Inter-comparison of precipitation products over Europe:
experiences, results and recommendations

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Overview

Introduction

- European IPWG validation basics

Experiences

- Day-to-day running of a validation site
- Data availability, ingest, processing, checking

Results

- Summary of results
- Radar performance; MPE performance

Recommendations

- Current issues
- Recommendations…

IPWG European validation

- Radar used as 'ground truth'
- Composite of radars over UK, France, Germany, Belgium and Netherlands
- Nominal 5 km resolution
- Equal-area polar-stereographic projection

- Data and product ingest
- Near real-time
- Statistical and graphical output (SGI/Unix; f77/netpbm)

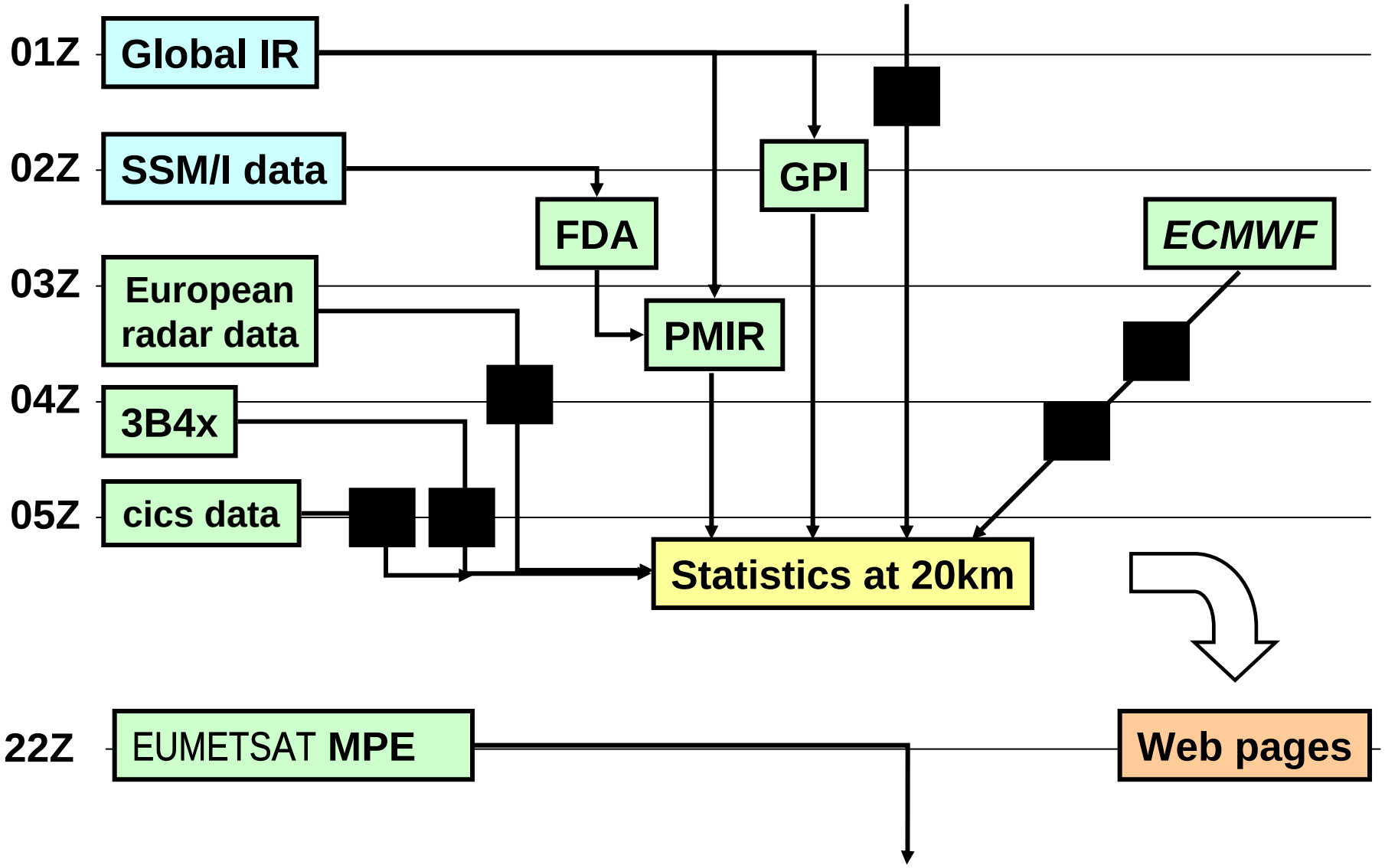
- Currently developing the BALTEX region data set…

Processing setup

Perceived requirements:

- **Daily inter-comparison** → 00Z-24Z (also -06, -09, -12Z)
- **0.25 degree resolution** → 25 km resolution
- **Real-time** → near real-time dependent upon product
- **Validation data** → radar data (gauge being added later)
- **Automatic** → quasi-automatic (not '*operational*')
- **Many products** → limited number of products

Processing Schedule



Processing system

Initial setup:
Setting of dates
Cleaning out old/decayed data

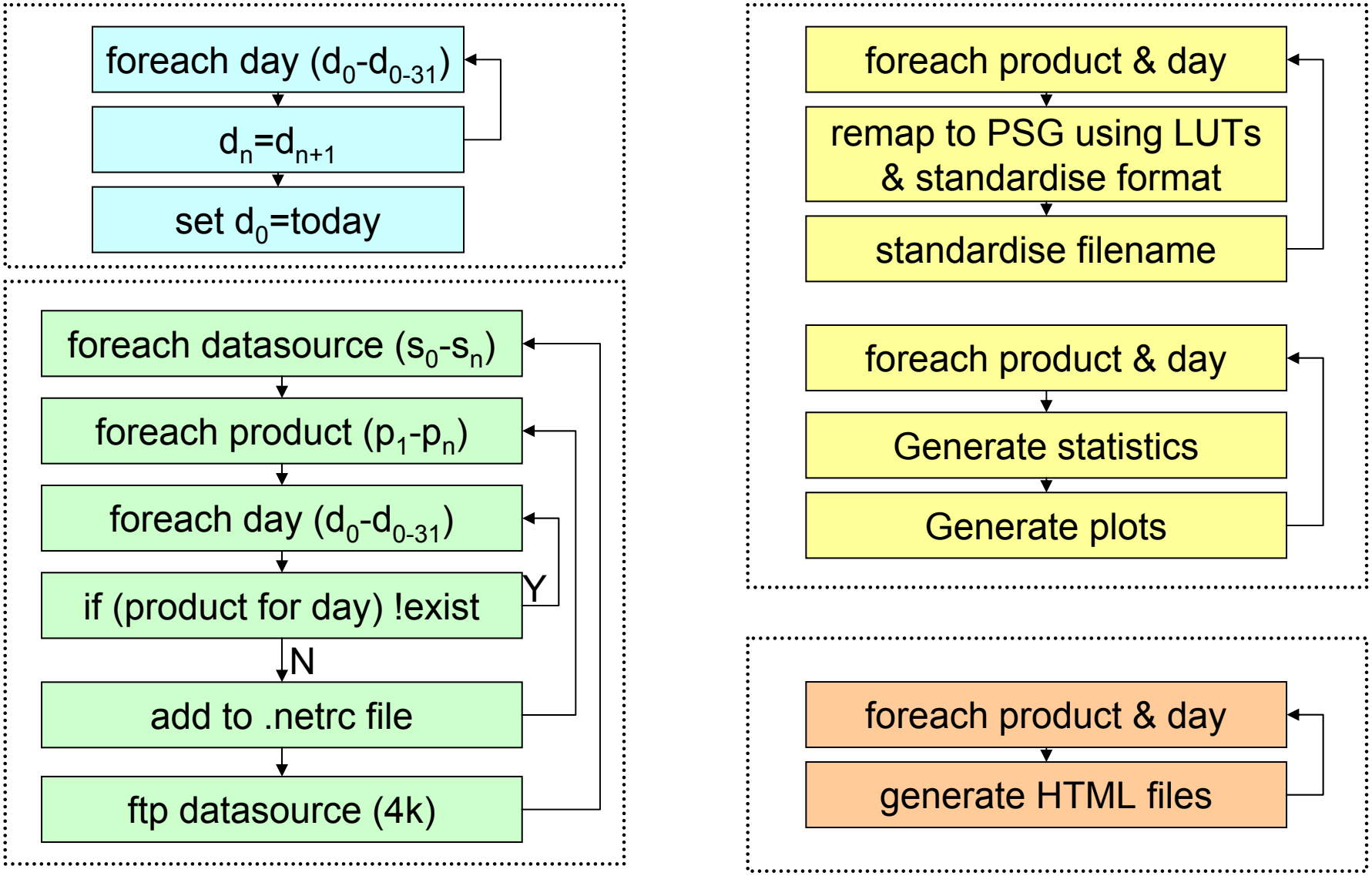
Acquiring data:
Searching existing data
Listing missing data
Creation of .netrc file
ftp data sources

Remapping of data:
5 km PSG projection
(equel area)

