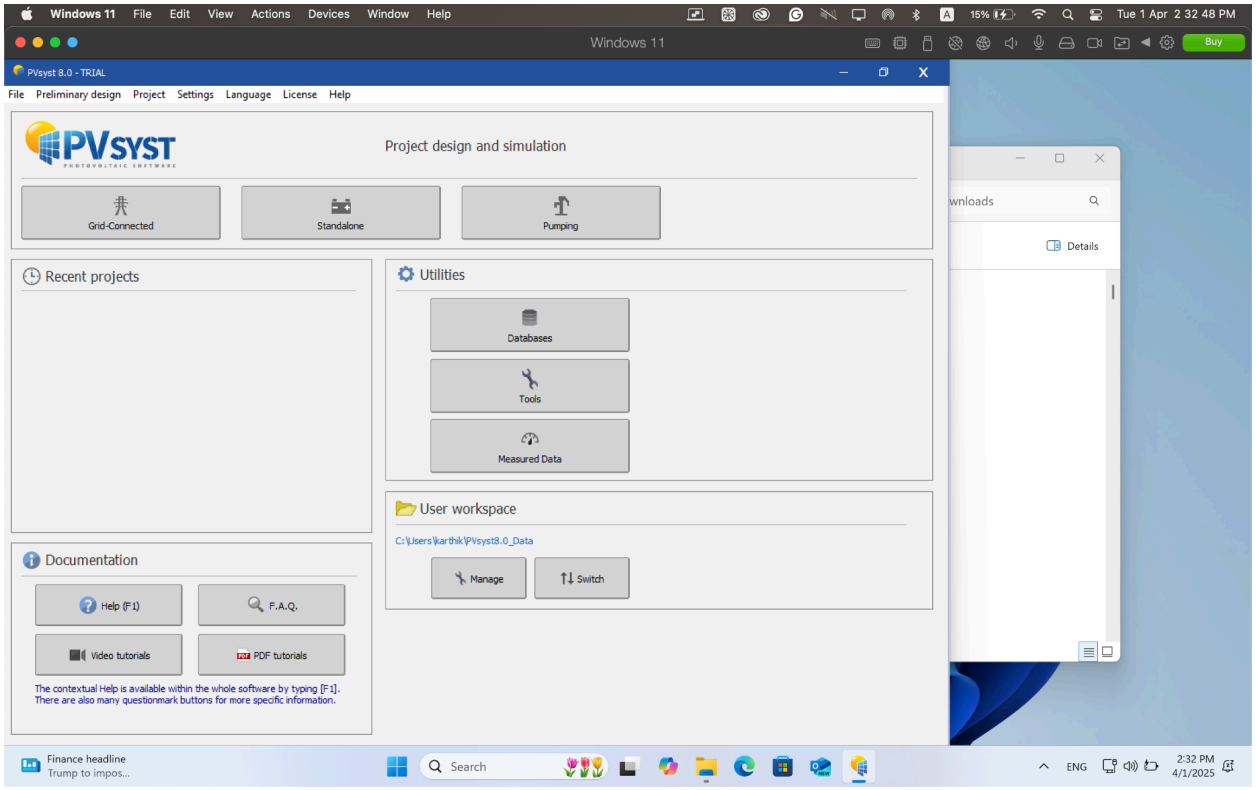
Sustain and Company Intern (PVsyst Task)

Task 1: Open PVSyst and Familiarize Yourself with the Interface

Launching PVsyst on system.



Exploring the **main sections** on the home screen:

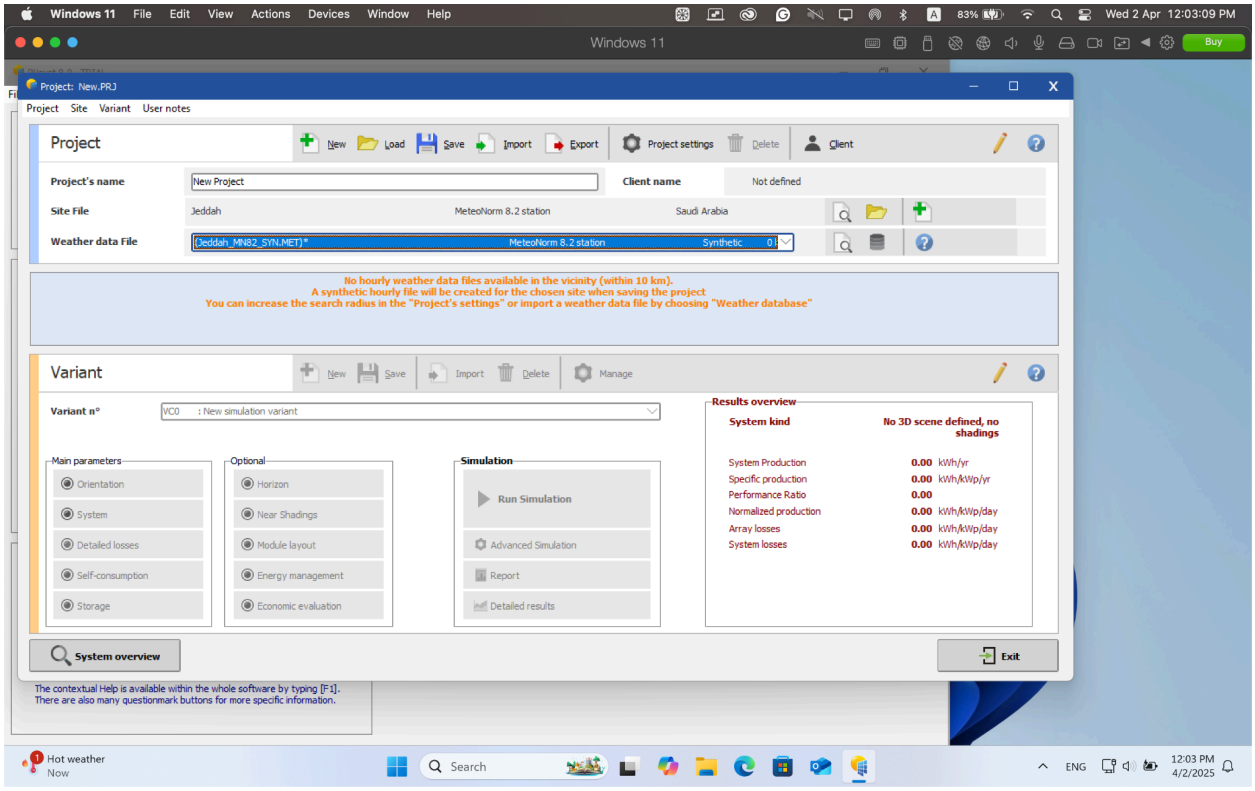
- **Project Design** – To create and configure a new PV project

  In Home page: There are 3 types of projects in this

  Grid-Connected → For designing solar PV systems connected to the power grid.
  Standalone → For off-grid solar PV systems with battery storage.
  Pumping → For solar water pumping systems.

And also there is a **Utilities Section**

Databases → Contains climate data, PV module, and inverter specifications.
Tools → Additional utilities for system analysis.
Measured Data → Allows importing and analyzing real-world performance data.



Now opening **Grid-Connected** project we get

Project Information (Top Section)

Project's Name → Set as "New Project" (You can rename it).

Site File → Selected **Jeddah**, using **MeteoNorm 8.2 station** (climate data source).we can select any specified location from the list and

MeteoNorm is a global **climate and meteorological database** that provides **solar radiation, temperature, and weather data** for renewable energy simulations. PVSyst uses **MeteoNorm 8.2** to generate or import weather data for specific locations worldwide.

If Measured Data is Available → PVSyst imports real meteorological data from a weather station.

