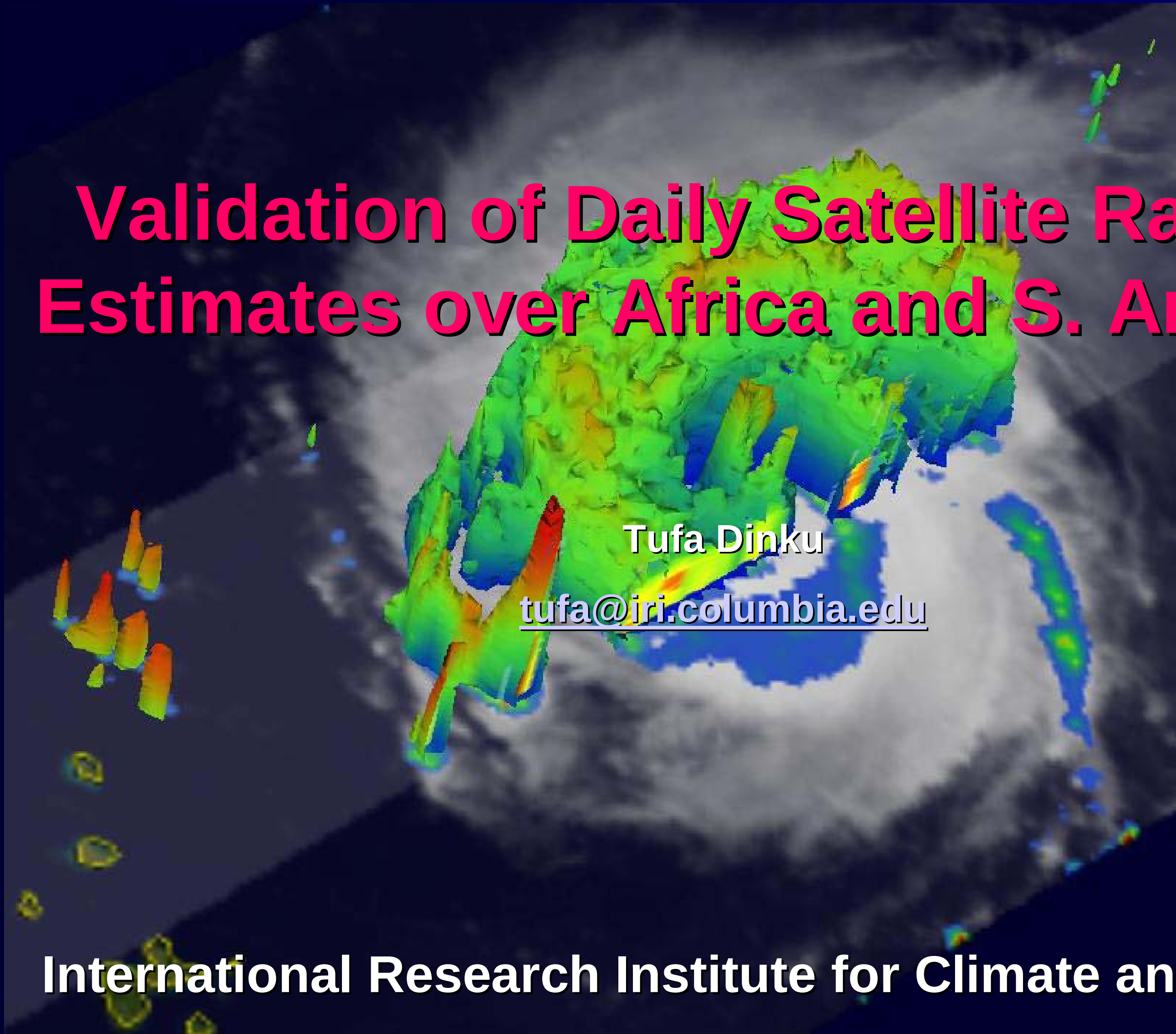
Validation of Daily Satellite Rainfall Estimates over Africa and S. America



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Outline

I. Motivation

II. The Satellite Rainfall Estimation Problem

III. Validation over Different countries/regions

Motivation

Motivation

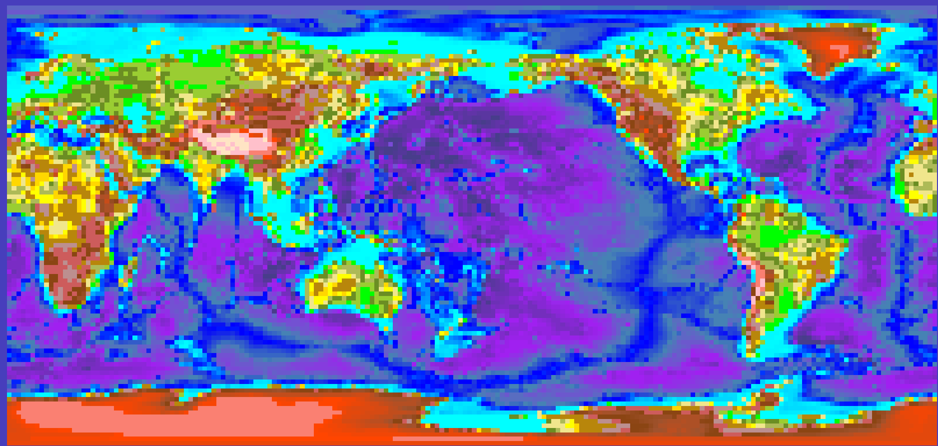
The IRI Data Library: Making Data Accessible for Climate Applications

