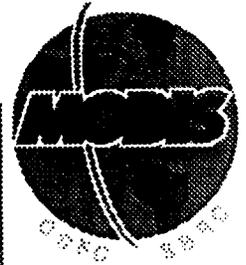
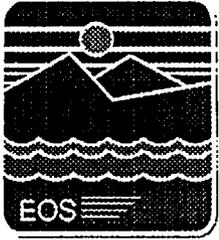


# MODIS

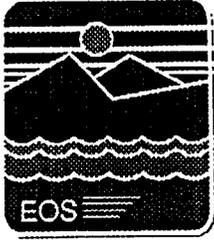


## Level 1B Preliminary Design Review



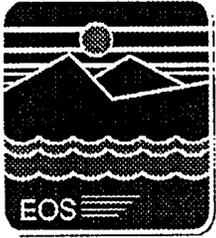
# Introduction

Dr. Richard Barbieri

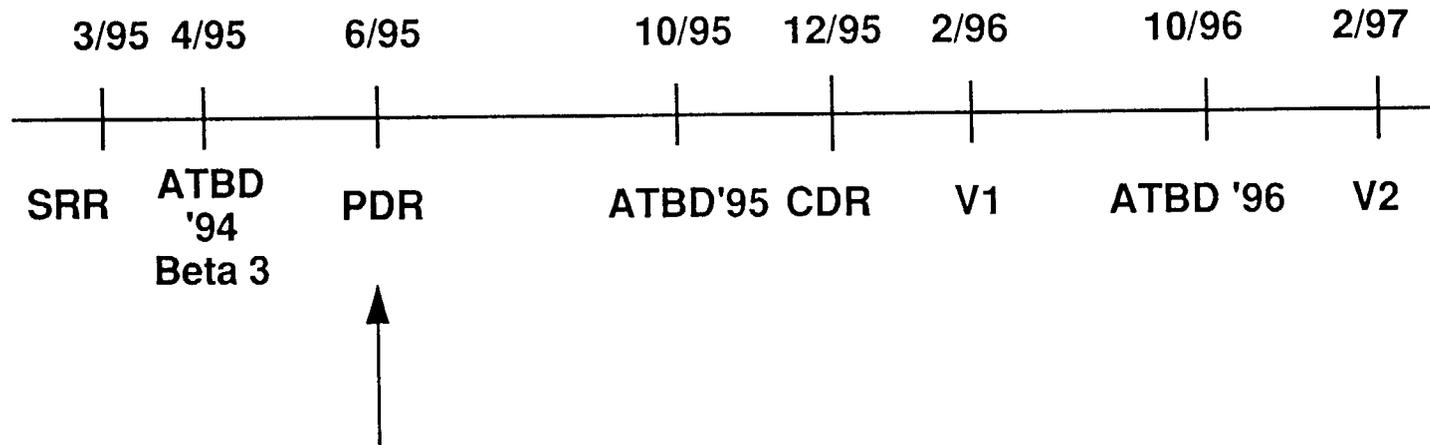


# Topics

- Introduction
- Within Granule Processing
  - L1B Computer Software Configuration Item (CSCI)
- Cross Granule Processing
  - Xgran\_SD CSCI (Solar Diffuser)
  - Xgran\_SRCA CSCI (Spectroradiometric Calibration Assembly)
- Test Plan



# Major MCST Events

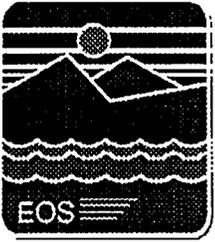


We are here



# Purpose

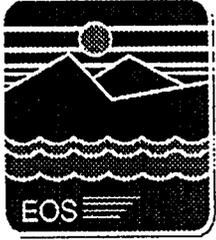
- Present the preliminary architecture of the MODIS Level 1B Version 1 software system scheduled for delivery to SDST in February, 1996



# Functionality

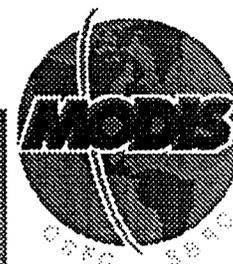
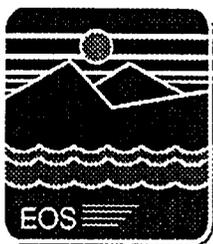
The Level 1B software must:

- ingest Level 1A data
- perform limited data monitoring
- perform limited data quality determination
- calibrate sensor data
- transform sensor data counts to radiances
- report the processing status
- produce the Level 1B data product
- create and append metadata



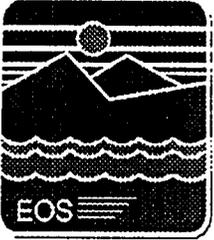
# Background

- Prototype Development
  - Beta 1 - Heritage Delivery , January 1994
  - Beta 2 - Demonstrate Portability, October 1994
  - Beta 3 - Exercise SDP Toolkit Interfaces, April 1995



# Future Deliveries

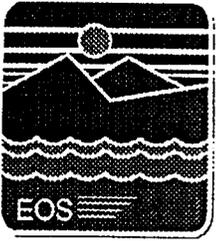
- Version 1.0 - Test all major functional capabilities, interfaces and messaging systems, February 1996
- Version 2.0 - Verified, launch ready, operational software system to support post-launch processing, February 1997
- Updated versions as appropriate to meet specific requirements imposed by the MODIS Science Team Leader



# Levels of Software Development



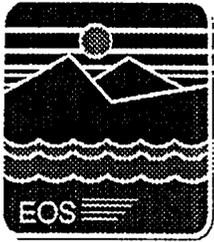
- Standard Data Products Software
  - Operational Level 1B data processing system for SDST
- Special Data Products Software
  - Special Maneuvers and On-Orbit Test Software
  - Team Leader Compute Facility (TLCF) Utilities Software



# Standard Data Product Software Development



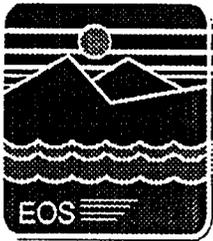
- External Product Reviews
  - Requirements
  - Design
  - Documentation
- Independent Verification
  - code walk-throughs
  - testing
- External Delivery



# Special Data Products Software Development



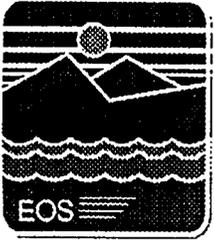
- Internal Product Reviews
  - Requirements
  - Design
  - Documentation
- Internal Verification Procedures
  - code walk-throughs
  - testing
- S/W will remain on TLCHF



# S/W Development Objectives



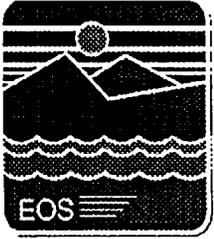
- The operational software developed by MCST will be:
  - reliable
  - modular
  - portable
  - maintainable
  - reusable
  - efficient with respect to consumption of computer resources



# S/W Development Approach



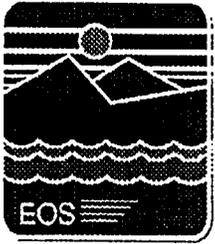
- The MCST team is focused and disciplined to balance the software development objectives in the context of budget constraints



# Design Overview

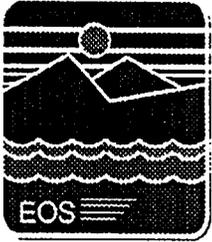


Marghi Hopkins



# Objectives

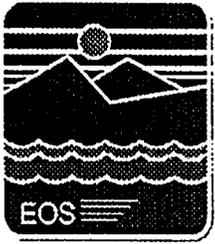
- Level 1B Version 1 delivery implements the technical content of the Algorithms Theoretical Basis Document (ATBD) for 1995.
- Identify and address inconsistencies
- Ensure that the Level 1B Version 1 delivery is fully compliant with what comes out of PDR



# Major Architectural Divisions



- Three CSCIs
  - Within Granule Processing:
    - L1B CSCI
  - Cross Granule Processing:
    - Xgran\_SD CSCI
    - Xgran\_SRCA CSCI

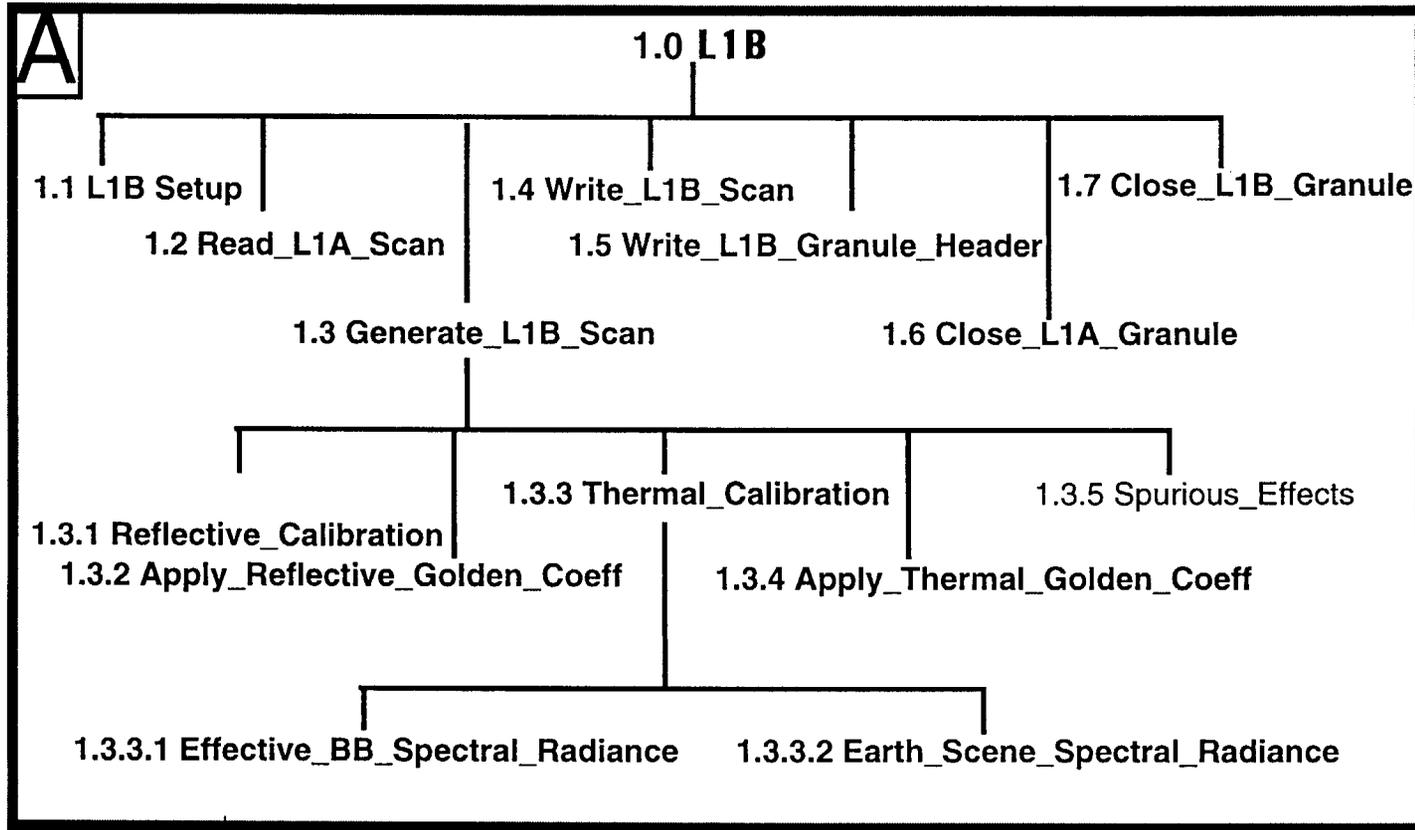


# Justification For Multiple CSCIs



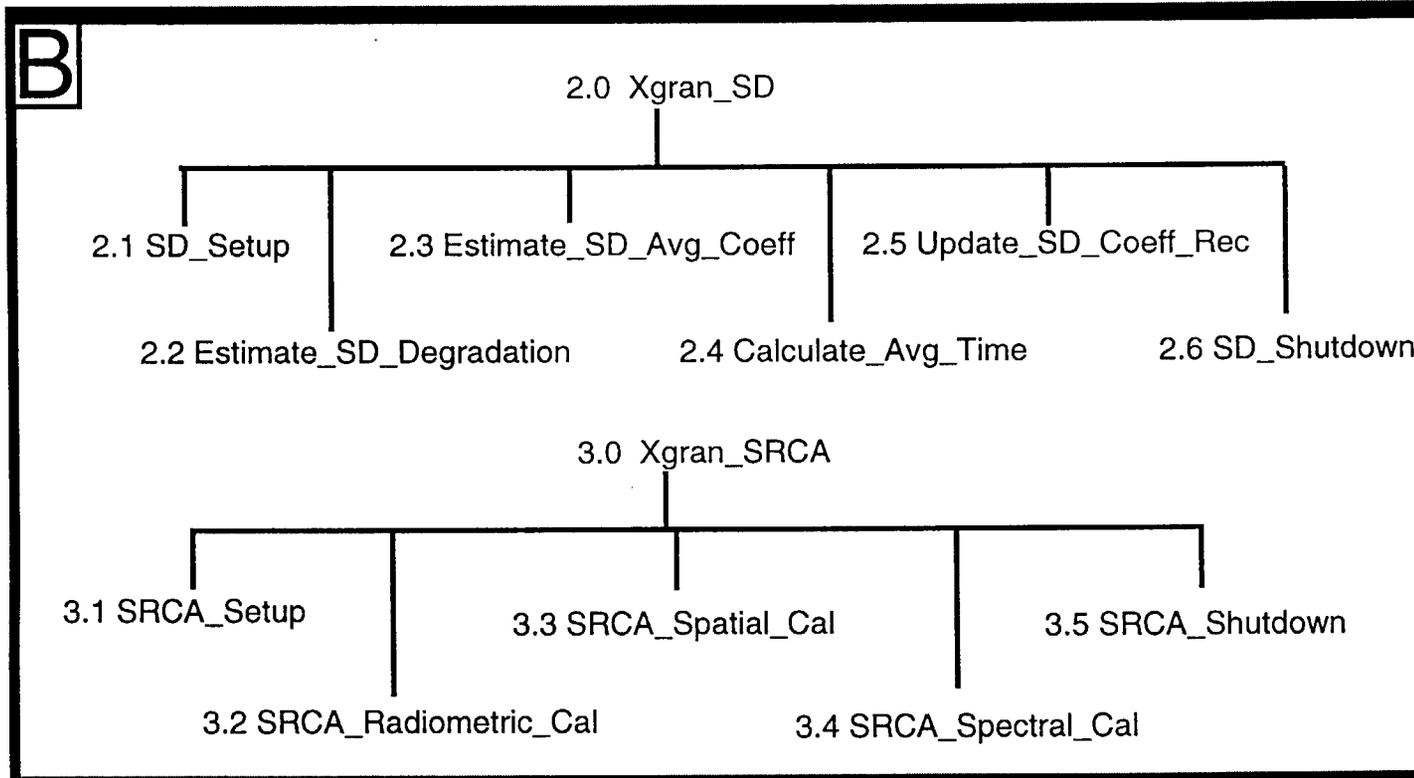
- Balance the level of effort required for
  - Configuration management
  - Maintenance of the software
  - Retesting
  - Redelivery

