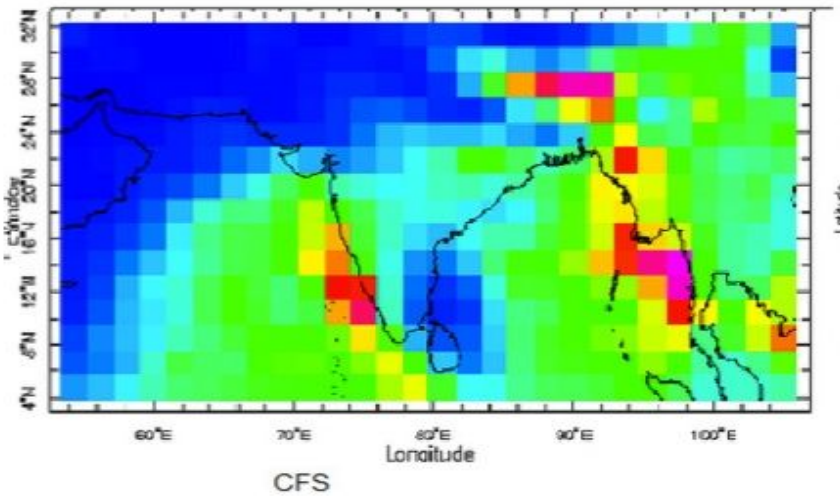
pa ipos
total development...

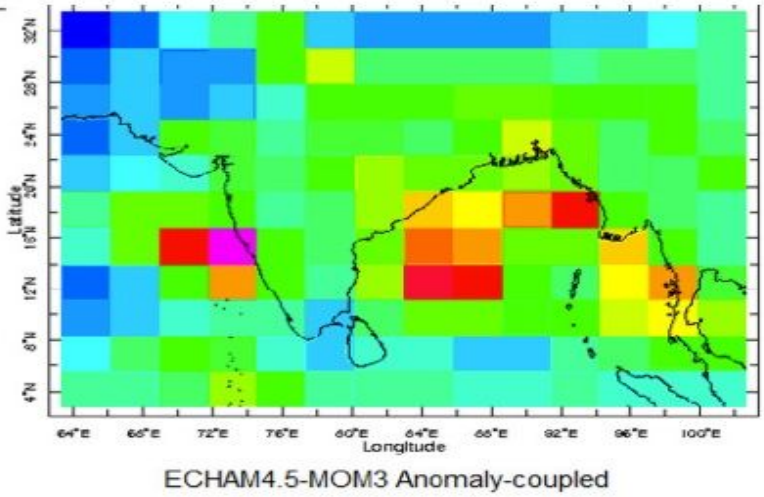
IRI International Research Institute for Climate and Society
EARTH INSTITUTE | COLUMBIA UNIVERSITY

CLIMATE CHANGE:

CLIMATE AND WEATHER PREDICTION



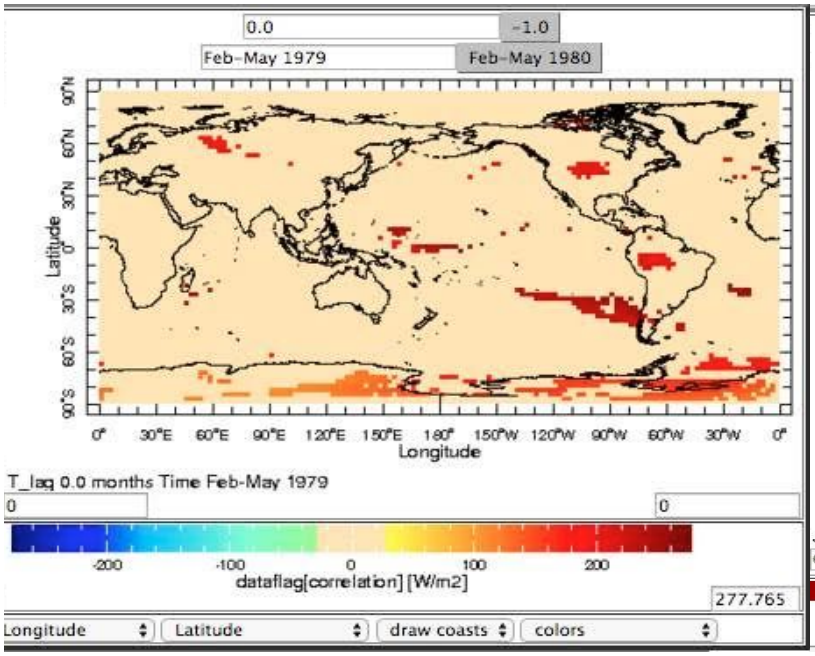
CFS



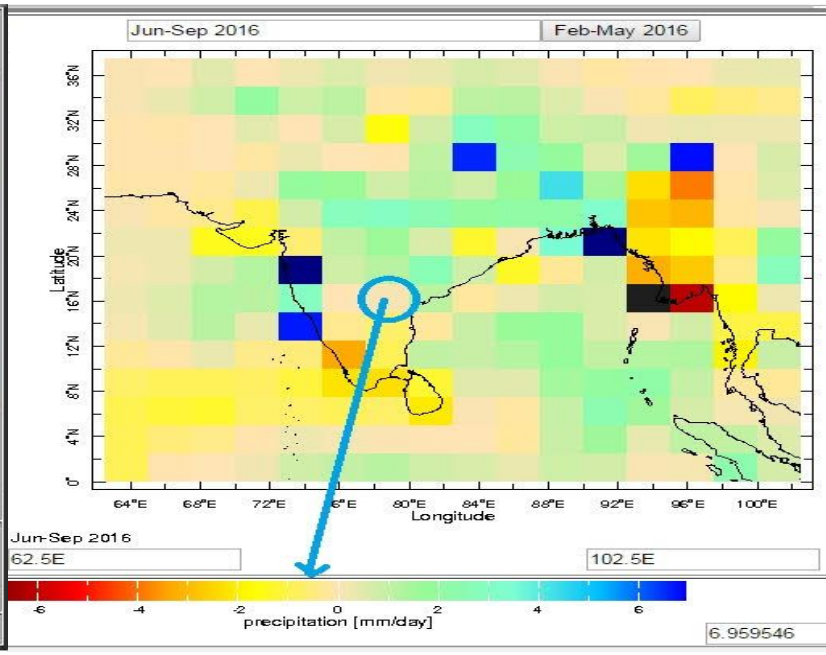
ECHAM4.5-MOM3 Anomaly-coupled

PREDICTION I: TOTAL SEASONAL RAINFALL

TECHNIQUE: KNN ON OUTGOING LONG RANGE RADIATION



Step I: Finding Predictors for Each State



Step II: Actual Rainfall Conditions

RESULTS: SEASONAL FORECASTS FOR 2017 MONSOON SEASON

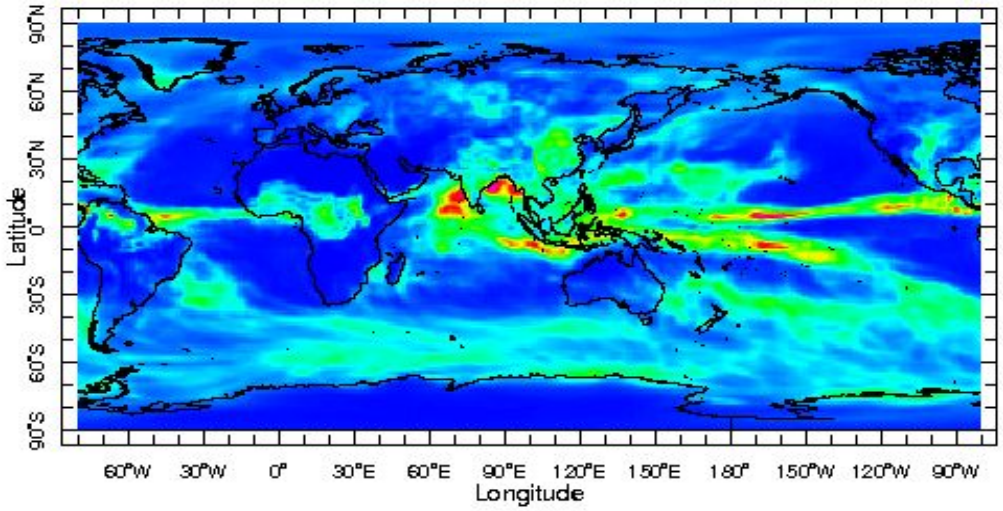
	Prediction Date	Aggressive Forecast	Conservative Forecast	Climatology Forecast	Actual Condition Monsoon Anomaly
Andhra Pradesh	**1 June**	**0.69**	0.50	0.42	1.00
	1 April	0.08	0.02	-0.02	
Assam	**1 June**	**-0.41**	-0.30	-0.28	-0.60
	1 April	0.723	0.689	0.571	
Bihar	**1 June**	**0.62**	0.46	0.31	1.03
	1 April	-0.433	-0.489	-0.272	
Chhattisgarh	**1 June**	**-0.33**	-0.15	-0.16	-0.32
	1 April	0.29	0.27	0.21	
Goa	**1 June**	0.27	0.34	**0.28**	-0.07
	1 April	-1.0	-0.8	-0.6	
Gujarat	**1 June**	**0.69**	0.73	0.39	0.96
	1 April	0.11	-0.08	-0.18	
Haryana	**1 June**	0.90	0.54	**0.31**	0.41
	1 April	-0.15	-0.13	-0.06	

