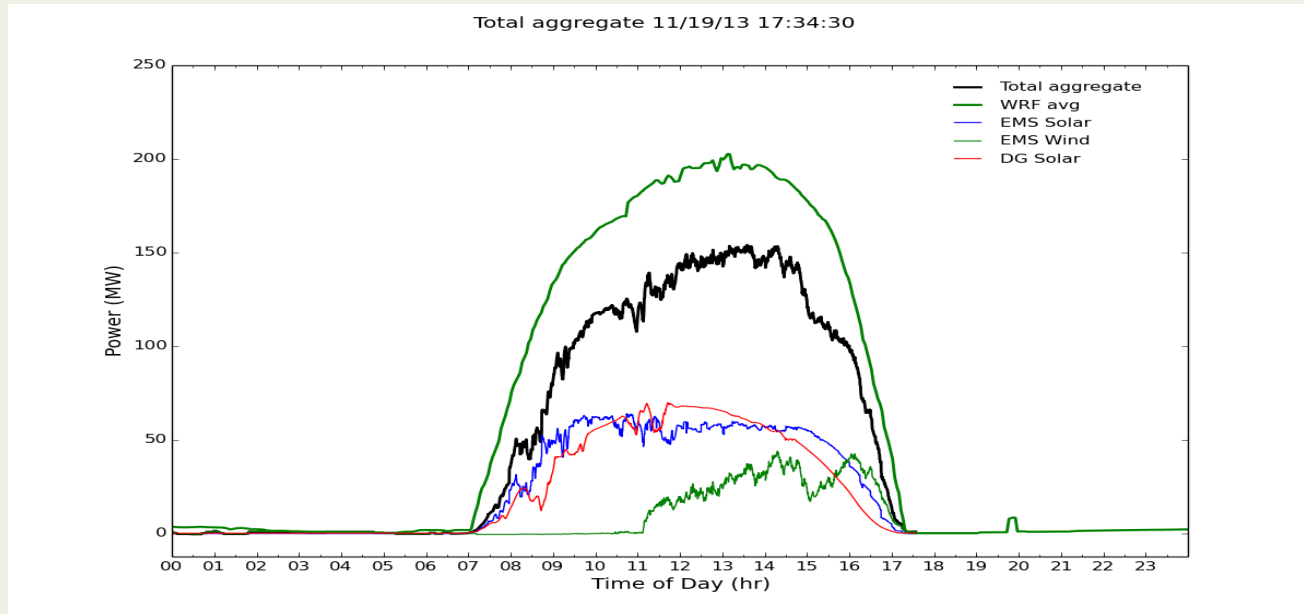


Real-Time PV Power Forecasting



Will Holmgren

Postdoctoral Research Assistant

Department of Physics

University of Arizona



Alex Cronin, Associate Professor, Physics

Antonio Lorenzo, Grad Student, Opt. Sci.

Eric Betterton, Dept. Head, Atmo. Sci.

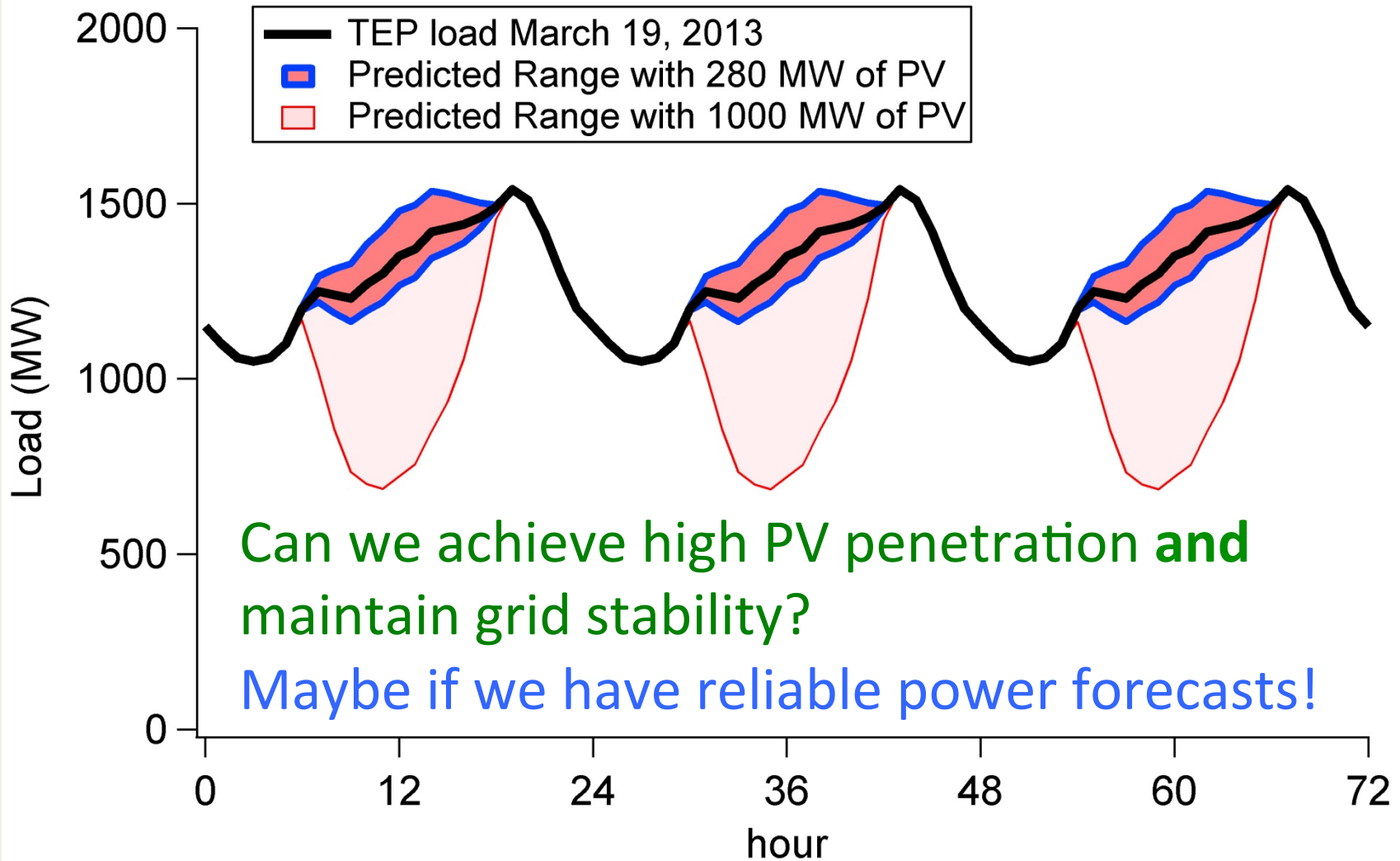
Mike Leuthold, Meteorologist, Atmo. Sci.

Chang Ki Kim, Post doc, Atmo. Sci.

