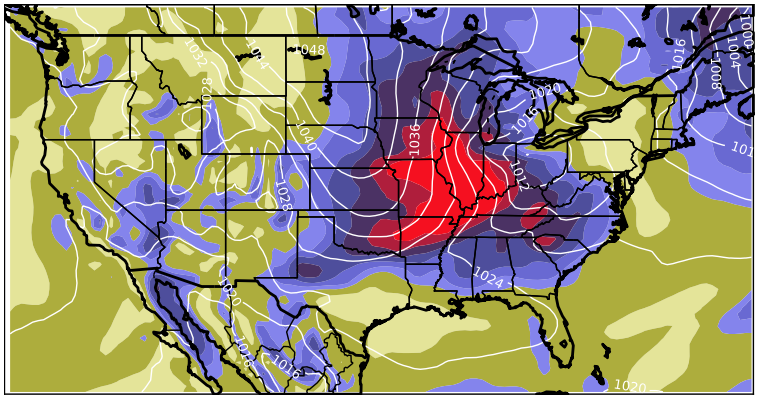
Reforecasts Will Improve Weather Data for Renewable Energy Applications

- Problem: Older weather forecasts exhibit systematic bias because forecast models were imperfect.
  - Affects renewable-energy related variables like wind, precipitation (for hydropower), and solar-energy.
- Solution: Regenerate long time series of past forecasts (reforecasts) using NOAA's current modeling system. Resulting data will lead to better forecasts affecting wind turbines, solar collection, and hydroelectric sources.
- Significant NERSC user support helped enable this work.



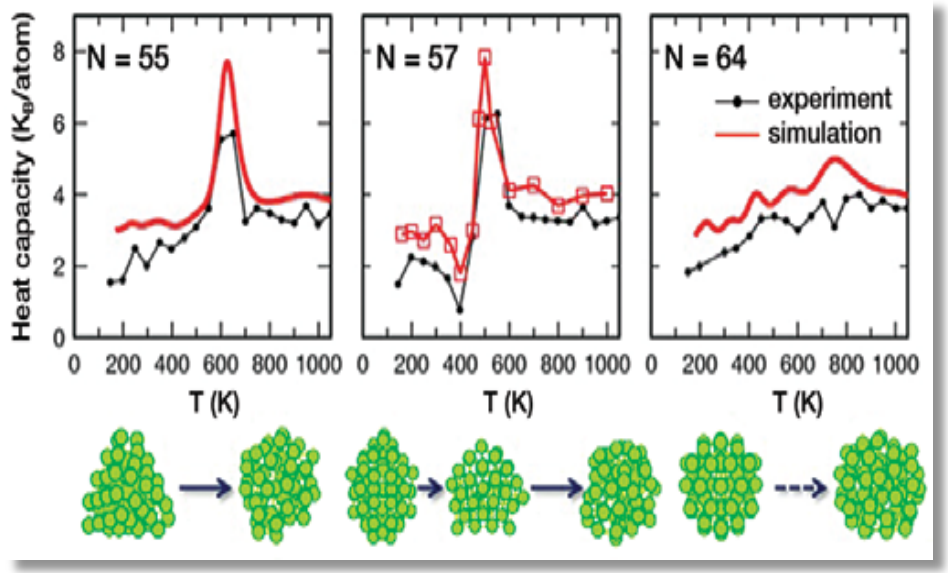
Sample of a product that can be generated from a reforecast showing wind speed for a 3-day forecast from Jan 12, 2009. Red areas indicate where the wind speed is much stronger than in the original forecast. This result is relevant for wind turbines.

Computation Reveals Origin of Diverse Melting Behavior in Aluminum Nanoclusters

- Unlike bulk materials, metallic nanoclusters (with about 55 atoms) exhibit size-sensitive melting changes: adding just a *single atom* to a nanocluster can cause a dramatic change in melting behavior. Why?

- Molecular dynamics studies at NERSC by NREL scientists revealed the key role of cluster symmetry on the size-sensitive melting behavior.

