SURFEX Installation

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1. Download the required SURFEX version

Open-SURFEX

Can be directly downloaded on the SURFEX website open_surfex_v8_1.tar.gz

https://www.umr-cnrm.fr/surfex/spip.php?article387

- not included : DrHOOK, FA/LFI formats, GAUSSIAN grid

- updated each 6 months only

or

SURFEX with GIT

If you are developer, if you need more frequent updates, or if you need what is not in Open-SURFEX (DrHOOK, FA/LFI formats, GAUSSIAN grid), we invite you to

follow the procedure to get a GIT account and to access real-time modifications of the code.

- GIT server (access possible outside Météo-France)

- Documentation/Procedure : http://www.umr-cnrm.fr/surfex/spip.php?article415

- One account by computer

1. Download the required SURFEX version

For the training course, the code is provided in SURFEX-ALL-2022.tar.gz

```
cd $HOME

tar -xzvf SURFEX-ALL-2022.tar.gz

rm -f SURFEX-ALL-2022.tar.gz
```

▶ **VERSION_81/** : directory with the SURFEX code

▶ **VERSION_81/MY_RUN/KTEST/stage_surfex/** : directory with the practical exercises

▶ **data/** : directory with physiographic files needed for the exercises

▶ **exercises.pdf** : document with instructions for the different exercises

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2. Presentation of SURFEX repository

src/ : configure, Makefile*, Rules.* : files used for compilation.
Compilation directory.

src/OFFLINE

src/SURFEX   fortran code

src/ASSIM

src/LIB : librairies

exe/ : empty at the beginning. Executables are linked in this directory at the end of the compilation.

conf/ : profile files are created in this directory

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3. Compile SURFEX master

Initialization of environment variables needed for SURFEX

▶ `./configure`

▶ `. ../conf/profile_surfex-LXgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0`

→ *The name of the profile can change. When configure is executed, a profile is printed on the screen. You have to load this profile.*

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3. Compile SURFEX master

Initialization of environment variables needed for SURFEX

- ► `./configure`

- ► `. ../conf/profile_surfex-LXgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0`

→ *The name of the profile can change. When configure is executed, a profile is printed on the screen. You have to load this profile.*

Compilation of the master version of the code

- ►`make` (→ takes about 15min)

- ►`make installmaster` (→ to link the executables in the directory exe)

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3. Compile SURFEX master

Compilation : always in the src/ directory

```
cd $HOME/SFX/VERSION_81/src/

export ARCH=LXgfortran
```

3. Compile SURFEX master

Compilation : always in the src/ directory

```
cd $HOME/SFX/VERSION_81/src/

unset ARCH
```

```
./configure
```

3. Compile SURFEX master

Compilation : always in the src/ directory

```
cd $HOME/SFX/VERSION_81/src/
unset ARCH
```

```
. ../conf/profile_surfex-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
```

3. Compile SURFEX master

Compilation : always in the src/ directory

```
cd $HOME/SFX/VERSION_81/src/

unset ARCH
```

```
make
```

3. Compile SURFEX master

Compilation : always in the src/ directory

```
cd $HOME/SFX/VERSION_81/src/

unset ARCH
```

```
make installmaster
```

3. Compile SURFEX master

At the end, (after "make installmaster") master executables should have been created and linked in the directory VERSION_81/exe/

In $HOME/SFX/VERSION_81/exe , you have now:

```
OFFLINE-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
PGD-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
PREP-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
SODA-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
```

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3. Run SURFEX master - EXAMPLE

→ Go to your run directory
      `cd $HOME/SFX/VERSION_81/MY_RUN/KTEST/hapex/`

→ This directory must contain:
  - your OPTIONS.nam
  - your forcing files
  - links to the physiographic files needed for your experiment
  - links to the executables

→ In this example, you already have in the run directory an OPTIONS.nam and a forcing file (FORCING.nc)

→ Links for physiographic files

→ Links for executables pgd/prep/offline

→ Run SURFEX
`./pgd.exe`
`./prep.exe`
`./offline.exe`

4. Compile your own version

- Choose a name for your own source directory in src/, for example MYSRC/

- Place in src/MYSRC/ the routines with your modifications

- Recompile SURFEX with your modifications

```
cd $HOME/SFX/VERSION_81/src/

export VER_USER=MYSRC

./configure

. ../conf/profile_surfex-Lxgfortran-SFX-V8-1-1-MYSRC-MPIAUTO-OMP-O2-X0

make user

make installuser
```

