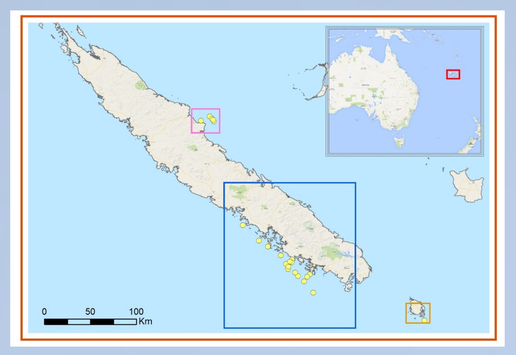
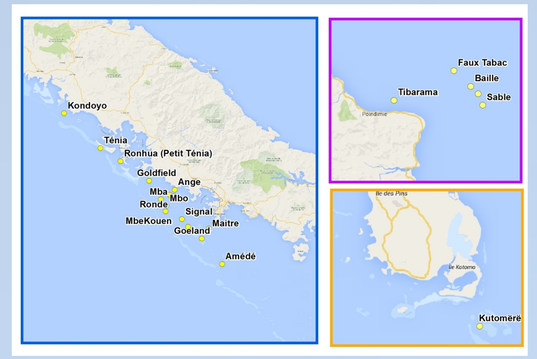


Islets of New-Caledonia lagoons in the perspective of climate change and sea level rise



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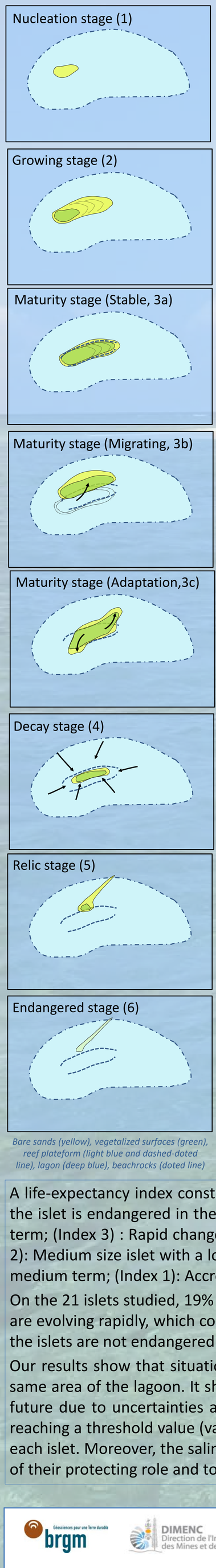
Introduction and problematic

The Grande-Terre of New Caledonia and its proximal islands are surrounded by a barrier reef (at a mean of 10 to 15 km from the coast) enclosing large lagoons. On July 7th 2008, UNESCO included some parts of the lagoons of New Caledonia in the list of the *Reef Diversity and Associated Ecosystems*. Sandy islets (cayes) from New Caledonian lagoons lie on lagoonal reef platforms or on the reef barrier and play a major role in the lagoonal ecosystems. They have a high importance in the Caledonian culture and way of life. One of the recurrent question from governmental agencies and people concerns the islets future in the perspective of Climate Change and Sea Level Rise. In this context, the Coastal Observatory of New Caledonia (OBLIC) has initiated research about the past evolution of islets and about their futures.