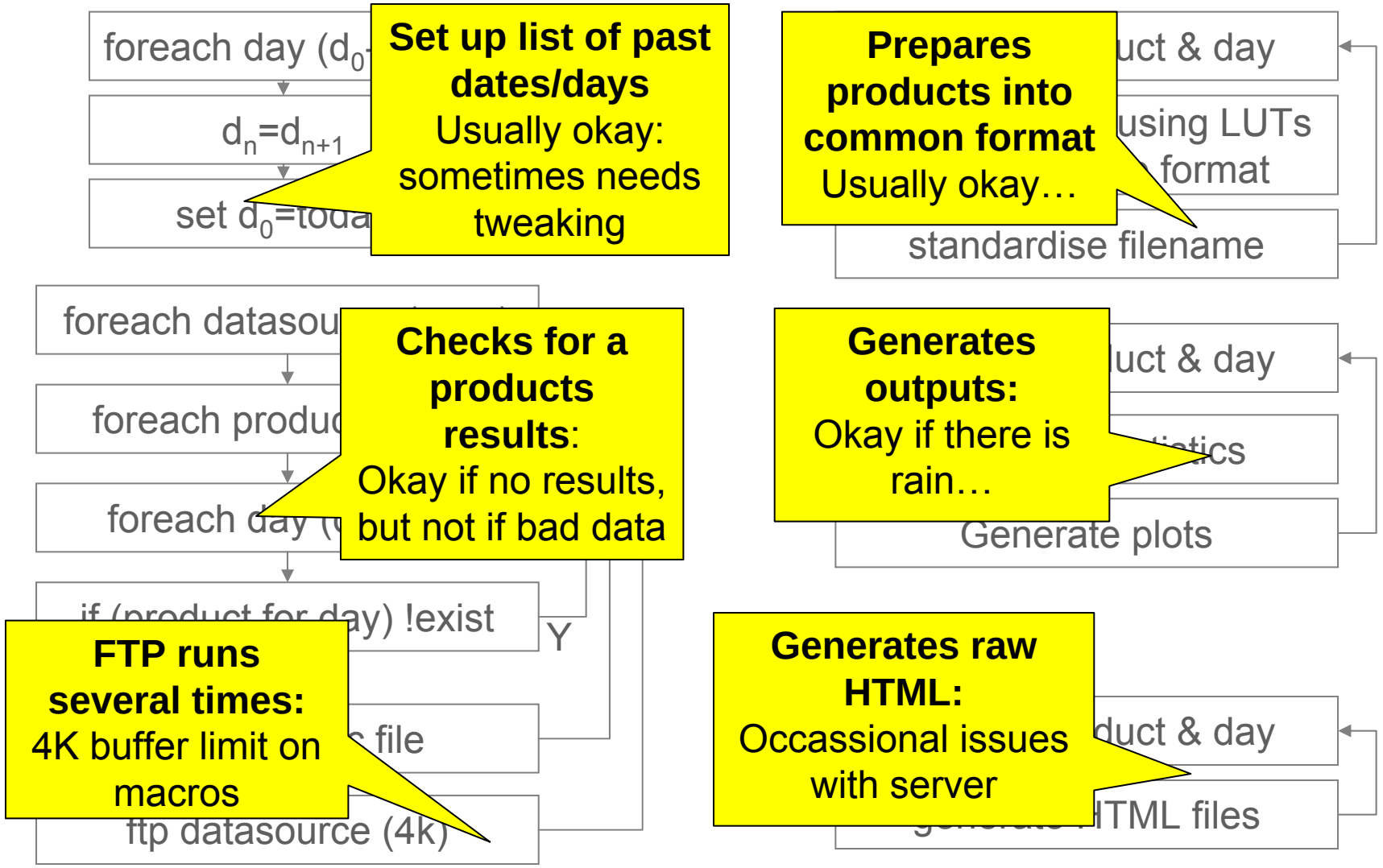
Results generation:
Statistical analysis
Graphical output

Web pages:
Generate HTML files
Copy over to server

Processing checks



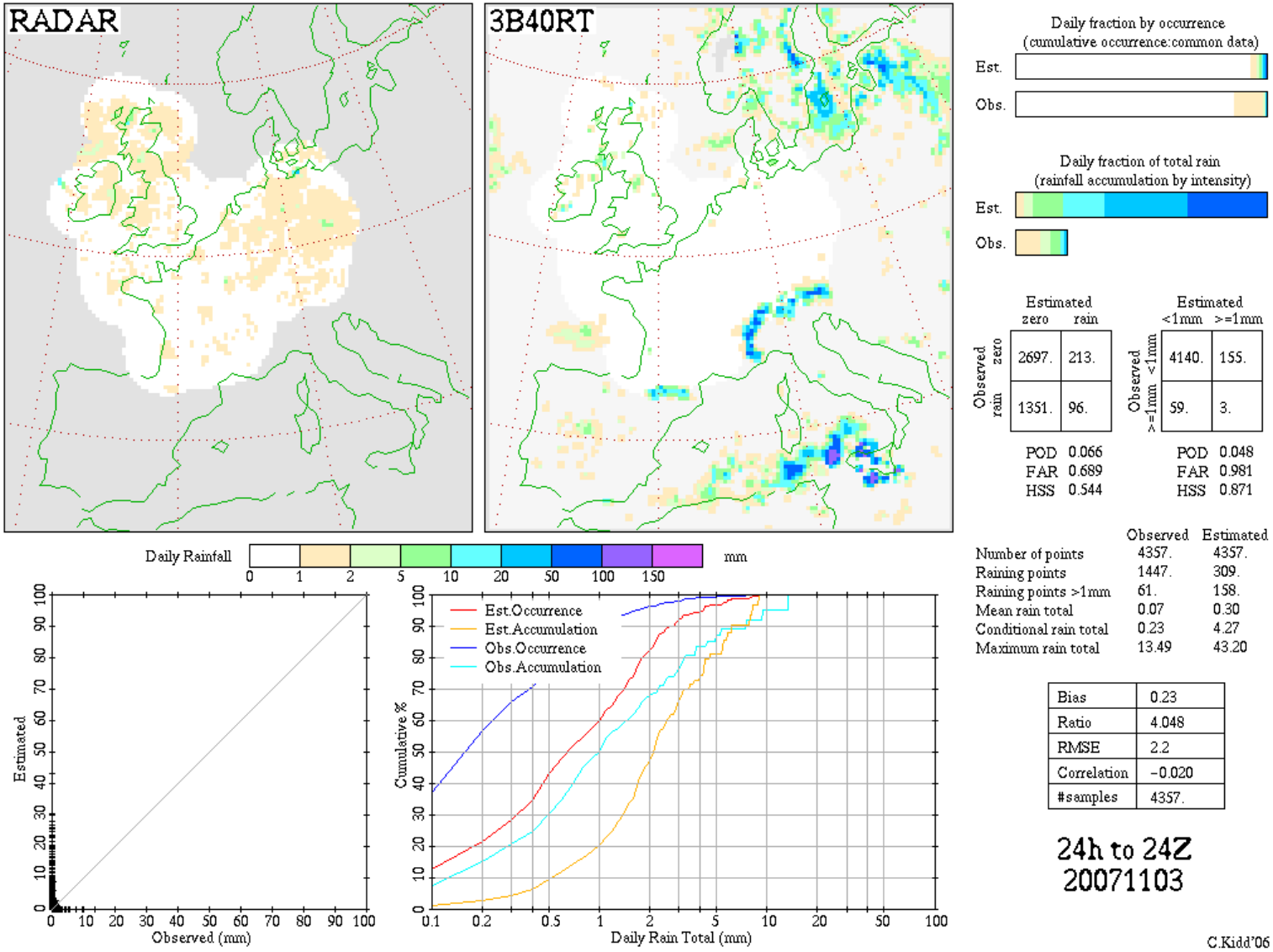
Processing checks



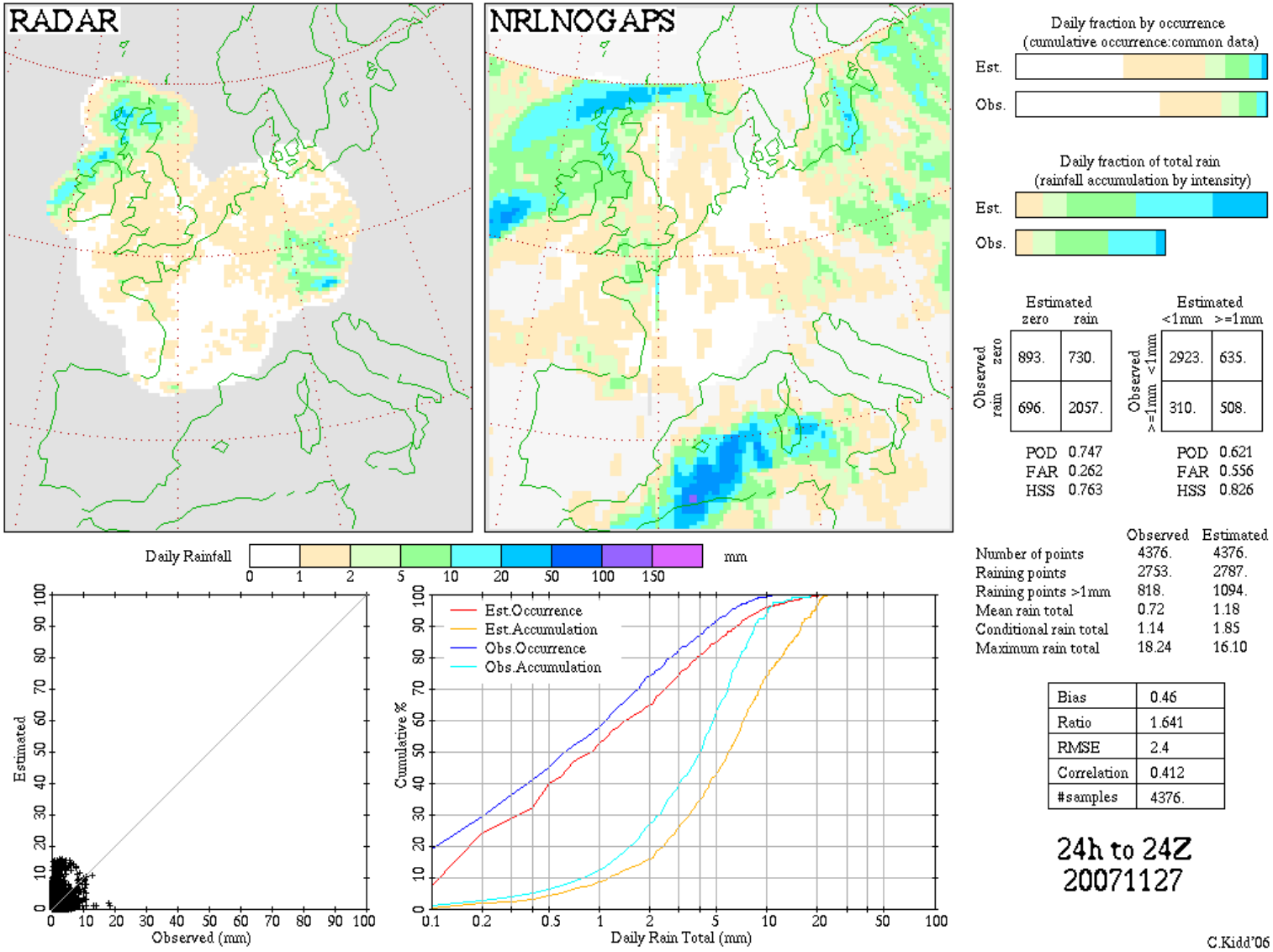
IPWG-EU Results

- Similar to other regions: seasonal dependence of satellite techniques (poorer in winter)
- Models tend to overestimate rain area/extent
- Satellite products underestimate rain area/extent
- Significant day-to-day variations: rainfall patterns, extent, intensity affect statistics
- Surface contamination noticeable in winter

