

# MODIS Calibration & Characterization Report

## Introduction

*By*

**John L. Barker/MCST Project Scientist  
MODIS Characterization Support Team (MCST)**

NASA/Code 925: Sensor Development and Characterization Branch

Joan Baden (Email: [baden@highwire.gsfc.nasa.gov](mailto:baden@highwire.gsfc.nasa.gov) or Phone: 301-286-1378 or FAX 301-286-4661) *editor*  
Research and Data Systems Corporation (RDC)7855 Walker Drive, Suite 460, Greenbelt, Maryland 20770  
Phone: 301-982-3700 / Fax: 301-982-3749

*Presented at The*

MODIS Calibration Working Group Meeting  
NASA/Goddard Space Flight Center (GSFC)  
Building 22, Room 365  
Greenbelt, MD 20771

**28 September 1993**

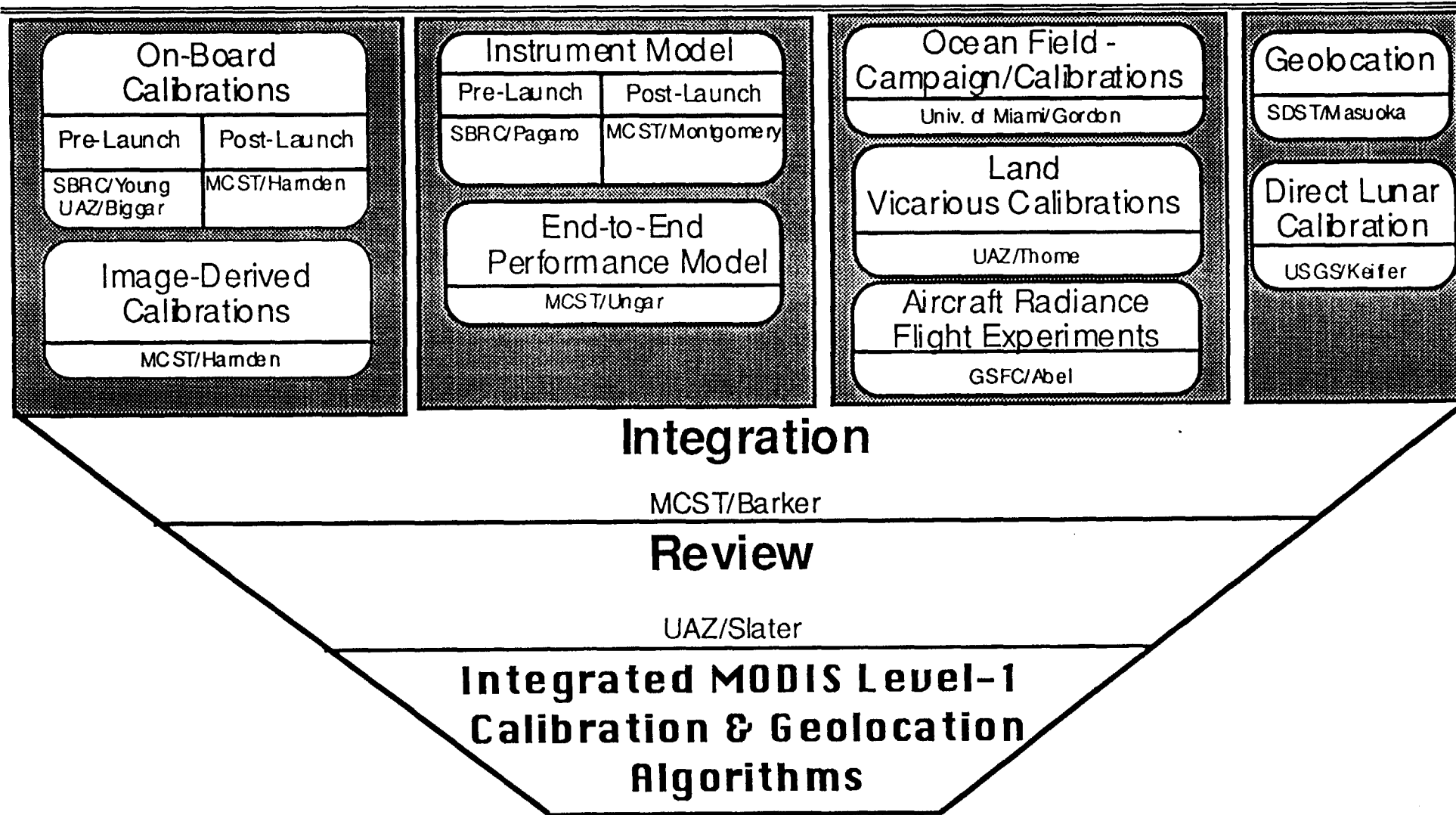
# MODIS Instrument Calibration Requirements

