

A satellite image of the Earth showing Africa and South America. Overlaid on the landmasses is a color-coded map representing rainfall estimates. The colors range from blue (low rainfall) to green, yellow, and red (high rainfall). The map shows significant rainfall patterns across both continents, with higher concentrations in certain regions like the Amazon basin and parts of central Africa.

Validation of Daily Satellite Rainfall Estimates over Africa and S. America

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The Earth Institute at Columbia University

The logo of the International Research Institute for Climate and Society (IRI) is located in the bottom right corner. It consists of the letters "IRI" in a large, serif font, with a circular graphic element behind them.

Outline

- I. Motivation**
- II. The Satellite Rainfall Estimation Problem**
- III. Validation over Different countries/regions**



Motivation



Motivation

The IRI Data Library: Making Data Accessible for Climate Applications

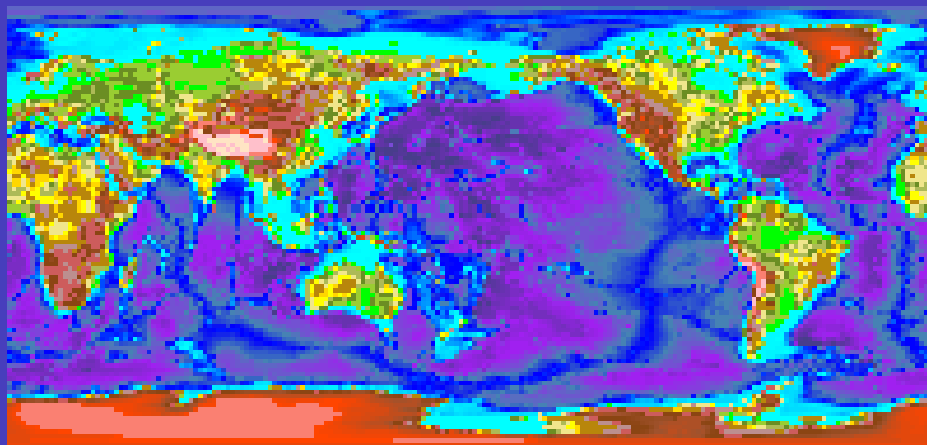
Over 300 datasets providing a thorough image of Earth's past, present, and near-future climate

Historical Model Simulations

Hydrology

Atmospheric Indices

Air-Sea Interface



Oceanography

Seasonal Forecasts

Topographic and Land Characteristics

Atmosphere

Radiation Budget


IRI Data Library: <http://iridl.ldeo.columbia.edu>

IRI/LDEO Climate Data Library - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

[http://iridl.ldeo.columbia.edu/](#) Go

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Data Library

expert

Finding Datasets

By Category

By Source

By Search

Help Resources

Tutorial

Questions and Answers

help@iri

IRI/LDEO Climate Data Library

The IRI/LDEO Climate Data Library contains over 300 datasets from a variety of earth science disciplines and climate-related topics. It is a powerful tool that offers the following capabilities at no cost to the user:

- access any number of datasets;
- create analyses of data ranging from simple averaging to more advanced EOF analyses;
- monitor present climate conditions with maps and analyses in the [Maproom](#);
- create visual representations of data, including animations;
- download data in a variety of commonly-used [formats](#), including GIS-compatible formats.

Are you new to the world of climate data? Check out our [Introduction to Climate Data](#) page.

What's New

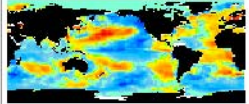
Mar 08 - Shapes for [climate zones in Sri Lanka](#) have been added as a new Features data set

Mar 08 - A new "International Federation" Map Room has been added to the IRI Map Rooms and is accessible from the [Map Room front page](#). It contains a forecast precipitation map tool developed in collaboration with the International Federation of Red Cross and Red Crescent Societies that features analyses to provide context for global precipitation forecasts.

Mar 08 - A new "linked pdf" image option has been added to the Figure Viewer pages of the Data Library. Clicking on the "linked pdf" button will produce a clickable PDF version of the image you are viewing that links back to the Figure Viewer page for the image in the Data Library. The following link provides an example: [February 2008 SSTA](#)

Feb 08 - A k-means cluster analysis named [k-means136](#) has been added to the Data Library as a new function

Monitoring Global Climate



Map Room

A collection of maps and analyses used to monitor climate conditions. Click on any of the maps to modify the figures or access the source data.

Climate Information Digest

A monthly publication covering global climate events, their impacts and the seasonal forecast.

ENSO Web

Information about El Niño-Southern Oscillation.

Climate Highlights

Finding Data

[Datasets by Category](#)

[Datasets by Source](#)

[Dataset Search](#)

[Browse/Search Datasets](#)

[Browse/Search Maproom](#)

Help Resources

[Introductory Tutorial](#)

[Statistical Analysis Tutorial](#)

[Ingrid Function Documentation](#)

[Questions and Answers](#)

Done

Assessing the qualities of rainfall data sets

- There are many rainfall products in IRI data library
- IRI uses these products for different projects over different parts of the world, and also helps partners in developing countries to use the data
- But these data sets come from different sources and have different quality/accuracy
- We want to have a better understanding of the qualities/accuracies of these data sets



The Satellite Rainfall Estimation Problem



What sensors “see”

IR & VV

MW (high frequency-
scattering by ice)

MW (low frequency-
emission by rain)

