

Study of Atmospheric Carbon Dioxide in Mauritius and its effect on the Coastal Sea Water Acidification

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EuroAfrica-ICT Forum – 14, 15 Nov 2011



Team members

Phase 1 (One Year)

- Dr Babajee D K R (Principal Investigator),
- Assoc Prof (Dr) Mohamudally N, Manager of Consultancy & Technology Transfer Centre, University of Technology, Mauritius.
- Research Assistant (Programmer and Statistician).

Team members

Phase 2 (Two years)

- Dr Babajee D K R (Principal Investigator),
- Assoc Prof (Dr) Mohamudally N, Manager of Consultancy & Technology Transfer Centre, University of Technology, Mauritius.
- Dr Boodhoo K, Department Of Chemistry, Faculty Of Science, University Of Mauritius,
- Research Assistant (Carbon Chemistry Of Seawater)

Project Summary

- The accumulation of carbon dioxide CO_2 in our atmosphere causes a reduction in the re-radiation of energy from the Sun back into outer space and this consequently leads to global warming.
- A second aspect of carbon dioxide that is not yet a major issue in climatic changes is the accumulation of carbon from CO_2 in our oceans that leads to ocean acidification ([1,2,6]).

Project Summary

- Ocean acidification is the name given to the ongoing increase of hydrogen ion, H^+ which results in a decrease the pH of the Earth's oceans, caused by their uptake of atmospheric carbon dioxide from the atmosphere [3].
- Increased CO_2 in the atmosphere has led to decreasing alkalinity of seawater and there is concern that this may adversely affect organisms living in the water.

Project Summary: Phase 1

- We are interested to do a carbon footprint over coastal region of the island.
- We propose to develop a mobile data collection system with GPS [7] that will help to take measurements quickly and in 3 dimensions.
- We also propose to model the map of Mauritius in xy plane for the location.

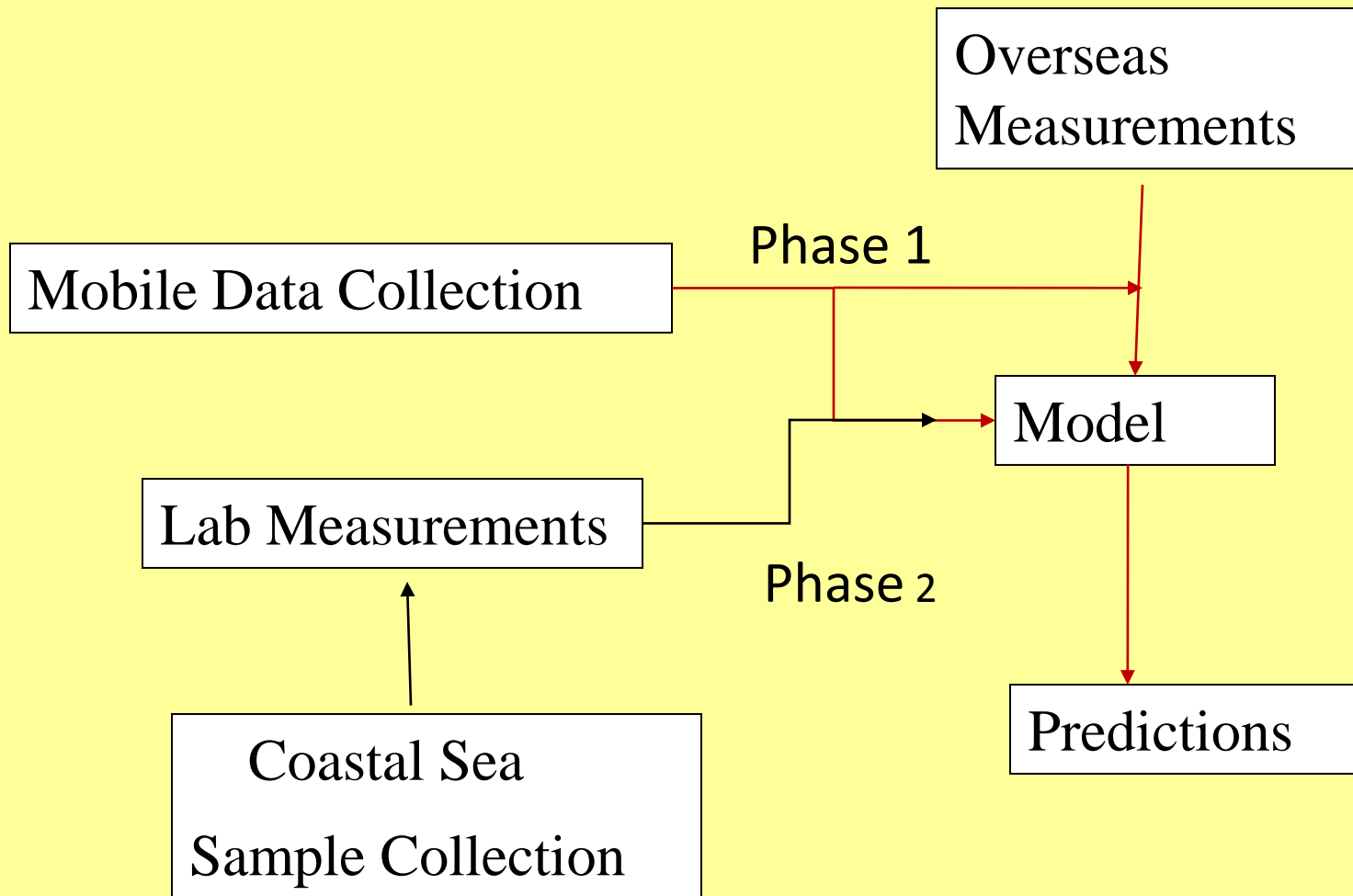
Project Summary: Phase 1

- In this way, we obtain data of concentration of CO₂ in ppm depending on the location.
- We can feed the data in the computer using smart phones and a model is developed to analyze the concentration of CO₂ throughout Mauritius. Using the data, we can calculate the pH of seawater using the usual carbon chemistry of the seawater and predict the pH of our seawater for the following decades.