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

Air-Sea Interface

Historical Model Simulations

Topographic and Land Characteristics



Hydrology

Atmosphere

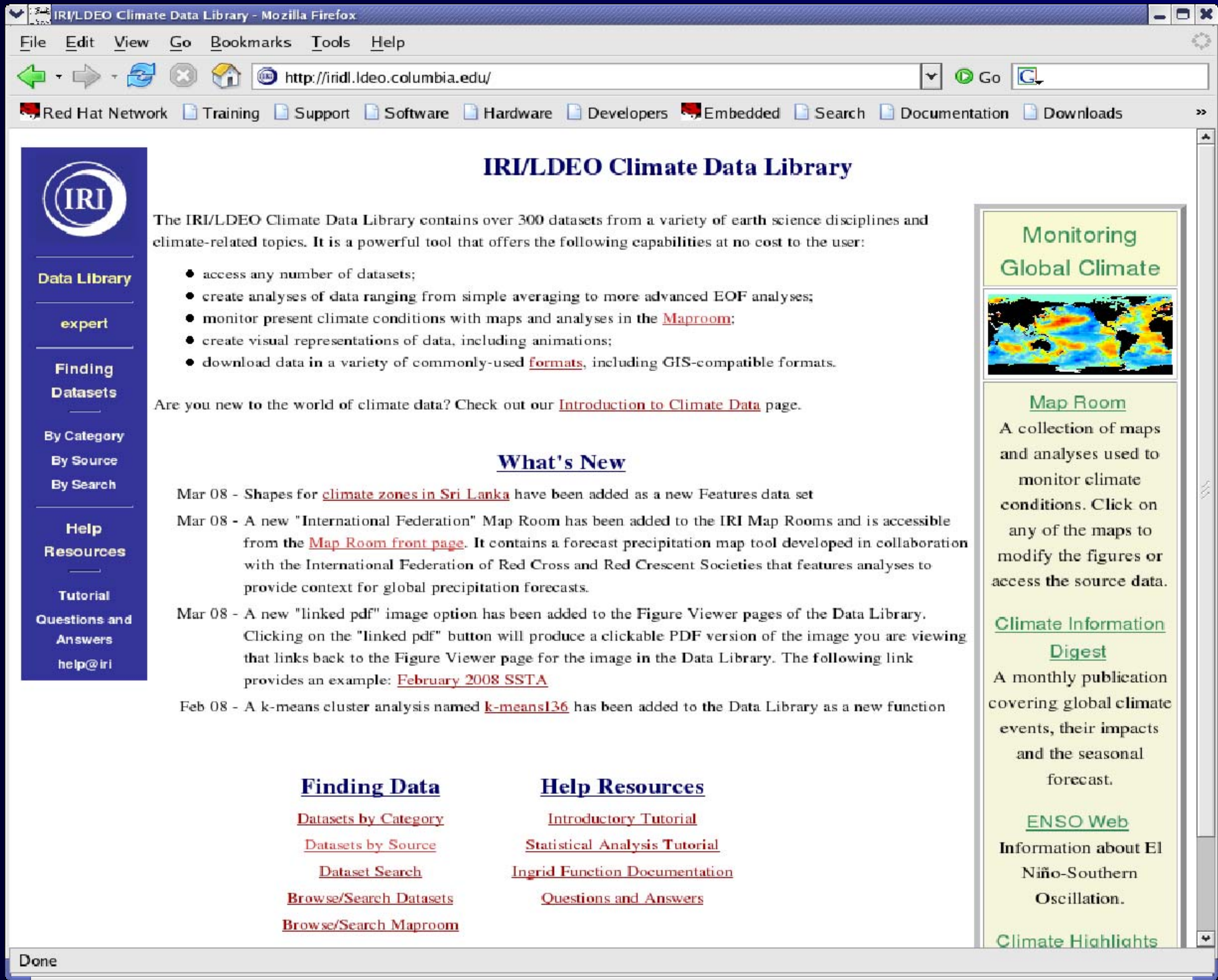
Atmospheric Indices

Radiation Budget

Oceanography

Seasonal Forecasts

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

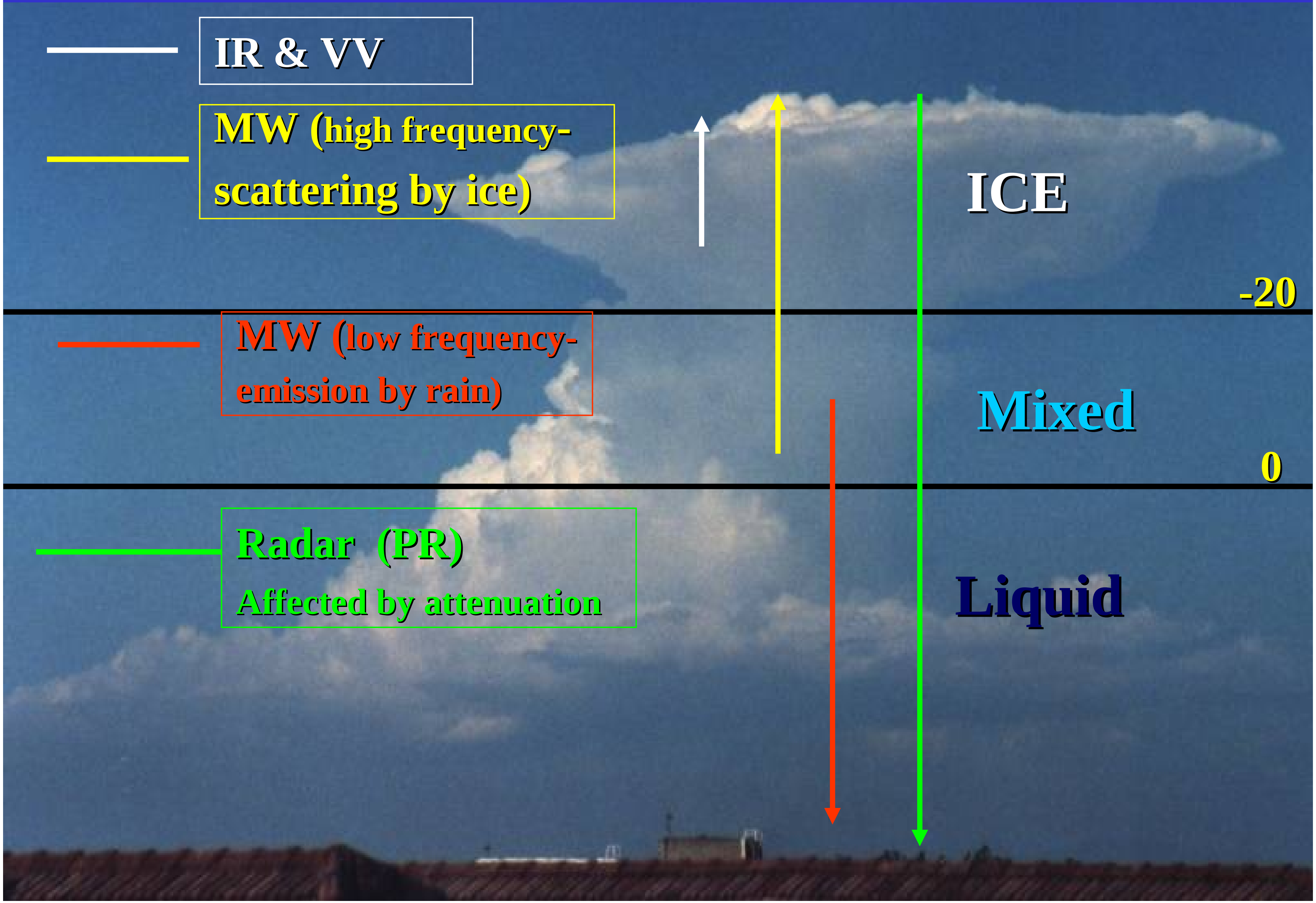


Assessing the qualities of rainfall data sets

- 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"



