

INFORMATION OF DOCTORAL DISSERTATION

Thesis Title: **A research on the effect of the Climate change and Sea level rising of Geological environment in Ho Chi Minh City.**

Major : **Địa chất công trình.**

Major Code: **62.44.65.01**

PhD Student: Ho Chi Thong (Name in Vietnamese: **Hồ Chí Thông**)

Scientific advisor:

1. **Assoc.Prof.Dr. Đậu Văn Ngộ**

Education Organization: **HCMC University of Technology – Vietnam National University Ho Chi Minh City.**

1. Dissertation Summary

Ho Chi Minh City, which has low and flat terrain, well developed canal system, and strongly influenced of semi-diurnal tide, is on downstream of estuaries of the Saigon and Dong Nai and the other wide and deep rivers. The geological environment of this area is mainly soft sediment, Quaternary, and partially saline due to sea water. These characteristics make the geological environment vulnerable to climate change –that is, sea level rise. The thesis is on the construction of Mathematical Models F28 and GMS6.5 to forecast the quantity of saltwater border movement in rivers canals and in Pleistocene aquifers, and also forecasts the changes in river-bed erosion and sedimentation, riverside erosion activities according to sea level rise scenarios 15, 30, 50, 75, 100 cm in the 21st century. When the sea level rise reaches to 100 cm, saline border in dry season on the Dong Nai River moved into the inland 6.8 km, crossing Cat Lai station, and deeply into 12.33km on the Saigon River deep, approaching Phu An station, threatening river-water exploiting plants. Saltwater migration on rivers and canals leads to soil saline intrusion, groundwater in Holocene sediments, and rising groundwater levels. The level of saltwater border migration in the Pleistocene aquifers decreased from upper to lower. Riverbed sediment- erosion gyration damages the shoreline when sea level rise is not large, erosion is more obvious than sedimentation. This activity will be much stronger when extreme rain and flood and tide coincide in sea level rise conditions; causes serious flooding in the city if there is no flood drainage system for Sai Gon river.

Severe dry due to climate change in the context of sea level rise strongly shift the saline border. The changes of the geological environment due to Climate change - Sea level rise such as saline intrusion, groundwater rising, etc. cause negative impacts on construction works, economic activities - works, loss surface water and groundwater resources.

2. Results of the dissertation

The research results allow/ help to withdraw the following main conclusions:

1. The geological environment in Ho Chi Minh City with the characteristics of soft quaternary sediments of large thickness and wide distribution, along with such natural geographic conditions as low and flat terrains, well developed canal –river systems, long coastline, semi-diurnal tide regime and its very deep inland influence, etc., makes this environment vulnerable under the impact to climate change – sea level rise.
2. Using various and suitable mathematical models allows the Dissertation to forecast the flooded land area, the quantity of saltwater border movement presently existing in the river – canal system and in Pleistocene aquifers, the river-bed erosion and sedimentation level, and riverside stabilization loss according to sea level rise scenarios 15, 30, 50, 75, 100 cm in the 21st century.
3. With the sea level rise scenario 1m, the flooded area on the lower section of the Saigon – Dong Nai rivers will increase from 10,451 square kilometers to more than 23,095 square kilometers, of which large areas of land in HCMC City will be flooded when there is sea level rise without sea dykes. Corresponding to the sea level rise scenario 1m, the flooded area of the city is up to 17.84% of the city area
4. With the greater sea rise level scenario, the saltwater border on the river –canal system moved deeper inland, leading to soil saline intrusion, groundwater and groundwater level rise in increasingly expanded Holocene sediments. When the sea level rise reaches 100 cm, the saline border 1g/ liter in dry season on the Dong Nai River moves into the inland 6.8 km much more, crossing Cat Lai station, and

deeply 12.33km much more on Saigon River, approaching Phu An station, crossing many locations of the existing river-water exploiting plants.

5. Riverbed sediment- erosion gyration damages the shoreline when sea level rise is not large, erosion is more obvious than sedimentation. This activity will be much stronger when extreme rain and flood and tide coincide in sea level rise conditions; causes serious flooding in the city if there is no flood drainage system for Sai Gon river. Severe dry due to climate change in the context of sea level rise strongly shift the saline border. The changes of the geological environment due to Climate change - Sea level rise such as saline intrusion, groundwater rising, etc. cause negative impacts on construction works, economic activities - works, loss surface water and groundwater resources.
6. When there is the sea level rise, the current saltwater border in the Pleistocene aquifers moves more deeply inland, narrowing the light underground water distribution; the higher the sea level rise is, the greater the quantity of the salty sea movement is, the saltwater border movement reduces from the upstream to downstream. The saltwater boundary can move 1,200 meters much more deeply inland.
7. The sea level rise causes fluctuations in the river-bed sedimentation - erosion activities, threatening the s riverbank stabilization of Saigon river section running across the City; the increase level of sedimentation – erosion is not serious, the erosion is shown much more clearly than the sedimentation. When there is the sea level rise, the velocity of the withdrawing tidal currents extends beyond the erosion-bearing velocity of the two riverbanks; the riverbank erosion, change will be strong, especially at the curved section of the river.
8. Under the condition of sea level rise, when extreme weather conditions happen, such as severe drought case making the saltwater boundary movement larger; if extreme rain and floods coincides tides, it will strongly impact the river-bed

sedimentation – erosion, riverbank erosion, with the risk of severe flood in HCMC in case there is no works of draining flood into other basin for Saigon river.

9. Changes in the geological environment in Ho Chi Minh City caused by climate change such as salinity intrusion, ground water level rise, etc., causes negative impacts on construction works, works-building activities, damages and threatens the exploitation of water, surface water and underground water resources.

3. Futher research of the dissertation

Currently, data, information regarding to forecast level of dry and extreme flood, planning of sea/ river embankment, planning of flood drainage system for Sai Gon river,... are not enough so quantitative of flood, saltwater border migration, development of erosion activities are unable to forecast when extreme weather happen due to climate change in sea levels rise conditions. Therefore, research must be implemented deeper to assess and forecast more detail regarding changes of the geological environment due to climate change - sea level rise and impacts of these changes including:

1. To determine scope and levels of rising groundwater in Holocene sediments according to sea levels rise scenarios
2. To determine level of soil saline intrusion due to sea levels rise and assess potential impacts
1. To research and assess impact levels of sea levels rise to the stable of constructions according to different scenarios.

Scientific advisors

PhD student

Assoc. Prof. Dr. Dau Van Ngo

Ho Chi Thong