# 1 Definitions, statistics used

The following definitions and acronyms are used throughout this note:

SIA denotes secondary inorganic aerosol and is defined as the sum of sulphate ($SO_4^{2-}$), nitrate ($NO_3^-$) and ammonium ($NH_4^+$). In the EMEP/MSC-W model SIA is calculated as the sum: SIA= $SO_4^{2-}$ + $NO_3^-$ (fine) + $NO_3^-$ (coarse) + $NH_4^+$

PPM denotes primary particulate matter, originating directly from anthropogenic emissions. It is usually distinguished between fine primary particulate matter, $PPM_{2.5}$ with aerosol diameters below 2.5 $\mu$m and coarse primary particulate matter, $PPM_{co}$ with aerosol diameters between 2.5$\mu$m and 10$\mu$m.

$PM_{2.5}$ denotes fine particulate matter, defined as the integrated mass of aerosol with diameter up to 2.5 $\mu$m. In the EMEP/MSC-W model $PM_{2.5}$ is calculated as the sum: $PM_{2.5} = SO_4^{2-}$ + $NO_3^-$ (fine) + $NH_4^+$ + SS(fine) + $PPM_{2.5}$

$PM_{10}$ denotes particulate matter, defined as the integrated mass of aerosol with diameter up to 10 $\mu$m. In the EMEP/MSC-W model $PM_{10}$ is calculated as the sum: $PM_{10} = PM_{2.5}$ + $NO_3^-$ (coarse) + SS(coarse) + $PPM_{co}$

SOMO35 is the sum of Ozone Means Over 35 ppb is the new indicator for health impact assessment recommended by WHO. It is defined as the yearly sum of the daily maximum of 8-hour running average over 35 ppb. For each day the maximum of the running 8-hours average for $O_3$ is selected and the values over 35 ppb are summed over the whole year.

If we let $A_8^d$ denote the maximum 8-hourly average ozone on day $d$, during a year with $N_y$ days ($N_y$ = 365 or 366), then SOMO35 can be defined as:

$$SOMO35 = \sum_{d=1}^{d=N_y} \max\left(A_8^d - 35 \text{ ppb}, 0.0\right)$$

where the $\max$ function ensures that only $A_8^d$ values exceeding 35 ppb are included. The corresponding unit is ppb·days (abbreviated also as ppb·d).

AOT40 is the accumulated amount of ozone over the threshold value of 40 ppb, i.e.:

$$AOT40 = \int \max(O_3 - 40\,\text{ppb}, 0.0)\,dt$$

where the $\max$ function ensures that only ozone values exceeding 40 ppb are included. The integral is taken over time, namely the relevant growing season for the vegetation concerned, and for daytime only. The corresponding unit are ppb·hours (abbreviated to ppb·h).

Although the EMEP/MSC-W model generates a number of AOT-related outputs, these pages present results for three "practical" definitions:

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**AOT40$_f^{\mathbf{3m}}$** - AOT40 calculated over April-September from $O_3$ concentrations at 3 m height. This AOT40 is close to that derived from measurements. (Technically, the 3 m is above the displacement height, and so close to the top of a forest canopy, but well above a crop canopy).

**AOT40$_f^{\mathbf{uc}}$** - AOT40 calculated for forests using estimates of $O_3$ at forest-top ($uc$: upper-canopy). This AOT40 is that defined for forests by the UNECE Mapping Manual, but using a default growing season of April-September.

**AOT40$_c^{\mathbf{uc}}$** - AOT40 calculated for agricultural crops using estimates of $O_3$ at the top of the crop. This AOT40 is close to that defined for agricultural crops by the UNECE Mapping Manual, but using a default growing season of May-July, and a default crop-height of 1 m.

POD$_Y$ - (Was AFstY) - Phyto-toxic ozone dose, is the accumulated stomatal ozone flux over a threshold Y nmol m$^{-2}$ s$^{-1}$, i.e.:

$$\text{POD}_Y = \int \max(F_{st} - Y, 0)\, dt \tag{1}$$

where stomatal flux $F_{st}$, and threshold, $Y$, are in nmol m$^{-2}$ s$^{-1}$, and the `max` function evaluates $\max(A-B, 0)$ to $A-B$ for $A > B$, or zero if $A \leq B$. This integral is evaluated over time, from the start of the growing season (SGS), to the end (EGS).

For the generic crop and forest species, the suffix "gen" can be applied, in this report e.g. POD$_{1.0,\text{gen-DF}}$ (or AF$_{st}1.6_{\text{gen-DF}}$) is used for forests and POD$_{3.0,\text{gen-CR}}$ (or AF$_{st}3_{\text{gen-CR}}$) is used for crops.

POD was introduced in 2009 as an easier and more descriptive term for the accumulated ozone flux. The definitions of AFst and POD are identical however.