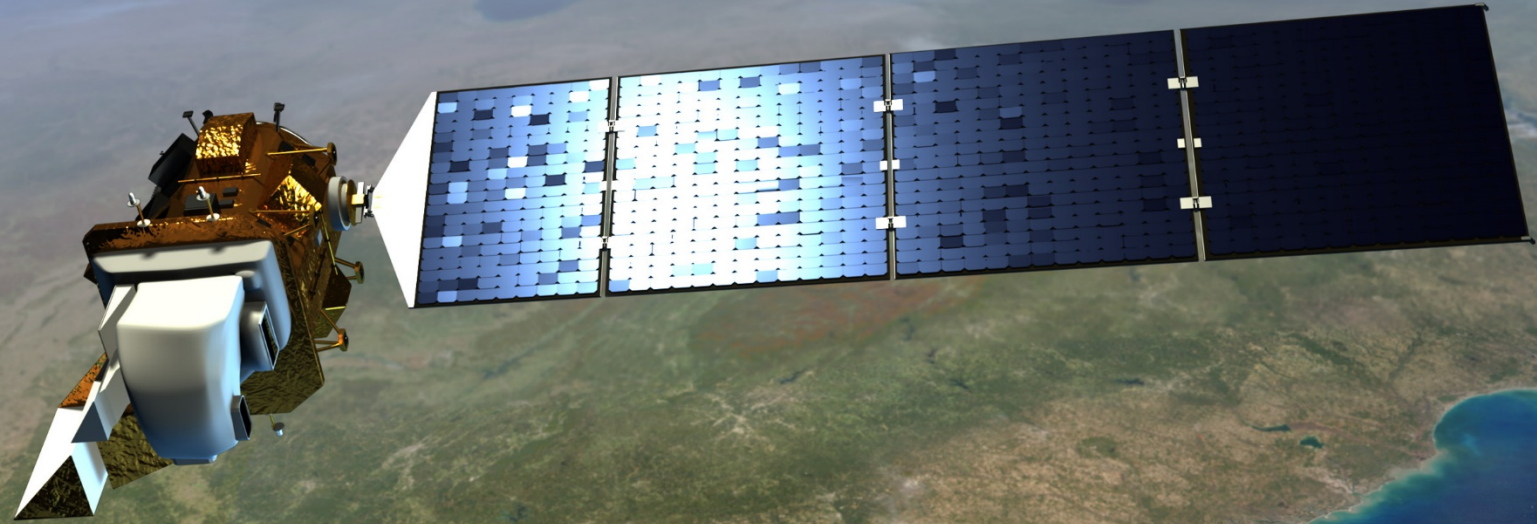# NOAA CREST
2016-2021

Reza Khanbilvardi

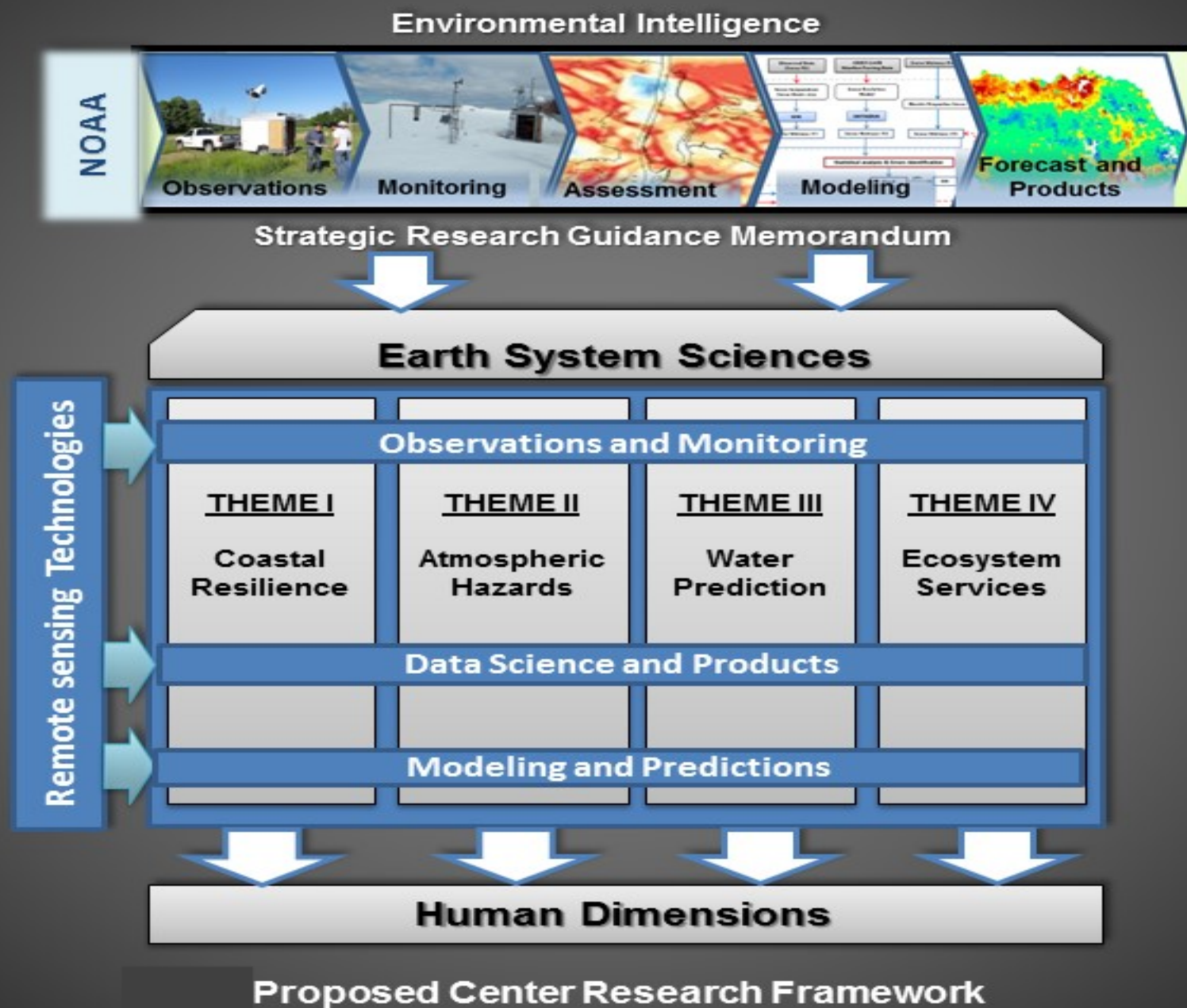NOAA CREST Center, The City College of CUNY, NY

