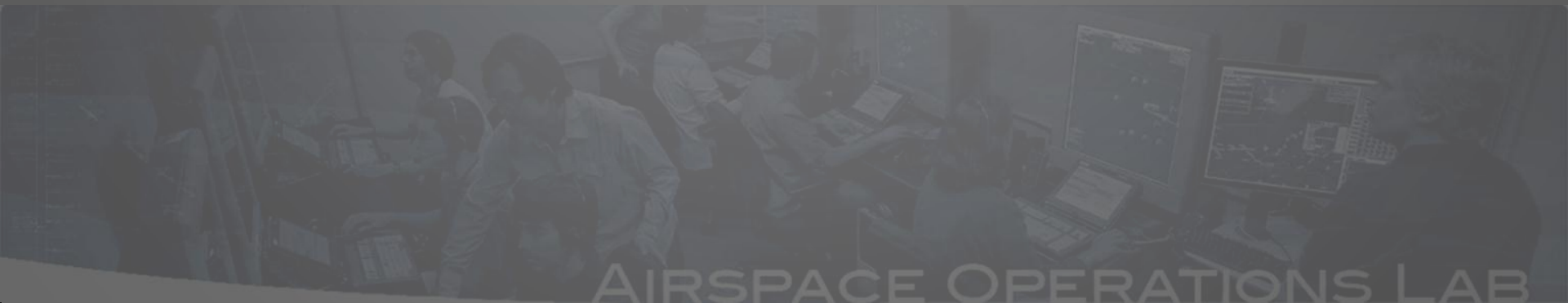


# How to Prepare and Run a Simulation

Michael Kupfer & Jeffrey Homola



# Outline

- Airspace
- Positions and Operator Modes
- Technology Assumptions
- Simulation Setup
- Real Time Simulation Control
- Q&A



# Airspace Selection

- Simulation scope often defines the airspace choice
  - Previous simulations
  - Routes, traffic flows, airports of interest,
  - How many sectors? Multiple centers?
  - TRACON / En-route

## Example CMS study: Airspace SCT / LAX → TRACON

- Major airport, heavy traffic loads
- Metroplex with interacting traffic flows
- Already operative RNAV arrival routes and OPDs
- Close proximity to NASA Ames

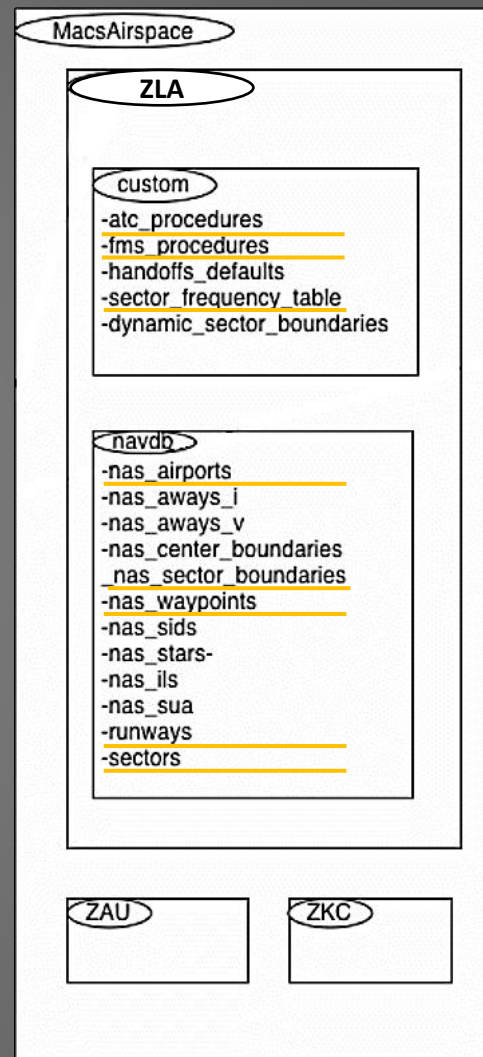
# Airspace Selection

- Frequently used and readily available airspace adaptations:
  - ZID\_SDF
  - ZLA
  - ZKC
  - ZAU
  - ZME
  - ZFW\_DFW
  - ZOB
  - ZNY
- MACS airspace adaptations very similar to CTAS adaptations
- MACS – ADRS adaptation synchronization necessary
  - fms\_procedures
  - atc\_procedures
  - waypoints file
- Properties file:
  - Contains property items specific for each airspace
  - Sets directories of adaptation files and lists those filenames

# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.

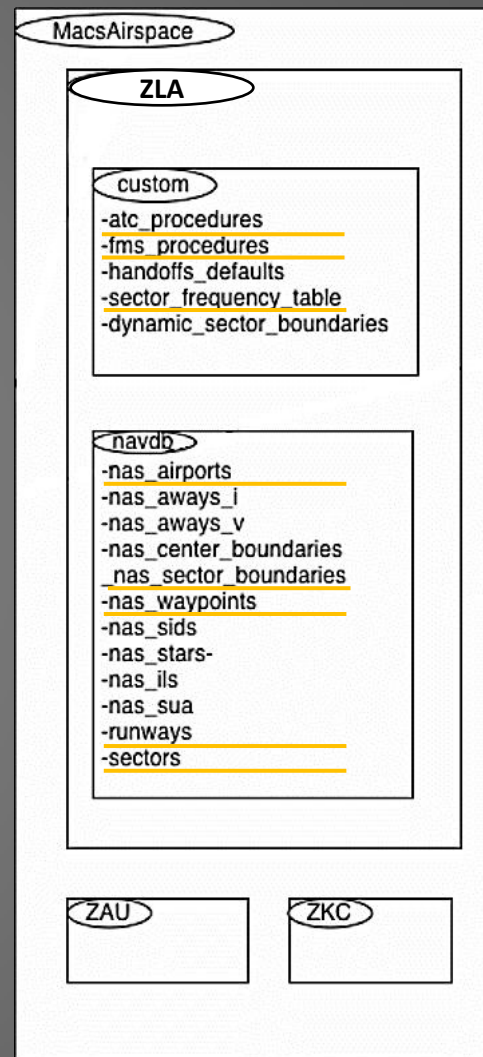
```
TRACON Sectors
#num    center_point    radius arpt    rwy    video_map    position    position
#    lat long            file      name      symbol
#
201 334445 1182010 50 LAX all none.dat zuma Z
202 334445 1182010 50 LAX all none.dat stadium S
203 334445 1182010 50 LAX all none.dat downe D
204 334445 1182010 50 LAX all none.dat feeder F
205 334455 1182010 50 LAX all none.dat feeder_south U
206 334445 1182010 50 LAX all none.dat tower T
207 334445 1182010 50 LAX all none.dat planner P
256 335633 1182429 40 LAX 6L none.dat TMC E
```



# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies

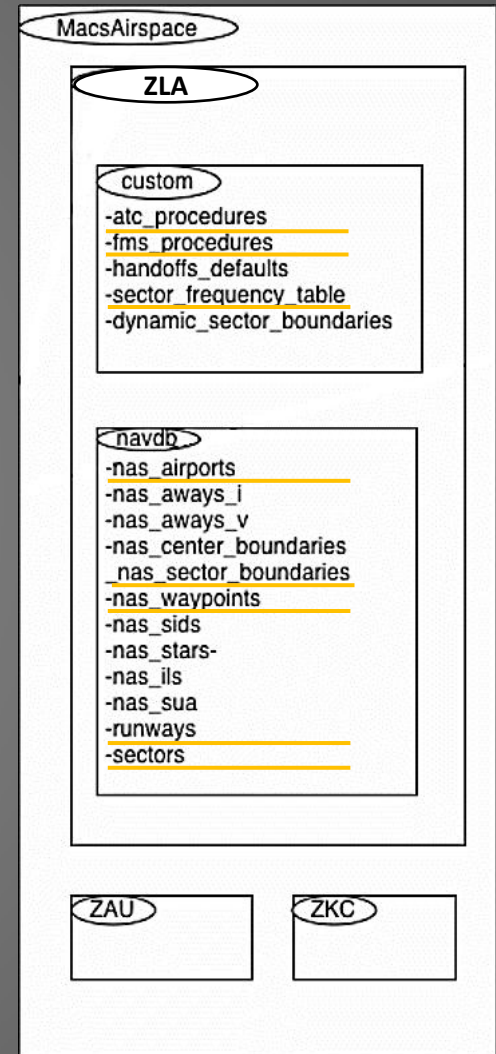
```
#ZLA_37, en route ghost
ZLA_37 127.6
#
#ZLA_201, zuma
ZLA_201 124.5
#
#ZLA_202, stadium
ZLA_202 122.1
#
#ZLA_203, downe
ZLA_203 128.3
```



# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors

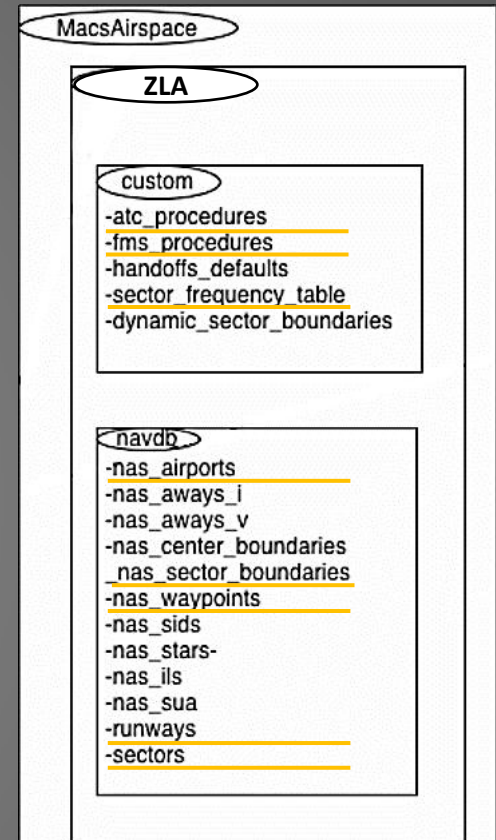
```
sector      20101
region      include
altitude    070/190
vertex      335426 1182631
vertex      340946 1192439
vertex      341906 1192503
vertex      342954 1185959
vertex      343048 1185019
vertex      340604 1184104
vertex      340559 1182653
```





# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors
- fms\_procedures: defining STARS, approaches, etc.

