



Contextual Compression of Large-Scale Wind Turbine Array Simulations

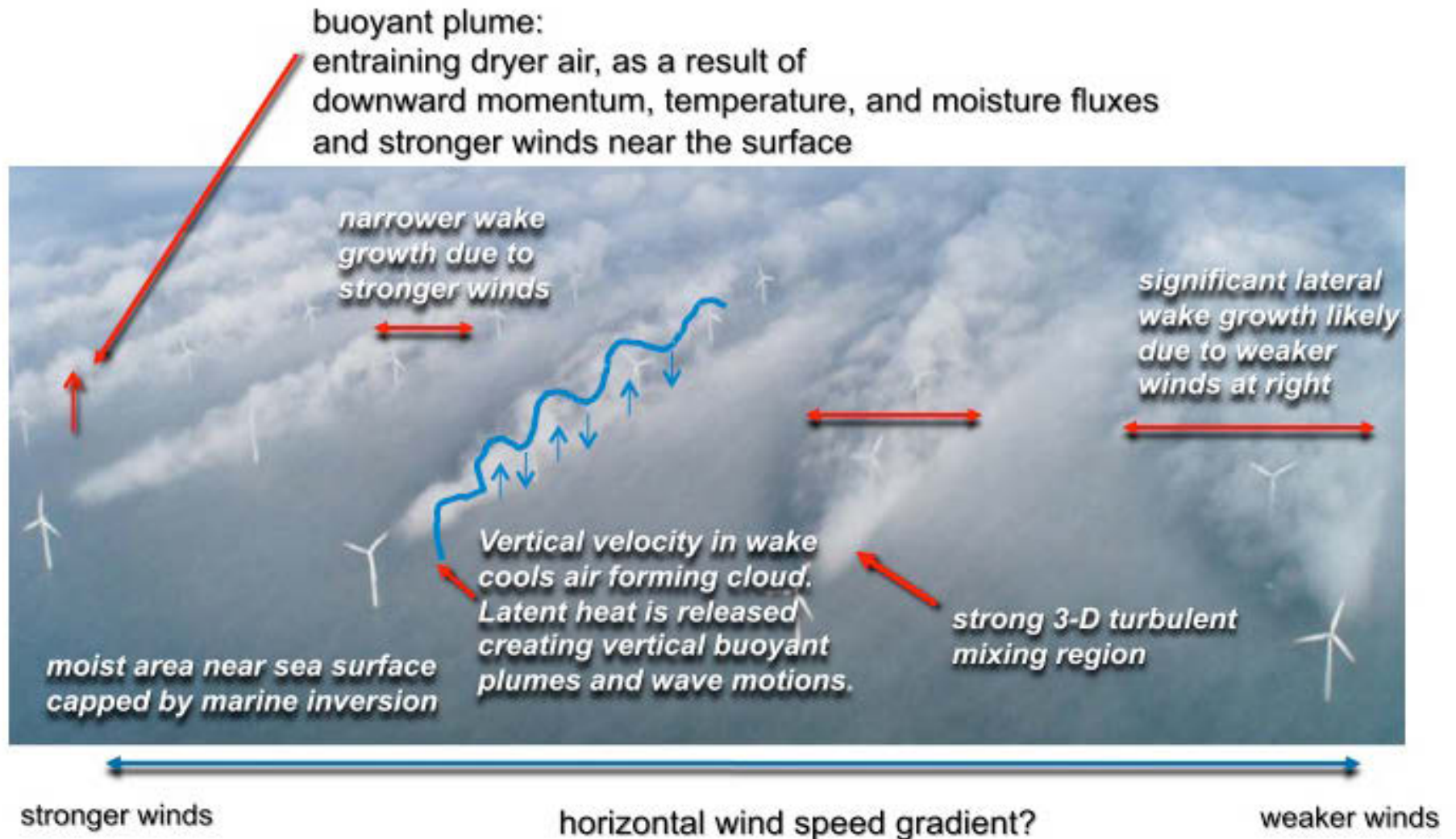
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Kristi Potter, John Clyne (NCAR)

The 2nd International Workshop on Data Reduction for Big Scientific Data (DRBSD-2)

