

Example Visibility

Arranged in Order of PM 2.5
Concentration

Source Notes, 1 of 2

- These photos are from the archive at <http://www.colorado.gov/airquality/report.aspx>. Choose 'Live Image of Denver' and 'Air Quality by Monitoring Site', CAMP.
- An automated camera at 13th Avenue & High Street in Denver took the photos. It faces WNW.
- Time stamps are Mountain Standard Time and are not adjusted for daylight savings.

Source Notes, 2 of 2

- Particulates (PM) were measured at the CAMP air monitoring station in downtown Denver at Broadway & 21st Street. The next slide shows CAMP's location. The monitors meet Federal Reference Method standards.
- PM 2.5 values are an average of measurements made every 6 seconds in the hour before the photo was taken.
- To help calibrate visibility to sight distances, the next slide shows landmarks.

Interpreting Photos

- Sight distance provides a rough measure of particulate pollution. How far is a landmark whose outlines are just barely discernible? The next slide gives distances for several.
- The National Ambient Air Quality Standard (NAAQS), or upper limit, for fine particulates (PM 2.5) is a 24-hour average of 35 ug/m^3 . In contrast, photos are instantaneous and the measurements listed are 1-hour averages.

Landmarks, with distances from camera in miles

Rosalie Peak, 37

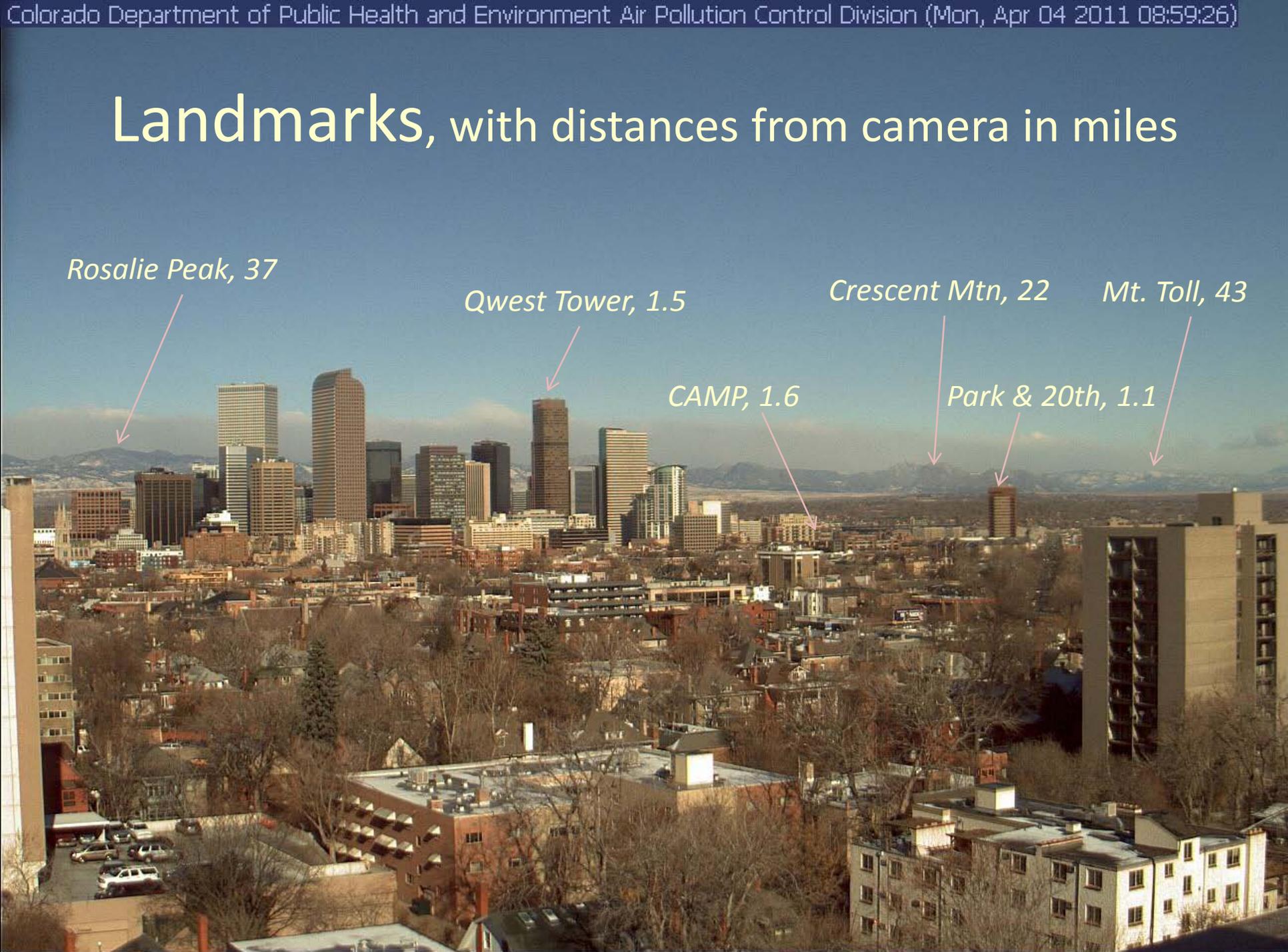
Qwest Tower, 1.5

Crescent Mtn, 22

Mt. Toll, 43

CAMP, 1.6

Park & 20th, 1.1



Possible Reasons for Anomalous Visibility

- Other pollutants than PM, especially NO_x , can affect visibility. So can high humidity.
- Pollution concentrations can vary within a mile or less.
- A frontal passage can bring in cleaner air. Traveling at 25 mph, a front may be in the camera's view for about 2 hours before reaching CAMP.
- Sun angle matters. In the morning, with sun behind the camera, apparent pollution is minimized. Time stamps are in the upper right corner of each photo. In the evening, facing the setting sun, the same pollution appears heavier. To use visibility distance to accurately estimate particulate concentration requires that the sun be behind the viewer.