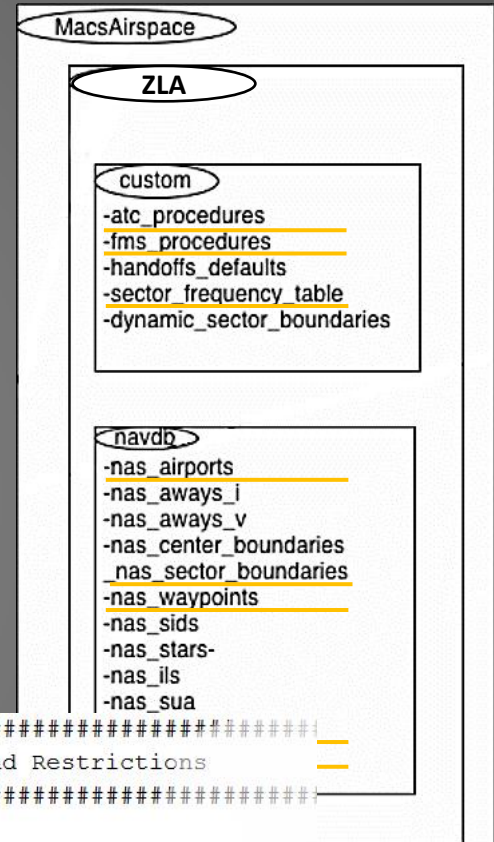


STAR	LAX ALL ALL	RIIVR2	GRAMM:AT17000:S280, RUSTT, RIIVR
STAR	LAX ALL ALL	SEAVU2	KONZL:AT17000:S280, CATAW, SEAVU
STAR	LAX ALL ALL	OLDEE1	LAADY:AT17000:S280, SEAVU
STAR	LAX ALL ALL	SHIVE1	SHIVE:AT15500:S280, MADOW:AT10000:S240, SLI:AT7300:S210
STAR	LAX ALL ALL	SADDE7	SADDE:AT11500:S240, BAYST, CULVE:AT7100:S210
STAR	LAX ALL ALL	LEENA2	SXC:AT17000:S280, CLUSTR, MADOW:AT10000:S240, SLI:AT7300:S210



# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors
- fms\_procedures: defining STARS, approaches, etc.
- atc\_procedures: defining atc routes



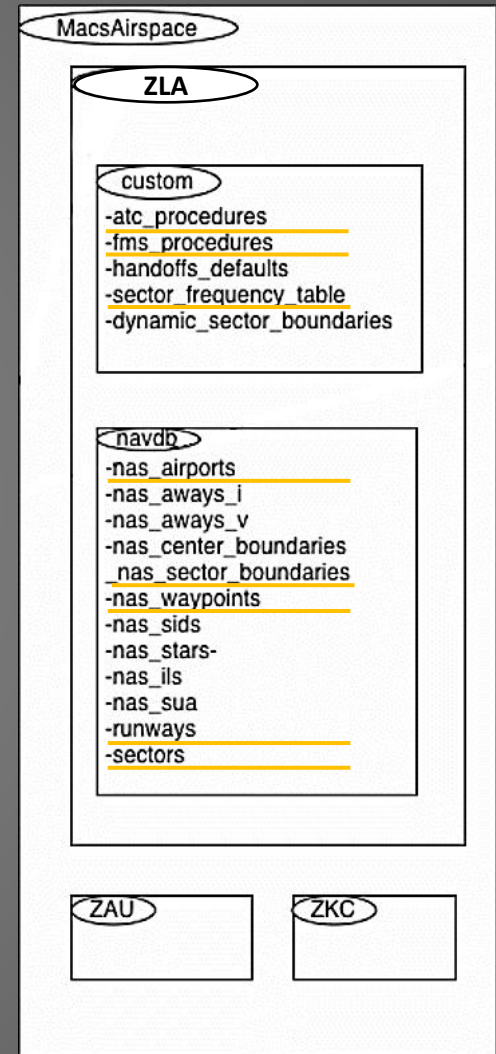
```

#####
#TYPE          AIRPORT RWY ENTRYFIX      TYPE   Name                               DescentCas Range Waypoints and Restrictions
#####
#
#LAX24R
ARRIVAL        LAX      LAX24R  HEC      JET      HEC.RIIVR2.LAX24R      300    200  HEC, GRAMM:AT17000:S280, RUSTT, RIIVR, M
ARRIVAL        LAX      LAX24R  PGS      JET      PGS.RIIVR2.LAX24R      300    200  PGS, GRAMM:AT17000:S280, RUSTT, RIIVR, M
ARRIVAL        LAX      LAX24R  TNP      JET      TNP.SEAVU2.LAX24R      300    200  PKE, TNP, IPHIW, KONZL:AT17000:S280, C
ARRIVAL        LAX      LAX24R  JLI      JET      JLI.OLDEE1.LAX24R      300    200  HIIHO, JLI, LAADY:AT17000:S280, SEAVU, M
ARRIVAL        LAX      LAX24R  AVE      JET      AVE.SADDE7.LAX24R      300    200  AVE, REYES, PIRUE:AT18000:S280, FIM, SA
ARRIVAL        LAX      LAX24R  RZS      JET      RZS.SADDE7.LAX24R      300    200  RZS, DEANO:AT20000:S280, VTU, SADDE:AT
  
```

# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors
- fms\_procedures: defining STARS, approaches, etc.
- atc\_procedures: defining atc routes
- waypoints: defining waypoints and their location

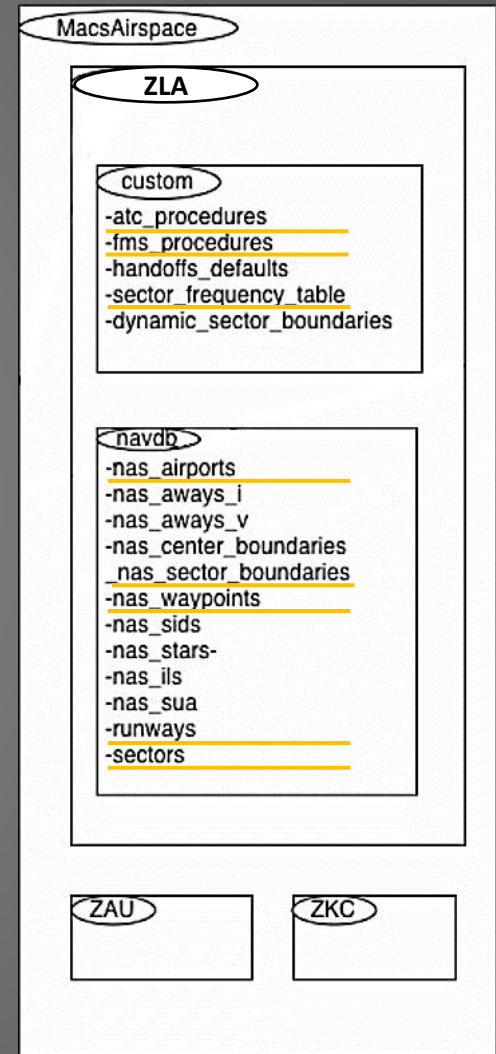
#	name	lat	long	var	elev
1	SHASTA	340427	1181134	0	1
1	GREENE	335952	1181053	0	1
1	BLACKE	335812	1181335	0	1
1	LASSEN	335829	1181041	0	1



# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors
- fms\_procedures: defining STARS, approaches, etc.
- atc\_procedures: defining atc routes
- waypoints: defining waypoints and their location
- airports: defining airports and their reference point location

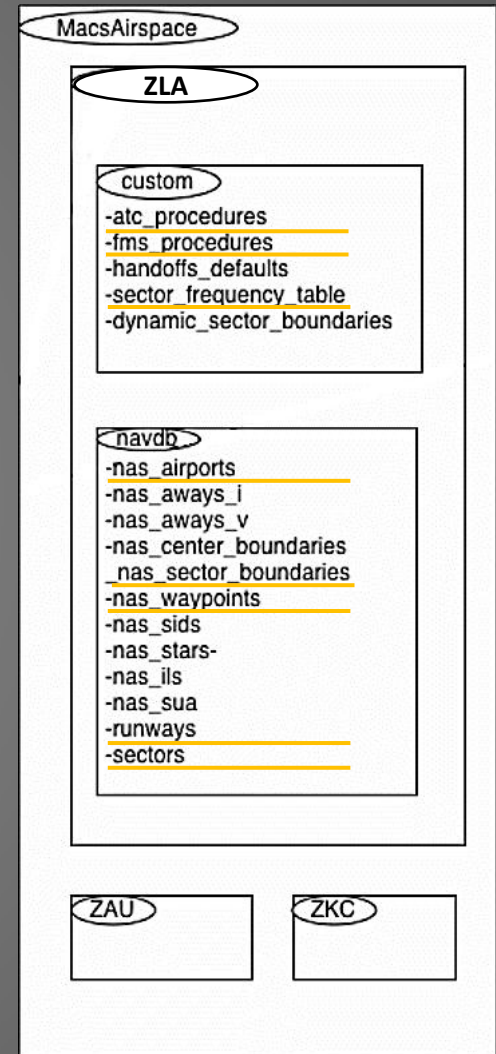
#id	lat	long	elev	loc	
#					
AAA	400931	892006	5	I	
AAS	372130	851834	9	I	
ABE	403908	752625	4	E	
ABEL	332500	1151000	2	I	
ABI	322441	994055	18	I	
ABQ	350225	1063634	54	E	
ABY	313208	841140	1	E	



# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors
- fms\_procedures: defining STARS, approaches, etc.
- atc\_procedures: defining atc routes
- waypoints: defining waypoints and their location
- airports: defining airports and their reference point location
- runways: defining runways and their reference point location

```
runway 24R
waypoint          LAX24R
true_course      264.34
approach_distance 6.41
intercept_altitude 2167
approach_gate     LAX_24R_APCGT
final_approach_fix ROMEN
extended_final    LAX_24R_XFNL
back_of_dump_wpt LAX_24R_BOD
```