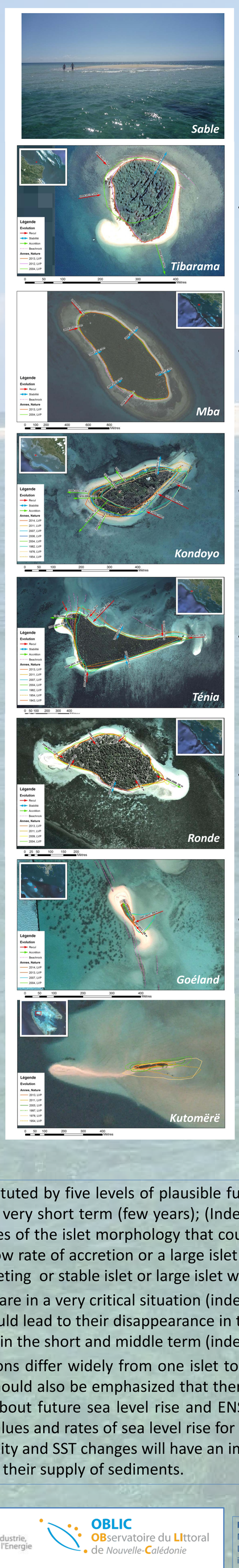
Typology of caledonian islets

Evolution stages

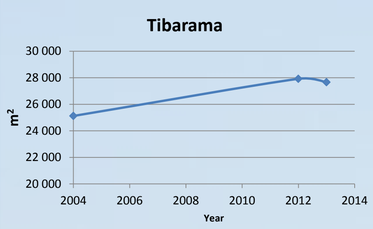


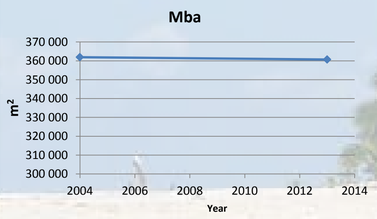
Bare sands (yellow), vegetalized surfaces (green), reef plateform (light blue and dashed-doted line), lagon (deep blue), beachrocks (doted line)