November 17, 2017
Denver, Colorado

NREL/PR-2C00-70574

Motivation

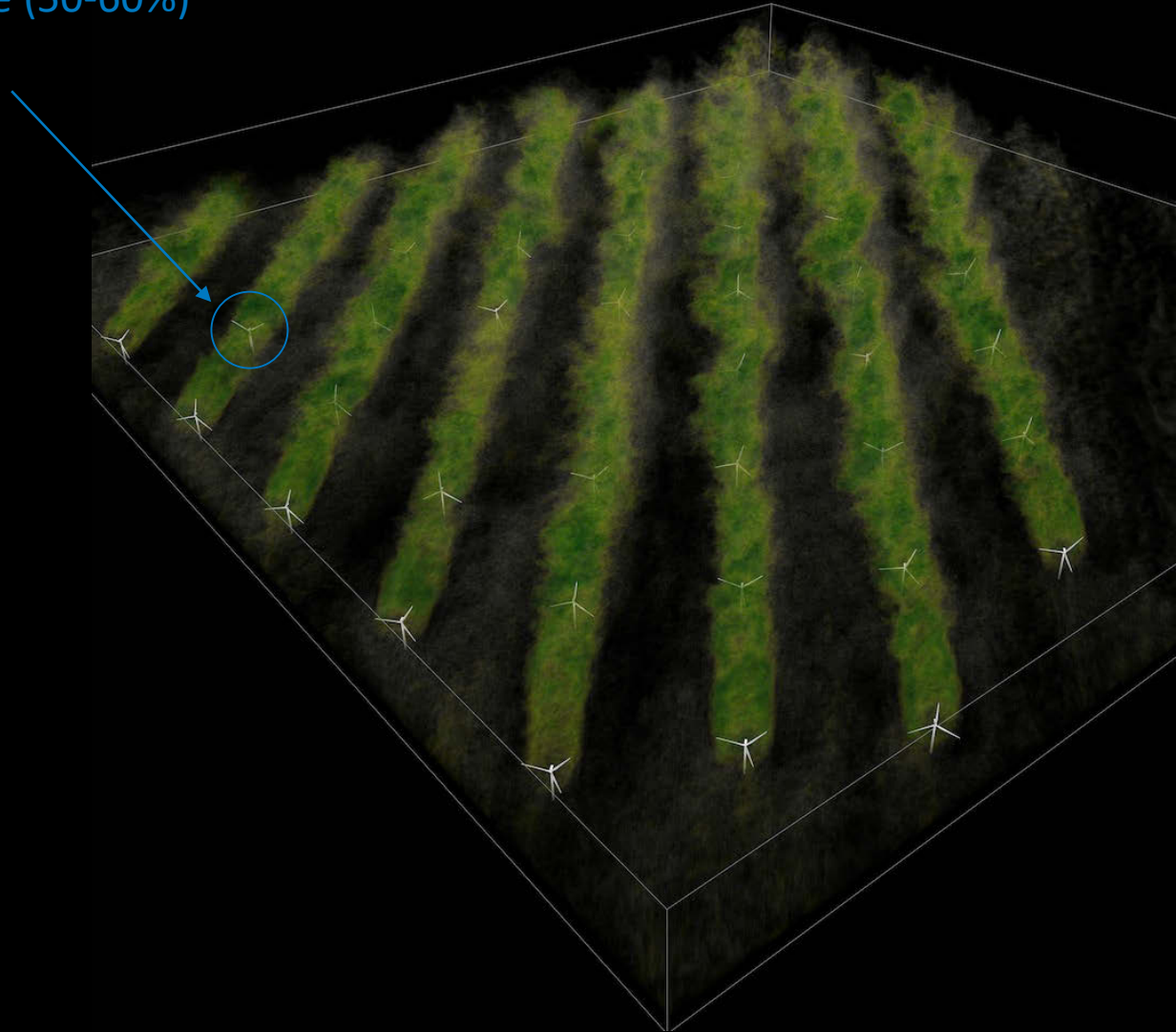


conceptual analysis by N. Kelley, NREL

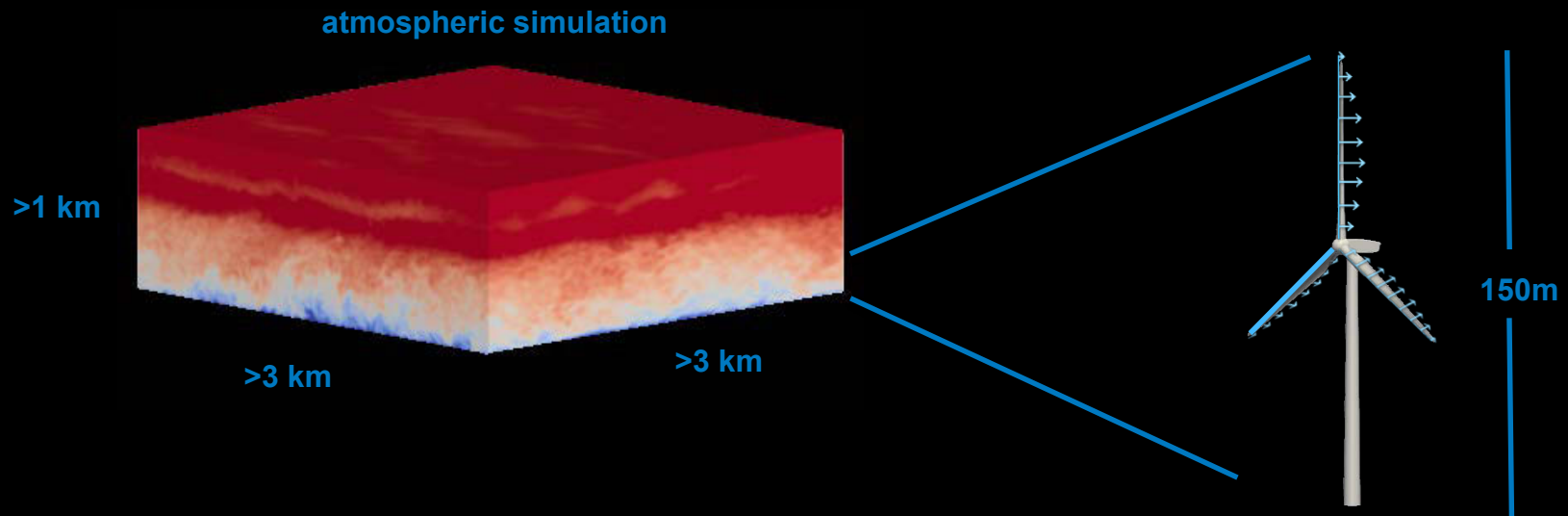
Background: Turbine Wake Effects

Downstream turbines

- Reduced power performance (50-60%)
- Higher gearbox forces (30%)
- Shorter lifespans



