A python-based processing chain facilitating automated COSMO simulations and post-processing

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- COSMO users of our group:

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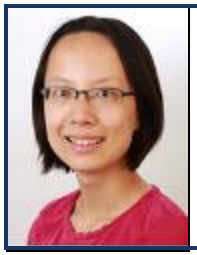

QING MU
COSMO-ART

DAVID OCHSNER
Maintenance, Testing, Documentation

Different users, COSMO versions, purposes, projects etc.

Goal: Create a tool that unifies and automates data pre-processing, int2lm, COSMO runs, post-processing

COSMO Processing Chain

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- Originally developed using Shell scripts
  - Not very flexible
  - Cumbersome maintenance
- Translation to Python 3
- Version control with git and own GitLab server
  - Master and own working version
  - Standard git workflow (forks, branches, issues, merge requests …)
- Anaconda3 environment
  - Installation with EasyBuild on Piz Daint (CSCS)
  - Additional Python modules + own «amrs» package

Basic Features

- Easy creation of own COSMO cases
  - Subfolder as case name
  - One configuration file
  - Flexible namelist files
  - Tracer information from .csv files
- Automatic restart runs
- Nested runs possible
- Thorough documentation
- Clear output folder structure
- Compressed netCDF output files with pre-defined tolerances

Configuration File

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- cosmo_processing_chain/cases/example/config.py

```
import os

# ORGANIZATIONAL ================================================================ #
compute_host = 'daint'
compute_queue = 'debug' # 'normal'
compute_account = 's862'

# case name = pathname in cases/
path = os.path.realpath(__file__)
casename = os.path.basename(os.path.dirname(path))

# Restart
restart_step = 24

# INPUT ========================================================================= #
# METEO ---------------------------------------------------------------------- #
meteo_dir = os.path.join(input_root, 'meteo')
meteo_prefix = "laf"
meteo_inc = 1

# EMISSIONS ------------------------------------------------------------------ #
# anthropogenic emissions pre-processed for mother and nested domain
emissions_dir = os.path.join(input_root, 'emissions_coarse')
emis_gridname = "CO2_CO_NOX_Berlin-coarse_"
```

Namelist Files

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- cosmo_processing_chain/cases/example/cosmo_INPUT_ORG.cfg

```
&LMGRID
! Berlin full domain
  ie_tot        = 70,
  je_tot        = 60,
  ke_tot        = 60,
  pollon        = -170,  ! origin lon: 10.0
  pollat        =  43,   ! origin lat: 47.0
  dlon          = 0.1,
  dlat          = 0.1,
  startlat_tot  =  2.5,
  startlon_tot  = -1.4,
/
&RUNCTL
  dt            = 10.0,
  hstart        = {cfg.hstart},
  hstop         = {cfg.hstop},
  ydate_ini     = '{cfg.inidate_yyyymmddhh}',
  nprocx        = {cfg.cosmo_np_x},
  nprocy        = {cfg.cosmo_np_y},
  nprocio       = 0,
  hincmxt       = 1.0,
```

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COSMO processing chain

Command line help:

```
$ python run_chain.py -h
```

Run examples:

```
$ python run_chain.py example 2015-01-01 0 24
$ python run_chain.py example_cosmoart_mother example_cosmoart_nested 2015-06-26 0 12
$ python run_chain.py example_oae 2015-01-01 0 24 -j meteo icbc oae modis biofluxes int2lm post_int2lm cosmo pos
```

