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The State of the Art and Science of Coastal Engineering

INTEGRATED MANAGEMENT PLAN FOR CLIMATE RESILIENCE OF COASTAL AREAS IN TOGO



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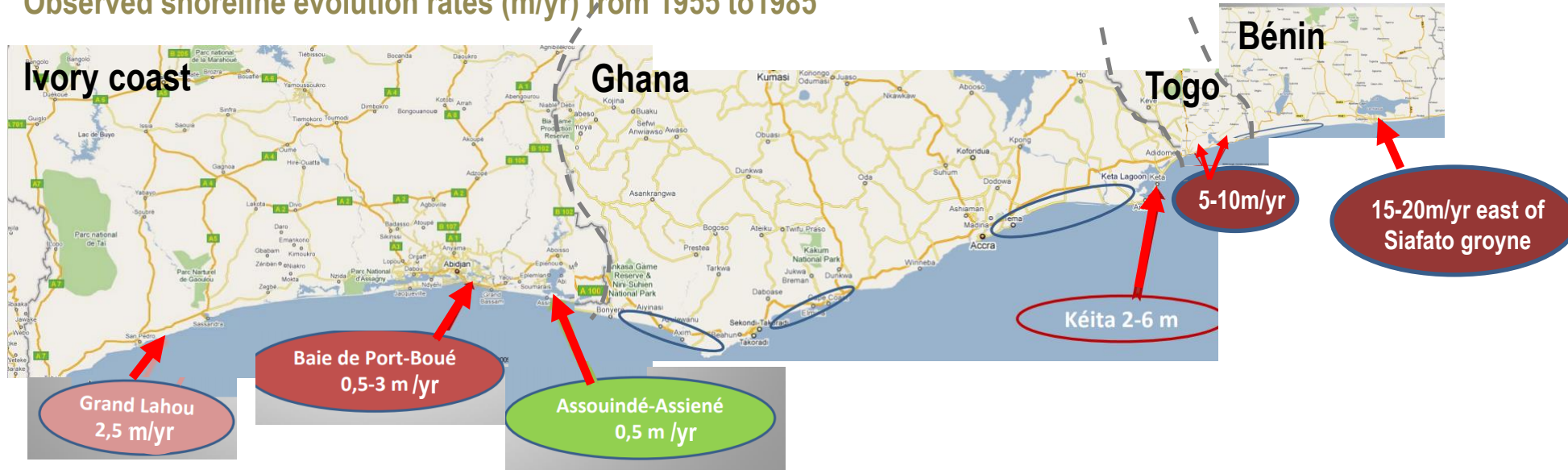
Banque Africaine
de Développement



I - Strong coastal erosion and shoreline retreat leading to important asset loss in the past

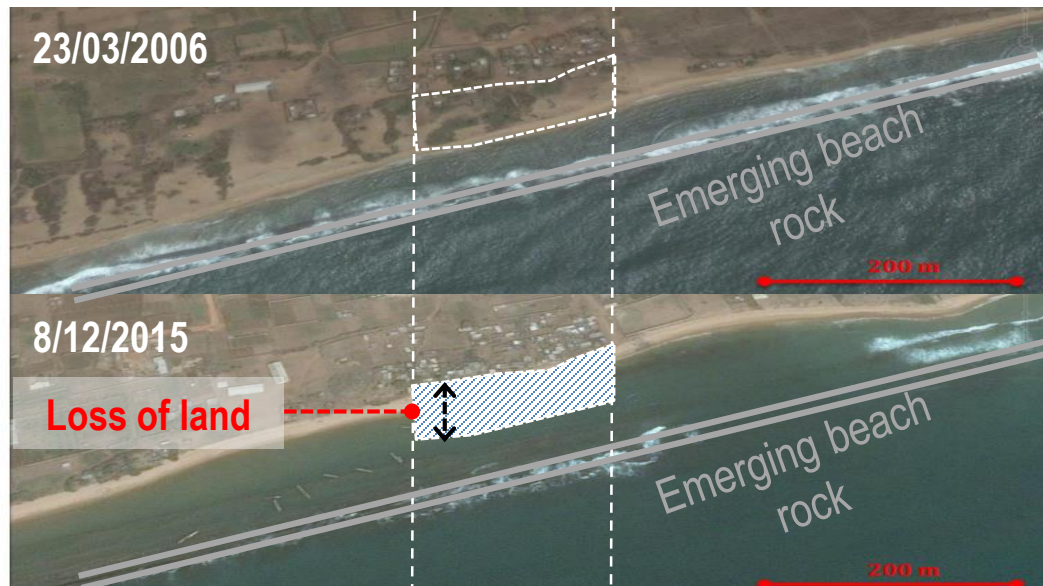
- **Regional phenomenon** : Gulf of Guinea and Gulf of Benin coasts have been experiencing strong erosion

