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Bern 2.5D Model

- How to run several thc-runs in parallel ProjectBern25Dparallel
- Bugs, limitations, ToDo's ProjectBern25Dbugs

Source code

- SVN repository https://svn.iac.ethz.ch/repos/projects/bern2.5d (classic view)
- Or browse the source code https://svn.iac.ethz.ch/websvn/repos/wsvn/projects.bern2.5d (nice view)
- Check out **latest version (trunk)** - the trunk is work in progress!

```
svn co https://svn.iac.ethz.ch/repos/projects/bern2.5d/trunk bern2.5d-trunk
```

- If you have once checked out the trunk version you can always **update your working copy** of the trunk to the latest trunk version on the svn server by executing inside your trunk folder `bern2.5d-trunk` the command

```
svn update
```

- View **change log** of latest version (trunk) https://svn.iac.ethz.ch/websvn/repos/wsvn/projects.bern2.5d/?op=log&rev=0&isdir=1 or

```
svn log
```

- Check out version 1.0, original code from Kasper Plattner, compiles with gfortran, pgf90, ifort

```
svn co https://svn.iac.ethz.ch/repos/projects/bern2.5d/tags/1.0 bern2.5d-1.0
```

- Check out original code from Kasper Plattner

```
svn co https://svn.iac.ethz.ch/repos/projects/bern2.5d/tags/original_plattner_code b
```

or

```
svn export https://svn.iac.ethz.ch/repos/projects/bern2.5d/tar/bern2.5d_linux_knutti
```

- For more information about how to work with subversion and the `svn` command see ServiceSvn.

Getting started

- Checkout latest version

```
svn co https://svn.iac.ethz.ch/repos/projects/bern2.5d/trunk bern2.5d-trunk
```

- Read the provided readme files

```
cd bern2.5d-trunk
less README.txt
less COMPILE.txt
less MACHINES.txt
```

Compile

- See also **`COMPILE.txt`** and **`MACHINES.txt`**

- Define the following environmental variables. This can be for example done by **loading modules**, see below. Or with the `export` (bash) or `setenv` (tcsh) command.
  - **FC** : Fortran Compiler
  - **NETCDF** : path to your netcdf installation, libnetcdf.a should be in $NETCDF/lib, include files in $NETCDF/include
  - **FFLAGS** : additional compiler flags, for example set `FFLAGS=-g` for debugging

- On IAC systems you can use modules to set these variables correctly

- Environment for **pgf90**

```
module load pgi netcdf/3.6.3-pgf90
```

- Environment for **ifort**

```
module load ifort netcdf/3.6.3-ifort
```

- Environment for **gfortran**

```
module load gfortran netcdf/3.6.3
```

- Compile

```
make clean
make
```

Scripts

- List of scripts

Scriptname	Purpose
thc.sh	**Run the Bern 2.5 D model**
thc_run.sh	Run a spinup run or transient run
create_case.sh	Create a spinup or transient case
create_restart_file.sh	Create a restart file
list_files.sh	List thc related files
edit_files.sh	Edit and show variables in spinup and transient startfiles
crestart.sh	Simple wrapper script to run crestart (obsolete)

- All scripts come with an internal **help**, just run the script with option `-h` or `-help`, for example

```
./list_files.sh -h
```

Run test case

- Run the test case model:

```
./thc.sh -s test
```

Run a spinup case

- Run default susciar4 spinup model :

```
./thc.sh -s susciar4_default
```

  Note: susciar4_default is equal to susciar4_knum1_iadv1

Run a transient case

- Run transient model (the spinup run has to be done in advance):

```
./thc.sh -r susciar4_default -t ar4_sres_a2_ar4_default
```

  In this case the transient run (**-t**) ar4_sres_a2_ar4_default is restarted (**-r**) from the spinup run susciar4_default

Run a spinup run followed by a transient run

- Do a spinup run followed by a transient run

```
./thc.sh -s susciar4_default -t ar4_sres_a2_ar4_default
```

