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# Solutions for Urban Wood- Burning Heating Systems

Dr. Axel Friedrich

19th VERT Forum

Bern, March 19th 2026

# Why are the Problems related to Wood Heating so important?

Yearly about 70.000 premature death caused by  $PM_{2,5}$  in Germany (EEA 2024)

Relation: Course of Covid-19 and by particle induced pre existing conditions

Air pollution caused by wood stove „under the radar“:  
Location of monitoring stations and focus on larger particles

Existing monitoring stations: WHO AQG often not met

**Climate impact of black carbon emissions**

Origin of the wood.

# Measurement Instruments

Measurement of Black Carbon (BC):  
BCMeter and eBCMeter

Air passes filter paper

BC are deposited at the filter paper

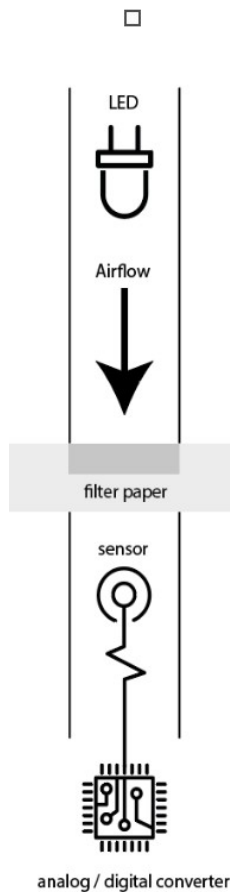
A Photometer evaluate the darkness  
of the paper with a laser with 880nm  
wavelength

A computer calculates the  
concentration

Data can be checked per Interface

The measurement devices were  
developed by Jonas Dahl und Axel  
Friedrich

[www.bcmeter.org](http://www.bcmeter.org)



# Filter paper Measurement BCMeter



# Climate

# Global heating is turning white Alps green, study finds

**Vegetated areas above treeline have increased by 77%  
since 1984, satellite data shows**

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**Patrick Barkham**

🐦 @patrick\_barkham

Thu 2 Jun 2022 18.00 BST

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📷 Rising temperatures from global heating and increased rainfall are prolonging the growing season on the Alps. Photograph: Philippe Desmazes/AFP/Getty Images

[https://www.theguardian.com/environment/2022/jun/02/global-heating-is-turning-white-alps-green-study-finds?CMP=Share\\_iOSApp\\_Other](https://www.theguardian.com/environment/2022/jun/02/global-heating-is-turning-white-alps-green-study-finds?CMP=Share_iOSApp_Other)

# Alpine glaciers are melting even on the highest peaks

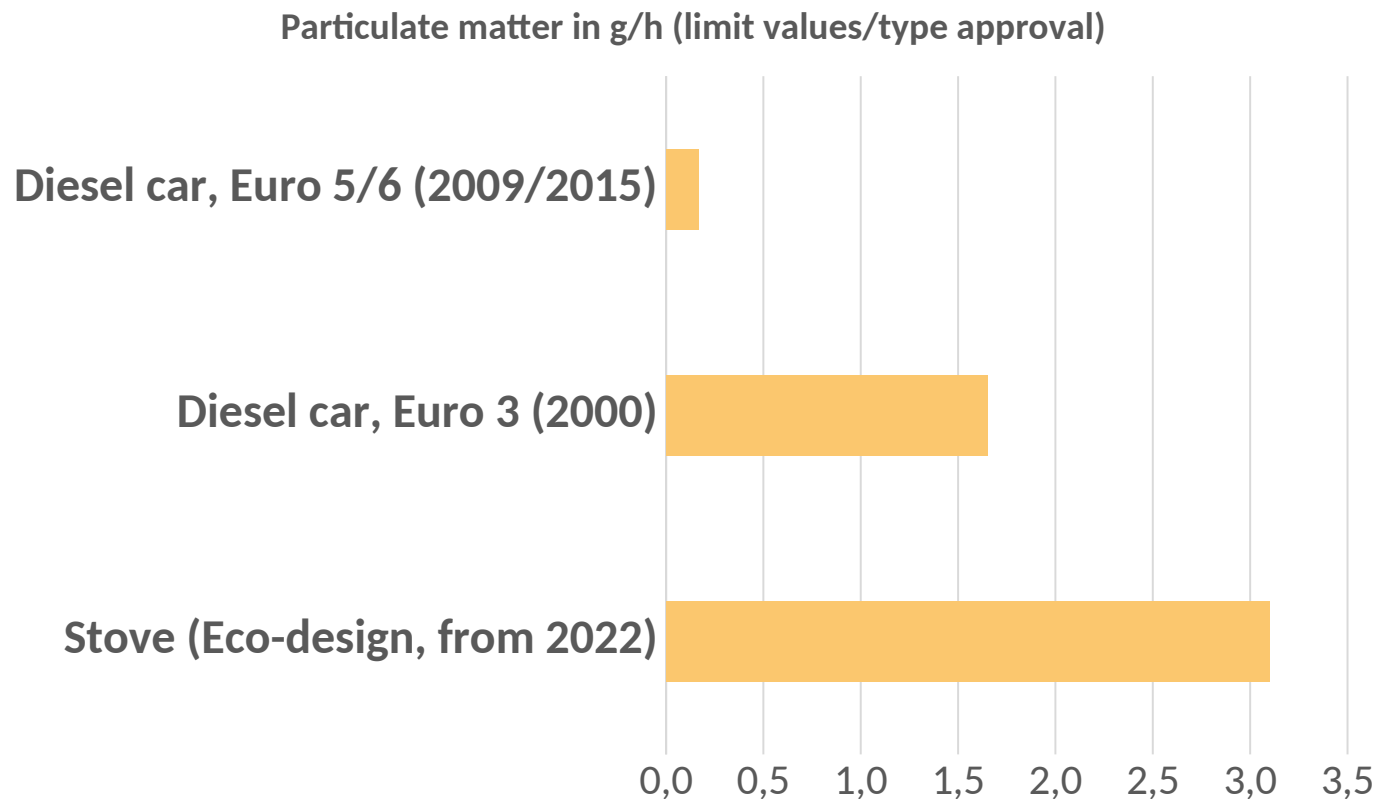


▲ The Clariden Glacier in the Swiss Central Alps in September 2025. Matthias Huss

