



La pollution oubliée : la pollution thermique

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Pollution

« La pollution est une **modification défavorable du milieu naturel** qui apparaît en totalité ou en partie comme un sous-produit de **l'action humaine**, au travers des effets directs ou indirects altérant les critères de répartition des flux de l'énergie, des niveaux de radiation, de la constitution physicochimique du milieu naturel et de l'abondance des espèces vivantes.»

Défavorable pour qui ?




« constitue une pollution **toute modification** du flux de l'énergie, de l'intensité des rayonnements, de la concentration des constituants chimiques naturels ou encore l'introduction dans la biosphère de substances chimiques **artificielles produites par l'homme** »

Dictionnaire encyclopédique des pollutions (Ramade, 1992)



Substances chimiques naturelles
Etat de référence

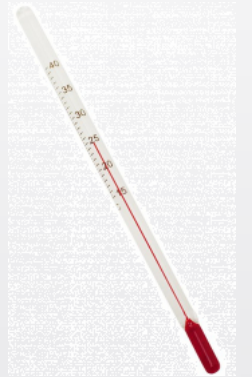




Selon Bang (1980), la pollution est essentiellement un jugement de valeur sur ce que chacun souhaite trouver dans l'environnement ; ce jugement étant ou non étayé par des données scientifiques et implique toujours un choix.

Température versus chaleur


- La température est la mesure macroscopique de l'agitation moléculaire. Elle se mesure en °C ou en kelvin.
- La chaleur est l'énergie échangée lors d'un transfert thermique vers ou depuis un système thermodynamique. Elle se mesure en joule.
- La chaleur n'est en général pas directement mesurable et on l'approxime par des mesures de changement de température.



