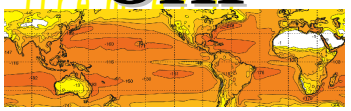


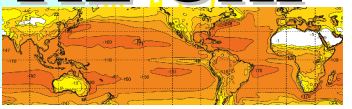
TIE-OHF WP4
Product Generation, Inter-Comparison and Uncertainty Characterizations

WP Objectives

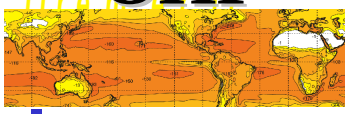
- Sensitivity studies and algorithm improvement
  - ✓ Use different SST data (including ESA CCI)
  - ✓ Use different SSM/I input data
  - ✓ Impact of sea state on flux parameterization
  - ✓ Impact of marine optical properties
- Use improved retrieval methods for wind speed and humidity as well as improved flux parameterizations
- Evaluation of data sets, Error characterization
  - ✓ Comparison against in-situ data
  - ✓ Characterize specific deficiencies in the algorithms to derive the geophysical parameters, particularly cross relations between the individual variables (e.g. SST dependent biases of near surface humidity)
- Ensemble generation
  - ✓ Generation of an ensemble of realizations through “smart perturbations” (e.g. based on reprocessing to above point).
- Consistency checks (“Cage Studies”) of the ensemble and process studies (El Nino etc.)
  - ✓ Examine the sensitivity of estimated fluxes and the oceanic heat budget to changes in the optical properties of the water, using ocean-colour data and a light transmission model, combined with a General Ocean Turbulence model

TIE-OHF Global Data Collection

TIE-OHF



	Wsp	Qa	SST	Ta	τ	LHF	SHF	LW	SW	Period	Spatial Resolution	Temporal Resolution	Format
IFREMER	X	X	X	X	X	X	X			1999 – 2009	0.25°×0.25°	Daily	NetCdf
HOAPS	X	X	X	X		X	X	X	X	1987 - 2008	0.5°×0.5°	6-hourly and Monthly	NetCdf
OAFLux	X	X	X	X		X	X	X	X	1985 - 2014	1°×1°	Daily	NetCdf
SEAFLUX	X	X	X	X		X	X			1998 - 2007	0.25°×0.25°	3-hourly	Binary
J-OFURO	X	X			X	X	X			1988 - 2008	1°×1° 0.25°×0.25°	Daily Monthly	NetCdf
ERA Interim	X	X	X	X	X	X	X	X	X	1992 - 2012	0.75°×0.75°	6-hourly	Grib
CFSR	X	X	X	X	X	X	X	X	X	1992 - 2010	0.38°×0.38°	6-hourly	Grib
NOCS2	X	X	X	X		X	X			1992 – 2010	1°×1°	Daily Monthly	NetCdf



Product Generation : Specific Air Humidity Issue

- **Specific Air Humidity :**

  qa_{10} = f(Tb,SST,Ta) (Bentamy *et al*, 2013)

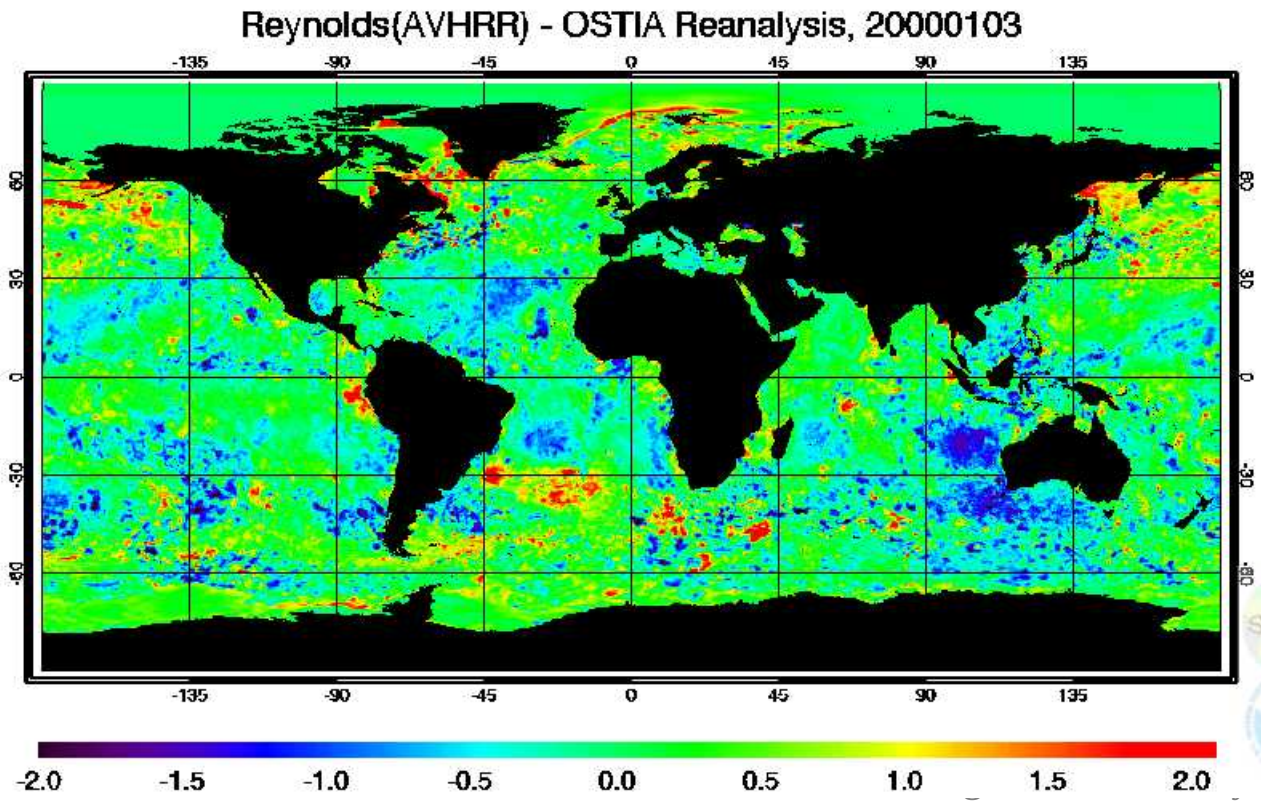
  Tb are from SSM/I F10 – F15

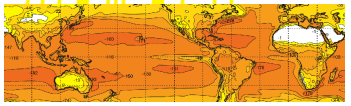
- **Consistency (Fundamental Climate Data Record (Sapiano *et al*, 2013))**
  - **Tb are from Univ colorado / NOAA/NESDIS**

- **Reprocessing**
  - $qa_{10} = f_1(\mathrm{Tb}_{19V}) + f_2(\mathrm{Tb}_{19H}) + f_3(\mathrm{Tb}_{22V}) + f_4(\mathrm{Tb}_{37V}) + g(\mathrm{SST}) + h(\Delta T)$
  - Calibration based on collocated Tb and qa_{10} from ICOADS and buoys (Bentamy *et al*, 2014)

Product Generation : Sea Surface Temperature Issue

- HR SST V2 (Reynolds *et al*, 2007)
  - Sea Ice Free Global Daily-analysis / 0.25°×0.25°
- CCI SST
- Sea Ice Free Global Daily-analysis / 0.05°×0.05°



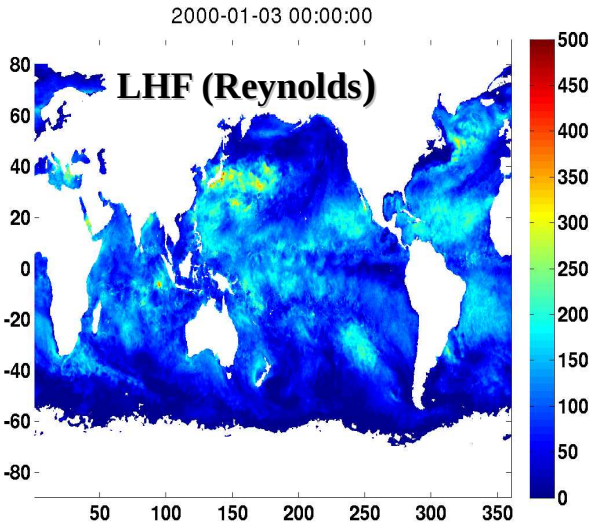


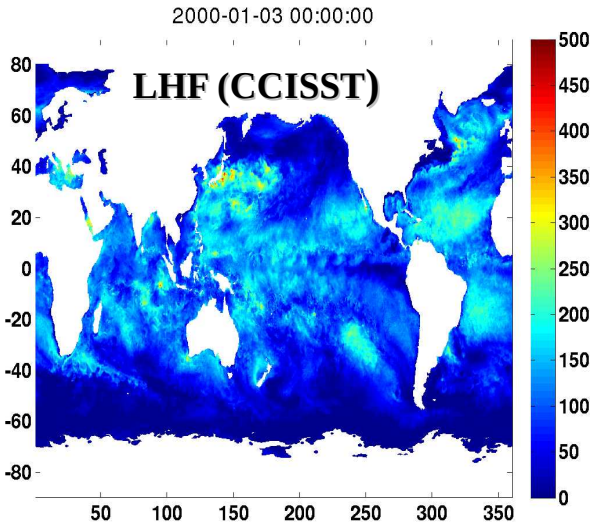
Product Generation
1999 - 2009

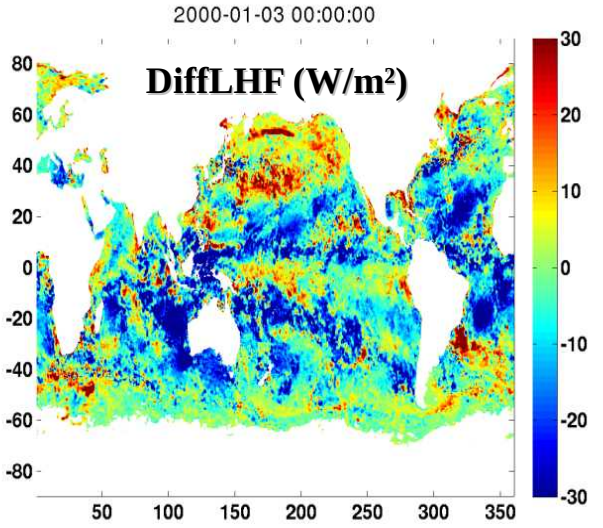
- **Wind :**
  - QuikScat retrievals (V3 (Fore *et al*, 2011)) including (Bentamy *et al*, 2012) results
- **Specific Air Humidity : New release**
- **Air Temperature:**
  - Corrected Era Interim
- **Sea Surface Temperatures**
  - HR SST V2 (Reynolds *et al*, 2007)
  - CCI SST

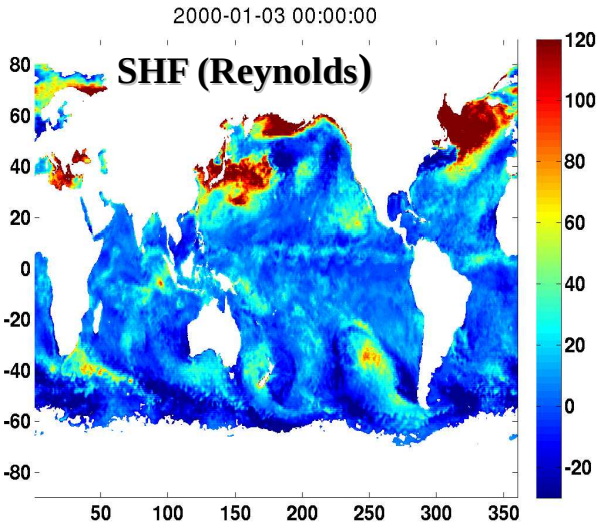
Objective Method (Bentamy *et al* , 2013) **Calculations of Global Daily 0.25°x0.25° Flux Analyses.**

