Progress On AVHRR-Based Global Vegetation Processing System (GVPS) and Products

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Summary

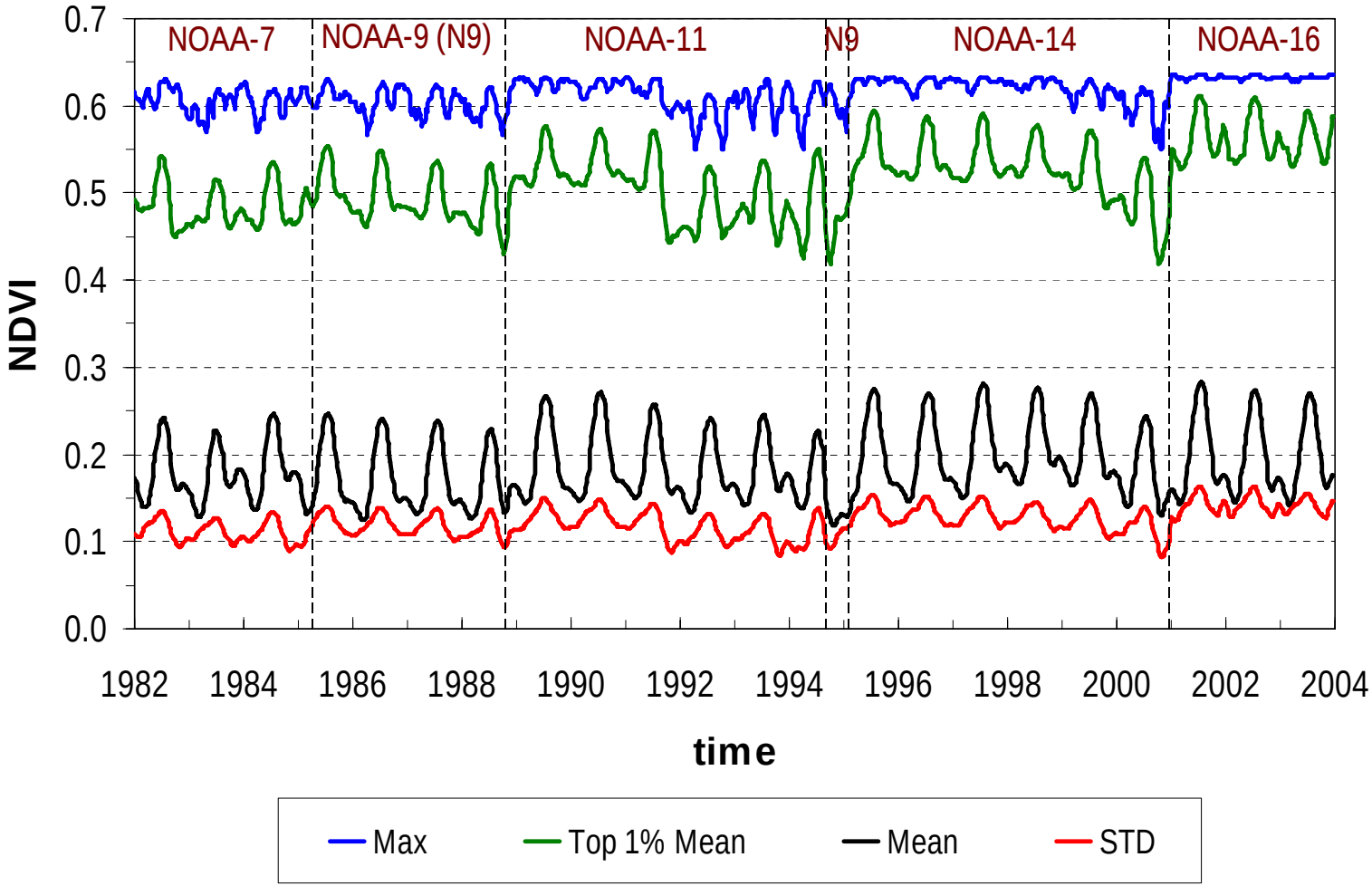
- Major enhancement made to the GVPS by implementing the adjusted cumulative distribution function (ACDF) method in operational algorithm, producing a consistent and quality improved long-term dataset.
- Products evaluated
- GVPS system currently in transition to operations
- Other progress

  - Jiang, L., J. D. Tarpley, K. E. Mitchell, W. Guo, B. H. Ramsay, and F. N. Kogan, Deriving near real time global green vegetation fraction from AVHRR-based global vegetation indices, to be submitted to *JHM*, 2007.
  - Jiang, L., J. D. Tarpley, K. E. Mitchell, S. Zhou, F. N. Kogan, and W. Guo, Adjusting for long term anomalous trends in NOAA's global vegetation index datasets, in review at *IEEE Trans. Geosci. Rem. Sens.*, 2007.

Major Enhancement to the GVPS

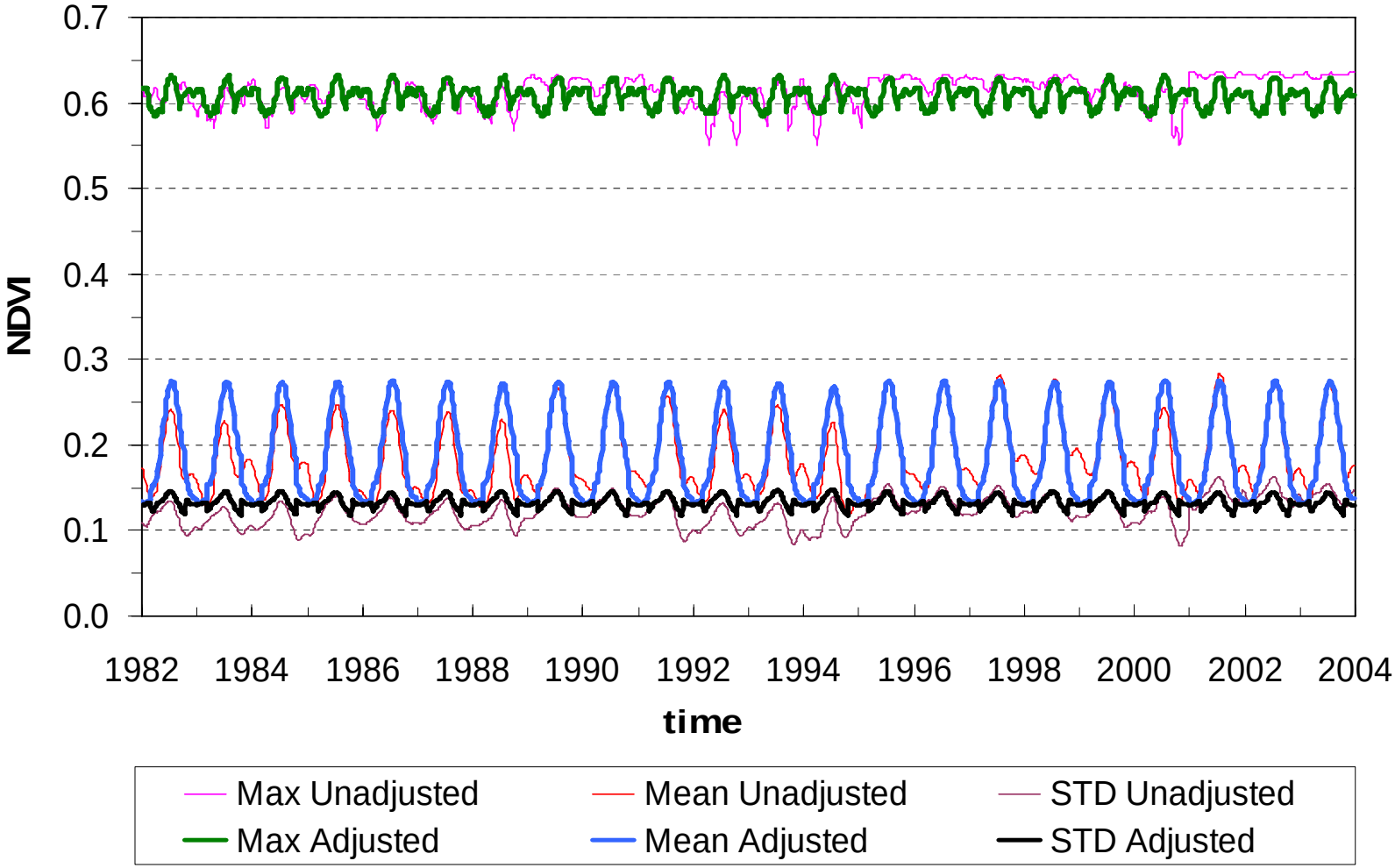
- ACDF adjustment applied to SMN from 1981 to current (using most stable quality data from 6-yr – benchmark climatology)

