

Characterizing Solar Spectral Irradiance Variability with Synthetic Models and their Applicability to LWS Science Goals

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Outline

- Characterizing solar activity
- Irradiance models, synthesis
- Spectral variability
- Toward LWS goals

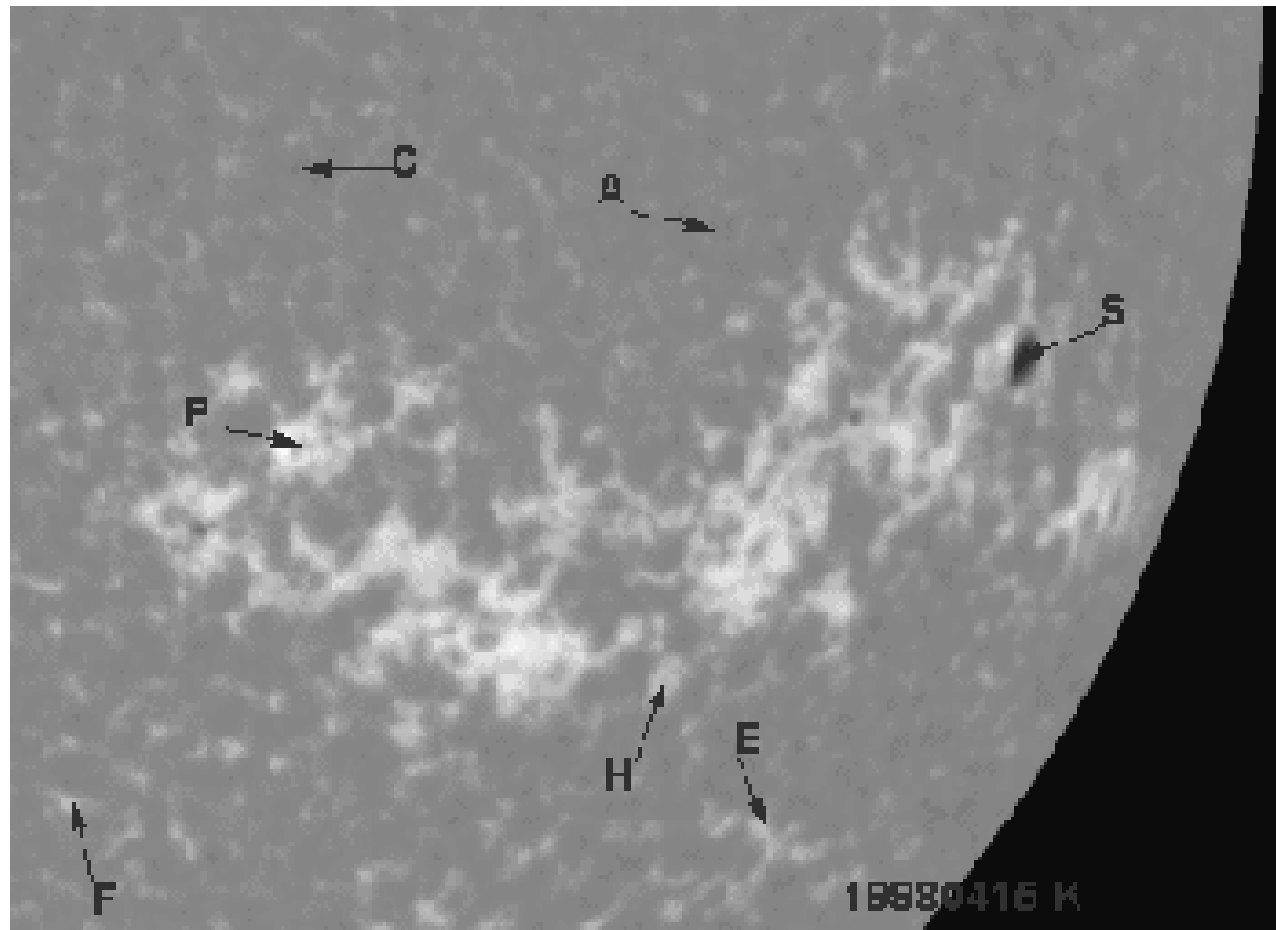
Characterizing solar activity

- Separate irradiance signal into components/ structures
- Identify surface components that contribute differently to irradiance/ radiance
- Associate semi-empirical models of the solar atmosphere with components
- Use detailed radiative transfer
- Account for detailed center to limb variations
- Convolve spectra with measured instrument profiles
- Compare with observations in absolute units (where possible)

