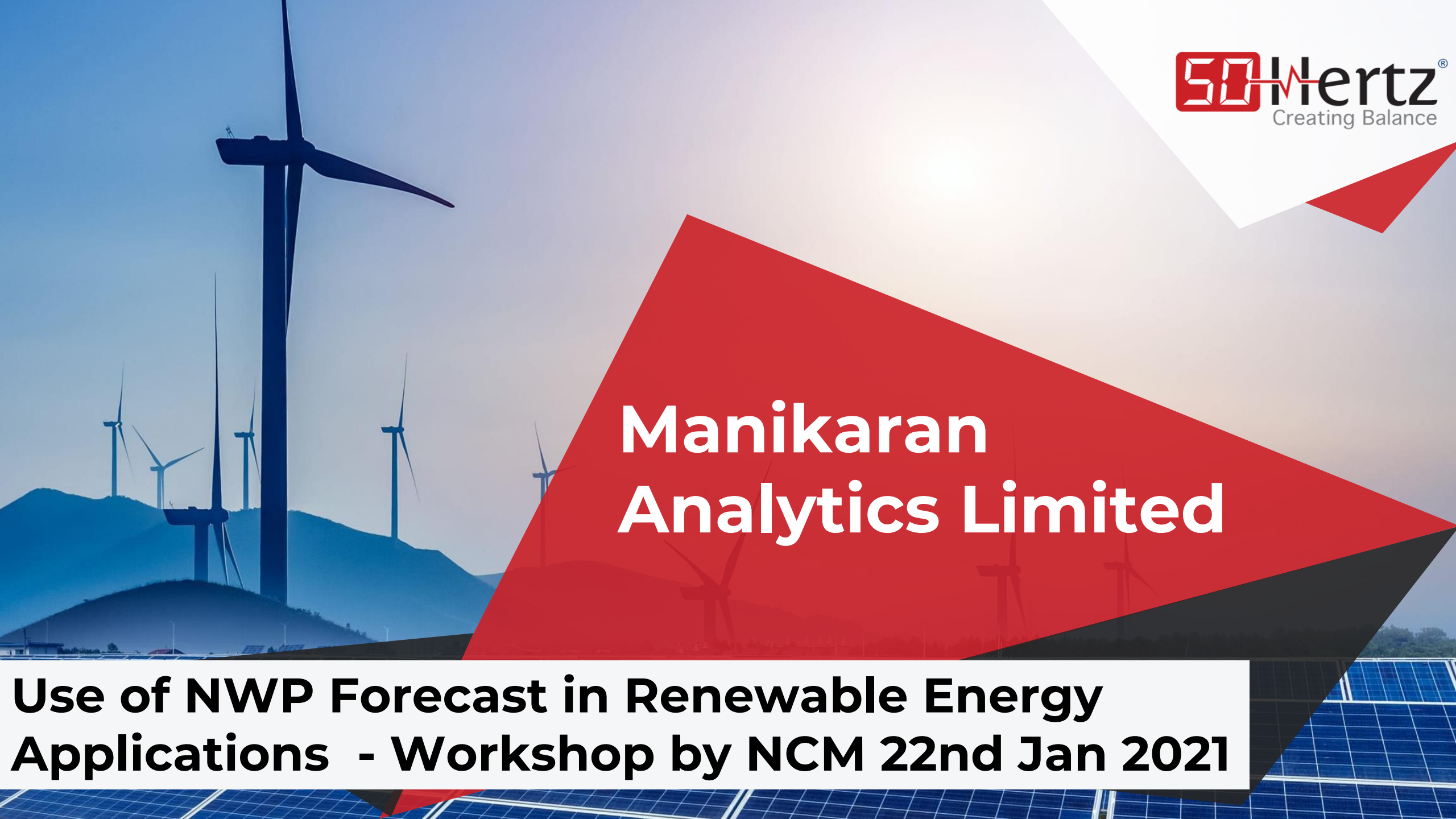


50Hertz
Creating Balance

Manikaran Analytics Limited

Use of NWP Forecast in Renewable Energy Applications - Workshop by NCM 22nd Jan 2021

Introduction

- Manikaran Group
- Journey so far
- NWP data from NCMRWF
- Forecast Approach
- Data Discussions
- Challenges
- About Our Setup

Manikaran Group

MPL

Manikaran Power Limited

Power, Natural Gas and Coal Trading

MPSL

Manikaran Power Systems Limited

Smart Energy Monitoring & Energy Efficient Products

MAL

Manikaran Analytics Limited

(Forecasting & Scheduling) – Wind & Solar Energy Analytics Services

MRL

Manikaran Renewables limited

Roof-top Solar EPC

Journey so Far

Sapling Planted

2011

June
2012

Initiated R&D

Initiated R & D

Developed Wind Power Scheduling s/w

Initiated scheduling of multiple wind farms

June
2013

Dec
2014

Developed i-WPFS & i-SPFS

Integrated Wind/Solar Power Forecasting & Scheduling) engine.

Re50hertz launched

Revised version of software

June
2018

Aug
2020

Re50hertz High Availability

Software Upgrade

Portfolio size 32 GW

Jan
2021

CERTIFIED ISO 9001:2008 COMPANY

CERTIFIED ISO 27001:2013 CERTIFIED

Significance of NWP data in RE-Forecasting

- Effective maintenance of reliable electric grids and Energy trading.
- MAL uses Numerical Weather Prediction (NWPs) data that provides skillful predictions at times beyond a few hours with specialized methods based on observations.
- Leveraged proven forecasting methodologies for each temporal, as well as spatial, scale.

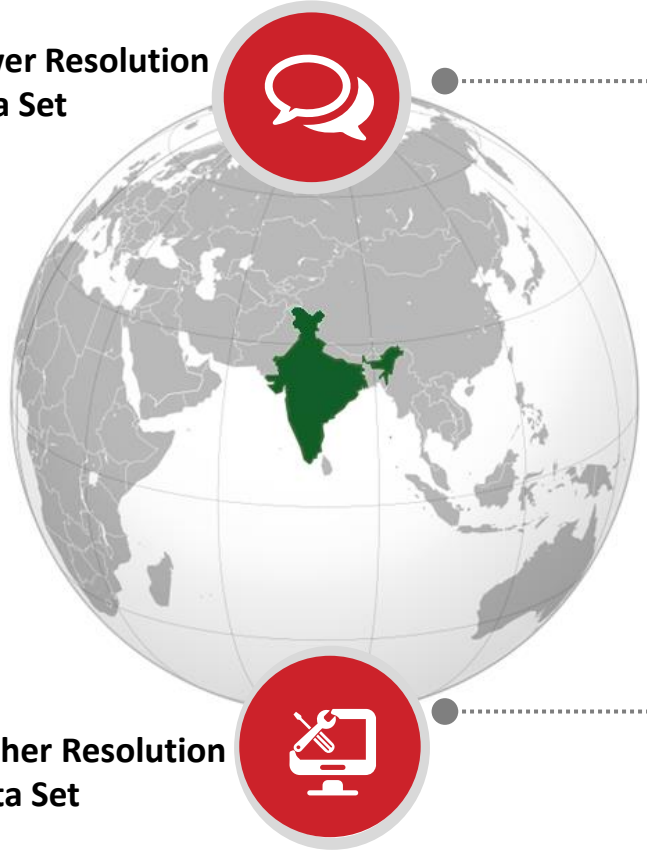
Numerical Weather Data from NCMRWF

Numerical Weather Data for Indian Region

Spatial Resolution :	12.5 X 12.5 Km
Temporal Resolution:	1 hour
Z files Revision:	00UTC & 12UTC
Vertical levels:	10m & 50m surf., 990 hPa, 960 hPa, 925 hPa.
Parameters :	U & V component of Wind Speed, Geopotential Height.

