



Closed-loop operational calibration checks

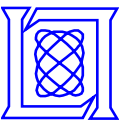
Full closed loop CrIS simulation

STAR JPSS Annual Science Team Meeting

Session 4: CrIS & ATMS SDRs

D. L. Mooney, MIT/LL

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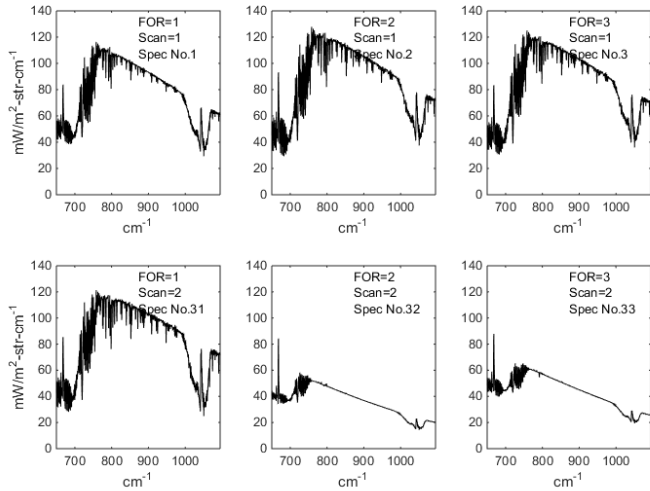
Motivation

- **CrIS calibration algorithms are complicated**
 - Measured interferogram for off-axis extended FOV
 - Delivery of equivalent on-axis interferogram on different wavenumber scale
- **Checking the performance of the algorithm has been difficult with operational data because the “truth” is not known exactly**
- **Operational A4 algorithm requires h5 files**
- **A simulation technique was developed to**
 - Use NOAA88b atmospheres (T, P, water vapor)
 - LBLRTM to produce high resolution LBL spectra
 - Operational like long interferograms were computed, FIR filtered, decimated, and packed into binary streams
- **Code to read operational h5 files and uniquely replace packed interferograms with unique simulated one relatable back to a specific NOAA88b atmospheric**
- **Process h5 files and compare to known input**

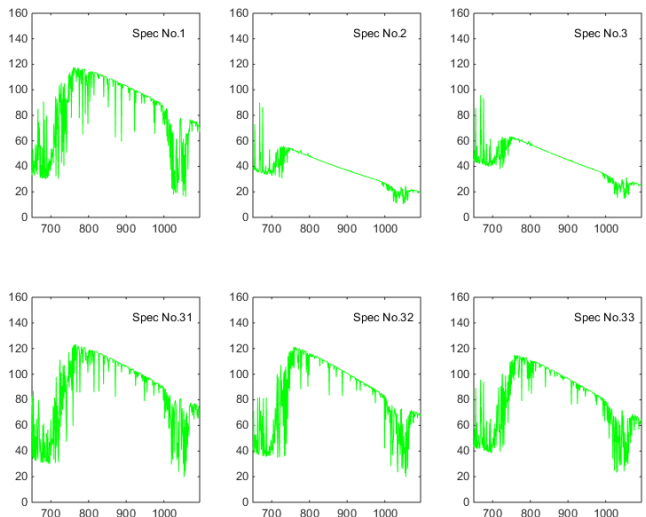


The spectra in the LW h5 files are uniquely identified with input spectra with IET time

