Improvement of NDVI Time Series Using a Statistical Method.

Normalization of NDVI

Using Empirical Distribution Functions (EDF)

Marco Vargas[1], F. Kogan[1], W. Guo[2]

[1] NOAA/NESDIS/STAR/SMCD
[2] IMSG

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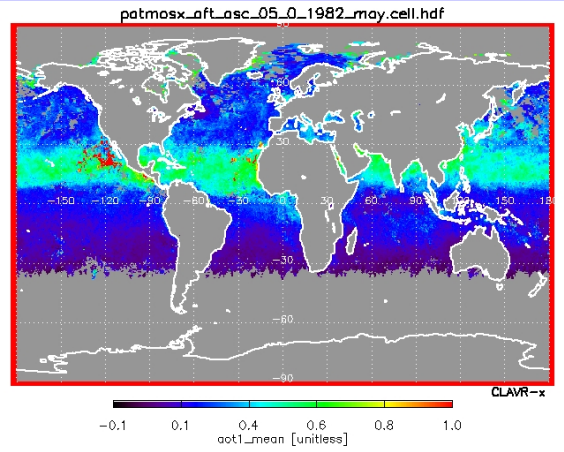
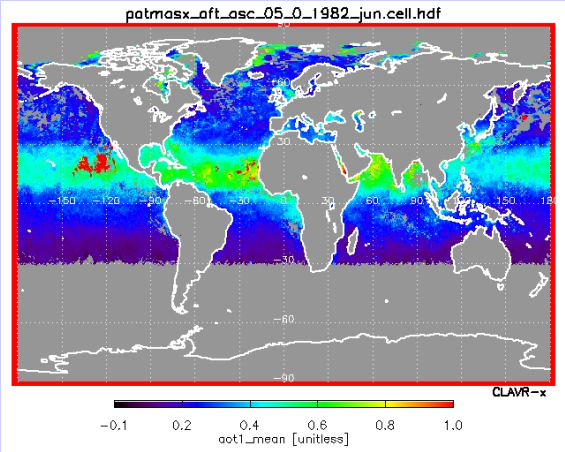
marco.vargas@noaa.gov

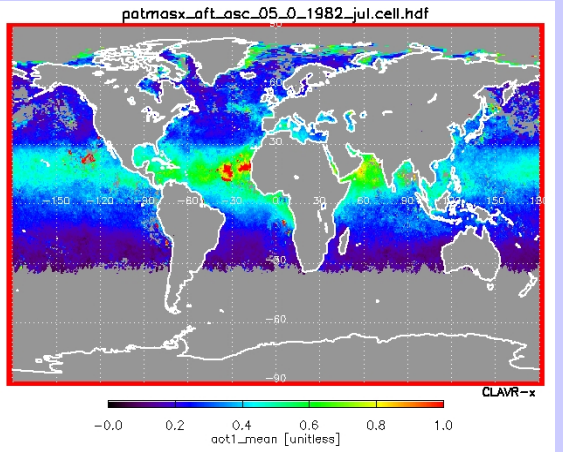
Known Problems on time series of NDVI (AVHRR derived)

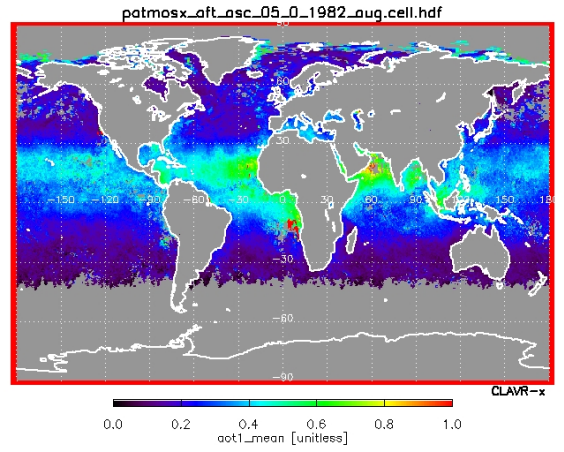
- Volcanic eruptions (Mt. Pinatubo and El Chichon).
- Sensor degradation.
- Satellite orbital drift.
- Different satellite missions (sensor intercalibration).
- Atmospheric correction.

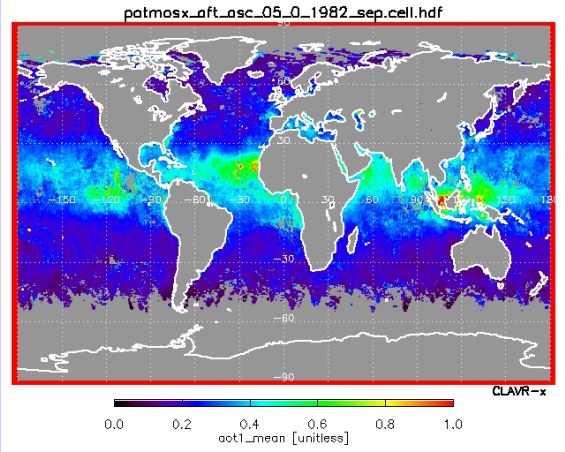
Aerosol Optical Thickness (Monthly mean)
(after El Chichon eruption)

