# High-frequency Tropical Cyclone Forecasts: Intensity

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Thanks to: Vijay Tallapragada, Sam Trahan, Ryan Torn, William Lewis, and Yi Jin

# Outline

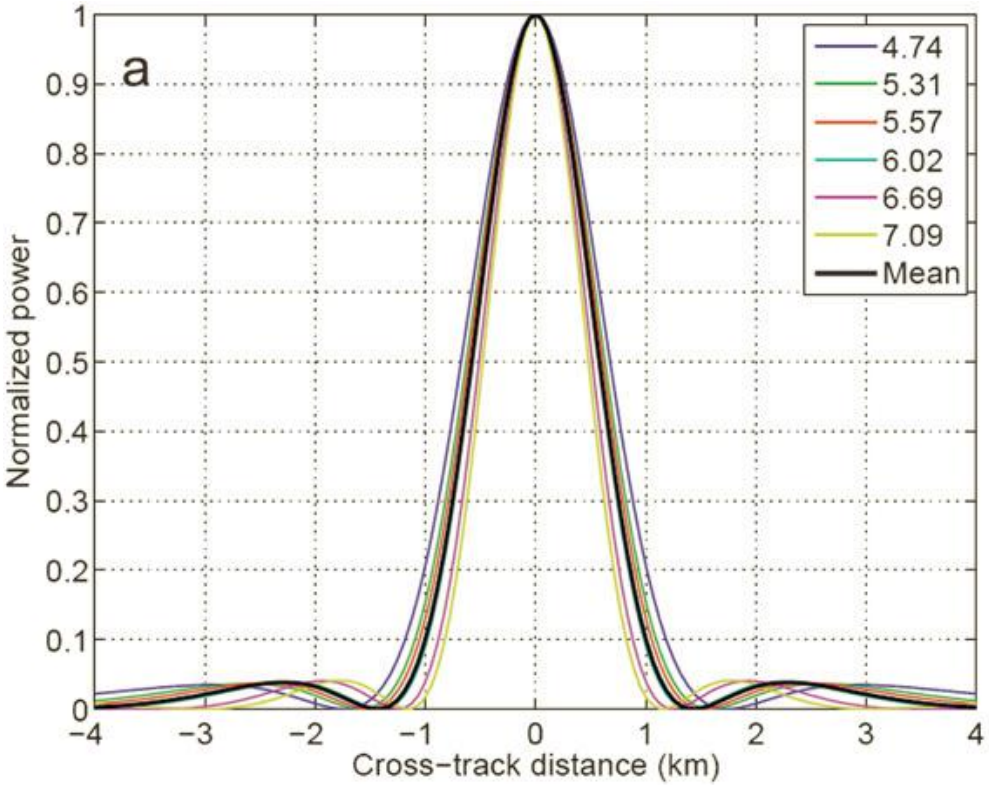
- Comparison of observed and modeled intensity
- Samples and Statistics for Participating Models:
  - H212 (planned 2012 HWRF)
  - HWF3 (2011 HFIP HWRF)
  - AHW4
  - UWN8
  - COAMPS-TC (not shown)
- Conclusions and future work

# NHC Best Track

- Best track values are intended to be "representative" values over a 6h interval3
  - Not instantaneous
- Intensity determined from variety of sources
  - Flight level winds and SFMR
  - Dvorak Estimates
  - Land and buoy observations

# Reality vs model

- At 10,000 ft, SFMR has a 50% power footprint with a diameter of 1.3km, (1% power = 2.8km)
- 10-s averages from SFMR are used to determine intensity operationally
  - Resulting footprint is smaller than the gridspacing of some models