Structures

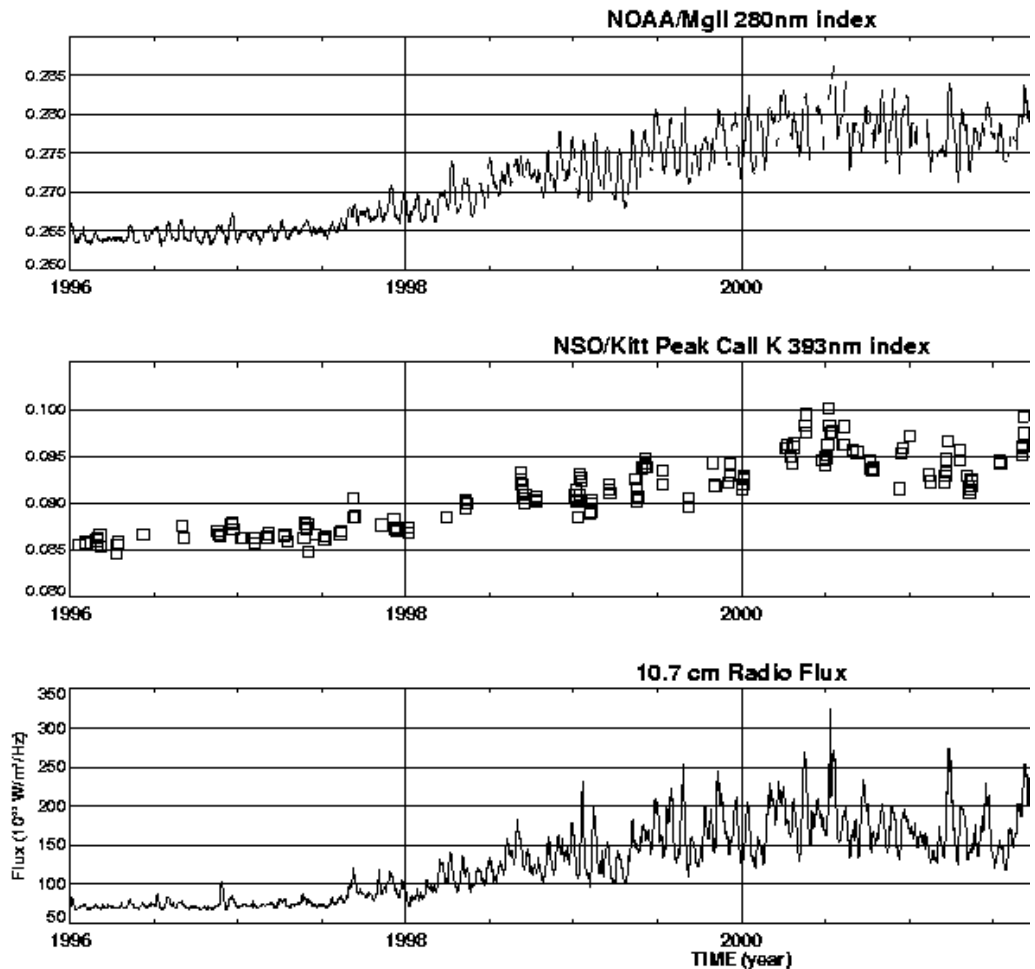
- A – faint cell interior/ network
- C – average cell center quiet Sun
- E – average network
- F – bright network/ faculae
- H – average plage
- P – bright plage
- S – sunspot umbra

Intensity structures (PSPT CaIIK)



Disk-averaged solar activity

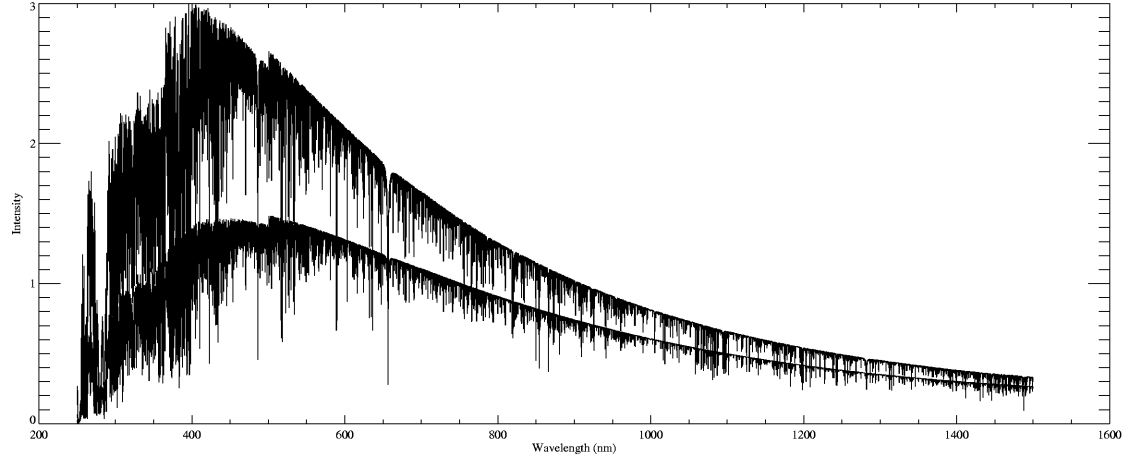
- Mg II index
- Ca K plage index
- F10/E10
- Σ_K/Σ_R
- Use for spectral irradiance not just total



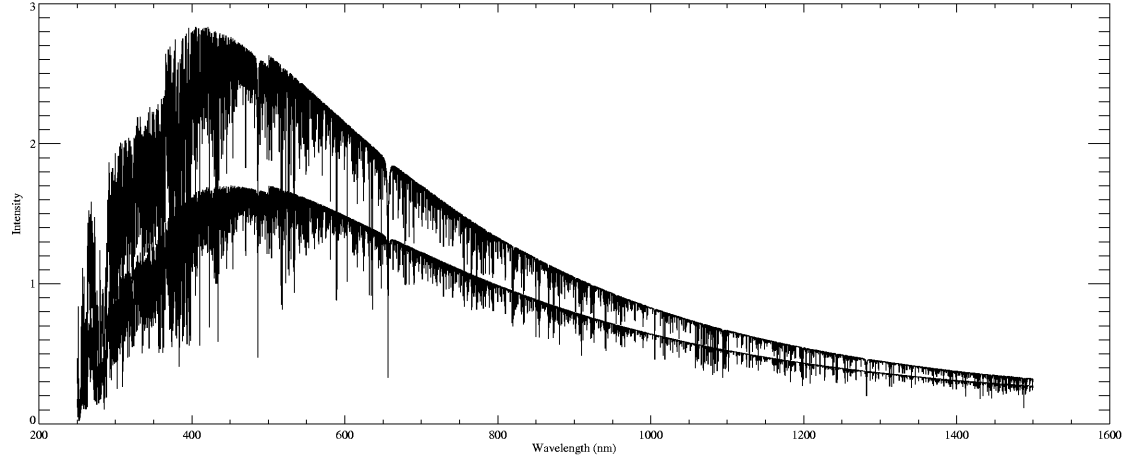
Irradiance Models, synthesis

- Physics-based models (absolute units)
 - Intensity – $I(\lambda, t) = \sum_{\text{structures}} \sum_{\text{disk}} I_{\text{structure}}(\lambda, \mu)$
 - $I_{\text{structure}}(\lambda, \mu) = \text{Integral} (S(\tau) \exp(-\tau/\mu) d\tau/\mu)$
- Non-LTE radiative transfer, multi-level atoms, molecules, ionization, continuum and line-by-line, using variable spectral resolution, for any disk position
- Source function calculations – some PRD, some CRD, some “net radiative bracket” (see Fontenla et al. 1999 for details)