Meteorological Data & Parameters

Lower Resolution data Set



Higher Resolution Data Set

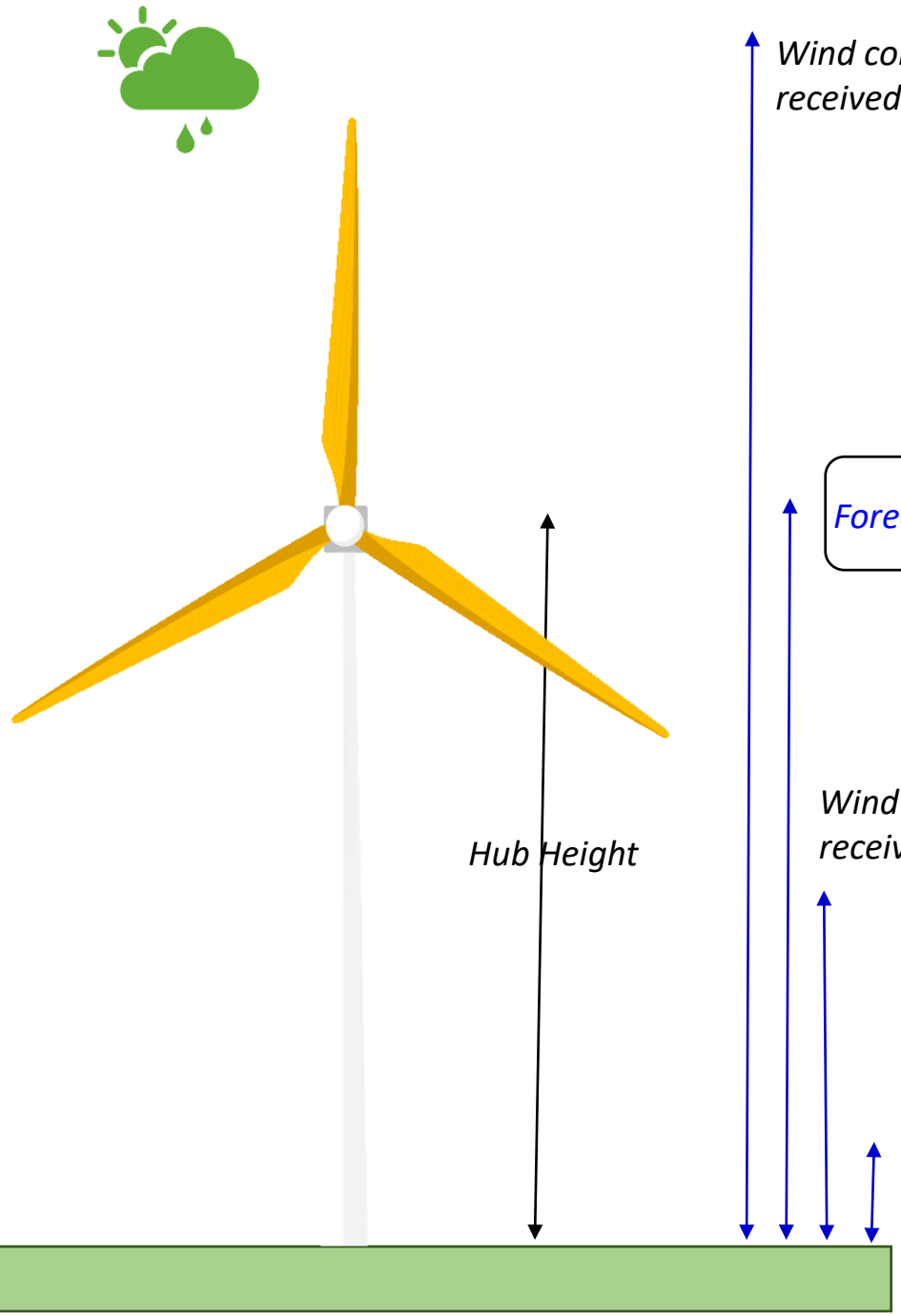
Demand Forecasting

Wind Speed forecasting

Solar forecasting

Weather Inputs for Forecasting

- GHI
- Precipitation
- Temperature
- Specific Humidity
- Relative Humidity
- Wind Speed
- Wind Direction



Wind components at 925 hPa received in Weather data

A. Wind Speed Interpolation/Extrapolation using:

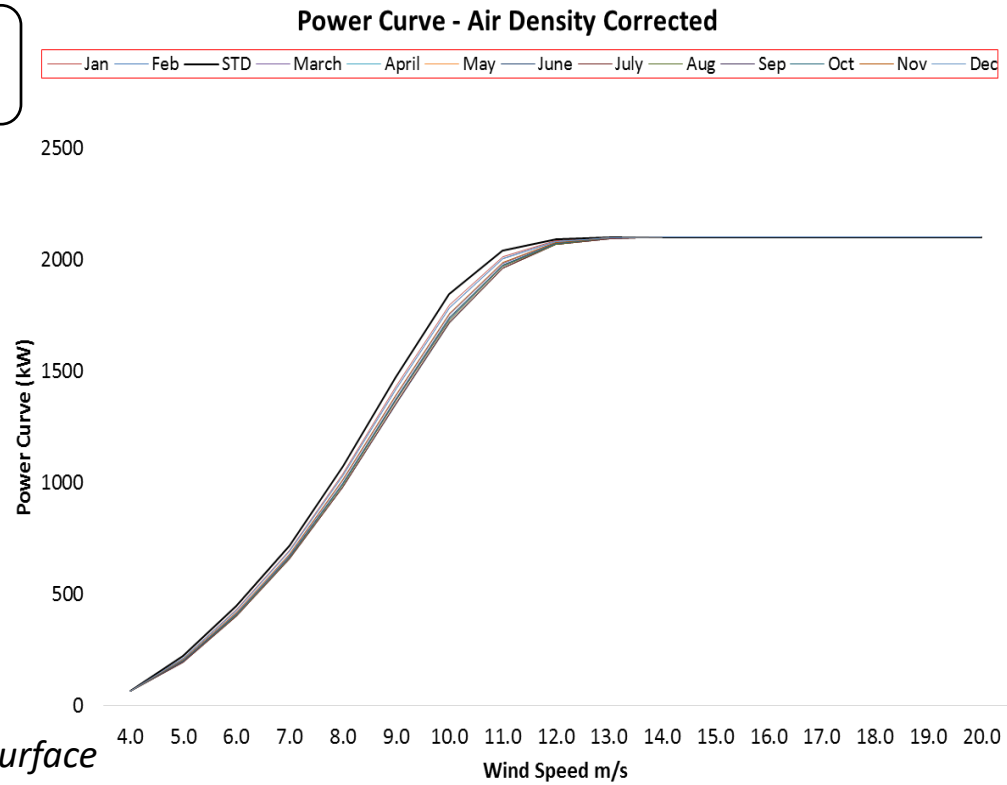
1. ***Logarithmic law (Uses Surface roughness)***
2. ***Power law (Uses Wind Shear exponent)***

B. Site Specific Air Density
C. Diurnal profile of various parameters.

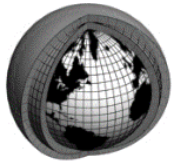
Forecasted Wind Speed & Power at HH

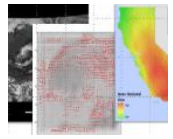
Wind components at 50 m from surface received in Weather data

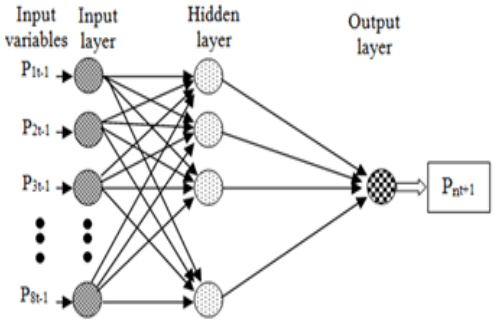
Wind components at 10 m from surface received in Weather data

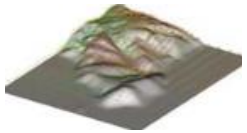


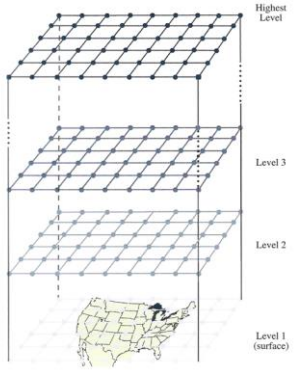
Forecast Approach

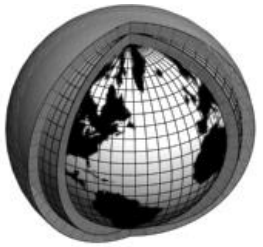












Time Series Analysis

- Persistence
- AR, MA, ARMA, ARIMA & SARIMA

NWP Prediction + Time Series Analysis

- ANN, KNN
- Fuzzy Logic Model
- SVM, Random Forest

NWP Prediction + Hybrid Approach:

Uses results of physical approach(uses Local effects of Terrain) as initial value for Machine Learning

NWP Run:

Accuracy of NWP Prediction of weather parameters after solving governing equations of Atmosphere is far more than any statistical approach

Ultra Short Term Forecast
Few min. to 1 hr. ahead

Short Term Forecast
(1 hr to 10 hrs. ahead)

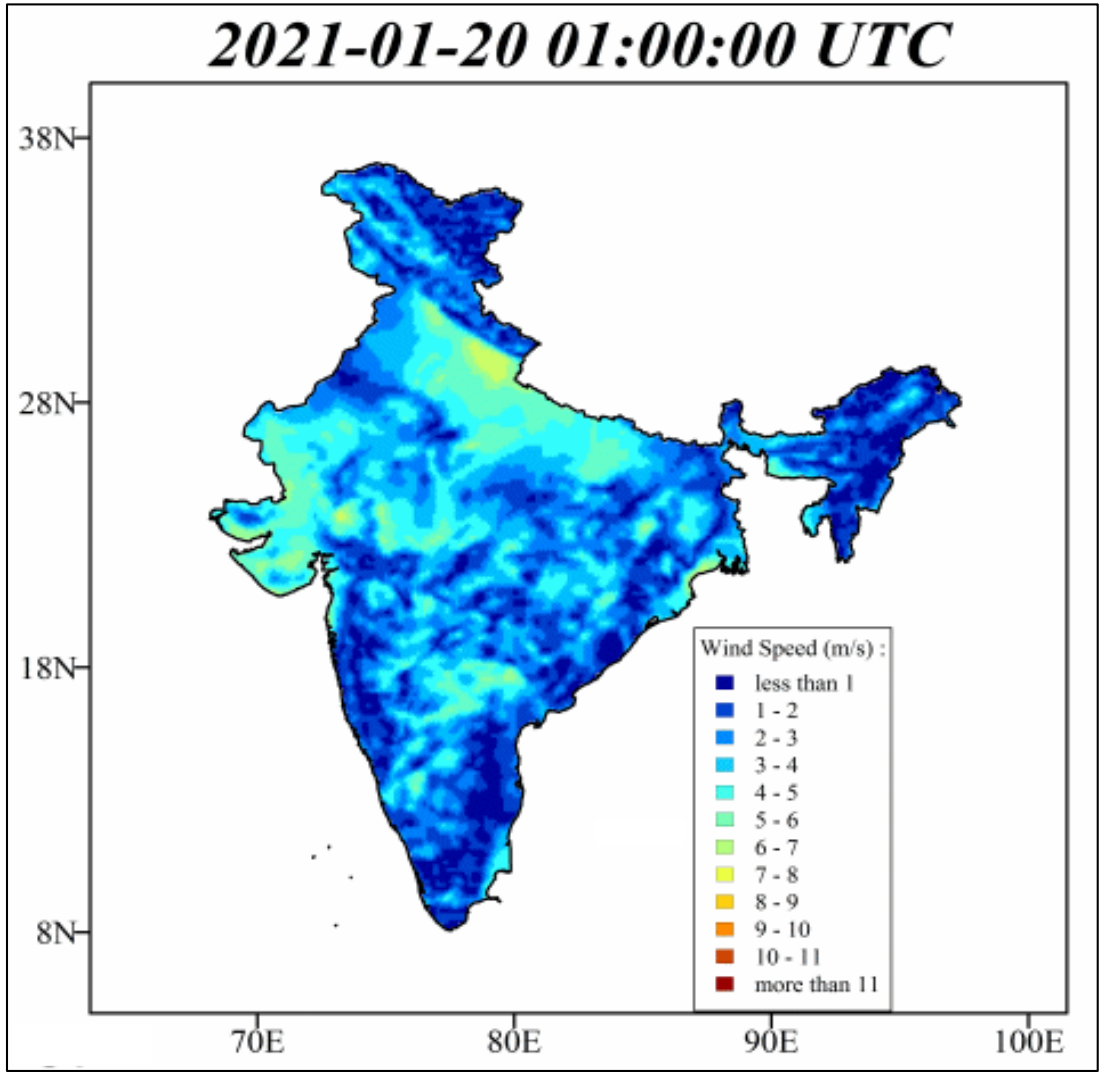
Medium Term Forecast
(10 hrs. to 1 week ahead)