Ardeth Barnhart, Director, UA-REN

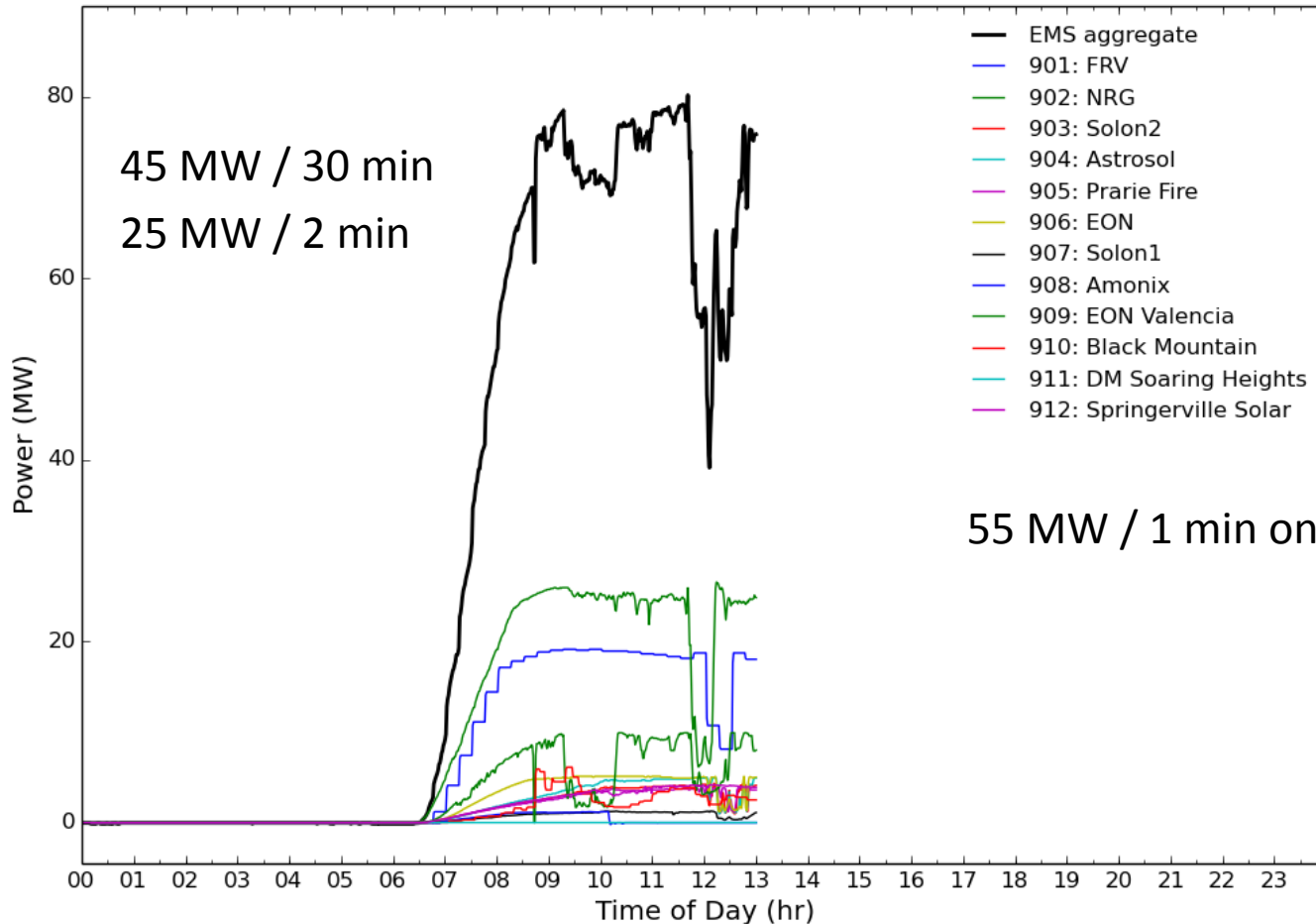
Rey Granillo, Developer, UA-REN

PV impact on TEP load

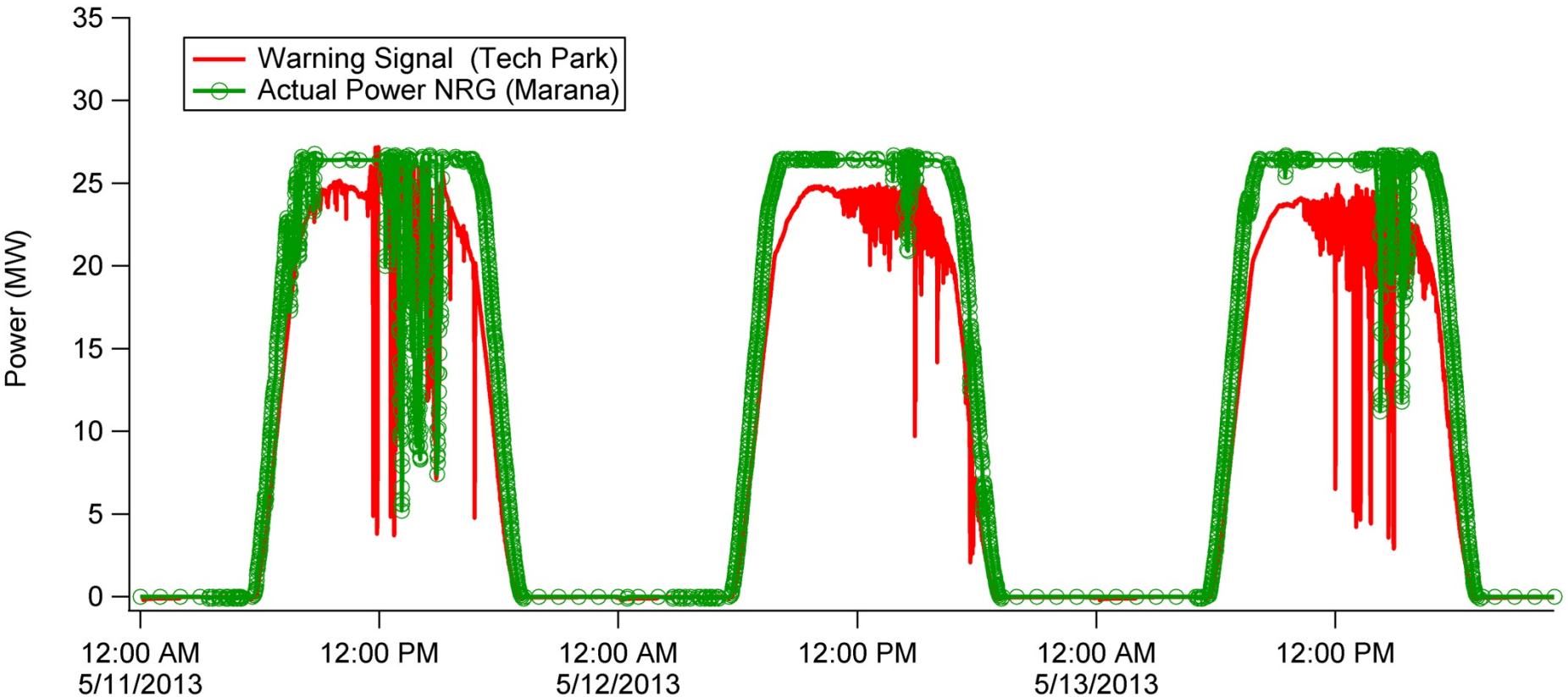


PV Power Variability

EMS aggregate 2013-10-09