## Level 1B Software Hierarchy

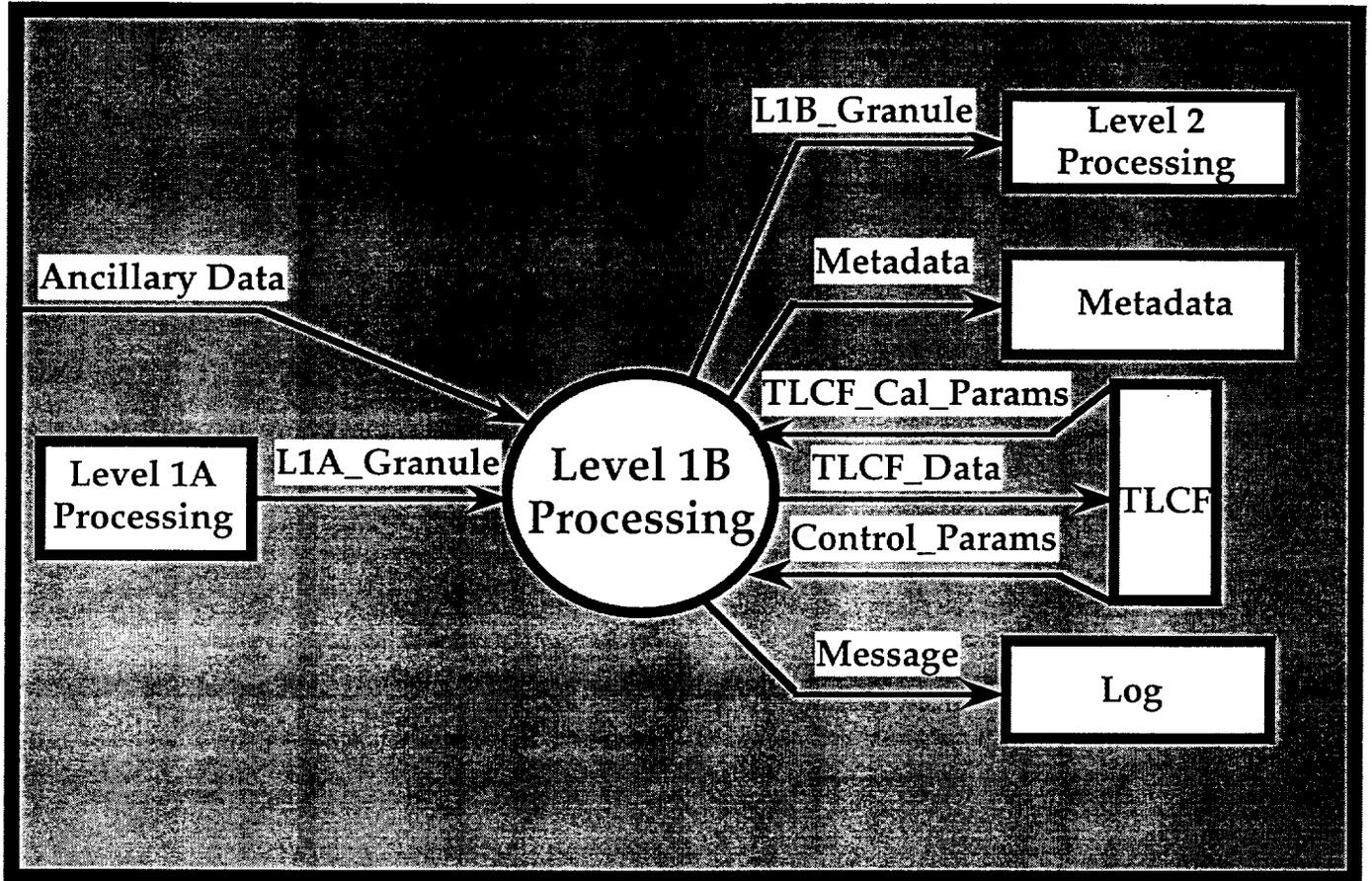


A section(**bold**) = Within-Granule processing  
Core Algorithm

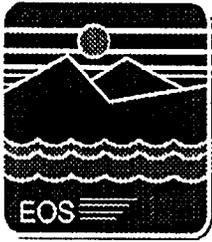
## Level 1B Software Hierarchy



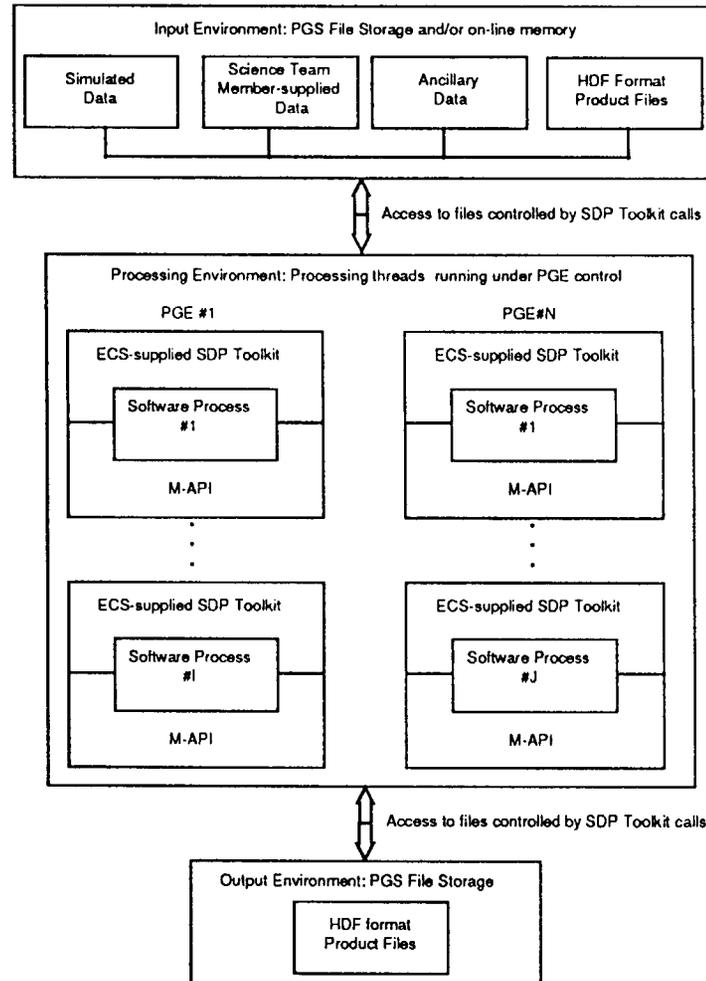
B section(bold) = Cross-granule processing



## Level 1B Processing Context



# SDP S/W Context



## Classes of Look-up Tables

Blackbody Radiance  
Irradiance of the Sun  
A(Thermal Gain)  
B(Thermal Offset)  
Blackbody Reflected Radiance  
Solar Diffuser Coefficients  
Detector BRDF  
Q(Nonlinear Thermal Term)  
Blackbody emissivity  
Blackbody Term  
Calibration Parameters  
Reflective Detector Information  
Within Orbit Variability  
Blackbody Rho  
Earth-view Rho  
Relative Spectral Response (RSR)  
Solar Diffuser Coefficient History  
Solar Diffuser Coefficients  
Solar Diffuser Information  
Solar Diffuser Stability Monitor  
BRDF

# TOOLS

## Memory (SDP Toolkit)

Allocate

Free

## SMF (SDP Toolkit)

Transmit messages

## Files (SDP Toolkit)

Open

Close

Build file names

Read

Write

## Granules

Define

Initialize

Fill

Manipulate headers

Manipulate data

Transform to HDF format

Show

## Scans

Define

Initialize

Fill

Manipulate headers

Manipulate data

Show

## Lists

Define

Initialize

Store record

Remove list

Insert list

Next list

Reset to top of list

Join list

## Look-up Tables

Single-Indexed

Double\_Indexed

Create

Write

Clean up

Read

Initialize

Show

Multiply

Integrate

Set a character string

Extract an entry (or value)

