

Global Warming & Land Cover Change from Space

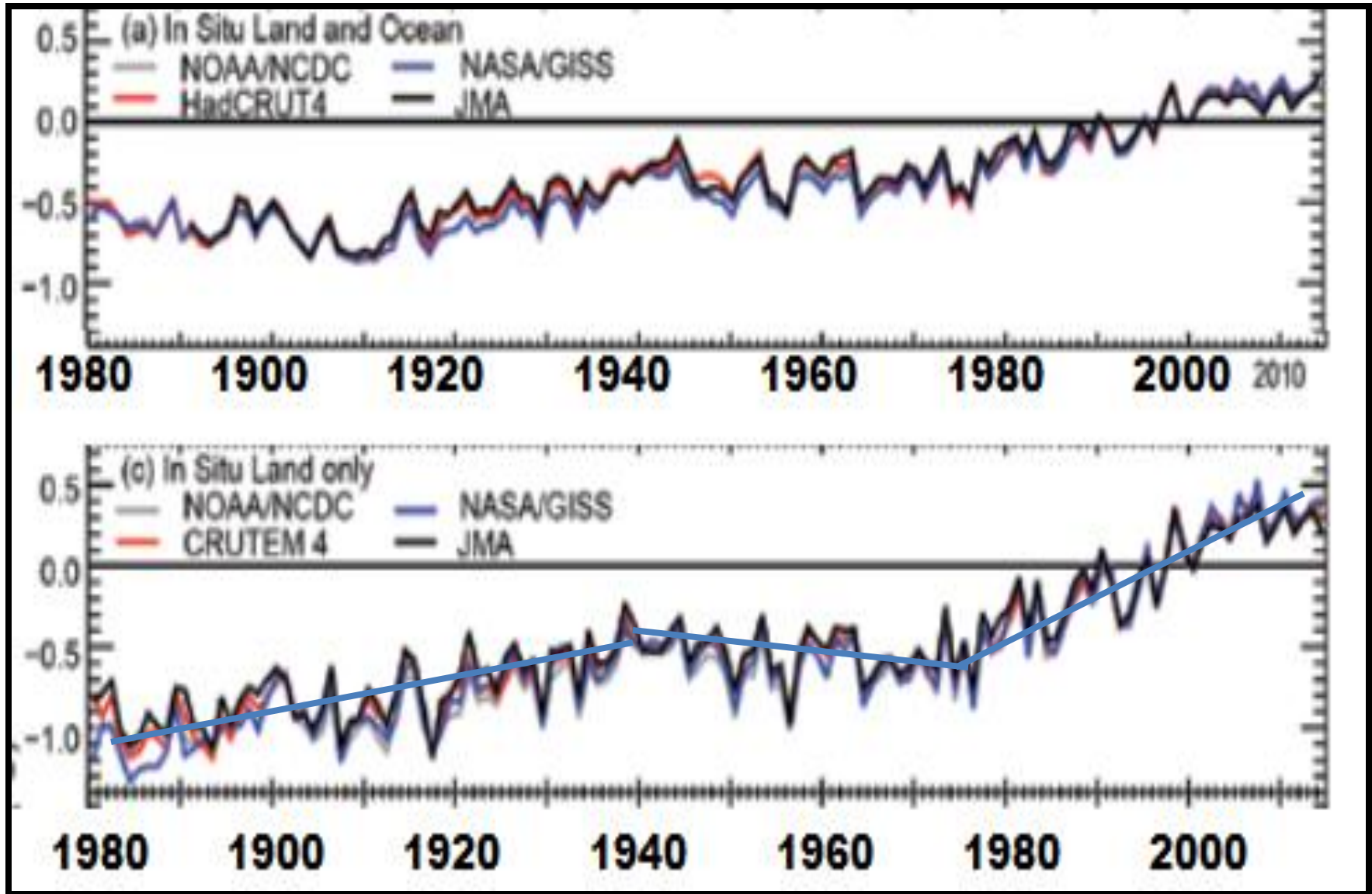
Felix Kogan

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National Environmental Satellite Data and Information Services (NESDIS)
Center for Satellite Applications and Research (STAR)

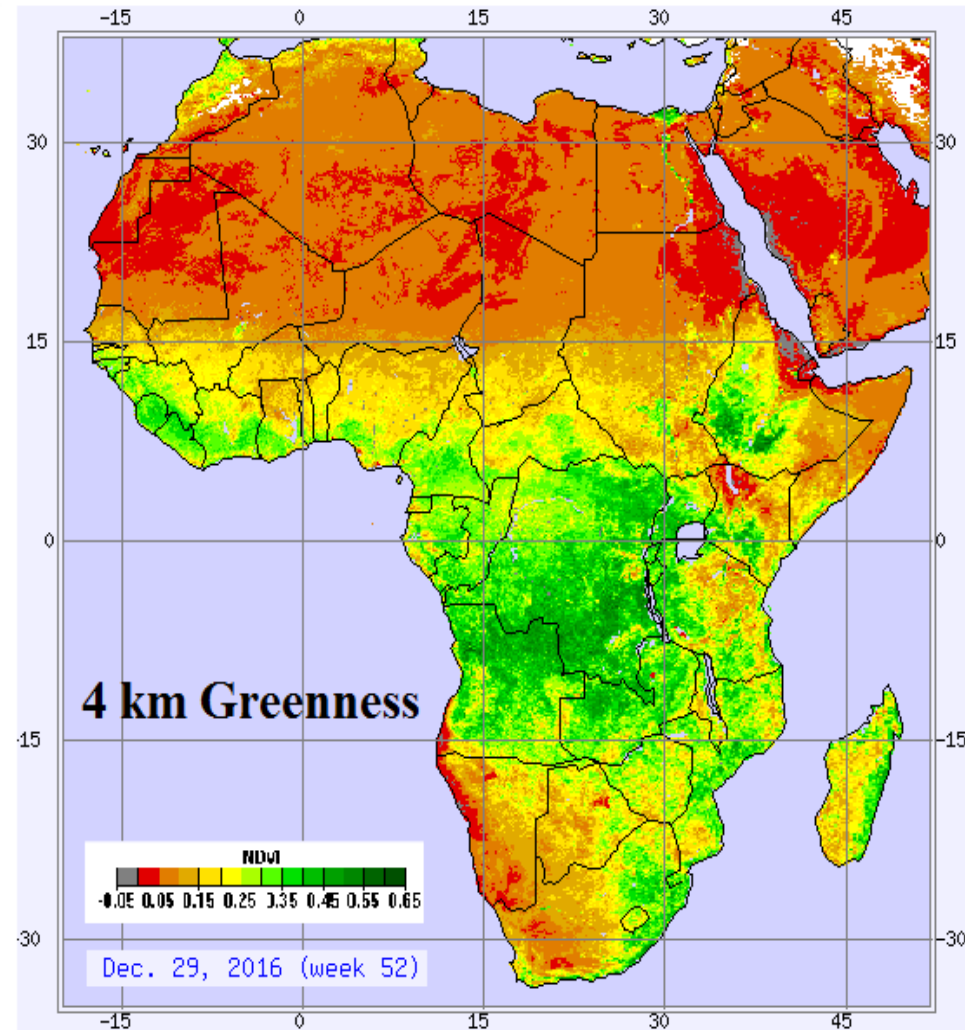
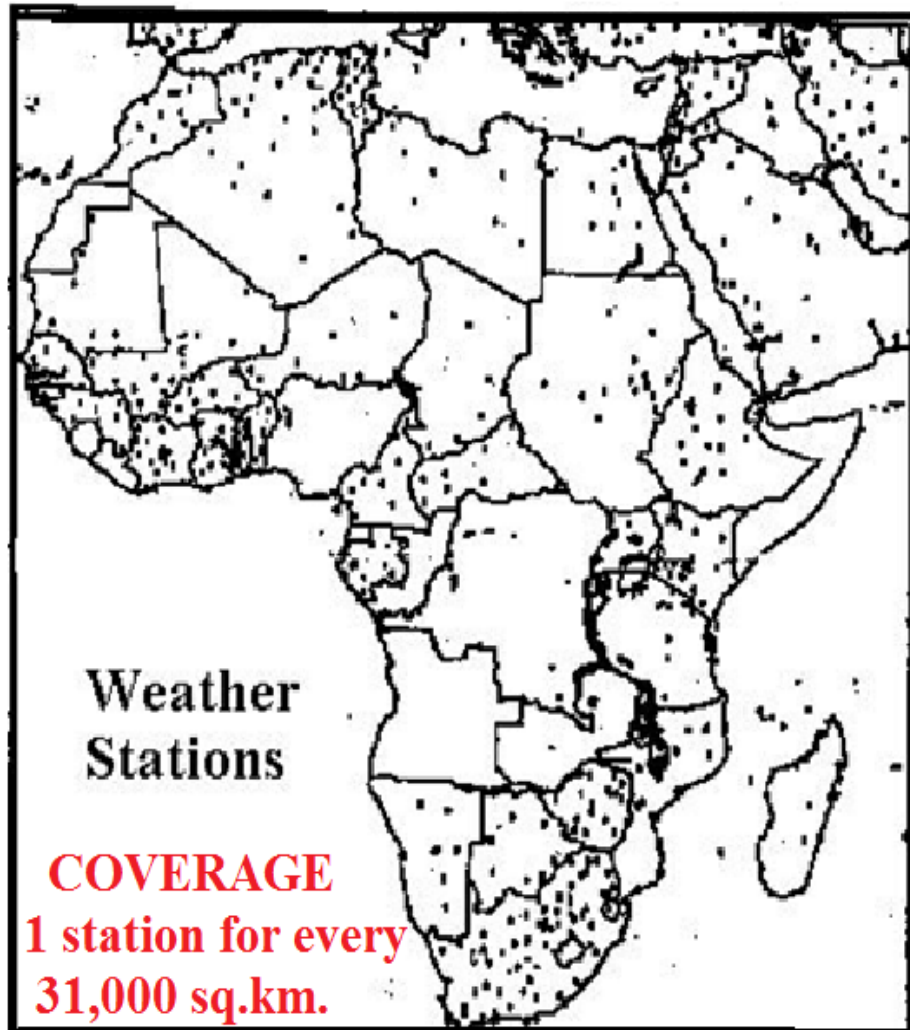
GLOBAL CONCERNS

- **Growing world population (WP):**
2016 - WP **7.4** billions;
By 2050 – WP will be **12** billions (projection)
- **Leveling off Grain Production**
- **Declining stock of natural resources** (water, vegetation)
- **Global changes** (dry area increase, land withdrawal for real-estate)
- **Land degradation** (deforestation, soil fertility)
- **Current climate constraints & economy**
- **Climate warming**
- **Land cover change**
- **Increase in weather extremes**

NOAA/NASA In Situ Land & Ocean Temperature Anomaly



Weather Stations & Satellite Data Coverage



NOAA Operational Satellites for Land Cover Monitoring

Sensors *Advanced Very High Resolution Radiometer (AVHRR)*

Visible Infrared Imaging Radiometer Suite (VIIRS)

Satellites NOAA: NOAA-7, 9, 11, 14, 16, 18, 19

SNPP & JPSS

Data Resolution *Spatial* - 0.5, 1, 4 (GAC), 8 & 16 km

Temporal - 7-day composite

Current Period: 36-year (1981-2016)

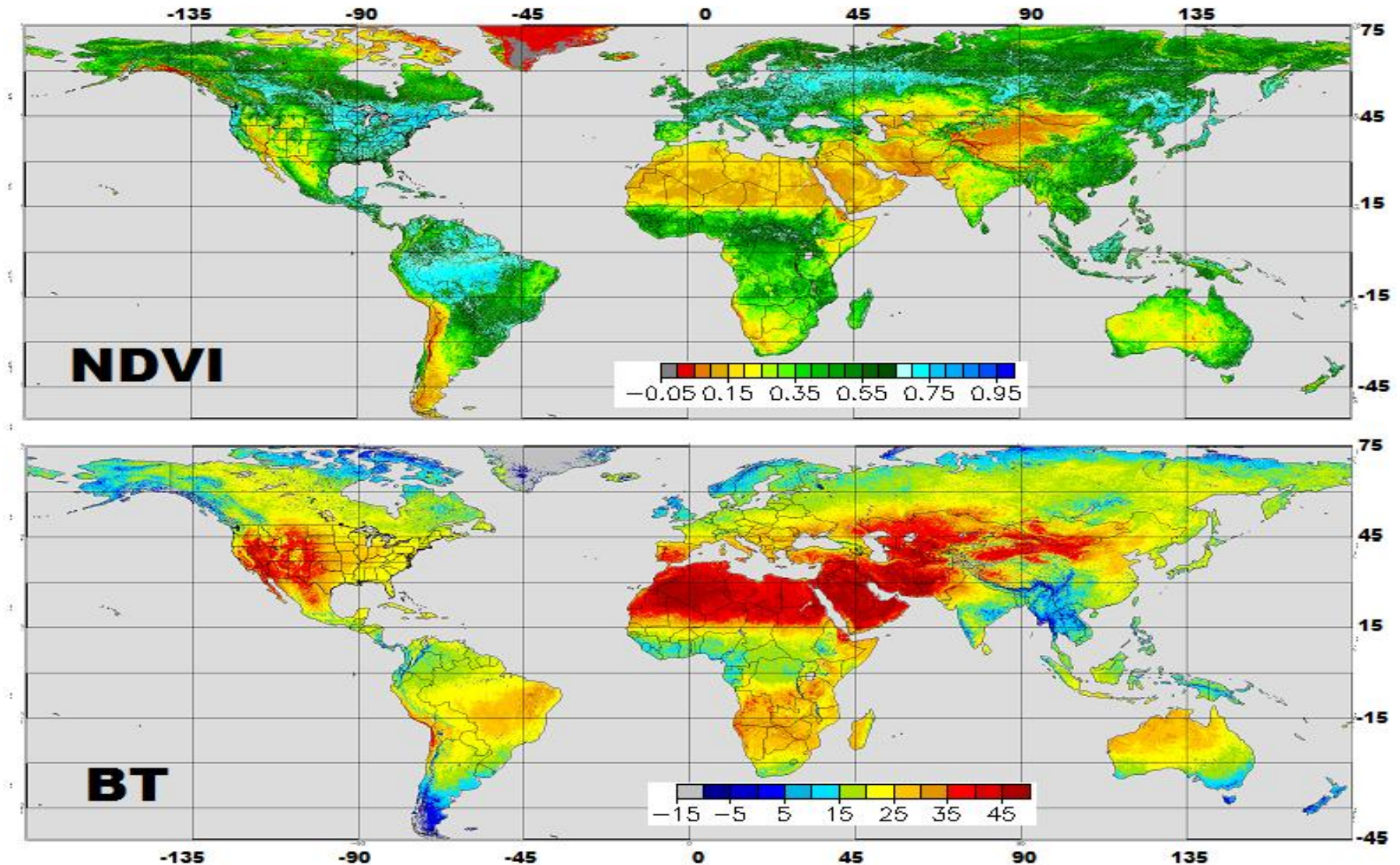
5-year (2012-2016)

Coverage **World** (75 N to 55 S)

