

The Development of Upperair Thailand Cumulus Modeling (TCM)

Case study: Upper Northern, Central, Eastern and Northeastern parts of Thailand

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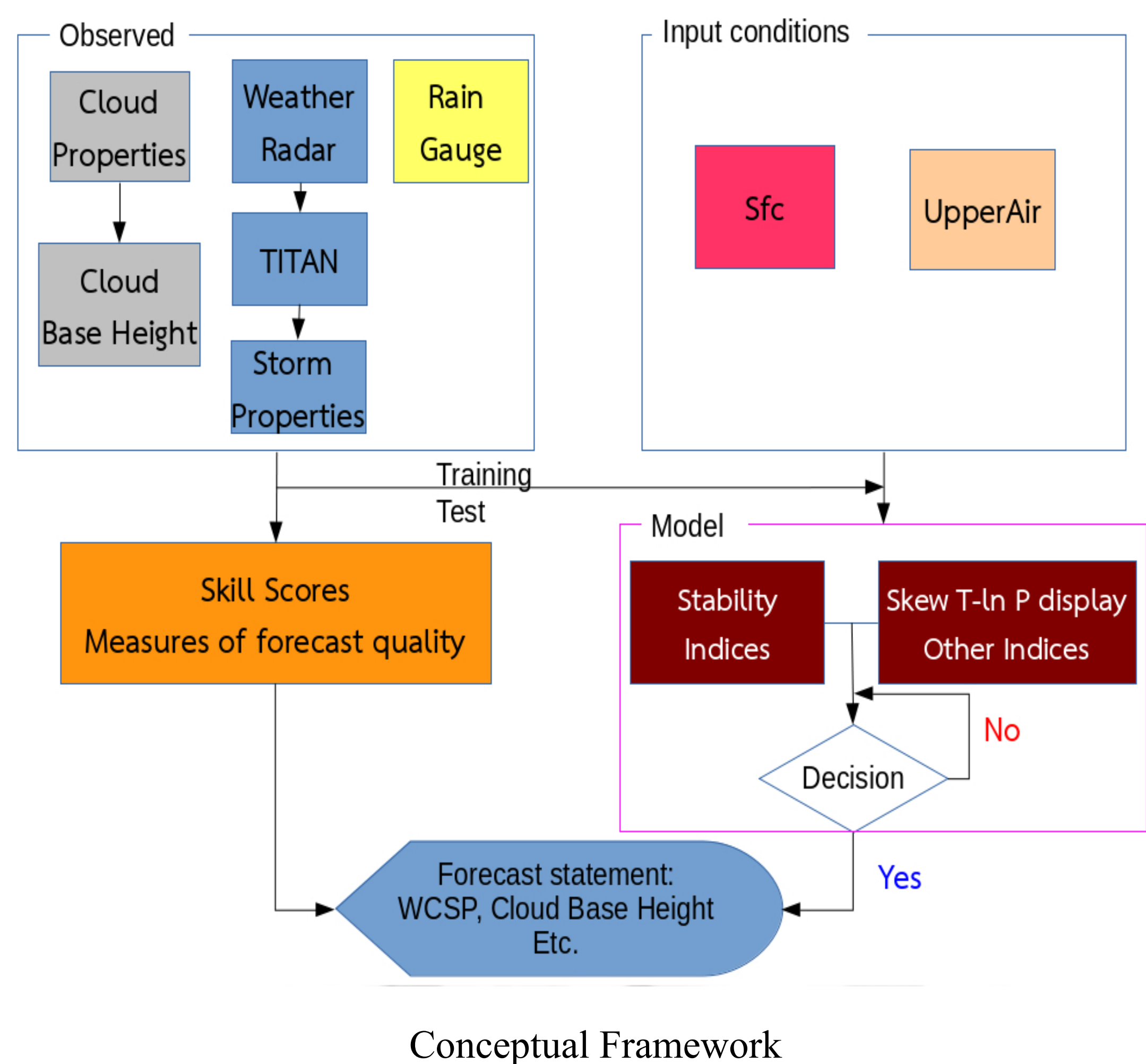
Introduction

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.