Radar (PR)
Affected by attenuation

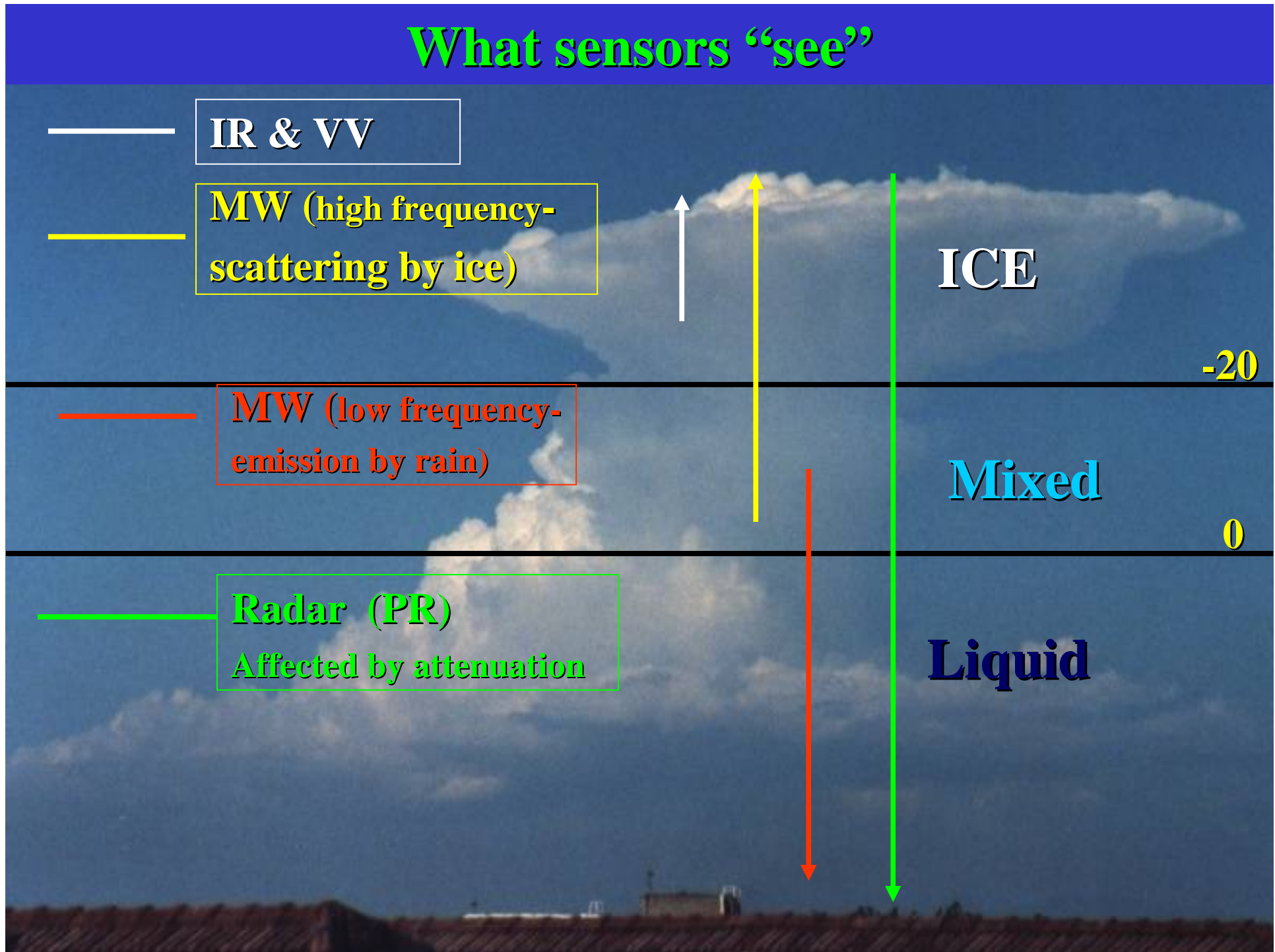
ICE

-20

Mixed

0

Liquid

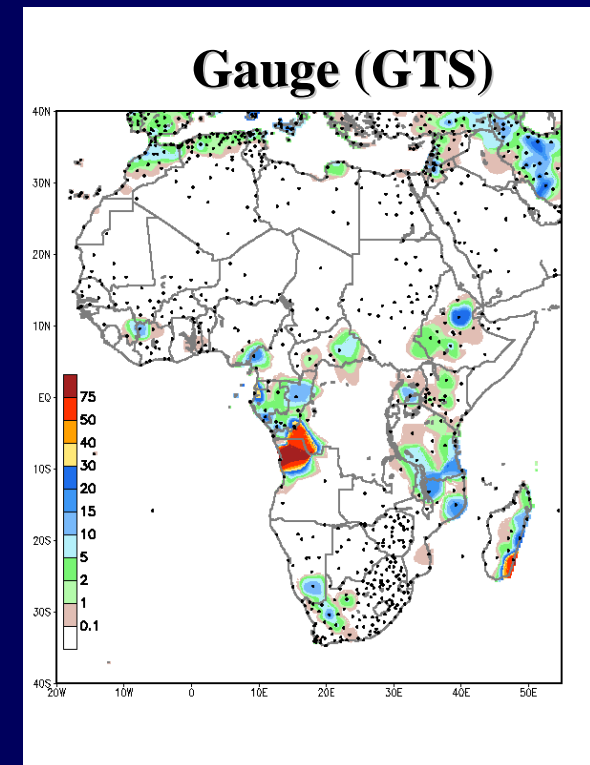
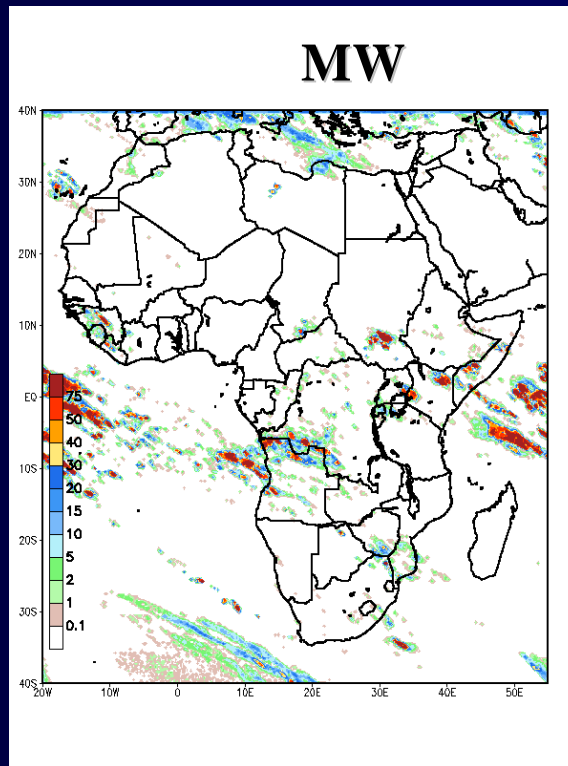
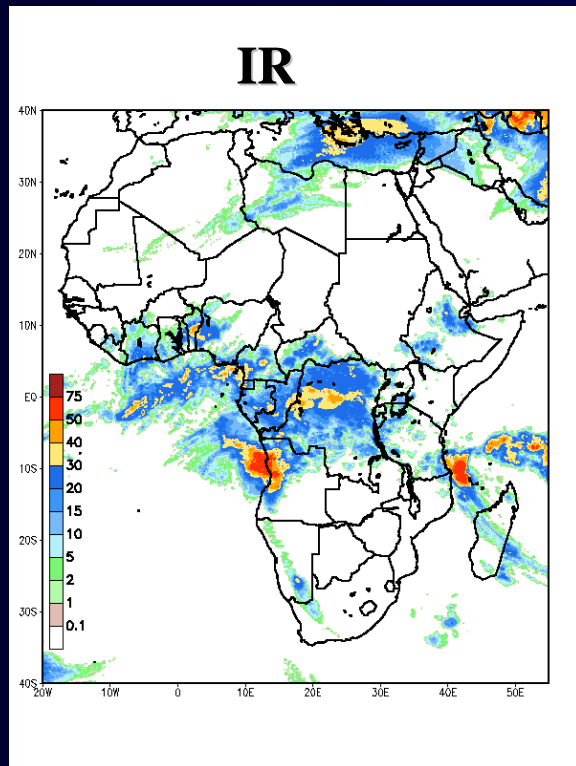