If No Measured Data is Found (Like in our Case for Jeddah) → PVSyst generates **synthetic weather data** using long-term averages and meteorological models.

In our **case:**

The message **"No hourly weather data files available within the vicinity (10 km)"** means that there is **no ground station data** nearby.
Instead, PVSyst will generate a **synthetic hourly weather file** for Jeddah using **MeteoNorm's statistical model**.

Weather Data File → You have selected **"Synthetic"**, meaning no actual measured data is available within 10 km, so PVSyst will generate artificial hourly weather data.

Client Name → Not defined (You can assign a client if needed).

Project Controls → Options for **New, Load, Save, Import, Export, and Project Settings**.

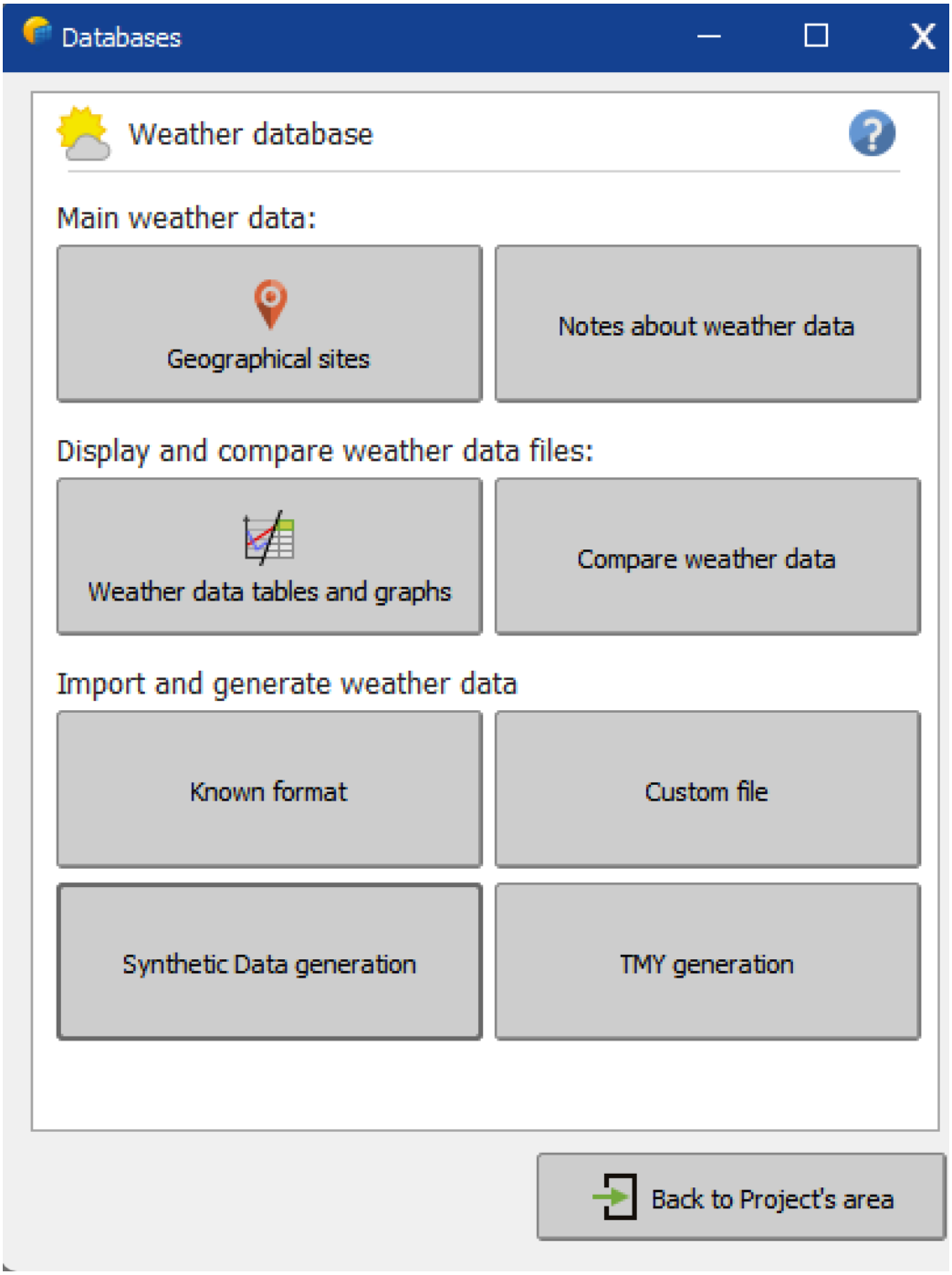
Variant Definition (Middle Section)

This is where you define different simulation setups:

Main Parameters:
✅ **Orientation** – Defines panel tilt and azimuth.
✅ **System** – Select PV modules, inverters, etc.
✅ **Detailed Losses** – Configure efficiency losses due to temperature, cables, etc.
✅ **Self-Consumption** – If using batteries or direct consumption.
✅ **Storage** – Define battery storage if included.

Optional Parameters:
📌 **Horizon** – Defines distant shading effects.
📌 **Near Shadings** – Evaluates shading from nearby obstacles.
📌 **Module Layout** – Panel arrangement.
📌 **Energy Management** – Grid interaction settings.
📌 **Economic Evaluation** – Financial analysis of the project.

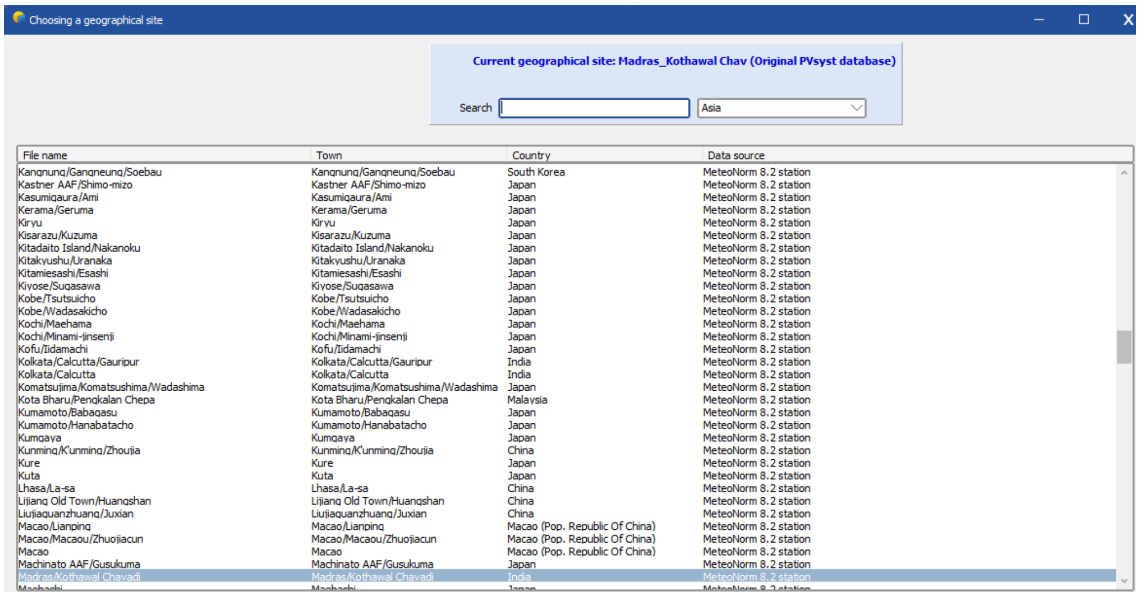
- **Climate Data** – To import and analyze weather data.