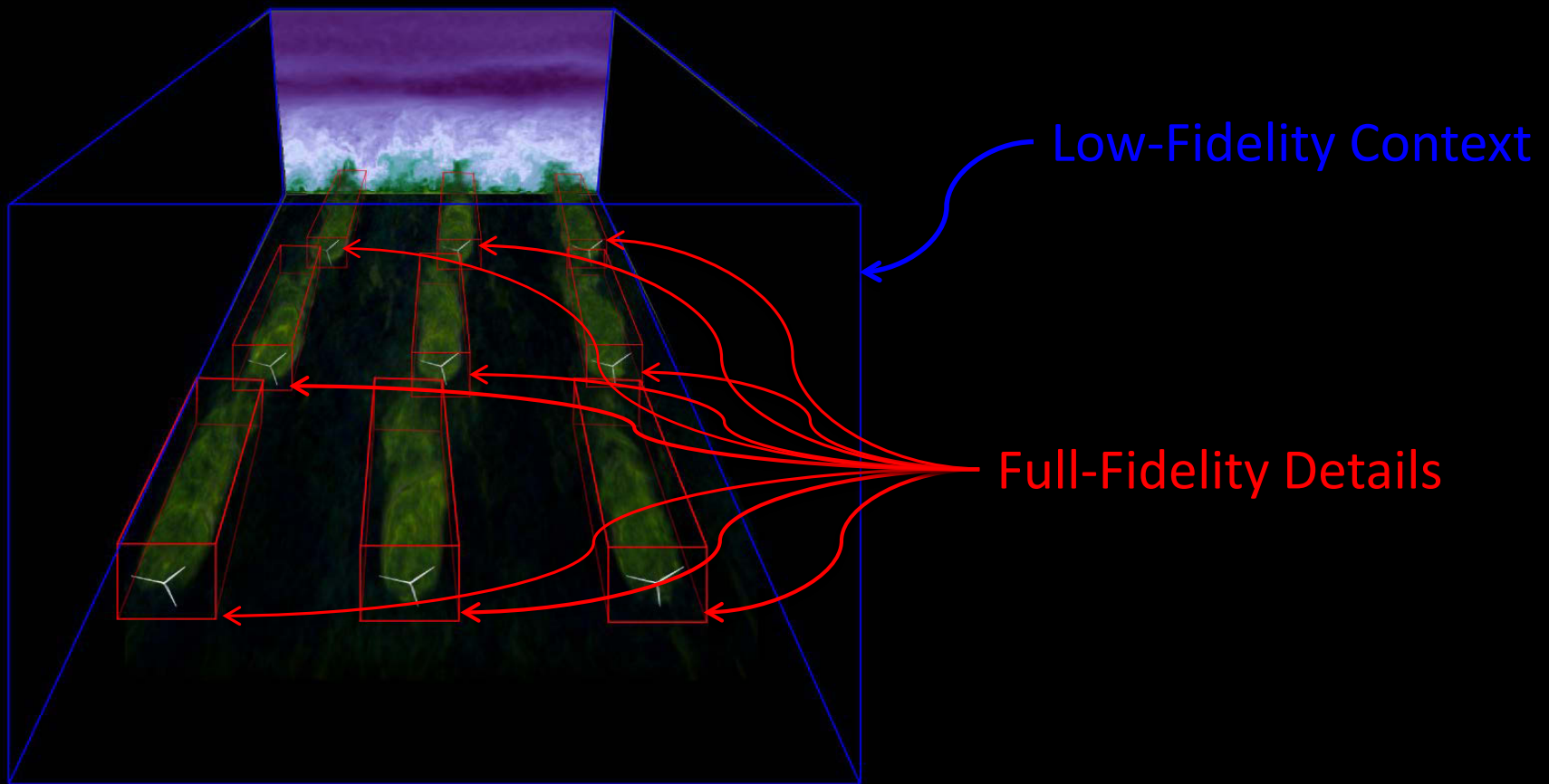
Data



- Minimum size: 3000m x 3000m x 1000m
- Uniform grid w/ resolution ~1m
 - ~ 100 GB/timestep/variable
- Unstructured “nested” grid
 - 10m atmosphere