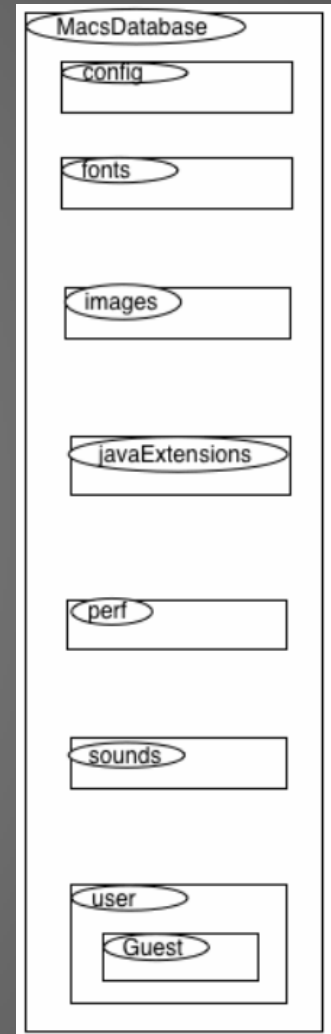


# Adjusting the Airspace Adaptation

- sectors file: set sector name, position symbol, etc.
- sector\_frequency\_table: setting the radio frequencies
- nas\_sector\_boundaries: defining the perimeter of the sectors
- fms\_procedures: defining STARS, approaches, etc.
- atc\_procedures: defining atc routes
- waypoints: defining waypoints and their location
- airports: defining airports and their reference point location
- runways: defining runways and their reference point location
- *Pilot \*.cfg files: setting rules for pilot ownership*

```
NAME          zla_201
:
:
RULES         DISPLAY
sector       all
active       yes
playback     no
source       macs
flights      all
status       all
callsign     all
cdti         yes
END_RULES

RULES         CONTROL
sector       ZLA_201
active       yes
```

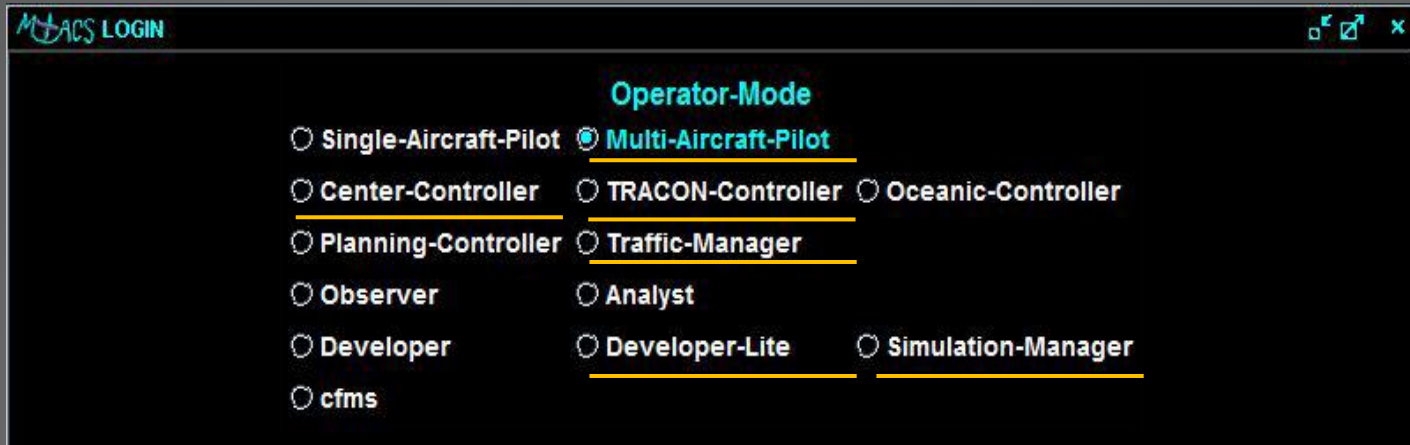




# Position Selection

- Airspace selection will determine which basic positions and operator modes are needed
- Adding additional positions depend on the simulation focus and goals
- Basic MACS positions :
  - Simulation Manager
  - Sector controllers (Center- or, TRACON controller)
  - Ghost controller(s)
  - Pseudo pilots
- Other positions
  - Area supervisor
  - Multi Sector Planner / TMC
  - D-side sector controller
  - Observer stations
- 13 Operator modes in MACS: provide specific functionalities for pilots, controllers, simulation support or, researchers

# Choosing the Operator Mode



## CMS example:

- **Simulation Manager** (simulation control)
- **TRACON Controller** (sectors 201, 202, ...)
- **Center-controller** (ghost station)
- **Multi-Aircraft Pilot**
- **Traffic-Manager** (supervisor)
- **Developer Lite** (researcher stations)

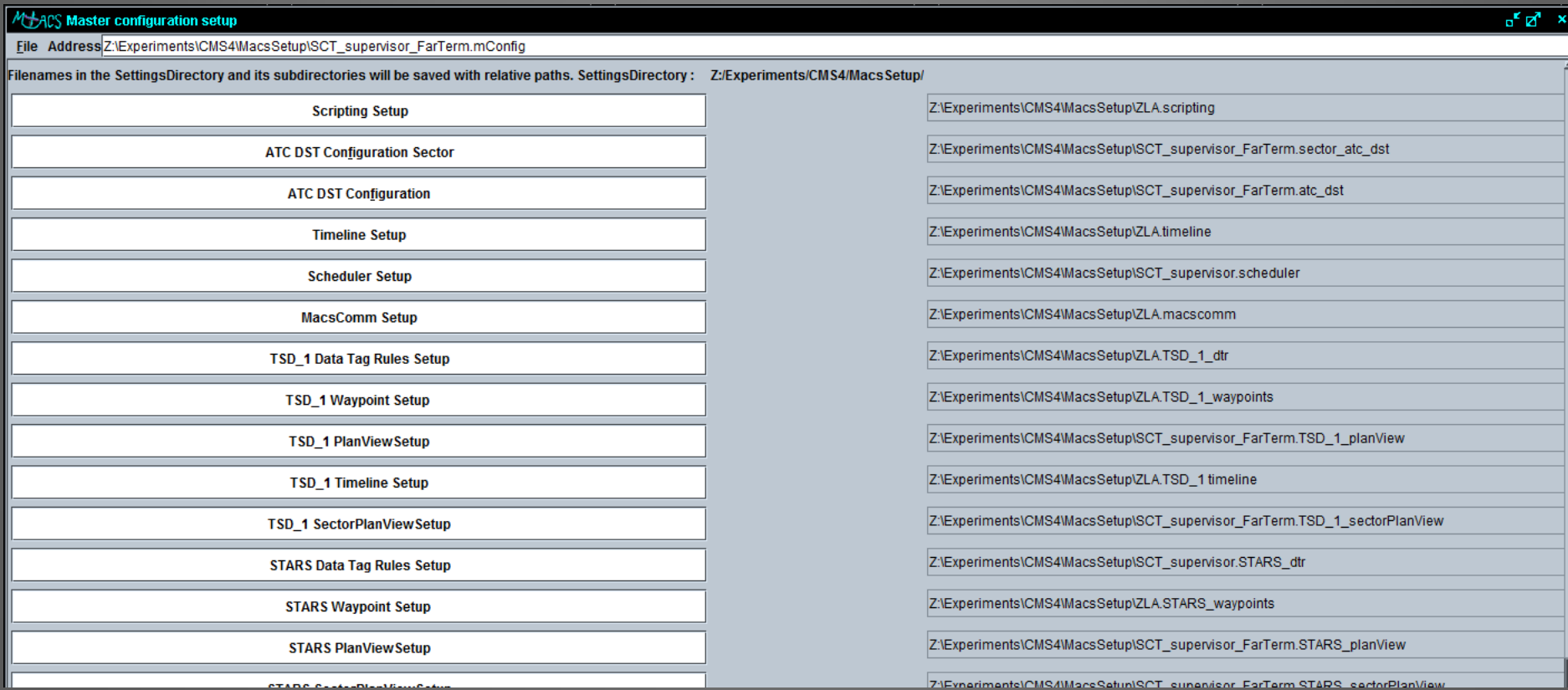
More information under: <https://aol1.arc.nasa.gov:8443/display/macs/Getting+started+with+MACS>



# MACS Setup Panels:

## Modes, Tools, Parameters

- MACS settings are specified in various setup files
- Master configuration file holds the references to all available setup files
- Individual vs. common setup file (Attention! Setup file edits)



The screenshot shows the 'MACS Master configuration setup' application window. The title bar includes the MACS logo and the text 'Master configuration setup'. The address bar shows the file path: 'Z:\Experiments\CMS4\MacsSetup\SCT\_supervisor\_FarTerm.mConfig'. Below the address bar, a message states: 'Filename in the SettingsDirectory and its subdirectories will be saved with relative paths. SettingsDirectory : Z:\Experiments\CMS4\MacsSetup/'. The main area of the window is a table with two columns: the first column lists the names of various setup panels, and the second column lists their corresponding file paths.

