

Spatio-temporal Analyses of correlation between NOAA Satellite RFE and Weather Stations' Rainfall Record in Ethiopia

Third UN SPIDER Meeting - Bonn



Ephrem Gebremariam **geo3**

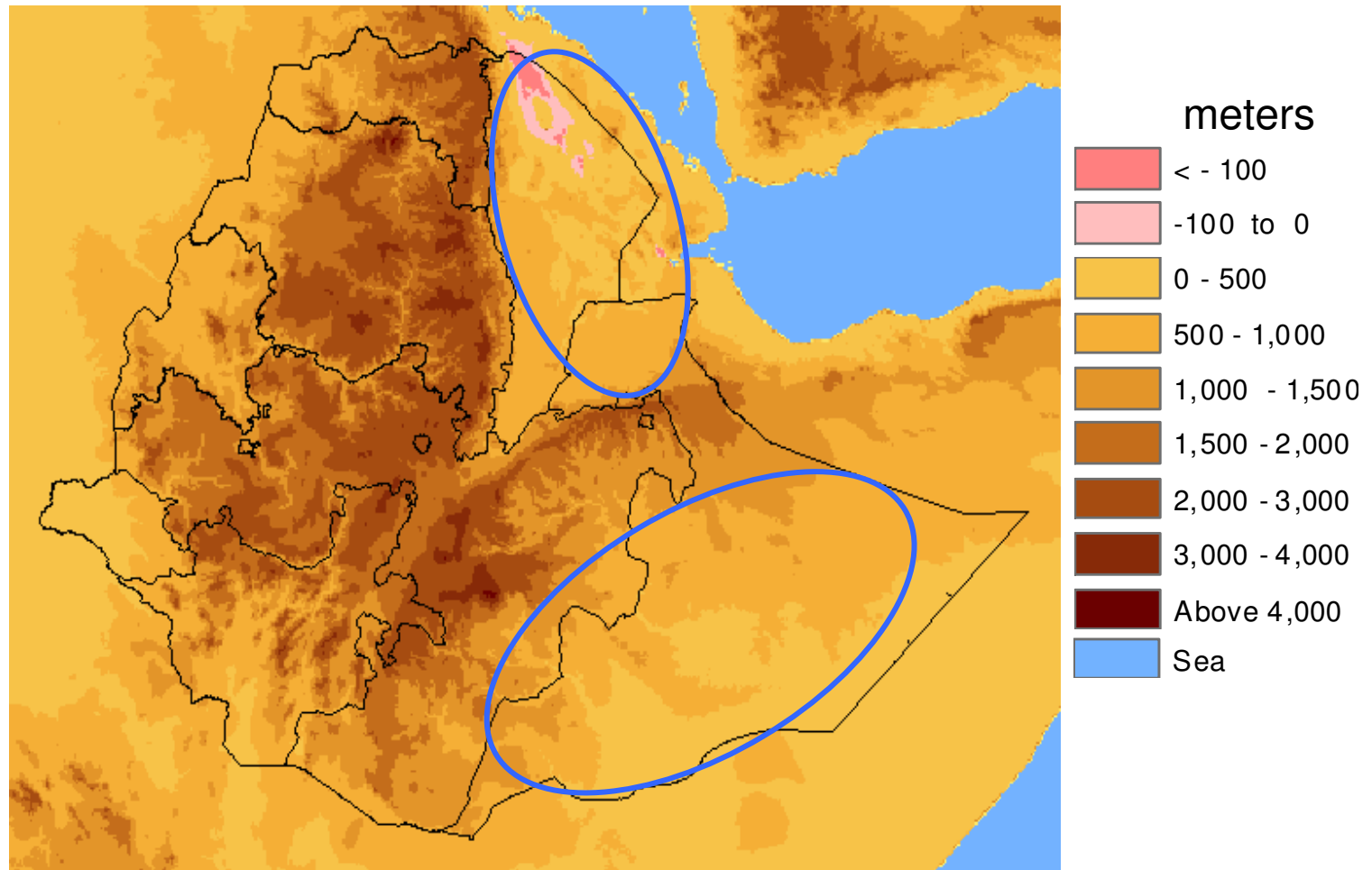


ESYSTEMS AFRICA

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Background

- East Africa and Great Altitudinal Variation



Background

- **East Africa and Great Altitudinal Variation**
- **Different Types Climatic Zones**
- **Dependent on rain-fed agriculture**
- **Erratic Rainfall causes famine**
- **Need For Advanced Early Warning**

Objectives and Significance

- **Correlation**

Rainfall Estimates (RFE)

Vs

Rainfall Records

- **Marking out Similarities and differences**
- **Well informed decisions during Planning and Early Warning**



