

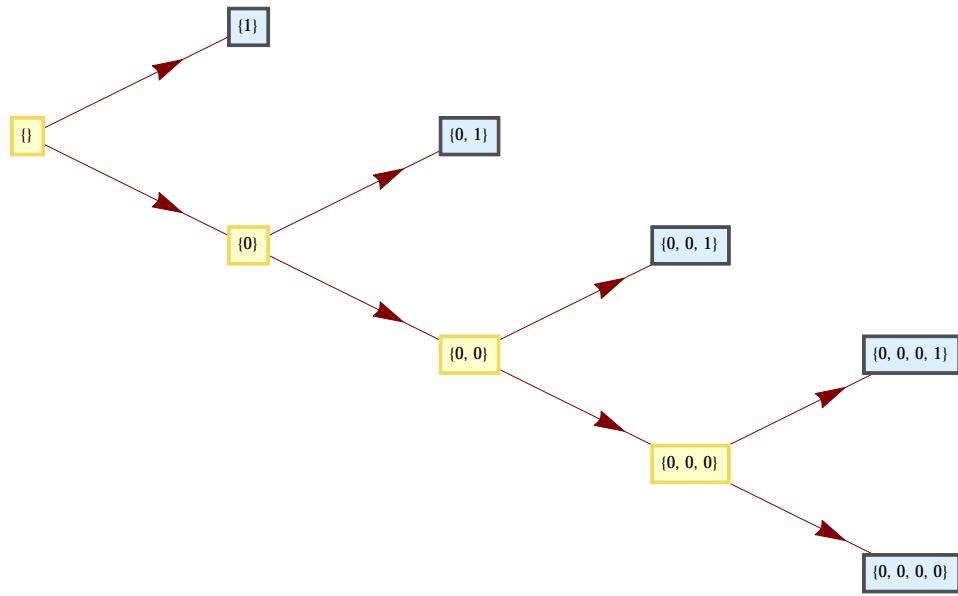
# Nino34 1870-2013: Wavelet Analysis

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Source: [http://www.esrl.noaa.gov/psd/gcos\\_wgsp/Timeseries/Data/nino34.long.data](http://www.esrl.noaa.gov/psd/gcos_wgsp/Timeseries/Data/nino34.long.data)

```
1870  25.58  26.16  26.31  27.19  28.05  26.61  26.19  25.99  26.22  25.82  25.86  25.79
1871  26.33  26.18  26.83  27.27  27.16  27.16  26.62  26.54  26.51  26.40  26.35  26.01
...
2013  26.16  26.36  27.12  27.69  27.59  27.36  26.94  26.59  26.66  26.49  26.64  26.50
```

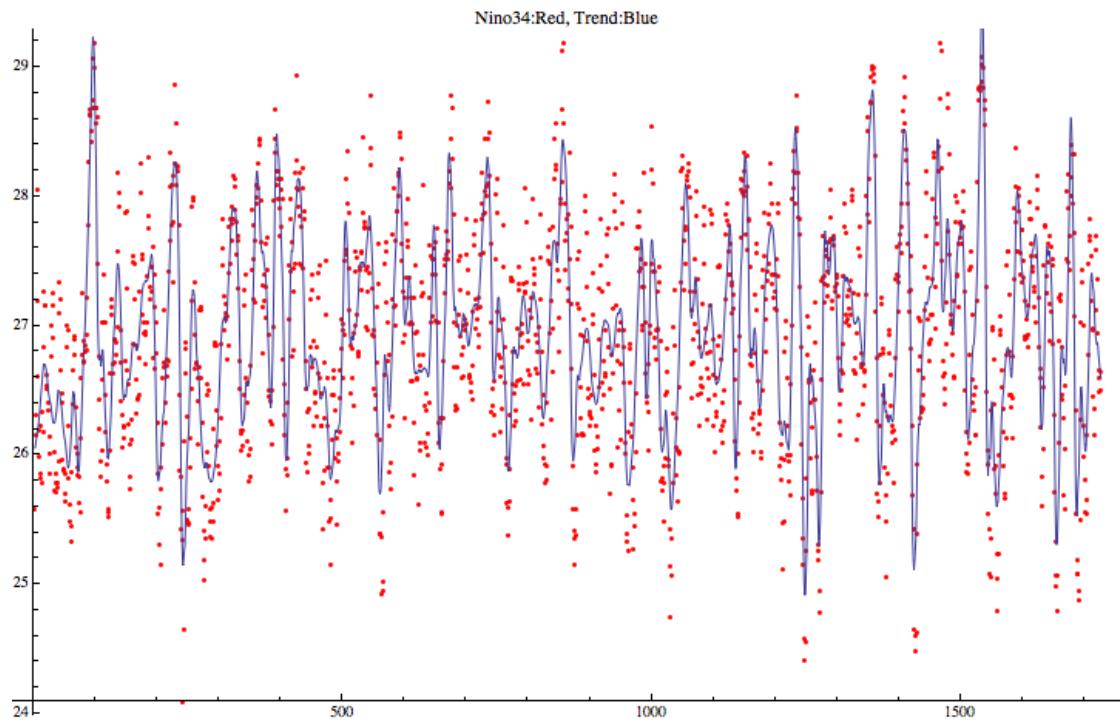
Daubechies Wavelet [4]



