

# **Where does the dust come from?**

## **An analysis of the days with the highest particulate concentration on the Bishop Paiute Reservation 2003-2006**



PHOTO COURTESY OF GBUAPCD

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**Bishop Paiute Tribe**  
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# Where is the Bishop Paiute Tribe?

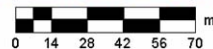


- On the California-Nevada Border
- In the “deepest valley” at 4,000ft between the Sierra Nevada and White Mountains
- 200 miles South of Reno
- 270 miles East of Las Vegas
- 300 miles North of Los Angeles

Data use subject to license.

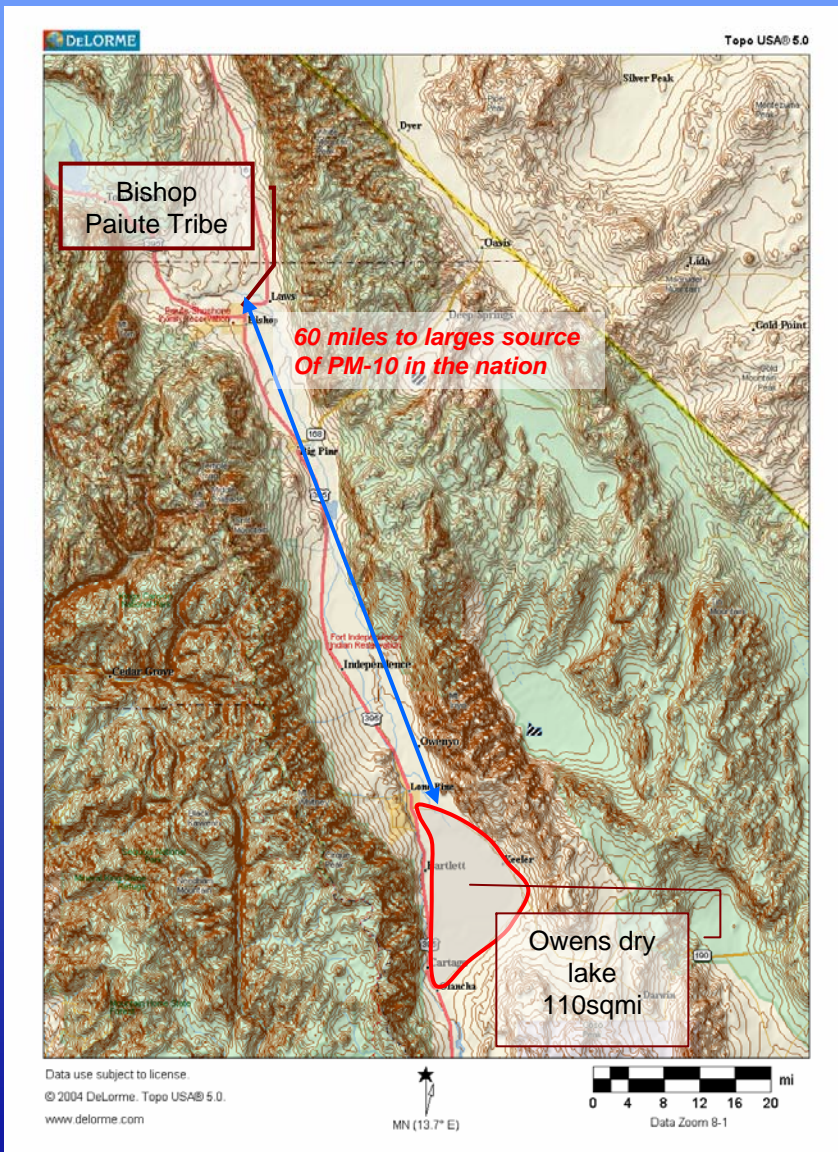
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Data Zoom 6-3

# Why are we interested in dust?



- The Bishop Paiute Reservation is only 60 miles North of the Owens Dry Lake
- The **largest source of PM-10 in the nation**
- Releasing thousands of tons of dust into the air each year

# What makes airborne dust?

Simple answer: wind + soil disturbance

- The dry lake was once a lake
- Early in the 20<sup>th</sup> century it was drained when an aqueduct was built to transport water to the City of Los Angeles
- Alkali soils on the lakebed + moisture = a surface that is very susceptible to wind erosion
- Winds pick up sand which in turn stirs up smaller particles, creating airborne dust



# What does the dry lake look like?

Before, during, more during



# What questions are we trying to answer?

1. Do dust episodes on the dry lake impact the Bishop Paiute Reservation?
  - Can our data and methods allow us to sort high PM-10 days into those where there is likely to have been an impact from the dry lake?
2. Have things changed since the implementation of controls? ← (*hard question*)

# What are we studying?

High dust days as measured by PM-10

1. Started with days with at least one hour over  $100\mu\text{g}/\text{m}^3$  → too many of these for detailed study
2. Selected days with at least one hour over  $200\mu\text{g}/\text{m}^3$ 
  - All days that exceed the California and Bishop tribal 24-hour standard ( $50\mu\text{g}/\text{m}^3$ ) have at least 1 hour over  $200\mu\text{g}/\text{m}^3$
  - Other significant dust episodes have hourly concentrations in this range
  - Excludes episodes have a high fine fraction → smoke

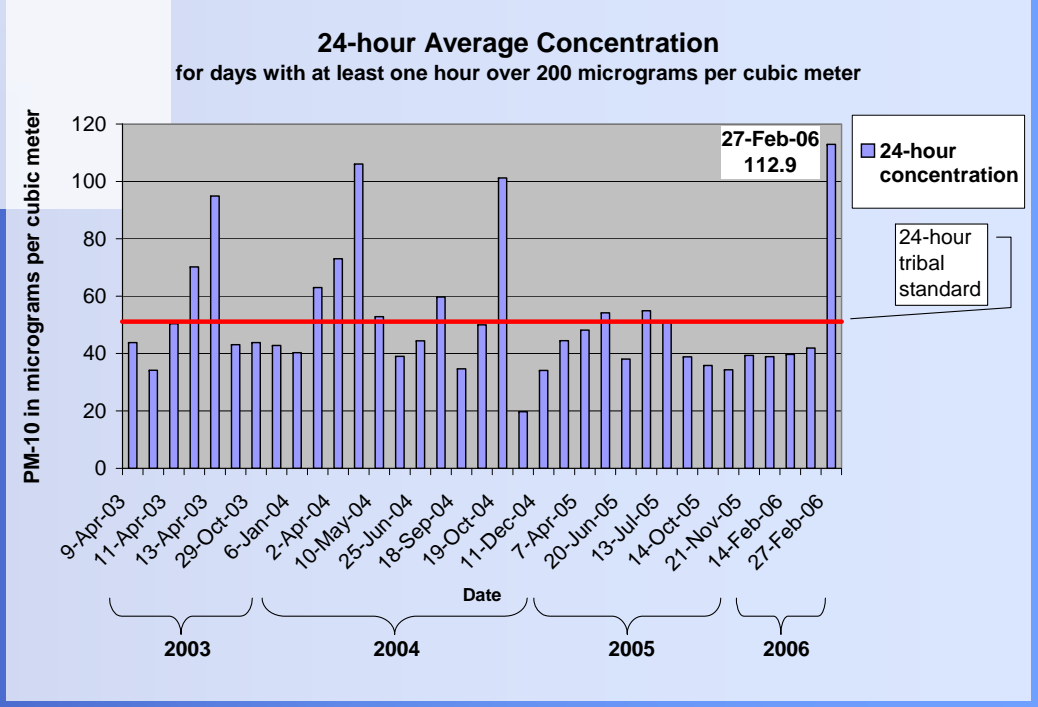
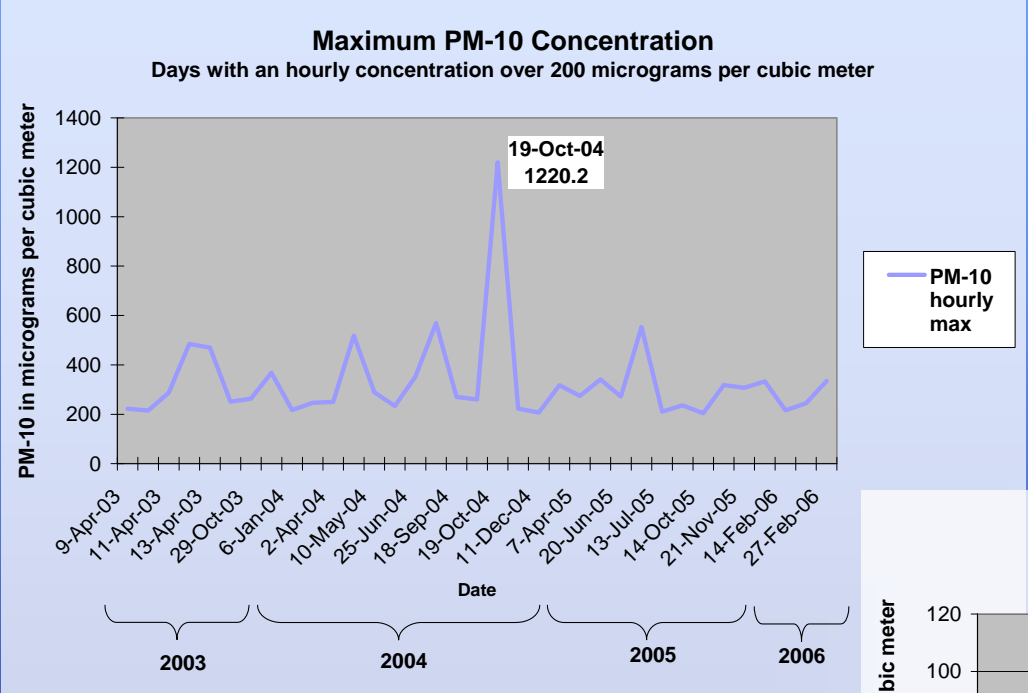
# How many episodes are there?

