

Electronic Documentation Form

1. Report Title and Type (Thesis/Research Study/Dissertation/Project)

Title: MONITORING AGRICULTURAL DROUGHT USING MODIS TEMPERATURE VEGETATION DRYNESS INDEX IN MAE NAM CHI BASIN, THAILAND.

Type: Thesis

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4. **Field of Study: Remote Sensing and Geographic Information System.**

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6. **External Examiner (for Dissertations only)**

7. **Expert Comments on the Work and Facility for the Feedback from the Users**

8. Abstract of the Work

Drought occurs when there is lack of water in a particular area and is usually caused by reduced amount of rainfall over that particular area. The impact of drought is usually noticed in the agricultural land only on its onset. For that reason agricultural drought monitoring in near-real time is very important.

This research brings a method of predicting drought and monitoring its severity in near real time using Terra MODIS images. Terra MODIS images with reflective band of 250 m resolution and thermal infrared band of 1 km resolution with high temporal frequency data were used in this study. The satellite images from 2001 to 2003 were analyzed. The temperature vegetation dryness index (TVDI), which integrates normalized difference vegetation index and land surface temperature was used to detect surface moisture and in monitoring drought in Mae Nam Chi basin. Year 2003 has higher TVDI value while, 2001 has lower TVDI value when compared within the analysis years. Accordingly the same year (2003) received less rainfall compared to other years and was declared drought year where as 2001 was a normal year.

The difference NDVI (DEV_{NDVI}) was selected to develop the model for drought risk prediction. TVDI and DEV_{NDVI} were used to detect drought occurrence during the dry season and was found to be reliable. A verification drought index when compared with the drought risk map shows a significant correlation than annual rainfall during dry season. However during hot season TVDI shows significant correlation than DEV_{NDVI}

when compared with drought risk level but it has no correlation with annual rainfall with both.

TVDI and DEV_{NDVI} were used to compute drought risk prediction model using linear regression during the dry season. The model was tested with the data collected within 2001 to 2003. 19th October as the starting of dry season of every year was considered for compare on of the difference in the results. The results showed that the value for 2003 was much higher than other two years at the beginning of dry season; hence it was declared severe drought year. The model was also applied to the recent data collected on 18th February 2005 as it can illustrate drought risk area during present time. Validation assessment of the model with monthly rainfall proved to be reliable for drought monitoring and perdition. This model proved useful for near real time drought monitoring and prediction. However some limitation has to be considered as the model here was applied to non irrigated land areas.

9. Keywords (minimum 5; maximum 10)

Agricultural drought, MODIS, NDVI, LST, TVDI, DEV_{NDVI} .

10. Bibliographic data

Andersen J. et. al. 2002. *Perspectives in using a remotely sensed dryness index in distributed hydrological models at the river-basin scale*. Hydrological Process. 16, 2973-2987.

Al-Bakri J.T. and Suleiman A.S. 2004. *NDVI response to rainfall in different ecological Zones in Jordan*. International Journal of Remote Sensing 25(19), 3897-3912

Carlson Toby N. et. al. 1995. *An interpretation of methodologies for indirect measurement of soil water content*. Agricultural and Forest Meteorology 77, 191-205.

Changyao Wang. et. al. 2004. *Evaluating soil moisture status in China using the temperature-vegetation dryness index (TVDI)*. Can. J. Remote Sensing 30(5), 671-679.

Eileen L. Penaflor. 2003. *Environmental Investigation at Tone le Sap Lake Using MODIS and ground Truth Data*. . Asian Institute of Technology. Bangkok. Thailand.

Foody G.M. 2003. *Geographical weighting as a further refinement to regression modeling: An example focused on the NDVI-rainfall relationship*. Remote Sensing of Environment 88, 283-293.

Gillies, R. R., Carlson, T. N., Cui, J., Kustas, W. P., and Humes, K. S., 1997, *A verification of the 'triangle' method for obtaining surface soil water content and energy fluxes from remote measurement of the Normalized Difference*

