

N83 22302 <sup>413</sup>

MODELING CORRELATION WITH FLIGHT DATA

H. K. F. Ehlers  
Johnson Space Center



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SHUTTLE ENVIRONMENT WORKSHOP

MODELING CORRELATION WITH FLIGHT DATA

H. K. F. EHLERS

MOLECULAR (CONTAMINATION) FLOW MODELING  
(SPACE 2 PROGRAM)

- PURPOSE OF THE MODEL
  - PREDICT THE INDUCED ENVIRONMENT OF THE SPACE SHUTTLE ORBITER/PAYLOAD ON-ORBIT
    - MODEL OUTPUT PARAMETERS
      - DENSITY
      - COLUMN DENSITY
      - RETURN FLUX
  - PREDICT THE INDUCED GAS FLOW BETWEEN ORBITER/PAYLOAD SURFACES
    - MODEL OUTPUT PARAMETERS
      - DIRECT SOURCE TO RECEIVER GAS FLOW
      - REFLECTED SOURCE TO RECEIVER GAS FLOW

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MOLECULAR (CONTAMINATION) FLOW MODELING  
(SPACE 2 PROGRAM)

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- MODEL DESCRIPTION

THE MODEL IS A COMPUTER PROGRAM RELATING CERTAIN INPUT PARAMETERS TO THE REQUIRED OUTPUT PARAMETERS. THE INPUT PARAMETERS CHARACTERIZE THE TIME DEPENDENT STATUS OF THE ORBITER/PAYLOAD

- INPUT PARAMETERS

- BODY GEOMETRY
- MATERIALS GAS EMISSION/REFLECTION/ABSORPTION CHARACTERISTICS
- ENGINE/VENT CHARACTERISTICS
- AMBIENT/EMITTED GAS INTERACTION
- TEMPERATURES
- TIME DEPENDENCE