CICS Science Conference
University of Maryland, College Park, MD
November 29-1 December, 2016

NOAA – Cooperative Science Center for Earth Systems Science and REmote Sensing Technologies

Proposed Center Research Framework

Theme I: Coastal Resilience

CREST Faculty: M. Tzortziou (Lead), A. Gilerson, S. Ahmed, J. Cherrier, K. McDonald, R. Armstrong, R.Rodriguez, J. Munoz
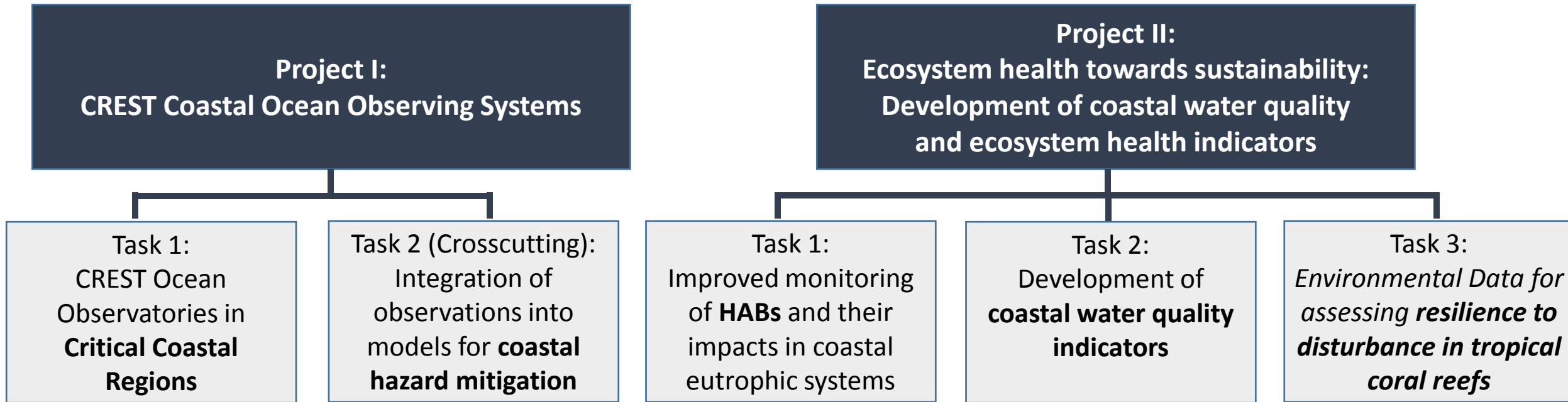
Improving coastal resilience depends critically on coastal intelligence and developing a deeper understanding of coastal processes, dynamics, and vulnerability to anthropogenic and natural stressors.

Theme I addresses this high research priority for NOAA through a combination of **coastal observations**, **advanced modeling**, development of **new remotes sensing tools**, and assessment of **environmental and socioeconomic** efficacy of developed approaches for mitigating these stressors.

Coastal environments are among the most vulnerable yet economically valuable ecosystems on Earth. Comprehensive **integration of social science into research** is a key priority in Theme I.

Theme I: Coastal Resilience

Project I: CREST Coastal Ocean Observing Systems	Project II: Ecosystem health towards sustainability: Development of coastal water quality and ecosystem health indicators

Task 1: CREST Ocean Observatories in **Critical Coastal Regions**	Task 2 (Crosscutting): Integration of observations into models for **coastal hazard mitigation**	Task 1: Improved monitoring of **HABs** and their impacts in coastal eutrophic systems	Task 2: Development of **coastal water quality indicators**	Task 3: *Environmental Data for assessing **resilience to disturbance in tropical coral reefs***

Project I: Understanding the complexity of coastal ecosystems from space and improving our ability to manage our coastal natural resources requires advanced observational infrastructure. CREST will contribute to NOAA's efforts to develop **integrated coastal ocean observing systems and networks** with advanced measurement capabilities in urban temperate and tropical coastal waters

Project II: Supporting NOAA's leading role in coastal ecosystem management towards sustainability, CREST will apply in-situ and satellite observations to develop remote sensing tools for monitoring and assessment of physicochemical and biological indicators relevant to **coastal water-quality and ecosystem health.**

Theme 2: Atmospheric Hazards

CREST Faculty: Fred Moshary (Lead), Pat McCormick, Ruben Delgado, Barry Gross, John Anderson & Rafael Rodriguez Solis

Project 1 : Weather Hazards

Storm & Strom Surge Prediction

Improved P-ETSS storm surge modeling system
GOES-R Storm Now Casting:
Validation of GFDL GCM Lightning Simulations with GOES-R
Convective initiation products in coastal processes

Heat Stress and Urban Modeling

Heat indexes now-cast
Urban thermal storage product
Improved urbanized numerical weather forecasting product with representation for urban land-surface processes

Theme 2: Atmospheric Hazards

Project 2: CREST Observing Systems for Atmospheric Process and Air Quality Applications

The CREST Earth System Observing Network (CESON)

Satellite Research Products

High resolution regional AOD for VIRRS and GOES-R

Climatology of Planetary Boundary Layer (PBL) dynamics
and Smoke and Dust Transport

Validation of OMPS limb profiler

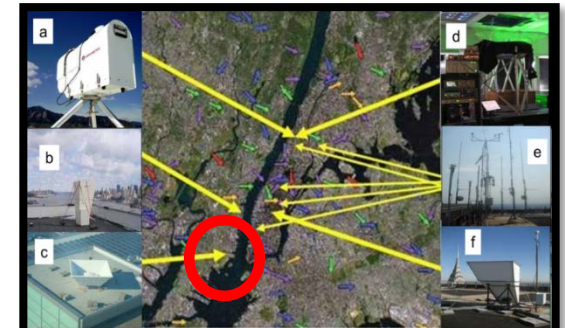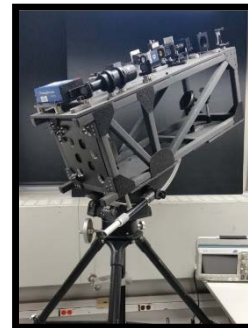Validation of Chemical Transport Models