# **Air Pollution**

# Local space heaters (stoves)

## Emission requirements: stoves vs. cars

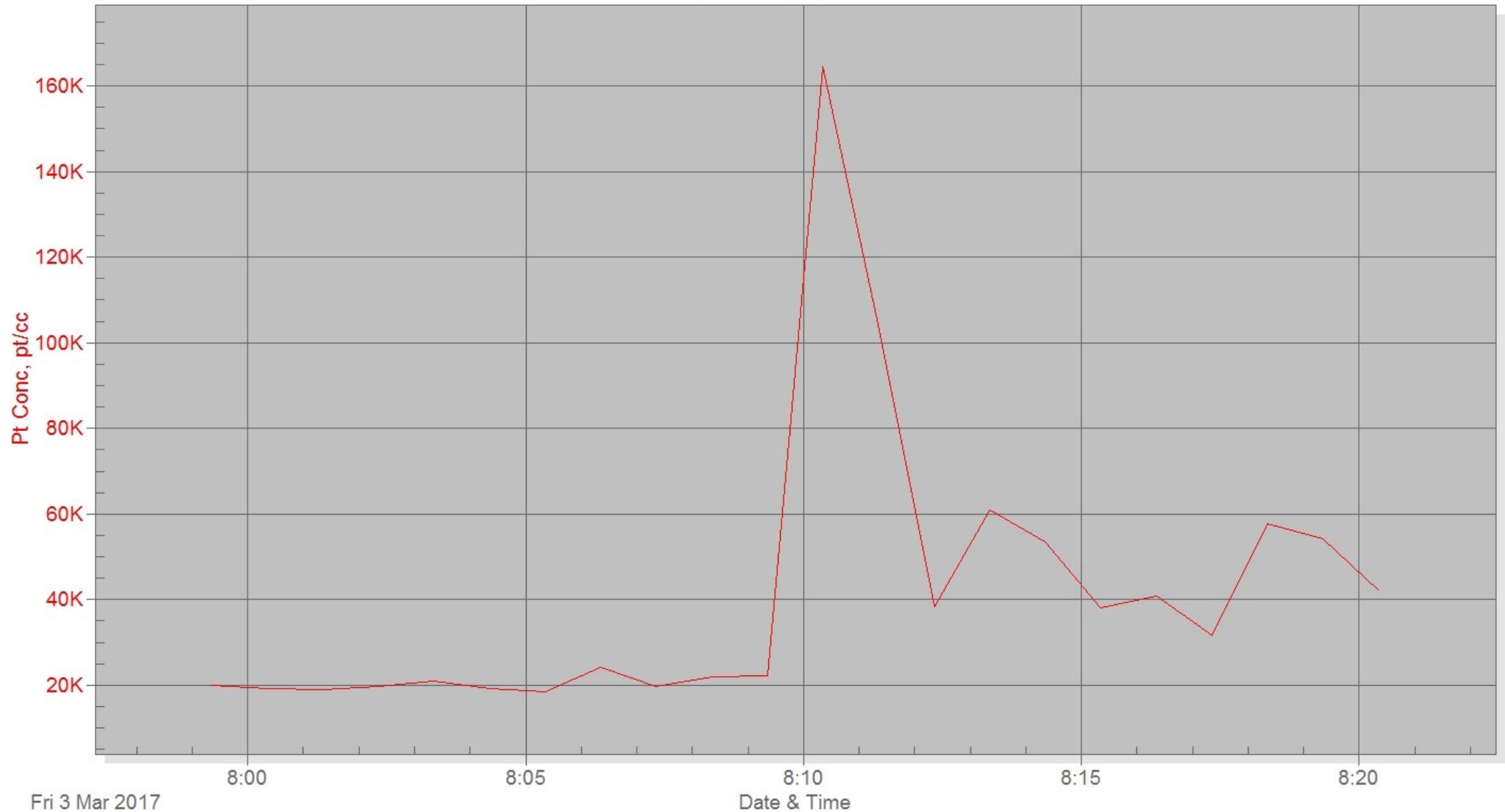


**Problem: Even correct operated wood stoves emit by far too much particles and other pollutants as PAHs and hydrocarbons**

Source: Air Quality Expert Group (2017): The Potential Air Quality Impacts from Biomass Combustion

