



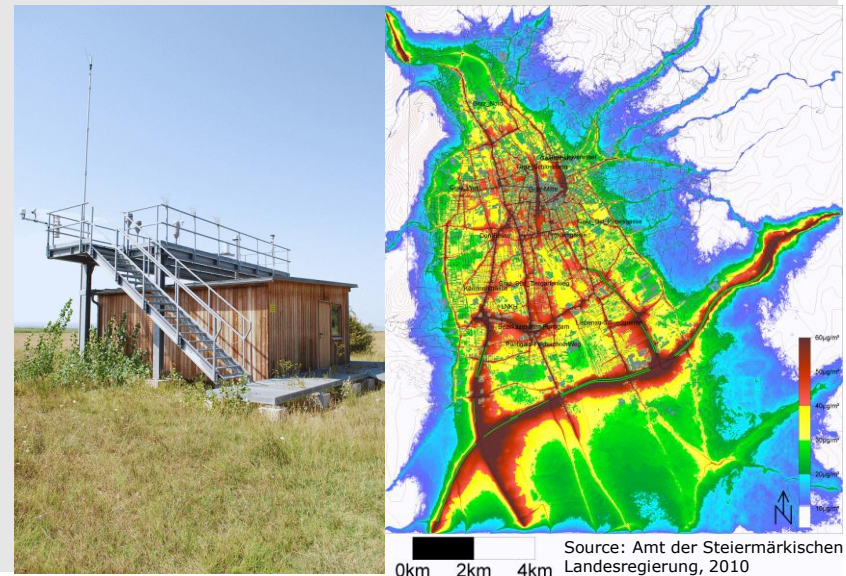
Assessment of ambient air quality

Criteria for assessment regimes, number and location of monitoring sites

Assessment of ambient air quality

Assessment Regimes:

- Fixed Measurement
- Indicative Measurement
- Modelling
- Objective Estimation
- *A combination of these*



Determination of the Assessment Regime Directive 2008/50/EC, Article 6

Definition of assessment depending on pollution level

Pollution levels exceed the Upper Assessment Threshold:

- Assessment by Fixed Measurement
- May be supplemented by Modelling and/or Indicative Measurement

Pollution levels between the Lower and the Upper Assessment Threshold:

- Assessment by a combination of Fixed Measurement (less monitoring sites) and/or Modelling or Indicative Measurement

Pollution levels below the Lower Assessment Threshold:

- Assessment by Modelling and/or Objective Estimation

Data Quality for Assessment Regimes

Annex I of AQD and **Annex IV of 4thDD** lay down
Data Quality Objectives for different assessment types,
with different criteria for

- Data capture
- Time coverage
- Uncertainty



Data quality objectives – fixed measurements

	Sulphur dioxide, nitrogen dioxide and oxides of nitrogen and carbon monoxide	Benzene	Particulate matter (PM ₁₀ /PM _{2.5}) and lead	Ozone and related NO and NO ₂
Fixed measurements ⁽¹⁾				
Uncertainty	15 %	25 %	25 %	15 %
Minimum data capture	90 %	90 %	90 %	90 % during summer 75 % during winter
Minimum time coverage:				
— urban background and traffic	—	35 % ⁽²⁾	—	—
— industrial sites	—	90 %	—	—

Data quality objectives – indicative measurements, modelling, objective estimation

	Sulphur dioxide, nitrogen dioxide and oxides of nitrogen and carbon monoxide	Benzene	Particulate matter (PM ₁₀ /PM _{2.5}) and lead	Ozone and related NO and NO ₂
Indicative measurements				
Uncertainty	25 %	30 %	50 %	30 %
Minimum data capture	90 %	90 %	90 %	90 %
Minimum time coverage	14 % ⁽⁴⁾	14 % ⁽³⁾	14 % ⁽⁴⁾	> 10 % during summer
Modelling uncertainty:				
Hourly	50 %	—	—	50 %
Eight-hour averages	50 %	—	—	50 %
Daily averages	50 %	—	not yet defined	—
Annual averages	30 %	50 %	50 %	—
Objective estimation				
Uncertainty	75 %	100 %	100 %	75 %