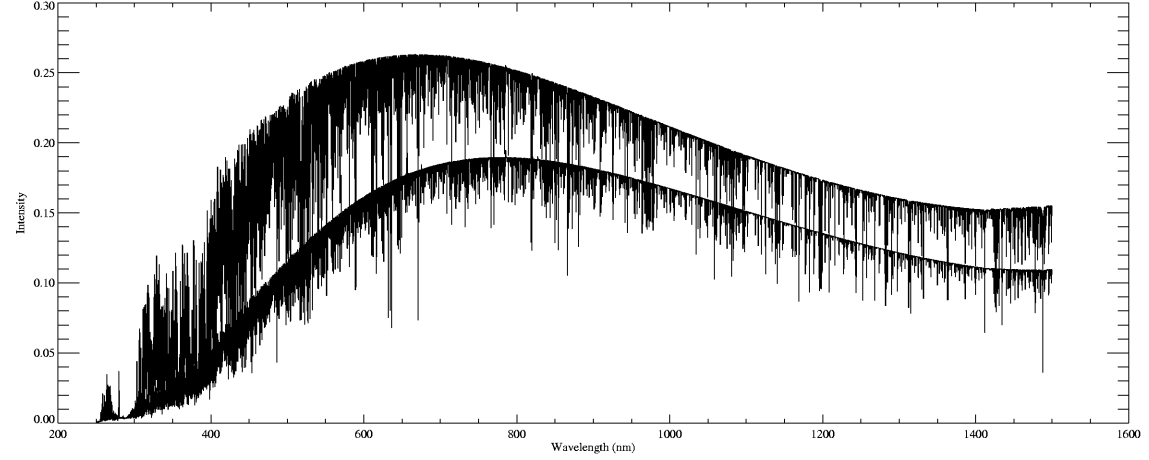
2500_15000_new_1.00000.lba Model:



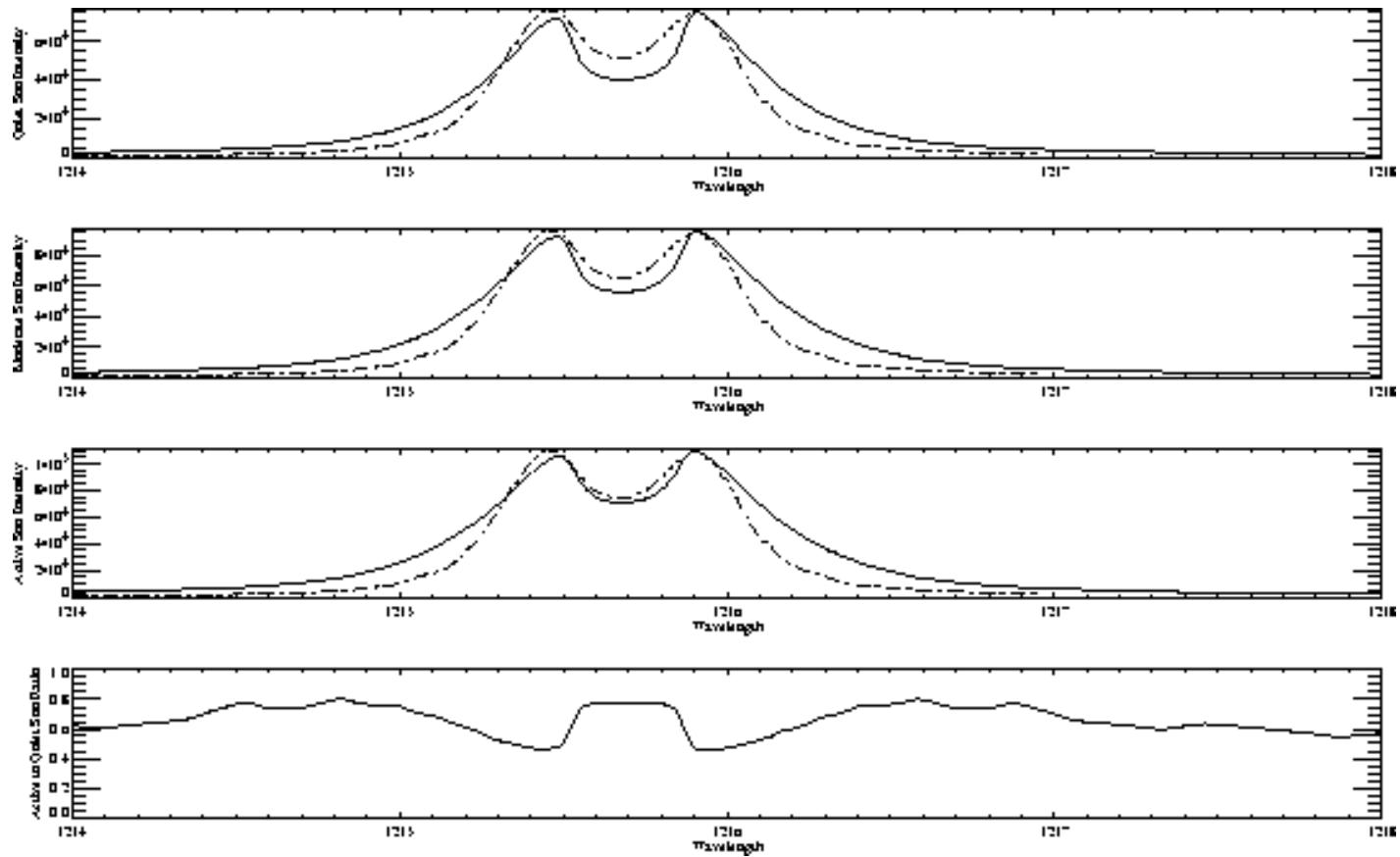
2500_15000_new_1.00000.lba Model:



2500_15000_new_1.00000.lba Model:



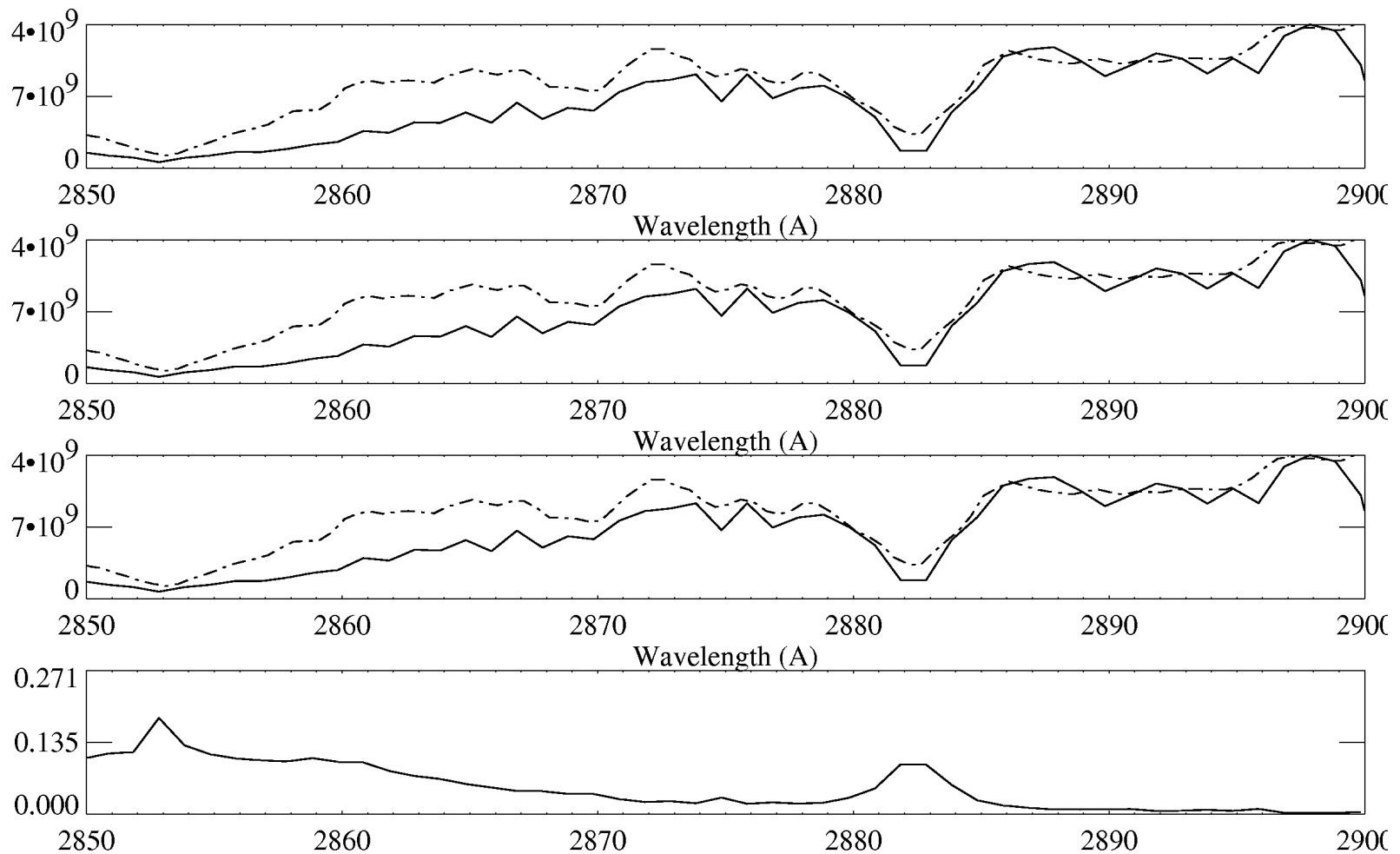
Lyman- α model and Lemaire obs



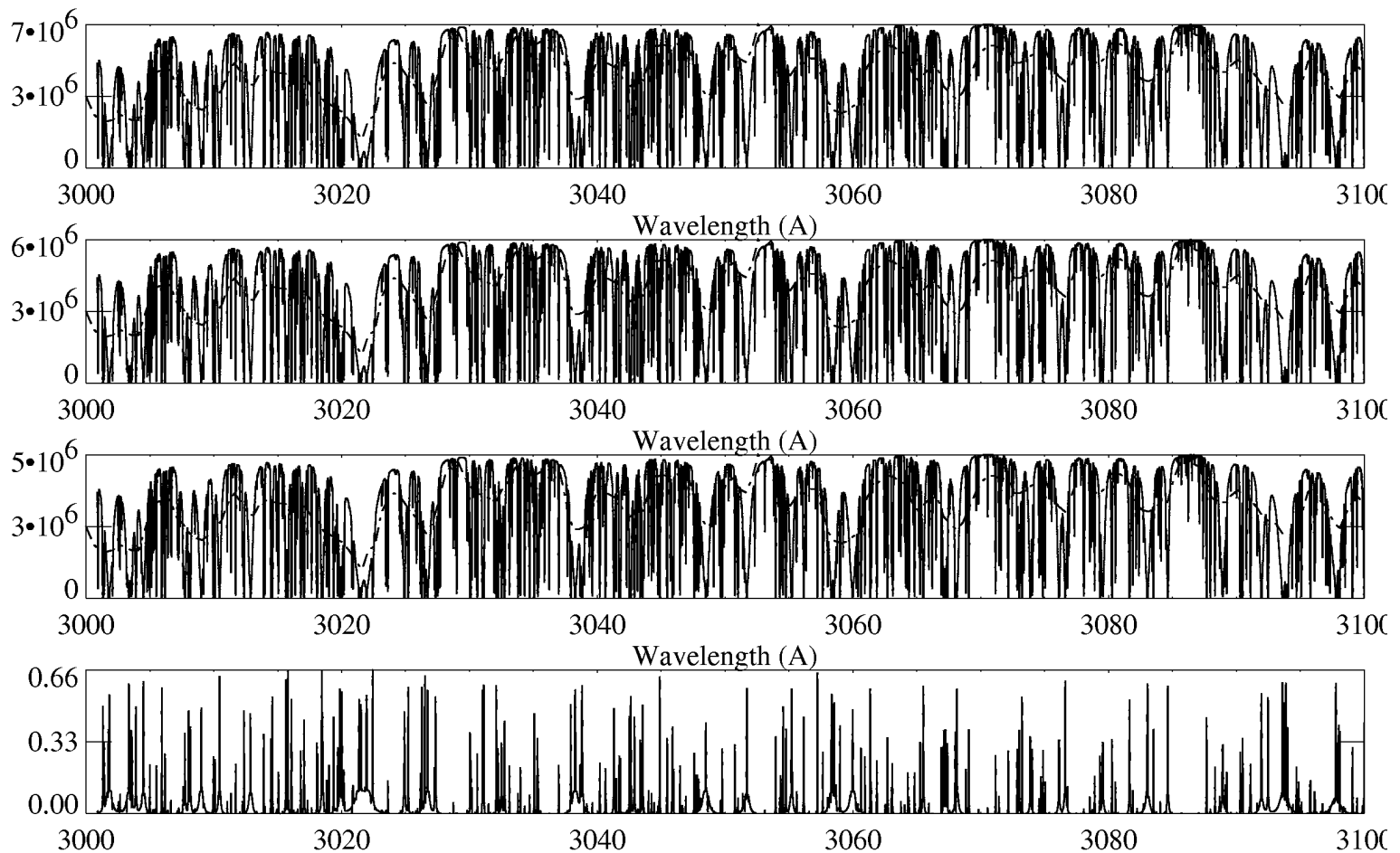
