Sensitivity of the ACCESS forecast model statistical rainfall properties to resolution

Hanh Nguyen
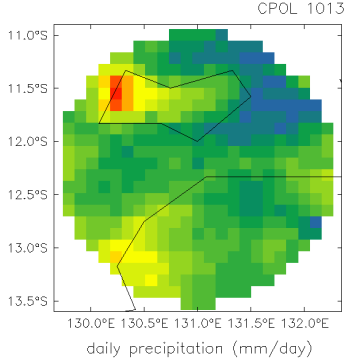
Alain Protat

Michael Whimpey
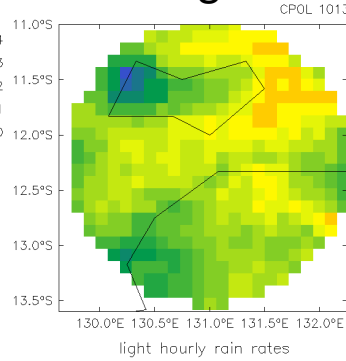
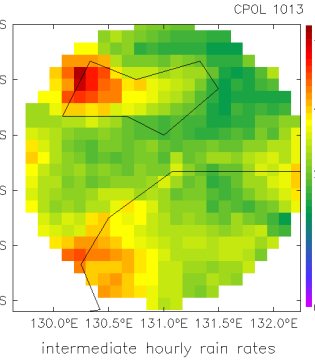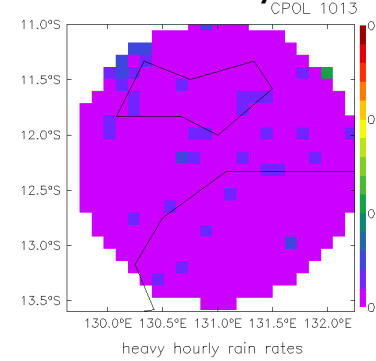# Model errors from ACCESS-A compared to CPOL over Darwin
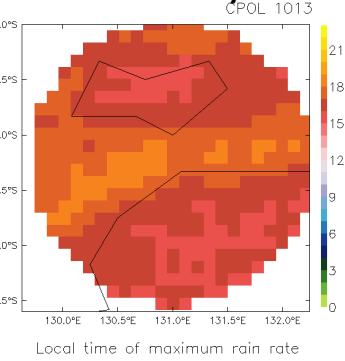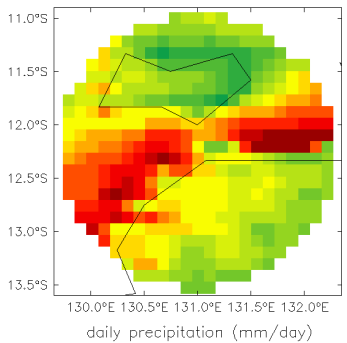
Mean rain rate	Light	Intermediate	Heavy	Diurnal cycle
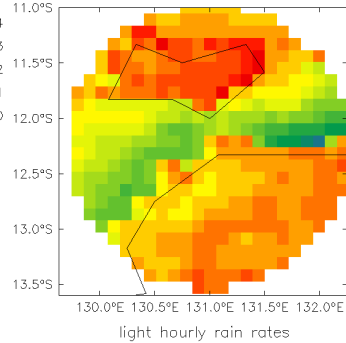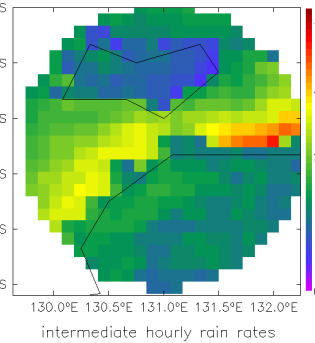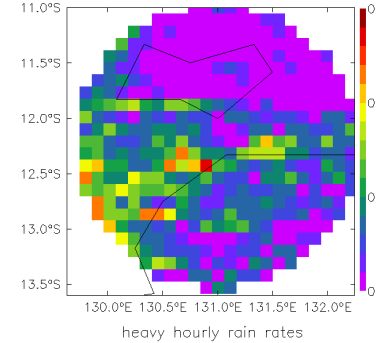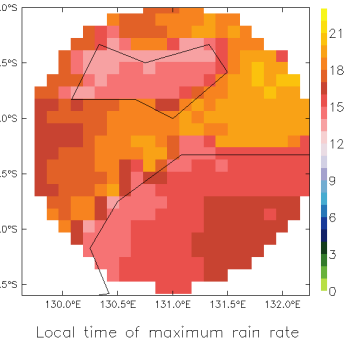
Overestimate mean daily rain over ocean: primarily from the intermediate rain rates and grid point storms , although partly compensated by underestimate of light rain rates.

