A Unique Approach to the Collection of Boundary Air Quality and Meteorological Data for Ozone Attainment Modeling in California's South Coast Air Basin

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South Coast Air Quality Management District

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Overview

- Study background
- Study objectives
- Instrumentation packages
- Sampling strategies
- Mid-course reviews
- Data processing and validation
- Flights conducted
- Analyses to be performed

Study Background

- SoCAB designated as severe-nonattainment for ozone
- Attainment modeling requires understanding boundary conditions
- Lack of offshore information on ozone and precursors
- Meteorology of the southern California coast
  - Strong subsidence inversion
  - Shallow marine layer
  - Complex 3-D land and sea breeze interactions

Study Objectives

- Collect an annual data set documenting offshore air quality and meteorology over the annual cycle
- Develop and deploy instrumented packages in a cost-effective manner to collect background level data
- Prepare the aircraft instrument package to be battery powered, self contained, require no airframe modifications and be quickly installed and removed
- Conduct the study in a manner to comply with VFR flight rules for airborne operations
- Conduct sampling operations in a safe manner

Instrumentation Packages

- Aircraft
- Rawinsonde/Ozonesonde
- Offshore island measurements

Aircraft Package

- Temperature
- Relative humidity
- Ozone
- Optical $PM_{2.5}$
- GPS Position
- Carbonyl
- Summa canister
  - VOC and Sulfur compounds
- CO / SO_2 bag sampling
- Black carbon

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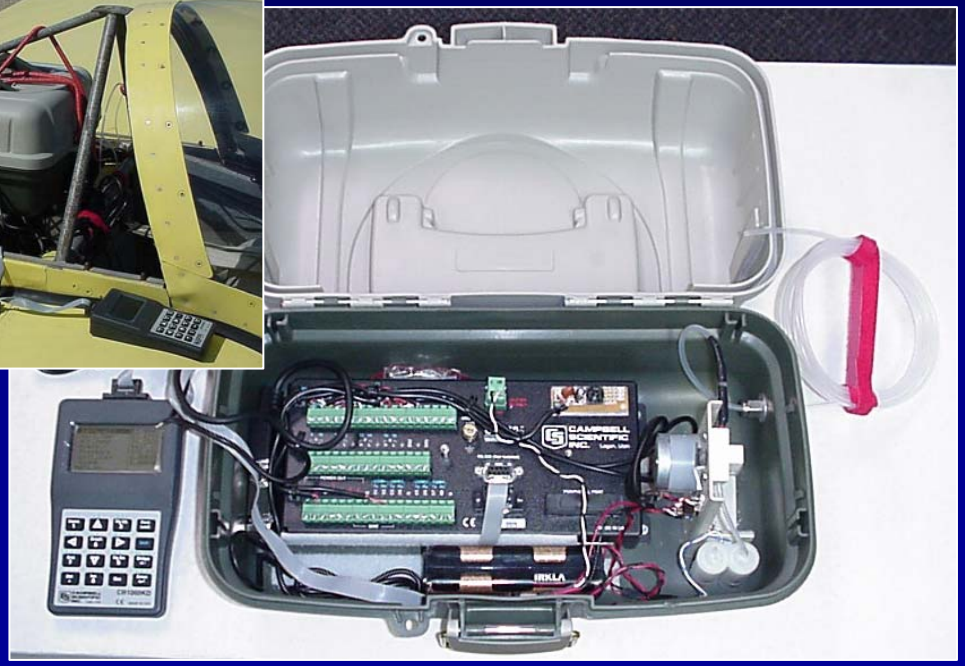

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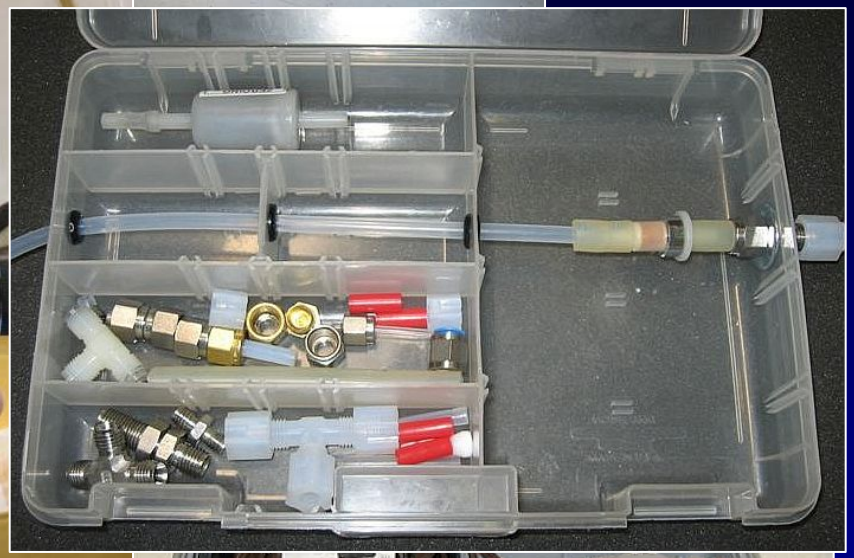

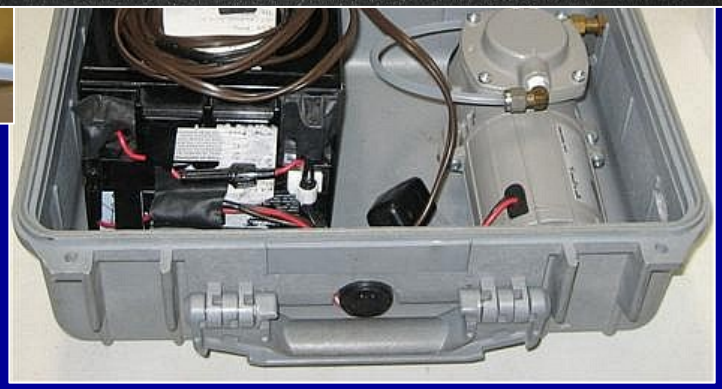

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VOC C_2 – C_{12} *PAMS Protocol GC/MS/FID*

