Assessment of ozone in ambient air

EU-indicators and trends in Belgium

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Ozone in ambient air

- formation and destruction mechanisms

Ozone in mixing layer: simplified formation and destruction scheme

(280 - 430 nm) UV

hours - days

$NO_2 + h\nu + O_2 \rightleftharpoons NO + O_3$

minutes

$R'O_2\bullet \leftarrow RO\bullet$

$RO_2\bullet$

$OH\bullet$ $HO_2\bullet$

hours - days

VOC (RH + OH•)

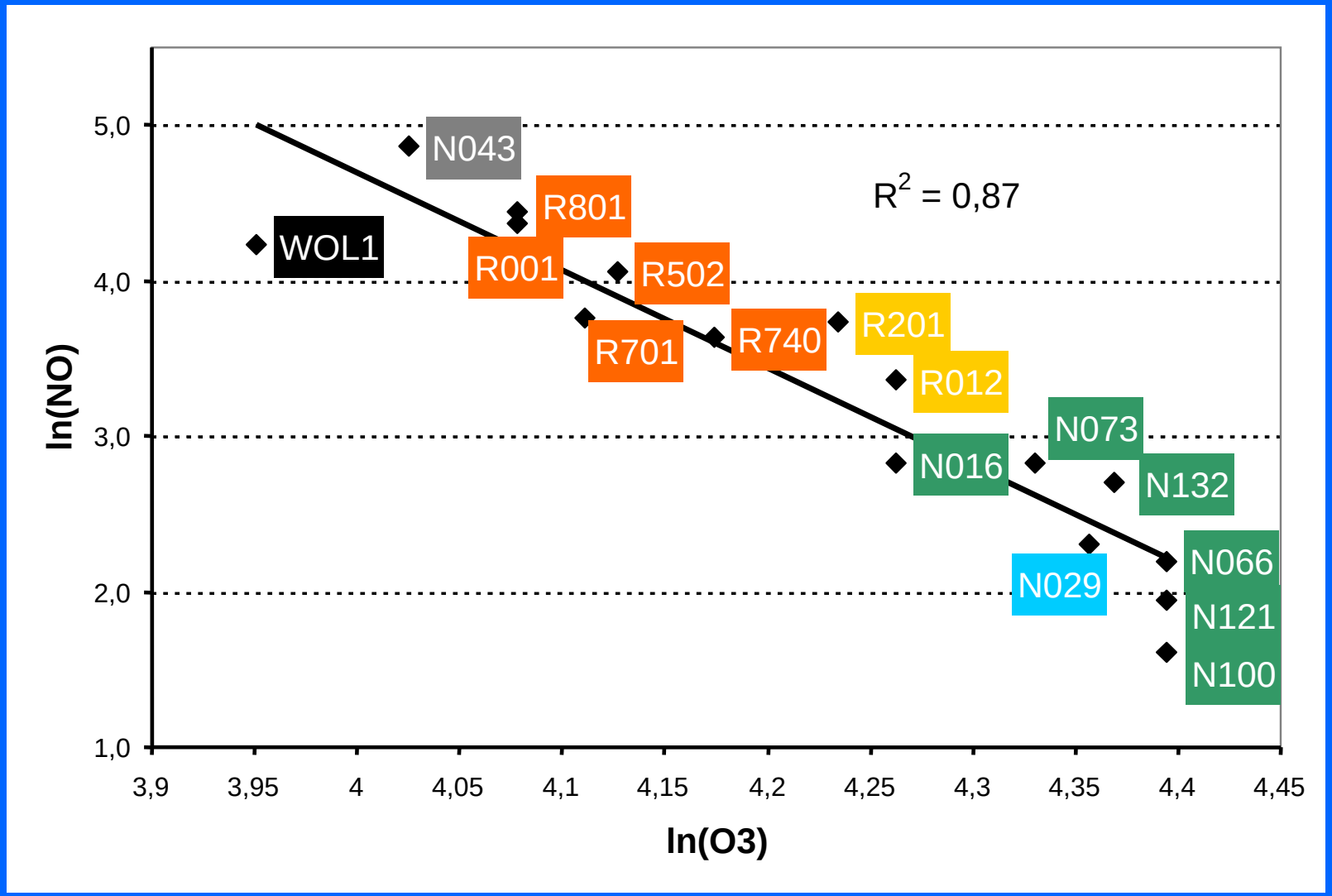
RH + OH• + O_2 -> RO_2• + H_2O

RO_2• + **NO** -> RO• + **NO_2**

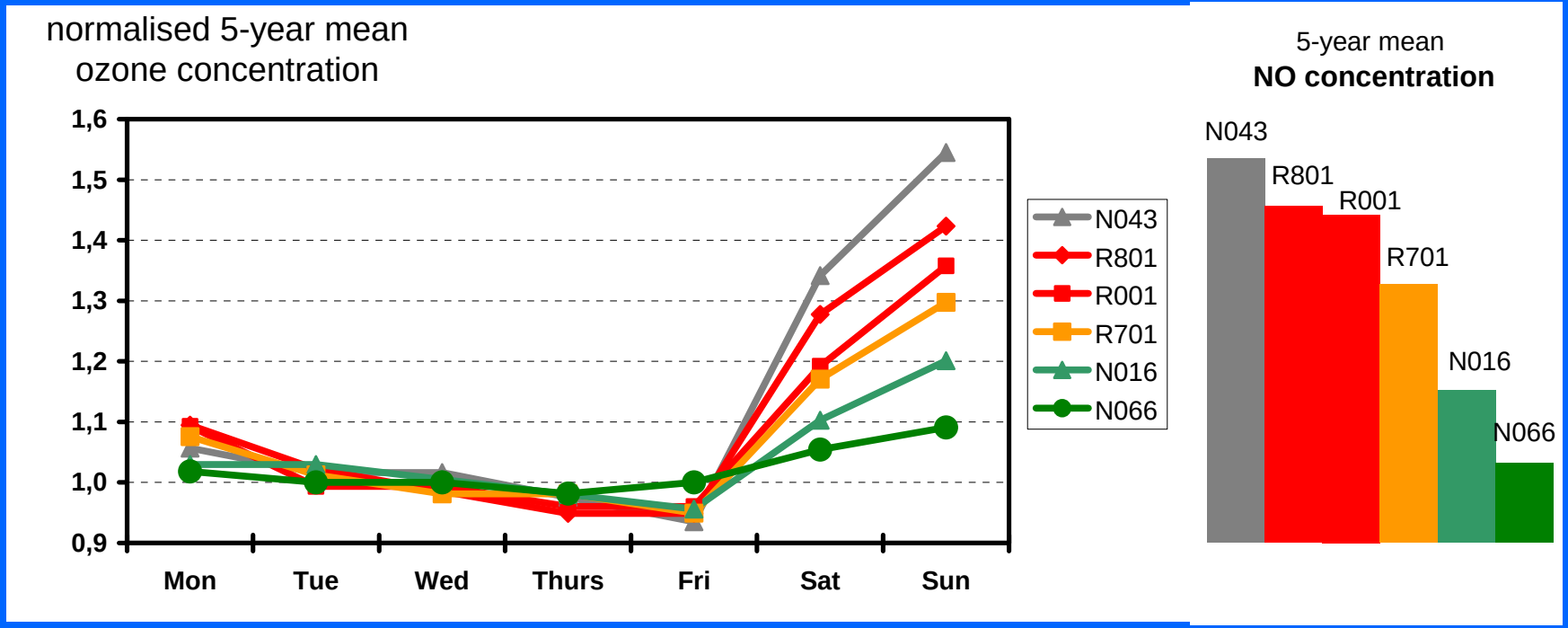
RO• + O_2 -> carbonyl + HO_2•

HO_2• + **NO** -> OH• + **NO_2**

O_3 ~ NO : averaged daily maxima (1998-2002)



Weekend effect (less traffic - more ozone)



Less NO means more O_3

- in rural areas (less NO)
  $\Rightarrow$ more ozone than in inner cities

- weekend-effect in cities (of N-W Europe):
  less traffic (less NO)
  $\Rightarrow$ more ozone than on working days

Ozone in ambient air

- formation and destruction mechanisms

- EU indicators for assessment
  - EU directive on ozone 2002/3/EC
  - EU strategy against acidification, eutrophication and tropospheric ozone

    $\Rightarrow$ NEC directive 2001/81/EC

EU- ozone directive 2002/3/EC introduces 2 new parameters for constructing indicators

- 1 health related parameter (WHO)

  maximum daily 8-hour mean (max8h)

  (maximum journalier de la moyenne sur 8 heures)

