ExaWind at NREL: Upping the Ante

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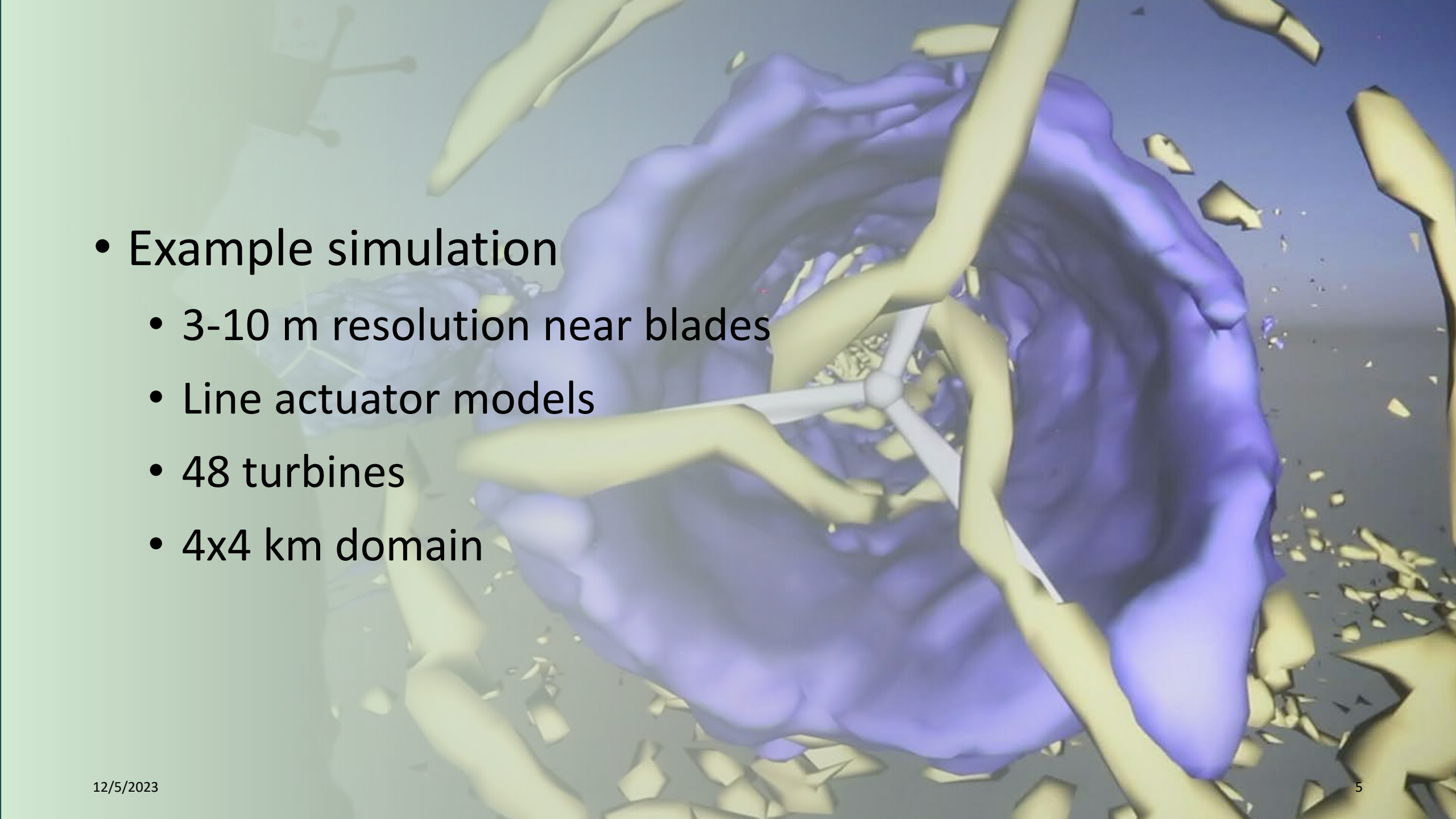
An Era of ExaWind

- What is ExaWind?
  - Part of the Exascale Computing Project
    - Deliver the world's first Exascale ecosystem
  - Many-turbine blade-resolved simulations in complex terrain

Wind Simulations

- Wait, why wind?
  - Suffer from a curse of scales
  - Kilometers of context
  - Microns of resolution
  - Definitely an Exascale problem!


