NHERI GSC
January General Meeting

NHERI
GSC

2025

NHERI GSC
Graduate Student Council

Agenda

11:00-11:10 Welcome & Announcements

11:10-11:45 Craig Jansen

11:45-11:55 Questions

11:58-12:00 Wrap up

12:00-12:30 Wind & Reconnaissance RSR Meetings

Welcome New Members

Narayan	Kumar	Felipe	Vicencio
Estovio	Timothy	Min Thit	Khant
Syed Mostofa	Asif	Sajan	K C
Md Mostafizur	Rahman	Ferial	Ahmadi
Ahmed	Maky	Tania	Lamichhane
Maharin	Khondoker	Hafiz Abdul	Basit
Kamrul	Islam	Ezaz Ali	Khan
Yubaraj	Karki		

*Reach out to Daniel Yahya and Diako Abiass to learn how to get involved!

NHERI GSC
Graduate Student Council

Membership Certificates

NSF NHERI GSC members who would like to receive a formal membership certificate may request a certificate twice a year (January 1- January 30 and August 1- August 30) by filling out the following Google Form (https://bit.ly/NSFNHERIGSC_MembershipCertificate).

Registered members who have participated in at least two NSF NHERI GSC events the prior semester will be sent a membership certificate (view example).

Conference Opportunities!

Conference	Dates	Abstract
AAG: 2025 American Association of Geographers	March 24-25, **2025**	Closed
EMI: ASCE Engineering Mechanics Institute	May 27-30, **2025**	Closed
IWSHM: International Workshop on Structural Health Monitoring	September **2025**	February 1, **2025**
YCSEC: Young Coastal Scientist and Engineers Conference	April 3-4, **2025**	Closed
ACWE: 15th Americas Conference for Wind Engineering	May 19-25, **2025**	Closed
ANNSIM: Annual Modeling & Simulation Conference	May 26th-29th, **2025**	Open, Paper deadline Jan. 19, **2025**
Geotechnical Frontiers Conference	March 2-5, **2025**	Closed
Natural Hazards Workshop	July 13-16, **2025**	Unknown

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Conference Opportunities!

Conference	Dates	Abstract
AGU24: American Geophysical Union	December 9-13, **2024**	Closed
Forensic Engineering Congress	November 4, **2024**	Closed
Society of Risk Analysis Conference	December 8-12, **2024**	Closed
IMAC	February 10-13, **2025**	Closed
American Sociological Association Virtual	January 30-31, **2025**	Closed
Association for Public policy Analysis & Management	November 21st- 23rd, **2024**	Closed
NHERI Computational Symposium	February 5-7, **2025**	Closed

Abstracts are closed but registration is open.

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Graduate Student Council

Natural Hazards Center Award

50th Annual Natural Hazards Research & Applications Workshop (**July 13 - 16, 2025**) and the 2025 Researchers Meeting (**July 16 - 17, 2025**)

Award Description

Meals and registration will be covered for five NHERI GSC Members.

Awardee Responsibilities

- **Abstract Submission**: Submit an abstract for either: NHC Poster Session or Researchers Meeting
- **Session Recording**: Record two sessions during the Natural Hazards Workshop.
- **Apply for funding:** https://bit.ly/2025funding_NHW

Awardees will receive details and guidance to fulfill their responsibilities.

Opportunities

NHERI GSC
Graduate Student Council

NSF NHERI Summer Institute

GSC members who attend 2 meetings between **August 1, 2024-February 23, 2025**, are eligible to apply for funding to apply for the Institute.

Info Sessions

Learn more about the NSF NHERI Summer Institute @ 5:00 pm Central Time

- January 28, 2025

Apply

NHERI
Natural Hazards Engineering Research Infrastrucure

NSF | NHERI GSC Graduate Student Council

Open NHERI GSC Nominations!

Open **January 17-3**1
Voting via Qualtrics on **February 3-5**

Open Positions

1. Vice Chair of Research
2. Vice Chair of Workshop & Mentoring
3. Vice Chair of Social Media & Outreach
4. Vice Chair of Networking & Community Building
5. Vice Chair of Diversity, Equity, and Inclusion
6. NHERI GSC User Forum Representative

Nominate

NHERI GSC
Graduate Student Council

Vote on Proposed Amendments

- NHERI GSC members will vote on the proposed amendments via a Qualtrics survey
- The survey includes the updated amendments for review
- The survey was sent out today
- Voting will close on Sunday, January 19, 2025

NHERI GSC
Graduate Student Council

NHERI GSC Research Subcommittee Meetings!

Group Breakout Rooms

Breakout Rooms (*30 Minutes*):

1. Reconnaissance Subcommittee
Presentation#1 by Dr. Antonio Balderrama
Topic: Lessons Learned from Hurricane Otis

Presentation#2 by Dr. Brad Wham

Topic: Lessons Learned from Marshall Colorado Wildfire

2. Wind Engineering Subcommittee
Presentation by Dr. Shaopeng Li
Topic: A Novel Wind Tunnel Testing Method for Debris Flight in Turbulent Winds

Hosted by:

Mohammad Movahedi

RSR of Reconnaissance

Arezoo Bakhshizadeh

RSR of Wind Engineering

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DATA CHALLENGE

at the NHERI GSC MINI CONFERENCE

2025
MAY 16

FRIDAY
10 AM - 5 PM CT

Register today!

Registration ends January 24!

- *Make an Impact!*
- *Earn recognition and mentorship!*
- *Showcase Your Work!*
- *Work with other researchers!*

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Vote on Mini-Conference Guest Speaker
https://form.jotform.com/250145647524052

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Graduate Student Council

Speaker Introduction

Craig Jansen

User Experience Designer
Office of Research

Texas Advanced Computing Center (TACC)

cjansen@tacc.utexas.edu

NHERI GSC
Graduate Student Council

Using DesignSafe to Advance Natural Hazards Engineering

Craig Jansen

User Experience / User Interface (UX/UI) Researcher
Texas Advanced Computing Center (TACC)
University of Texas at Austin

NSF NHERI DESIGNSAFE · TEXAS The University of Texas at Austin · UCLA · RICE · Florida Tech · TACC

Supporting Your Research Process From Start to Finish

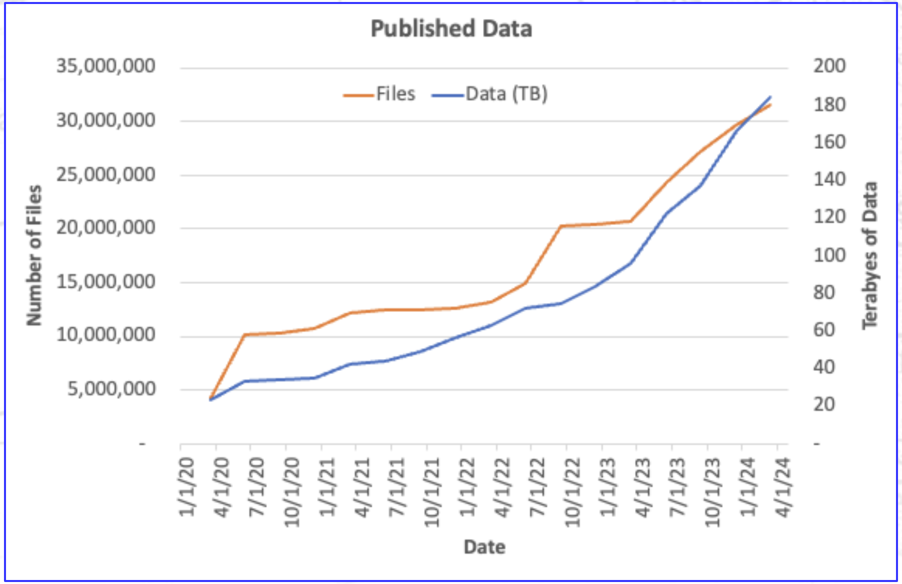
- Explore relevant prior work in ***Published Datasets*** and ***reuse*** it in your research – No log-in required!
- Connect you with a ***network of researchers*** to support your project
- Upload ***large data*** to your research team's shared ***Project***
- Utilize the computational power of ***Tools & Applications***
- ***Curate & Publish*** your data to share with the community
  - Compliant with White House Office of Science & Technology Policy *Ensuring Free, Immediate, and Equitable Access to Federally Funded Research*

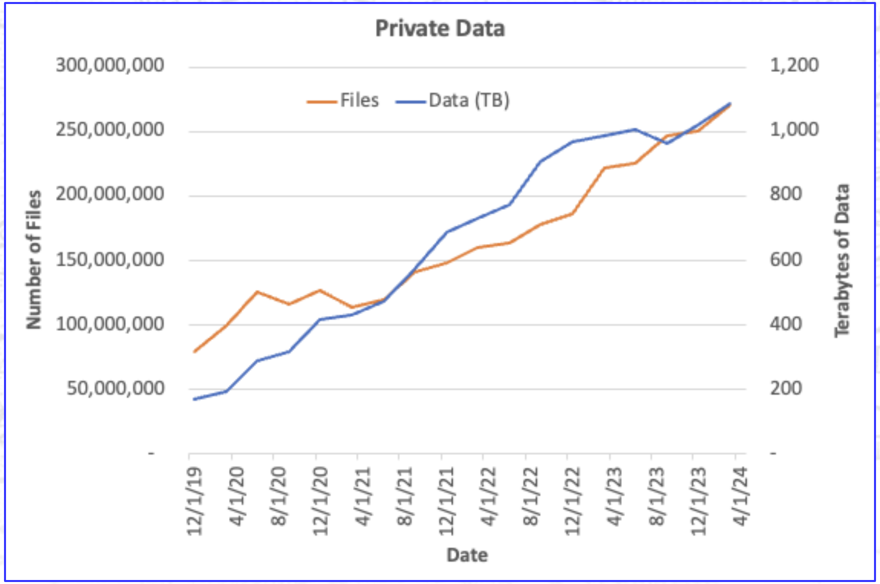
Community Impact

A snapshot of our community impact dating back to July 2015:

- **> 9,000** user accounts
- **282** marker paper citations https://doi.org/10.1061/(ASCE)NH.1527-6996.0000246
- **100** training events, **> 5,000** attendees
- **> 200** outreach events
- **~350,000** web hits online
- **~1,000** published datasets
  - **~400,000** published files previewed or downloaded
- **> 330,000** Slack posts

Data Depot Repository





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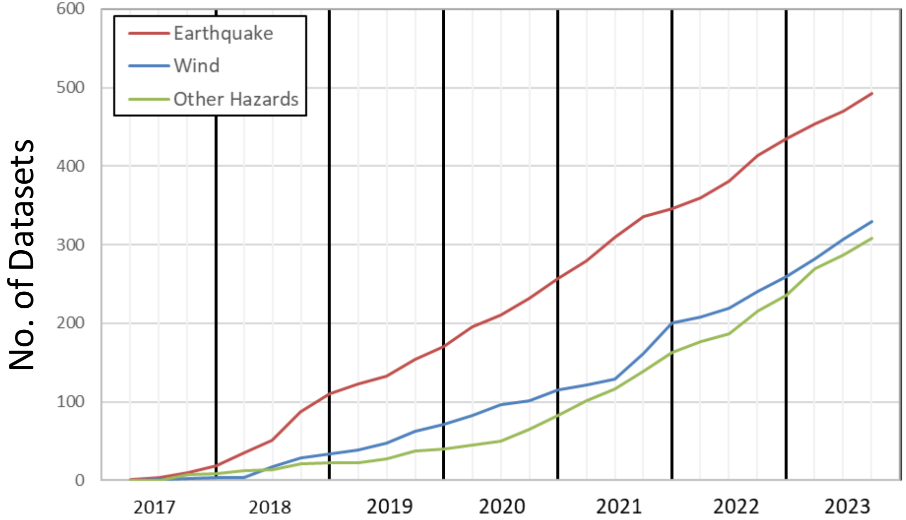
Data Publishing and Reuse

Published Datasets

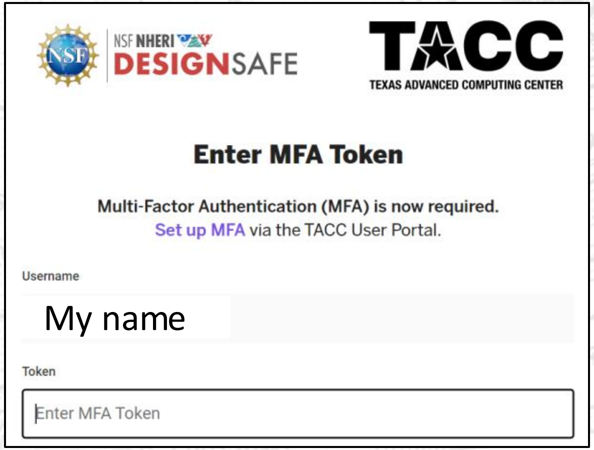


Data Reuse

Year	DesignSafe Citation	Primary Data Use	Subsequent Data Reuse	Totals
Q1-3 2024	35	92	147	274
2023	64	142	140	346
2022	65	107	105	277
2021	42	89	60	191
2020	52	74	61	187
2019	21	25	30	76
2018	26	31	13	70

DesignSafe Accounts

- DesignSafe Account = TACC Account
- Multi-factor authentication (MFA) required to login
  - Authenticator apps (e.g., Duo, Google Auth, 1Password)
  - Set up via TACC User Portal (https://tacc.utexas.edu/portal)
- New DesignSafe account takes ~ 2 business days to set up (working to automate this process)



DesignSafe Data Depot

DATA DEPOT

Add

Private

- My Data
- Work
- My Projects
- Box.com
- Dropbox.com
- Google Drive

Public

- Published
- Published (NEES)
- Community Data

Help

Find in My Projects

Project ID	Title	Principal Investigator
PRJ-3885	WMA_GEOSPATIAL TEST MAP	John Gentle
PRJ-2224	Walk Experiment Demo	Tracy Brown
PRJ-2743	Nathan Geo Data 2	Nathan Franklin
PRJ-4513	Simulations - Site Response using OpenSees	Maria Esteva
PRJ-2387	Field Research Project	Craig Jansen
PRJ-4337	Hybrid Simulation Test	Craig Jansen
PRJ-4336	Hybrid Simulation Test 2	(N/A)
PRJ-4333	Hybrid Simulation Test 3	(N/A)
PRJ-4102	Hybrid Sim Testing Craig	Craig Jansen
PRJ-3987	Testing Again	Craig Jansen
PRJ-3978	Simulation Project Testing Amends	Craig Jansen

Published Datasets *Search across a variety of domains*

DATA DEPOT

Add

- My Data
- Work
- My Projects
- Box.com
- Dropbox.com
- Google Drive
- Published
- Published (NEES)
- Community Data

Help

Search | Author, Title, Keyword, Description, Natural Hazard Event, or Project ID | **Natural Hazard Type** All Types | **Year Published** All Years | Clear Filters

Project ID	Title	Principal Investigator	Description	Keywords	Publication Date
PRJ-4359	Shake Table Test of a Resilient Full-Scale Ten-Story Mass Timber Building (Dataset)	Shiling Pei	View Description	Mass timber, resilience, shake table test	11/15/2024
PRJ-5694	Shake Table Test of the NHERI TallWood 10-story Mass Timber Building with Post-tensioned Rocking Walls and Supplemental Uplift Friction Dampers (Experimental)	Daniel Dowden	View Description	shake table test, mass timber, post-tensioned rocking wall	10/31/2024
PRJ-2657	NHERI UC San Diego LHPOST6 Modular Testbed Building (MTB2) (Experimental)	Tara Hutchinson	View Description	Shake table tests, building models, testbed model	10/29/2024
PRJ-5626	Research Experiences for Undergraduates (REU), NHERI 2024: Development of a Total Environmental Data Interaction System for the NSF NHERI LHPOST6 (Research Experience for Undergraduates)	Emersen Liauw	View Description	LHPOST6, UCSD, Weather Monitoring System	8/31/2024
PRJ-5617	Research Experiences for Undergraduates (REU), NSF NHERI 2024: Assessment of Fire Sprinkler System in a 10-Story Cold-Formed Steel Building During Seismic Loading Scenarios (Research Experience for Undergraduates)	Leah Seifert	View Description	NSF NHERI UCSD LHPOST6, CFS, Non-structrual	8/28/2024
PRJ-5613	Research Experiences for Undergraduates (REU), NSF NHERI 2024: Contributions to the Development of a Framework for Predicting Weldment Fracture (Research Experience for Undergraduates)	Michael Morales	View Description	weldment fracture, finite element, microstructures	8/27/2024
PRJ-5602	Research Experiences for Undergraduates (REU), NHERI 2024: Contribution in Study of Soil-Steel Pipe Piles In-Ground Hinge Performance (Research Experience for Undergraduates)	Saul Romero	View Description	NSF NHERI UCSD LHPOST6, Soil Pit, Steel Pipe Piles	8/21/2024
PRJ-4760	Natural Hazards Research Summit 2024: Innovations in Cold-formed Steel	Amanpreet Singh	View Description	Cold-formed Steel, Tall	6/24/2024

Facility: Six Degree of Free...

- **Experimental** — Experiment Type: All Types
- **Simulation** — Simulation Type: All Types
- **Field Research** — Field Research Type: All Types; Natural Hazard Year: All Years
- **Hybrid Simulation** — Hybrid Simulation Type: All Types
- **Other** — Data Type: All Types

Project Structure

Published Project contains all Datasets & DOIs in one page

PRJ-2141 | CFS-NHERI: Seismic Resiliency of Repetitively Framed Mid-Rise Cold-Formed Steel Buildings

PI	Hutchinson, Tara
Co-PIs	Schafer, Benjamin; Peterman, Kara
Project Type	Experimental
Natural Hazard Type(s)	Earthquake
Awards	Collaborative Research: Seismic Resiliency of Repetitively Framed Mid-Rise cold-Formed Steel Buildings | Collaborative Research: Seismic Resiliency of Repetitively Framed Mid-Rise cold-Formed Steel Buildings |
Keywords	Cold-Formed Steel, In-line Wall Testing, Finishes, Gravity Walls, Tall building Systems, Fastener Testing, D

Datasets with Metrics & Citations

Experiment | **Wall Line Tests: Phase 1 -- Shake Table Tests**

Cite This Data:
Singh, A., T. Hutchinson, X. Wang, Z. Zhang, B. Schafer, F. Derveni
Formed Steel Buildings [Version 2]. DesignSafe-CI. https://doi.org/

Download Citation: DataCite XML | RIS | BibTeX
189 Downloads 4617 Views 2 Citations **Details**

Experiment | **Cold-Formed Steel Framed Shear Wall Database**

Cite This Data:
Zhang, Z., M. Eladly, C. Rogers, B. Schafer (2022). "Cold-Formed S
https://doi.org/10.17603/ds2-ag1e-6m27

Download Citation: DataCite XML | RIS | BibTeX
105 Downloads 4284 Views 1 Citations **Details**

Organization allows for quick understanding of large datasets

Analysis | **Data Processing Tools**

Model Configuration | **Test Group 4**

↳ Sensor Information | **Test Group 4: Test Protocol, Sensor/C**

↳ Event | **Test Group 4: Demolition / Specimen Removal**

↳ Event | **Test Group 4: Dynamic Events**

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DesignSafe Data Models

Structured, yet ***flexible***, data models for different types of research

Experimental Project
For physical work, typically done at an experimental facility or in the field.

Simulation Project
For numerical and/or analytical work, done with software.

Hybrid Simulation Project
For work using both physical and numerical components.

Field Research Project
For work done by observation in areas affected by a natural hazard.

Other Project
For work other than the project types above.

Your data must be curated in order to be discovered, and understood for years to come.

Describing your data

What is this project about?

How can data in this project be reused?

How is this project unique?

Who is the audience?

Think of social scientist **who has never taken an engineering class..**
Would they understand it?

Organizing your data

Model Configuration Files describing the design and layout of what is being tested (some call this a specimen).

Sensor Information Files about the sensor instrumentation used in a model configuration to conduct one or more event.

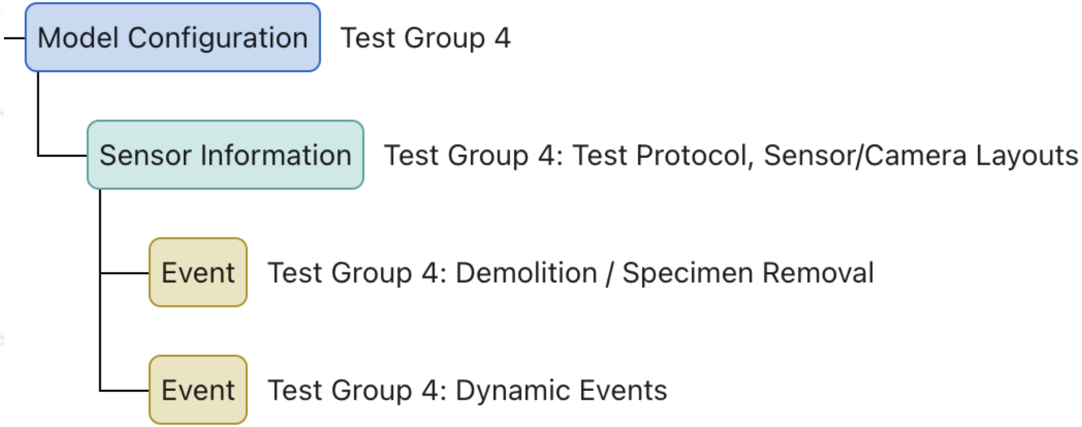
Event Files from unique occurrences during which data are generated.

Analysis Tables, graphs, visualizations, Jupyter Notebooks, or other representations of the results.

Report Written accounts made to convey information about an entire project or experiment.

Start early!

1 | Add Experiments 2 | Add Categories 3 | Relate Data



Felxible data model

Model Configuration | **Read me**

↳ Sensor Information | **Benders**

Model Configuration | **Layout**

↳ Sensor Information | **CPT Load**

↳ Event | **CPT**

↳ Sensor Information | **DI-RP072**

↳ Event | **DI-RP072 pile load test**

↳ Sensor Information | **Rough pile**

↳ Event | **Rough pile load test**

↳ Sensor Information | **RI-DP030**

↳ Event | **RI-DP030 pile load test**

↳ Sensor Information | **DI-RP030**

↳ Event | **DI-RP030 pile load test**

↳ Sensor Information | **Smooth pile**

↳ Event | **Smooth pile load test**

Analysis | **Data Visualization**

Analysis | **Data Processing Tools**

Model Configuration | **Test Group 4**

↳ Sensor Information | **Test Group 4: Test Protocol, Sensor/Camera Layouts**

↳ Event | **Test Group 4: Demolition / Specimen Removal**

↳ Event | **Test Group 4: Dynamic Events**

Model Configuration | **Test Group 3**

↳ Sensor Information | **Test Group 3: Test Protocol, Sensor/Camera Layouts**

↳ Event | **Test Group 3: Test Setup / Specimen Installation**

↳ Event | **Test Group 3: Dynamic Events**

Model Configuration | **Test Group 2**

↳ Sensor Information | **Test Group 2: Test Protocol, Sensor/Camera Layouts**

↳ Event | **Test Group 2: Test Setup / Specimen Installation**

↳ Event | **Test Group 2: Dynamic / Slow Monotonic Pull Events**

↳ Event | **Test Group 2: Demolition / Specimen Removal**

Model Configuration | **10-story Mass Timber Building**

↳ Sensor Information | **Instrumentation drawings and**

↳ Event | **Test 1_WN_X**

↳ Event | **Test 2_WN_Y**

↳ Event | **Test 3_EQ_225_Y**

↳ Event | **Test 4_EQ_225_YZ**

↳ Event | **Test 5_EQ_475_Y**

↳ Event | **Test 6_EQ_475_YZ**

↳ Event | **Test 7_WN_X**

↳ Event | **Test 8_WN_Y**

↳ Event | **Test 9_EQ_975_Y**

Shake Table Metadata

Select Model Configuration file tags or

- Concrete
- Loading Protocol Ground Motions
- Loading Protocol Intensity
- Masonry
- Material Test
- Numerical Model
- Protective System Damping
- Protective System Isolation

Select Sensor Information file tags

Shake Table

- Accelerometer
- Displacement Sensor
- Load Cell
- Linear Potentiometer
- Soil Sensor
- Strain Gauge

Your efforts are worthwhile!

*"The categories, such as model configuration, sensor info, events, and analysis, are clear and well-structured, making it **easy to navigate and comprehend** the dataset."*

*"The data seems to be organized in a logical manner that **helps understanding**."*

*The project and experiment **descriptions provide essential context** for understanding the dataset, outlining the goals, objectives, and methodology employed...*

*The categories offer a **clear and logical structure** for organizing the experimental data. The data appears to be well-organized, enabling easy navigation and **locating specific information** within the project.*

26 January 2023: DesignSafe Data Depot certified as a Trustworthy Data Repository by the CoreTrustSeal Standards and Certification Board (thru 26 Jan 2026)

- Evaluated on 16 components across 3 themes:
  - Organizational infrastructure
  - Digital object management
  - Technology
- Fewer than 4% of data repositories worldwide have been certified.
  - 115 certified repositories, 3094 registered repositories at re3data.org

Dataset Awards

NHERI Community | News | Help

- Community Calendar
- User Forum Committee
- Technology Transfer Committee
- **DesignSafe Dataset Awards**
- Hybrid Simulation Collaboratory (MECHS)
- Social Media
- Branding Toolkit

Dataset PRJ-3499

ARkStorm 2.0: Atmospheric Simulations Depicting Extreme Storm Scenarios Capable of Producing a California Megaflood

Adapted from the visualization for ARkStorm2.0 by James Done, with the color scale based on Scripps/CW3E's AR scale

California Flooding from the ARkStorm

Climate-induced storm flood data wins 2023 DesignSafe Dataset awards

Make Data Count Metrics

Experiment | **Wall Line Tests: Phase 1 -- Shake Table Tests**

Cite This Data:
Singh, A., T. Hutchinson, X. Wang, Z. Zhang, B. Schafer, F. De
Formed Steel Buildings [Version 2]. DesignSafe-CI. https://do

Download Citation: DataCite XML | RIS | BibTeX
189 Downloads 4617 Views 2 Citations **Details**

Unique Investigation: Refers to the number of one-hour sessions during which a user viewed metadata or previewed/downloaded/copied files associated with this DOI

Unique Request: Refers to the number of one-hour sessions during which a user previewed downloaded/copied files associated with this DOI

Total Requests: All downloads, previews, and copies of files plus Project Downloads.

Dataset Metrics [Updated 07/2024]

Aggregated Usage	
Unique Investigations (views)	1003
Unique Requests (downloads)	275
Total Requests	2290

Quarter 2024	Unique Investigations	Unique Requests	Total Requests
Jan-Mar	32	32	733
Apr-Jun	5	5	15
Jul-Sep	26	6	31
Oct-Dec	--	--	--

These metrics are presented according to the Make Data Count standard.