Modify startfiles

- See **`edit_files.sh`** script

```
./edit_files.sh -h
```

Run thc with modified startfiles

- You can modify the startfiles within the thc.sh command

```
./thc.sh -set kvnum=1,khnum=1,iadv=1 -s susciar4
```

  This will set kvnum=1, khnum=1 and iadv=1. Note: This is equal to

```
./thc.sh -s susciar4_default
```

Run a transient thc with on other forcing file

- Place your forcing file in the folder **`forcing`**
- The name and path of the forcing file for a transient run is defined in the transient startup file in a line similar to

```
'forcing/start_ar4_sres_a2_ar4.dat'                    forcing (chfile_indus)
```

- Use option **`-set`** to change the name of the forcing file. **IMPORTANT:** Use a backslash **** to escape the ' sign !

```
./thc.sh -set forcing="\'forcing/file1.dat\'" -r susciar4_default -t ar4_sres_a2_ar4
```

How the option -set defines the name of the startfile and the case name

- If you modify the startfiles with the option **-set**, a MD5-string will be appended to the name of startfile and therefore to the name of the new case.
- The MD5-string is calculate from the parameters given by the **-set** option. Run the script **`./md5.sh`** to find out the MD5 sum. For example

```
./md5.sh kvnum=1,khnum=1,iadv=1
```

- Note that the MD5 sum is independent of the order of the parameters

```
./md5.sh kvnum=1,khnum=1,iadv=1
MD5c3478ce6723a70b7fb3a4c2e57c97737
./md5.sh iadv=1,kvnum=1,khnum=1
MD5c3478ce6723a70b7fb3a4c2e57c97737
```

- If you don't want to choose the string which is appended, use the option **-add**, for example

```
./thc.sh -set kvnum=1,khnum=1,iadv=1 -add setup1 -s susciar4
```

This will create the case susciar4_setup1.spinup instead of susciar4_MD5c3478ce6723a70b7fb3a4c2e57c97737.spinup

More options

- If you want to re-do a run, use the option **`-f`** (force) to overwrite everything

```
./thc.sh -f -s susciar4_default
```

- Run thc with nice 19 (**`-n 19`**)

```
./thc.sh -n 19 -s susciar4_default
```

- Run thc quiet (**`-q`**) - with no output

```
./thc.sh -q -s susciar4_default
```

- See all the available option of thc.sh by running

```
./thc.sh -h
```

Create only the case directory

- Create case directory for a spinup case

```
./create_case.sh -s susciar4_default
```

- Create case directory for a transient case

```
./create_case.sh -r susciar4_default -t ar4_sres_a2_ar4_default
```

List thc related files

- List available spinup start files

```
./list_files.sh -ls
```

- List available restart files (`-lr`) and available transient (-lt) start files

```
./list_files.sh -lr -lt
```

Run thc on brutus batch system

- Compile thc, see also **`MACHINES.txt`**

```
module purge
module load pgi netcdf/4.0.1                  # in case you want to use Portland com
module load intel netcdf/4.0.1                # in case you want to use Intel compil
export FC=gfortran; module load netcdf/4.0.1  # in case you want to use GNU gfortran
make clean
make
```

- Create a case, for example for spinup susciar4_default

```
./create_case.sh -s susciar4_default
```

- Submit batch job

```
bsub < ./cases/susciar4_default.spinup/susciar4_default.spinup.lsf
```

- Afterwards LSF log files are in the case folder, for example

```
cases/susciar4_default.spinup/susciar4_default.spinup-out.JOBID
cases/susciar4_default.spinup/susciar4_default.spinup-err.JOBID
```

Run several thc in parallel on brutus

- Use the LSF jobfile **`par_thc.lsf`** and the script **`par_thc.sh`** to distribute thc-runs over several nodes. For more info see ProjectBern25Dparallel