- PROGRAM

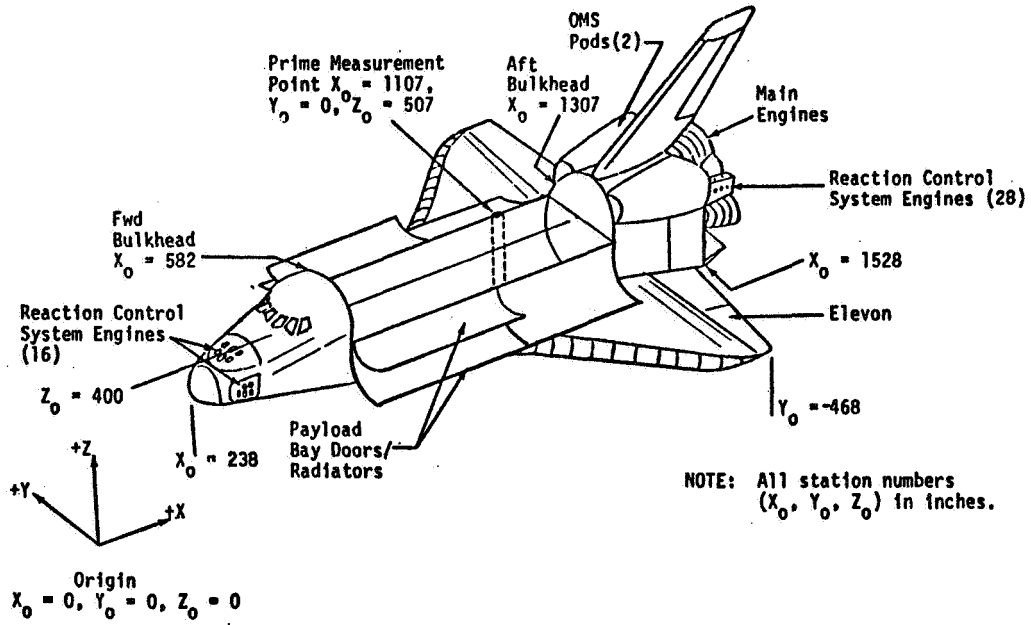
- MOLECULAR TRANSPORT MECHANISMS

MODEL APPLICATION: ORBITER FLIGHT TESTS

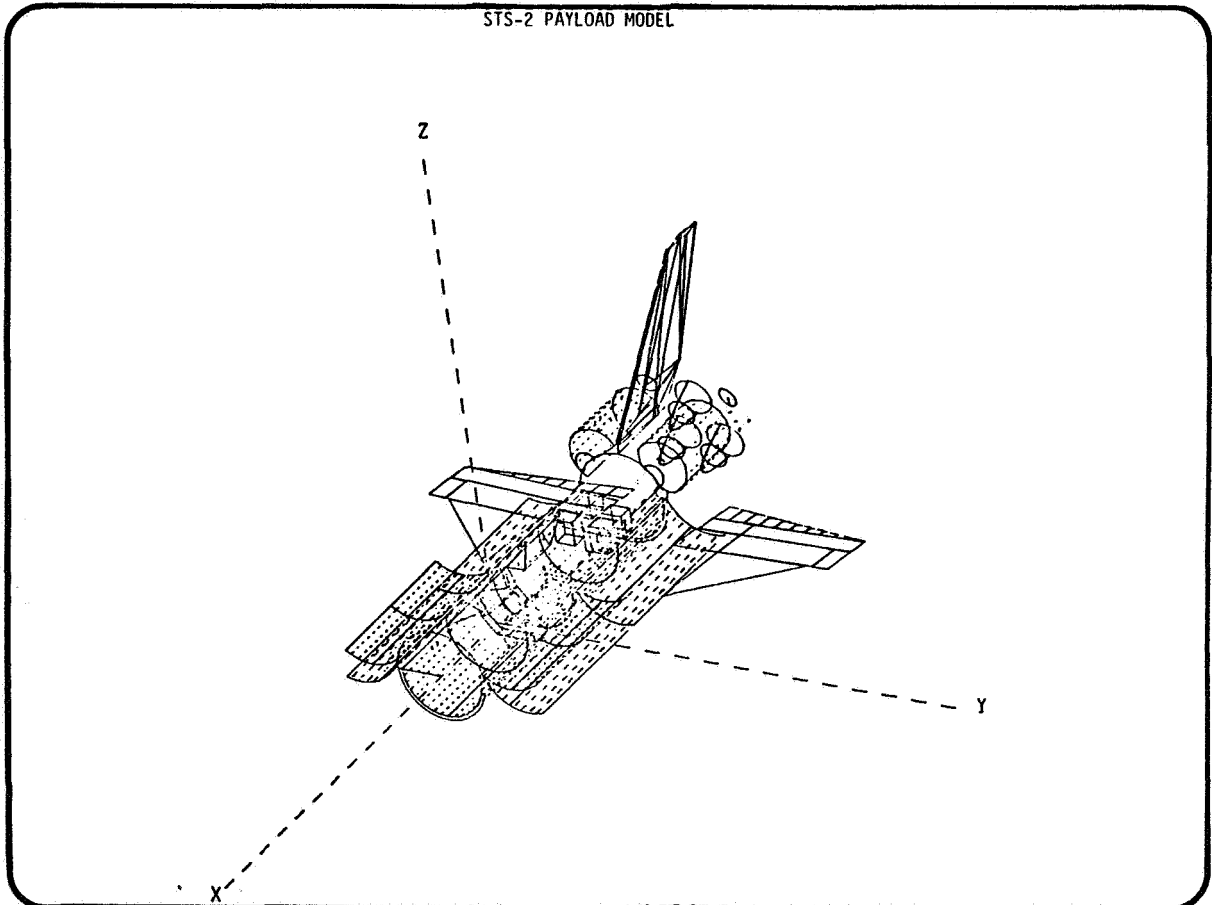
- INDUCED GAS ENVIRONMENT OF ORBITER/PAYLOAD SYSTEM
  - STS-1
  - STS-2
  - STS-3
- INDUCED DIRECT GAS FLOW FROM ORBITER/PAYLOADS TO SENSITIVE AREAS (IN BAY)
  - IECM INSTRUMENTS
- RETURN FLUX TO SENSITIVE AREAS
  - IECM INSTRUMENTS
- INDUCED DIRECT GAS FLOW FROM ORBITER/PAYLOADS TO UNBERTHED PAYLOAD/SENSITIVE INSTRUMENTS
  - IECM ON RMS