Himachal Pradesh	**1 June**	**0.50**	0.43	0.37	0.58
	1 April	-0.89	-0.67	-0.55	
Jammu and Kashmir	**1 June**	**0.44**	0.41	0.27	0.44
	1 April	-0.05	-0.05	-0.02	
Jharkhand	**1 June**	**1.35**	0.94	0.63	1.60
	1 April	0.36	0.40	0.19	
Karnataka	**1 June**	**1.19**	0.89	0.63	1.17
	1 April	-0.79	-0.15	-0.08	
Kerala	**1 June**	1.16	1.30	**0.87**	0.25
	1 April	1.89	1.39	0.84	
Madhya Pradesh	**1 June**	**-0.68**	-0.28	-0.20	-0.90
	1 April	-0.19	-0.20	-0.16	
Maharashtra	**1 June**	**0.744**	0.520	0.401	1.07
	1 April	0.34	0.34	0.12	
Odisha	**1 June**	-0.07	**-0.19**	-0.11	-0.80
	1 April	-0.47	-0.44	-0.35	
Punjab	**1 June**	0.82	**0.62**	0.38	0.62
	1 April	0.21	0.23	0.14	
Rajasthan	**1 June**	**0.33**	0.17	0.11	0.38
	1 April	0.43	0.17	0.17	
Tamil Nadu	**1 June**	0.22	0.13	**0.00**	-0.40
	1 April	-0.43	-0.50	-0.34	
Telangana	**1 June**	**-0.28**	-0.32	-0.26	-0.21
	1 April	0.79	0.83	0.63	
Uttar Pradesh	**1 June**	1.29	1.20	**0.88**	0.89
	1 April	-0.44	-0.45	-0.35	
Uttarakhand	**1 June**	**2.40**	2.10	1.39	2.85
	1 April	-0.95	-1.04	-0.85	
West Bengal	**1 June**	**0.94**	0.58	0.33	1.06
	1 April	0.01	0.02	0.01	
NorthEast	**1 June**	0.37	**0.04**	0.15	0.01
	1 April	-1.17	-0.95	-0.54	
Andamans	**1 June**	-0.06	0.00	-0.07	0.00
	1 April	-0.11	-0.03	-0.01	

PREDICTION II: TIME SERIES RAINFALL FORECAST

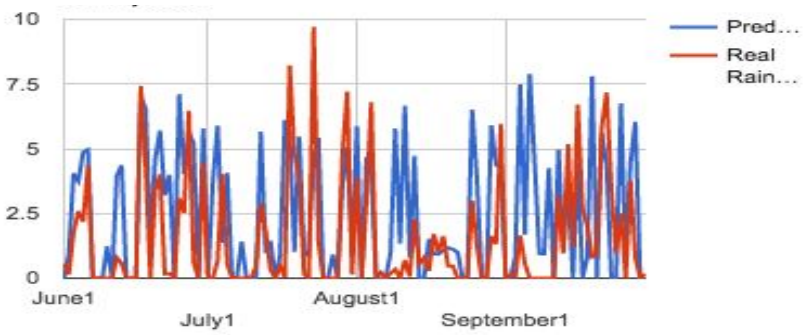
TECHNIQUE: GCM DOWNSCALING

GCM Downscaling: Temporal Rainfall At District Scale Resolution Prediction (June 1). The GCM used in this process is a model from COLA model