## Arrays

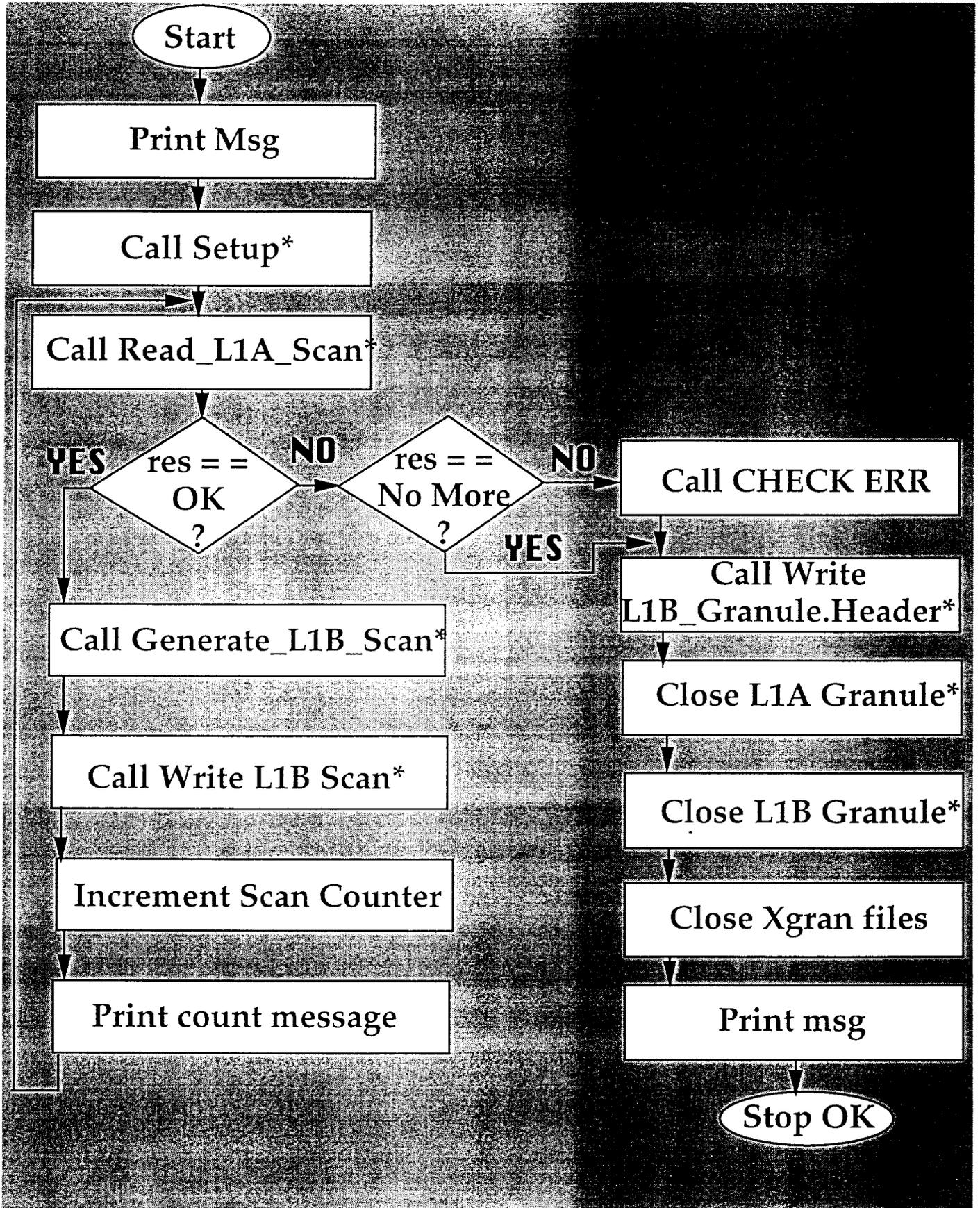
One-Dimensional

Two-Dimensional

Read

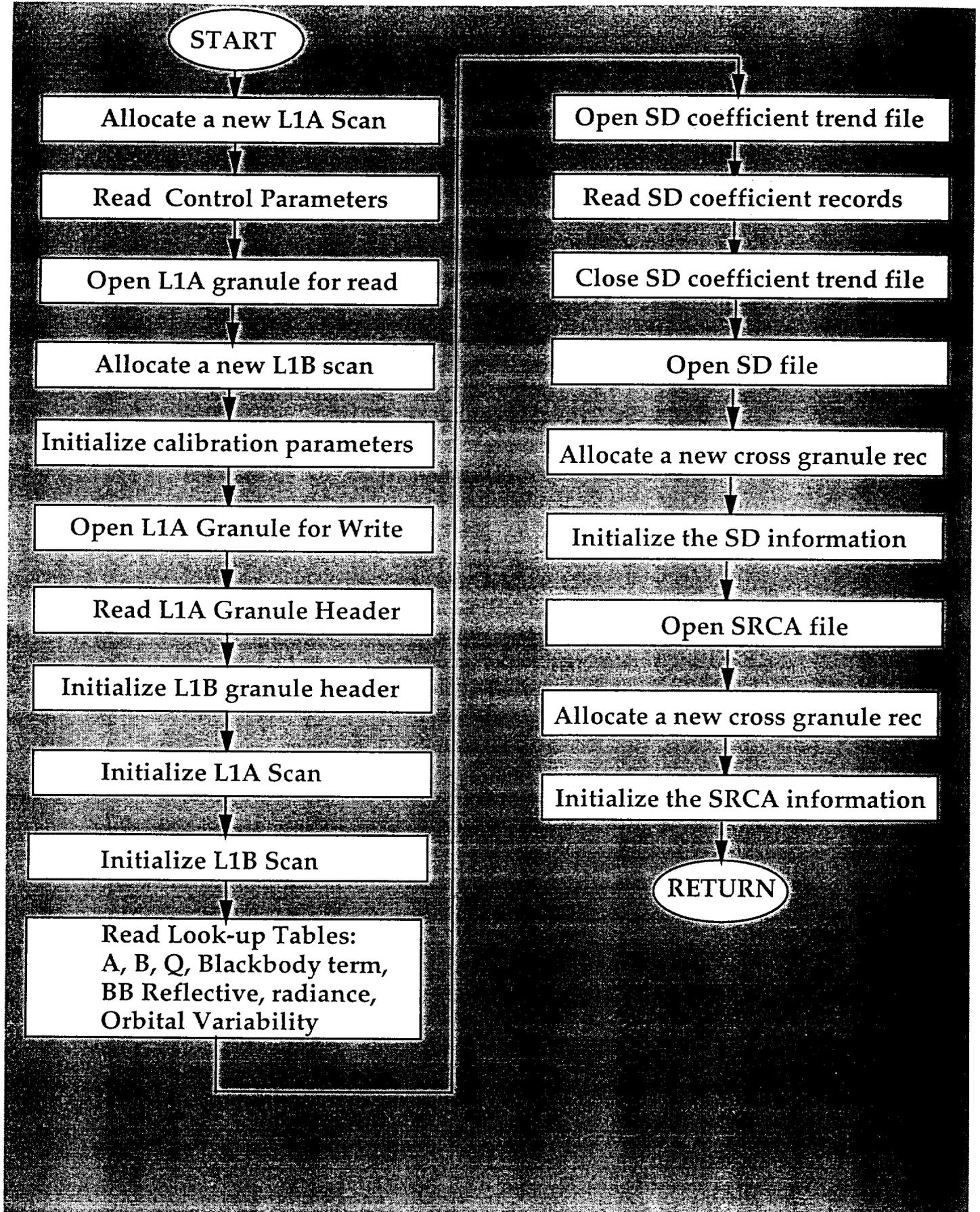
Write

# 1.0 Main L1B

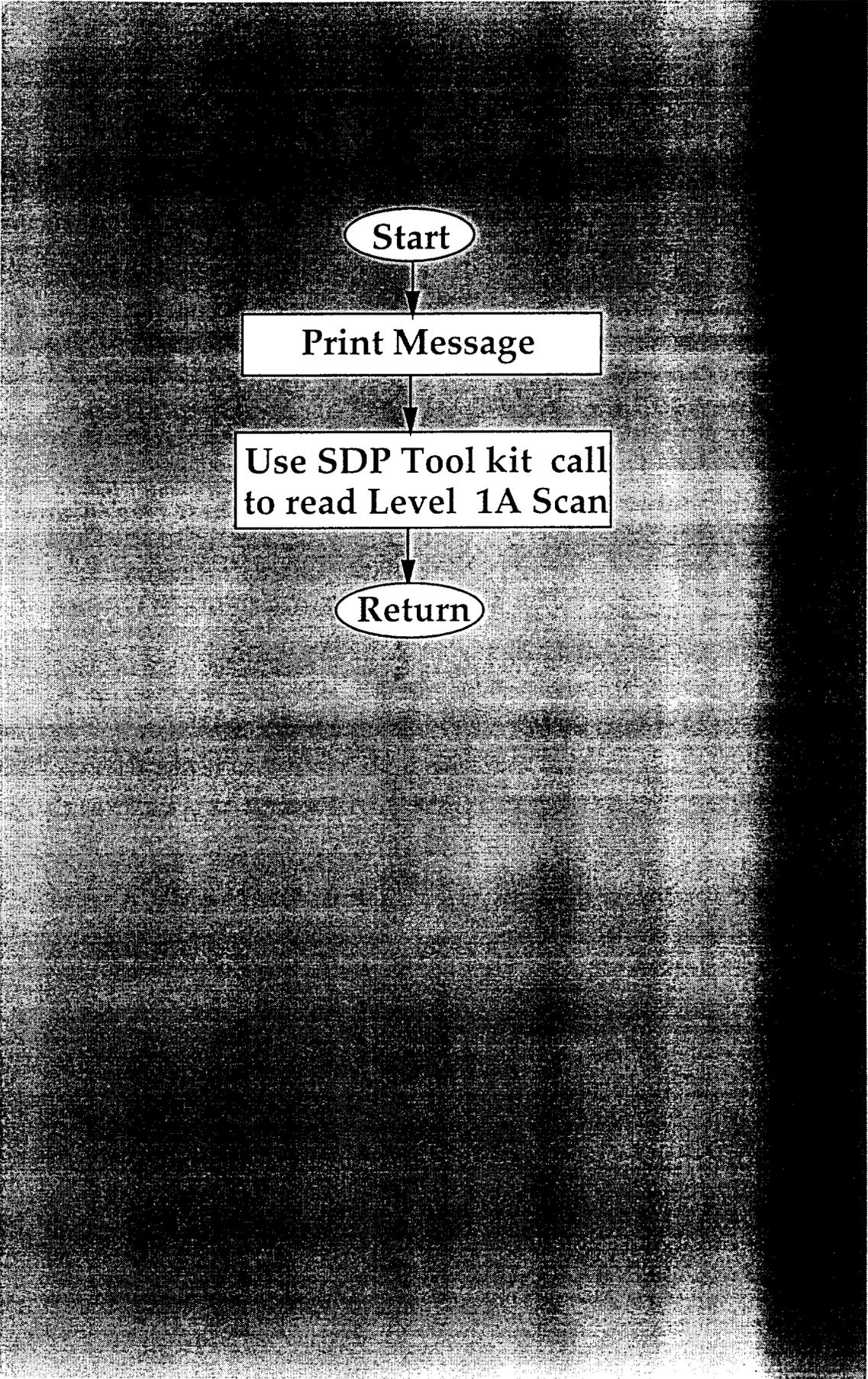


\*Call CHECK ERR

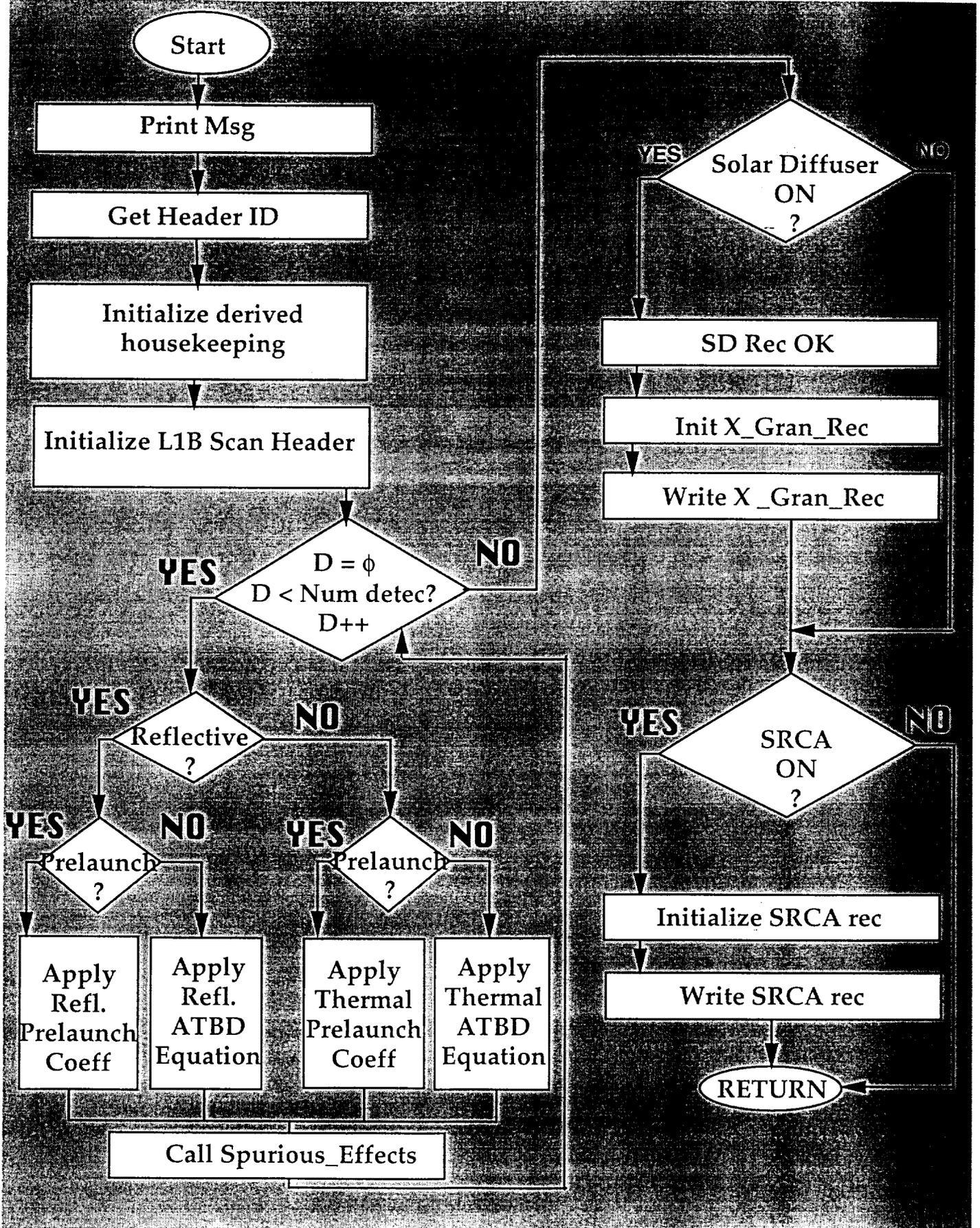
# 1.1 Setup



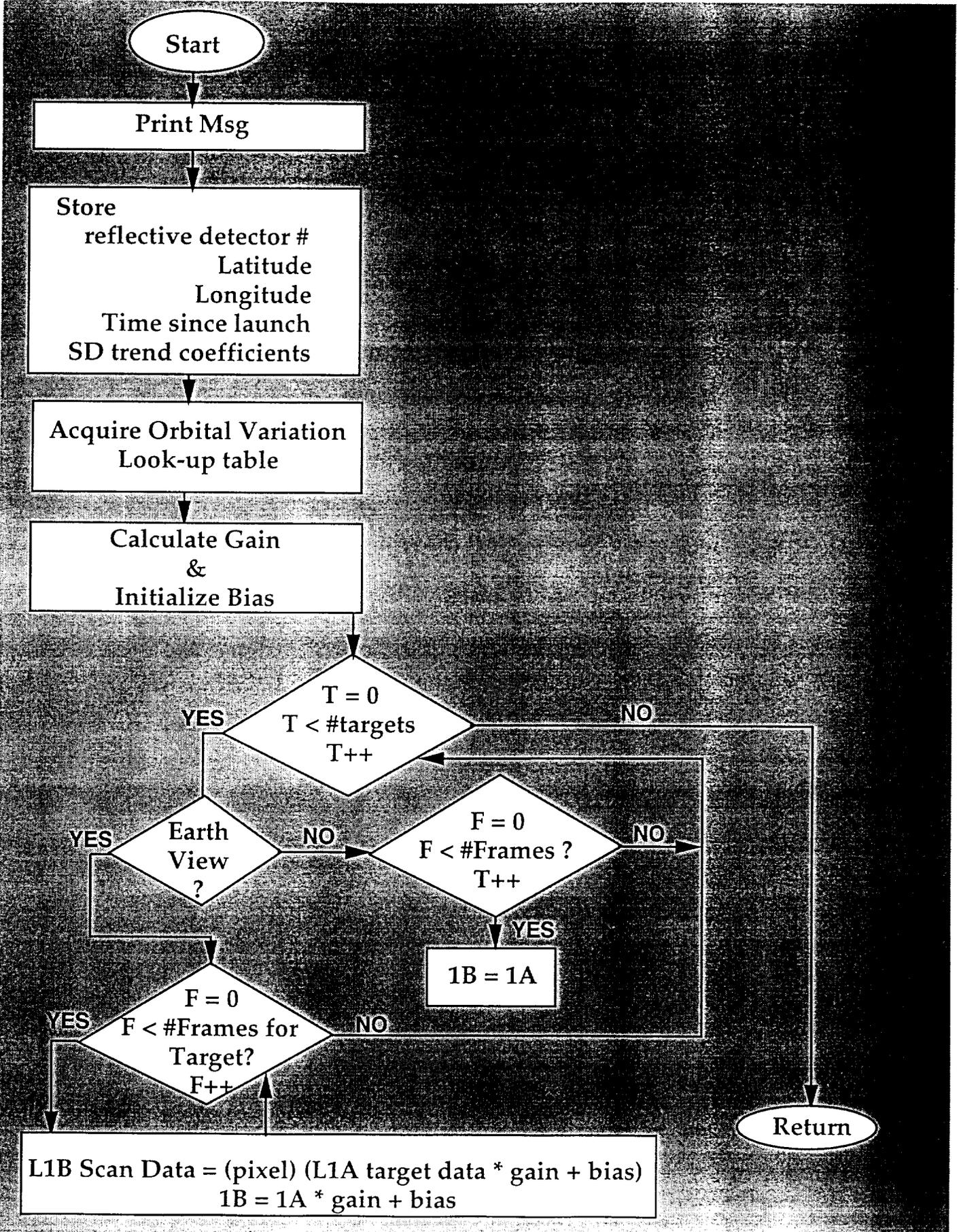
# 1.2 Read\_L1A\_Scan



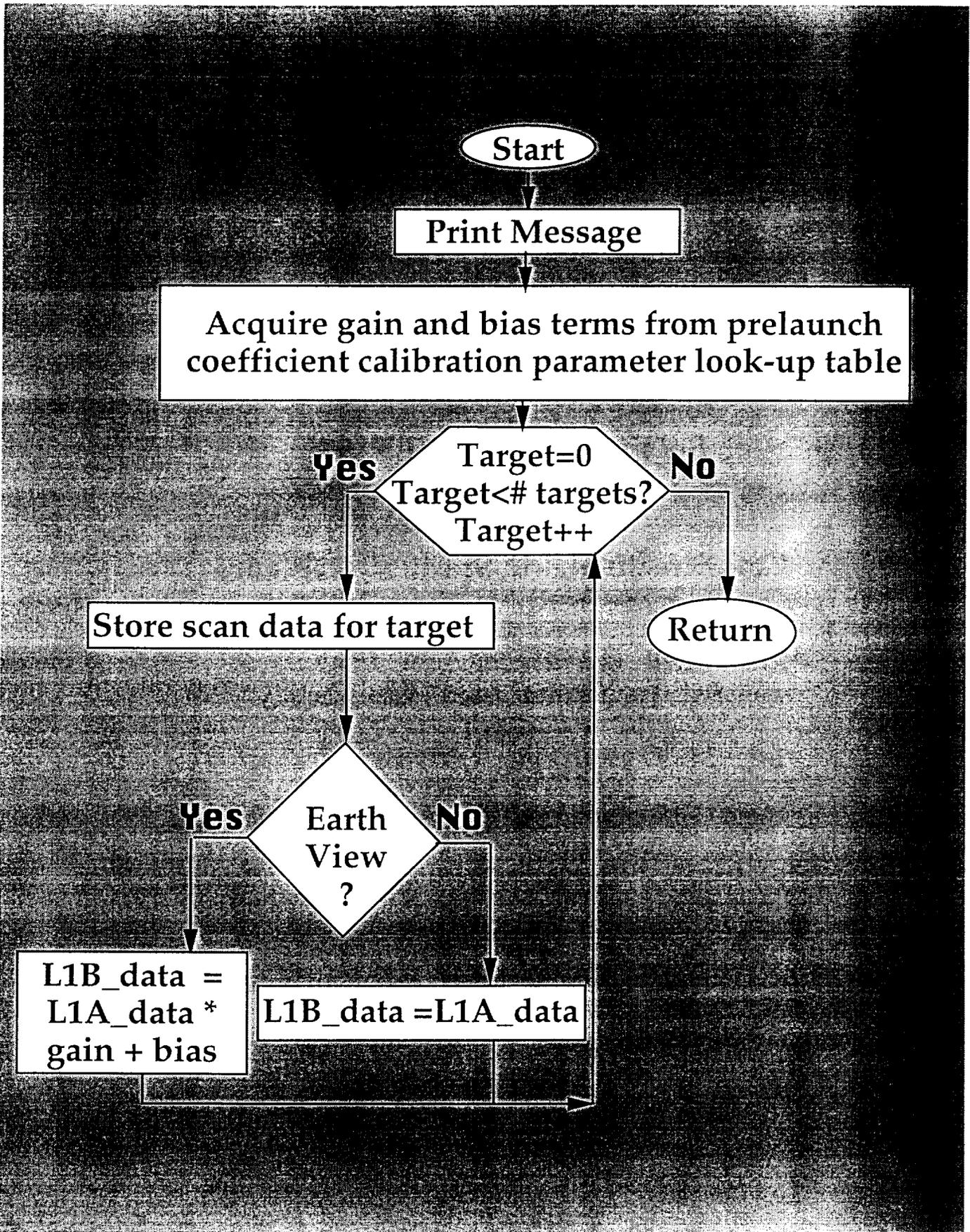
# 1.3 Generate L1B Scan



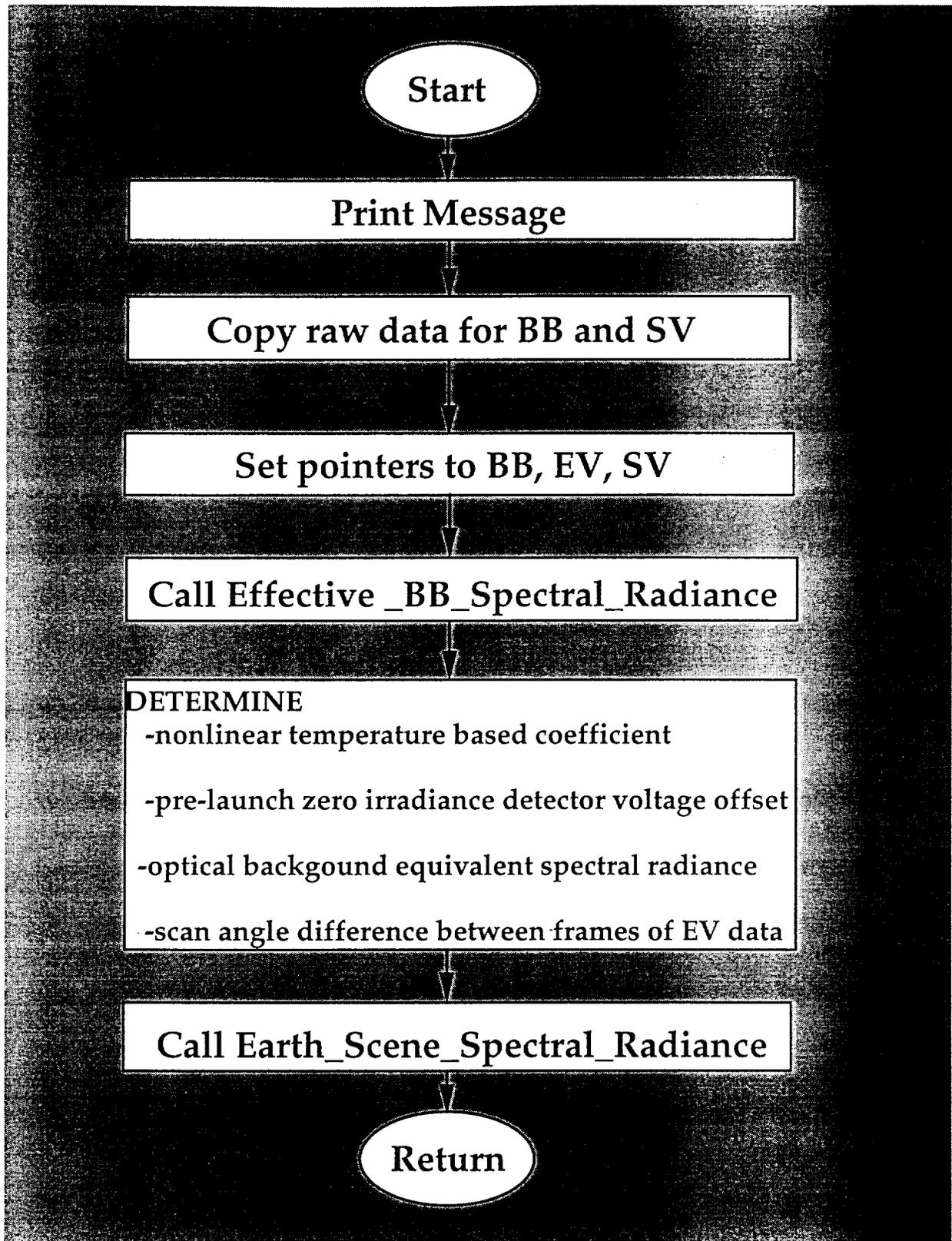
