

## PhD Candidate:

Johannes M. Luetz

# PHD PROPOSAL

## SEA LEVEL REFUGEES

**Prospective Title:** Opportunities And Success Factors For Controlled Climate Change Migration – Lessons From Present-Day Small Island Resettlements

*“When we talk about a one metre rise in global sea level we are also talking about 500 million people who are going to have to look for new homes. So far we don’t have any instruments to manage this.” (Prof. Dr. Hans Joachim Schellnhuber, Director Potsdam Institute for Climate Impact Research, Chairman German Advisory Council on Global Change (WBGU), Senior Advisor to the German Government) <sup>(1)</sup>*

### Research Background

This PhD project is a follow-on study to a year of desk and field research on climate change preparedness carried out for the humanitarian INGO World Vision. The published report ("Planet Prepare," WVI, 2008) <sup>(2)</sup> calls on policy makers, development organisations and donor governments to take a more proactive stance in dealing with the growing vulnerabilities of developing countries in the face of climate change. The study saw hundreds of islanders and coast dwellers interviewed. A number of interviews feature in the report. These eyewitness accounts from across the Asia Pacific suggest that climate change migration has already become a present-day reality for numerous developing communities. More research is needed. This PhD study seeks to make a qualitative and quantitative contribution.

### Research Rationale

Evidence suggests that the world is teetering on the brink of an era of large-scale climate change migration. While civilisations have previously abandoned some locations in favor of others on account of climatic changes and related resource constraints, <sup>(3)</sup> the order of magnitude on which climate change is expected to deracinate people and create flows of environmental exiles in the 21st century is unprecedented. Research estimates vary in their precise figures but hold one similarity in common: the prognoses range in the dozens and hundreds of millions of people. <sup>(4)</sup> <sup>(a-f)</sup> Left unchecked and unmanaged, such massive-scale movements of climate exiles within, and across, international borders, could destabilise nations internally, create tensions within the international community and – in the absence of political forethought and

management – become a formula for protracted, bloody conflicts and human misery. <sup>(5)</sup>

The changes should not be relegated to the future. Indications are that the crisis is already beginning to manifest itself. The first evacuation of low-lying islands due to rising sea levels is underway in the Carteret Islands of Papua New Guinea. <sup>(6)</sup> Other islands are on the brink of disappearing under the sea <sup>(7)</sup> or of becoming uninhabitable due to the growing demands of increasing island populations on diminishing fresh water supplies. <sup>(8)</sup> Coastal communities such as Labutali in Papua New Guinea <sup>(9)</sup> Shishmaref in Alaska <sup>(10)</sup> or Dalalkandi/Tajumuddin on Bhola in Bangladesh <sup>(11)</sup> have had to be abandoned on account of rising sea levels and unmanageable levels of erosion. In 2008 the Maldives announced the creation of a sovereign wealth fund to pool earnings from tourism to buy land elsewhere should rising sea levels inundate the country and necessitate the forced resettlement of the nation's 400,000 islanders. <sup>(12)</sup>

Assessment reports by the UN Intergovernmental Panel on Climate Change (IPCC), the 2007 Nobel Peace Prize-winning global authority on climate change, have projected a rise in global sea levels from thermal expansion (warmer water occupies more space) of 18-59cm this century. <sup>(13)</sup> Since these projections specifically exclude any contributions of meltwater runoff from the disintegrating ice sheets of Greenland and West Antarctica, <sup>(14)</sup> the IPCC itself acknowledges that "larger values cannot be excluded." <sup>(15)</sup> Recent studies not only confirm the IPCC's bleak outlook but suggest it may be overly optimistic in its assessment. <sup>(16)</sup> The IPCC sets out what can be thought of as a lowest common denominator consensus, and headline risk numbers which were published only two years ago are already understood to have erred on the side of understatement. <sup>(17)</sup> Moreover, positive feedback processes and the passing of tipping points <sup>(18)</sup> could lead to irreversible and self-reinforcing warming of the Earth's climate system and accelerate the melting of the Greenland and West Antarctic ice sheets. <sup>(19)</sup> Reputable scientists have warned that sea level rises on the order of 2m this century are conceivable <sup>(20)</sup> but do not as such constitute worst-case scenarios. <sup>(21)</sup>

Given the inertia of the Earth's climate system and the longevity of CO<sub>2</sub> in the atmosphere – 1/3 remains in the air after a century and 1/5 after a millennium <sup>(22)</sup> – much unavoidable warming is already locked into the climate pipeline from past emissions. The implicational corollary is stark and striking: no matter how aggressive future mitigation strategies may be, the looming crisis of climate change migration can no longer be averted. <sup>(23)</sup> In an attempt to contain the magnitude of the climate change migration crisis and create

an instrument to master it, this PhD project seeks to manage the unavoidable so as to avoid the unmanageable. <sup>(24)</sup>

## Scope And Disambiguation

While climate change will lead to numerous adverse effects that trigger migration (e.g. depletion of freshwater reserves, degradation of soils, dieback of forests, advancing desertification, the spread of diseases, etc.), this PhD research will be limited to a study of people displaced by rising sea levels. This study will call them Sea Level Refugees (SLRs). <sup>(25)</sup>

## Research Project And Method

*Summary:* This PhD project will take three years to complete and will be divided into three parts. The first part will be an analysis of the likely number of future SLRs (geographic information system analysis). The second part will be an analysis of the global capacity to cope with these numbers of future SLRs (capacity analysis). Assuming that global capacity cannot cope with such high numbers of future SLRs, part two of the study is already expected to be a deficit analysis. Part three of the study will take stock of the assumed deficit and explore strategies and means to create new institutions or frameworks which can increase capacity to the needed levels. Extensive field research will accompany the study.

