

### 2.1. Deterministic VT Concept.

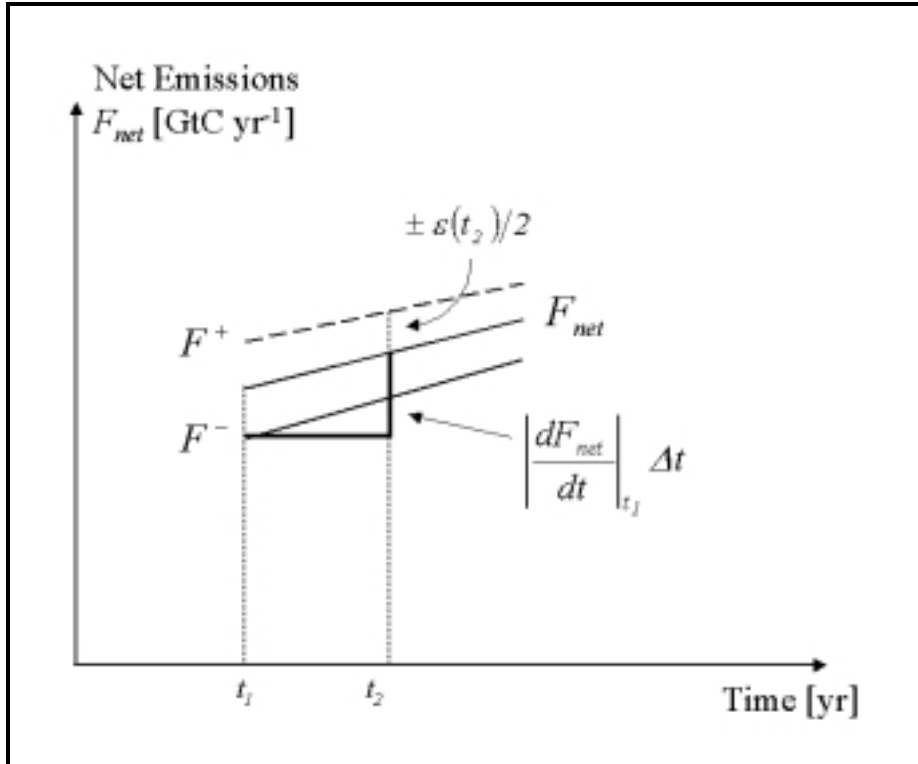
The deterministic VT concept was formulated by Jonas *et al.* (1999) (see also Jonas and Nilsson, 2001: Section 3.1.2). Their condition for favorable verification requests that the absolute change in the net emissions of carbon (or any other greenhouse gas) at time  $t_2$ ,  $|\Delta F_{net}(t_2)|$ , with reference to time  $t_1$  ( $t_1 < t_2$ ), is greater than the uncertainty in the reported net carbon emissions at time  $t_2$ ,  $\frac{1}{2}\varepsilon(t_2)$ . Mathematically, this condition is expressed as:

$$|\Delta F_{net}(t_2)| > \frac{\varepsilon(t_2)}{2}. \quad (2.1)$$

Under the non-restrictive assumption that first-order (i.e., linear) approximations are applicable, we obtain:

$$\left| \frac{dF_{net}}{dt} \right|_{t_1} \Delta t > \frac{1}{2} \left\{ \varepsilon(t_1) + \left( \frac{d\varepsilon}{dt} \right)_{t_1} \Delta t \right\}. \quad (2.2)$$

This VT concept is visualized in Figure 3, where  $F_{net}$  describes the net carbon emissions and  $\pm \frac{\varepsilon}{2}$  (defined via  $F^+$  and  $F^-$ , the upper and lower uncertainty limits of the net carbon emissions) the symmetric uncertainty in  $F_{net}$ .



**Figure 3:** Favorable verification: Simplified linear graphical representation of Equation (2.1) for increasing net carbon emissions ( $F_{net}$ ) and a decrease in their uncertainty ( $\pm \frac{\varepsilon}{2}$ ). Source: Jonas *et al.* (1999), modified.

We consider Equation (2.2) for the case  $\left| \frac{dF_{net}}{dt} \right|_{t_I} > \frac{1}{2} \left( \frac{d\varepsilon}{dt} \right)_{t_I}$ . The time  $\Delta t$  is the VT for the dynamical system considered under Equations (2.1) and (2.2). It is the time, which is required for the emission change to outstrip its underlying uncertainty. For the given system, the VT is given by the inequality

$$\Delta t > \frac{\varepsilon(t_I)}{2 \left| \frac{dF_{net}}{dt} \right|_{t_I} - \left( \frac{d\varepsilon}{dt} \right)_{t_I}} . \quad (2.3)$$

The important detail that should be borne in mind from the aforementioned is that the deterministic VT concept assumes that uncertainty can be represented by symmetric intervals.