really, really clean: 1 ug/m^3



2 ug/m³

2 ug/m^3

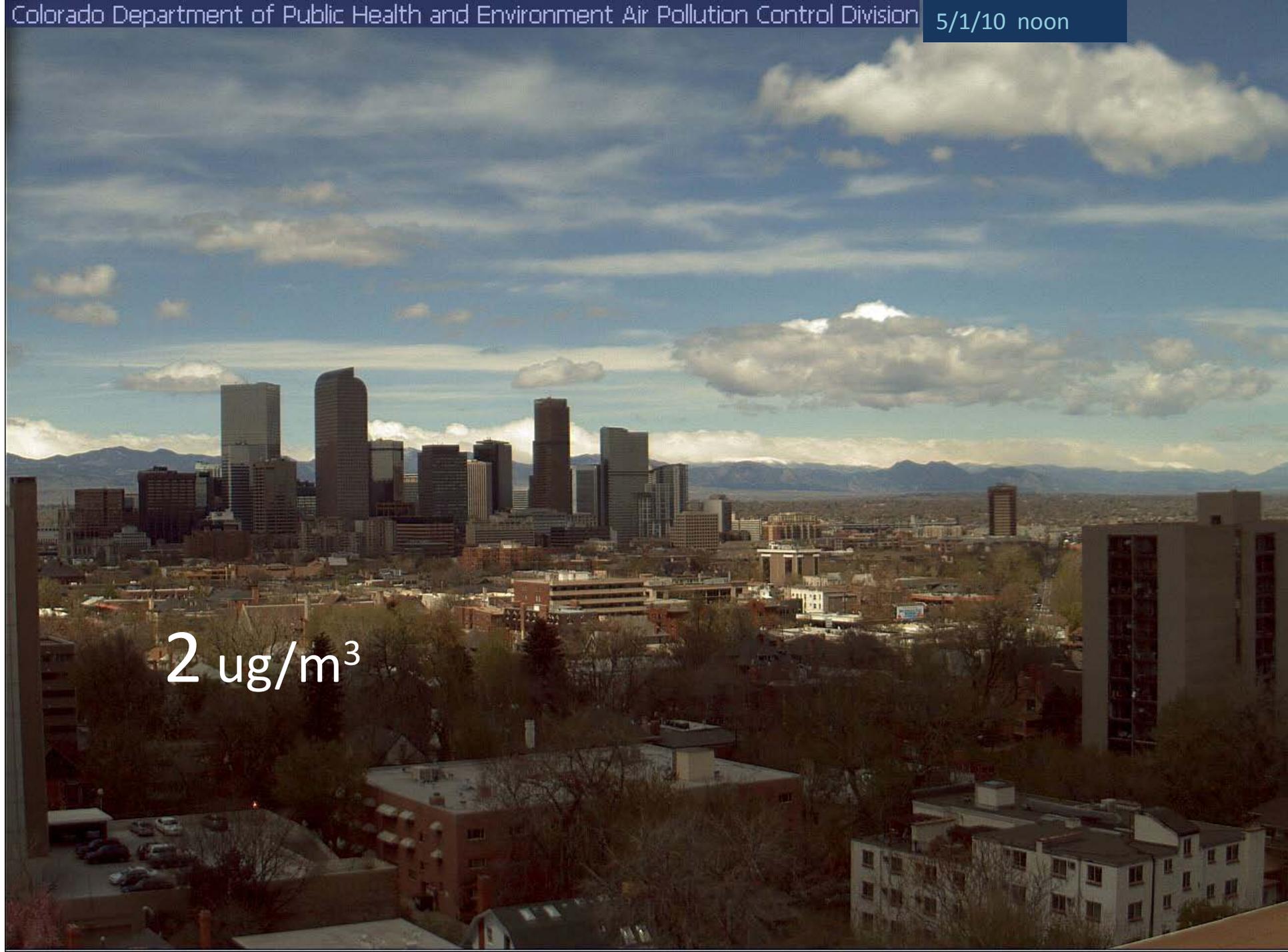
An aerial photograph of the Denver, Colorado skyline. The image shows a dense urban area with numerous skyscrapers and residential buildings. The sky is clear and blue. In the foreground, there are trees and a parking lot with several cars. The text '2 ug/m³' is overlaid on the left side of the image.

An aerial photograph of the Denver skyline, showing various skyscrapers and a dense urban area with trees in the foreground. The sky is clear and blue. A white text overlay is positioned in the lower-left quadrant of the image.