Since 2022:

Over 45,000 Unique Requests (UR) across all DesignSafe datasets (~1500/month)

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Making Changes After Publishing

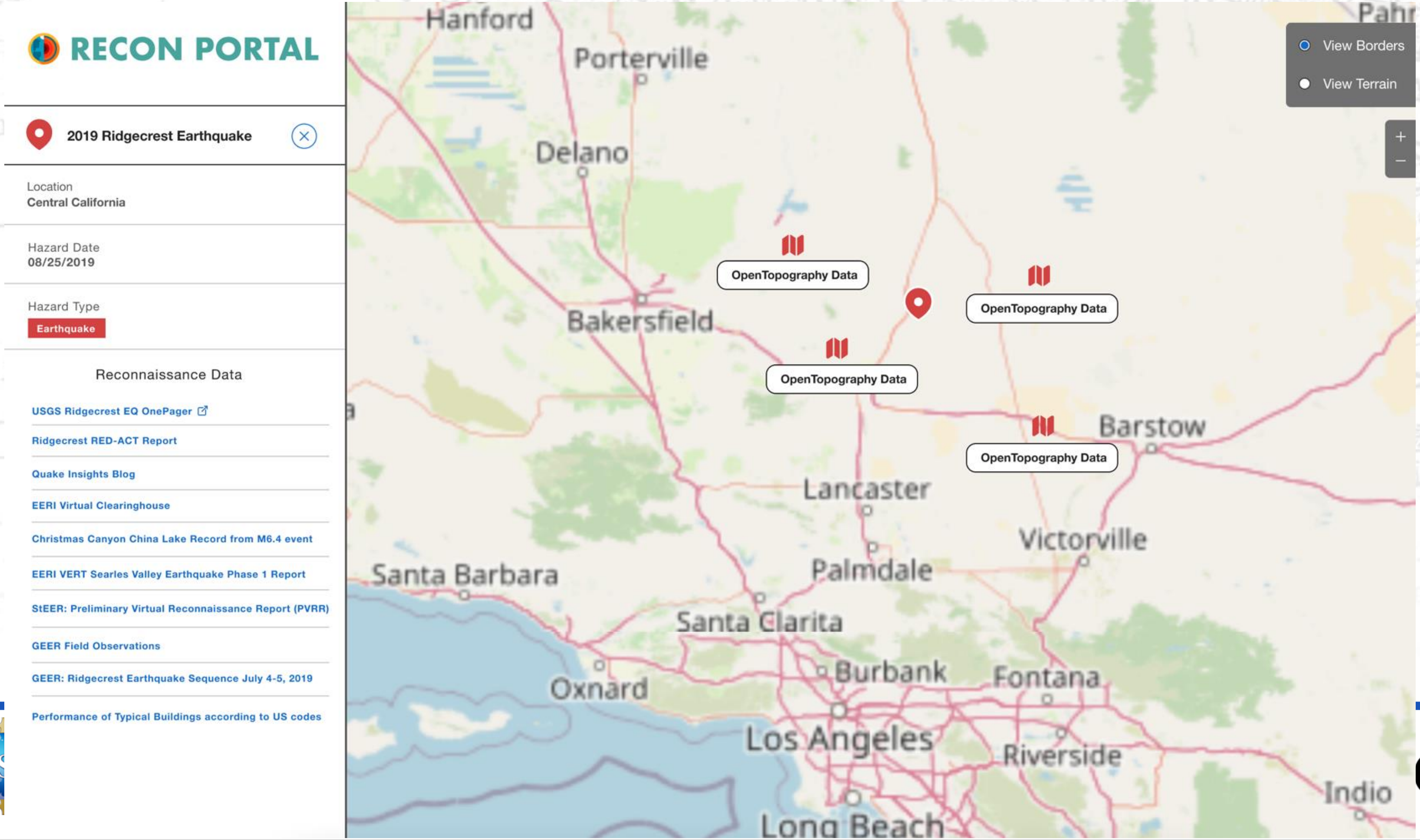
- Versioning
  - Changing **data** requires a new version
  - New citation with v2 appended to the end
- Amending
  - Changing **metadata** can be done by amending a publication
  - Citation stays the same
- Publish subsequent datasets over time

Curation Assistance

- Curation and publication guidelines under ***User Guides***
  - https://www.designsafe-ci.org/user-guide/curating/
- Data transfer methods
  - https://www.designsafe-ci.org/user-guide/managingdata/#data-transfer-guides
  - Web browser/Dropbox/etc (smaller uploads), Globus, Cyberduck
- Virtual Curation Office Hours
  - DesignSafe Data Curators: Maria Esteva and Craig Jansen
  - Tuesday and Thursday at 1 pm Central (or by appt)
  - https://www.designsafe-ci.org/facilities/virtual-office-hours/

slack

Recon Portal



Computing Allocation

- High-performance computing (HPC) allocations are required for certain Tools and Applications
  - 10,000 SU/yr is given upon request
    - You must explain why your research needs the power of HPC
  - Larger allocations available by request
  - Access to CPUs and GPUs for AI
  - Faster than our normal TACC allocation process

Tools & Apps: Simulation

- Applications that take advantage of High Performance Computing (HPC)
- Learn about the systems: tacc.utexas.edu/systems/all/
- Easy-to-use interface full of helpful information for new users
- Also available through API or at the Command Line

Simulation

ADCIRC

Coastal circulation and flooding model.

Flood • Hurricane/Tropical Storm • Storm Surge

Popular *Open Source*

OpenSees

Advanced seismic and structural analysis.

Earthquake

Popular *Open Source*

Tools & Apps: Analysis & Visualization

Analysis

Jupyter
Interpret python code into intuitive graphs and visualizations with these highly customizable notebooks.

Popular *Open Source*

MATLAB
Analyze data, develop algorithms, and create models.

Popular *Licensed*

Visualization

FigureGen
Create images for ADCIRC files using this Fortran program.

Open Source

GiD
Create mesh geometry of physical structures for simulations. Useful for finite element modeling.

Licensed

ParaView
Visualize datasets of all sizes on various systems.

Open Source

Potree
View and convert pointclouds to Potree format for very large LiDAR datasets.

Open Source

STKO
Visualize data from OpenSees with this Scientific ToolKit for OpenSees (STKO).

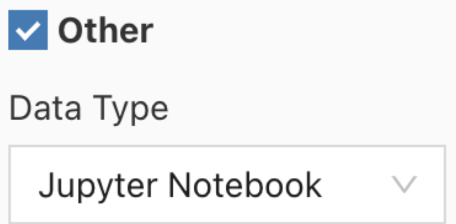
Earthquake

Licensed

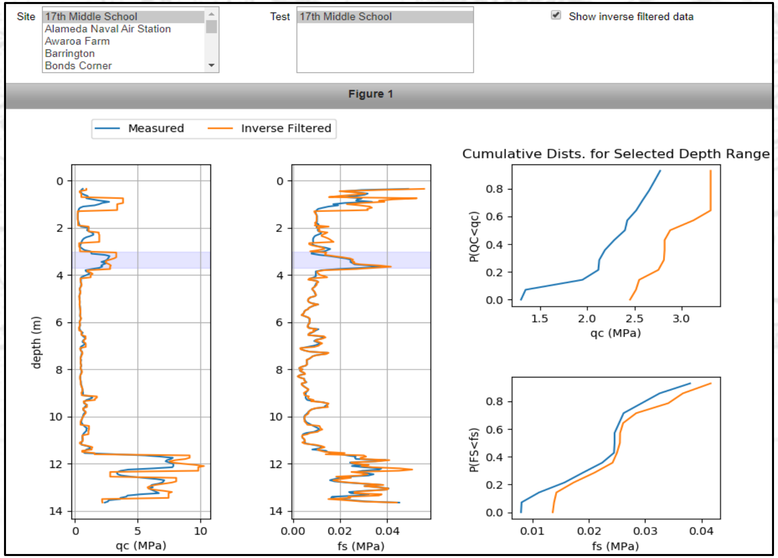
VisIt
Build configurable visualizations to analyze large datasets.

Open Source

Jupyter Notebooks

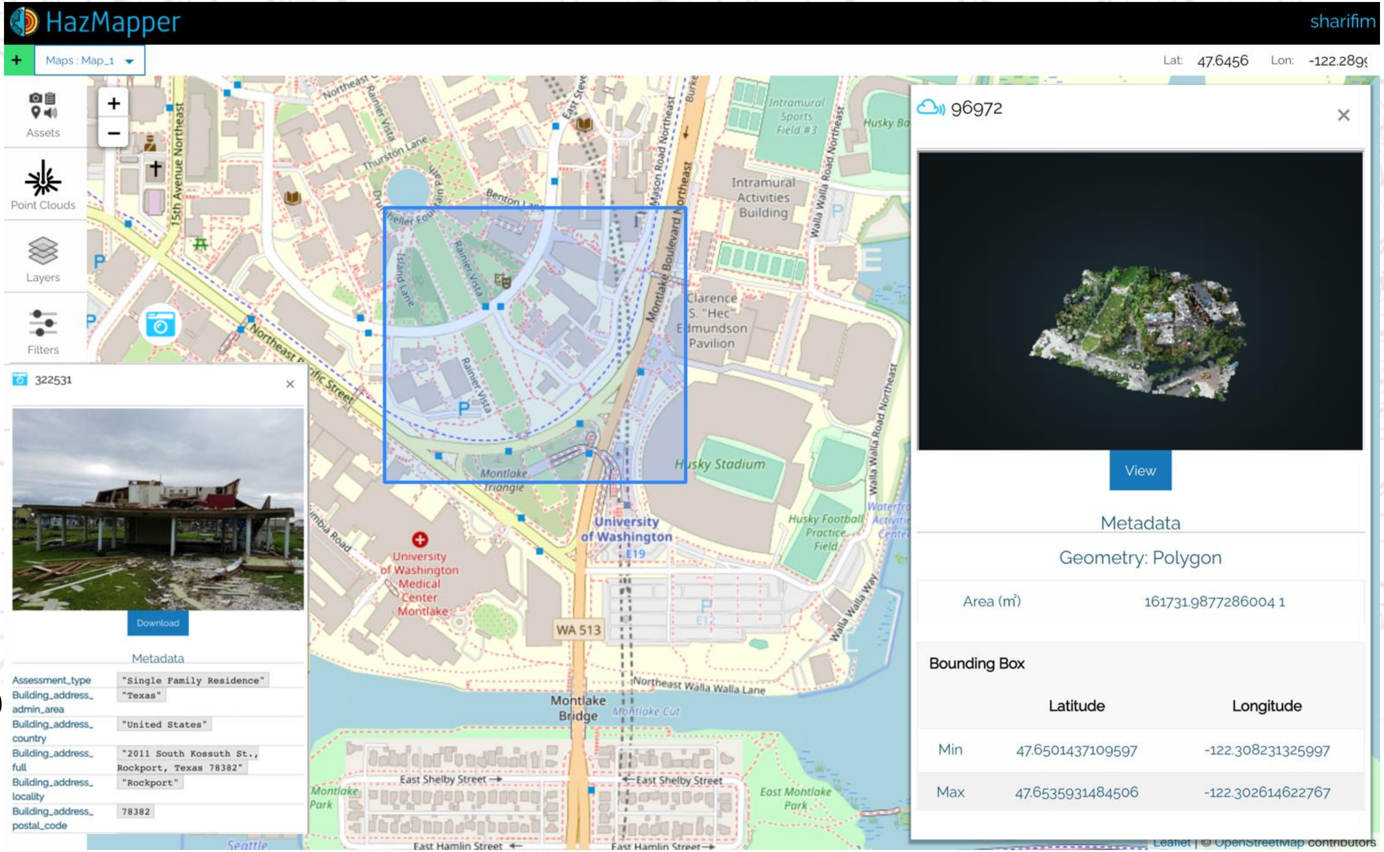


- Custom notebooks in Python or R that contain live code, equations, visualizations, and text
- JupyterHub gives access to Data Depot files
- Can write scripts for data processing, AI or machine learning
- Include these in your publications!
- Accelerates data reuse by showing how to analyze data



HazMapper

- Easy access to images and point cloud data
- Link to Potree viewer
- Links to Streetview imagery (Mapillary)
- Developed by DesignSafe & RAPID



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Use Case Products

- Example research workflows using Tools & Apps

Use DesignSafe | Lear

- Data Depot
- Tools & Applications
- Recon Portal
- User Guides
- Use Cases

Use Cases

Overview

- Data Analytics
- GeoHazard
- Seismic
  - Seismic Response of Concrete Walls
  - Soil Structure Interaction
  - Experimental Shake Table Testing
  - Shake Table Data Analysis Using ML
  - OpenSees Model Calibration
- Wind and Storm Surge

Training

DESIGNSAFE

Use DesignSafe | Learning Center | NHERI Facilities | NHERI Community

- Training
- Educational Resources
- Summer Institute
- REU Summer Program
- Graduate Student Council
- DesignSafe Academy
- SimCenter Learning Tools

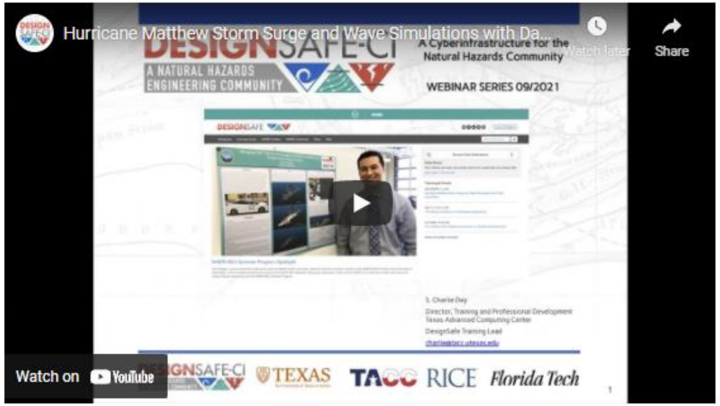
TRAINING

Upcoming Training

Tutorial and workshop opportunities from across the NHERI DesignSafe community of sites and facilities.

SEPT 30	OCT 21-22	DEC 16-17
What's New in DesignSafe	NHERI@UTexas Large Mobile Shaker Workshop	NHERI@UCSD Users Training Workshop
Online — Register	Online — Register	Online

Training Archive



NEW Hurricane Matthew Storm Surge and Wave Simulations with Data Assimilation
September 15, 2021

Visit NHERI DesignSafe's YouTube Channel

Featured Playlists

- DesignSafe Tutorials
- SimCenter Series: Studying Coastal Hazards with HydroUQ
- 2021 Joint NSF NHERI WOW and Lehigh RTMD EF User Workshop
- SimCenter Series: Advances in Computational Modeling and Simulation

DesignSafe has **already been funded** for your natural hazard research!

Can I use DesignSafe if I'm not funded by the National Science Foundation?

Yes! - Your work must be related to natural hazards.

DesignSafe: We are here for you!

Available to the Global Natural Hazards Research Community

- Interact with us and the community using the DesignSafe Slack team
- Cite data using DOIs in your reference list
- Cite DesignSafe marker paper (Rathje et al. 2017, *Natural Hazards Review*) if you use DesignSafe in your research

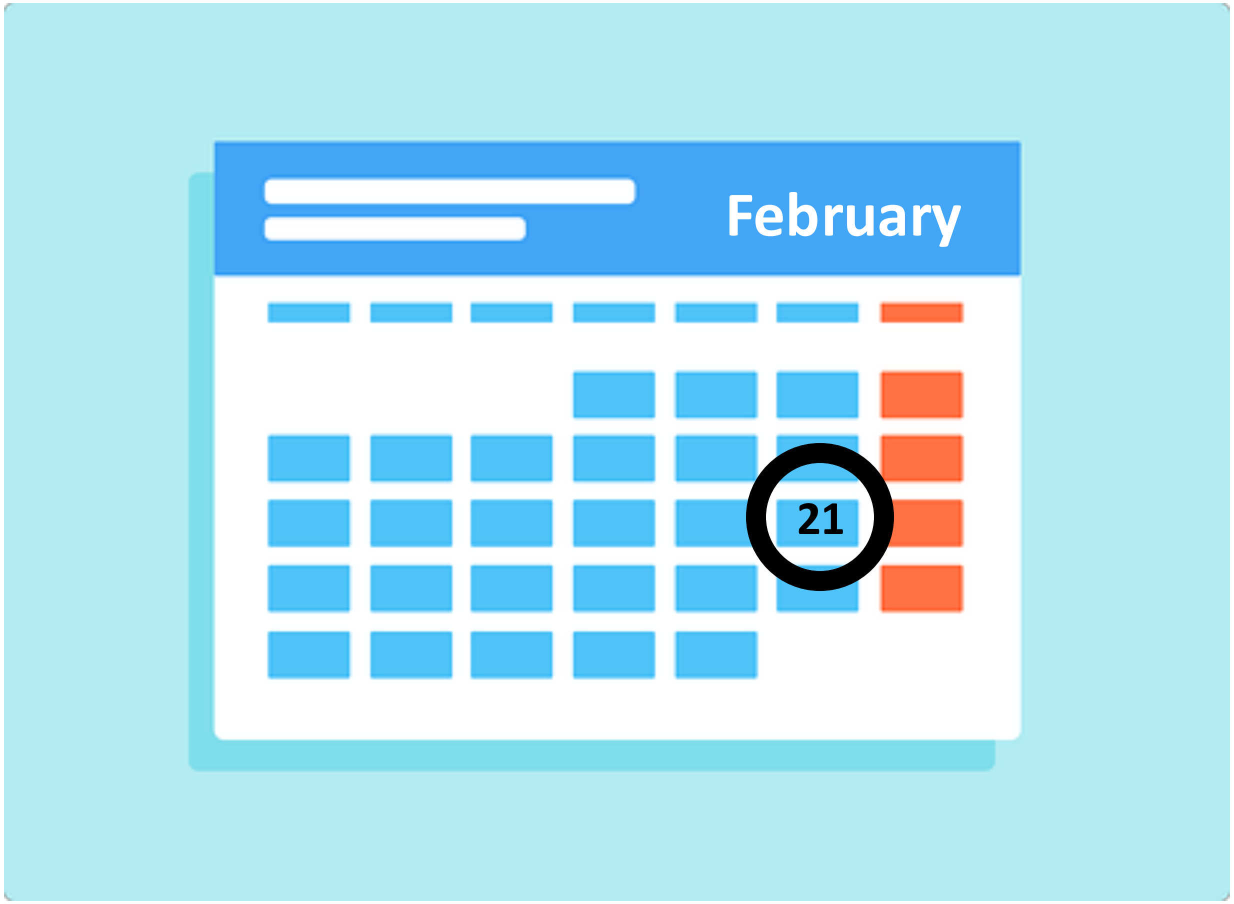
slack

Please share your feedback, ideas, experiences!

Craig Jansen cjansen@tacc.utexas.edu, Ellen Rathje e.rathje@mail.utexas.edu

Future Meeting Dates

3rd Friday of every month at 11:00am CST



NHERI GSC
Graduate Student Council

NHERI GSC Research Subcommittee Meetings!

Group Breakout Rooms!

Breakout Rooms (*30 Minutes*):

1. Reconnaissance Subcommittee
Presentation#1 by Dr. Antonio Balderrama
Topic: Lessons Learned from Hurricane Otis

Presentation#2 by Dr. Brad Wham

Topic: Lessons Learned from Marshall Colorado Wildfire

2. Wind Engineering Subcommittee
Presentation by Dr. Shaopeng Li
Topic: A Novel Wind Tunnel Testing Method for Debris Flight in Turbulent Winds

Hosted by:

Mohammad Movahedi

RSR of Reconnaissance

Arezoo Bakhshizadeh

RSR of Wind Engineering

NHERI GSC Graduate Student Council

NHERI GSC Reconnaissance RSR Meeting

NHERI GSC

2025

Lesson Learned from Reconnaissance Research

January 17, 2024
12:00 pm CT

Dr. Juan Antonio Balderrama
&
Dr. Brad Wham

NSF | NHERI GSC Graduate Student Council

Speaker Introduction

Dr. Juan Antonio Balderrama

Associate Professor of Instruction

juan.balderrama@uta.edu

NHERI GSC
Graduate Student Council

Hurricane Otis Post-Disaster Assessment

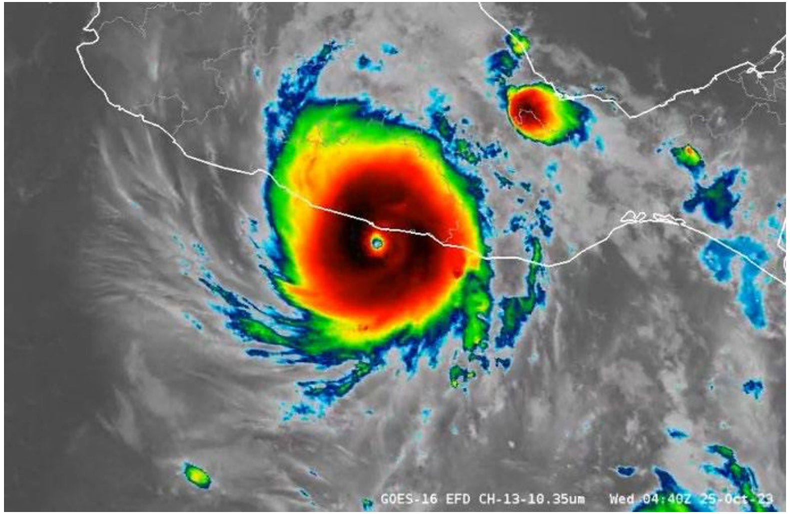
NHERI GSC January 17, 2025, Virtual Meeting

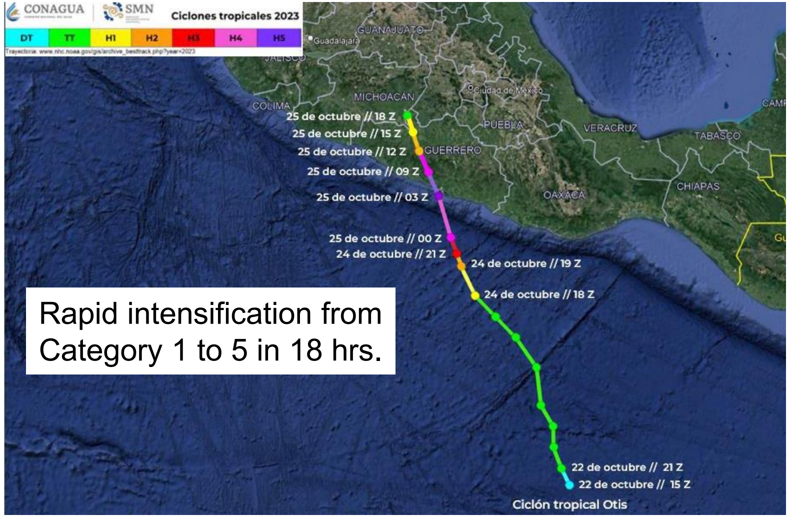
Juan Antonio Balderrama Garcia Mendez, PhD, PE
Associate Professor of Instruction
The University of Texas at Arlington

Presentation Agenda

1. Overview of Hurricane Otis
2. Acapulco Jurisdiction Design Aspects (Hazards)
3. Establishing Questions to Inform the FAST Strategy
4. Reconnaissance Survey Strategy
5. Areas Surveyed
6. Data Collection Methodology
7. Key Observations
8. Logistic Challenges
9. Lessons from Otis
10. Acknowledgements

Overview of Hurricane Otis (October 2023)

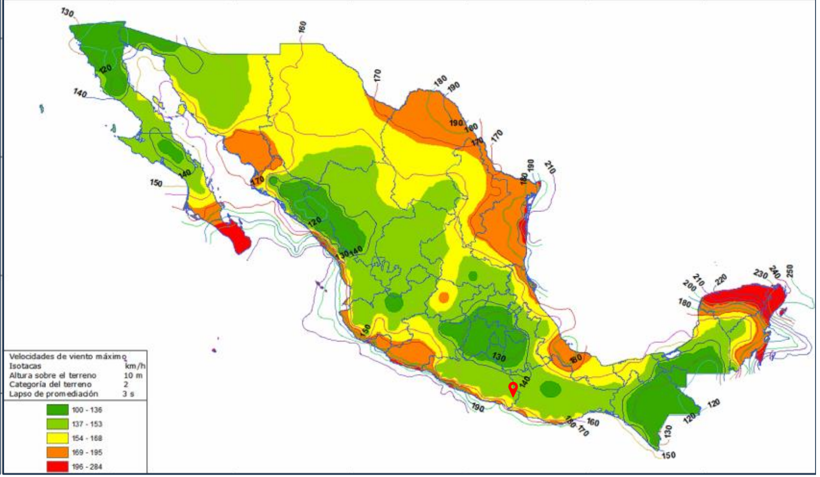




UTA

Acapulco Jurisdiction Design Aspects (Hazards)

2015 CFE Manual Seismic Design Criteria	2020 CFE Manual Wind Design Criteria

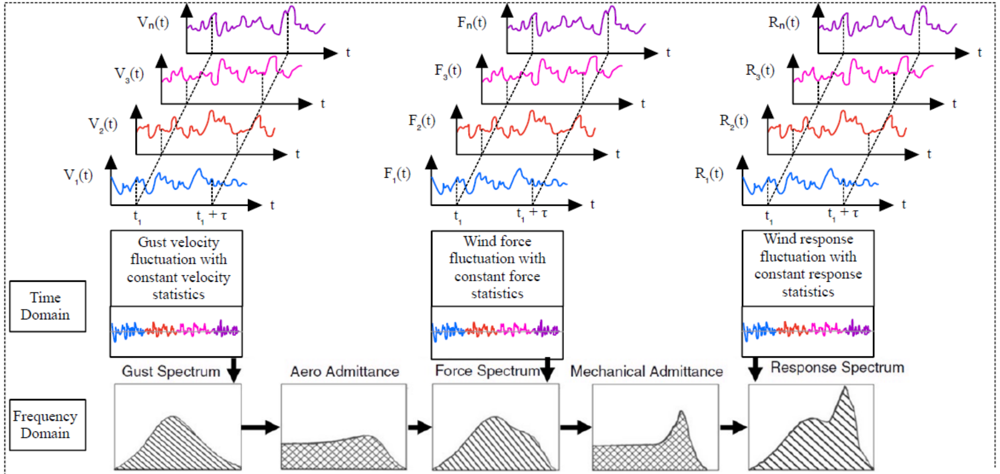


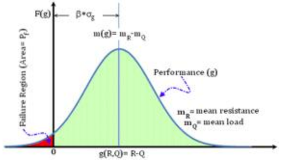
Site specific seismic spectra per ASCE 7 2016 criteria from a previous design bid in Playa Diamante were higher than California spectra

Basic Wind Speeds (3 s gust open terrain)
- 141 km/hr for 050 yr. return period
- 164 km/hr for 200 yr. return period

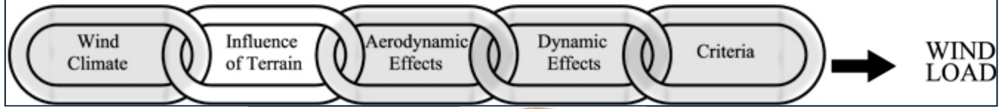
2023 Hurricane Otis Peak Gust
- 330 km/hr (5 meter height on a dock, open water)

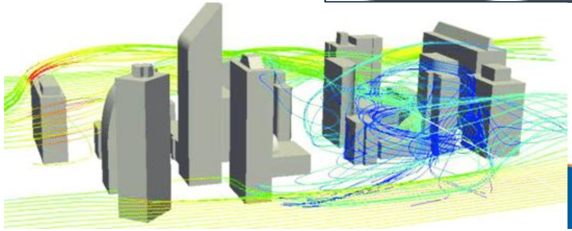
Establishing Questions to Inform the FAST Strategy

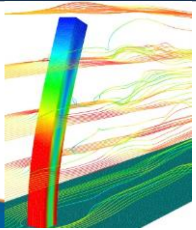


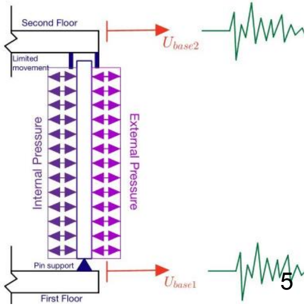


The Alan G. Davenport Wind Loading Chain



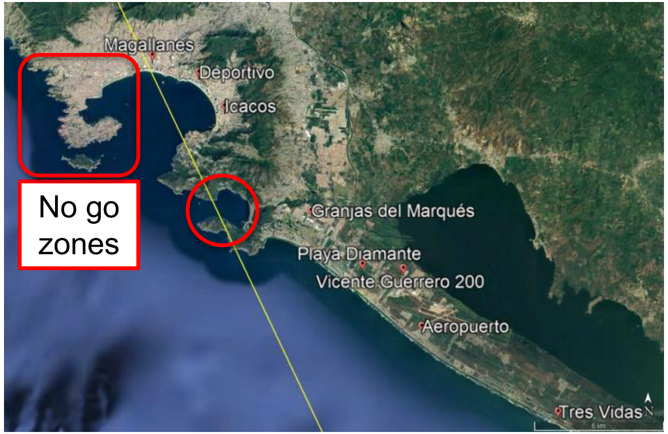






Reconnaissance Survey Strategy

Security concerns to define reconnaissance trajectory



CFE recommended: stay near the beach (tourist areas), avoid inland areas (mountains).

