

Summary

- aircraft must be coordinated, but each must accomplish its scientific goals and produce a self-contained data set
- collaborations must be designed to use the strengths of each aircraft
 - G-1: low, slow, and close in to MCMA
 - King Air: aerosol distributions looking down from high alt.; scouting in conjunction with the C-130
 - C-130: vertical profiling and walls from close in to MCMA to regional scales to the Gulf of Mexico
 - DC-8 – predominantly regional in the Gulf of Mexico, with Pacific possible. A flight or two close in the MCMA in coordination with other aircraft - and intercomparison
 - J-31 generally near the coast often in coordination with King Air, DC-8 and the C-130
 - FS King Air will characterize intermittent regional sources (fires, others?) in the MCMA region
- strawman flight scenarios should be developed/firmed up including location and timing as they will help to prioritize flight opportunities as the meteorology unfolds

- tight coordination in the forecasting is essential, where flight plans for the aircraft studies are accomplished in joint web-conferenced meetings
- but model uncertainties exist which need to be investigated by the aircraft
- forecast capabilities need to be tested and improved
 - how does the BL develop during a typical day
 - how often does outflow occur to the NE sector? how often does this occur at high altitudes only and how often throughout the LT?
 - how much shear occurs during these events and how does the seabreeze from the NE interfere with the low-level outflow in the evening?
 - is the outflow at the top of the BL over MEX maintaining its altitude as it flows to the NE?
 - how much of the residual BL is re-entrained into the expanding BL and under what conditions does this happen?
 - Norte event would clear out the city and a NE event occurring after a Norte would be a great opportunity .. but: are Norters typically followed by stagnant conditions?

- DC-8 flight scenarios

- early close-in flight coordinated with the C-130 and King Air – intercomparison of in situ and remote sensing instruments – confidence building for the C-130 remote sensing capability and King Air Scouting capability
- Lagrangian efforts in coordination with the C-130 to northeast
- Pollution over the Gulf of Mexico
- Missed approach on MEX or landing at MEX in the morning and takeoff again in the afternoon
- Biomass burning and regional pollution flight
- Sampling to the southwest of MEX
- ~3 intercomparisons with the C-130 desired, intercomp. with J-31 (vertical profile) and King Air
- intercomparison during test flight period, e.g., downwind of DEN?
- satellite overpasses

- C-130 flight scenarios

- looking at outflow in and around the MCMA complex terrain and examine the flow and the chemistry and coupling with aerosol chem. and physics for different meteorological conditions – profiles and “stacked walls” (~0.5 to 2 days)
- profiles over ground sites
- characterize regional pollution sources
- upwind and downwind sources
- comparisons with the DC-8 early – preferably and at least two other times
- intercomparisons with the G-1 - ~3 times??
- ~3 radiative closure profiles coordinated with the J-31 and King Air (to characterize aerosols and combine with optical properties)
- more source characterization IF G-1 will fly an abbreviated instrument package
- night and early morning flights

- G-1 flight scenarios
 - T1 – T2 Lagrangian experiment
 - MCMA region general pollution evolution
 - Local source characterization
 - sampling near specific large sources to understand their contributions to the pollution
 - verify conceptual models boundary layer dynamics of Fast and deFoy
 - overflights of CENICA, T1, T2, (and Santa Ana??)
 - Composition of residual layer
 - Coordination with King Air, comparisons with C-130, FS King Air

- J-31 flight scenarios
 - profiling and low altitude transects primarily over water (for min altitude)
 - cloud free conditions needed except for over cloud transects & orbits
 - needs good cloud forecasts
 - Satellite underflights for validation
 - orbits over vegetation & urban area to characterize surface albedo & BRDF
 - intercomparisons and coordinated closure flights desired with DC-8, C-130 (profiles in dirty air) as well as King Air (overflights)
 - some profiles or low legs over AERONET sites (one at VER, MEX, T1, T2)
 - need to find out how low the J-31 can fly over these locations

Langley King Air flight Scenarios

- King Air will deploy to meet a variety of objectives
 - Provide context and plume location for G-1 and C-130
 - Investigate retrievals of aerosol microphysical parameters from remote sensing data
 - Instrument comparisons and combined aerosol retrievals with King Air and J-31 instruments
 - CALIPSO validation
- Above objectives define flight “elements” that can be inserted into flight plans. Flight plan for a given day will be designed to take maximum advantage of the plans developed for the G-1 and C-130 – i.e., King Air flight “elements” inserted in a way that maximizes impact to overall MIRAGE science.
- Flight elements:
 - Scouting flights to locate the plume for the G-1 and C-130
 - MCMA basin, downwind of MCMA, Gulf coast
 - Coincident measurements with in situ instruments for aerosol retrieval development
 - Overflights of G-1 and C-130 wall patterns and profiles
 - Overflights of T0, T1, and T2 ground sites
 - Overflights over AERONET sensors, especially advanced polarization-sensitive sensor (Veracruz?)
 - King Air – J-31 coordinated flights
 - Radiative closure experiment: Overpass of coordinated J-31/C-130 coordinated spirals
 - CALIPSO validation
 - Flights along ground tracks; will be a combination of day (~1400 local time) or night (~0200 local time)
 - Potential opportunity for joint flights with J-31 for day orbit intercepts

