

Impact of Urban Environments on the Water and Radiation Budget of Coniferous Trees

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Research Objectives

Purpose

- Measure the water and radiation budget of coniferous trees in an urban environment
- Compare data collected from study trees to existing computerized models used to predict the water and radiation budget of these trees
- Improve upon the ability of the computerized model to predict reality

Water Budget

$$\text{Precipitation} = \text{Infiltration} + \text{Evaporation} + \text{Runoff}$$

Radiation Budget

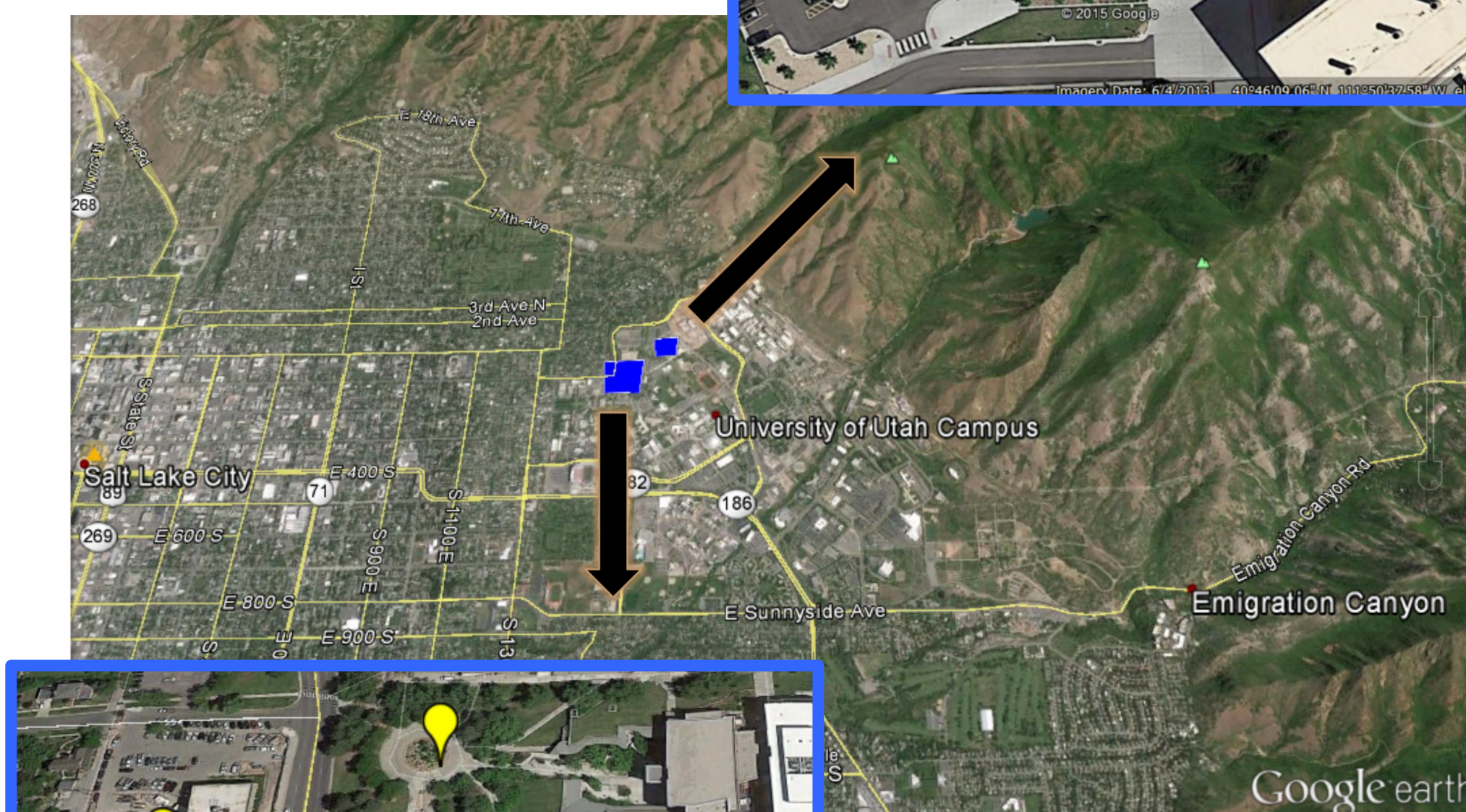
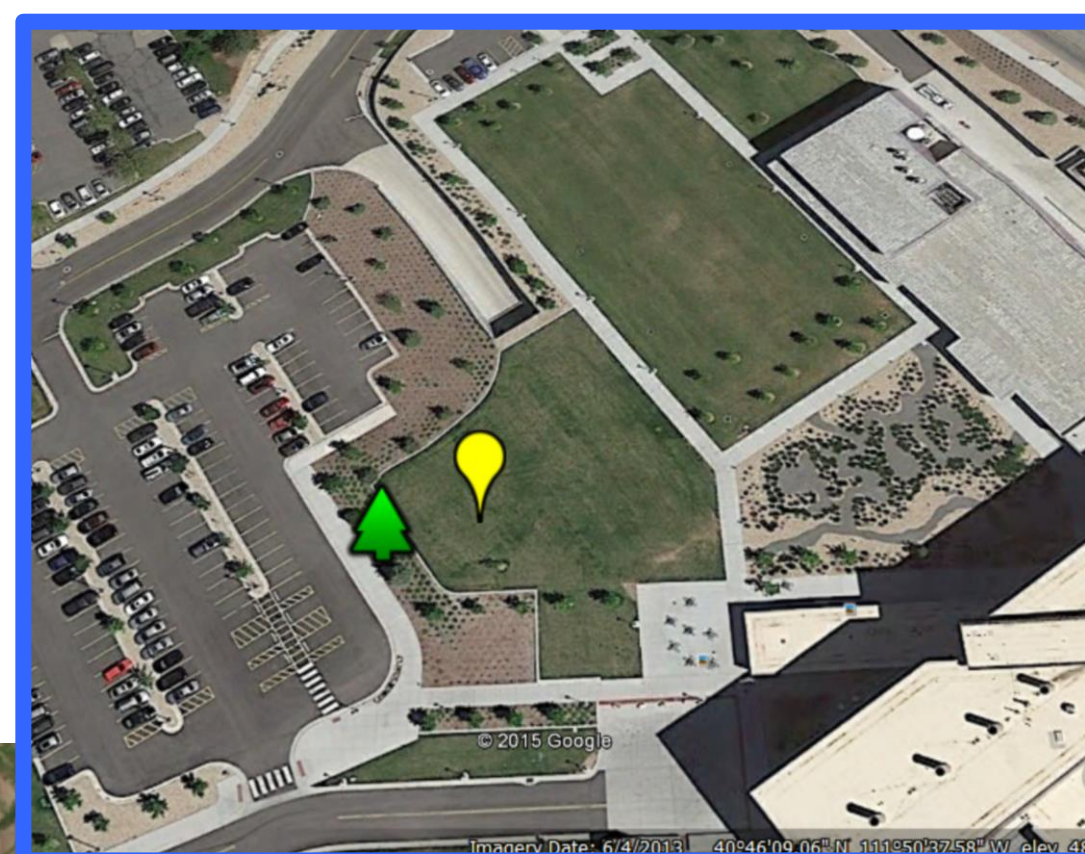
$$\text{Solar Radiation (LW + SW)} = \text{Sensible Heat Flux} + \text{Latent Heat Flux} + \text{Diffusion}$$