Wind Simulations
of the
Old West

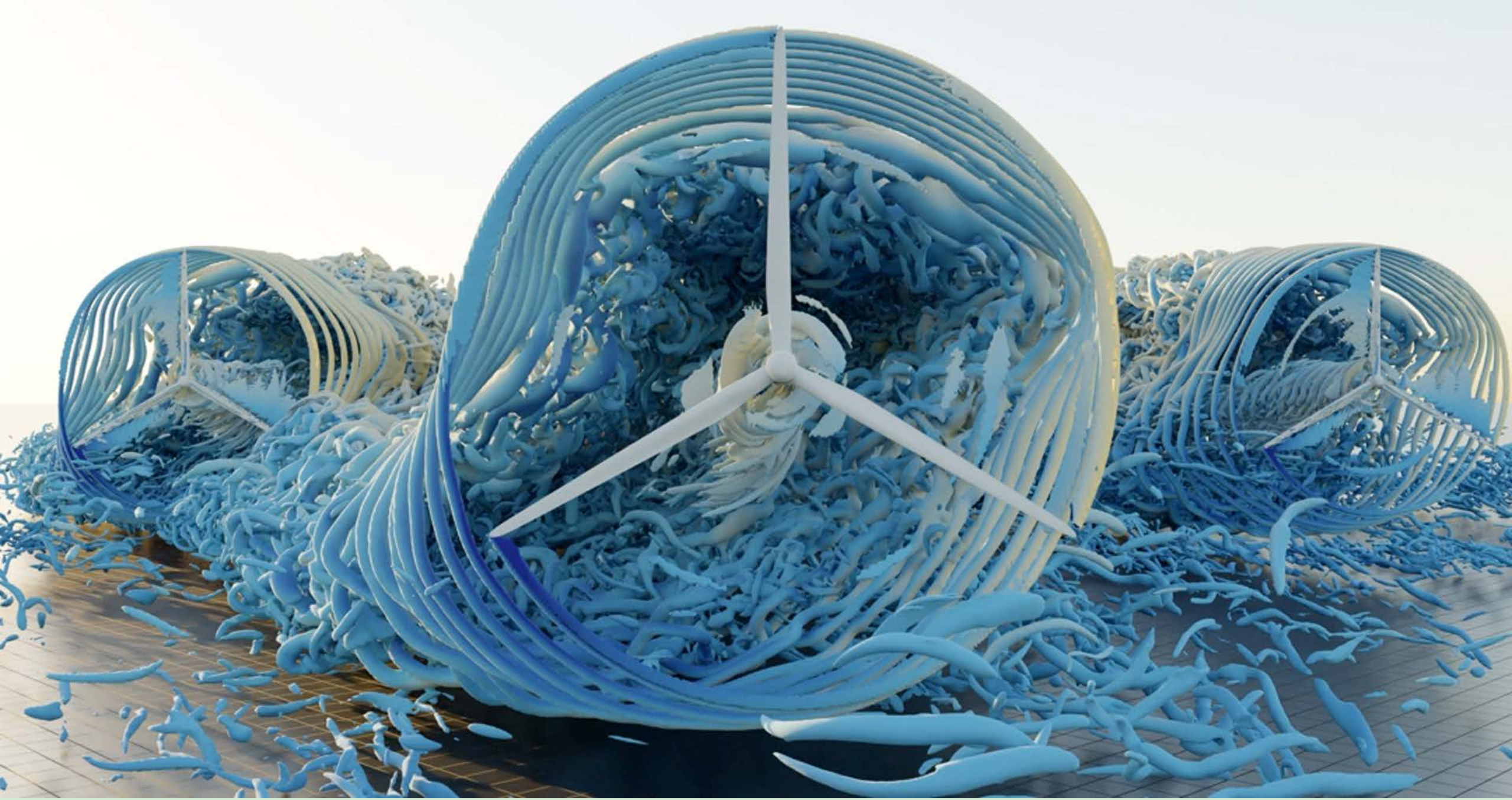


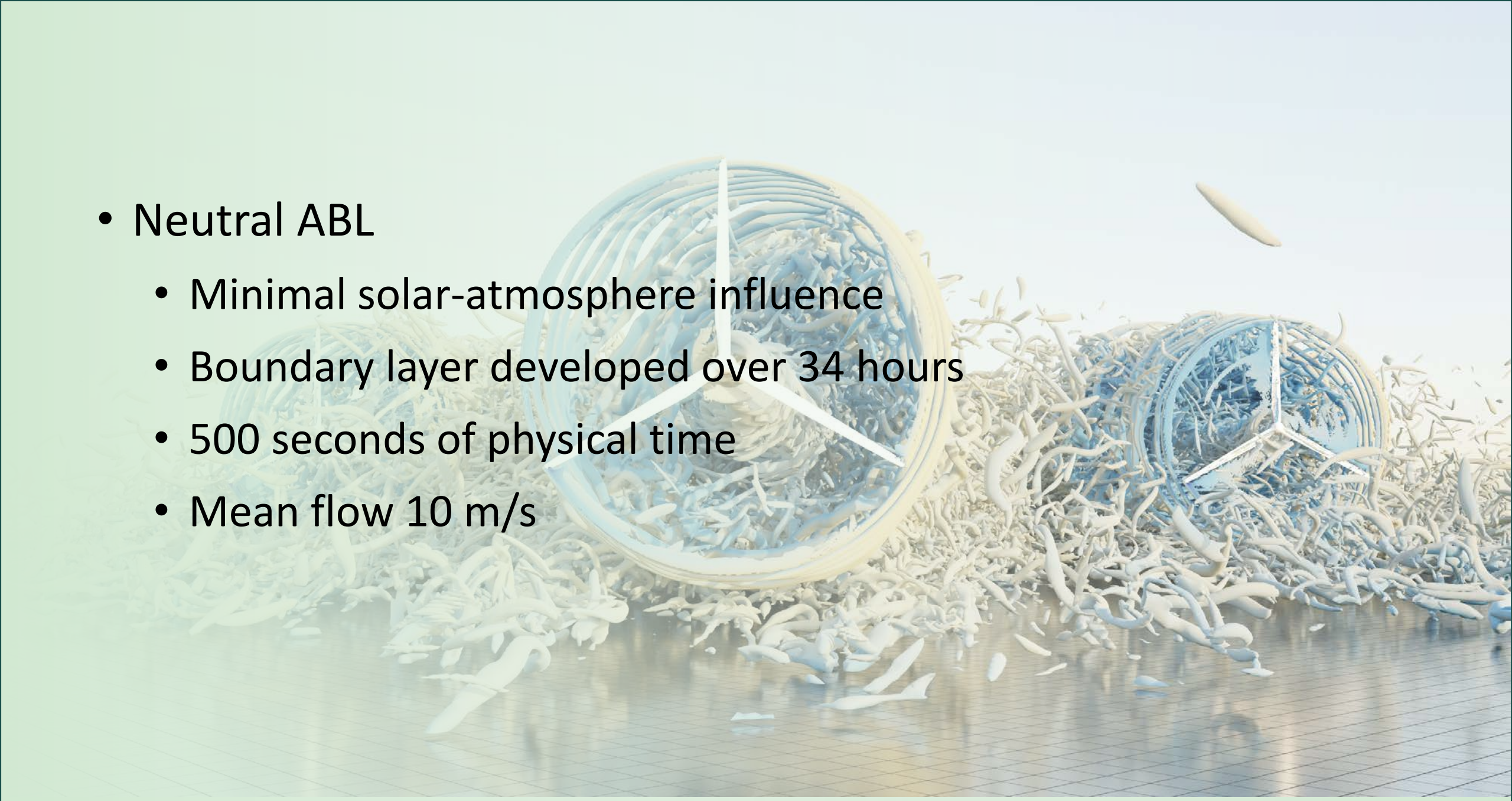
- Example simulation
  - 3-10 m resolution near blades
  - Line actuator models
  - 48 turbines
  - 4x4 km domain

MORE!

