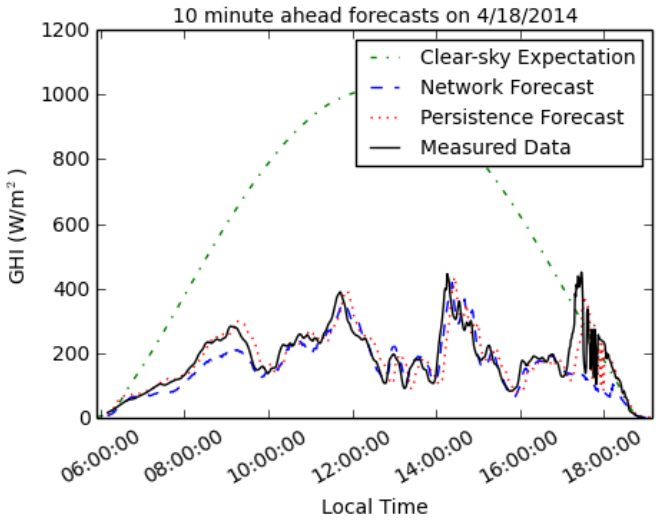

Fig. 5. Example 10 minute ahead forecasts made on 4/18/2014. The network forecast, clearness persistence forecast, clear-sky expectation, and measured data are shown. The forecasts for 10 minutes in the future are made every minute.

is constant and a measurement based persistence model that assumes the measured irradiance will be constant for the next 30 minutes. As expected, the measurement persistence model has larger errors than a clearness persistence model as forecast horizon increases because it does not account for the diurnal cycle. For comparison, the clear-sky forecast model simply assumes that any future irradiance will be the same as the clear-sky expectation. We also evaluated MAE and RMSE error statistics for WRF forecasts that are generated 2 to 20 hours in advance.

Table II and Figs. 6-7 present error statistics for a single irradiance sensor in the UASTP. The mean absolute error (MAE) and root mean squared error (RMSE) (using the standard definitions as found in [11]) at forecast horizons in multiples of 5 minutes are shown in Table II. A plot of MAE vs forecast time horizon is shown in Fig. 6 and a plot of RMSE vs forecast time horizon is shown in Fig. 7. The clearness persistence MAE and RMSE at the 0 minute forecast horizon is not identically zero because we limit the clearness to a maximum of 1.1 and errors in the clear-sky expectation in the early morning and late evening occasionally result in a calculated clearness in excess of this 1.1 limit. We then use this 1.1 clearness to calculate the expected irradiance, leading to small errors at zero time horizon. The network forecast is similarly affected by this clipping, but the larger error at the 0 minute horizon is mainly due to the interpolation we use to make clearness maps. Since this interpolation is smoothed for interpolation stability, the calculated clearness does not always match the measured clearness. Despite these errors, it is encouraging that our irradiance network based forecasts outperform the persistence model for the days studied for 1 to 28 minutes as measured by RMSE and 2 to 17 minutes as measured by MAE.

TABLE II
ERROR STATISTICS FOR 26 DAYS IN APRIL FOR PERSISTENCE AND NETWORK FORECASTS. BOLD FONT INDICATES WHEN THE NETWORK FORECAST OUTPERFORMS PERSISTENCE FORECASTS.

	Clearness Persistence		**Network Forecast**	
Forecast Horizon	MAE (W/m^2)	RMSE (W/m^2)	MAE (W/m^2)	RMSE (W/m^2)
0 min	0.166	1.23	3.26	11.3
5 min	30.4	58.6	**27.6**	**48.1**
10 min	38.7	69.1	**36.6**	**60.0**
15 min	43.6	74.8	**43.0**	**67.9**
20 min	47.7	79.0	50.0	**74.7**
25 min	50.6	81.3	54.1	**78.6**
30 min	52.9	83.2	60.1	85.4

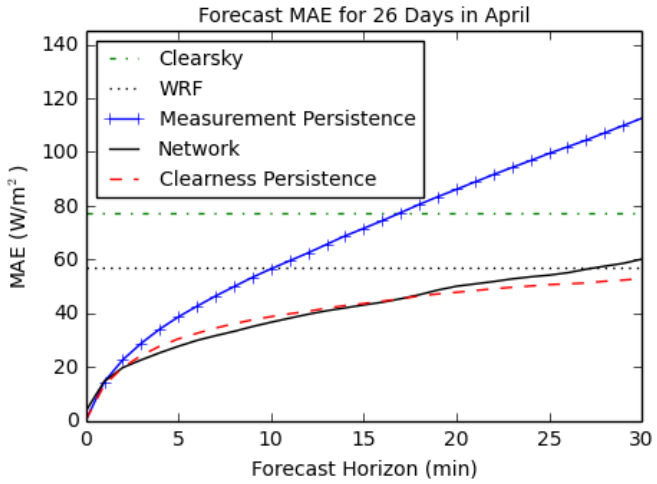

Fig. 6. Mean absolute error as a function of forecast horizon for a single sensor calculated each day and averaged over 26 days in April.

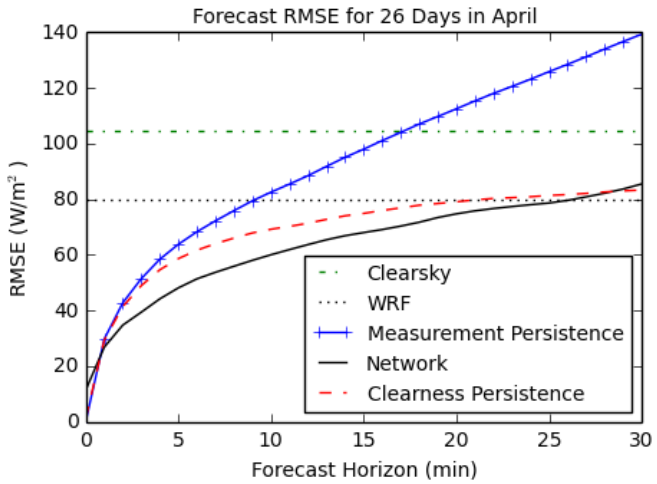

Fig. 7. Root mean squared error as a function of forecast horizon for a single sensor calculated each day and averaged over 26 days in April.