International Water Resources Association
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Title "The impact assessment of climate change on groundwater resource development in the Vietnamese Mekong Delta. Case study: Tra Vinh Province"

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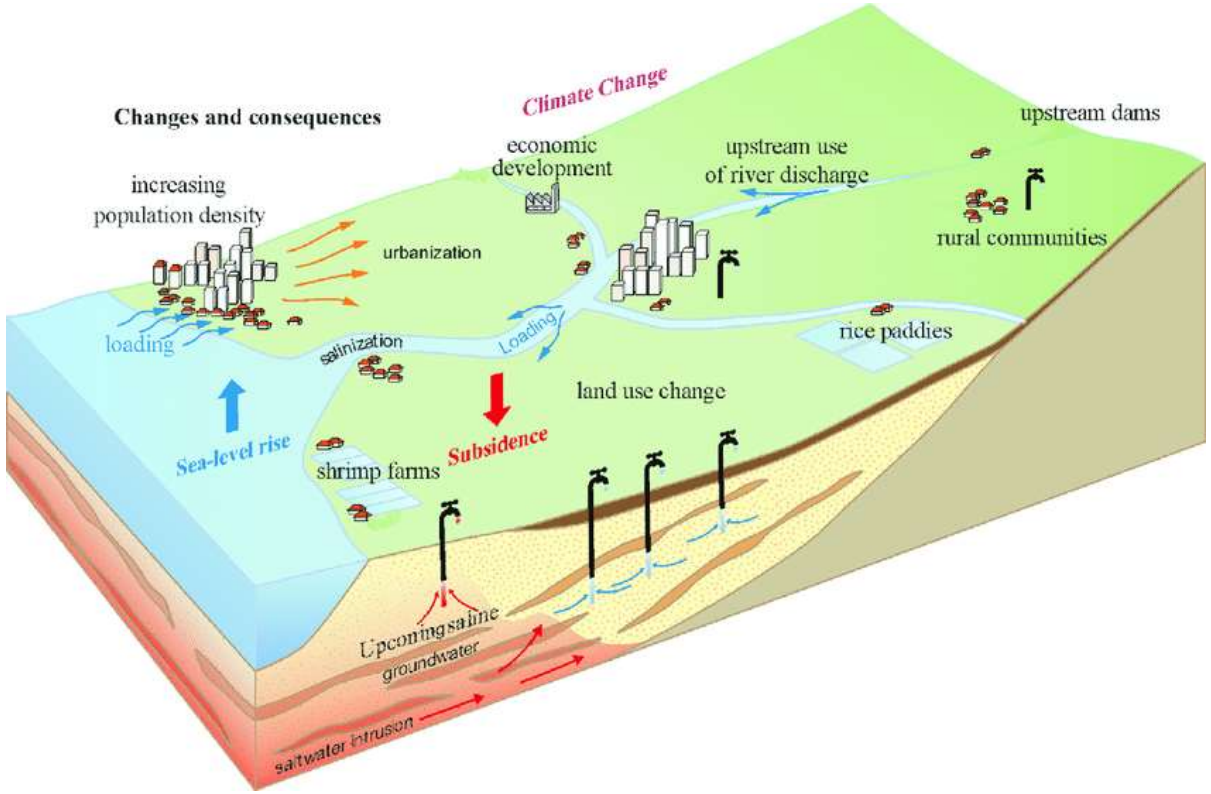
BACKGROUND

➢ GW issues

- limited renewable freshwater resources (MIE, 2013)
  dam operation, climate change
- increasing water demand in the MD (Wagner, Tran et al. 2012)
  over-abstracted (Ha, Ngoc et al. 2015, Bui T.V, 2013)
- Groundwater issues:
  groundwater depletion
  saline water intrusion
  land subsidence

"achievement of a sustainable balance between water demand and water supply is a major challenge "?

Overview of threats to coastal aquifers in the Mekong Delta,Vietnam (MKD) (Delsman, 2015)



