

A MODEL FOR THE EFFECT OF AIR POLLUTANTS ON FOREST GROWTH

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The model aims at predicting growth under conditions where air pollutants are present. It is based on photosynthesis and on the allocation of photosynthetic products for growth.

MODEL OF PHOTOSYNTHESIS

It is assumed that air pollutants released during energy production mainly affect photosynthesis in two ways:

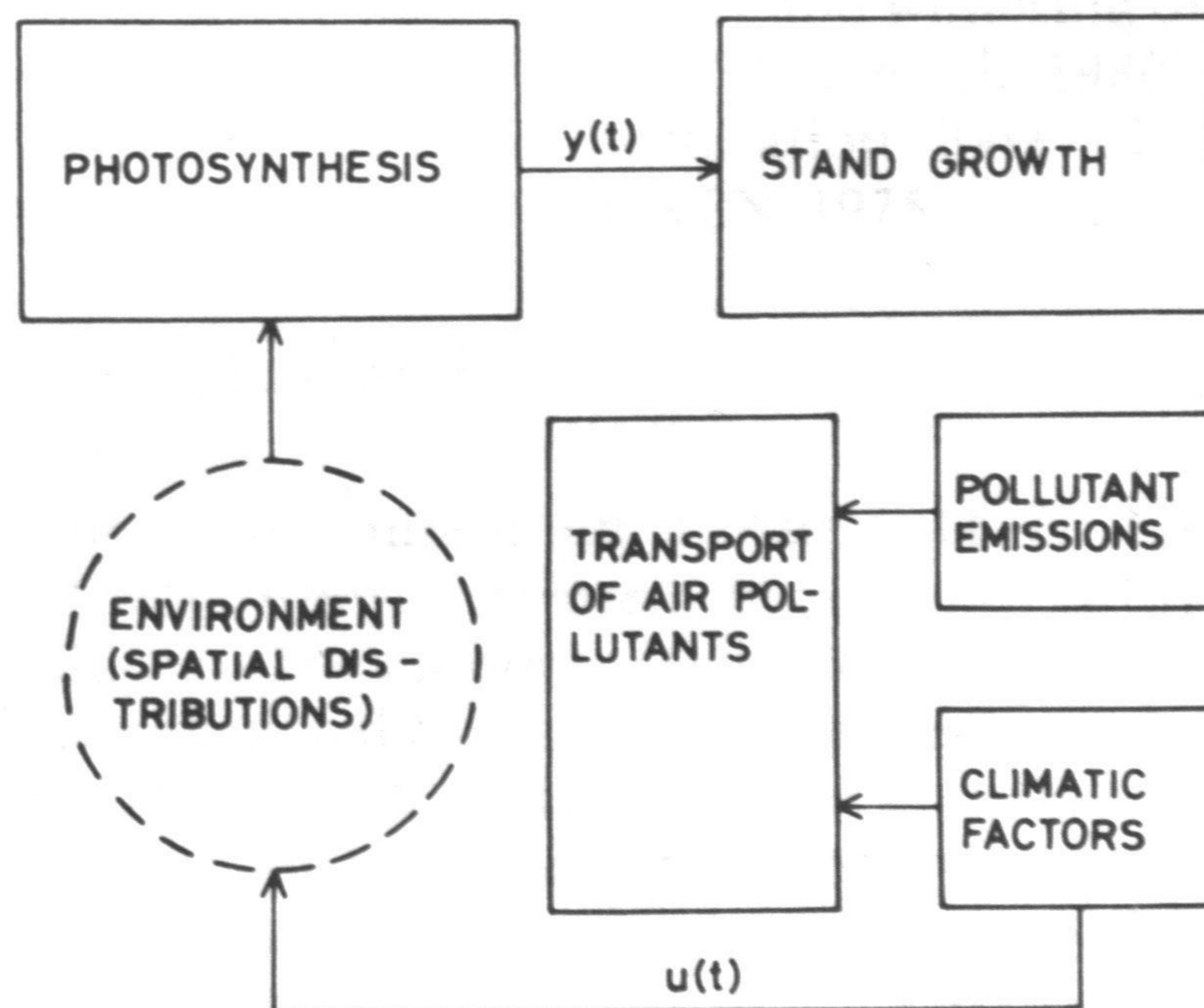
- 1) directly by injuring the photosynthetic mechanism
- 2) indirectly by leaching nutrients

The two effects are studied empirically in order to identify a submodel for the photosynthesis of a plant exposed to air pollutants. The structure of the submodel is sketched in Fig. 1. It is expressed by the following equations: (for denotations, see Fig. 1)

$$S_1: \begin{cases} \frac{d}{dt} Z(t) = \varphi Z(t), u(t), t \\ v(t) = \gamma Z(t), u(t), t \end{cases}$$