Total Reduced Sulfur *ASTM D-5504*

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Rawinsonde/Ozonesonde

- Winds
- Temperature
- Relative Humidity
- Ozone

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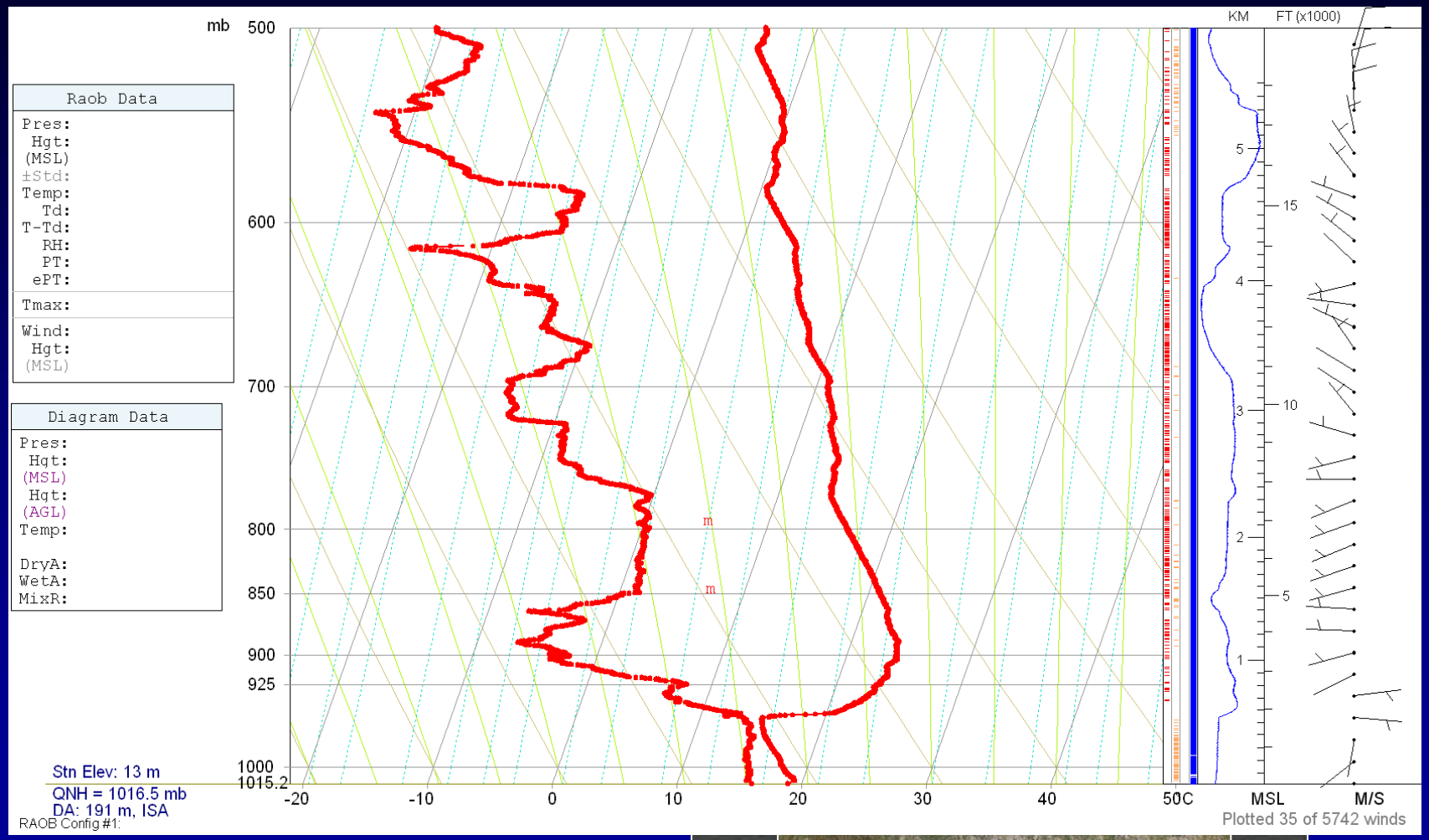
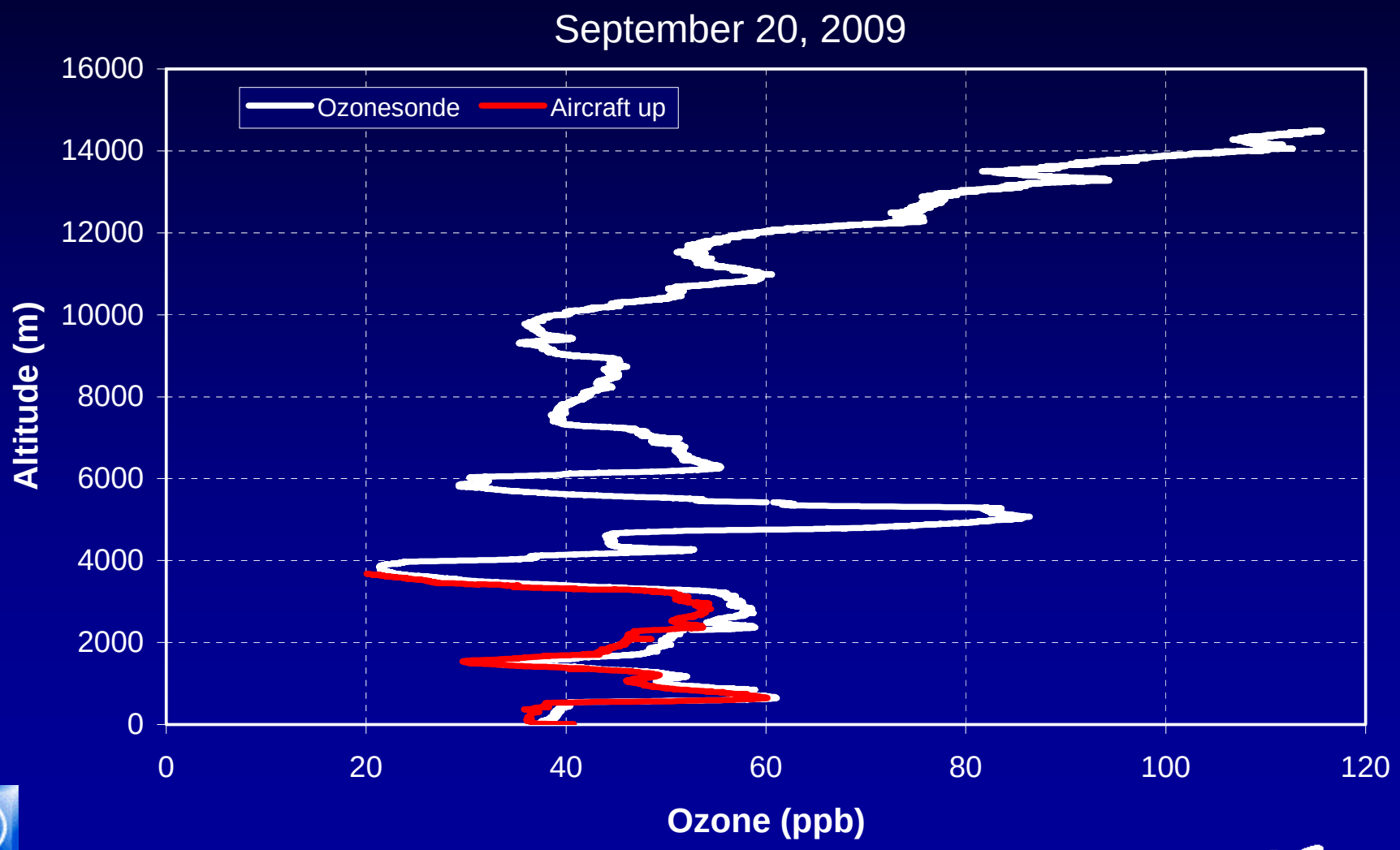
Rawinsonde/Ozonesonde



