



Wavelet Transform-Based Data Compression and its Application to the Meteorological Data Sets

Dr. Ning Wang and Dr. Renate Brummer
7 May 2003

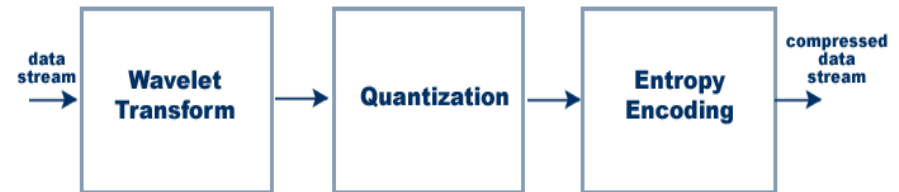
Wavelet Transform-Based Data Compression and its Application to the Meteorological Data Sets

Why:

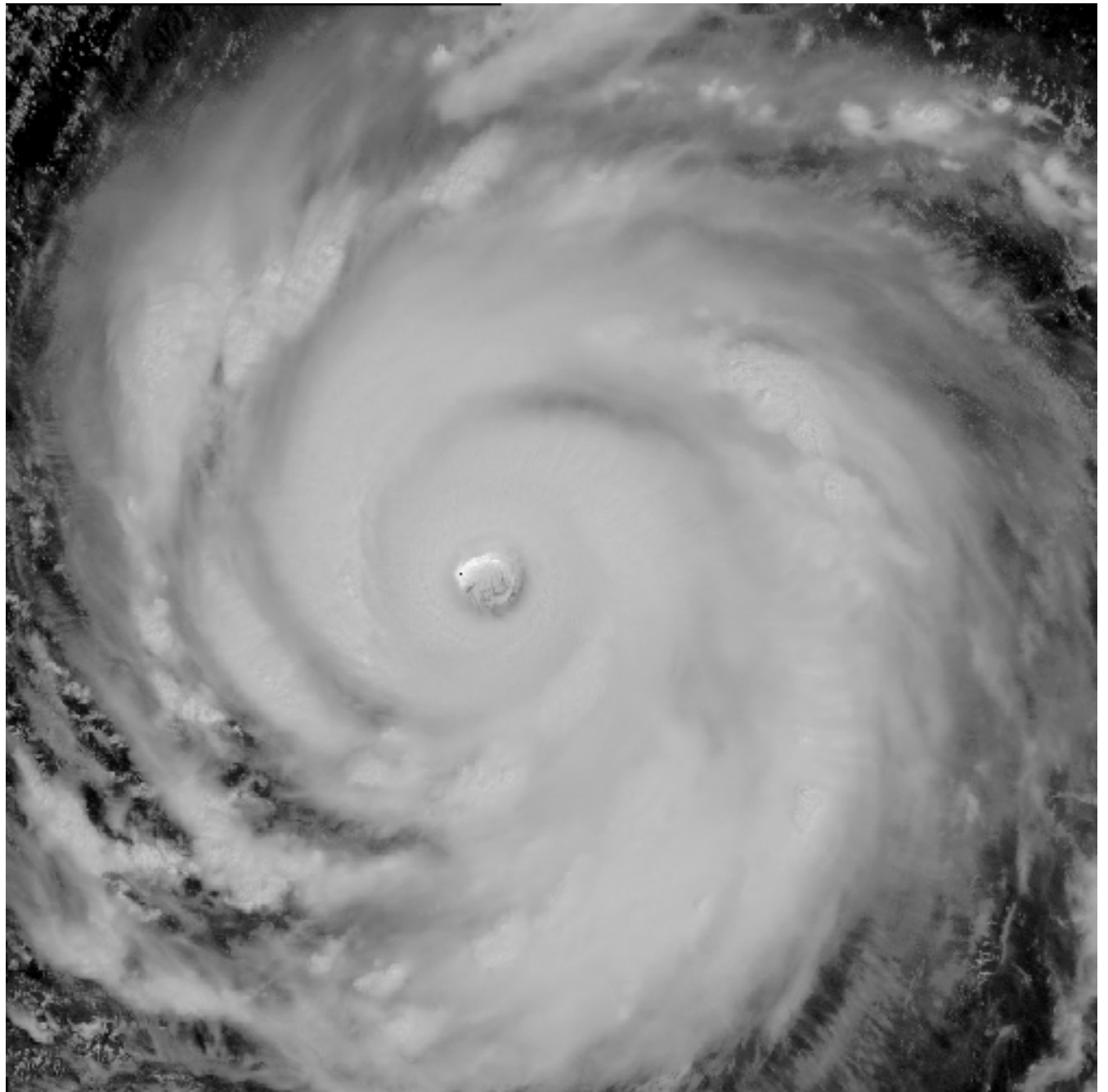
- increased data volume

Objectives:

- ability to control precision
- lower space resolution and higher dimensionality

