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Presented at the FIG Congress 2018,
May 6-11, 2018 in Istanbul, Turkey

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Paper ID: 9236 (Peer Review)

Spatio-temporal Analysis for Monitoring Water Quality of Skudai River, Malaysia

By:

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Introduction



Having to build a 7-storey filtration tower just before the river enters the sea



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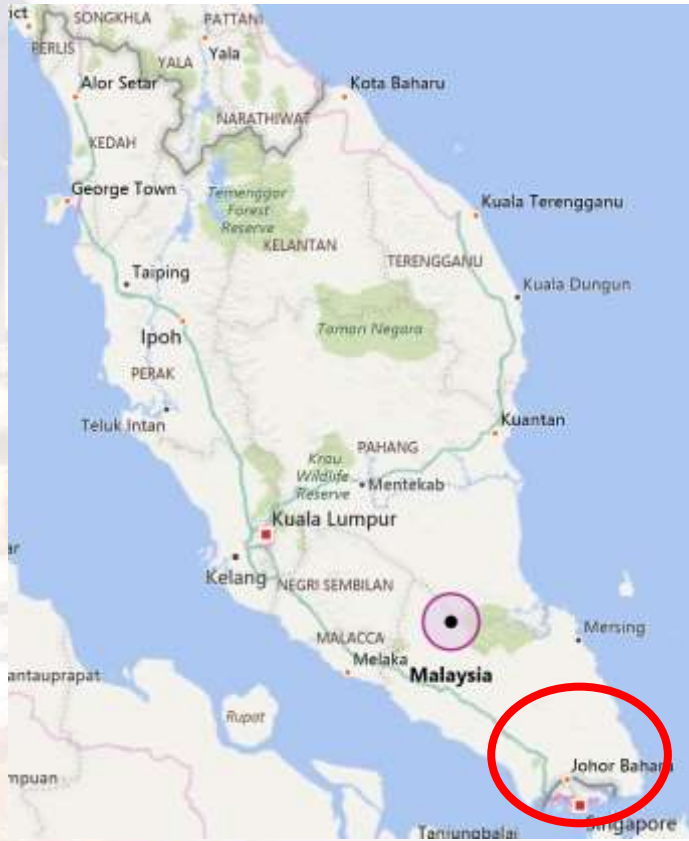


Polluted Rivers in Johor Bahru (JB)



Together with Tebrau and Segget River, Skudai River is one of the most polluted in JB (IRDA, 2014)

Geographical Location



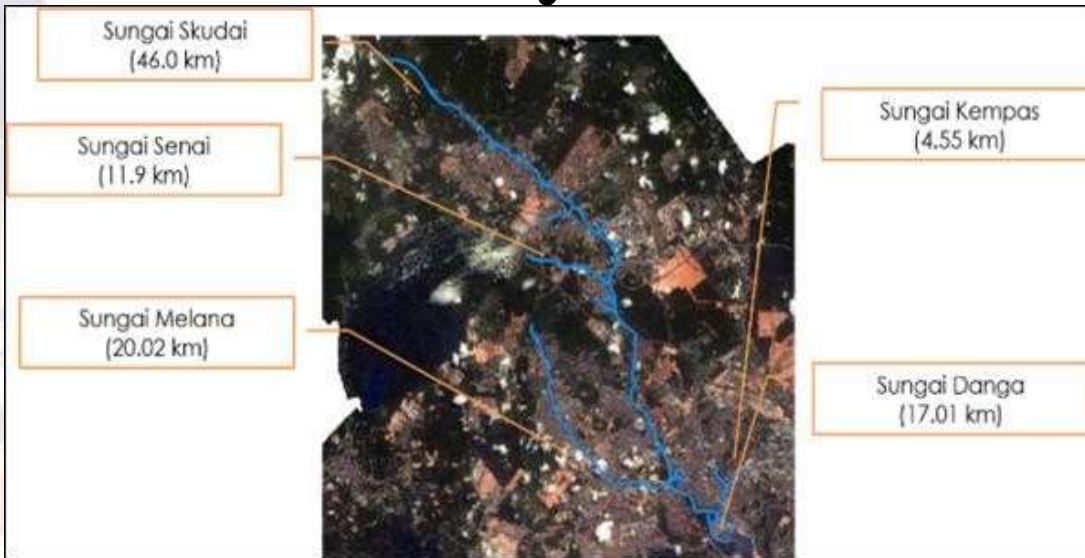
Motivation

- Millions have been spend for rehab however condition stays worse (Jamin, 2014).
- After the formation of Iskandar Economic Region, river issue is getting crucial than ever (Hangzo and Cook, 2014).
- Sources of pollution varied.