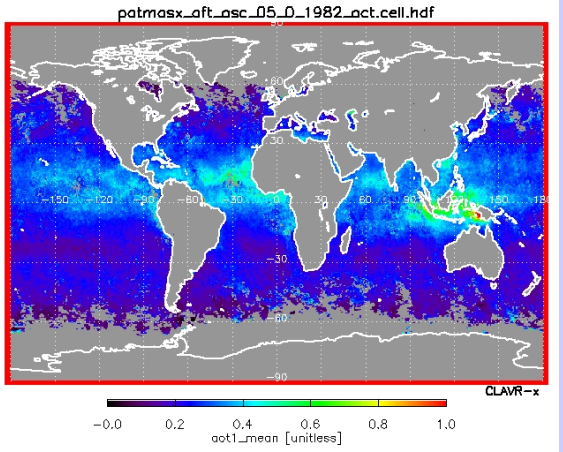






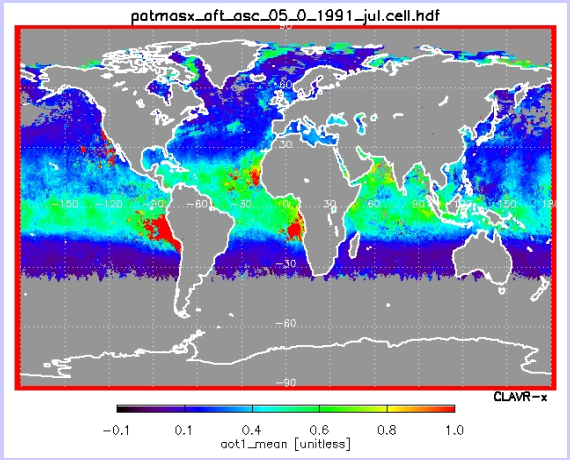


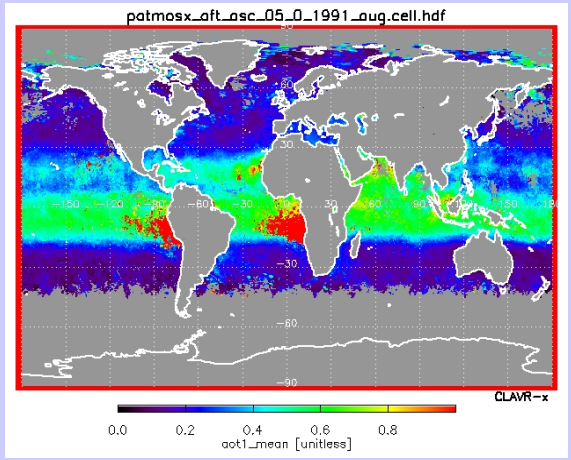


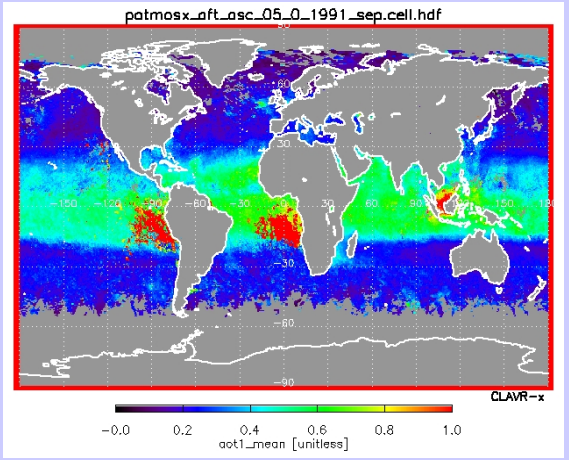


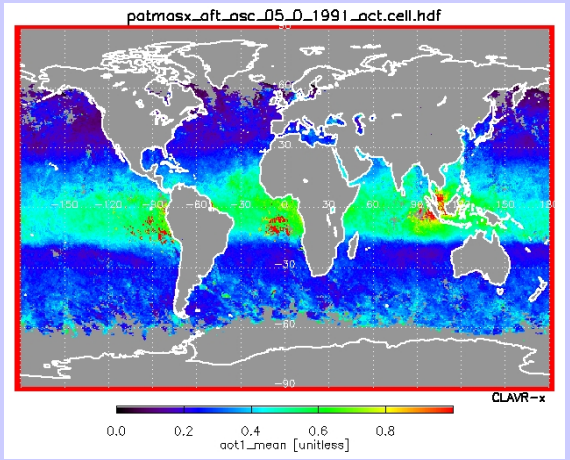
from: AVHRR Pathfinder Atmospheres - Extended (PATMOS-x)

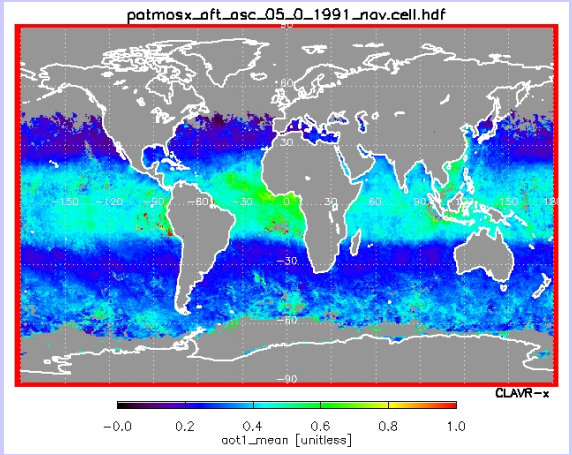
Aerosol Optical Thickness (Monthly mean)
(after Mt. Pinatubo eruption)

