FLEXPART training course 2013
Compilation and execution

Installation and compilation

Pre-requisites for ECMWF-GFS versions (not done in the course)

- Jasper libraries http://www.ece.uvic.ca/~frodo/jasper/ → free software-based reference implementation of the codec specified in the JPEG-2000 Part-1 standard (i.e., ISO/IEC 15444-1) – it is the jpeg compressing part for the grib libraries

```
unzip jasper-1.900.1.zip
cd jasper-1.900.1
./configure [--prefix=<installation path>]
make
make check
make install
```

- Grib-api libraries (1.6.1 or later) http://www.ecmwf.int/products/data/software/downloads → to decode GRIB 1 and 2 meteo. Files.

```
tar -xvf grib_api-1.9.5.tar.gz
./configure [--with-jasper=<jasper path>]
make
make check
make install
```

- Check documents (for local installation in the IMG computers!):
  - Grib_Installation_Instruction_gfortran.pdf
  - Grib_Installation_Instruction_ifort.pdf

Installation and compilation

Compiling version 8.X / 9.X

- Get the source code from the (current) webpage (check future flexpart.eu developments)

  wget http://zardoz.nilu.no/~flexpart/flexpart/FLEXPART_90.02.tar.gz

  wget http://zardoz.nilu.no/~flexpart/flexpart/flexpart_82-3.tar.gz

- Uncompress the file(s) into the already created directories (the main directory is not compressed) tar -zxvf flexpart_82-3.tar.gz

- For our course – > log into your user *(see PC-instructions document)*

  ssh -X username@srvx1.img.univie.ac.at

  If windows : Putty → open first Xming or similar session, then putty, enable X11 forwarding and then log in following the windows dialogs.

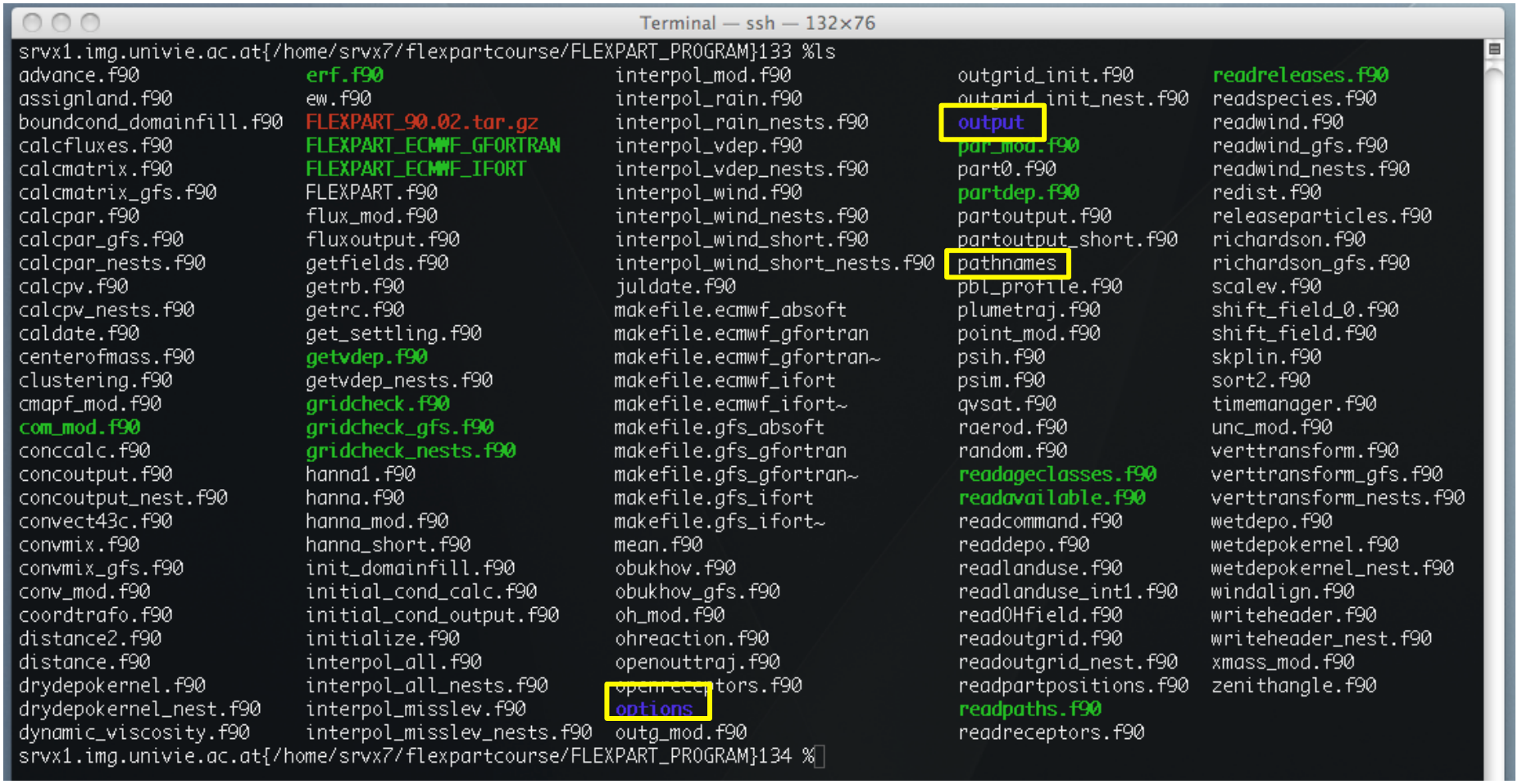
  Get the source code:

