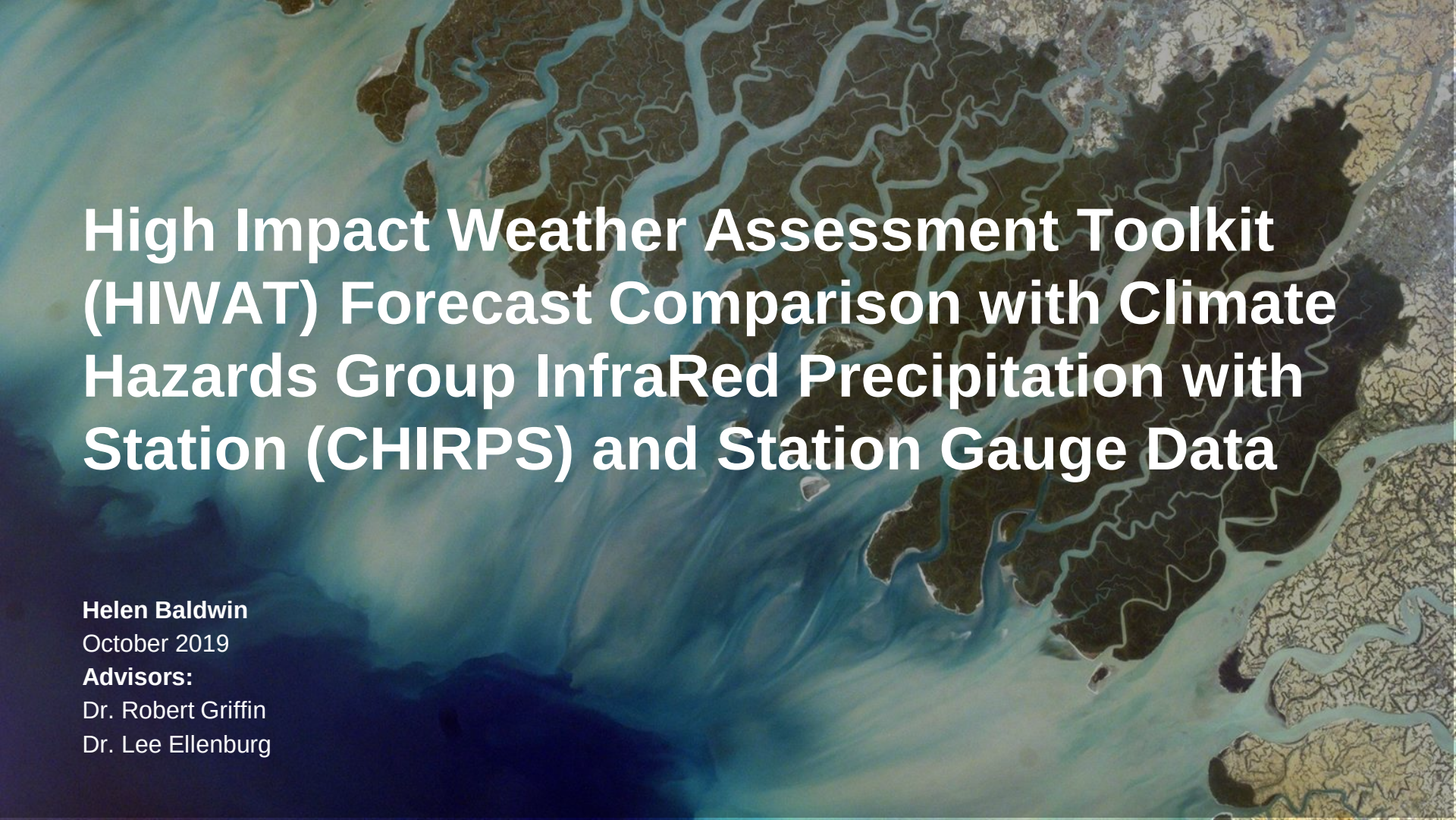

High Impact Weather Assessment Toolkit (HIWAT) Forecast Comparison with Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) and Station Gauge Data

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October 2019
Advisors:
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Overview

Community Concern

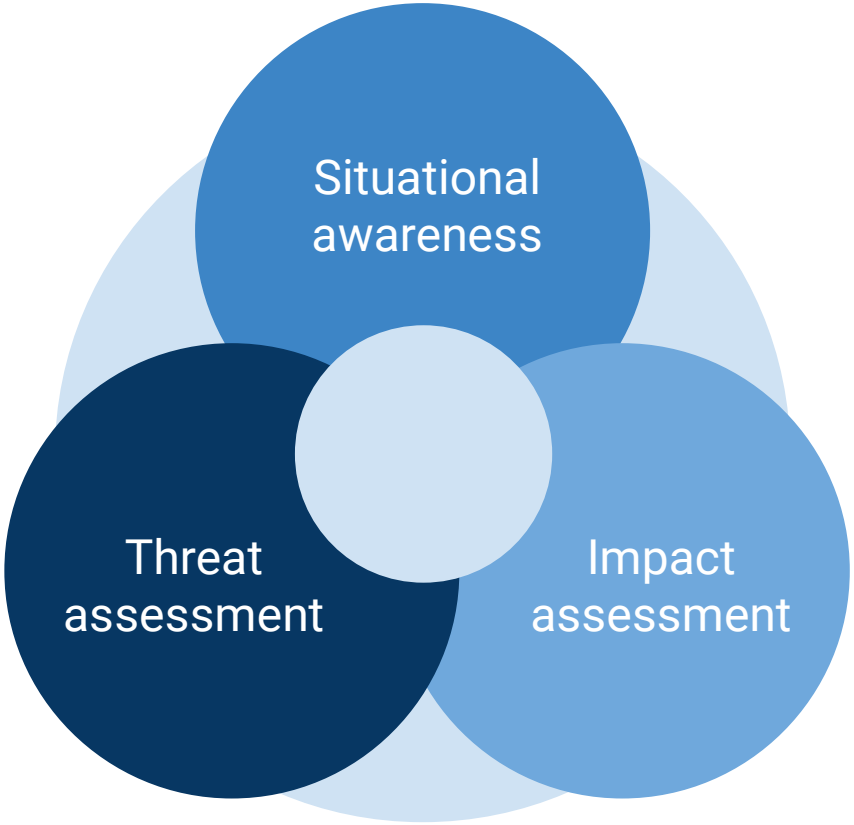
- Monsoon flooding, data sparsity

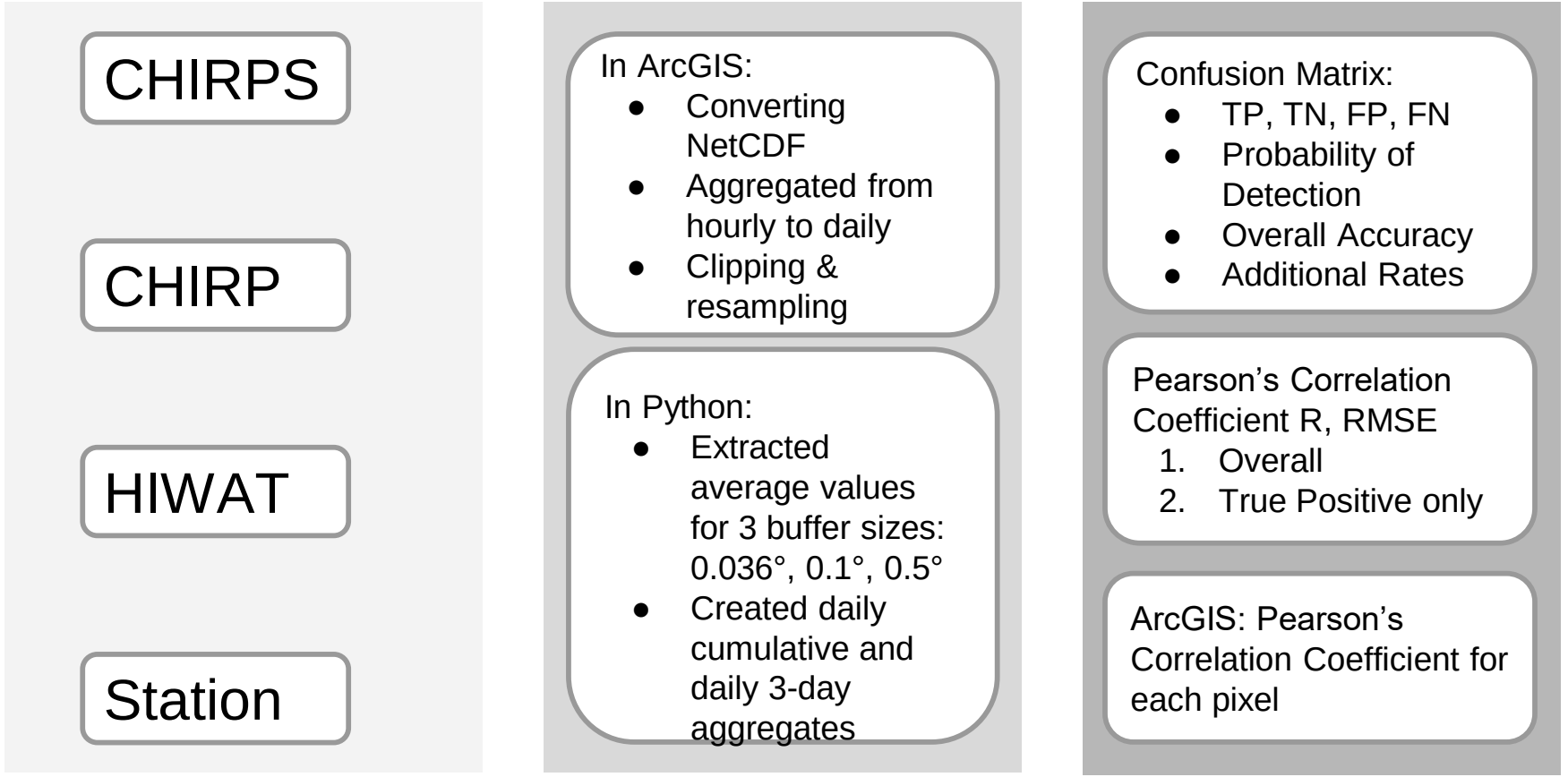
Objectives:

- Compare CHIRP and CHIRPS with station to establish comparison as equivalent to station validation
  - 3 buffer sizes: 0.036°, 0.1°, 0.5°
  - Daily 3 day aggregation
  - Daily cumulative
- Validation/Comparison of HIWAT with station
- Validation/Comparison of entire HIWAT extent with CHIRP

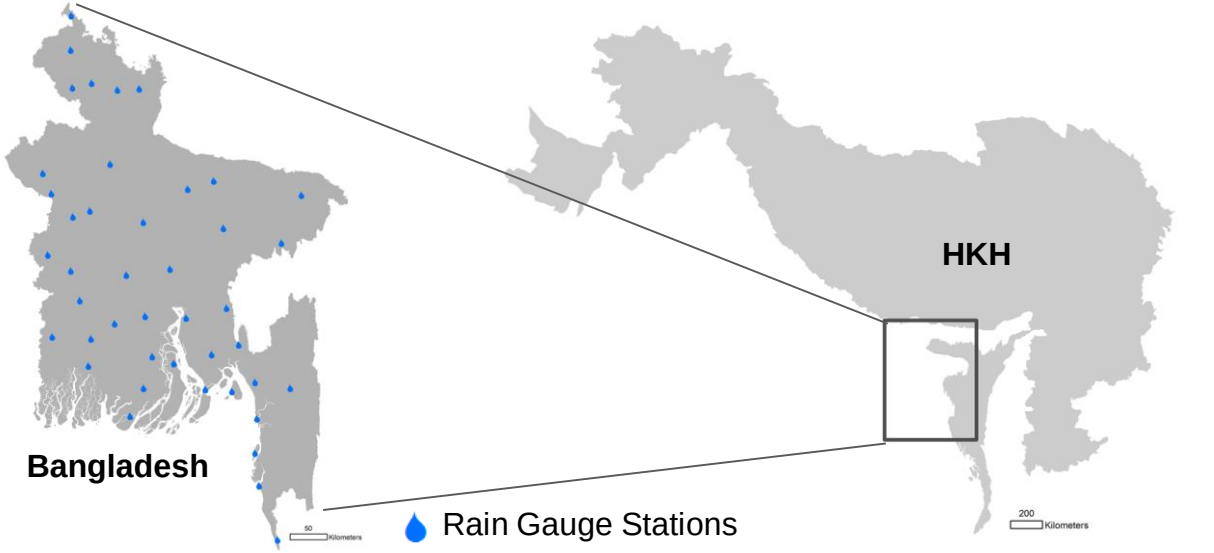
HIWAT: High Impact Weather Assessment Toolkit consists of three Earth observation-based tools to address extreme weather hazards

Use: Precipitation forecast can be routed through RAPID (expand) for higher resolution (compared to ECMWF) flash flood forecasting




CHIRPS
CHIRP
HIWAT
Station
In ArcGIS:
Converting NetCDF
Aggregated from hourly to daily
Clipping & resampling
In Python:
Extracted average values for 3 buffer sizes: 0.036°, 0.1°, 0.5°
Created daily cumulative and daily 3-day aggregates
Confusion Matrix:
TP, TN, FP, FN
Probability of Detection
Overall Accuracy
Additional Rates
Pearson's Correlation Coefficient R, RMSE
1. Overall
2. True Positive only
ArcGIS: Pearson's Correlation Coefficient for each pixel
Data Acquisition
Pre-processing
Analysis

Data Acquisition



Dataset	Parameter	Resolution	Time Period	Area
HIWAT (PMM)	Precipitation	Hourly, 0.036°	March - August, 2018	HKH Bounding Box
CHIRPS		Daily, 0.05°		
Station		Daily, N/A	March - June, 2018	Bangladesh

Daily

Datasets Compared	Buffer	Pearson's R	P-value	R (TP) 0.01, 2, 5, 10	P-value (TP)	RMSE
Station to CHIRP	0.036°	0.53	0.0	0.47, 0.47, 0.47, 0.52	<<0	16.37
	0.1°	0.53	0.0	0.47, 0.46, 0.47, 0.53	<<0	16.38
	0.5°	0.52	0.0	0.46, 0.45, 0.46, 0.48	<<0	16.45
Station to CHIRPS - CS	0.036°	0.50	<<0	0.42, 0.39, 0.38, 0.35	<<0	18.17
	0.1°	0.50	<<0	0.42, 0.40, 0.38, 0.35	<<0	18.08
	0.5°	0.51	<<0	0.41, 0.40, 0.37, 0.33	<<0	17.68
Station to CHIRPS - CHG	0.036°	0.50	<<0	0.42, 0.39, 0.38, 0.35	<<0	18.17
	0.1°	0.50	<<0	0.41, 0.39, 0.37, 0.34	<<0	18.10
	0.5°	0.51	<<0	0.41, 0.40, 0.37, 0.33	<<0	17.68
Station to HIWAT	0.036°	0.33	<<0	0.26, 0.21, 0.18, 0.16	<<0	23.41
	0.1°	0.33	<<0	0.27, 0.23, 0.18, 0.17	<<0	23.05
	0.5°	0.37	<<0	0.30, 0.26, 0.24, 0.21	<<0	21.66

Daily Cumulative

Datasets Compared	Buffer	Pearson's R	P-value	R (TP) 0.01, 2, 5, 10	P-value (TP)	RMSE
Station to CHIRP	0.036°	0.96	0.0	0.95, 0.95, 0.95, 0.95	0.0	111.4
	0.1°	0.96	0.0	0.95, 0.95, 0.95, 0.95	0.0	112.5
	0.5°	0.96	0.0	0.95, 0.95, 0.95, 0.94	0.0	117.2
Station to CHIRPS - CS	0.036°	0.96	0.0	0.95, 0.95, 0.95, 0.94	0.0	100.4
	0.1°	0.96	0.0	0.95, 0.95, 0.95, 0.95	0.0	99.2
	0.5°	0.96	0.0	0.96, 0.95, 0.95, 0.95	0.0	96.05
Station to CHIRPS - CHG	0.036°	0.96	0.0	0.95, 0.95, 0.95, 0.94	0.0	100.4
	0.1°	0.96	0.0	0.95, 0.95, 0.95, 0.95	0.0	99.4
	0.5°	0.96	0.0	0.96, 0.95, 0.95, 0.95	0.0	96.0
Station to HIWAT	0.036°	0.80	0.0	0.77, 0.74, 0.73, 0.72	0.0	318.6
	0.1°	0.81	0.0	0.77, 0.74, 0.73, 0.72	0.0	316.6
	0.5°	0.82	0.0	0.79, 0.76, 0.76, 0.75	0.0	305.9

Daily Rolling 3-day Aggregate

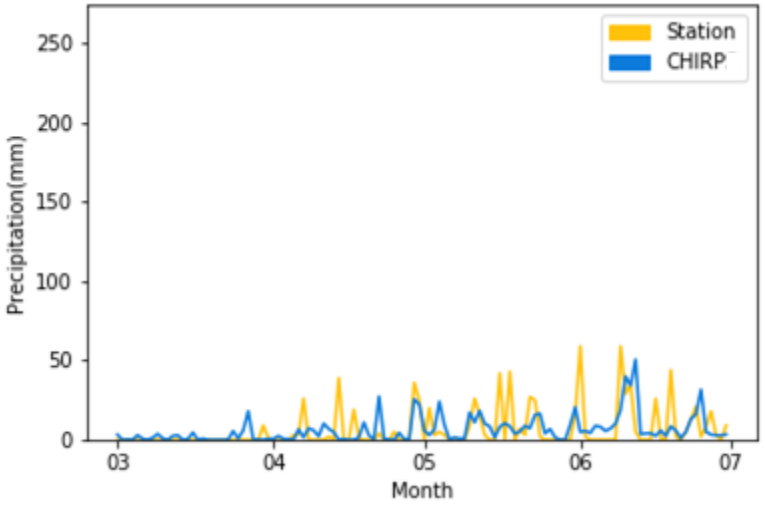
Datasets Compared	Buffer	Pearson's R	P-value	R (TP) 0.01, 2, 5, 10	P-value (TP)	RMSE
Station to CHIRP	0.036°	0.70	0.0	0.67, 0.66, 0.65, 0.66	<<0	30.20
	0.1°	0.70	0.0	0.67, 0.66, 0.65, 0.67	<<0	30.24
	0.5°	0.69	0.0	0.65, 0.64, 0.64, 0.65	<<0	30.74
Station to CHIRPS - CS	0.036°	0.67	<<0	0.62, 0.61, 0.61, 0.60	<<0	33.19
	0.1°	0.67	0.0	0.62, 0.61, 0.62, 0.61	<<0	33.11
	0.5°	0.67	0.0	0.61, 0.62, 0.61, 0.61	<<0	32.95
Station to CHIRPS - CHG	0.036°	0.67	<<0	0.62, 0.61, 0.61, 0.60	<<0	33.19
	0.1°	0.67	<<0	0.62, 0.61, 0.60, 0.60	<<0	33.18
	0.5°	0.67	0.0	0.61, 0.62, 0.61, 0.61	<<0	32.95
Station to HIWAT	0.036°	0.52	0.0	0.45, 0.42, 0.40, 0.37	<<0	44.28
	0.1°	0.52	0.0	0.46, 0.43, 0.41, 0.38	<<0	43.60
	0.5°	0.57	0.0	0.51, 0.48, 0.46, 0.45	<<0	40.74

