

Homework 2: Deterministic Temperature Forecasting
using the Simplified Temperature Tendency Equation

A. A Simple Forecast Equation for Temperature

The local tendency of temperature can be used to calculate the rate of change of temperature at a fixed location. This, in turn, can be used to determine the change in temperature over a fixed time interval if that rate is multiplied by the total time period over which the changes will occur.

$$\frac{\partial T}{\partial t} dt = \left(\frac{DT}{Dt} - \vec{V} \cdot \nabla T \right) dt \quad (1)$$

This, then, can be algebraically added to the initial temperature at the location to obtain a forecast temperature. In this homework, you are only calculating the forecast change.

B. Exercise: Answer on Separate Sheet

Say that the temperature at San Francisco International Airport (SFO) is changing at a constant rate of $-0.5^\circ\text{C}/\text{hr}$.

1. What is the net LOCAL temperature change at SFO at the end of a 6 hour increment?
2. What are the symbolic forms of the LOCAL CHANGE of $-0.5^\circ\text{C}/\text{hr}$ and the 6 hour increment (in algebraic notation)?
3. What is the symbolic form of the expression you used to answer question (1) in differential calculus notation?
4. Now, suppose that you know that radiative cooling is responsible for about 1°C cooling in all the air parcels that moved across the station during that six hour period. In other words, $DT/Dt = -1^\circ\text{C}/6\text{h}$

What was total contribution of three dimensional temperature advection to the temperature change that occurred over the 6 hour time increment?