CONFERENCE PROCEEDING

Developing Model for Predicting Land Surface Temperature Change in The Three Southernmost Provinces of Thailand Using MODIS data

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ABSTRACT

The objectives of this study were (i) to analyze the seasonal pattern and trend of land surface temperature (LST) change in the three southernmost provinces of Thailand (ii) to investigate the suitable models for predicting an average temperature in the three southernmost provinces of Thailand, and (iii) to evaluate the predicting performance of constructed models by using root mean square error (RMSE). The observation data used in this study were obtained from MODIS LST Data in NASA website which were collected every 8 days during January 1, 2001 to December 31, 2020 .Time lags of Land Surface Temperature has been used for being predicting variable and Land Surface Temperature as an outcome of the proposed model.The accuracy of proposed model has been evaluated by using Root Mean Square Error (RMSE). All finding results detail will be described later in the extended abstract. However, it cannot be guaranteed that the same performance for each model will be the same for other study areas.

Keywords: *Land Surface Temperature, Predicting Models, Simple Linear Regression, Multiple Linear Regression, Natural Cubic Spline*

INTRODUCTION

Land surface temperature change is one of the greatest concerns among human race. It has been reported in various research that temperature change could have significant impact on both crop yields and animal production.While a short term forecast could provide us a quick response to the change.In this project, LST temperature change of the three southernmost provinces of Thailand was investigated. Firstly, its trend was analyzed by fitting simple linear regression to the seasonally adjusted LST. Then by applying the cubic spline method, a shorter tendency of LST change was produced. After that, ARIMA model was used to fitting and obtaining an equation model for forecasting.

MATERIALS AND METHODS

Firstly, the trend of LST was analyzed by Simple linear regression (SLR) which is of the form

$$\hat{y} = a + bt$$

where $\hat{y}$ is the predicted LST, t is time, a is the intercept, and b is the regression coefficient of time. A straight line given by SLR provides the tendency of LST change in the future.The cubic spline function is a function of the form.where t is time, $a, b, c_1, \dots, c_{p-2}$ are the coefficients, p is the number of knots, t_k is time at knot k and

$(x)_+$ is a positive function giving the value of $\max(x, 0)$.Finally, ARIMA model was applied as a predictive model for forecasting. In general, the model is equipped with 3 parameters as ARIMA (p, d, q), where p is the order of the AR term, d is the number of differencing required to make the LST stationary, and q is the order of the MA term.

$$s(t) = a + bt + \sum_{k=1}^{p-2} c_k \left[(t - t_k)_+^3 - \left(\frac{t_p - t_k}{t_p - t_{p-1}} \right) (t - t_{p-1})_+^3 + \left(\frac{t_{p-1} - t_k}{t_p - t_{p-1}} \right) (t - t_p)_+^3 \right]$$

RESULTS, DISCUSSION AND CONCLUSIONS

The SLR gives a slightly decreasing trend as $\hat{y} = 28.56100 - 0.000092t$ having a negative slope. As each observation if of 8 days, this means the LST would decrease 0.000092 degrees Celsius every 8 days. After 2020, the LST is likely to continue decreasing. However, by the nature of the cubic function, at some time in the future the LST would stop decreasing and bounce back to increase again. The 95% confidence interval of each day of observation throughout the last 20 years shows that the first 4-6 observations of each year, the LST is significantly below the overall means, as well as, the last 4-8 observations of the year. The ARIMA(2,0,0) fitting to the training LST produced

$$\hat{y}_t = 6.045266 + 0.349295y_{t-1} + 0.4386254y_{t-2}$$

The result gives RMSE of 1.177144 and 1.219618 for the former and latter sets, respectively.

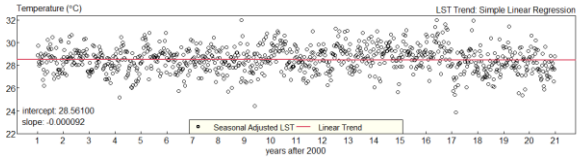

Figure 1: A linear trend of LST given by SLR showing a slightly negative tendency

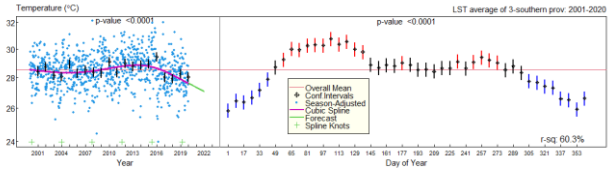

Figure 2: A shorter period of future trend given by cubic spline function (left panel) suggesting a negative tendency. The 95% confidence interval of each day of observation (right panel) showing days in which the LST is higher or lower the overall average LST for the last 20 years

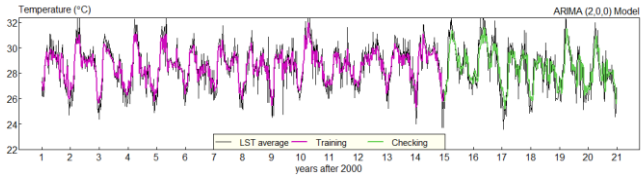

Figure 3: ARIMA(2,0,0) fits to training set (magenta) and checking set (green)

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REFERENCES

Arenas-Castro, S., Gonçalves, J. F., Moreno, M., & Villar, R. (2020). Projected climate changes are expected to decrease the suitability and production of olive varieties in southern Spain. Science of The Total Environment, 709, 136161

Das, J., Poonia, V., Jha, S., & Goyal, M. K. (2020). Understanding the climate change impact on crop yield over Eastern Himalayan Region: ascertaining GCM and scenario uncertainty. Theoretical and Applied Climatology, 142(1), 467-482

Gao, J., Yang, X., Zheng, B., Liu, Z., Zhao, J., Sun, S., ... & Dong, C. (2019). Effects of climate change on the extension of the potential double cropping region and crop water requirements in Northern China. Agricultural and Forest Meteorology, 268, 146-155.

Kao, Y. C., Rogers, M. W., Bunnell, D. B., Cowx, I. G., Qian, S. S., Anneville, O., ... & Young, J. D. (2020). Effects of climate and land-use changes on fish catches across lakes at a global scale. Nature communications, 11(1), 1-14

Liu, Z., Cuo, L., Li, Q., Liu, X., Ma, X., Liang, L., & Ding, J. (2020). Impacts of Climate Change and Land Use/Cover Change on Streamflow in Beichuan River Basin in Qinghai Province, China. Water, 12(4), 1198

Samie, A., Abbas, A., Azeem, M. M., Hamid, S., Iqbal, M. A., Hasan, S. S., & Deng, X. (2020). Examining the impacts of future land use/land cover changes on climate in Punjab province, Pakistan: implications for environmental sustainability and economic growth. Environmental Science and Pollution Research, 27(20), 25415-25433