# Saskatchewan Glacier Albedo Analysis - Database Statistics Report

This report provides basic statistical analysis of the Saskatchewan Glacier albedo database, containing MODIS satellite data from 2010-2024. The database includes two primary datasets: MCD43A3 (general albedo measurements) and MOD10A1 (snow albedo measurements), with comprehensive quality assessments and temporal coverage.

## Dataset Overview

The database contains comprehensive measurements for both MCD43A3 and MOD10A1 datasets:  
  
• MCD43A3 Measurements: 1,830 total records spanning from 2010-06-01 to 2024-09-30, covering 15 years of observations  
• MOD10A1 Measurements: 1,830 total records spanning the same temporal range (2010-06-01 to 2024-09-30), also covering 15 years  
  
Both datasets provide identical temporal coverage, ensuring consistency for comparative analysis and trend detection across the 15-year study period.

## Albedo Statistics by Ice Fraction

MCD43A3 dataset shows distinct albedo patterns across different ice fraction classes:  
  
• Border (0-25% ice): Average albedo = 0.2944  
• Mixed Low (25-50% ice): Average albedo = 0.2786  
• Mixed High (50-75% ice): Average albedo = 0.3113  
• Mostly Ice (75-90% ice): Average albedo = 0.3386  
• Pure Ice (90-100% ice): Average albedo = 0.4383  
  
The data reveals a clear trend where albedo values increase with ice fraction percentage, with pure ice areas showing the highest reflectance (0.44) and mixed low areas showing the lowest (0.28). This pattern is consistent with physical expectations, as ice surfaces reflect more solar radiation than mixed or border areas.

## Seasonal Distribution

The temporal distribution of observations across seasons shows:  
  
• Early Summer: 1,830 observations (100% coverage)  
• Mid Summer: 930 observations (50.8% coverage)  
• Late Summer: 900 observations (49.2% coverage)  
  
Early summer shows complete coverage across both datasets, while mid and late summer periods have roughly equal representation. This distribution reflects the melt season focus of the analysis, with comprehensive early summer monitoring when albedo changes are most significant for glacier dynamics.

## Dataset Comparison: MCD43A3 vs MOD10A1

Comparison between MCD43A3 (general albedo) and MOD10A1 (snow albedo) reveals significant differences:  
  
MOD10A1 Albedo Values by Ice Fraction:  
• Border (0-25% ice): Average albedo = 0.4159 (+0.1215 vs MCD43A3)  
• Mixed Low (25-50% ice): Average albedo = 0.3879 (+0.1093 vs MCD43A3)  
• Mixed High (50-75% ice): Average albedo = 0.4155 (+0.1042 vs MCD43A3)  
• Mostly Ice (75-90% ice): Average albedo = 0.4417 (+0.1031 vs MCD43A3)  
• Pure Ice (90-100% ice): Average albedo = 0.5346 (+0.0963 vs MCD43A3)  
  
MOD10A1 consistently shows higher albedo values across all ice fraction classes, with differences ranging from 0.096 to 0.122. This is expected as MOD10A1 specifically focuses on snow albedo, while MCD43A3 provides more general surface albedo measurements.

## Data Quality and Coverage

Pixel coverage analysis reveals the spatial extent and data availability:  
  
MCD43A3 Dataset:  
• Average valid pixels per observation: 46  
• Minimum pixels: 0 (complete cloud cover or data gaps)  
• Maximum pixels: 163 (optimal conditions)  
  
MOD10A1 Dataset:  
• Average valid pixels per observation: 57 (+24% more coverage)  
• Minimum pixels: 0 (complete cloud cover or data gaps)  
• Maximum pixels: 170 (optimal conditions)  
  
MOD10A1 shows superior pixel coverage with 24% more valid pixels on average, likely due to its specific optimization for snow detection and processing algorithms.

## Summary and Conclusions

Key findings from the Saskatchewan Glacier albedo database analysis:  
  
1. Temporal Coverage: Both datasets provide comprehensive 15-year coverage (2010-2024) with 1,830 observations each, ensuring robust temporal analysis capabilities.  
  
2. Albedo Patterns: Clear relationship between ice fraction and albedo values, with pure ice showing highest reflectance (MCD43A3: 0.44, MOD10A1: 0.53).  
  
3. Dataset Differences: MOD10A1 consistently shows higher albedo values (+10-12%) and better pixel coverage (+24%) compared to MCD43A3.  
  
4. Seasonal Focus: Strong emphasis on early summer observations (100% coverage) with balanced mid and late summer representation (~50% each).  
  
5. Data Quality: Variable pixel coverage (0-170 pixels) indicates the importance of cloud filtering and quality assessment in trend analysis.  
  
This database provides a solid foundation for analyzing long-term albedo trends and understanding glacier surface dynamics across different temporal and spatial scales.

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