High resolution Reanalysis over the Cantabrian Coast

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- Preliminary info
- Performed runs
- Results

Preliminary info

Motivation

1. Jesús Fernández's Thesis:

   Comparison between statistical and dynamical downscaling models for precipitation.

2. RAMSHES MCyT project:

   UB, UCM, UPV-EHU, Usal

Objective: The analysis of the climatic variability of precipitation

Hardware

Linux Cluster (UPV-EHU)

- 4 P-IV nodes $\times$ 2.0GHz
- 1Gb RAM / nodo
- 800 Gb HD

Software

PGI Compilers, v5.0

Runs

Run characteristics

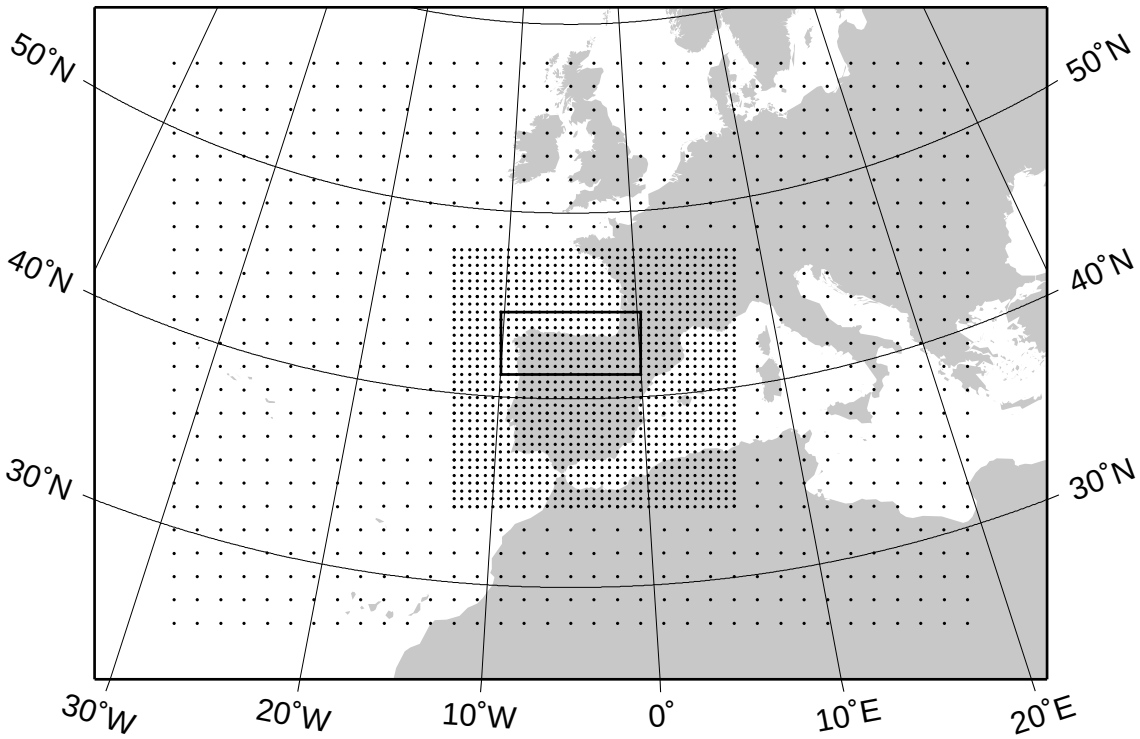
- Domains: D1 135km, D2 45km, D3 15km
- Two–way nesting
- $\Delta t = 400s$
- Boundary conditions: NCEP Reanalysis
- Nudging

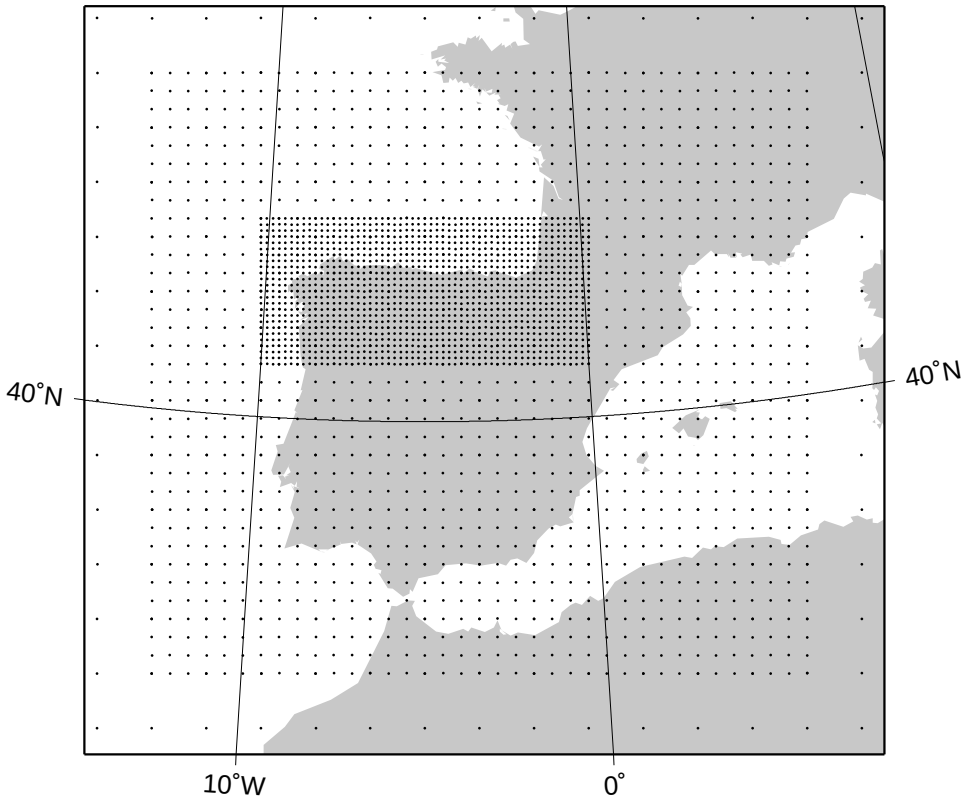
$$\text{Stored} \quad \begin{cases} D1 & 24h & (354Mb/yr) \\ D2 & 12h & (1{,}0Gb/yr) \\ D3 & 6h & (2{,}2Gb/yr) \end{cases}$$