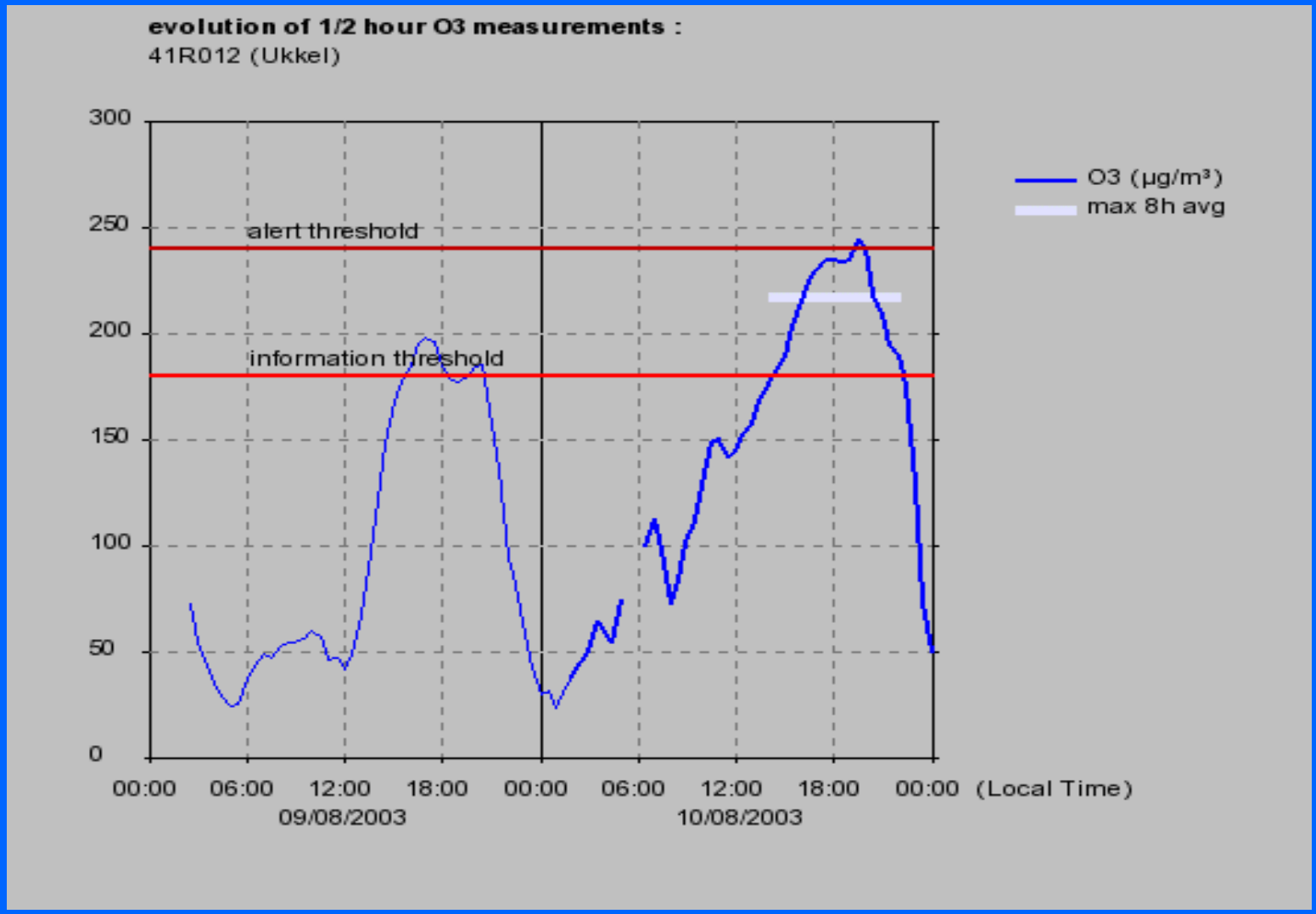
  (hoogste 8-uursgemiddelde van een dag)

  (höchster 8-Stunden-Mittelwert eines Tages)

- 1 ecosystem related parameter (UNECE)

  $AOT40_{ppb}$: **A**ccumulated **E**xposure over **T**hreshold of 40 ppb (= 80 µg/m³)

maximum daily 8-hour mean (max8h)



http://www.irceline.be

Health related indicators

- $NET60_{ppb}$-max8h (in directive)

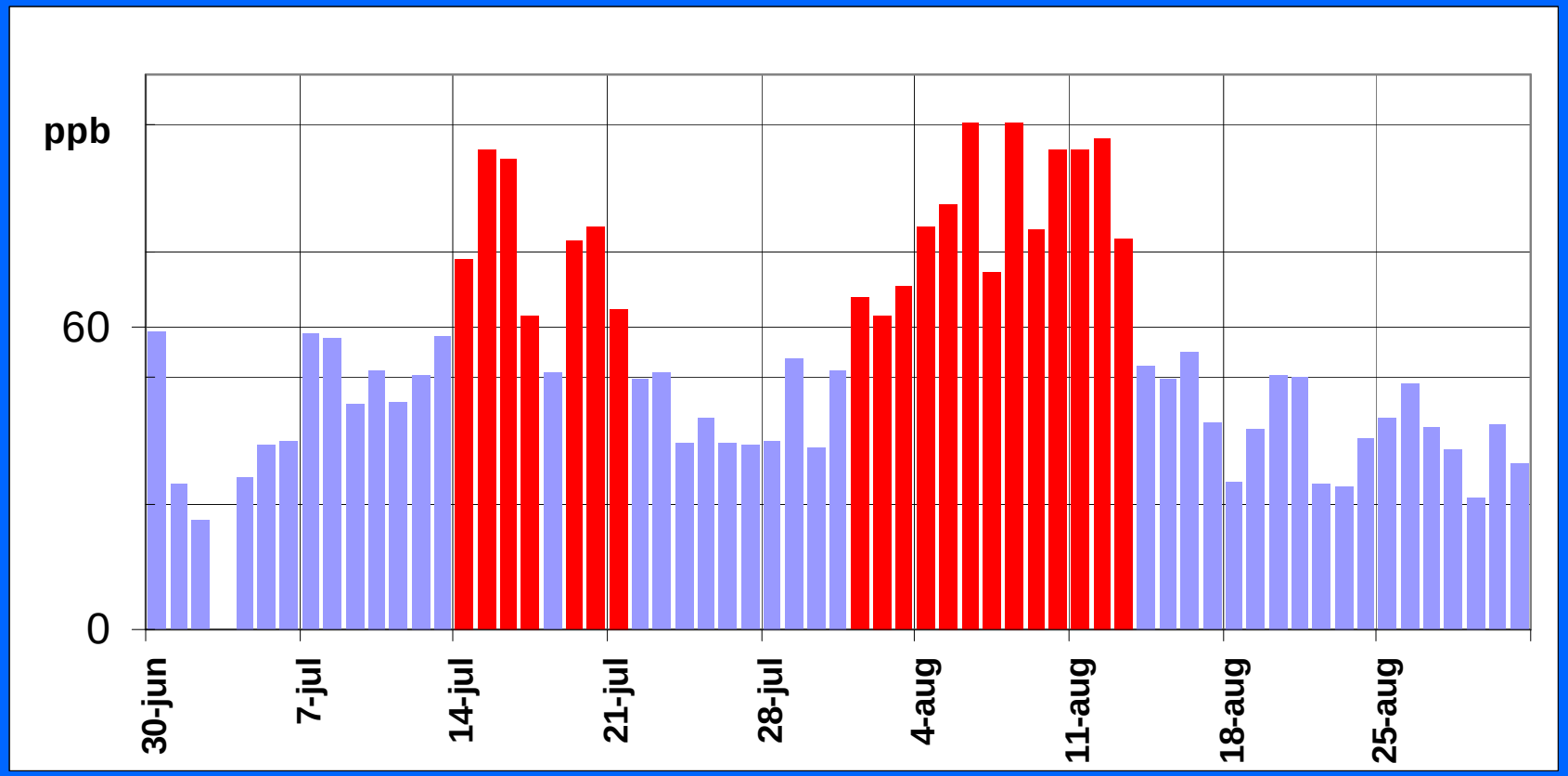
  Number of **E**xceedances of the **T**hreshold of 60 ppb (=120 µg/m³) by the maximum daily 8-hour mean

  ⇒ EU Target value in 2010 : ≤ 25 days per calendar year (averaged over 3 years)

  ⇒ EU Long term objective: 0 (8h-mean never should exceed 120 µg/m³ any more)

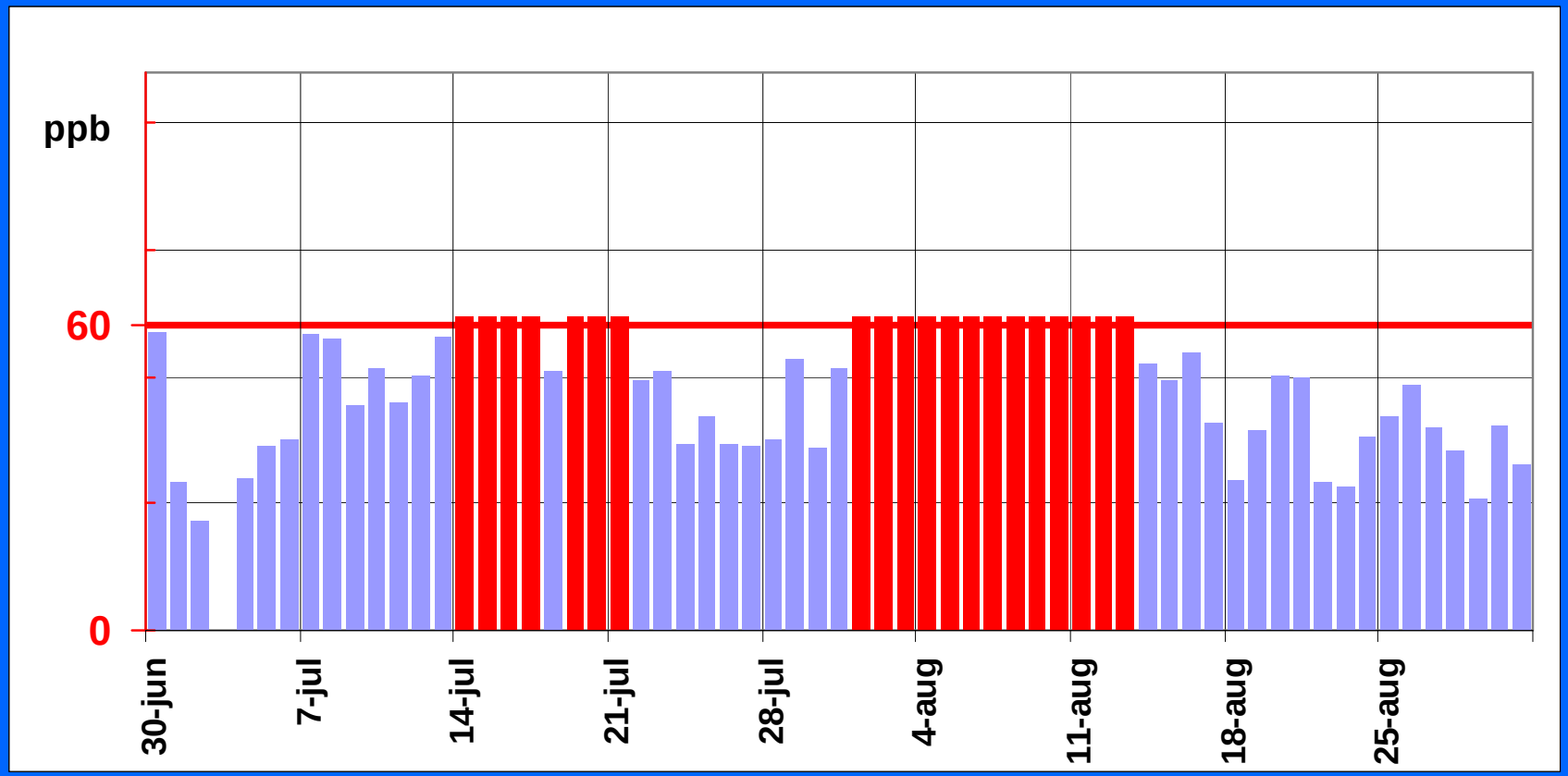
$NET60_{ppb}$: EU target value to protect health