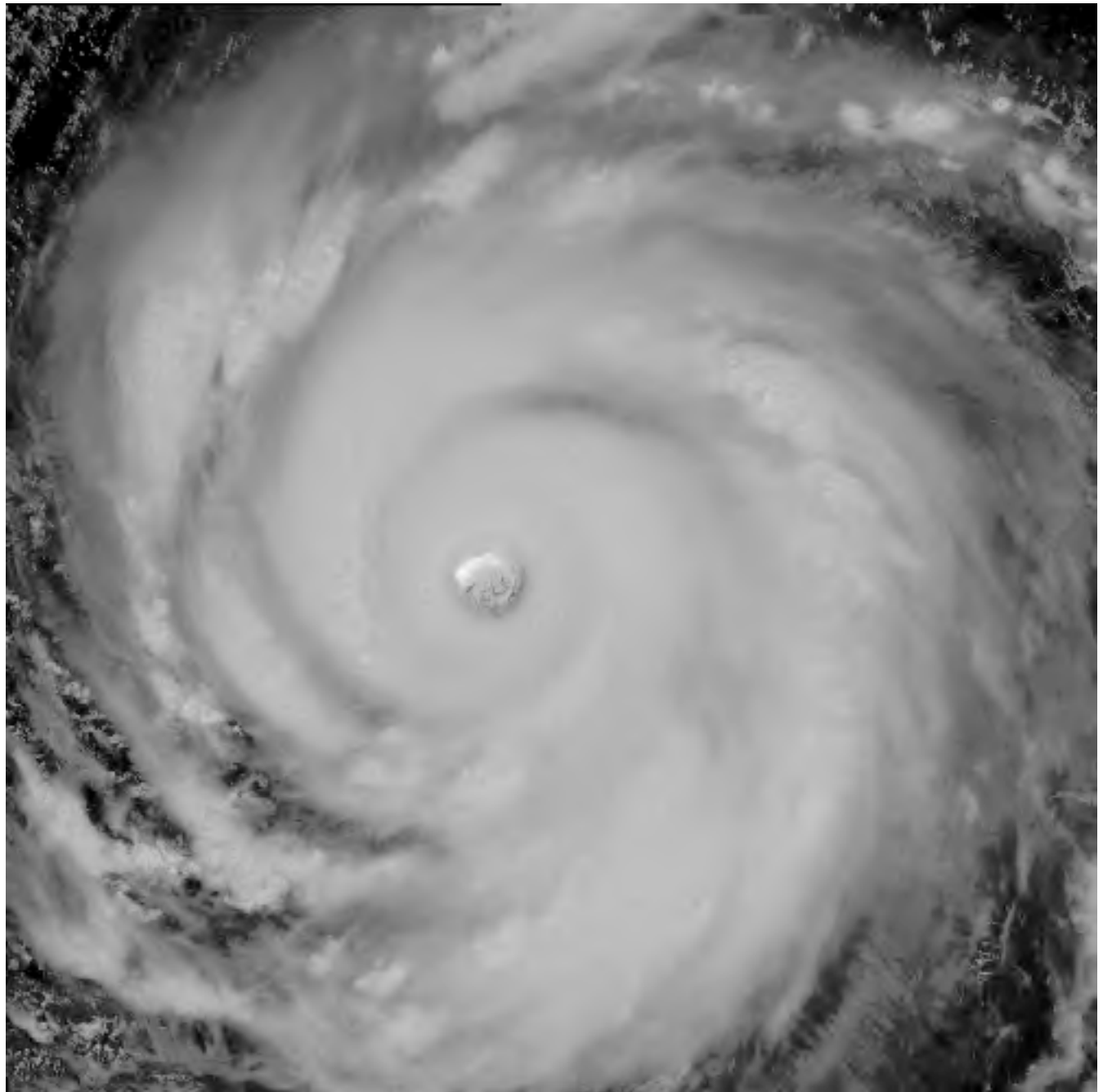


Compression:
Original 1:1



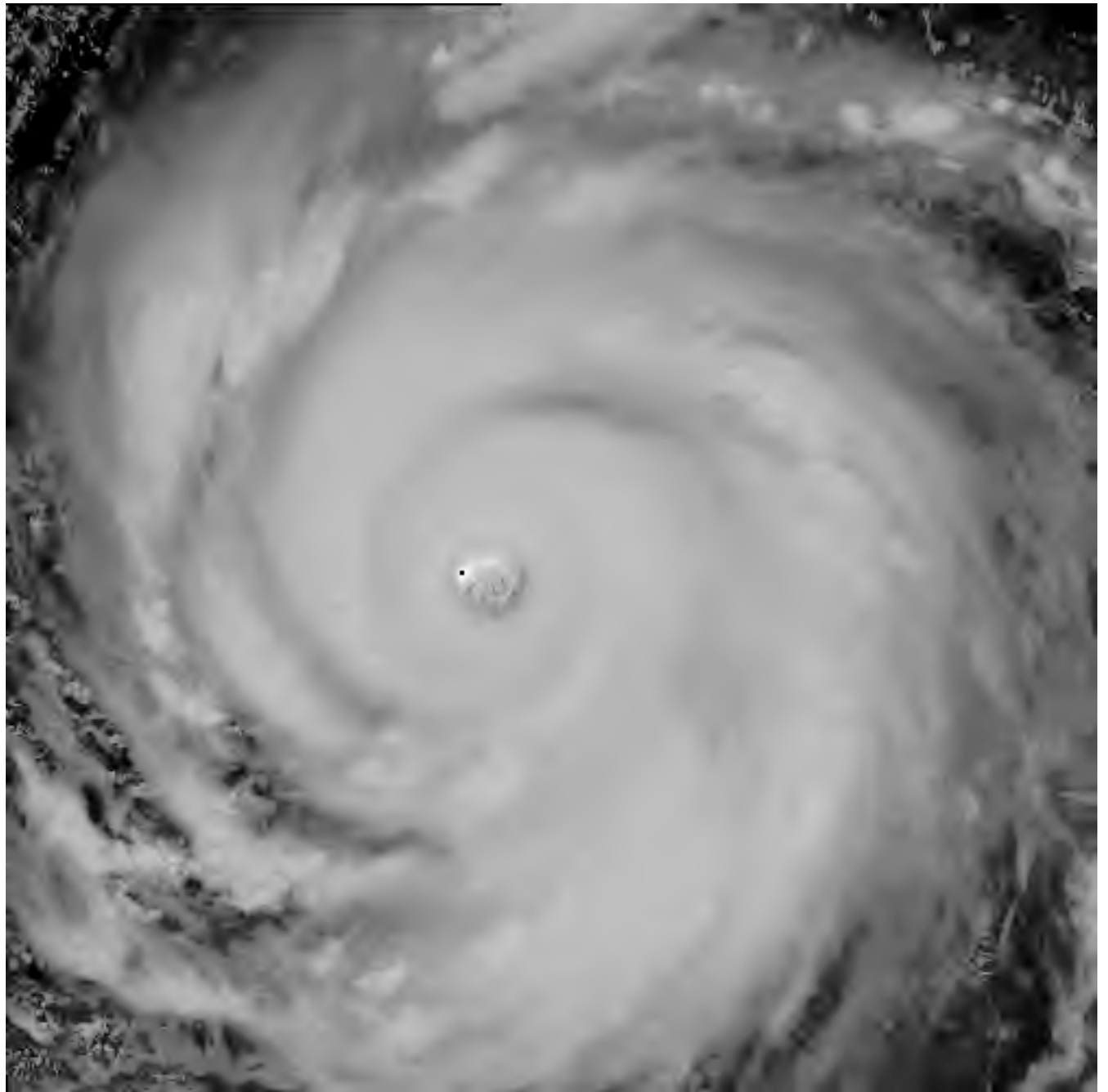
Compression:

20:1



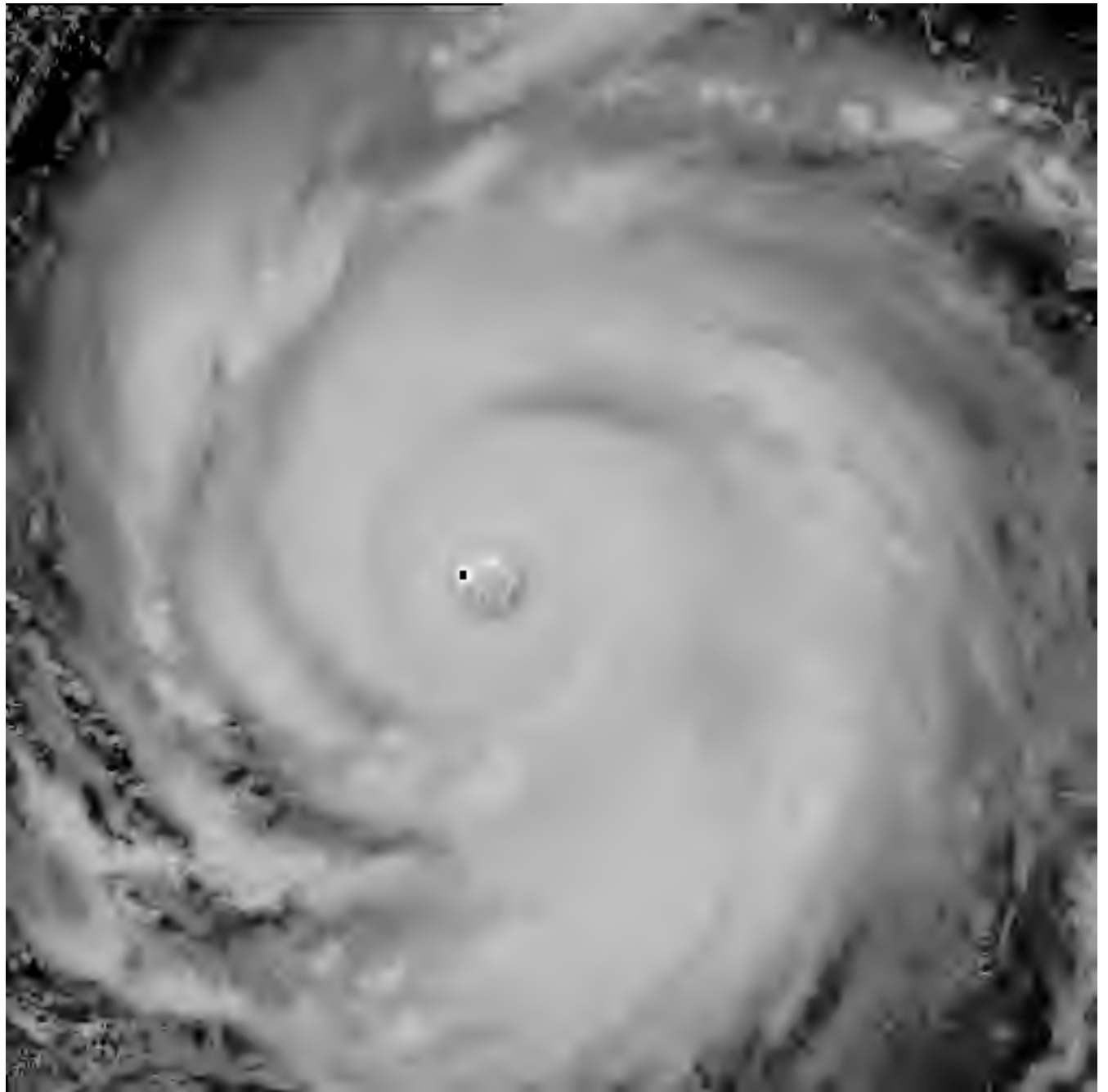
Compression:

50:1

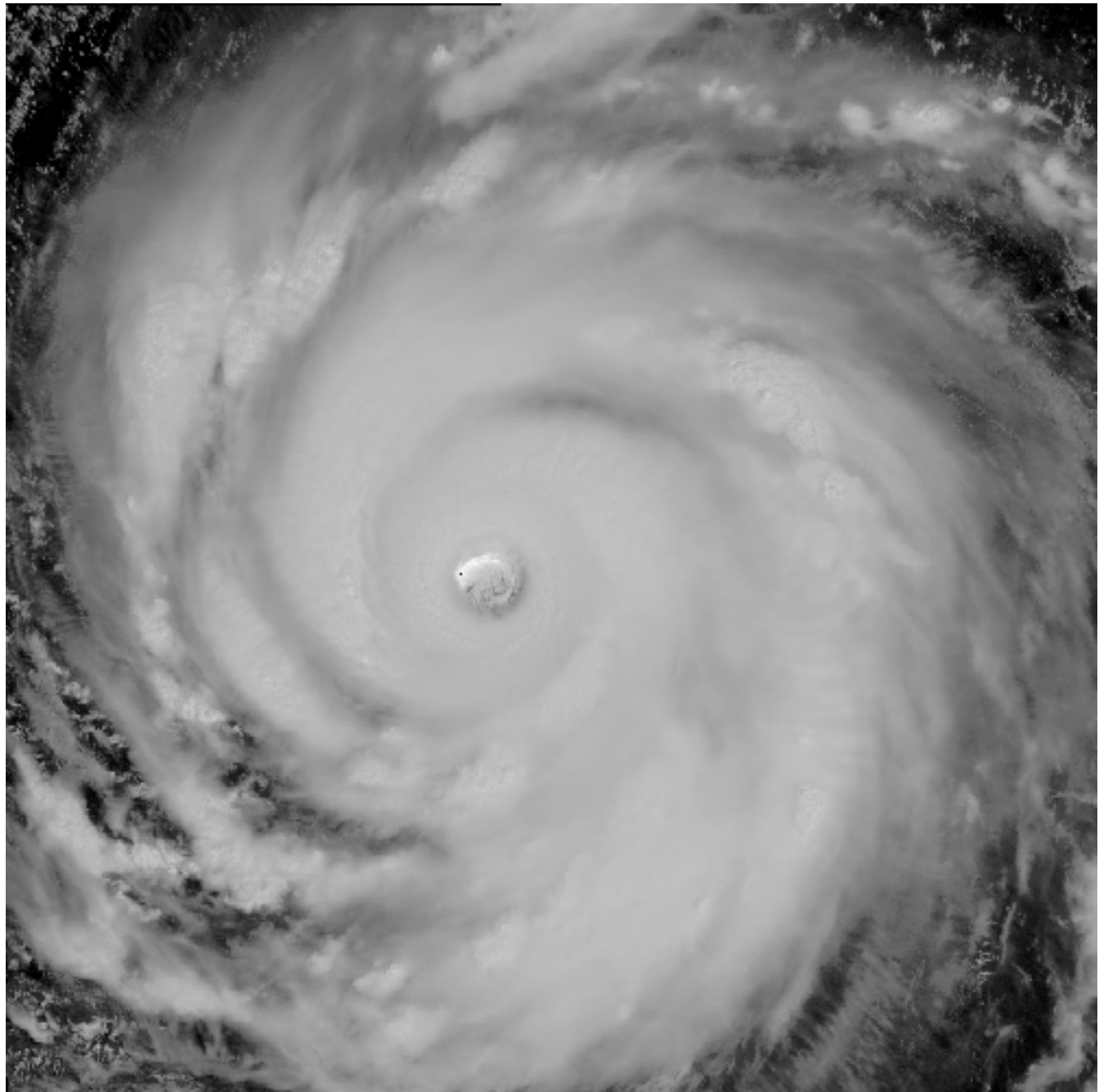


Compression:

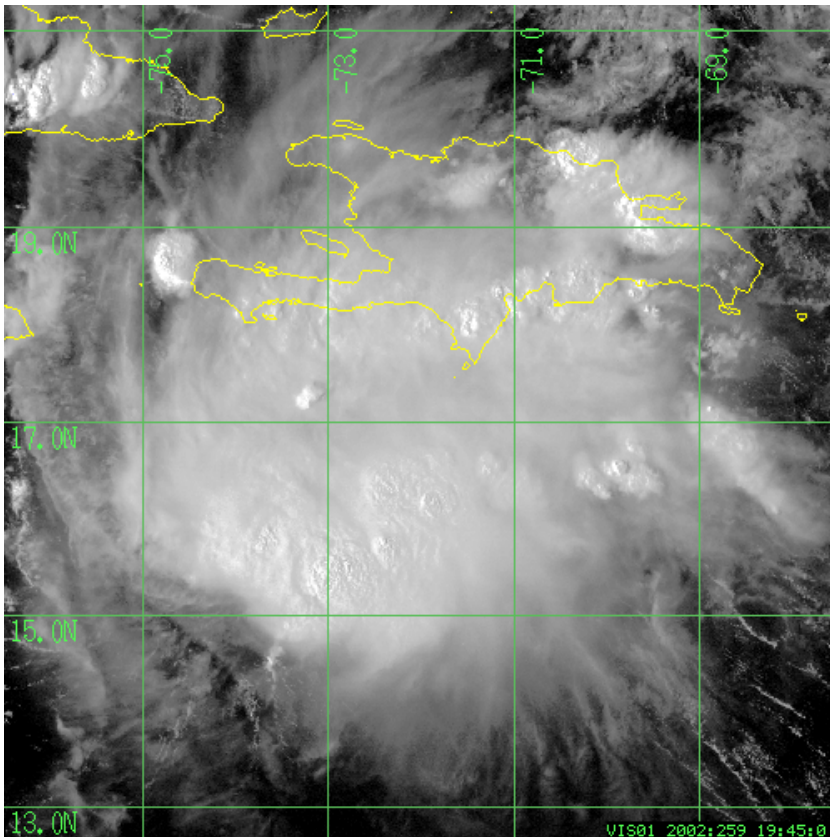
100:1



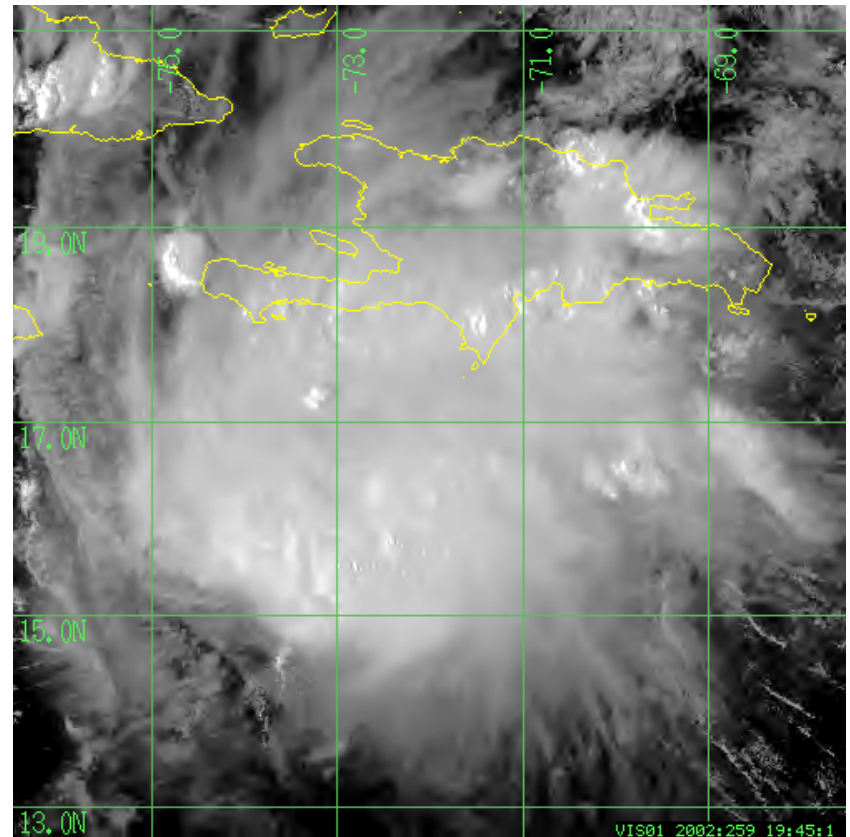
Compression:
Original 1:1



Our Compression v.s. JPEG (I)