Sensor strength/weakness

Sensor	Strength	Weakness
IR	Hi temporal resolution and wide spatial coverage	<ul style="list-style-type: none">• Weak relation to rainfall• Cirrus contamination
VV	Hi temporal resolution and wide spatial coverage	<ul style="list-style-type: none">• Weak relation to rainfall• Bright clouds no rain• Not available during night
MW	Strong relation to rainfall	<ul style="list-style-type: none">• Low frequency• Narrow spatial coverage• Partial beam filing
Radar	Most accurate	<ul style="list-style-type: none">• Limited coverage• Attenuation

Most of the current algorithms combine good *space/time resolution* of IR estimates with the better *accuracy* of MW estimates

Merging IR, MW and Gauge: an example



Validation

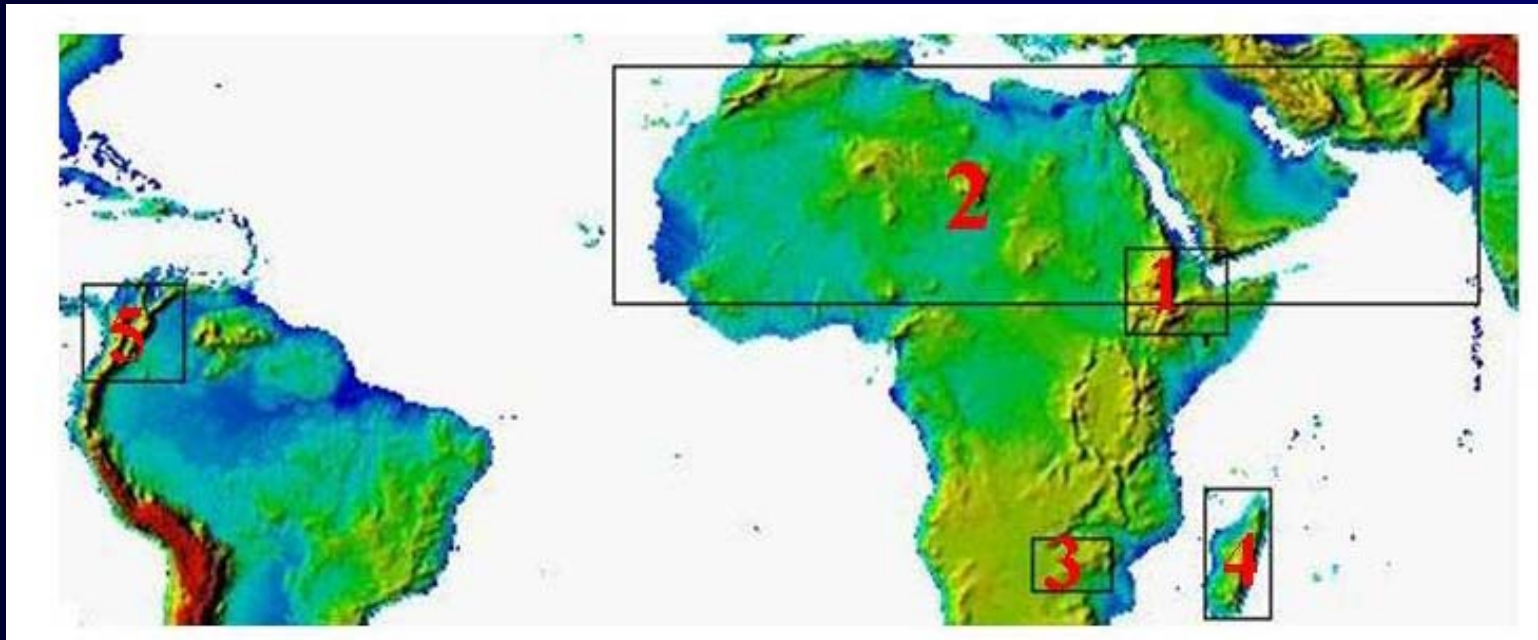


Satellite rainfall products evaluated

<u>Product</u>	<u>Time Res</u>	<u>Space Res</u>	<u>Existence</u>	<u>MW</u>	<u>Gauge</u>
CMORPH	3-hourly	0.25deg	2002-Pres	Y	N
GSMaP	3-hourly	0.10 deg	2003-2007	Y	Y
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



Validation sites



Current validation regions

1. **Ethiopia:** Validation at spatial and temporal, scales
2. **Desert locust recession regions :** Validation at daily time scale and spatial resolution of 0.25-deg.
3. **Zimbabwe:** validation at of 0.25-deg
4. **Madagascar:** Validation different temporal and spatial scales
5. **Columbia:** Validation at different temporal and spatial scales

