Atmospheric Physics (ATPH) Graduate Program

UMBC

Overview of UMBC

- 14,000 Students
  - ~11,000 undergrad
  - ~3,000 grad
- 37 Academic Programs
  - 21 PhD programs

UMBC

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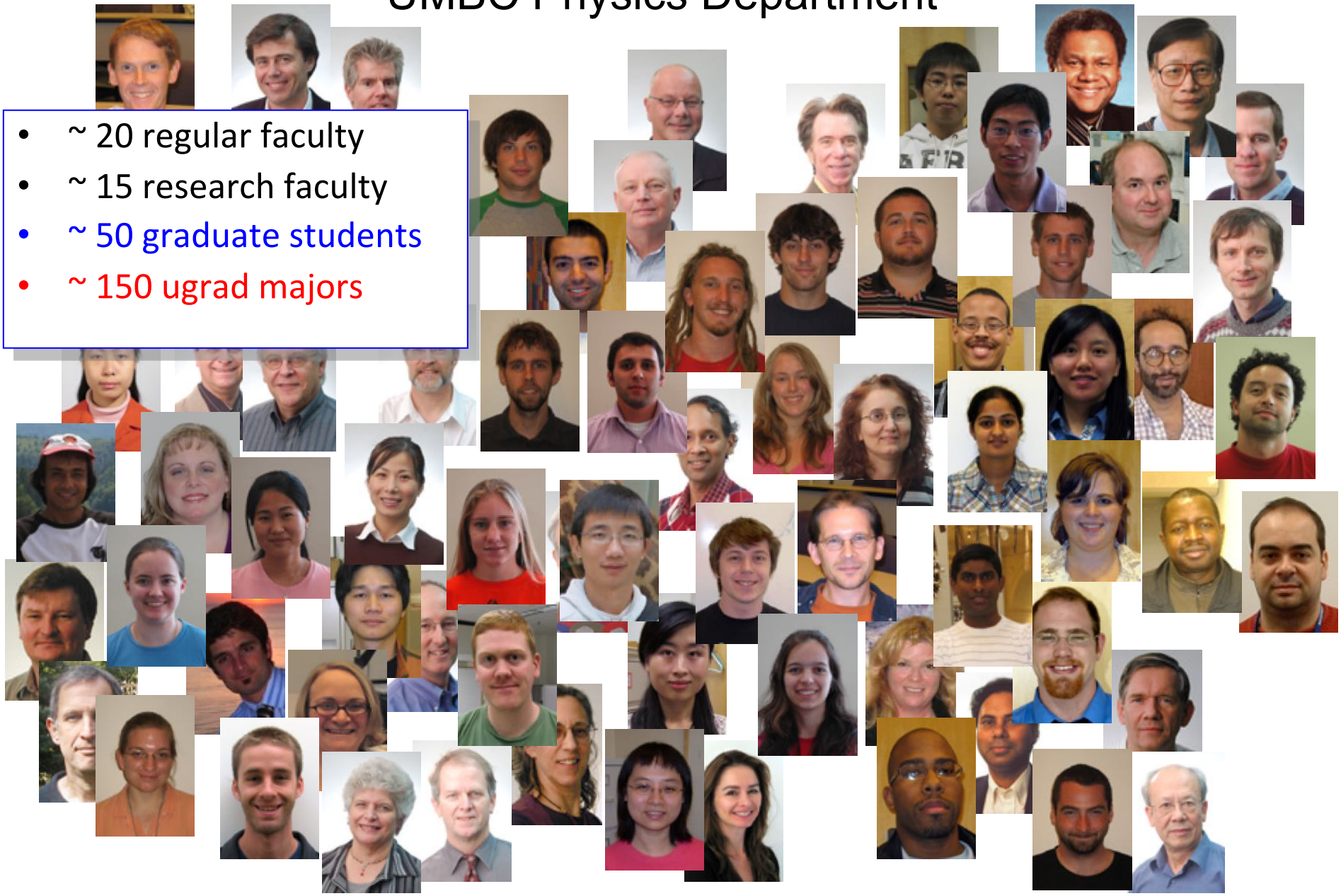
- ARL
- APL
- NRL
- NSA
- Northrop-Grumman
- NASA Goddard
- …..

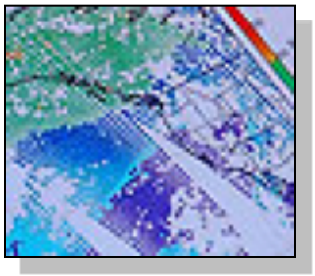
UMBC

UMBC Physics Department

- ~ 20 regular faculty
- ~ 15 research faculty
- ~ 50 graduate students
- ~ 150 ugrad majors