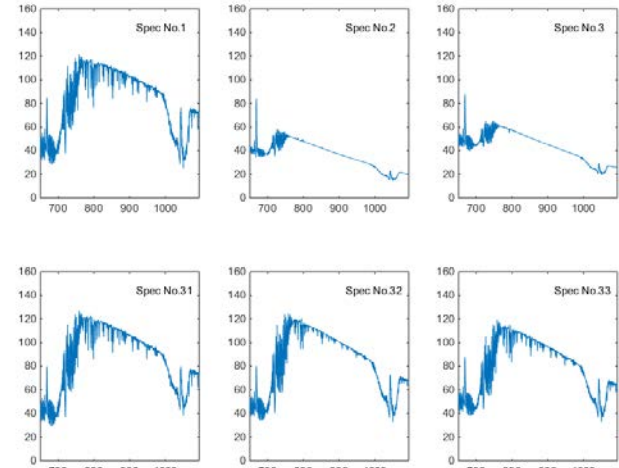
LW calibrated NM h5 spectra



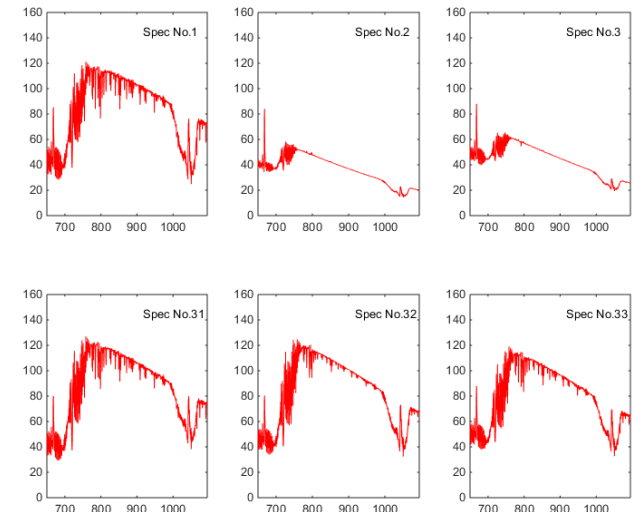
LBL spectra from LBL h5



Calibrated Reference spectra from DM matrix



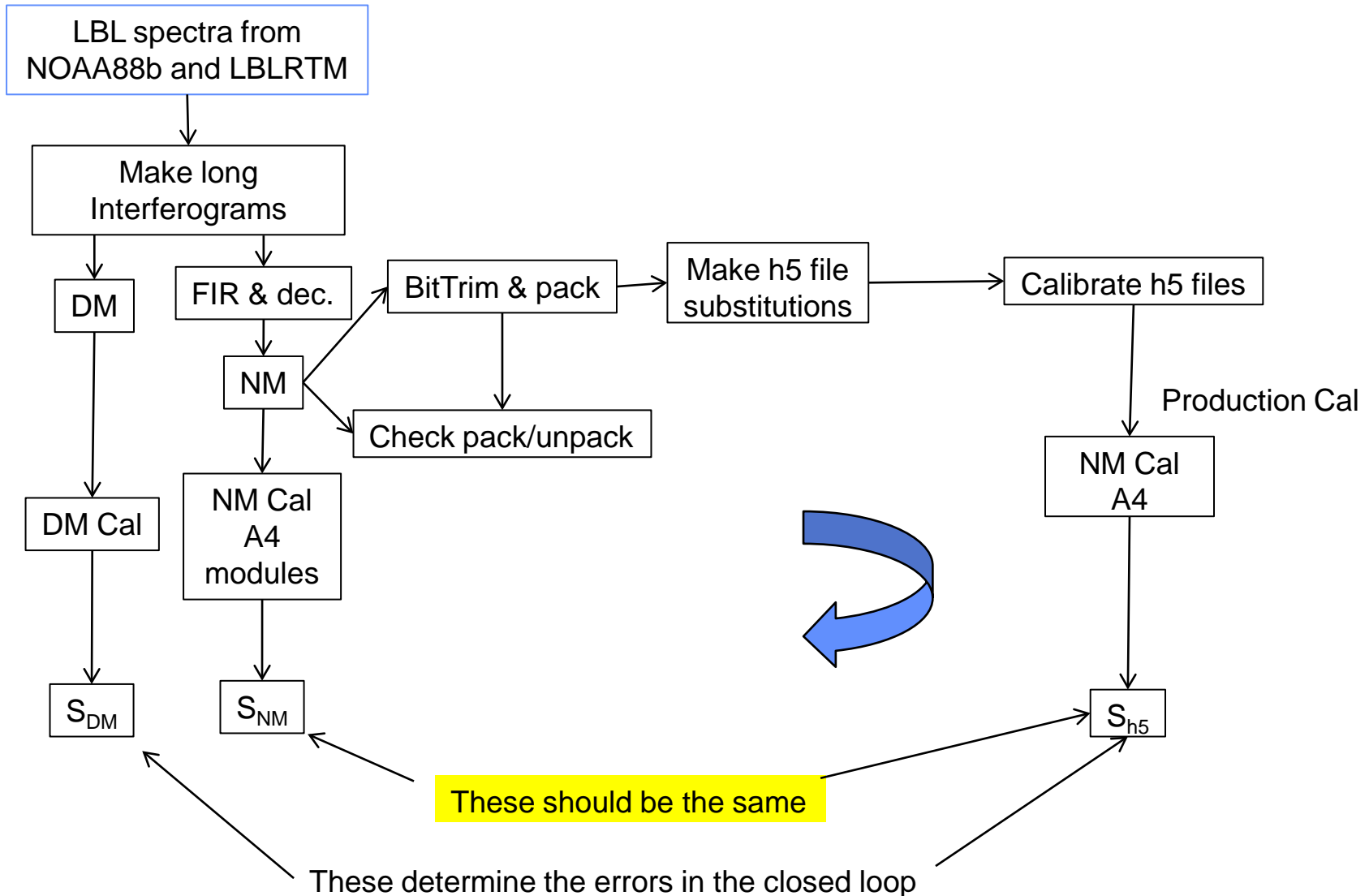
Calibrated NM matrix spectra