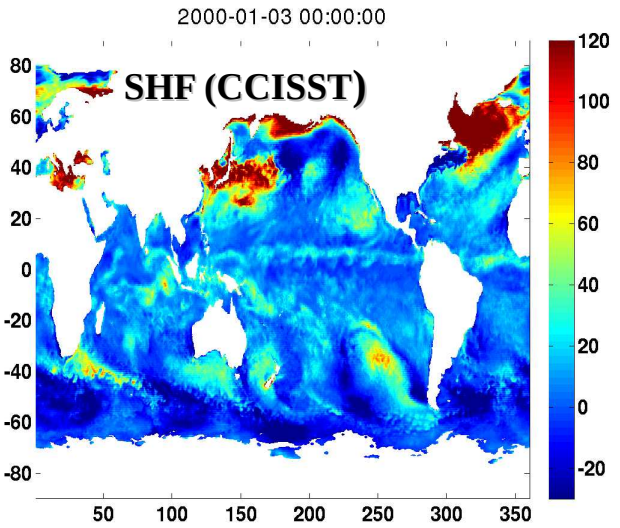
Product Generation
Examples of 03 January 2000

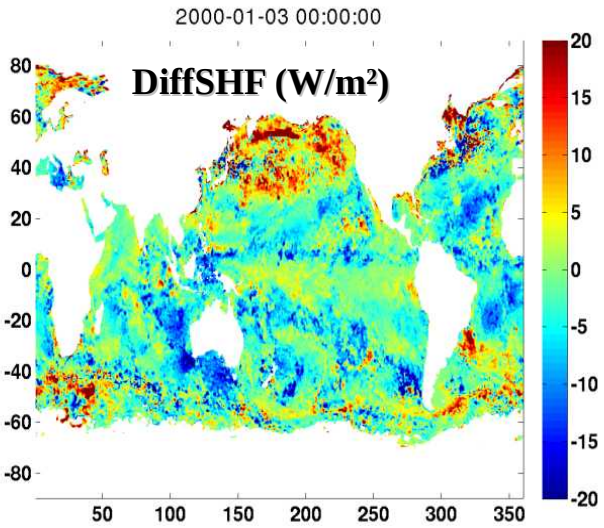


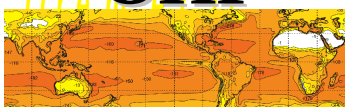












Accuracy Issue : Difference Sources

Cal/Val Procedures

Raw Data

Spatial / temporal resolutions

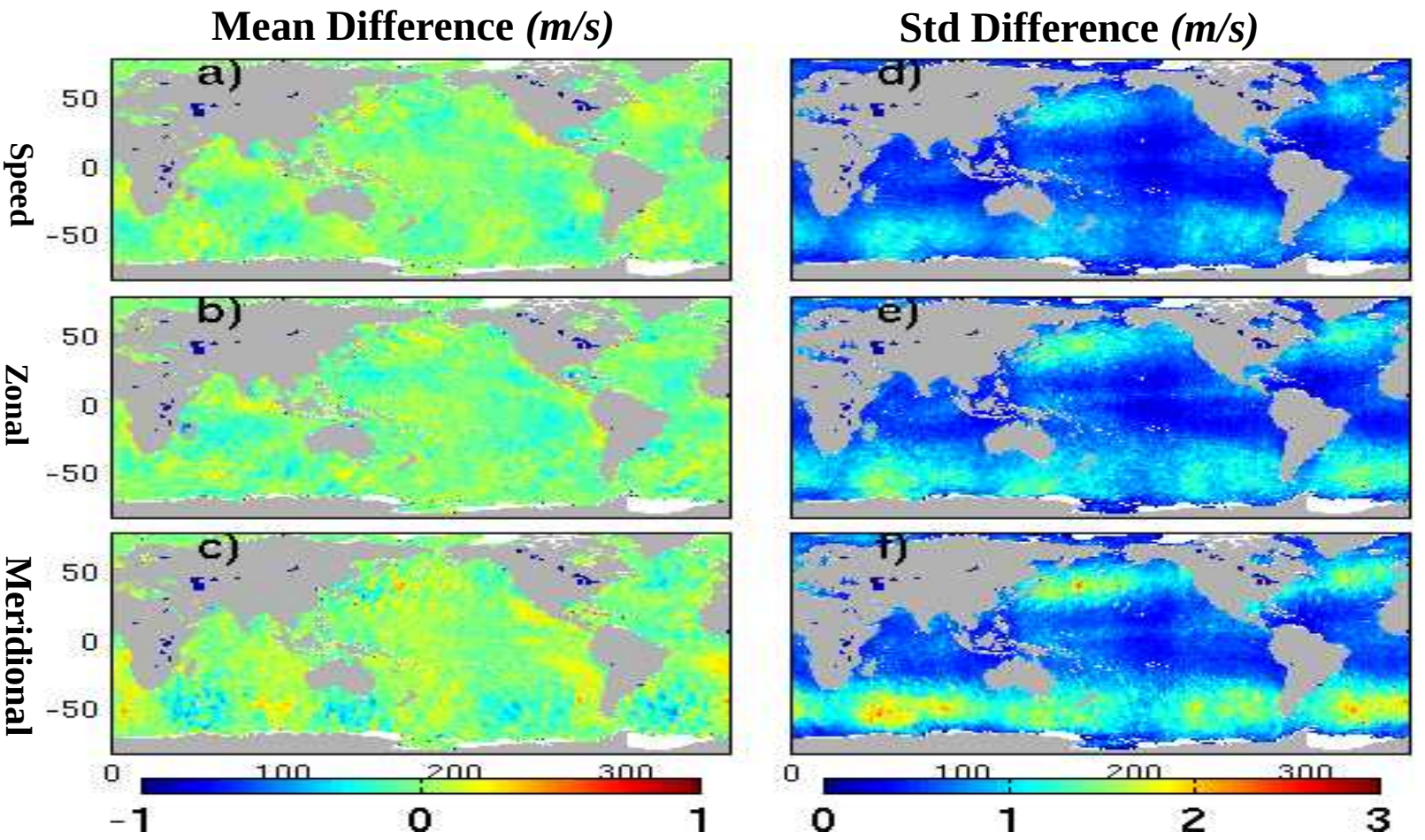
Analysis Method

Estimation of Bulk Variables (Qa, Wsp, SST, TA,…)

Flux parameterizations

Error Source Relied on Objective Method

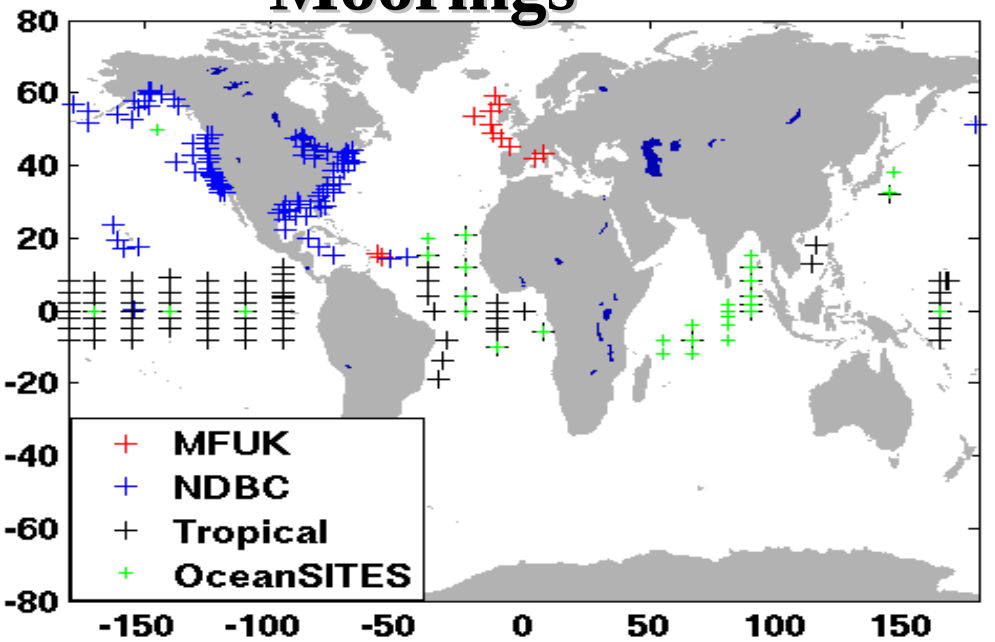
- Using ERA I re-analyses
- 6-hourly Estimates are interpolated in time and space over Swaths : Simulated Data
- Determination of Daily Analysis from Simulated Data
- Comparison to Daily-averaged ERA I Estimates



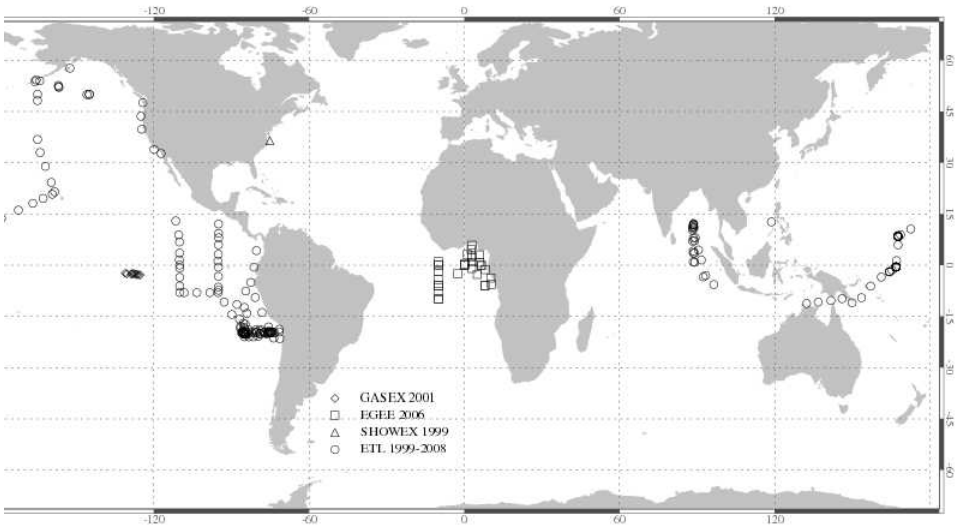
TIE-OHF WP4
Accuracy Characterizations

References:

Moorings



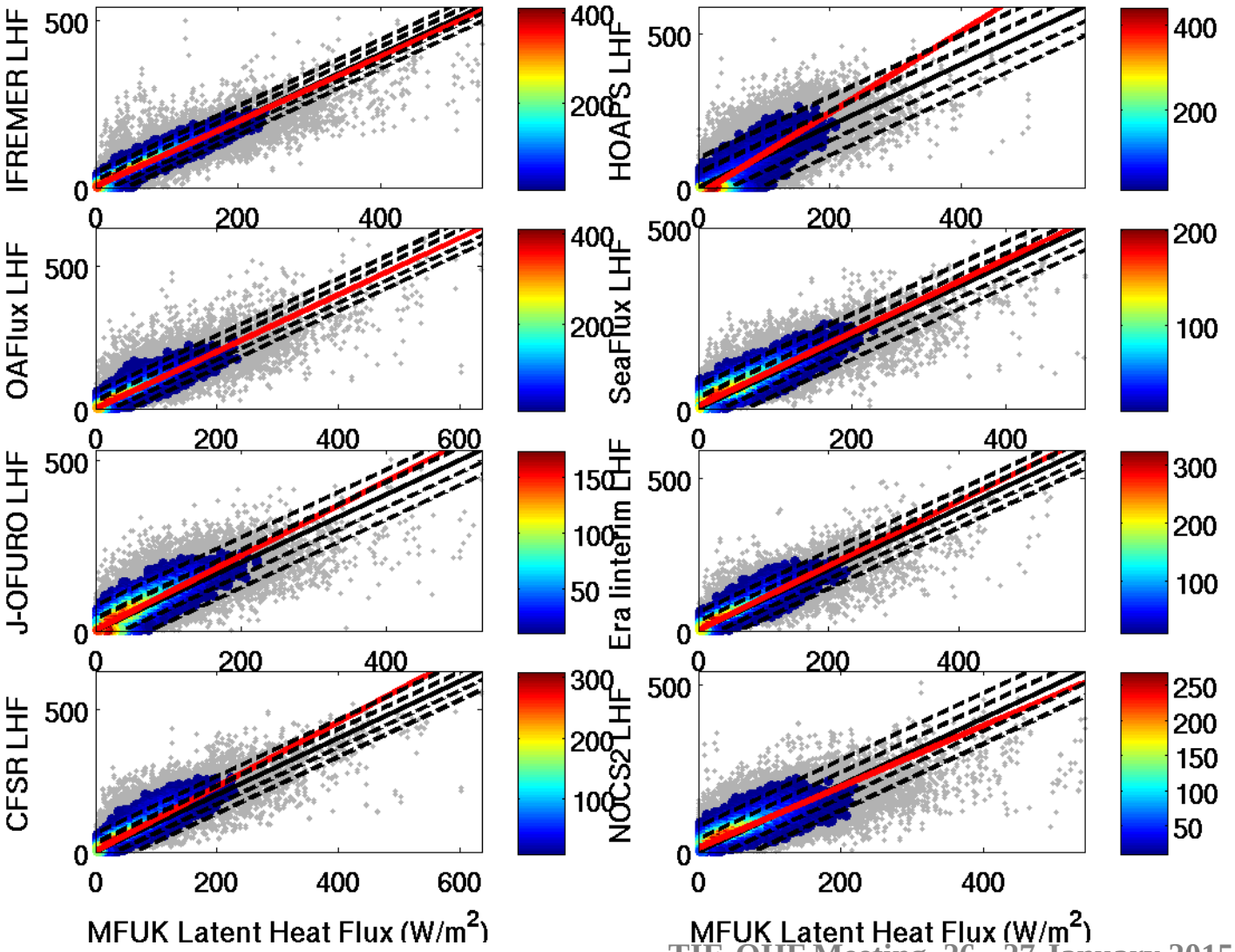
Campaigns



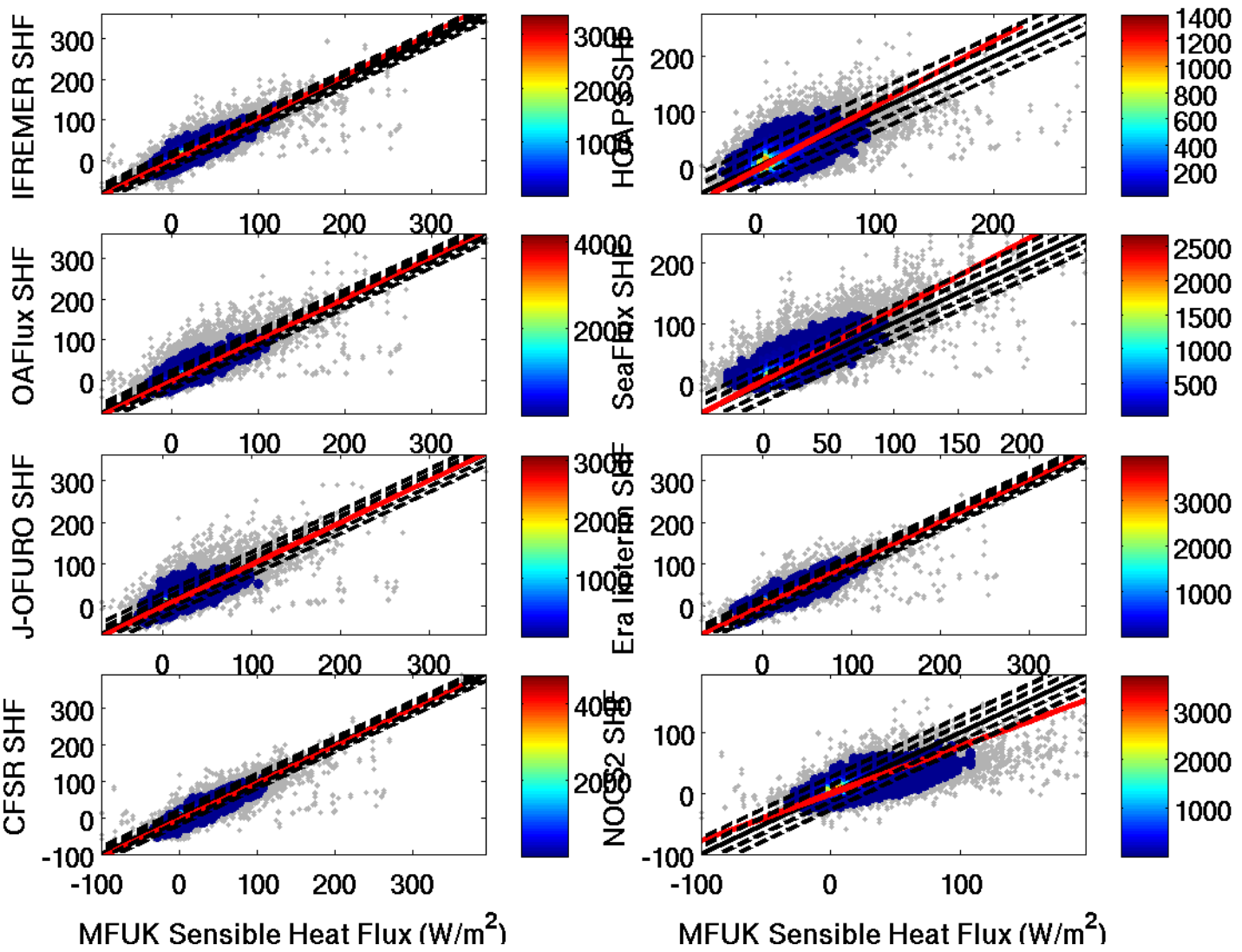
Collocation

- Calculation of Daily-averaged In-situ Estimates
- Calculation of Daily-averaged HOAPS and SeaFlux Estimates
- Spatial Criteria: 2times of Product Spatial Resolution. Max 1°.
- Temporal Criteria: Day

TIE-OHF WP4
Accuracy Characterizations



TIE-OHF WP4
Accuracy Characterizations



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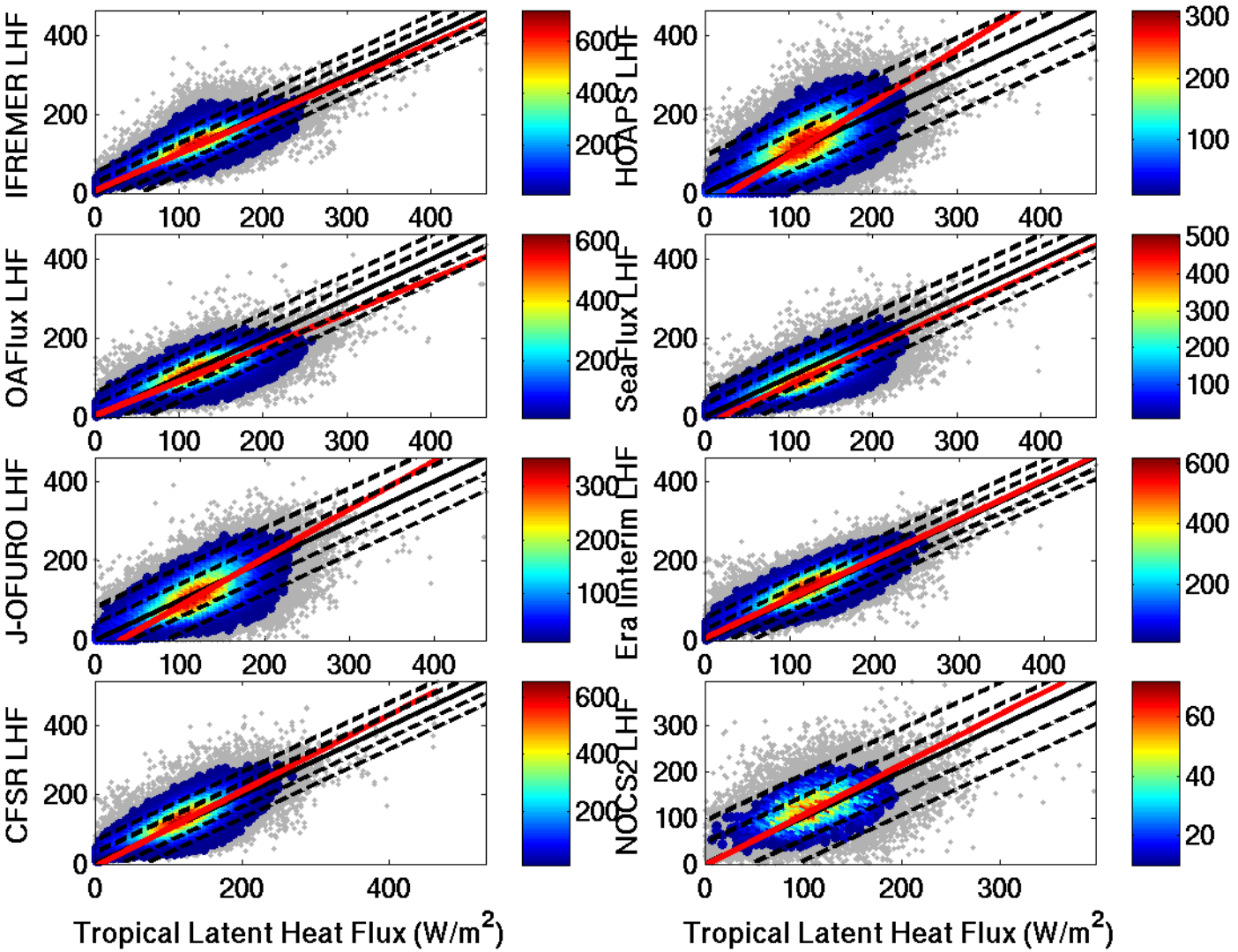