Data quality objectives – 4thDD

	Benzo(a)pyrene	Arsenic, cadmium and nickel	Polycyclic aromatic hydrocarbons other than benzo(a)pyrene, total gaseous mercury	Total deposition
— Uncertainty				
Fixed and indicative measurements	50 %	40 %	50 %	70 %
Modelling	60 %	60 %	60 %	60 %
— Minimum data capture	90 %	90 %	90 %	90 %
— Minimum time coverage:				
Fixed measurements	33 %	50 %		
Indicative measurements (*)	14 %	14 %	14 %	33 %

(*) Indicative measurement being measurements which are performed at reduced regularity but fulfil the other data quality objectives.

Data quality objectives - Time coverage and data capture

- For all pollutants with hourly limit values:
Time coverage = 100% of year
Data capture: > 90% of monitored hourly values
Time for routine maintenance, service and regular calibration is not included in calculation of data capture!
- For annual limit values:
time coverage may be less, data capture in the covered time has to be > 90%

Data quality objectives - Uncertainty

- Often addressed as „expanded measurement uncertainty“
- European standards give advice how to calculate
- Contributions to uncertainty:
 - Results of tests during type approval
 - Long and short term drifts, repeat abilities at zero and span, dependence on voltage,...
 - Local conditions at the monitoring site
 - Ambient and container temperature, pressure, interferences, humidity,...
 - Contribution from actual QA/QC
 - Uncertainty of calibration gases, data capture, number of calibrations,...

Determination of the minimum number of monitoring sites per zone and pollutant

- Directive 2008/50/EC, Annex V for SO₂, PM₁₀, PM_{2.5}, NO₂, NO_x, CO, Pb, Benzene
- Directive 2008/50/EC, Annex IX for Ozone
- Directive 2004/107/EC Annex III for heavy metals and PAH

Annex V (2008/50/EC) Determination of the minimum number of monitoring sites

- Step 1: Define **zones**
- Step 2: Identify **pollution levels** due to diffuse sources in relation to assessment thresholds
- Step 3: Determine minimum **number of monitoring stations** per zone according to **Annex V** [Table A.1](#)
- Step 4: Assess pollution levels in the vicinity of **point sources** and determine appropriate monitoring stations
- Step 5: **PM_{2.5}** sites for **AEI**: 1 monitoring station per city exceeding 100.000 inhabitants
- Step 6: SO₂ and NO_x stations for **vegetation** protection: Identify pollution level in relation to assessment threshold and determine number of sites according to Annex V.C

Determination of zones

There are no strict provisions for the delimitation of zones, except criteria for agglomerations:

- More than 250.000 inhabitants, or less, if considered appropriated.

The delimitation of any other zones is up to the MS.

