

# Weather Research and Forecast (WRF) Scaling, Performance Assessment and Optimization

Comparison of Compilers and MPI Libraries on Cheyenne

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# Outline

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Background

Intro

Results

Summary

## Background

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## The Weather Research and Forecast Model

“WRF is a state-of-the-art atmospheric modeling system designed for both meteorological research and numerical weather prediction. It offers a host of options for atmospheric processes and can run on a variety of computing platforms. WRF excels in a broad range of applications across scales ranging from tens of meters to thousands of kilometers, including the following.”

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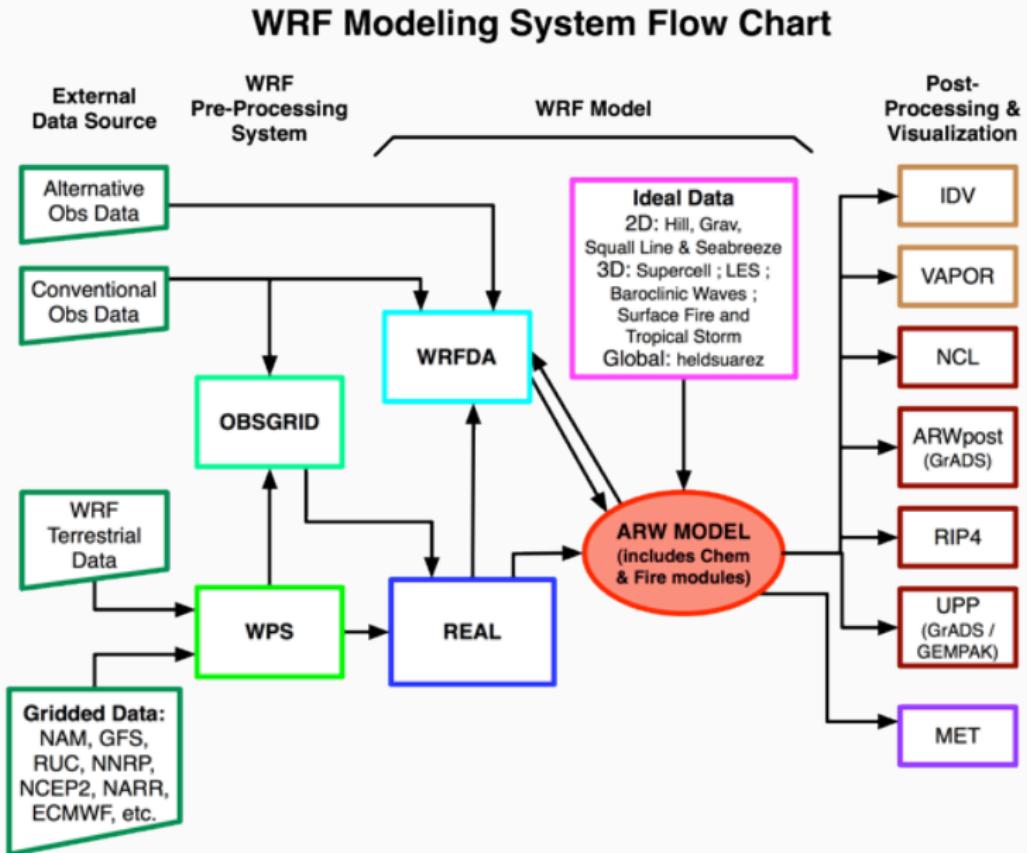
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- Meteorological studies
- Real-time NWP
- Idealized simulations
- Data assimilation
- Earth system model coupling
- Model training and educational support

# WRF Flowchart



# Intro

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## Test cases

- conus12km
- conus2.5km
- new\_conus12km
- new\_conus2.5km
- katrina1km
- katrina3km
- maria1km
- maria3km