Overestimate mean daily rain over land: primarily from the light rain rates and grid point storms , although partly compensated by underestimate of intermediate rain rates.
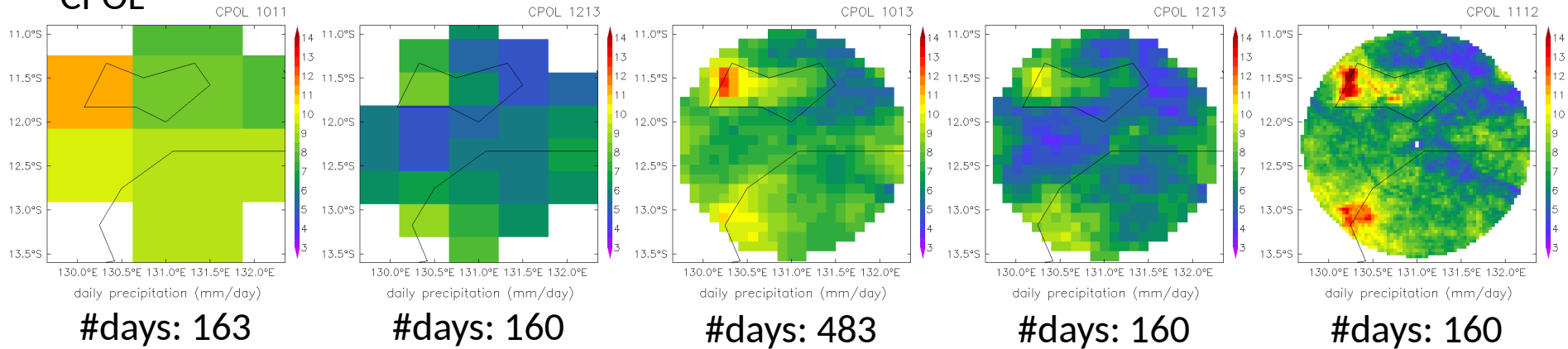
Diurnal cycle too early over land and the western ocean, too late over the eastern ocean

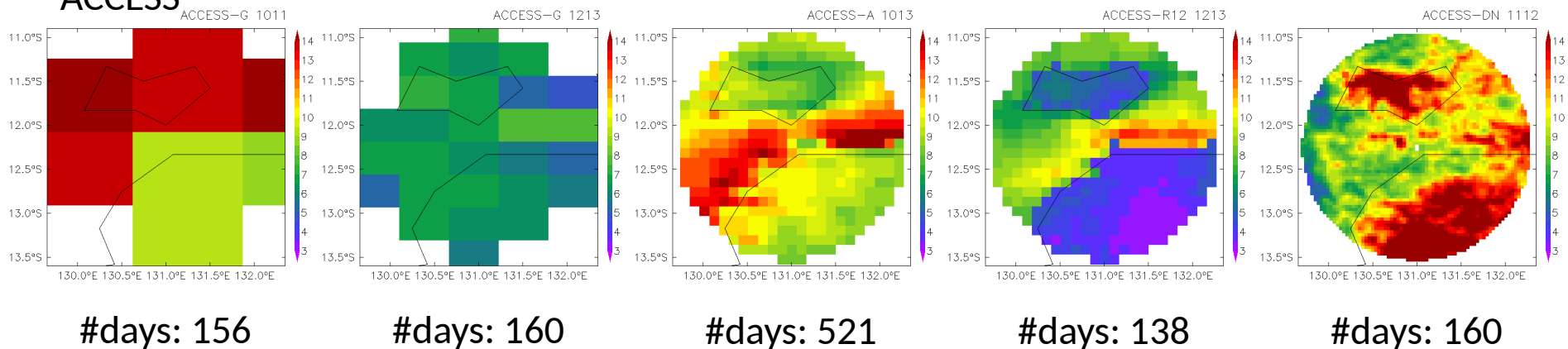# How does the model resolution affects model errors?

