Wavelet Analysis Documentation

Release 1

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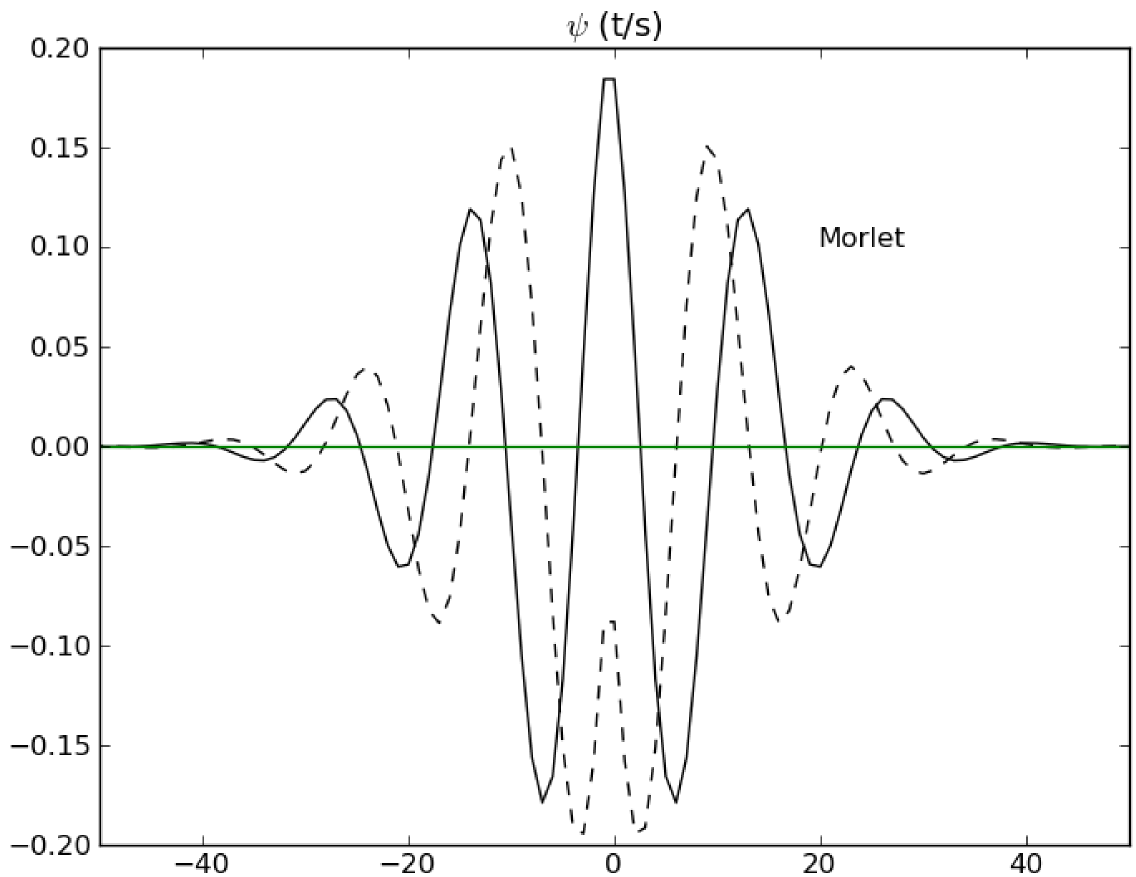

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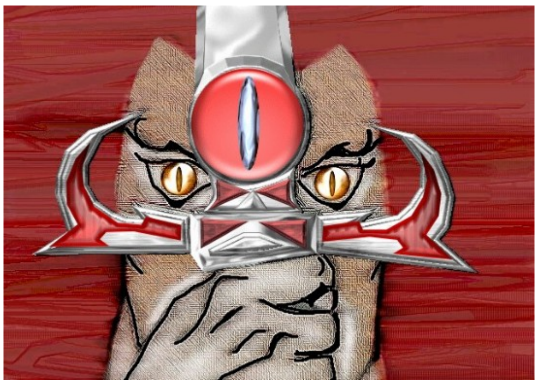
Contents:

CHAPTER 1

Eye of Thundera



"Eye of Thundera - give me sight beyond sight".

When Lion-O's friends were in danger, he invoked the power of Thundera through the Sword of Omens. The sword has the mystical Eye of Thundera, that gave to Lion-O the sight beyond sight.

Wavelet analysis is similar to the Eye of Thundera, in the sense that it'll give you the power to localized a pulse in frequency and time domain - sight beyond stationarity.