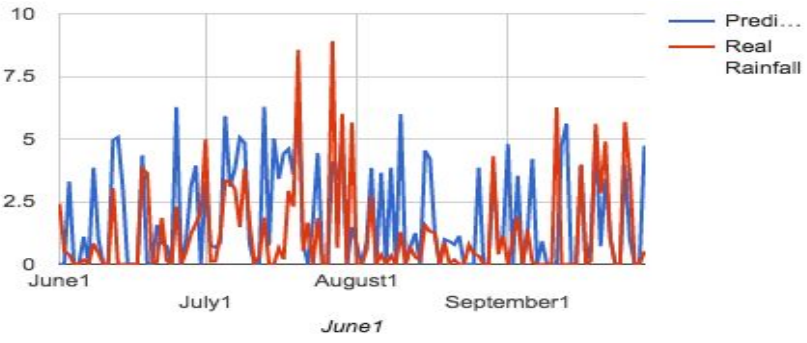
M 3.0 L 0.5 months S 0000 1 Jun 2016

RESULTS FOR 2017 MONSOON SEASON



PREDICTED VS REAL RAINFALL Lat:Lon 17.5,77.5

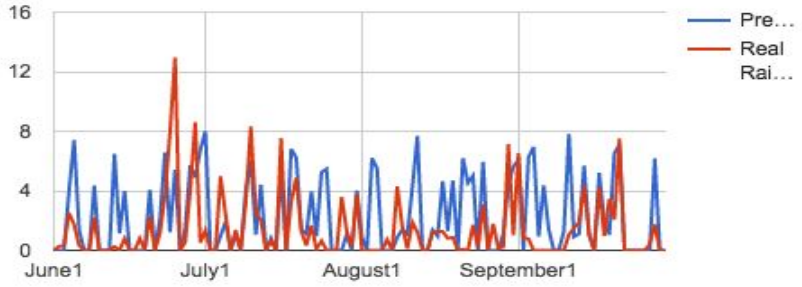
TS	MAD	MSE	RMSE	MAPE
67.455	1.66	5.91	2.436	48.77
		Covariance Matrix		
		6.17	2.93	
Correlation 0.548		2.93	4.76	



PREDICTED VS REAL RAINFALL Lat:Lon 17.5,78.5

TS	MAD	MSE	RMSE	MAPE
54.79	1.357	4.351	2.08	43.98
		Covariance Matrix		
		4.087	1.741	
Correlation 0.46		1.741	3.386	

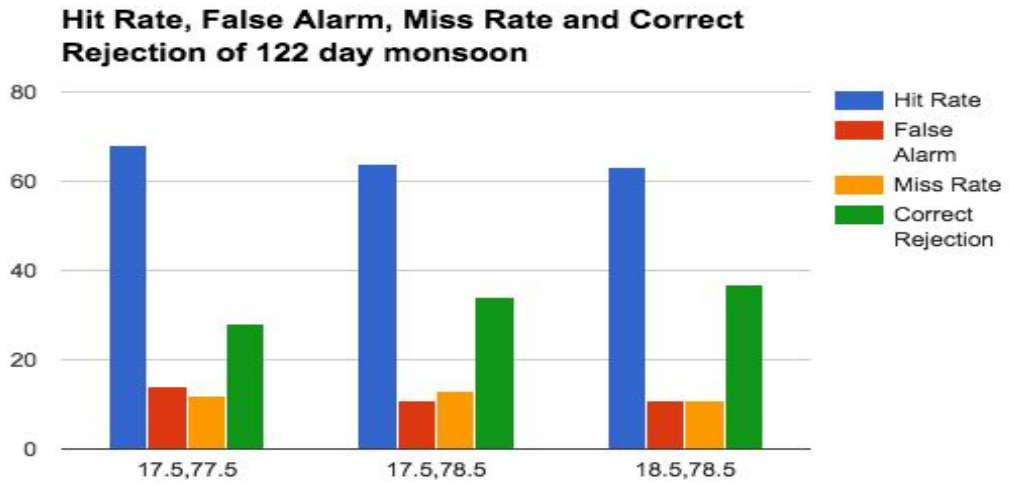
Pred 17.5, 78.5 vs Real Conditions



PREDICTED VS REAL RAINFALL Lat:Lon 18.5,78.5

TS	MAD	MSE	RMSE	MAPE
63.32	1.69	7.31	2.70	49.104
		Covariance Matrix		
Correlation		6.77	2.651	
	0.454	2.651	5.09	

