



RACORO 2009

The ARM Aerial Facility Perspective

**Jason Tomlinson, John Hubbe, Beat Schmid, Debbie
Ronfeld, and Lynne Roeder**
Pacific Northwest National Laboratory
March 29, 2009
ARM Science Team Meeting
Louisville, KY

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AAF Role in RACORO

- ▶ The ARM Aerial Facility provides the logistical support and technical expertise to enable the successful operation of the RACORO campaign
 - Provided some instruments and placed contracts for the use of others
 - Logistics
 - Provide technical experts in the field
 - Oversees safety
 - Coordinates and provides weather forecasting
 - Assists in the coordination of personnel
 - Media and public relations to educate the public about the campaign
 - Guides the creation of and help to maintain the RACORO website and WIKI to ensure the sharing of ideas and information



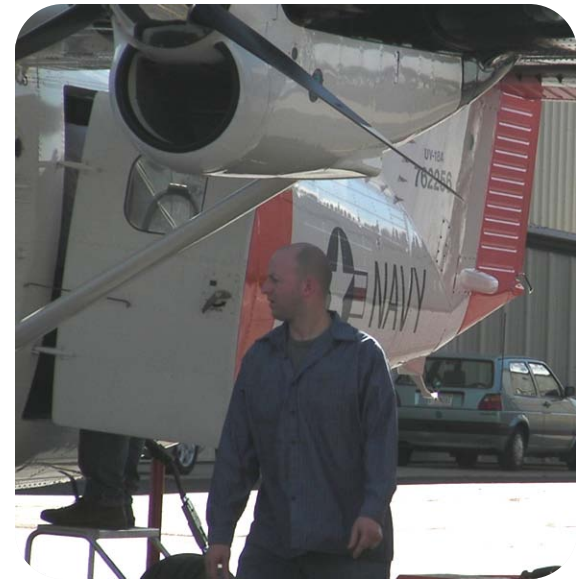
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CIRPAS Instrumentation & Operations



Haf Jonsson



Greg Cooper

Instrument PIs

Anthony Bucholtz

Don Collins

Glenn Diskin

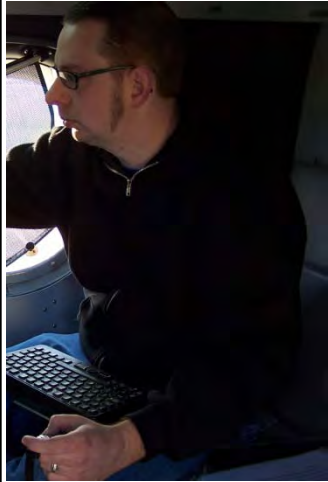
Chuck Long

Hermann Gerber

Paul Lawson

Roy Woods

Routine Operations



Jesse Barge



Mike Hubbell



Dan Bierly



**Dave
McSwiggan**



Chris McGuire

RACORO Media and Public Relations

▶ Public Relations

- John Hubbe spoke at two elementary schools about climate, and RACORO
- Guthrie/Edmond Board Meeting (Pete Lamb and Debbie Ronfeld)

▶ Media Relations

- OCAST interview
- Edmond Sun
- Releases to the ARM community



AAF RACORO Collaborations

- ▶ Collaboration with the NASA B-200 HSRL
 - After June 1st operations move to Ponca City, OK
 - Greenwood Oklahoma Jet will be providing the hangar and office space
- ▶ Cloud Tomography
- ▶ Satellite feeds
 - MISR Local Mode (Marshak)
 - ASTER request submitted (Cairns)