Parameter*	Requirement (Goal)	Predicted	
		Pre-Launch	On-Orbit
<b>Radiometric Calibration</b>		<b>%(+/-1<math>\sigma</math>)</b>	
Below 3000nm (Reflective)	5.0	4.0	
Above 3000nm (Emissive)	1.0		
Except 20,	0.75(0.50)	4.0	
31 & 32, and	0.50(0.25)		
31 High & 32 High	10		
Reflectance (Relative to the Sun)	2.0	4.0	2.0
Spectral Band-to-Band Stability			
Full Scale	0.5		
Half Scale	1.0		
<b>Spectral Characterization</b>		<b>nm</b>	
Center Wavelength			
Pre-Launch	0.5		
On-Orbit	1.0		
<b>Geometric Characterization</b>		<b>IFOV(+/-3<math>\sigma</math>)</b>	
Band-to-Band Registration Required	0.2 (0.1)	0.1	0.15

\*Radiometric Accuracy is at specified typical radiance and can be 1% larger from 0.3 L<sub>typ</sub> to 0.9 L<sub>Max</sub> based on multiple samples of uniform, extended non-polarized sources.

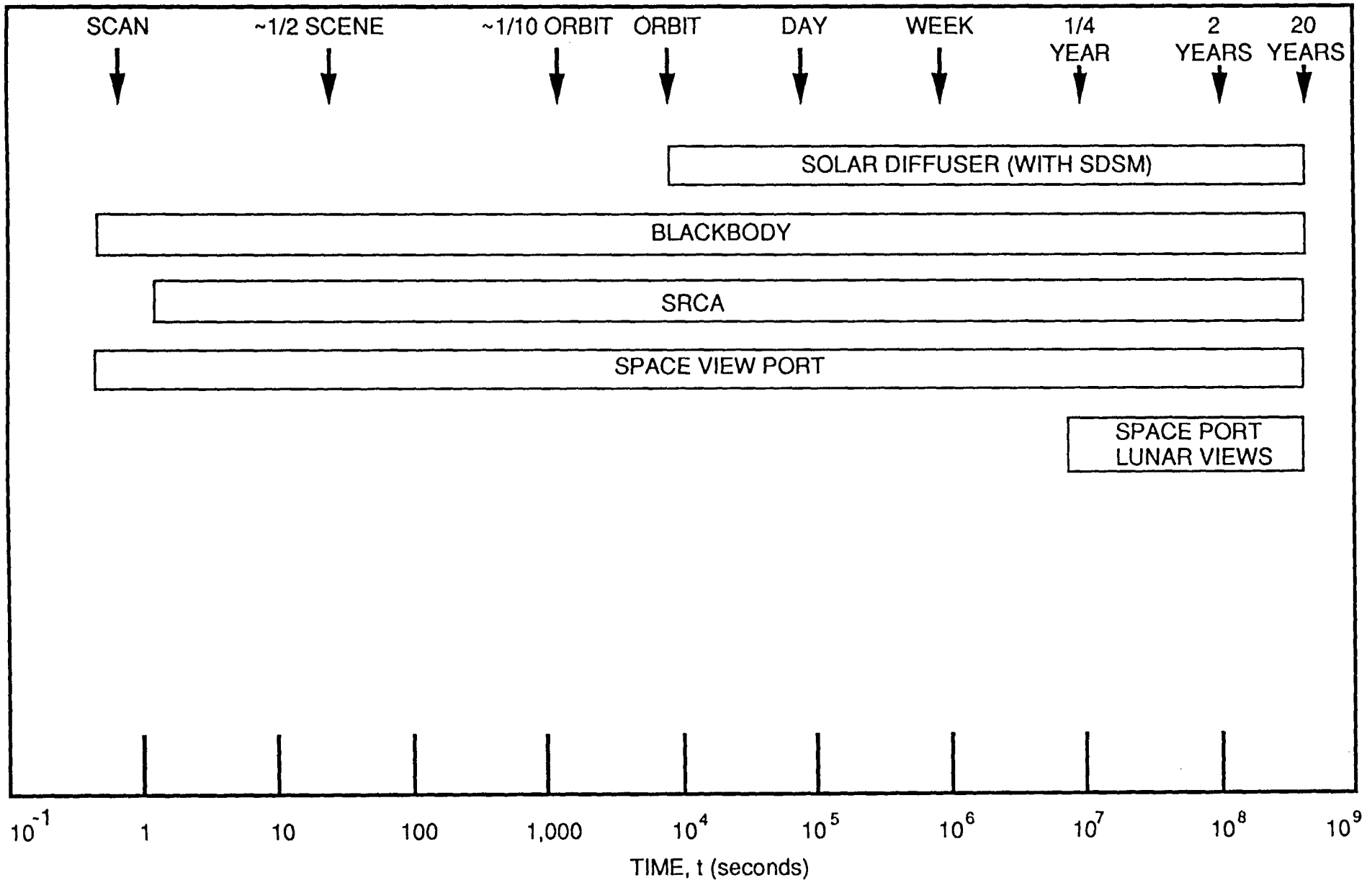
# MODIS

## Characterization & Calibration Data Sources

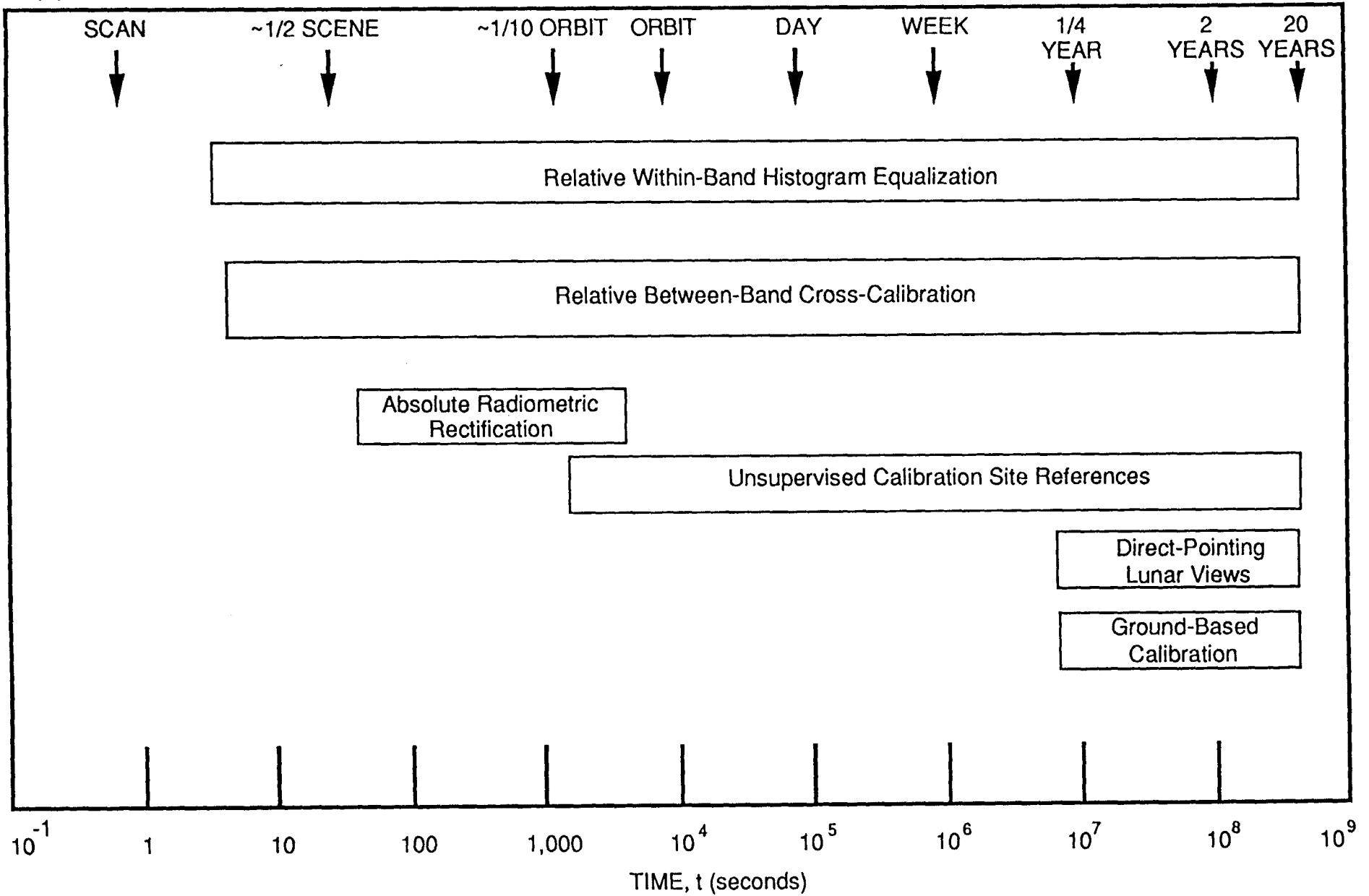


