New Calibration of ASM Diffuser Solar Spectrum

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Introduction

- Currently available solar spectra in SCIAMACHY L1 products:
  - D0:
    Fully calibrated ESM diffuser spectrum, affected by additional spectral features (speckles) -> used in e.g. ozone, aerosol retrieval
  - A0:
    ASM diffuser spectrum, no radiometric calibration, but less artificial differential features -> preferred for DOAS applications
  - Some additional spectra, mostly unused
- Aim of SQWG-3 Work Package:
  Generation of fully calibrated ASM Diffuser solar spectrum which could be used for all applications
- Idea: Scale A0 spectrum with a spectrally broadband factor derived from ratio A0/D0

Notes

- Input for algorithm are A0 and D0 spectra of L1 V8 product GADS (should be best matches in time, usually one orbit apart); operational processing could use data base instead

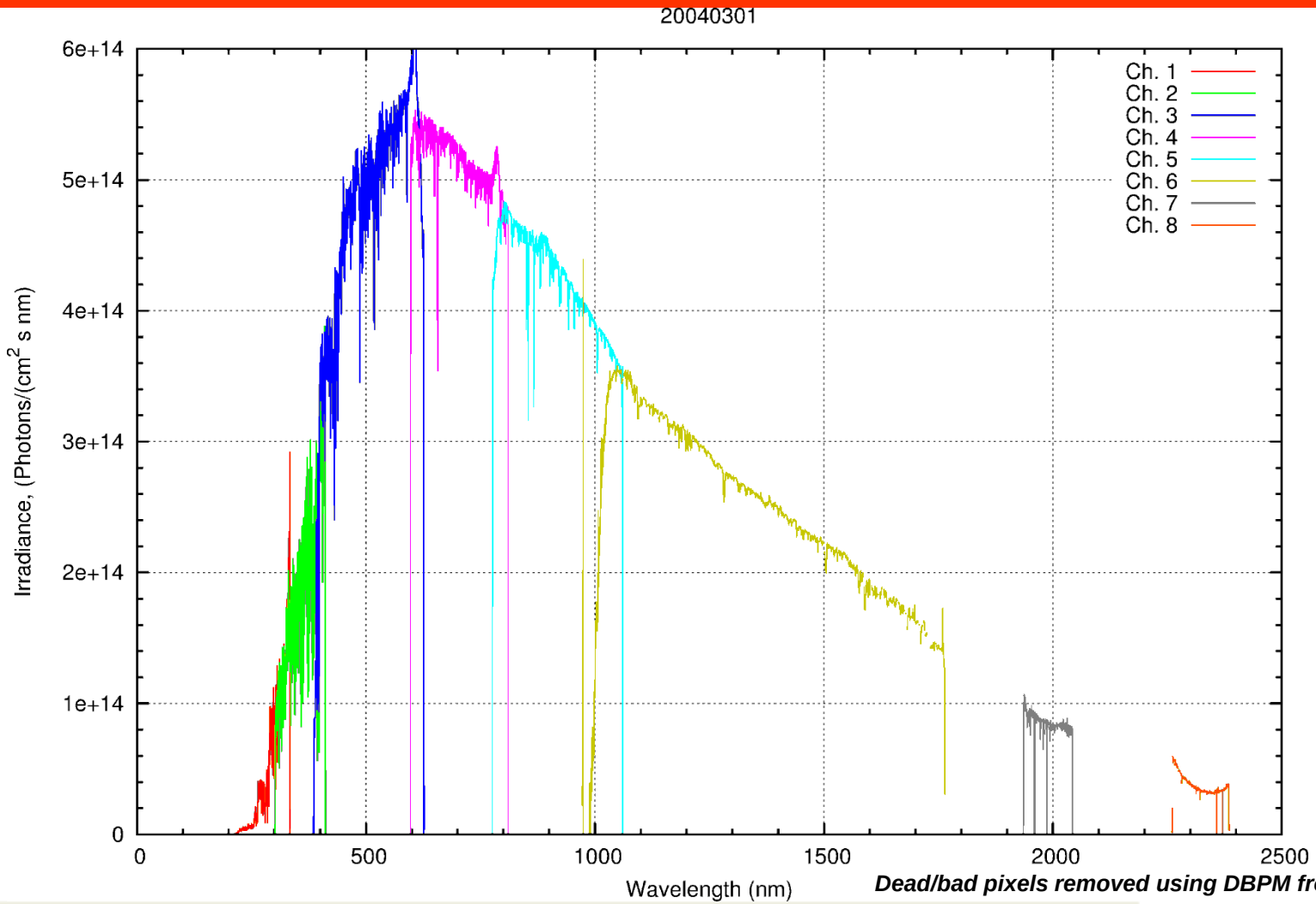
- Requirement for new ASM diffuser solar spectrum: Differential structures should be very similar to A0

-> Correction/calibration factor has to be spectrally smooth

- Absolute radiometric quality of new spectrum is limited by quality of D0 spectrum

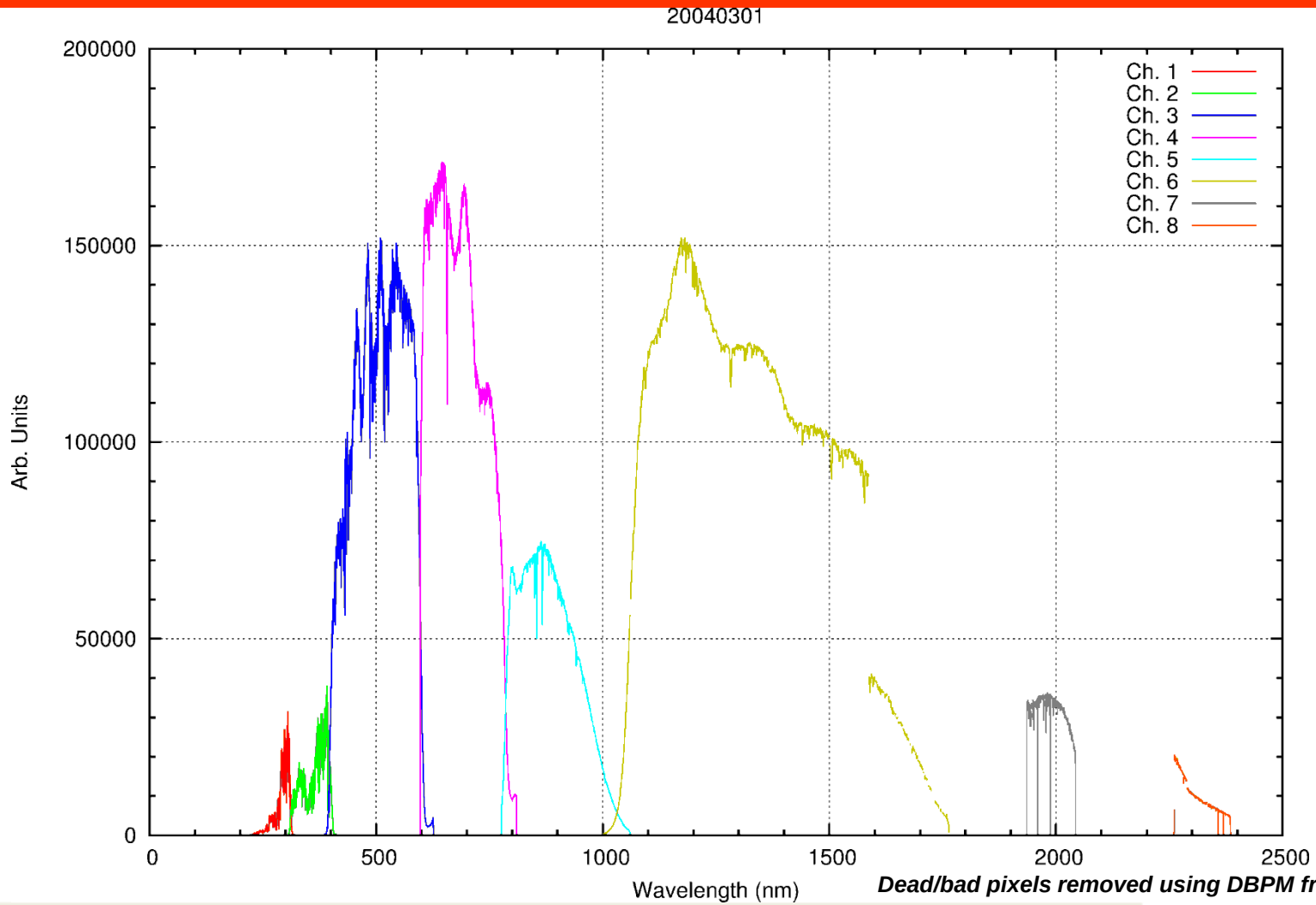
-> Problems of D0 might be transferred to new spectrum