# Ultra fine Particle Measurement in a small Village in Baden- Württemberg

Unterjessingen  
Morgenmessung

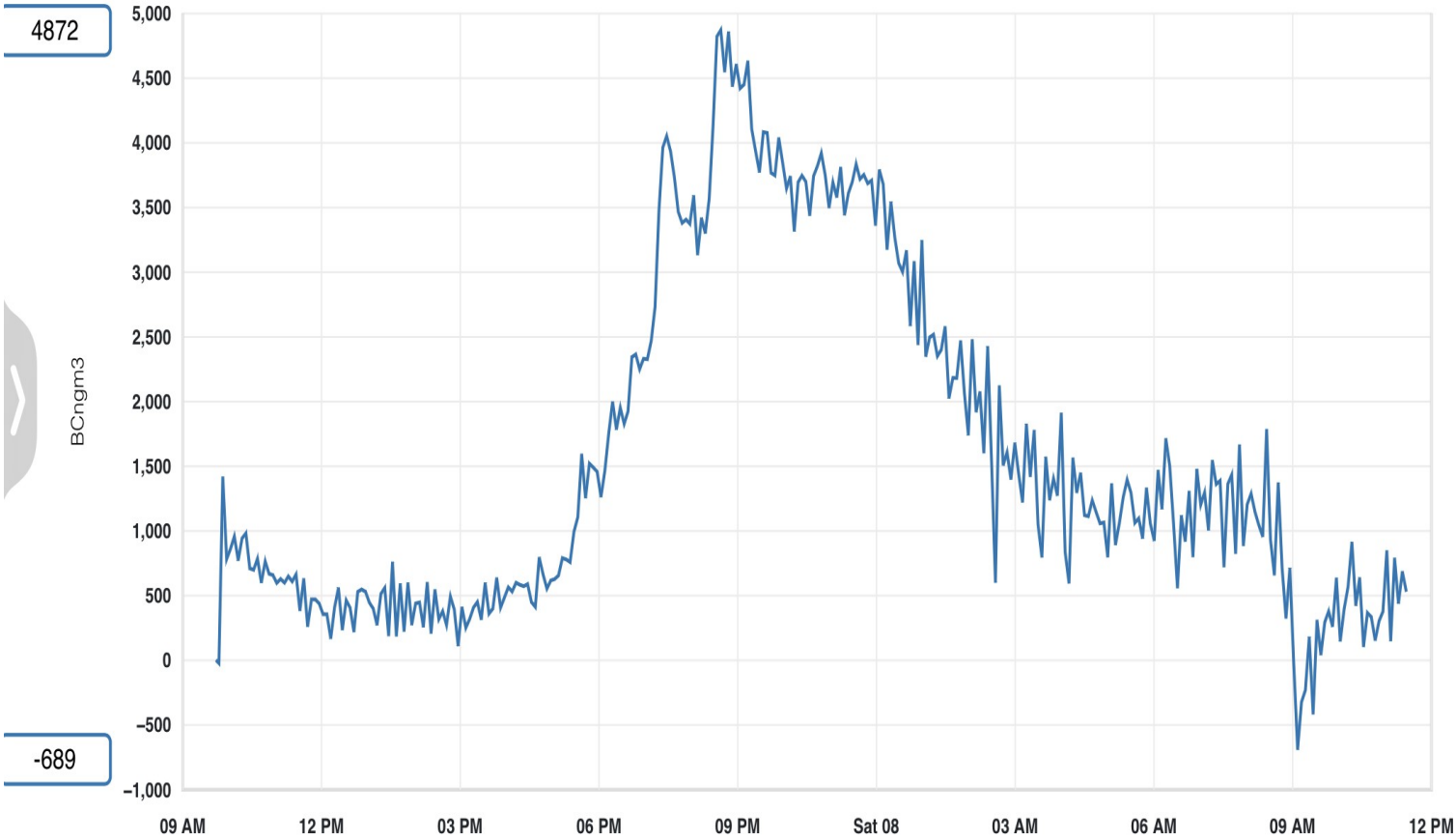


Fri 3 Mar 2017

# Diurnal Concentrations Black Carbon in a Living Area in Berlin



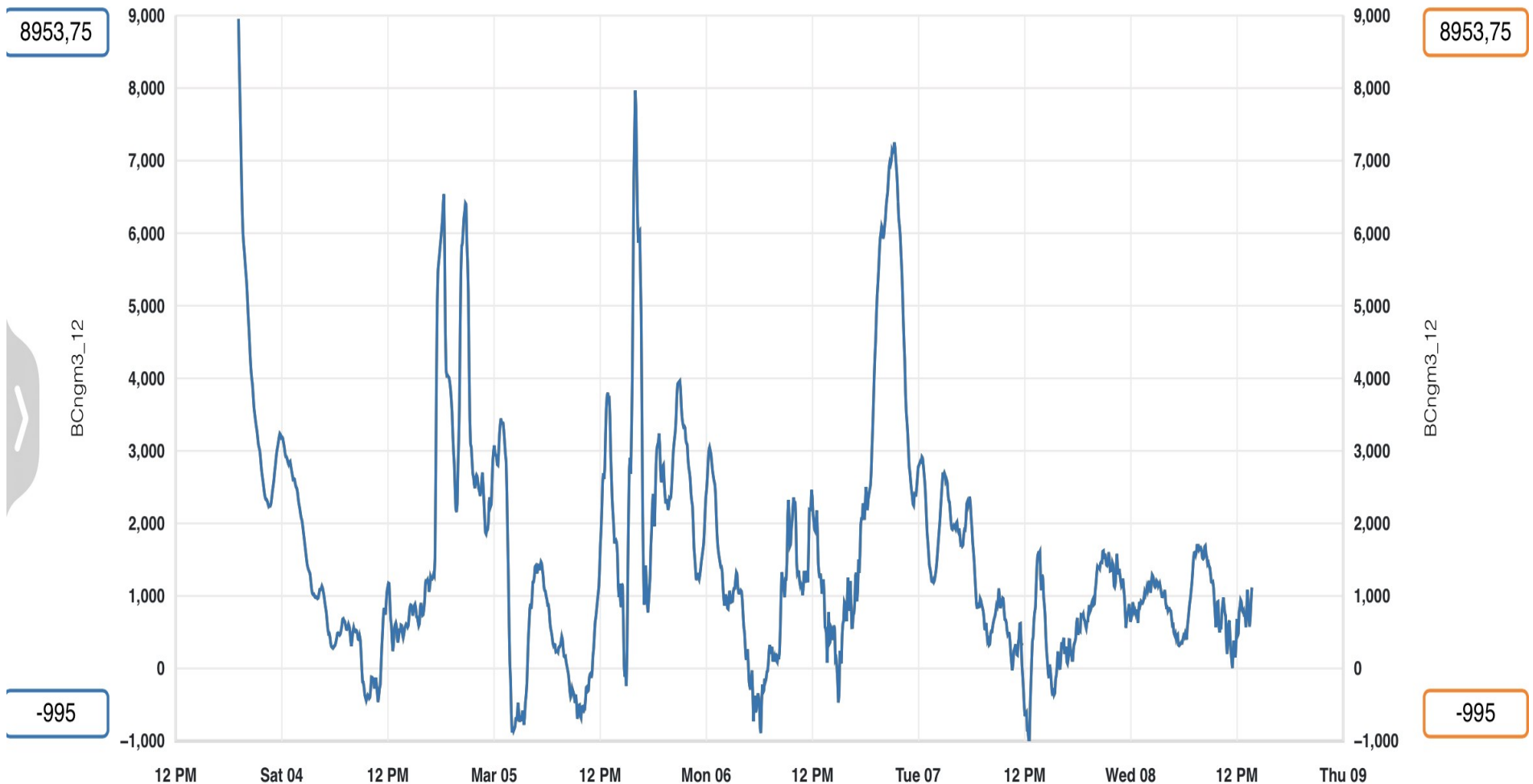
Show data: [log\\_current.csv](#) [BCngm3](#) [BCngm3\\_12](#) [Show 2nd Graph!](#) [Reset Zoom](#)



[New Log](#) [Stop sampling](#) [Reload Data](#) [Download Data](#) [Access all logs](#)

# Black Carbon Measurement in the “Papageiensiedlung” Berlin Zehlendorf

Select Dataset: log\_current.csv BCngm3\_12 BCngm3\_12 Hide Reset Zoom



New Project started this Winter

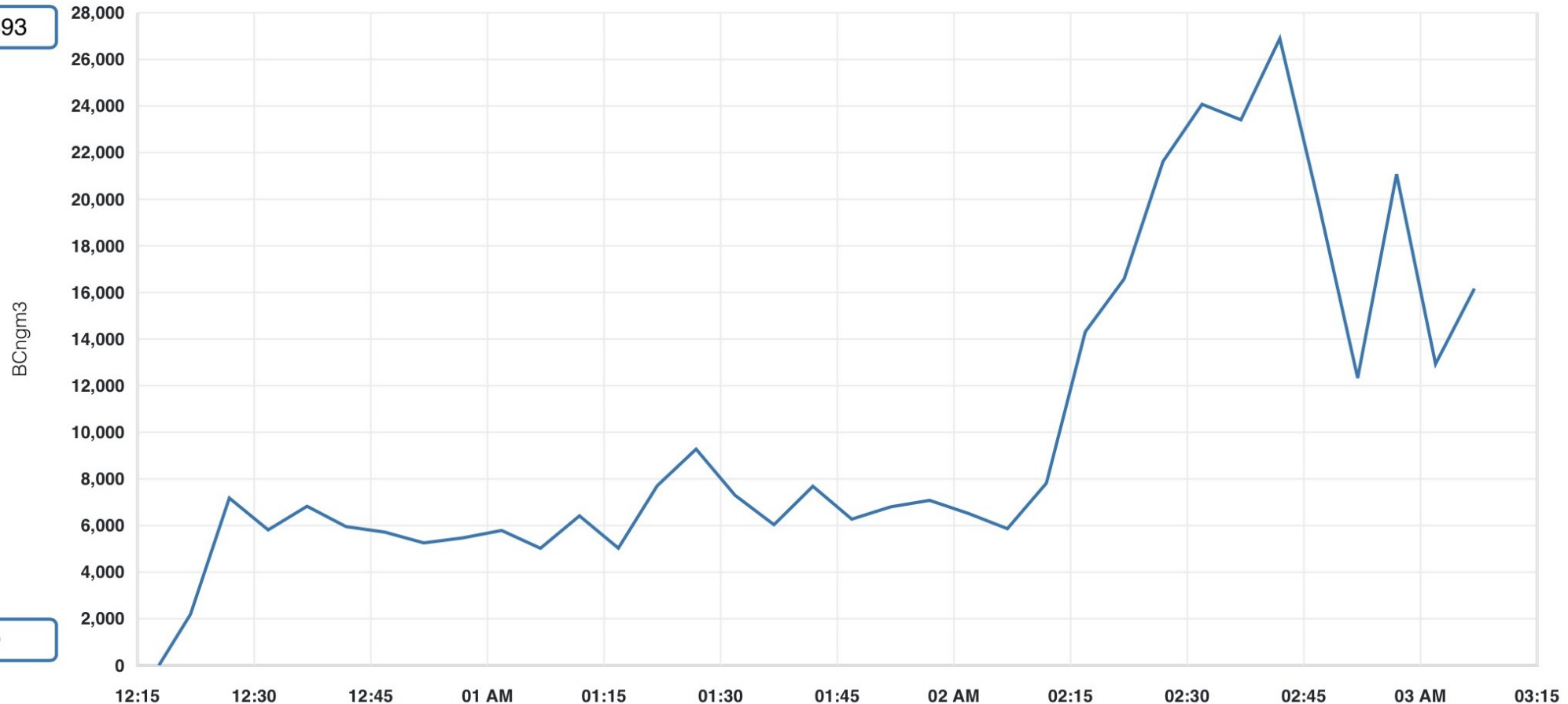
Goal:

Black Carbon measurements over  
20 month in 10 Spas with 2 BCMeter

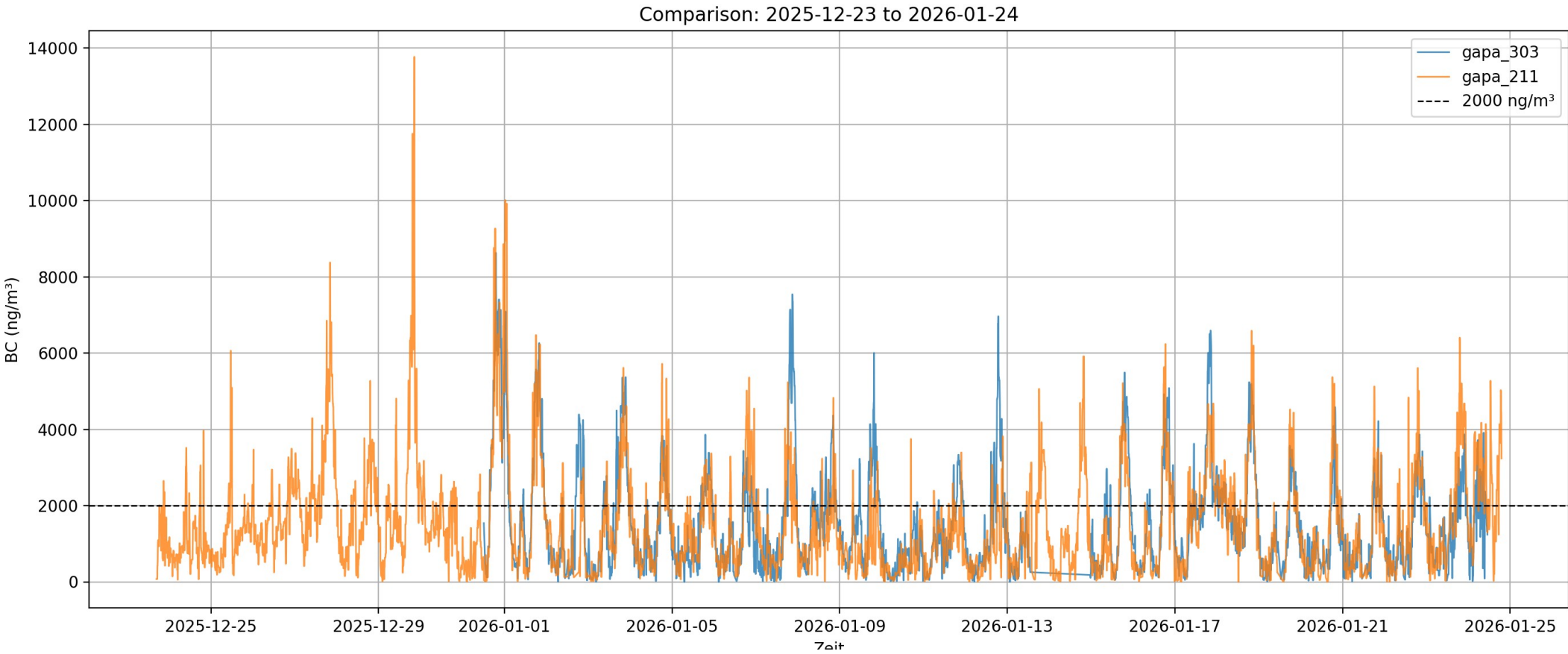
# Black Carbon Measurement in Bad Windsheim



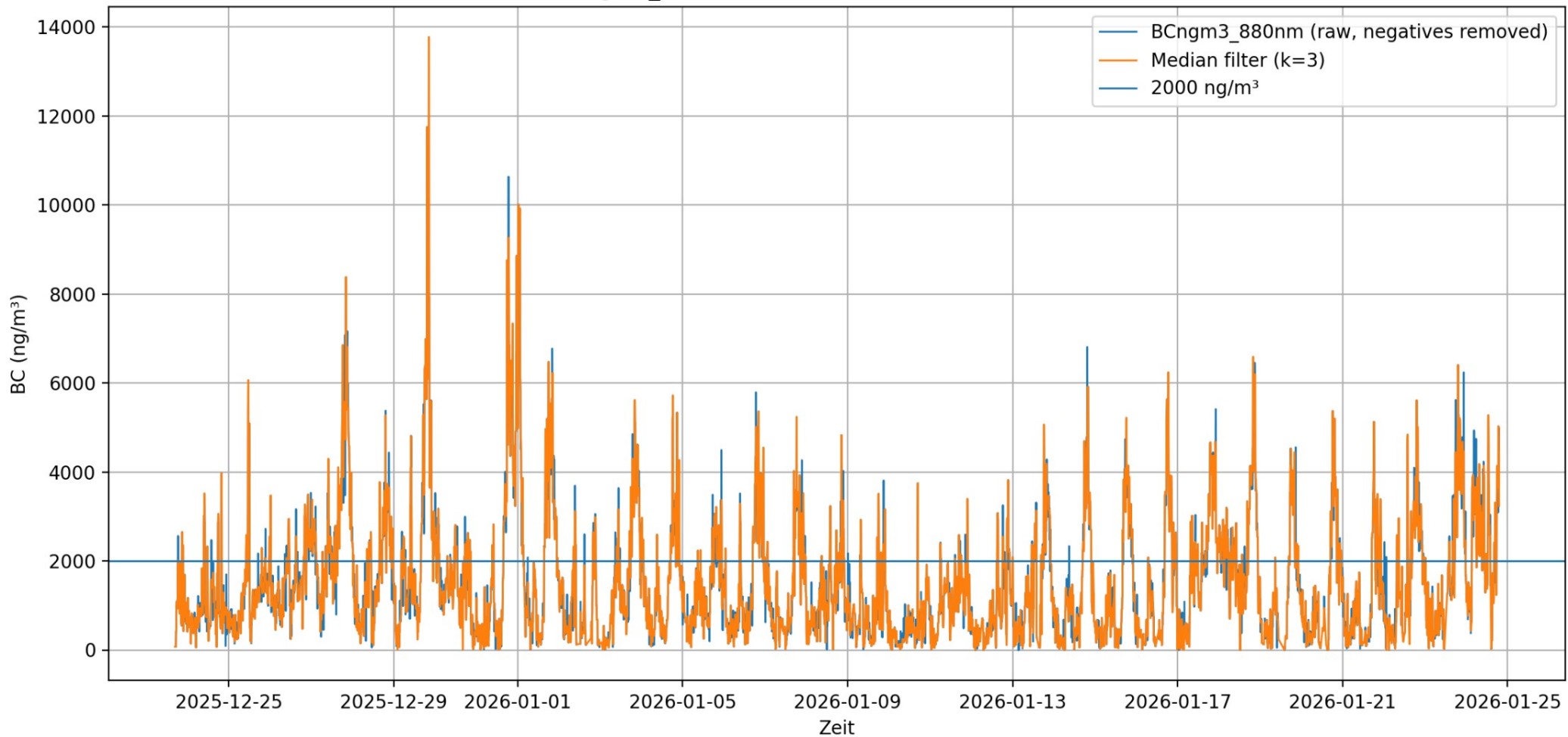
Show data:



# Measurement of Black Carbon at two Locations in Garmisch-Partenkirchen

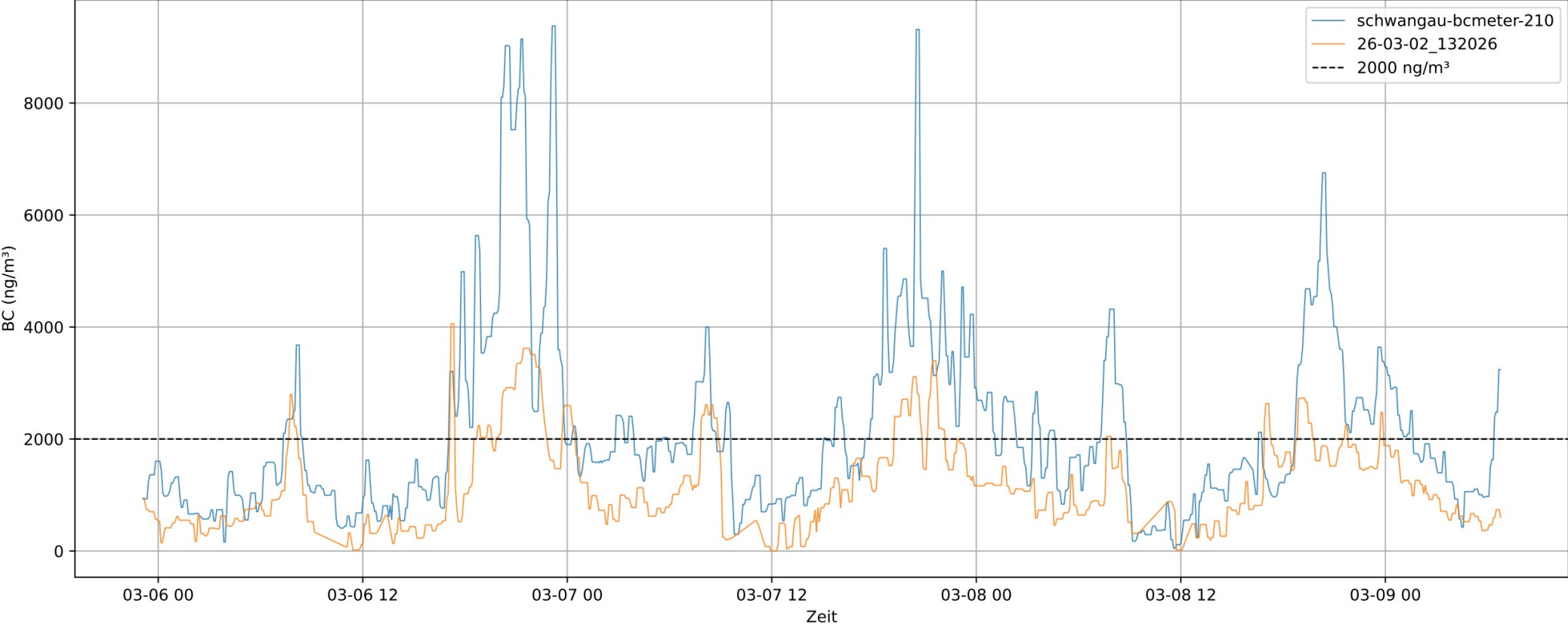


# Black Carbon Messung in Garmisch-Partenkirchen

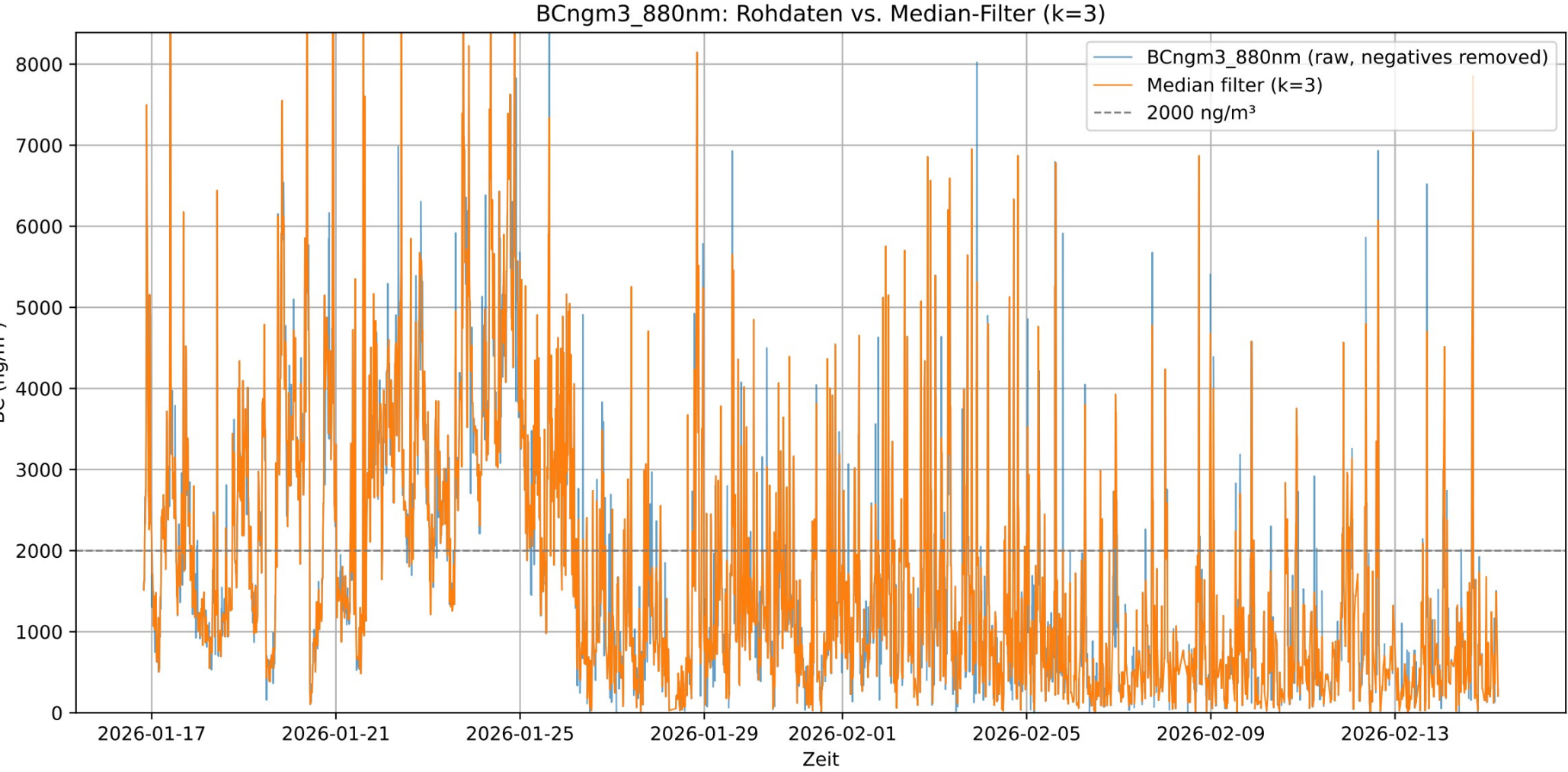


# Measurement of Black Carbon at two Locations in Schwangau

Comparison: 2026-03-05 to 2026-03-09



# Black Carbon Measurement in Bad Wilhelmshöhe



**Solution**

# Electrostatic Precipitator

# OekoSolve

Umwelt. Energie.



**KW**  
Kutzner + Weber

Partikelabscheider Airjekt 1 Basic®



 **SCHRÄDER**  
ABGASTECHNOLOGIE



**exodraft**



# Particle Number Reduction by an Exodraft Particle Precipitator

Test Set-Up

Start PTI Test

Abort PTI Test

Data Files

OBD Not Connected - Is Key On?