$NET60_{ppb}$: number of days with maximum daily 8h mean > 120 µg/m³
20 days at N016 (july - aug 2003)



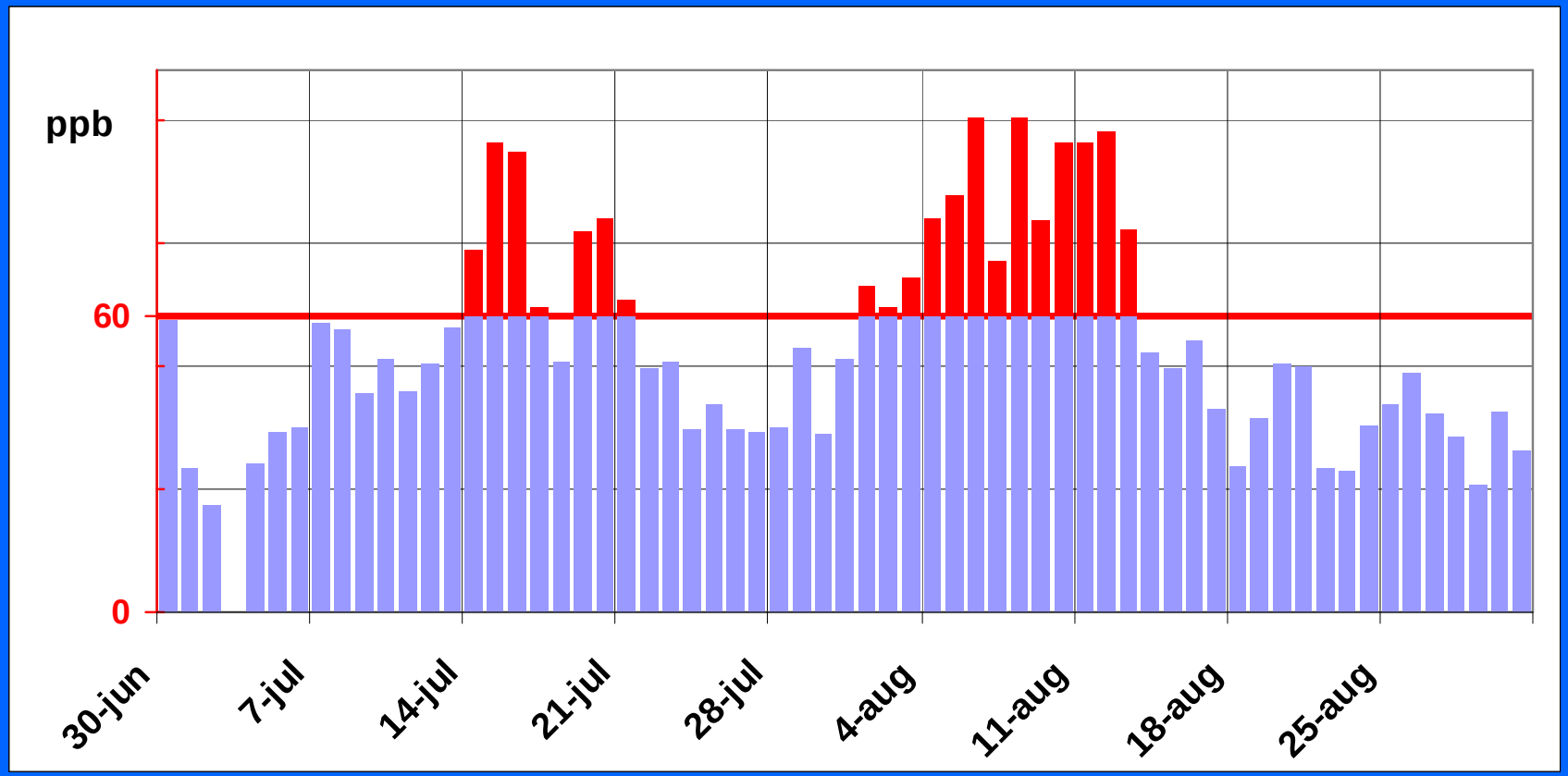
$NET60_{ppb}$: EU target value to protect health

$NET60_{ppb}$: number of days with maximum daily 8h mean > 120 µg/m³
also 20 days !



$AOT60_{ppb}$: the EU strategy target to protect health

Accumulated excess **O**ver **T**hreshold of 120 µg/m³by all maximum daily 8h means at N016 during july - aug 2003 (3 370 ppb.h)



Health related indicators

- $NET60_{ppb}$-max8h (in directive)

  Number of **E**xceedances of the **T**hreshold of 60 ppb (=120 µg/m³) by the maximum daily 8-hour mean

  ⇒ EU Target value in 2010 : ≤ 25 days per calendar year (averaged over 3 years)

  ⇒ EU Long term objective: 0 (8h-mean never should exceed 120 µg/m³ any more)

- $AOT60_{ppb}$-max8h (in EU strategy)

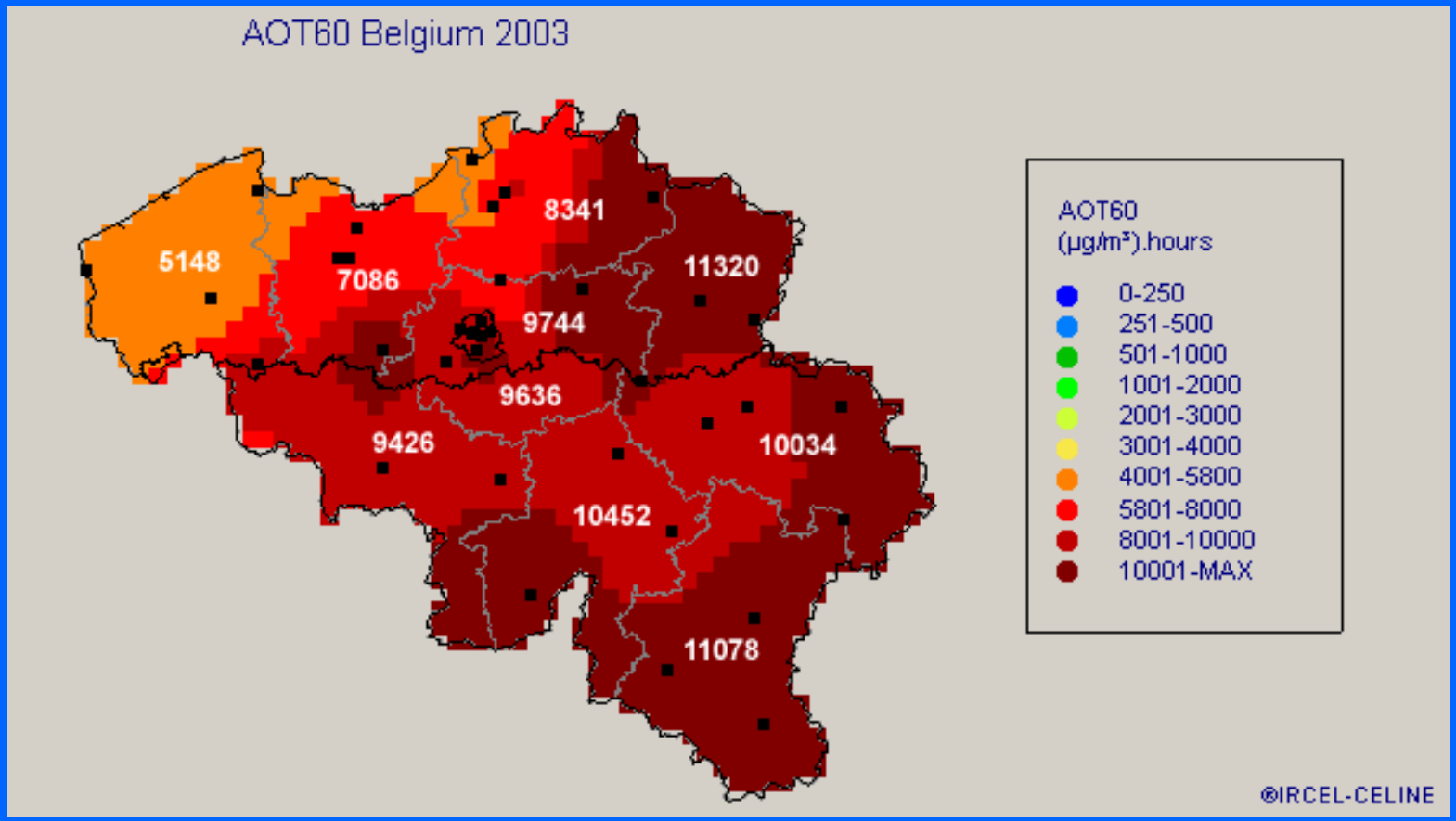
  Accumulated **E**xposure over the **T**hreshold of 60 ppb (=120 µg/m³) by the maximum daily 8-hour mean

