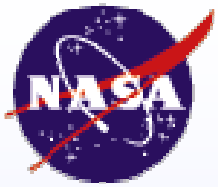


The NEWS Water and Energy Cycle Climatology Project

Matthew Rodell, Tristan L'Ecuyer, Hiroko Kato Beaudoing, and the NEWS Water and Energy Cycle Climatology Team

Matt Rodell
NASA GSFC

NASA Energy and Water Cycle Studies (NEWS)

- A multi-year effort in the U.S. to build satellite-based global water and energy cycle datasets and to do integrative science

- Datasets cover most aspects of the water and energy cycles
  - -Water vapor
  - -Precipitation
  - -Evaporation and latent heat
  - -etc

- Example integrative studies include this presentation, a global water cycle assessment, as well as
  - -Global energy cycle
  - -Extreme events
  - -Improved modeling
  - -Evaporation and latent heating

Matt Rodell
NASA GSFC

The State of the Global Water Cycle

Premise: In order to evaluate water cycle consequences of climate change, a water cycle working group was formed in 2006 to establish the current "state of the global water cycle".

Methods: Use modern observation-integrating products and associated error-analyses to develop a climatology of water cycle components for each continental/oceanic to global scale region.

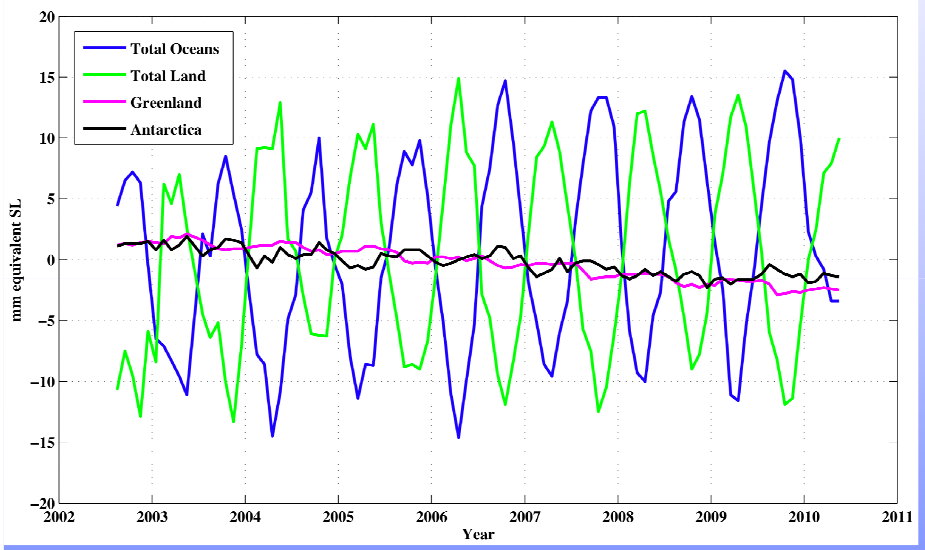
Outcomes: (1) A baseline for water cycle / climate change studies and model assessments. (2) Quantitative graphical depictions of the water cycle.

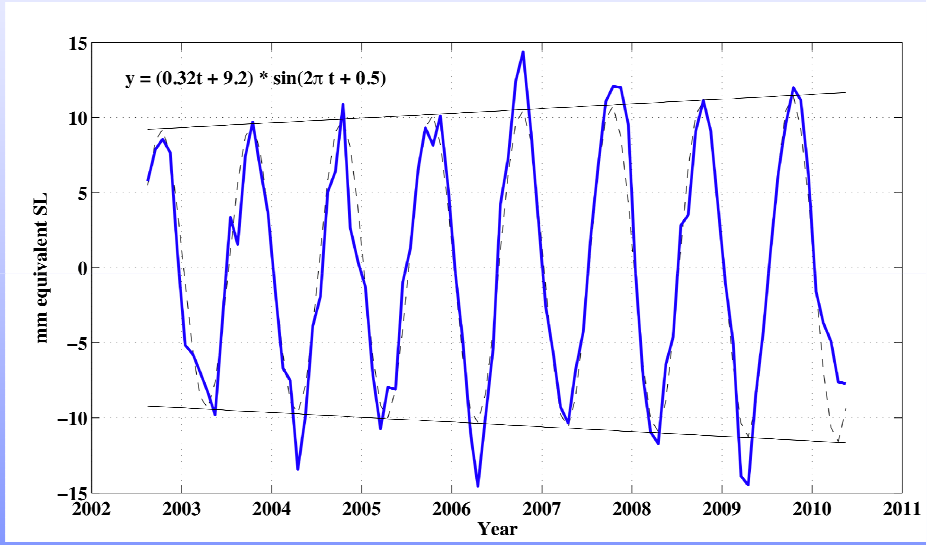
Matt Rodell
NASA GSFC

Example integrative studies from my group

Mass variations in Earth's global water reservoirs

Famiglietti, Chambers, Nerem, Wahr, Swenson, Velicogna





Matt Rodell
NASA GSFC

Example integrative studies from my group

Yesterday's talk on global discharge

Famiglietti, Chambers, Willis, Hilburn

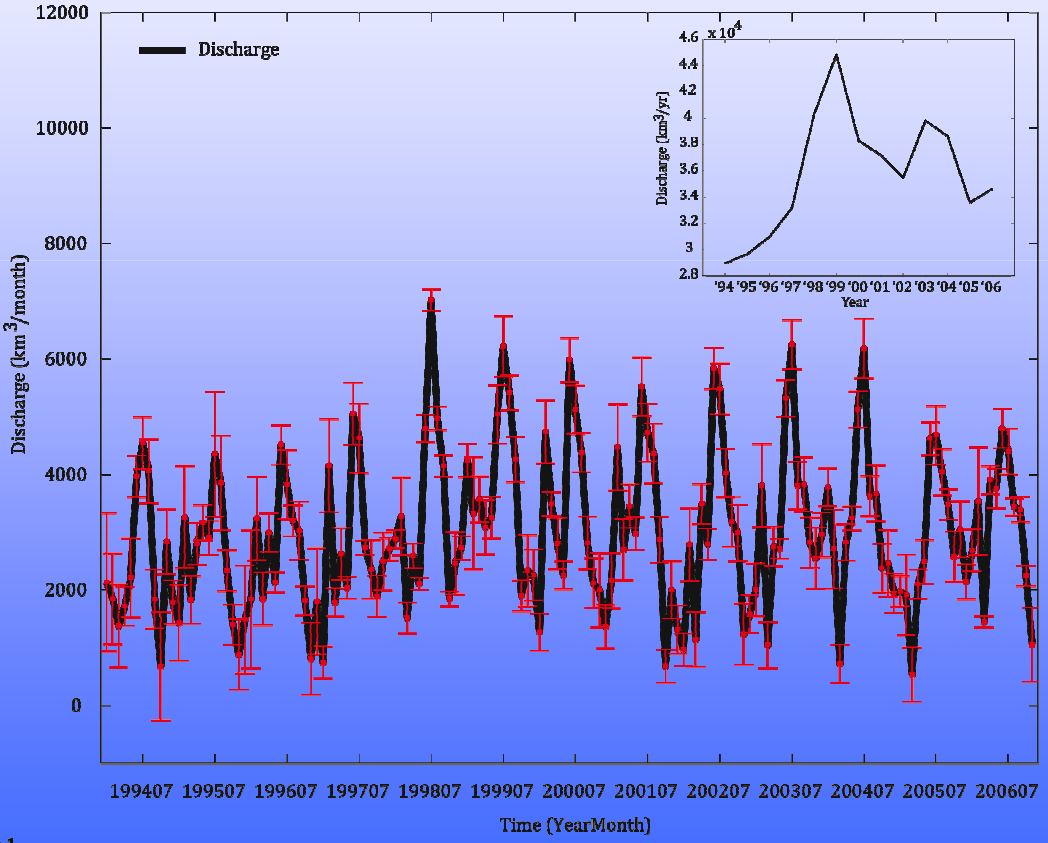


Figure 1

Matt Rodell
NASA GSFC

‘State of the water cycle from remote sensing’