4. Compile your own version

At the end, (after "make installuser") the executables for your version should have been created and linked in the directory VERSION_81/exe/

In $HOME/SFX/VERSION_81/exe :

```
OFFLINE-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
PGD-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
PREP-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
SODA-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
OFFLINE-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
PGD-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
PREP-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
SODA-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
```

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4. Compile your own version - EXAMPLE

Modify the code

```
cd $HOME/SFX/VERSION_81/src/

mkdir MYSRC/

cp SURFEX/ini_data_cover.F90 MYSRC/

gedit MYSRC/ini_data_cover.F90
```

Add at line 2538, after CALL ARRANGE_COVER

```
    print * , 'DATA_NATURE',size(XDATA_NATURE),XDATA_NATURE(1:10)
```

save and close ini_data_cover.F90

4. Compile your own version - EXAMPLE

Compile with your modification

```
Open a new terminal

cd $HOME/SFX/VERSION_81/src/

export VER_USER=MYSRC

./configure

. ../conf/profile_surfex-Lxgfortran-SFX-V8-1-1-MYSRC-MPIAUTO-OMP-O2-X0

make user

make installuser
```

4. Compile your own version - EXAMPLE

Run SURFEX with your MYSRC version

→ go to the run directory

```
cd $HOME/SFX/VERSION_81/MY_RUN/KTEST/hapex/
```

→ Create the links to the executables of your MYSRC version

```
ln -s ../../../exe/OFFLINE-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
offline_mysrc.exe

ln -s ../../../exe/PGD-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
pgd_mysrc.exe

ln -s ../../../exe/PREP-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0-MYSRC
prep_mysrc.exe
```

→ Rerun SURFEX

```
./pgd_mysrc.exe
```

5. To change configure options

Configure is executed with some default options of compilation.

▶ **Options for VER_MPI:**

NOMPI (no MPI), MPIAUTO (default MPI library on the PC), specific libraries to be defined

```
export VER_MPI=NOMPI
./configure
. ../conf/profile_surfex-Lxgfortran-SFX-V8-1-1-NOMPI-OMP-O2-X0
make
```

▶ **Options for OPTLEVEL :** (optimization level) : DEBUG, O2 (default)

```
export OPTLEVEL=DEBUG
```

Documentation : https://www.umr-cnrm.fr/surfex/spip.php?article368

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6. Documentation / recommandation for installation

▶ http://www.umr-cnrm.fr/surfex/spip.php?article191

User's guide > 1. How to install the sofware > 1.2. Export off-line version of SURFEX

▶ Recommandations about compilation (V8):

http://www.umr-cnrm.fr/surfex/spip.php?article368

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6. Documentation / recommandation for installation

▶ http://www.umr-cnrm.fr/surfex/spip.php?article191

User's guide > 1. How to install the sofware > 1.2. Export off-line version of SURFEX

▶ Recommandations about compilation (V8):

http://www.umr-cnrm.fr/surfex/spip.php?article368

First important recommandation : before to run an experiment (pgd, prep or offline), you need to type