PVRR damage photos & questions to define strategy

1. No access to buildings
2. Systematic failures to building envelopes

Strategy: focus on building envelopes and roofs for as many high rise buildings as possible and capture data for low and mid-rise buildings encountered along the way for comparison (split the team in two to capture damage from the beach and damage from the street).

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Areas Surveyed

Main Acapulco Bay (day 1 prior to teacher union strikes)

Playa Diamante (days 2 & 3, safer feeling)

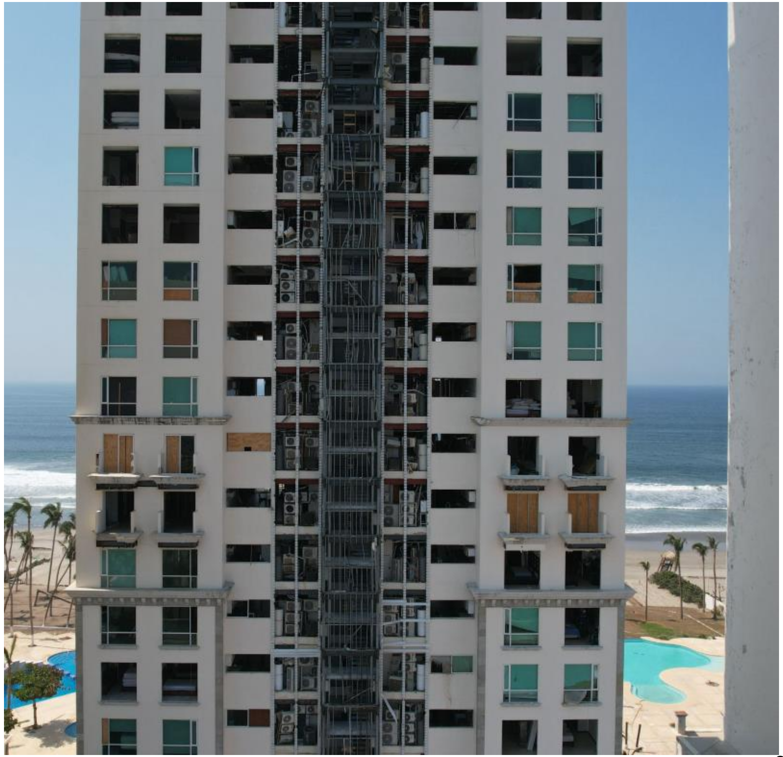
8 colonias (neighborhoods) covered, grouped buildings in 20 clusters

Data Collection Methodology

UAS Higher Flight Survey of Building Cluster

Cell Phone Photographs from Ground & Fulcrum App

UAS Panoramas Wrapping Vertically Up Select Buildings

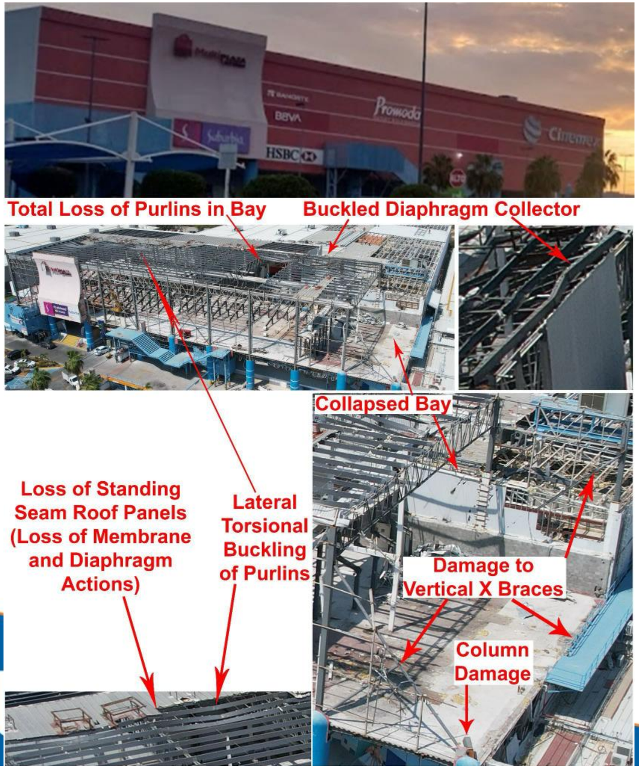


Key Observations High Rise Buildings

- Most assessed buildings were in the high-end architecture market sector (ambitious views) and combined the use of veneer walls, curtain walls, and infill walls as their wall cladding system.
- Lattice metallic panels, louvers, and cement board veneers were implemented as ventilated facades and enclosures of utilities shaft.
- These were all systematically damaged, regardless of the element type.

Key Observations Low Rise Commercial Buildings

Car dealerships, wholesale stores (e.g., WalMart, HomeDepot), distribution centers, and other lightweight steel buildings sustained heavy damaged to their building envelope and MWFRS



Logistics Challenges

- **Restricted Zones:** Army and navy facilities, as well as airport areas, were designated as no-fly zones or had restricted flight elevations
- **Bird Hazards:** Drone operators had to remain vigilant for birds of prey, which tended to follow the drone
- **Complex Aerodynamics:** Turbulent flow features around buildings affected drone flight stability
- **Glare:** Extremely difficult to direct the drone operator in real time due to the screen glare
- **Limited Access:** Beach areas and the four sides of buildings were heavily restricted and made highlighting the need for specialized drones capable of surveying from both beach and street perspectives
- **Signal Interference and Limited Access Points:** Widely spaced beach access points and building interference with the drone's line of sight disrupted control, complicating efforts to survey all four elevations in a single operation (we had to survey several buildings from the street first and then from the beach; could have brought more drones)
- **Traffic Hazards in the Main Acapulco Bay**

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Lessons from Otis

From the assessment we cannot identify the exact causes of the widespread damage in Acapulco. However, we can identify knowledge gaps in the wind-to-damage chain from our observations and our understanding of the hypothetical basis behind the design codes and standards adopted for structural engineering in Acapulco:

- Effects of recent extreme weather patterns on hurricane risks
- Flow within urban canopies
- Wind-induced dynamic response of buildings and effects on lateral force resisting systems (LFRS) and components and cladding (C&C)
- Wind design and retrofit considerations of predominantly seismically-designed buildings
- Risk consistency evaluations of building design provisions for sites without clear governing lateral load hazards

Acknowledgements

- This disaster assessment was made possible by NSF StEER and by the support and guidance provided by StEER's leadership:
  - Mohammad S. Alam, University of Hawai'i at Manoa
  - Tracy Kijewski-Correa, University of Notre Dame
  - David O. Prevatt, University of Florida
  - Ian Robertson, University of Hawai'i at Manoa
  - David Roueche, Auburn University
- The event was coordinated by:
  - Keegan Wolohan, University of Notre Dame
- The drone operator, Jorge Hernandez Toral

Questions?

UTA

Speaker Introduction

Dr. Brad Wham
Assistant Professor

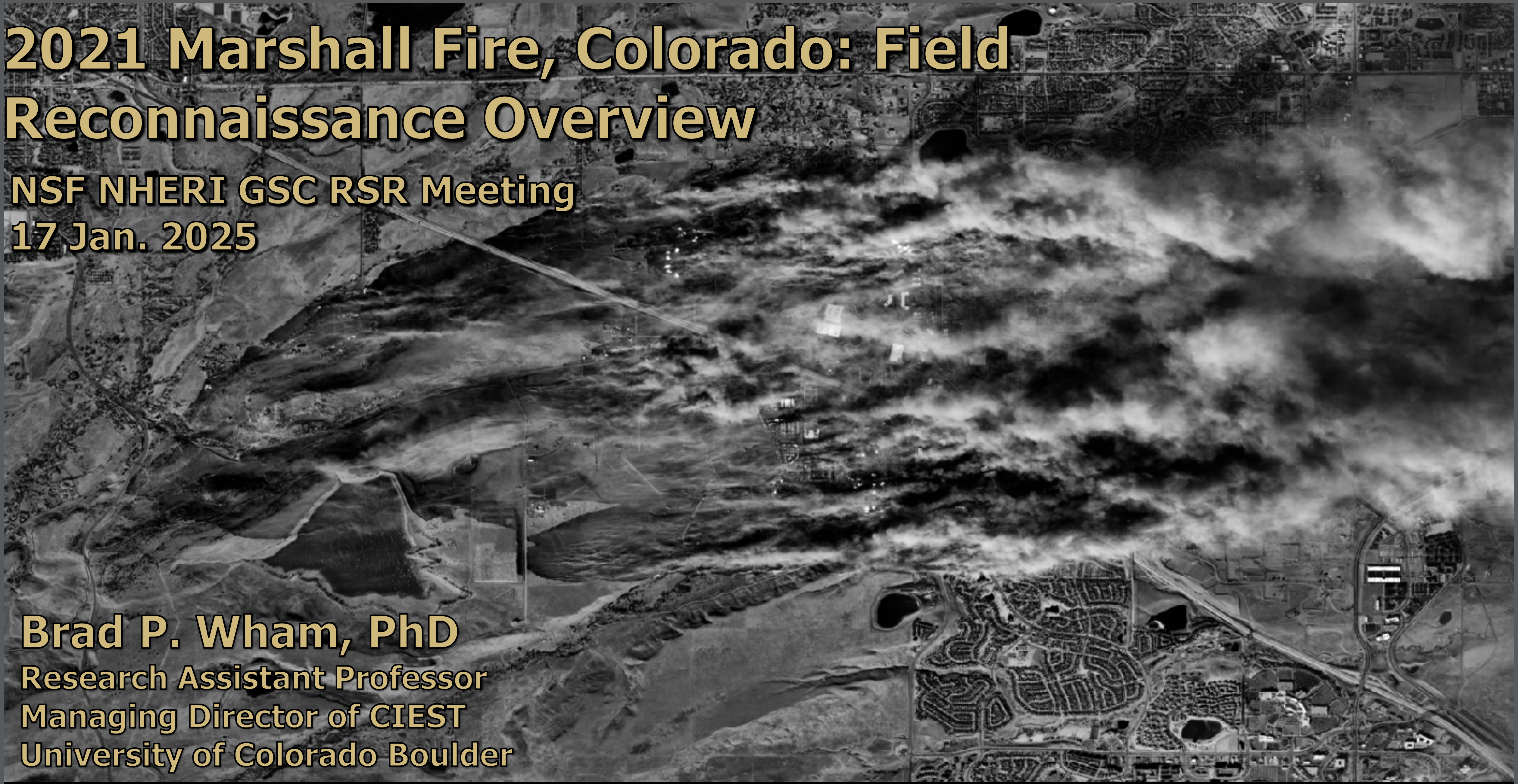
brad.wham@colorado.edu

NHERI GSC Graduate Student Council

2021 Marshall Fire, Colorado: Field Reconnaissance Overview

NSF NHERI GSC RSR Meeting
17 Jan. 2025

Brad P. Wham, PhD
Research Assistant Professor
Managing Director of CIEST
University of Colorado Boulder

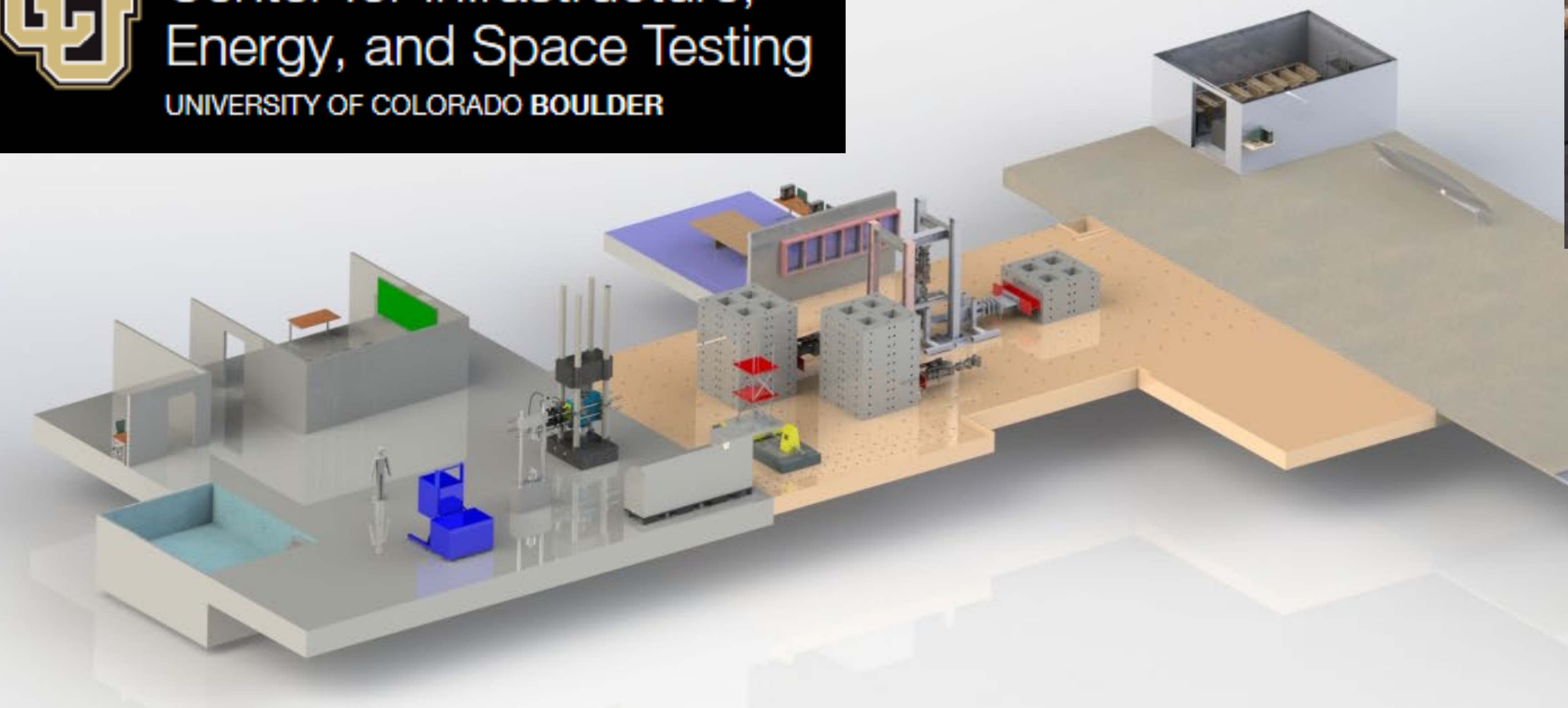


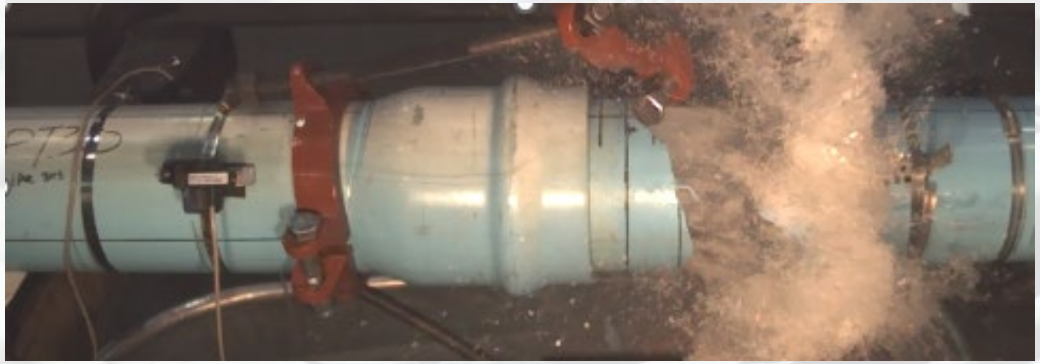
Background

Earthquake Reconnaissance:
- Christchurch, New Zealand (2013)
- Kumamoto, Japan (2017)
- Hokkaido, Japan (2018)
- Kahramanmaraş, Turkey (2023)

Brad P. Wham, PhD
Assistant Research Professor
Managing Director of CIEST
Civil, Environmental, and Architectural Engineering

Center for Infrastructure, Energy, and Space Testing
UNIVERSITY OF COLORADO **BOULDER**

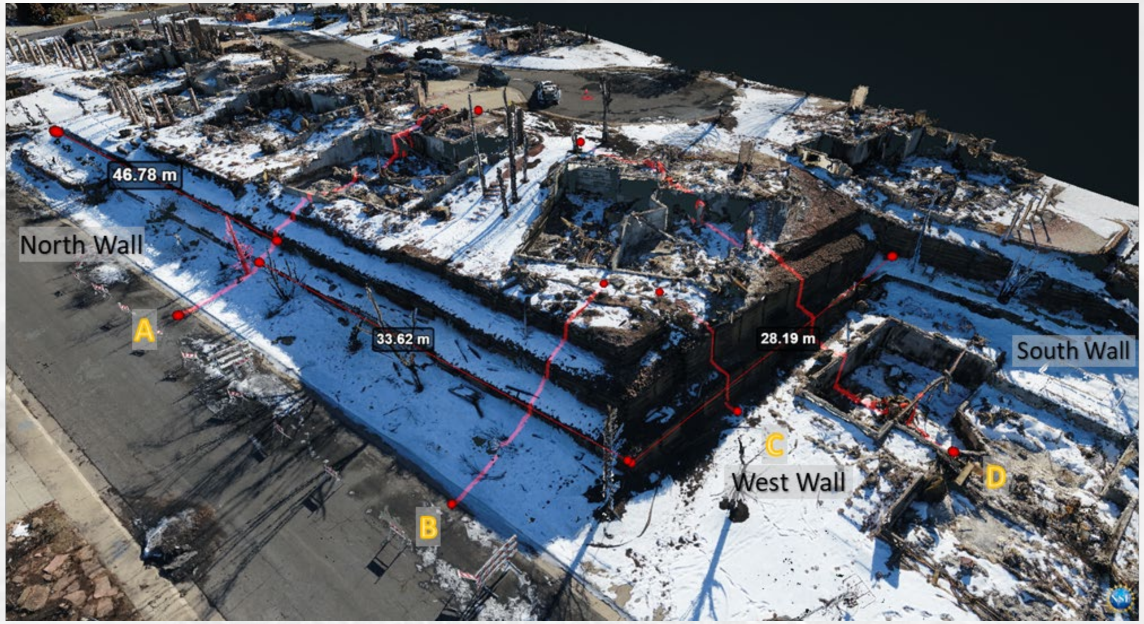




Outline

- **Marshall Fire Overview**
  - **Event overview**
  - **Initial Response (Water Utility)**
- **Field Reconnaissance (GEER)**
  - **Planning**
  - **Example data sets**
  - **Housing**

- **Topics not Discussed**
  - **Lifeline system interdependencies**
  - **Wildfire impacts on Water quality**
  - **Team Water Quality Response**



The Marshall Fire, December 30, 2021

- Most destructive in Colorado history in terms of the number of homes and businesses destroyed (>1,000 buildings in Boulder County, Louisville, and Superior).
- >**$1 Billion** in damages per NOAA, 6,000+ ac, 40,000+ evacuated

- Heavy Spring rains
- Bone dry summer and fall (no snow)
- 70 mph sustained winds, Gusts >100 mph

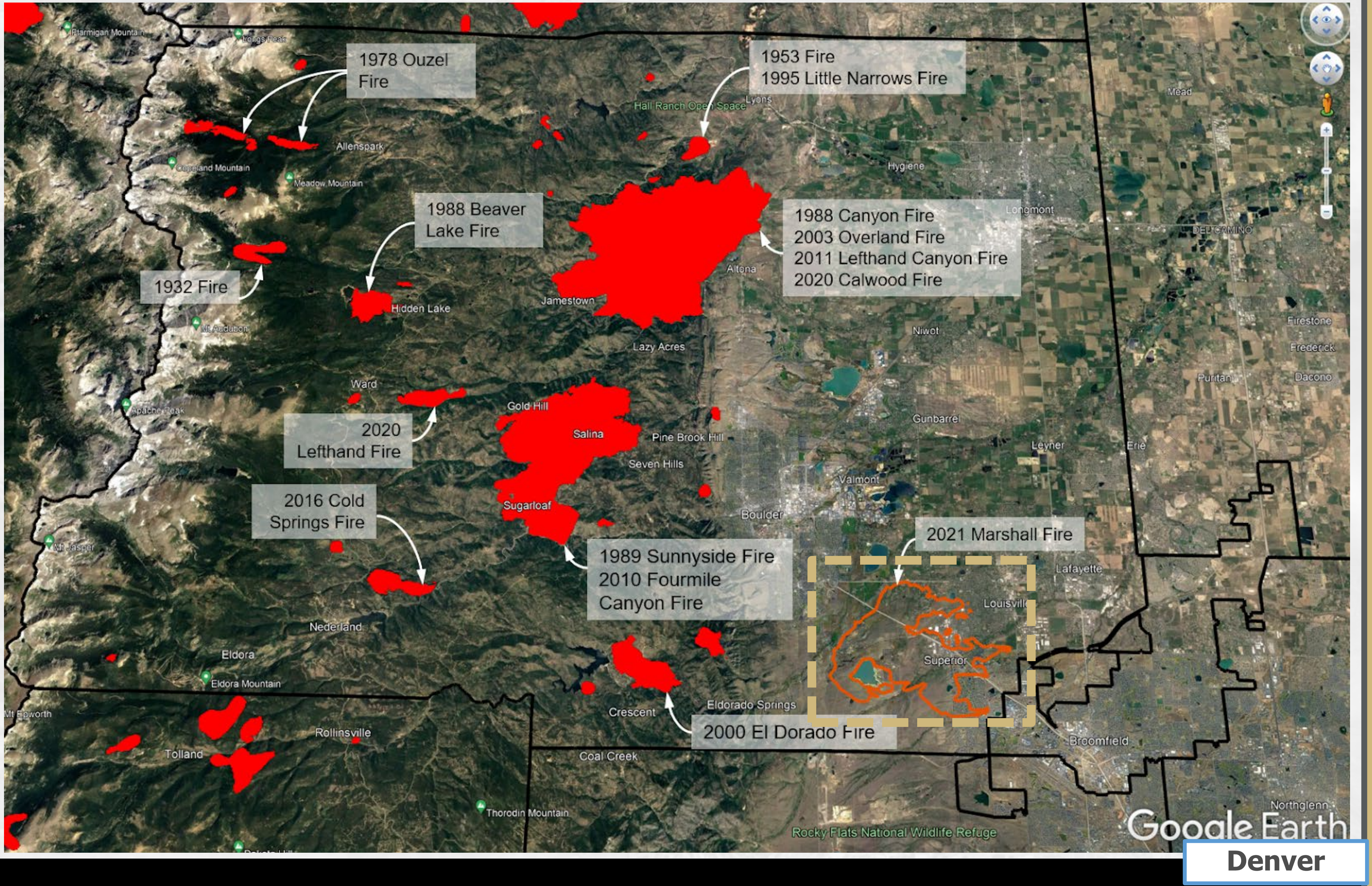
Parameter	**2021 U.S.**	**2021 Marshall Fire**	**2018 Camp Fire**
Median income	$62,843	$127,292	$51,566
Mean home value	$217,500	$576,800	$49,000
B.S. degree+	32.1%	76.3%	26.0%

CURRENTLY ACTIVE INCIDENTS

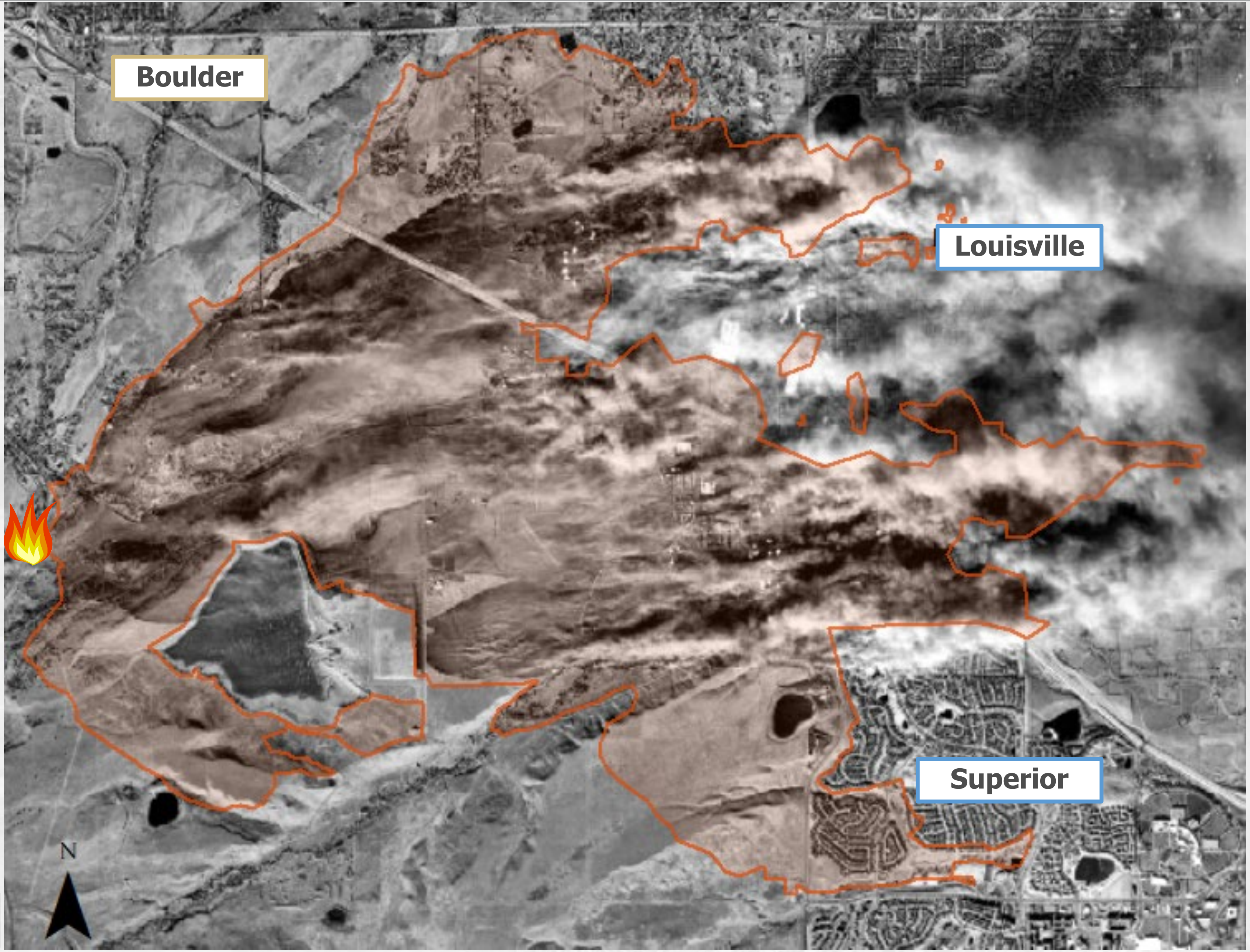
Search: Search incidents

INCIDENT	COUNTIES	STARTED	ACRES	CONTAINMENT
Palisades Fire	Los Angeles	1/07/2025	23,713	31%
Eaton Fire	Los Angeles	1/07/2025	14,117	65%
Auto Fire	Ventura	1/13/2025	61	85%