NEWS Water Cycle Working Group

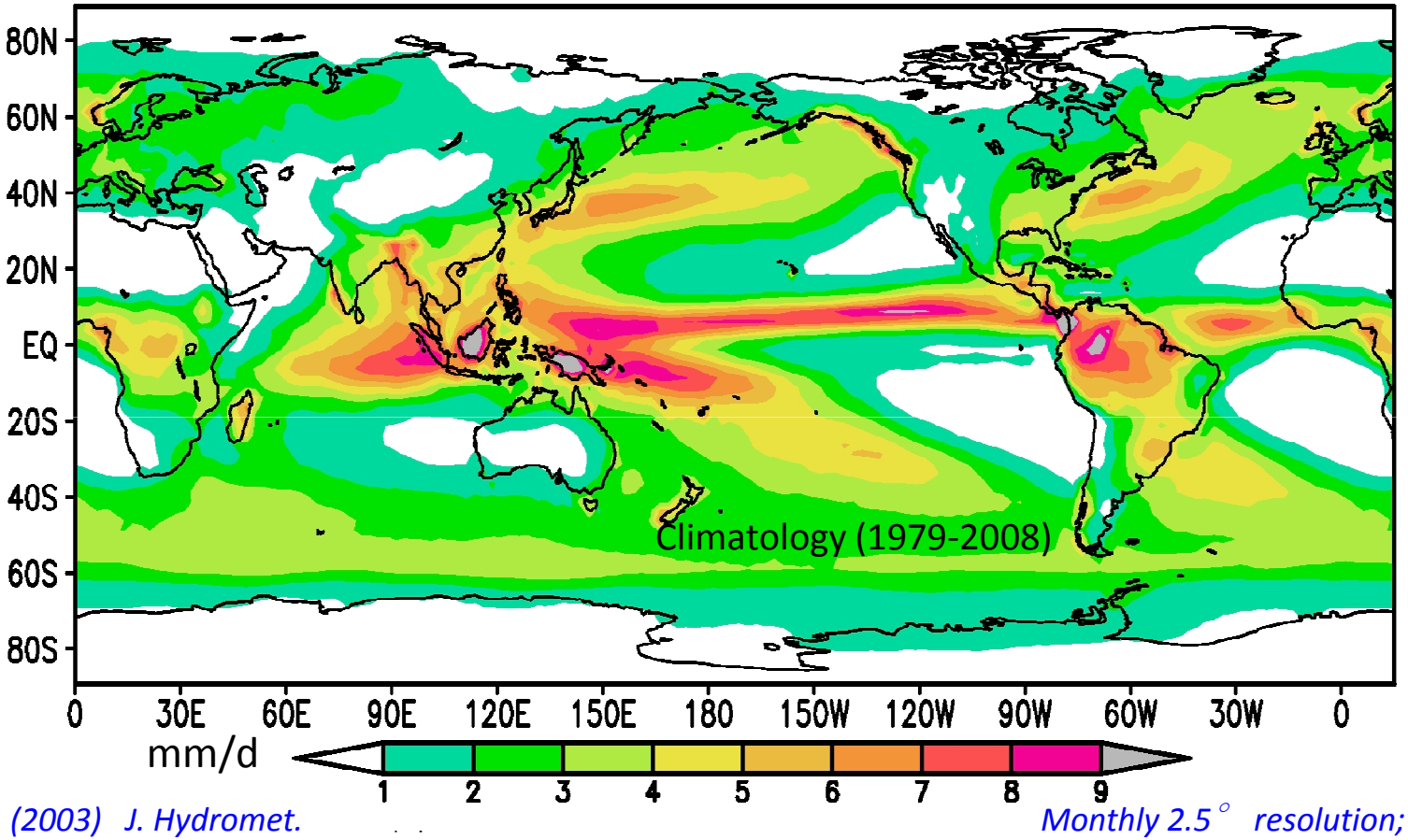
Matt Rodell
NASA GSFC

Global Precipitation Climatology Project (GPCP)

A global data set project under WCRP/GEWEX

Adler, Huffman, Chiu, Xie, Ferraro, Schneider

Monthly Analysis of Global Precipitation Using Satellite and Gauge Information (1979-present)



Adler et al. (2003) J. Hydromet.
Huffman et al. (2009) GRL

GPCP data used in > 1200 journal articles

Monthly 2.5° resolution; pentad and daily products also

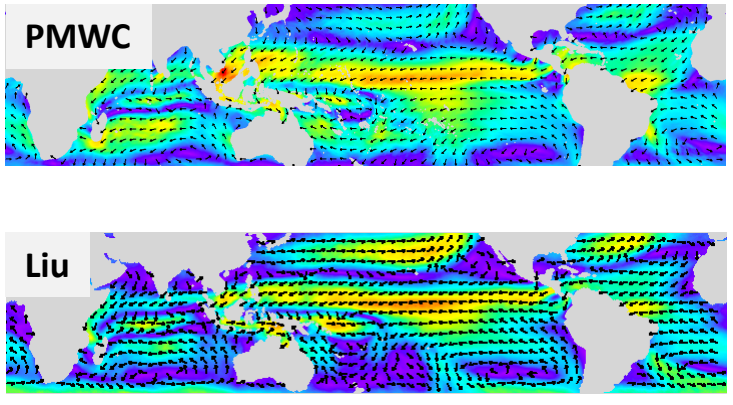
Low-orbit microwave over ocean and land adjusting geo-IR and merged with gauges over land with sounder estimates at high latitudes

http://www.ncdc.noaa.gov/oa/wmo/wdcamet-ncdc.html
http://precip.gsfc.nasa.gov

Atmospheric Vapor Flux

- PMWC
  - "Passive Microwave Water Cycle" (Version-01b)
  - Resolution: 0.25-deg, monthly maps, global
  - Date Range: 1987-2009 (SSM/I)
  - Parameters: WVT spd, dir, div; evap, precip, vapor
  - Technique: adjust WVT to match E-P, uses CCMP winds (derived from RSS winds)
  - Reference: Hilburn (2009), RSS Tech Report 092409, www.remss.com
  - Note: update planned to PMWC using all new RSS Version-7 geophysical retrievals (from SSM/I, SSMIS, TMI, AMSR-E, and WindSat)
- Liu
  - Tim Liu (Version 3)
  - Resolution: 0.5-deg, daily maps, global (+/- 75 deg)
  - Date Range: 1999-2008 (QuikSCAT)
  - Parameters: WVT u,v, div
  - Technique: Support Vector Regression, uses 850 mb winds
  - Reference: Xie, Liu, and Tang (2008), doi:10.1016/j.rse.2007.09.003.