### 1.3.1 Reflective Calibration



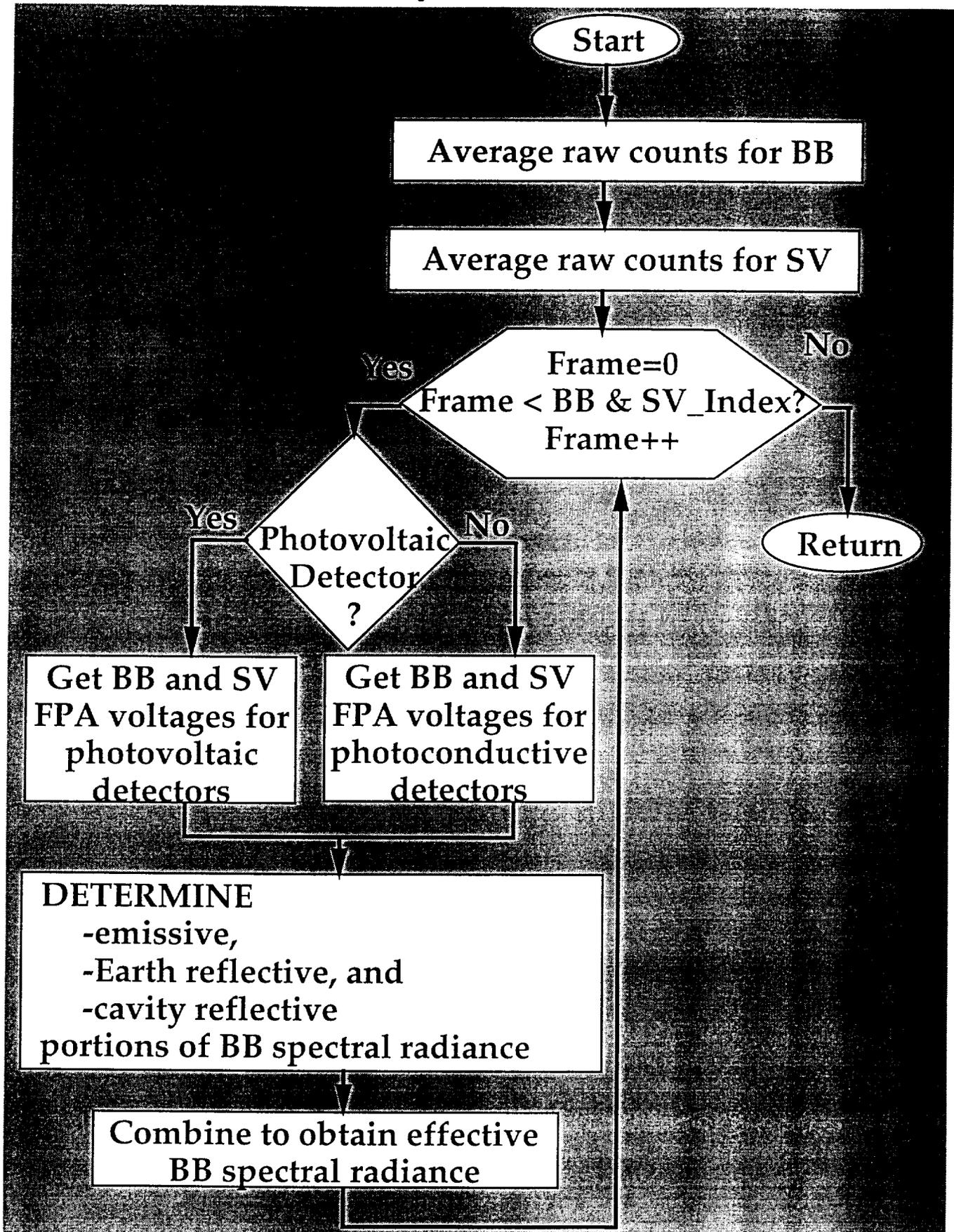
### 1.3.2 Apply\_Reflective\_Prelaunch\_Coeff



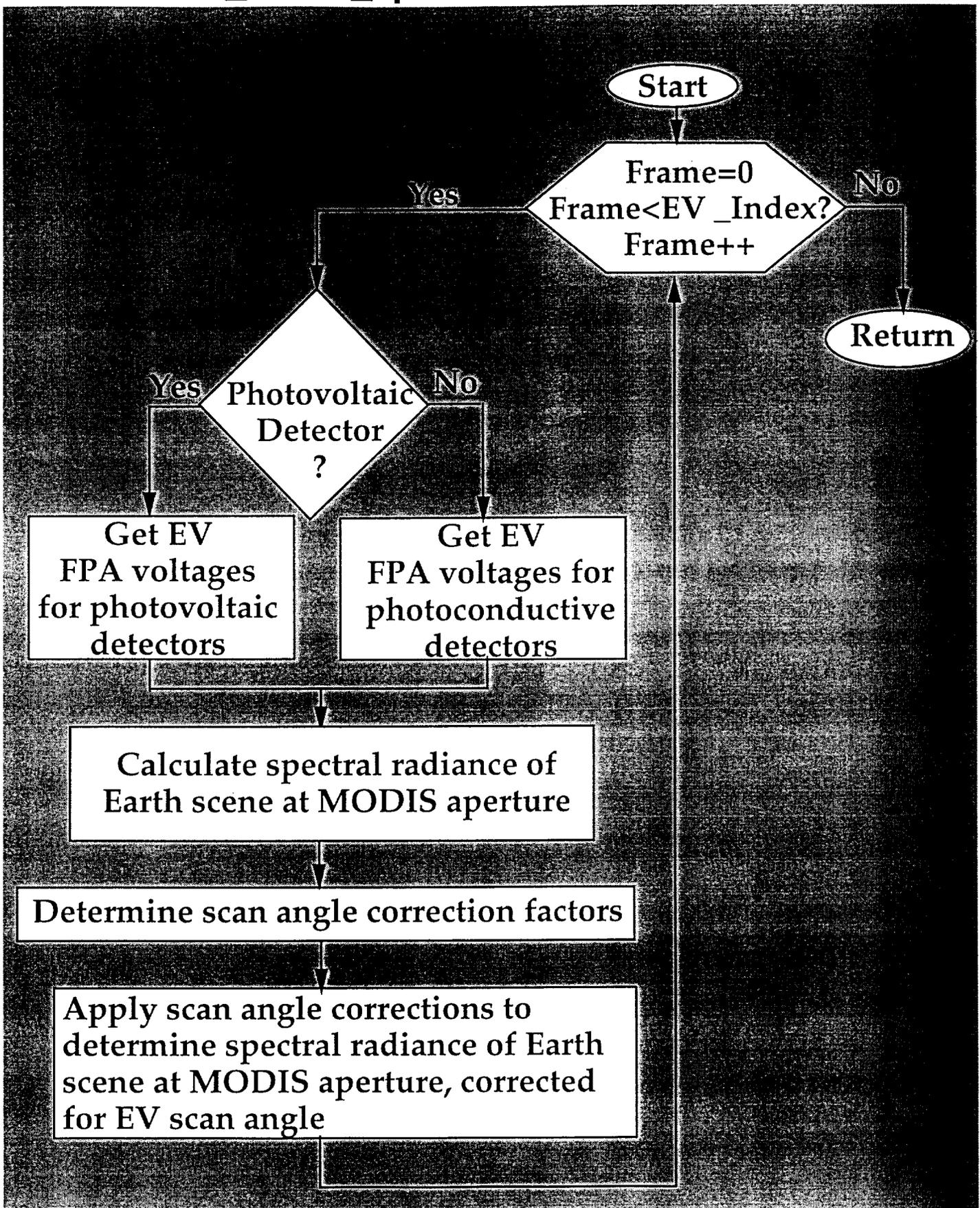
### 1.3.3 Thermal Band Calibration



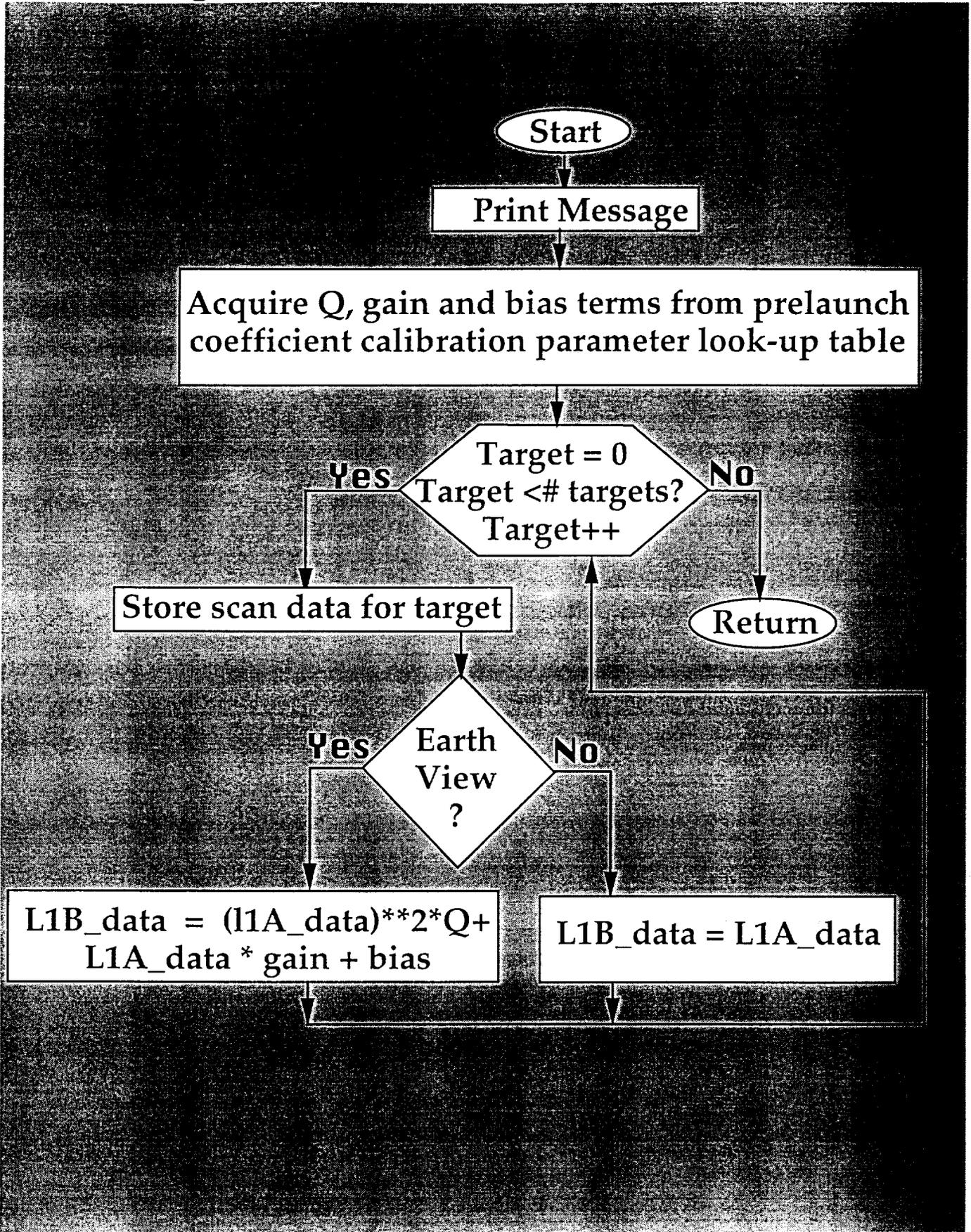
### 1.3.3.1 Effective\_BB\_Spectral\_Radiance



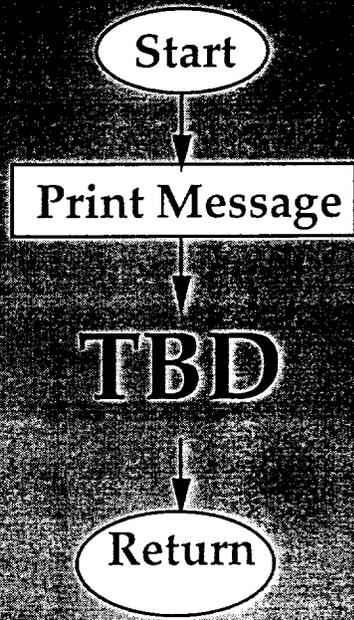
### 1.3.3.2 Earth\_Scene\_Spectral\_Radiance



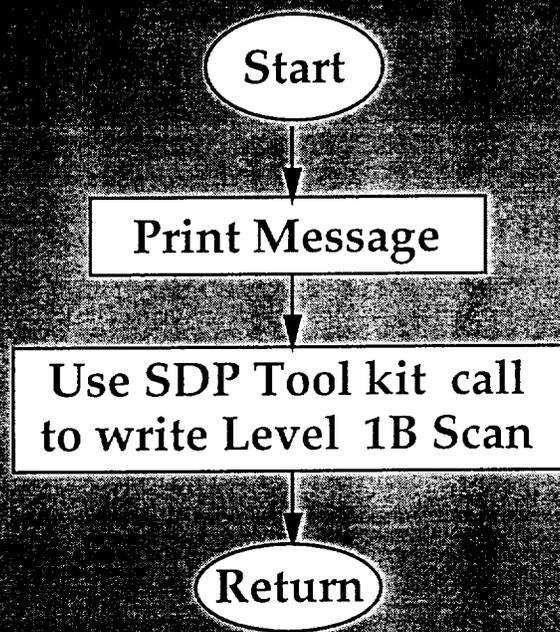
### 1.3.4 Apply\_Thermal\_Prelaunch\_Coeff