*Part 1:* The first part will be an analysis of the likely number of future SLRs (geographic information system analysis). Since there is no conclusive scientific agreement about the likely speed with which sea level can be expected to rise, <sup>(26)</sup> three different sea level rise scenarios (50cm, 1m, 2m) will be assumed for the year 2050. Accordingly, under each scenario the maps of the world will look different. Sealed nations, Small Island States, atolls, low-lying coastal zones and river delta systems will be particularly affected. <sup>(27)</sup> Accounting for different rates of population growth in the affected areas and assuming these rates remain steady, the completion of part one of the study should make it possible to foreshadow the approximate number of future SLRs worldwide under each sea level rise scenario in the year 2050. Although historical evidence suggests that population mass movements are not gradual but take place in waves as societal tipping points are crossed, <sup>(28)</sup> the next four decades constitute the theoretical time window for preparatory global action. Put simply, part one stakes out the challenge.

*Part 2:* The second part will be an analysis of the global capacity to cope with these numbers of future SLRs (capacity analysis). Assuming that global capacity cannot cope with such high numbers of future SLRs, part two of the study is already expected to become a deficit analysis. Existing insti-

tutions such as the United Nations along with frameworks such as the 1951 Geneva Convention Relating to the Status of Refugees or the Universal Declaration of Human Rights will be scrutinised and measured against the foreseeable future requirements. Unlike refugees forced to flee their homes as a result of war or persecution who have the possibility of return when things get better in the future, SLRs have no such hope of ever returning "home." (29) In many areas of the world a certain volume of SLRs may be absorbed by neighbouring countries of linguistic or cultural similarity or affinity. (30) In most instances, however, the available capacity is assumed to be vastly insufficient to absorb the residual overflow. Stated simply, part two will try to assess the global capacity for SLR uptake and calculate the shortfall.

*Part 3:* The third part will take stock of the assumed deficit and explore strategies and means to create new institutions, frameworks and/or bilateral/multilateral agreements which may increase capacity to the needed levels. It is difficult at this stage to predict what solutions will be necessary, although a number of approaches have been put forward. One such suggestion has been the creation of a UN Exodus Programme / International Attestation System with the authority to "certify" SLRs and issue them "global green cards" and the inferred right of asylum. (31) Considerations invariably also include schemes in poverty reduction and population growth management, including equitable resource distribution programmes. (32) The question of who owns the oil reserves in the Arctic should be discussed along with the political feasibility of designating these reserves as a "world heritage" in order to both safeguard the environment and raise funding for future SLRs who will be deracinated as a direct result of the actions of "the world." (33) There is widespread agreement that states must make a binding commitment to assume responsibility for future SLRs in line with their greenhouse gas emissions. (34) Whether calculations should be based on present, recent or cumulative historical emissions is a matter that needs to be analysed. By and large, it is hoped that part three will benefit from the inspired input of a large group of courageous and forward-thinking stakeholders.

## Field Research

To ensure the (macro) adaptation strategy is in sync with prevailing realities at grassroots (micro) level, field research is proposed in numerous sample locations. Taking stock of cultural realities and "feeling the pulse" of affected populations will make the study more holistic and its implementation more realistic. Assessing a vulnerable people's level of "preparedness" will be as critical as examining their cultural and migratory preferences. Proposed locations for field re-

search should include what the PhD candidate assumes to be SLR sending countries (Tuvalu, Kiribati, Carteret Islands of PNG, Maldives, Bangladesh, etc.) as well as SLR receiving countries (Australia, Fiji, etc.) (35) The field research will be centered in (but not limited to) the South and Asia Pacific. The proposed length of field research is 90 days per year (for each of three consecutive years). It is to be carried out in three locations each year (one month in each location). In this way the field research workload will be evenly spread out which will make its successful completion more reasonably practicable.

*Summary:* In short, the macro adaptation strategy will survey the challenges from 30,000 feet, the field research will inspect them from within the trenches. This will allow for a comprehensive study approach that conjoins desk and field, macro and micro, theory and practice.

## Confirmed Travel

Maldives: 23-31 May 2009 (36)

## Funding Requirements

Assuming that a scholarship can cover tuition fees, lodging and living expenses, funding will need to be secured to cover the cost of all field-related research. Based on estimates collated and published by the German fiscal authority (Finanzamt), (37) the following field research costs should be assumed and budgeted:

For 90 days field work (3 months p.a.) in 3 locations:  
Ground expenses: 90 days @ €100 per day = €9,000 p.a.  
Flights: €1,000 per flight per location = €3,000 p.a.  
Research Costs/Books/Conferences: €3,000 p.a.  
TOTAL Costs Field Research: €15,000 p.a.

