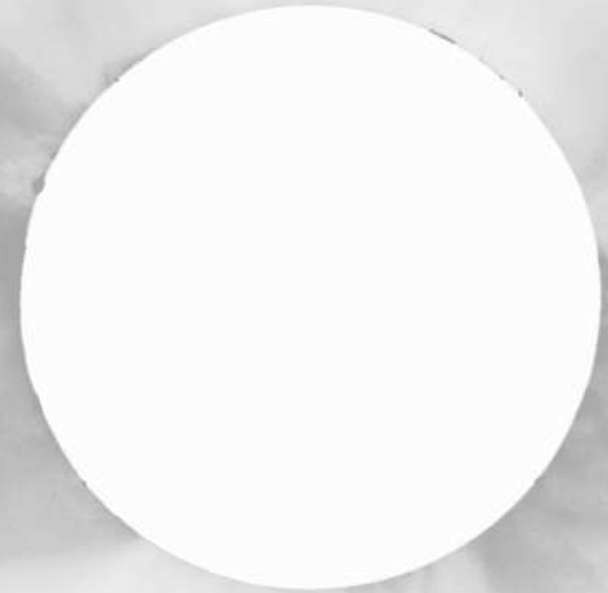
ARTSE: Atmospheric Response to a Total Solar Eclipse



W. Scott Gunter

Assistant Professor of Atmospheric Science

Dept. of Earth and Space Sciences

Columbus State University

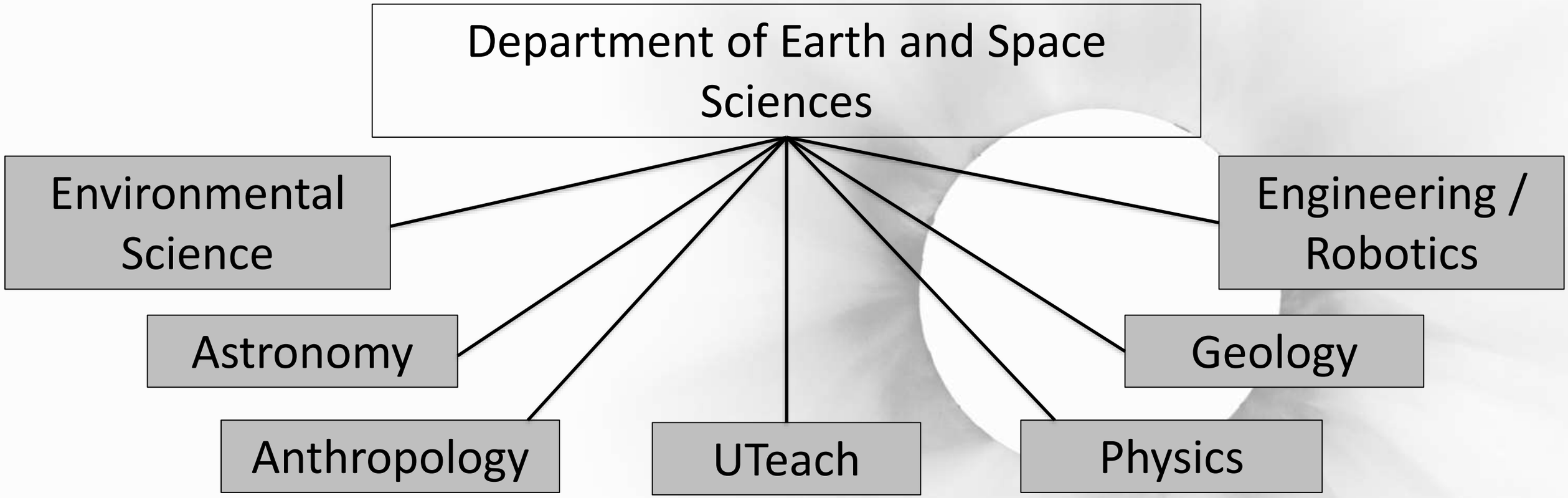
gunter_william@columbusstate.edu

Eclipse 2017

Ignite NCAR

NCAR UCAR | UCARConnect University Corporation for Atmospheric Research

Who is Columbus State University?



- Other CSU-affiliated facilities include the Oxbow Meadows Environmental Learning center and the Coca-Cola Space Science Center (CCSSC)
- As a PUI, CSU prides itself on providing unique, hands on educational experiences for students while engaging students in research.

ARTSE: Atmospheric Response to a Total Solar Eclipse

- Goals:
  - Provide students with an immersive experience in meteorological instrumentation, field work, and data analysis.
  - Obtain measurements of standard near-surface (<10 m) meteorological parameters and fluxes during the total solar eclipse for the scientific record of this event.
  - Synthesize the meteorological data with high-resolution telescope data in the form of planetarium video