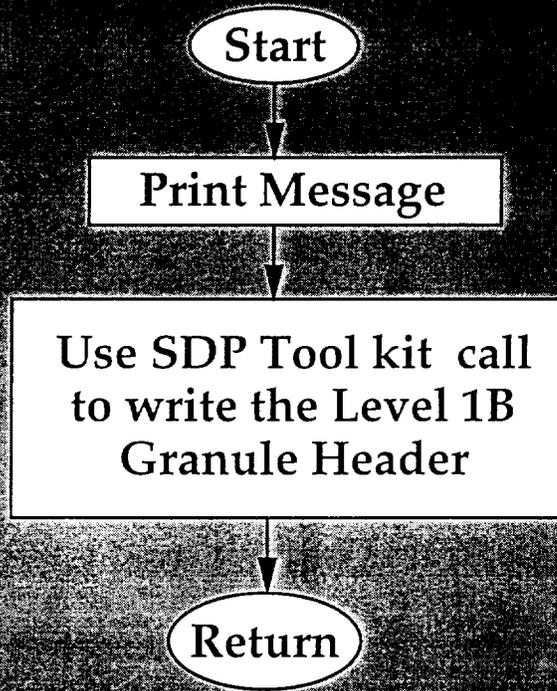
### 1.3.5 Spurious\_Effects



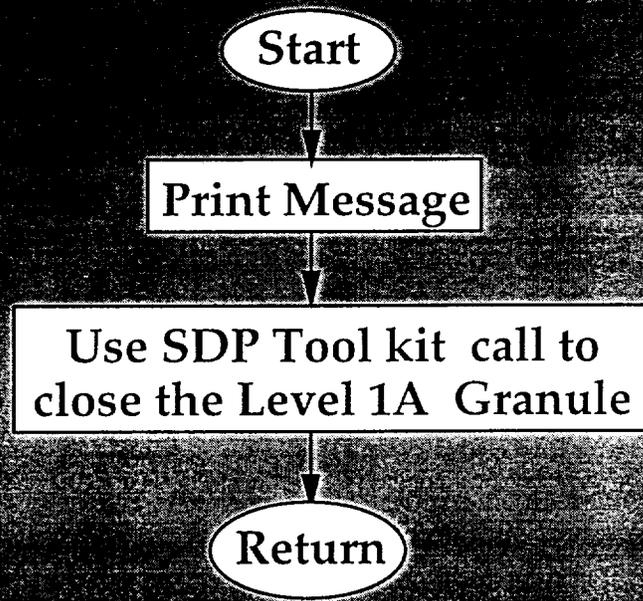
## 1.4 Write\_L1B\_Scan



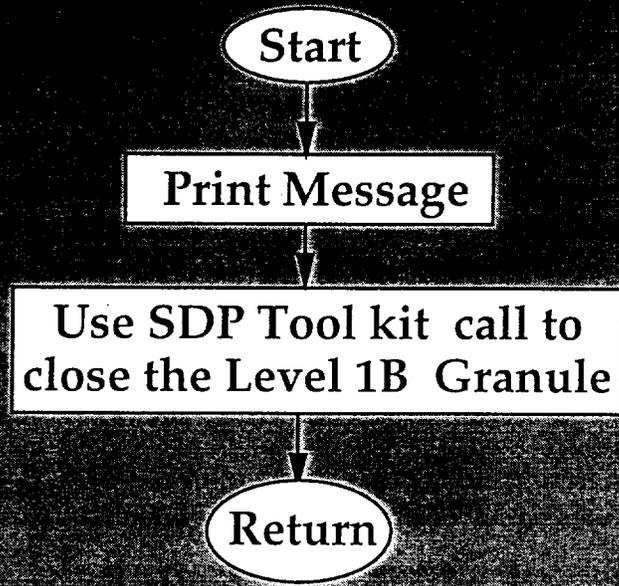
## 1.5 Write\_L1B\_Granule\_Header

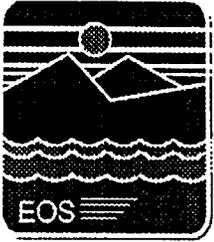


## 1.6 Close\_L1A\_Granule



## 1.7 Close\_L1B\_Granule



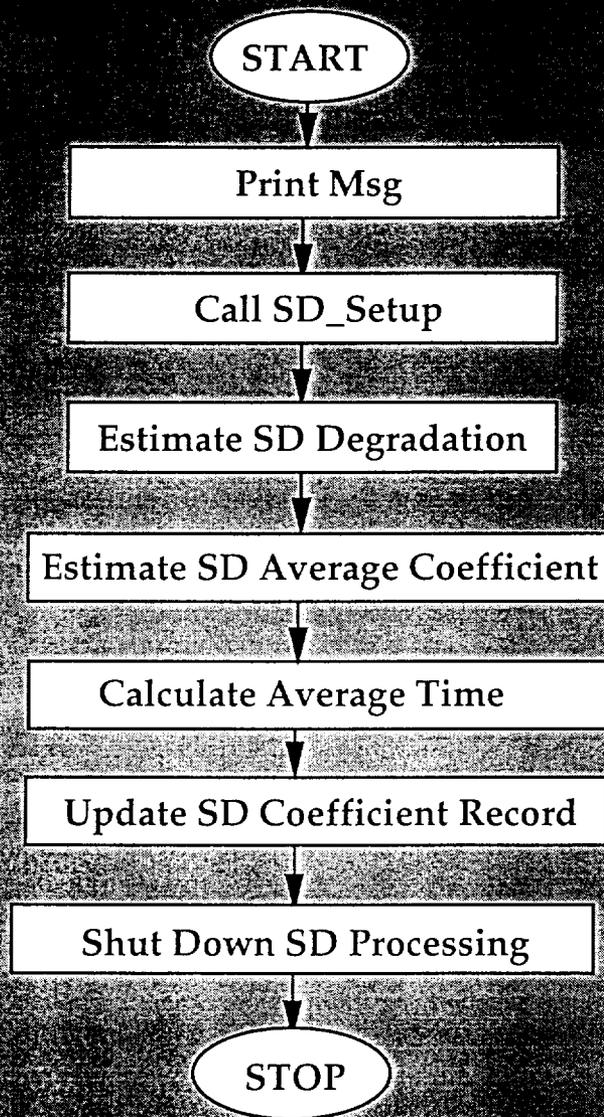


# Xgran\_SD CSCI (L1B-02)

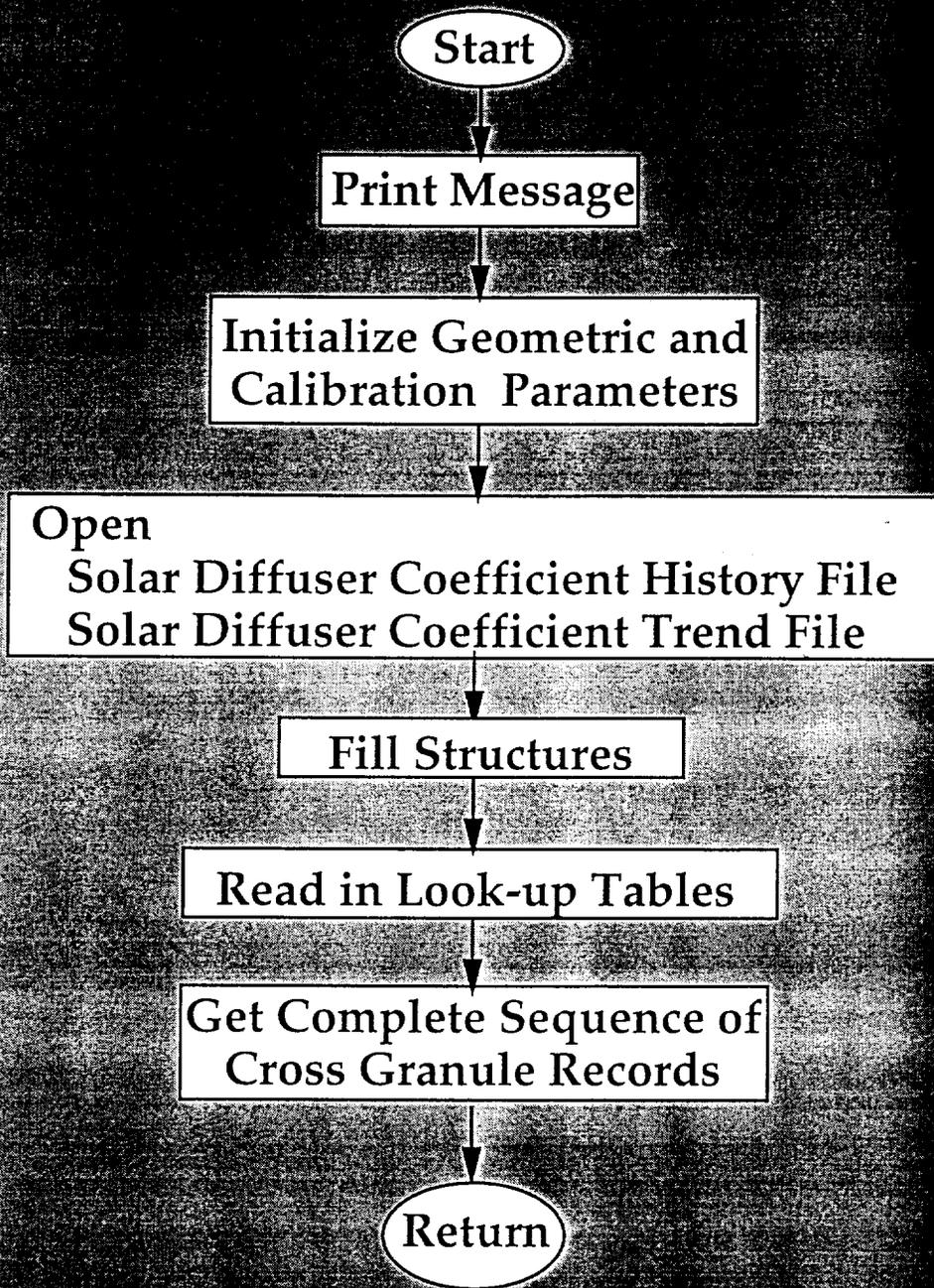


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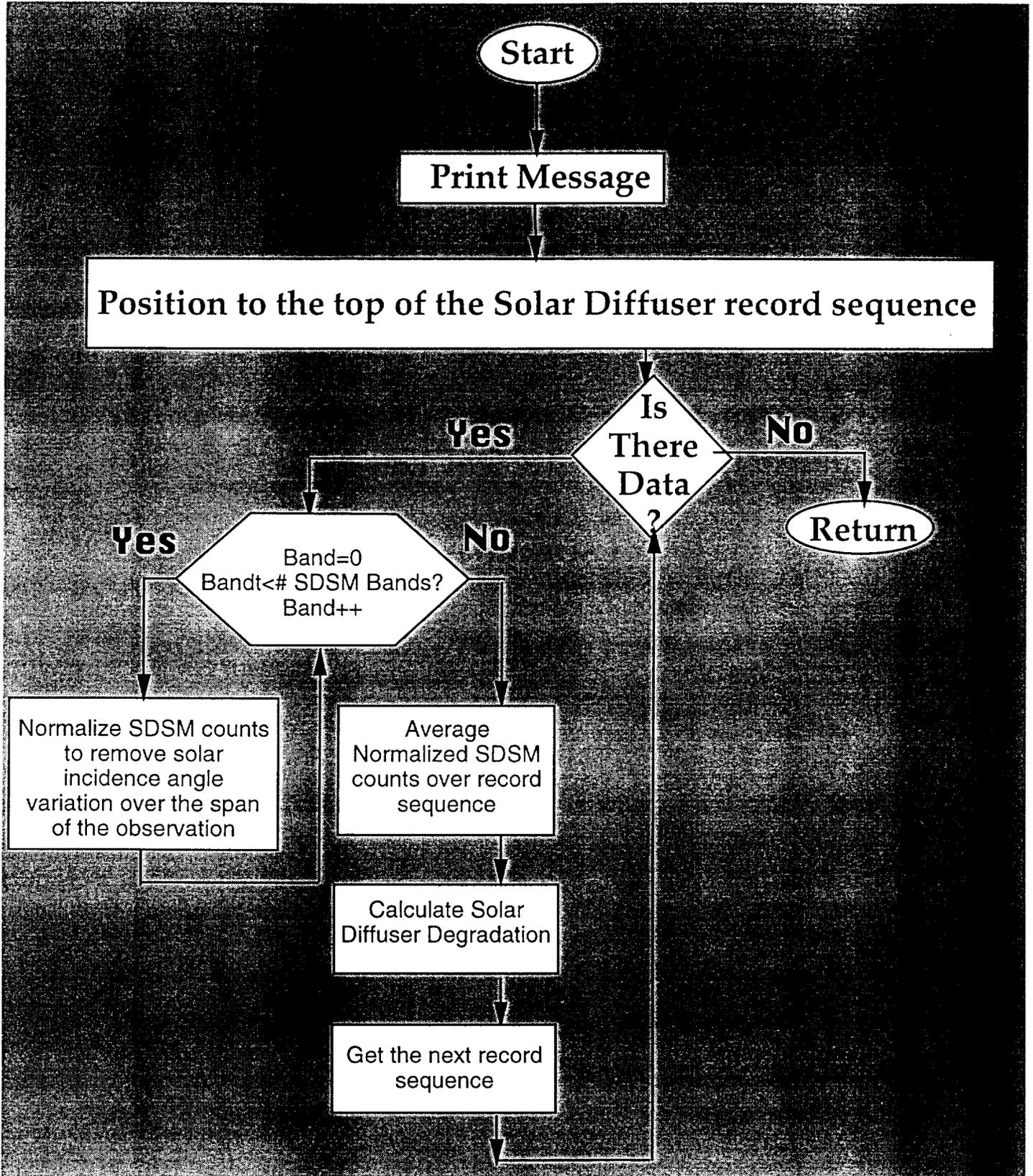
## 2.0 Cross Granule Solar Diffuser Processing