- Consequently, new SMN climatology derived (Max, Min NDVI), new GVF climatology derived (mean, STD for 24 years from 1982 to 2005)



Time series of weekly maximum, mean of top 1% highest, mean, and standard deviation of global smoothed NDVI (**un-adjusted**)

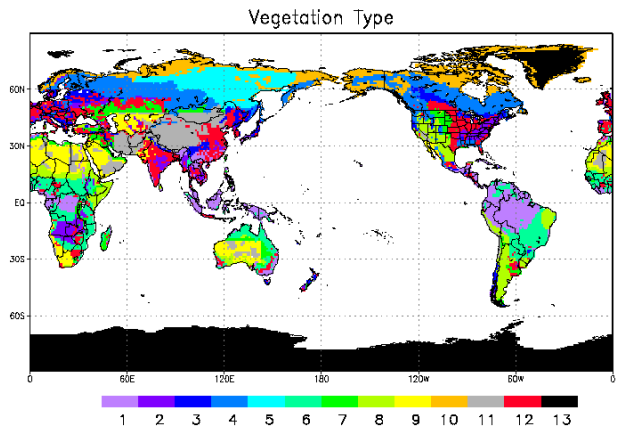
Evaluation



Maximum, mean, and standard deviation of global NDVI before and after ACDF adjustment

Comparison of un-adjusted and ACDF adjusted NDVI for different land classes

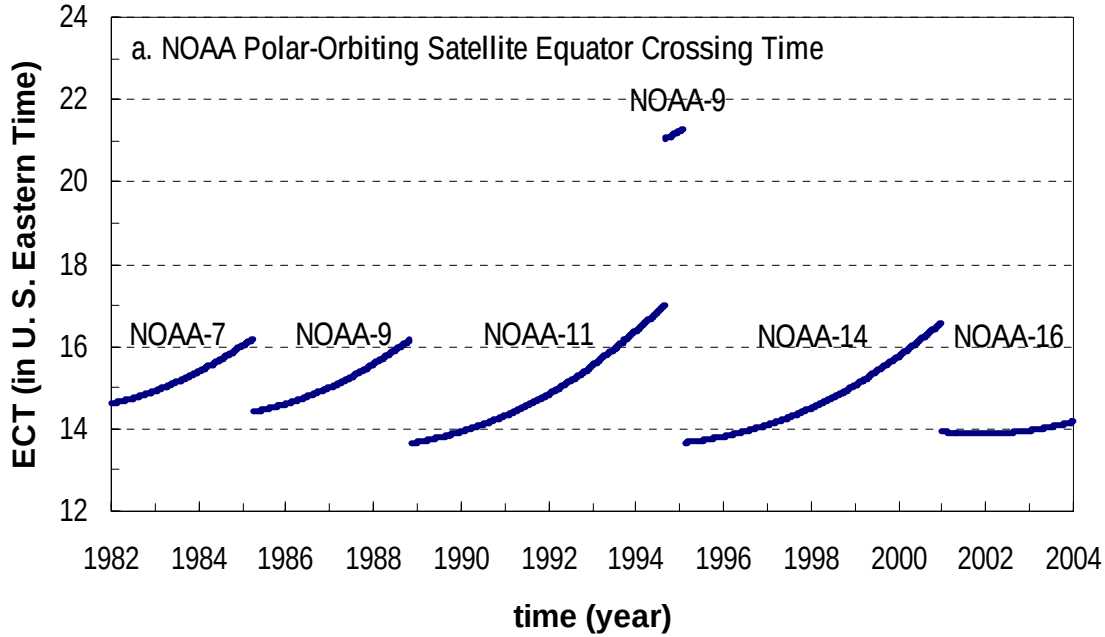
Class	Pixels%	Unadjusted		Adjusted	
		Mean of Annual Averaged NDVI	Trend from 1982 to 2003	Mean of Annual Averaged NDVI	Trend from 1982 to 2003
1	8.95%	0.312	+14.96%	0.332	-0.56%
2	4.01%	0.262	+15.35%	0.282	-0.04%
3	4.35%	0.237	+18.66%	0.255	+3.42%
4	13.68%	0.185	+13.06%	0.184	+1.94%
5	7.11%	0.161	+4.38%	0.133	-4.21%
6	9.67%	0.263	+13.19%	0.285	-1.16%
7 & 12	16.57%	0.199	+17.90%	0.217	+2.34%
8 & 9	15.22%	0.113	+2.91%	0.128	-4.43%
10	9.86%	0.129	+15.29%	0.080	+4.88%
11	8.79%	0.088	+3.50%	0.100	-2.75%
Overall	98.00%	0.186	+14.91%	0.189	+0.13%



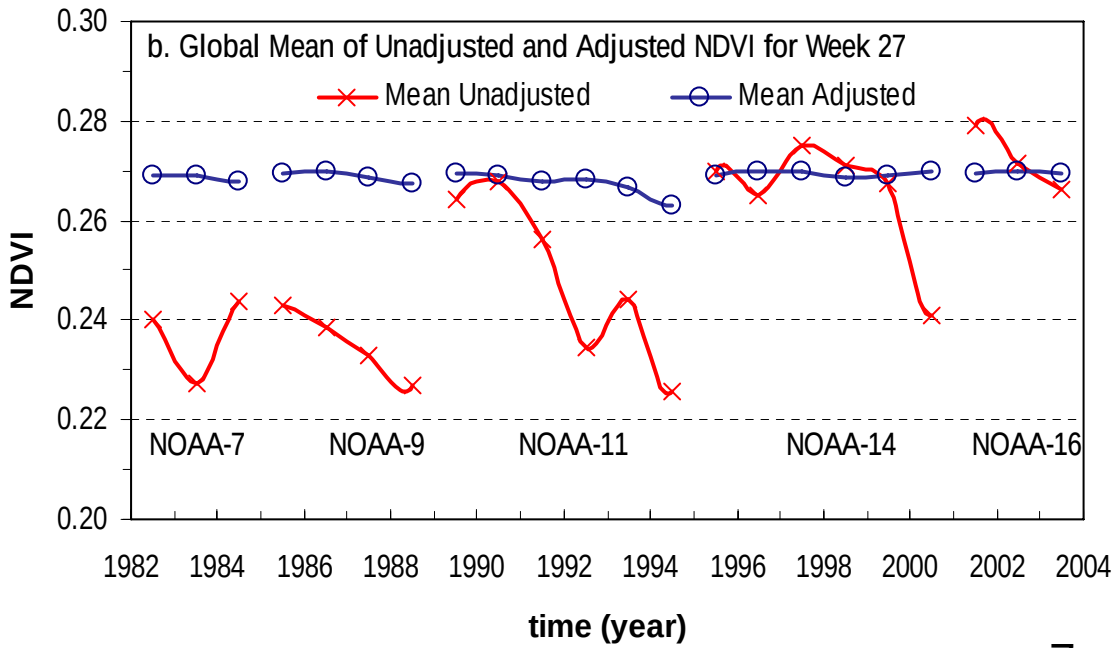
Land Surface Types:
1) Broadleaf-evergreen trees (tropical forest); 2) Broadleaf-deciduous trees; 3) Broadleaf and needle leaf tree;
4) Needle leaf evergreen trees; 5) Needle leaf deciduous trees (larch); 6) Broadleaf trees with ground cover (savanna);
7) Short groundcover (in perennial);
8) Broadleaf shrubs with perennial ground cover; 9) Broadleaf shrubs with bare soil;
10) Tundra (dwarf trees and shrubs with ground cover);
11) Bare soil; 12) Cropland (cultivated); 13) Glacial.

