Long-term Water Temperature Trends in the Chesapeake Bay

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Background and Motivation

- To assess the effect of climate change on the water quality of the Chesapeake Bay, it is important to isolate the increase in temperature throughout the water column due to long term climate warming conditions
- In the past, our Estuary model predicted a slower increase in temperature near the bottom of the Bay than at the surface

Background and Motivation

- If this process is still in effect, it could have meaningful implications on nutrient goals, as hypoxic volume is sensitive to small changes in water temperature, especially at in deeper water

Background and Motivation

- Thus, we need to investigate the effect water depth has on the long term temperature trends in the Chesapeake Bay

Literature Review

- We reviewed pertinent literature on the subject and found that climate change scenarios have been run in the Chesapeake Bay by applying a constant change in water temperatures across time and space

Literature Review

- The primary evidence for this assumption was a study of long term temperature trends of surface and subsurface observations at different locations in the Chesapeake Bay published in 2004.
- This study reported ‘insignificant’ changes in long term temperature trends based on whether or not the measurements were surface (1 or less meters from surface) or subsurface (15 meters or more from surface)

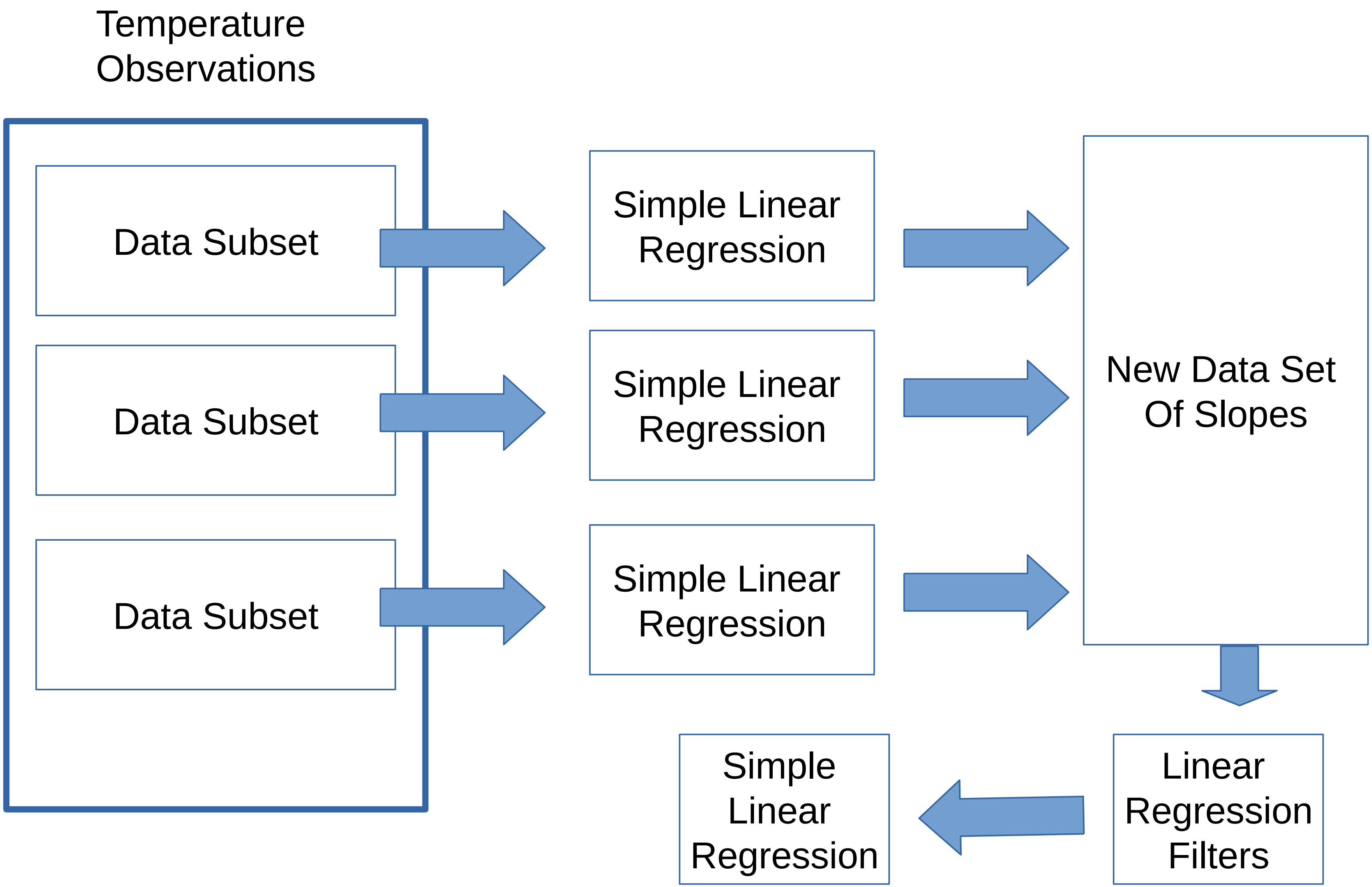
Methods – Observed Data

We studied observations by splitting up the data into meaningful unique subsets and performing individual simple linear regressions

Additionally, a set of rules was used to accept or reject each individual regression. Though not perfect, this allows us some amount of confidence in the trends we study

These regressions were then compiled into a single dataset, and a second regression was performed.

