WRF-MOSIT

A Multi-Operating System Install Toolkit for installing the Weather Research and Forecasting (WRF) suite of models.

Hatheway, W., Snoun, H., ur Rehman, H. et al.
WRF-MOSIT: a modular and cross-platform tool for configuring and installing the WRF model.
Earth Sci Inform 16, 4327–4336 (2023).
https://doi.org/10.1007/s12145-023-01136-y

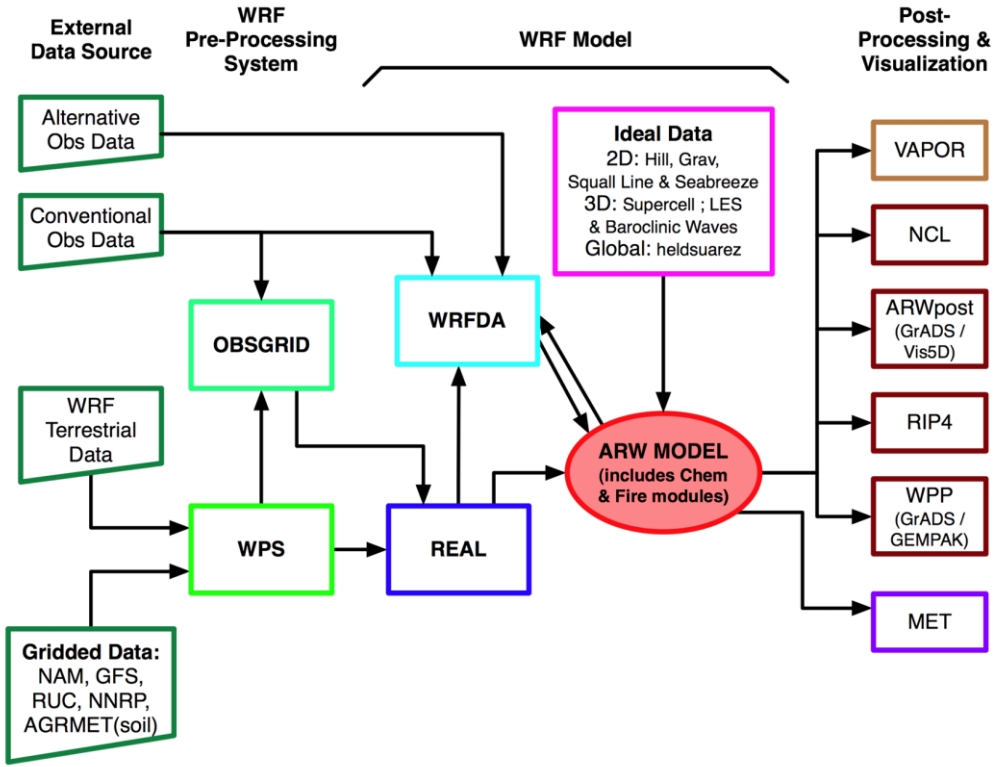
Presentation Overview

- Brief history of the Weather Research and Forecasting (WRF) Model
- Quick summary of WRF structure
- Identifying the challenges of installation
- Overview and history of the WRF-MOSIT
- Features and structure of the WRF-MOSIT
- Future works and potential improvements
- Q&A

Overview of WRF

- Flexible, state-of-the-art numerical weather model
- Key Features:
  - Two dynamical cores
    - Nonhydrostatic Mesoscale Model (NMM) – replaced
    - Advanced Research WRF (ARW) – currently supported
  - Nested simulations
    - 1-way nesting
    - 2-way nesting
  - Scalability and portability
  - Multiple input data options
  - Variety of physics options
  - Data assimilation capabilities
- Developed in conjunction by: NCAR, NCEP, ESRL, USAF, NRL, OU, FAA