  ⇒ decrease in 2010 by 2/3 of 1990 value

  ⇒ and absolute upper limit of 5 800 (µg/m³).h

Ozone (2003) : excess burden for health (AOT60)

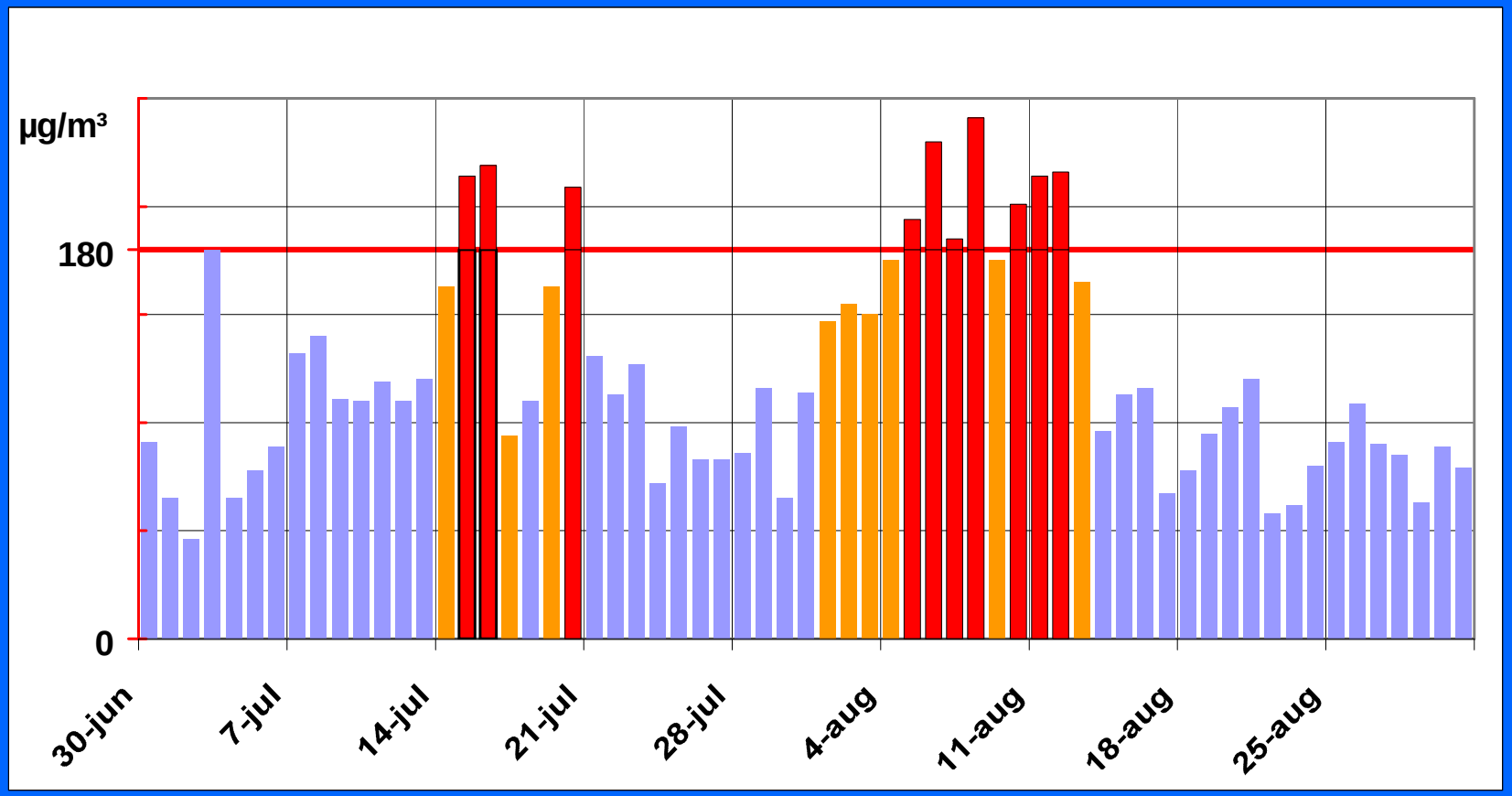
$AOT60_{ppb}$: **A**ccumulated excess **O**ver **T**hreshold of 120 µg/m³
by all maximum daily 8h means during a year



Source: http://www.irceline.be/~celinair/documents/ozon_bel_2003.pdf

EU threshold for information of the public (180 µg/m³)

N016 : daily maximum of 1 hour mean concentrations (july -aug 2003)



Ecosystem related indicators

- $AOT40_{ppb}$-vegetation

  excess above 80 µg/m³ of all 1-hourly concentrations

  – measured between 08:00 and 20:00 h CET

  – accumulated from may to july

  ⇒ TV in 2010 : 18 000 (µg/m³).h (avg over 5 years)