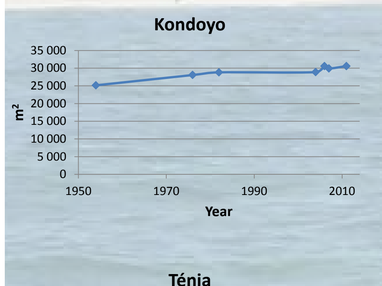
Illustration of islets typology

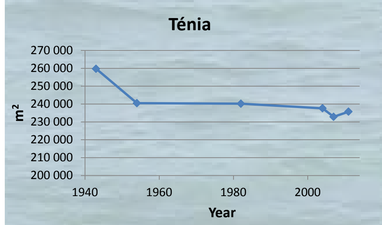


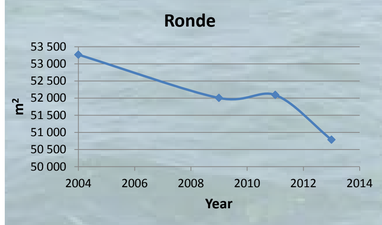
Evolution of islets's surfaces

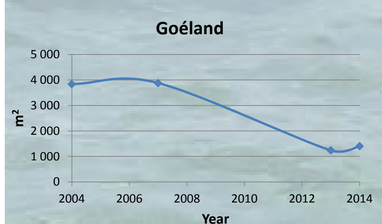


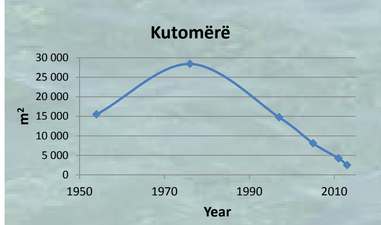




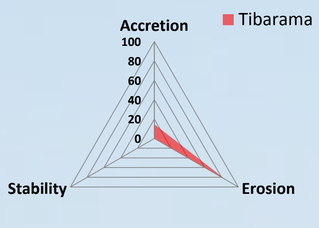


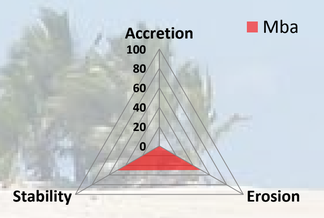


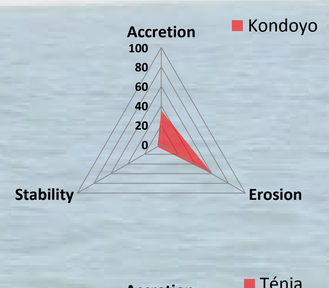


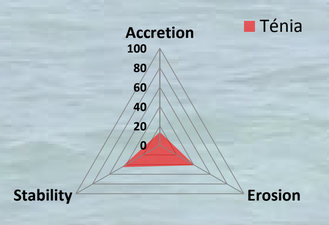


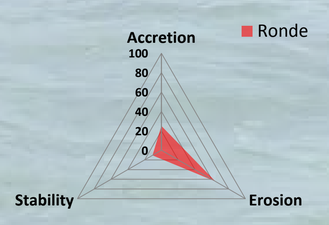
Percentage of length of coastline affected by erosion, accretion or stable (2013-2014)

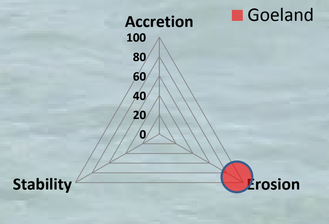


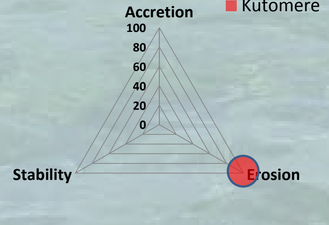












Method

More than twenty islets from the southwestern and eastern lagoons of Grande-Terre (New Caledonia main island) and one from Nokanhui atoll (Ile des Pins) have been studied. Such studies integrate field works (geomorphology, sedimentology) and analysis of historical evolution of the islets using available photographs and satellites images on timespan from 70 to 10 years). For each period, erosion and accretion rates, shapes, area of each islet have been assessed. Moreover, the forcing factors such as winds, waves, tropical storms or cyclones, and the ENSO have been analyzed, in order to understand links between forcing factors and the islets evolution.

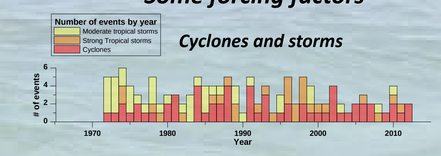
Islets characteristics and life cycle

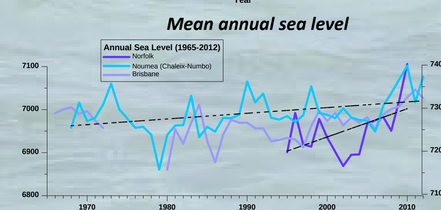
Islets characteristics are highly variable in term of: area, shape, evolution trends during the last decades. Actually all islets have at least 50% of their coasts affected by erosion and for 4 of them this rate reaches 100%. Islets showing increasing area during the past years are very rare. Six main stages constitute the life-cycle of Caledonian islets, namely: nucleation, growing, maturity, decay, relic and endangered. Changes of the environmental parameters and of the forcing factors can lead the islets from one stage to another.

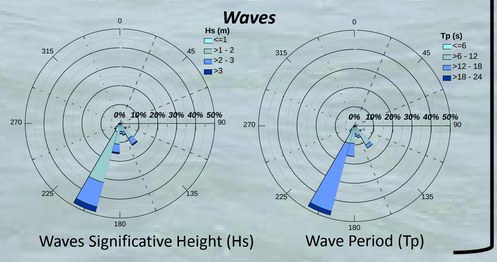
The future of islets

The future of each islet is linked to its past evolution, its present day stage, intensity of processes currently acting and future evolution of environmental parameters. ENSO and IPO which influence the intensity and direction of trade winds and the average sea level in the SW Pacific are one of the main factors controlling islets recent evolution. Extreme events like cyclones, storms and austral swells are morphogenetic and can have irreversible impacts on the islets.