Observed shoreline evolution rates (m/yr) from 1955 to 1985

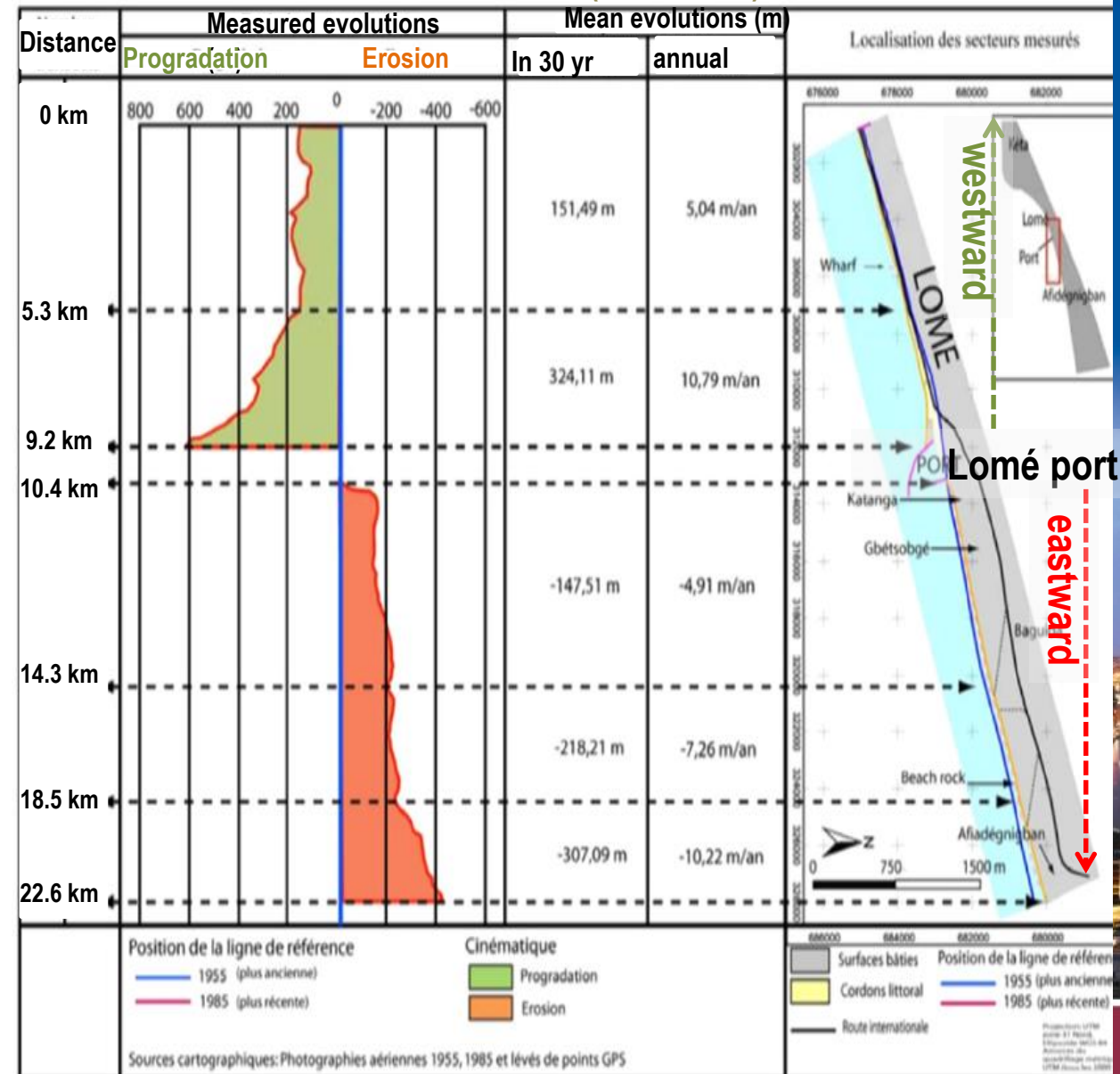


I - Strong erosion leading to great asset loss in the past

- **Togo in particular : substantial shoreline retreat**
 - 5 to 10 m/yr during the period 1955-1985
 - 20 to 30 m/yr during the recent period 1985-2009
- **Consecutive losses**
 - Coastal road linking Lomé to Aného **removed twice**
 - Total **disappearing** of human assets (coastal villages, dwellings, schools, cimeteries,...)
 - **Loss** of lands, plantations, road and tourism infrastructures
 - **Business disruption** (fishing in particular)
 - Permanent **threat for existing coastal assets**