ESM D0 Spectrum



Dead/bad pixels removed using DBPM from product

ASM A0 Spectrum



Dead/bad pixels removed using DBPM from product

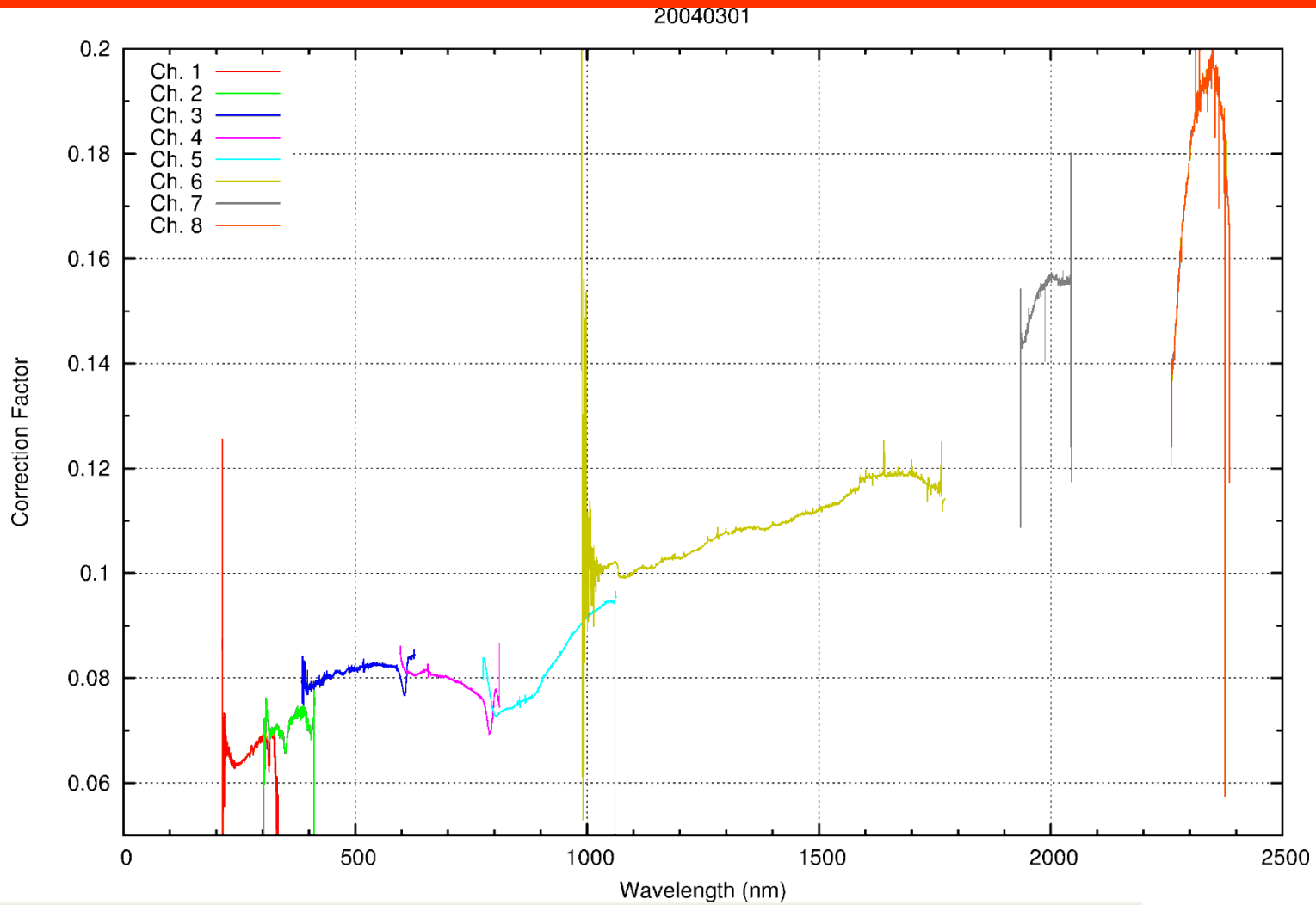
Pre-processing Steps

- Additional correction for A0 spectrum:
  - Apply ABSRAD (M1 element) to A0 spectrum
  - Apply on-ground to in-flight (etalon) correction

- For both A0 and D0:
  - Remove dead/bad pixels
  - Remove NaNs (TBC – not needed for V8 data)
  - Remove negative values (TBC)
  - Interpolate channel-wise over removed pixels