## Open Questions

- Can the geographic information system analysis proposed for part one be realistically managed? Perhaps part one can build on studies previously undertaken? (38) Is it conceivable to "outsource" portions of this analysis to another PhD candidate or research institute so as to make the survey of vast coastal detail more manageable? [Two country examples reveal the extreme long lengths of some countries' coastlines: The *Philippines* is an archipelago of 7,107 islands with a complex coastline just short of the Earth's circumference. (39) According to a recent Greenpeace study, a one-metre rise in sea level is projected to affect 64 out of 81 provinces and inundate 700 million square metres of land

area. <sup>(40)</sup> Another nearby archipelago has even more islands. Spread across a chain of more than 17,000 islands, *Indonesia* is the world's largest archipelagic state and has a coastline of more than 50,000 km. <sup>(41)</sup> For the benefit of comparison, the world has around 860,000 km of total coastline – more than twice the distance of the Earth to the Moon.] <sup>(42)</sup>

- How should one-off extreme weather events (e.g. storm surges) be reflected in the study? What should be the baseline global average sea level and baseline year? How about areas with high tidal differences?
- How should different rates of sea level rise (for different regions of the world) be reflected in the study? (Sea level rises in the Western Pacific have been observed to exceed the global average rate of 3mm/yr.) <sup>(43)</sup>

### Consulted Professors/ Potential Supervisors/ Reviewers

Hans Joachim Schellnhuber (Director Potsdam Institute for Climate Impact Research, Chairman German Advisory Council on Global Change WBGU, Senior Government Advisor)

John Merson (Director Institute of Environmental Studies, University of New South Wales, UNSW)

Diana Liverman (Director Environmental Change Institute, Oxford University, on leave of absence in 2009 to sit on U.S. Government advisory committee on climate change)

Colin Filer (Research School of Pacific and Asian Studies (RSPAS), Australian National University, ANU)

Patrick D. Nunn (Professor of Oceanic Geoscience, The University of the South Pacific, Suva, Fiji)

### PhD Project And Publication Language

English (the translation of tribal languages into English is assumed to be inevitable. Local guides/translators will need to be recruited and their remuneration budgeted).

### Envisaged Starting Date

August 2009

### Sponsors

World Vision has indicated interest to co-sponsor the study.



### Participation Welcome

For the people of the 21st century climate change migration represents both a new problem and a problem on a new order of magnitude. Think about the challenges of accommodating 100,000 refugees in refugee camps or temporary shelters and then imagine a flood of refugees numbering in the hundreds of millions. The challenges are so daunting and the potential consequences so far-reaching and frightening that multistakeholder participation and ownership should be invited on a global level. To that effect this PhD proposal is submitted on the understanding that the possibility of a global panel of supervisors should be seriously considered. This could enhance the quality of the study and increase chances of implementing its concluding recommendations.

### PhD-Relevant Online Resources

PhD Proposal Pictured Brochure Version {12 pages, 5MB}:  
<http://jml-design.de/PhD/Brochure.pdf>

PhD Proposal Text-only Version: {8 pages, 100KB}:  
<http://jml-design.de/PhD/Proposal.pdf>

Previous World Vision Preparedness Study  
"Planet Prepare": {124 pages; 8MB}  
[http://wvasiapacific.org/downloads/PlanetPrepare\\_LowRes.pdf](http://wvasiapacific.org/downloads/PlanetPrepare_LowRes.pdf)

Curriculum Vitae (CV): {3 pages; 70KB}  
[http://jml-design.de/PhD/CV\\_JMLuetz.pdf](http://jml-design.de/PhD/CV_JMLuetz.pdf)

References: {2 pages; 50KB and 700KB}  
<http://jml-design.de/PhD/SRipsas.pdf>  
<http://jml-design.de/WorldVision/JEast.pdf>  
<http://jml-design.de/WorldVision/KBangert.pdf>

### PhD Candidate Contact Details

Johannes M. Luetz  
Dovestr. 11  
10587 Berlin  
Germany

P: +49 (0)30 39746116  
F: +49 (0)30 39746117  
M: +49 (0)163 7462571  
[j.luetz@gmx.com](mailto:j.luetz@gmx.com)