# Compilers and MPI Libraries

- GNU Compiler Collection (GCC) versions 6.3.0, 8.1.0
  - WRF compiles with -O2 default
    - Tried -O3 and -mfma (enables FMA instruction set)
    - Use -ofast?
- Intel Compiler versions 17.0.1, 18.0.1
- MPT, MVAPICH

# Settings

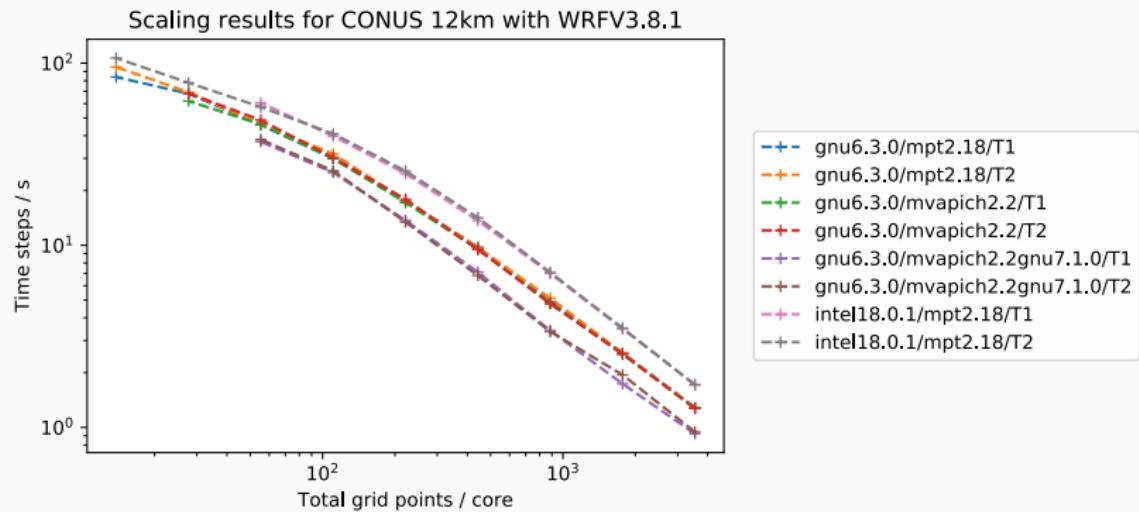
- MVAPICH

[http://mvapich.cse.ohio-state.edu/static/media/  
mvapich/mvapich2-2.3rc2-userguide.html#x1-19100011.15](http://mvapich.cse.ohio-state.edu/static/media/mvapich/mvapich2-2.3rc2-userguide.html#x1-19100011.15)