Sensitivity analysis *(1985–1989)*

- Cumulus: Grell and Kain–Fritsch
- PBL: Blackadar and MRF
- Radiative scheme: Dudhia and RRTM

Used domains





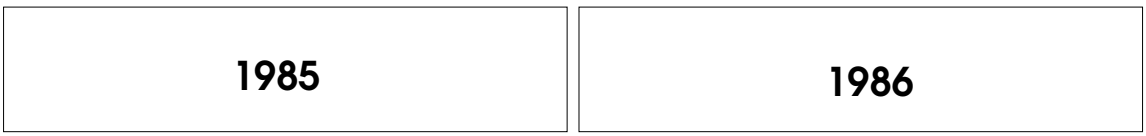
Handicaps for a climatic run with MM5

Linux OS

Limit to the file size: 2 Gb

Sol: The input files were splitted for each year and the model restarted accepting different BC

MMINPUT
LOWBDY
BDYOUT



MMINPUT	→	MMINPUT.1985	MMINPUT	→	MMINPUT.1985
MMIN	→	MMIN.1985	MMIN	→	MMIN. 1986
LOWBDY	→	LOWBDY.1985	LOWBDY	→	LOWBDY.1986
BDYOUT	→	BDYOUT.1985	BDYOUT	→	BDYOUT.1986

The MM5 is run by a driver shell script which automates the new input process (To be contributed to the Red Iberica)

INTERPF

Limited to process up to 1000 records (≈ 9 months)

Sol: Slight modification to the source code

MM5

- `mm5.print.out` output is formatted for small numbers (IXTIMR!!)
  Sol: Slight modification to the source code
- Decimal drift and integer truncation related problems appear in the 2^{nd} year in FDDA (MM5/fdda/in4dgd.F) and in the 7^{th} year for restarting purposes (MM5/domain/io/initsav.F)
  Sol: Not-so-slight modification to the source code

INTERPB

- Limited to process up to 1000 records
- Writes big REGRID and intermediate format files which are not used.

Sol: Slight modification to the source code

mm5tonetcdf

No date prior to 01-jan-1970 can be managed due to the use of time.c (the C standard time library)
Sol: Source code modified to use the udunits library (To be contributed to the Red Iberica)

Results

Validation data sets

- Monthly precipitation from UCM
  16 stations over the Cantabrian Coast

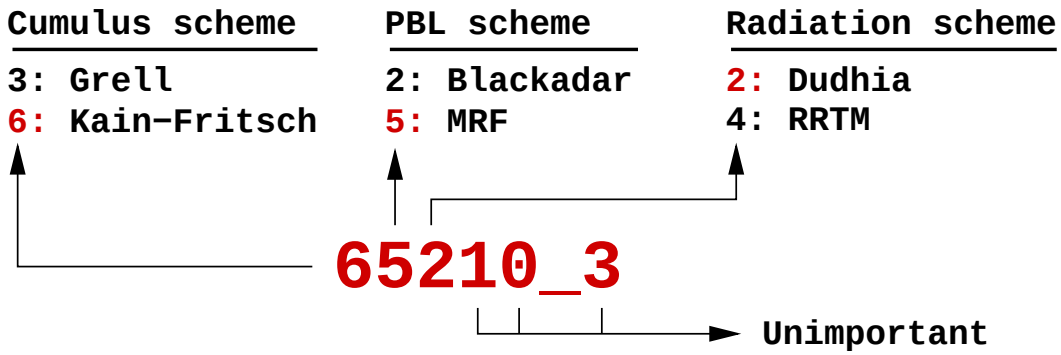
  González-Rouco et al. (2001) "Quality control and homogeneity of precipitation data in the Southwest of Europe", J Clim 14:964–978

- Monthly precip. and temperature from CRU
  $0.5° \times 0.5°$ grid over land

  New et al. (2000) Representing twentieth–century space–time climate variability. Part II: Development of 1901–96 Monthly Grids of Terrestrial Surface Climate", J Clim 13:2217–2238

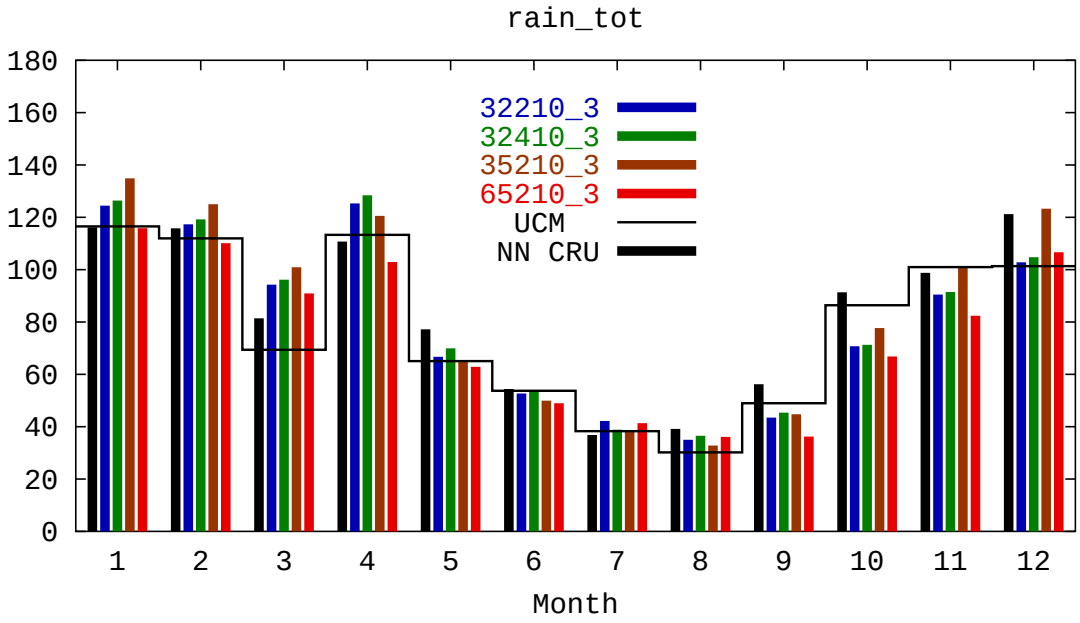
- Daily precipitation from INM
  11 stations over the Cantabrian Coast

