Course agenda: What's behind the curtain of the NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission?

University of Maryland Baltimore County (and GSFC)
1-5 August 2022

General schedule notes

- Instructors will meet at 8:00 am each morning
- The class will begin at 8:30 am each morning
- Lunch will be 12:00 pm to 1:00 pm each day, except on Tuesday (11:30 to 12:30)
- Both morning and afternoon sessions include a break
- Class end time varies each day
- On Monday and Wednesday, we'll meet after dinner for a "fireside chat"
- On Tuesday and Thursday, we'll have dinner away from UMBC

In person instructor key

BC = Brian Cairns
IC = Ivona Cetinic
JT = Jessie Turner
JW = Jeremy Werdell
LAR = Lorraine Remer
PWZ = Pengwang Zhai

Monday, August 1

Morning (8:30 to 12:00)

- Lecture 1 (L1): Welcome! (JW, PWZ)
- Icebreaker (JT)
- L2: History of ocean color from satellites (JW)
- L3: History of atmospheric science from satellites (LAR)
- L4: PACE mission overview (JW)

Afternoon (12:00 to ~5:00)

- L5: How does it work: radiative transfer through the ocean and atmosphere (PWZ)
- L6: How does it work: passive remote sensing, radiometry, and polarimetry (BC)
- L7: How does it work: SPEXone (BC)

Evening (after dinner)

- Fireside chat with special guests from NASA HQ (Laura Lorenzoni, Hal Maring, Woody Turner)

Tuesday, August 2

Morning (8:30 to 11:30)

- L8: PACE in a consumer's market (JW)
- L9: How does it work: HARP2 (LAR)
- Lab 1: Playing with light (IC, LAR, JT)
- HARP2 facilities tour (LAR)

Afternoon (12:30 to 4:00)

- How does it work: OCI (Eric Gorman)
- How does it work: Flight projects (Gary Davis, Veronica Pinnick, Beth Weinstein, Brad Weidema)

Evening (4:00 - …)

- Picnic dinner at Patapsco State Park

Wednesday, August 3

Morning (8:30 to 12:00)

- L10: PACE data products and approaches
  - Ocean color from OCI (Amir Ibrahim, IC, JT)
  - Aerosols and clouds from OCI (LAR, Andy Sayer)
  - Polarimetry and simultaneous retrievals (PWZ, BC)
- Lab 2: Addressing interdisciplinary science questions using PACE (LAR)

Afternoon (12:00 to 4:00)

- Box lunch
- GSFC facilities tour

Late afternoon (4:00 to ~5:00)

- Report out from Lab 2

Evening (after dinner)

- Fireside chat with special guest from GSFC Office of Communications

Thursday, August 4

Morning (8:30 to 12:00)

- L11: PACE for earth system modeling (Arlindo da Silva)
- L12: Taking an idea to orbit panel
  - Aircraft instruments (BC)
  - Earth venture suborbital (IC, BC)
  - Earth venture instruments (Antonio Mannino)
  - Cubesats (LAR)
  - Directed missions (JW)
- Lab 3: Shark tank exercise (IC, JT)

Afternoon (1:00 to ~5:00)

- L13: PACE data – files, formats, levels, access (Fred Patt)
- Lab 4: Playing with data (JW, JT, others)
- L14: PACE applications (Erin Urquhart, Natasha Sadoff)

Evening (5:00 to …)

- Dinner at Union Brewing Co.