IRI

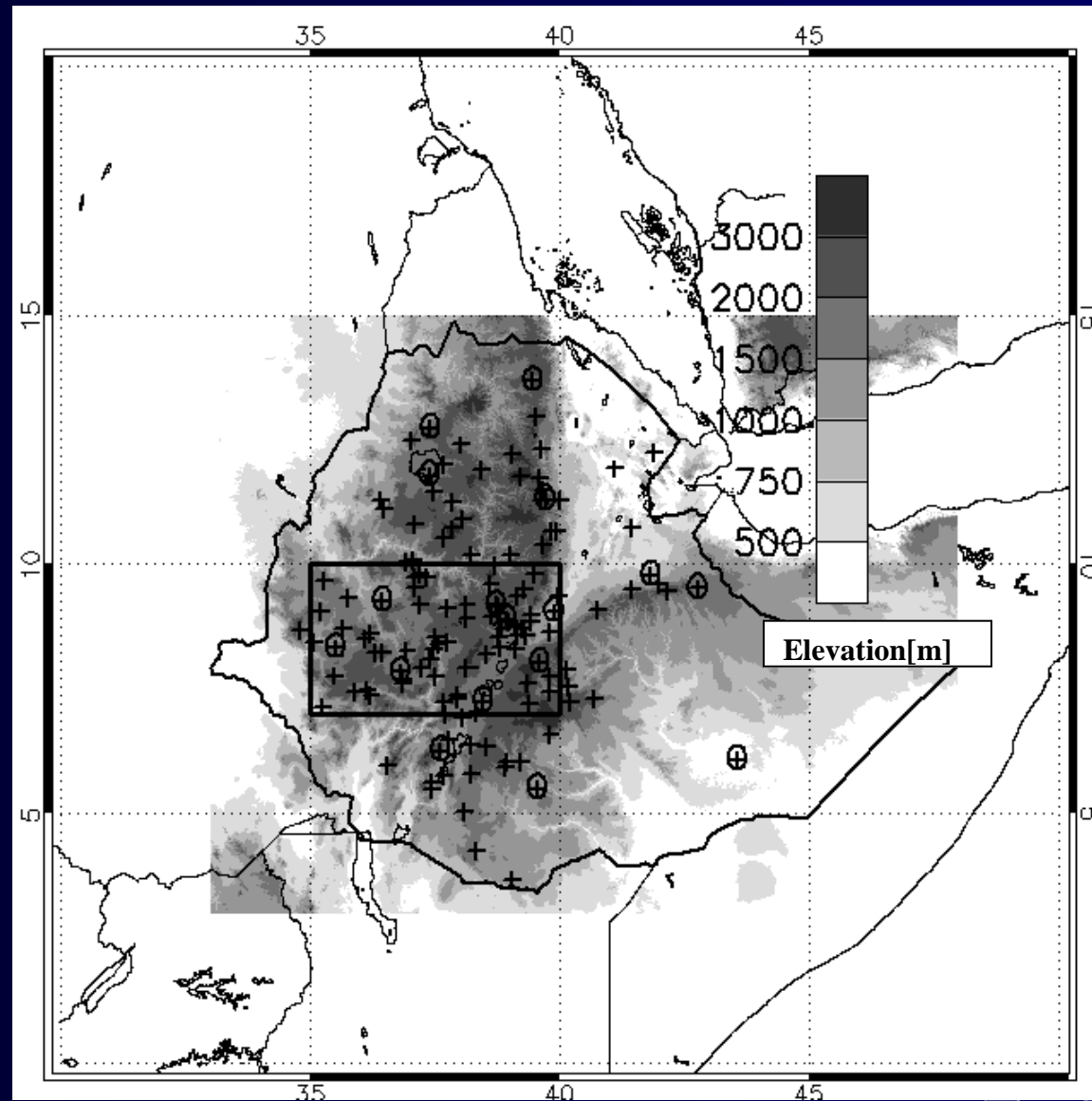
Gridding Raingauge Data

Gauge data gridded using Anomaly Interpolation

- Kriging for interpolating of means (climatology)
- Angular-Distance Weighting for ratios
- Minimum one gauge per 0.25° grid box



Validation over Ethiopia



Rainfall threshold used: 1mm

IRI

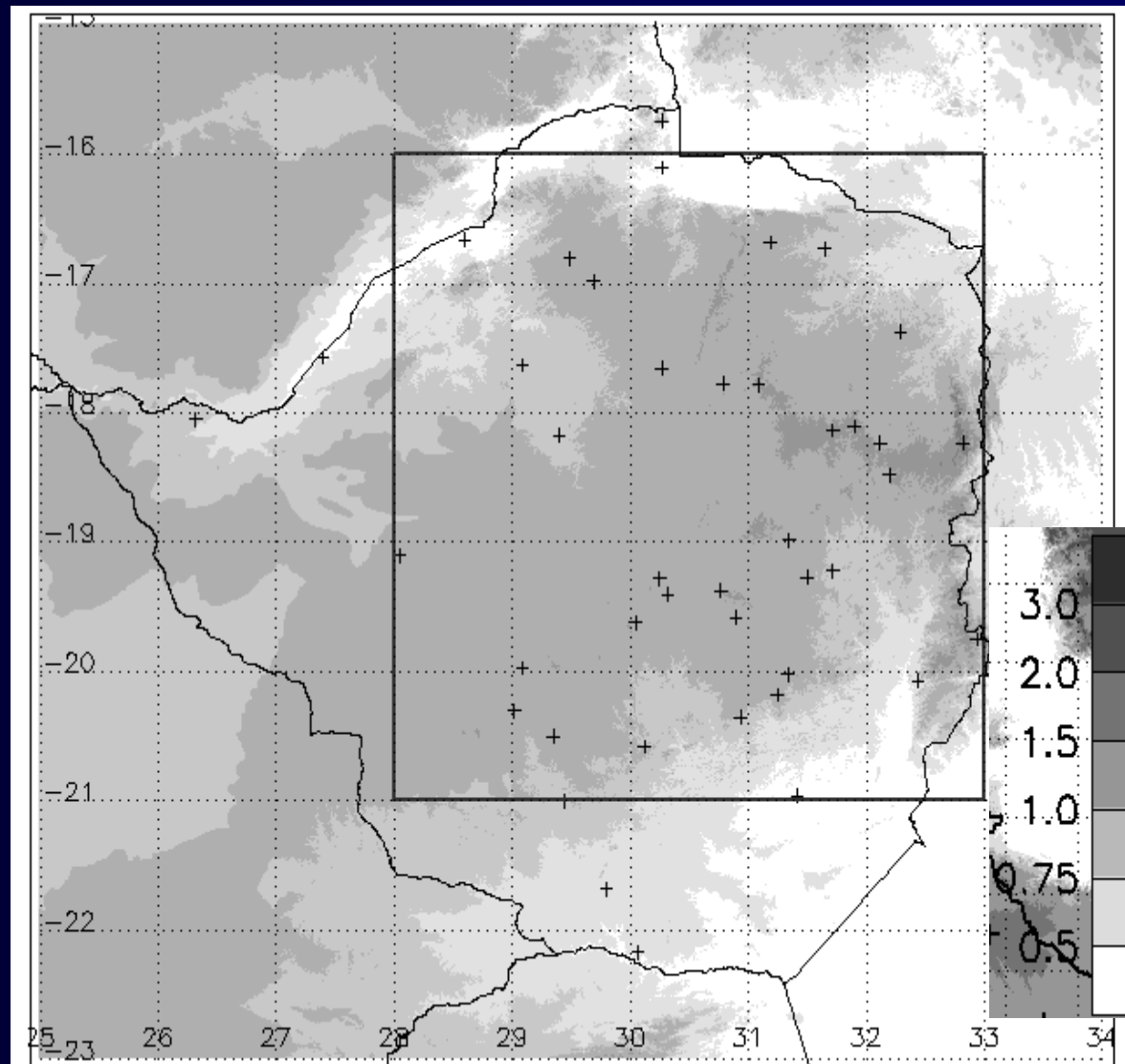
Validation over Ethiopia

	RFE	PERSSIAN	NRLB	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
POD	0.72	0.70	0.61	0.69	0.60	0.81
FAR	0.12	0.11	0.12	0.11	0.11	0.14
HSS	0.29	0.31	0.26	0.30	0.24	0.33