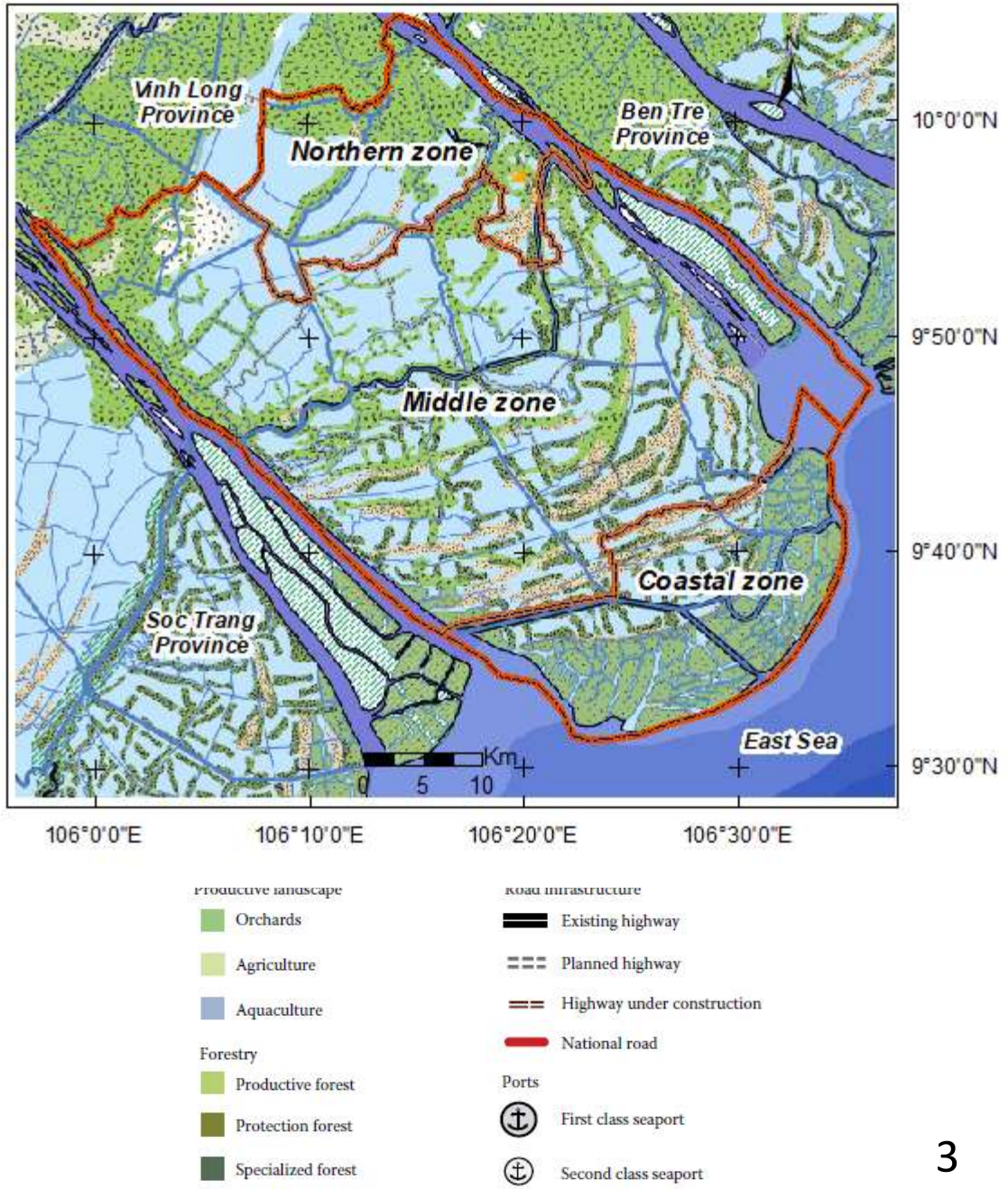
BACKGROUND

➢ Objectives

- Estimate future GW demands based on various socio-economic development and CC scenarios
- Assess the impact of GW demand scenarios on GWLs, GW storage and salinity movement

➢ Study area

- A coastal province covers 2,341 km^2
- One of the highest vulnerability area under climate change in Mekong Delta Vietnam
- Very poor province with agriculture and aquaculture is main economic activities
- Availability of fresh surface water is mainly dependent on up-stream discharge and tidal
- Three different zones: potential of water resources (Van T.P, 2020)



RESULTS

Scenarios of climate change and socioeconomical development

- Three scenarios represent three Global Circulation Models (GCMs) of medium emission (RCP 4.5), which cover the range of plausible climate change in the Lower Mekong Basin to 2030 (MRC, 2016)
- Two socio-economic scenarios: business as usual (BAU) that is to are mainly based on the existing tendency of socio-economic conditions in the study area, follow the strategy of the Mekong Delta Plan (MDP), which aims to sustainable and prosperous development in the far vision of the VMD (MIE 2013)