Sensitivity run notation

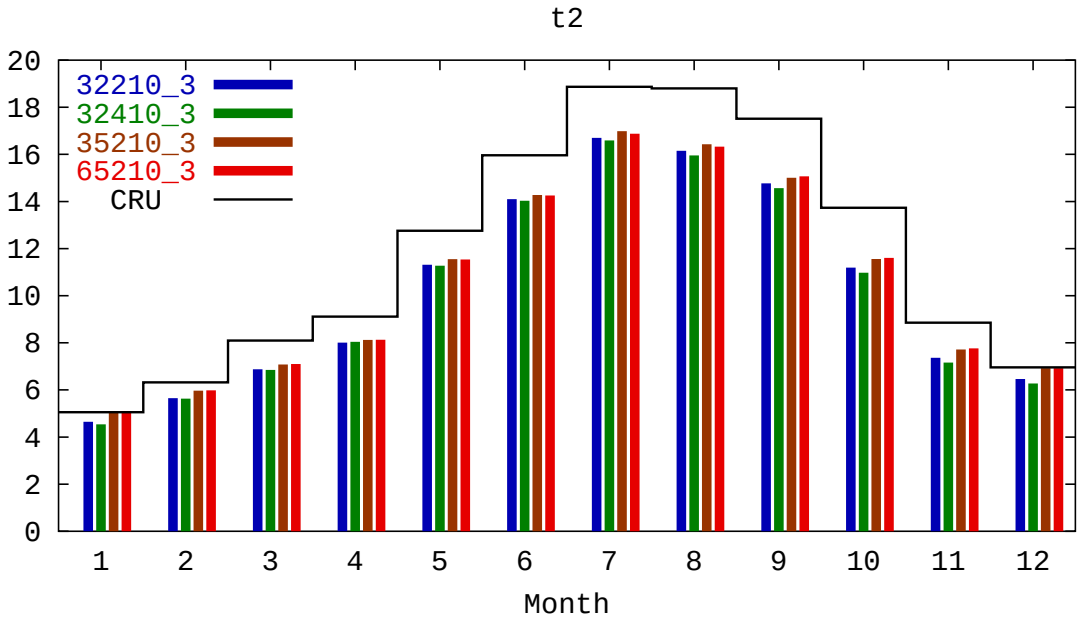


Annual cycle

Precipitation

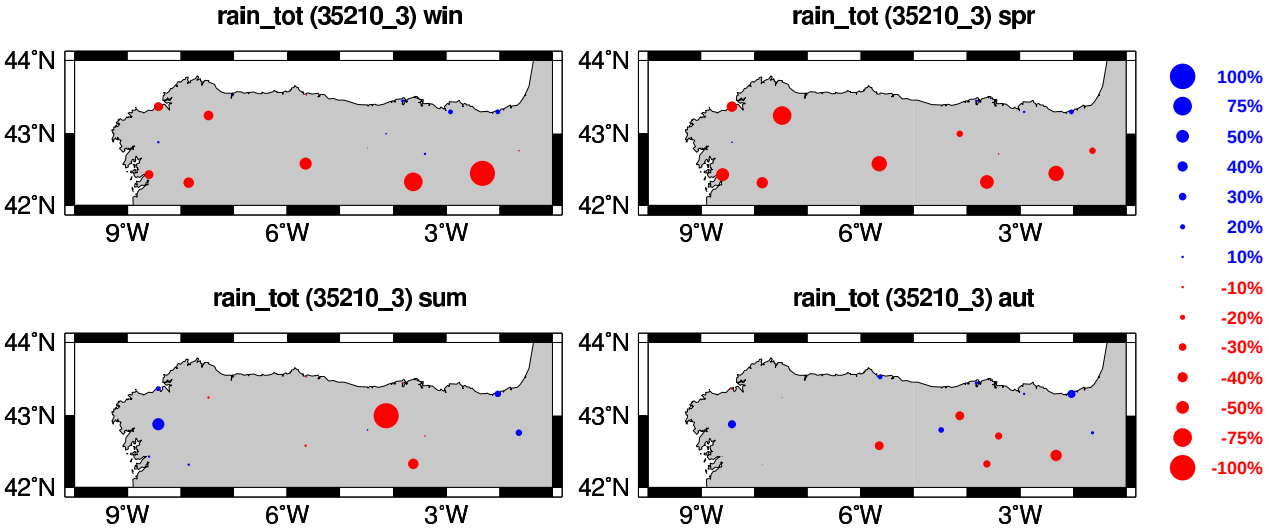


Temperature

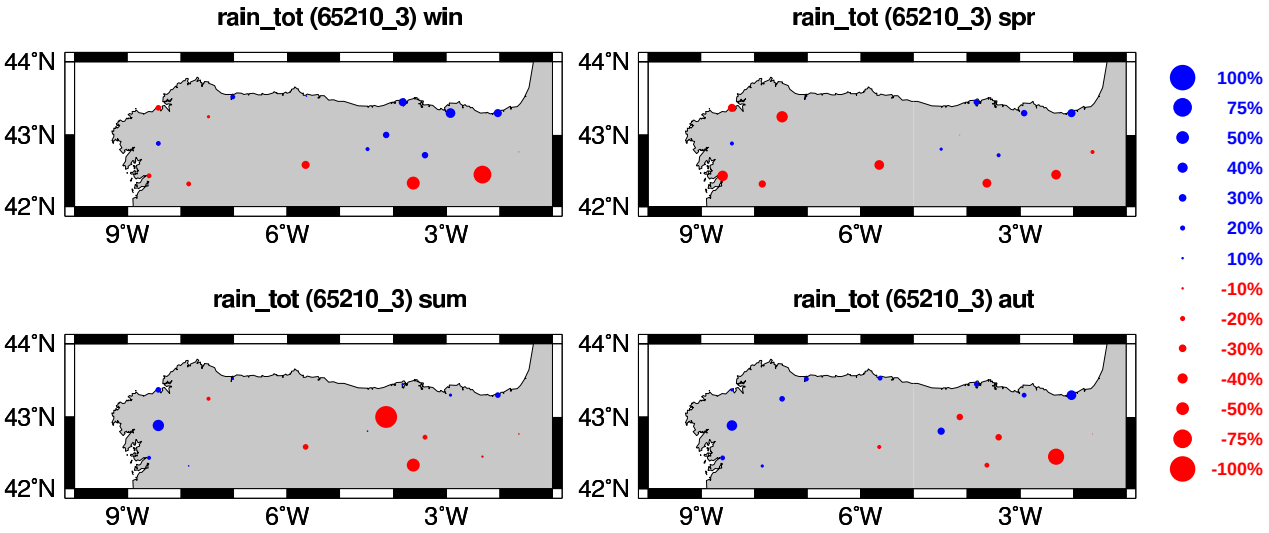