$2 \mu\text{g}/\text{m}^3$

2 $\mu\text{g}/\text{m}^3$

An aerial photograph of the Denver, Colorado skyline. The city's skyscrapers are visible in the background against a blue sky with scattered clouds. In the foreground, there are residential and commercial buildings, many with flat roofs. The text '2 ug/m³' is overlaid in white on the left side of the image.



2 ug/m³



3 ug/m³



5 ug/m³

9 $\mu\text{g}/\text{m}^3$

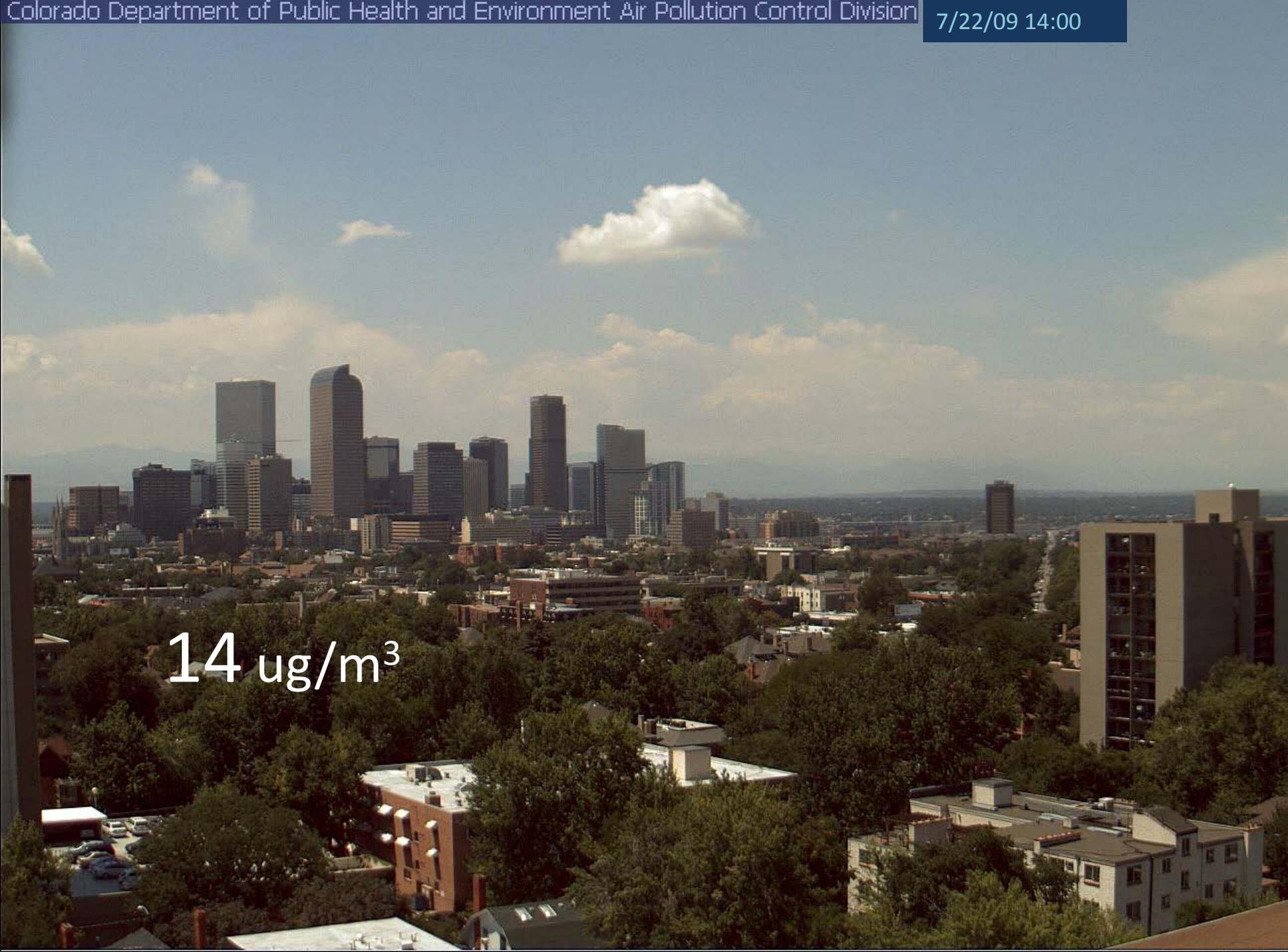
An aerial photograph of a city skyline, likely Denver, Colorado, taken from an elevated position. The foreground is filled with lush green trees and several multi-story buildings. In the middle ground, a dense cluster of skyscrapers forms the city's skyline. The background shows a hazy horizon with mountains under a clear, light blue sky. A white text overlay in the lower-left quadrant of the image reads "9 ug/m³".