 - 1m to capture wake dynamics
 - ~4 GB/timestep/variable + ~40 GB of metadata

Objective

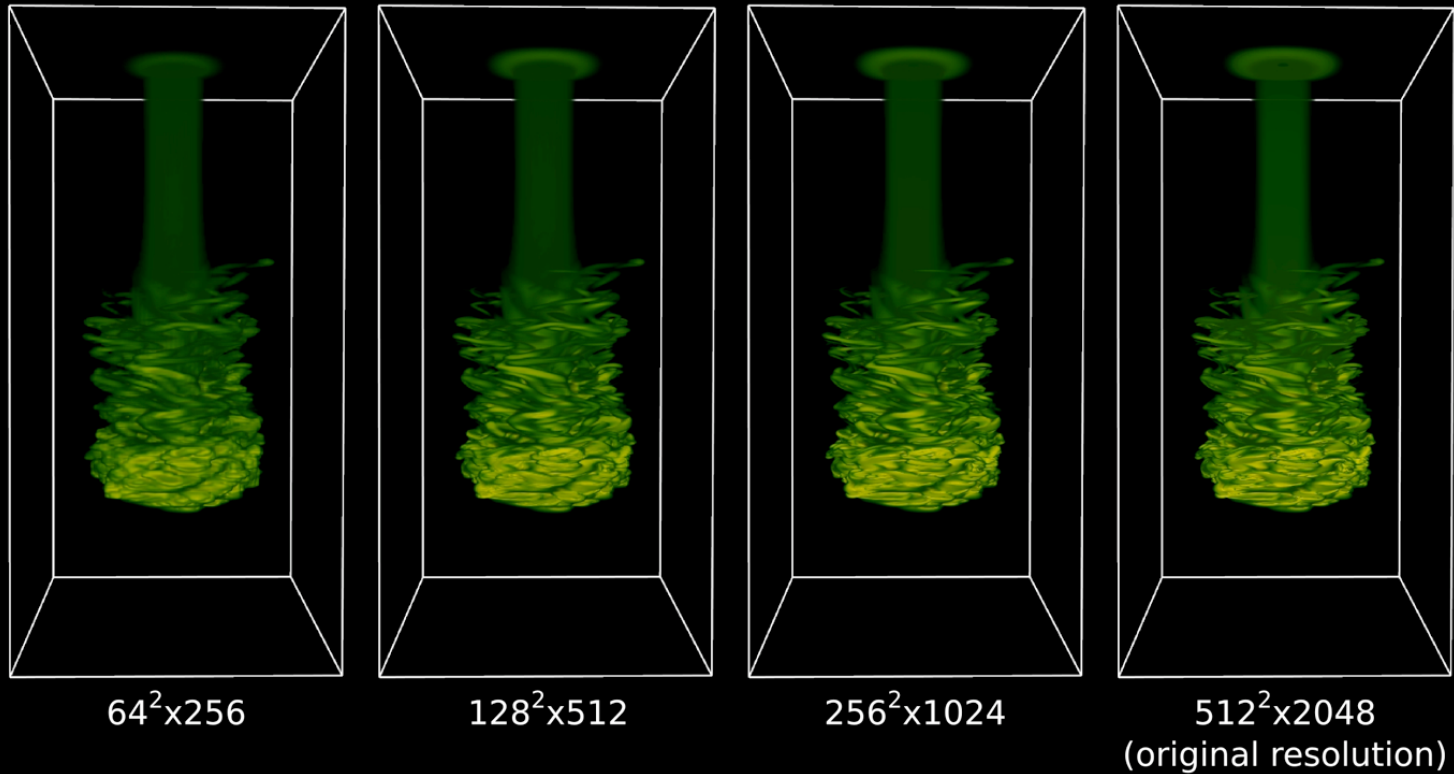
Show the detailed flow of the turbine wakes in the context of the atmospheric conditions.



