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4.4.4 Problem Set: Greenhouse gas production scenarios

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We will consider two different greenhouse case production scenarios.

1. The first scenario we will refer to as the **growth scenario**. Specifically, the production rates of $[H_2O]$ and $[CO_2]$ will increase linearly over the first 60 years, such that by the end of this growth period, they are three times what they were originally. Beyond these 60 years, the production will remain constant (i.e. three times the initial rates).

   Implement this growth scenario in the `PHC_growth` function in `climate.py`. Note that the initial production rates are stored in the IVP object's parameter dictionary, and should be accessed using a getter. Also make your implementation general with respect to `tgrowth` and not just 60 years.

   When your implementation is correct, running `climate.py` should produce the plots in Figures 4.16 and 4.17. The main block calls the `run_climate_nominal` function, which uses the most-probable values of C, τ_H, and τ_C.

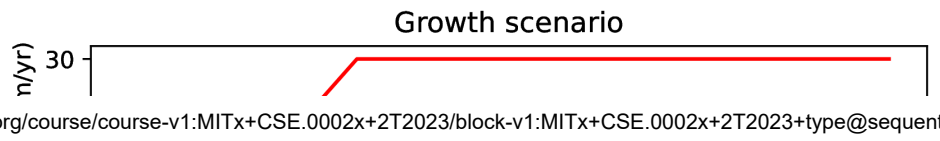
2. Next, implement the second scenario which we will refer to as the **decline scenario**. Specifically, the production rates will decrease linearly over the first 10 years, such that at the end of this decline period, the rates will be half what they were originally. Beyond these 10 years, the production will remain constant (i.e. half the initial rates).

   Implement this decline scenario in the `PHC_decline` function. (Remember to make your implementation general with respect to `tdecline`.) Then in the main block of `climate.py`, uncomment the second `try-except` block, which also contains a call to `run_climate_nominal`. When your implementation is correct, you should see the plots in Figures 4.18 and 4.19.

3. Complete the implementation of `run_climate_nominal` by returning the maximum temperature rise that occurs over the 200-years simulation for the nominal case. Include print statements so that running `climate.py` produces the following output with the same formatting and precision.

```
Scenario = Growth scenario
Nominal case:
dTmax = 7.49 degrees K

Scenario = Decline scenario
Nominal case:
dTmax = 1.24 degrees K
```



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