Curl and Warp Analysis of the LTPP SPS-2 Site in Arizona

September 28, 2011

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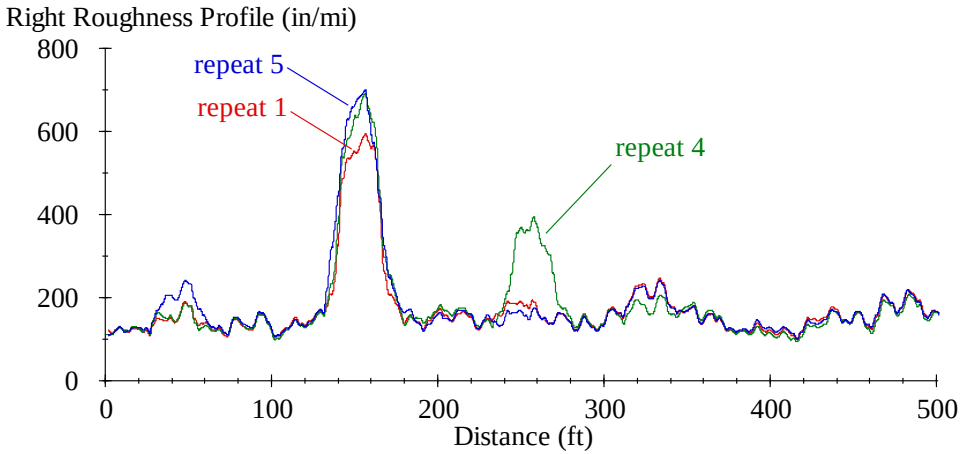
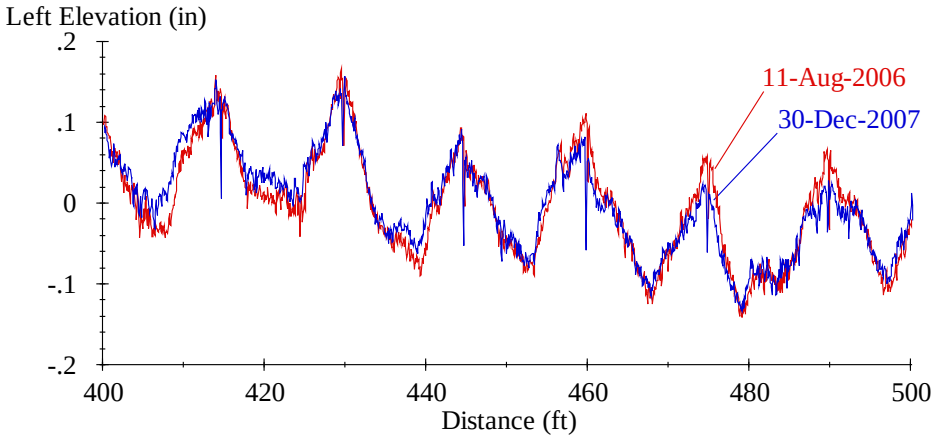
Traditional Profile Analyses