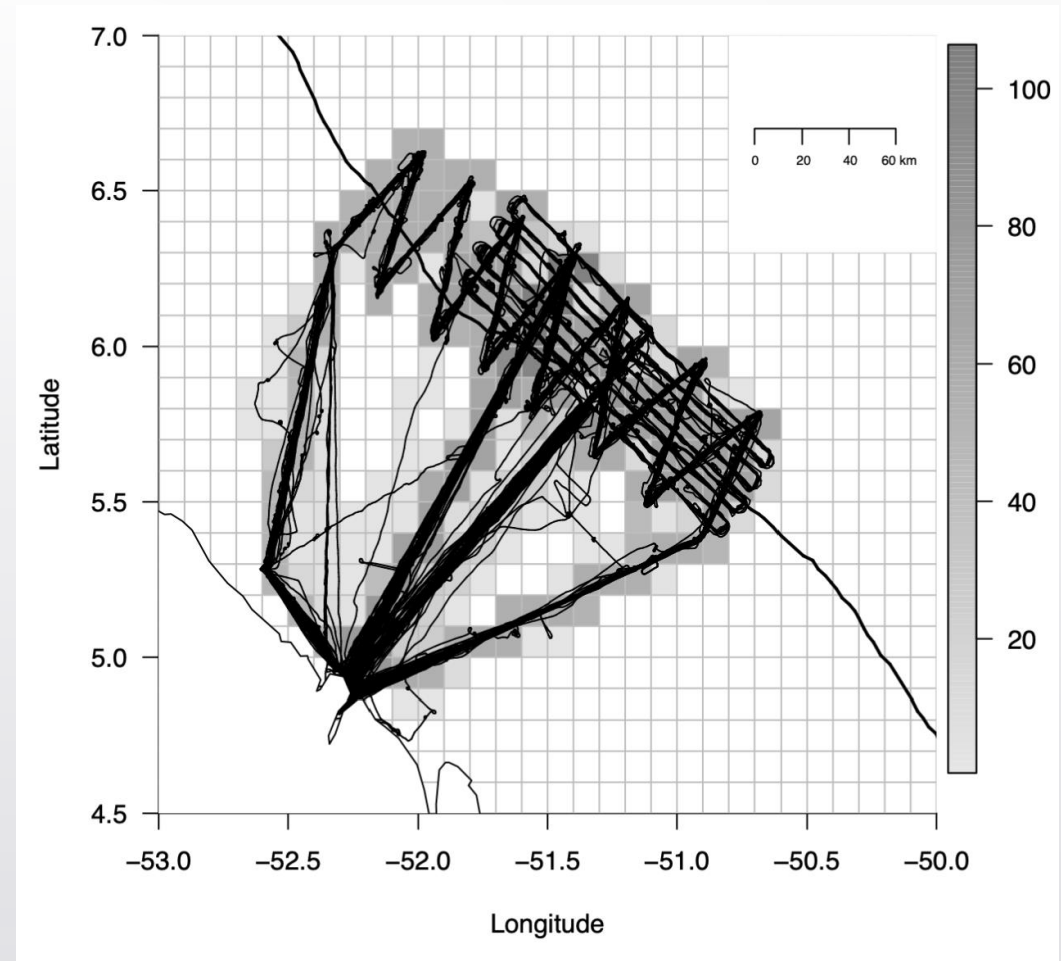
Macro- and micro-plastic at sea



- Worldwide problem
- Plastics are concentrated at sea in different vortex but are also found in all coasts



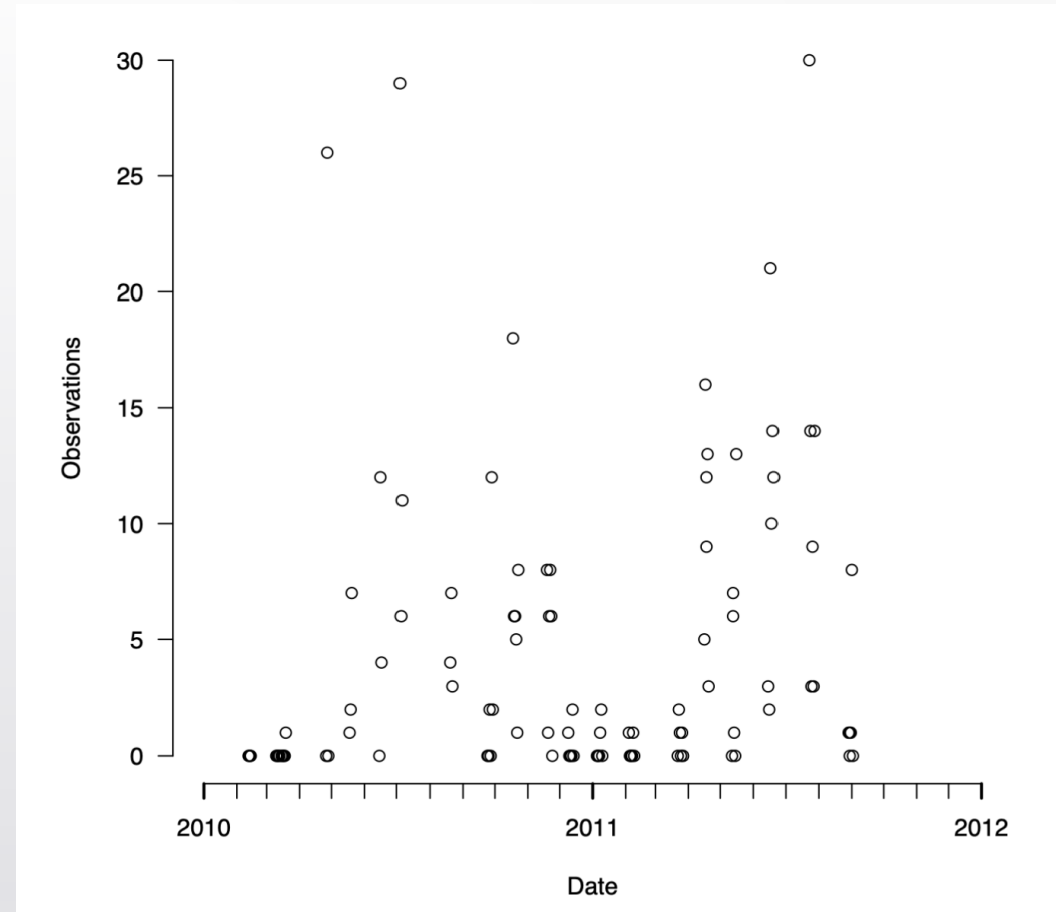
Survols du littoral guyanais



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Survols du littoral guyanais