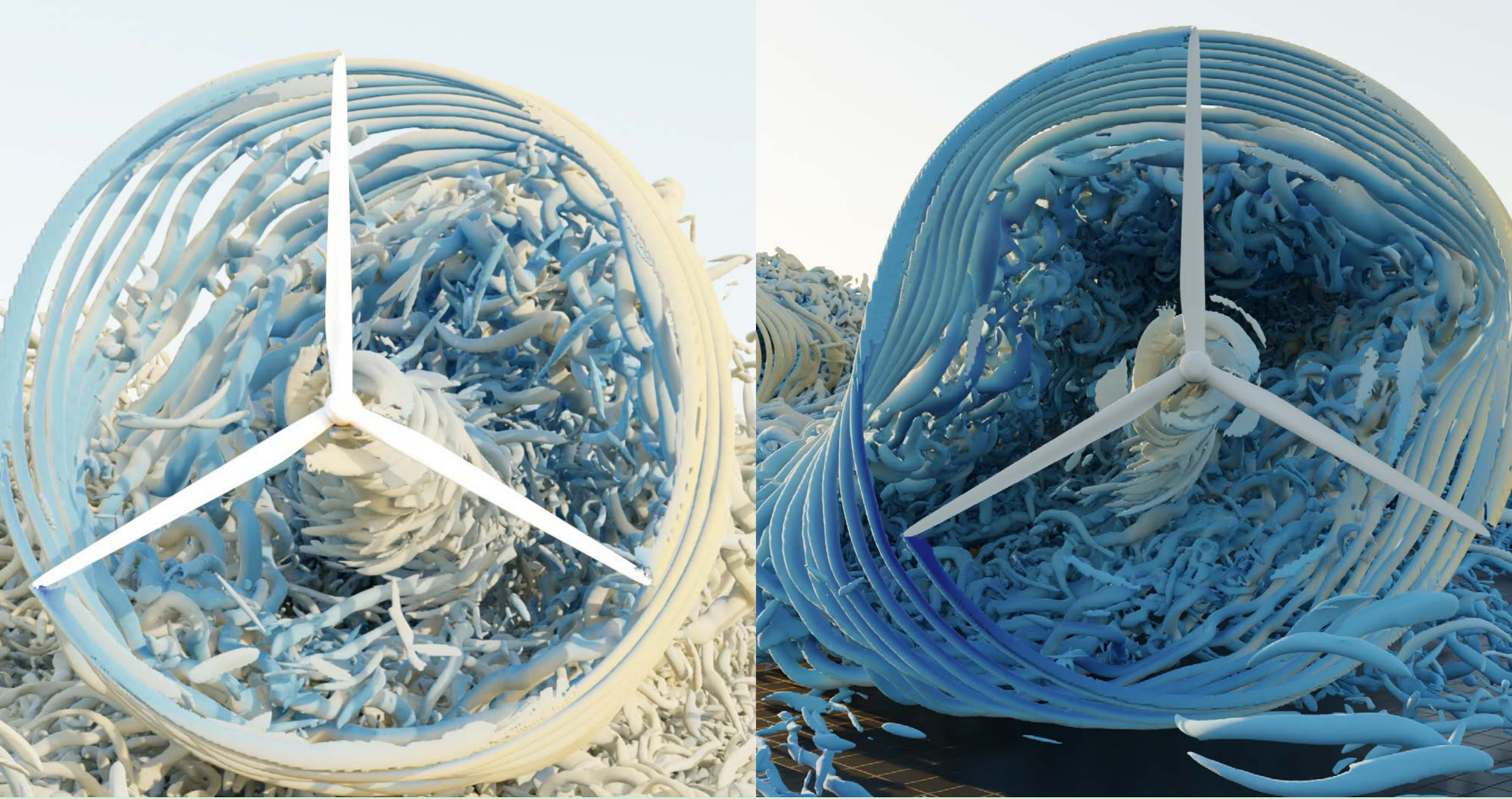
- Demonstrate improvements of ExaWind software stack
  - Run on Summit, visualized at NREL
  - Four turbines
  - 1.9 km x 1.5 km x 0.94 km
  - Hybrid AMR-Wind + Nalu-Wind
    - 615 million cells (3 levels refinement) for periphery
    - 8 million cells unstructured for near-body
    - Microns near the blades; 9 levels of resolution total
- Two ABLs; Neutral and Stable cases