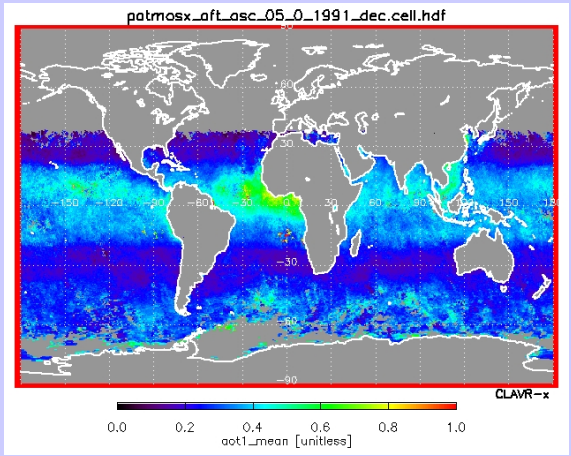






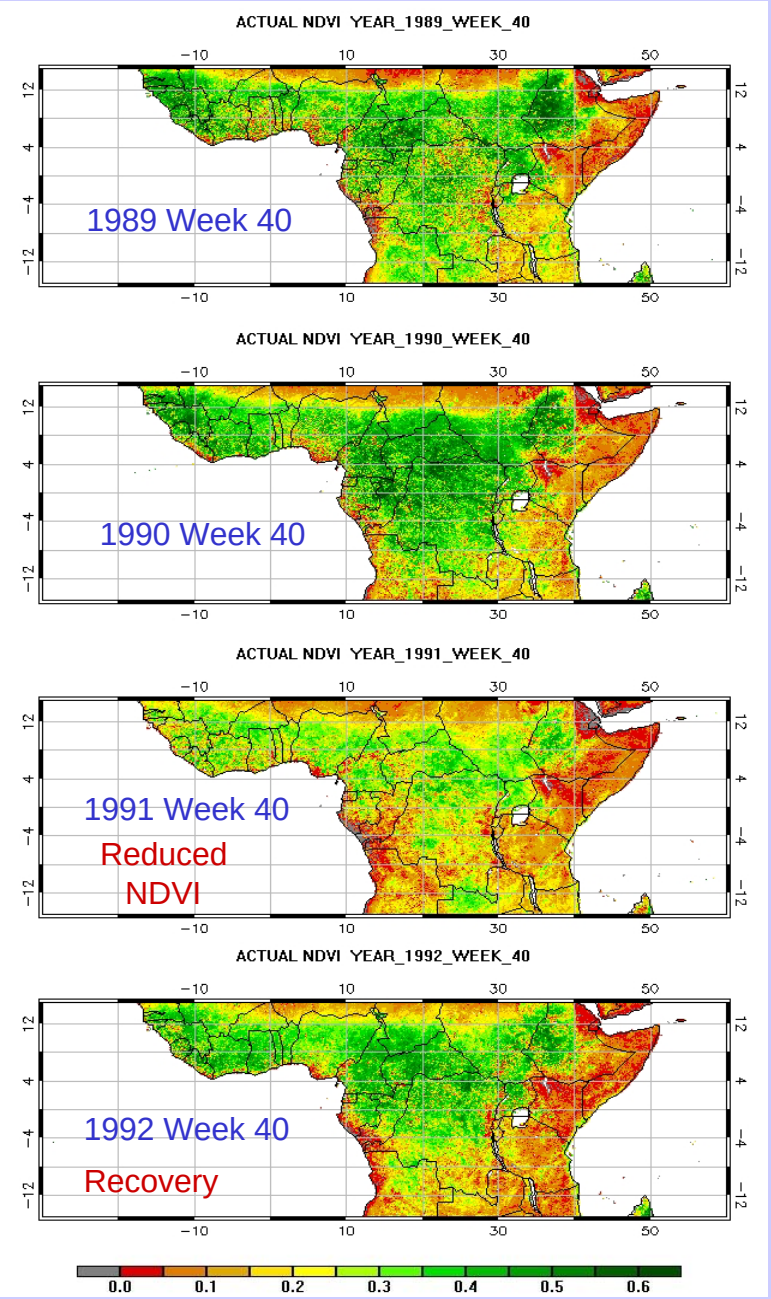


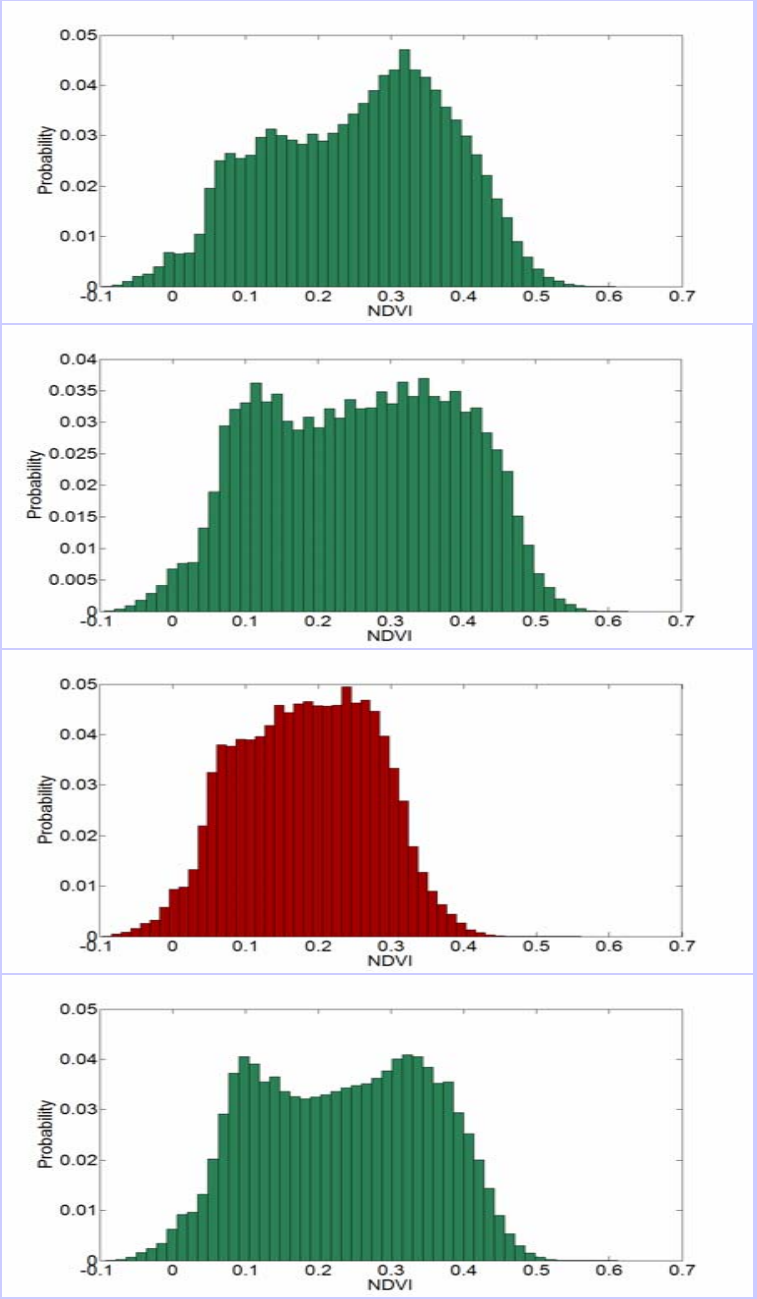




from: AVHRR Pathfinder Atmospheres - Extended (PATMOS-x)

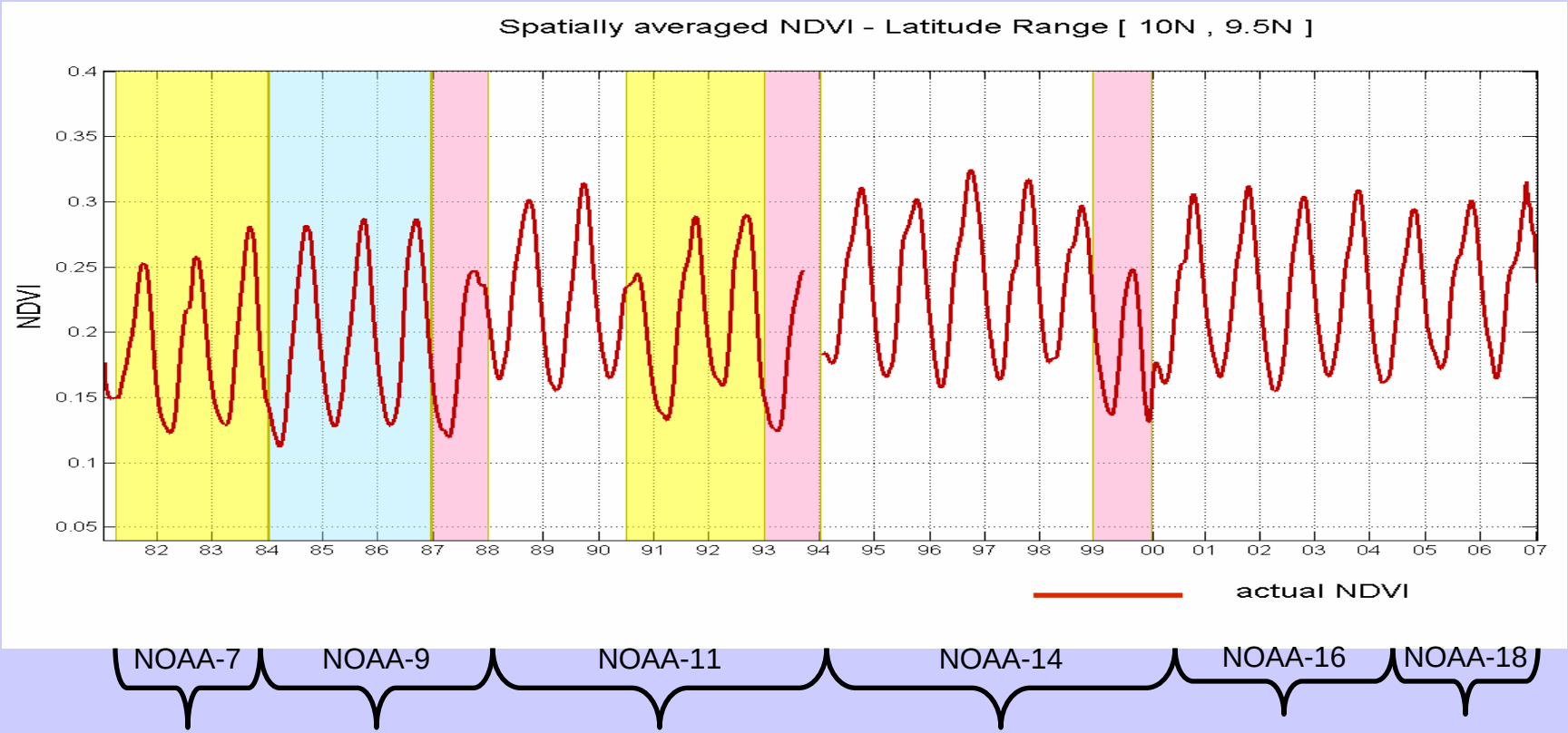
TOA – NDVI Central Africa





GVIx dataset. 4km res. 7-Day comp.