Dependence on Satellite Equator Crossing Time (ECT)

a. Satellite ECTs for the period 1982 to 2003;



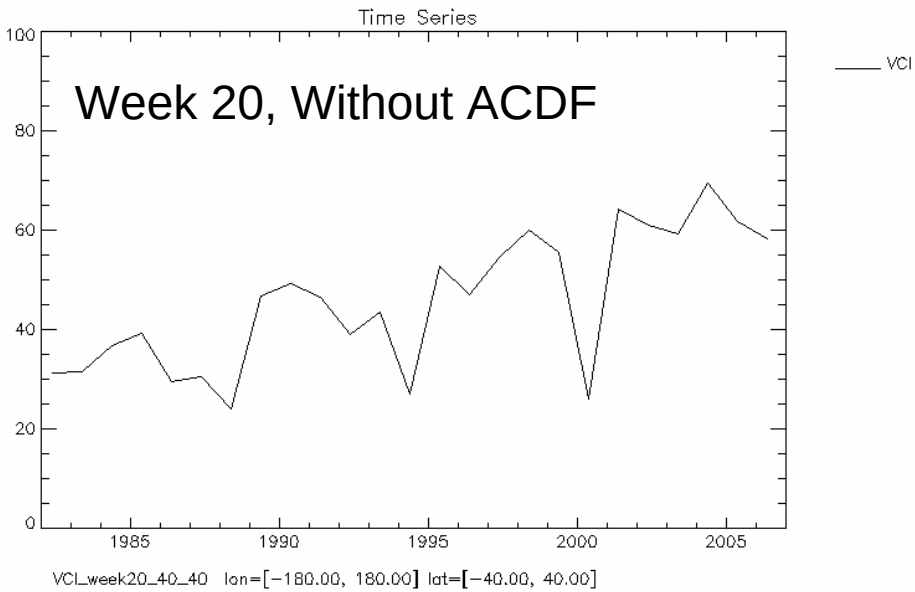
b. Global mean of unadjusted and adjusted NDVI for week 27 from 1982 to 2993.

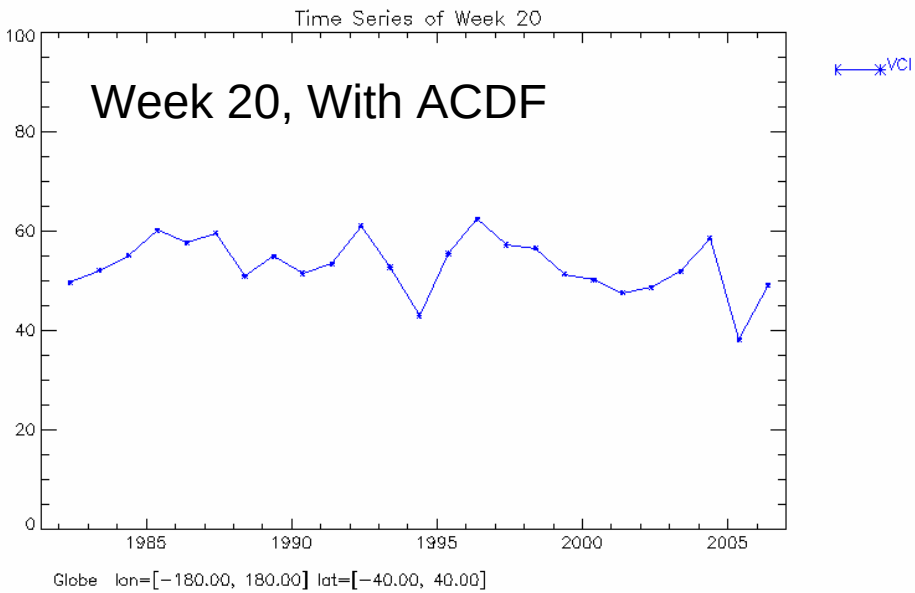


Ability to detect vegetation anomaly – drought detection by Vegetation Condition Index (VCI)

