

Effects of Climate Change on the World's Oceans

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*Hicacos penninsula, face to
future changes.*

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Fuente: GEOCUBA



Fuente: www.haiti.com/maps/carib_map_page.html



Source: Office of Beach



Physic-geographic Characteristic

- It is a bar formed for gritty and calcarenita, presenting fossil dunes.
- Length 20 km, width 1-2 km.
- Plain region with some hills and low high over sea level
- Tropical climate with subtropical influence. Exposure to tropical and extratropical storms
- Little development of edaphic covering
- Not favorable hydric balance. High salinity
- Strong and persistent influence of the winds



FRAGILITY
SUSCEPTIBILITY
to
IMPACTS
of the
MAN AND NATURE

VULNERABILITY

Socio-economic characteristic

- Area 14.4 km²
- Population (around 8 th inhabita
- Around 60 % of building area
- Density 500 inhab/km²
- Growth yearly Rate 1.7
- Index of Masculinity 0.989
- High educational level
- Good health care
- Efficient Civil Defense system
- Main generator of employments tourism.

In last 25 years:

- *The population grew 1.8 times.*
- *Between 0 and 14 years stable, duplicate / 15 and 49 and triplicate + 50 years*



Socio-economic characteristic II

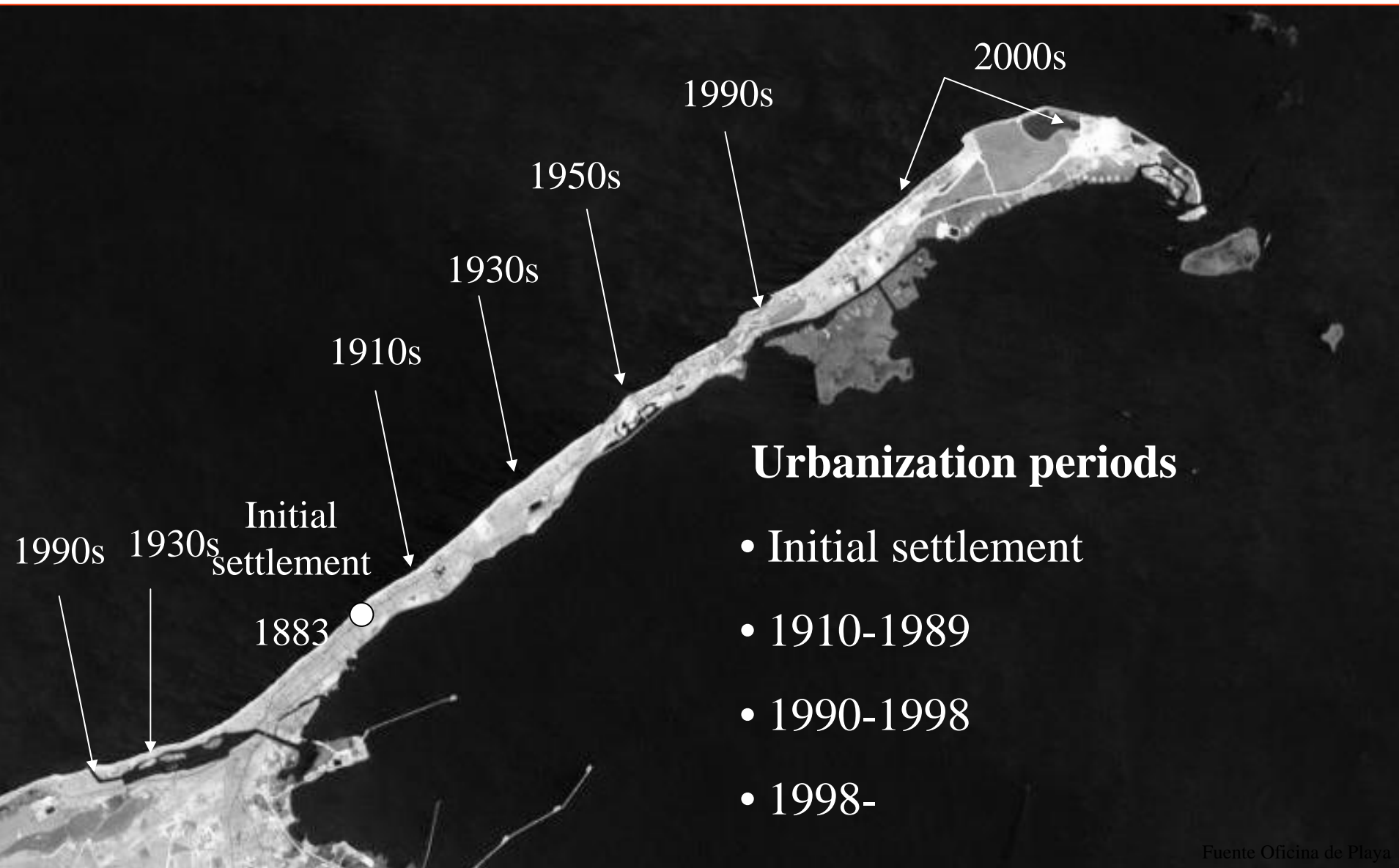
- Principal tourism place with around 35 % of the national touristic income. And more than 0.6 M of tourists per year.



