

Adaptabilidad al Cambio del Clima: Las Inundaciones y la Adaptación Urbana

EL FENOMENO DE LA INUNDACION. J Javier Diez

- **Las Inundaciones, un fenómeno natural o antropogénico?:**
- **Tipos y causas.**
- **Clima y Territorio.**
- **Los cambios del Clima y el Cambio Climático.**
- **El factor oceánico:**
 - **a) la Máquina Térmica Oceánico Atmosférica y**
 - **b) las variaciones en el nivel del mar;**
- **El factor humano:**
 - **Ocupación del territorio, población y desarrollo;**
 - **Riesgo y vulnerabilidad;**
- **Inundaciones Urbanas:**
- **Daños, Recuperación, Adaptación Protección y Resiliencia o Acomodo,)**



EL FENÓMENO DE LA INUNDACIÓN

**Las Inundaciones,
¿un fenómeno natural o antropogénico?**



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TIPOS Y CAUSAS



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CAUSAS

- Continental precipitations start the hydrologic cycle, resulting:
 - Flash flood ?
 - soil infiltration
 - surface runoff
- Precipitation in the form of rain immediately triggers pluvial flooding (flash flooding when the intensity is extreme). If it continues, eventually fluvial flooding can occur.
- The presence of urban land and infrastructures represent important, modifying factors
- Sea level controls the mouth of the basin's drainage, ultimately governing flood levels
- A temporary rise in sea level acts as a dam at the mouth, blocking river drainage and causing a rise in the water level on the river, its floodplain and the surrounding areas