- Five versions of the model are analysed:
  - ACCESS-G (lat x lon: 0.83°x1.25° ; season: 2010-11)
    - APS0 (UM vn6.4/PS17)
  - ACCESS-G (0.375°x0.56° ; 2012-13)
    - APS1 (UM vn7.5/PS24) with increased resolution from ~80km to 40km, 50 to 70 model levels, and improved physical parameterization
  - ACCESS-A (0.11°x0.11° ; 2010-13)
    - Nested in the APS0 version of ACCESS-G
  - ACCESS-R(12) (0.11°x0.11° ; 2012-13)
    - Nested inside the APS1 version of ACCESS-G
    - Replaces the ACCESS-A
  - ACCESS-C (DN) (0.036°x0.036° ; 2011-12)
    - Nested inside the APS1 version of ACCESS-R (but with UM vn7.6)

- CPOL data are first regridded to each of the model's version resolution for direct comparison between modelled and observational seasonal features.

Mean daily rain rate for Nov-April

CPOL

| #days: 163 | #days: 160 | #days: 483 | #days: 160 | #days: 160 |

ACCESS

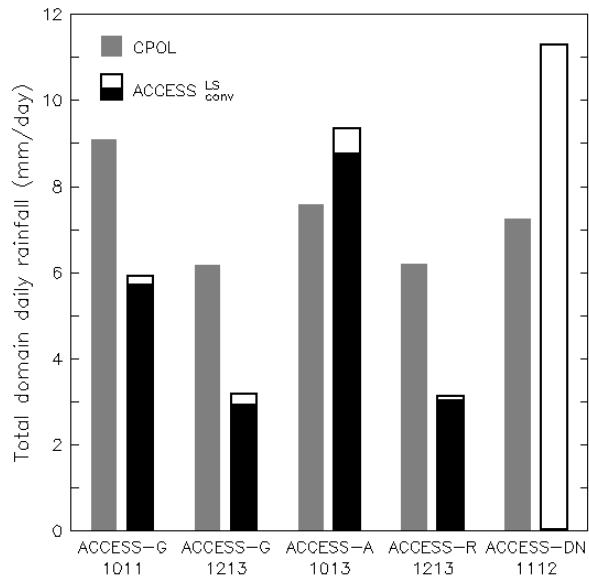| #days: 156 | #days: 160 | #days: 521 | #days: 138 | #days: 160 |

Reduced overestimate in the higher res ACCESS-G
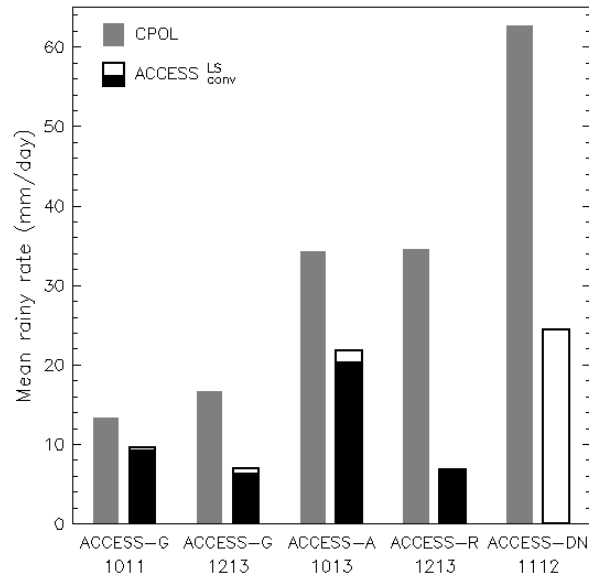
ACCESS-R worse that ACCESS-G

Land/sea contrast of dry/wet bias in ACCESS-A and -R is reversed in the ACCESS-DN which now tends to be too wet overall

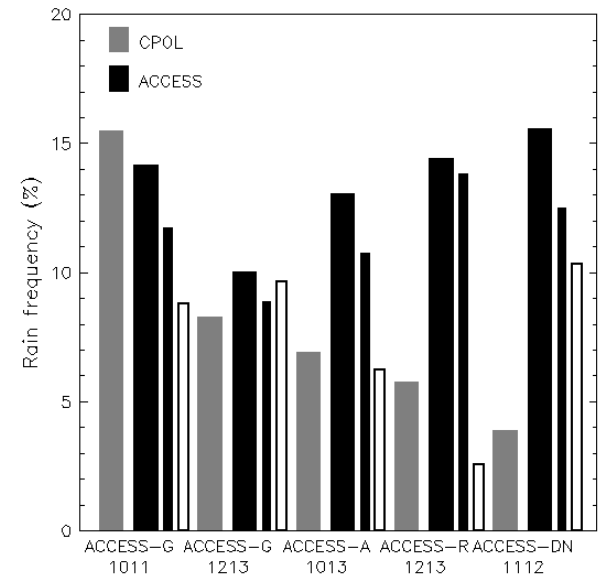# Distribution of daily rainfall properties

