CDR DEVELOPMENT PROJECT

The Development of a 20-year Database of Ocean Surface and Near-Surface Properties

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CDR Team Meeting
July 30 – Aug 1, 2013

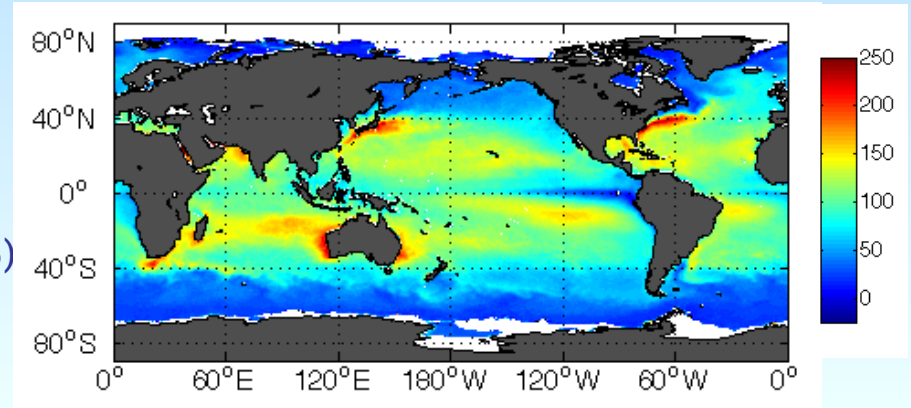
Outline

- Project Description
- Production and QA Approach
- Applications
- Schedule & Issues

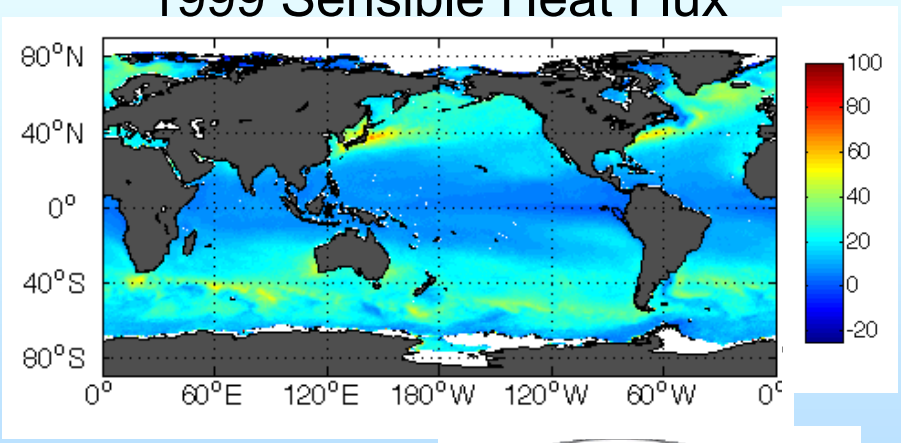
SeaFlux Climatological Data Set Version 1.0

- Near-surface air temperature and humidity
  - Roberts et al. (2010) neural net technique
  - SSM/I only from CSU brightness temperatures (thus only covers 1997 - 2006)
  - Gap-filling methodology -- use of MERRA variability – 3 hour
- Winds
  - Uses CCMP winds (cross-calibrated SSM/I, AMSR-E, TMI, QuikSCAT, SeaWinds)
  - Gap-filling methodology -- use of MERRA variability – 3 hour
- SST
  - Pre-dawn based on Reynolds OISST
  - Diurnal curve from new parameterization
  - Needs peak solar, precip
- Uses neural net version of COARE
- Available at http://seaflux.org

1999 Latent Heat Flux



1999 Sensible Heat Flux



Project Description

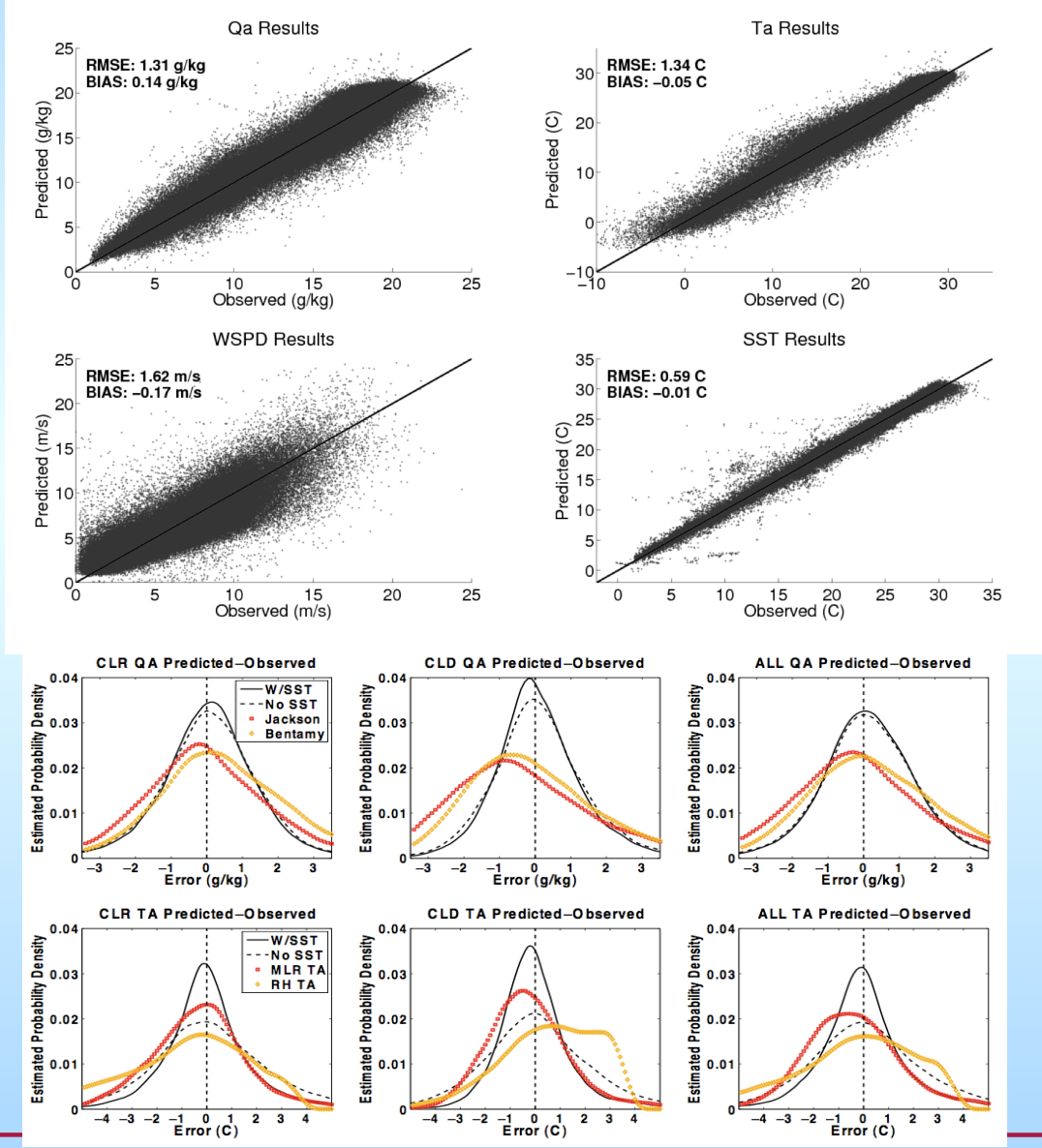
- sea surface temperature and near-surface parameters of wind speed, temperature, and humidity → determination of the air-sea turbulent heat fluxes
- Source Data
  - AVHRR/AMSR (Reynolds +)
  - SSM/I
  - Supporting data: solar radiation, ice flags
- Adaptations for CDR program (Version 1.1)
  - Corrections for EIA
  - Creation of NetCDF files
  - Extension to entire SSM/I record
  - No use of CCMP winds