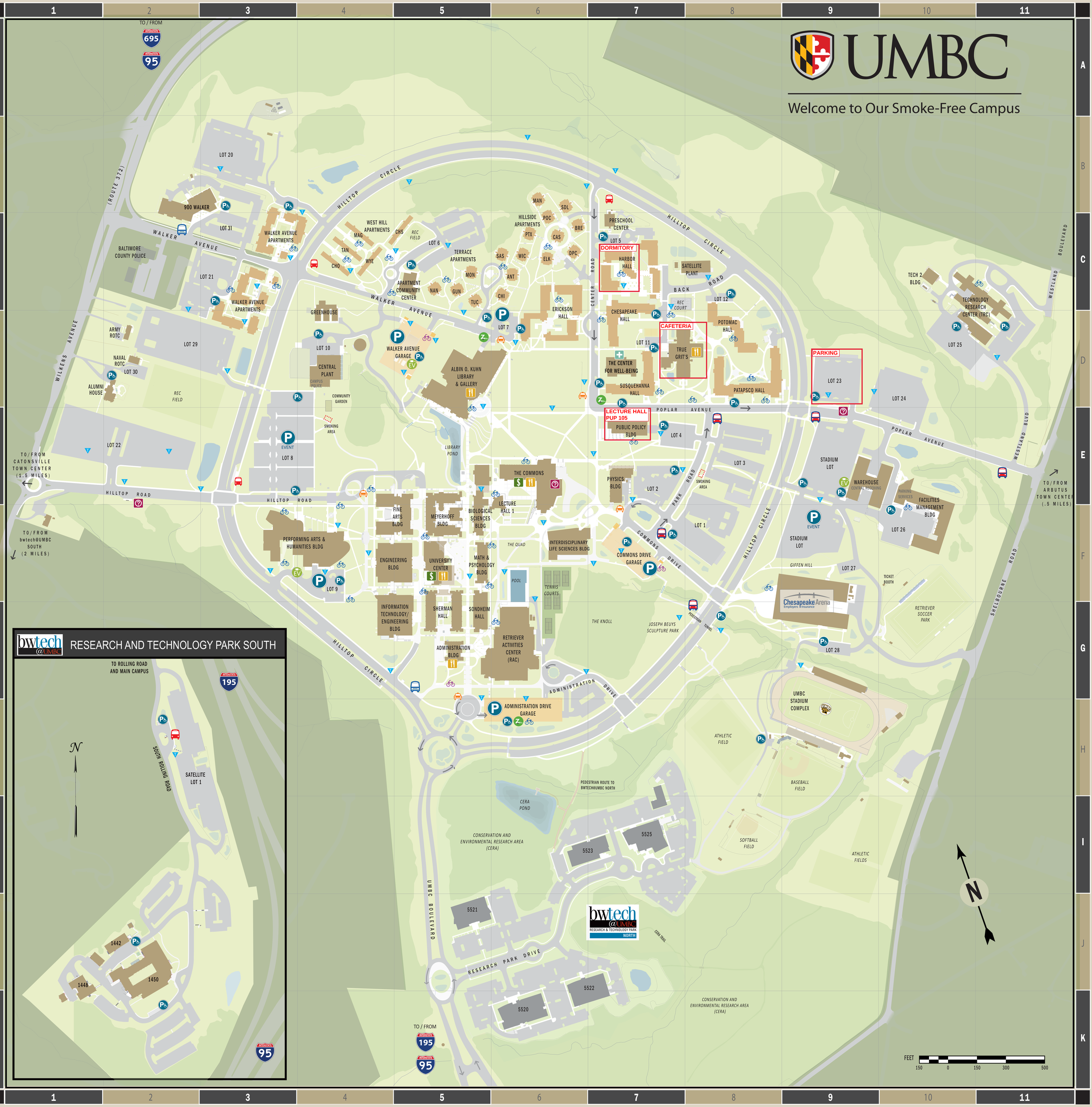
Friday, August 5

Morning (8:30 to 12:00)

- L15: System vicarious calibration (JW)
- L16: Validating ocean and atmospheric data products (Amir Ibrahim, Andy Sayer, Lachlan McKinna, IC)
- L17: Uncertainties for performance assessments (Amir Ibrahim, Andy Sayer, Lachlan McKinna)
- Wrap-up (all)