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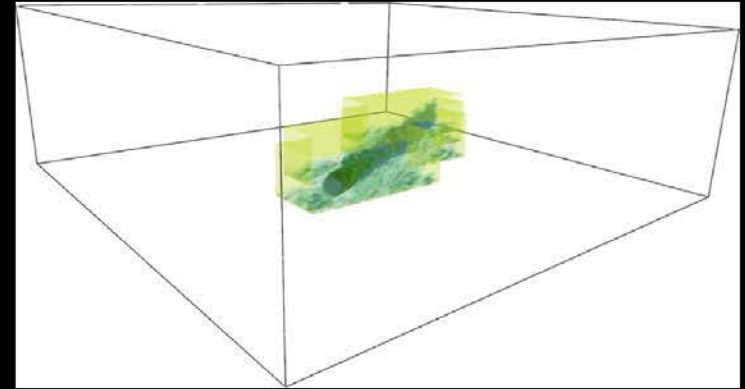
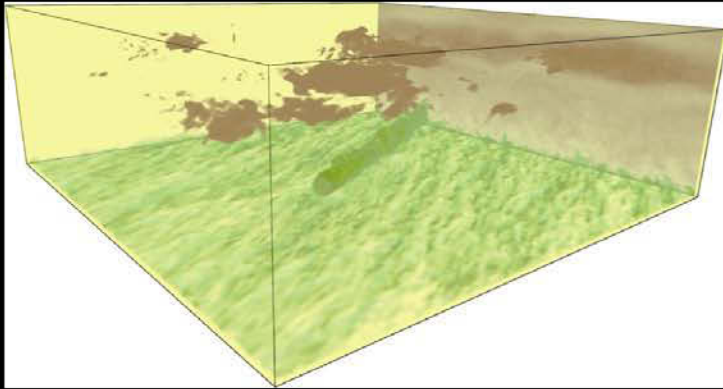


Example: Two Turbine Uniform Case

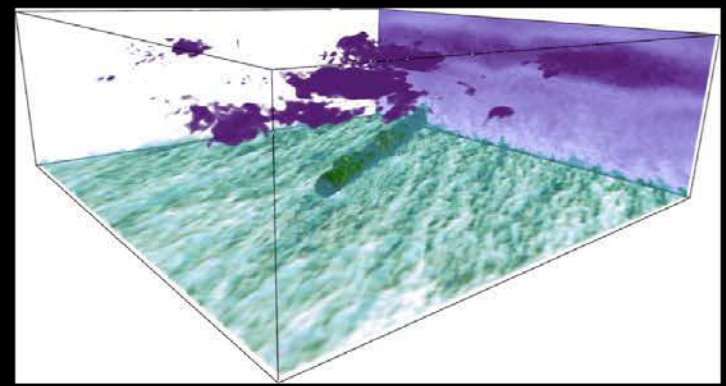
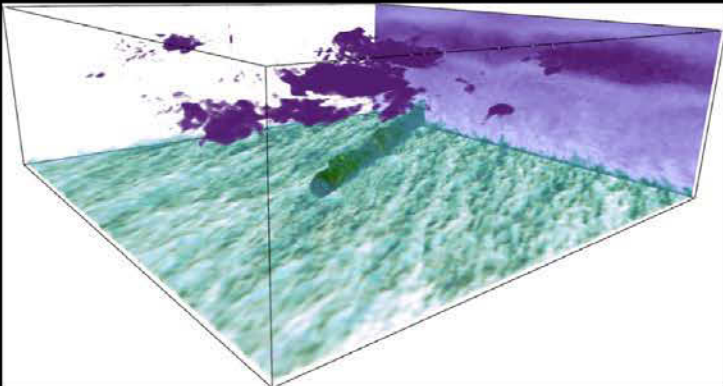
Original (Full) Fidelity
112 GB