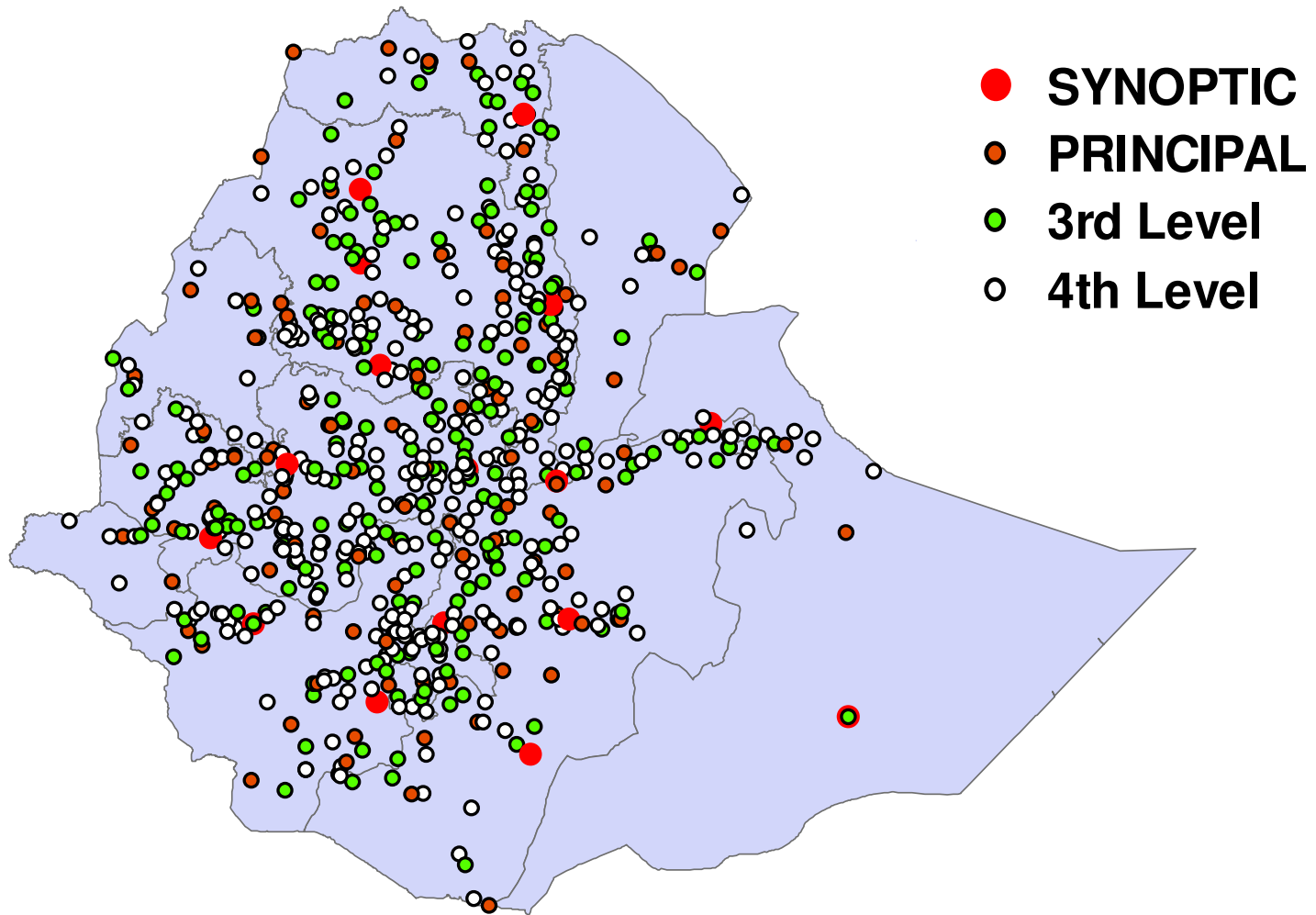
Data Sources

- **NMA National Meteorological Agency of Ethiopia**
 - **NOAA (National Oceanic and Atmospheric Administration)**
- 