    export OMP_NUM_THREADS=1

in the terminal where you will run the experiment.
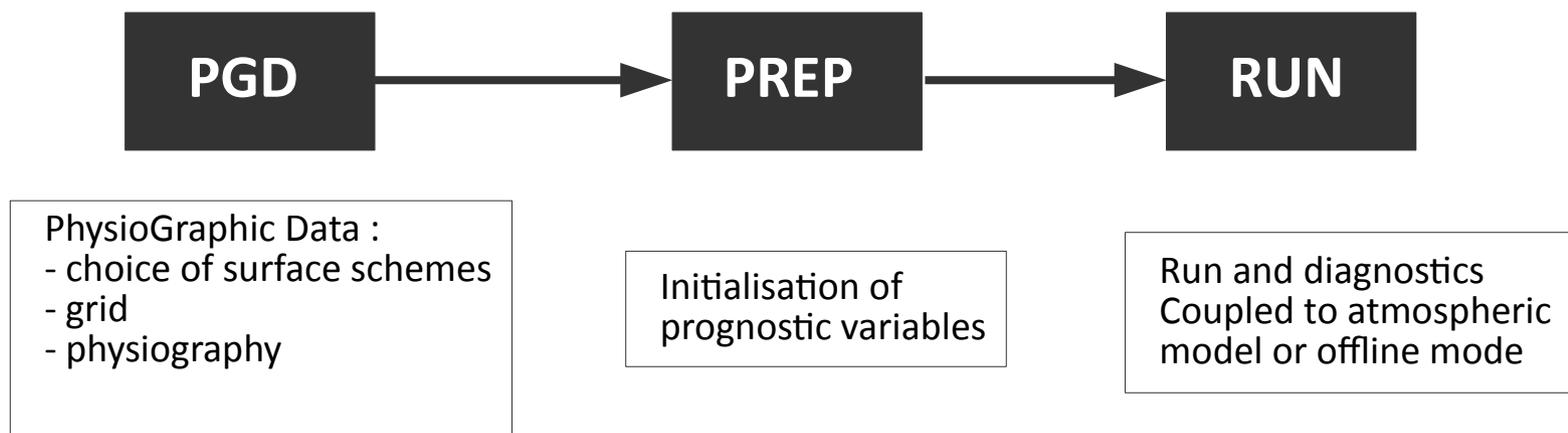
→ You can add this line in your $HOME/.bashrc

7. Running SURFEX : the sequence

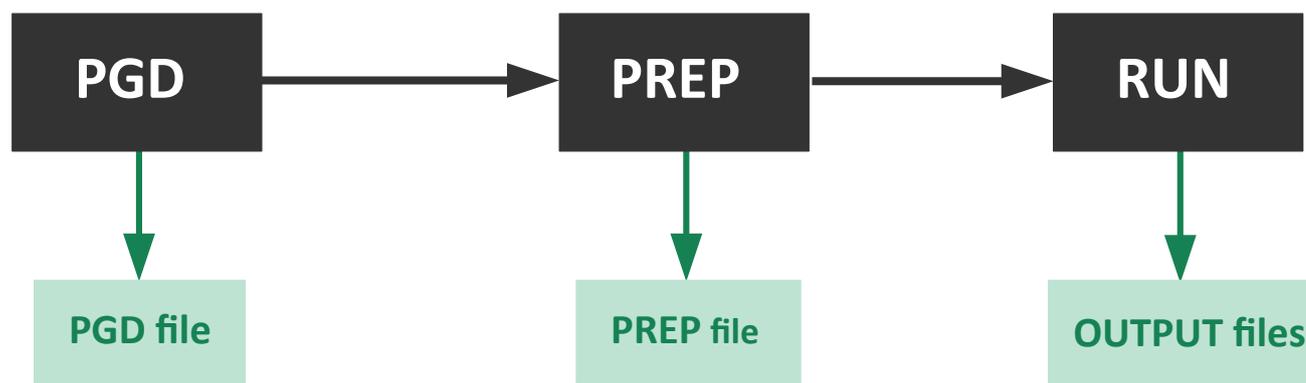At the end of the compilation, different executables have been created.

In $HOME/SFX/VERSION_81/exe

```
OFFLINE-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
PGD-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
PREP-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
SODA-Lxgfortran-SFX-V8-1-1-MPIAUTO-OMP-O2-X0
```

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7. Running SURFEX : the sequence