-> ‘Reference’ spectra for A0 and D0

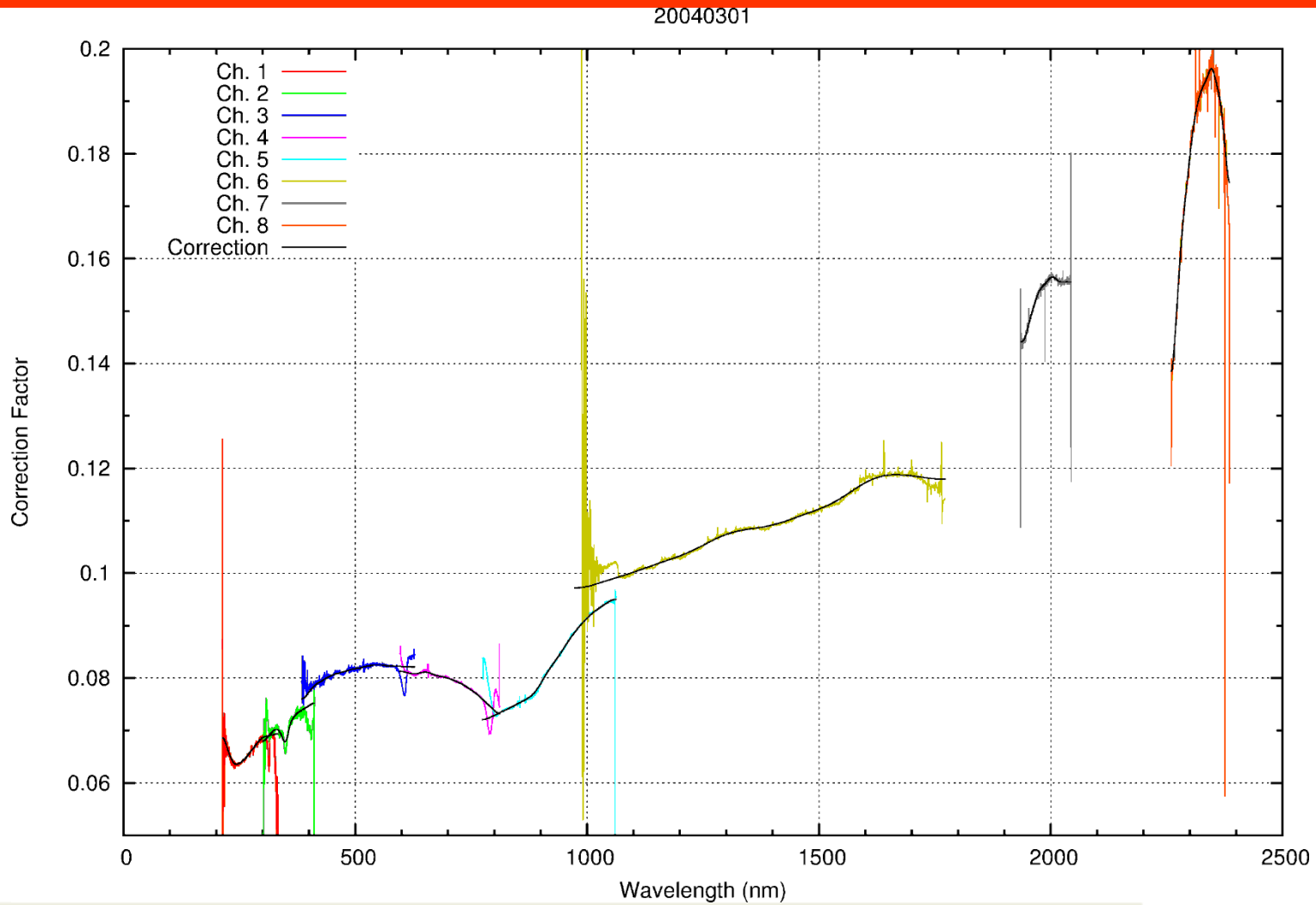
Ratio A0/D0 Reference Spectra



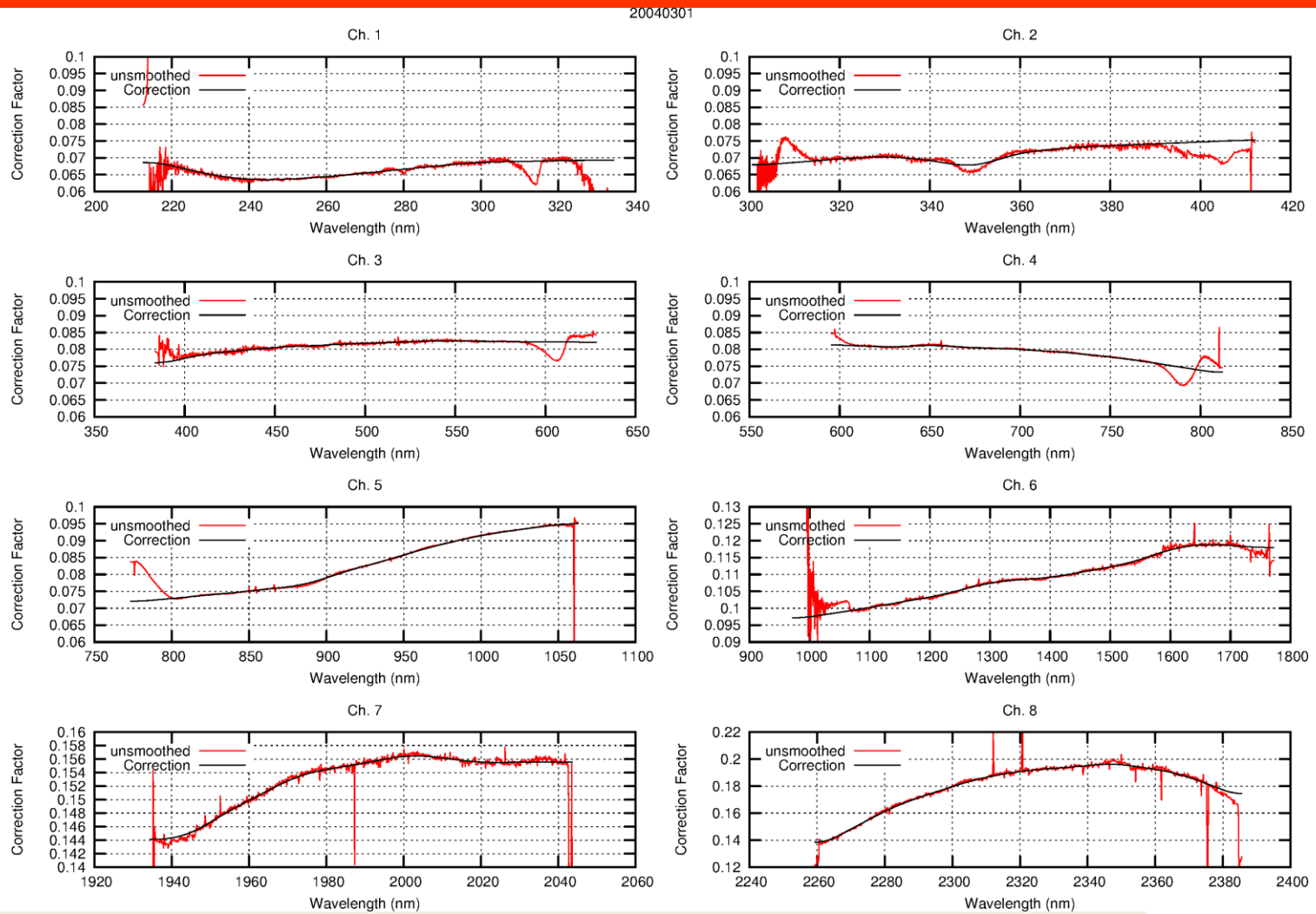
Smoothing of A0/D0 Ratio

- Generate smooth correction factor:
  - *Step 1: Pre-filtering*
    - Remove Fraunhofer lines (Mg II and Ca II)
    - Remove 15 pixels at channel edges (blinded/low signal)
    - TBC: Remove polarisation feature in ch. 2 (330 – 360 nm) - currently not done
    - Interpolate channel-wise over removed pixels
  - *Step 2: Filter out additional outliers / bad pixels:*
    - Smooth with 11 pixel boxcar
    - Compare smoothed with unsmoothed ratio
    - Remove all pixels with differences larger 5%
    - Interpolate channel-wise over removed pixels
  - *Step 3: Smooth filtered data with 101 (TBC) pixel boxcar*
  - *Step 4: Remove channel edges / overlaps:*
    - Extrapolate smoothed ratio for these regions
    - Smooth again with 101 pixel boxcar to get rid of remaining steps
- Apply correction:
  - Divide ‘reference’ A0 by correction factor

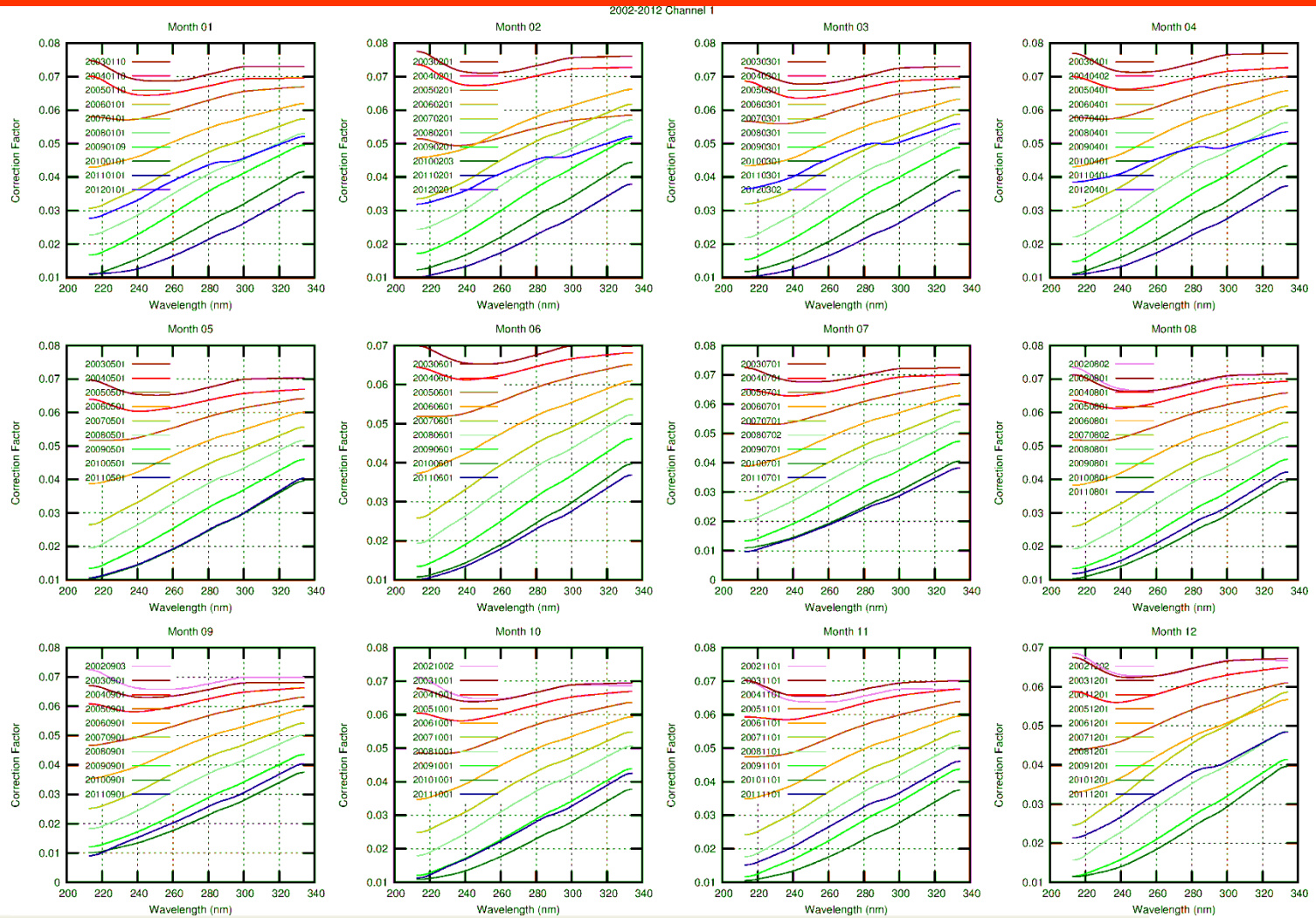
Correction Factors



Correction Factors (Channels)



Time Series of Correction Factors Ch. 1



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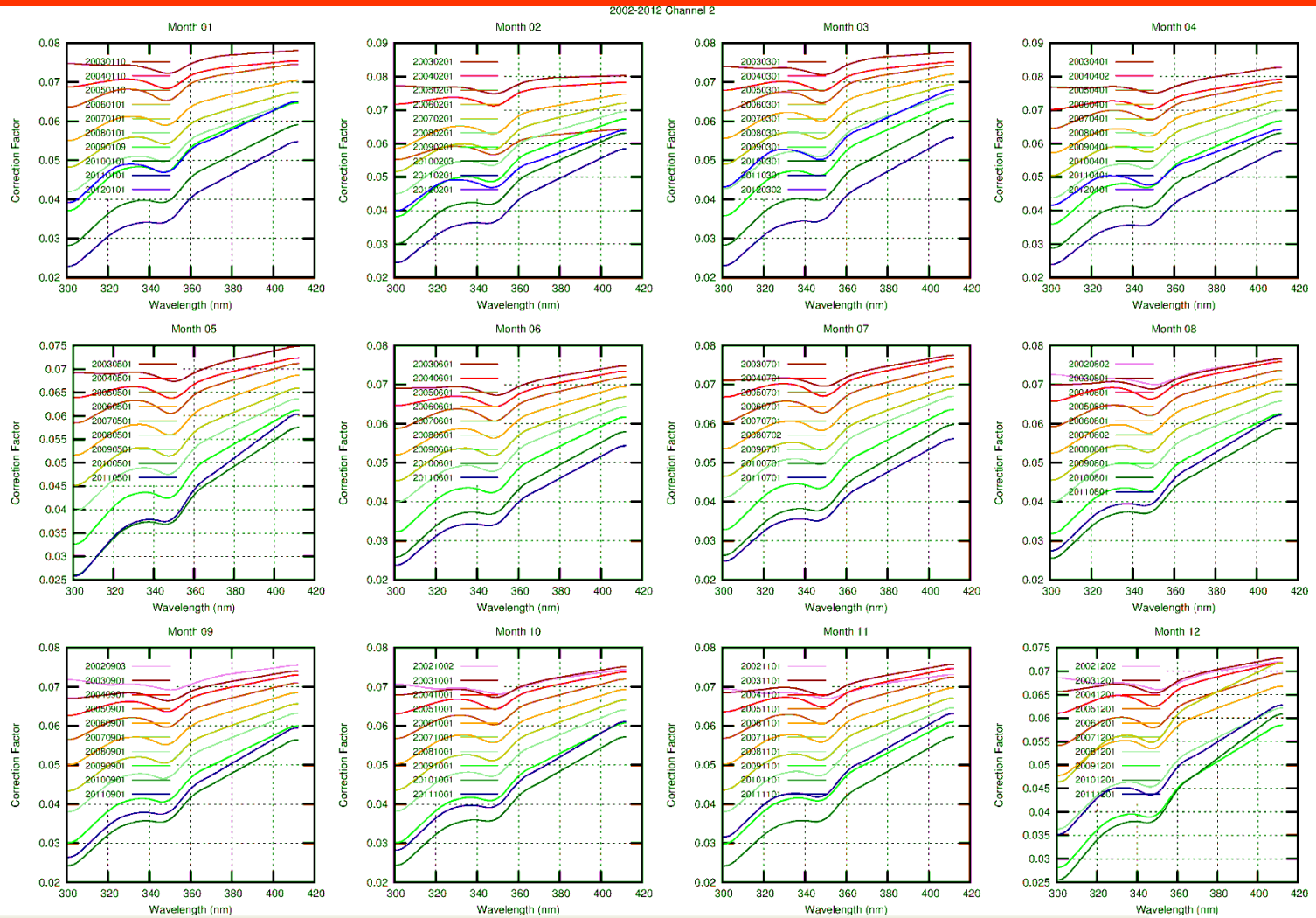
Time Series of Correction Factors Ch. 2