- 35 days with at least one hour with a concentration over  $200\mu\text{g}/\text{m}^3$ 
  - 2003 – 10 days (*8 months of data only*)
  - 2004 – 14 days
  - 2005 – 10 days (*some caused by local construction*)
  - 2006 – 3 days (*6 months of data only*)

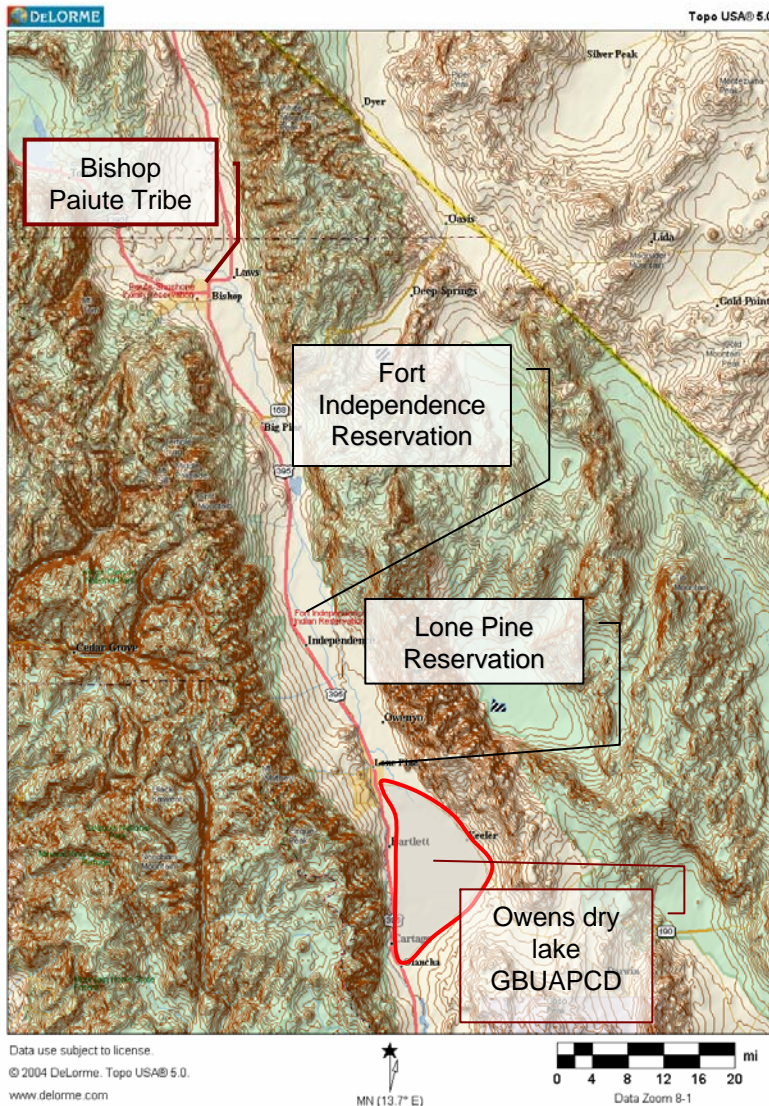
# What do the episodes look like?

- Maximum hourly concentration 1,200 $\mu\text{g}/\text{m}^3$
- Typical wind gust at max concentration 30-40mph
- Typical wind direction at max concentration SE
  - ESE to SSE on 54% of days)
- Most episodes involve frontal passage (66%)

# Hourly Maxima and 24-Hour Concentrations

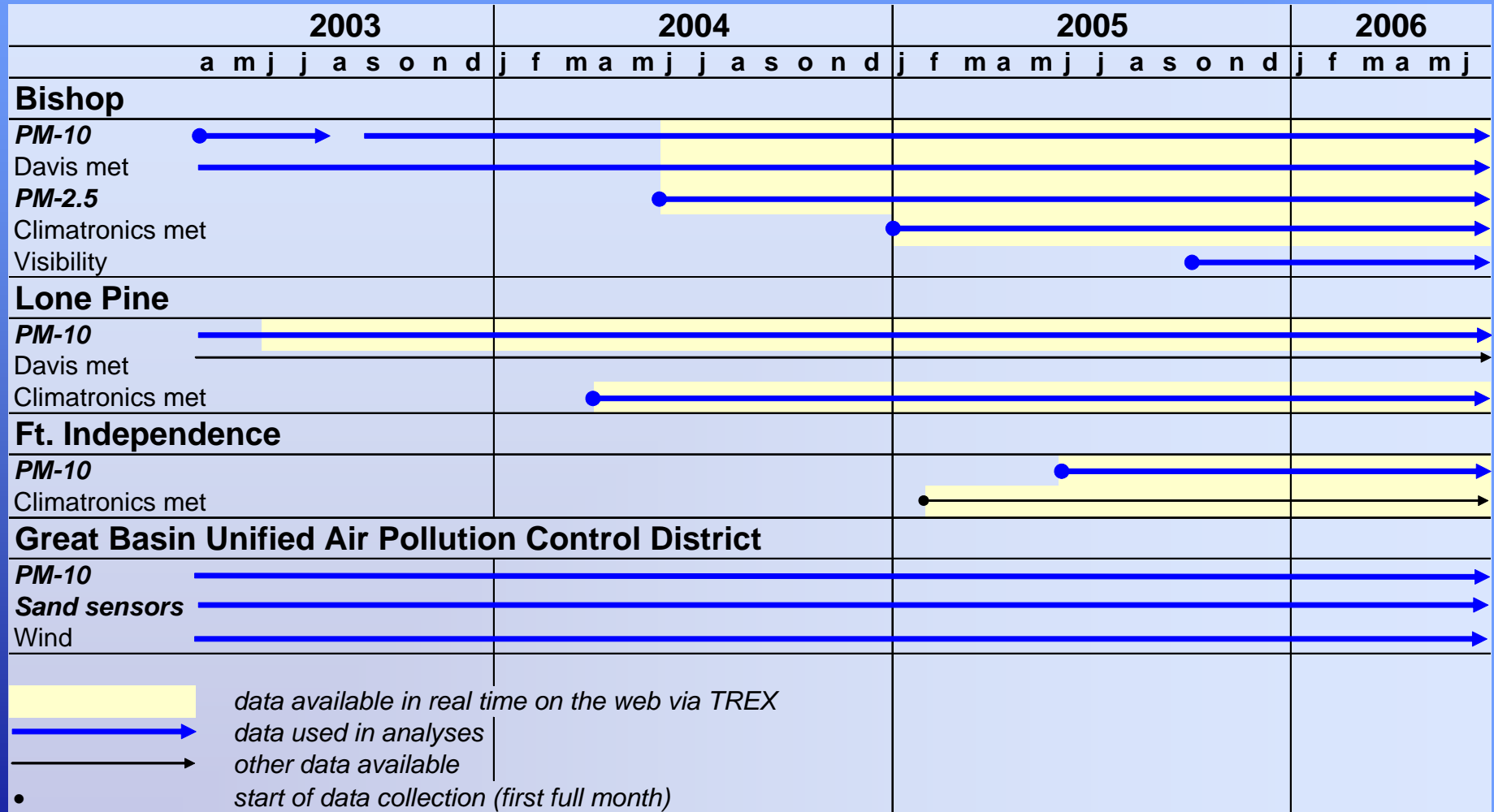


# Where do the data come from?



- The Bishop Paiute Tribe's Air Quality Program
- The Lone Pine Paiute Shoshone Reservation's Air Quality Program
- The Ft. Independence Reservation's Air Quality Program
- The Great Basin Unified Air Pollution Control District
  - Responsible for mitigation efforts on the dry lake

# Data Availability



# Analysis Methods

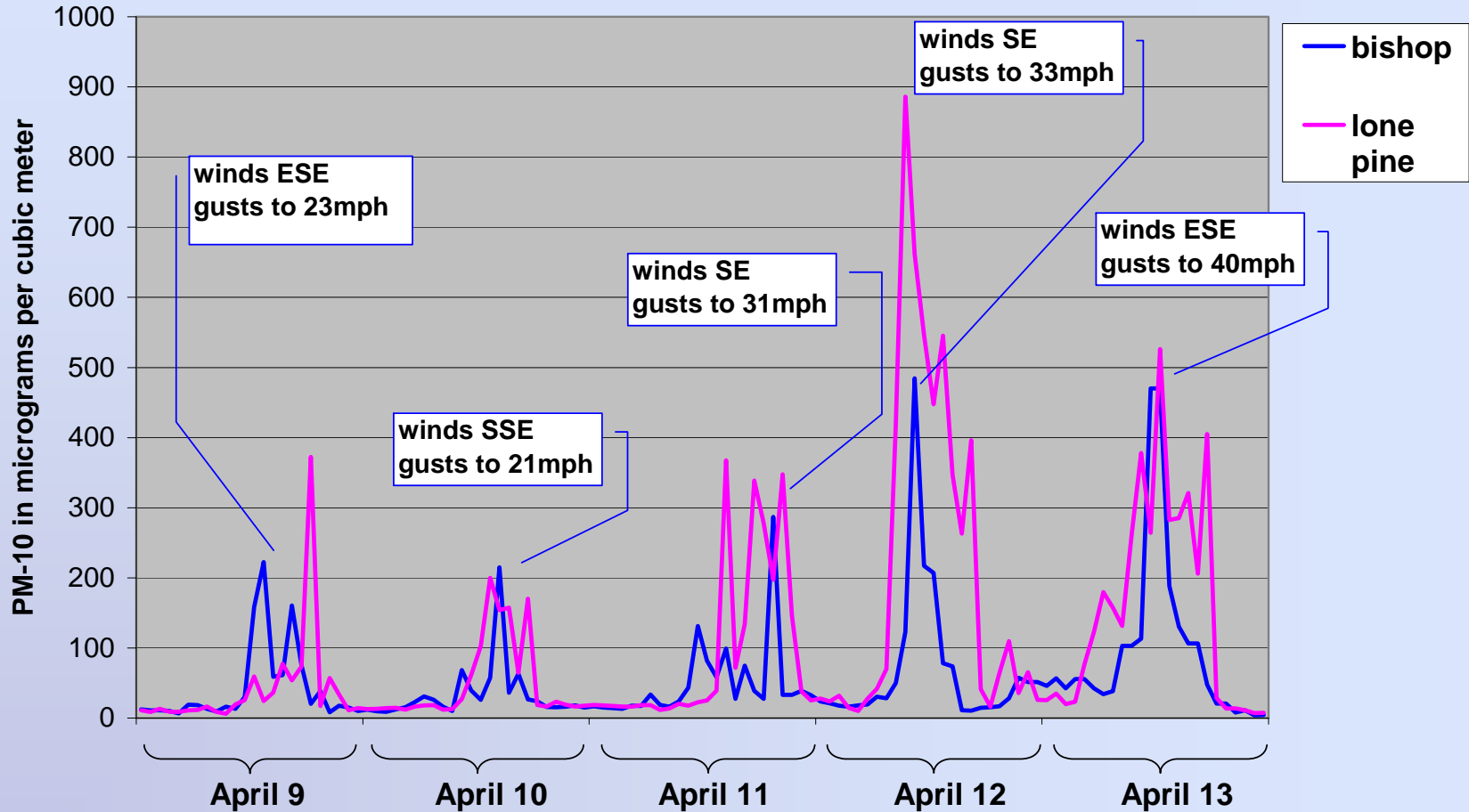
- 2003 forward
  - Graphical methods, adding new data as they become available
  - Maps of activity on the dry lake
  - Modeling of back trajectories with HySplit
- 2005 forward
  - Pollution roses
  - Visibility information (*photos of a fixed location, taken at the top of each hour*)

