The Development of Royal Rainmaking's Beneficial Area Evaluation System: Automatic Dynamic Target

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Introduction

In 2006 – 2016, Royal Rainmaking's beneficial area was evaluated using Fix Target Area method (Fix). However, with weather and land use continually changed, Fix method may not be longer performed well with present operation. Consequently, Radar Composite and Dynamic Target Area methods (Dyn) were developed and implemented since 2017.
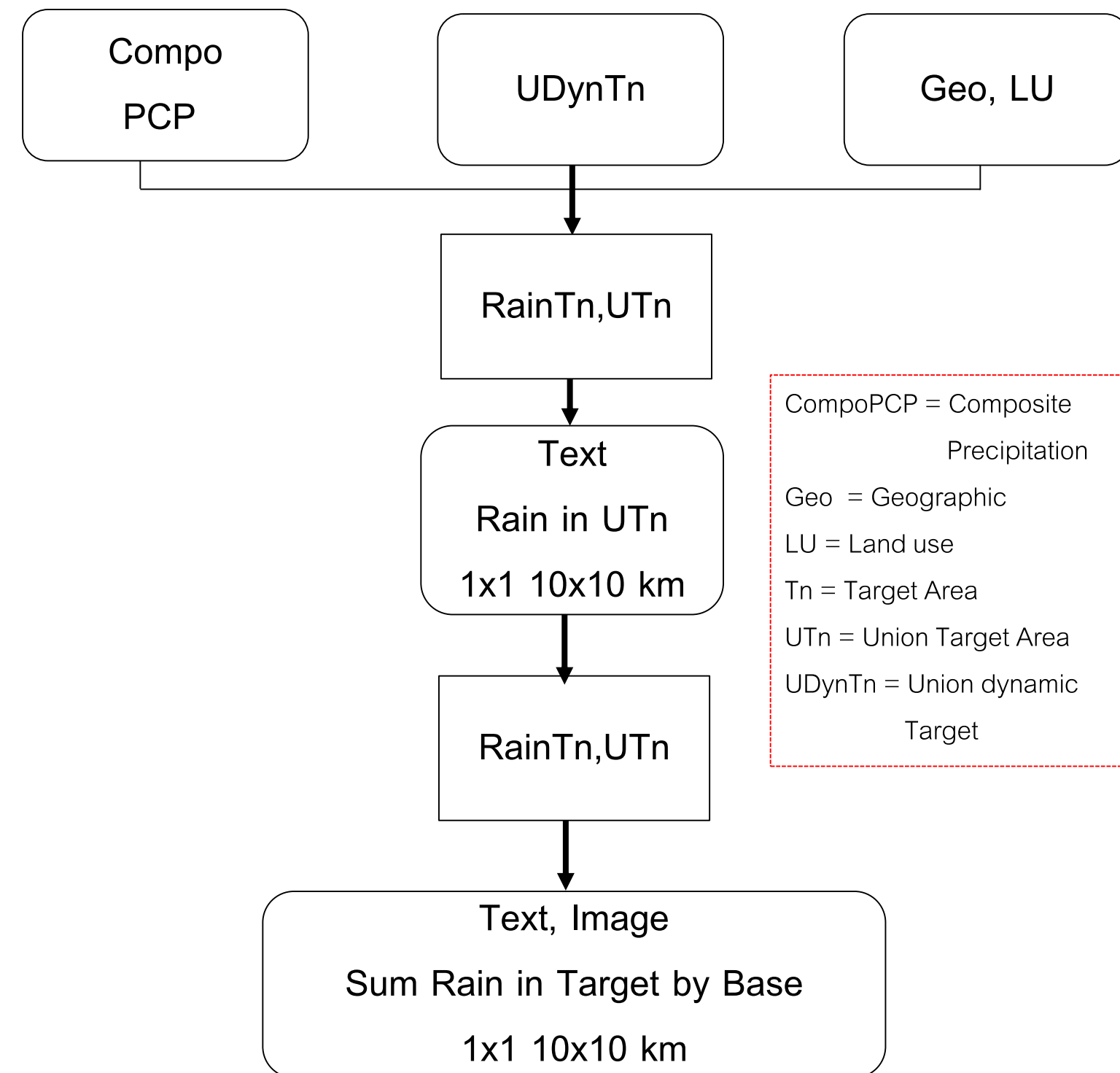
Methods