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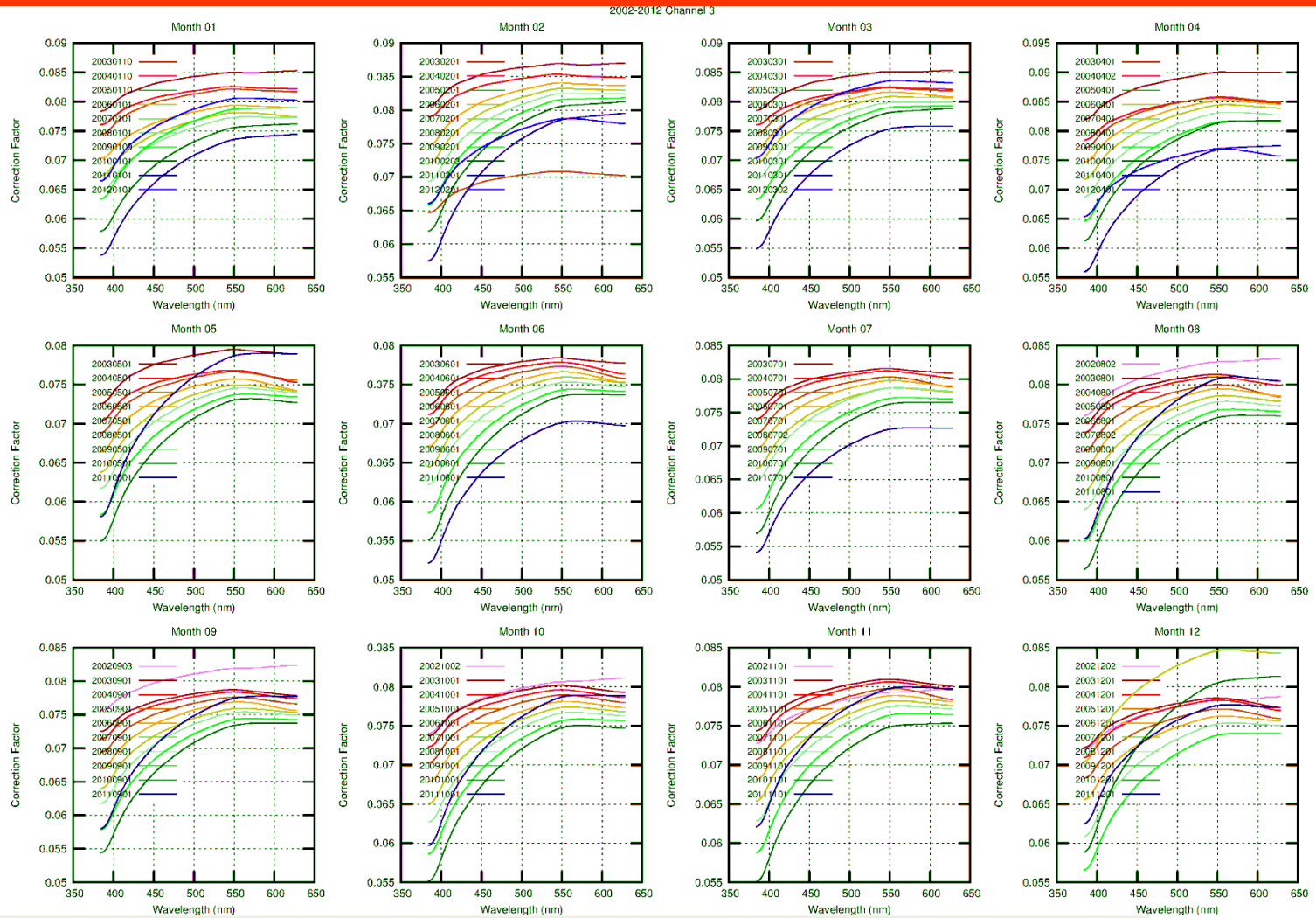
Time Series of Correction Factors Ch. 3



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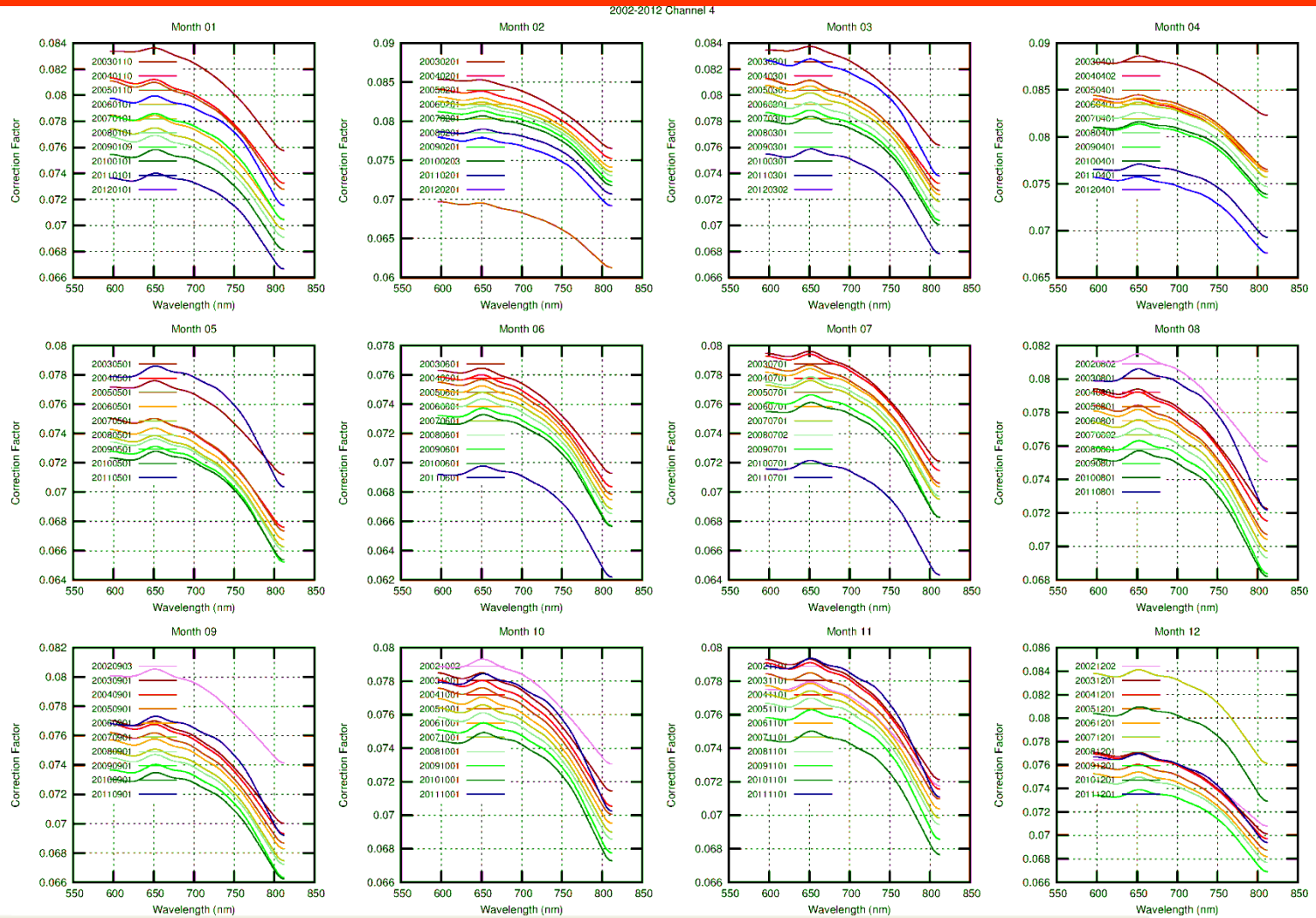
Time Series of Correction Factors Ch. 4