Energy Function indicates {0,0,0} as the Trend:

```
{1} → 0.0000247928, {0, 1} → 0.000101315, {0, 0, 1} → 0.000211335,
{0, 0, 0, 1} → 0.000207313, {0, 0, 0, 0} → 0.999455
```

Right-most x-axis 2013, left-most 1870, 12 months per year, **total of 1728 months**:



# Scalogram

From Kleem paper:

## Stochastic theories for the irregularity of ENSO

The wavelet is reported to be Morlet:

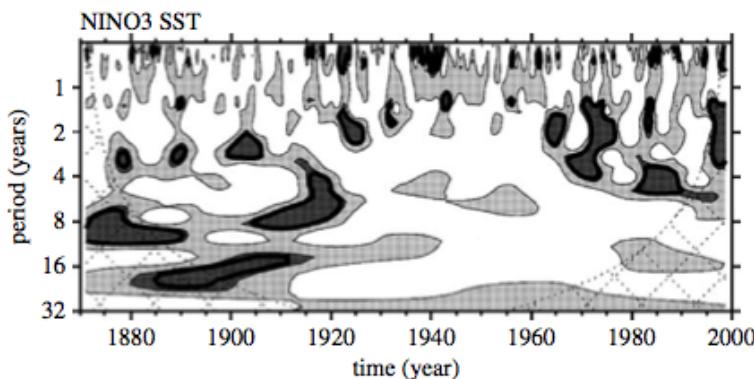


Figure 2. Wavelet analysis of the time-varying spectrum of the NINO3 SST index. Adapted from the work of Torrence & Webster (1999).

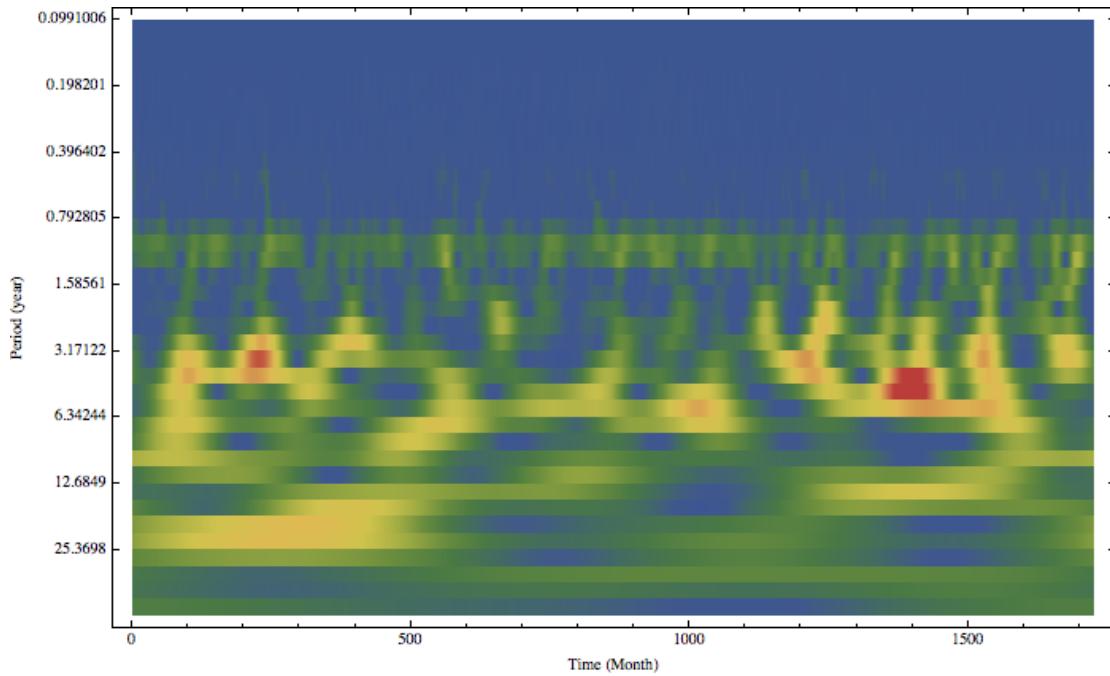
The SST data can be extended back in time to the mid-nineteenth century using global EOFs to fill data-sparse regions that are prominent in the deep tropics before 1950 (e.g. Rayner *et al.* 2003). While the basic qualitative structure of the spectrum does not change much (see below), it is interesting to note, however, that there are significant decadal variations in the details. This is illustrated in figure 2, adapted from Torrence & Webster (1999), where a wavelet analysis technique has been used to extract time variations in the spectrum over the past 100 years or so. Given the apparently rather significant decadal variations, one must show a little caution in assigning the reliable but short data in figure 1 a definitive status. Note also that well-defined, rather narrow spectral peaks can occur in the data from time to time but are not persistent over the entire record.