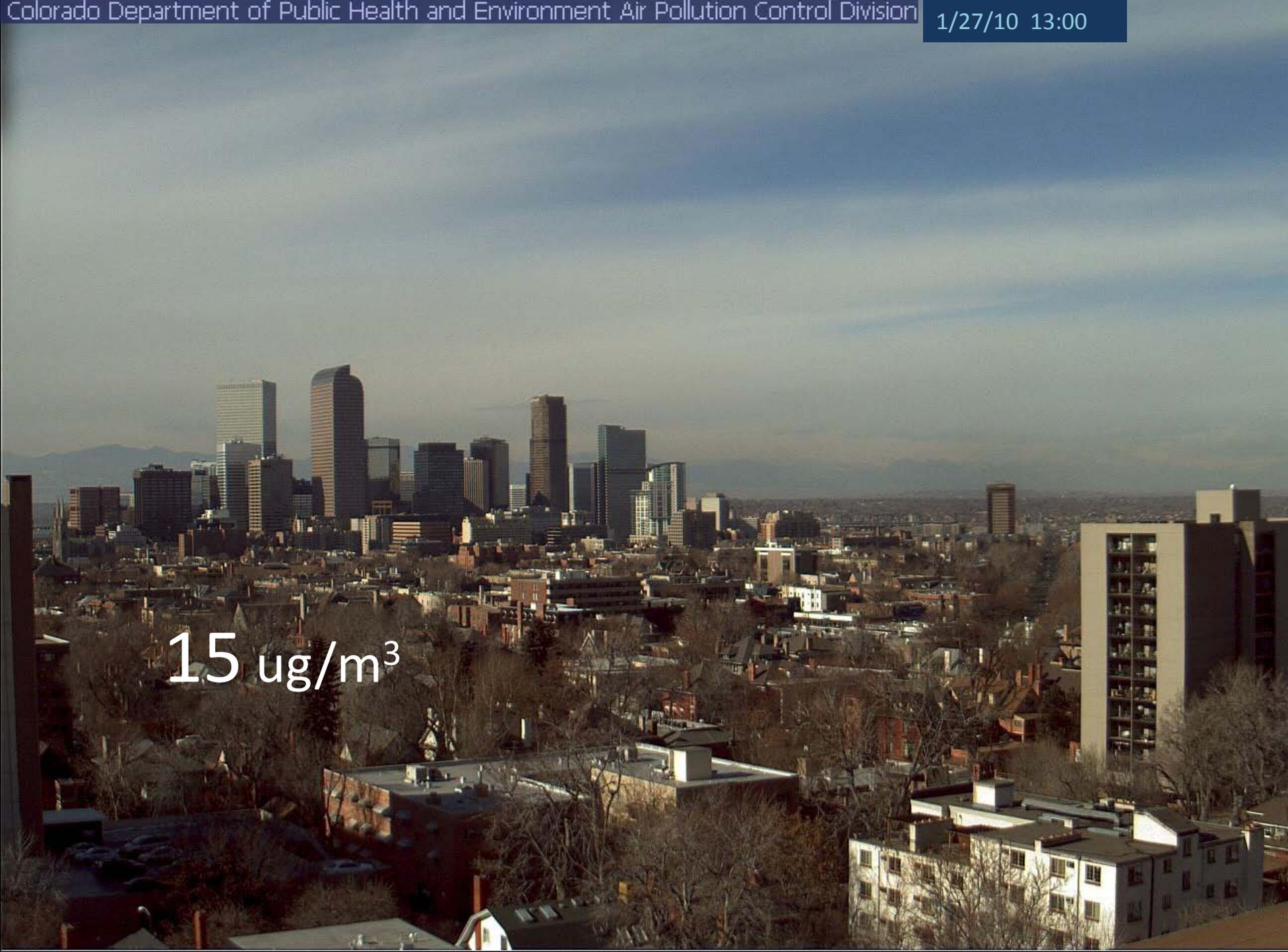
10 ug/m³



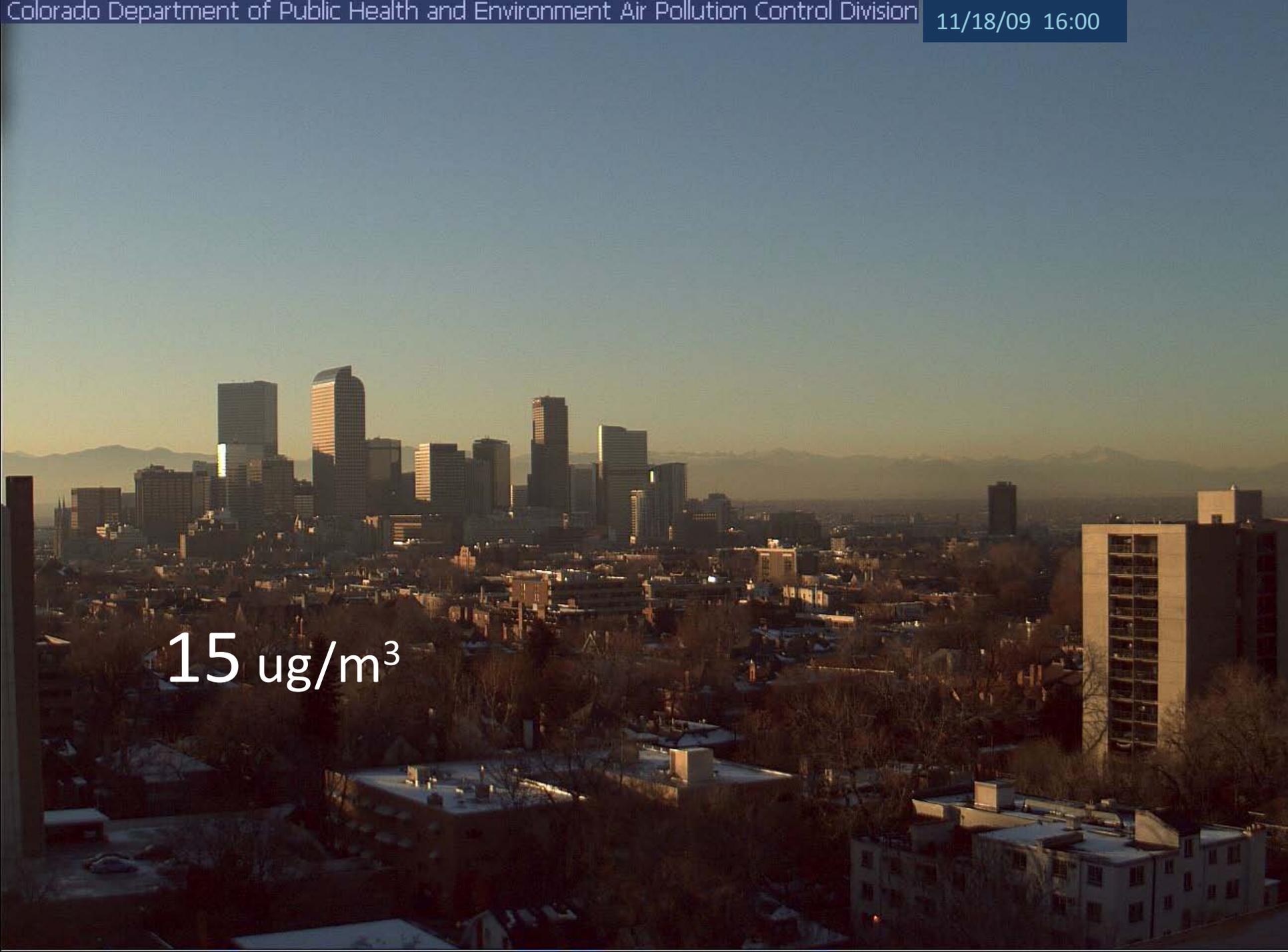
11 ug/m³



14 ug/m³



15 $\mu\text{g}/\text{m}^3$



15 $\mu\text{g}/\text{m}^3$

An aerial photograph of a city skyline, likely Denver, Colorado, taken from an elevated position. The foreground shows residential buildings and trees. The middle ground is dominated by a dense cluster of skyscrapers. The background features a range of mountains under a heavy, overcast sky. A white text overlay is positioned in the lower-left quadrant of the image.