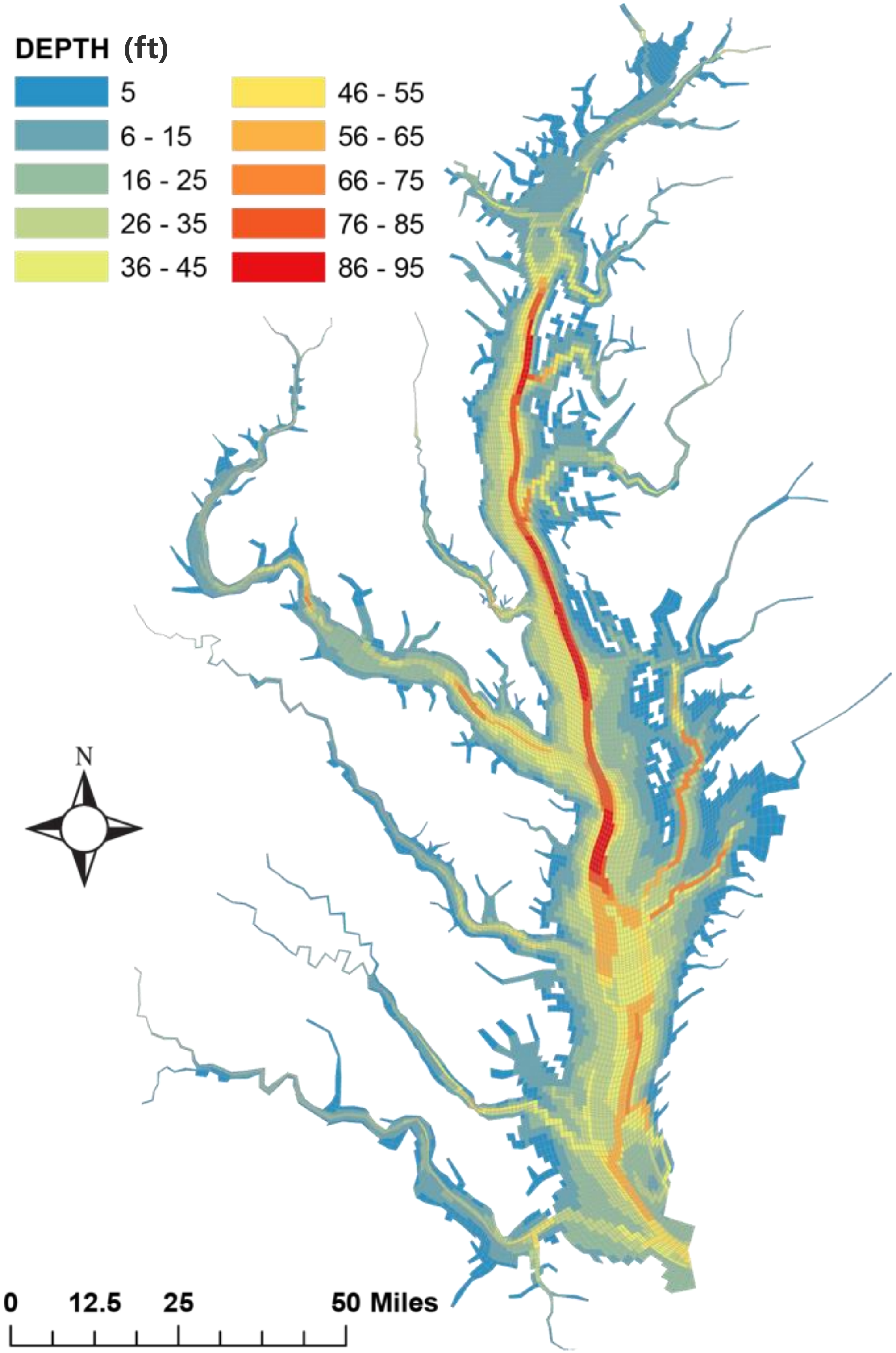
Methods – Observed Data



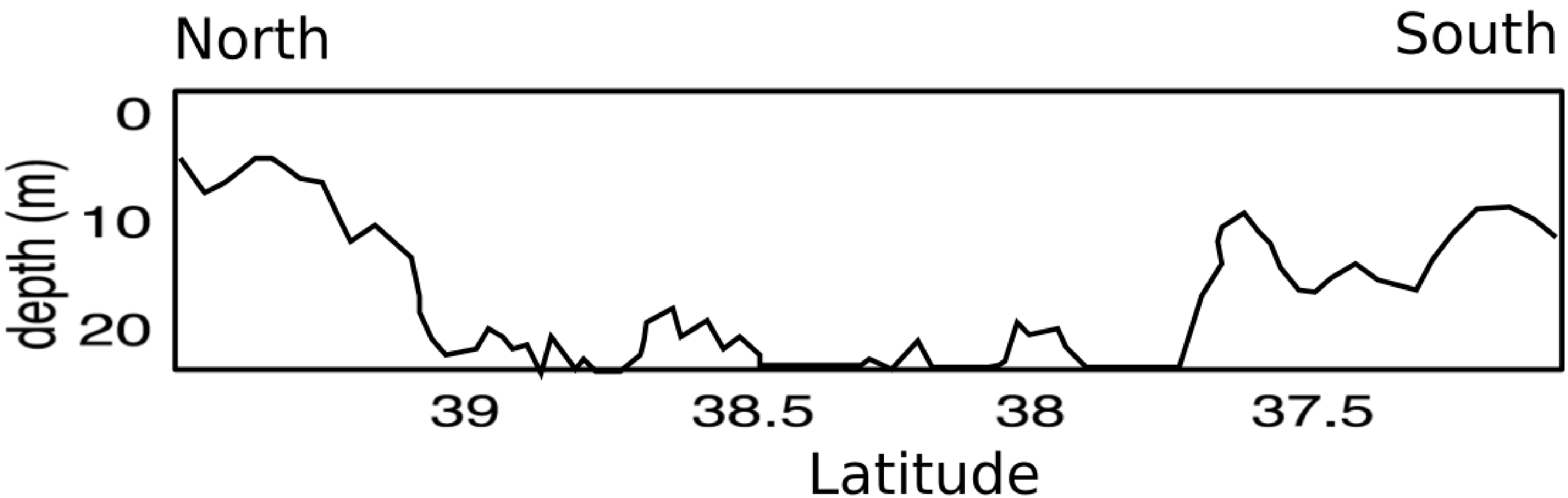
Methods – Data Subsets

By splitting up the data into meaningful unique subsets and performing individual simple linear regressions, we could investigate the long-term slope from many “points-of-view”

- Advantages → simple and quick
- Disadvantages → variable quality, hard to check all assumptions


DEPTH (ft)
5
6 - 15
16 - 25
26 - 35
36 - 45
46 - 55
56 - 65
66 - 75
76 - 85
86 - 95
N
0
12.5
25
50 Miles

