



Diurnal and semidiurnal temperature modulations at SMB buoy

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Tidal vs. Meteorological forcing in SST at the SMB NOAA buoy



- Temperature measured by the Santa Monica Bay NOAA buoy has a strong diurnal modulation
- Is it tidal or meteorological?
- Test: tidal forcing is produced by the gravitational forces between the earth, sun and moon. Meteorological should be related to only the solar day via either direct heating or wind related to differential heating

Implementation



- For very long time series, solar and lunar tides, and the solar day can be resolved. Temperature modulations can be compared to the separated solar and lunar frequencies.
- Meteorological forcings will correspond to the solar day. Tidal forcing will correspond to both the lunar and solar tides.
- Need at least 8000 hours of data to separate the diurnal frequencies, less for harmonic separation of the semidiurnal frequencies
- Fourier transform long time series and compare frequencies

Major tidal frequencies



K_1	Lunisolar	23.935 hr	0.04178 hr^{-1}
O_1	Principle lunar	25.819	0.03873
P_1	Principle solar	24.066	0.04155
Q_1	lunar	26.868	0.03722
M_2	Principle lunar	12.421	0.08051
S_2	Principle solar	12.000	0.08333
N_2	Lunar elliptic	12.658	0.07900
K_2	Lunisolar	11.967	0.08356