# Now let's look at some sample episodes, starting with 2003

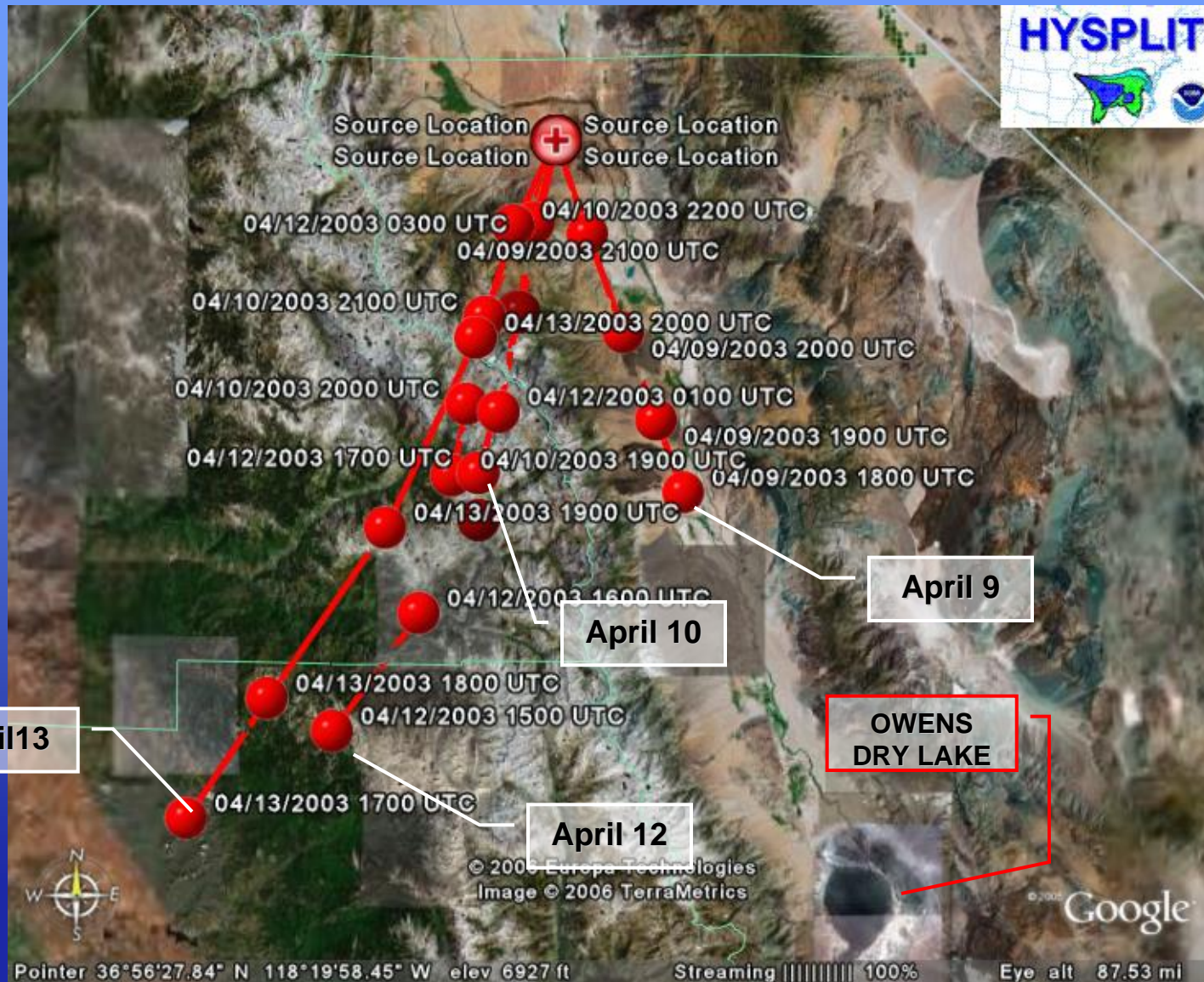
- One episode for each year
- Typically a multi-day event
- Graphs, back trajectories, maps
- Starting in 2005, pollution roses and visibility
- This analysis was repeated for every day with at least one hour with a concentration over  $200\mu\text{g}/\text{m}^3$

# 5-day episode, Apr. 9-13, 2003

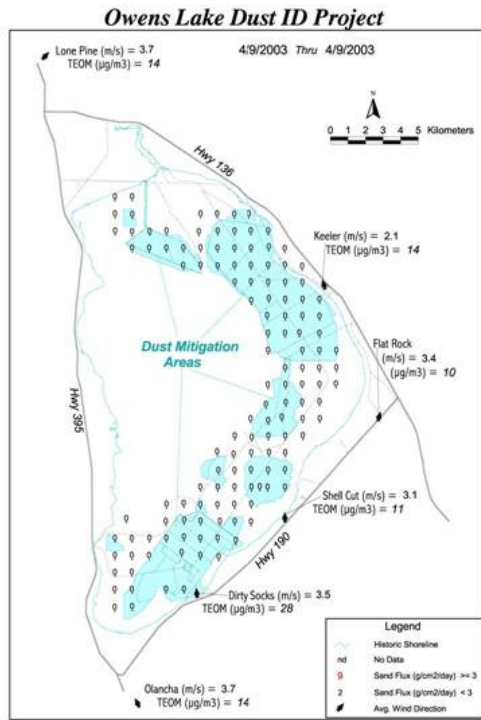
Episode April 9-13, 2003



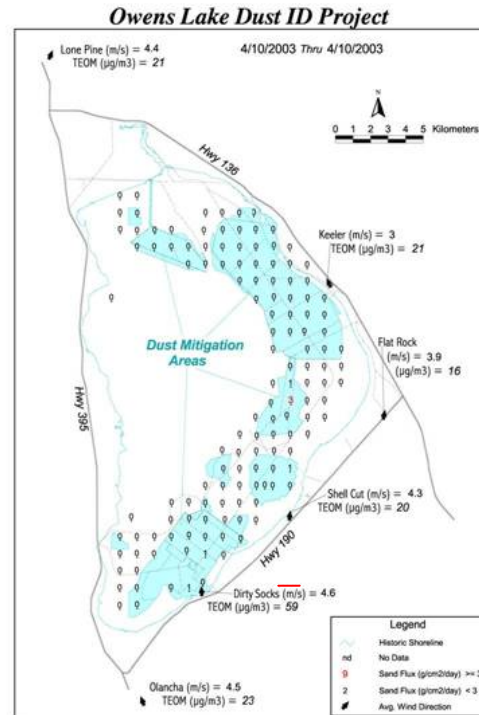
# Back-trajectory, April 9-13, 2003



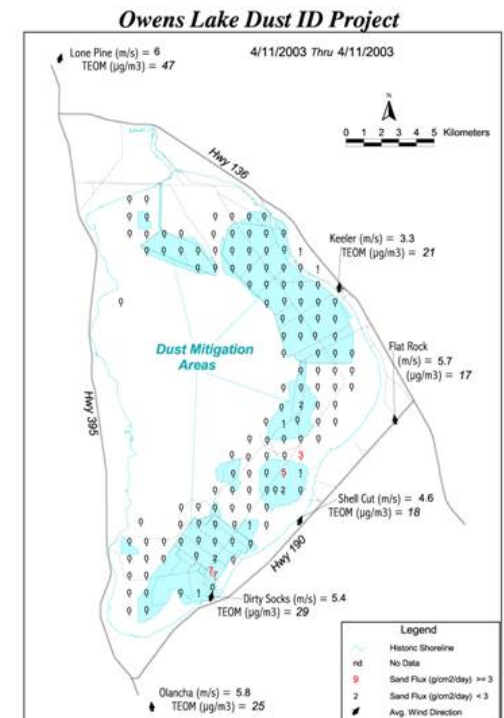
# Dry Lake Activity April 9-13, 2003



April 9



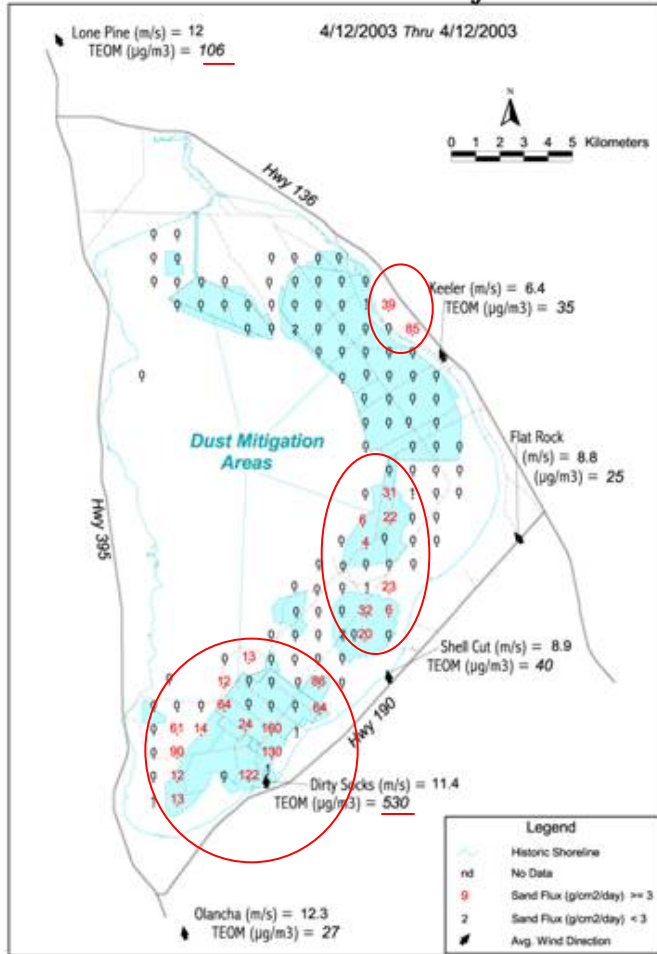
April 10



April 11

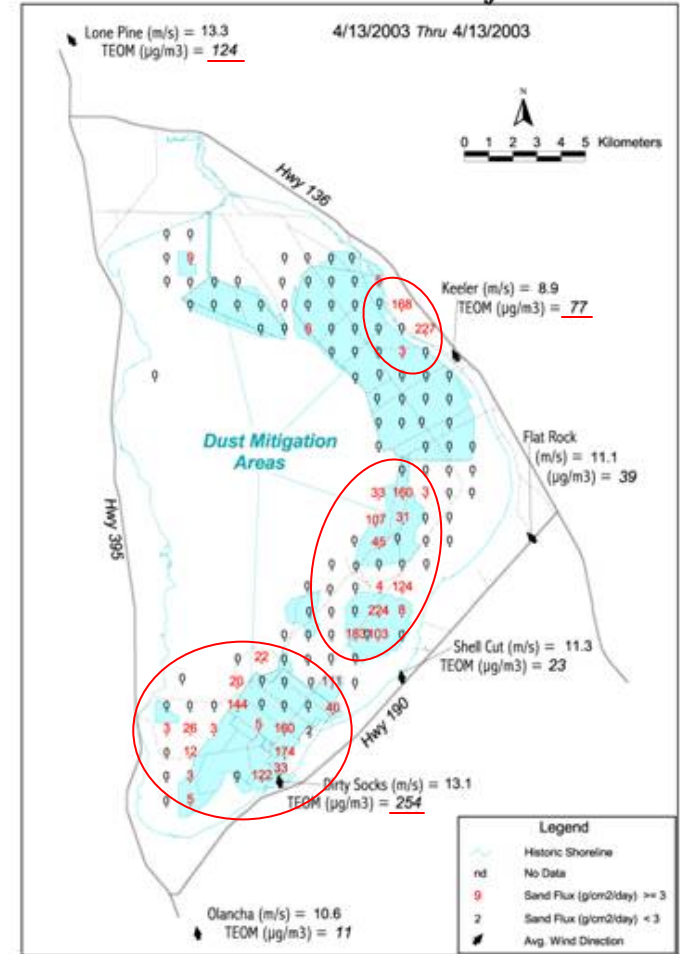
# Dry Lake Activity April 9-13, 2003

## Owens Lake Dust ID Project



April 12

## Owens Lake Dust ID Project



April 13

# What did we learn?

## ALL DAYS

- Winds are from SE quadrant + evidence of frontal passage
- High concentrations at Lone Pine Reservation