PTI Phase 1

Parameter	Data	Units
RPM		R/min
Coolant Temp		°C
Mass Air Flow		g/s
Particles		#/cm3
Result		

PTI Phase 2

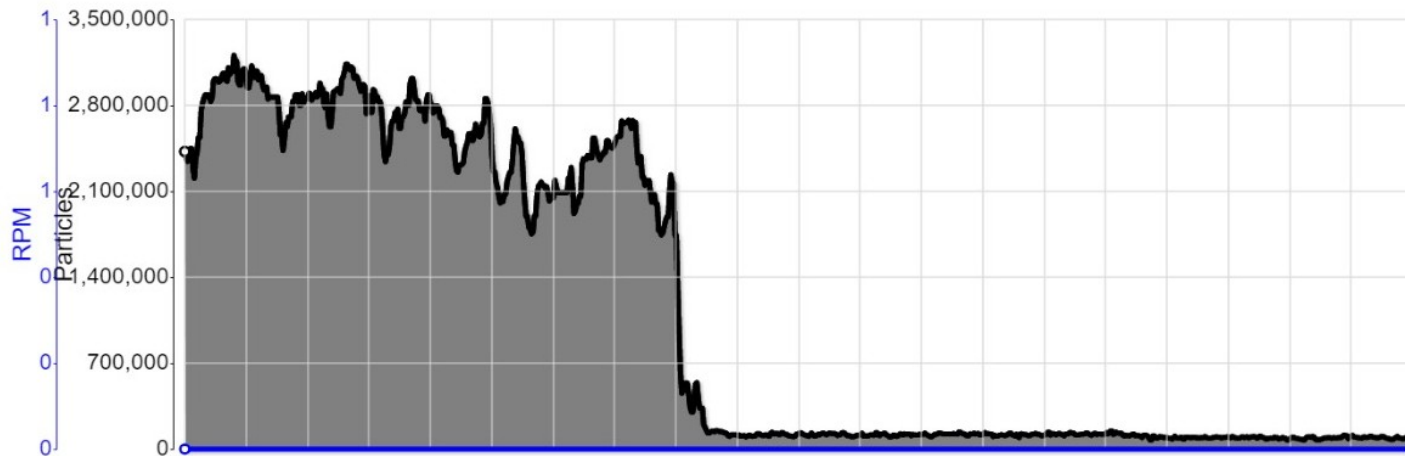
Parameter	Data	Units
RPM		R/min
Coolant Temp		°C
Mass Air Flow		g/s
Particles		#/cm3
Result		

PTI Phase 3

Parameter	Data	Units
RPM		R/min
Coolant Temp		°C
Mass Air Flow		g/s
Particles		#/cm3
Result		

PTI Results

Parameter	Data	Units
RPM		R/min
Coolant Temp		°C
Mass Air Flow		g/s
Particles		#/cm3
Result		



Sampling

Particles

8.09e+4

RPM

0

Coolant Temp, °C

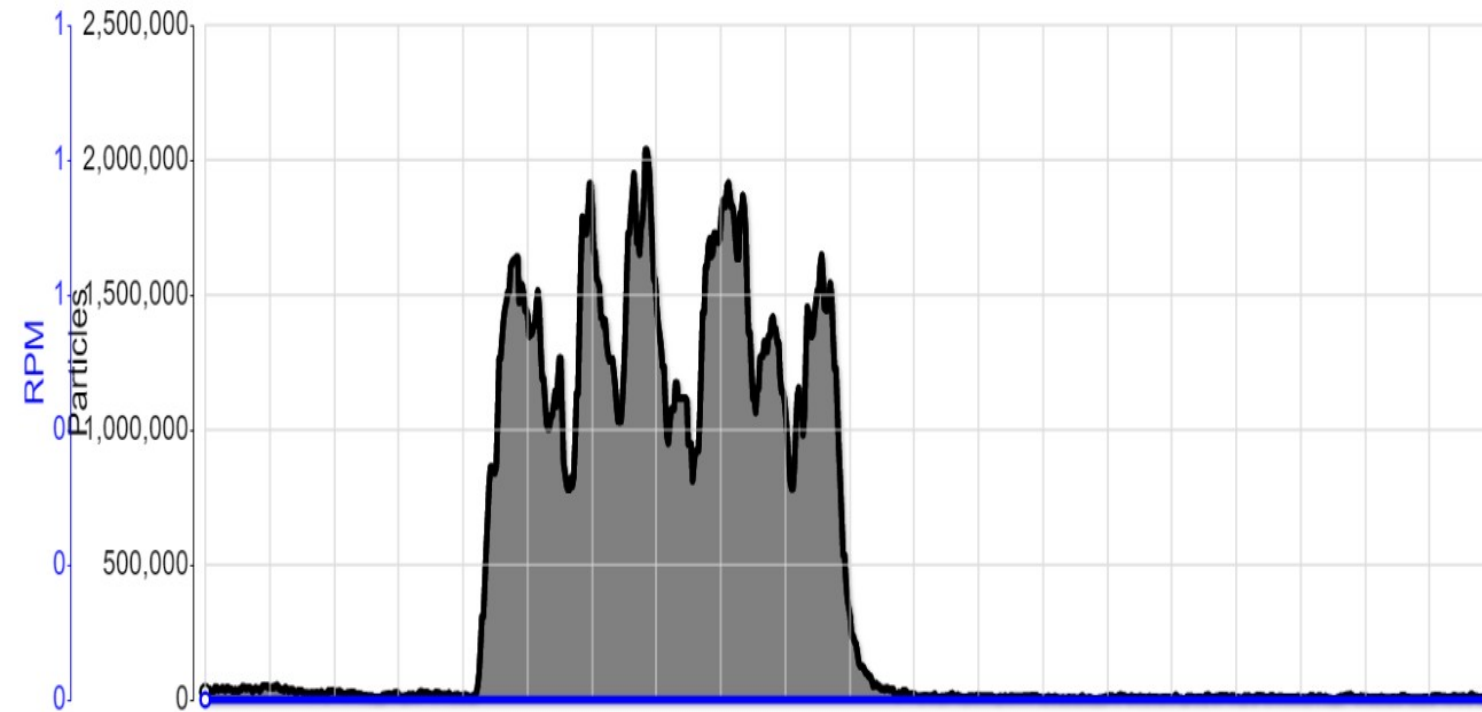
0

MAF, g/s

0.00

# Particle Reduction by a Kutzner+Weber Particle Precipitator

## K+W Airjet Basic



Sampling

Particles

6.81e+3

RPM

Zurück

Alt + Linkspfeil

Vorwärts

Alt + Rechtspfeil

Neu laden

Strg + R

Coola

Speichern unter...

Strg + S

Drucken...

Strg + P

Streamen...