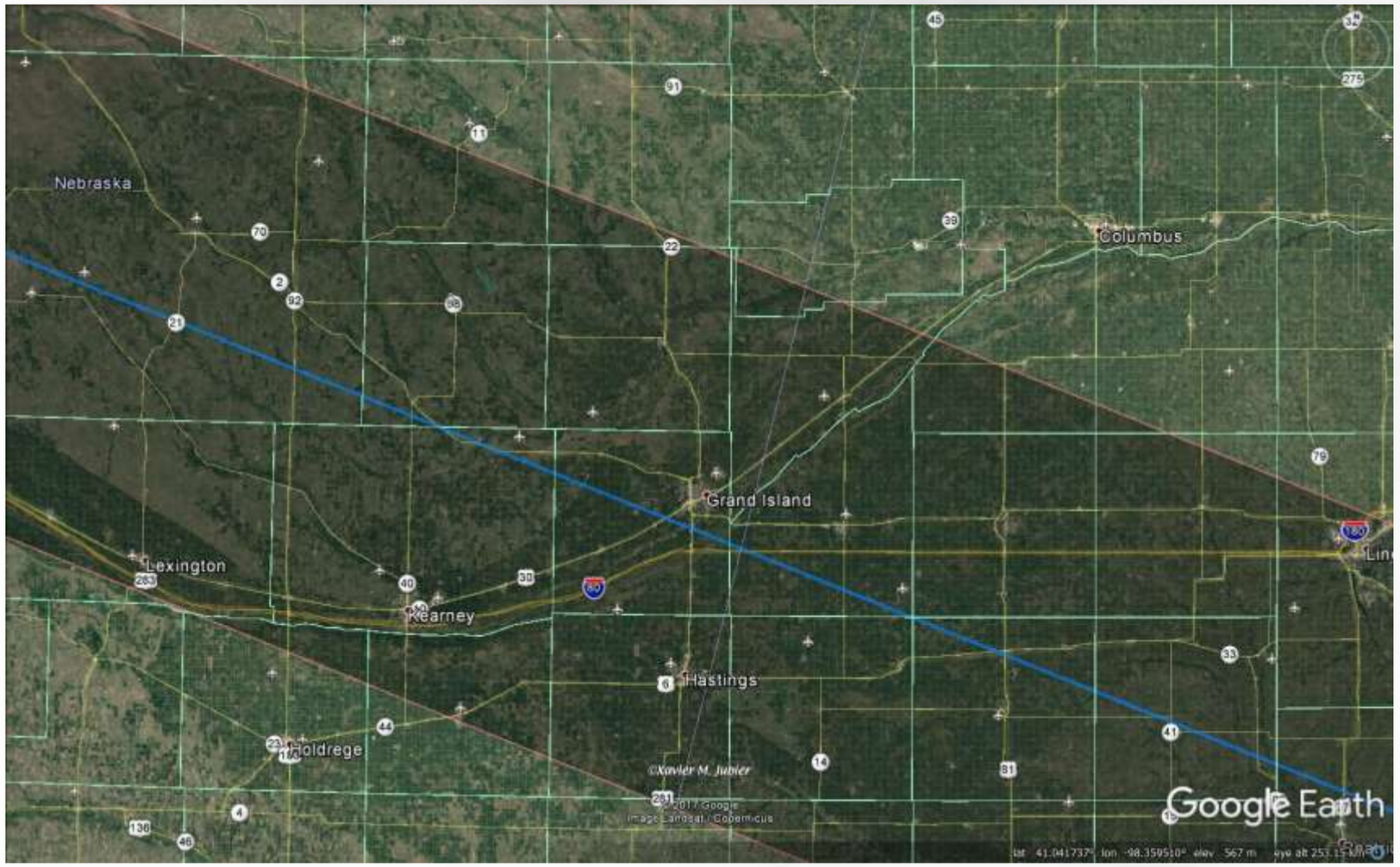
ARTSE Deployment

- Instrumentation is being provided through the Educational Deployment Program at NCAR's Earth Observation Laboratory, supported by NSF.

- Two towers outfitted with instrumentation capable of measuring near surfaces fluxes, short / long wave radiation, and concentrations of CO_2 and water vapor will be deployed in Grand Island, NE.

Why Grand Island, NE?

- In the path of totality
- Cloud Concerns



Credit: Xavier Jubier for Google Earth kmz.