**Remark:** Wavelets below are not padded, thus similar to the paper above.

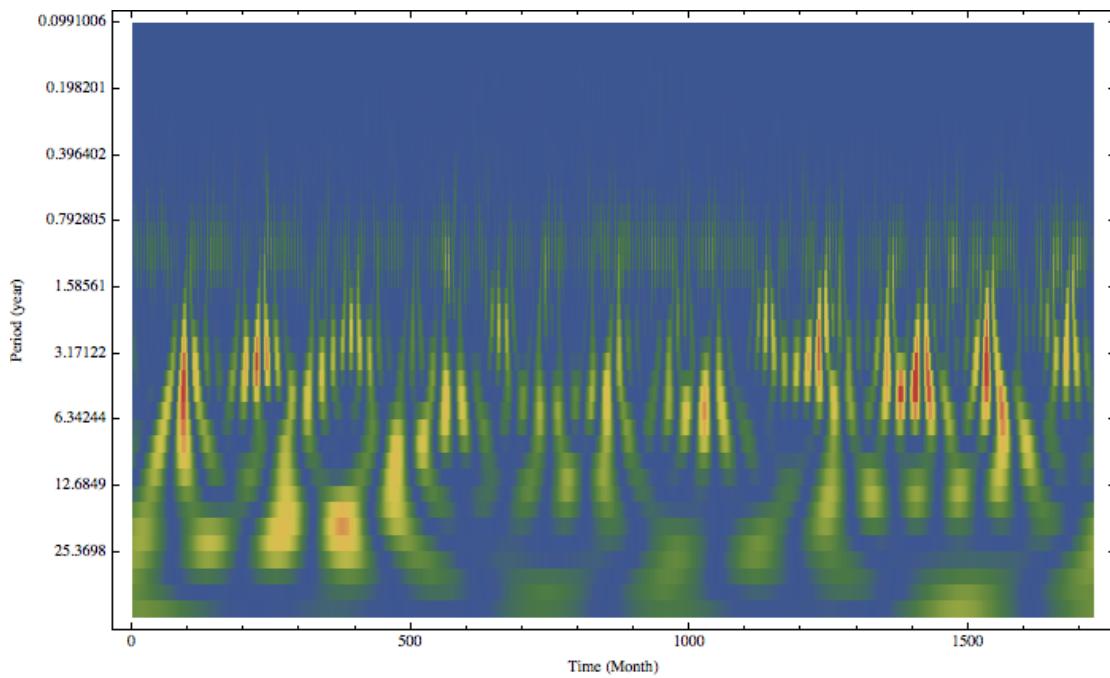
Color Scheme: Blue Min, Red Max



**Morlet Wavelet**



**DGaussian Wavelet [4]**



**Gabor Wavelet [4]**