  ⇒ LTO : 6 000 (µg/m³).h

- $AOT40_{ppb}$-forest

  excess above 80 µg/m³ of all 1-hourly concentrations

  – measured between 08:00 and 20:00 h CET

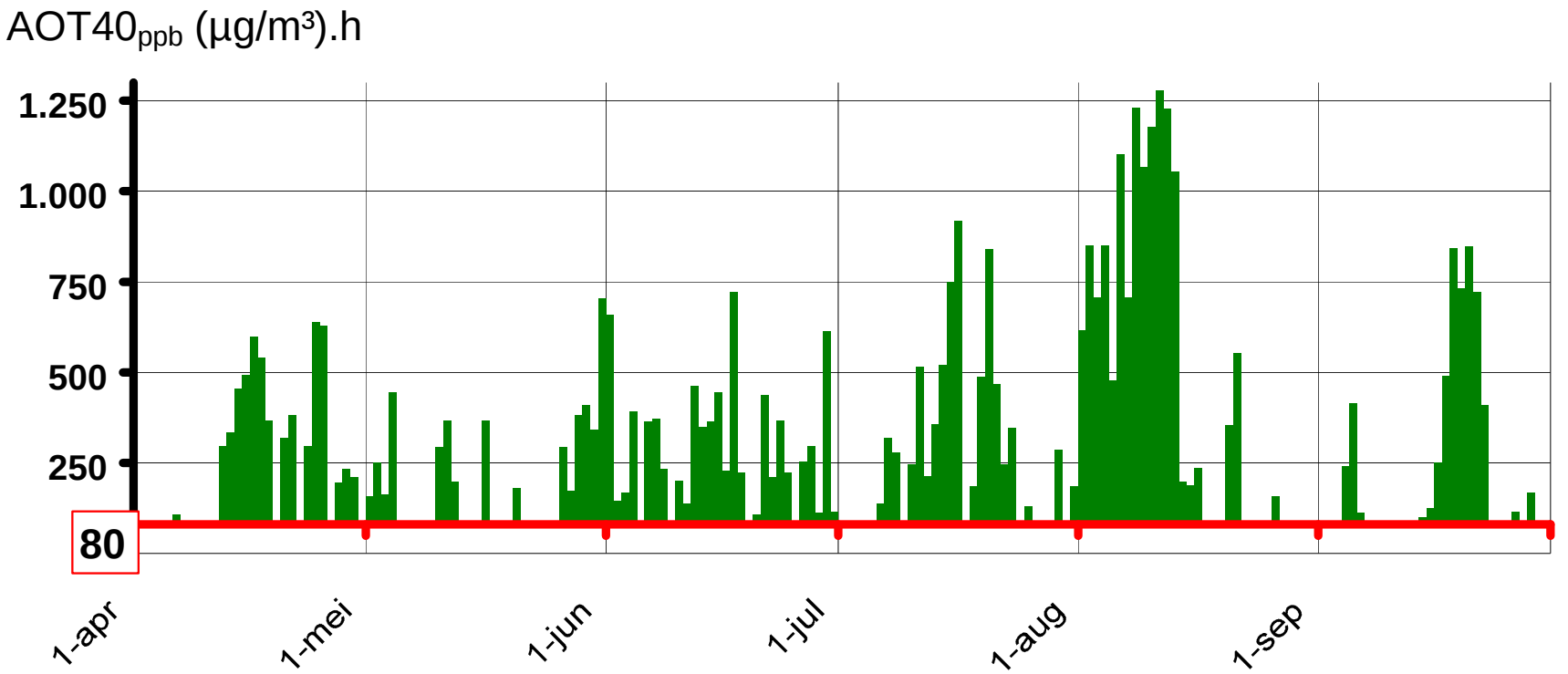
  – accumulated from april to september

  ⇒ EU ‘reference value’ : 20 000 (µg/m³).h

$AOT40_{ppb}$: burden for forests and vegetation

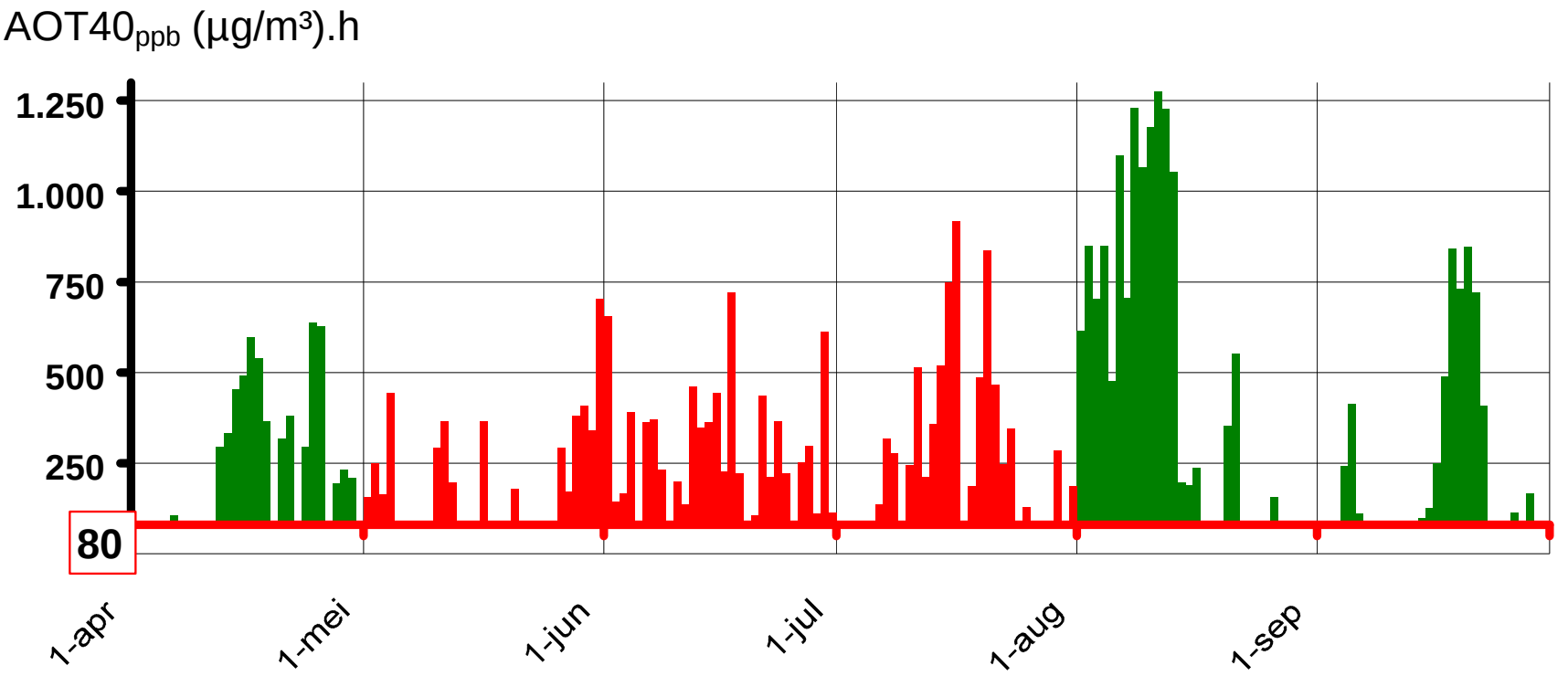
AOT40ppb_forest (apr-sept)

at N066 (Eupen) during 2003



$AOT40_{ppb}$: burden for forests and vegetation

AOT40ppb_forest (apr-sept) and AOT40ppb_veg (mai-july)
at N066 (Eupen) during 2003



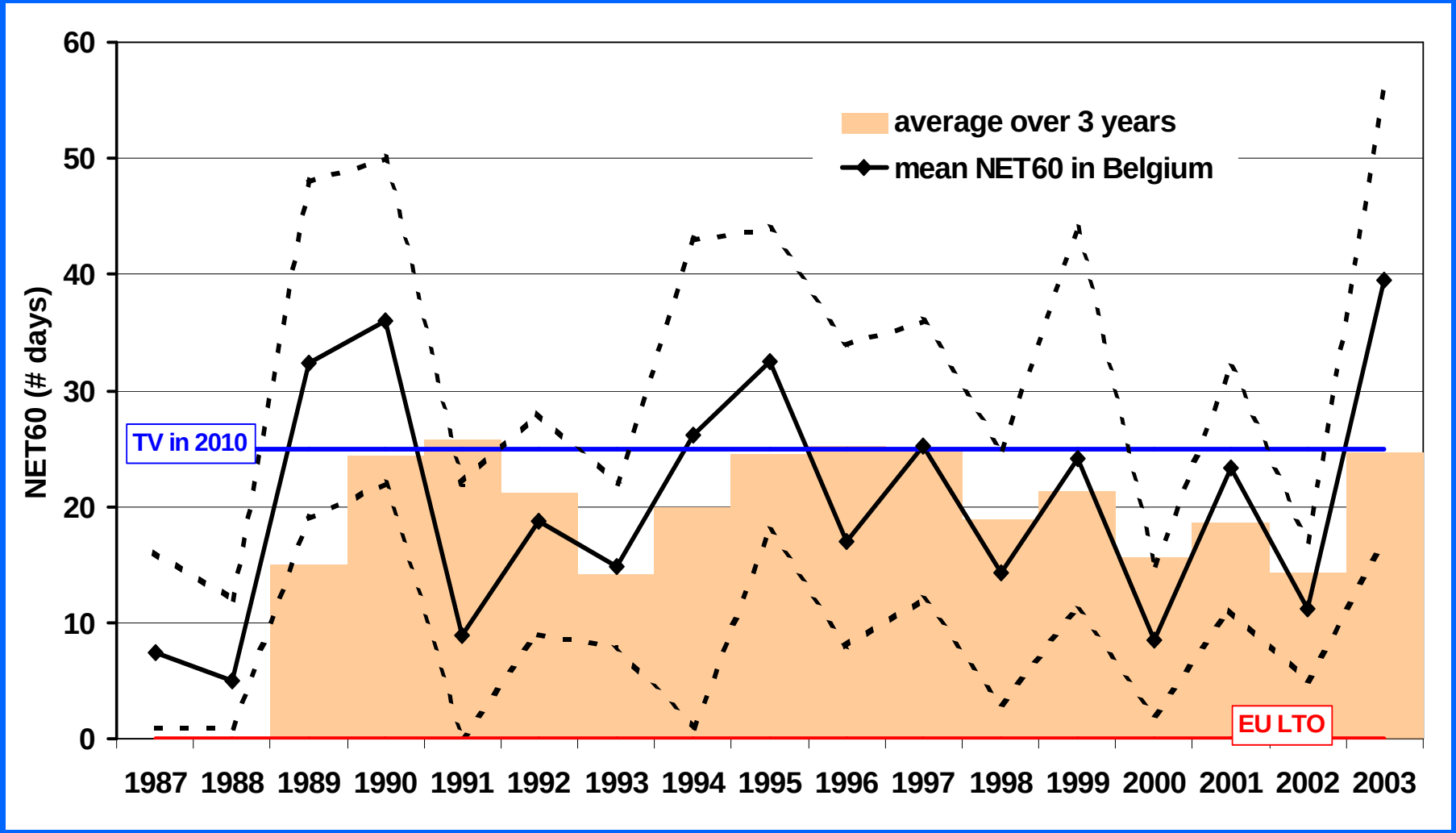
Ozone in ambient air

- formation and destruction mechanisms
- EU indicators for assessment

- trends of indicators for protection of
  - public health ($NET60_{ppb}$ and $AOT60_{ppb}$)
  - vegetation ($AOT40_{ppb}$_vegetation)
  - forests ($AOT40_{ppb}$_forest)

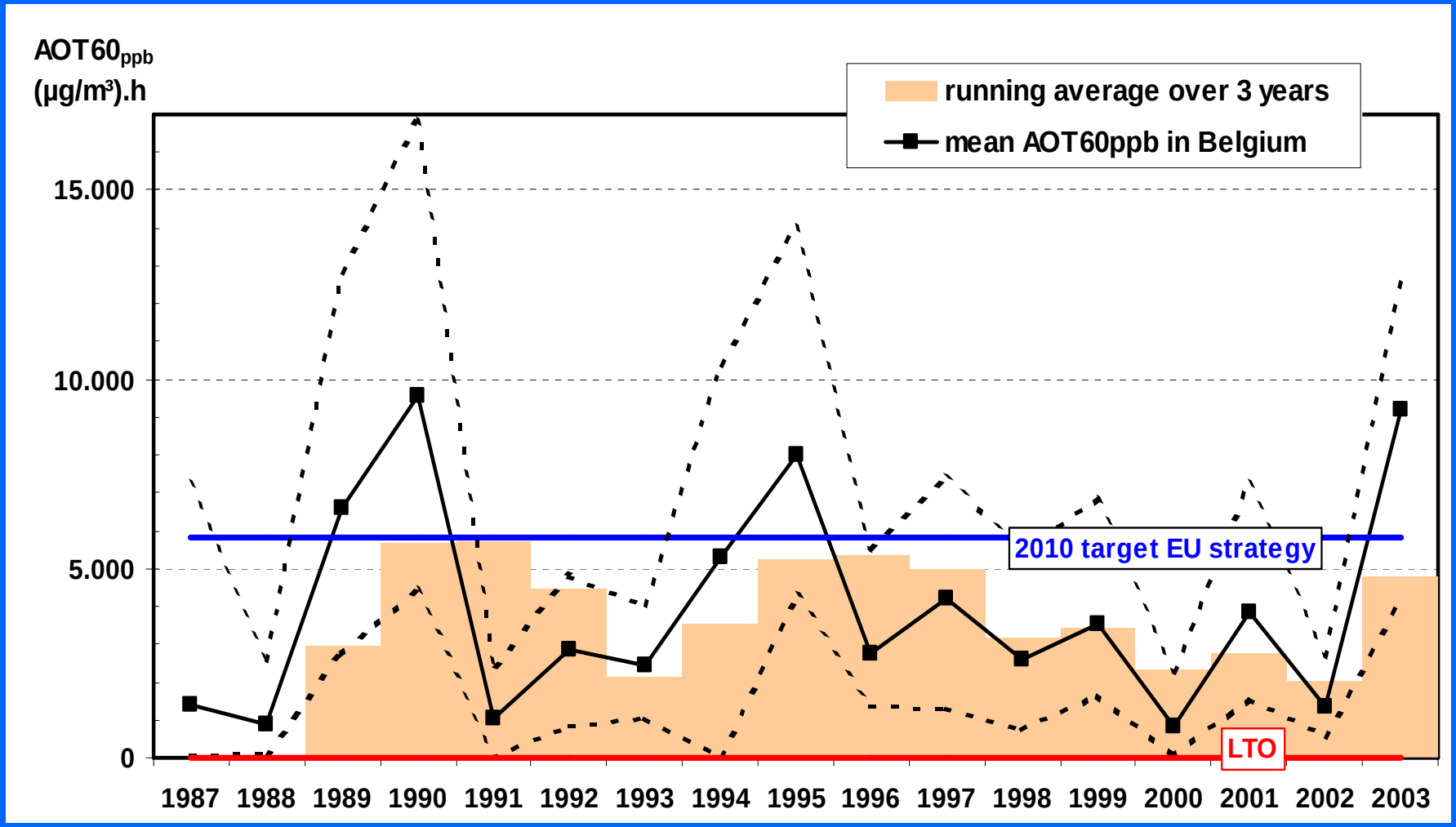
$NET60_{ppb}$-max8h : protection of health