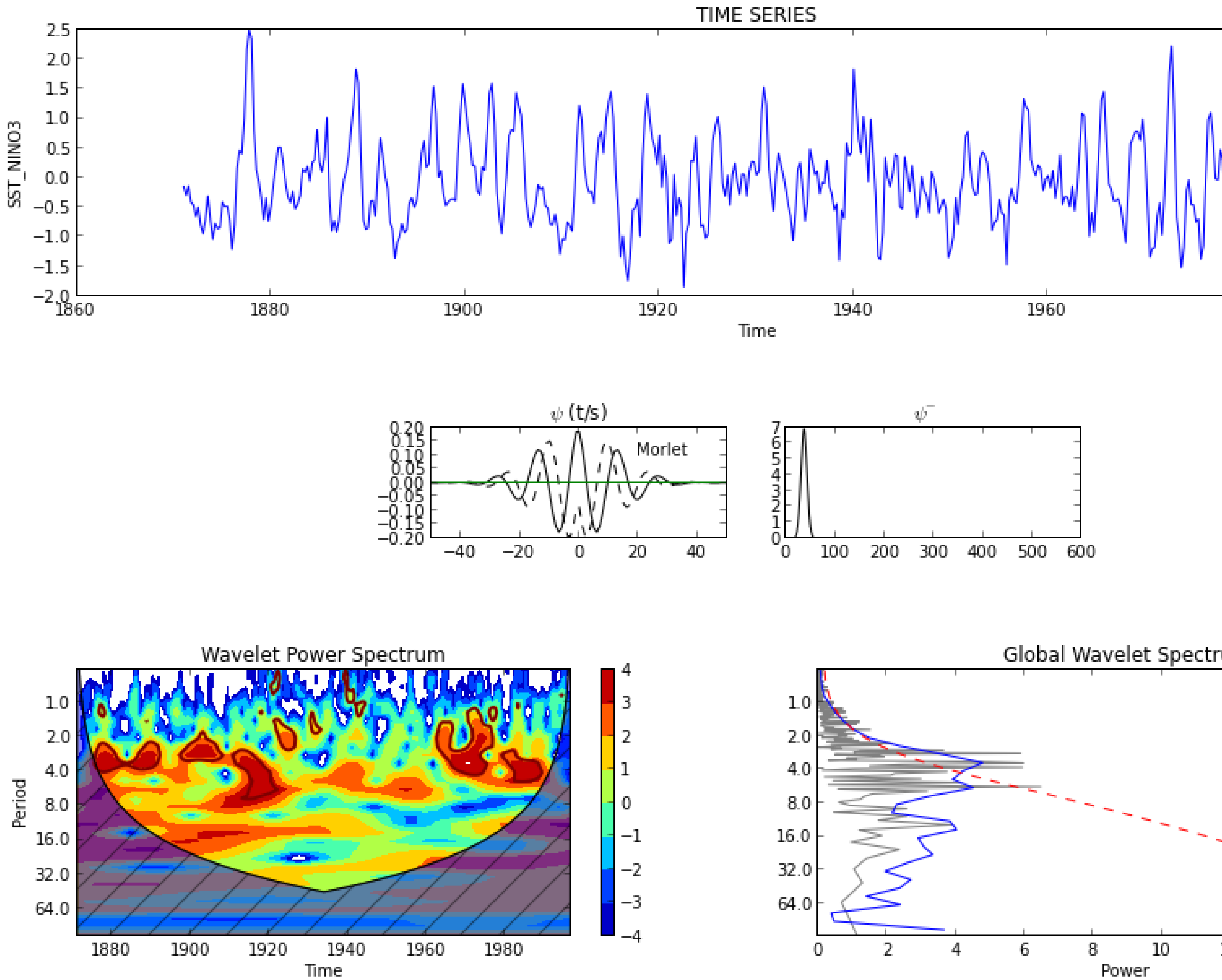
This guide includes a Continuous Wavelet Transform (CWT), significance tests from based on Torrence and Compo (1998) and Cross Wavelet Analysis (CWA) based on Maraun and Kurths(2004).

CHAPTER 2

Examples

2.1 Continuous Wavelet Transform (CWT) Niño3 SST

This is the final result:



How can anyone turn a 1D to 2D information? The code will explain to you!

The code is structed in two scripts:

- lib_wavelet.py : python's functions library
- wavetest.py : call functions and plot

```
              +----------------+
              |   wavetest.py   |
              +----------------+
                     |
             +----------------+
             | lib_wavelet.py |
             +----------------+
                     |
+----------------+  +----------------+
|  def wavelet    |--| def wave_signif|
+----------------+  +----------------+
```

```
                    |
+-----------------+  +-----------------+
| def nextpow2    |--| def wave_bases |
+-----------------+  +-----------------+
```

Note: The Morlet wavelet is used as default in this code.

Building the puzzle ...

2.1.1 Why/when should I use the wavelet analysis

The wavelet analysis is used for detecting and characterizing its possible singularities, and in particular the continuous wavelet transform is well suited for analyzing the local differentiability of a function (Farge, 1992).

"Therefore the wavelet analysis or synthesis can be performed locally on the signal, as opposed to the Fourier transform which is inherently nonlocal due to the space-filling nature of the trigonometric functions. " (Farge,1992).

	Fourier	Wavelet
context	sound	image
character	stationary	nonstationary
to see	global features	singularities

Choose the right glasses for what you want to see !

2.1.2 More info:

Informações
www.wavelet.org
www.wavelet.ens.fr
www.sbmac.org.br/comAnalise5.php
www.lac.inpe.br/wwlet
dmsun4.bath.ac.uk/resource/warehouse.htm
www.unistuttgart.de/iag/
www.cosy.sbg.ac.at/~uhl/wav.html
norum.homeunix.net/~carl/wavelet/
ftp.nosc.mil/pub/Shensa/Signal_process/
Softwares
www.amara.com/current/wavesoft.html
www-rocq.inria.fr/scilab/contributions.html
www-dsp.rice.edu/software/rwt.shtml
www-stat.stanford.edu/~wavelab/
www.stats.bris.ac.uk/~wavethresh/software
paos.colorado.edu/research/wavelets/software.html

Fonte: Domingues (2012)