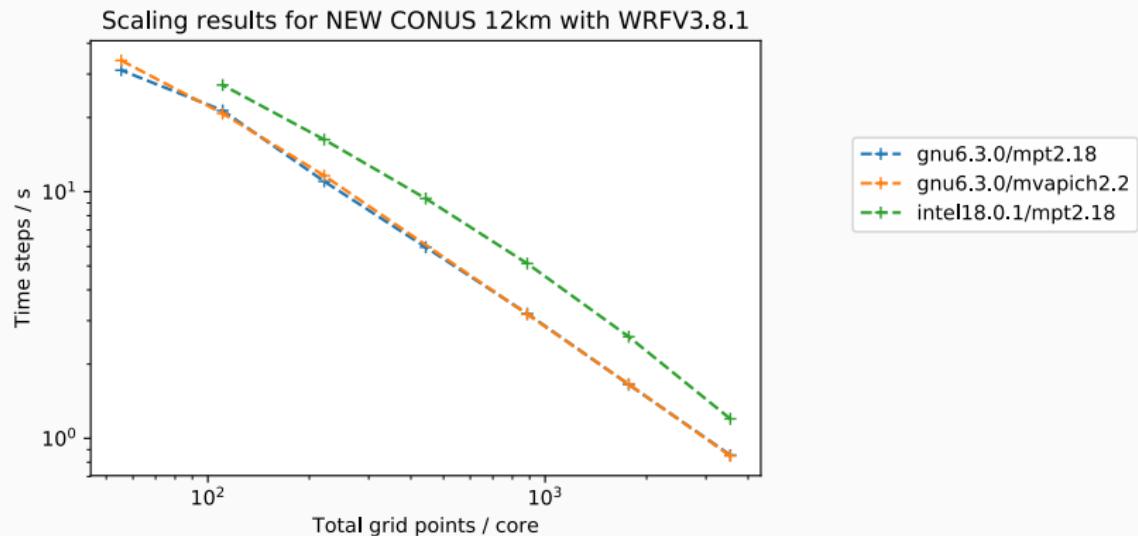
## Results

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# CONUS 12km

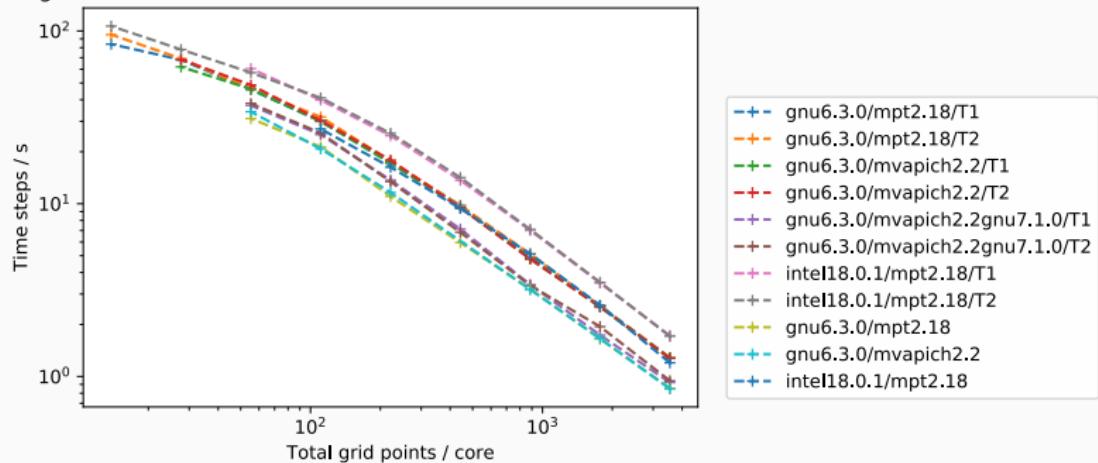


# NEW CONUS 12km WRFV3.8.1



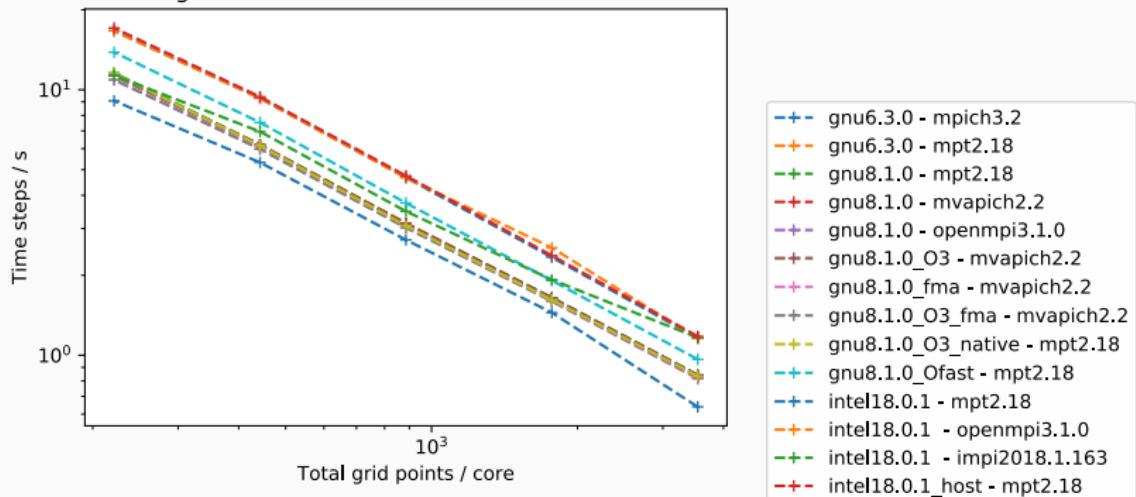
# Old CONUS 12km vs New CONUS 12km WRFV3.8.1