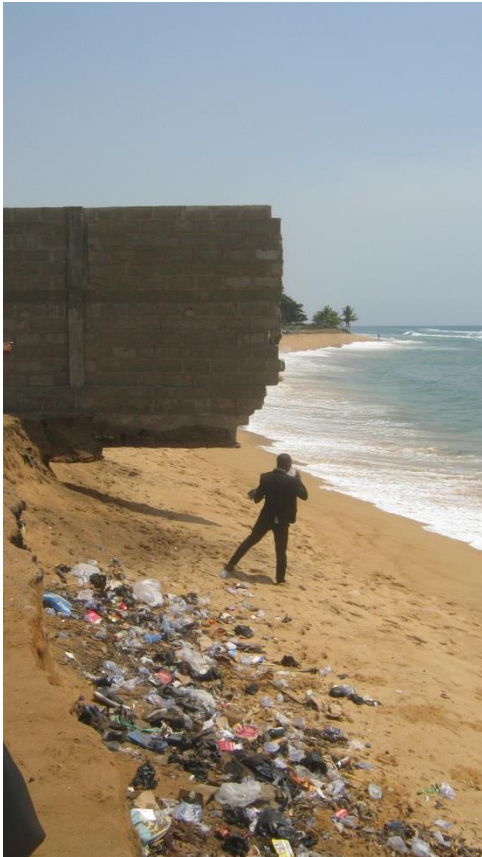


Shoreline evolution from 1955 to 1985 (Blivi, 2010)



I - Strong erosion leading to great asset loss in the past

- Illustration of threats and losses



Building located in Baguida Plage, threatened by shoreline retreat 8/05/2018



Same building, collapsed 12/05/2018



Courtesy to Dak Martin Doleagbenou for the recent pictures



II - Causes of erosion : natural and anthropogenic

- Natural important eastward longshore sediment transport ($\approx 500\,000\text{ m}^3/\text{yr}$ to $1\text{ M m}^3/\text{yr}$)
- Disturbed since the 60ies, by coastal and river developments, bad human practices.... led to strong erosion trend
 - Building of deep water port of Lomé (in the 60^{ies}) interrupting the littoral drift
 - Recent civil works for port extension interrupting the littoral drift
 - Dam / hydroelectric developments on Volta River (Ghana) drastically decreasing sediment supply
 - Important sand mining in shallow waters → Implementation of a ban in 2011 but not strictly enforced (evidence on illustration below)



Evidence of Lomé port impact



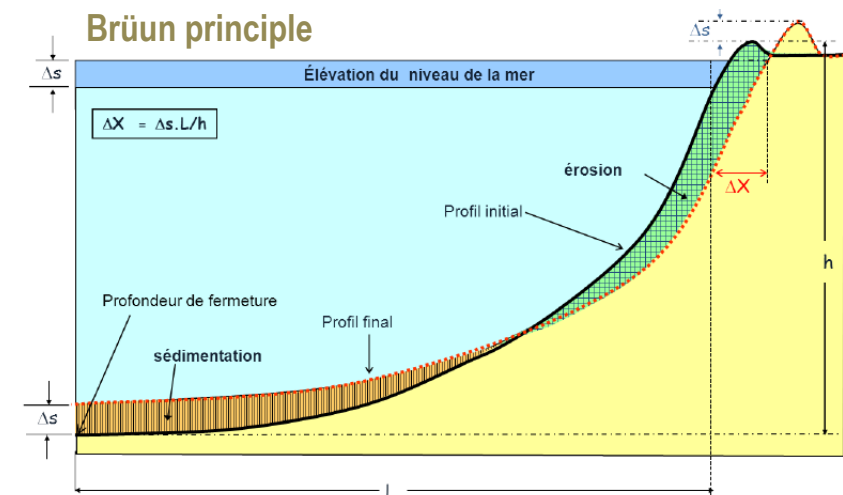
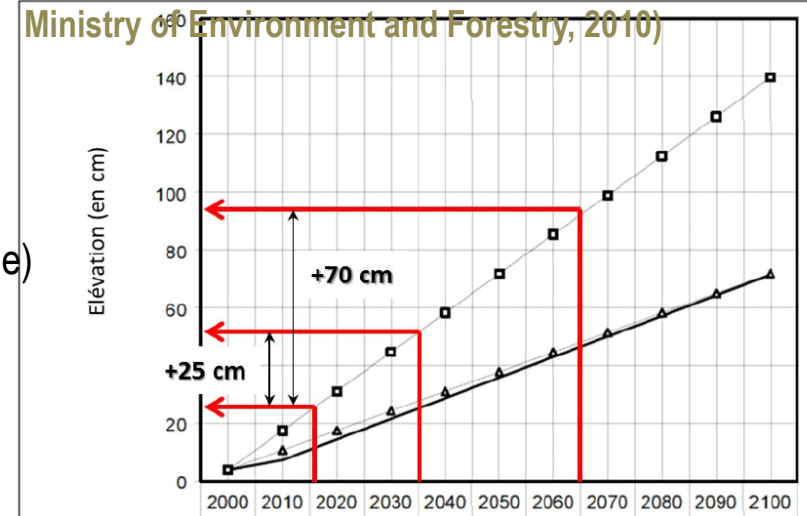
Sand mining chain, ARTELIA 2015