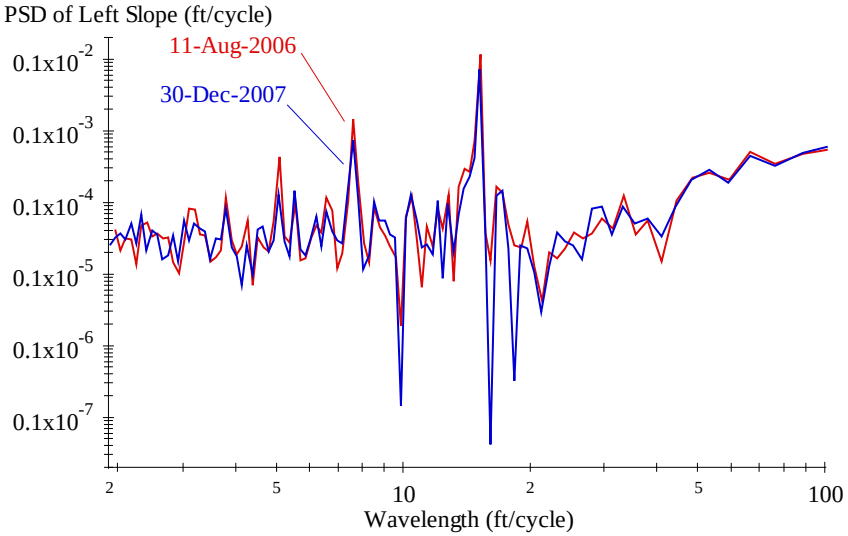


Continuous Roughness Reports

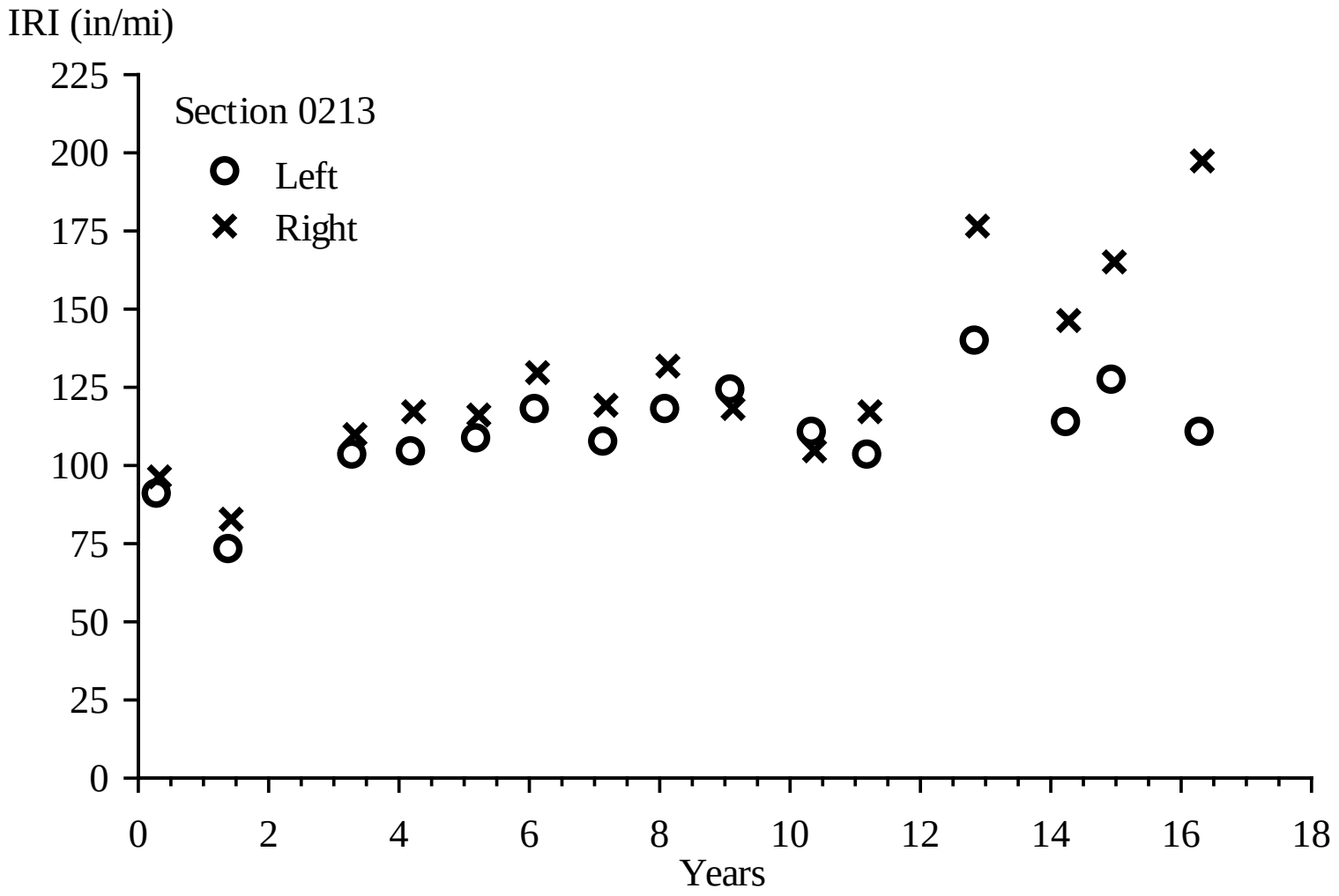


Filtered Profile PLots

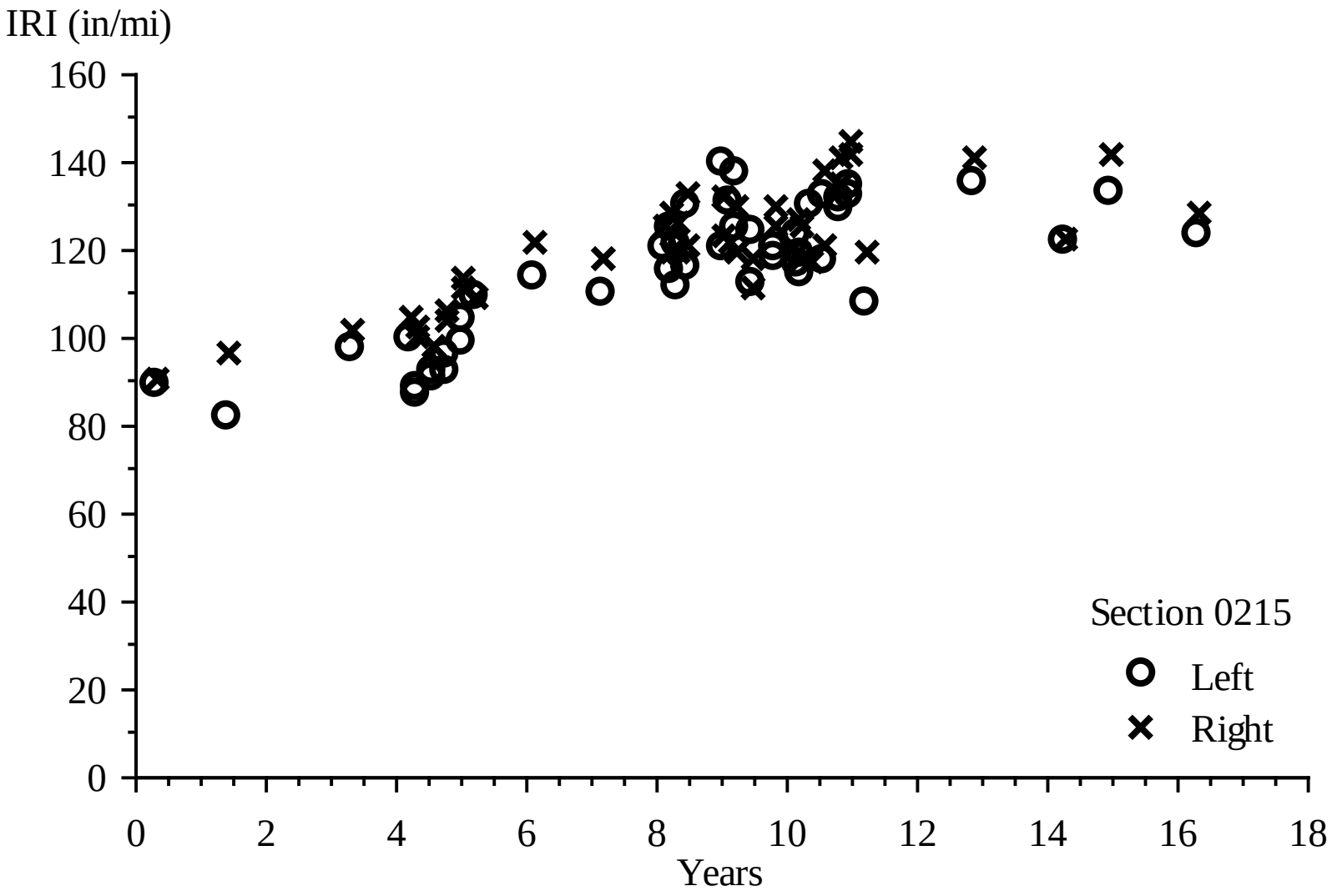
Spectral Analysis



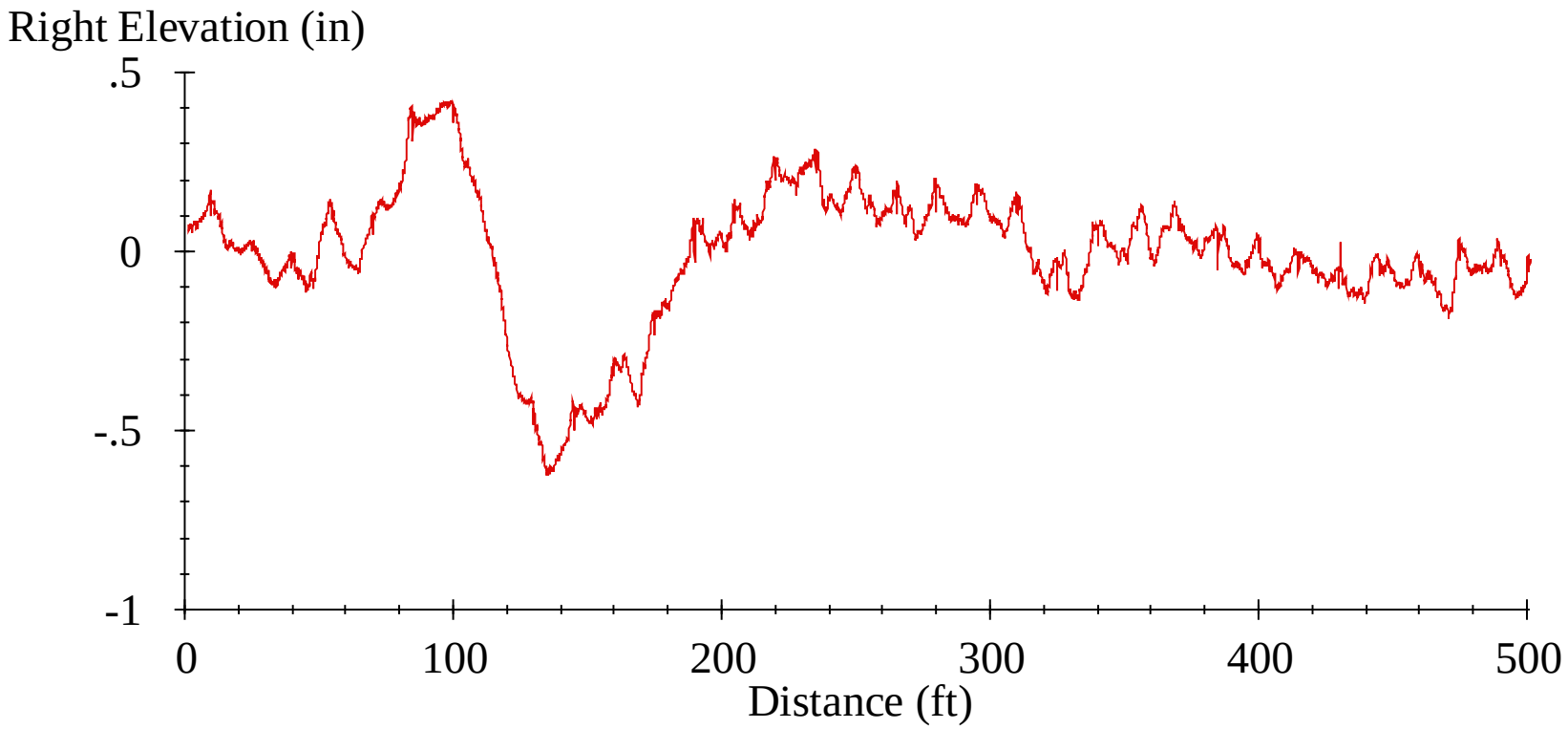
Roughness Progression, Section 0213



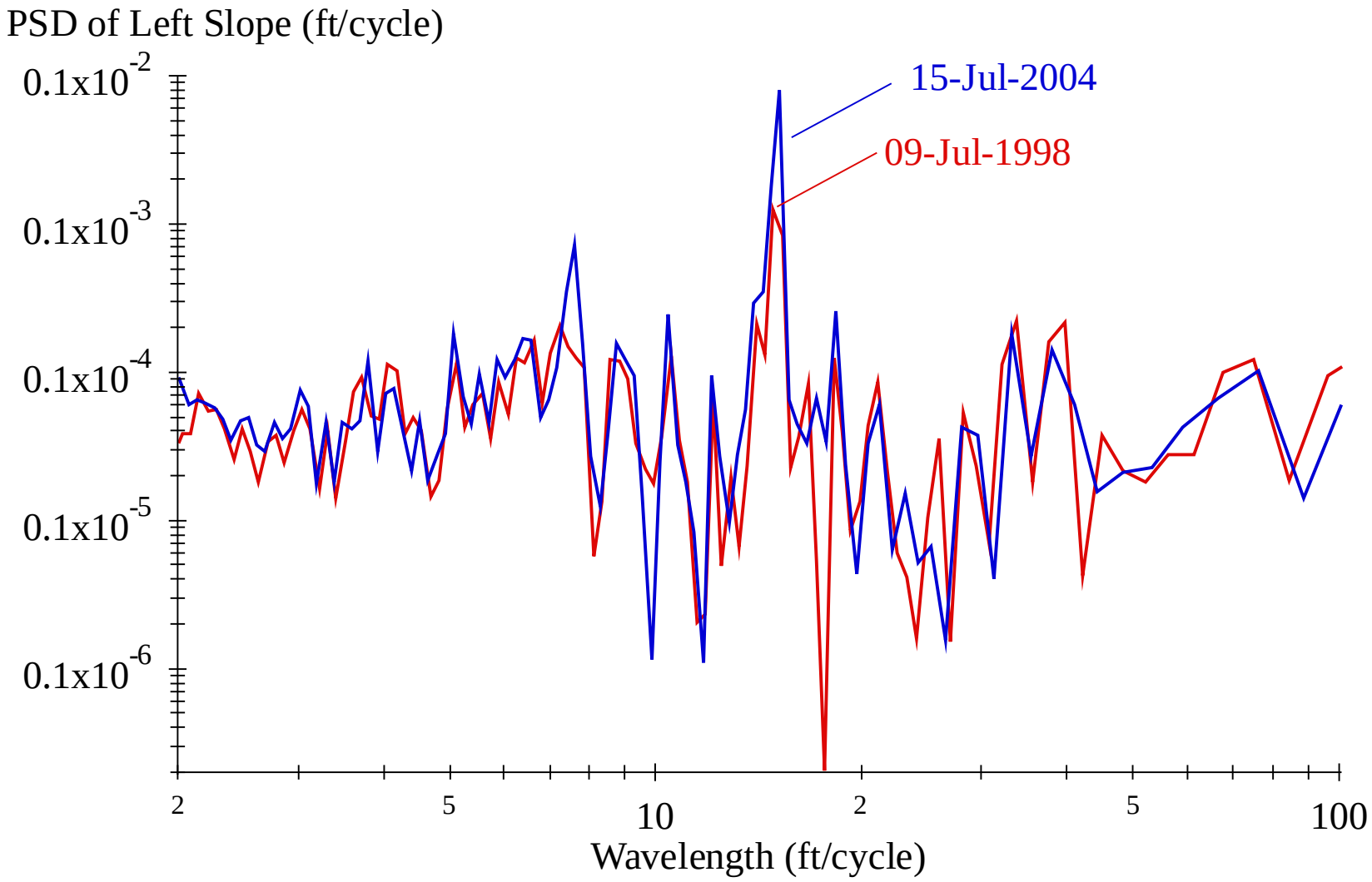
Roughness Progression, Section 0215