Project Description

CDR(s) (Validated Outputs)	Period of Record	Spatial Resolution; Projection information	Time Step	Data format	Inputs	Uncertainty Estimates (in percent or error)	Collateral Products (unofficial and/or unvalidated)
SST	1998-2007	0.25° equal angle	3 hours	Binary	Reynolds, diurnal warming parameterization, SRB, GPCP	< 0.2° C	
Near-surface air humidity, winds, & temperature	1998-2007	0.25° equal angle	3 hours	Binary	SSM/I, ice flags, land flags	Ta: < 0.1 °C Qa: 0.26 g/kg U: < 0.2 m/s	
Latent and sensible heat fluxes	1998-2007	0.25° equal angle	3 hours	Binary	SST, Ta, Qa, Winds	LHF: 14 W/m^2 SHF: 6 W/m^2	

Production Approach: U, Ta, qa

- Use of neural net technique from SSM/I fields (Roberts et al. 2010)
- Gridding into equal-angle grids
- Interpolation using model gradients



Approach: SST

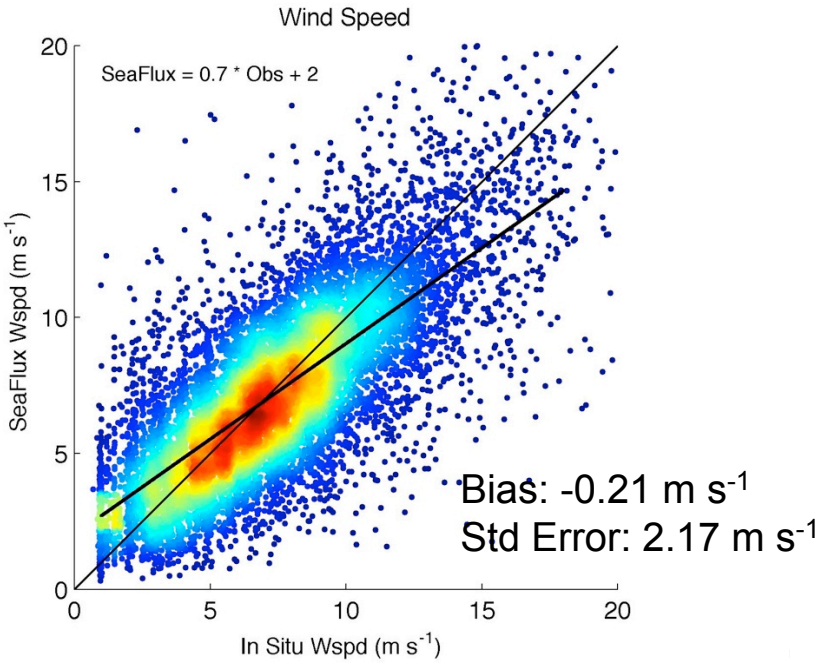
- Creation of pre-dawn SSTs
  - Currently Reynolds +
- Diurnal cycle inclusion
  - Estimation by paramaterization – done for entire time period
- Production of final gridded SST datasets