Results: Pearson Correlation Coefficient, RMSE

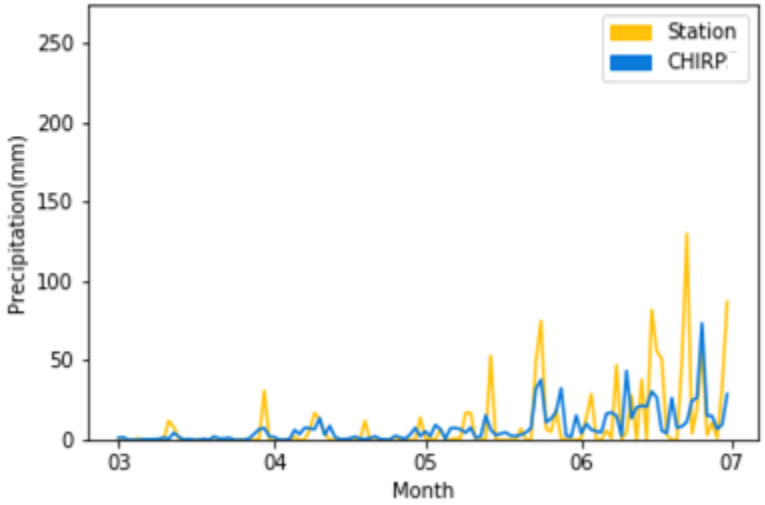
1. **All Comparisons:**
    a. Isolating True Positives did not improve performance (R and RMSE)
    b. Increasing precipitation presence threshold above 0.1 mm did not improve performance
2. **HIWAT to Station:**
    a. Moderate, positive correlation for daily, daily cumulative and 3-day rolling aggregate
    b. Lowest correlation with station of products → expected since forecast
    c. 0.5° buffer consistently performed best (R and RMSE)
3. **CHIRP/CHIRPS to Station:**
    a. Moderate to high positive correlation, highest for daily cumulative precipitation
    b. Buffer size same result except daily comparison, where CHIRPS 0.5° and CHIRP 0.036°

CHIRP to Station: Daily

Barisal

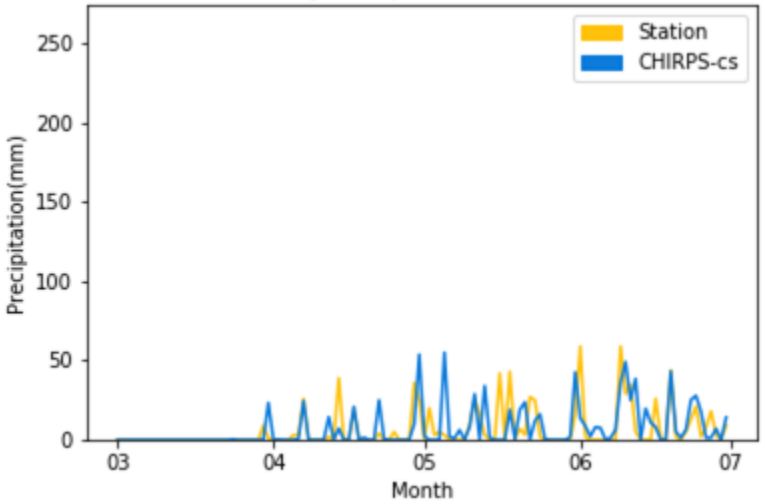


Tetulia



CHIRPS-CS to Station: Daily

Barisal



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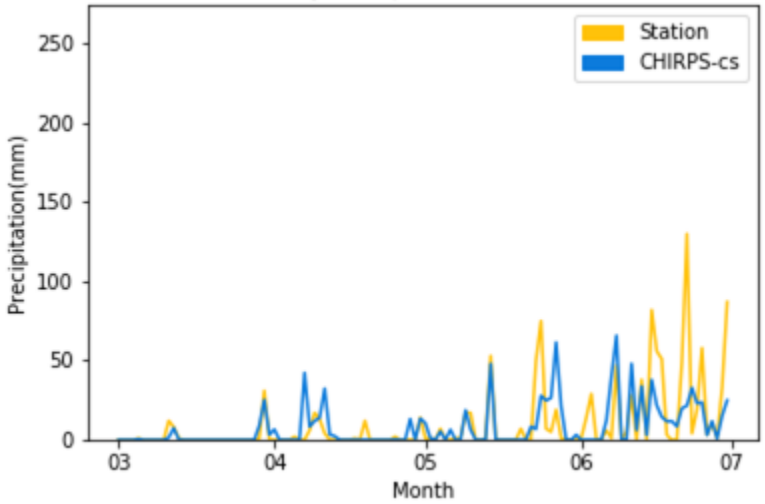
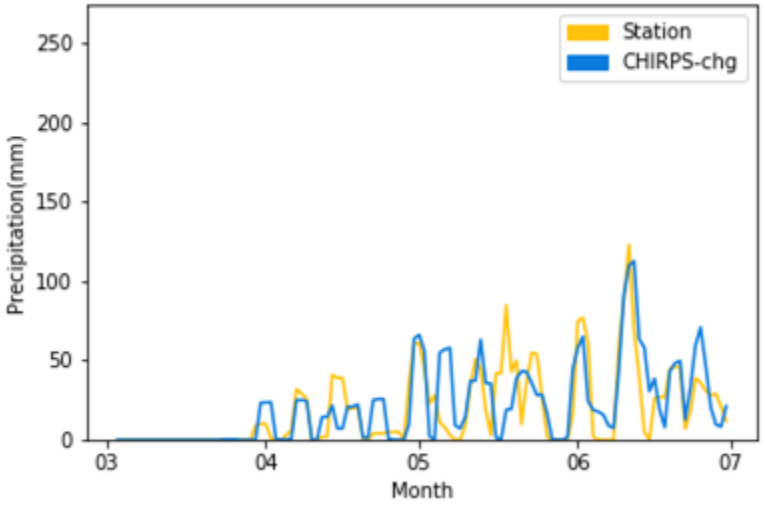


CHIRPS-CHG to Station: Daily

Barisal



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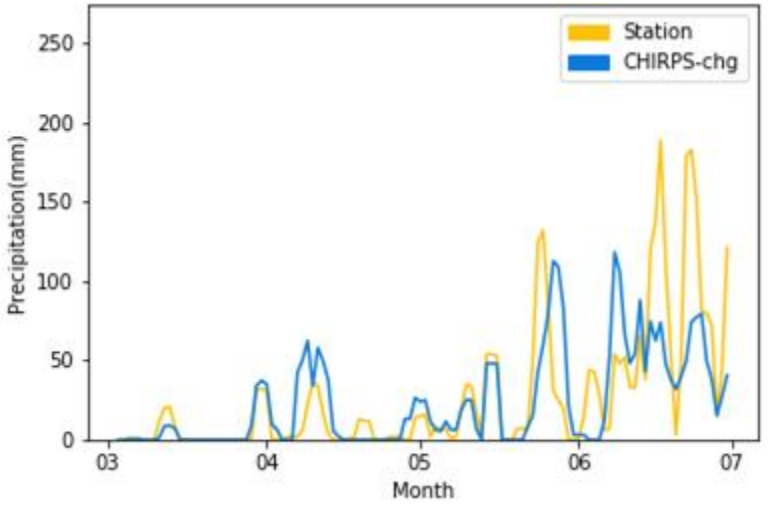
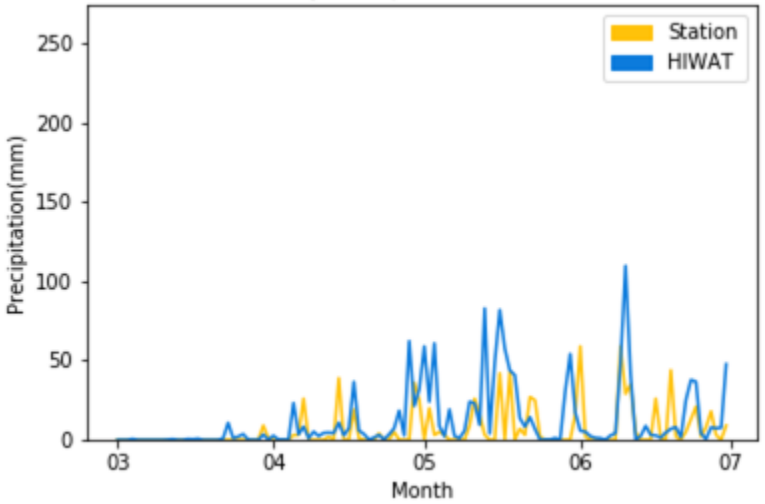