Rawinsonde/Ozonesonde



Offshore Island Measurements

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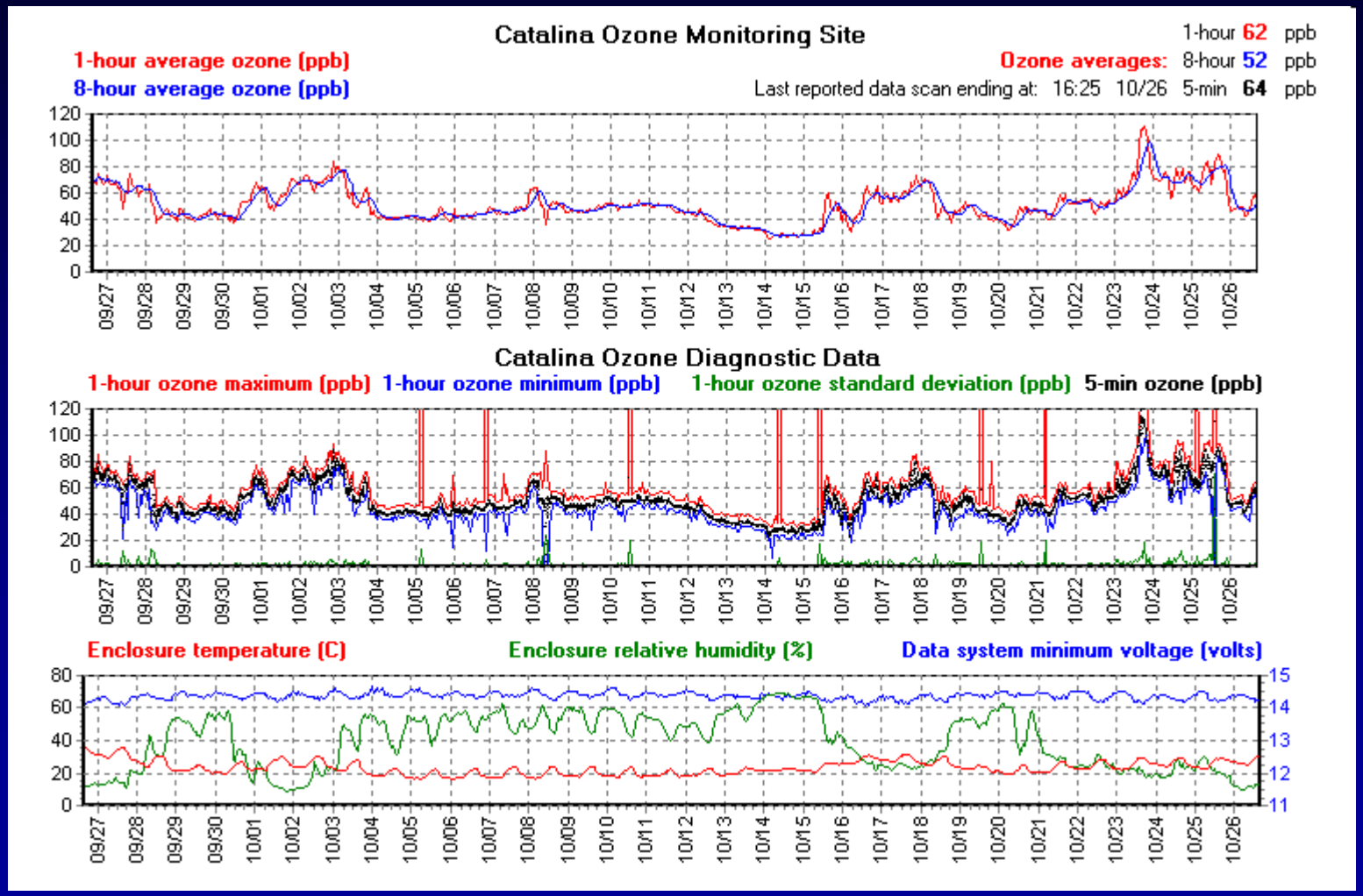
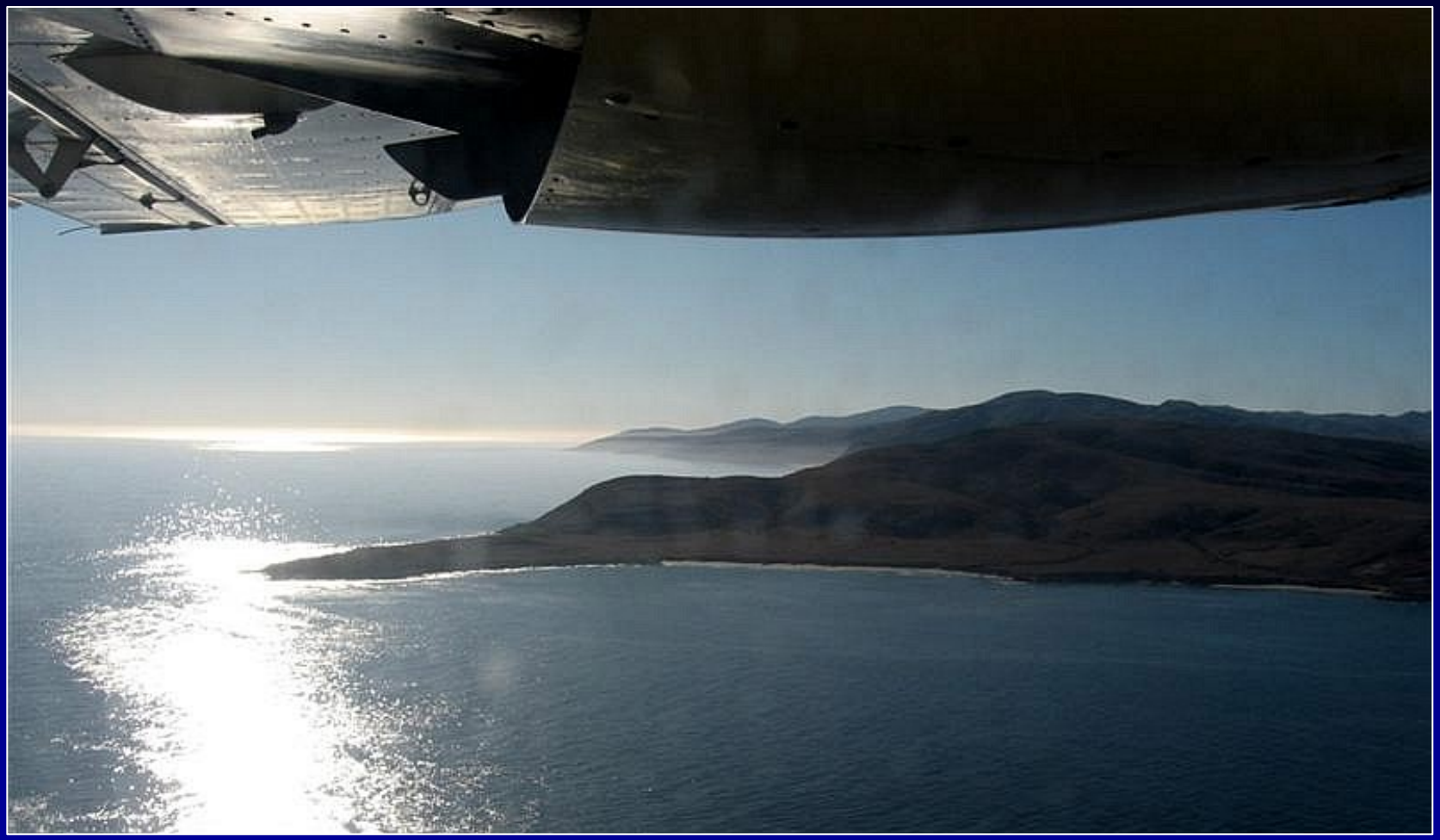