$NET60_{ppb}$: number of days with maximum daily 8h mean > 120 µg/m³



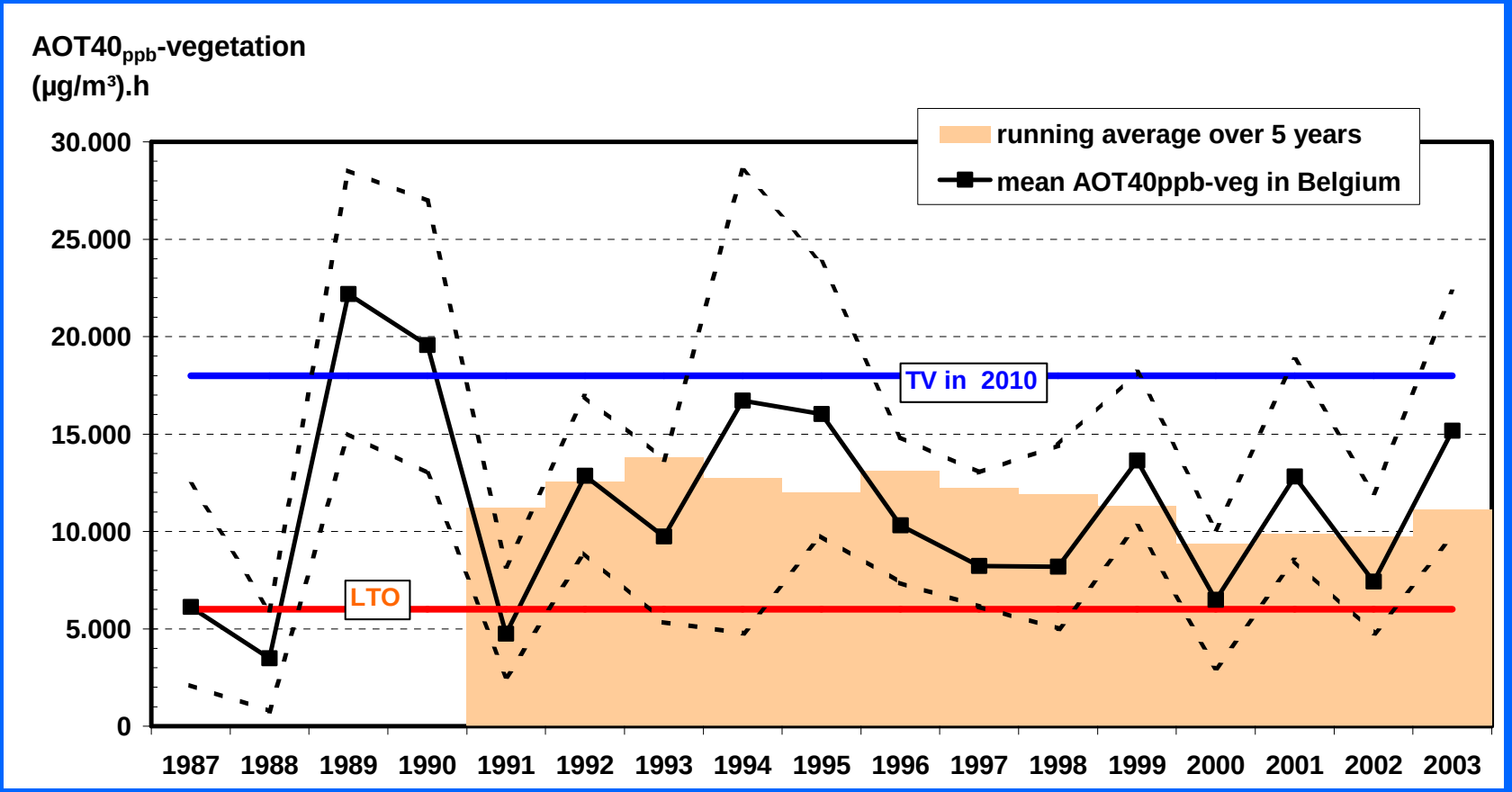
$AOT60_{ppb}$-max8h : protection of health

$AOT60_{ppb}$: **A**ccumulated excess **O**ver **T**hreshold of 120 µg/m³
by all maximum daily 8h means during a year



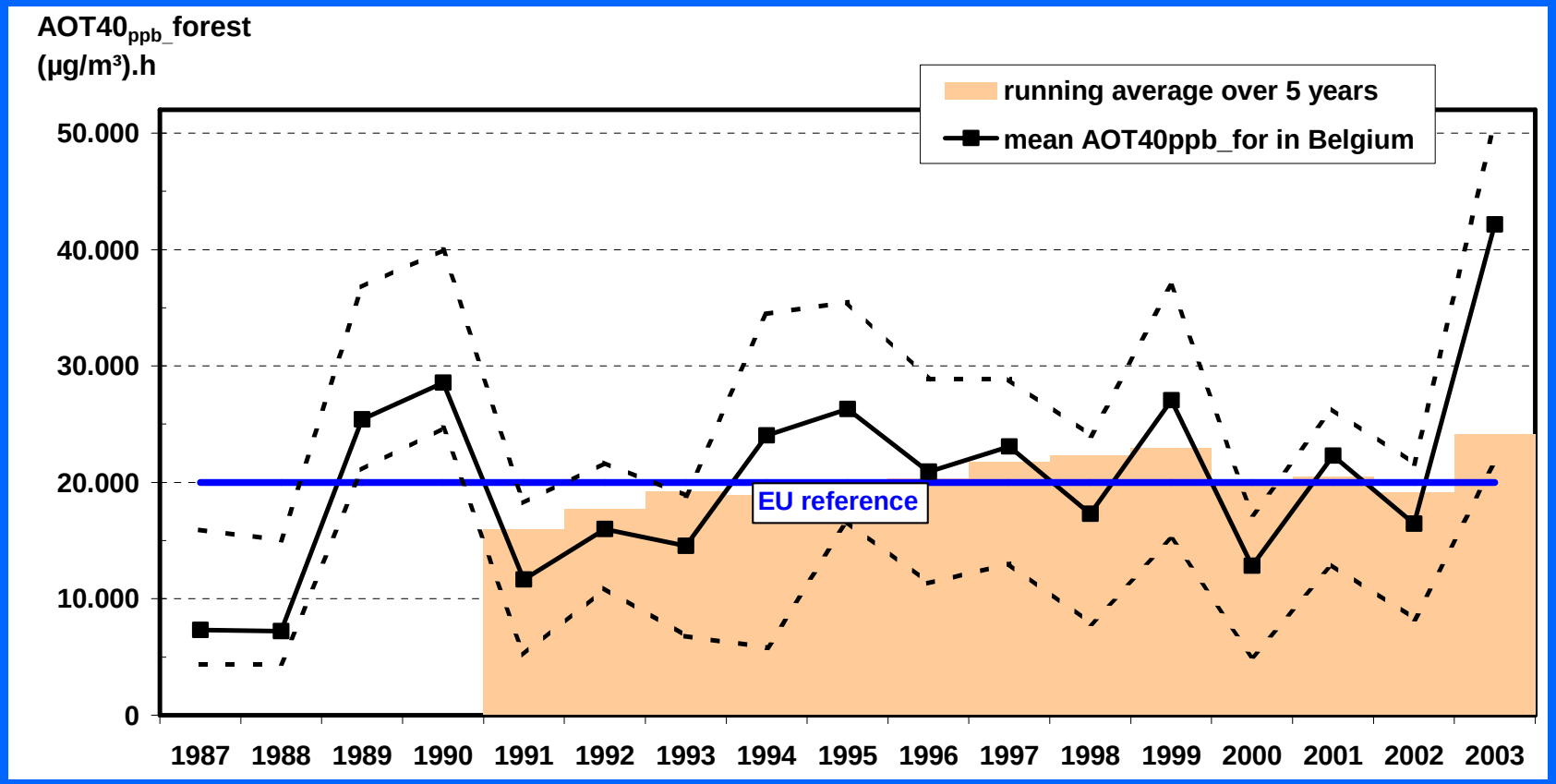
$AOT40_{ppb}$-vegetation : protection of vegetation

AOT40ppb calculated from 1 hour values (between 8 and 20 h CET) from **May to July**



$AOT40_{ppb}$-forest : protection of forests

AOT40ppb calculated from 1 hour values (between 8 and 20 h CET) from **April to Sept**

