

Forecasting the presence of atmospheric pollens

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Abstract. The forecasting process includes several aspects. The scientific aspects include (i) a priori observations, like statistics of weather attributes during recent years, variation of earlier atmospheric pollen amounts, and general correlations between weather factors and pollen frequencies. (ii) The present-day observations are made closer to the flowering season, and they include e.g. the development of the present and forecasted weather, the development of the flower buds, and information obtained from other countries. The practical aspects include effective television, radio and newspaper service, necessary education and information, rapid data analysis and transfer systems, and good national and international cooperation.

Forecasting the occurrence, quality and quantity of the various pollens in the atmosphere is an important aspect in the preventive treatment of allergic diseases. The forecasting includes numerous various processes. They can be grouped into scientific and practical aspects.

1. SCIENTIFIC ASPECTS

These deal with the information related to plant ecology in general, to pollination ecology in particular, and with the meteorological factors. A great part of the scientific factors can be taken into account already before the start of flowering, while others must be studied and observed closer to, or during the pollen season.

1.1. *A priori observations*

1. STATISTICS ON WEATHER ATTRIBUTES

Almost 100 % of the development of the flower buds can be explained by temperature alone. One of the most applicable temperature factors is the temperature sum, but also the daily maximum temperature can be applied. The early-flowering plants

(e.g. alder), and the late-flowering plants (e.g. *Artemisia*) behave in a different way to the various temperature factors. Using the temperature factor alone, about 80 % of all the variation in birch pollen occurrence and amounts could be explained (3).

2. STATISTICS ON ATMOSPHERIC POLLEN OCCURRENCE

The next figures show the birch pollen occurrence in Turku during the 10-year period 1974–1983.

Year	Start mo-da	> 100 · m-3 mo-da	Maximum mo-da
1974	05–04	05–17	05–17
1975	04–16	05–06	05–13
1976	05–04	05–11	05–15
1977	05–04	05–05	05–20
1978	05–05	05–16	05–21
1979	05–02	05–21	05–22
1980	04–30	05–05	05–08
1981	05–08	05–12	05–16
1982	05–01	05–06	05–08
1983	04–20	05–05	05–08
$\bar{x}$	04–30	05–10	05–15
1984 error	05–01 +02	05–02 –08	05–18 +03

Using only this information, the start, the 100 pollen grain limit, and the maximum can be estimated with about one week's accuracy. The actual dates for this year are also given, the respective errors are +2, -8 and +3 days, respectively. It should be observed, that in the most prediction studies the cumulative frequencies prove to be more useful than the daily records.

3. *Distribution of pollen producing plants.* This is an important aspect which often has been forgotten. E.g. in Turku we get yearly plenty of elm (*Ulmus*) pollen, because it is a commonly planted tree here in town, but the native occurrences in SW. Finland are extremely rare.

4. *Phenological statistics of the flowering times.* These are obtainable for various localities, and they often relate to fairly long periods.

5. *Correlations between weather factors and pollen frequencies. Mathematical modelling.* Correlations alone, simple or multiple, rarely tell anything about the true relations between climatic factors and pollen occurrence (2). An advanced treatment, called »operational forecast», was presented by Törnevik (3). Using such or even more simple models, the accuracy of the flowering predictions can be substantially improved.

6. *Number of flower buds.* The intensity of the flowering in all trees varies from year to year. The abundance of flower buds is perhaps partly subjected to endogenous variation, but at least affected by the growth conditions of the previous year. It is easily calculated or at least estimated e.g. 2-3 months before the flowering season.

1.2. Present-day observations

We shall only shortly list some of the most important aspects:

1. *Development of the present and forecasted weather.*

2. *Development of the flower buds.* It should be observed, that due to unfavorable weather, a part of the flower buds may re-

main undeveloped.

3. *Information obtained from various field locations.*

4. *Information obtained from other countries.* This is a very important point. E.g. for us in Turku it would be essential to obtain the pollen counts from southern Sweden and also from Estonia and from the Leningrad region the very same day they have been made.

5. *Continuous correction of the prediction models.*

2. PRACTICAL ASPECTS

There are a number of practical problems to be solved before an effective forecasting is made. A scientific treatment, even if completely competent, is alone worth of nothing. I should perhaps lay even more stress on these practical questions than to the scientific aspects. In this connection, however, we almost restrict to a list of problems.

1. *Collection and analysis of the atmospheric pollen data.*

2. *Education and information about the forecasting service.* This is one of the most essential points in the whole forecasting system. We might have excellent scientific resources, we might have arranged the distribution of our results wonderfully; but if people do not know about it, it has all been wasted time. Here a close cooperation with medical doctors, and with the societies of people suffering from allergies, as well as with the information channels is required.

3. *Television and radio service.*

4. *Newspaper information.*

5. *Pollen Bulletins.* The Finnish Pollen Bulletin was established in 1976, and the present volume is number 9. The Finnish Pollen Bulletin is probably the first Bulletin which has claims for an »official status»; there where earlier weekly reports issued at least by Dr. Davies in London (1).

6. *Rapid data transfer systems (telefax, telex).* We have found that the telefax service offered by the telephone companies is

very practical: with it we can send a sheet of written text exactly as it is, you can include drawings, and everything will be received exactly in the original form.

7. *Good international cooperation.* We should be able to create a network of telecommunications in the Nordic countries, the adjacent parts of Soviet Union included, which satisfies our information needs. It is question of planning, and – of money.

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