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AAF RACORO Adaptations

▶ Lack of Clouds

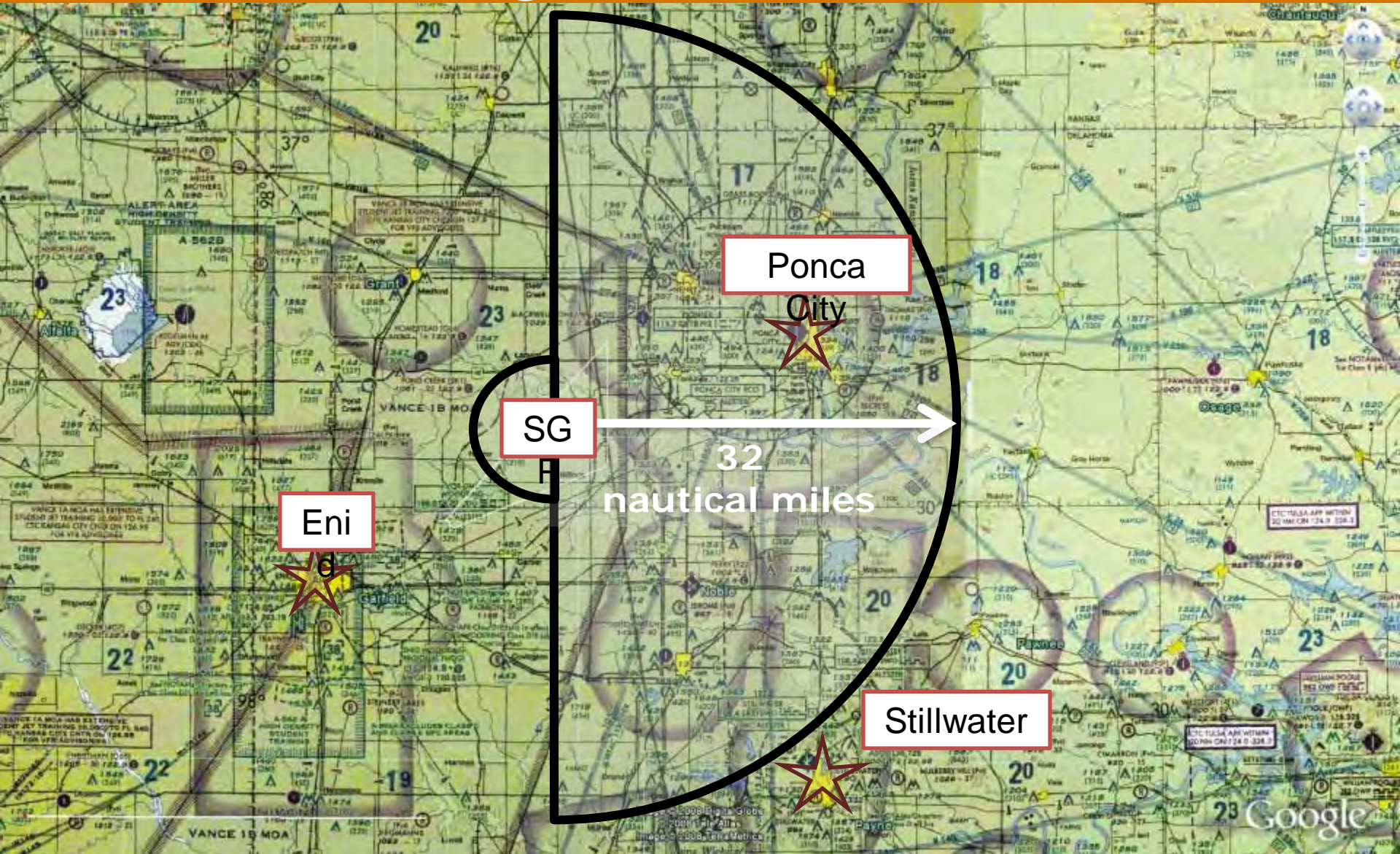
- AAF in cooperation with the DOE Aviation Safety Office have increased the operations area from 50 to 200 nautical miles