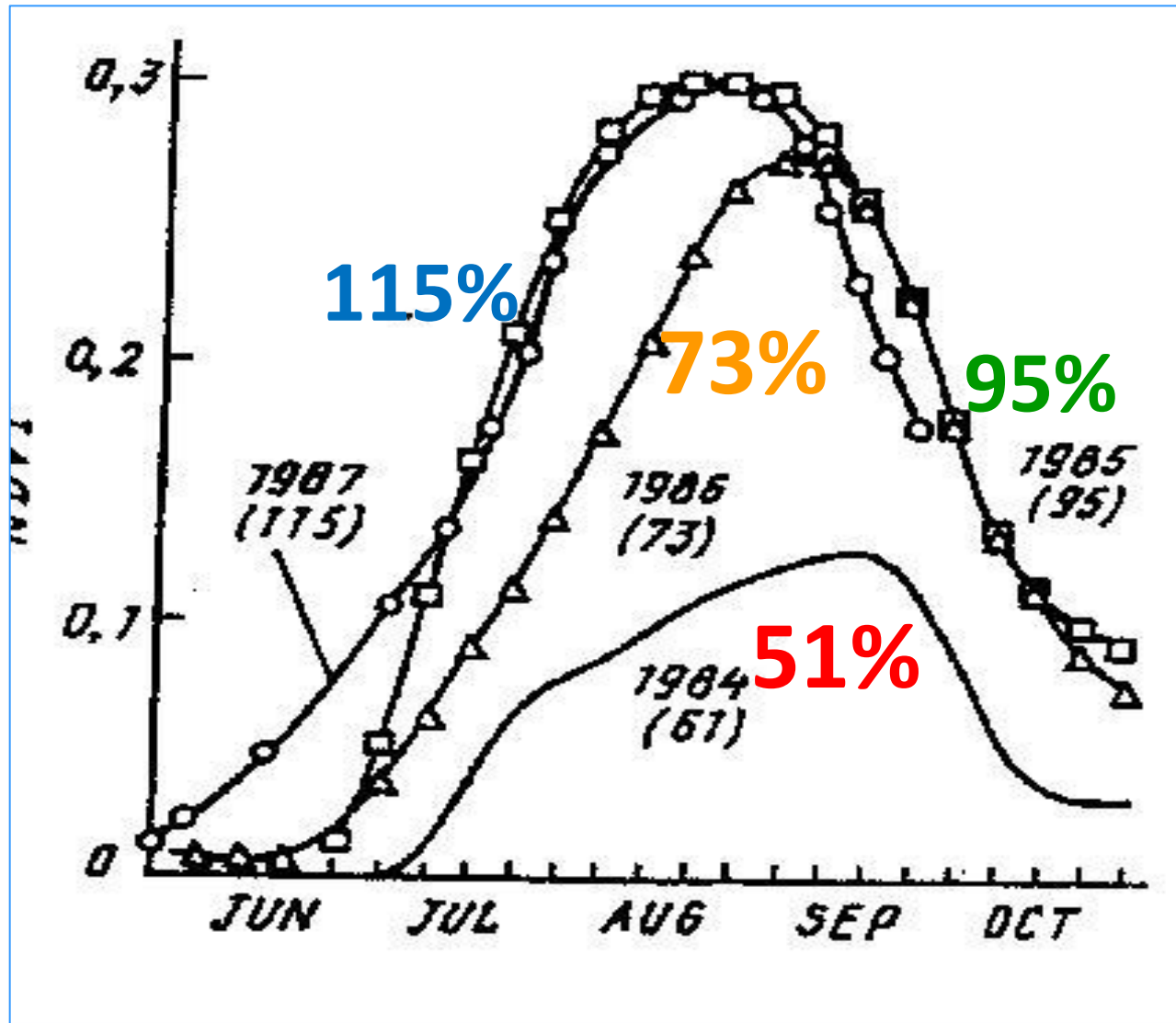
Channels VIS , NIR , Thermal

INDICES NDVI & Brightness Temperature

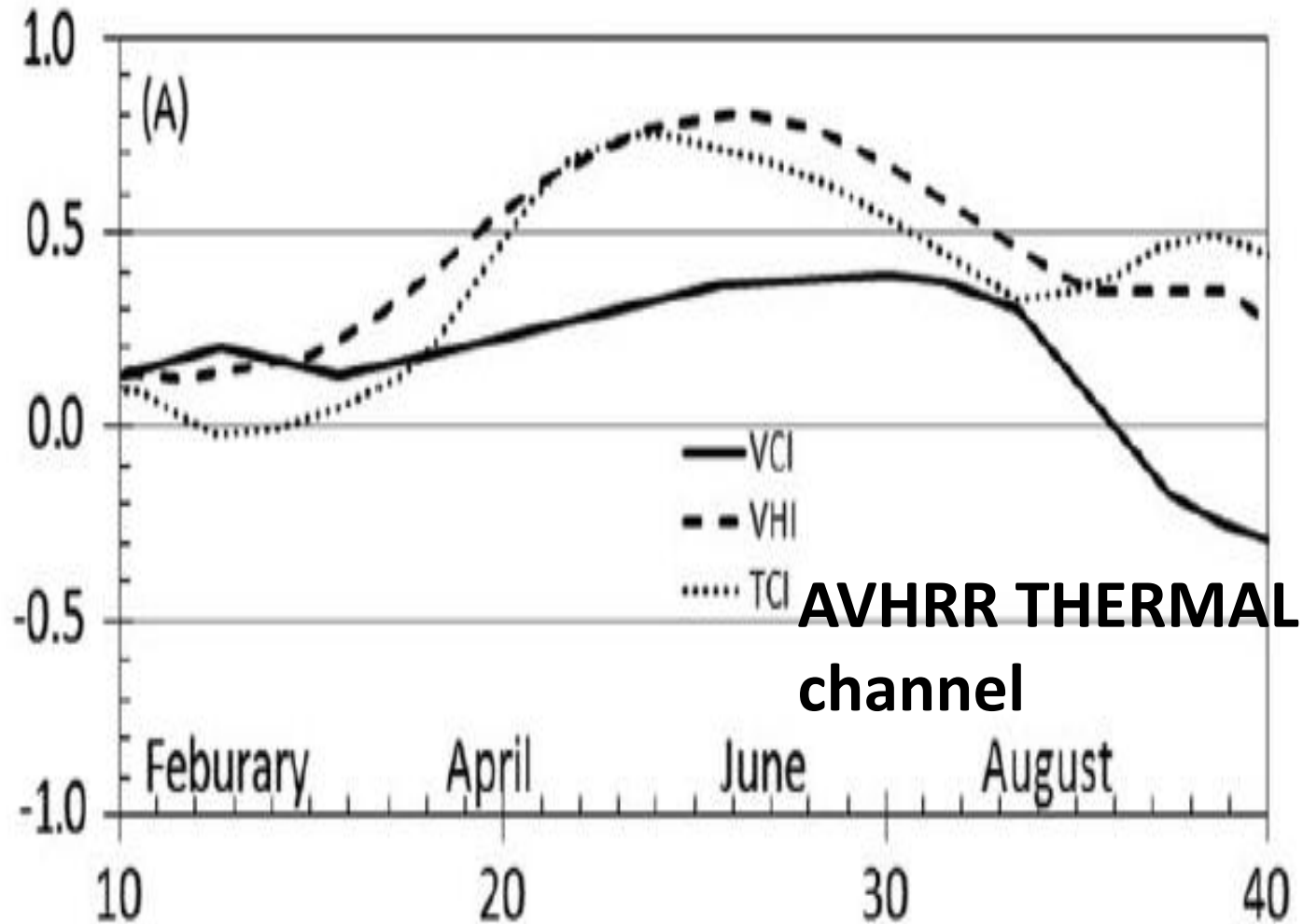
Normalized Difference Vegetation Index & Brightness Temperature



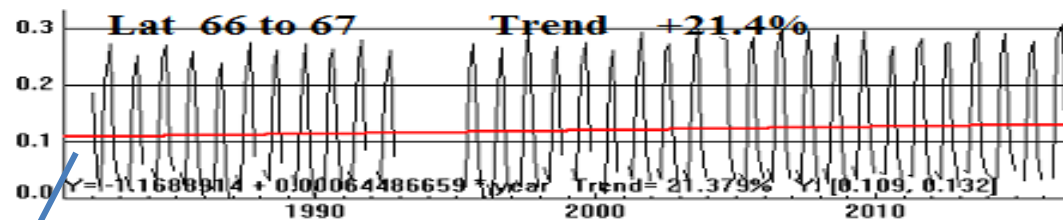
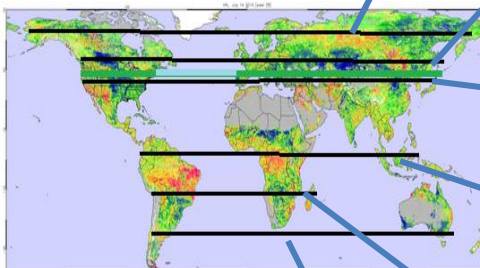
NDVI & Rainfall (% of mean) SUDAN



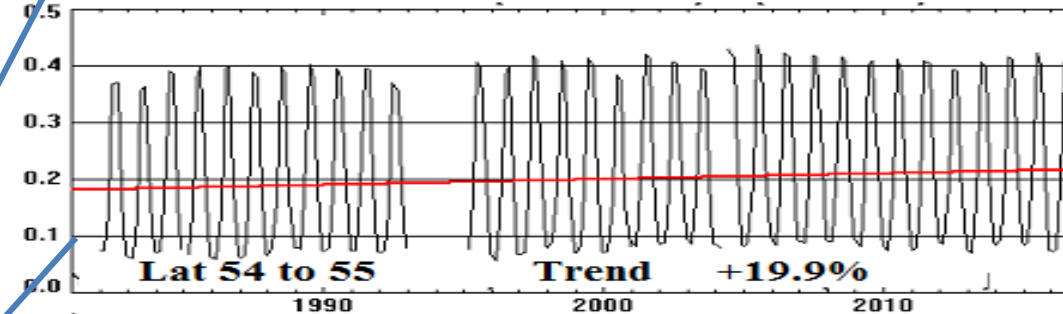
Correlation of Russia (Saratov) Yield with VH data