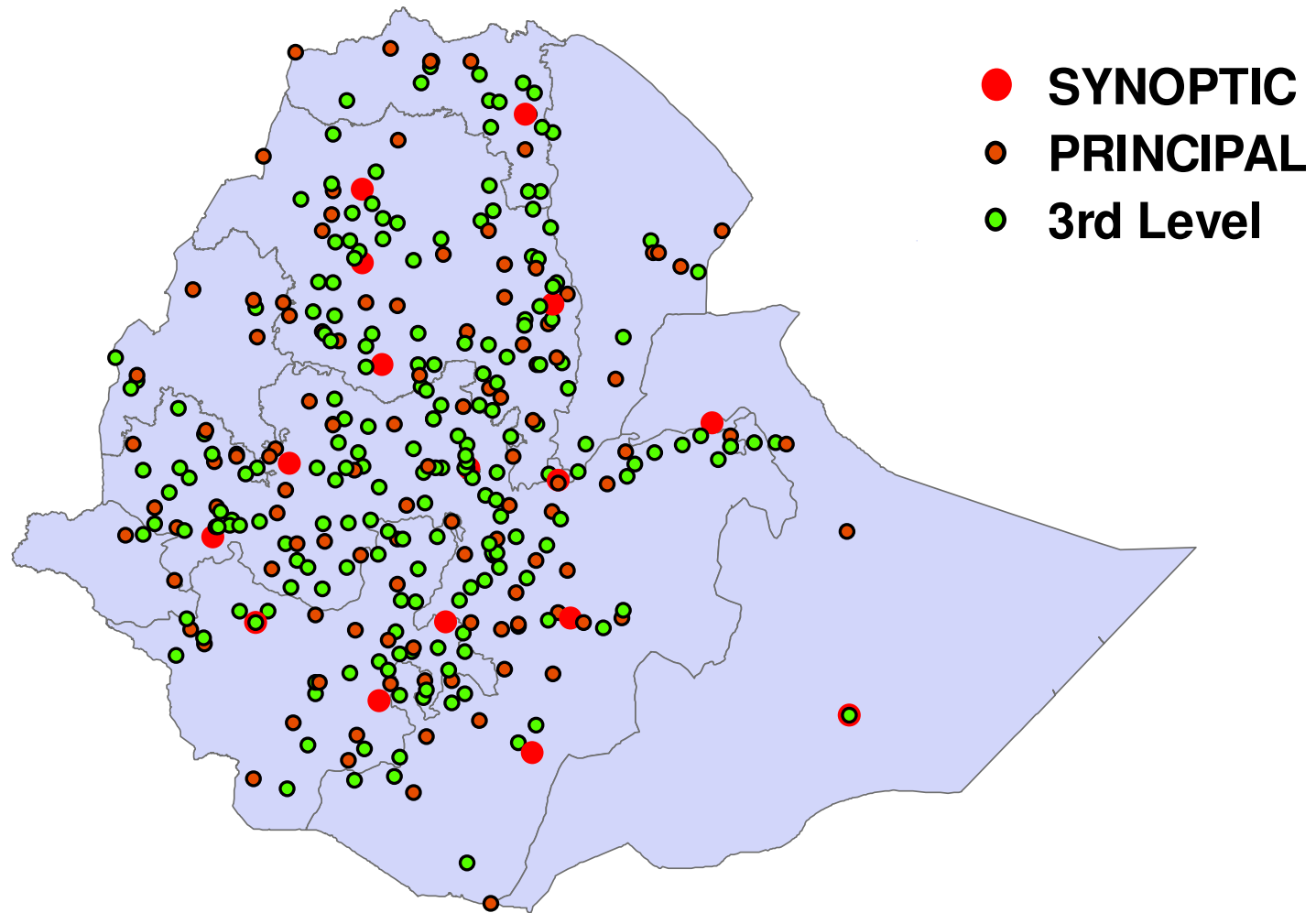
NMA Rainfall Records

- **Around 700 stations**
 - **Synoptic, Principal, 3rd and 4th Level**

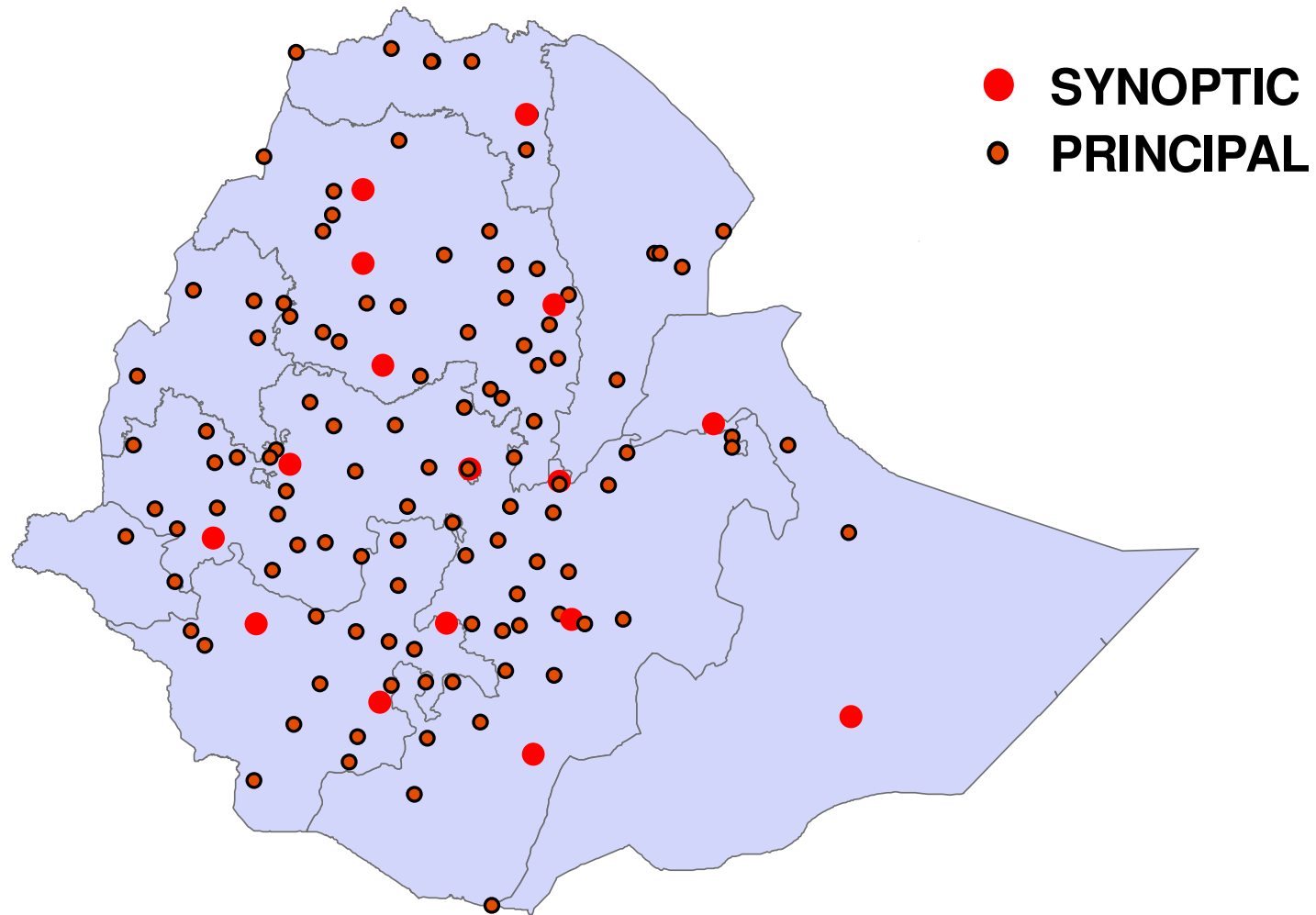
Stations Excluded



Stations Excluded



Stations Considered



NMA Rainfall Records

- **Around 700 stations**
 - **Synoptic, Principal, 3rd and 4th Level**
- **Up to 6 decades Meteorological data**
- **Data flow and Quality Control**

USGS RFE Images

- RFE 1.0 [meteosat, GTS & Warm Cloud Info.] (1995 – 2000)
- RFE 2.0 uses CCD & Station Rainfall data in addition. (2001 – Present)
 - 8 km resolution
 - Free download as a dekad (10 days) data from FEWSNET



