
Czech
Hydrometeorological
Institute

Pollution without borders: the consequences of fires and the air forecast

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Outlines

- Long-distance, supra-regional transport of pollution
- The consequences of fires, including accidents
- Air quality forecast

Long-distance, supra-regional transport of pollution

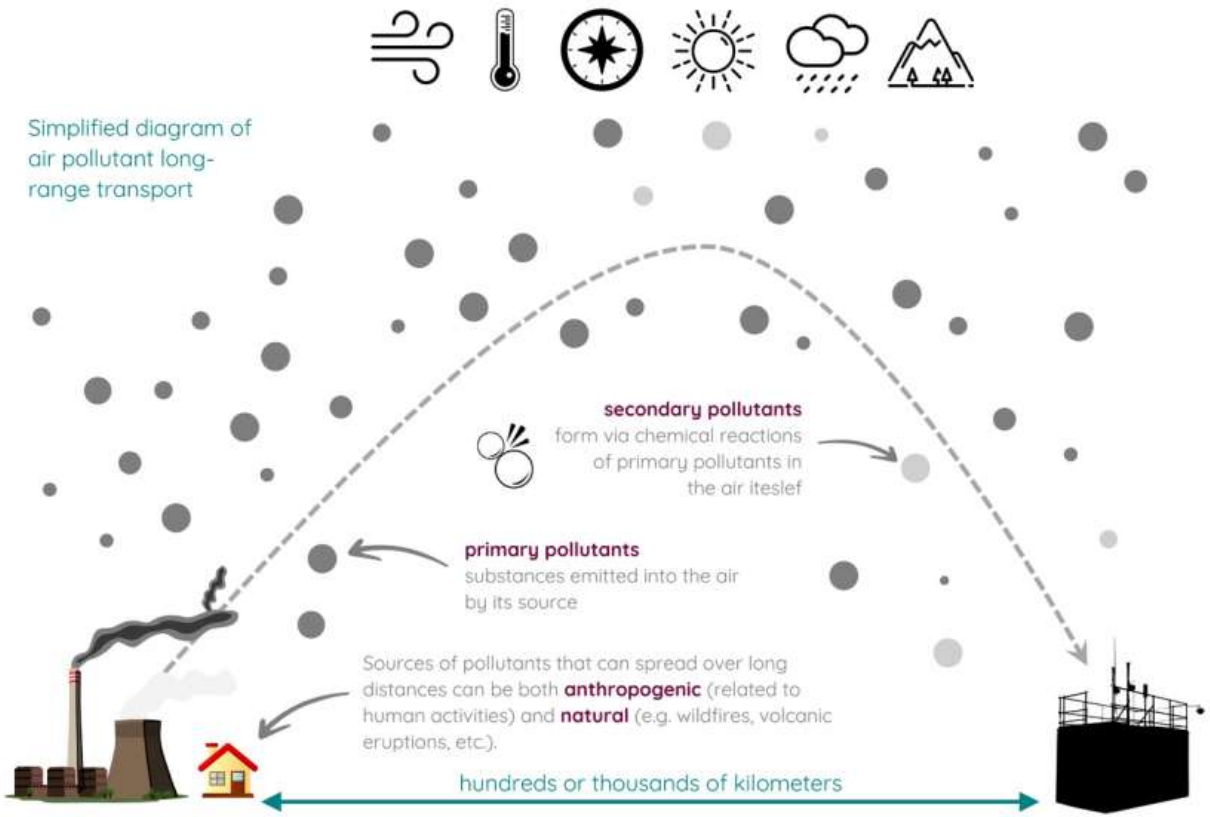
The impact of transport on air quality

- Pollutants travel far: air pollutants like $PM_{2.5}$, ozone, and nitrogen oxides can be transported by wind hundreds to thousands of kilometers.
- Cross-border effects: pollution generated in one region or country can significantly affect air quality in another.
- Secondary pollutants form in transit: gases like SO_2 and NO_x can react in the atmosphere to form secondary particles (e.g., sulfates, nitrates) far from their original source.
- Elevated background levels: long-range transport raises the baseline concentration of pollutants, worsening local conditions even when local emissions are low.