January 2003

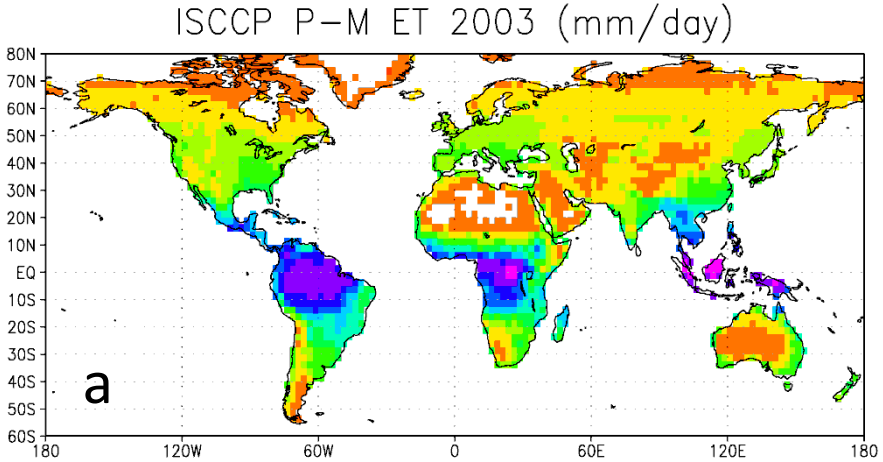


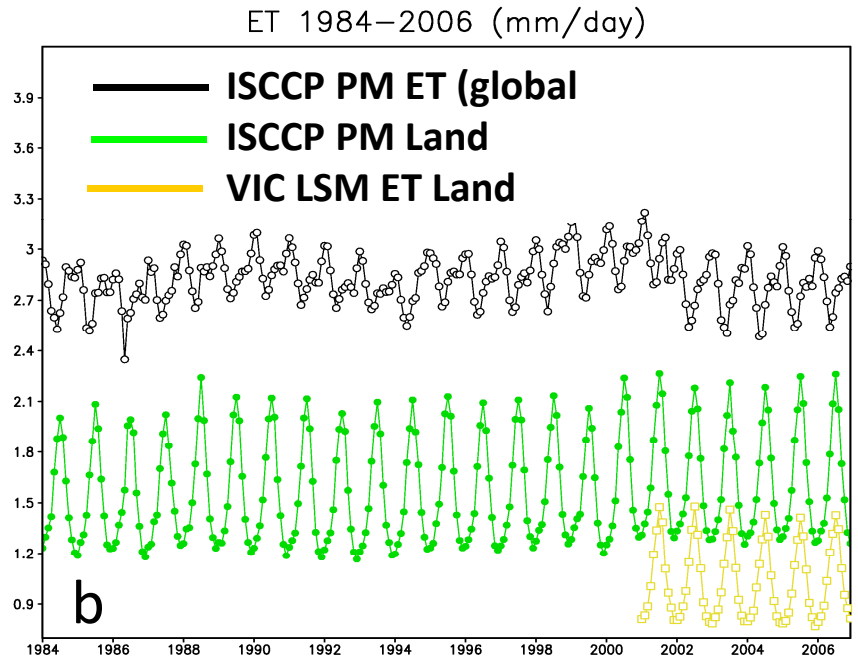
Water vapor transport vectors (mm m/s)

Development and diagnostic analysis of a multi-decadal global evaporation product for NEWS