Merit and Demerits

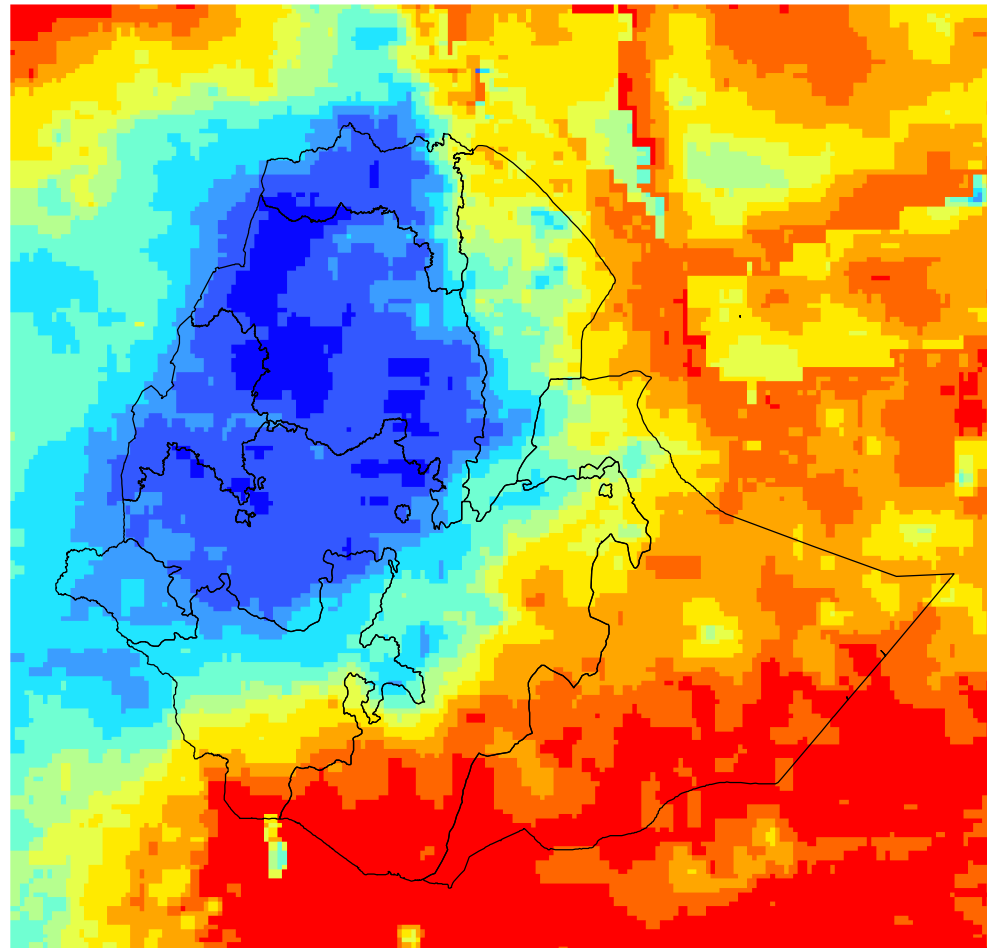
Advantages of RFE

- Spatial Coverage
- Dependable Timeliness

Advantages of Rainfall Records

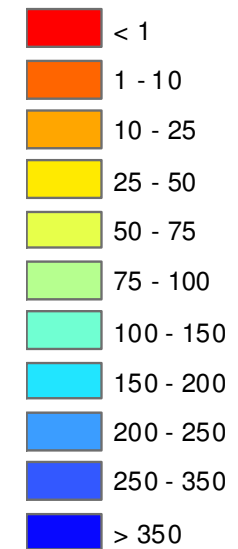
- Accuracy
 - Time Range
- 

RFE Image



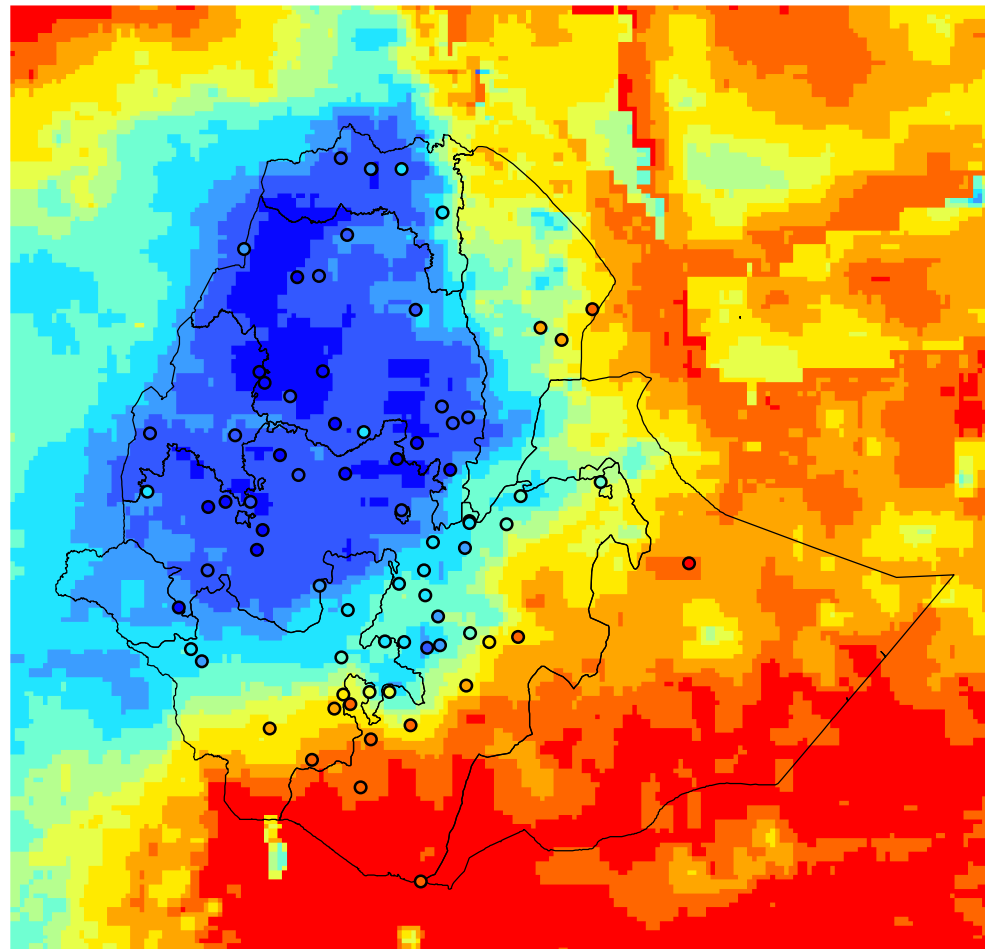
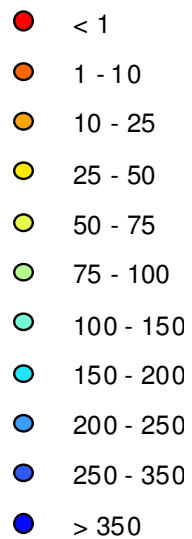
July
2006