Study Site

University of Utah, SLIC, UT (middle)

USTAR/Molecular Biology Building Domain (top)

Engineering Quad Domain (bottom)



Symbols Legend
 Study Tree
 Secondary Tree
 Reference LEMS
 Reference Flux Tower

Research Methods

Experimental Setup

- Two main study trees with all instruments and sensors
- Secondary trees with thermocouples and sap flux sensors
- Reference Local Energy Measurement Stations (see LEMS poster by Heather King) with soil moisture and atmospheric turbulence sensors
- Reference Energy Flux Tower with soil heat flux and atmospheric turbulence sensors



USTAR study tree (left)



3D Point Cloud of Engineering Quad study tree (right) created with data from Faro Laser Scanner Focus^{3D} X330 (middle)



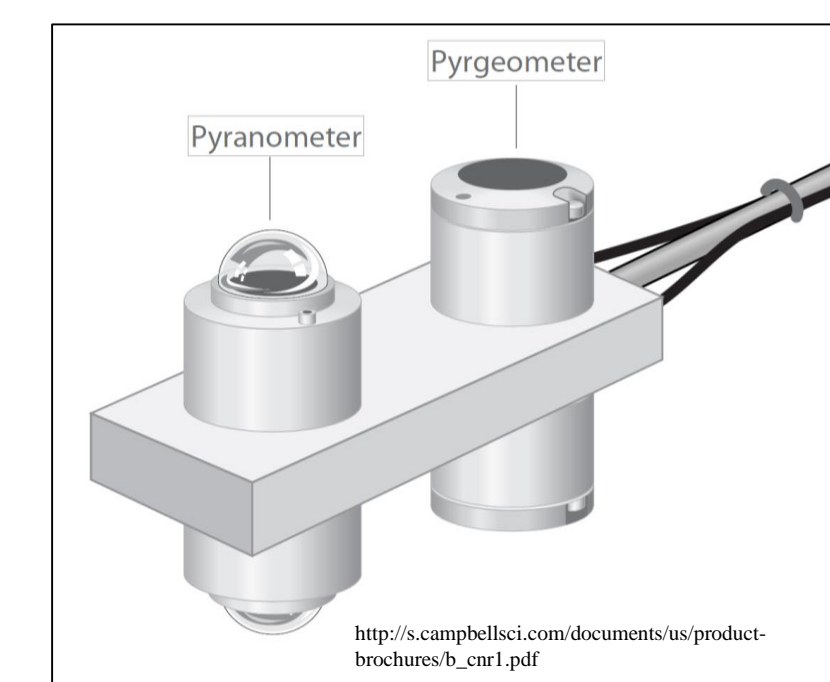
Instruments and Sensors



RM Young WindBird (wind speed & direction)



Thermocouple (needle temperature)



CNR1 (solar radiation)



PAR sensor (photosynthetically active radiation)