HIWAT to Station: Daily

Barisal



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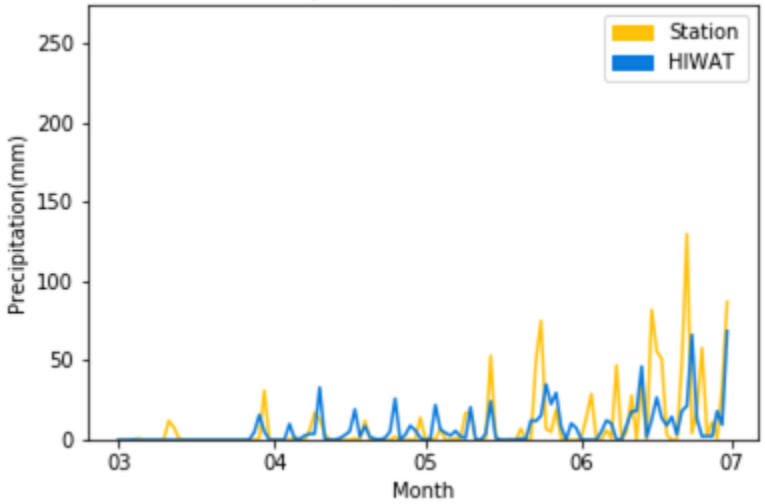
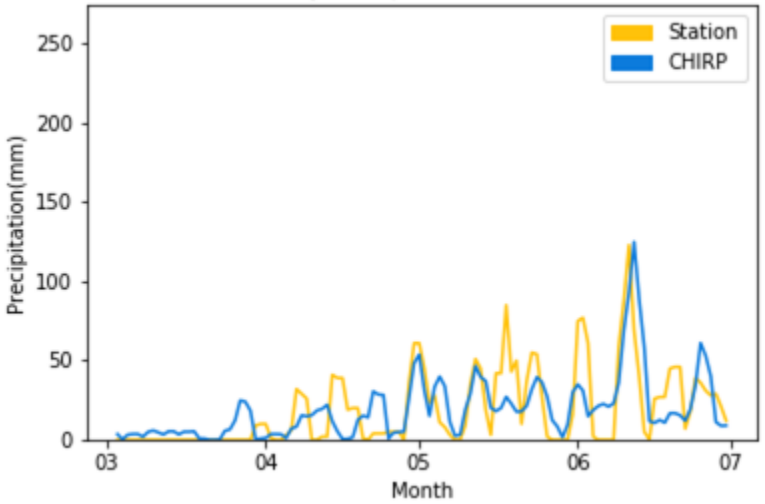


CHIRP to Station: Daily 3-day Aggregate

Barisal



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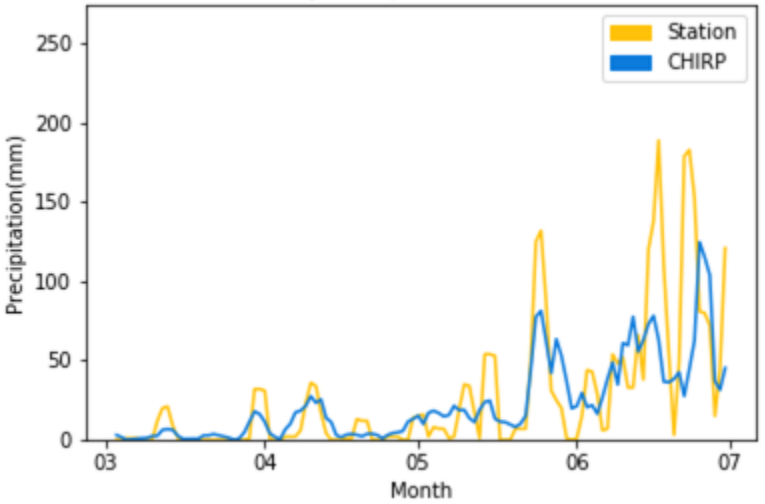

CHIRPS-CS to Station: Daily 3-day Aggregate

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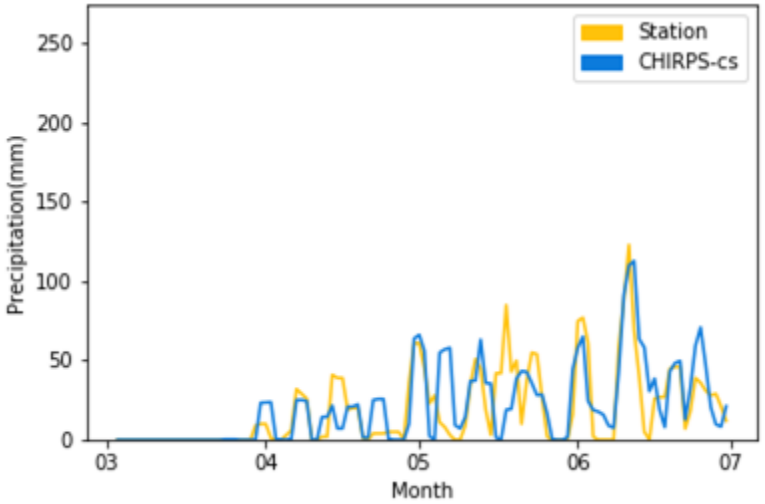

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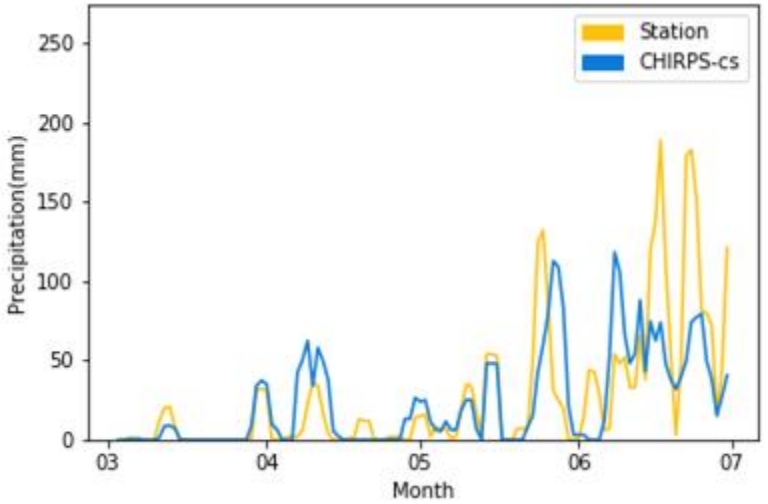

CHIRPS-CHG to Station: Daily 3-day Aggregate

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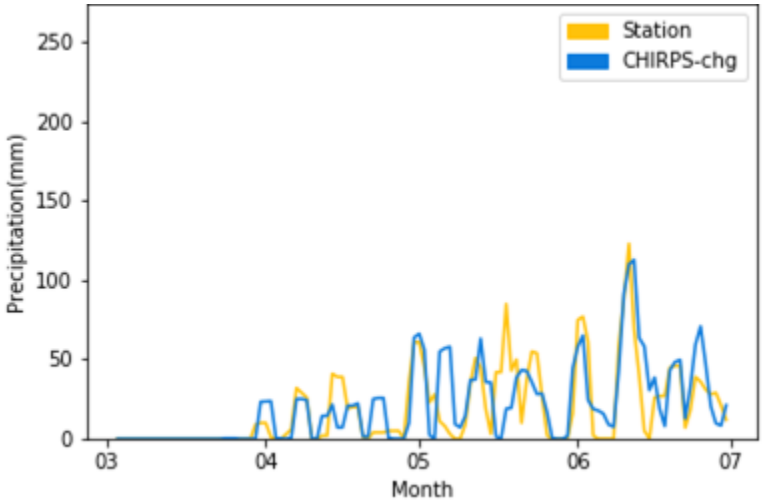

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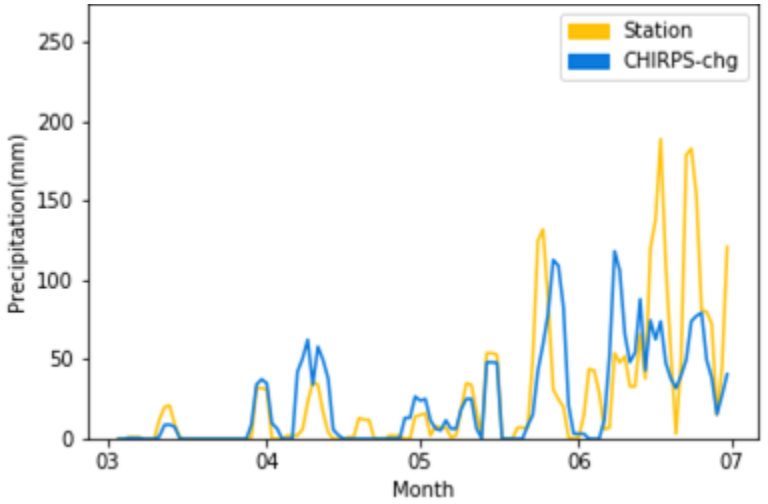
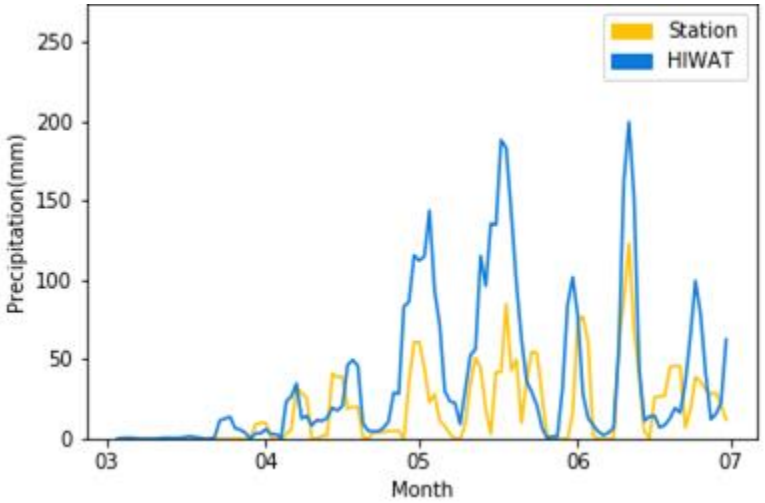