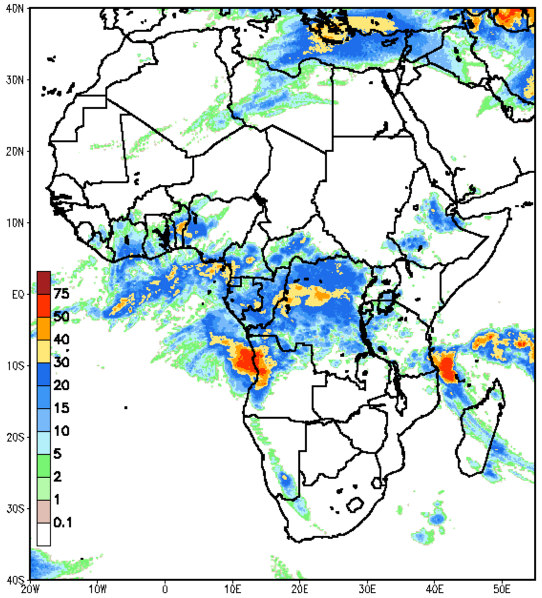
Sensor strength/weakness

Sensor	Strength	Weakness
IR	Hi temporal resolution and wide spatial coverage	• Weak relation to rainfall • Cirrus contamination
VV	Hi temporal resolution and wide spatial coverage	• Weak relation to rainfall • Bright clouds no rain • Not available during night
MW	Strong relation to rainfall	• Low frequency • Narrow spatial coverage • Partial beam filing
Radar	Most accurate	• Limited coverage • Attenuation

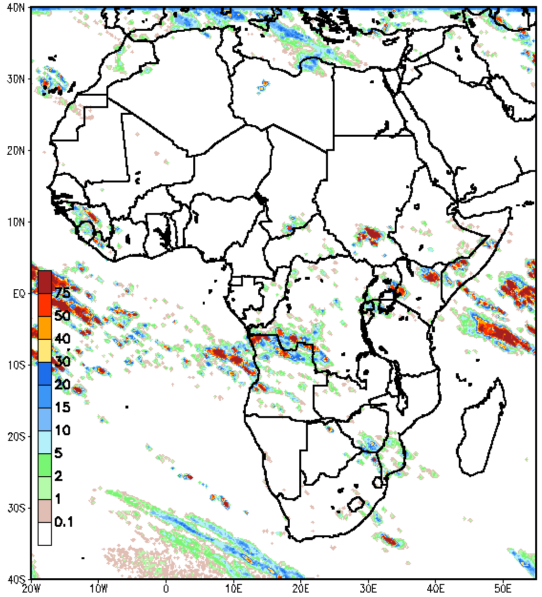
Most of the current algorithms combine good *space/time resolution* of IR estimates with the better *accuracy* of MW estimates

Merging IR, MW and Gauge: an example

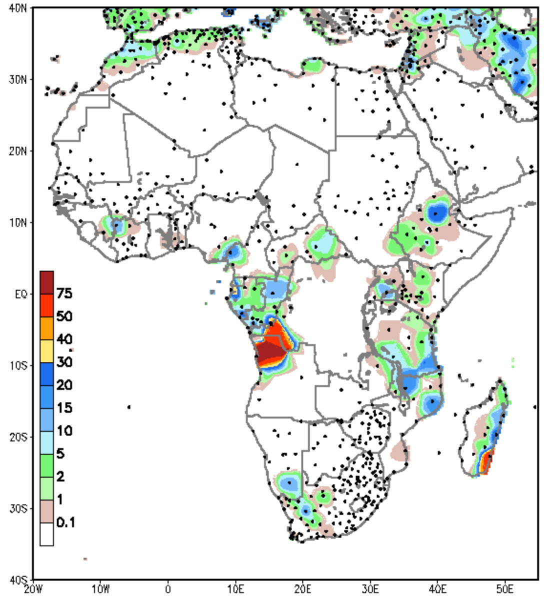
IR



MW



Gauge (GTS)

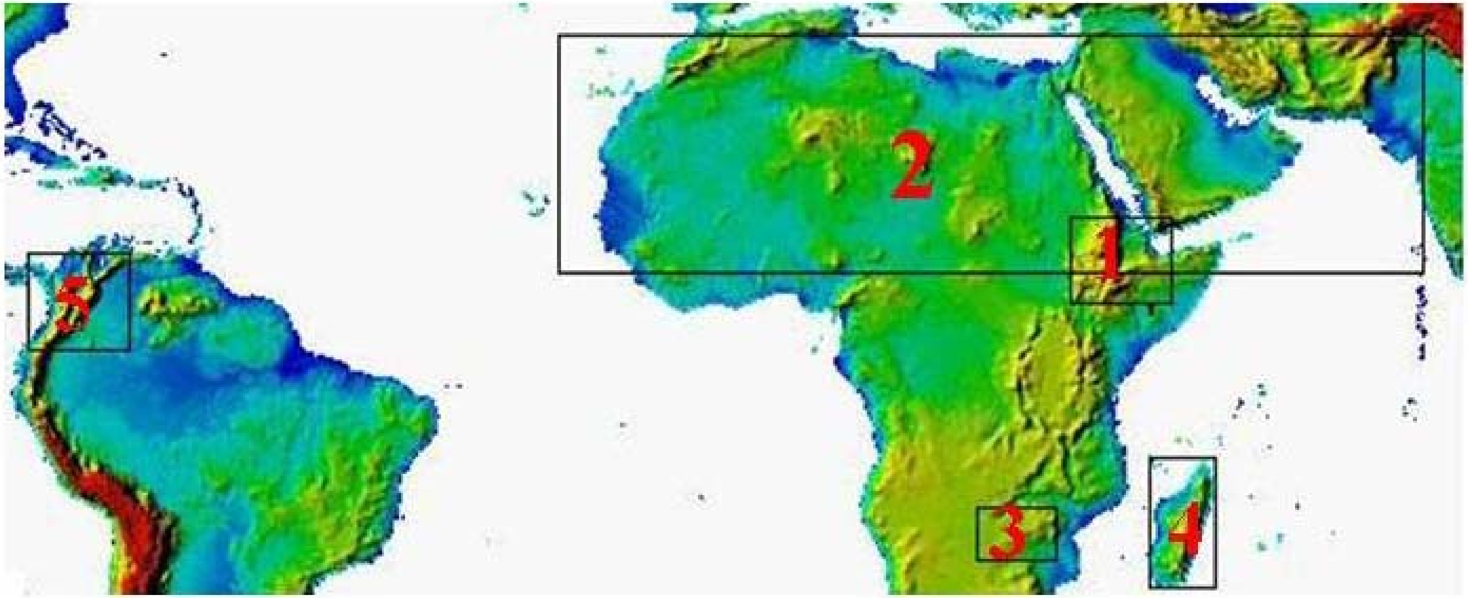


Validation

Satellite rainfall products evaluated

Product	Time Res	Space Res	Existence	MW	Gauge
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