Scaling results for OLD CONUS 12km vs NEW CONUS 12km with WRFV3.8.1

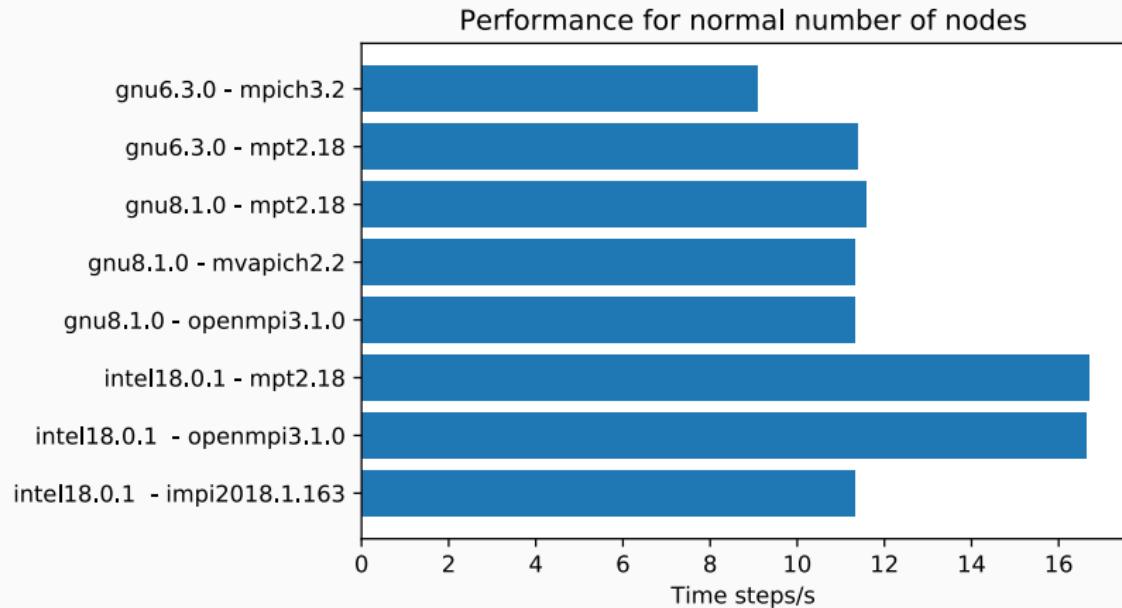


# New CONUS 12km

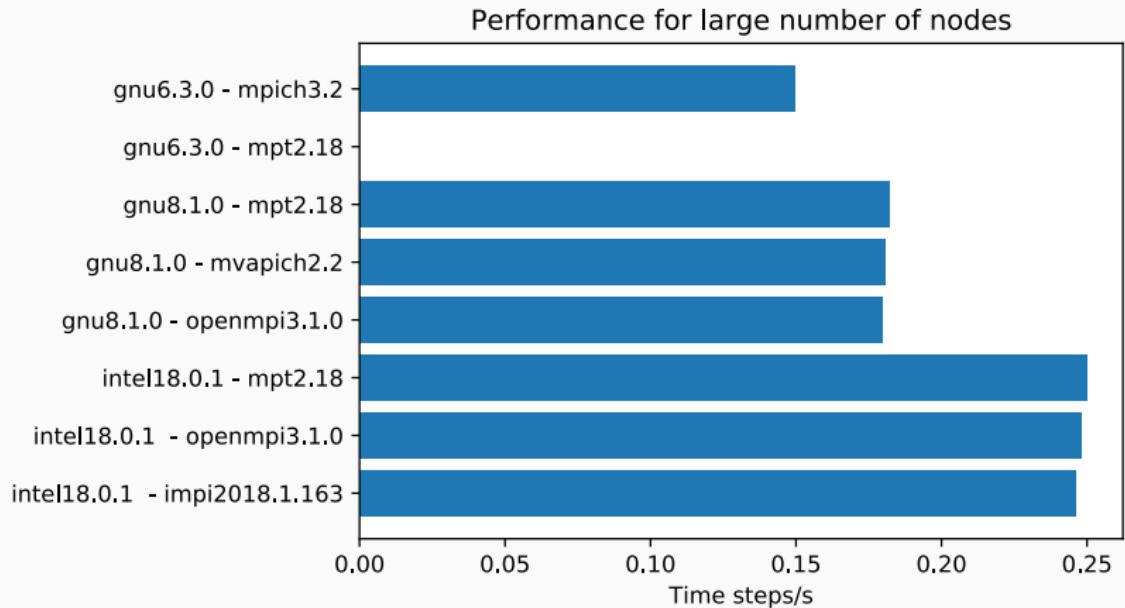
Scaling results for NEW CONUS 12km with WRFV4.0