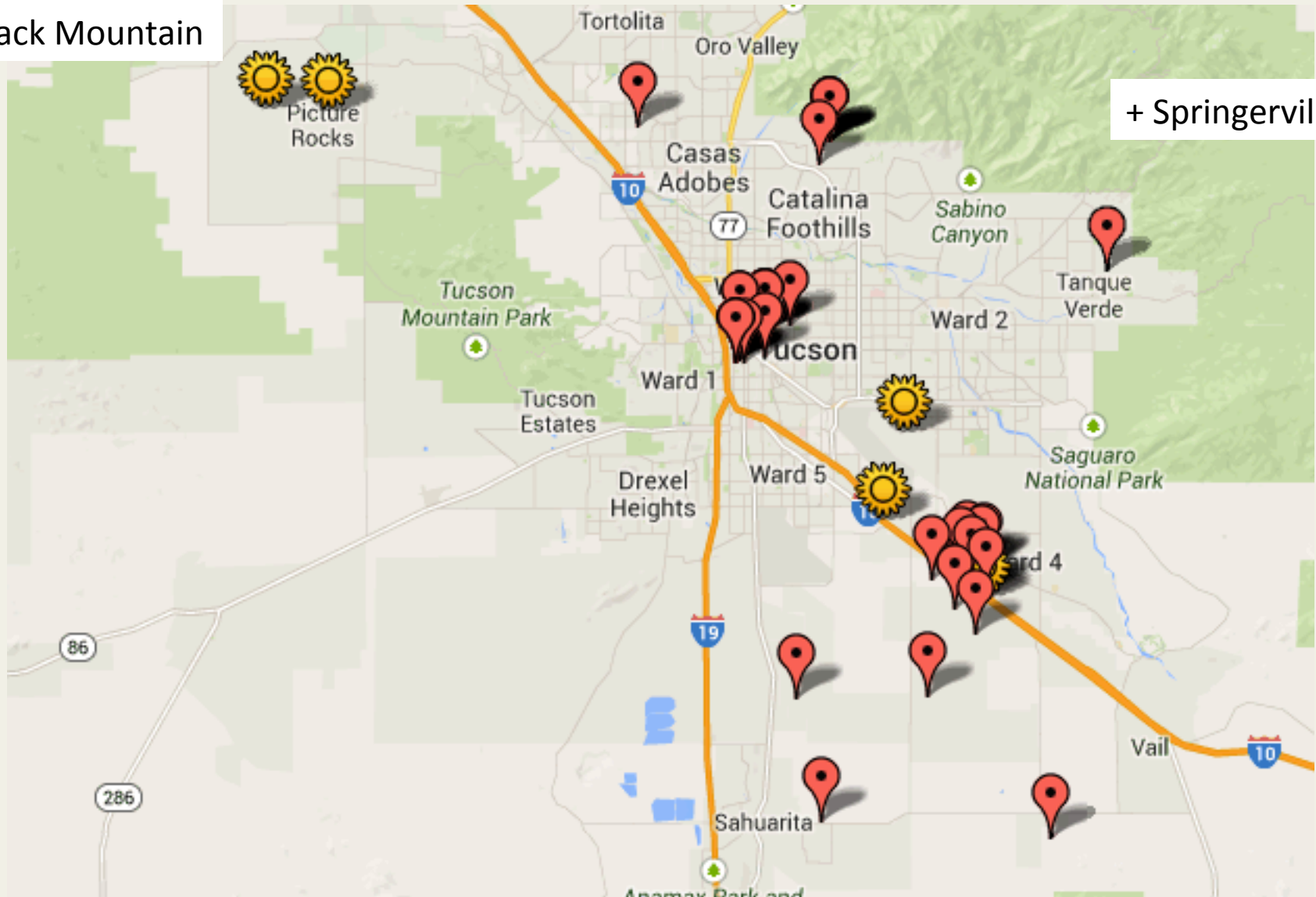
Predicting power using PV data



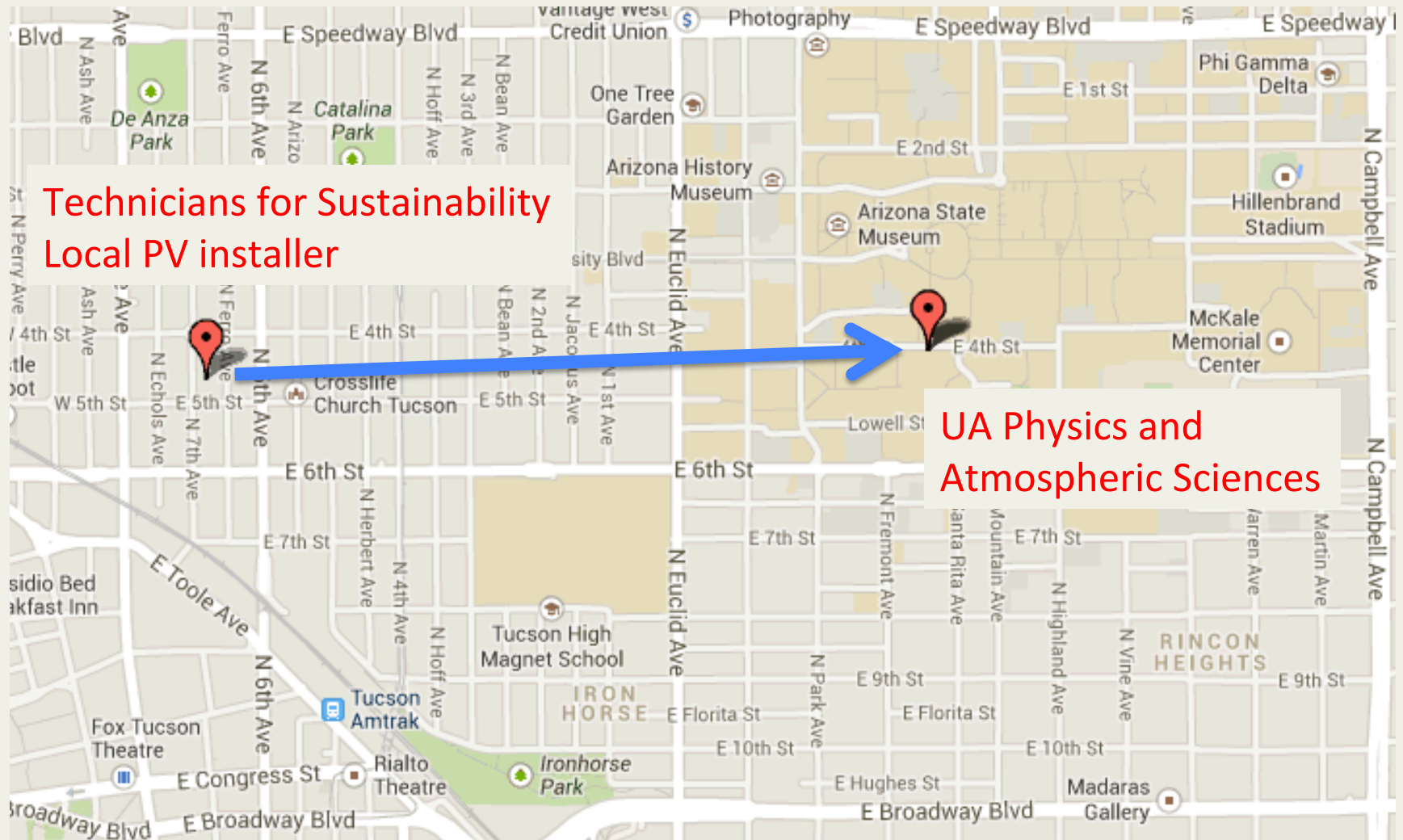
Real-time data sources map

+ Black Mountain

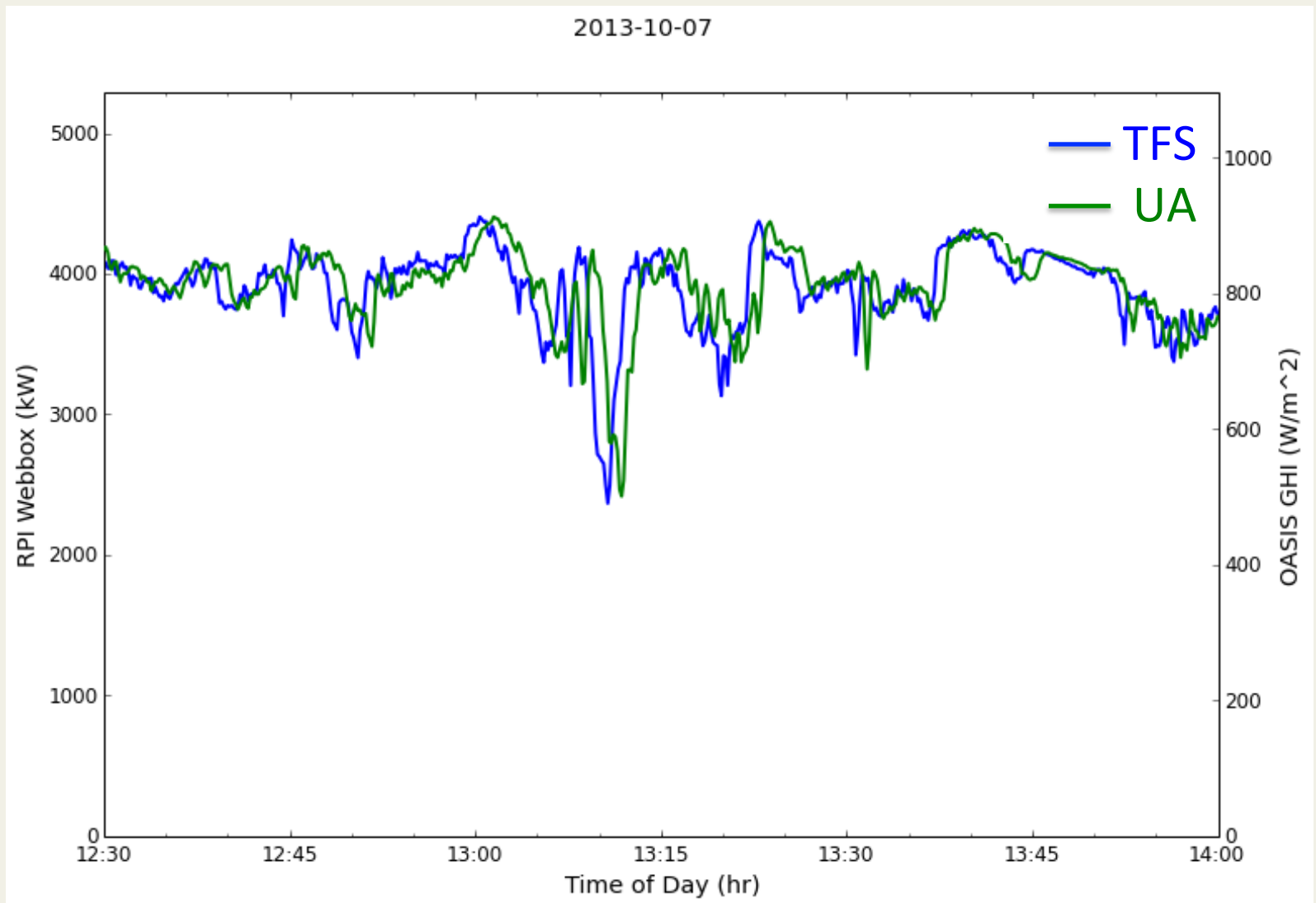
