Conclusion

Ayant défini la hausse du niveau moyen relatif de la mer (HNMRM) comme étant la somme de la contribution des dynamiques continentale et océanique, cette étude s'était fixé comme objectifs principaux de 1) déterminer, pour Trinidad la contribution de ces deux dynamiques verticalement et horizontalement, 2) de montrer que le facteur dominant de la HNMRM depuis 1990 est la subsidence et 3) de développer une méthodologie basée sur un SIG pour évaluer l'intrusion marine considérée comme la composante horizontale de la HNMRM.

Les résultats obtenus montrent, sous réserve des erreurs qui pourraient entacher les estimations des deux dynamiques, que la HNMRM calculée est inférieure à l'estimé marégraphique, d'une valeur comprise dans l'intervalle 4,7 à 13,4 mm/an. Il est à remarquer qu'on a opté pour des résultats sous forme d'intervalles, et ce, pour diminuer l'effet des erreurs de détermination de certaines valeurs, erreurs qu'on n'a pas pu prendre en compte dans nos calculs.

La différence entre la HNMRM calculée et celle observée a été attribuée à la dynamique continentale, et tout particulièrement à une subsidence due à l'exploitation excessive du pétrole offshore, au lieu d'être attribuée à un quelconque facteur de la dynamique océanique non pris en compte (comme des perturbations inter décennales par exemple), et ce, pour les raisons suivantes :

1) La dynamique océanique en général, et les perturbations inter décennales en particulier, agissent sur des échelles spatiales qui dépassent les dimensions d'une petite île comme Trinidad. Donc leurs impacts physiques sur la côte devraient se ressembler sur des plages de même nature géologique et géomorphologique. Or

mis à part las ressemblance de l'intrusion du sel marin dans les deux puits étudiés, les profils des plages ont montré que l'érosion diffère d'une plage à l'autre, certaines plages semblant beaucoup plus se combler que s'éroder.

2) Dans la partie nord de la côte ouest, au bord du golfe de Paria, le marégraphe donne entre 1990 et 1999 une HNMRM de 15,2 mm/an. Dans le centre de cette côte, les autorités de l'île érigent des murs pour se protéger de cette hausse, tandis qu'au sud et au sud ouest de cette côte, les falaises connaissent un taux d'érosion exceptionnelle au lieu-dit Mont-Peltier et une maison entière a été emportée par la mer en moins de cinq ans. Bien sûr, ces phénomènes pourraient s'expliquer aussi bien par la dominance de la dynamique continentale que par la dynamique océanique. Mais voilà que pas plus de deux kilomètres au sud de la maison détruite, l'analyse des profils des plages révèle une « érosion négative » qui pourrait s'interpréter comme un dépôt de sédiments. Mais qu'on a interprété comme un soulèvement du fond marin qui se serait produit suite à la poussée interne des couches géologiques le long de la ligne de faille traversant la région et sur laquelle était érigée la maison submergée.

3) La HNMRM observée entre 1984 et 1999 est environ 6 mm/an inférieure à celle observée entre 1990 et 1999, ce qui montre qu'au même moment où la maison était en train de s'engloutir au sud, la HNMRM montait au nord, probablement sous l'effet du même mouvement isostatique dont les effets s'étendirent jusqu'à Port of Spain.

4) À la même époque, les séismes superficiels se sont multipliés dans le golfe de Paria où rien que du côté trinidadien,

> l'exploitation pétrolière offshore faisait baisser le niveau de la nappe pétrolière en moyenne de 18,1 mm/an, et ce depuis 1954. Du côté des exploitations pétrolières de l'atlantique, la nappe pétrolière baissait, en moyenne, de 48,7 mm/an depuis 1964. Or, juste en face de ces exploitations pétrolières, sur la côte est, la plage Cocos est la seule plage où les profils ont montré une érosion soutenue depuis 1990. Donc là aussi le niveau de la mer n'aurait pas cessé de monter. Comme cette plage est, elle aussi, située sur une ligne de faille, on a conclu à la présence d'une subsidence liée à l'exploitation offshore de pétrole et qu'on a évalué entre 4,7 et 13,4 mm/an.

Cependant, même si la dominance de la dynamique continentale semble évidente et que l'existence de subsidence sur plusieurs points de la côte est probable, l'analyse des profils des plages, l'évaluation des deux dynamiques et l'intrusion des sels marins dans les aquifères n'ont pas permis d'infirmer l'existence de certaines composantes de la dynamique océanique omises dans les calculs et évaluations.