Historic Fires in Colorado



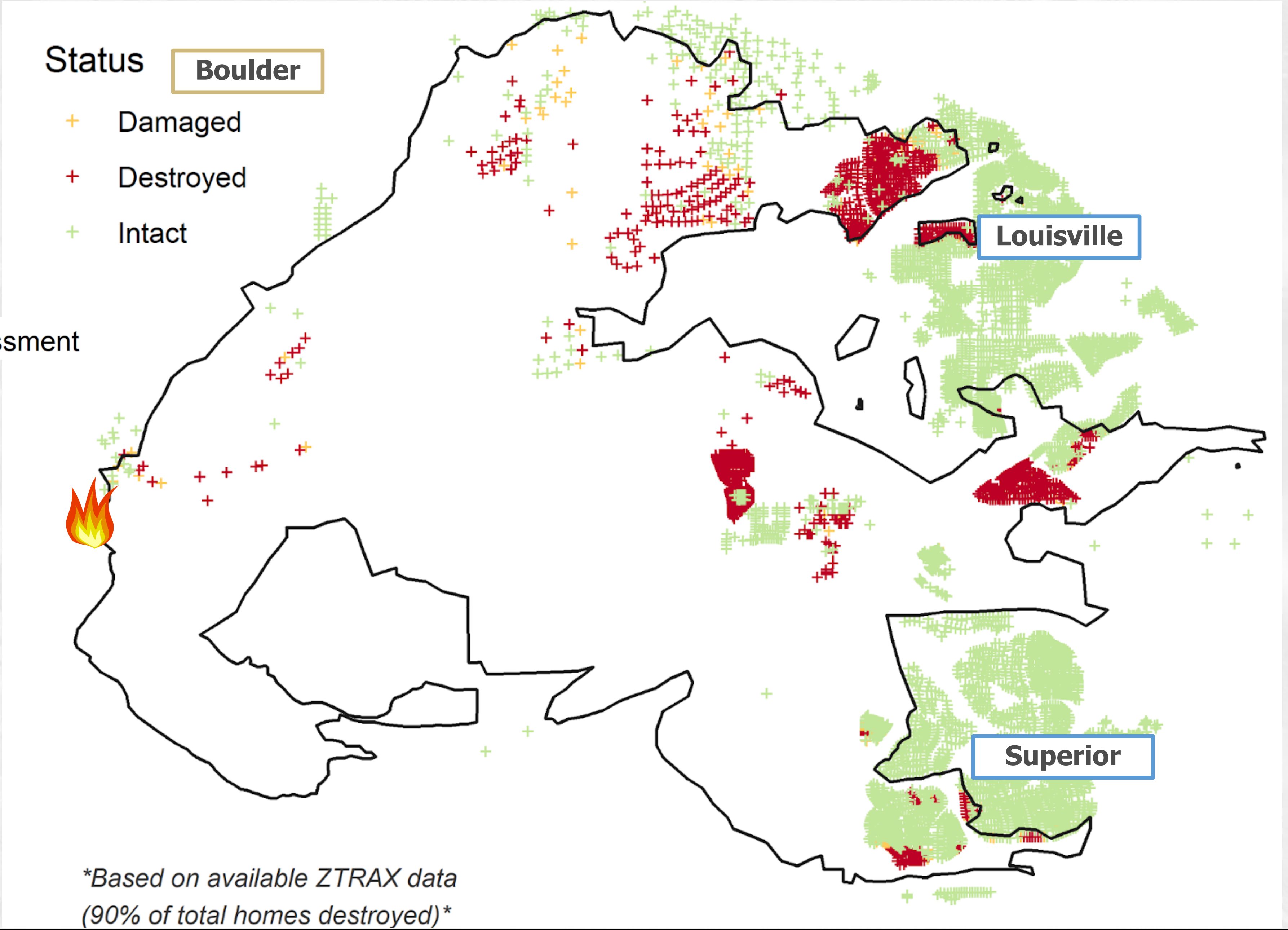
Marshall Fire Overview



(Maxar, 2021)

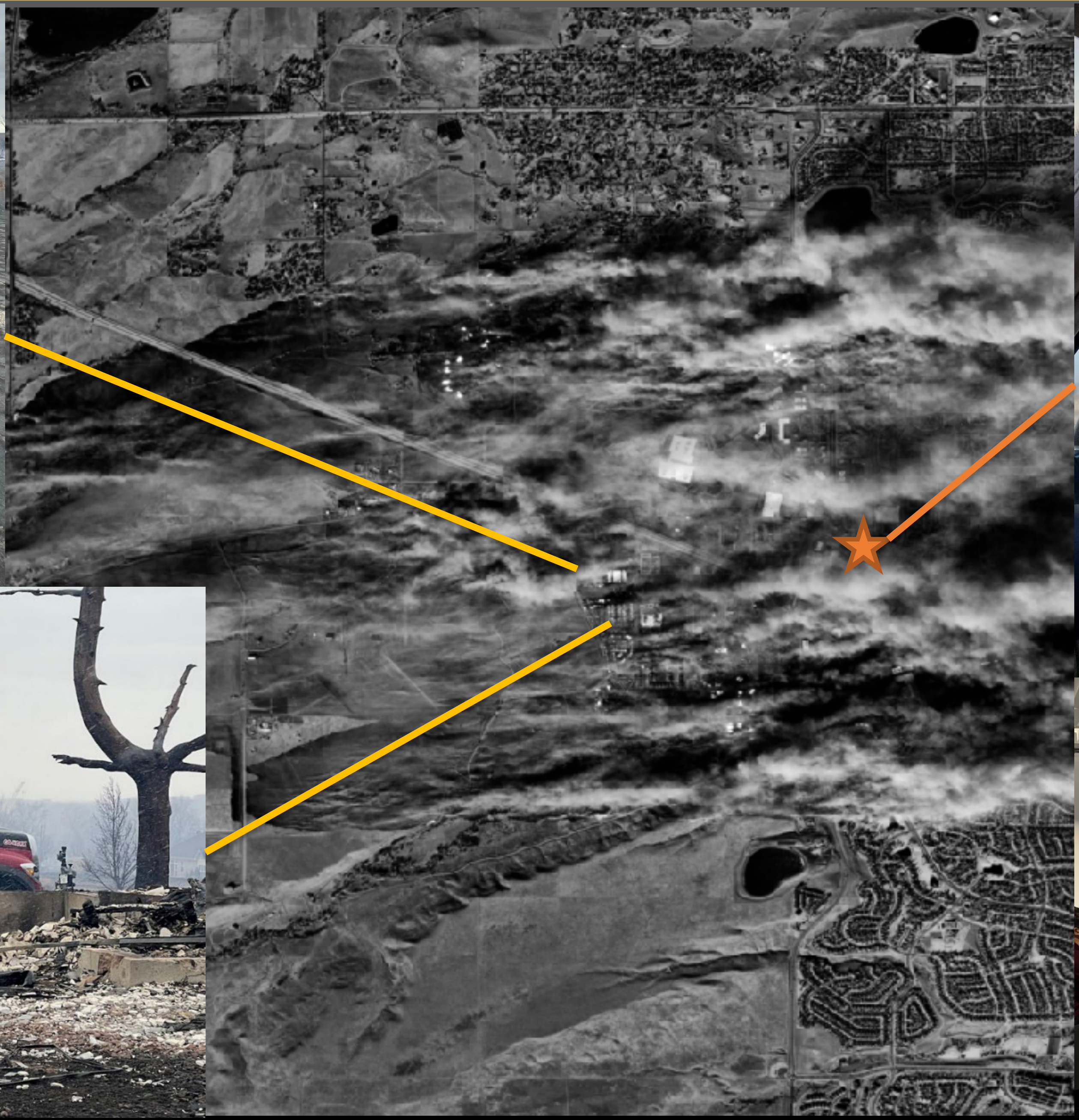
Marshall Fire Overview

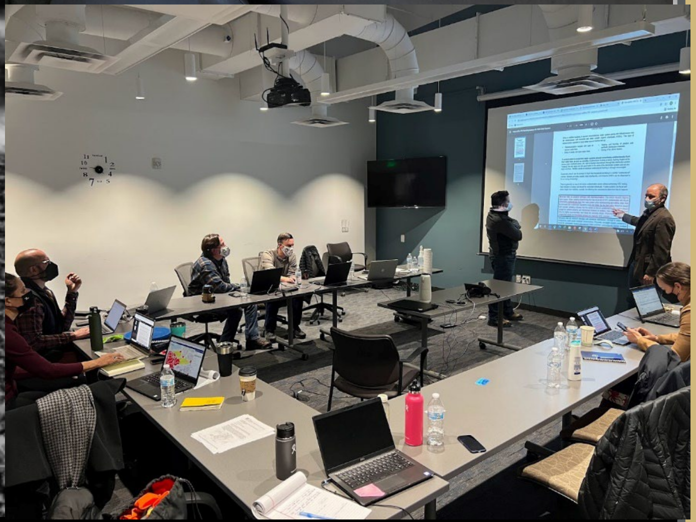
Marshall Fire, CO (2021) Damage Assessment



Data Sources:
Boulder County Sheriff's Office,
Zillow Transaction and Assessment Database (ZTRAX),
NIFC Current Fire Perimeters

Figures by Maxwell Cook, Johannes Uhl, Jennifer Balch, Stefan Leyk; Data source: ZTRAX

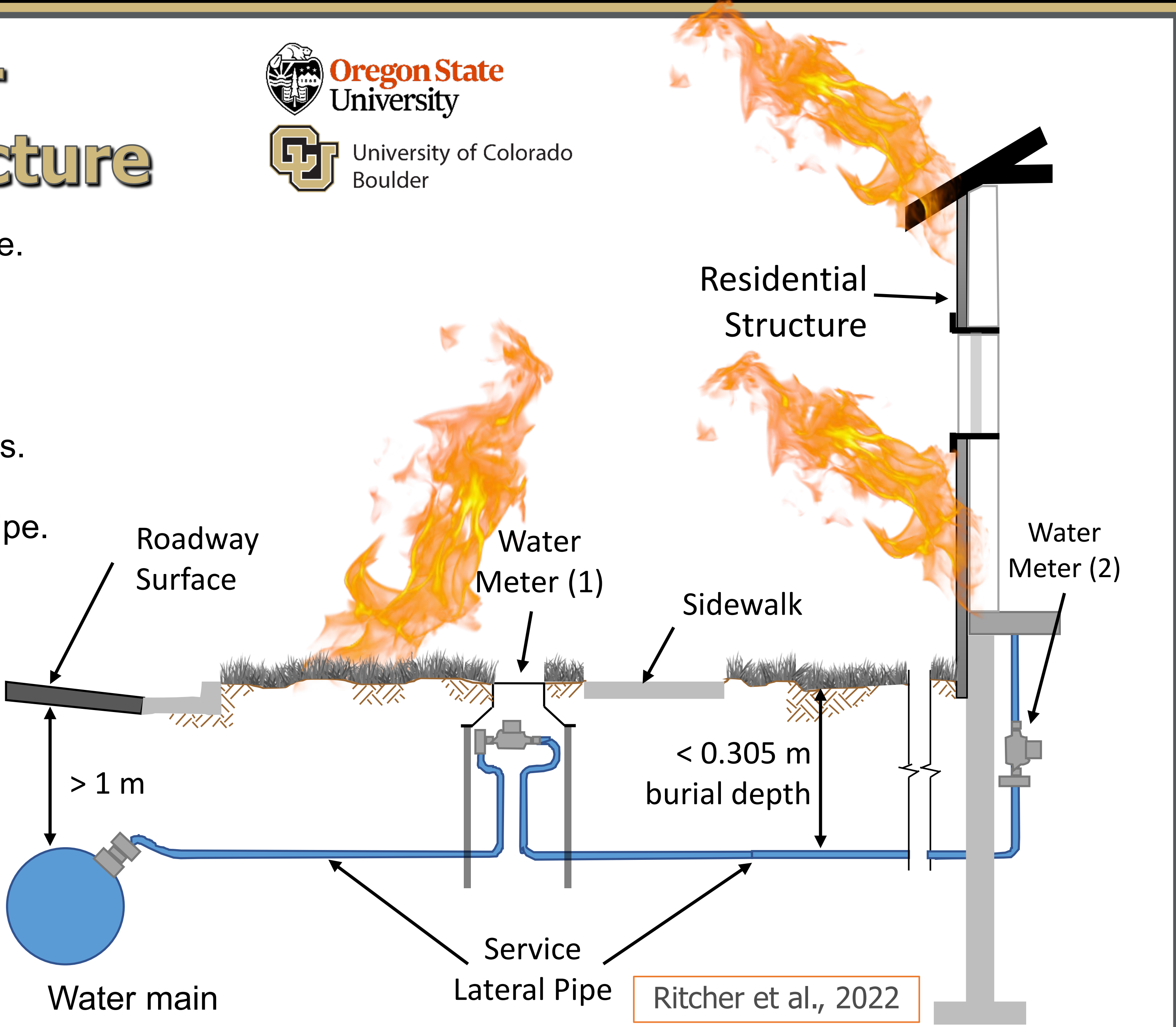




Fire Impacts on Water Distribution Infrastructure

Oregon State University
University of Colorado Boulder

- Burning homes **release chemicals**, like benzene. They also act as a fuel source, heating **service lines beneath the ground**.
- Increased water usage during a fire creates decompression and backflow in waterlines.
- Vacuum draws these chemicals into the pipelines. Service lines are heated/damaged.
- Contaminants may absorb into or adsorb onto pipe. Damaged service lines will need to be replaced.



Field Resonance

<u>GEER Team</u>

- *Erica Fischer (structures, fire) [co-lead]*
- *Brad Wham (lifelines, geotech, structures) [co-lead]*
- *Abbie Liel (structures, risk)*
- *Shideh Dashti (geotechnical)*
- *Amy Javernick-Will (construction engineering)*
- *Andrew Welton (environmental engineering)*

<u>Rapid Team</u>

- *Jaqueline Zdebski*
- *Michael Grilliot*
- *Karen Dedinsky*
- *Jamie Vickery*
- *And Jeff and Joe of course*

Oregon State University

University of Colorado Boulder

PURDUE UNIVERSITY

UNIVERSITY of WASHINGTON

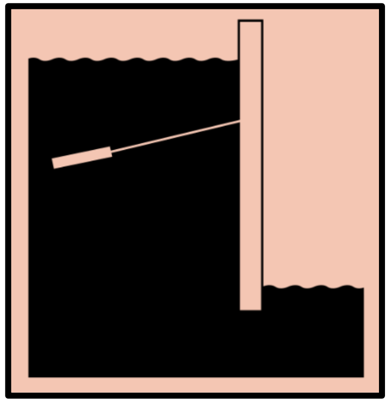
http://www.geerassociation.org/

RAPID NHERI Natural Hazards Reconnaissance

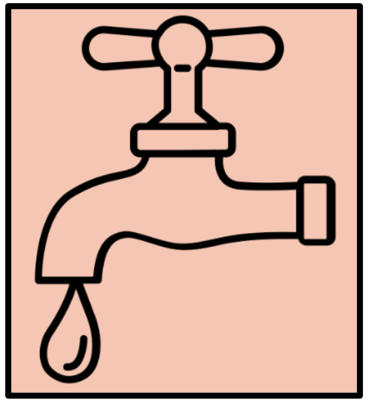
https://rapid.designsafe-ci.org/

Overview of GEER mission

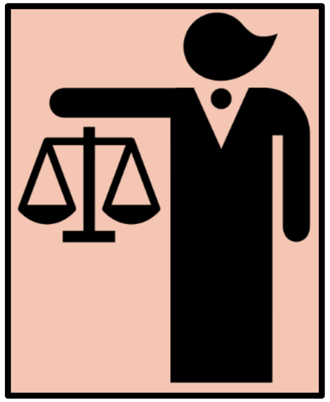
Characteristics of homes that influenced survivability



Performance of slopes and retaining structures



Behavior of lifelines and the role of utilities throughout and during the response to the fire



Changes in policies immediately after the fire

In-field data collection January 23 – 30
Additional drone flights February 12 – 14, March xx-xx

Oregon State University
University of Colorado Boulder
PURDUE UNIVERSITY
GEER
NSF

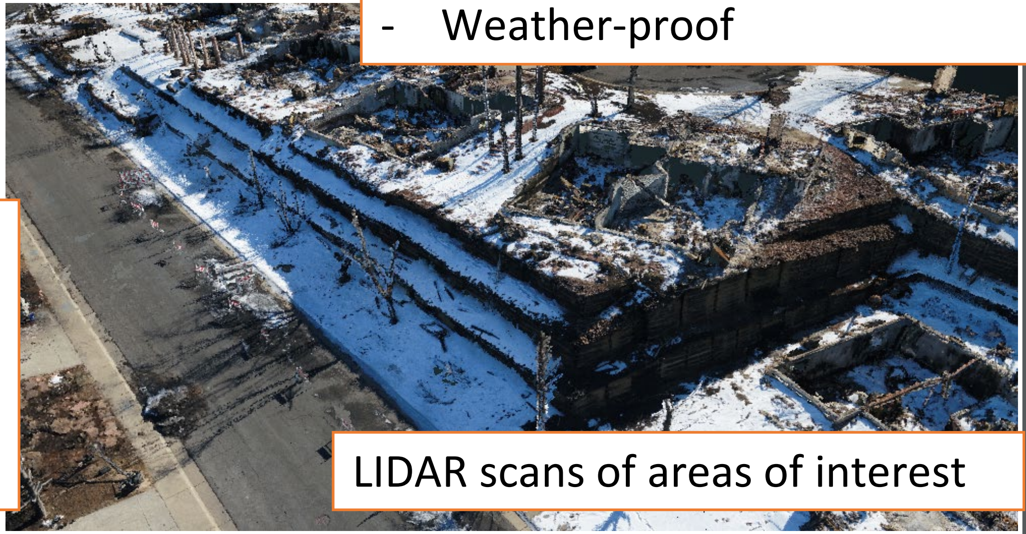
UAV Aircraft

RAPID NHERI
Natural Hazards Reconnaissance

Fixed wing:
eBee X
- Accuracy: 1.4 cm (0.6 in.)
- 90 min flight time
- Max. Coverage: 550 Acres

Quadcopter:
DJI Matrice 210 w/ X4S Camera
- Weather-proof

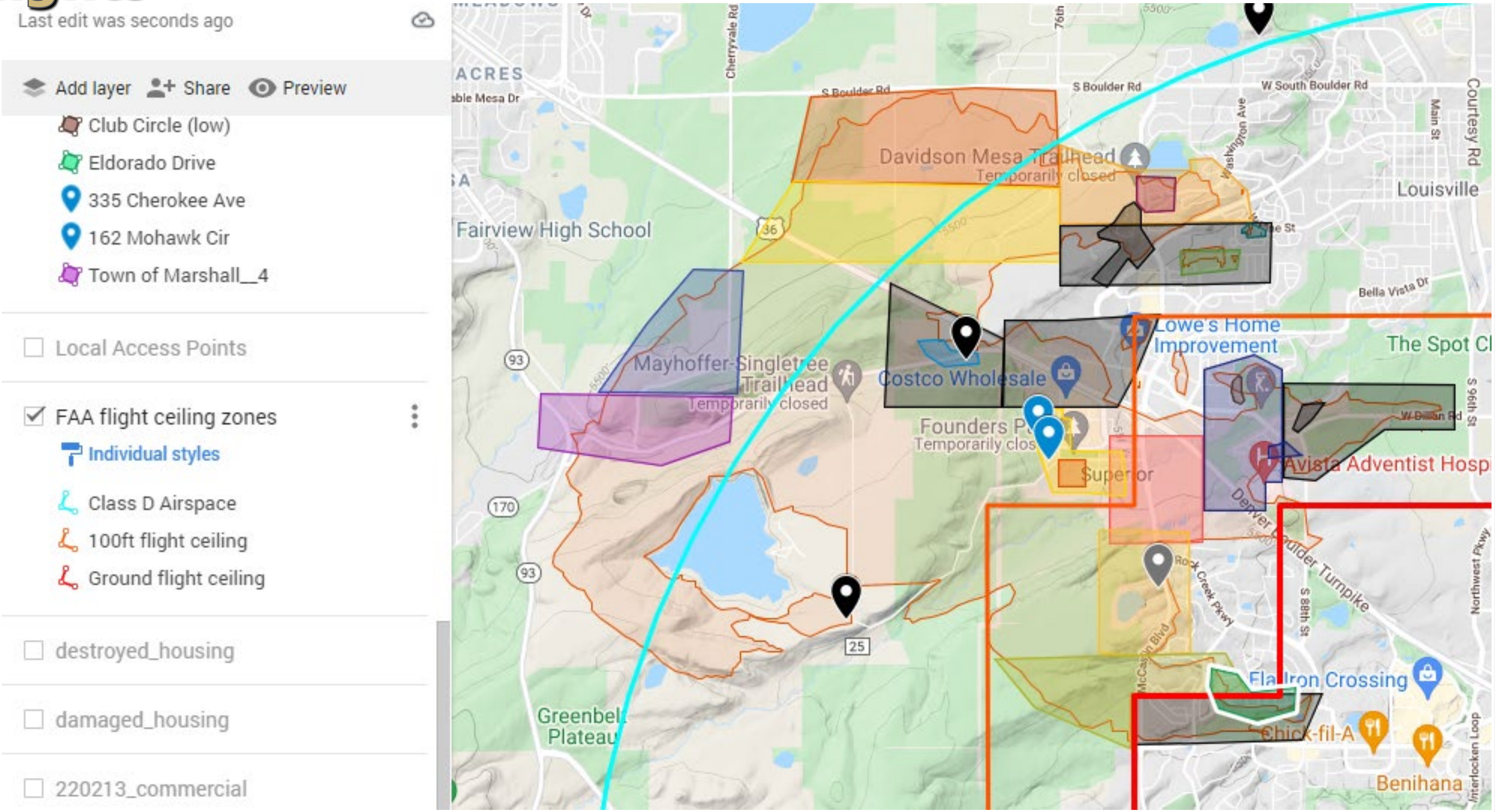
Fixed wing:
Trinity F90+
- 90 min flight time
- Max. Coverage: 1720 Acres
- Max. altitude 14,000 ft



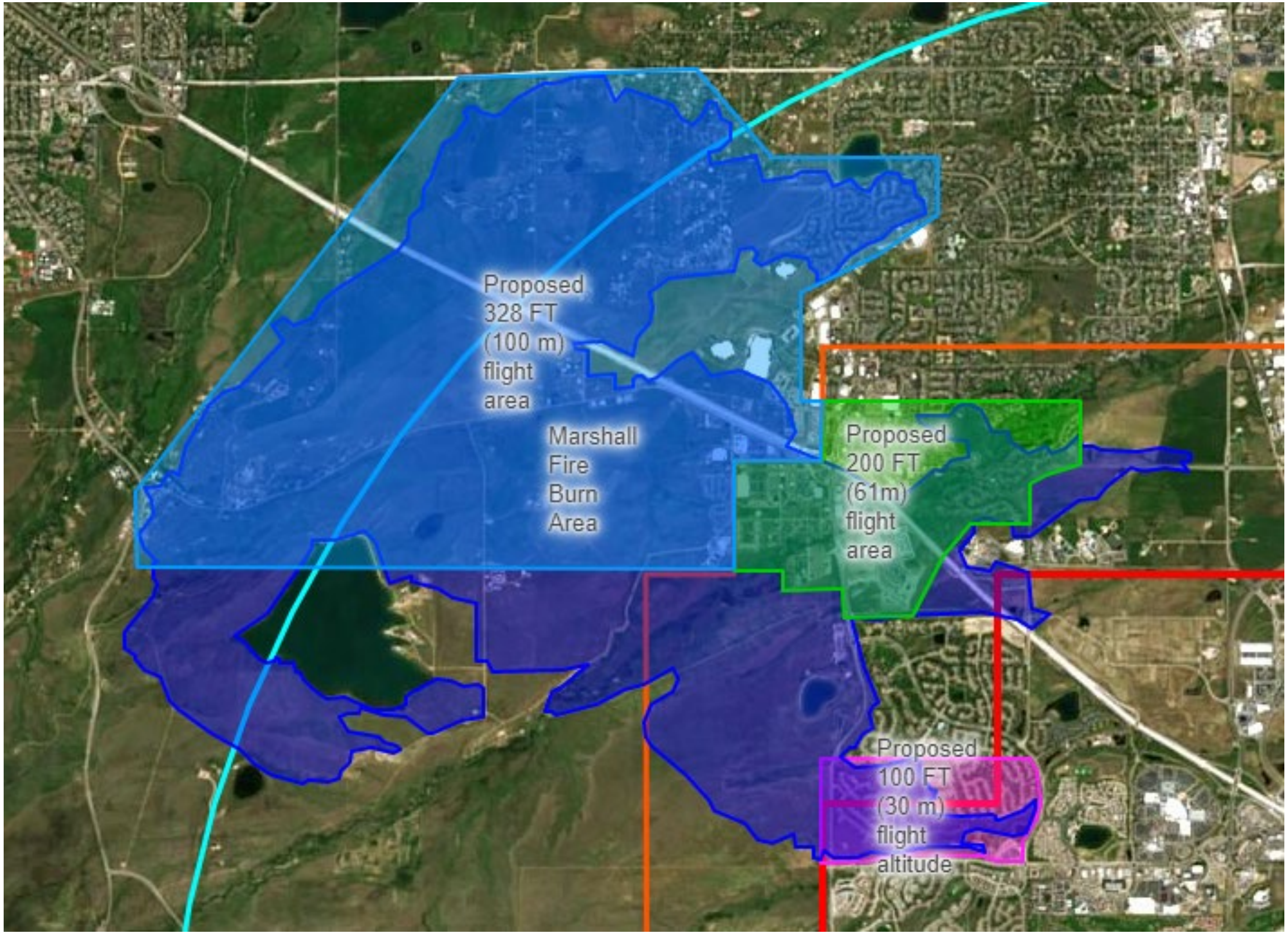
LIDAR scans of areas of interest

UAV Flights

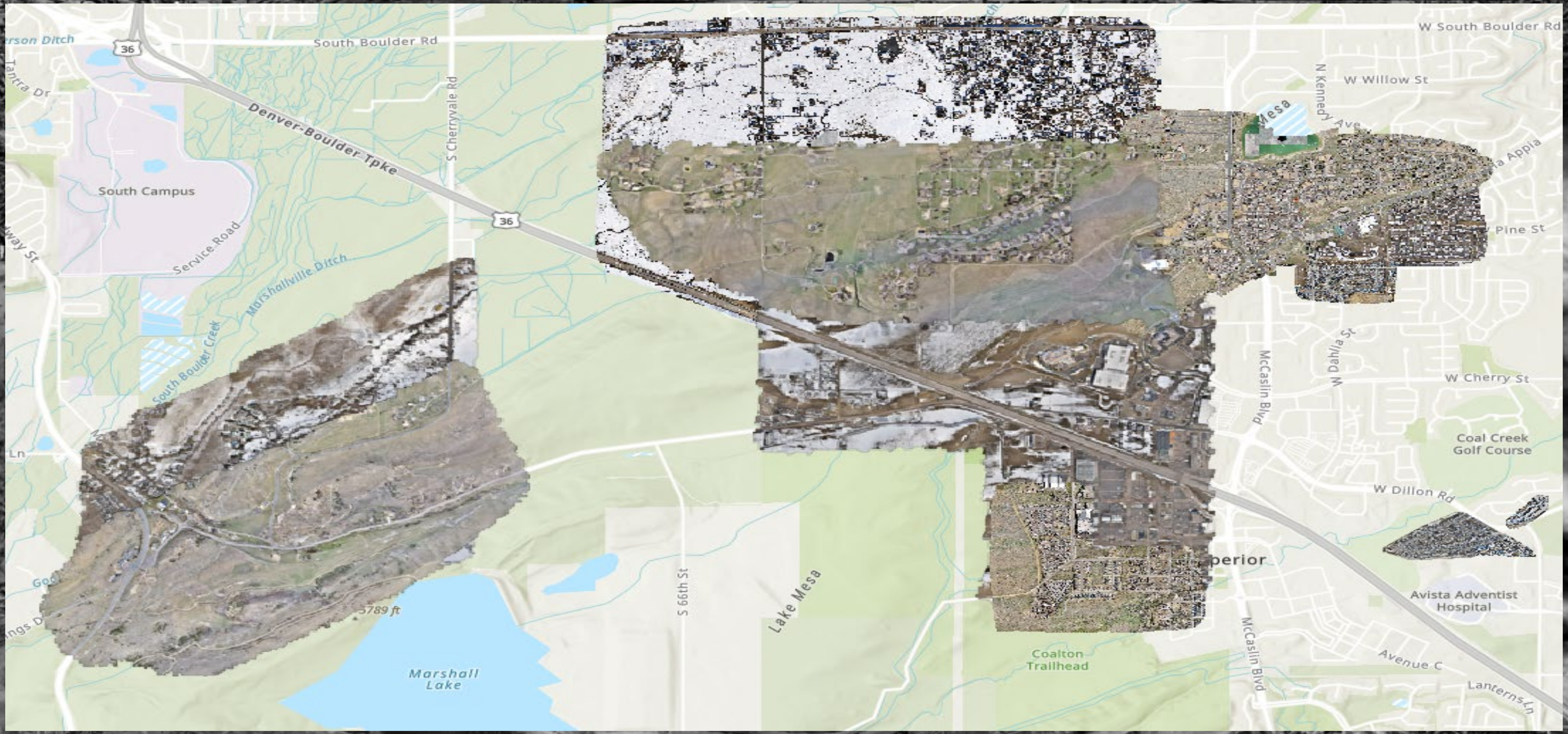
https://www.google.com/maps/d/u/0/edit?mid=1G83LCZoWe3HvbXYUxJ-Y_qG6tQ-x5flo&ll=39.96440432249915%2C-105.21959304862702&z=14