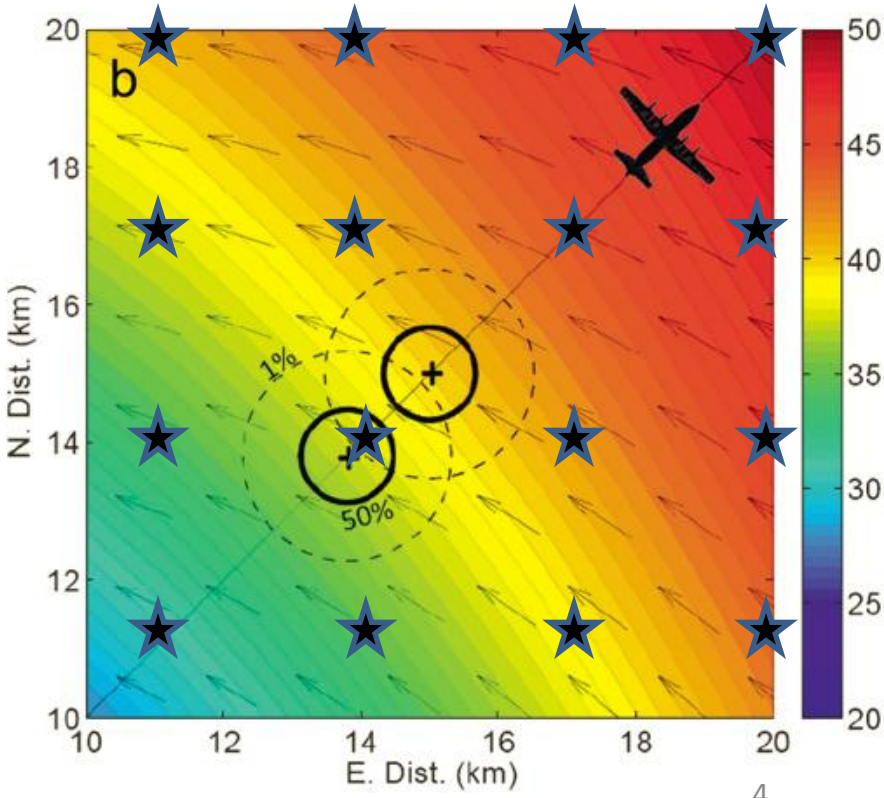



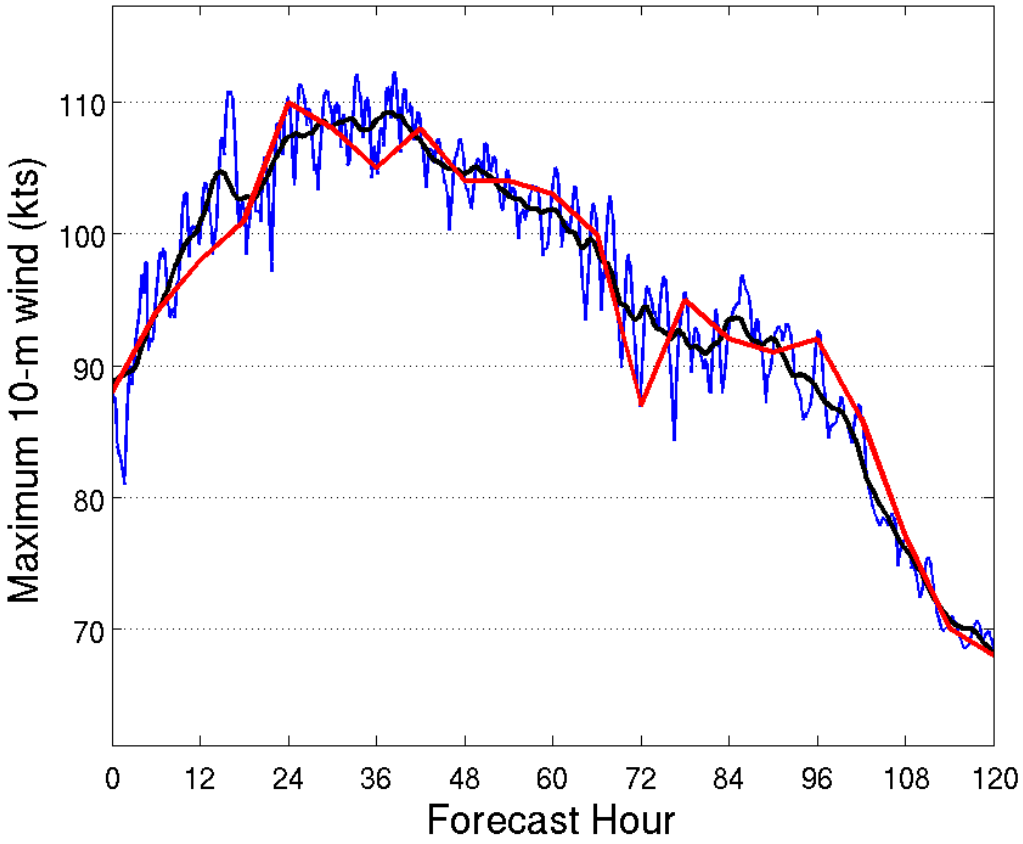

Figure 7 from Uhlhorn and Nolan 2012

# High Frequency (HTCF) Output

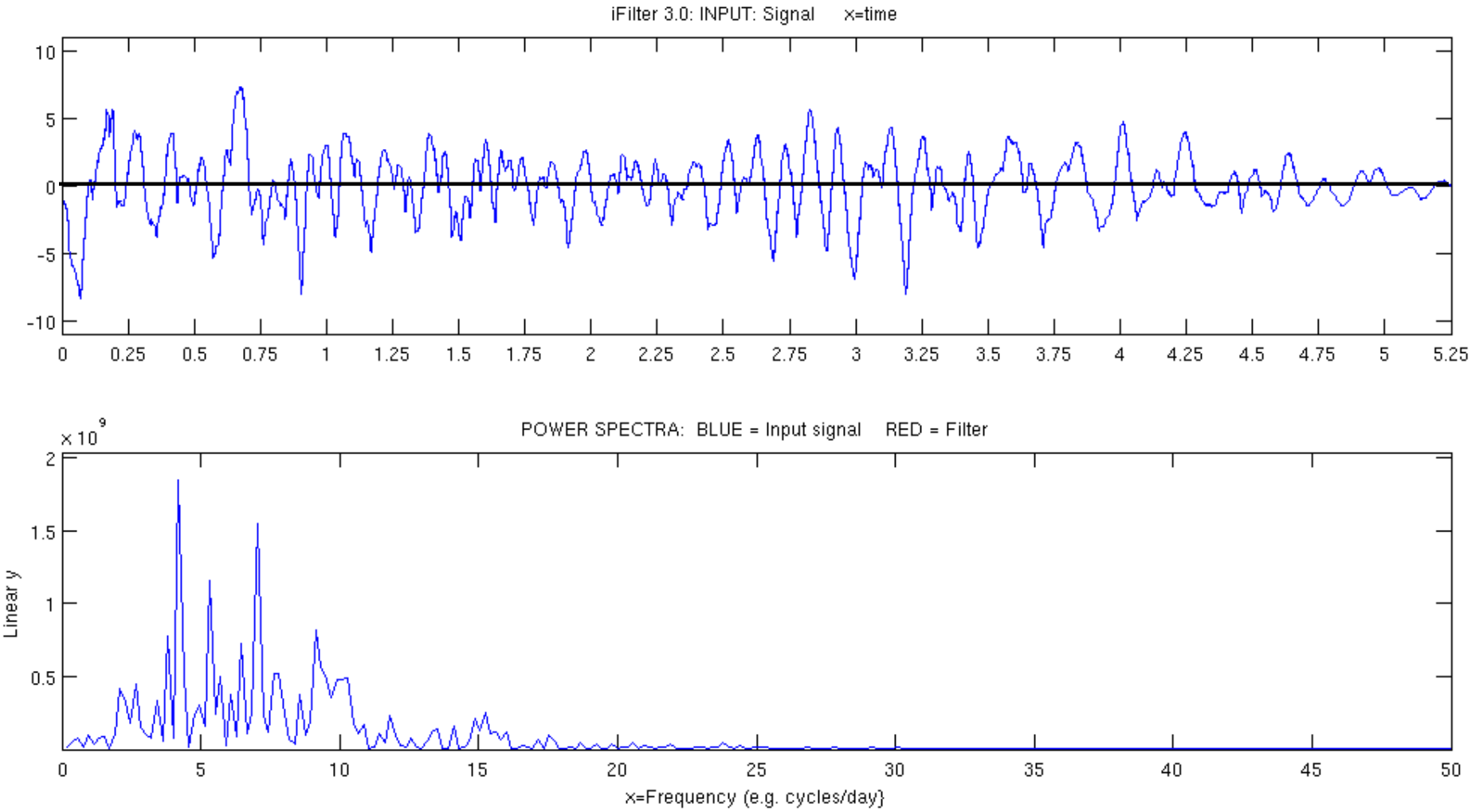
- Simple tracker run at every time step (nearly)
  - Maximum wind in inner-most domain
  - Minimum pressure in inner-most domain
  - Location of maximum wind, minimum pressure, and nest center
- 5 Cases Examined
  - Emily 05L 2011080200
  - Irene 09L 2011082400
  - Katia 12L 2011090500
  - Maria 14L 2011091200
  - Rina 18L 2011102400