File: L1 Cal Plan Name 2.6.1

# Approximate validity domains (time) for MODIS On-Board Calibration (OBC)

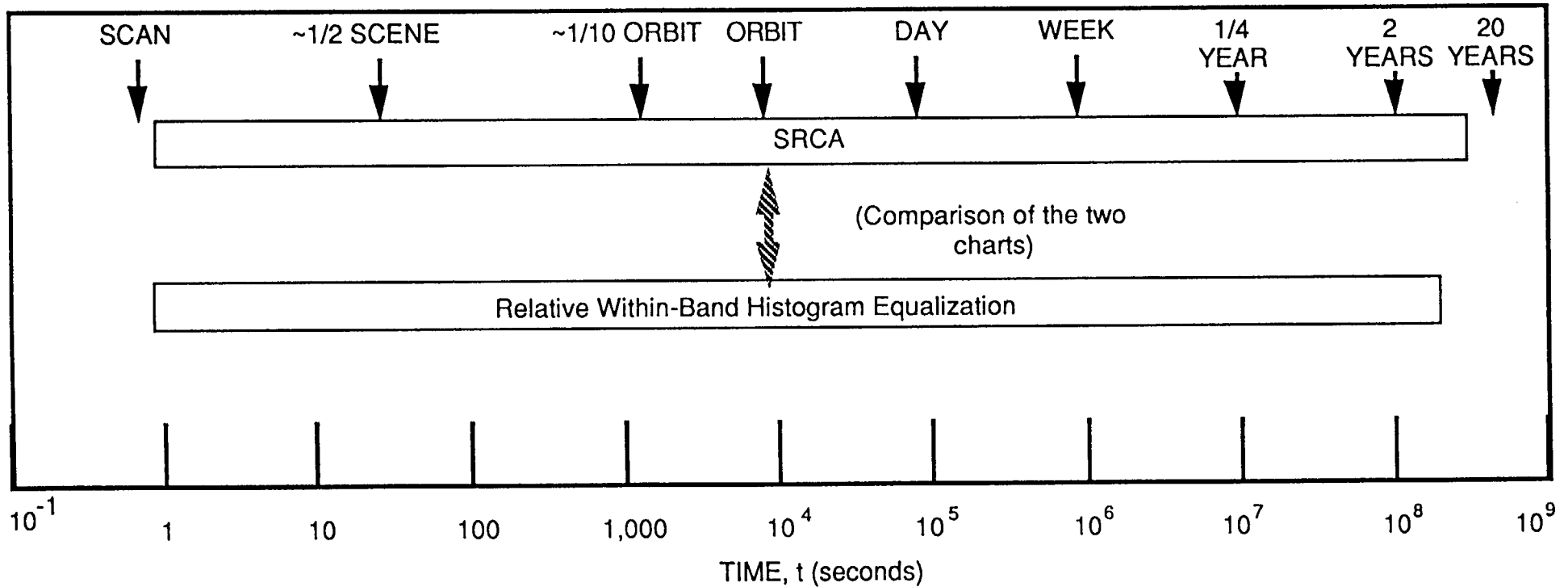


# Approximate Validity Domain Time for MODIS Image-Derived Calibration Technologies



# Example of redundant calibration techniques used to verify within-orbit radiometric behavior of instrument as measured by SRCA.

Approximate Validity Domain Time for MODIS Image-Based Calibration Technologies



# ***MODIS Calibration Processing Products\****

---

## Level-1A Data (MOD01)

- Each Pixel Geolocated
- Calibration Coefficients Included as Ancillary Data

## Level-1B Calibrated Data (MOD02)

- Each Pixel Geolocated
- Radiometric Calibration Applied Such that Data Value Dynamic Range of 1 to 65,535 (2 byte, halfword integer) Represents Spectral Radiance Range of  $L_{\lambda\text{Min}}$  to  $L_{\lambda\text{Max}}$  for each Band