Observing System Technologies & Field Campaigns

ASOS ceilometer network aerosol products

Lidar technology development

Field campaign data products

Theme III Water Prediction

CREST Faculty: Naresh Devineni (Lead), Reza Khanbilvardi, Tarendra Lakhankar, Nir Krakauer, Balazs Fekete, Shakila Merchant
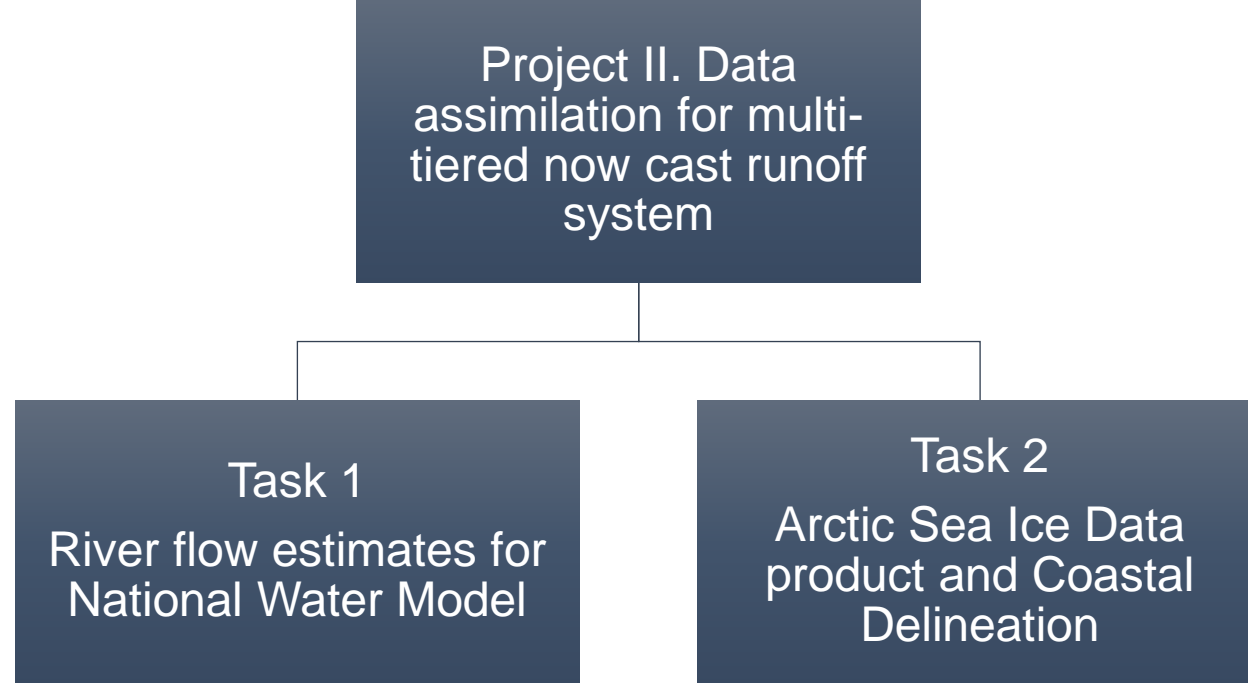
- Developing a unified water prediction system using remote sensing of earth systems.

- This work aligns with the **NOAA's "Water Prediction" research priority**.

- Unified water prediction and modeling methodologies will be created to aid the development of operational products and services.
  - Climate-informed integrated water and ecosystems modeling,
  - Socio-economic impacts and vulnerability assessments.

- The work supports NOAA's mission to provide improved protection of life and property from natural hazards, and for a better understanding of the total environment.
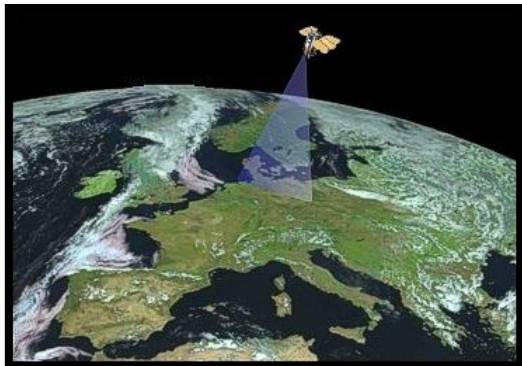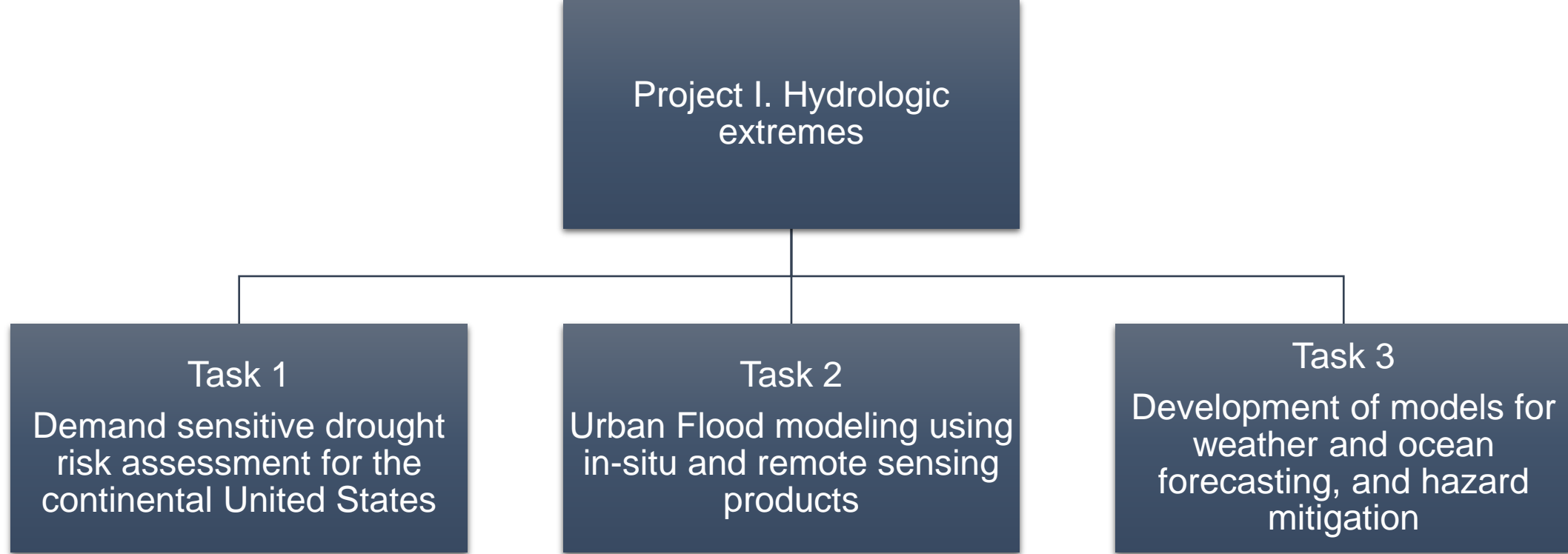
Extremes can have adverse impacts on the natural ecosystem, society and the economy of the region. It is important to explore strategies for adaptation to natural hazards and to manage the potentially impacted sectors.