Rainfall climatology

35210

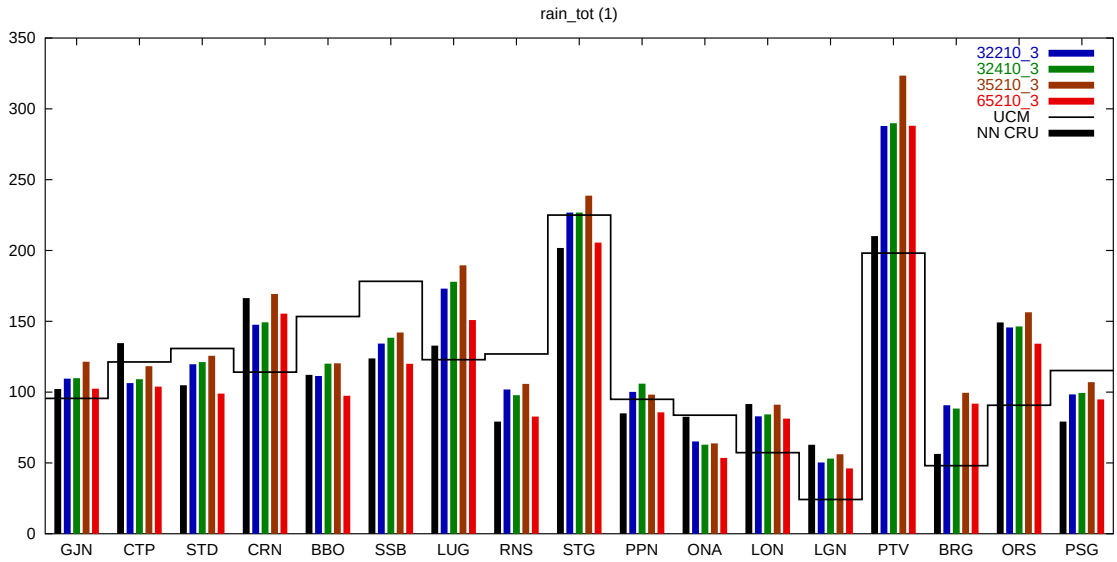


65210

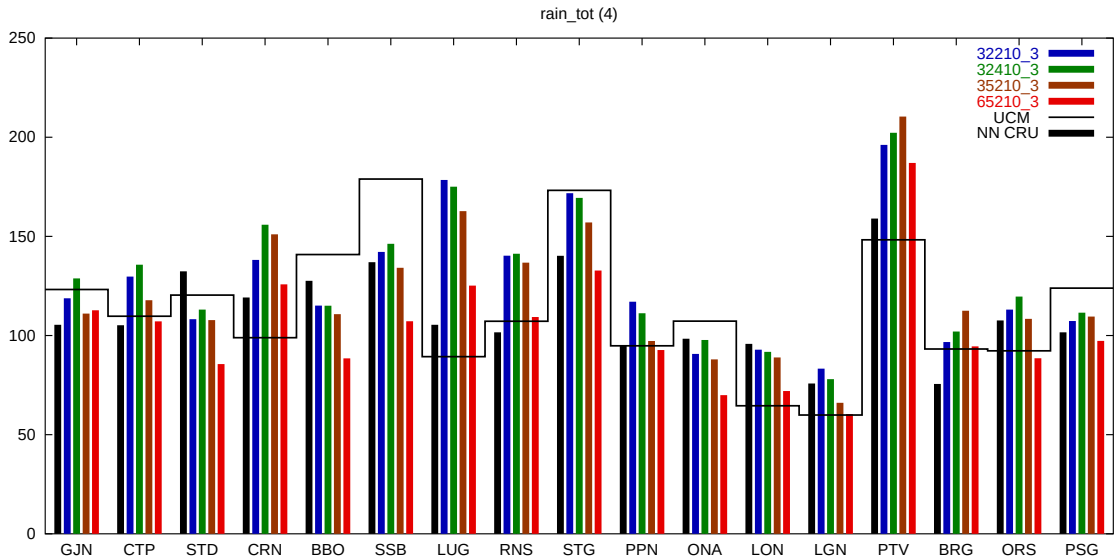


Monthly climatologies (per station)

