Rainfall Observation over sub-Saharan Africa: Problems and Prospects

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Outline

1. Problem: observation network, data access
2. Alternative sources

   2.1 Gridded rainfall products

   - Strengths, Weaknesses, Validation

   2.2. Satellite rainfall estimates

   - Strengths, Weaknesses, Validation

   2.3. Model outputs

   - Strengths, Weaknesses

3. Prospects/Recommendations

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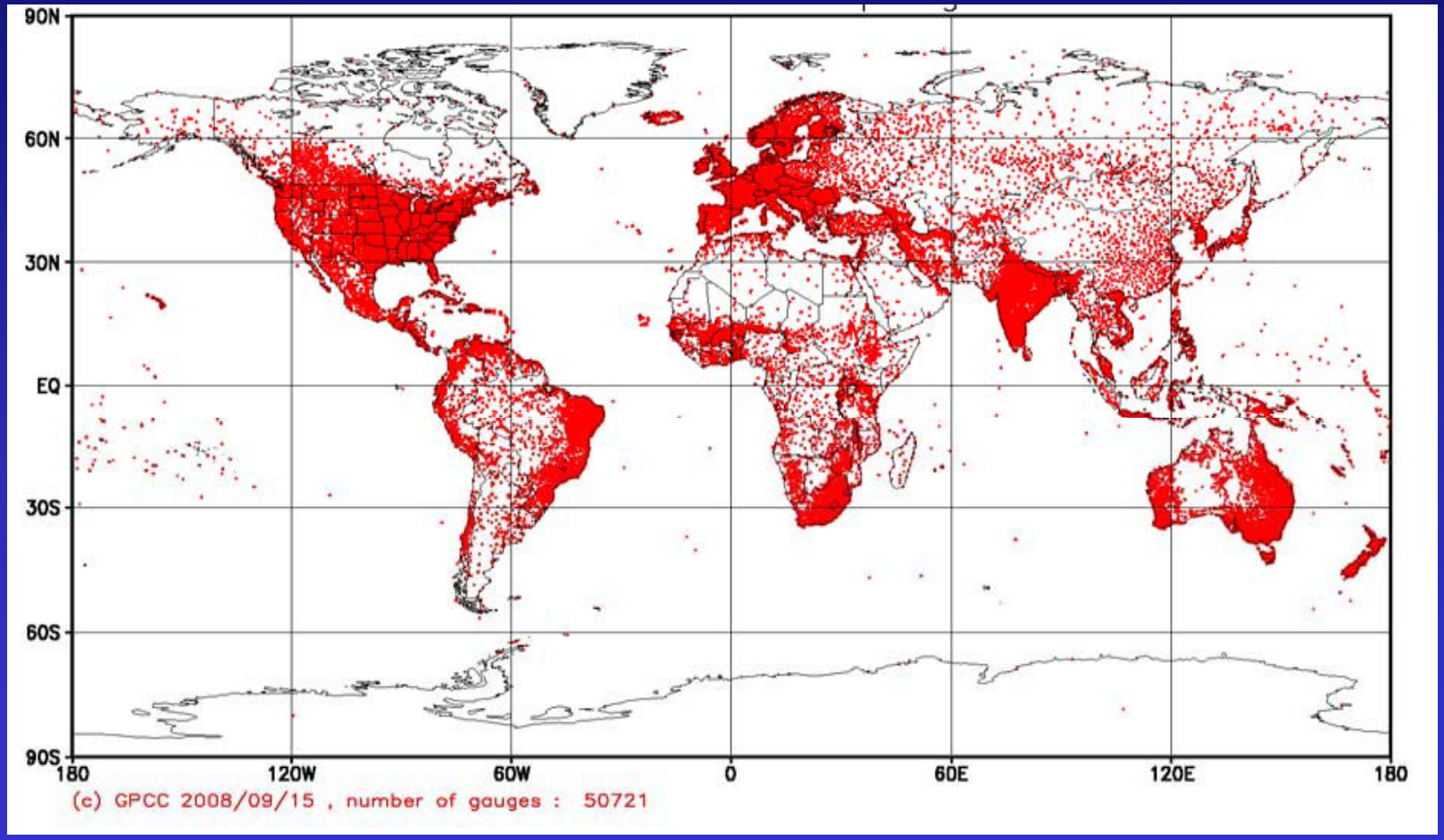
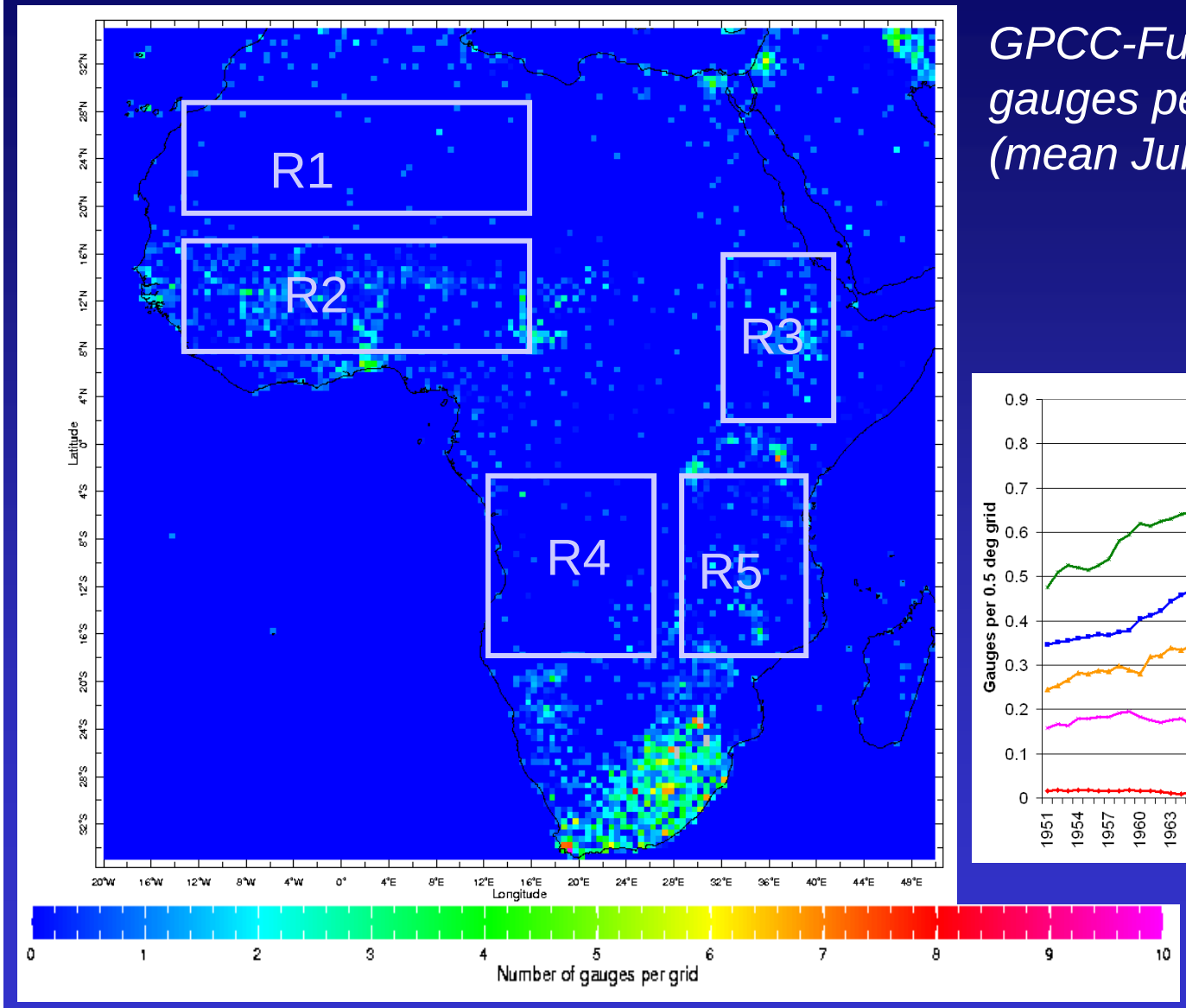
Observation network