# H212

- 3km horizontal gridspacing
- Instantaneous ATCF intensity



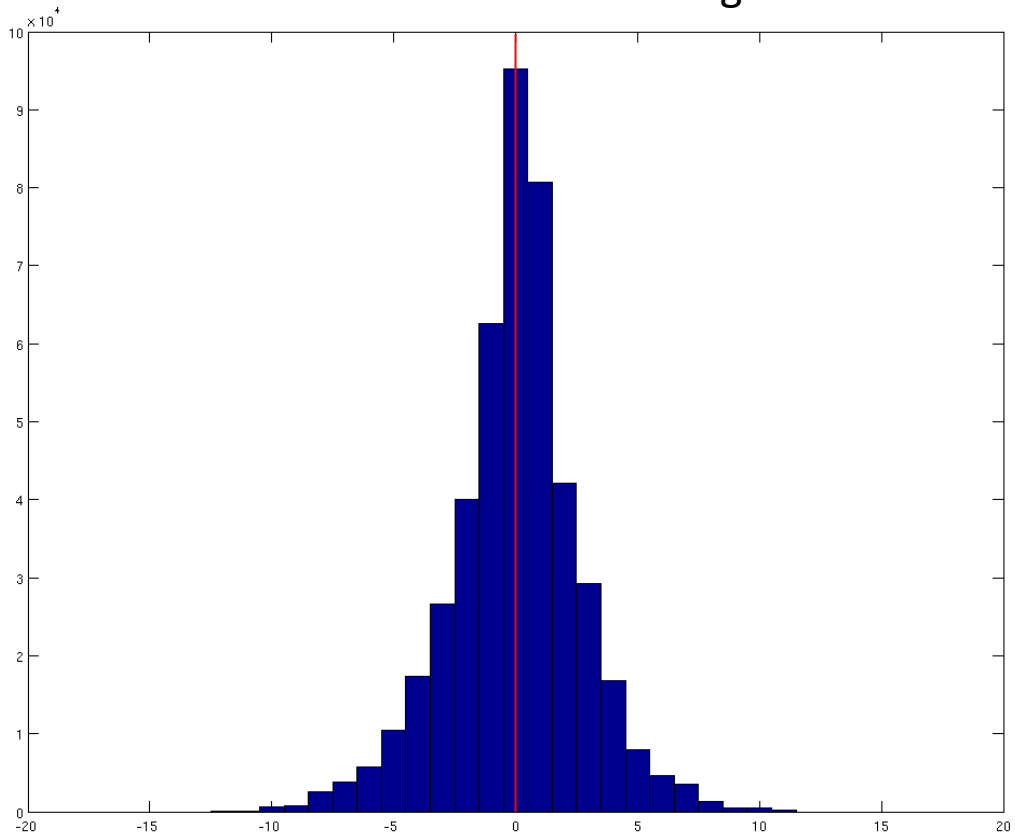
# H212 Spectral Analysis



# H212 Stats

- Intensity fluctuations occur primarily on a timescale of 3-8 hours
  - Longer than convective timescale (in reality)
- Instantaneous value is typically within 5 kts of the 6-hr mean, but difference can be as large as 10+ kts.