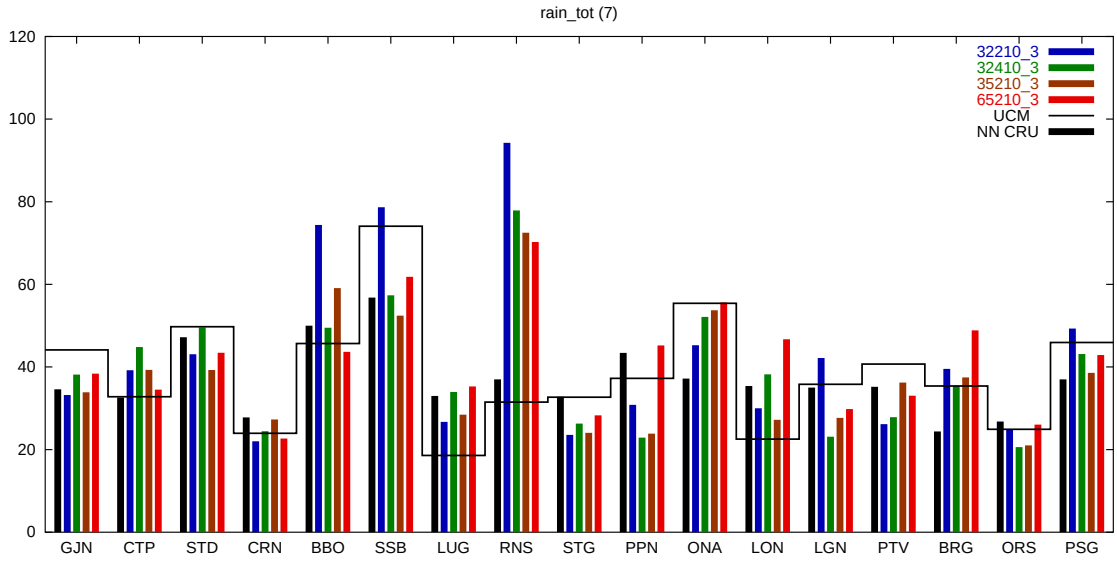
January



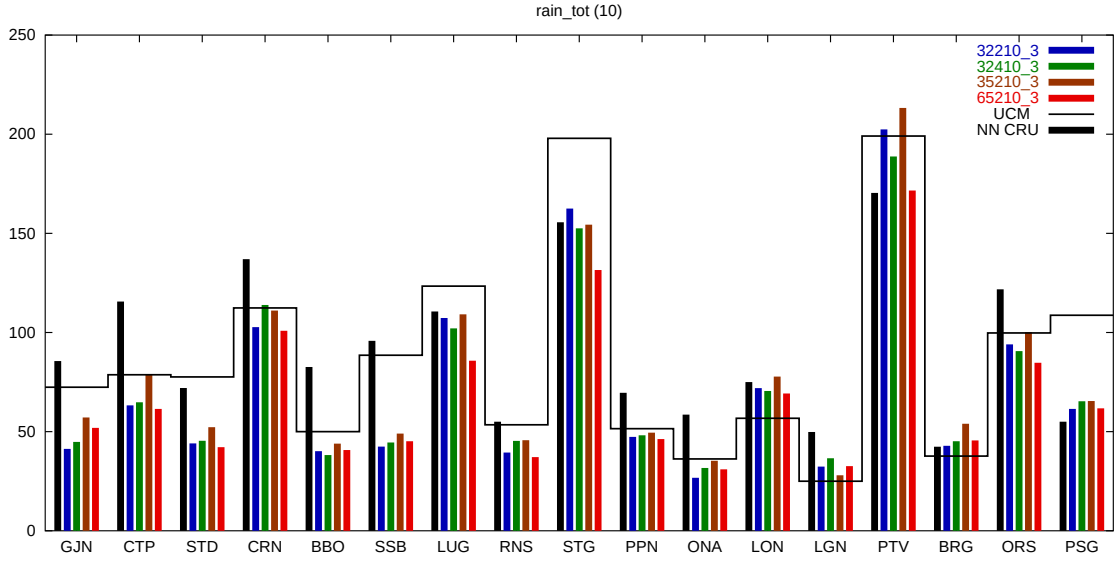
April



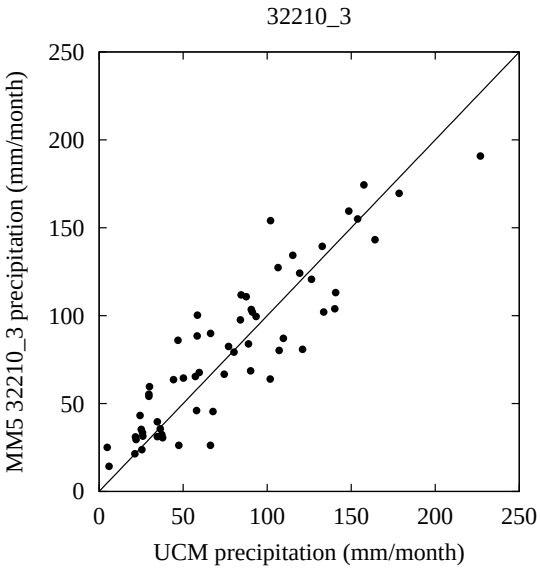
July

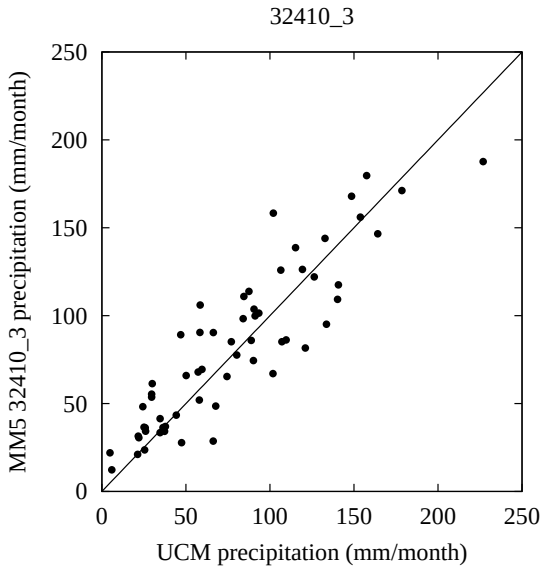


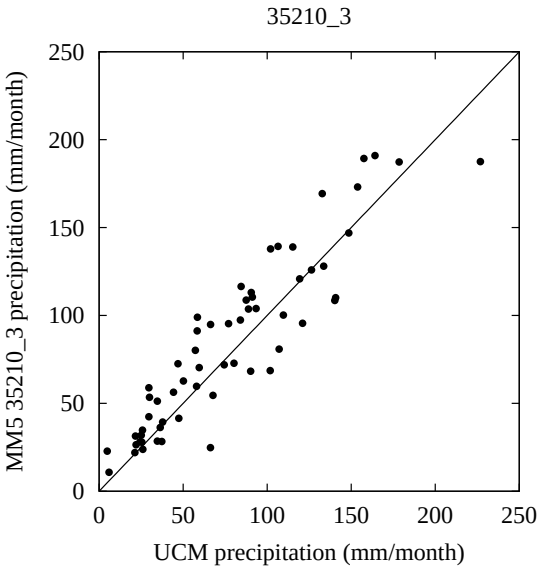
October

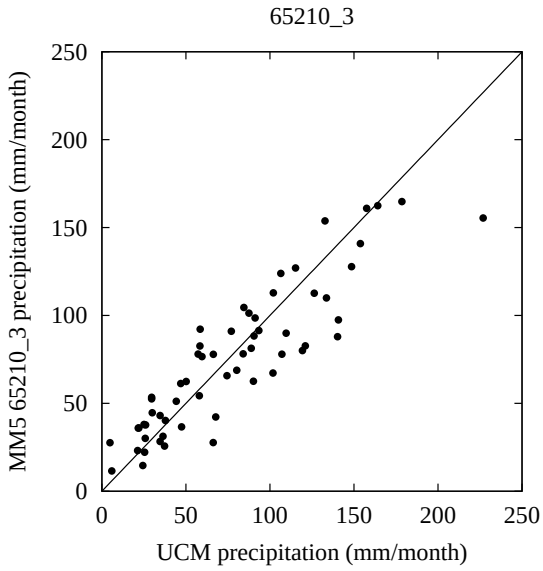


Scatter plots

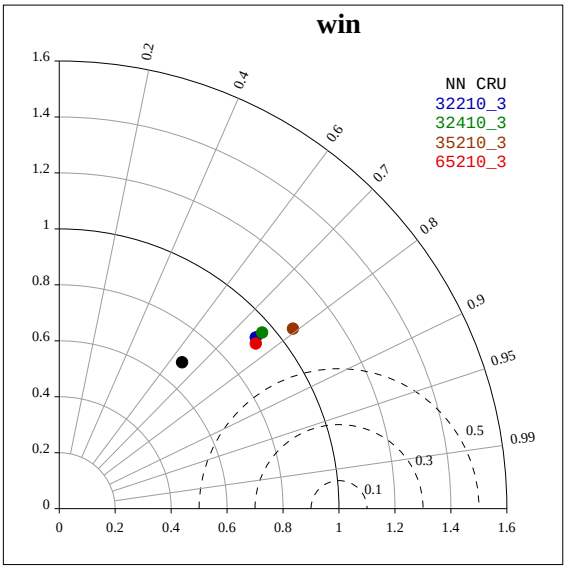


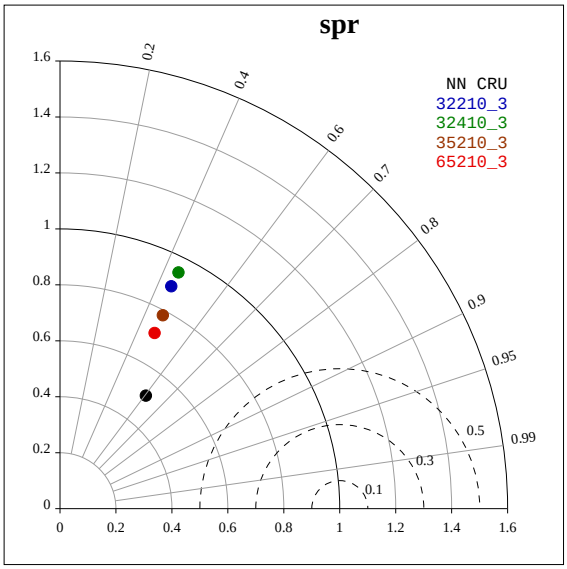