Block-wise Compressed
5.8 GB

a)

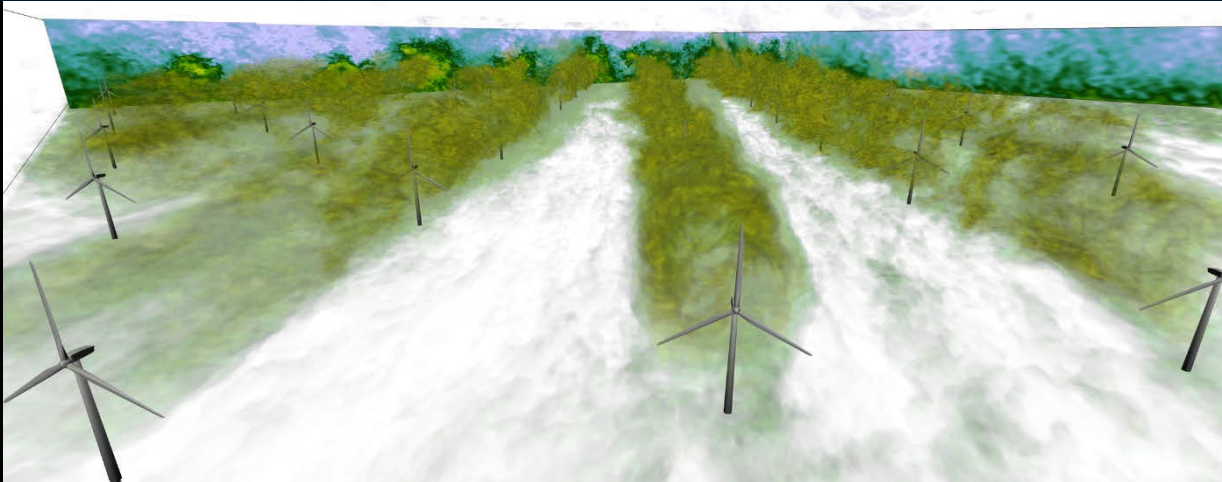


b)