2.1.3 Papers:

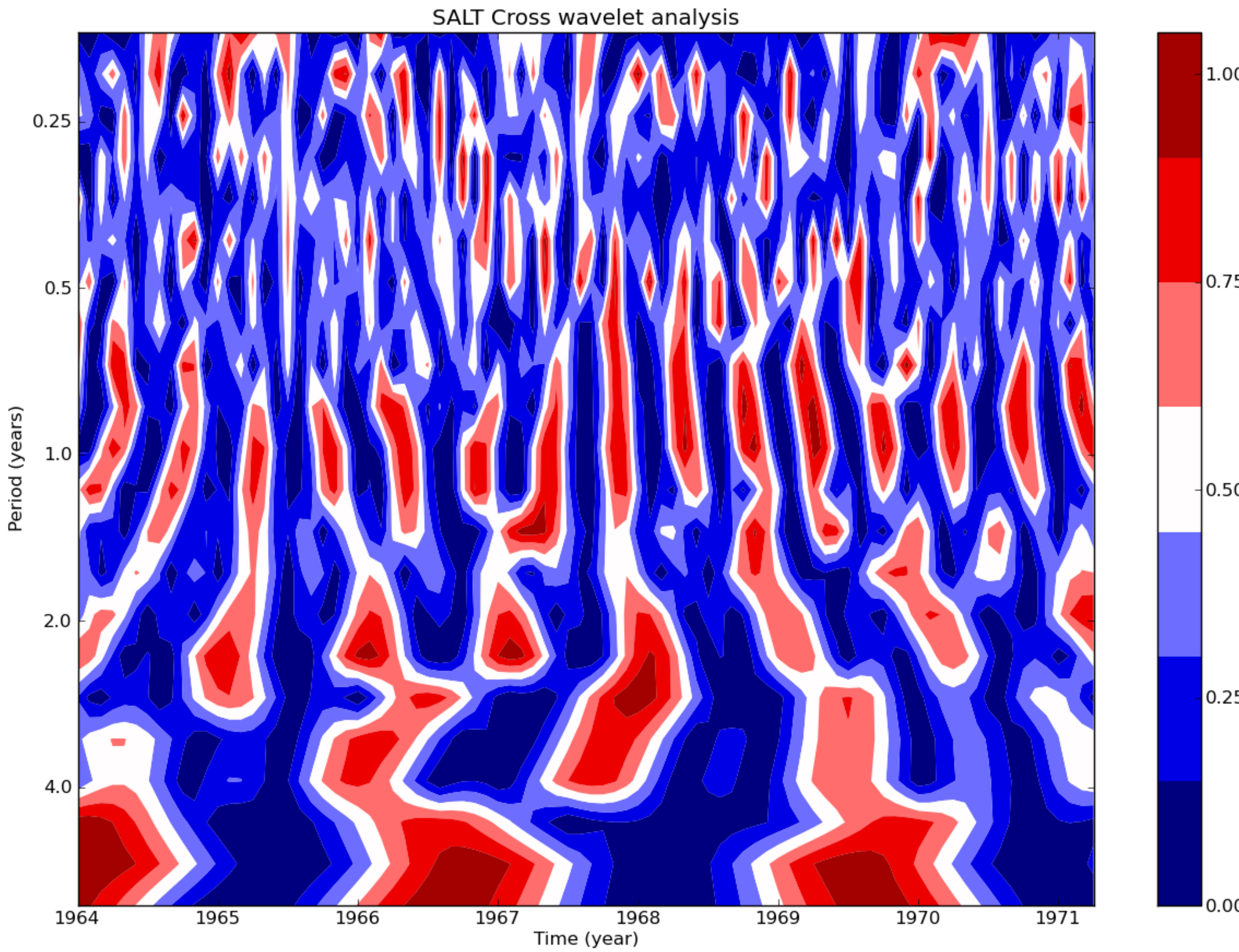
Farge, M. 1992. Wavelet transforms and their applications to turbulence. Annu. Rev. Mech., 24: 395-457

Domingues, M. O.; Kaibar, M.K. 2012. Wavelet biortogonais. Revista brasileira de Ensino de Física,n.3, 34: 3701

2.2 Cross Wavelet Analysis (CWA)

A normalized time and scale resolved measure for the relationship between two time series x(ti) and y(ti) is the wavelet coherency (WCO), which is defined as the amplitude of the WCS(wavelet cross spectrum) normalized to the two single WPS(wavelet power spectrum) (Maraun and Kurths, 2004):

$$WCO_i(s) = |WCS_i(s)|/(WPS_i(s)WPS_i(s))^{1/2}$$


SALT Cross wavelet analysis
Period (years)
0.25
0.5
1.0
2.0
4.0
1964
1965
1966
1967
1968
1969
1970
1971
Time (year)
1.00
0.75
0.50
0.25
0.00

CHAPTER 3

Cookbook

1. Download de package

Go to the page:

```
https://pypi.python.org/pypi/waipy/
```

Download waipy-version.tar.gz

2. Unpacked in you download dir:

   ```
   tar -vzxf waipy-version.tar.gz
   ```

3. Enter into the directory:

   ```
   cd waipy-version
   ```

4. Install package:

   ```
   python setup.py install
   ```

5. Open ipython:

   ```
   ipython
   import waipy
   # loading data for test
   data,time = waipy.load_txt('sst_nino3.dat',0.25,1871)
   # normalizing time series
   data_norm = waipy.normalize(data)
   # calculating continuos wavelet transform using Morlet wavelet
   result = waipy.cwt(data_norm,0.25,1,0.25,2*0.25,7/0.25,0.72,6,'Morlet')
   # ploting the result - impath: 'Users/you/figures/'
   waipy.wavelet_plot('SST_NINO3',time,data,0.03125,result,impath)


   CROSS ANALYSIS
   cross_power, coherence = waipy.cross_wavelet(result['wave'],result['wave'])
   waipy.plot_cross(cross_power,time,result)
   waipy.plot_cohere(coherence,time,result)
   ```

CHAPTER 4

DIY

Do it Yourself (DIY) your own wavelet toolkit!