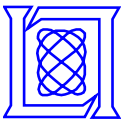


- H5 file cal
- DM matrix cal
- LBL spectra
- NM matrix cal



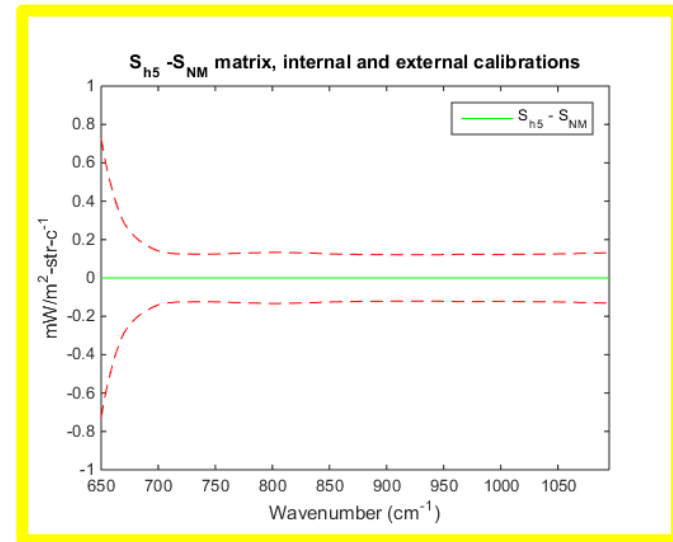
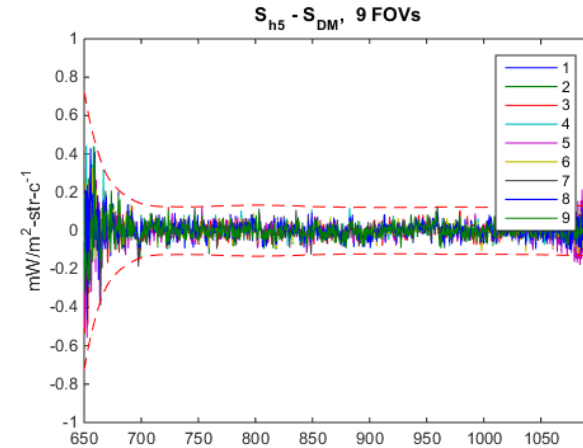
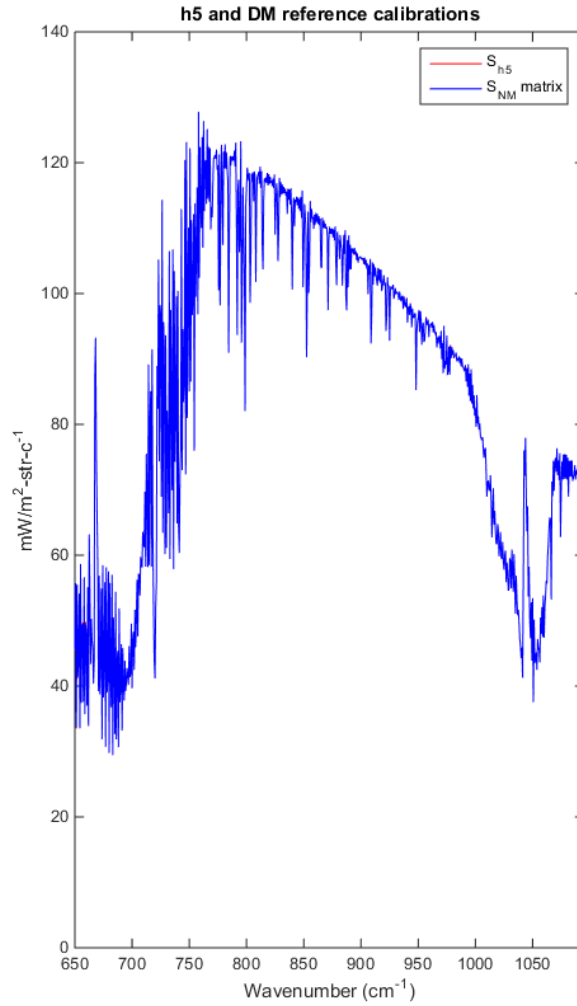
Top level view of closed loop test