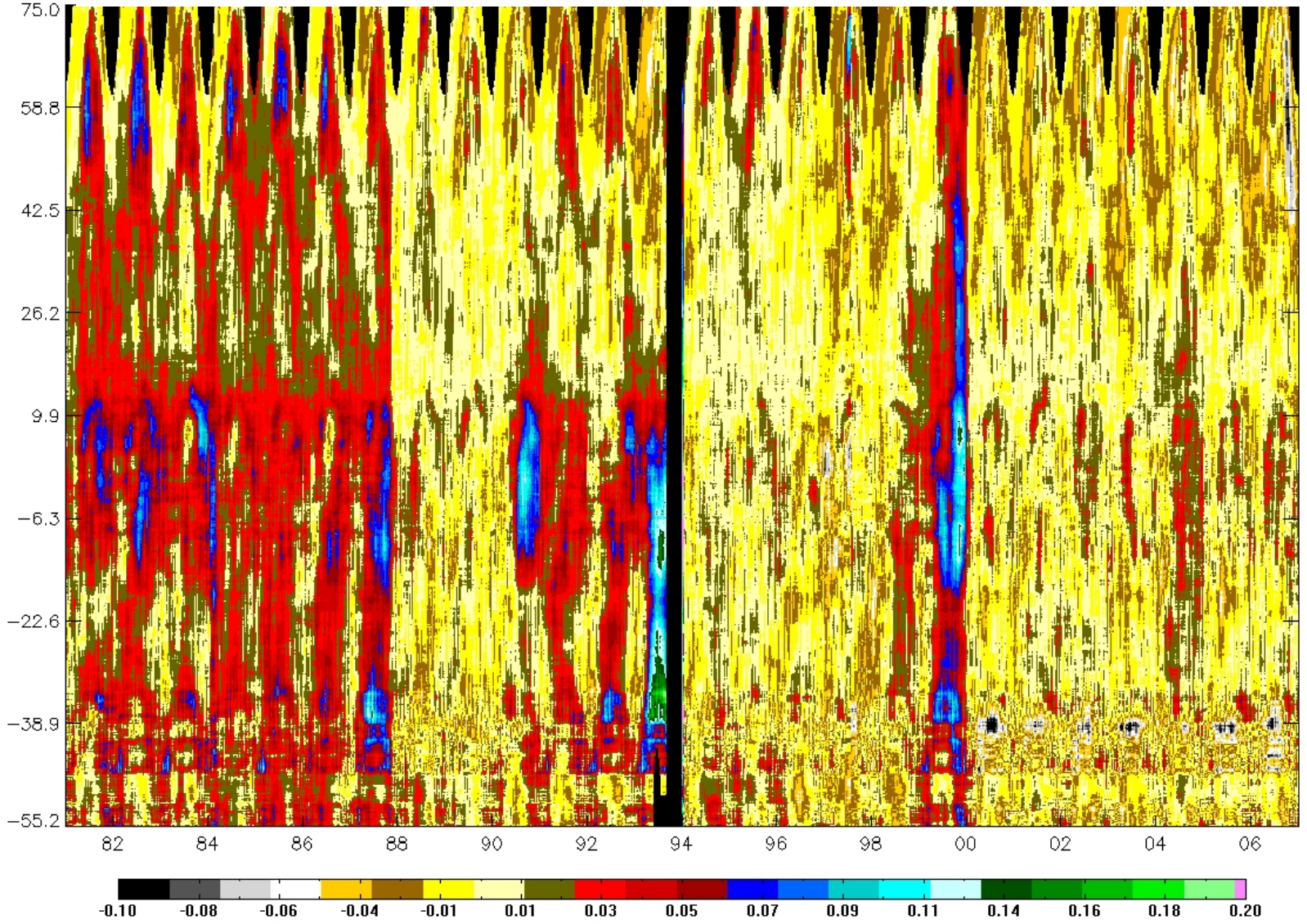
TOA NDVI Time Series (AVHRR)



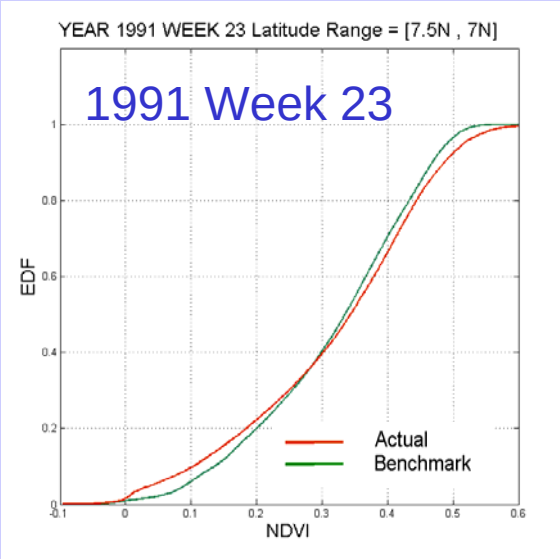
- The statistical method to remove the effect of volcanic aerosols makes use of a Benchmark NDVI.
- The Benchmark NDVI is calculated from five years of NDVI data (89,90,95,96,97) by averaging them.
- Benchmark years are not contaminated by volcanic aerosols and not affected by orbital drift.

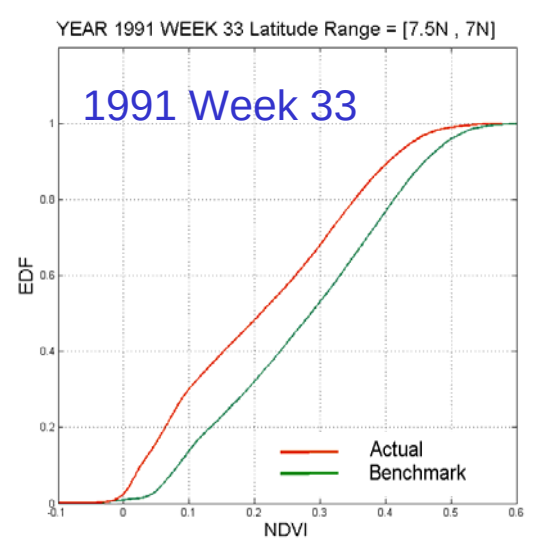
GVIx dataset. 4km res. 7-Day comp.

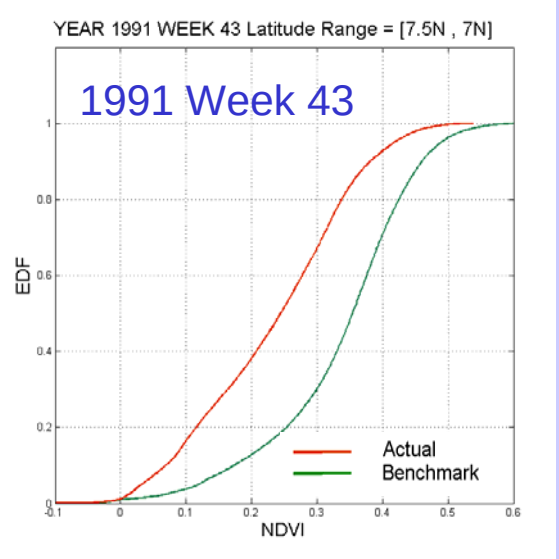
Difference between Benchmark NDVI and Actual NDVI (1982 – 2007)