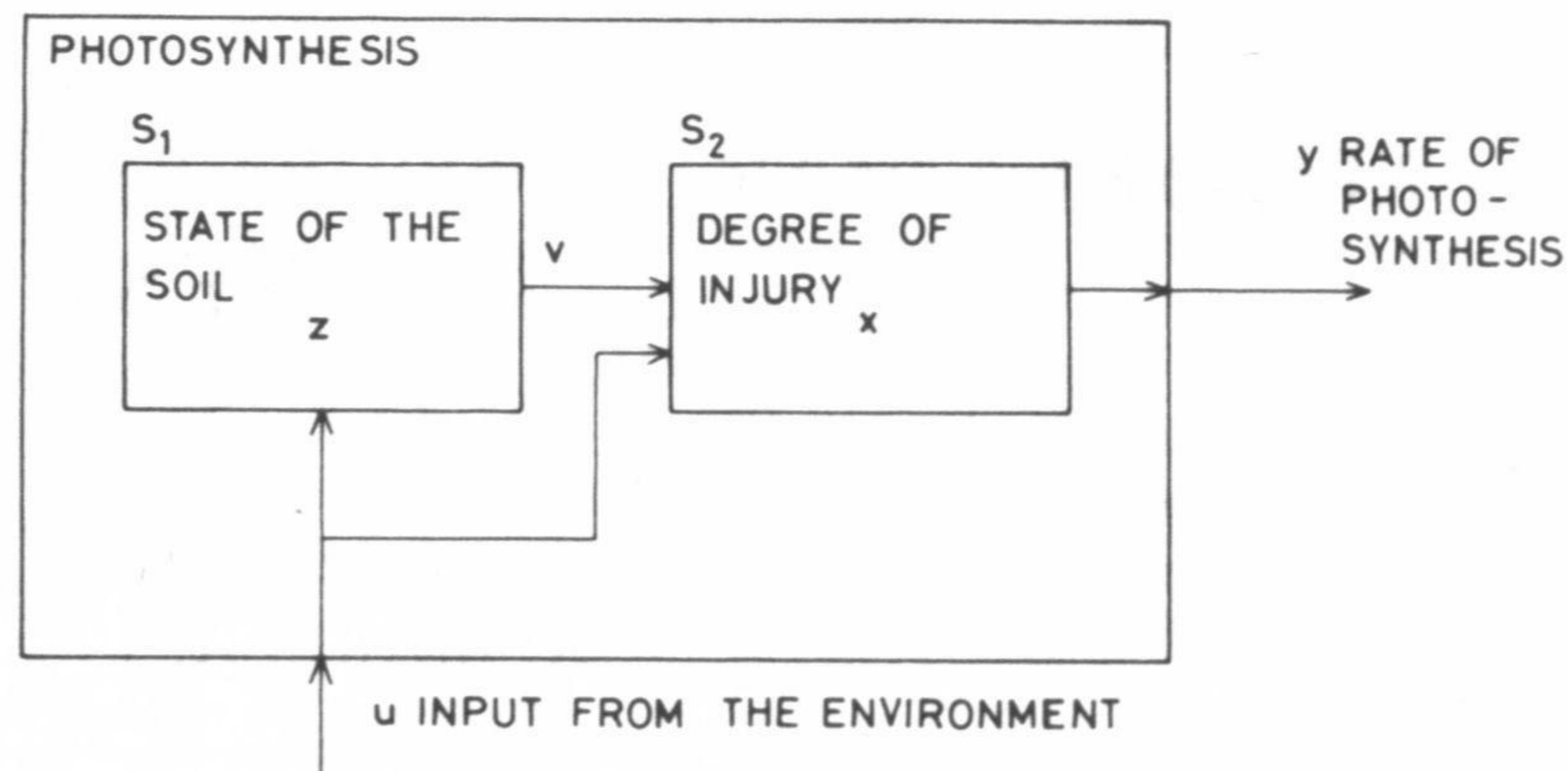
$$S_2: \begin{cases} \frac{d}{dt} X(t) = f X(t), u(t), t \\ y(t) = g X(t), u(t), t \end{cases}$$

The change in the state of the soil under acid precipitation is studied by chemical soil analysis. The states of injury and the photosynthetic rates of seedlings exposed to different concentrations of SO₂ are measured continuously. The measurements are connected to actual plant injuries during this century by multielement analysis of needles and by analyzing the changes in tree ring widths.



MODEL OF STAND GROWTH

The submodel is combined to a larger model that simulates stand growth on the basis of photosynthetic production and its allocation to different organs (Fig. 2). This procedure enables information about momental photosynthetic rate to be utilized at the stand level with a time step of one year. So far, preliminary simulations under unpolluted conditions have been carried out.



APPLICATION

The stand model will be applied to two purposes:

1) the present state of forests in Finland is compared with the simulated state based on the assumption that no pollutants are present

2) the decrease in forest yield under different conditions derived from predictions about long-range pollutant transport in Europe is analyzed.