+ Springerville



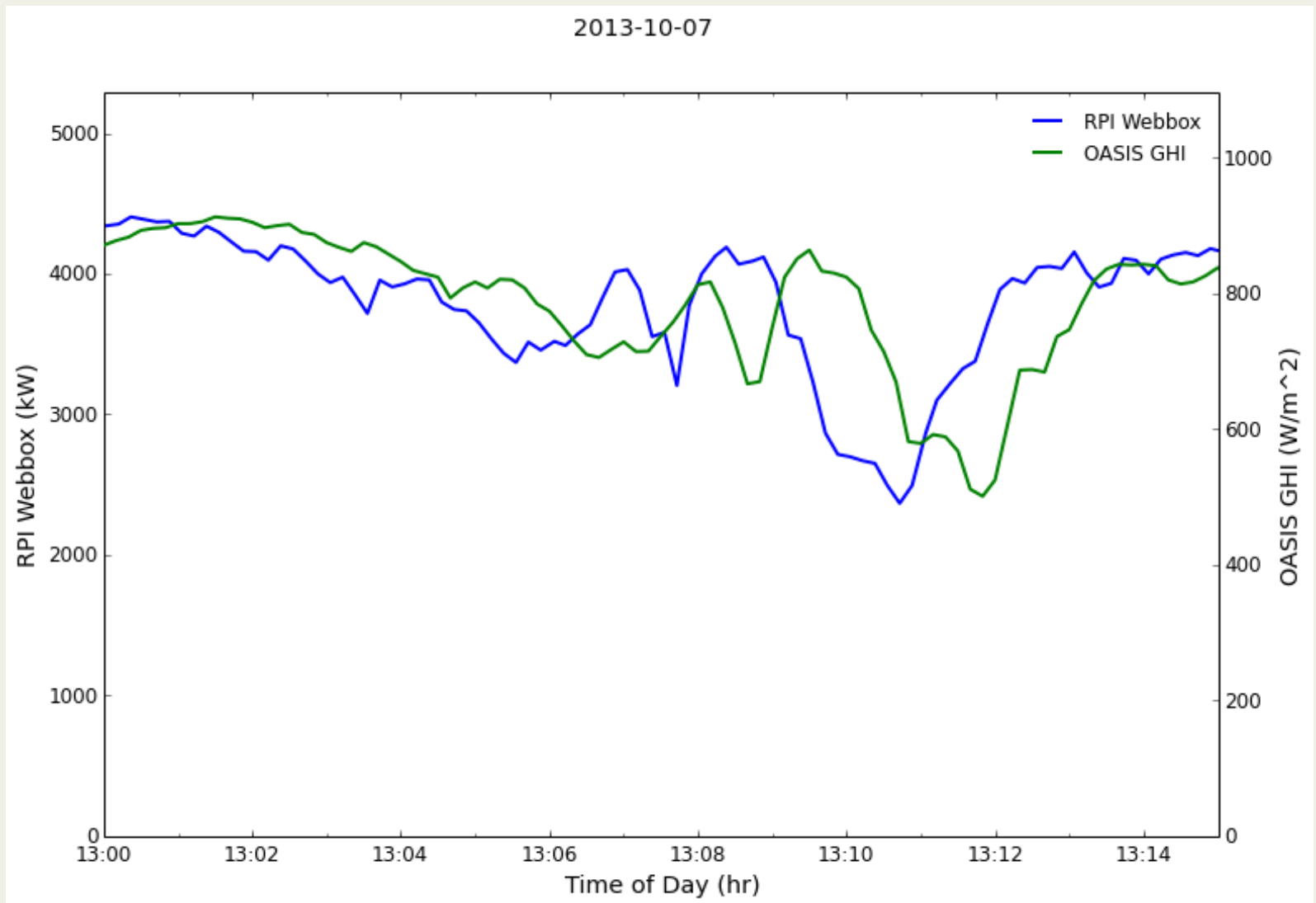
TFS to UA 1 min warning



TFS to UA 1 min warning



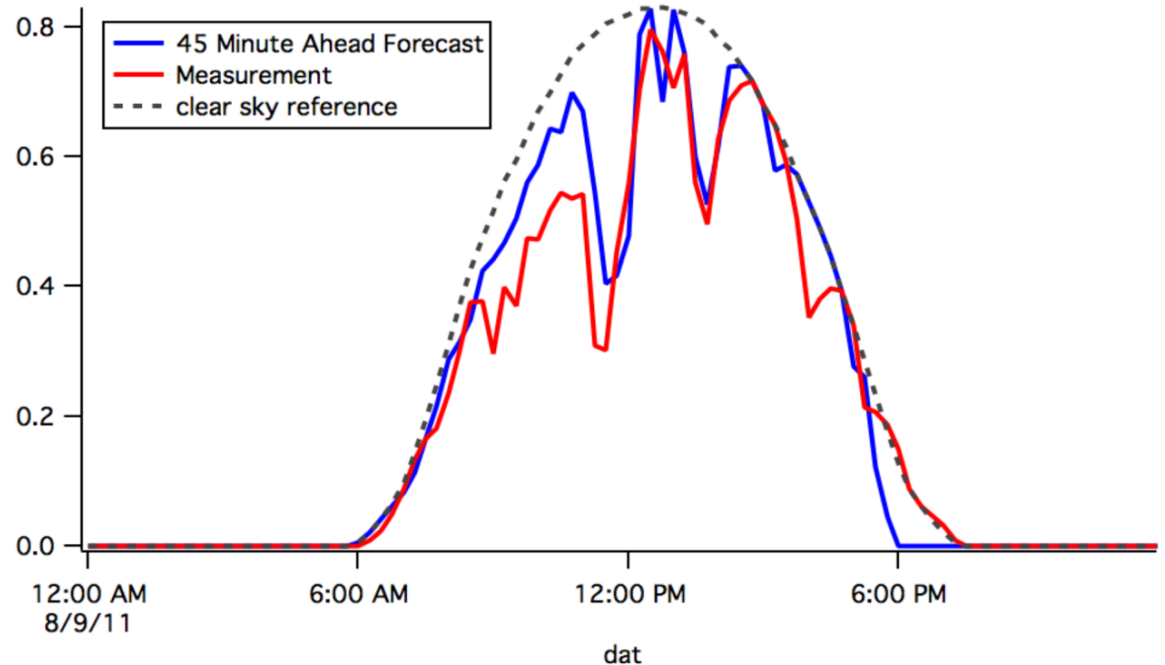
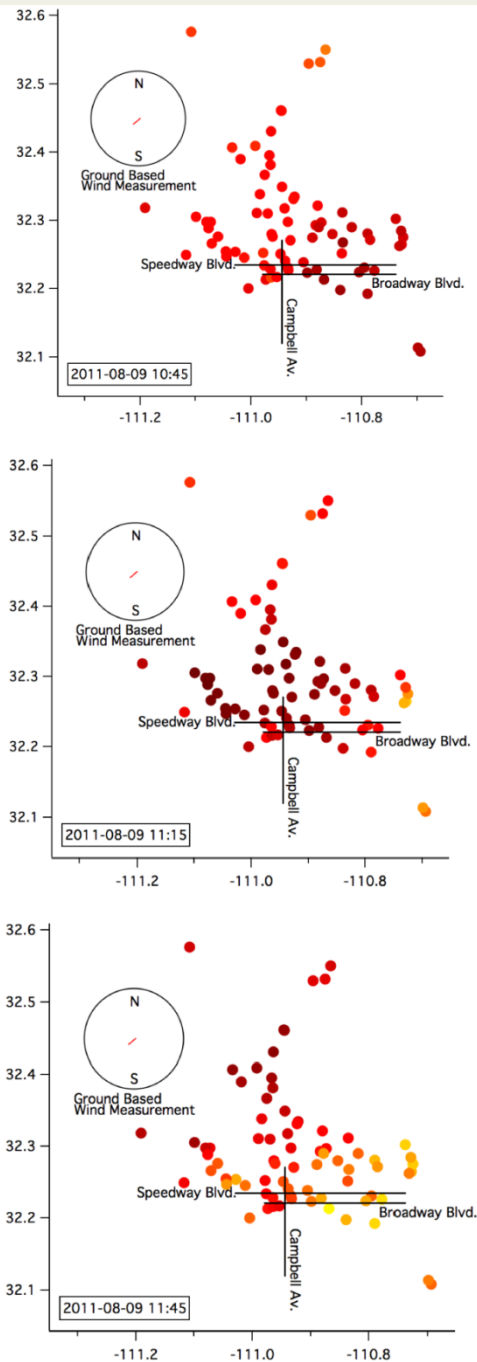
TFS to UA 1 min warning