Long Term Forecast
(1 week to 1 yr. ahead)

Approaches of Forecast

Forecast Lead Time

Forecast Wind Speed scenario over India




Case Study 1
Site 1: Gujarat : Wind Farm
Months (Oct'20 – Nov'20)

Wind Farm in Gujarat : Results for the Month of Oct'20

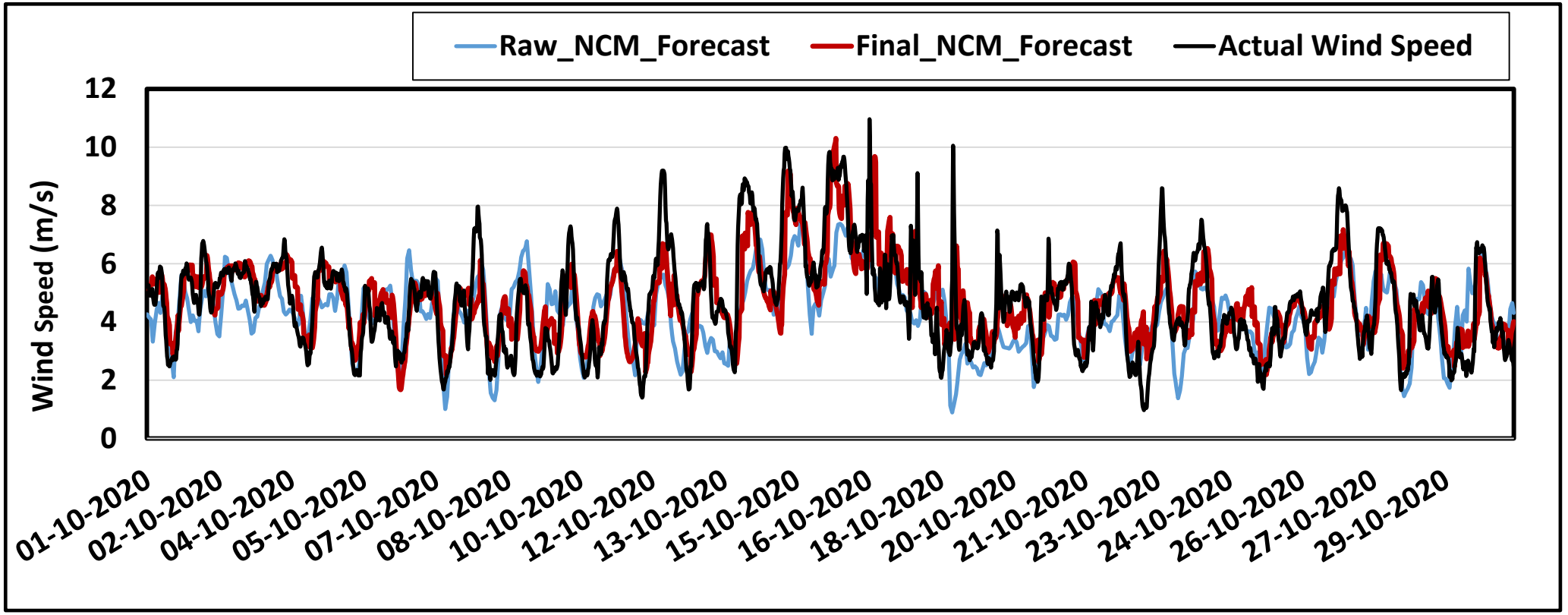


Figure represents a Time-series plot of Wind Speed for the month of October 2020 over a 200 MW site in Gujarat.

Wind Farm in Gujarat : Results for the Month of Nov'20

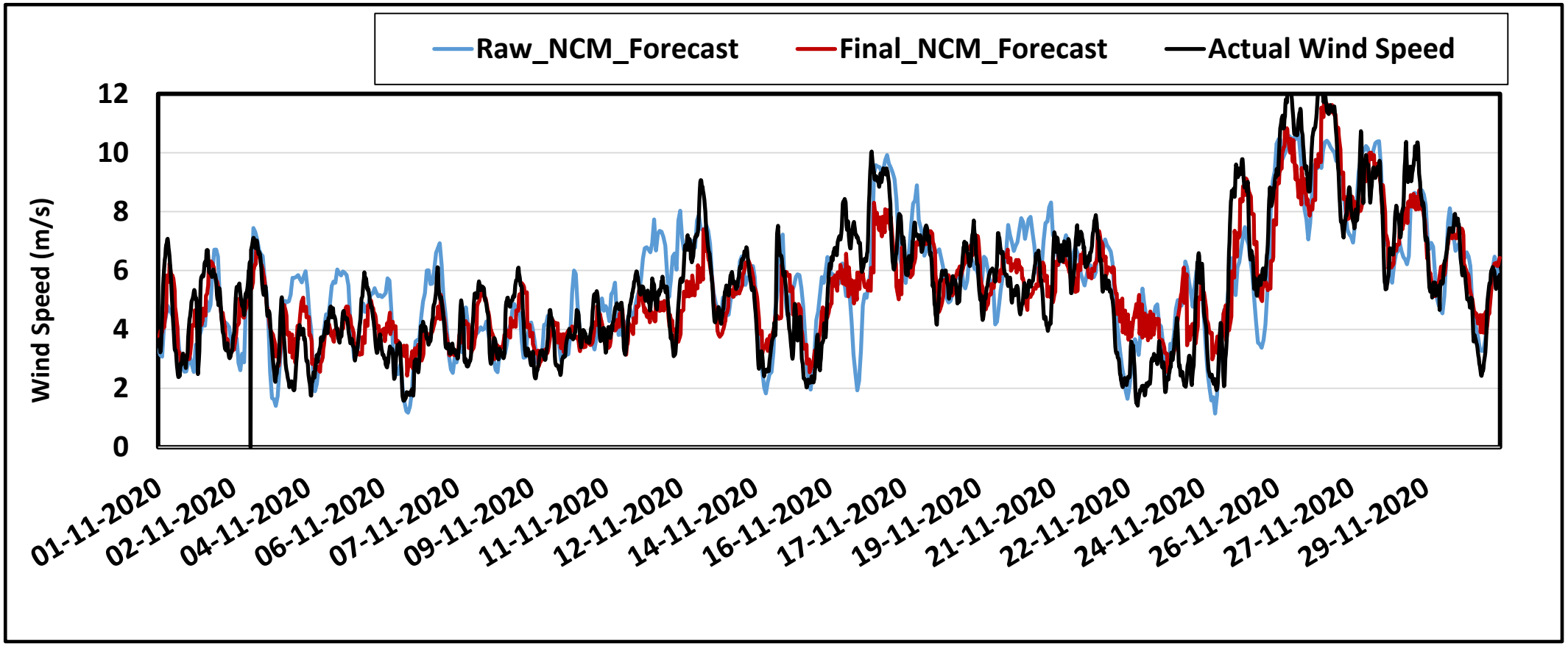
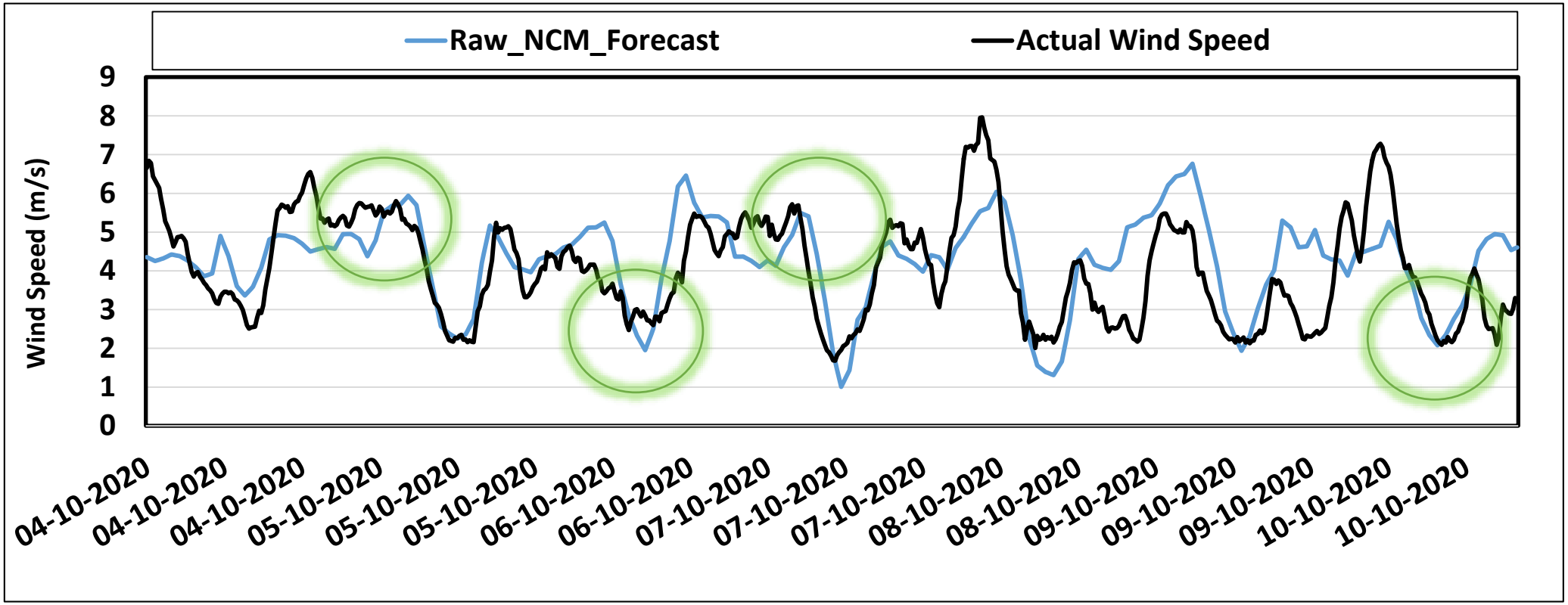