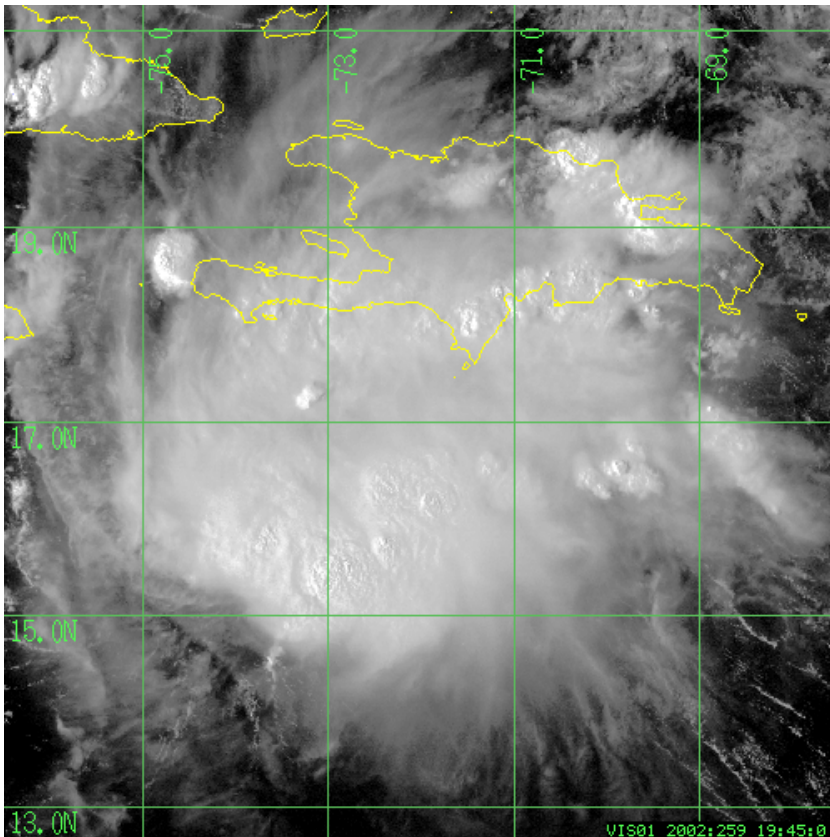


original

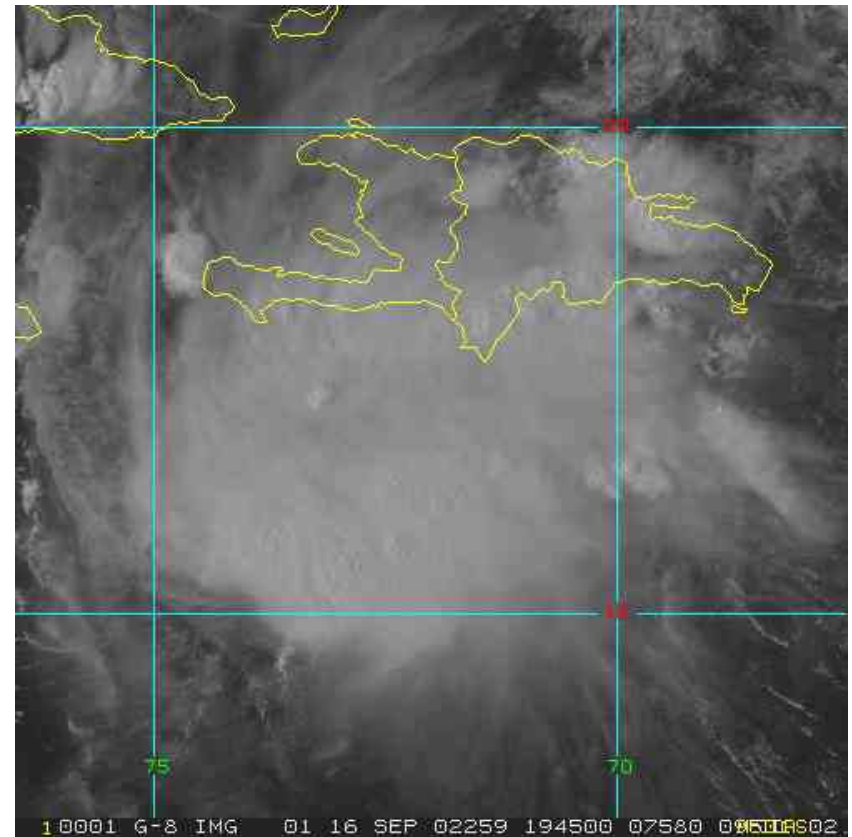


30:1 wavelet compression

Our Compression v.s. JPEG (II)



original



JPEG compressed

JPEG 2000: Main Features

- An image compression format
- Each image is comprised of a number of component(s). Grayscale -- 1, RGB -- 3
- Inter-component transform: RGB-->YCrCb
- Intra-component transform: Wavelet
- Quantizer: scalar quantization with a deadzone
- Entropy encoder: arithmetic encoder

Pros and Cons of JPEG2000

- International standard
- Error resilience
- Less efforts for developing and distributing the decoder (Maybe)

