A 30+ year hourly history or TMY file is finally completed within 30 minutes and the user notified of its availability for direct download. A typical file structure is shown in Fig. 20.

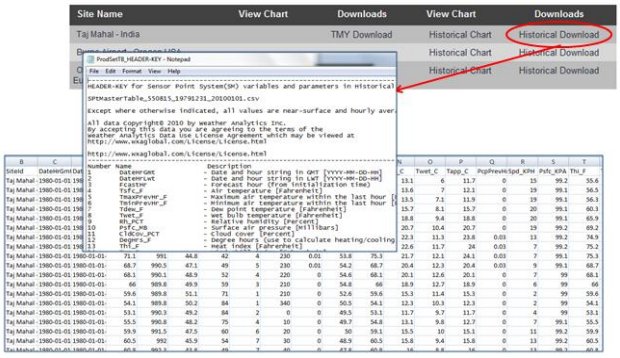

Fig. 20: Detailed hourly time-series downloads

4.2 Data display and Graphical Review

Once a user's site is activated, the user may review all variables with a graphics tool that supports zooming from the full period down to a few days or hours (Fig. 21).

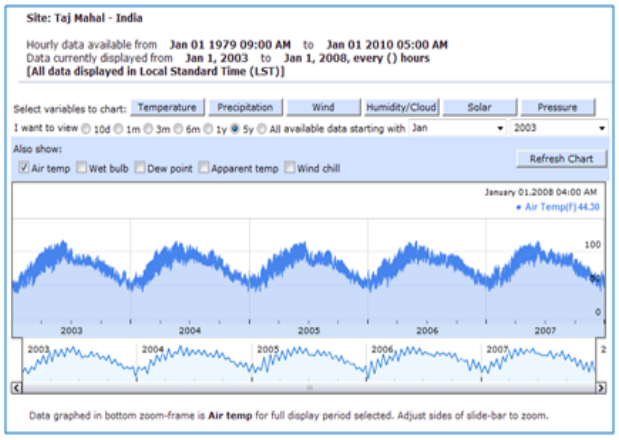

Fig. 21: Graphical review with zooming

Quick review of potential sites of interest before requesting the full hourly history is facilitated by the availability of 31-year summary data for over 600,000 Virtual Sensor Stations™ sites across the globe (Fig. 22).

4.3 Data Delivery Options

Users may request the full complement of variables in their output or may select a subset of interest. To support a variety of modeling and simulation systems the historical output data is made available in multiple formats, including .CSV, .EPW, .TM2 and .BIN. Users may also request individual years in .EPW or .BIN formats to support targeted and comparative analysis of years with suspected highs and lows in GHI and DNI. For automatic systems full Web Data Services access is supported.

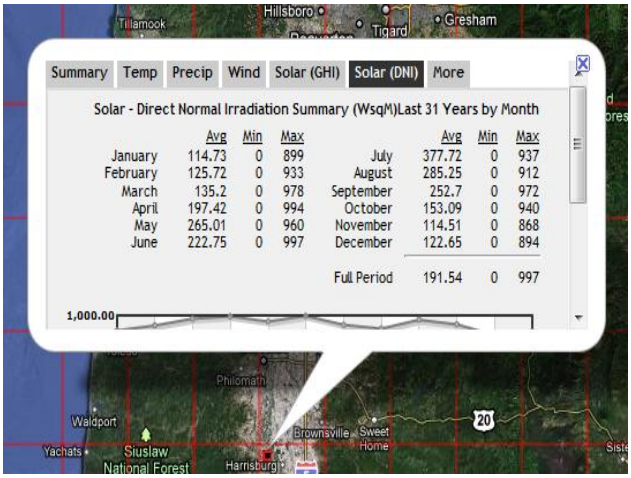

Fig. 22: 31-year monthly summary data for GHI and DNI

5. POTENTIAL SOLAR APPLICATIONS

5.1 Site Selection and Analysis

Potentially, to those wanting to perform solar site selection analyses, the results of these efforts based on the CFSR dataset represent an accessible network of "virtual weather stations" placed one every 35 km around the globe that have been in continuous operation since January 1979, reporting with 100 % reliability each hour. The interactive and direct access to the numerical data output of these virtual stations can be used to support solar site selection and analysis at multiple levels, including:

- Initial identification of potential sites of interest using an interactive map-based interface with 30-year climate-summary data
- On-location TMY files for modeling and first-level analysis of site potential
- Detailed on-site 31-year hour-by-hour time series data and 30 single-year EnergyPlus input files to support more detailed site analyses.

Under development are techniques for de-biasing the 31-year CFSR-based output utilizing short-term on-site sensor readings. These will exploit model output statistics (MOS) and full-physics column model technologies. The resulting dataset effectively extends a measured data record of as little as one year, and the reach of statistical

analyses, to 31 years. The ability to select individual years from the 31-year record enables a more accurate characterization of the potential short-term or long-term variability, particularly when TMY-type data are not enough.

5.2 High Precision Forecasting

While the historical data output discussed above tracks the 35-km spatial resolution of the CFSR data, the WxA Sensor Point™ system is able to provide far higher precision for forecasts, particularly in the first 24 hours. Sensor Point™ uses a column model approach to integrate the roughly 35-km resolution NOAA Global Forecast System (GFS) output with nearby sensor readings, thereby increasing the GFS spatial accuracy and forecast frequency to that of the sensor output, and localizing the forecast to footprints as small as 1 km.

Sensor Point™ can use private sensors, including radiometers, with real-time remote data access. These on-site sensors enable short-term solar radiation and other key variable forecasts specific to that site. Since there is complete control of the observational data, frequent updates are an option. In this way, the 35 meteorological variables that are available for the last 31-year period can also be part of 7-day forecast time series. Among other important applications, such forecasts are an efficient tool to help electric utilities and independent service operators manage and dispatch the variable production of solar electricity in their grid. Similar integrated sensor-driven column model systems have been successfully deployed to support other weather-sensitive operations, such as those controlling airport acceptance rates [5].

6. SUMMARY

The global network of over 600,000 reliable and accurate Virtual Sensor Stations™ to support site research and analysis has become a convenient reality. Time series data are now readily available via the WxA web site portal (http://www.wxaglobal.com) for over 35 weather variables, including GHI and DNI. Both historical and forecast time series data are available.

The WxA historical database is based on the hour-by-hour, 31-year, 35-km resolution CFSR model output data. The CFSR model uses raw sensor data and physics to provide for this period a detailed and accurate picture of the earth-atmosphere system. The WxA hour-by-hour, 7-day, 35-km resolution forecast database is built on the GFS model output data localized with Sensor Point column model technology. Both WxA historical and forecast databases hold the same variables.

Uses for the WxA data include first-pass analyses of candidate solar sites, simulations of building energy systems and other environmentally sensitive systems. Input data files are available in formats that can be immediately used as input to popular spreadsheet tools and software applications, such as the EnergyPlus ‘epw’ format. Data file content can either be hour-by-hour time series for periods up to 31 years or based on Typical Meteorological Year (TMY) statistical criteria. Single-year time series data can be provided as “Actual Meteorological Year” (AMY) epw and .bin format files.

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The University of Oregon Solar Radiation Monitoring Laboratory and their network of monitoring stations provide sound solar resource data for planning, design, deployment, and operation of solar electric facilities and for improved tuning of satellite solar radiation data. The Baseline Surface Radiation Network (BSRN) is part of the World Radiation Monitoring Center. Both networks are commended for the quality of their data.

7. REFERENCES

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