FAA Proposed Flight Area



2D Imagery (Orthomosaic)



https://www.arcgis.com/home/webmap/viewer.html?layers=6be1ef0adf93486abe65d2066893cf9c

2D Imagery (Orthomosaic)

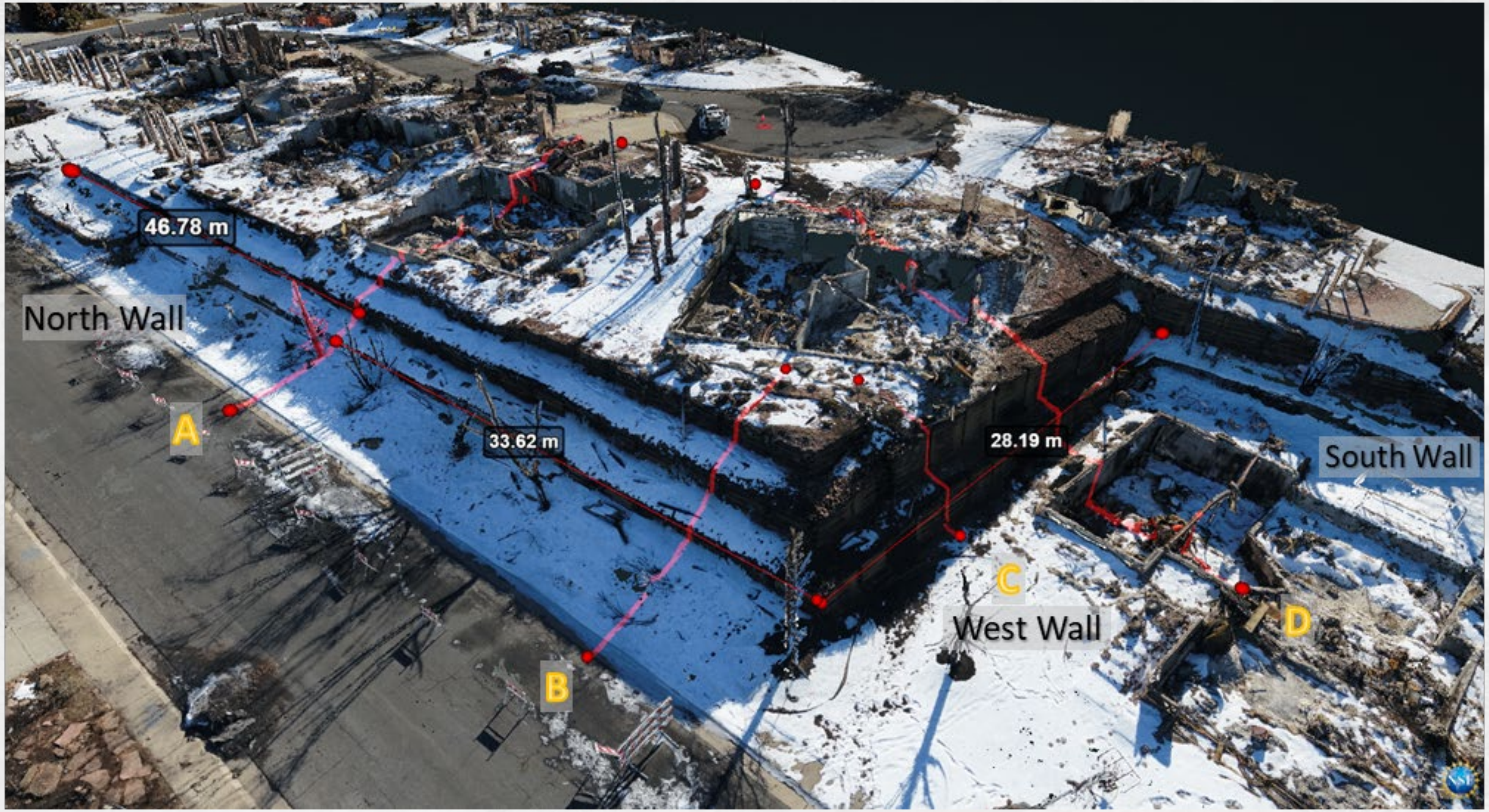
https://www.arcgis.com/home/webmap/viewer.html?layers=6be1ef0adf93486abe65d2066893cf9c

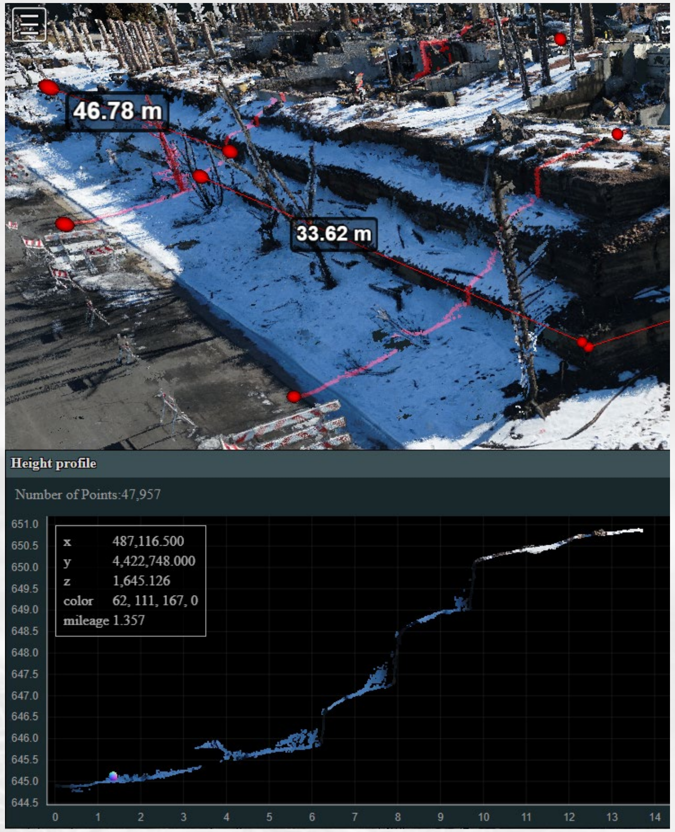
Structure from Motion Modeling

https://hazmapper.tacc.utexas.edu/hazmapper/project-public/473bc0e5-0da4-492c-afe1-0b0d99d463b3

Structure from Motion Modeling

https://hazmapper.tacc.utexas.edu/hazmapper/project-public/473bc0e5-0da4-492c-afe1-0b0d99d463b3





Ground Surveys

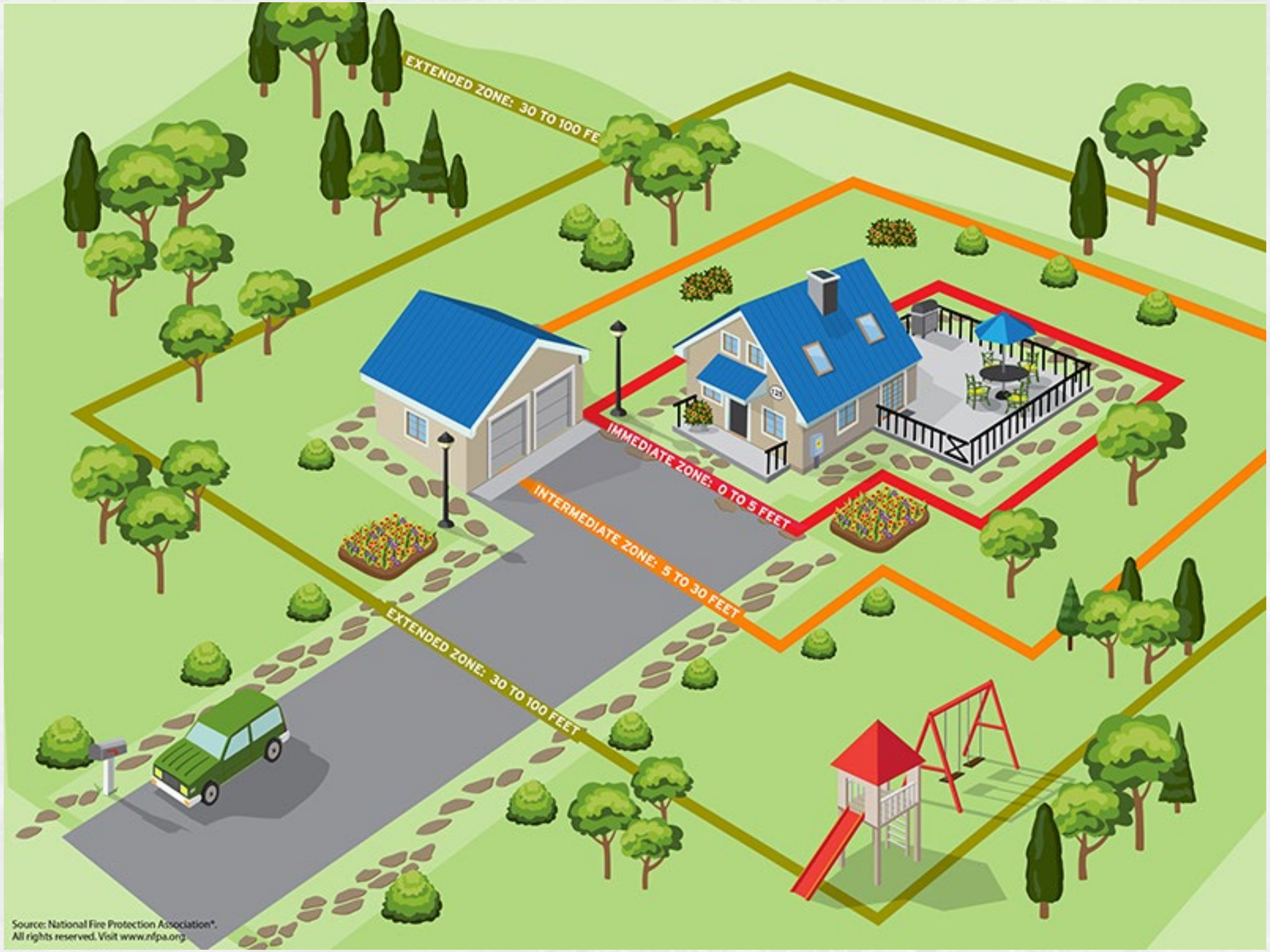
Damage state of homes

Proximity of homes to other damaged homes

Proximity of homes to one another

Proximity of homes to open space

WUI Code Recommendations



Preliminary Findings

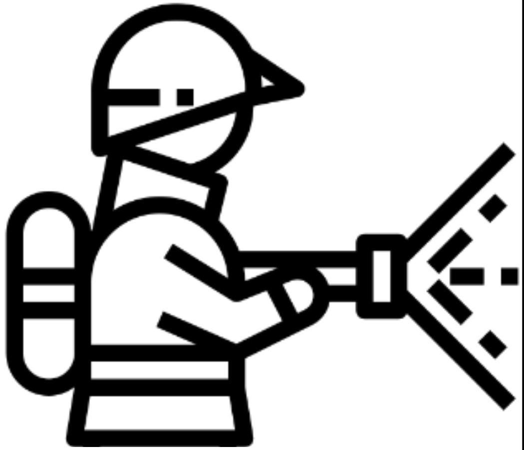
Closely spaced houses

High intensity of fire (high temperatures)

No protection on vents

Fences touching homes/Burnt fences

Proximity to open space



Firefighting strategies

(Ellery et al., 2023)

How the data has been used

- Sharing data with Municipalities to aid recovery and decision making
- Follow on grants
  - NSF Rapids (e.g., Housing & Policies)
  - WRF Grant on Utility response
- Data has been used for:
  - Fire Initiation Assessment
  - Water contamination studies (e.g., Whelton et al. 2023)
  - Open space assessment
  - Pavement assessment
  - Rebuilding efforts
  - FEMA MAT Team
  - Social Science Survey Teams
  - Others….

Acknowledgements

Local municipalities

City of Louisville

Town of Superior

West Metro Fire

Louisville Fire

Student support

Amy Metz (OSU)

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Nicholas Berty (CU)

Jacob Klingaman (CU)

Jessica Ramos (CU)

Hailey Rae Rose (CU)

NHERI Rapid Cente: Jaqueline Zdebski, Michael Grilliot, Karen Dedinsky

National Science Foundation (NSF) GEER

Water Research Foundation

Many others…

Brad P. Wham, Ph.D.
Brad.Wham@Colorado.edu

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Student GEER Team
Nicholas Berty (CU)
Jacob Klingaman (CU)
Jessica Ramos (CU)
Hailey Rae Rose (CU)
Amy Metz (OSU)
Dae Kun Kang (OSU)

GEER TEAM
Brad Wham (CU) [co-lead]
Erica Fischer (OSU) [co-lead]
Abbie Liel (CU)
Shideh Dashti (CU)
Amy Javernick-Will (CU)
Andrew Welton (Purdue)

Brad P. Wham, Ph.D. Brad.Wham@Colorado.edu

Local Agencies/Utilities
City of Louisville/ Louisville Fire
Town of Superior Public Works
West Metro Fire
East Boulder Water Utility
Boulder County (OEM)
CDHPE
Xcel Energy

NHERI Rapid Center:
Jaqueline Zdebski
Michael Grilliot
Karen Dedinsky
Jamie Vickery

National Science Foundation (NSF) GEER

Town of Superior | City of Louisville | Louisville Fire District | West Metro Fire Rescue District | RAPID NHERI Natural Hazards Reconnaissance | GEER | NSF

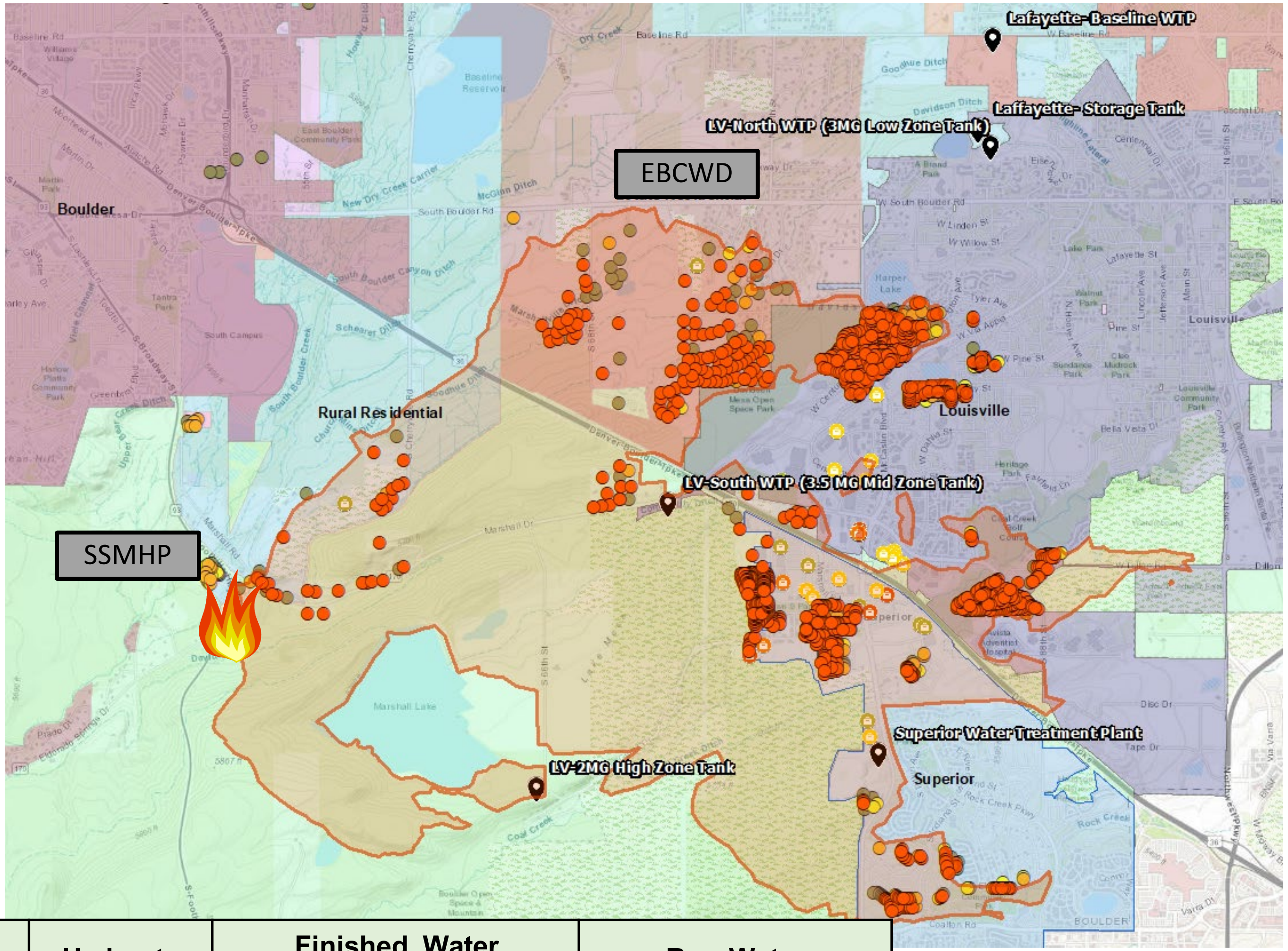
Some References and Resources

- Fischer, E., Wham, B.P., Dashti, S., Javernick-Will, A., Liel, A.B., Whelton, A.J., Berty, N.W., Klingaman, J., Metz, A., Ramos, J., & Rose, H.-R. (2022). *The 2021 Marshall Fire, Boulder County, Colorado. Geotechnical Extreme Event Reconnaissance (GEER) Association.* https://doi.org/10.18118/G6KT04
- Wham, B.P., Fischer, E., Dedinsky, K., Zdebski, J., Grilliot, M., Lyda, A., Berty, N.W., Kang, D.K., Klingaman, J., Metz, A., Ramos, J., Rose, H.-R., Dashti, S., Javernick-Will, A., Liel, A.B., & Whelton, A.J. (2023). "Marshall Fire Reconnaissance - 2022". Designsafe-CI. https://doi.org/10.17603/DS2-GARB-1N48
- Whelton, A.J., Seidel, C., Wham, B.P., Fischer, E.C., Isaacson, K., Jankowski, C., MacArthur, N., McKenna, E., & Ley, C. (2023). "The Marshall Fire: Scientific and policy needs for water system disaster response". *AWWA Water Science*, *5*(1), 1–21. https://doi.org/10.1002/aws2.1318
- Ellery, M., Javernick-Will, A., Liel, A.B., & Dickinson, K. (2023). "Jurisdictional decision-making about building codes for resiliency and sustainability post-fire". *Environmental Research: Infrastructure and Sustainability*, *3*(4), 045004. https://doi.org/10.1088/2634-4505/ad02b8
- FEMA P-2320. (2023). "Mitigation Assessment Team Report (MAT): Marshall Fire Building Performance, Observations, Recommendations, and Technical Guidance". Retrieved from https://www.fema.gov/sites/default/files/documents/fema_p2320-marshall-fire-mat-report-appendices.pdf

- **Water Research Foundation Reports**
- **CU CONVERGE Workshops:** https://docs.google.com/document/d/1IAMi4qXCfs8fTz2CAKm8Ee9rYTgRBdXqixN6D0Upfvs/edit

Marshall Fire Overview: Water Systems

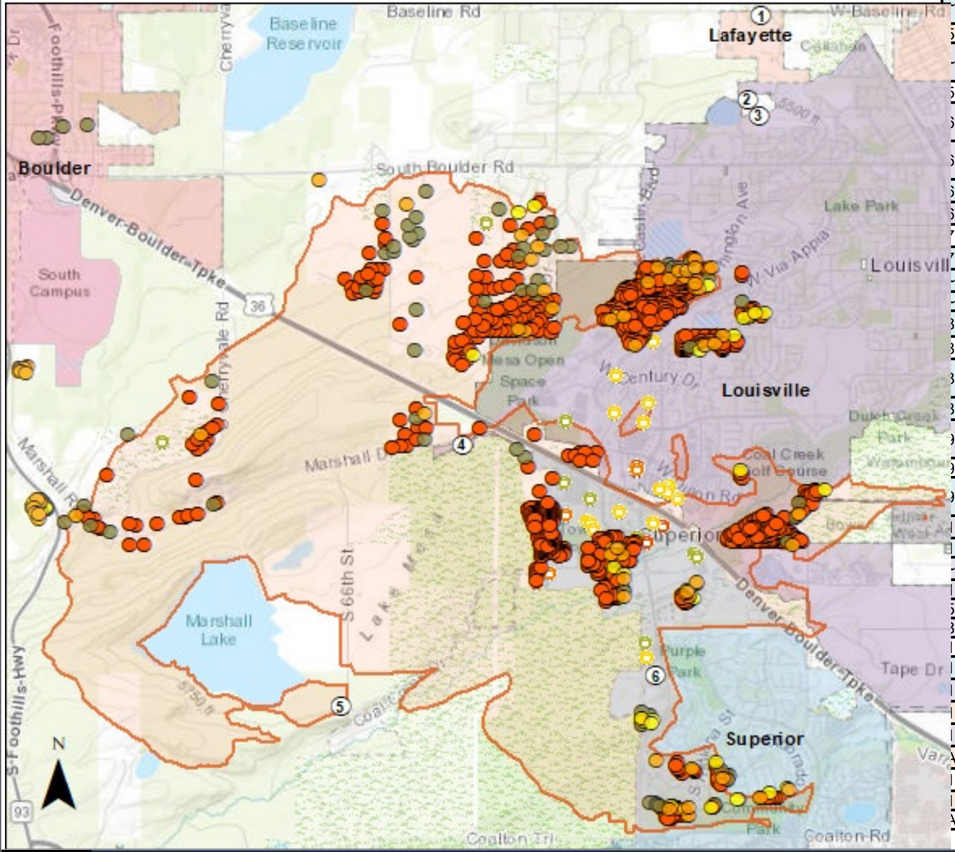
5 Public water systems were damaged affecting about 60,000 people



Public Water System (pop.)	Damaged/Destroyed Properties	Water Mains, miles	Hydrants	Finished Water Storage, MG	Raw Water
Louisville (20,319)	593 of 7,339	120	1,200	7.5	Surface water
Superior (17,170)	436 of tbd	50	430	3.4	Surface water
Lafayette (28,700)	22 of 9,700	177	900	14	Surface water
EBCWD (300)	72 of 137	8	40	0.1	Lafayette
S.S. Mobile Home Park (150)	3 of 61, wind	<1	None	None	1 Well

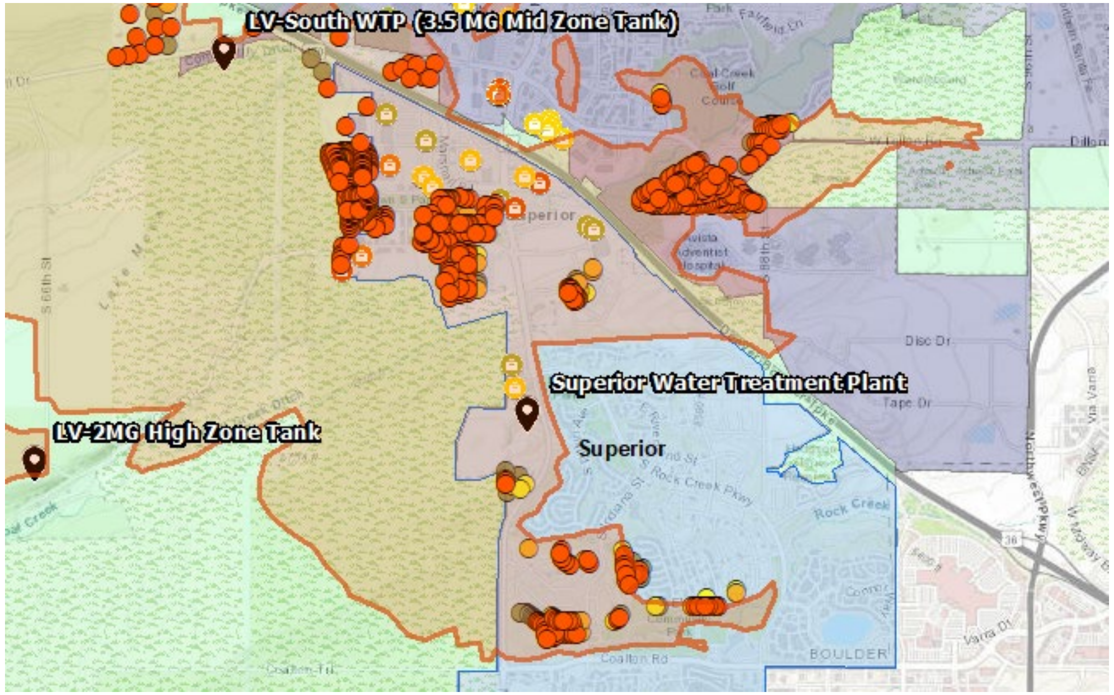
Eldorado Artesian Spring: 2 wells, one spring

Timeline (Water)



