CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
S0604

Project Title
A Study of Marine Surface Currents Using IR Thermography

Abstract

Objectives/Goals
To measure the magnitude of marine surface currents using infrared themography.

Methods/Materials
I utilized my connected pool and spa, and rented two infrared cameras. The first camera was a PD 300 Radiometric Super-Cooled Thermal Infrared that provided the ability to measure the temperature from the IR Image stored in the digital image. The second was a PalmIR Pro 400 DX Infrared Camera that provided the ability to record video documentation of the thermal plume. To run the experiment I first blocked the connection between my pool and spa using bricks; I then heated the spa and removed a brick to create a connection. I observed and recorded the event with both infrared cameras. With the PalmIR Pro 400 DX I recorded the data to video tape. With the PD 300 Radiometric camera I took digital radiometric photographs every 5 seconds.

Conclusions/Discussion
When two still bodies of water at different temperatures are connected, a current is spontaneously generated. Mechanical and digital conventional thermometers were insufficient in accuracy and method to measure the phenomenon. By examining the currents using IR Video and Thermography I discovered- Thermal surface currents appear to pulse. By examining the changes in surface temperatures as recorded by the radiometric camera at intervals corresponding to the video pulse phenomenon, I was able to zero in on and document the event When the gradient reaches approximately 1.5°C, the density difference provides enough gradient to induce a new surge in flow. This appears as a pulse of hot water. Infrared is reflected just as visible light is. There is no lag in the commencement of the thermal current flow upon removing the barrier. This contrasts with earlier observations using the dye technique where the current needed to get to a more substantial flow to carry the dye out. A temperature gradient of 1.5° C or above significantly speeds thermal current flow. Much larger gradients appeared to be required using the drop dye technique used in previous experiments by the author. Good design is necessary but measurement is everything. The use of the thermal video camera permitted visualizing a pulse phenomenon in the evolution of the thermal surface current and the radiometric camera permitted direct temperature measurement to .1 degree C. Well worth my ($200) personal investment in renting the thermal imaging equipment for my science fair project.

Summary Statement
The measurement of marine surface currents using IR thermographic cameras.

Help Received
Mother edited report. Brother helped with cameras.