- Intensity activity of services in function of the tourism development.
- Other smaller productions.
- Near the area there is the biggest petroleum extraction of the country. (it extracts around 1.5 M of petroleum per year)



Pole development



Urbanization periods

- Initial settlement
- 1910-1989
- 1990-1998
- 1998-



Initial Settlement

Source: Arch .Elena Royo Muñoz, IPF



1910 – 1989 I



Source: www.icentre.spb.ru

1910 – 1989 II



1990 - 1998



1987



2001

Antropogenization aspects

- Fragmentation of the ecosystems
- Deforestation (dune, mangrove, etc)
- Constructions on the dune
- Sand extraction
- Canalisation of Paso Malo Lagoon
- South freeway
- Non appropriate architecture
- Increase in the consumption of water
- Golf field
- Use over carrying capacity
- No correct technology to clean the beach
- Stress in the ecosystems
- Increase of the population and economic interests exposed to floods and storms



Source Office of Beach



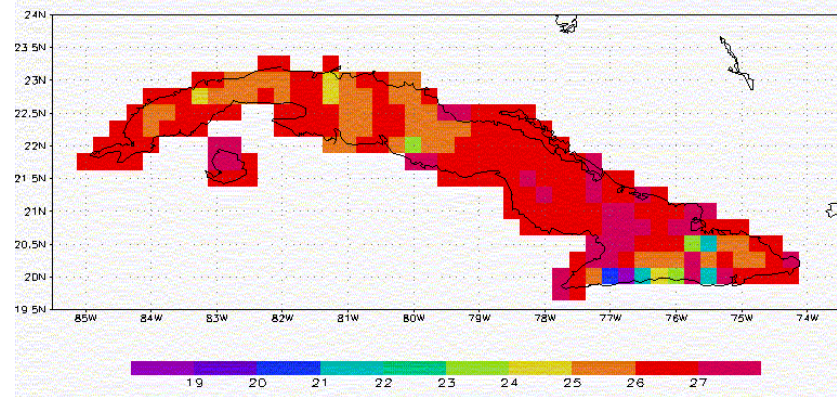
Source: Office of Beach

+FRAGILITY
+SUSCEPTIBILITY
- RESISTANCE
- RECOVERY (RESILIENCE)
+ EXPOSURE
to
IMPACTS
of the
MAN & NATURE

VULNERABILITY

What happen with the climate ?