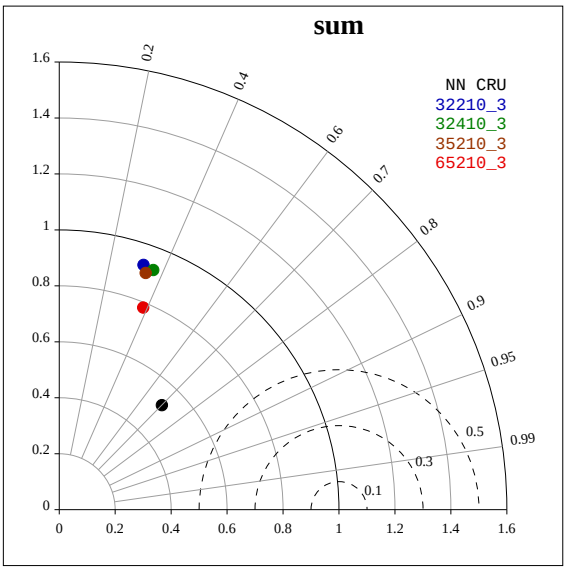


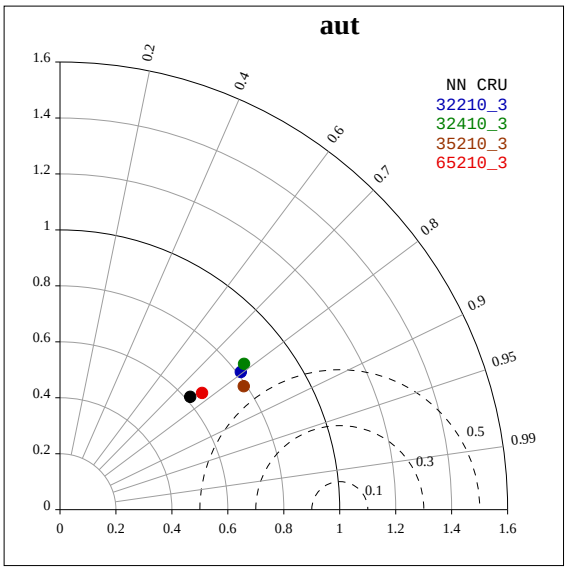


Taylor graph

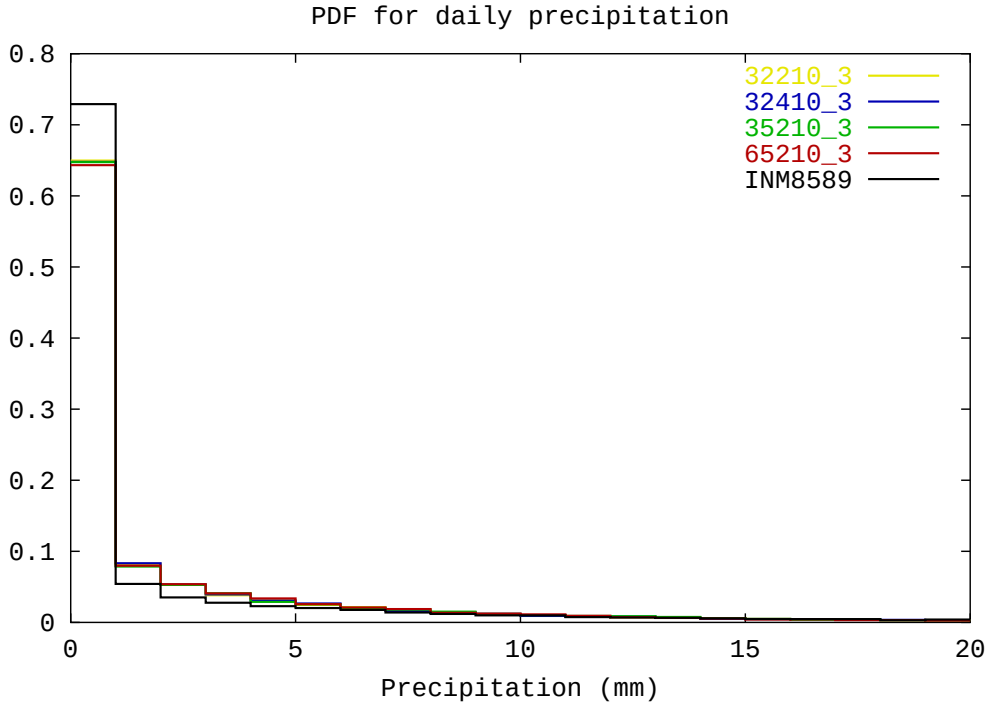


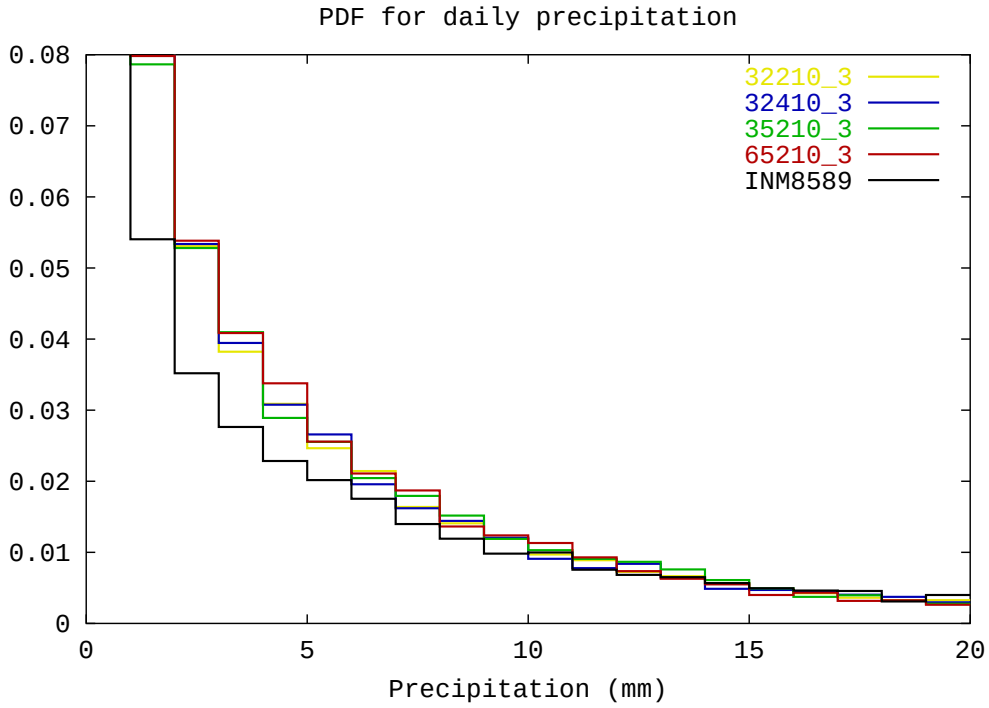






Daily data


PDF for daily precipitation
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
Precipitation (mm)
32210_3
32410_3
35210_3
65210_3
INM8589


PDF for daily precipitation
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
5
10
15
20
Precipitation (mm)
32210_3
32410_3
35210_3
65210_3
INM8589

Contingency tables

Total CT (%) for Run32210_3

Obs	<.1	<10	>10
<.1 (11817)	64.9	34.0	1.1
<10 (6122)	14.8	73.9	11.4
>10 (1698)	5.1	52.9	42.0

Total CT (%) for Run32410_3

Obs	<.1	<10	>10
<.1 (11817)	58.4	40.7	0.9
<10 (6122)	13.7	74.3	12.1
>10 (1698)	3.8	54.6	41.6