Total domain rainfall

Rainfall intensity

Rainfall frequency

Total domain rainfall underestimated in all except ACCESS-A and -DN

Model fails to reproduce intensity and frequency dependence seen in CPOL: it even tends to have increased frequency (produced by the convective scheme) with increased resolution. Note frequency of rains produced by the large scale scheme does decrease…
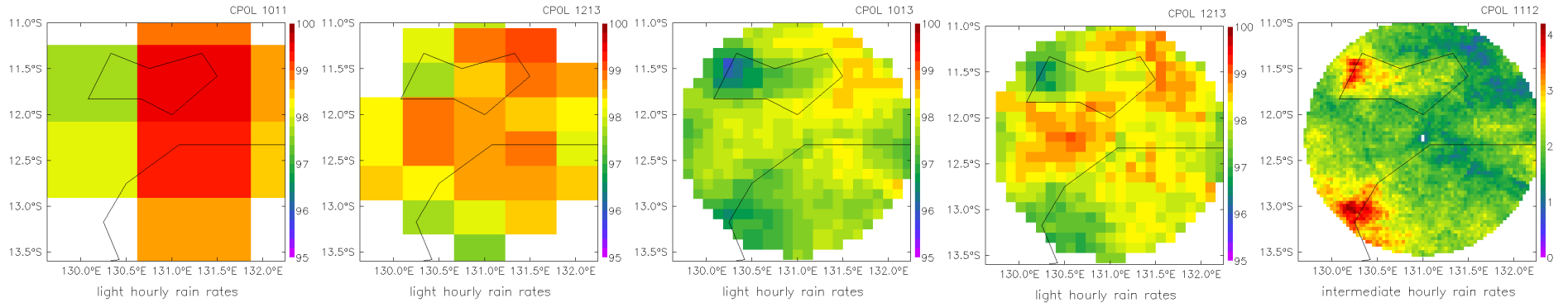
PDF of hourly rain rate