No.	Socio-economic development		Climate change		Combined scenarios
	Name	Description	GCMs (RCP)	Description	
1	Business as usual (BAU)	Following local plan	GISS-E2-R-CC	Drier overall (CD)	S1
2	Business as usual (BAU)	Following local plan	IPSL-CM5A_MR	Increased seasonal variability (CI)	S2
3	Business as usual (BAU)	Following local plan	GFDL-CM3	Wetter overall (CW)	S3
4	Develop as MDV master plan (DAM)	Following regional master plan	GISS-E2-R-CC	Drier overall (CD)	S4
5	Develop as MDV master plan (DAM)	Following regional master plan	IPSL-CM5A_MR	Increased seasonal variability (CI)	S5
6	Develop as MDV master plan (DAM)	Following regional master plan	GFDL-CM3	Wetter overall (CW)	S6

RESULTS

GW demand estimation

Duration without freshwater

Climate scenario	Average dry season flow in Tan Chau (1995-2004) m^3/s	Projected ratio in RCP 4.5 %	Average dry season flow (2021-2030)	Duration without freshwater at Tra Vinh (days)
Lower	3729	-25%	2,797	107
Medium	3729	8%	4,027	38
Upper	3729	30%	4,848	0

Water use proportion

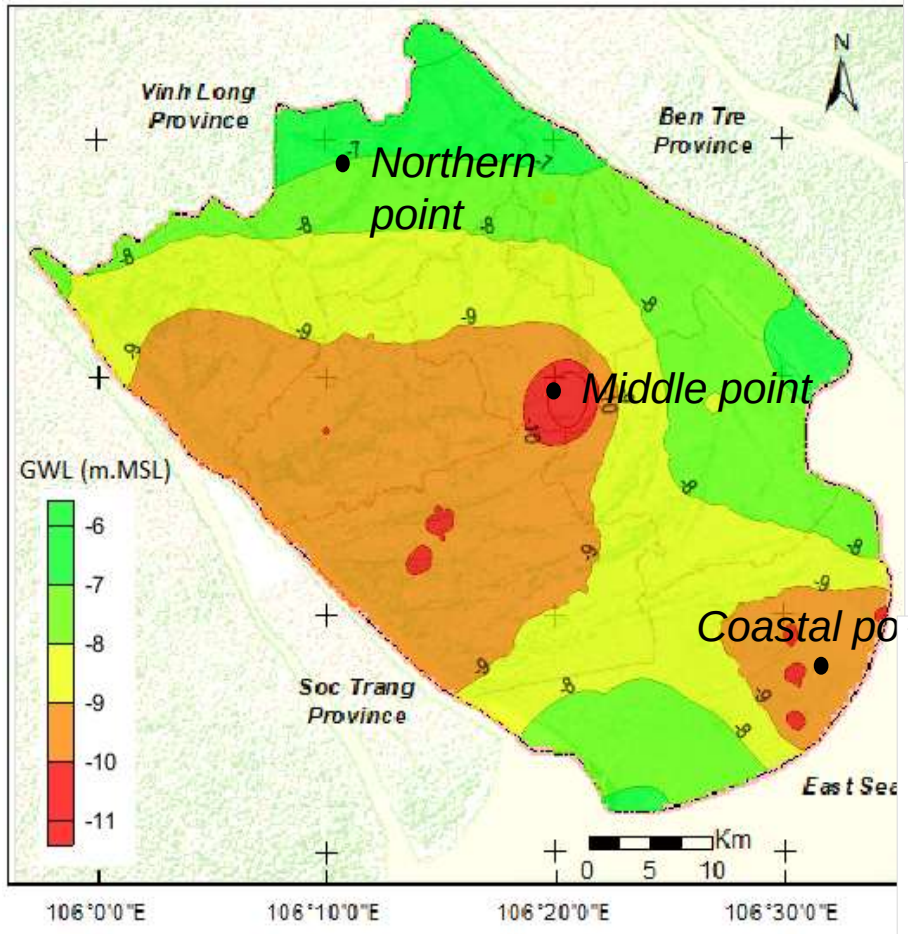
Zone	Proportion of groundwater use in dry season				Ratio of GWU in wet/dry (%)
	In domestic and industrial demand	Agriculture and aquaculture demand			
		Lower scenario	Medium scenario	Upper scenario	
Northern zone	44%	35%	13%	6%	54%
Middle zone	76%	71%	25%	13%	63%
Coastal zone	87%	100%	100%	100%	74%