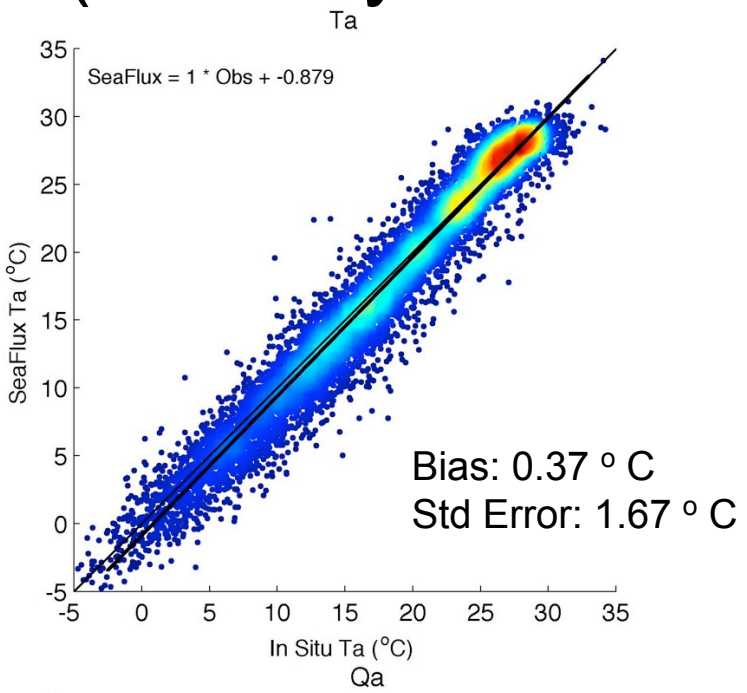
Validation & Quality Assurance

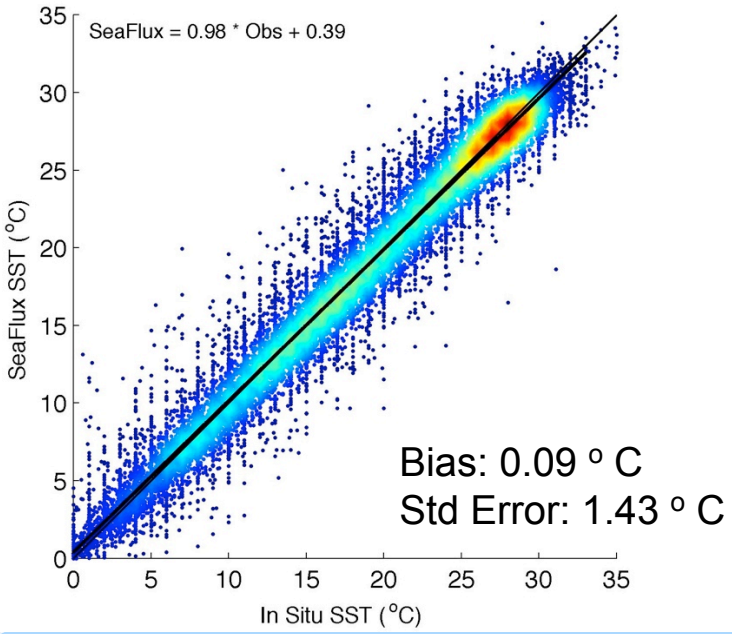
- Uncertainty analysis by comparisons with IVAD (ship-based data, not used in production of data)
- Propagation of errors, simple sampling theory
- Uncertainty estimated at each time step and location for all products
  - Calculation of both systematic and random uncertainties
  - Uncertainties shown in product table are total over the 1998 – 2007 time period

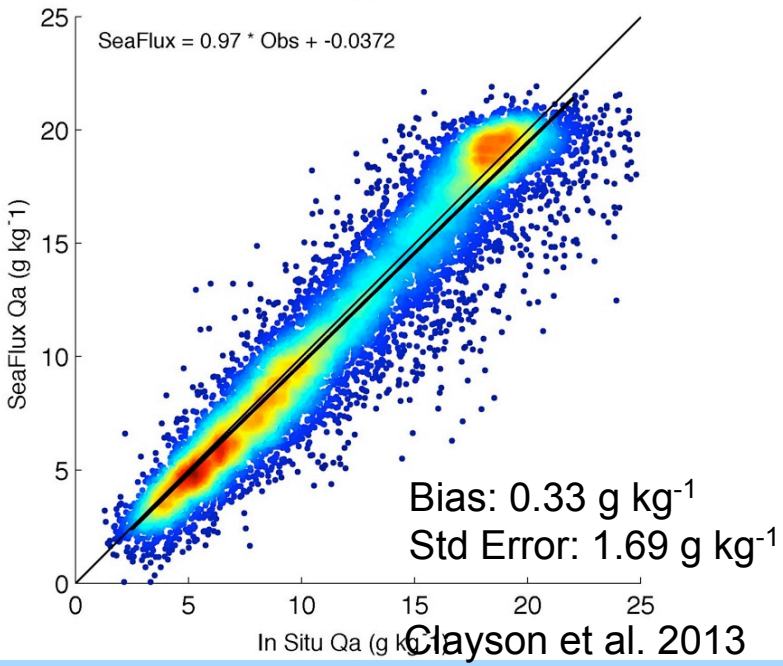
$$\sigma_{LHF} = \left[\left(\rho_a L_v U (Qs - Qa) \sigma_{C_E,sys} \right)^2 + \left(\rho_a L_v C_E (Qs - Qa) \sigma_{U,sys} \right)^2 + \left(\rho_a L_v C_E U \sigma_{(Qs-Qa),sys} \right)^2 + 2 r_{(Qs-Qa),U} \left(\left(\rho_a L_v C_E \right)^2 (Qs - Qa) U \sigma_{(Qs-Qa),sys} \sigma_{U,sys} \right) \right.$$
$$\left. + \left(\rho_a L_v U (Qs - Qa) \sigma_{C_E,ran} \right)^2 + \left(\rho_a L_v C_E (Qs - Qa) \sigma_{U,ran} \right)^2 + \left(\rho_a L_v C_E U \sigma_{(Qs-Qa),ran} \right)^2 + 2 r_{(Qs-Qa),U} \left(\left(\rho_a L_v C_E \right)^2 (Qs - Qa) U \sigma_{(Qs-Qa),ran} \sigma_{U,ran} \right) \right]^{1/2}$$

Comparisons with IVAD data (courtesy of E. Kent)