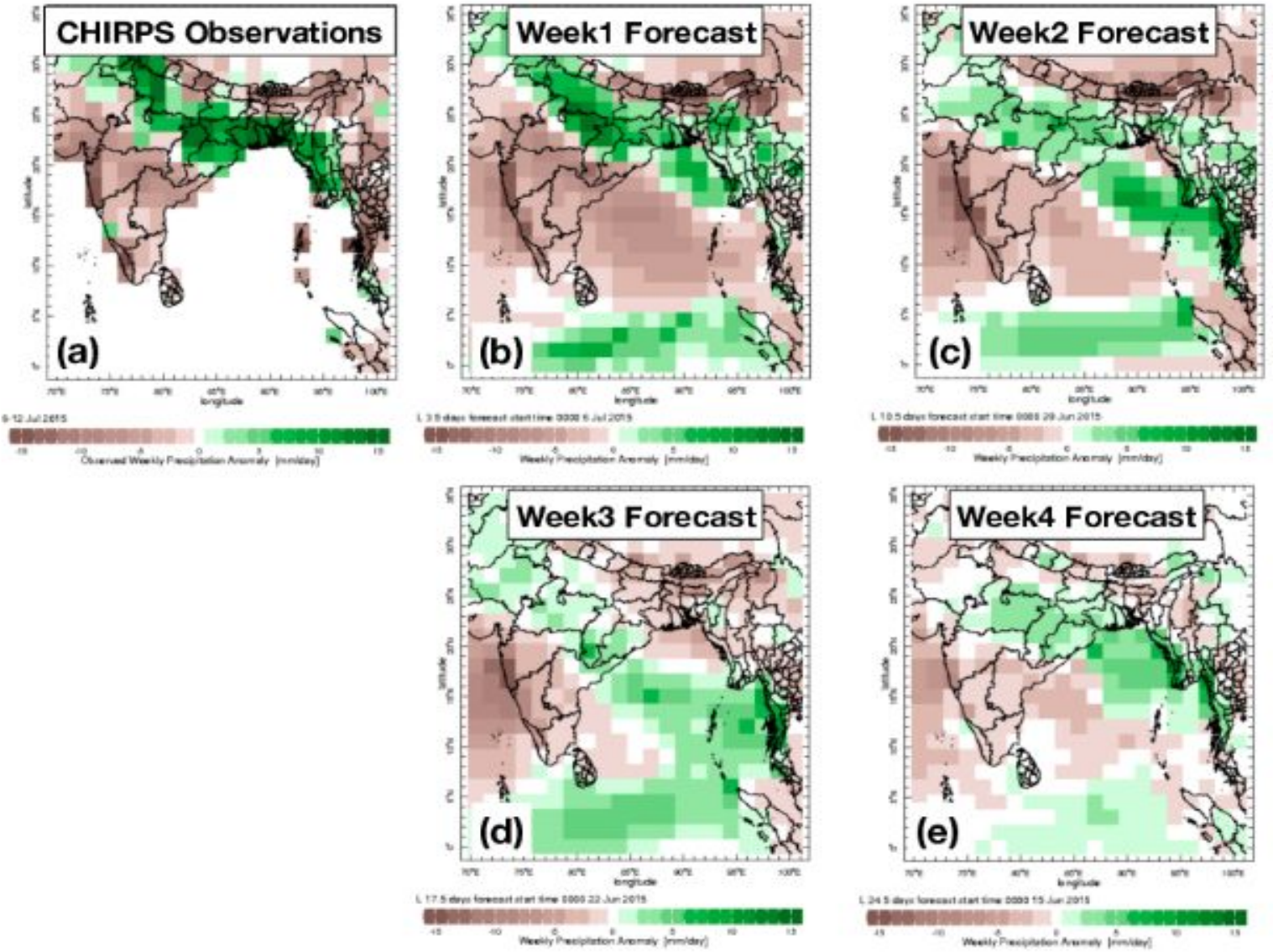
Comparison: The predictions are compared with values generated by gauge data provided by IMD and also compared with NOAA NCEP CPC UNIFIED_PRCP GAUGE_BASED which they correct using satellite data of cloud cover.The measured and predicted are for little different locations (so one could see little shift) but the pattern is recognizable. So the model has a good hit rate as could be seen.



PREDICTION III: IN-SEASON WEATHER FORECAST

TECHNIQUE: WWRP/WCRP SUB-SEASONAL TO SEASONAL PREDICTION

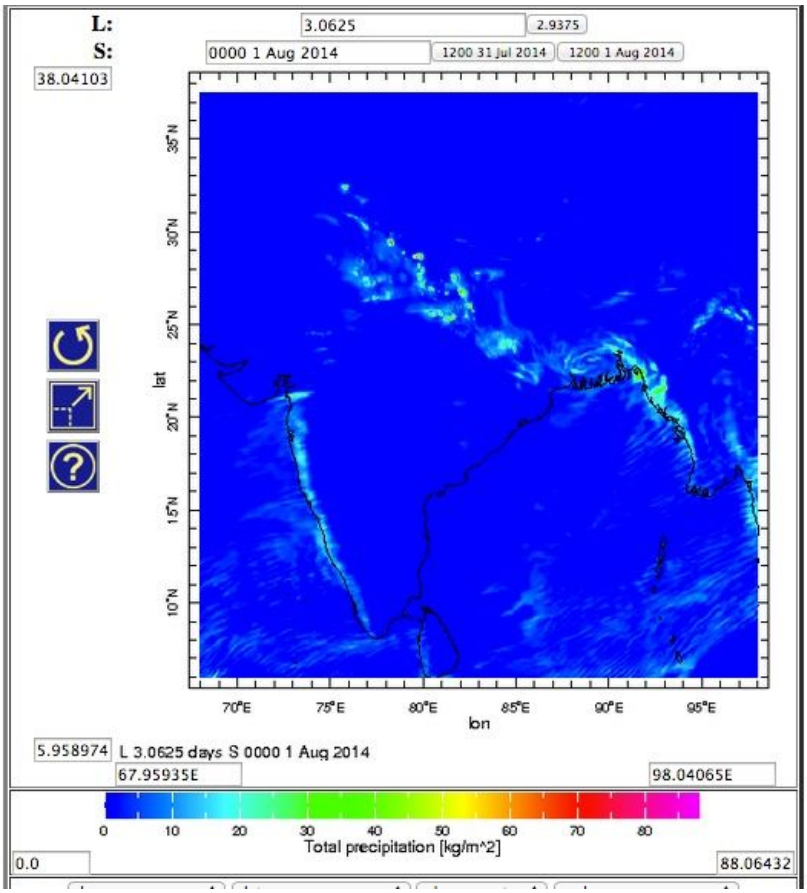
- Weather Within Climate: This is the short term prediction at weekly scale that uses the ECMWF product.
- This helps predict any changes within a season due to any event.