Project I will address this significant area, exploring the modeling, and prediction of floods and droughts, their climate and atmospheric determinants, and how these may affect interlinked human activities at multiple scales of cities and river basins.

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┌─────────────────────────┐
│   Project II. Data      │
│   assimilation for multi-│
│   tiered now cast runoff │
│   system                 │
└─────────────────────────┘
           │
     ┌─────┴─────┐
     │           │
┌─────────────┐  ┌─────────────┐
│   Task 1    │  │   Task 2    │
│             │  │             │
│ River flow  │  │ Arctic Sea  │
│ estimates   │  │ Ice Data    │
│ for National│  │ product and │
│ Water Model │  │ Coastal     │
│             │  │ Delineation │
└─────────────┘  └─────────────┘
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Project II will implement a hydrological model testbed for implementing new hydrological data assimilation methods that could be integrated into the **National Water Model** developed by NOAA for operational river discharge, flood and drought forecasting.

This work will be carried out in collaboration with the Consortium of Universities to Advance Hydrological Science (**CUAHSI**), which regularly organizes the CUAHSI Summer Institute at the NOAA National Water Center, Tuscaloosa, AL to provide scientific support for the NWM development.

Theme IV: Ecosystem Services

CREST Faculty:
Tarendra Lakhankar, Peter Romanov, Hamidreza Norouzi, Reza Khanbilvardi and Kyle MacDonald (CUNY)
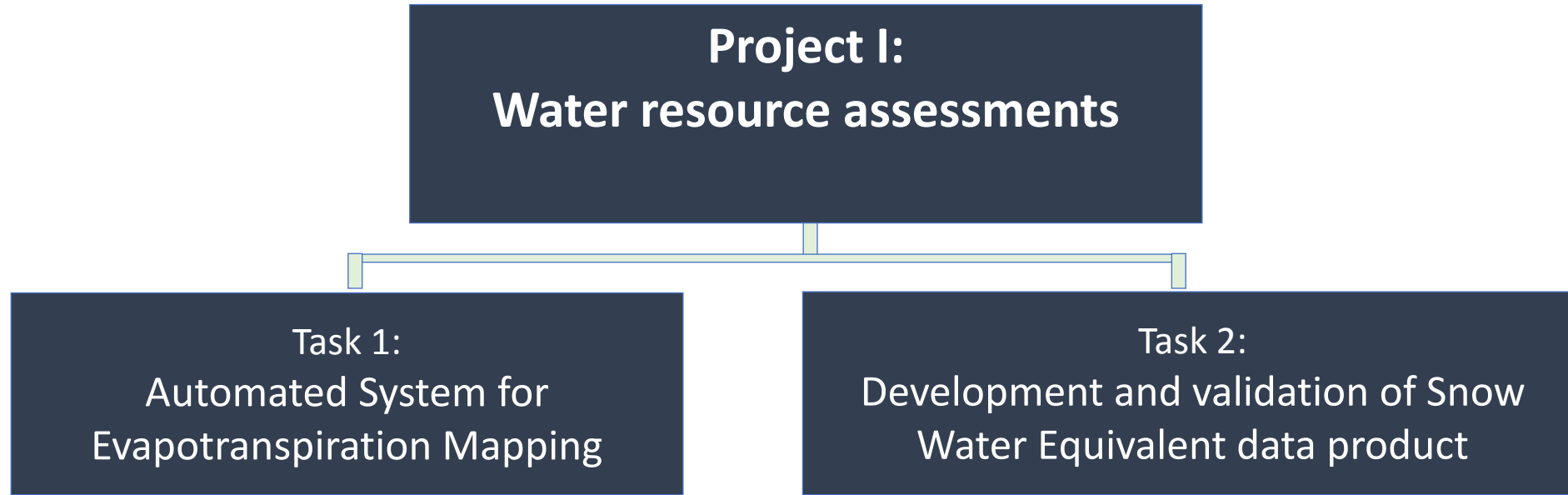**Walter Oechel, Donatella Zona, and Trent Biggs (SDSU)**
Craig Tweedie, and Miguel Velez-Reyes (UTEP)
Rafael Rodriguez and Roy Armstrong (UPRM)

The goal of Theme IV is to improve the observational and predictive understanding of land surface multi-year, seasonal and ephemeral processes associated with climate drivers through synoptic monitoring of the terrestrial domains.
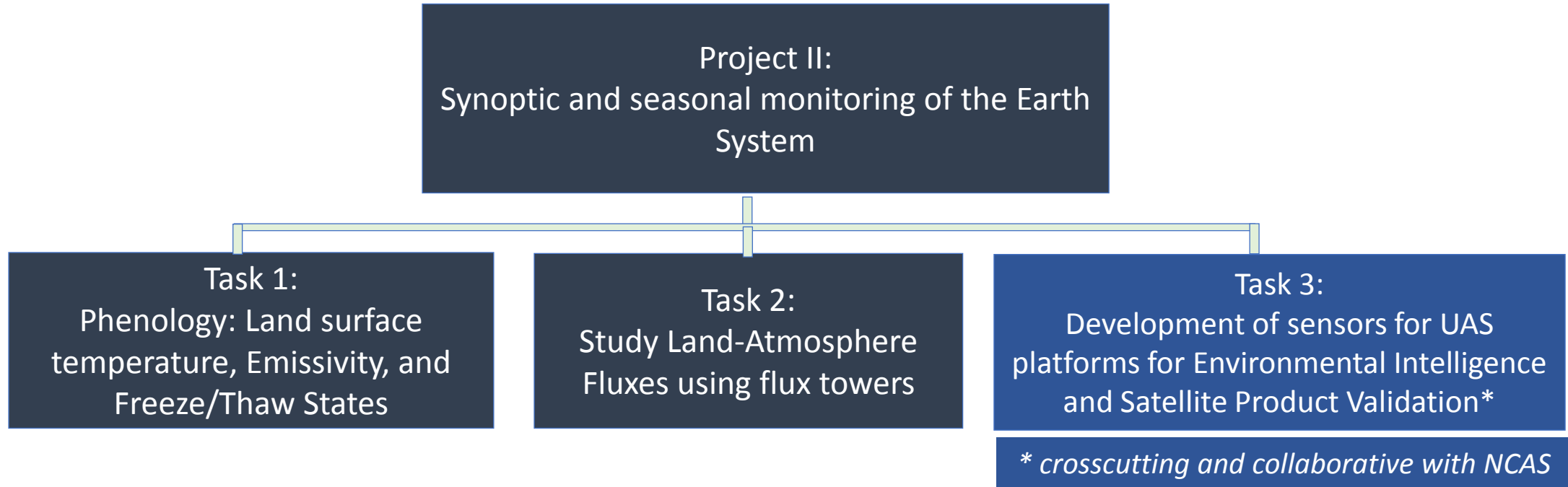
This theme integrates models with state-of-the-art observations across latitudinal gradients and supports **NOAA's goals of Climate Adaptation and Mitigation, and Weather Ready Nation.**