Sampling Strategies

- Random, non forecasted flight schedule
  - Weekend and weekday
- Collect continuous data (2-sec)
  - Ozone
  - Optical $PM_{2.5}$
  - Meteorology (temperature, RH)
- Initial, mid-flight and final vertical soundings
- Outbound Integrated sample (VOC, sulfur, carbonyls) collection in mixed layer
  - Modified based on cloud conditions
  - Three sets of samples
- Return flight based on observed conditions

Sampling Strategies



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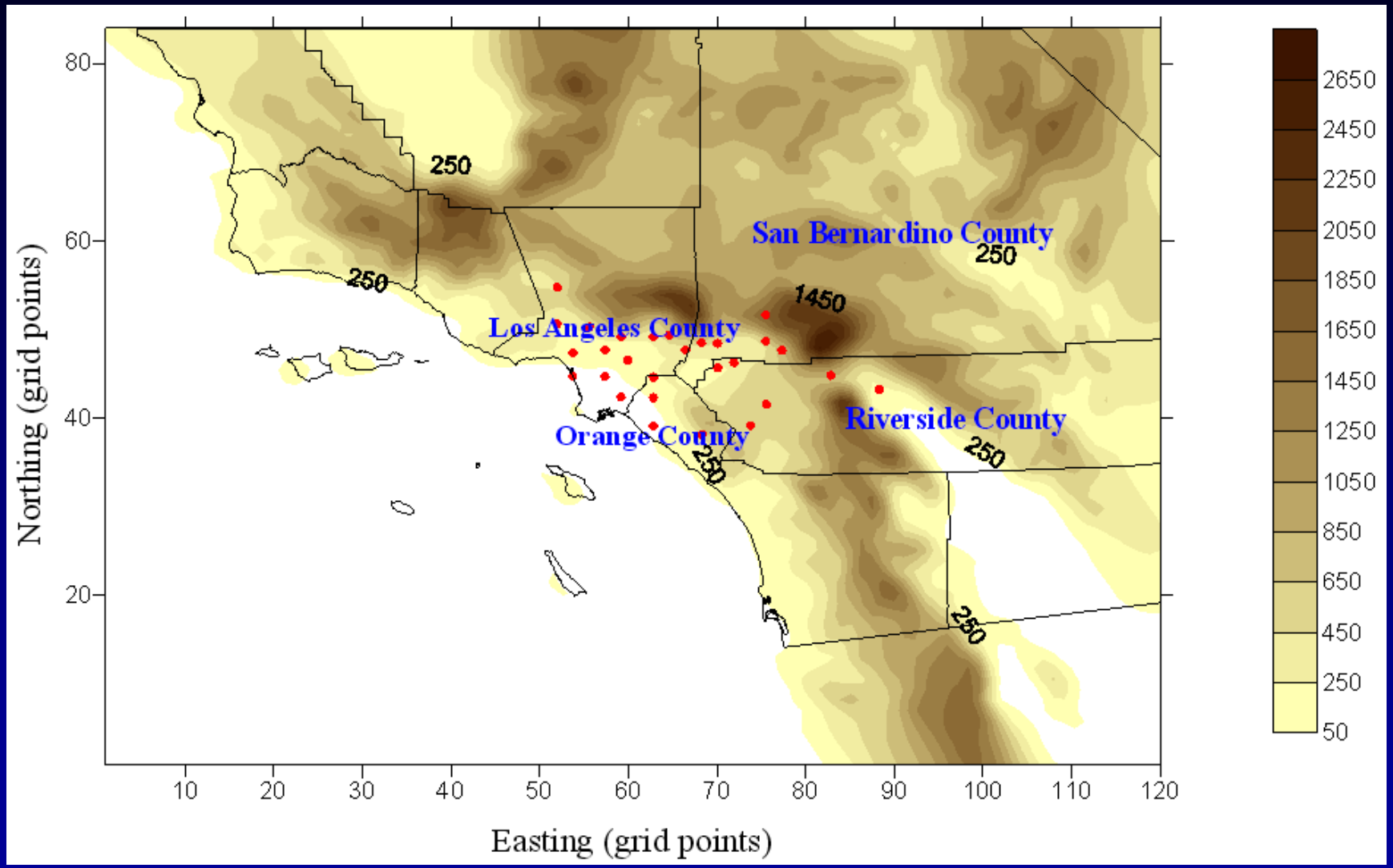
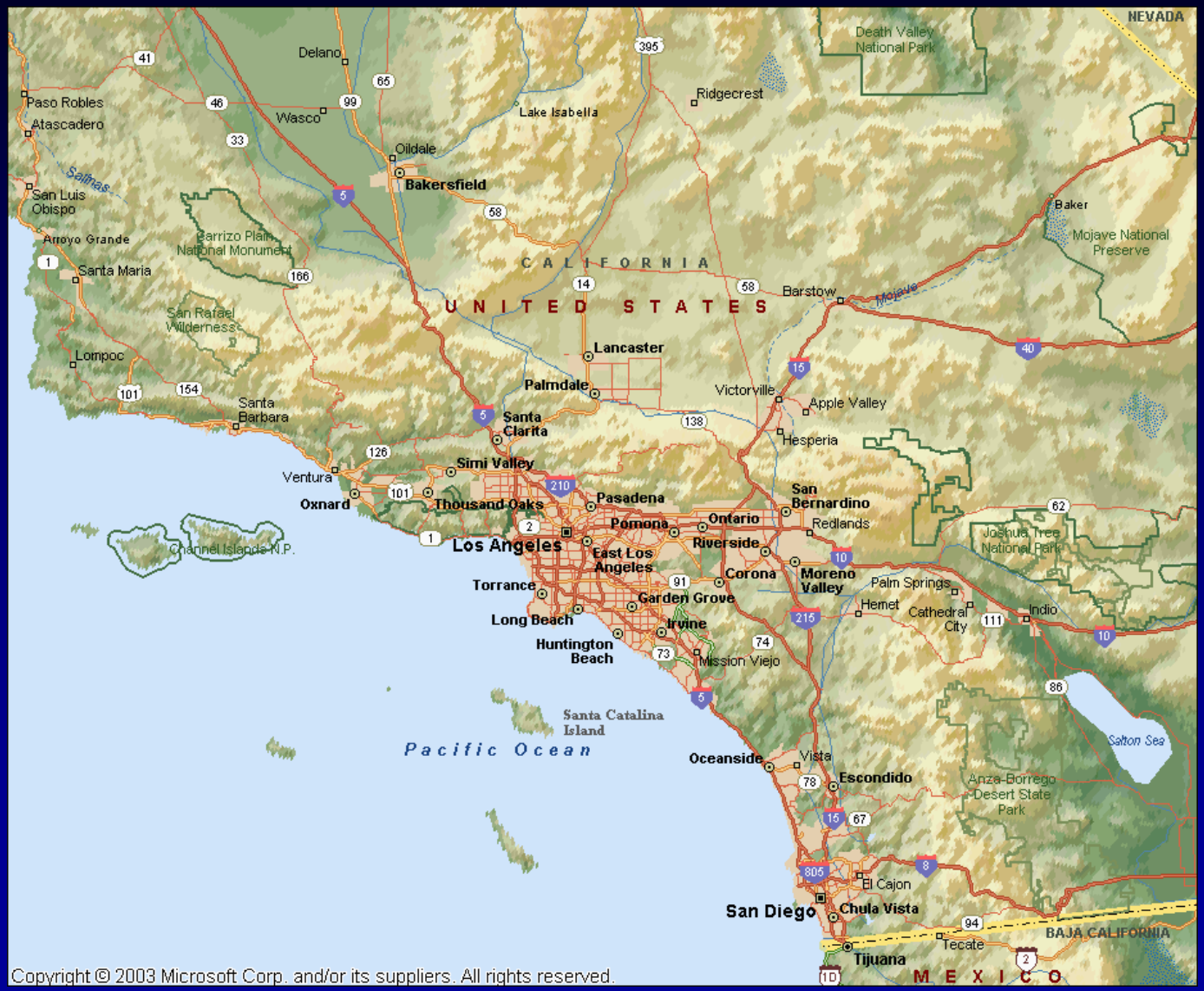


