Urban Boundary Layer Observations & Analysis

Research Update

Presented: 11/12/2021

Project Updates

Completed

- Average vertical profiles of quantities
- GOES-R data visualization algorithm (SST + LST)
- Draft of paper outline

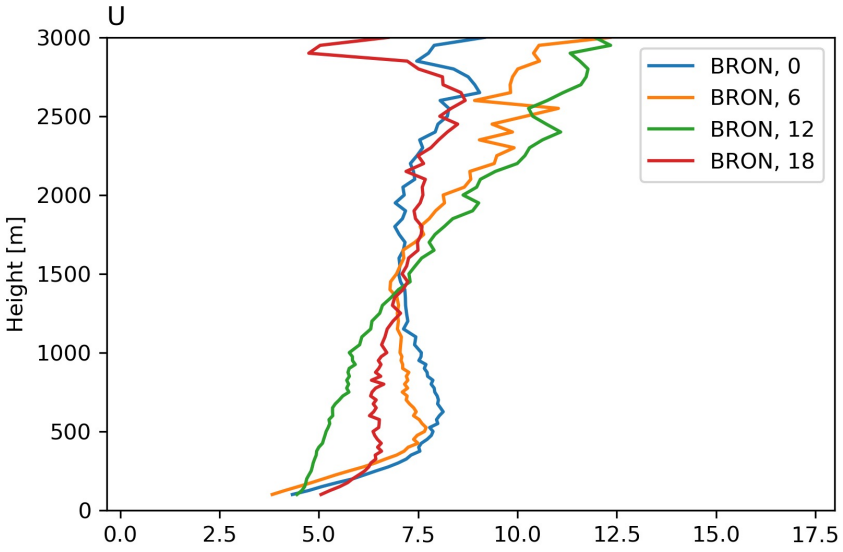
In process

- Getting Mesonet flux data for 2018, 2020, 2021
- Identifying case study days (typical heat wave example, typical normal example, typical sea breeze example)
- Spectral analysis for select heat wave days in 2021
- Quality control procedures for lidar and radiometer data
- AMDAR flight data in process

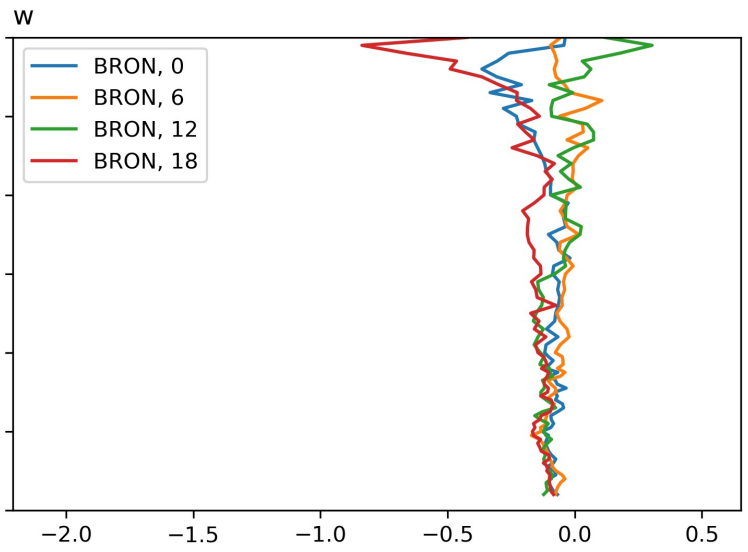
Average vertical profiles (average only)

- Plots shown below include averaged data over 48 heat wave days from 2019-2021
- Bronx data only shown for clarity