Data set

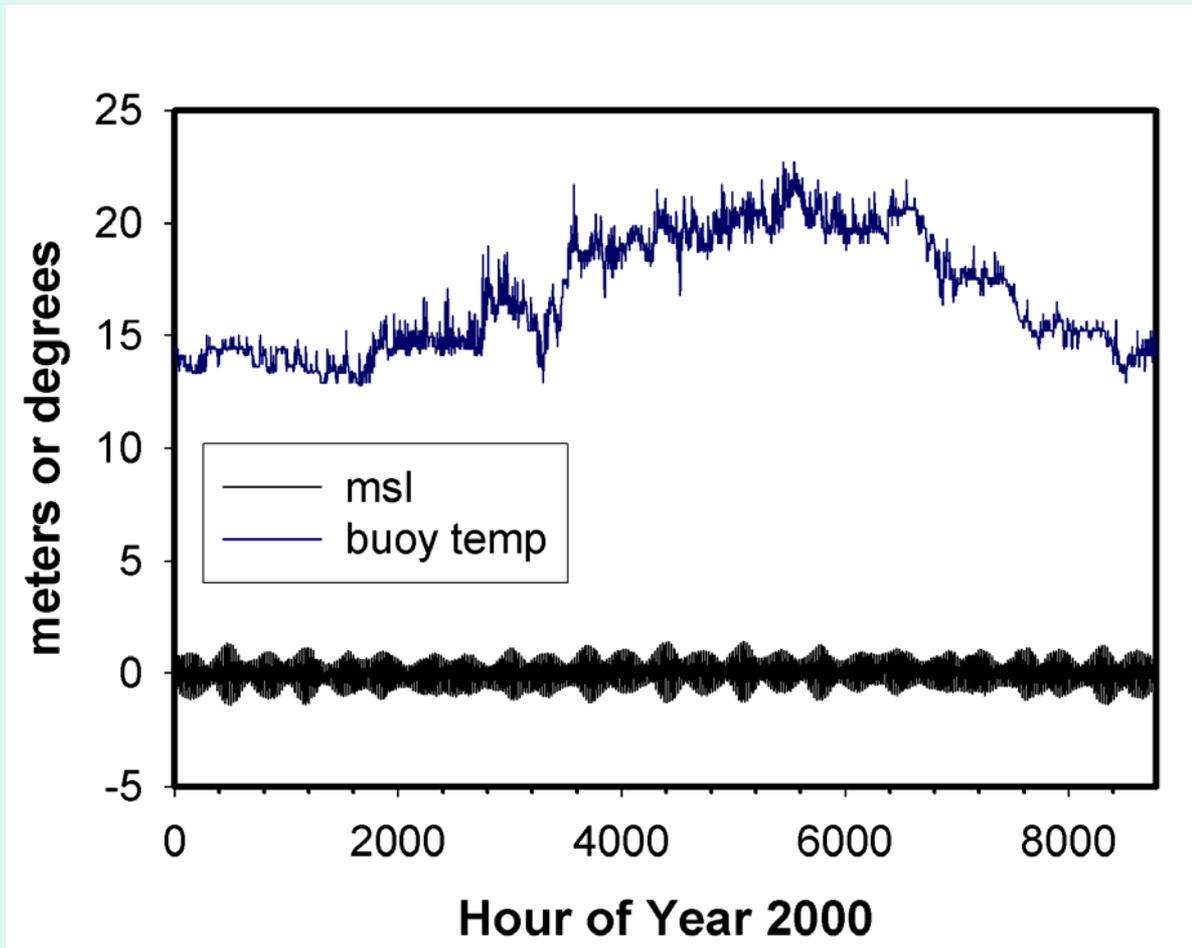


- Hourly samples for all of year 2000 (8784 hours)
 - Temperature from NOAA Buoy
 - Buoy 46025
 - Mean sea level (msl) from Outer LA Harbor
 - Station 9410660