Princeton University

PI: Eric F Wood

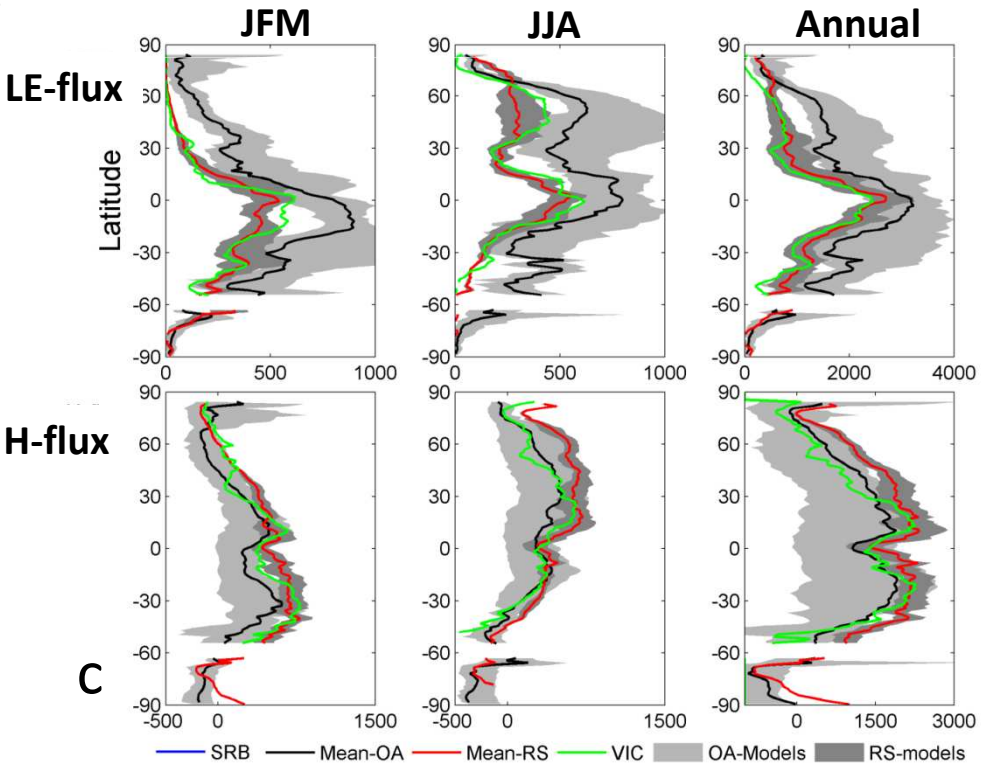




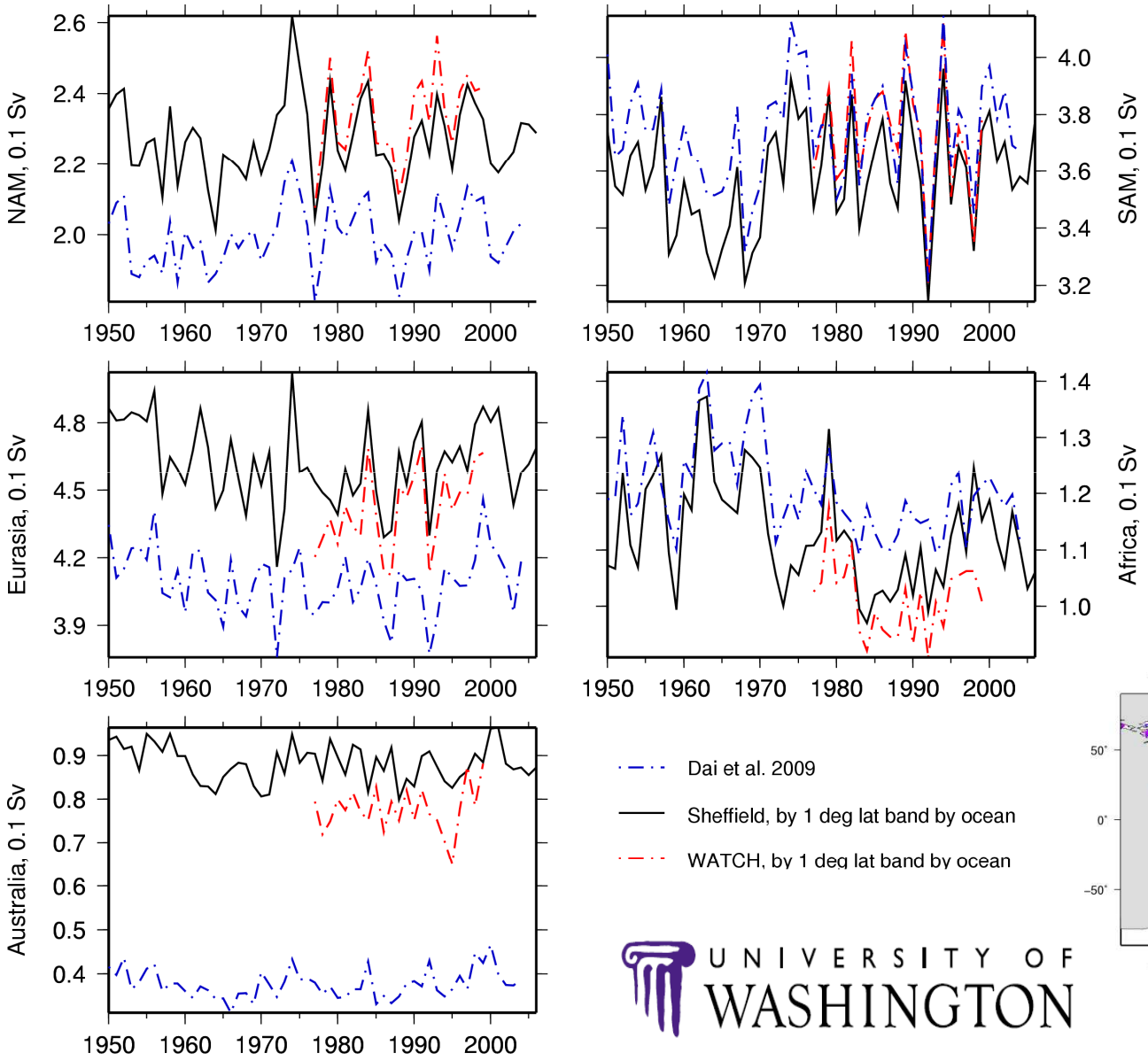
Panel a: Annual terrestrial ET using the ISCCP data and a Penman-Monteith RS model

Panel b: 1984-2007 terrestrial and global ET estimates using PM/ISCCP. Note comparison to VIC LSM and global P ~2.8 mm/day

Panel c: Comparing remote sensing to operational models being assessed by NEWS

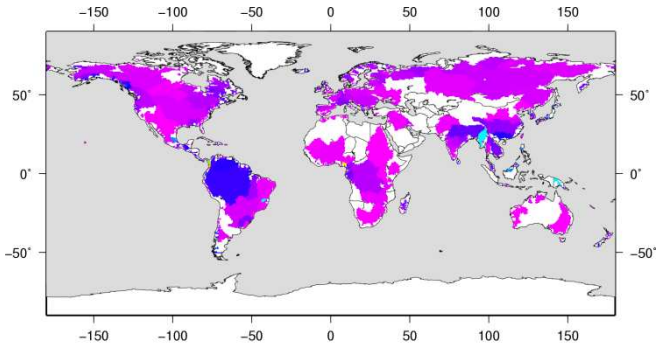


Continental runoff to the ocean



Following Dai et al. 2009:

- Runoff estimated from 920 streamflow gages.
- Gaps in record filled in based on regression with VIC modeled runoff
- Unmonitored areas filled in based on ratio of gaged flow and VIC modeled runoff.

