WRF-LIS User's Guide

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Revision 1.0

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History:

Revision	Summary of Changes	Date
1.0	LIS 6.0 - WRF 3.0	March, 2010

Contents

1 Introduction **3**
1.1 What's New 3
1.1.1 LIS 6.0 - WRF 3.0 3

2 Background **4**
2.1 WRF-LIS 4

3 Preliminaries **5**

4 Obtaining the Source Code **6**
4.1 Downloading the Source Code 6

5 Building the Executable **7**
5.0.1 Development Tools 7
5.0.2 Required Software Libraries 7
5.0.3 Optional Software Libraries 7
5.0.4 Build Instructions 8

6 Running the Executable **13**

DRAFT

1 Introduction

This is the WRF-LIS ' User's Guide. This document describes how to download and install the WRF and LIS codes and instructions on building a combined executable.

This document consists of several sections, described as follows:

1 Introduction: the section you are currently reading

2 Background: general information about the WRF-LIS project

3 Preliminaries: general information, steps, instructions, and definitions used throughout the rest of this document

4 Obtaining the Source Code: the steps needed to download the source code

5 Building the Executable: the steps needed to build the WRF-LIS executable

1.1 What's New

1.1.1 LIS 6.0 - WRF 3.0

1. This version enables coupling between LIS (version 6.0) and WRF (version 3.0) using the Earth System Modeling Framework (ESMF) (version 3.1.0rp2).

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2 Background

This section provides some general information about the WRF - LIS project.

2.1 WRF-LIS

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3 Preliminaries

This section provides some preliminary information to make reading this guide easier.

Commands are written like this:

```
% cd /path/to/WRFV3LIS6
```

```
% ls
```

"...compiler flags, the run `gmake`."

File names are written like this:

/path/to/WRFV3LIS6/src

You need to create a working directory on your system to install the coupled WRF - LIS system. Let's call this directory */path/to/WRFV3LIS6/*. Throughout the rest of this document, this directory shall be referred to as *$WORKING*. You should create a directory to run the executable in. This directory can be created anywhere on your system, but, in this document, we shall refer to this running directory as *$WORKING/run*.

DRAFT

4 Obtaining the Source Code

This section describes how to obtain the source code needed to build the WRF-LIS executable.

The source code is maintained in a Subversion repository; thus, you need the Subversion client (svn) to obtain this code. If you need any help regarding Subversion, please go to http://subversion.tigris.org/.

4.1 Downloading the Source Code

To obtain the source code needed for coupled WRF-LIS, you must first obtain access to the LIS source code respository. To obtain access you must contact the LIS team. Once you have access to the repository, you will be given the correct Subversion command to run to checkout the source code.

1. Go to the working directory

   ```
   % cd $WORKING
   ```

   ```
   % svn checkout
   https://flood.gsfc.nasa.gov/svn/external/WRF/branches/AFWA_LIS-6_WRF_3.0-devel
   .
   ```

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5 Building the Executable

This section describes how to build the source code and create WRF-LIS' executable – named `wrf_LIS_ESMF.exe`.

5.0.1 Development Tools

This code has been compiled and run on Linux PC (Intel) systems, and IBM AIX systems. These instructions expect that you are using such a system. In particular you need

- IBM
  - XL Fortran version 12.1
  - GNU's make, gmake, version 3.77
- Linux
  - Intel Fortran Compiler version 11.1.038
  - GNU's make, gmake, version 3.77

5.0.2 Required Software Libraries

In order to build the LIS executable, the following libraries must be installed on your system:

- Earth System Modeling Framework (ESMF) version 3.1.0rp2 (http://www.esmf.ucar.edu/) Please read the ESMF User's Guide for details on compiling ESMF with MPI support and without MPI support ("mpiuni"). Note that ESMF must be compiled with MPI support for using WRF-LIS system in a multiprocessor environment.

5.0.3 Optional Software Libraries

The following libraries are not required to compile LIS. They are used to extend the functionality of LIS.

- Message Passing Interface (MPI) – If you wish to run the MPI-based running mode
  - vendor supplied, or
  - MPICH version 1.2.7p1 (http://www-unix.mcs.anl.gov/mpi/mpich1/)
- If you choose to have NETCDF support, please download the netcdf source (http://www.unidata.ucar.edu/software/netcdf/) and compile the source to generate the NETCDF libray.