*The scarce persistence of those variations of the climate in our country doesn't even allow to speak of that the **climate is changing**, However if they already appear some variations, among them:*

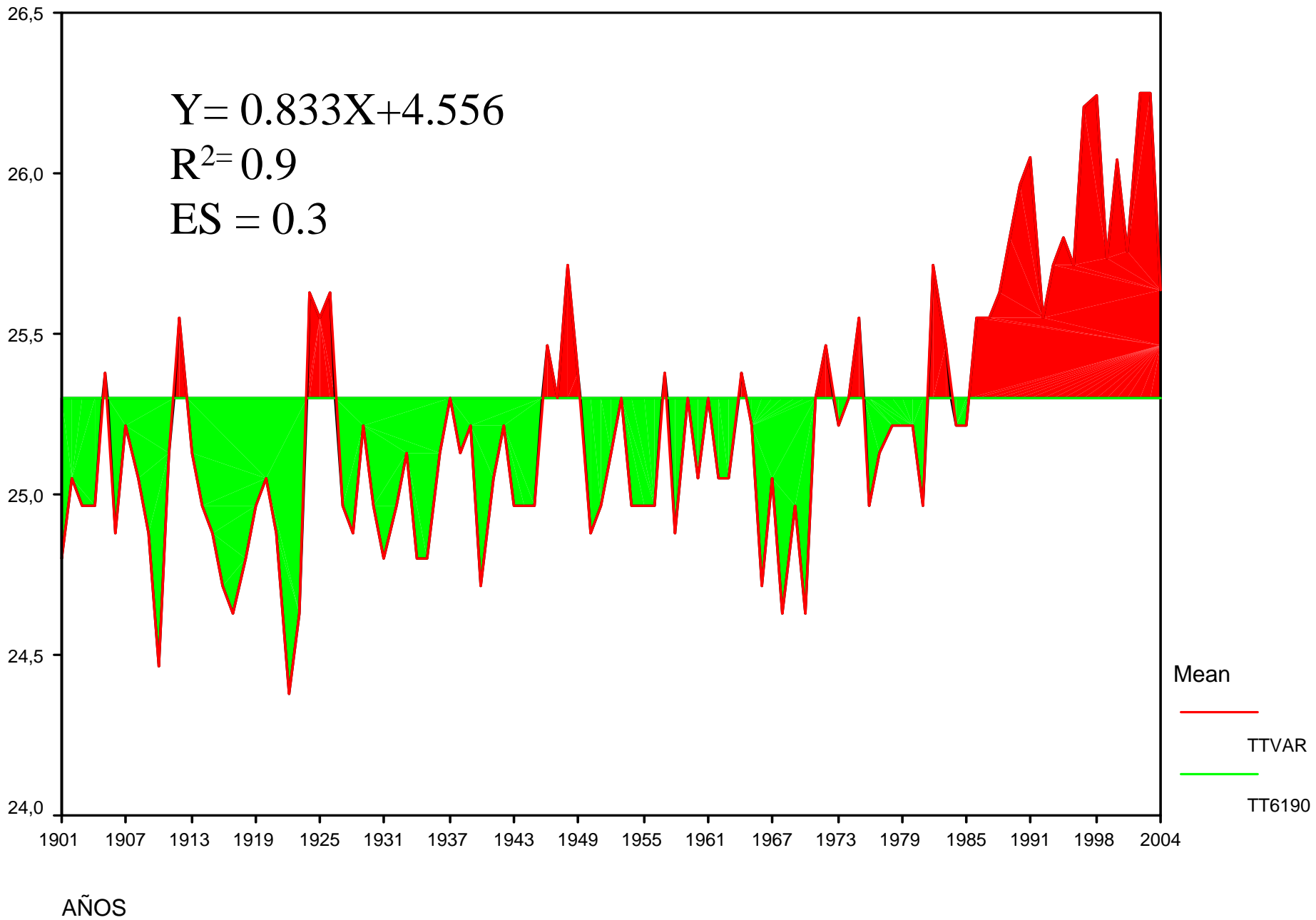


Increases of the values of temperatures between 0.4 and 0.6°C in the last 10 years, bigger in hours of the night and morning and smaller in the noon.