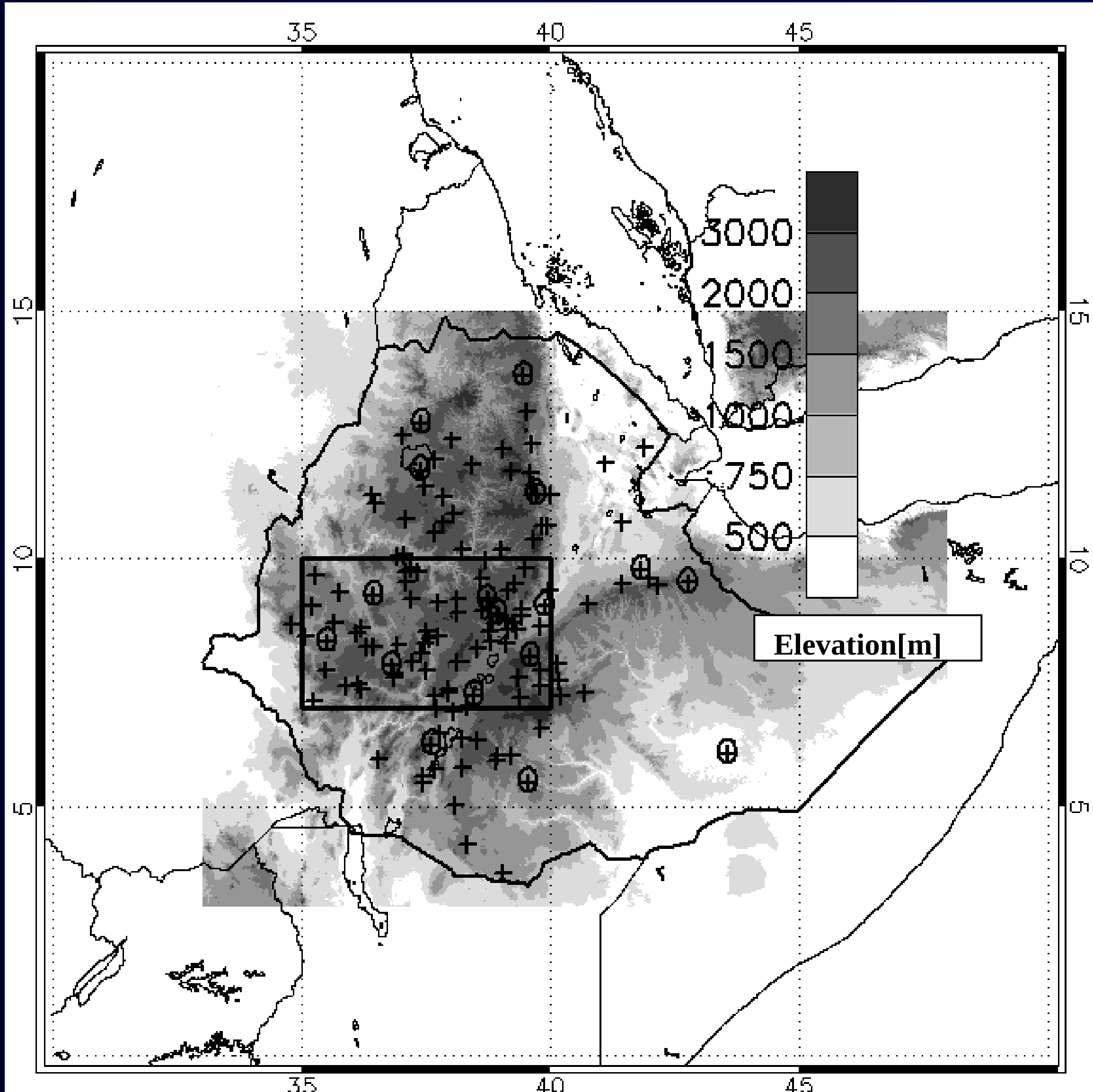
1. Ethiopia: Validation at spatial and temporal, scales
2. Desert locust recession regions : Validation at daily time scale and spatial resolution of 0.25-deg.
3. Zimbabwe: validation at of 0.25-deg
4. Madagascar: Validation different temporal and spatial scales
5. Columbia: Validation at different temporal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