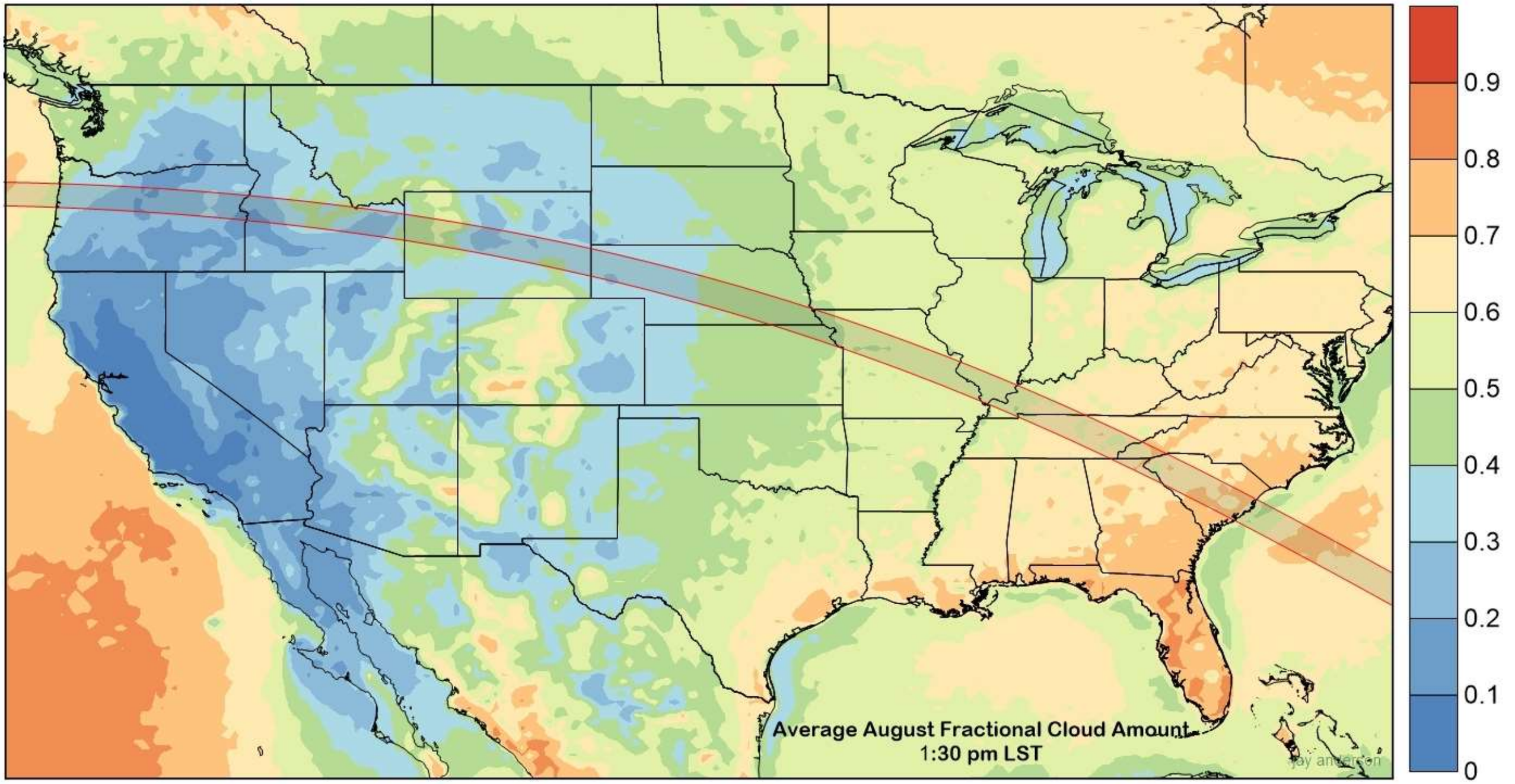


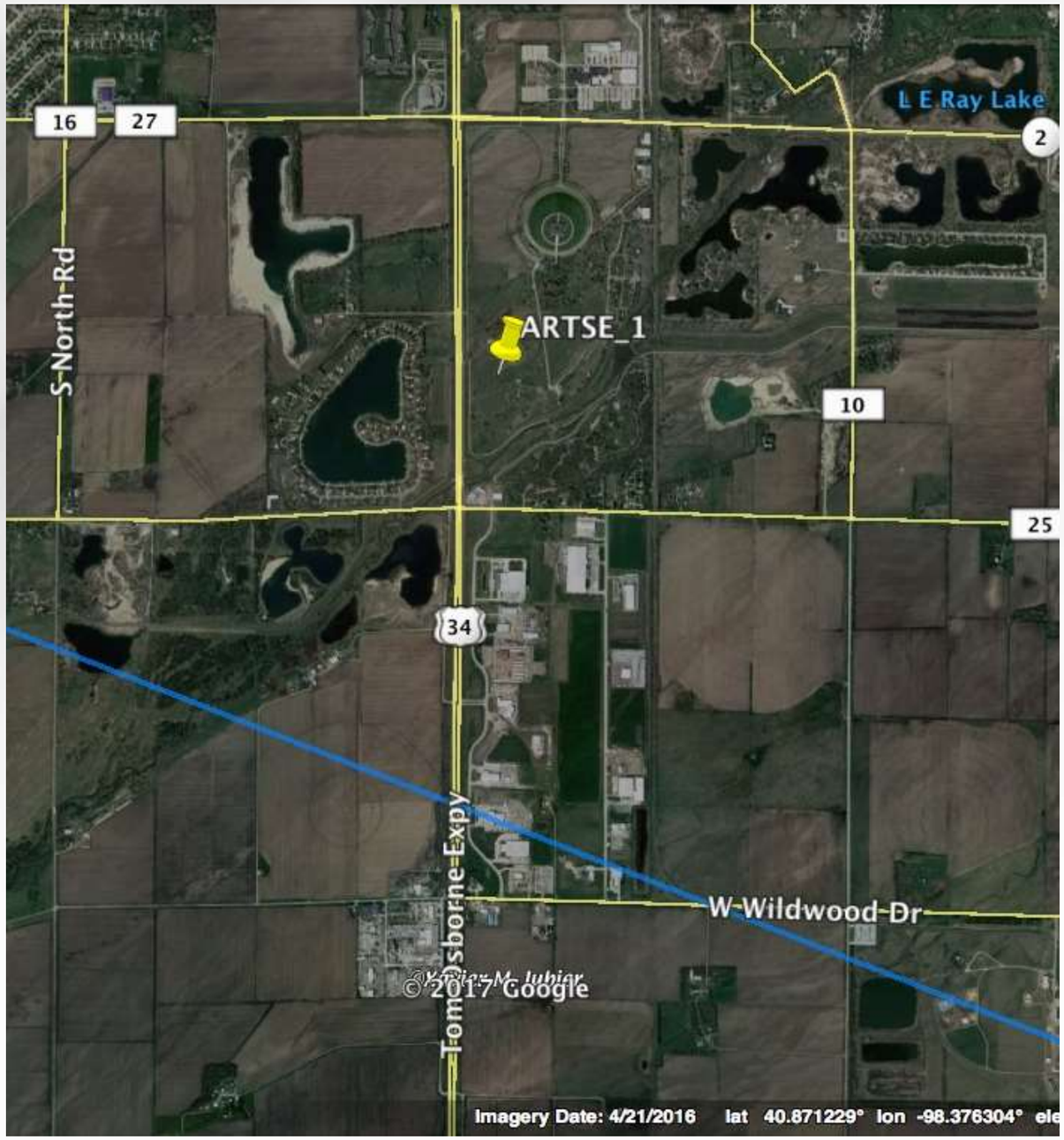
Image Credit: J. Anderson; http://eclipsophile.com/overview/

Why Grand Island, NE?

- In the path of totality
- Cloud Concerns
- Exposure Concerns
- Great Community Outreach Opportunity!

