2015 JST-NFS-DFG-RCN Workshop On Distributed Energy Management Systems

Collaborative researches between meteorologists and researchers in the EMS

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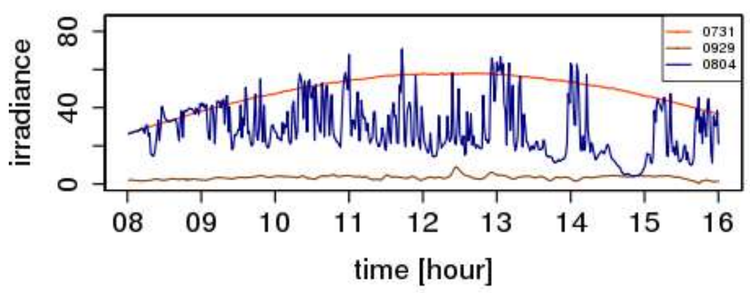
Background:

Our team, TEEDDA, was the group of meteorologists. We know the earth well, but we are not specialists in the energy management.
Introduction of renewable energy is expanding. So to contribute the development of the distributed energy management collaborative works between meteorologist and the specialists in the energy management are necessary.
We have been worked on several collaborative works. Two topics are introduced in this poster.

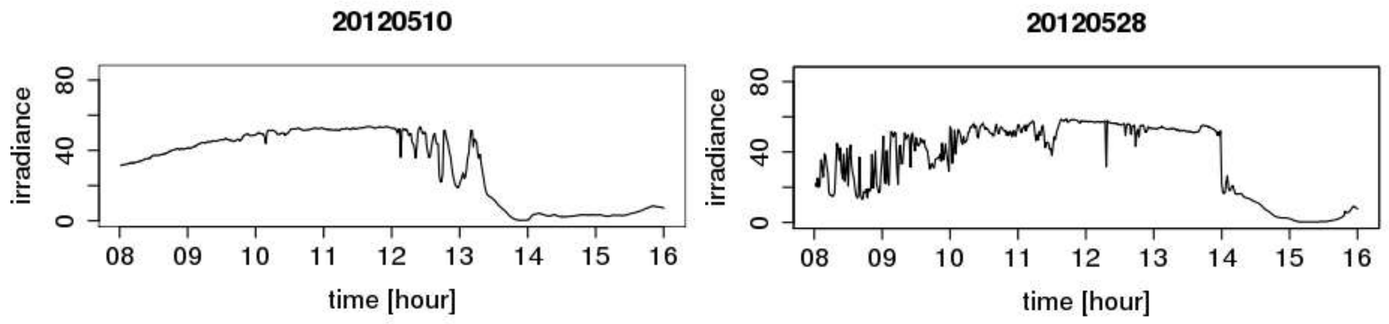
Topic 1: Evaluation of fluctuation of solar irradiance

Watanabe, Takamatsu, Ohmori and Nakajima (2014)

The variation of solar irradiance influences on the control of the PV system strongly.
Sample entropy is used to represent the variation in solar irradiance.



Sky condition (date)	Sample Entropy (r=3, m=2)
Fine day (July 31)	0.0210
Overcast(September 29)	0.0091
Cloudy(August 4)	0.9485



Tokyo	10 May 2012	28 May 2012
Standard deviation	20.32	20.28
Sample entropy	0.11	0.27

Sample entropy is an index to measure the regularity of time series.
Sample entropy become large when the solar irradiance fluctuates rapidly.

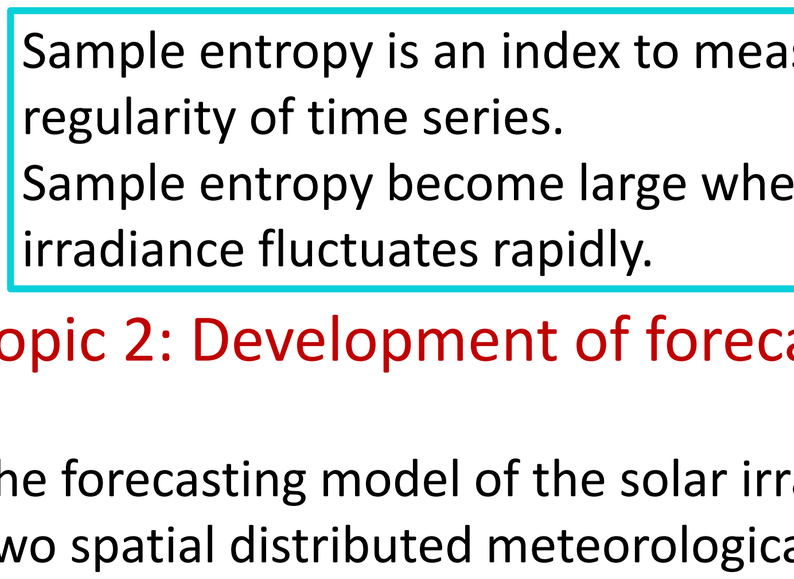
Using sample entropy we can distinguish two time series of same standard deviation and evaluate the fluctuation in solar irradiance.

Topic 2: Development of forecasting model of solar irradiance with machine learning method

Ogawa, Takeda, Watanabe,and Nakajima (2014)

The forecasting model of the solar irradiance with the LASSO was developed.
Two spatial distributed meteorological data with fine spatial resolution are used as input to the forecasting model.

1. Solar irradiance data: This data is produced with our EXAM system. The EXAM system is based on the geostationary satellite observation, cloud retrieval system and radiative transfer model.
2. Weather forecast data: This grid point value (GPV) data is produced with the mesoscale forecast model of Japan Meteorological Agency (JMA).



An example of solar irradiance data at 12:00 JST June 1, 2012

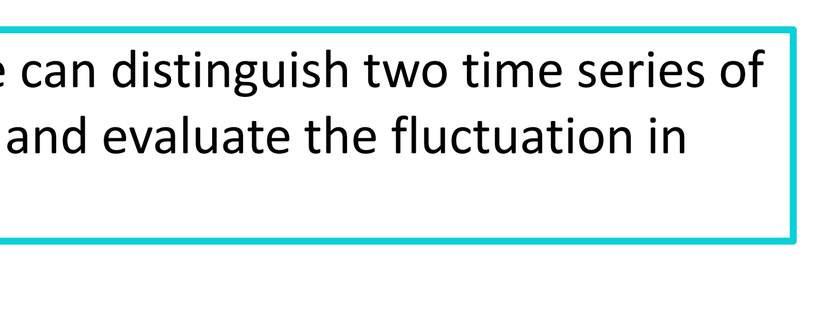
Forecasting model of solar irradiance is:

$$\hat{P}_t = \sum_{i=1}^{M} \varphi_t^i P_{t-i} + \sum_{j=1}^{N} \eta_t^j F_t^j + \varepsilon$$

where Pt and Ft are solar irradiance and weather forecasting data at time t respectively .
ϕ and η are regression coefficients.

The criterion of Lasso is

$$\min_{\varphi,\eta} \left\{ (P_t - \sum_{i=1}^{M} \varphi_t^i P_{t-i} - \sum_{j=1}^{N} \eta_t^j F_t^j)^2 + \lambda(\|\varphi\|_1 + \|\eta\|_1) \right\}$$



The forecast errors and the number of features for the nine cities in Japan

Our forecasting model can provide the one-hour forecast of solar irradiance everywhere in Japan thanks to two fine resolution datasets.

Next Step: We want to collaborate with more specialists in the EMS. Any interested researchers is welcome!!