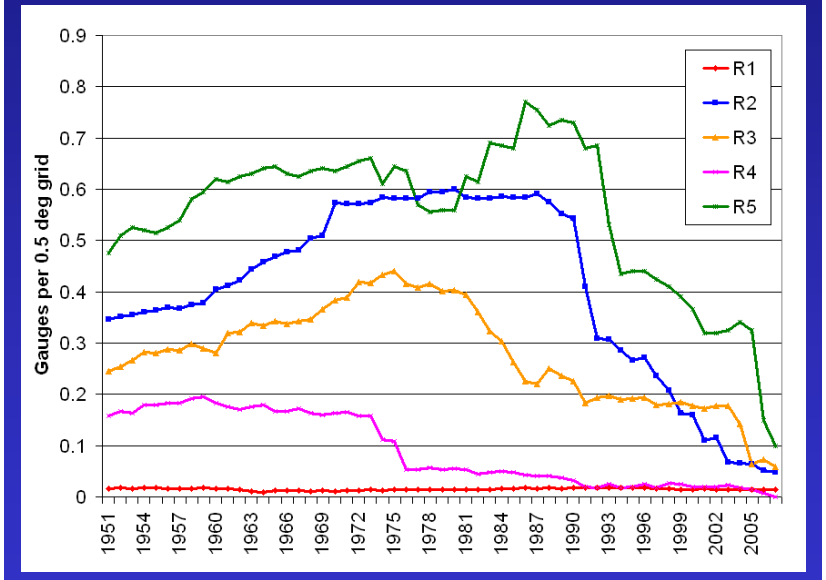
Spatial distribution of monthly data, based on at least 10 years of data, available in the GPCC data base



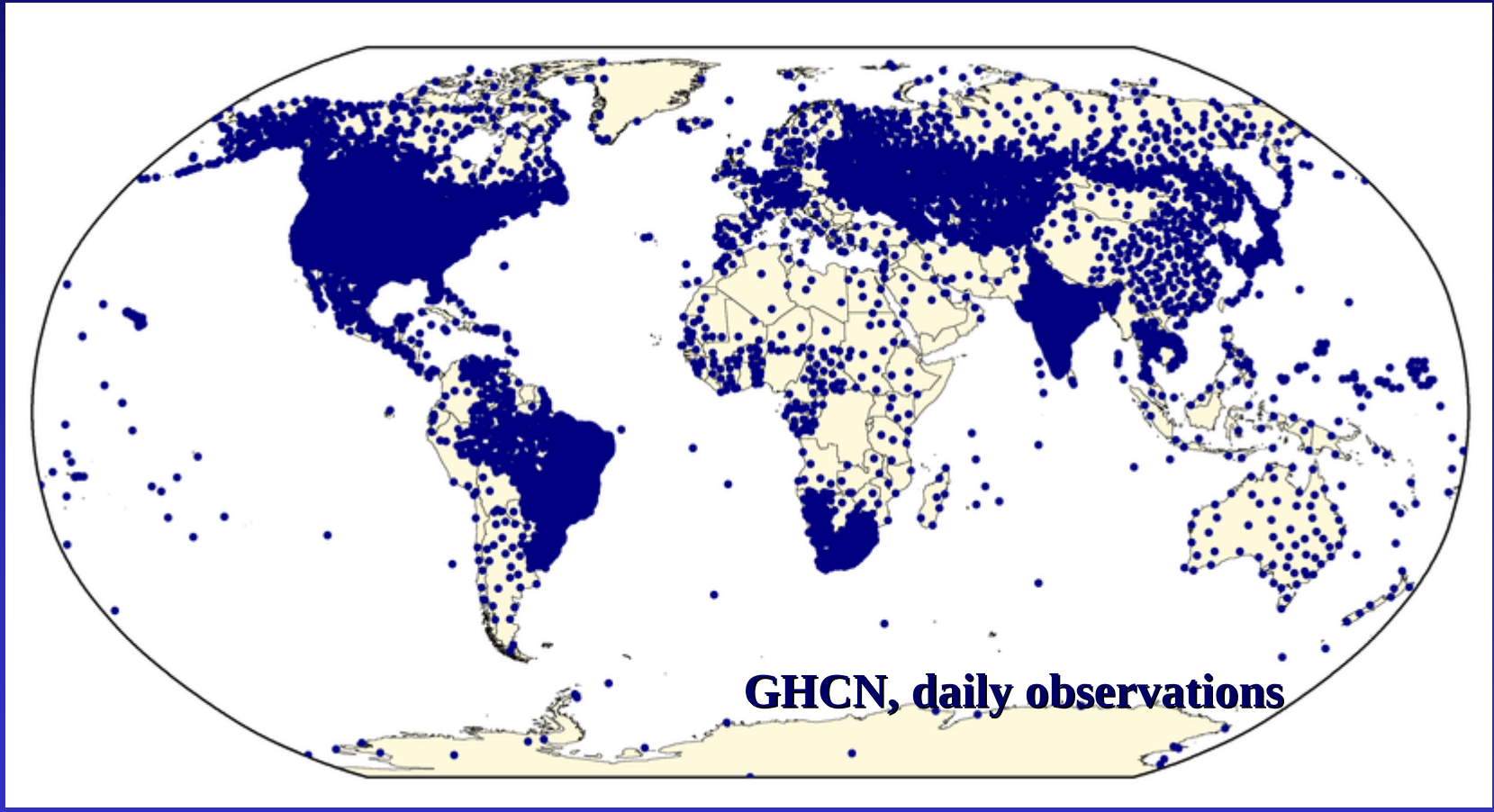
Observation network



GPCC-Full data: Number of gauges per 0.5 deg grid (mean Jul. 1951-2007)



Daily data available



Data access issues

- Hard to get data, particularly out side the countries

  -Sometimes it hard to get data even from within country
- Most station are located in the cities, no data for rural areas
- In many places historical data is still in hard copy format
- There are also issues of data quality