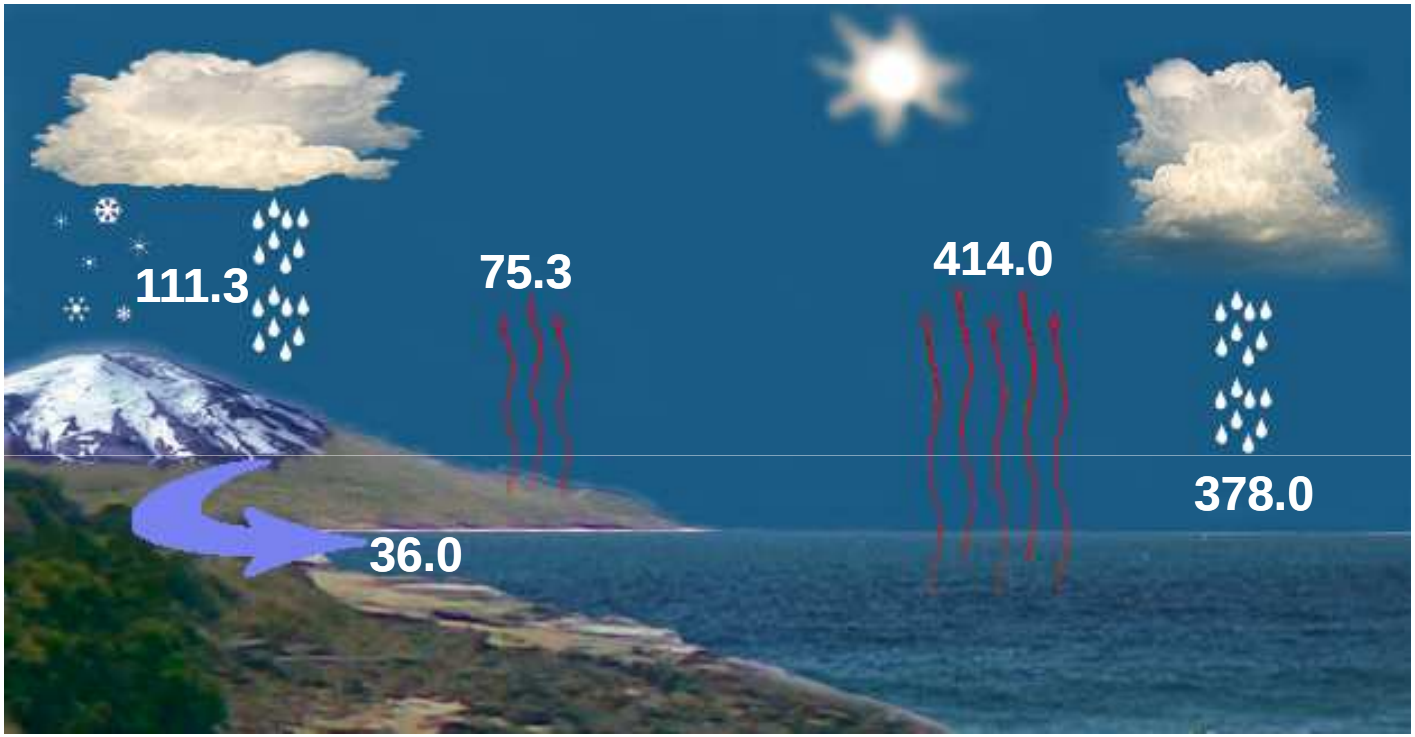


Monitored basins

UNIVERSITY OF WASHINGTON

NEWS: State of the Global Water Cycle

Modern estimates of water fluxes based on advanced observations and models

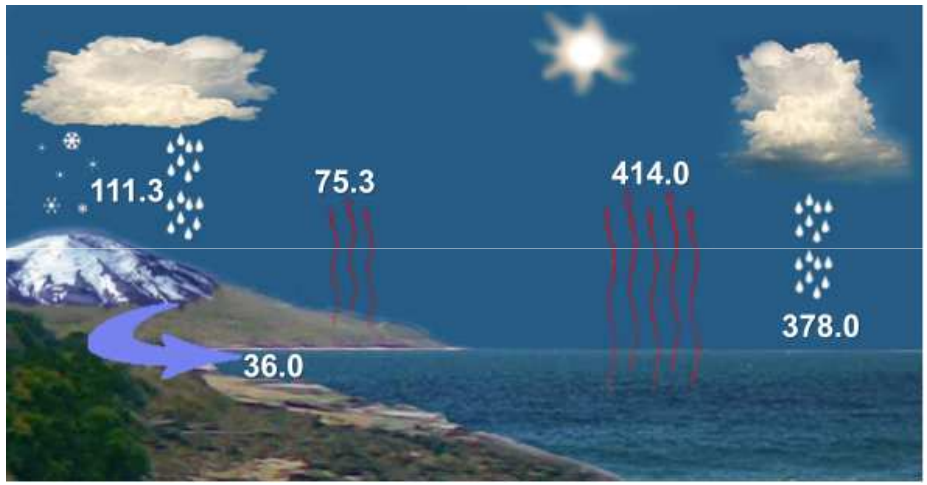


Global mean water fluxes (1,000 km^3/yr) at the start of the 21st century, based on satellite and ground-based observations and data integrating models. A comprehensive assessment of the global water cycle is being carried out by a multi-institutional team of investigators supported by NASA's Energy and Water Cycle Study (NEWS) program.

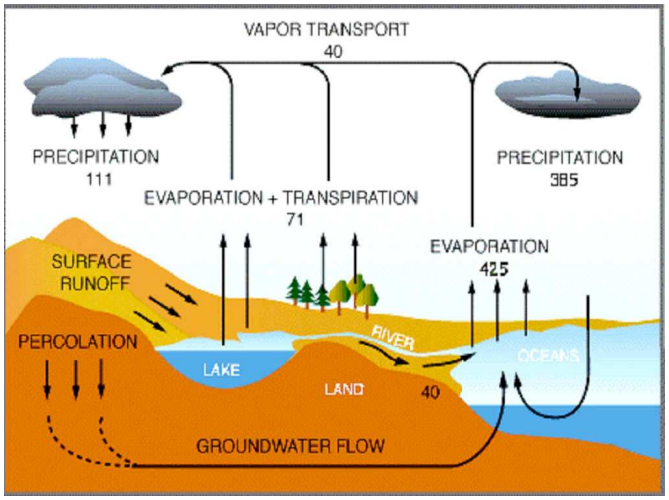
Characterizing the global water cycle requires data and expertise that can only be harnessed through an integrative team effort, as is fostered by NEWS