WRF Modeling System Flow Chart



WRF Installation Requirements

- OS requirements:
  - Debian Kernel OS (Ubuntu, Arch Linux, Linux Mint, etc.)
  - Fedora Kernel OS (Redhat Linux, Centos, Rocky Linux, etc.)
  - XNU kernel OS (MacOS)
  - Windows Sub System Linux
- Required libraries
  - NetCDF
  - MPICH
  - Jasper
  - Libpng
  - Zlib
  - gcc/gfortran/cpp
- Libraries can be built from source file or package managers

WRF Installation Challenges

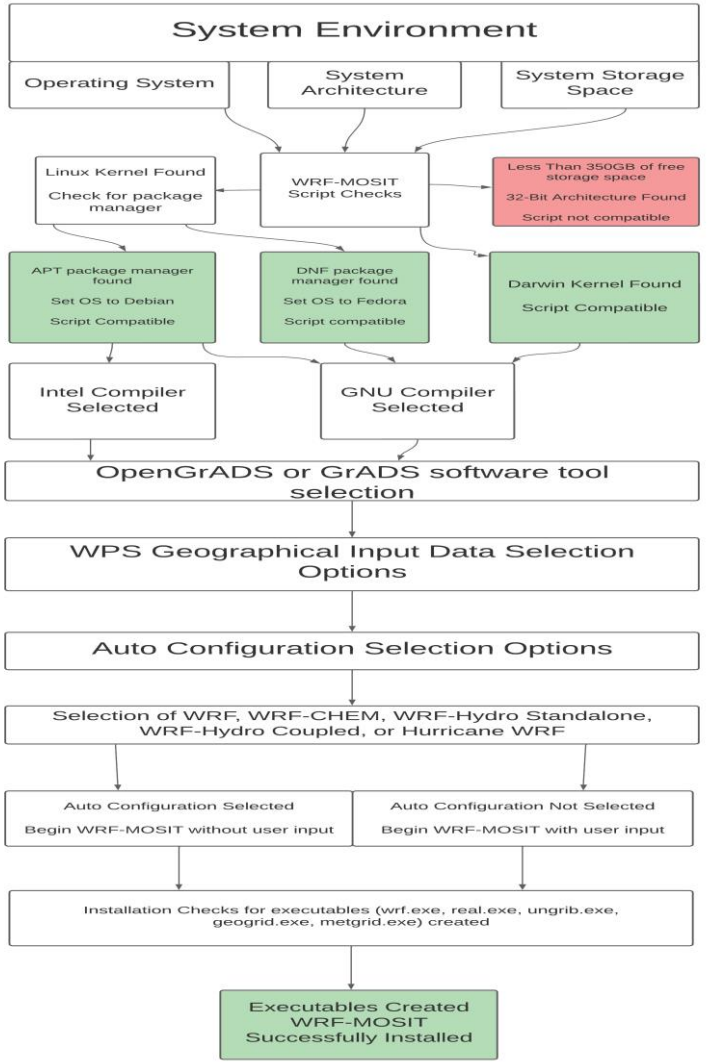
- Different operating systems require different packages and libraries
- Tutorials change based on operating system
- Users are not familiar with terminal-based systems
- Additional setup for different versions of WRF
- Library compatibility issues for newer versions of the required libraries
- Post processing tools have different systems requirements and installation

The Solution: WRF-MOSIT

- WRF-MOSIT: Multi-Operating System Install Toolkit
  - Developed to make it easier to install and run WRF
- How does WRF-MOSIT solve the challenges
  - Fully automated install package
    - Streamlines install process
    - Little to no user interaction with terminal needed
  - Installs all required libraries, packages, binaries, and source files
    - Compatibility and updates maintained by author of the toolkit
  - Freedom of choice in Fortran compilers (GNU or Intel)
  - Semi-GUI interface provides guided steps

Structure of WRF-MOSIT

- Performs system tests to determine OS
- Tests for storage space requirements
- Compiler choice (Intel or GNU)
- Autoconfiguration
- WRF model selection
- Installation checks for successful installation
- Open-Sourced and freely available on GitHub
- Includes support for older pre/post processing tools



Included: Libraries, Software, Packages, etc.