HIWAT to Station: Daily 3-day Aggregate

Barisal



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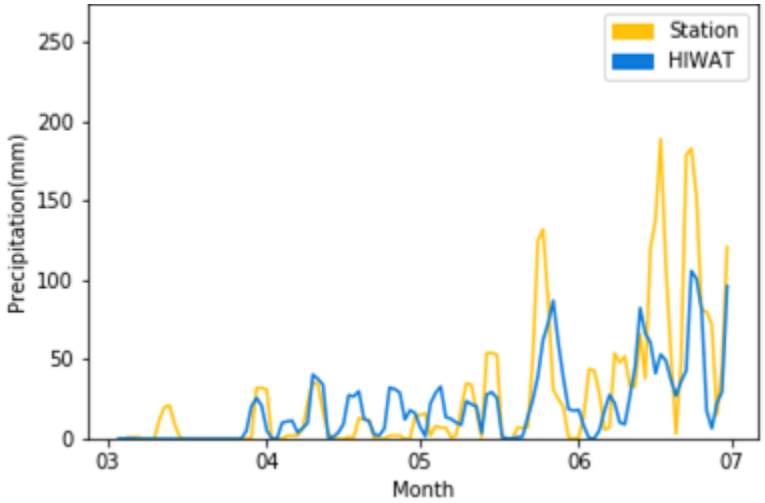
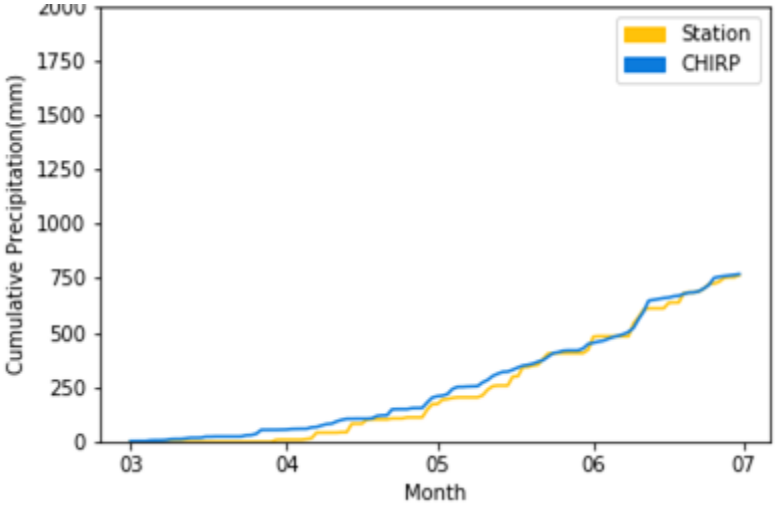


CHIRP to Station: Cumulative

Barisal



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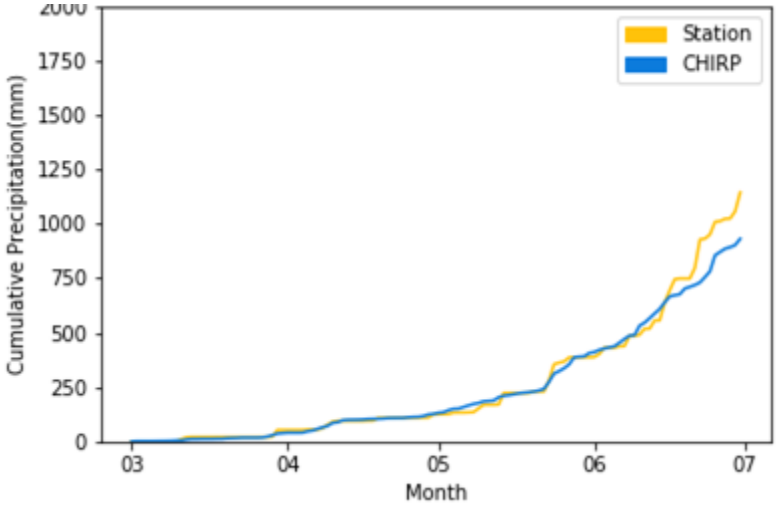
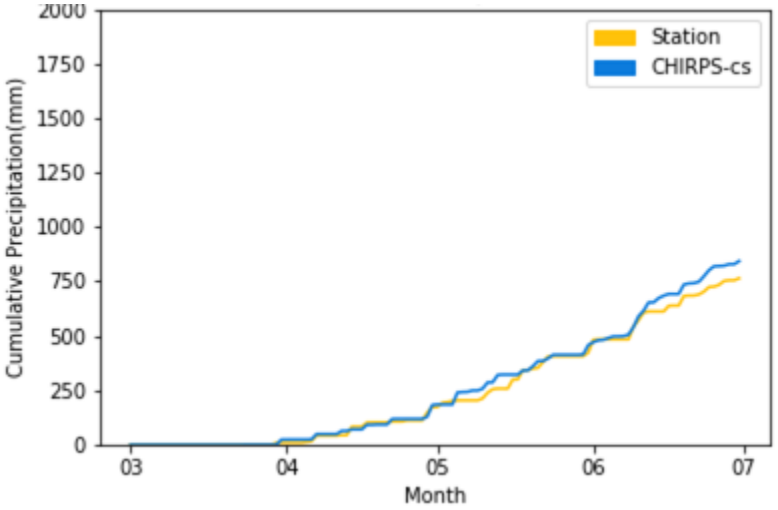


CHIRPS-CS to Station: Cumulative

Barisal



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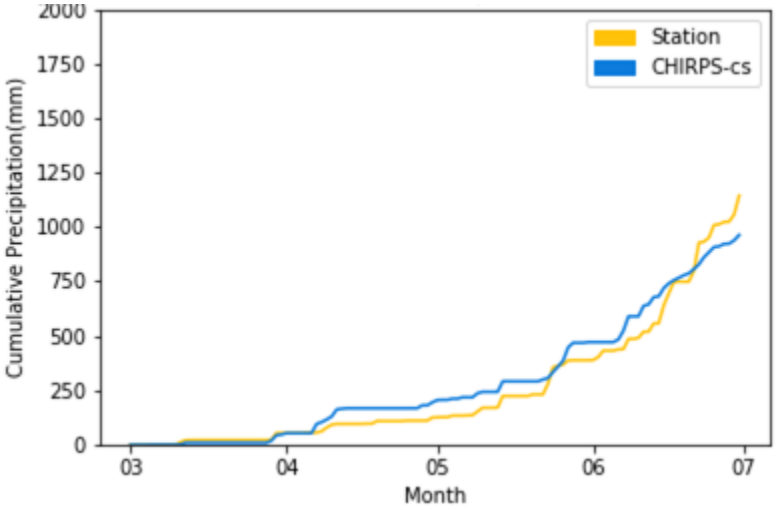

CHIRPS-CHG to Station: Cumulative

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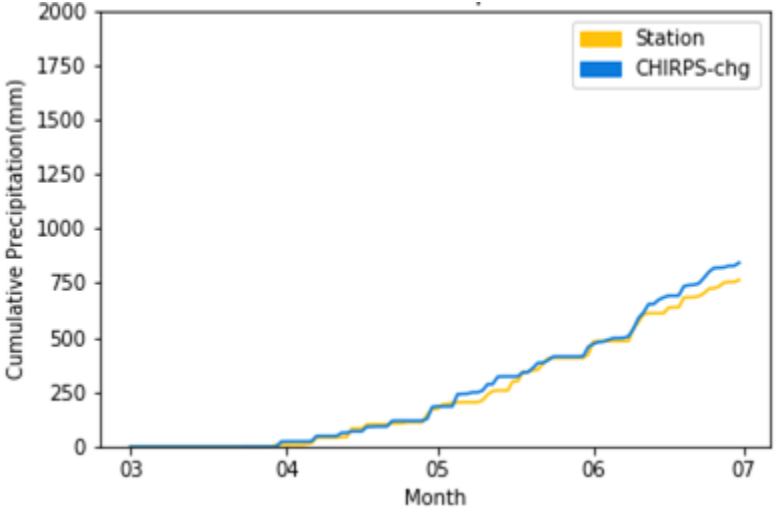

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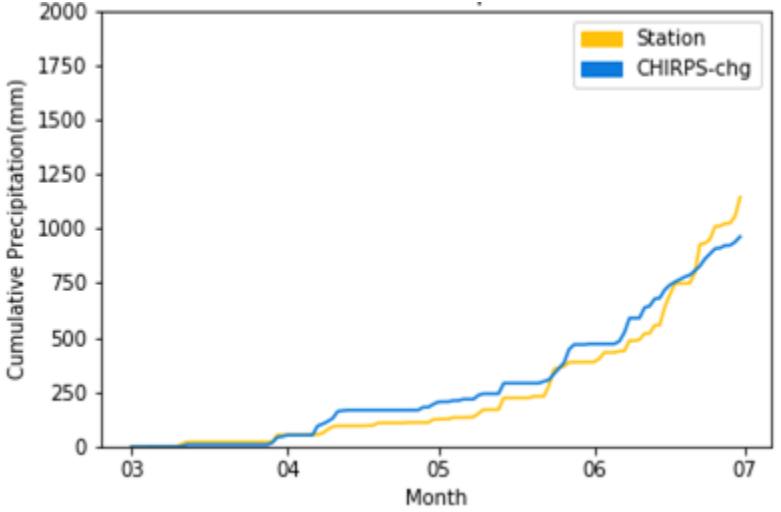