## Endnotes/ Bibliography

- (1) KLIMA Magazin, Nr. 01/2009, pp 72-77, "Der Klimaflüsterer" (Confirmed during face-to-face interview at PIK-Potsdam on 21 April 2009)
- (2) Luetz, J., Planet Prepare, Preparing Coastal Communities in Asia for Future Catastrophes, World Vision International, ISBN 1-887983-47-3 {Available: [http://www.wvasiapacific.org/downloads/PlanetPrepare\\_LowRes.pdf](http://www.wvasiapacific.org/downloads/PlanetPrepare_LowRes.pdf) }
- (3) In "Field Notes From a Catastrophe" (Bloomsbury, ISBN 978-0-7475-8550-3, pp 93-99), Elizabeth Kolbert cites research by Harvey Weiß (Science, August 1993) which concluded that the end of the Akkadian empire was the product of a drought "so prolonged and so severe that it represented, in his words, an example of 'climate change.'" Since then the list of cultures whose demise is linked to climate change has grown. They include the Classic Mayan civilisation (800 A.D.), Tiwanaku civilisation near Lake Titikaka in the Andes (1100 A.D.) and the Old Kingdom of Egypt (2200 B.C.)
- (4) Research estimates vary in their precise figures but hold one similarity in common: they range in the dozens and hundreds of millions of people. A few voices make the point clear:
- (a) Prof. Dr. James Hansen, Director NASA Goddard Institute for Space Studies and Adjunct Professor Columbia University Earth Institute:
- "If emissions follow a business-as-usual scenario, sea level rise of at least two meters is likely this century. Hundreds of millions of people would become refugees. No stable shoreline would be reestablished in any time frame that humanity can conceive." {Source: Global Warming Twenty Years Later: Tipping Points Near. Briefing before the Select Committee on Energy Independence and Global Warming, U.S. House of Representatives. National Press Club on June 23, 2008. J. Hansen. Accessed 31 Jul 2008 @ [http://www.columbia.edu/~jeh1/2008/TwentyYearsLater\\_20080623.pdf](http://www.columbia.edu/~jeh1/2008/TwentyYearsLater_20080623.pdf) }
- (b) World Bank Report:
- "... global warming could well promote SLR [sea level rises] of 1m-3m in this century, and unexpectedly rapid breakup of the Greenland and West Antarctic ice sheets might produce a 5m SLR. ... Our results reveal that hundreds of millions of people in the developing world are likely to be displaced by SLR within this century; and accompanying economic and ecological damage will be severe ... To date, there is little evidence that the international community has seriously considered the implications of SLR for population location and infrastructure planning in developing countries." {Source: Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and Yan, J., (2007) "The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis", Policy Research Working Paper No. 4136. Washington D.C., World Bank. February. From page 51f.}
- (c) Indian Institute of Technology researcher Prof. Dr. S.C. Rajan:
- In the event of sea level rises of 1m, 3m or 5m, – 65 million, 92 million or 128 million people respectively, would become homeless in South Asia alone. {Source: Blue Alert. Climate Migrants in South Asia: Estimates and Solutions. A Report by Greenpeace. Sudhir Chella Rajan. Chennai, India. Page 1. Accessed 15 Apr 2008 @ <http://www.greenpeace.org/raw/content/india/blue-alert-report.pdf> }
- (d) United Nations Human Development Report 2007/2008:
- "Global temperature increases of 3-4°C could result in 330 million people being permanently or temporarily displaced through flooding." {Source: Fighting climate change: Human solidarity in a divided world. UN Human Development Report 2007/2008. Page 9. Accessed 22 Aug 2008 @ <http://hdr.undp.org/en/reports/global/hdr2007-2008/> }
- (e) Prof. Dr. Schellnhuber, Director Potsdam Institute for Climate Impact Research, Chairman German Advisory Council on Global Change (WBGU), Senior Advisor to the German Government:
- "When we talk about a one metre rise in global sea level we are also talking about 500 million people who are going to have to look for new homes. So far we don't have any instruments to manage this." {Source: KLIMA Magazin, Nr. 01/2009, pp 72-77 "Der Klimaflüsterer" (Confirmed during face-to-face interview at PIK-Potsdam on 21 April 2009)}
- (f) Lord Nicholas H. Stern, British economist whose landmark review of the economics of climate change published in 2006 highlighted the severe cost to the world of doing nothing, addressing 2,500 climate scientists in Copenhagen (March 2009):
- "You'd see hundreds of millions people, probably billions of people who would have to move and we know that would cause conflict, so we would see a very extended period of conflict around the world, decades or centuries as hundreds of millions of people move." {Source: BBC News. Climate scenarios 'being realised'. Matt McGrath. Accessed 28 March 2009 @ <http://news.bbc.co.uk/2/hi/science/nature/7940532.stm> }
- (5) Two sources for reference:
1. Heating up the Planet. Climate Change and Security. Alan Dupont, Graeme Pearman. Lowy Institute for International Policy. Double Bay. 2006. ISBN 1-921004-22-3. {Page vii.} Accessed 1 April 2008 @ <http://www.lowyinstitute.org/PublicationGet.asp?i=391>
  2. World in Transition – Climate Change as a Security Risk: Summary for Policy Makers. German Advisory Council on Global Change (WBGU). Accessed 1 April 2008 @ [http://www.wbgu.de/wbgu\\_jg2007\\_kurz\\_engl.pdf](http://www.wbgu.de/wbgu_jg2007_kurz_engl.pdf)
- (6) Cited on pages 20-24 in <sup>(2)</sup>. Two sources for reference:
1. Face-to-face interview by the PhD candidate with Sea Level Refugee and Tulele Peisa NGO founding director Ursula Rakova, Buka, Bougainville, Papua New Guinea. 17 March 2008. Supplementary telephone interview 10 April 2008.
  2. Multiple secondary sources cite the evacuation, including this source from Papua New Guinea: {Carteret Islands sinking fast. The National / Pacnews. 17 October 2007. Accessed 5 Feb. 2008 @ [http://www.islandsbusiness.com/archives/index\\_dynamic/containerNameToReplace=MiddleMiddle/focusModuleID=130/focusContentID=10446/tableName=mediaRelease/overrideSkinName=newsArticle-full.tpl](http://www.islandsbusiness.com/archives/index_dynamic/containerNameToReplace=MiddleMiddle/focusModuleID=130/focusContentID=10446/tableName=mediaRelease/overrideSkinName=newsArticle-full.tpl) }