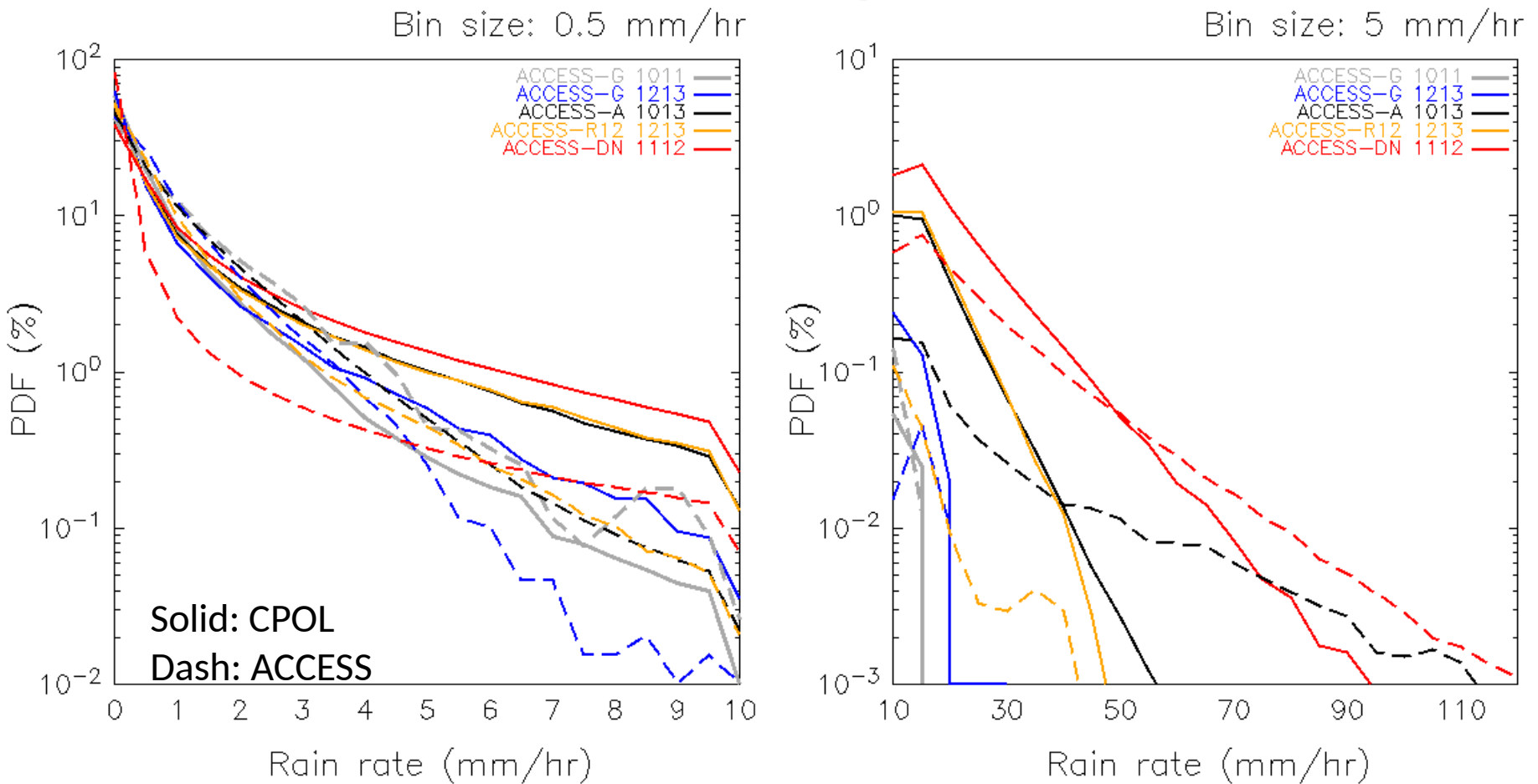
Reduced overestimate of light rains only in ACCESS-DN, which also has the most realistic PDF albeit generally underestimating except for the extremely small and extremely large rains
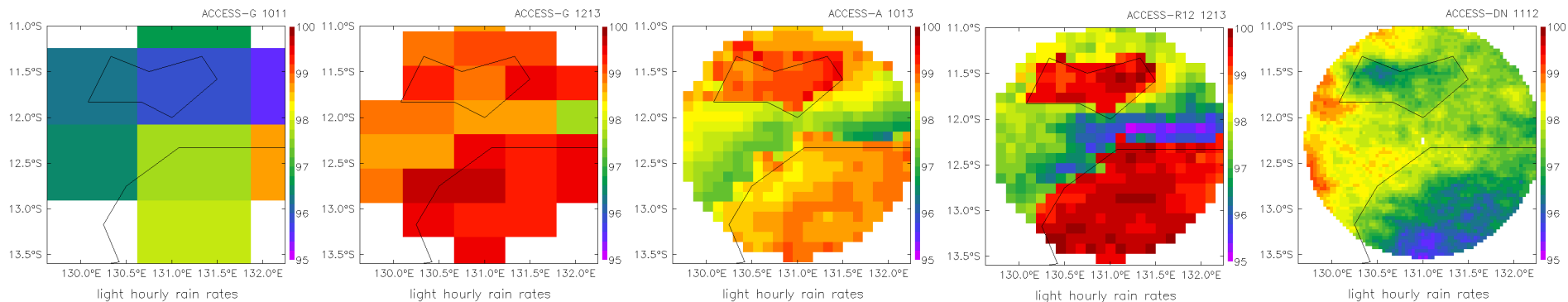
The grid point storms seen in ACCESS-A are eliminated in the other versions of the model
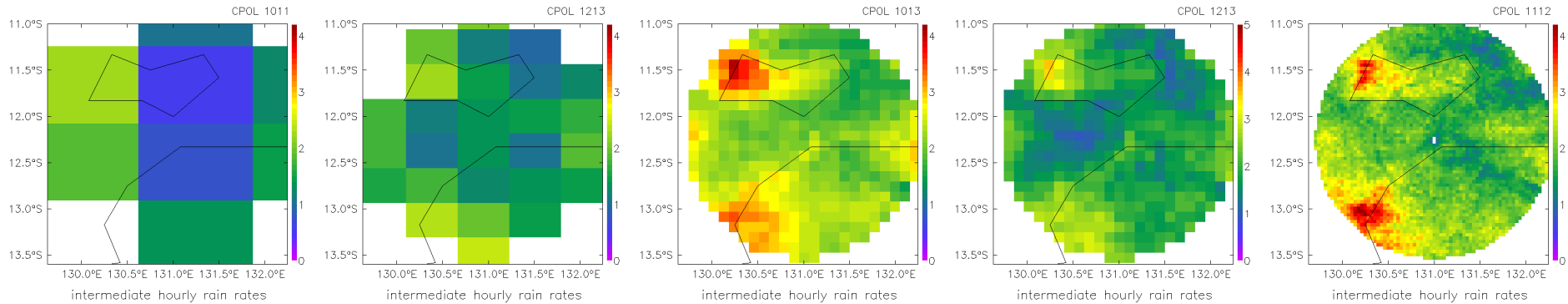
Light rain rate frequency (<4mm/hr)