LW h5 file, DM reference, NM reference

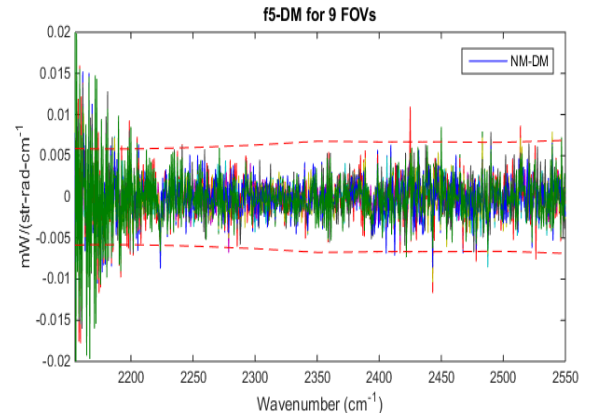
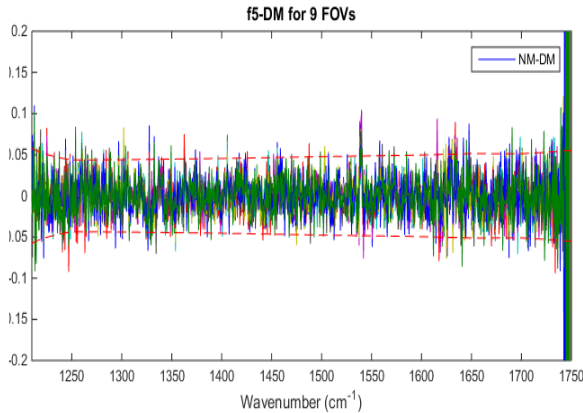
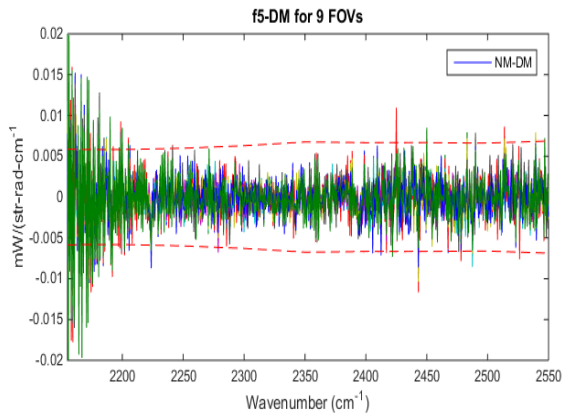
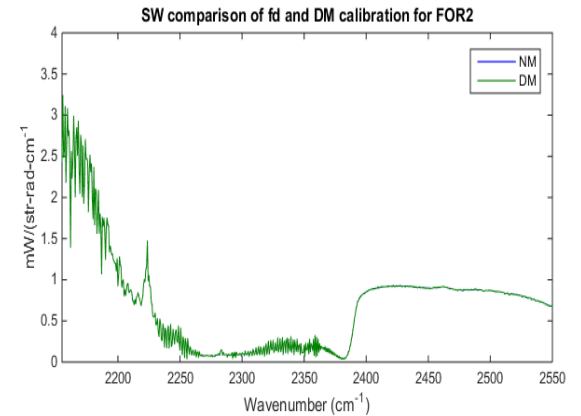
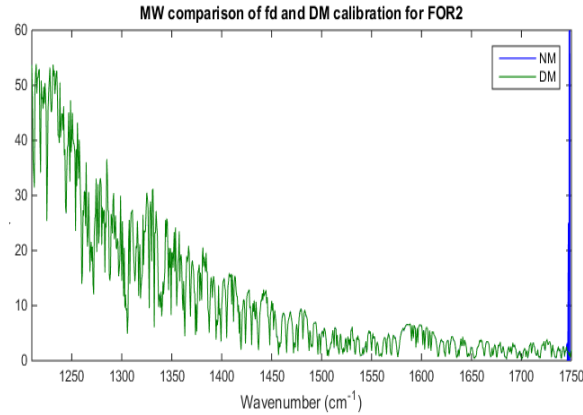
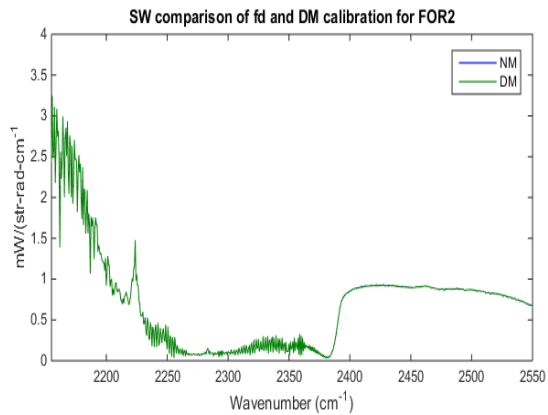
LW h5 file and DM calibrations