Results: Snow problems



Results: rain extent



IPWG European Validation

00-24Z correlation statistics

date	NOGAPS	3B40RT	3B41RT	3B42RT	AMSU
071129	-	0.129	0.179	0.196	-
071128	0.644	0.065	0.191	0.132	0.353
071127	0.412	-0.081	0.185	-0.077	0.133
071126	0.394	0.369	-0.056	0.222	0.150
071125	0.593	0.023	0.290	0.095	0.077
071124	0.564	0.085	0.230	0.328	0.268
071123	0.454	0.111	0.129	0.247	0.497
071122	0.436	0.409	0.333	0.419	0.483
071121	0.480	0.250	-0.008	0.201	0.228
071120	0.453	0.218	-0.034	0.020	0.296
071119	-	-0.010	-0.126	-0.025	-0.175
071118	-	0.274	0.550	0.603	-0.104
071117	0.773	0.298	0.619	0.576	-0.046
071116	0.088	-0.005	-0.009	0.038	-0.019
071115	0.199	0.138	-0.030	0.063	0.023
071114	0.349	0.235	0.330	0.313	0.028
071113	0.459	0.105	0.241	0.198	-0.010
071112	0.377	0.286	0.168	0.302	0.181
071111	0.582	0.124	0.435	0.344	0.278
071110	0.718	0.305	0.479	0.486	0.208
071109	0.536	0.157	0.233	0.239	0.128

IPWG European Validation

00-24Z ratio statistics

product too dry				~right				product too wet			
0.000	0.200	0.500	0.800	0.900	0.950	1.050	1.100	1.200	1.500	1.800	2.000

date	NOGAPS	3B40RT	3B41RT	3B42RT	AMSU	CMORPH	CPCMW	HYDRO-E	PMIR	FDA	NRLGEO	NRLPMW
071129	-	0.824	0.348	0.619	-	-	-	-	-	-	-	-
071128	1.206	4.229	2.189	3.536	0.454	0.598	0.606	0.663	-	-	1.922	2.277
071127	1.641	8.646	0.737	6.059	0.540	2.962	3.727	0.388	-	0.022	2.502	3.440
071126	0.782	0.593	0.170	0.256	0.098	0.055	0.112	0.033	-99.000	0.179	0.127	0.234
071125	0.947	0.551	0.201	0.309	0.330	0.126	0.221	0.535	0.053	0.246	0.337	0.460
071124	1.210	0.873	1.353	1.015	0.381	0.231	0.252	0.402	0.074	0.085	0.335	0.401
071123	0.905	0.511	0.989	0.842	0.384	0.170	0.217	0.515	0.192	0.077	0.265	0.316
071122	0.977	0.863	0.418	0.650	0.488	0.365	0.404	0.287	0.144	0.358	0.640	0.616
071121	0.920	0.779	0.399	0.699	0.552	0.404	0.478	0.183	0.030	0.111	0.327	0.491
071120	0.998	0.621	1.639	1.198	0.345	0.289	0.286	0.809	0.046	0.105	0.308	0.429
071119	-	0.608	1.491	1.051	4.737	0.227	0.236	0.681	0.059	0.035	0.399	0.397
071118	-	0.539	1.046	0.802	3.217	0.368	0.375	0.516	0.120	0.092	0.310	0.339
071117	0.876	0.813	1.174	0.943	2.838	0.475	0.390	0.768	0.087	0.252	0.335	0.405
071116	1.669	4.258	0.634	2.287	38.054	0.837	0.796	0.152	-	0.263	0.816	1.034
071115	0.838	2.594	0.273	1.199	15.732	0.206	0.235	0.028	0.025	0.155	0.300	0.443
071114	1.056	0.455	0.160	0.396	3.574	0.134	0.189	0.186	-	0.038	0.178	0.255
071113	1.025	0.290	1.036	0.685	3.185	0.129	0.140	0.425	0.145	0.080	0.197	0.285
071112	0.747	0.641	1.101	0.511	0.306	0.163	0.190	0.247	0.225	0.115	0.216	0.309

Performance of radar data

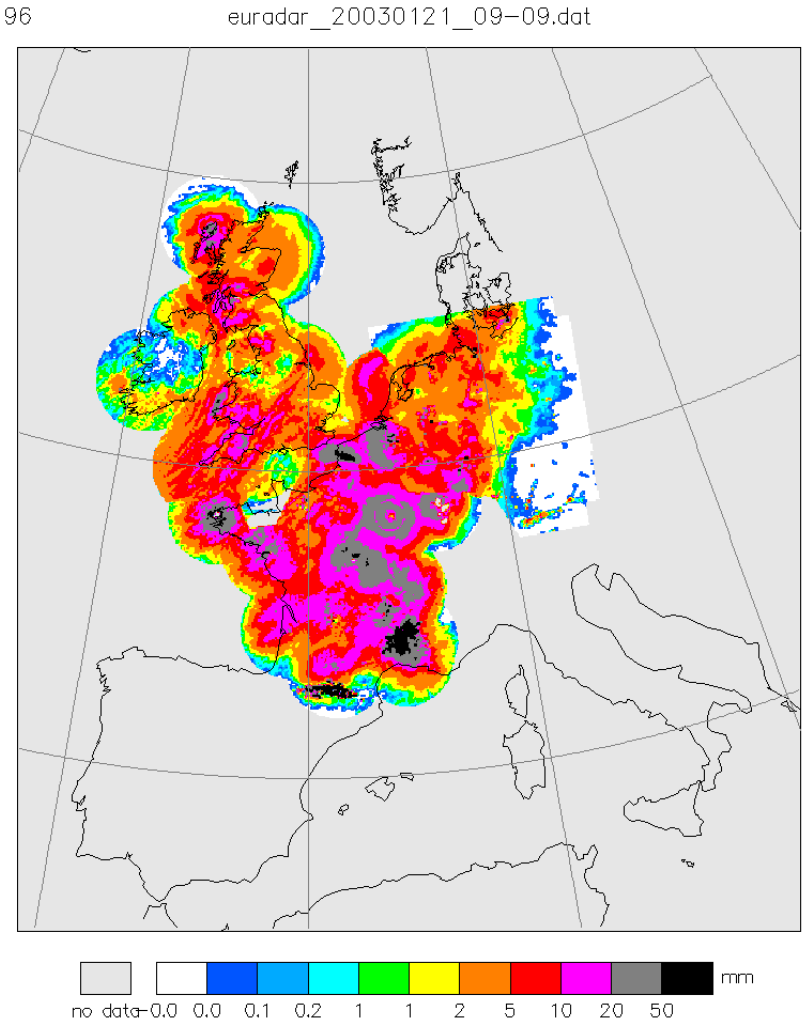
Radar data:

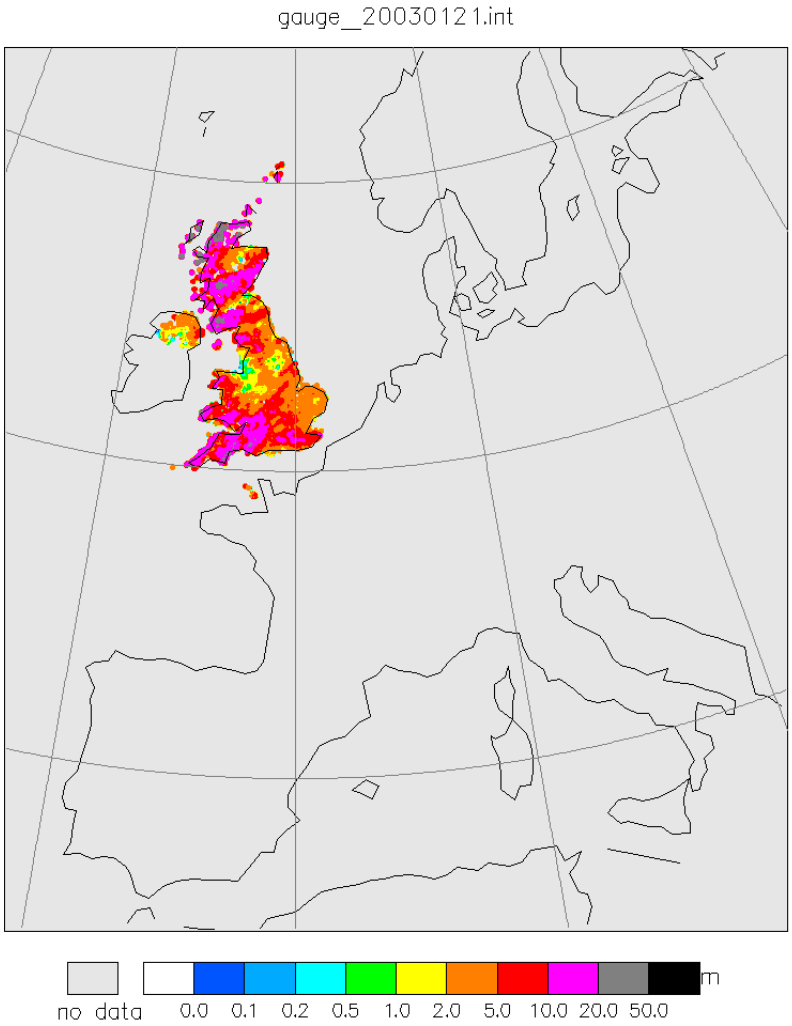
- European composite – different radar systems, difference calibration strategies, different QC.
- Nominally 5km 15-minute data product; available within ~ 1 hour; 2002-present
- Known errors include range effects and anaprop (including shipping!)

