LRTAP
Long-range Transboundary Air Pollution

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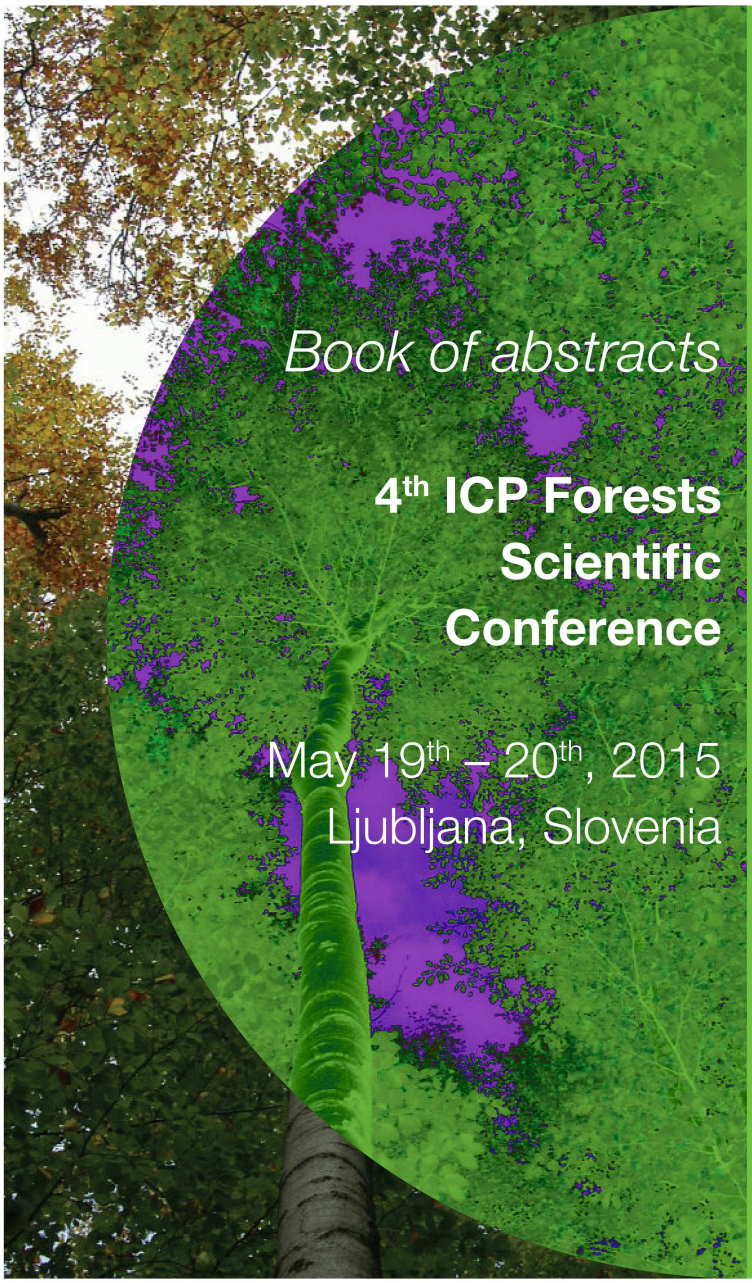

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Long-term trends and effects of air pollution on forest ecosystems, their services, and sustainability

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Defoliation reconsidered?

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Since the 1980s defoliation (often assessed by means of crown transparency) is the most used indicator of tree condition adopted in Europe. It has been criticized for its subjectivity and scarce relation with meaningful endpoints. Here we collated the results of three different studies carried out in France and Italy to investigate the relationship between defoliation/ transparency and other measured indicators of tree growth and health.

In a first study, basal area increment (BAI) and mean defoliation of conifers and broadleaves in the French Level II network RENECOFOR were examined for the growing periods 1995-2004 (47 plots, 2008 trees) and 2000-2009 (63 plots, 3, 116 trees). A second, similar study was carried out on *Picea abies* (L.) Karts., in Trentino, Northern Italy, on 13 Level I plots and two growing periods, 2001-2005 (136 trees) and 2005-2009 (111 trees). The third study was carried out also in Trentino: nine *Picea abies* trees were randomly selected along an elevation gradient (900-1500 m asl) and examined for crown transparency, shoot length, needle weight, chlorophyll fluorescence, and stable isotopes in needles (δ 13C and δ 18O).

BAI resulted negatively and significantly related to defoliation at both the French and Italian plots, and growth reduction of 0.73-1.49% per unit increase of defoliation can be expected. The gradient study revealed that the response of trees to elevation is consistently and significantly recorded by the various indicators (e.g. reduced shoot length, needle weight, chlorophyll fluorescence, and increase of crown transparency).

We argue that, despite its "bad" reputation, defoliation can be considered as an effective indicator of forest health and vitality. Its role among the indicators of Sustainable Forest Management is justified, also in view of its long-term documentation in terms of QA/QC procedures at national/international level. These are strong arguments for supporting and promoting forest health monitoring networks.