Network-based Forecasts

Retrospective forecasts based on data from 100 rooftops

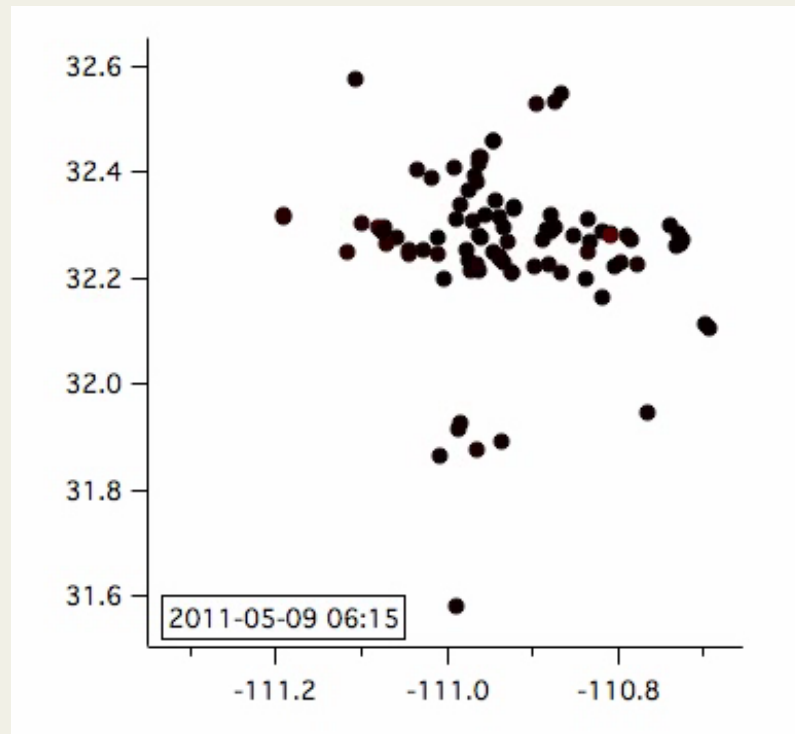
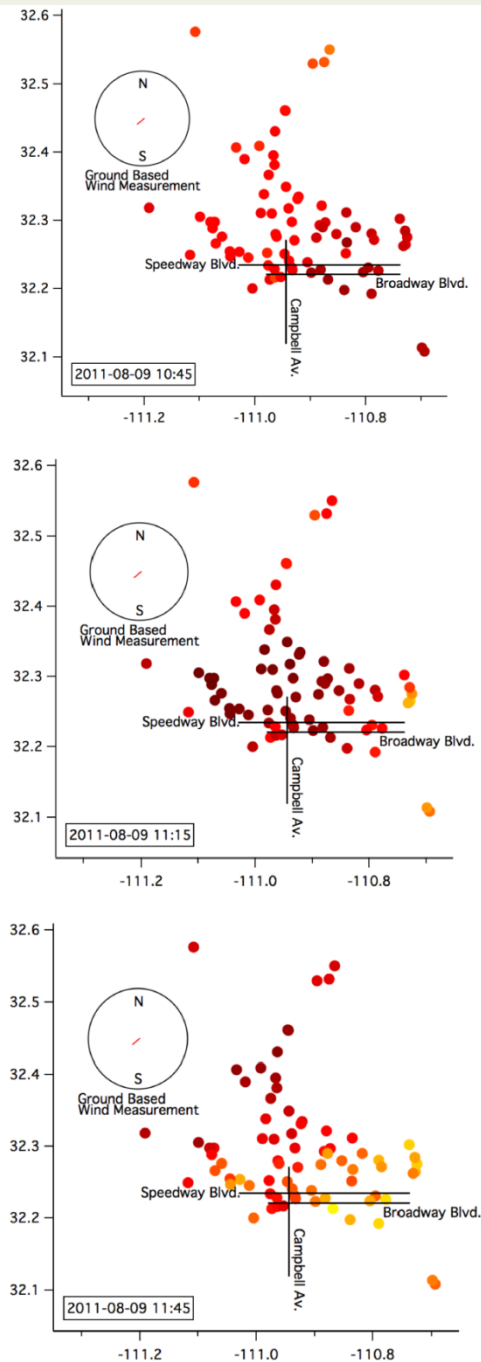
Building system to do this in real-time