  - wget http://zardoz.nilu.no/~flexpart/flexpart/FLEXPART_90.02.tar.gz
  - cp /home/srvx7/flexpartcourse/FLEXPART_PROGRAM/FLEXPART_90.02.tar.gz .

  mkdir Src → create a directory where you will untar and compile the source code
  cd Src
  tar –zxvf FLEXPART_90.02.tar.gz

Installation and compilation

Compiling version 8.X / 9.X



This is not a wise structure for working. Go one level above and create EXERCISES

mkdir ../EXERCISES

mkdir ../EXERCISES/HelloWorld

Move/copy options and output and pathnames in the HelloWorld directory

Installation and compilation

Compiling version 8.X / 9.X

Terminal — ssh — 132×76

```
srvx1.img.univie.ac.at{/home/srvx7/flexpartcourse/FLEXPART_PROGRAM}133 %ls
advance.f90                erf.f90                    interpol_mod.f90                outgrid_init.f90        readreleases.f90
assignland.f90             ew.f90                     interpol_rain.f90               outgrid_init_nest.f90   readspecies.f90
boundcond_domainfill.f90   FLEXPART_90.02.tar.gz      interpol_rain_nests.f90         output                  readwind.f90
calcfluxes.f90             FLEXPART_ECMWF_GFORTRAN    interpol_vdep.f90               par_mod.f90             readwind_gfs.f90
calcmatrix.f90             FLEXPART_ECMWF_IFORT       interpol_vdep_nests.f90         part0.f90               readwind_nests.f90
calcmatrix_gfs.f90         FLEXPART.f90               interpol_wind.f90               partdep.f90             redist.f90
calcpar.f90                flux_mod.f90               interpol_wind_nests.f90         partoutput.f90          releaseparticles.f90
calcpar_gfs.f90            fluxoutput.f90             interpol_wind_short.f90         partoutput_short.f90    richardson.f90
calcpar_nests.f90          getfields.f90              interpol_wind_short_nests.f90   pathnames               richardson_gfs.f90
calcpv.f90                 getrb.f90                  juldate.f90                     pbl_profile.f90         scalev.f90
calcpv_nests.f90           getrc.f90                  makefile.ecmwf_absoft           plumetraj.f90           shift_field_0.f90
caldate.f90                get_settling.f90           makefile.ecmwf_gfortran         point_mod.f90           shift_field.f90
centerofmass.f90           getvdep.f90                makefile.ecmwf_gfortran~        psih.f90                skplin.f90
clustering.f90             getvdep_nests.f90          makefile.ecmwf_ifort            psim.f90                sort2.f90
cmapf_mod.f90              gridcheck.f90              makefile.ecmwf_ifort~           qvsat.f90               timemanager.f90
com_mod.f90                gridcheck_gfs.f90          makefile.gfs_absoft             raerod.f90              unc_mod.f90
conccalc.f90               gridcheck_nests.f90        makefile.gfs_gfortran           random.f90              verttransform.f90
concoutput.f90             hanna1.f90                 makefile.gfs_gfortran~          readageclasses.f90      verttransform_gfs.f90
concoutput_nest.f90        hanna.f90                  makefile.gfs_ifort              readavailable.f90       verttransform_nests.f90
convect43c.f90             hanna_mod.f90              makefile.gfs_ifort~             readcommand.f90         wetdepo.f90
convmix.f90                hanna_short.f90            mean.f90                        readdepo.f90            wetdepokernel.f90
convmix_gfs.f90            init_domainfill.f90        obukhov.f90                     readlanduse.f90         wetdepokernel_nest.f90
conv_mod.f90               initial_cond_calc.f90      obukhov_gfs.f90                 readlanduse_int1.f90    windalign.f90
coordtrafo.f90             initial_cond_output.f90    oh_mod.f90                      readOHfield.f90         writeheader.f90
distance2.f90              initialize.f90             ohreaction.f90                  readoutgrid.f90         writeheader_nest.f90
distance.f90               interpol_all.f90           openouttraj.f90                 readoutgrid_nest.f90    xmass_mod.f90
drydepokernel.f90          interpol_all_nests.f90     openreceptors.f90               readpartpositions.f90   zenithangle.f90
drydepokernel_nest.f90     interpol_misslev.f90       options                         readpaths.f90
dynamic_viscosity.f90      interpol_misslev_nests.f90 outg_mod.f90                    readreceptors.f90
srvx1.img.univie.ac.at{/home/srvx7/flexpartcourse/FLEXPART_PROGRAM}134 %
```