4.1 CWT - Niño3 SST

4.1.1 0. Import python libraries

```
import numpy as np
import pylab
from pylab import detrend_mean
import math
```

4.1.2 1.Choose and implement the wavelet function

```
def wave_bases(mother,k,scale,param):
  """Computes the wavelet function as a function of Fourier frequency
   used for the CWT in Fourier space (Torrence and Compo, 1998)
   -- This def is called automatically by def wavelet --

   _____________________________________________________________________
   Inputs:
          mother - a string equal to 'Morlet'
          k      - a vectorm the Fourier frequecies
          scale  - a number, the wavelet scale
          param  - the nondimensional parameter for the wavelet function

   Outputs:
          daughter       - a vector, the wavelet function
          fourier_factor - the ratio os Fourier period to scale
          coi            - a number, the cone-of-influence size at the scale
          dofmin         - a number, degrees of freedom for each point in the wavelet power (Mor

   Call function:
          daughter,fourier_factor,coi,dofmin = wave_bases(mother,k,scale,param)
   _____________________________________________________________________
```

Note: The Morlet wavelet is used as default in this code.

- expnt *Check it out*:

```
expnt = -pow(scale*k-k0,2)/2*(k>0)
```

Note: Only the values of the last scale are avaiable on checkitout.

```
+---------------------------------------+
|               scale[a1] = 32          |
|             +-----------------+       |
|             |-0               |       |
|             |                 |       |
|len(k) = 512 |                 |       |
|             |                 |       |
|             |               -0|       |
|             +-----------------+       |
+---------------------------------------+
```

- norm *Check it out*:

```
norm = math.sqrt(scale*k[1])*(pow(math.pi,-0.25))*math.sqrt(len(k))
```

```
+---------------------------------------+
|          scale[a1] = 32               |
|       +-----------------+             |
|       |2.66        39.07|             |
|       +-----------------+             |
|                                       |
+---------------------------------------+
```

- daughter *Check it out*:

```
daughter = []                                          # define daughter as a list
for ex in expnt:                                       # for each value scale (equal to next po
        daughter.append(norm*math.exp(ex))
k = np.array(k)                                        # turn k to array
daughter = np.array(daughter)                          # transform in array
daughter = daughter*(k>0)                              # Heaviside step function
```

Note: Only the values of the last scale are avaiable on checkitout.

```
+---------------------------------------+
|               scale[a1] = 32          |
|             +-----------------+       |
|             |0.0              |       |
|             |                 |       |
|len(k) = 512 |                 |       |
|             |                 |       |
|             |              0.0|       |
|             +-----------------+       |
+---------------------------------------+
```

4.1.3 2. Find the next pow of 2

```
def nextpow2(i):
    n = 2
    while n < i: n = n * 2
    return n
```

4.1.4 3. Compute wavelet power spectrum

```
def wavelet(Y,dt,mother,param):#,pad,dj,s0,J1,mother,param):
    """Computes the wavelet continuous transform of the vector Y, by definition:

        W(a,b) = sum(f(t)*psi[a,b](t) dt)                a dilate/contract
        psi[a,b](t) = 1/sqrt(a) psi(t-b/a)               b displace

        Only Morlet wavelet (k0=6) is used
        The wavelet basis is normalized to have total energy = 1 at all scales
        ______________________________________________________________________
        Input:
             Y - time series
             dt - sampling rate
             mother - the mother wavelet function
             param - the mother wavelet parameter

        Output:
             ondaleta - wavelet bases at scale 10 dt
             wave - wavelet transform of Y
             period - the vector of "Fourier"periods ( in time units) that correspond to the sc
             scale - the vector of scale indices, given by S0*2(j*DJ), j =0 ...J1
             coi - cone of influence

        Call function:
        ondaleta, wave, period, scale, coi = wavelet(Y,dt,mother,param)
        ______________________________________________________________________
```

```
n1 = len(Y)                                                     # time series length
s0 = 2*dt                                                       # smallest scale of the wavelet
dj = 0.25                                                       # spacing between discrete scales
```

- J1 *Check it out*

```
J1= int(np.floor((np.log10(n1*dt/s0))/np.log10(2)/dj))         # J1+1 total os scales
```

- Call nextpow2 *Check it out*

```
if (pad ==1) :
        base2 = nextpow2(n1)                                    #call det nextpow2
n = base2
```

- k *Check it out*:

```
# construct wavenumber array used in transform
# simetric eqn 5
k = np.arange(n/2)
import math
k_pos,k_neg=[],[]
for i in range(0,n/2+1):
        k_pos.append(i*((2*math.pi)/(n*dt)))                    # frequencies as in eqn5
        k_neg = k_pos[::-1]                                     # inversion vector
        k_neg = [e * (-1) for e in k_neg]                       # negative part
        k_neg = k_neg[1:-1]                                     # delete the first value of k_ne
k = np.concatenate((k_pos,k_neg), axis =1)                      # vector of symmetric
```

```
+----------------------------------------+
|                  1                     |
|             +------+                   |
```

```
|              | 0.0  |                    |
|              |      |                    |
|len(k) = 512  |      |                    |
|              |      |                    |
|              |-0.049|                    |
|              +------+                    |
+-----------------------------------------+
```

- f *Check it out*:

```
# compute fft of the padded time series
f = np.fft.fft(x,n)
```

```
+-----------------------------------------+
|                 1                        |
|              +------------+              |
|              |-9.33e-15+0j|              |
|              |            |              |
|len(k) = 512  |            |              |
|              |            |              |
|              |31.9 -5.55j |              |
|              +------------+              |
+-----------------------------------------+
```

CHAPTER 5

Check it out

Here you can check the outputs of each variable of the previous algorithm.