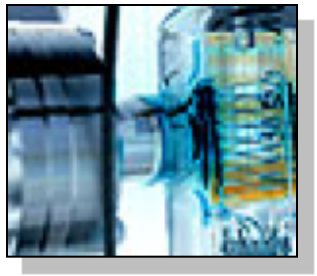
4 main research areas at UMBC



Atmospheric Physics

Astrophysics

Condensed Matter Physics



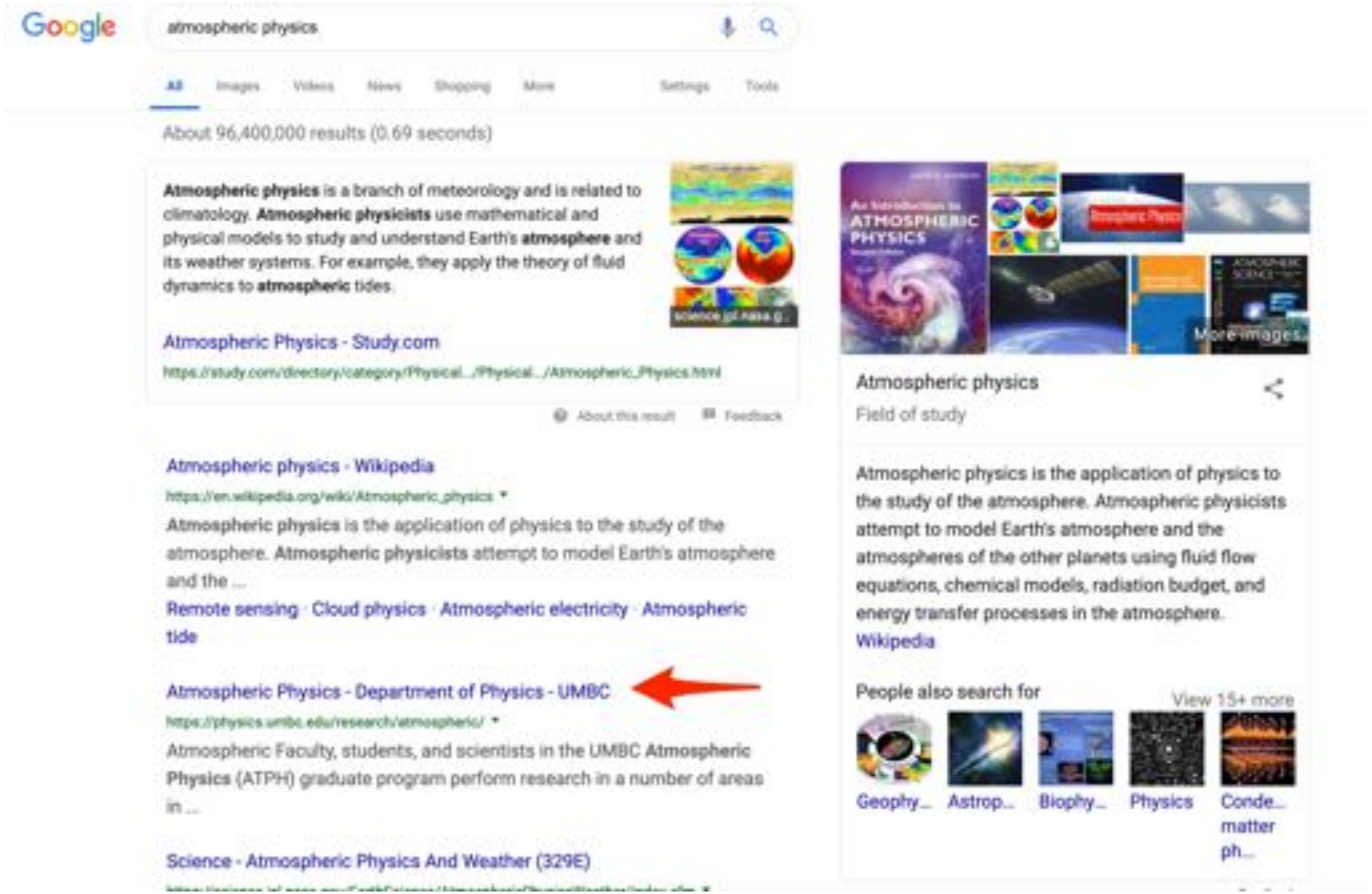
Quantum Optics & Information

Atmospheric Physics (ATPH) PhD program:

ATPH program accounts for ¼ of faculty, 1/3 of graduate students

Physics PhD program

We are #1 “Atmospheric Physics” Program



UMBC

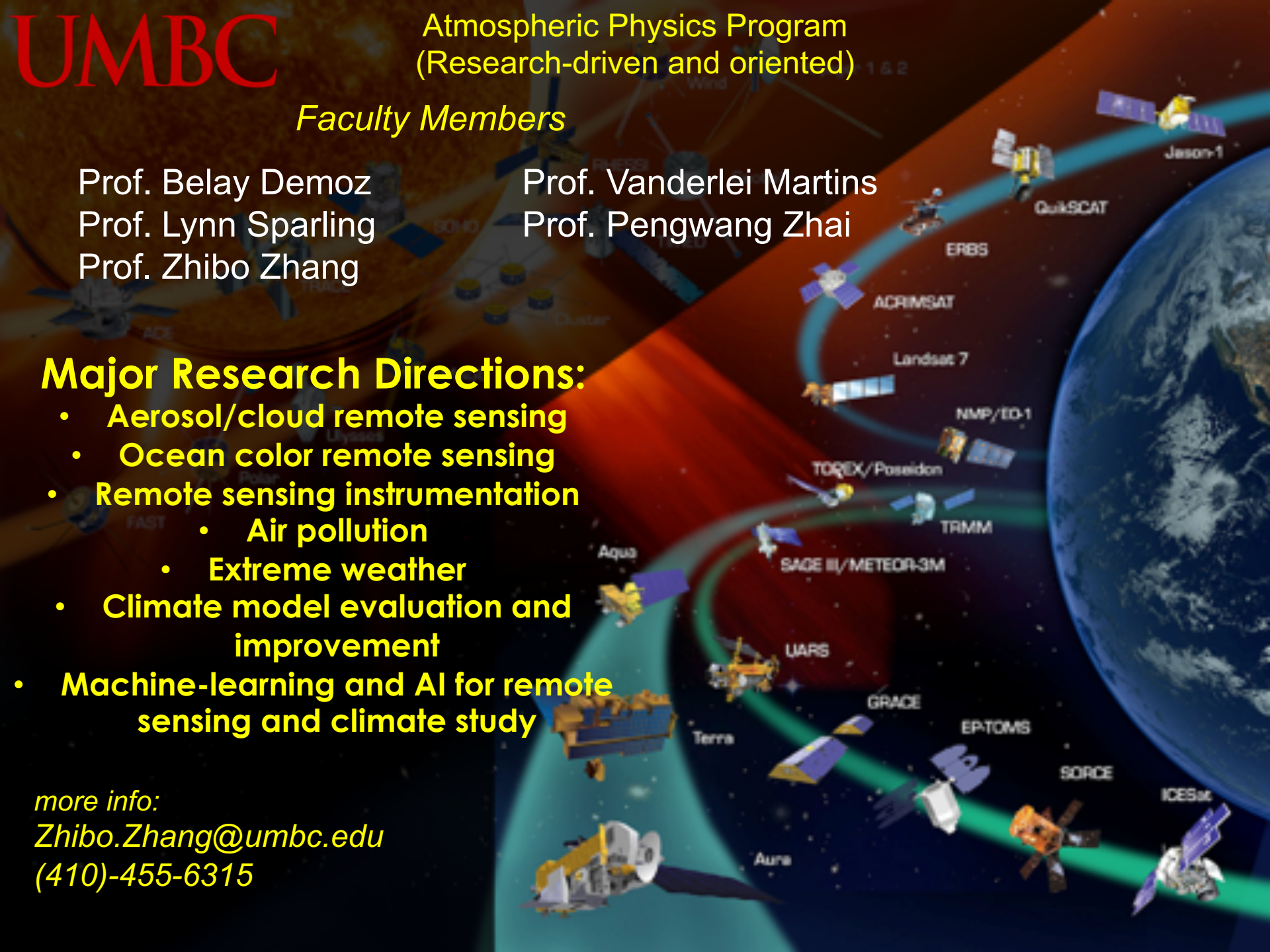
Atmospheric Physics Program
(Research-driven and oriented)