18 $\mu\text{g}/\text{m}^3$

18 $\mu\text{g}/\text{m}^3$





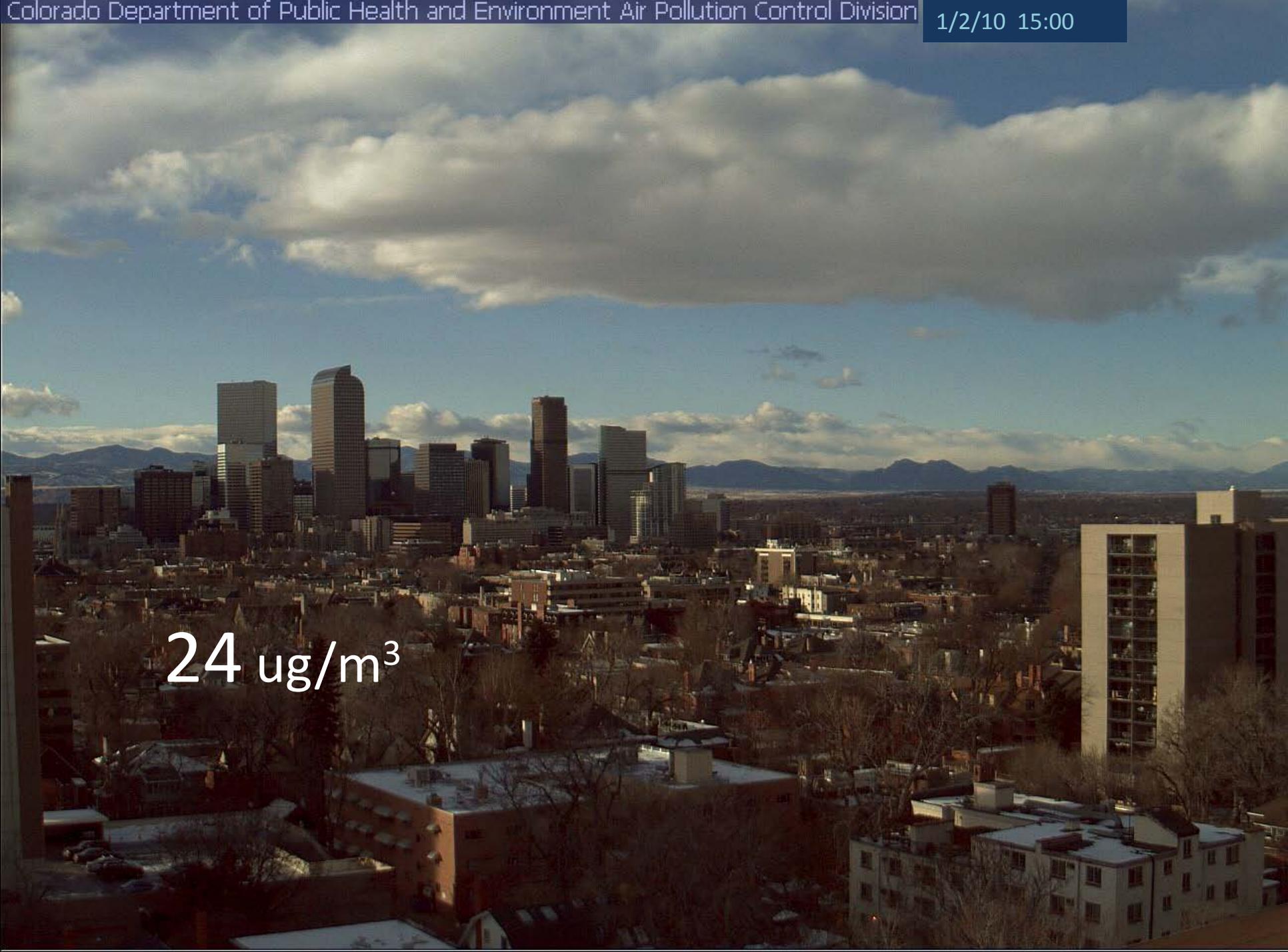
20 ug/m³

20 $\mu\text{g}/\text{m}^3$

An aerial photograph of a city skyline, likely Denver, Colorado, showing a dense cluster of skyscrapers in the center. The foreground is filled with residential and commercial buildings, many with flat roofs. The sky is overcast with grey clouds, and a single white contrail is visible in the upper right. The text '20 ug/m^3' is overlaid in white on the left side of the image.