5.1 CWT - Niño3 SST

5.1.1 Niño3 SST data

```
-0.15
-0.30
-0.14
-0.41
-0.46
-0.66
-0.50
-0.80
-0.95
-0.72
-0.31
-0.71
-1.04
-0.77
-0.86
-0.84
-0.41
-0.49
-0.48
-0.72
-1.21
-0.80
 0.16
 0.46
 0.40
 1.00
 2.17
 2.50
 2.34
 0.80
 0.14
-0.06
-0.34
-0.71
```

```
-0.34
-0.73
-0.48
-0.11
 0.22
 0.51
 0.51
 0.25
-0.10
-0.33
-0.42
-0.23
-0.53
-0.44
-0.30
 0.15
 0.09
 0.19
-0.06
 0.25
 0.30
 0.81
 0.26
 0.10
 0.34
 1.01
-0.31
-0.90
-0.73
-0.92
```

5.1.2 expnt

```
[ -0.00000000e+00  -2.56680392e-01  -1.04288176e+01  -4.85164116e+01
 -1.14519462e+02  -2.08437970e+02  -3.30271934e+02  -4.80021356e+02
 -6.57686233e+02  -8.63266568e+02  -1.09676236e+03  -1.35817361e+03
 -1.64750031e+03  -1.96474248e+03  -2.30990009e+03  -2.68297317e+03
 -3.08396170e+03  -3.51286569e+03  -3.96968514e+03  -4.45442004e+03
 -4.96707040e+03  -5.50763622e+03  -6.07611749e+03  -6.67251422e+03
 -7.29682641e+03  -7.94905405e+03  -8.62919715e+03  -9.33725571e+03
 -1.00732297e+04  -1.08371192e+04  -1.16289241e+04  -1.24486445e+04
 -1.32962803e+04  -1.41718316e+04  -1.50752984e+04  -1.60066806e+04
 -1.69659783e+04  -1.79531914e+04  -1.89683200e+04  -2.00113640e+04
 -2.10823235e+04  -2.21811985e+04  -2.33079889e+04  -2.44626947e+04
 -2.56453161e+04  -2.68558528e+04  -2.80943051e+04  -2.93606728e+04
 -3.06549559e+04  -3.19771545e+04  -3.33272686e+04  -3.47052981e+04
 -3.61112431e+04  -3.75451035e+04  -3.90068794e+04  -4.04965708e+04
 -4.20141776e+04  -4.35596998e+04  -4.51331376e+04  -4.67344907e+04
 -4.83637594e+04  -5.00209434e+04  -5.17060430e+04  -5.34190580e+04
 -5.51599885e+04  -5.69288344e+04  -5.87255957e+04  -6.05502726e+04
 -6.24028649e+04  -6.42833726e+04  -6.61917958e+04  -6.81281345e+04
 -7.00923886e+04  -7.20845581e+04  -7.41046432e+04  -7.61526436e+04
 -7.82285596e+04  -8.03323910e+04  -8.24641378e+04  -8.46238001e+04
 -8.68113779e+04  -8.90268711e+04  -9.12702798e+04  -9.35416040e+04
 -9.58408436e+04  -9.81679986e+04  -1.00523069e+05  -1.02906055e+05
 -1.05316956e+05  -1.07755773e+05  -1.10222506e+05  -1.12717154e+05
 -1.15239717e+05  -1.17790195e+05  -1.20368590e+05  -1.22974899e+05
```

```
-1.25609124e+05  -1.28271265e+05  -1.30961321e+05  -1.33679292e+05
-1.36425179e+05  -1.39198982e+05  -1.42000699e+05  -1.44830333e+05
-1.47687881e+05  -1.50573346e+05  -1.53486725e+05  -1.56428020e+05
-1.59397231e+05  -1.62394357e+05  -1.65419398e+05  -1.68472355e+05
-1.71553228e+05  -1.74662016e+05  -1.77798719e+05  -1.80963338e+05
-1.84155872e+05  -1.87376321e+05  -1.90624687e+05  -1.93900967e+05
-1.97205163e+05  -2.00537275e+05  -2.03897302e+05  -2.07285244e+05
-2.10701102e+05  -2.14144875e+05  -2.17616564e+05  -2.21116168e+05
-2.24643688e+05  -2.28199123e+05  -2.31782474e+05  -2.35393740e+05
-2.39032921e+05  -2.42700018e+05  -2.46395031e+05  -2.50117959e+05
-2.53868802e+05  -2.57647561e+05  -2.61454235e+05  -2.65288825e+05
-2.69151330e+05  -2.73041751e+05  -2.76960087e+05  -2.80906338e+05
-2.84880505e+05  -2.88882588e+05  -2.92912586e+05  -2.96970499e+05
-3.01056328e+05  -3.05170072e+05  -3.09311732e+05  -3.13481307e+05
-3.17678798e+05  -3.21904204e+05  -3.26157525e+05  -3.30438762e+05
-3.34747915e+05  -3.39084983e+05  -3.43449966e+05  -3.47842865e+05
-3.52263679e+05  -3.56712409e+05  -3.61189054e+05  -3.65693615e+05
-3.70226091e+05  -3.74786483e+05  -3.79374790e+05  -3.83991012e+05
-3.88635150e+05  -3.93307204e+05  -3.98007173e+05  -4.02735057e+05
-4.07490857e+05  -4.12274572e+05  -4.17086203e+05  -4.21925749e+05
-4.26793210e+05  -4.31688588e+05  -4.36611880e+05  -4.41563088e+05
-4.46542211e+05  -4.51549250e+05  -4.56584205e+05  -4.61647075e+05
-4.66737860e+05  -4.71856561e+05  -4.77003177e+05  -4.82177708e+05
-4.87380156e+05  -4.92610518e+05  -4.97868796e+05  -5.03154990e+05
-5.08469098e+05  -5.13811123e+05  -5.19181063e+05  -5.24578918e+05
-5.30004689e+05  -5.35458375e+05  -5.40939977e+05  -5.46449494e+05
-5.51986926e+05  -5.57552274e+05  -5.63145538e+05  -5.68766717e+05
-5.74415811e+05  -5.80092821e+05  -5.85797746e+05  -5.91530587e+05
-5.97291343e+05  -6.03080015e+05  -6.08896602e+05  -6.14741105e+05
-6.20613523e+05  -6.26513857e+05  -6.32442105e+05  -6.38398270e+05
-6.44382350e+05  -6.50394345e+05  -6.56434256e+05  -6.62502082e+05
-6.68597824e+05  -6.74721481e+05  -6.80873054e+05  -6.87052542e+05
-6.93259945e+05  -6.99495264e+05  -7.05758499e+05  -7.12049649e+05
-7.18368714e+05  -7.24715695e+05  -7.31090591e+05  -7.37493403e+05
-7.43924130e+05  -7.50382773e+05  -7.56869331e+05  -7.63383805e+05
-7.69926194e+05  -7.76496498e+05  -7.83094718e+05  -7.89720853e+05
-7.96374904e+05  -8.03056871e+05  -8.09766752e+05  -8.16504550e+05
-8.23270262e+05  -8.30063890e+05  -8.36885434e+05  -8.43734893e+05
-8.50612268e+05  -8.57517558e+05  -8.64450763e+05  -8.71411884e+05
-8.78400920e+05  -8.85417872e+05  -8.92462739e+05  -8.99535522e+05
-9.06636220e+05  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
-0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
```

```
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00
 -0.00000000e+00  -0.00000000e+00  -0.00000000e+00  -0.00000000e+00]
```

