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NATIONAL AND LOCAL TRENDS IN AIR QUALITY DATA

A TWENTY-YEAR ANALYSIS

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This report examines air quality trends in nationwide as well as Utah's localized results by analyzing key AQI data from the years 2004, 2014, and 2024. While these three benchmark years provide valuable insights, it is essential to acknowledge that the EPA offers annual data; integrating all available datasets would yield deeper understanding of evolving trends and more accurate assessments of our progress.

Between 2004 and 2024, national average seasonal AQI levels have shown a significant improvement. In 2004, summer recorded the highest average AQI of 62.17, whereas winter had the lowest at 45.47. By 2024, the summer AQI dropped to 47.12 while winter further improved to 37.19, reflecting the positive impact of air quality initiatives and emissions controls. Nonetheless, localized hotspots persist in certain counties such as Inyo, California, which continue to experience exceptionally high AQI values despite overall statewide improvements. We can see localized challenges in reducing AQI similarly in the Wasatch Front counties, where geographical factors impact AQI despite pollution measures in place.

Health-related metrics at the state level indicate a moderate enhancement in air quality. For instance, the number of "Unhealthy" air days in Utah counties slightly decreased—from 7 days in 2014 to 6 days in 2024. Although this reduction marks progress, it remains modest compared to national trends reported by the EPA, where numerous regions have achieved more substantial decreases in unhealthy air days. This discrepancy suggests an opportunity for Utah to refine its environmental policies, particularly during periods when pollutant levels peak.

Expanding our current analysis to include data from every year would offer a more detailed perspective on Utah's air quality trajectory. Annual data would facilitate more accurate trend identification, detection of seasonal shifts, and evaluation of specific policy interventions over time—thereby aligning local results more closely with EPA benchmarks. Further analysis and comparison with other Western states could be conducted to benchmark the AQI considering our region's annual challenges with wildfire impacts.

In summary, Utah has made significant strides in improving air quality over the past two decades. However, the persistence of localized pollution and relatively modest reductions in unhealthy days necessitate continued and targeted policy efforts. Incorporating annual data into our analysis will be crucial for developing more effective environmental strategies to protect public health and ensure a sustainable future for the state.

Queries:

```
--What is the average AQI (air quality index) by year by season (winter, spring, summer, fall)?--
SELECT round(avg(dabc."AQI" ), 2) AS average_aqi
, EXTRACT (YEAR FROM "Date") AS YEAR
, CASE
        WHEN EXTRACT(MONTH FROM "Date") IN (12, 1, 2) THEN 'Winter'
        WHEN EXTRACT(MONTH FROM "Date") IN (3, 4, 5) THEN 'Spring'
        WHEN EXTRACT(MONTH FROM "Date") IN (6, 7, 8) THEN 'Summer'
        WHEN EXTRACT(MONTH FROM "Date") IN (9, 10, 11) THEN 'Fall'
END AS Season
FROM daily_aqi_by_county dabc
GROUP BY Season, YEAR
ORDER BY YEAR, season

--What were the top 10 locations with worst AQI in each year?--
WITH worst_aqi_location AS (
        SELECT EXTRACT(YEAR FROM "Date") AS YEAR
        , "county Name" AS county_name
        , "State Name" AS state_name
        , MAX("AQI") AS worst_aqi
        FROM daily_aqi_by_county dabc
        GROUP BY YEAR, "county Name", "State Name"
        )
SELECT YEAR
, county_name
, state_name
```

```
, worst_aqi
FROM (
        SELECT *
        , row_number() OVER (PARTITION BY YEAR ORDER BY worst_aqi desc) AS
ranking
        FROM worst_aqi_location
) subq
WHERE ranking <= 10
ORDER BY YEAR, worst_aqi DESC;



--What were the top 10 locations that had the best improvement over 20 years, from the
first year to the most recent year?--
WITH yearly_aqi AS (
   SELECT EXTRACT(YEAR FROM "Date") AS year
        , "county Name"
        , "State Name"
        , AVG("AQI") AS avg_aqi
   FROM daily_aqi_by_county dabc
   GROUP BY year, "county Name", "State Name"
),
location_improvement AS (
   SELECT "county Name" AS county_name
      , "State Name" AS state_name
      , FIRST_VALUE(avg_aqi) OVER (
         PARTITION BY "county Name", "State Name"
         ORDER BY year ASC
```

```
    ) AS aqi_2005
    , FIRST_VALUE(avg_aqi) OVER (
        PARTITION BY "county Name", "State Name"
        ORDER BY year DESC
    ) AS aqi_2024
  FROM yearly_aqi
)
SELECT DISTINCT county_name
    , state_name
    , round(aqi_2005, 2) AS aqi_2005
    , round(aqi_2024, 2) AS aqi_2024
    , round((aqi_2005 - aqi_2024), 2) AS improvement
FROM location_improvement
ORDER BY improvement desc
LIMIT 10;

--What were the 10 locations with the worst decline over 20 years?--
WITH yearly_aqi AS (
  SELECT EXTRACT(YEAR FROM "Date") AS year
      , "county Name"
      , "State Name"
      , AVG("AQI") AS avg_aqi
  FROM daily_aqi_by_county dabc
  GROUP BY year, "county Name", "State Name"
),
location_decline AS (
  SELECT "county Name" AS county_name
```

```
      , "State Name" AS state_name
      , FIRST_VALUE(avg_aqi) OVER (
          PARTITION BY "county Name", "State Name"
          ORDER BY year ASC
      ) AS aqi_2005
      , FIRST_VALUE(avg_aqi) OVER (
          PARTITION BY "county Name", "State Name"
          ORDER BY year DESC
      ) AS aqi_2024
   FROM yearly_aqi
)
SELECT DISTINCT county_name
      , state_name
      , round(aqi_2005, 2) AS aqi_2005
      , round(aqi_2024, 2) AS aqi_2024
      , round((aqi_2024 - aqi_2005), 2) AS decline
FROM location_decline
ORDER BY decline desc
LIMIT 10;


--In Utah counties, how many days of "Unhealthy" air did we have in each year? Is it
improving?--
WITH monthly_data AS (
  SELECT EXTRACT(YEAR FROM "Date") AS YEAR
     ,COUNT(*) AS unhealthy_days
  FROM daily_aqi_by_county dabc
  WHERE dabc."State Name" = 'Utah'
```

```
  AND dabc."Category" = 'Unhealthy'
  GROUP BY EXTRACT(YEAR FROM "Date")
)
SELECT YEAR
    ,unhealthy_days
FROM monthly_data
GROUP BY unhealthy_days, YEAR
ORDER BY YEAR;


--In Salt Lake County, which months have the most "Unhealthy" days? Has that
changed in 20 years?--
WITH monthly_data AS (
  SELECT
      EXTRACT(MONTH FROM "Date") AS month
      ,EXTRACT(YEAR FROM "Date") AS YEAR
      ,COUNT(*) AS unhealthy_days
  FROM daily_aqi_by_county dabc
  WHERE dabc."county Name" = 'Salt Lake'
    AND dabc."Category" = 'Unhealthy'
  GROUP BY EXTRACT(YEAR FROM "Date"), EXTRACT(MONTH FROM "Date")
)
SELECT
    MONTH
    ,YEAR
    ,unhealthy_days
FROM monthly_data
GROUP BY unhealthy_days, MONTH, YEAR
```

```
ORDER BY YEAR, MONTH;
```