Modeling Domain

Sampling Strategies



Sampling Strategies

AQMD

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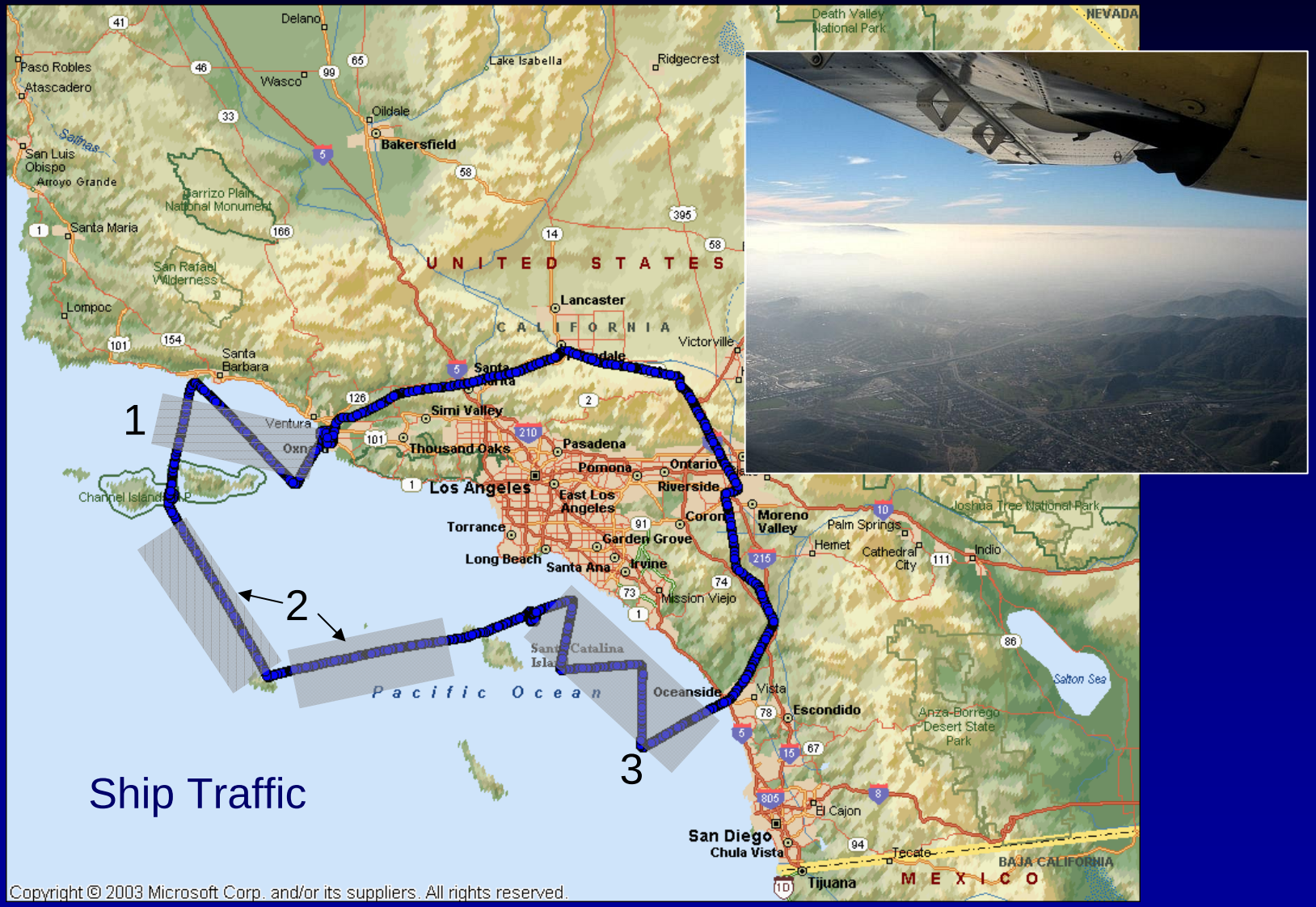
Sampling Strategies



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Sampling Strategies

AQMD

Sampling Strategies

Outbound Leg

Sampling Strategies

Sampling Strategies

Mid Course Reviews

March 2009

- Increase frequency to 2/month
- Weekend and weekday flights
- Increased altitude for aircraft soundings
- Remove ozonesonde in favor of two rawinsondes
- Add relative humidity to aircraft
- Improved detection limits for VOCs through pre-analysis of canisters
- Add bag collection and analysis for SO_2 and CO
- Prepare web site for cumulative database development

Mid Course Reviews

July 2009

- Resume ozonesonde in morning soundings
- Add Catalina Island monitoring
- Evaluate Black Carbon measurements
- Intercompare ozone standards and aircraft ozone analyzer
- Evaluate layering results observed to alter flight plans
- Confirm lab detection limits for VOCs and sulfur
- Plan for aircraft NO_x measurements

Data Processing and Validation

- Lab analyses
  - Sulfur within 24 hours
  - All data turned around in ~1 week
- Aircraft data files
  - Reviewed and calibrations applied ~1 week
- Flight Summary of events ~ 1 week
- Internal Web Posting of all data (web page)
  - Flight processed, laboratory summary, spreadsheet
  - Two way client posting of analyses
  - All flight pictures date and time stamped

Project Web Page

Offshore and Onshore Air Pollutant Measurements Aloft - Mozilla Firefox

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Offshore and Onshore Air Pollutant ...

Offshore and Onshore Air Pollutant Measurements Aloft

An Airborne Study Performed for the SCAQMD

By

T&B Systems

Southern California's South Coast Air Basin (SoCAB) is currently designated as severe-nonattainment for ozone. As such, the Clean Air Act (CAA) requires that a photochemical grid model be used to demonstrate future attainment. A basic requirement for such models is to understand the background ozone and precursors at the model boundaries, and in particular at the over water western boundary. The objective of this on-going project is to quantify and develop an annual profile of the boundary concentrations. The program is conducted using an aircraft equipped with instrumentation to measure meteorological variables as well as ozone, carbonyls and VOCs. Sampling missions include offshore collection along key traverse routes as well as vertical soundings at specific locations onshore and offshore. The aircraft profiles are augmented by rawinsonde/ozonesonde measurements at a coastal airport to further document the meteorology and ozone conditions during the aircraft sampling periods. All measurements are made using a portable, self-contained instrument package designed by T&B Systems and used in a chartered aircraft that required no airframe or electrical modifications.