General increase in the higher resolution version of ACCESS-G
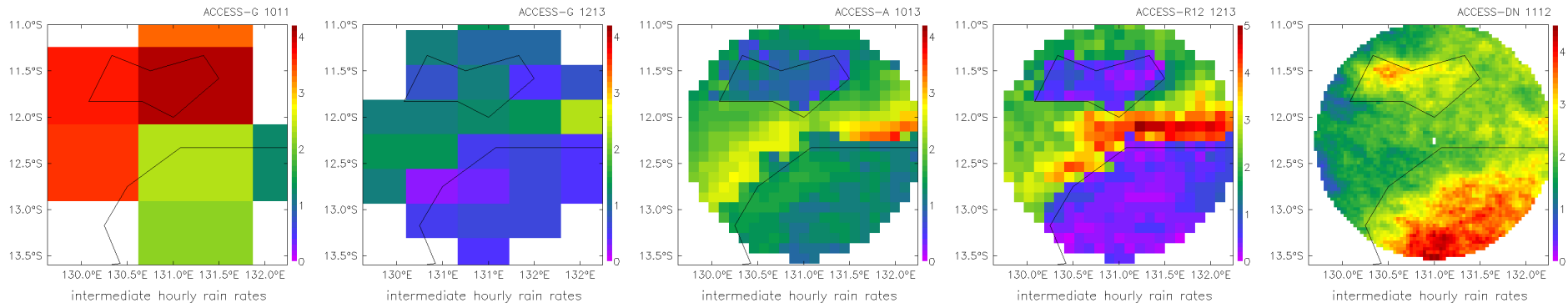No improvement in ACCESS-R: land/sea contrast issue?
ACCESS-DN reduces (but too much) rains over land and increases (but wrong locations) over ocean.

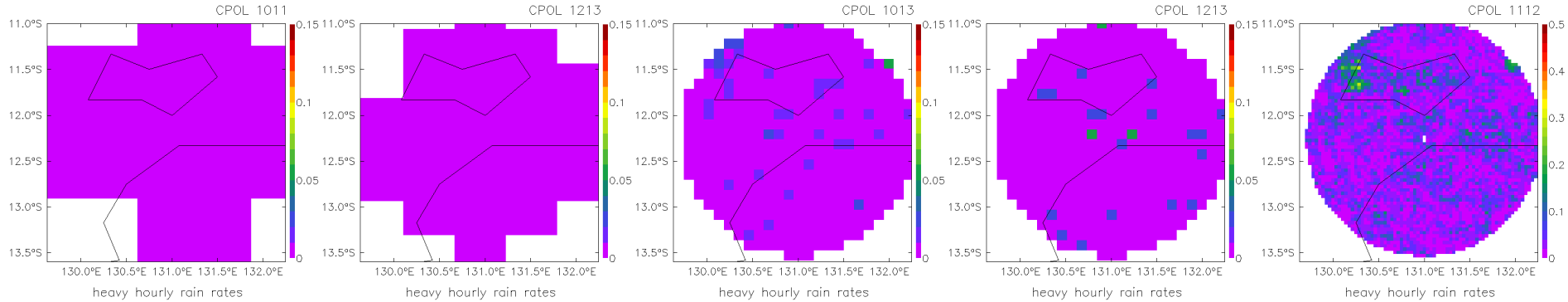# Intermediate rain rate frequency (<40mm/hr)