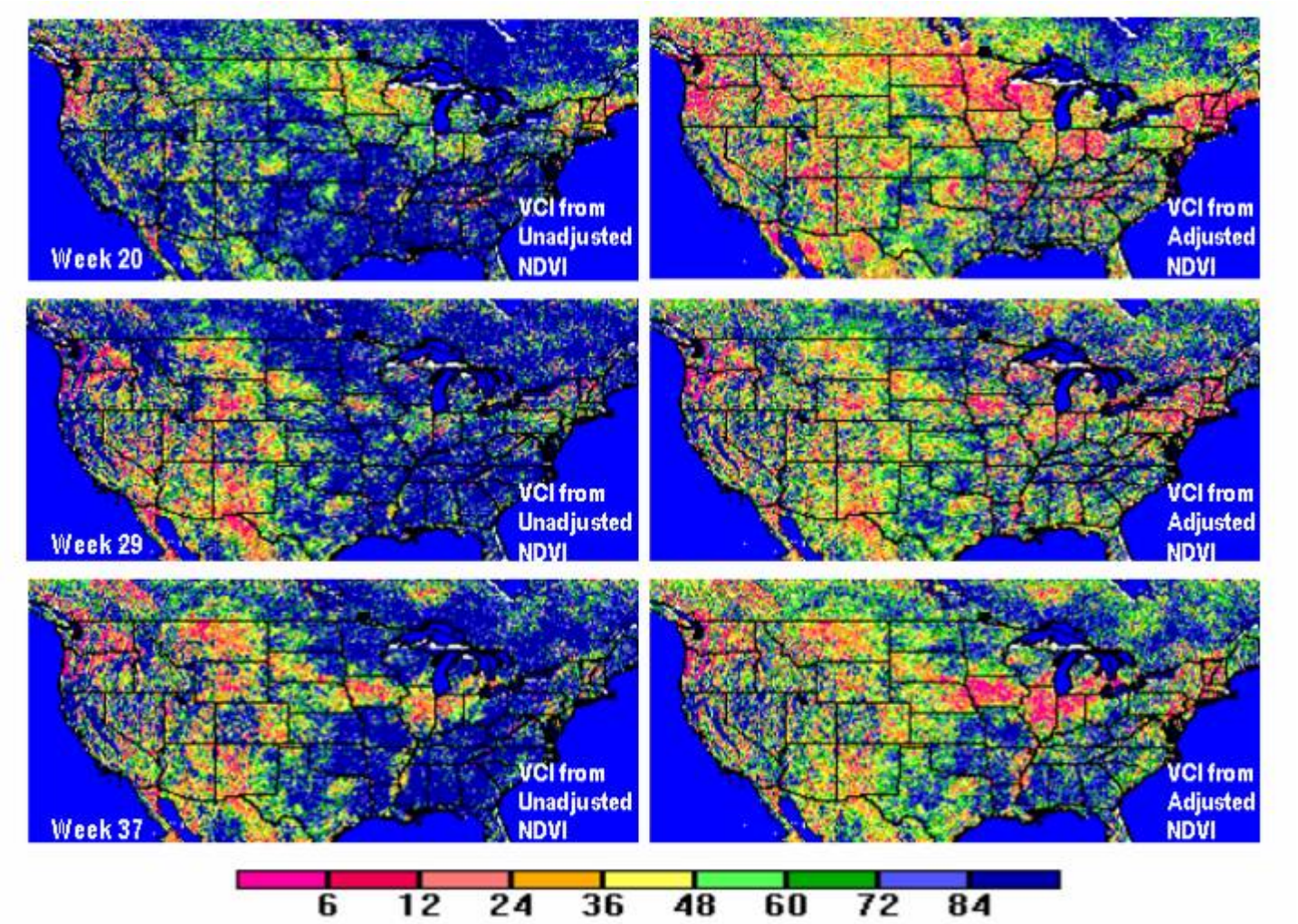
- Zonal averaged time series comparison

$$VCI = \frac{ND - ND_{\min}}{ND_{\max} - ND_{\min}}$$





- Regional comparison



Comparison of Vegetation Condition Index (VCI) resulted from un-adjusted and adjusted NDVI datasets over the CONUS (27N~53N, 127W~67W) in 2005 for weeks 20 (May), 29 (July) and 37 (September)

GVF derived from vegetation indices

a). Comparison of *directGVF* and *GVF*

$$directGVF = (NDVI - C_0) / C_1$$

where C_0=0.05, C_1=0.44

$$GVF_w = \overline{GVF}_w + [a(w,c,h) + b(w,c,h) \cdot VCI_w] \cdot \sigma_{GVF_w}$$

where a and b are derived from the SGVF vs. VCI relationship

$$\left(SGVF_w = \frac{GVF_w - \overline{GVF_w}}{\sigma_{GVF_w}} \quad , \quad VCI = \frac{NDVI - NDVI_{\min}}{NDVI_{\max} - NDVI_{\min}} \right)$$

Average *a* and *b* for Northern Hemisphere and Southern Hemisphere

N. H. Class	a mean (or intcpt0 mean)	a std (or intcpt0 std)	b mean	b std	Intcpt100 mean	intcpt100 std
1	-3.748	0.194	0.071	0.003	3.375	0.135
2	-3.406	0.356	0.068	0.005	3.405	0.182
3	-3.306	0.671	0.069	0.007	3.581	0.229
4	-3.082	0.657	0.068	0.004	3.768	0.399
5	-2.783	1.008	0.066	0.012	3.783	0.524
6	-3.525	0.204	0.067	0.005	3.220	0.393
7+12	-3.273	0.371	0.069	0.004	3.620	0.096
8+9	-3.224	0.176	0.069	0.004	3.678	0.214
10	-2.952	0.634	0.072	0.007	4.258	0.549
11	-3.263	0.260	0.070	0.005	3.733	0.280
Mean	**-3.256**	**0.453**	**0.069**	**0.006**	**3.642**	**0.300**

S. H. Class	a mean (or intcpt0 mean)	a std (or intcpt0 std)	b mean	b std	Intcpt100 mean	intcpt100 std
1	-4.143	0.313	0.075	0.004	3.360	0.090
2	-3.637	0.256	0.068	0.004	3.196	0.251
3	-3.627	0.251	0.070	0.006	3.408	0.402
4	-3.186	0.518	0.065	0.009	3.267	0.423
5	-2.879	0.180	0.061	0.005	3.256	0.340
6	-3.827	0.380	0.073	0.004	3.435	0.145
7+12	-3.482	0.192	0.070	0.003	3.518	0.135
8+9	-3.117	0.141	0.069	0.003	3.809	0.190
10	-3.039	0.349	0.064	0.004	3.332	0.422
11	-3.050	0.262	0.070	0.004	3.923	0.239
Mean	**-3.399**	**0.284**	**0.068**	**0.005**	**3.450**	**0.264**

(Note:

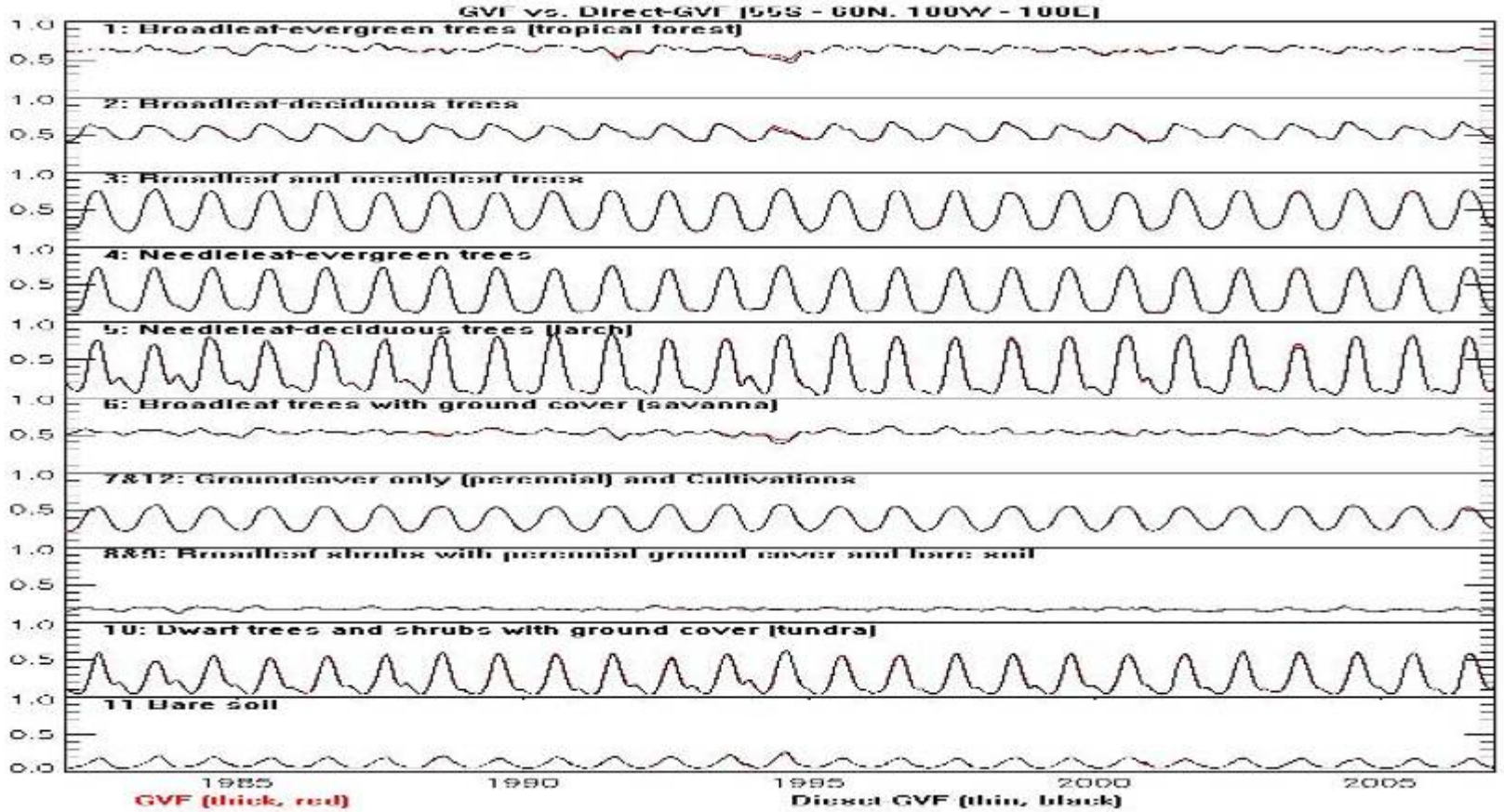
intcpt0=a,

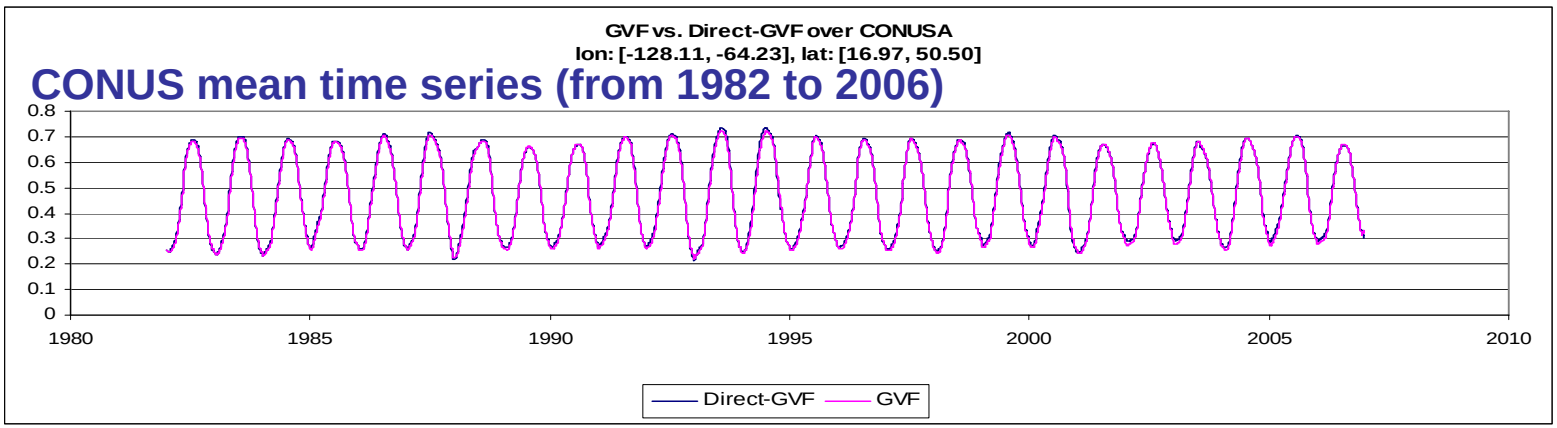
intcpt100 = a + b*100)

$$GVF_{low} = \overline{GVF} + \text{intcpt0} \cdot \sigma_{GVF}$$

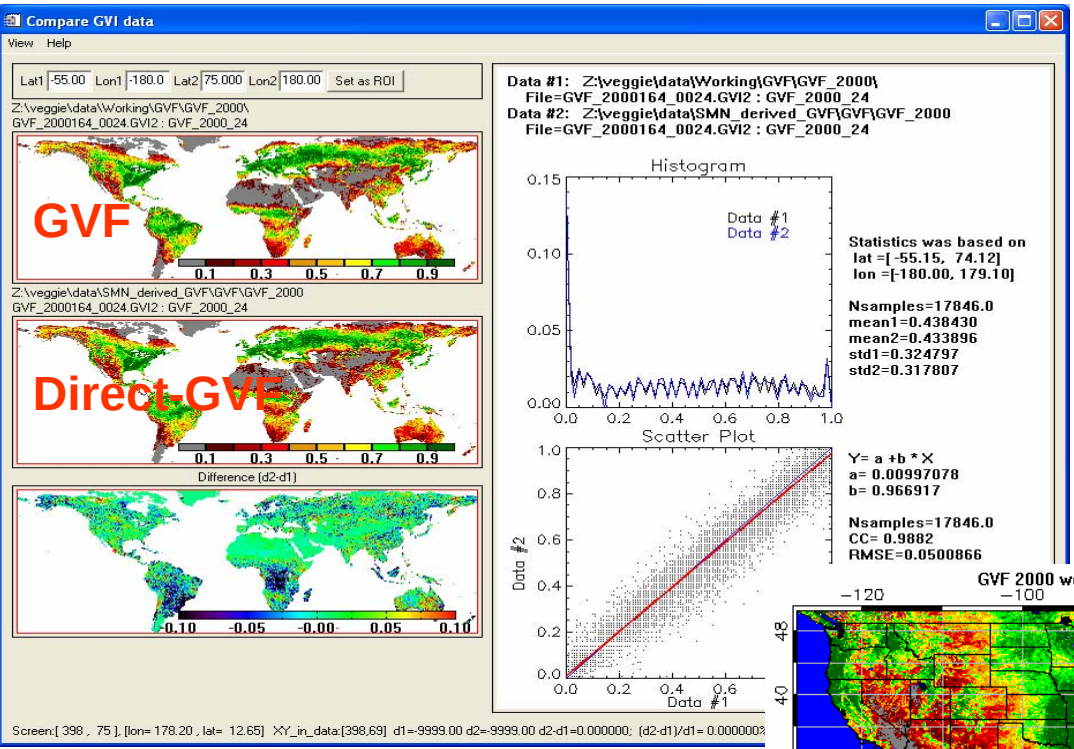
$$GVF_{high} = \overline{GVF} + \text{intcpt100} \cdot \sigma_{GVF}$$

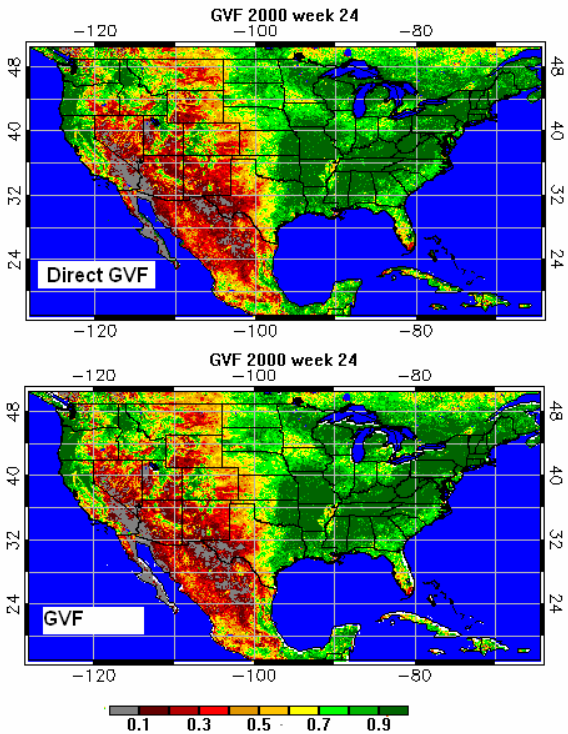
Comparison of *directGVF* and *GVF* (for all land classes, CONUS)