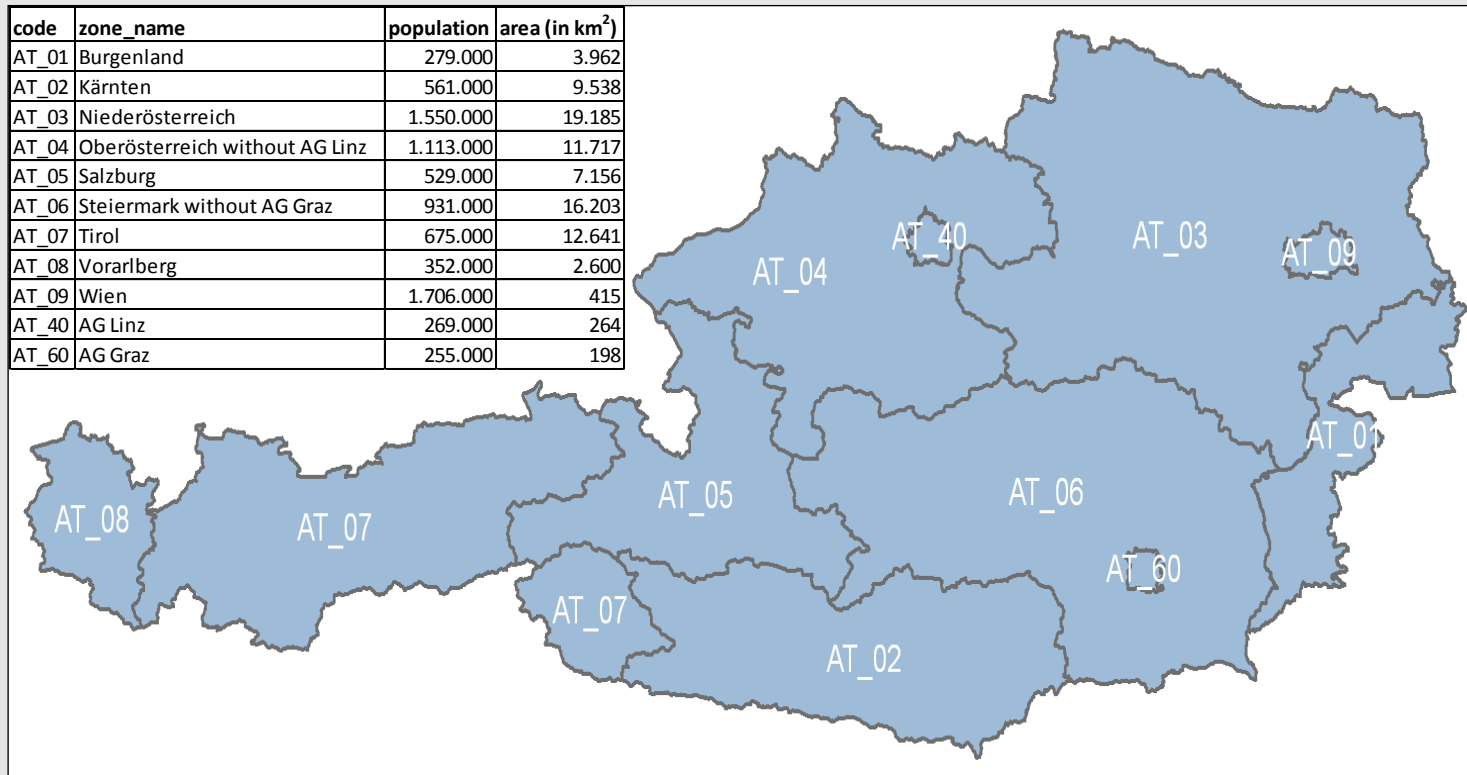
Different approaches are applied:

1. Administrative units
2. Geographic or climatic areas (e.g. plane, mountainous, coastal areas)
3. Population distribution (e.g. grouping medium towns to one zone)
4. Pollution levels (e.g. zones for specific pollutants around industrial hot spots)

Zones and agglomerations – pollutants except Ozone

Non-agglomeration zones follow administrative boundaries of Federal Provinces

code	zone_name	population	area (in km ²)
AT_01	Burgenland	279.000	3.962
AT_02	Kärnten	561.000	9.538
AT_03	Niederösterreich	1.550.000	19.185
AT_04	Oberösterreich without AG Linz	1.113.000	11.717
AT_05	Salzburg	529.000	7.156
AT_06	Steiermark without AG Graz	931.000	16.203
AT_07	Tirol	675.000	12.641
AT_08	Vorarlberg	352.000	2.600
AT_09	Wien	1.706.000	415
AT_40	AG Linz	269.000	264
AT_60	AG Graz	255.000	198