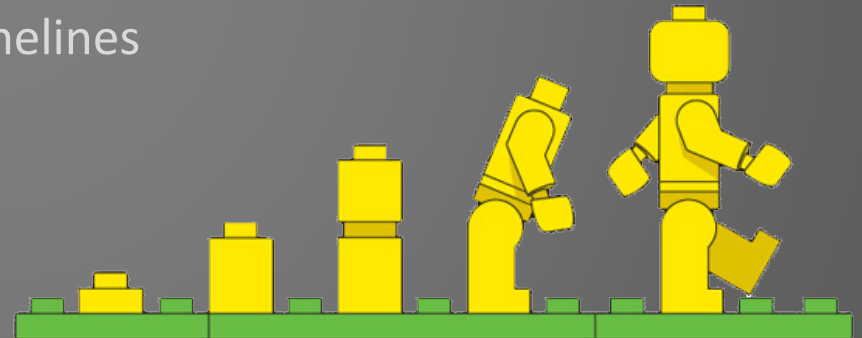
Setup Panel Name	File Path
Scripting Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.scripting
ATC DST Configuration Sector	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor_FarTerm.sector_atc_dst
ATC DST Configuration	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor_FarTerm.atc_dst
Timeline Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.timeline
Scheduler Setup	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor.scheduler
MacsComm Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.macscomm
TSD_1 Data Tag Rules Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.TSD_1_dtr
TSD_1 Waypoint Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.TSD_1_waypoints
TSD_1 PlanViewSetup	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor_FarTerm.TSD_1_planView
TSD_1 Timeline Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.TSD_1 timeline
TSD_1 SectorPlanViewSetup	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor_FarTerm.TSD_1_sectorPlanView
STARS Data Tag Rules Setup	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor.STARS_dtr
STARS Waypoint Setup	Z:\Experiments\CMS4\MacsSetup\ZLA.STARS_waypoints
STARS PlanViewSetup	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor_FarTerm.STARS_planView
STARS SectorPlanViewSetup	Z:\Experiments\CMS4\MacsSetup\SCT_supervisor_FarTerm.STARS_sectorPlanView

# MACS Setup Panels:

## Modes, Tools, Parameters

### Technology Assumptions

- Dependent on simulation scope different tools or automation levels can be enabled/disabled
- Example CMS3 simulation: successively more advanced toolsets
  - Timelines, early late indicators
  - Slot markers, timelines, early late indicators
  - Speed advisories, slot markers, timelines
- Other
  - State Source (radar/ADS-B)
  - Manual / auto hand off
  - Conflict Alert, Conflict Probe, full auto resolution (AAC)
  - Conflict and weather trial planning
  - Early/Late indicators, Speed advisories
  - ...

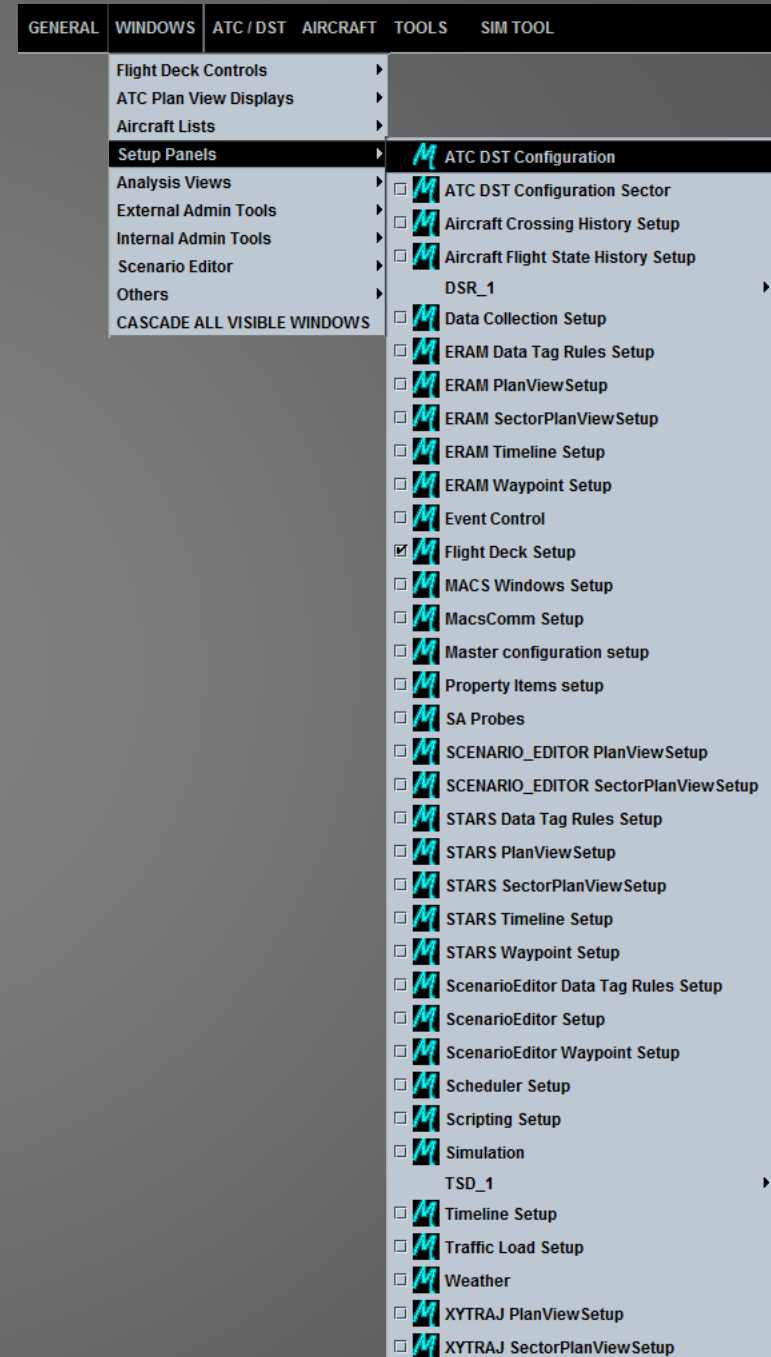


# MACS Setup Panels:

## Modes, Tools, Parameters

### Some important setup files:

- ATC DST Configuration
- ATC DST Configuration Sector
- DSR/STARS/TSD Plan View Setup
- DSR/STARS/TSD Sector Plan View Setup
- DSR/STARS/TSD Timeline Setup
- DSR/STARS/TSD Data Tag Rules Setup
- Data Collection Setup
- Flight Deck Setup
- Scheduler Setup
- Weather Setup



# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration

Flight rule	Treat as autonomous	Snap to invisible waypoints	Tolerance (nm)	Truncate LL	Use Auto Altitude
VFR	<input type="checkbox"/>	<input type="checkbox"/>	1000	<input type="checkbox"/>	<input type="checkbox"/>
IFR	<input type="checkbox"/>	<input type="checkbox"/>	1000	<input type="checkbox"/>	<input type="checkbox"/>
TFR	<input type="checkbox"/>	<input type="checkbox"/>	1000	<input type="checkbox"/>	<input type="checkbox"/>
AFR	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1000	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Trajectory sequencer: MULTI\_PASS

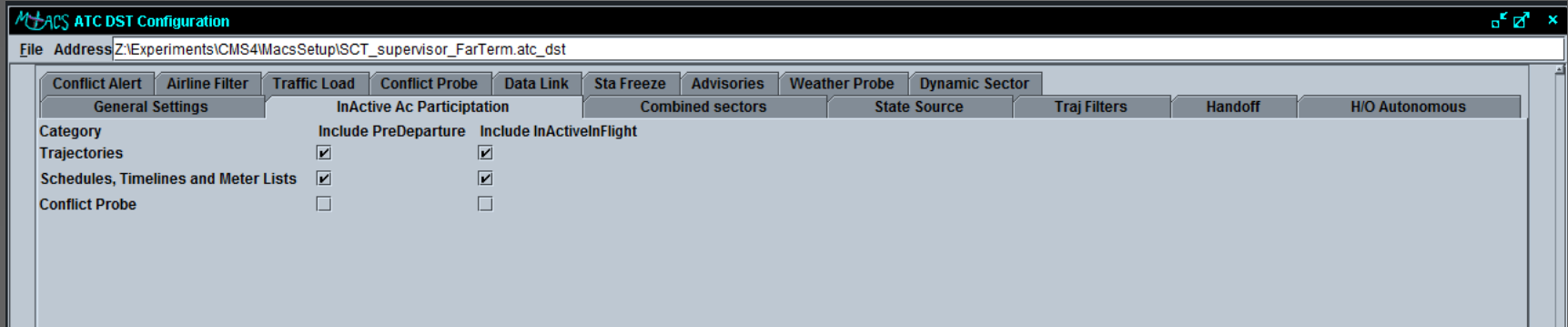
**General Settings**

- Define which aircraft are treated as autonomous (this has implications on other settings (conflict probe, handoffs, etc.))

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration



#### InActive Ac Participation

- Defines if not-yet-initialized in-flight aircraft or pre-departures are considered for the computation of trajectories, schedules, etc.

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration

File Address Z:\Experiments\CMS4\MacsSetup\SCT\_supervisor\_FarTerm.atc\_dst

Conflict Alert Airline Filter Traffic Load Conflict Probe Data Link Sta Freeze Advisories Weather Probe Dynamic Sector

General Settings InActive Ac Participation Combined sectors State Source Traj Filters Handoff H/O Autonomous

ETMS Data Smoothing

AC/State for Computations use DSR outside / STARS inside TRACON

TRACON Radius 100.0 TRACON Ceiling 25000.0

Center TRACON

Tracker Source Selection

Track data source ADSB

Position update Synched at ADSB rate (1s)

Tag value update Synched at ADSB rate (1s)

History Selection

Center radar	TRACON radar	ADSB	Perfect
Length/number fixed field	Length/number fixed field	Length/number fixed field	Length/number fixed field
Fixed length 3	Fixed length 3	Fixed length 3	Fixed length 3
Spacing/Update rate Synched at Center rate(12s)	Spacing/Update rate Synched at TRACON rate (4.2s)	Spacing/Update rate Synched at ADSB rate (1s)	Spacing/Update rate Separately Synched

State Source

- Define the data source for Center/TRACON
- Define settings for history data computation
- Define sync rates

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration

The screenshot shows the MACS ATC DST Configuration window. The title bar reads "MACS ATC DST Configuration". The address bar shows "File Address Z:\Experiments\CMS4\MacsSetup\SCT\_supervisor\_FarTerm.atc\_dst". The window has several tabs: Conflict Alert, Airline Filter, Traffic Load, Conflict Probe, Data Link, Sta Freeze, Advisories, Weather Probe, Dynamic Sector, General Settings, InActive Ac Participation, Combined sectors, State Source, Traj Filters, Handoff, and H/O Autonomous. The "Handoff" tab is selected. The configuration options are as follows:

Accept-handoffs initially	<input checked="" type="checkbox"/>
Auto-handoff enabled	<input type="checkbox"/>
Auto-handoff if inside receiving sector	<input type="checkbox"/>
Use 4D trajectory data only (no assigned altitude limits)	<input type="checkbox"/>
Stable conditions time (Seconds)	30.0
Distance to next sector (NM)	30.0
Minimum travel time through next sector (Seconds)	90.0
Wait time after Accept/Retract (Seconds)	60.0
Post handoff time (Seconds)	10.0
Auto-accept handoff enabled	<input type="checkbox"/>
Accept handoff after (Seconds)	30.0
Auto-Accept handoff within (NM)	10.0

#### Handoff

- Enable/disable auto-handoff
- Define rules for (auto-) handoff (when, where, etc.)



# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration

MACS ATC DST Configuration

File Address Z:\Experiments\CMS4\MacsSetup\SCT\_supervisor\_FarTerm.atc\_dst

Conflict Alert Airline Filter Traffic Load **Conflict Probe** Data Link Sta Freeze Advisories Weather Probe Dynamic Sector

General Settings InActive Ac Participation Combined sectors State Source Traj Filters Handoff H/O Autonomous

Enable conflict probe  Enable Manual Trial Planning  Enable conflict resolution (AAC)  Enable TSAFE resolution

External conflict probe (CTAS)  External Trial Planner (CTAS)  External conflict resolver (CTAS)

Managed/Managed	Trial plan/Managed	Managed/Autonomous	Autonomous/Autonomous
Probe Enabled <input type="checkbox"/>	Probe Enabled <input type="checkbox"/>	Probe Enabled <input type="checkbox"/>	Probe Enabled <input type="checkbox"/>
Automatic Resolutions <input type="checkbox"/>	Automatic Resolutions <input type="checkbox"/>	Automatic Resolutions <input type="checkbox"/>	Automatic Resolutions <input type="checkbox"/>
Earliest time for auto-res (sec to LOS) 480	Earliest time for auto-res (sec to LOS) 480	Earliest time for auto-res (sec to LOS) 480	Earliest time for auto-res (sec to LOS) 480
Latest time for auto-res (sec to LOS) 120	Latest time for auto-res (sec to LOS) 120	Latest time for auto-res (sec to LOS) 120	Latest time for auto-res (sec to LOS) 120
AutoResolution Uplink <input type="checkbox"/>	AutoResolution Uplink <input type="checkbox"/>	AutoResolution Uplink <input type="checkbox"/>	AutoResolution Uplink <input type="checkbox"/>
Use AutoExecution Limits <input type="checkbox"/>	Use AutoExecution Limits <input type="checkbox"/>	Use AutoExecution Limits <input type="checkbox"/>	Use AutoExecution Limits <input type="checkbox"/>
AutoExec: Maximum Delay (sec) 60	AutoExec: Maximum Delay (sec) 60	AutoExec: Maximum Delay (sec) 60	AutoExec: Maximum Delay (sec) 60
AutoExec: Maximum Heading Change 31.0	AutoExec: Maximum Heading Change 31.0	AutoExec: Maximum Heading Change 31.0	AutoExec: Maximum Heading Change 31.0
AutoExec: Maximum Altitude Change 2200.0	AutoExec: Maximum Altitude Change 2200.0	AutoExec: Maximum Altitude Change 2200.0	AutoExec: Maximum Altitude Change 2200.0
AutoExec: Maximum Speed Change 50.0	AutoExec: Maximum Speed Change 50.0	AutoExec: Maximum Speed Change 50.0	AutoExec: Maximum Speed Change 50.0
AutoResolution Graphics <input type="checkbox"/>	AutoResolution Graphics <input checked="" type="checkbox"/>	AutoResolution Graphics <input type="checkbox"/>	AutoResolution Graphics <input type="checkbox"/>
AutoApprove requests <input type="checkbox"/>	AutoApprove requests <input type="checkbox"/>	AutoApprove requests <input type="checkbox"/>	AutoApprove requests <input type="checkbox"/>
TSAFE Resolutions <input type="checkbox"/>	TSAFE Resolutions <input type="checkbox"/>	TSAFE Resolutions <input type="checkbox"/>	TSAFE Resolutions <input type="checkbox"/>
Start time for TSAFE res (sec to LOS) 180	Start time for TSAFE res (sec to LOS) 180	Start time for TSAFE res (sec to LOS) 180	Start time for TSAFE res (sec to LOS) 180
Auto TSAFE Uplink <input type="checkbox"/>	Auto TSAFE Uplink <input type="checkbox"/>	Auto TSAFE Uplink <input type="checkbox"/>	Auto TSAFE Uplink <input type="checkbox"/>
Uplink time for TSAFE res (sec to LOS) 120	Uplink time for TSAFE res (sec to LOS) 120	Uplink time for TSAFE res (sec to LOS) 120	Uplink time for TSAFE res (sec to LOS) 120
Auto TSAFE Return to Flight Plan <input type="checkbox"/>	Auto TSAFE Return to Flight Plan <input type="checkbox"/>	Auto TSAFE Return to Flight Plan <input type="checkbox"/>	Auto TSAFE Return to Flight Plan <input type="checkbox"/>
Auto TSAFE Return Owned Only <input type="checkbox"/>	Auto TSAFE Return Owned Only <input type="checkbox"/>	Auto TSAFE Return Owned Only <input type="checkbox"/>	Auto TSAFE Return Owned Only <input type="checkbox"/>
Show if in my sector or if I own one aircraft <input type="checkbox"/>	Show if in my sector or if I own one aircraft <input type="checkbox"/>	Show if in my sector or if I own one aircraft <input type="checkbox"/>	Show if in my sector or if I own one aircraft <input type="checkbox"/>
Show if I don't own either aircraft <input type="checkbox"/>	Show if I don't own either aircraft <input type="checkbox"/>	Show if I don't own either aircraft <input type="checkbox"/>	Show if I don't own either aircraft <input type="checkbox"/>
Minimum Look Ahead Time 1.0	Minimum Look Ahead Time 1.0	Minimum Look Ahead Time 1.0	Minimum Look Ahead Time 1.0
Look Ahead Time / On Route 15.0	Look Ahead Time / On Route 15.0	Look Ahead Time / On Route 15.0	Look Ahead Time / On Route 15.0
Look Ahead Time / Off Route 5.0	Look Ahead Time / Off Route 5.0	Look Ahead Time / Off Route 5.0	Look Ahead Time / Off Route 5.0
Lateral Separation 3.0	Lateral Separation 3.5	Lateral Separation 5.5	Lateral Separation 5.5
Lateral Separation Low Altitude 5.0	Lateral Separation Low Altitude 5.0	Lateral Separation Low Altitude 5.0	Lateral Separation Low Altitude 5.0

**Conflict Probe**

- Enable/disable different probes/resolution modules
- Set probe and resolution parameters for combination of managed and autonomous aircraft

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration

The screenshot shows the 'MACS ATC DST Configuration' window with the 'Data Link' tab selected. The window title bar shows the file path: Z:\Experiments\CMS4\MacsSetup\SCT\_supervisor\_FarTerm.atc\_dst. The 'Data Link' tab is active, showing various configuration options.

**Data Link Configuration Options:**

- Data link enabled
- Downlink Settings**
  - Use downlinked intent
  - Use downlinked profile
- Uplink Settings**
  - Eligibility required
  - Over ride lack of DL equipage
  - Limited Datalink Uplink to downstream changes
- Seconds to first Trial plan Turn: 90
- Seconds to Turn for data link uplink: 1800
- TOC Mode: OFF
- RTA Mode IFR: OFF
- RTA Mode AFR: OFF
- Use arrival message for RTA
- Timeout Settings**
  - Timeout period: 40
  - Transfer period: 6
  - Positive Response Timeout period: 6
- Display Settings**
  - Use PlanViewSetupWindow to control display of datalink views (menu text, status list, and banner)
- Menu text**

Enabled	Referent	Text	Return type
<input checked="" type="checkbox"/>	M1	CHECK STUCK MIC	ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY
<input type="checkbox"/>			ROG_UNA_SBY

#### Data Link

- Enable/disable DL
- Define requirements and parameters
- Transfer of Communication (TOC)

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration

File Address: C:\Users\mkupfer\NASA\_SJSU\_UARC\_work\MACS\Experiments\ICMS4\MacsSetup\default.atc\_dst

Airline Filter Traffic Load Conflict Probe Data Link Sta Freeze Advisories Weather Probe Dynamic Sector Altitude definitions Corridors

General Settings InActive Ac Participation Combined sectors State Source Traj Filters Handoff H/O Autonomous Conflict Alert

Default fix type: Threshold  Automatically change runway when TMA data Freeze  Use Error Checking on Swap and Resequencing

These are coordinated with Scheduler Setup panel, never save this without saving Scheduler Setup as well

name	freeze	mode	dist (nm sec)	opt dist freeze pt	all ac freeze
LAX24R	true	TIME_TO_STA	1200	NONE	false
LAX25L	true	TIME_TO_STA	1200	NONE	false

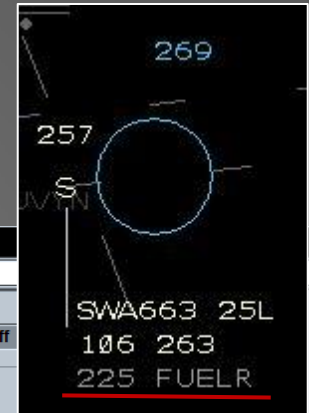
#### STA Freeze

- Coordinated with scheduler setup
- Set reference point for STA freeze
- When/Where to freeze

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration



MACS ATC DST Configuration  
File Address Z:\Experiments\CMS4\MacsSetup\ZLA\_201\_FarTerm.atc\_dst

Conflict Alert | Airline Filter | Traffic Load | Conflict Probe | Data Link | Sta Freeze | Advisories | Weather Probe | Dynamic Sector  
General Settings | InActive Ac Participation | Combined sectors | State Source | Traj Filters | Handoff

#### 4D Trajectory Logic

LOGIC TYPE: SPEEDS\_FOR\_NOMINAL\_OPD Tactical Speeds to join Nominal Optimal Profile Descents

Enabled  STA assignment required  speed advisories enabled  Early/Late indication enabled

Min secs ac must be late to show advisory or late time: 1 Min secs ac must be early to show advisory or early time: 1

