CHAPTER 5 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Although climate models are able to predict climate change over a long time period, it is difficult to determine the predictability. Lyapunov exponent (LE) is one of the most widely used qualitative measures of predictability and has verified to be the most useful dynamical diagnostic for chaotic systems.

This research is interested in predictability of surface air temperature by the Educational Global Climate Model (EdGCM) in simulating Earth's atmosphere response to increase in greenhouse gases. Five initial conditions with different levels of carbon dioxide are generated from EdGCM to test the predictability. The domain of study is Southeast Asian region between latitude 4° S to 28° N and longitude 95° E to 115° E. The period of study is the month of April for the years 2010 to 2100. Many methods based on LE; finite size Lyapunov exponent, finite time Lyapunov exponent, local Lyapunov exponent, maximum Lyapunov exponent and supremum Lyapunov exponent are used to measure the predictability. A new method, namely modified Lyapunov exponent (MoLE) is established as an additional predictability measurement. The results show that MoLE agrees with most of existing methods and indicate that predictability of surface air temperature by EdGCM decreases with increasing level of carbon dioxide, with the maximum predictability about 110 years.

In addition, two initial conditions of increasing level of methane together with increasing level of carbon dioxide are generated to further test the impact of the greenhouse gases on predictability. The results show that predictabilities of the greenhouse gases do not show significant differences. The measurement by MoLE again agrees with other methods and the maximum predictability is about 110 years. All results also imply a good performance of EdGCM.

The objective of this research is to investigate the predictability of Southeast Asia regional climate change by a EdGCM using a modified Lyapunov exponent method. Summary of the main results is shown in Tables 5.1.

Table 5.1 Summary of predictability measurement of surface air temperature from EdGCM for all experiments.

Method	**Predictability (years)**						
	PER1	**PER2**	**PER3**	**PER4**	**PER5**	**PER6**	**PER7**
LE	100	90	100	80	60	100	90
FSLE	100	90	100	110	100	90	90
MLE	110	100	90	90	80	100	100
SLE	110	110	110	90	70	100	90
MoLE	110	110	90	80	60	100	90
Time period	100-110	90-110	90-110	80-110	60-100	90-100	90-100

5.2 Recommendation

1. Effects of other greenhouse gases such as N_2O, CFC-11 and CFC-12 should be studied.
2. More experiment cases for different seasons should be investigated.