NOAA-CREST Weather Camp, 2009
Introduction

The NOAA-CREST weather camp ran from July 20-31. Nine high school students attended, and 2 undergraduates assisted the Camp Director and the Outdoor Facilitator. The first week was a day camp held on the campus of the City College of New York. Basic concepts of meteorology were explored in a hands-on classroom environment, and various experts addressed the camp. During the second week the camp moved to Long Island to be near the local office of the National Weather Service. Nights were spent at Wildwood State park, camping in tents for full awareness of the environment, cooking and socializing around the campfire. Each morning was spent at the NWS office learning about aspects of their work from various speakers, while the afternoons were spent in field studies. As will be seen from the pictures that follow, Weather Camp was both a learning and a bonding experience!

Participants 2009

Camp Director: Brian Vant-Hull
Outdoor Facilitator: Mike Balk

National Weather Service Collaborators: Jeff Tongue, Nancy Furbush

Guest Presenters: Mark Arend, Bill Rossow; NOAA-CREST
Bob Rabin, National Severe Storm Laboratory
Leonard Druyan, NASA GISS/Columbia University
Regina Cabrera, National Weather Service
Eric Blake, National Hurricane Center (video conference)

Undergraduate Camp Counselors: Janelle Lawrence, Alma Reynosa

Campers
Wellesley
Noelle
Jennifer
Damani
Lawrence
Jeremy
Jaynelle
Alexandra
Koren

Campers were recruited from New York City high schools. All costs were covered by NOAA-CREST
The First Week

Monday was a day for basic concepts. After figuring out a jumbled treasure map to find hidden candy and learn about vectors at the same time, the crew was introduced to Newton’s laws of motion. Now that everyone knew how forces and velocities behaved, it was time to learn about the forces that cause our weather.

First was pressure, and special Vernier hand-held LabQuest analyzers were brought out to learn about the relationship between the molecular model of pressure, density, and volume. But the pressure in the air must hold up the air itself, so we had to learn how stacking cold air next to warm air leads to interesting consequences….

But to understand air motion on a small scale you have to know about buoyancy. With Newton’s laws and the molecular model, it doesn’t take long to figure out why heating fluids cause them to float.

The last ‘force’ to understand was the Coriolis effect, most easily understood by actually doing it: spin around and try to make a basket!

Hmm….I wonder what makes it so difficult?
So with pressure, buoyancy and the Coriolis effect, we could put things together to explain how wind moves around a low pressure system, and why ‘Low’ means bad weather!

And so that was the end of the first day....
Tuesday morning found us bouncing superballs off walls to understand adiabatic warming and cooling. Pumping air into a bottle and seeing the temperature rise then drop as air was released related theory to reality. This led to a discussion of what happened to air as it rose in the atmosphere, then the effects on buoyancy and stability. The *atmospheric lapse rate* has a lot to do with whether warm air can keep rising!

This was demonstrated by visiting Mark Arend’s convection chamber:

It stopped convecting when the water on top got warm, might this have something to do with lapse rate??

But as air cools something will happen to the water vapor mixed with it. We all became water molecules, and played the evaporation/condensation game: colliding with each other and flipping pennies to see if we would evaporate or not. From this we could understand heat, temperature, and phase changes. And from phase changes we get the idea of saturation temperature, dew point, and relative humidity.

Time to grab our labquests, measure humidity and dew point inside, then run out to the balcony where it was raining and measure it again. Any differences?

Put together ideas of adiabatic cooling and saturation, and you can make your own cloud in a bottle!
With the ideas of convection, stability, saturation and phase changes in mind, we were all set to calculate if clouds would form, and if so how high. Our first forecasts from weather camp… but we had to wait for next week to see if they would work.

It was time to tie everything together, clouds, coriolis, pressure… finally we can talk about how fronts form and the effects on weather:

With all these ideas floating in our heads, we were prepared to talk to an expert, and put questions to someone who could answer them best. So Dr. Bill Rossow, head of the International Satellite Cloud Climatology project came in, talked about his work, and provoked questions about how clouds affected the climate, and how climate change affected clouds.

But just because he raised the questions didn’t mean he would answer them!
Wednesday was a day for discussing global circulation and the global climate. Starting with air rising from the equator, it rises, and turns, and doesn’t make to the poles! The atmosphere breaks up into cells, just like on Jupiter! This global pattern explains trade winds and deserts.

Now surface effects can be imposed on this flow, and we get the Bermuda high, and seabreezes, and nor’easters.

That afternoon we discussed the global heat balance, and the greenhouse effect, and climatic feedbacks.

Our climate specialist wasn’t available until the next day, but we hadn’t had a chance to take about severe weather, and Bob Rabin from the National Severe Storm Laboratory was in town. We learned all about thunderstorms, tornados, and how they are tracked.
On Thursday we wanted to learn about remote sensing. One way to start is by making a ‘cloud’ out of milk drops in water, and using the labQuest light detectors to see how the reflected and transmitted light changed as more milk was added to make the clouds thicker. This idea of optical depth could be related to aerosol and water vapor measurements.

