Landsat-5 TM and Landsat-7 ETM+ Performance Update

LDCM Science Team Meeting

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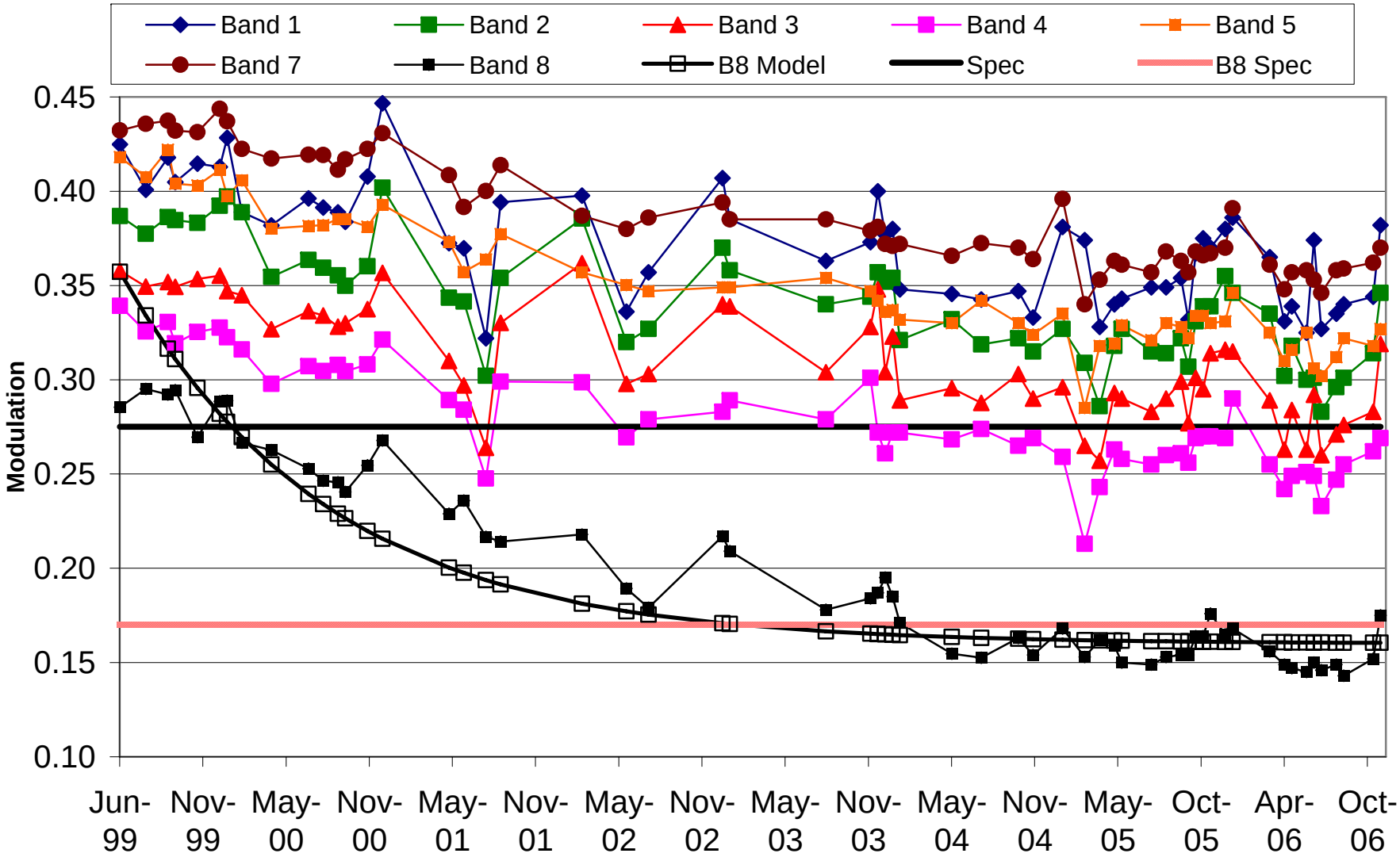
Landsat-7 ETM+ Geometric and Spatial Update