Elevation Profile, Section 0213



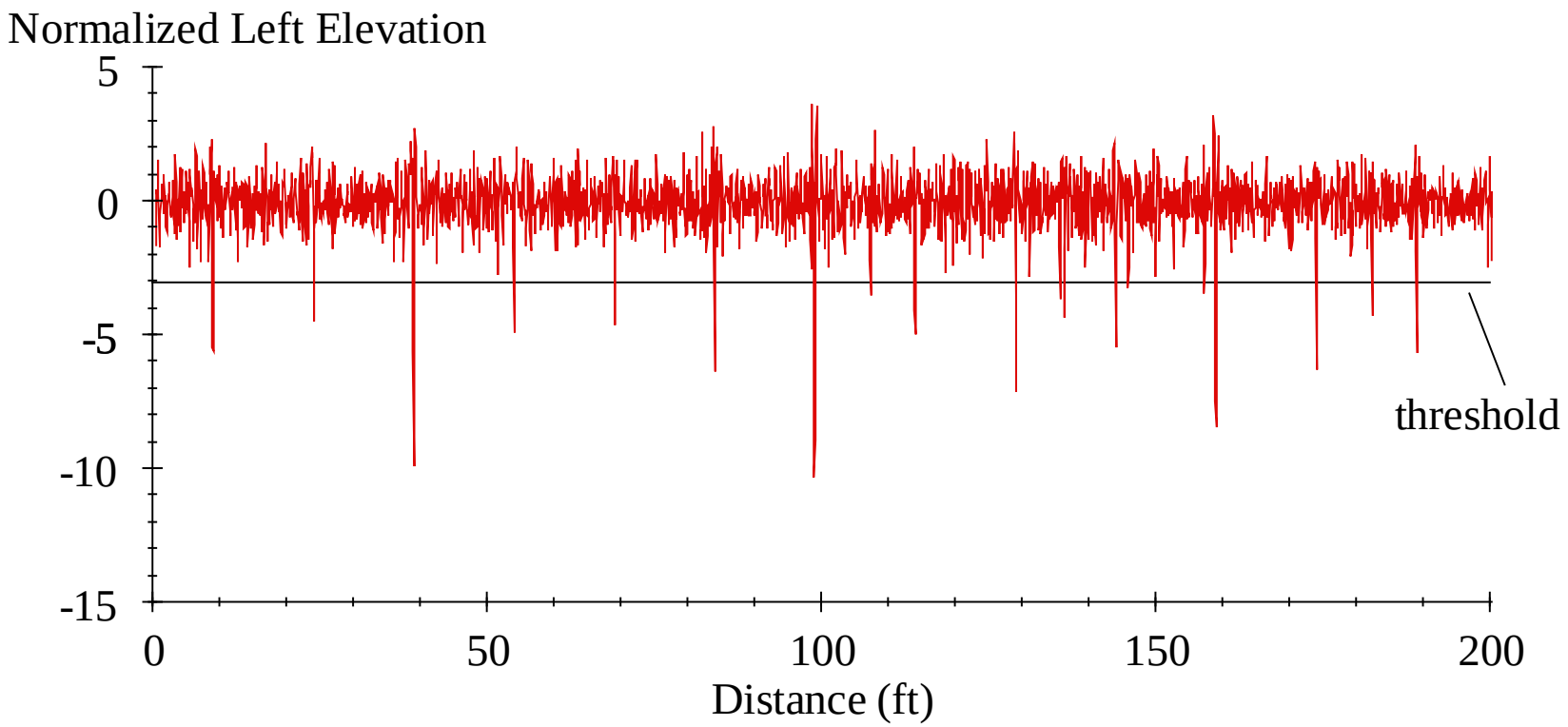
Spectral Density, Section 0215



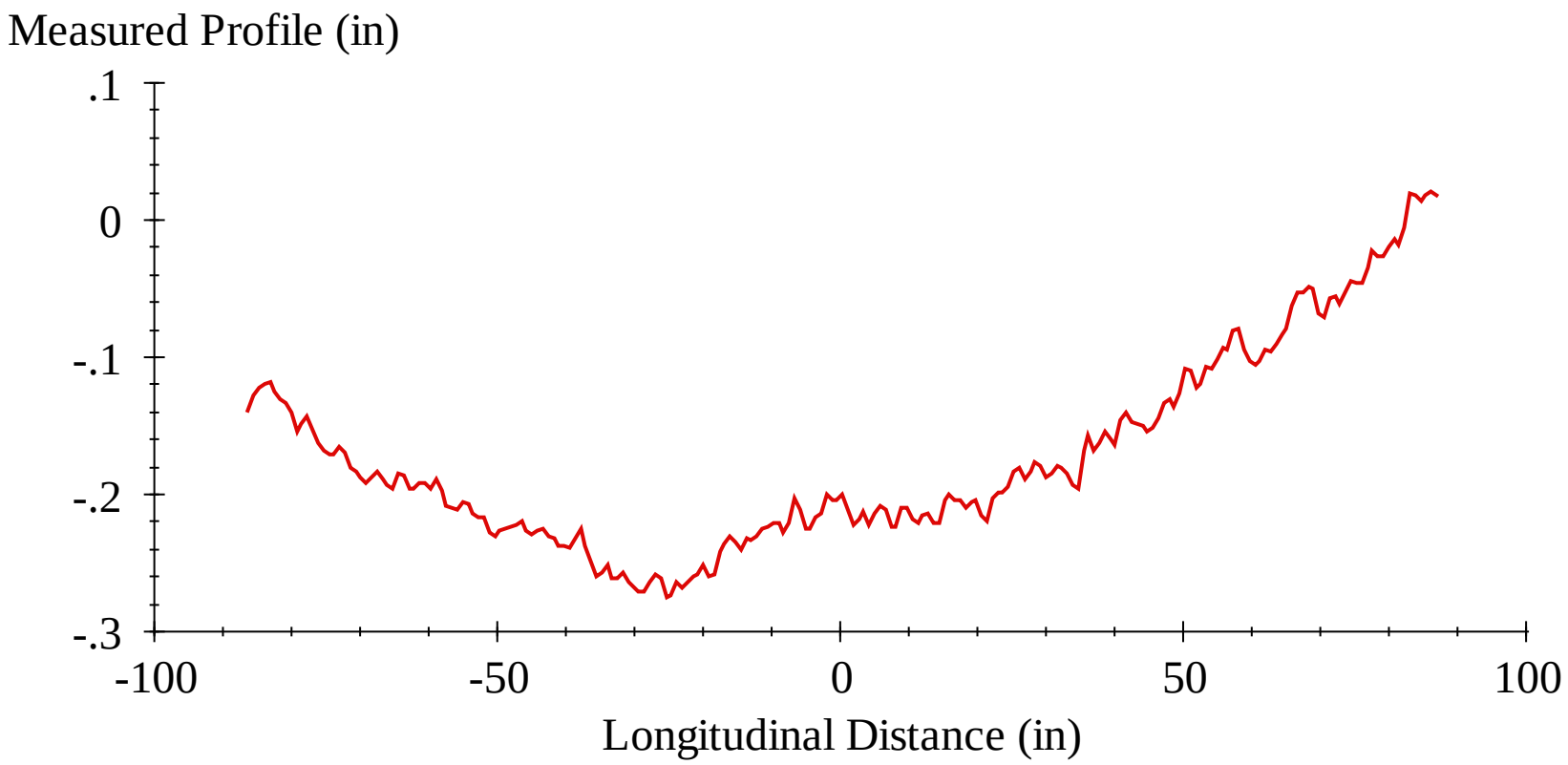
Methods

- Perform slab-by-slab analysis
- Estimate curl at each slab with one value
- Aggregate the level of curl over each profile
- Estimate the influence of curl on the IRI
- Re-examine roughness progression