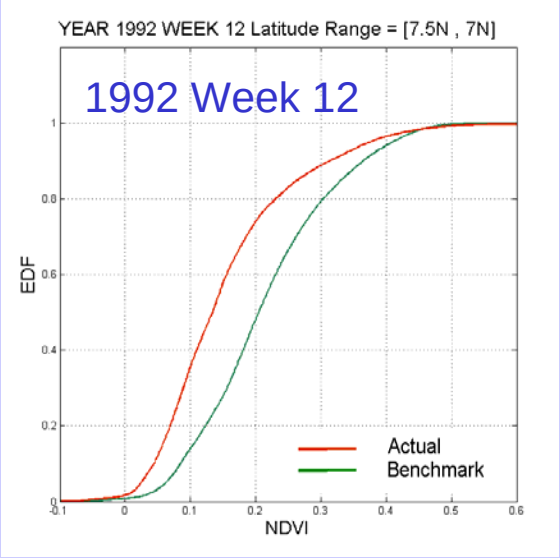


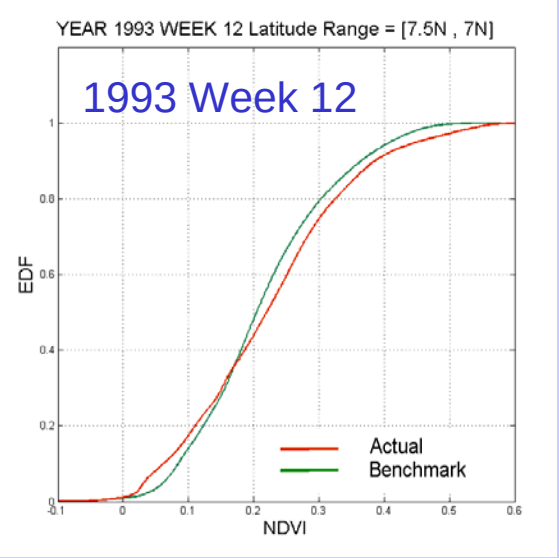
Effect of Volcanic Aerosols on EDF (Empirical Distribution Function). **Latitude Band 7.5N – 7N** (before and after **Mt. Pinatubo** eruption)

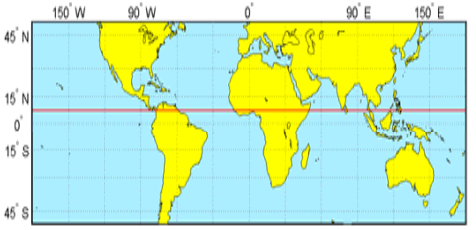












Latitude Band 7.5N – 7N

Normalization of NDVI
Using Empirical Distribution Functions (EDF)

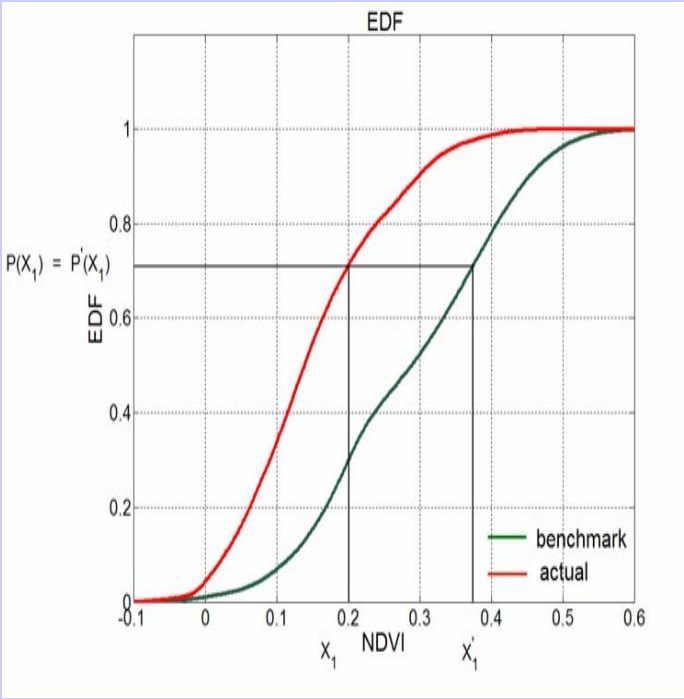
Procedure:

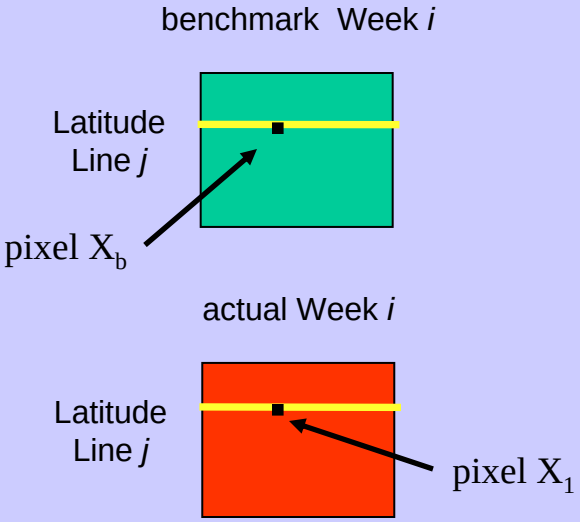
1) For the NDVI value X1 in the Image, find the percentage value from the actual EDF. In the illustration it is $P(X_1)$

