



# Introduction to NCEPLIBS

Kyle Gerheiser - NOAA/EMC  
UFS SRW Training

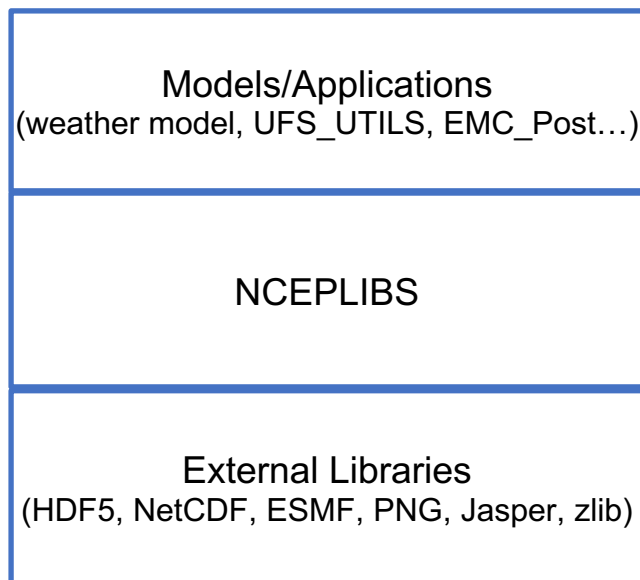


# NCEPLIBS

- NCEPLIBS is a collection of ~15 internally developed libraries and utilities that are used by the weather model and other applications
- Provide model I/O, grid transformations, interpolation, grib utilities...
- Mostly Fortran, some C
- CMake build system
- Distributed on Github
- Most users can treat NCEPLIBS as a block box once they are installed

# Library Hierarchy

- NCEPLIBS sits in the middle between the external dependencies and the model



# The Libraries

- bacio - Binary I/O
- bufr - BUFR utilities
- g2 - grib2 encoder/decoder
- g2tmpl - grib2 template utilities
- gfsio - gfs gaussian to grib
- ip - grid interpolation (grib1 templates)
- ip2 - grid interpolation (grib2 templates)
- landsfcutil - Land surface utilities
- nemsio - I/O for NEMS
- nemsiogfs - I/O for NEMS gfs
- sfcio - surface I/O
- sigio - sigma I/O
- sp - spectral transformations
- w3emc - grib1 encoding/decoding
- w3nco - grib1 encoding/decoding
- wrf\_io - wrf I/O
- wgrib2 - wgrib2 utility

# I/O Libraries

- Models need to create and ready many types of files
- BACIO - Binary I/O
- GFSIO - GFS Gaussian to grib
- SIGIO - Sigma restart I/O for global spectral model
- WRF\_IO - I/O for UPP
- SFCIO - Surface file I/O
- NEMSIO - NEMS I/O
- NEMSIORGFS NEMS-GFS I/O

# Grib Libraries

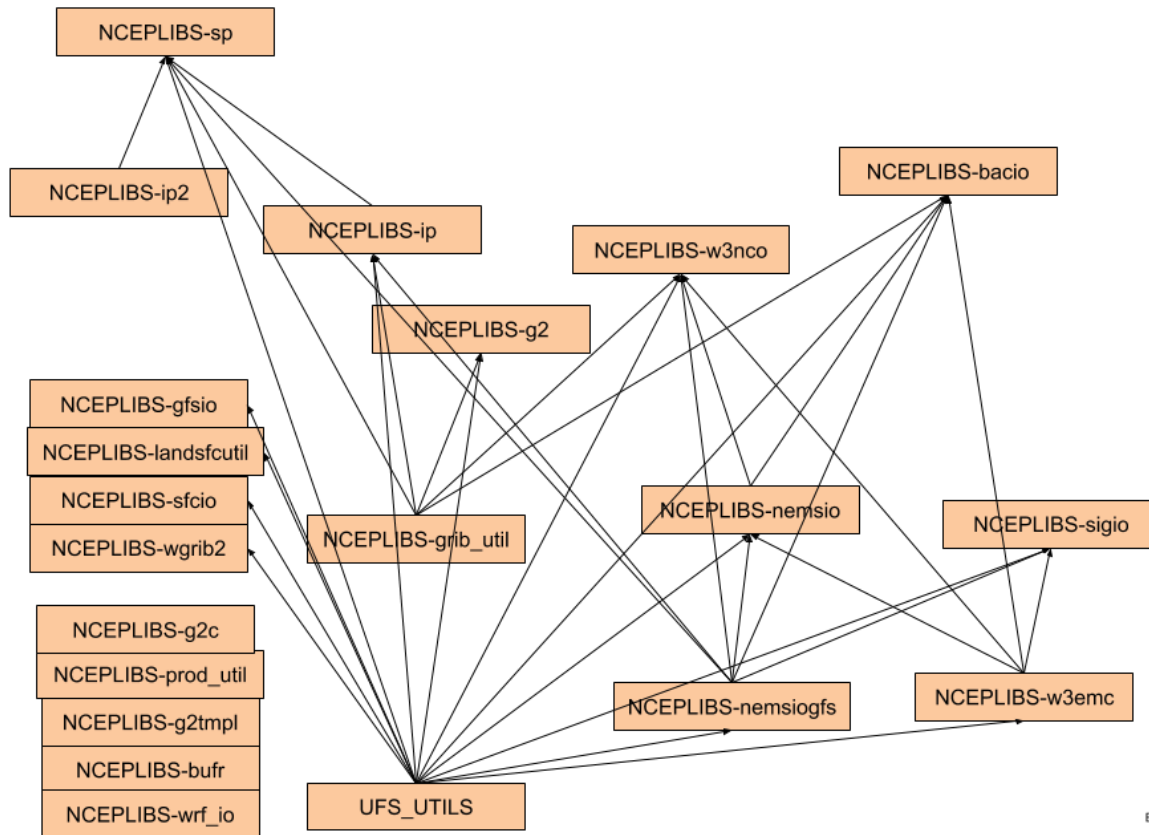
- GRIB is a common file format used in meteorology to store weather data
- Two editions (GRIB 1 and GRIB 2)
  