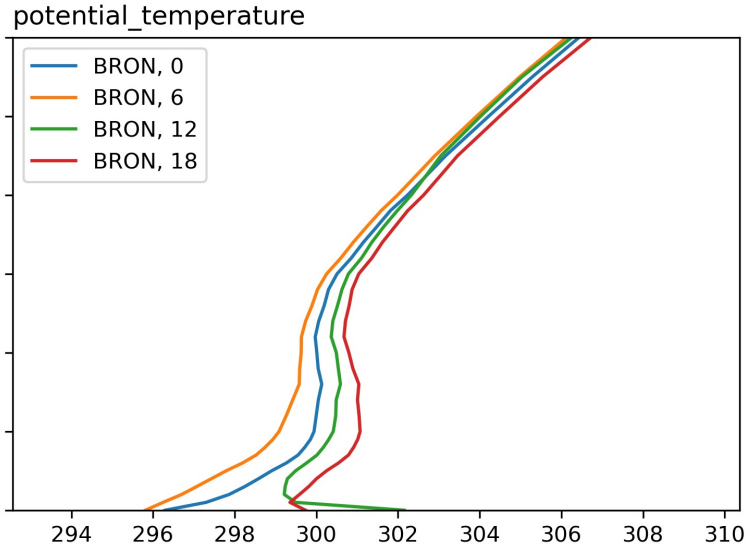
Mean horizontal wind speed



Vertical velocity



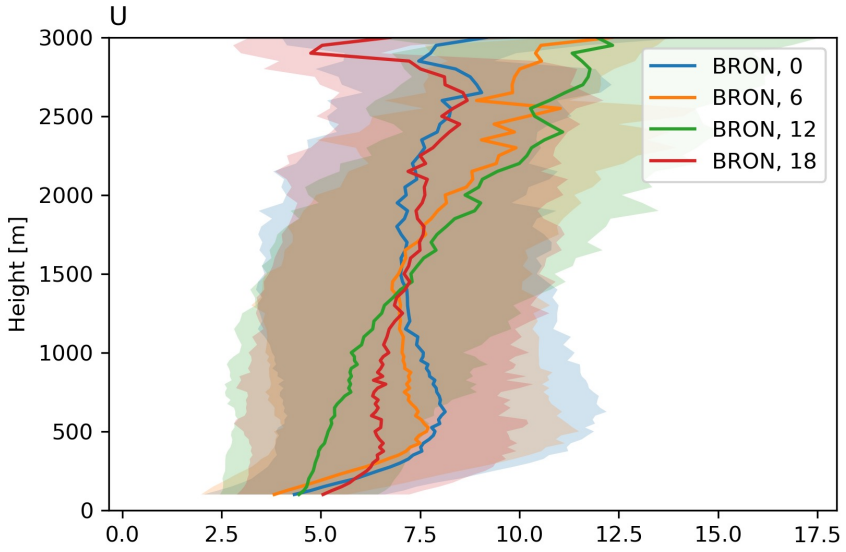
Potential temperature



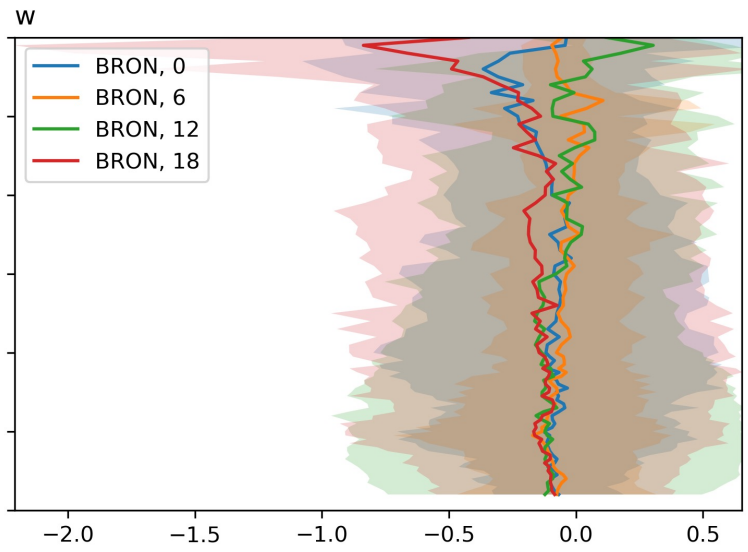
Average vertical profiles (average with 1-sigma overlay)

- Plots shown below include averaged data over 48 heat wave days from 2019-2021
- Bronx data only shown for clarity

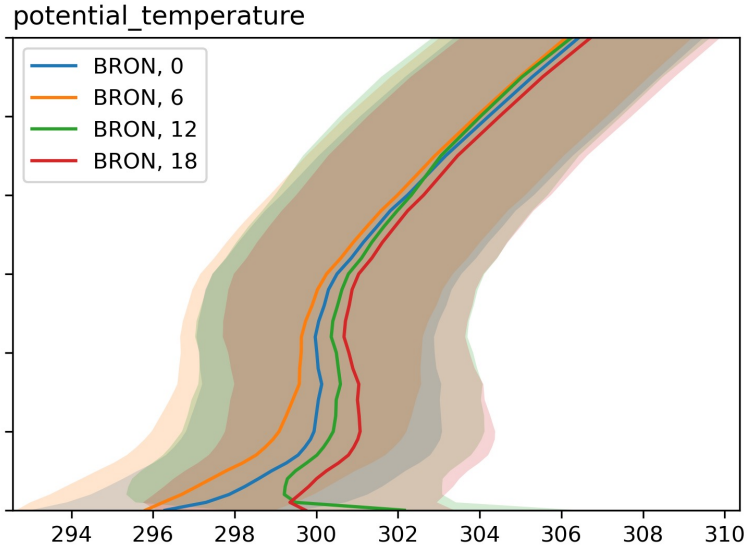
Mean horizontal wind speed



Vertical velocity



Potential temperature



GOES-R Data Visualization

- Intended to ”set the stage” for case study dates
- Combined GOES-R LST and SST data
- SSTs included for use in sea breeze analysis
- Dates with clear skies will be chosen for best GOES-R data quality