24 ug/m³



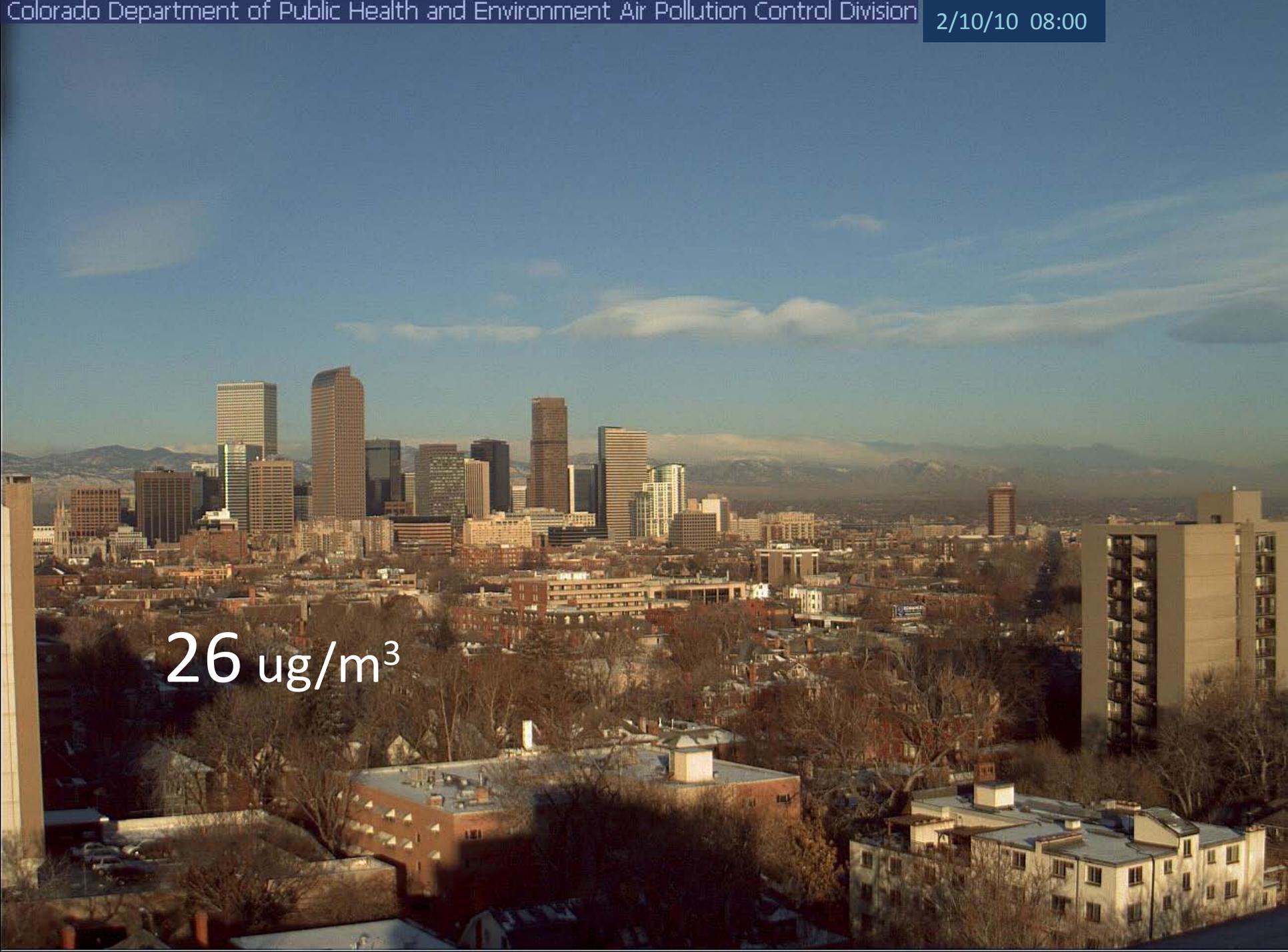
24 $\mu\text{g}/\text{m}^3$



24 ug/m³



26 $\mu\text{g}/\text{m}^3$



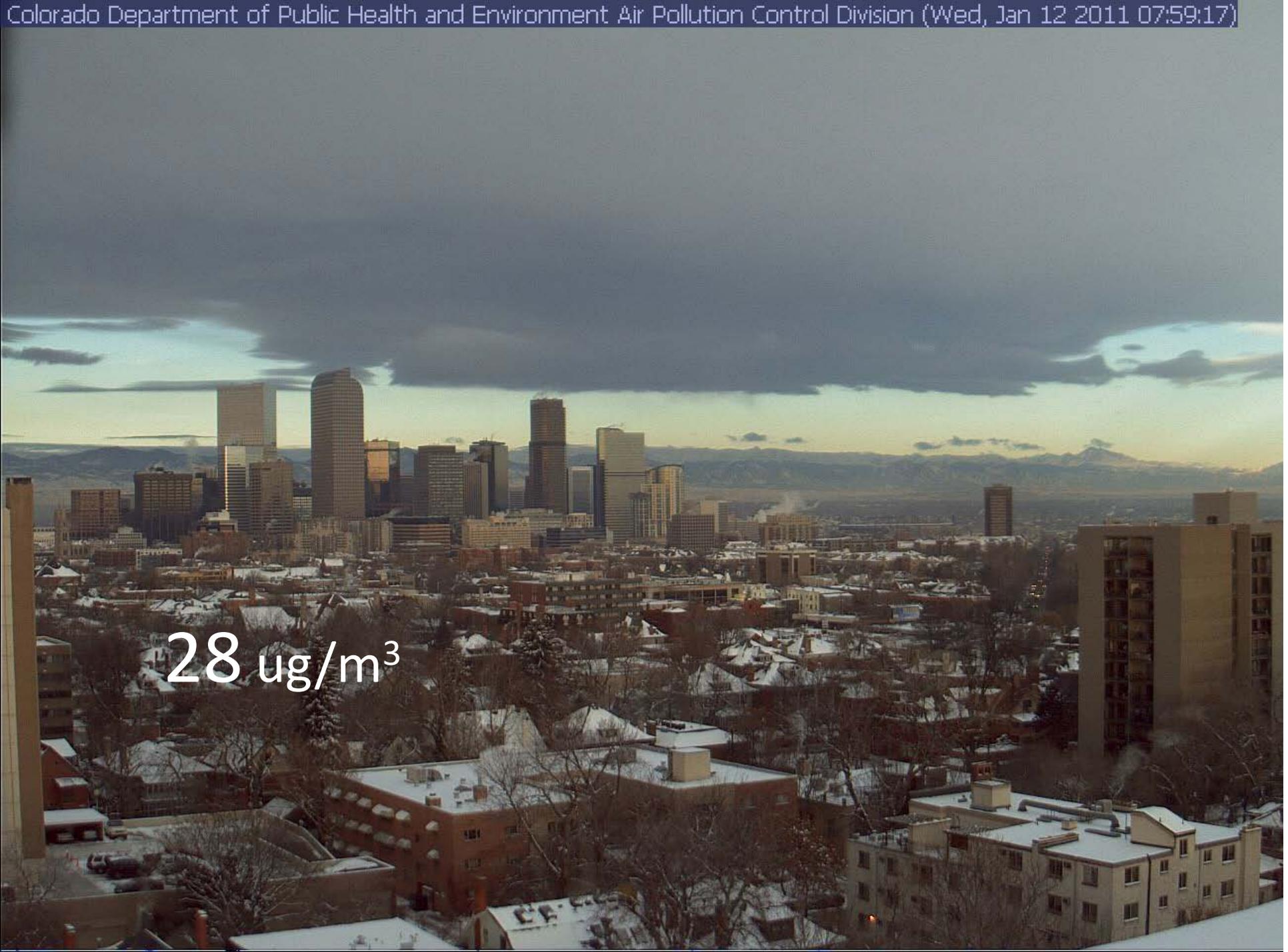
26 $\mu\text{g}/\text{m}^3$



27 $\mu\text{g}/\text{m}^3$

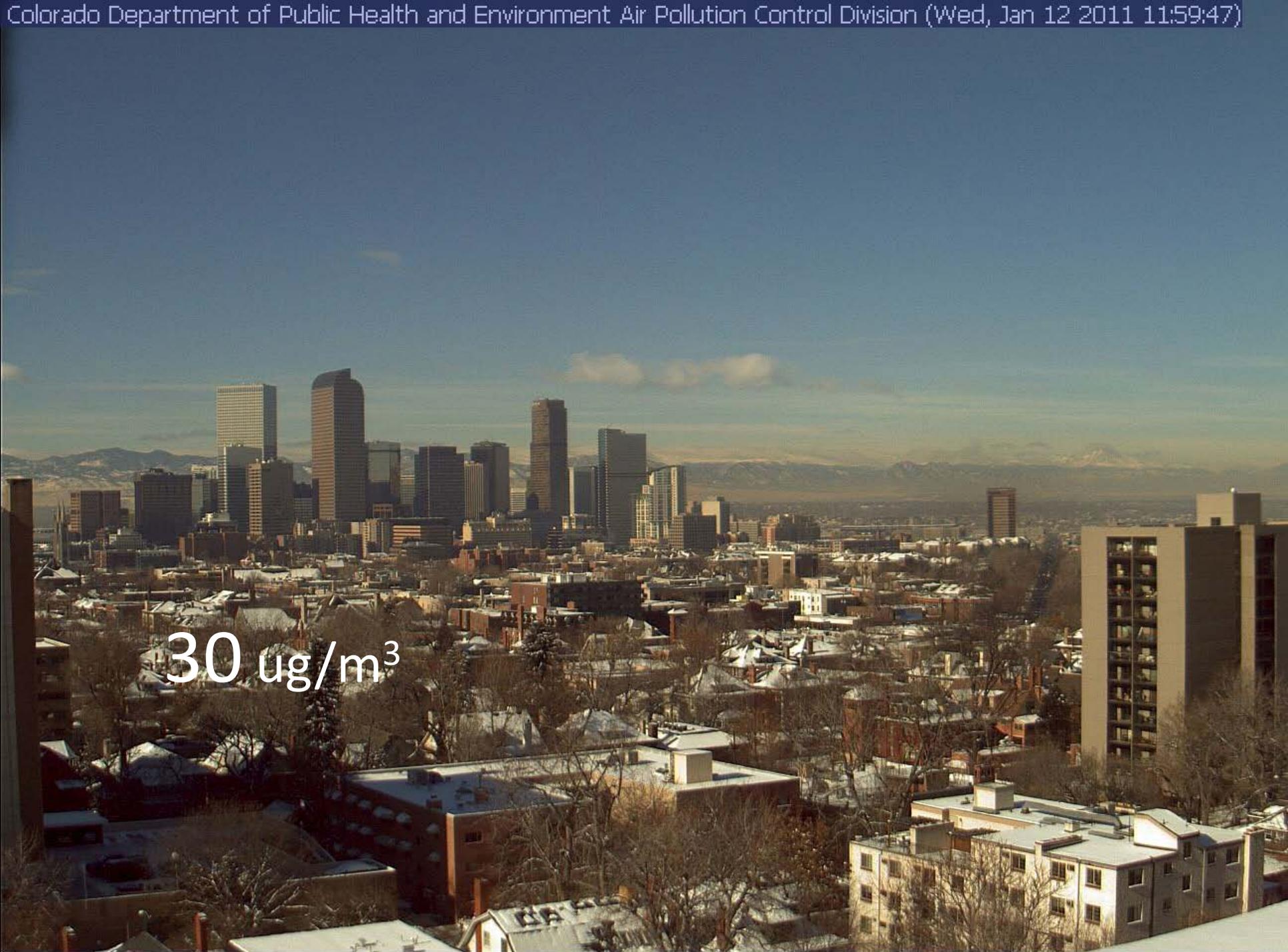
28 $\mu\text{g}/\text{m}^3$





28 $\mu\text{g}/\text{m}^3$

30 $\mu\text{g}/\text{m}^3$



An aerial photograph of a city skyline, likely Denver, Colorado, showing a dense cluster of skyscrapers in the background and residential buildings in the foreground. The sky is clear with some light clouds. A white text overlay in the lower-left quadrant indicates a pollution level of 30 ug/m³.

30 $\mu\text{g}/\text{m}^3$