PREDICTION IV: SHORT TERM (3-7 Day) FORECAST

TECHNIQUE: WRF MODELS

WRF Predictions: This is the short term prediction of three day scale that uses the WRF product.



This message is given to the farmers so that they might not irrigate or put fertilizer in the field.

SMS Message

ਪੰਜਾਬ ਖੇਤੀਬਾੜੀ ਯੂਨਿਵੇਰ੍ਸਿਟੀ ਕਲ ਨੂ ਤੁਹਾਡੇ ਪਿੰਡ ਵਿਚ ਬਾਰਿਸ਼ ਹੋਣ ਦੀ ਜਾਣਕਾਰੀ ਦਿੰਦੀ ਹੋਈ, ਪਾਣੀ ਨਾ ਲਾਉਣ, ਖਾਦਾਂ ਅਤੇ ਸਪ੍ਰੇ ਨਾ ਪਾਉਣ ਦੀ ਸਿਫਾਰਿਸ਼ ਕਰਦੀ ਹੈ|

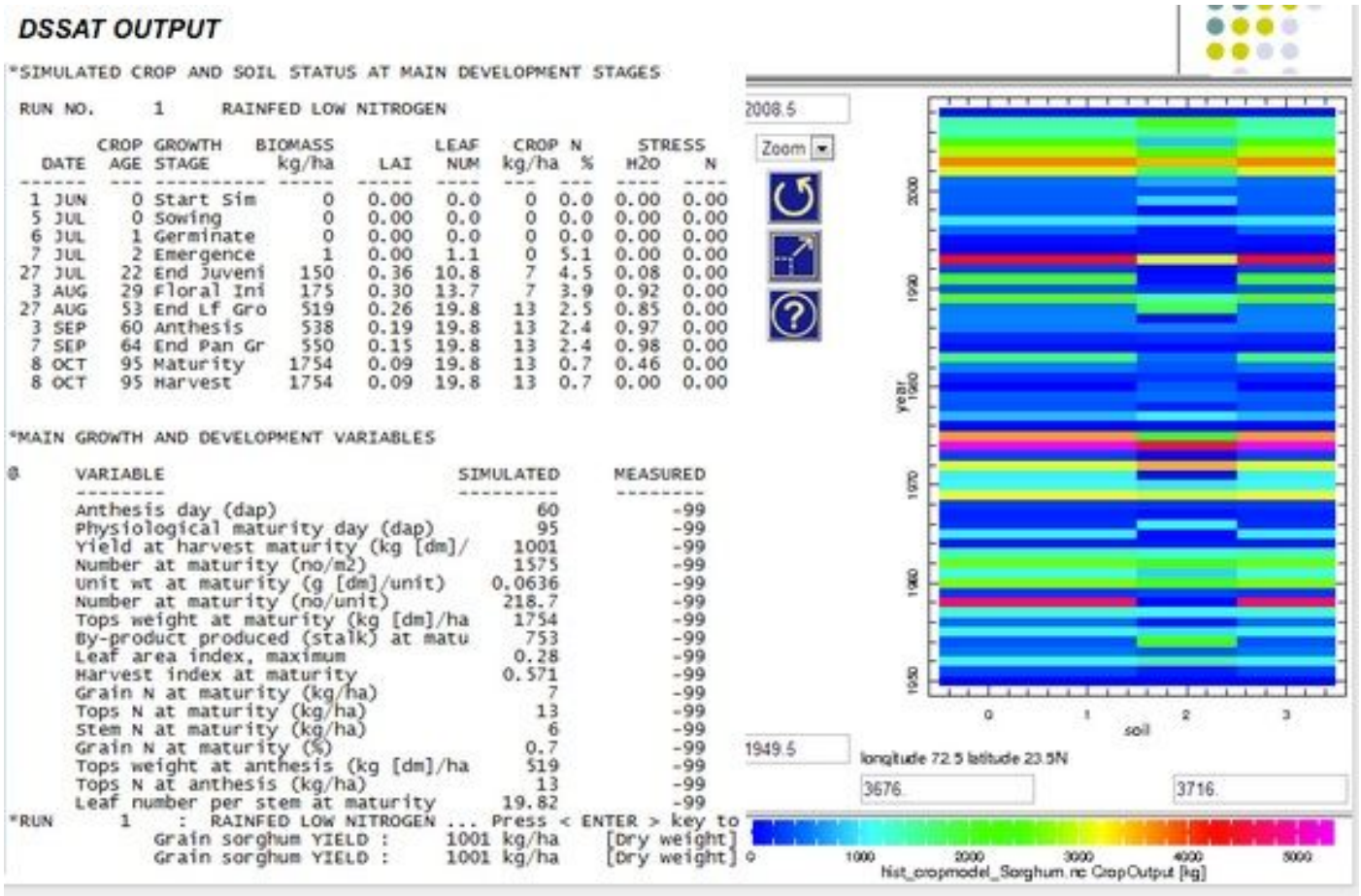
Voice Message

ਸਤ ਸ੍ਰੀ ਅਕਾਲ | ਪੰਜਾਬ ਖੇਤੀਬਾੜੀ ਯੂਨਿਵੇਰ੍ਸਿਟੀ ਲੁਧਿਆਣਾ ਆਪਦਾ ਸਵਾਗਤ ਕਰਦੀ ਹੈ| ਕਲ ਤੁਹਾਡੇ ਪਿੰਡ ਵਿਚ ਬਾਰਿਸ਼ ਹੋਣ ਦੀ ਕਾਫੀ ਸੰਭਾਵਨਾ ਹੈਂ | ਸੋ ਯੂਨਿਵੇਰ੍ਸਿਟੀ ਪਾਣੀ ਨਾ ਲਾਉਣ ਦੀ ਸਿਫਾਰਿਸ਼ ਕਰਦੀ ਹੈਂ| ਫਾਸਲ ਵਿਚ ਕਲ ਨੂ ਖਾਦ ਨਾ ਪਾਈ ਜਾਵੇ, ਸਪ੍ਰੇ ਵੀ ਮੌਸਮ ਠੀਕ ਹੋਣ ਤੇ ਕੀਤੀ ਜਾਵੇ |

PREDICTION V:PREDICTING CROP BEHAVIOR

TECHNIQUE: GCM DOWNSCALING AND CROP MODEL INTEGRATION

- This is a seasonal scale prediction of how the crops will behave over the monsoon season.
- The inputs to the model are predicted time series of rainfall, minimum and maximum temperatures, solar radiation and soil type.
- The forecasts could help build crop stress index in the region of interest.
- This could be used for planning fertilizer and agriculture inputs.



DSSAT OUTPUT

*SIMULATED CROP AND SOIL STATUS AT MAIN DEVELOPMENT STAGES

RUN NO. 1 RAINFED LOW NITROGEN