Theme IV: Ecosystem Services

Project I:
Water resource assessments

Task 1:
Automated System for Evapotranspiration Mapping

Task 2:
Development and validation of Snow Water Equivalent data product

Project I: Develop the ET and Snow observational and data products that will (1) address critical challenges in water cycle observations, (2) improve understanding of the vulnerability of agricultural systems to interannual variability in weather, and (3) better represent human-environment interactions, including feedbacks on regional climate.
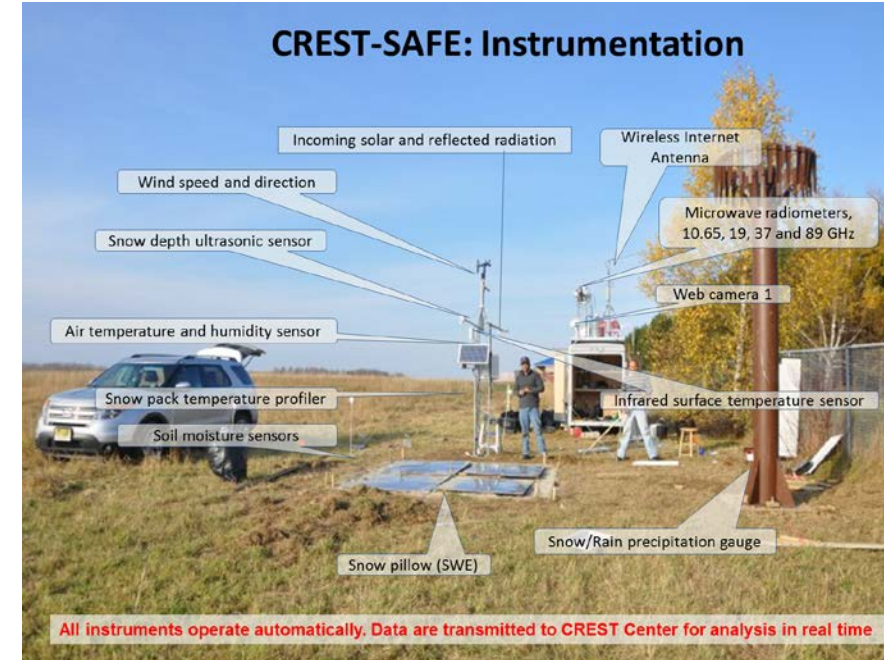
Theme IV: Ecosystem Services

Project II:
Synoptic and seasonal monitoring of the Earth System

Task 1:
Phenology: Land surface temperature, Emissivity, and Freeze/Thaw States

Task 2:
Study Land-Atmosphere Fluxes using flux towers

Task 3:
Development of sensors for UAS platforms for Environmental Intelligence and Satellite Product Validation*

* crosscutting and collaborative with NCAS

Project II: Under this project, we aims to develop a global scale multiyear phenology dataset, derived from multiple satellite remote sensing datasets and supporting field investigation and validations of trans-domain phenomena and teleconnections associated with regional feedbacks and global climate processes.

NOAA-CREST Infrastructure & Research Field Sites

- **CREST-Snow Analysis and Field Experiment, (CREST-SAFE)**
  Location: Caribou, ME

- **CREST-Soil Moisture Advanced Radiometric Testbed (CREST-SMART)**
  Location: Millbrook, NY and Mayaguez, PR

- **New York Urban Hydro-meteorological Testbed (NY-uHMT)**
  Location: Distributed in New York City

- **Long Island Sound Coastal Observatory (LISCO)**
  Location: New York City

- **NYCMetNet**
  Location: Distributed in New York City

- **CREST LIDAR Facility**
  Location: The City College of New York

- **Satellite Earth Observation System**
  Location: The City College of New York

CREST-Snow Analysis and Field Experiment (CREST-SAFE), Caribou, ME

CREST-SAFE Experiment located on the premises of NWS Regional Forecast Office at Caribou Regional Airport, Caribou, ME

http://crest.ccny.cuny.edu/snow/index.html

37 GHz Radiometer
89 GHz Radiometer

Snow Temperature Profiler

Snow Pillow (SWE)
Rain/Snow Gauge
Soil Moisture (2.5, 5, 10cm)
Soil Temp (2.5, 5, 10cm)
Network Cameras (2)

Infrared Thermometer (Skin Temperature)
Snow Depth Sensor
Radiation Sensors
Wind Speed/Direction, Humidity/air temperature

DoD/Navy Funding (2013)
19 and 10.65 GHz Radiometers
CIMEL Sun Photometer

Snow Wetness profiler
GMON3 SWE Sensor

2010   2011   2012   2013   2014

Timeline of Instruments installed at CREST-SAFE Site

Instruments at the CREST-SAFE, Caribou, Maine

Snow Temperature Profiler

Microwave Radiometers

Trailer

Snow Wetness Sensors

Grain size and Density Instruments
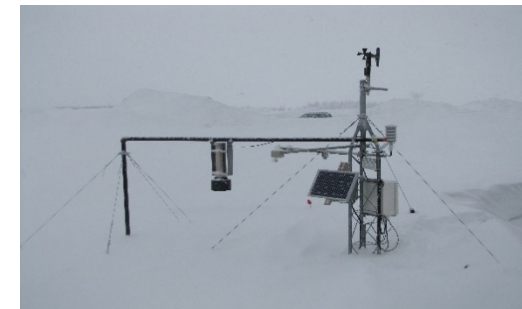
Snow Water Equivalent (SWE) Sensors