ARTSE Deployment: Student and Community Engagement

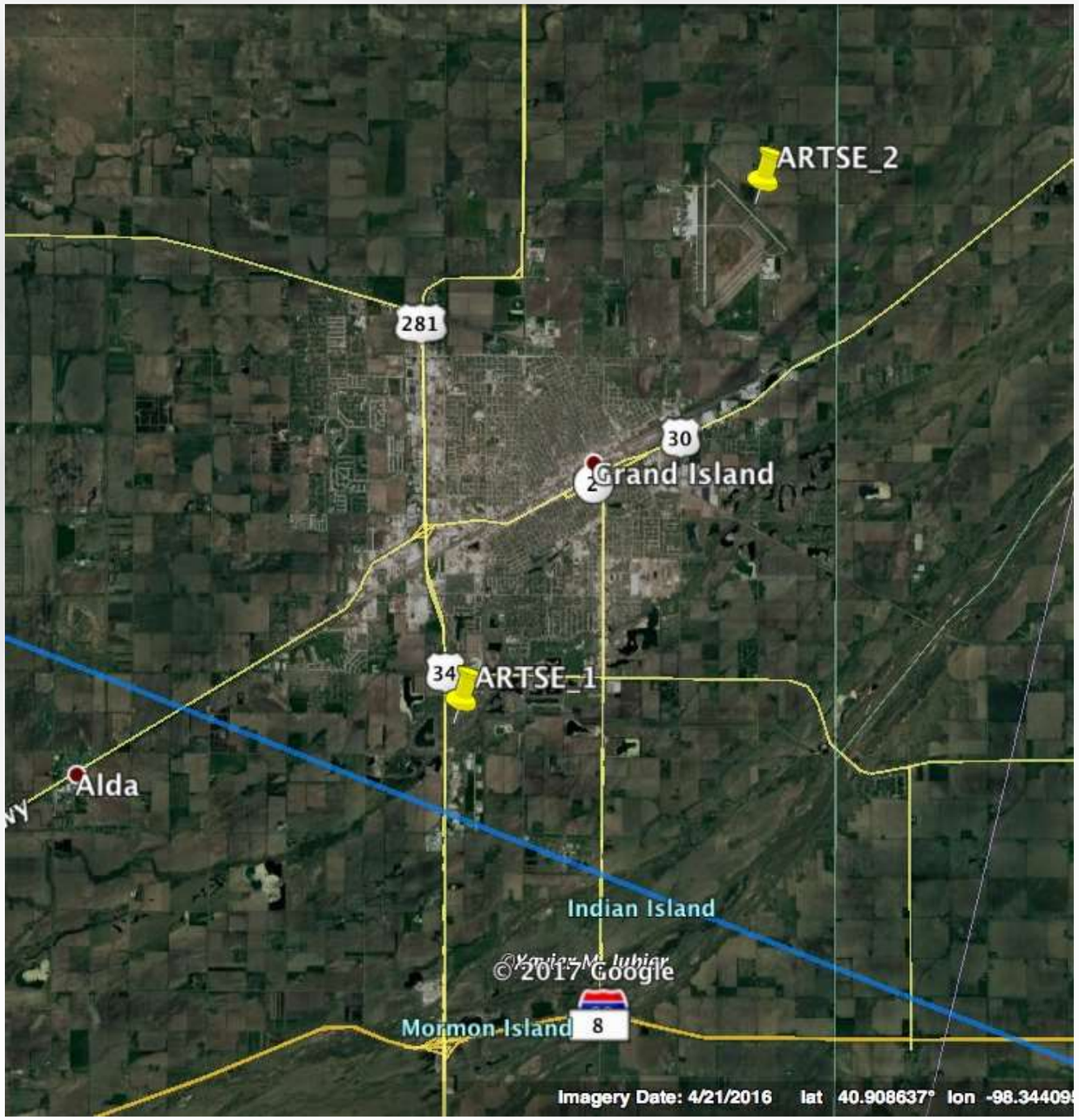
- Stuhr Museum of the Prairie Pioneer
- ~ 1.7 km from Centerline
- ”Gem over the Prairie Eclipse Event”
- CSU will be involved in museum-organized programming that will consist of a live display of data from the flux station (thanks to NCAR EOL!) and talks from CSU astronomers.



Credit: Xavier Jubier for Google Earth kmz.

ARTSE Deployment: Research Objectives

- Central Nebraska Regional Airport
- ~ 13 km from Centerline
- Data from this station will be more supportive of research objectives
  - Better exposure
  - Anticipated isolation / security



Credit: Xavier Jubier for Google Earth kmz.