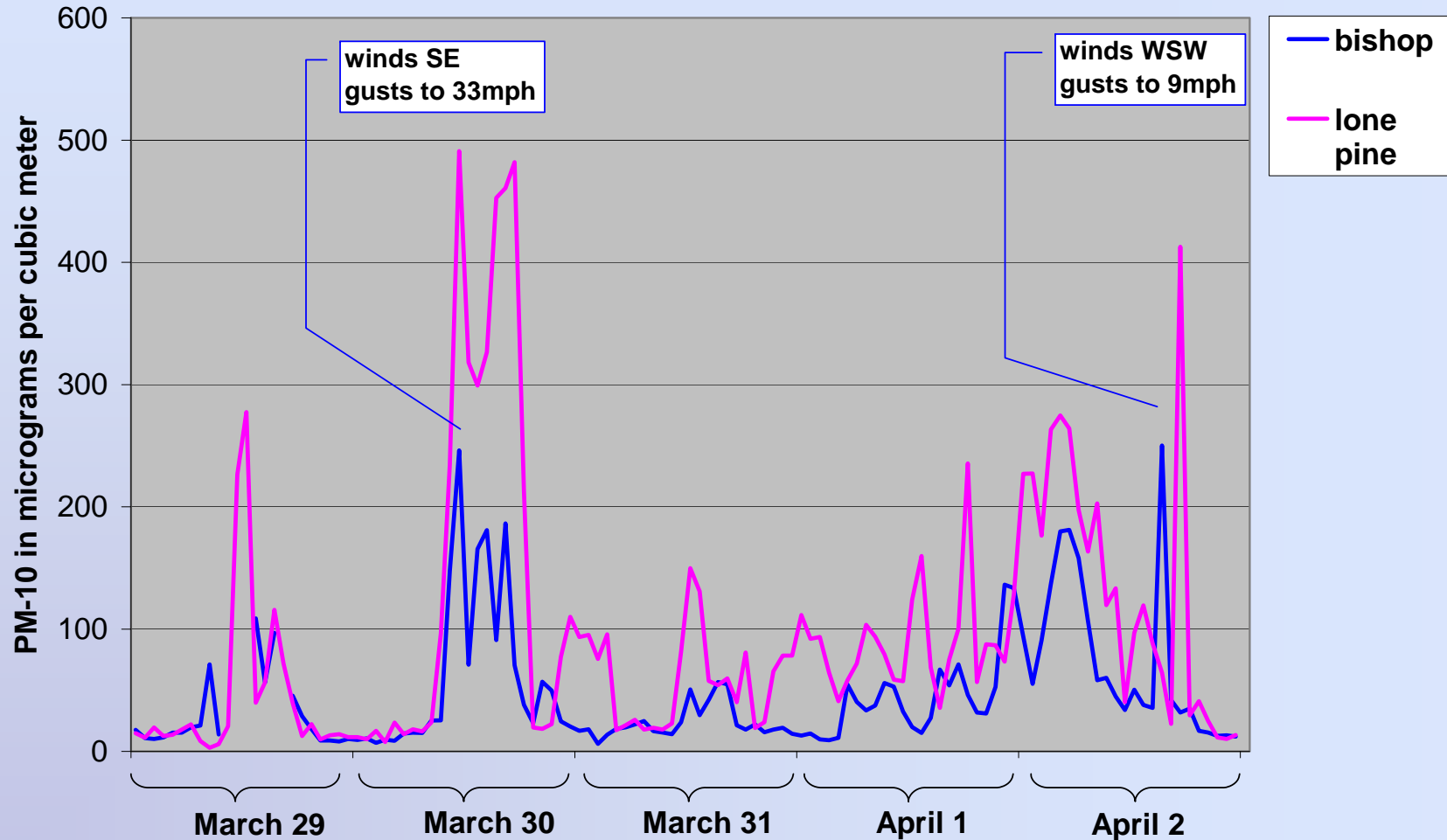
## ONLY 2 DAYS

- Activity on dry lake (though TEOMS around lake have high concentrations on 3 days)

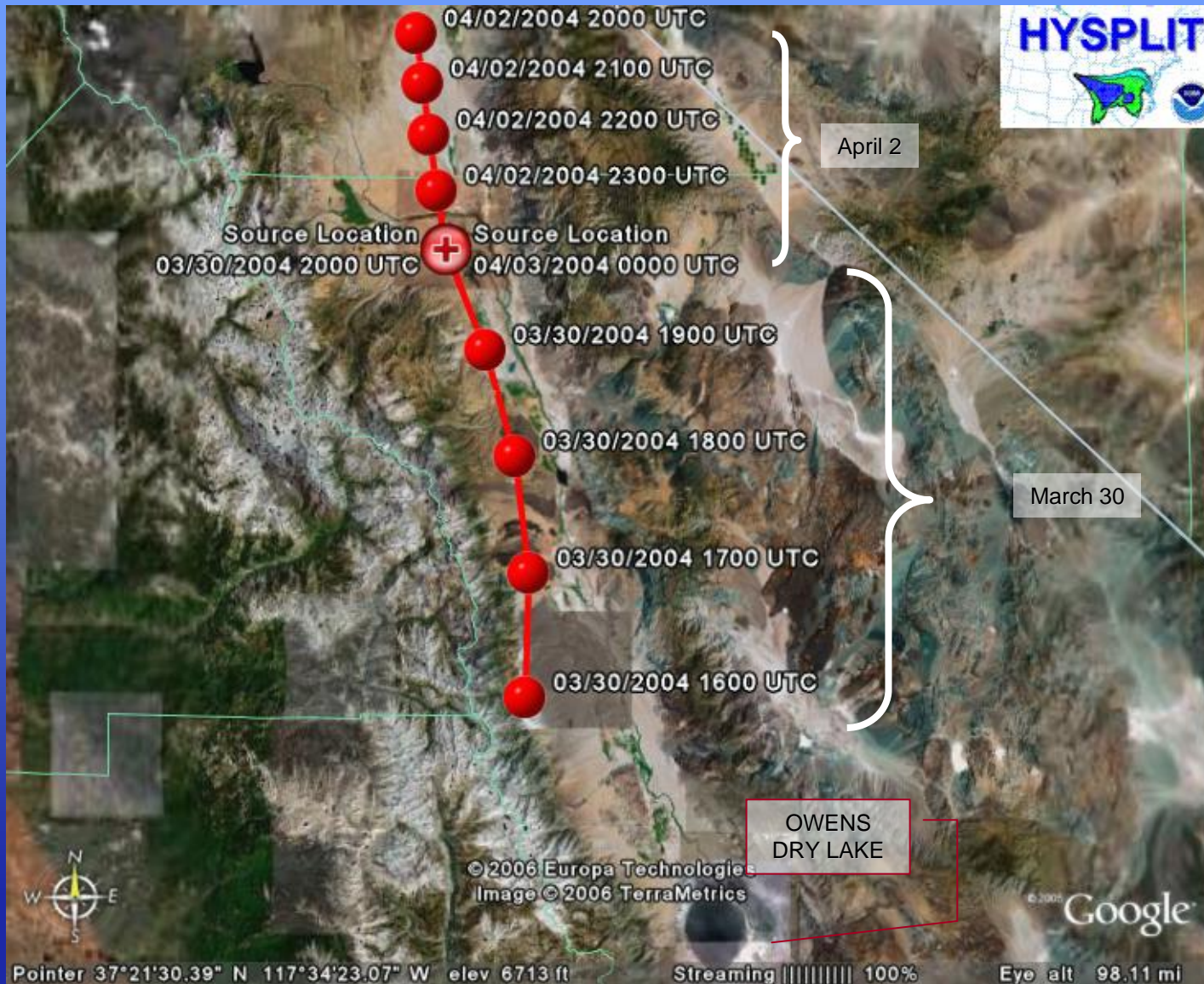
HySplit was of limited value

# 5-day episode, March 29- April 2, 2004

Episode March 29-April 2, 2004



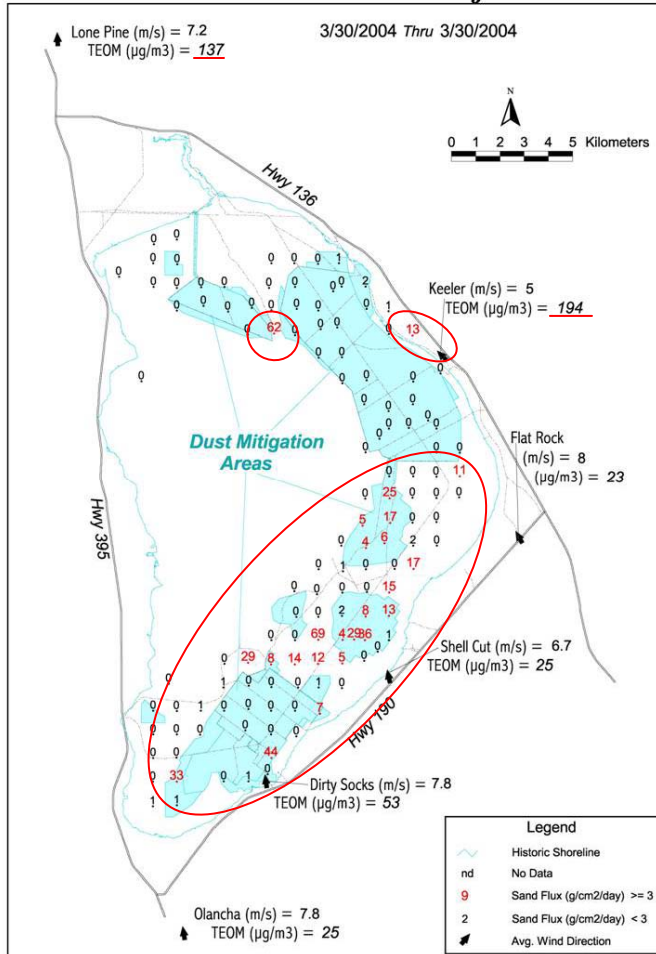
# Back-trajectory March 30 and April 2, 2004