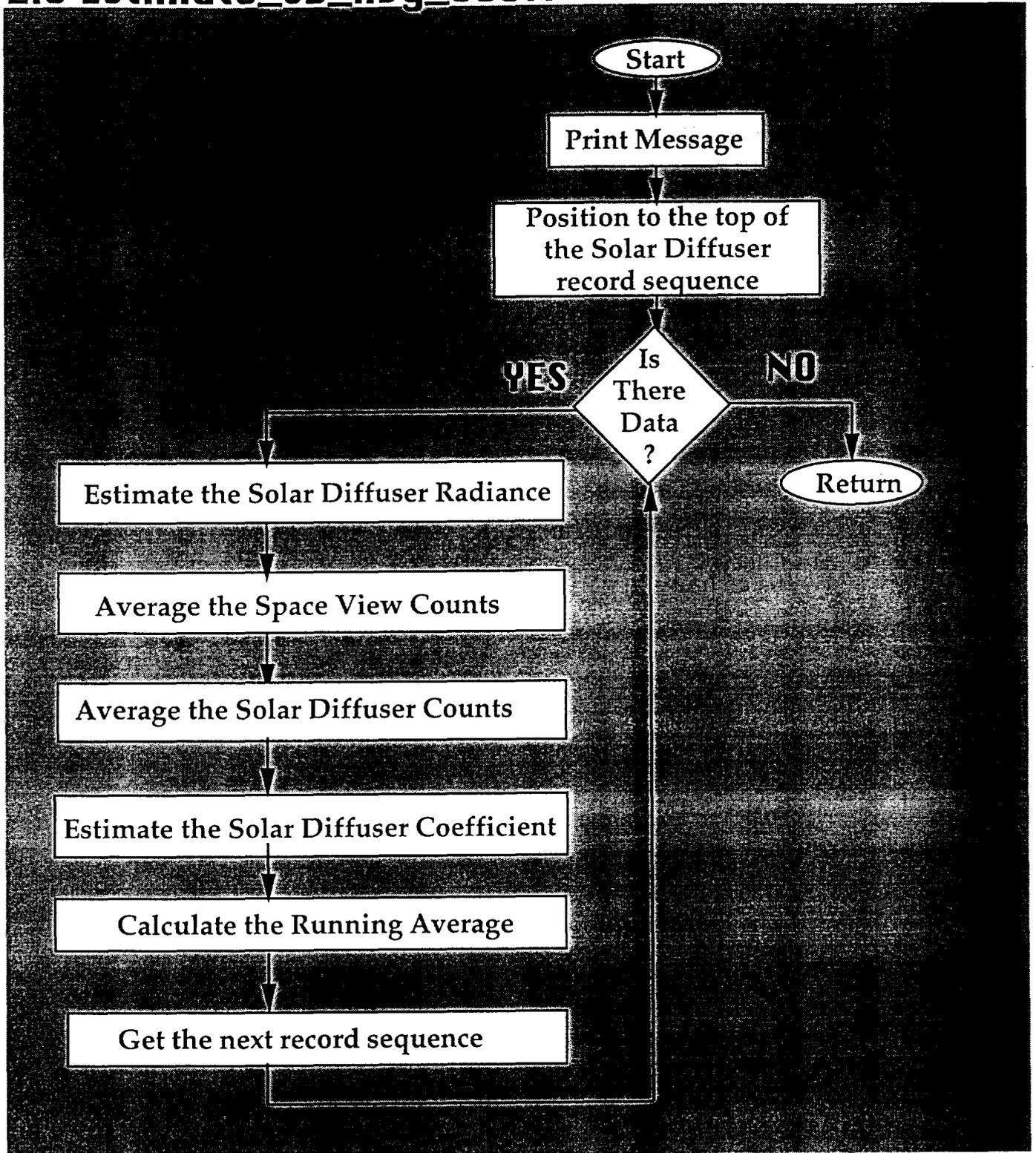
## 2.1 SD\_Setup



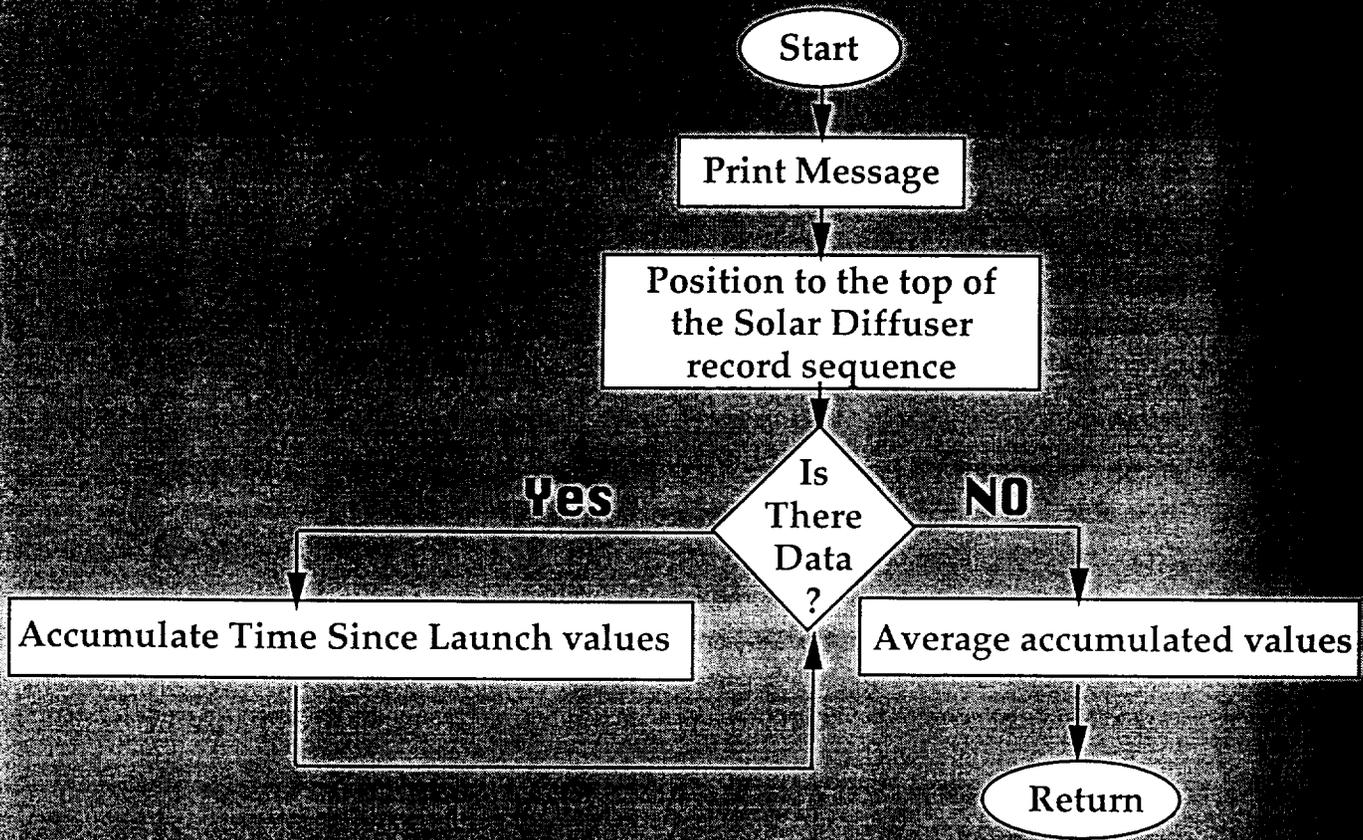
## 2.2 Estimate\_SD\_Degradation



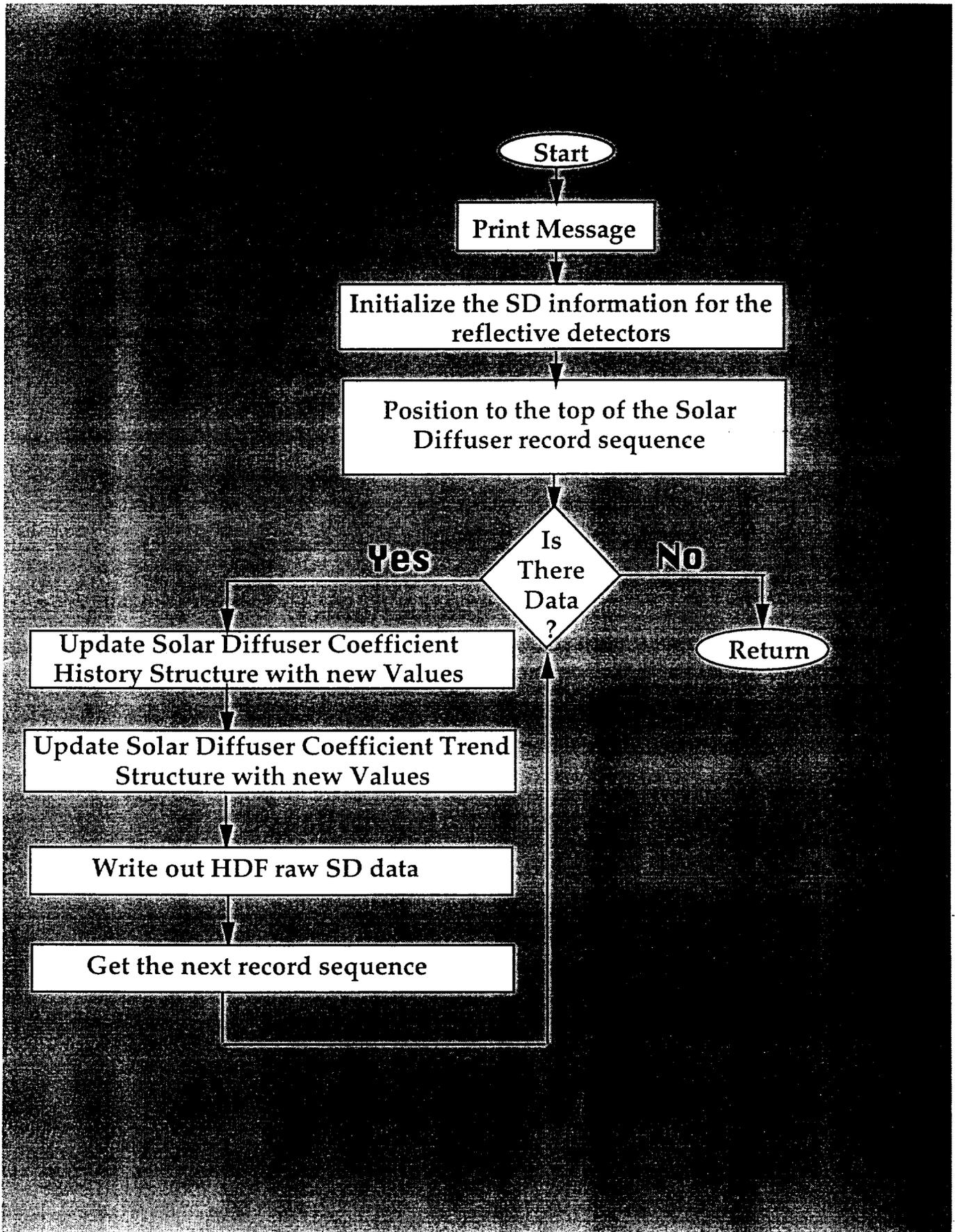
## 2.3 Estimate\_SD\_Avg\_Coeff



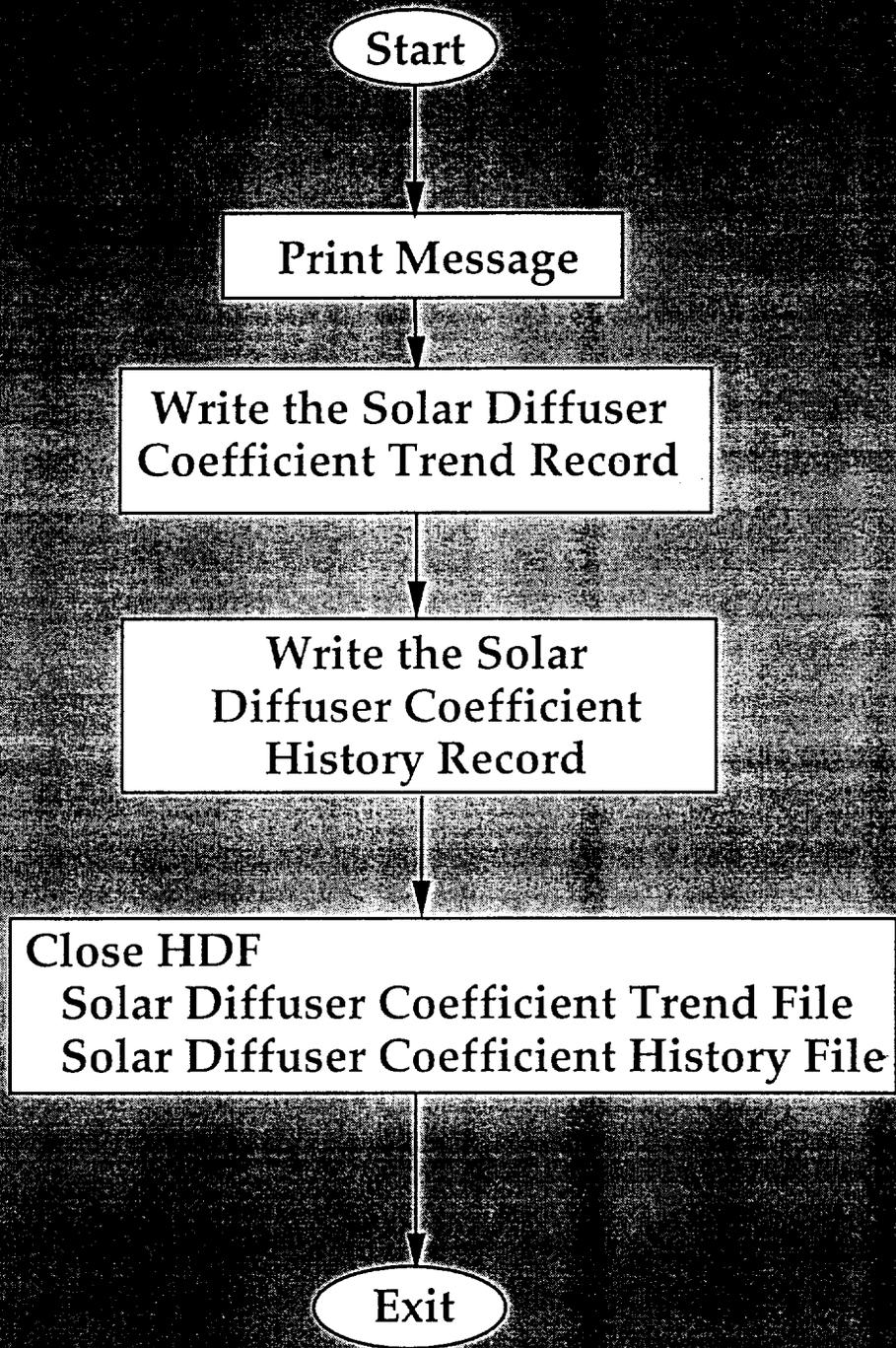
## 2.4 Calculate\_Average\_Time

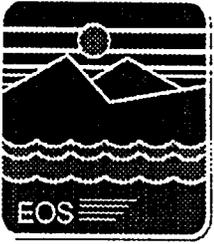


## 2.5 Update\_SD\_Coeff\_Rec



## 2.6 SD\_Shutdown



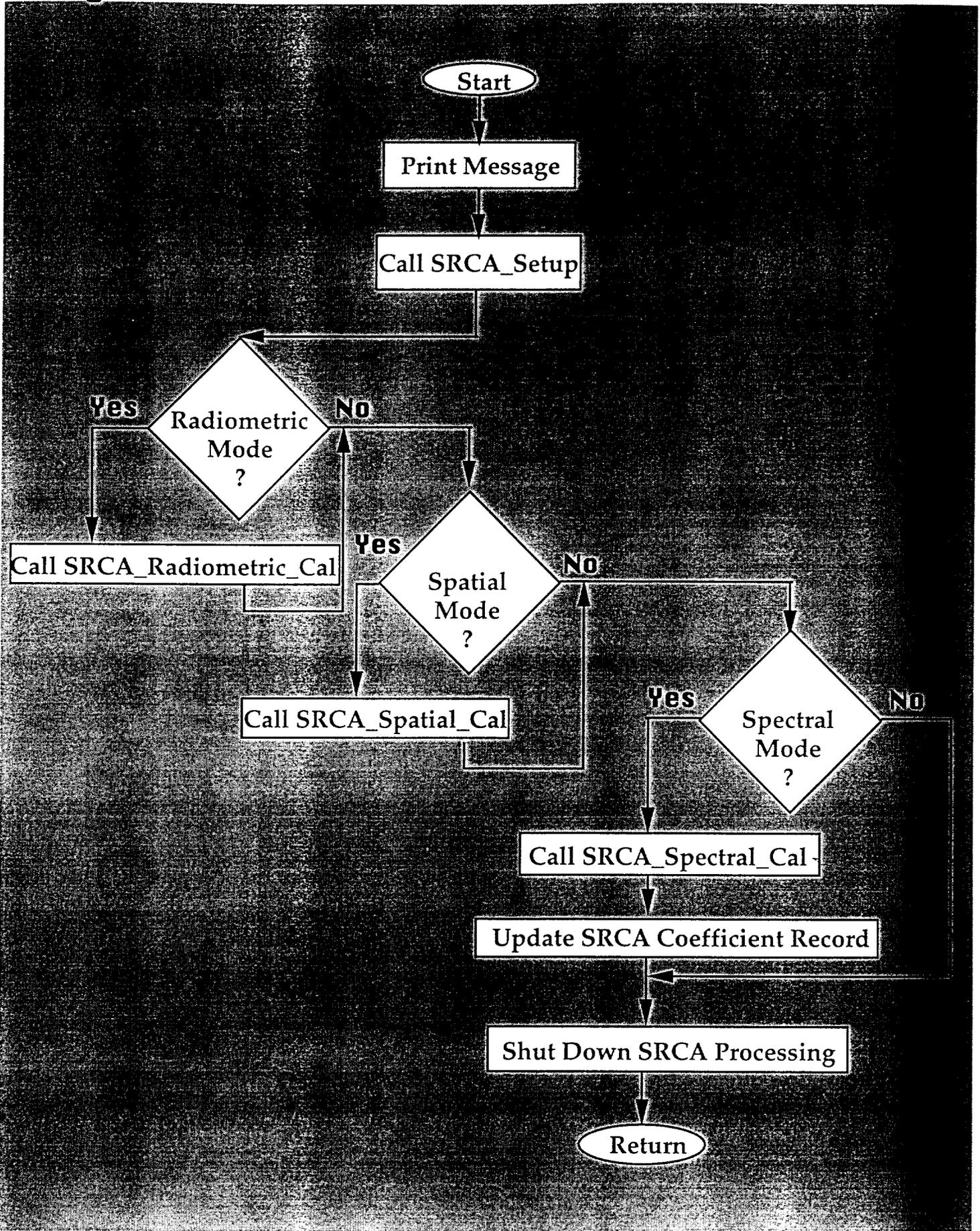


# Xgran\_SRCA CSCI (L1B-03)

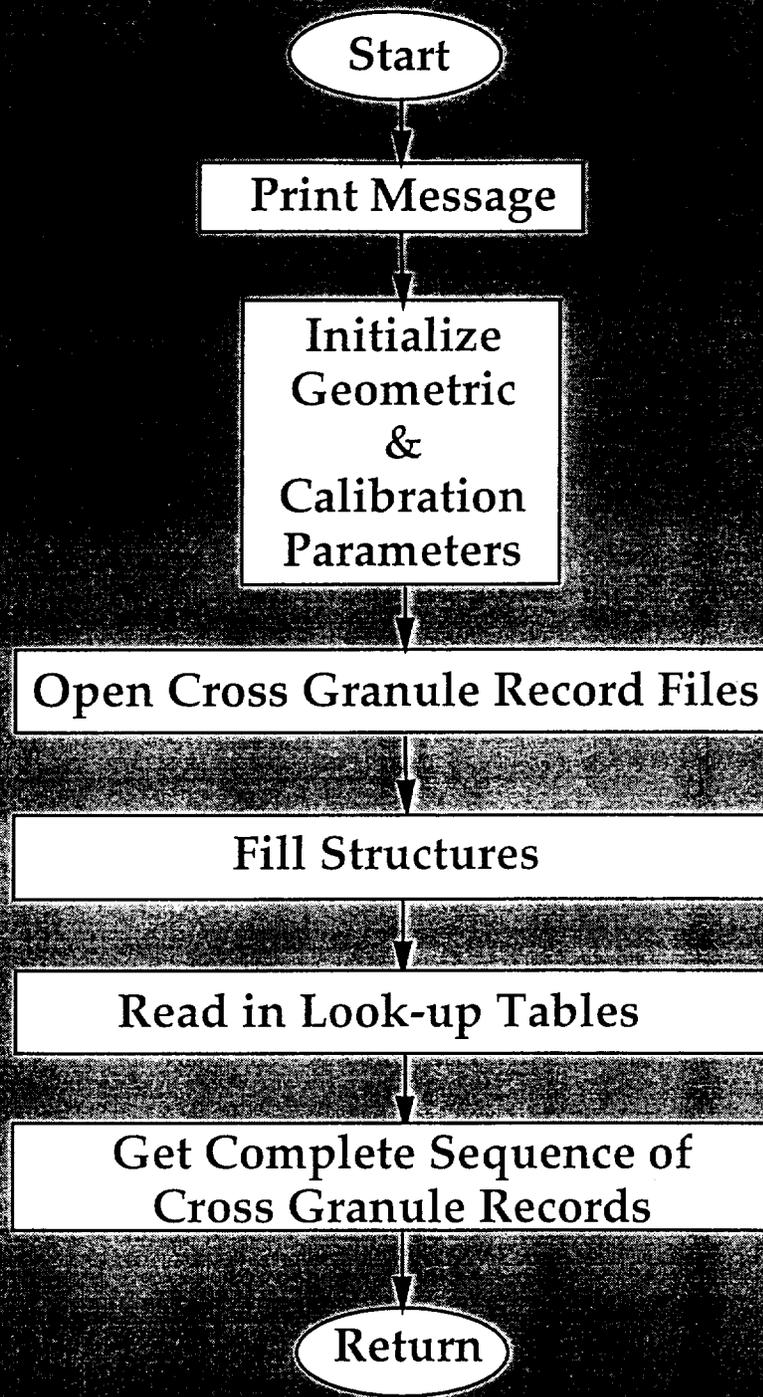


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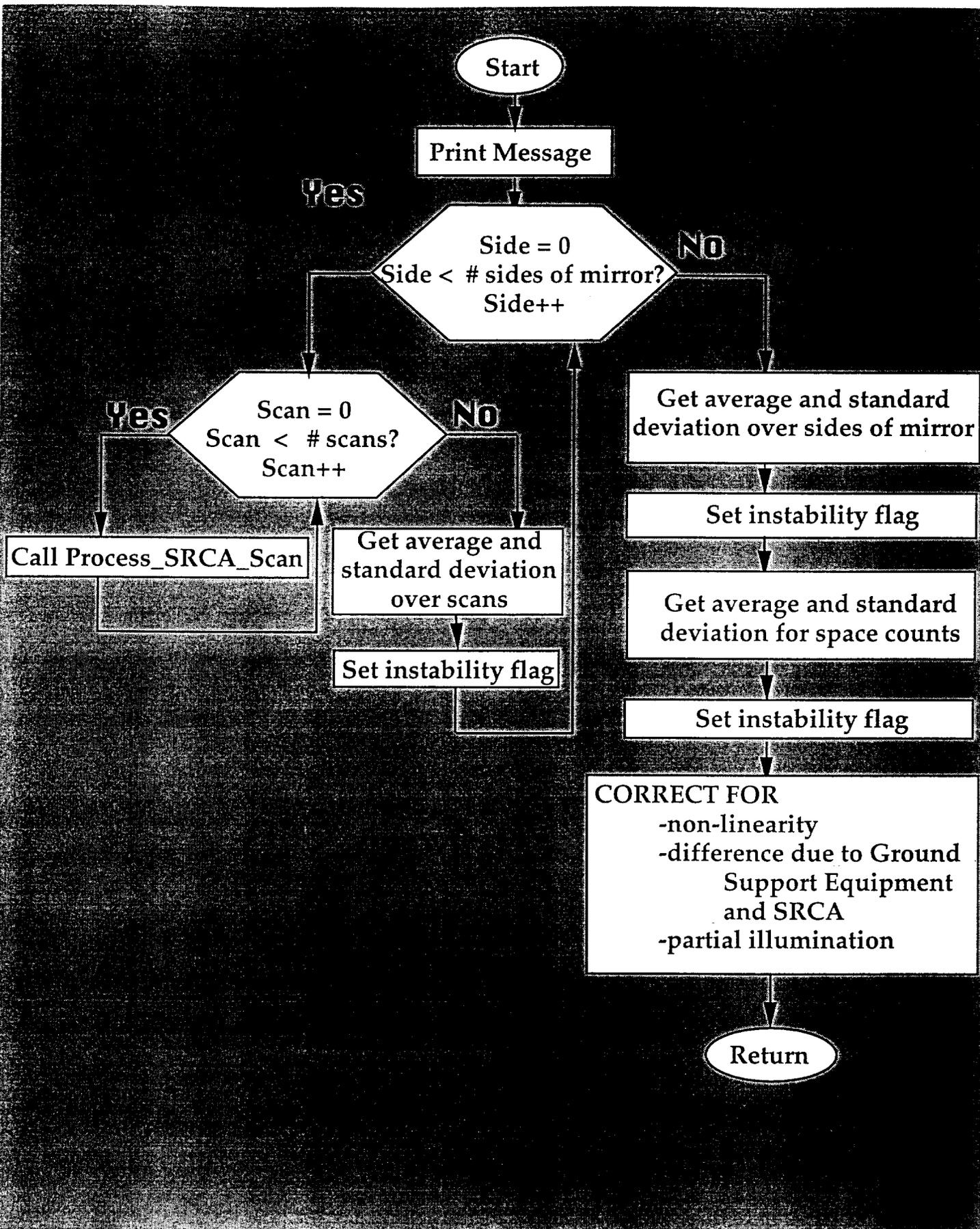