- **Key Result** Provides insight for understanding phase changes of nanoparticles, important for thermal energy storage and catalysis.



Simulated heat capacities (red) are compared with experimental data (black) for aluminum nanoclusters consisting of 55, 57, and 64 atoms (shown in green).

U.S. DEPARTMENT OF ENERGY | Office of Science

BES – ALCC Project

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Dec2011

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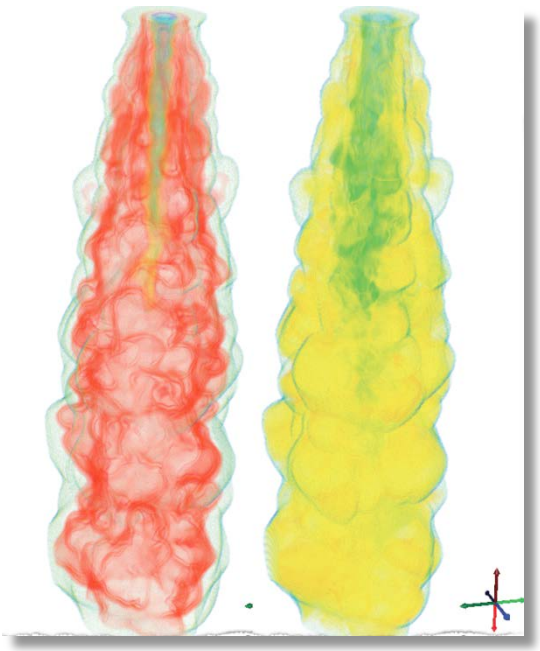
Quantitative Assessment of a Coal Gasification Model

- Coal Gasification offers a versatile and clean method for converting coal into gaseous fuel.
  - But simulation of such a complex physical phenomenon requires significant validation efforts.
- NERSC resources were used to model a real coal gasifier with the ARCHES Large Eddy Simulation (LES) code. LES is required for accurate combustion simulation.
- The validated method can now be used to assess retrofit techniques for coal gasifiers, helping to reduce CO_2 emissions.
- NERSC resources were a vital part of Ph.D. thesis of C.M. Reid, now a postdoc at LLNL.



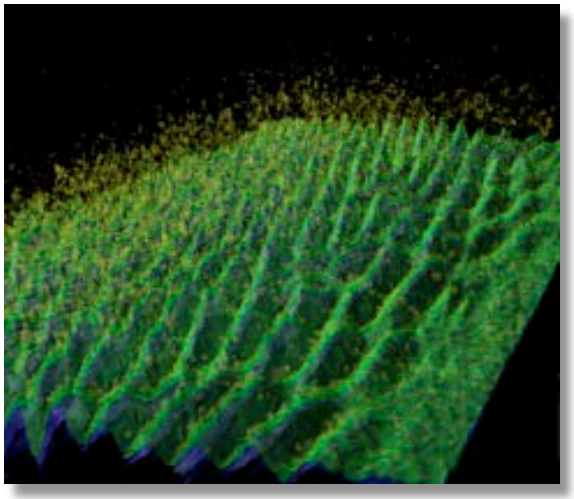
Influence of coal particle size on temperature: larger particles (right) take longer to heat up

Simulation of Laser-Plasma Interactions for Inertial Fusion Energy Identifies Important Instability

- Certain high frequency laser-plasma instabilities can limit overall gain in inertial fusion energy facilities.

- Simulation of "two-plasmon decay" demonstrated the staged acceleration of electrons.
  - Trapped electrons are further accelerated in a higher density region where the wave has a higher phase velocity.

- The staged acceleration can give rise to highly energetic electrons that can be detrimental for "direct drive" laser experiments.
  - Involves fundamental plasma physics questions on nonlinear plasma waves; paper submitted to PRL.



Simulations using OSIRIS showing the white water (of energetic electrons) on top of a sea of plasma waves generated by a high frequency hybrid instability.