- Vegetation Index (NDVI) and surface radiant temperature*. International Journal of Remote Sensing, 18, 3145-3166
- Lei, Ji., Albert, J. Peters, 2003, *Assessing vegetation response to drought in the northern Great Plains using vegetation and drought indices*. Remote Sensing of Environment, 87, 85-98
- Mongkholsawat. C., 2001. *An Evaluation of Drought Risk in Northeast Thailand using Remote Sensing data and GIS*, Computer Center, Faculty of Agriculture, Khon Kaen University, Thailand
- Murat Karabulut. 2003. *An examination of relationships between vegetation and rainfall using maximum value composite AVHRR-NDVI data*. Turk J Bot 27, 93-101
- Narongrit. C., 2000. *Land cover classification in Thailand using a combination of vegetation index and day and night time thermal bands of NOAA-AVHRR*. Asian Institute of Technology. Bangkok. Thailand.
- National Drought Mitigation Center.,1996, Article: *Categories of Drought Definitions*, <http://www.enso.unl.edu/ndmc.enigma>
- N.R.Patel and P.Endang. 2003. *Spatial Variability Estimation of Moisture Index for classifying Agroclimates in Kumaon Himalaya*. Asian Journal of Geoinformatics 4(1),53-59
- Office of Natural Resource and Environmental Policy and Planning. 2003, *The State of Environment Report*. <http://www.onep.go.th>
- Prathumchai, K. 1999. *Assessment of Drought Risk Using Remote Sensing and GIS A Case Study in Lop Buri Province, Thailand*. Asian Institute of Technology. Bangkok. Thailand.
- Ping Zhang. et. al. 2004. *Climate-related vegetation characteristics derived from Moderate Resolution Imaging Spectroradiometer (MODIS) leaf area index and normalized difference vegetation index*. Journal of geophysical research 109
- Preesan Rakwatin. 2003.*Evaluation of Cloud Coverage in Indochina Peninsular Using Terra MODIS Data*. Asian Institute of Technology. Bangkok Thailand.
- Qin, Z. and A. Karmieli. 1999. *Review Article: Progress in the Remote Sensing of Land Surface Temperature and Ground Emissivity Using NOAA-AVHRR Data*. International Journal of Remote Sensing 20 (12), 3367-2393
- Ramesh P. Singh, Sudipa Roy and F. Kogan. 2002, *Vegetation and temperature*

- condition indices from NOAA AVHRR data for drought monitoring over India*
Rizatus Shofiyati 2001, *Agricultural Drought Monitoring and Assessment Using Remote Sensing and GIS: An Application for Upper Brantas Watershed, Indonesia*. Asian Institute of Technology. Bangkok. Thailand.
- Samuel, N., Goward., Yongkang Xue., and Kevin, P. Czajkowski., 2002, *Evaluating land surface moisture condition from the remotely sensed temperature/vegetation index measurement and exploration with the simplified simple biosphere model*. *Remote Sensing of Environment*, 79, 225-242
- Sanholt, I., Pasmussen, K., and Anderson, J., 2002, *A simple interpretation of the surface temperature/vegetation index space for assessment of the surface moisture status*. *Remote Sensing of Environment*, 79, 213-224
- Tian G., D.L.B. Jupp, Y. Qin, T.R. McVicar, and F. Li. 1998. *Monitoring Soil Moisture and Drought Using AVHRR Satellite Data II: Applications*. CSIRO Earth Observation Centre, Canberra, ACT.
- Sobrino, J.A., and Kharraz, J.EL., 2003, *Surface temperature and water vapour retrieval from MODIS data*. *International Journal of Remote Sensing* 24 (24), 5161-5182
- Song X. et. al. 2004. *Early detection system of drought in East Asia using NDVI from NOAA/A VHRR data*. *Remote Sensing* 25, 3105-3111.
- Tran Hung and Yasuoka Yoshifumi 2003. *MODIS applications in environmental change researches in the Indochina region*.
- Wilhite, D.A. 2000. *Drought as a natural hazard: Concepts and definitions*.
- Wan, Z.-M., and Dozier, J., 1996, *A generalized split-window algorithm for retrieving land surface temperature from space*. *IEEE Transactions on Geoscience and Remote Sensing*, 34, 892-905
- Wan, Z., Wang, P., and Li, X., 2004. *Using MODIS Land Surface Temperature and Normalized Difference Vegetation Index products for monitoring drought in the southern Great Plains, USA*. *International Journal of Remote Sensing* 25 (1), 61-72
- Wan, Z.-M., and Li, Z., 1997, *A physics-based algorithm for retrieving land surface emissivity and temperature from EOS/MODIS data*. *IEEE Transactions on Geoscience and Remote Sensing*, 35, 980-996
- Wen-Cheng Huang and Lun-Chin Yuan. 2004. *A drought early warning system on real-time multireservoir operations*. *Water Resources Research* 40, 1-13.

Internet Sources

<http://www.calmit.unl.edu>

<http://www.cossa.csiro.au>

<http://www.crisp.nus.edu.sg>

<http://edcdaac.usgs.gov/modis/dataproducts.asp>

<http://www.iwmi.cgiar.org>

11. Type of Project (Sponsored/Non-Sponsored), if applicable

Sponsored

12. Details of the Sponsor/Donor, if applicable

Donor: Ministry of Agricultural and Cooperative of Thailand

13. Specific Agreement involved in the Sponsorship Agreement; if applicable

None

14. AIT Code Number