2) Find the point on the benchmark EDF with the same percentage value

$$P(X_1) = P(X'_1)$$

3) Finally, use the EDF of the benchmark to find the normalized NDVI value X'_1

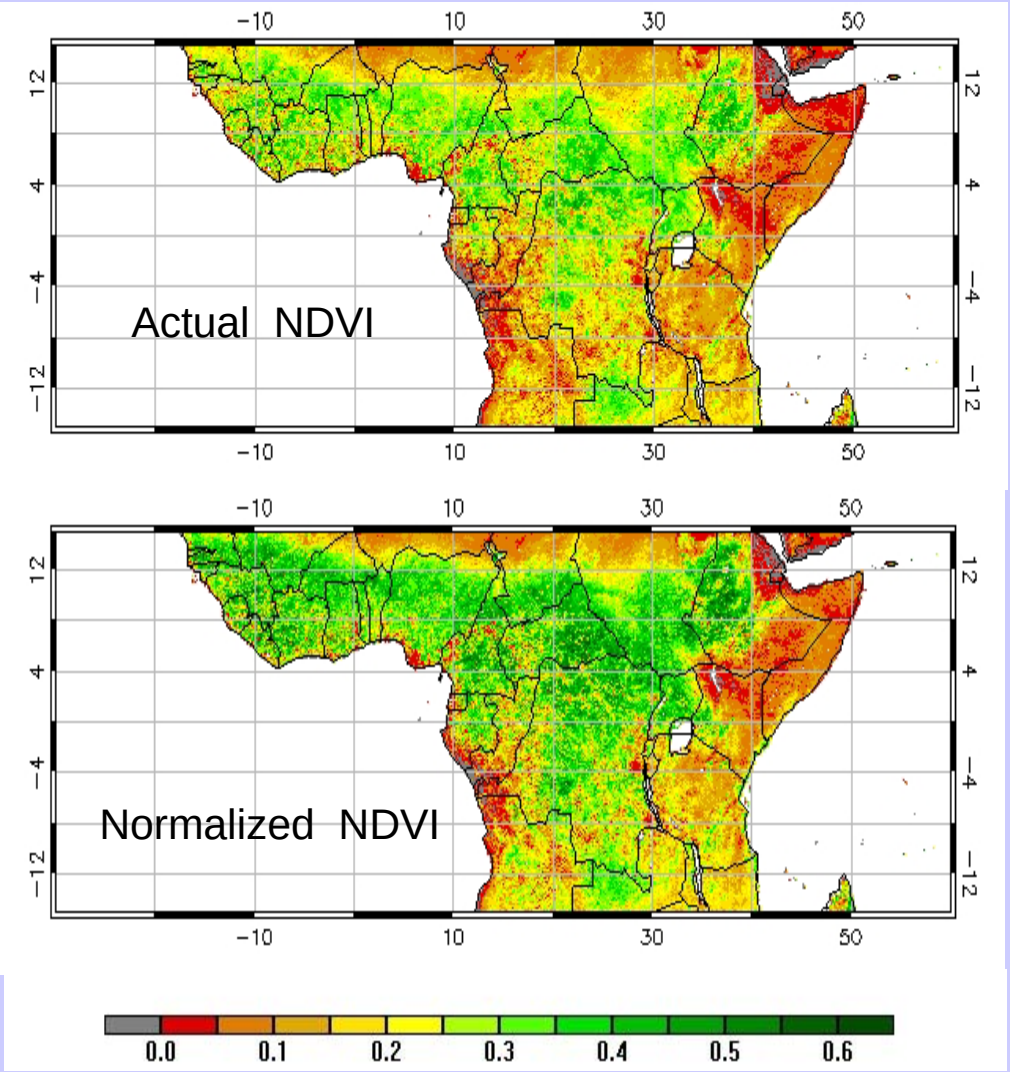


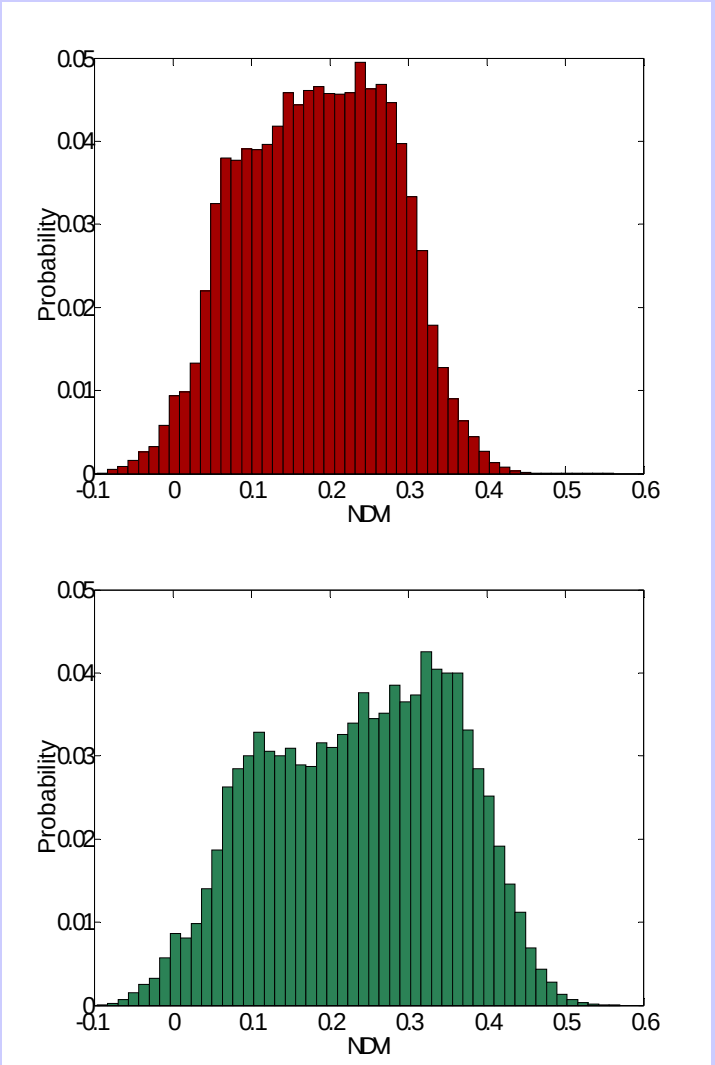


if $X_b > X_1$ and $(X_b - X_1) >$ Threshold then, apply normalization

if $X_b < X_1$ do not apply normalization

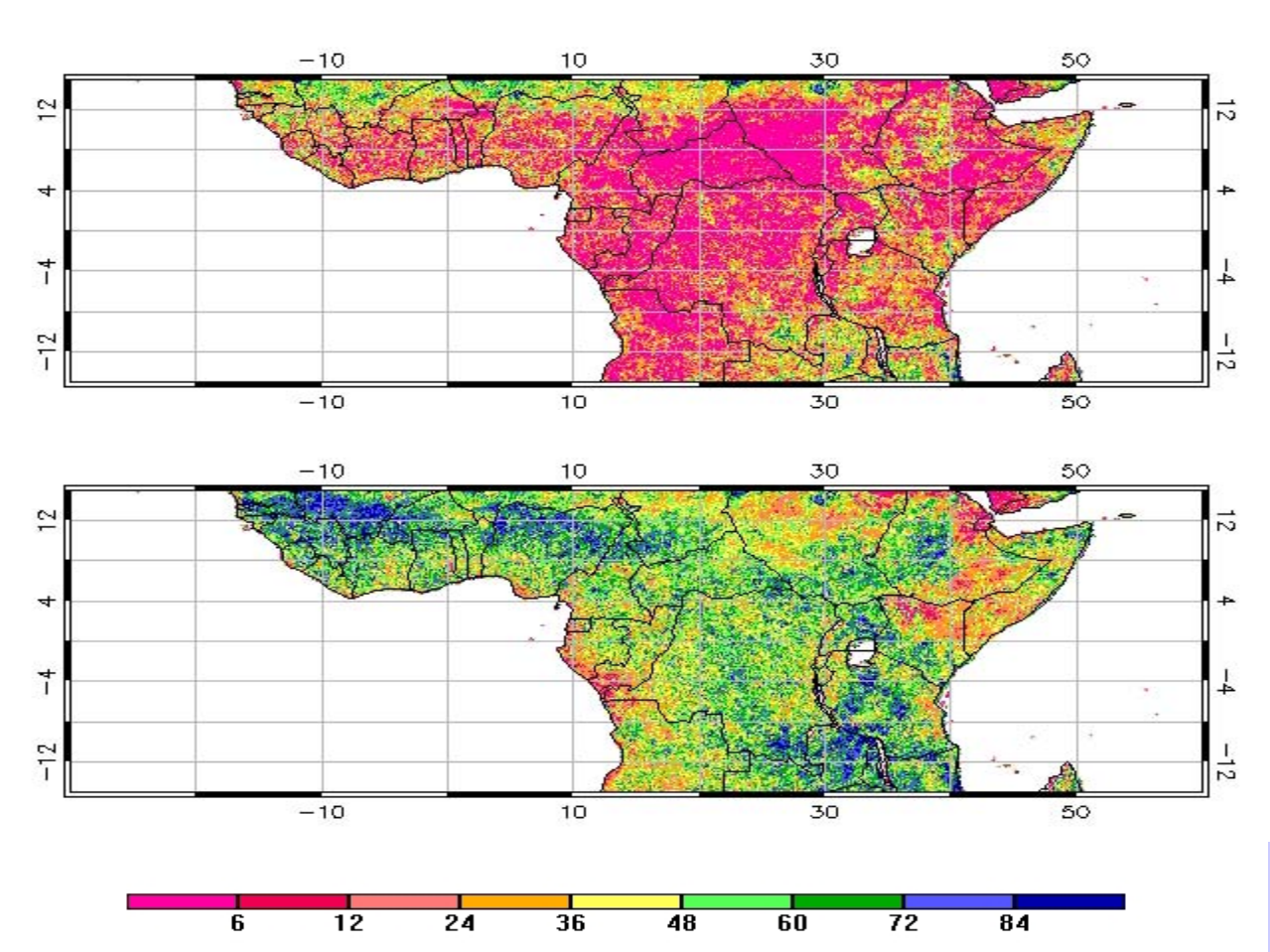
NDVI Year 1991 Week 40 (after **Mt. Pinatubo** eruption)





GVIx dataset. 4km res. 7-Day comp.

