

Analogue Ensemble Forecast Model

Copyright

This software is Copyright © 2016 The Regents of the University of California. All Rights Reserved. Permission to copy, modify, and distribute this software and its documentation for educational, research and non-profit purposes, without fee, and without a written agreement is hereby granted, provided that the above copyright notice, this paragraph and the following three paragraphs appear in all copies.

Permission to make commercial use of this software may be obtained by contacting:

Technology Transfer Office
9500 Gilman Drive, Mail Code 0910
University of California
La Jolla, CA 92093-0910
(858) 534-5815

invent@ucsd.edu

The software program and documentation are copyrighted by The Regents of the University of California. The software program and documentation are supplied "as is", without any accompanying services from The Regents. The Regents does not warrant that the operation of the program will be uninterrupted or error-free. The end-user understands that the program was developed for research purposes and is advised not to rely exclusively on the program for any reason.

IN NO EVENT SHALL THE UNIVERSITY OF CALIFORNIA BE LIABLE TO ANY PARTY FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, ARISING OUT OF THE USE OF THIS SOFTWARE AND ITS DOCUMENTATION, EVEN IF THE UNIVERSITY OF CALIFORNIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. THE UNIVERSITY OF CALIFORNIA SPECIFICALLY DISCLAIMS ANY WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE SOFTWARE PROVIDED HEREUNDER IS ON AN "AS IS" BASIS, AND THE UNIVERSITY OF CALIFORNIA HAS NO OBLIGATIONS TO PROVIDE MAINTENANCE, SUPPORT, UPDATES, ENHANCEMENTS, OR MODIFICATIONS.

Introduction

Analogue ensemble forecast following Alessandrini et al [1] was implemented in the following code. The principal idea of the analog ensemble forecast is to use a clustering method to identify time periods in the past ("analogues") that were similar to the time immediately preceding and during the current forecast horizon. These time periods represent an "ensemble" that can be used to (i) correct the deterministic forecast given past forecast errors and to (ii) generate probabilistic forecasts.

Instructions for Modifying and Running the Files

Users may use this script to generate analogue ensemble forecast at any location given that observations and archived forecast data are available. To do so, users should replace the files in 2 folders: history and forecast. The history folder should include observation and archived historical forecasts for the desired analogue time periods, and the forecast folder should include forecasts and/or

observation for the desired validation time periods. If the script is used for operational forecasting, then the forecast folder would only contain one file with the forecast produced for the next day(s).

“forecast.csh” does not require modification if the input file’s format and name are the same as the example site provided (i.e. columns of variables are the same and the file name starts with FCST_*).

“forecast.csh” is the main script for running the analogue ensemble forecast. To run the script, simply type “./forecast.csh” into a terminal, and the output files will be saved in the output folder. The open source NCAR Command Language (NCL) was used [2]. Installation instructions for NCL can be found here <https://www.ncl.ucar.edu/Download/>.

Example Application

The package of files contains an example to illustrate the application of the method. In the example, the variables used to identify the analogues are Clearsky index (Kt), Temperature at 2m (T2m), and Liquid water path (LWP).

File Structure

The sample data are contained in 3 folders: history, forecast, and output.

1. The history folder includes archived historical WRF forecasts from 5/1/2014 to 4/30/2015. The variables are forecasted Global Horizontal Irradiance (GHI), Observed GHI (OBS_GHI), forecasted Liquid Water Path (LWP), forecasted Temperature at 2m (T2m), and Clearsky GHI (CLRGHI). Clearsky index is then calculated based on GHI and CLRGHI in the main script. Time stamps are structured as “Year_JulianDay_ForecastMinutes”. For example, “2014_122_F0030” is equivalent to 5/2/2014 06:30, or a forecast horizon of 30 minutes from the time the forecast was generated. These files are used to select the analogues.

2. The forecast folder includes the files for the validation period in May 2015.

3. The output folder includes analogue ensemble forecasts for May 2015.

For questions, please e-mail jkleissl@ucsd.edu.

Acknowledgments

The development of this program was sponsored by a California Public Utilities Commission (CPUC) California Solar Initiative (CSI) 3 contract to the University of California, San Diego. The project was managed by Stephan Barsun (Itron). The CIS3 project report “Ensemble Forecasting of Solar Irradiance in Coastal Southern California” describes an application of this model and is available on the calsolarresearch.org website.

References

[1] Alessandrini, S., L. Delle Monache, S. Sperati, and G. Cervone. "An Analog Ensemble for Short-term Probabilistic Solar Power Forecast." *Applied Energy* 157 (2015): 95-110. Web. <http://www.sciencedirect.com/science/article/pii/S0306261915009368>

[2] The NCAR Command Language (Version 6.3.0) [Software]. (2016). Boulder, Colorado: UCAR/NCAR/CISL/TDD. <http://dx.doi.org/10.5065/D6WD3XH5>