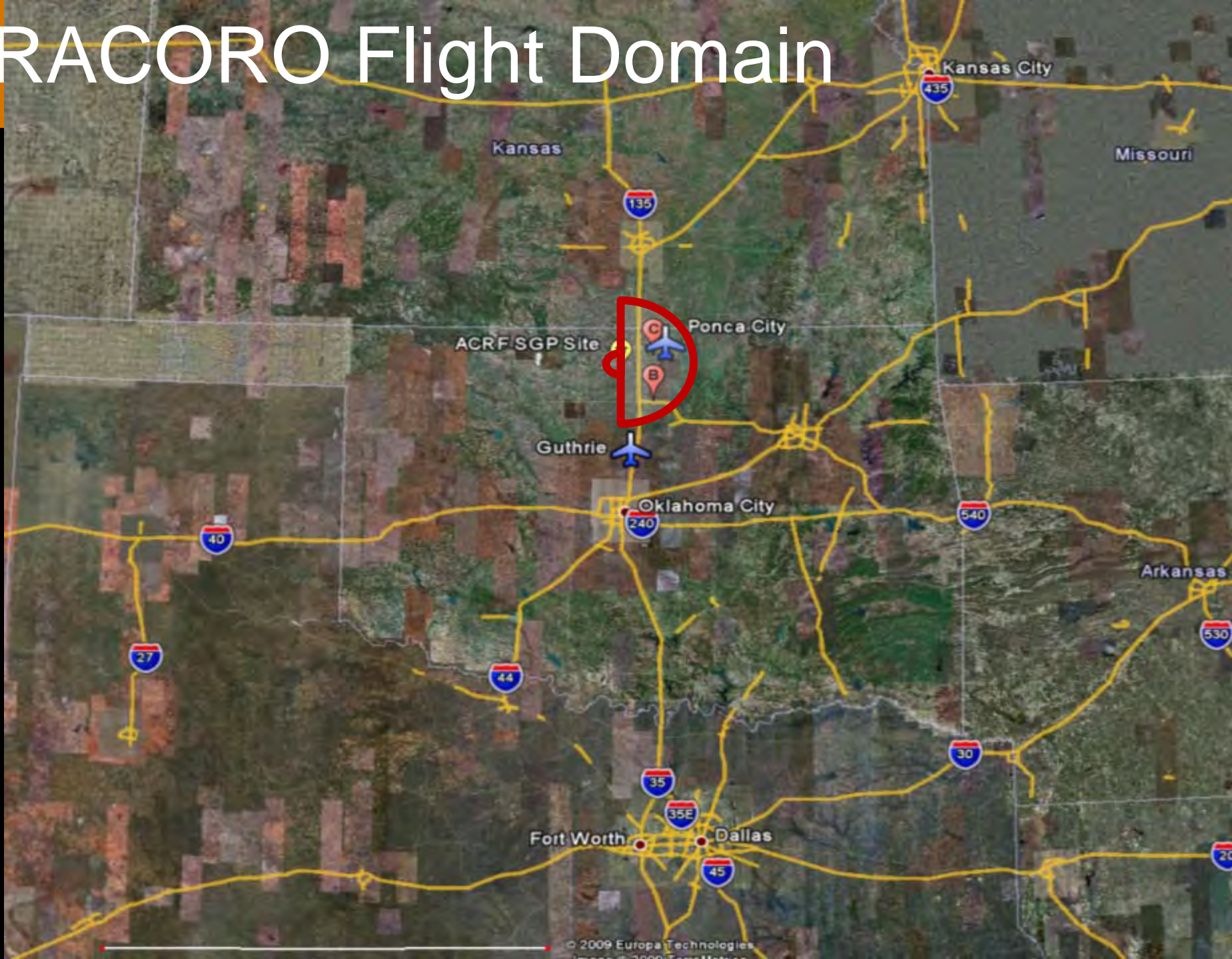
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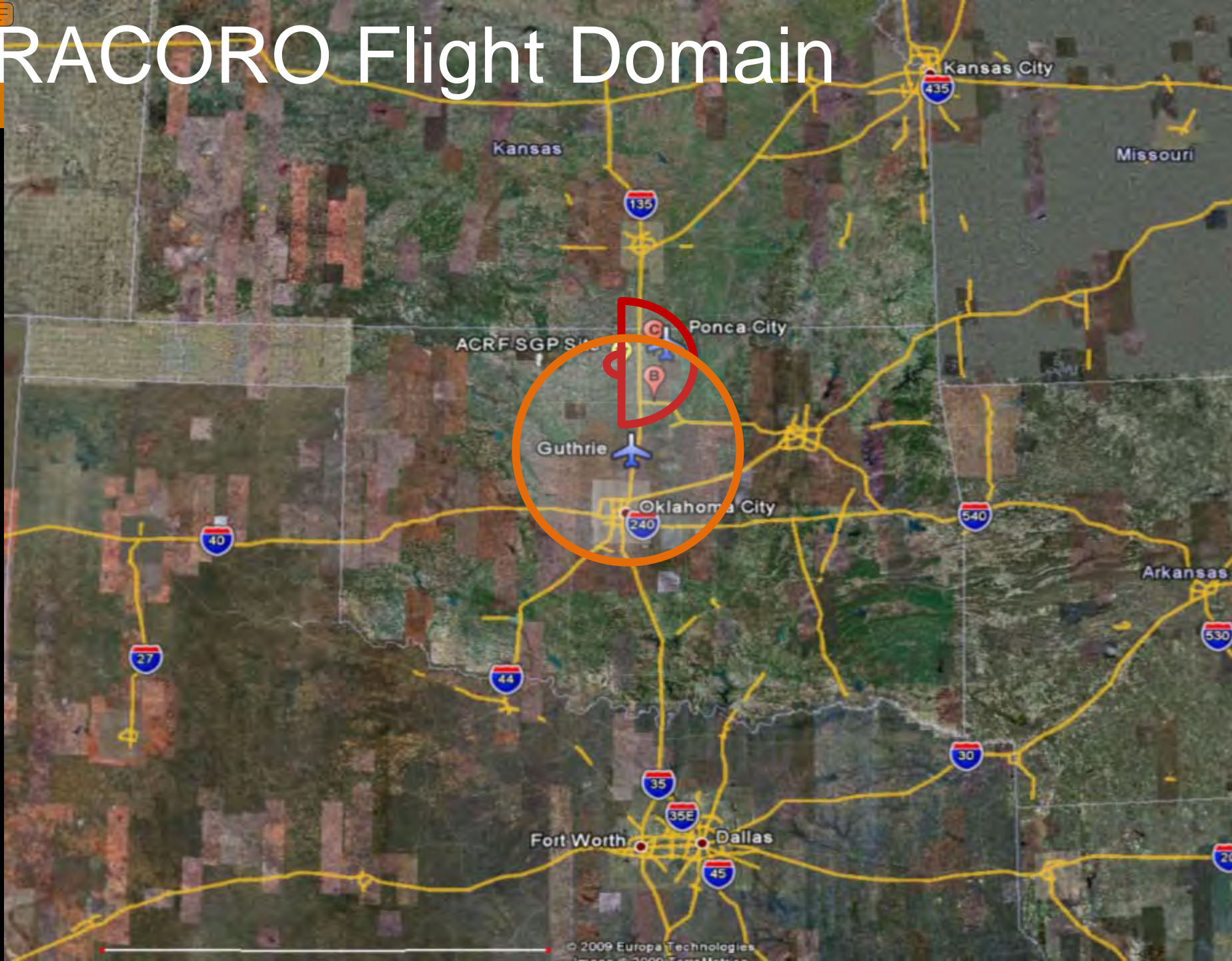
RACORO Flight Domain