DRY  
LAKE  
RE-  
RUN

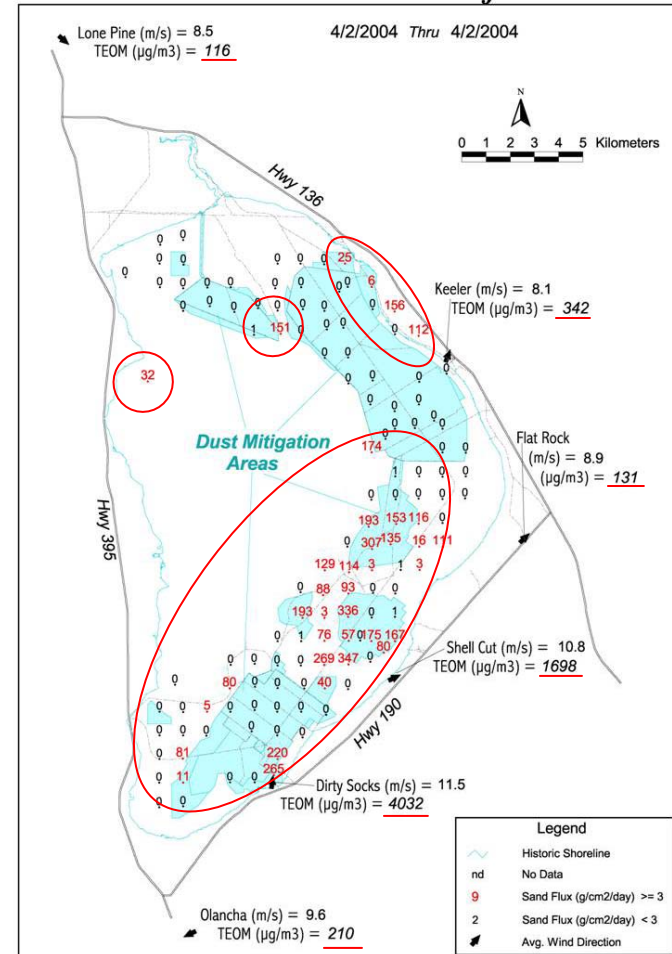
# Dry lake March 30 and April 2, 2004

## Owens Lake Dust ID Project



March 30

## Owens Lake Dust ID Project



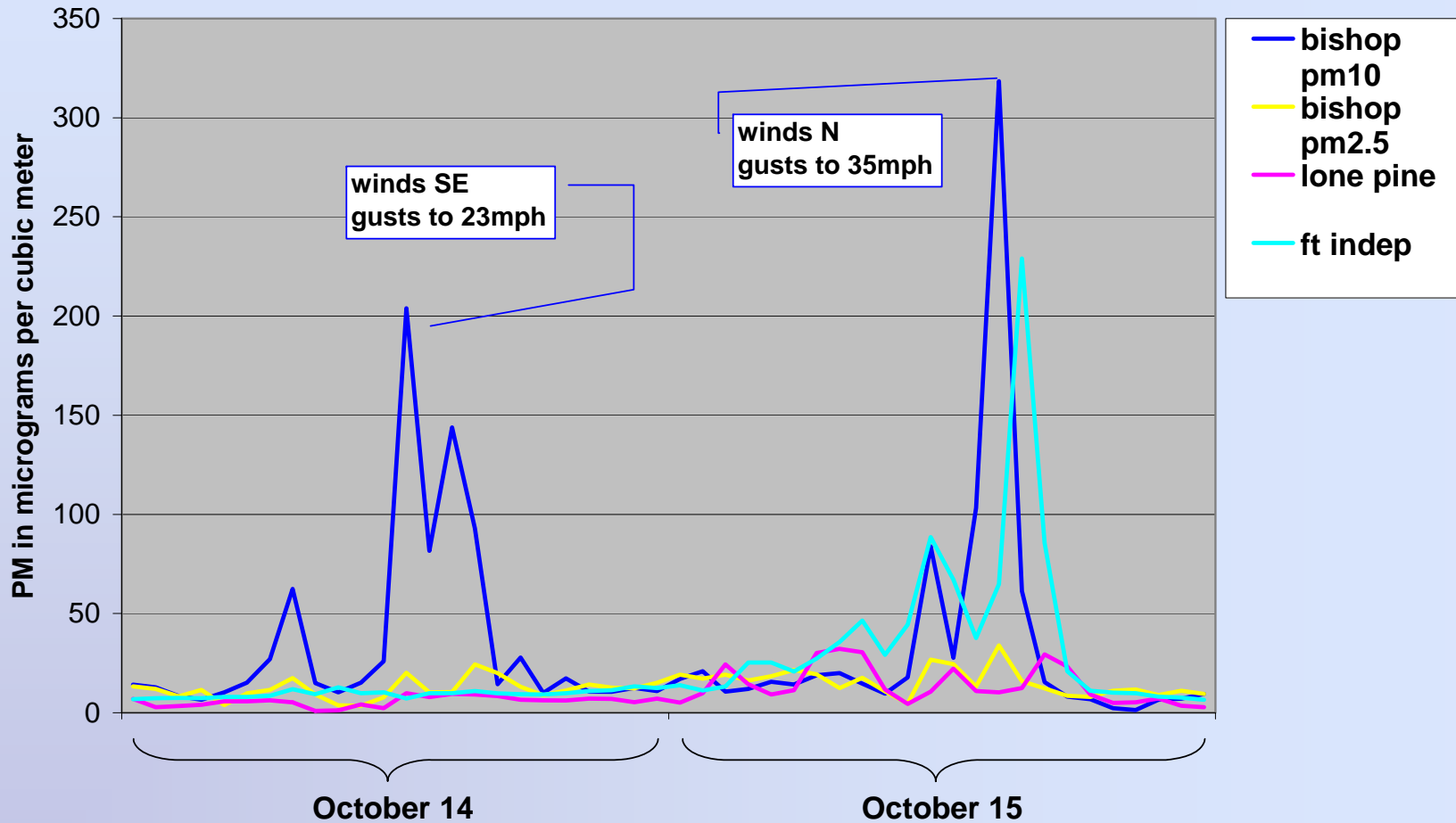
April 2

# What did we learn?

- Wind direction varied, with an interesting reversal
- High concentrations at Lone Pine Reservation
- Activity on dry lake and on TEOMS around lake
- HySplit worked well

# 2-day episode, October 14-15, 2005

Episode October 14-15, 2005

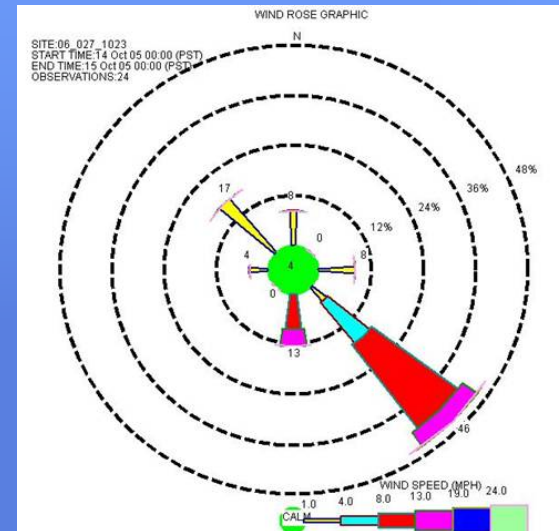
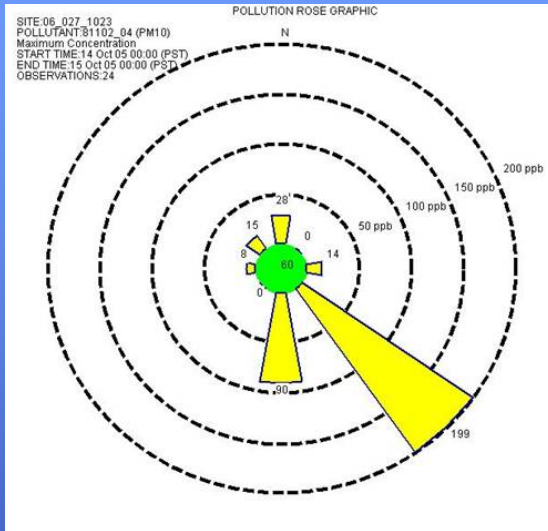


# Wind and Pollution Roses

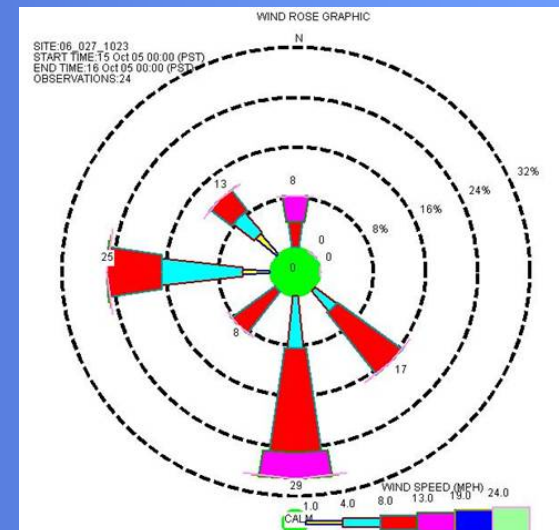
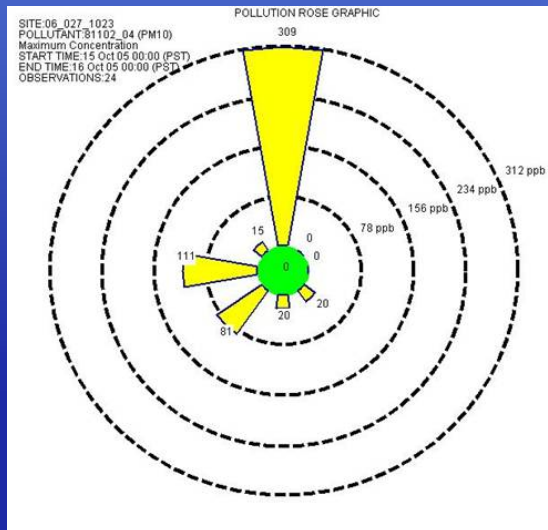
## Oct 14-15, 2005