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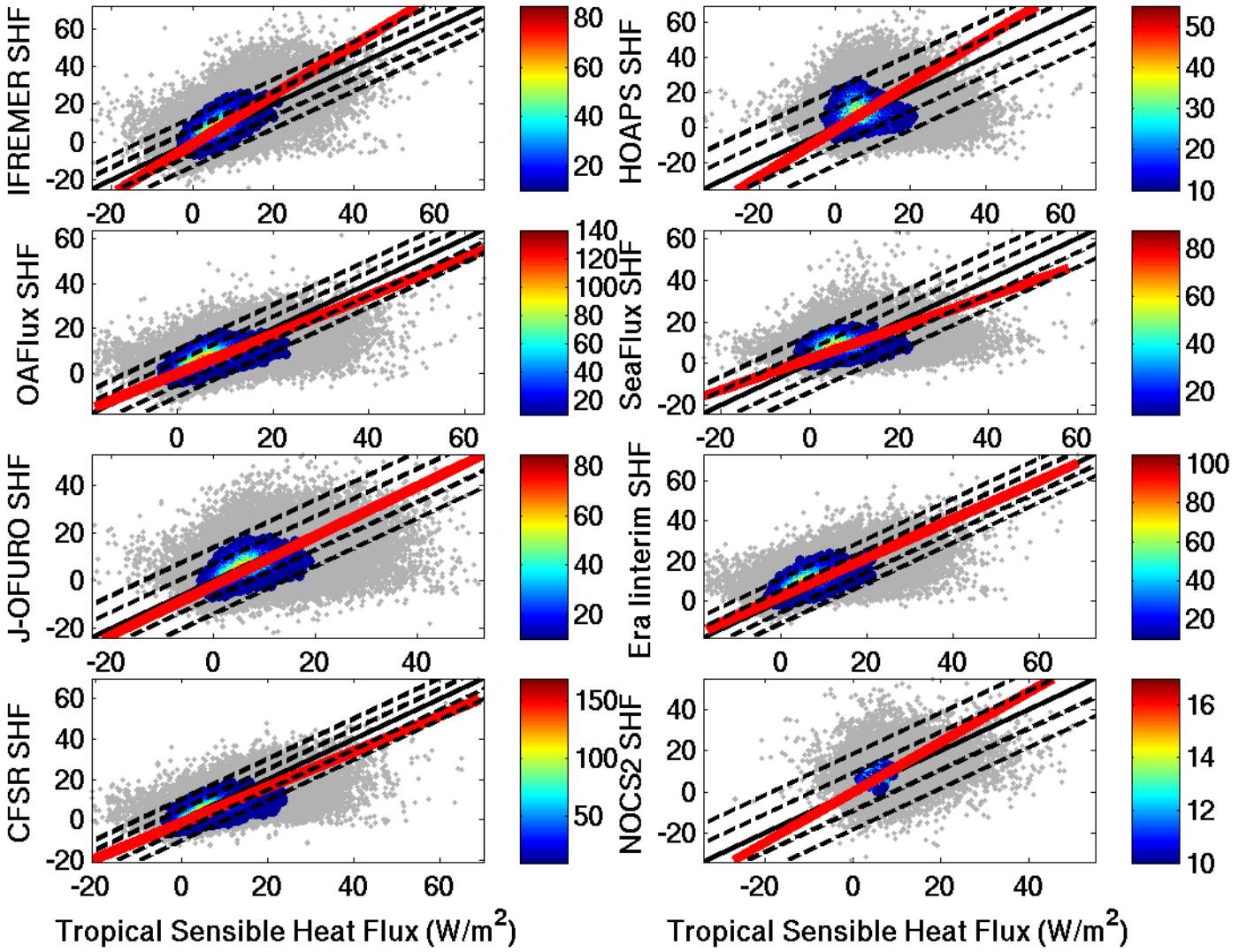
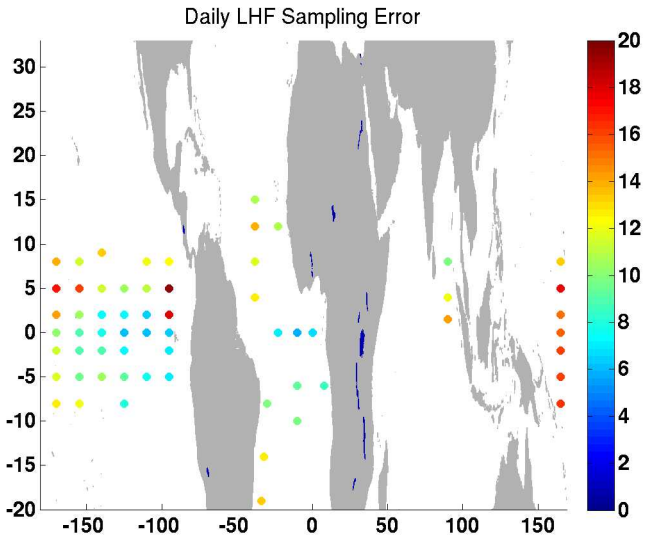
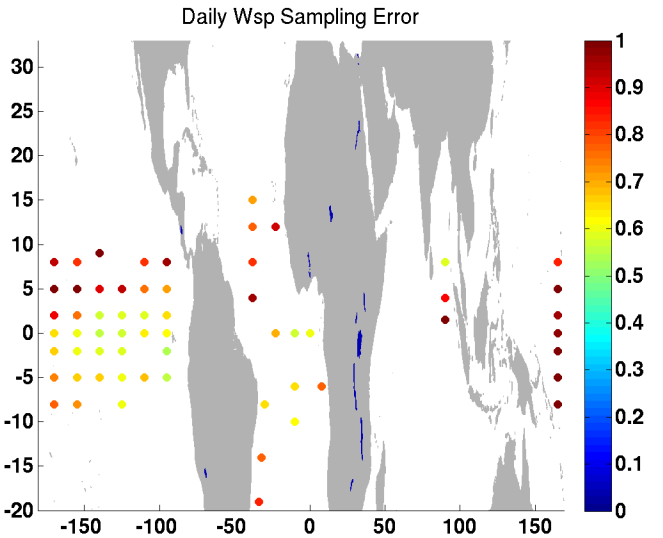
Accuracy Characterizations

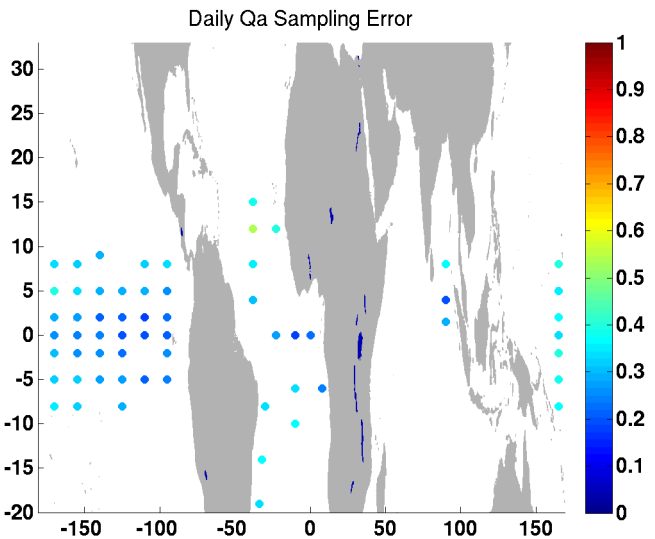


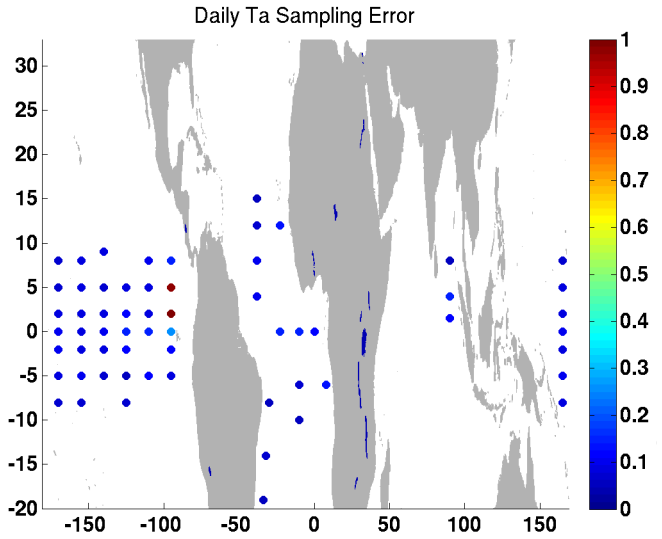
Temporal Sampling Impact

- Use of simulated satellite data from buoy measurements
  - <X> : Time - Averaged surface parameter from Hourly Buoy Data
  - <X'> : Time - Averaged surface parameter from Hourly Buoy Data close to satellite passes
  - Rms of <X> - <X'>









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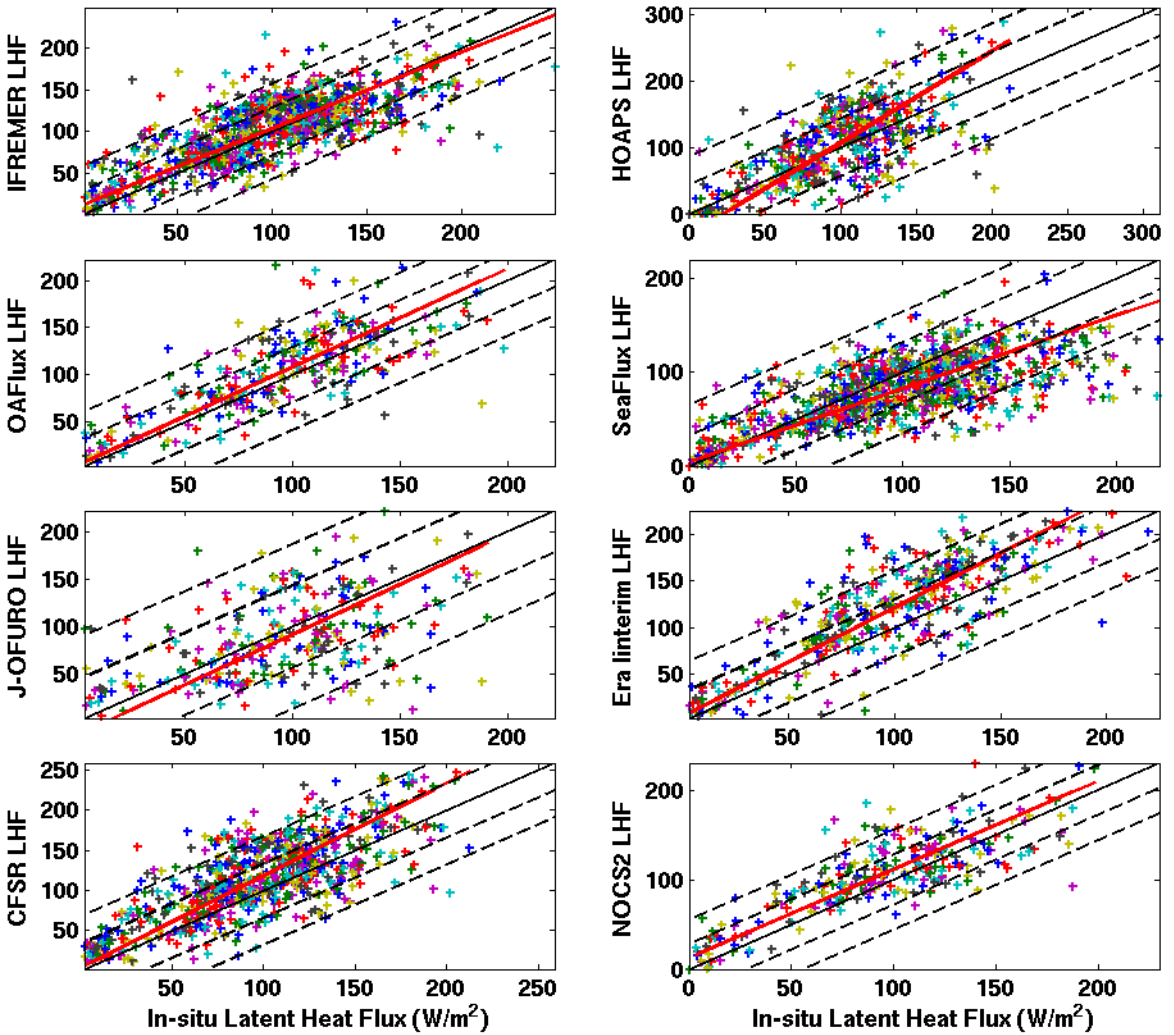
Accuracy Characterizations