5.1.3 norm

```
2.6626707276
2.90366301799
3.16646697417
3.45305672056
3.76558505511
4.1063996206
4.47806053968
4.88335964587
```

```
5.3253414552
5.80732603598
6.33293394834
6.90611344113
7.53117011021
8.21279924121
8.95612107936
9.76671929173
10.6506829104
11.614652072
12.6658678967
13.8122268823
15.0623402204
16.4255984824
17.9122421587
19.5334385835
21.3013658208
23.2293041439
25.3317357934
27.6244537645
30.1246804409
32.8511969648
35.8244843174
39.0668771669
```

5.1.4 daughter

```
[  0.00000000e+000   3.02227389e+001   1.15512975e-003   3.32199420e-020
   7.18849746e-049   1.17043831e-089   1.43393706e-142   1.32185190e-207
   9.16867683e-285   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
   0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
```

```
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
```

```
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000
  0.00000000e+000   0.00000000e+000   0.00000000e+000   0.00000000e+000]
```

5.1.5 J1

```
31
```

5.1.6 n = base2

```
512
```

5.1.7 k

```
     [  0.            0.04908739   0.09817477   0.14726216   0.19634954
  0.24543693   0.29452431   0.3436117    0.39269908   0.44178647
```

```
   0.49087385   0.53996124   0.58904862   0.63813601   0.68722339
   0.73631078   0.78539816   0.83448555   0.88357293   0.93266032
   0.9817477    1.03083509   1.07992247   1.12900986   1.17809725
   1.22718463   1.27627202   1.3253594    1.37444679   1.42353417
   1.47262156   1.52170894   1.57079633   1.61988371   1.6689711
   1.71805848   1.76714587   1.81623325   1.86532064   1.91440802
   1.96349541   2.01258279   2.06167018   2.11075756   2.15984495
   2.20893233   2.25801972   2.3071071    2.35619449   2.40528188
   2.45436926   2.50345665   2.55254403   2.60163142   2.6507188
   2.69980619   2.74889357   2.79798096   2.84706834   2.89615573
   2.94524311   2.9943305    3.04341788   3.09250527   3.14159265
   3.19068004   3.23976742   3.28885481   3.33794219   3.38702958
   3.43611696   3.48520435   3.53429174   3.58337912   3.63246651
   3.68155389   3.73064128   3.77972866   3.82881605   3.87790343
   3.92699082   3.9760782    4.02516559   4.07425297   4.12334036
   4.17242774   4.22151513   4.27060251   4.3196899    4.36877728
   4.41786467   4.46695205   4.51603944   4.56512682   4.61421421
   4.6633016    4.71238898   4.76147637   4.81056375   4.85965114
   4.90873852   4.95782591   5.00691329   5.05600068   5.10508806
   5.15417545   5.20326283   5.25235022   5.3014376    5.35052499
   5.39961237   5.44869976   5.49778714   5.54687453   5.59596191
   5.6450493    5.69413668   5.74322407   5.79231146   5.84139884
   5.89048623   5.93957361   5.988661     6.03774838   6.08683577
   6.13592315   6.18501054   6.23409792   6.28318531   6.33227269
   6.38136008   6.43044746   6.47953485   6.52862223   6.57770962
   6.626797     6.67588439   6.72497177   6.77405916   6.82314654
   6.87223393   6.92132131   6.9704087    7.01949609   7.06858347
   7.11767086   7.16675824   7.21584563   7.26493301   7.3140204
   7.36310778   7.41219517   7.46128255   7.51036994   7.55945732
   7.60854471   7.65763209   7.70671948   7.75580686   7.80489425
   7.85398163   7.90306902   7.9521564    8.00124379   8.05033117
   8.09941856   8.14850595   8.19759333   8.24668072   8.2957681
   8.34485549   8.39394287   8.44303026   8.49211764   8.54120503
   8.59029241   8.6393798    8.68846718   8.73755457   8.78664195
   8.83572934   8.88481672   8.93390411   8.98299149   9.03207888
   9.08116626   9.13025365   9.17934103   9.22842842   9.27751581
   9.32660319   9.37569058   9.42477796   9.47386535   9.52295273
   9.57204012   9.6211275    9.67021489   9.71930227   9.76838966
   9.81747704   9.86656443   9.91565181   9.9647392   10.01382658
  10.06291397  10.11200135  10.16108874  10.21017612  10.25926351
  10.30835089  10.35743828  10.40652567  10.45561305  10.50470044
  10.55378782  10.60287521  10.65196259  10.70104998  10.75013736
  10.79922475  10.84831213  10.89739952  10.9464869   10.99557429
  11.04466167  11.09374906  11.14283644  11.19192383  11.24101121
  11.2900986   11.33918598  11.38827337  11.43736075  11.48644814
  11.53553552  11.58462291  11.6337103   11.68279768  11.73188507
  11.78097245  11.83005984  11.87914722  11.92823461  11.97732199