PM-10

Wind

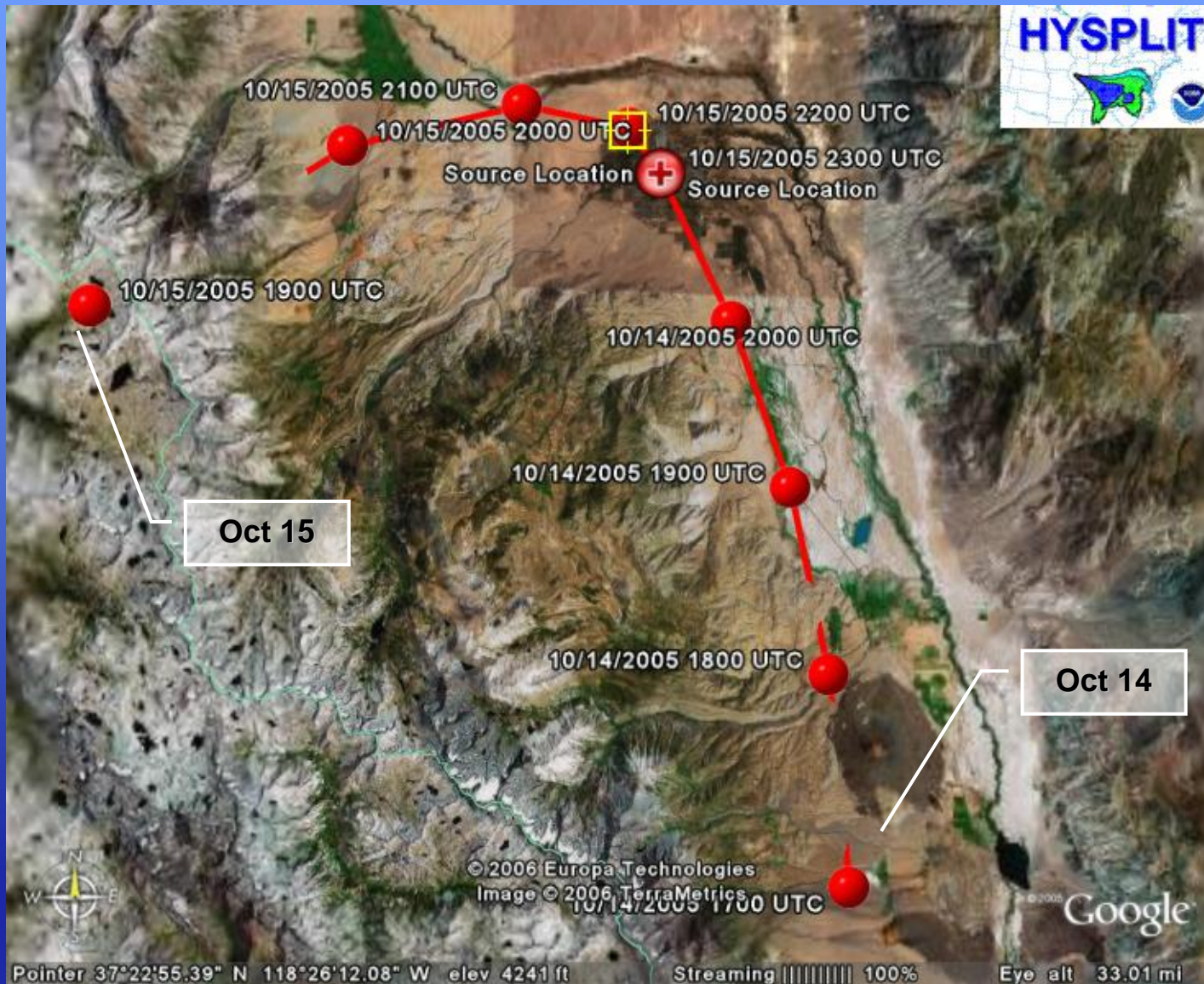


Oct 14



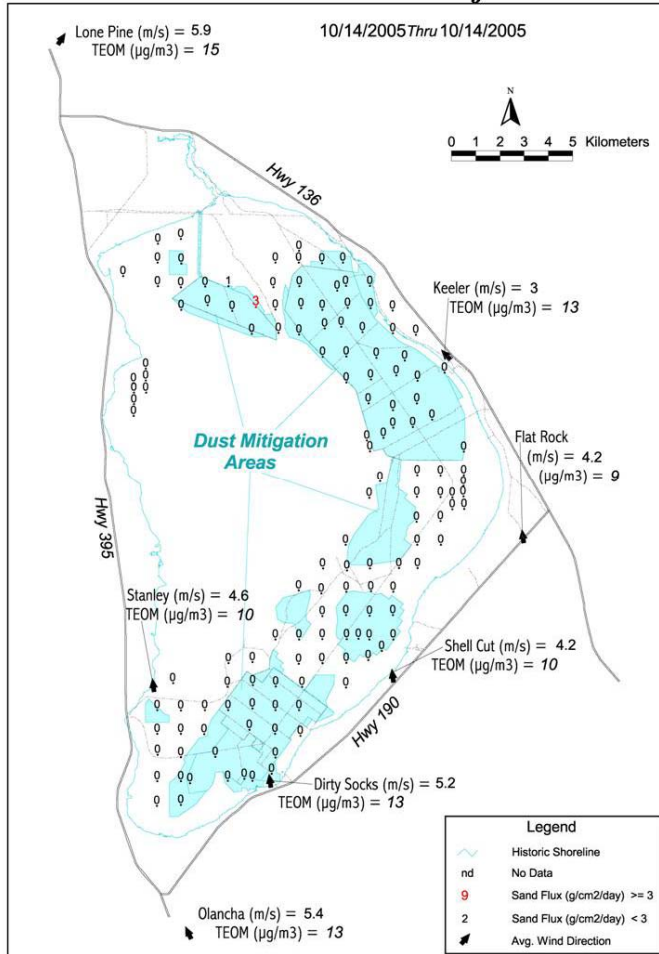
Oct 15

# Back-trajectory October 14-15, 2005



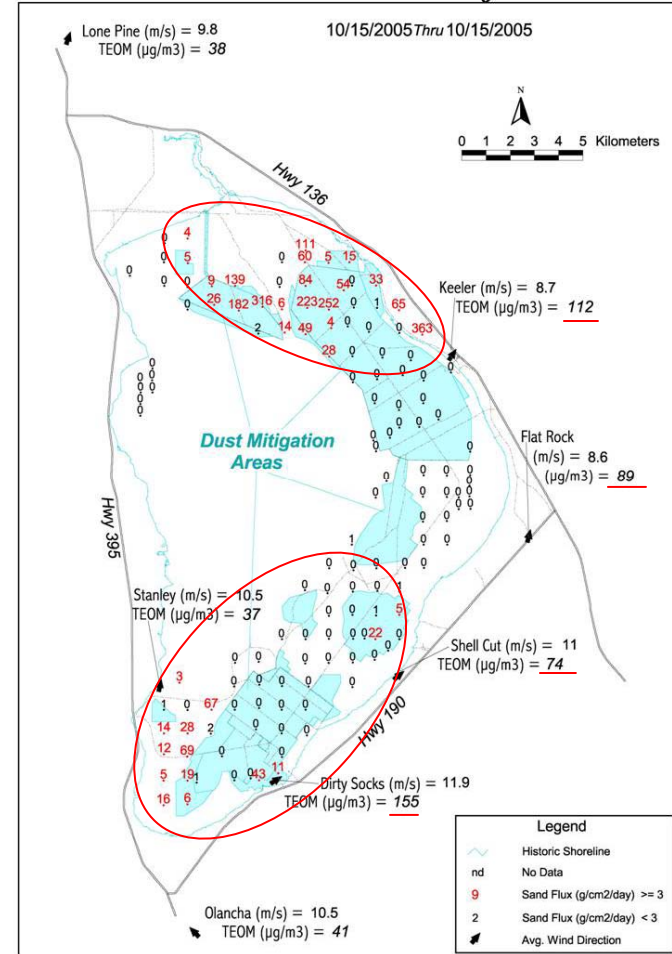
# Dry Lake Activity October 14-15, 2005

## Owens Lake Dust ID Project



October 14

## Owens Lake Dust ID Project



October 15

# Visibility October 14-15, 2005



Oct 14



Oct 15

# What did we learn?

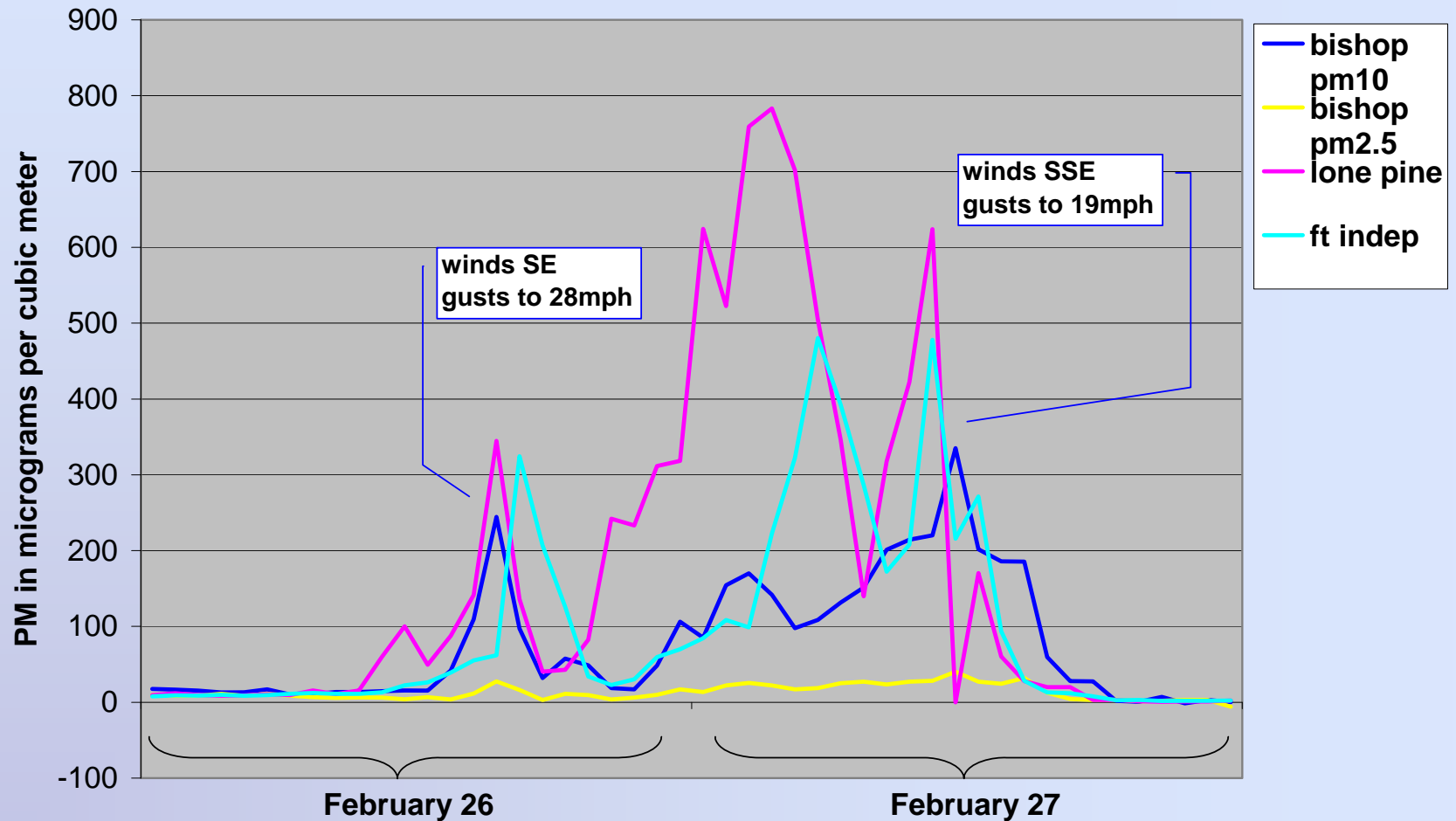
- Wind direction varied, with an interesting reversal
- Good agreement of wind gust information with pollution/wind rose
- No high concentrations Lone Pine
- Visibility information is strongly affected by weather (water vapor), but is useful for identifying storms
- HySplit is in general agreement with other wind information

## ONE DAY ONLY

- Activity on dry lake and on TEOMS around lake
- High concentration at Ft. Independence