Project Summary: Phase 2

- We wish to study the solution chemistry of carbon dioxide in our seawater in details.
- Taking measures of the concentrations of chemical substances that affect the carbon chemistry, we need to test the carbon system in laboratory [6].
- Taking data of the concentration of CO_2 in the atmosphere obtained in Phase 1, we can calculate the pH of the coastal sea water using the carbonate chemistry of the seawater obtained in Phase 2, rf to figure 1. Then, using the global CO_2 model in [2], we can predict the pH of the our coastal seawater until 2100.

Flowchart of Project



Project Justification

- Mauritius is an island in the Indian Ocean. It is obvious that it will be affected by seawater acidification.
- Furthermore, Mauritius is surrounded by coral reefs which are responsible for our blue lagoons and white sandy beaches which are tourist attractions.
- It is of paramount importance that we know the effect of atmospheric carbon dioxide on the pH of the seawater.
- In this way, we can predict the effect of seawater acidification on our coral reefs.

Project Activities:

Phase 1 (one year)

- We propose to measure the concentration of CO₂ in different coastal places using a transect [9] in Mauritius using Vaisala CARBOCAP[®] Carbon Dioxide Module GMM111.
- We need a research assistant to write a program to enable data capture between the CARBOCAP and the smart phone.

Project Cost Components :

Phase 1 (one year)

- Payments of personnel per month: Rs 15000 for PI, Rs 12000 for team member and Rs 15,000 for research assistant.

Total: Rs 504,000 (one year) ~ \$ 18,000

Project Cost Components :

Phase 1 (one year)

Items	Total Costs
CO ₂ meter support	10,000
2 Solar Protection Device	5,000
Portable Meteorological Station (temperature)	40,000
Portable anemometer	45,000
2 Smart phones(GPS enabled)	Rs 50,000
2 Vaisala CARBOCAP	Rs 30,000
Data collection and Miscellaneous	Rs 66, 000
Transport	Rs 60, 000
Total	306,000 (\$10, 000)

Project Activities:

Phase 2 (Two years)

- We need to take data collection of sample of sea water through the Island.
- We need a boat for the trips.
- We also need a chemist to take measures of variables in the carbon chemistry of the Indian Seawater.
- We need to study the carbon components in seawater in the chemical laboratory.

Project Cost Components:

Phase 2 (Two years)

- Payments of personnel per month: Rs 15000 for PI, Rs 24000 for two team members and Rs 12000 for research assistant. Total: Rs 1,224,000 (two years)

Cost of equipments

- Titration Cell, Electrode cell, Gravimetric calibration of apparatus, coulometer, Tubing, Cathodes, anodes, borosilicate glass container Schott Duran, Gas chromatograph with temperature controlled oven (Rs 4,000,000).
- Boat trips, sample flasks, Miscellaneous Rs 776,000
- Grand Total (~ \$ 275,000)

Funding for Phase 1 & 2

- Phase 1 : \$ 28, 000 (\$ 10,000 from university + \$ 18,000 from local funding agency)
- Phase 2: \$ 275, 000 Funding required

Validation and Dissemination of results

- An awareness campaign on the effect of seawater acidification based on the five cases can be carried out to sensitize people on how their future actions can be crucial in reducing their CO₂ emissions.

Prior research undertaken by PI

- The Principal Investigator has studied the global CO₂ model [2] and applied it to compare the values of pH obtained from the model with the observed ones in his PhD thesis [1].
- He has used the values of CO₂ measured by the National Oceanic and Atmospheric Administration (NOAA) at the Mauna Loa Observatory, Hawaii from 1959 to 2009 [8].
- He also gave predicted values of the pH in 2100 for five cases.

References

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- [3] Caldeira, K. & Wickett, M. E. (2003). Seawaterography: Atmospheric carbon and ocean *pH*. *Nature* 425, 365.
- [4] DOE (1994). Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water. *in* A. G. Dickson & C. Goyet, eds, 'ORNL/CDIAC-74'.
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- [6] Griffiths, G. W., McHugh, A. J. & Schiesser, W. E. (2008). An introductory global CO₂ model. *Chem. Biochem. Eng. Q.* 22, 265.
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- [8] Tans, P. (2009-12-11). Trends in carbon dioxide. *National Oceanic and Atmospheric Administration Earth System Research Laboratory*,
"http://www.esrl.noaa.gov/gmd/ccgg/trends/".
- [9] Measurements of atmospheric CO₂ concentrations along a transect,
http://www.carboeurope.org/education/CS_Materials/TransectCatalunya.pdf.

Thank you