Figure 1 Conceptual Framework

Results

Z-R relationship obtained from Department of Royal Rainmaking and Agricultural Aviation (DRRAA)'s research or other institutes' research were used for radar rainfall estimation of Royal Rainmaking Radar stations. If no research conducted at that particular radar station, Z-R relationship of convective rain was automatically used. Accumulated Radar Rainfall acquired from above mentioned Z-R was statistically constructed as CountMax, AvgMax and AvgAvg composite radar data. After comparison , AvgMax was closer to gauge (WSR-88D). Thus, AvgMax was used to calibrate rain area and rain volume

| Rain Estimation: G/R	Radar Sattahip (z=201R1.5: DRRAA)			Radar Pimai (z=300R1.4: WSR-88D)			Radar Satahip & Pimai (Composite Area)		
	Avg Avg	CountMax	Avg Max	Avg Avg	CountMax	Avg Max	Avg Avg	CountMax	Avg Max
G/R Dry	1.34	1.14	1.05	1.45	1.18	1.08	1.44	1.12	0.94
G/R Wet	1.35	1.15	0.98	1.54	1.24	1.11	1.43	1.10	0.93
STDEV Dry	1.09	0.89	0.82	1.08	0.80	0.80	0.64	0.58	0.55
STDEV Err Dry	0.14	0.12	0.11	0.14	0.11	0.11	0.08	0.08	0.07
STDEV Wet	0.72	0.61	0.54	0.62	0.52	0.48	0.60	0.54	0.43
STDEV Err Wet	0.09	0.08	0.07	0.08	0.07	0.06	0.80	0.07	0.06
% R Dry error	-34.00	-14.00	-4.50	-45.00	-18.00	-7.50	-44.00	-11.50	6.00
% R Wet error	-35.00	-15.00	2.00	-54.00	-23.50	-10.50	-43.00	-10.00	7.50
% Avg R error	-34.50	-14.50	-1.25	-49.50	-20.75	-9.00	-43.50	-10.75	6.75

Figure 2 Rainfall estimation
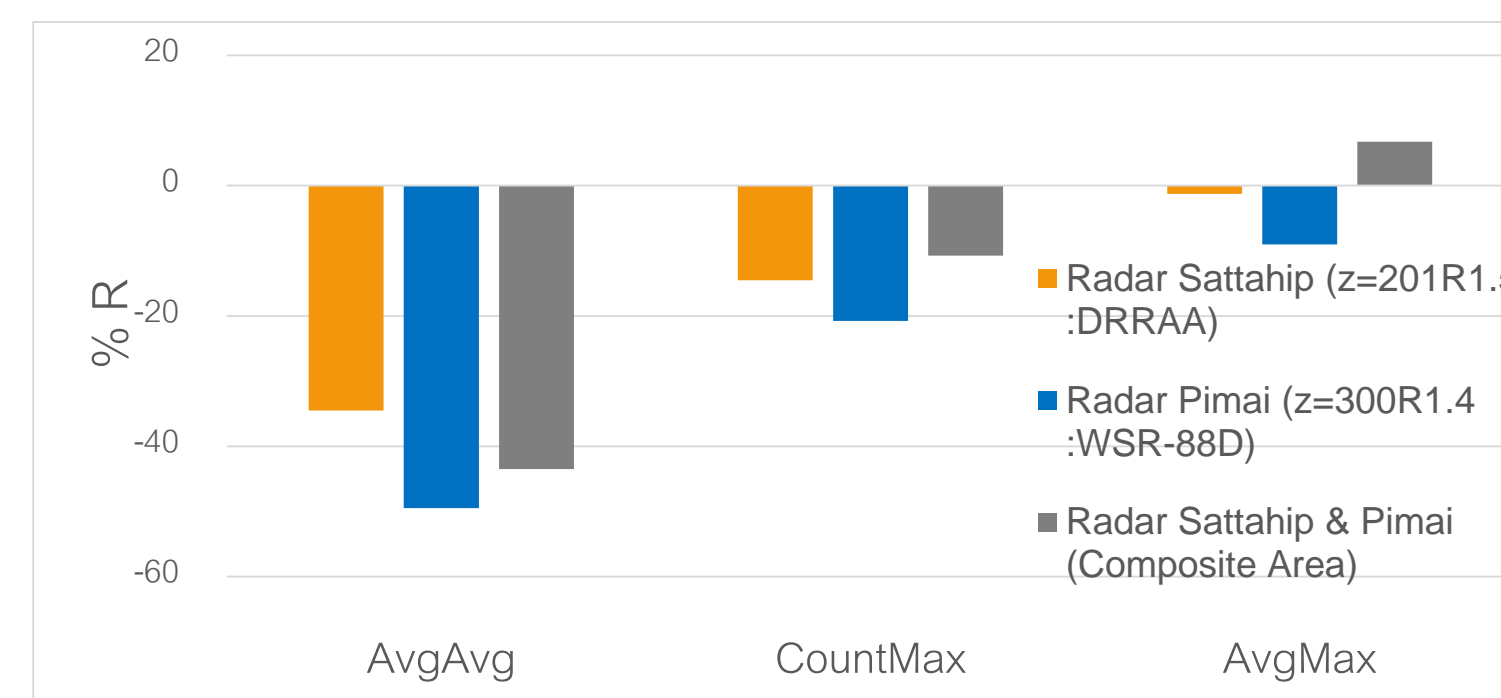
Figure 3 Percent error of rainfall estimation