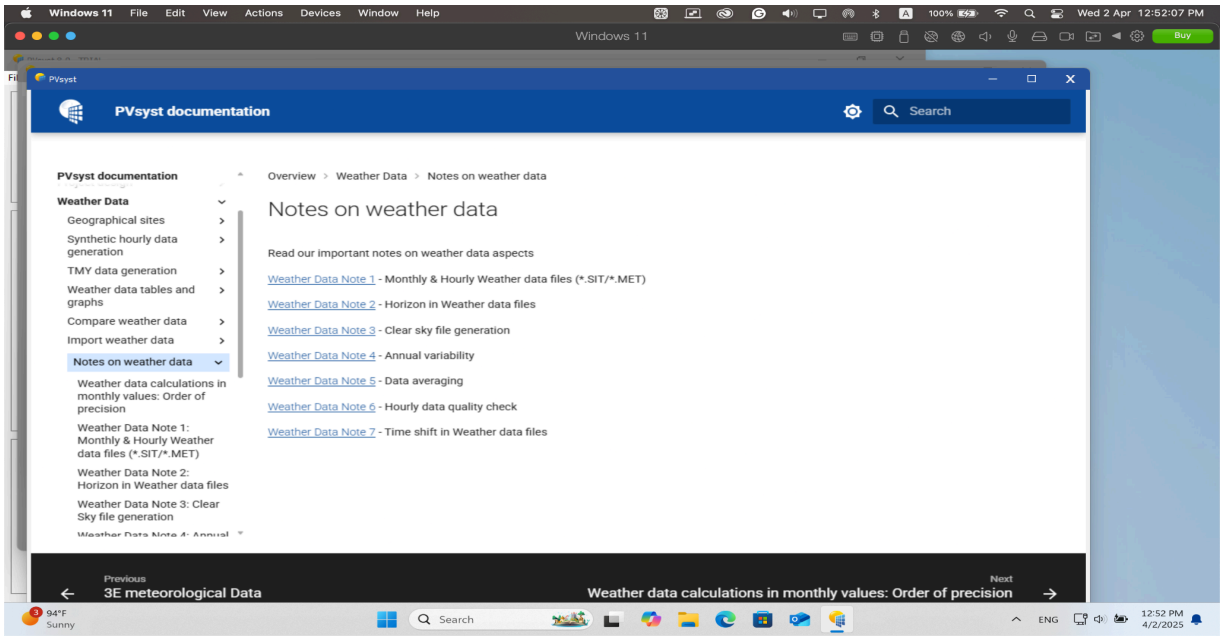


Main Weather Data

Geographical Sites: Select or define the project's location.This determines solar radiation levels, temperature, and other climate parameters. Uses MeteoNorm 8.2 as the default weather data source.

Notes About Weather Data: Provides details on the available climate databases. Helps users understand data sources and assumptions behind the weather models.