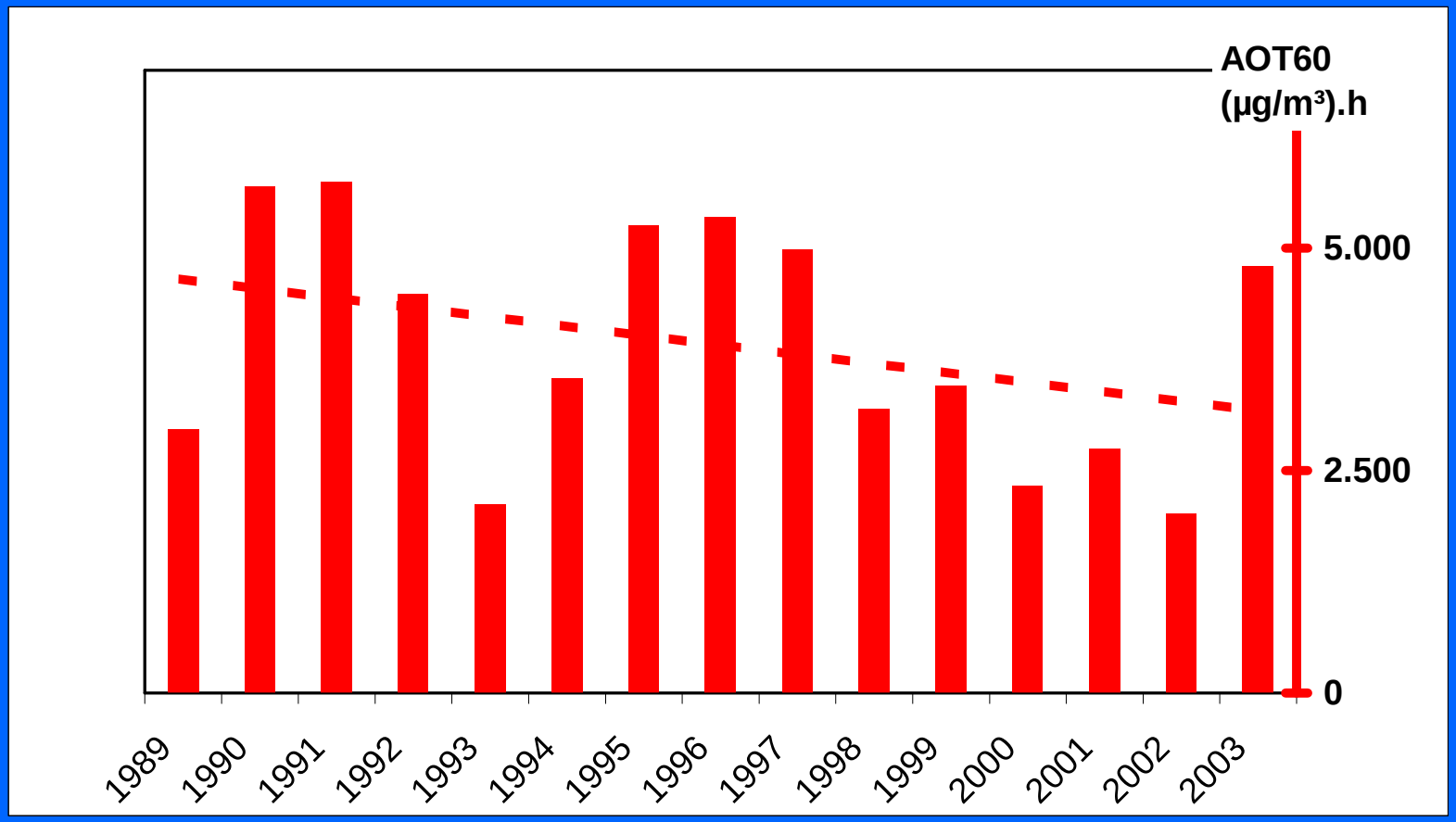


Ozone in ambient air

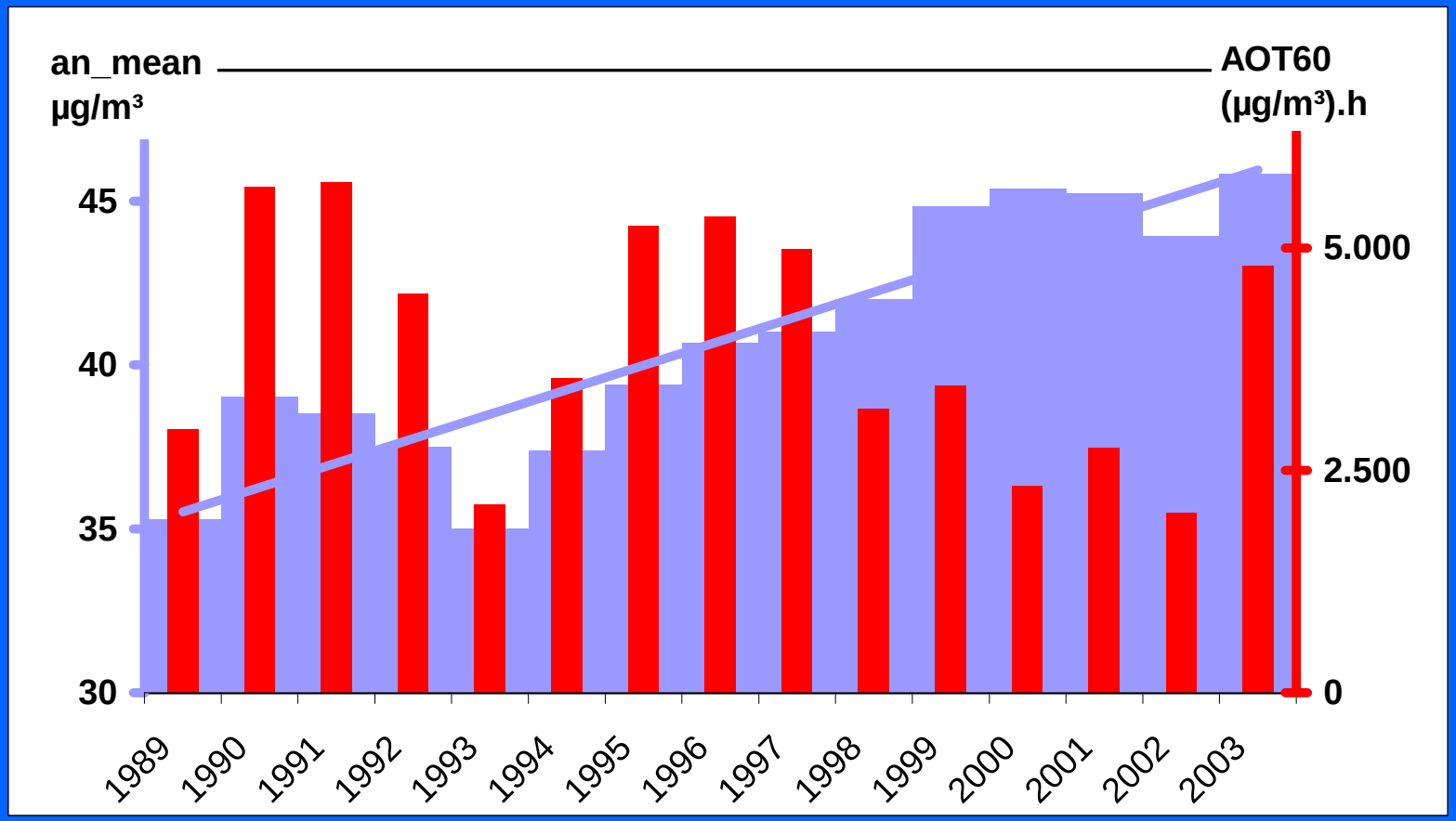
- formation and destruction mechansisms
- EU indicators for assessment
- trends of indicators in Belgium

- is it getting better ?
  peaks and annual means

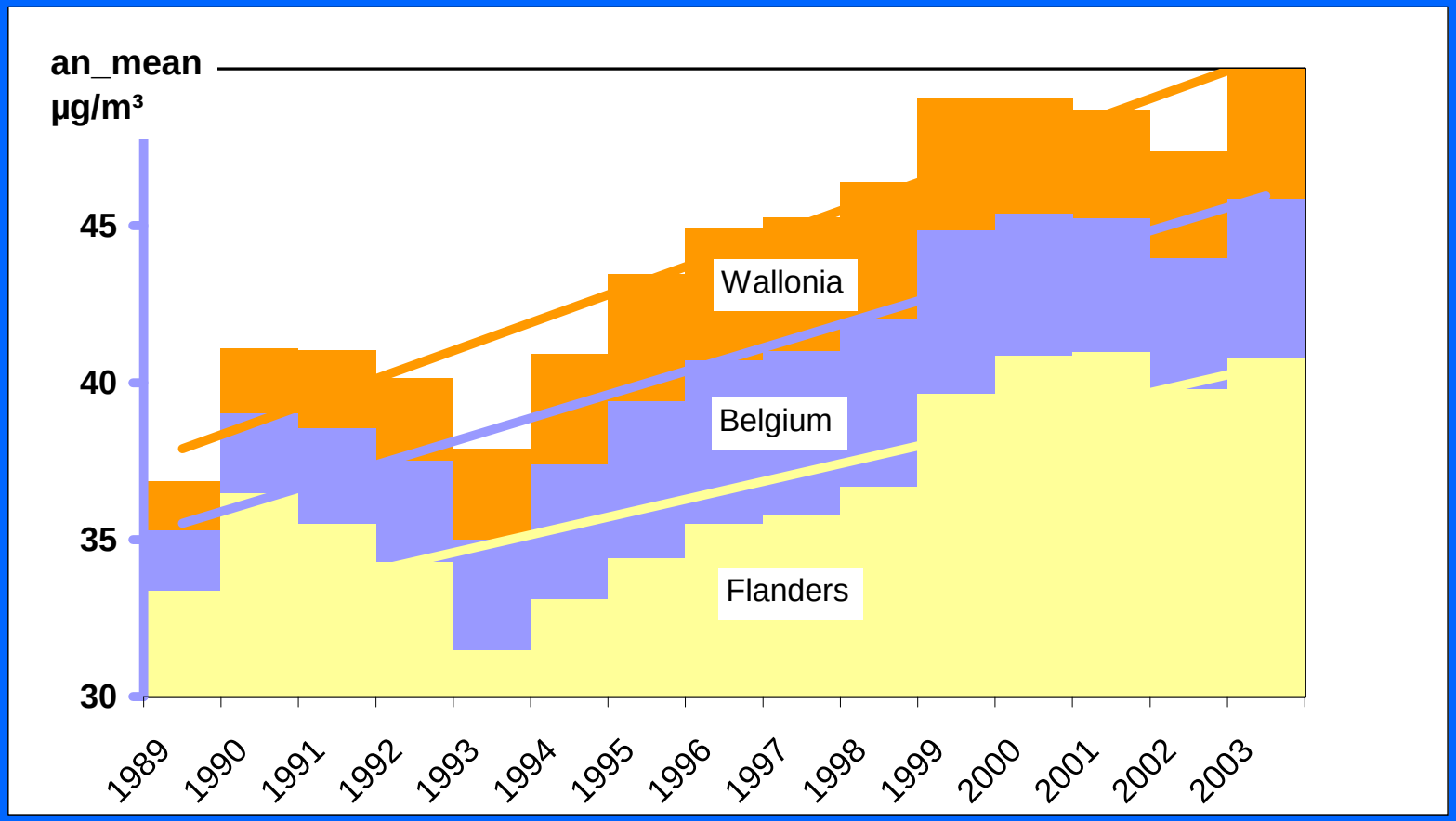
peaks in Belgium (3 year average of $AOT60_{ppb}$)