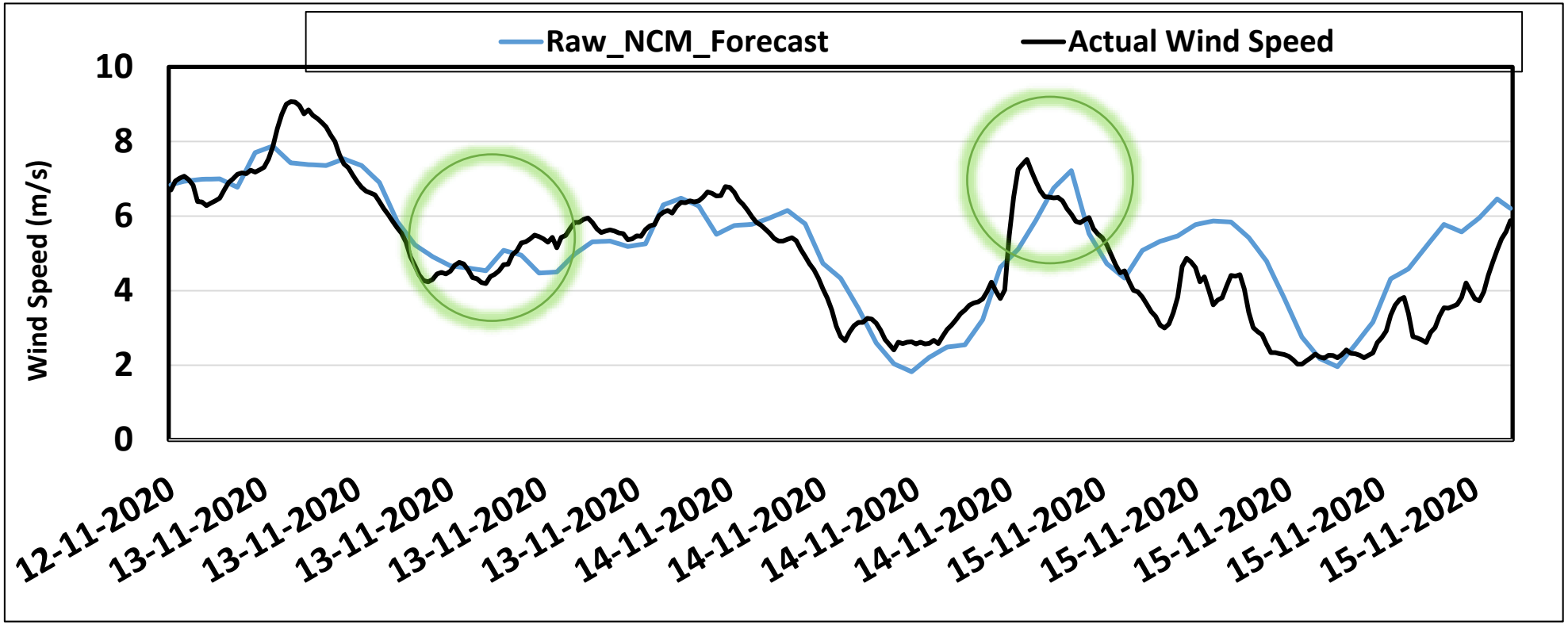
Figure represents a Time-series plot of Wind Speed for the month of November 2020 over a 200 MW site in Gujarat.

Wind Farm in Gujarat : Results for the Associated Accuracy



An analysis, shown in Fig above, highlights consistent wind behaviors captured by the dataset, providing useful meteorological insights.

Wind Farm in Gujarat : Results for the Associated Accuracy



The above Fig. indicates the Highs & Lows are very well simulated in NCM dataset. It is highly correlated with the Actual Wind Speed.

Case Study 2

Site 1: Rajasthan - Wind Farm

Months (Oct’20 – Nov’20)

Wind Farm in Rajasthan : Results for the Month of Oct'20

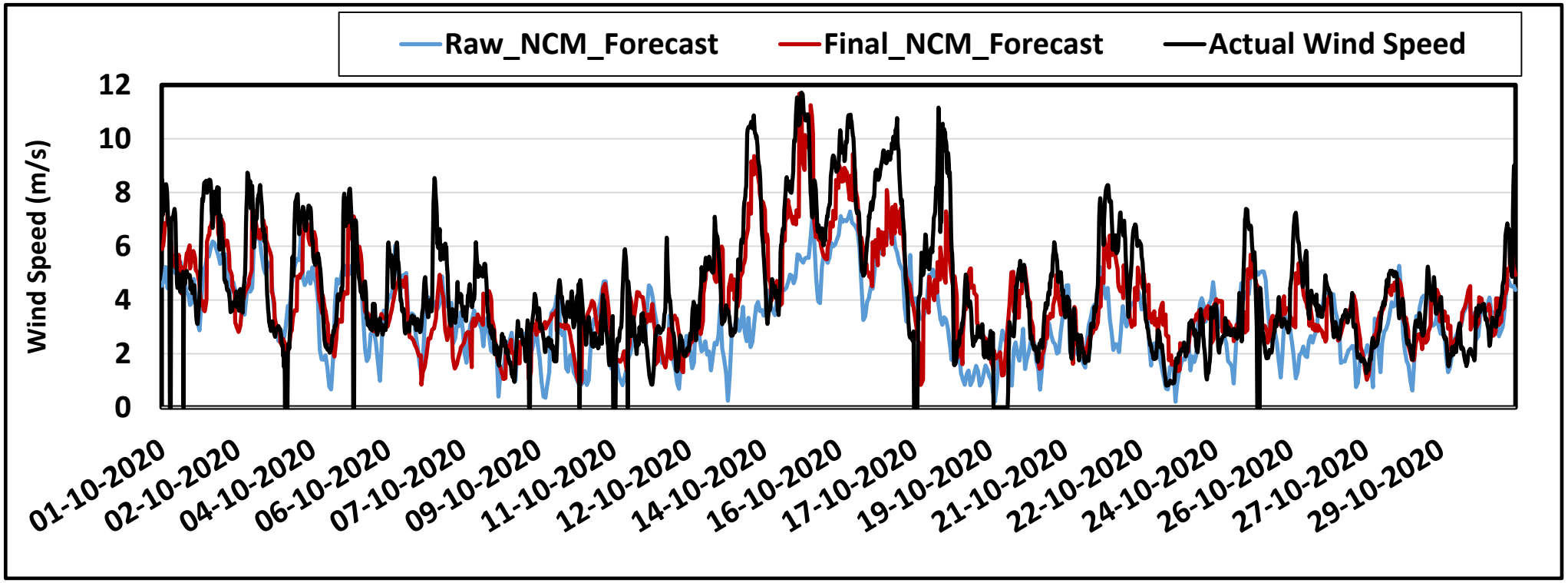


Figure represents a Time-series plot of Wind Speed for the month of October 2020 over a 200 MW site in Rajasthan.