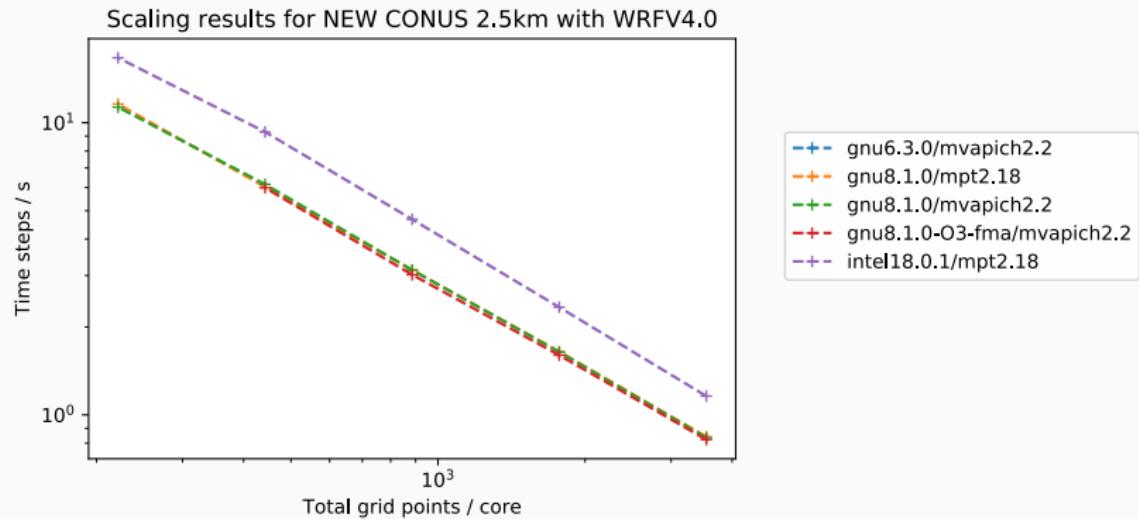
# New CONUS 12km Normal



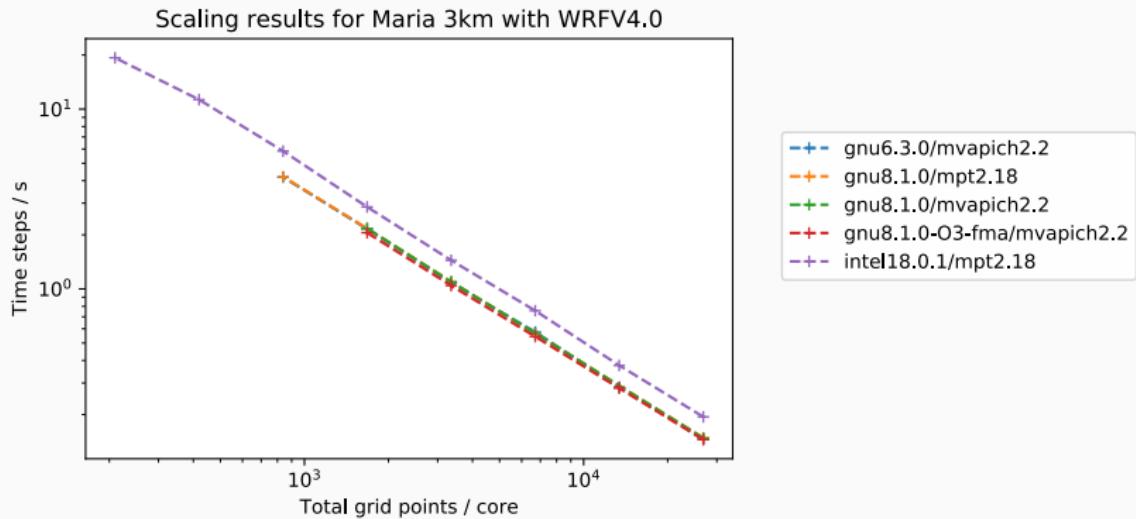
# New CONUS 12km Large



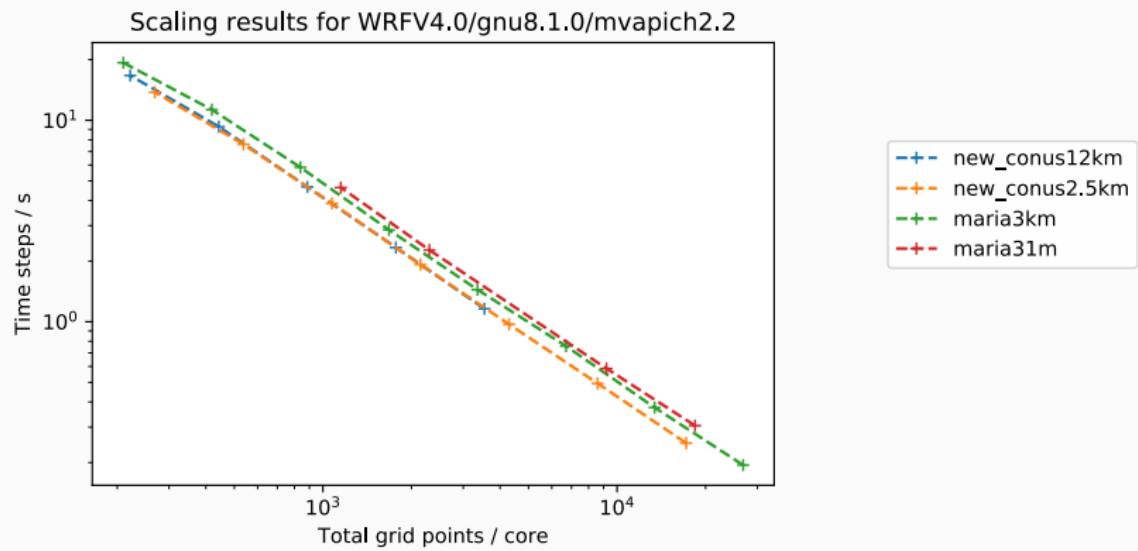
# New CONUS 2.5km



# Maria 3km



# Case comparison



## Summary

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# Conclusions?

- Brownian motion begins with a random walk
- $\langle R_N^2 \rangle = NL^2$  can be related to physical quantities through forces
  - Randomness is very helpful: it allows us to average out a terms<sup>1</sup>

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<sup>1</sup>The Feynman Lectures on Physics, Vol. I