GW demand

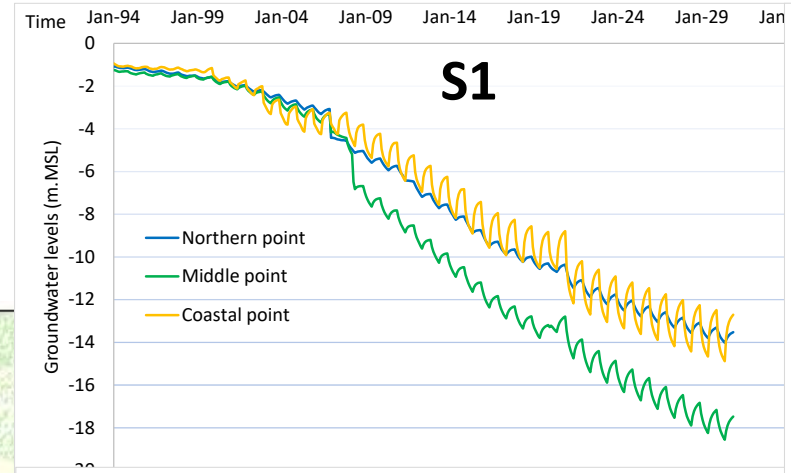
Zone	GWU estimation in 2018	Summary projected change in GW demand in next decade (%)					
		Business as usual (BAU)			Followed Mekong Delta Plan (MDP)		
		Lower (S1)	Medium (S2)	Upper (S3)	Lower (S4)	Medium (S5)	Upper (S6)
Northern zone	2.8	129%	96%	54%	61%	32%	11%
Middle zone	28.5	86%	20%	14%	13%	-41%	-44%
Coastal zone	10.6	34%	16%	8%	-29%	-54%	-65%
Total	41.8	76%	24%	16%	6%	-39%	-46%