III - Perspectives of evolution : vulnerability to Climate Change and sea level rise

- **Erosion will be worsened in the future due to climate change and particularly to sea level rise of (mean assumptions)**
 - In 2030 : +0,20 m
 - In 2050 : +0,35 m
 - In 2100 : +0,70 m
- **Associated shoreline retreat assessment (Brüun rule)**
 - In 2035 : **mean value of - 8 m** (- 4,0 to -10,0 m depending on considered profile)
 - In 2065 : **-14 m to -25 m**
- **Expected consequences of sea level rise on Togolese coastal area**
 - Shoreline erosion rate increasing
 - Increase of marine submersion risk
 - Increase of salt water intrusion risk → ecological upheaval

Projections for mean sea level rise in Togo (FEM-UNDP ,
Ministry of Environment and Forestry, 2010)



IV - National and international concern

- **African Development Fund 13th cycle (2014 - 2017)**

African Development Bank (AfDB) is supporting the Togolese government's effort of strengthening regional integration through the financing of transport infrastructure, in particular the “rehabilitation of the corridor Lome-Cotonou and transport facilitation project”.

The main objective of AfDB project is to finance :

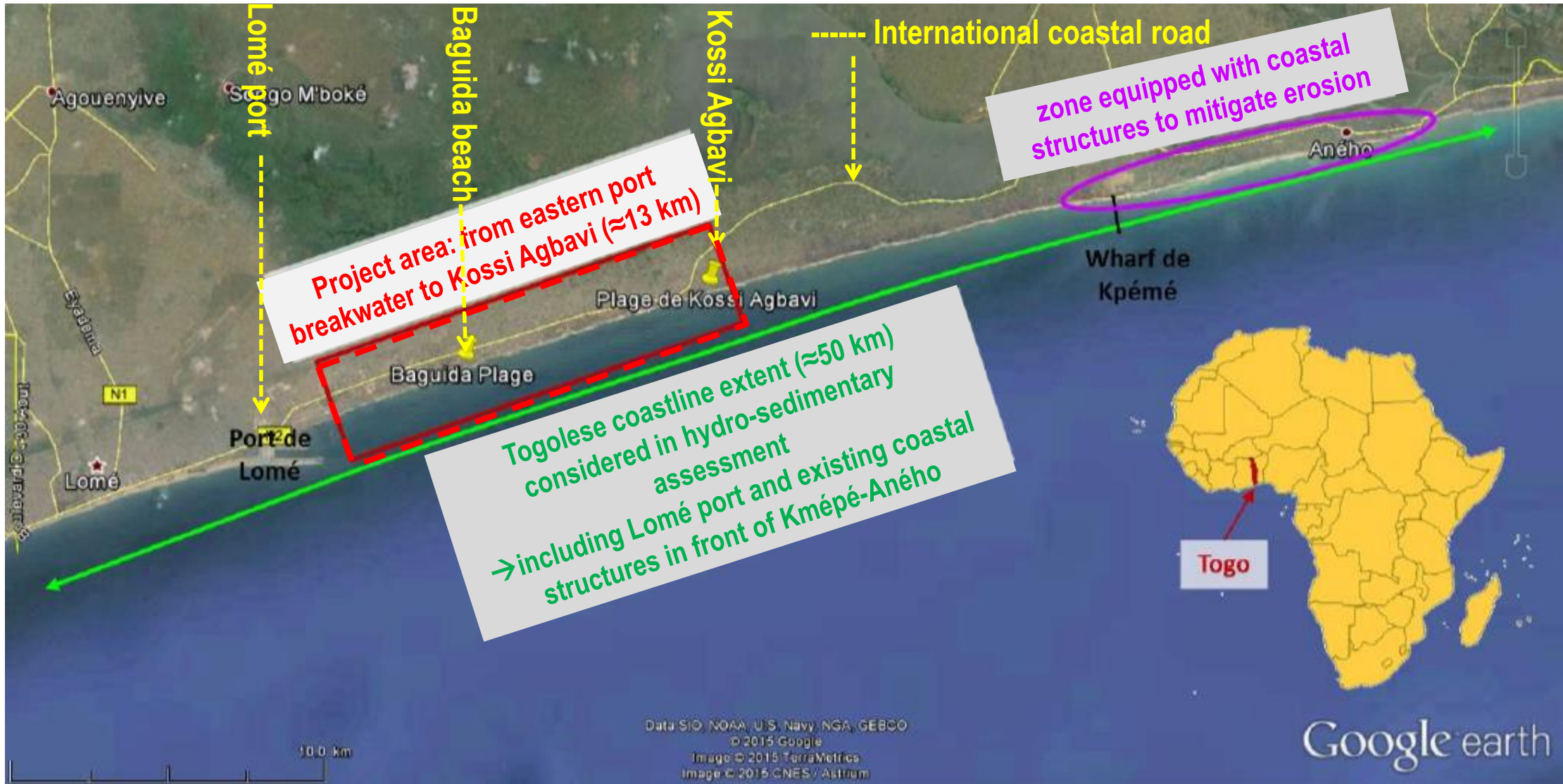
- Related infrastructure
- Capacity building that will make coastal infrastructure climate resilient.