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Strengths, Weaknesses

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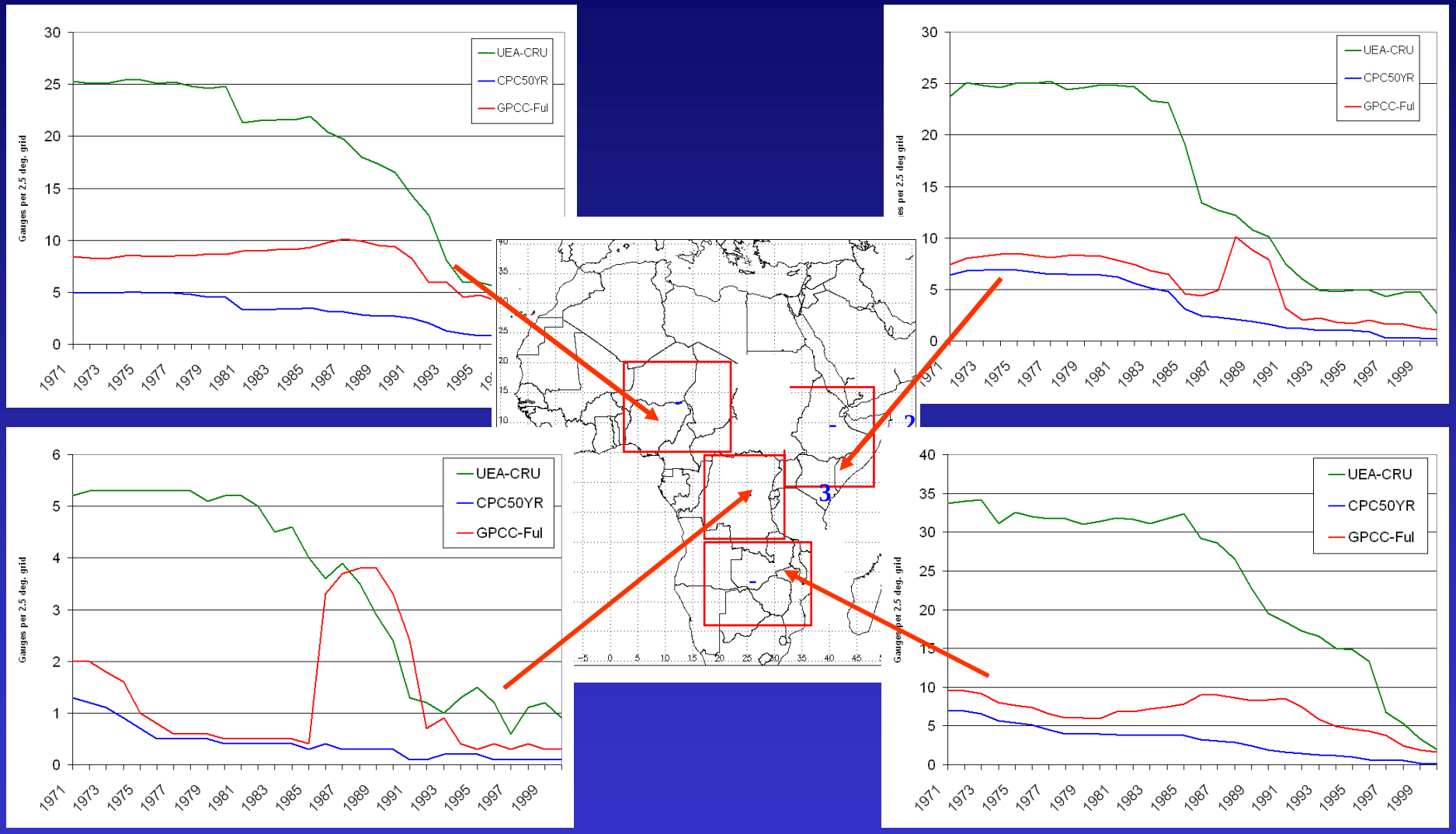
Some gridded products

Product	Resolution (deg.)	Existence
GPCC-mon	1.0, 2.5	1986-Pres
GPCC-ful	0.5, 1.0, 2.5	1901-2007
GPCC-clm	0.5, 1.0, 2.5	1951-2000
UEA-CRU	0.5	1901-2002
NOAA-CPC	2.5	1948-Pres

Mean number of gauges in 2.5º grid box



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Gridded products

Strengths

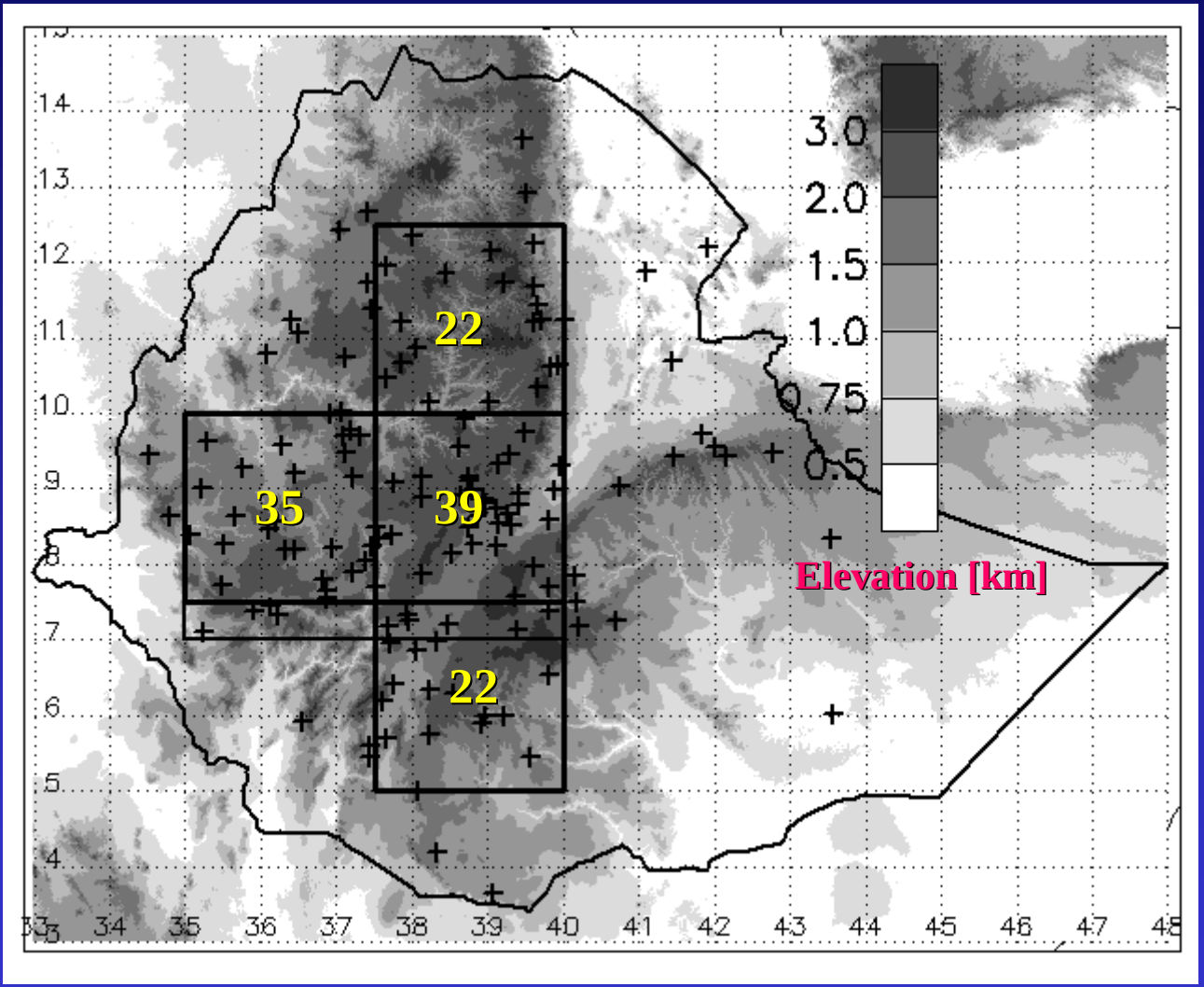
- Makes the data available
- Data is available for places with no raingauges
- Long time series (some starting from 1901)
- Easier for spatial analysis