Time (MST)	Event/notice/advisory	Org/ Area
11 AM	Fire reported at 11:06 AM; Highway 93 and Marshall Rd	Marshall
11:47 AM – 2:51 PM	Boulder County Sheriff Office issues evacuation orders for >35k residence (see Section 7.4.1 for details)	Starting with Marshall and extending to LV
~11:30 AM	SWTP (South Water Treatment Plant) staff evacuated	LV–PW
12 – 1 PM	Fire enters South WTP, power loss	LV
~12:15 PM	Additional staff arrive to WTP, plant production increased from 650 to 1200 GPM, turbidity shutdown setpoint increased, staff prepared to evacuate	SUP (WTP) REC
1 PM	Fire visible from Terminal Reservoir (WTP)	SUP (WTP) REC
~1 PM	Water pressure begins to decrease, staff decides to drive into fire area to SWTP LV–PW turned North plant to maximum capacity (8 MGD)	LV–PW
1:53 PM	Recorded flow of treated water stopped, likely due to power loss/fluctuation; flow rate was 1200 GPM	SUP (WTP) REC
2:00 PM	**Maxar Satellite Picture taken**	**Maxar/BoCo**
2 PM	Fire had not yet entered WTP, approaching from North	SUP (WTP)
2 PM	Booster station lost communication near where the fire ultimately damaged properties	LAF
2:25 PM	- Natural gas shut off, generator quit, *total power loss* - staff evacuated due to smoke, closed influent valve to WTP, opened north hydrant to protect assets	SUP (WTP) REC
2 – 3 PM	LV–PW asks XCel Energy to prioritize getting power back to water treatment plants low on water.	LV–PW
2:30 PM	EBCWD losses power/internet (they had data up to that point)	EBCWD
3 PM	Water storage tanks were topped off. WTP evacuated.	LAF
~3 PM	WTP emergency generator destroyed by fire	SUP (WTP)
3 – 4 PM	LV loses electricity and natural gas at the Louisville Fire Station (backup power)	LFPD
3 – 4 PM	LV–PW arrive at interconnect, still no power at SWTP	LV–PW (SWTP)
~4 PM	REC contacts LV-SWTP about opening interconnect to SUP	LV–PW & SUP & REC
-4:15 PM	Staff returned to WTP, only 2-phase power had been restored (need 3-phase for proper function of much equipment), power surges caused failure of automatic transfer switch, only half of plant with power	SUP (WTP) REC
5 PM	Raw water pump stations at 2 reservoirs lost power for 15 min. 2 generators did not kick on, but 1 diesel generator turned on.	LAF
-5 PM	LV–PW drives to mid–zone & high–zone tanks to check water levels. Only 2 ft of water left in tanks. When LV staff returns to mid–zone tank, the tank is empty.	LV–PW
5:15 PM	LV-PW & SUP open interconnect station to feed 1 MGD to SUP due to multiple failures of SUP WTP and inability to keep up with water demand	SUP-PW, REC, LV-PW (SWTP)
6 PM (6–7 PM)	No power at LV SWTP; shut off interconnect to SUP; staff manually open raw water valve at SWTP to allow untreated water into system to maintain pressure (~6:45 PM) and provide water for firefighting	LV–PW (SWTP)
6 PM	LV–PW calls LV Fire to voice concern that water treatment plants are burning. LFPD confirms plants are not burning and prepares a strike team to deploy if necessary.	LFPD & LV–PW
6:18 PM	Treated water flow restarted at 2000 GPM, increased to 3300 GPM by 10 PM, and stayed at that rate for the next 29 hours	SUP (WTP)
6 – 7 PM	Fiber connection between Louisville water plants is damaged through the splice connection melting	LV–PW
7:50 PM	Boil water advisory issued by CDPHE to LV, SUP, EAS, EBCWD, & SSMHP	Boulder County
7 PM	Browns Hill Electric Controls arrives to begin diagnostic troubleshooting & repairs	SUP (WTP) REC
-7 PM	SCADA was restored, storage tanks at 15% full, down from 90% when fire shut down the WTP	SUP (WTP) REC
-8 PM	SUP–PW starts shutting curb stops to destroyed homes	SUP- PW
8:15 PM	By this time, all filters operated manually at max. production as well as chlorine pumps and both raw water trains	SUP (WTP) REC
8 – 9 PM	LAF connects hydrant to LV, provides 1.5 MGD through one–way valve to aid pressure loss	LAF & LV
8:30 PM	SUP-PW informs REC that many hydrants were left open by firefighters; 6 in. dia. fire suppression line in Target was ruptured/wide open, took several more hours to close	SUP (WTP) REC
8:30 PM	Xcel again contacted to ask to help restore full power to WTP	SUP (WTP) REC
9 – 10 PM	XCel Energy drives natural gas trucks to LV SWTP. Natural gas service line cut and hooked up to the tanks to bring power back to the plant. Both LV WTPs begin running at full capacity (13 MGD total).	Xcel Energy & LV–PW
9:11 PM	The FEMA authorized federal funds for use to help firefighting costs, approving the state's Fire Management Assistance Grant	FEMA
9:45 PM	By this time, Xcel has completed repairs to on-site transformer and reestablished 3-phase power; full function of process equipment & instrumentation	SUP (WTP) REC
10:50 PM	Power restored at SWTP, chem pumps on, 5 MGD flow, Alum at 40 ppm, flow observed in clear well	LV–PW (SWTP)
12:45 AM	LV-PW closed interconnect with SUP	SUP (WTP) REC
-1 AM[1]	LV Operations Staff convene to discuss dangerously low water system pressure. Storage tanks still low.	LV–PW (SWTP)
1 – 7 AM[1]	Staff shuts off curb stops to damaged/destroyed properties or at entrances to neighborhoods, aiding pressure concerns and firefighting	LV–PW/ Louisville
5:35 AM	By this time, SWTP producing compliant potable water	LV-PW (SWTP)
8 – 9 AM	Water levels in storage tanks began rising	LV–PW
10 AM	Fire impacted area estimated to be 6,219 acres	BC–OEM[2]
12/31	Pump, process, controllers and communication (SCADA) system checks.	SUP (WTP) REC
12/31 Mid–day	Water levels within water storage tanks in Louisville are back to normal levels	LV–PW
12 PM	Start removal of water meters at the 22 destroyed homes on cul–de–sacs	LAF
12/31 Morning	SUP on–site storage tank was re–filled	SUP–PW
Afternoon	Flushed hydrants near 22 destroyed homes on cul–de–sacs	LAF
12/31 Mid–day	Snow starts	Boulder County
12/30 – 31	LAF WTP loses power intermittently	LAF
All Day	SSMHP experiences wind damage and structure leaking	Marshall

Timeline (Superior)



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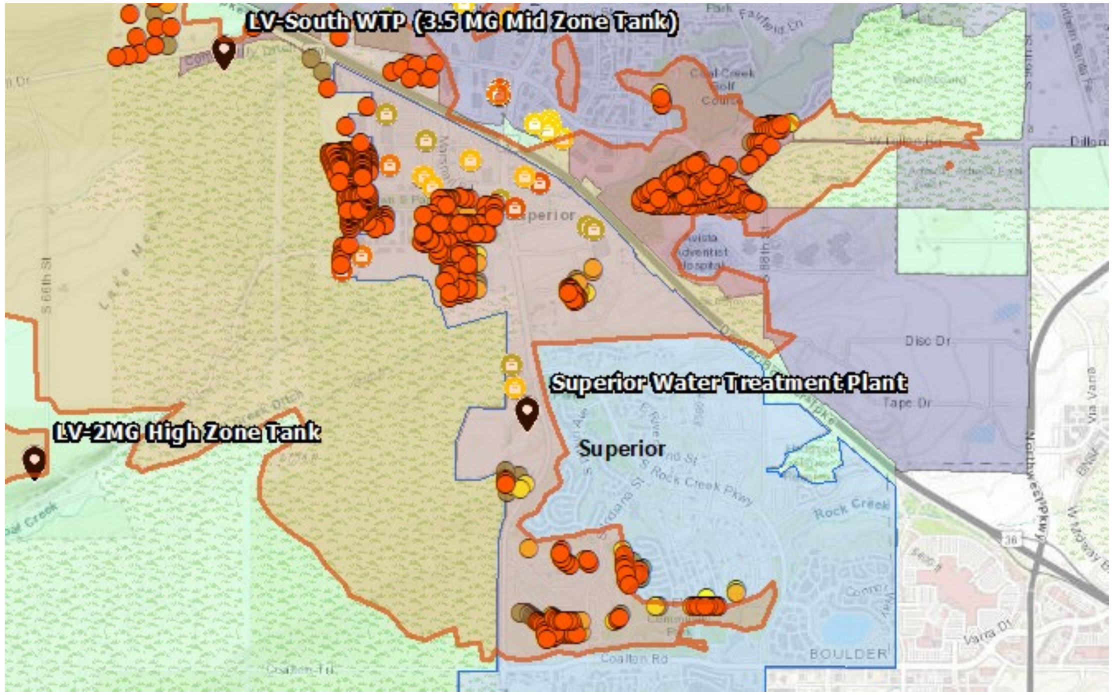
12/31	Pump, process, controllers and communication (SCADA) system checks.
12/31 Morning	SUP on–site storage tank was re–filled
12/31 Mid–day	Snow starts; Building plumbing pipes froze, broke, and leak

Timeline (Superior)



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12/31 Mid–day	Snow starts; Building plumbing pipes froze, broke, and leak

Other Lifelines

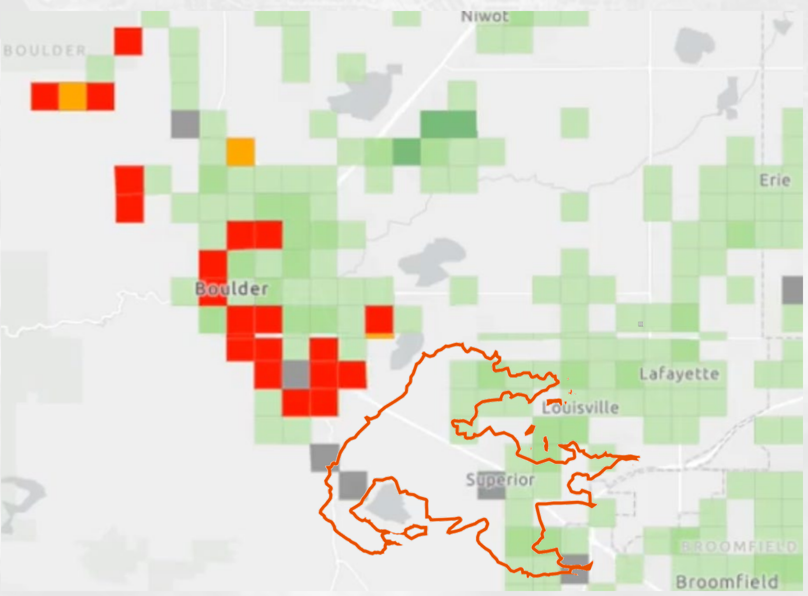
- Natural Gas
  - 13,000 customers with out gas
  - Xcel Energy dispatched 500 employees to help and provided thousands of portable heaters (freezing temperatures)
  - 6 Jan., most customer restored

- Electric
  - Statewide- 100,000 customers lost power (high winds impacted before fire)
  - Day after the fire, more than 5,500 without electricity
  - 3:52 PM- power our at evacuation center, facility relocated
  - 3 Jan. (4 days post fire) electric restoration "nearly complete"

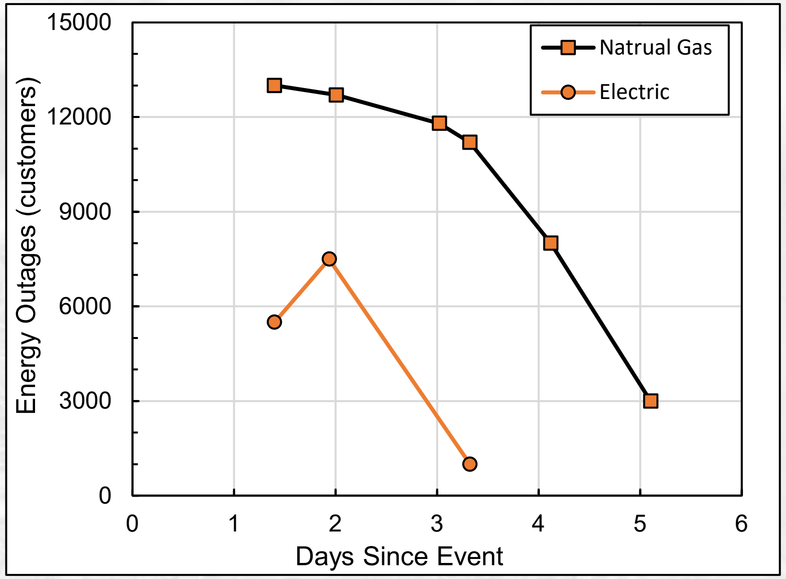
- Telecommunications
  - Xfinity- 8% of customers without connection one week after fire

- Wastewater- treatment challenges

- Transportation- evacuations, supplies notice



11 AM (12/30) (Gridmetrics, 2022)



Water Utility Response

- Internal leadership, exceptional staff, and requests for aide helped Louisville and Superior utilities stabilize

- **Mutual Aid:** Relationships between neighboring towns helped in asking for help during and after the fire.
  - Boulder, Ft. Collins, Erie, Westminster, South Adams County, Broomfield, Longmont, more…

- Lifeline interdependencies were critical to identify and react to; rapid communication among agencies

- Technology was important to Louisville and Superior in finding valves, isolating systems, flushing, and identifying sampling locations to restore service

- Transparent Public Communication

On December 31, boil water advisories were issued to the Louisville, Superior, Eldorado Artesian Spring, East Boulder Water District, and Sans Souci Mobile Home Park, and were rescinded between January 4 to 6 (CDPHE 2022a) with additional guidance issued for building owners (CDPHE, 2022b; CDPHE 2019). <u>Almost one month after the fire, CDPHE issued a “bottled water advisory” to EBCWD, then rescinded it six days later</u> (CDPHE 2022c).

Thank you!

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NHERI GSC
Wind RSR Meeting

NHERI GSC

2025

A Novel Wind Tunnel Testing Method for Debris Flight in Turbulent Winds

January 17, 2025
12:00 pm CT

Shaopeng Li

NSF | NHERI GSC
Graduate Student Council

Speaker Introduction

Dr. Shaopeng Li

Assistant Professor
University of Louisiana Lafayette

shaopeng.li@louisiana.edu

NHERI GSC
Graduate Student Council

A Novel Wind Tunnel Testing Method for Debris Flight in Turbulent Winds

Shaopeng Li[1], Kimia Yousefi Anarak[2], Ryan Catarelli[3], Yanlin Guo[2], Kurtis Gurley[3], John van de Lindt[2]

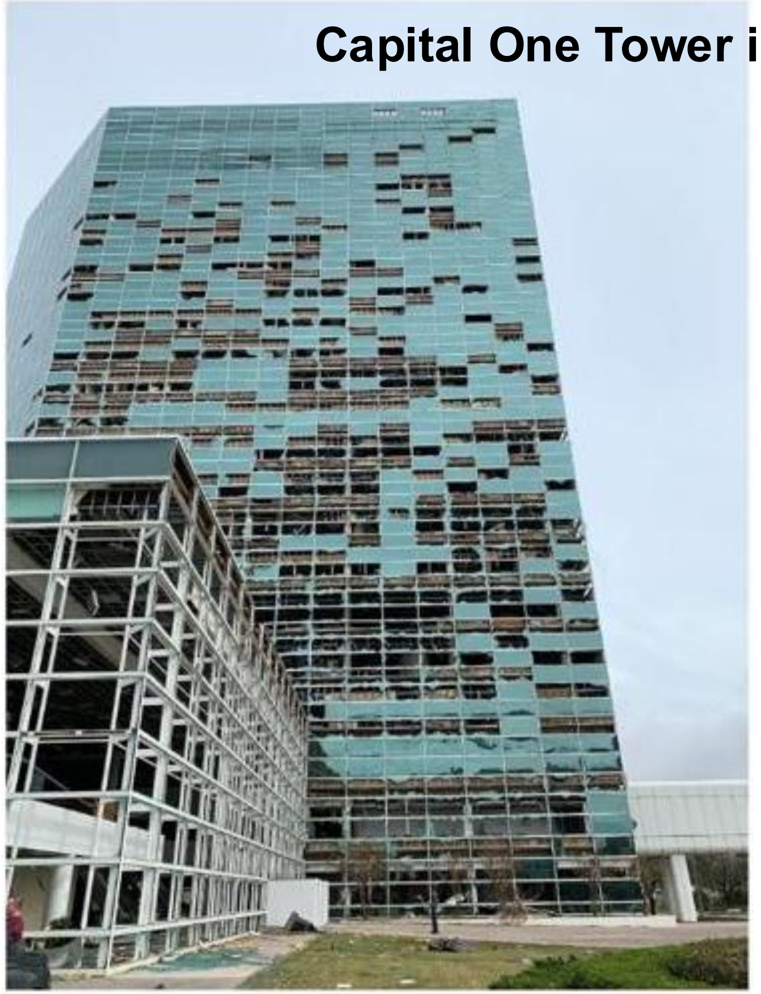
[1]University of Louisiana at Lafayette
[2]Colorado State University
[3]University of Florida

Outline

1. Background and motivation
2. Theory
3. Illustrative numerical example
4. Experimental investigation
5. Concluding remarks and future directions

Background and motivation

Capital One Tower in Lake Charles, Louisiana



Building façade damaged by windborne debris in Hurricane Laura in 2020

Building demolished by on September 7, 2024, because it is too expense to repair

Background and motivation

Quantity the risk of windborne debris

↓

Model the debris flight in turbulent winds

Numerical approach

- Difficult to accurately and efficiently simulate spatiotemporally varying wind field and the unsteady aerodynamic loads on debris.

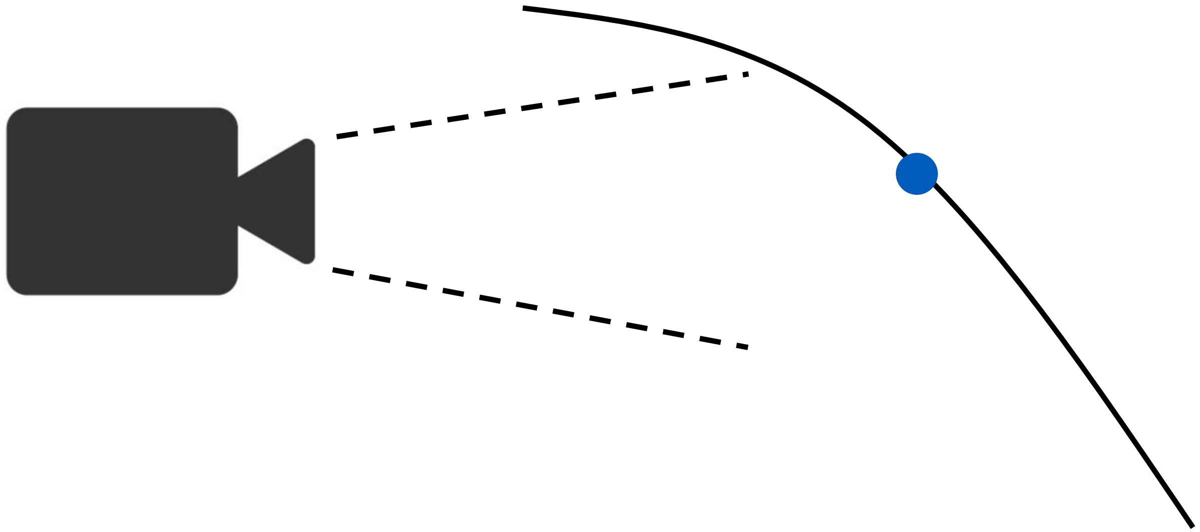
Experimental approach

- Physically generate the turbulent wind field and debris flight in reduced scale in the wind tunnel.

Background and motivation

Experimental approach

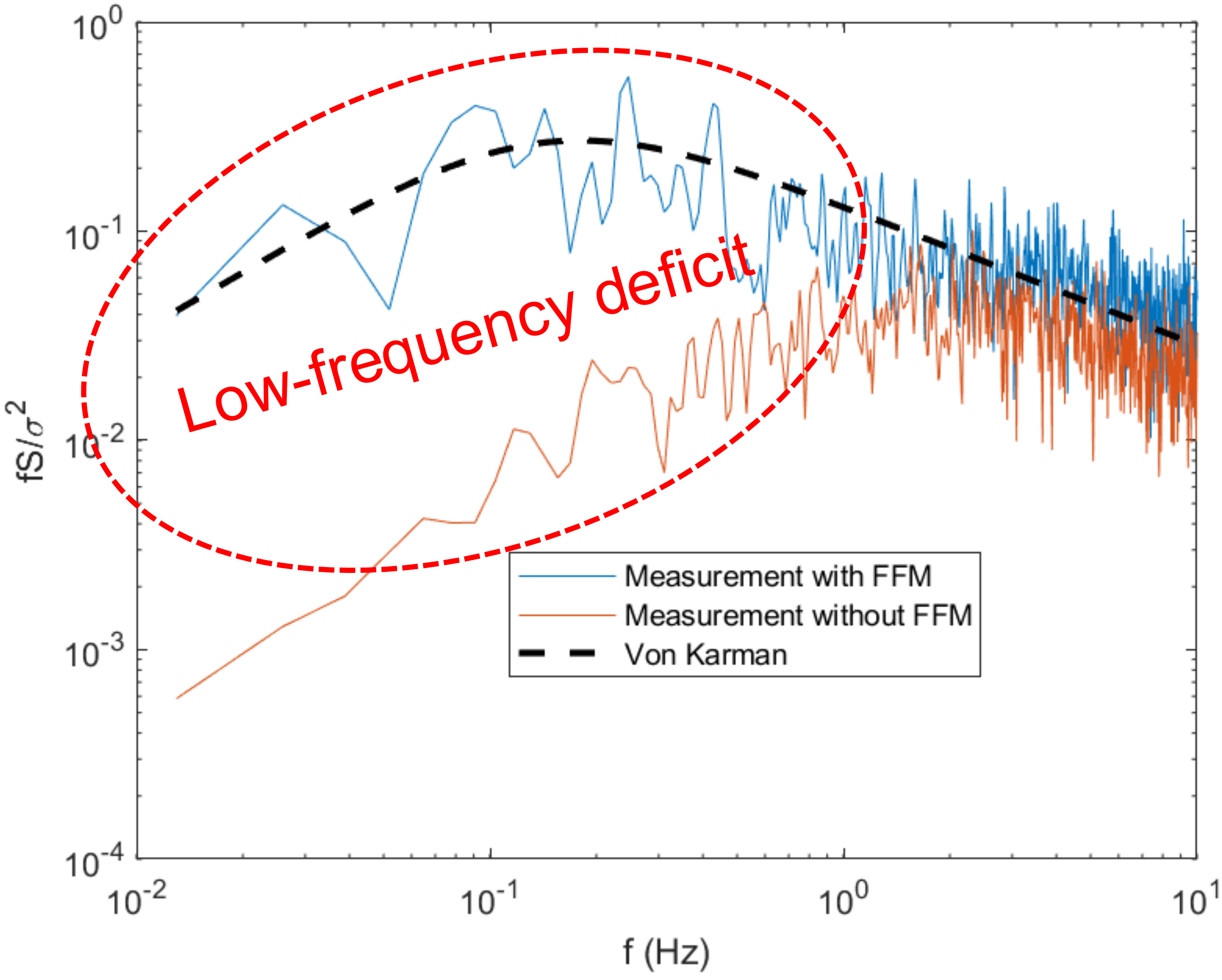
- Debris flight trajectories are usually captured by high-speed cameras.
- To ensure the camera can see the debris, the geometric scale needs to be relatively large.
- For example, a 3cm diameter gravel under 1:20 scale is only 1.5mm large (reaching the limit of cameras).



Background and motivation

Experimental approach

- At large geometric scale, there exists a significant **deficit in low-frequency turbulence** due to the limited size of wind tunnel.
- This deficit makes debris flight tests **unreliable**.
- The issue can be mitigated by **active turbulence generation** (e.g., using active fans and rotating blades).
- However, active devices are **not generally available** to many wind tunnel facilities.



Background and motivation

Goal

Develop an alternative method for debris flight testing without relying on active devices.

Outline

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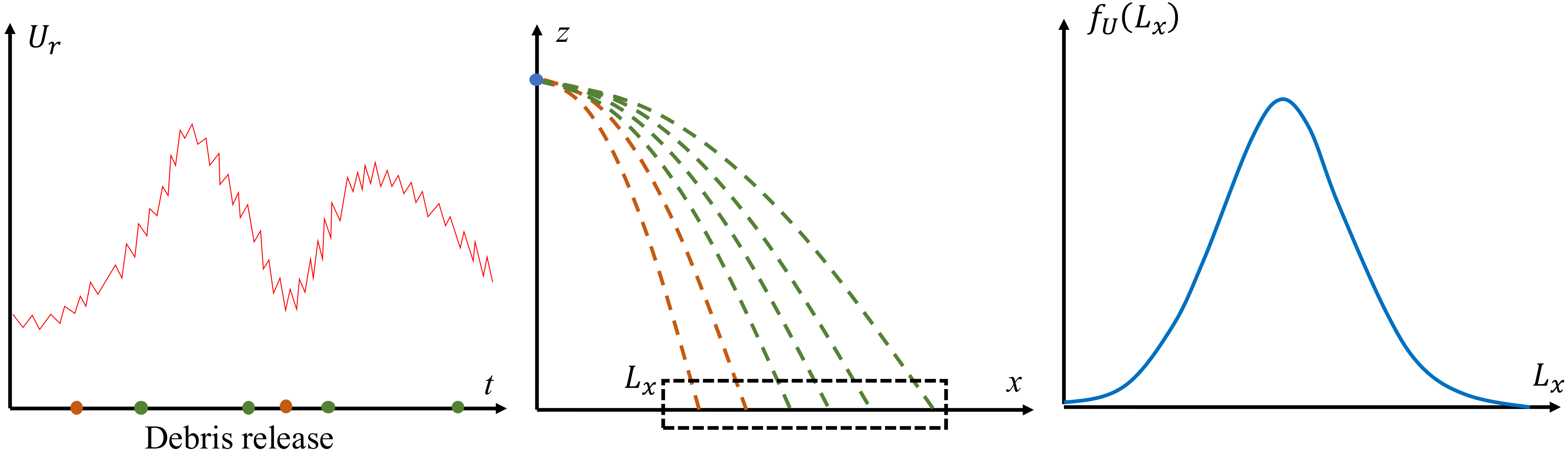
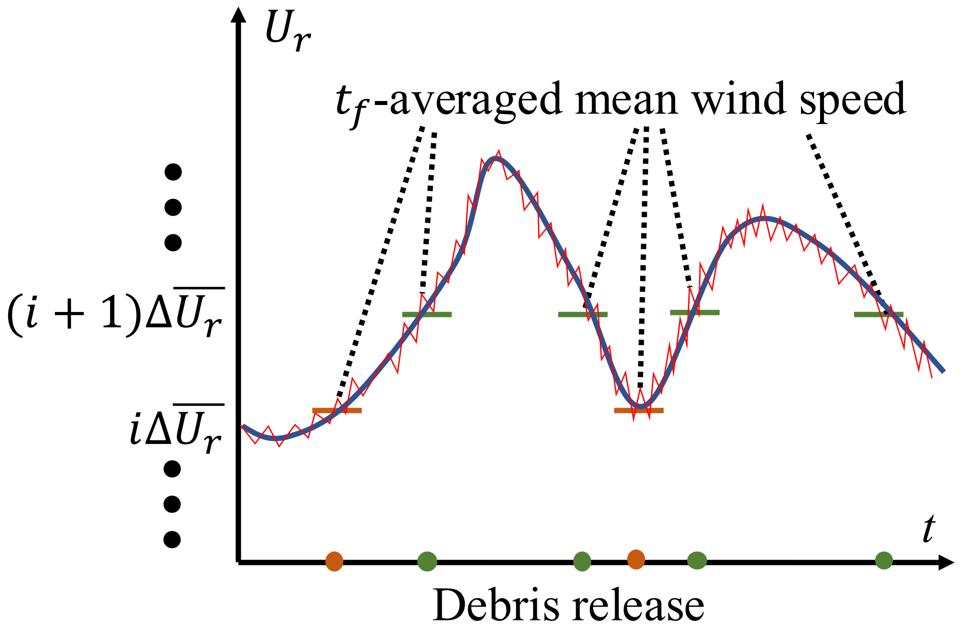
Theory



Baseline "unsteady" approach

- Active devices are used to introduce low-frequency wind turbulence.
- Debris is randomly released to the turbulent wind field.
- Debris flight trajectories are captured by high-speed cameras to study the statistics of flight distance.