Normal mode calibrations are self consistent



White noise when comparing NM spectra to DM (TRUTH) spectra



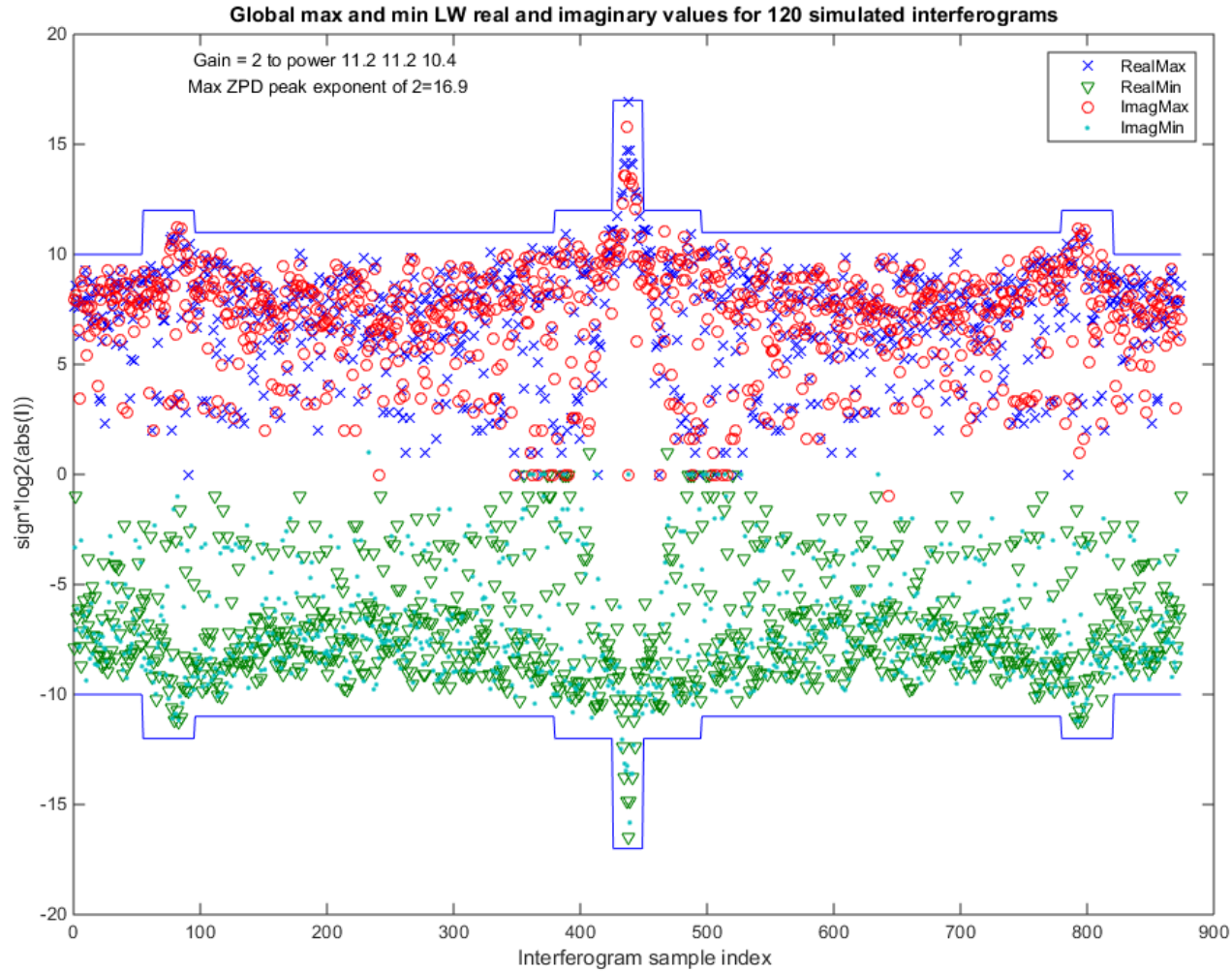


Review of results

- **No noise added to simulation**
- **Gain prior the bit trimming has no error**
- **Main errors**
 - 14 bit A/D error (primary)
 - FIR output trimming error
- **Errors mask small algorithm differences**