CREST-Soil Moisture Advanced Radiometric Testbed (CREST-SMART),
Location: Millbrook, NY and Mayaguez PR

The established network was selected by NASA for the Cal/Val of the SMAP mission
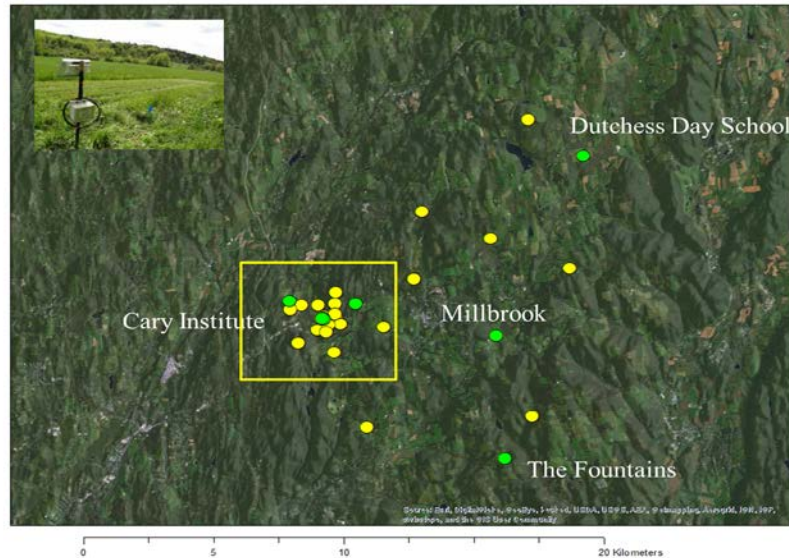
Location of installed In-situ Soil Moisture Stations around Radiometer Site

L-band Radiometer

Joint Field Experiment in May 2012

Ground Equipment used for Research and Education Outreach activities at Millbrook Site

New York Urban Hydro-meteorological Testbed (NY-uHMT)

- CREST NY-uHMT will be having ground based 20 weather stations providing real-time data located in 5 boroughs (Bronx, Manhattan, Brooklyn, Staten Island Queens, and 2 stations at long island) of New York City.

- Each weather station includes instrumentations to measure soil moisture, Rainfall/snowfall, Temperature and humidity probe.

- The objective of this tested is to improve the accuracy and lead time of measuring and accessing the precipitation and providing Warn-on-flash flood forecasts and warnings in the New York City region for a range of public and private decision-makers that result in measureable benefit for public safety and the economy.

Location: 20 weather stations evenly distributed 5 borough of New York City
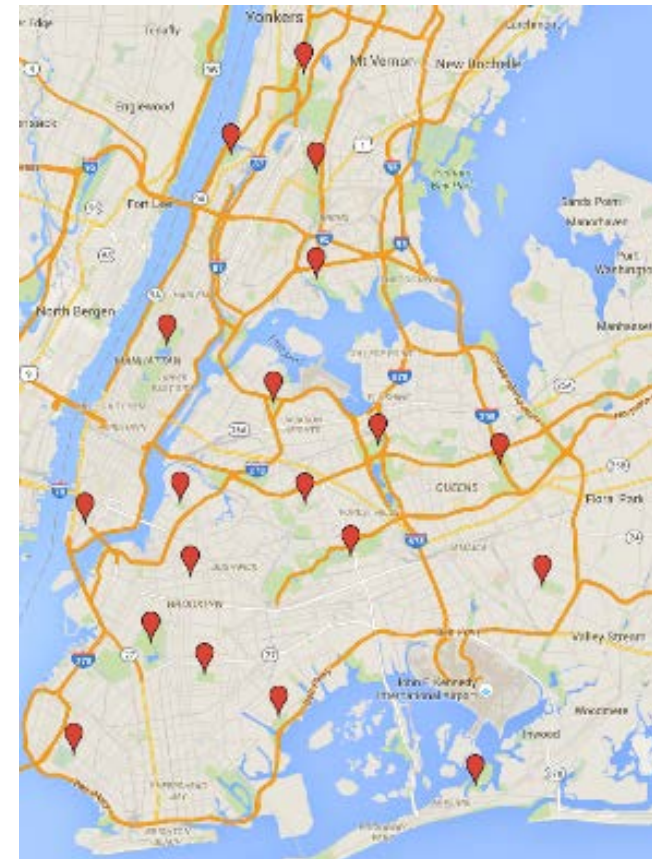
Long Island Sound Coastal Observatory (LISCO)
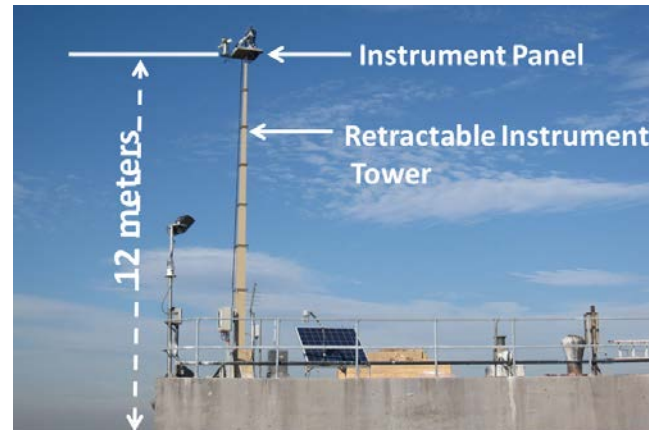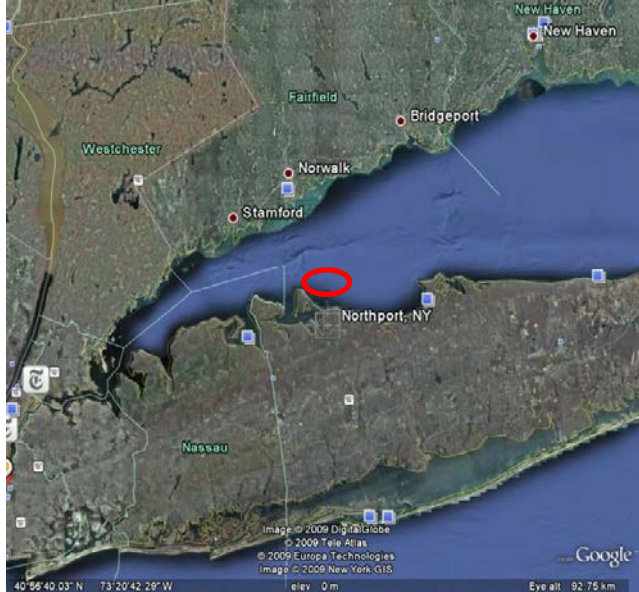
The platform combines an AERONET SeaPRISM radiometer and CIMEL Electronique as a part of AERONET Ocean Color Network, with a co-located HyperSAS set of radiometers capable of hyperspectral measurements of water-leaving radiance, sky radiance and down-welling irradiance. SeaPRISM data are transferred by the satellite link to NASA.