Les plus importantes de ces composantes ne seraient certainement pas les vagues atlantiques ni le phénomène d'El Nino car les côtes qui souffrent le plus de l'érosion ne sont pas celles de l'est ou du nord donnant sur l'atlantique, mais celle du golfe de Paria bien protégée et où les vagues et les courants sont les moins forts de la région.

Aussi, ce qu'on peut affirmer au terme de cette étude c'est que l'effet de la dynamique continentale est prédominant et que la différence entre la HNMRM calculée est celle observée pourrait être largement attribuée à la subsidence au golfe de Paria. Donc, comme la dynamique océanique calculée (hausse du niveau moyen de la mer absolue ou HNMM) est nettement inférieure à la HNMRM observée au marégraphe de Port of

Spain, il serait encore trop tôt pour attribuer aux changements climatiques la HNMRM observée récemment à Trinidad.

En outre, malgré l'évidence de la dominance de la dynamique continentale, plusieurs « coins d'ombre » subsistent ne serait-ce que parce que nos estimations et nos calculs ont été basés sur des valeurs globales de la littérature et que les profils des plages ont été construits à partir de certaines mesures prises dans des conditions favorisant les erreurs pouvant impliquer une surestimation de l'érosion.

Toutefois, il faut se rendre à l'évidence que certaines parties des côtes trinidadiennes sont bel et bien en train de sombrer et que l'île est davantage menacée par une HNMRM due à une action anthropique locale qu'aux conséquences d'un réchauffement global.

Le SIG utilisé dans le cadre de cette étude a permis de visualiser le comportement de l'intrusion future des eaux marines dans les zones côtières et d'évaluer les pertes en superficie des types d'occupation des sols. Il a permis en particulier de montrer la vulnérabilité du terminal gazier, projeté à Mont-Peltier sur la côte sud ouest. Il a aussi permis de mettre en relief la menace qui pèse, à Oropouche, sur l'agriculture ainsi que sur une mangrove constituant un écosystème fragile de l'île.

La conception de ce SIG est simple et peu coûteuse. Il se base sur un modèle numérique d'élévation du terrain (MNE) qui, une fois reclassé à l'aide des scénarios de la HNMRM, permet de générer des masques de simulation de l'intrusion de la mer. Il suffit ensuite de superposer par multiplication ces masques aux couches d'information spatiale pour générer, comme extrants, des cartes thématiques et des statistiques.

On n'a retenu pour ce SIG que l'impact de la HNMRM future sur l'occupation des sols, sur la topographie et le tracé d'un terminal gazier.

Mais rien n'empêche d'exploiter ce même SIG pour analyser d'autres informations spatiales comme celles relatives au réseau routier, aux installations pétrolières, à l'habitat des espèces sauvage, etc.

Les résultats obtenus sont assez précis pour être utilisés en vue de formuler des stratégies d'adaptation aux impacts futures de la HNMRM. Dans le cas du SIG de cette étude, la résolution des extrants cartographiques pourrait être assimilés à la précision d'une carte topographique au 1/10,000^{e} pour le site de Mont-Peltier et au 1/50,000^{e} pour Oropouche.

Outre l'utilisation d'outils d'analyse et de modélisation comme les SIG, les autorités locales devraient donc multiplier les moyens de surveillance car ,comme on l'a vu le long de cette étude, le problème est souvent très limité dans l'espace et les endroits qui sont le plus affectés (Icacos et South Cocos) se trouvent assez loin des sites surveillés par les marégraphes.

Des stations GPS, avec ou sans marégraphes, seraient donc nécessaires surtout pour surveiller la dynamique continentale aux plages sensibles. Les mesures des profils des plages devraient également se poursuivre dans les plages à risque. Mais il faudrait en améliorer la technique et l'approche.

Il faudrait surtout bien situer les points-repères des profils à une distance raisonnable de la ligne de côte, les bien matérialiser et ancrer au sol et s'assurer de leur pérennité en les rattachant au réseau géodésique local. Un rattachement au réseau de nivellement national serait également souhaitable, et ce, pour contrôler leur stabilité verticale quand on n'a pas accès aux moyens de positionnement pas satellite (GPS).

Le plus grand soin doit être également apporté aux opérations de mesure. Il faudrait en particulier s'arranger pour effectuer ces opérations à marée basse, et ce, afin d'éviter les erreurs découlant de l'inclinaison de la mire par rapport à la verticale ainsi que son enfoncement dans le sable sous l'action des courants développés par le mouvement des vagues. Il faudrait rappeler que ce sont ces erreurs qui induisent ces erreurs grossières dont il était question plus haut et qui font exagérer l'effet d'érosion.

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