PGD → **PREP** → **RUN**

PhysioGraphic Data :
- choice of surface schemes
- grid
- physiography

Initialisation of prognostic variables

Run and diagnostics
Coupled to atmospheric model or offline mode

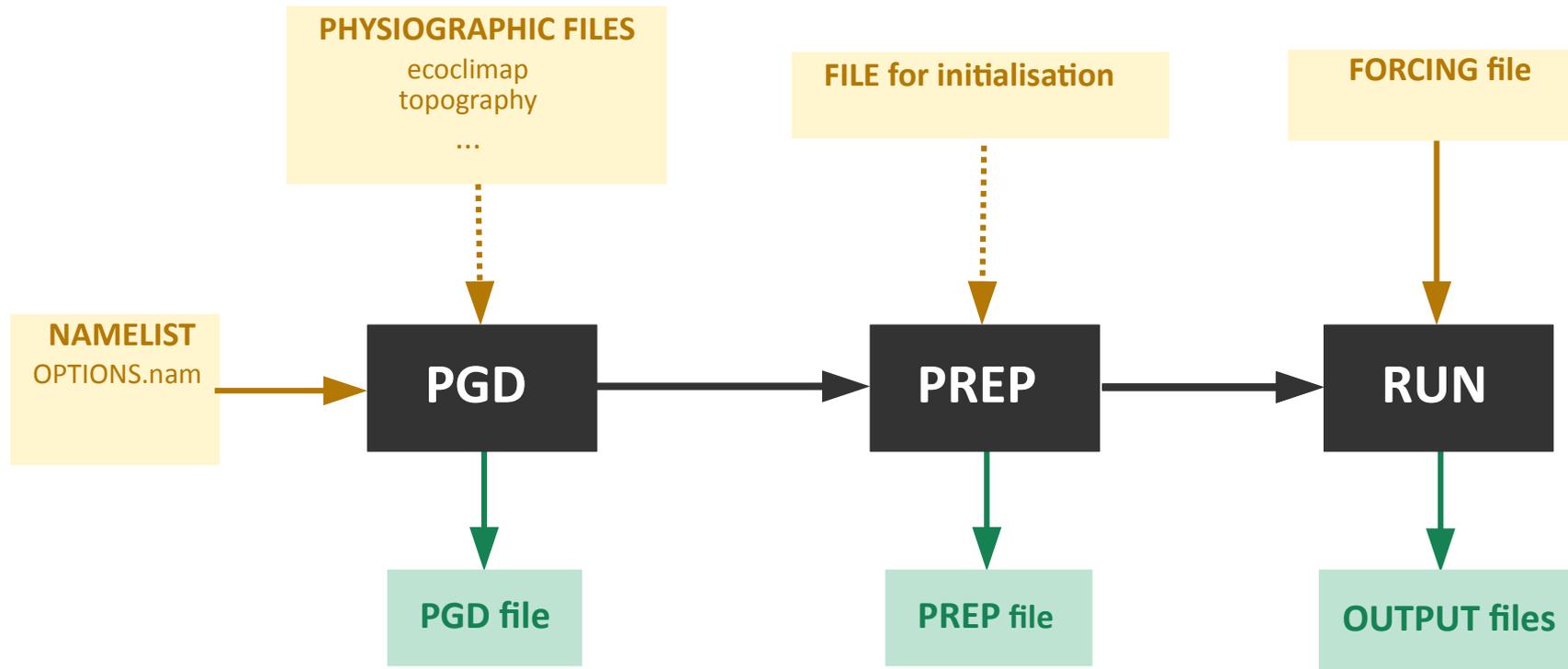METEO FRANCE

7. Running SURFEX : the sequence

7. Running SURFEX : the sequence

Input files
Output files

7. Running SURFEX : the input files

The use of SURFEX in requires the preparation of several types of files, especially the input data necessary for the run. All these files need to be present (or linked) in your run directory.

OPTIONS.nam : The namelist OPTIONS.nam is the SURFEX codified external ASCII file where the user defines the configuration for its experiment.

7. Running SURFEX : the input files

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OPTIONS.nam : The namelist OPTIONS.nam is the SURFEX codified external ASCII file where the user defines the configuration for its experiment.

```
                        Exemple OPTIONS.nam

&NAM_FRAC               LECOCLIMAP = T
/
&NAM_COVER              YCOVER    = 'ECOCLIMAP_I_GLOBAL',
                        YCOVERFILETYPE = 'DIRECT'
/
&NAM_PGD_GRID           CGRID = 'CONF PROJ '
/
&NAM_CONF_PROJ_GRID     XLONCEN = -76.,
                        XLATCEN = 20.,
                        NIMAX   = 216,
                        NJMAX   = 120,
                        XDX     = 10000,
                        XDY     = 10000
/
&NAM_CONF_PROJ          XLON0 = -76.,
                        XLAT0 = 20.,
                        XRPK  = 0.,
                        XBETA=0.
/
&NAM_PGD_SCHEMES        CNATURE = 'ISBA  ',
                        CSEA    = 'SEAFLX',
                        CTOWN   = 'TEB   ',
                        CWATER  = 'WATFLX'
/
&NAM_ZS                 YZS='gtopo30',
                        YZSFILETYPE='DIRECT'
/
```

- Succession of different namelist blocks
  (begin with **&** and end with **/**)