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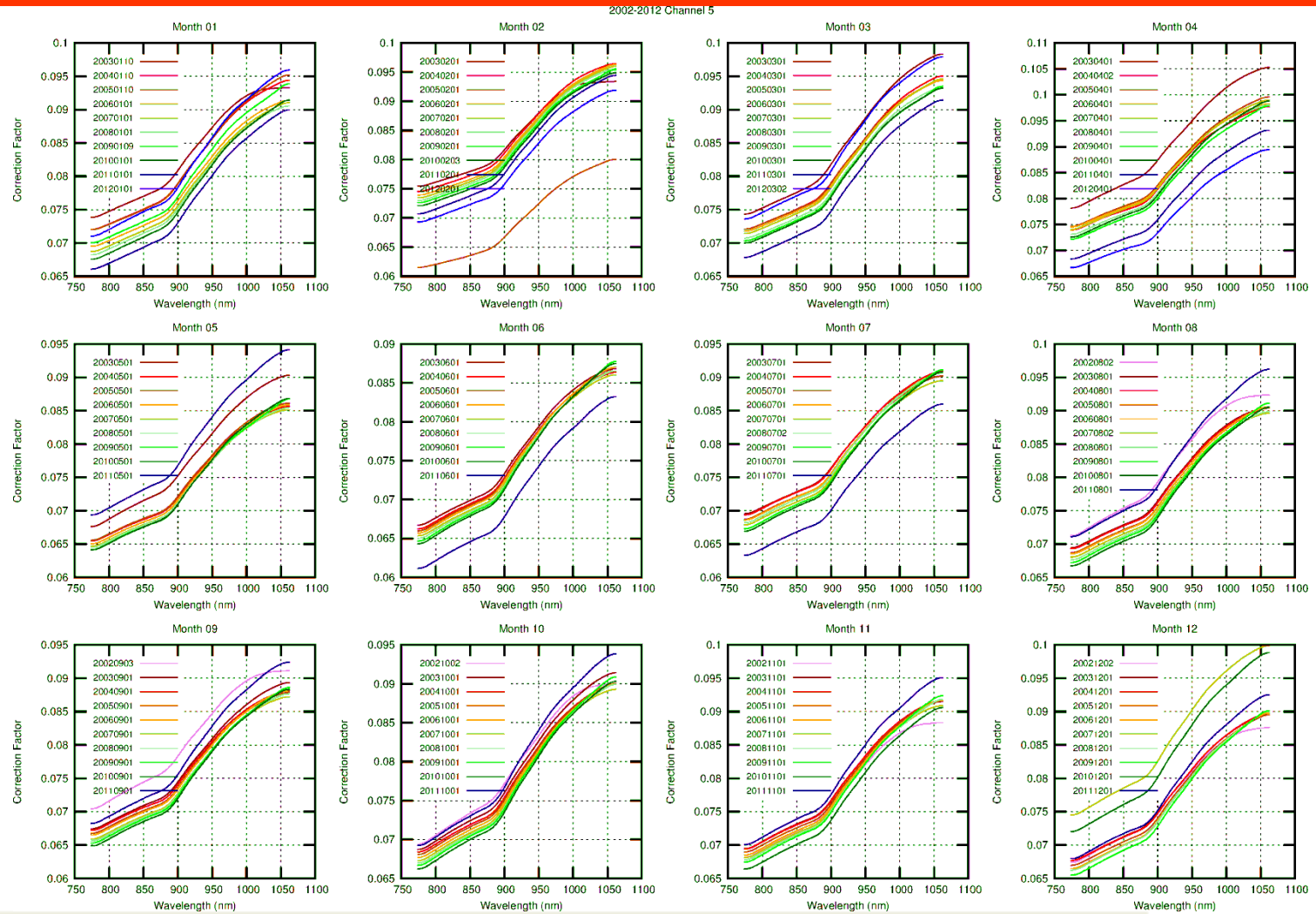
Time Series of Correction Factors Ch. 5



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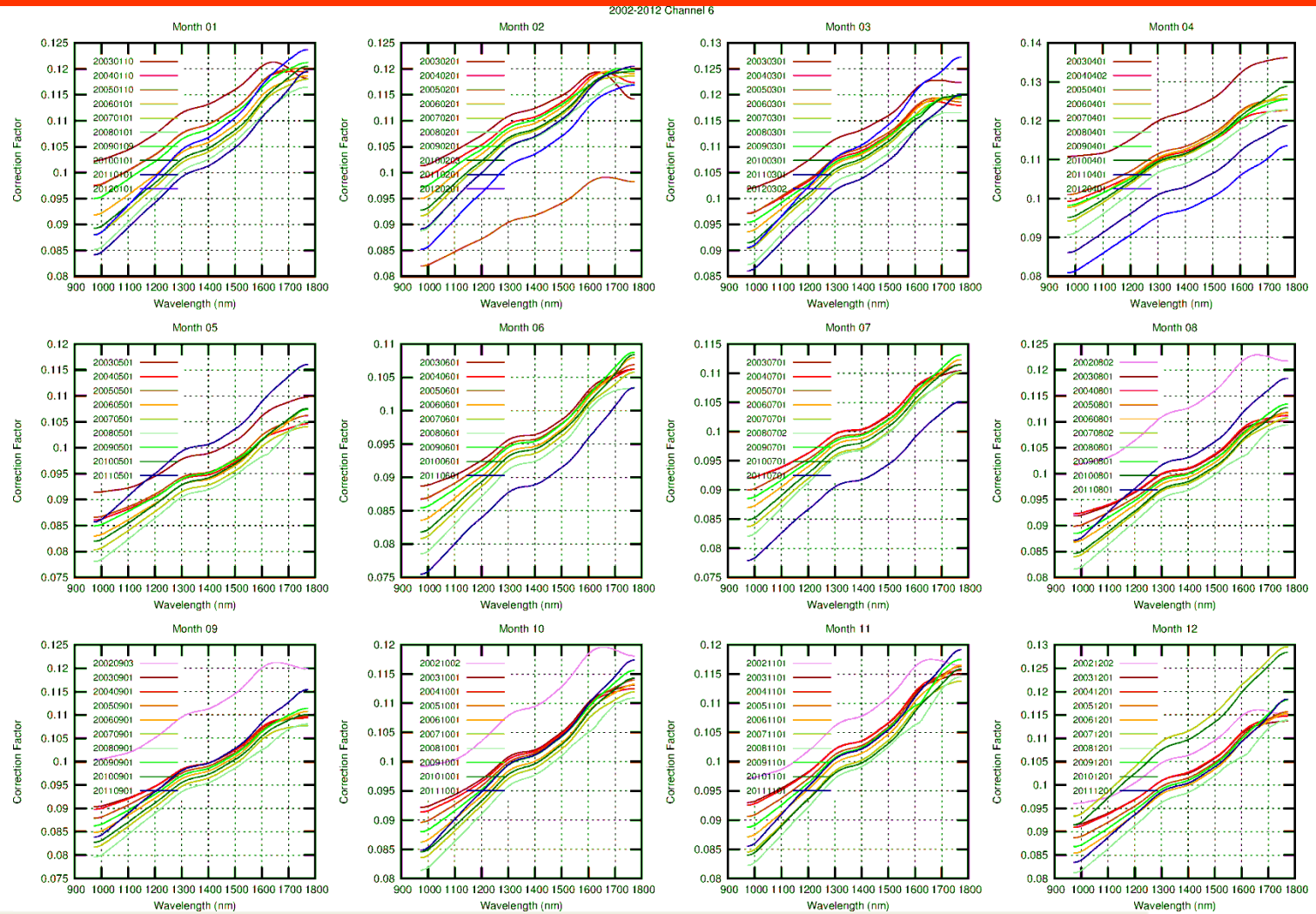
Time Series of Correction Factors Ch. 6



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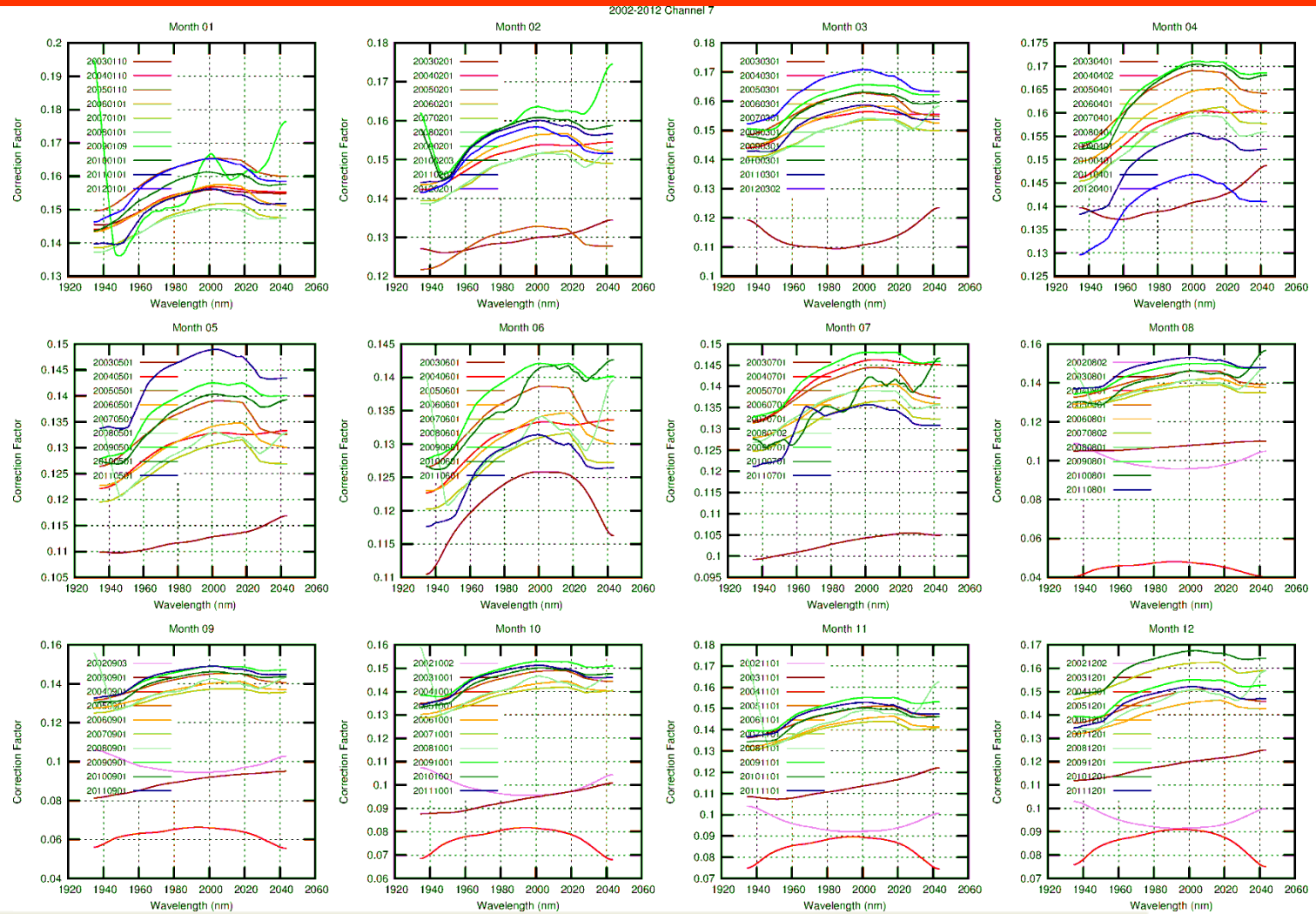
Time Series of Correction Factors Ch. 7