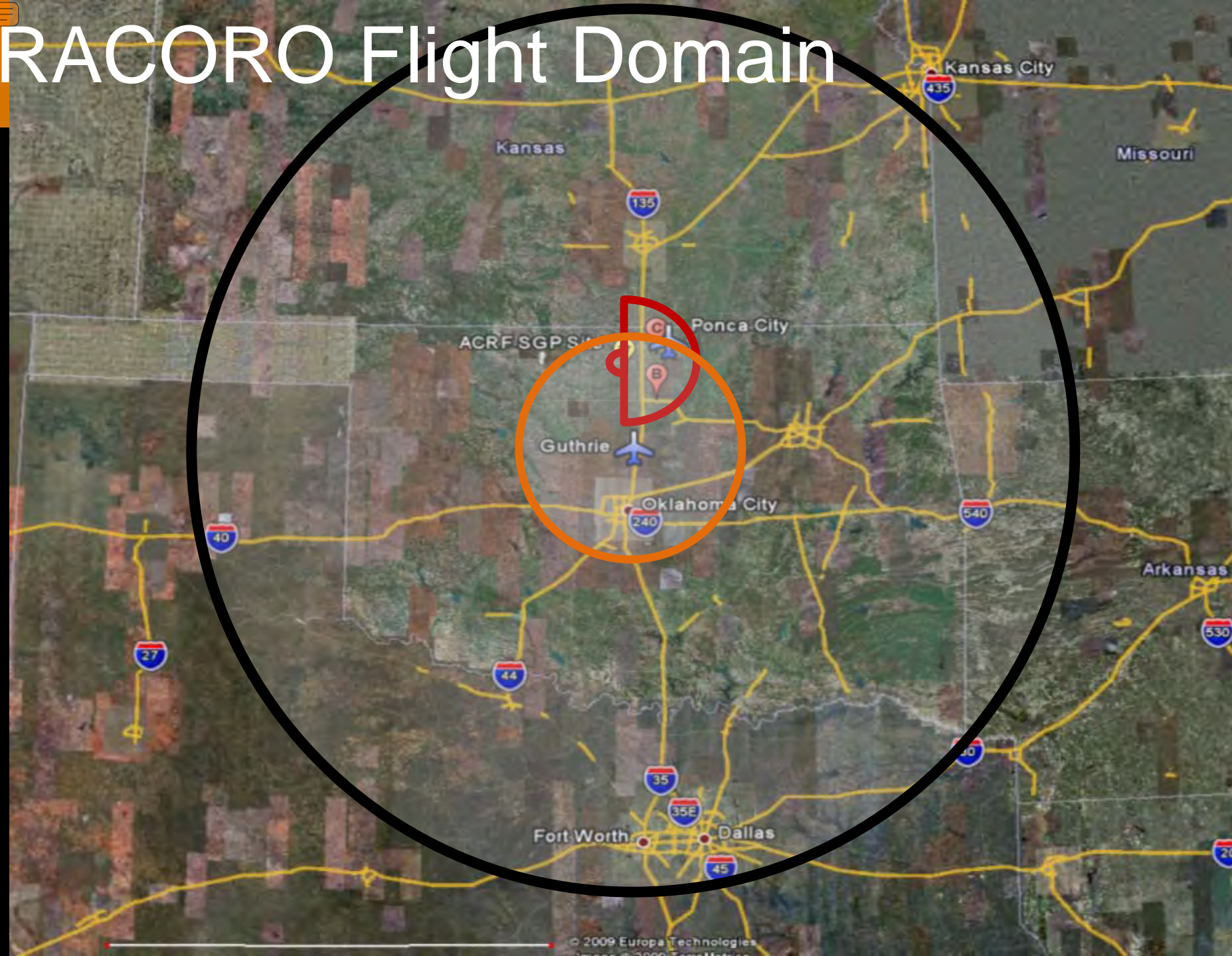
RACORO Flight Domain



RACORO Flight Domain



RACORO Flight Domain



AAF RACORO Adaptations

▶ Lack of Clouds

- AAF in cooperation with the DOE Aviation Safety Office have increased the operations area from 50 to 200 nautical miles