Air pollutant long-range transport

The air has knows no boundaries. If there are elevated concentrations of a particular pollutant in a particular location, **it does not mean that the source of that pollution has to be somewhere nearby. When pollutants are emitted from a particular source, they spread (disperse) into the surrounding area, and at the same time they may react with each other in different ways in the air**, giving rise to different types of pollutants. Long-range transport refers to the dispersion of substances through the air to the surroundings over a longer distance, with a threshold of > 100 km being the most commonly used.

Simplified diagram of air pollutant long-range transport



Factors affecting the dispersion of airborne pollutants from their source

The dispersion of substances in the air depends on a number of factors, including:

- wind speed and direction
- solar radiation intensity
- vertical temperature gradient in the atmosphere (eg. temperature inversion)
- precipitation
- emission source height above the ground
- terrain
- air pollutant type
- mass and size of the particle

Estimation of the nature and significance of long-distance transport

Assessing the nature and significance of long-range transport of pollutants is a very complex issue. Specific models are used which take into account a number of factors, theoretical knowledge of regional and local air flow, knowledge of meteorological and dispersion conditions, the nature and location of air pollution sources in specific locations, knowledge of air pollutant reactions, etc.

Example of long-range transport

- transport of Saharan dust over to Europe

Cross-Border Pollution in the 2024 EU Air Quality Directive

EU member States are required to cooperate in identifying sources of cross-border pollution and coordinating actions to improve air quality. This includes coordinating air quality plans and short-term action plans.

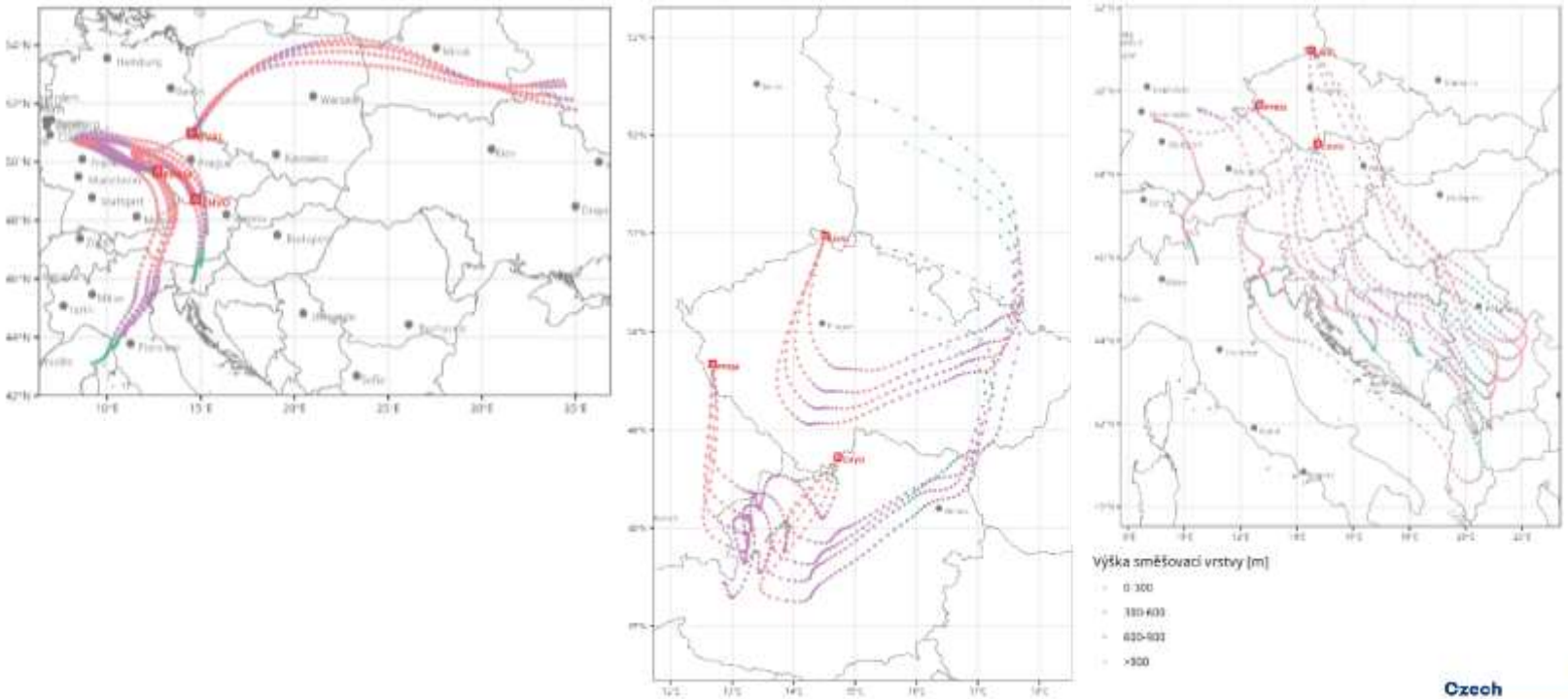
When assessing air quality, Member States must take into account pollution originating from other countries and implement measures to minimize its impact.