- Band-to-Band registration typically 0.05 pixels or better in line and scan direction (excluding band 6)
- MTF @ Nyquist changing consistent with pre-launch model--band 4 slightly below specification of 0.275
- Geodetic accuracy improved to < 20 m RMS since March 2005 Gyro 3 depowering (approx 1/3 pre 3/2005 values)
- Bumper mode transition expected during summer 2007

Along-Scan MTF @ Nyquist vs. Date



Landsat-5 TM Geometry Update

- Landsat-5 TM operating in bumper mode since 2002
  - Monthly parameter updates
  - Best geometric performance if data are ordered at least 1 month after acquisition (predicted versus refined parameters)
- Fixed array operations have introduced more uncertainty in spacecraft pointing knowledge
  - We see larger and more frequent step corrections in the on-board attitude estimates
    - Symptom of star updates correcting accumulated attitude error
  - New processing logic was added to detect and correct the step offsets in the quaternion data

Bumper Mode Performance Summary

- **Bumper behavior has become more stable since the fixed solar array transition**
  - More stable usage patterns
- **Within-scan accuracy summary:**

	FWD Line RMSE	FWD Samp RMSE	REV Line RMSE	REV Samp RMSE
ETM+ SAM Mode	**4.3 m**	**4.0 m**	**4.0 m**	**3.9 m**
TM Bumper Mode (Predicted) Life	**5.7 m**	**8.1 m**	**5.7 m**	**8.0 m**
Since 2/8/05	**5.7 m**	**8.3 m**	**5.7 m**	**8.5 m**
TM Bumper Mode (Refined) Life	**5.6 m**	**6.1 m**	**5.7 m**	**6.3 m**
Since 2/8/05	**5.7 m**	**6.3 m**	**5.7 m**	**6.3 m**

USGS

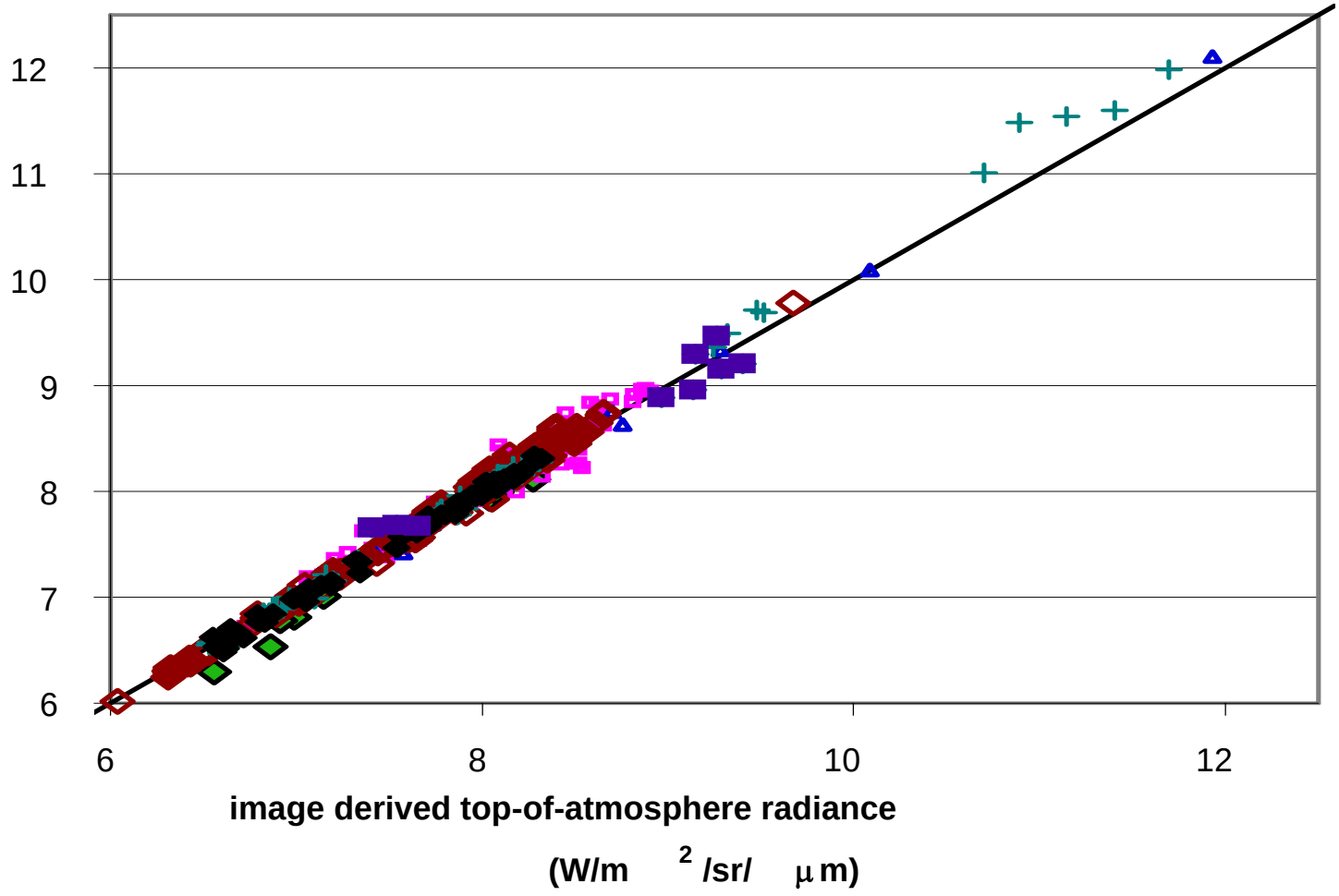
Landsat-7 ETM+ Reflective Band Radiometry Update

