Instructions:

Mock exam for “Climatology and Climate models” module. This mock exam is to be intended as an example of the actual exam. Differently from the actual exam, you can consult all of the course material or other online resources.

There are 6 multiple choice questions and 4 open-ended questions. For multiple choice, more than one answer may be correct. Wrong answers won’t result in a penalty of the score.

The duration of the exam is 1.5 hrs.

Multiple choice questions:

1. In the global energy balance, how big is the storage term (heat stored in the ocean)?
    a. 1.0 W/m^2
    b. 0.6 W/m^2
    c. 0.9 W/m^2
    d. 2.0 W/m^2

2. Does the top of atmosphere albedo depend on:
    a. Zenith angle and season
    b. Latitude, season, type of surface
    c. Latitude, season, atmospheric composition, type of surface
    d. Zenith angle, season, longitude, type of surface
    e. Latitude, atmospheric composition, altitude

3. The parametric test to determine the statistical significance of a trend is significant if the p-value is less than 0.5:
    a. True
    b. False
    c. None of the above

4. Equilibrium climate sensitivity is typically smaller than the transient climate response:
    a. Because ocean heat uptake reduces global warming
    b. Because the climate system takes a long term to equilibrate
    c. The statement is not true

5. The albedo effect of a cloud depends on:
    a. The emission temperature of the cloud
    b. The optical thickness of the cloud and its altitude
    c. The ratio between ice and water content in the cloud

6. In regions of mean subsidence, dry regions are found. This is because:

a. These regions are not found over the oceans
b. These regions are covered by low-level clouds
c. These regions are adiabatically warmed by descending air motion
d. These regions experience higher evaporation compared to precipitation
e. These regions are characterized by deep-convection clouds
f. There is oceanic upwelling

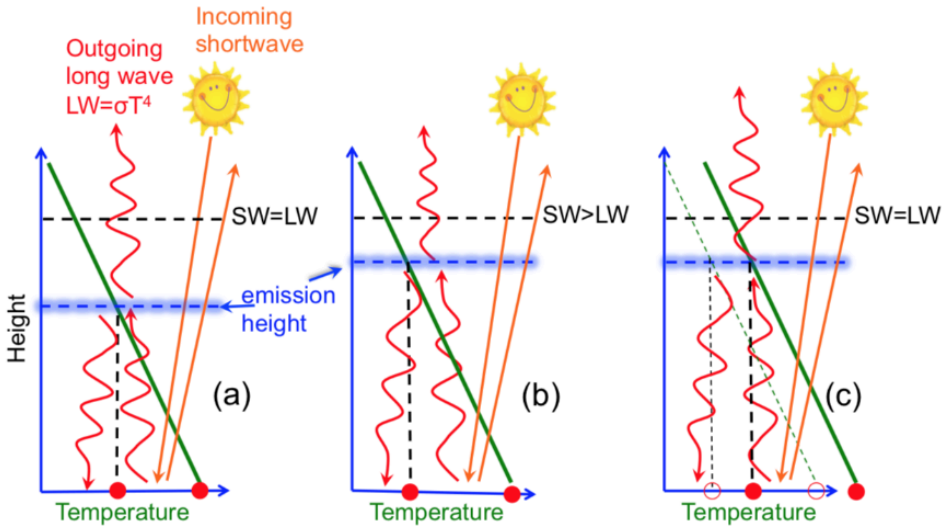
Open-ended questions:

7. Below are the equations for the two-layer ocean model. Discuss each term in the two equations. Sketch the short term vs the long term temperature response in the case of a 40m deep ocean and a 4000m deep ocean. Discuss the differences in the results based on the depth of the ocean.

$$C_{surface} = \Delta F_{2x} - \lambda_{LW}\Delta T_{surface} - \gamma(\Delta T_{surface} - \Delta T_{deep})$$

$$C_{deep} = \gamma(\Delta T_{surface} - \Delta T_{deep})$$

8. What are the mechanisms leading to Arctic amplification?
9. Given the following figure, explain the anthropogenic greenhouse effect:



10. Wet get wetter, dry get drier: Why is the change in the precipitation minus evaporation proportional to its mean value?