Data and Procedure

Skudai River Study Area



Class 3 River – extensive treatment required due to status of water supply

Data

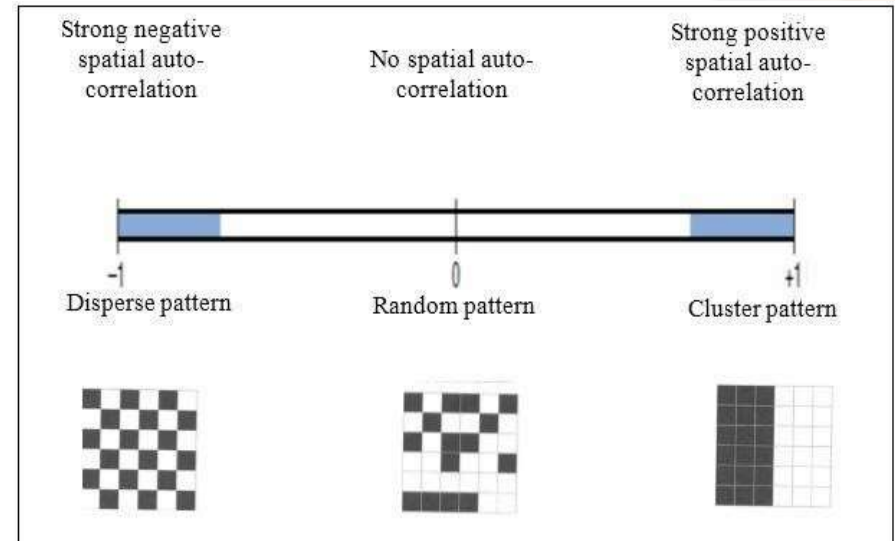
Water Quality Index (WQI):

- pH
- BOD
- COD
- Ammonia nitrogen
- Suspended solid
- Dissolve oxygen

Moran's I Autocorrelation for Selecting Dataset

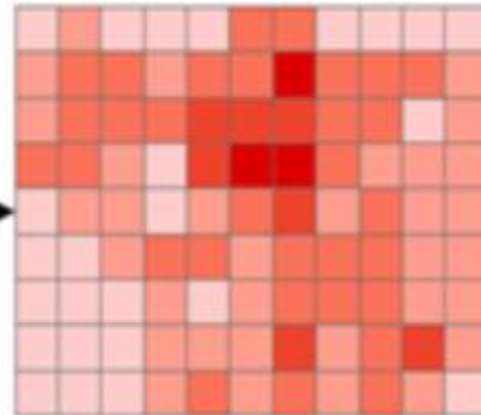
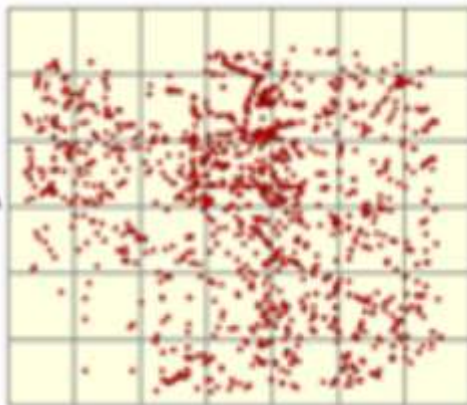
Station #	River	13 Stations	11 Stations
3SI01	Kempas	47.88	47.88
3SI02	Kempas	54.47	54.47
3SI05	Skudai	55.61	55.61
3SI06	Skudai	60.13	60.13
3SI07	Skudai	62.50	62.50
3SI09	Skudai	84.80	84.80
3SI10	Skudai	69.32	69.32
3SI13	Skudai	66.75	66.75
3SI14	Skudai	63.52	63.52
3SI17	Skudai	55.53	55.53
3SI18	Skudai	90.30	-
3SI15	Melana	81.88	-
3SI16	Melana	51.50	51.50

$$I = \frac{N \sum_{i=1}^n \sum_{j=1}^n w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\left(\sum_{i=1}^n \sum_{j=1}^n w_{ij} \right) \sum_{i=1}^n (x_i - \bar{x})^2}$$



Hot-spot Getis-Ord G_i^* for Spatio-temporal Analysis

$$G_i^* = \frac{\sum_{j=1}^n w_{i,j} x_j - \bar{X} \sum_{j=1}^n w_{i,j}}{S \sqrt{\frac{n \sum_{j=1}^n w_{i,j}^2 - \left(\sum_{j=1}^n w_{i,j}\right)^2}{n-1}}}$$