LW NM data is tight within bit trim values as are MW and SW





Simple algorithm comparison

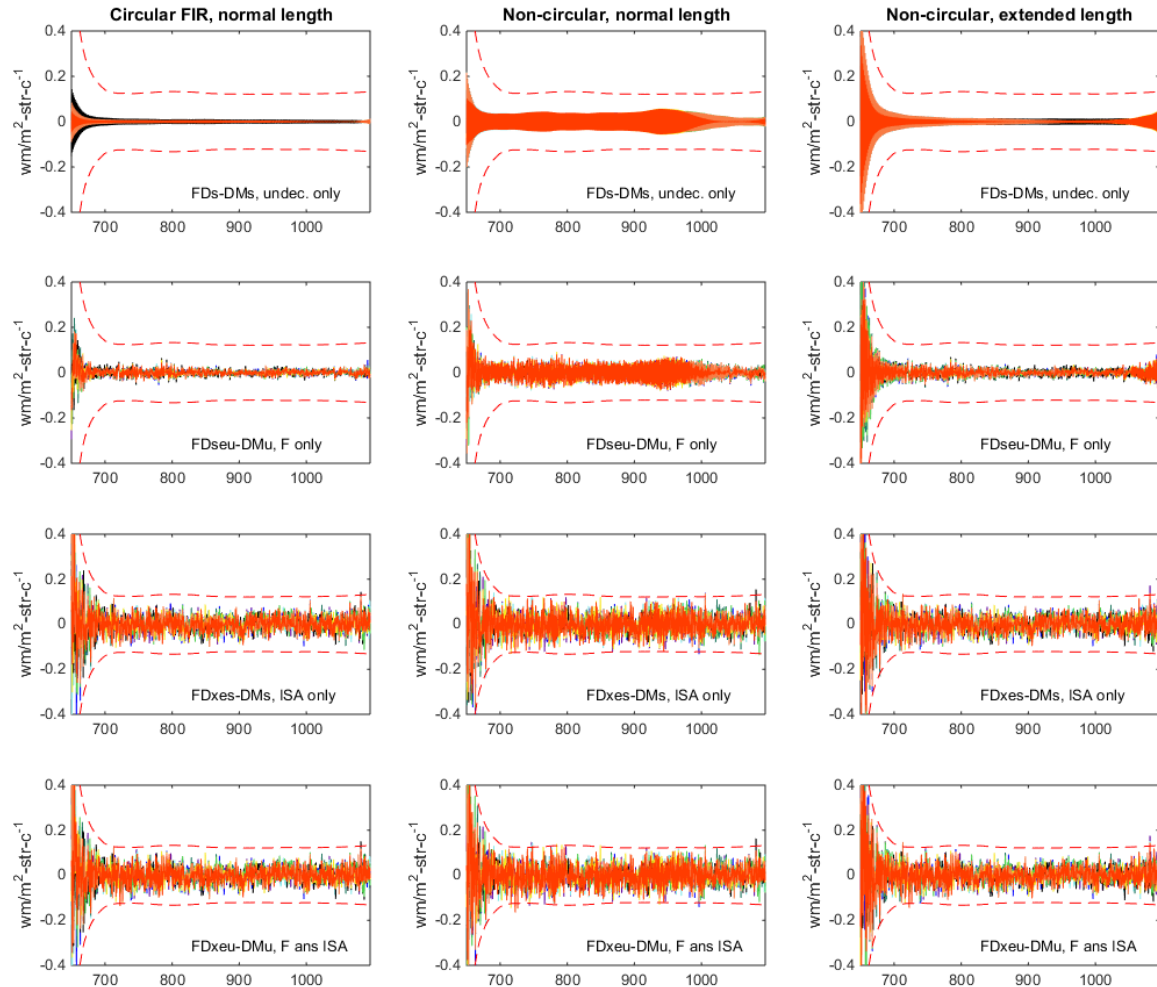
- **Three options**
 - **Circular filtering (ideal)**
 - **Non-circular FIR filtering (operational)**
 - **Extended length interferogram mitigation of non-circular filtering**
- **Evaluation of the effects of two non-linear operations**
 - **14 bit A/D truncation**
 - **FIR filter output truncation**
- **ISA and F transformations produce output noise that is uncorrelated with DM (truth) noise**
- **Differences in the algorithms masked by noise**
 - **Averaging is required**