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^{o} grid box**

Validation over Ethiopia



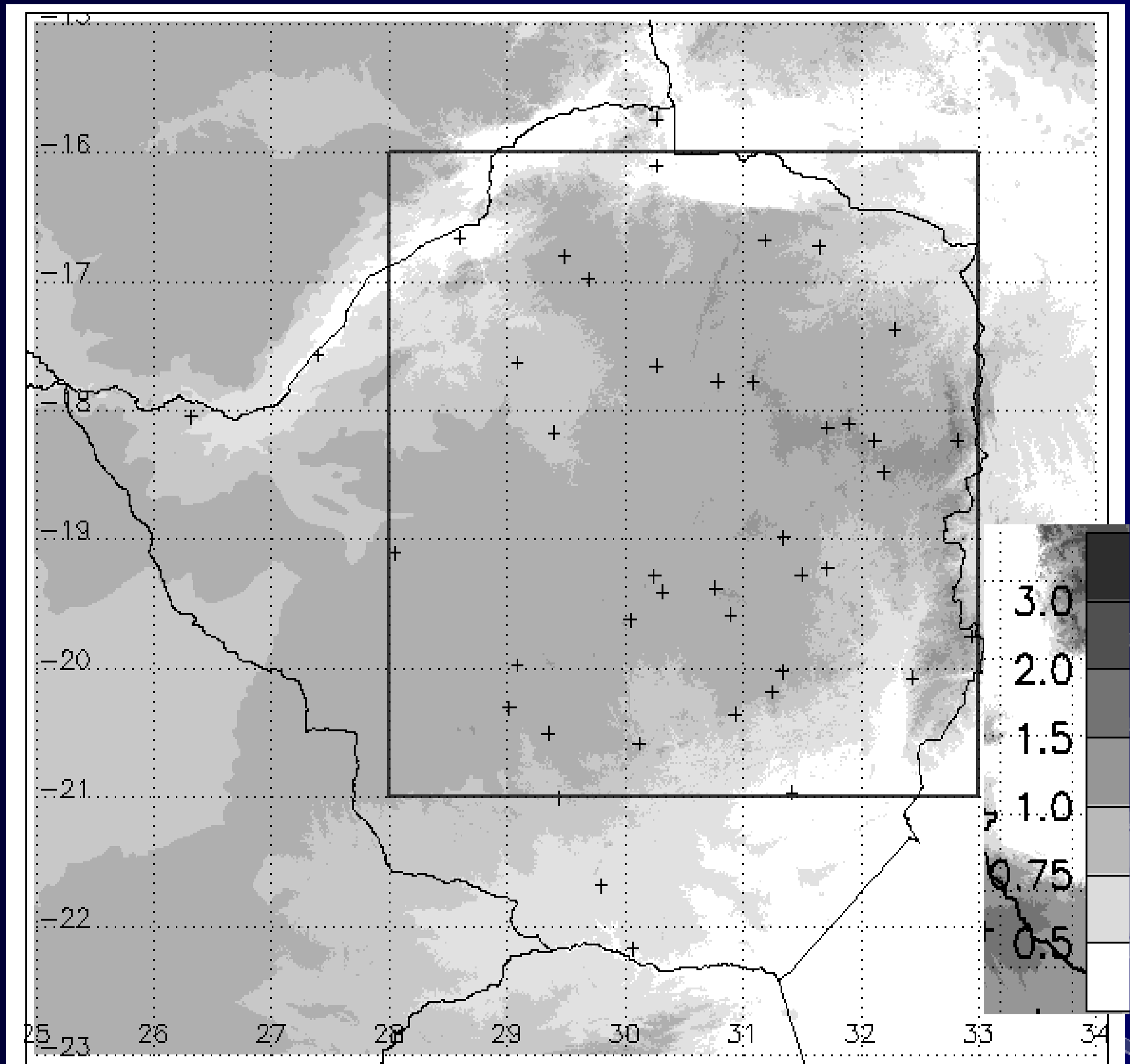
Rainfall threshold used: 1mm

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

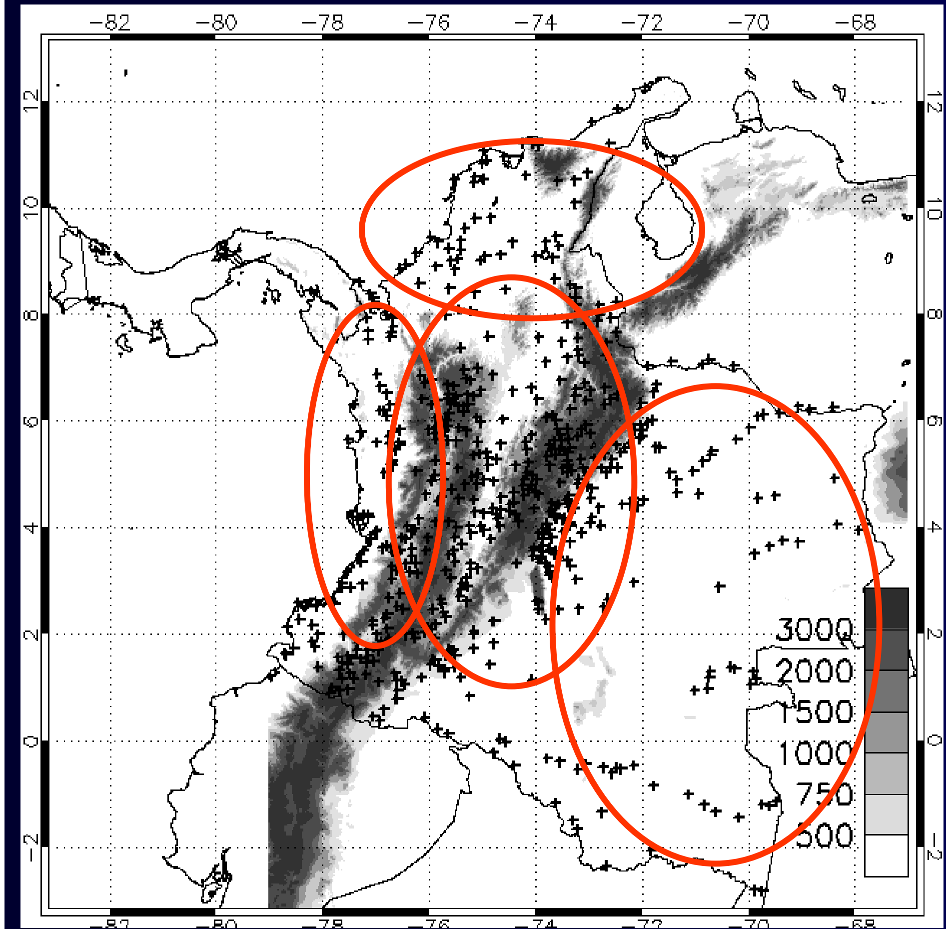
Validation over Zimbabwe

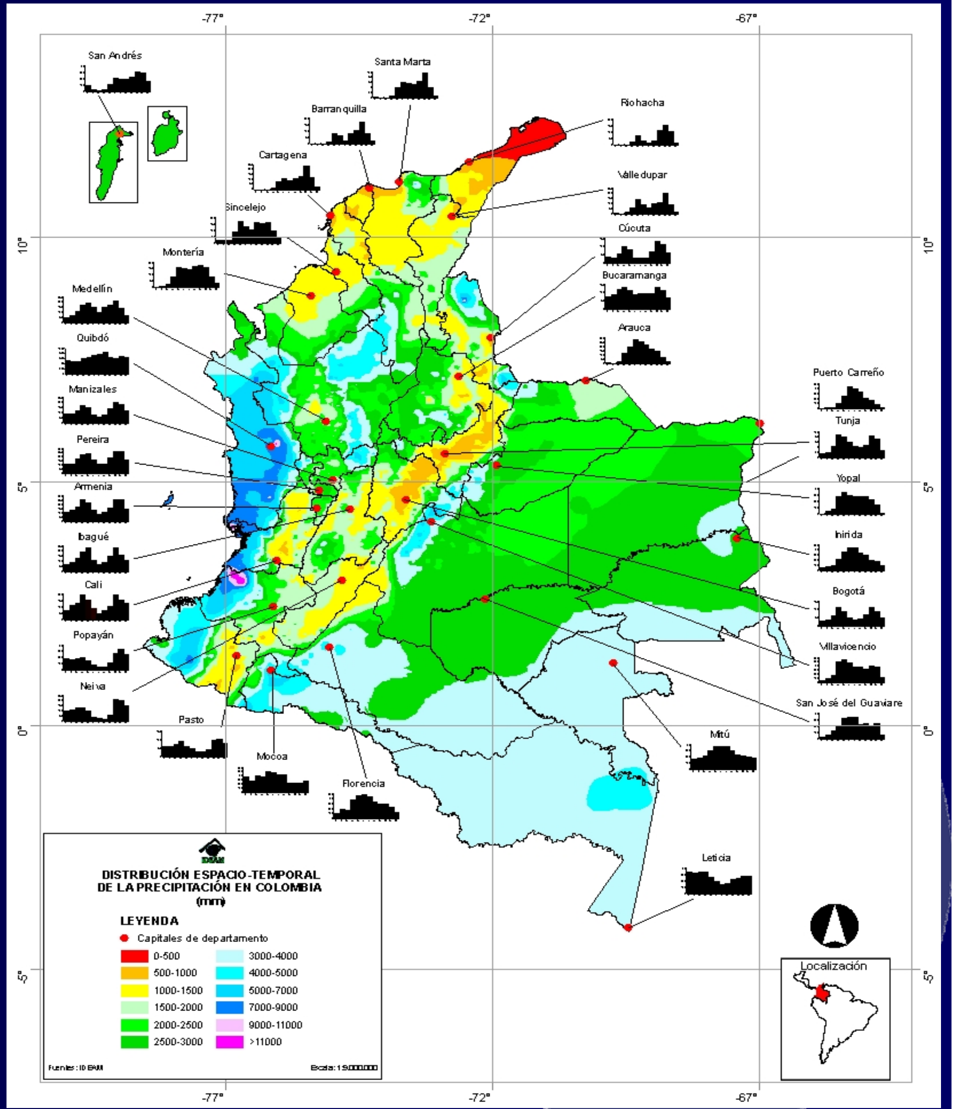


Validation over Zimbabwe

	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

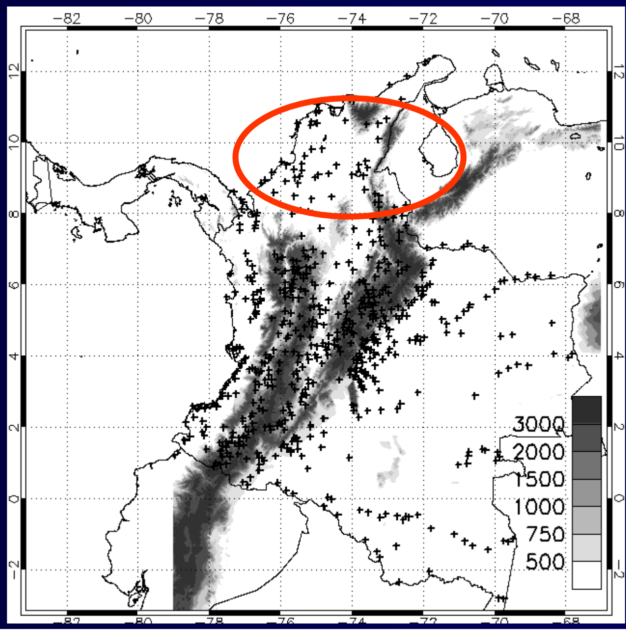
Validation over Colombia





Caribbean