MODELED SHUTTLE ORBITER CONFIGURATION

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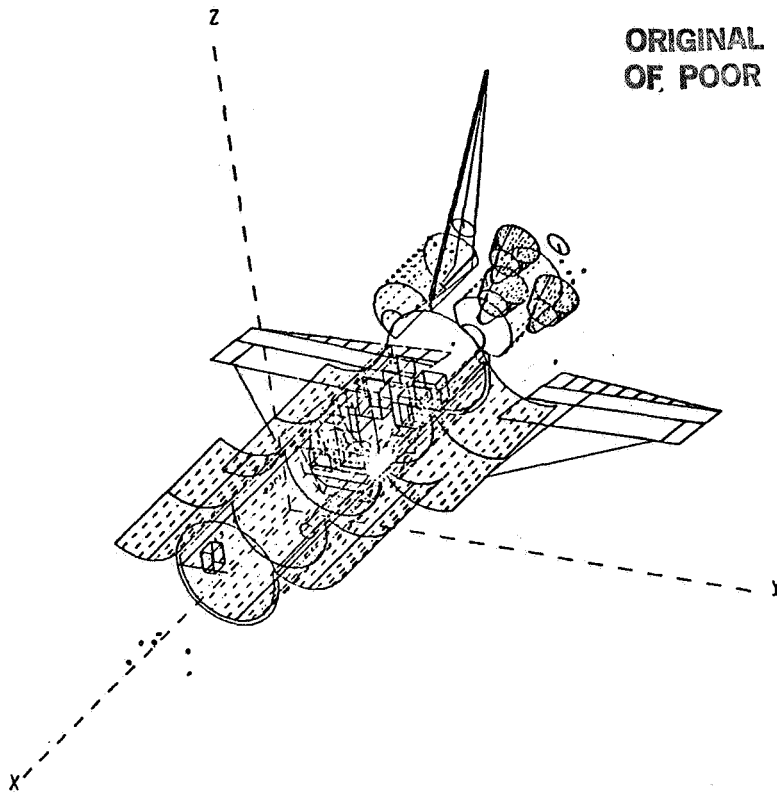


STS-2 PAYLOAD MODEL



STS-3 PAYLOAD MODEL

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MODELING CORRELATION WITH FLIGHT DATA

- DIRECT FLOW OF OUTGASSING MOLECULES FROM BAY SURFACES TO TQCM'S ON THE IECM  
(IN  $10^{-12}$  G/CM<sup>2</sup> SEC) (STS-2/IECM IN ZLV ATTITUDE)

SPACE 2 PREDICTIONS	LOCATIONS	MEASUREMENTS
8.3	RIGHT	0...6.3
10.4	FWD	6.3...15.4
7.3	AFT	2...6.5
19.8	LEFT	0...4.0

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MODELING CORRELATION WITH FLIGHT DATA

- DIRECT FLOW OF OUTGASSING MOLECULES FROM BAY SURFACES TO TQCM'S ON THE IECM  
(IN  $10^{-12}$  G/CM<sup>2</sup> SEC) (STS-3/TAIL TO THE SUN ATTITUDE)

SPACE 2 PREDICTIONS	LOCATIONS	MEASUREMENTS
2.7	RIGHT	2...27
3.8	FWD	17...47
2.1	AFT	5...18
2.2	LEFT	7...25
0.07	TOP	5...15

MODELING CORRELATION WITH FLIGHT DATA

- RETURN FLUX OF WATER MOLECULES FROM THE FLASH EVAPORATORS TO THE MASS SPECTROMETER ON THE IECM  
(IN COUNTS PER SEC) (STS-2/IECM IN ZLV ATTITUDE)

SPACE 2 PREDICTIONS	LOCATION	MEASUREMENT
1000	TOP	250...750

MASS SPECTROMETER MEASUREMENT OF RETURN FLUX  
(IN COUNTS/2 SEC, NEAR RAM ATTITUDE)