- Relative detector-to-detector normalization, i.e., striping less than ± 0.1%
- Between-date detector gain stable to < 3% over mission life (< 0.5%/year)
- Absolute radiometric accuracy better than ± 5%
- Noise stable over mission life
  - Small improvement with SLC-off
  - Anomalous coherent noise gone with SLC-off
- SLC failure had no significant impact on L7 ETM+ reflective band radiometry- continues to be excellent

Landsat-7 ETM+ Thermal Band Radiometry Update

- Relative detector-to-detector normalization, i.e., striping less than ± 0.1%
- No observable change in instrument responsivity
- Absolute radiometric accuracy better than 1K
- Noise stable over mission life

Ground-Based Absolute Calibration



BLUE/GREEN: JPL data

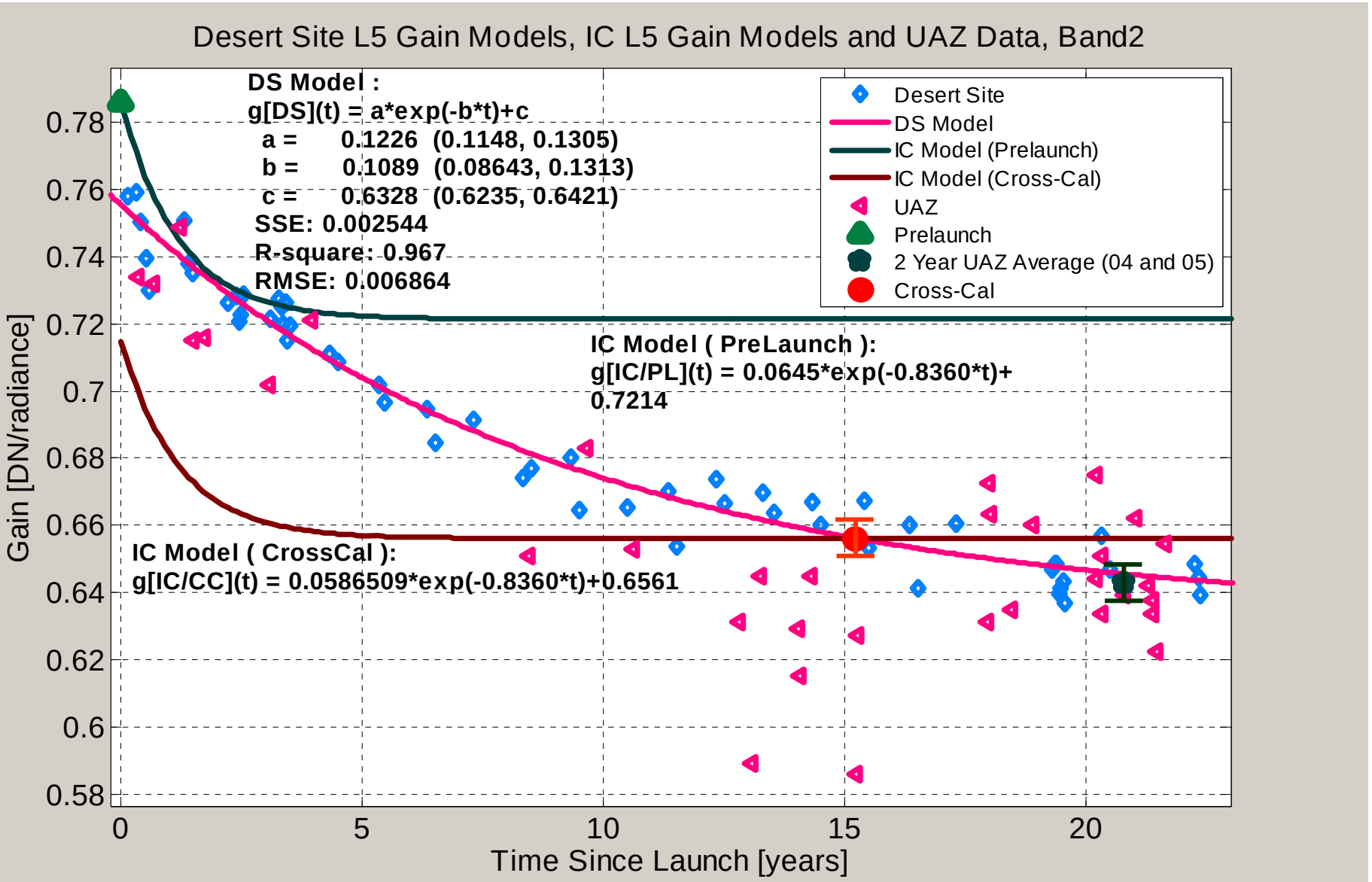
PINK/BROWN: RIT data

BLACK: Historical recently processed Tahoe data

PURPLE: recent Salton Sea

Landsat-5 TM Reflective Band Radiometry Update

- Within-band within-scene internal stability
  - Scan-Correlated Shift (SCS) of up to 0.7 DN
    - Correctable with scan line-by-scan line background subtraction
  - Memory Effect of up to 4 DN
    - Currently corrected in NLAPS processing
  - Some banding and striping issues remain to be resolved
- Between-date stability
  - Interference cycling from icing on B5 and B7
    - Correctable with IC processing or LUT that includes interference cycling
- Radiometric calibration processing
  - Uses Gain Calibration History stored in Look-Up Table
  - Extracts and applies biases on a scan line by scan line basis
  - Rescaled to Fixed Radiance Range (LMIN, LMAX)
  - Recently obtained datasets from ESA indicate calibration history can be improved
    - **Revised calibration LUT release planned for 3/5/2007**



Proposed updated calibration curve in pink, tied to 1999 ETM+ cross-cal

Landsat-5 TM Thermal Band Radiometric Calibration Update

- Sensitivity reduced by up to 50% by icing build-up on cold focal plane window
  - Correctable with Internal Calibrator
- Current ground measurements show some bias compared to internal calibrator calibrated imagery
  - Bias by +0.092 W/m^2 sr μm (~0.65K at 300K) for data processed beginning 3/5/2005
- Radiometric Calibration on Scene-by-Scene Basis using the response to the Internal Calibrator
  - Rescaled to Fixed Radiance Range (LMIN, LMAX)
  - Absolute accuracy ±2%

L5 Ground-Based Absolute Calibration