Weather Risk Management for the Energy Sector

The Challenge
Accurate assessment of the present and future state of the atmospheric parameters that impact the energy industry is vital to public welfare and economic growth. A significant number of decision makers are required to make critical judgments on a daily basis associated with production, distribution, storage, and demand, which are directly affected by weather. However, these decisions are sometimes reached with inaccurate weather forecasts, leading to substantial economic losses.

Along with state variables (temperature, pressure, etc.), energy industry decision makers are concerned with the impacts of hazardous weather on system infrastructure and energy commodity pricing. Recently, hurricanes Ivan, Katrina and Rita demonstrated the importance of critical infrastructure protection, as these events resulted in considerable disruptions in the oil and natural gas markets.

In an effort to help mitigate the risks associated with weather, NCAR carries out research and development focused on weather forecasting, including seasonal and inter-annual predictions.

The National Center for Atmospheric Research (NCAR) is involved in a number of activities dedicated to improving the understanding of weather and climate and collaborating with decision makers on how best to foresee and react to short and long-term changes in the atmosphere. In an effort to help mitigate the risks associated with weather, NCAR carries out research and development focused on weather forecasting, including seasonal and inter-annual predictions.

Dynamic Integrated forecast (DICast®)
The Dynamic Integrated foreCast (DICast®) system ingests meteorological data (observations, numerical model output, statistical data, climate data, etc.) and produces tuned meteorological forecasts at user-defined forecast sites and lead times.

The DICast® system ingests data from multiple sources and applies automated forecasting techniques to each data source. Each of these forecast modules produces an independent forecast. Forecast skill is then improved using a fuzzy logic scheme that calculates a weighting of the inputs based on recent performance and then combines the individual forecasts into an integrated and enhanced consensus forecast.

Key advantages of this approach include the capability to: (1) utilize as many or as few input analysis/forecast products or techniques as desired, (2) easily accommodate the addition or removal of data or product inputs, (3) adaptively weight component forecast techniques according to their proven performance for specific conditions and locales, (4) easily adapt to missing data or apply automatic quality control processes for input data or weather products, (5) incorporate human forecaster experience and ‘rules of thumb’ into the system via weighting procedures, (6) adapt and evolve the system easily from one regime to another, where conditions and major forecast influences vary, and (7) establish a dynamic link between forecast verification and component weighting to systematically evolve the weighting of input components.

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JNT
Through the Joint Numerical Testbed (JNT), NCAR is interacting with research and operational communities to test and evaluate advanced numerical techniques and systems to accelerate the transfer of these technologies to operational users. This initiative will also provide a better understanding of atmospheric physical processes. As a result, decision makers will have the necessary tools to make well-informed strategic, tactical and operational decisions related to severe weather events that adversely impact the energy market.

Thunderstorm Auto-nowcasting System
A short-term (0-6 hr) time and space specific forecast of thunderstorms provides valuable information for the energy sector. NCAR conducts research and develops systems aimed at improving thunderstorm nowcasts on the regional scale, with the Auto-nowcaster (ANC), and on the national-scale with the National Convective Weather Forecast product (NCWF).

The practice of nowcasting requires the forecaster to review and assimilate a variety of disparate observations and model results within the context of their knowledge of how the atmosphere works (i.e., the “conceptual model”). By the nature of the nowcast problem, the time available for the human to review data and make a nowcast is always very limited.

ANC mimics much of what is normally done by the human (without the time stress). ANC uses a data fusion system to assimilate a variety of data sets, (which could include forecaster input) to create nowcasts that are issued at regular intervals (usually every 5 min) and that are based on conceptual models of how storms initiate, grow and dissipate. A primary component of the ANC is its ability to identify and characterize boundary-layer convergence lines. Boundary-layer information is used along with storm and cloud characteristics to augment extrapolation with nowcasts of storm initiation, growth and dissipation.

RTFDDA
The Real-Time Four Dimensional Data Assimilation (RTFDDA) system is a computer-model that was originally developed by NCAR for producing analyses of current meteorological conditions and forecasts for U.S Army test ranges. Since then, the system has been adopted by other DoD and government agencies for support of special missions and for homeland-security applications.

RTFDDA focuses its computational resources on forecasting for specific geographic areas - not the entire continent, for example. This narrow focus enables the model to resolve a greater number of meteorological features while maintaining accuracy. The forecasting system can be deployed worldwide to address meteorological or man-made threats. For example, RTFDDA has been used for counter-terrorism support for both the Athens and Salt Lake City Olympics and to forecast the movement of hazardous material potentially released into the atmosphere. The system was used by the Army to support operations in Afghanistan and Iraq and it provided superior forecasts of Hurricane Rita in September 2005. In summary, the system excels at representing the details of the day-to-day weather, as well as the extreme weather associated with hurricanes and thunderstorms.

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