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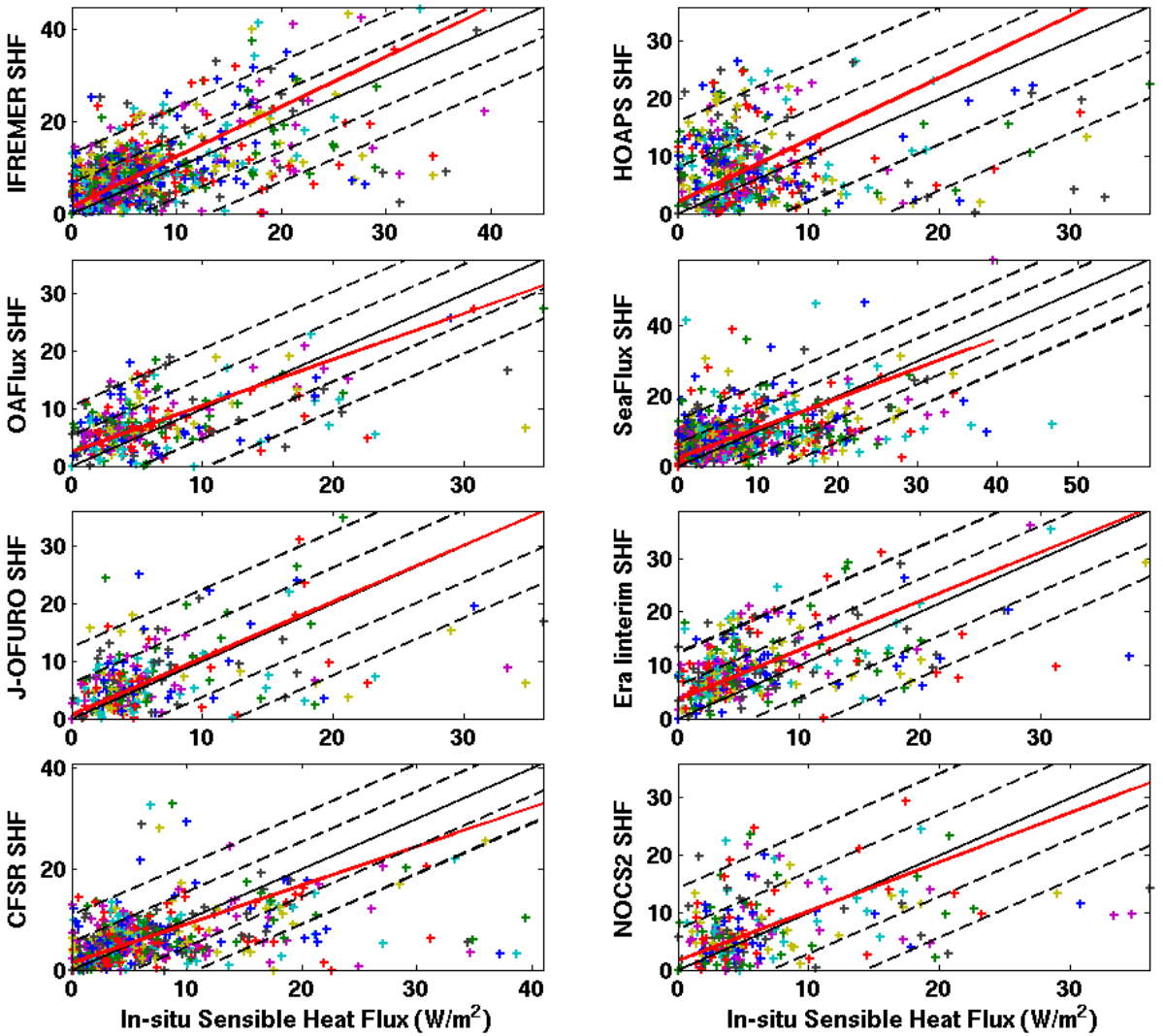

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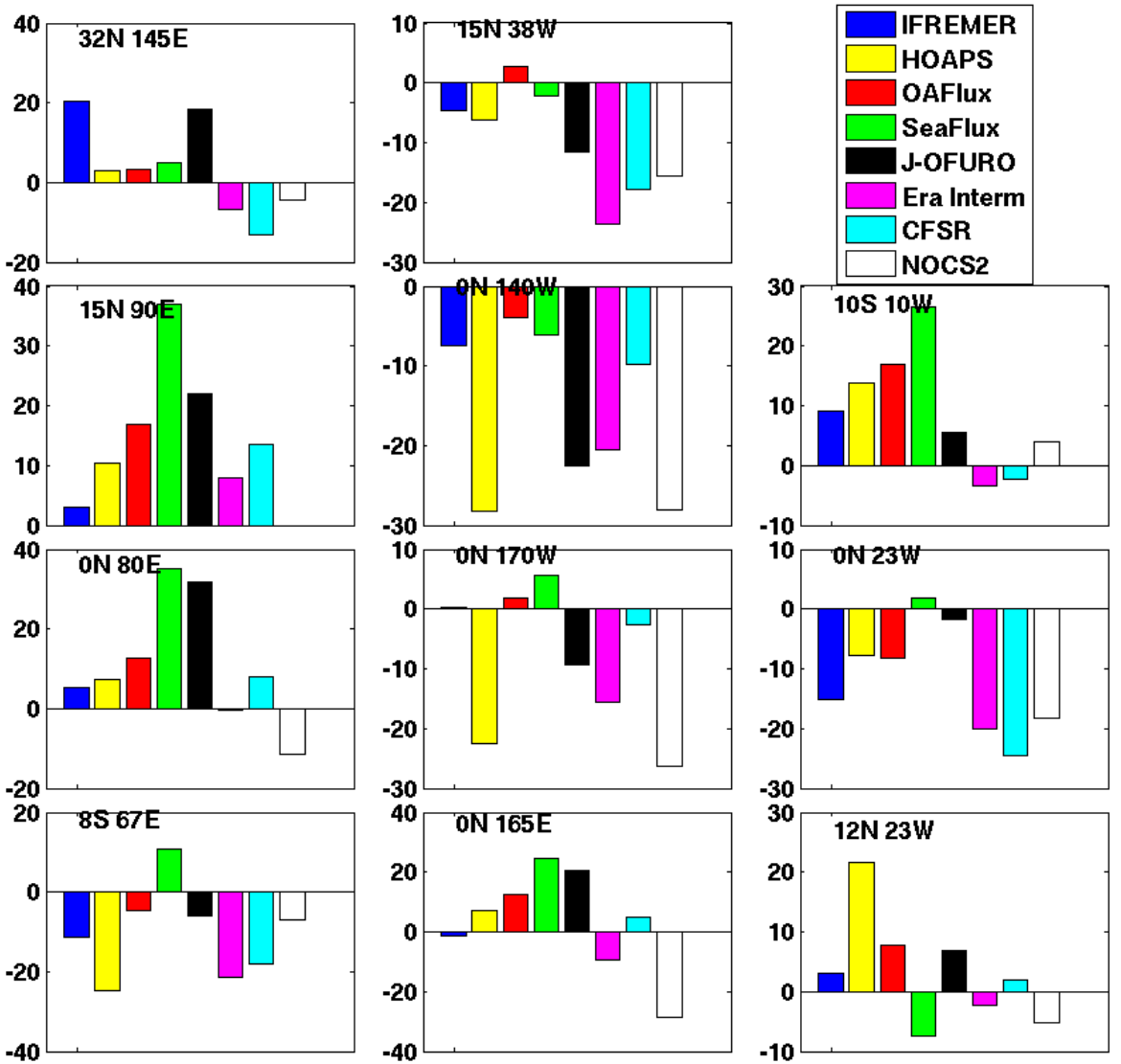

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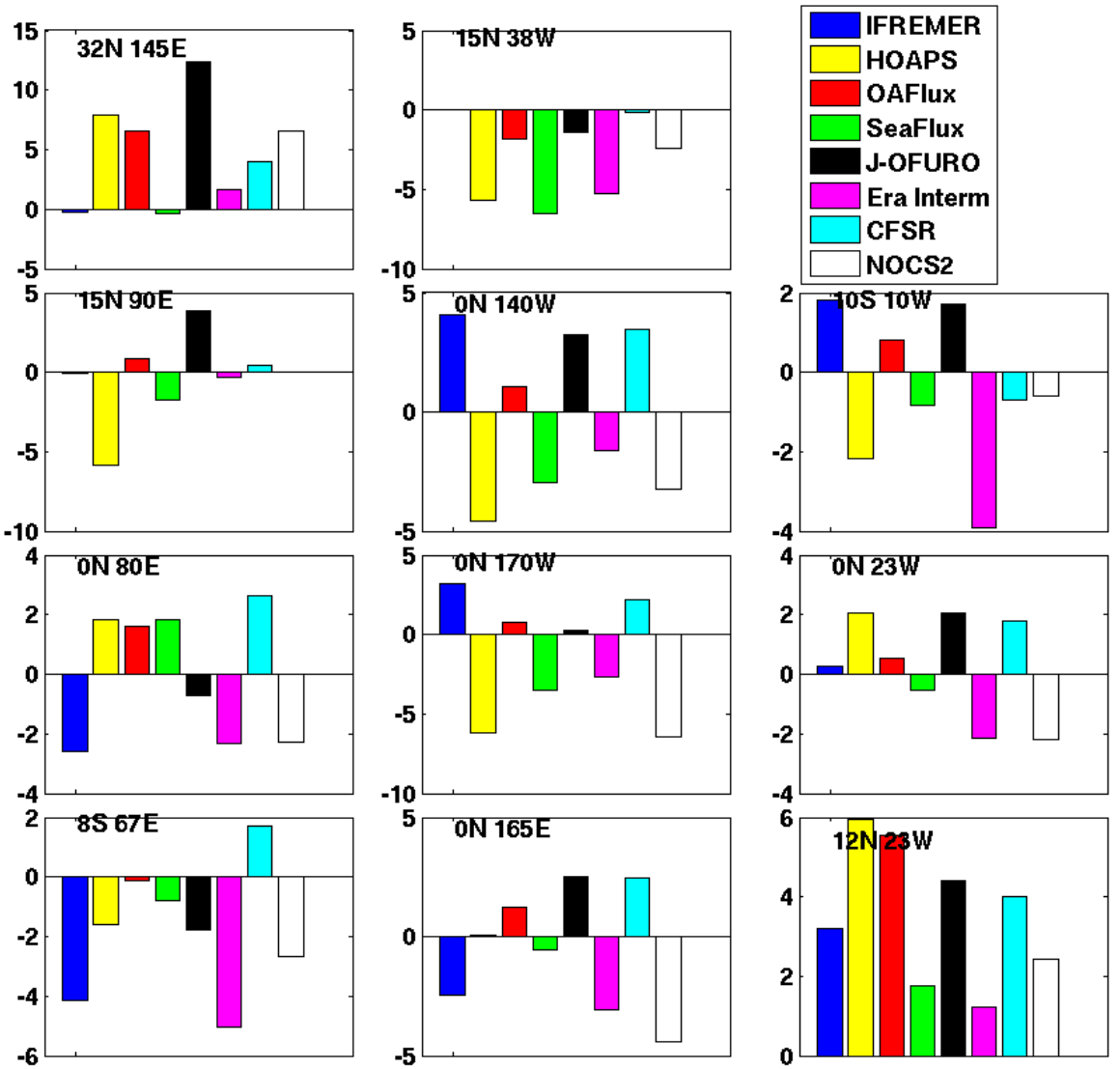
Accuracy Characterizations