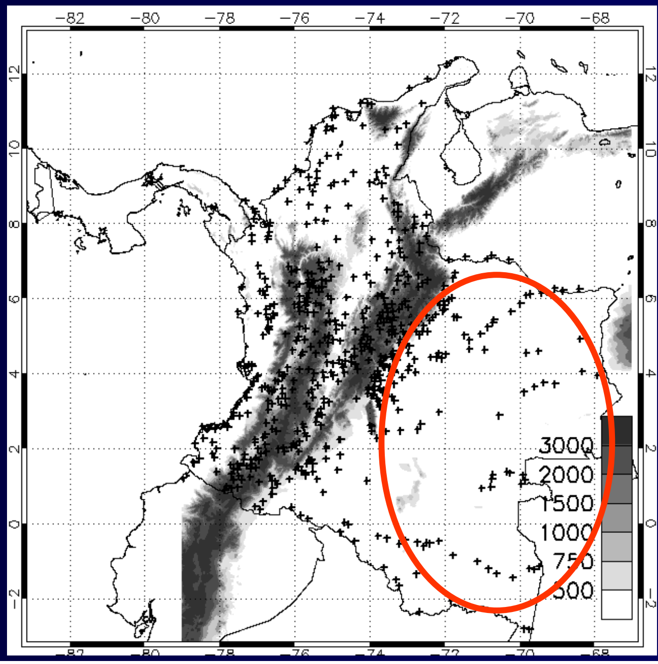
	NRL	3B42RT	3B42	CMORPH	GSMap+
CC	0.43	0.46	0.49	0.49	0.5
Bias	1.4	1.25	0.82	1.22	1.03
MAE	1.28	1.19	0.88	1.1	0.97
POD	0.75	0.67	0.73	0.75	0.75
FAR	0.24	0.17	0.23	0.22	0.18
HSS	0.53	0.54	0.52	0.55	0.59



Amazon

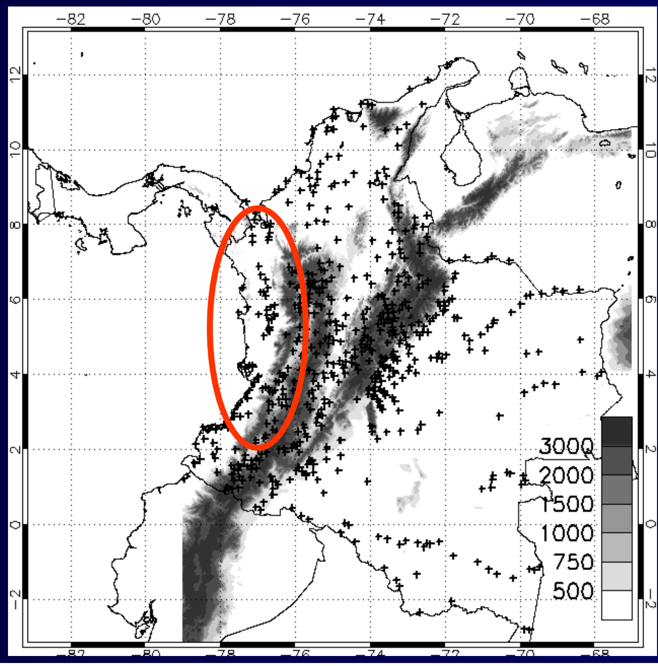
	NRL	3B42RT	3B42	CMORPH	GSMap+
CC	0.47	0.46	0.49	0.52	0.53
Bias	0.96	0.86	0.85	0.96	0.67
MAE	0.91	0.9	0.83	0.84	0.76
POD	0.71	0.67	0.73	0.77	0.72
FAR	0.12	0.11	0.12	0.12	0.1
HSS	0.50	0.47	0.52	0.55	0.52