UMBC

Welcome to Our Smoke-Free Campus



bwtech @UMBC RESEARCH AND TECHNOLOGY PARK SOUTH

CAMPUS DIRECTORY

FREQUENT DESTINATIONS

Accessibility & Disability Services, 212 Math & Psychology Bldg F5
Admissions, Graduate, 2nd Floor Administration Bldg G5
Admissions, Undergraduate, Ground Floor facing Pond
Albin O. Kuhn Library & Gallery E5
Black Box Theatre, 127 Performing Arts & Humanities Bldg F4
Bookstore, The Commons E6
bwtech@UMBC North J5/J7
bwtech@UMBC South J2
Center for Art, Design and Visual Culture,
105 Fine Arts Bldg F4/F5
Earl and Darielle Linehan Concert Hall,
235 Performing Arts & Humanities Bldg F3
Dance Cube, 337 Performing Arts & Humanities Bldg F4
Library & Gallery, Albin O. Kuhn D5
Music Box, 151 Performing Arts & Humanities Bldg F3
Parking Services, 100 Facilities Management Bldg E10
Proscenium Theatre, 103 Performing Arts & Humanities Bldg F4
University Center Ballroom, 301 University Center F5

BUILDINGS

900 Walker B2
Administration Building G5
Alumni House D1
Army ROTC D2
Biological Sciences Building F5
The Center for Well-Being D7
Central Plant D4
The Commons E6
Chesapeake Employers Insurance Arena G9
Engineering Building F4/F5
Facilities Management Building E10/F10
Fine Arts Building F4/F5
Greenhouse D4
Information Technology/Engineering Building (ITE) G4/G5
Interdisciplinary Life Sciences Building F6
Lecture Hall 1 F6
Library & Gallery, Albin O. Kuhn D5
Mathematics & Psychology Bldg F5
Naval ROTC D2
Meyerhoff Chemistry Building F5
Performing Arts and Humanities Building F4
Physics Building E7
Preschool Center C7
Public Policy Building E7
Retriever Activities Center (RAC) G6
Satellite Utility Plant C7/C8
Sherman Hall G5
Sondheim Hall G5
Technology Research Center (TRC) C10/D10
Tech 2 Building C10
True Grit's D7
UMBC Stadium Complex H9
University Center F5
Warehouse E9

STUDENT HOUSING

Chesapeake Hall D7
Erickson Hall D6
Harbor Hall C7
Patapsco Hall D8
Potomac Hall D8
Susquehanna Hall D7
Walker Avenue Apartments C3

Hillside Apartments
Sideling (SDL) B6
Pocomoke (POC) C6
Manokin (MAN) B6
Patuxent (PTX) C6
Elk (ELK) C6
Deep Creek (DPC) C6
Casselman (CAS) C6
Breton (BRE) C6

West Hill Apartments
Chester (CHS) C4
Wye (WYE) C4
Magothy (MAG) C4
Tangier (TAN) C4
Choptank (CHO) C4

Terrace Apartments
Nanticoke (NAN) C5
Gunpowder (GUN) C5
Monocacy (MON) C5
Sassafras (SAS) C6
Wicomico (WIC) C6
Antietam (ANT) C6
Chincoteague (CHI) C6
Tuckahoe (TUC) C5

VISITOR PARKING

Administration Drive Garage H5
Commons Drive Garage F7
Walker Avenue Garage D5
Lot 7 D6
Lot 9 F4