Methods – Observed Data



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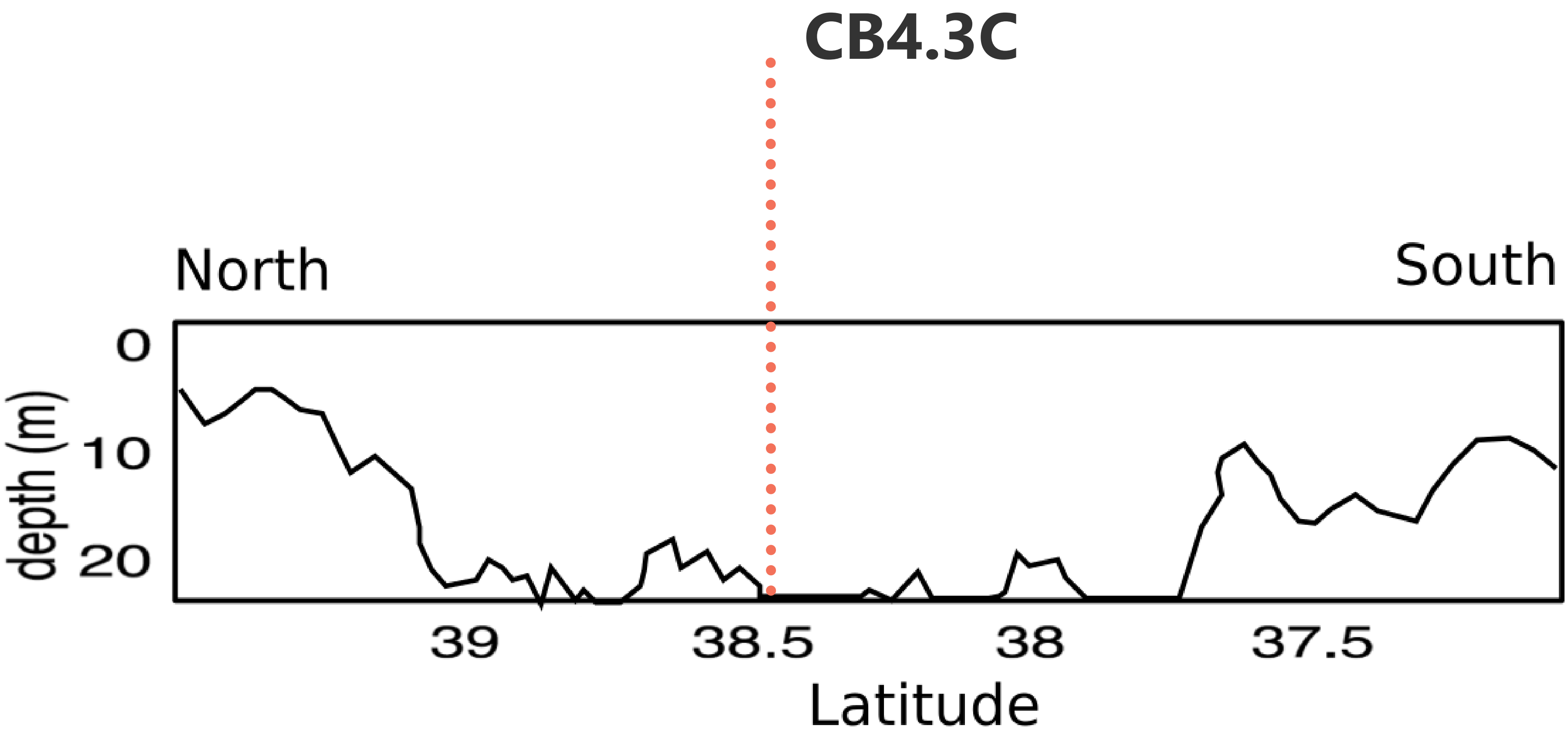