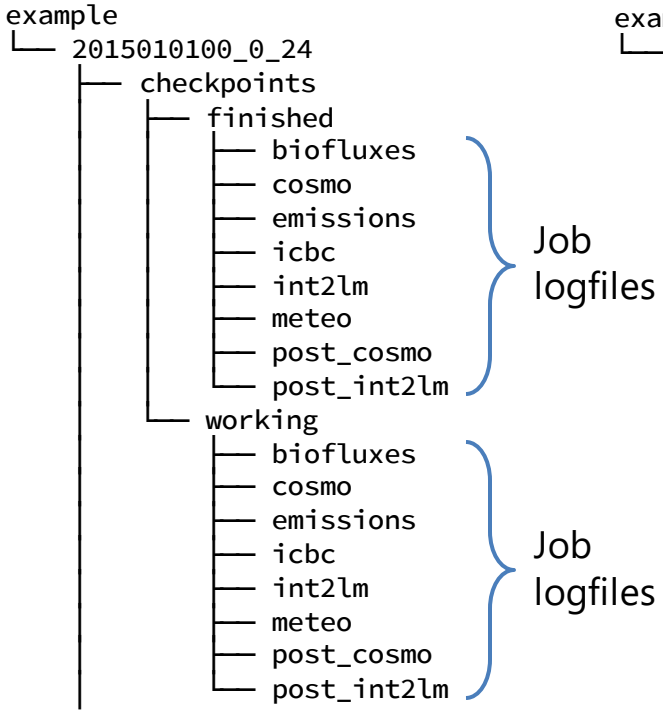
Requirements: amrs

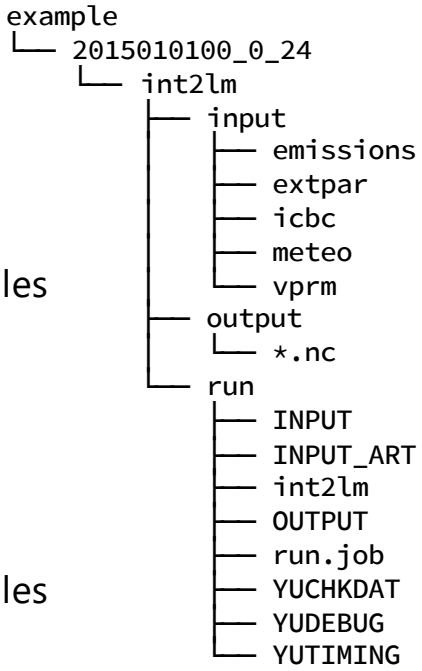
Build documentation locally (make sure you have sphinx installed):

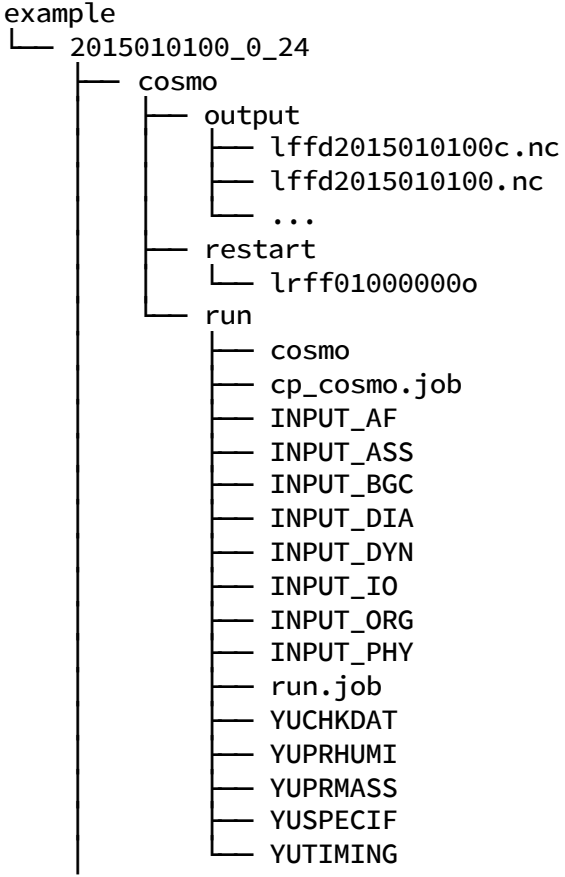
```
$ cd doc/
$ make html
$ make text
```

If all else fails: read documentation source files at docs/source/*.rst

Output Structure







Lossy Compression of netCDF4 Output Files

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- Converting 32-bit floating point variables to 16-bit signed integer
- Using netCDF4 attributes `add_offset` and `scale_factor`
- Compression ratio 2-3
- Definition of own tolerances to conserve required precision of output fields:

```
# name,     rtol,   atol
  U,        0.0,    0.001
  V,        0.0,    0.001
  W,        0.0,    0.001
  T,        0.0,    0.01
  P,        0.0,    0.1
  CO2_BG,   0.0,    1e-8
  …
```

Sharing our Code

- `cosmo_processing_chain` and `amrs` maintained on Empa's GitLab server
- Question: Which platform to share code?
- Details to be discussed

Thank you!