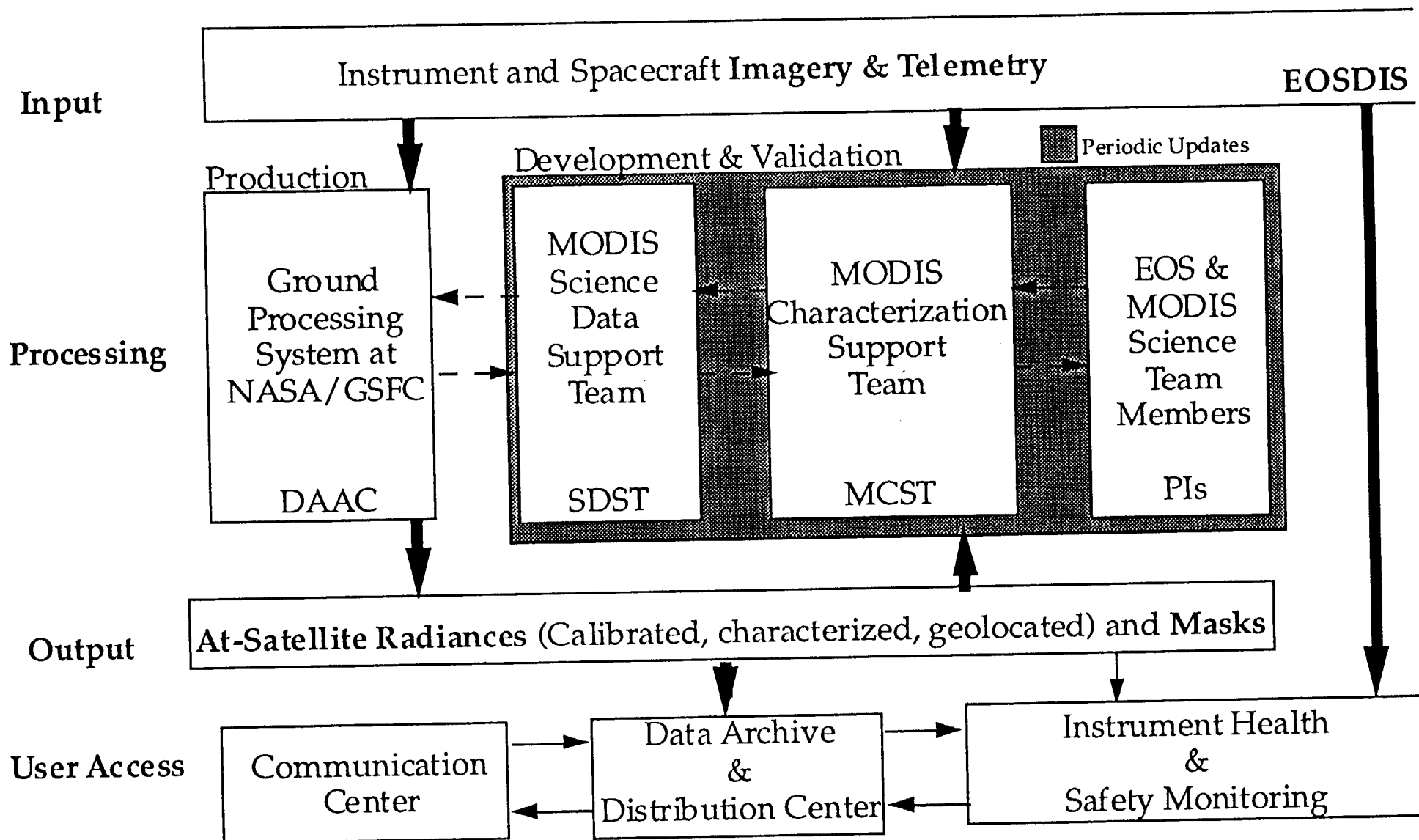
## Level-1B Utility Masks (MOD18)

- 1-Bit Masks for Cloud/Clear, Land, Water, Subnormal Channels, Pure/Mixed Pixels, ...
- 3-Bit Masks for Pixel Area, Cloud Fraction, ...

### \*Metadata

- Quality Assurance Data for Each Pixel
- Processing Applied to Each Band

# MODIS Level-1 Product Flow





# Three 8-Byte MODIS Level-1B Utility Masks for 250, 500 and 1000 m Bands of Instrument Channel, Data, and Scene Usefulness