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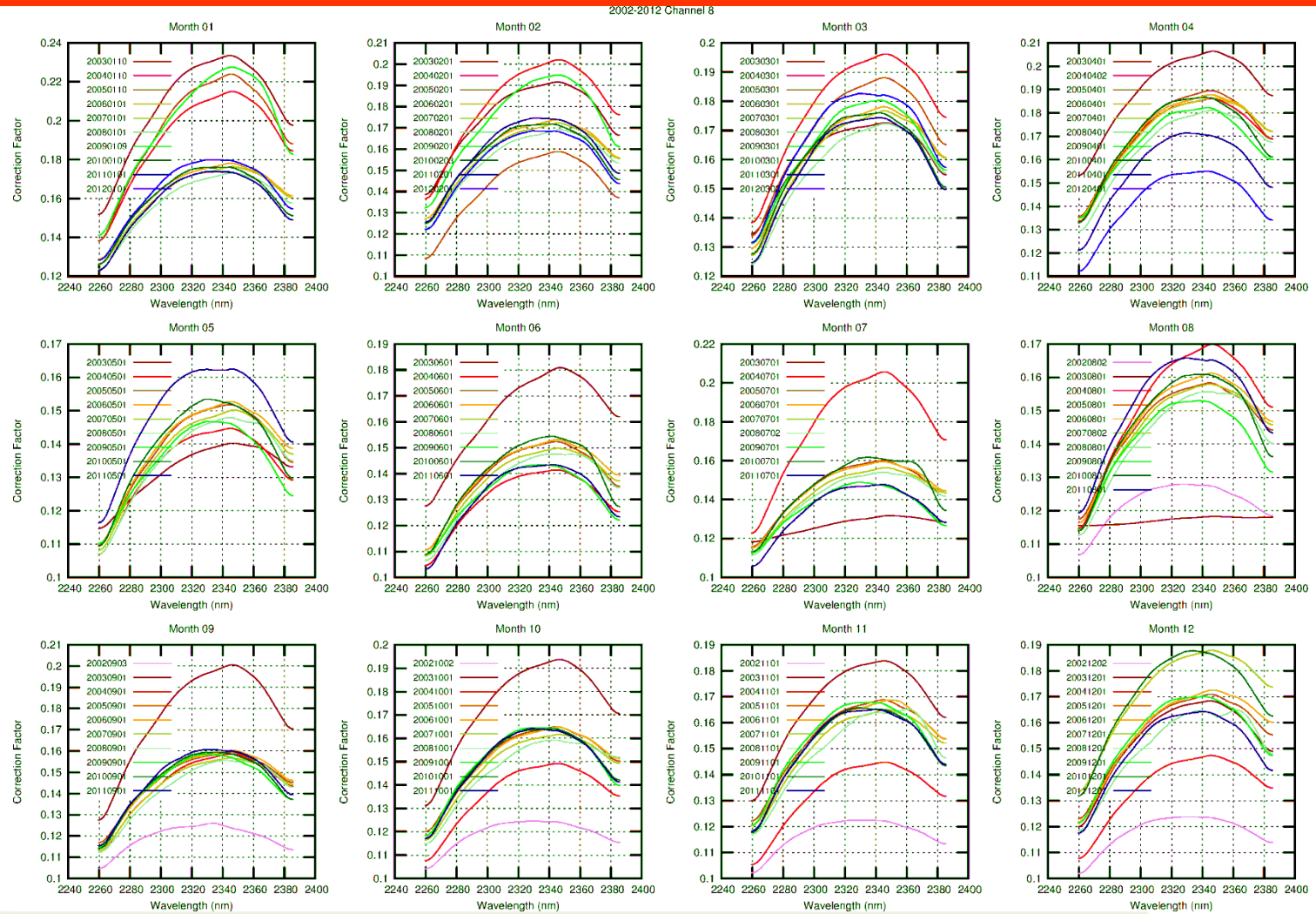
Time Series of Correction Factors Ch. 8



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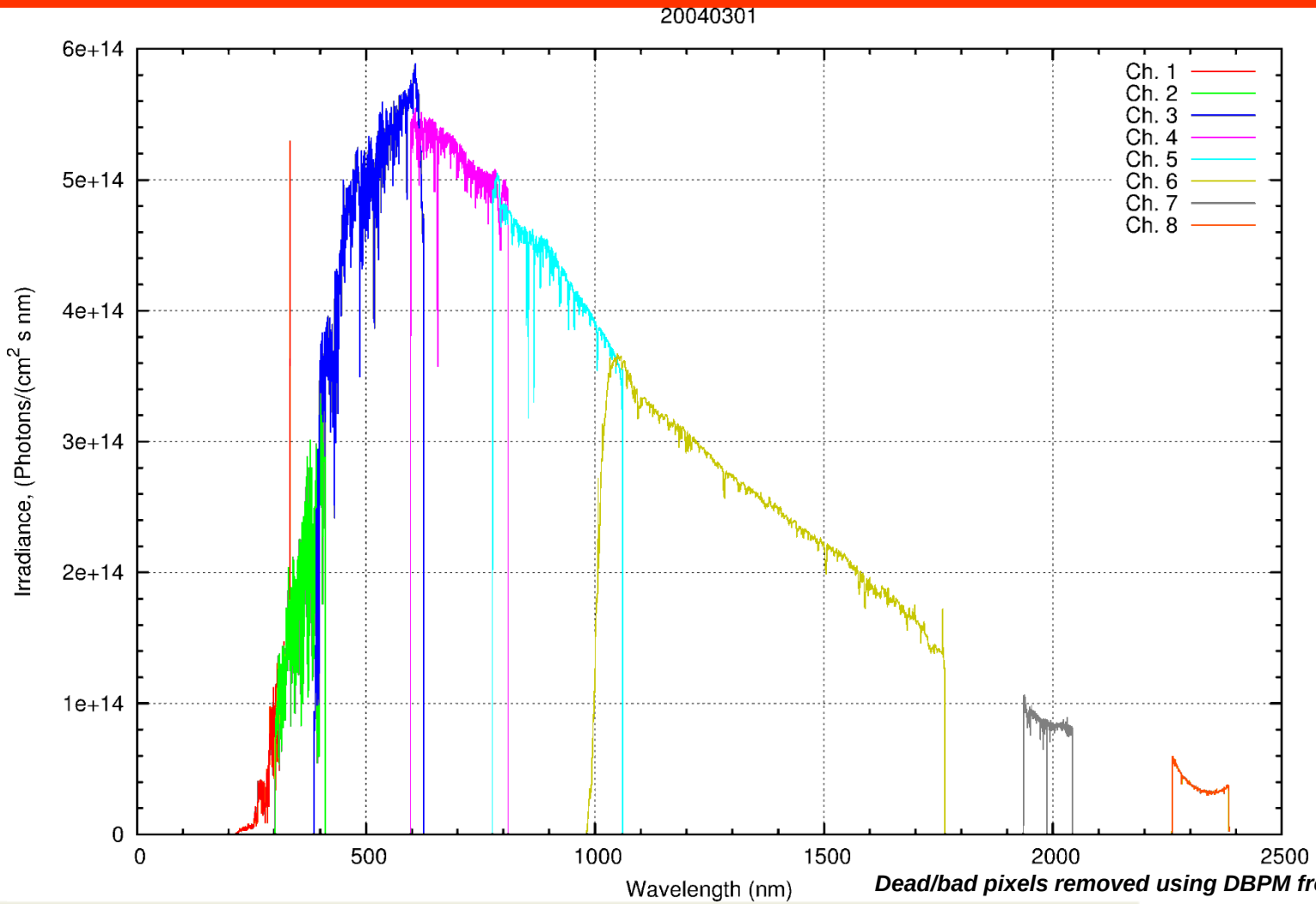
Resulting New ASM Solar Spectrum