LW NM cal – DM cal (TRUTH) for A4 algorithm

Simulation

- Floating point
- FIR truncation
- 14 bit A/D
- FIR truncation & 14 bit A/D



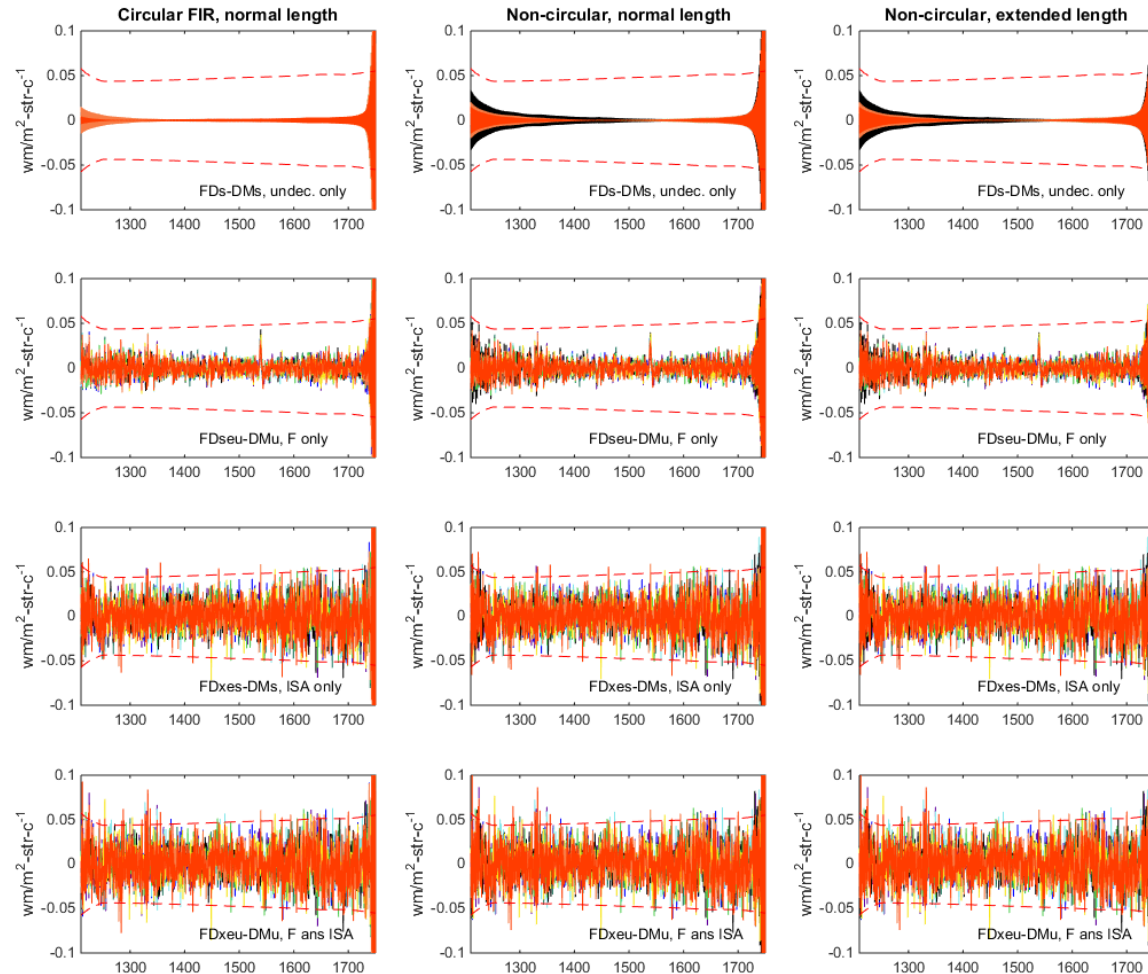
Small algorithm differences masked by truncation noise