  12.02640938  12.07549676  12.12458415  12.17367153  12.22275892
  12.2718463   12.32093369  12.37002107  12.41910846  12.46819584
  12.51728323  12.56637061 -12.51728323 -12.46819584 -12.41910846
 -12.37002107 -12.32093369 -12.2718463  -12.22275892 -12.17367153
 -12.12458415 -12.07549676 -12.02640938 -11.97732199 -11.92823461
 -11.87914722 -11.83005984 -11.78097245 -11.73188507 -11.68279768
 -11.6337103  -11.58462291 -11.53553552 -11.48644814 -11.43736075
 -11.38827337 -11.33918598 -11.2900986  -11.24101121 -11.19192383
 -11.14283644 -11.09374906 -11.04466167 -10.99557429 -10.9464869
 -10.89739952 -10.84831213 -10.79922475 -10.75013736 -10.70104998
 -10.65196259 -10.60287521 -10.55378782 -10.50470044 -10.45561305
```

```
-10.40652567 -10.35743828 -10.30835089 -10.25926351 -10.21017612
-10.16108874 -10.11200135 -10.06291397 -10.01382658  -9.9647392
 -9.91565181  -9.86656443  -9.81747704  -9.76838966  -9.71930227
 -9.67021489  -9.6211275   -9.57204012  -9.52295273  -9.47386535
 -9.42477796  -9.37569058  -9.32660319  -9.27751581  -9.22842842
 -9.17934103  -9.13025365  -9.08116626  -9.03207888  -8.98299149
 -8.93390411  -8.88481672  -8.83572934  -8.78664195  -8.73755457
 -8.68846718  -8.6393798   -8.59029241  -8.54120503  -8.49211764
 -8.44303026  -8.39394287  -8.34485549  -8.2957681   -8.24668072
 -8.19759333  -8.14850595  -8.09941856  -8.05033117  -8.00124379
 -7.9521564   -7.90306902  -7.85398163  -7.80489425  -7.75580686
 -7.70671948  -7.65763209  -7.60854471  -7.55945732  -7.51036994
 -7.46128255  -7.41219517  -7.36310778  -7.3140204   -7.26493301
 -7.21584563  -7.16675824  -7.11767086  -7.06858347  -7.01949609
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  4.14154791e+00 +3.88101677e+00j  -3.49387850e+00 +3.33401794e+00j
 -4.98871051e+00 -4.34623494e-02j  -4.56206279e+00 +2.69654051e+00j
  3.17474328e+00 -2.11438667e+00j  -5.59874977e+00 +2.09324690e+00j
  4.82202023e+00 +2.89162351e+00j  -8.65593675e+00 +9.88496857e-01j
 -4.89973492e+00 +3.71042895e+00j   8.75248662e+00 +2.45433070e+00j
 -5.57255954e+00 +5.37013258e+00j   1.19003485e+01 +8.04337982e+00j
 -1.77831537e-01 -9.62136461e+00j   1.77329816e+00 +2.81605212e+00j
 -4.58299469e-01 -6.97538289e+00j  -8.09583385e+00 +4.13545491e+00j
 -4.85770921e-01 -3.54148727e+00j   3.35782193e+00 -3.93013351e+00j
  6.62382542e+00 +3.48897271e+00j   9.09512677e+00 -8.91010489e+00j
 -1.66753700e+00 +2.75928310e+00j   4.43059018e+00 -2.06757944e+00j
 -5.42047457e+00 +9.23378865e-01j   2.72176435e+00 -6.98502700e+00j
  1.46012643e+00 -2.44094753e-01j  -5.05461548e+00 +3.62284021e+00j
  1.25076985e+01 +4.74538178e+00j  -3.88247527e-02 +5.19125251e+00j
  4.55529833e-01 -7.82906659e+00j   1.08211230e+00 +1.68283711e+00j
  3.45995479e+00 -8.55350975e+00j   2.88716744e+00 +1.12878650e+01j
 -7.15384522e+00 -1.28564590e+00j  -8.70660659e+00 +2.53306002e+00j
```

```
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-6.71723371e+00 -7.75791506e+00j   1.06880987e+01 -1.44295920e+01j
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-1.80108889e+01 -1.79099247e+01j   1.23803677e+01 +1.05603646e+01j
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-5.27930469e+00 +5.74702771e-01j   2.10844577e+00 +1.92349761e+01j
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-1.08264253e+00 -9.83156497e+00j  -1.09835992e+01 -2.30761642e+00j
-4.13237545e+01 +1.08048930e+01j   1.29065811e+01 +3.10520852e+00j
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-2.03599722e+01 +9.57531718e+00j  -1.35013335e+00 -8.47739521e+00j
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-1.20994488e+01 +1.77202737e+01j   4.22945944e+00 -2.54750309e+01j
 3.14850419e+01 +5.56894604e+01j  -9.70252767e+00 -1.20695989e+01j
-4.15293503e+01 +2.97035717e+01j  -4.79273593e+01 +1.94849901e+01j
```

```
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 8.13380138e+00 -2.83729559e+01j  -2.33207773e+01 -2.94818271e+01j
 2.75887423e+00 -2.71899377e+01j   3.19039222e+01 -5.54731812e+00j]
```

Manual

6.1 Wavelet.load_txt

wavelet.load_txt(archive,dt,date1)

Open and read an archive .txt with data only (without date)

Parameters

archive [vector] Vector archive to be open.

dt: number Time-sample of the vector. Example: Hourly, daily, monthly, etc...

date1: number The initial time of the data. Example: 1985.