UV 285-290nm model and ATLAS3/SUSIM (full res)



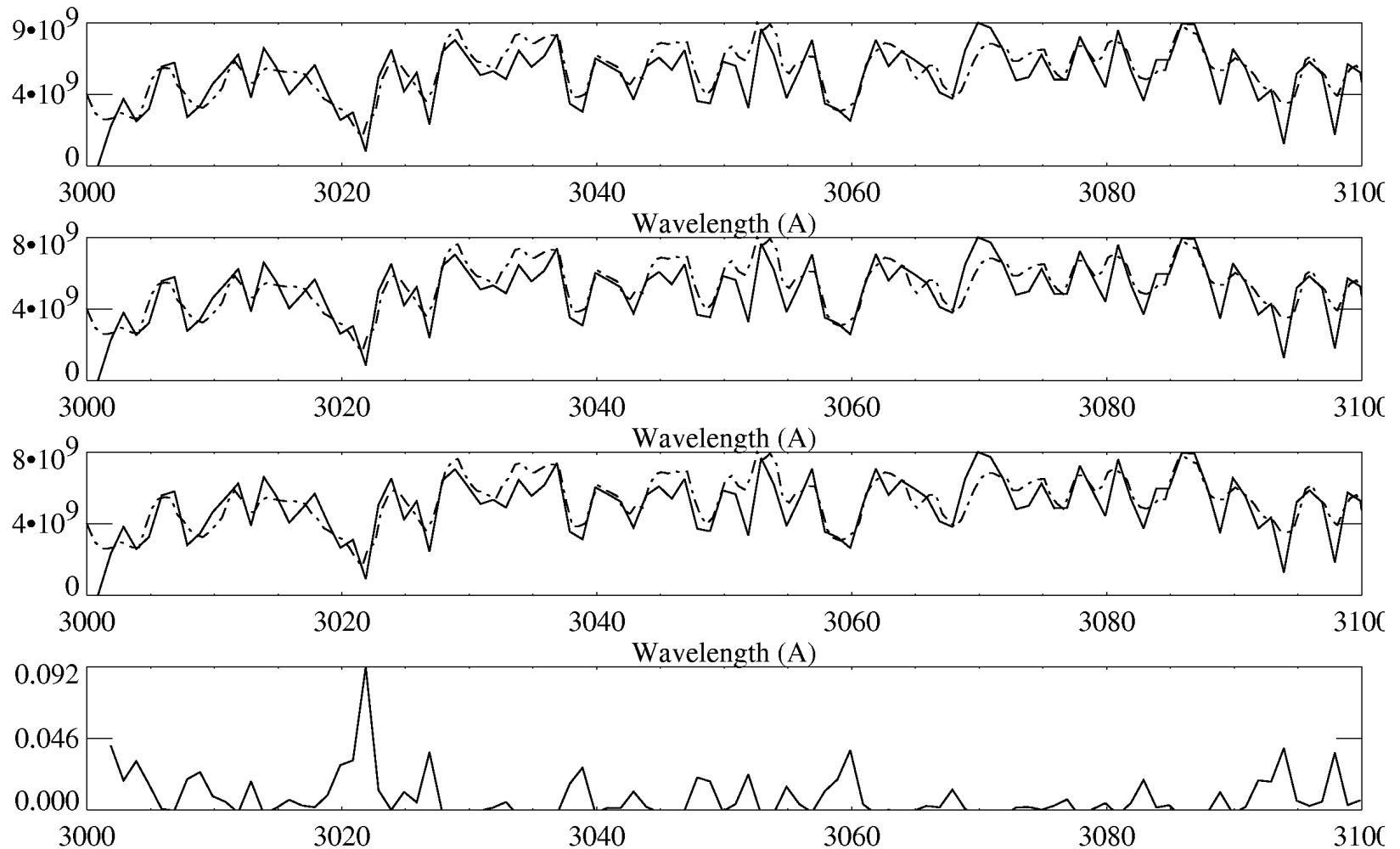
UV 285-290nm model and ATLAS3/SUSIM (0.15nm res)