HIWAT to Station: Cumulative

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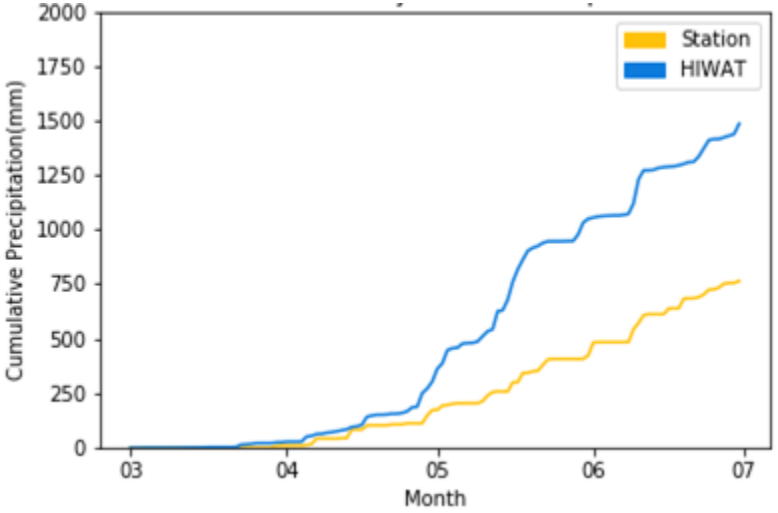

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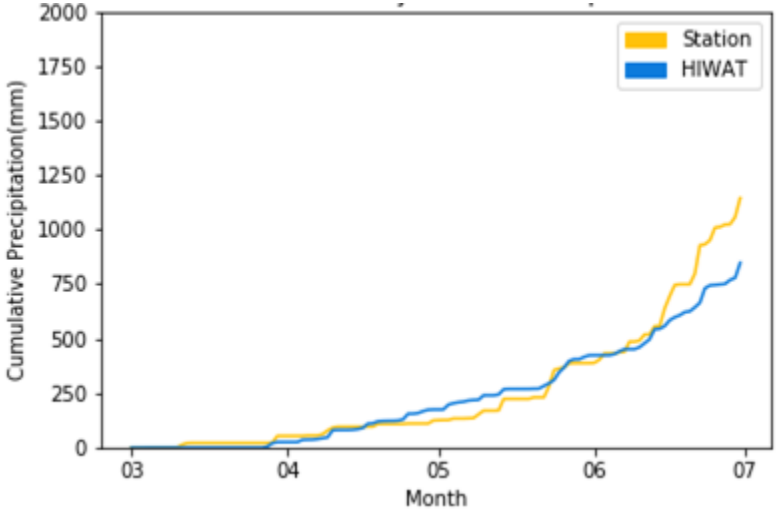
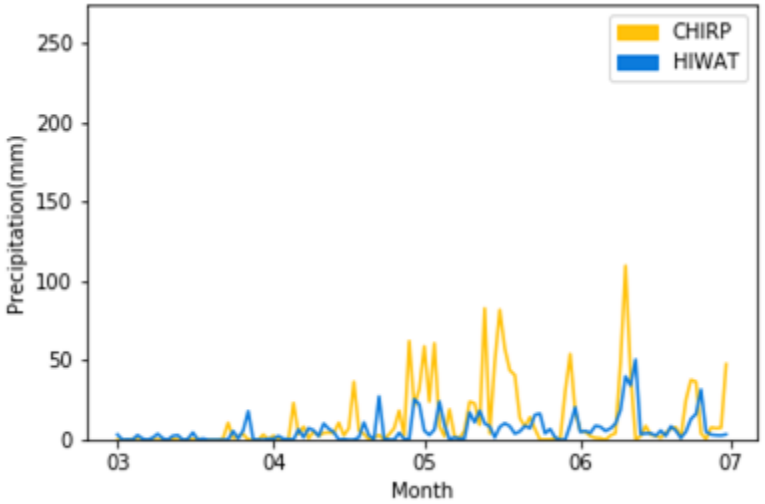


HIWAT to CHIRP: Daily

Barisal



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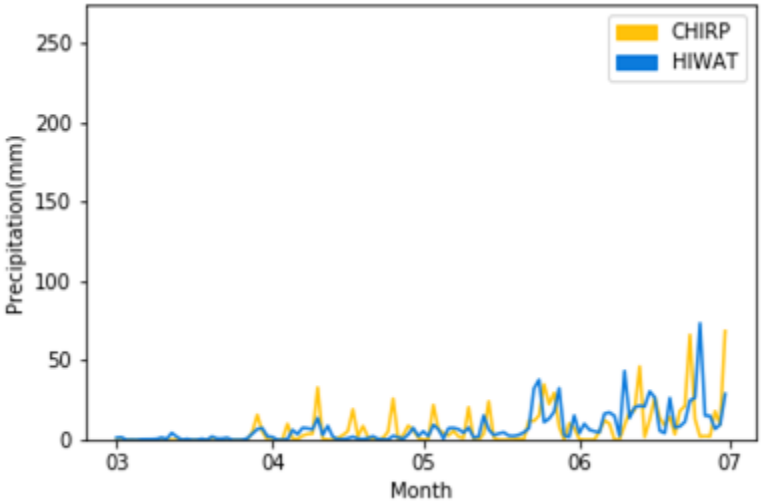
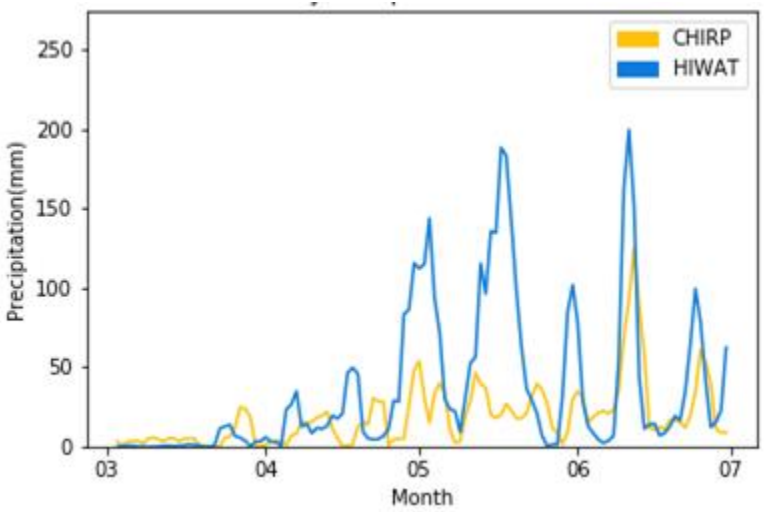


HIWAT to CHIRP: 3-day Rolling Aggregate

Barisal



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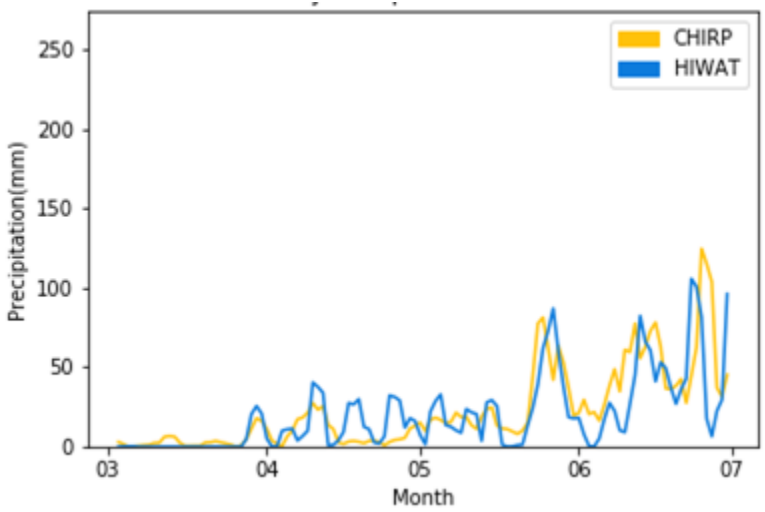
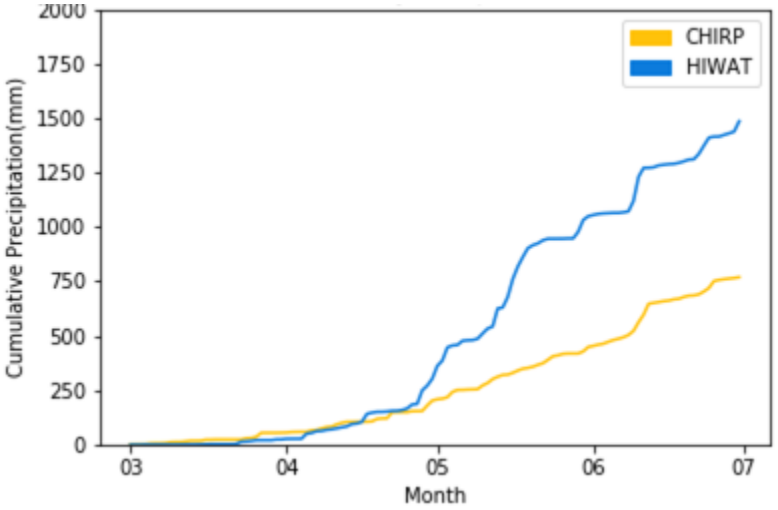