Faculty Members

Prof. Belay Demoz
Prof. Lynn Sparling
Prof. Zhibo Zhang
Prof. Vanderlei Martins
Prof. Pengwang Zhai

Major Research Directions:

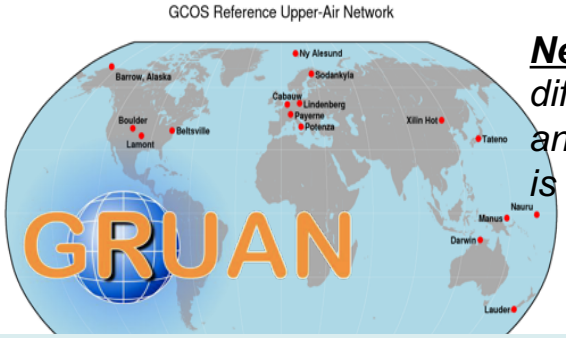
- Aerosol/cloud remote sensing
- Ocean color remote sensing
- Remote sensing instrumentation
- Air pollution
- Extreme weather
- Climate model evaluation and improvement
- Machine-learning and AI for remote sensing and climate study



more info:
Zhibo.Zhang@umbc.edu
(410)-455-6315

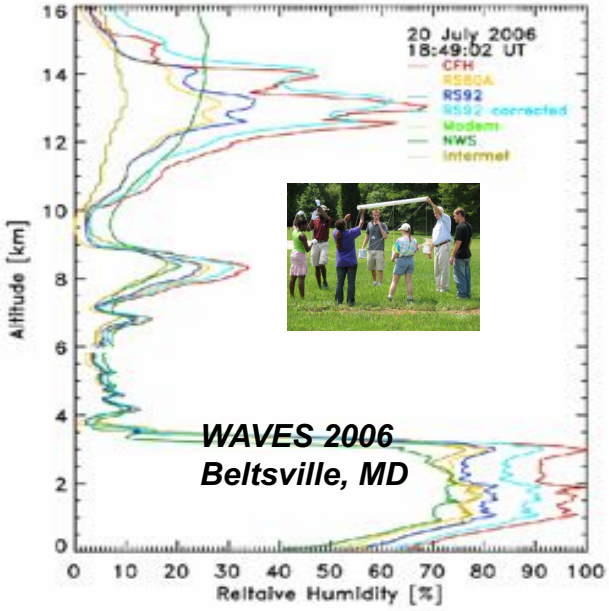
Dr. **Belay B. Demoz**
UMBC-Physics/JCET

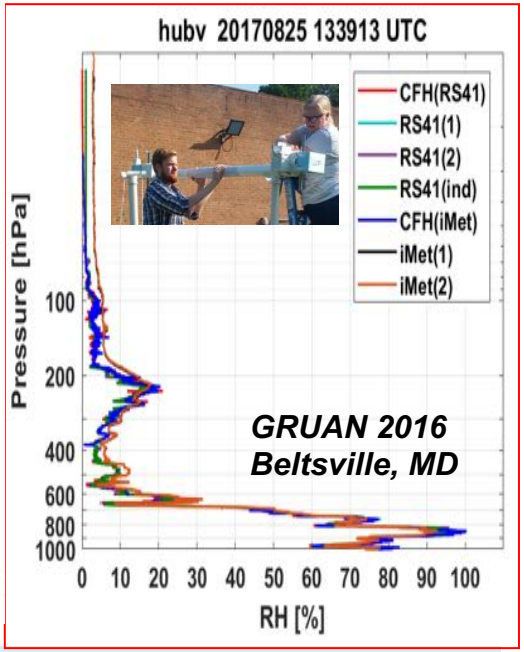
Questions: What physics controls the weather?
How do we measure the these processes?
What type of instruments and what quality?

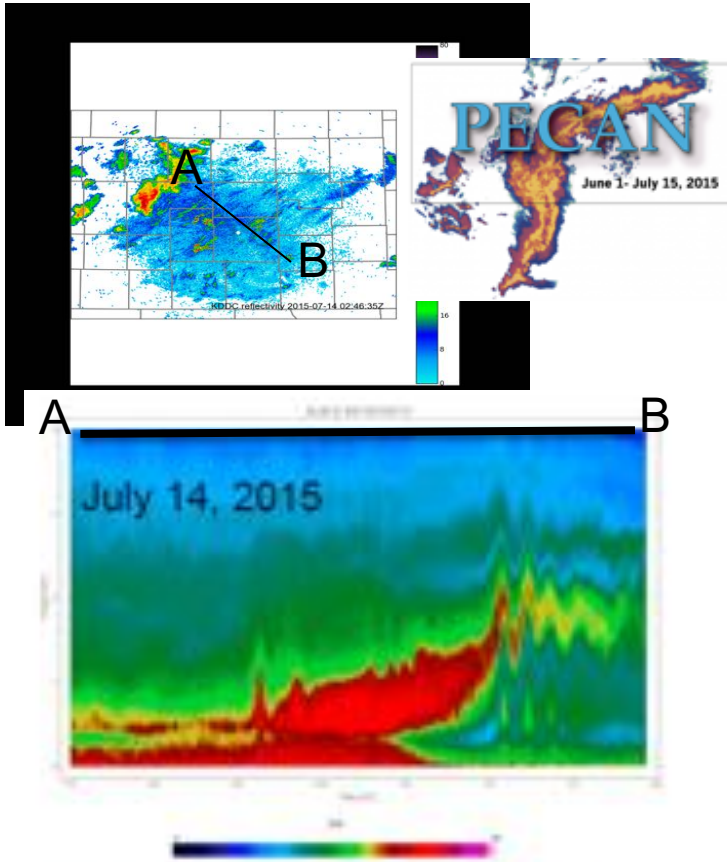


Networks: *linking observation from different sites – to solve a climate and weather problem. Example here is from a climate network GRUAN.*

Instrumentation: *physics, network capability, What and how can we improve on multi-instrumentation networks? How should they be deployed.*







Diagnosing Model physics: *Use the observation to constrain, validate, improve models. .*

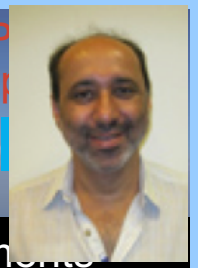
Making sense of what is measured: *An example of cold front generated bore and associated role undulations during PECAN*