Where appropriate, Member States should cooperate with non-EU countries (especially candidate countries) to address cross-border pollution.

Member States must inform the public about air quality, including information on cross-border pollution.

Examples of regional penetration of aerosol transported at high altitudes into the ground layer

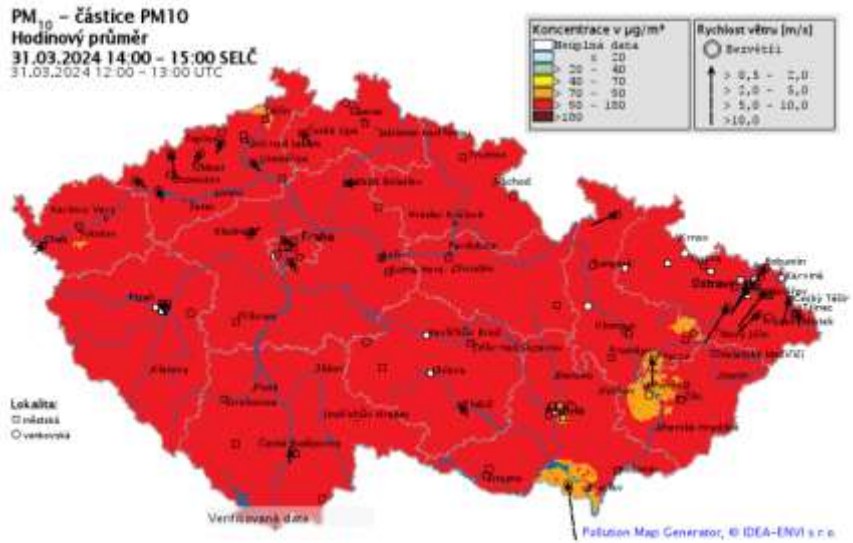
Episodic transport of mineral particles into central Europe from the eastern steppes - the two main areas of origin of silicate mineral dust, namely the desert regions of North Africa and the steppes of Ukraine and further east.



Sahara dust smog episodes?

At the turn of March and April 2024, an unusual smog event occurred caused by Saharan dust transported over the Central Europe. High concentrations of PM_{10} particles affected almost the entire Czechia.