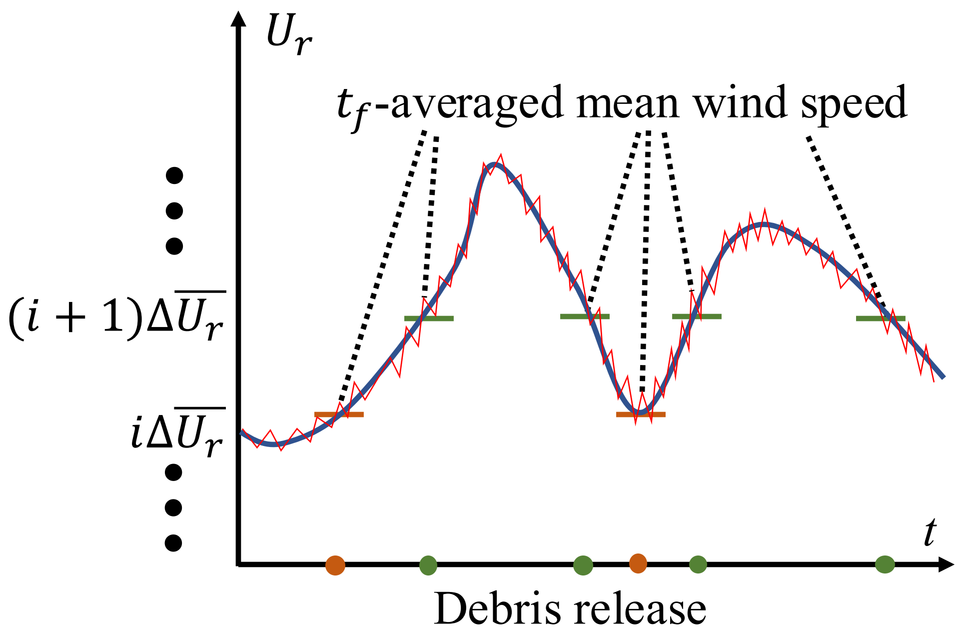
Theory



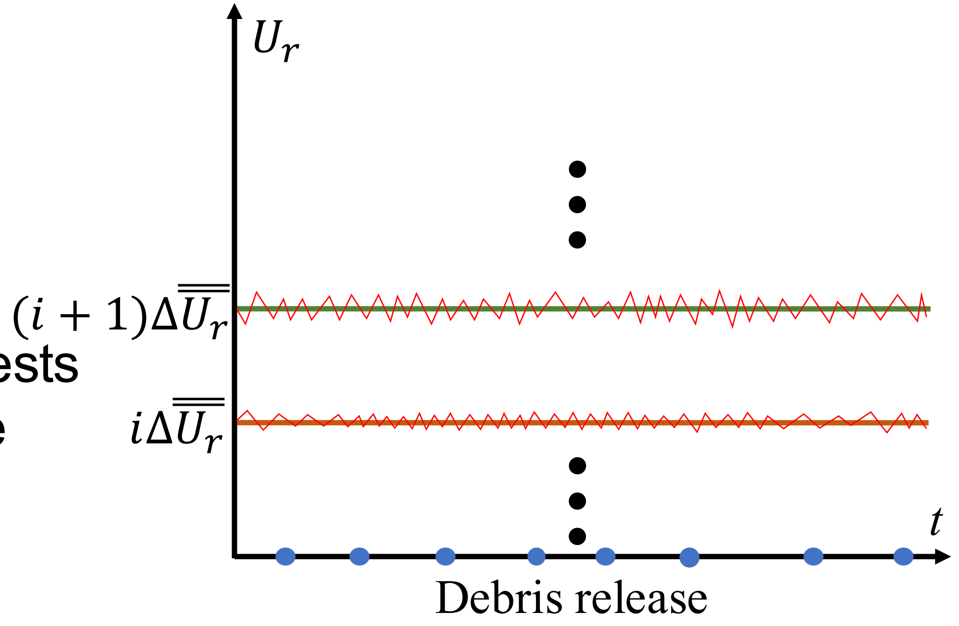
Observation

- Each debris flight has a short duration and depends on the “gust” wind.
- Consequently, the wind speed for debris flight can be decomposed into (1) a time-varying mean averaged over the flight duration (**low-frequency turbulence**), and (2) the fluctuation component (**high-frequency turbulence**).

Theory



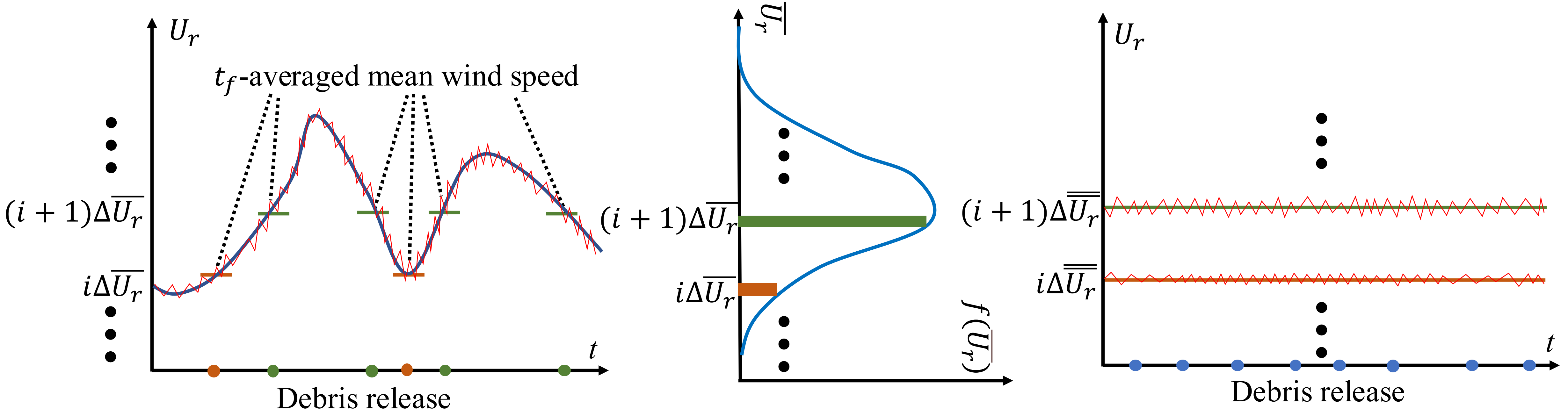
This can be realized by conventional wind tunnel tests without active devices.



Assumption

- The "**unsteady**" debris flight is an ensemble of "**quasi-steady**" flight under varying mean wind speeds and a constant turbulence intensity.
- **Rationale**: The small-scale high-frequency turbulence can rapidly adjust to the changes imposed by the large-scale low-frequency turbulence and reach equilibrium (**rapid equilibrium assumption**).

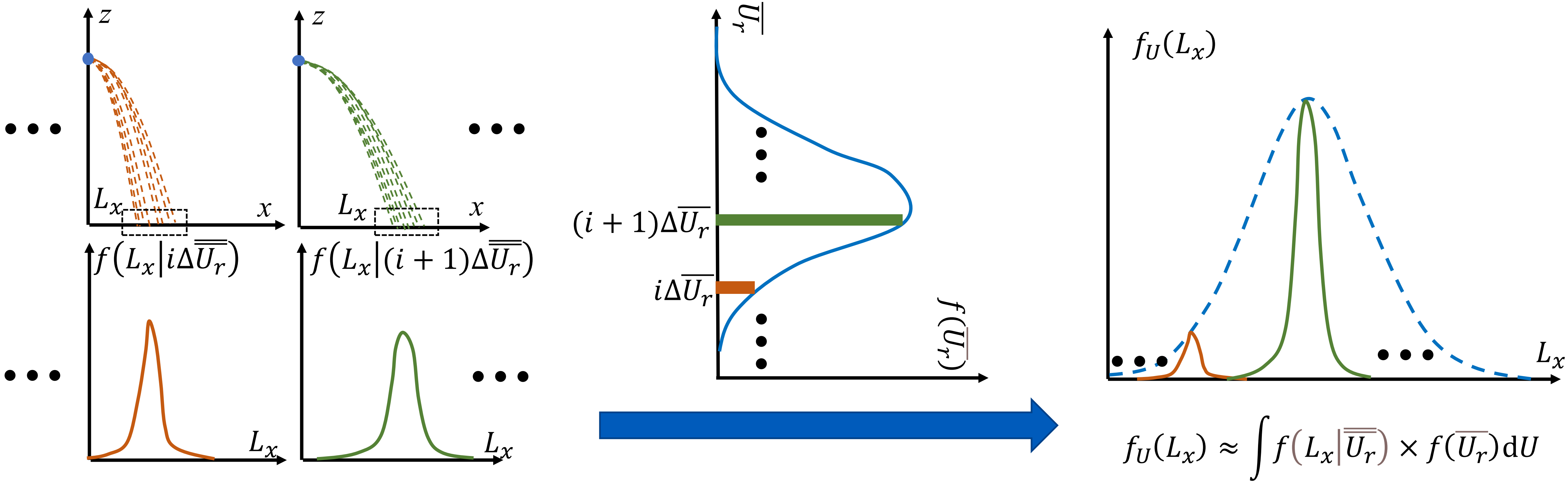
Theory



Proposed "quasi-steady" approach

- Low-frequency turbulence is first considered by **physically** conducting conventional wind tunnel tests under multiple mean wind speeds.

Theory



Proposed "quasi-steady" approach

- The results under different mean wind speeds are then **numerically** post-processed according to the statistics of the full turbulence spectrum to correct the low-frequency deficit impact on debris flight.

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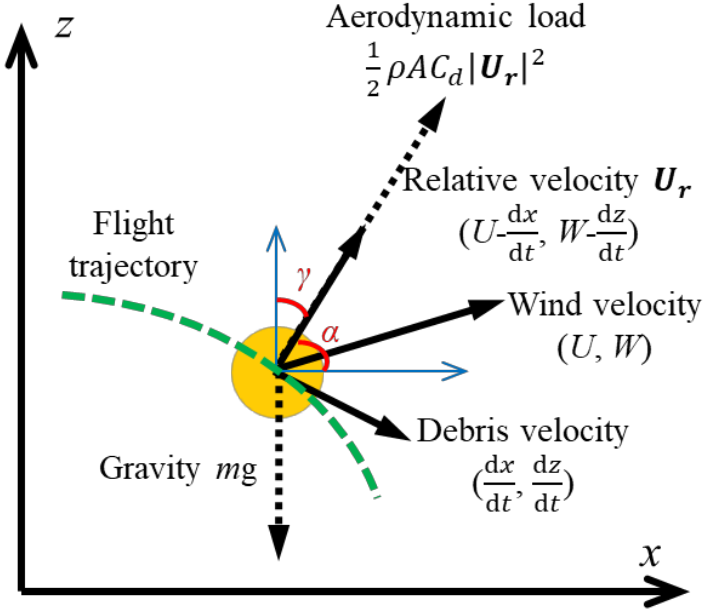
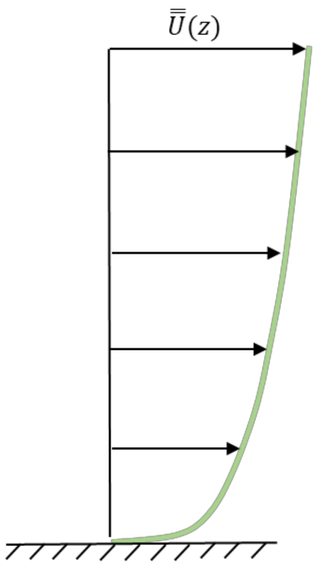
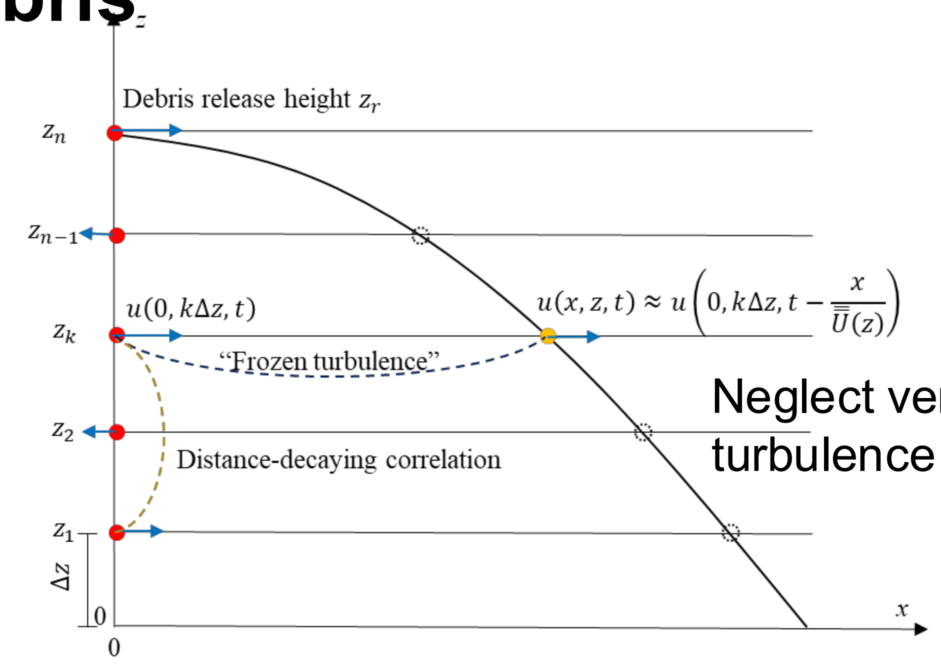
Illustrative numerical example

Two-dimensional flight of spherical debris





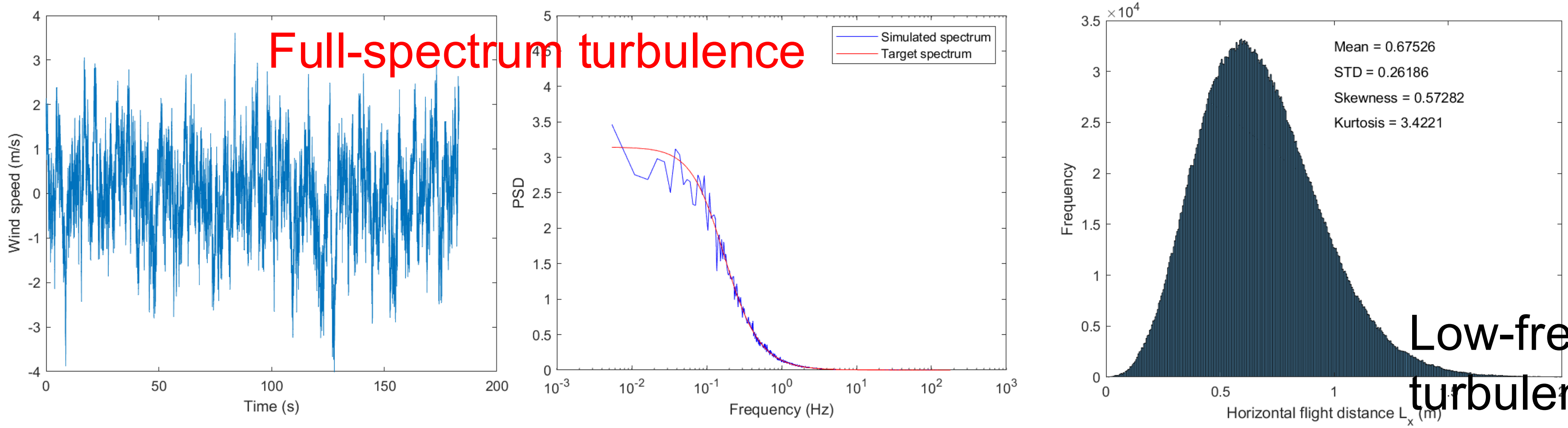


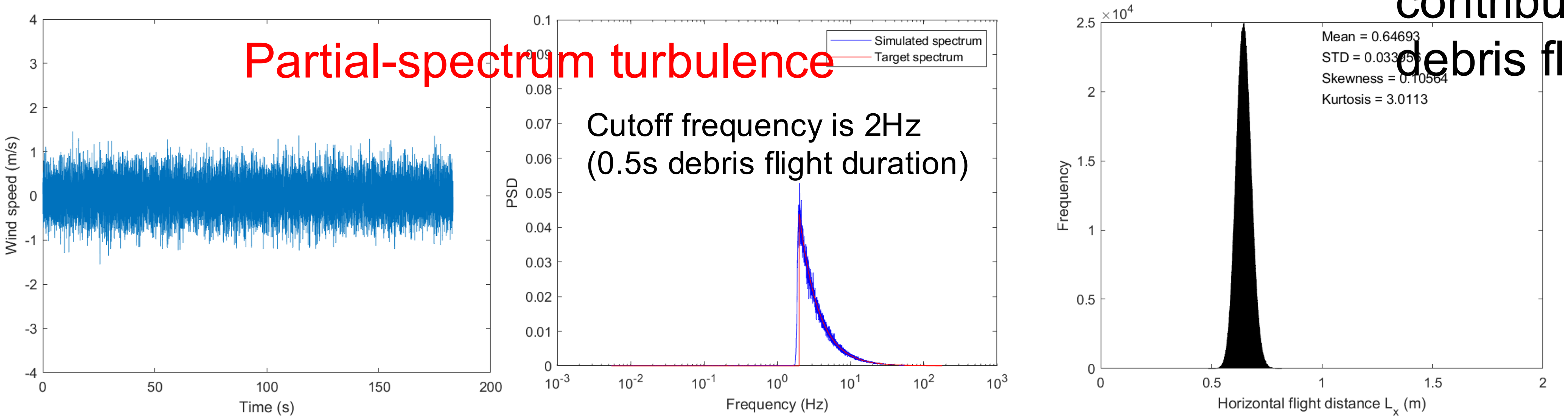
Neglect vertical turbulence

Parameters	Values
Debris diameter d	1.5 mm
Debris density ρ	2.5 g/cm^3
Debris mass m	4.42×10^{-3} g
Debris release height	1 m
Wind speed at release height	8 m/s
Drag coefficient C_d	0.5
Gravitational acceleration g	9.8 m/s^2
Air density ρ_a	1.225 kg/m^3

Illustrative numerical example

Impact of low-frequency turbulence

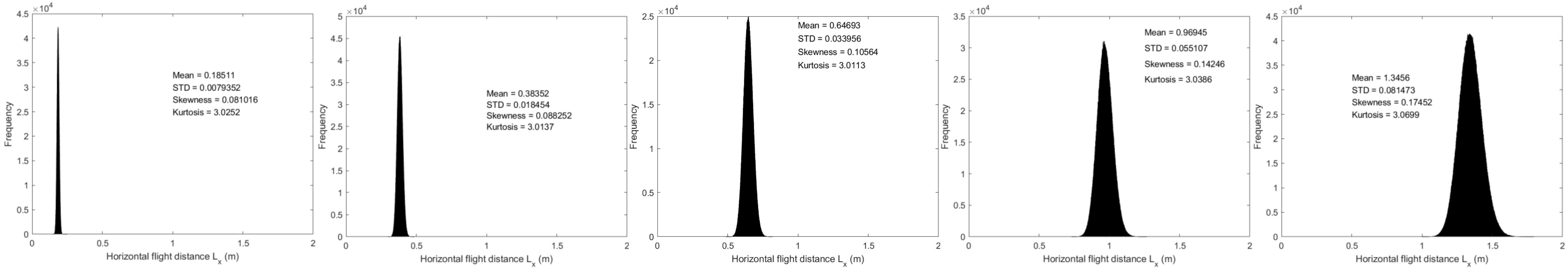




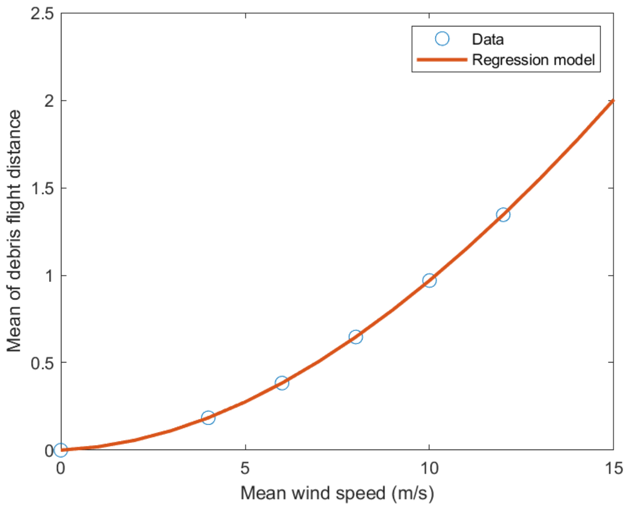
Low-frequency turbulence contributes greatly to debris flight variation

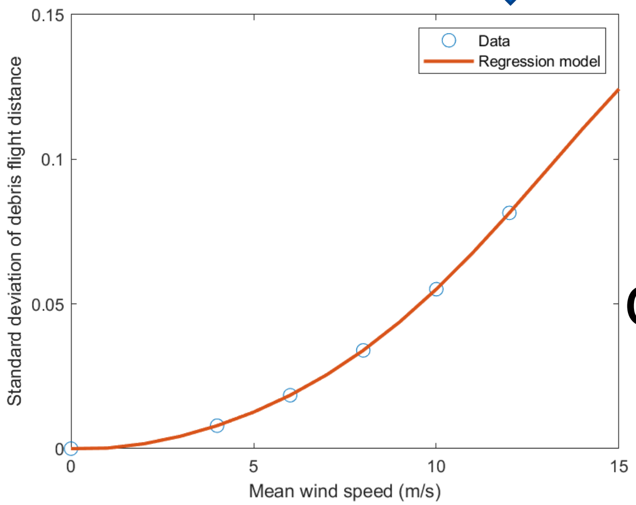
Illustrative numerical example

Reproduce the baseline result using "quasi-steady" approach



Debris flight under different mean wind with partial-spectrum turbulence

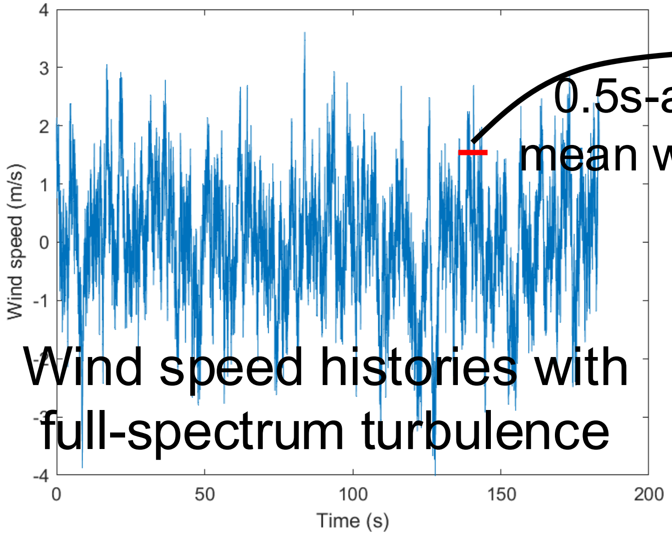




Build surrogate models to predict mean and STD (assume Gaussian distribution) of debris flight distance under different mean wind

Illustrative numerical example

Reproduce the baseline result using “quasi-steady” approach

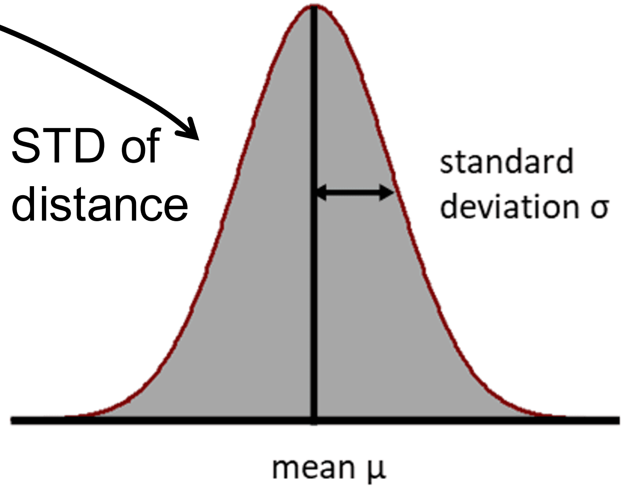


Wind speed histories with full-spectrum turbulence

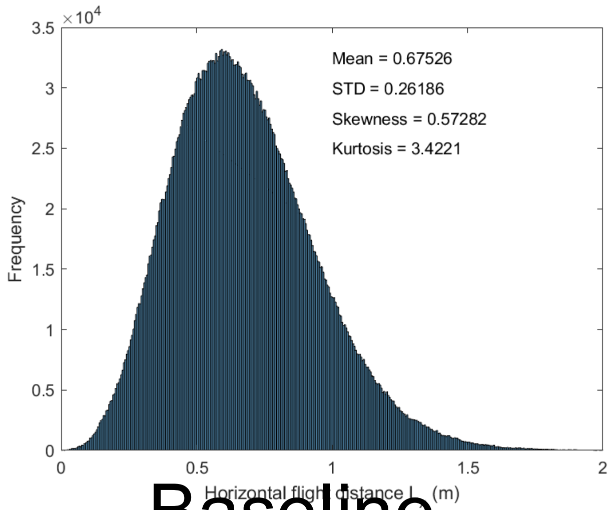
0.5s-averaged mean wind speed

Surrogate model

Mean and STD of debris flight distance

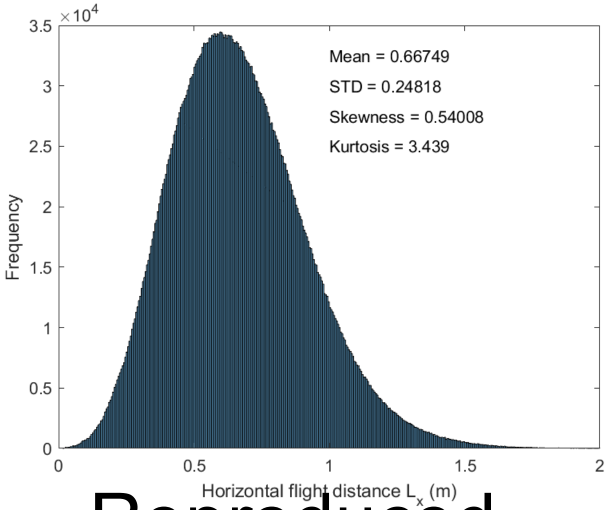


Random samples from Gaussian distribution



Baseline

Very close



Reproduced

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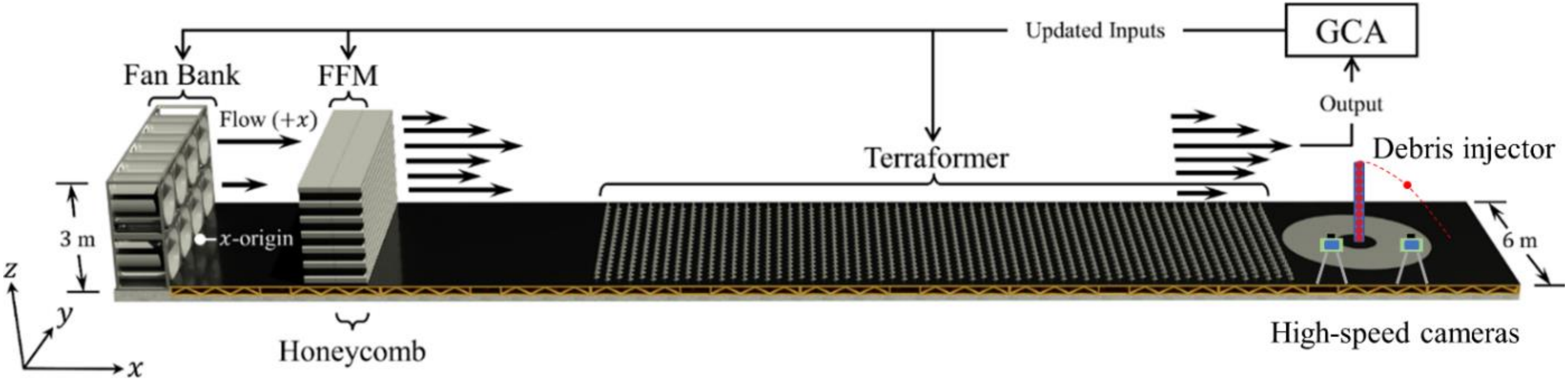
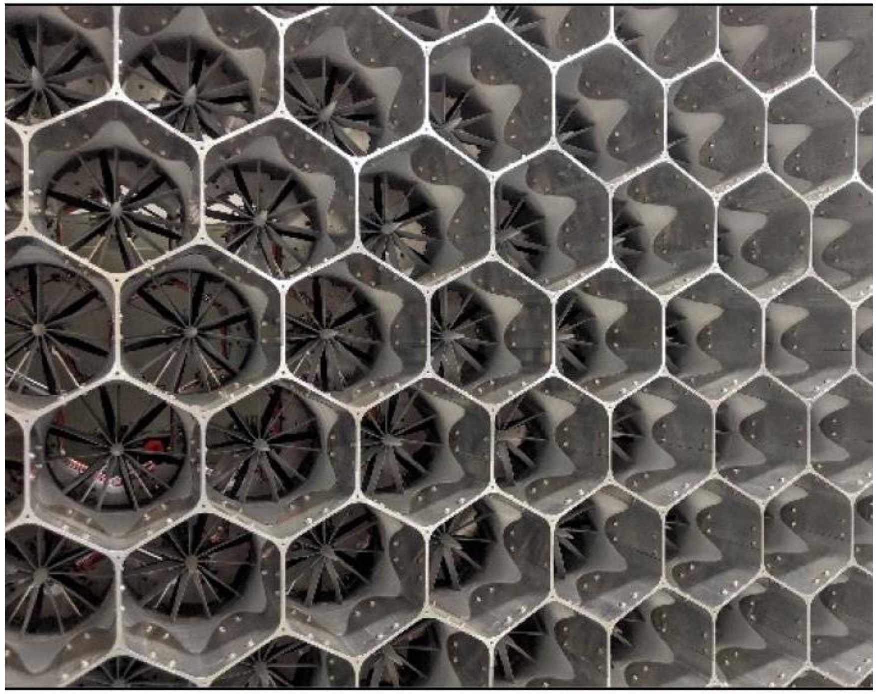
Experimental investigation