- (7) Tuvalu – the fourth-smallest country in the world and most commonly known for its internet domain .tv – could be next: "The sea level is rising so much ... that [Tuvalu's] water has become too salty to drink and to grow vegetables." {Source: Tuvalu feeling the effects of climate change, sea level rising fast. Pacnews. 2nd Ed. 3 April 2008. Page 4 © PINA 2008. Suva, Fiji. [www.pinanius.com](http://www.pinanius.com)}. As the rising waters are progressively creeping up the scrawny neck of the nine tiny Tuvaluan islands – "slowly but effectively killing them off" {Source: Tuvalu struggles to hold back tide. BBC News. 22 January 2008. Environment correspondent David Shukman. Accessed 11 Apr 2008 @ <http://news.bbc.co.uk/2/hi/science/nature/7203313.stm>} – island communities across the Pacific are watching with trepidation, bracing themselves at the prospect of being forced to abandon their island homes and relocate to foreign lands as "climate change refugees." Thousands of coastal communities around the world stand to be affected. Additional references:  
1. <http://www.theage.com.au/news/national/surging-seas-force-islanders-to-pack-their-bags/2006/01/04/1136050495641.html>  
2. <http://www.humanrights-geneva.info/Tuvalu-s-climate-change-refugees,2905>
- (8) Four sources for reference:  
1. Refer to PhD "brochure-version" (page 5) for a graphic depiction of progressive island submergence and freshwater lens contamination. <http://jml-design.de/PhD/Brochure.pdf>  
2. Cited on page 23 in <sup>(2)</sup>. {Source: Climate Change and Sea Level. Part One: Physical Science. Edited By T.H. Aung, C. Kaluwin and G.W. Lennon. 1998. National Tidal Facility. ISBN 0-7258-0636-2. Page 97.}  
3. Earth Tok 2, earth structure, processes and hazards from a Papua New Guinea perspective. Hugh L. Davies. University of Papua New Guinea. 2006. ISBN 9980-84-761-1. Pages 111-112.  
4. "By mid-century, climate change is expected to reduce water resources in many small islands, e.g. in the ... Pacific, to the point where they become insufficient to meet demand during low-rainfall periods." {Source: IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. Geneva. Switzerland. Cited on pages 12, 49 and 52}.
- (9) Cited on pages 24-25 in <sup>(2)</sup> {The PhD candidate conducted numerous on-site interviews in Labutali / Puwamo, Papua New Guinea. 19 March 2008. Accompanying guides: Mondo Sigar (Chairman Labutali Community-Based Organisation), Thomas Warr (Village Development Trust NGO), David Hapatoto (World Vision PNG). In total several dozen villagers were interviewed. The total number of Labutali villagers was estimated by Mondo Sigar to be "about 2,500."}
- (10) Cited on pages 7-34 in <sup>(3)</sup> {Also In DVD: SZENARIO 2100. Dramatische Prognosen über die Auswirkungen des Klimawandels. ©2008 Universal Pictures Germany.}
- (11) {The PhD candidate conducted an on-site face-to-face interview with Abdul Mannan in Dalakandi on the Island of Bhola (Tajumuddin Upazila), Bangladesh. 22 April 2008. The total population of the island of Bhola is estimated at 1.6-2.2 million.} The interview features in *Planet Prepare*, pages 26-29 in <sup>(2)</sup>