_gfs routines for the GFS version of flexpart

Installation and compilation

Compiling version 8.X / 9.X

Terminal — ssh — 132×76

```
srvx1.img.univie.ac.at{/home/srvx7/flexpartcourse/FLEXPART_PROGRAM}133 %ls
advance.f90                erf.f90                    interpol_mod.f90                outgrid_init.f90        readreleases.f90
assignland.f90             ew.f90                     interpol_rain.f90               outgrid_init_nest.f90   readspecies.f90
boundcond_domainfill.f90   FLEXPART_90.02.tar.gz      interpol_rain_nests.f90         output                  readwind.f90
calcfluxes.f90             FLEXPART_ECMWF_GFORTRAN    interpol_vdep.f90               par_mod.f90             readwind_gfs.f90
calcmatrix.f90             FLEXPART_ECMWF_IFORT       interpol_vdep_nests.f90         part0.f90               readwind_nests.f90
calcmatrix_gfs.f90         FLEXPART.f90               interpol_wind.f90               partdep.f90             redist.f90
calcpar.f90                flux_mod.f90               interpol_wind_nests.f90         partoutput.f90          releaseparticles.f90
calcpar_gfs.f90            fluxoutput.f90             interpol_wind_short.f90         partoutput_short.f90    richardson.f90
calcpar_nests.f90          getfields.f90              interpol_wind_short_nests.f90   pathnames               richardson_gfs.f90
calcpv.f90                 getrb.f90                  juldate.f90                     pbl_profile.f90         scalev.f90
calcpv_nests.f90           getrc.f90                  makefile.ecmwf_absoft           plumetraj.f90           shift_field_0.f90
caldate.f90                get_settling.f90           makefile.ecmwf_gfortran         point_mod.f90           shift_field.f90
centerofmass.f90           getvdep.f90                makefile.ecmwf_gfortran~        psih.f90                skplin.f90
clustering.f90             getvdep_nests.f90          makefile.ecmwf_ifort            psim.f90                sort2.f90
cmapf_mod.f90              gridcheck.f90              makefile.ecmwf_ifort~           qvsat.f90               timemanager.f90
com_mod.f90                gridcheck_gfs.f90          makefile.gfs_absoft             raerod.f90              unc_mod.f90
conccalc.f90               gridcheck_nests.f90        makefile.gfs_gfortran           random.f90              verttransform.f90
concoutput.f90             hanna1.f90                 makefile.gfs_gfortran~          readageclasses.f90      verttransform_gfs.f90
concoutput_nest.f90        hanna.f90                  makefile.gfs_ifort              readavailable.f90       verttransform_nests.f90
convect43c.f90             hanna_mod.f90              makefile.gfs_ifort~             readcommand.f90         wetdepo.f90