Results:

123 average_aqi	123 year	A-Z season
51.8	2,004	Fall
57.55	2,004	Spring
62.17	2,004	Summer
45.47	2,004	Winter
39.59	2,014	Fall
45.97	2,014	Spring
46.4	2,014	Summer
41.87	2,014	Winter
40.54	2,024	Fall
41.58	2,024	Spring
47.12	2,024	Summer
37.19	2,024	Winter

123 year	A-Z county_name	A-Z state_name	123 worst_aqi
2,004	Inyo	California	5,637
2,004	Mono	California	926
2,004	Fairbanks North Star	Alaska	859
2,004	Matanuska-Susitna	Alaska	501
2,004	Maricopa	Arizona	375
2,004	Mariposa	California	352
2,004	Mobile	Alabama	263
2,004	San Bernardino	California	242
2,004	Los Angeles	California	229
2,004	Kern	California	222
2,014	Mono	California	2,739
2,014	Inyo	California	957
2,014	Washoe	Nevada	935
2,014	Pinal	Arizona	924
2,014	Riverside	California	541
2,014	Dona Ana	New Mexico	450
2,014	Imperial	California	352
2,014	Kern	California	307
2,014	Yuma	Arizona	284
2,014	Placer	California	265
2,024	Inyo	California	1,322
2,024	Dona Ana	New Mexico	692
2,024	Santa Cruz	Arizona	494
2,024	Bernalillo	New Mexico	443
2,024	El Paso	Texas	431
2,024	King	Washington	354
2,024	Fairbanks North Star	Alaska	325
2,024	Cochise	Arizona	307
2,024	Pinal	Arizona	289
2,024	Ottawa	Oklahoma	288

A-Z county_name	A-Z state_name	123 aqi_2005	123 aqi_2024	123 improvement
Inyo	California	161.16	70.3	90.86
Kern	California	117.26	63.42	53.83
Mono	California	67.97	21.4	46.58
Navajo	Arizona	50.44	12.1	38.35
Hawaii	Hawaii	56.83	19.38	37.45
Garfield	Utah	41.42	4.1	37.32
Uinta	Wyoming	42.13	6.89	35.24
Jefferson	Alabama	75.36	40.64	34.72
Rosebud	Montana	41.42	6.75	34.67
Carbon	Wyoming	43.13	8.74	34.39

A-Z county_name	A-Z state_name	123 aqi_2005	123 aqi_2024	123 decline
Catano	Puerto Rico	20.21	76.21	56
Cameron	Texas	50.9	83.69	32.79
Lincoln	Wyoming	16.15	42.32	26.17
Johnson	Wyoming	11.99	38.02	26.03
Napa	California	31.87	54.06	22.2
El Paso	Texas	58.08	79.12	21.04
Eddy	New Mexico	44.08	64.14	20.06
Pueblo	Colorado	30.95	50.58	19.63
Hidalgo	Texas	47.34	66.54	19.2
Richmond City	Virginia	18.38	37.3	18.92

123 year	123 unhealthy_days
2,014	7
2,024	6

123 month	123 year	123 unhealthy_days
1	2,014	2
7	2,024	2
8	2,024	1