Intel Fortran Compiler
- Libraries
  - Zlib – 1.2.13
  - Libpng – 1.6.39
  - JasPer – 1.900.1
  - HDF5 – 1.14.3
  - PHDF5 – 1.14.3
  - PNETCDF – 1.12.3
  - NetCDF-C – 4.6.1
  - NetCDF-Fortran – 4.9.0
  - Intel OneAPI

GNU Fortran Compiler
- Libraries
  - Zlib – 1.2.13
  - MPICH – 4.1.2
  - Libpng – 1.6.39
  - JasPer – 1.900.1
  - HDF5 – 1.14.3
  - PHDF5 – 1.14.3
  - PNETCDF – 1.12.3
  - NetCDF-C – 4.6.1
  - NetCDF-Fortran – 4.9.0

Included: Software

Intel Fortran Compiler

- WRF Suite
  - WRF-ARW - 4.5.2
  - WPS - 4.5
  - WRFPLUS – 4.5.2
  - WRFDA 4DVAR – 4.5.2
  - WRF-CHEM w/KPP – 4.5.2
  - WRF-CHEM 3DVAR – 4.5.2
  - WRF-Hydro (Standalone) – 5.2
  - WRF-Hydro (Coupled) – 4.5.2
  - Hurricane WRF (HWRF) – 4.3.3
  - WRF-CMAQ – 4.5.2/5.4
  - WRF-SFIRE – v2
- Geography Files
  - Mandatory WPS geog Input Data
  - Geog Input Data for Specific Applications
  - Optional geog Input Data

GNU Fortran Compiler

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Included: Pre/Post Processing

Intel Fortran Compiler

- DTC's Model Evaluation Tools (MET) – 11.0.0
- DTC's METplus – 5.0.0
- Unified Post Processor (UPP) – 4.1
- ARWPost – 3.0
- WRF-Python – 1.3.2
- NCAR Command Language (6.8.6)
- GrADS – 2.2.2
- OpenGrADS – 2.2.1.0
- WRF CHEM Tools
- Climate Data Operators (conda)

GNU Fortran Compiler

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- WRF CHEM Tools
- Prep Chem Source
- RIP4
- Climate Data Operators (conda)

