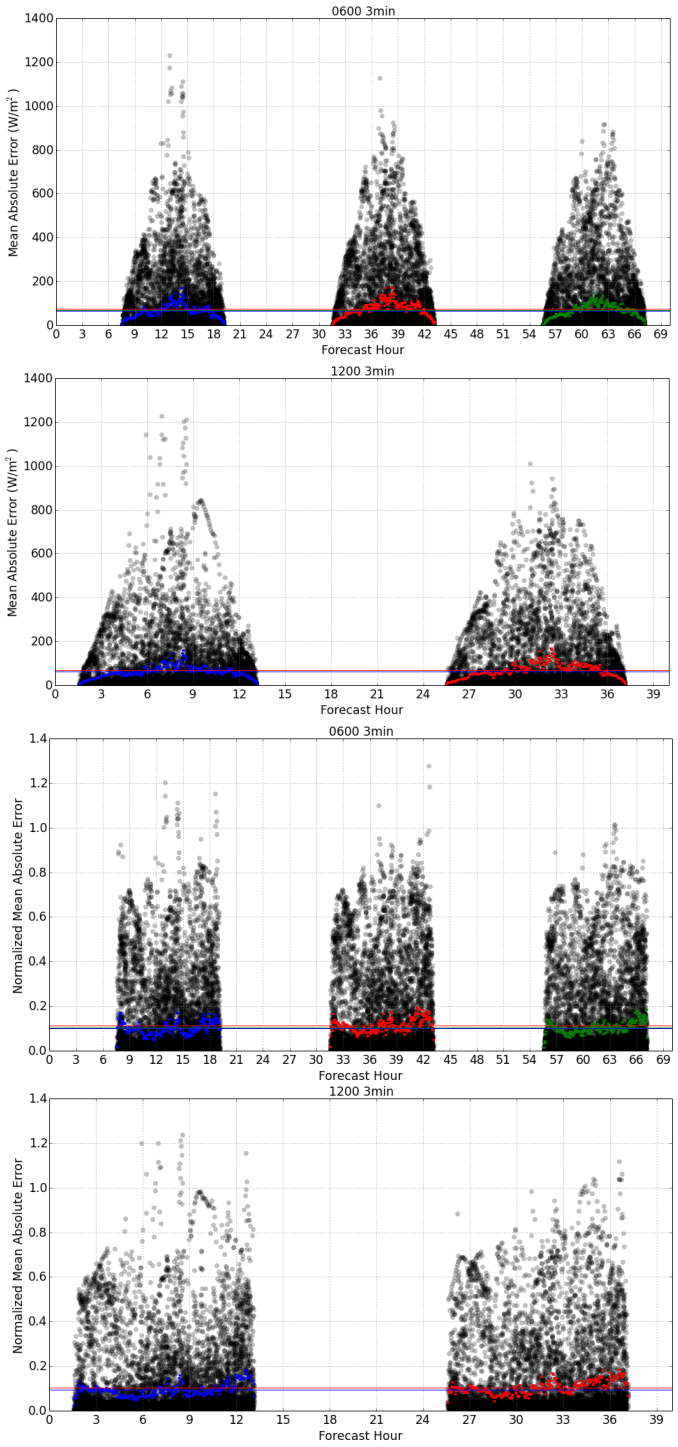

Fig. 2. GHI WRF forecast MAE and NMAE calculated every 3 minutes (grey dots) vs. forecast hour. Blue, red, and green dots show the average MAE at that forecast time across all 6Z or 12Z forecasts in the month of April, 2014. Blue, red, and green lines show the daily average MAE for days 1, 2, and 3, respectively. The data show a slight trend towards less accurate forecasts in the afternoons.

B. Satellite Imagery

Our WRF models, like all currently available numerical weather models, are insufficient to predict short-term variability with high confidence. The first method we use to predict short-term variability is satellite image processing. We use the visible and infrared channels of the GOES satellite imagery, combined with WRF model output, to determine the irradiance that reaches the ground. Figure 3 shows an example of the satellite derived irradiance map. The derived irradiance map can then be propagated forward in time using the WRF model wind speeds at the estimated cloud height. More sophisticated methods using image analysis algorithms do exist for satellite-based forecasting [2], however, we find that using the WRF model wind velocity is simple and still accurate for the majority of cloud systems in Southern Arizona. We will present a more detailed analysis of our satellite imagery forecasts in future work.

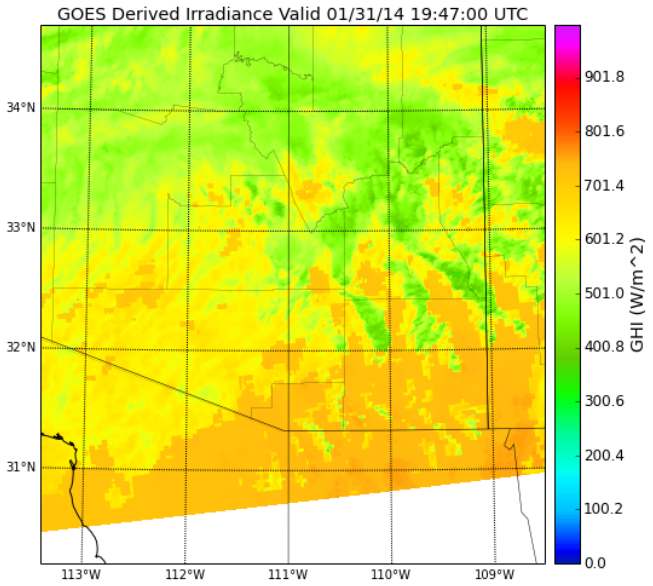

Fig. 3. GOES derived irradiance centered near Tucson, Arizona. This image corresponds to approximately 1/31 13:00 MST in Figure 1.

C. Network of irradiance sensors

A network of PV systems and irradiance sensors forms the final forecasting tool in our collection [8, 10]. We use PV output from 10 utility-scale systems and 20 residential systems as a proxy for irradiance. Data loggers on these systems send us data every 2 seconds to 15 minutes, depending on the system. We have also developed custom irradiance sensors that communicate via cellular modems. These sensors send us 1-second resolution data every 60 seconds. Figure 4 shows the network node locations and type.

The first step in creating a forecast from this sensor network is to create clear sky profiles for each sensor. We determine the sensor clear sky profiles using filtered historical data. We then interpret deviations from the clear sky profile as shadowing from clouds. We calculate the clearness index for