Weaknesses

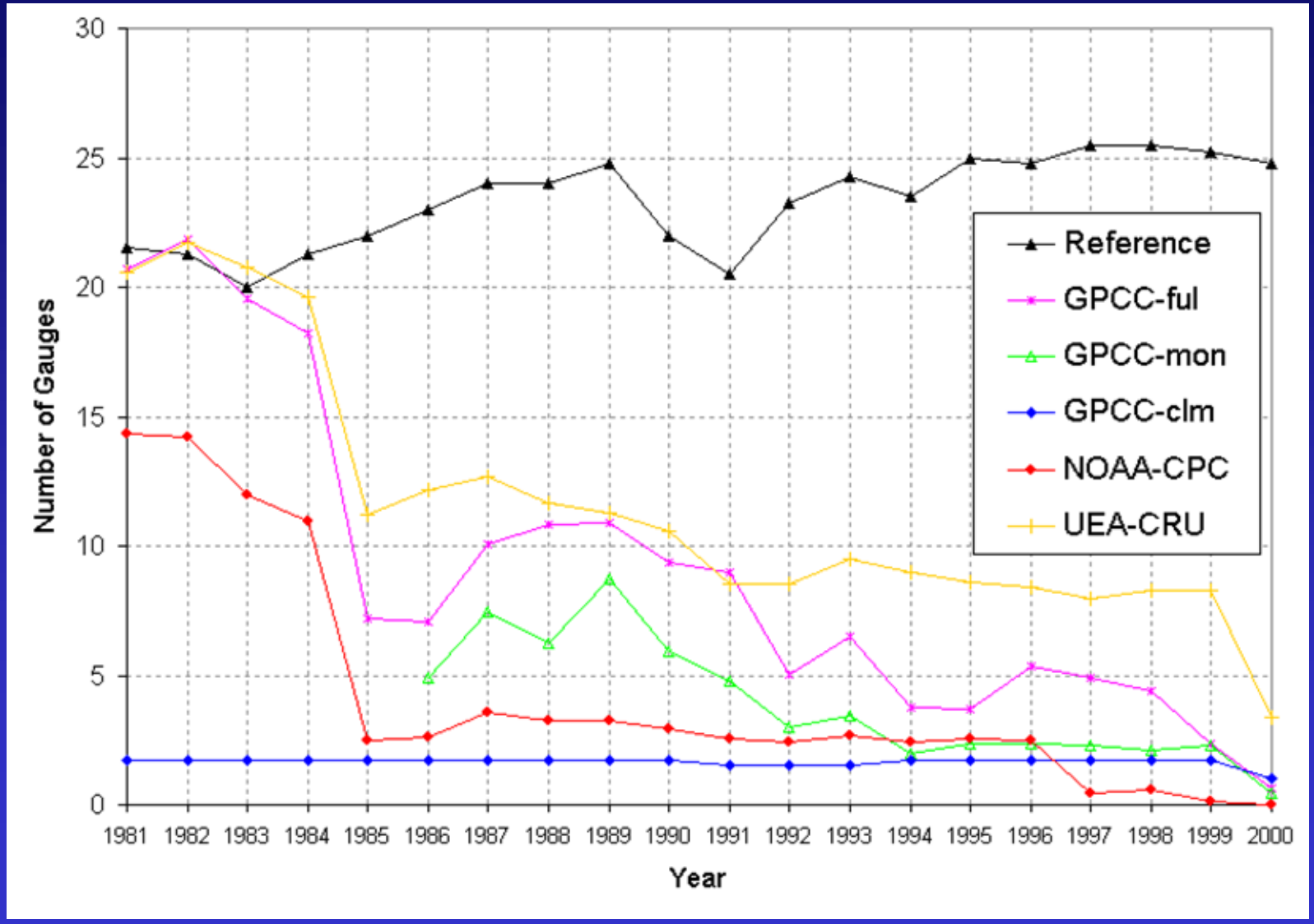
- Depend on availability raingauges
- Available only at monthly time scale
- Relatively low spatial resolution (0.5 deg)
- Inhomogeneity due to varying number of gauges

