

Observation and difference analysis of carbon fluxes in different types of soil in Tianjin coastal zone

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Abstract. Tianjin Coastal Zone is located in the coastal area of the Bohai Sea, belonging to the typical coastal wetland, with high carbon value. Over the past decade the development of great intensity, there are obvious characteristics of artificial influence. This study focuses on observing the carbon fluxes of different soil types in the coastal area under strong artificial disturbance, summarizing the carbon sink calculation formula according to the soil type, and analyzing the main influencing factors affecting the carbon flux. The results show that there are representative intertidal zones in Tianjin, and the respiration of soil and secondary soil are different. The main influencing factors are soil surface temperature or air temperature. Coastal zones with different ecosystems can basically establish the relationship between temperature and soil carbon flux. ($R^2 = 0.5990$), the relationship between artificial backfill is $Q = 0.2061 - 0.2129T - 0.0391T^2$ ($R^2 = 0.7469$), and the artificial soil is restored by artificial soil and the herbaceous greening is carried out. The relationship is $Q = -0.1019 + 0.0327T'$ ($R^2 = 0.6621$), T-soil temperature, T'-air temperature. At the same temperature, soil carbon fluxes in shoal wetlands are generally stronger than artificial backfill, showing more carbon source emissions.

1. Instruction

Because of the high degree of development, most of the coastal areas of Tianjin port are artificially developed and used to maintain the original state of the soil type has been difficult to see. Wang Feng and others of the research results that: Tianjin Binhai New Area of unused land and construction land area to a larger rate of increase, the annual rate of change were as high as 54.05% and 14.46%. Vegetation, Yantian, freshwater, swamp, oceans and tidal flats have different rates of land area reduction. The average annual rate of change for the beach is -6.05% and the vegetation is -2.49%.^[1] On the basis of previous studies, according to the different soil utilization conditions, this study selected typical representative soil for comparison. Including artificial grassland, estuary mud bank, estuary and artificial backfill area.

There is a lack of effective observation method for the study of carbon flux in the beach, and the problem of insufficient record is observed. Qiao Mingyang, Shen Chengcheng and others on the island forest soil was observed^[2]. The results showed that the soil respiration rate was observed under the secondary forest of the island. Liu Zhixiong et al.^[3] bserved the flux of Minjiang Rivewetland. The above methods are used to observe the static box method, because the measurement method is generally limited to a certain range of soil.



2. Material and Methods

Tianjin Binhai New Area (38 ° 40'N ~ 39 ° 00'N, 117 ° 20'E ~ 118 ° 00'E) is located in the north of the North China Plain, the lower reaches of the Haihe River Basin, the east side of the city center of Tianjin, near the Bohai Sea, north and Feng-nan of Hebei Province, adjacent to the south and Hebei Province, Huang-hua City phase. Tianjin Binhai New Area, including Tang-gu District, Han-gu District, Da-gang District, three administrative regions and Tianjin Economic and Technological Development Zone, Tianjin Port Free Trade Zone, Tianjin Port and part of the area include Dong-li District, Jin-nan District. There are 2270 km² of land and 3000 km² of sea. The annual climate is 12.6 °C, the annual precipitation is 604.3mm, the landform belongs to the coastal alluvial plain, the northwest is high, the southeast is low, the elevation is 1~3 m, the ground slope is less than 1/10000. [4]

2.1. Collecting and processing methods

The natural geography of the Tianjin port coastal zone is characterized by extensive beach area, which is formed by marine sediments and river sediments. (Including natural forest land, natural grassland, sea area, beach, shallow waters, swamp wetlands and salt fields); recuperation and recreation land (urban green space); abandoned land (mainly refers to the land Wasteland)[5].

The main techniques used in the analysis of soil physical and chemical properties were: soil type identification, selection of typical soil samples, and sampling observation in the sample survey area. Nankai University Hao Cui and others [6]. The soil samples are analyzed by artificial investigation method, Meng Weqing et al [7]. The relationship between land use type and different ecological factors was analyzed by artificial investigation and GIS analysis. Based on the previous survey results, this paper also uses the method of manual survey and sampling to analyze the physical and chemical properties of soil and organize the main laws.