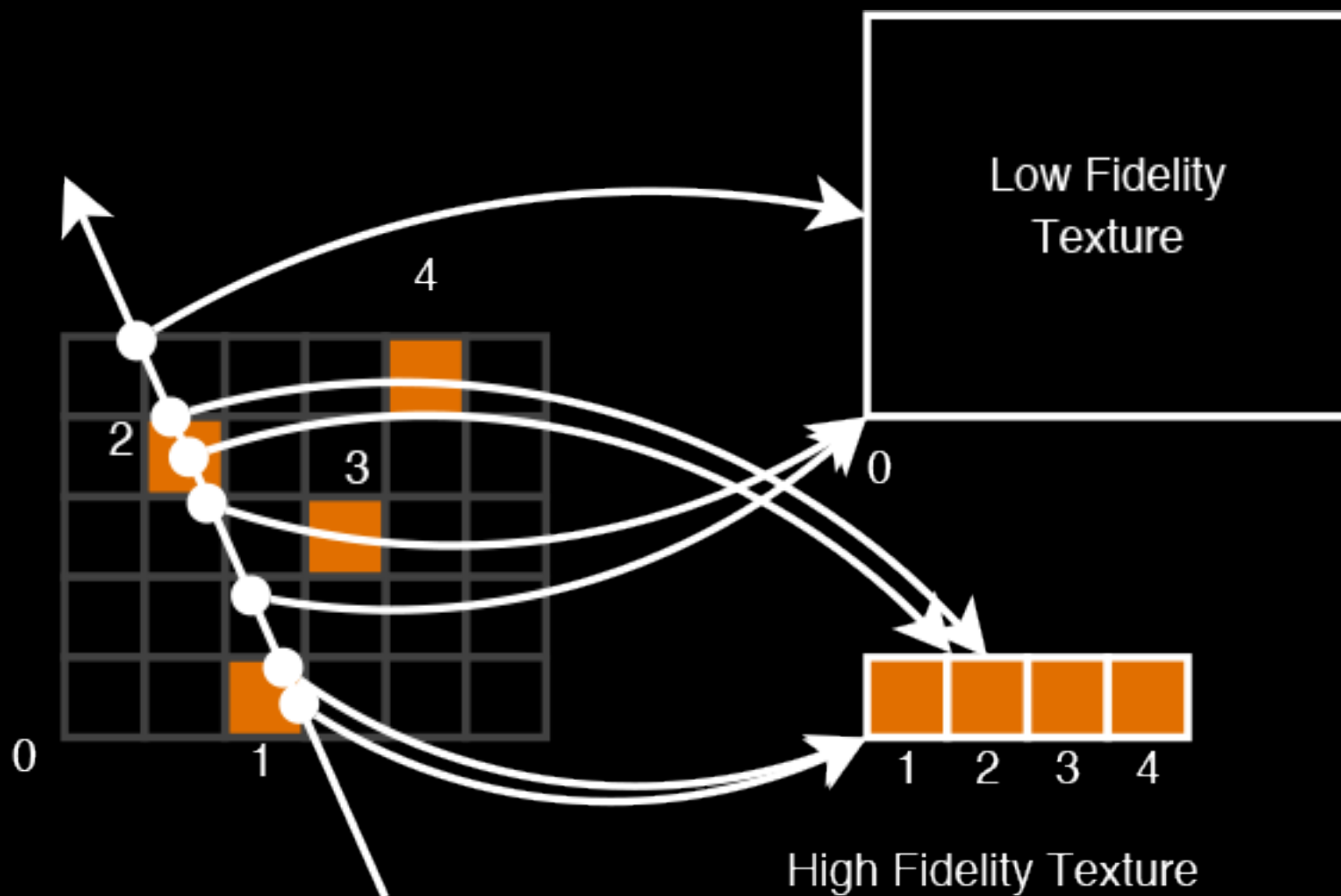
3008m x 3008m x 1024m @ 1m resolution
9.2 billion cells

48 Turbine Case

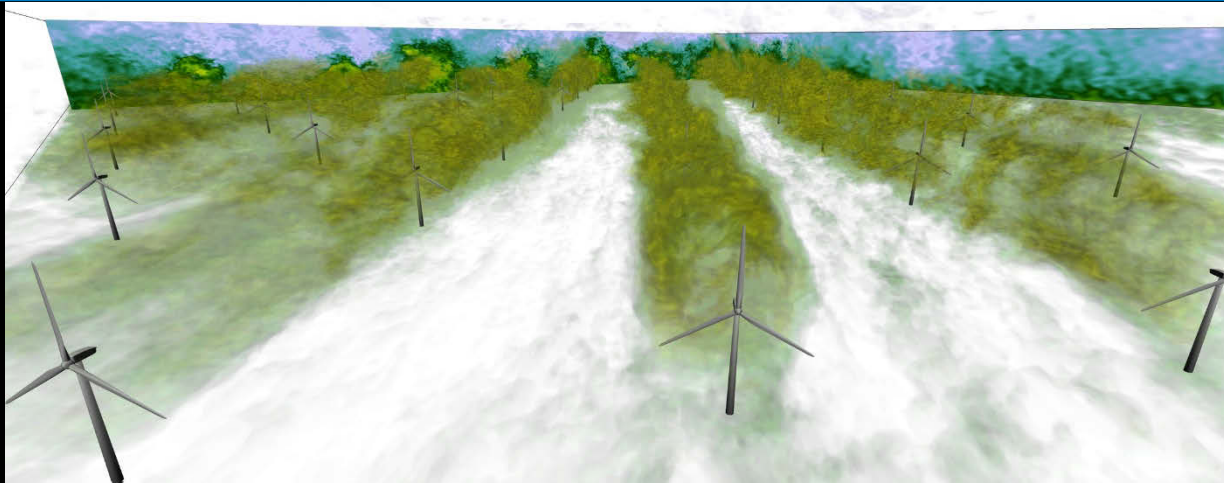


	Unstructured grid	Uniform grid	Mixed Resolution VDC
Reconstruction	n/a	CPU	CPU
Frame rate	*	0.5 fps	0.5 fps
Render time	*	2s	2s
Time to frame	hours	360s	300s
\bar{u} volume size	3.9 GB	38.7 GB	3.7 GB
Metadata size	39.9 GB	673 KB	674 KB