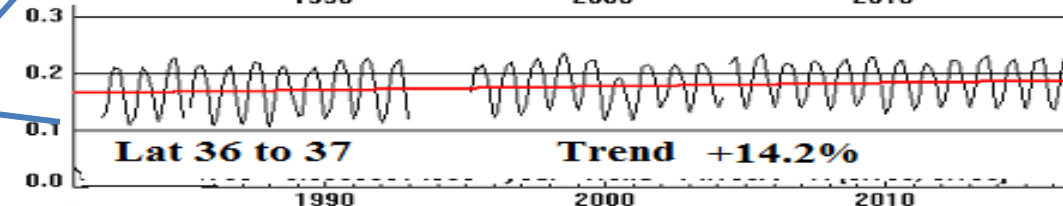
Latitudinal NDVI Trend



+21.4%



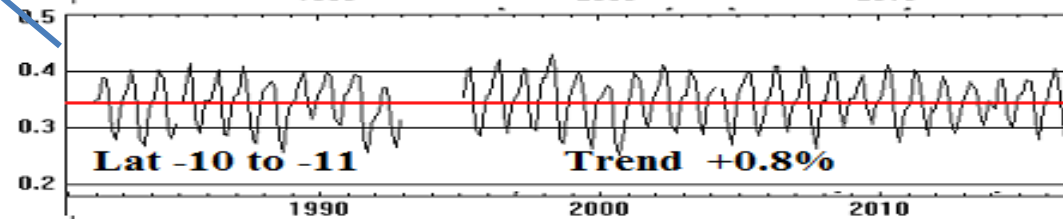
+19.9%



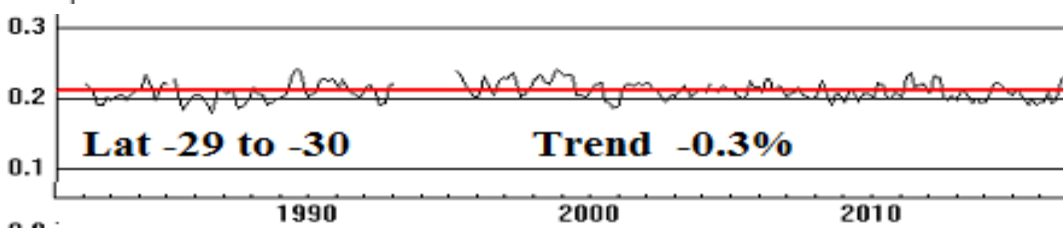
+14.2%



+ 1.8%



+ 0.8%



- 0.3%

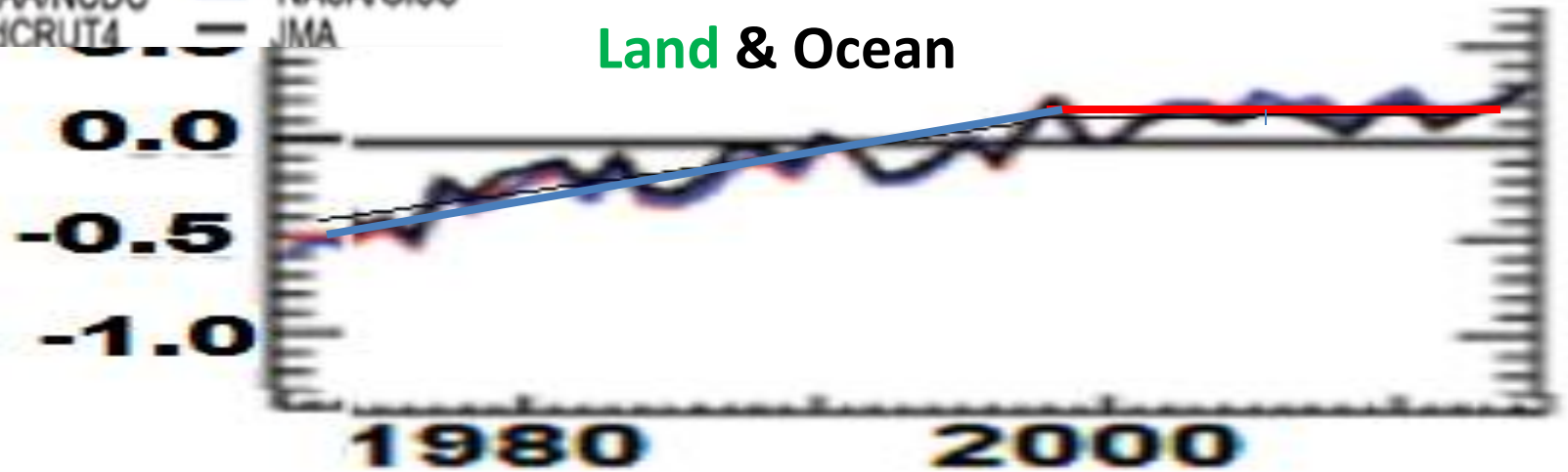
Global Temperature Anomaly 1980-2014

NOAA/NCDC, [NASA/GISS](#), HadCRUT4, JMA

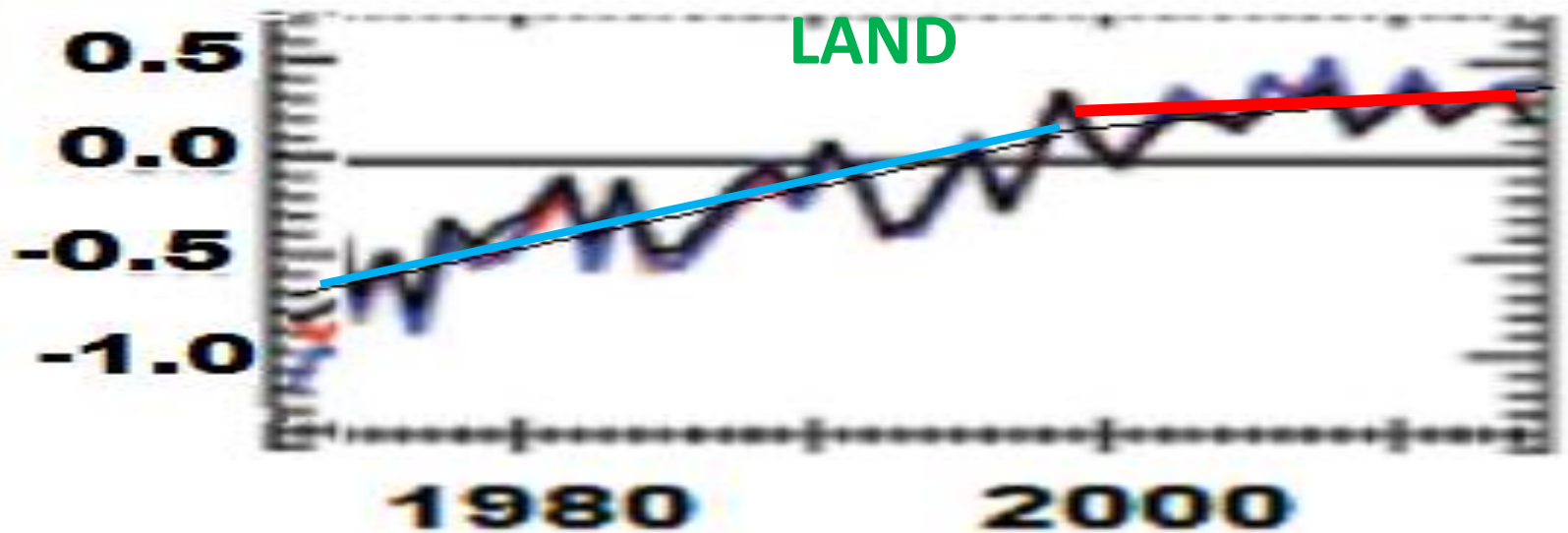
(a) In Situ Land and Ocean

— NOAA/NCDC — NASA/GISS
— HadCRUT4 — JMA

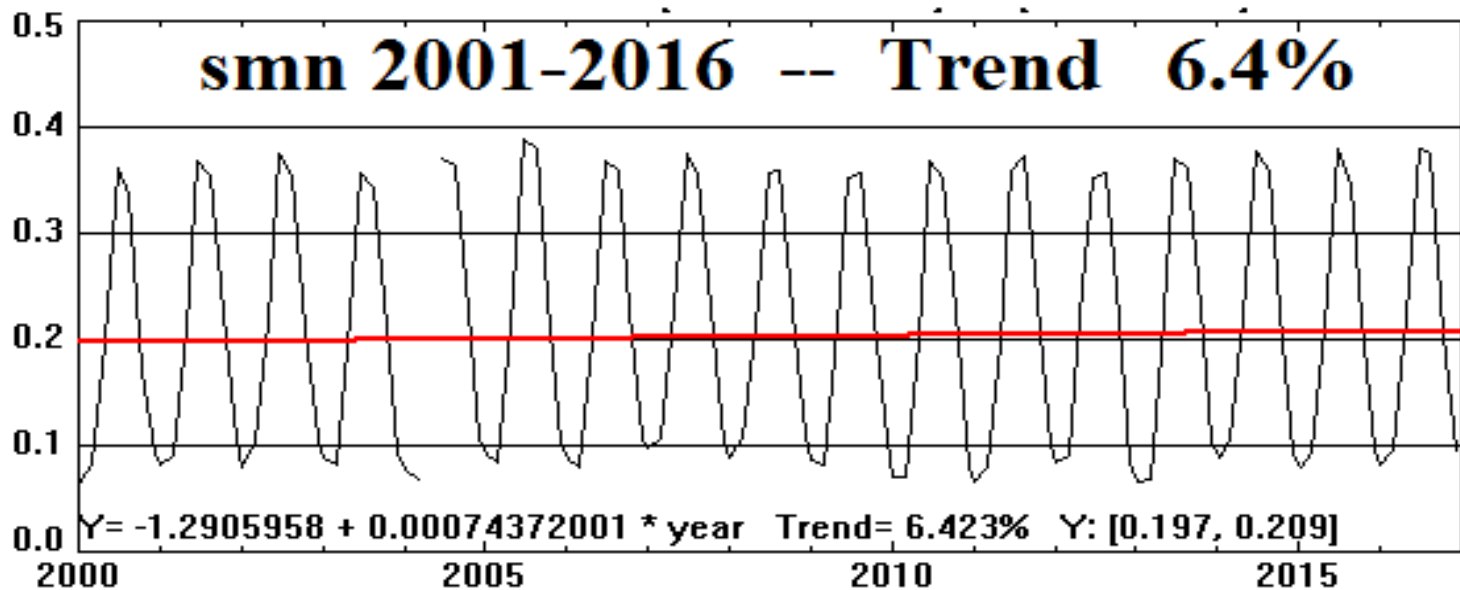
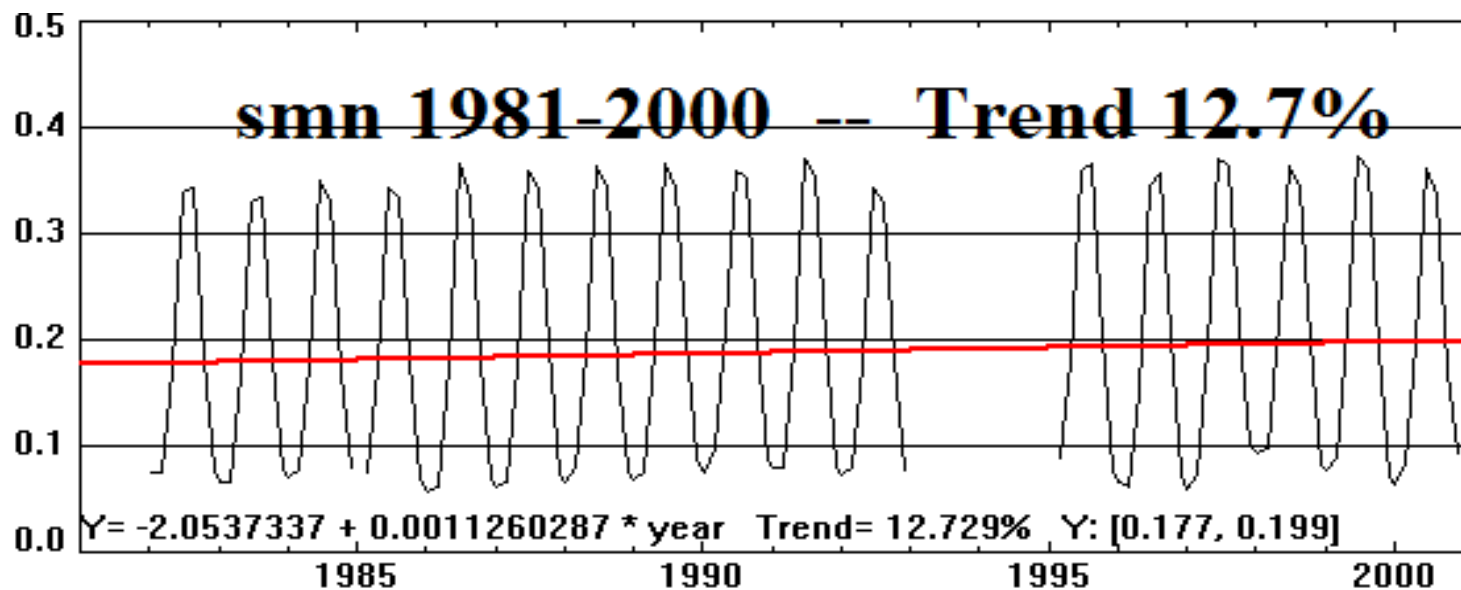
Land & Ocean



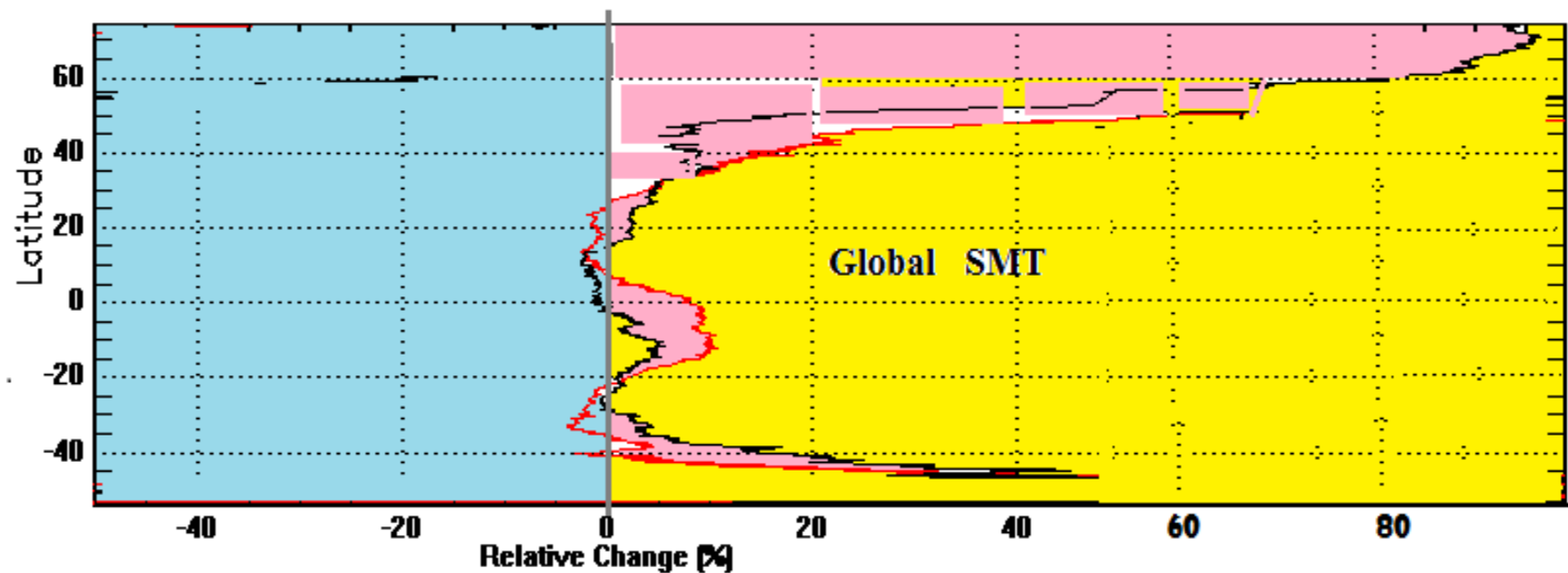
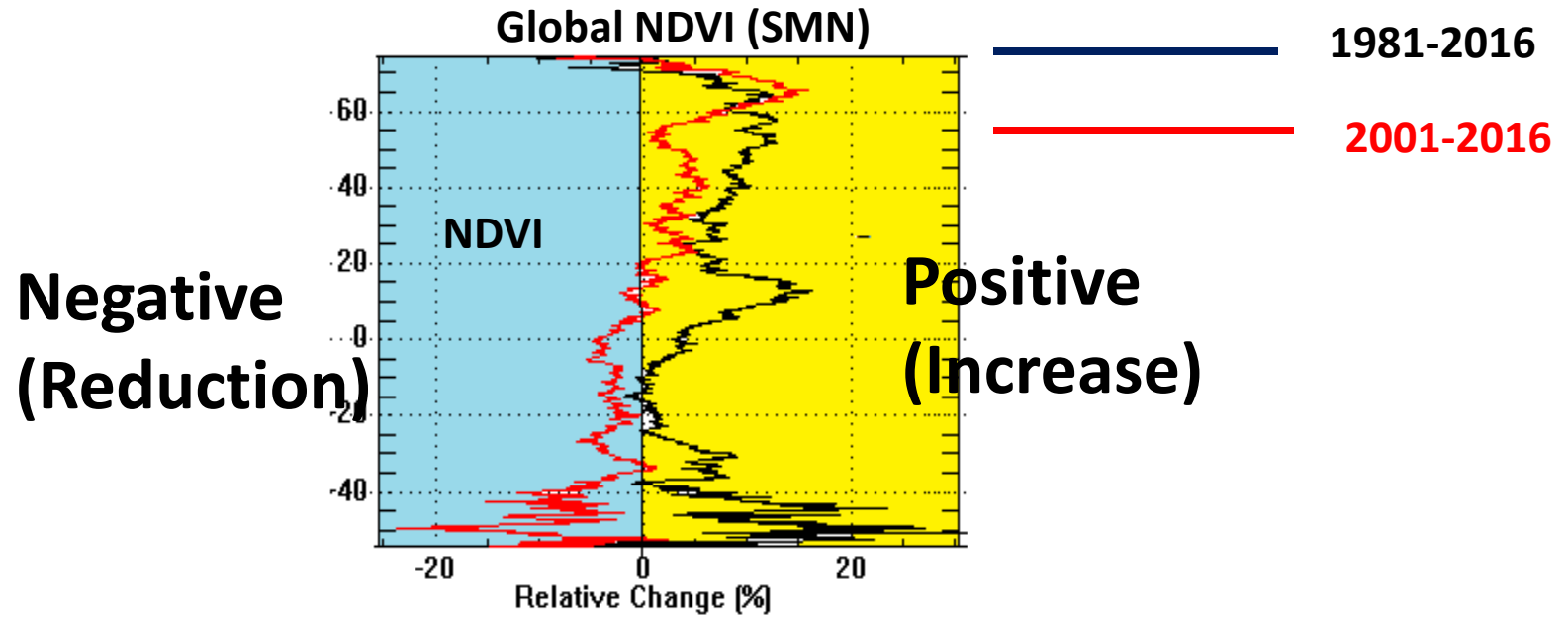
LAND



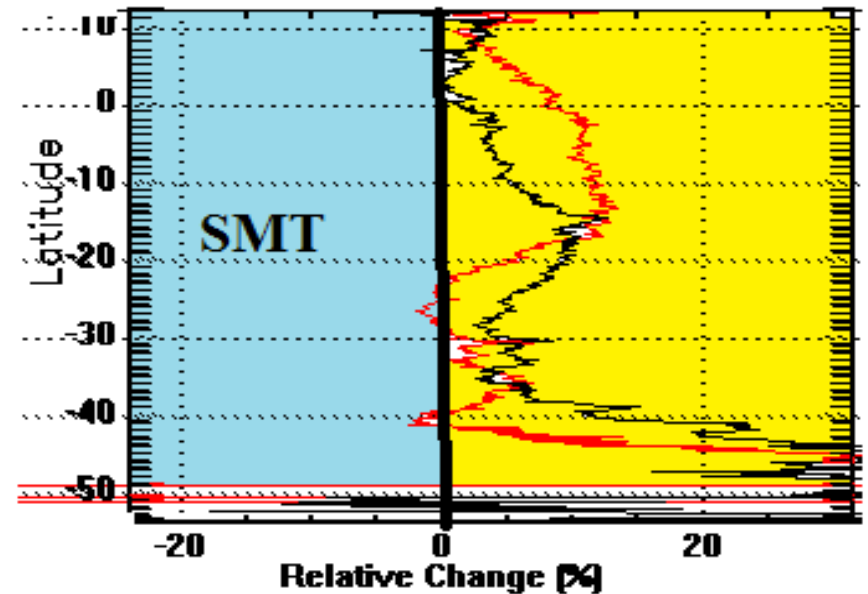
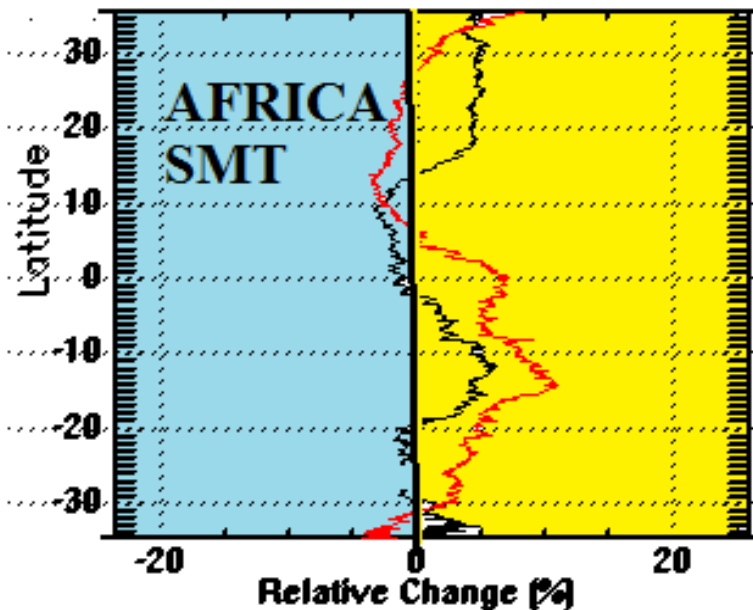
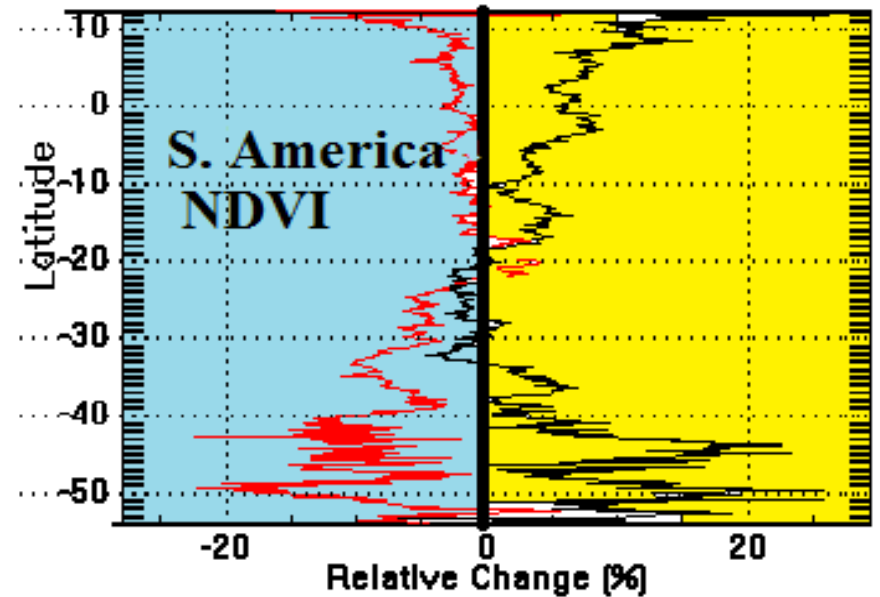
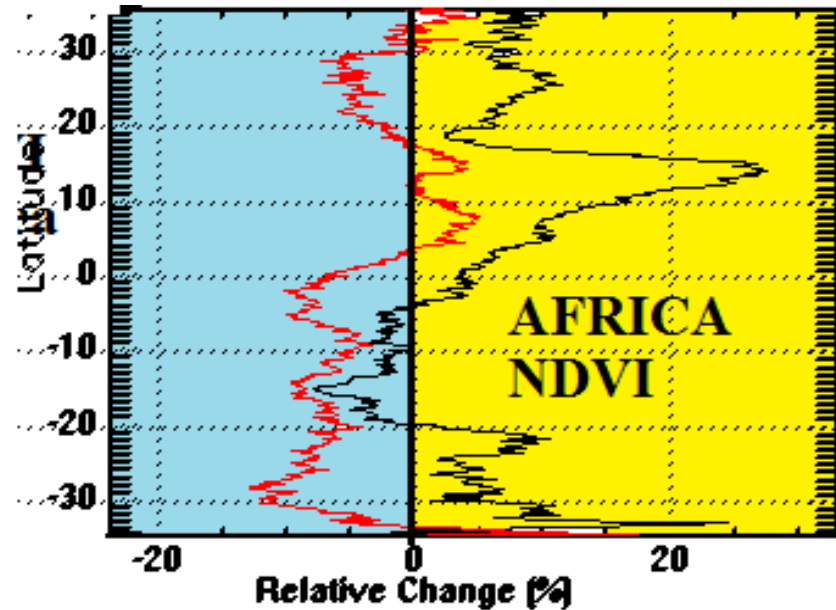
NDVI Trend for Lat 54-55N