Setup for a crash

- Run spinup case susciar4

```
./thc.sh -s susciar4
```

- **1. Case**: Run transient case sres_a2_BernCC_targwfb2.5progipccar4jan09

```
./thc.sh -r susciar4 -t sres_a2_BernCC_targwfb2.5progipccar4jan09

Time: 21021.2 yr      dt:   20.3 d     dta:   16.8 h
./thc.sh: line 167:  2139 Floating point exception$THC $ex_trans $ex_restart
ERROR: thc exit with an error.
```

- **2. Case**: Run transient case sres_a2_test

```
./thc.sh -r susciar4 -t sres_a2_test

Time: 20326.2 yr      dt:   20.3 d     dta:   16.8 h
./thc.sh: line 167:  2241 Floating point exception$THC $ex_trans $ex_restart
ERROR: thc exit with an error.
```

- **3. Case**: Run transient case ar4_sres_a2_ar4_gwfb_3.2

```
./thc.sh -r susciar4 -t ar4_sres_a2_ar4_gwfb_3.2

Time: 20310.2 yr      dt:   20.3 d     dta:   16.8 h
./thc.sh: line 169: 25445 Floating point exception$THC $ex_trans $ex_restart
ERROR: thc exit with an error.
```

- **The crash can be avoided**, if you start with spinup `susciar4_iadv1`, `susciar4_knum1` or `susciar4_knum1_iadv1` instead of `susciar4` !

- **Crash Matrix**

Spinup	Transient	Runs without crash
susciar4	sres_a2_BernCC_targwfb2.5progipccar4jan09	☹
susciar4	sres_a2_test	☹
susciar4	ar4_sres_a2_ar4_gwfb_3.2	☹
susciar4_iadv1	sres_a2_BernCC_targwfb2.5progipccar4jan09	☺
susciar4_iadv1	sres_a2_test	☺
susciar4_iadv1	ar4_sres_a2_ar4_gwfb_3.2	☺
susciar4_knum1	sres_a2_BernCC_targwfb2.5progipccar4jan09	☺
susciar4_knum1	sres_a2_test	☺
susciar4_knum1	ar4_sres_a2_ar4_gwfb_3.2	☺
susciar4_knum1_iadv1	sres_a2_BernCC_targwfb2.5progipccar4jan09	☺
susciar4_knum1_iadv1	sres_a2_test	☺
susciar4_knum1_iadv1	ar4_sres_a2_ar4_gwfb_3.2	☺

Benchmarks

- Summary: **Best performance** reached with **intel compiler**

- Single thc run. **Minimum time** of

```
time ./thc.sh -f -s susciar4 >/dev/null
```

Compiler	Flags	System	Time
gfortran 4.8.1	-O3 -ffpe-trap=invalid,zero,overflow -fno-automatic	rasperypi	270m 28s
ifort 10.1	-O3 -fpe0	firebolt	18m 26s
pgf90 7.2-3	-O3 -Ktrap=fp	firebolt	20m 10s
gfortran 4.1.2	-O3 -ffpe-trap=invalid,zero,overflow -fno-automatic	firebolt	21m 39s
ifort 10.1	-O3 -fpe0	iacdipl-2	11m 50s
pgf90 7.2-3	-O3 -Ktrap=fp	iacdipl-2	16m 19s
gfortran 4.3.2	-O3 -ffpe-trap=invalid,zero,overflow -fno-automatic	iacdipl-2	15m 09s
ifort 10.1	-O3 -fpe0	fluffy	8m 19s
pgf90 7.2-3	-O3 -Ktrap=fp	fluffy	9m 25s
gfortran 4.3.2	-O3 -ffpe-trap=invalid,zero,overflow -fno-automatic	fluffy	11m 31s
pgf90 9.0-1	-O3 -Ktrap=fp	brutus3 (login node)	14m 59s
ifort 10.1.018	-O3 -fpe0	brutus3 (login node)	10m 01s
ifort 10.1	-O3 -fpe0	Xeon X5690 3.47GHz (atmos)	6m 02s
ifort 10.1	-O3 -fpe0	Xeon E5-2690 2.90GHz (kryo)	6m 30s
ifort 10.1	-O3 -fpe0	Xeon E3-1275 3.50 GHz	4m 08s
ifort 10.1	-O3 -fpe0	i7-2600 3.40GHz	4m 56s
ifort 10.1	-O3 -fpe0	i5-3570 3.40GHz	4m 15s
ifort 13.1.3	-O3 -fpe0	Xeon E5-2697 v2 2.70GHz	5m 32s