ARTELIA mandated by the AfDB to study an integrated coastal zone management plan which aims at protecting the 15 km shoreline located between:

- **Baguida** (Western extremity of the study area)
- **Kossi Agbavi** (Eastern one)





Objectives of the project

Component I : Making infrastructure climate resilient

Component II : Supporting local coastal communities

Component III : M&E* and KM**

*** Monitoring & Evaluation ** Knowledge Management**



Component I - Making infrastructure climate resilient

Methodology

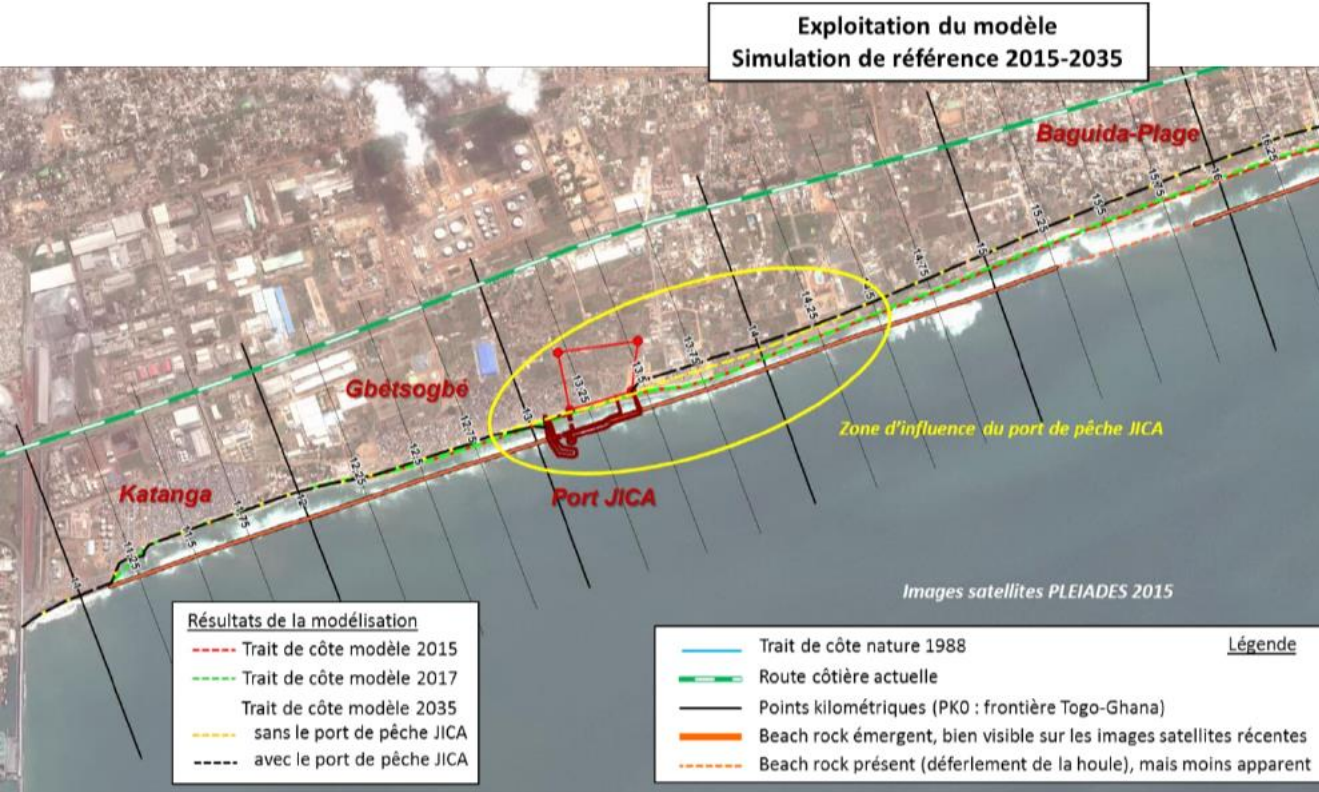
- **Field visit : community consultation and field data collection**
 - few scientific data/lack of monitoring
- **Study of the existing dynamics and shoreline evolution rates**
 - Fields data collection
 - Study of historical shoreline positions
 - Modelling
 - Wave fields → assessment of wave climate along the coast
 - Nearshore currents
 - Shoreline evolution → calibration of Unibest model parameters on past shoreline positions
- **Study of the future dynamics and shoreline evolution positions**
 - Modelling of shoreline evolution in 20 years, considering maintained existing coastal developments and JICA port development
 - Mapping of shoreline position in 20 years on current land use plan
- **Study of protection measures**
 - Technical proposition : **3 scenarios combining hard and soft measures**
 - Mapping of shoreline position in 20 years considering each scenario + maintained existing coastal developments + JICA port
 - Dimensioning of coastal structures
- **Costs/benefits assessment and choice of the best scenario**



