Improved Satellite-Based Estimates of the Near Surface Specific Humidity for Air-Sea Flux Computations

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Motivation

- Needed for production of large-scale maps of the sensible and latent heat flux
- Near-surface specific humidity and air temperature are the most difficult quantities to retrieve remotely
- Can the accuracy of the retrievals be improved with the use of multi-sensor data?

Conclusions

- Data from the SSM/T-2 and AMSU-B sounders can add extra information to the retrieval of q_a.
- The best 2-channel retrieval used 22V and 183±3 GHz.
- While SSM/I best provides information on the total integrated water vapor content, the 183±3 GHz channel adds information on the middle tropospheric water vapor content enabling better estimates of the surface impact.
- Slightly poorer results were obtained if the 183±7 GHz lower tropospheric channel were used in place of 183±3. The addition of 183±7 provided only a small improvement.

Acknowledgments

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References

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Liu, W. T., 1986: Statistical relation between monthly mean precipitable water and surface level humidity over global oceans, Mon. Weather Rev.

Miller, D. K., and K. B. Katsaros, 1992: Satellite-derived surface latent heat fluxes in a rapidly intensifying marine cyclone, Mon. Weather Rev.

Schlüssel, P. et al., 1995: Retrieval of latent heat flux and longwave irradiance at the surface from SSM/I and AVHRR measurements, Adv. Space Res.

Schulz, J. et al., 1997: Evaluation of satellite-derived latent heat fluxes, J. Climate.

Evaluation of Existing Algorithms

Several existing methods were intercompared and then evaluated against a large set of direct observations compiled under the SEAFLUX project. The processing was performed using common data on 0.5° global grids on monthly and daily time scales.

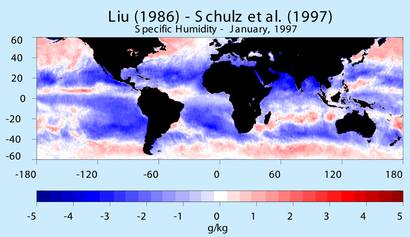
Specific Humidity Algorithms Evaluated

- Liu (1986)
- Miller and Katsaros (1992)
- Schlüssel et al. (1995)
- Schulz et al. (1997)
- Chou et al. (1997)

Validation Data Sets with Direct Observations

CMO 97	6/13 - 7/30/96	40.5 N, 289.5 E
DFCG	11/21/97 - 1/5/98	N. Indian Ocean
Jasmine	5/5 - 5/31/99	Bay of Bengal
Nauru99	6/15 - 7/18/99	Tropical Western Pac.
Kwajex	7/28 - 9/12/99	near Kwajalein Atoll
Moorings Cruise	9/14 - 10/21/99	Gulf of Alaska
PACS Moorings	6/97 - 7/98	Tropical Eastern Pac.
EPIC	11/11 - 12/2/99	Tropical Eastern Pac.

Intercomparison of the Algorithms



Monthly Global q_a Product RMS Differences (g/kg)

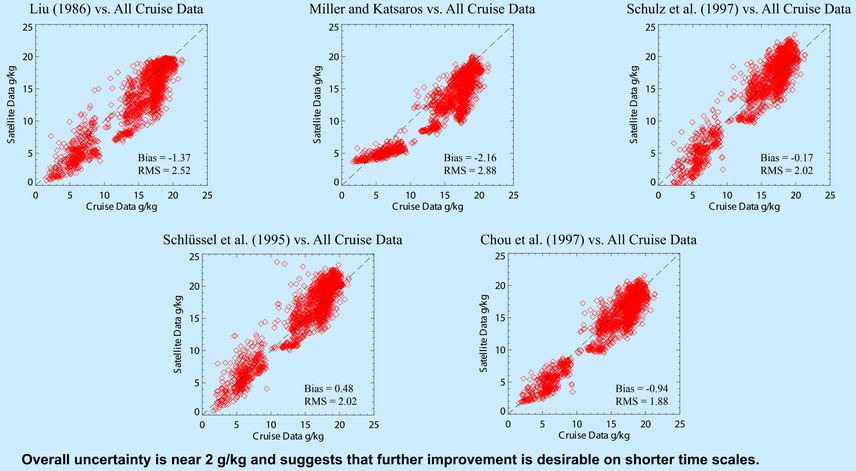
	M&K	Schulz	Schlüssel	Chou
Liu	1.42	1.38	1.99	1.17
M&K		2.21	2.72	1.58
Schulz			1.32	0.84
Schlüssel				1.67