Rainfall threshold used: 1mm

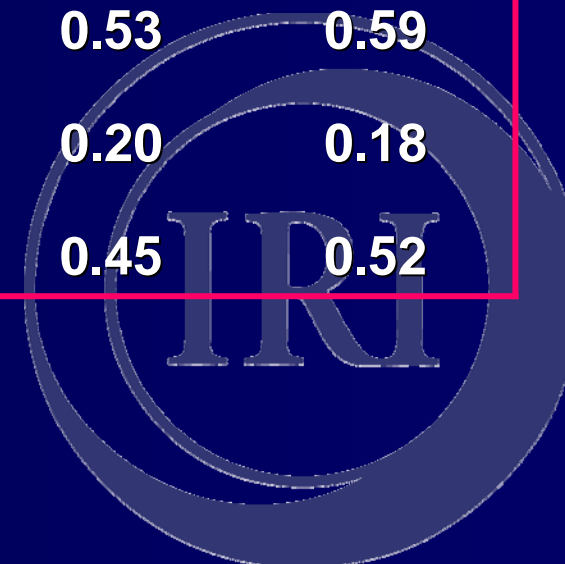


Validation over Zimbabwe

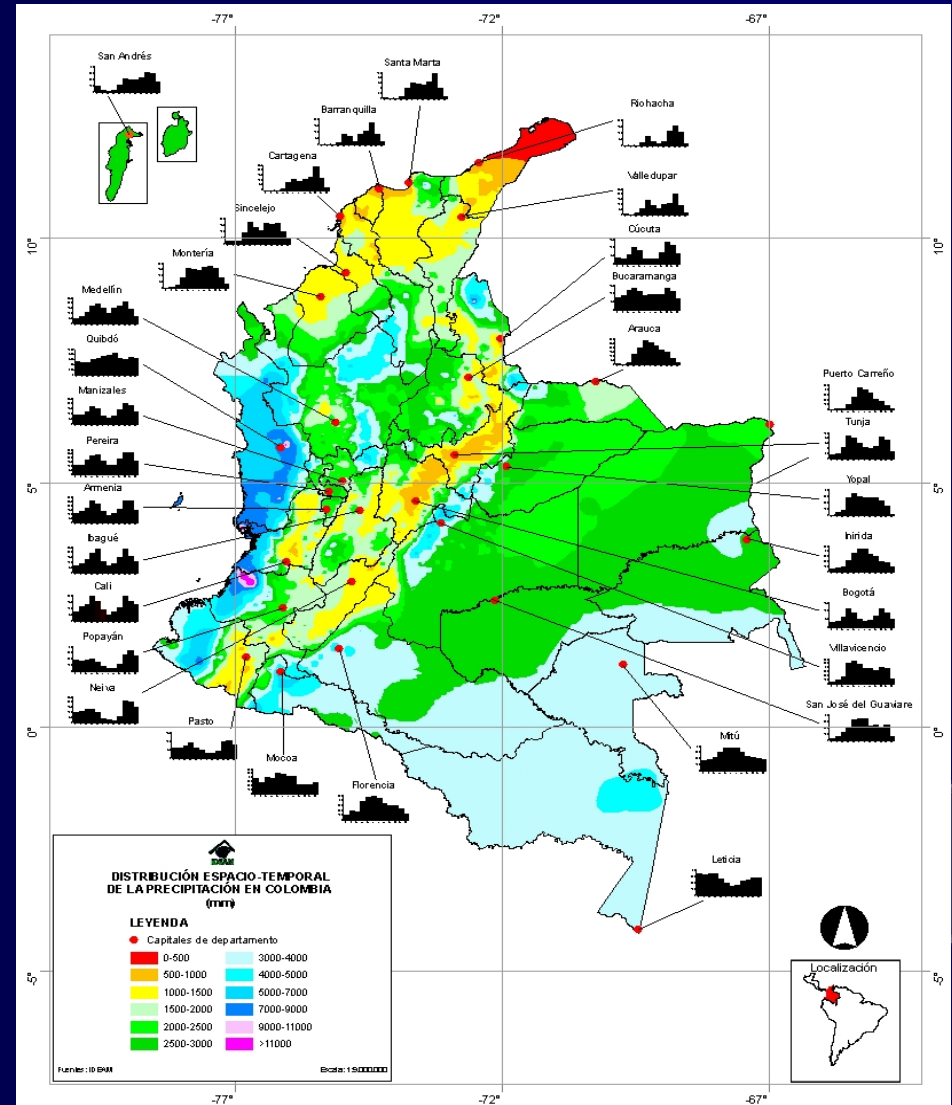
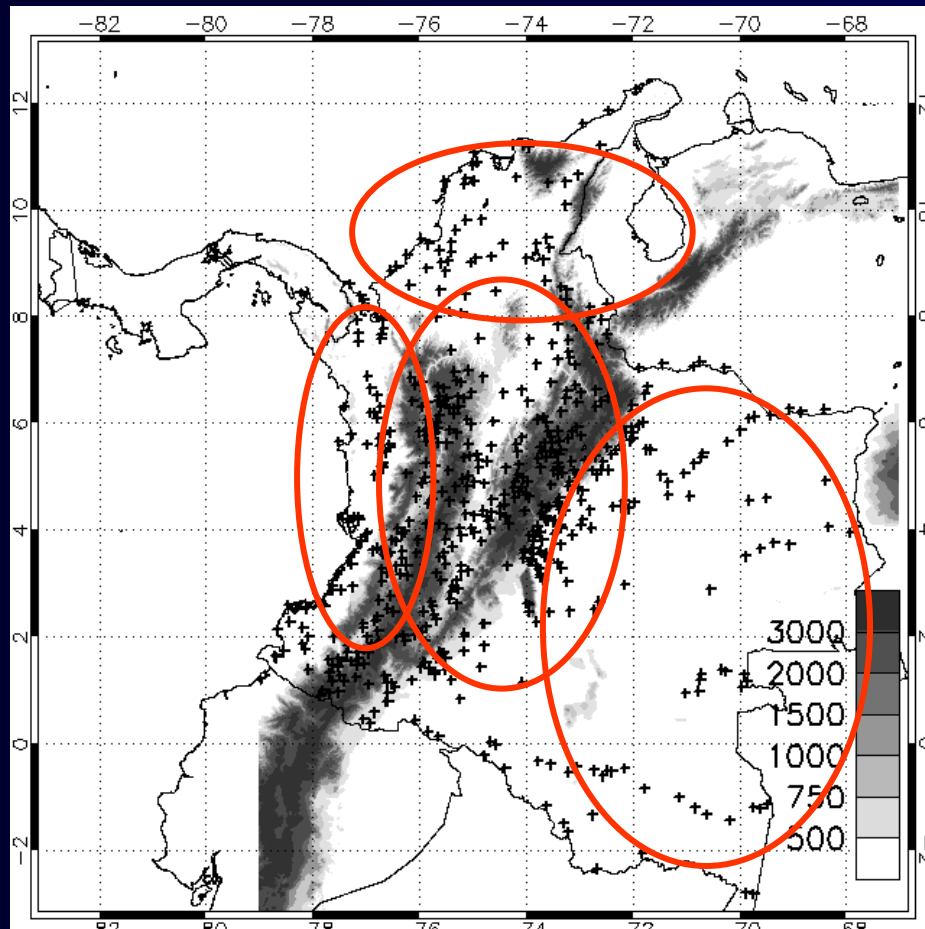


Validation over Zimbabwe

	RFE	PERSIANN	NRL	3B42	3B42RT	CMORPH
CC	0.64	0.47	0.40	0.56	0.45	0.47
Bias	1.02	3.23	1.12	1.07	1.15	0.98
RMS[%]	183	703	280	225	292	251
POD	0.77	0.68	0.58	0.63	0.53	0.59
FAR	0.19	0.28	0.24	0.18	0.20	0.18
HSS	0.65	0.50	0.46	0.55	0.45	0.52