convmix.f90                hanna_short.f90            mean.f90                        readdepo.f90            wetdepokernel.f90
convmix_gfs.f90            init_domainfill.f90        obukhov.f90                     readlanduse.f90         wetdepokernel_nest.f90
conv_mod.f90               initial_cond_calc.f90      obukhov_gfs.f90                 readlanduse_int1.f90    windalign.f90
coordtrafo.f90             initial_cond_output.f90    oh_mod.f90                      readOHfield.f90         writeheader.f90
distance2.f90              initialize.f90             ohreaction.f90                  readoutgrid.f90         writeheader_nest.f90
distance.f90               interpol_all.f90           openouttraj.f90                 readoutgrid_nest.f90    xmass_mod.f90
drydepokernel.f90          interpol_all_nests.f90     openreceptors.f90               readpartpositions.f90   zenithangle.f90
drydepokernel_nest.f90     interpol_misslev.f90       options                         readpaths.f90
dynamic_viscosity.f90      interpol_misslev_nests.f90 outg_mod.f90                    readreceptors.f90
srvx1.img.univie.ac.at{/home/srvx7/flexpartcourse/FLEXPART_PROGRAM}134 %
```

A bunch of sample makefiles → we will edit one for our purpose MIND that libraries (grid_api) should be available for the selected compiler

Installation and compilation

- Edit the files the files contining hard-coded dimensions and parameters

  include* *mod.f90 → **includepar / par_mod.f90** are The Files to check when compiling (let's check them)

- Adapt the makefile to your own library paths and compilers (sample makefiles are available)

Makefiles with gfortran and ifort for ECMWF versions include* *mod.f90

Terminal — ssh — 132×76

GNU nano 2.0.9 File: makefile.ecmwf_gfortran

```
SHELL = /bin/bash
MAIN = FLEXPART_GFORTRAN
#
```

where are your grid_api and compiler libraries?

```
FC       = gfortran
INCPATH  = /xnilu_wrk/flex_wrk/bin64/grib_api/include
LIBPATH1 = /xnilu_wrk/flex_wrk/bin64/grib_api/lib
LIBPATH2 = /flex_wrk/flexpart/lib64/gfortran/lib/
#FFLAGS   =   -O3 -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
FFLAGS   =   -O2 -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
#FFLAGS   =   -fbounds-check -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
LDFLAGS  = $(FFLAGS) -L$(LIBPATH2) -L$(LIBPATH1) -lgrib_api_f90 -lgrib_api -lm -ljasper
#

MODOBJS = \
par_mod.o               com_mod.o \
conv_mod.o              hanna_mod.o \
interpol_mod.o          cmapf_mod.o \
unc_mod.o               oh_mod.o \
xmass_mod.o             flux_mod.o \
point_mod.o             outg_mod.o

OBJECTS = \
writeheader.o           assignland.o\
calcpar.o               part0.o \
```