▶ Non-SGP Clouds

▶ Twice a day flying option

▶ Clear-sky Options

- Albedo mapping (Sally, Chuck, & Andy)
- Aerosol Characterization (Graham & John)
- Turbulence & Raman Lidar (Dave, Haf, & Larry)

RACORO Web Resources

▶ Google Earth Flight Playback

- Displays images taken during the flight
- Replicates the location of clouds
 - The darker the cloud icon the higher the LWC
- Eventually will display images taken from the forward and port looking cameras
- [CABIN_09032002 local.kml](#)

RACORO Web Resources



ARM RACORO Field Campaign

VIEW CART PEOPLE | SITE INDEX | HOME

SEARCH

ABOUT ARM ABOUT ACRF SCIENCE SITES INSTRUMENTS MEASUREMENTS DATA PUBLICATIONS EDUCATION FORMS

User Information Field Campaigns Capabilities & Products Organization Operations Updates Facility Statistics Contacts

Routine AAF Clouds with Low Optical Water Depths (CLOWD) Optical Radiative Observations (RACORO)



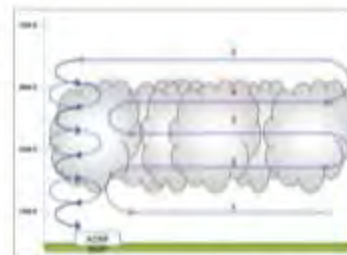
Clouds with low-optical water depths (CLOWD) refer to "thin" clouds that contain a limited amount of water, which are often below 100 g/m^3 . This cloud type is very common—occurring in the earth's boundary-layer (from the earth's surface up to about 2.5 km) throughout the globe. However, because these clouds are thin and often broken, even the best ground-based instruments have trouble accurately measuring their cloud properties. Attempts to retrieve these properties by different methods produces varying results, and such discrepancies prevent resolving uncertainties within climate models. To resolve this dilemma, a better understanding of this cloud type is needed that can only be achieved by acquiring the critical in-situ data needed to evaluate and refine existing retrieval algorithms from ground-based instruments.

Between January and June 2009, the RACORO field campaign will conduct routine flights below, within, and above these boundary layer liquid-water clouds in the vicinity of the [ACRF Southern Great Plains site](#). Coordinated by the [ARM Aerial Facility](#), a Twin Otter aircraft equipped with a full payload of research instrumentation will obtain representative statistics of cloud microphysical, aerosol, and radiative properties of the atmosphere. The data will be used to validate retrieval algorithms and support process studies and model simulations of boundary layer clouds and, in particular, CLOWD-type clouds.

For additional details, see the [RACORO Science Questions](#) web page.

**The ARM Aerial Facility was previously known as the ARM Aerial Vehicles Program.*

As in other mid-latitude regions, low-level boundary-layer clouds occur frequently at the ACRF Southern Great Plains site.



This figure shows a potential flight configuration during RACORO. The Twin Otter aircraft will take measurements at five different altitudes: up to 12,500 ft (about 3600 m), then spiral down in close proximity to the SQP site. Flights will occur at different times throughout the day to sample variations in cloud properties.

RACORO Home

- [Science Questions](#)
- [Proposals](#)
- [Full Proposal](#) (PDF, 886K)
- [CLOWD Working Group](#)

Experiment Planning

- [Steering Committee](#)
- [Meetings](#)
- [Science & Operations Plan](#) (PDF, 640K)
- [Measurements](#)
- [SQP Data Plot](#)
- [Collaborations](#)
- [RACORO web](#)

News

- [News & Press](#)
- [Fact Sheet](#) (PDF, 528K)
- [Images](#)

Contacts

- [Andreas Vogelmann](#), Lead Scientist

<http://acrf-campaign.arm.gov/racoro/>

Send comments to: [LJ](#)
Last Modified: January 2007
[Privacy & Security Notice](#)
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RACORO Web Resources

▶ What's Available

- RACORO documentation
- Links to SGP data plots
- RACORO in the news
- Images from the project

▶ Plans for the website

- Table of flights that includes flight date, duration, mission objective, weather conditions, and a Google flight path

RACORO Web Resources

- ▶ The WIKI behind the scene
 - Automatically keeps track of flight hours
 - Provides calendars which indicate research flights and PI rotation schedule
 - A running weather summary
 - Each research flight has a dedicated topic which displays flight notes and images, quick looks of the flight data, and data plots from the SGP site
 - A data quality topic is provided for PIs to indicate and comment on the quality of the data collected for a particular flight
- ▶ Most of this will become public after the project to aid future researchers in their use of the data
- ▶ Community effort...many thanks to Andy Vogelmann, RSC, PI's, Sherman Beus, Debbie Ronfeld, John Hubbe, and Tonya Martin