Reduced overestimate on the north-western region, but too much reduction around Darwin in ACCESS-G ⭢ even more marked in ACCESS-R
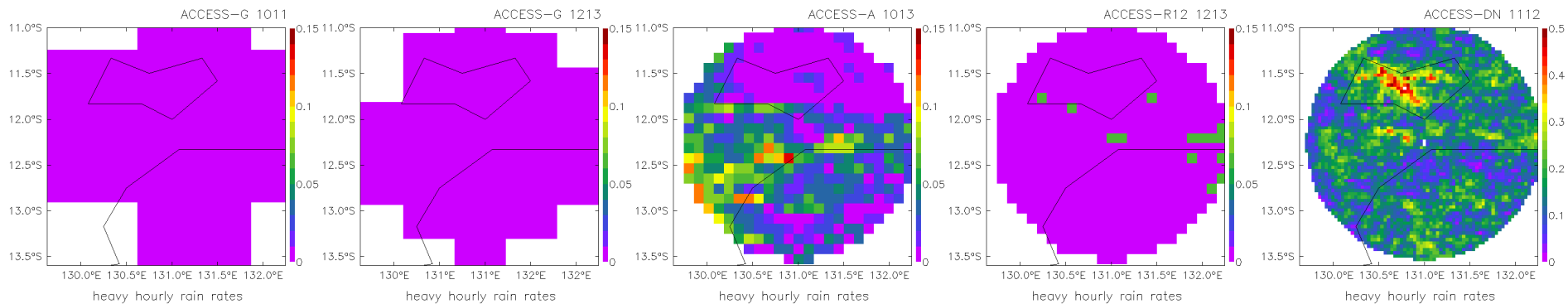Reduced rains over ocean and increased (but wrong locations) over land in ACCESS-DN.

Heavy rain rate frequency (>40mm/hr)
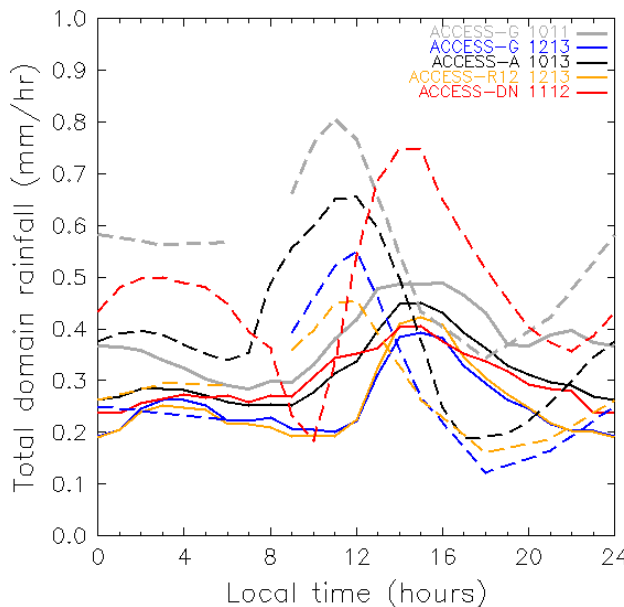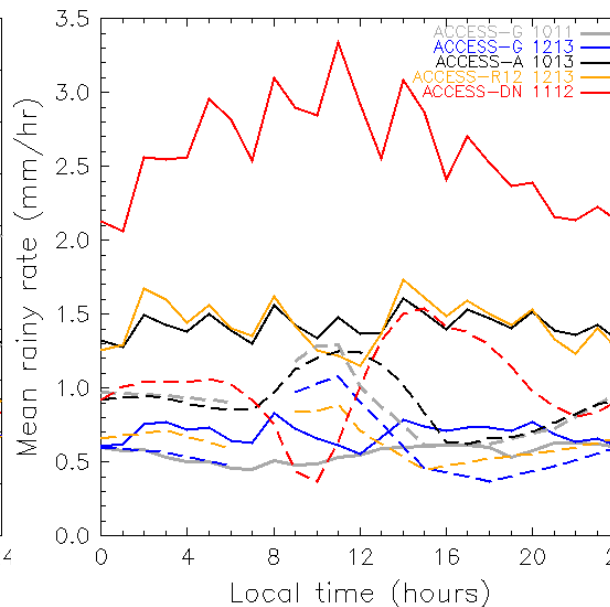
CPOL