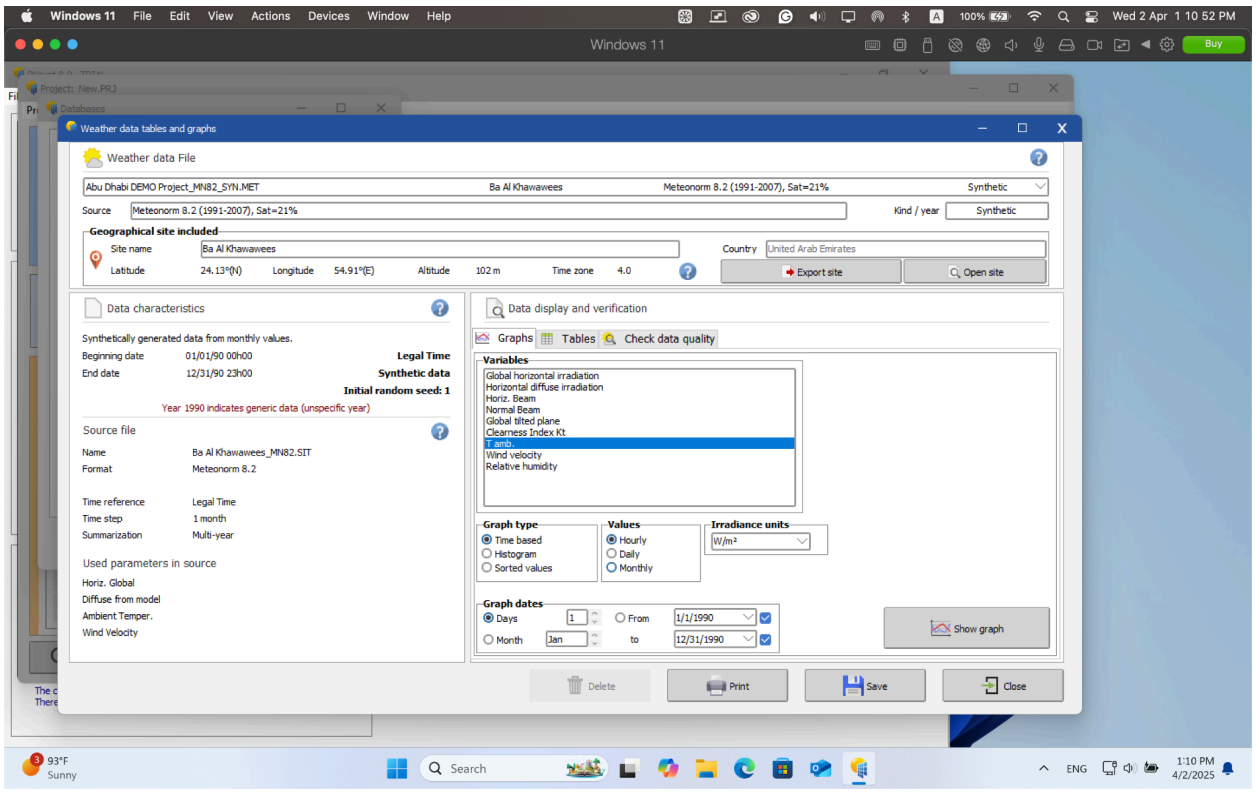


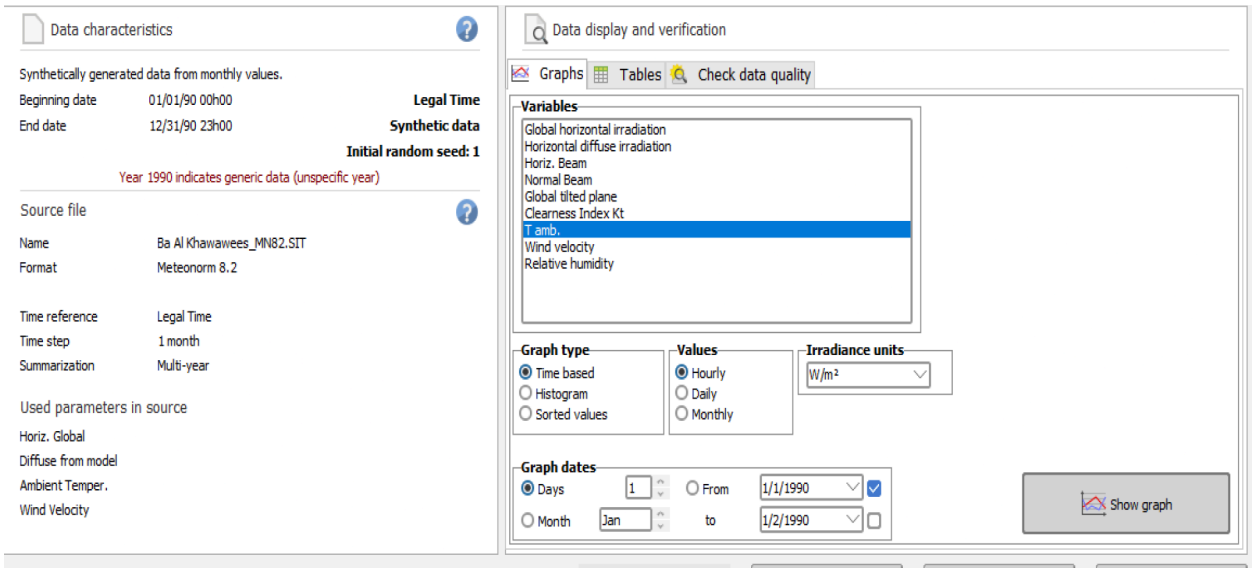


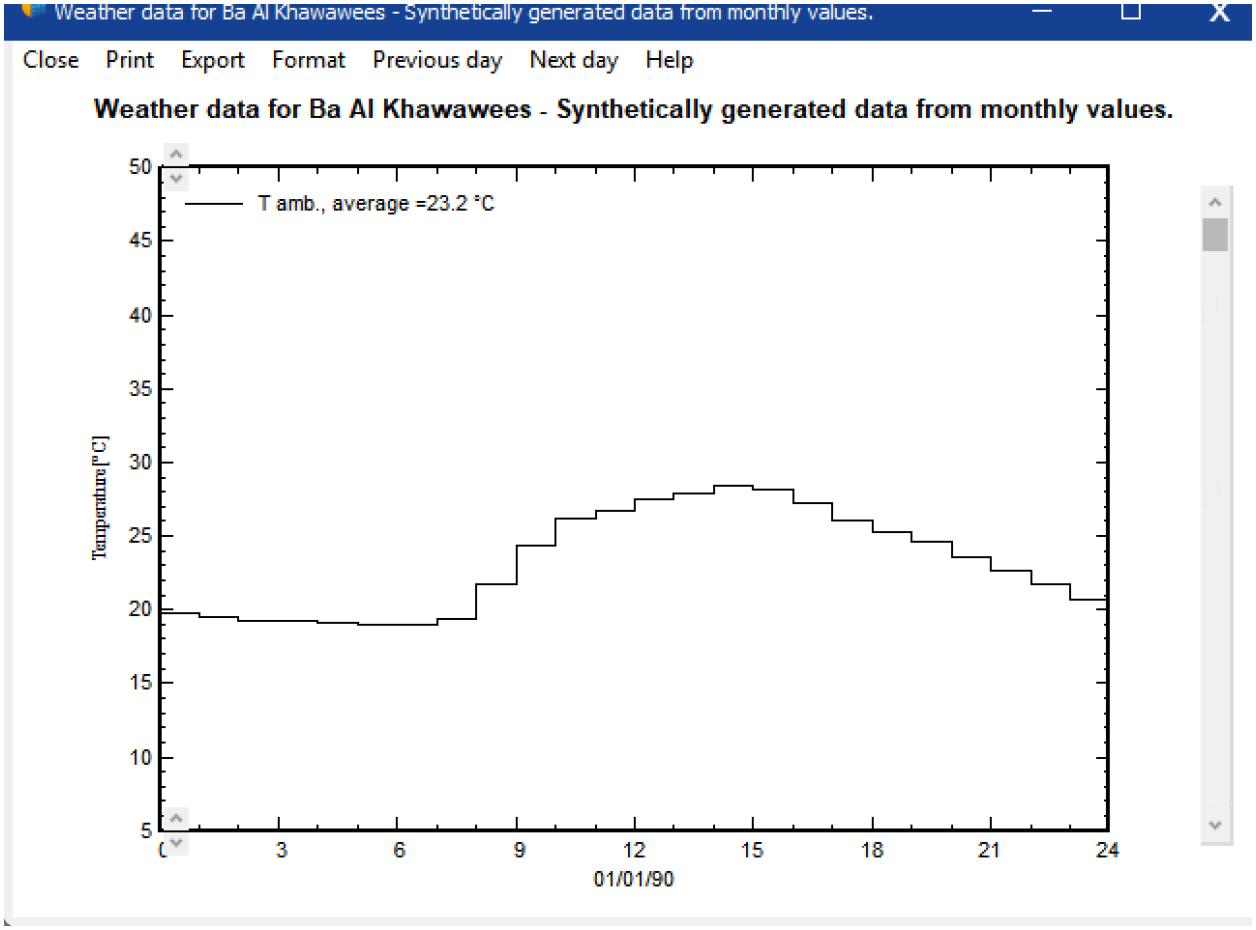
Display & Compare Weather Data

Weather Data Tables & Graphs : Visualize monthly , daily , hourly weather data. Have many variables. And 3 types of graph types: time based, Histogram, Sorted Values.

Limitations: we can only set date values to maximum of 15 days. And also it shows for few limited locations.(not all)






Weather data for Ba Al Khawawees - Synthetically generated data from monthly values.
Close
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Weather data for Ba Al Khawawees - Synthetically generated data from monthly values.
T amb., average =23.2 °C
Temperature [°C]
50
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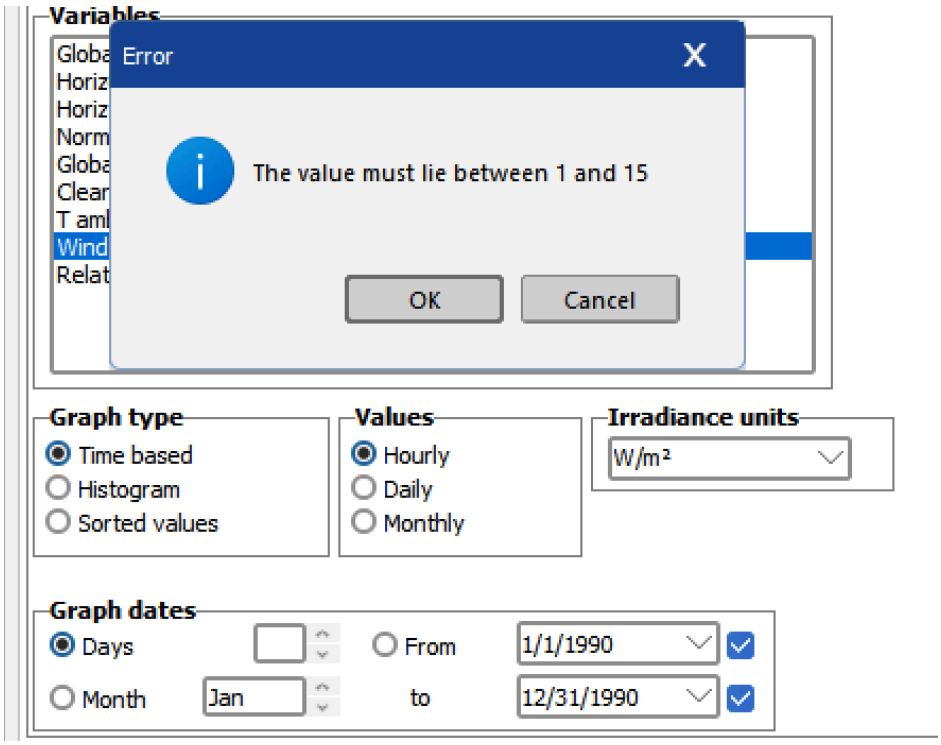
Variables
Error
The value must lie between 1 and 15
OK
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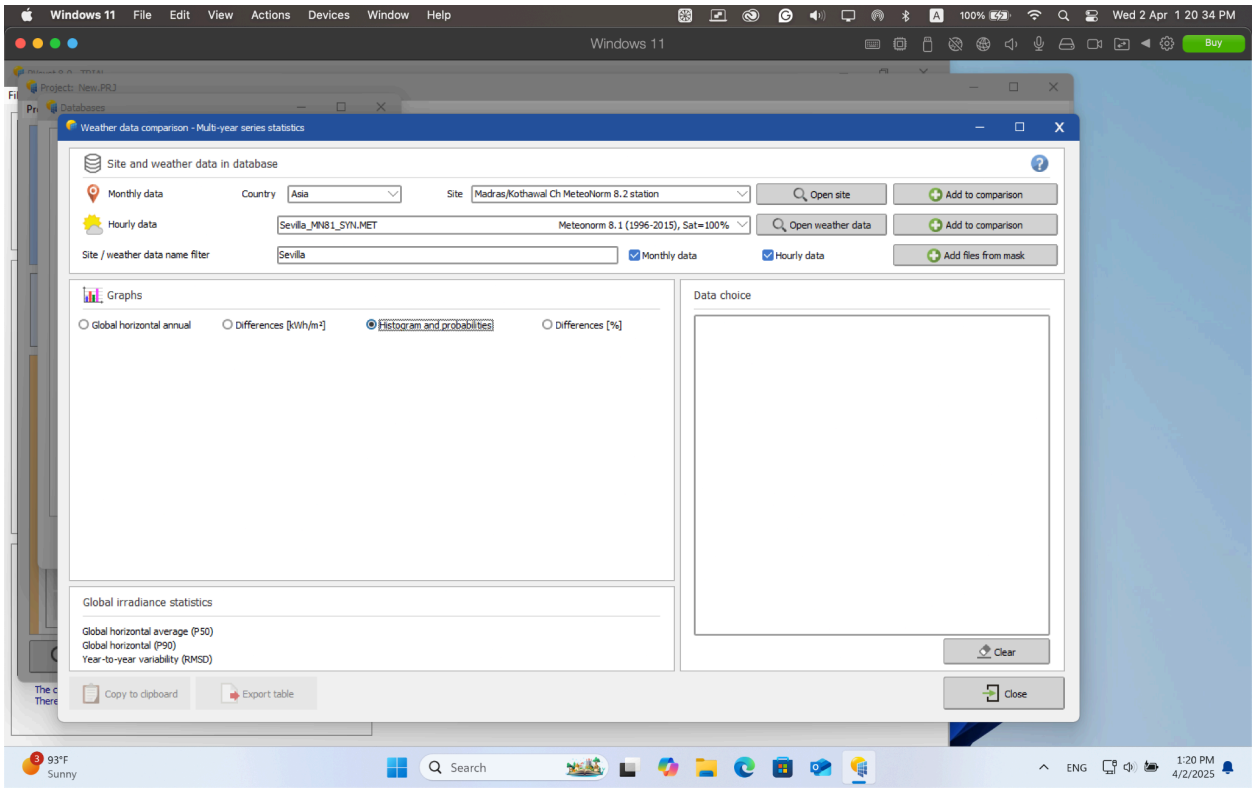
Graph type
Time based
Histogram
Sorted values
Values
Hourly
Daily
Monthly
Irradiance units
W/m²
Graph dates
Days
From
1/1/1990
Month
Jan
to
12/31/1990