Min secs ac must be late to compute advisory: 5 Min secs ac must be early to compute advisory: 5

Minimum Altitude to be included: 2200.0 Maximum Altitude to be included: 25000.0

ASTAR use dynamic (FMS active) trajectory  ASTAR use ATC procedures

Use Next Schedule Point only for Speed Advisory

#### Self Spacing Logic

SPACING PROTOCOL: Basic LOGIC TYPE: NONE

Enabled  STA assignment required

Select Lead with same category(jet/turbo)

Maximum secs ac can be ahead to show advisory: 30

Minimum Altitude to be included: 1000.0

ASTAR use dynamic (FMS active) trajectory  ASTAR use ATC procedures

Use Next Schedule Point only for Speed Advisory

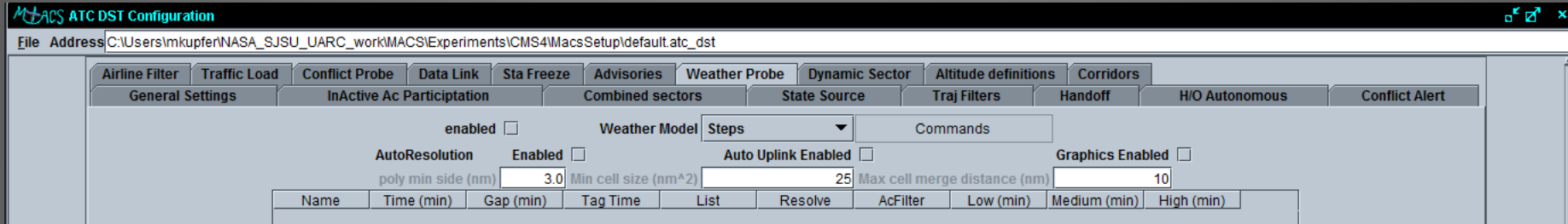
#### Advisories

- Enable/disable Speed Advisories, Early/Late indicators, Self Spacing
- Different Logic types and spacing protocols e.g.,
  - SPEEDS\_FOR\_NOMINAL\_OPD
  - AIRBORNE\_SPACING\_ADVISORY
  - SPACING\_FEEDBACK
- Set parameters for when advisories are displayed

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration



### Weather Probe

- Compute predicted weather cell penetration

# MACS Setup Panels:

## Modes, Tools, Parameters

### ATC DST Configuration Sector

MACS ATC DST Configuration Sector

File Address Z:\Experiments\CMS4\MacsSetup\ZLA\_201\_FarTerm.sector\_atc\_dst

Main Ownership Handoff H/O Autonomous Conflict Probe Controller Preference

**Sector controller**

Single Sector Ownership  Single Sector Ownership ZLA\_201

ACTIVE OWNERSHIP ENABLED

Handoff to all sectors you don't own

Handoff Autonomous to all sectors you don't own

Conflict Probe Sync Sectors from Ownership

**CMS supervisor:**

Single Sector Ownership  Single Sector Ownership ZLA\_207

ACTIVE OWNERSHIP ENABLED

#### Main

- Set the sector ownership
- Set sector related handoff and conflict probe rules

# MACS Setup Panels:

## Modes, Tools, Parameters

### STARS Data Tag Rules Setup

MACS STARS Data Tag Rules Setup

File Edit Address Z:\Experiments\CMS4\MacsSetup\ZLA\STARS\_dtr

Copy from limited Copy from full

default tag position NORTH

show main data tag

lines in main data tag 3

Line 1, number of fields 3

Line 2, number of fields 5

Line 3, number of fields 1

show tag line at ac position

Line 1, number of fields 1

Name	Filter	TagRules	TagLayout	TagColor	TagAppearance	TagItemColor	TagItemAppearance	AcPositionTag	Symbol	History	SymbolColor	SymbolFlash	LeaderLine	TimelineColors
default		default	default		default	default	default	default	?	default		default	default	
owned														
25L													custom	

- Design the appearance of the data tags in the STARS display
- Use filters to create rules for different sub-groups of aircraft
- Set the correct priority of rules in the list
- More information:  
<https://aol1.arc.nasa.gov:8443/display/macs/MACS+Questions+and+Answers>



# MACS Setup Panels:

## Modes, Tools, Parameters

### STARS Plan View Setup

MACS STARS PlanViewSetup

File Address Z:\Experiments\CMS4\MacsSetup\ZLA\_201\_FarTerm.STARS\_planView

Colors Fonts Mode Feedback Sector Display Mouse/Keyboard/DAK ATC Specific Options DataTag Popup Views Ac to Display Target/History Tools Weather

Flight plan/Halo display

default

Default look ahead time

Entire plan

Default time

Show trajectory

- Modify the appearance of the STARS display

— Colors, fonts, ...

- Change the keyboard, mouse, and trackball behavior as well as the keyboard mapping

- Define which aircraft are displayed

- Enable functions and tools and set their parameters i.e., data block popup menus, history symbols, pulse predictors, slot markers, spacing cones, etc.

Spacing circles

Show spacing circles for all aircraft

Show spacing circles for dwelled aircraft

Cones

Base cone length on runway scheduler

Base cone length on next merge point scheduler

Base cone length on lead aircraft

Slot Markers

Show slot markers for all aircraft

Show slot markers for controlled aircraft

Timeout after Handoff (sec)

Show slot markers for dwelled aircraft

Show slot marker after handoff

Timeout for all Slots (sec)

Time Based Radius

Show ground speed on slot markers

Enable Altitude Filter (ft)

Show indicated air speed on slot markers

# MACS Setup Panels:

## Modes, Tools, Parameters

### STARS Plan View Setup

**Mouse/Keyboard/DAK**

Mouse/Pointer Assignments

left button: Pick

middle button: Enter

right button: Enter

Pointer interaction: Drag

Pan enabled

Snap-To TrialPlan Waypoint enabled

Snap To Waypoint Dist (pix): 24

Pick Range Pix: 30

Keyboard Mapping

PC mapping  FAA mapping (Keyboard before 2005)

FAA mapping (Keyboard 2005 and later)  FAA mapping (PC via USB)

(Cortron) USB Keyboard  ARTS (Orbit) USB Keyboard

**Ac to Display**

Suppress aircraft outside sector range

Include pre-departure ac

Include inactive in flight ac

Min/Max altitude filter(ft) min: 28000 max: 99900

**Weather**

Convective Weather

Low  (0, 77, 39)

Medium  (51, 153, 0)

High  (163, 204, 122)

Draw weather AutoResolver bounding polygons

Loop

Start time (min): -60

End time (min): 0

Speed up factor: 2.0

Pause time (sec): 0

Update frequency: 6 min

Use Future Colors

Low

Medium

High

Weather Probe Motion

Weather Display Motion

# MACS Setup Panels:

## Modes, Tools, Parameters

### Scheduler Setup

- Define schedulers at various points
- Adjust different parameters
- Filters to apply schedulers to certain sub groups of aircraft
- Editable spacing constraints
- Gets coordinated with ATC DST Setup → Sta freeze

Enable Scheduling

Name: CMS3

Spacing Data: CMS3

Resolution (sec): 1

Excess time (sec): 0.0

Excess distance (nm): 0.5

Units: NAUTICAL\_MILES

	Trail Small	Trail Large	Trail Heavy	Trail 757
Lead Small	3.0	3.0	3.0	3.0
Lead Large	4.0	3.0	3.0	3.0
Lead Heavy	6.0	5.0	4.0	4.0
Lead 757	5.0	4.0	4.0	4.0

These are coordinated with ATC DST Configuration Sta Freeze panel, never save this without saving ATC DST Configuration as well

name	enabled	type	planner	Auto Resolve (AR)	AR: min delay (sec)	AR: favor slower (sec)	AR: min sec to UC	early max (sec)	1st ac sch	trajectory type	crossOver	acFilter	spacing
LAX24R	true	MACS	false	false	10	5	180	30	false	FlightPlan	LAX24R	FROM	CMS3
LAX25L	true	MACS	false	false	10	5	180	30	false	FlightPlan	LAX25L	FROM	CMS3
LAX24L	true	MACS	false	false	10	5	180	30	false	FlightPlan	LAX24L	NO_ITEMS	CMS3
LAX25R	true	MACS	false	false	10	5	180	30	false	FlightPlan	LAX25R	NO_ITEMS	CMS3
SAN27	true	MACS	false	false	10	5	180	30	false	FlightPlan	SAN27	FROM	CMS3
CULVE	true	MACS	false	false	10	5	180	30	false	Nominal	CULVE	FROM	3_NMI
SLI	true	MACS	false	false	10	5	180	30	false	Nominal	SLI	FROM	3_NMI
FUELR	true	MACS	false	false	10	5	180	30	false	Nominal	FUELR	FROM	3_NMI
PALAC	true	MACS	false	false	10	5	180	30	false	Nominal	PALAC	FROM	3_NMI

# MACS Setup Panels:

## Modes, Tools, Parameters

### STARS Timeline Setup

MACS STARS Timeline Setup

File Edit Address Z:\Experiments\CMS4\MacsSetup\ZLA.STARS\_timeline

Slack slop (sec)   
 Overlap slop (sec)

timeline	length (min)	gap (min)	ownedOnly	pixPerMin	crossOver	showStack	showOverlap	assign	swap	reset	move	plan	L arvType	L scheduler	L acFilter	R arvType	R scheduler	R acFilter
LAX24R	25	0	false	35	LAX24R	true	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	LAX24R	FROM
LAX25L	25	0	false	35	LAX25L	true	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	LAX25L	FROM
CULVE	20	0	false	35	CULVE	false	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	CULVE	FROM
SLI	20	0	false	35	SLI	false	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	SLI	FROM
FUELR	20	0	false	35	FUELR	false	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	FUELR	FROM
PALAC	20	0	false	35	PALAC	false	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	PALAC	FROM
SAN27	60	0	false	10	SAN27	true	true	false	false	false	false	false	FLIGHT_PLAN_ETA	NONE	FROM	SCHEDULE_STA	SAN27	FROM

meter list maxLines ownedOnly crossOver etaType staType scheduler delayDisplayOptions acFilter item item item item item item item