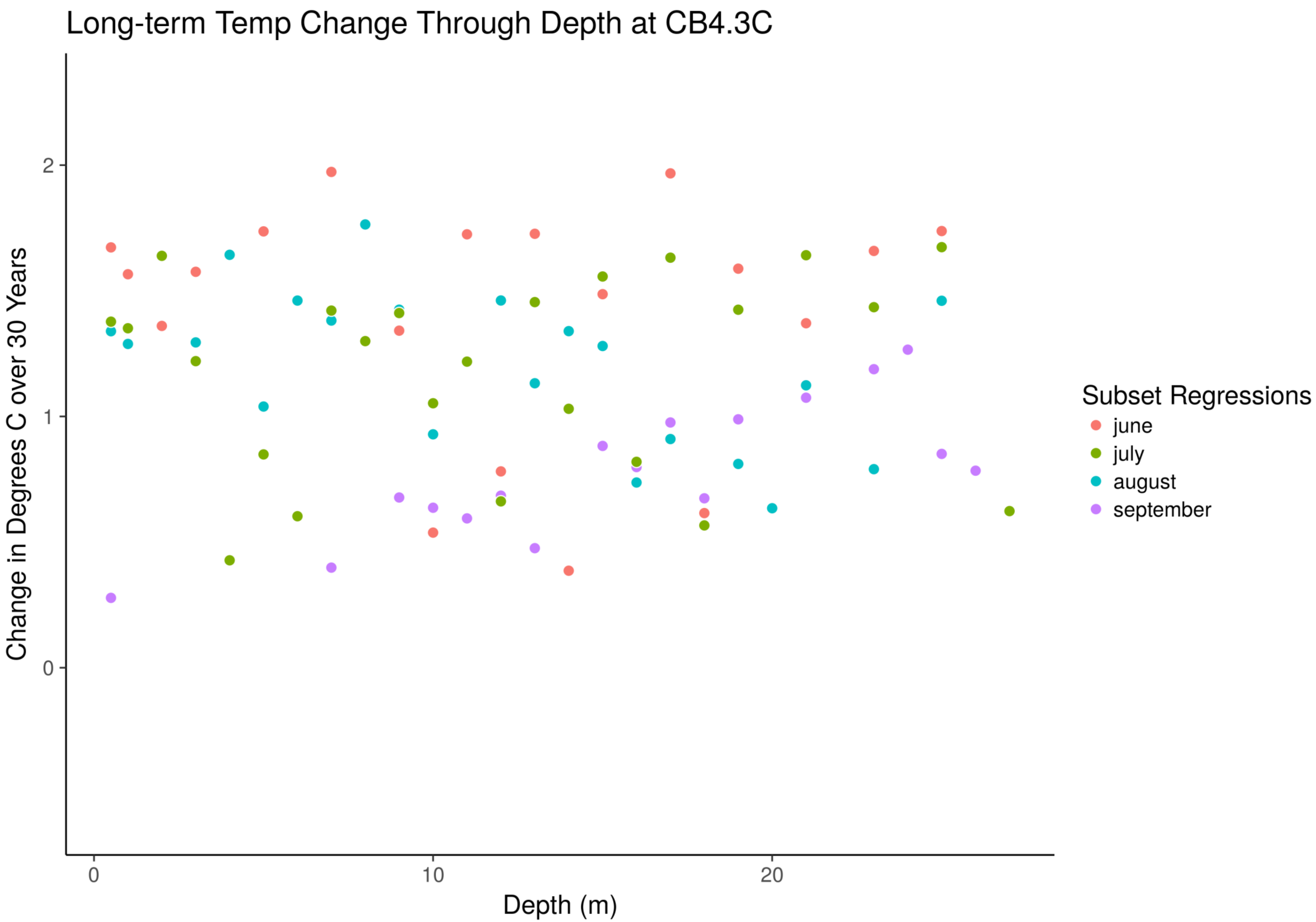
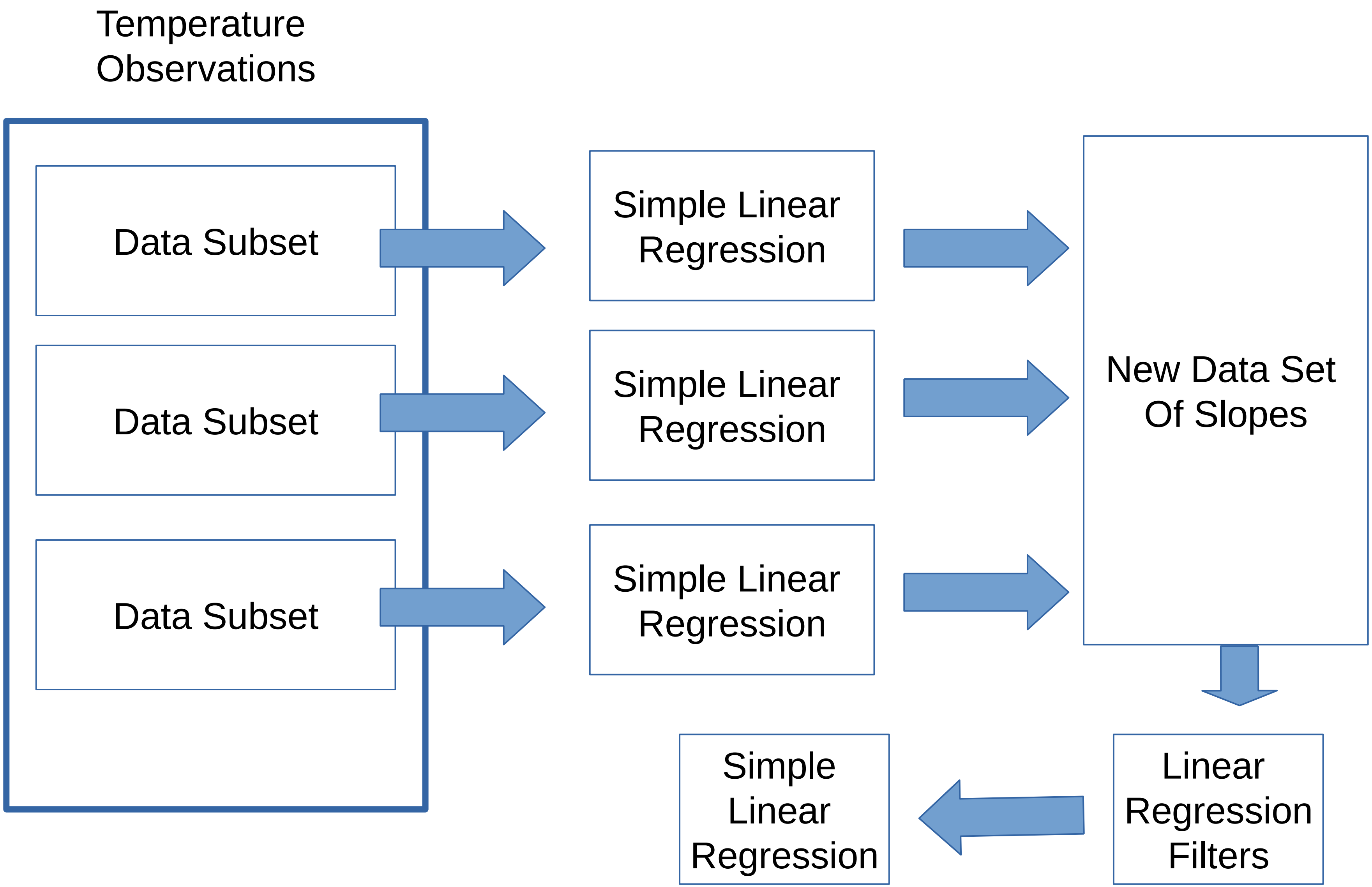
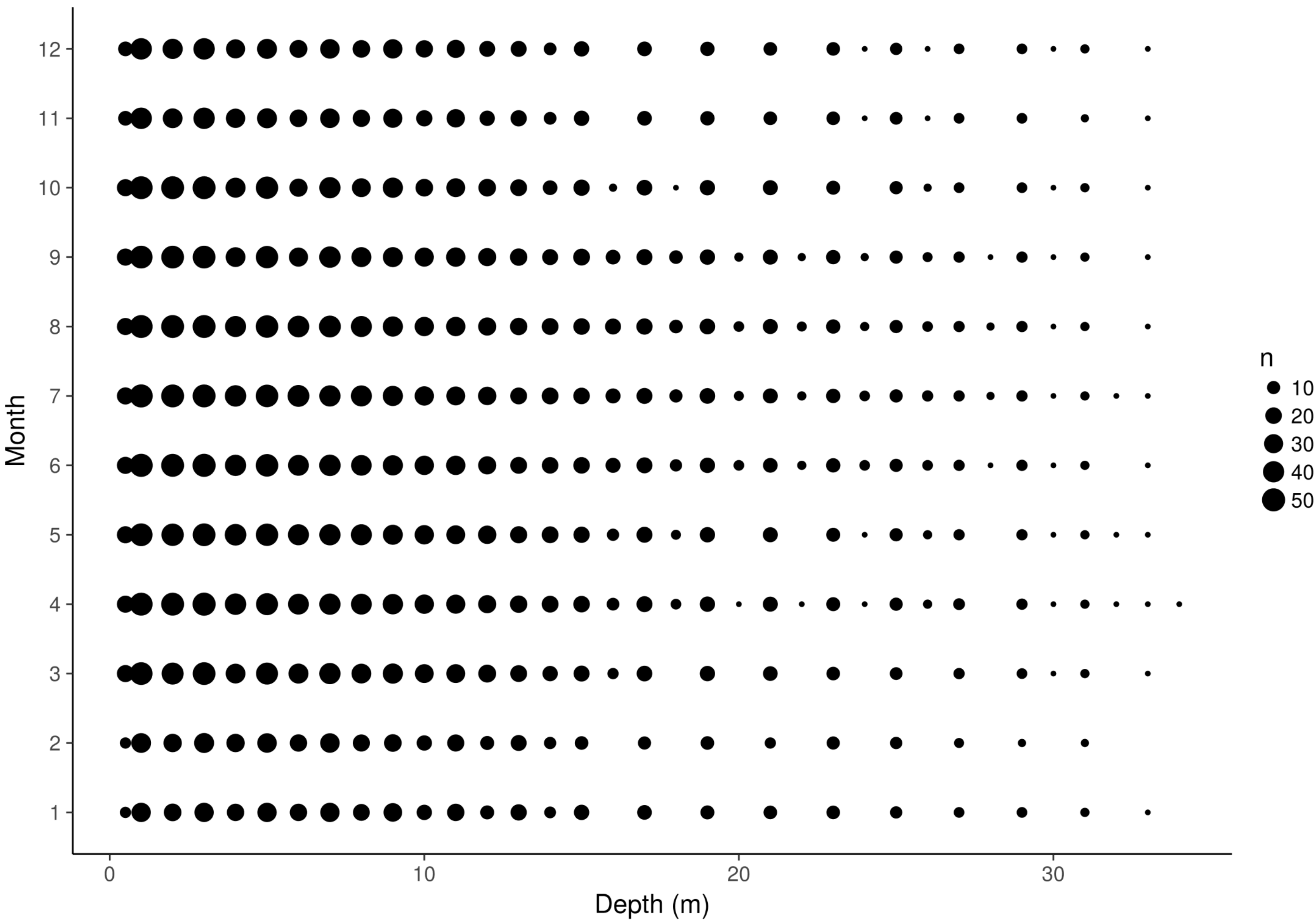