New -- Data from the Catalina Island ozone station are now posted at

	T&B Processed					Laboratory Processed					
						PDF Summaires					
Flight Date	Flight Summary	Pictures	Balloon Soundings	Aircraft Data	Bag Samples	VOC	Sulfur	Carbonyls	Spreadsheet	Other Data	AQMD Analyses
Various											
11/14/08											
01/08/09											
02/01/09											
03/10/09											
04/05/09											

Done

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08/20/09											
08/23/09											
09/20/09											
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10/25/09											
10/29/09											

AQMD

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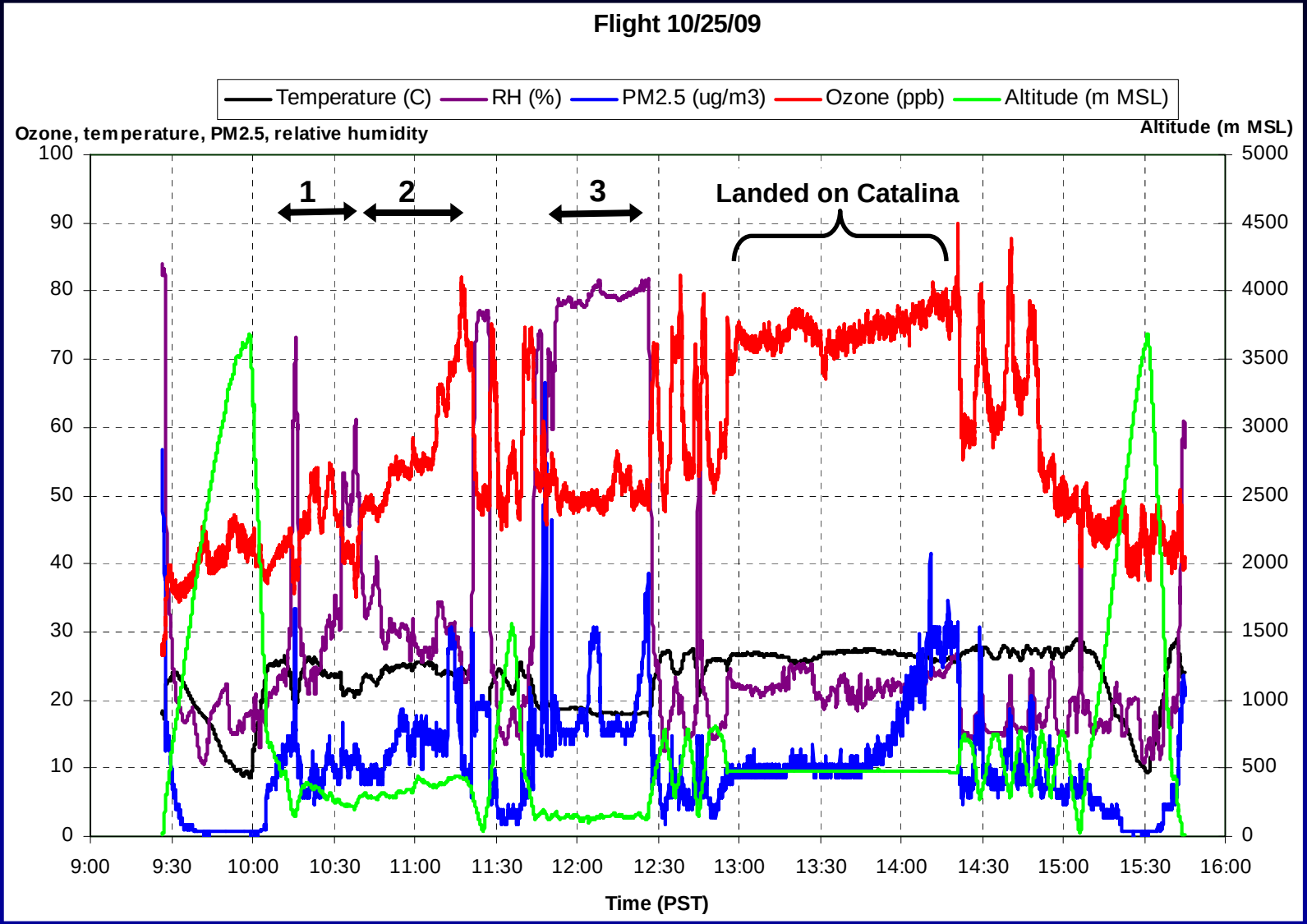
Sample Flight Record