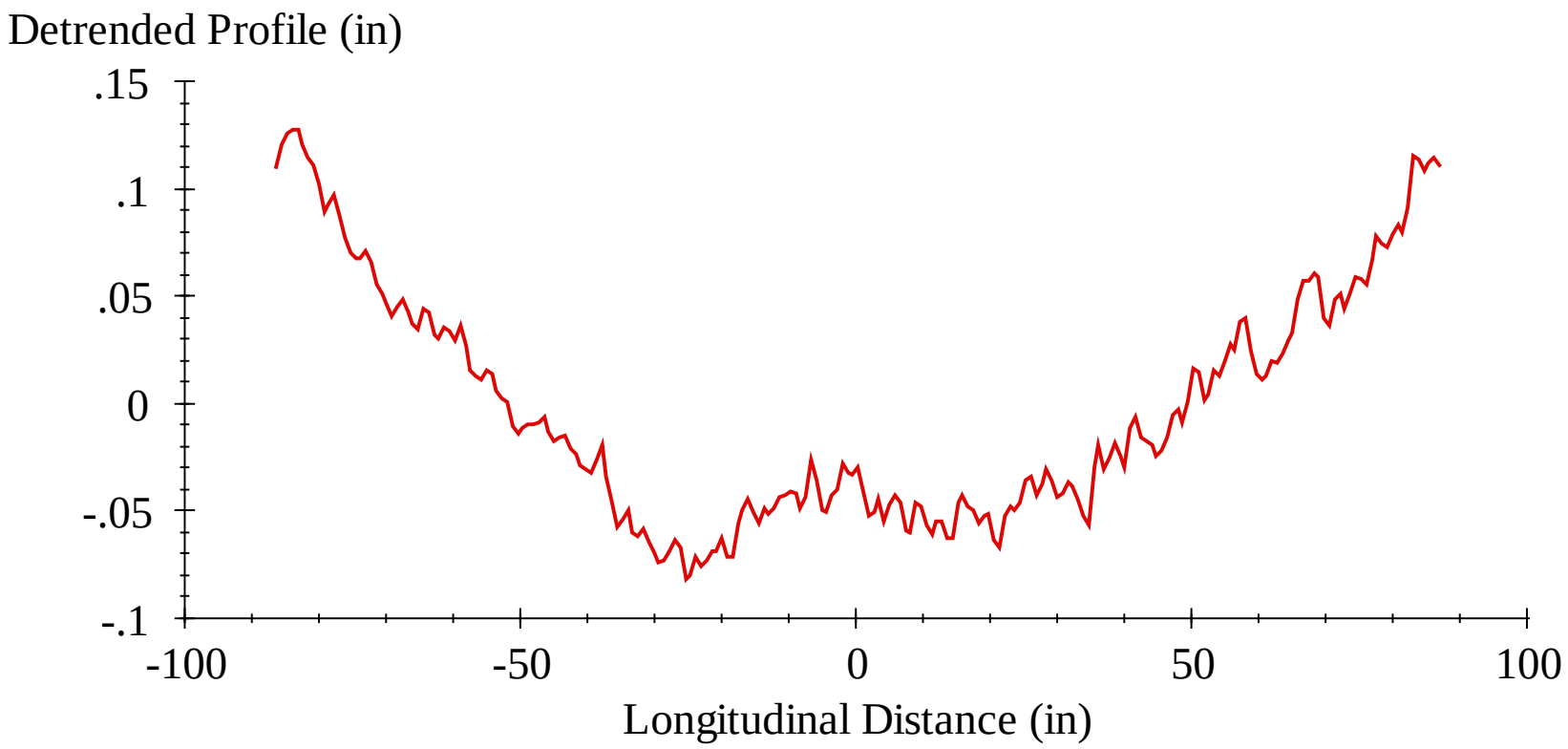
Joint Detection



Isolated Slab Profile



Detrended Slab Profile



Westergaard Equations

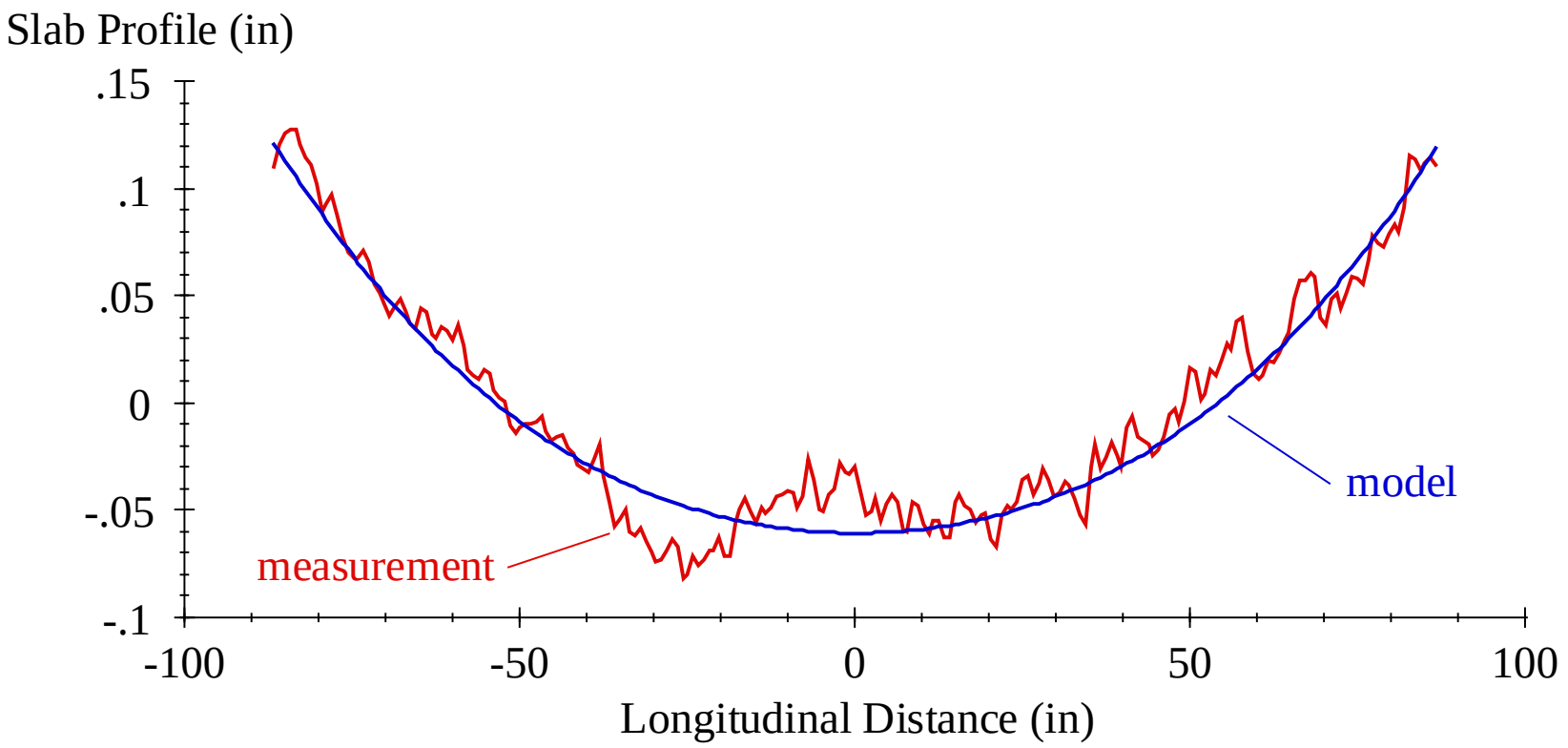
$$z = -z_0 \frac{2\cos\lambda\cosh\lambda}{\sin 2\lambda - \sinh 2\lambda}\left[(-\tan\lambda + \tanh\lambda)\cos\frac{x}{l\sqrt{2}}\cosh\frac{x}{l\sqrt{2}}\right.$$

$$\left. +(\tan\lambda + \tanh\lambda)\sin\frac{x}{l\sqrt{2}}\sinh\frac{x}{l\sqrt{2}}\right]$$

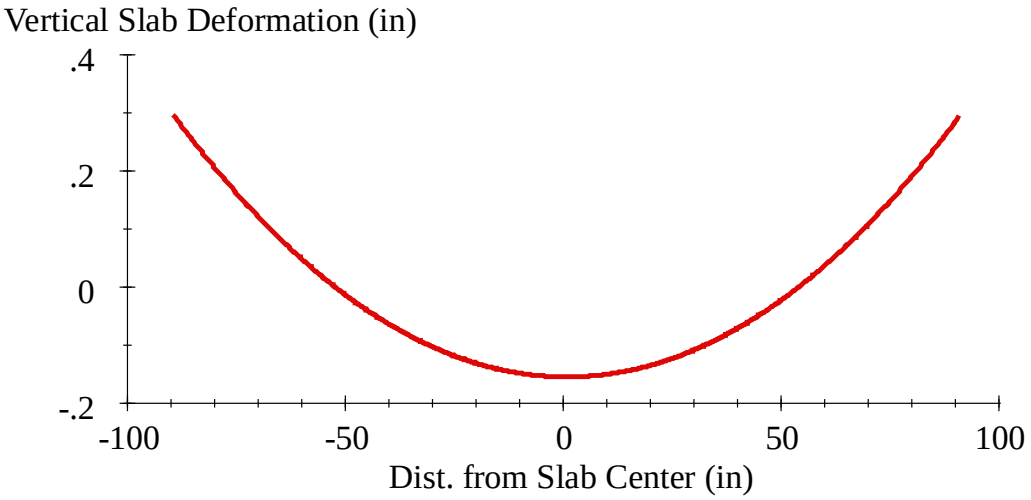
$$z_0 = \frac{-(1+\mu)(\alpha\Delta T + \Delta\varepsilon_{sh})}{h} l^2 \qquad \lambda = \frac{b}{l\sqrt{8}} \qquad l = \sqrt[4]{\frac{Eh^3}{12(1-\mu^2)k}}$$