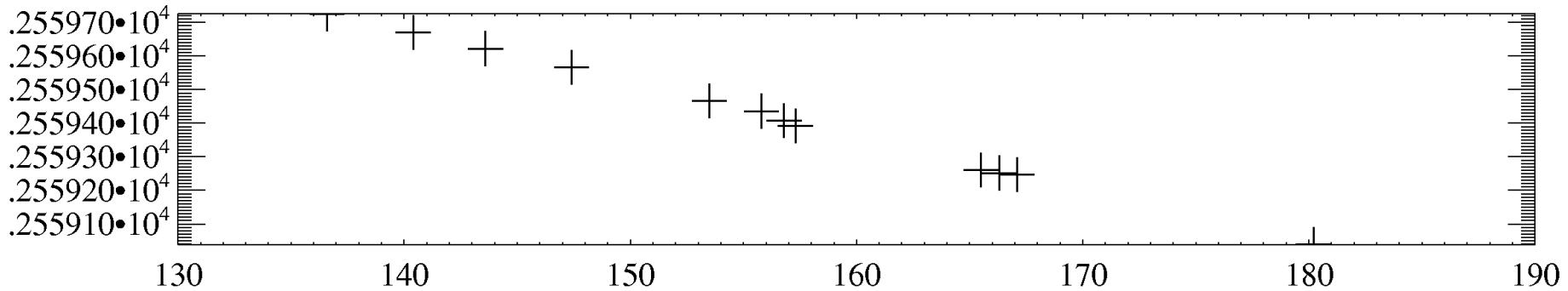
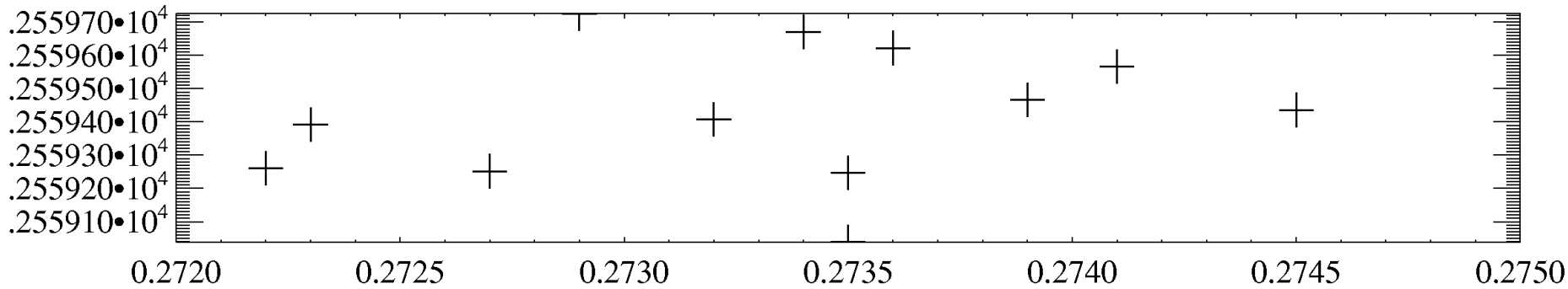
UV 300-310nm model and ATLAS3/SUSIM (full res)



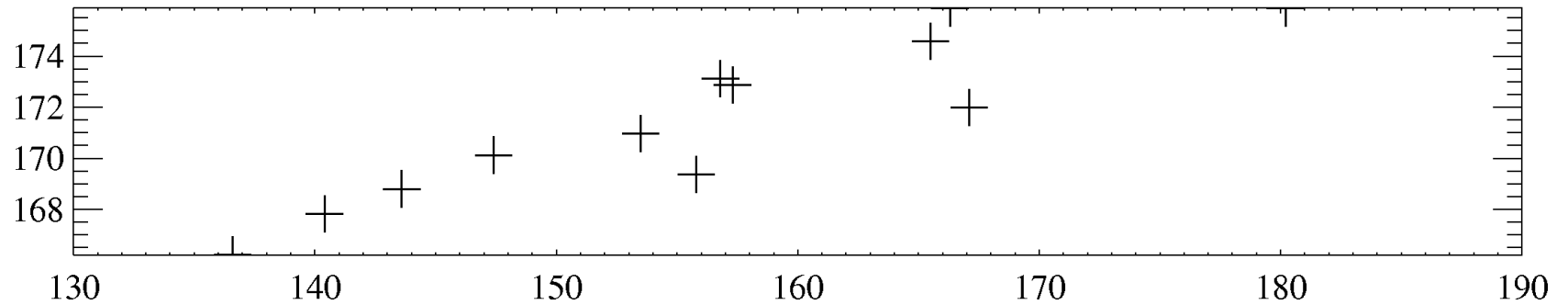
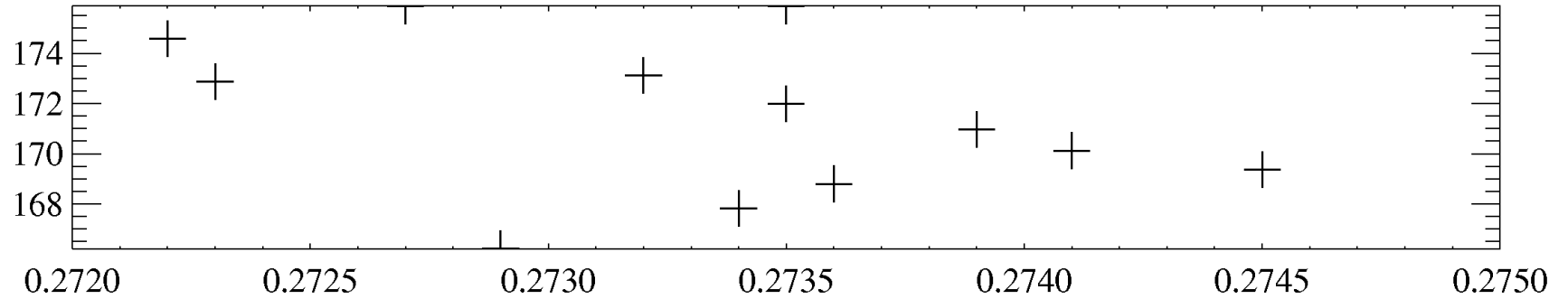
UV 300-310nm model and ATLAS3/SUSIM (0.15nm res)