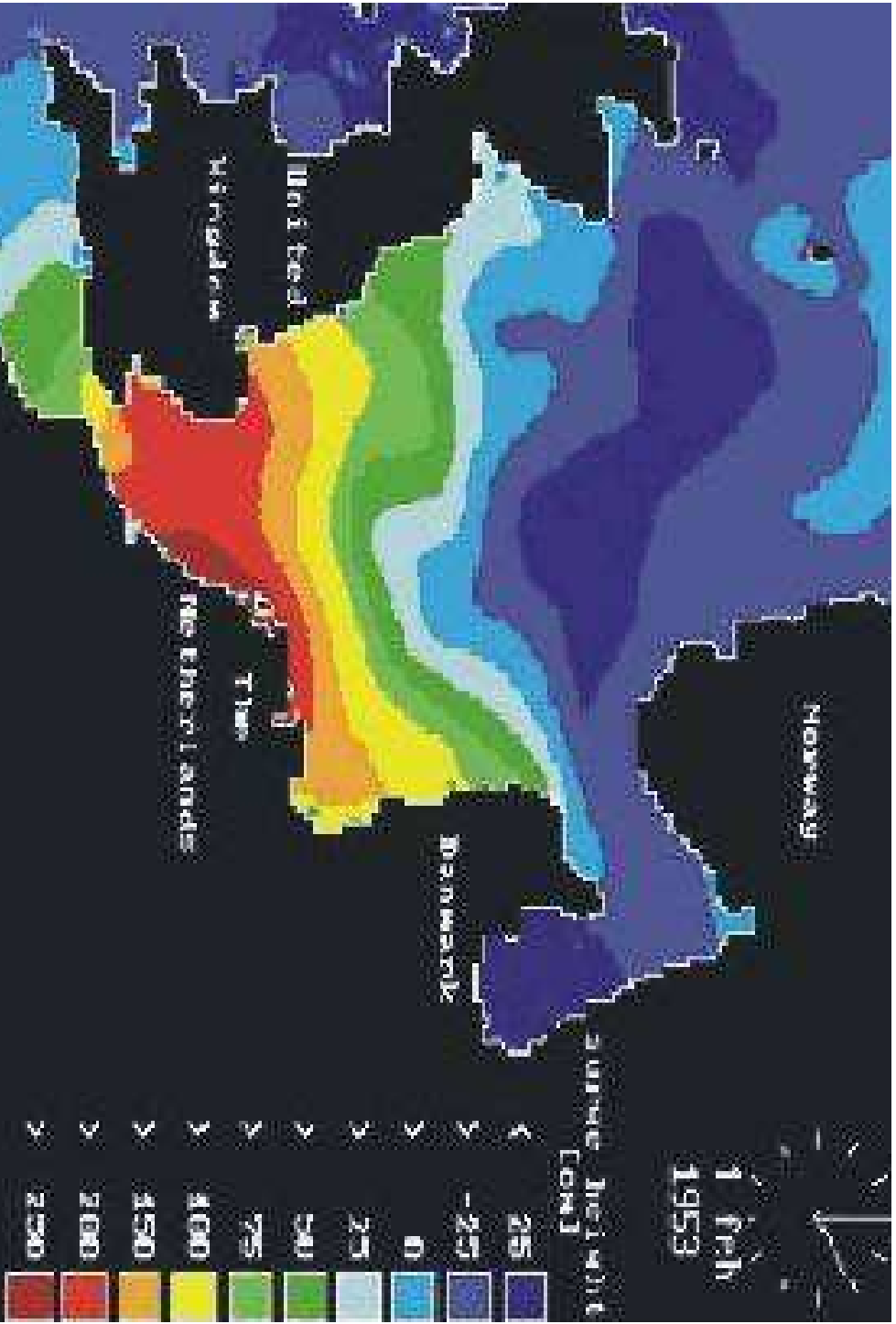
TIPOS

So, it is possible to distinguish between:

- pluvial floods: caused by rain water (flash floods mainly here)
- fluvial floods: caused by an increase in the concentration of runoff in a river channel
- groundwater floods: emergence from soil-saturated underground waters
- coastal floods: elevation of base drainage level
- joint floods: concomitance of two or more types of floods



TIPOS



CLIMA Y TERRITORIO:

CAMBIOS DEL CLIMA (CAMBIO CLIMATICO? VS. ESTACIONARIEDAD)