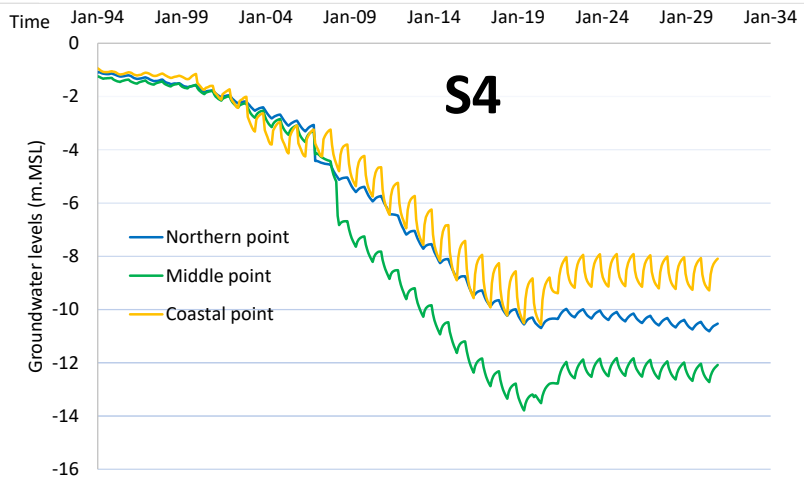
RESULTS

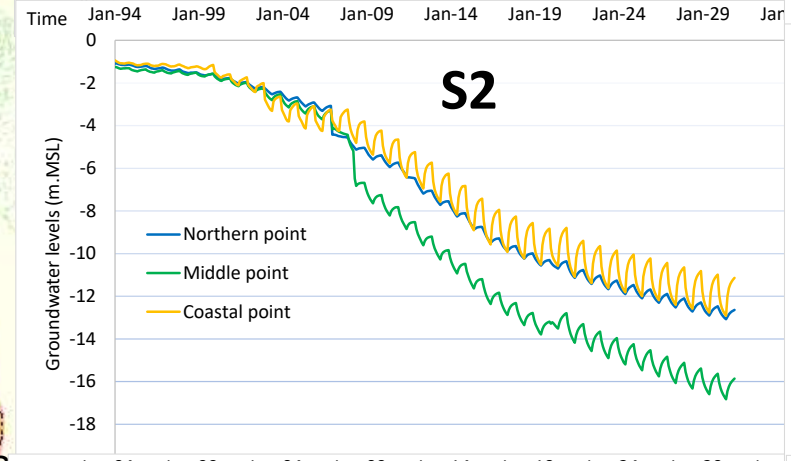
➢ GWLs change

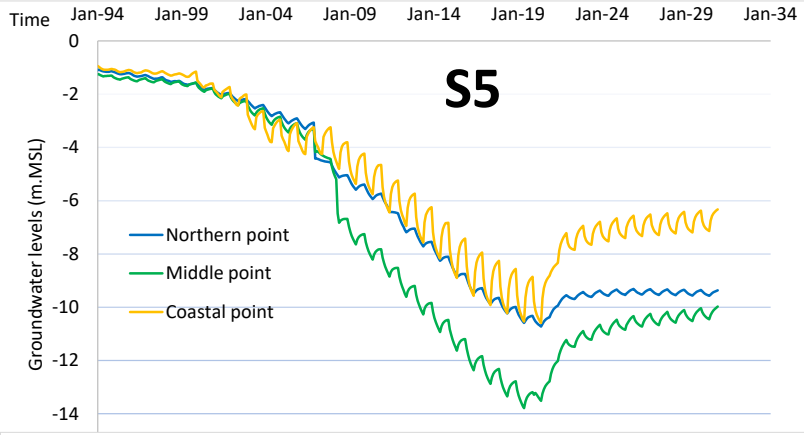


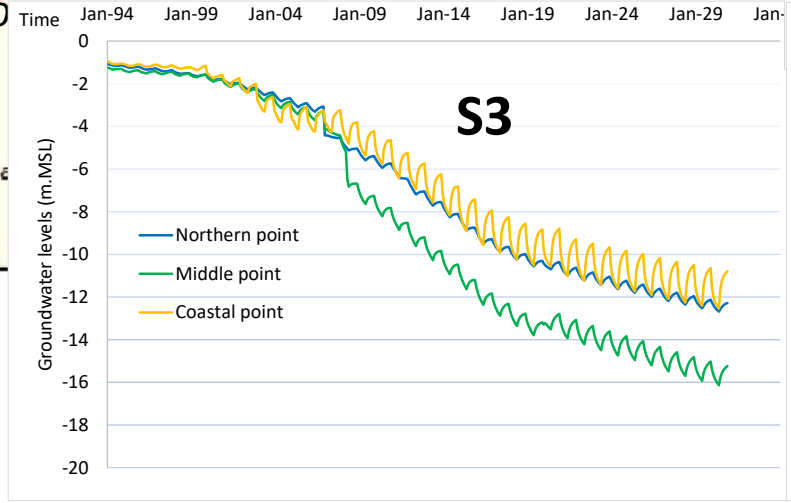
GWLs distribution of qp_{2-3} aquifer in March 2018 (Van T.P, 2020)