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

Methods



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 (HAI) 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

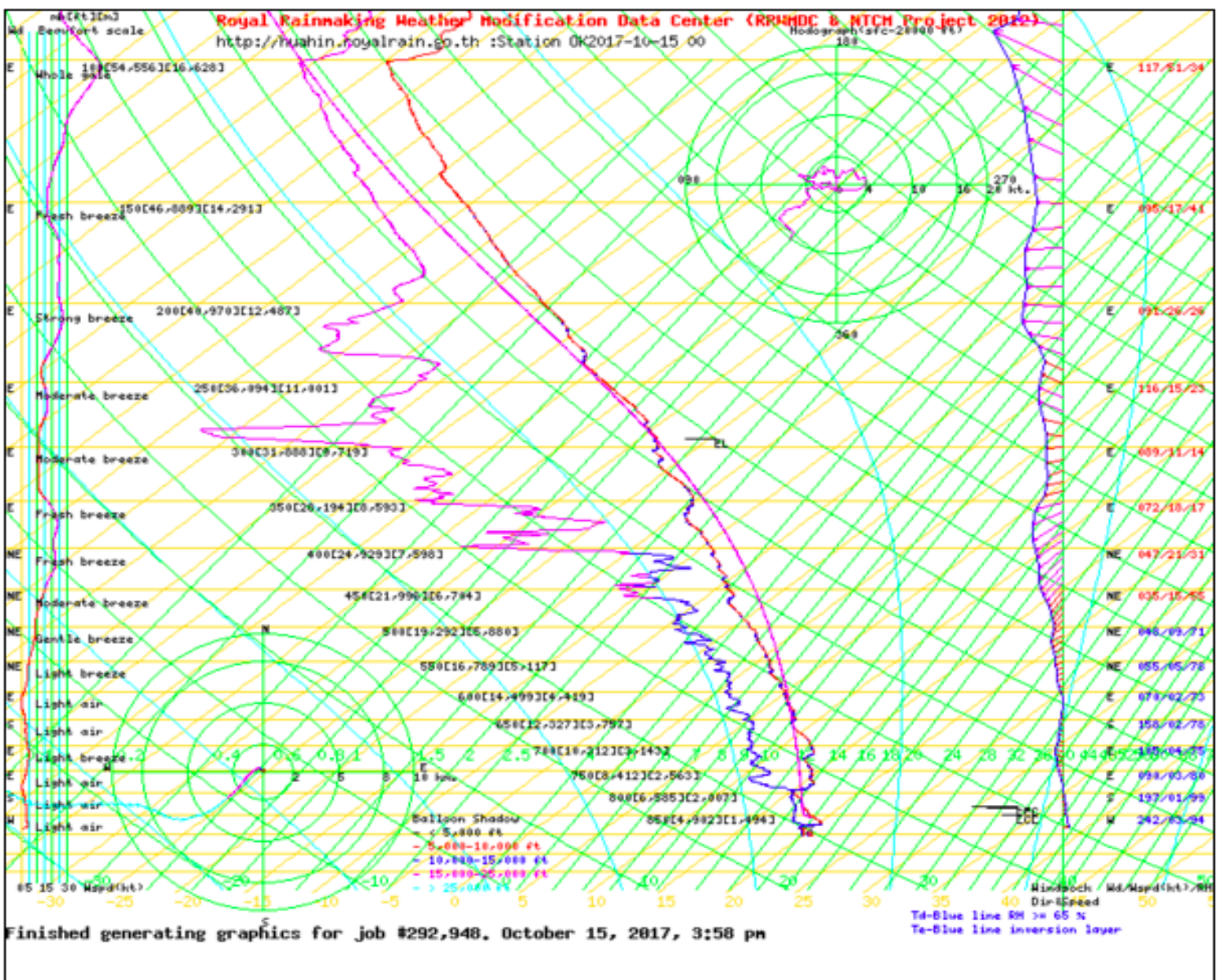
Table 1 : Input Regional Parameters for models