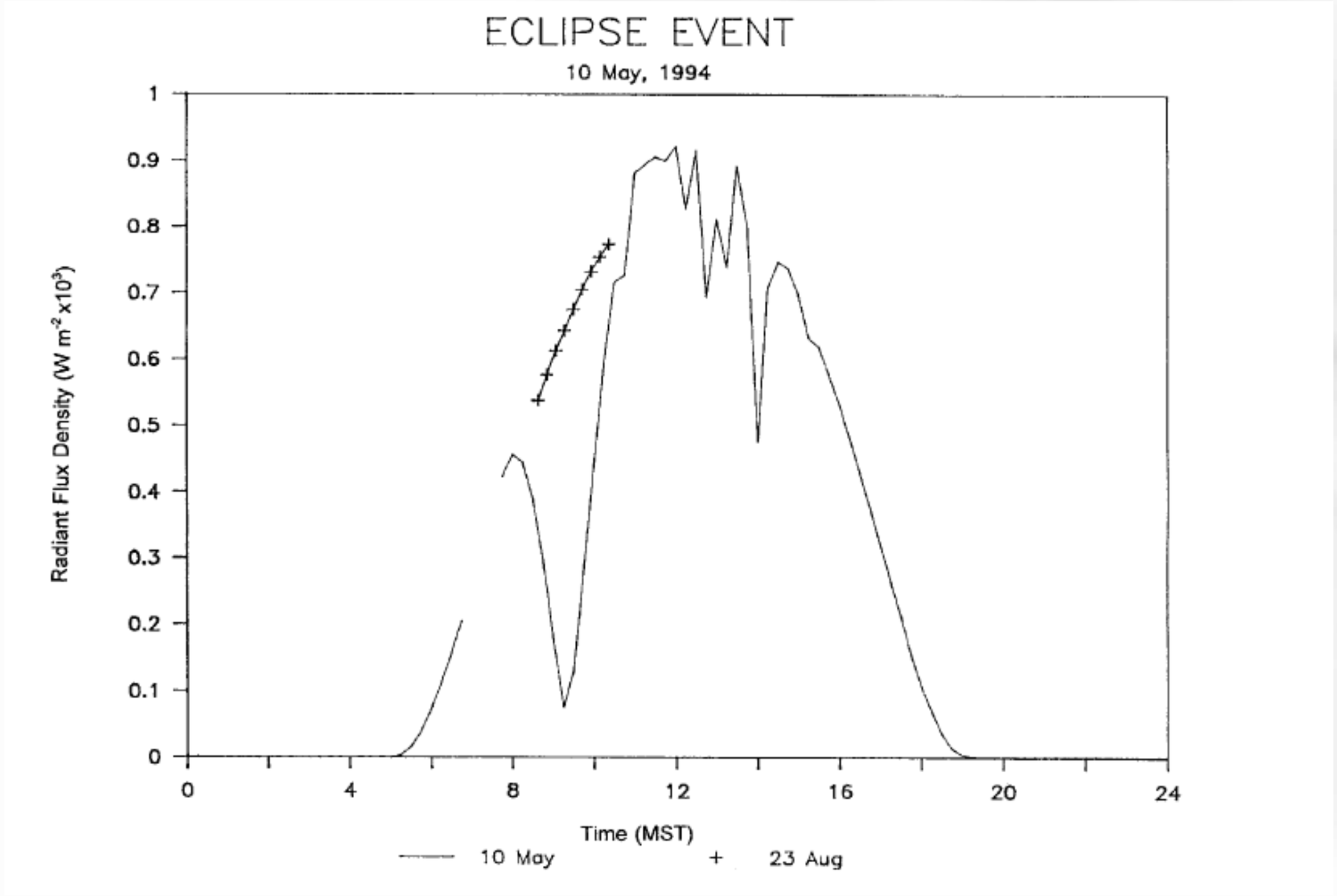
Expected Results

- ISFS stations will collect data that will describe the evolution of standard atmospheric variables during the eclipse:
  - Wind speed -- Long / Short Wave Radiation
  - Temperature -- Relative Humidity

- ISFS stations will collect data that will enable the computation of:
  - Sensible Heat Flux
  - Latent Heat Flux
  - Momentum Flux
  - CO_2 Flux

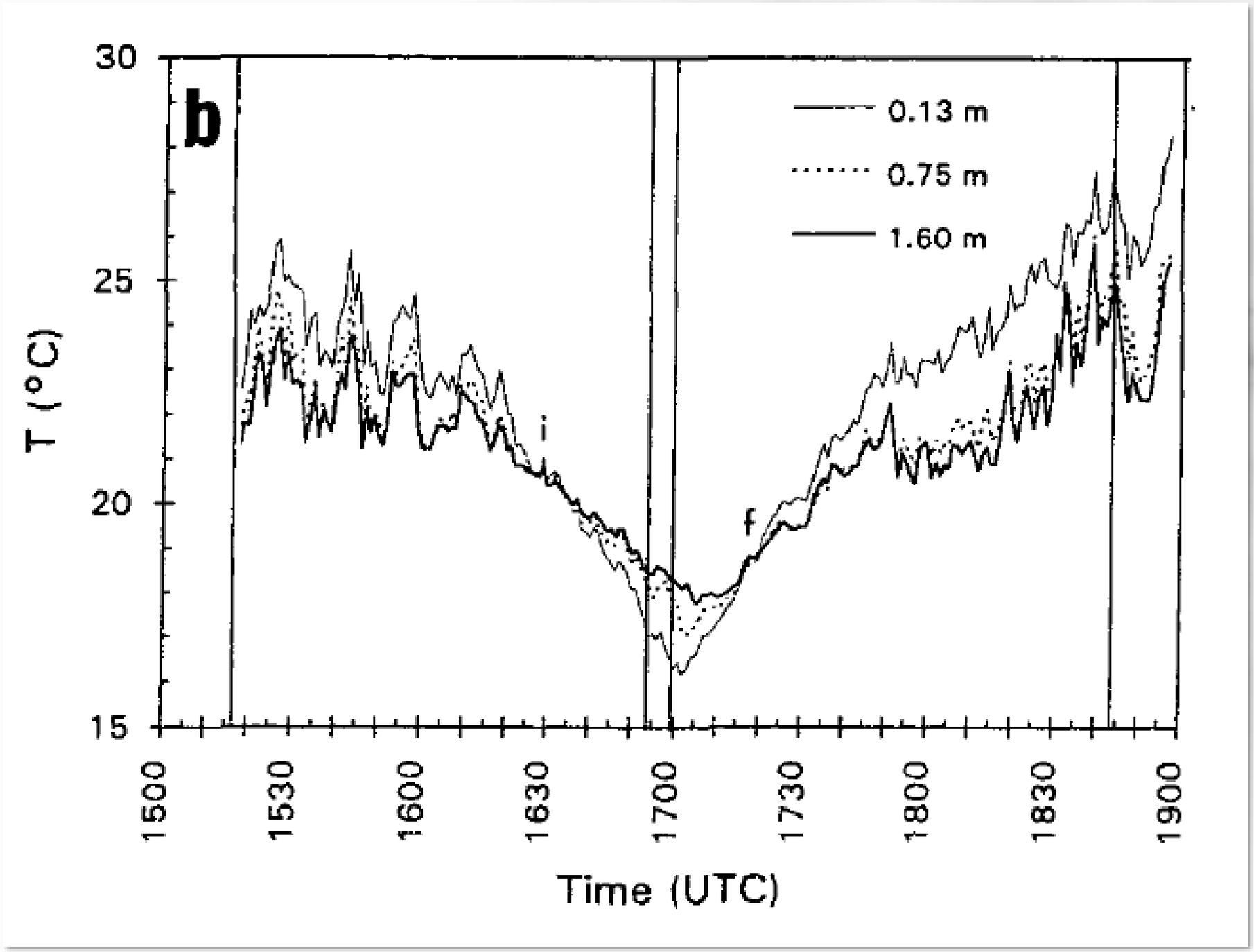
- Previous experiments from both partial and total eclipses will provide points of comparison.