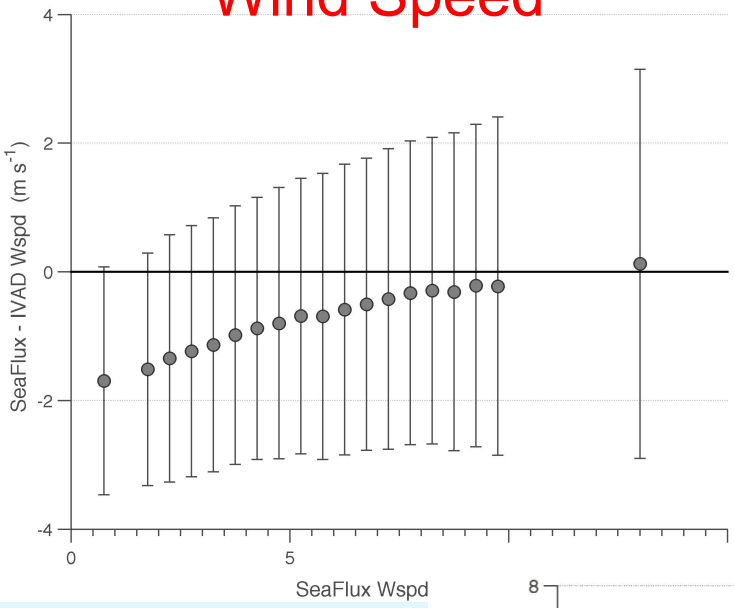




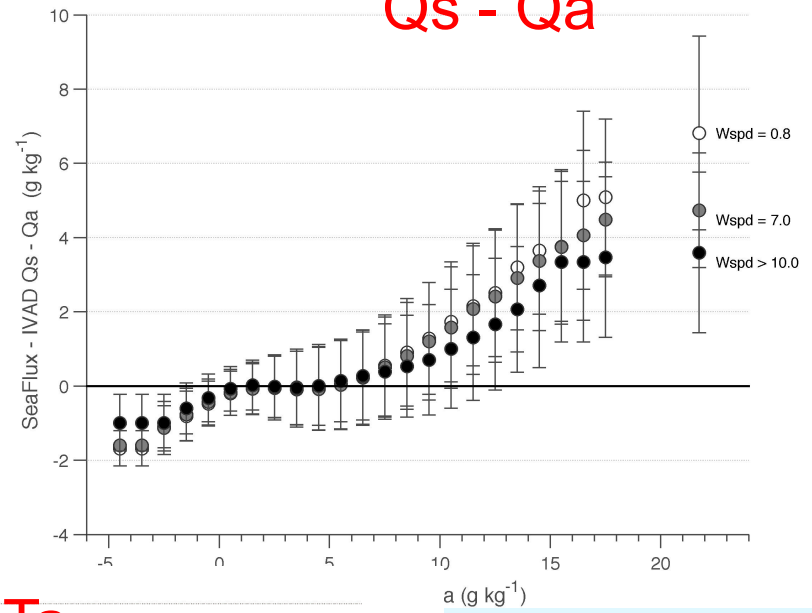
Clayson et al. 2013

Evaluating uncertainty using IVAD data

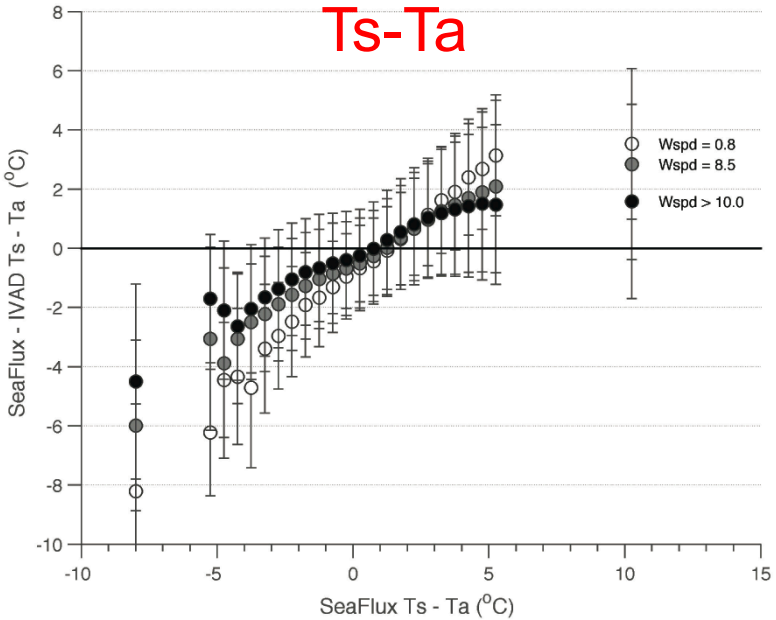
Wind Speed



Qs - Qa

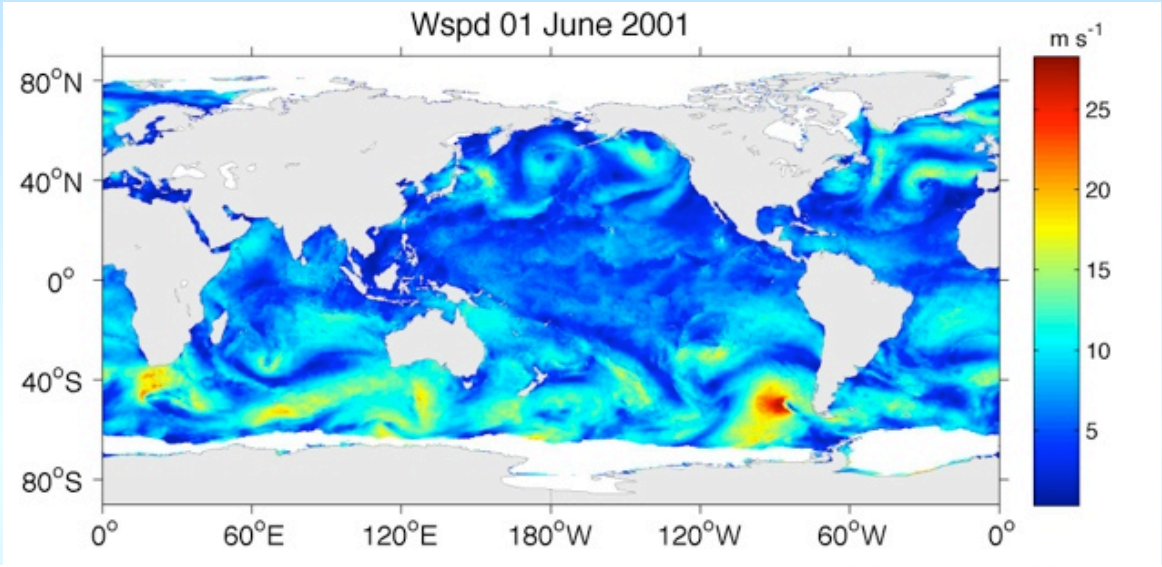


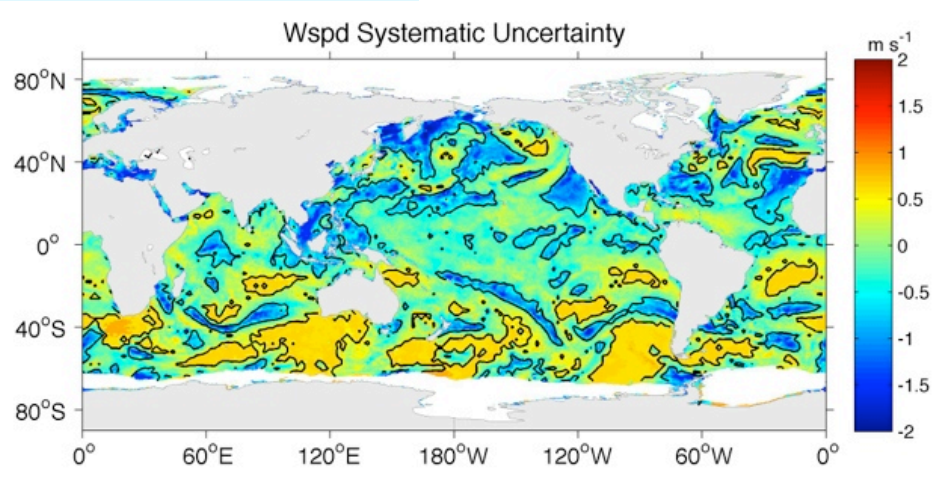
Ts-Ta

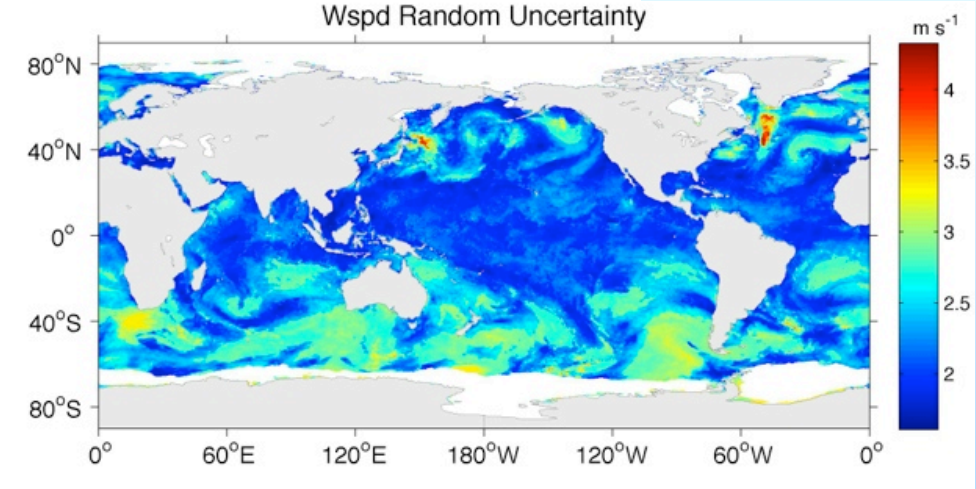


Clayson et al. 2013

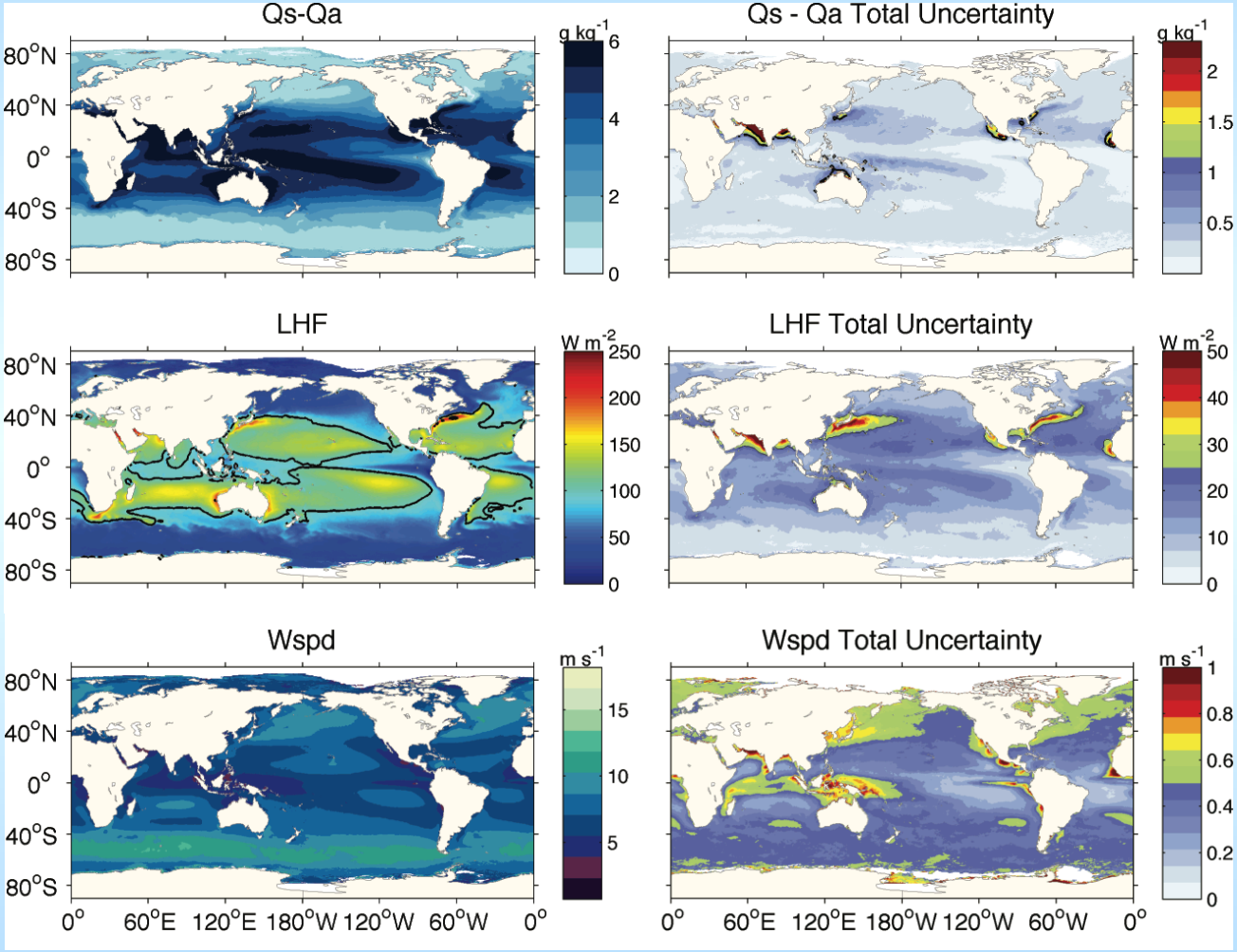
