The Development of Upperair Thailand Cumulus Modeling (TCM)
Case study: Upper Northern, Central, Eastern and Northeastern parts of Thailand

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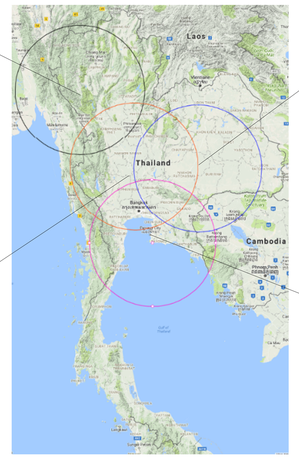
Introduction

Thailand weather modification planning, especially rain enhancement, requires reliable daily weather data of upperair indices which is usually measured every morning at 00 UTC using radiosonde. Data from daily radiosonde have been interpreted and used for warm cloud seeding potential forecasting. However, the overall forecasting and instability indices of current using models are still unreliable and unsuitable for each regions of Thailand, due to the variation of topography and climatic difference. Therefore, the study of upperair indices and new model development have been conducted during year 2012 – 2015, to find regional upperair indices for each part of Thailand and develop the better warm cloud seeding models to support the daily rain enhancement activities.

DRRAA radar site, Omkoi, Chiangmai



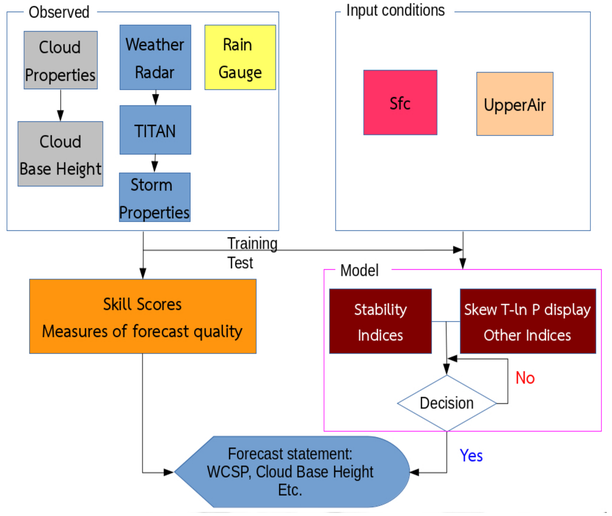
DRRAA radar site, Pimai Nakornratchasima

DRRAA radar site, Takli, Nakornsawa

DRRAA radar site,Sattahip Rayong

Radar sites of Study Area in Upper Northrn, Central, Eastern and Northeastern parts of Thailand

Methods



Conceptual Framework

Data from year 2012-2015 are separated into dry (15.Oct – 14.May) and Wet season (15.May – 14.Oct). Upperair data gathering from 4 weather stations of Department of Royal Rainmaking and Agricultural Aviation (DRRAA), had been used as training data to model. Whereas, storm properties derived from DRRAA's 4 weather radar stations and rainfall amount data from rain gauge networks of Thai meteorological department (TMD) and Hydro and Agro Informatics Institute (HAII) installed within each radar measured ranges had been used as observed data for validation (Test data). Correlation coefficient ® statistics is used for upperair indices selection. The statistical comparison of new and old model had been made using skill score of Heidke and Peirce Skill Score (HSS), Peirce Skill Score (PSS), Gandin-Murphy Skill Score (GMSS) and accuracy.

Results

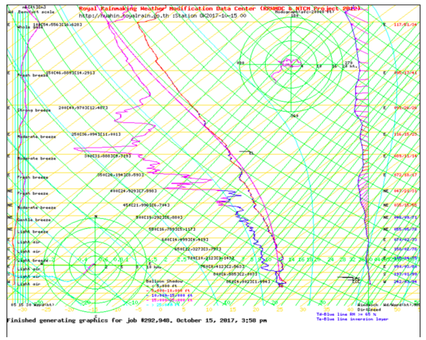
Table 1 : Input Regional Parameters for models

Model	Rainy Season	Dry Season
GPCM (Old Model)	8	8
NTCM (Upper North Model)	9	9
CTCM (Central Model)	11	27
ETCM (East Model)	13	44
ITCM (Northeast Model)	8	20

Table 2 :Forecast accuracy of models in percentage

Season	% of Forecast Accuracy							
	NTCM	GPCM	CTCM	GPCM	ETCM	GPCM	ITCM	GPCM
Dry Season (15.Oct – 14.May)	45.5	66.7	53.3	40.0	43.6	20.0	67.70	67.03
Rainy Season (15.May – 14.Oct)	39.1	3.1	49.3	27.0	48.8	32.4	69.08	61.97
Average	42.3	34.9	51.3	33.5	46.2	26.2	68.39	64.50

The models developed from this study have been shown in DRRAA intranet fro daily decision making of operation scientists. The model illustrate in 2 sections one is skew T ln P and second part is indices and WCSP forecasting.



SKEW T ln-P from TCM

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NCAPESfc (Normalized for CAPESfc)              = 0.034 m/s^2
NCAPESfc_25 (Normalized for CAPESfc_25)        = 0.040 m/s^2
NCAPESfc_50 (Normalized for CAPESfc_50)        = 0.037 m/s^2
NCAPESfc_100(Normalized for CAPESfc_100)       = 0.025 m/s^2
NCAPESfc_150(Normalized for CAPESfc_150)       = 0.020 m/s^2
NCAPE850 (Normalized for CAPE850)              = 0.024 m/s^2
NCAPE850_800 (Normalized for CAPE850_800)      = 0.024 m/s^2
NCAPE850_750 (Normalized for CAPE850_750)      = 0.027 m/s^2
NCAPE925 (Normalized for CAPE925)              = 9999 m/s^2

Wet bulb Zero Heights                  = 16018 ft

Thickness sfc - 500 mb                 = 4731 m.
Thickness 850 - 500 mb                 = 4391 m.

SFC Max Temp Previous Day= 9999 c

Northern Thailand s upperair forcast by NTCM(Omkoi Station)
Harn Cloud Seeding Experimental Day Declaration Criteria
Wet season jd=208 gd=2017-10-15
Max ,Min Criteria = 9,-45
WCSC all_fiCCLpMean150=9026/-5
WCSC RHCCLMean50=97/1
WCSC AVGRH0_10KFT=86.4320/1
WCSC AVGRH10_18KFT=75.0670/0
WCSC LI50mbLayer500=-1.35/0
WCSC SI850_800mbLayerDif500mb=-0.02/1
WCSC CAPE850_800=159/-5
WCSC TTI=43.6/0
WCSC CINmean75 TmaxPD=,20.96/-5
Harn Cloud Seeding Potential= Good/-12/61%/1
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Upperair Indices calculated results and WCSP forecast

Conclusions

According to results of study, old models have 8 input indices in dry and wet season, upper northern part has 9 input indices in dry season and 9 input indices in wet season, central part has 27 input indices in dry season and 11 input indices in wet season, eastern part has 44 input indices in dry season and 13 input indices in wet season, and north eastern part has 10 input indices in dry season and 7 input indices in wet season. Therefore, the implication upperair indices are difference in each regions and season. Statistical skill score performed between new and old model found out that the percentage of accuracy and scores for each region of new model are higher than old models for every scores and season.

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