UMBC
www.umbc.edu/laco

L A C O

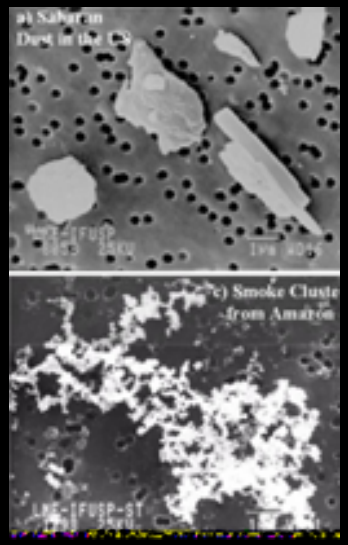
Laboratory for Aerosols, Clouds and Optics

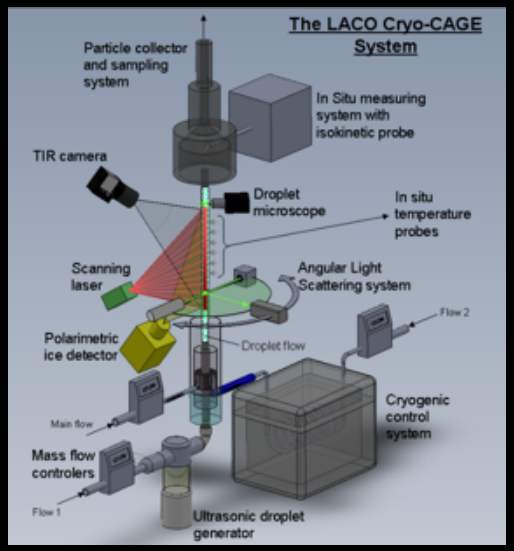
martins@umbc.edu



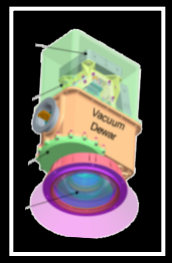
New Remote Sensing Instruments and Algorithms

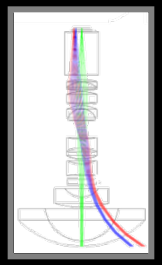
Laboratory Simulations and Measurements

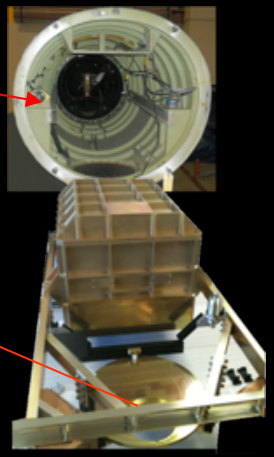




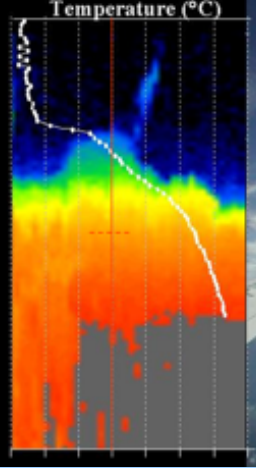
Instrument Development

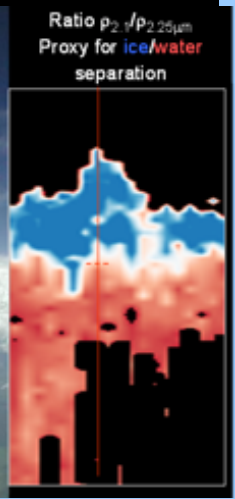






Field and Aircraft Measurements

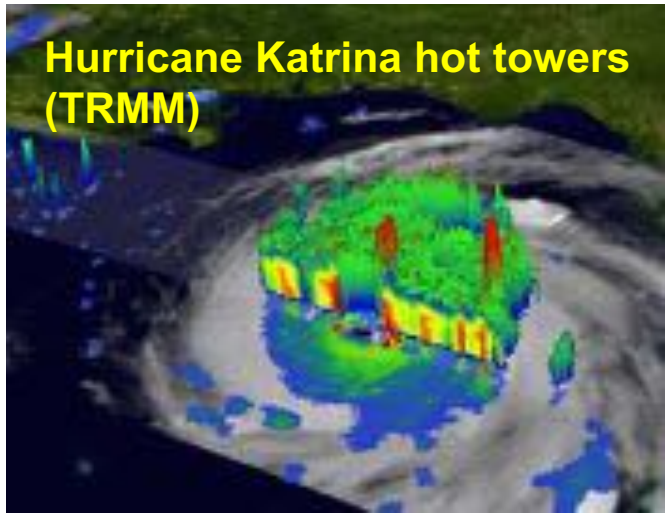




First UMBC Satellite Underway…

Lynn Sparling Research areas:

Hurricanes: Small scale processes in the eye and eyewall and links to intensity change

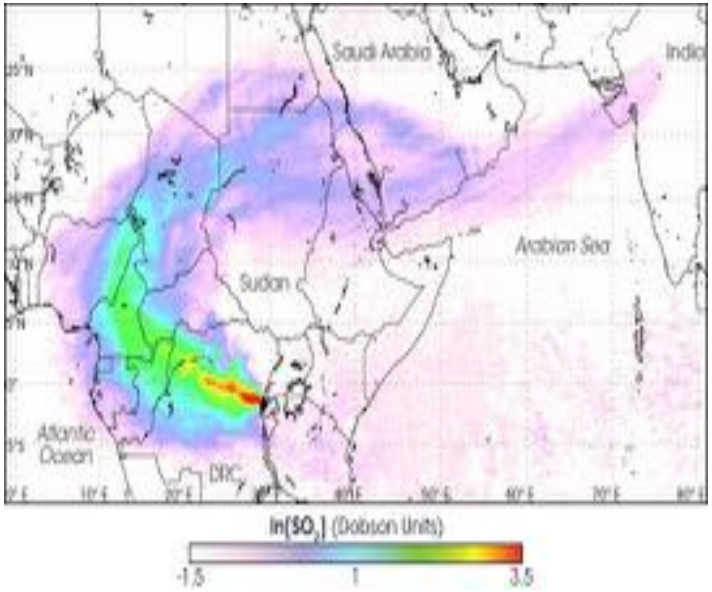


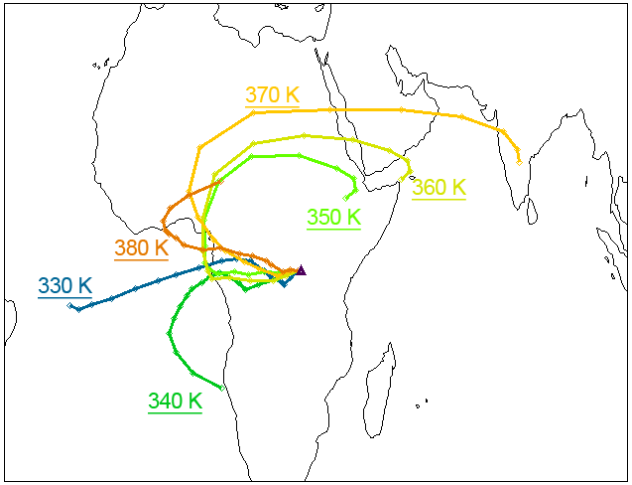
Low level winds:

Energy generation and boundary layer dynamics.