Expected Results



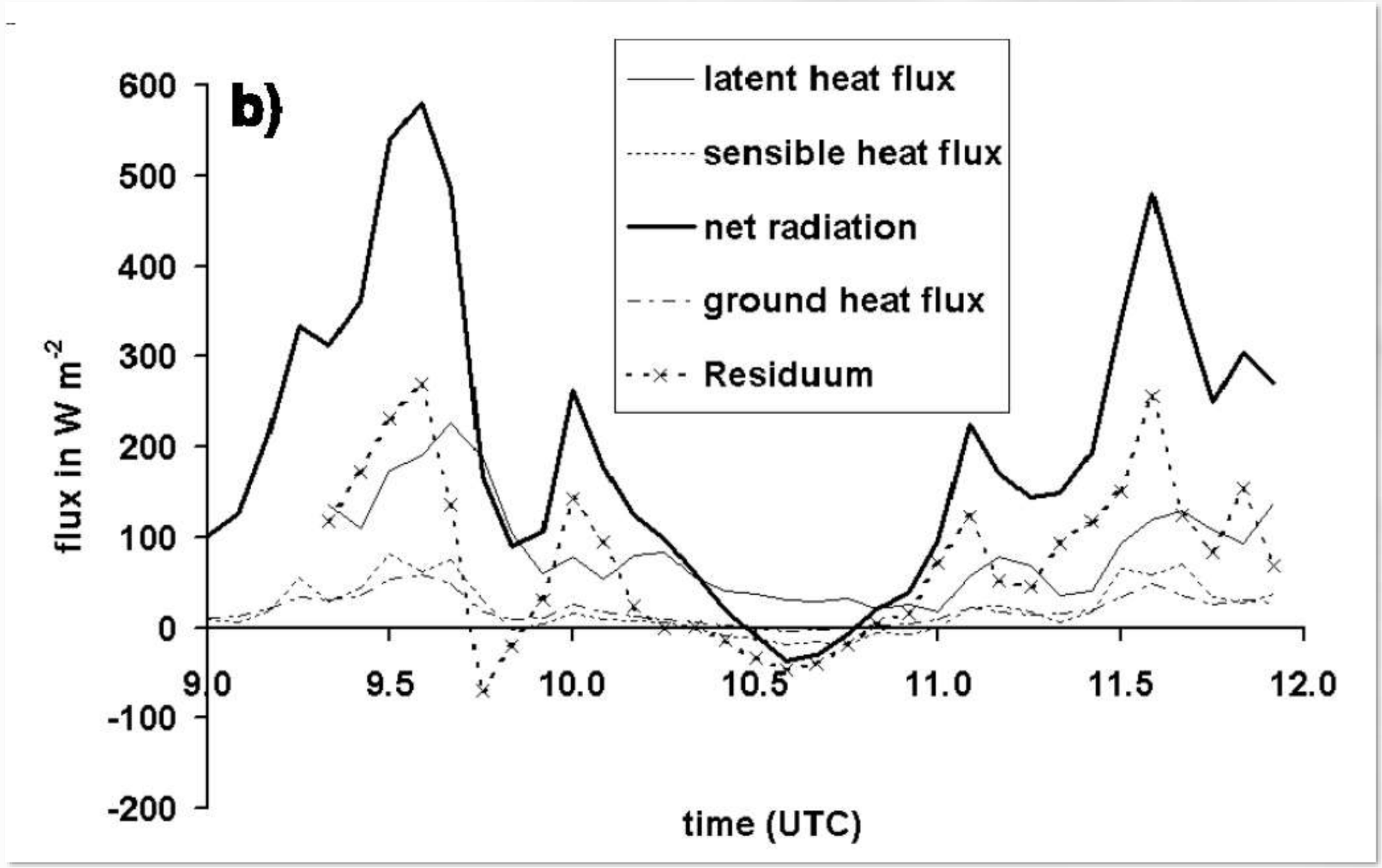
Eaton et al. (1997)