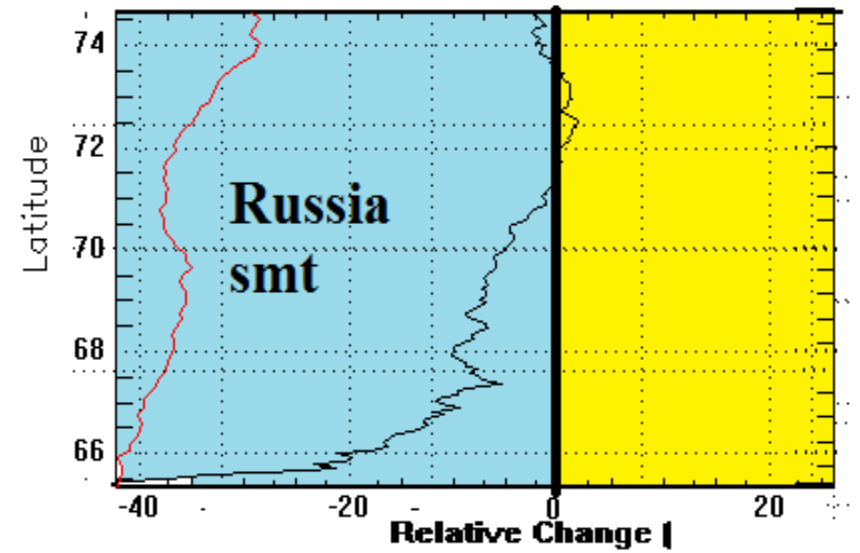
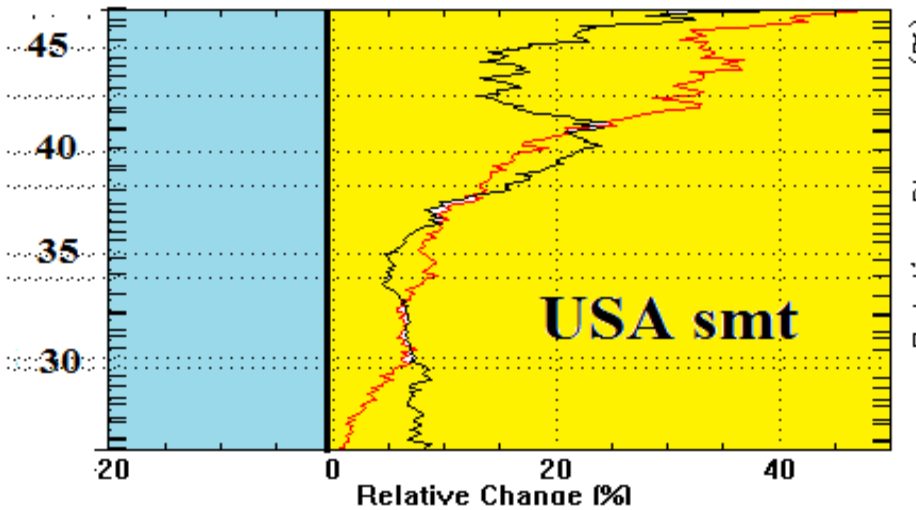
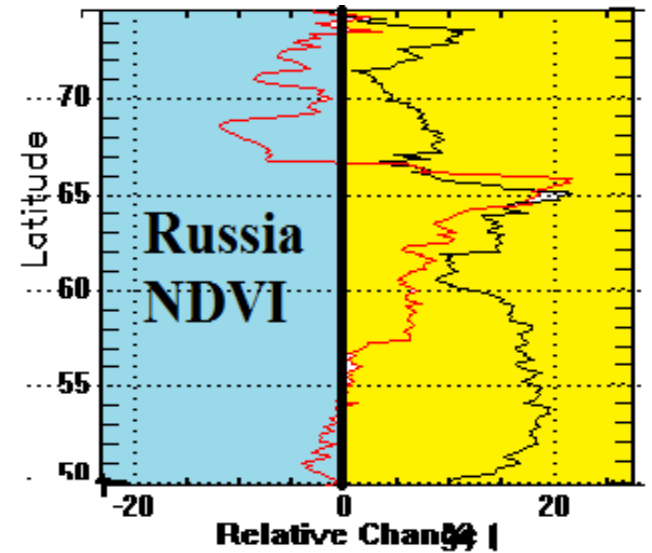
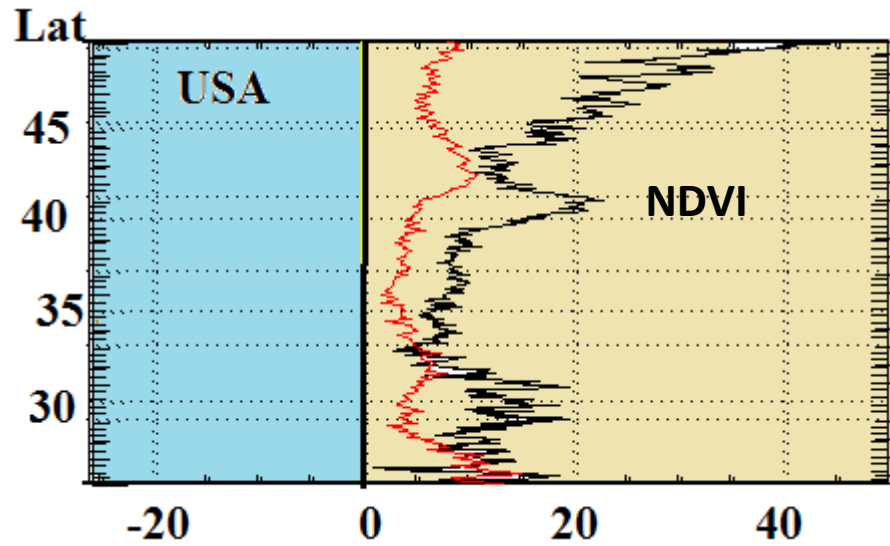
Relative latitudinal changes in Global NDVI and BT during 1981-2016



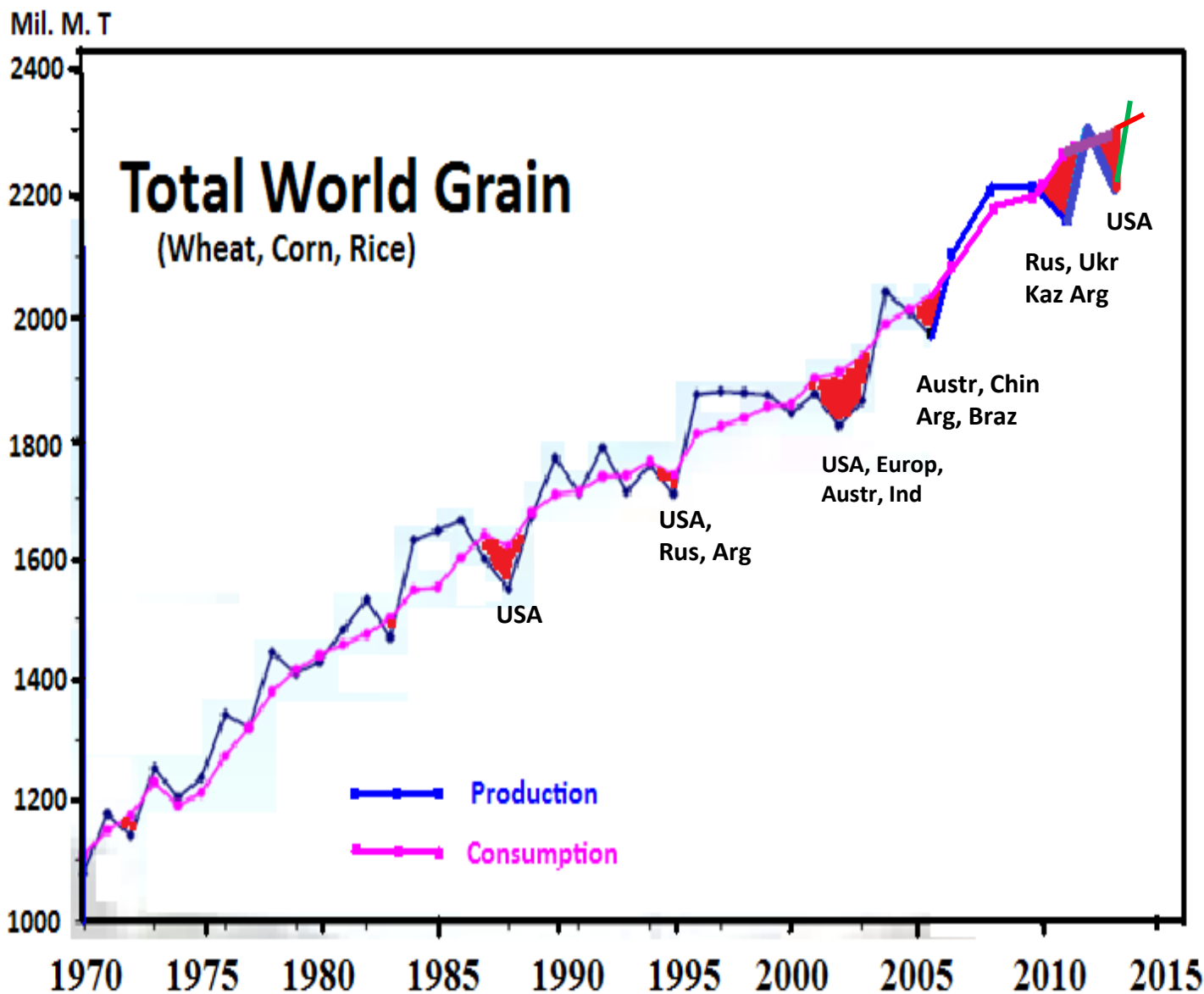
Relative latitudinal changes continental 16 km NDVI and BT during 1981-2016



Relative latitudinal changes: **USA & Russia** 16 km NDVI and BT during 1981-2016



World Grain Production-Consumption, 1970-2012



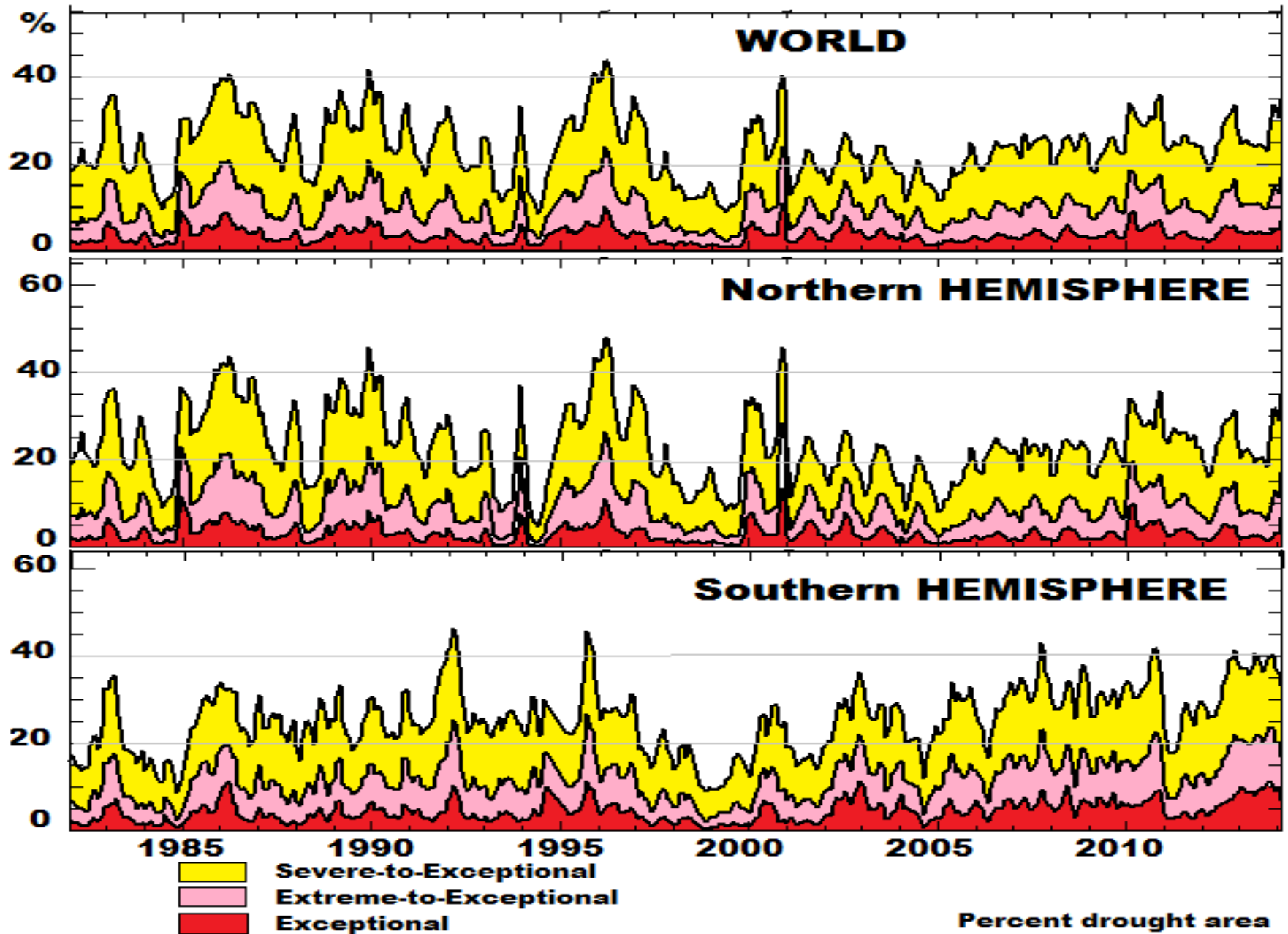
Droughts

2013 - Argentina, Brazil, Australia, USA
2012 – USA
2011 – USA
2010 – Russia, Ukraine, Kazakhstan, Argentina
2007 – Australia, China, Argentina, Brazil
2003 – USA, Europe, Australia, India, China
1996 – USA, Russia, Argentina, Kazakhstan Australia
1988 – USA