Rain Area and Rain Volume calculated from Royal Rainmaking Huahin Center's daily operation over Kaeng Krachan and Pranburi Basin data during wet and dry season in 2018 were employed to assess Fix, Dyn and Storm Tracking (ST) system performance. Fix and Dyn's Accumulative Rain Area and Volume were higher than ST's for all season. However, Dyn evaluation results were closer to ST's than Fix's. In addition, Rain Area ratio of Dyn/ST was 3.3, Fix/ST was 7.0, Rain Volume ratio of Dyn/ST was 1.7 and Fix/ST was 3.6 for all season.
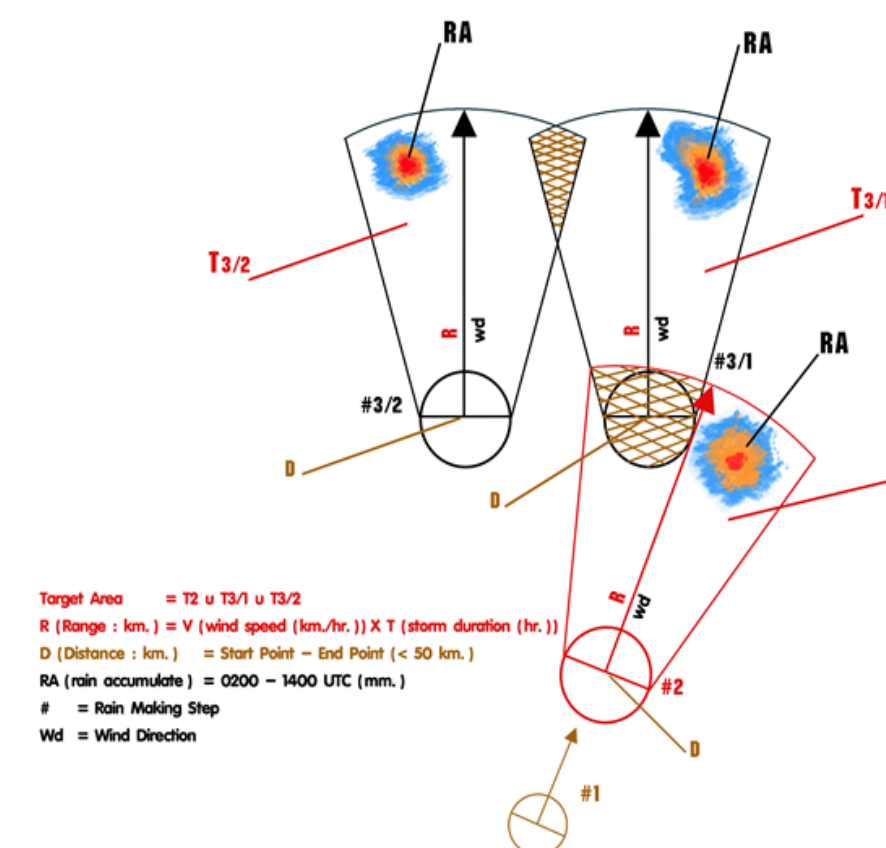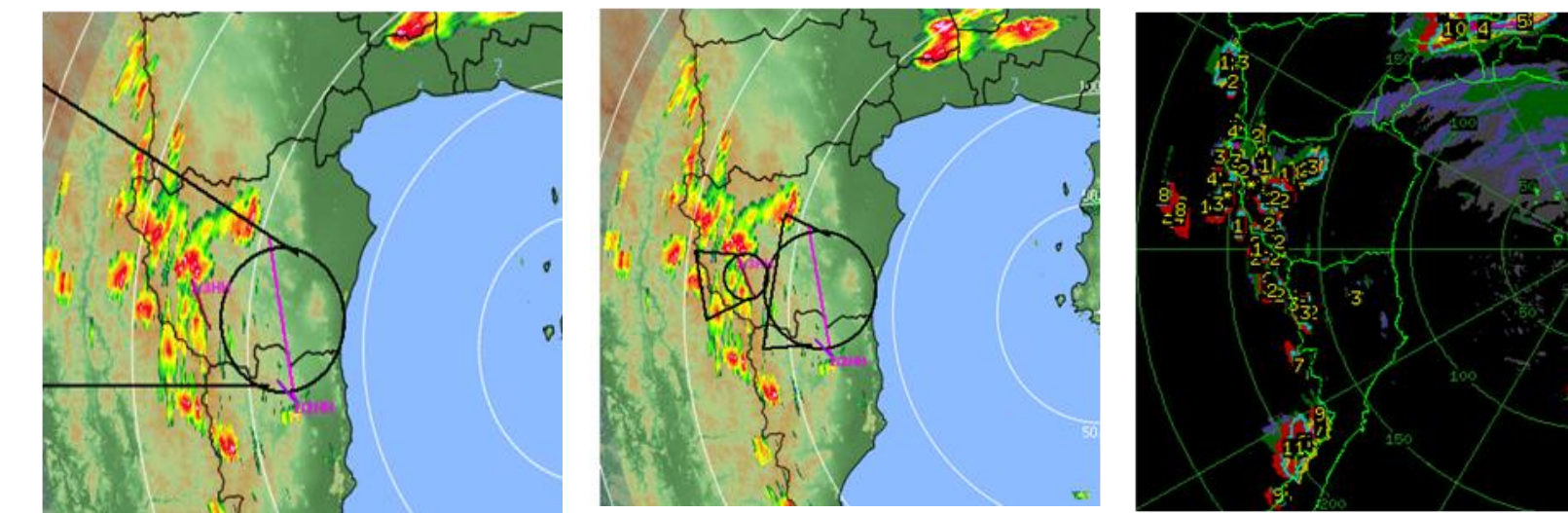