RACORO Wiki Sneak Peak

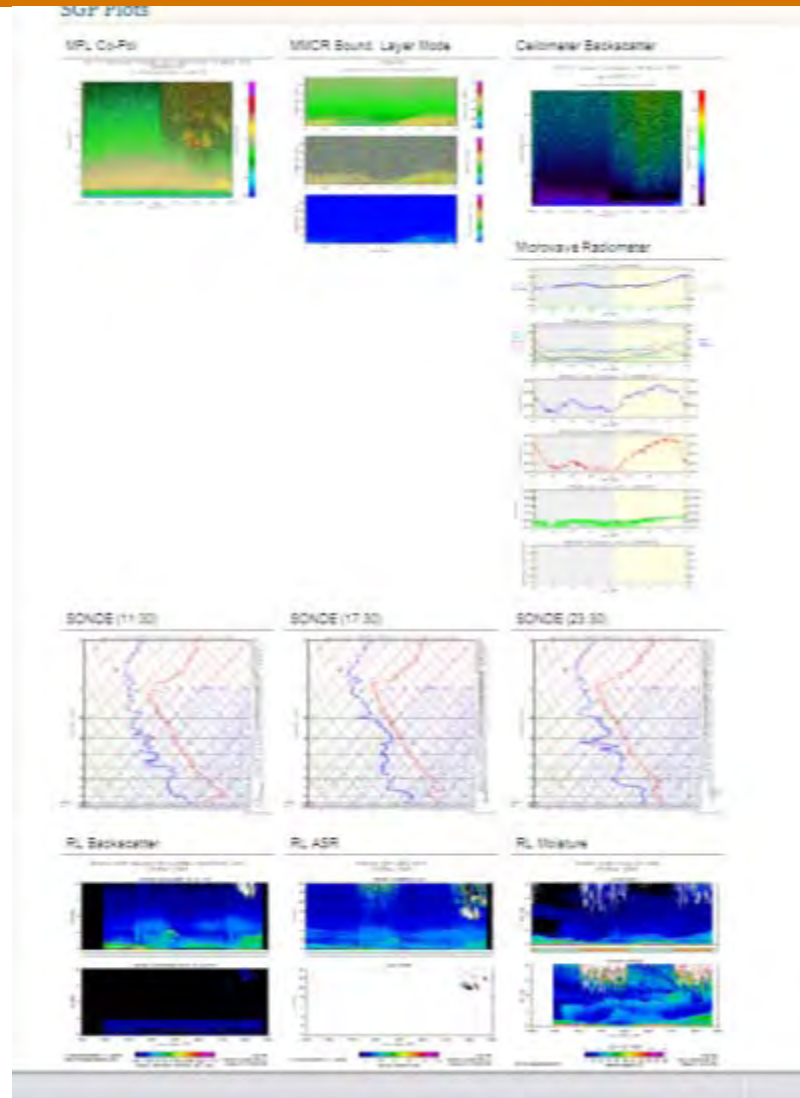
March 2009						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
01 PI:Long Co PI:Feingold <u>Research Flight</u>	02 PI:Feingold Co PI:Comstock	03 PI:Feingold Co PI:Comstock	04 PI:Feingold Co PI:Comstock <u>Research Flight</u>	05 PI:Feingold Co PI:Comstock	06 PI:Feingold Co PI:Comstock	07 PI:Feingold Co PI:Comstock
08 PI:Feingold Co PI:Comstock	09 PI:Comstock Co PI:Turner	10 PI:Comstock Co PI:Turner	11 PI:Comstock Co PI:Turner	12 PI:Comstock Co PI:Turner	13 PI:Comstock Co PI:Turner	14 PI:Comstock Co PI:Turner
15 PI:Comstock Co PI:Turner <u>Research Flight</u>	16 PI:Turner Co PI:Vogelmann	17 PI:Turner Co PI:Vogelmann <u>Research Flight</u>	18 PI:Turner Co PI:Vogelmann <u>Research Flight</u>	19 PI:Turner Co PI:Vogelmann	20 PI:Turner Co PI:Vogelmann <u>Research Flight</u>	21 PI:Turner Co PI:Vogelmann
22 PI:Turner Co PI:Vogelmann	23 PI:Vogelmann Co PI:McFarquhar	24 PI:Vogelmann Co PI:McFarquhar <u>Research Flight</u>	25 PI:Vogelmann Co PI:McFarquhar	26 PI:Vogelmann Co PI:McFarquhar	27 PI:Vogelmann Co PI:McFarquhar	28 PI:Vogelmann Co PI:McFarquhar
29 PI:Vogelmann Co PI:McFarquhar	30 PI:McFarquhar Co PI:Ogren <u>Research Flight</u>	31 PI:McFarquhar Co PI:Ogren Post-flight Call @ 1145 CDT Wx Brief @ 1145 CDT				