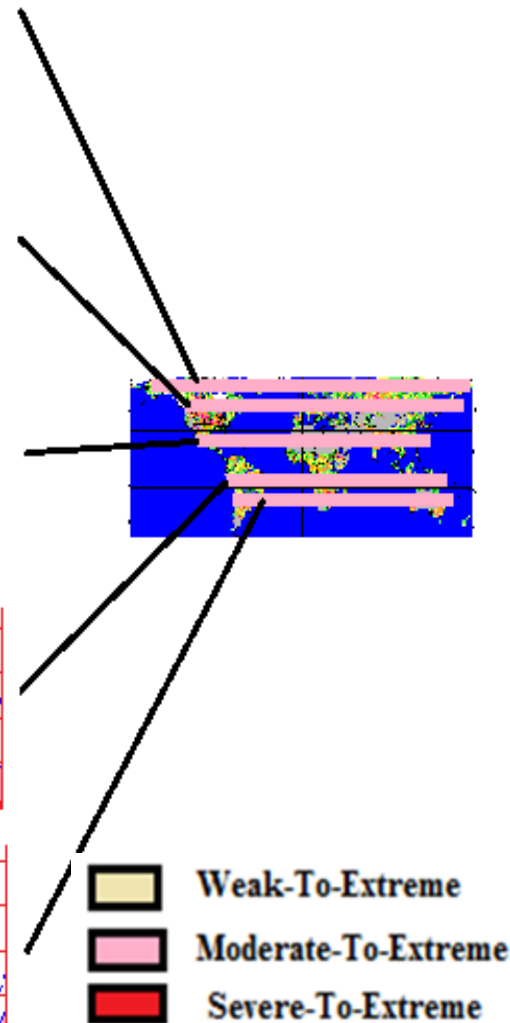
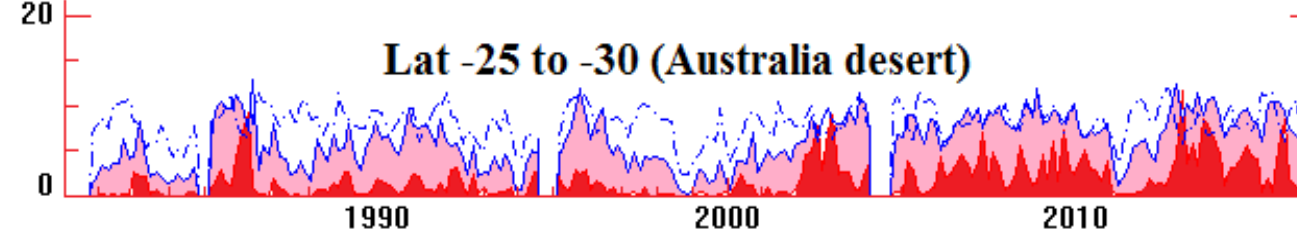
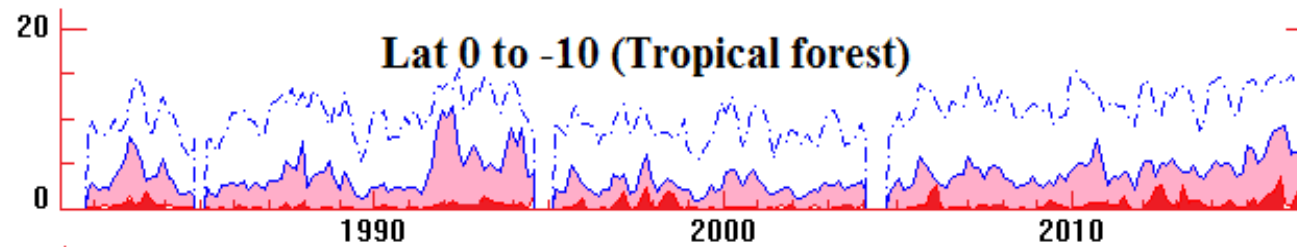
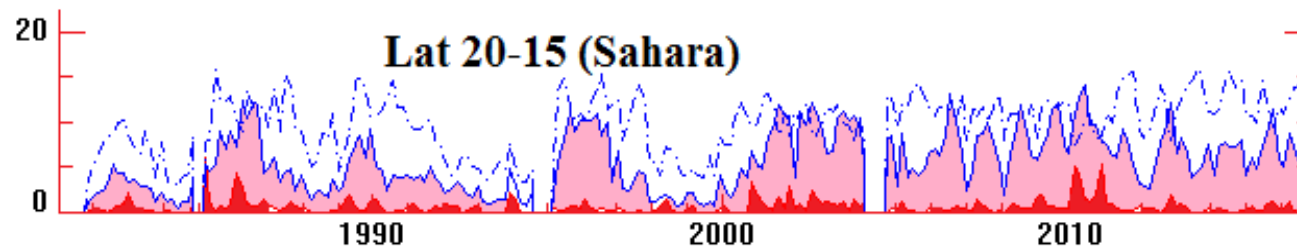
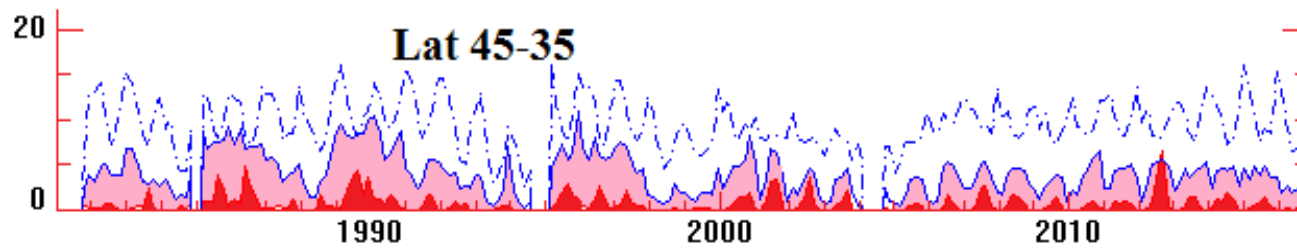
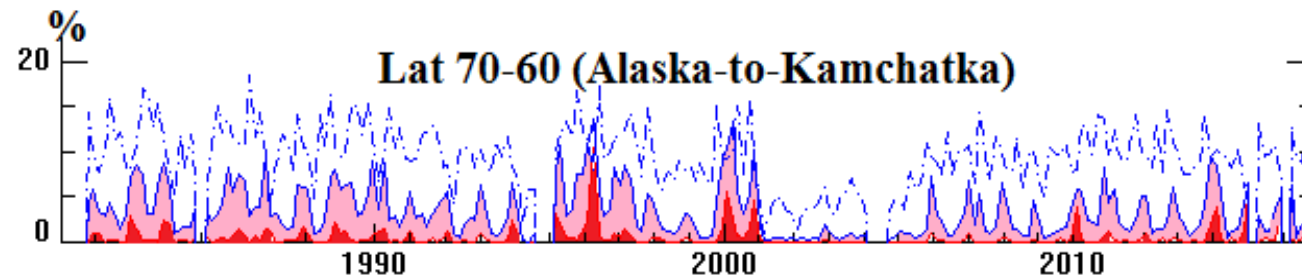
Droughts and Fires in USA

Year	Name	Cost (Bill \$)	Death (#)	States Affected	Damage
2015	Western Drought Western and Alaskan Wildfires	4.5	0	CA, NV, OR, WA, ID, MT, UT, AZ	Agricult. Fires
		3.0	12		Fires
2014	Western Drought	4.0	0	TX, OK, KS	Pastures/Crops
2013	Western/Plains Drought/Heatwave	10.4	53	AZ, CA, CO, IA, ID, IL, KS, MI, MN, MO, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WI, WY	Crops
2012	Drought/Heatwave Western Wildfires	30.0	123	NV, ID, MT, WY, UT, CO, AZ, NM, TX, ND, SD, NE, KS, OK, AR, MO, IA, MN, IL, IN, GA	Crops
				CO, ID, WY, MT, CA, NV, OR, WA	Fires
2011	Southern Plains Southwest Drought & Heat Wave Wildfires Texas, New Mexico, Arizona	12.0	95	TX, OK, NM, KS, LU	Pastures
		1.4	5	TX, NM, AZ	Fires