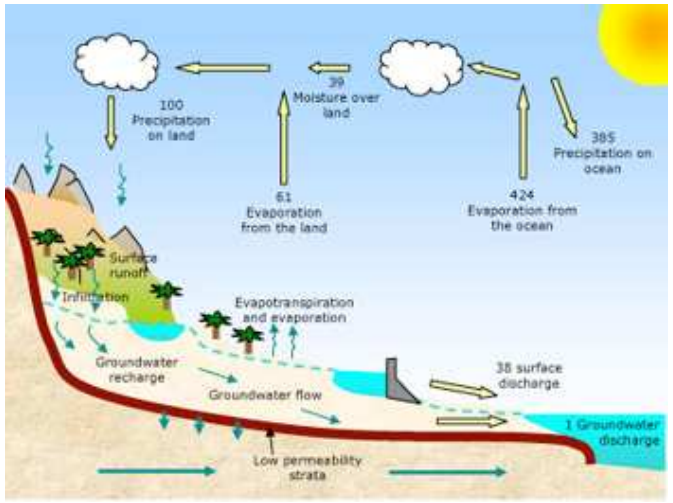
Matthew.Rodell@nasa.gov

•NEWS

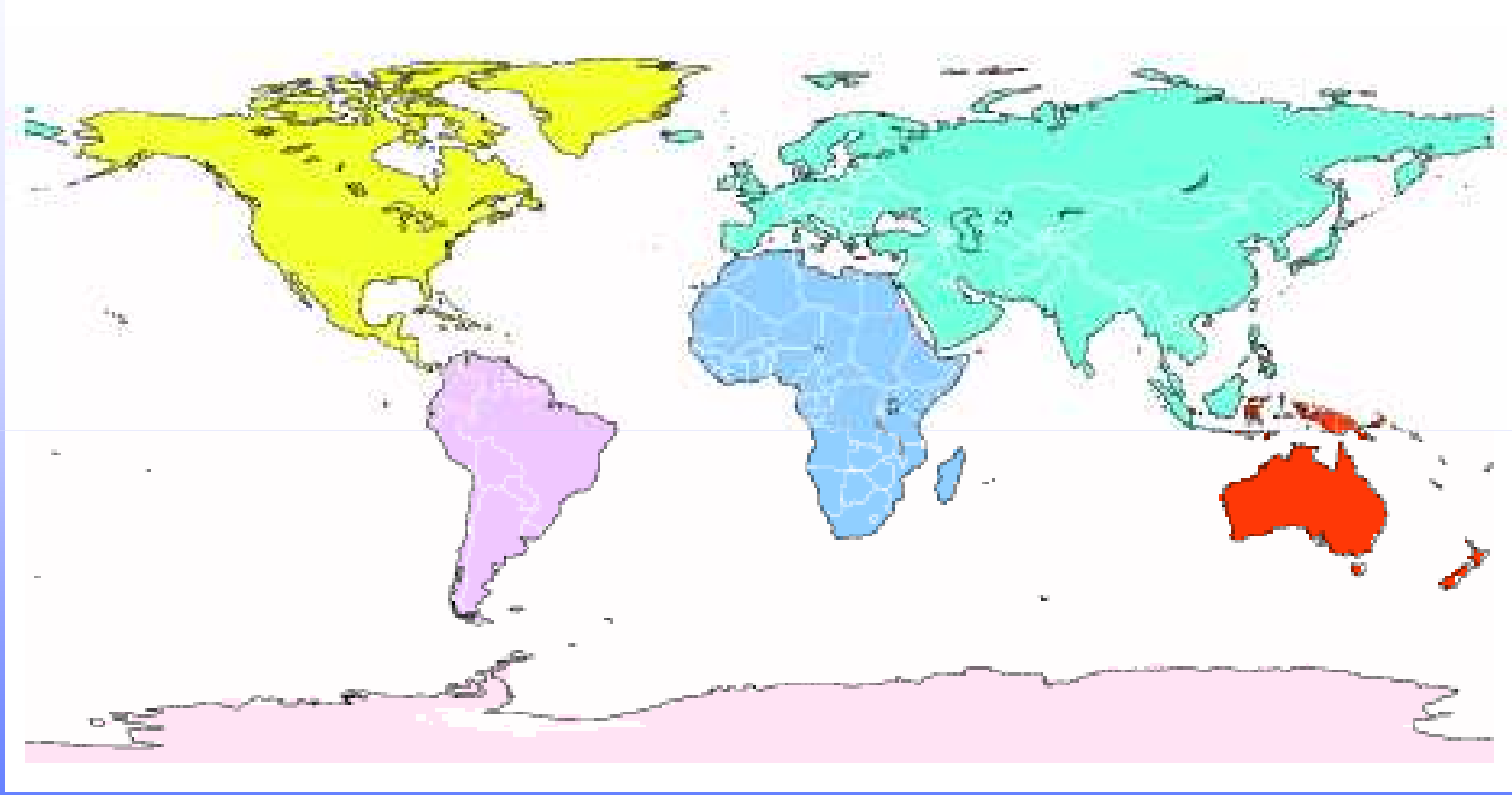


•From the web



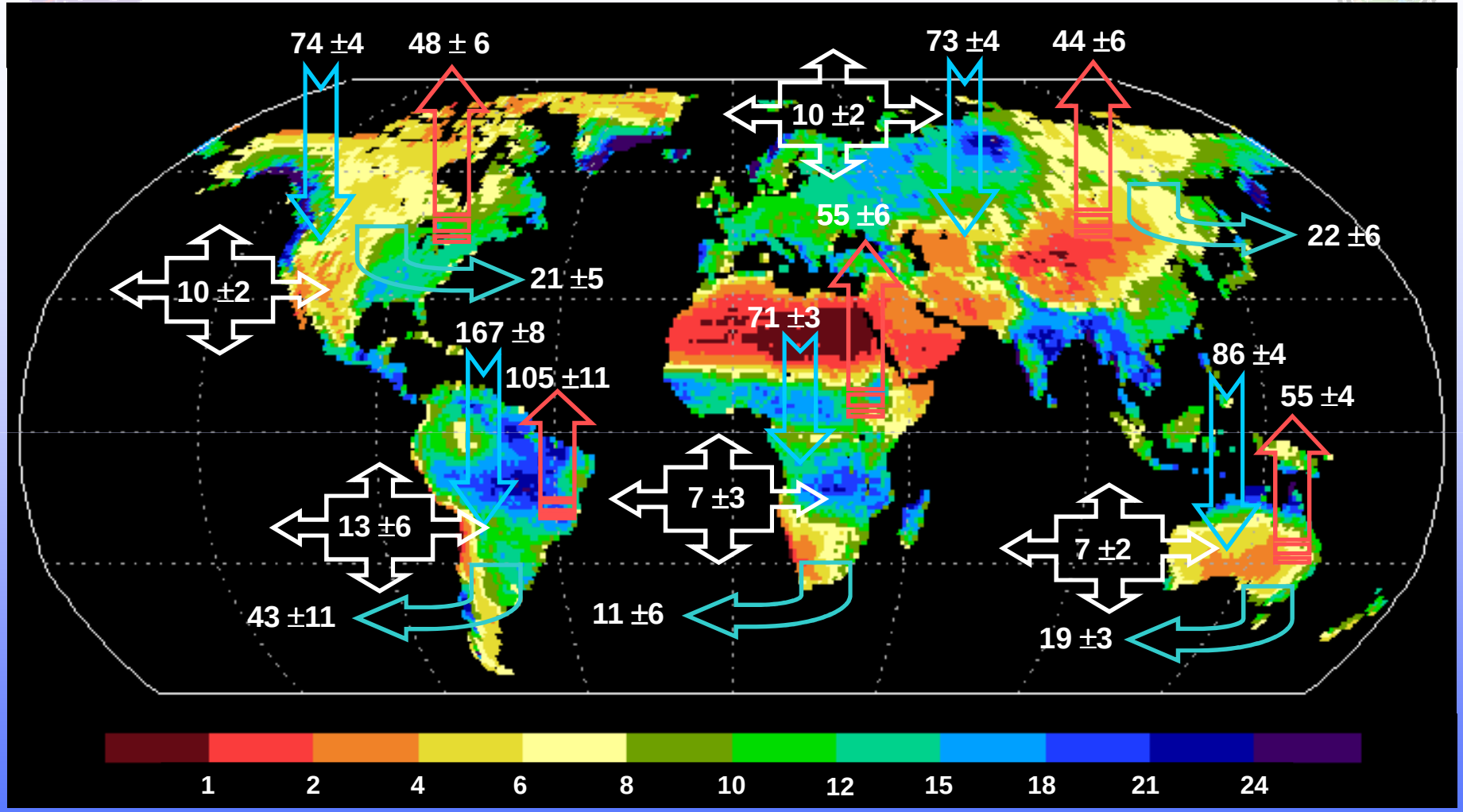


Continental Regions



Matt Rodell
NASA GSFC

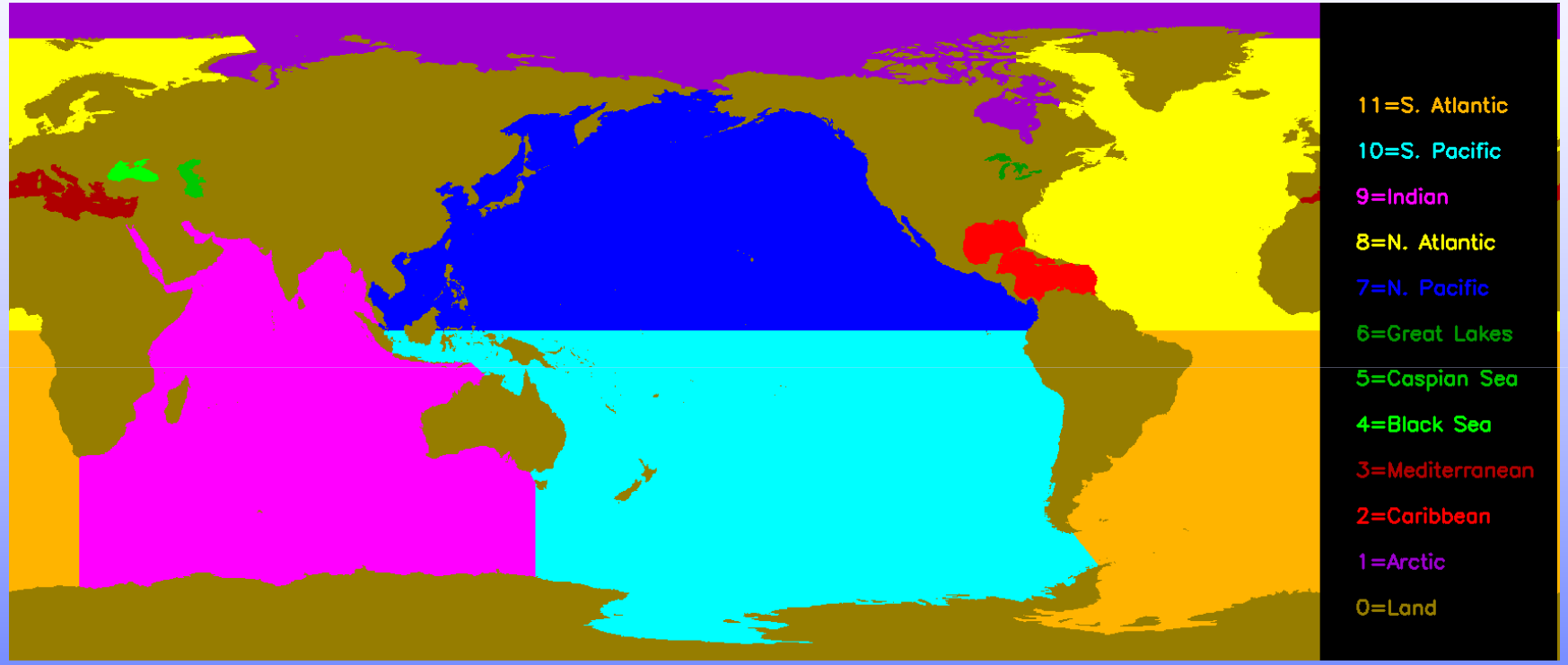
Mean Annual Continental Fluxes



Precipitation (downward arrows), evapotranspiration (upward arrows), runoff (outward arrows), and annual amplitude of terrestrial water storage (white boxes) in cm/yr. Background shows GRACE-based amplitude of the annual cycle of terrestrial water storage (cm/yr).