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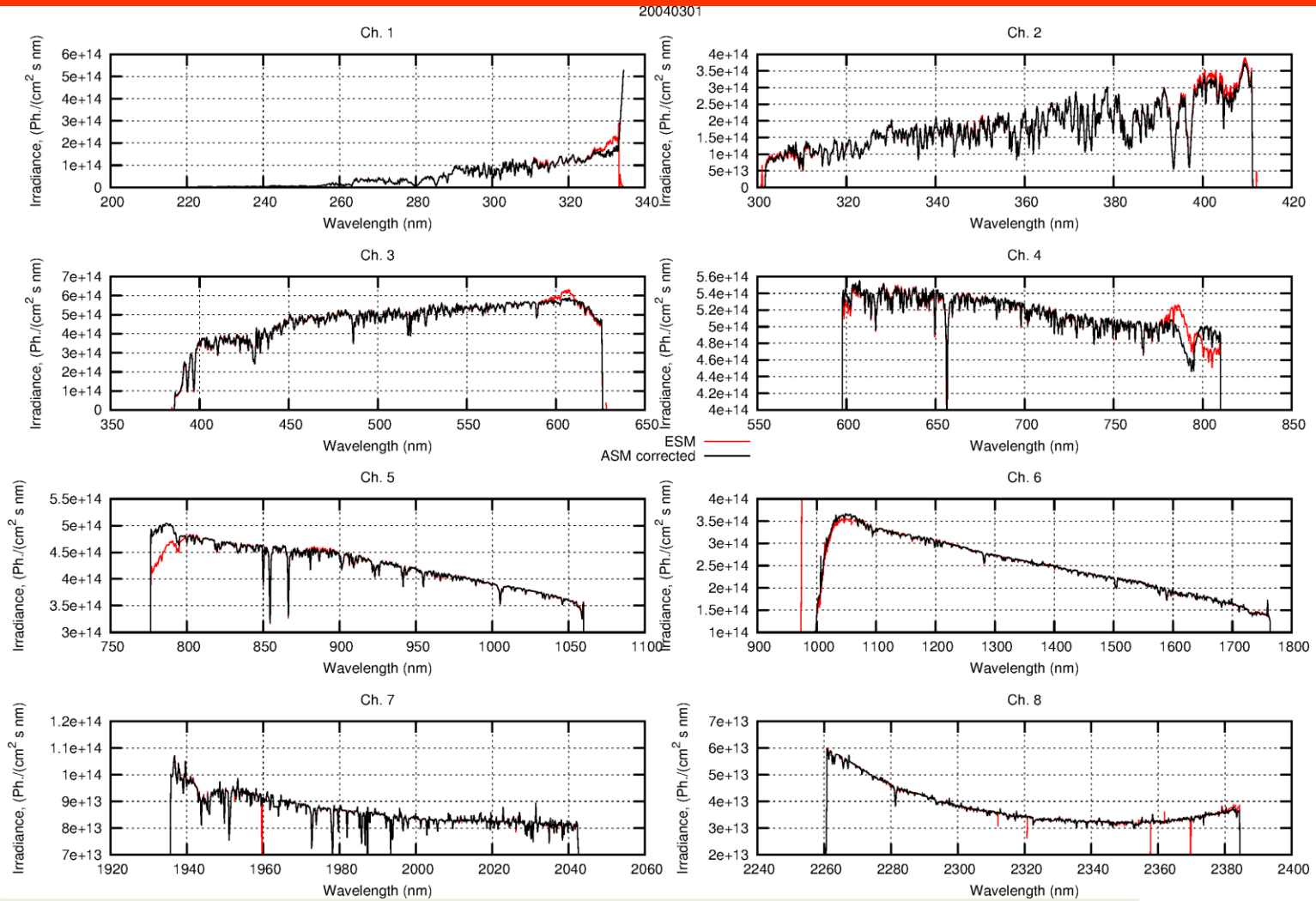
New ASM Solar Spectrum vs. ESM (D0)



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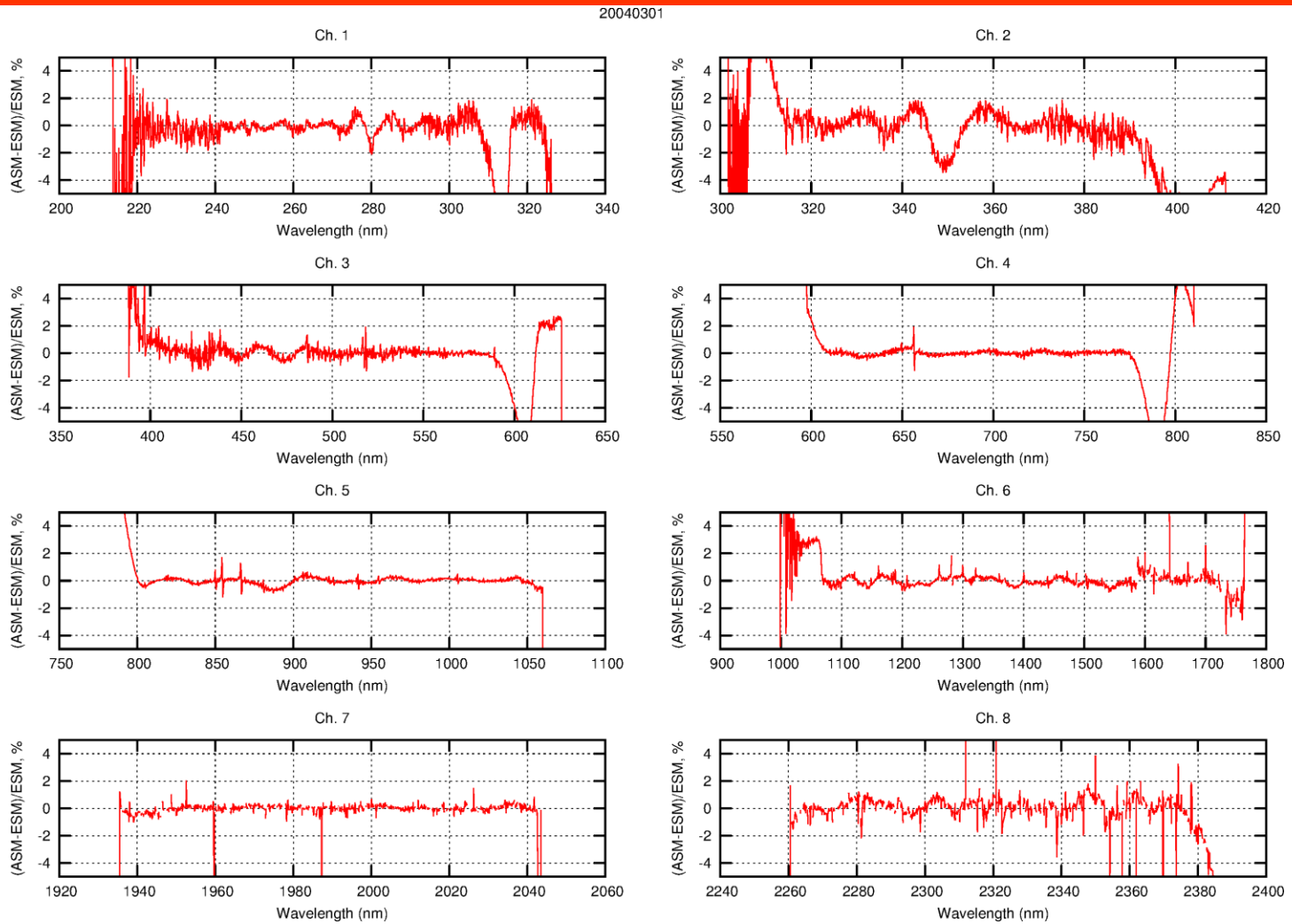
Ratio New ASM / ESM (D0) Spectrum



Pixel ratio

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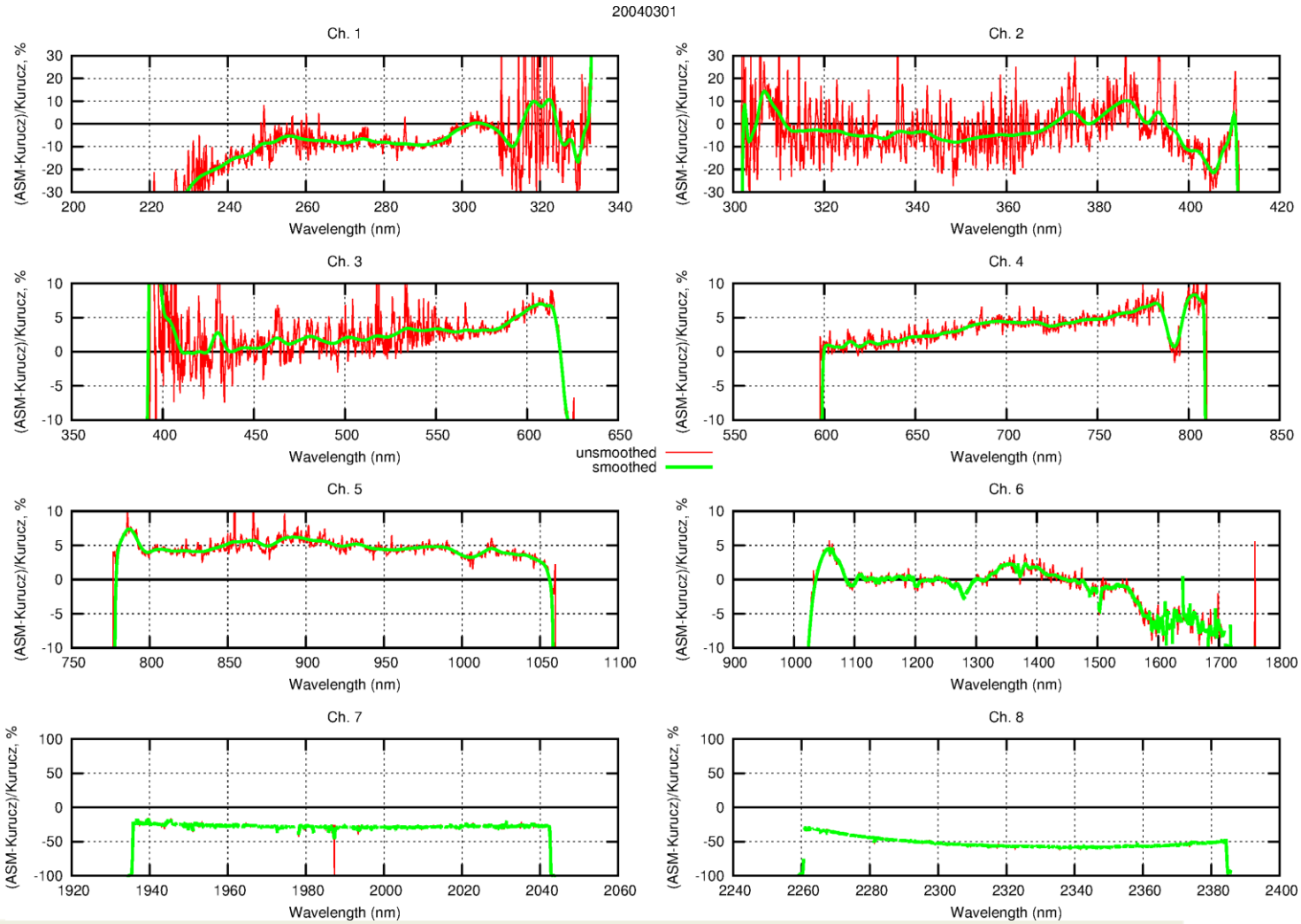
Ratio New ASM / Kurucz Spectrum