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RACORO Wiki Sneak Peak



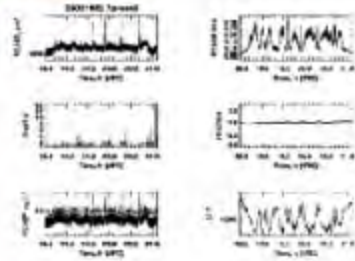
Acknowledgements:
Sherman Beus, DMF, and
Dave Turner

RACORO Wiki Sneak Peak

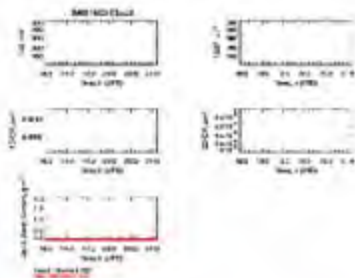
Flight Plots

[Legend for the Plots](#)

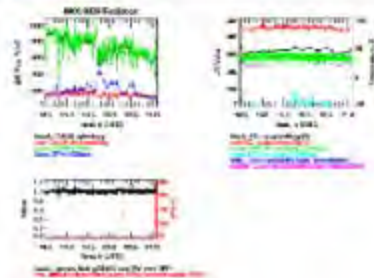
Aerosol



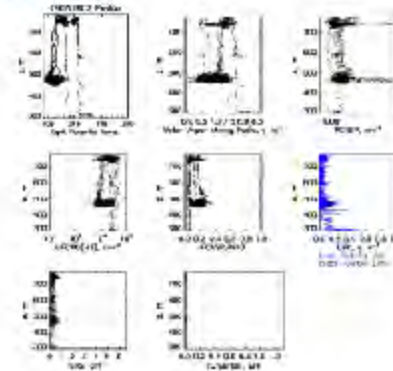
Cloud



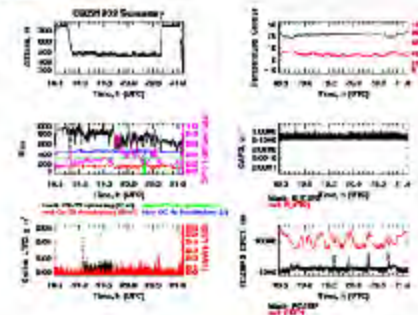
Radiation



Profile



Summary



Acknowledgements: Haf Jonsson, Anthony Bucholtz Jennifer Comstock, and Chaomei Lo



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RACORO Wiki Sneak Peak

Wiki Configuration

AAF

ICCAGRA

New Topic

Notifications

Recent Changes

CLASIC

ISDAC

RACORO

SPARTICUS

Tools & Reference

Change Password

Users Guide

Text Formatting

Flight Summary - 20090318

- [Flight Summary](#)
- [Flight Plots](#)
- [SGP Plots](#)
- [Comments](#)

Flight Summary

Depart	Return	Hours	Synopsis	Google Earth
18:27 UTC	21:07 UTC	2.7	CF albedo mapping under cirrus and broken cirrus.	KML
Flight hours to date		34.9		

Flight times were 1827-2107. 2.7 total flight time.

We transited to the south point of the "pinwheel" pattern at 2500.

We descended to 1600' MSL about 5 miles prior to the leg. We ran the pattern at 1600. That was ~500' AGL. The pattern began at 1853 and ended at 1944.

We repositioned to do the "paper clip" pattern. That was also ran at 1600. It started at 1946 and ended at 2038.

We flew back to Guthrie at 2500.

There were cirrus over head the entire time. Sometimes broken, sometimes overcast. There were several control burns going on, and we were in close proximity to them on a couple of legs, but did not fly through the smoke plume directly.

The pinwheel was not centered on the CF. The original point was off by about 1/4 of a mile, and that is what the pattern was based on. I reset the CF point for the other patterns but I didn't have time to reset all of the points for today's flight.

The paper clip pattern was centered on the CF.

The Cesana was up and flying and we had good communications with him.

Mike Hubbell
CIRPAS Chief Pilot

Weather Summary


cirrus, broken and overcast

Aircraft Instrumentation Status

Jesse reports no glitches.

Surface Instrumentation Status

Flight Images



Acknowledgements: Debbie,
John, Mike/Chris, Jesse



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RACORO Wiki Sneak Peak

The screenshot shows a Wiki page titled "Weather and Flight Outlook" for the location "Guthrie, OK". The page includes a navigation sidebar on the left with links to Wiki Home, Wiki Configuration, AAF, and ICCAGRA. The main content area features a weather widget from Weather Underground showing current conditions: Clear, Humidity: 55%, Visibility: 10 miles, and Wind: calm. The temperature is 56°F / 14°C. There are also links for "March", "February", and "January". Below the weather widget is a table titled "March" with columns for Day of Week, Date, Observed Weather, 24 Hour Forecast, and Long Range Forecast.