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MISSION	AMU 18	AMU 28	AMU 32	AMU 44
STS-2	4E+5...4E+3	(9...7)E+5	1E+4*	(7...1.5)E+4
STS-3		(1...5)E+6	1.5E+2...5E+4	≈500

\*1E+4 = 1.10<sup>4</sup>

SPACE 2 PREDICTIONS OF RETURN FLUX  
(IN MASS SPECTROMETER COUNTS/2 SEC, RAM ATTITUDE)

MISSION	SOURCE	OUTG**	H <sub>2</sub> O	N <sub>2</sub>	CO <sub>2</sub>	O <sub>2</sub>
STS-2	OUTGASSING/ DESORPTION*	106	83	66	48	22
STS-2	CABIN LEAKAGE		136	14000	166	3800

\*AT 20 HOURS MISSION ELAPSED TIME  
\*\*MODELED AMU:100

MODELING CORRELATION WITH FLIGHT DATA

RETURN FLUX

PREDICTED STS-2 CONTRIBUTIONS FROM MOLECULAR SOURCES TO MEASURED VALUES

MOLECULAR SOURCE* \ AMU	18	28	32	44
DESORPTION	NORMAL: MINOR TILES: MAJOR	MINOR	MINOR	MINOR
CABIN LEAKAGE	MINOR	MINOR	MODERATE	MINOR
AMBIENT N <sub>2</sub>	-	MAJOR	-	-
AMBIENT O	-	-	MODERATE	-
OTHER	-	TO BE ANALYZED	MINOR	TO BE ANALYZED

\*OUTGASSING - NO SIGNIFICANT AMOUNTS OF HEAVY MOLECULAR SPECIES HAVE BEEN OBSERVED ABOVE PREDICTED LEVELS



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RETURN FLUX MEASUREMENT ERROR ANALYSIS

MAJOR CONTRIBUTORS TO ERRORS IN THE DATA ANALYSIS ARE:

- MOLECULAR COLLISION PROCESS
- MASS SPECTROMETER CALIBRATION FACTOR, DEPENDING ON SYSTEM PUMPING SPEED
- MASS SPECTROMETER SYSTEM CHARACTERISTICS (H<sub>2</sub>O, CH<sub>4</sub>)
- AMBIENT CONTRIBUTIONS

SPACE 2 PREDICTIONS OF MOLECULAR COLUMN DENSITIES  
(IN MOLECULES/CM<sup>2</sup> SEC)

MISSION	SOURCE	OUTG	H <sub>2</sub> O	N <sub>2</sub>	CO <sub>2</sub>	O <sub>2</sub>
STS-2	OUTGASSING/ DESORPTION***	0.6E+10**	0.2E+11	0.1E+11	0.7E+10	0.4E+10
STS-3	OUTGASSING/ DESORPTION****	0.4E+11	0.1E+12	0.6E+11	0.4E+11	0.2E+11
STS-2/3	CABIN LEAKAGE	-	0.1E+12	0.6E+13	0.7E+11	0.2E+13
STS-2	FLASH EVAPORATORS	-	1.4E+13	-	-	-
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GOALS		1.0E+10*	1.0E+11	1.0E+13	1.0E+11	1.0E+13

- \* PER SPECIES
- \*\* 0.6E+10 = 0.6 · 10<sup>10</sup>
- \*\*\* AT 20 HOURS MISSION ELAPSED TIME, ZLV ATTITUDE
- \*\*\*\* AT 20 HOURS MISSION ELAPSED TIME, TOP SUN ATTITUDE

MODELING CORRELATION WITH FLIGHT DATA

SUMMARY

- GOOD CORRELATION FOR DIRECT FLOW (TQCM)
- GOOD CORRELATION FOR RETURN FLUX, STS-2/H<sub>2</sub>O
- CORRELATION FOR RETURN FLUX FROM OTHER MOLECULAR SOURCES/SPECIES APPEARS TO BE WITHIN EXPECTATIONS. MORE ANALYSIS IS REQUIRED
- SPACE 2 MODEL SEEMS TO BE AN ADEQUATE PREDICTIVE TOOL

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