Wind Farm in Rajasthan : Results for the Month of Nov'20

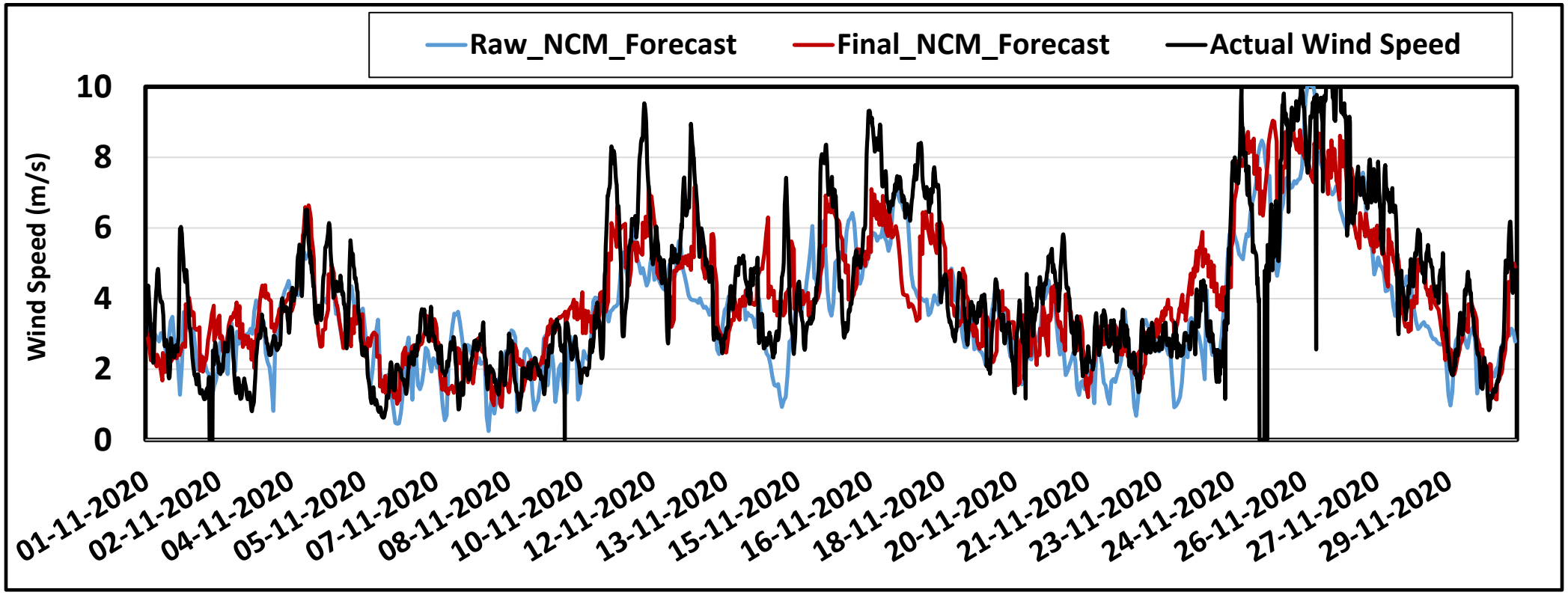
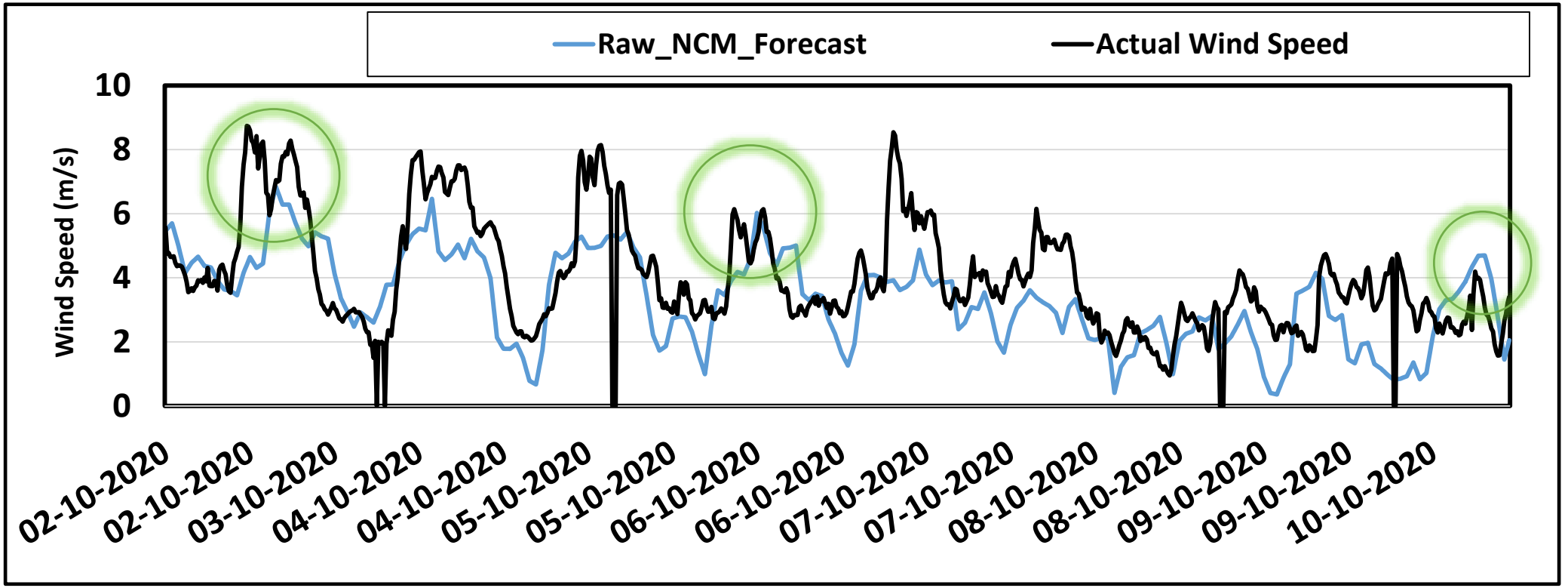


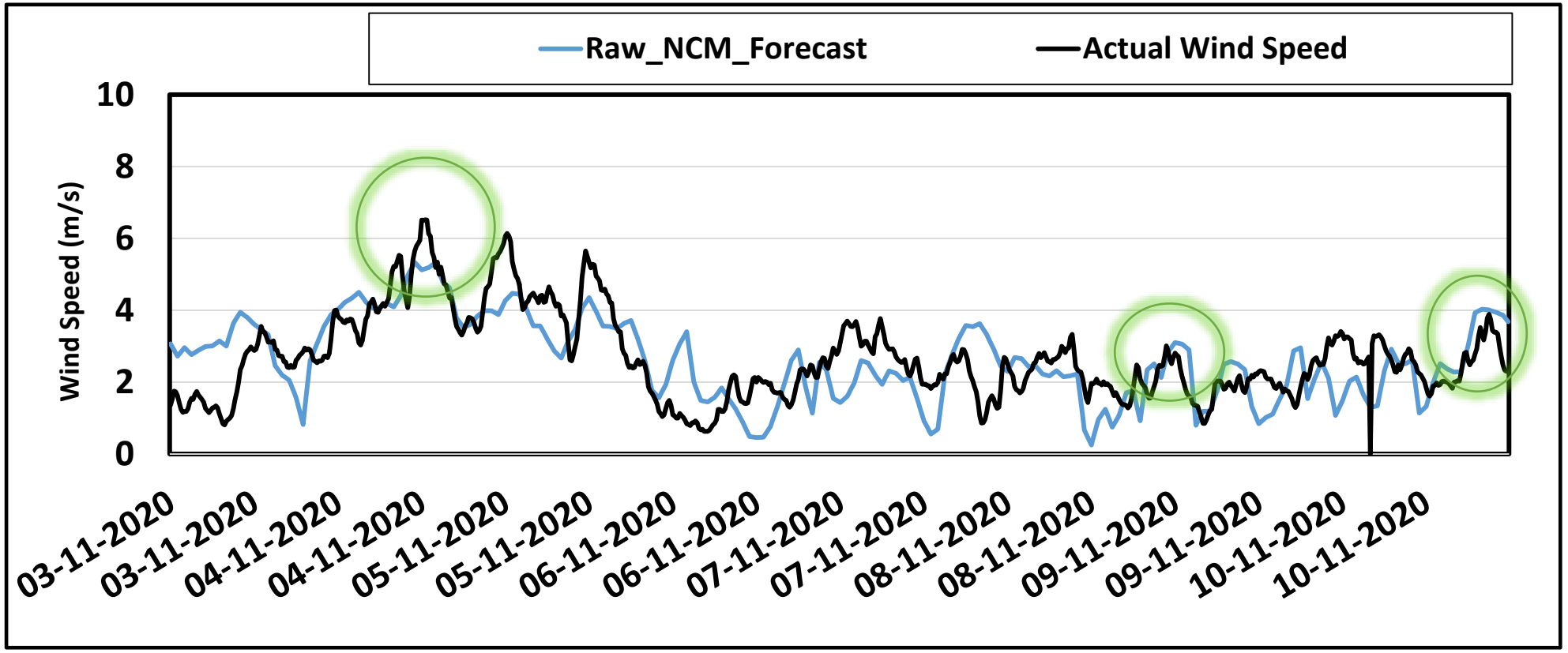
Figure represents a Time-series plot of Wind Speed for the month of November 2020 over a 200 MW site in Rajasthan.

Wind Farm in Rajasthan : Results for the Associated Accuracy



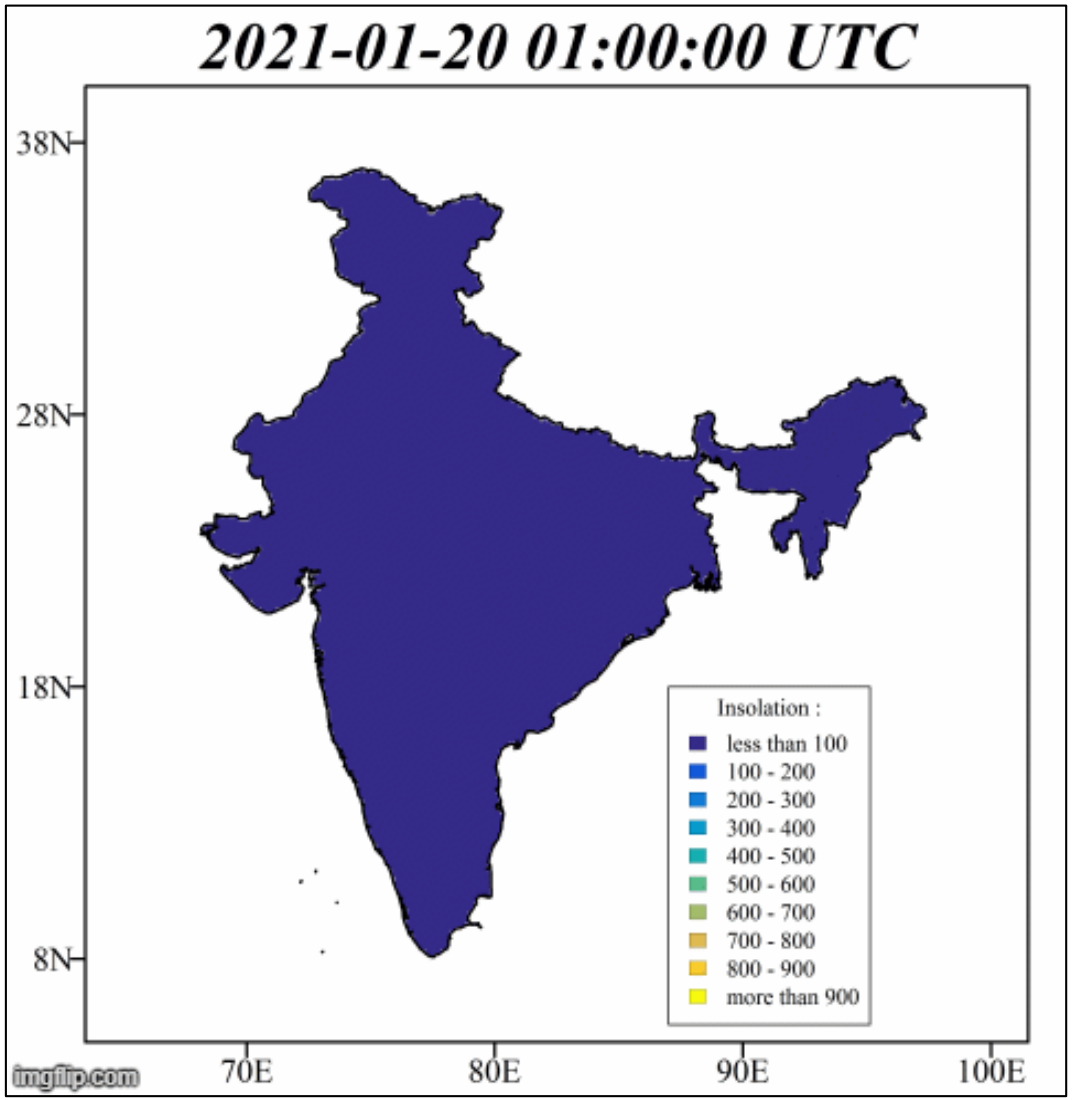
- An analysis, shown in Fig above, highlights consistent wind behaviors captured by the dataset, providing useful meteorological insights.