Figure 4 Royal Rainmaking's Dyn target area

Figure 5 Fix target area method

Figure 6 Dynamic target area method

Figure 7 Storm tracking

Ratio	Rain Area (M^2)		Rain Volume (M^3)	
	Dyn/ST	Fix/ST	Dyn/ST	Fix/ST
Dry season	3.1	6.3	1.6	3.4
Wet season	3.5	7.7	1.9	3.9
All season	3.3	7.0	1.7	3.6

Figure 8 Ratio of rain area and rain volume
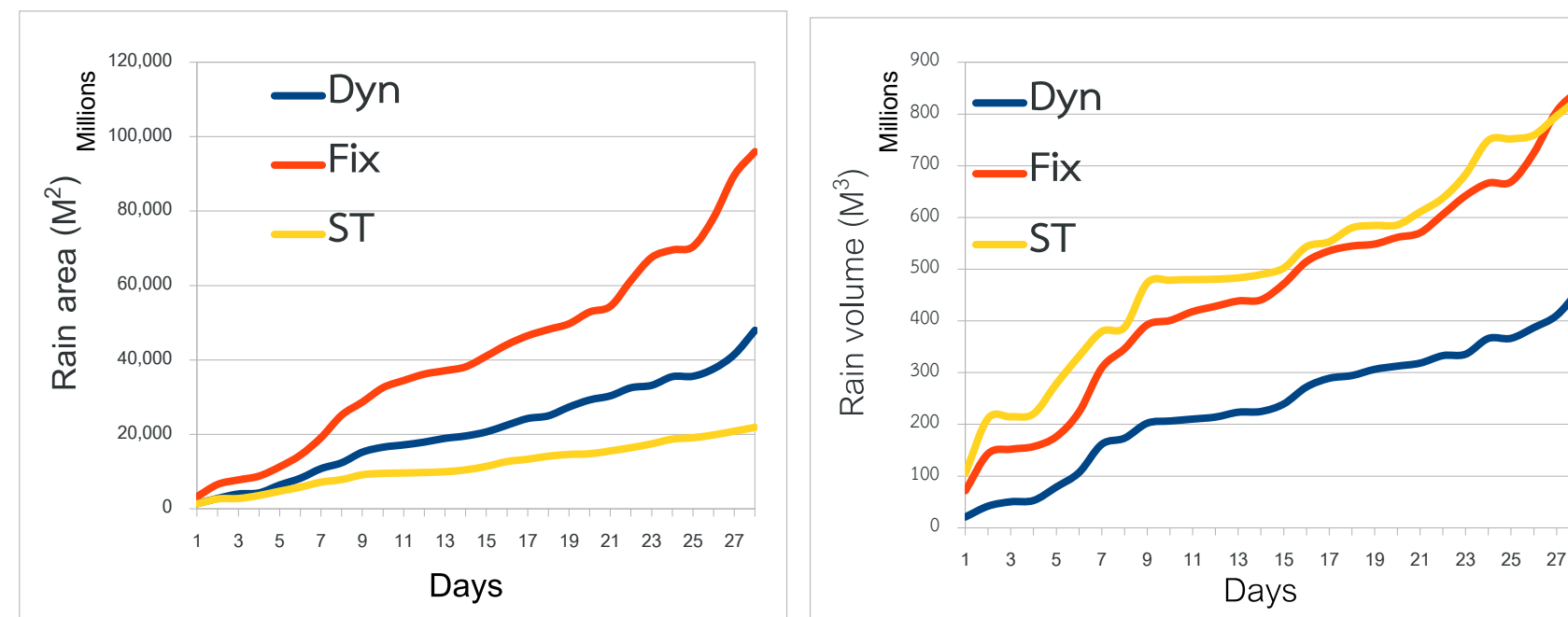

(a)   (b)

Figure 9 Accumulate rain area (a) and rain volume (b) in dry season
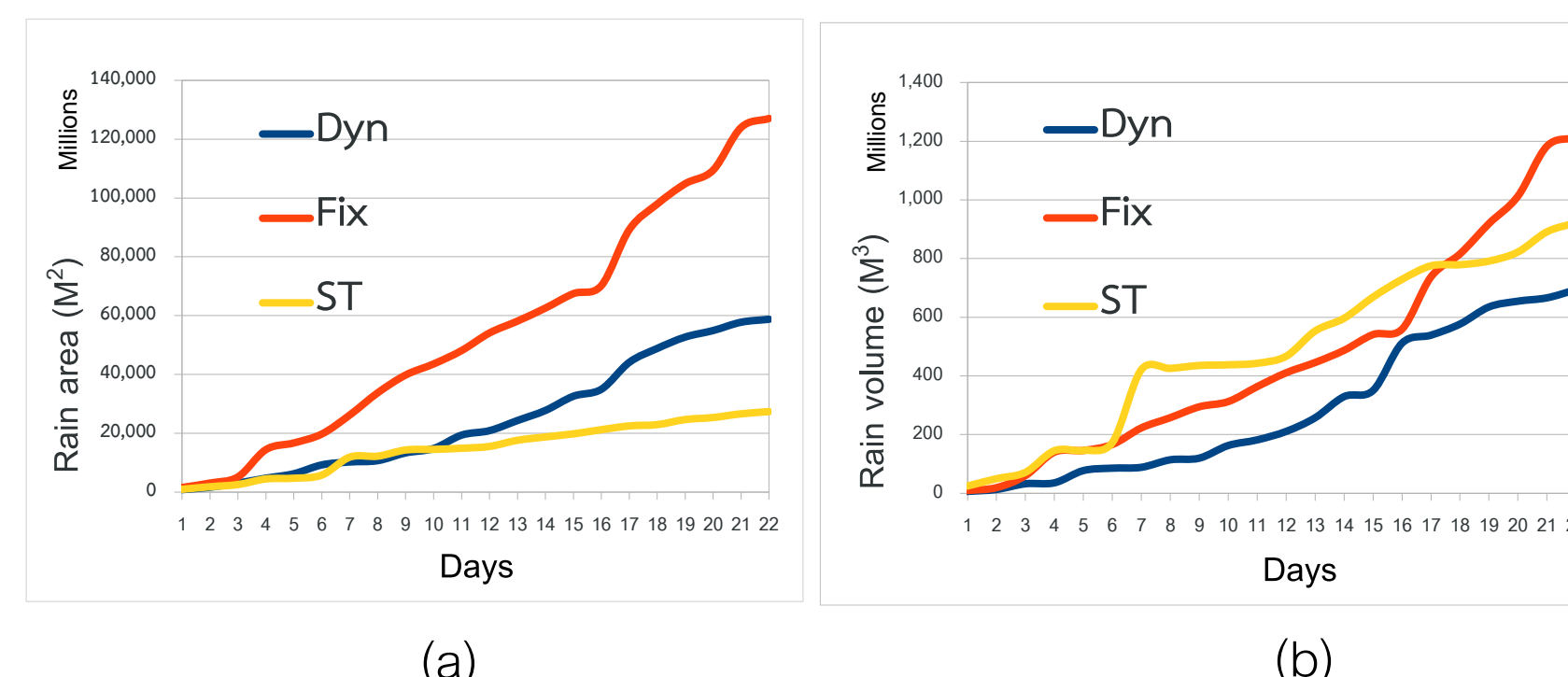