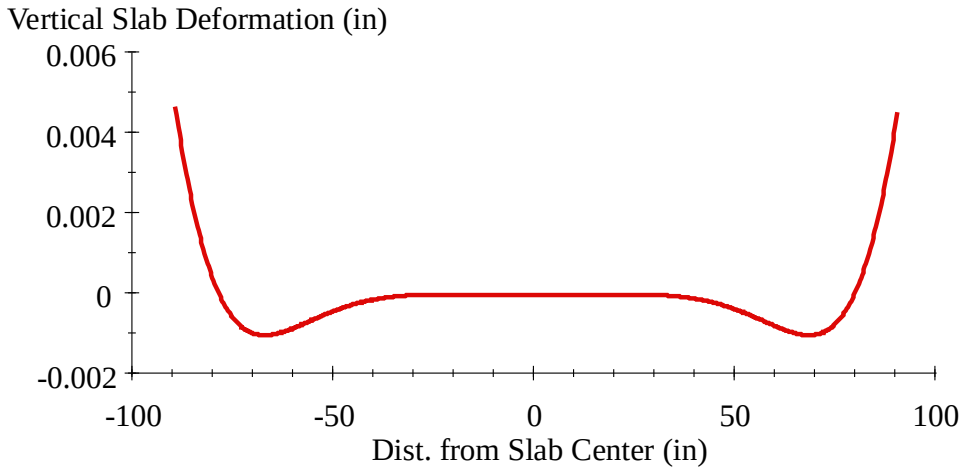
$$PSG = \frac{(\alpha\Delta T + \Delta\varepsilon_{sh})}{h}$$