Component I - Making infrastructure climate resilient

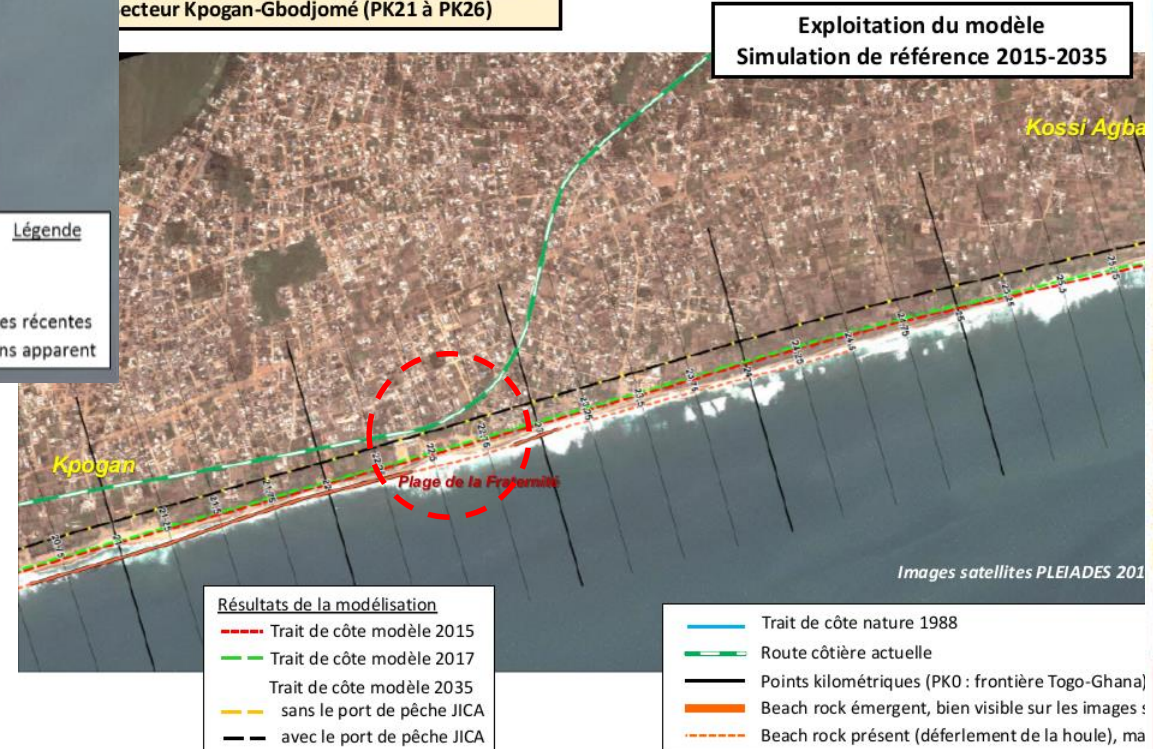
Main results from study of the future dynamics and shoreline evolution positions (in 2035)