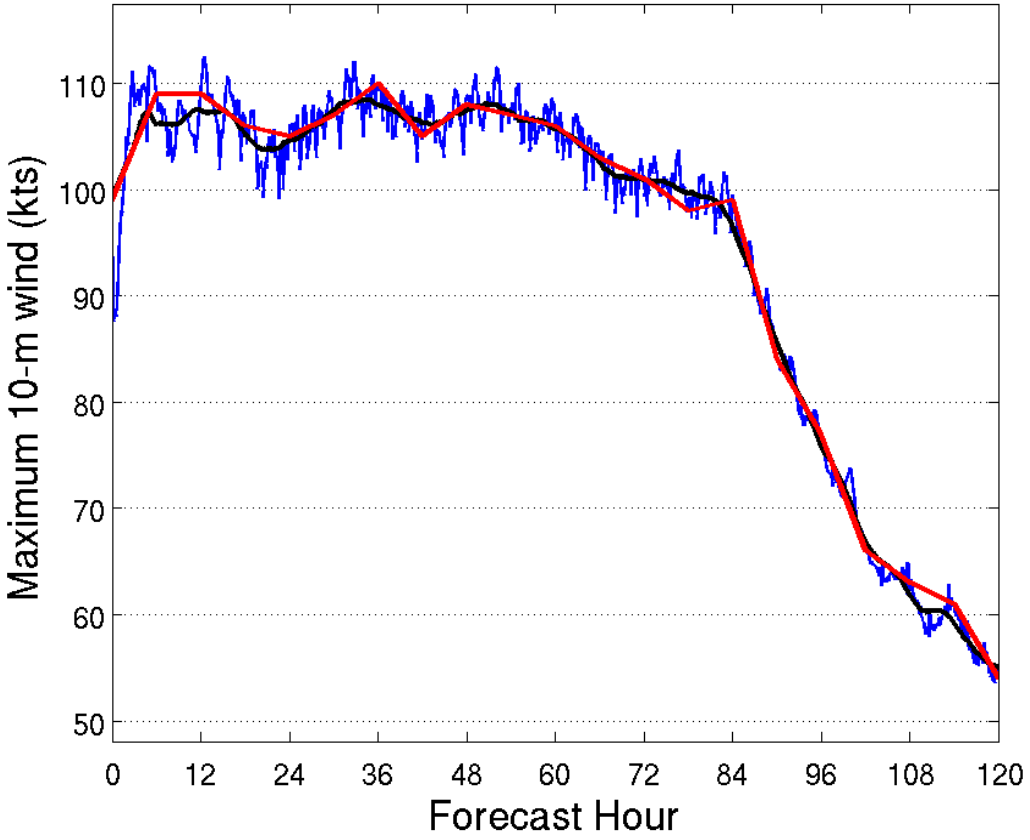
Difference: HTCF-6-hr running mean



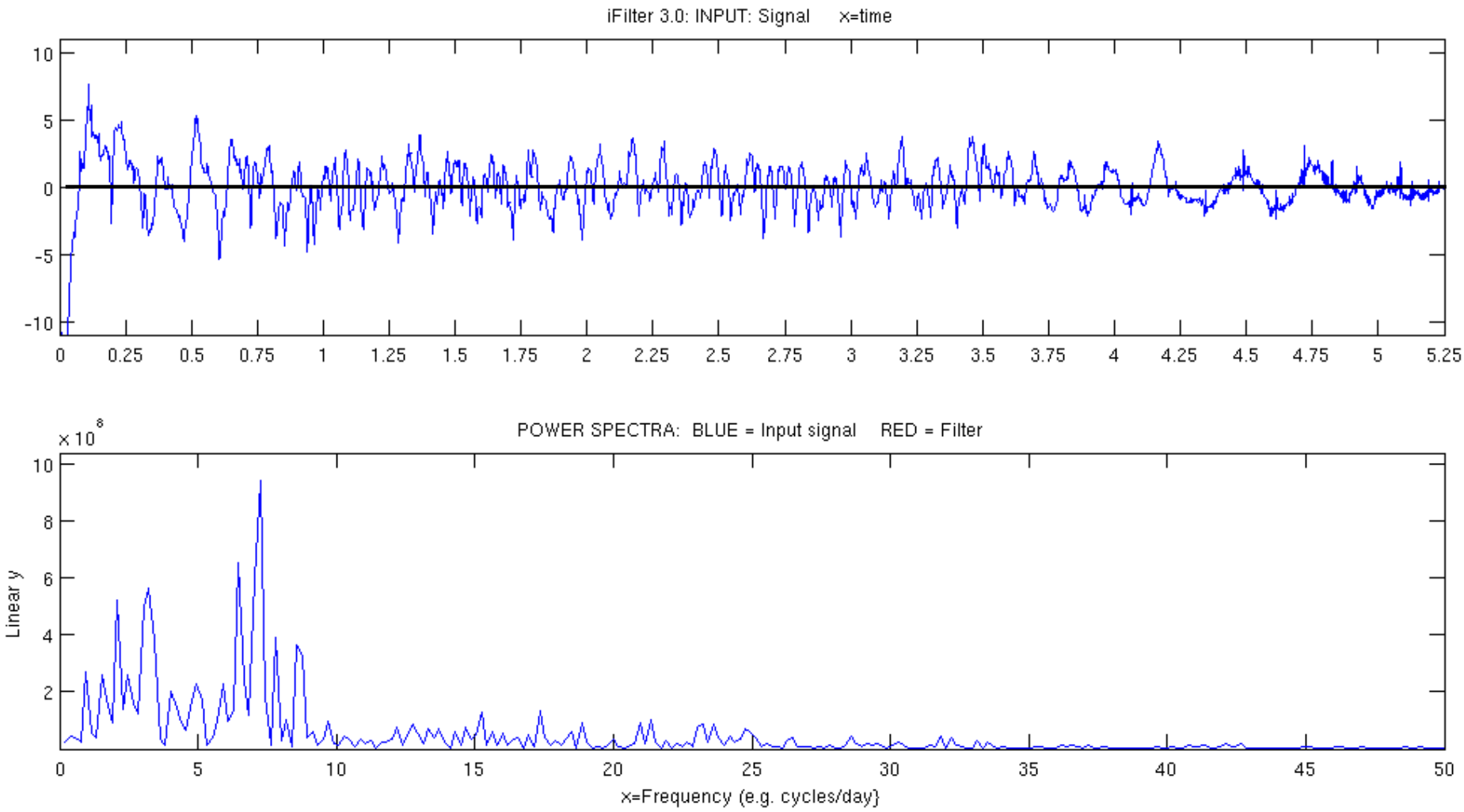

| Average | 2.0 |
|---|---|
| Standard Deviation | 2.7 |
| Maximum | 12.0 |

# HWF3

- 3km horizontal gridspacing
- Instantaneous ATCF intensity



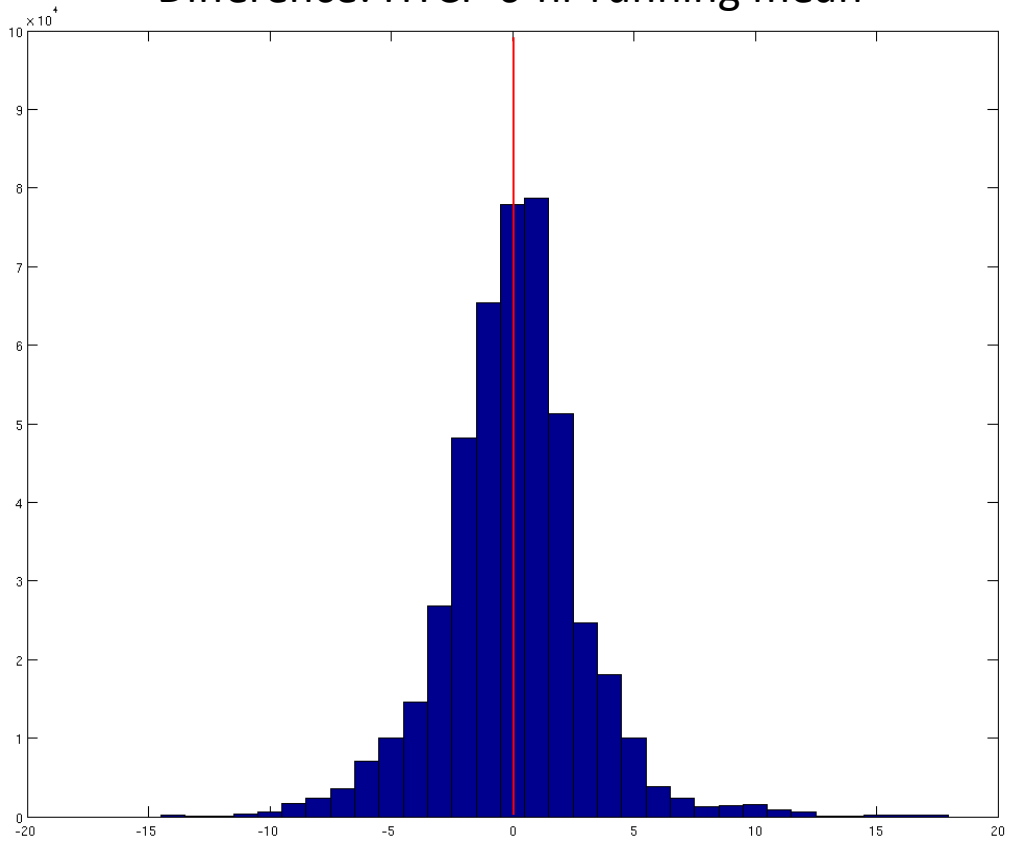
# HWF3 Spectral Analysis



# HWF3 Stats

- Like H212, intensity fluctuations occur primarily on a timescale of 3-8 hours
- Fluctuations are larger than H212
- Intensity is typically within 6 kts of the 6hr running mean, but can deviate by as much as 18kts (a full S.S. category)