EVENT PARKING

Stadium Lot E9/F9
Lot 8 E3

GENERAL INFORMATION

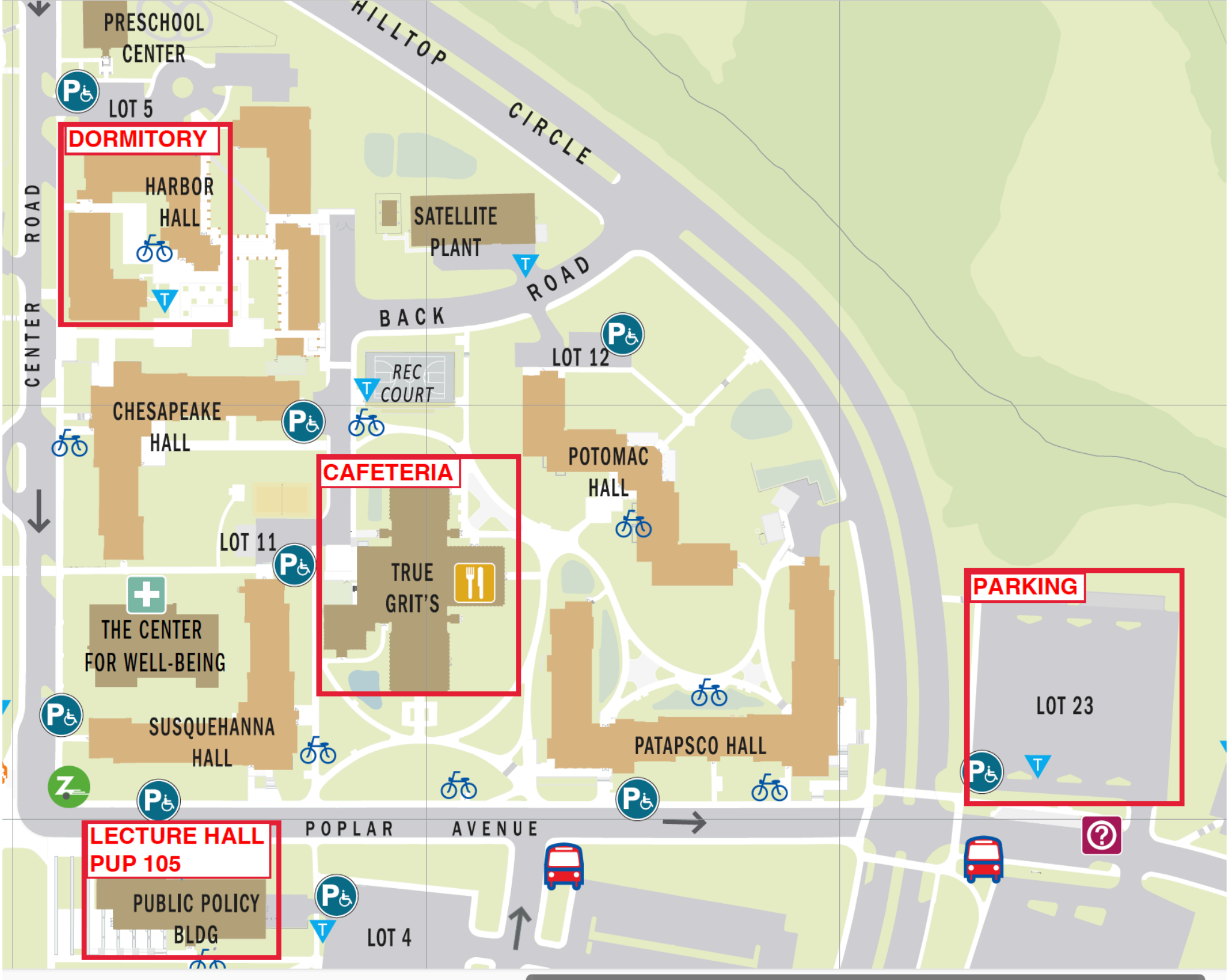
For more information call
410-455-1000

For Campus Police call
410-455-5555

LEGEND

- Visitor Parking
- Event Parking
- Accessible Parking
- Information Desk/Vehicular Kiosk
- Dining Locations
- ATM
- University Health Services
- Emergency Phone
- MTA Bus Stop Only
- MTA and UMBC Shuttle Bus Stop
- UMBC Shuttle Bus Stop Only
- Taxi Pickup Area
- Bicycle Rack
- Bicycle Repair Station
- Zip Car Location
- EV Charging Station