According to the results of Lu Yakun and Liu Jiazhen, the diurnal variation of soil carbon flux in artificial poplar forest is the result of the daily variation of temperature and water factor and the synergistic effect of soil nutrient and salt. The diurnal variation of soil carbon flux in natural grassland mainly affected by ground temperature and relative humidity Impact [8]. Keith et al.'s research shows that soil temperature and humidity may account for 97% of soil respiration. Most studies used non-linear models:

$$S = ae^{bT}W^c \quad (1)$$

The effects of soil temperature and soil water content on soil respiration were discussed [9]. In the formula, S - represents soil respiration, T - represents soil temperature, W - represents soil moisture content, "e" is constant, and "a, b, c" is undetermined constant.

2.2. Determination

The typical types of soils selected in Tianjin Binhai New Area include artificial turf (recuperation and recreation land), artificial sand land (landfill area) and bare beach. Locations selected are in the urban construction area, the new Eco-city be built and the beach near Yong-ding estuary and Da-gu estuary. The Co-ordinates of Sampling Points are shown in Table 1 and Figure 1.

Table 1. The Co-ordinates of Sampling Points.

Point	Longitude	Latitude	Name	Soil type
1	117° 43' 15"E	38° 58' 44"N	Eco city	Artificial sand land
2	117° 44' 44"E	39° 50' 02"N	Yong-ding estuary	Secondary grassland
3	117° 38' 06"E	38° 50' 26"N	Binhai Urban Area	Artificial turf
4	117° 38' 16"E	38° 50' 32"N	Da-gu estuary	Beach



Figure 1. Sampling points

Field sampling was performed using a soil sampler. Diagonal method to select the 3 points, remove the surface of the ashes and organic matter residue, the use of diameter 30cm of the soil were collected 0 ~ 10cm, 10 ~ 20cm, 20 ~ 40cm a total of three layers of soil samples, remove the obvious plant root and dry falling objects and other impurities, into the numbered aluminum box, sent to the laboratory analysis.

Soil respiration was observed using ADC BioScientific Ltd's LCpro-SD instrument. 12 hours in advance in the field buried with the instrument box closed steel ring, to avoid the interference of temporary operation.

Using ADC BioScientific Ltd's LCpro-SD instrument for observation. The observation principle of the CO₂ flux of this kind of instrument is open circuit type infrared gas analysis (IRGA). The method is now widely used in scientific research. The precision of the instrument is 0.1ppm, and the reaction is rapid and the gas concentration can be measured continuously Variety. The infrared gas analyzer method constructed by this technique is considered the ideal method for measuring the gas concentration ^[10].

The instrument can simultaneously observe the relevant parameters such as H₂O flux, air relative humidity, soil temperature, surface air temperature, air pressure, water vapour pressure, gas flow rate and record the measured time and date. All data is stored in the instrument file record, and the computer is processed after the observation is completed. Data is compiled and plotted using SPSS.

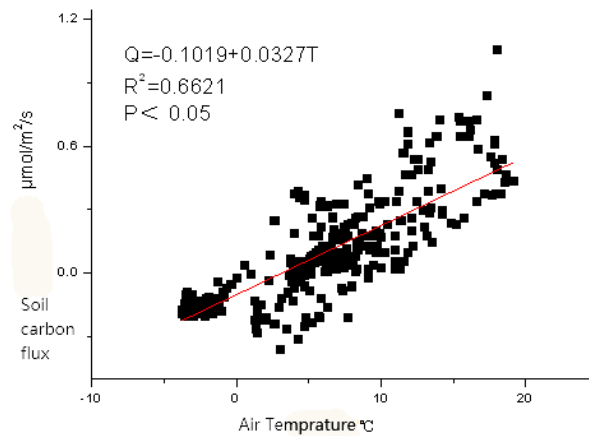
2.3. Data Processing and Analysis

The relationship between soil respiration and temperature is given by further analysis of the observation results of this subject. The process uses binomial relations or exponential relations to calculate the main parameters and correlation coefficients. Each station is calculated as follows:

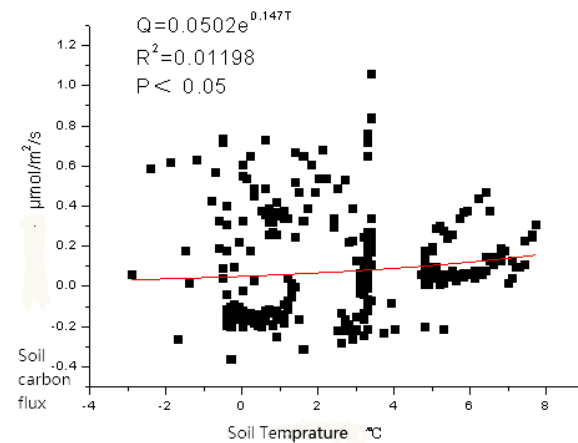
(1) Binhai Urban Area

Measurement time: January 8, January 10, January 12, March 1, 2016.