## Illustrative 1-bit Binary Level-1 Pixel Masks

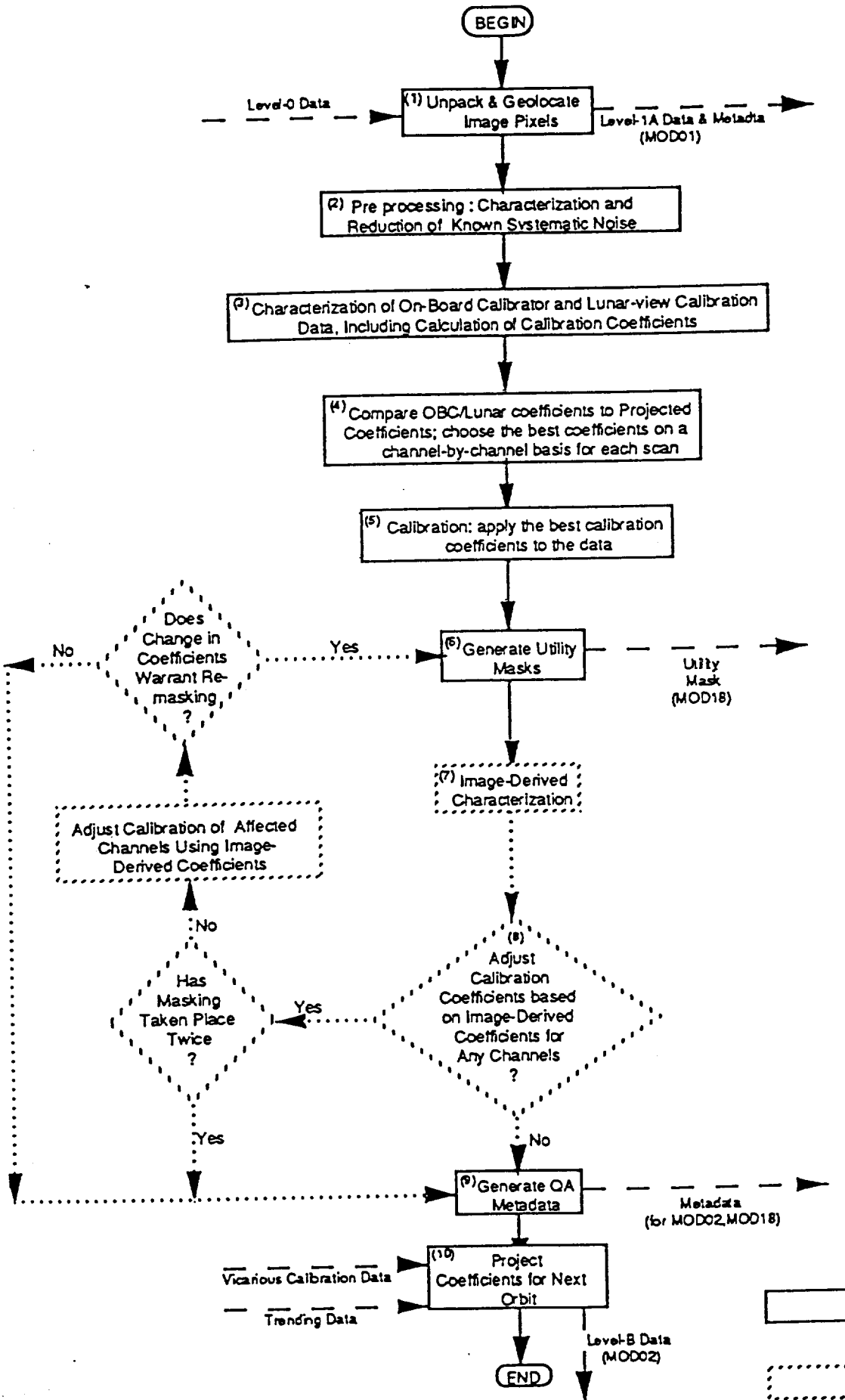
- Replaced Dead Channels
- Overlapped with Adjacent Scan
- Opaque Clouds
- Calculated Cloud Shadow
- Spatially Homogeneous Pixels
- Land
- Calculated Potential Glint
- Unreplaced Noisy Channels
- No Overlapped Ground Pixels
- Transparent Clouds
- Radiometric Outlier
- Mixed Pixel (Mixels)
- Water
- Actual Observed Glint

## Illustrative 3-bit Fractional Level-2 Pixel Masks

- Pixel Area on Ground
- Opaque Cloud Fraction
- Solar Irradiance at Top of Atmosphere
- Modular Transfer Function (MTF) Significance on Radiometry
- Size of Corrected (or Uncorrected) Systematic Errors
- Water Fraction
- Snow/Ice Fraction

# OVERVIEW: Level-1 Processing Flow

(Derived From MODIS L-1 Geolocation, Characterization and Calibration Algorithm Theoretical Basis Document; Version 1; 9/7/93)



10

Core Algorithm  
Subsequent

# MODIS Level-1 Processing Flow