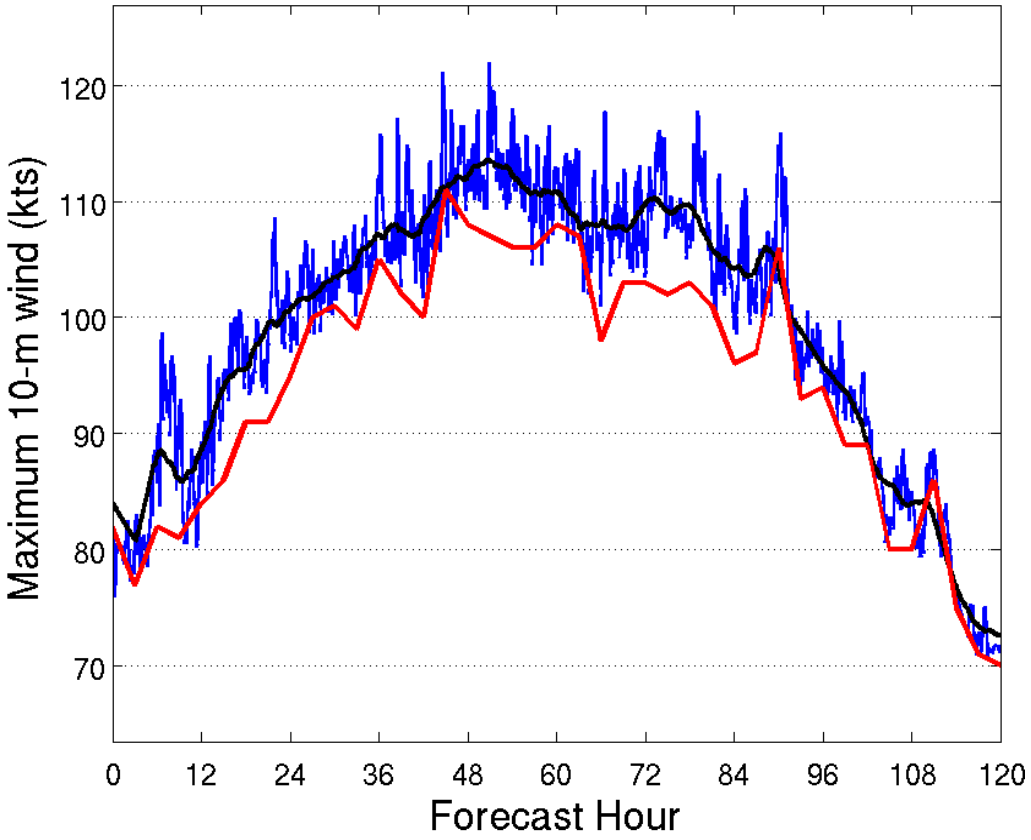
Difference: HTCF-6-hr running mean



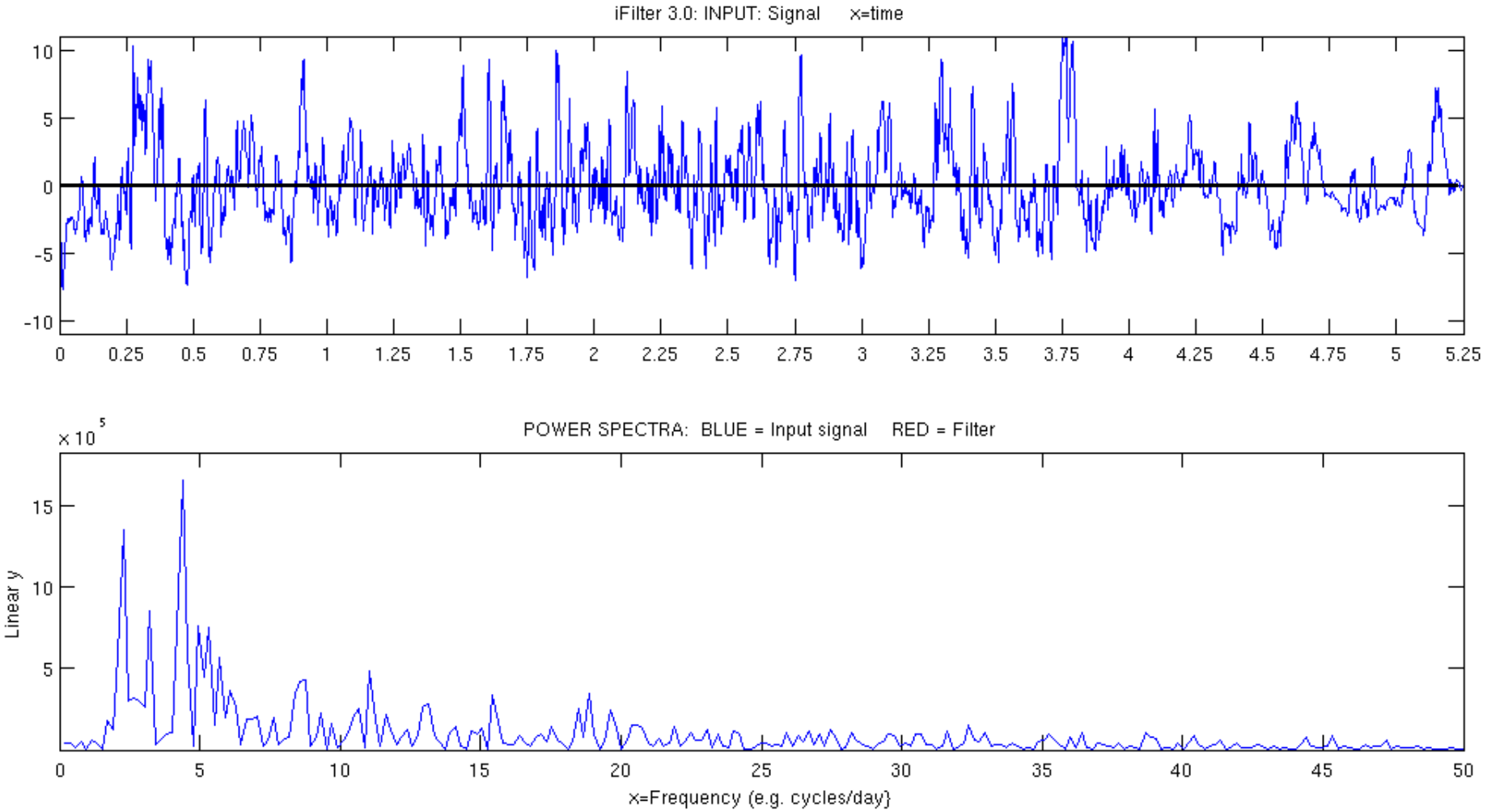

| Average | 2.1 |
|---|---|
| Standard Deviation | 2.9 |
| Maximum | 18.0 |

# AHW4

- 4km horizontal gridspacing
- Instantaneous, 12-km spatially averaged ATCF intensity