Compare Weather Data :



Import & Generate Weather Data

Known Format

Import weather data from standard sources like NASA, PVGIS, NREL-NSRDB.
Supports TMY (Typical Meteorological Year), EPW, and CSV formats.

Custom File

Allows users to upload their own weather station data.
Useful if you have real-world site-specific measurements.

Synthetic Data Generation

PVSyst creates estimated hourly data based on long-term climate trends.
Uses MeteoNorm to generate missing values.
Beneficial when no measured data is available.

TMY (Typical Meteorological Year) Generation

Generates a TMY dataset (an average year based on historical climate data).
Useful for long-term solar PV performance predictions.

- **System Definition** – To define PV modules, inverters, tracking systems, etc.

PV Modules (Solar Panels)

Choose from the built-in **PV module database** or add a custom module.
Define parameters like: Module type (**monocrystalline, polycrystalline, thin-film**)
Power rating (**Watt-peak, Wp**)
Efficiency, temperature coefficient, and degradation rates

Inverters

Select an inverter from the **inverter database** or define a custom one.
Key parameters: Power capacity (**kW**)
Maximum input voltage and MPPT range
Efficiency (typically **95%–99%**)
Number of MPPTs (single or multiple tracking inputs)

System Layout

Define how modules are **connected in series and parallel**.
Configure **string sizes and array layout**.
Helps optimize **voltage levels and inverter performance**.

Mounting System & Tracking

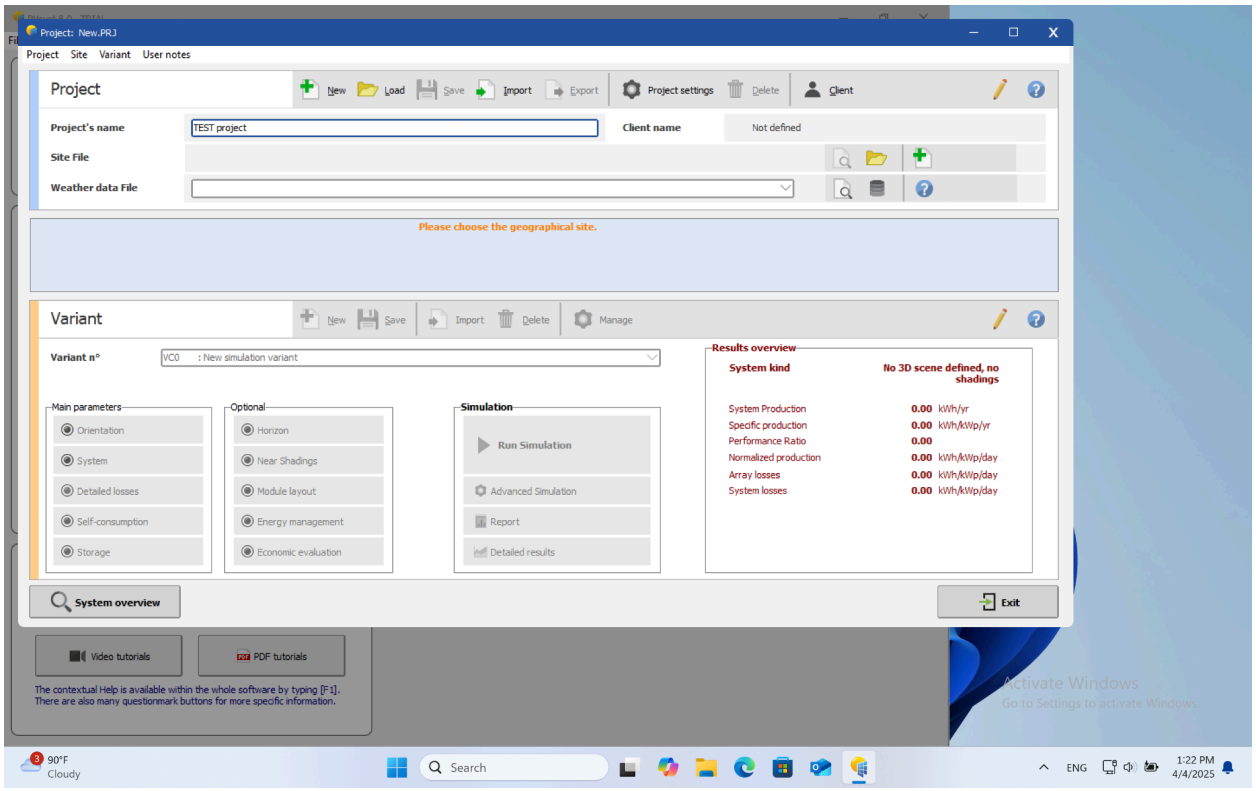
Choose between:
Fixed tilt (common for rooftop and ground-mounted systems)
Single-axis tracking (tracks the sun in one direction)
Dual-axis tracking (adjusts for both azimuth and altitude)
Tracking increases energy yield but adds **higher installation and maintenance costs**.