RF in mm/Month



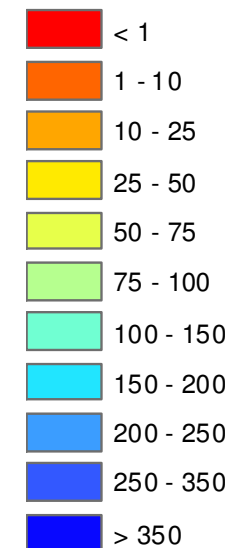
RFE Image & Stations Data

RF in mm/Month

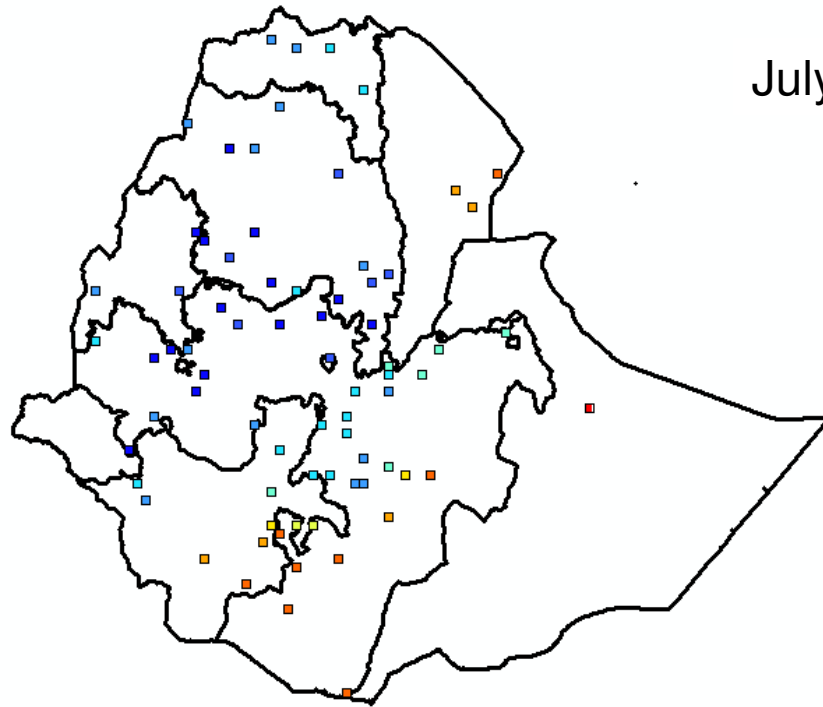


July
2006

RF in mm/Month

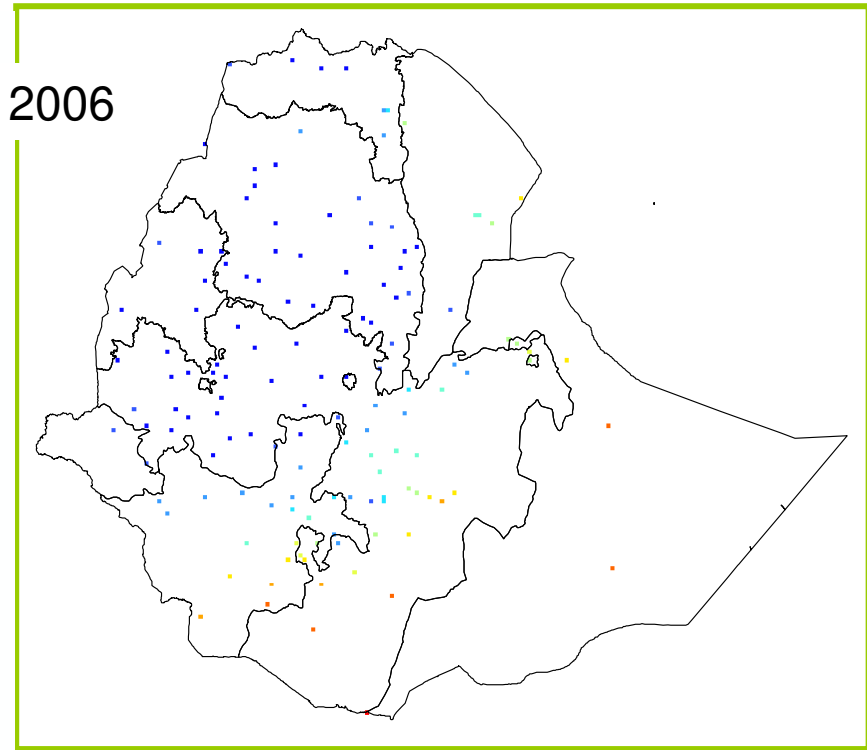


Station Data (Raster) & RFE samples