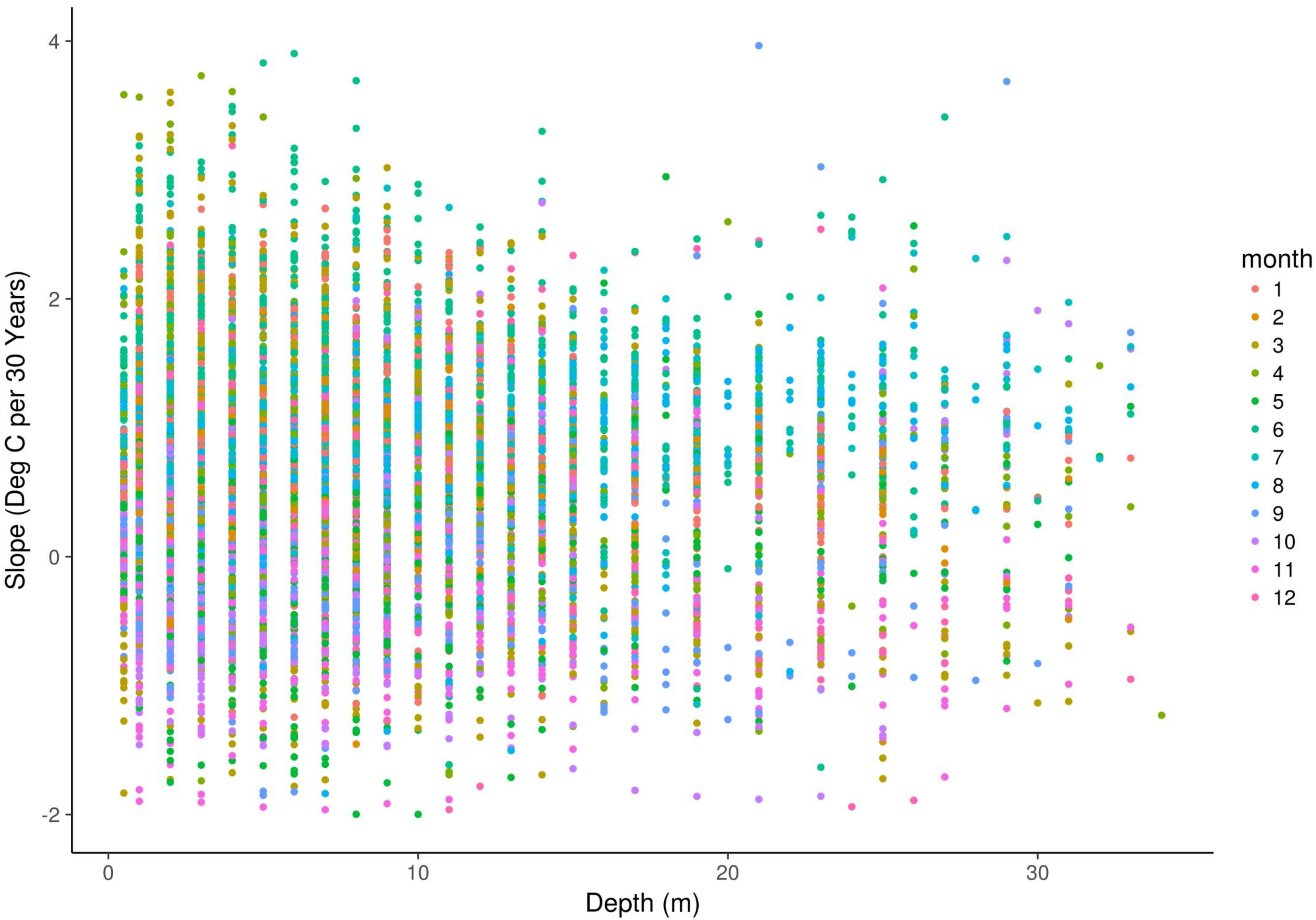
Long-term Temp Change Through Depth at CB4.3C
Change in Degrees C over 30 Years
Depth (m)
0
1
2
0
10
20
Subset Regressions
june
july
august
september