Shading Analysis

Define obstacles (buildings, trees) that can cause shading losses.
Run a **shading analysis** to optimize panel placement.

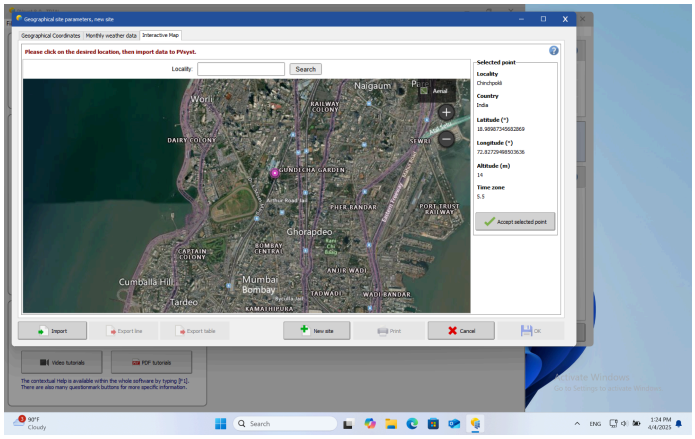
Task 2: Document the PVSyst Workflow (Create a Visual Diagram)

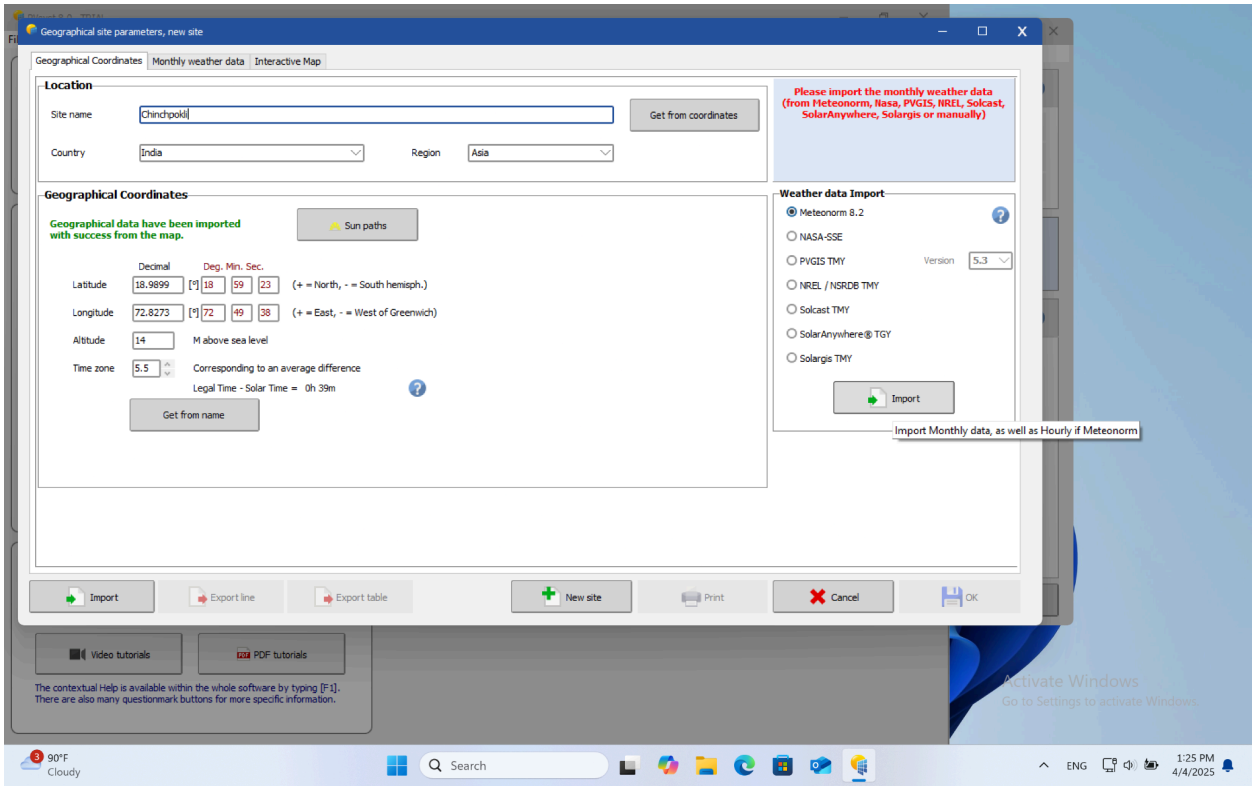
1. **Start with a New Project** by entering the project name, location, and description.



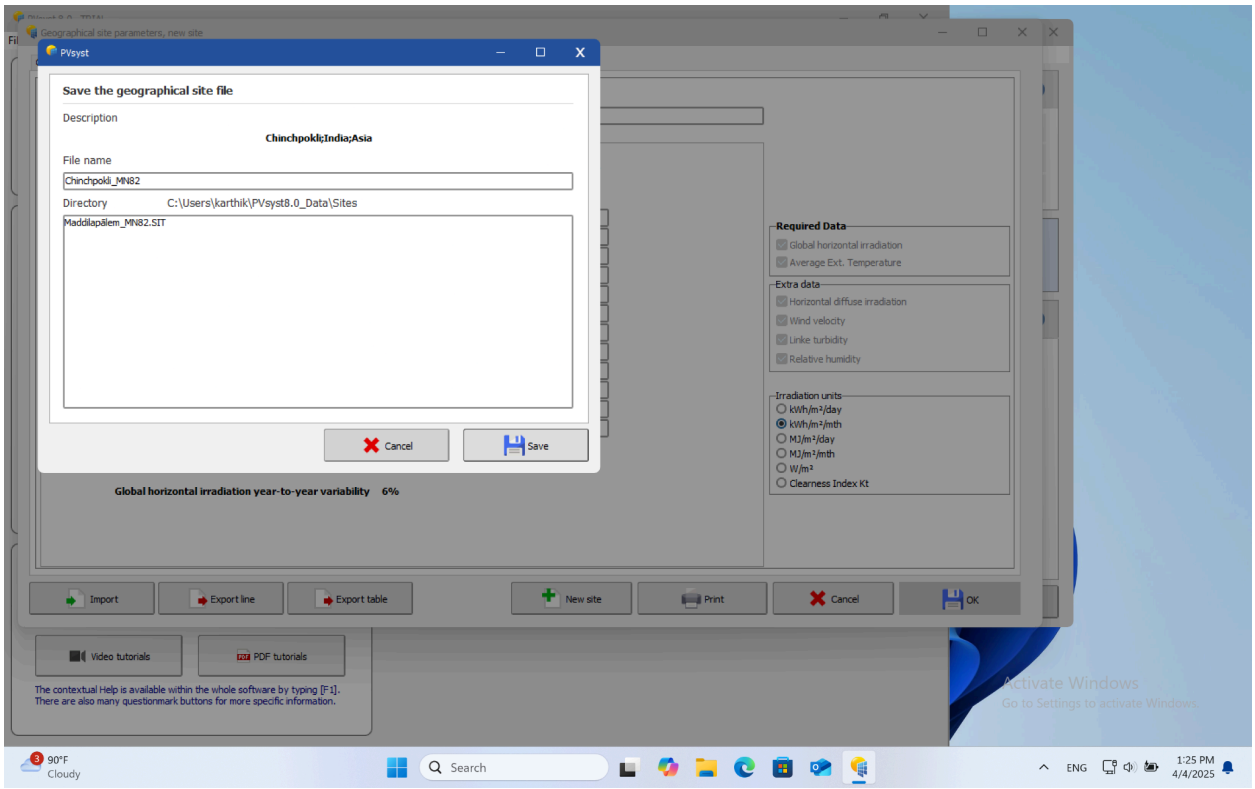
2 Import Climate Data

- Go to the location option and select the location where we are placing a PV panel.