VCI Year 1991 Week 40 (after **Mt. Pinatubo** eruption)



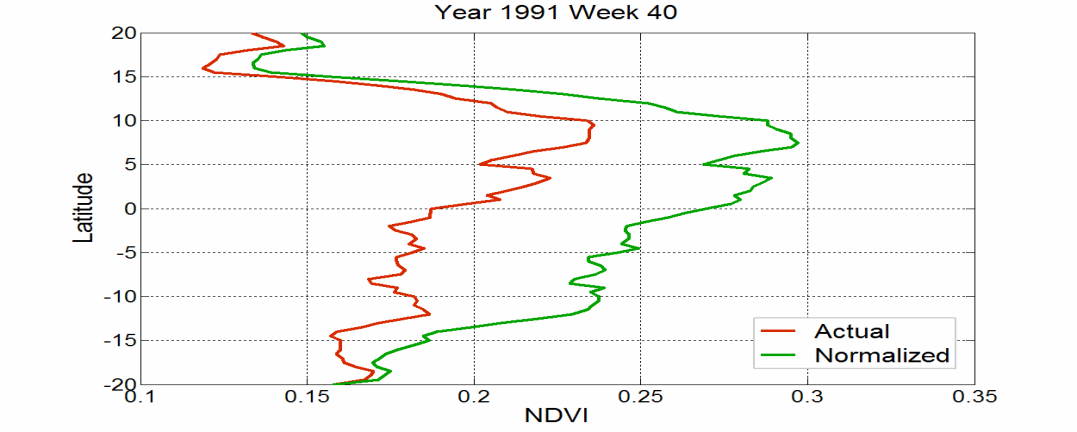
Actual VCI

Normalized VCI

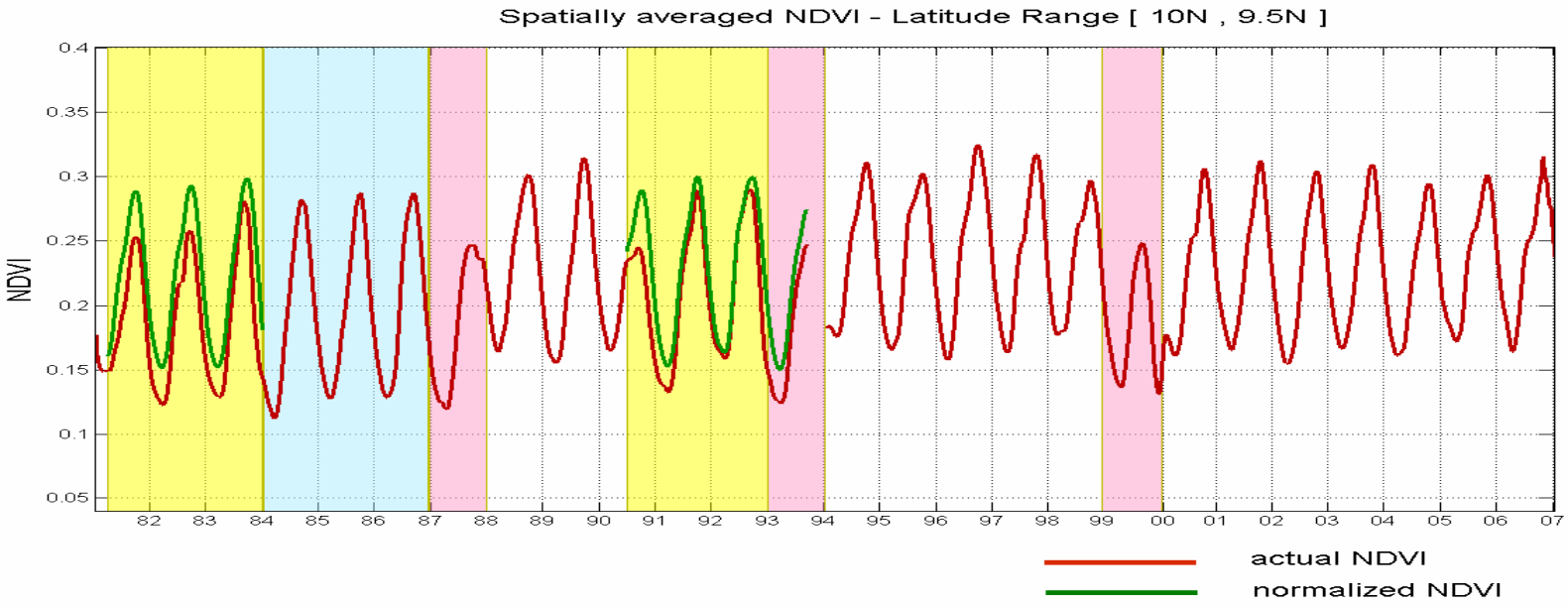
- VCI (Vegetation Condition Index) is one of the VH (Vegetation Health) products derived from the NOAA - GVIx dataset.
- VCI changes from 0 to 100, corresponding to changes in vegetation condition from extremely unfavorable to optimal.

GVIx dataset. 4km res. 7-Day comp.

Latitudinal profile of NDVI Week 40 Year 91



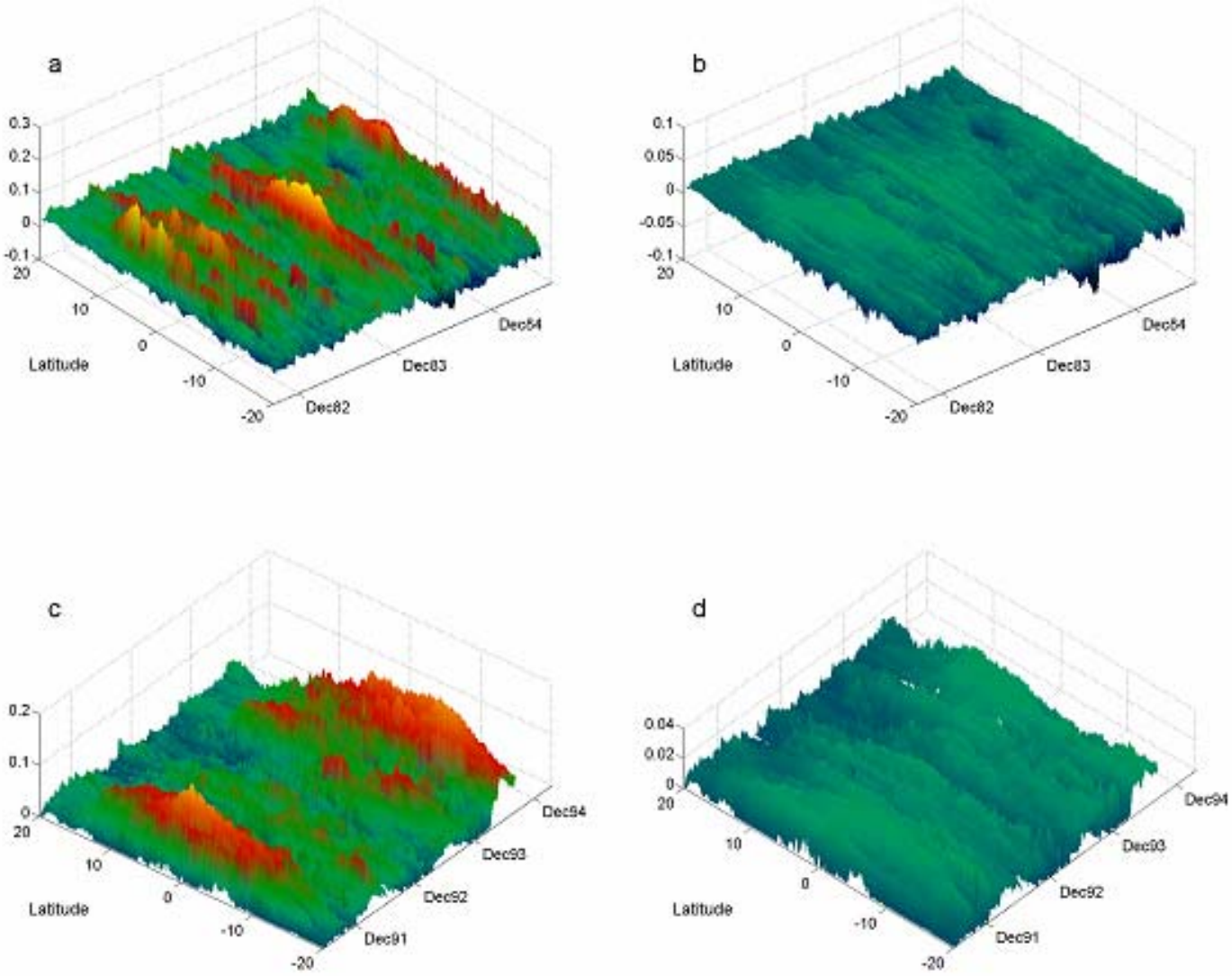
TOA - NDVI Time Series (AVHRR)