- (12) Paradise almost lost: Maldives seek to buy a new homeland, The Guardian, Monday 10 November 2008, Randeep Ramesh in Male, Accessed 25 April 2009 @ <http://www.guardian.co.uk/environment/2008/nov/10/maldives-climate-change> {The 2007/2008 UN Human Development Report also notes the vulnerabilities: "For the Maldives, where 80 percent of the land area is less than 1 metre above sea level, even the most benign climate change scenarios point to deep vulnerabilities." [Source: Fighting climate change: Human solidarity in a divided world. Page 100.] Accessed 22 Aug 2008 @ <http://hdr.undp.org/en/reports/global/hdr2007-2008/>}
- (13) IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. Geneva. Switzerland. {Pages 8 and 45.}
- (14) Vaughan, D.G. and Arthern, R., (2007) "Why Is It Hard to Predict the Future of Ice Sheets?" Science. Vol. 315. No. 5818. 16 March. Pages 1503-1504.
- (15) Cited on pages 13 and 54 in <sup>(13)</sup>
- (16) Kerr, R.A., (2007) "Pushing the Scary Side of Global Warming", Science. Vol. 316. No. 5830. 8 June. Pages 1412-1415. {See also recent study referenced in <sup>(21)</sup>}
- (17) BBC News. Climate scenarios 'being realised'. Matt McGrath. Accessed 28 March 2009 @ <http://news.bbc.co.uk/2/hi/science/nature/7940532.stm>
- (18) Numerous feedback processes and potentially cataclysmic consequences are mentioned on pages 54-55 in <sup>(2)</sup> {Also: Climate change and trace gases. James Hansen, Makiko Sato, Pushker Kharecha, Gary Russell, David W. Lea, Mark Siddall. Phil. Trans. R. Soc. A (2007) 365. Pages 1925-1954. doi:10.1098/rsta.2007.2052. 18 May 2007} Accessed 29 Jul 2008 @ [http://pubs.giss.nasa.gov/docs/2007/2007\\_Hansen\\_et\\_al\\_2.pdf](http://pubs.giss.nasa.gov/docs/2007/2007_Hansen_et_al_2.pdf)
- (19) References: (1) Alley, R.B., Clark, P.U., Huybrechts, P. and Joughin, I., (2005) "Ice-Sheet and Sea-Level Changes", Science, Vol. 310, No. 5747. 21 October. Pages 456-460. (2) Bamber, J.L., Alley, R.B. and Joughin, I., (2007) "Rapid Response of Modern Day Ice Sheets to External Forcing", Earth and Planetary Science Letters, Vol. 257, No. 1-2. 15 May. Pages 1-13. (3) Shepherd, A. and Wingham, D., (2007) "Recent Sea-Level Contributions of the Antarctic and Greenland Ice Sheets", Science, Vol. 315. No. 5818. 16 March. Pages 1529-1532. (4) Truffer, M. and Fahnenstock, M., (2007) "Rethinking Ice Sheet Time Scales", Science. Vol. 315. No. 5818. 16 March. Pages 1508-1510. (5) Fricker H.A., Scambos, T., Bindschadler, R., and Padman, L., (2007) "An Active Subglacial Water System in West Antarctica Mapped from Space", Science. Vol. 315. No. 5818. 16 March. Pages 1544-1548. (6) Howat, I.M., Joughin, I., and Scambos, T.A., (2007) "Rapid Changes in Ice Discharge from Greenland Outlet Glaciers", Science, Vol. 315. No 5818. 16 March. Pages 1559-1561. (7) Zwally, H.J., Abdalati, W., Herring, T., Larson, K., Saba, J., and Steffen, K., (2002) "Surface Melt-Induced Acceleration of Greenland Ice-Sheet Flow", Science, Vol. 297, No. 5579. 12 July. Pages 218-222.

