SIO 15 (FQ 2024) – Homework #6 Due November 12, 2024

Maximum score: 20 points + 1 bonus point

- 2 penalty points for late submission (more than 30 min past due date)

Divide by 4 for contribution to total cumulative

ANSWERSHEET

Topics 17 – 18

1) a) Watch the lecture 17 podcast for 2023 (see Canvas announcement for canceled lecture on 11/4/24): Explain why the day/night temperature on Venus is so high (e.g. higher than on Mercury even though Mercury is closer to the sun). (0.5 pt)
   b) In the 1995 Chicago heat wave, the urban heat island effect was one of several human-caused factors that enhanced the misery. Name three other human-caused factors that are not related to the urban heat island. (0.5 pt)
   c) In October 2023, of all U.S. states which one experienced the most severe drought? What was the drought level (provide D level and description). (0.5 pt)
   d) In the time since 1900, when was the worst drought/heatwave event in the U.S.? Provide year(s) and name of the event. (0.5 pt)
   (2 points total)
   a) Venus' atmosphere is made of mainly CO2, a strong greenhouse gas
   also accepted: similar answers that mention the greenhouse gas effect from CO_2
   b) power outages, overtaxed emergency services, lack of preparedness,
   also accepted: people afraid of opening windows b/c of high crime rate
   c) Louisiana; D4, Exceptional drought
   -0.25 pt if one of the three is missing
   d) 1930s Dust Bowl
   -0.25 pt if one is missing

2) go to droughtmonitor.unl.edu.
   a) For the current map (valid Oct 29, 2024), which state currently has the largest area in an exceptional drought? (0.5 pt)
   b) Which two neighboring states (one in the Midwest, one in the Northeast) have smaller areas with a D4-level drought? (0.5 pt)
   c) Choose the map for October 31, 2023. What was the highest drought level in California? (0.5 pt)
   d) In the map for December 6, 2022, what was the highest drought level in California? (0.5 pt)
   e) Under the 'data' tab, we now look at time series. Choose "state" and area type and "California" as are. Since 2000, from when to when did California's most prolonged and intense drought last? For dates, consider only the D4 level. (0.5 pt)
   (2.5 points total)

a) Texas

NB: the map 'valid Nov 5, 2024' looks nearly identical as the one in the homework video, with respect to the homework question

b) Ohio, West Virginia

-0.25 pt if one is missing

c) D0, abnormally dry

-0.25 pt for partial answer

d) D4, exceptional drought

-.025 pt for partial answer

e) 1/4/2014 – 1/4/2017

-0.25 pt for partial answer

3) Heat index. For the following, use the chart in the book, lecture slides or the class website. The following questions are best summarized in a table. Properly label the categories in the table (i.e. provide a header row that lists the categories). After setting up the columns for a) add rows for each of b) – c)

a) Given an air temperature of 80ºF, what is the heat index for the following 4 values for relative humidity: 5%, 20%, 40%, 80% (0.5 pt)

b) Give the corresponding values for an air temperature of 90ºF and for 100ºF. (0.5 pt).

c) Given an air temperature of 80ºF, for which relative humidity does the air feel warmer than it really is? Work only with the data in your table. (0.25 pt)

d) Given an air temperature of 100ºF, for which relative humidity does the air feel warmer than it really is? Work only with the data in your table. (0.25 pt)

e) Given a relative humidity of 80%, discuss the difference in heat index effect for an air temperature of 80ºF with that of 100ºF. Here, do not just give numbers but discuss the impact of the effect. (0.5 pt)

(2 points total)

a) + b)

Title: Heat Index - Apparent Temperature in deg F

Temp (deg F)	Rel hum 5%	Rel Hum 20%	Rel hum 40%	Rel hum 80%
80	74	77	79	86
90	84	87	93	113
100	93	99	110	158

+0.5 pt if a table is given instead of values, with the table properly labeled

a) -0.25 pt for partially correct values or missing units (the unit must be given at least once)

b) -0.25 pt for partially correct values or missing units (the unit must be given at least once)

c) 80%

d) 40%; 80%

also accepted: 40%

NB: the question here may be ill-posed as the heat index implies a minimum rel. humidity beyond which air will always feel warmer; so if 40% makes air feel warmer, then it is implied that 80% makes it feel even more extreme

e) heat index is much more extreme at higher given temperature
-0.25 pt if only numbers are given but no narrative that indicates the large difference in impact

4) Wind chill factor, use the chart given in the lecture slides. For b) and c) make a similar table as for 2b)-c).
   a) Why does wind speed have an effect on felt temperature? (0.25 pt)
   b) Given an air temperature of 30ºF, what is the wind chill for the following wind speeds: 5 mph, 15 mph, 25 mph, 35 mph (0.5 pt)
   c) Give the corresponding values for an air temperature of 0ºF (0.25 pt)
   d) Given a temperature of -15ºF and 10 mph winds, how long does it take to develop frost bites? (0.5 pt)
   e) How about -15ºF and 20 mph winds? (0.5 pt)
   (2 points total)

a) wind blows away warming air around the skin
b) + c) Title: Wind Chill Factor – Apparent Temperature in deg F

Temp (deg F)	Wind speed	15 mph	25 mph	35 mph
	5 mph			
30	25	19	16	14
0	-11	-19	-24	-27