Long-range transport:

Tracking SO2 emissions from volcanoes.

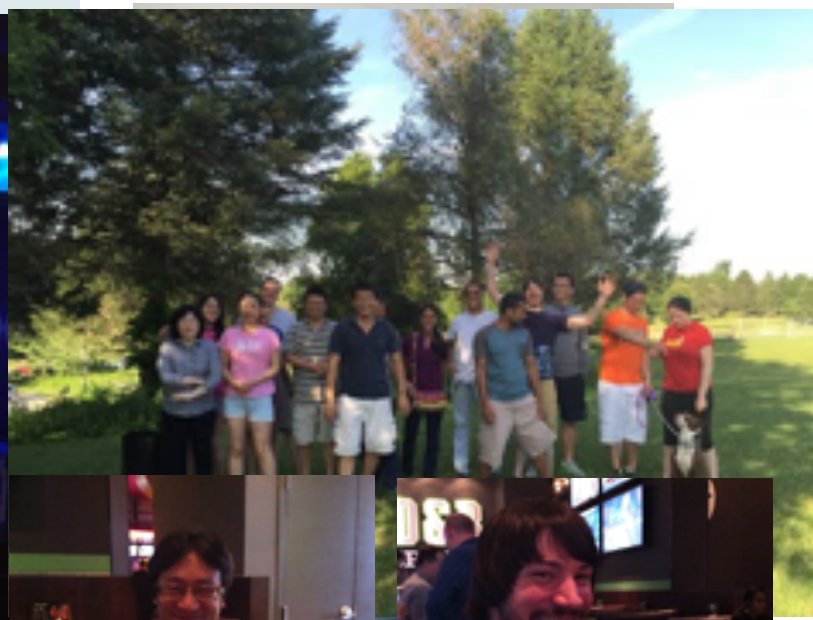




Aerosol, **C**loud, **R**adiation-**O**bservation and **S**imulation (**ACROS**) Group led by

Dr. Zhibo Zhang

Supported by
NASA
Department of Energy (DOE)
National Science Foundation (NSF)



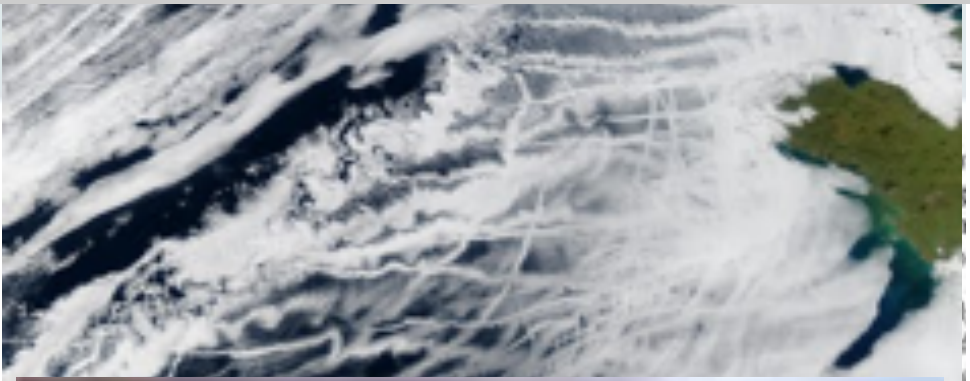
ACROS @ UMBC

Home People Research Publications News Openings-and-Opportunities

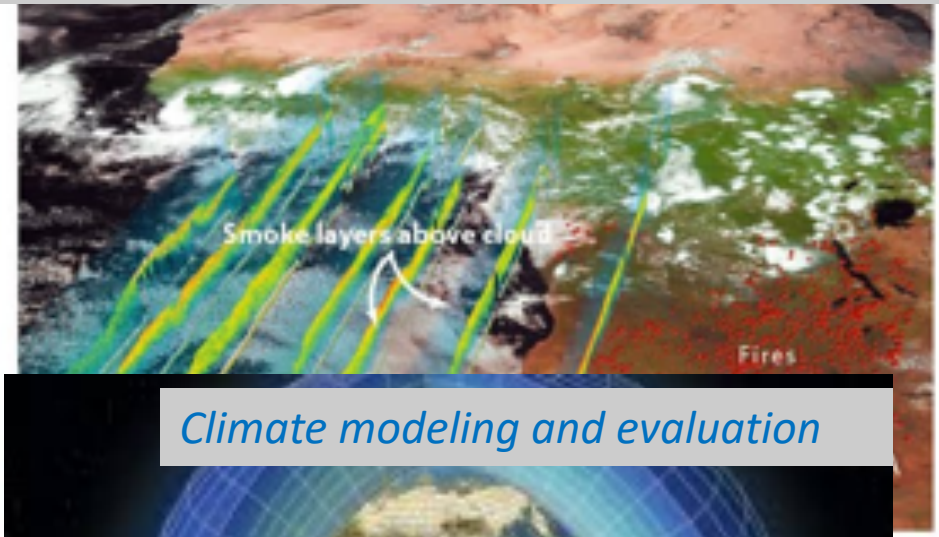
ACROS: Aerosol, Cloud, Radiation–Observation and Simulation group at UMBC