Custom GPU Renderer

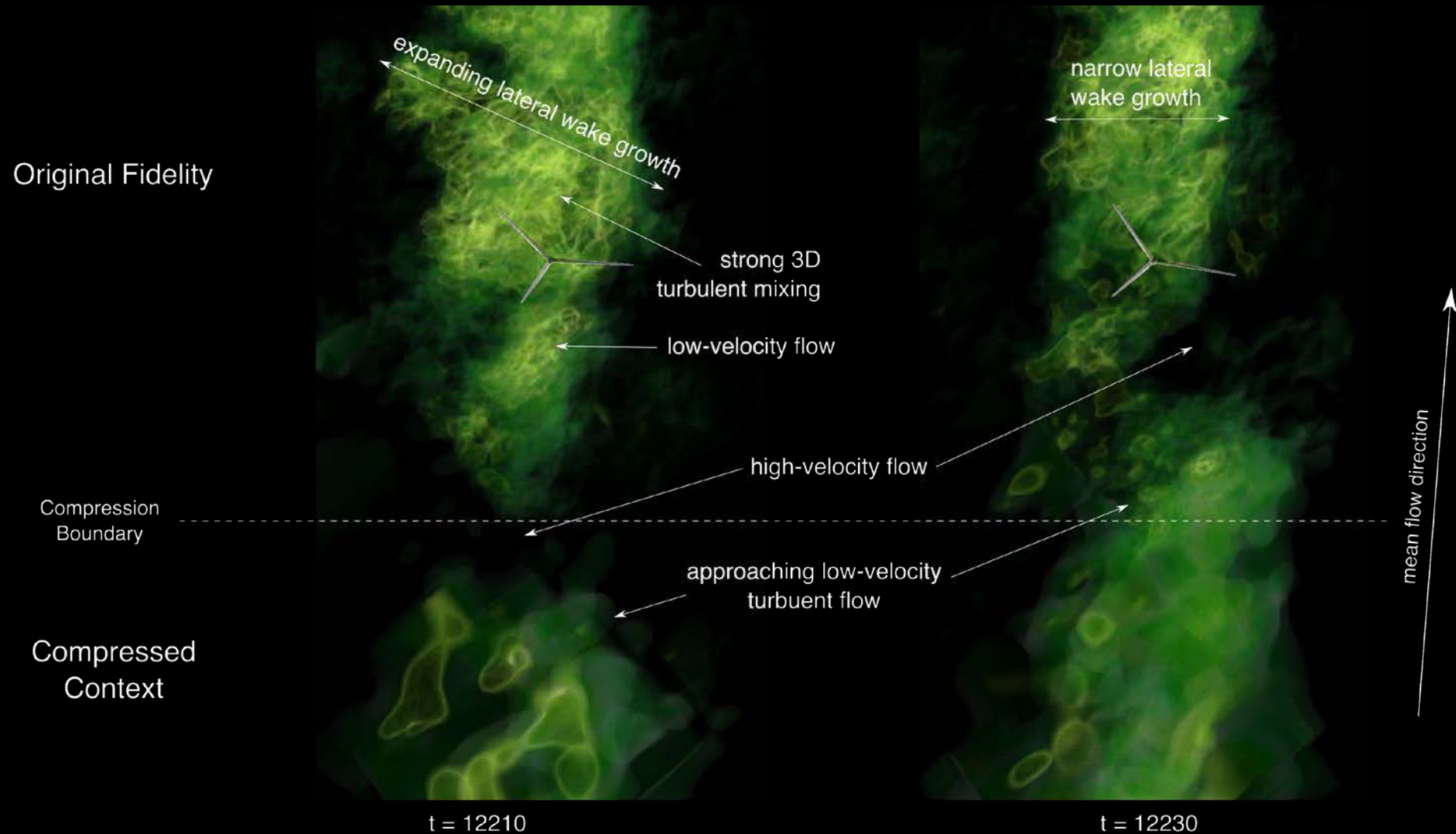


48 Turbine Case



	Unstructured grid	Uniform grid	Mixed Resolution VDC	Mixed Resolution VDC
Reconstruction	n/a	CPU	CPU	GPU
Frame rate	*	0.5 fps	0.5 fps	3-12 fps
Render time	*	2s	2s	0.08-0.33s
Time to frame	hours	360s	300s	70s
\bar{u} volume size	3.9 GB	38.7 GB	3.7 GB	3.7 GB
Metadata size	39.9 GB	673 KB	674 KB	674 KB

Contextualized Compression



Acknowledgements

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