**During the period 1990 – 2006, the following effects of ozone were detected on crops and natural vegetation* in Europe:**

- ❑ **Ozone injury was detected in 16 European countries**
- ❑ **Effects on biomass and yield were reported for central and southern Europe**
- ❑ **Over 80 species of natural vegetation showed symptoms including species from meadows, wetlands and forest margins**
- ❑ **Over 30 crop species, including wheat, maize, soybean, potato, tomato, lettuce and chicory showed visible symptoms**
- ❑ **On occasions, ozone episodes caused so much damage to leafy crops that they could not be sold (e.g. in Greece)**
- ❑ **Ozone effects were well correlated with maps of ozone uptake (flux) but not with maps of ozone concentration, e.g. damage was found in Sweden where predicted ozone fluxes were relatively high but ozone concentration was relatively low**

*** effects on tree species were not included in this study**

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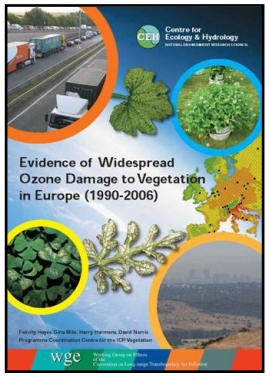
## Further Information

For further information and a copy of the full report, please visit our website (icpvegetation.ceh.ac.uk) or contact:

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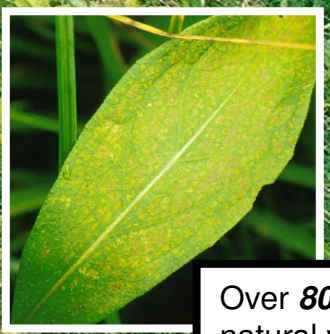
Over ***30 species*** of crops were damaged by ozone

# Evidence of widespread ozone pollution damage to vegetation in Europe (1990 – 2006)



Over ***80 species*** of natural vegetation were damaged by ozone



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# Ozone effects 1995 to 2004