https://sites.google.com/umbc.edu/acros/home

Satellite-based Cloud/Aerosol Remote Sensing

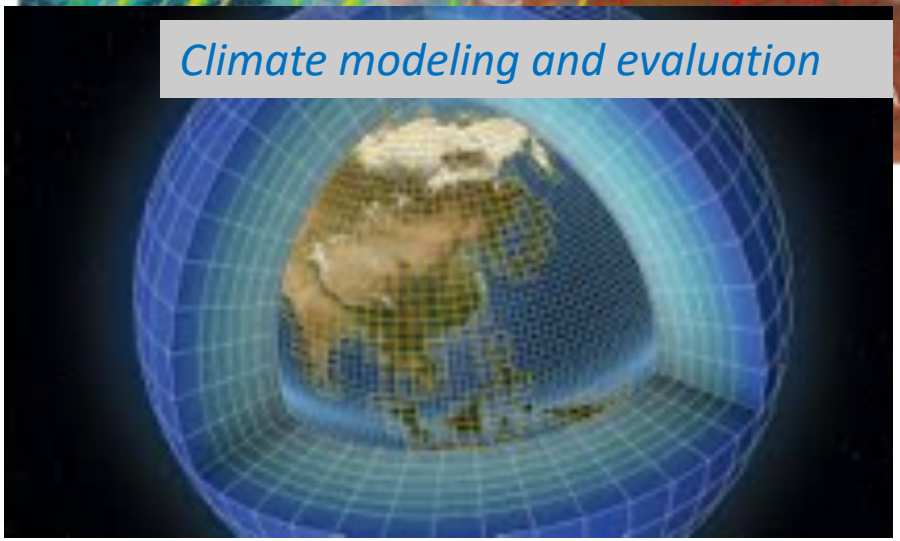


Aerosol-cloud-radiation interactions



Radiative effects of aerosols

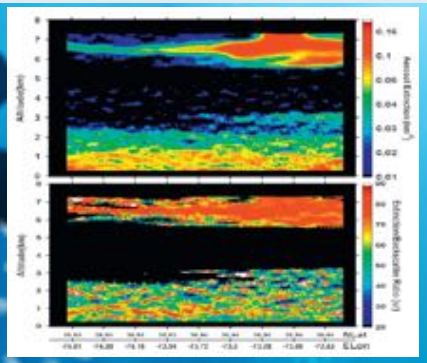
Climate modeling and evaluation

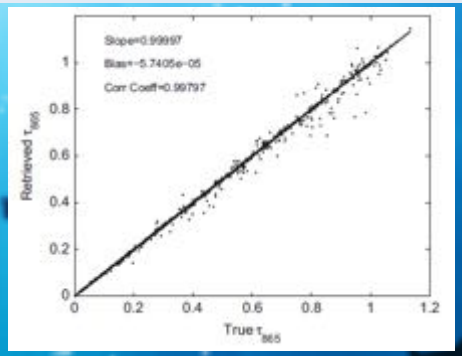


Dr. Pengwang Zhai
Physics Department, UMBC

Quest: To develop new optical remote sensing methods for ocean water and aerosols.

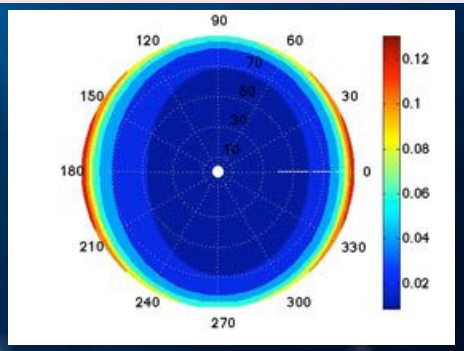
Optical Remote Sensing





Light Scattering

Radiative Transfer



UMBC

JCET
The Joint Center for Earth Systems Technology
http://jcet.umbc.edu/

NASA

Earth Science Joint Center with NASA Goddard

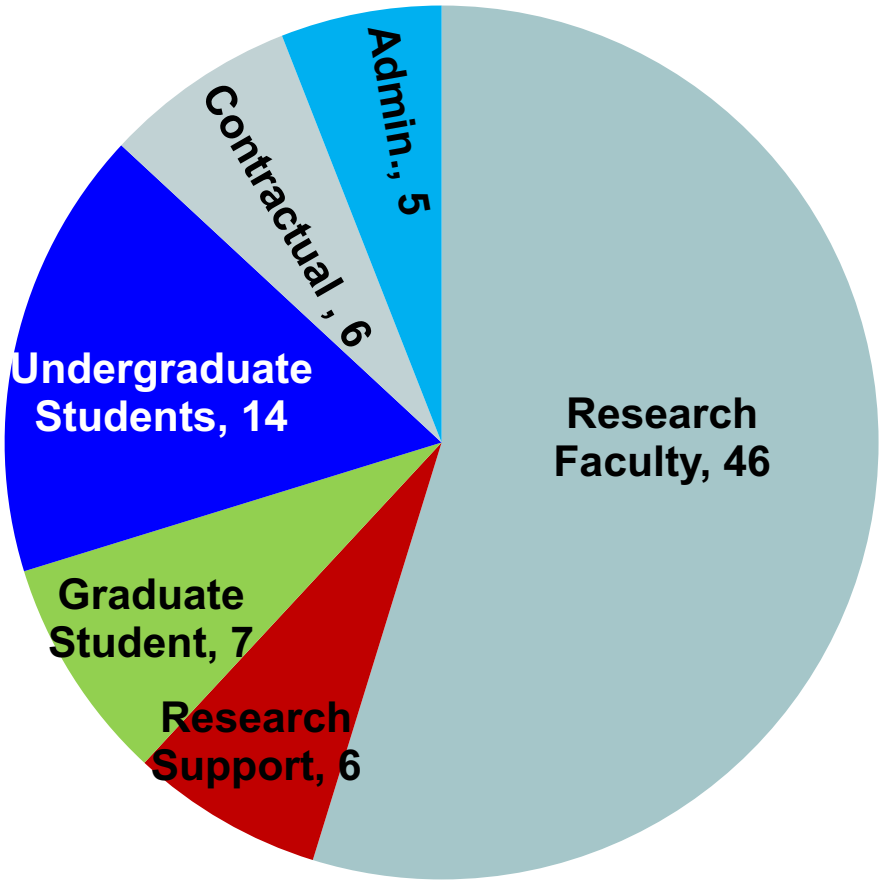
7/1/95 – 6/30/98 – *(H. Melfi)*
7/1/98 – 12/31/05 - (Melfi/Hoff)
10/1/05 – 9/30/10 - (Hoff)
10/1/10 – 9/30/15 – *(Hoff/ Eichenlaub)*
10/1/15 – 9/30/20 – *(Demoz)*

Beyond the numbers:

- *2011-2017: ~ 800 journal papers*
- *2006-2018: ~ 138 graduate students*
- *Hundreds of undergrads*

JCET 2020: Celebrating 25 years of collaborative research and education

JCET: By the numbers



2017-2018 JCET Composition	
Research Analysts	5
Faculty Research Assistants	2
Associate Research Engineer	1
Assistant Research Engineer	1
Research Assistant Professors	6
Assistant Research Scientists	4
Associate Research Scientists	4
Research Associate Professors	10
Senior Research Scientists	6
Research Professor	6
Post-Doc Research Associates	6
Program Coordinator	1
Administrative Staff	5
Contractual	6
Undergraduate Students	14
Graduate Students	7
Total	*84*

JCET: Teaching Contribution

PHYSICS

PHYS 621: Intro to Atmospheric Science
PHYS 622: Clouds, Aerosol and Radiation
PHYS 640/440: Computational Physics
PHYS 721: Atmospheric Radiation
PHYS 741: Inverse Methods
PHYS 335: Physics & Chemistry of the Atmosphere
PHYS 112: Basic Physics II
JCET Seminars – Professional Development for graduate students:
PHYS 650: Precipitation Science (Spring 2018)

CSEE

CSMC 626: Computer Security

Honors College:
Climate Change & Public Policy
Proposed:
Interdisciplinary Climate Change (undergraduate)

GES

GES 302: Arctic Geography
GES 311: Weather and Climate
GES 381: Remote Sensing
GES 400x: Earth's Cryosphere
GES 415: Climate Change
GES 481/681: Remote Sensing and Image Processing for Environmental Applications

Mixing Layer Height
or
"Boundary Layer Height"

- Diagnostic variable atmospheric transport and dispersion forecasting models.

- Without realistic PBL heights models have large errors that result in inadequate public protection against unhealthy air quality.

- National Research Council has recommended a "network of networks"[1]
  - After 60 years of remote sensing research, it is astounding that the PBL is not measured regularly throughout its diurnal cycle

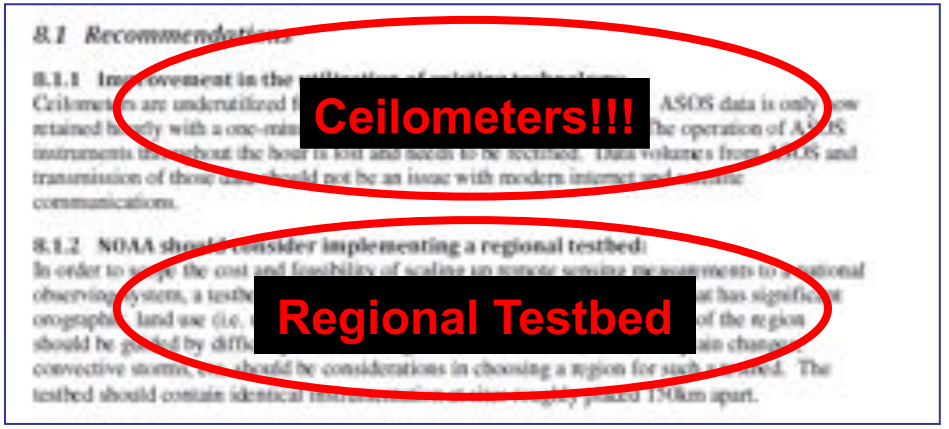
1- NRC. 2009. *Observing Weather and Climate from the Ground Up: A Nationwide Network of Networks*. Washington, DC: National Academy Press.

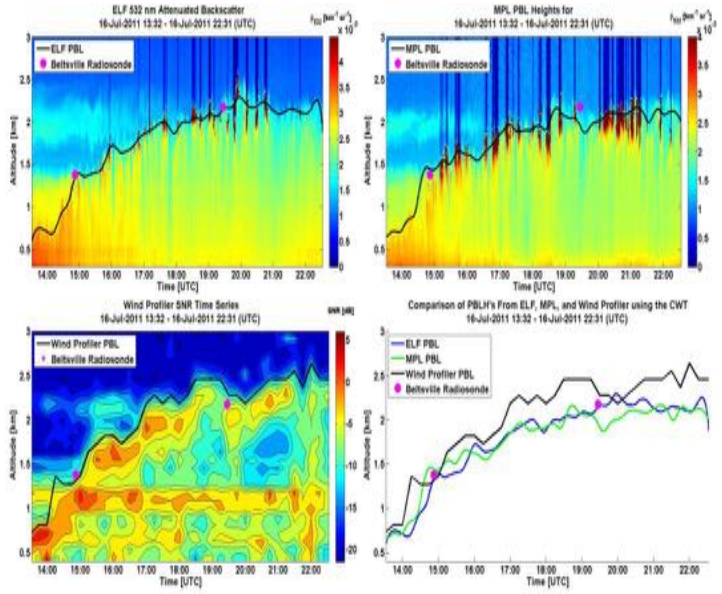
Observations Lead The Way

NRC
R. Hoff
Observing Weather and Climate from the Ground Up: A Nationwide Network of Networks (2009)

NSF
B. Demoz
Thermodynamic Profiling Technology Workshop (2011)

NASEM
R. Delgado
The Future of Atmospheric Boundary Layer Observing, Understanding, and Modeling (2018)



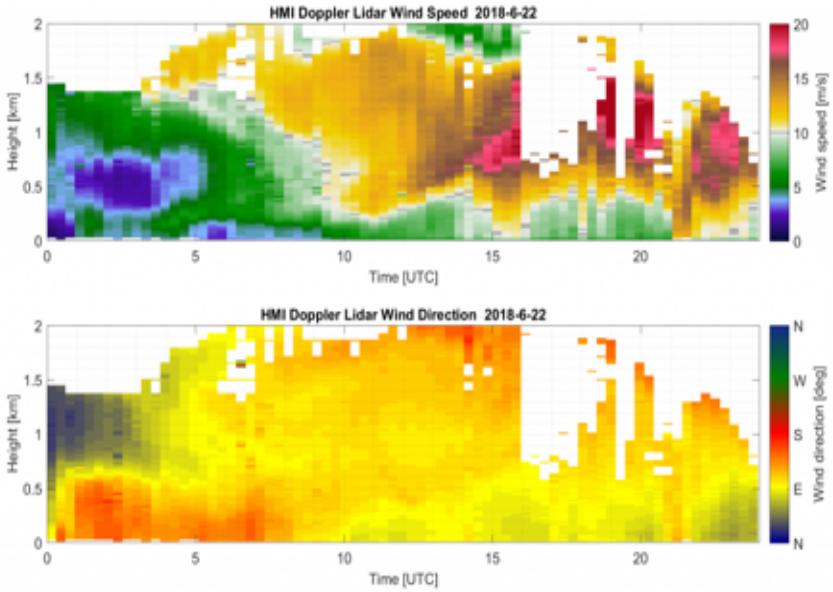


*Compton et al. (2013), J. Atmos. Ocean. Tech., doi:10.1175/JTECHD-12-00116.1

Air Quality:
www.lidar.umbc.edu or Search for "smogblog"

Land-water differences in O_3 within the boundary layer and correlation of diurnal evolution of dynamics and chemistry.