Gauge data:

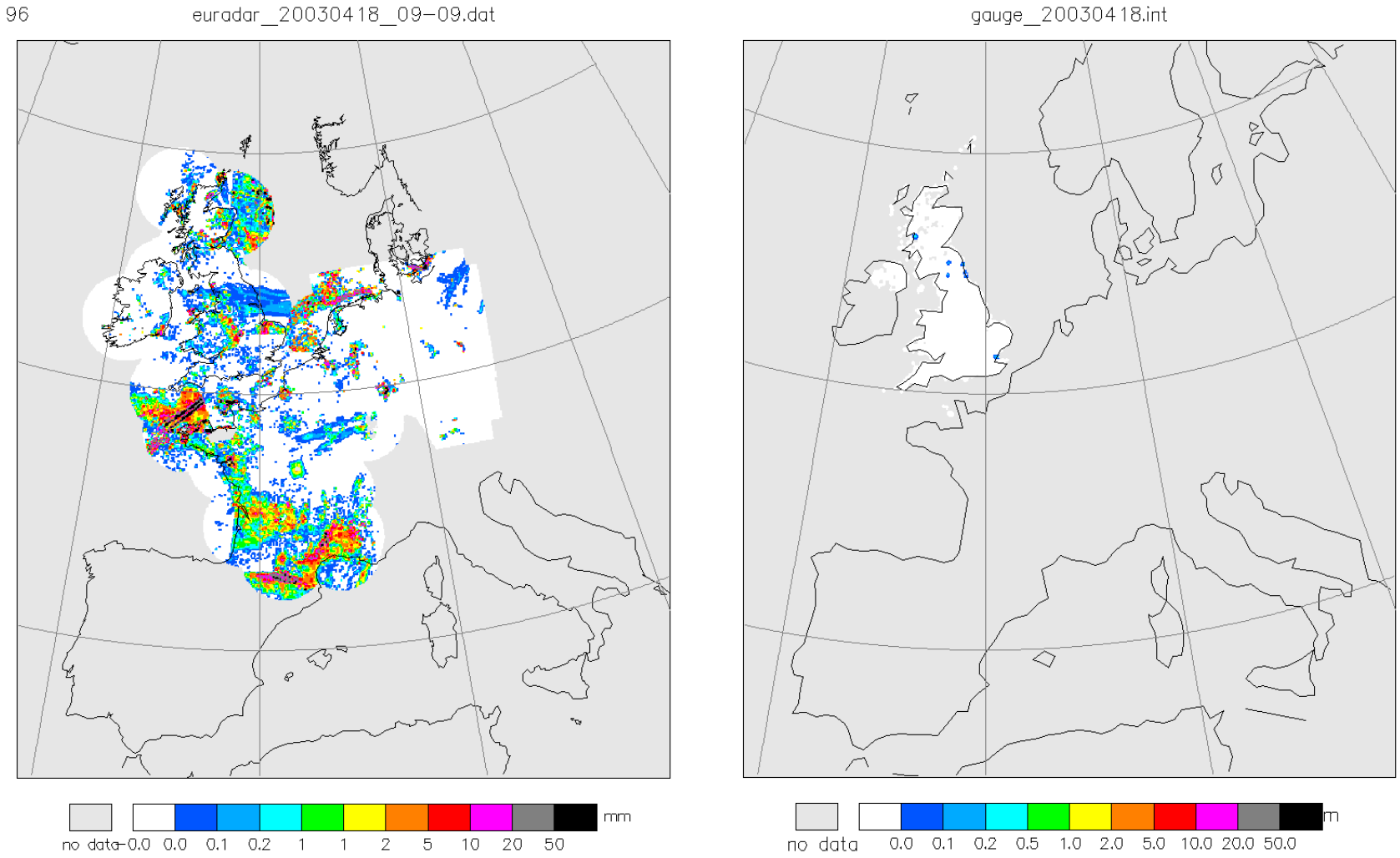
- 09-09Z data (dated at end of period)
- ~6000 daily gauges with mean 10km spacing
- available 1 month in arrears

Radar & gauge data

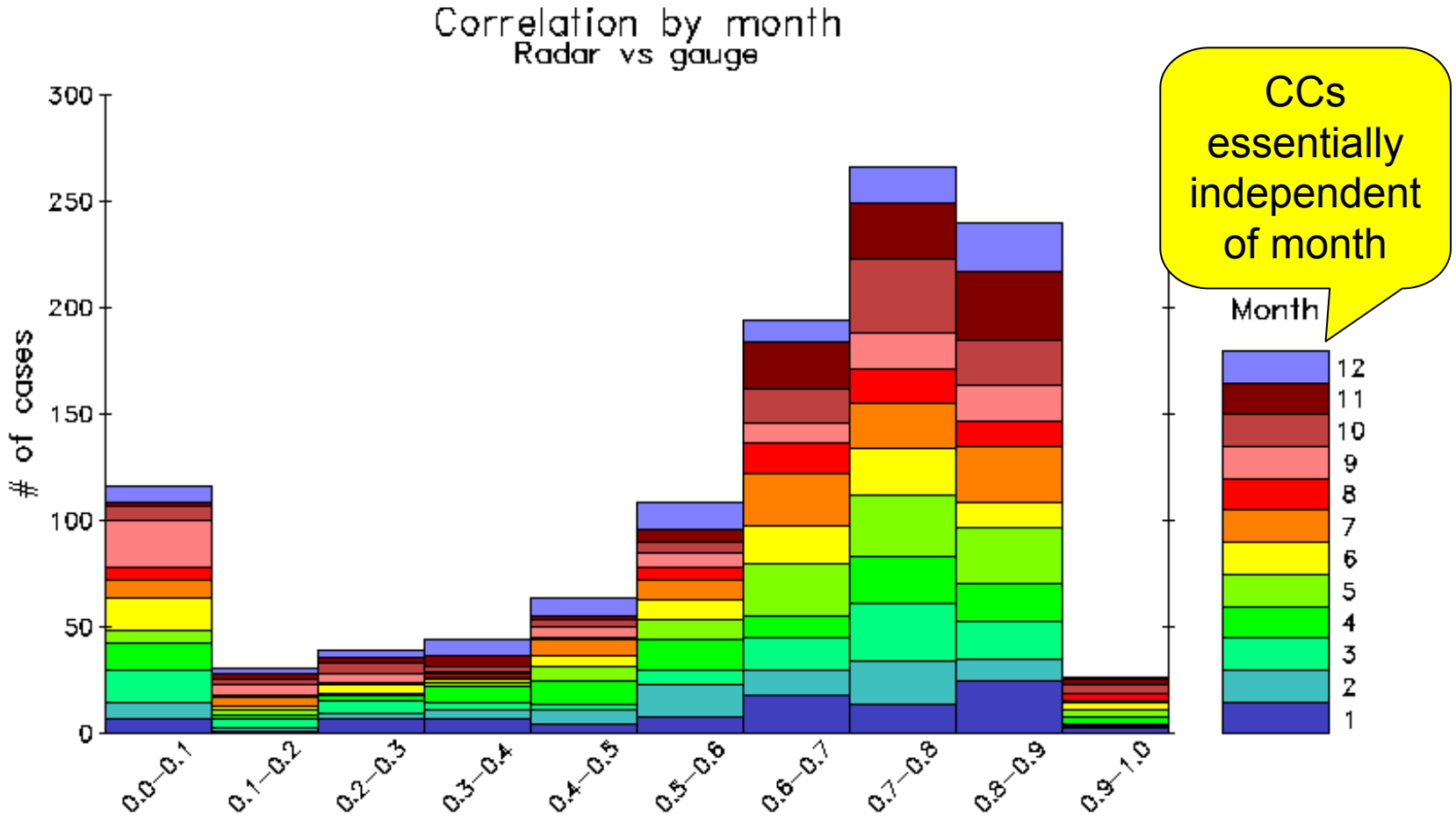




- a bad day…

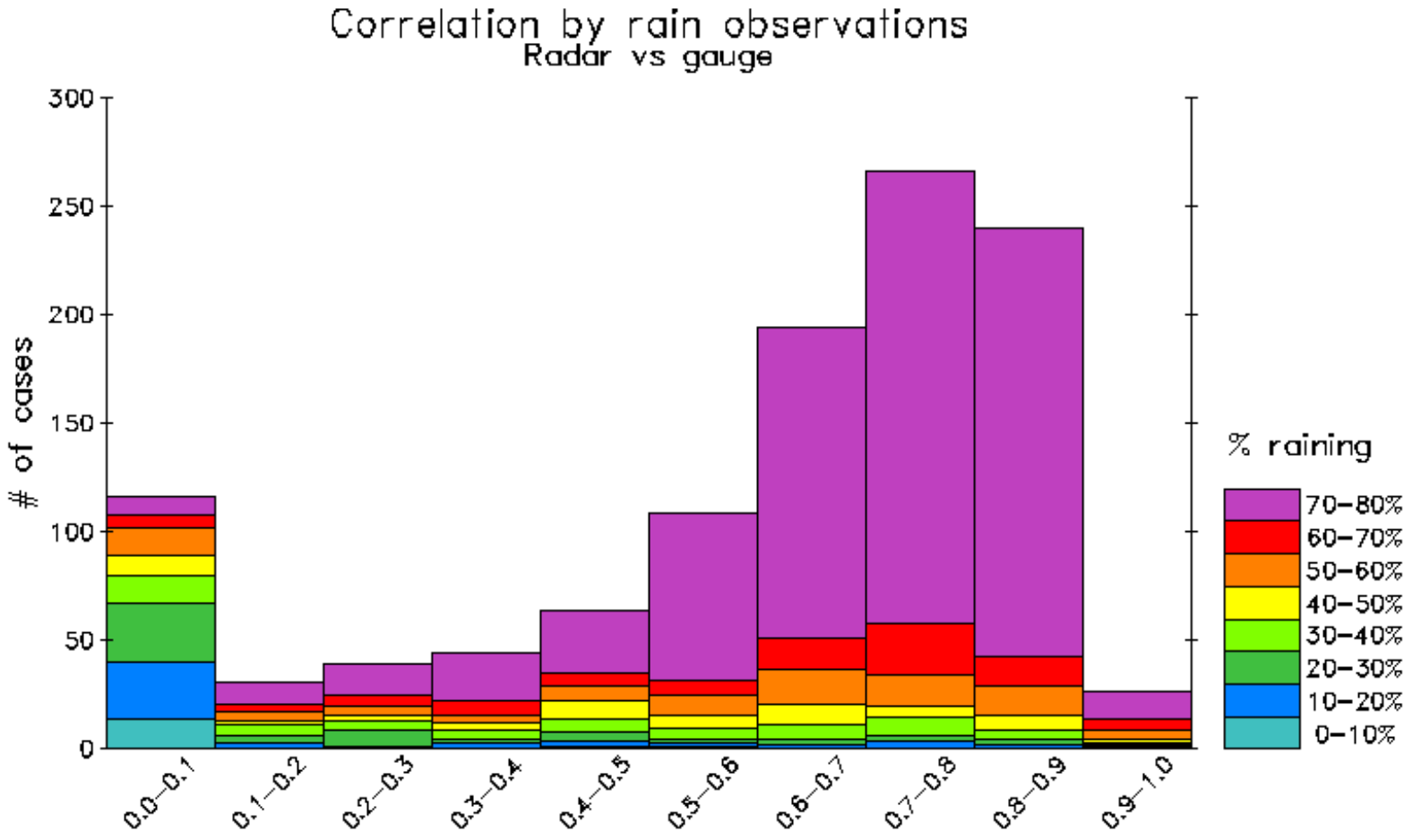

96
euradar_20030418_09-09.dat
gauge_20030418.int
no data -0.0 0.0 0.1 0.2 1 1 2 5 10 20 50
mm
no data 0.0 0.1 0.2 0.5 1.0 2.0 5.0 10.0 20.0 50.0
m