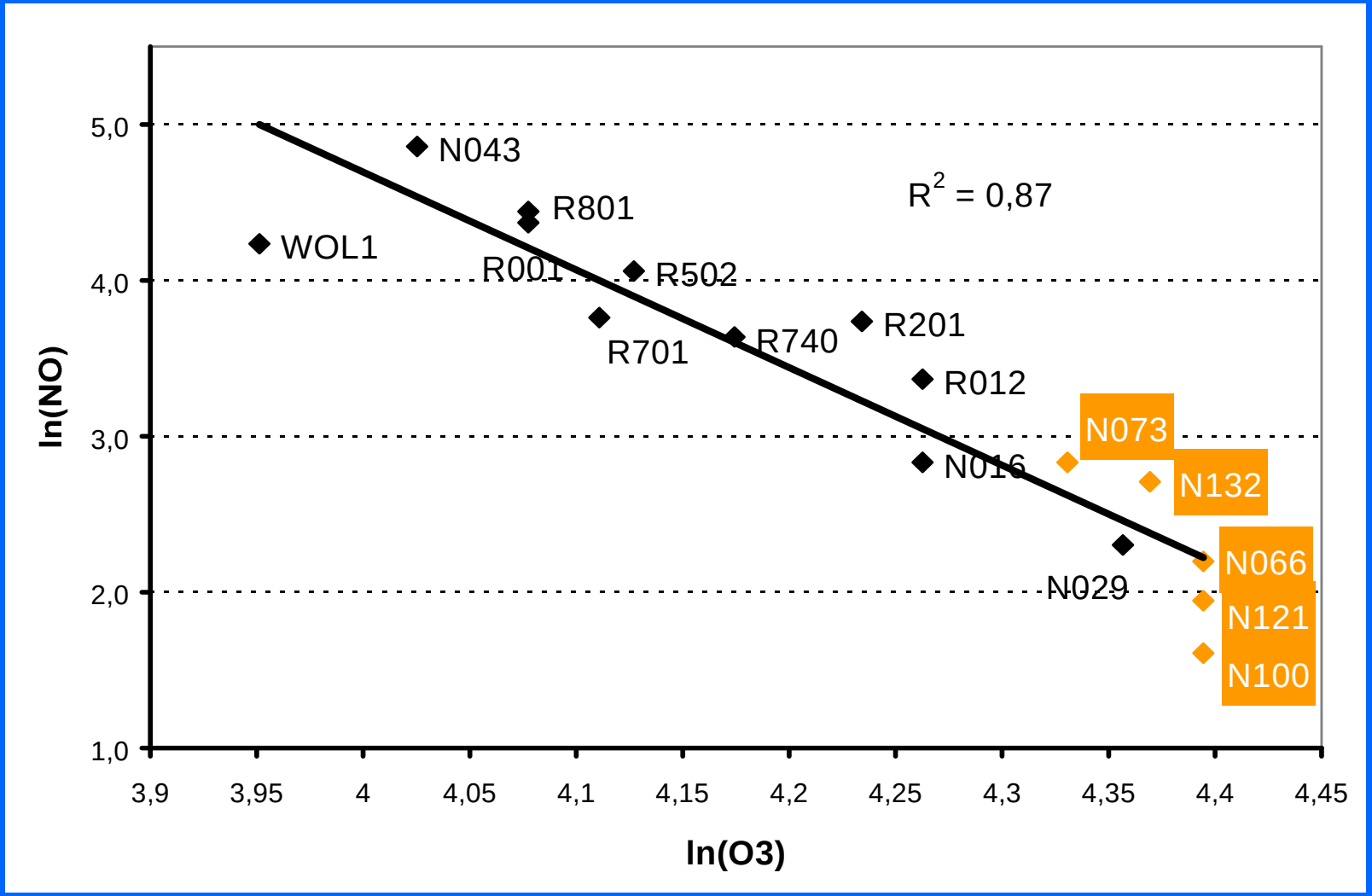
3 year average of annual mean values in Belgium



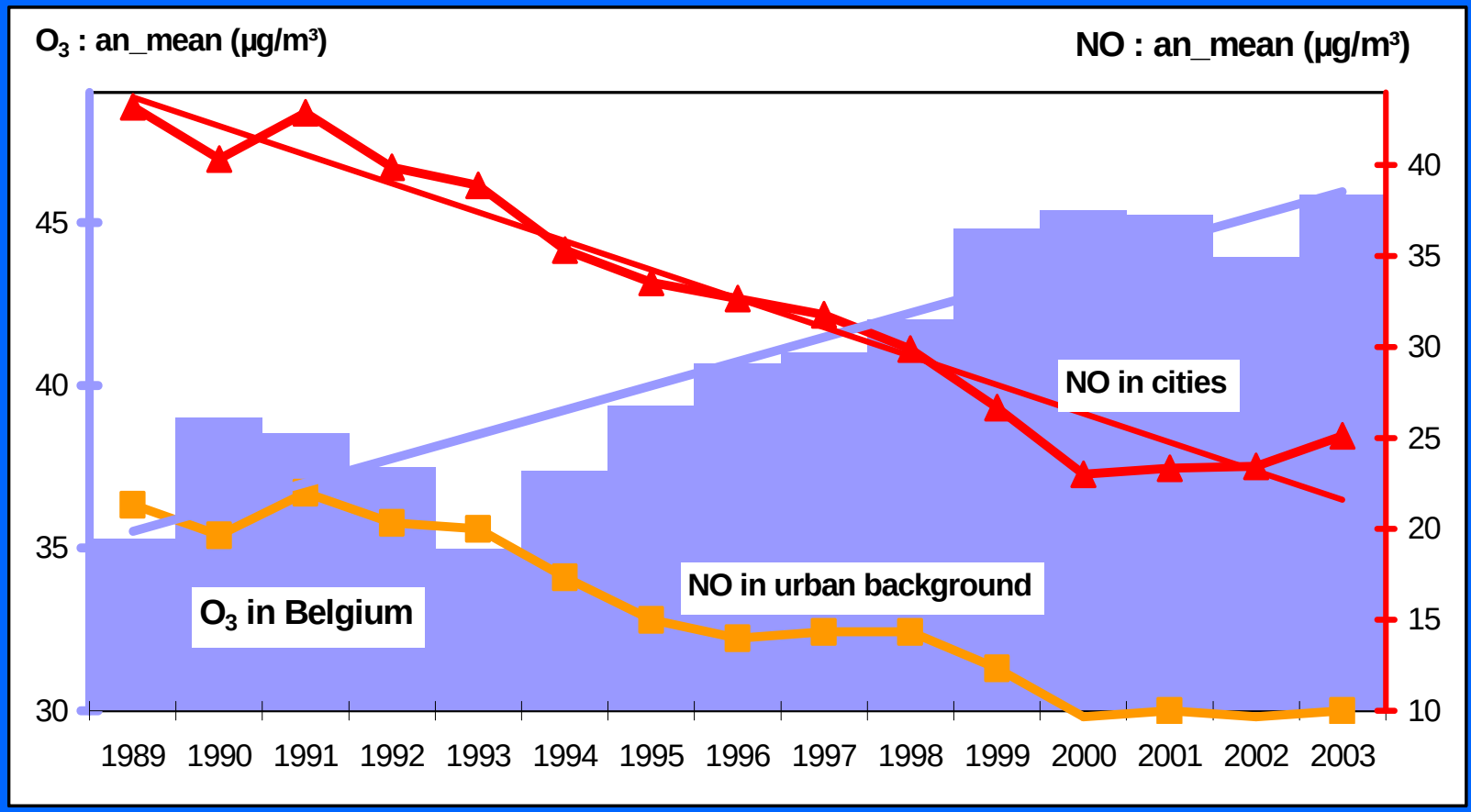
3 year average of annual mean values in Regions



O_3 ~ NO : averaged daily maxima (1998-2002)



NO : 3 year average of annual mean values



3 year average of AOT 0 and AOT 35_{ppb}