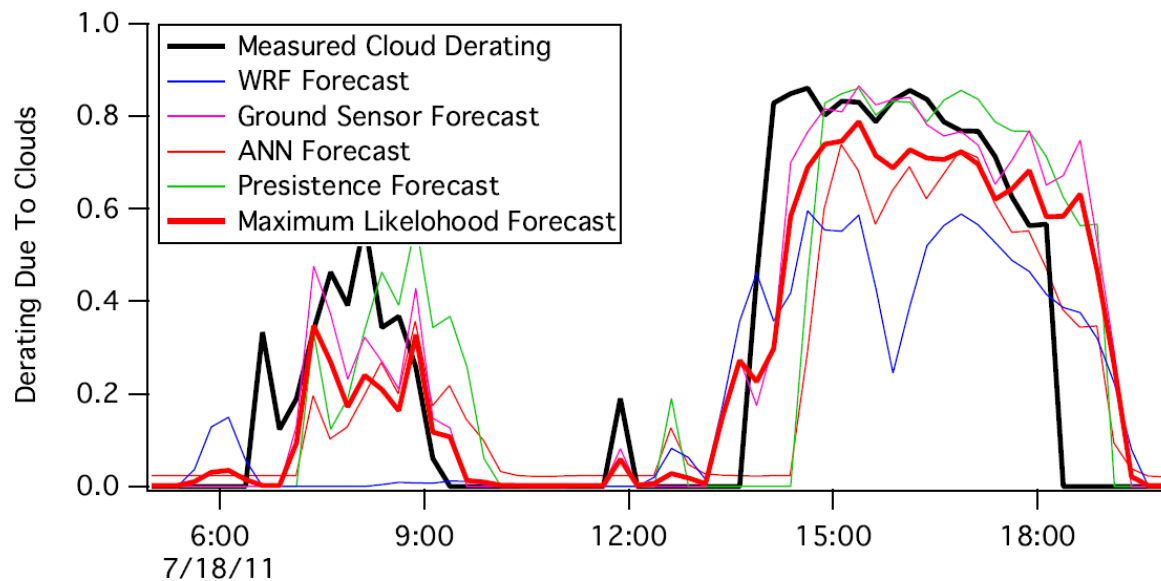
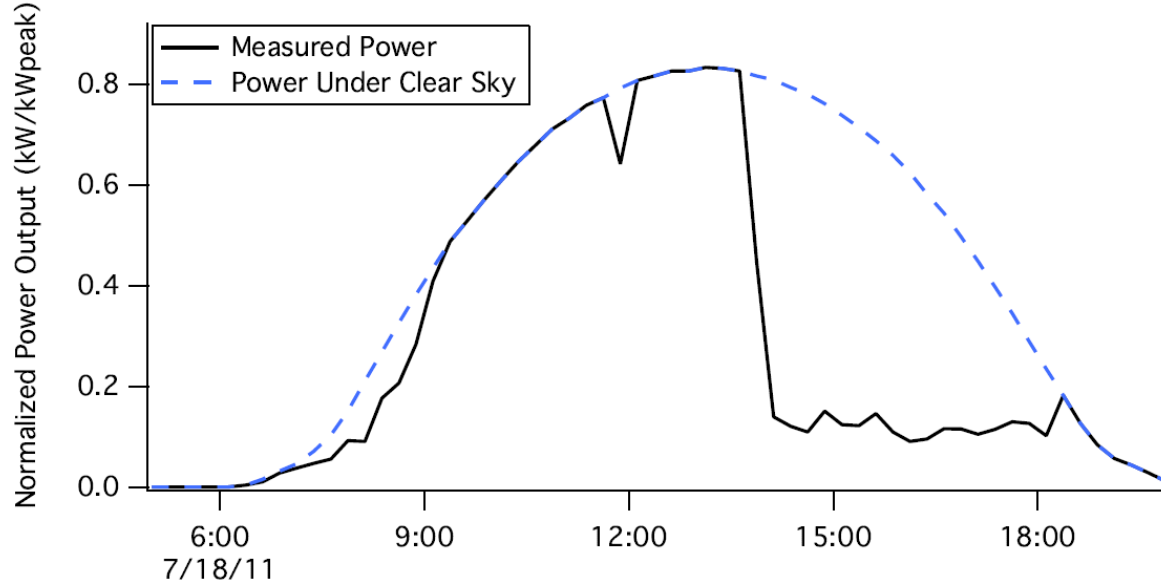
Network-based Forecasts