Zones and agglomerations – ozone

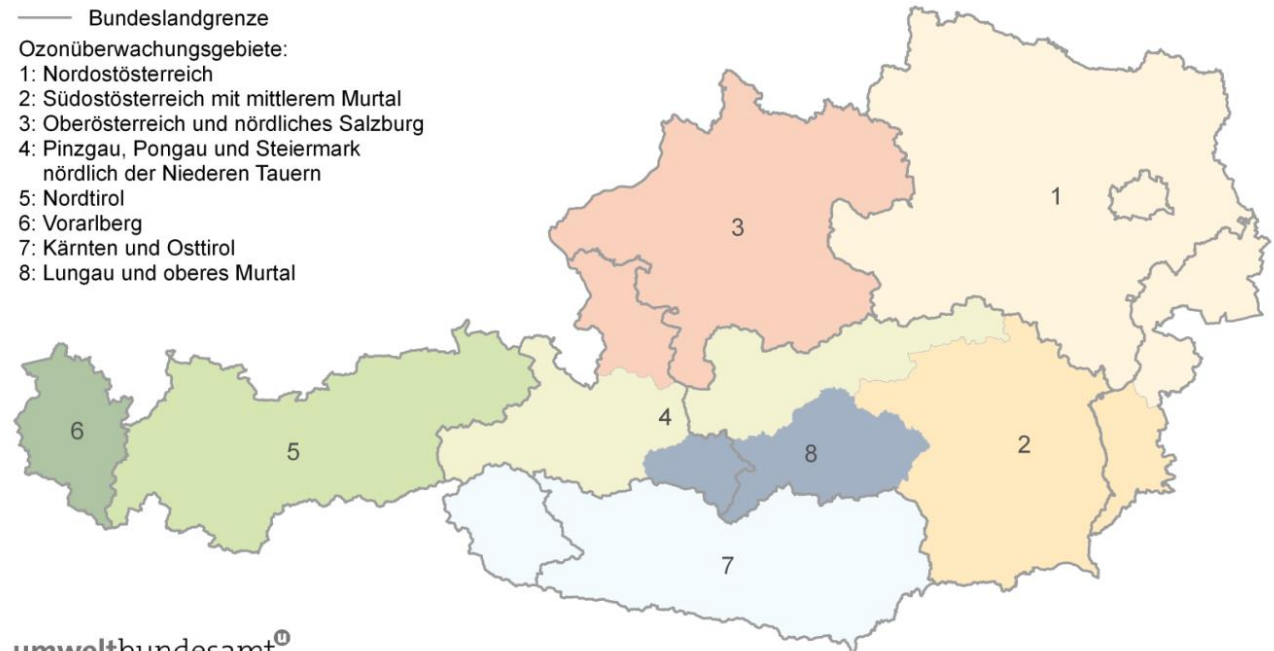
For ozone, the zoning is orientated on the spatial characteristics of ozone peak values

Ozonüberwachungsgebiete

— Bundeslandgrenze

Ozonüberwachungsgebiete:

- 1: Nordostösterreich
- 2: Südostösterreich mit mittlerem Murtal
- 3: Oberösterreich und nördliches Salzburg
- 4: Pinzgau, Pongau und Steiermark nördlich der Niederen Tauern
- 5: Nordtirol
- 6: Vorarlberg
- 7: Kärnten und Osttirol
- 8: Lungau und oberes Murtal



umweltbundesamt^u

Location of monitoring sites

Annex V.A.1

Annex V.A.1 requires for PM₁₀, PM_{2.5}, NO₂, CO, and Benzene

- ratio background/traffic sites between 1:2 and 2:1
- at least 1 traffic and 1 urban background site per zone (if at least 2 sites per zone are necessary).

Macro-scale siting criteria 2008/50/EC, Annex III.B

Requires locating monitoring sites:

- Representative for the **general exposure of the population** (urban background)
- Representative for **highest concentrations** people are exposed to (traffic and industrial hot-spot locations)

Criteria for vegetation/ecosystem monitoring sites:

- Remote from towns, main roads and industrial installations



Micro-scale siting criteria 2008/50/EC, Annex III.C

Criteria for free air flow around the air inlet:

- at least 270° free of obstacles
- 0.5 m from building line

Height of air inlet:

- between 1.5 and 4 m above ground
- higher inlet justified for sites with larger representative area

Traffic sites:

- maximum 10 m from kerbside
- 25 m away from junctions

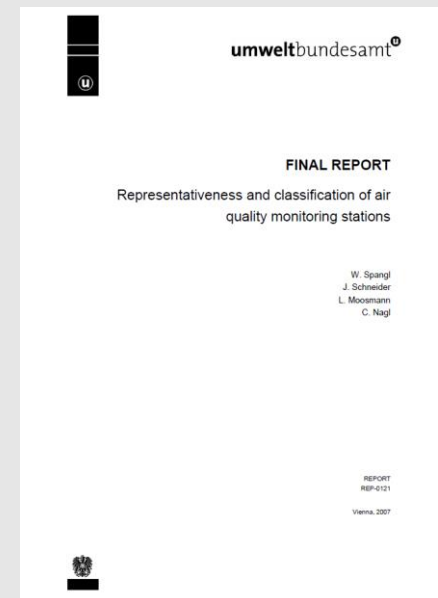


Free air flow?



Representativeness of monitoring sites

- No definition of the spatial representativeness of monitoring stations in the AQ legislation
- Study (2007) for the European Commission by Umweltbundesamt GmbH on definition and criteria for representativeness of air quality monitoring sites
- The final report can be downloaded here:
http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?pub_id=1684



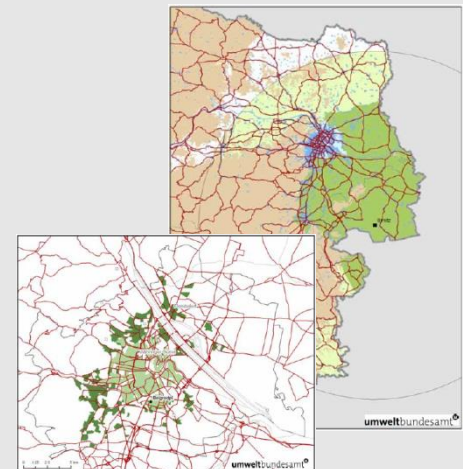
Representative area (UMWELTBUNDESAMT 2007)

Representative area of a monitoring site is **defined** by

1. concentrations within a given range
2. similar reasons for this concentration

Determination of representative area by

- Spatial information on pollutant concentration
- Emission class
- Dispersion situation
- Maximum distance (related to atmospheric transformation)



Representativeness of monitoring sites – further studies

Studies on representativeness of AQ monitoring sites:

- *S. JANSSEN ET AL. (2008): Spatial interpolation of air pollution measurements using CORINE Landcover data. Atmospheric Environment, Vol. 42, Issue 20, pages 4884-4903.*
- *S. JANSSEN ET AL. (2011): Land use to characterize spatial representativeness of air quality monitoring stations and its relevance for model validation. Atmospheric Environment, Vol. 59, Issue 1, pages 492-500*
- *W. LEFEBVRE ET AL. (2010): Making high resolution air quality maps for Flanders, Belgium. Flemish Institute for Technological Research (VITO), Department of Environmental Modelling.*

Representativeness based on the transport of air masses during a certain time period:

- *S. Henne, S. Solberg et al. (2009): Report on supersite representativeness and representativeness assessment method. GEOmon Project no. 036677.*

Assessment of spatial representativeness based on sampling surveys:

- *M. BEAUCHAMP ET AL. (2011). Spatial representativeness of an air quality monitoring station. Application to NO₂ in urban areas. Spatial Data Methods for Environmental and Ecological Processes, 2nd Edition, Foggia and Gargano, Italy, 1-2 September 2011.
<http://aisberg.unibg.it/bitstream/10446/25284/1/54.pdf>.*
- *M. BOBBIA ET AL. (2008). Représentativité spatiale d'une station de mesure de la pollution atmosphérique (Spatial representativeness of an air pollution measurement). Pollution Atmosphérique, n°197, 63-75.*

Contact & Information

Iris Buxbaum

+43 1-31304-5964, iris.buxbaum@umweltbundesamt.at

Umweltbundesamt
www.umweltbundesamt.at

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