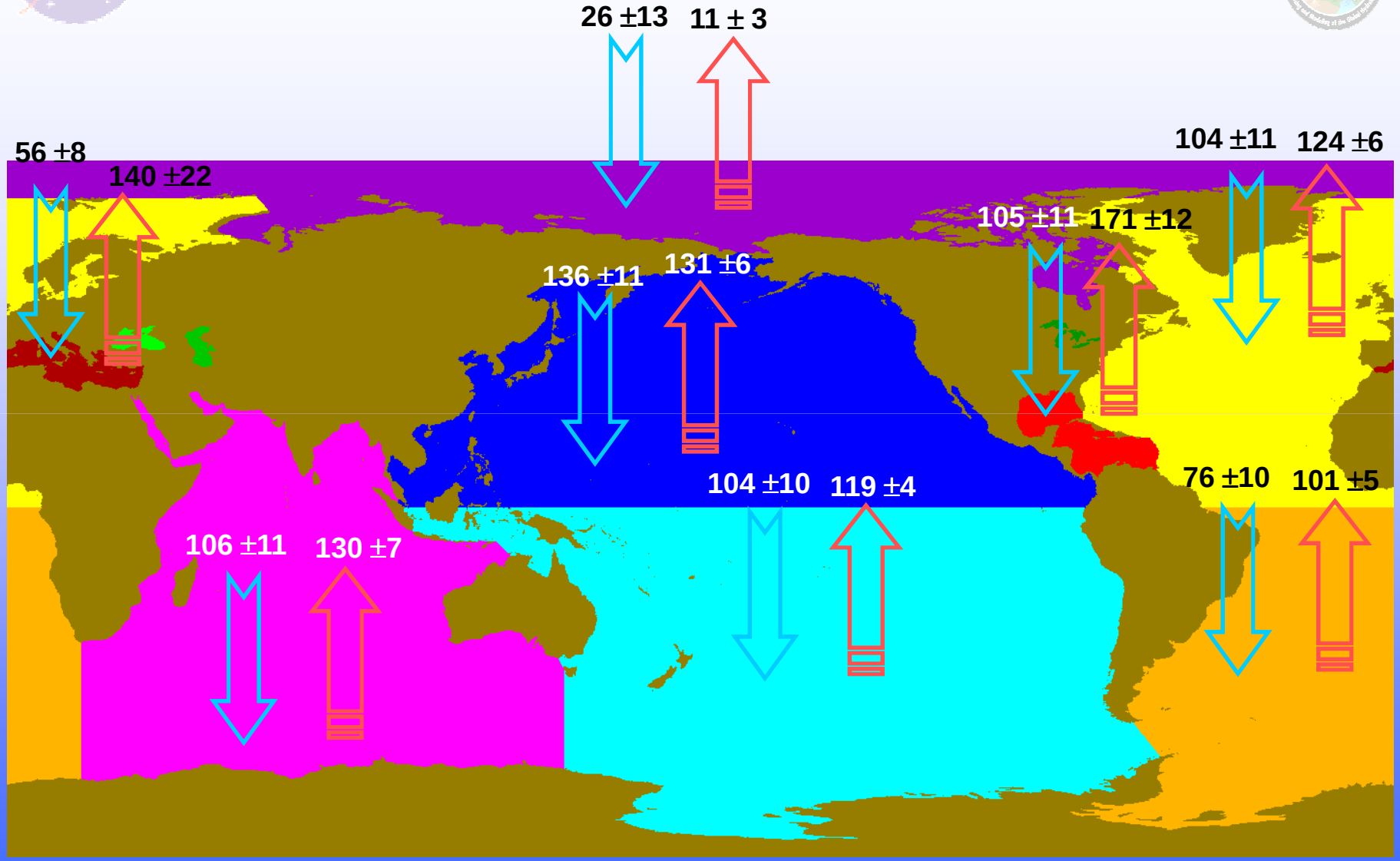
Matt Rodell
NASA GSFC

Oceanic Regions



Matt Rodell
NASA GSFC

Mean Annual Oceanic Fluxes



Matt Rodell
NASA GSFC

Global ocean precipitation from GPCP and CMAP

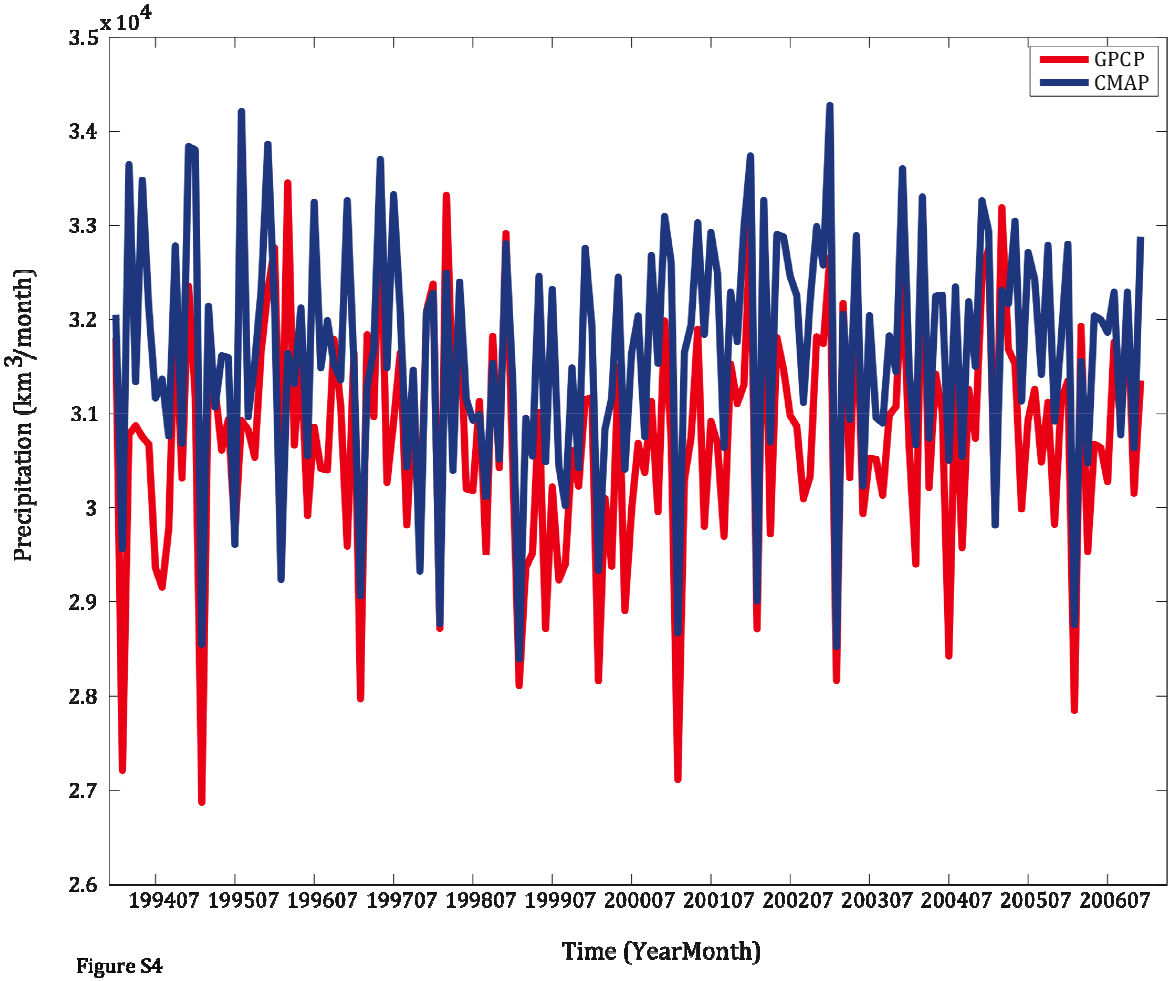


Figure S4

•*Syed et al., 2010*

Global ocean evaporation from OAFlux, HOAPS, SSM/I

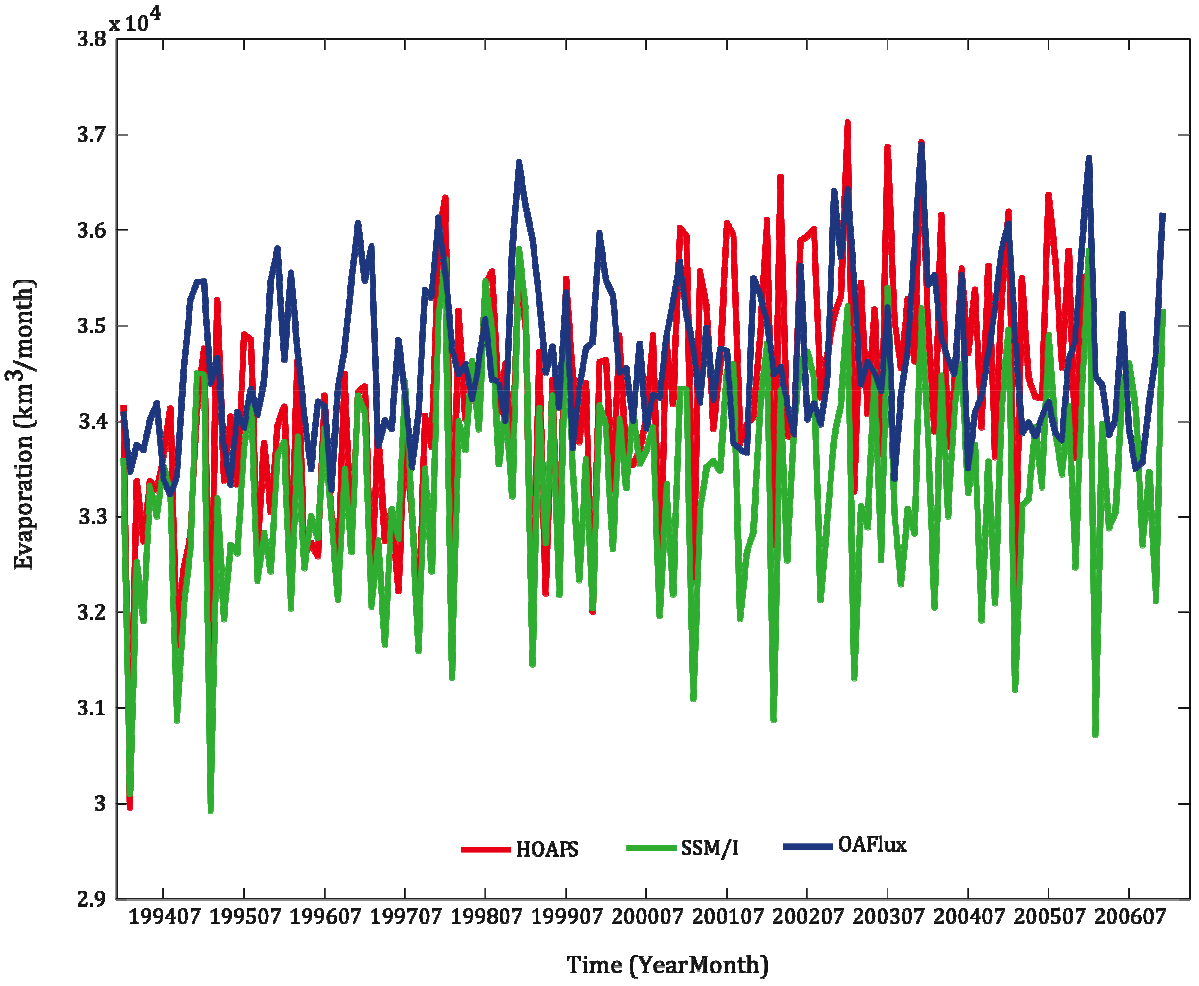