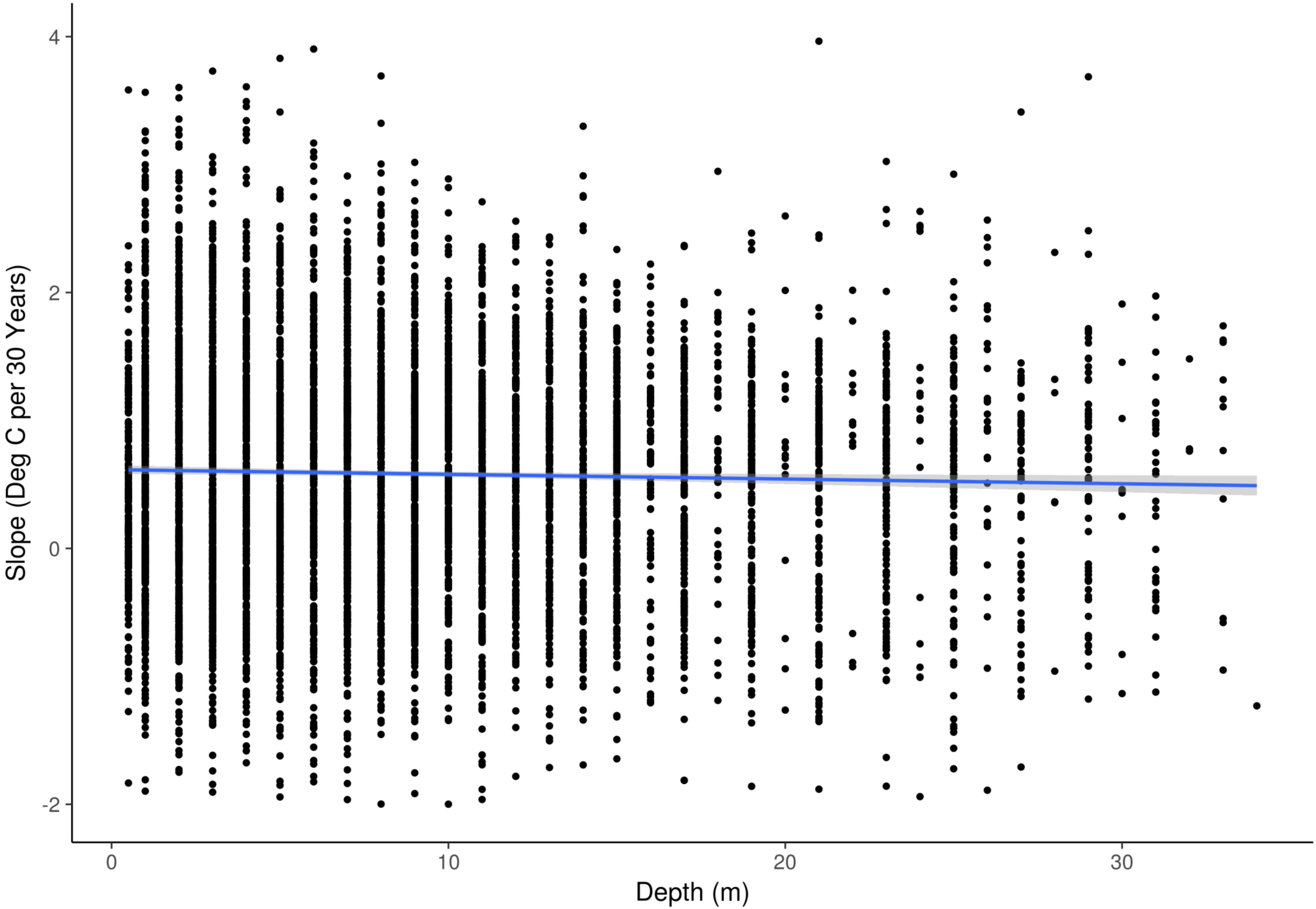
Methods – Observed Data

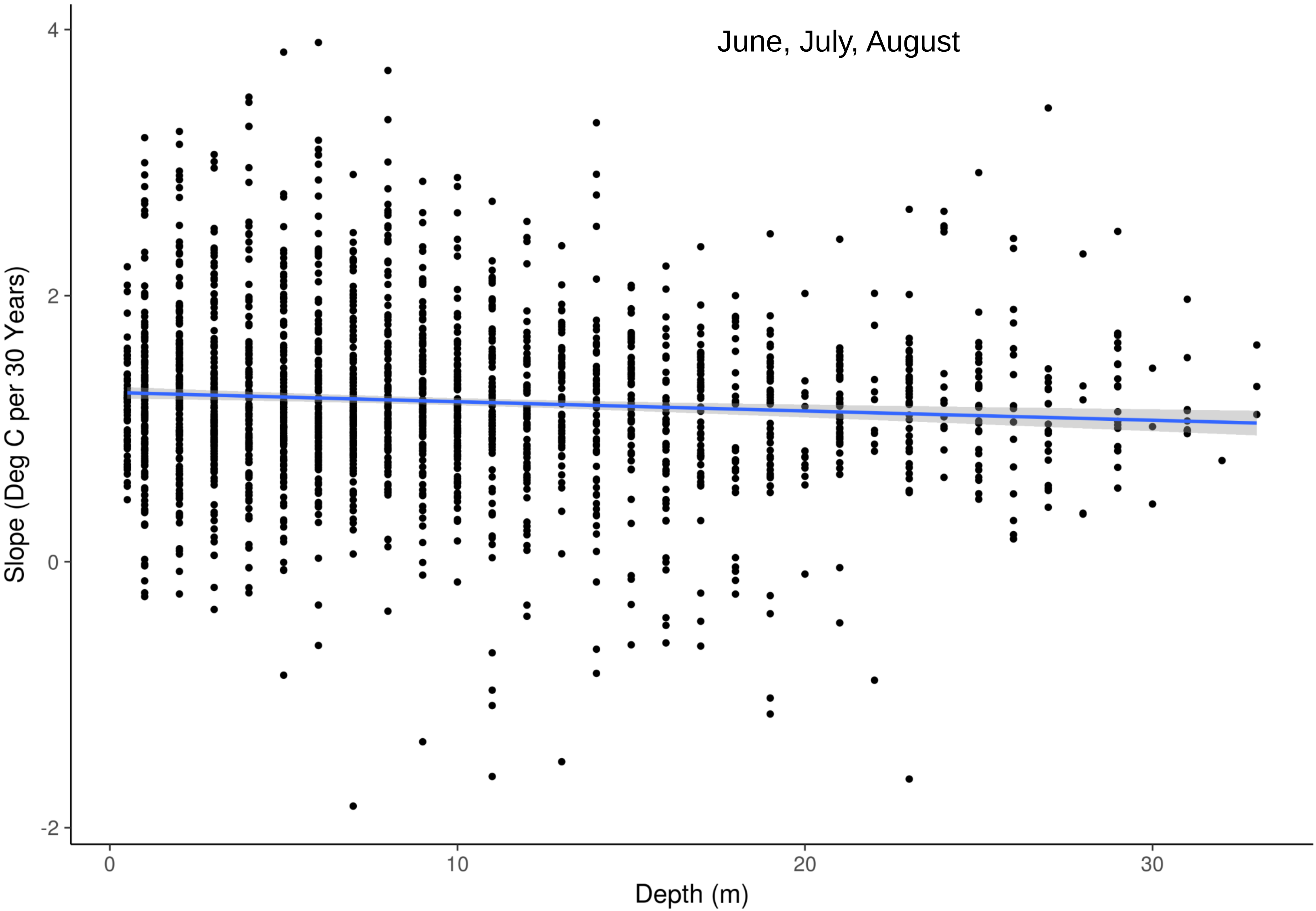


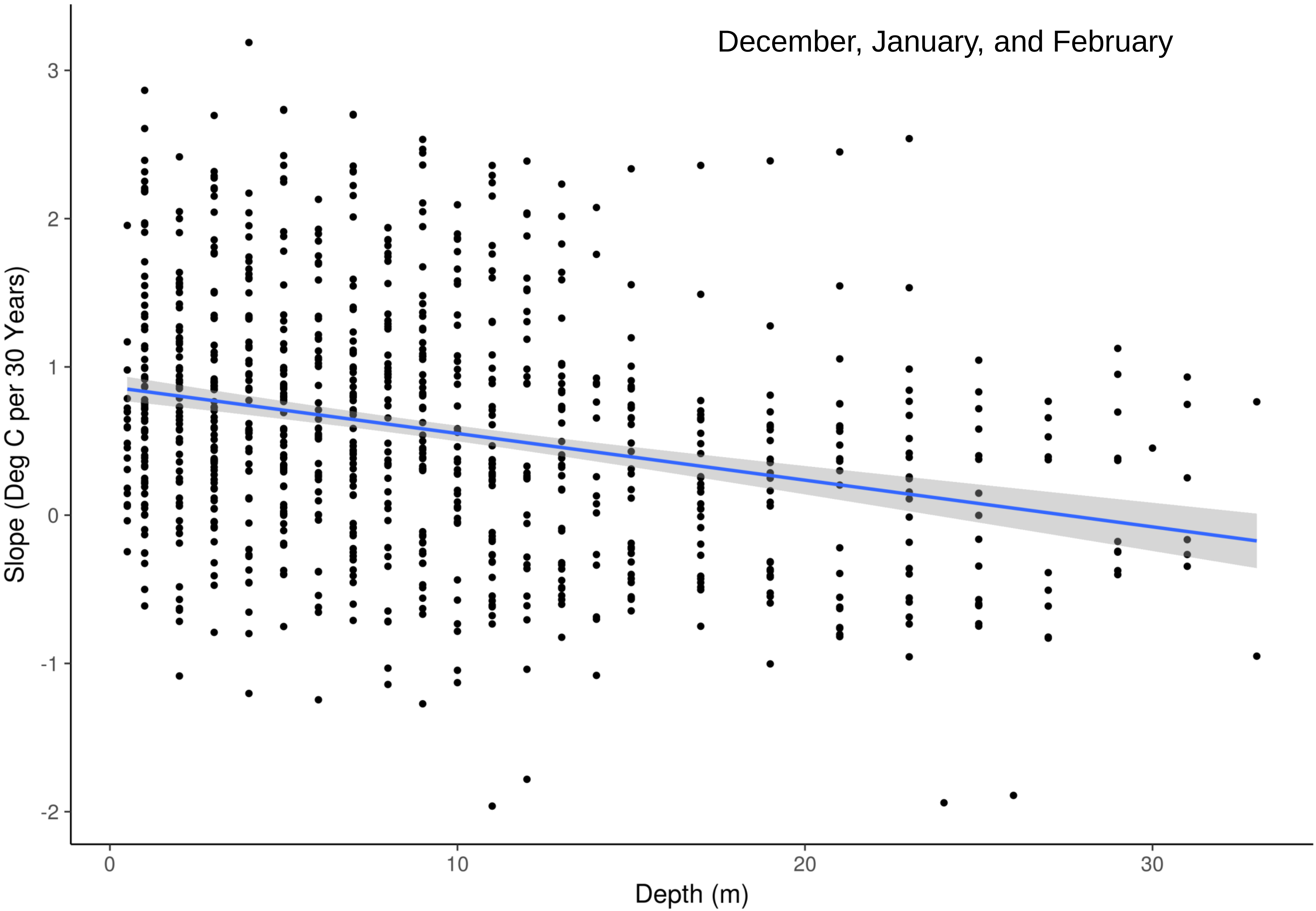


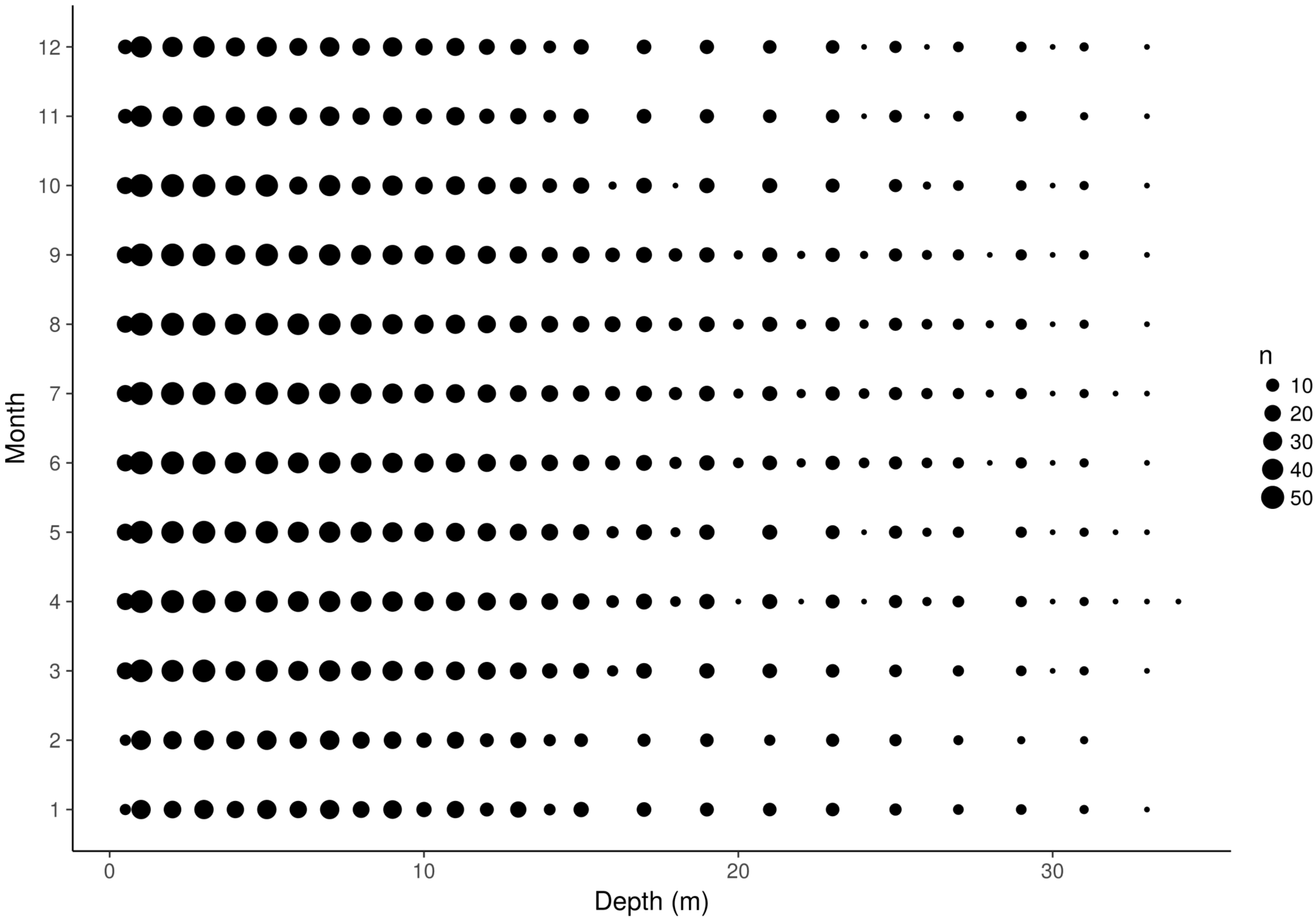
Month
12
11
10
9
8
7
6
5
4
3
2
1
0
10
20
30
Depth (m)
n
10
20
30
40
50


Slope (Deg C per 30 Years)
4
2
0
-2
0
10
20
30
Depth (m)
month
1
2
3
4
5
6
7
8
9
10
11
12


Slope (Deg C per 30 Years)
4
2
0
-2
0
10
20
30
Depth (m)


June, July, August
Slope (Deg C per 30 Years)
4
2
0
-2
0
10
20
30
Depth (m)


December, January, and February
Slope (Deg C per 30 Years)
Depth (m)
3
2
1
0
-1
-2
0
10
20
30



n
10
20
30
40
50
Month
12
11
10
9
8
7
6
5
4
3
2
1
0
10
20
30
Depth (m)

Context: The Increasing linear trend overall is about 0.4 Deg C per Decade

Month	Change in Deg C per Decade per meter	Effect on Increasing Temperature at 20 Meters Deg C per Decade
All	0.001	-0.02
January	-0.007	-0.14
February	-0.0003	-0.006
March	-0.017	-0.34
April	-0.01	-0.22
May	-0.007	-0.13
June	-0.01	-0.2
July	0.008	0.05
August	0.001	0.03
September	0.012	0.25
October	0.012	0.25
November	-0.002	-0.03
December	-0.014	-0.3

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