# 2-day Episode, February 26-27, 2006

Episode February 26-27, 2006



# Wind and Pollution Roses

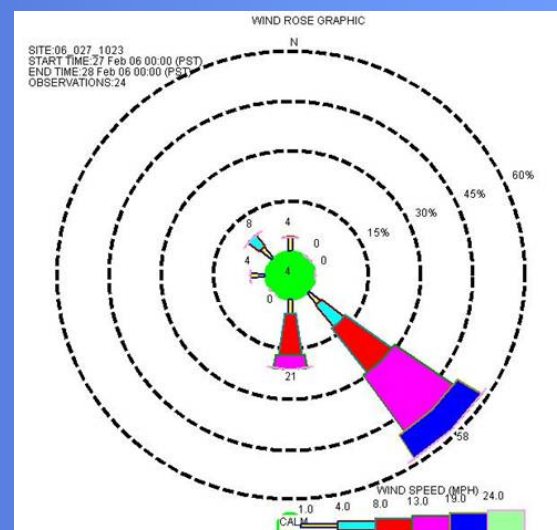
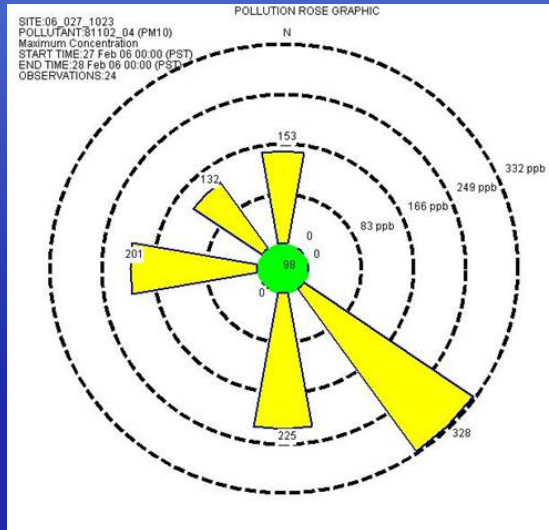
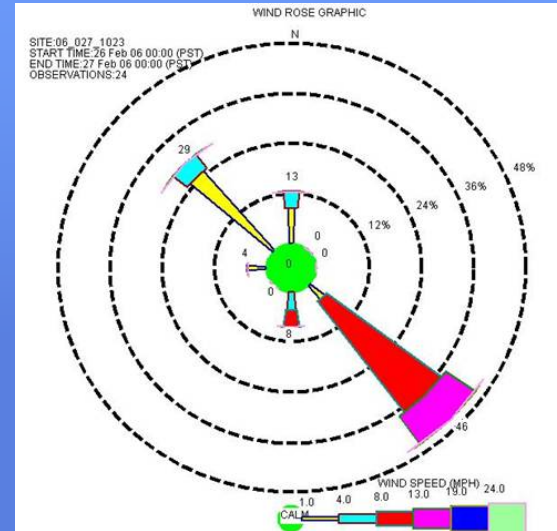
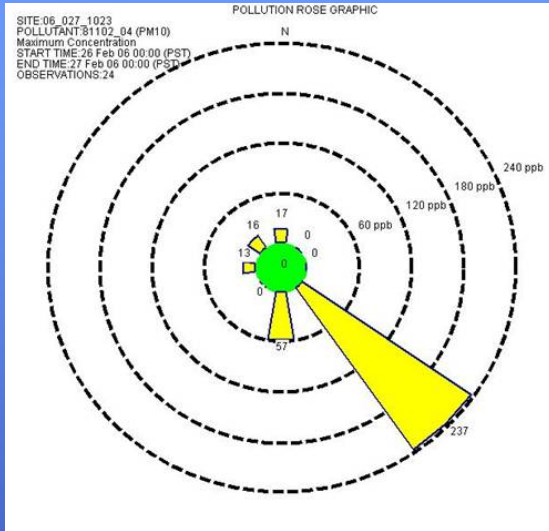
## February 26-27, 2006

PM-10

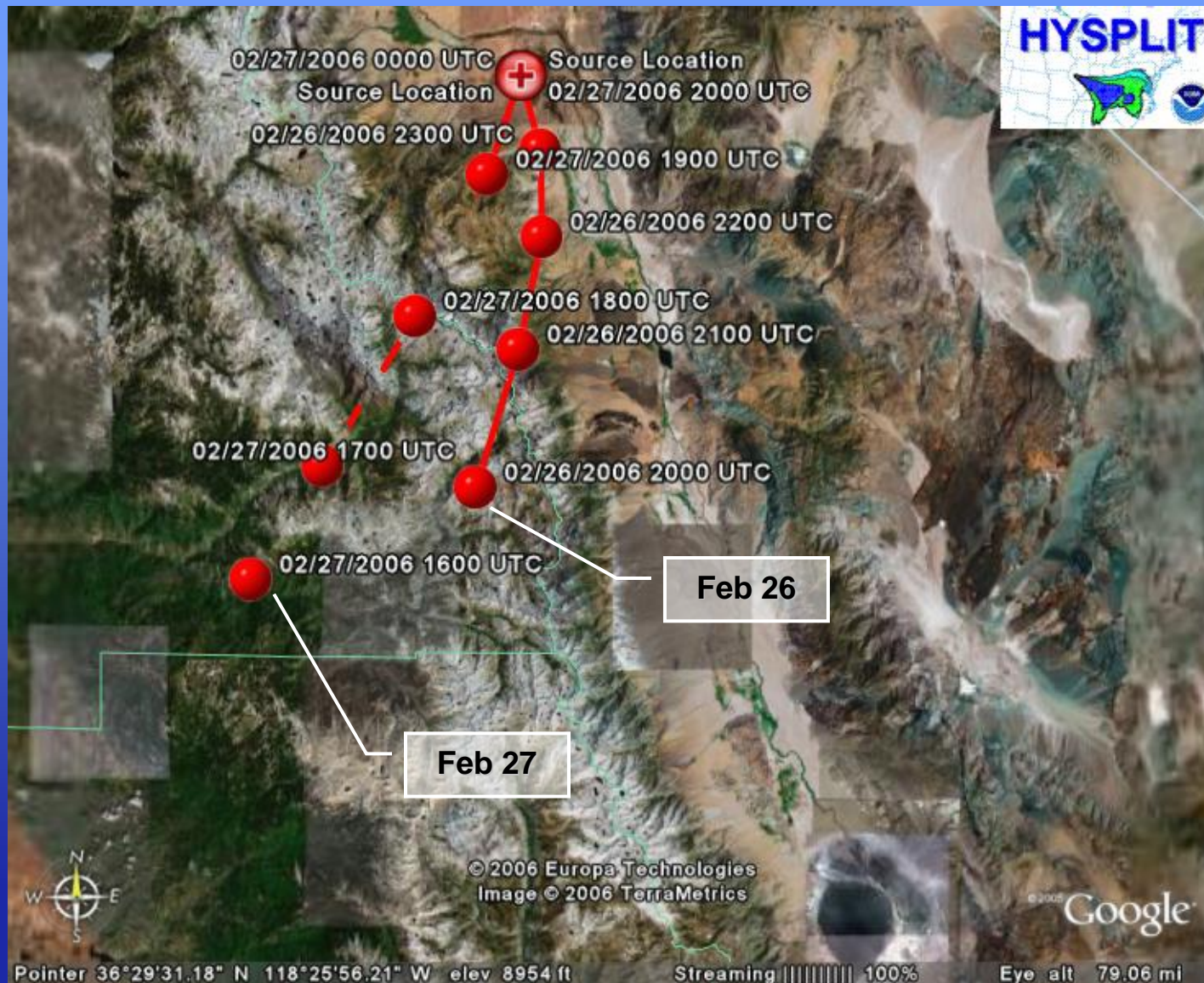
Wind

Feb 26

Feb 27

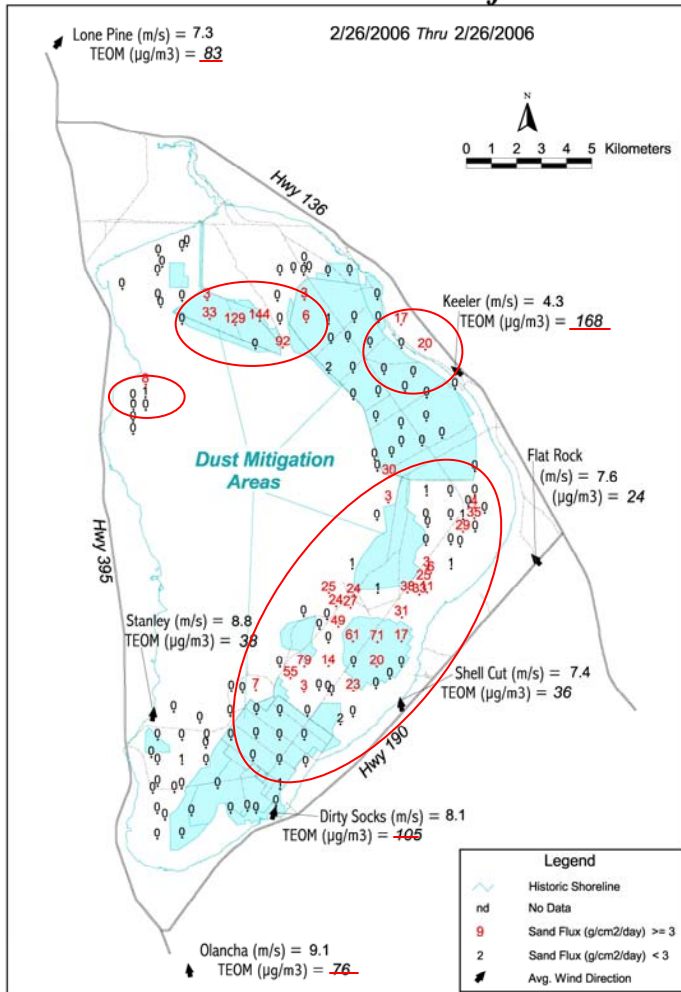


# Back-trajectory February 26-27, 2006



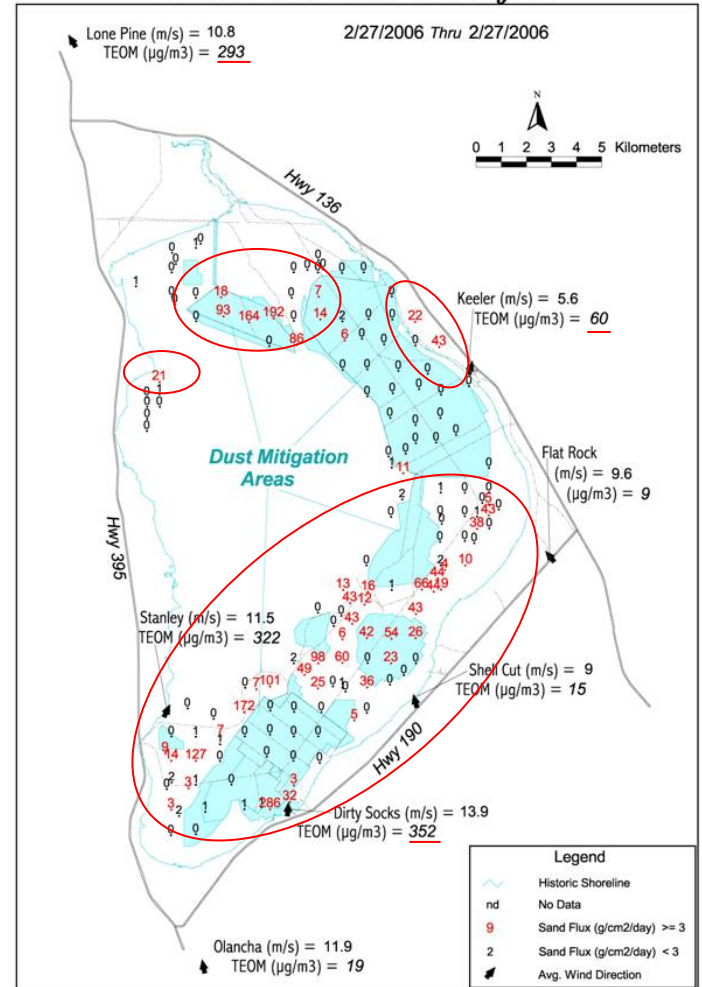
# Dry Lake Activity February 26-27, 2006

