#### Science Justification for TSI Requirements

#### Greg Kopp,

# Laboratory for Atmospheric and Space Physics University of Colorado







# Long-Term Change

Given the measured natural variability of TSI, how long does it take to confidently resolve small differences that *may be* representative of long-term change?

- Need to resolve <0.1% change over ~100 years
  - This solar variability rate approximately matches current 0.001%/year instrument stability
  - Improved absolute accuracy helps this detection over long time scales







- The Maunder Minimum in the late 1600's is a significant longterm change scientifically important to climate research.
  - Solar output decreased 0.1-0.3% for 70 years
  - > Temperatures were ~0.2-0.4 C colder than the early 1900s (Little Ice Age)





# Long-Term Change – Detection Via Instrument Stability

- Plot shows possible solar variability with time (solid grey lines)
  - Want to detect Maunder Minimum levels of 0.1% / 100 years (0.001%/yr)

Current instrument stabilities are comparable to desired long-term solar variability detection thresholds, making detection marginal.





Solar Irradiance CDR Workshop, 23-24 Feb. 2011

### Long-Term Change – Detection Via Instrument Accuracy

- With good absolute accuracy (horizontal portions of colored lines), can detect this rate of change given time
  - The better the absolute accuracy, the less time required for trend detection





### Solar Variability and Measurement Capabilities



## **TSI Accuracies and Stabilities Address Climate Needs**



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#### **Stability Facilitates Trend Detection**

