

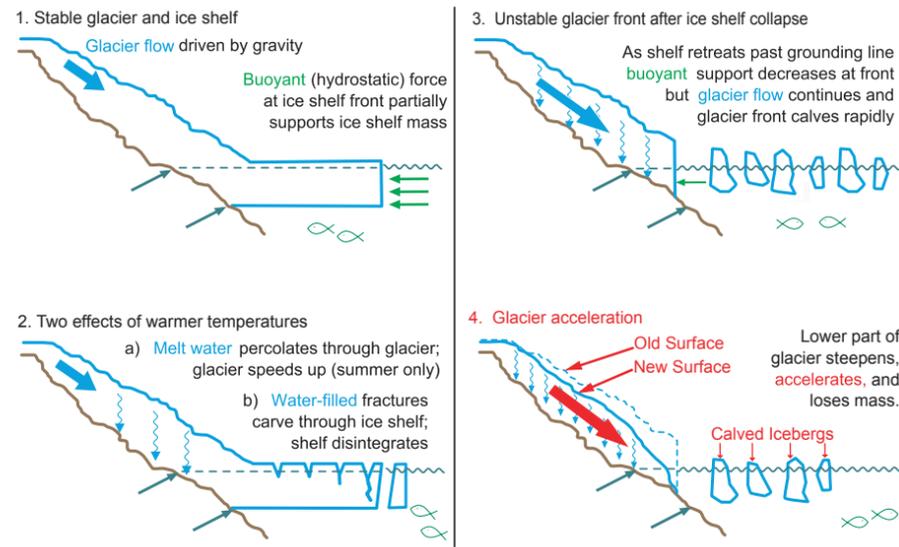
▶ not fully replace the water that flows into the sea and that evaporates from the surface.

NONLINEARITY AND UNCERTAINTY !

Taking all factors into account, the latest estimates published by the 2,500 scientists of the Intergovernmental Panel on Climate Change (IPCC) in 2007, predict a probable sea-level rise of less than one meter by 2100. But these conclusions are based on studies done up to 2005 at best and on a scientific and political consensus of terms and facts to be included. Arriving at this figure of less than a meter, the IPCC acknowledges that it does not account for the movements of glacial ice sheets, quite simply because no one has figured out how to model them yet. The result is that many scientists, including some participants in the IPCC work, have noted that the estimates are probably too optimistic. The problem is that variations in ice-sheet movement can be nonlinear. The fact that they have contributed to a rise of 1.2 mm a year for the past ten years does not mean that they will continue the same way. They could speed up more and more.

EXAMPLE OF NONLINEAR PHENOMENA IN ACTION: GLACIAL "PINNING POINT" COLLAPSE

In 2002, the Larsen B ice shelf, a 10,000-year old glacial platform in Antarctica one-third the size of Corsica, disintegrated in the course of a few weeks, probably from the combined effect of summer melt water on the base of the glacier and on the solidity of the floating shelf. The result: the ice shelf broke up into a multitude of icebergs in just a few days. This had no effect on sea level since the shelf was already floating but the glacier that feeds the ice shelf is no longer stabilized by the "pinning point" platform, so its descent into the sea speeds up. It seems certain that ice will play a major role in sea-level rise even though that role is simply not well enough understood today to account for it fully in models. Water will rise in response to the ice's action and the ice responds to the climate's action, with no regard for models, as the latest figures seem to show. □



How an ice shelf disintegrates. (Image by Ted Scambos and Michon Scott, National Snow and Ice Data Center, University of Colorado, Boulder. Online : <http://nsidc.org/sotc/iceshelves.html>.)

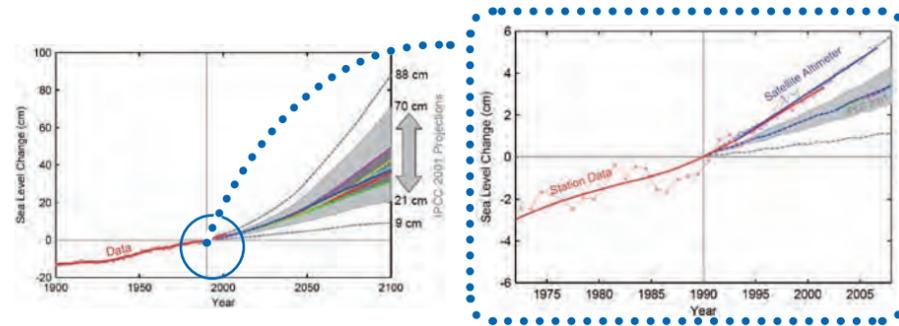
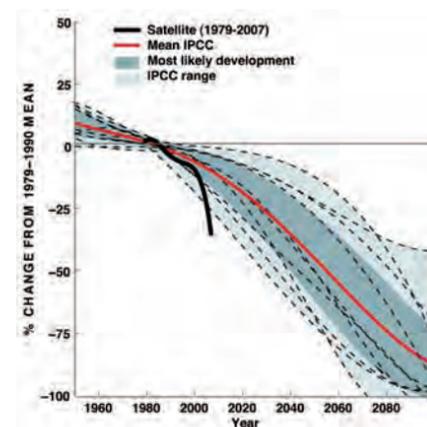