RF station data converted to Raster

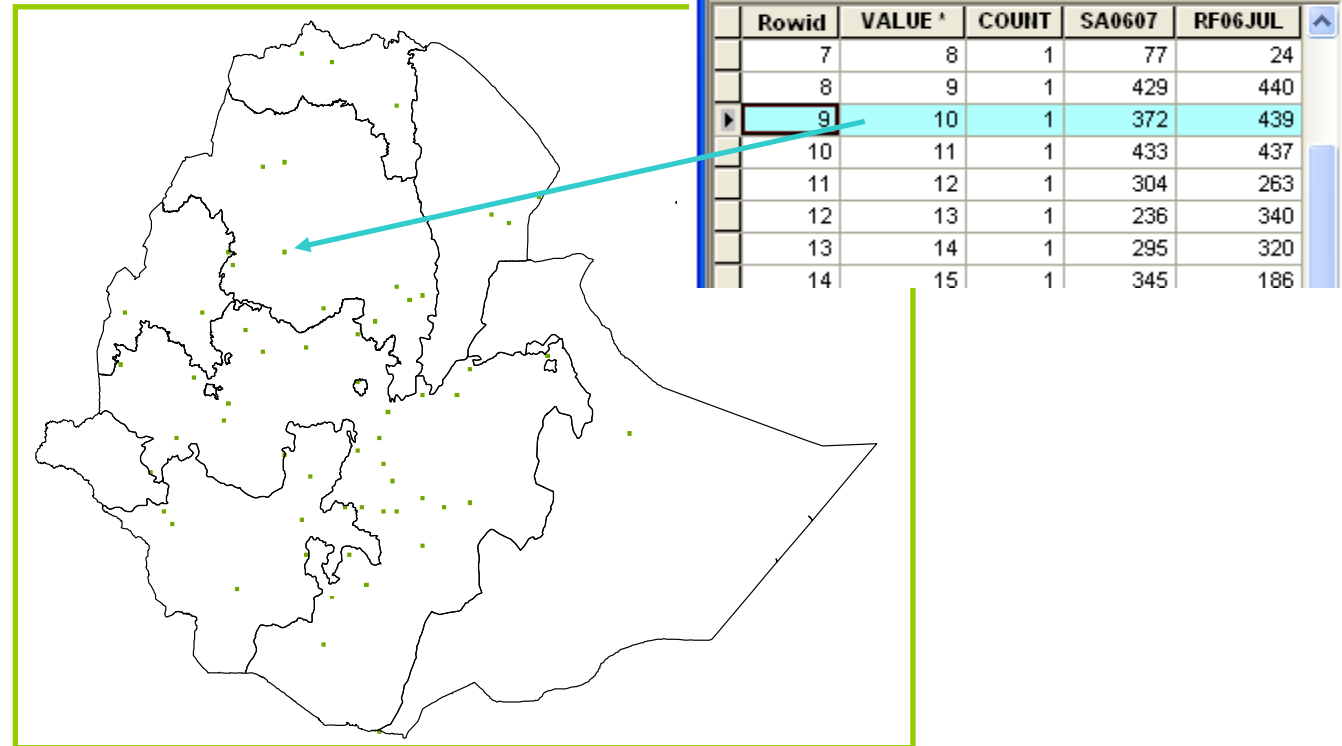
July 2006



Sample RF values are extracted

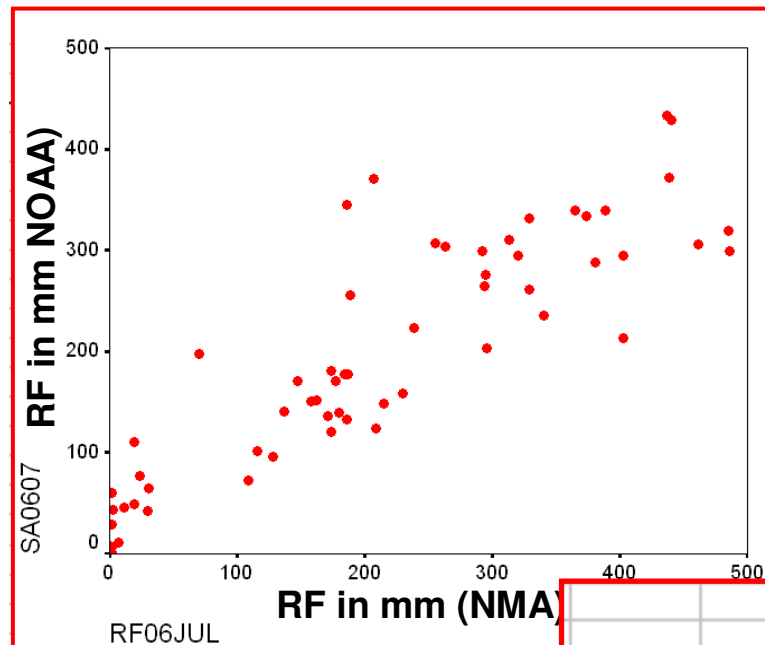


Combined Raster



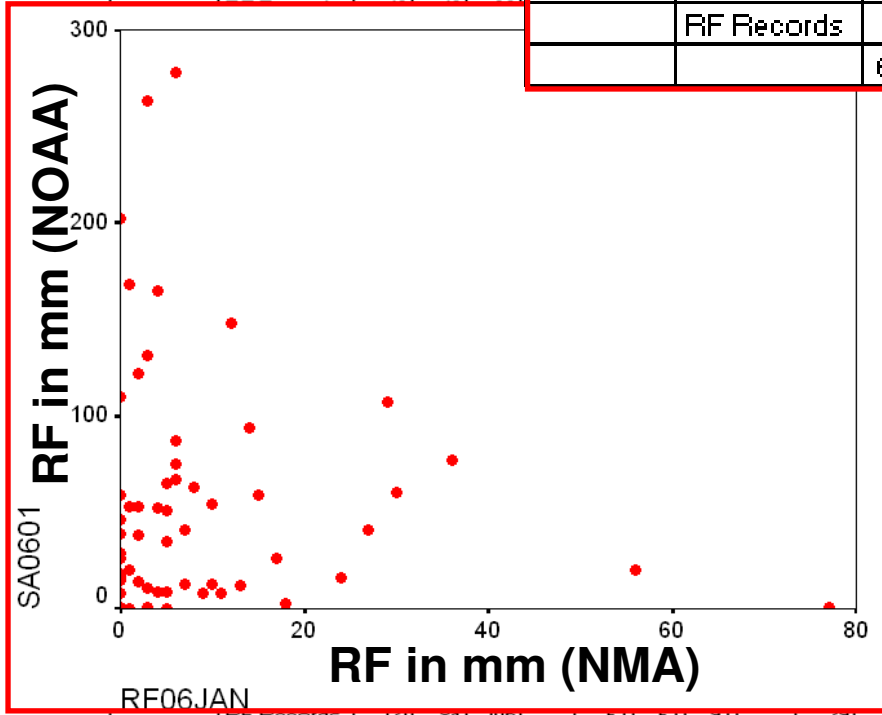
- 132 Combined Images
(Jan 96 to Dec 06)