Plastique en mer

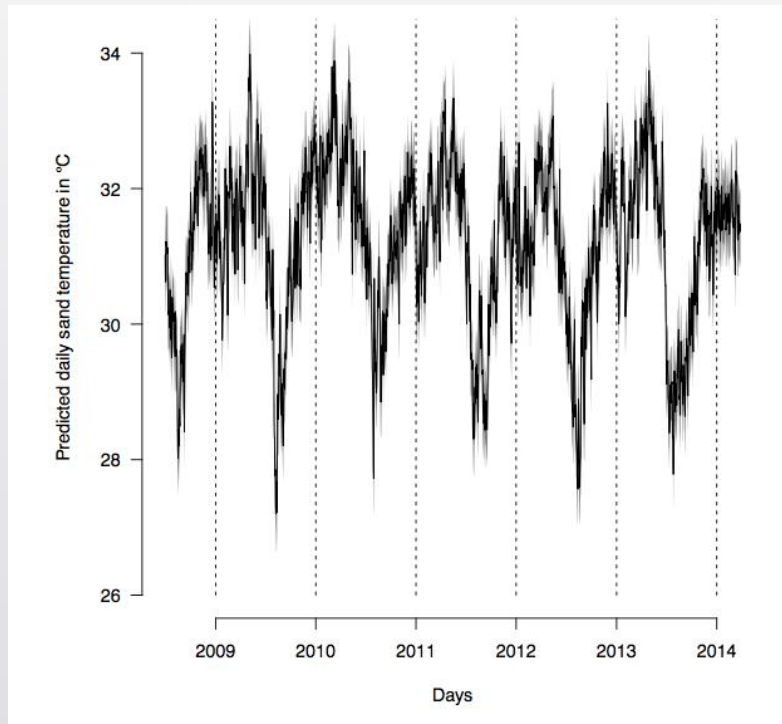


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Nigeria: Nettoyage des plages – 2016



Sand temperature in Nigerian beach



Sand temperature at -70 cm

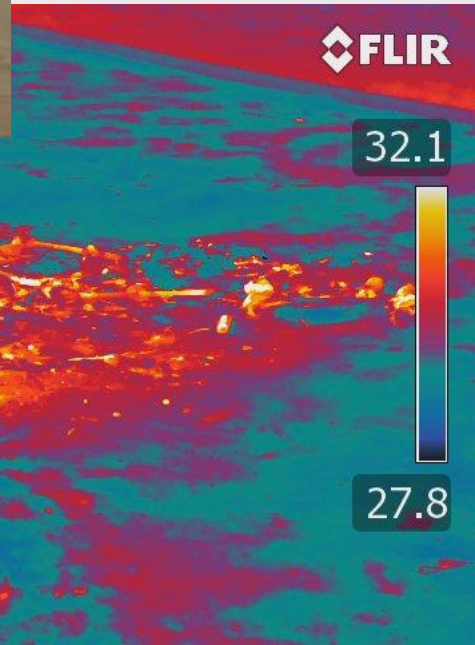
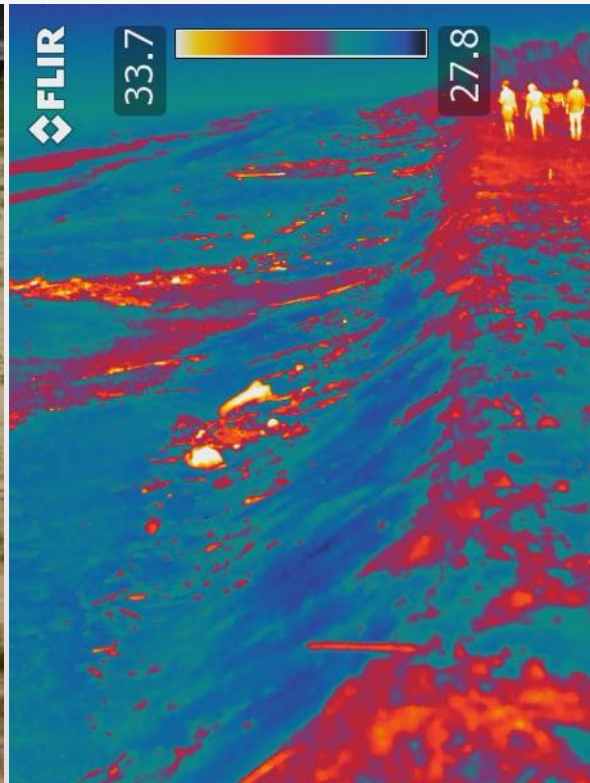
- High temperatures can impair normal development of marine turtles and feminize embryos as a consequence of temperature-dependent sex determination.