Chart showing the comparison between IPCC predictions (3rd IPCC report, 2001) and observations through 2006: the observations (solid red and blue line) are just on the edge of the maximum error of model predictions (dotted gray line). (Source : Church, J. A., and N. J. White (2006), "A 20th century acceleration in global sea-level rise", *Geophys. Res. Lett.*, 33, L01602, doi:10.1029/2005GL024826.)



In this graph, direct observations of sea-ice loss are already outpacing the IPCC scenario using the highest levels of CO₂. (Source : "The big melt, lesson from the Arctic Summer of 2007" David Spratt, CarbonEquity).
Online : www.carbonequity.info

TUVALU AND THE POST-OIL ERA

By Fanny Héros & David König

Tuvalu is the first sovereign nation in danger of completely disappearing under a rising sea level linked to climate change. This archipelago of nine islands covers 26 km² of land strewn over one million km² of territorial waters right in the middle of the Pacific Ocean. It is not waiting for the rest of the world to realize the extent of the looming catastrophe before organizing its own survival: in spite of the relentless countdown they face, Tuvaluans have started down the road to a post-oil era through the actions of Alofa Tuvalu.



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world. Tuvalu joined AF's ten-year program "Small Is Beautiful" at the end of 2004. The goal of "Small Is Beautiful" is to make Tuvalu, before its predicted disappearance, a model for nations respectful of the environment. A proud battle.

The first part of the program is educational; it consists of building a new national image by publicizing the concrete and reproducible steps that Tuvalu has taken in the past three years. The second part consists of studying adaptation solutions in Tuvalu itself. The last part consists of looking for new places where the nation of Tuvalu could be transplanted while preserving its way of life and culture, if exile becomes inevitable.

THE POST-OIL ERA BEGINS NOW.

In line with the recommendations of a 2005 energy study, Alofa Tuvalu is concentrating first and foremost on energy efficiency and the potential of biomass, supported by ADEME (French Environment and Energy Management Agency) and SOPAC (Pacific Islands Applied Geoscience Commission) and in collaboration with TIMI (Tuvalu Maritime Training Institute) and the local government. The National Renewable Energy Training Center on the island of Amatuku was officially launched in 2007 with the construction of a biodigester using pig manure, situated adjacent to the main sty. A training program more than eight weeks long, including four on-site workshops and 198 volunteers, teaches how to build, use and maintain a biodigester.

GAINING TIME...

Tuvaluans know it: they must gain time. They must stave off the day of exile, a fate the great majority refuses to accept, especially since current international legislation offers no protection for a nation that loses its land. Exile, presented as if it were already arranged with New Zealand, is in fact only open to some Tuvaluans. As for neighboring Australia, it is issuing temporary work permits when there is a need for manual labor. So for now, Tuvaluans have to stay in the archipelago. Like the rest of the world, Tuvaluans are feeling the full force of rising oil prices in their daily life. The media currently portray Tuvaluans as the first victims of a global phenomenon but less press space goes to the fact that these people are especially

receptive to solutions that already exist and can be quickly implemented. Developing energy resources like biomass and, to a lesser extent, wind and solar power, does more than ease their household expenses. It saves and consolidates their fragile habitat as much as possible. and thus prolongs their ancestral land's ability to fend off increasingly violent winds, higher and higher tides, ever more battering rainstorms, longer and longer droughts, lower and lower agriculture yields, and an ever more necessary reliance on imports.

The Franco-Tuvaluan organization *Alofa Tuvalu* (AT) is committed to providing guidance for the remaining decades, to waging this battle with Tuvaluans and serving as an example for the rest of the

A "borrow-pit" on Funafuti



© Jocelyn Carlin / Panos

In 1942 the American military forces filled these mud pits with coral that was "borrowed" from the unpopulated shores of the island to build a runway. Sixty years on, the population is forced to live on and around 4 hectares of tidal pools that are littered with detritus.



© Andre Vitchek

Another "borrow-pit" on Funafuti

► The pig-manure biodigester produces, at one and the same time, low-cost cooking gas that can substitute directly for bottles of imported butane and high-quality compost. The publicity generated by the installation spread the idea to Madagascar, the Tuamotus, Tristan da Cunha and even as far as France and Senegal. In Tuvalu, the campus of the University of the South Pacific is looking into installing a unit, as are two other islands in Tuvalu, Nanumea and Nukulaelae (where using chicken droppings is being considered).