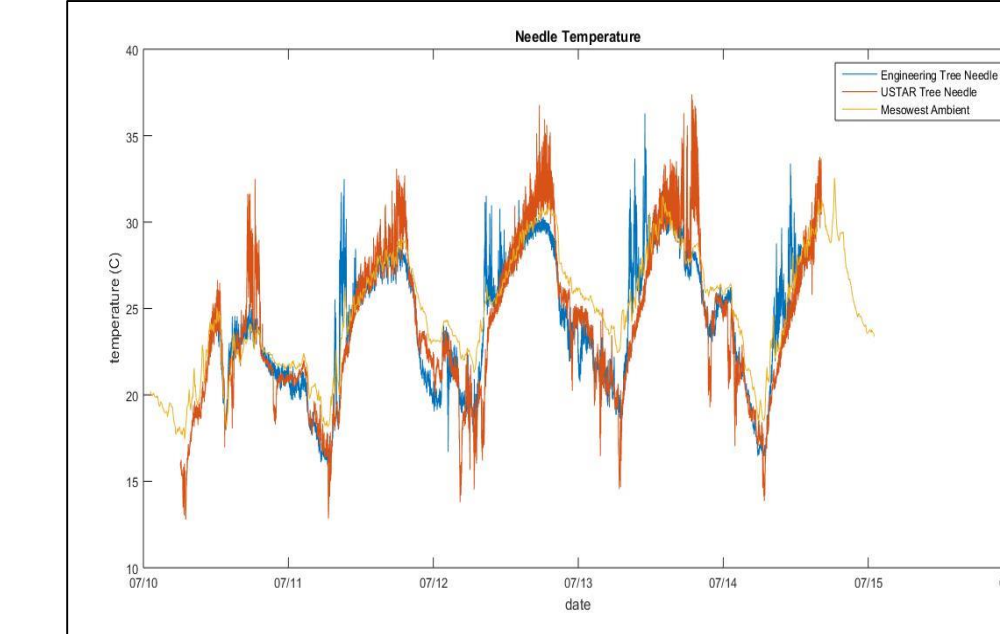
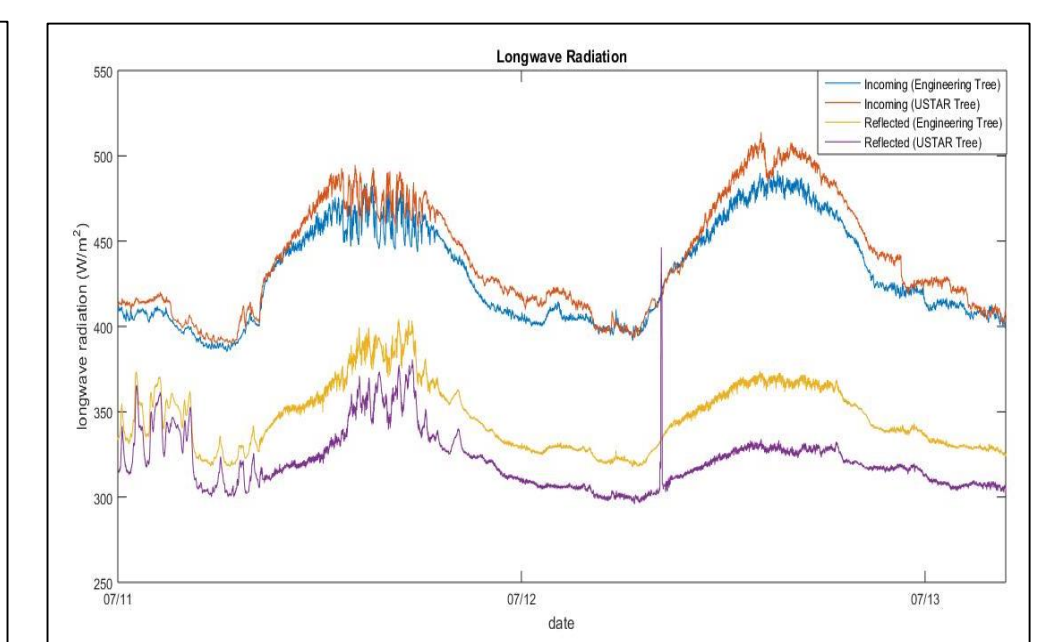
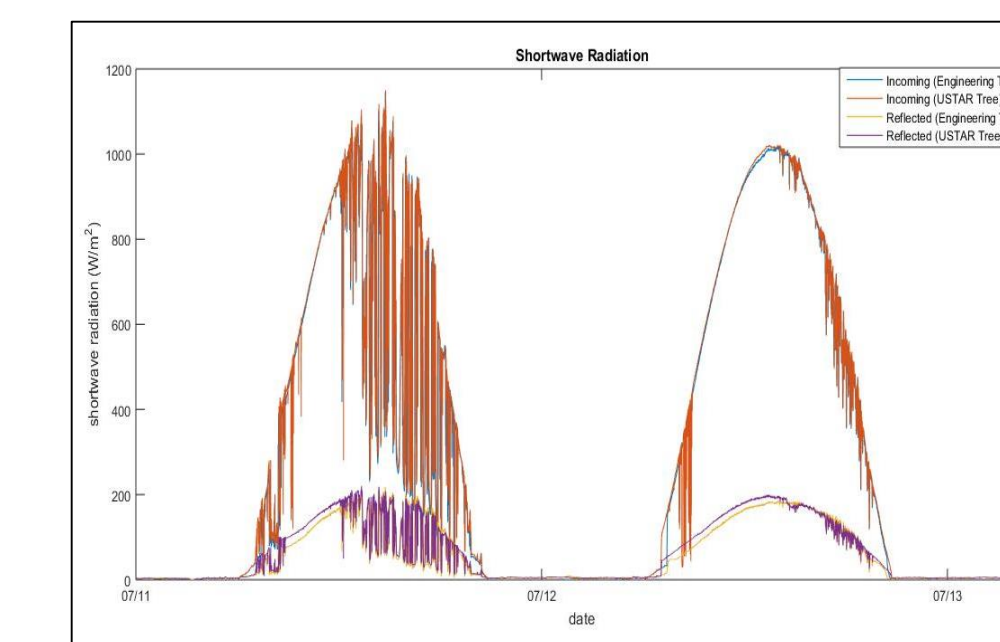


Sap flux sensors (sap temperature, later used to determine water flux)