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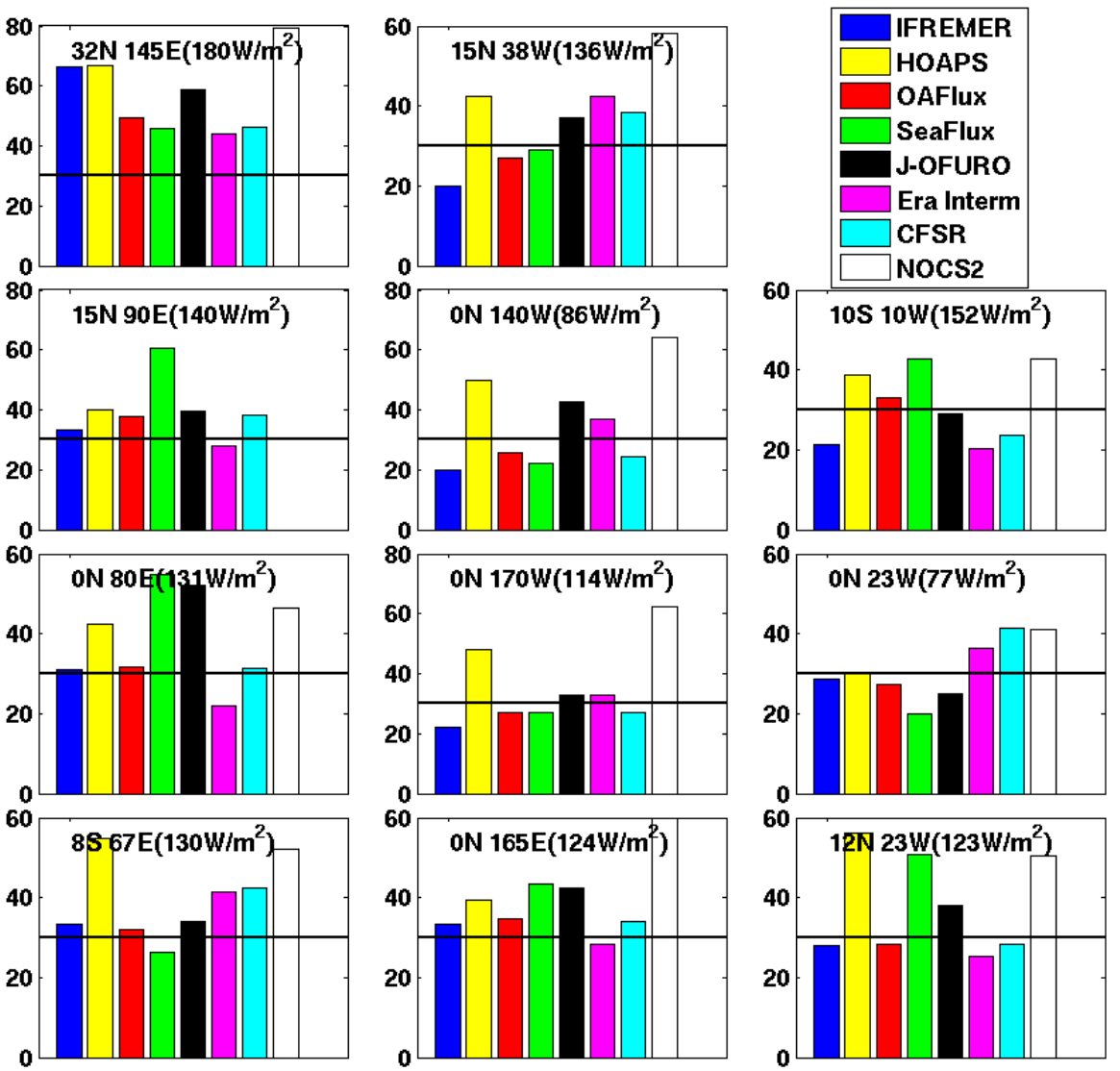
Accuracy Characterizations



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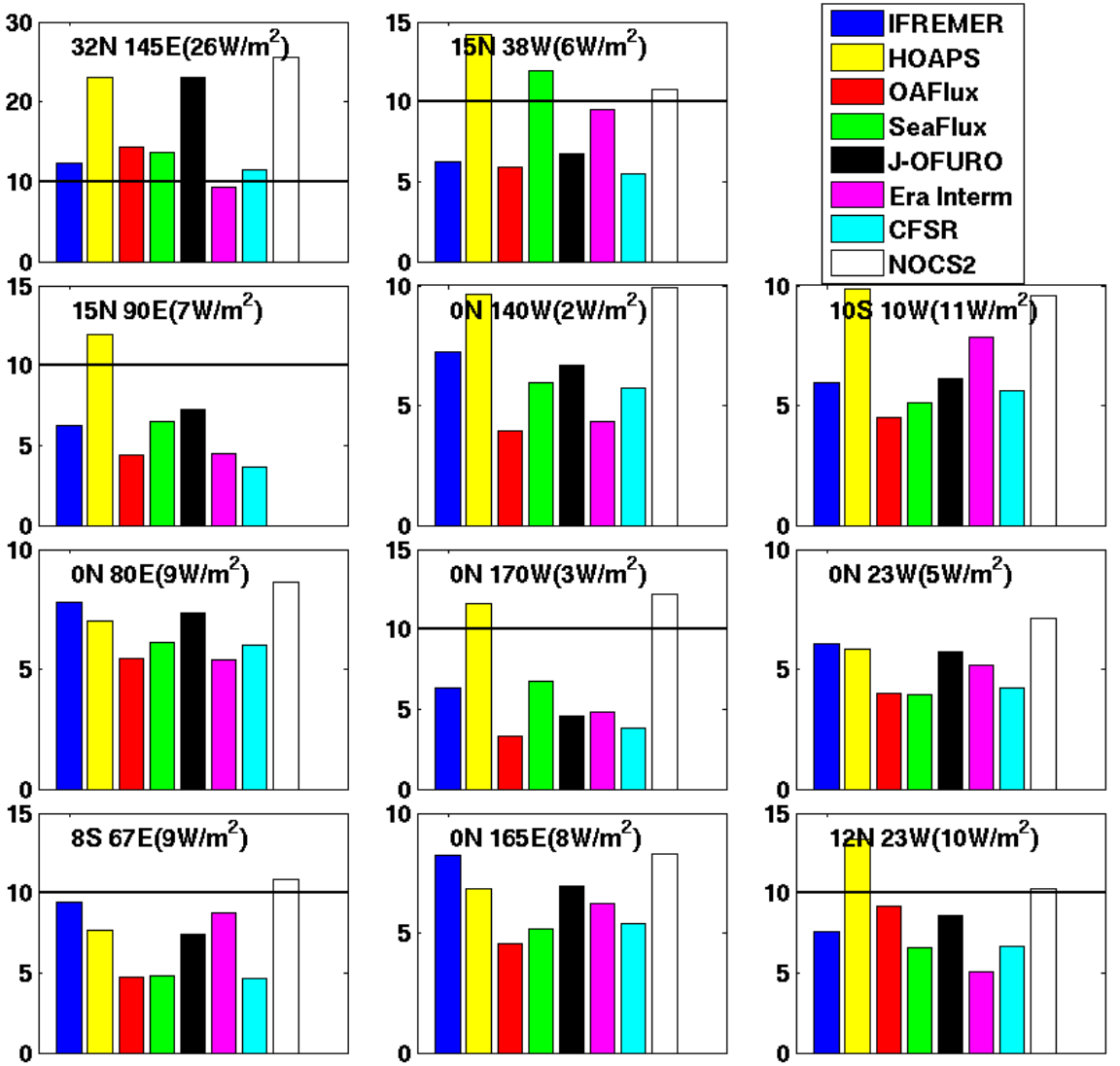
Accuracy Characterizations



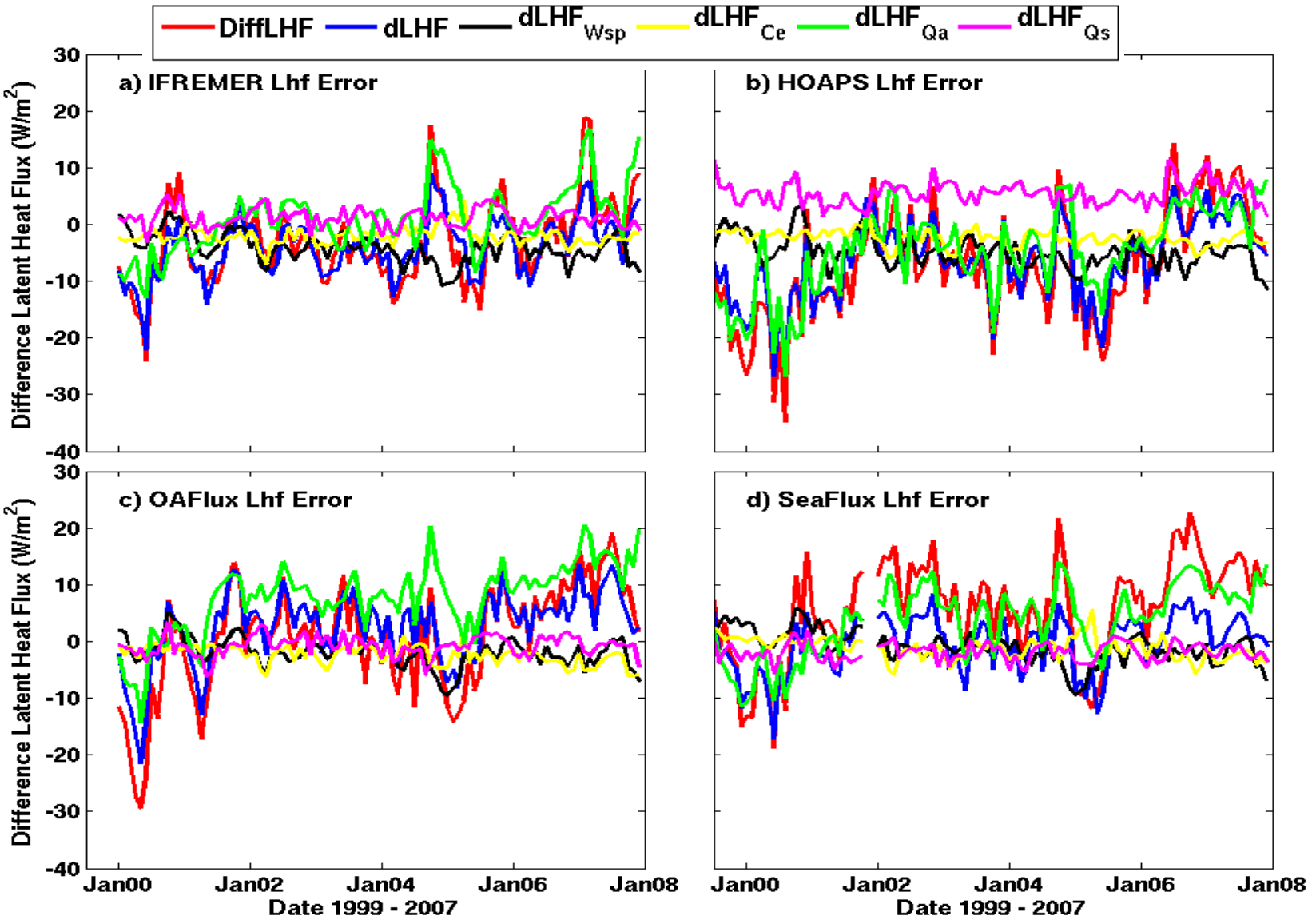
Uncertainty Characterizations

$$dLhf = (\partial Lhf/\partial U)dU + (\partial Lhf/\partial Ce)dCE + (\partial Lhf/\partial Qa)dQa + (\partial Lhf/\partial Qs)dQs$$

$$= dLHF_U + dLHF_{Ce} + dLHF_{Qa} + dLHF_{Qs}$$

$$Lhf = \rho \times Lv \times U \times (Qs-Qa)$$

$$dU = U_{buoy} - U_{satellite;}\ dCe = Ce_{buoy} - Ce_{satellite};\ dQa = Qa_{buoy} - Qa_{satellite};\ dQs = Qs_{buoy} - Qs_{satellite}$$