The ideas of transmission and scattering can be applied to radar and satellite. An interactive CD produced by our partner institute in Wisconsin, CIMMS, was used to explore and practice the concepts of remote sensing in the IR, visible, and water vapor channels.

With this introduction a visit to the computer lab to play with satellite imagery was in order.

A program that let different channels be substituted in the RGB display demonstrated what kinds of information could be found by looking at different wavelengths, as seen in the images of a lake in Canada, seen first in the visible, then in a combination of red, near infrared, and thermal infrared. The smoke can be distinguished from the clouds!

Thursday ended with a field trip to the Goddard Institute for Space Science (GISS) near Columbia, where Dr. Leonard Druyan talked about Climate Change. This was done in teleconference with one of our sister camps at Howard University.
Friday was such a nice day that after a whole week in a room without windows we had to get outside. So we took our camping chairs and table, and went out in the main quadrangle to talk about numerical weather prediction.

Using pennies to represent the mass of air at each level, we first produced a stable atmosphere and saw the exponential decay of density with altitude.

Then we transferred this stable atmosphere to a two-dimensional grid, and perturbed it to see what would happen. Time to remember Newton’s laws....

A change in density would cause a change in pressure exerted on the air in adjacent grids. This would result in changes in velocity and mass transport. Then we recalculate the pressures and start over. Boundary problems drove us a little crazy, but the idea was there. It took an hour to make one time step, so now we know why computers are so important for weather prediction!

Next week we were moving to Long Island, so we discussed what we would need for camping, then broke up to go get ready for the big adventure.
The Second Week

We piled into the vans on Sunday afternoon, and headed east to Wildwood State Park.

Once there we set up camp, collected firewood…

…but then had to go explore, especially the walk to the beach!

Even fully dressed, the girls just couldn’t resist getting in the water.
After the salt water, everyone wanted to take a shower. So cooking dinner didn’t start until dark, but everyone pitched in…

… followed by campfire time with marshmallows.

Monday morning we were up bright and early, because we were visiting the National Weather Service!
We met our NWS collaborators, Jeff and Nancy, who first gave us a tour of the operations room, then took us outside to make some observations.

After discussing the observations and comparing to those at the airport, it was time to go for a picnic lunch right on the Brookhaven campus.
After lunch we measured cloud sizes and motions, then took a tour of the radar dome, which had to be turned off just so we could visit. It’s a long ways up!

The day was far from over, we needed to go to the beach to measure how the wind affected the waves…

…but since the wind was blowing onshore anyway, we’d just have to visit again to observe the sea-breeze in effect!
We couldn’t spend as much time at the beach as we’d like because we had to get back for a weather balloon launch. The lifeguards left at 5 pm anyway.

And up it went…..

After that it was time to go back and enjoy the campfire.
Tuesday we did more weather observations, and discussed hurricanes. Having a little time on our hands we demonstrated how solar heating can produce buoyancy.

That afternoon we split into groups, with a small group going into the forecaster training center, while the rest traveled around Brookhaven National Labs taking measurements of the urban heat island effect. We got back together for a videoconference with the National Hurricane Center.

We spent Tuesday night in a hotel, where at a banquet Jeff and Nancy gave a presentation on careers in meteorology. That night we watched Nancy’s copy of “a Perfect Storm”.

Wednesday morning we returned to the NWS to discuss severe weather.

That afternoon as a small group went with Jeff into the training center the rest of us made homemade sextants to use for measuring cloud base. We only had stratus clouds that day, but could practice on the radar dome. It was Thursday that we used them on the clouds.

We returned to camp early enough to get our cooking finished in daylight.
There was another discovery: adiabatic cooling affects propane too! Ice on the fuel tanks.

That morning we were discussing thunderstorms, and sure enough, we could see and hear storms across Long Island Sound. That night all the campers tried to sleep in the van, but we barely even got rained on. The weather camp bubble protected us.

Thursday morning at the NWS office we looked into what happens to the weather once it hits the ground. The regional head of hydrology, Regina Cabrera, came to talk about water management. She had a neat hands-on soil transport model to play with.

That afternoon we had cumulus clouds, so took our own handmade sextants to measure cloud base using trigonometry and compare to our calculations based on the dewpoint. Unfortunately the numbers did not agree too well.

It was okay, because we wanted to get to the beach to measure the sea breeze anyway. Jeff warned us about the rip tides, and true to form one prominent member of our crew had to be rescued by the lifeguards.

There were lots of things we wanted to do on our last evening in camp.
Some people wanted to mount expeditions….others just wanted to take a nap.

But eventually, it was time to say goodbye to Long Island. Camp was over.