/10 (Some good work)
- Bed lithology – 3/10 (Must try harder!)
- Geothermal heat flux – 1/10 (wake up!!!)
Summary and Future Directions

- Natural climate variations (with solar and particle forcing) are the backdrop on which anthropogenic effects are projected.
- The Earth’s climate system is immensely complex with many nonlinearities and multiple feedback processes.
- The Sun is also inherently complex and its outputs are subtle—we must understand the fascinating interaction of these Sun-Earth systems.
- Accurate records of drivers and responses of the climate system exist for only a relatively short period (decades) and longer reconstructions have many uncertainties.
- Models must include all natural forcing and feedbacks in order to predict future evolution of the climate system.
- Large transient changes of the solar and solar-terrestrial system (such as the recent solar minimum or major eruptive events) should be used to test sensitivities to various drivers.
A combined climacogram of all 10 temperature observation sets and proxies

- **Enhanced change**
- **Common perception:** Pure random change

The actual climatic variability at the scale of 100 million years equals that of 3 years of a pure random climate!

The orbital forcing is evident for scales between $10^4$ and $10^5$ years

This slope supports an HK behaviour with $H > 0.92$

The HK behaviour extends over all scales

From Markonis and Koutsoyiannis (2011)

D. Koutsoyiannis, Hydrology and Change
Concluding remarks

- The world exists only in change
- Change occurs at all time scales
- Change is hardly predictable in deterministic terms
- Humans are part of the changing Nature—but change is hardly controllable by humans (fortunately)
- Hurst-Kolmogorov dynamics is the key to perceive multi-scale change and model the implied uncertainty and risk
- Hydrology has greatly contributed in discovering and modelling change—however, lately, following other geophysical disciplines, it has been affected by 19th-century myths of static or clockwork systems, deterministic predictability (cf. climate models) and elimination of uncertainty
- A new change of perspective is thus needed in which change and uncertainty are essential parts
L’Aquila Accusations

- Prosecution purports a criminal miscommunication of seismic risk. The seven scientists are charged with:
  - conducting a risk assessment that was “generic and ineffective in relation to the activities and duties of prediction and prevention”
  - providing civil authorities and the public with “incomplete, imprecise, and contradictory information about the nature, causes, and future developments of the seismic hazards in question”
  - characterizing the seismic swarm that affected L’Aquila for about three months before the mainshock as “a normal geological phenomenon”
- In sending the case to trial, the L’Aquila judge agreed with the prosecution that public statements made by the defendants “thwarted the activities designed to protect the public.”
Summary:

- Effects of eruptions in Magnitude 7 range (Tambora, Laki) on climate were due to sulfate aerosols (100-200 Tg), but the cause of assumed volcanically-induced effects and linkages needs more study.

- Impact would be limited to a few degrees centigrade cooling over land-masses in NH (< in SH, but 90% of world’s population lives in NH) – not threatening sustainability (except locally but sufficient to offset global warming for months to ~ 2 years).

- Impact of very large ash clouds requires more attention; modeling efforts such as those by Folch & Sulpizio [2010] for Vesuvius ash needed.

- The 50-100 Mt range of S gas release may yield densest, long-lasting aerosol clouds; self-limiting effects will mute impact with larger mass.

- Mean occurrence rate of 1-2 per century may be an underestimate.

- Cumulative effects will have wide reach compared to those, e.g., of major earthquake or tsunami.