Radar vs Gauge correlations



Radar is calibrated using gauge data – even so, cc's rarely exceed 0.9

Radar vs Gauge correlations – by rain extent



Correlations (and other statistics) are dependent upon rain extent

High-temporal resolution study

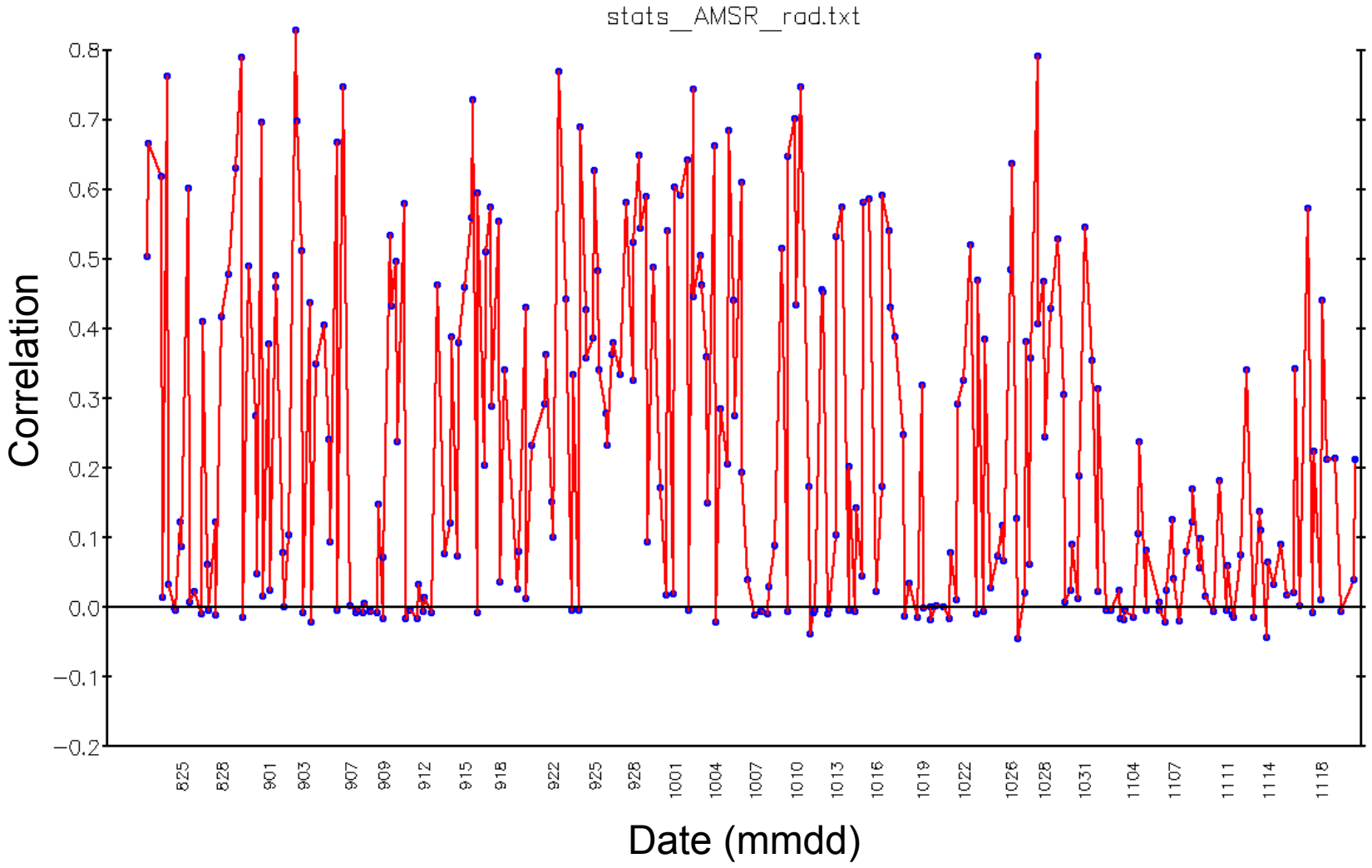
EUMETSAT Multi-spectral Precipitation Estimate

- Nominal 15 minute estimates
- Utilises multi-spectral capabilities of SEVIRI sensor
- Remapped to 0.25 degree resolution