In 2008, AT tackled a subject of international debate: biofuels from farmed feedstocks. Media coverage of biomass, feedstocks and the problems created by commercial use of food crops in industrial quantities sowed doubt about applications for local use and production, even in Tuvalu. Gilles Vaitilingom, a specialist in biofuels and researcher at CIRAD (Center for International Cooperation in Agricultural Research for Developing Countries), and Sarah Hemstock, an expert in biomass, went to Tuvalu to convince skeptics that well-planned use of resources to meet controlled energy needs is, in the end, reasonable. The goal is for Tuvaluans to be able to maintain inter-island transportation of people and goods, which is presently depressed by out-of-reach gasoline prices. Local biofuel production on each island according to its needs and the availability of a resource that does not threaten traditional uses—that would give full meaning to one name for the coconut palm: the tree of life. The program would include biodiesel from copra, gasoline from *todi* (fermented coconut tree sap) and gas from organic wastes.

Beyond the communications campaign, Alofa Tuvalu has carried out several public demonstrations in Tuvalu, attended by the country's First Lady, wife of the Prime Minister and the Honorary President of AF, Nala Apisai. AT made the choice to take the time to prove how relevant coconut-derived fuel is for a country

like Tuvalu rather than try to impose a technology in the context of international tensions. The production of biofuels on each island will stimulate the local market for copra without competing with exports and without hindering food supplies since it involves an unused part of the resource. It also correlates to a revival of plantations. The only danger to the program is China's great energy demand; The Chinese are actively seeking out land in the Pacific for massive alcohol production from cassava. Lucrative propositions have already been proffered in Fiji but there is little risk that the 26 km² of Tuvaluan land, soaked with salt water, will rate high on the list of coveted terrain.

One clear, immediate benefit for Tuvaluans from these local biofuels is the reduction of their dependence on petroleum for maritime and land-based transportation while preserving their environment. Beyond minimizing greenhouse gas emissions, the coconut plantations hold shorelines together, retain sand, offer protection from winds and slow down erosion.

AN INCONVENIENT TRUTH

To drive home the point and open residents' eyes to the global context, Alofa Tuvalu organized a public showing of the film *An Inconvenient Truth*, followed by a discussion with Enele Sopoaga, former United Nations ambassador from Tuvalu. At the end, Prime Minister Apisai Ielemia dubbed Gilliane Le Gallic, AF president and coordinator of the ten-year plan, Environmental Ambassador for Tuvalu. She recalled the watchword that impels her organization: "We are all Tuvaluans!" The slogan is one way to draw the attention of the entire world to the fate of this minuscule archipelago and, beyond that, to the crucial issue of sea-level rise. □

LINK: <http://www.alofatuvalu.tv>

Fanny Héros is a scientific journalist who has been responsible for Alofa Tuvalu's educational activities and mission since 2004.

"TO SHOW THE PEOPLE OF TUVALU AND THE REST OF THE WORLD THAT SOLUTIONS EXIST RIGHT NOW!"

Interview conducted by Fanny Héros



© Alofa tuvalu

A conversation with Gilles Vaitilingom, expert in biofuels, researcher at CIRAD (Center for International Cooperation in Agricultural Research for Developing Countries), who was commissioned by the non-governmental organization Alofa Tuvalu and by the French Environment and Energy Management Agency for the environmental program "Small is Beautiful".

FANNY HÉROS: *You have just come back from a mission to develop biomass energy in Tuvalu. Can you tell us about what you accomplished?*

GILLES VAITILINGOM: Our first big task was communicating with the people and meeting with responsible authorities and community leaders. We explained to them all the potential for energy from the coconut palm, a major tree present all over the Pacific, to replace the usual fuel and gas sources (gasoline, fuel oil

and butane) with *todi* gasoline (from fermented coconut tree sap), biodiesel from copra (dried coconut meat) and gas from burning coconuts and their shells.

FH.: *How did Tuvaluans react to your work?*

G.V.: At the household level, people consume gasoline primarily for their mopeds, cars and small fishing boats, and kerosene for cooking. So they were rather astounded to see that you could make gasoline from *todi* and gas from coconut shells, at a cost of no more than \$2.40 a liter. As for the authorities, they were ready to listen and especially interested in the possibilities of improving Tuvalu's future.

FH.: *Isn't producing biodiesel from copra in Tuvalu just a pipedream?*

G.V.: Not at all. It might have seemed farfetched two years ago but today, it's different. Two years ago, the price of oil was beginning to flirt with \$70 a barrel; when I arrived in Tuvalu, it was \$108, a month later it reached \$130. Things have changed very quickly and in the present context, producing biodiesel for 11,000 citizens is absolutely relevant.

FH.: *You are very familiar with the Pacific but you had never gone as far as Tuvalu before. What impressions have you brought back from this trip?*

G.V.: I was particularly struck by the long crescent of land that is Funafuti and how it is threatened by the rising sea level. You are very aware of it when you are there. I was struck also by the dynamism of the young Tuvaluans. They are very happy to be living there. I will return with pleasure. □