Variation in the annual distribution of the precipitation with an increment of those accumulated in the less rainy period and a decrease in the rainy one.

More frequent and intense events of droughts.

The area has been affected by 4 hurricanes in the 10 last years.



What will happen with the climate ?

- More frequent and intense droughts ?
- Bigger cyclonal activity?
- Bigger exposure to storms?
- The sea level will increase?
- The temperatures will rise?

Year	Sea Level rise(cm)
2010	4.71
2030	11.91
2050	21.63
2100	50.82

Month	Tt		Tx		Tn	
	2020s	Dif.	2020s	Dif.	2020s	Dif.
MAM	25,44	1,27	27,87	1,3	23,25	1,29
JJA	27,09	1,42	29,25	1,52	25,35	1,35
SON	26,17	1,45	28,42	1,5	24,42	1,37
DJF	23,82	1,12	26,15	1,16	21,84	1,11
ANN	25,63	1,31	27,92	1,37	23,71	1,28

Vulnerability

Natural

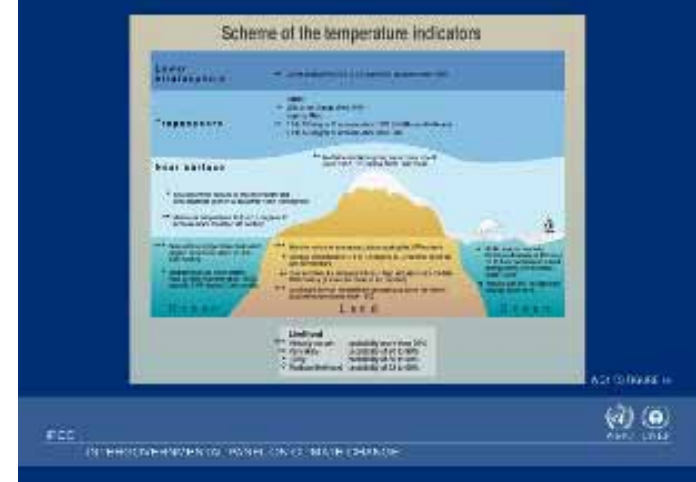
- Exposure to tropical and extratropical storms.
- Low height over sea level.
- Soils low developed
- Strong and persistent influence of the winds.
- Hidric balance no-favorable
- Young landscapes.
- Flat relief.

Human

- Its human settlement and socio-economy activity near to the coast
- Building on the dune
- Dune deforestation
- Sand extraction
- Channalization of Paso Malo Lagoon
- South Freeway
- Golf field
- Non appropriate architecture
- Increase in the consumption of water
- Use over carrying capacity
- No correct technology to clean the beach



Source: www.shareyourphoto.com



Source: www.ipcc.ch

Uncertainties: What will happen with the global warming, that answer will have the atmosphere, that impacts will cause the climatic change, that effects will have on the economy, environment and society.



Source: www.ipcc.ch



Source: Arch. Lorenzo Castillo

Impacts & effects

- Affectations of the sea's species by sea warming and changes in the coastal ecosystems.
- Lost of spaces by sea invasion.
- Affectation to the human settlement near to the coast mainly for flooding sea and extremes weather events.
- Environmental changes in the pathogens habitat
- Affectations in the water resources by overpumping and growth of the probability to be affected by salinity intrusion
- Most exposure to the salinization of the cultivated soils
- Loss of the touristic potential by loss of the beach, growth temperatures. (receiver/originator)
- Increase of the erosion process of the beach.
- More exposure to storm

Beaches	Years	Sea Level Rise (m) KYOTOA1	Lost of the Coast (m)	
Las Américas	2010	0.0471	1.81	
	2030	0.1191	4.59	
	2050	0.2163	8.33	
	2100	0.5082	19.57	
Caney	2010	0.0471	2.41	
	2030	0.1191	6.09	
	2050	0.2163	11.05	
	2100	0.5082	25.97	
Cosmonautas	2010	0.0471	3.55	
	2030	0.1191	8.97	
	2050	0.2163	16.28	
	2100	0.5082	38.26	