(a)   (b)

Figure 10 Accumulate rain area (a) and rain volume (b) in wet season
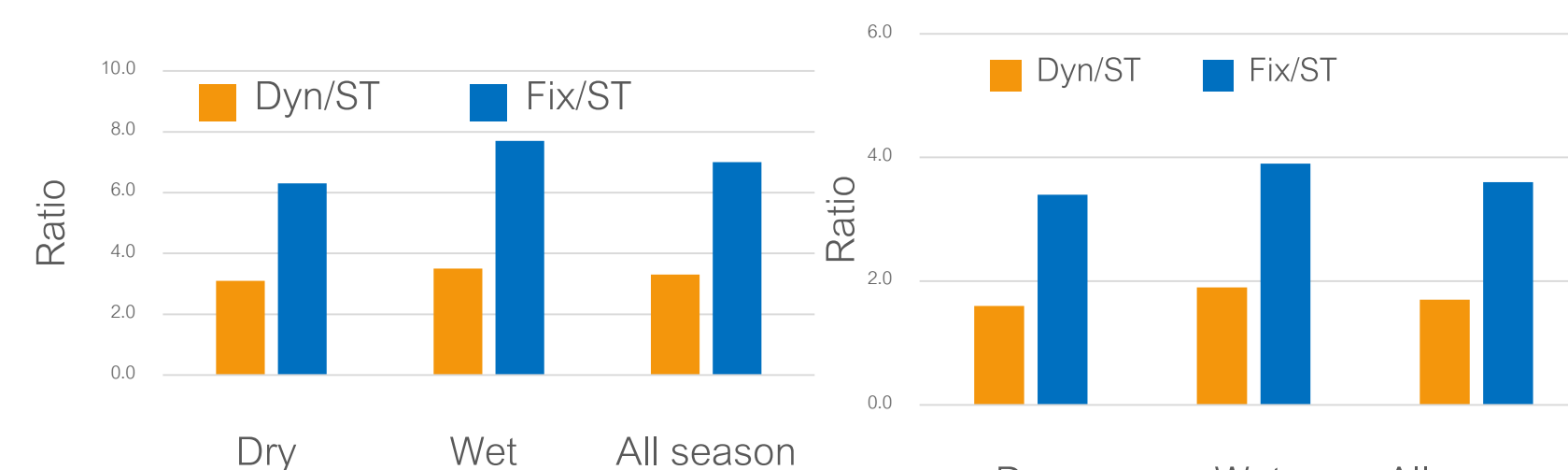