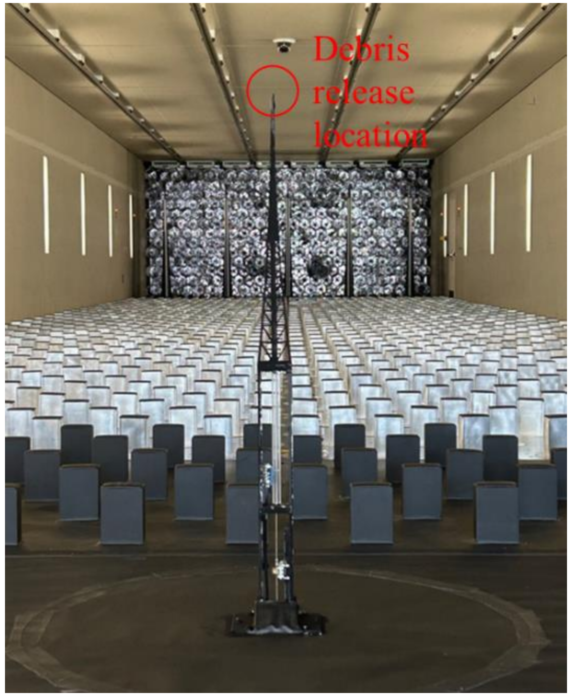
Test setup in the wind tunnel at the University of Florida



Experimental investigation

Test setup in the wind tunnel at the University of Florida





Active controlled fans:

Flow Field Modulator (FFM)

Debris release mechanism:

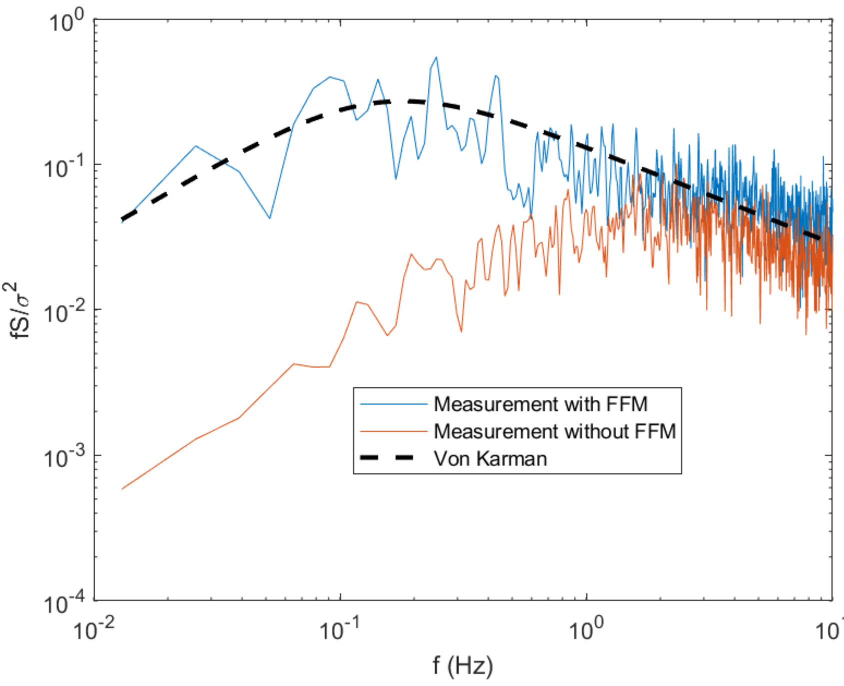
Automatic release of 1.5mm-diameter debris every two seconds

Cameras and lights:

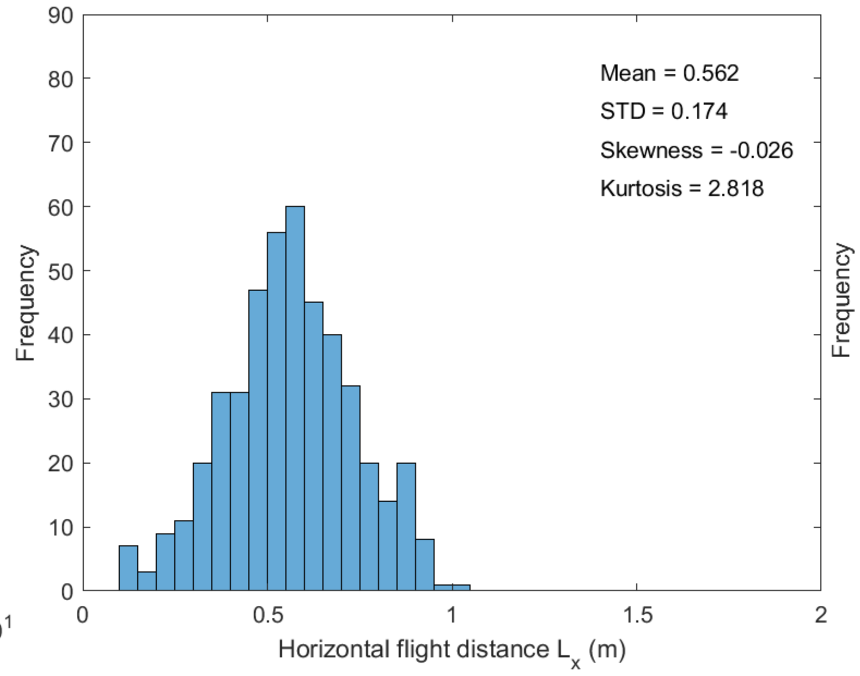
Two cameras capture 100 frames per second under flicker-free lights

Experimental investigation

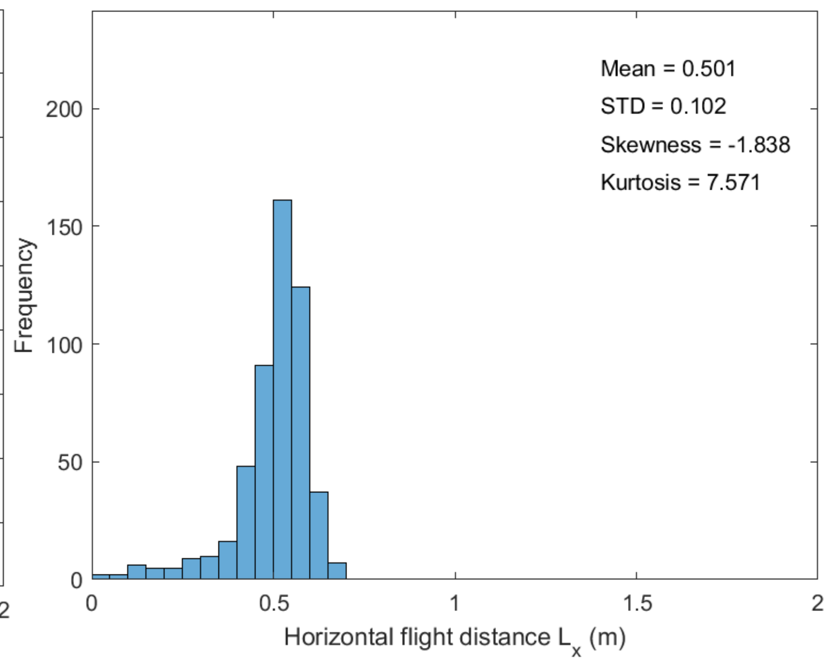
Impact of low-frequency turbulence



Turbulence spectrum with and without FFM



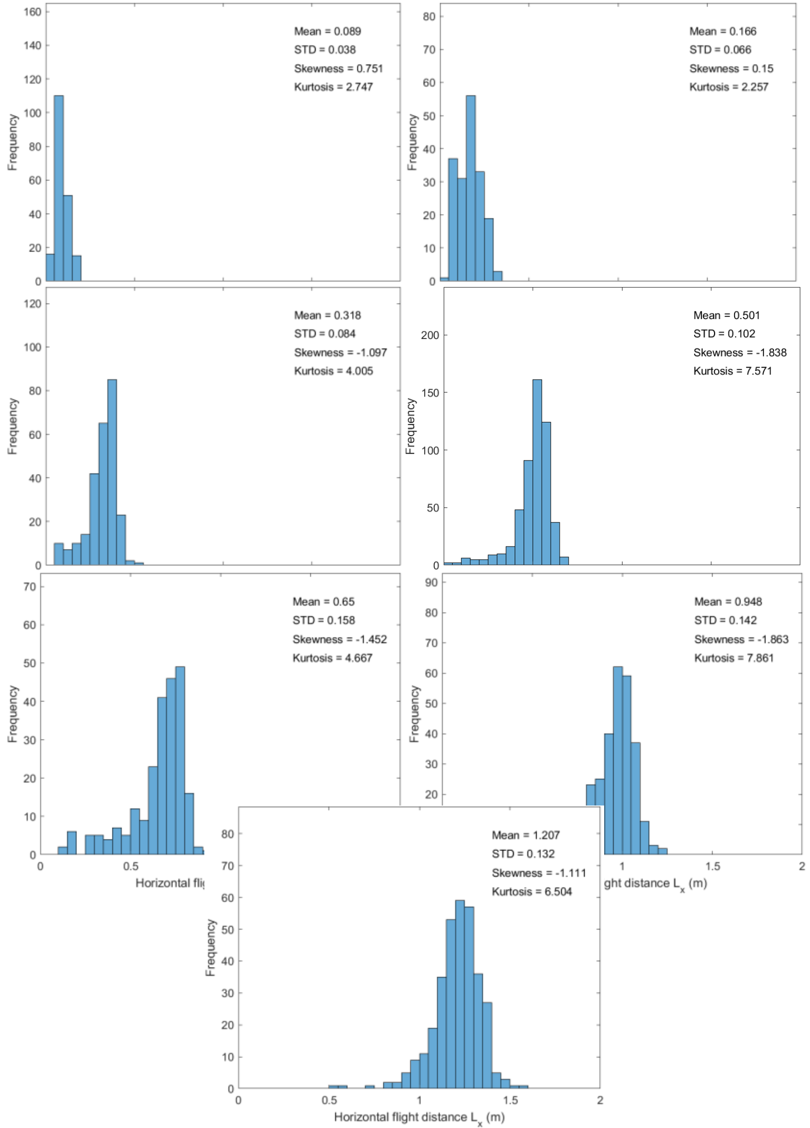
Debris flight with FFM



Debris flight without FFM

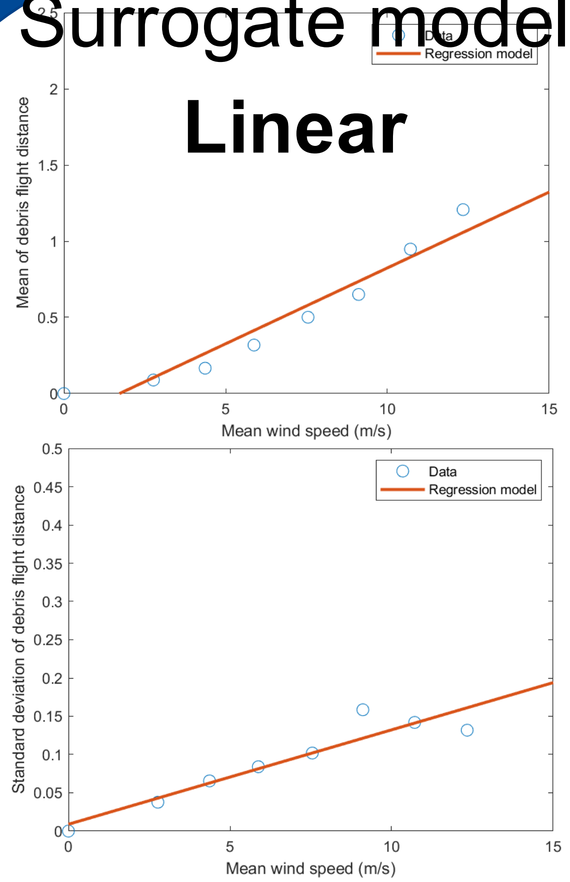
Experimental investigation

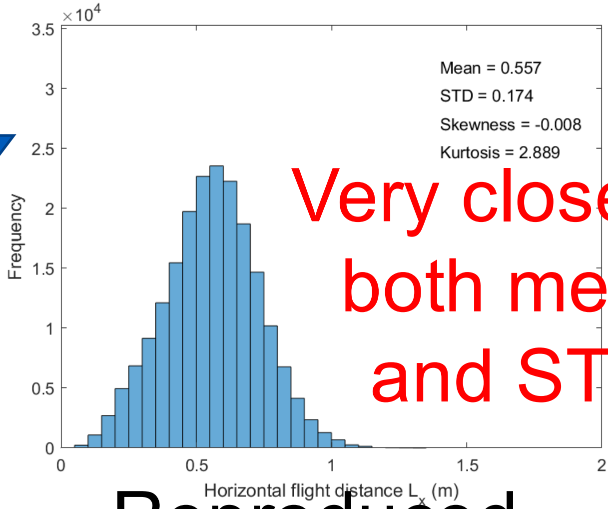
Reproduce the baseline result using “quasi-steady” approach



Surrogate model

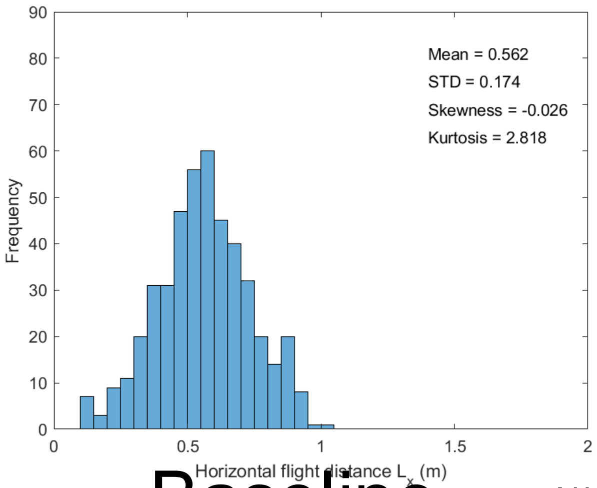
Linear





Very close for both mean and STD

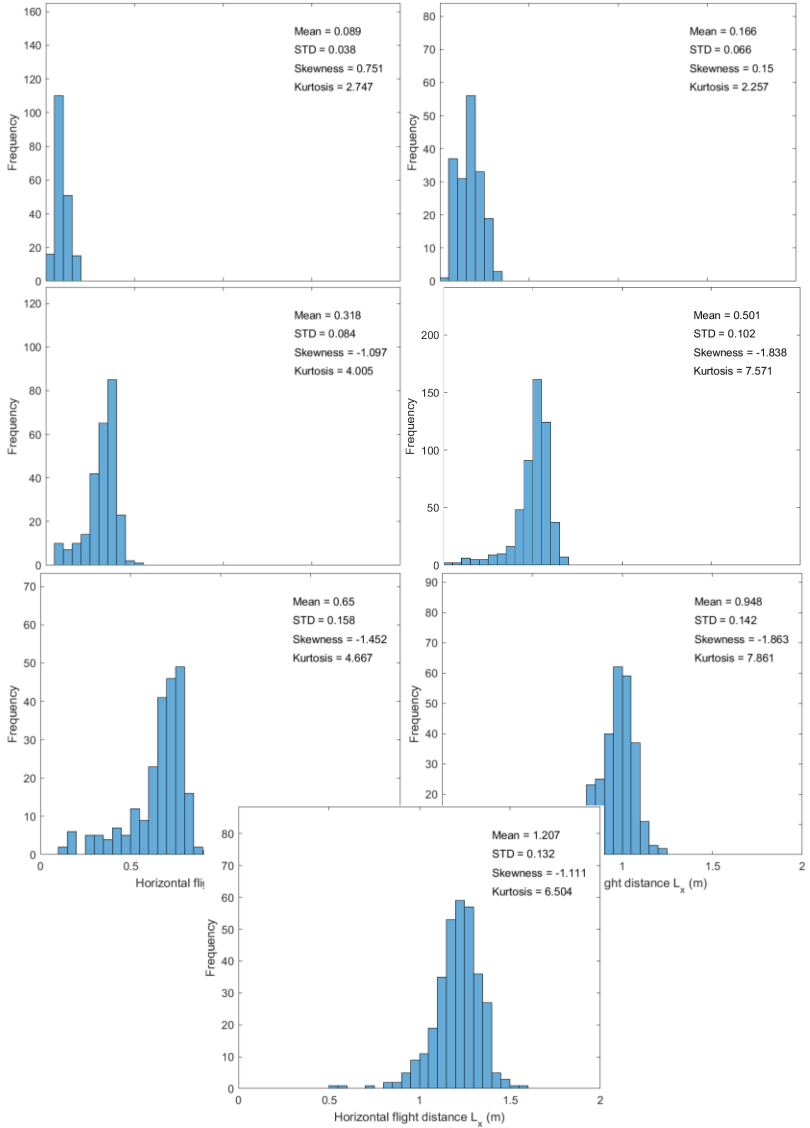
Reproduced



Baseline

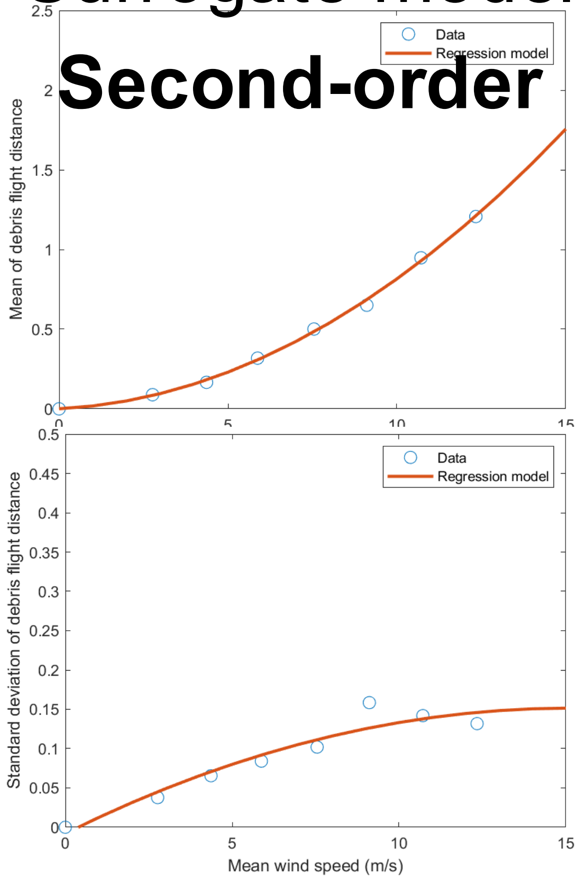
Experimental investigation

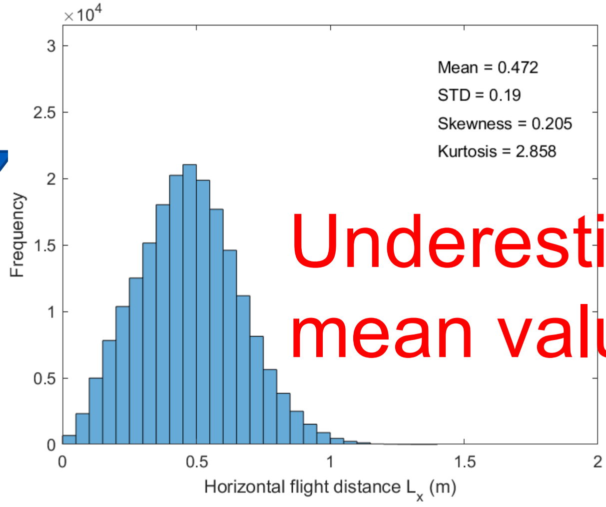
Reproduce the baseline result using "quasi-steady" approach



Surrogate model

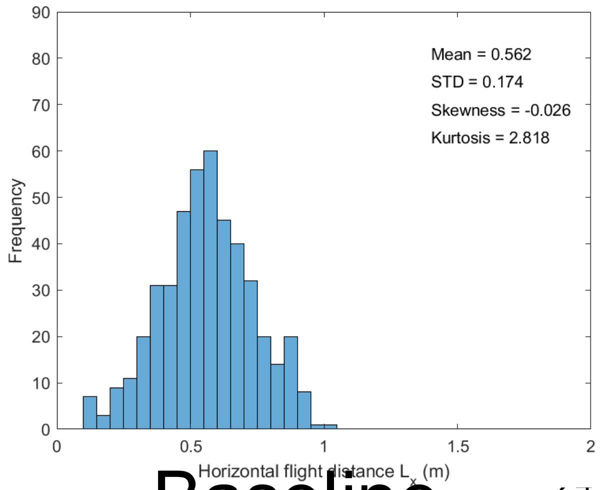
Second-order





Underestimate mean value

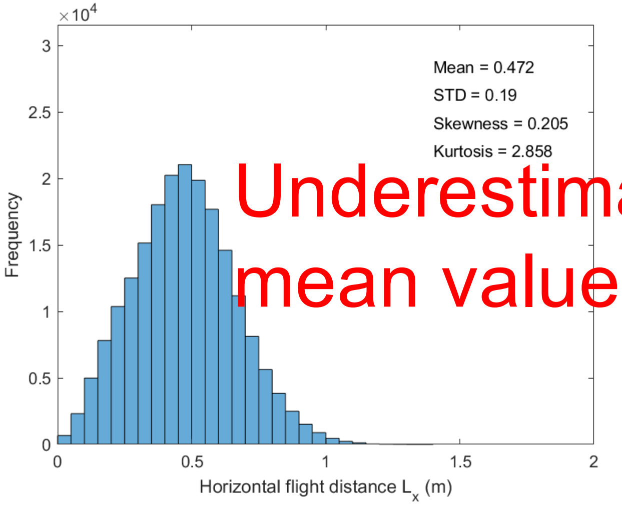
Reproduced



Baseline

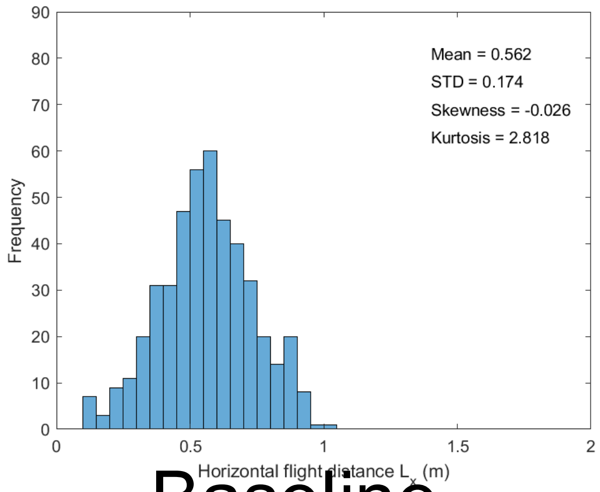
Experimental investigation

Reproduce the baseline result using “quasi-steady” approach



Underestimate mean value

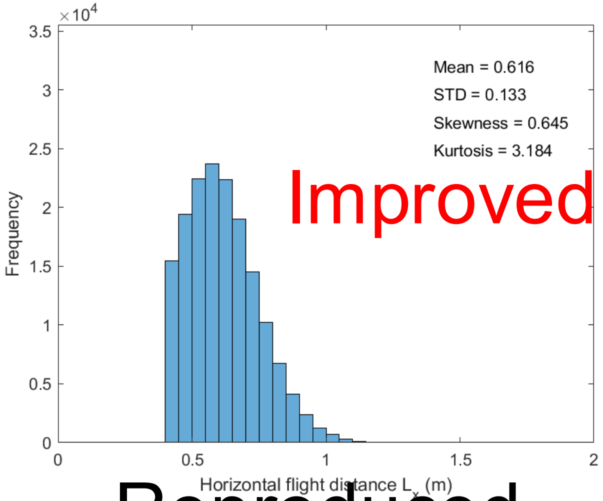
Reproduced



Baseline

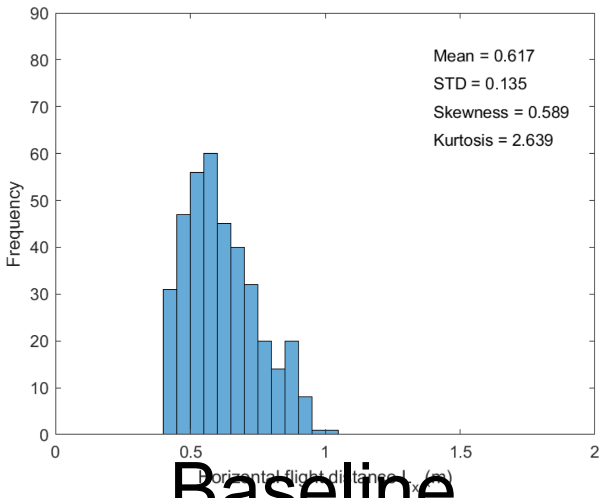
Debris under low wind speed may not be picked up by the wind due to the contact and friction from debris injector

Remove the samples with short flight distance (under 0.4m)



Improved match

Reproduced



Baseline

Outline

1. Background and motivation
2. Theory
3. Illustrative numerical example
4. Experimental investigation
5. Concluding remarks and future directions

Concluding remarks and future directions

- A “**quasi-steady approach**” is developed for debris flight in turbulent winds **without relying on active devices**.
- In this approach, low-frequency turbulence is first considered by **physically conducting** conventional wind tunnel tests under multiple mean wind speeds.
- The results are then **numerically post-processed** according to the statistics of the full turbulence spectrum to correct the low-frequency deficit impact on debris flight.

Concluding remarks and future directions

- The **numerical example** shows that the “quasi-steady approach” can **accurately reproduce** the results of the “unsteady approach” and hence validates the theory.
- The **experimental investigation** shows that the “quasi-steady approach” can reasonably predict the variation of debris flight distance, while the accuracy in predicting the mean is **sensitive to the selected regression models**.
- The match of the two approaches can be **improved by removing the short-distance debris flight data**, implying the existence of relatively large experimental errors in debris flight under lower wind speeds.

Concluding remarks and future directions

Future investigations are needed to address

- The validity of the rapid equilibrium assumption in the flow field near the injector
- The influence of vertical turbulence in the debris flight
- The reliability of experimental scheme for releasing small-size debris

Thank you!

Q&A

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Thank you!

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