ACCESS

Grid point storms seen only in ACCESS-A
ACCESS-DN overestimates overall
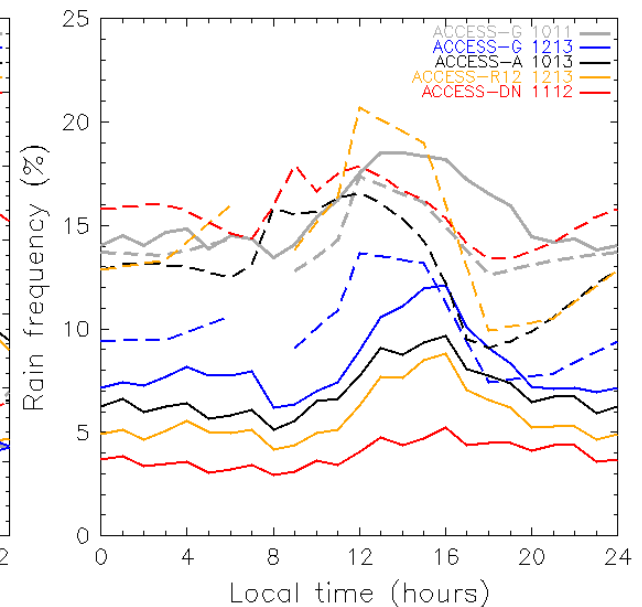
Diurnal cycle of hourly rain PDF

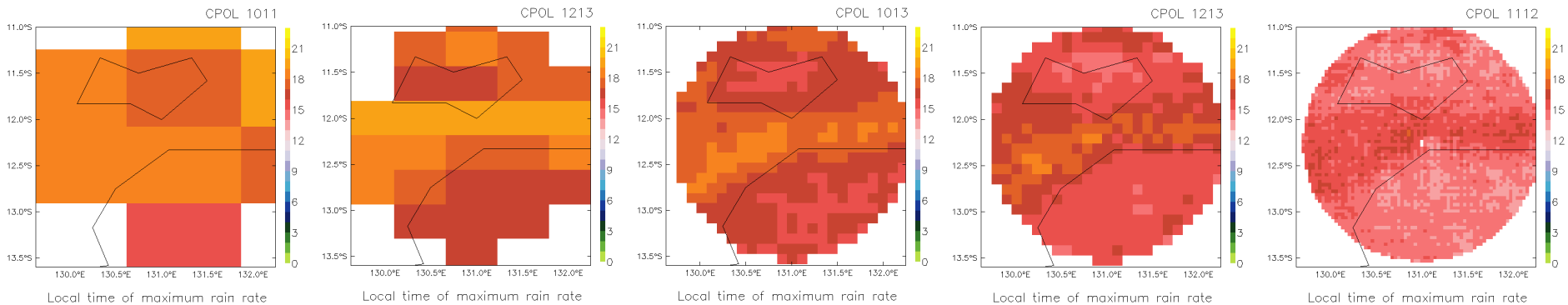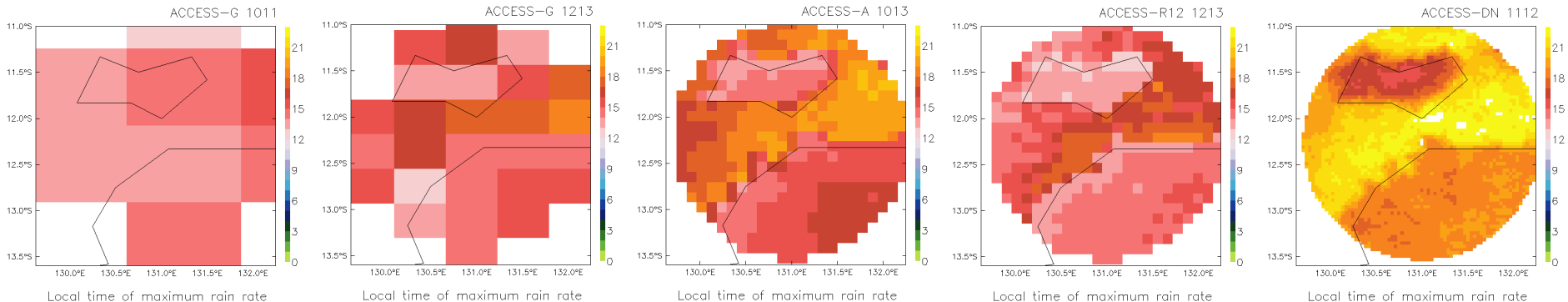Total domain rainfall   Rainfall intensity   Rainfall frequency

Only ACCESS-DN reproduces the correct timing of the total domain rainfall peak
Diurnal cycle of the intensity is still seen in all versions of the model
The diurnal cycle of frequency still peaks too early

Local time of the diurnal max rain rate

Increased resolution delay the diurnal peak, tending to improve it except for the ACCESS-DN that now tends to peaking too late