Instantaneous fields







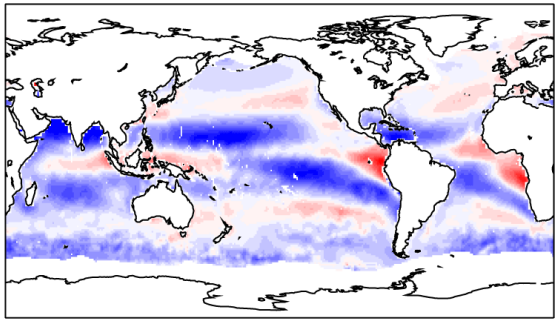
SeaFlux Uncertainty Estimates



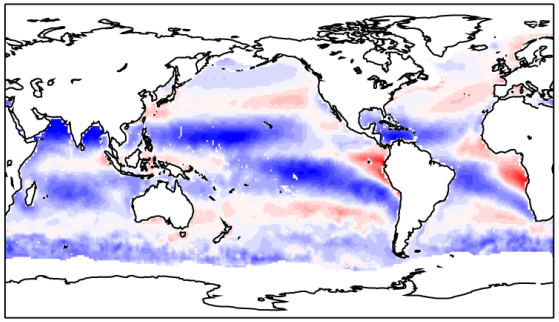
Variable	Global uncertainty
LHF (W m^{-2})	13.9 (15.4%)
SHF (W m^{-2})	5.7 (32%)
Windspeed (m s^{-1})	0.12 (1.6%)
Qa (g kg^{-1})	0.26 (2.2%)
SST (°C)	0.1 (< 1%)
Ta (°C)	0.01 (< 1%)
Ts - Ta (°C)	0.23 (16.1%)
Qs - Qa (g kg^{-1})	0.15 (4.1%)