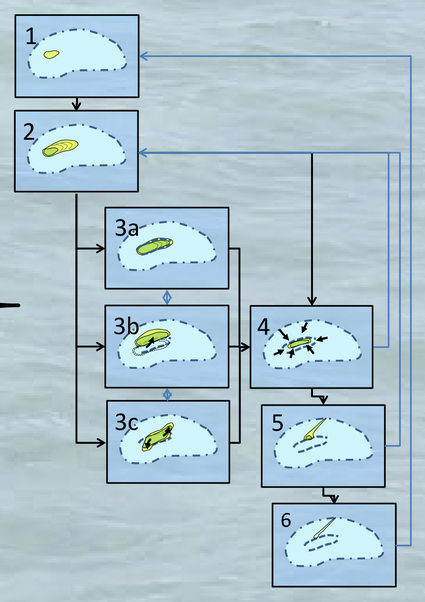
Some forcing factors







Islets life cycle

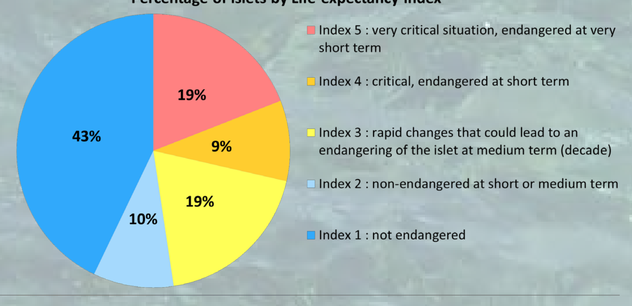


The question of the future of one islet may be addressed through : (i) its today stage within the life-cycle, (ii) its specific morphological characteristics (altitudes, area and shape..), some of these characteristics constituting a resilience or a fragility factor (area, altitude, presence and continuity of beach rocks, relation with the patch reef, location in respect with the passes…), (iii) the intensity of observed processes currently acting on the islet

A life-expectancy index constituted by five levels of plausible futures have been created: (Index 5) : Very critical situation, the islet is endangered in the very short term (few years); (Index 4) : Critical situation, the islet is endangered in the short term; (Index 3) : Rapid changes of the islet morphology that could endanger the islet in the medium term (decade) , (Index 2): Medium size islet with a low rate of accretion or a large islet with a low rate of land loss, not endangered in the short or medium term; (Index 1): Accreting or stable islet or large islet with very low land loss, not endangered.

On the 21 islets studied, 19% are in a very critical situation (index 5), 9% of the islets are in a critical situation (index 4), 19% are evolving rapidly, which could lead to their disappearance in the medium term but not in the short term(index 3), 10% of the islets are not endangered in the short and middle term (index 2) and 43% are not endangered at all (index 1).

Our results show that situations differ widely from one islet to another, even, in some cases, among those located in the same area of the lagoon. It should also be emphasized that there is more uncertainty regarding the medium and long term future due to uncertainties about future sea level rise and ENSO. Other sources of uncertainty concern the likelihood of reaching a threshold value (values and rates of sea level rise for example), which would change the capacity for resilience of each islet. Moreover, the salinity and SST changes will have an impact on the reefs integrity which can lead to a modification of their protecting role and to their supply of sediments.



Conclusion

Past evolutions and actual characteristics of caledonian islets are various. In the future, the evolution of lagoonal islets under climate change and rising sea level will be highly variable in relation with their resilience capacity. Due to their variety and sensibility, the Caledonian islets are good indicators of environmental and climatic change for New Caledonia and thus can be a reference site for the monitoring of the impacts of the sea level rise and climate change in the Pacific Ocean on very small islands.

References : Garcin M., Vendé-Leclerc M., Le Cozannet G., Maurizot P., Nicoale-Lerma A., Robineau B. (submitted) Lagoon islets as indicators of recent environmental changes in the South Pacific – the New Caledonian example

Acknowledgements:This work has been realized within the OBLIC project (*Observatoire du littoral de Nouvelle-Calédonie*) supported by the Government of New Caledonia (DIMENC) and by BRGM (French Geological Survey). We thank the DITTT, DTSI (NC Gov.) and the South Province (DENV) for providing satellite images, orthophoto and ancient aerial photographs, the SHOM for providing bathymetric data, METEO NC for cyclonic and meteorological data