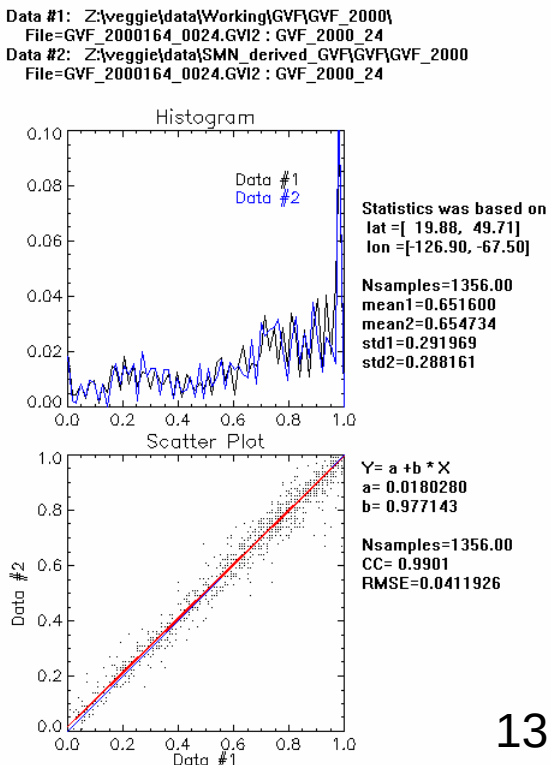




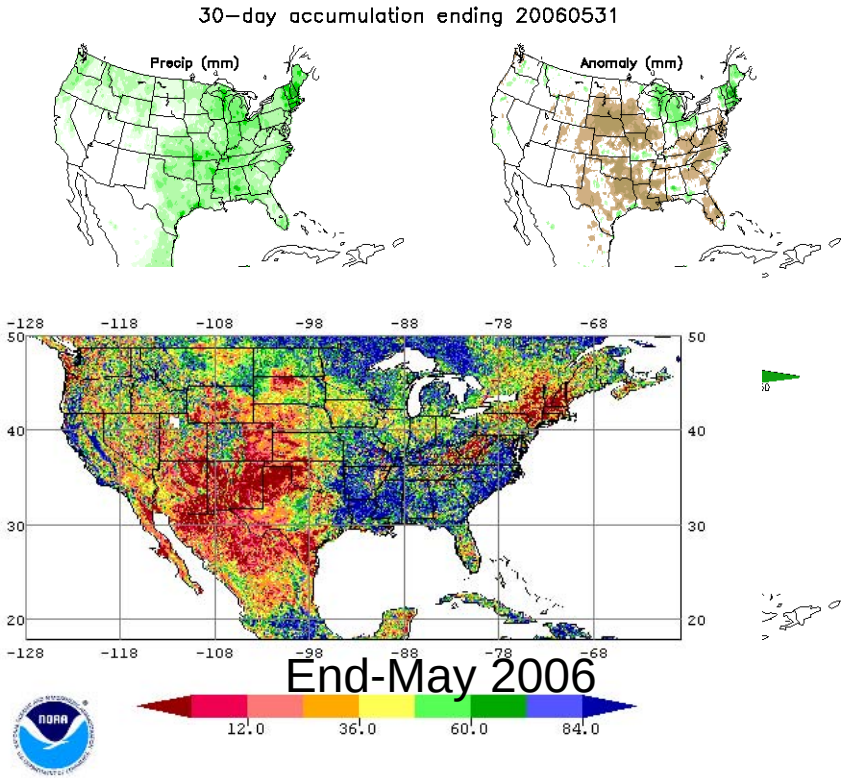
Comparison of directGVF and GVF for week 24, 2000, global and CONUS



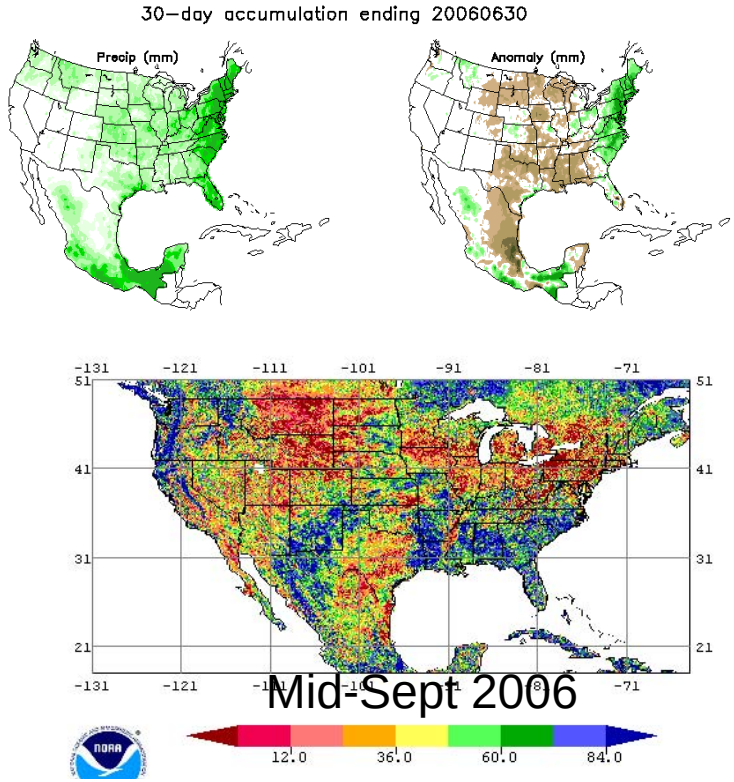




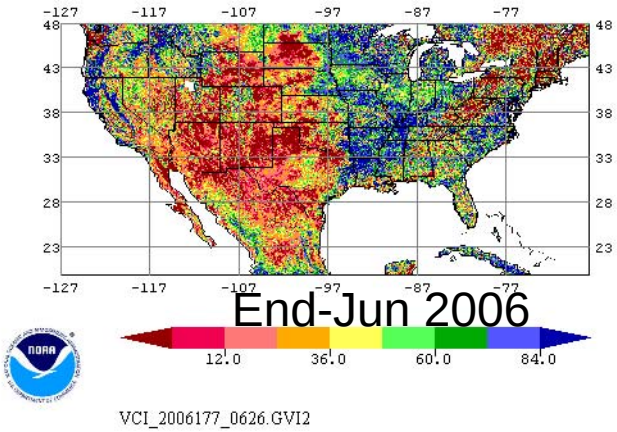
b) Vegetation Anomaly and Precipitation Anomaly



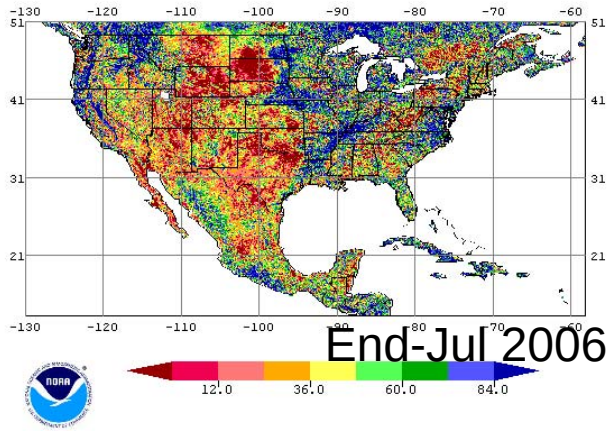
End-May 2006



Mid-Sept 2006



End-Jun 2006



End-Jul 2006

c) Remarks

- Weekly GVF climo based on ACDF adjusted NDVI has higher NDVI mean value than the currently used monthly GVF in NCEP/EMC models (for obvious reasons)-
- Both directGVF and GVF are provided as operational products, potentially keep one for simplicity after further evaluation.