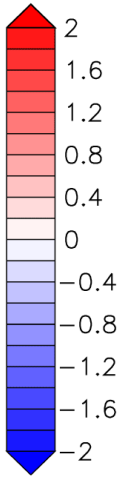
Outside analysis of specific humidity

GSSTF3 - NOCv2.0 (g kg^{-1})

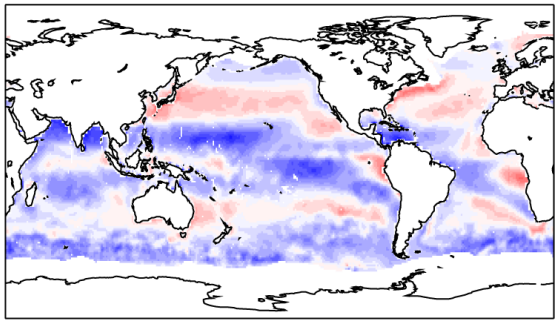


HOAPS3.2 - NOCv2.0 (g kg^{-1})

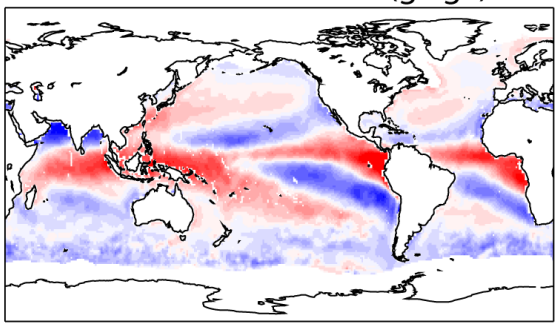




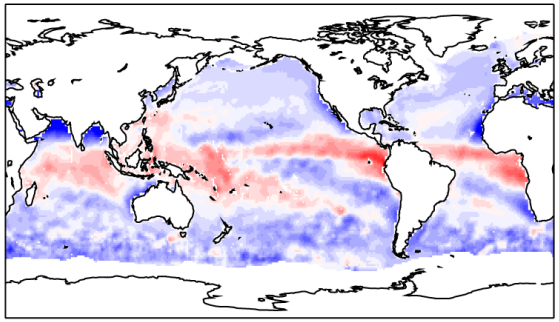
IFREMER - NOCv2.0 (g kg^{-1})



J-OFURO2- NOCv2.0 (g kg^{-1})



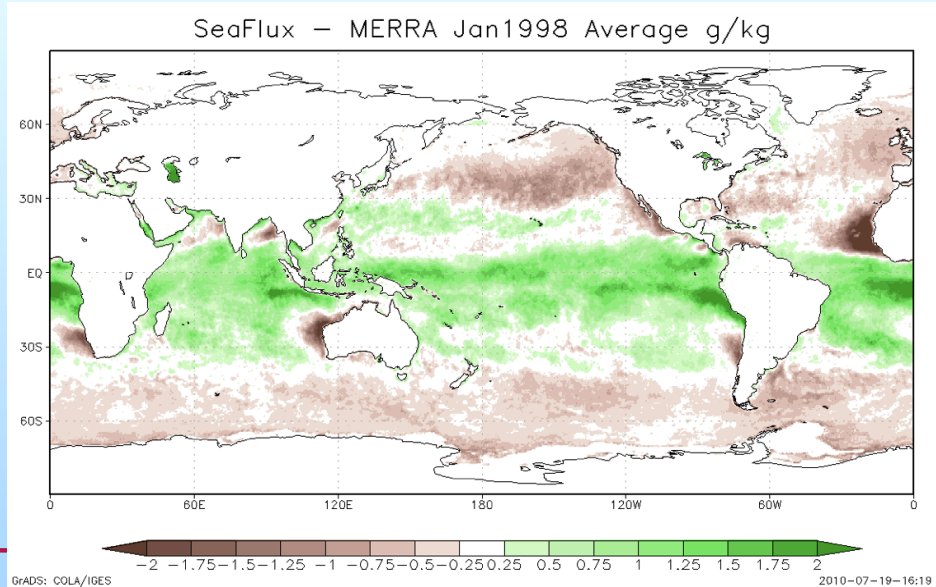
SeaFluxV2.0- NOCv2.0 (g kg^{-1})



Prytherch et al. (2013)

Uses and Applications

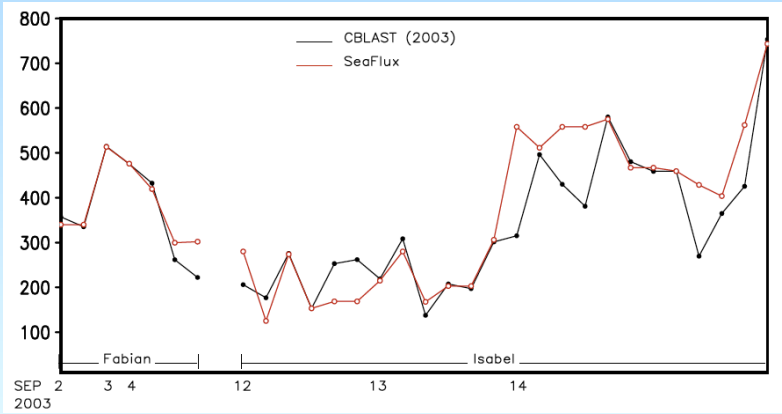
- Science user communities
  - GEWEX, SeaFlux, CLIVAR, SOLAS, NASA NEWS, GHRSST, UK MET
  - energy and water cycle studies, climate analyses, modelers (presentations to teachers, students, Eastman Chemical Company board)
- Several examples
  - An analysis of extremes, for instance hurricanes/mid-latitude storms
  - Comparisons with MERRA. Starting work with NASA GEOS modelers to evaluate/improve coupling for weather to seasonal scales.
  - New global analyses of water, heat cycles (NASA NEWS, Stephens et al 2012)
  - Understanding of distributions of near-surface properties including fluxes and how they evolve over time