- G2 - GRIB2 encoder/decoder
- G2TMPL - Utility for GRIB2 templates
- WGRIB2 - Executable for reading/writing/interacting with grib2 files
- W3EMC - GRIB1 encoder/decoder
- W3NCO - GRIB1 encoder/decoder

## Other Libraries

- SP - (Sp)ectral transformations
- Landsfcutil - Land surface utilities
- IP - Interpolates between different grids (grib1 descriptors)
- IP2 - Interpolates between different grids (grib2 descriptors)

# NCEPLIBS Inter-dependencies

NCEPLIBS Inter-dependencies Oct 1, 2020





# CMake Build System

- All NCEPLIBS use a CMake build system
- CMake is an open-source, cross-platform family of tools designed to build, test and package software similar to Autotools
- Benefits
  - Uses an out-of-source build
  - Easy to integrate tests into the build system
  - Provides a way of finding packages using package config files
  - Supports multiple generators (default is make, but also Ninja and more)
  - Cleaner than manually writing make files

# Building the Libraries



# NCEPLIBS-external

- NCEPLIBS-external is a compilation of third-party libraries required to build NCEPLIBS, and by extension the UFS weather model
  - zlib, HDF5, NetCDF, libpng, libjpeg, Jasper, WGRIB2, ESMF
  - <https://github.com/NOAA-EMC/NCEPLIBS-external>
- First step in building and running the weather model
- CMake wrapper to build and download external packages
- Features
  - Can be configured to build only certain libraries
  - Provides Lua and tcl modules

# NCEPLIBS Umbrella Build

- Building all those libraries individually would be tedious
- Luckily there's an “umbrella” build that builds all the libraries for you
  - <https://github.com/NOAA-EMC/NCEPLIBS>
- Requirements
  - Fortran and C compiler
  - Libraries listed under NCEPLIBS-external
- Features
  - Provides Lua and tcl module files for convenience
  - Flat or hierarchical install structure

# Building NCEPLIBS

- NCEPLIBS is available on Github
  - <https://github.com/NOAA-EMC/NCEPLIBS>

```
> git clone https://github.com/NOAA-EMC/NCEPLIBS.git
> cd NCEPLIBS
> mkdir build && cd build
> cmake .. -DCMAKE_PREFIX_PATH=<dependencies> -DCMAKE_INSTALL_PREFIX=<install path>
> make

> module use <install path>/modules
> module load NCEPLIBS
```

# hpc-stack

- Shell script based build system for building software stack needed for NOAA applications
  - <https://github.com/NOAA-EMC/hpc-stack>
- One stop shop for HDF5, NetCDF, ESMF, NCEPLIBS, and more
- Contains up-to-date libraries for develop branch of UFS
- Works on workstations (macOS, Linux) and HPC systems
- Can build with or without modules

# Building hpc-stack

- Steps

- > git clone <https://github.com/NOAA-EMC/hpc-stack.git>
- > cd hpc-stack
- > <edit config/config\_\*>
- > <edit stack/stack\_\*>
- > ./setup\_modules.sh -c config/config\_custom.sh -p `pwd`/install (skip if not using modules)
- > ./build\_stack.sh -c config/config\_custom.sh -p `pwd`/install -y stack/stack\_ufs\_weather\_ci.sh -m (-m for modules)

# Resources

- Detailed instructions can be found on Github
  - <https://github.com/NOAA-EMC/NCEPLIBS-external>
  - <https://github.com/NOAA-EMC/NCEPLIBS>
  - <https://github.com/NOAA-EMC/hpc-stack>
- Github Wiki
  - <https://github.com/NOAA-EMC/NCEPLIBS/wiki>
- We are active on Github if any issues are encountered



# Questions?