Validation

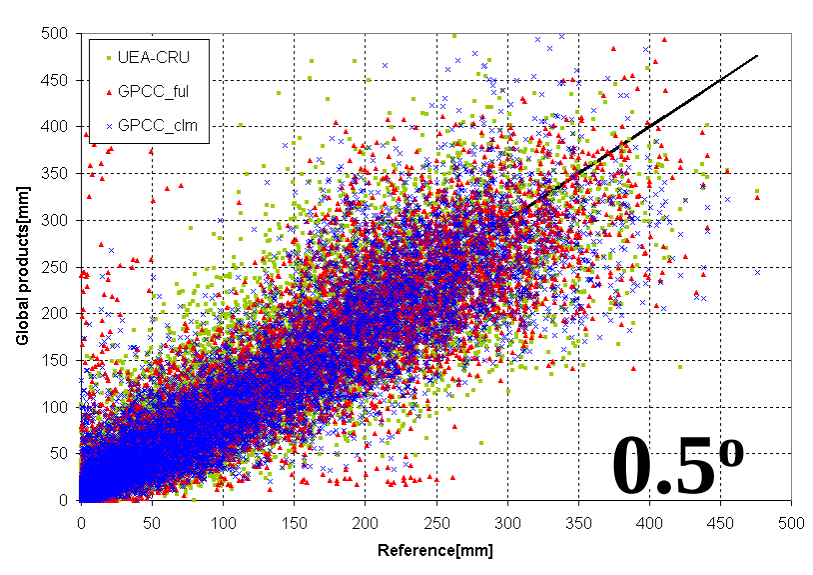
Validation site and data

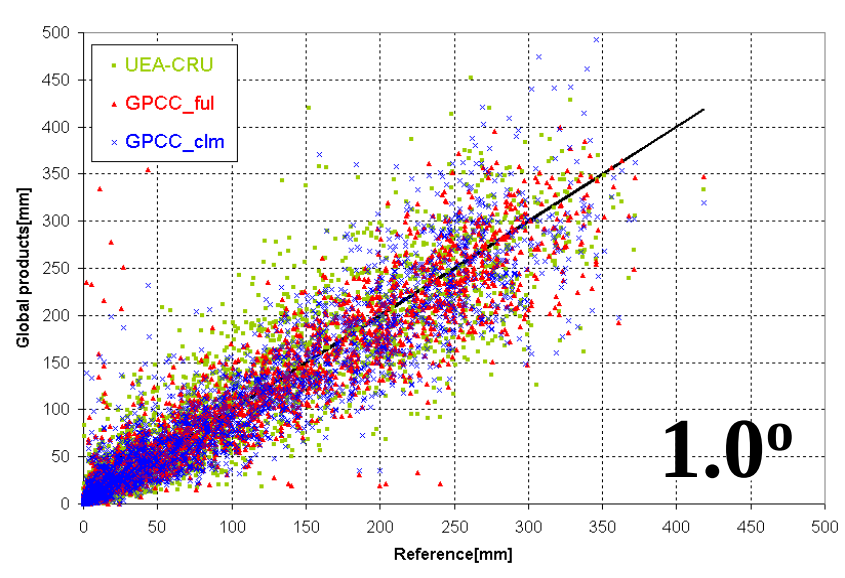


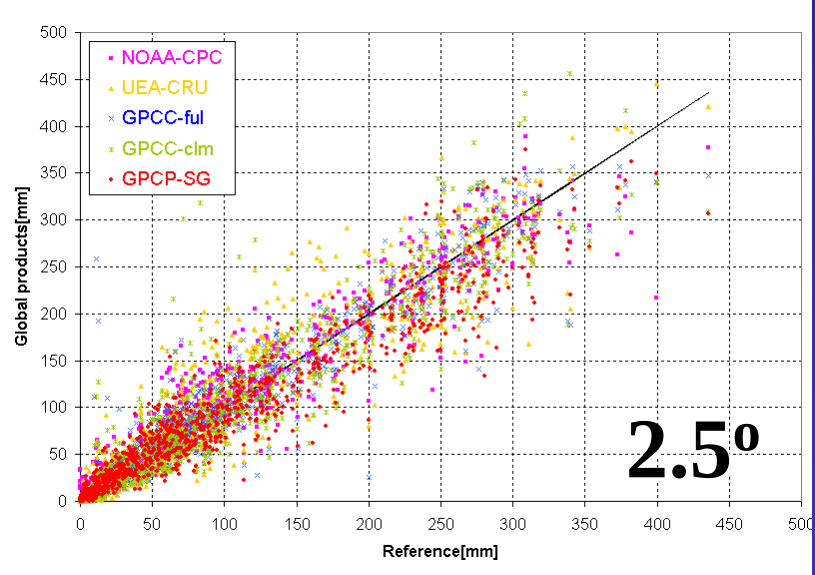
Data: Number of gauges per 2.5° grid



Validation @ different resolution







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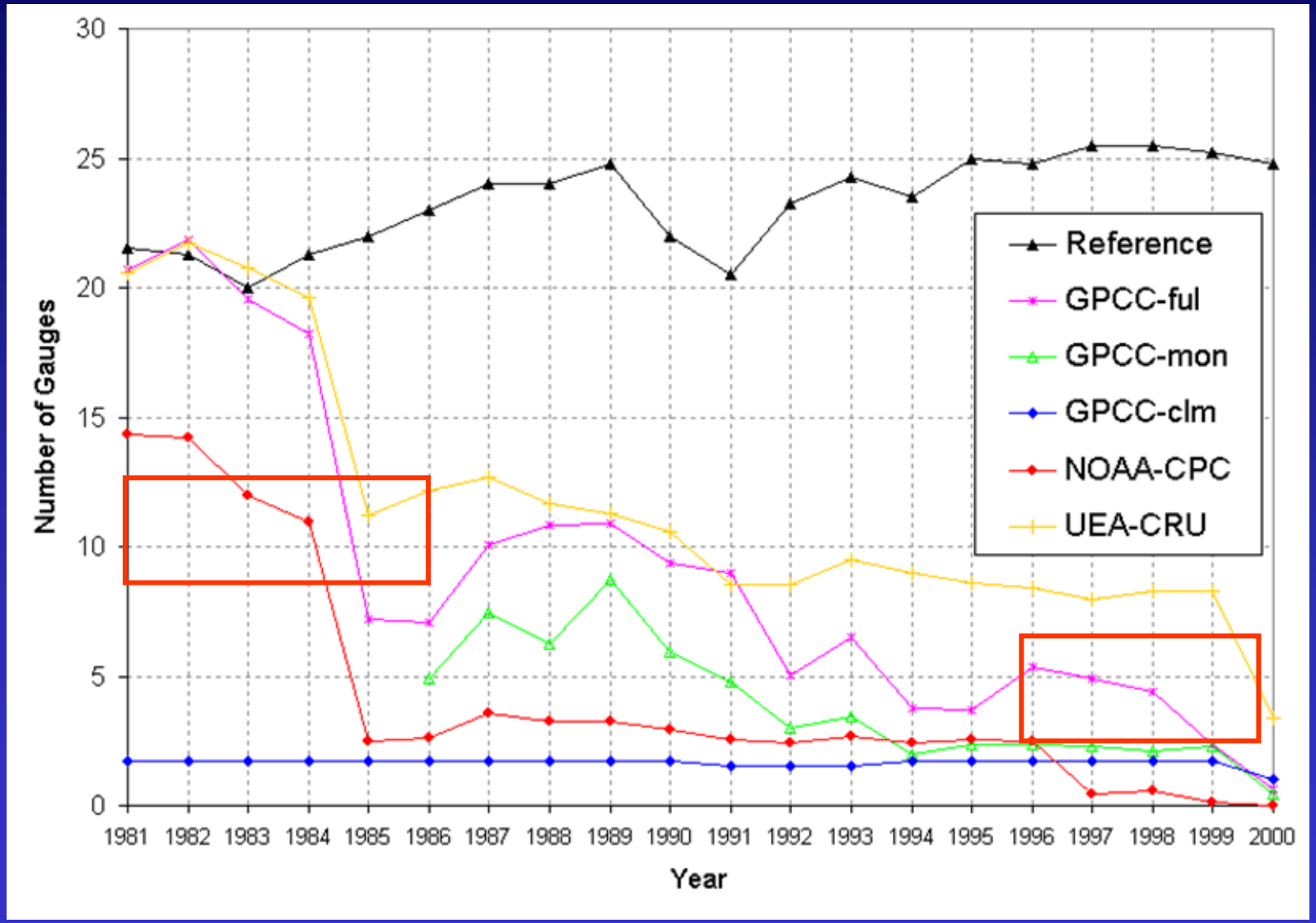
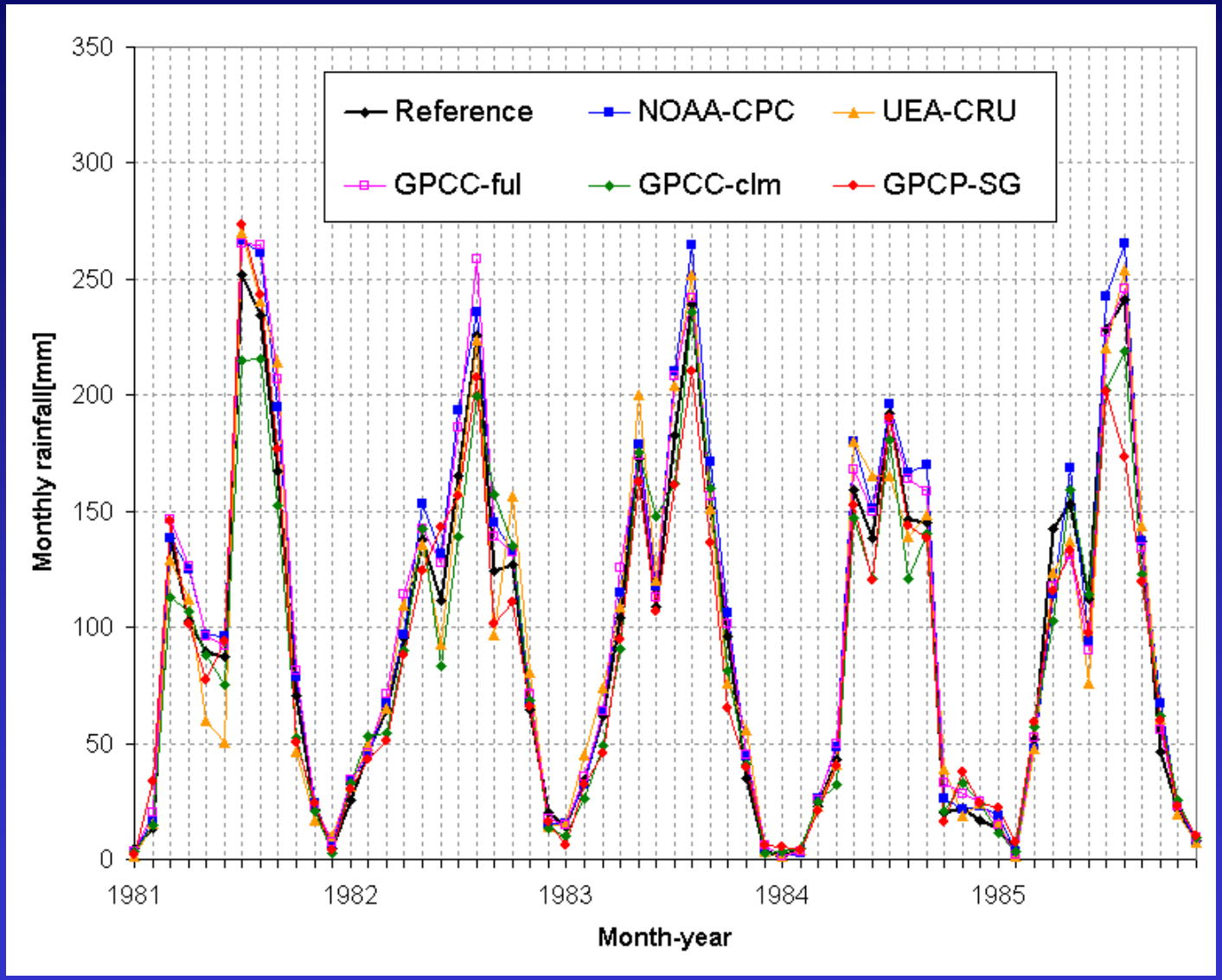
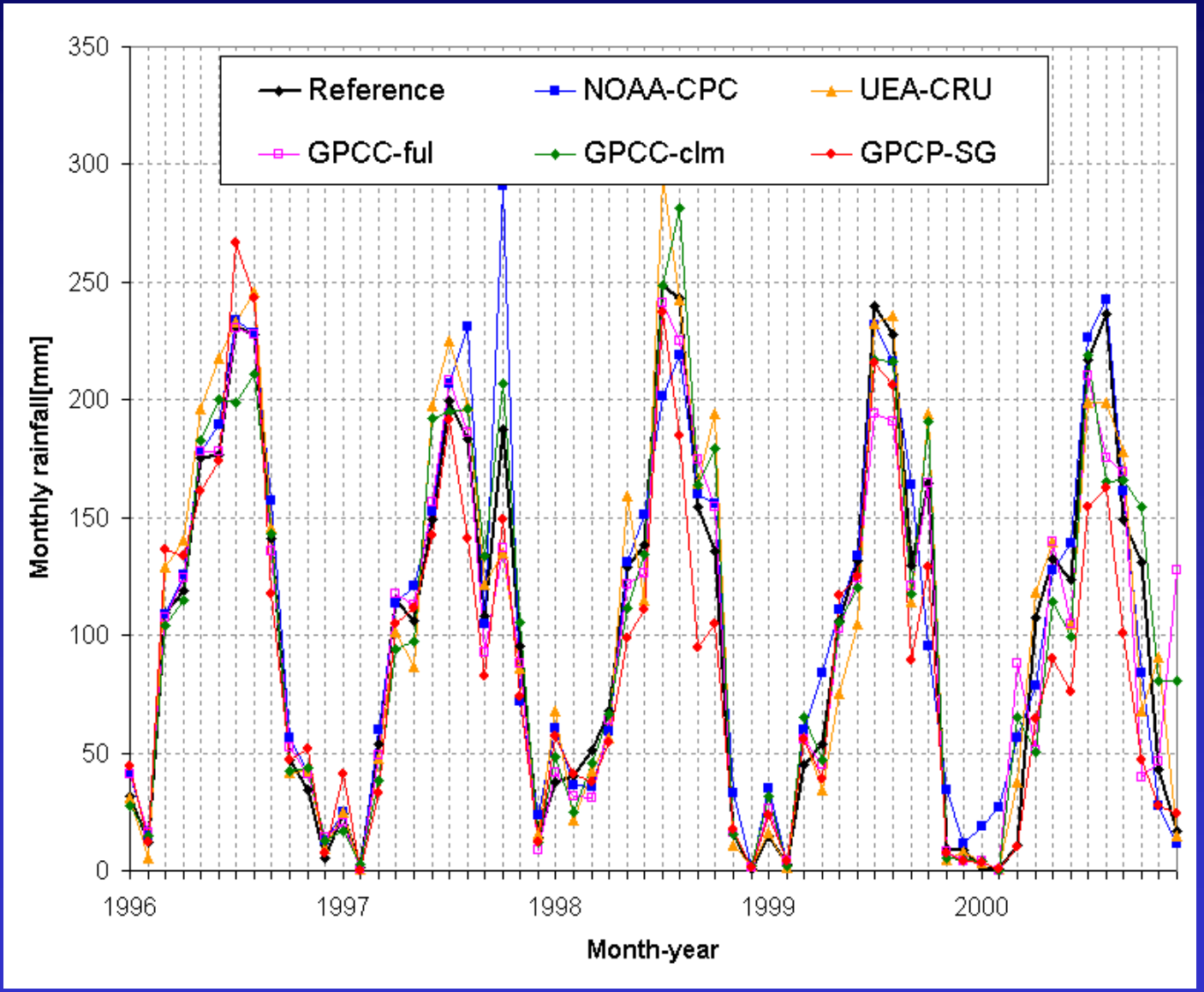
Comparing time series