Sample Curve Fit

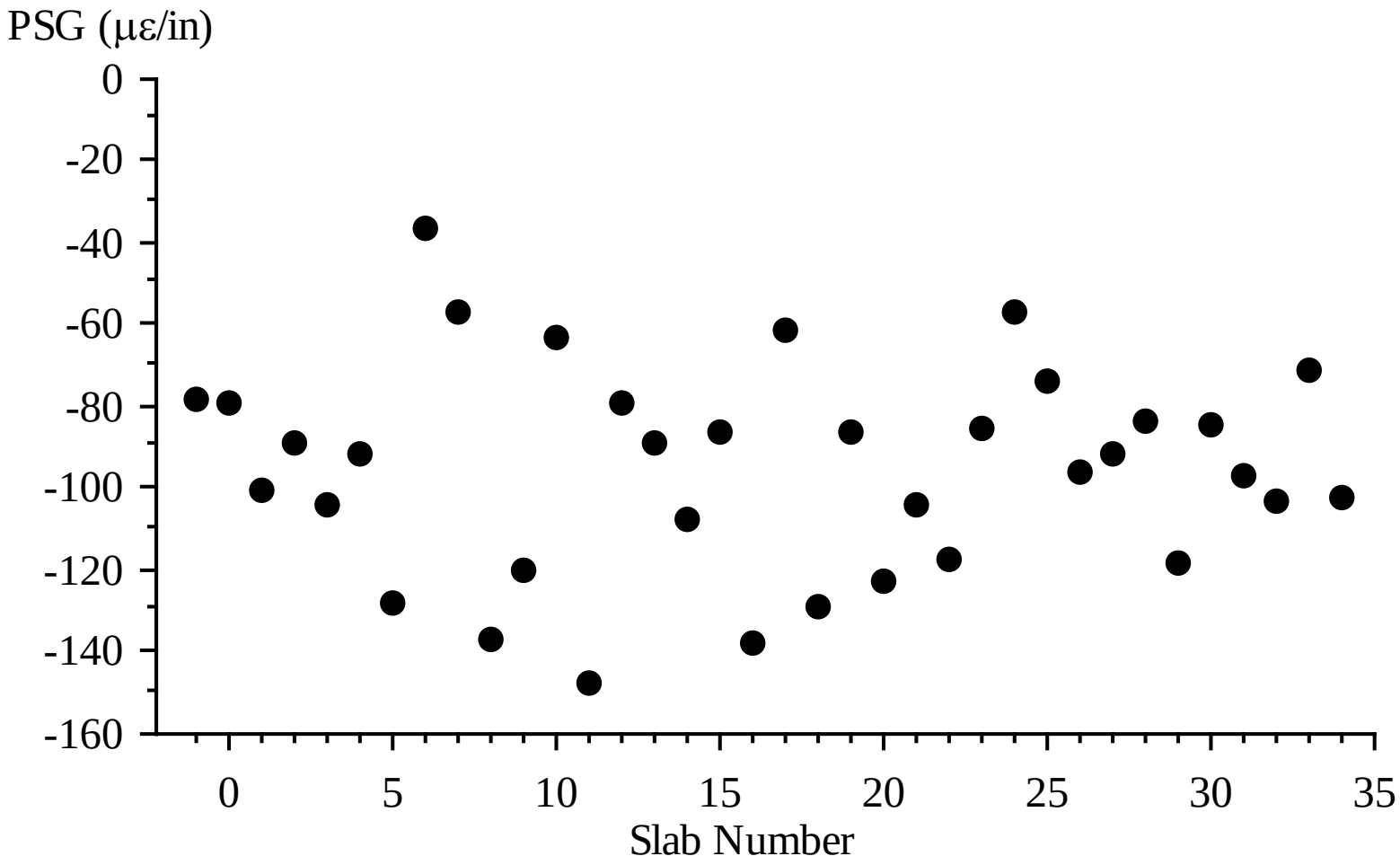


Idealized Slab Profiles

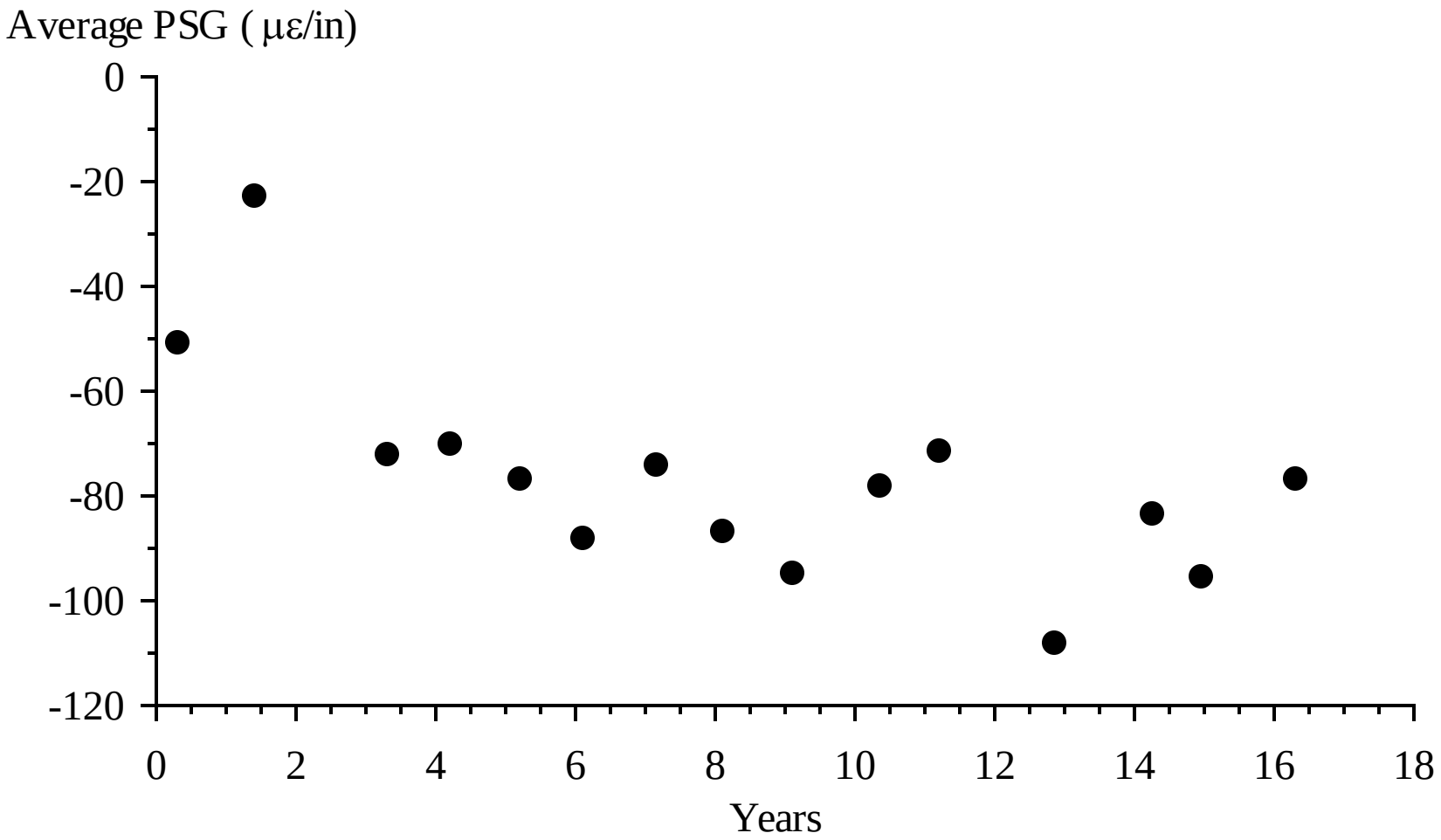




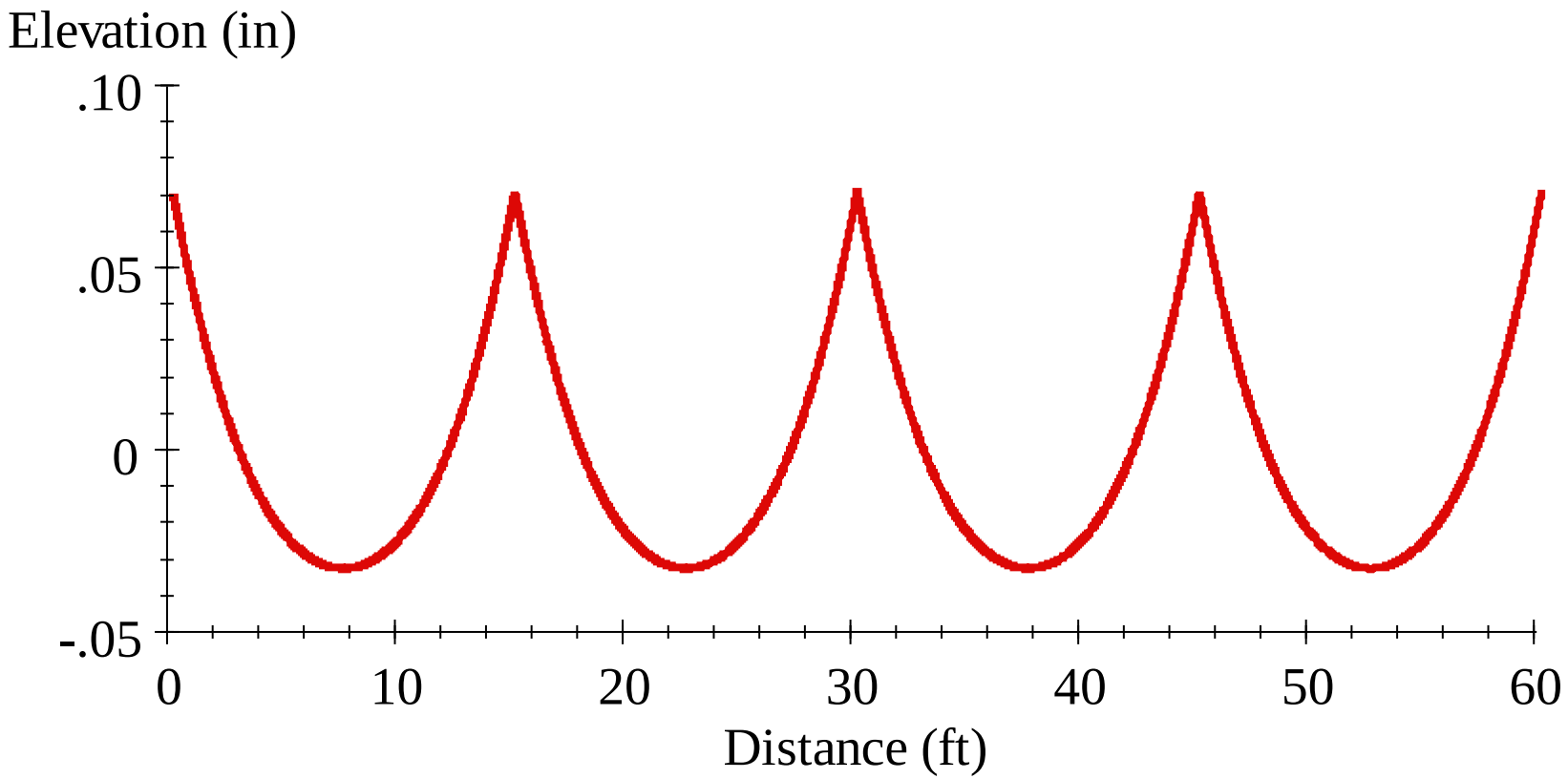
Slab by Slab Pseudo Gradient



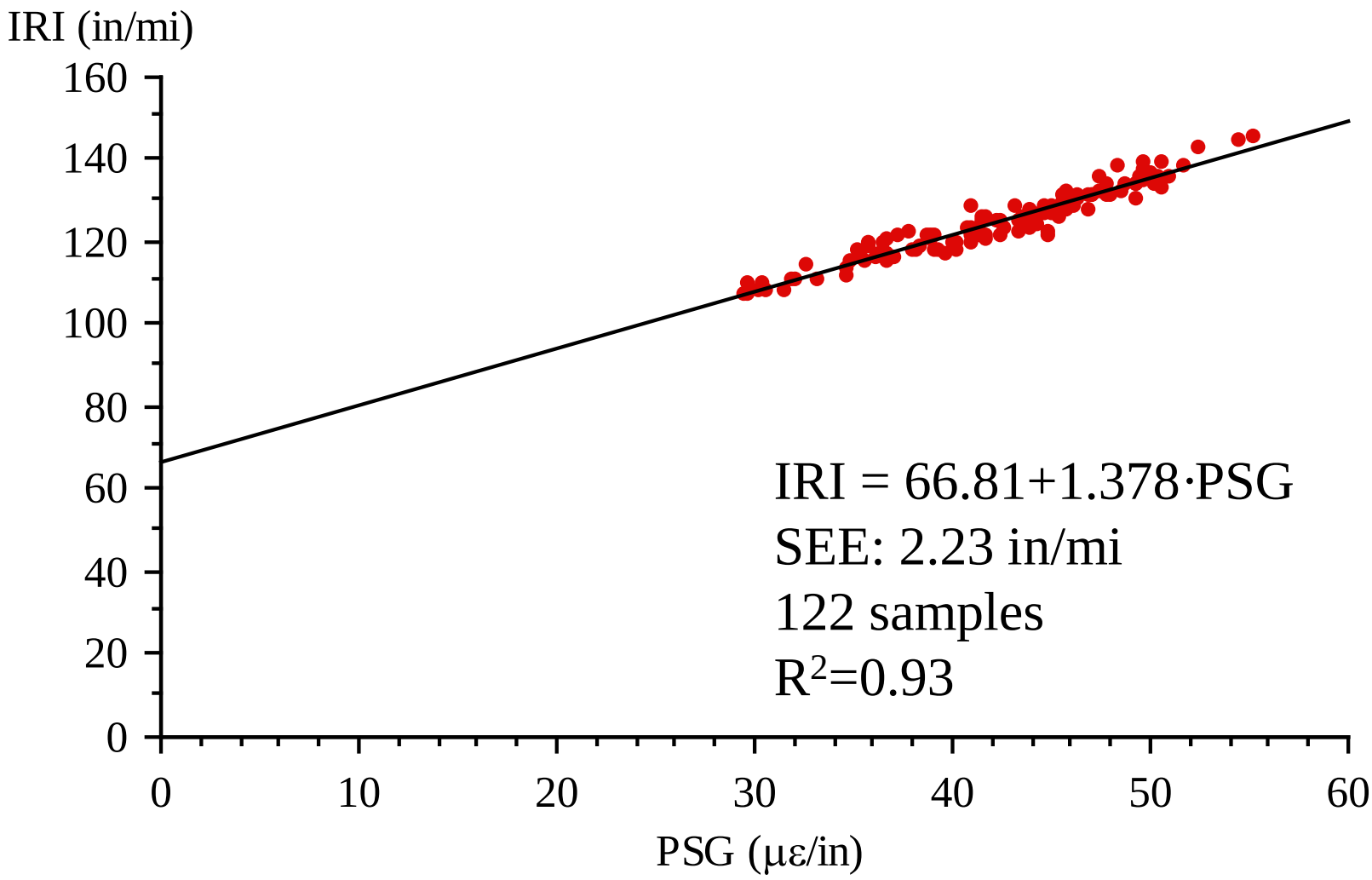
Average Pseudo Gradient over Time



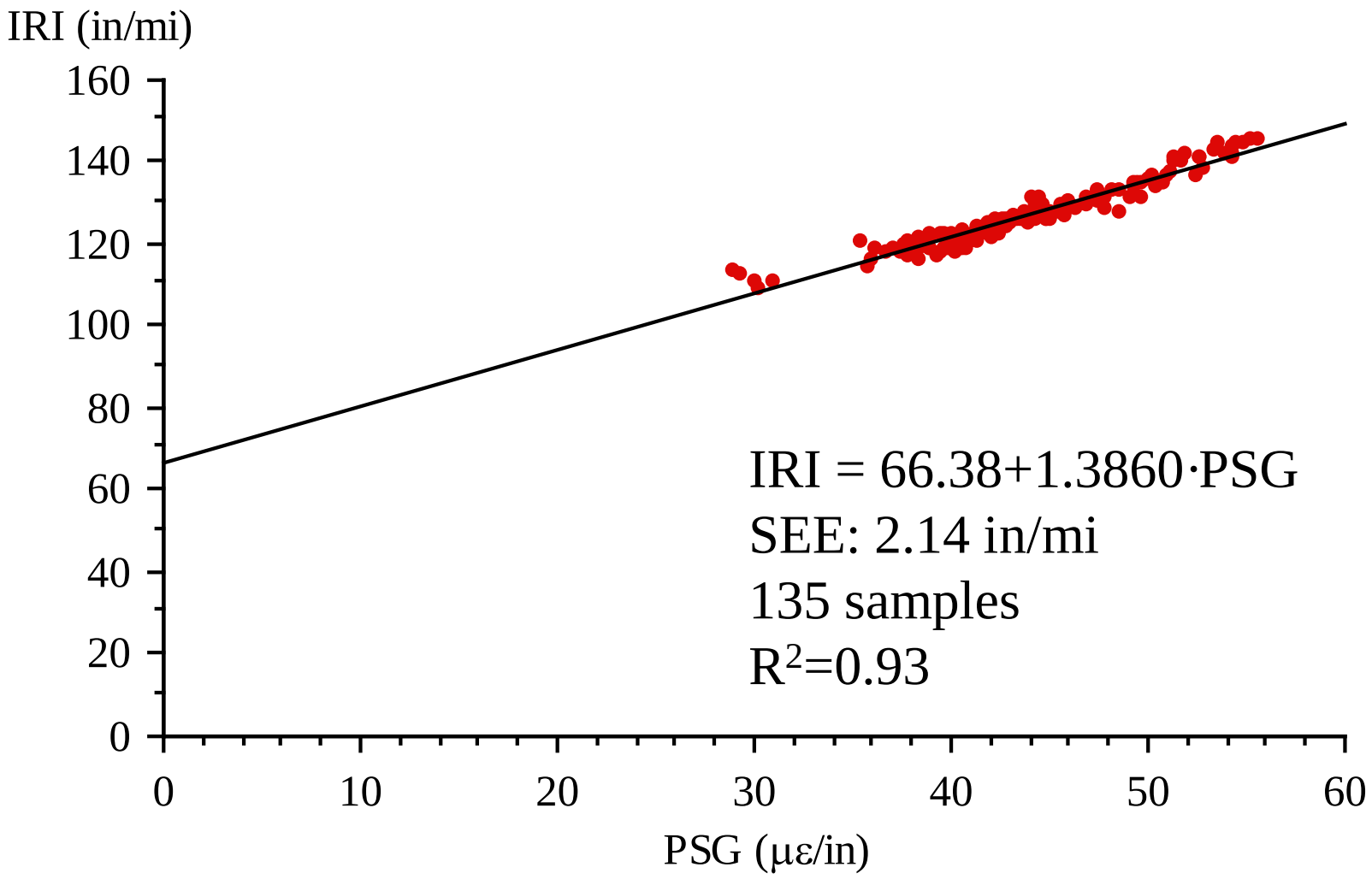