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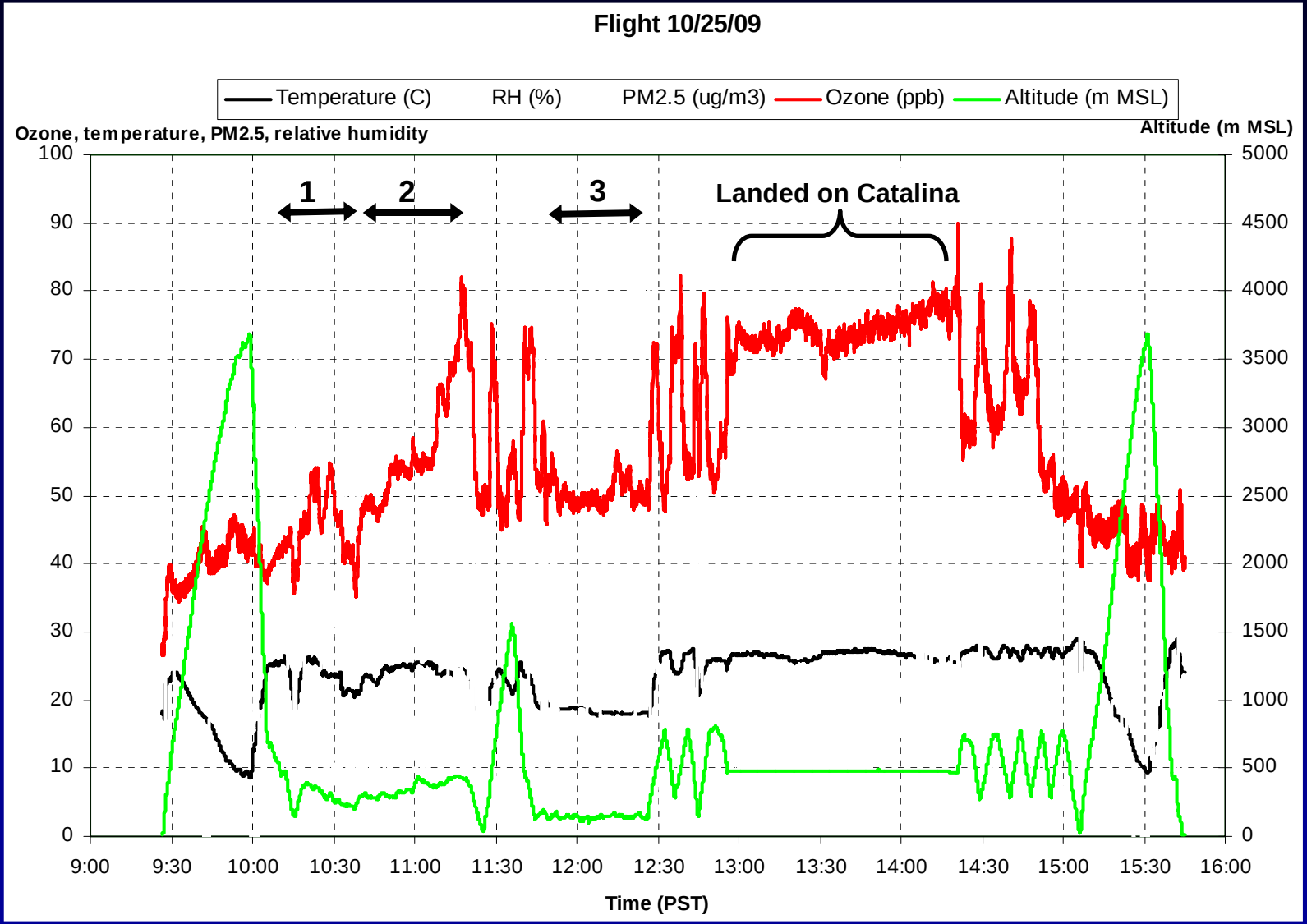
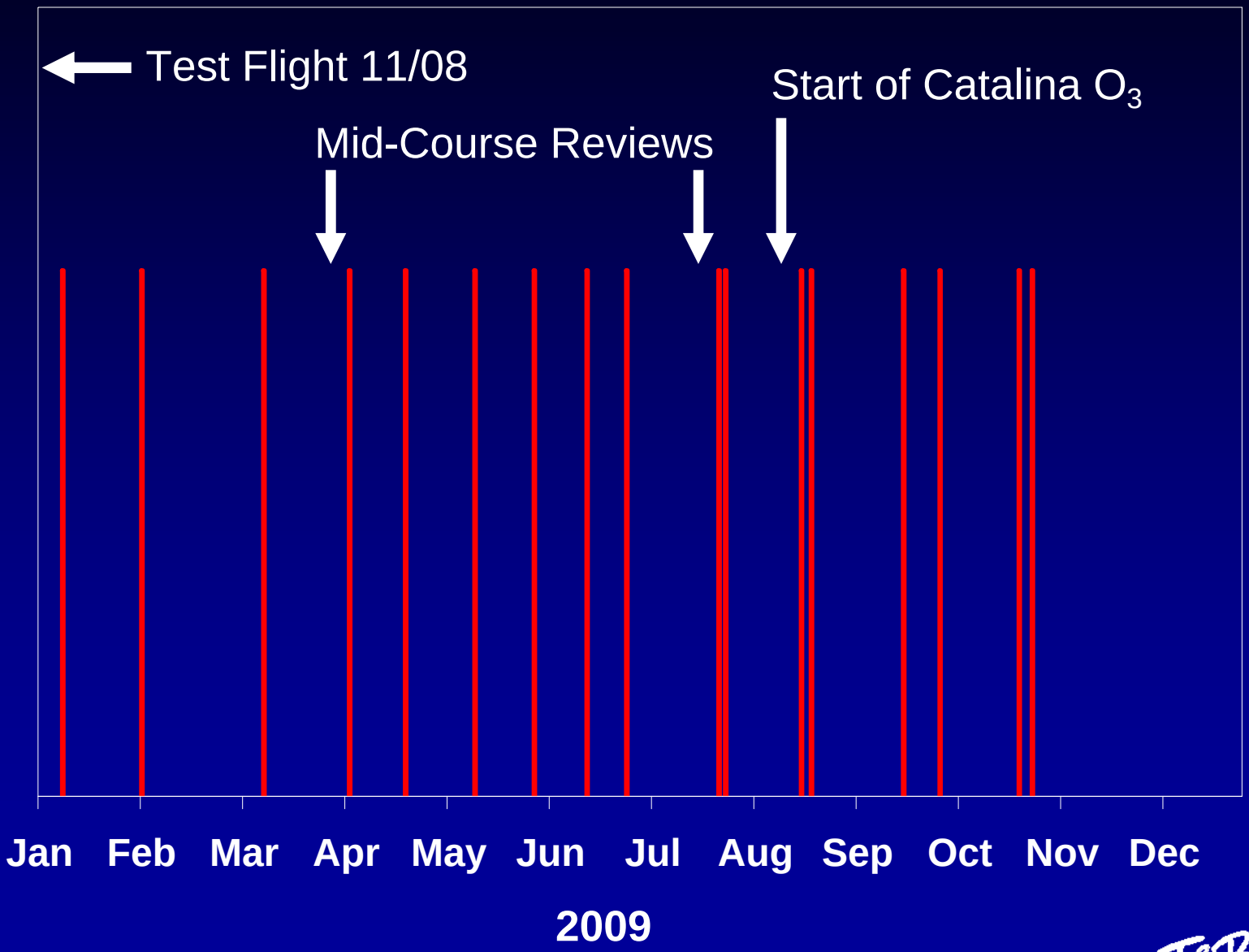


Flights Conducted



Analyses

- Characterize sampling periods
  - Meteorology (inversion statistics and extent)
  - Include detailed profiles from radar/RASS network
  - Air quality (ozone and precursors)
- Characterize seasonal differences
  - Four seasons vs. ozone/non-ozone seasons
- Mine the VOC and carbonyl data for patterns
- Characterize the offshore extent of O_3
- Relate airborne O_3 to SoCAB and Catalina
- Evaluate the existing modeling tools to help explain the observations
- Develop boundary conditions

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Questions or Comments?