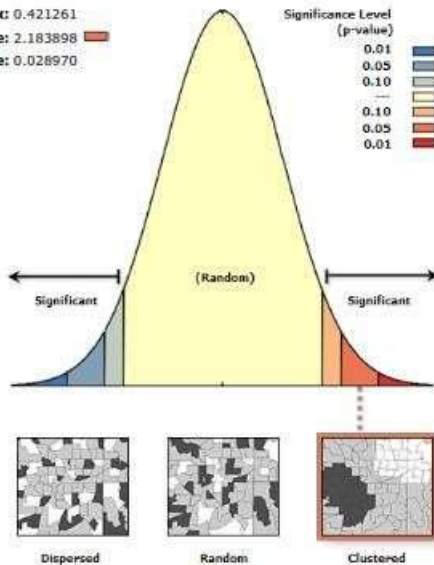


Results and Discussion

Moran's I Autocorrelation for Selecting Dataset

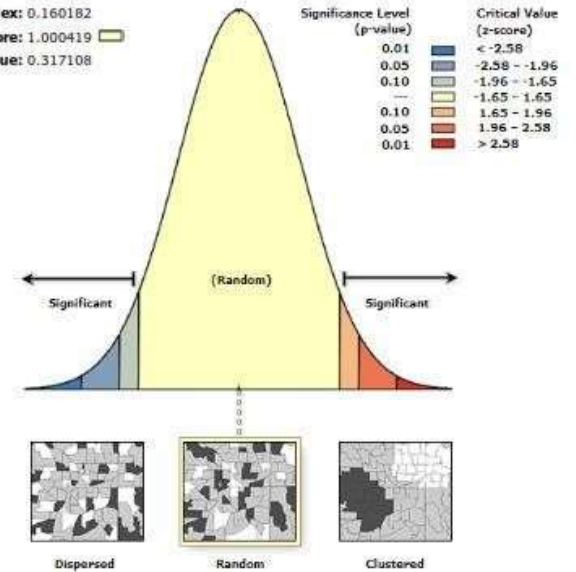
Properties	13 Station	11 Station
Moran's Index	0.42	0.16
z-score	2.18	1.00
p-value	0.03	0.32
Variance	0.053	0.068
Expected Index	-0.083	-0.100
Distribution	Clustered	Random

Moran's Index: 0.421261
z-score: 2.183898
p-value: 0.028970



Given the z-score of 2.18, there is a less than 5% likelihood that this clustered pattern could be the result of random chance.

Moran's Index: 0.160182
z-score: 1.000419
p-value: 0.317108



Given the z-score of 1.00, the pattern does not appear to be significantly different than random.



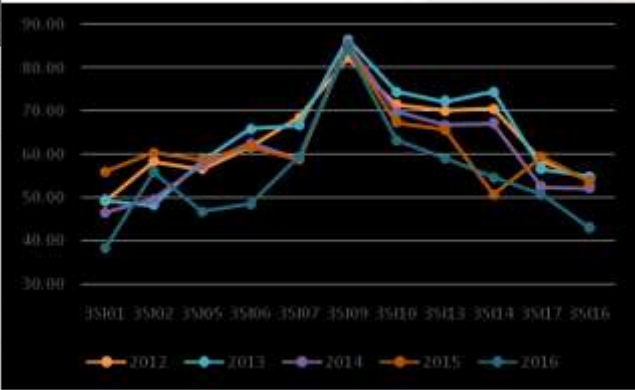
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Hot-spot Getis-Ord G_i^* for Spatio-temporal Analysis



WQI for the year 2012 - 2016



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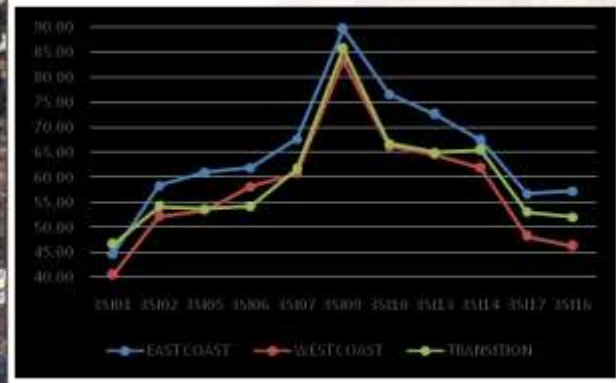


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Seasonal WQI



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Summary Remarks

Downstream area is the most polluted

Central area tends to be polluted in certain period due to human activities

More studies needed to clarify unusual WQI in 2015 – anthropogenic and land use towards water quality

Another recommendation – to study movement of pollution and pollutant

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