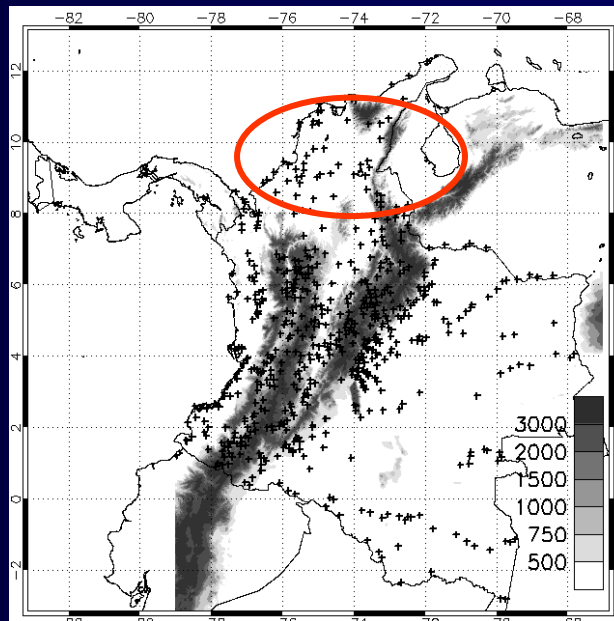


Validation over Colombia



Caribbean

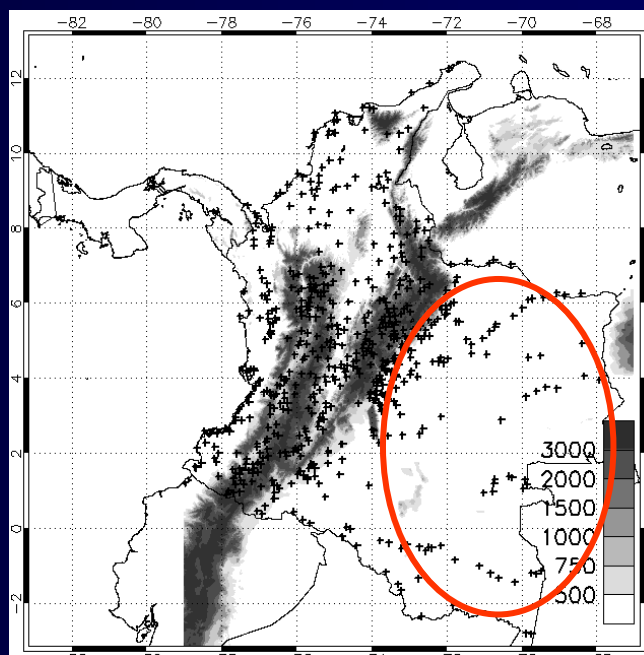
	NRL	3B42RT	3B42	CMORPH	GSMaP+
CC	0.43	0.46	0.49	0.49	0.5
Bias	1.4	1.25	0.82	1.22	1.03
MAE	1.28	1.19	0.88	1.1	0.97
POD	0.75	0.67	0.73	0.75	0.75
FAR	0.24	0.17	0.23	0.22	0.18
HSS	0.53	0.54	0.52	0.55	0.59



Amazon

	NRL	3B42RT	3B42	CMORPH	GSMaP+
CC	0.47	0.46	0.49	0.52	0.53
Bias	0.96	0.86	0.85	0.96	0.67
MAE	0.91	0.9	0.83	0.84	0.76
POD	0.71	0.67	0.73	0.77	0.72
FAR	0.12	0.11	0.12	0.12	0.1
HSS	0.50	0.47	0.52	0.55	0.52

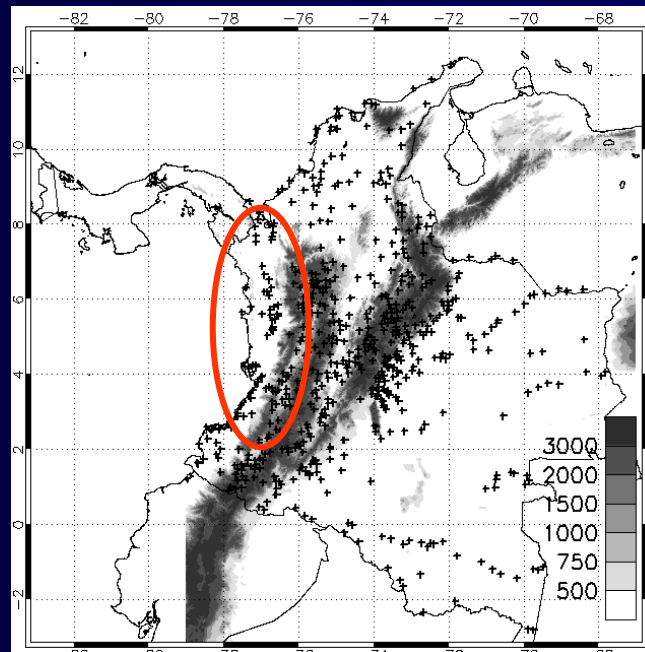
Elv LE 500, North
Mean = 6.7



Pacific

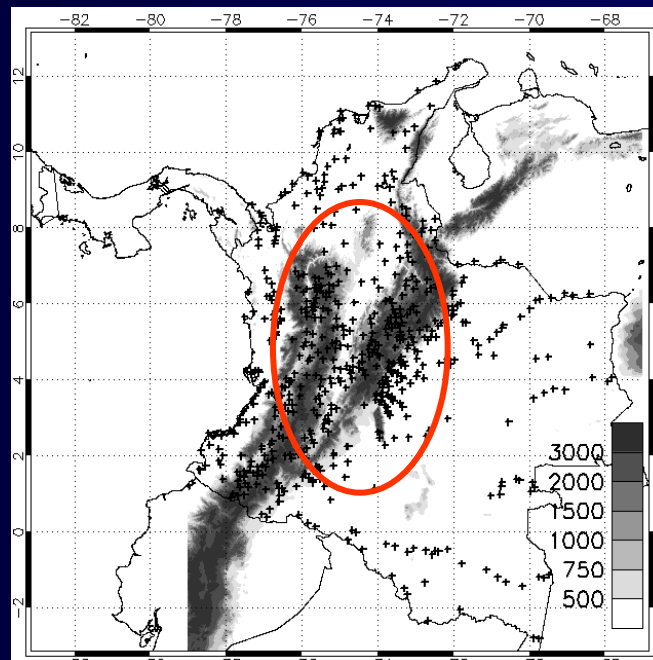
	NRL	3B42	3B42RT	CMORPH	GSMaP+
CC	0.41	0.41	0.44	0.45	0.45
Bias	0.7	0.54	0.84	0.71	0.64
MAE	0.83	0.8	0.93	0.81	0.8
POD	0.70	0.70	0.62	0.73	0.71
FAR	0.08	0.09	0.06	0.07	0.06
HSS	0.34	0.32	0.31	0.38	0.38