Wind Farm in Rajasthan : Results for the Associated Accuracy



- The above Fig. indicates the Highs & Lows are very well simulated in NCM dataset. It is highly correlated with the Actual Wind Speed.

Forecast Insolation scenario over India

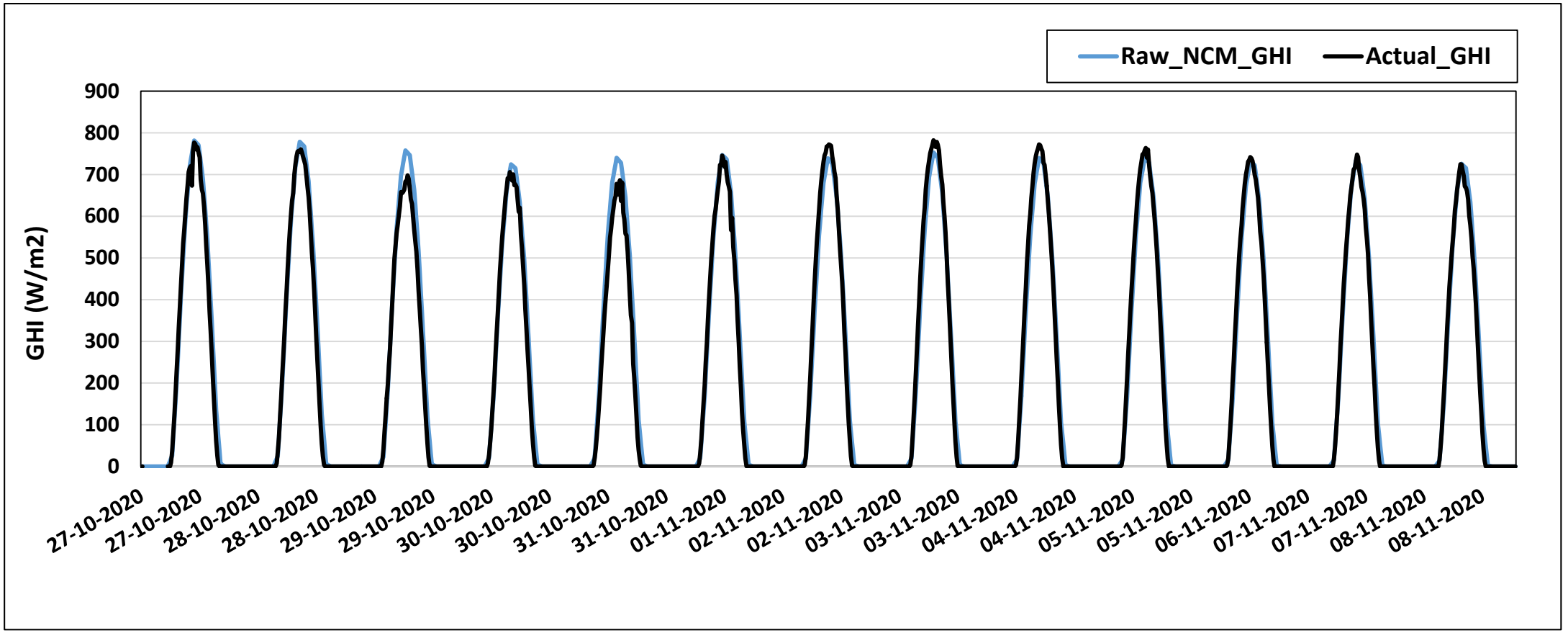


Case Study 3

Site 1: Rajasthan - Solar Farm

Months (Oct’20 – Nov’20)

Solar Farm in Rajasthan : Results during Month of Oct & Nov'20



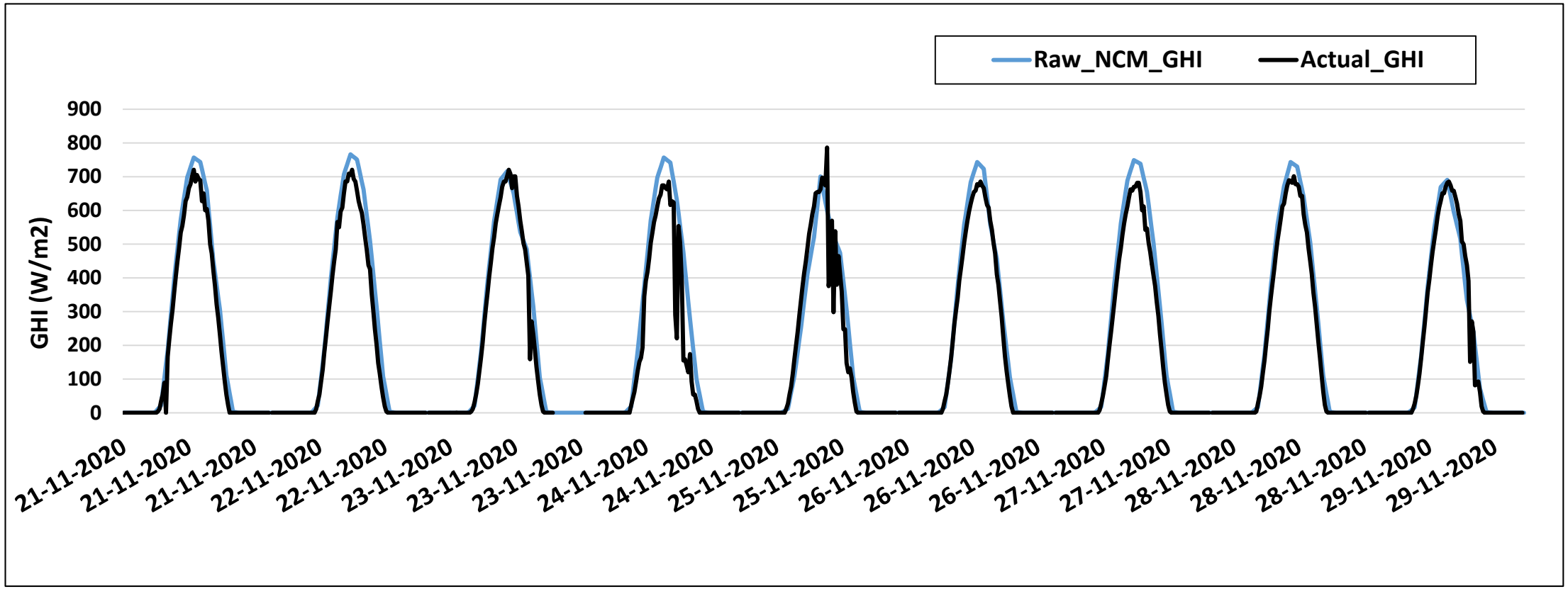
- An analysis, shown in Fig above, highlights consistent GHI behavior captured by the dataset, providing useful meteorological insights.

Case Study 4

Site 2: Maharashtra - Solar Farm

Months(Nov’20)

Solar Farm in Maharashtra : Few Results from Month of Nov'20

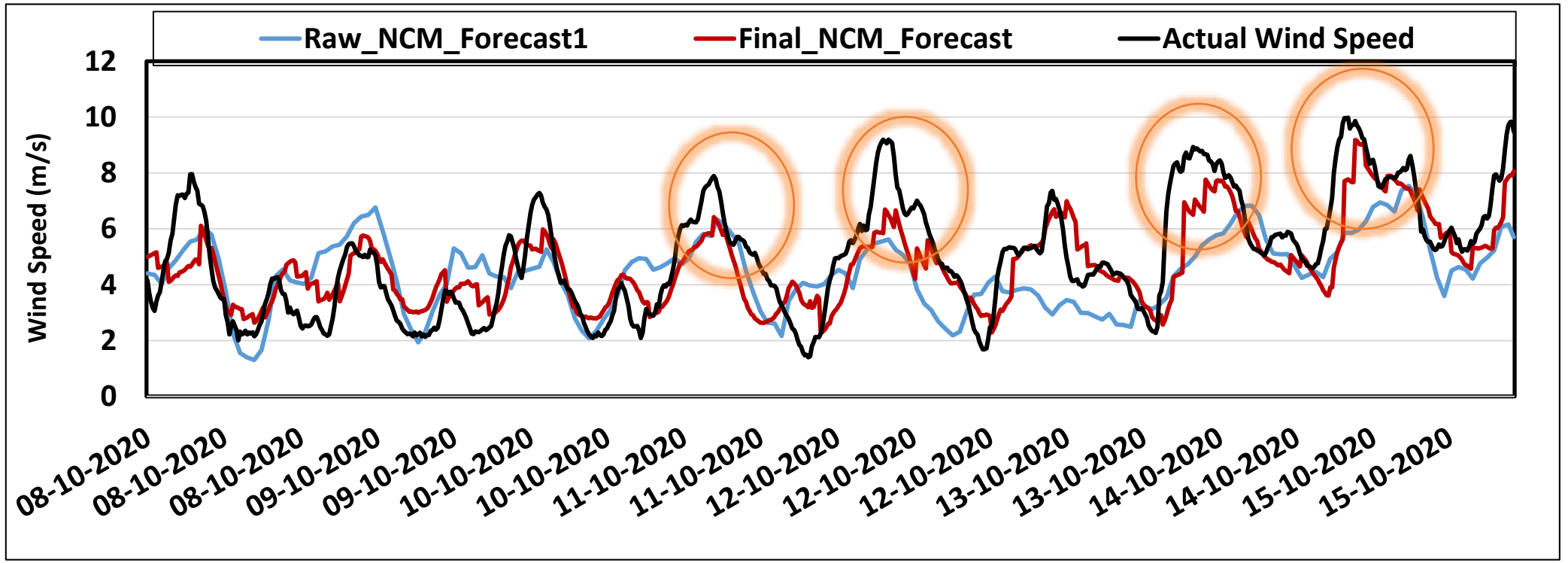


- An analysis, shown in Fig above, highlights consistent GHI behavior captured by the dataset, providing useful meteorological insights.