Daily Global q_a Product RMS Differences (g/kg)

	M&K	Schulz	Schlüssel	Chou
Liu	3.46	3.46	3.75	3.47
M&K		2.63	2.93	1.91
Schulz			1.32	0.99
Schlüssel				1.59

Significant differences are observed between the algorithms and give a first estimate of the likely uncertainty

Evaluation Against Direct Observations

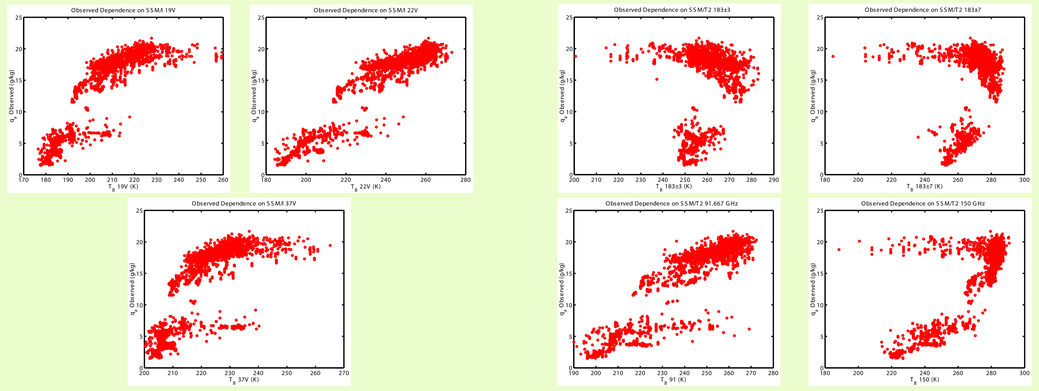


Overall uncertainty is near 2 g/kg and suggests that further improvement is desirable on shorter time scales.

Evaluation of New Algorithm Forms

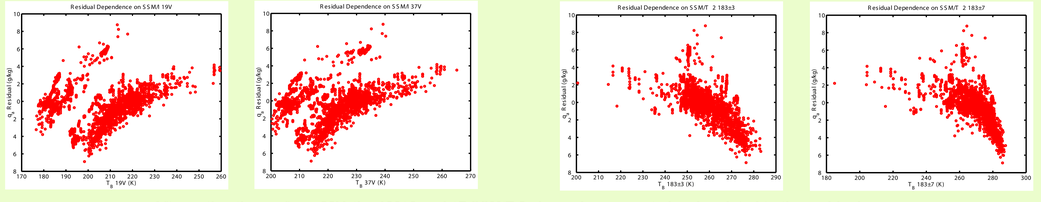
Simultaneous matches (on a daily time scale) were formed between the direct observations, SSM/I brightness temperatures, and SSM/T-2 brightness temperatures to determine if the addition of SSM/T-2 data could improve the retrievals.

Direct Relationship of the Individual Channels to q_a



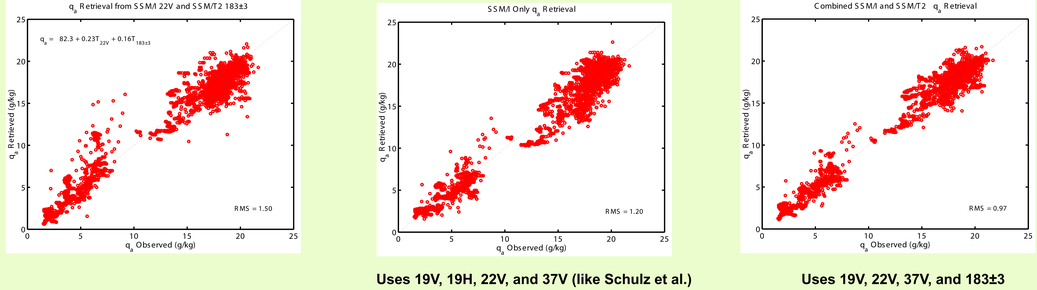
SSM/I 22V provides the best correlation to q_a. SSM/T-2 channels individually are not as closely related.

Channel Dependence of q_a Retrieval Residual (SSM/I 22V Retrieval Algorithm)



After estimating q_a from 22V, the 183±3 and ±7 SSM/T-2 channels are most closely related to the residuals.

Comparison of Multi-Channel q_a Retrieval Algorithms



Uses 19V, 19H, 22V, and 37V (like Schulz et al.)

Uses 19V, 22V, 37V, and 183±3