DATE	CROP AGE	GROWTH STAGE	BIOMASS kg/ha	LAI	LEAF NUM	CROP N kg/ha	CROP N %	STRESS H2O	STRESS N
1 JUN	0	Start Sim	0	0.00	0.0	0	0.0	0.00	0.00
5 JUL	0	Sowing	0	0.00	0.0	0	0.0	0.00	0.00
6 JUL	1	Germinate	0	0.00	0.0	0	0.0	0.00	0.00
7 JUL	2	Emergence	1	0.00	1.1	0	5.1	0.00	0.00
27 JUL	22	End Juveni	150	0.36	10.8	7	4.5	0.08	0.00
3 AUG	29	Floral Ini	175	0.30	13.7	7	3.9	0.92	0.00
27 AUG	53	End Lf Gro	519	0.26	19.8	13	2.5	0.85	0.00
3 SEP	60	Anthesis	538	0.19	19.8	13	2.4	0.97	0.00
7 SEP	64	End Pan Gr	550	0.15	19.8	13	2.4	0.98	0.00
8 OCT	95	Maturity	1754	0.09	19.8	13	0.7	0.46	0.00
8 OCT	95	Harvest	1754	0.09	19.8	13	0.7	0.00	0.00

*MAIN GROWTH AND DEVELOPMENT VARIABLES

@ VARIABLE	SIMULATED	MEASURED
Anthesis day (dap)	60	-99
Physiological maturity day (dap)	95	-99
Yield at harvest maturity (kg [dm]/	1001	-99
Number at maturity (no/m2)	1575	-99
Unit wt at maturity (g [dm]/unit)	0.0636	-99
Number at maturity (no/unit)	218.7	-99
Tops weight at maturity (kg [dm]/ha	1754	-99
By-product produced (stalk) at matu	753	-99
Leaf area index, maximum	0.28	-99
Harvest index at maturity	0.571	-99
Grain N at maturity (kg/ha)	7	-99
Tops N at maturity (kg/ha)	13	-99
Stem N at maturity (kg/ha)	6	-99
Grain N at maturity (%)	0.7	-99
Tops weight at anthesis (kg [dm]/ha	519	-99
Tops N at anthesis (kg/ha)	13	-99
Leaf number per stem at maturity	19.82	-99