- (20) Two References:
1. Hansen, J., Director NASA Goddard Institute for Space Studies and Adjunct Professor Columbia University Earth Institute: "If emissions follow a business-as-usual scenario, sea level rise of at least two meters is likely this century. Hundreds of millions of people would become refugees. No stable shoreline would be reestablished in any time frame that humanity can conceive." {Source: Global Warming Twenty Years Later: Tipping Points Near. Briefing before the Select Committee on Energy Independence and Global Warming, U.S. House of Representatives. National Press Club on June 23. J. Hansen. Accessed 31 Jul 2008 @ [http://www.columbia.edu/~jeh1/2008/TwentyYearsLater\\_20080623.pdf](http://www.columbia.edu/~jeh1/2008/TwentyYearsLater_20080623.pdf)}
  2. Ramstorf, S., Professor of Physics of the Oceans, Potsdam University, Head of Earth System Analysis, Potsdam Institute for Climate Impact Research: A study shortly to be published predicts a likely sea level rise this century of 75-190cm. {Study mentioned by Prof. Schellnhuber in <sup>(21)</sup>}
- (21) Schellnhuber, H.J., Director Potsdam Institute for Climate Impact Research, face-to-face interview at PIK-Potsdam on 21 April 2009.  
 {Independent of Schellnhuber's comments a recent study of coral fossils (Nature, 16 April 2009) examined sea-level fluctuations during the planet's last inter-ice age warm period (121,000 years ago), and found that melting ice sheets had raised sea levels by as much as 3m in a matter of decades. While the study is preliminary and in need of independent confirmation at other, similar sites where old coral fossils have been deposited, the Nature study remains a grim warning that fast-rising sea levels are not without historical precedent.} References:
1. <http://www.nature.com/nature/journal/v458/n7240/edsumm/e090416-08.html>
  2. [http://www.nytimes.com/2009/04/16/science/earth/16coral.html?\\_r=1](http://www.nytimes.com/2009/04/16/science/earth/16coral.html?_r=1)
  3. <http://www.time.com/time/health/article/0,8599,1891605,00.html>
  4. <http://news.nationalgeographic.com/news/2009/04/090415-sea-levels-catastrophic.html>
- (22) Global Warming 20 Years Later: Tipping Points Near. Jim Hansen. 23 June 2008. National Press Club, and House Select Committee on Energy Independence & Global Warming. Washington D.C., USA. PowerPoint Presentation. Accessed 31 Jul 2008 @ [http://www.columbia.edu/~jeh1/2008/TippingPointsNear\\_20080623.ppt](http://www.columbia.edu/~jeh1/2008/TippingPointsNear_20080623.ppt) [Slide 28]
- (23) "No matter how aggressive future climate change mitigation strategies may be, we can be sure that by the end of the century there will be millions of 'boat people' from developing countries looking for safer ground." {Source: Sujatha Byravan and Sudhir Chella Rajan. Providing New Homes for Climate Change Exiles. Climate Policy. Vol. 6. Pages 247-252. 2006. Accessed 24 Jul 2008 @ [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=950329](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=950329)}
- (24) Expression borrowed from "Heaven and Earth", Potsdam Institute for Climate Impact Research, 2007, page 8. Also used in: Scientific Expert Group on Climate Change (2007) Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable, Report prepared for the United Nations Commission on Sustainable Development, eds Bierbaum RM, Holdren JP, MacCracken MC, Moss RH, Raven PH (Sigma Xi, Research Triangle Park, NC, and United Nations Foundation, Washington, DC).
- (25) The term climate or sea level "refugee" is used on the understanding that the term has already been embraced by the mainstream public domain, even while the legal definition of "refugee" remains that rendered by the 1951 Geneva Convention Relating to the Status of Refugees.
- {Note: Numerous academics have proposed that "climate refugees" be defined as "people who have to leave their habitats, immediately or in the near future, because of sudden or gradual alterations in their natural environment related to at least one of three impacts of climate change: sea-level rise, extreme weather events, and drought and water scarcity." Rather than extending the existing definition of "refugees" under the 1951 Geneva Convention Relating to the Status of Refugees, the proponents call for a "new legal instrument specifically tailored to the needs of climate refugees – a Protocol on Recognition, Protection and Resettlement of Climate Refugees to the United Nations Framework Convention on Climate Change." {Source: Preparing for a Warmer World. Towards a Global Governance System to Protect Climate Refugees. Frank Biermann and Ingrid Boas. Global Governance Working Paper No 33. November 2007. Amsterdam et al.: The Global Governance Project. Accessed 18 Jul 2008 @ <http://www.glogov.org/images/doc/WP33.pdf>}}
- (26) The 2007/2008 UN Human Development Report highlights the possibility of "nasty surprises" and "catastrophic risks" posed by the "known unknowns" of rapid ice shelf disintegration, warning that "the demise of the Greenland and West Antarctic ice sheets are perhaps the greatest of all the threats linked to climate change ... One of the reasons for uncertainty about the future is that ice sheet disintegration, unlike ice sheet formation, can happen *very rapidly*." {Source: United Nations Development Programme (UNDP). Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world. Published 2007. Pages 36-37. New York, USA. ISBN 978-0-230-54704-9}.
- (27) Cited on pages 42-43 in (2). Also In:
1. The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. McGranahan, G., D. Balk and B. Anderson. 2007. Environment & Urbanization 19(1): 17-37 (2007). International Institute for Environment and Development (IIED).
  2. Center for International Earth Science Information Network (CIESIN). Columbia University, New York. {Webaddress: <http://sedac.ciesin.columbia.edu/gpw/lec3.jsp>}
  3. New Scientist Environment. Coastal living – a growing global threat. 28 March 2007. NewScientist.com. Catherine Brahic. Accessed 8 Jan. 2008 @ <http://environment.newscientist.com/channel/earth/dn11483-coastal-living--a-growing-global-threat-.html>
- (28) Blue Alert. Climate Migrants in South Asia: Estimates and Solutions. A Report by Greenpeace. Sudhir Chella Rajan, Indian Institute of Technology. Chennai, India. Page 7. Accessed 15 Apr 2008 @ <http://www.greenpeace.org/raw/content/india/blue-alert-report.pdf>