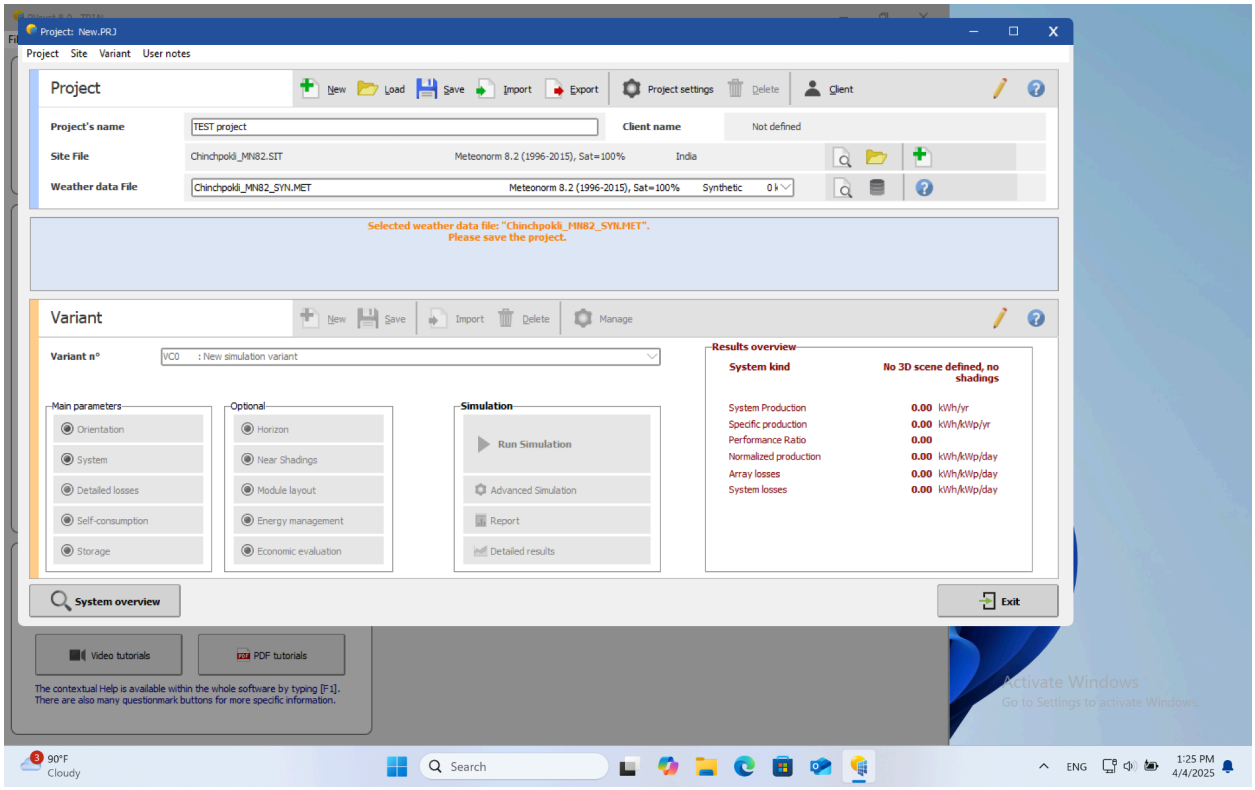




Import the climate data at the location



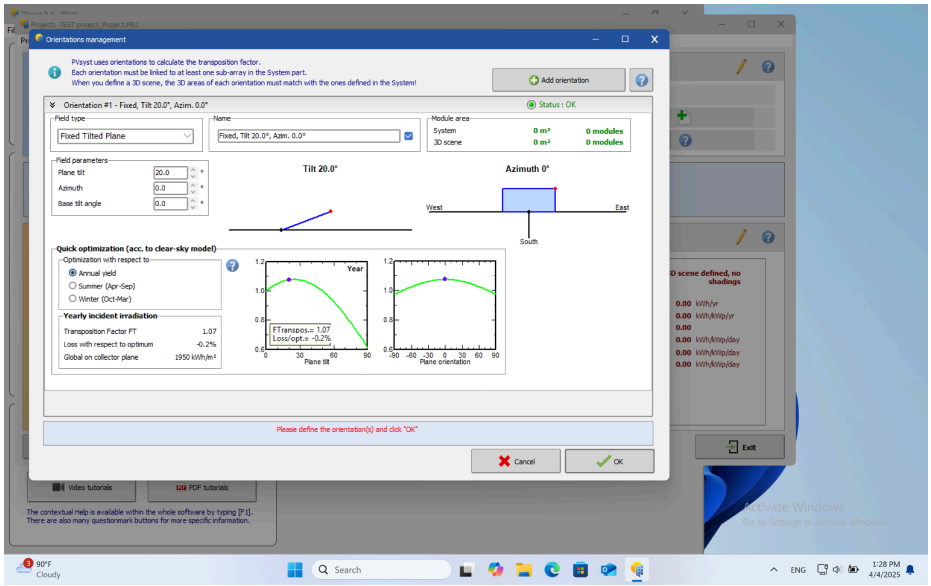
Save the file to the database



- We are ready to go to next step

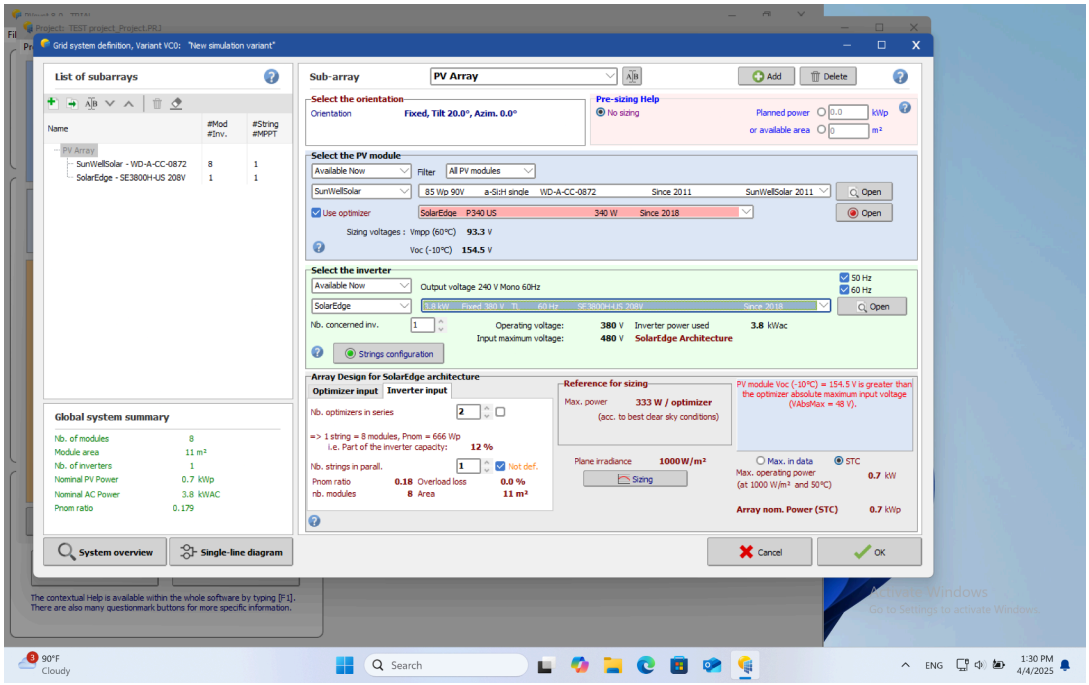
3 In variant

- Go to orientation.



Set the orientation to desirable options.