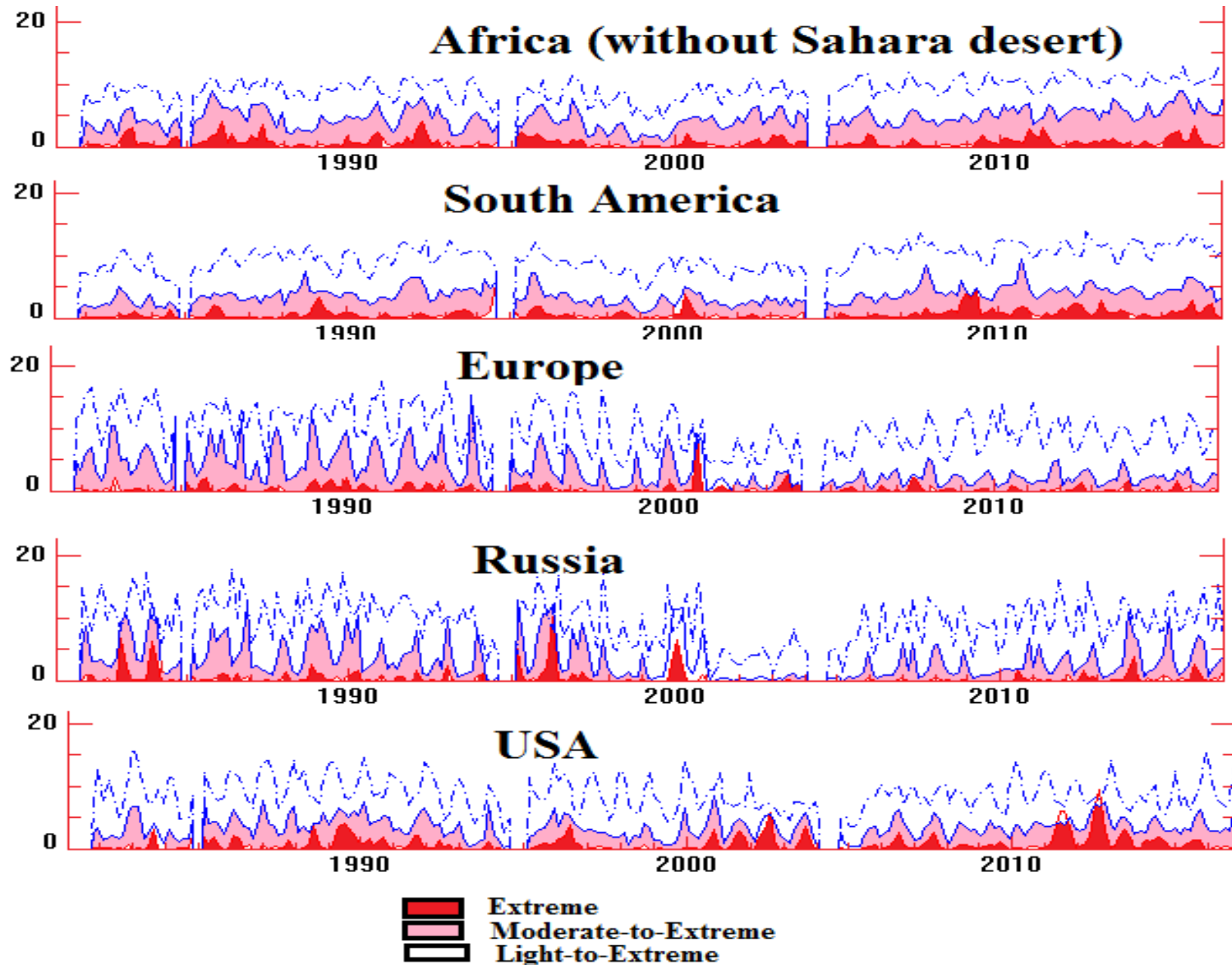
Climate: Percent Land under Drought



VH Drought Area & Intensity: WORLD by Latitudes

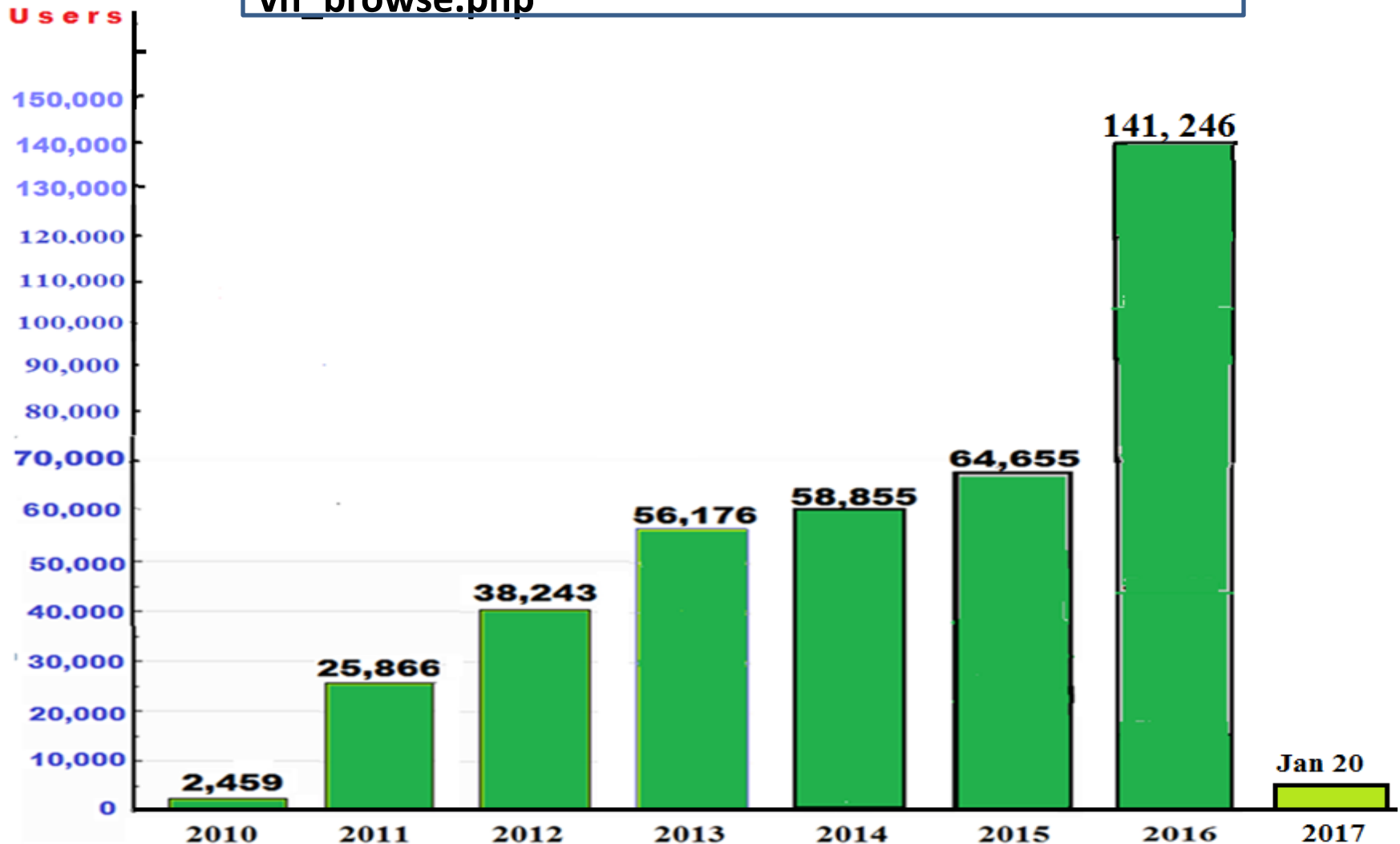


VH Drought Area & Intensity: by Countries& Continents



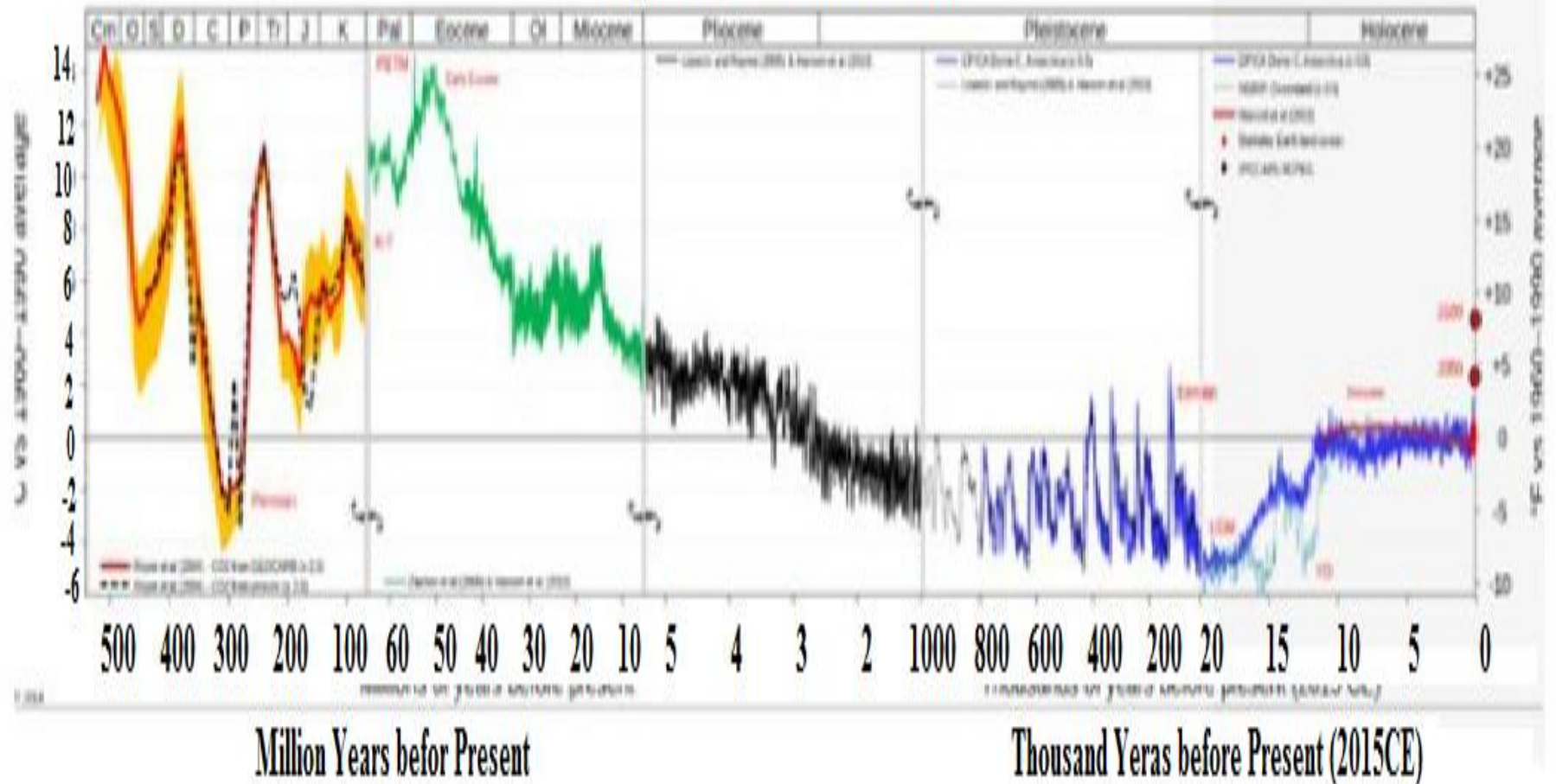
Users attending Vegetation Health WEB

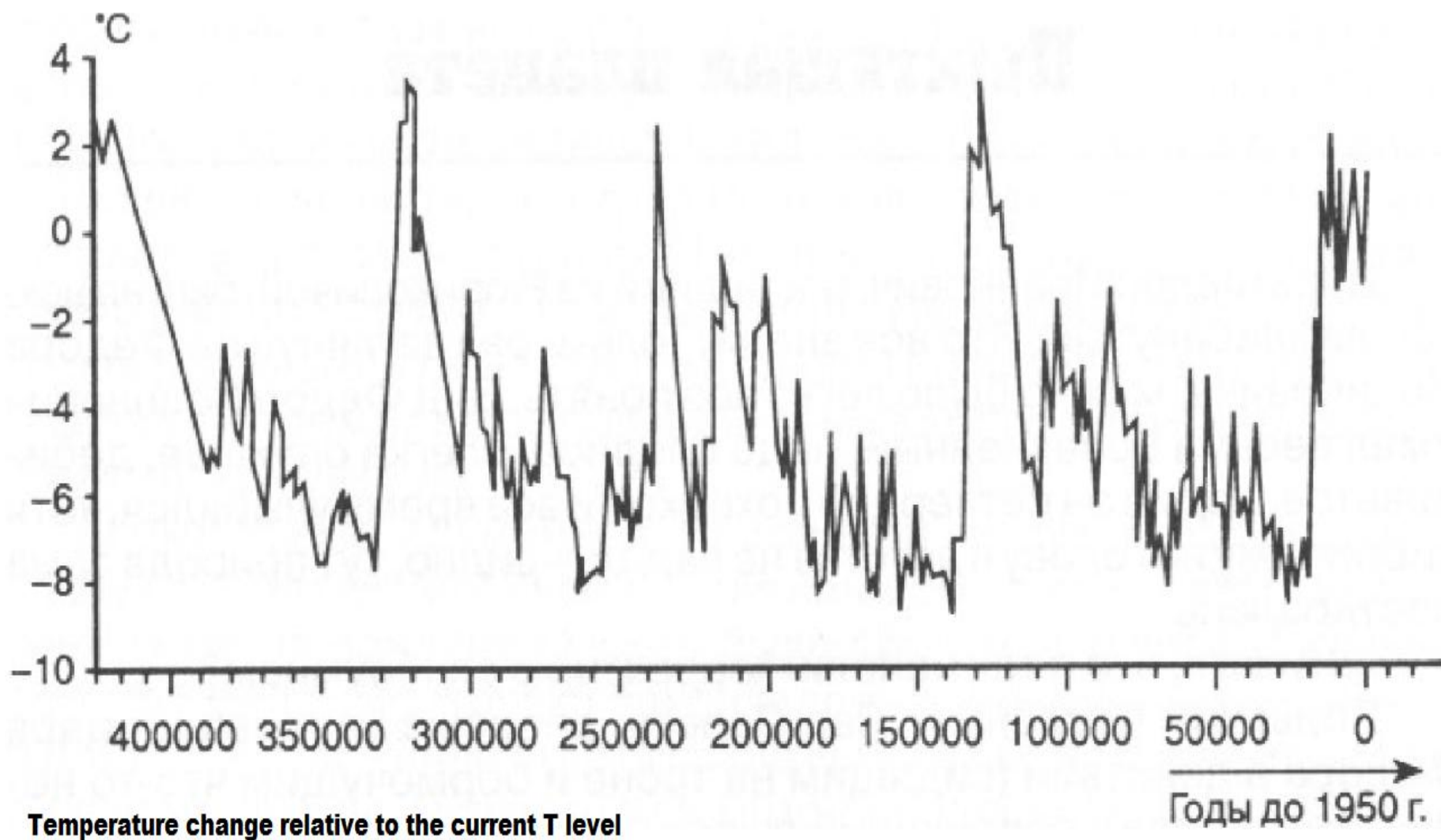
https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vh_browse.php



EXTRA

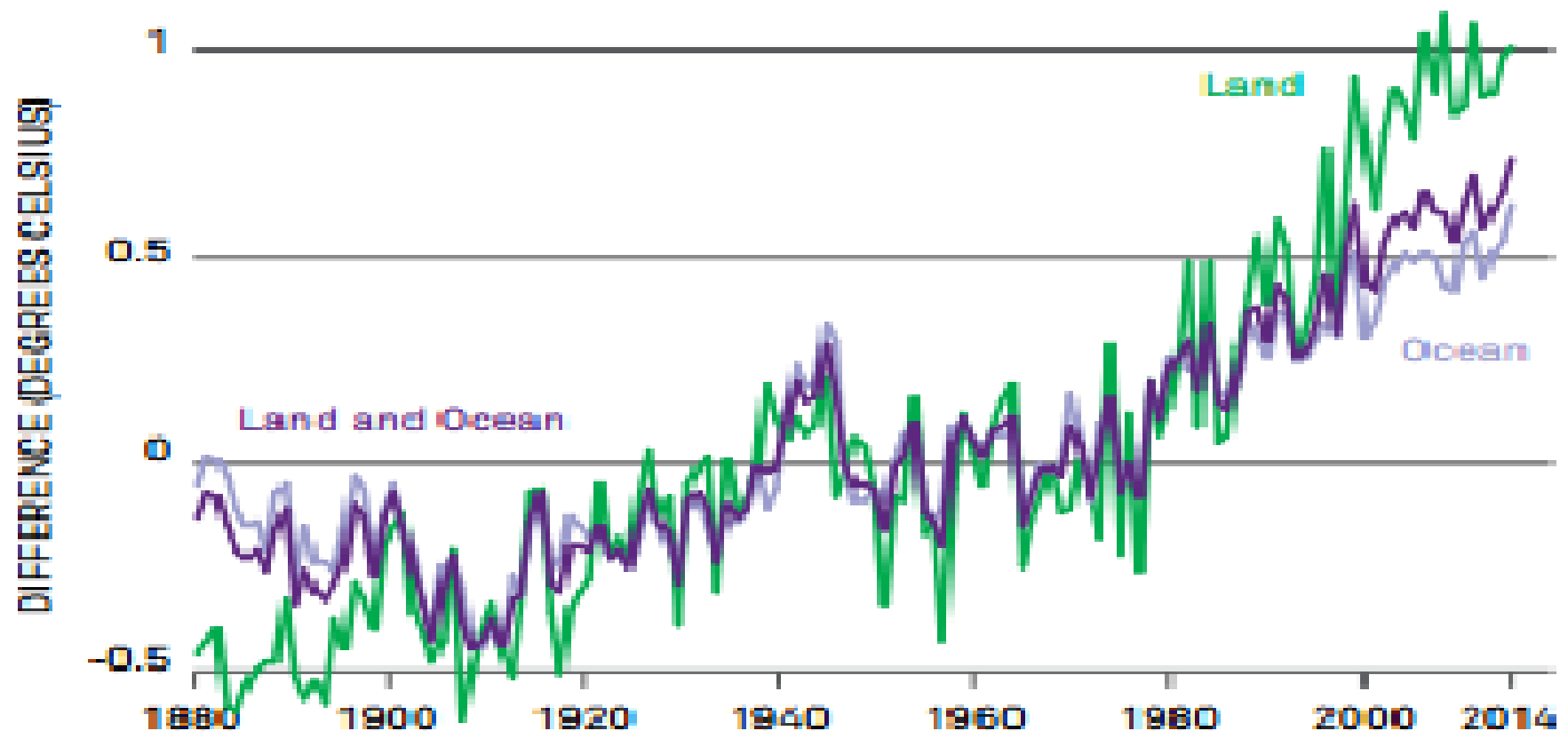
Temperature of Planet Earth





TEMPERATURE RISING

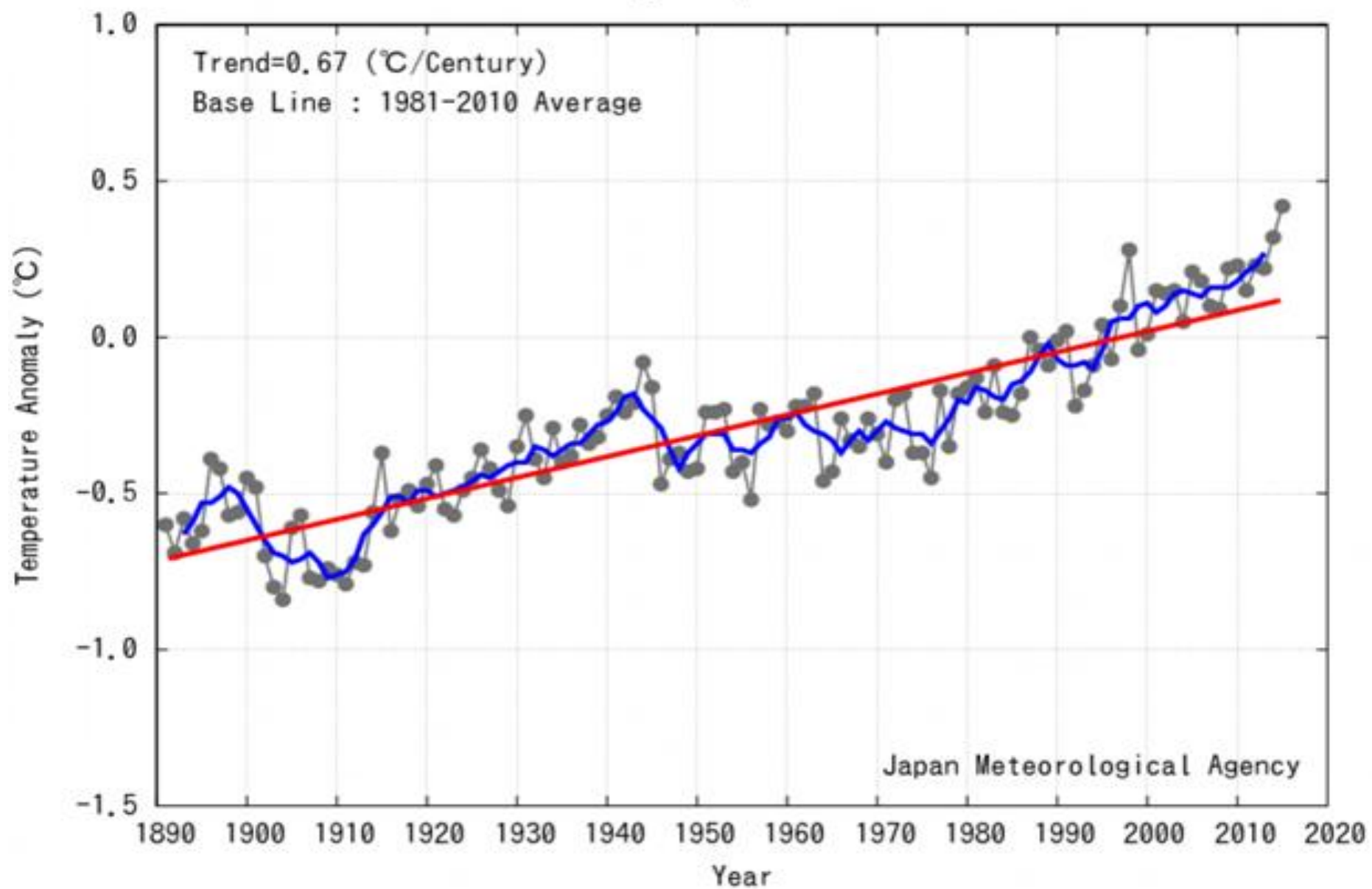
Global Temperature Difference From Average, 1880 to 2014

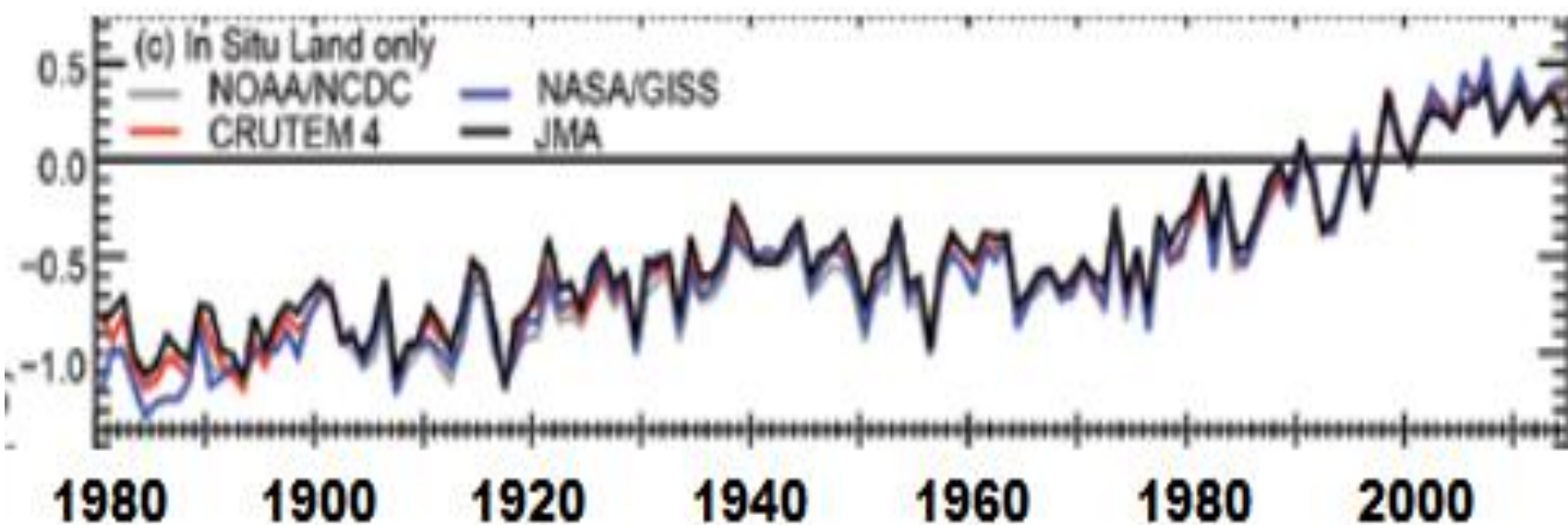
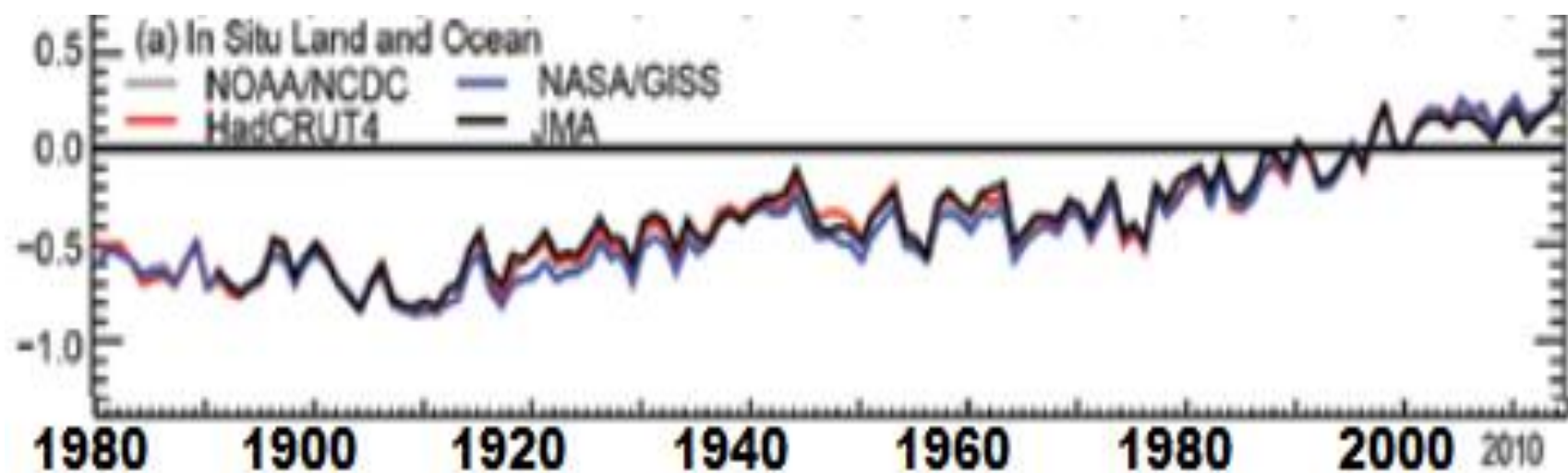