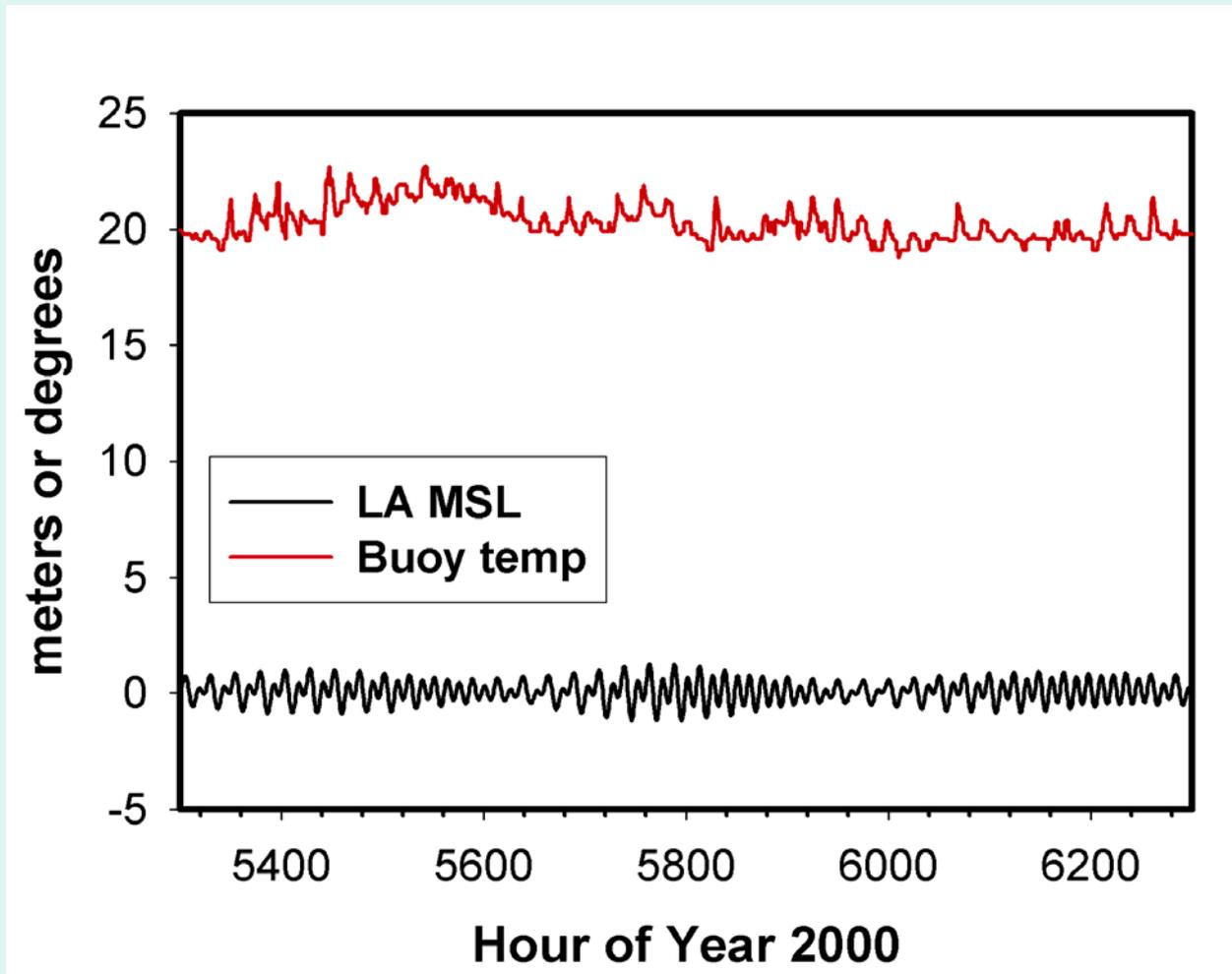
Data



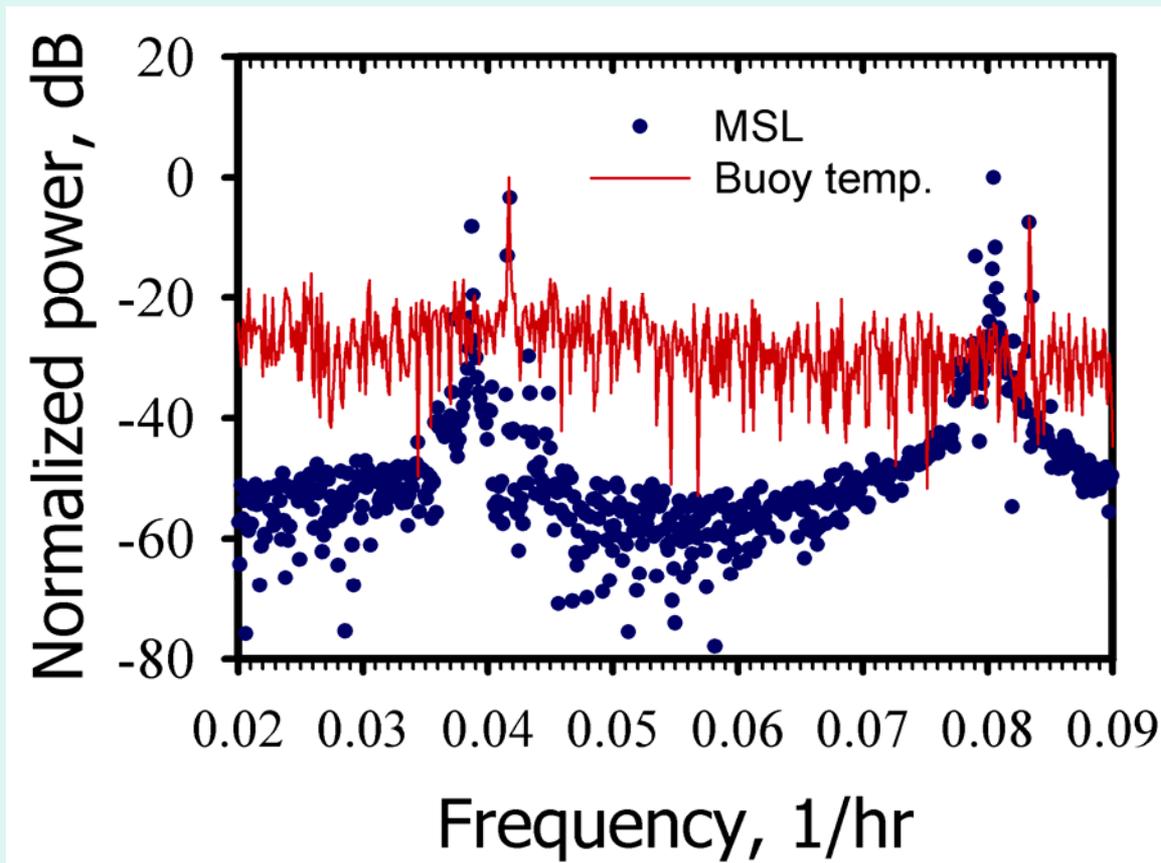
LA Harbor MSL and