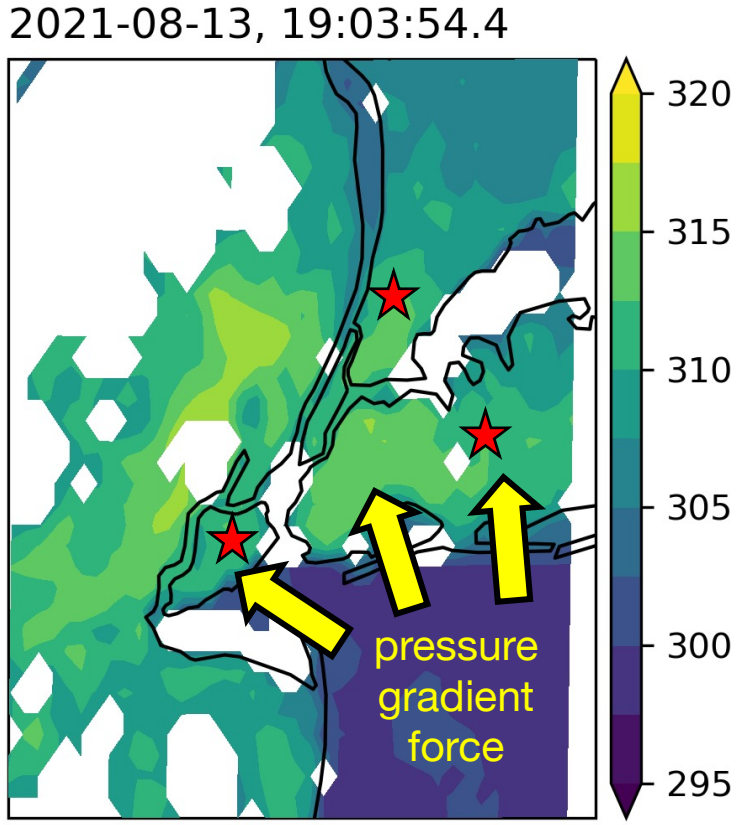


Figure: LST and SST shown at a specific time on 08/13/2021 (~15:00 LST)

Paper Outline - Draft

1. Background and introduction (relevance of this work, literature reviews, identify literature gaps)
2. Data and methodology
    1. Data sources (EC systems, lidar, microwave radiometer, ASOS, GOES-R, AMDAR)
    2. Data quality control methods
    3. Methodology of derived parameters (Ri, potential temperature, air pressure, etc.)
    4. Methodology for identifying events (heat wave days, sea breezes)
3. Results
    1. Average profiles and quantities (typical normal and heat wave profiles)
    2. Case study days
        1. Synoptic scale meteorological conditions
        2. Daily analysis (morning → afternoon → evening → night)
        3. Statistical analyses (surface layer to mixed layer coupling)
    3. Effect of sea breeze on boundary layer properties (thermodynamics, moisture transport)
    4. Error analysis
4. Discussion (normal vs. heat wave BL properties, effects of sea breeze, surface/mixed layer relationship sources of error)
5. Conclusions

Backup

Project Overview

- Objective: address gap in literature concerning the atmospheric boundary layer in urban areas
- Methods: (1) synthesize observations from various sources to compile data on surface, surface layer, and mixed layer properties;
  (2) use analytical methods to obtain derived quantities
- Outcome:

Project Schedule (as of 09/20)

Literature Review → Data Synthesis → Grouping and Patterns → Data Analysis & Statistics → Post-processing & writing

Objective

- Identify research gaps

Status

- Completed

ECD

- 08/20/2021

Research gap(s)

- Sea-breeze effects during heat waves
- Effects of soil moisture on UBL in heat waves
- Nocturnal UBL properties during heat waves
- Effect of surface forcings on eddies
- BL height during heat waves

Objective

- Construct xArray Dataset (Python structure)
- Employ parallelization for big data handling

Status

- In process

ECD

- 09/22/2021

Data sources

- NYS Mesonet
- CCNY instruments
- AMDAR

Objective

- Stability grouping
- Heat wave identif'n
- Wind direction

Status

- In process

ECD

- 10/08/2021 (iterative)

Objective

- Spectral analysis (eddy analysis)
- Statistical analyses (surface forcings → UBL properties)
- Turbulence parameters

Status

- To be completed

ECD

- 10/29/2021 (iterative)