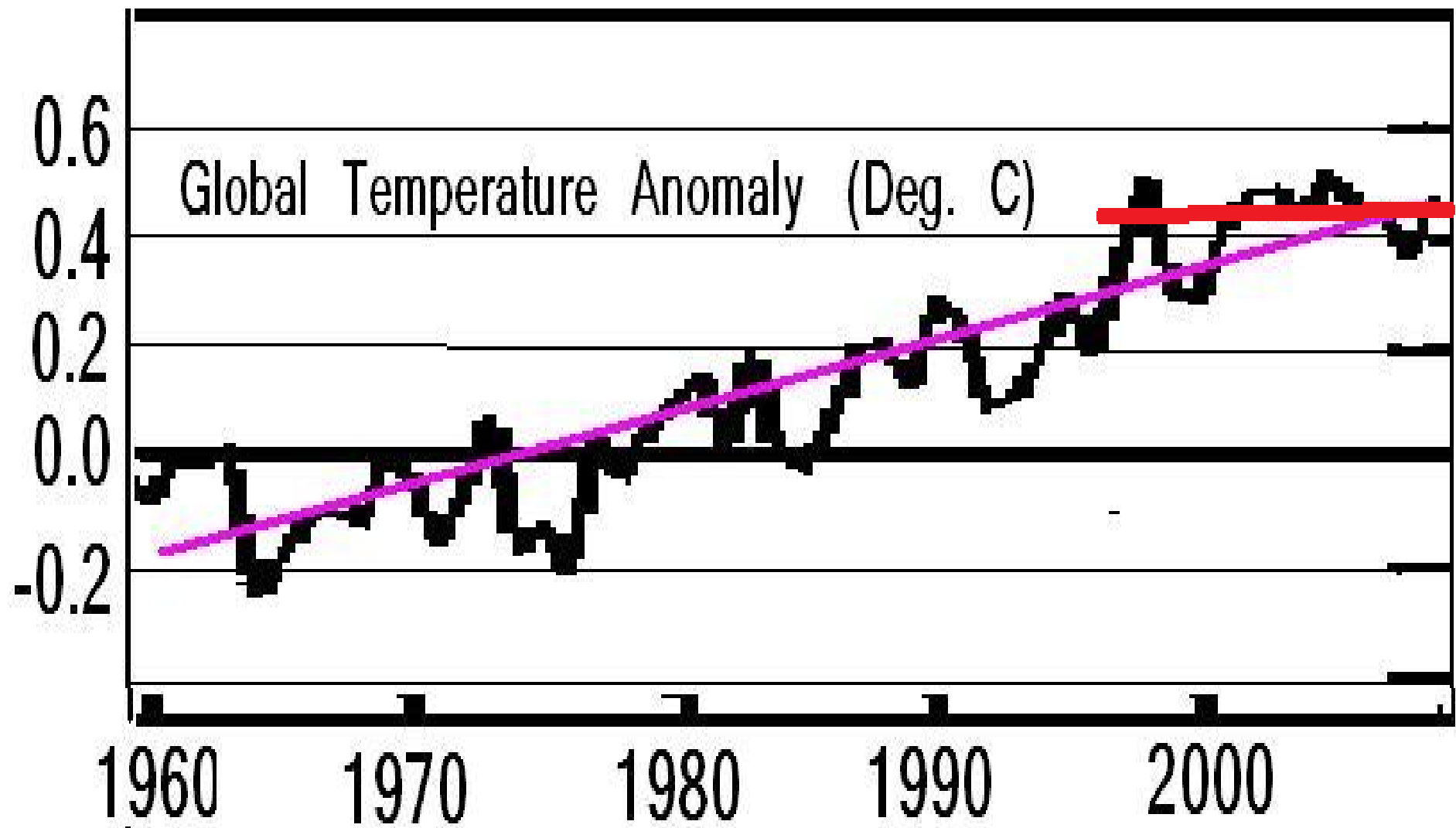
Sources: BlackRock Investment Institute and U.S. National Oceanic and Atmospheric Administration, September 2015.

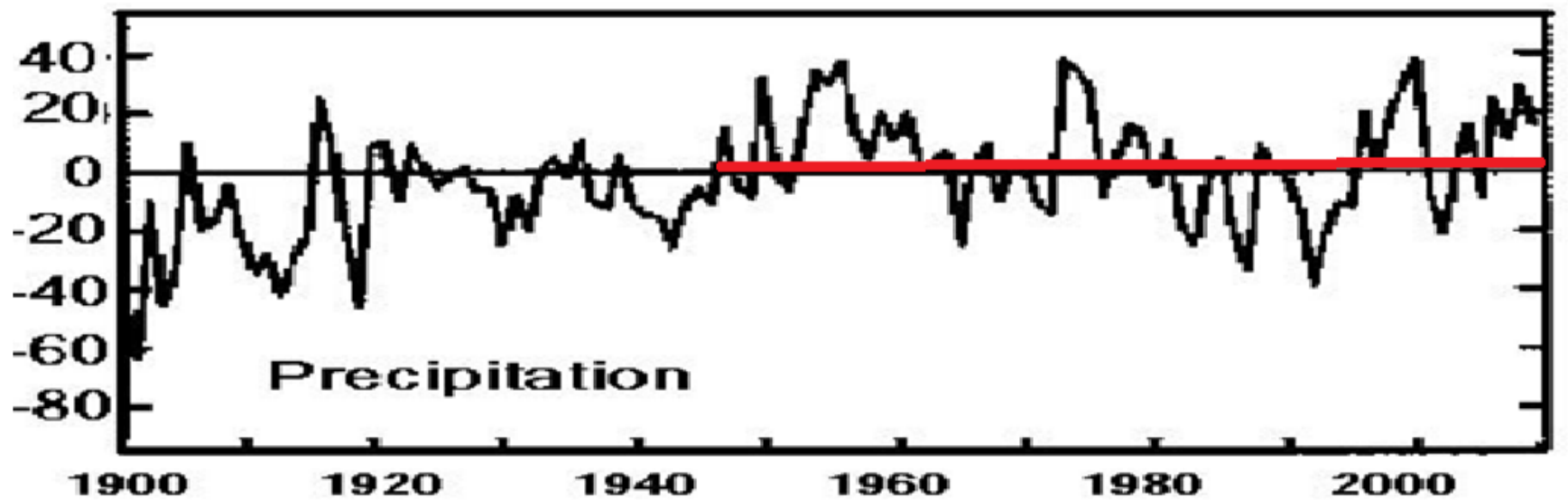
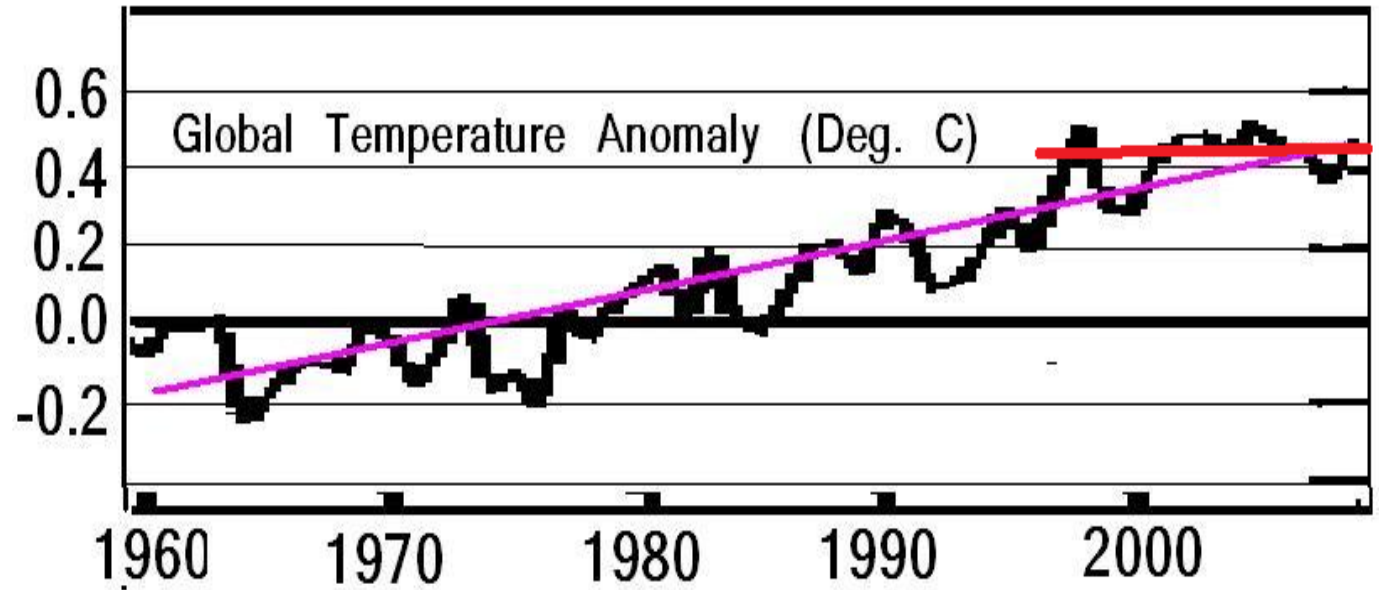
Note: The lines show the difference in global temperatures versus the 20th century average, measured in degrees Celsius.