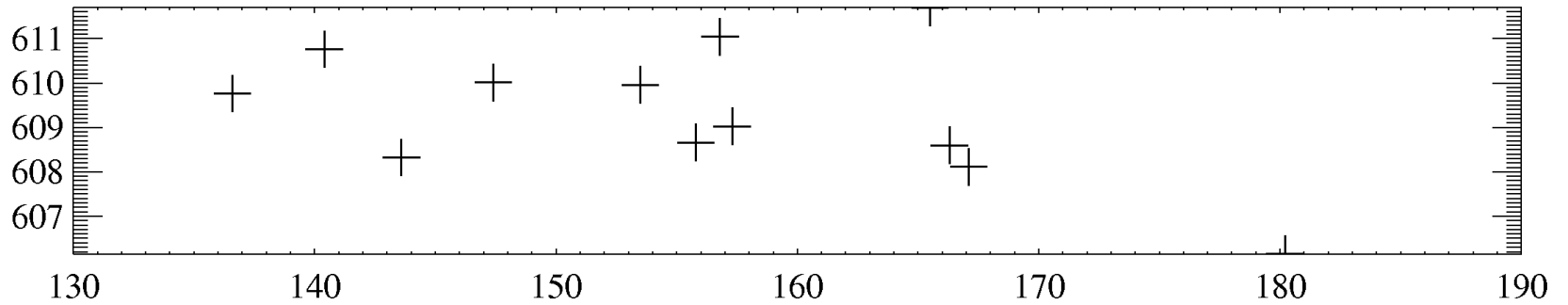
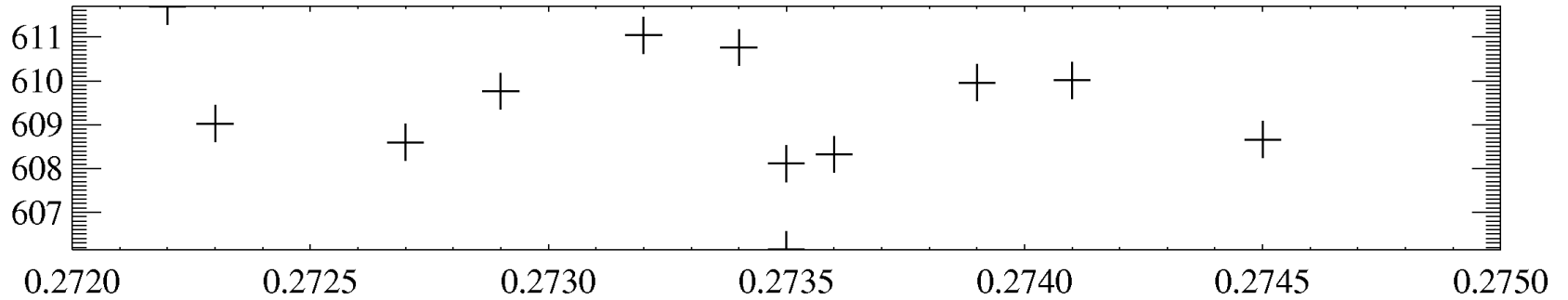
Mg II and F10 - “Summed” irradiance