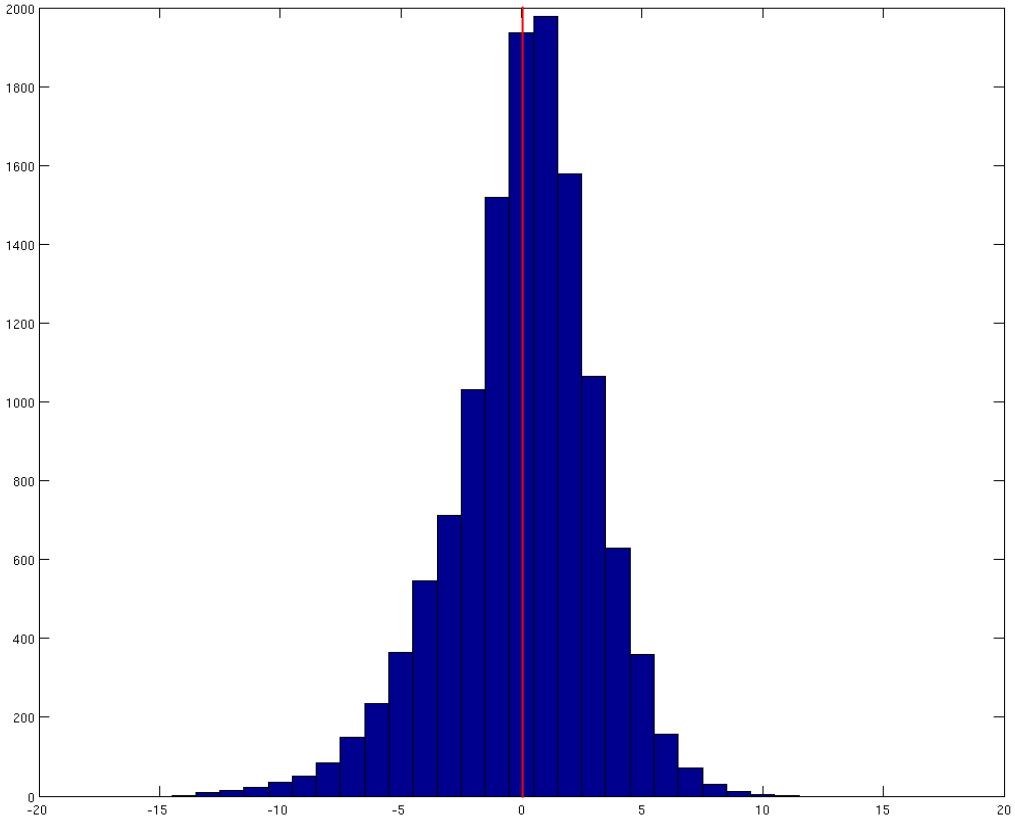
# AHW4 Spectral Analysis



# AHW4 Stats

- Like H212 and HWF3, intensity fluctuations occur primarily on a timescale of 3-8 hours
  - Larger contribution at higher frequencies
- Intensity is commonly within 6 kts of the running mean, however fluctuations as large as 14 kts were observed