CMET Balloons Real-time Aircraft Flight Planning and Coordination

CMET Balloon Operations

- Intensive met observations within MC outflow (u,v,T,P,RH, and trajectories)
- Main focus on north-west to north-east, or south outflow
- Mobile (minivan) launch from outside MEX class-B airspace
- 6 hours advance notice to enable transport to launch site
- Balloons flown as pairs (one sounding, one constant-level)
- 1-3 day flights
- 10 total balloons = 5 transport events
- Balloon control and flight planning from Veracruz Operations Center

Lagrangian Flight Planner (LFP): G-1, C-130, and Ground Command Center

- Real-time balloon and aircraft positions displayed on LFP map
- Forecast plume trajectory also displayed on LFP map
- Use the LFP to adjust and refine flight plans based on the balloon trajectories, wind shear information, and the observed plume geometry

“FS” King Air

Flight Scenarios

Fires of opportunity (source and plume aging & mixing with urban)

Hidalgo State (NE of MC) from base in Pachuca

Morelos State (SW of MC (sugar cane) Pachuca

Yucatan from temporary base in Veracruz

Planned Fires from base in Pachuca

Sierra Madre Oriental (NE of MC): Jalisco (W of MC)

Vertical Profiles from base in Pachuca and above T2

(intercomparison with G-1, C-130?)

Paso de Cortez & the “Gap” (coordinate with Microlight and ground site) – fire scouting for Microlight

Of Inflow S or N of MC (can coordinate with other aircraft)

Measurements Trace gases (FTIR, Cans) Particles (UHSAS, PASS, AMS, MPS-3 (particle microscopy)

Needs

Up-to-date hotspots, weather, fire-intel from other planes & agencies communications with other aircraft and ground sites

Lagrangian Experiment

Assume 2 to 3-day transport event to the NE

Transport event is initiated in the afternoon – injection into the synoptic flow

G-1 takeoff **midday of day 1** to sample the fresh outflow over and around the city – or two flights, one in the morning, one in the afternoon

Pair of Smart Balloons launched afternoon from T-1

Next morning: King Air takes off 2-3 hrs ahead of the C-130 and maps plume – narrow C-130 altitude range to sample

Smart balloons will have to be tracked by C-130 flight planning team and by the forecasters.

J-31 would take off after King Air returns from M/C area and intercompare. J-31 would fly their maneuvers over the Ocean and attempt satellite validation (timing of overpasses?). Coordinated profile with C-130

Later the same morning: C-130 takes off and flies transects through the plume at 2, maybe 3 distances from M/C and flies profiles through the plumes. Smart Balloons tracked by C-130 and intercepted as often as possible/suitable

Next day: DC-8 takes off and tries to find plume over the Gulf of Mexico. Smart balloons may still be of help here.

Forecast models need to be constantly updated throughout the period with assimilated info – Balloon tracks, measured winds, etc.

- flight planning process
 - early morning forecasting/sat. groups analyze their products
 - 10 am separate meetings in HOU and VER to summarize met. outlook and prospects for flights
 - 11 am joint videocon – summaries by each team – make decision to fly next day, and long term opportunities, make strawman flight plans
 - HOU and VER teams develop detailed flight plans
 - afternoon videocon to finalize plans
 - file flight plans at VER late afternoon
 - for lagrangian case daily updates on what was seen and how forecasts developed and adjust flight plans for DC-8
 - involvement of the G-1 team in flight planning needs to be discussed. There are personnel issues at the moment. King Air might have a similar problem

- action items

- each aircraft leadership team draw up some typical flight plans, including coordinated flights
- typical flight plans sent to Sasha, who passes them on the SENEAM for comment
- need to find out how much latitude there is in changing flight locations and timing during the flights
- possibilities for flights near T1 (SEDENA)
- aircraft coordination, but everyone having a self-contained data set

- come up with firmed up flight scenarios – individual aircraft groups
- approach SENEAM about running a lidar over the city?
- could have G-1 and C-130 do flights at about 1500 ft at about 10 am to look at top of mixed layer. This would be about 300 ft above the helicopter traffic, but 1200 feet is not a hard restriction for civil aviation
- approach SENEAM to determine how much flexibility there is to change the flight plans in near real time for adjustments depending on what remote sensing instruments tell us
- intercomparison questions? Can we do wingtip-towings flights over the city or just outside the city at least over T-1?
- desired a level leg followed by a climb/descent and another level leg (45 min total)

- communication – bandwidth for videocon,
- aircraft-to-aircraft 0- to ground (but chat is sufficient really)

- try out videocon during next visit
- limited (one?) missed approach of the DC-8 on MEX?
- low level flying in/over the city with LIDAR off? Still able to look up?
- landing in MEX an option for DC-8?

Requested Forecast Products

- MCMA basin scale: MC to Pachuca
 - 24 hour plume forecasts at 3 layers, 0-1km, 1-2 km, and 2-4 km. Movies preferred
 - Boundary layer heights
 - Clouds and precipitation
- Export to Gulf scale
 - 48 and 72 hour plume forecasts at 0-2 km, 2-4 km, above 4km
 - plumes identified by source and emission time

- flight plans and summaries should be posted on the web as soon as finalized
- coordination of aircraft flights with non-continuous ground sampling such as additional sondes, canisters, mobile sites, etc.