Comparing time series 1981-1986



Comparing time series 1996-2000



Validation summary

0.5-deg	UEA-CRU	GPCC-ful	GPCC-clm
CC	0.89	0.90	0.90
Bias	1.01	0.99	0.99
MAE[mm]	32.3	27.1	29.1

1 deg	UEA-CRU	GPCC-ful	GPCC-clm
CC	0.91	0.92	0.92
Bias	1.02	0.99	1.00
MAE[mm]	28.3	21.9	24.9

2.5-deg	UEA-CRU	GPCC-ful	GPCC-clm	NOAA-CPC
CC	0.94	0.96	0.94	0.95
Bias	1.03	1.00	1.00	1.04
MAE[mm]	21.3	15.6	20.3	17.6

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Some of the available products

Product	Time Res	Space Res	Existence	PM	Gauge
CMORPH	30-min	0.07 deg	2002-Pres	Y	N
GSMaP	hourly	0.10 deg	2003-2006	Y	N
NRL	3-hourly	0.25 deg	2003-2006	Y	N
PERSIANN	3-hourly	0.25 deg	2000-2006	Y	N
TRMM-3B42	3-hourly	0.25 deg	1998-Pres	Y	Y
TRMM-3B42RT	3-hourly	0.25 deg	2002-Pres	Y	N
CPC-RFE	Daily	0.1 deg	2001-Pres	Y	Y
CPC-ARC	Daily	0.1 deg	1995-Pres	N	Y
GPCP-1DD	Daily	1.0 deg	1996-Pres	Y	Y
TAMSAT	10-daily	0.05 deg	1996-Pres	N	N
GPCP	Monthly	2.5 deg	1979-Pres	Y	Y
CMAP	Monthly	2.5 deg	1979-Pres	Y	Y
TRMM-3B43	Monthly	2.5 deg	1998-Pres	Y	Y

Satellite rainfall estimates

Strengths

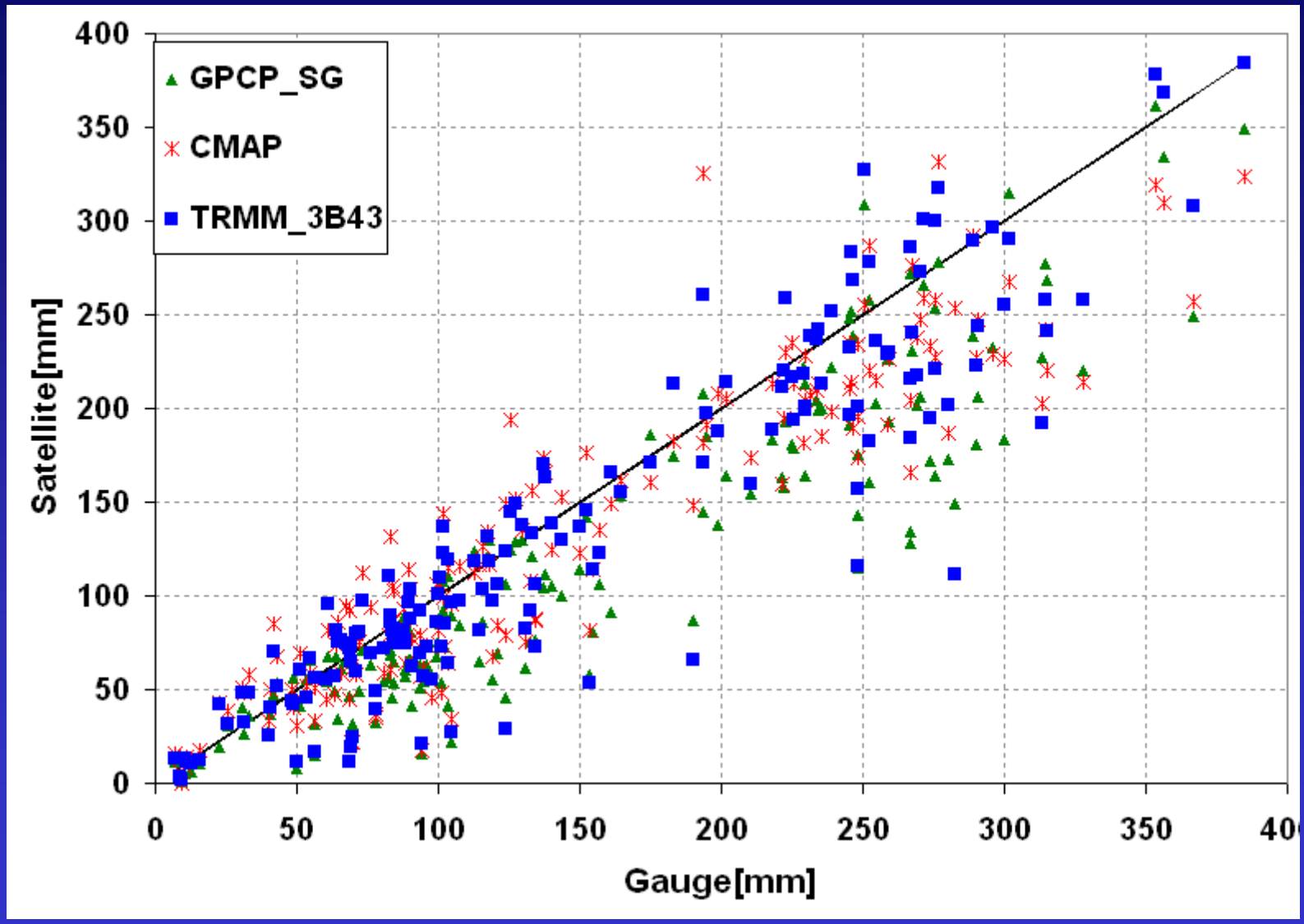
- Good spatial coverage
- Spatial average (as opposed to point data)
- Long enough time series (~30 years)
- Near-real time availability