Retrospective forecasts based on data from 100 rooftops

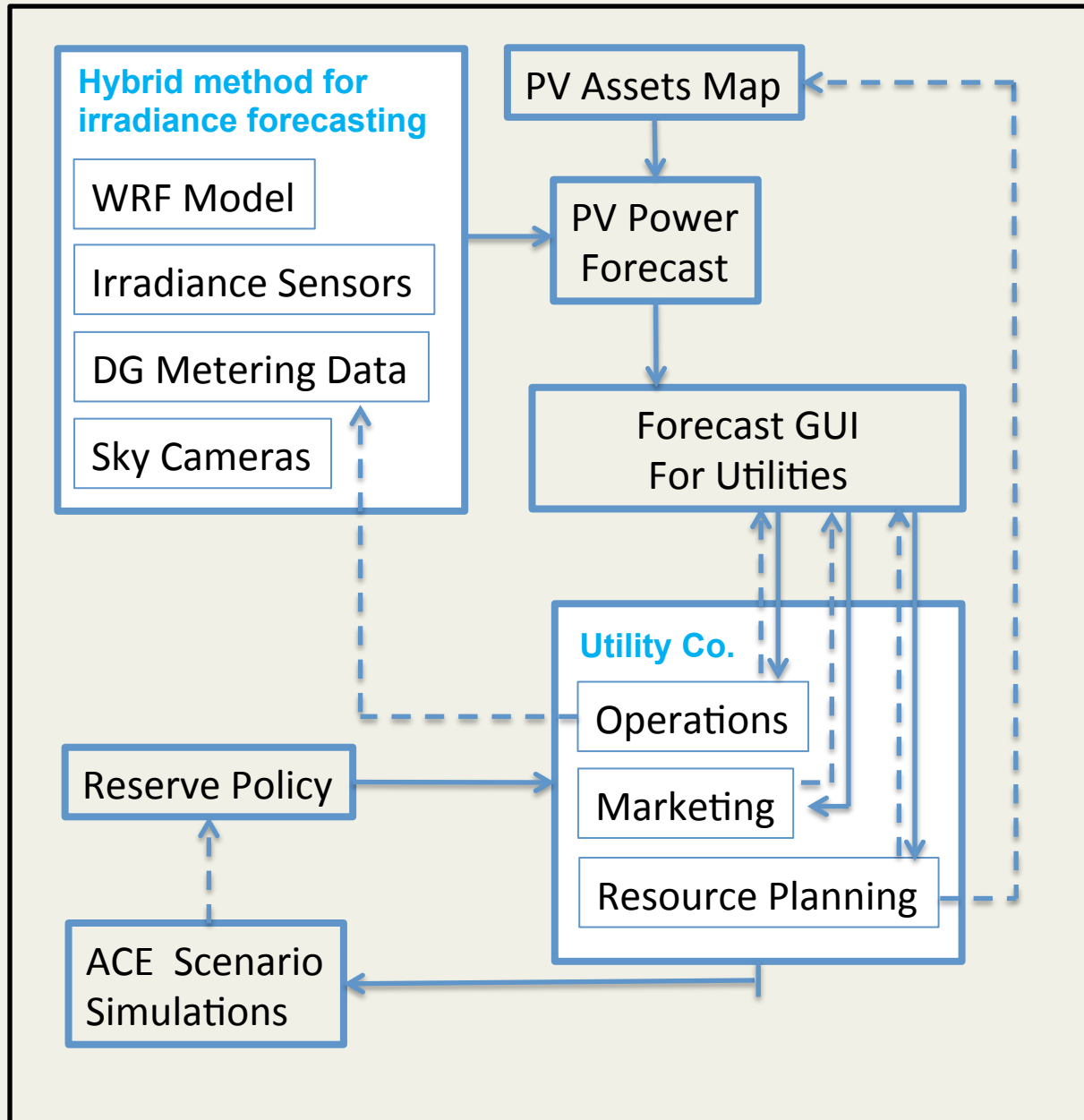
Building system to do this in real-time



Hybrid forecasting

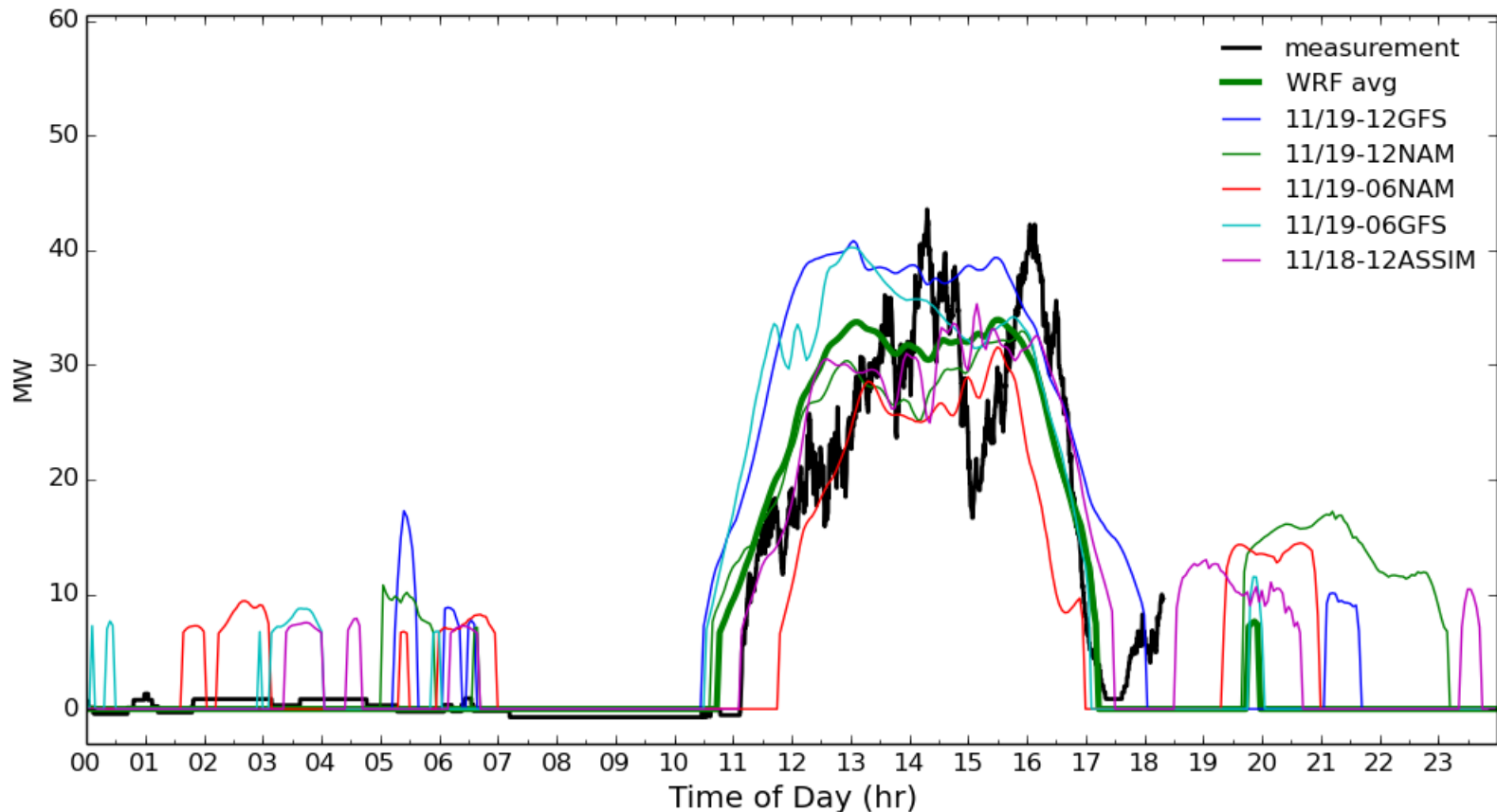


Hybrid forecasting utility integration



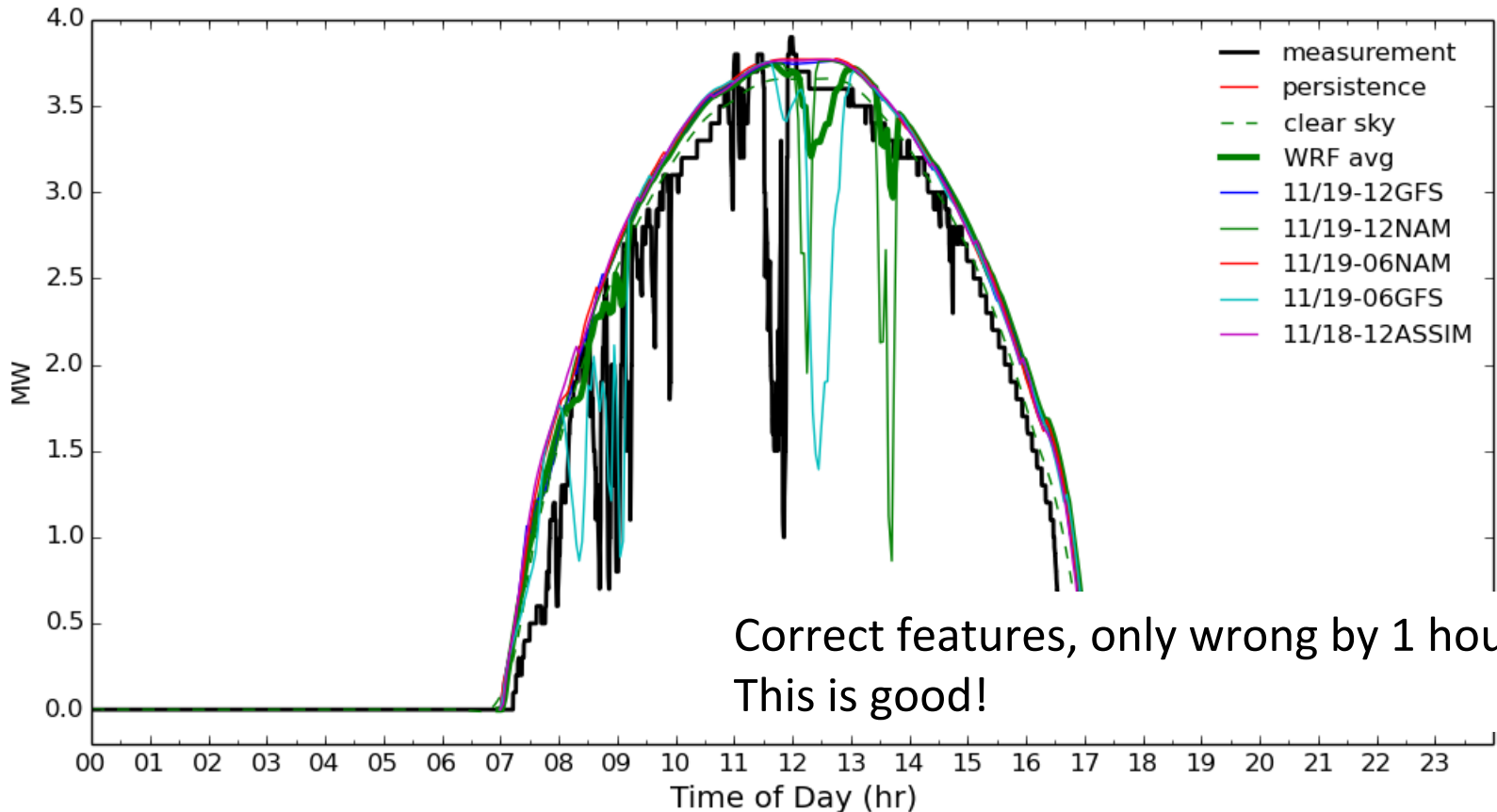
ATMO Wind forecasting for TEP

Macho Springs Wind EMS, 801. 11/19/13 18:22:44

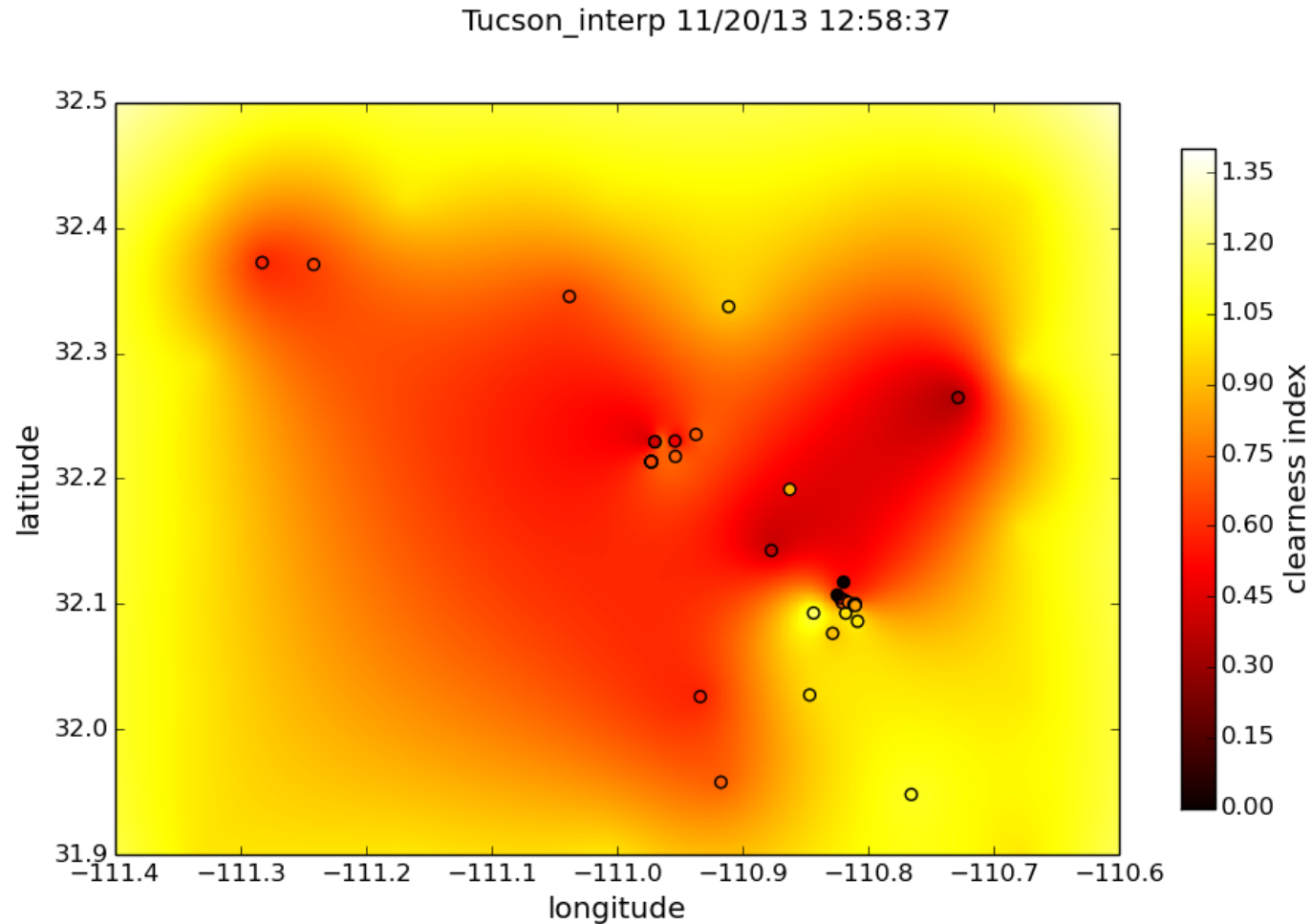


Solar forecasting for TEP

Solon2 EMS, 903. 11/19/13 18:22:44



Real time clearness maps



Website for TEP



THE UNIVERSITY OF ARIZONA®

Forecasts for TEP EMS sites, irradiance sensors, and rooftop PV

Maps

Full dataset
UA-STP
google map

TEP EMS data

EMS Aggregate
901: FRV EMS
902: NRG EMS
903: Solon2 EMS
904: Astrosol EMS
905: Prairie Fire EMS
906: EON EMS
907: Solon1 EMS
908: Amonix EMS

Irradiance sensors

11181: OASIS DNI
11184: OASIS GHI
112: iSensor Solon1