Expected Results: Near Surface Temperature



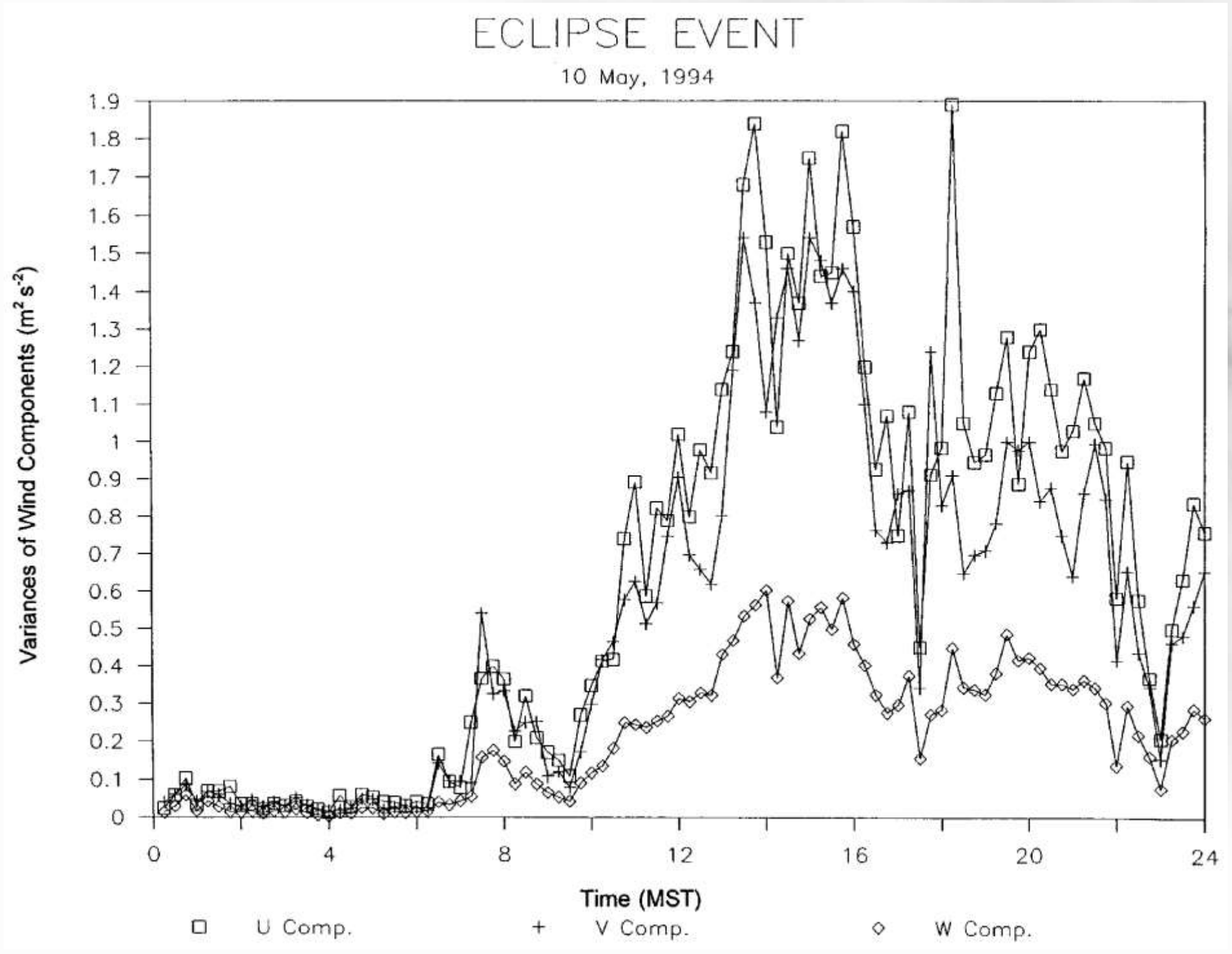
Segal et al. (1996)

Expected Results: Heat Fluxes



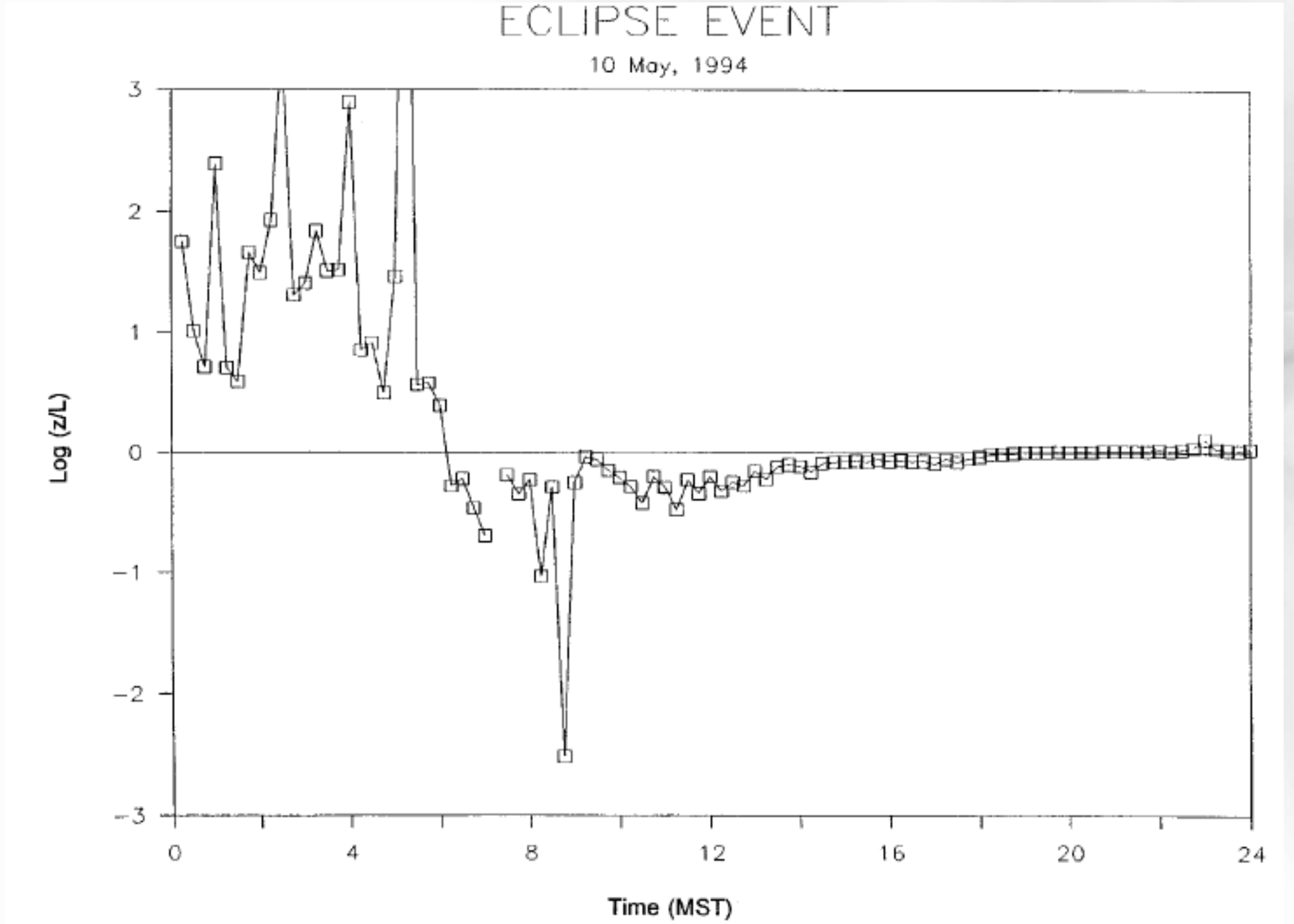
Foken et al. (2001)