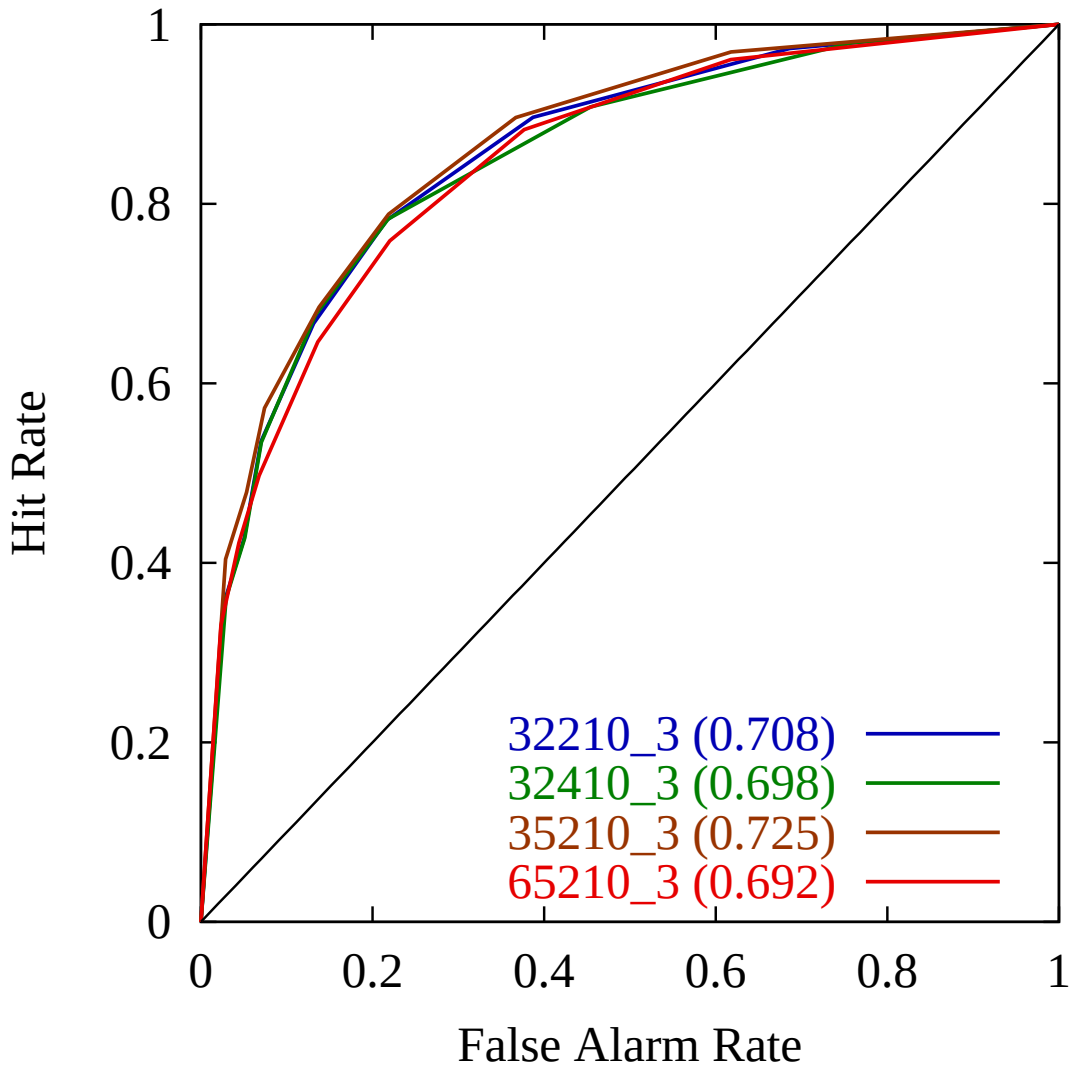
Total CT (%) for Run35210_3

Obs	<.1	<10	>10
<.1 (11817)	67.1	31.9	1.0
<10 (6122)	14.4	73.2	12.4
>10 (1698)	4.4	48.8	46.8

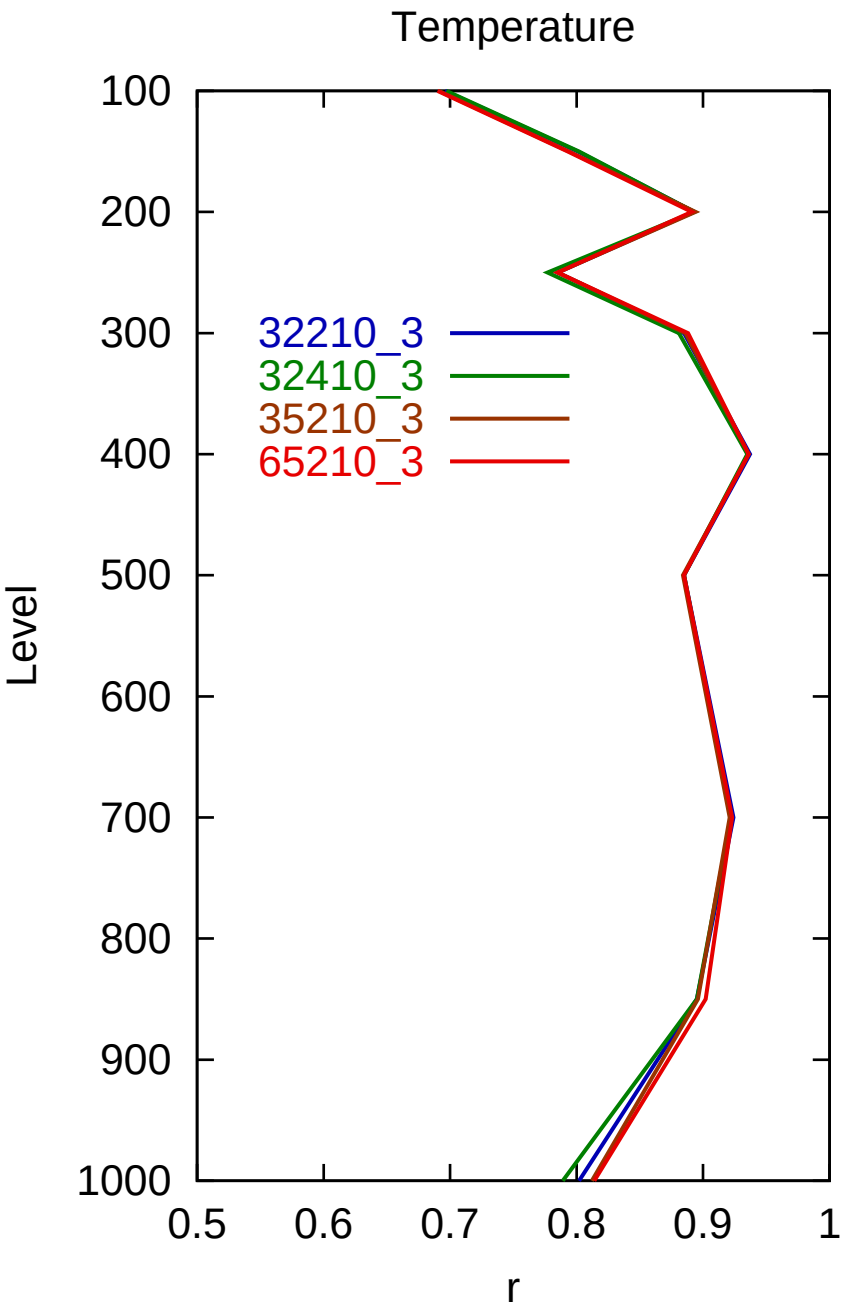
Total CT (%) for Run65210_3

Obs	<.1	<10	>10
<.1 (11817)	66.7	32.4	0.9
<10 (6122)	17.1	72.7	10.2
>10 (1698)	6.1	51.9	42.0

ROC Curves


Hit Rate
False Alarm Rate
0
0.2
0.4
0.6
0.8
1
32210_3 (0.708)
32410_3 (0.698)
35210_3 (0.725)
65210_3 (0.692)

12h Vertical profi le (A Coruña)



Summary and conclusions

- Multi–year MM5 run over a wide region
- Sensitivity analysis to several parametrizations
- The results for monthly precipitation show:
  1. The average monthly annual cicle is better reproduced by the Kain-Fitsch cumulus scheme in winter and by Grell in autumm
  2. The Kain-Fritsch scheme tends to produce less rainfall than Grell and, thus presents less monthly variability.
  3. But, in general, there is an agreement between the model runs
- For daily precipitation:
  1. The agreement among models is still bigger
  2. All parametrizations underestimate the number of dry days