Case Study 5

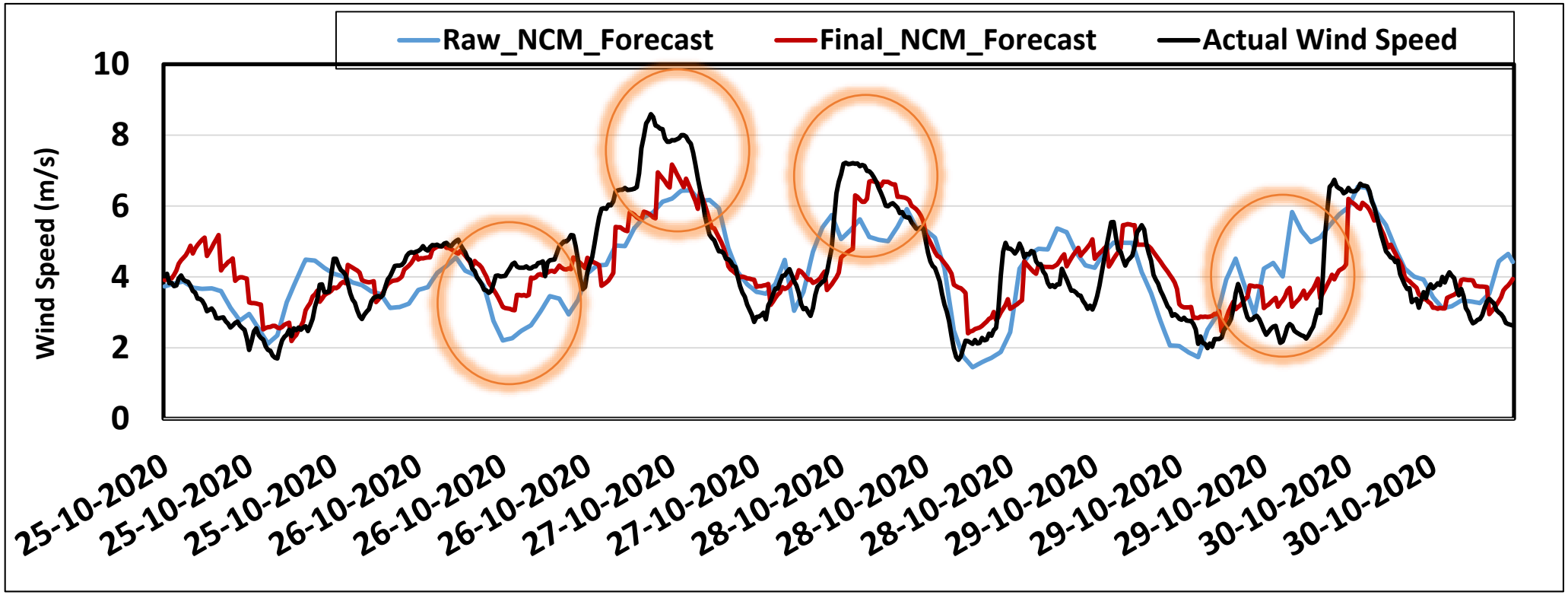
Challenges in Wind & Solar Power Forecasting

Challenges in Wind Power Forecasting

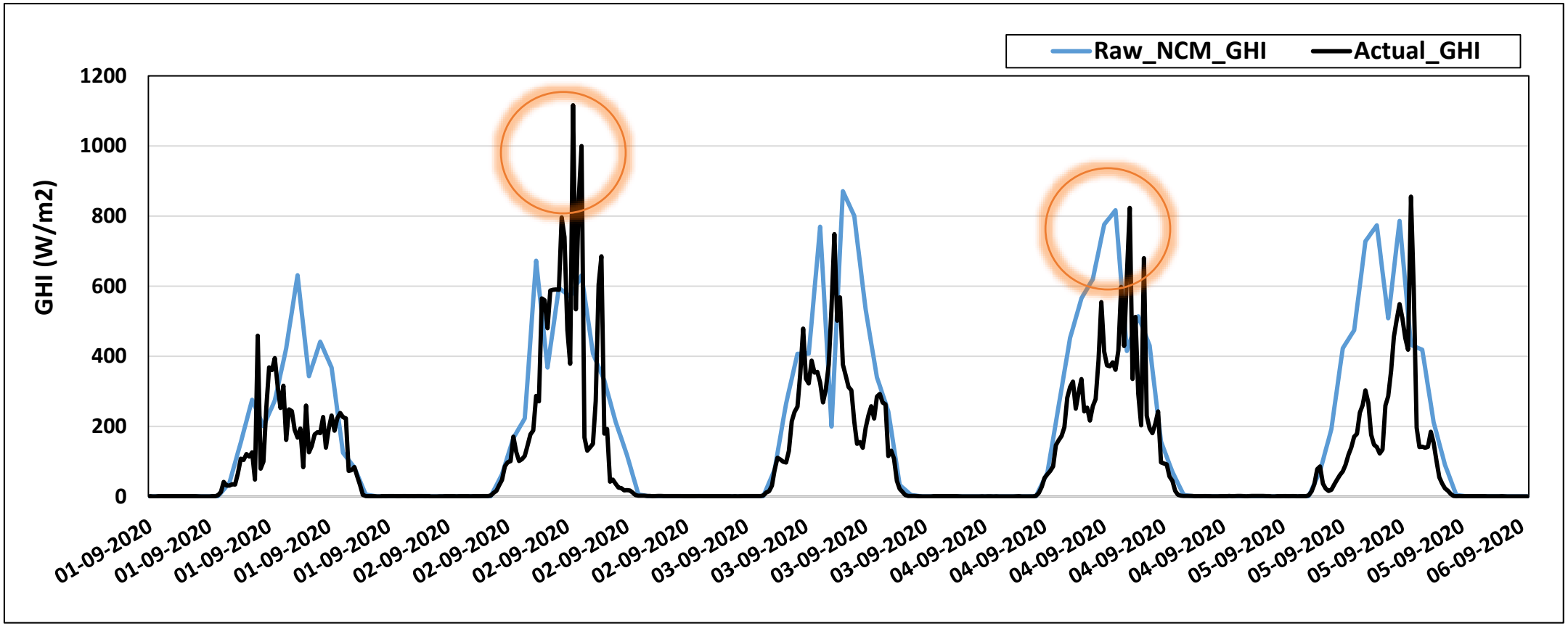


- Ramping Events- Ramp Up & Ramp Down.
- Complex Terrain
- Day-Ahead Forecast for Energy exchange Markets.

Challenges in Wind Power Forecasting

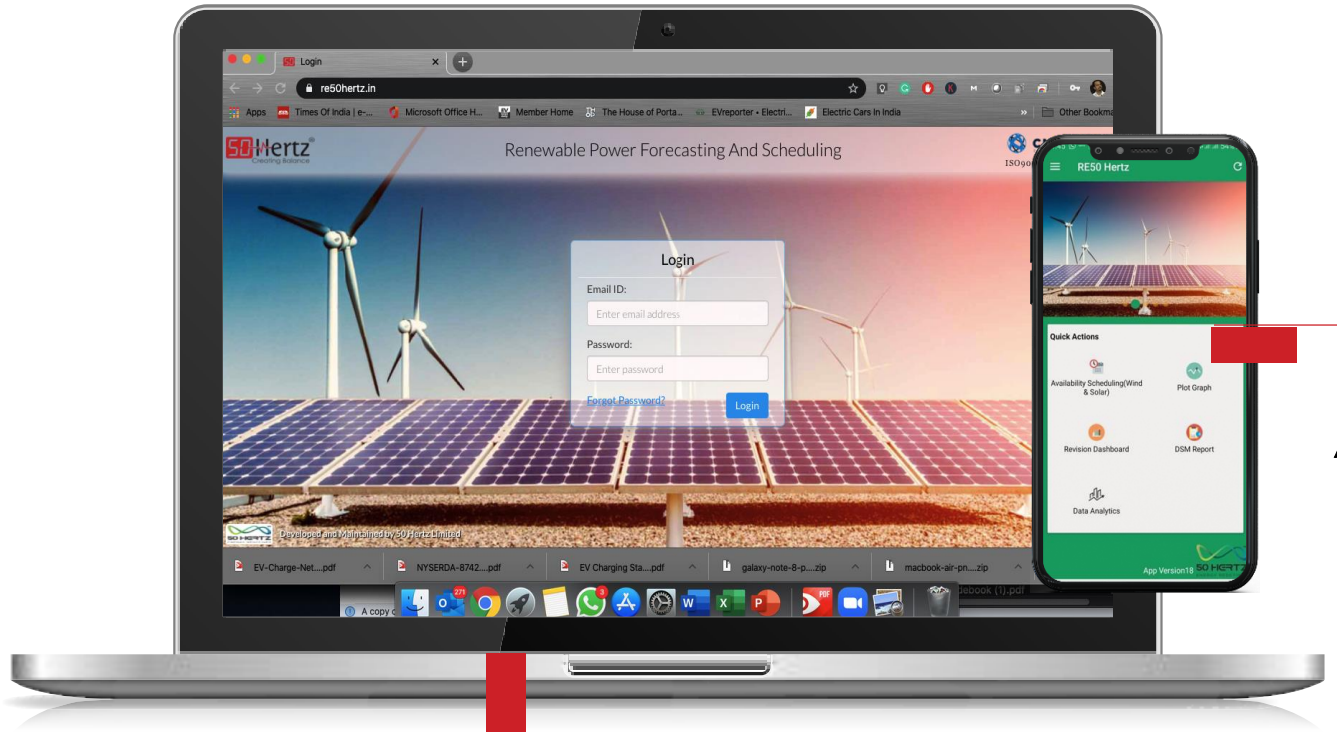


Challenges in Solar Power Forecasting



- Estimation of Cloud Motion Vectors.
- Day-Ahead Forecast for Energy exchange Markets.