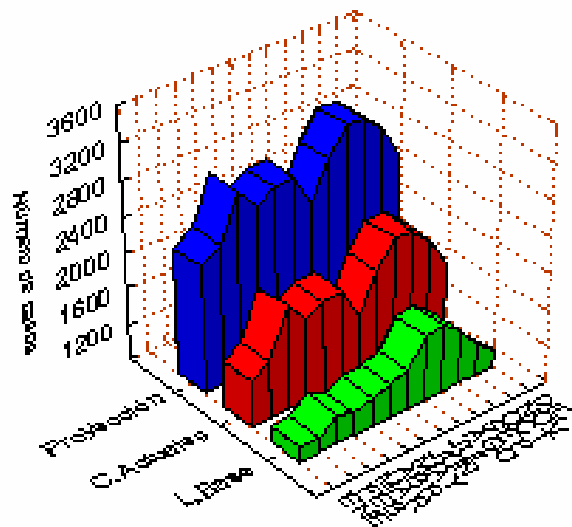


Source: Office of Beach



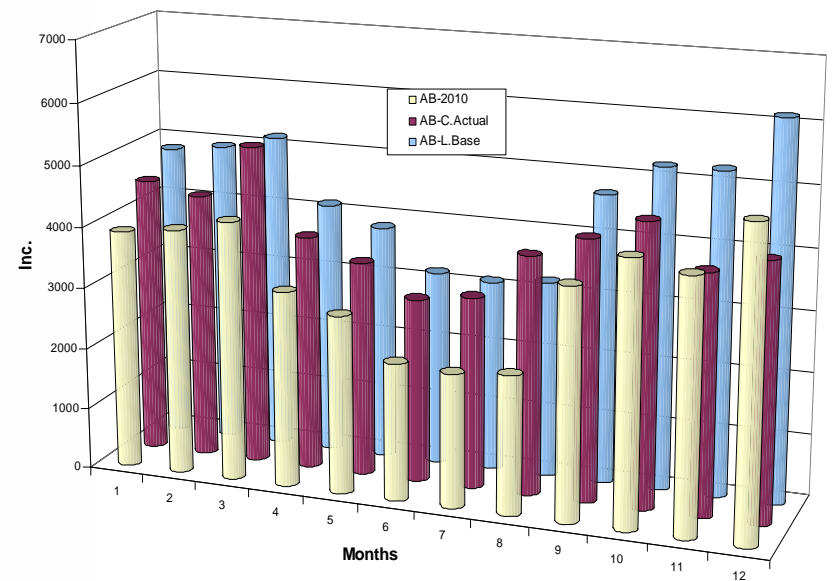
Source: Office of Beach

Fig 10. Comportamiento de la Hepatitis Viral en Cuba para el 2010 respecto a la Línea Base



Cortesía Lic. Paulo Ortiz

Evolution of Asthma Incidence (AB) in Cuba. Climate change to 2010



Cortesía Lic. Paulo Ortiz

Adaptation

- An integrated program of measures, where the approaches of scientists, specialists and stakeholders appear and in that is represented the physical planning, the beach management, the tourist activity and other economic activities, the health, the architecture, the landscape science, the ecology, the government and the population.
- In this program it must aboard retroces, accommodation and protection measures in the first case leading to the leaving of activities or spaces, second one to the measures that allows coexist with future scenaries and in the third leading to the decreasing the vulnerabilities, strengthening the defence of the zones.

