SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2014

Project Title: Downscaling a wetter/hotter outlier GCM for the EURO-CORDEX initiative

Computer Project Account: SPIESWEE

Principal Investigator(s): Conor Sweeney

Affiliation: UCD, Dublin, Ireland

Name of ECMWF scientist(s) collaborating to the project (if applicable) None

Start date of the project: September 2012

Expected end date: August 2014

Computer resources allocated/used for the current year and the previous one

(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	8,000,000	5,991,931	4,500,000	3,740,010
Data storage capacity	(Gbytes)	10,000	5,000	10,000	10,000

Summary of project objectives

The aim of this special project is to provide high resolution regional climate model (RCM) data for Europe over the period 1950-2100. This will contribute to a larger voluntary project, EURO-CORDEX, which is gathering data from a range of RCMs driven by different global climate models (GCMs). Recent GCM analyses have shown a need for downscaling "hotter/wetter" GCMs. The "Model for Interdisciplinary Research on Climate" (MIROC) GCM, developed in Japan, was found to be suitable. This special project uses data from MIROC to drive the CCLM RCM at a resolution of 0.11 degrees. EURO-CORDEX is a collaborative initiative, and by producing these downscaled data, the project team will have access to data produced by other members of the EURO-CORDEX initiative. It is expected that analyses of these data will lead to publications in leading, peer-reviewed journals.

Summary of problems encountered (if any)

A code was written to prepare the MIROC5 GCM data for use with the CCLM RCM. However, the code increased the date using a gregorian calendar. The MIROC5 model, however, uses a 365 day (no leap day) calendar. This resulted in the code generating data for leap days by copying data from the previous day. This error was not noticed, as the CCLM RCM model ran happily with this data. By the time the error was spotted, the downscaling was almost complete.

The error in the code has been corrected, and data regenerated for CCLM. Colleagues Jennifer Brauch (Deutscher Wetterdienst, Germany) and Klaus Keuler (Brandenburg technological university Cottbus, Germany) have offered to run the simulation again on the DKRZ high performance computing platform to check the effect of this error. They will also run the simulation for RCP85.

Summary of results of the current year (from July of previous year to June of current year)

MIROC2caf code corrected, shared with EURO-CORDEX community, and documented (attached).

MIROC5 data prepared for historical (1949-2006) CCLM runs and copied to DKRZ to share with EURO-CORDEX community.

I presented a poster on preparing MIROC5 data for CCLM at the CCLM Assembly in ETH Zurich, August 2013. This was a worthwhile trip, as I met other members of the EURO-CORDEX community who will be continuing these simulations.

Historical run completed: 1949-2006.
RCP45 run completed: 2006-2062.

RCP45 2062-2070 will be complete before August 2014.

Data will be retrieved and archived in UCD before August 2014.

List of publications/reports from the project with complete references

None yet

Summary of plans for the continuation of the project

(10 lines max)

All project work will be completed by August 2014. No continuation of project planned.

MIROC2caf

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1 Retrieve data

I retrieved the MIROC5 data from ESG using their wget scripts. Data retrieved are listed in Table 1.

variable	long name	grid	period
orog	Surface Altitude	Land Grid	one file
sftlf	Land Area Fraction	Land Grid	one file
sftof	Sea Area Fraction	Ocean Grid	one file
snw	Surface Snow Amount	Land Grid	decadal, 1940 - 2009
tslsi	Surface Temperature Where Land or Sea Ice	Land Grid	annual, 1949 - 2005
tos	Sea Surface Temperature	Ocean Grid	decadal, 1940 - 2009
hus	Specific Humidity	Land Grid	monthly, 194912 - 196907
ta	Air Temperature	Land Grid	monthly, 194912 - 196907
ua	Eastward Wind	Land Grid	monthly, 194912 - 196907
va	Northward Wind	Land Grid	monthly, 194912 - 196907

Table 1: MIROC5 data retrieved

`t_skin` is generated using `sftof, tslsi, tos`.
Land Grid:

- 256 nlon x 128 nlat
- lon : first = 0 last = 358.59375 inc = 1.40625 degrees east circular
- lat : first = -88.9277354 last = 88.9277354 degrees north

Ocean Grid:

- nx = 256 ny = 224
- lon : min = 0.0163634736 max = 359.994476 degrees east circular
- lat : min = -89.8470459 max = 89.8470459 degrees north

2 RUN_MIROC2caf.sh

A script called `RUN_MIROC2caf.sh` is used to read the data from the MIROC5 NetCDF files and write them as individual caf data files. A few things need to be set inside this script:

- start and end dates (YYYYMMDD) for generating caf files

  ```
  YMDs=19491201
  YMDe=19550101
  ```

- BASEDIR, the directory where MIROC5 data files are stored
  M5DIR, the directory where (temporary) renamed data will be stored
  CAFDIR, the directory where caf data files will be stored

  ```
  BASEDIR=/media/conor/MIROC5
  M5DIR=/media/DATA/M5DATA
  CAFDIR=/media/conor/CAFDATA
  ```

  This script expects/requires MIROC5 data files in the following format for `ta, ua, va, hus`:

  ```
  ta/ta_6hrLev_MIROC5_historical_r1i1p1_YYYYMMDDHH-YYYYMMDDHH.nc
  ```

  as well as:

  ```
  tslsi/tslsi_3hr_MIROC5_historical_r1i1p1_YYYYMMDDHH00-YYYYMMDDHH00.nc
  tos/tos_day_MIROC5_historical_r1i1p1_YYYYMMDD-YYYYMMDD.nc
  ```

- Set the experiment type:

  ```
  EXP=historical # historical, rcp45, ...
  ```

- Set location of static data files:

  ```
  orogfile=$BASEDIR/orog/orog_fx_MIROC5_${EXP}_r0i0p0.nc
  sftlffile=$BASEDIR/sftlf/sftlf_fx_MIROC5_${EXP}_r0i0p0.nc
  sftoffile=$BASEDIR/sftof/sftof_fx_MIROC5_${EXP}_r0i0p0.nc
  ```

Note that the script is hard-coded to skip leap days. This is because the MIROC5 data used the 365_day calendar with no leap days.

3 Prepare data

The script does the following:

- Unpack data from MIROC5 data files
- copy existing variable data files for specified date YYYYMMDDHH
- Interpolate snw, tos from daily data (HH=12)
- Interpolate tos from ocean to land grid, and generate t_skin from tslsi and tos. Differences between land grid and ocean grid can lead to some missing data near coasts. Use ta data from level 0.997499228 for these near-coast missing data

4 caf format

The script then puts data into the format required by int2lm:

- add the surface pressure field (read from `ta` file)
- rearrange lon/lat to -180,180,-90,90
- divide snw by 100 to change units to metres
- reverse vertical levels
- rename variables
- rename dimension lev to level
- add ak bk time_bnds

I didn't manage to do the last step using CDO/NCO, so I manually generated a NetCDF data file (akbk.nc) containing ak, bk and time_bnds, and append this static file each time.

This data is generated as follows:

- MIROC5 data contain `double a_bnds(40, 2), b_bnds(40, 2)`

$$\begin{aligned} ak(1) &= a\_bnds(2, 40) \\ ak(2) &= a\_bnds(1, 40) \\ ak(3) &= a\_bnds(1, 39) \\ &\vdots \\ ak(40) &= a\_bnds(1, 2) \\ ak(41) &= a\_bnds(1, 1) \end{aligned}$$

- include:

```
double time_bnds(time, bnds) ;
...
 time_bnds =
  0, 0 ;
```

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