Plastic in sand changes the physical properties of sand: thermal pollution?

- Thermal properties of sand (thermal conductivity, thermal diffusivity) are determined by the physical properties of substrate
- When plastics are mixed to sand, what is the change of thermal properties of sand and then the temperature?

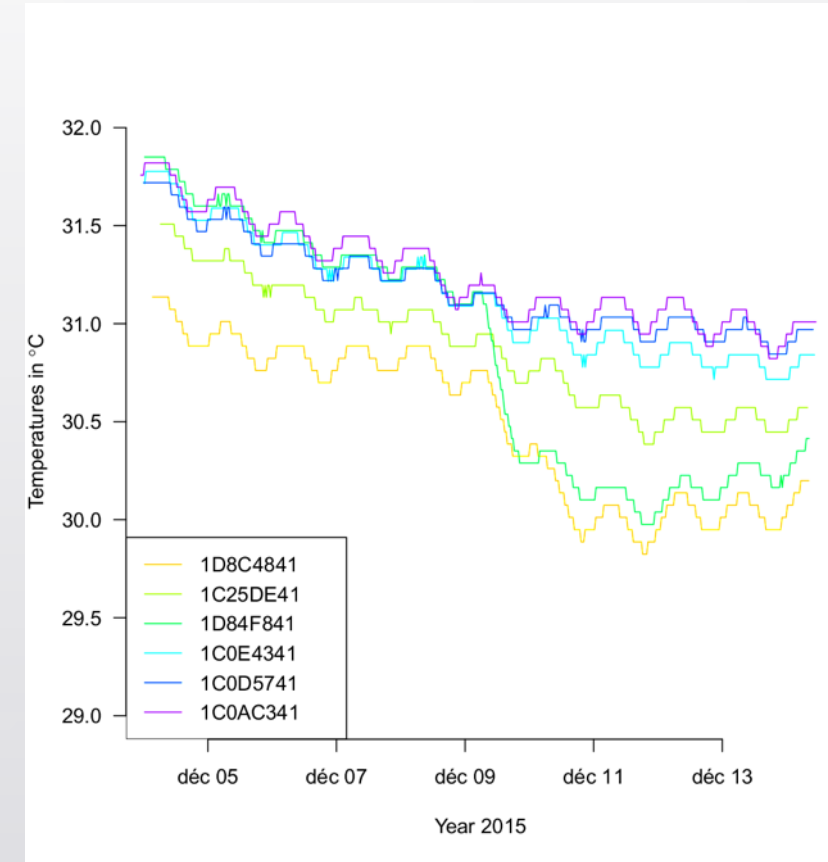
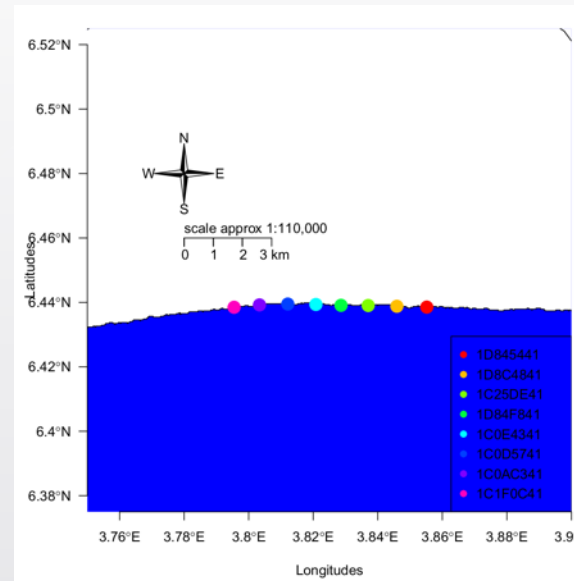


Survey using infrared camera



Heterogeneity of temperatures in absence of plastic

- Temperature data loggers were deployed along the Eleko beach in Lagos Nigeria between at 50 cm depth and 3 m from vegetation at varying distances to determine the heterogeneity of the sand temperatures.
- Sand temperature heterogeneity can be at large as 1.5°C but the closer the dataloggers are, the most similar are the temperatures.