- (29) Sujatha Byravan and Sudhir Chella Rajan. Providing New Homes for Climate Change Exiles. *Climate Policy*. Vol. 6. Pages 247-252. 2006. Accessed 24 Jul 2008 @ [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=950329](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=950329) Also In: *The Social Impacts of Climate Change in South Asia*. Sujatha Byravan and Sudhir Chella Rajan. Paper. March 2008. Accessed 24 Jul 2008 @ [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1129346](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1129346)
- (30) In *KLIMA Magazin*, Nr. 01/2009, pp 72-77 "Der Klimaflüsterer", Prof. Schellnhuber, Director of the Potsdam Institute of Climate Impact Research describes how Bangladeshis might initially migrate to India before looking for safer shores elsewhere. Rajan S.C. suggests similar people movements (28) (29)
- (31) Proposed by Director Potsdam Institute for Climate Impact Research Schellnhuber during face-to-face interview at PIK-Potsdam on 21 April 2009.
- (32) The interrelatedness of poverty reduction, education and economic growth on prospects of human development were identified by the PhD candidate in a previous study: *Opportunities for Global Poverty Reduction in the 21st Century. The Role of Policy Makers, Corporations, NGOs, and Individuals*. Johannes Luetz. 2007. Berlin. Germany. ISBN 978-3-86682-107-1.
- (33) Thoughts considered worthy of public debate in the international policy making arena by the PhD candidate. The scheme should be explored prior to further large-scale oil explorations and/or countries staking their claims to these oil fields.
- (34) *The Future Oceans – Warming Up, Rising High, Turning Sour*. Special Report. German Advisory Council on Global Change. 2006. ISBN 3-936191-14-X. Available 29 Jul 2008 @ [http://www.wbgu.de/wbgu\\_sn2006\\_en.pdf](http://www.wbgu.de/wbgu_sn2006_en.pdf) The authors note and recommend: "Adopting innovative instruments of international law for refugees from sea-level rise: At present no nation has any obligation under international law to receive migrants whose homeland has been lost due to climate-induced flooding. In the long term, however, the international community will not be able to ignore the issue of 'sea-level refugees' and will therefore need to develop appropriate instruments for the secure reception of affected people in suitable areas, ideally in areas that correspond to their preferences. It would be expedient to develop a fair burden-sharing system, under which states make a binding commitment to assume responsibility for these people in line with their greenhouse gas emissions. To inform the policymaking process, studies in the fields of law and social sciences should be undertaken." (Core Messages 7, pages 97-98)
- (35) The study will be more holistic in terms of potential innovation, and more realistic in terms of potential implementation, if it explores options and prompts dialogue and research in the direction of both SLR sending *and* receiving nations. {Patrick D. Nunn, Professor of Oceanic Geoscience at the University of the South Pacific, Suva, Fiji, mentions a community from Tuvalu that has relocated to Niue, along with long-standing groups of relocatees that live on Rabi and Kioa islands in Fiji. The suitability of these islands as SLR receiving nations for Pacific islanders should be assessed.}
- (36) The trip is funded by the PhD candidate out of his own means.
- (37) For each day spent abroad, the German fiscal authority estimates expenses for board (Verpflegungsmehraufwendungen) and lodging (Pauschbetrag für Übernachtungskosten). The estimates differ from country to country. Added together and averaged out, the figures yield the daily costs for ground expenses. Accordingly, the budgeted amount of €100 per day should be seen as a conservative average estimation at the lower end of the foreseeable daily costs. German Federal Ministry of Finance, expectable expenses by country per day. Accessed 27 April 2009 @ [http://www.bundesfinanzministerium.de/nn\\_58004/DE/BMF\\_Startseite/Service/Downloads/Abt\\_IV/BMF\\_Schreiben/041,templateId=raw,property=publicationFile.pdf](http://www.bundesfinanzministerium.de/nn_58004/DE/BMF_Startseite/Service/Downloads/Abt_IV/BMF_Schreiben/041,templateId=raw,property=publicationFile.pdf)
- (38) The following study could be explored in terms of its potential to serve as a platform for collaborative research on part 1: Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and Yan, J., (2007) "The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis", Policy Research Working Paper No. 4136. Washington D.C., World Bank. February. Accessed 3 Sept 2008 @ [http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/02/09/000016406\\_20070209161430/Rendered/PDF/wps4136.pdf](http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2007/02/09/000016406_20070209161430/Rendered/PDF/wps4136.pdf)
- (39) Disaster Monitor, Philippines, World Vision International, Fact Sheet, Johannes Luetz, Published 2008, page 1. Accessed 25 April 2009 @ [http://www.wvasiapacific.org/downloads/Philippines\\_web.pdf](http://www.wvasiapacific.org/downloads/Philippines_web.pdf)
- (40) *The Philippines: A Climate Hotspot*. Climate Change Impacts and the Philippines. Greenpeace. April 2007. <http://www.greenpeace.org/raw/content/seasia/en/press/reports/the-philippines-a-climate-hot.pdf>
- (41) Disaster Monitor, Indonesia, World Vision International, Fact Sheet, Johannes Luetz, Published 2008, page 1. Accessed 25 April 2009 @ [http://www.wvasiapacific.org/downloads/Indonesia\\_web.pdf](http://www.wvasiapacific.org/downloads/Indonesia_web.pdf) Also: <https://www.cia.gov/library/publications/the-world-factbook/fields/2060.html>
- (42) Two sources for reference / Coast-mapping satellites:  
1. [http://www.esa.int/esaEO/SEMAV21XDYD\\_index\\_0.html](http://www.esa.int/esaEO/SEMAV21XDYD_index_0.html)  
2. <http://ares.jsc.nasa.gov/education/Activities/ExpMoon/DistanceMoon.pdf>
- (43) Two References:  
1. Intergovernmental Panel on Climate Change, Fourth Assessment Report (2007) Chapter 5 (pages 385-432): Bindoff, N.L., J. Willebrand, V. Artale, A. Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley and A. Unnikrishnan, 2007: Observations: Oceanic Climate Change and Sea Level. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.  
2. South Pacific Sea Level & Climate Monitoring Project, Monthly Data Report August, 2008. Accessed 25 April 2009 @ [www.bom.gov.au/ntc/IDO60101/IDO60101.200808.pdf](http://www.bom.gov.au/ntc/IDO60101/IDO60101.200808.pdf) ■