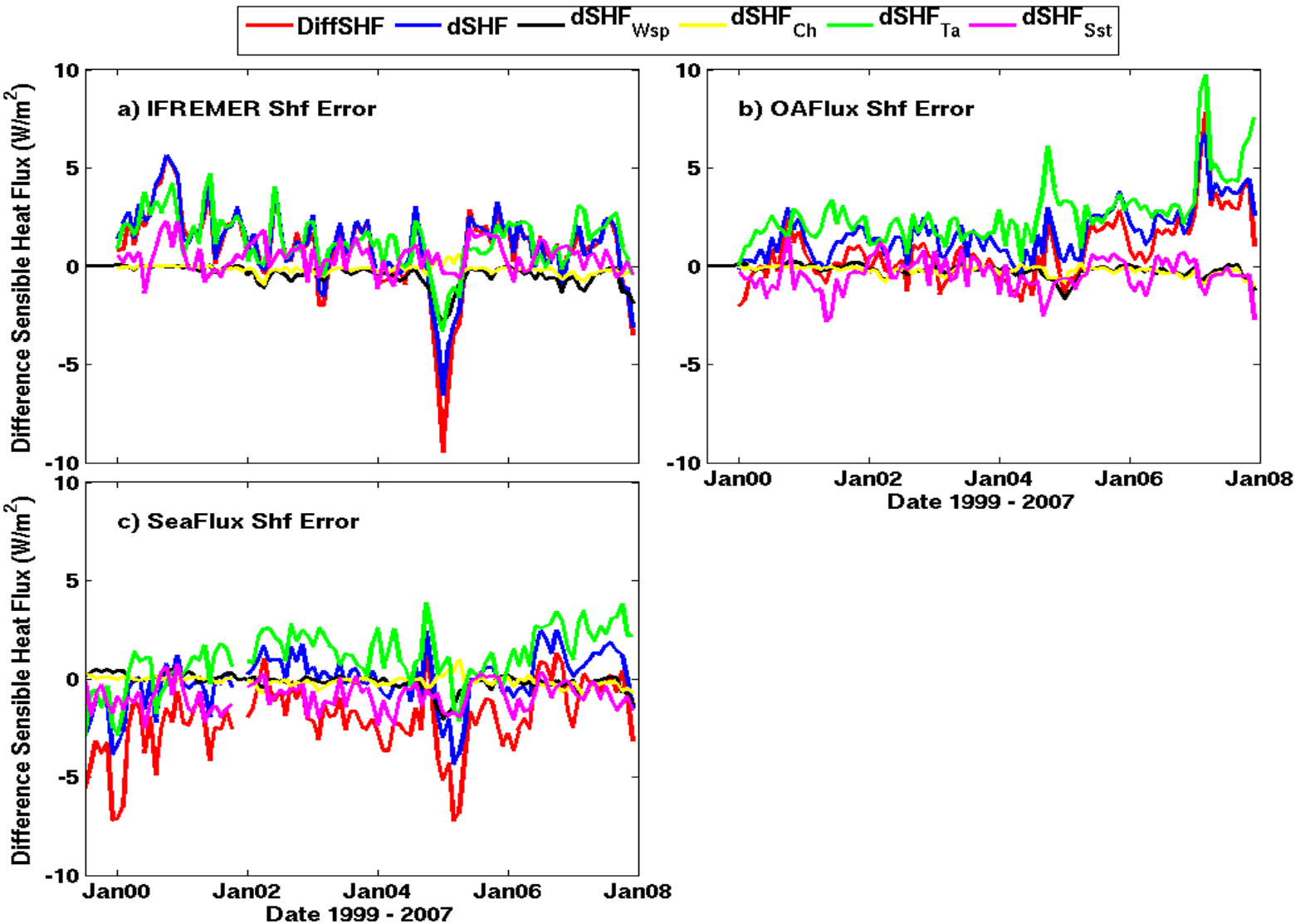
Uncertainty Characterizations

$$dShf = (\partial Lhf/\partial U)dU + (\partial Lhf/\partial Ch)dCH + (\partial Lhf/\partial Ta)dTa + (\partial Lhf/\partial Sst)dSst$$

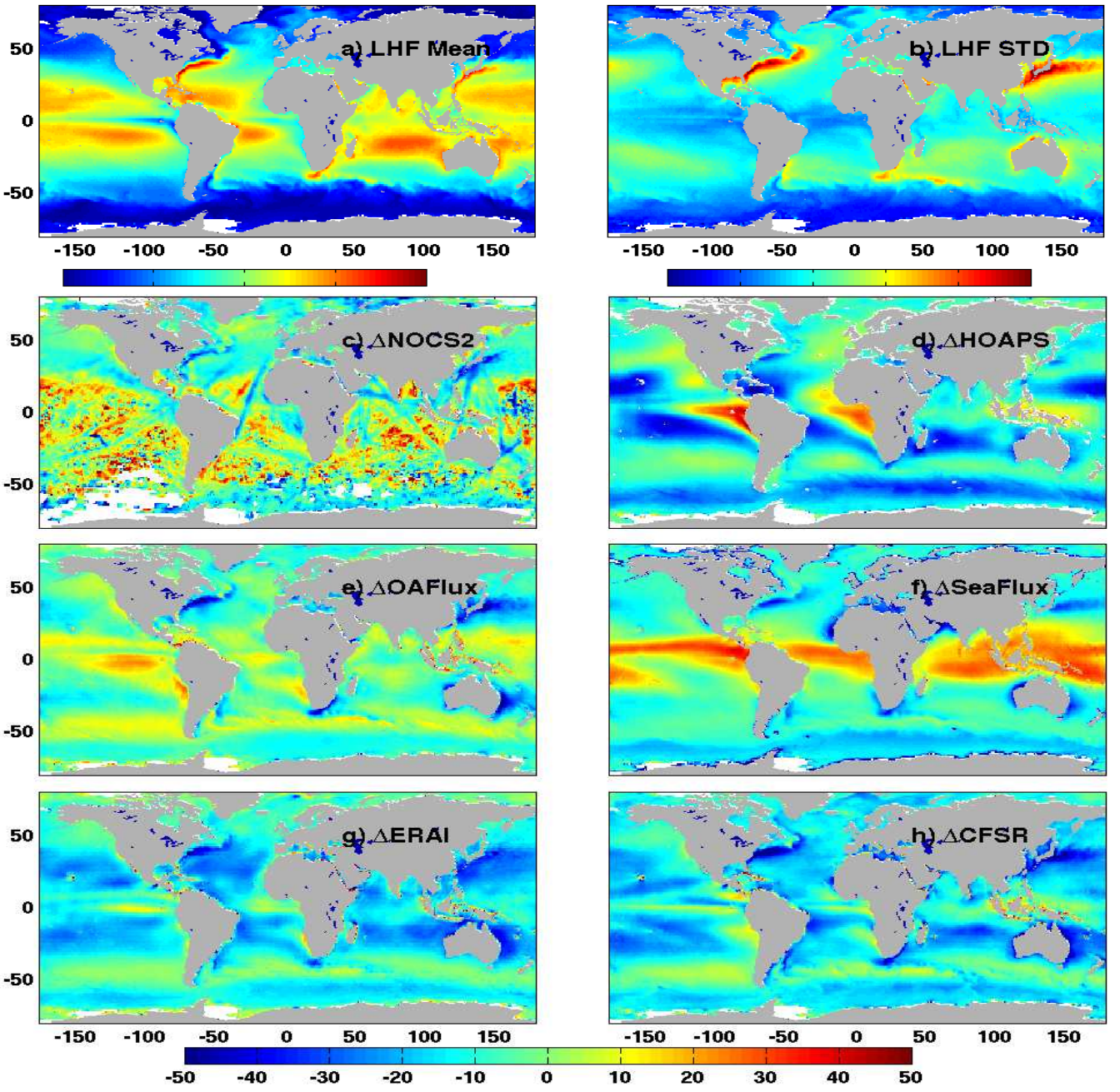
$$= dLHF_{U} + dLHF_{Ch} + dLHF_{Ta} + dLHF_{Sst}$$