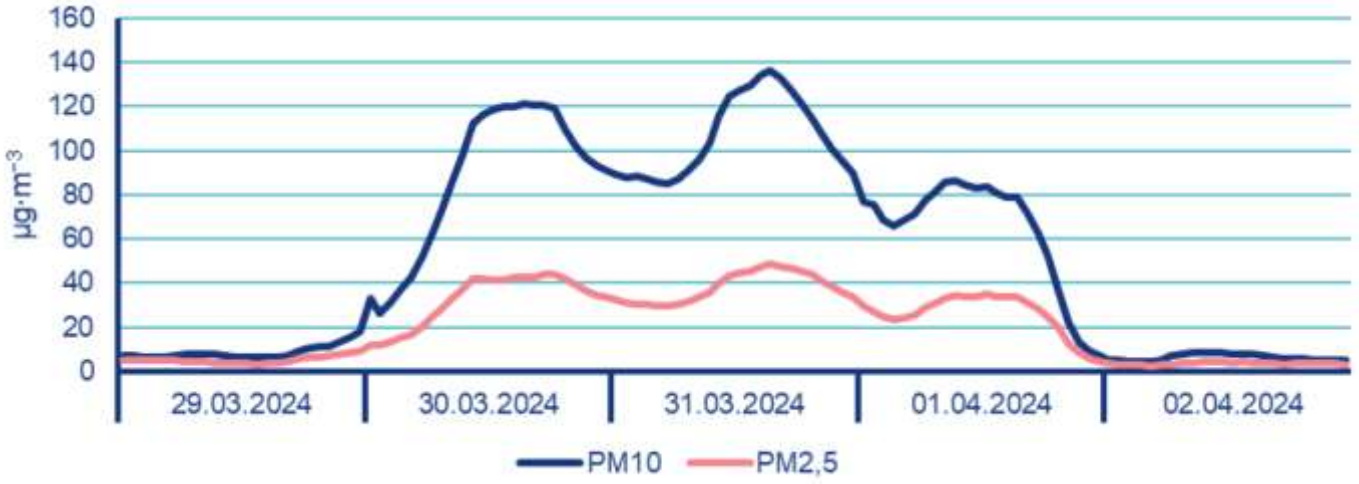
Meteorological conditions were very different from typical winter smog situations - the dust arrived under good dispersion conditions with sustained high wind speeds.



Sahara dust smog episodes.

Saharan dust reaches the Czech Republic several times a year through long-range transport. It usually remains in higher layers of the atmosphere, causing hazy skies, lower temperature peaks, and reduced performance of solar power plants. When accompanied by rain, the dust settles on surfaces, visible as dirty cars, windowsills, and other objects. However, the episode at the turn of March and April 2024 was exceptional, as the dust particles moved very close to the ground, resulting in increased concentrations of PM particles in the air we breathe.

Amendments to legislation on smog situations are being prepared.



Not only Sahara dust…

Europe Air Quality Alert: Canadian Wildfire Smoke

12. 6. 2025

Is the air quality poor in Europe?

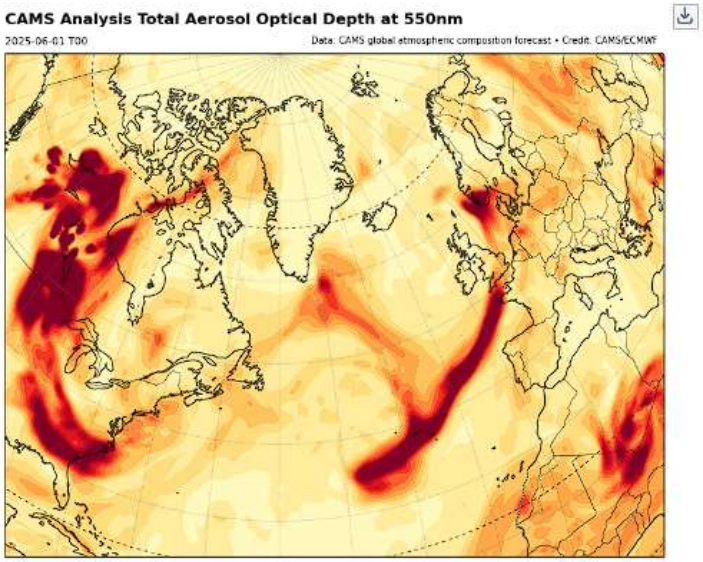
Extensive, widespread wildfires have been burning across the Canadian provinces of Alb
Saskatchewan since May 2025. At the start of June, a large plume of Canadian wildfire sr
the North Atlantic and reddened European skies (1).

https://www.iqair.com/newsroom/europe-air-quality-alert-canadian-wildfire-smoke?srsltid=AfmBOoqc6xHA6a5YWkJpaTNXZDHXV0ez4cXCjb56F1wMjaua0NJdCXTs

Copernicus: Large smoke transport from Canadian wildfires reaches Europe

3rd June 2025

Newsflash
Bonn, 03/06/2025



This press release is also available in other languages.