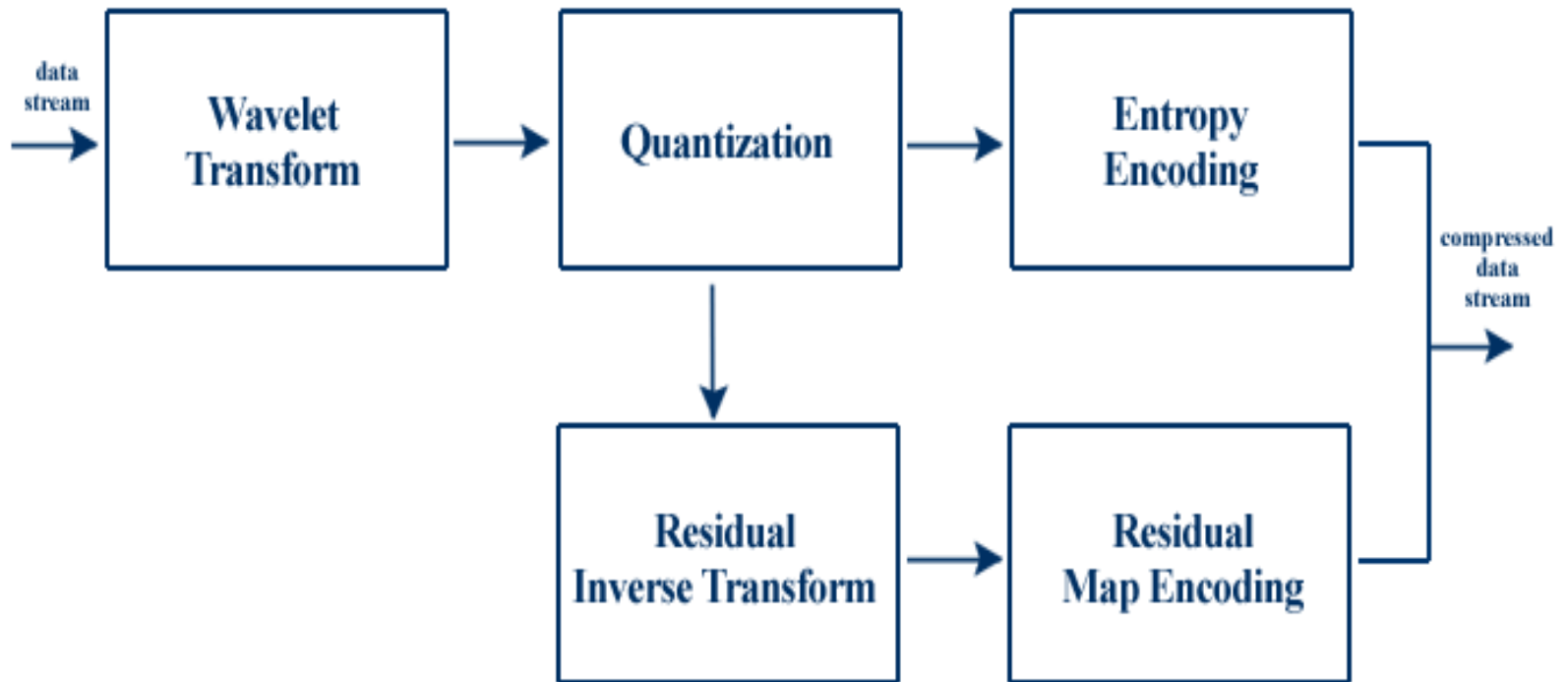
Pros and Cons of JPEG2000

- Not flexible
- Primitive quantization and rate control techniques
- Limited to 2D transform (w/o extension)
- The standards for extension (part 2) and conformance testing (part 4) not been officially established and recognized

Grid Data Compression

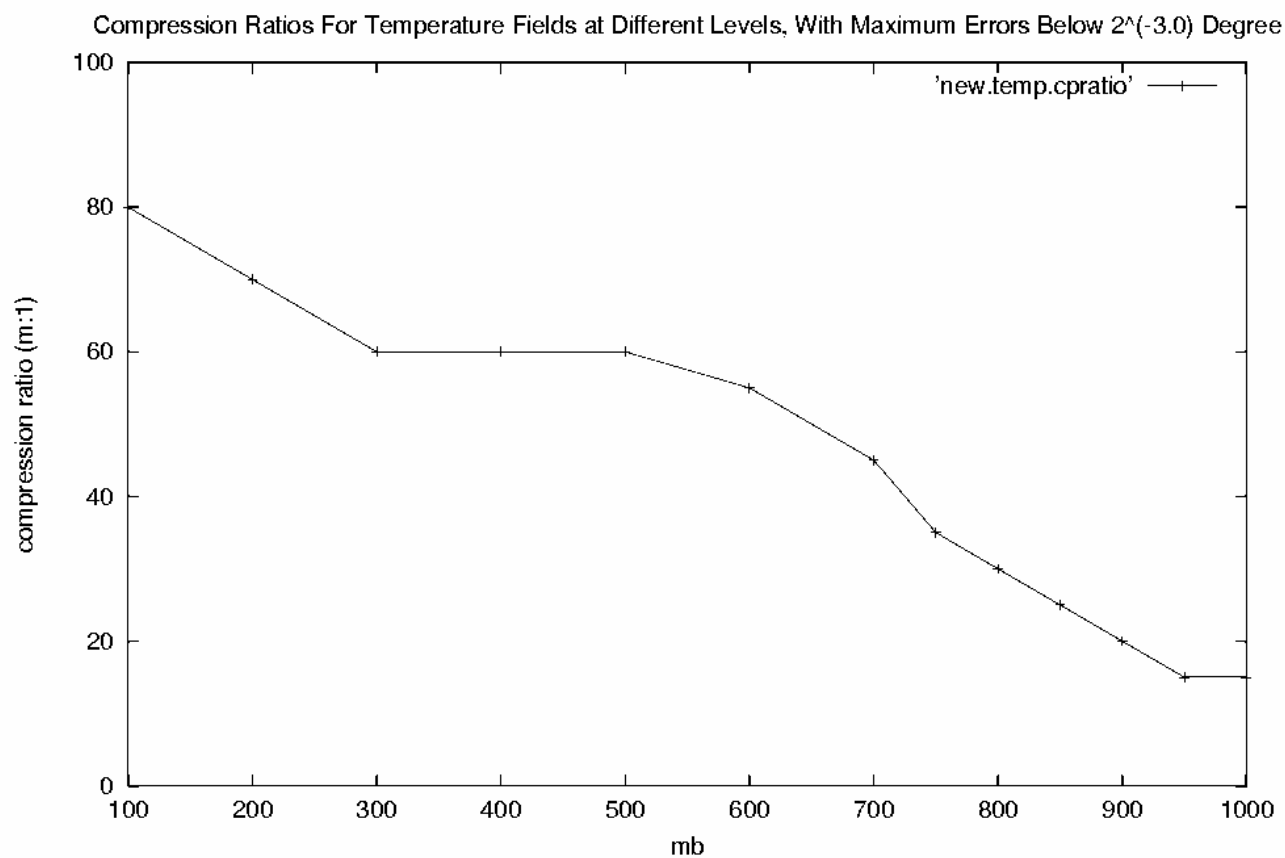
- Why?
 - increased data volume
- What makes grid data compression different from image compression ?
 - lower space resolution and higher dimensionality
 - importance of controlling the precision of data