An aerial photograph of a city skyline, likely Denver, Colorado, taken from an elevated position. The foreground shows residential buildings with snow on their roofs and bare trees. The middle ground is filled with a dense urban area. In the background, a prominent skyline of skyscrapers is visible against a blue sky with scattered white clouds. A white text overlay in the lower-left quadrant of the image displays the value '32 ug/m³'.

32 $\mu\text{g}/\text{m}^3$

33 $\mu\text{g}/\text{m}^3$



An aerial photograph of a city skyline, likely Denver, Colorado, showing various skyscrapers and buildings. The foreground is filled with green trees and residential or commercial buildings. The sky is a pale blue with some light clouds. A white text overlay is centered in the lower half of the image.

24-hour avg. NAAQS: 35 $\mu\text{g}/\text{m}^3$

An aerial photograph of the Denver, Colorado skyline. The city's skyscrapers are visible in the background against a cloudy, overcast sky. The foreground shows a dense residential area with snow-covered roofs and bare trees. A large white text overlay is positioned in the lower-left quadrant of the image.

36 $\mu\text{g}/\text{m}^3$

39 $\mu\text{g}/\text{m}^3$





really, really dirty: 45 ug/m^3

Questions or comments? Contact
Colorado's Smoke Management
Program, 303 692 3244.