Example

Retroces (retreat away from the low lying area)

- Demolition of the buildings on the dune, respecting the cultural values and with the population “resettlement”
- Steady decrease of the population and economic interests in areas vulnerable to flooding



Accomodation

- Diversification of the touristic activity.
- Protection or regulation of the water use (protection)
- Architecture in harmony with the environment.
- Keep the Civil Defense system.
- Integrated Coastal Management

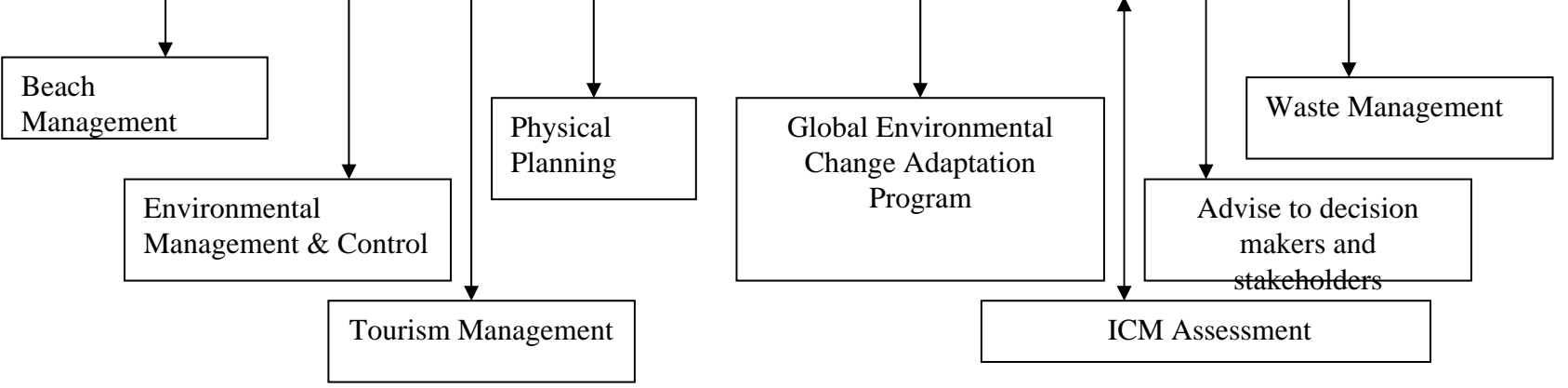
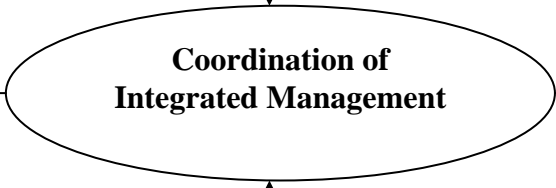
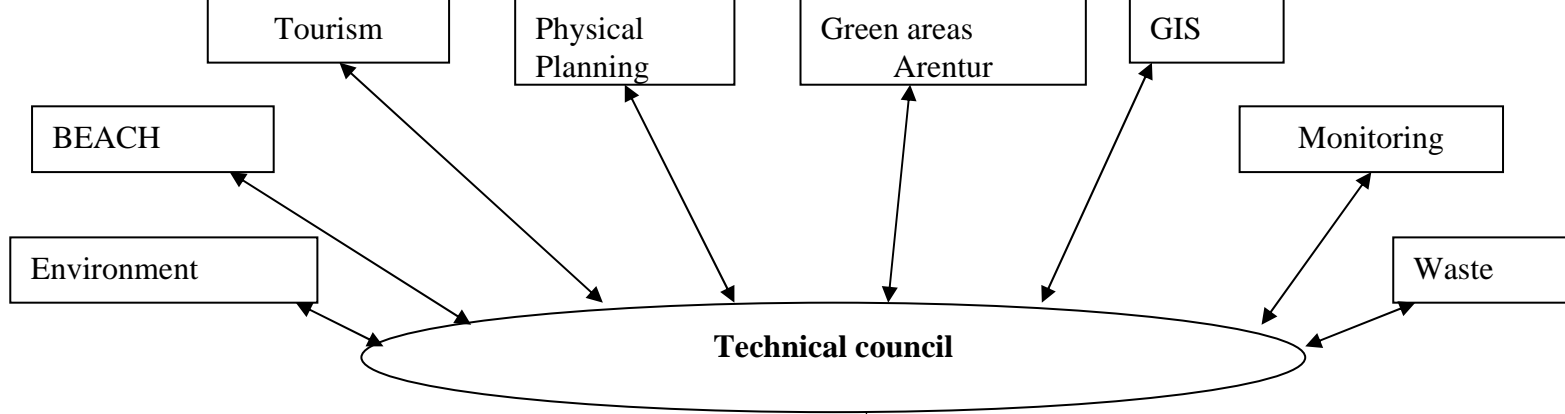