Elv LE 500, Pacific
 $\sigma_{an} = 15.9$

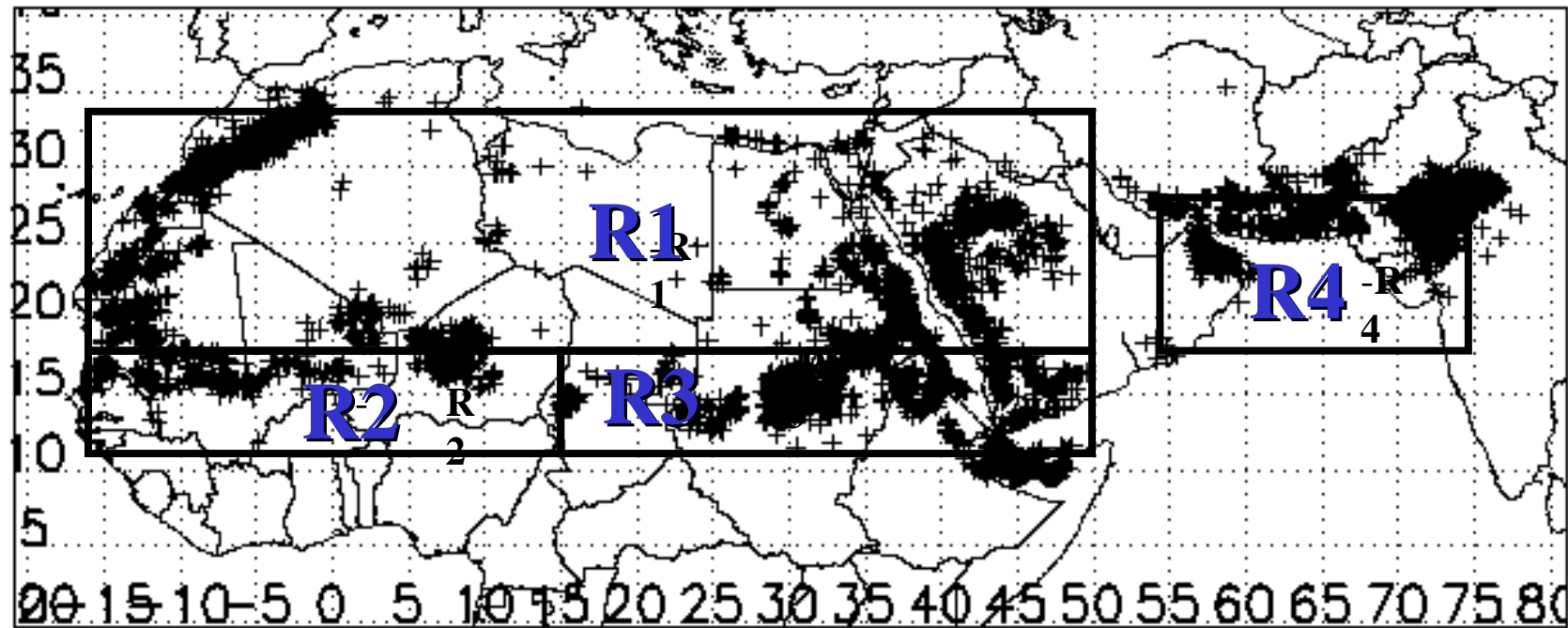


Highland

	NRL	3B42RT	3B42	CMORPH	GSMaP+
CC	0.46	0.47	0.55	0.57	0.57
Bias	1.1	0.9	0.79	0.88	0.65
MAE	1.0	0.90	0.78	0.80	0.74
POD	0.66	0.62	0.68	0.68	0.63
FAR	0.19	0.15	0.15	0.14	0.12
HSS	0.41	0.42	0.47	0.48	0.47



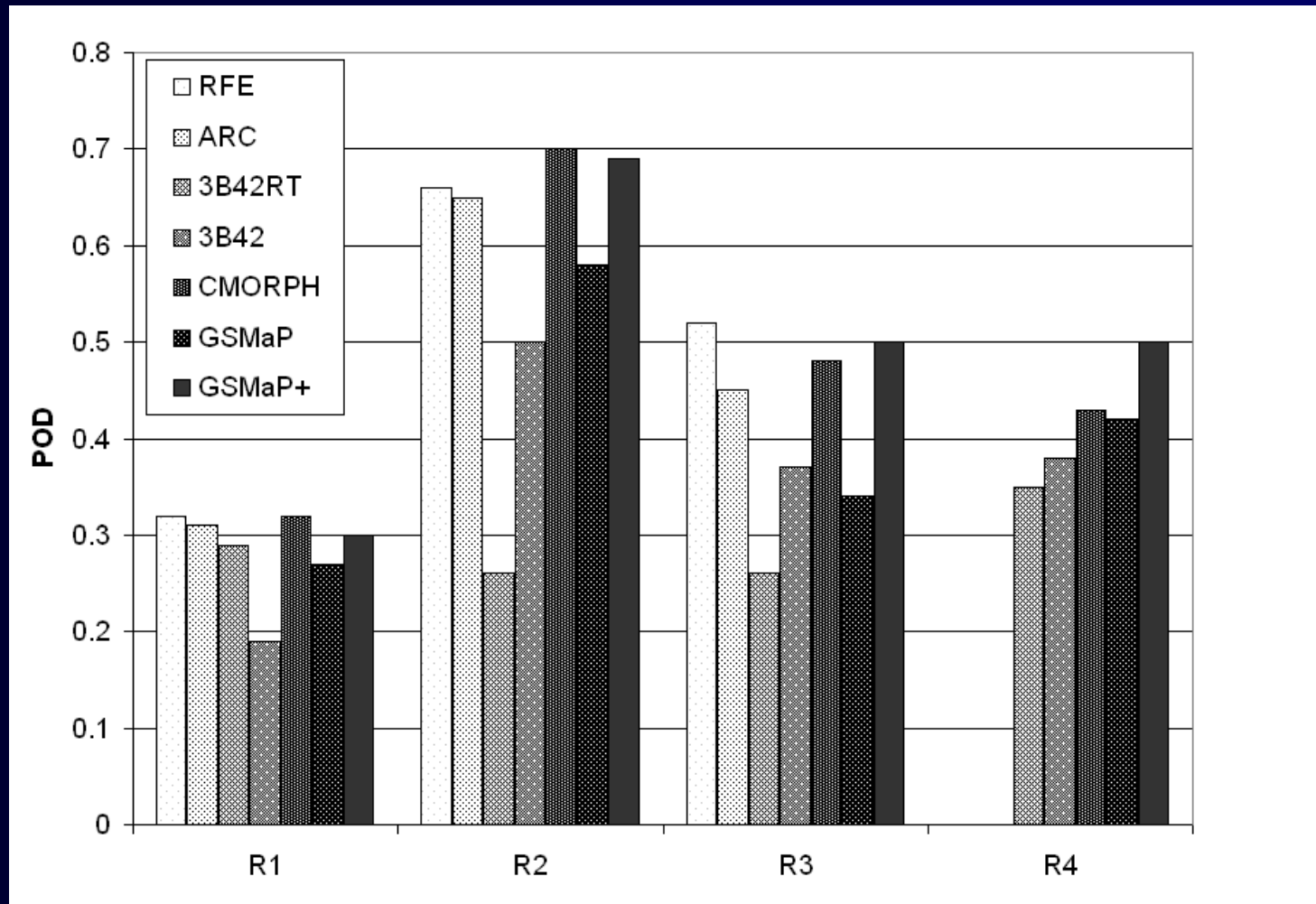
Validation over Desert Locust Regions



- Data obtained from FAO-DLIS
- Over 20,000 qualitative reports(2003-2006) used
- About 7,000 used after quality control