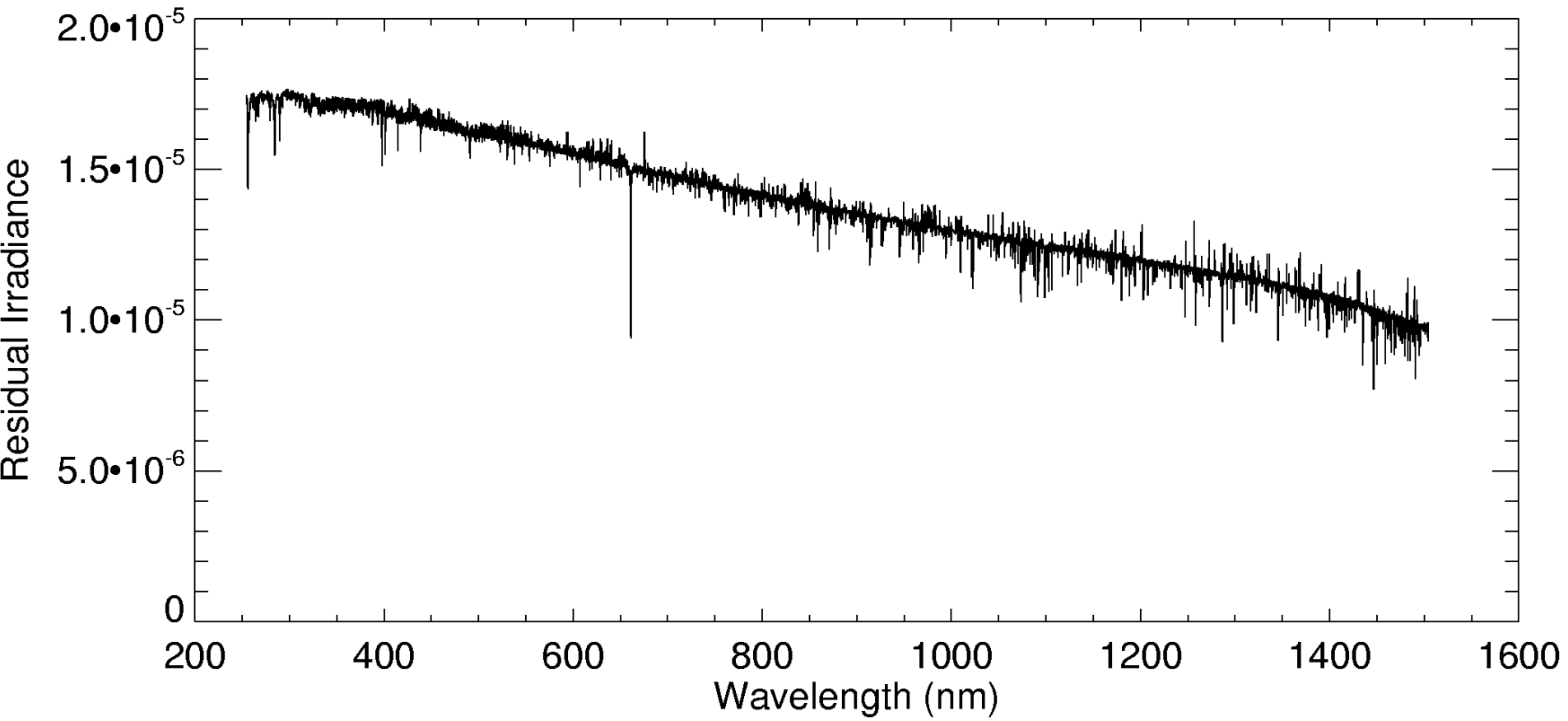


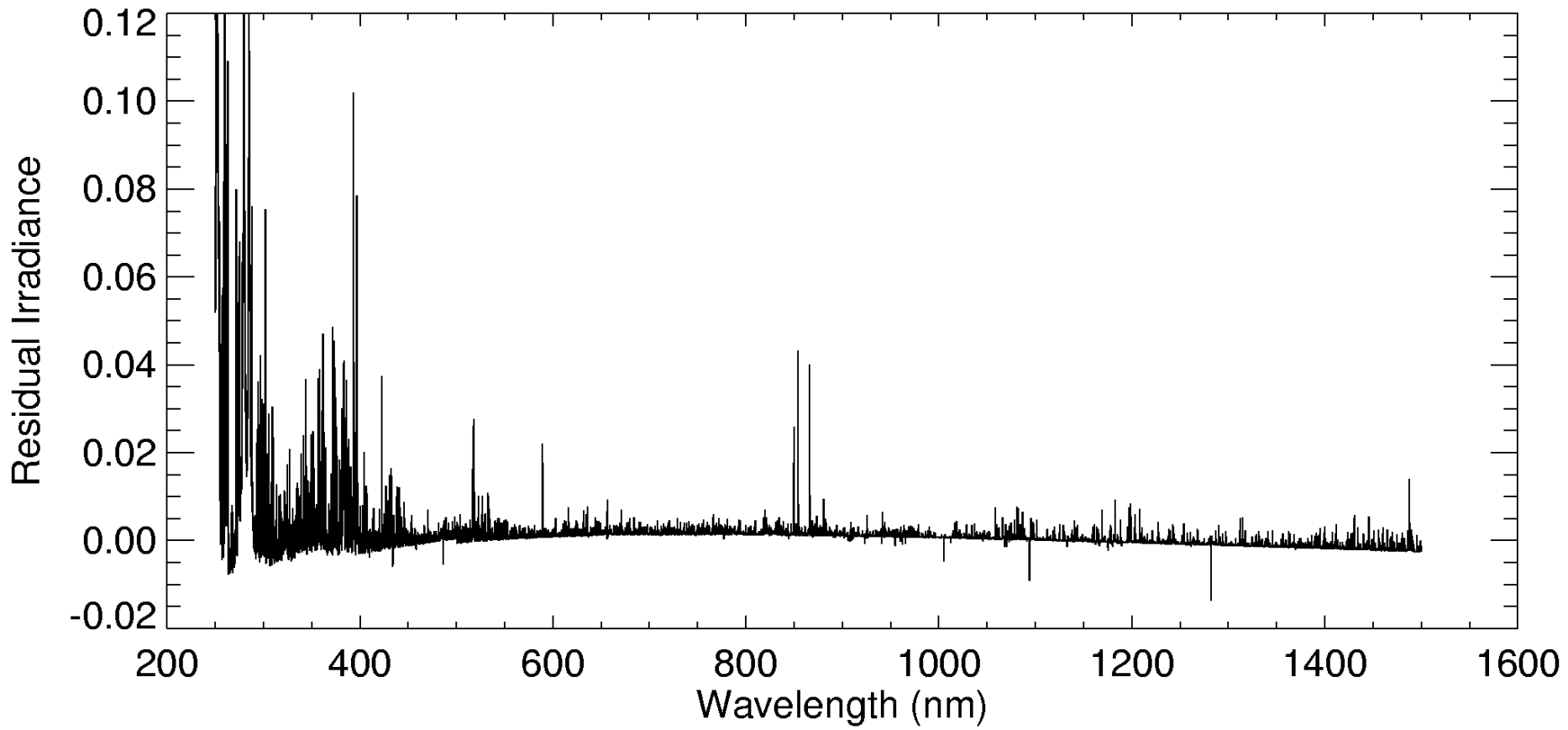
Mg II and F10 - “UV” band irradiance



Mg II and F10 - visible band irradiance







Toward LWS goals

- Quantify EUV/UV (and visible/near-IR) variability with detailed decompositions of solar images (magnetic and intensity)
- Develop relation to disk-averaged measures of solar activity available over many decades
- Correlate with banded irradiances
- Continue to improve accuracy of radiance spectra (atomic and molecular physics and data)
- Develop a set of spectral variability models covering decadal and century timescales