HIWAT to CHIRP: Cumulative

Barisal



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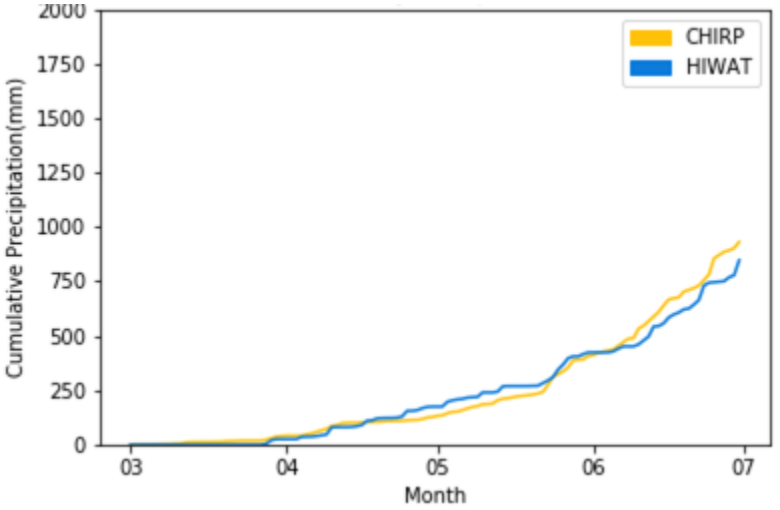


Buffer 0.036 Threshold: 0.01 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	700 (TN) - 13.4%	2226 (FP) - 42.5%
Station - precip	67 (FN) - 1.3%	2224 (TP) - 42.8%

Threshold: 2 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	1973 (TN) - 37.7%	1433 (FP) - 27.4%
Station - precip	298 (FN) - 5.7%	1533 (TP) - 29.3%

Threshold: 5 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	2774 (TN) - 52.9%	993 (FP) - 19.0%
Station - precip	497 (FN) - 9.5%	973 (TP) - 18.6%

Threshold: 10 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	3366 (TN) - 68.1%	529 (FP) - 10.1%
Station - precip	644 (FN) - 12.3%	498 (TP) - 9.5%

Station to CHIRP, Buffer 0.036: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**56.2**	**66.9**	**71.5**	**77.6**
Misclassification Rate	43.8	33.1	28.5	22.4
True Positive Rate (POD)	**97.1**	**83.7**	**66.2**	**43.6**
False Positive Rate	76.1	42.1	26.4	12.9
True Negative Rate	23.9	57.9	73.6	87.1
Precision	50.2	51.7	49.5	48.5
Prevalence	44.1	35.0	28.1	21.8

Buffer 0.1 Threshold: 0.01 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	686 (TN) - 13.1%	2240 (FP) - 42.8%
Station - precip	64 (FN) - 1.2%	2247 (TP) - 42.9%

Threshold: 2 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	1968 (TN) - 37.6%	1438 (FP) - 27.5%
Station - precip	293 (FN) - 5.6%	1538 (TP) - 29.4%

Threshold: 5 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	2791 (TN) - 53.3%	976 (FP) - 18.6%
Station - precip	497 (FN) - 9.5%	973 (TP) - 18.6%

Threshold: 10 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	3572 (TN) - 68.2%	523 (FP) - 10.0%
Station - precip	640 (FN) - 12.2%	502 (TP) - 9.6%

Station to CHIRP, Buffer 0.1: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**56.0**	**66.9**	**71.9**	**77.8**
Misclassification Rate	44.0	33.1	28.1	22.2
True Positive Rate (POD)	**97.2**	**84.0**	**66.2**	**44.0**
False Positive Rate	76.6	42.2	25.9	12.8
True Negative Rate	23.4	57.8	74.1	87.2
Precision	50.1	51.7	49.9	49.0
Prevalence	44.1	35.0	28.1	21.8

Buffer 0.5 Threshold: 0.01 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	516 (TN) - 9.9%	2410 (FP) - 46.0%
Station - precip	45 (FN) - 85.9%	2266 (TP) - 43.3%

Threshold: 2 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	1934 (TN) - 36.9%	1472 (FP) - 28.1%
Station - precip	278 (FN) - 5.3%	1553 (TP) - 29.7%

Threshold: 5 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	2775 (TN) - 53.0%	992 (FP) - 18.9%
Station - precip	488 (FN) - 9.3%	982 (TP) - 18.8%

Threshold: 10 mm

CHIRP (prediction) vs. Station (true)		
N = 5237	CHIRP - none	CHIRP - precip
Station - none	3586 (TN) - 68.5%	509 (FP) - 9.7%
Station - precip	654 (FN) - 12.5%	488 (TP) - 9.3%

Station to CHIRP, Buffer 0.5: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**53.1**	**66.6**	**71.7**	**77.8**
Misclassification Rate	46.9	33.4	28.3	22.2
True Positive Rate (POD)	**98.1**	**84.8**	**66.8**	**42.7**
False Positive Rate	82.4	43.2	26.3	12.4
True Negative Rate	17.6	56.8	73.7	87.6
Precision	48.5	51.3	49.7	48.9
Prevalence	44.1	35.0	28.1	21.8

Buffer 0.036 Threshold: 0.01 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1267 (TN) - 49.6%	199 (FP) - 7.8%
Station - precip	439 (FN) - 17.2%	651 (TP) - 25.59%

Threshold: 2 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1401 (TN) - 54.8%	298 (FP) - 11.7%
Station - precip	319 (FN) - 12.5%	538 (TP) - 21.0%

Threshold: 5 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1520 (TN) - 59.5%	347 (FP) - 13.6%
Station - precip	259 (FN) - 10.1%	430 (TP) - 16.8%

Threshold: 10 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1710 (TN) - 66.9%	306 (FP) - 12.00%
Station - precip	225 (FN) - 8.8%	315 (TP) - 12.3%

Station to CHIRPS-CS, Buffer 0.036: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**75.0**	**75.9**	**76.3**	**79.2**
Misclassification Rate	25.0	24.1	23.7	20.8
True Positive Rate (POD)	**59.7**	**62.8**	**62.4**	**58.3**
False Positive Rate	13.6	17.5	18.6	15.2
True Negative Rate	86.4	82.5	81.4	84.8
Precision	76.6	64.4	55.3	50.7
Prevalence	42.6	33.5	27.0	21.1

Buffer 0.1 Threshold: 0.01 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1236 (TN) - 48.4%	230 (FP) - 9.0%
Station - precip	400 (FN) - 15.6%	690 (TP) - 27.0%

Threshold: 2 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1387 (TN) - 54.3%	312 (FP) - 12.2%
Station - precip	302 (FN) - 11.8%	555 (TP) - 21.7%

Threshold: 5 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1519 (TN) - 59.4%	348 (FP) - 13.6%
Station - precip	259 (FN) - 10.1%	430 (TP) - 16.8%

Threshold: 10 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1719 (TN) - 67.3%	297 (FP) - 11.6%
Station - precip	220 (FN) - 8.6%	320 (TP) - 12.5%

Station to CHIRPS-CS, Buffer 0.1: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**75.4**	**76.0**	**76.3**	**79.8**
Misclassification Rate	24.6	24.0	23.7	20.2
True Positive Rate (POD)	**63.3**	**64.8**	**62.4**	**59.3**
False Positive Rate	15.7	18.4	18.6	14.7
True Negative Rate	84.3	81.6	81.4	85.3
Precision	75.0	64.0	55.3	51.9
Prevalence	42.6	33.5	27.0	21.1

Buffer 0.5 Threshold: 0.01 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1057 (TN) - 41.4%	409 (FP) - 16.0%
Station - precip	204 (FN) - 8.0%	886 (TP) - 34.7%

Threshold: 2 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1320 (TN) - 51.6%	379 (FP) - 14.8%
Station - precip	229 (FN) - 9.0%	628 (TP) - 24.6%

Threshold: 5 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1496 (TN) - 58.5%	371 (FP) - 14.5%
Station - precip	232 (FN) - 9.1%	457 (TP) -17.9%

Threshold: 10 mm

CHIRPS - CS (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1726 (TN) - 67.5%	290 (FP) - 11.3%
Station - precip	226 (FN) - 8.8%	314 (TP) - 12.3%

Station to CHIRPS-CS, Buffer 0.5: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**76.0**	**76.2**	**76.4**	**79.8**
Misclassification Rate	24.0	23.8	23.6	20.2
True Positive Rate (POD)	**81.3**	**73.3**	**66.3**	**58.1**
False Positive Rate	27.9	22.3	19.9	14.4
True Negative Rate	72.1	77.7	80.1	85.6
Precision	68.4	62.3	55.2	52.0
Prevalence	42.6	33.5	27.0	21.1

Buffer 0.036 Threshold: 0.01 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1267 (TN) - 49.5%	199 (FP) - 7.8%
Station - precip	439 (FN) 17.2%	651 (TP) - 25.5%

Threshold: 2 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1401 (TN) - 54.8%	298 (FP) - 11.7%
Station - precip	319 (FN) - 12.5%	538 (TP) - 21.0%

Threshold: 5 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1520 (TN) - 59.5%	347 (FP) - 13.6%
Station - precip	259 (FN) - 10.1%	430 (TP) - 16.8%

Threshold: 10 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1710 (TN) - 66.9%	306 (FP) - 12.0%
Station - precip	225 (FN) - 8.8%	315 (TP) - 12.3%

Station to CHIRPS-CHG, Buffer 0.036: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**75.0**	**75.9**	**76.3**	**79.2**
Misclassification Rate	25.0	24.1	23.7	20.8
True Positive Rate (POD)	**59.7**	**62.8**	**62.4**	**58.3**
False Positive Rate	13.6	17.5	18.6	15.2
True Negative Rate	86.4	82.5	81.4	84.8
Precision	76.6	64.4	55.3	50.7
Prevalence	42.6	33.5	27.0	21.1

Buffer 0.1 Threshold: 0.01 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	(TN) - %	233 (FP) - 9.1%
Station - precip	(FN) - %	693 (TP) - 27.1%

Threshold: 2 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1387 (TN) - 54.3%	312 (FP) - 12.2%
Station - precip	302 (FN) - 11.8%	555 (TP) - 33.5%