Bilder an Google Lens senden

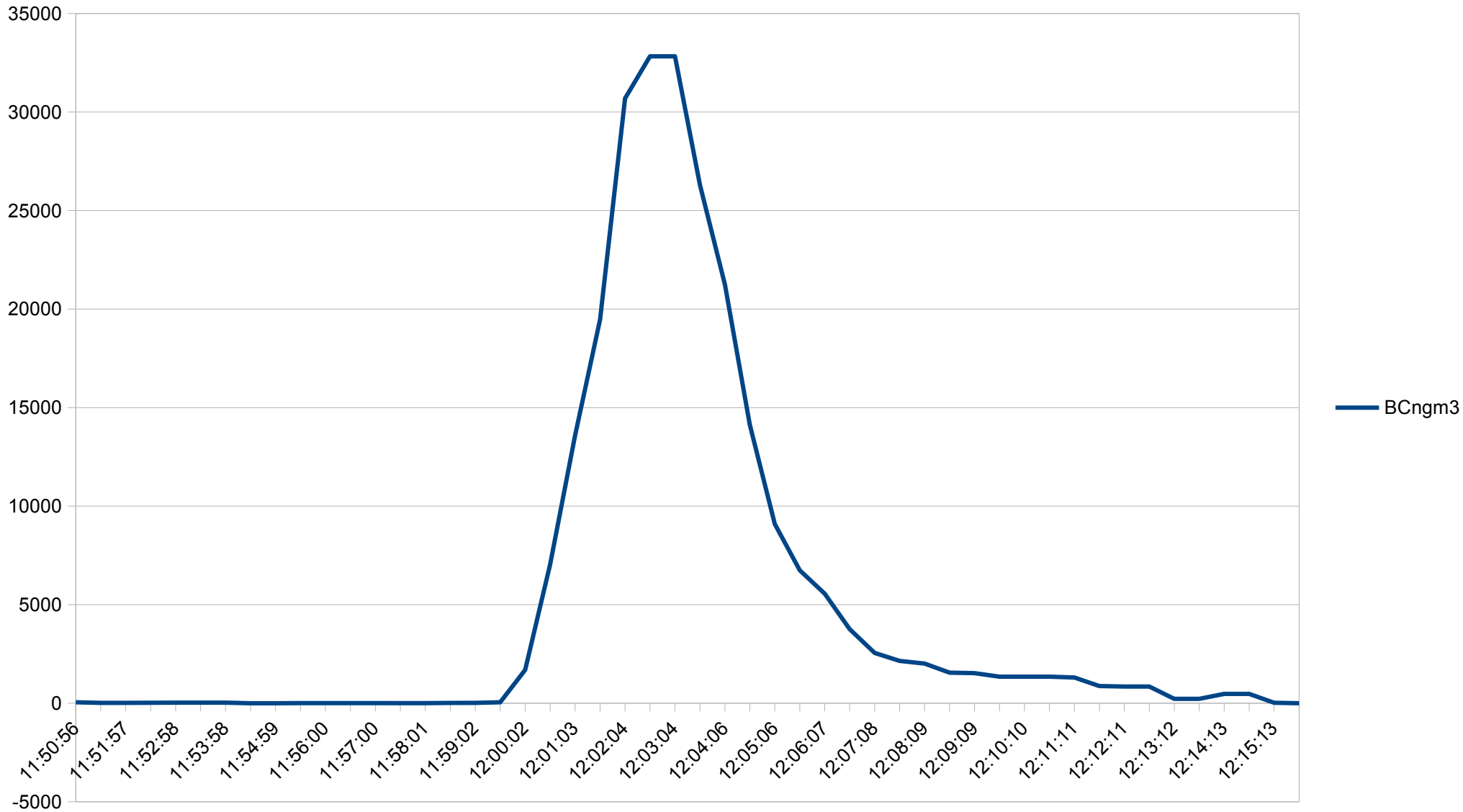
MAF,

An meine Geräte senden

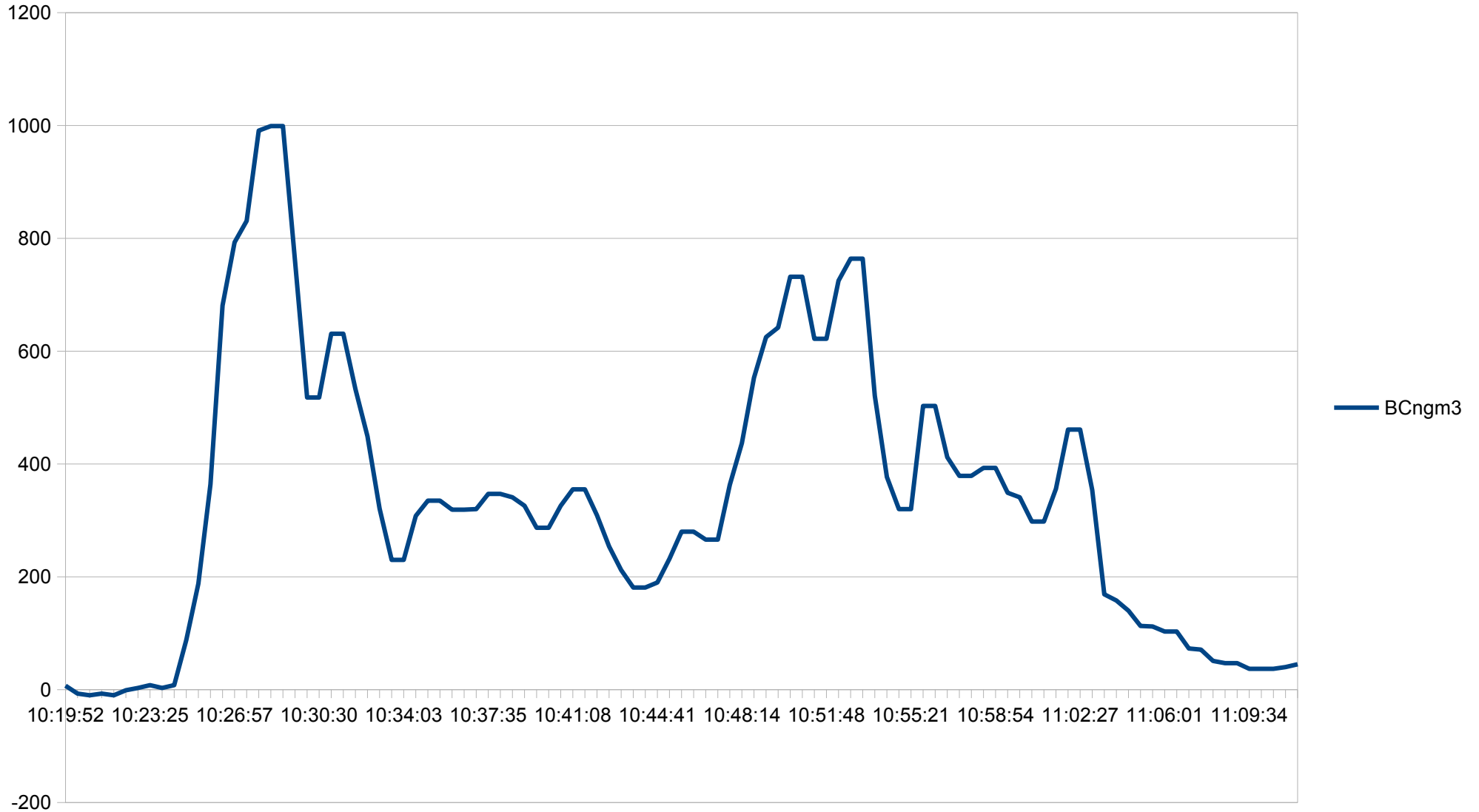
QR-Code für diese Seite erstellen

Auf Deutsch übersetzen

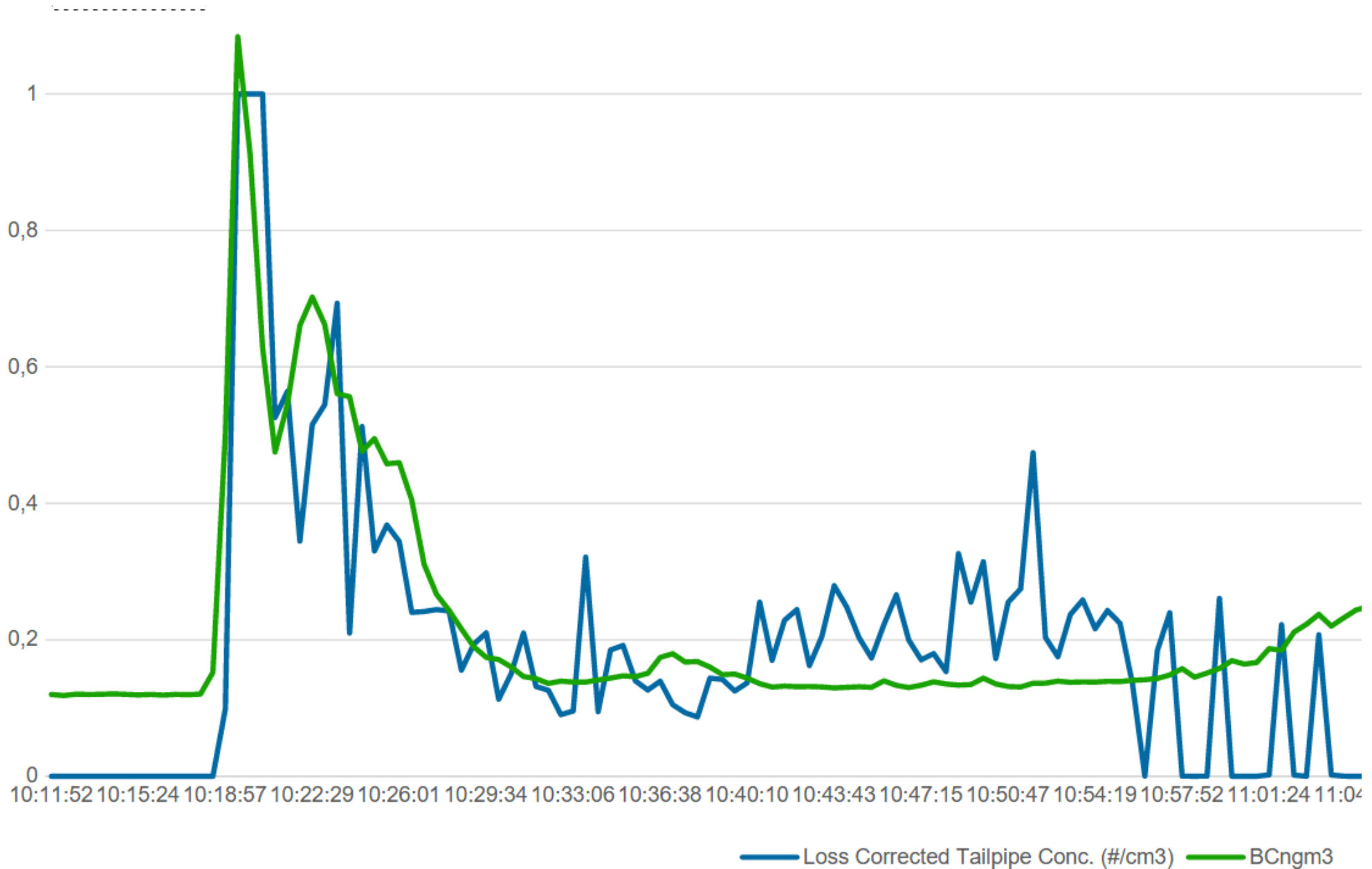
# BCMeter Measurement without Precipitator



# BCMeter Measurement with Precipitator



# Normalized PN and BC Concentration of Wood Stove Emissions



# What should be done?

- 1. Permission of new wood stoves only, if these stoves meet the requirements of the „Blue Angel (Blauer Engel)“  
Realisation e.g. with building regulation.
- 2. Revision of the EU Ecodesign for wood stoves with limits equivalent to “Blue Angel (Blauer Engel)“.