2021 CAMPUS MAP


PRESCHOOL CENTER
HILLTOP CIRCLE
LOT 5
DORMITORY
HARBOR HALL
CENTER ROAD
SATELLITE PLANT
ROAD
BACK
REC COURT
LOT 12
CHESAPEAKE HALL
CAFETERIA
POTOMAC HALL
LOT 11
TRUE GRIT'S
PARKING
THE CENTER FOR WELL-BEING
LOT 23
SUSQUEHANNA HALL
PATAPSCO HALL
LECTURE HALL PUP 105
POPLAR AVENUE
PUBLIC POLICY BLDG
LOT 4

Laptop Computer Preparation for Pre-PACE Training

In preparation for the training course for the Plankton, Aerosol, Cloud, and ocean Ecosystems (PACE) satellite mission in Baltimore, Maryland, August 1-5, 2022, plan to bring a laptop if one is available to you. We will be walking through data access and visualization using the following software:

NASA SeaDAS
Requires an Earthdata User Account: https://urs.earthdata.nasa.gov/
Download: https://seadas.gsfc.nasa.gov/downloads/
Instructions: https://seadas.gsfc.nasa.gov/tutorials/video_tutorials/
Note: SeaDAS has historically worked best for Mac or Linux. Windows Users may want to rely on Panoply or SNAP.

Panoply
Download: https://www.giss.nasa.gov/tools/panoply/download/
Instructions: https://www.giss.nasa.gov/tools/panoply/help/

Optional: ESA SNAP
Download: http://step.esa.int/main/download/snap-download/
Instructions: http://step.esa.int/main/doc/tutorials/

Please download and test the software before arriving at the course. To test the software, check that it will open a netCDF file containing latitude, longitude, and the desired variable. If you don't have a netCDF file available, download a test file at: https://oceancolor.gsfc.nasa.gov/l3/ This will require an EarthData User Account, the same as downloading NASA SeaDAS (see above).

Resources for Pre-PACE Training

This set of resources is a starting point for learning about the objectives and goals of the Plankton, Aerosol, Cloud, and ocean Ecosystems (PACE) satellite mission. This upcoming satellite is being developed by the U.S. National Aeronautics and Space Administration (NASA) to monitor Earth's surface, extending and improving NASA's over 20-year record of satellite observations of global ocean biology, aerosols, and clouds.

1. **PACE Mission:**
   - Why don't all ocean color satellites measure hyperspectral radiances at meter-scales?
     Video: https://www.youtube.com/watch?v=wkb4qgMEFjQ
     Slides: http://misclab.umeoce.maine.edu/OceanOpticsClass2021/wp-content/uploads/2021/08/Lecture_33_satellites_photons_Werdell.pdf
   - PACE website: https://pace.oceansciences.org/home.htm
   - PACE website > PACE-related Presentation Materials: https://pace.oceansciences.org/documents.htm?id=presentation
   - Keeping PACE with NASA's Plankton, Aerosol, Cloud, ocean Ecosystem mission Video: https://www.youtube.com/watch?v=VFpcNbcQz0M
   - NASA Ocean Color Website > PACE Portal: https://oceancolor.gsfc.nasa.gov/data/pace/
   - Lessons-Learned in the Implementation of NASA's Earth Venture Class Report: https://www.nationalacademies.org/our-work/lessons-learned-in-the-implementation-of-nasas-earth-venture-class

2. **Ocean Optics and Aquatic Remote Sensing:**
   - NASA Ocean Color Current Algorithm Descriptions: https://oceancolor.gsfc.nasa.gov/atbd/
   - NASA ARSET Introduction to Remote Sensing for Coastal and Ocean Applications: https://appliedsciences.nasa.gov/join-mission/training/english/arset-introduction-remote-sensing-coastal-and-ocean-applications
   - Ocean Optics Web Book: https://www.oceanopticsbook.info/
   - Ocean Optics Web Book > Remote Sensing > Ocean Color: https://www.oceanopticsbook.info/view/remote-sensing/ocean-color
   - Ocean Optics Web Book > Atmospheric Correction: https://www.oceanopticsbook.info/view/atmospheric-correction/chapter-overview
   - Most Recent Ocean Optics class website (2021): http://misclab.umeoce.maine.edu/OceanOpticsClass2021/index.php/schedule/