WRF-MOSIT Usage & Efficiency

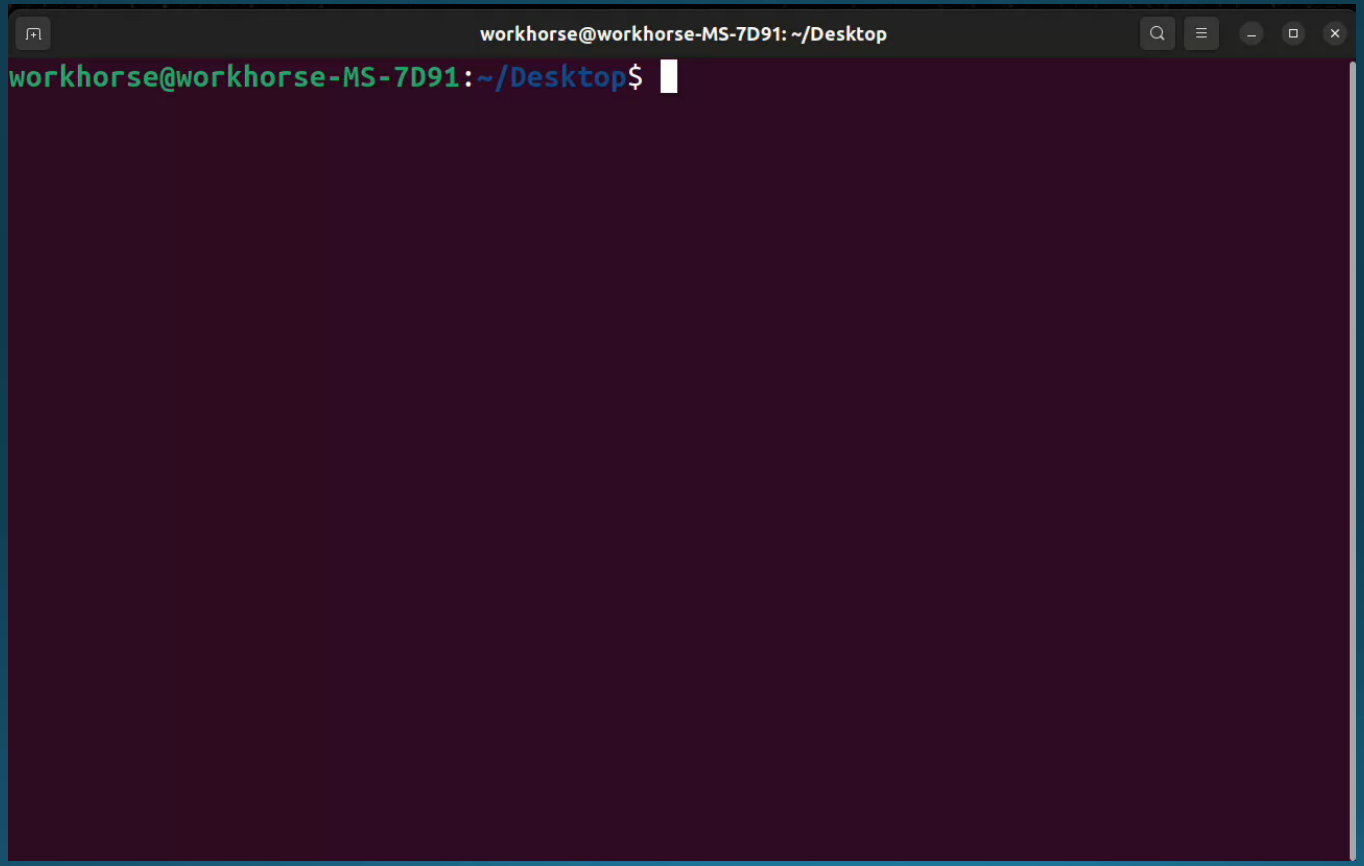
Usage

- 4700+ unique IP address downloads
- 135+ Countries
  - ~67% of the world

Efficiency

- One-click Installation
  - ~ 45-100 minute installation time
    - Assuming 10 mb/s download speed
    - Options selected

Interface


workhorse@workhorse-MS-7D91: ~/Desktop
workhorse@workhorse-MS-7D91:~/Desktop$

Future Works & Potential Improvements

Future Works

- New WRF coupled models
  - COAWST
- Standard meteorological chart python codes
- Updates to libraries
- Additional Pre/Post processing software

Potential Improvements

- Python GUI for software installation
- Enhanced Streamlining

Discussion & Conclusion

- WRF can be a complicated tool to install
  - New users unfamiliar with terminal commands
  - New system OS is different than Windows or MacOS
- Pre/Post processing tools require additional libraries and packages to install with WRF. This adds time and frustration to users.
- The WRF-MOSIT seeks to help new users by semi-automating the process for them.
  - This allows users to focus on their research and/or forecasting
- WRF-MOSIT is free on GitHub for anyone to use
  - https://github.com/HathewayWill

Summary

- WRF is a complicated tool to install
- Additional libraries and packages required to install with WRF
- WRF-MOSIT helps new users by semi-automating the process
  - Less time for installation, more time for research
- WRF-MOSIT is free on GitHub
  - https://github.com/HathewayWill

Thank you for your time!

- I will answer any questions if we have time remaining.
- Otherwise please feel free to contact me through my LinkedIn.
  - https://www.linkedin.com/in/williamhatheway/