Procedure for Grid Data Compression



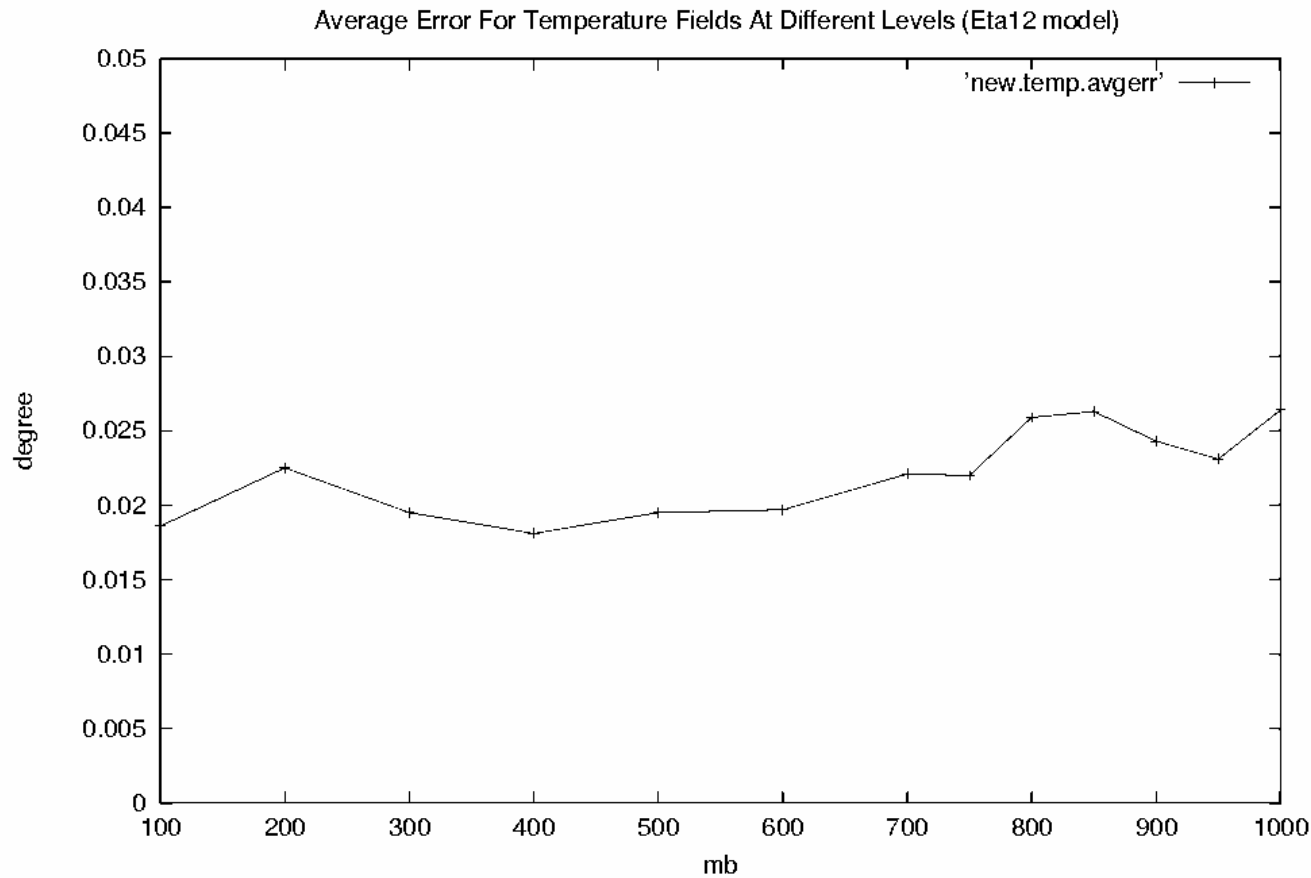
Temperature Precision Control with MaxError < 0.125 K