Transition to Operations

- System Delivered to NESDIS/OSDPD (Mar'07)

- Operational testing, fine tuning, documentation currently underway (e.g., 1-month test running, training, reprocessing from 1982)

- Operational data availability to NCEP/EMC (expected by June 2007)

- Experimental data (climo and near real-time) available at NESDIS/STAR (POC: Wei.Guo@noaa.gov)

- Continuous improvement (open ended at NESDIS/STAR)

Future Work

- **Sensitivity tests using the improved GVF products in EMC models**

- **Impact studies – validation by ground data and summarize forecast skill statistics (currently carried out by *Cheng-Zhi Zou / Weizhong Zheng* at NESDIS/STAR)**

- **Other relevant efforts: GVI-x (global 4km NDVI capability using AVHRR-based data), MeteOp GVF (global 2km NDVI capability using MeteOp)**

Backup Slides

Project Title: Improving the Global Vegetation Processing System (GVPS)

PIs and Co-PIs: Dan Tarpley and Le Jiang

NWP Center Collaborators: Kenneth Mitchell

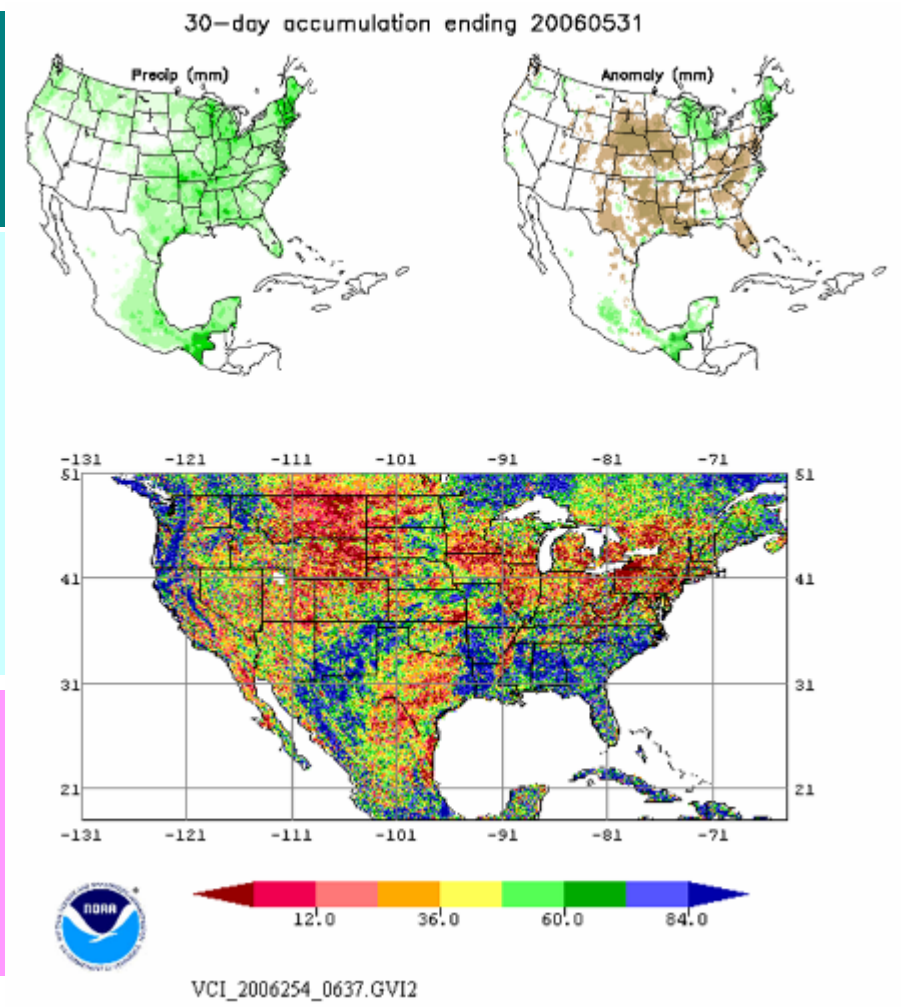
Accomplishments

- Major enhancement made to the AVHRR-based global vegetation processing system (GVPS), producing a consistent and quality improved long-term and near real-time vegetation dataset for operational use.

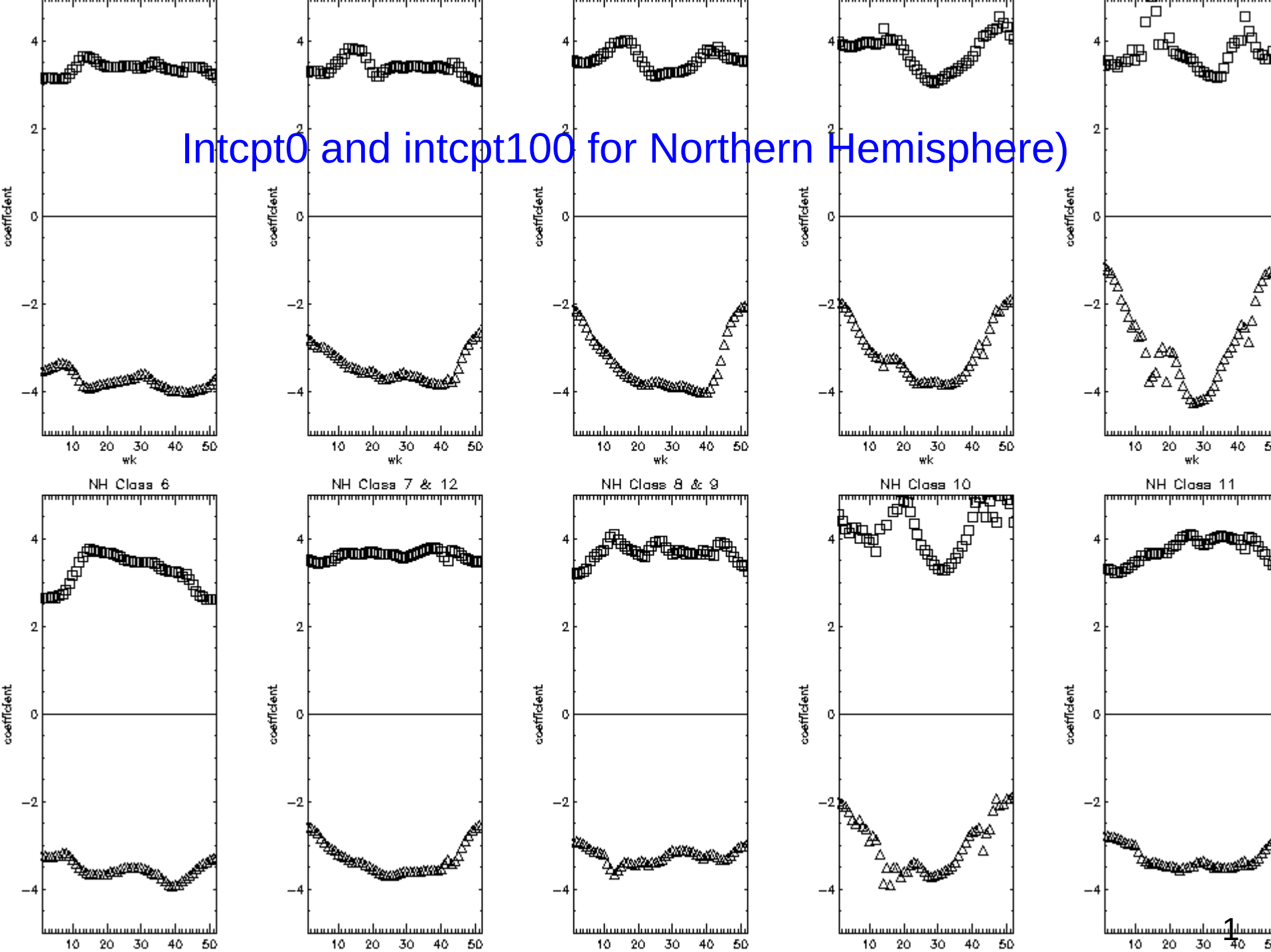
- GVPS currently in transition to operations