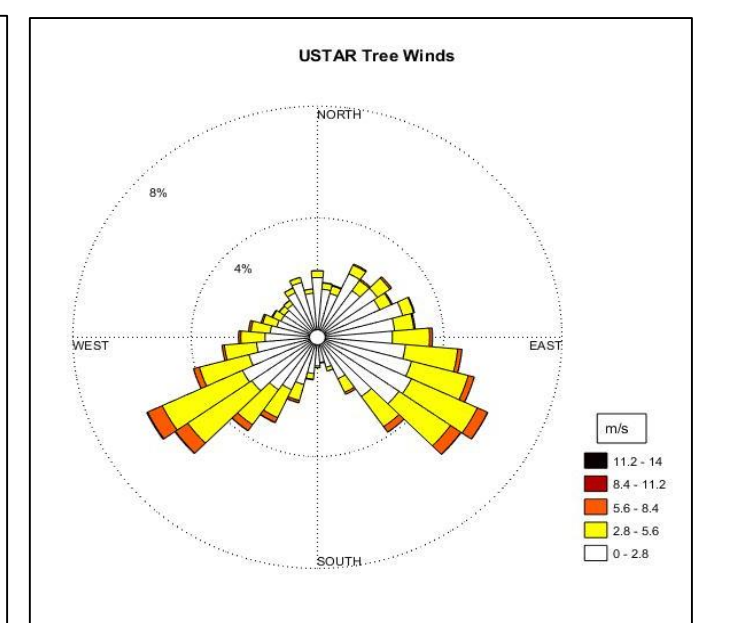
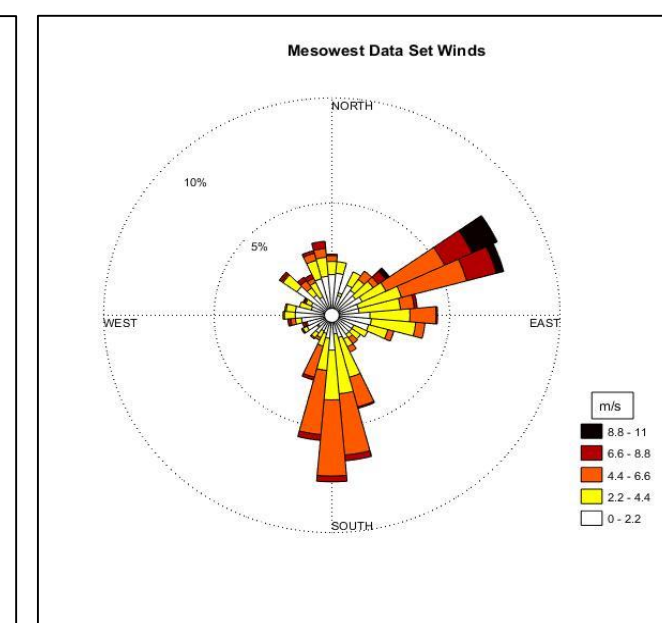
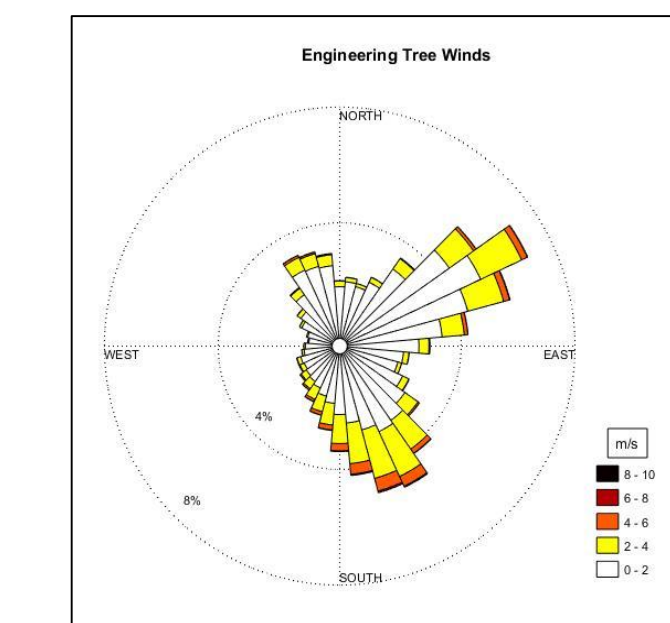


HMP45 (air temperature & relative humidity)

Data



Radiation data (above), temperature data (left) and wind data (bottom). Mesowest data is from a weather station on the roof of the WBB building on the University of Utah campus



Other Data Collected

- Air temperature and relative humidity
- Sap temperature
- Photosynthetically active radiation (with reference PAR sensor on top of the Kennecott Building on the University of Utah campus)

Why Does This Matter?

- Validate existing computerized model that is able to predict the water and radiation budget in urban environments for trees
- Broadleaf trees have been studied in the past, but coniferous trees have not
- New and existing urban landscaping can be tailored to best conserve water resources
- Better understand how urban form (i.e anthropogenic-made structures and anthropogenic activities) affects the water and radiation budget of coniferous trees

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