Expected Results: Turbulence



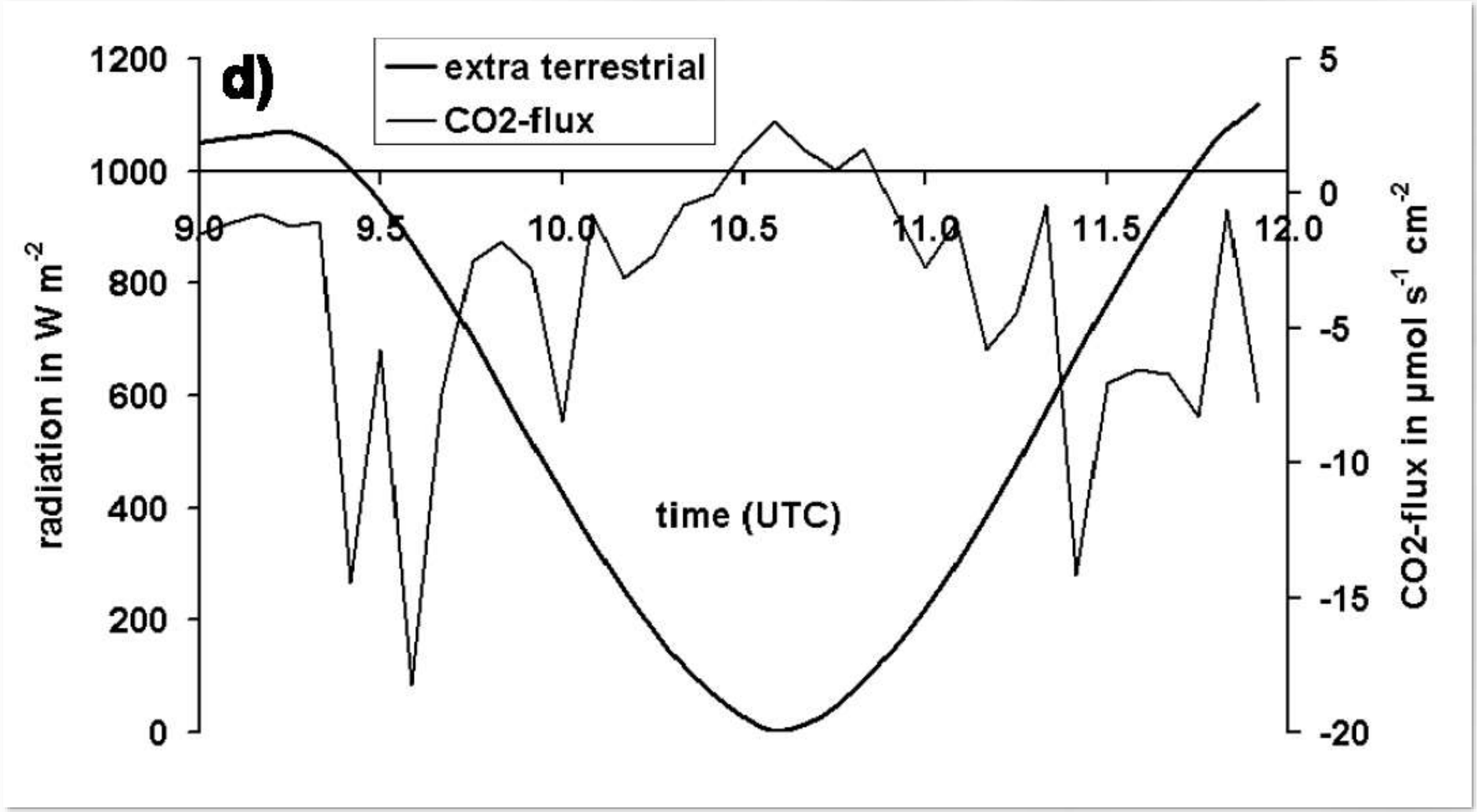
Eaton et al. (1997)

Expected Results: Stability



Eaton et al. (1997)

Expected Results: CO_2 Flux



Foken et al. (2001)

Undergraduate Benefits

- ATSC 5555
  - Direct experience with meteorological field work and instrumentation.
  - Course designed around data analysis and developing a tool box to deal with large datasets.
  - Compare w/ flux data from a 200 m meteorological tower operated by Texas Tech University.
  - Goal of conference paper and / or publication
- ATSC 1112
  - Develop two activities for inclusion in the CSU laboratory manual for the introductory atmospheric science course
  - In class “Clicker” exercises and other educational material for the introductory atmospheric science and astronomy courses.

Community Benefits

- Development of planetarium video for CCSSC
- Educational units for CCSSC
- Educational units for middle / high school students through collaborations with UTeach Graduates

ARTSE Summary

- The ARTSE project is an education-based field experiment that leverages NCAR's Educational deployment program to introduce geoscience students to meteorological instrumentation and field work.

- Deliverables include:
  - A robust dataset that will support multiple research objectives
    - 1 conference presentation
    - 1 peer-reviewed publication
  - Planetarium video that is a product of merged ISFS time histories and high resolution eclipse video.
  - In-class exercises for undergraduates
  - New laboratory exercises for undergraduates
  - Educational units for middle school students

For more information:

W. Scott Gunter, PhD
Assistant Professor of Atmospheric Science
Dept. of Earth and Space Sciences
Columbus State University
gunter_william@columbusstate.edu

Thanks:

NCAR EOL Educational Loan Program / ISFS Facility (Steve Oncley, Alison Rockwell)

UCAR and NSF for the invitation and travel support to attend the media showcase

CSU for travel support for students participating in ARTSE

Eclipse 2017

Ignite NCAR

NCAR UCAR | UCARConnect
University Corporation for Atmospheric Research