Figure 11 Rain area ratio   Figure 12 Rain volume ratio

Conclusions

Base on current Royal Rainmaking daily operation which focus on designated targets, Royal Rainmaking's beneficial area evaluation using Automatic Dynamic Target Area (Dyn) is the most suitable system owing to evaluation data are proximate to natural cloud properties.
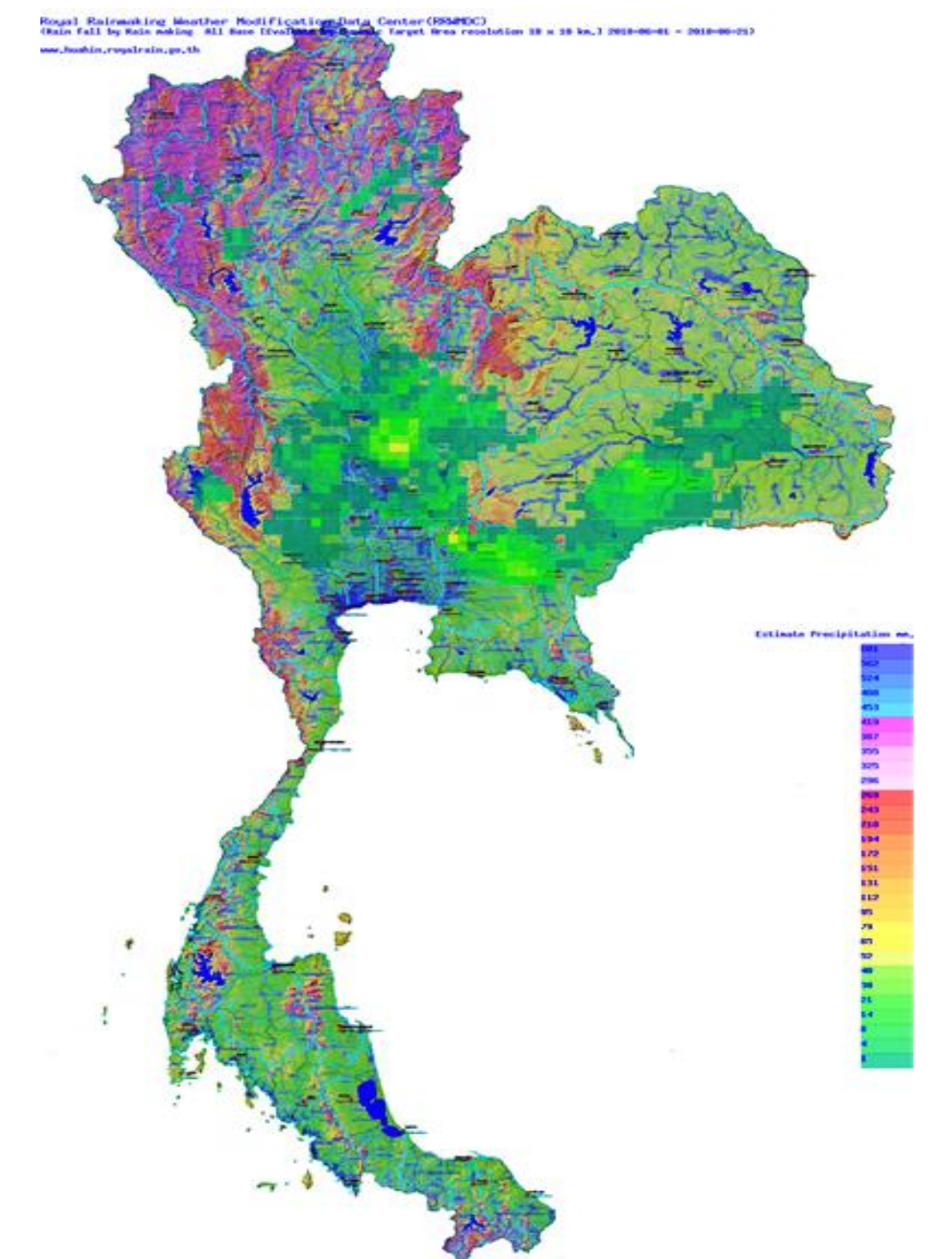

Figure 13 Royal Rainmaking's beneficial area

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