Weaknesses

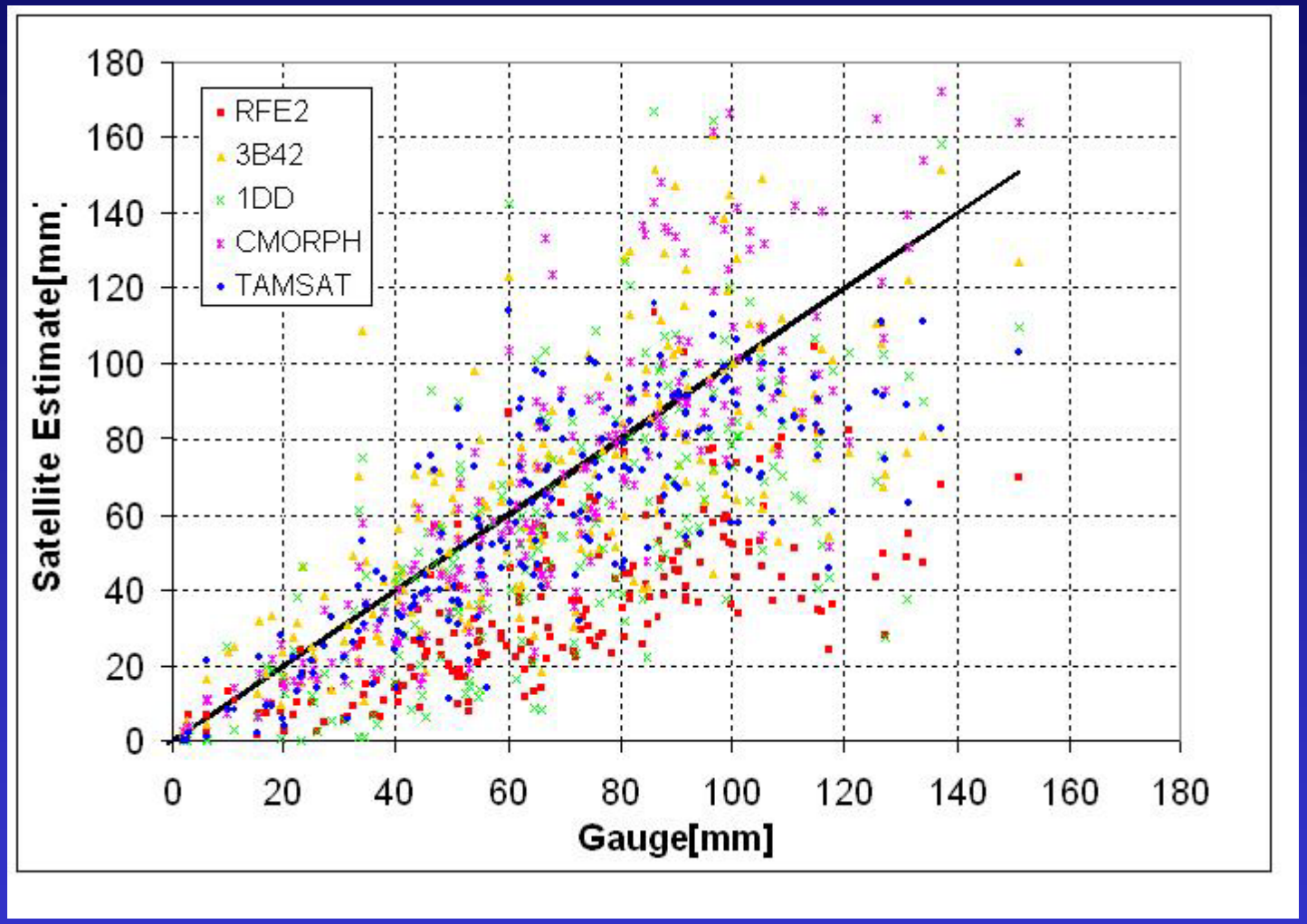
- Accuracy
- Short time series of homogenous data
- Inhomogeneities of long time series
  - Different sensors (IR, PM)
  - Different algorithms
  - Different number of gauges

Validation

Monthly @ 2.5-deg



10-daily @ 1.0 deg



Validation summary

Daily @ 0.25-deg	RFE	PERS	NRL	3B42	3B42RT	CMORPH
CC	0.26	0.40	0.36	0.39	0.37	0.32
Bias	0.60	1.54	0.85	0.84	0.83	0.91
RMS[%]	133	238	152	134	157	133

10-Daily @ 1 deg	RFE	1DD	3B42T	3B42	TAMSAT	CMORPH
CC	0.66	0.71	0.72	0.72	0.79	0.83
Bias	0.55	0.72	0.95	0.87	0.93	0.98
RMS[%]	58	46	50	39	31	32

Monthly @ 2.5-deg	GPCP	CMAP	3B43
CC	0.92	0.92	0.92
Bias	0.80	0.91	0.92
RMS[%]	30	24	25

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Model outputs

Strengths:

- Excellent space and time resolution
- Estimates in real time
- Includes meteorological context from other model fields
- Good historical time series from reanalyses

Weakness

- Forecast, not observation
- Model does not represent processes perfectly

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Prospects 1: Better observation

1. **Climate Information for Development in Africa (ClimDev Africa)/GCOS**

Results Area 1: Widely available climate information, packaging and dissemination.