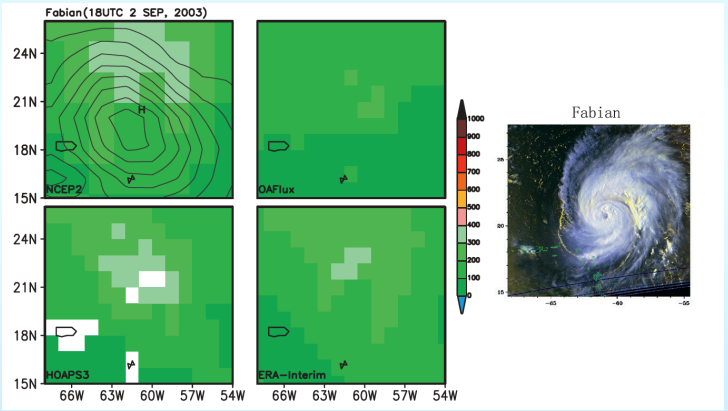


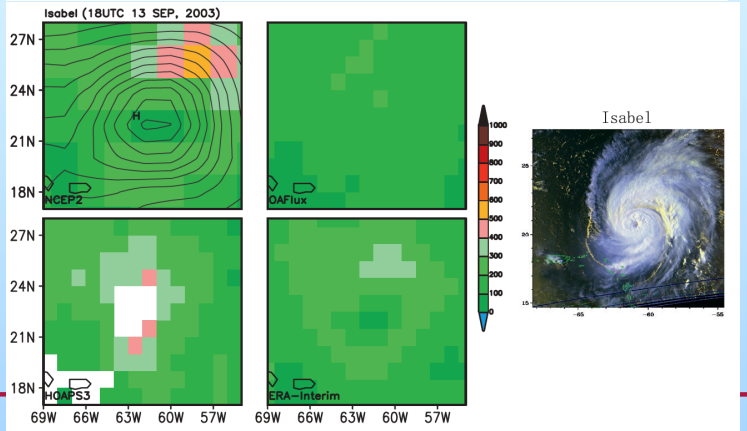
Roberts et al. (2012)

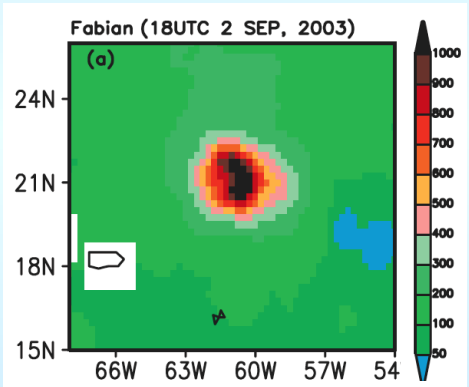
Improved hurricane fluxes

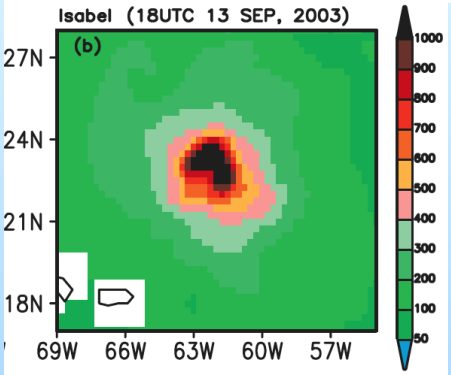
- High-resolution structure of the lower atmosphere including heat and water air-sea exchanges during storms





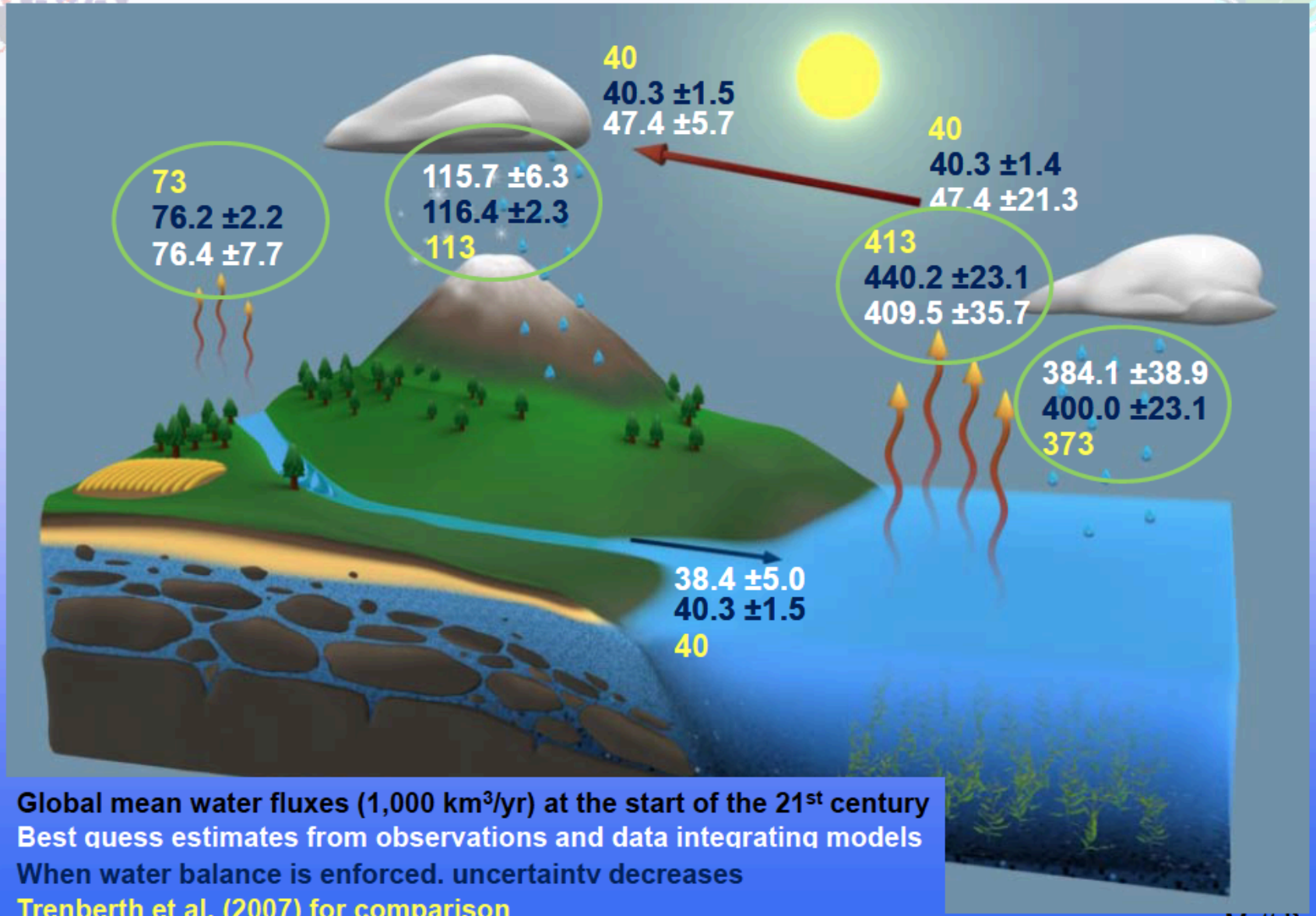






Liu et al. (2011)