+0.25 pt if a table is given instead of values, with the table properly labeled
d) between 10 and 30 min
-.25 pt if unit is missing
e) under 10 min
-0.25 pt if unit is missing

5) Air masses and fronts.
   a) What happens when a cold air mass advances on a warm air mass? Include answers to: which air is moving where, which air mass ends up at the bottom, which on the top? (0.5 pt)
   b) What kind of front is forming? (0.5 pt).
   c) Where and what kind of weather is typically associated with this kind of front? (0.5 pt)
   d) In a wave cyclone, which front moves faster, the cold front or the warm front? (0.5 pt)
   (2 points total)
   a) cold air pushes beneath warm air
   b) cold front
   c) Local heavy rain behind the front; sometimes even thunderstorms
   -0.25 pt for partial answer (either weather or location missing)
   NB: along the front is not a sufficient answer
   +0.25 pt if thunderstorms are mentioned
   d) cold front

6) a) What are the three principal ways for thunderstorms to form? (0.5 pt)
   b) Where in the U.S. do we have the highest occurrence of thunderstorms? (0.5 pt)
   c) Why is standing under a tree during a thunderstorm not a good idea? (0.5 pt)
   d) Where in the world do we find the highest occurrence of lightning flashes? (0.5 pt)
   (2 points total)

a) orographic lifting; convective lifting, cold front moving into region with very warm air
b) Florida
c) a tall tree may provide shortest distance between a cloud and the ground
d) Congo

7) a) What is a supercell thunderstorm? (0.5 pt)
b) Which fraction of supercell thunderstorms spawn tornadoes? (0.5 pt)
c) Why is a microburst dangerous to aviation? (0.5 pt)
d) In Tornado Alley, when do the majority of tornadoes occur? When do most fatalities from tornadoes occur? (0.5 pt)
(2 points total)
a) a very large rotating severe thunderstorm
b) 15%
c) a microburst may push landing planes closer to ground level
d) Apr – Jul; Mar-May
-0.25 pt if one answer is missing

8) News clip November 01, 2024:
a) Unusually balmy weather left which two states vulnerable to hundreds of wildfires? (0.5 pt)
b) Are these the same two states found in problem 2b)? (0.25 pt)
c) For both states, how many fires burn currently, compared to a normal year? (0.5 pt)
d) What is the usual cause of wildfires? (0.25 pt)
e) Which fires elsewhere have prepared emergency workers in the Northeast with what to expect? (0.5 pt)
(2 points total)
a) New Jersey and Connecticut
b) no
c) New Jersey: 377 compared to 26; Connecticut: 84 compared to 5
-0.25 pt if parts of answers are missing
d) people
e) larger wildfires out west

9) Go to earth.nullschool.net. Choose the date 11/4/24 12:00 local (PST) or 20:00 UTC.
a) Provide the coordinates of the center of the storm along the Aleutian islands? (0.5 pt)
b) To the southeast of this storm, and separated approximately by the 40ºN latitude, there are two systems with rotating winds. Which one is a low-pressure, which a high-pressure system? (0.5 pt)
c) Coming from the Pacific ocean, over which state(s) in the U.S. does the jet stream come on land? (0.5 pt)
d) What is the approximate maximum wind speed in that area? Provide the altitude you chose, one of only two alternatives according to the homework video, and the maximum wind speed. (include units for both) Both are needed for full points. (0.5 pt)
(2 points total)
a) 52.29 deg N; 167.94 deg W
-0.25 pt for partial answer/units missing
+0.25 pt if a wind speed is given: something around 4 km/h or 1.0 m/s or 2 kn or 2 mph
b) both are high pressure systems

c) Oregon;
also accepted: Washington;
d) if chosen 500 hPa: about 184 km/h or 51.2 m/s or 99 kn or 114 mph
if chosen 250 hPa: about 245 km/h or 68.0 m/s or 132 kn or 152 mph
-0.25 pt if something is missing (number or unit)

10) Go to water.noaa.gov. This site shows current flood levels at river gauges in the U.S.
The Mississippi River currently experiences water levels below the low water threshold between New Madrid, MO and Vicksburg, MS. Find the river gauge along the Mississippi River at Vicksburg, MS.
a) What is the latest observation (water level and discharge)? Include units. Also log the date/time of your observation. (0.5 pt)
b) click on "full information". Scroll down to the crest data. When and at which height did the highest historic crest occur? Include units. (0.5 pt)
c) When and at which height was the most recent crest? (0.25 pt)
d) Is this most recent crest among the top 5 historic crests? (0.25 pt)
e) Now repeat a)-d) for the river gauge at St. Louis, MO. (1 pt)
(2.5 points total)
a) for example: 7.22 ft/265 kcfs on 11/8/24 at 5:00 pm PST
-0.25 pt if something is missing (number or unit)
b) 57.10 ft on 05-19-2011
-0.25 pt for partial answer
c) 45.81 ft on 04-15-2021
-0.15 pt for partial answer
d) no
e) for example: 10.54 ft/201 kcfs on 11/8/24 at 6:00 pm PST;
49.58 ft on 08-01-1993
31.46 ft on 03-21-2021
no
-0.5 pt for partial answer