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



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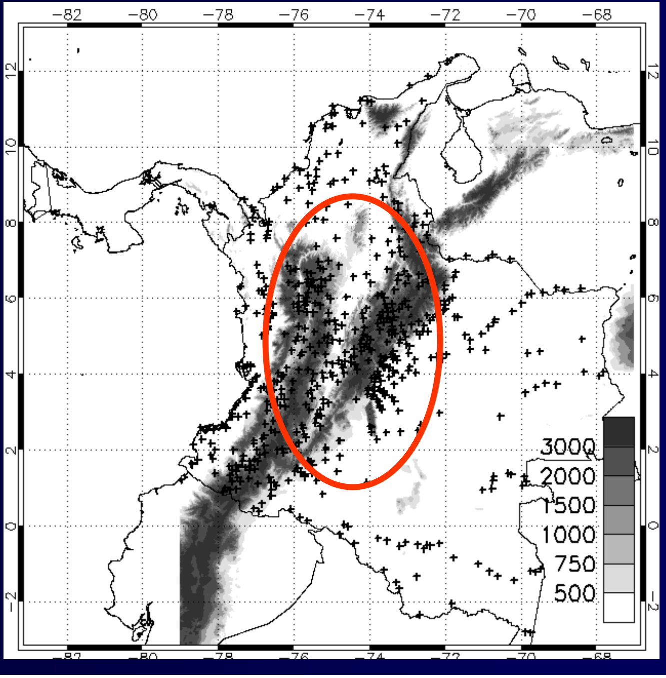
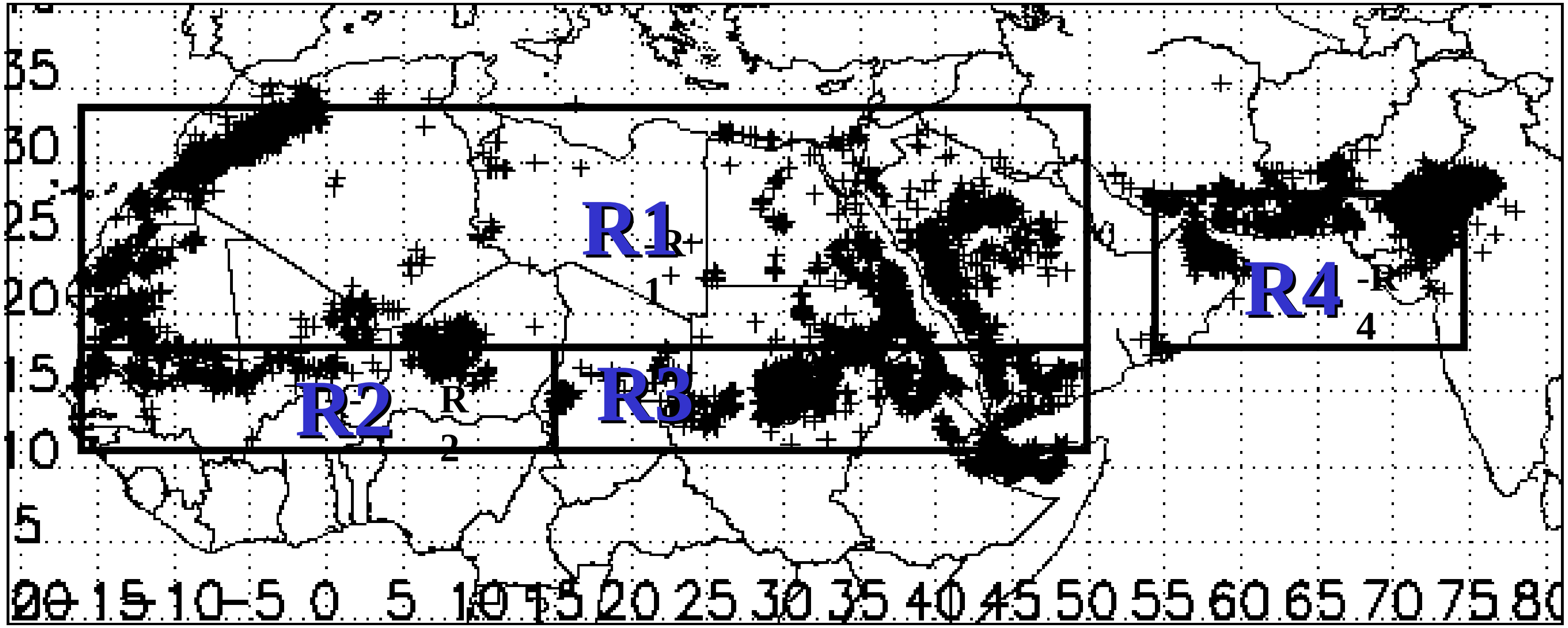
Highland