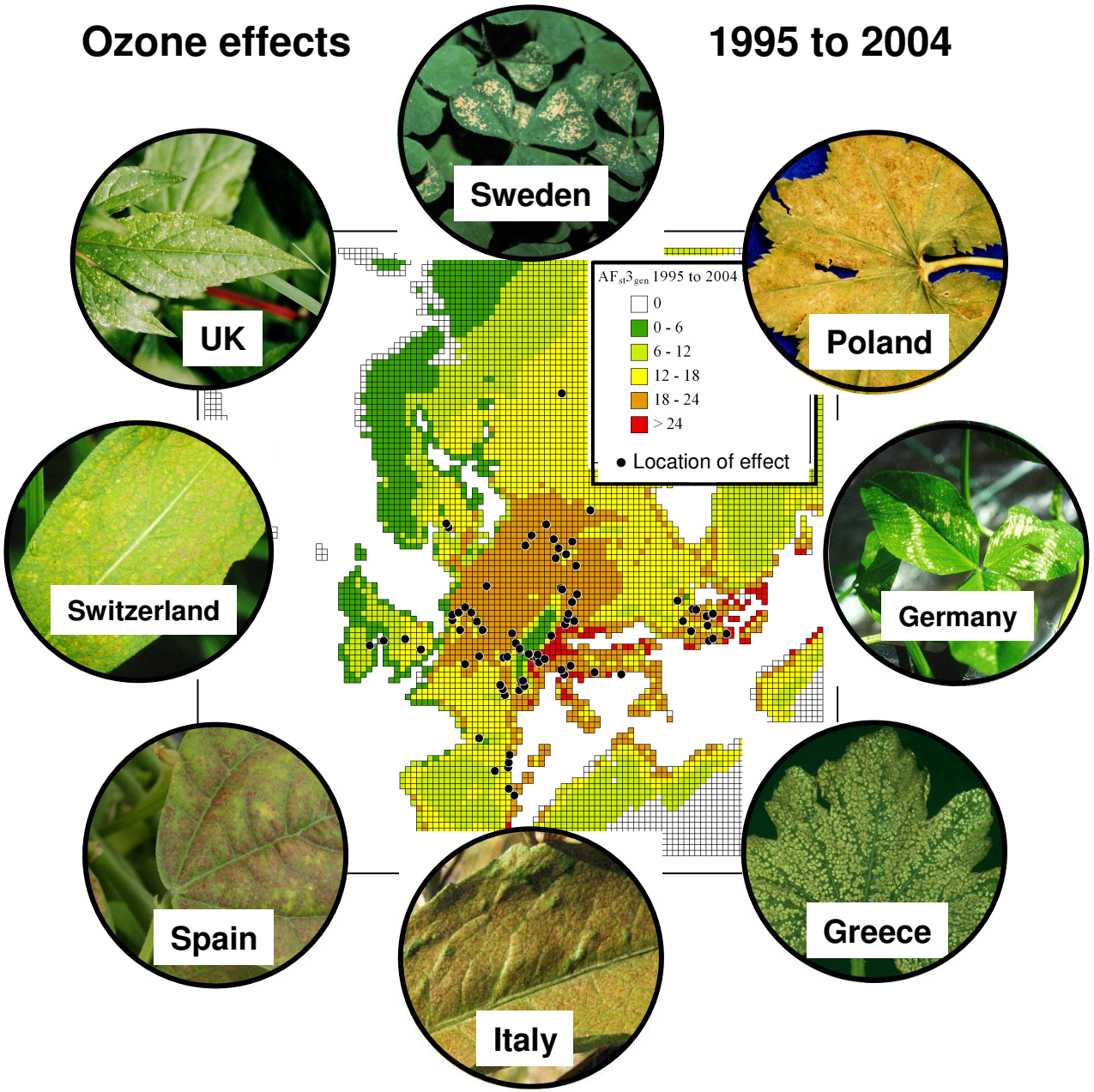
## Ozone Pollution in Europe

Ozone pollution is formed from a series of chemical reactions involving oxides of nitrogen, carbon monoxide and non-methane volatile organic compounds. Some of these compounds occur naturally, but mostly they arise as a result of man's activities e.g. from car vehicle exhausts and industry.

Ozone is always present at background levels of 25-40 ppb in Europe, but during warm, dry conditions and especially those associated with stable high pressure over large areas of Europe, ozone episodes occur where concentrations rise to above 60 ppb for several consecutive days. Ozone concentrations are usually highest in upland and rural areas, downwind of major cities.

## Damaging effects on vegetation

As well as health effects, ozone pollution poses a major threat to our vegetation, with plants responding to both background concentrations and those found in ozone episodes. Effects include visible injury (see photos), early die-back, decreased growth and reductions in both yield quality and quantity. Over 30 species of crops and 80 species of natural vegetation are damaged by ozone pollution in Europe. Many tree species are also ozone-sensitive, but effects on these were not included in this study.




## The Role of the ICP Vegetation

Thirty four countries of Europe plus the USA contribute experimental data and modelling expertise to the ICP Vegetation, an International Cooperative Programme reporting to the United Nations Convention on Long-range Transboundary Air Pollution (LRTAP Convention) on the effects of air pollution on crops and natural vegetation. Maps like the one in the centre of this leaflet are used to inform international policy on the effectiveness of air pollution control and future requirements, leading ultimately to improvements in air quality across Europe.

## Data collection and maps

The Coordination Centre for the ICP Vegetation compiled lists of evidence of damage from: surveys of fields and natural vegetation for damage, biomonitoring surveys with indicator species (e.g. the ICP Vegetation white clover survey), *ad hoc* observations of injury by ozone specialists and experiments in which ozone was filtered out of ambient air. Effects data were mapped against ozone concentration parameters and $AF_{st}3gen$ (accumulated modelled ozone uptake (flux) by a generic crop), as shown here.

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