OWLETS-2
Ozone Water-Land Environmental Transition Study



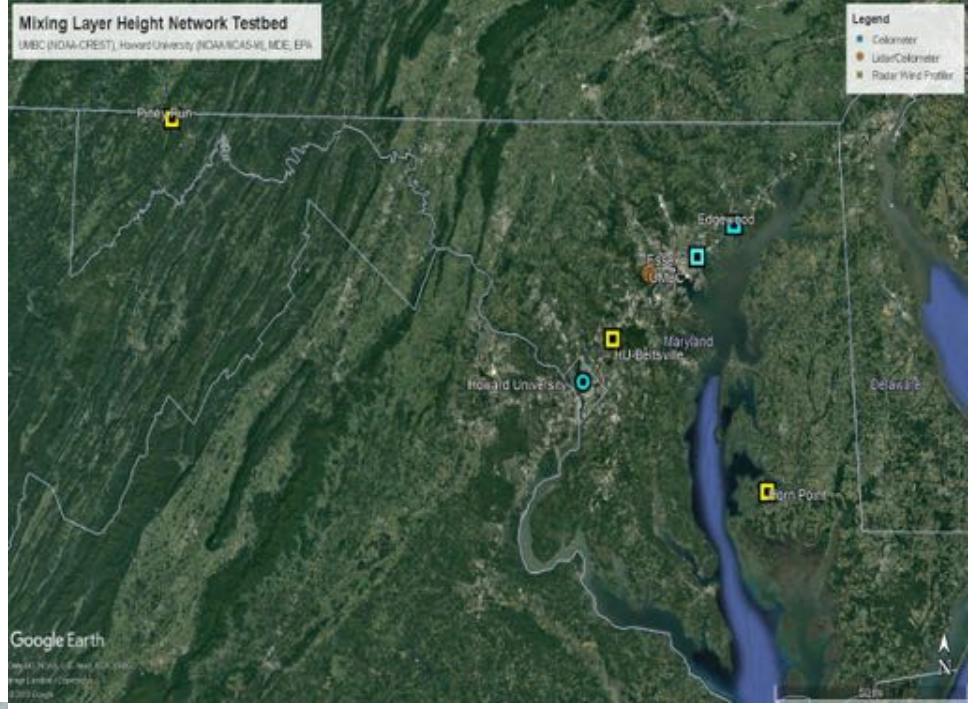
What source groups and locations do policy makers need to focus on to reduce ozone over the Chesapeake Bay?

- Power Plants and Poultry/Agriculture Industry Impacting Air Quality in the Chesapeake Bay

NOAA-CREST CENTER FOR EARTH SYSTEM SCIENCES AND REMOTE SENSING TECHNOLOGIES

Interdisciplinary Research Undergraduate and Graduate Students

Atmospheric Physics
Biology
Computer Science and Electrical Engineering
Geography and Environmental Systems
Math and Statistics
Mechanical Engineering
Physics



Mixing Layer Height Network Testbed

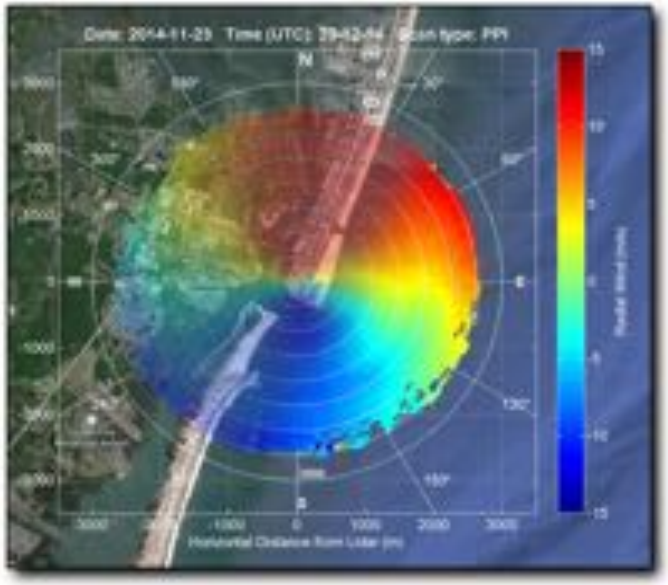
State and Federal Stakeholders
MDE, EPA, NOAA, NASA

“Lidar Compound Eye” View of the World Carbon Management

All wind capacity is not created equal: untangling uncertainties in offshore wind energy development.

Coastal Doppler Wind Lidar Measurements

- Focuses on building bridges between atmospheric science and public policy to help reduce economic uncertainties in the offshore wind energy industry

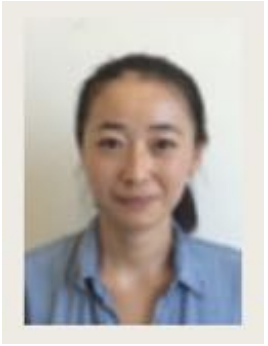


UMBC’s newest research center: the Earth and Space Institute (ESI).

Multiple opportunities available for graduate students

- GAANN Fellowship
- JCET research fellowship
- Research assistantship
- Teaching assistantship
- NASA/NSF fellowship

JCET Fellowship



GAANN Fellowship

Recent NASA NESSF fellowship

Recent graduates

NASA postdoc program (working for NASA!)

Contact information

Important Links

- UMBC Physics department
  - http://physics.umbc.edu/
- UMBC ATPH program
  - http://physics.umbc.edu/research/atmospheric/
- UMBC graduate school
  - http://gradschool.umbc.edu/
- UMBC Joint Center for Earth Systems Technology (JCET)
  - http://jcet.umbc.edu/

Contact Information

Zhibo Zhang: ATPH program director

Zhibo.Zhang@umbc.edu

(410) 455-6315

Apply for *ATPH* program today