GVIx dataset. 4km res. 7-Day comp.

Difference between Benchmark NDVI and Actual NDVI

Difference between Benchmark NDVI and Normalized NDVI



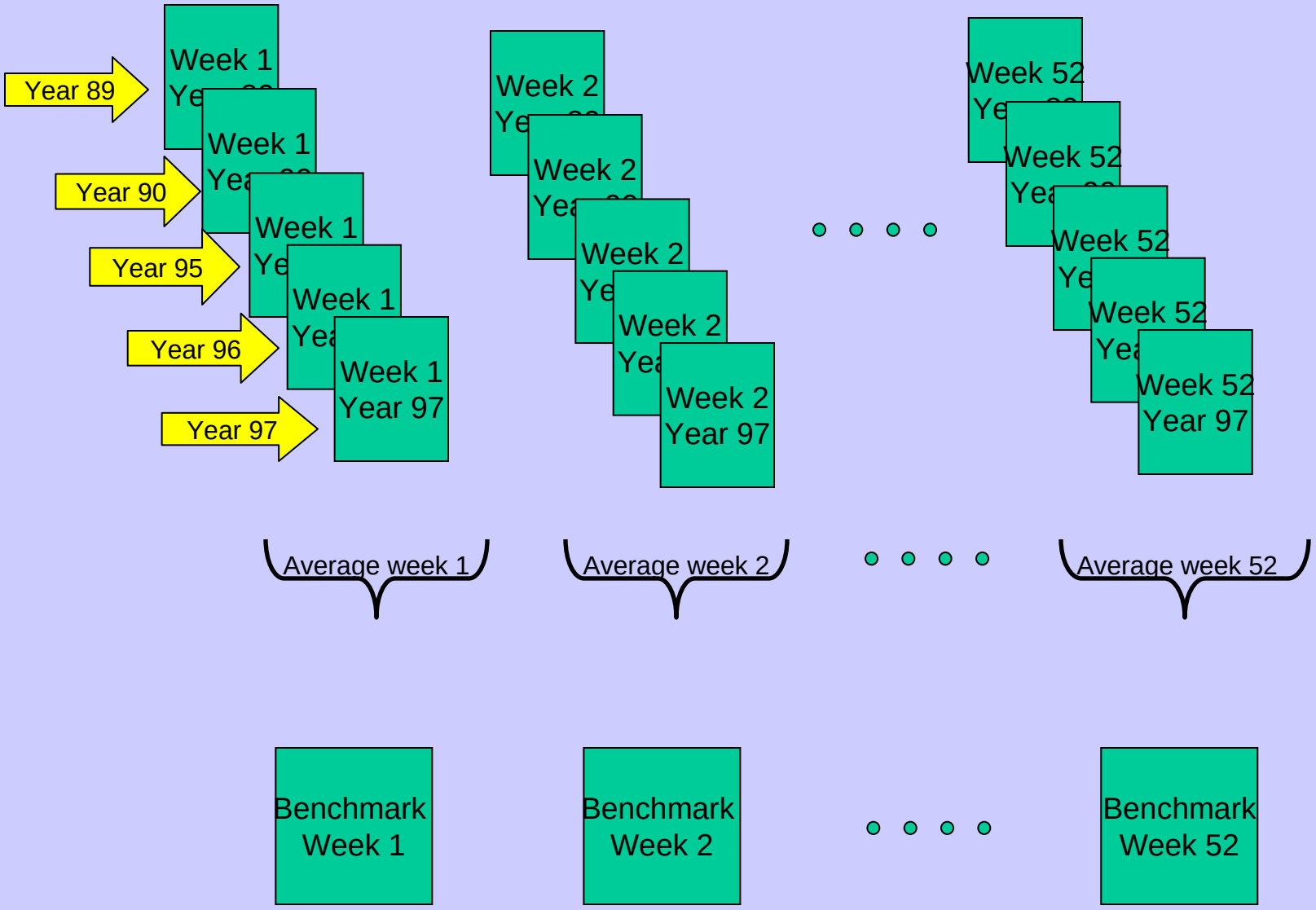
Summary and Future Work

- Need to implement other corrections to enable the analysis of long-term trends.
- The normalization removes the negative bias introduced by the volcanic aerosols.
- This correction will potentially allow for better regional drought assessment.
- Validation still pending.
- We will compare our time series to GIMMS and LTDR time series.
- Also, perform indirect validation using VH indices to predict crop yield and compare results to agricultural data.

Thank you!

BACK UP SLIDES

Benchmark NDVI is a composite NDVI (average) from 5 years



EDF normalization

Year 1989 Week *i*

Latitude Line *j*

Year 1990 Week *i*

Latitude Line *j*

Year 1995 Week *i*

Latitude Line *j*

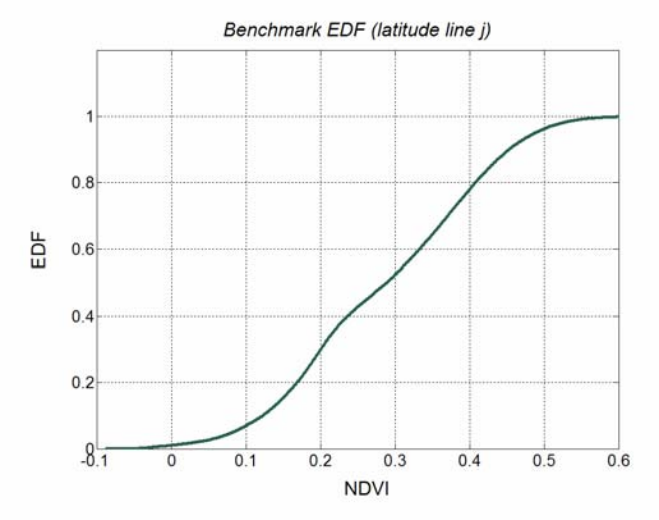
Year 1996 Week *i*

Latitude Line *j*

Year 1997 Week *i*

Latitude Line *j*

Take all pixels from the 5 latitude lines to build the benchmark EDF



Week *i*

Latitude Line *j*