Buoy Temperature



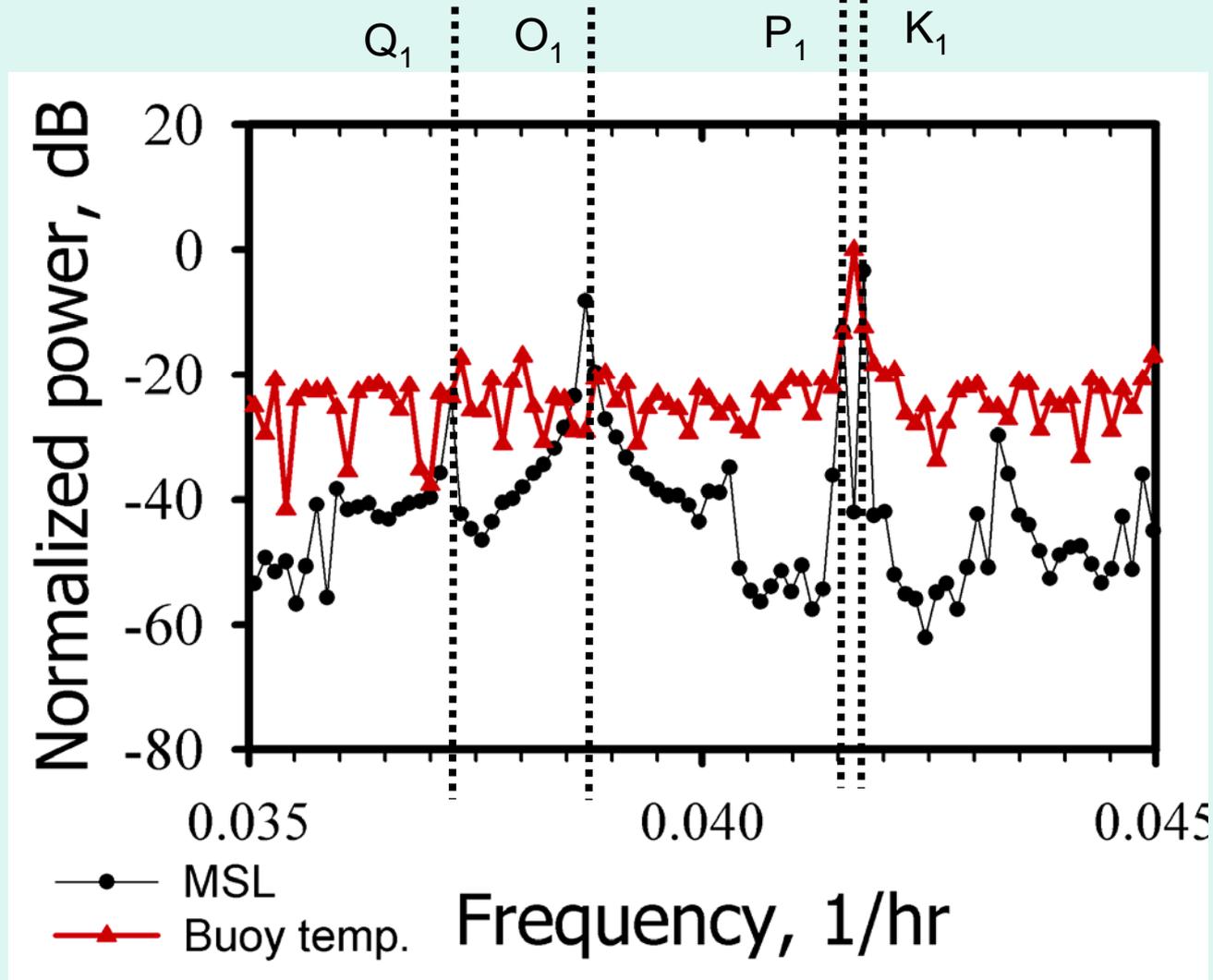
Expanded view of buoy temperature and harbor msl