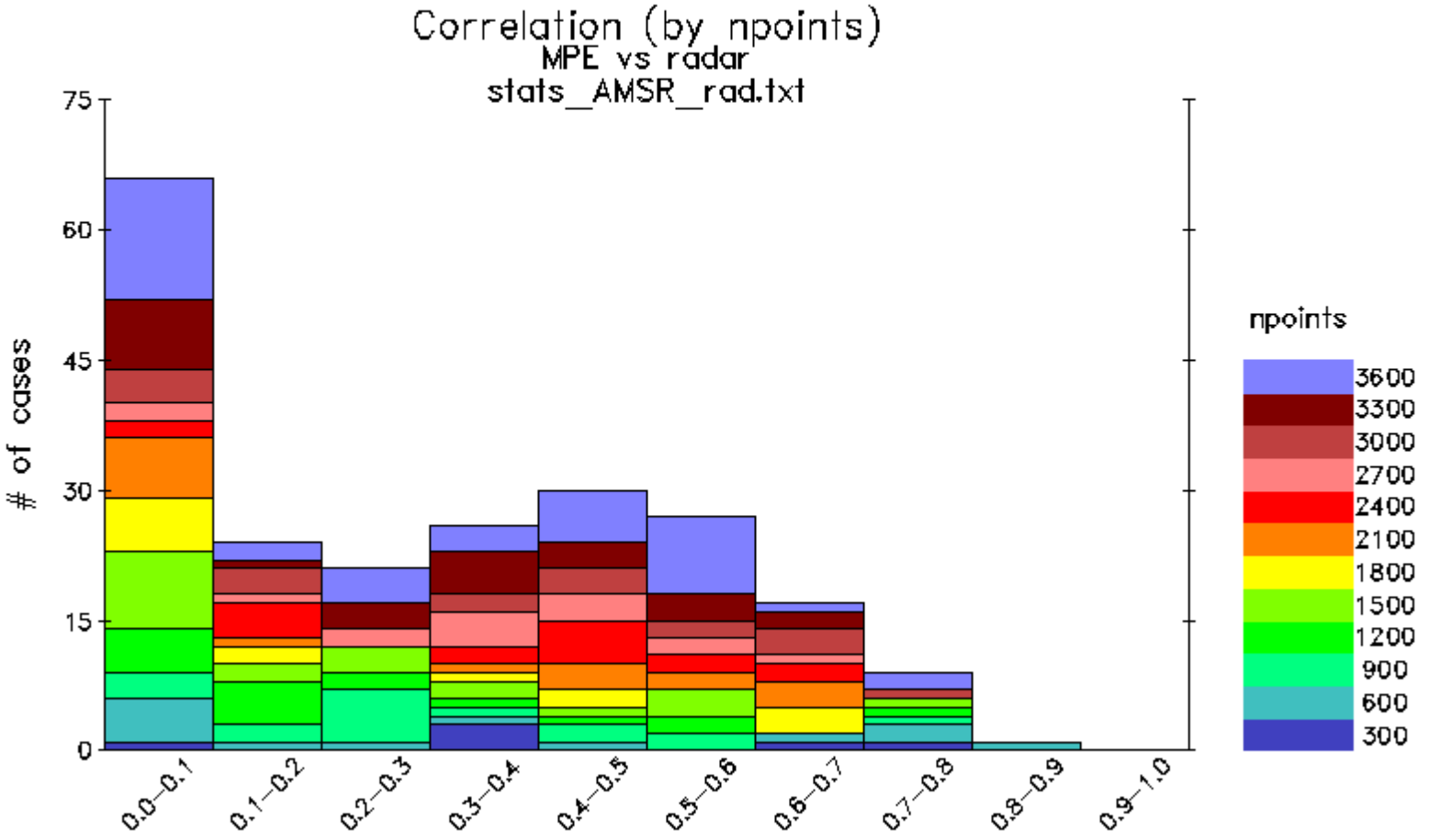
AMSR L2 Rain product *(for comparison)*

- Nominal 25km (ave'd 5km) instantaneous estimates

AMSR instantaneous: very variable

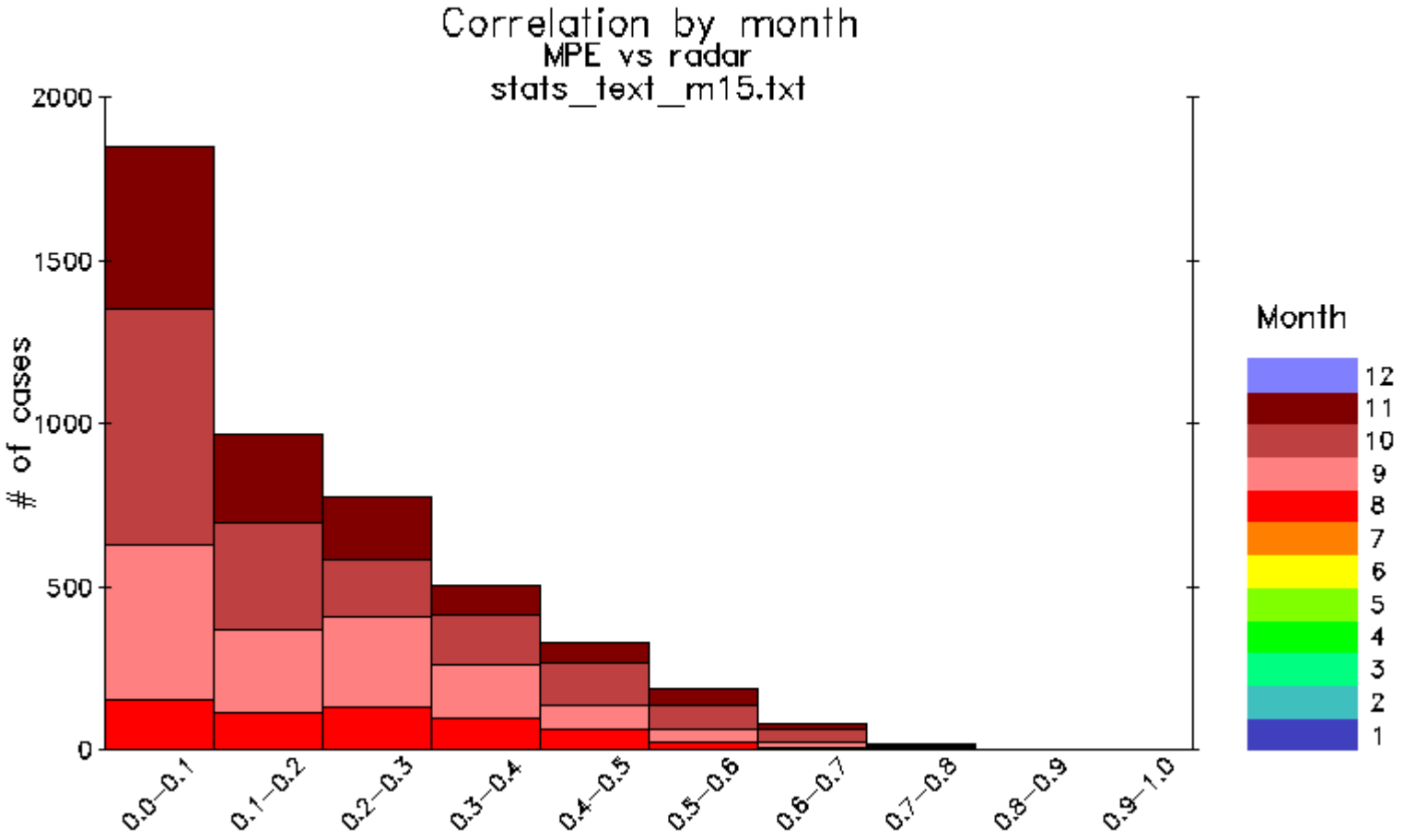


AMSR vs radar (instantaneous)