*RUN 1 : RAINFED LOW NITROGEN ... Press < ENTER > key to

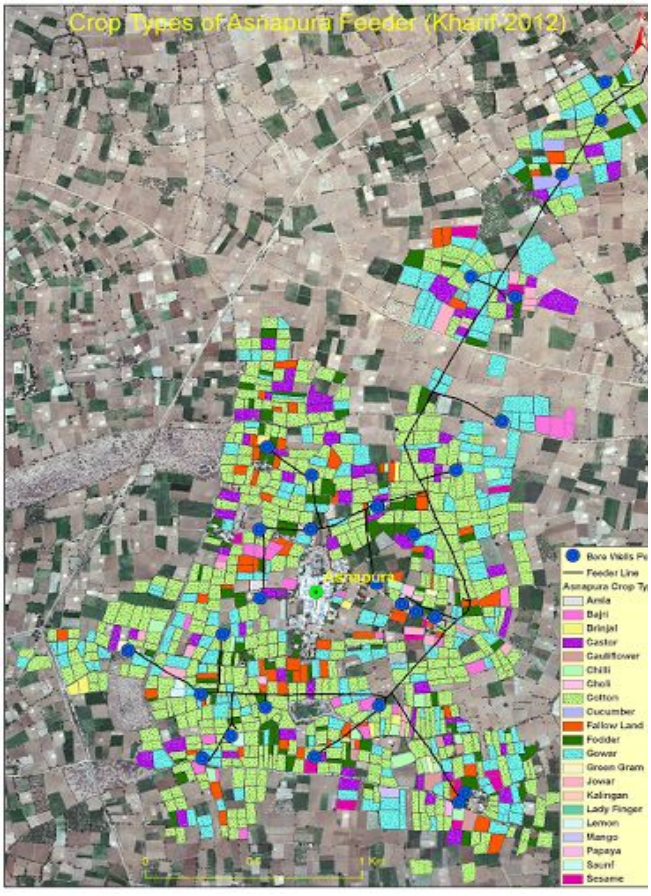
Grain sorghum YIELD : 1001 kg/ha [Dry weight]

Grain sorghum YIELD : 1001 kg/ha [Dry weight]

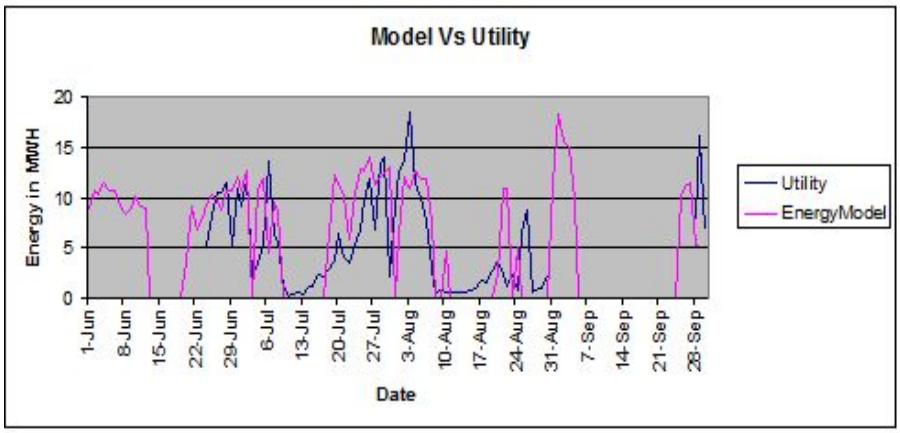
PREDICTION VI:PREDICTING AG-FEEDER DEMAND

TECHNIQUE: GCM DOWNSCALING AND ENERGY MODEL INTEGRATION

- This is a seasonal scale prediction of how the feeder will behave over the monsoon season.
- The inputs to the model are predicted time series of rainfall, crop coefficients, groundwater depth and crop types.
- The forecasts could help build energy stress index in the region of interest.
- This could be used for planning solar and agricultural pumping inputs.



PREDICTED VS REAL UTILITY VALUES FOR ASNAPURA FEEDER



PREDICTION VII:PREDICTING SOLAR RADIATION

TECHNIQUE: GCM DOWNSCALING AND SOLAR MODEL INTEGRATION

- One could clearly see the negative correlation between the rainfall and solar radiations.
- This technique could be used in the future to build energy trading solutions for solar technology.