Correlation Values

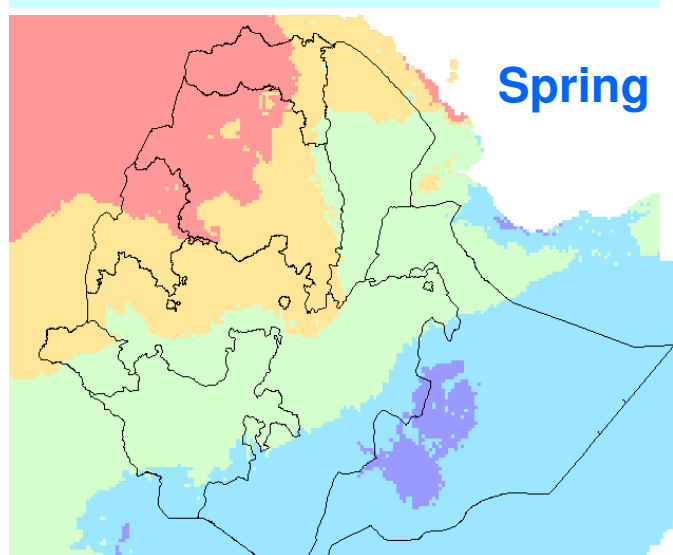
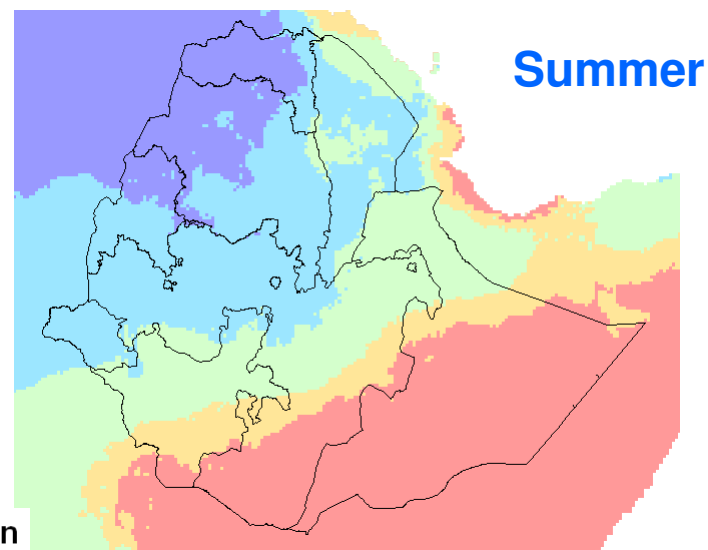
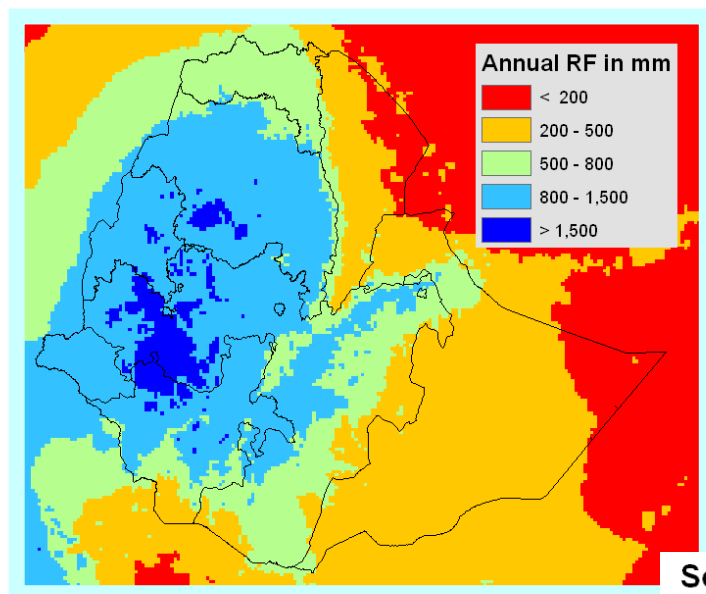


2003				2004				2005				2006			
SD	N	r	Mean	SD	N	r	Mean	SD	N	r	Mean	SD	N	r	Mean
11	75	0.38	34	34	97	0.61	26	52	74	0.25	53	59	67	-0.10	
20	75		31	30	97		28	23	74		8	13	67		
			103%				96%				630%				
20	98	0.71	24	18	96	0.28	8	9	65	0.05	34	30	74	0.51	
24			18	31	96		15	30	65		29	26	74		
			135%				55%				118%				
32	104	0.59	31	20	101	0.35	64	34	103	0.67	65	49	84	0.76	
37	104		39	45	101		79	44	103		67	56	84		
			73%				82%				96%				
69	107	0.77	109	53	104	0.64	70	44	102	0.71	88	76	88	0.58	
79	107		112	65	104		88	71	102		106	106	88		
			97%				79%				83%				
61	105	0.76	76	73	101	0.85	141	71	99	0.59	125	89	78	0.82	
64	105		70	77	101		143	100	99		120	88	78		
			103%				98%				104%				
101	109	0.82	59	47	105	0.78	73	82	98	0.86	103	70	80	0.81	

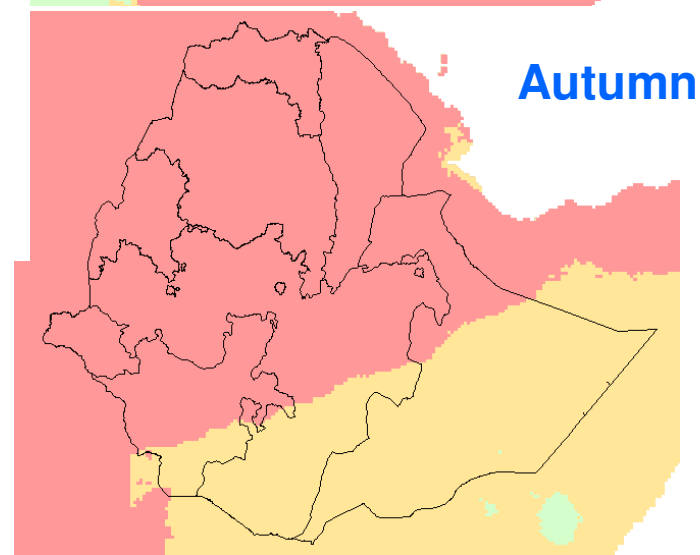
		RF in mm (NMA)																							
RF06JUL								2006																	
								Mean				SD				N				r					
Jul	RFE	223	145	102		173	Jul	RFE	199	117	73	0.86					192	118	98		133	106	80		
	RF Records																55%				77%				
	Difference	52%				65%											148	77	91	0.75	199	117	73	0.86	
Aug	RFE	102	65	106	0.63	109											206	117	91		214	146	73		
	RF Records																72%				93%				
	Difference																98	56	91	0.66	179	83	85	0.76	
	RF Records	215	116	106		192	108	109		219	110	110		199	113		192	113	91		231	122	85		
	Difference	48%				57%				63%				71%			51%				77%				
Sep	RFE	55	47	86	0.76	79	56	109	0.76	73	59	107	0.73	105	63	104	0.64	84	54	89	0.70	131	91	76	0.80
	RF Records	122	85			114	74	109		148	107	107		136	98	104		150	101	89		140	98	76	
	Difference	45%				63%				43%				77%				56%				34%			
Oct	RFE	54	47	105	0.74	60	57	97	0.71	49	44	100	0.55	51	39	99	0.53	54	33	94	0.40	104	62	69	0.55
	RF Records	121	84	105		67	67	97		39	37	100		71	46	99		69	68	94		126	98	69	
	Difference	45%				91%				126%				72%				79%				83%			
Nov	RFE	30	38	80	0.57	12	13	63	0.69	61	55	103	0.45	36	42	97	0.77	43	41	74	0.44	88	84	62	0.67
	RF Records	28	34	80		15	17	63		31	40	103		49	54	97		33	33			49	61	62	
	Difference	106%				81%				193%				74%				129%				180%			
Dec	RFE	10	17	72	0.39	40	49	96	0.69	38	37	98	0.40	21	31	67	0.69	17	17	35	-0.09	77	87	67	0.61
	RF Records	24	44	72		53	49	96		33	33	98		23	30	67		4	12	35		4			