	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



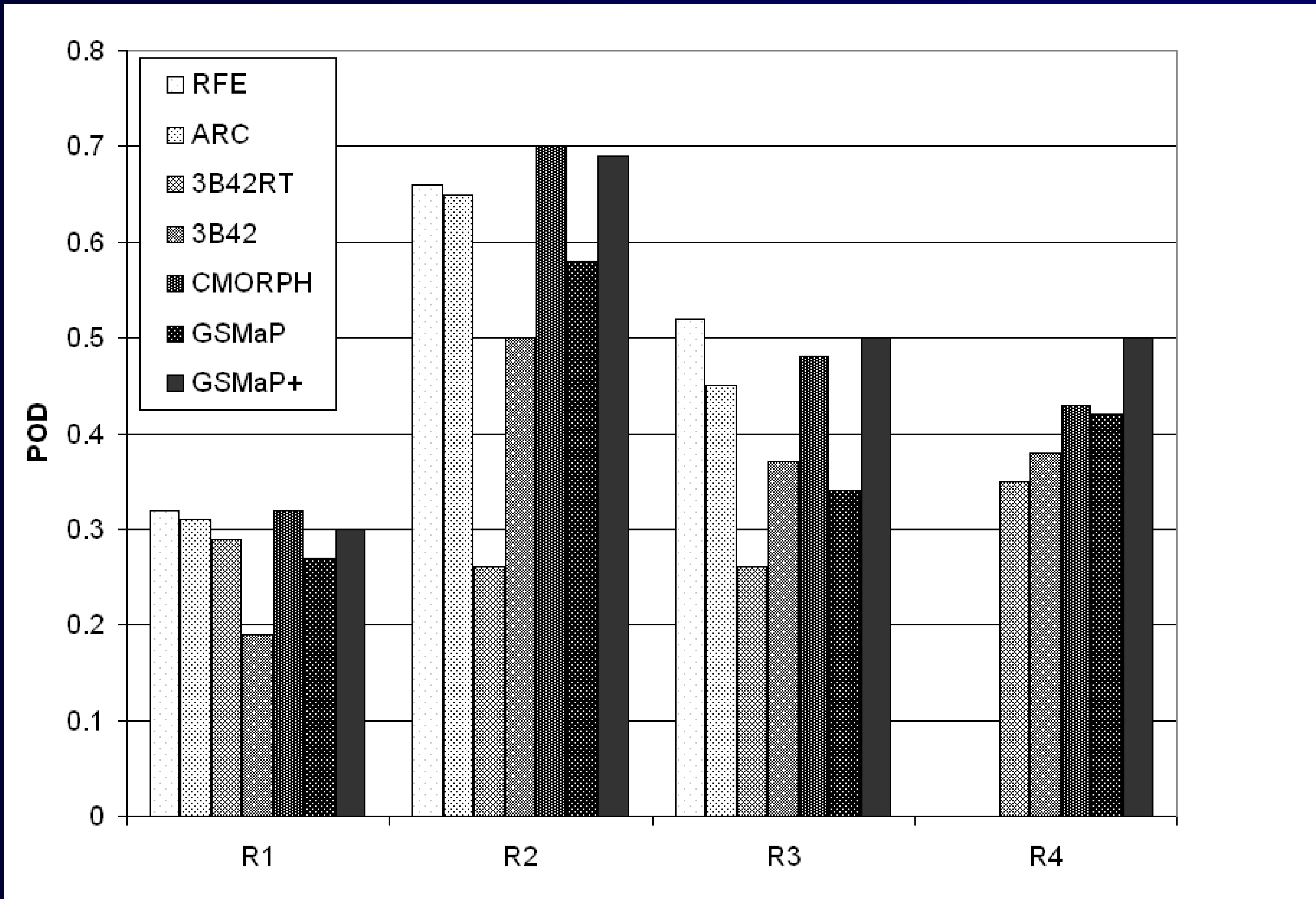
Validation over Desert Locust Regions



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

IRI

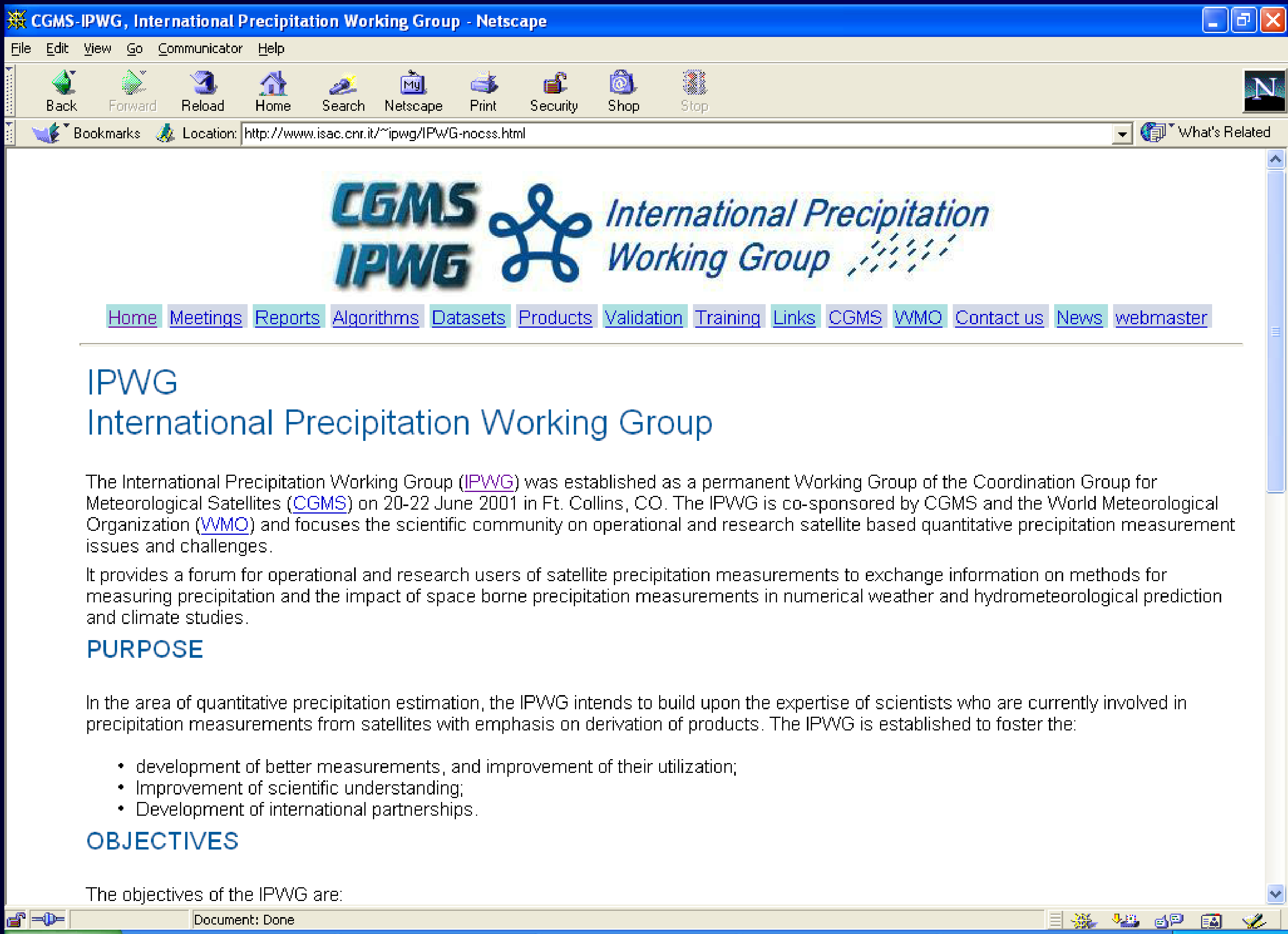
Validation over Desert Locust Regions



Rainfall threshold used: 0.5 mm

All about satellite rainfall estimation

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



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