1.1 Rescue historical data

1.2 Improve data management capacities

1.3 Upgrade observation and communication systems.

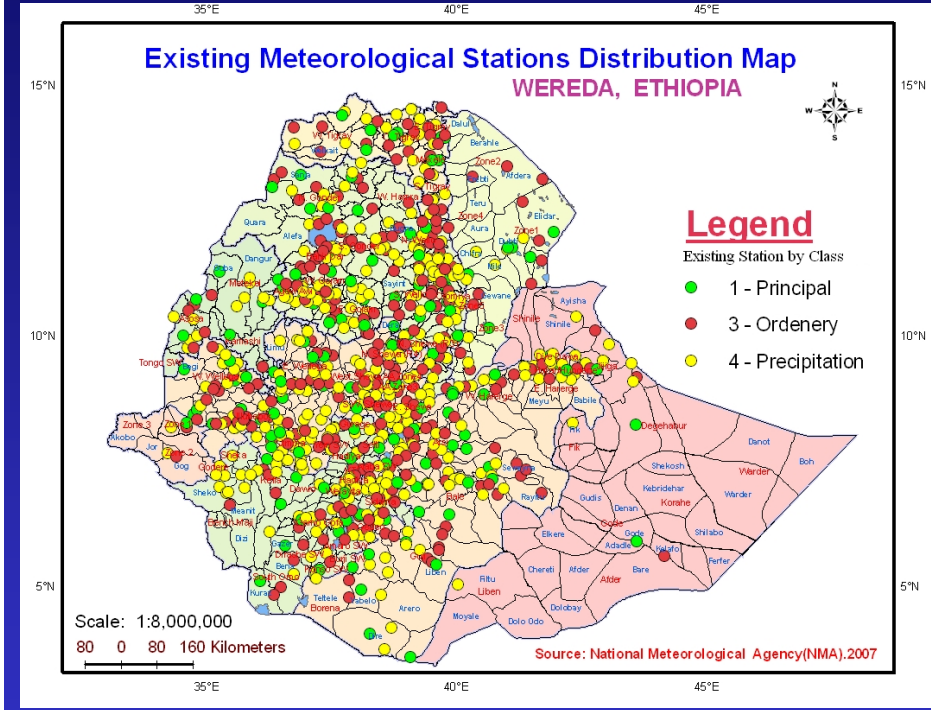
Prospects 2: Better satellite estimates

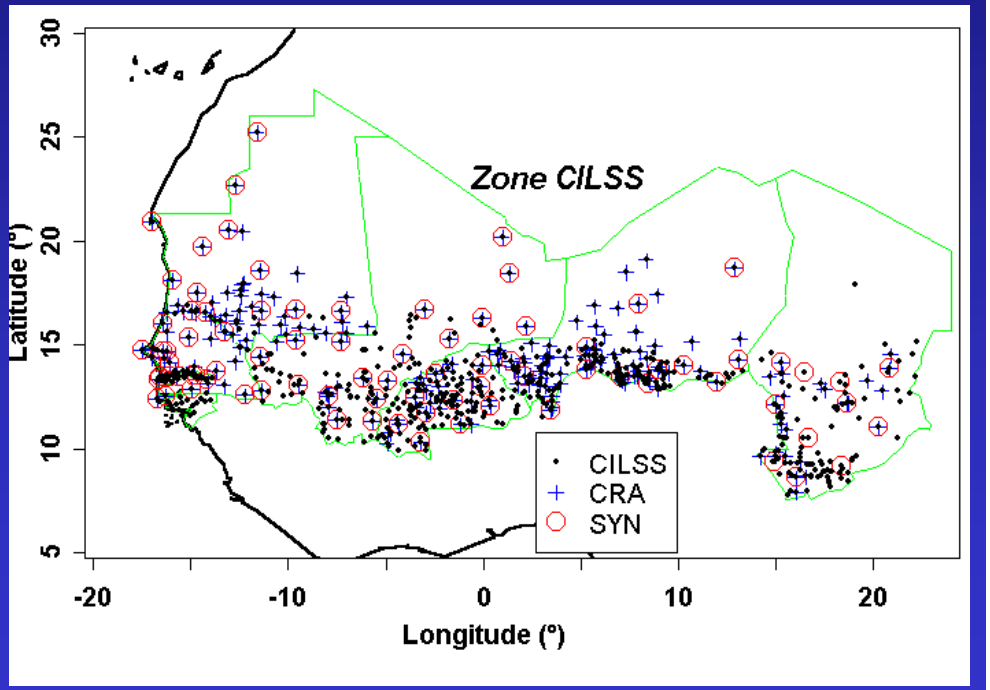
- **Better observation: Global Precipitation Mission**
  - Advanced passive microwave radar sensors
  - Much better sampling frequency (3-hourly)

- **Better Algorithms**
  - CMORPH (CPC morphing)
  - GSMaP (Global Satellite Mapping of Precipitation)
  - Better PM algorithms

Recommendation 1

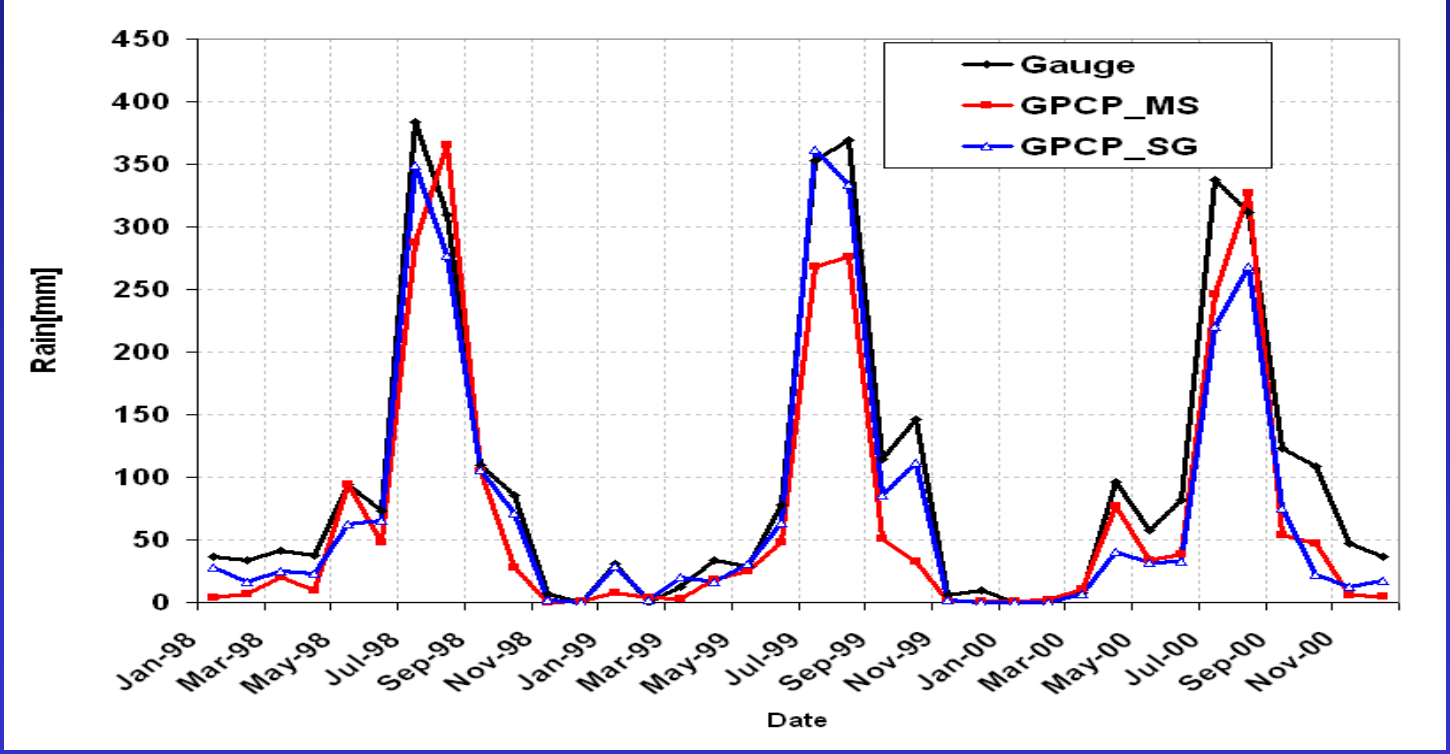
Develop high resolution gridded rainfall data for each country using ALL available data





Recommendation 2

- Calibrate satellite algorithm locally
  - Using available gauge
  - Using PR
- Process historical time series from raw METEOSAT data
- Merge with available gauge



Example: Ethiopia

IRI-Google-UoR-NMA project

- Calibrate IR-algorithm using available gauges
- Produce 30-year time series daily/ten-daily satellite rainfall estimates at 0.1 deg.
- Produce 30-year time series of gridded raingauge data
- Produce 30-year time series of blended gauge-satellite time series

Summary

- Station distribution is sparse over most Africa
- There are problems accessing available data
- Gridded raingauge data, satellite estimates, and to less extent model outputs are used as alternative data sources
- These sources have their own strengths and weaknesses
- There are some hopes for more station and better satellite estimates
- Optimum use of available gauges and satellite rainfall estimates is recommended.

THANK YOU