MW NM cal – DM cal (TRUTH) for A4 algorithm

Simulation

- Floating point
- FIR truncation
- 14 bit A/D
- FIR truncation & 14 bit A/D



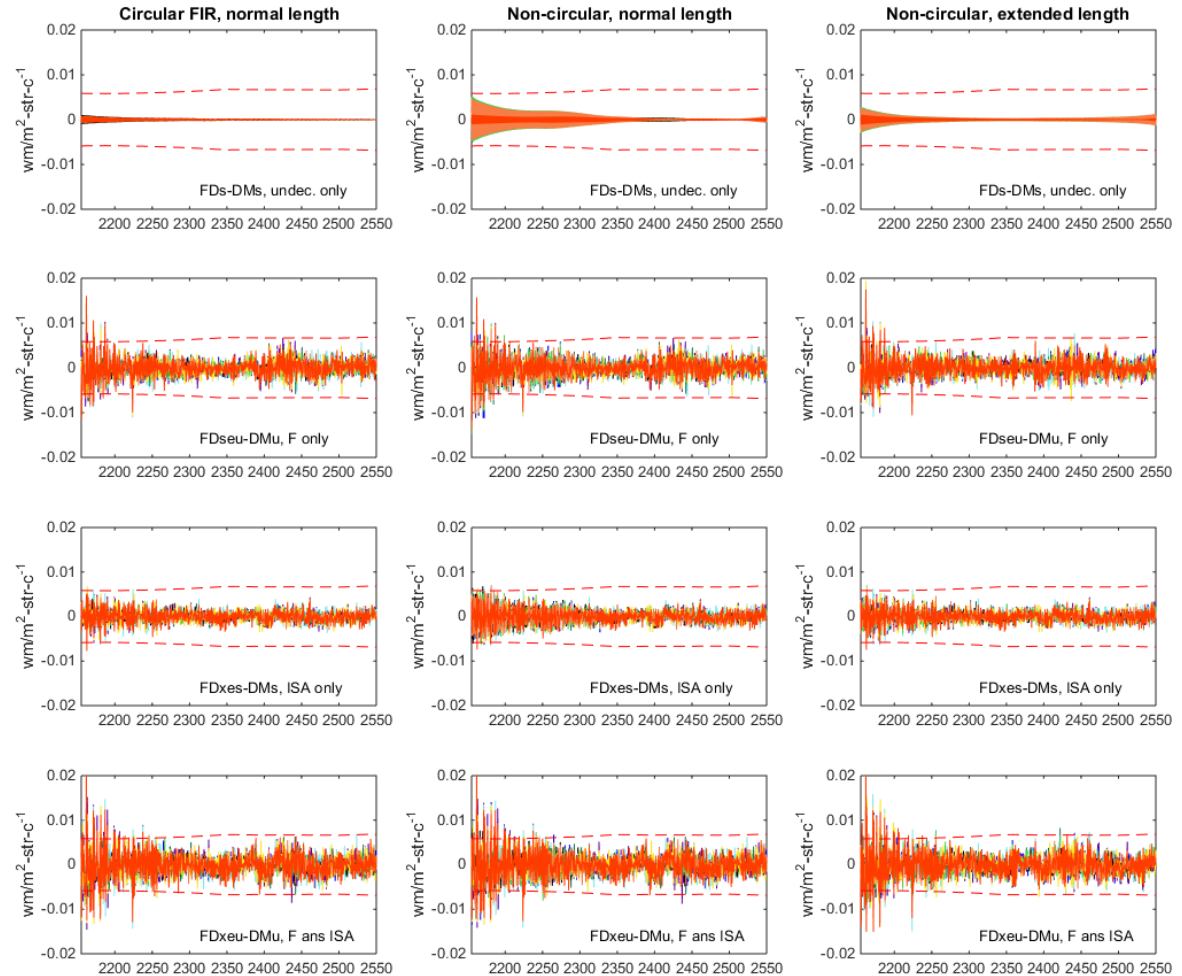
Small algorithm differences masked by truncation noise



SW NM cal – DM cal (TRUTH) for A4 algorithm

Simulation

- Floating point
- FIR truncation
- 14 bit A/D
- FIR truncation & 14 bit A/D



Small algorithm differences masked by truncation noise



Summary

- **We can insert simulated interferograms derived from LBL spectra from NOAA88b atmospheres into operational h5 data streams.**
- **MATLAB code for modifying h5 files is compact and deliverable to NOAA/STAR**
- **Allows checking of operational algorithms with known inputs**
- **Various uses are being evaluated**
- **Algorithm comparisons below the truncation noise require averaging**