Download translation

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https://atmosphere.copernicus.eu/copernicus-large-smoke-transport-canadian-wildfires-reaches-europe

Consequences of the fire in the Czech Switzerland National Park

July 24, 2022; over 1,000 hectares affected; over 6,000 firefighters involved

Strongly supported by extreme drought and high temperatures

Smoke spread tens to hundreds of kilometers

https://www.npcs.cz/zpravodaj-ceske-svycarsko

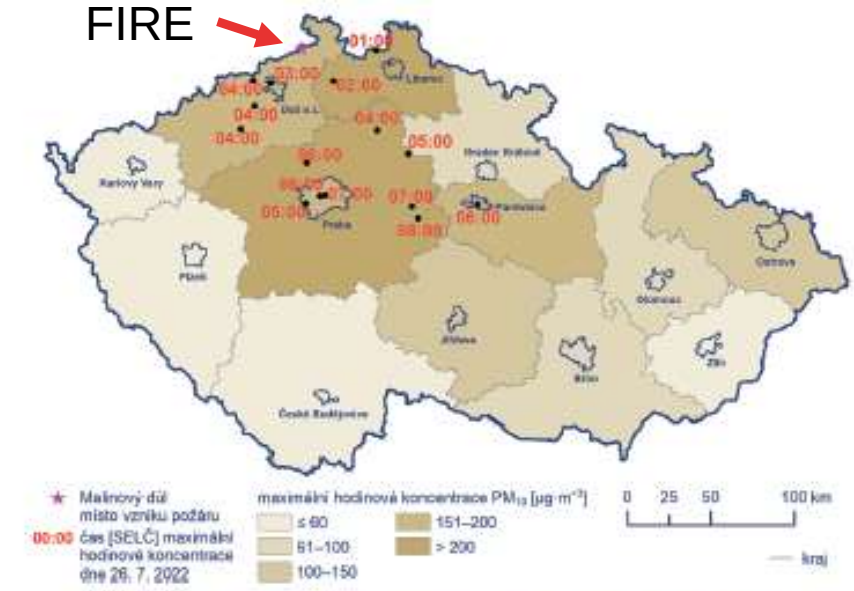
Consequences of the fire in the Czech Switzerland National Park

Smoke significantly affected air quality at night and in the morning (25-27 July) over a large part of Central Europe (even hundreds of km from the fire)

Good dispersion conditions paradoxically facilitated smoke dispersion

Dominance of the fine fraction $PM_{2.5}$ - the more hazardous component

Reduced horizontal visibility observed, smoke plume also detected by LIDAR (up to 2 km above ground)



Maximální hodinové koncentrace PM_{10} vyšší než 100 μg·m⁻³ na stanicích imisního monitoringu, 26. 7. 2022

Situation after an environmental accident with benzene leakage

Chemical Accident of February 28, 2025

Location: Hustopeče nad Bečvou, Přerov District, Czech Republic

Cause: leakage of toxic benzene from a rail tanker. The benzene entered the air, water and soil, resulting in elevated concentrations of benzene in the ambient air.

There is a risk of contamination of surface and underground water.

Capturing of the leaked substance and site decontamination.

Ongoing monitoring of air and water quality. Monitoring CHMI results are shared with the public: https://www.ovzdusi.cz/hustopeceNadBecvou/

The National Institute of Public Health (SZÚ) is carrying out individual health risk assessments based on CHMI's measured data.

Air quality forecast

Air quality forecast

Short-term forecast (1-3 days ahead) determining the expected level of air pollution.

Allows to warn the population and vulnerable groups (children, elderly, sick) in time about deteriorating air quality and prevent health complications.

Use of:

- Alerting the public via web, social networks, public allert systems
- Decision support (e.g. traffic regulation, recommendation of heating restrictions)
- Planning activities for schools, sports grounds, etc.

Creating a forecast

Combination:

- meteorological models (weather, wind, temperature)
- emissions data (transport, heating, industry)
- measurement of pollutant concentrations (PM10, NO_2, O_3, etc.)
- computational models of pollution dispersion

European air quality forecast plots

https://atmosphere.copernicus.eu/european-air-quality-forecast-plots

Every day CAMS provides four-day forecasts of the EU-WHO regulated pollutants, other air quality pollutants, pollens and aerosol tracers for Europe based on CAMS' regional ensemble model.

The maps and charts are accessible, can be used in applications.

Thank you for your attention

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