Global Average Temperature in Summer





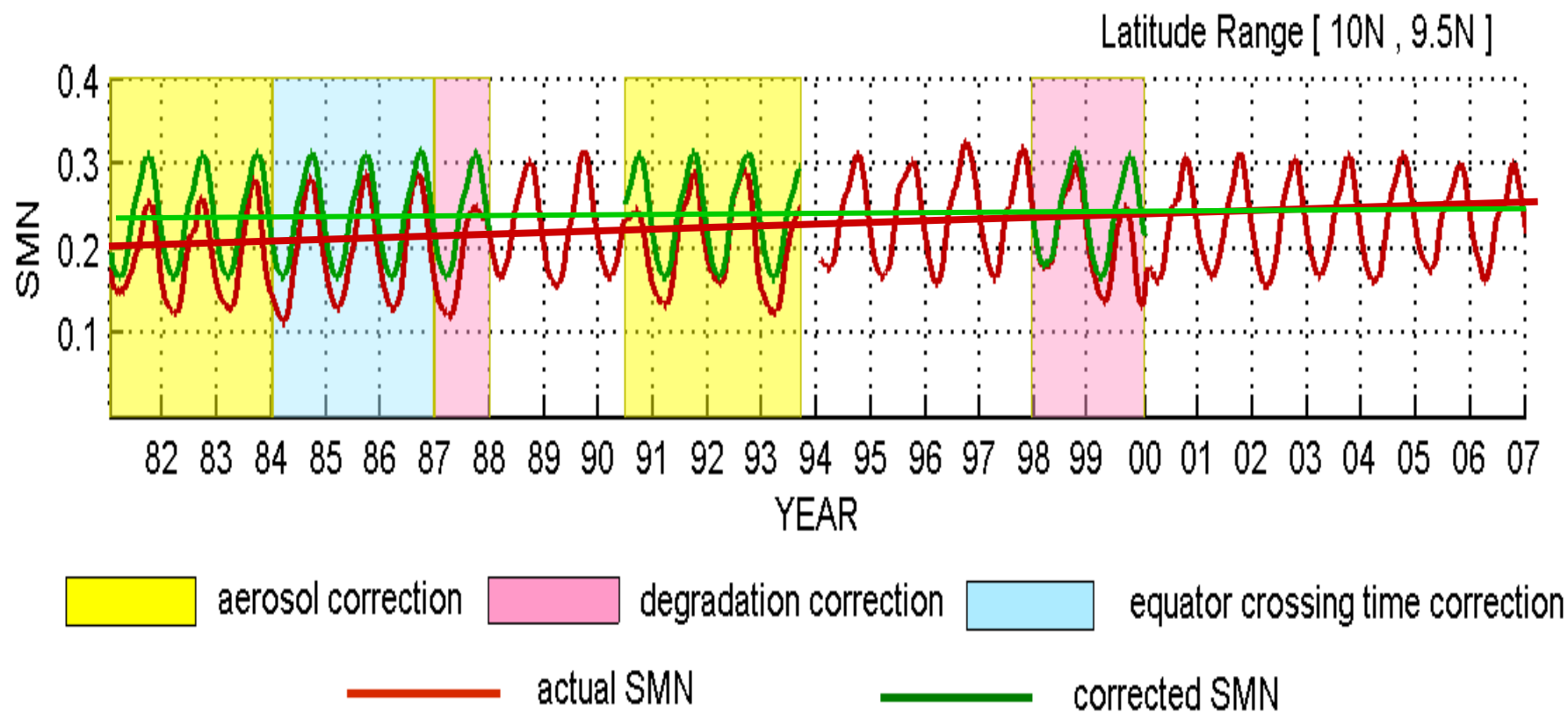




Corrected & Non Corrected AVHRR-NDVI from NOAA_GVI-x data set

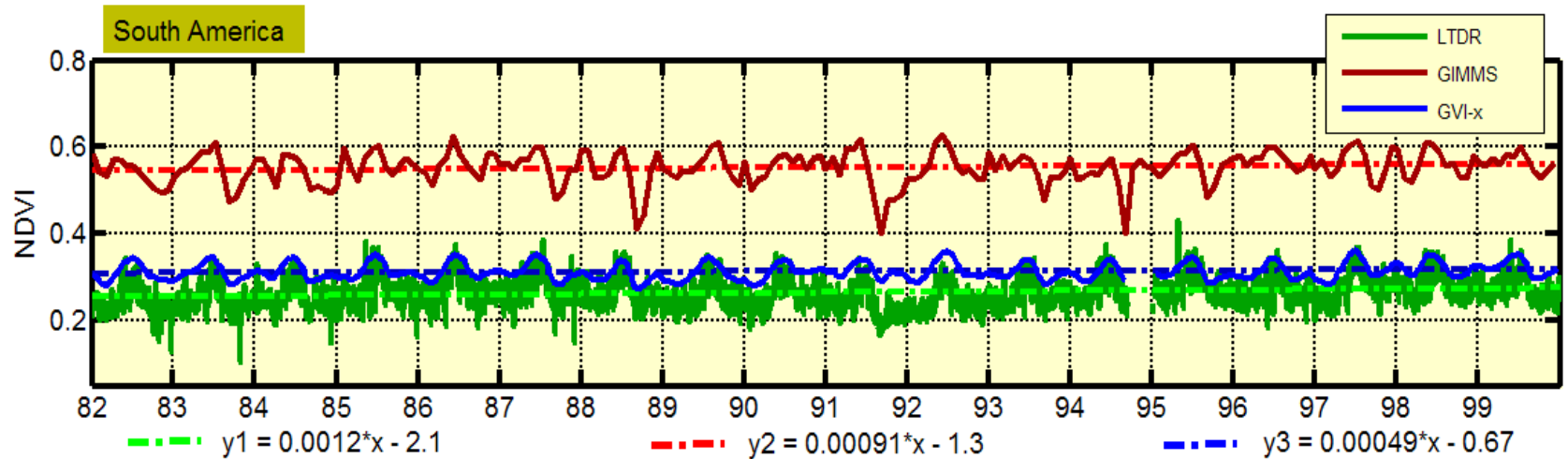
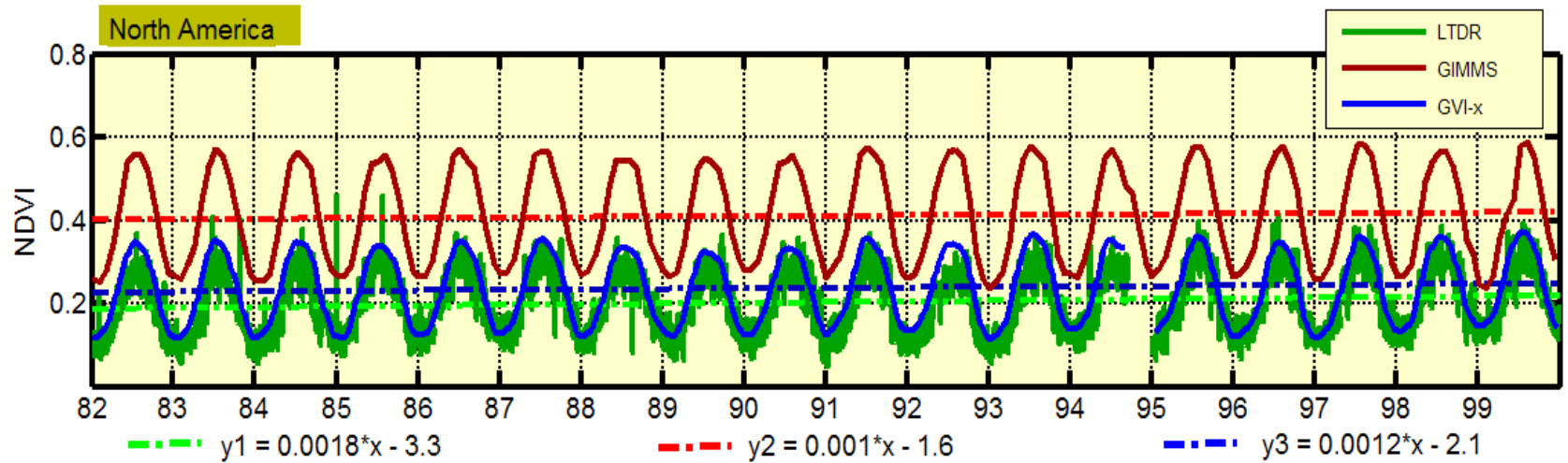


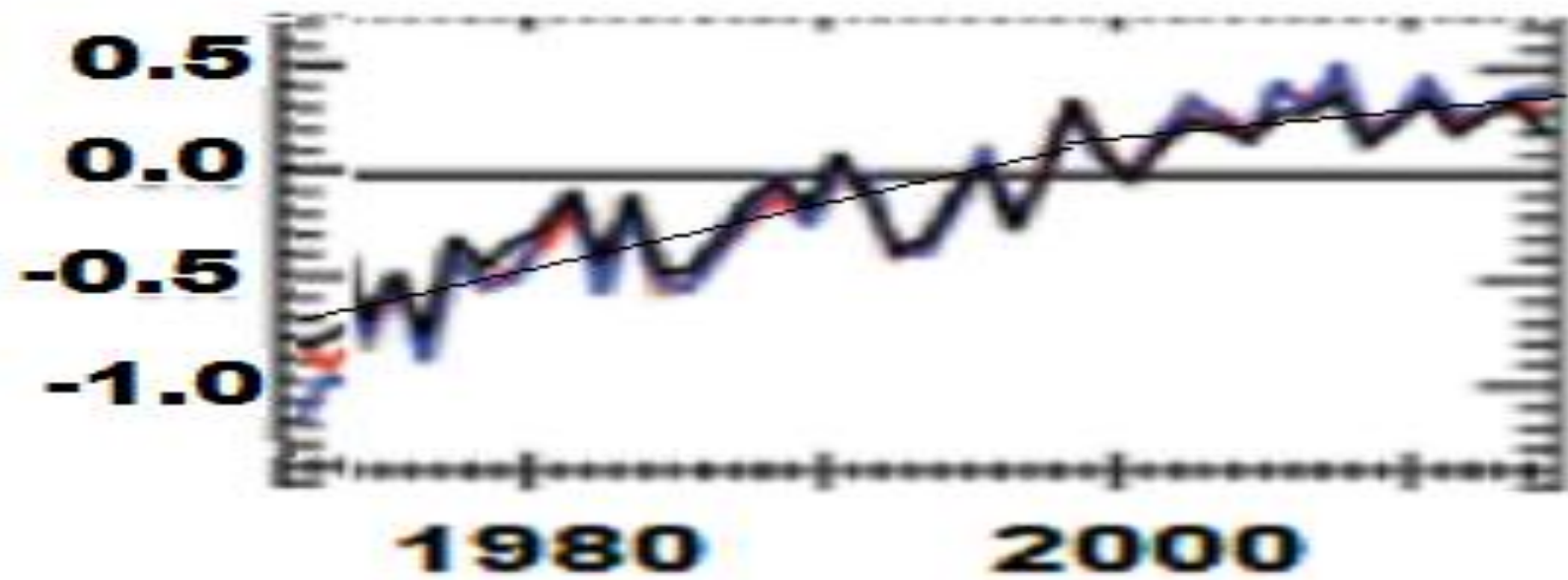
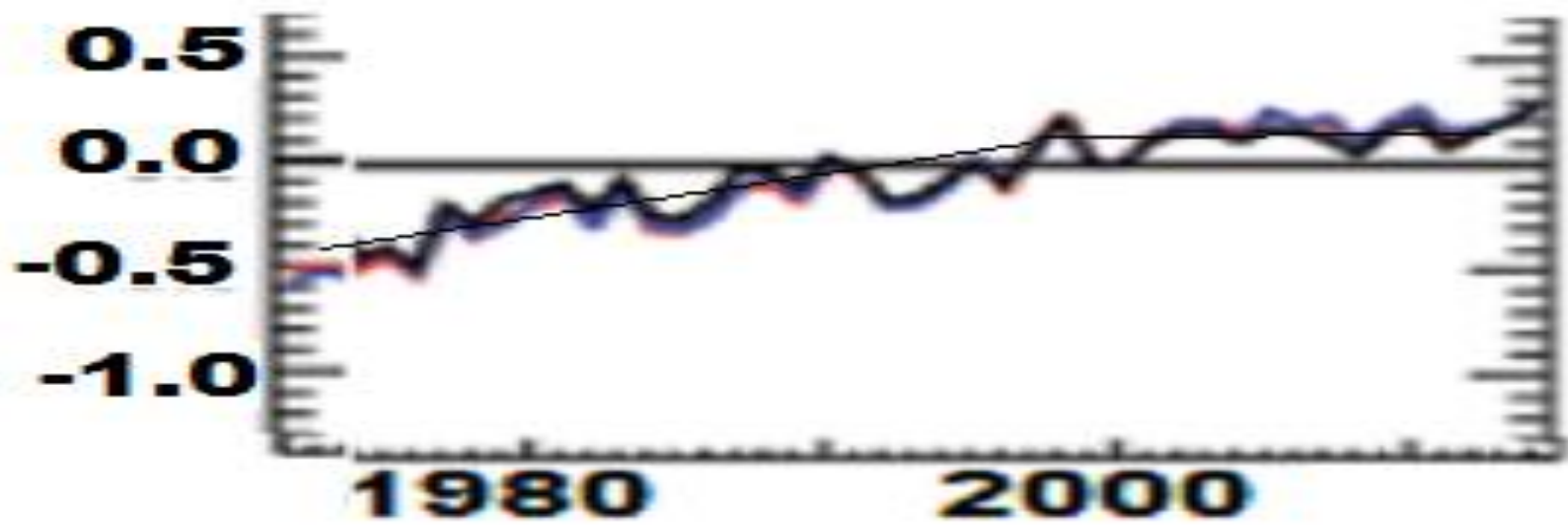
Supports the CLIMATE Goal



NDVI time series

1982-1999

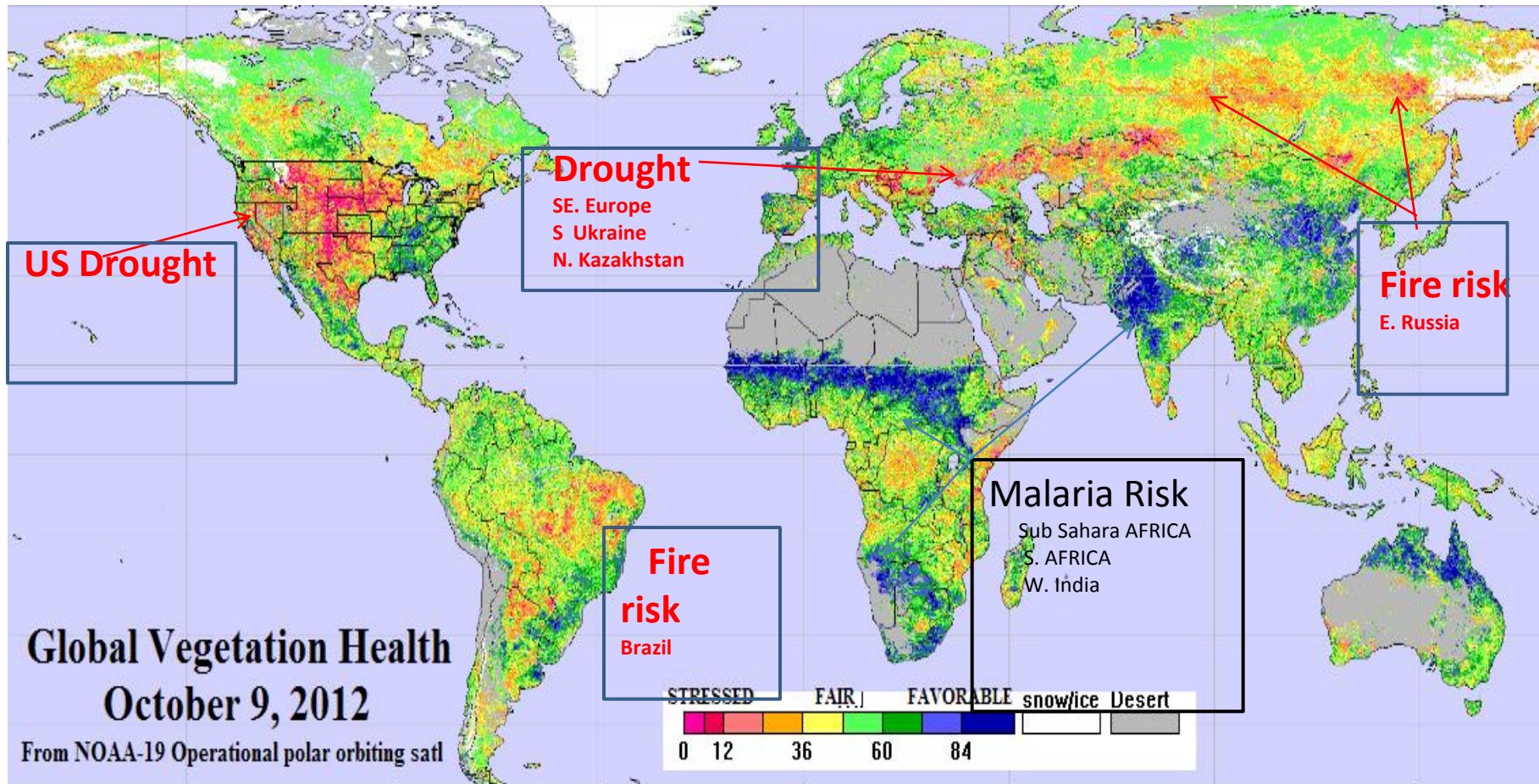




NOAA, NASA, England?

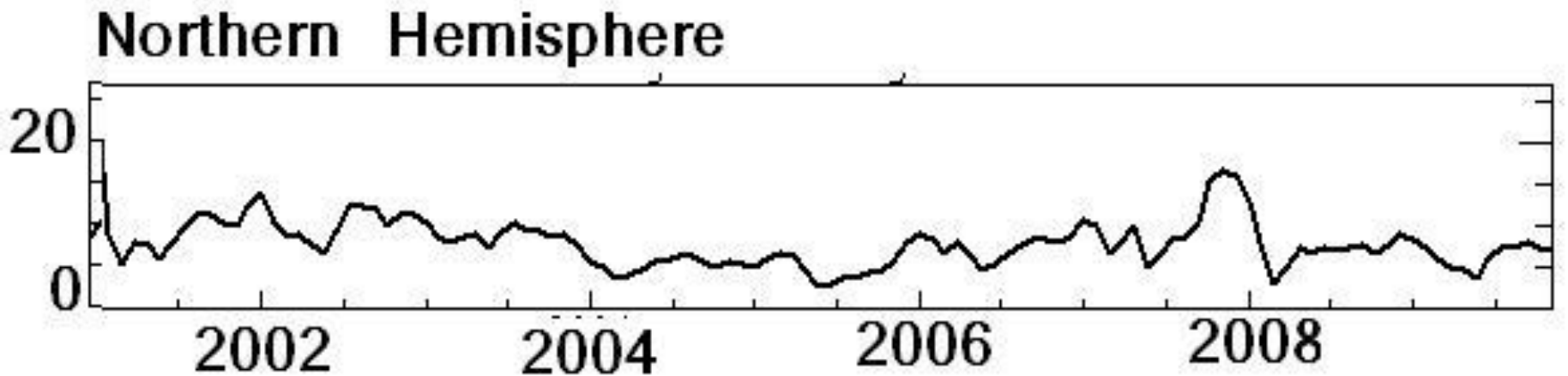
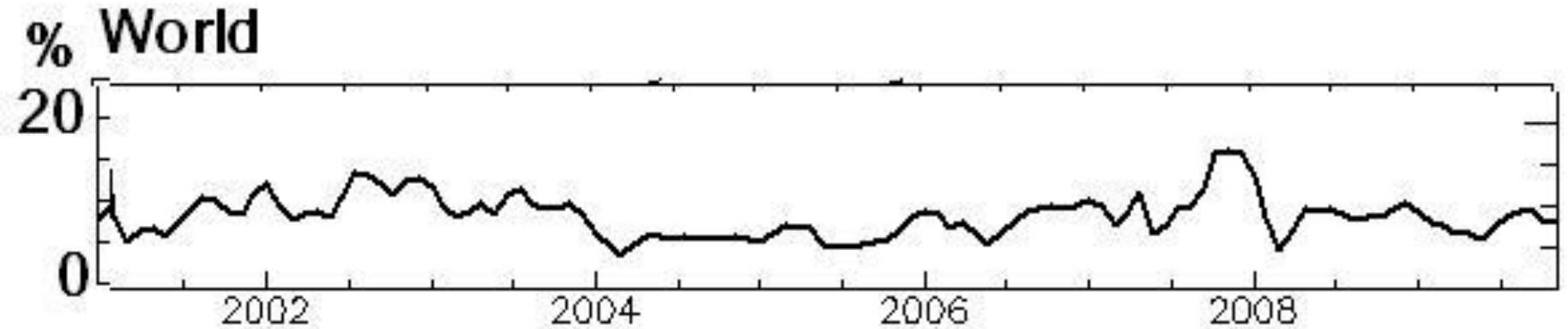
2012 Global Vegetation Health

From AVHRR/NOAA-19 Operational Polar Orbiting Satellite



Drought Area & Intensity (DAI) ?

Severe-to-Exceptional Drought (% from the World area), 2000-2010



Percent of the world area under severe-to-exceptional drought