115: iSensor Solon1
152: iSensor UASTP

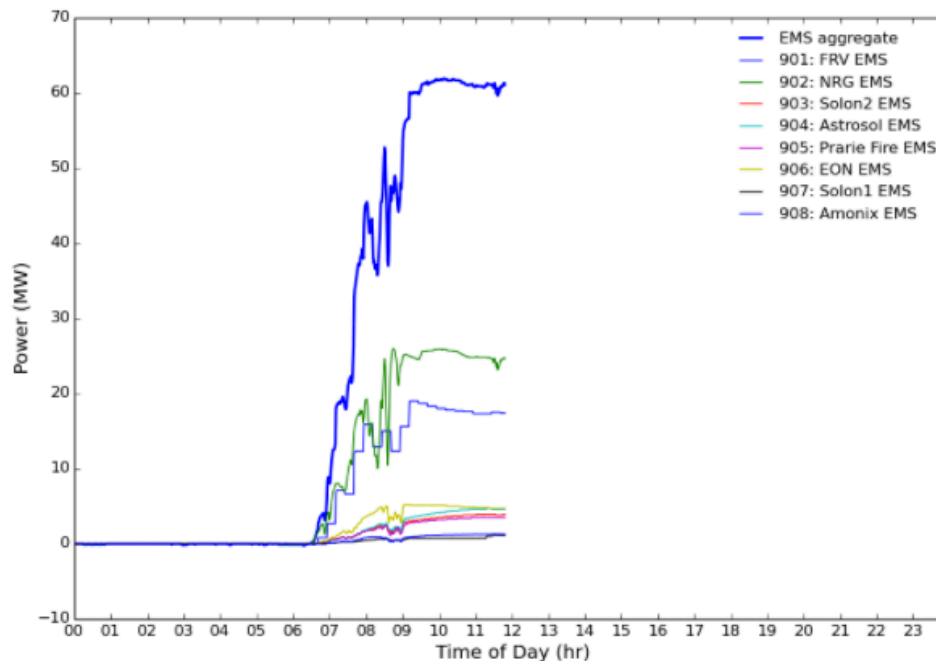
kW rooftop PV

401: Sunny WebBox
403: Sunny WebBox
404: Sunny WebBox
405: Sunny WebBox
406: Sunny WebBox
407: RPI Webbox
408: Sunny WebBox
415: Sunny WebBox
416: Sunny WebBox
418: Sunny WebBox
422: RPI WebBox

Overview figures

Sensor figures

EMS aggregate 2013-10-07



Website for TEP



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908: Amonix
909: EON Valencia
910: Black Mountain
911: DM Soaring Heights
912: Springerville Solar

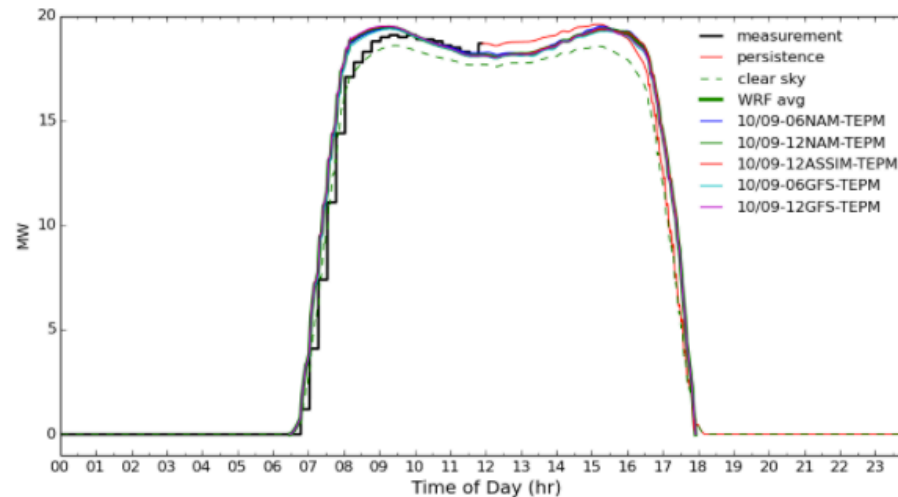
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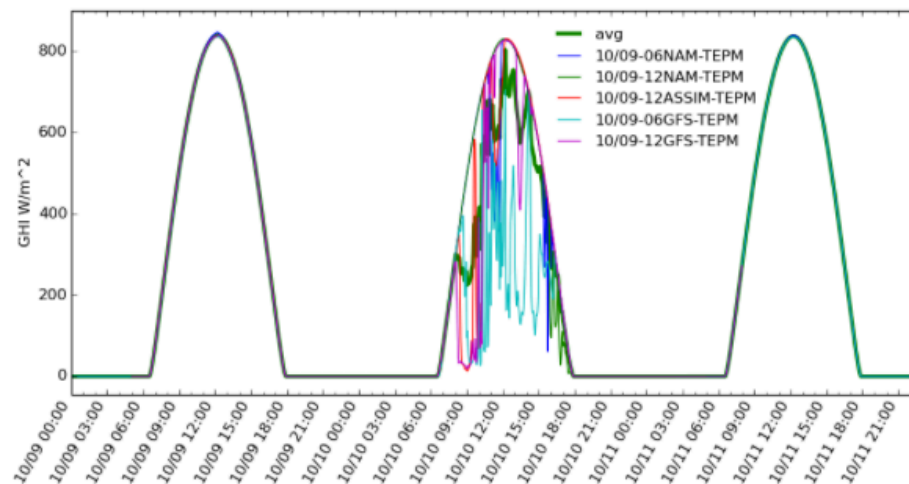
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416: Sunny WebBox
418: Sunny WebBox
422: RPI WebBox

FRV EMS, 901. 2013-10-09



WRF GHI, FRV EMS, 901



Website for TEP



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