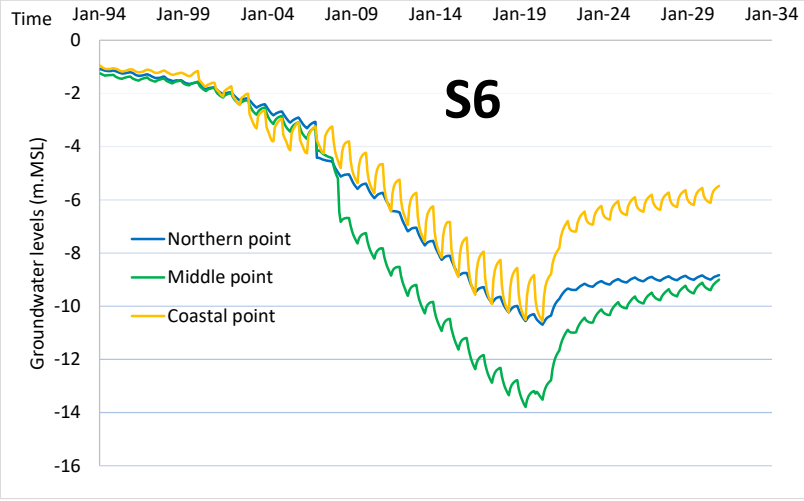








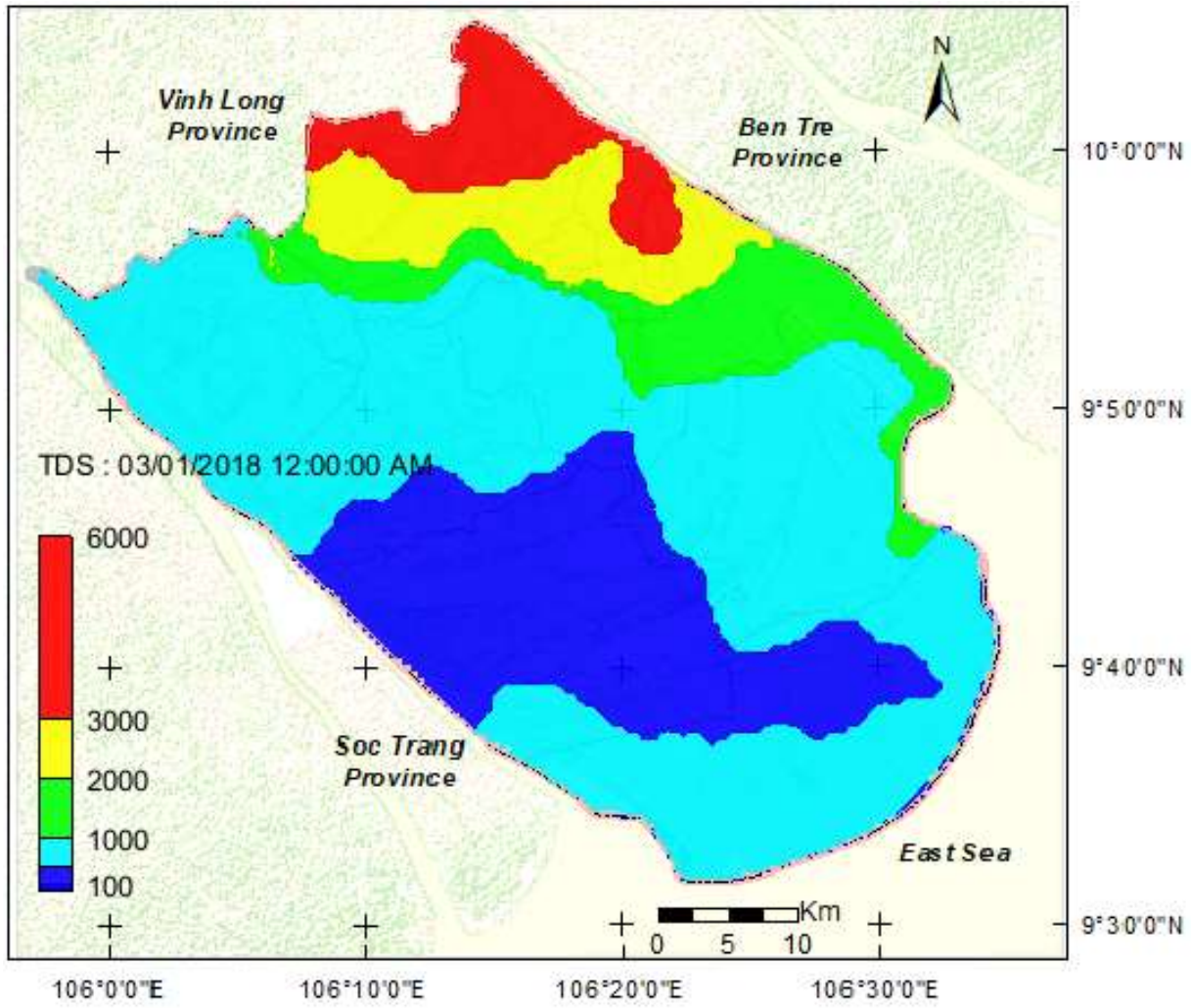




RESULTS

➢ Extension of saline GW area (Pleistocene aquifer: qp_{2-3})

- *Salinity GW distribution (*TDS distribution in March 2018*)*



Scenario	Increasing percentage of saline GW area (TDS >1,000 mg/l)		
	qh aquifer	qp_3 aquifer	qp_{2-3} aquifer
S1	8%	19%	17%
S2	7%	13%	15%
S3	6%	10%	10%
S4	6%	8%	9%
S5	5%	7%	7%
S6	3%	50%	4%

CONCLUSIONS

- Long term groundwater use will cause significantly storage depletion of the whole GW system and saline movement in northern zone. GW recharge is very limited, i.e., it contributed only 34 % of total groundwater abstraction
- Mean dry season discharge from upstream of Mekong river show a significant effect on groundwater use in the study area.
- Scenarios by following the master plan of Vietnamese Mekong Delta showed a dramatical decrease in GW demand by changing crop pattern. Scenarios, with maintaining development as usual, will lead to a very high GW demand (2 times compared with current groundwater use in 2018).
- By the end of next decade, GW exploitation under business as usual (S1-S3) scenarios is predicted to let GWLs decrease from 3 to 5m, and saline GW area increase from 10 to 17%
- Changing land use pattern following the master plan (S4-S6) will lead GW demand to be able to meet sustainable yield of the aquifer system by the current network of pumping wells.

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