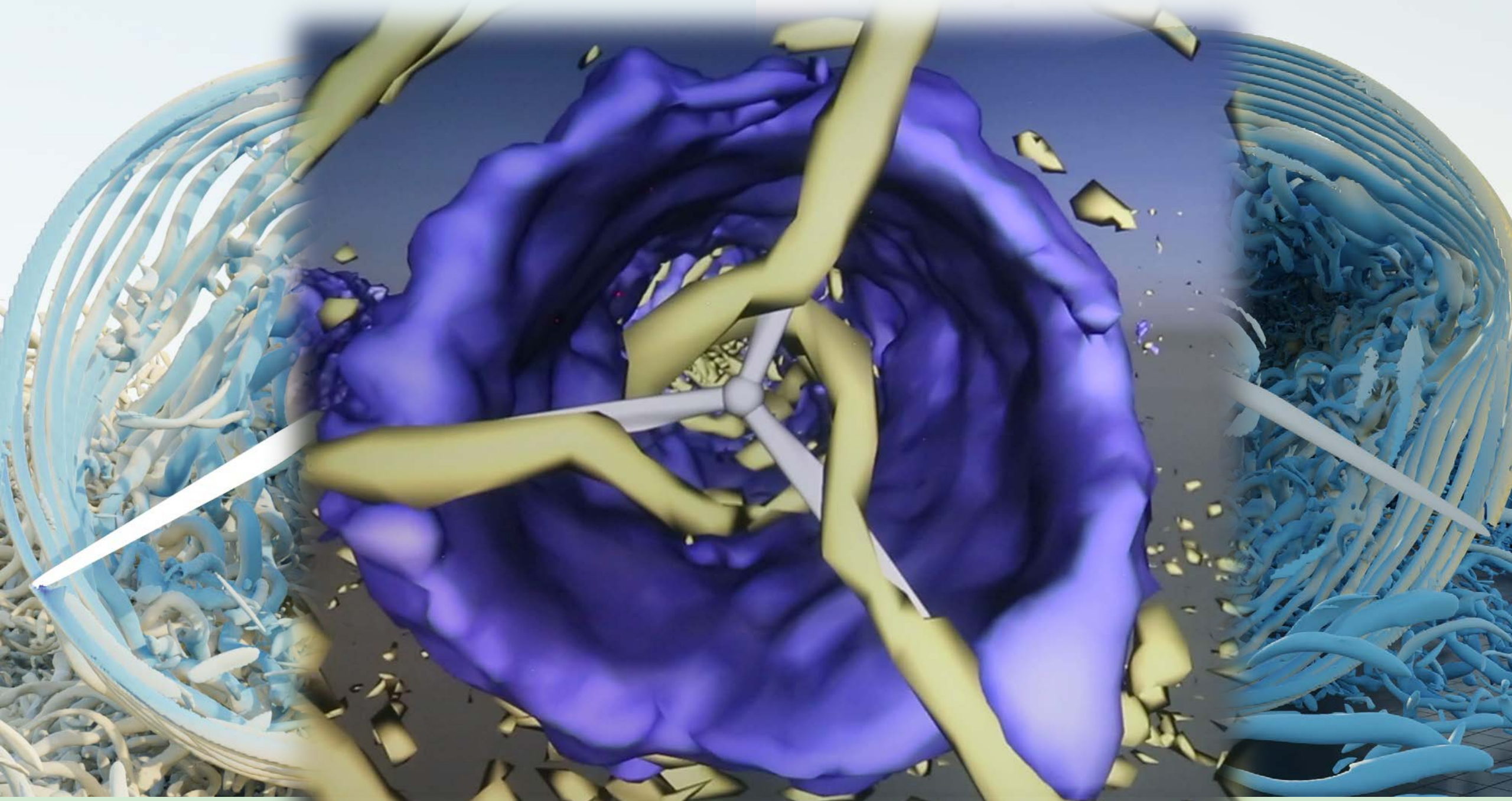
- Stable ABL
  - Cooling of Earth’s surface
  - Common near coastal areas
  - Boundary layer developed over 28 hours