For supervisor:

assign	swap	reset	move	plan
true	true	true	true	true
true	true	true	true	true

L arvType	L scheduler	L
FLIGHT_PLAN_ETA	NONE	TO*
FLIGHT_PLAN_ETA	NONE	TO*
FLIGHT_PLAN_ETA	NONE	TO*
FLIGHT_PLAN_ETA	NOMINAL_ETA	
FLIGHT_PLAN_ETA	FLIGHT_PLAN_ETA	
FLIGHT_PLAN_ETA	CURRENT_ETA	
FLIGHT_PLAN_ETA	DIRECT_TO_ETA	
FLIGHT_PLAN_ETA	DATA_LINKED_ETA	
FLIGHT_PLAN_ETA	CTAS_ETA	
	CTAS_STA	
	SCHEDULE_STA	

- Define timelines and meter lists

- ETA/STA types
- Appearance
- Filters

- Feeds into STARS Sector PlanView Setup → Optional Views

# MACS Setup Panels:

## Modes, Tools, Parameters

### Data Collection Setup

- Define which data collection items will be logged and in which frequency
- 10 a.m. day 2: MACS Data Output and Analysis Session

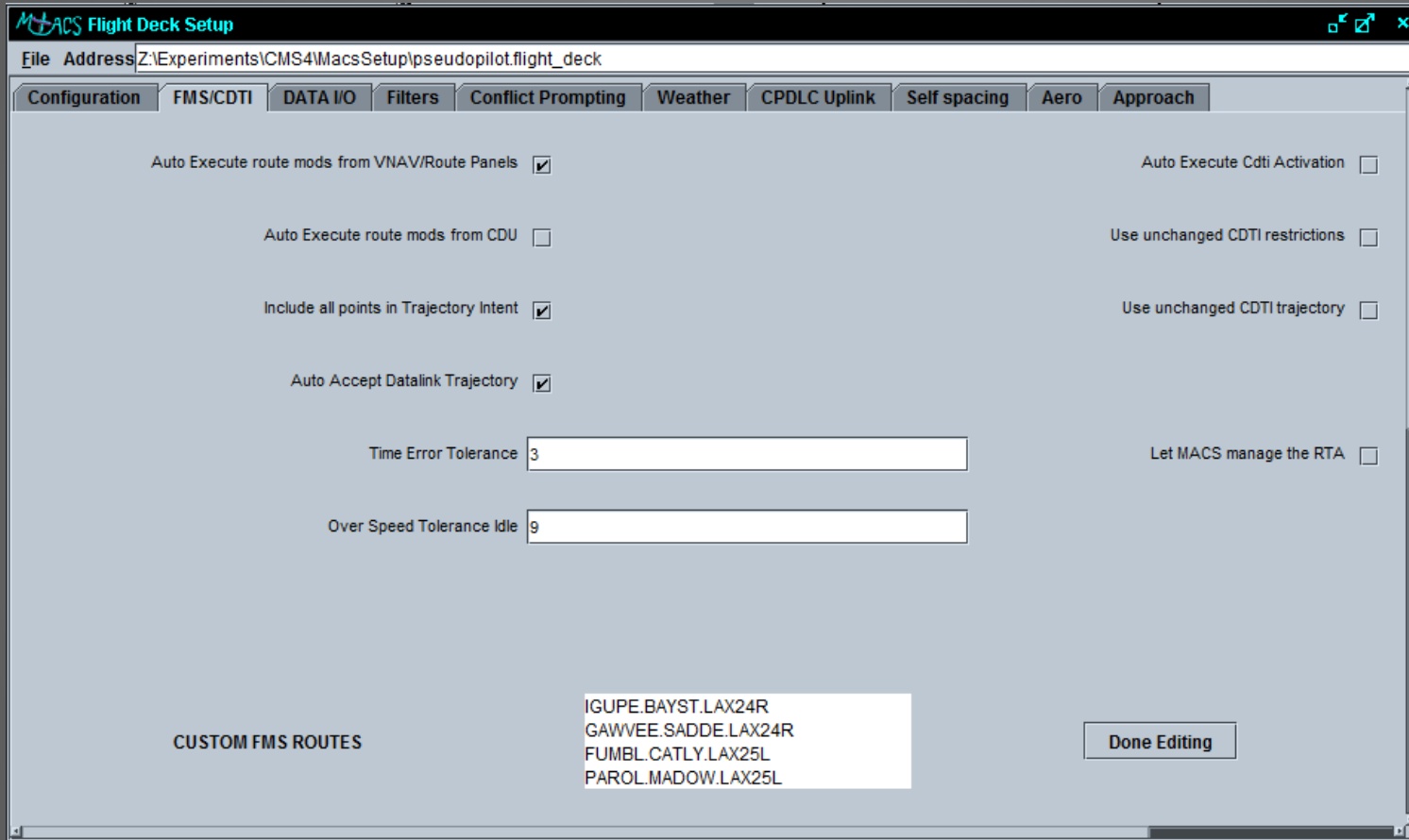
The screenshot shows the 'MACS Data Collection Setup' window with the following elements:

- File Address:** Z:\Experiments\CMS4\MacsSetup\ATC.dataCollection
- Control Panel:** Control, ATC State log, Custom log
- Logging Options:**
  - recordConflictAlert (NOTE: dependent on settings in Conflict Alert tab of ATC DST Configuration setup window)
  - recordSeparationViolation (NOTE: dependent on settings in Conflict Alert tab of ATC DST Configuration setup window)
  - recordSectorCount
  - recordConflictProbe (NOTE: dependent on settings in Conflict Probe tab of ATC DST Configuration setup window)
- Meter Fix Crossing Options:** Meter fix crossing, Waypoint crossing, Runway crossing, Distance/time flown
  - no meter fix logging
  - log meter fix crossing through trajectory data
  - log meter fix crossing through position calculations
- test radius (NM) for meter fix crossing calculations:** 3.0
- Meter fix search list:**
  - Waypoint in meter fix search list: LAX25L, LAX24R, SHIVE, PIRUE, KONZL, SXC, DEANO, LAADY, GRAMM
  - Buttons: Add meter fix, Remove selected meter fix

# MACS Setup Panels:

## Modes, Tools, Parameters

### Flight Deck Setup



- Define aircraft functionalities and flight deck displays
  - FMS/CDTI, CPDLC Uplink, Self Spacing

# MACS Setup Panels:

## Modes, Tools, Parameters

### Weather Setup

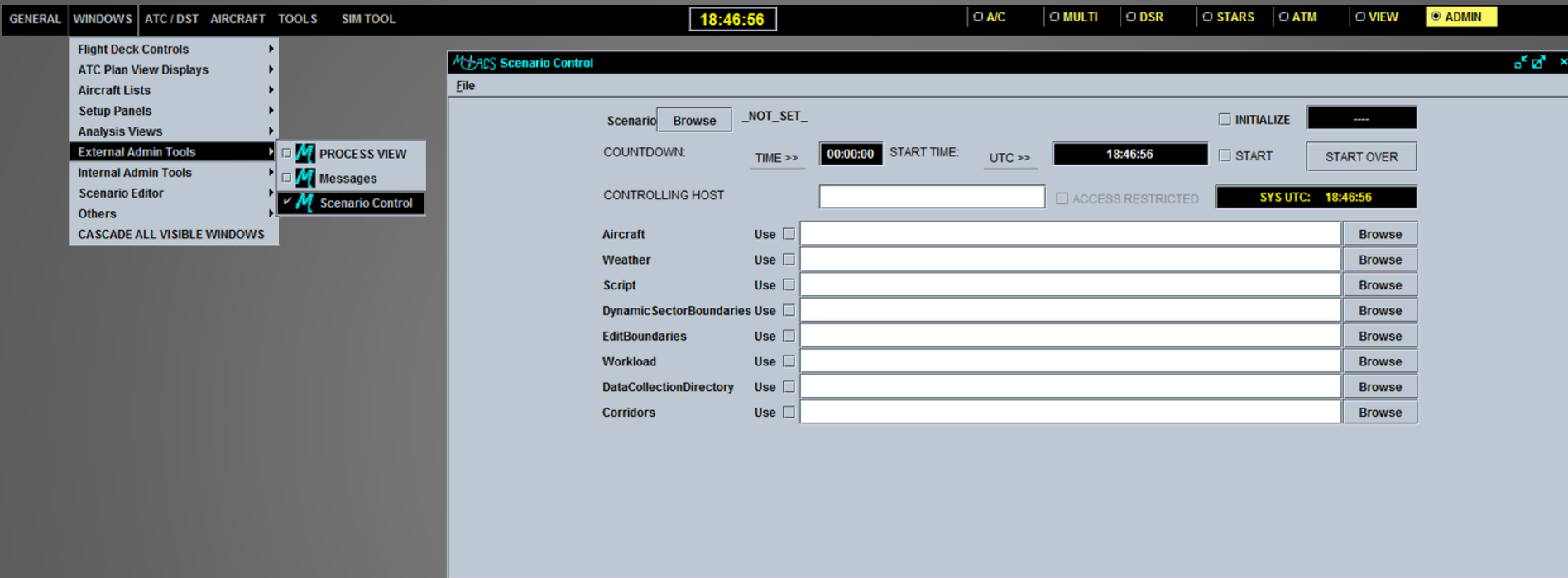
- Define constant winds for environment, flight deck and ATC forecast
- Enable/disable convective weather and reference to weather \*.xml file (see also scenario control window)

The screenshot shows the MACS Weather application window. The title bar reads "MACS Weather" and the address bar shows the file path: "C:\Users\mkupfer\NASA\_SJSU\_UARC\_work\MACS\Experiments\CMS4\MacsSetup\WINDS\_MINUS\_BIAS\_FINAL.weather". The main interface has four tabs: "ENVIRONMENT", "FLIGHT DECK FORECAST", "ATC FORECAST", and "Wx Selection". The "ENVIRONMENT" tab is active. It contains several checkboxes: "RUC ATMOSPHERE" (unchecked), "VERTICAL ONLY" (checked), and "Standard Atmosphere" (checked). Below these is a text field for "Current Ruc File" and a "BROWSE/LOAD" button. A sub-panel titled "View RUC Weather" is open, showing a table of atmospheric parameters for various altitudes. The "Edit Vertical Only" sub-panel is also visible.

