Title
NIMS Public Health Applications: Algal Blooms

Authors
Robert Gilbert
Victor Chen
Willie Chen
et al.

Publication Date
2005

Center for Embedded Networked Sensing

NIMS Public Health Applications: Algal Blooms

Robert Gilbert, Victor Chen, Willie Chen, Gerald Kim, Yeung Lam, Michael Stealey, Dr. Richard Ambrose, and Dr. William Kaiser
Dr. Richard F. Ambrose's Lab

Introduction: Watershed Health and Water Quality

Anthropogenic Influences

- **Landscape Changes**
  Developments cause physical changes in streams and the surrounding watershed. These alterations result in noticeable changes in stream dynamics. Some alterations include: reduction in tree cover, changes in stream substrate, channelization of runoff, and widening of stream basins.
- **Nutrient and Pollution Loading**
  Streams receive nutrients and chemicals through runoff and subsurface flow. In developed areas, nutrients and other pollutant loads increase. Some pollutants include: nitrate, ammonia, phosphates, and heavy metals.

Ecological Response

- **Algal Blooms**
  Algae responds quickly to fluctuations in stream conditions. Changes in nutrients, light, substrate, etc. can enable increased algal production. ***Algal blooms*** can cause a variety of negative effects: fish/invertebrate kills, foul odors, reduction in ecosystem quality, aesthetic degradation, toxicity, and loss of recreational waters.
- **Other Water Quality Effects**
  Waste waters can also carry harmful bacteria and toxic chemicals, which can be an significant public health risk in recreational waters.

Problem Description: High Resolution Spatial and Temporal Water Sensing

Algal blooms and other negative stream conditions result from dynamic, interrelated factors. Understanding complex biotic and abiotic interactions require multi-scale, high-resolution measurements. Stream conditions can change rapidly. Conventional low-resolution field sampling may miss important system dynamics.

Proposed Solution: NIMS-RD & NIMS-3D high resolution sampling

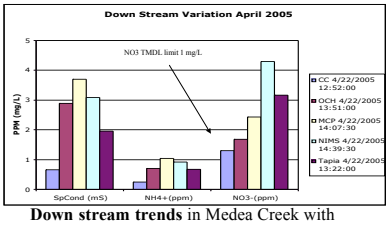
Current Project:
Medea Creek

•Monthly 24-h cross section sampling with MiniSonde 4A accompanied by: Dissolved Oxygen, light readings, oxygen isotope analysis, velocity, algal biomass, algal point samples and MiniSonde point sample (Cond., NO_3, NH_3, pH, Temp) at sites throughout the stream.

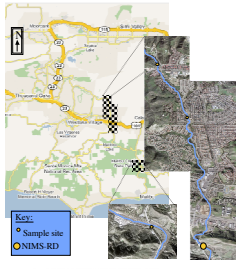
•Conventional grab sampling cannot provide even a fraction of the temporal or spatial resolution provided by the NIMS-RD

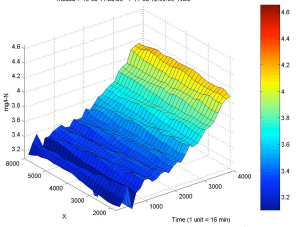
•Point sampling makes assumptions regarding homogeneity of nutrients at a sampling site over a 24-hour periods

NIMS-RD performing **a comb scan of a urban stream** (Medea Creek) in Augora Hills



Down stream trends in Medea Creek with reference site (CC).





Change in nitrate (NO_3) over a 24-hour period for a cross section in Medea Creek. 12pm 7/10/05 to 12pm 7/11/05

Emerging Projects:
Merced River

•Deploy NIMS-RD with MiniSonde 4A to explore the dynamics at the junction between two streams: one with heavy industrial runoff and one without

•Opportunity to apply NIMS-RD technology to a larger river system

NIMS-3D Stream Lab

•Modeling these complex nutrient dynamics in an artificial stream lab is very challenging. However, using automated injections with the NIMS-3D system, it is possible to **create several nutrient (or pollutant) regimes simultaneously**.

•This enables the controlled study of the integrative effect of dynamic exposures to algal taxa by measuring their productivity potential with a colorimetric test.

•Once algal response are quantified, a similar analysis can be used in the field to integrate natural chemical regimes.

•MiniSonde Sensors system includes: temperature, pH, conductivity, nitrate,and ammonia.