Day of Week	Date	Observed Weather	24 Hour Forecast	Long Range Forecast
Sunday	1	Cirrus clouds	Cirrus clouds	Cirrus through Friday
Monday	2	Cirrus clouds	Cirrus clouds	Cirrus through Friday
Tuesday	3	Cirrus clouds	Cirrus clouds	Cirrus through Friday
Wednesday	4	Cirrus clouds	Cirrus clouds	
Thursday	5	Cirrus clouds	Cirrus clouds	Slight chance of thunderstorms Saturday afternoon and evening. Mostly clear Sunday.
Friday	6	Cirrus clouds	Mid-High level clouds with a chance of thunderstorms.	Mostly sunny Sunday through Tuesday
Saturday	7	Thick mid-level clouds		
Sunday	8	Few high cirrus		
Monday	9	Cloudy with Thunderstorms	Few cirrus clouds	Cold front arriving Tuesday night, mostly clear Wednesday, and a chance of wintry precip later in the week
Tuesday	10	Cold front cloudiness	Cirrus clouds	Supercooled cloudiness with chances of wintry precip through Friday
Wednesday	11	Cirrus clouds	Supercooled clouds with chance rain/snow	Supercooled clouds through Saturday
Thursday	12	Low level	Slight chance morning wintry	Supercooled clouds through Saturday with

Acknowledgements: Daniel & Justin



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RACORO Wiki Sneak Peak

ARM 

Jason Tomlinson

ARM Wiki » AAF » RACORO » Racoro Data Quality Control

25 Mar 2009 - 18:38 GMT - Glenn Diskin

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Data Quality Control

For discussion click on topic: [Atmospheric State](#), [Aerosol](#), [Clouds](#), [Radiation](#)

For flight summary information click on date.

To contact instrument PI click on name.

INSTRUMENTS	INSTRUMENT PI	0122	0124	0206	0208	0217	0226	0301	0304	0315	0317	0318	0320	0324
Atmospheric State														
DLH	Glenn Diskin	●	●	●	●	●	●	●	●	●	●	●	●	●
Temp and H2Ov	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
Vertical Velocity and Horizontal Winds	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
DAQ Pictures Taken		●	●	●	●	●	●	●	●	●	●	●	●	●
Aerosol														
CCN	Roy Woods	●	●	●	●	●	●	●	●	●	●	●	●	●
CPCs	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
DMA	Don Collins	●	●	●	●	●	●	●	●	●	●	●	●	●
PCASP	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
Clouds														
2D CIP	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
2D-S	Qixu Mo Paul Lawson	●	●	●	●	●	●	●	●	●	●	●	●	●
CAPS	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
CIN	Hermann Gerber	●	●	●	●	●	●	●	●	●	●	●	●	●
FSSP	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
LWC-CAPS	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
LWC-CIN	Hermann Gerber	●	●	●	●	●	●	●	●	●	●	●	●	●
LWC-PVM-100A	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
LWC-SEA	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
Radiation														

ARM Wiki » AAF » RACORO » Racoro Data Quality Control

25 Mar 2009 - 18:38 GMT - Glenn Diskin

[Edit](#) [Attach](#) [Printable](#)

Data Quality Control

For discussion click on topic: [Atmospheric State](#), [Aerosol](#), [Clouds](#), [Radiation](#)

For flight summary information click on date.

To contact instrument PI click on name.

INSTRUMENTS	INSTRUMENT PI	0122	0124	0206	0208	0217	0226	0301	0304	0315	0317	0318	0320	0324
Radiation														
CG4 (IR)	Anthony Bucholtz Chuck Long	●	●	●	●	●	●	●	●	●	●	●	●	●
CM22 (Solar)	Anthony Bucholtz Chuck Long	●	●	●	●	●	●	●	●	●	●	●	●	●
Hydrorad	Anthony Bucholtz Chuck Long	●	●	●	●	●	●	●	●	●	●	●	●	●
IRT	Haf Jonsson	●	●	●	●	●	●	●	●	●	●	●	●	●
MFR	Anthony Bucholtz Chuck Long	●	●	●	●	●	●	●	●	●	●	●	●	●
SPN-1	Anthony Bucholtz Chuck Long	●	●	●	●	●	●	●	●	●	●	●	●	●

Instructions:
 Click the edit button above. This will modify the calendar to give you a drop down menu for each week. The menu contains four choices for availability:

- 'led-box-gray' Unknown
- 'led-box-red' Bad
- 'led-box-yellow' Caution
- 'led-box-green' Good
- 'led-box-blue' Missing



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AAF Perspective on RACORO

- ▶ AAF is working with CIRPAS and the science team to ensure 300 research flight hours aboard the CIRPAS Twin Otter
- ▶ Have increased the flight domain from 32 nautical miles to 200 nautical miles to enable more opportunities to sample clouds
- ▶ Coordinates and creates a multitude of services for the project
 - Acquisition and contracting of a multitude of instruments
 - Crew Scheduling
 - Logistics
 - Safety
 - Flight Planning
 - Meteorological forecasting
 - Media and Public relations
 - Web resources
 - Oversees the design and update of the RACORO WIKI