To install these libraries, follow the instructions provided at the various URL listed above.

DRAFT

5.0.4 Build Instructions

1. Perform the steps described in Section 4 to obtain the source code. (Commands on the NCAR IBM (AIX) platform (Bluefire) are shown as examples)

2. Set environment variables

   WRF_LIS to 1;

   `% export WRF_LIS=1`

   Set the LIS_ARCH to reflect the platform that you are working on

   `% export LIS_ARCH=AIX` ; on IBM AIX machines
   `% export LIS_ARCH=linux_ifc` ; on Discover/Columbia

   Set paths to ESMF (ESMFLIB - path to ESMF library and ESMFINC - path to ESMF modules)

   ```
   % export ESMFLIB=/mmm/users/sujay/esmf_install/lib/libg/AIX.default.64.mpi.default
   % export ESMFINC=/mmm/users/michalak/esmf_install/mod/modg/AIX.default.64.mpi.default
   ```

   Specify the C compiler on your platform
   `% export CC=xlc`

3. Enable the specific version of the fortran compiler (for tcsh):

   ```
   setenv MODULE_SHELL tcsh

   setenv MODULESROOT /contrib/Modules
   setenv MODULESVERSION 3.2.6
   setenv MODULESHOME ${MODULESROOT}/${MODULESVERSION}
   setenv MODULESPATH ${MODULESHOME}/modulefiles

   setenv DEFAULT_MODULES "modules lsf"

   source ${MODULESHOME}/init/${MODULE_SHELL}

   alias module eval \`/contrib/Modules/$MODULESVERSION/bin/modulecmd csh \!\* \`

   module purge
   module load ${DEFAULT_MODULES}

   module load xlf/12.01.0000.0005
   ```

   (for bash):

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```
source /contrib/Modules/3.2.6/init/bash
module load xlf/12.01.0000.0005
```

4. Run the WRF configure utility

   `% ./configure` which leads to a screen such as:

```
------------------------------------------------------------------------
Please select from among the following supported platforms.

   1.  AIX xlf compiler with xlc  (serial)
   2.  AIX xlf compiler with xlc  (smpar)
   3.  AIX xlf compiler with xlc  (dmpar)
   4.  AIX xlf compiler with xlc  (dm+sm)

Enter selection [1-4] :
```

   Make an appropriate selection (3 for a parallel configuration)

   The next prompt will be:

```
Compile for nesting? (1=basic, 2=preset moves, 3=vortex following) [default 1]:
```

   This version only supports the basic nesting currently. So please choose 1 as the selection.

   At this point, the configure script should generate a file called *configure.wrf*.

5. Goto the *$WORKING/lis/arch* directory. A number of files named *configure.lis.** exist in this directory. Each file contains the configurable options that are specific for each architecture and compiler. For example, the file *configure.lis.aix* contains the set of configurable options for an IBM AIX platform. Depending on your choice of platform, edit this file or create a new file for your platform with the set of options. The following is a list of variables that need to be specified in the *configure.lis* file.

DRAFT

Variable	Description
FC	fortran 90 compiler
FC77	fortan 77 compiler
LD	fortran linker
CC	C compiler
INC_NETCDF	path to NETCDF header files
LIB_NETCDF	path to NETCDF library files
INC_HDF	path to HDF header files
LIB_HDF	path to HDF library files
INC_HDFEOS	path to HDFEOS header files
LIB_HDFEOS	path to HDFEOS library files
LIB_MPI	path to mpi libraries
INC_MPI	path to mpi header files
LIB_ESMF	path to esmf libraries
MOD_ESMF	path to esmf modules
CFLAGS	flags for C compiler
FFLAGS	flags for Fortran 90 compiler
FFLAGS77	flags for Fortran 77 compiler
LDFLAGS	flags for linker

If the user choses to compile and run on a single processor with no MPI, the options in the *configure.lis* file should be specified accordingly. Specifying the compiler preprocessor flag *-DSPMD* enables the compiling of the code with MPI support. Removing this flag produces a serial version of LIS.

6. Compile the new GRIB library, *libw3.a*. You must edit the *Makefile* located in *$WORKING/lis/lib/w3lib*. Uncomment the appropriate block of compiler flags, then run `gmake`.

7. Compile the new GRIB library, *griblib.a*. You must edit the *Makefile* located in *$WORKING/lis/lib/grib*. Uncomment the appropriate block of compiler flags, then run `gmake`.

8. Compile the new GRIB library, *read_grib*. You must edit the *Makefile* located in *$WORKING/lis/lib/read_grib*. Uncomment the appropriate block of compiler flags, then run `gmake <arch>`, where `<arch>` is the appropriate architecture or compiler label. Running `gmake` will produce a list of acceptable values. For example, to compile on a system using the Intel Fortran compiler, run `gmake ifc`.

9. All the included libraries are now generated. Copy the appropriate *configure.lis.** file to *$WORKING/lis/make/configure.lis* and edit this *configure.lis* file to make sure the file paths are specified correctly. A sample *configure.lis* file on bluefire is shown below:

```
# Standard installation
FC              = mpxlf90_r
FC77            = mpxlf_r
```

DRAFT

```
CC              = mpcc_r
LD              = mpxlf90_r
INC_NETCDF      = /usr/local/netcdf/include
LIB_NETCDF      = /usr/local/netcdf

LIB_MPI         = /usr/lpp/ppe.poe/lib
INC_MPI         = /usr/lpp/ppe.poe/include

LIB_ESMF        = /mmm/users/sujay/esmf_install/lib/libg/AIX.default.64.mpi.default
MOD_ESMF        = /mmm/users/sujay/esmf_install/mod/modg/AIX.default.64.mpi.default


FFLAGS          = -I$(INC_MPI) -I$(MOD_ESMF) -c -g -qkeepparm \
                  -qsuffix=f=F90:cpp=F90 -q64 -WF,-DAIX,-DSPMD
FFLAGS77        = -I$(INC_MPI) -I$(MOD_ESMF) -c -g -qkeepparm \
                  -qsuffix=f=f:cpp=F90 -q64 -WF,-DAIX,-DSPMD
CFLAGS          = -c -w -g -qfullpath -q64 -qcpluscmt -DSPMD
LDFLAGS         = -q64 -bmap:map -bloadmap:lm -lmass \
                  ../lib/w3lib/libw3.a              \
                  ../lib/read_grib.aix/readgrib.a   \
                  ../lib/grib/griblib.a             \
                  -L$(LIB_ESMF) -lesmf -lC_r
```

10. Compile the dependency generator, *makdep*. Change directory into *$WORKING/lis/make/MAKDEP*. Run `gmake`.

11. Specify the desired library flags for LIS.

    Change directory into *$WORKING/lis/make*.
    `% cd $WORKING/lis/make`

12. Edit the *misc.h* file to specify if NETCDF, HDF4, HDF5 and GRIB2 support should be included.

    For example, if `define USE_NETCDF` is set, NETCDF support will be included.

    To disable NETCDF support, edit the *misc.h* file to specify `UNDEF USE_NETCDF`. Similar settings should be specified for HDF4, HDF5 and GRIB2 support.

13. Specify the coupled environment flags for LIS.

    Edit the *misc.h* file to ensure that the variable `COUPLED` is set to enabled

    Edit the *misc.h* file to ensure that the variable `INC_WATER_PTS` is set to enabled

    A sample *misc.h* on Bluefire is shown below:

DRAFT

```
#undef USE_HDF4
#undef USE_HDF5
#undef MINPACK
#undef USE_GRIB2
#undef CRTM
#define OFFLINE
#define COUPLED
#define INC_WATER_PTS
```

14. Run the compile script in the *$WORKING* directory

    ```
    % $WORKING
    % ./compile wrf
    ```

15. If the compile process is successful, the WRF-LIS executable called `wrf_LIS_ESMF.exe` will be produced in *$WORKING/main* directory.

DRAFT

6 Running the Executable

This section describes how to run the WRF-LIS executable.

To customize your run, you must modify the *lis.config* configuration file and the *namelist.wrf* files.

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References

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