Compiler	Flags	System	Time
ifort 13.1.3	-O3 -fpe0	Xeon E5-2680 v2 2.80GHz	4m 23s
ifort 13.1.3	-O3 -fpe0	Xeon E5-2670 v2 2.50GHz	4m 46s
ifort 13.1.3	-O3 -fpe0	Xeon E5-2660 v2 2.20GHz	5m 17s
ifort 13.1.3	-O3 -fpe0	Xeon E5-2650 v2 2.60GHz	4m 38s
ifort 10.1	-O3 -fpe0	Xeon E3-1245 v3 3.40GHz (FS W540)	3m 57s 

- Benchmarks of 400 **parallel runs**

```
./thc.sh -set iadv=1 -add iadv_1 -s susciar4
for i in $( seq 0 399 ); do
   var=$( printf "%03d\n" $i)
   echo "./thc.sh -f -set gwfb=2.$var -r susciar4_iadv_1 -t ar4_sres_a2_ar4"
done > joblist; echo END >> joblist
time ./par_thc.sh -g 2
```

Compiler	Flags	System	cores	Time	Time * core
ifort 10.1	-O3 -fpe0	fluffy	8	8m 27s	68m 
ifort 10.1	-O3 -fpe0	iacdipl-2	16	6m 47s	109m
ifort 10.1	-O3 -fpe0	firebolt	8	21m 0s	168m

Directory Layout

```
|-- cdf_2d                    (source code of cdf_2d.a)
|-- src                       (source code of thc)
|-- thc.sh                    (script to run thc *** main script ***)
|-- thc_run.sh                (script to run spinup and transient cases)
|-- create_case.sh            (script to create a new case)
|-- create_restart_file.sh    (script to create a restart file)
|-- list_files.sh             (script to list thc related files)
|-- edit_files.sh             (edit/show starfiles)
|-- crestart.sh               (points to old src/crestart)
|-- data                      (directory of data files, ???)
|-- forcing                   (directory of data files, forcing)
|-- start_files               (directory of start files)
|-- cases                     (directory containing runs/cases)
|   |-- susciar4.spinup        (case directory for susciar4 case, spinup run)
|   |   |-- input               (input date)
|   |   `-- output              (output data)
|   |-- susciar4.sres_a2_test  (case directory for transient run sres_a2_test,
|   ...                         spinup from susciar4 run)
|
|-- batch-template.lsf        (template for batch job script)
|-- COMPILE.txt               (read how to compile the model)
|-- MACHINES.txt              (machine specific documentation)
|-- README.txt                (general readme file)
`-- Makefile                  (main Makefile)
```

Debugging the model

- For debugging pgf90 compiled code, use Portland Group Debugger, see **/usr/local/pgi/linux86/7.2-3/doc/pgi72tools.pdf**
- or http://www.pgroup.com/doc/pgitools.pdf

- Load the compiler and corresponding the netcdf library, if not yet done

```
module load pgi netcdf/3.6.3-pgf90
```

- Compile with option `-g`

```
FFLAGS="-g"
make clean
make
```

- Run `thc` inside `pgdbg`

```
pgdbg src/thc
```

- Press **Run** inside the pgdbg gui

(old description for original code) Compile and run on firebolt

ProjectBern25Dold.

Access

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