ETA 12 from 14 May 2002



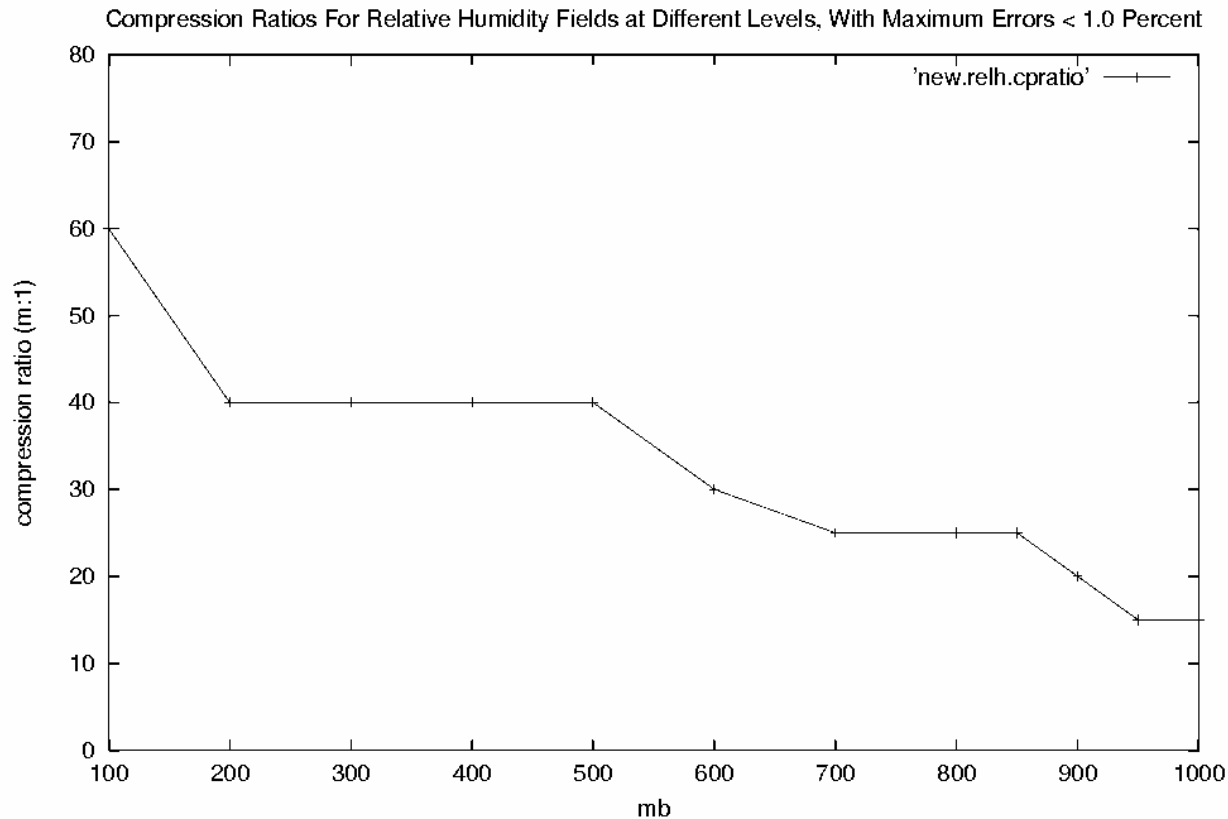
Temperature Average Error (K) for Previous Compression Factors

ETA 12 from 14 May 2002



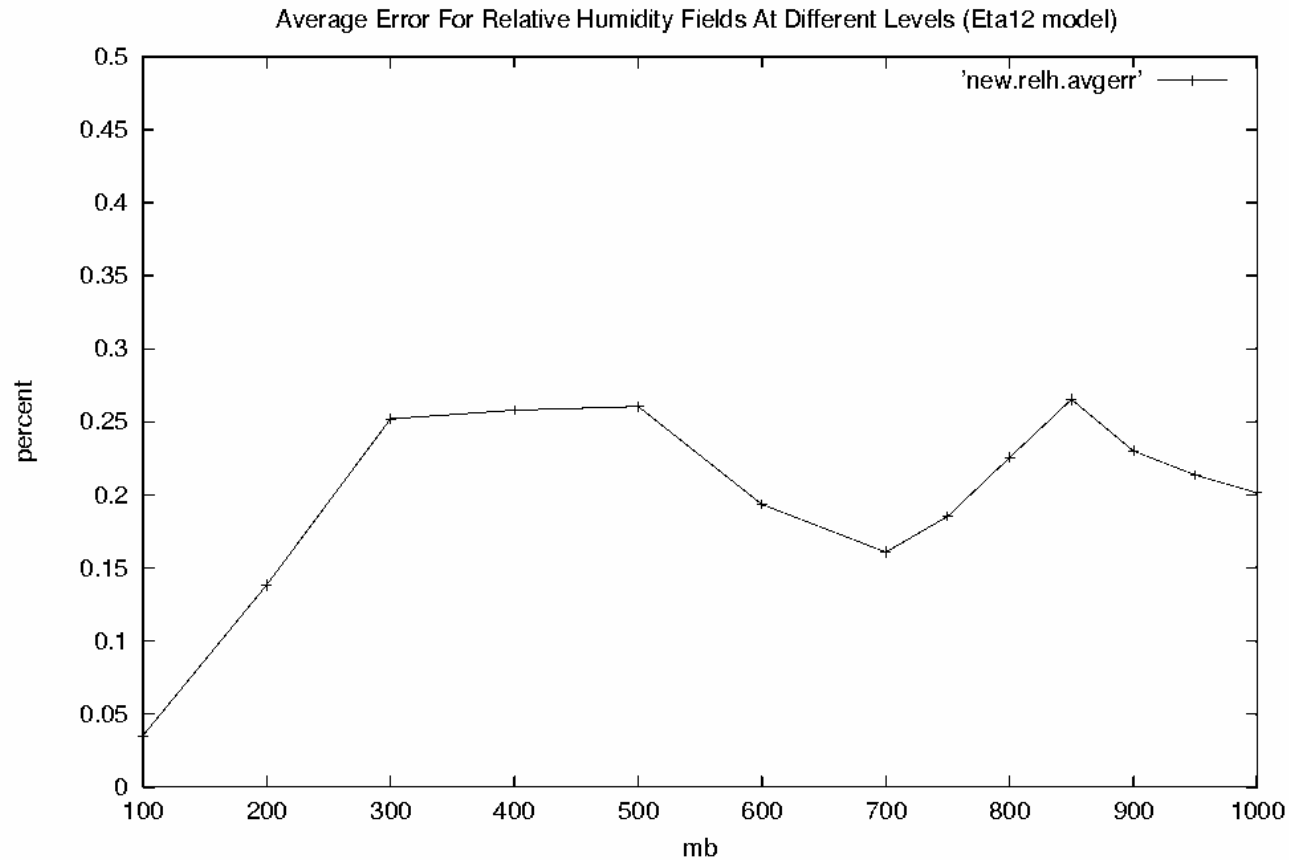
Relative Humidity Precision Control with Max Error < 1.0 Percent

ETA 12 from 14 May 2002



Relative Humidity Average Error for Previous Compression Factors

ETA 12 from 14 May 2002



Example: Eta 12 Model

Size of the original data sets: 12 GB

Bandwidth for transmission: 1.4 Mbit/sec

Transmisison time : 25 hours

Compressed data size (50:1): 240 MB

Transmisison time : 30 minutes

Summary

- Visible satellite imagery compression 20:1 to 50:1
- Grid data compression with precision control (our quasi-lossless example) 20:1 to 100:1
 - Note: The user can define the acceptable maximum or/and average error*
- Average storage and transmission time reduction 95% to 98%

—

Future Direction

- Fast wavelet transform code
- Fast quantizer with less memory consumptions
- Precision controlled grid data compression