Returns

data: array_like Raw of data

n: number The length of the data

time: array_like Raw of time sampling.

See also:

wavelet.load_netcdf

Notes

This function is linked to data/txt directory, so, if you have any file extension .txt put it in the following folder: :: /lib/wavelet/data/txt

Example:

```
>> dt = 0.25

>> date1 = 1871

# Test data = sst_nino3.dat is already in the package!

>> data,n,time = load_txt('sst_nino3.dat',dt,date1)
```

6.2 Wavelet.load_nc

wavelet.load_txt(file,var,dt,date1)

Open and read an archive .txt with data only (without date)

Parameters

file: vector Vector archive to be open.

var: string variable from archive.nc

dt: number Time-sample of the vector. Example: Hourly, daily, monthly, etc...

date1: number The initial time of the data. Example: 1985.

Returns

data: array_like Raw of data

time: array_like Raw of time sampling.

See also:

wavelet.load_txt

Example:

```
# Creating a netcdf file

# download the pupynere package

# more info : https://bitbucket.org/robertodealmeida/pupynere/

>> import pupynere as pp

>> f = pp.netcdf_file('simple.nc', 'w')

>> f.history = 'Created for a test'

>> f.createDimension('time', 10)

>> time = f.createVariable('time', 'i', ('time',))

>> time[:] = range(10)

>> time.units = 'days since 2008-01-01'

>> f.close()

# load netcdf

>> dt = 1

>> data, time = waipy.load_nc('simple.nc','time',dt,2000)
```

6.3 Wavelet.normalize

wavelet.normalize(data)

Data normalize by variance. The mean value is removed.

Parameters data: array_like Raw of data

Returns

data: array_like Raw of data normalized

variance: Data variance

Notes

You can skip this function if it the normalization is not necessary (e.g. EOF data).

Example:

```
>> dt = 0.25

>> date1 = 1871

# Test data = sst_nino3.dat is already in the package!

>> data,n,time = load_txt('sst_nino3.dat',dt,date1)

# This normalize by variance
>> data_norm, variance = normalize(data)
```

6.4 Wavelet.cwt

wavelet.cwt(data, dt, variance, n, pad, dj, s0, j1, lag1, param, mother)

Continuous wavelet transform from data. Wavelet params can be modified as you wish.

Parameters

data: array_like. Raw of data or normalized data.

dt: number. Time-sample of the vector. Example: Hourly, daily, monthly, etc...

variance: number. Data variance.

n: number. Length of the data.

pad: number/flag. Pad the time series with zeroes to next pow of two length (recommended).

Default: pad = 1.

dj: number. Divide octave in sub-octaves. If dj = 0.25 this will do 4 sub-octaves per octave.

s0: number. The maximum frequency resolution. If it is an annual data, s0 = 2*dt say start at a scale of 6 months.

Default: s0 = 2*dt.

j1: number. Divide the power-of-teo with dj sub-octaves each.

Default: j1 =7/dj.

lag1: number. Lag-1 autocoorelation for red noise background.

Default: lag1 =0.72.

param: number/flag. The mother wavelet param.

Default: param = 6 (Morlet function used as default).

mother: string. The mother wavelet funtion.

Default: moher = 'Morlet'.

Returns result: dict.

Return all parameters for plot.

See also:

wavelet.cwa

Notes

The Morlet wavelet is used as default int this code. The wavelet.cwt function call all lib_wavelet.py functions:

```
                     +-----------------+
                     |    cwt.py       |
                     +-----------------+
                            |
                    +-----------------+
                    | lib_wavelet.py |
                    +-----------------+
                            |
          +-----------------+  +-----------------+
          |  def wavelet    |--| def wave_signif|
          +-----------------+  +-----------------+
                  |
+-----------------+  +-----------------+
| def nextpow2    |--| def wave_bases |
+-----------------+  +-----------------+
```

Example

```
>> dt = 0.25

>> date1 = 1871

# Test data = sst_nino3.dat is already in the package!

>> data,n,time = load_txt('sst_nino3.dat',dt,date1)

# This normalize by variance
>> data_norm, variance = normalize(data)

# Continuous wavelet transform
>> result = cwt(data_norm,0.25,variance,n,1,0.25,2*0.25,7/0.25,0.72,6,'Morlet')
```

6.5 Wavelet.wavelet_plot

wavelet.wavelet_plot(time, data,dtmin, result)

Open and read an archive .txt with data only (without date)

Parameters

time: array_like Raw of time sampling.

data: number Time-sample of the vector. Example: Hourly, daily, monthly, etc...

dtmin number Power maximum resolution. Example: 0.03125

result: dict.

All parameters for plot from wavelet.cwt.

impath: the path where you want to save the figures.

Returns the plot

See also:

wavelet.cwa_plot

Notes

This plot the wavelet transform!

Example:

```
>> dt = 0.25

>> date1 = 1871

# Test data = sst_nino3.dat is already in the package!
>> data,n,time = load_txt('sst_nino3.dat',dt,date1)

# This normalize by variance
>> data_norm, variance = normalize(data)

# Continuous wavelet transform
>> result = cwt(data_norm,0.25,variance,n,1,0.25,2*0.25,7/0.25,0.72,6,'Morlet')

# Plot all results
>> wavelet_plot('SST_NINO3',time,data,0.03125,result,impath)
```

CHAPTER 7

Indices and tables

- *genindex*
- *modindex*
- *search*