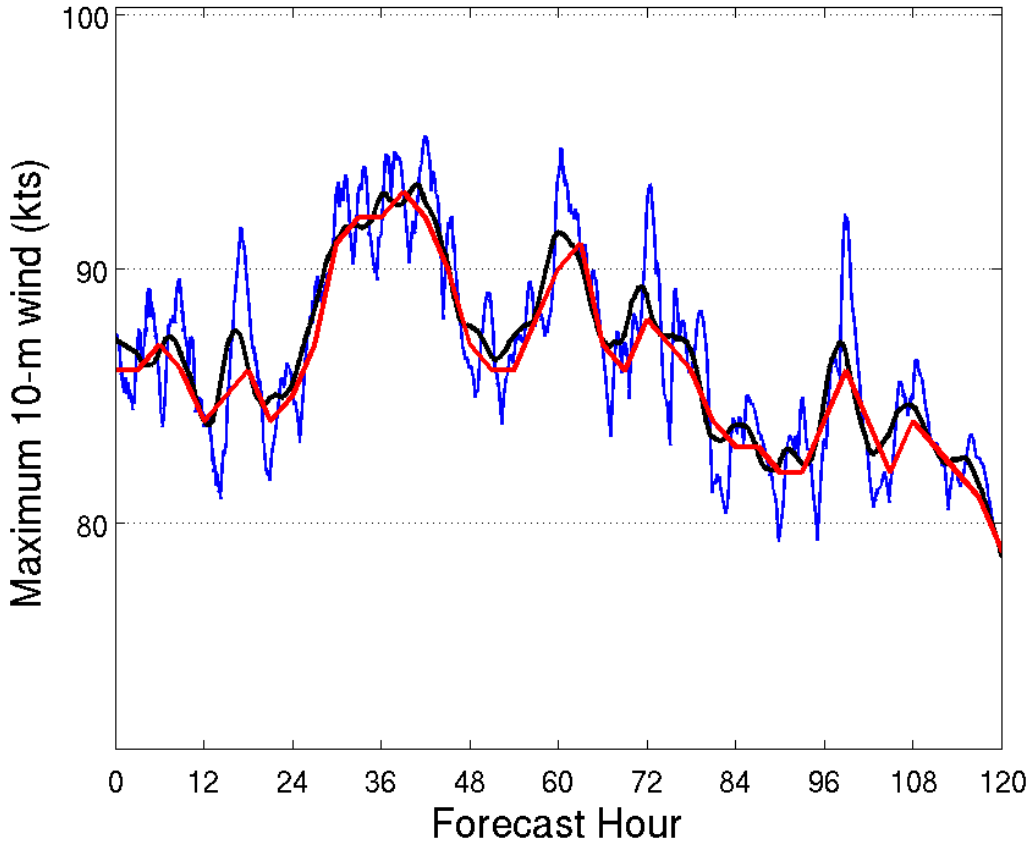
Difference: HTCF-6-hr running mean



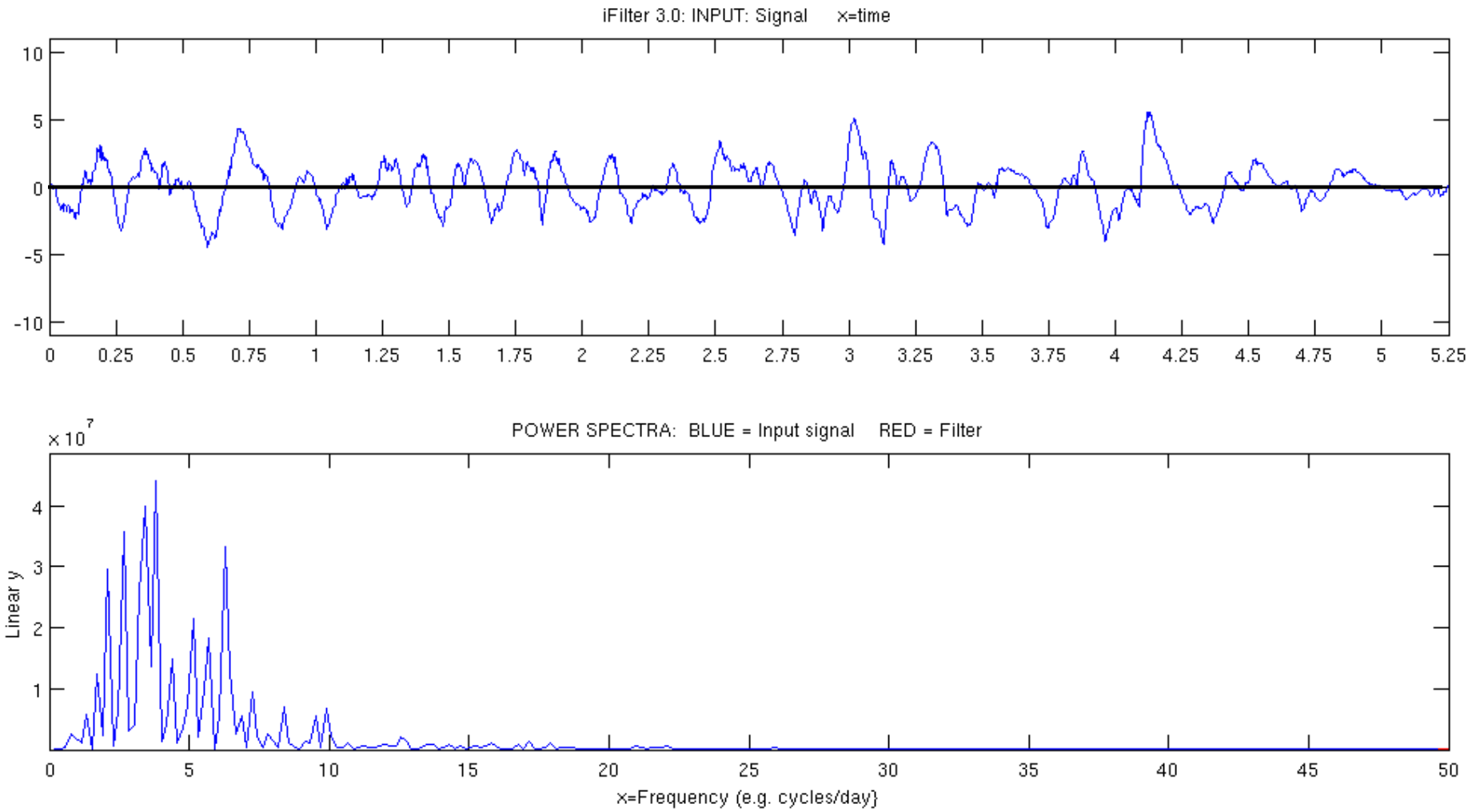

| Average | 2.3 |
|---|---|
| Standard Deviation | 3.0 |
| Maximum | 14.0 |

# UWN8

- 8km horizontal gridspacing
- 6 hour (+/- 3 hr) running mean ATCF intensity



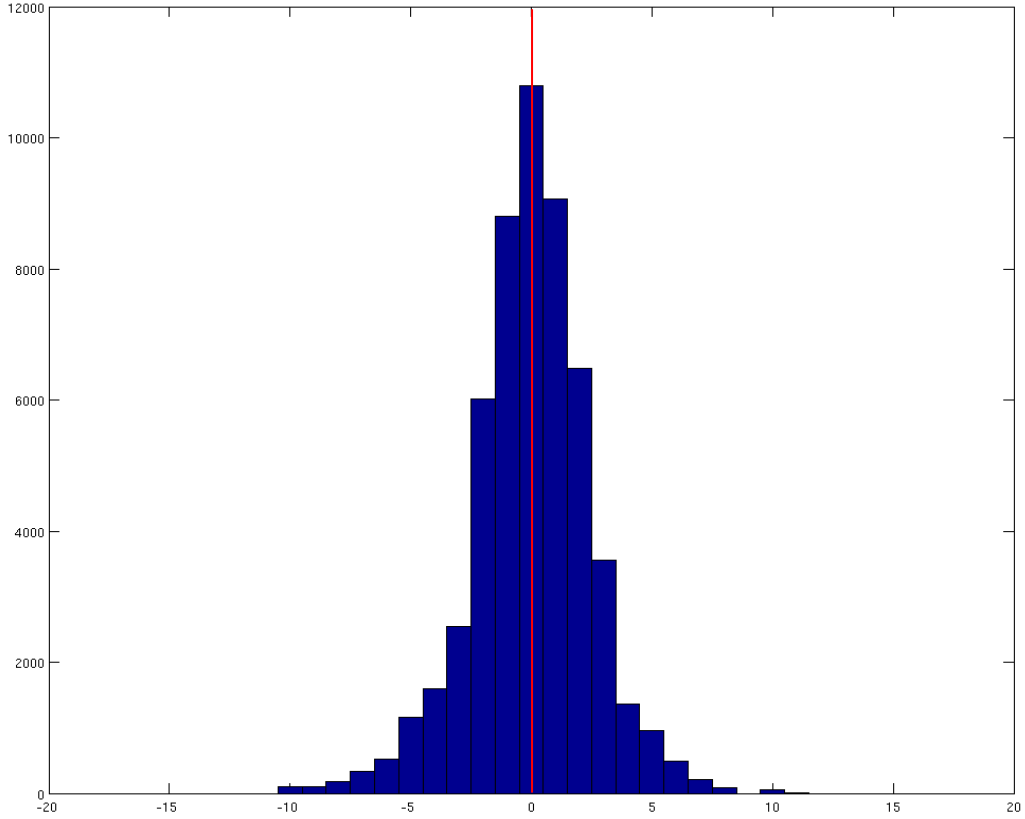
# UWN8 Spectral Analysis



# UWN8 Stats

- Intensity fluctuations occur almost entirely on a timescale of 3-8 hours
  - May be a function of gridspacing
- UWN8 has the smoothest intensity, and has the smallest difference between instantaneous intensity and the running mean

Difference: HTCF-6-hr running mean




| Average | 1.8 |
|---|---|
| Standard Deviation | 2.4 |
| Maximum | 10.6 |

# Conclusions

- ATCF output is not necessarily representative of what the model is predicting, or how NHC "observes" intensity
  - Methods such as spatial averaging may offset with the inherent under-sampling of real storms
  - How the tracker determines intensity has implications on model development and verification
- Variability of intensity is fairly consistent among models
  - HWF3 has the most variability
  - UWN8 has the least variability
- Fluctuations at timescales less than one hour appear to contribute very little to the variability of intensity
  - 15 minute output should be sufficient to resolve nearly all intensity fluctuations for operational applications ($4*\Delta T = 1$ hr)

# Next Steps

- Complete intensity analysis
- Inter-model structure comparisons
- Determine best way to display and share HTCF information
  - New HFIP products webpage

# Additional Experiments