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_12600 (Normalized for CAPESfc_12600) = 0.027 n/s^2
NCAPESfc_12650 (Normalized for CAPESfc_12650) = 0.027 n/s^2
NCAPESfc_12700 (Normalized for CAPESfc_12700) = 0.027 n/s^2
NCAPESfc_12750 (Normalized for CAPESfc_12750) = 0.027 n/s^2
NCAPESfc_12800 (Normalized for CAPESfc_12800) = 0.027 n/s^2
NCAPESfc_12850 (Normalized for CAPESfc_12850) = 0.027 n/s^2
NCAPESfc_12900 (Normalized for CAPESfc_12900) = 0.027 n/s^2
NCAPESfc_12950 (Normalized for CAPESfc_12950) = 0.027 n/s^2
NCAPESfc_13000 (Normalized for CAPESfc_13000) = 0.027 n/s^2
NCAPESfc_13050 (Normalized for CAPESfc_13050) = 0.027 n/s^2
NCAPESfc_13100 (Normalized for CAPESfc_13100) = 0.027 n/s^2
NCAPESfc_13150 (Normalized for CAPESfc_13150) = 0.027 n/s^2
NCAPESfc_13200 (Normalized for CAPESfc_13200) = 0.027 n/s^2
NCAPESfc_13250 (Normalized for CAPESfc_13250) = 0.027 n/s^2
NCAPESfc_13300 (Normalized for CAPESfc_13300) = 0.027 n/s^2
NCAPESfc_13350 (Normalized for CAPESfc_13350) = 0.027 n/s^2
NCAPESfc_13400 (Normalized for CAPESfc_13400) = 0.027 n/s^2
NCAPESfc_13450 (Normalized for CAPESfc_13450) = 0.027 n/s^2
NCAPESfc_13500 (Normalized for CAPESfc_13500) = 0.027 n/s^2
NCAPESfc_13550 (Normalized for CAPESfc_13550) = 0.027 n/s^2
NCAPESfc_13600 (Normalized for CAPESfc_13600) = 0.027 n/s^2
NCAPESfc_13650 (Normalized for CAPESfc_13650) = 0.027 n/s^2
NCAPESfc_13700 (Normalized for CAPESfc_13700) = 0.027 n/s^2
NCAPESfc_13750 (Normalized for CAPESfc_13750) = 0.027 n/s^2
NCAPESfc_13800 (Normalized for CAPESfc_13800) = 0.027 n/s^2
NCAPESfc_13850 (Normalized for CAPESfc_13850) = 0.027 n/s^2
NCAPESfc_13900 (Normalized for CAPESfc_13900) = 0.027 n/s^2
NCAPESfc_13950 (Normalized for CAPESfc_13950) = 0.027 n/s^2
NCAPESfc_14000 (Normalized for CAPESfc_14000) = 0.027 n/s^2
NCAPESfc_14050 (Normalized for CAPESfc_14050) = 0.027 n/s^2
NCAPESfc_14100 (Normalized for CAPESfc_14100) = 0.027 n/s^2
NCAPESfc_14150 (Normalized for CAPESfc_14150) = 0.027 n/s^2
NCAPESfc_14200 (Normalized for CAPESfc_14200) = 0.027 n/s^2
NCAPESfc_14250 (Normalized for CAPESfc_14250) = 0.027 n/s^2
NCAPESfc_14300 (Normalized for CAPESfc_14300) = 0.027 n/s^2
NCAPESfc_14350 (Normalized for CAPESfc_14350) = 0.027 n/s^2
NCAPESfc_14400 (Normalized for CAPESfc_14400) = 0.027 n/s^2
NCAPESfc_14450 (Normalized for CAPESfc_14450) = 0.027 n/s^2
NCAPESfc_14500 (Normalized for CAPESfc_14500) = 0.027 n/s^2
NCAPESfc_14550 (Normalized for CAPESfc_14550) = 0.027 n/s^2
NCAPESfc_14600 (Normalized for CAPESfc_14600) = 0.027 n/s^2
NCAPESfc_14650 (Normalized for CAPESfc_14650) = 0.027 n/s^2
NCAPESfc_14700 (Normalized for CAPESfc_14700) = 0.027 n/s^2
NCAPESfc_14750 (Normalized for CAPESfc_14750) = 0.027 n/s^2
NCAPESfc_14800 (Normalized for CAPESfc_14800) = 0.027 n/s^2
NCAPESfc_14850 (Normalized for CAPESfc_14850) = 0.027 n/s^2
NCAPESfc_14900 (Normalized for CAPESfc_14900) = 0.027 n/s^2
NCAPESfc_14950 (Normalized for CAPESfc_14950) = 0.027 n/s^2
NCAPESfc_15000 (Normalized for CAPESfc_15000) = 0.027 n/s^2
NCAPESfc_15050 (Normalized for CAPESfc_15050) = 0.027 n/s^2
NCAPESfc_15100 (Normalized for CAPESfc_15100) = 0.027 n/s^2
NCAPESfc_15150 (Normalized for CAPESfc_15150) = 0.027 n/s^2
NCAPESfc_15200 (Normalized for CAPESfc_15200) = 0.027 n/s^2
NCAPESfc_15250 (Normalized for CAPESfc_15250) = 0.027 n/s
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