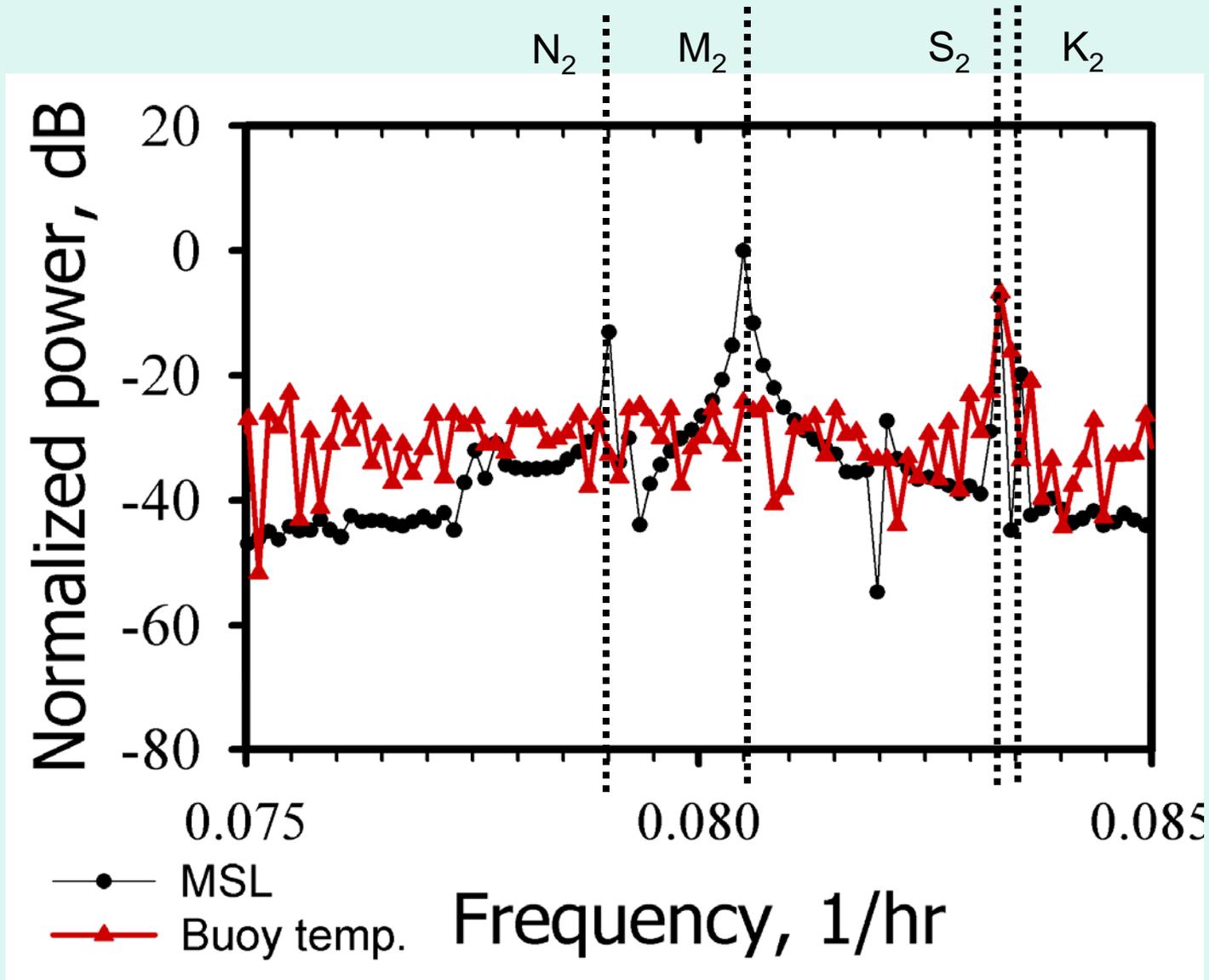
Power spectral density for year 2000, sea level and buoy temperature