Calculated shoreline position in 2035 considering maintained existing coastal developments and JICA port (or not)



- Impact of JICA port
- Coastal road threatened in 20 years
- Bagida school threatened in 20 years

Simulation d'évolution du trait de côte (UNIBEST)
secteur Kpogan-Gbodjomé (PK21 à PK26)



Component I - Making infrastructure climate resilient


Tested scenarios

SCENARIO V0 (from a previous study): Combination of 23 groynes and 2 breakwaters (built on beach rock)

SCENARIO V1 (from ARTELIA): combination 28 short groynes (located depending on threatened assets identified by shoreline evolution modelling)

SCENARIO V2 (from ARTELIA) : combination of 28 short groynes + beach replenishment in several cells (920 000 m²)

Origin of sediment for replenishment :
extracted from beach west of Lomé port (accretion area)
=
By-pass



Component I - Making infrastructure climate resilient

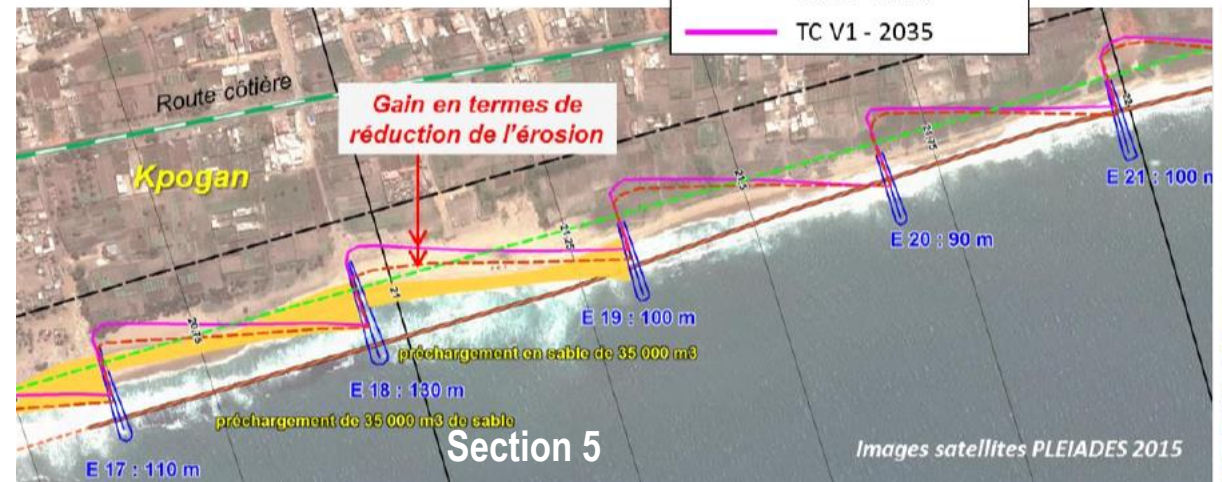
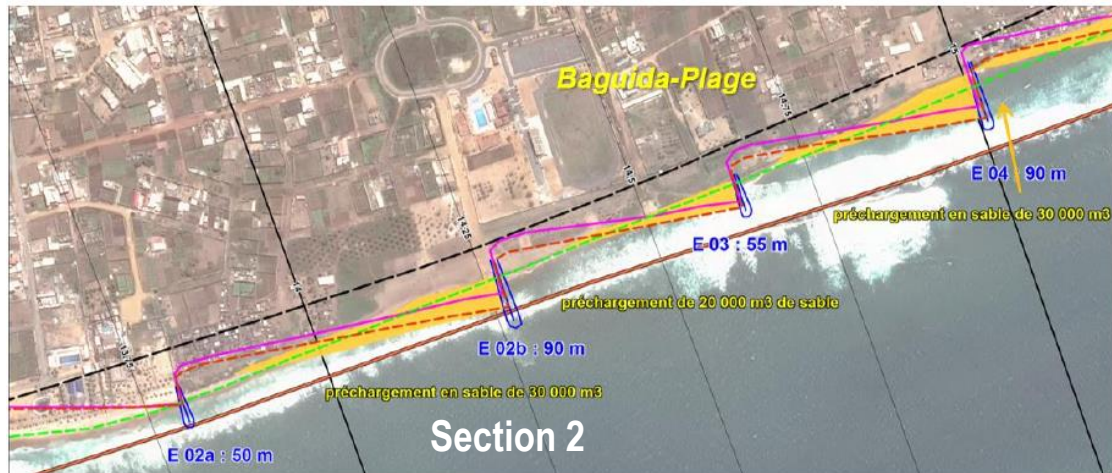
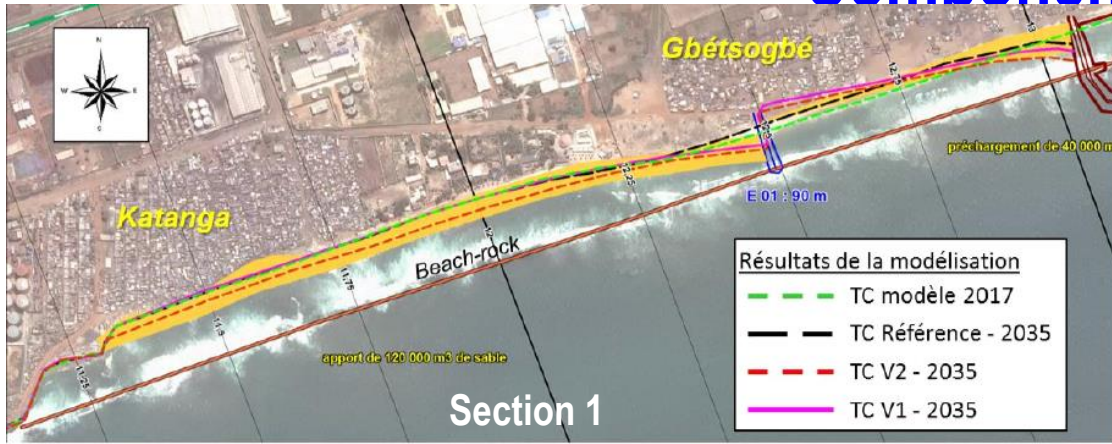
Conclusion of mapping of shoreline positions in 20 years considering each scenario