Location X	Location Y	Altitude	Wind Direction	Speed
354.264	278.27286	30000.0	265.0	60.0
		20000.0	265.0	50.0
		15000.0	265.0	34.0
		10000.0	265.0	25.0
		8000.0	265.0	20.0
		6000.0	265.0	16.0
		4000.0	265.0	10.0
		2000.0	265.0	8.0
		1500.0	265.0	6.0
		0.0	265.0	5.0



# Scenario Control Interface



## Scenario Control

- Scenario bundles are created and loaded through the Scenario Control interface
- Scenario Control also used for starting and stopping simulation runs

# Scenario Control Interface

The screenshot shows the MACS Scenario Control interface. At the top, the title bar reads "MACS Scenario Control". Below the title bar, there is a "File" menu. The main interface is divided into several sections:

- Scenario:** A dropdown menu showing "\_NOT\_SET\_" and a "Browse" button.
- INITIALIZE:** A checkbox and a button labeled "----".
- COUNTDOWN:** A section with "TIME >>" and a display showing "00:00:00".
- START TIME:** A section with "UTC >>" and a display showing "18:46:56".
- START:** A checkbox and a button labeled "START OVER".
- CONTROLLING HOST:** A text input field and a checkbox labeled "ACCESS RESTRICTED".
- SYS UTC:** A display showing "18:46:56".
- Configuration Table:** A table with columns for category, "Use" checkbox, file path, and "Browse" button.

Category	Use	File Path	Action
Aircraft	<input type="checkbox"/>	Scenario traffic file (.txt)	Browse
Weather	<input type="checkbox"/>	.weather file	Browse
Script	<input type="checkbox"/>	Python file (.py) used for scripted simulation events	Browse
DynamicSectorBoundaries	<input type="checkbox"/>	Scripted sector boundaries (.txt)	Browse
EditBoundaries	<input type="checkbox"/>	Set of editable sector boundaries (.txt)	Browse
Workload	<input type="checkbox"/>	Workload prompt setup file (.windowssetup)	Browse
DataCollectionDirectory	<input type="checkbox"/>	Where data will be written	Browse
Corridors	<input type="checkbox"/>	Corridor definition file	Browse

- Dependencies exist between local settings and the scenario bundle
- “Use” boxes must be checked for associated file to be distributed
  - If not, whatever is defined in a position’s master configuration file will be loaded
- When including convective weather, make sure proper path for .xml file is defined in the weather setup file’s “Wx Selection” tab and checkbox is checked
- Ensure ADRSs are collecting data (if desired)

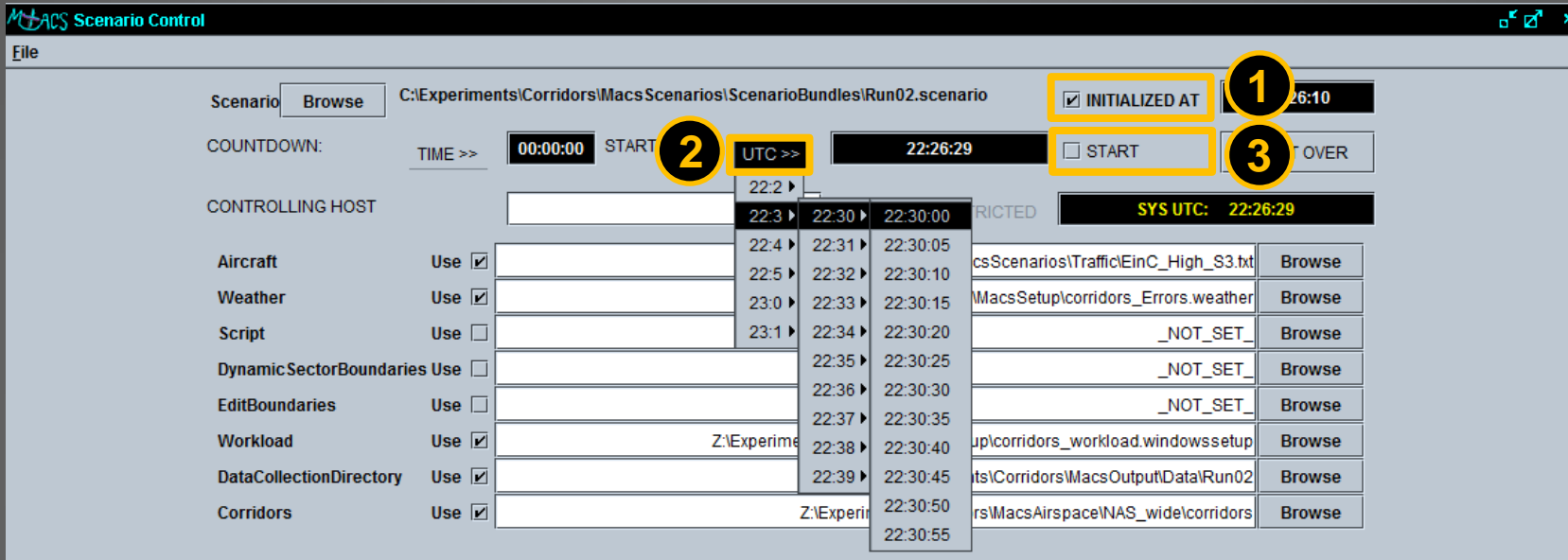
# Scenario Control Interface

The screenshot displays the MACS Scenario Control interface. On the left, a 'Select master scenario file' dialog is open, showing a file list with columns for file names and dates. The 'File Name' field is set to '20110404\_run24.scenario' and the 'Files of Type' is set to '\*.scenario'. The 'Open' button is visible. The main interface shows the 'Scenario' field with a 'Browse' button and the file path 'Z:\Experiments\CMS4\Macs Scenarios\scenario\_bundles\Datacollection\Week2\20110404\_run24.scenario'. The 'INITIALIZED AT' field shows '23:34:37'. The 'COUNTDOWN' field shows '-00:24:21' and the 'START TIME' field shows '23:34:38'. The 'CONTROLLING HOST' field is empty. The 'ACCESS RESTRICTED' checkbox is unchecked. The 'SYS UTC' field shows '23:58:59'. Below these fields is a table of configuration items:

Item	Use	Value	Action
Aircraft	<input checked="" type="checkbox"/>	Z:\Experiments\CMS4\Macs Scenarios\traffic_files\Datacollection\20110404_run24.txt	Browse
Weather	<input checked="" type="checkbox"/>	Z:\Experiments\CMS4\Macs Setup\WINDS_MINUS_BIAS_FINAL.weather	Browse
Script	<input checked="" type="checkbox"/>	Z:\Experiments\CMS4\Macs Scenarios\script_files\W2R24.py	Browse
DynamicSectorBoundaries	<input type="checkbox"/>	_NOT_SET_	Browse
EditBoundaries	<input type="checkbox"/>	_NOT_SET_	Browse
Workload	<input type="checkbox"/>	Z:\Experiments\CMS4\Macs Setup\ZLA.windowsetup	Browse
DataCollectionDirectory	<input checked="" type="checkbox"/>	Z:\Experiments\TestOutput\CMS4\DataCollection\Week2\MACS_data\run24	Browse
Corridors	<input type="checkbox"/>	_NOT_SET_	Browse

- Bundles can be loaded through the File menu or Browse portal (as shown)
- Ensure settings are correct. If ANY changes are made, make sure file is saved

# Scenario Control Interface



1. Check the "INITIALIZED AT" box to begin startup process
2. Select a desired and realistic start time through the "UTC" flyout menus
3. Check the "START" box to distribute the bundle
4. A countdown will begin in the "TIME" window

# Simulation Supervision

During simulation possible tasks may be:

- Modify controller displays (colors of tools, datablock layout, etc., bring up timelines)
- Restart station
  - Wrong shortcut loaded initially
  - Problems with displays
- Real time flight monitoring (XY Trajectory Panel)
- Assist pseudo pilots
- Delete aircraft

# Real Time Control Panels

- Real Time AC Editing (duplicate, modify non-initialized, or delete aircraft)

callsign	timeToEnter	atcType	type	departureAi...	departureR...	destination...	landingRun...	filedRoute	route	startPointN...	targetWayp...	heading
AA15418	0	B738	B738	TUS	NOT_SET	LAX	LAX25L	TUS./..MZB....	..PEBLE.SH...	324538N/1...	MZB	277.591

- Real Time AC Display: prepare to delete aircraft)

call	timeToEnter	atcType	type	departureAi...	departureR...	destination...	landingRun...	filedRoute	route	startPointN...	targetWayp...	headingTar...	trueHeading	latitu
AA154	0	B738	B738	TUS	NOT_SET	LAX	LAX25L	TUS./..MZB....	..PEBLE.SH...	324538N/1...	MZB	277.59177	276.18268	32.760
AFL69	0	B738	B738	TUS	NOT_SET	LAX	LAX25L	EWK./..MZ...	..PEBLE.S...	330246N/1...	PEBLE	307.6556	308.5556	33.046
ASA73	0	B738	B738	TUS	NOT_SET	LAX	LAX25L	ORD./..HE...	..GRAMM.R...	342711N/1...	GRAMM	220.96292	218.17125	34.453
AWE6205	0	B732	B732	BOS	NOT_SET	LAX	LAX25L	BOS./..TNP...	..KONZL.S...	335833N/1...	CATAW	268.81537	264.72162	33.975
DAL3771	0	B763	B763	JFK	NOT_SET	LAX	LAX25L	JFK./..TNP...	..CATAW.S...	335622N/1...	CATAW	267.75137	264.85236	33.939
JZA439	0	CRJ7	CRJ7	SLC	NOT_SET	LAX	LAX25L	SLC./..HEC...	..GRAMM.R...	345210N/1...	HEC	202.69965	209.56631	34.869
JZA4471	0	CRJ7	CRJ7	SLC	NOT_SET	LAX	LAX25L	SLC./..HEC...	..GRAMM.R...	344209N/1...	GRAMM	216.68239	218.17128	34.702

# Questions and Answers



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