$$Shf = \rho \times CP \times U \times (Sst - Ta)$$

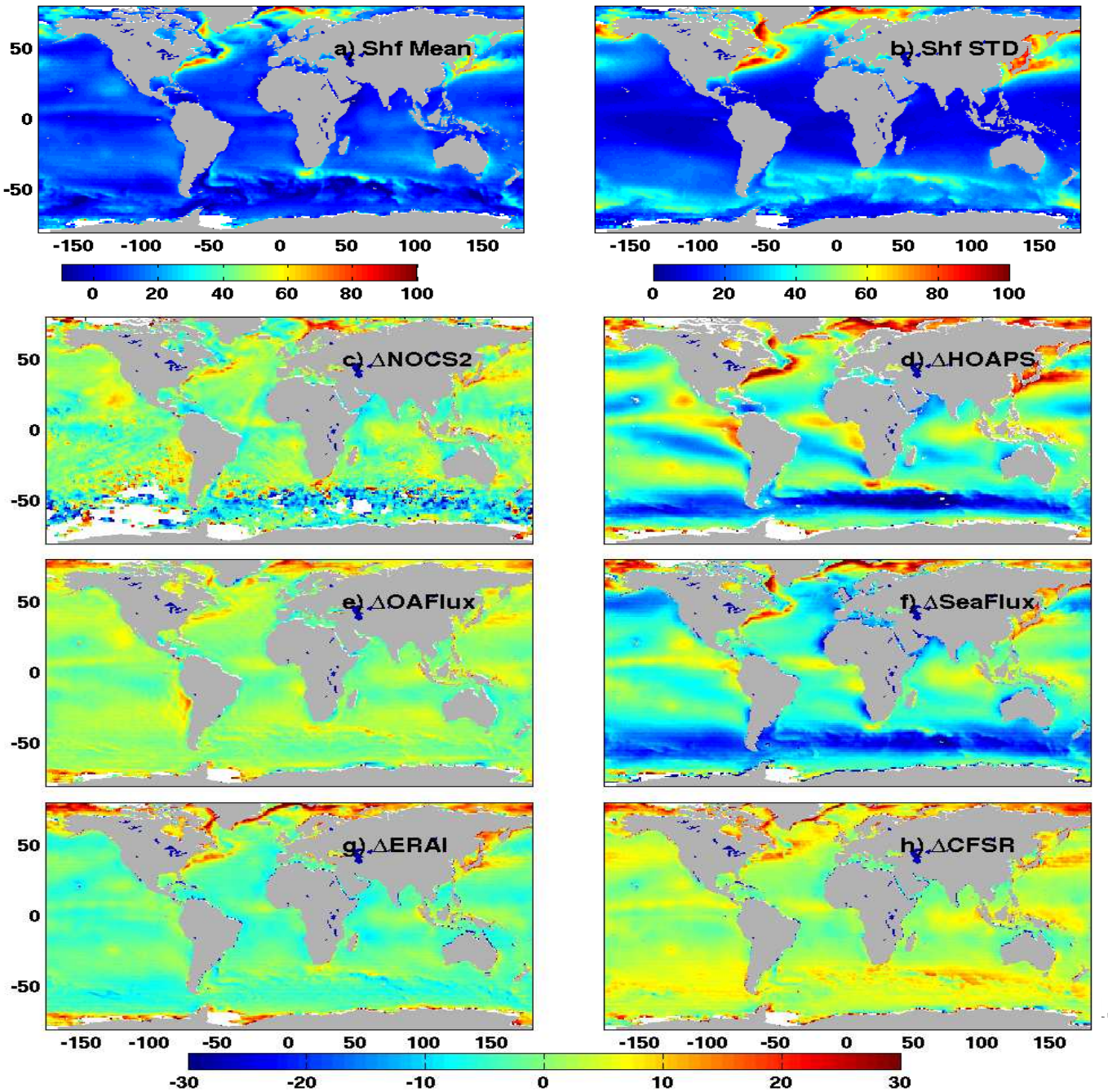
$$dU = U_{buoy} - U_{satellite;}\ dCh = Ch_{buoy} - Ch_{satellite};\ dTa = Ta_{buoy} - Ta_{satellite};\ dSst = Qsst_{buoy} - Qsst_{satellite}$$



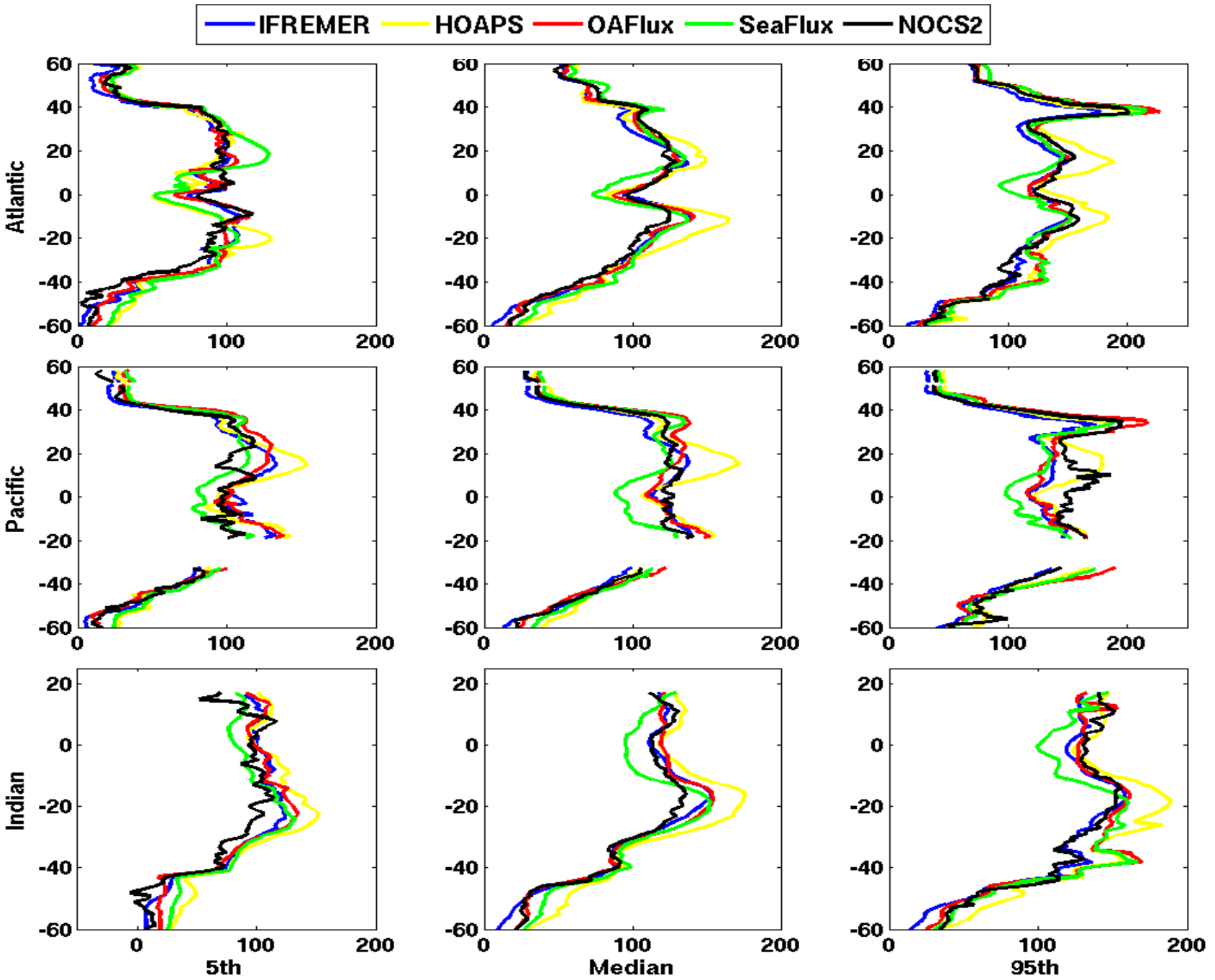
LHF Inter-Comparison



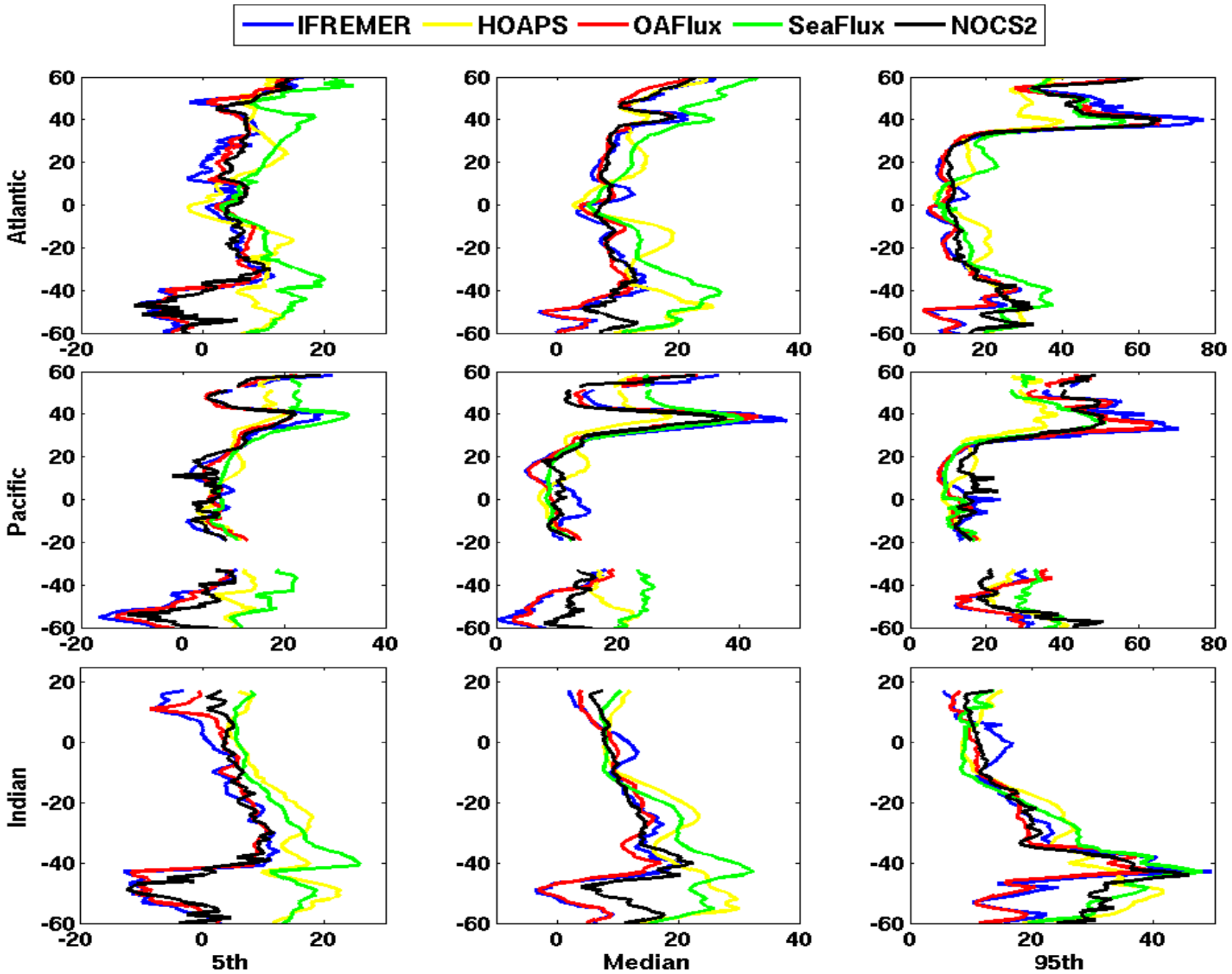
SHF Inter-Comparison

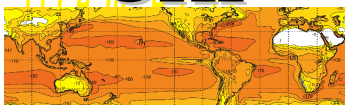


LHF Inter-Comparison



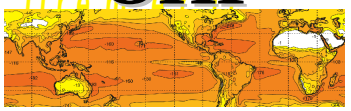
SHF Inter-Comparison





TIE-OHF WP4
Product Generation, Inter-Comparison and Uncertainty Characterizations

Statistic Parameters	Product	*W10*	*Qa*	*SST*	*Ta*	*τ*	*LHF*	*SHF*
Bias	IFREMER (***Reynolds***)	-0.20	-0.03	0.17	-0.11	0.00	3.41	1.98
	IFREMER (***CCISST***)			-0.02			-2.90	0.33
Standard deviation	IFREMER (***Reynolds***)	1.19	0.63	0.44	0.65	0.02	25.62	7.43
	IFREMER (***CCISST***)			0.29			26.49	7.60
Correlation	IFREMER (***Reynolds***)	0.86	0.94	0.98	0.94	0.86	0.86	0.76
	IFREMER (***CCISST***)			0.99			0.85	0.77



Summary

- **Flux New Release:**
  - Improvements are achieved
  - Better Results at global scale
  - Good Agreement with In-situ Estimates
  - Long Time Series: 1999 - 2009
- **Flux products**
  - Similar statistics from in-situ Comparisons
  - Main differences are relied on bulk variables
- **Inter comparisons**
  - Good agreement at global scale
  - Difference patterns are depicted