Idealized Profile



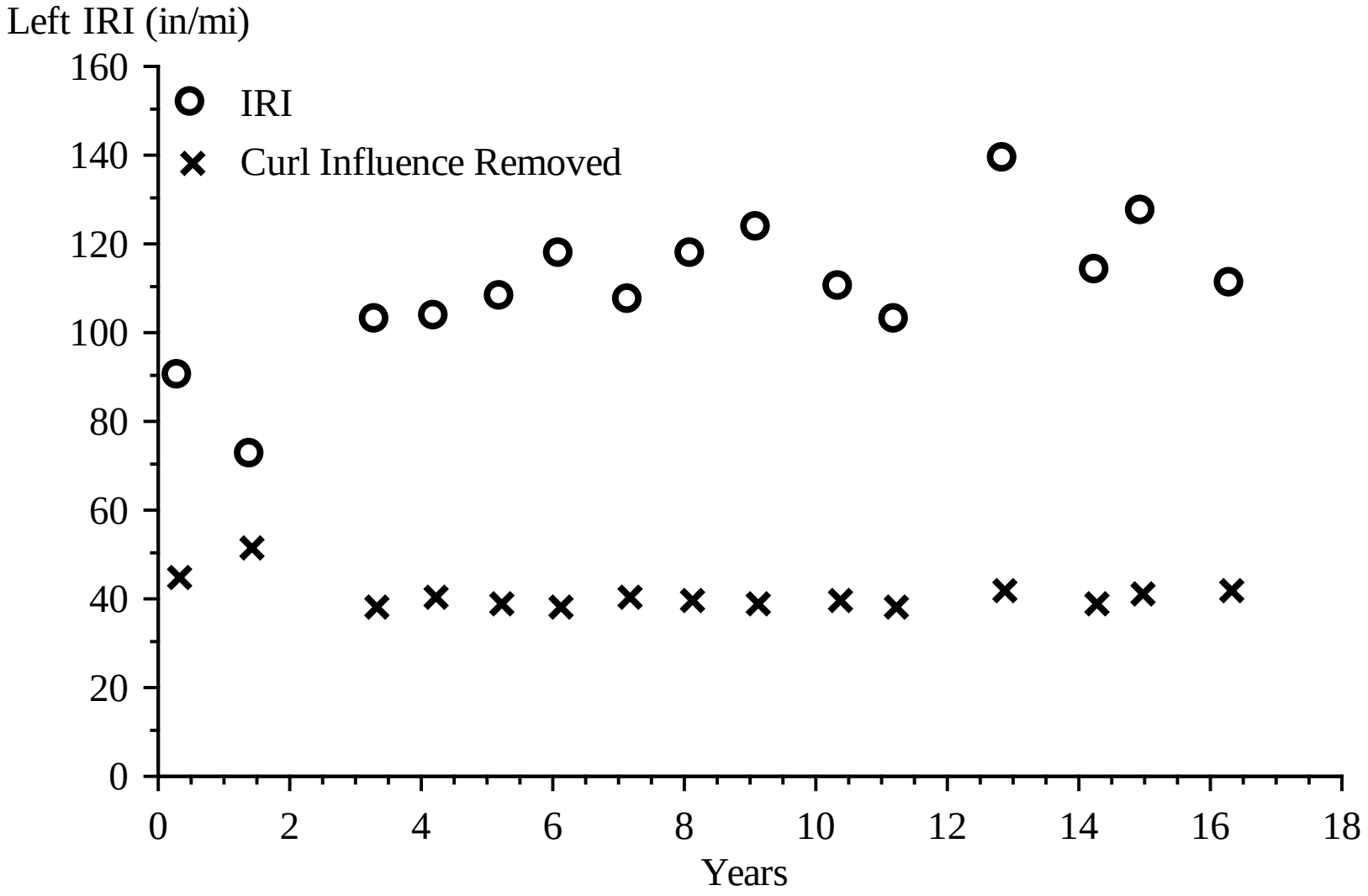
IRI versus Pseudo Gradient, LTPP



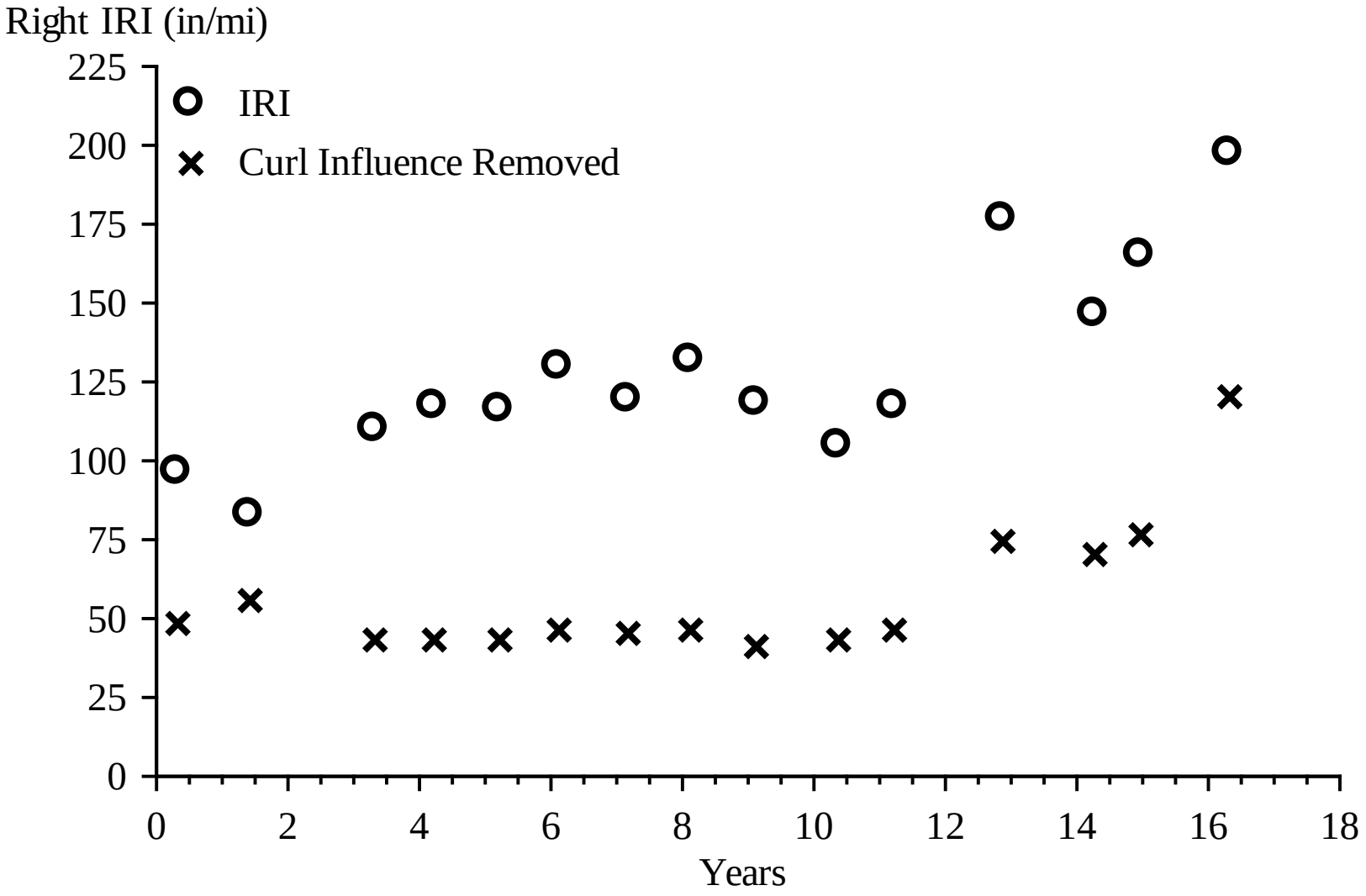
IRI versus Pseudo Gradient, FHWA



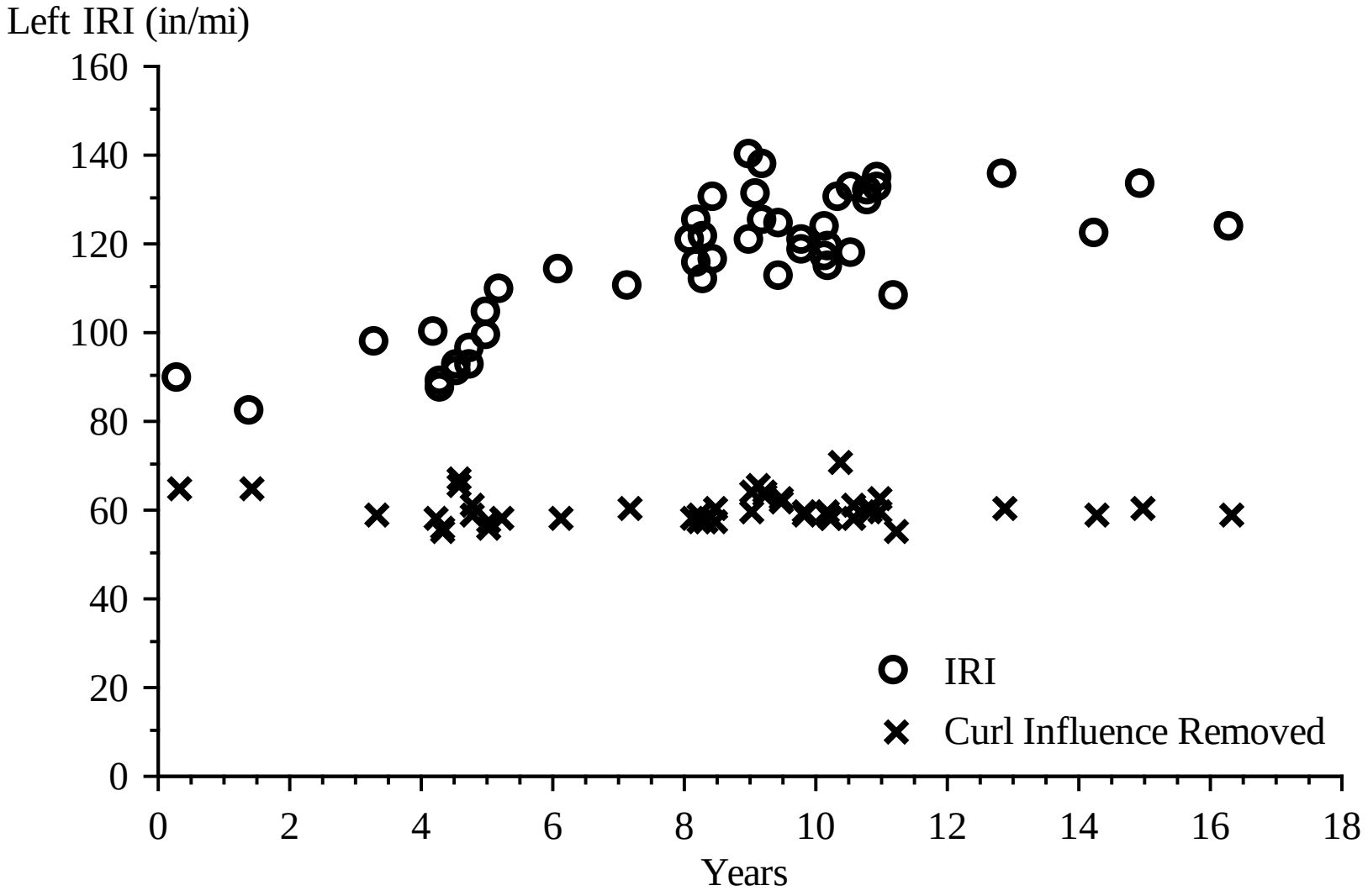
IRI Progression, Section 0213 Left



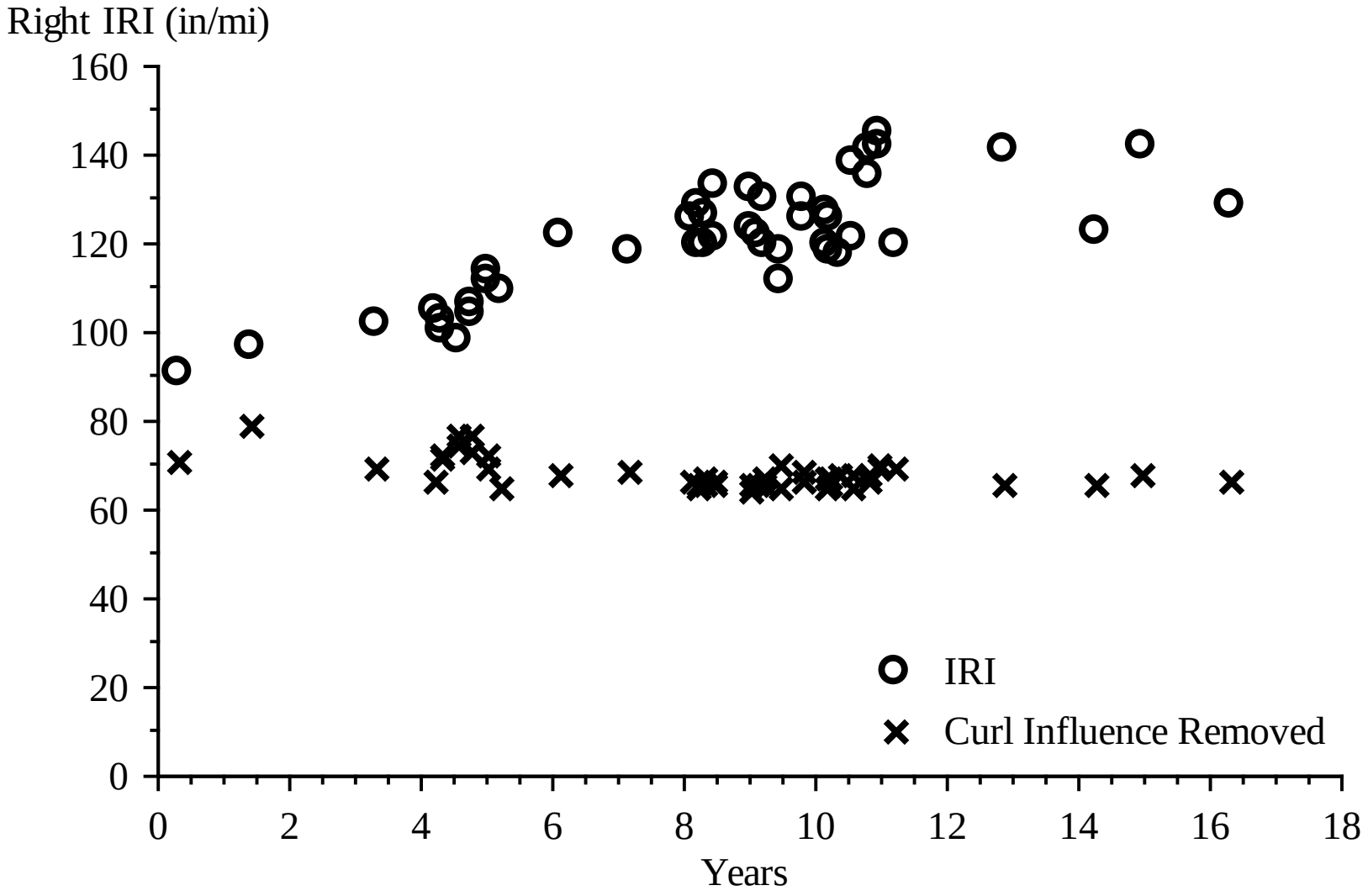
IRI Progression, Section 0213 Right



IRI Progression, Section 0215 Left



IRI Progression, Section 0215 Right



Remarks

- These data provided a unique opportunity.
- A roughness index is NOT an adequate surrogate for structural health.
- The methods presented here show promise.
- The PSG-IRI relationship needs more study.