Seasonal Rains



Seasonal Contribution



Similarities and Differences

High correlation during spring & summer and Low in winter

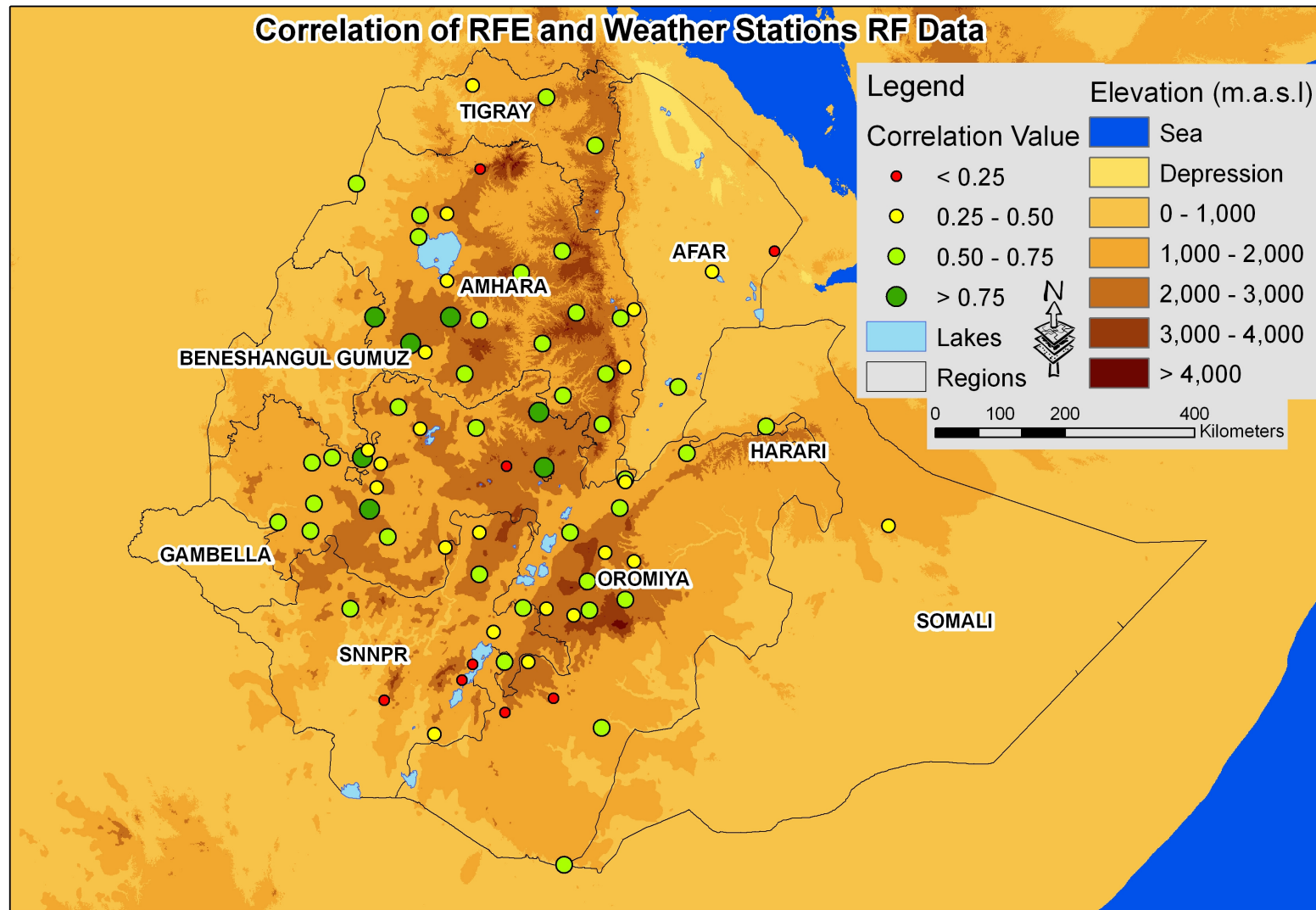
RFE 1.0		Min		Max		Average
	Spring	0.21	Apr '99	0.82	May '99	0.63
RFE 1.0	Summer	0.64	Aug '99	0.87	Jun '98	0.75
	Autumn	0.31	Nov '00	0.74	Oct '96	0.58
	Winter	-0.17	Feb '97	0.73	Jan '96	0.38
	Annual					0.58
RFE 2.0	Spring	0.35	Mar '04	0.87	May '04	0.67
	Summer	0.56	Aug '01	0.88	Jul'06	0.74
	Autumn	0.40	Oct '05	0.77	Nov '04	0.63
	Winter	-0.11	Jan '06	0.72	Feb '03	0.38
	Annual					0.60

Rainfall Amount

RFE 1 better similarity with NMA records than RFE 2

		Min		Max		Average
RFE 1.0	Spring	44%	Mar '97	119%	Mar '99	86%
	Summer	70%	Jun '00	127%	Jun '97	92%
	Autumn	40%	Nov '00	138%	Oct '96	79%
	Winter	14%	Dec '00	105%	Jan '99	63%
RFE 2.0	Spring	54%	Mar '01	108%	May '03	88%
	Summer	46%	Jun '04	108%	Jun '06	64%
	Autumn	45%	Sep '01	196%	Nov '03	94%
	Winter	38%	Jan '03	622%	Jan '06	133%

NOAA RFE and NMA RFR of Ethiopia



Discussion

- **Showed enough correlation for Early Warning Tasks caused by climatic variability but with some cautions.**
 - **Late Inception, Dry Spell and Early cessation of summer and spring rainfall.**
 - **Rainfall stresses in the lowland and pastoral parts of the country.**
 - **NOAA Need to revise certain RFE Images**

Information

- This article is published on International Journal of Applied Earth Observation and Geoinformation. (Will be available on www.sciencedirect.com in nov'09)

Ephrem G. Beyene
egmariam@esystems africa.com



Thank You