Cumulation, crash, coherency: A cryptocurrency bubble wavelet analysis:

Analysis on structural changes in Bitcoin/USD after price peaking during 2017 and falling by almost 50% in a month.
provide detailed visualizations with high time-frequency resolution of co-movement dynamics and conduct an extensive sensitivity analysis demonstrating the robustness of our statistical findings.

Data:
5 min daily data(288 samples per day) recorded from 11/01/2017 till 05/04/2018 (~16 months, ~138240(16*30*288) size of dataset) for ten cryptocurrencies traded at the Bittrex exchange.

Wavelet analysis:
A wavelet Ψ(t) fulfills the following two conditions:

- The first condition, admissibility, implies a zero mean.
- The second condition ensures that the wavelet is localized both in time and frequency space

$$\int_{-\infty}^{+\infty} dt\Psi(t) = 0$$
$$\int_{-\infty}^{+\infty} dt|\Psi(t)|^2 = 1$$

Make use of the Morlet wavelet, as it offers good temporal and spectral resolution.
The Morlet wavelet is defined as

$$\Psi_0(\eta) = \pi^{-1/4} e^{i\omega_0\eta} e^{-\eta^2/2}$$

where η is dimensionless time, and ω0(chosen to be 6 to satisfy admissibility condition) is dimensionless frequency

All wavelet coherence plots depicted in the present article were generated using the Cross Wavelet and Wavelet Coherence Toolbox

Volatility:
Determination of volatility based on previous 5 hours data(12*5 = 60 data points).

$$S_k = \sqrt{\frac{1}{59}\sum_{i=k}^{k+60} |\mu_i - P_i|^2}$$

where μk is the moving average that is defined to be(60 frame moving average)

$$\mu_k = \frac{1}{60} \sum_{i=k}^{k+60} P_i$$

Average True Range (ATR) indicator in Trading view, Moving Average(MA) which demonstrates these standard deviation and moving averages.

Normalization:

$$\widehat{P}_k = \frac{P_k - \mu_k}{S_k},$$

μk is moving average, Pk is time series price, Sk is standard deviation.