NYCMetNet, CCNY

- NYCMetNet provides latest meteorological observations in and around The New York metropolitan area (NYC).

- Observations are updated every 15 minutes to better characterize meteorological conditions within the NYC urban environment.

- Surface observations consist, in part, of near real-time atmospheric pressure, relative humidity, temperature, wind direction, wind speed, rain rate, and total rain accumulation measurements at building-top sites.
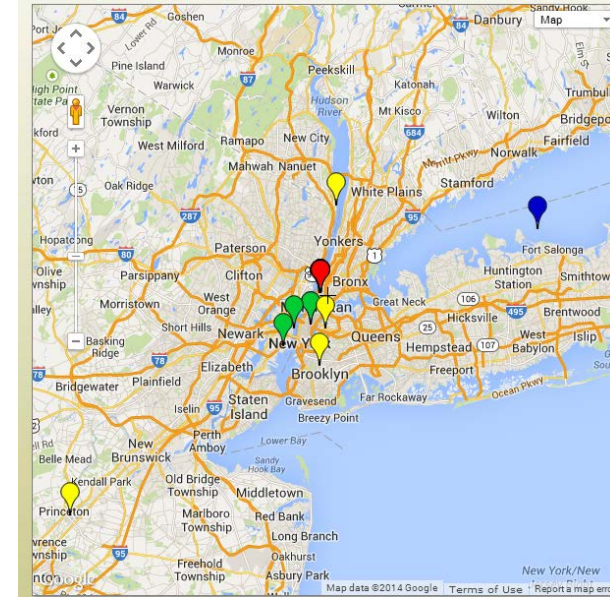
Location of Met Station

Sustained wind speed and direction
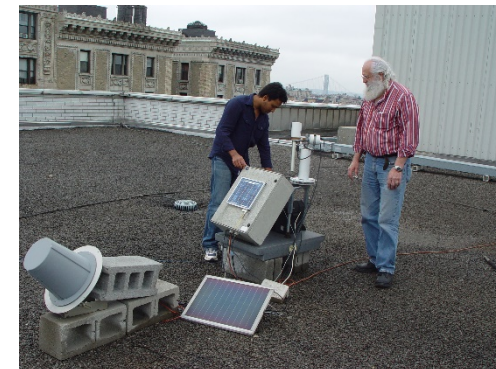
CREST LIDAR Facility
## at the City College of New York

CREST LIDAR Network (NY, VA, MD, PR) studies the vertical profiling along the Atlantic Coast transect from NYC to Caribbean with applications to aerosol transport and air quality. It has been cooperated in founding the International GAW Aerosol LIDAR Observation Network.
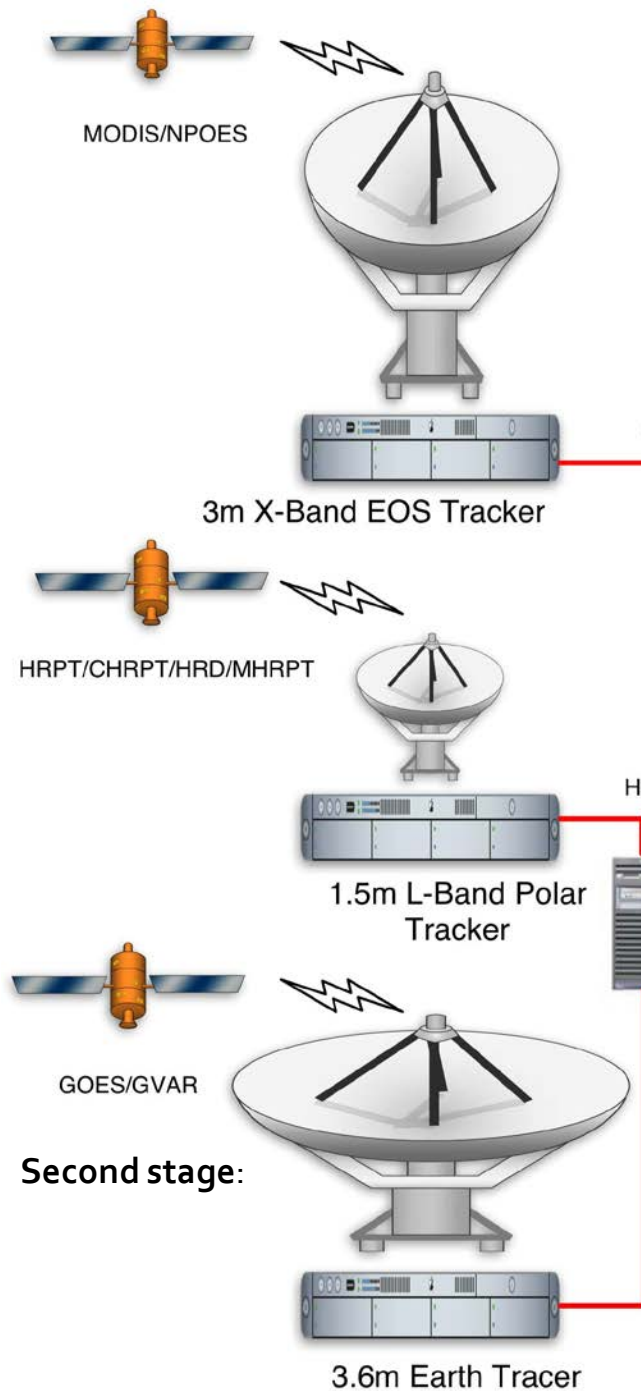