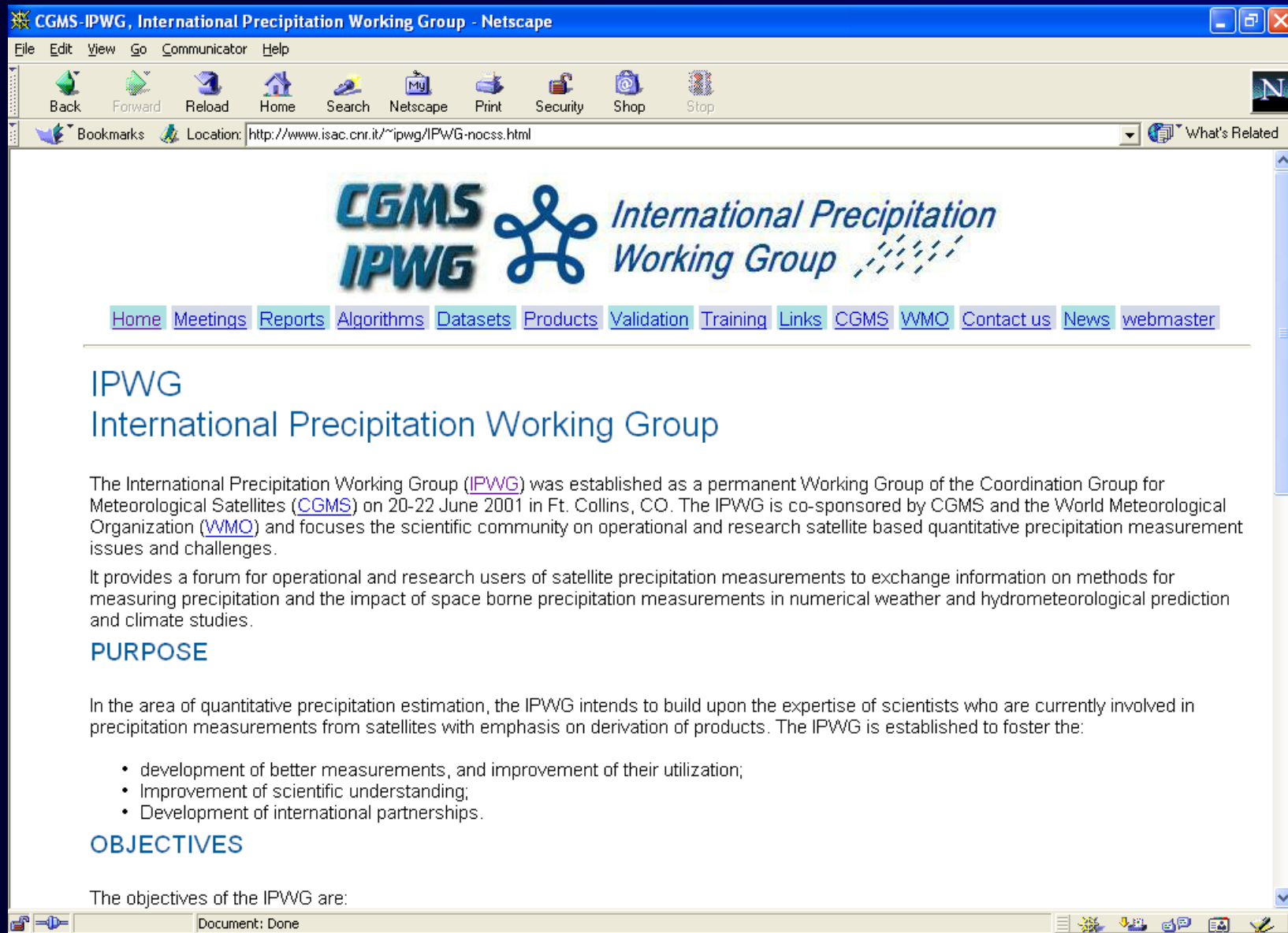
Validation over Desert Locust Regions



Rainfall threshold used: 0.5 mm

All about satellite rainfall estimation

<http://www.isac.cnr.it/~ipwg/>



The screenshot shows a Netscape browser window titled "CGMS-IPWG, International Precipitation Working Group - Netscape". The address bar shows the URL "http://www.isac.cnr.it/~ipwg/IPWG-nocss.html". The website content includes the CGMS IPWG logo, a navigation menu with links like Home, Meetings, Reports, Algorithms, Datasets, Products, Validation, Training, Links, CGMS, WMO, Contact us, News, and webmaster. The main text describes the IPWG's establishment and purpose.

CGMS IPWG International Precipitation Working Group

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IPWG International Precipitation Working Group

The International Precipitation Working Group ([IPWG](#)) was established as a permanent Working Group of the Coordination Group for Meteorological Satellites ([CGMS](#)) on 20-22 June 2001 in Ft. Collins, CO. The IPWG is co-sponsored by CGMS and the World Meteorological Organization ([WMO](#)) and focuses the scientific community on operational and research satellite based quantitative precipitation measurement issues and challenges.

It provides a forum for operational and research users of satellite precipitation measurements to exchange information on methods for measuring precipitation and the impact of space borne precipitation measurements in numerical weather and hydrometeorological prediction and climate studies.

PURPOSE

In the area of quantitative precipitation estimation, the IPWG intends to build upon the expertise of scientists who are currently involved in precipitation measurements from satellites with emphasis on derivation of products. The IPWG is established to foster the:

- development of better measurements, and improvement of their utilization;
- Improvement of scientific understanding;
- Development of international partnerships.

OBJECTIVES

The objectives of the IPWG are:

Publications

- **Dinku, T., P. Ceccato, K. Cressman, and S.J. Connor, 2009: Evaluation of daily satellite rainfall products over desert locusts recession regions. Submitted, *Journal of Applied Meteorology and Climatology*.**
- **Dinku, T., F. Ruiz, S.J. Connor and P. Ceccato 2009: Validation of satellite rainfall products over Colombia. Submitted, *JAMC***
- **Dinku, T., P. Ceccato, and S.J. Connor 2009: Challenges to Satellite Rainfall Estimation over Mountainous and Arid Parts of East Africa. Submitted, *International Journal of Remote Sensing*.**
- **Dinku, T., P. Ceccato, and S.J. Connor, 2009: Comparison of CMORPH and TRMM-3B42 over Mountainous Regions of Africa and South America. Accepted, chapter in a Springer book on '*Satellite Rainfall Applications for Surface Hydrology*'.**
- **Dinku et al., 2008: Intercomparison of global gridded rainfall products over complex terrain in Africa, *IJOC*, 28, 1627-1638**
- **Dinku et al., , 2008: Validation of high-resolution satellite rainfall products over complex terrain in Africa . *IJRS*, 29 (14), 4097–4110.**
- **Dinku et al., 2007: Validation of satellite rainfall products over East Africa's complex topography. *IJRS*, 28(7), 1503–1526.**



THANK YOU