f90

Compiling version 9.X with gfortran

Edit the makefile.ecmwf_gfortran (add the make clean option if needed)

```
SHELL = /bin/bash
MAIN = FLEXPART_ECMWF_GFORTRAN
#
FC      = gfortran
#
INCPATH  = /usr/local/include/
LIBPATH1 = /usr/local/lib/
LIBPATH2 = /usr/bin/gfortran/lib/
#
FFLAGS   =   -O2 -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
LDFLAGS  = $(FFLAGS) -L$(LIBPATH2) -L$(LIBPATH1) -lgrib_api_f90 -lgrib_api -lm -ljasper
#
MODOBJS = \
par_mod.o             com_mod.o \
conv_mod.o             hanna_mod.o \
interpol_mod.o         cmapf_mod.o \
unc_mod.o             oh_mod.o \
xmass_mod.o             flux_mod.o \
point_mod.o           outg_mod.o

OBJECTS = \
writeheader.o         assignland.o\
calcpar.o            part0.o \
……..
clean:
      rm *.o *.mod
```

Compiling version 9.X with ifort

From /home/srcx7/flexpartcourse/FLEXPART_PROGRAM/makefile.ecmwf_ifort

```
SHELL = /bin/bash
MAIN = FLEXPART_ECMWF_IFORT
#
FC      = ifort
#
INCPATH  = /home/srvx7/flexpartcourse/GRIB-API/GRIB-API-IFORT/include
LIBPATH1 = /home/srvx7/flexpartcourse/GRIB-API/GRIB-API-IFORT/lib
LIBPATH2 = /opt/intel/composerxe/lib
#
FFLAGS   =   -O2 -m64 -mcmodel=medium -convert little_endian  -I$(INCPATH)
LDFLAGS  = $(FFLAGS) -L$(LIBPATH2) -L$(LIBPATH1) -lgrib_api_f90 -lgrib_api -lm -ljasper
#
MODOBJS = \
par_mod.o              com_mod.o \
conv_mod.o             hanna_mod.o \
interpol_mod.o         cmapf_mod.o \
unc_mod.o              oh_mod.o \
xmass_mod.o            flux_mod.o \
point_mod.o            outg_mod.o


OBJECTS = \
writeheader.o          assignland.o\
calcpar.o              part0.o \
……..
clean:
      rm *.o *.mod
```

Compiling version 8.X with gfortran

Example for version 8.X

```
SHELL = /bin/bash
MAIN = FLEXPART_GFORTRAN
INCF    = incl*
#

FC      = gfortran
INCPATH  = /usr/local/include
LIBPATH1 = /usr/local/lib
LIBPATH2 = /usr/local/lib
#FFLAGS   =   -O3 -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
FFLAGS   =   -O2 -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
#FFLAGS   =   -fbounds-check -m64 -mcmodel=medium -fconvert=little-endian -frecord-marker=4 -I$(INCPATH)
LDFLAGS  = $(FFLAGS) -L$(LIBPATH2) -L$(LIBPATH1) -lgrib_api_f90 -lgrib_api -lm -ljasper
#

OBJECTS = flux_mod.o    oh_mod.o \
unc_mod.o             point_mod.o\
outg_mod.o             xmass_mod.o\
…

clean:
      rm *.o *.mod
```

Installation and compilation

Compiling and related runtime surprises version 8.X / 9.X

- Make the makefile to have all the routines compiled and inspect for possible warnings and errors make -f makefile.<xxx>
- Usual problems:
  - Wrong compiler eg: /bin/bash: /opt/absoft11.5/bin/f95: No such file or directory
  - Wrong library path
  - Variables in includepar too large, eg: Integer too big for its kind at (1) or *R_X86_64 …* either change dimensions or try to use appropriate flags such as mc-model=medium (very important in older non fortran 90 versions with variables not dynamically allocated)
  - Runtime problems can occur when the dimensions and parameters are not properly set in includepar or par_mod.f90. Modification of these files require recompilation and problems are not easy to identify. Look for segmentation faults. If killed right after execution: a) unlimit stack size b) adjust dimensions to fit the runs and reduce size of variables c) reduce number of particles

Life-savior: grep for the variables that give problems (e.g. grep -i igiveprobs par_mod.f90)