Protection

- Dune reforestation.
- Rescue of the autochthonous vegetation.
- Rescue of the mangrove areas.
- Maintenance and care of the beaches. (Regeneration)
- Regulation of the carrying capacity of the beaches.
- Replace of the cleaning system of the beach.
- Include the adaptation program in the Director Plan.



Source: Office of Beach
Fuente CISAM



Conclusions

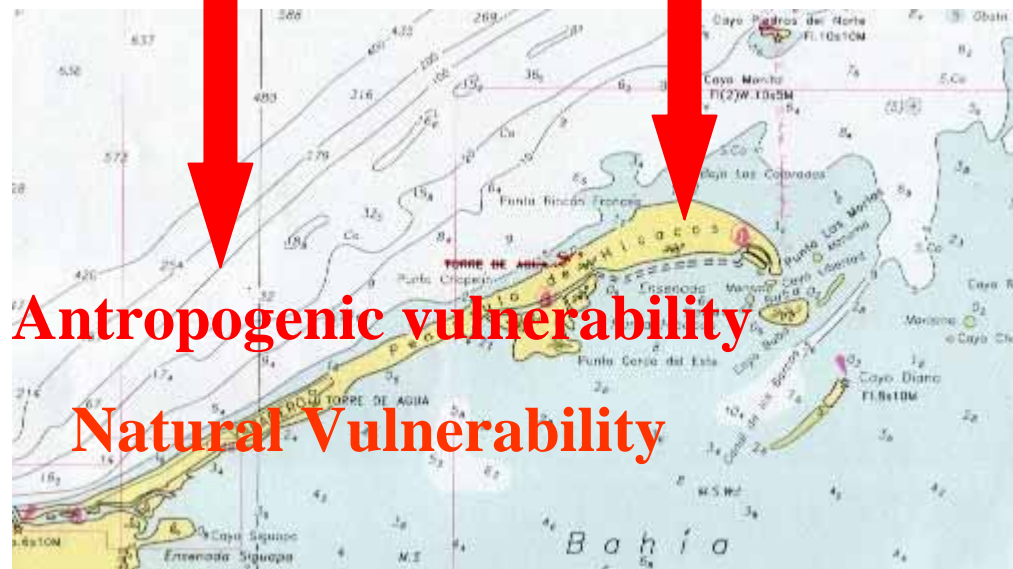
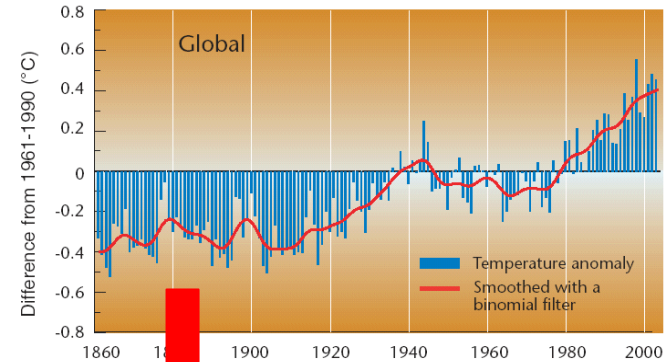
Global change



Fuente EEPA

Combined annual land air and sea surface temperatures from 1861-2003 relative to 1961-1990 for the globe

(Sources: Climatic Research Unit, University of East Anglia and Hadley Centre, The Met Office, UK)



Fuente GEOCUBA

Conclusions

Decrease vulnerability

Decrease impacts and contribution

ADAPTATION