① Relationship between temperature and soil carbon flux:



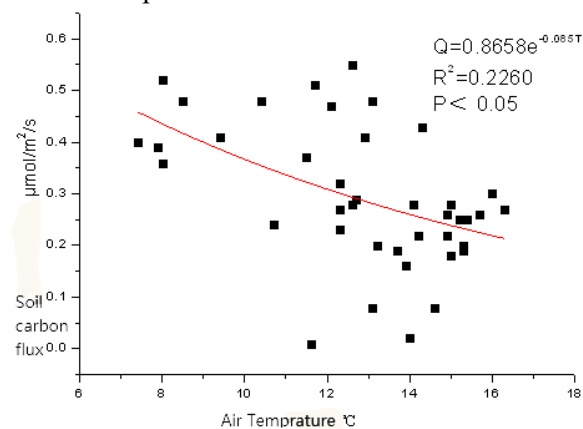
② Relationship between soil temperature and carbon flux:



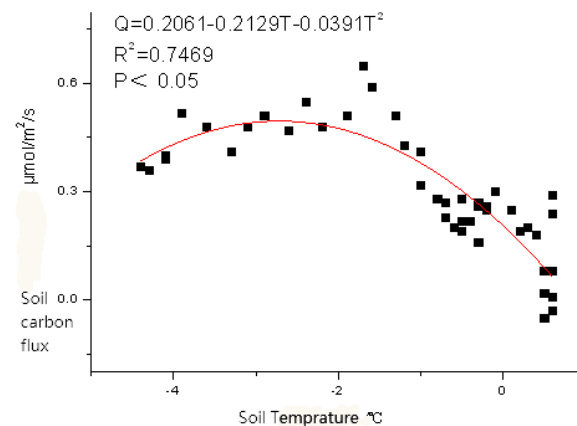
(2) Eco city

Measurement time: February 2, March 3, 2016.

① The relationship between air-temperature and soil carbon flux:



② Relationship between soil temperature and carbon flux:

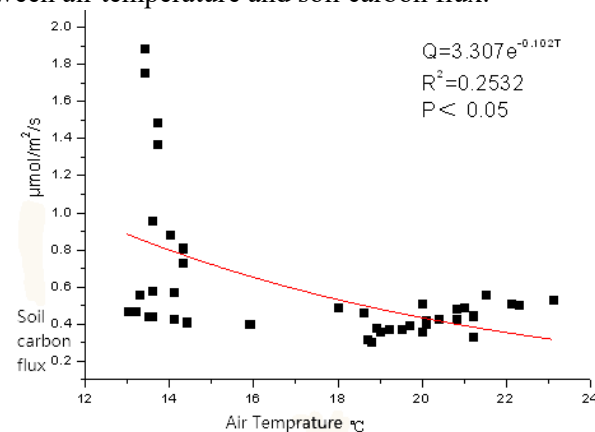


(3) Da-gu estuary

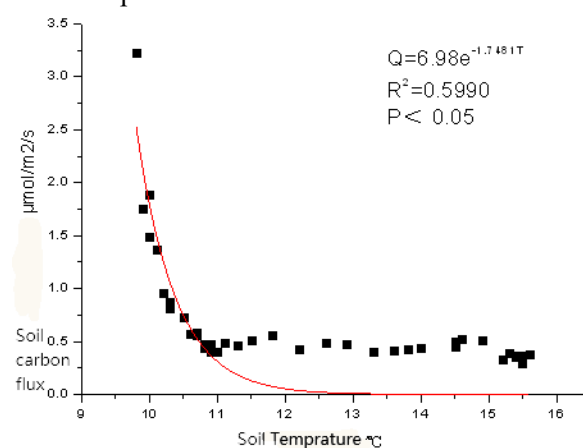
Measurement time: April 6&12, 2016.