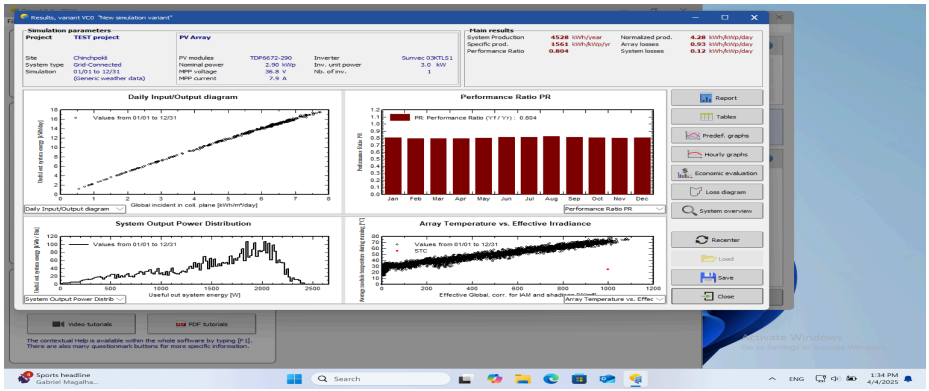
- Next go to System in variant.



Set the models of desirable PV and Inventor suiting each other. Run shading analysis etc if required

5 Run Simulation

- Set performance parameters.
- Run energy yield estimation.

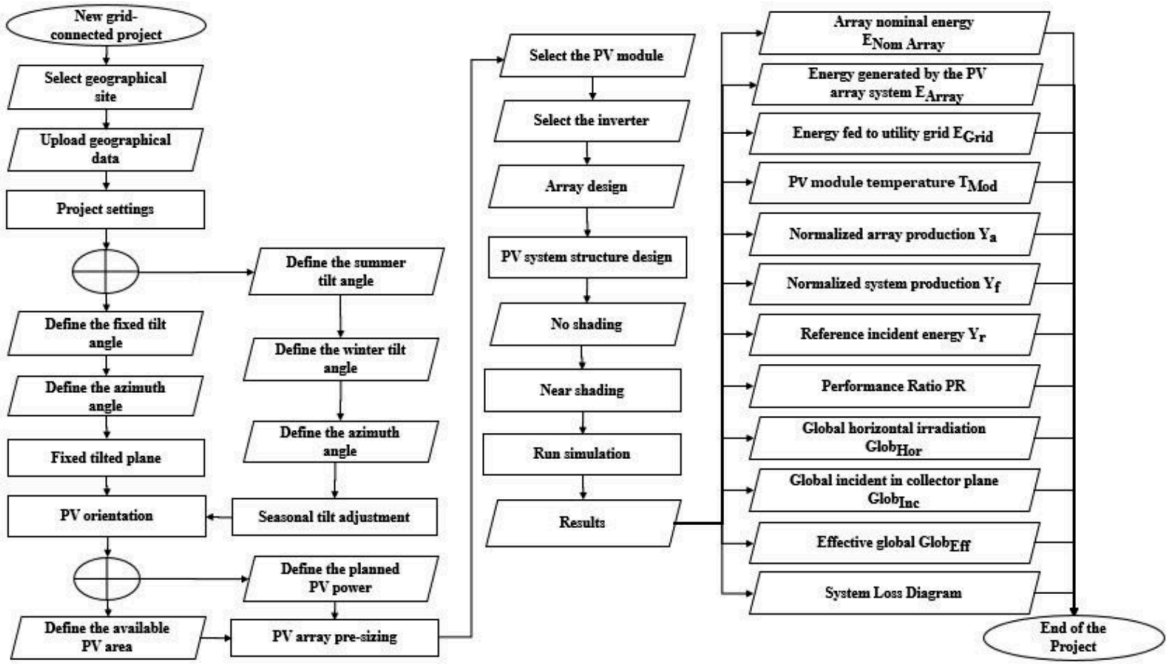


6 Generate Reports

- Review results: Energy yield, losses, efficiency.
- Export final **PDF reports**. Generated as text report

  test report PVsyst.pdf

Workflow Diagram



Task 3: Critical Evaluation of PVsyst

1. Supported Climate Data Formats (https://www.pvsyst.com/help-pvsyst7/meteo_datasources.htm)

PVsyst – Climate Data for India

Provider	Region	Data Type	Resolution	Period	Variables	Availability	In PVsyst
Meteonorm	Global	Synthetic (TMY + hourly)	Monthly → Hourly	Avg. 1961–2015	GHI, DHI, Temp, Wind, RH	Included	✔ At site creation
NREL India (TMY3)	India	TMY (measured/synthetic)	Hourly	2002–2011	GHI, DHI, Temp, Wind	Free	✔ (TMY3 Format)
PVGIS-ERA5	Global	Reanalysis + TMY	Hourly	2005–2020	GHI, DHI, DNI, Temp, Wind	Free	✔ At site creation
Solargis	Global	Satellite-based (TMY)	Hourly + Monthly	1994–Today	GHI, DHI, Temp, Wind	Paid	✔ File import
Solcast	Global	Satellite-based (TMY + TS)	Hourly	2007–Today	GHI, DHI, DNI, Temp, Wind, RH	Paid	✔ File import

Reuniwatt	Global	Satellite-based	Hourly	2004–Today	GHI, DHI, DNI, Temp, Wind	Paid	✔ File import
NASA-SSE (Old)	Global	Monthly (Satellite)	1° x 1° grid (~111 km)	1983–2005	GlobH, Temp	Free	✔ Old SIT import

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Climate Data Limitations for India in PVsyst

- **ERA5 integration is only TMY**, no real-time data or variability (e.g., no ENSO-year variations).
- **Old datasets** like NASA-SSE or NREL India are **outdated** (pre-2015).
- **No direct support for ERA5 hourly or real-time climate data**, unless externally processed.
- **Resolution issues** for many rural or remote Indian sites unless using **Solcast/Solargis (paid)**.
- **Synthetic hourly values (Meteonorm)** may not capture local microclimates (e.g., urban heat islands, coastal zones).
- **No GHI variability representation** (e.g., aerosols or seasonal dust not modeled dynamically).

Real PVSyst Case Studies

- https://www.sciencedirect.com/science/article/pii/S2214785321058259
- https://ieeexplore.ieee.org/abstract/document/6823519
- https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8574334
- https://www.researchgate.net/publication/313249367_PV_SIMULATION_SOFTWARE_COMPARISONS_PVSYST_NREL_SAM_AND_PVLIB#fullTextFileContent

Extract Insights from Developers

How Are Developers Using PVSyst?

- **System Design & Simulation:** Developers use PVSyst to design solar PV systems and simulate their expected energy output based on real-world conditions.
- **Shading & Loss Analysis:** It helps in modeling shading effects, system losses, and other technical factors that affect performance.
- **Reporting & Validation:** PVSyst is commonly used to create detailed reports for engineering reviews, financing, and investor presentations.

What Problems Do They Face?

- **Import Errors:** Developers face issues when importing models from tools like Rhino3D—such as incorrect panel orientation and scale mismatches.
- **Complex Interface:** The software is considered unintuitive by many users, making it hard to learn and use efficiently.
- **Limited Early-Stage Tools:** For quick project estimates or sales proposals, PVSyst lacks flexible layout and design tools compared to alternatives like Helioscope.

What Features Do They Wish It Had?

- **Better Layout Editing:** Users want easier ways to adjust panel configurations, tilt, and orientation without layout issues.
- **Improved 3D Model Support:** Seamless, error-free import from other design tools is a common request.

- **User-Friendly Interface:** A cleaner, more intuitive interface would make the software more accessible to both technical and non-technical users.

- **Faster Design Tools:** Tools for quick estimates and early-stage project layouts would make PVSyst more useful in sales and pre-feasibility phases.