Figure S5

•*Syed et al., 2010*

Achieving Water Balance

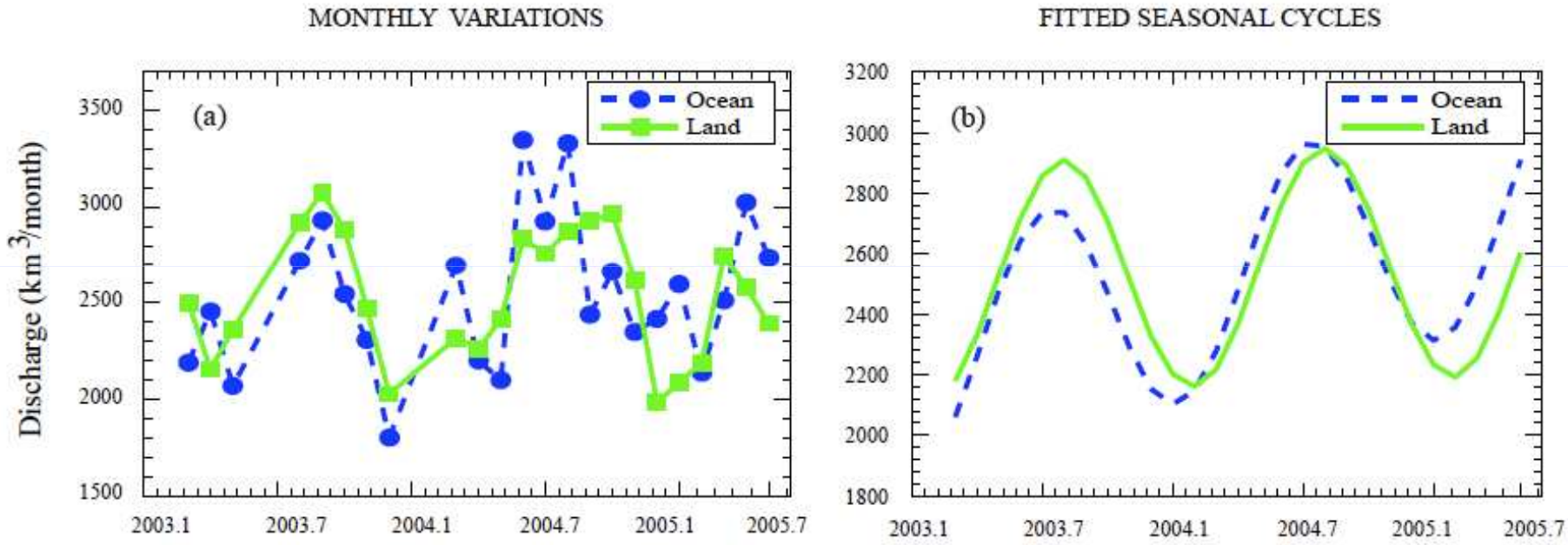
$$ET_{balanced} = ET_{best\_guess} + (WBR * \sigma_{ET} / (\sigma_P + \sigma_{ET} + \sigma_Q))$$

WBR = Water balance residual

σ = uncertainty/error (standard deviation of estimates)

Matt Rodell
NASA GSFC

Achieving Water Balance



Matt Rodell
NASA GSFC