Pixel ratio

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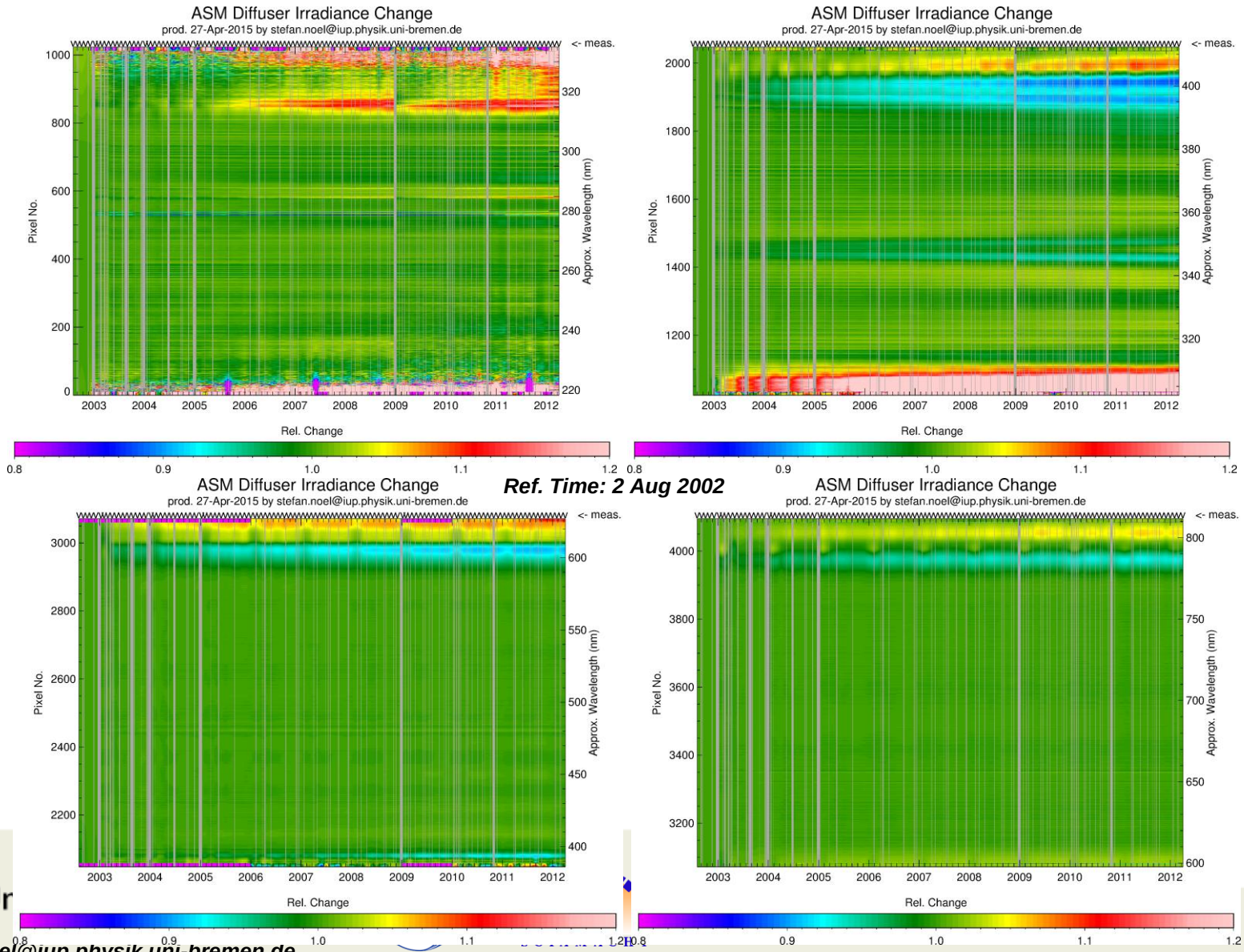
New ASM Solar Spectrum Changes Ch. 1-4



Ref. Time: 2 Aug 2002

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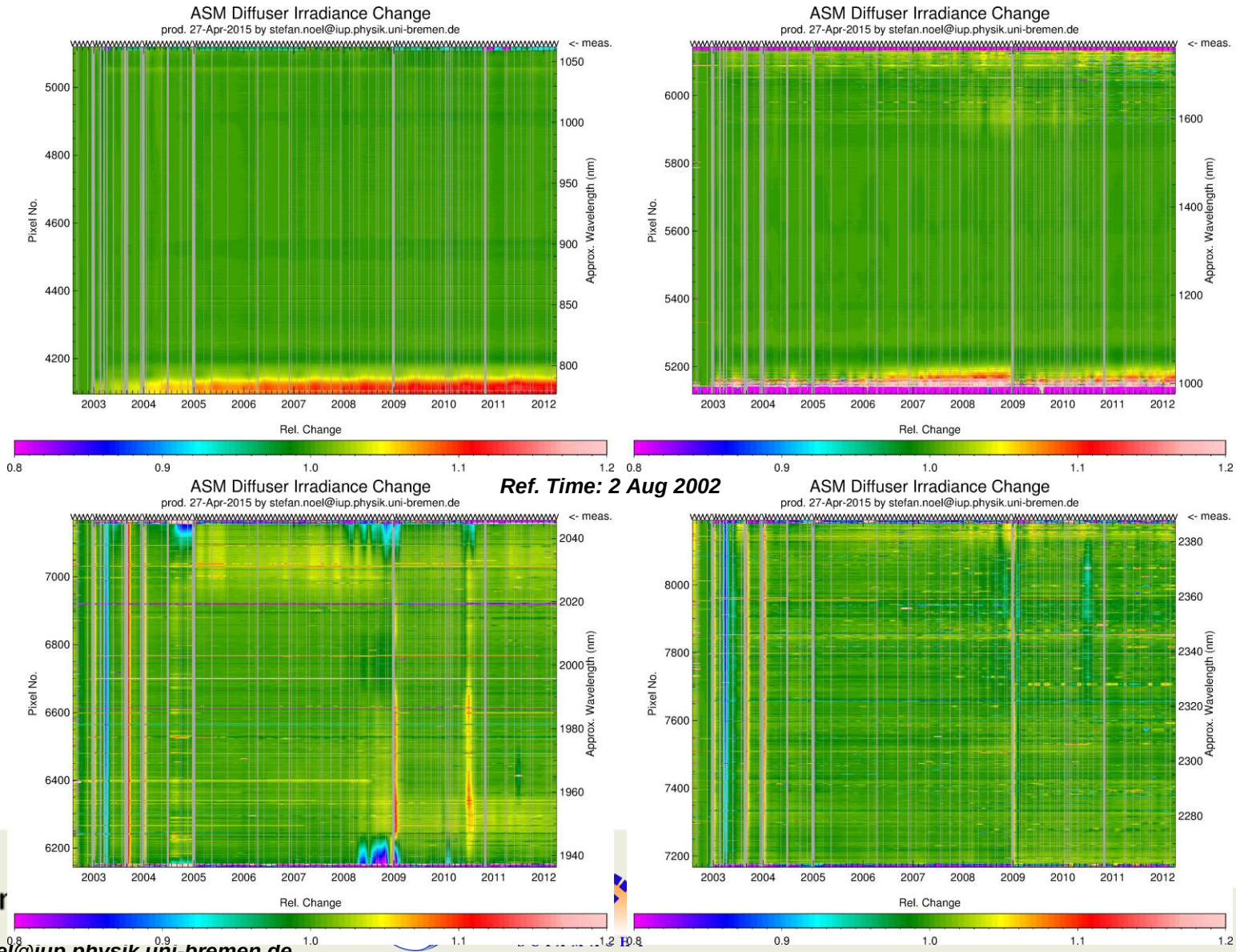
New ASM Solar Spectrum Changes Ch. 1-4



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Summary & Discussion

- New procedure for generation of calibrated ASM Diffuser developed
- Correction factors are smooth and seem stable over time
- New ASM solar data in overlaps, ch. 7 & 8 and around 350 nm feature in ch.2 have lower quality (-> disclaimer/README)
- Quality of new ASM spectrum to be checked by L2 retrieval:
  - Full test data set can be provided

- To be discussed:
  - Detailed settings (smoothing width, margins, definition/handling of overlaps, handling of negative values)
  - Etalon-like structure in ch. 1 & 2: Use smaller smoothing width for correction factor (e.g. 51 instead of 101pixels?)
  - Handling of ch.2 feature around 350 nm (consider in correction factor or not?)
  - Required input for operational processing