## Owens Lake Dust ID Project



February 26

## Owens Lake Dust ID Project



February 27

# Visibility February 26-27, 2006



Feb 26



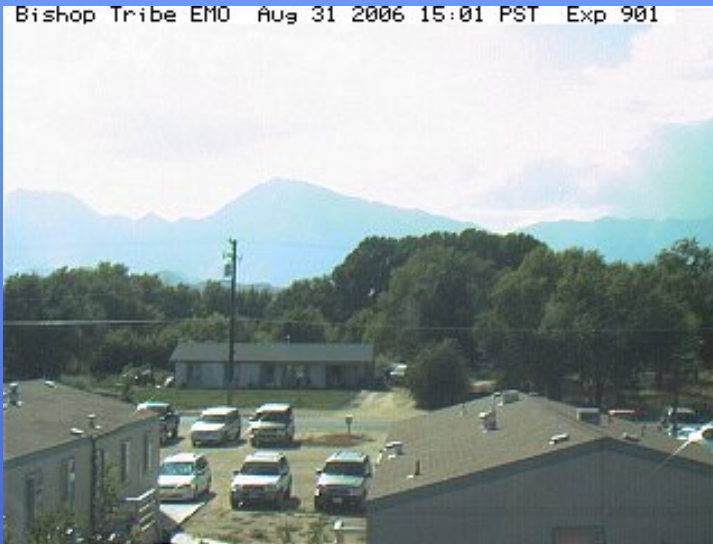
Feb 27

# What did we learn?

- Owens Valley-wide event
- Prolonged episode with high concentrations – highest 24-hour concentration
- Wind direction from SE quadrant
- Moderate agreement of wind gust information with pollution/wind rose
- High concentrations Lone Pine and Ft. Independence
- Visibility information is strongly affected by weather (water vapor)
- HySplit was of limited value
- Activity on dry lake and on TEOMS around lake

# Can dust affect visibility?

Example: August 31, 2006



- PM-10 at max  $214.2\mu\text{g}/\text{m}^3$ 
  - PM-2.5 = 24
  - fine fraction = 11.2%
- Impact on visibility (as measured here) depends a lot on the angle of the sun
- Wind at max SSE, gusts to 15mph
- Lone Pine
  - PM-10 = 21.1
- Ft. Independence
  - PM-10 = 24.2

# What can we conclude?

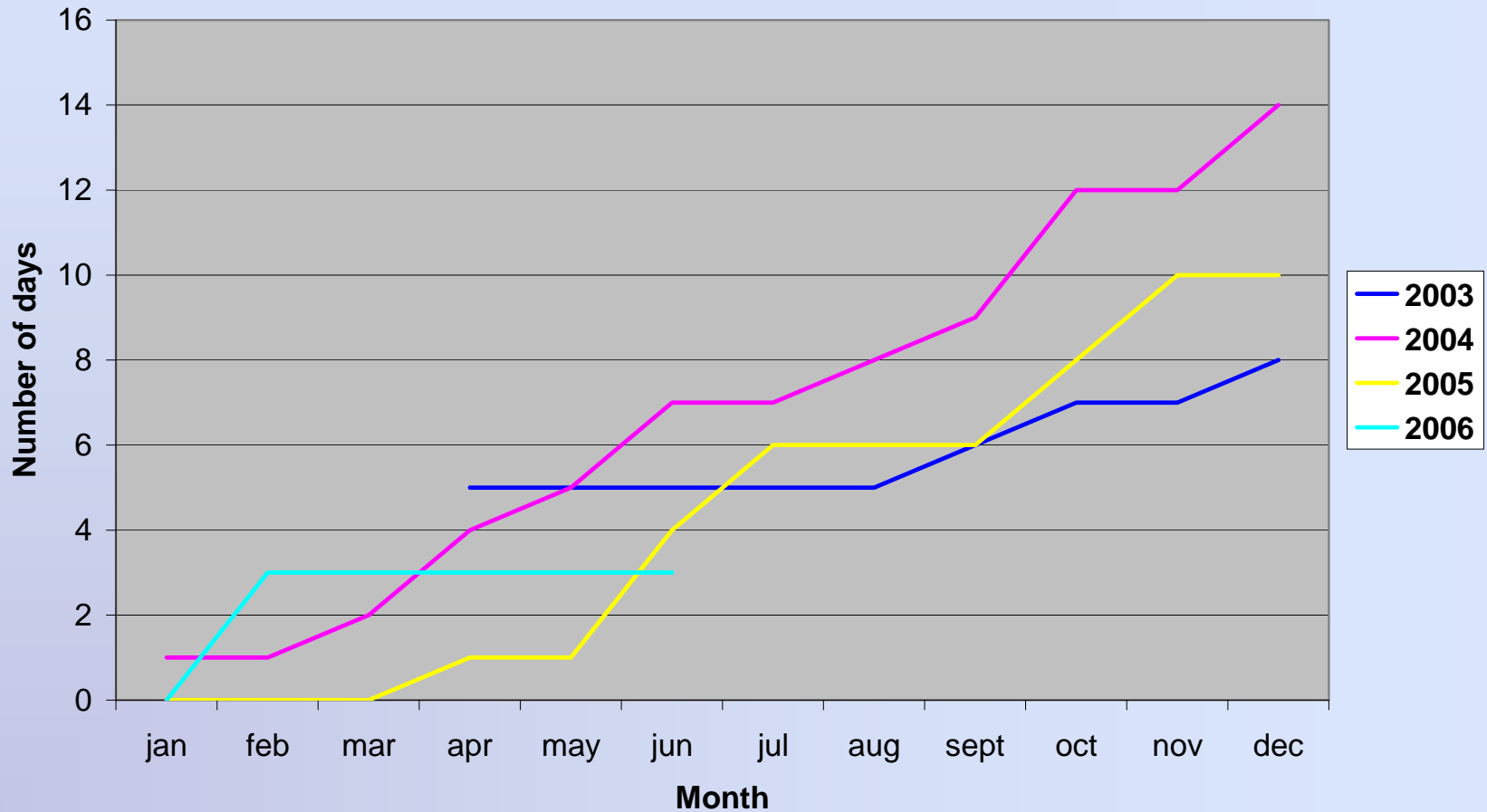
- We can separate high PM-10 days into those where the dry lake probably had an impact and those where it probably did not
  - 49% of high dust days also have high activity on the dry lake
  - 46% of high dust days are also high dust days for the Lone Pine Reservation
  - 33% of high dusts days are also high dust days for the Ft. Independence Reservation (*since June 2005*)
- ❖ Nearly half the time, there is evidence of activity on the dry lake when the Bishop Reservation has high PM-10 concentrations

# Have there been changes over time?

- Mitigation has proceeded
  - 1998 State Implementation Plan
    - ❑ 10 square miles by 2001
    - ❑ 13.5 square miles by 2002
    - ❑ 16.5 square miles by 2003
  - 2003 State Implementation Plan
    - ❑ 29.8 square miles by 2006
  - Work began in late 2001
  - 30 acres have shallow flooding or managed vegetation (salt grass)
- But the weather has not been consistent...

# Cumulative number of days with high PM-10 concentrations

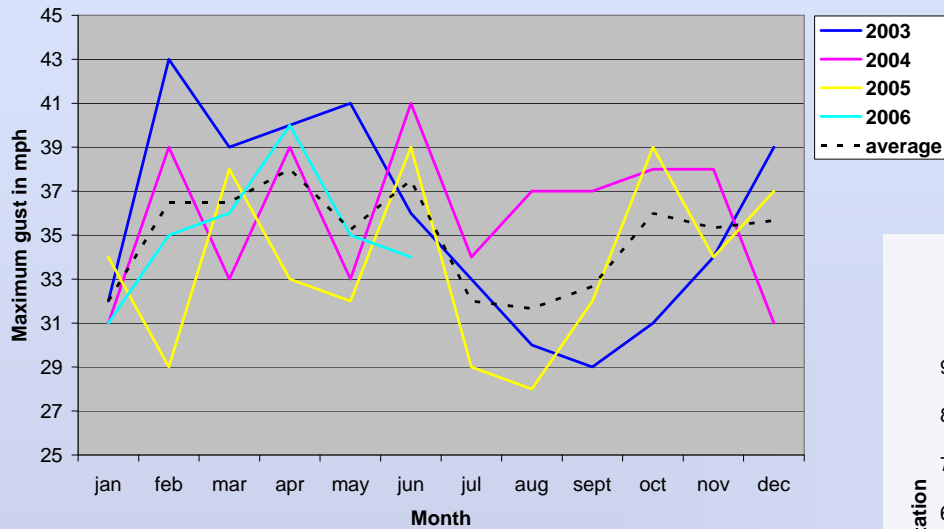
Cumulative Number of days with at least one hour with concentrations over 200 micrograms per cubic meter



# Wind and rain

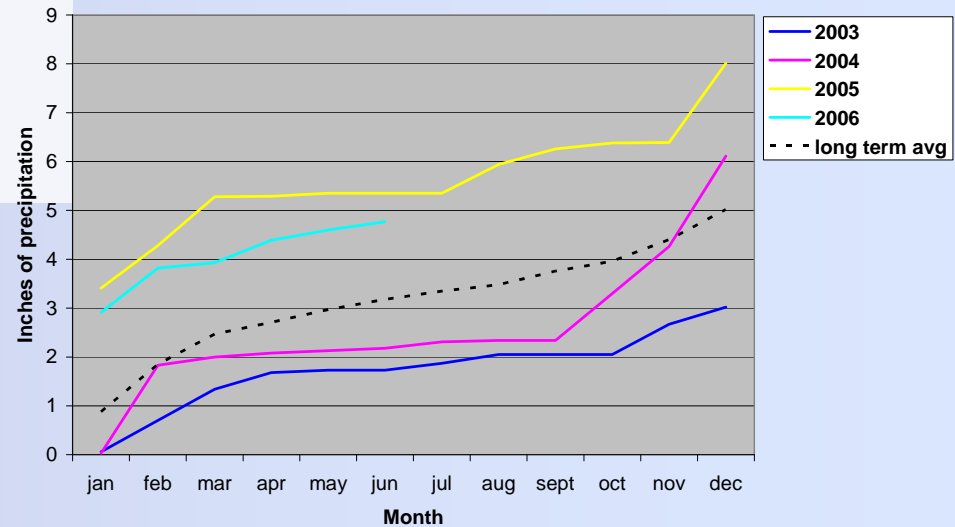
## Maximum wind gust

Monthly Maximum Wind Gust  
Bishop, January 2003 to June 2006



## Precipitation

Cumulative Number of Inches of Precipitation  
Bishop, January 2003 to June 2006



# Conclusions

- Dry lake emissions probably impact the Bishop Paiute Reservation
- Not enough data for firm conclusions about trends
  - Not enough years
  - Too much variability in the weather

# Policy Implications

- Litigation in process between GBUAPCD and LADWP over additional controls
- Elimination of federal PM-10 standard for rural areas may be important
- But, CA standard still applies and may come into play ( $50\mu\text{g}/\text{m}^3$ )
- Bishop Paiute Tribe has adopted its own PM standards (*same as CA*)



## **ACKNOWLEDGEMENTS**

- **The Bishop Paiute Tribal Council and Tribal Members**
- **US EPA and EPA Region 9**
- **My colleagues in the Environmental Management Office**
- **GBUAPCD**
- **Owens Valley Tribal Air Programs (*Lone Pine and Ft. Independence*)**
- **IPS MeteoStar and T&B Systems**



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