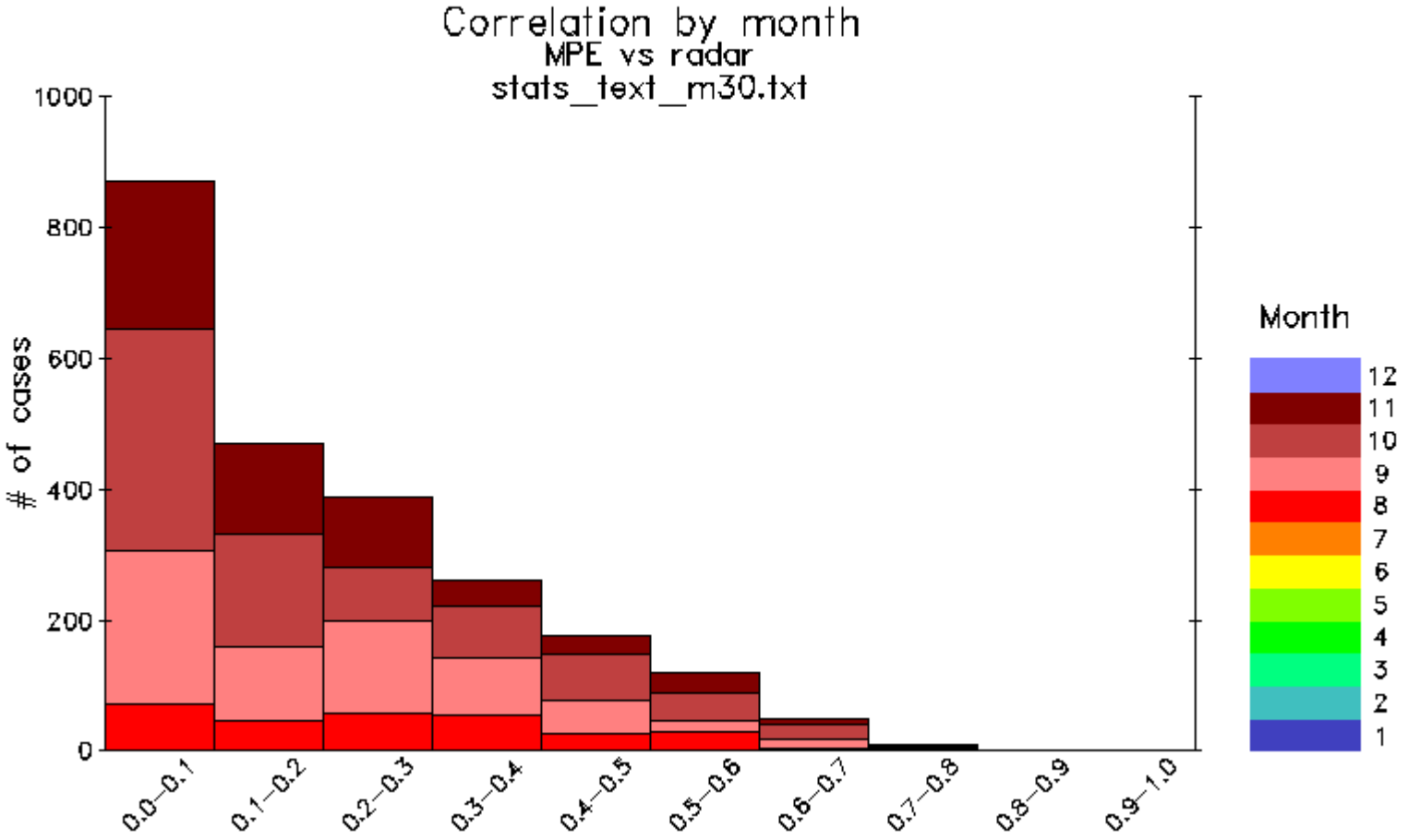


3 months of data: 20 August 2007 to 20 November 2007

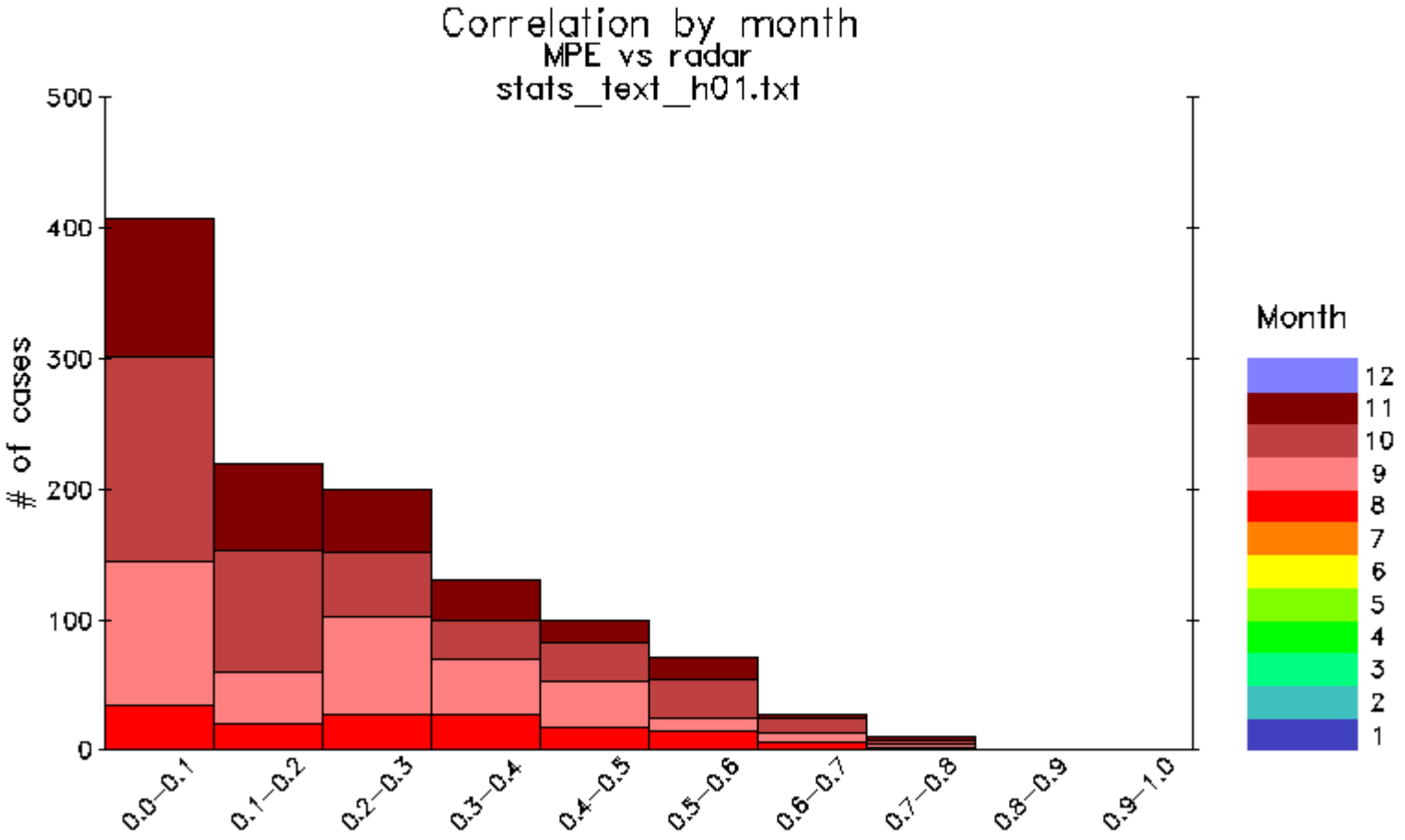
Vis/IR MPE vs radar: 15 minute



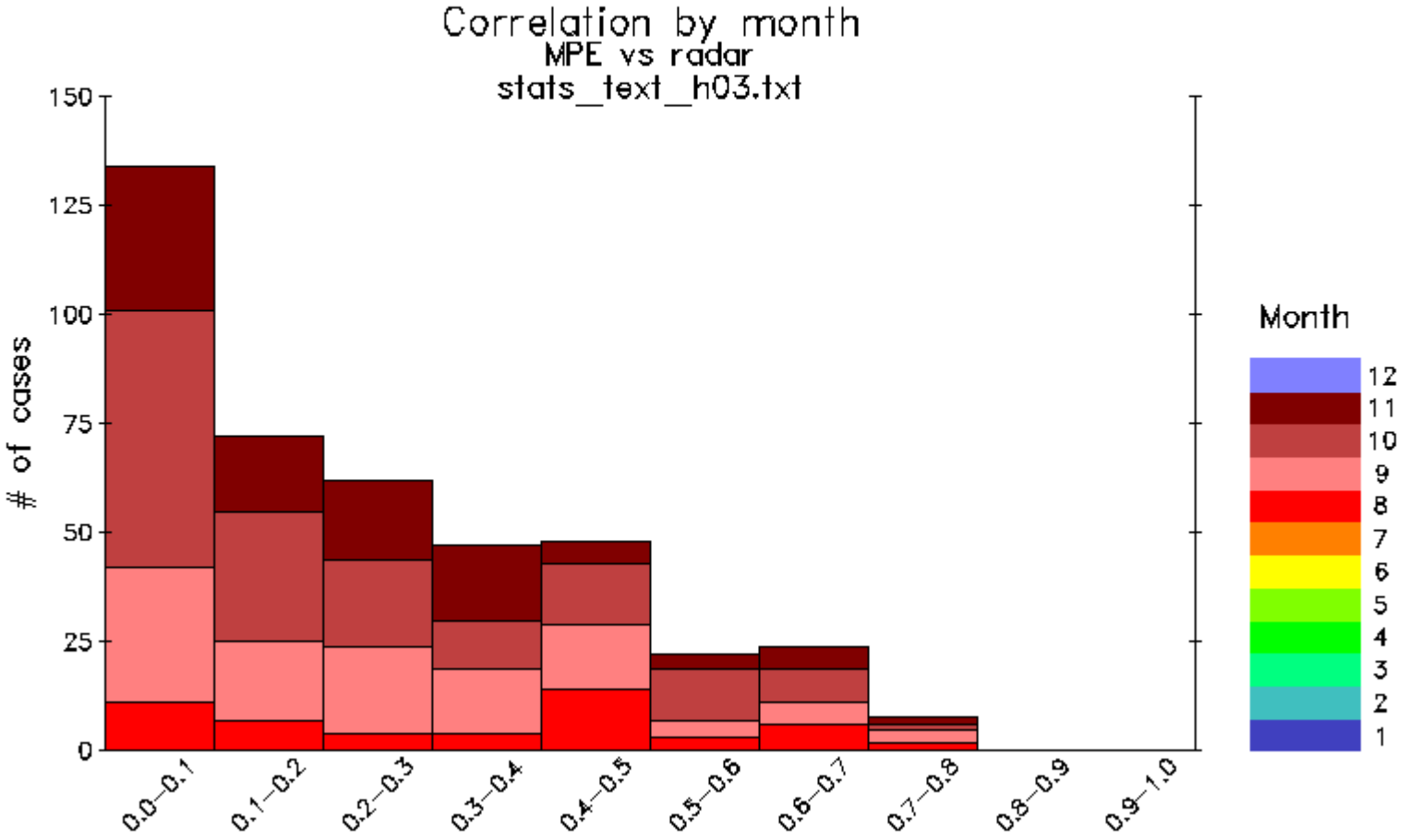
Vis/IR MPE vs radar: 30 minute



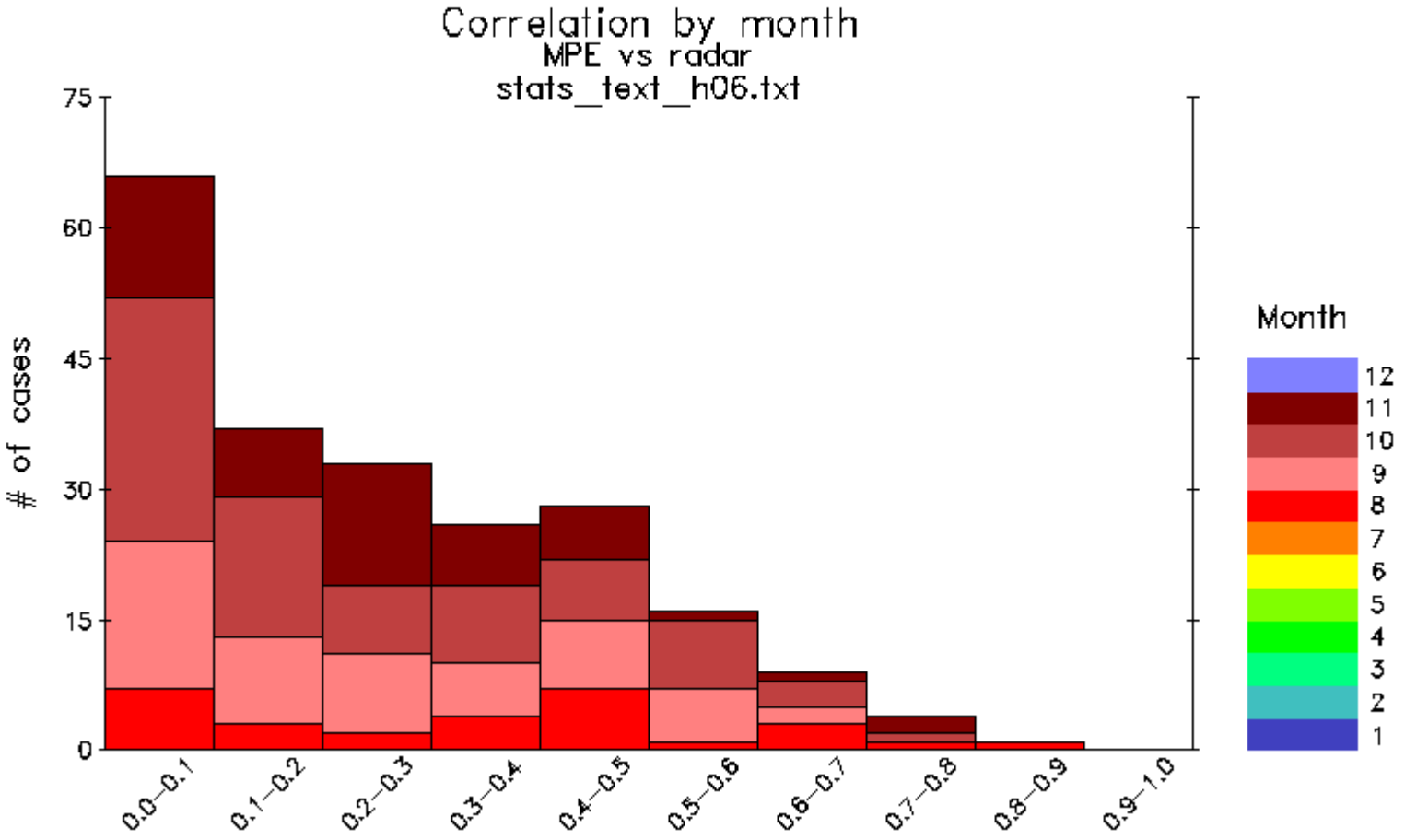
Vis/IR MPE vs radar: 1 hour



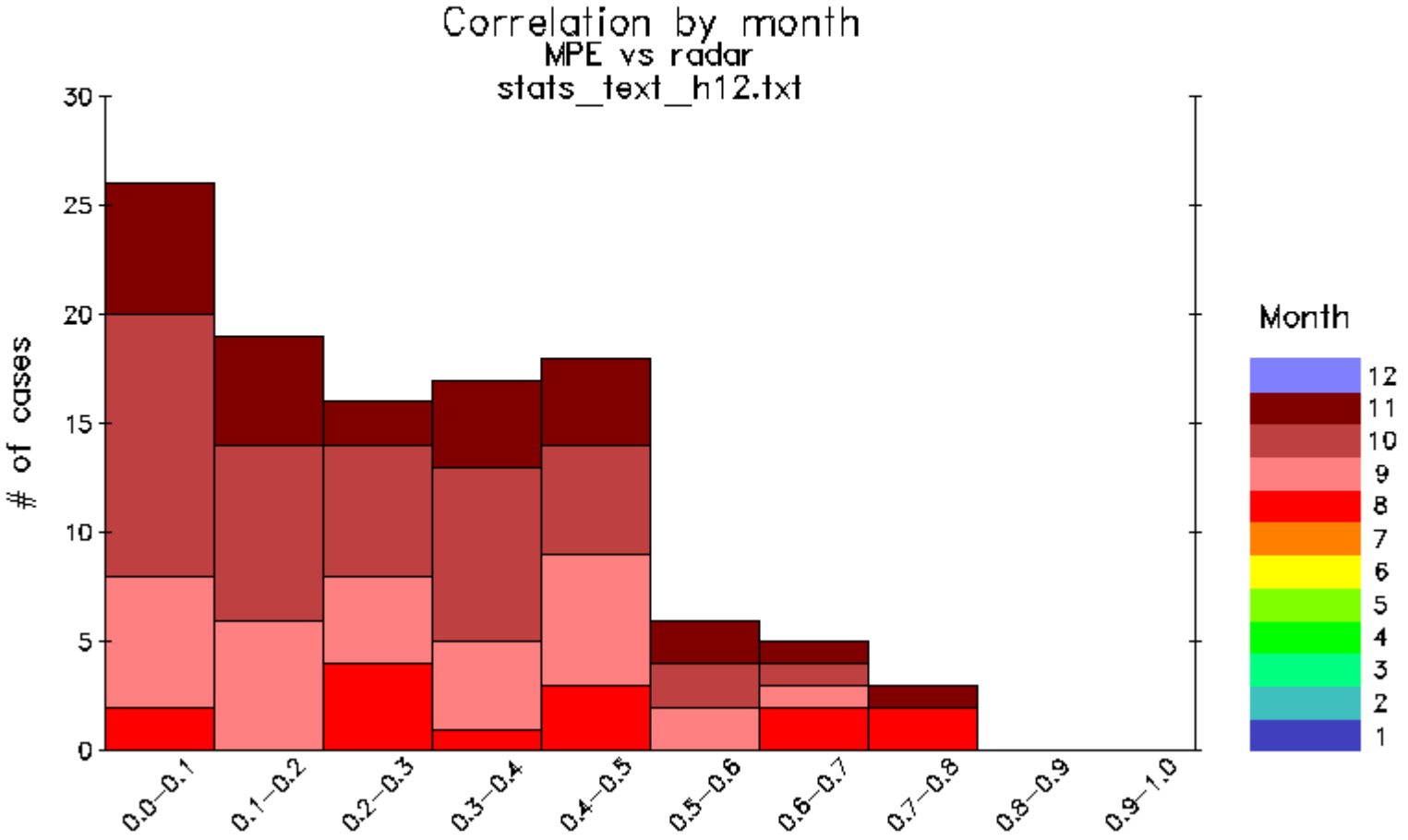
Vis/IR MPE vs radar: 3 hour



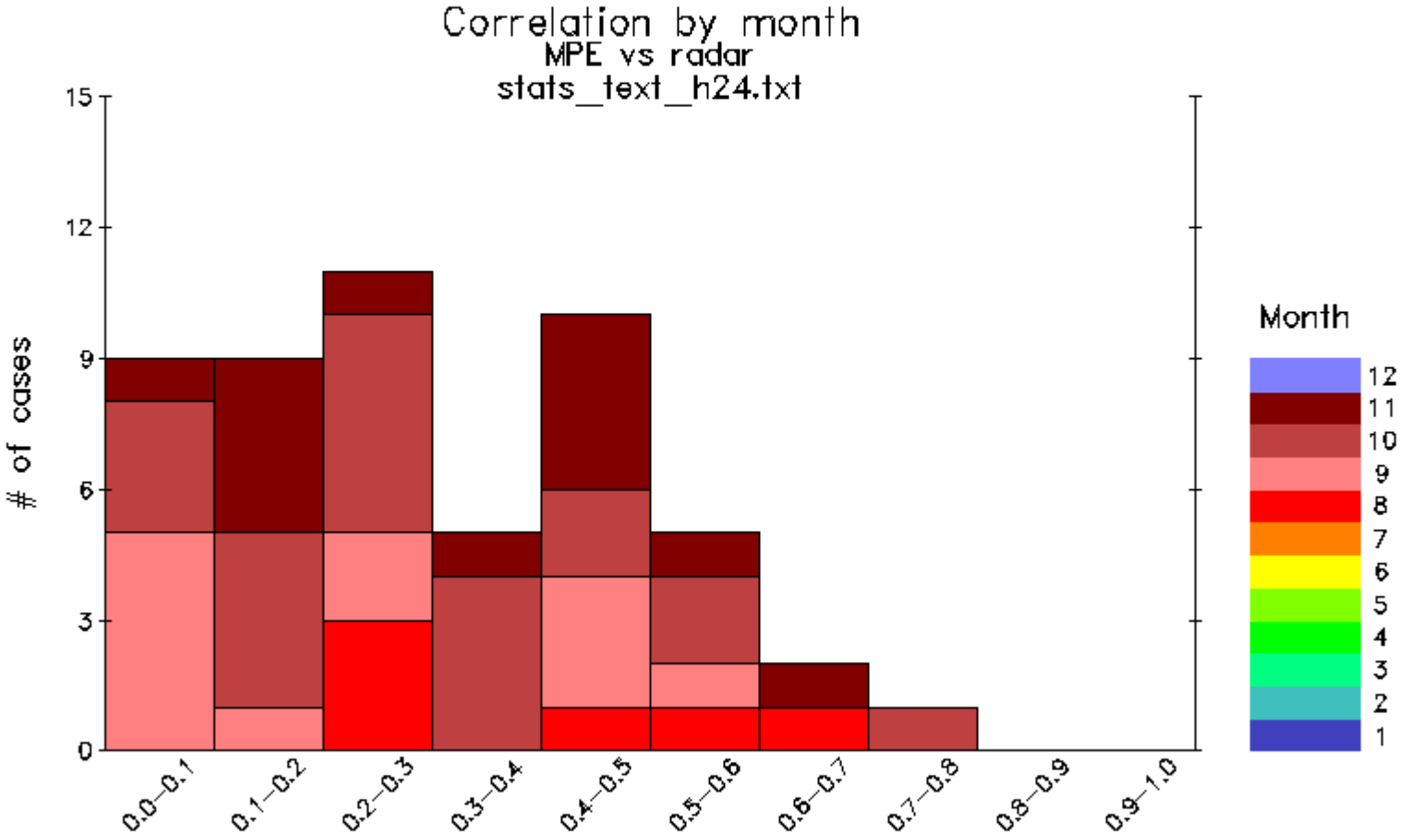
Vis/IR MPE vs radar: 6 hour



Vis/IR MPE vs radar: 12 hour

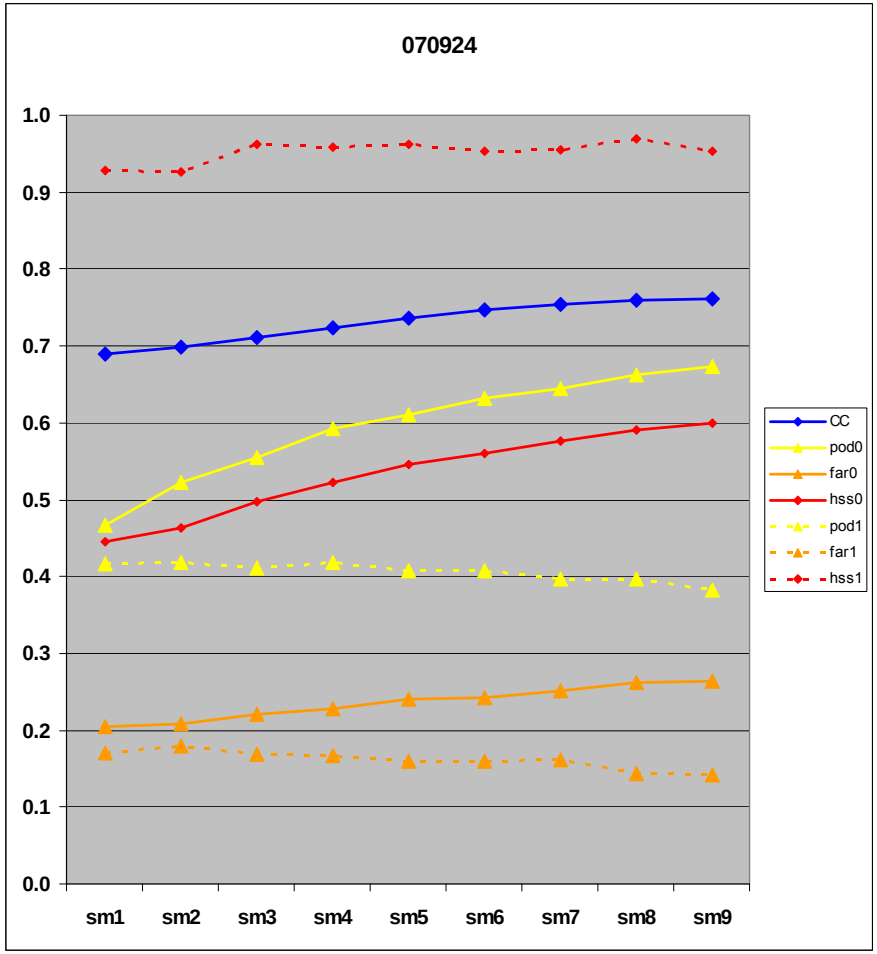


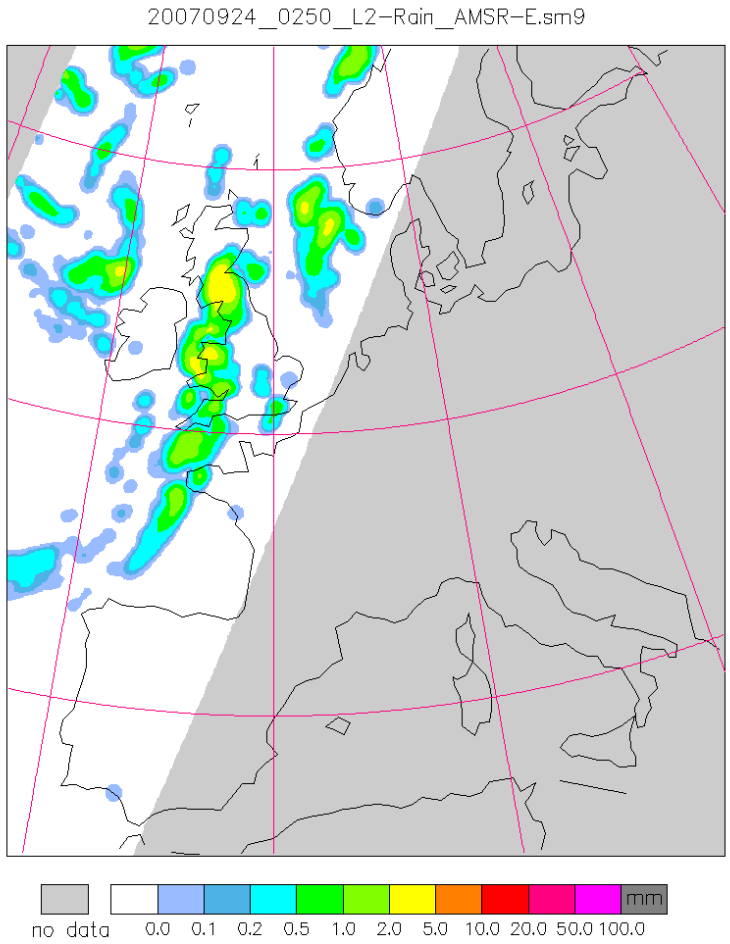
Vis/IR MPE vs radar: 24 hour



The critical temporal gap is ~3-6 hour accumulations

Statistical Performance





Performance can be improved just by smoothing the data!

Issues I

Standardisation of data sets – Why?

- Easier/better processing (& fewer errors)
- More coherent long-term data sets

Problems:

- Grid box vs grid point
- Instantaneous vs accumulation (i.e. ±1.5 hours or 00-03)
- Data resolutions (temporal & spatial)
- Data units (storage resolution vs retrieval resolution)
- Formats (I*2; I*4; R*4) (& units: mmh^{-1} ;mmd^{-1} ; kgd^{-1})
- Filename and date/time conventions (end, start, period)
- W-E (180°E/0°E & E-W) and N-S (or S-N) layout

Issues II

Statistical results are dependent upon the rainfall:

- intensity, extent and patterns
- temporal resolution
- spatial resolution

All these are inter-related and pose a multi-dimensional problem that cannot currently be adequately resolved

Recommendations

To establish guidelines for satellite precipitation data sets: we need to be forward thinking and establish common criteria that can and will be used to promote long-term data sets

Investigate statistical tests that are more relevant to the data sets we are dealing with, and that be applied over a range of spatial and temporal scales

To promote near real-time high resolution (sub-daily, <0.25 degree) precipitation inter-comparisons alongside those of the current IPWG comparisons: these should include combined & component products