Diurnal tides and temperature

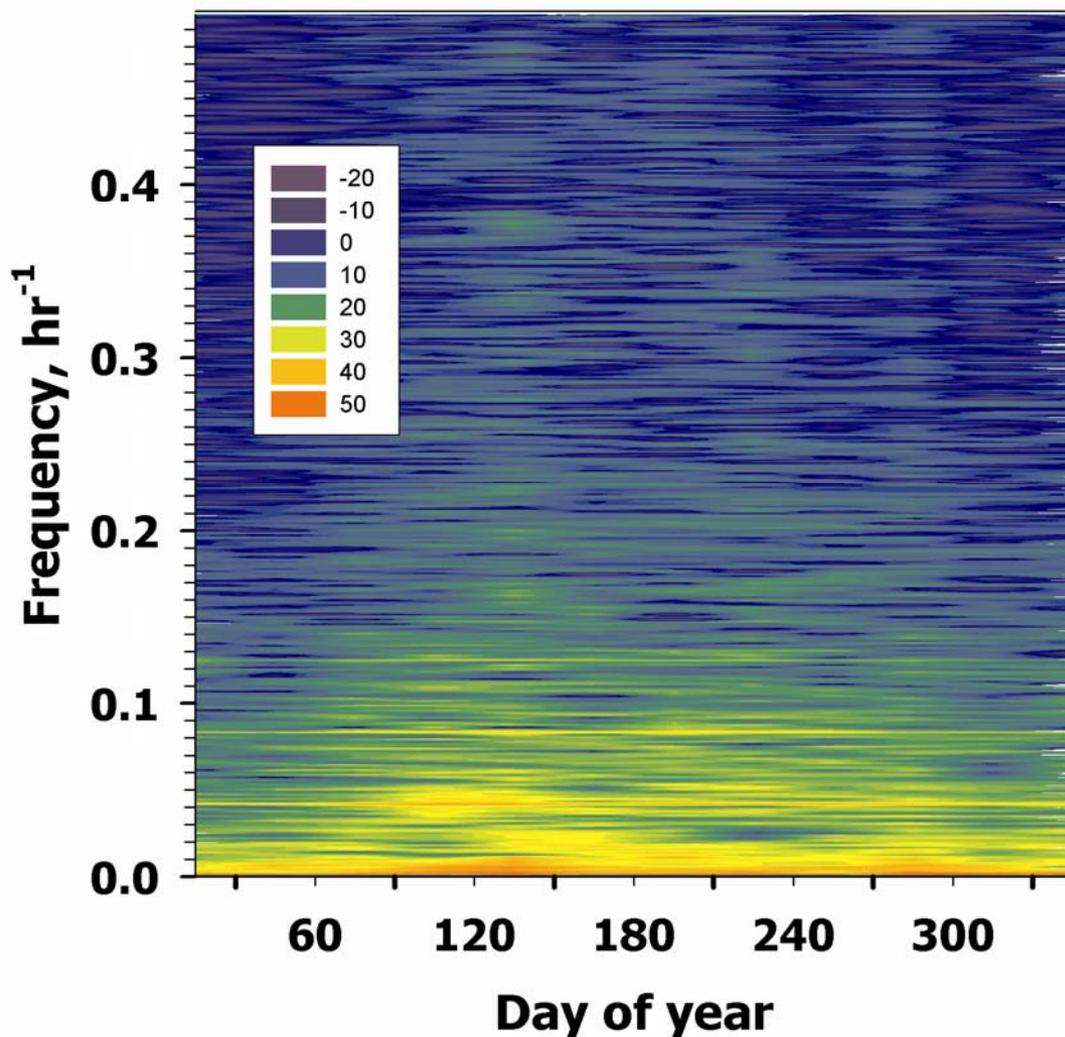


Semidiurnal tides and temperature



Buoy Temperature Spectrogram

Year 2000



Spectra computed from
12 720-hour contiguous
interval

← 8 hr

← 12 hr

← 24 hr

Analysis



- Meteorological effects are expected to have the periodicity of the solar day (24 hours).
- Tidal periods differ slightly from the 24-hr period.
- High-resolution analysis indicates that the temperature modulations are not at tidal frequencies, but at solar day frequencies and its harmonics

Conclusions



- Temperature fluctuations at the SMB NOAA buoy are at solar insolation frequencies, not lunar tidal frequencies, implying a meteorological forcing to the buoy SST.