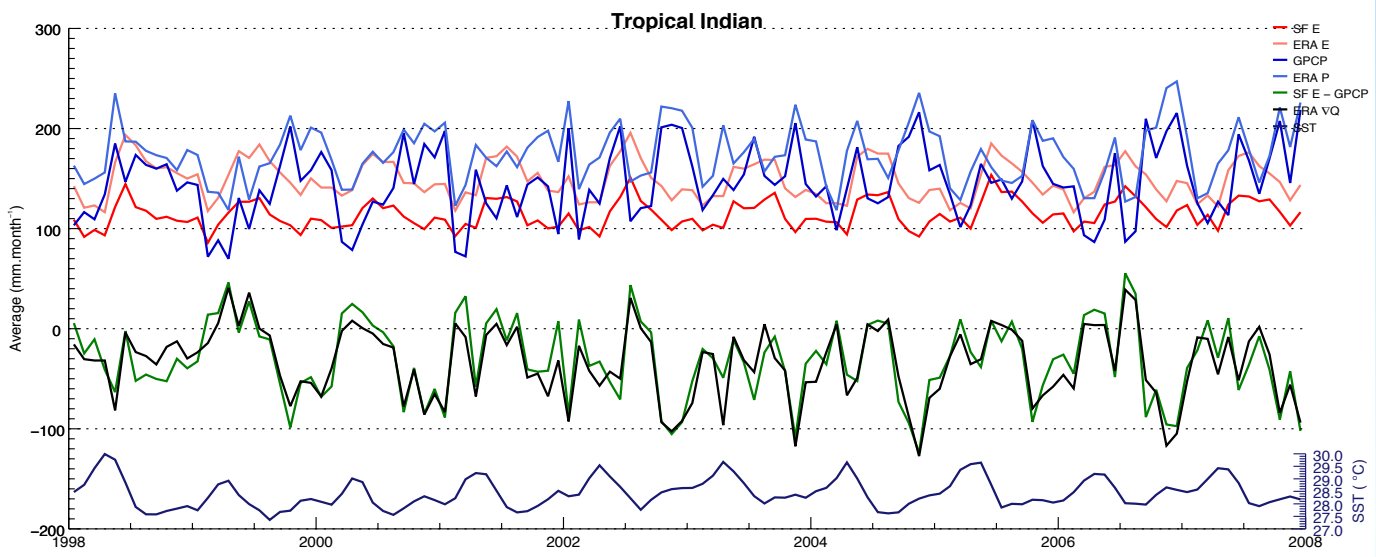
Global, Mean Annual Water Cycle

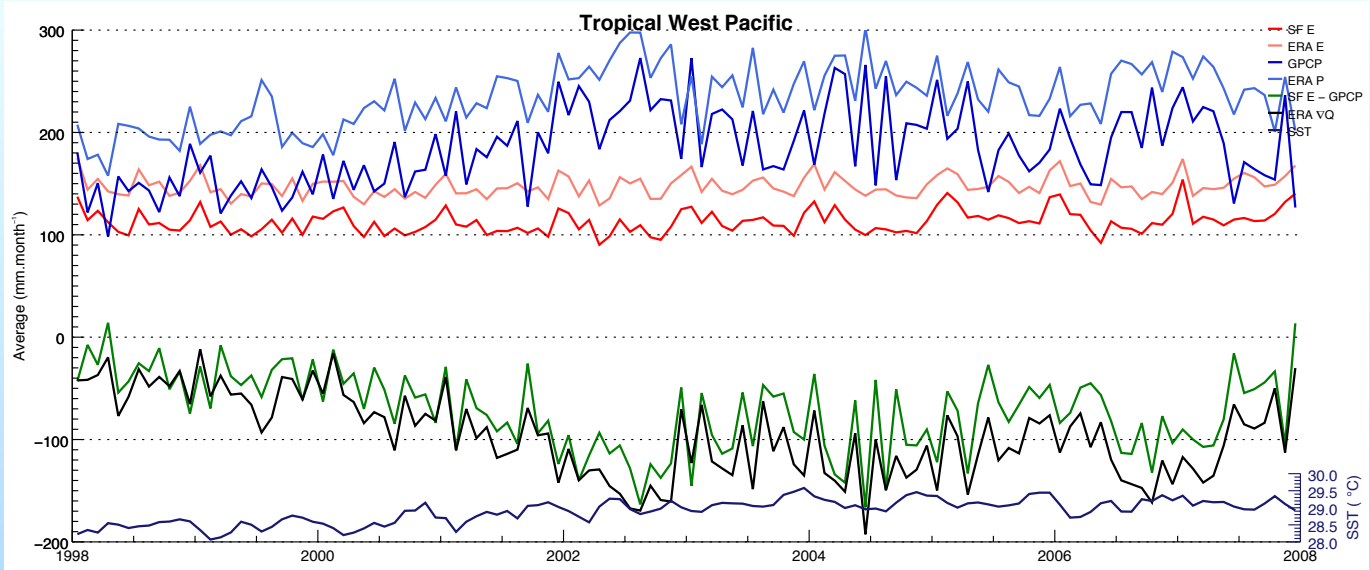


Global mean water fluxes (1,000 km³/yr) at the start of the 21st century
Best guess estimates from observations and data integrating models
When water balance is enforced, uncertainty decreases
Trenberth et al. (2007) for comparison

Matt Rodell
NASA GSFC

Regional Water Budgets





Brown and Kummerow 2013

Schedule & Issues

- Accomplishments over past year and project status
  - Submission and now revisions of paper outlining complete approach, uncertainty analysis, seasonal and diurnal variability
  - Uncertainty analysis finalized, uncertainties now available
  - Comparisons of CSU/Wentz TBs, inclusion of EIA

- Milestones (with dates) to finish development & testing.
  - Research data available to public, being used in current research and analysis programs
  - Over the next year: Sending of CDR version to CDR team, creation of appropriate documents including workflow, ATBD, etc.

- State any risks or concerns
  - Nothing major at this time

- How can the CDR Program better assist you?
  - At end of this workshop meet with production team to make sure we have all appropriate contact information to start process of handover