- 3. Program for the retrofit of old stoves with electrostatic precipitators, supported by a funding program.
- 4. Stricter control of wood imports to make sure these imports only from „Sustainable Forest Cultures“ .
- 5. Periodic Technical Inspection” os wood stoves by chimney sweepers with suitable measurement devices, e.g. particle number measurement devices as be used for Diesel vehicles or BCMeter.

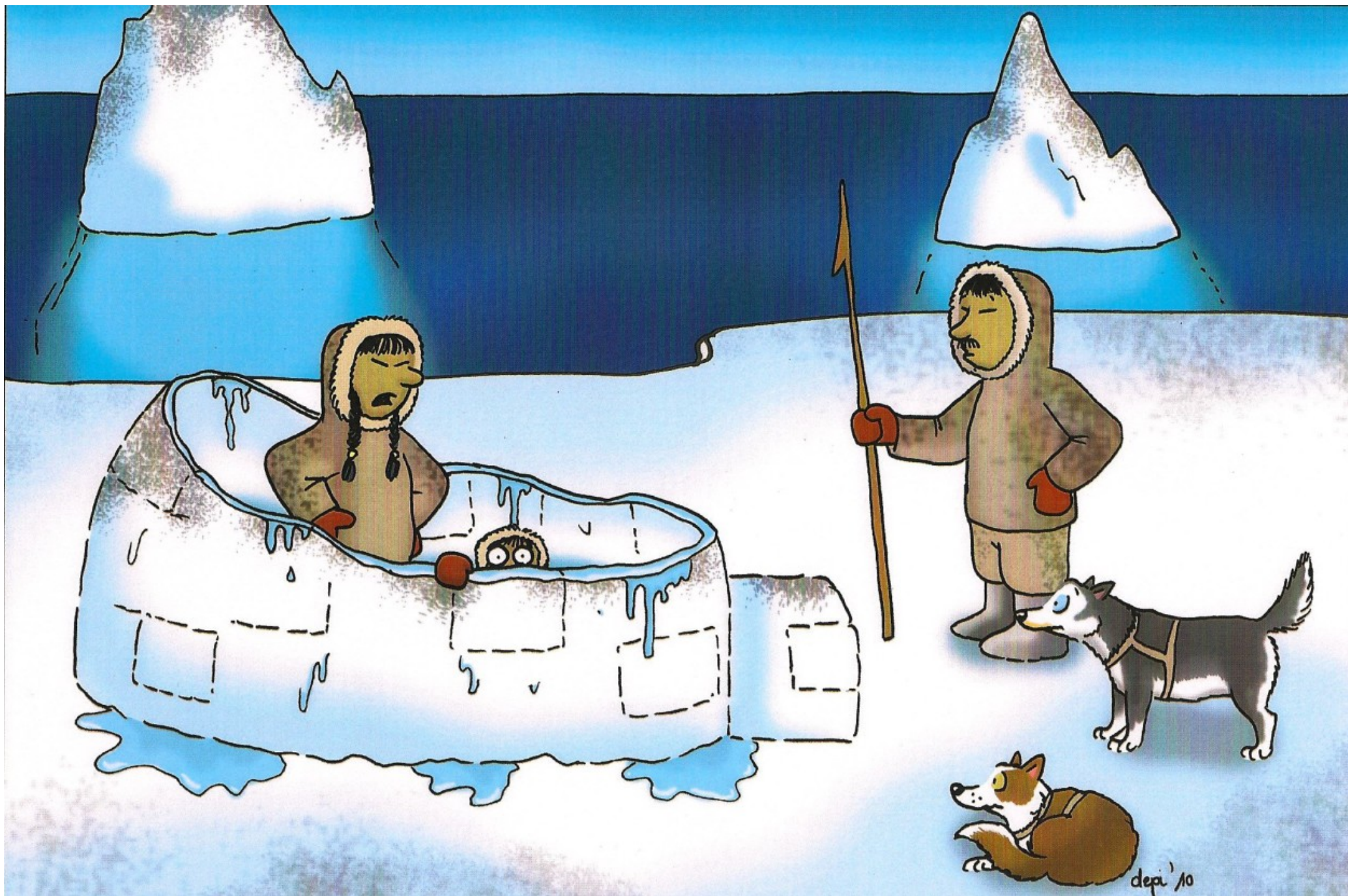
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**Nobody has the right to kill other  
people!**

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Damn Black Carbon! It is the fourth Roof this Year.



**Hungarian Village polluted by Wood Stove Emissions**