- Past Ocean Optics courses websites (7 courses from 2004 to 2019): http://misclab.umeoce.maine.edu/OceanOpticsClass2021/index.php/class-resources/

3. Aerosol Remote Sensing:

- Aerosol Remote Sensing by Lenoble, Remer, Tanré (Book, Free PDF download) https://link.springer.com/content/pdf/10.1007/978-3-642-17725-5.pdf
- Introduction to Aerosol Remote Sensing (Slides by Bréon): https://aerocom-classic.met.no/DATA/AEROCOM_PUBLIC/oxford10/pdf_gen/Breon_Intro_RemoteSensing.pdf
- Space-based Remote Sensing of Atmospheric Aerosols (Review Paper): https://www.issibern.ch/teams/aerosolsensing/earth_sci_rev.pdf
- Aerosol Measurements by SPEXone on the NASA PACE Mission: Expected Retrieval Capabilities (Article): https://doi.org/10.1016/j.jqsrt.2019.02.006

4. PACE-related Cloud Remote Sensing:

- Characterizing the information content of cloud thermodynamic phase retrievals from the notional PACE OCI shortwave reflectance measurements (Article): https://doi.org/10.1002/2017JD026493
- Remote sensing of cloud properties using PACE SPEXone and HARP-2 (Slides): https://pace.oceansciences.org/docs/sat_oct21_vanDiedenhoven01.pdf

5. Air Quality Remote Sensing:

- NASA ARSET Satellite Remote Sensing of Air Quality: https://appliedsciences.nasa.gov/join-mission/training/english/arset-satellite-remote-sensing-air-quality
- Air Quality Introductory Presentation Slides: https://appliedsciences.nasa.gov/sites/default/files/D1P1_overview.pdf
- NASA ARSET How NASA Measures Air Pollution: https://appliedsciences.nasa.gov/join-mission/training/english/arset-inside-look-how-nasa-measures-air-pollution
- Aerosol Particulate Matter Presentation Slides: https://appliedsciences.nasa.gov/sites/default/files/2020-11/InsideLookAQ_Part2_Final.pdf

6. Hyperspectral Remote Sensing:

- NASA Applied Remote Sensing Training (ARSET): Hyperspectral Data for Land and Coastal Systems: https://appliedsciences.nasa.gov/join-mission/training/english/arset-hyperspectral-data-land-and-coastal-systems

- Living up to the Hype of Hyperspectral Aquatic Remote Sensing: Science, Resources, and Outlook (Review Paper): https://www.frontiersin.org/articles/10.3389/fenvs.2021.649528/full
- National Science Foundation (NSF) National Ecological Observatory Network (NEON) Hyperspectral Data Tutorial: https://www.neonscience.org/resources/learning-hub/tutorials/introduction-hyperspectral-remote-sensing-data

7. Polarimetric Remote Sensing:

- Polarimetric remote sensing of atmospheric aerosols: Instruments, methodologies, results, and perspectives (Review paper): https://doi.org/10.1016/j.jqsrt.2018.11.024
- Ocean Optics Web Book > Polarization: https://www.oceanopticsbook.info/view/atmospheric-correction/level-2/polarization
- Hyper-Angular Rainbow Polarimeter (HARP) Polarimeter Presentation Slides: https://userpages.umbc.edu/~martins/laco/payload.htm
- Spatial distribution of cloud droplet size properties from Airborne Hyper-Angular Rainbow Polarimeter (AirHARP) measurements (Article): https://amt.copernicus.org/articles/13/1777/2020/

8. Terminology

- NASA ARSET Remote Sensing Glossary of Terms: https://appliedsciences.nasa.gov/arset-glossary
- Ocean Optics Web Book > Brief Definitions: https://oceanopticsbook.info/view/references/brief-definitions