Threshold: 5 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1517 (TN) - 59.3%	350 (FP) - 13.7%
Station - precip	261 (FN) - 10.2%	428 (TP) - 16.7%

Threshold: 10 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1721 (TN) - 67.3%	295 (FP) - 11.5%
Station - precip	219 (FN) - 8.6%	321 (TP) - 12.6%

Station to CHIRPS-CHG, Buffer 0.1: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**75.4**	**76.0**	**76.1**	**79.9**
Misclassification Rate	24.6	24.0	23.9	20.1
True Positive Rate (POD)	**63.6**	**64.8**	**62.1**	**59.4**
False Positive Rate	15.9	18.4	18.7	14.6
True Negative Rate	84.1	81.6	81.3	85.4
Precision	74.8	64.0	55.0	52.1
Prevalence	42.6	33.5	27.0	21.1

Buffer 0.5 Threshold: 0.01 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1057 (TN) - 41.4%	409 (FP) - 16.0%
Station - precip	204 (FN) - 8.0%	886 (TP) - 34.7%

Threshold: 2 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1320 (TN) - 51.6%	379 (FP) - 14.8%
Station - precip	229 (FN) - 9.0%	628 (TP) - 24.6%

Threshold: 5 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1496 (TN) - 58.5%	371 (FP) - 14.5%
Station - precip	232 (FN) - 9.1%	457 (TP) - 17.9%

Threshold: 10 mm

CHIRPS - CHG (prediction) vs. Station (true)		
N = 2556	CHIRPS - none	CHIRPS - precip
Station - none	1726 (TN) - 67.5%	290 (FP) - 11.3%
Station - precip	226 (FN) - 8.8%	314 (TP) - 12.3%

Station to CHIRPS-CHG, Buffer 0.5: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**76.0**	**76.2**	**76.4**	**79.8**
Misclassification Rate	24.0	23.8	23.6	20.2
True Positive Rate (POD)	**81.3**	**73.3**	**66.3**	**58.1**
False Positive Rate	27.9	22.3	19.9	14.4
True Negative Rate	72.1	77.7	80.1	85.6
Precision	68.4	62.4	55.2	52.0
Prevalence	42.6	33.5	27.0	21.1

Buffer: 0.036 Threshold: 0.01 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	1412 (TN) - 27.0%	1514 (FP) - 28.9%
Station - precip	247 (FN) - 4.7%	2064 (TP) - 39.4%

Threshold: 2 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	2422 (TN) - 46.2%	984 (FP) - 18.8%
Station - precip	638 (FN) - 12.2%	1193 (TP) - 22.8%

Threshold: 5 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	2967 (TN) - 56.7%	800 (FP) - 15.3%
Station - precip	653 (FN) - 12.5%	817 (TP) - 15.6%

Threshold: 10 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	3443 (TN) - 65.7%	652 (FP) - 12.4%
Station - precip	589 (FN) - 11.2%	553 (TP) - 21.8%

Station to HIWAT, Buffer 0.036: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**66.4**	**69.0**	**72.3**	**76.3**
Misclassification Rate	33.6	31.0	27.7	23.7
True Positive Rate (POD)	**89.3**	**65.2**	**55.6**	**48.4**
False Positive Rate	51.7	28.9	21.2	15.9
True Negative Rate	48.3	71.1	78.8	84.1
Precision	57.7	54.8	50.5	45.9
Prevalence	44.1	35.0	28.1	21.8

Buffer: 0.1 Threshold: 0.01 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	1346 (TN) - 25.7%	1580 (FP) - 30.2%
Station - precip	212 (FN) - 4.0%	2099 (TP) - 40.1%

Threshold: 2 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	2403 (TN) - 45.9%	1003 (FP) - 19.2%
Station - precip	606 (FN) - 11.6%	1225 (TP) - 23.4%

Threshold: 5 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	2951 (TN) - 56.3%	816 (FP) - 15.6%
Station - precip	631 (FN) -12.0%	839 (TP) - 16.0%

Threshold: 10 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	3430 (TN) - 65.5 %	665 (FP) - 12.7 %
Station - precip	585 (FN) - 11.2%	557 (TP) - 10.6%

Station to HIWAT, Buffer 0.1: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**65.8**	**69.3**	**72.4**	**76.1**
Misclassification Rate	34.2	30.7	27.6	23.9
True Positive Rate (POD)	**90.8**	**66.9**	**57.1**	**48.8**
False Positive Rate	54.0	29.4	21.7	16.2
True Negative Rate	46.0	70.6	78.3	83.8
Precision	57.1	55.0	50.7	45.6
Prevalence	44.1	35.0	28.1	21.8

Buffer 0.5 Threshold: 0.01 mm

HIWAT(prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	1097 (TN) - 20.9%	1829 (FP) - 34.9%
Station - precip	91 (FN) - 1.7%	2220 (TP) - 42.4%

Threshold: 2 mm

HIWAT(prediction) vs. Station (true)		
N = 5237	HIWAT- none	HIWAT- precip
Station - none	2266 (TN) - 43.3%	1140 (FP) - 21.8%
Station - precip	504 (FN) - 9.6%	1327 (TP) - 25.3%

Threshold: 5 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT - none	HIWAT - precip
Station - none	2846 (TN) - 54.3%	921 (FP) - 17.6%
Station - precip	571 (FN) - 10.9%	899 (TP) - 17.2%

Threshold: 10 mm

HIWAT (prediction) vs. Station (true)		
N = 5237	HIWAT - none	HIWAT - precip
Station - none	3367 (TN) - 64.3%	728 (FP) - 13.9%
Station - precip	550 (FN) - 10.5%	592 (TP) - 11.3%

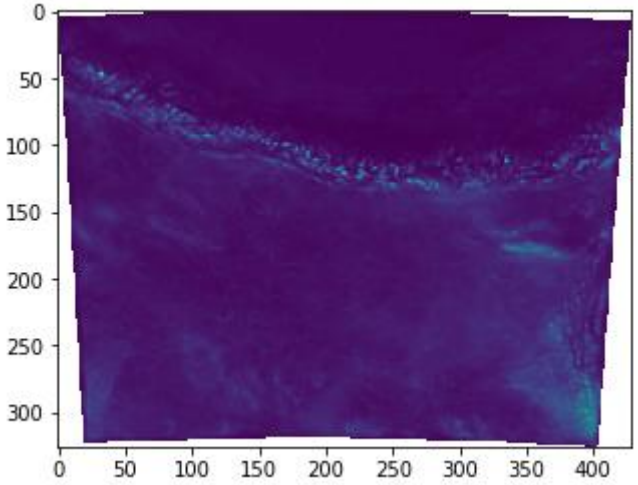
Station to HIWAT, Buffer 0.5: Relevant Rates (%)				
Threshold	0.01 mm	2 mm	5 mm	10 mm
Accuracy	**63.3**	**68.6**	**71.5**	**75.6**
Misclassification Rate	36.7	31.4	28.5	24.4
True Positive Rate (POD)	**96.1**	**72.5**	**61.2**	**51.8**
False Positive Rate	62.5	33.5	24.4	17.8
True Negative Rate	37.5	66.5	75.6	82.2
Precision	54.8	53.8	49.4	44.8
Prevalence	44.1	35.0	28.1	21.8

Contingency Table Results:

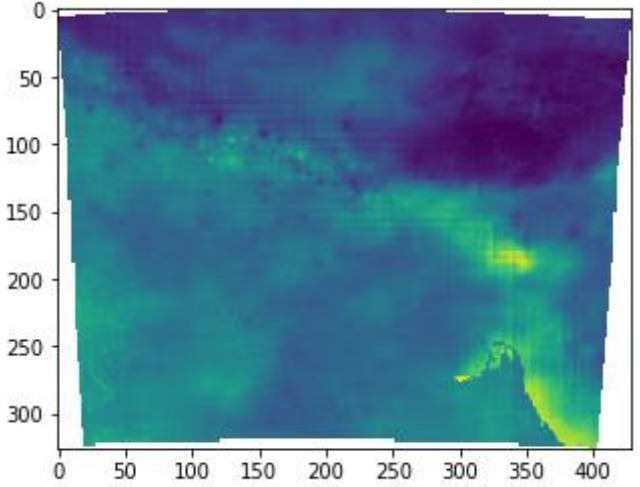
1. **Probability of Detection (TP Rate):**
    a. High for all comparisons
    b. 0.01 mm threshold performed best for all comparisons
2. **Thresholds determining absence/presence:**
    a. Overall accuracy increased with higher threshold,but higher thresholds had lower POD than lower thresholds (except for CHIRPS-CHG & CHIRPS-CS with Buffer 0.1 and Buffer 0.036)
3. **Overall Accuracy:**
    a. High for all comparisons
    b. Highest for cumulative, then 3-day agg, then daily totals

Pixel-to-Pixel Comparison:

Standard Deviation: HIWAT



Standard Deviation: CHIRP



Based on RMSE and R values, chose CHIRP for greater spatial & temporal comparison with precipitation forecast by HIWAT.

Conclusions/Discussion

Identification of precipitation

- Relatively high for all comparisons
  - can use CHIRP in place of station data to assess HIWAT forecasts of precipitation
  - Lowest for HIWAT to Stations
    - Forecast

Intensity of Precipitation

- Moderate to high positive correlations for all comparisons
- Reject null hypothesis for all comparisons
- Highest spatial correlation in

Next Steps

To expand the study:

- Include 2nd day HIWAT forecast
- Continue pixel to pixel analysis analysis
- Seasonal analysis: pre-monsoon vs. monsoon
- High/low intensity events

Contact Info

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Thank you!
Questions?