FACTORES

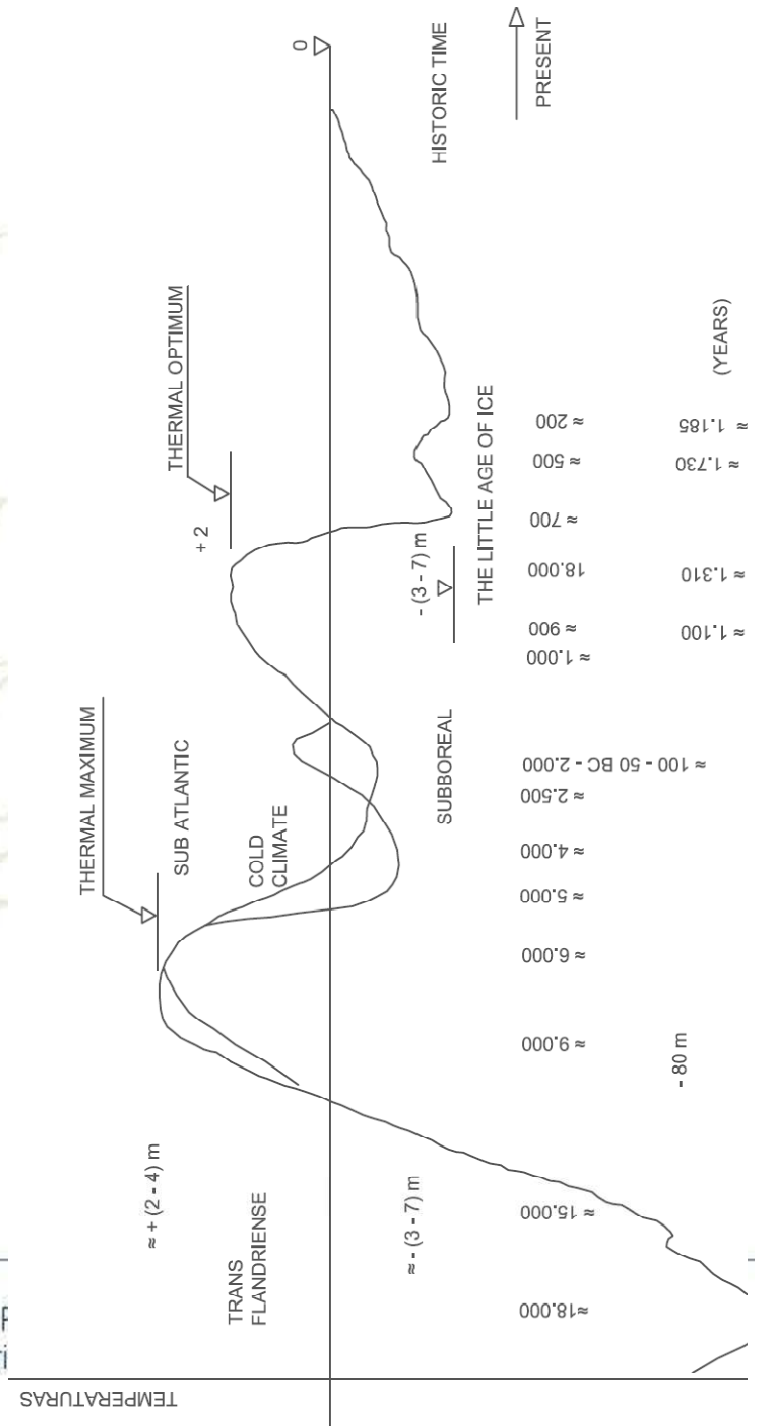


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LOS CAMBIOS DEL CLIMA Y EL CAMBIO CLIMÁTICO

- Milankovitch's theory (1930) tied the relative movement of the Earth's surface with respect to the sun to the four great waves of quaternary glaciations
- such a theory explained with accuracy the four glacial cycles generally referenced
- climate change, then, is triggered by two main changes:
 - in the sun's radiant activity and of its position relative to the planet
 - in the atmospheric greenhouse effect
- climate is the outcome of an Atmospheric-Oceanic Thermal Machine.



FACTOR OCEANICO

(EL GRAN OLVIDADO?)

LA MAQUINA TERMICA



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LA MÁQUINA TÉRMICA OCEÁNICO ATMOSFÉRICA

- atmosphere & oceans form a system of interactive fluids enlivened by solar radiation.
- atmospheric warming leads to inversions and gradients, what results in their motion.
- the movements of the oceans is also conditioned by the thermohaline gradients
- as a consequence a complex double circulation dictates the climate.
- the climate, then, is intrinsically changeable, but not by the nature of its own pattern



LAS VARIACIONES EN EL NIVEL DEL MAR

- the average sea level is determined for a specific place, time and sea state, and varies in the short and long term with changes in the oceans and with crustal movements
- the first question, then, is to distinguish between
 - **S. L. R.** attributable to every coast and ocean on the planet
 - the average specific sea level variation along any given coast
- the second issue is differentiating between the possible causes of general sea level rise due to global change.
- **eustasy** aims to account for the simultaneous vertical shifts of the sea surface all around the Planet
- **tectonics and volcanism:** vertical movement of certain portions of the crust



LAS VARIACIONES EN EL NIVEL DEL MAR

- **isostatic** changes: vertical movements in crust plates due to Archimedean principle
- depending on their immediate causes, isostatic changes can be:
 - glacio-isostatic,
 - hydro-isostatic
 - erosive
 - sedimentary
- **subsidence** comprises (erroneously) at least four other vertical movements:
 - strict isostasy, positive or negative
 - indirect isostasy
 - consolidation of sediments
 - anthropogenic compression



EL FACTOR HUMANO: OCUPACIÓN DEL TERRITORIO



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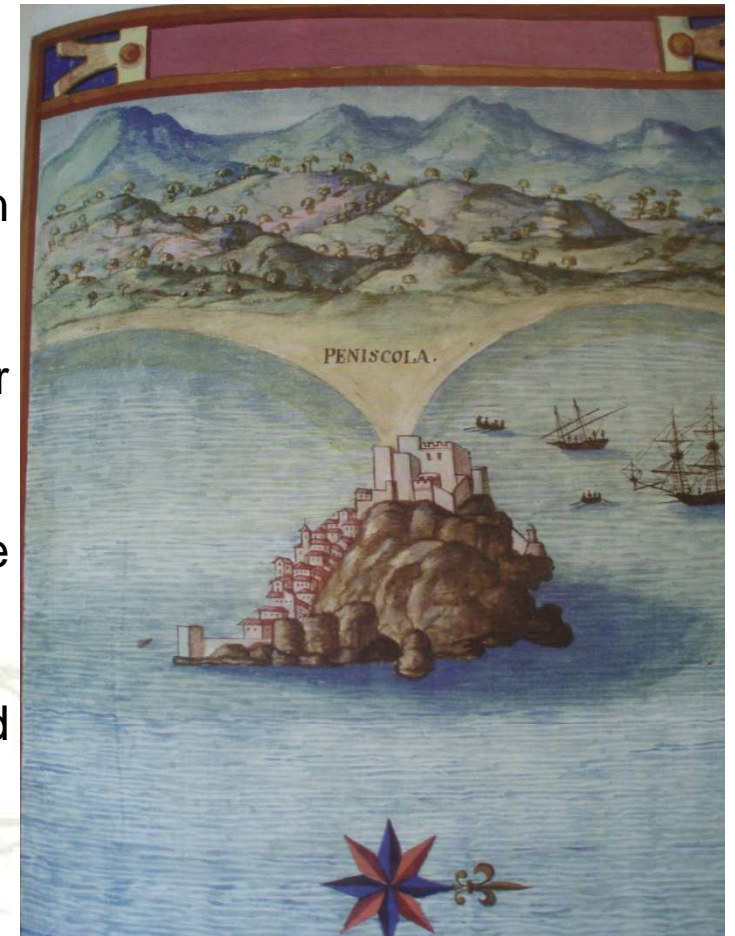
FACTOR HUMANO VS. CLIMA Y TERRITORIO