Client View Platforms



Re50Hertz
Android APP

Re50Hertz.in
Web portal

Use of SCADA Data

Forecasting Model (Training on Historic data set, and real time data set)

Scheduling Model

Output Forecast

Experience and Team

Generating in-house 4500+ forecasts using NWP data along with real time updates at every 15 minutes

Daily Submission of 6000+ Day ahead & Intra Day schedules to various SLDC's across India

Multiple machine learning Models to analyze "n" no. of forecasts and submission of the best forecasts

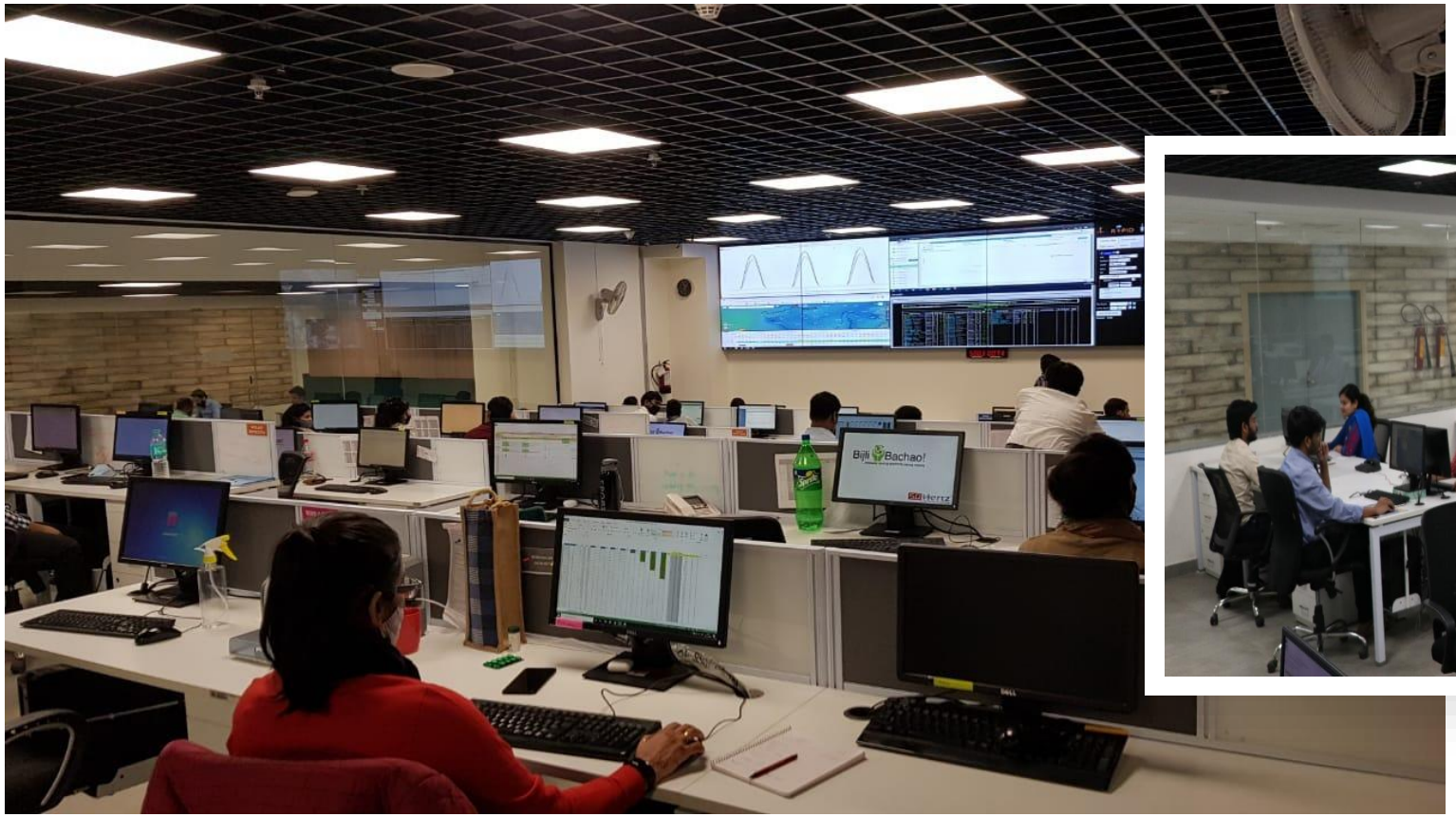
Reliable & secure cloud server with redundancy, exchanging approximately 90,000+ data files daily including SCADA, NWP, Special Energy Meter and Forecast Data

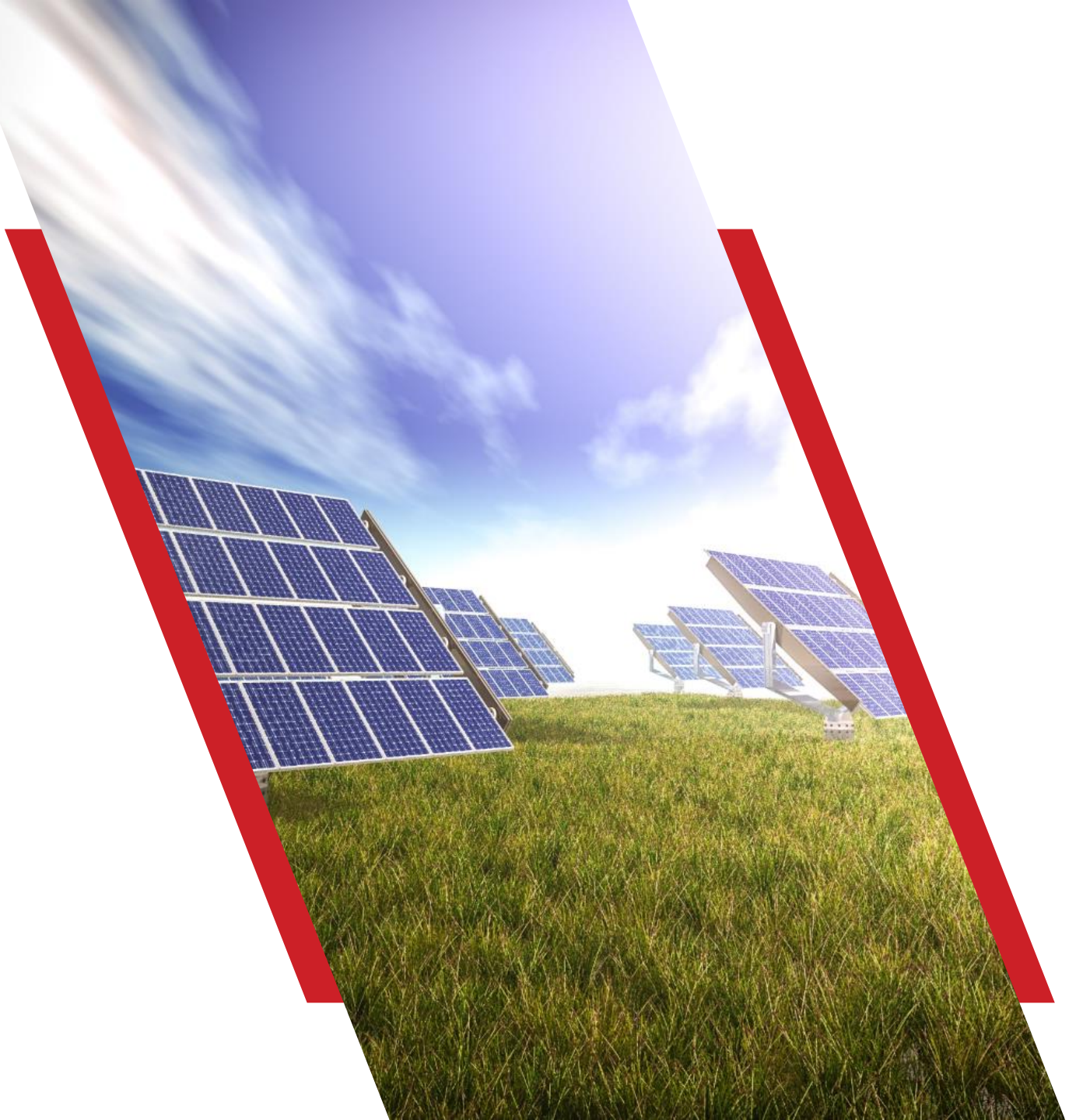
Highly reliable & secure database with redundancy, processing 3000 MB (3GB) data daily with Historical data since last 5.5 years

Web Based tool with multiple user authentication for Geo-visualization, Graphical/Table visualization, comparison, analyzing, downloading data & images

A dedicated team of Analysts, Statisticians, Economists, Energy modelers, Wind/Solar Resource, Software developers and 24*7 operation team

24*7 Operations, Monitoring & QA Team at our Delhi Control Centre





Thank You

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