- Sand accretion reduced at western side of Lomé port in scenario V2 without threatening existing assets
→ reduction of maintenance dredging cost

Immediate west of Lomé port



Component I - Making infrastructure climate resilient



- Assets better protected with scenario V1 and V2
- Calculated shoreline position in scenario V2 less inland
- Demonstration of pre-replenishment efficiency



Component I - Making infrastructure climate resilient

Costs/benefits assessment

- Assessment of the width of the strip of land threatened by erosion in 2035
= calculated shoreline retreat + 8 m (SLR) + 12 m (storm event)
- Choice of V2 : → **More expensive**
 - Extra cost for replenishment maintenance
 - But
 - Better protection of major assets (road, school...)
 - Great improvement of sediment management : by-pass accepted for the first time since the 60^{ies}



Component II - Supporting local coastal communities

Diversification of Income Generating Activities

- **Proposition of strategies helping 400 people to change their illegal economic activity into a legal and sustainable one**
 - Strengthening **6 existing IGAs**
 - Creating **5 new IGAs**
- **About 400 residents (64% women, 36% men) will benefit from technical training & financial support for reconversion**



M&E

- Identification of education, information and communication needs in matters of CC and impacts on coastal zone
- Identification of activities and operations in order to strengthen integration of CC issue
- Programme for M&E of coastal erosion
- Programme for M&E of adaptive behavior and knowledge capitalization among local communities coping with CC impacts
- Accurate identification of required investment for such M&E implementation.

KM programme

- **Training**
 - On sandy beach barrier evolution
 - On adaptation to climate change
- **Field visits/workshops/feedback presentations**
- **Dissemination of knowledge products on adaptation in coastal zones** (manuals, guides)
- **Organization of events**
 - for exchanges between project partners and counterparts in the country and in the West African sub-region
- **Designation of technical staff responsible for data collect/data aggregation**
- **Annual audits to assess the effectiveness of the project regarding erosion issues**



Scenario V2 validated by stirring committee

Chosen scenario V2 already found financing (Islamic Development Bank)

Call for tender already issued

→ Already a success in term of sediment management : sediment by-pass

→ A challenge in terms of local coastal communities supporting



Thank you for your attention !

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