Open-path Laser Measurements at 7.8 microns

Mid-IR Lidar at 4.5 microns

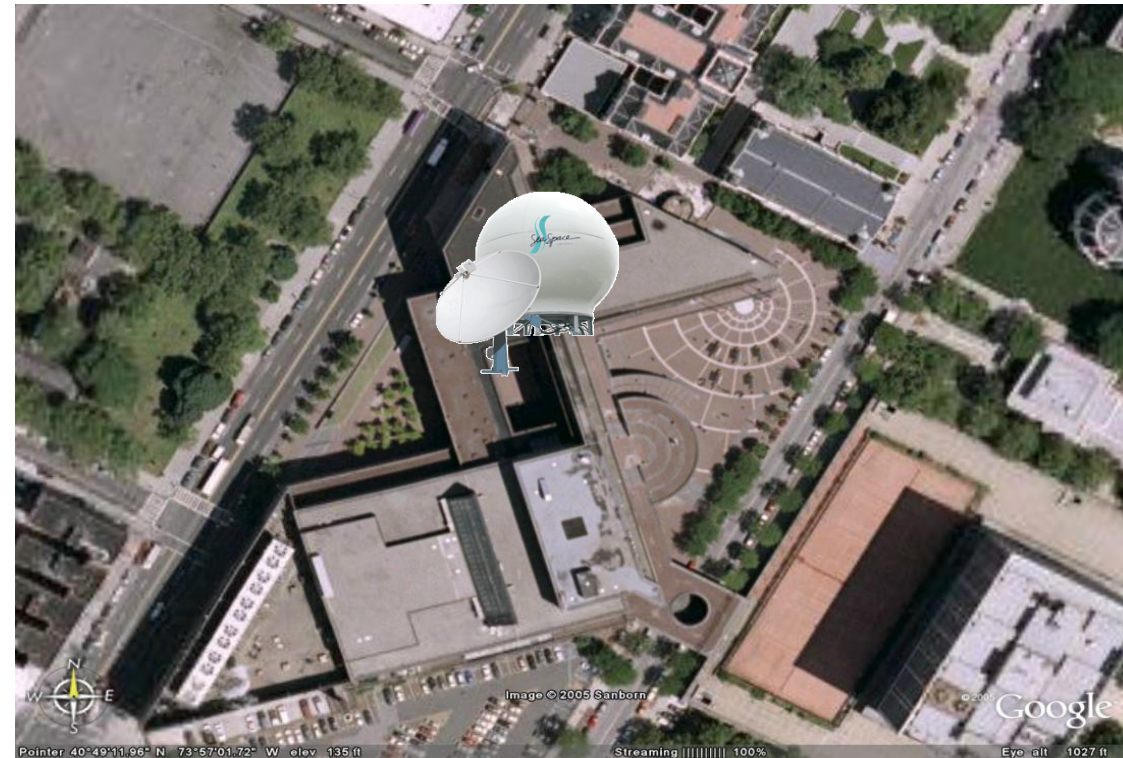2012 Oct18, CCNY-Lidar, range-corrected returns (log) at 1064-nm
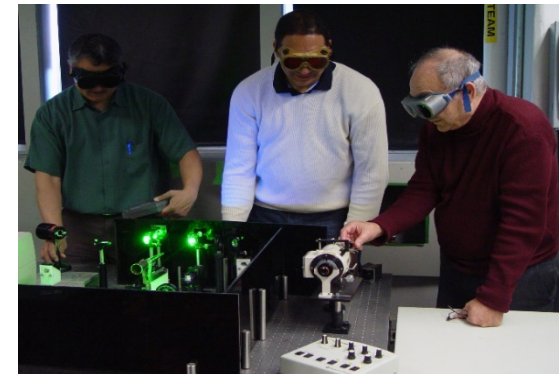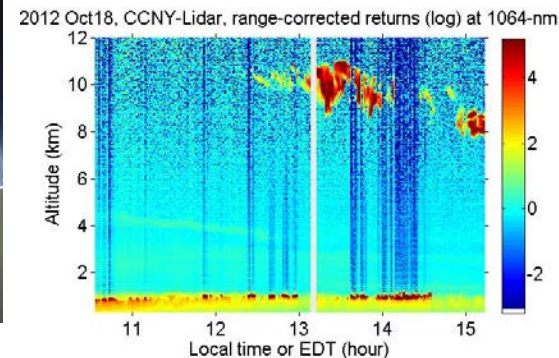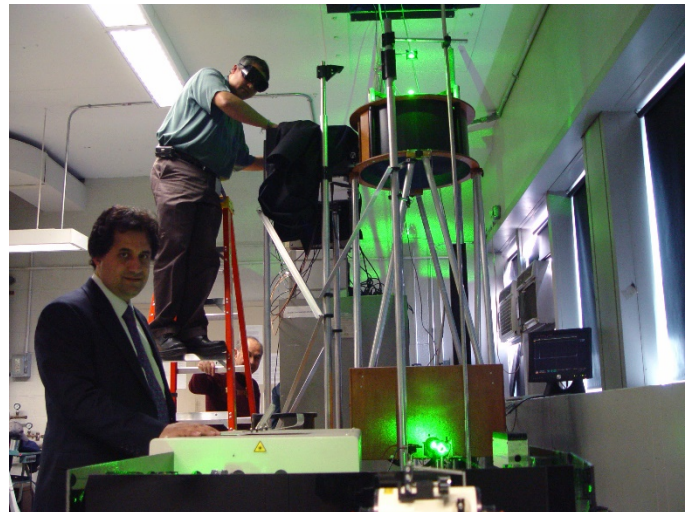
Satellite Earth Observation System

- The Satellite Receiving Station is a key component of CREST research . SRS is primarily responsible to acquiring, storing and algorithm processing of all satellite related products.
- The installation consists of two separate antennas and acquisition systems received and processed are from X-band transmitting polar orbiting satellites, Terra and Aqua, both equipped with MODIS instruments, and L-band data from the geostationary (GEOS-12) satellite.

Satellite Data Acquisition Unit

MODIS/NPOES

3m X-Band EOS Tracker

HRPT/CHRPT/HRD/MHRPT

1.5m L-Band Polar Tracker

GOES/GVAR

Second stage:

3.6m Earth Tracer

NAC building roof