- as populations expanded, cities were established in other climates above flood levels:
 - New Orleans city's late neighborhoods
 - new Dutch polders in the 16th and 17th centuries (Beemster, Purmer, ...)
 - the delay in settling and colonizing the East coast of the United States
- Rhine delta has required drastic transformations in order to protect its many large cities
- problems do not arise just from S.L.R. and associated climatic effects, but also from:
 - subsidence
 - isostasy
 - anthropogenic land transformations, urbanization and edifications
- coastline is shifted inland or seawards as a result of sea level change and ocean conditions (Bruun Rule (1962))
- anyway, the cities have spread into areas below the probable average sea level if not originally founded there



POBLACIÓN Y DESARROLLO

- populations and urban processes have been driven by climatic conditions both in latitude and altitude
- coasts in temperate climates have allowed for earlier urban development
- structural coasts with elevated orographic feature have favored cities
- sedimentary coasts are prone to agriculture and attracted later a larger population.
- this is easy to see in the Mediterranean:
 - cities on structural coasts: Athens, Haifa, Genoa, Monaco, Barcelona, etc.
 - cities on sedimentary coasts: Rome, Valencia, Alexandria and Venice
- but no city has been able to limit its growth: enormous conurbations in the world today are at huge risk: Southeast Asia, Sub-Saharan and equatorial Africa and the Gulf of Mexico.



EL FACTOR HUMANO: RIESGO Y VULNERABILIDAD



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RIESGO Y VULNERABILIDAD

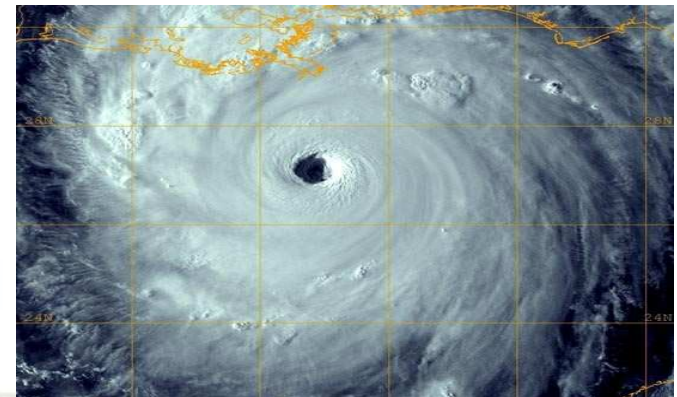
- terms complexity: lack of clear definitions
- **hazard**
 - *“potential source of harm”* (ISO/EC, 1999)
 - *“A physical event, phenomenon or human activity with the potential to result in harm. A hazard does not necessarily lead to harm”.* (FLOODsite risk glossary)
- **Vulnerability**
 - *“the degree of loss resulting from the occurrence of a phenomenon”* (ITC¹, 2004)
 - *“Characteristic of a system that describes its potential to be harmed. This can be considered as a combination of susceptibility and value”* (FLOODsite risk glossary)
- **Risk**
 - *“combination of the probability of occurrence of harm and the severity of that harm”* (ISO/EC, 1999)
 - *“Probability multiplied by consequence”* (FLOODsite risk glossary)
 - *“risk = hazard * exposure * consequence = probability * exposure * consequence* (Klijn, 2004)



URBAN FLOODS

Urban floods: Hurricanes Ike (2009) & Katrina (2004)

- under Katrina, the eye of the hurricane virtually passed right over the middle of the city, making the storm surge greatest facing the coast and at the very mouth of the river.
- days before, wave run-up was particularly relevant, hitting the city's coastline
- greater wave set-up & run-up were experienced here, making the water level higher
- the sea level rise at the mouth provoked a backwater effect reaching tributaries rivers
- heavy rains made it more difficult for the tributaries to drain into the great river
- The flooding in its basin was due, then, to both this drainage difficulty and to the actual rain and runoff



DAÑOS, RECUPERACIÓN, ADAPTACIÓN, PROTECCIÓN, RESILIENCIA O ACOMODO

- changes in current flood management:
 - from traditional “*Flood defence*”
 - to “*Living with floods*” (Integrated Flood Management)
- Need for resiliency: Resilient systems have the ability to:
 - absorb changes in driver and state variables
 - self-organise, learn and adapt
- The 4 As of Resilience:
 - awareness: to enhance the awareness and engagement in flood risk
 - avoidance: to limit flood damage and ease recovery by planning and adaptation
 - alleviation: to reduce flood risk
 - assistance: to provide support to recovery processes and building capacity





THANKS

TILL NEXT TIME



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