Problem Set 6: Groundwater salinity

enter the title of the groundwater basin you already selected in Problem Set 1 here

enter name here | enter date here | ESM 226: Groundwater Management

**Objectives:** The goal of this problem set is to (i) apply theoretical equations to estimate the depth to saline groundwater in a coastal groundwater basin (\*not\* your SGMA basin), and (ii) quantify vertical distributions of salinity in your SGMA basin.

**Grading:** Problem set comprises 10% of total course grade
**Submission deadline:** Problem set is due one week following the date it was distributed

# Question 1 – Seawater intrusion potential in Santa Barbara (3 marks)

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| (A – 1.5 marks, total) Open the file “SantaBarbaraMonitoringWells .xlsx”. Create a graph of well water elevation variations over time for monitoring well “342452119405504”, which is located <200 m from the sea. For each well water level measurement, calculate the theoretical elevation at which the fresh-saline water interface exists in this coastal aquifer. Add a second line plot to your graph depicting how this theoretical depth below the land surface to saline water has varied over time *(any negative values should be plotted as zero values)*. Orient your y-axis so that depth values increase in a downward direction. |  |
| (B – 1.5 marks, total) Open the file “SantaBarbaraMonitoringWells .xlsx”. Create a graph of well water level elevation variations over time for monitoring well “342603119430401”, which is located 3.7 km from the Stearn’s Wharf. For each well water level measurement, calculate the theoretical elevation at which the fresh-saline water interface exists in this coastal aquifer. Add a second line plot to your graph depicting how this theoretical depth below the land surface to saline water has varied over time. Orient your y-axis so that depth values increase in a downward direction. |  |
| (C – 1 mark) Juxtapose plots presented in part A and B. Specifically, comment on (i) the spatiotemporal patterns of well water level fluctuations over time, (ii) spatiotemporal patterns in the depth to saline water over time.  | Click or tap here to enter text. |

# *\*note that the well close to the coast likely contains some seawater, which complicates the interpretation of well water level measurements. Don’t fret about this in this Problem Set (i.e., you can, for now, just assume the column of water in the well is all fresh), but if you’re interested in reading more see: Post, V. Kooi, H., Simmons, C. Using hydraulic head measurements in variable‐density ground water flow analyses. Groundwater 45, 664–671 (2007).*

# Question 2 – Groundwater salinity distributions across the Central Valley (6 marks)

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| (A – 2 marks, total) Open the file entitled ‘SouthernCentralValleyTDS.xlsx”. Create a plot of well water salinity (i.e., total dissolved solids) versus depth. Orient the y-axis so that downward is deeper (i.e., well depth values increase in a downward direction on the y-axis).  |  |
| (B – 1 mark) Calculate the fraction of well water level measurements in your SGMA basin that exceed the EPA’s secondary drinking water standard for total dissolved solids. | Click or tap here to enter text. |
| (C – 1 mark, total) Describe – quantitatively – the vertical profile of groundwater salinity (1.5 marks).  | Click or tap here to enter text. |
| (D – 2 marks, total) Propose a hypothesis (or multiple hypotheses) that explain(s) the vertical structure of groundwater total dissolved solids measurements for your basin. Your hypotheses must include hydrological processes. | Click or tap here to enter text. |

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