- Some namelist are specific for PGD, PREP or RUN
  step, but there is only one namelist OPTIONS.nam
  for PGD/PREP/RUN steps

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7. Running SURFEX : the input files

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```
                    Exemple OPTIONS.nam

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/
&NAM_COVER            YCOVER     = 'ECOCLIMAP_I_GLOBAL',
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/
&NAM_PGD_GRID        CGRID = 'CONF PROJ '
/
&NAM_CONF_PROJ_GRID  XLONCEN = -76.,
                     XLATCEN = 20.,
                     NIMAX   = 216,
                     NJMAX   = 120,
                     XDX     = 10000,
                     XDY     = 10000

/
&NAM_CONF_PROJ       XLON0 = -76.,
                     XLAT0 = 20.,
                     XRPK  = 0.,
                     XBETA=0.

/
&NAM_PGD_SCHEMES     CNATURE = 'ISBA  ',
                     CSEA    = 'SEAFLX',
                     CTOWN   = 'TEB   ',
                     CWATER  = 'WATFLX'

/
&NAM_ZS              YZS='gtopo30',
                     YZSFILETYPE='DIRECT'

/
```

Possibility to use external database/maps or **physiographic files** (covers, topography, sand/clay fractions, bathymetry, organic carbon fractions,…)

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Physiographic files : Possibility to use external database/maps or physiographic files (covers, topography, sand/clay fractions, bathymetry, organic carbon fractions,…)

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Physiographic files : Possibility to use external database/maps or physiographic files (covers, topography, sand/clay fractions, bathymetry, organic carbon fractions,…)

Files used for initialization : Possibility to use external files to initialize all, or some prognostic variables during PREP step

7. Running SURFEX : the input files

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Physiographic files : Possibility to use external database/maps or physiographic files (covers, topography, sand/clay fractions, bathymetry, organic carbon fractions,...)

Files used for initialization : Possibility to use external files to initialize all, or some prognostic variables during PREP step

Forcing files

7. Running SURFEX : Forcing files

To run SURFEX in offline mode, atmospheric variables must be prescribed :
 - air temperature
 - specific humidity
 - wind speed
 - wind direction
 - downward direct shortwave radiation
 - downward diffuse shortwave radiation
 - downward longwave radiation
 - surface pressure
 - snowfall rate
 - CO2 concentration
 - rainfall

Different formats possible :

```
&NAM_IO_OFFLINE
     CFORCING_FILETYPE   = "NETCDF",

 /
```

7. Running SURFEX : Forcing files

NETCDF format:

Only one file called FORCING.nc

Names of variables, units, dimensions, etc... are described here:
https://www.umr-cnrm.fr/surfex/spip.php?article215

ASCII format:

A file per variable : Forc_TA.txt, Forc_PS.txt, etc...

Params_config.txt file : configuration file, with date, number of points, forcing time step, latitude, etc...

Names of files, units, etc.... are described here :
https://www.umr-cnrm.fr/surfex/spip.php?article214

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7. Running SURFEX : Output files

PGD file / PREP file : different formats possible (ASCII, NetCDF, FA, LFI)

```
&NAM_IO_OFFLINE
      CSURF_FILETYPE    = "NC",
  /
```

7. Running SURFEX : Output files

PGD file / PREP file : different formats possible (ASCII, NetCDF, FA, LFI)

```
&NAM_IO_OFFLINE
      CSURF_FILETYPE    = "NC",
  /
```

Run output files : different formats possible (ASCII, NetCDF, FA, LFI, BINARY,...)

```
&NAM_IO_OFFLINE
      CTIMESERIES_FILETYPE    = "ASCII",
  /
```

- many diagnostics written by default in output files
- diagnostics aggregated over all the surface, by tiles, by patches (nature)
- a selection can be defined in namelist (NAM_WRITE_DIAG_SURFn)
- other additional diagnostics can also be activated in namelist
    → see namelists NAM_DIAG_*

7. Running SURFEX

In your run directory :

- physiographic files necessary for the experiment (land cover database, soil texture, topography, etc.)

- a namelist OPTIONS.nam

- SURFEX executables (pgd, prep, offline)

- FORCING files

Output formats, output time step, etc. → NAM_IO_OFFLINE

Diagnostics → NAM_DIAG*

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Questions?