### 3.0 Xgran\_SRCA



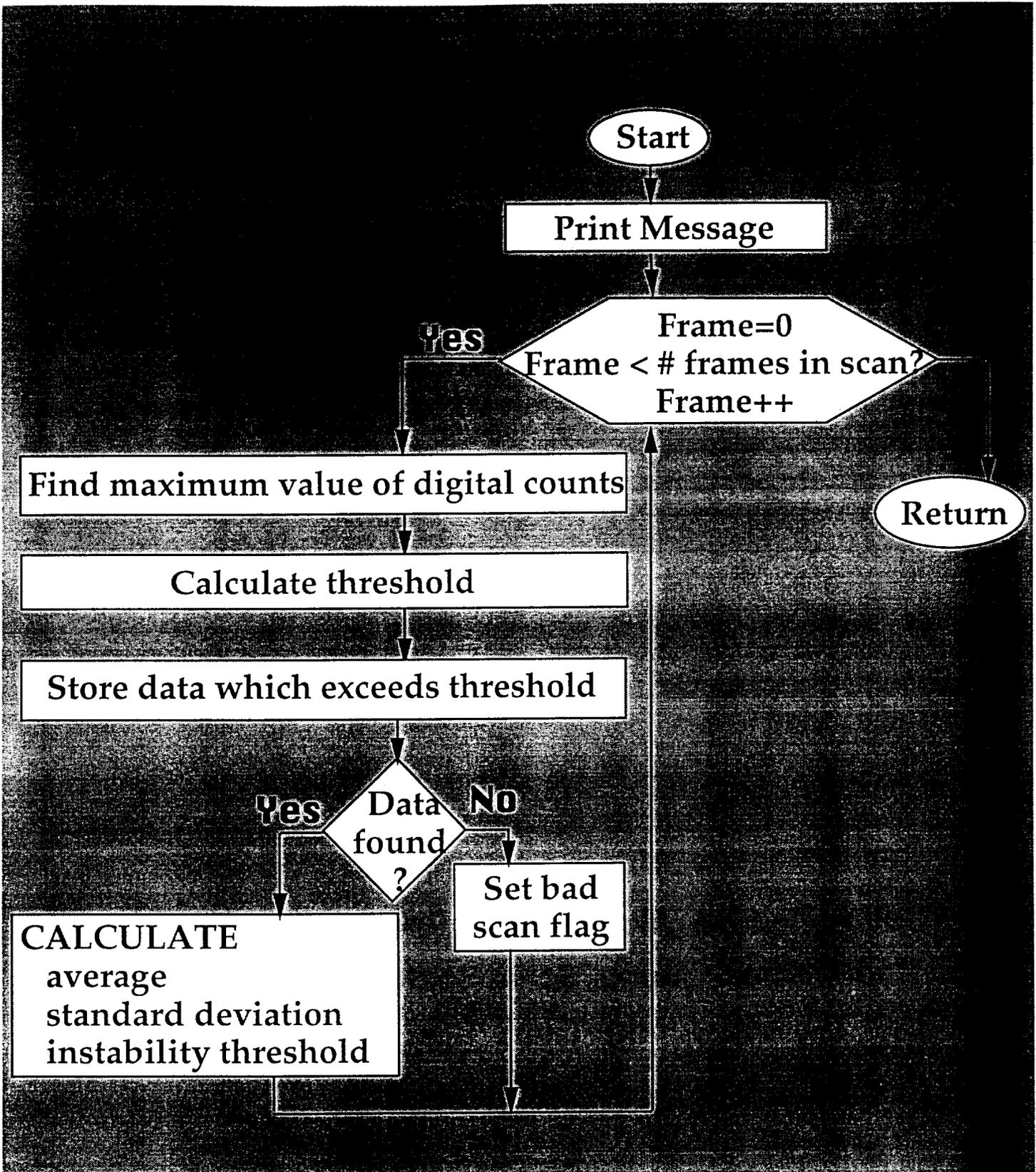
### 3.1 SRCA\_Setup



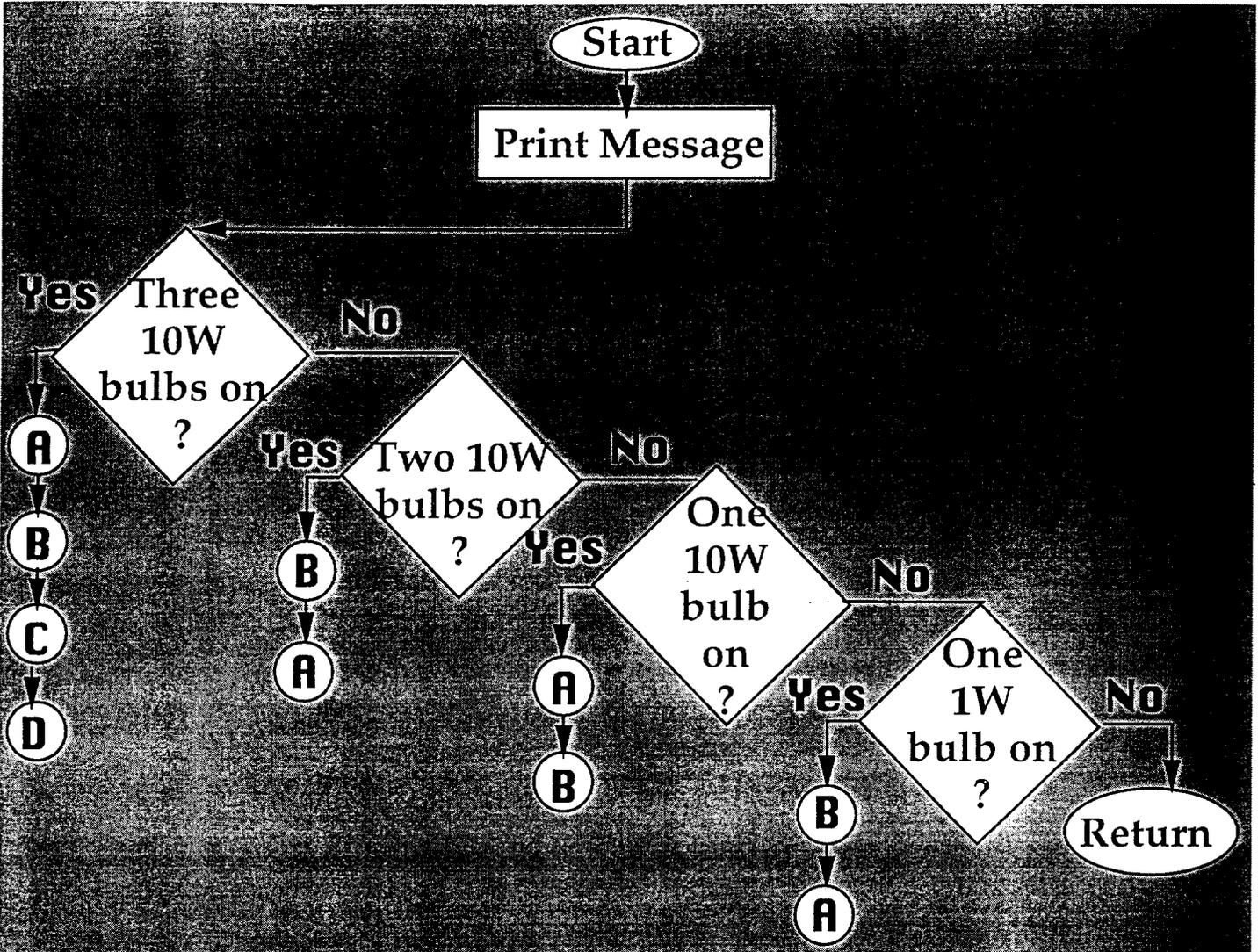
## 3.2 SRCA\_Radiometric\_Cal



### 3.2.1 Process\_SRCAscan

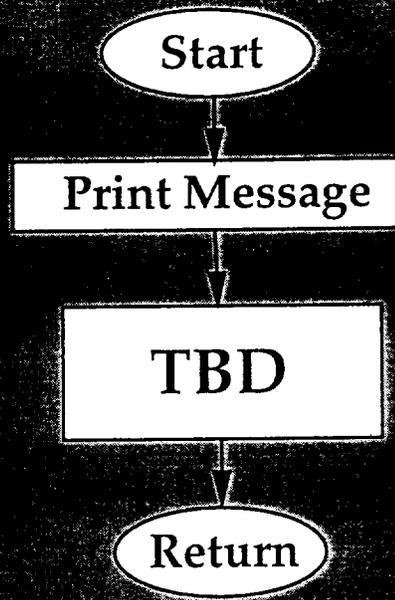


### 3.3 SRCA\_Spatial\_Cal

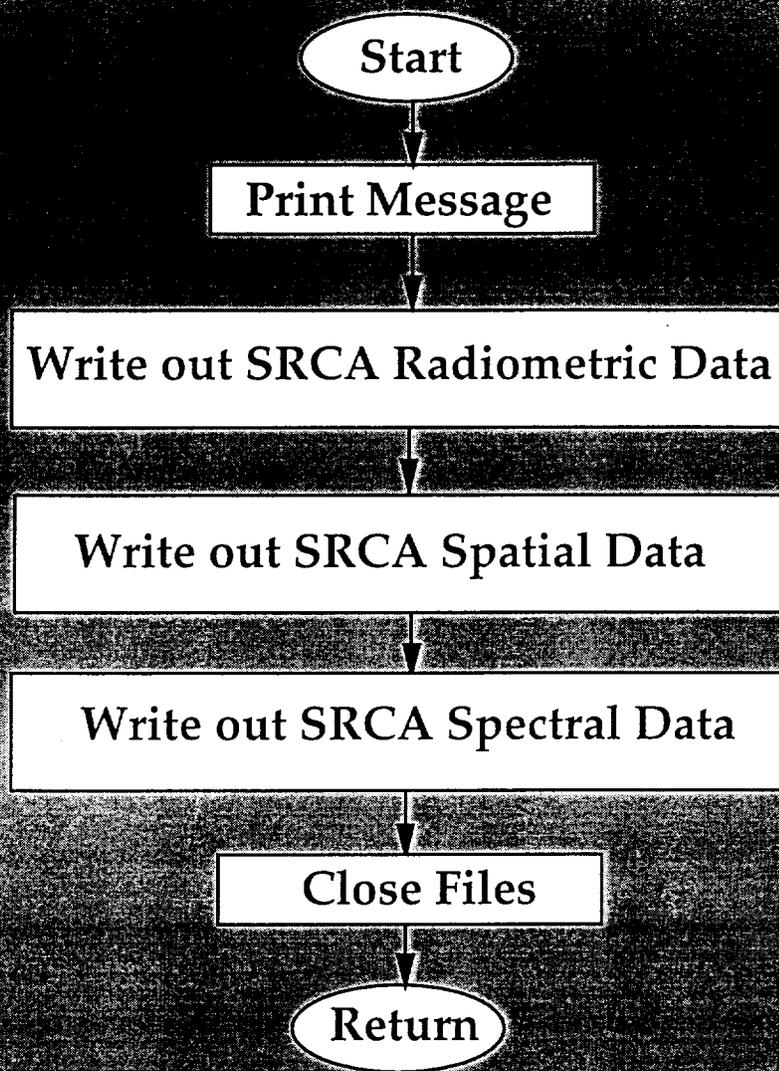


- (A) Call Reflective\_Along\_Scan\_Spatial\_Correction
- (B) Call Reflective\_Along\_Track\_Spatial\_Correction
- (C) Call Thermal\_Along\_Scan\_Spatial\_Correction
- (D) Call Thermal\_Along\_Track\_Spatial\_Correction