- Neutral ABL
  - Minimal solar-atmosphere influence
  - Boundary layer developed over 34 hours
  - 500 seconds of physical time
  - Mean flow 10 m/s





Visualization

- New scale, new problems
  - Large sims, large vis requirements
  - Software issues at scale, and with AMR
  - Lots of features

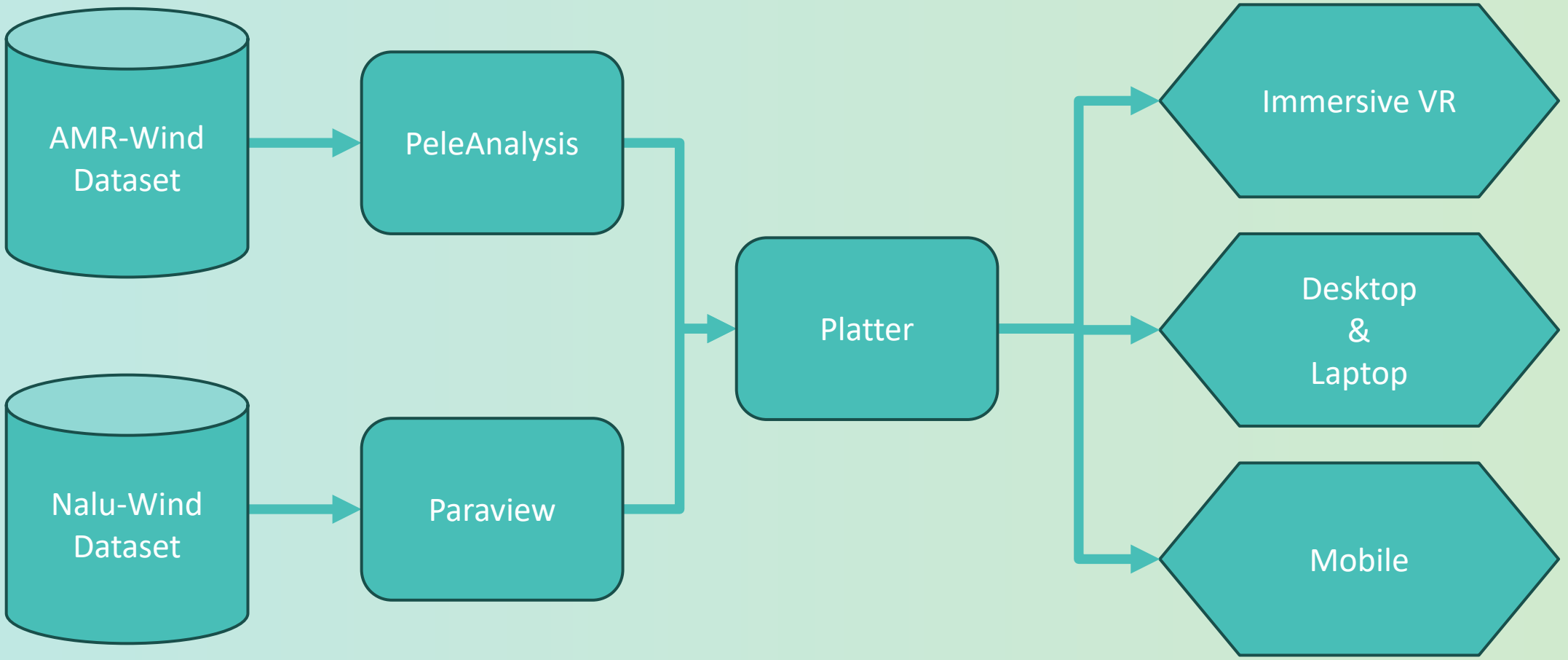
Visualization

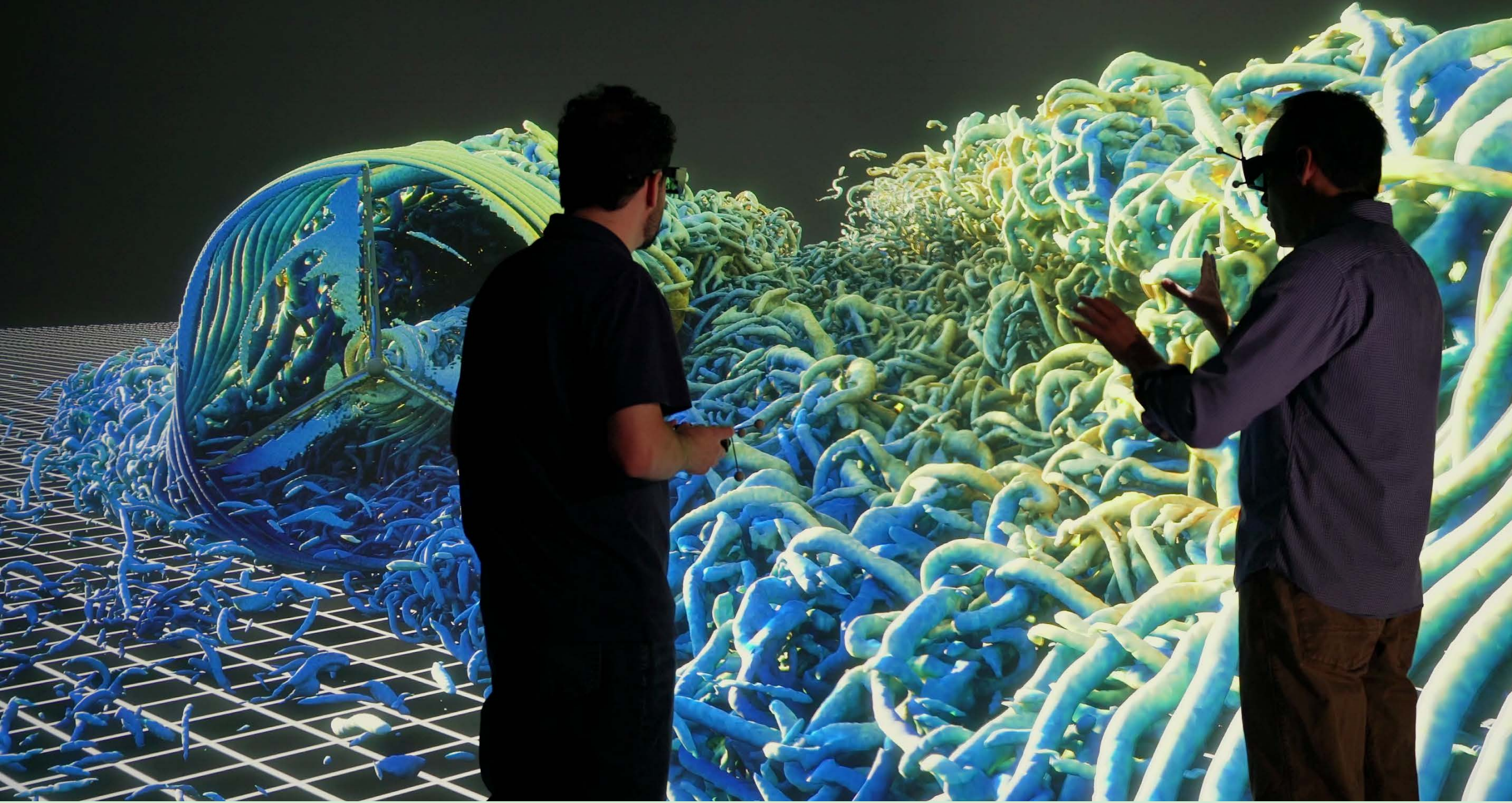
- How do we combat this?
  - Existing and new analysis tools
    - ParaView, VisIT, ASCENT, PeleAnalysis
  - Use immersive visualization suite, other devices
    - NOODLES

NOODLES?

- Lightweight collaborative visualization protocol
- Tie disparate software together
- Share in visualization
- Platform and software agnostic

Solution


AMR-Wind Dataset
Nalu-Wind Dataset
PeleAnalysis
Paraview
Platter
Immersive VR
Desktop & Laptop
Mobile

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Connect

Conclusion

- A look back
- A look at the present
  - Quick summary of ExaWind + visualization
- The future?
  - Clean up, more NOODLES

Questions?

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