Weather conditions: rain in the morning, 6:00 rain stopped. Wind 3, wind east, temperature 8-18 $^{\circ}\text{C}$. Afternoon began to rise in temperature, about 2 pm began to have the sun, haze began to appear.

① The relationship between air temperature and soil carbon flux:



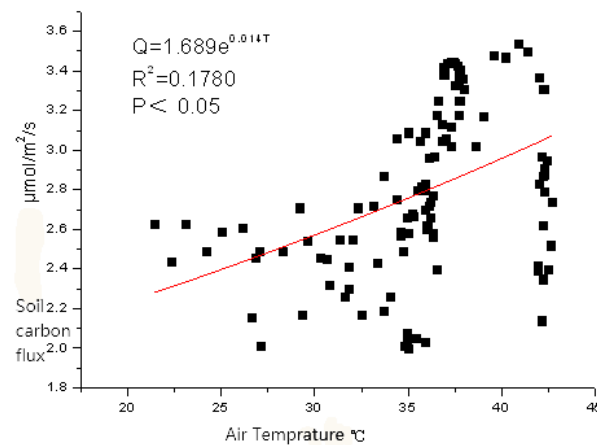
② Relationship between soil temperature and carbon flux:



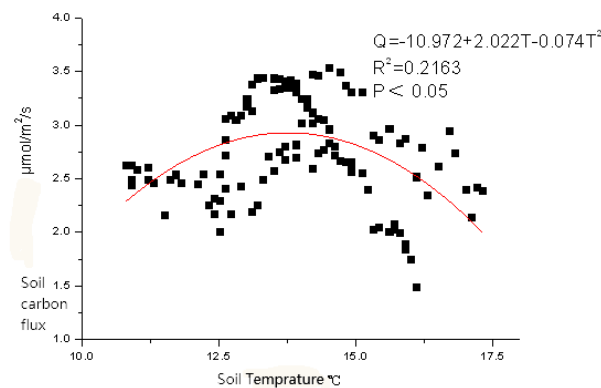
(4) Yong-ding estuary

Measurement time: April 2, April 8, April 13, 2016.

① The relationship between air temperature and soil carbon flux:



② Relationship between soil temperature and carbon flux:



The above process, the finishing, will be around the soil type by the impact of environmental factors are listed in Table 2.

Table 2 Relationship between soil carbon flux and temperature

Point	Type of soil	formula	
Binhai Urban Area	Artificial turf	$Q = -0.1019 + 0.0327T$ ($R^2 = 0.6621$)	T—Air temp.
		$Q = 0.0502e^{0.147T}$ ($R^2 = -0.01198$)	T—Soil temp.
		$Q = 0.8658e^{-0.085T}$ ($R^2 = 0.2260$)	T—Air temp.
Eco city	Artificial sand land	$Q = 0.2061 - 0.2129T - 0.0391T^2$ ($R^2 = 0.7469$)	T—Soil temp.
Da-gu estuary	Beach	$Q = 3.307e^{-0.102T}$ ($R^2 = 0.2532$)	T—Air temp.
		$Q = 6.98e^{-1.7481T}$ ($R^2 = 0.5990$)	T—Soil temp.
		$Q = 1.689e^{0.014T}$ ($R^2 = 0.1780$)	T—Air temp.
Yong-ding estuary	Secondary grassland	$Q = -10.972 + 2.022T - 0.074T^2$ ($R^2 = 0.2163$)	T—Soil temp.

3. Result

(1) Coastal ecosystems can basically establish the relationship between temperature and soil carbon flux. The relationship between the wetland is $Q = 6.98e^{-1.7481T}$ ($R^2 = 0.5990$) T-soil temperature, the correlation is better. Artificial backfill relationship is $Q = 0.2061 - 0.2129T - 0.0391T^2$ ($R^2 = 0.7469$) T-soil temperature, the correlation is better. After the artificial soil restoration, and planting herbs green, the relationship is $Q = -0.1019 + 0.0327 T$ ($R^2 = 0.6621$) T'-air temperature, the correlation is better.

(2) At the same temperature, soil carbon fluxes in shoal wetlands are generally stronger than artificial backfill, showing more carbon source emissions.

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