Future Plan

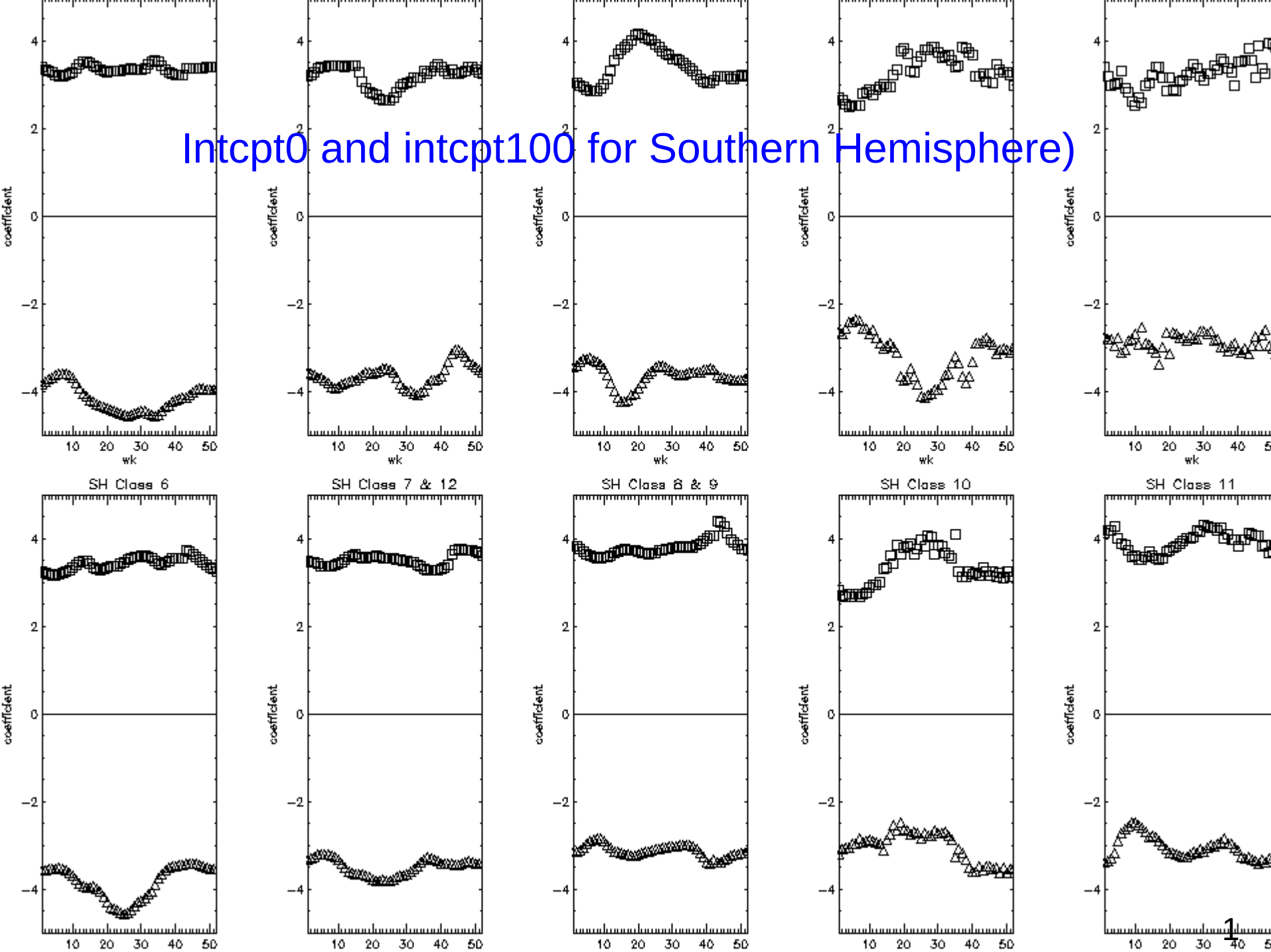
- Sensitivity & Impact studies in NWP models
- Continued improvements
- Improving components in LIS



Intcpt0 and intcpt100 for Northern Hemisphere)



Intcpt0 and intcpt100 for Southern Hemisphere)



Testing/Validation

1. Operations

- Regular weekly run

Non-interactive / Interactive mode: both OK.

- Reprocessing

For multiple satellites: using “Step-by-Step” reprocessing for 1136 weeks (from wk 35 of 1981 to wk 3 of 2007). Program runs fast without failure (taking total about 2 hr 40 min). OK.

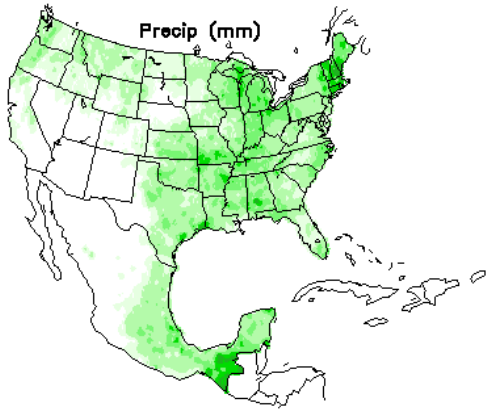
- Other utilities

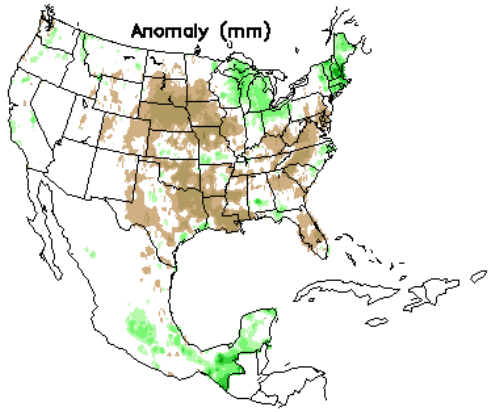
For the operational system, the existing built-in utilities are (more than) sufficient. No major issues encountered.

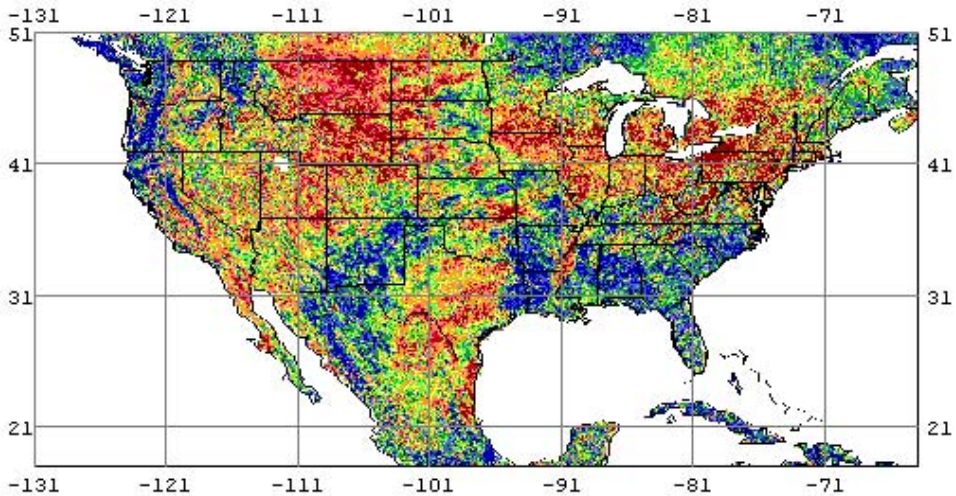
2. Documentation

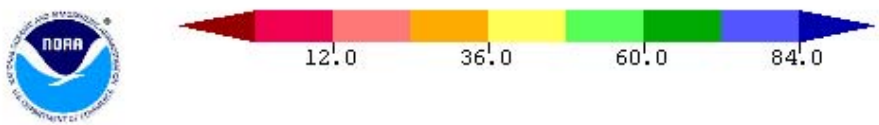
Need finalization before delivery to ESPC (to be done by end Feb’07)

30-day accumulation ending 20060531









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