### 3.4 SRCA\_Spectral\_Cal



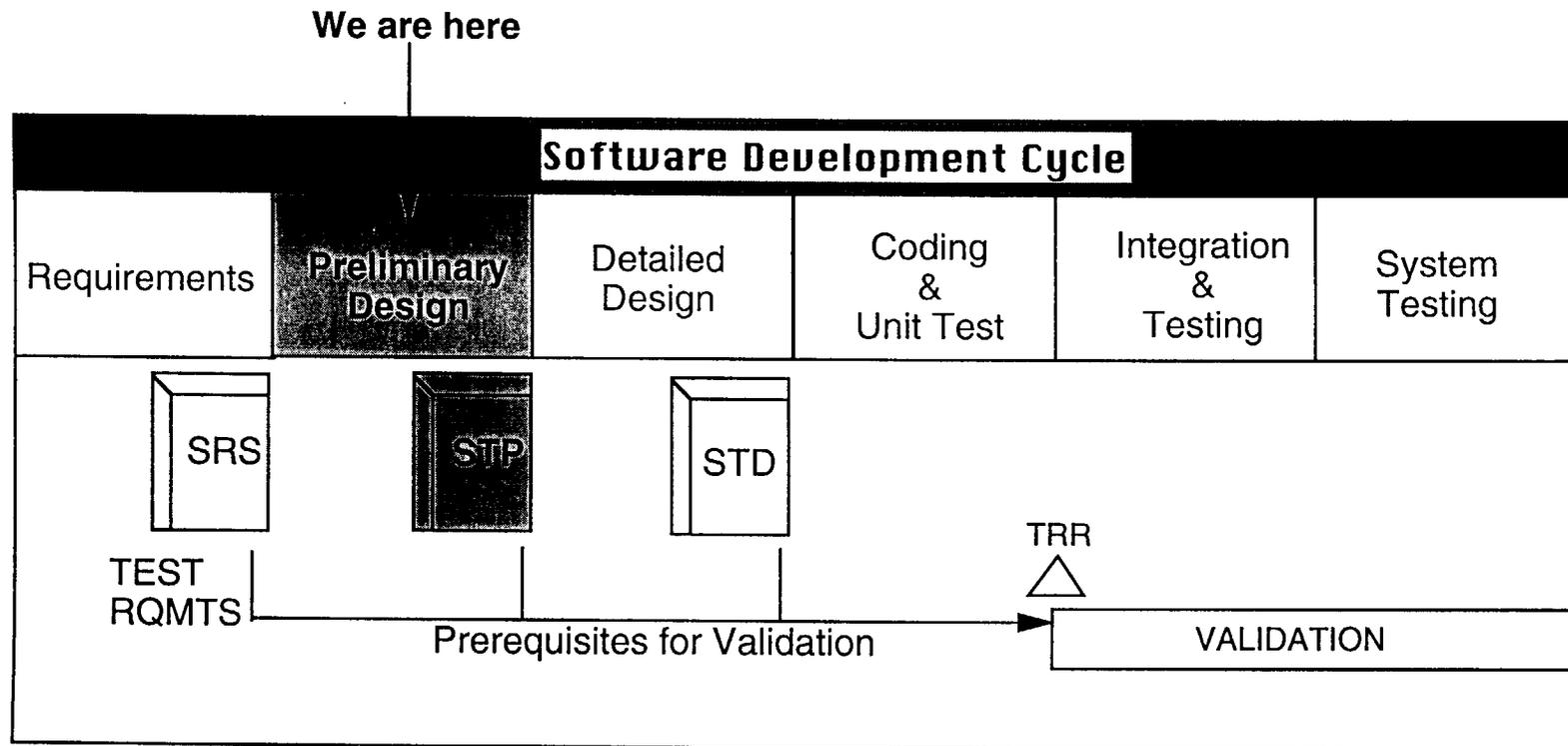
### 3.5 SRCA\_Shutdown



# **Software Test Plan (STP) Overview**

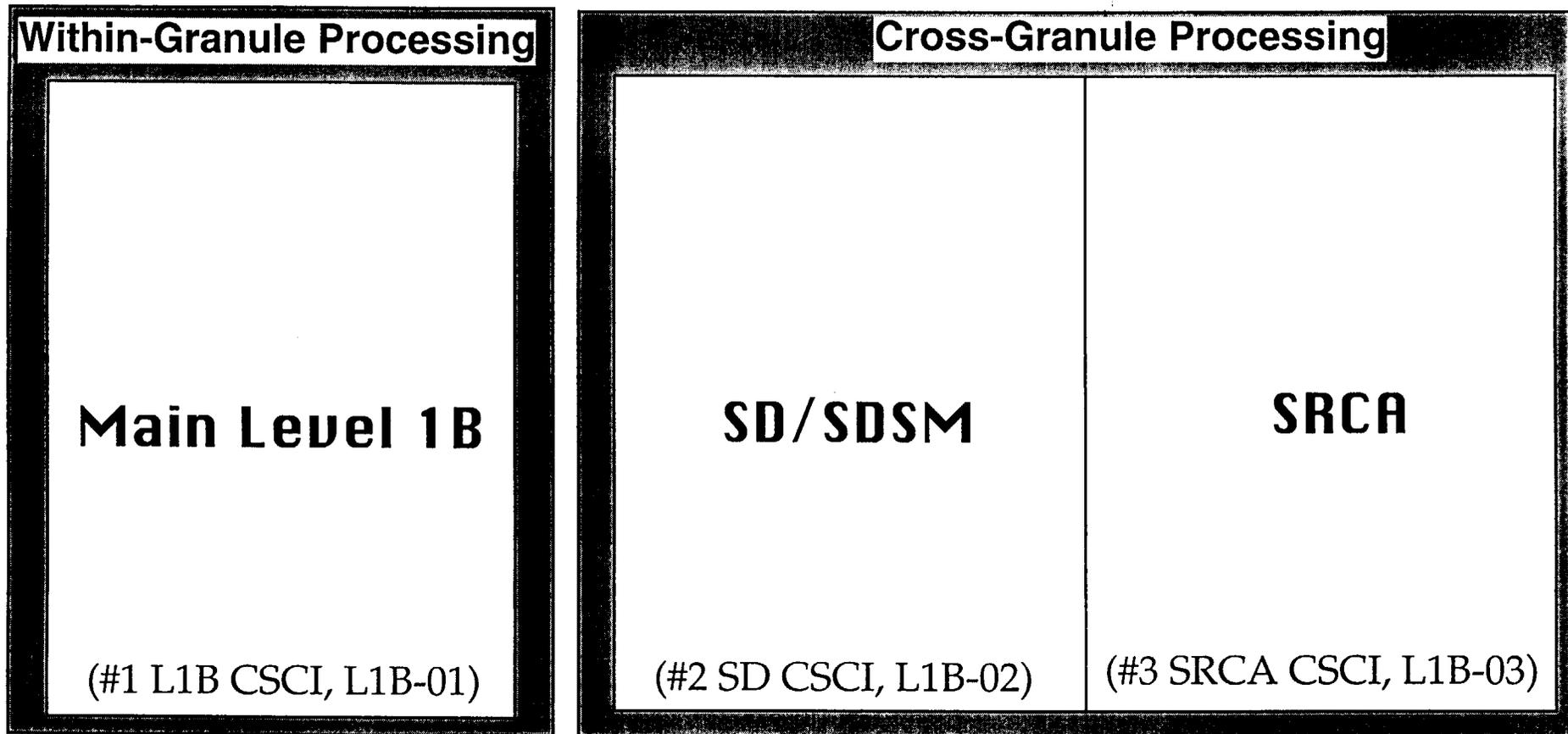
**Joan Baden**  
MODIS Preliminary Design Review (PDR)  
30 JUN 95

- The purpose of this presentation is to go over the **Software Test Plan (STP)** for the MODIS Level 1B software system.
- Software Test Plan (STP) addresses the **System Acceptance Testing (SAT)** activities and the environment in which those activities will take place for the MODIS Level 1B software system.



- RQMTS = Requirements
- SRS = Software Requirements Specification
- STP = **Software Test Plan**
- STD = Software Test Description
- TRR = Test Readiness Review

# MODIS Level 1B Production Software Broken into 3 CSCIs

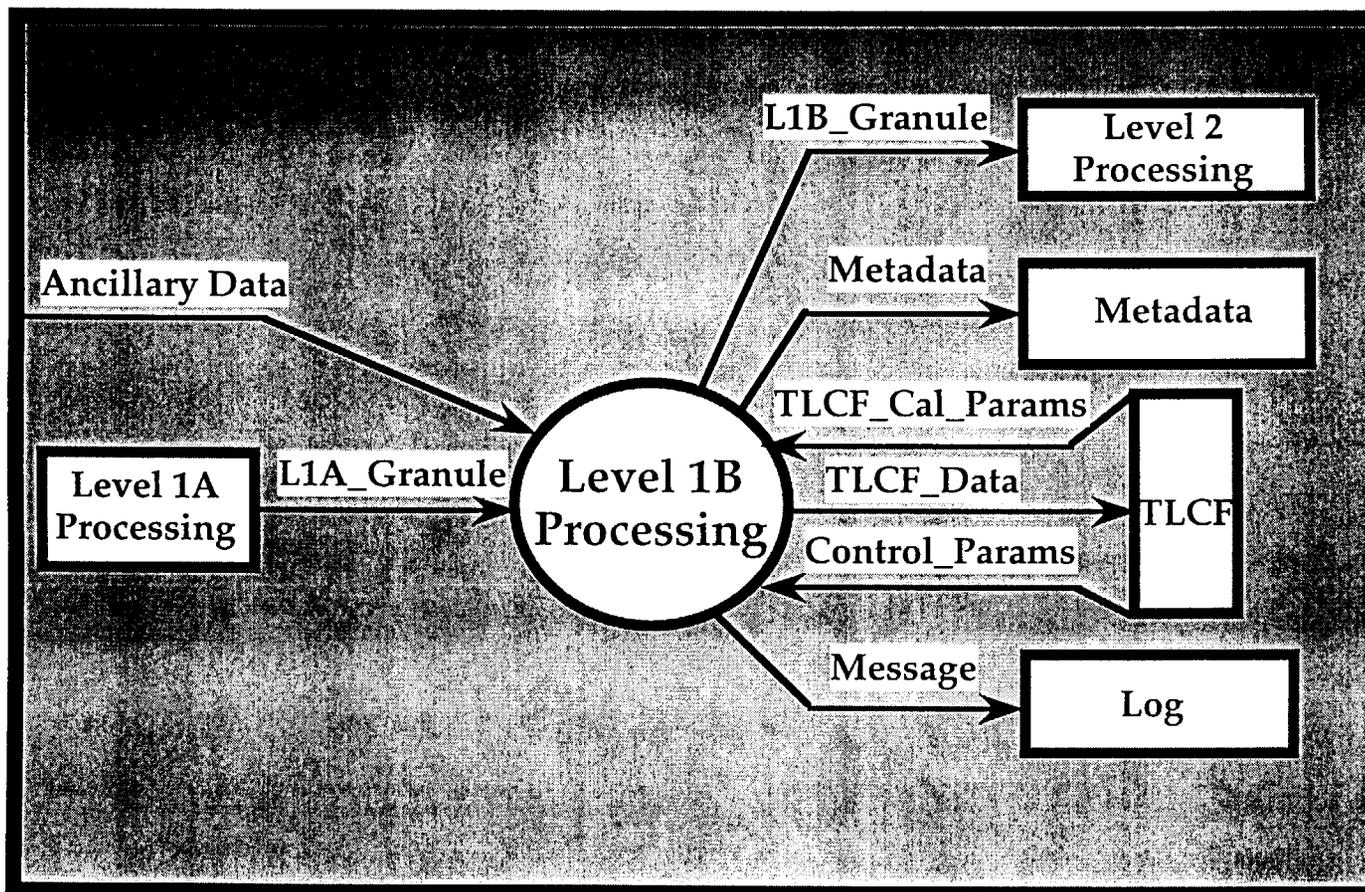


CSCI - Computer Software Configuration Item, a Configuration Management term. Configuration Management is a four-part process: configuration identification, configuration and change control, configuration status accounting, and auditing when needed. Configuration identification organizes software into computer software configuration items, establishes unique names and identifiers for these items (L1B-01, L1B-02, L1B-03, etc.), and designates key documents as specification baselines.

- MODIS Level 1B software implements the calibration algorithms documented in the October, 1994 ATBD

AUTHORS	
Thermal Algorithm - Dan Knowles/GSC, Larry Goldberg of Swales and Associates	} Overseen by Bruce Guenther Harry Montgomery Bill Barnes John Barker
SRCA Algorithm - Nianzeng Che and Tmitri Zukowski of Swales and Associates	
SD/SDSM Algorithm - Paul Anuta of RDC, and currently Bob Veiga of GSC	

- Context diagram for the Level 1B software system



# What does each CSCI do?

<b>Within Granule Processing</b>	<b>Cross granule processing</b>	
<p><b>Main Level 1B</b> (#1 L1B CSCI, L1B-01)</p>	<p><b>SD/SDSM</b> (#2 SD CSCI, L1B-02)</p>	<p><b>SRCA</b> (#3 SRCA CSCI, L1B-03)</p>
<p>Generates the L1B standard data product which contains the calibrated MODIS sensor data, in scientific units</p>	<p>Processes data acquired when the Solar Diffuser door is open to calculate and store an average coeff for the event, and trend data for the entire population of average coefficients; Generates a special data product containing raw SD and SDSM data.</p>	<p>Processes data according to the active mode SRCA is currently in. Radiometric, spectral modes used to monitor MODIS sensor calibration; Spatial mode describes misregistration of the detectors caused by shifts in the focal planes.</p>

# Test Environment\*

<b>MCST-Provided Software</b>	<b>SDST-Provided Software</b>	<b>SDST-Provided Hardware</b>
L1B CSCIs #1-3 Look-up/data tables L1B Data Product L1A Data Product Cross-Granule Working Files Log Files	Product Generation Executive (PGE) Unix OS specified by SDST at time of SAT Science Data Product (SDP) Toolkit Status Message Facility (SMF) Hierarchical Data Format (HDF)	4 Gbytes disk storage (minimum) Unix workstation Postscript printer Tape drive Magnetic tape

OS = Operating System

SAT = System Acceptance Testing

\*SDST is responsible for the maintenance of the test environment.

# ALL CSCI Test Requirements

Random selection of 10% of SW will be inspected for conformance to standards

Size & Execution time will be measured

Error detection, recovery, and reporting will be tested

External interfaces will be validated

Testing performed using nominal, extreme, erroneous inputs

<b>Test Classes:</b>	<b>Test Levels:</b>
Expected Value Testing	module or unit
Boundary Value Testing	integration
Stress Testing	system
Timing Testing	regression
Data Validation Testing	
Desk Check Testing	

# Types of Tests Performed on all CSCIs

External Interfaces Test

Functional Performance Test

Execution Time Test

Error Handling Test

Sizing Test

# Testing Schedule

Testing will begin in March of 1996.

# Problem Reporting

- Problems detected during SAT activity will be recorded on an IR or Incident Report.
- Problems will be assigned a priority and addressed by the SDST Test Manager who will then provide these to the developer for correction.