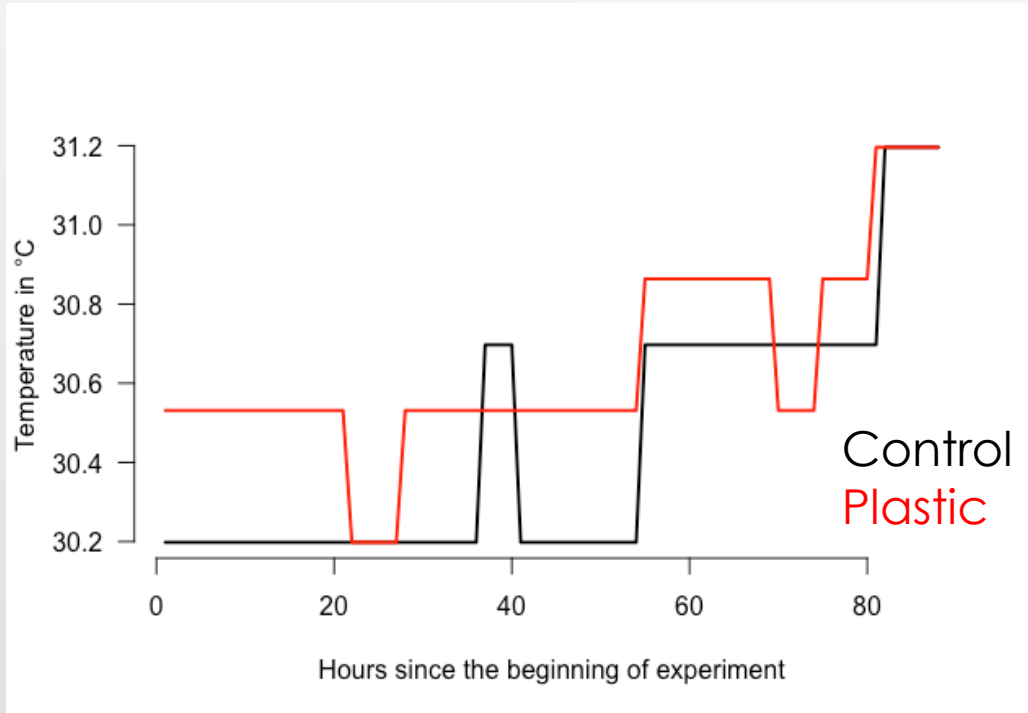


Experiment to analyze if plastics in sand can have an impact for marine turtles

- 2 replicates of temperature recorded at 50 cm depth in sand without plastics (C1 & C2) or with plastic (P1 or P2) at the top for a 5 day period (experiment 1) or 3 days (experiment 2). Each control and experiment dataloggers were localized at 1 m distant apart.
- Temperatures were recorded each hour.



Results of experiments



- In the 4 experiments, the temperature recorded by datalogger with plastic was always warmer than the temperatures recorded by datalogger without:
- $\Delta T = +0.036^{\circ}\text{C}$ (SE 0.014 $^{\circ}\text{C}$)
- $\Delta T = +0.353^{\circ}\text{C}$ (SE 0.021 $^{\circ}\text{C}$)
- $\Delta T = +0.186^{\circ}\text{C}$ (SE 0.028 $^{\circ}\text{C}$)
- $\Delta T = +0.418^{\circ}\text{C}$ (SE 0.026 $^{\circ}\text{C}$)



Conclusions

- Global warming is a widely recognized threat for marine turtles because it can feminize populations but also induce embryo mortality.



Climate change overruns resilience conferred by temperature-dependent sex determination in sea turtles and threatens their survival

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- By the effect of global warming on thermal properties of the beach, can be enhanced by plastic pollution.
- Solution is both local, by enhancing beach cleaning and global by a better waste management.