Grant Title: Joint-probability Analysis of the Natural Variability of Tropical Oceanic Precipitation

PI: Sandra E. Yuter
University of Washington
Department of Atmospheric Sciences
Box 351640
Seattle, WA 98195

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Research Activities:

1) Data sets delivered to the Goddard Distributed Active Archive Center (DAAC): 1) Kwajalein Experiment (KWAJEX) S-band calibrated, quality-controlled radar data, 12211 files of 3D volume data and 6832 files of 2D low-level reflectivity. 2) Raw and quality-control-processed versions of University of Washington Joss-Waldvogel disdrometer measurements obtained during KWAJEX. 3) A time series of synoptic-scale gif images of the Geostationary Meteorological Satellite (GMS) IR data for the KWAJEX period.

2) Dual-Doppler analysis of all Tropical Rain Measuring Mission (TRMM) Microwave Imager overpasses with radar echo within the dual-Doppler lobes during KWAJEX has been completed and placed on the web at: http://www.atmos.washington.edu/gcg/MG/KWAJ/ops-web/kwaj-overpass/

3) The GMS satellite data set for the KWAJEX period was obtained from University of Wisconsin and reprocessed into format amenable for comparison with radar data. GMS IR data have been added to the KWAJEX website's section on the TRMM satellite overpass perusal at http://www.atmos.washington.edu/gcg/MG/KWAJ/ops-web/overpass/

4) Aircraft microphysics flight-leg definitions for all aircraft and all missions during KWAJEX were completed to facilitate microphysics data processing. These legs were defined according to the relative positions of multiple aircraft and the pattern of radar echo. A total of 773 flight legs are defined and documented. A detailed catalog of the aircraft legs overlaid on radar data was placed on the web. http://www.atmos.washington.edu/gcg/MG/KWAJ/ops-web/prioritylegs/all_flt_legs/all_flt_legs.html A subset of 300 min of highest priority legs was identified for each aircraft for the first round of microphysics data processing.

5) As part of the KWAJEX Kitchen Sink Data set, a specialized radar data set was produced from the Kwajalein S-band radar data corresponding to the vertical profile of reflectivity and LWC at the location of the DC-8 AMPR swath for KWAJEX DC-8 aircraft missions.

6) A dual-Doppler analysis of the 11-12 August 1999 storm during KWAJEX using data from the Kwajalein S-band radar and the NOAA Ship Ronald H. Brown C-band radar was performed. Analysis of the evolving characteristics of reflectivity, divergence, and vertical velocity statistics for this storm including vertical profiles was completed as part of a student's Master's thesis.

7) Scientific oversight of the Kwajalein S-band radar has focused on working with Aeromet on deployment of additional rain measurement instruments including 500 m scale rain gauge array on Roi Namur Island, and development and testing of shield and siting to minimize wind-induced errors in disdrometer measurements. Worked with Colorado State professor V. Chandrasekar on assessing the quality and potential value to TRMM of the dual polarization radar data.

8) Collaboration with Dr. David Kingsmill of the Desert Research Institute on the TRMM Common Microphysics Products Definitions and aircraft microphysics processing.

9) Collaboration with University of Washington professor Robert Houze on development of new version of Kwajalein Ground Validation site rainmaps that quantify independent sources of error in rainfall mapping.

10) Collaboration with Columbia University professor Adam Sobel and University of Washington professor Christopher Bretherton on quality control processing of KWAJEX upper-air sounding data and analysis of large-scale equatorial waves in association with KWAJEX major rain events.

Student Thesis (PI was member of graduate committee)

Spooner, C. L., 2001: Dual Doppler analysis of an oceanic tropical mesoscale system during the Kwajalein Experiment (KWAJEX). M. S. Thesis, Texas Tech University, Atmospheric Sciences Group. 112 pp.

Publications –referred journal

Hagen, M. and S. E. Yuter, 2003: Relation between radar reflectivity and rainfall rate during the MAP-SOP. *Quart. J. Roy. Meteor. Soc.*, **129**, 477-493.

Houze, R. A., Jr., S. Brodzik, C. Schumacher, S. E. Yuter, and C. R. Williams, 2004: Uncertainties in oceanic radar rain maps at Kwajalein and implications for satellite validation. *J. Appl. Meteor.*, **43**, 1114-1132.

Kingsmill, D. E., S. E. Yuter, A. J. Heymsfield, P. V. Hobbs, A. V. Korolev, J. L. Stith, A. Bansemer, J. A. Haggerty, and A. L. Rangno, 2004: TRMM common microphysics products: A tool for evaluating spaceborne precipitation retrieval algorithms. *J. Appl. Meteor.*, in press.

Sobel, A. H., S. E. Yuter, C. S. Bretherton, and G. N. Kiladis, 2004: Large-scale meteorology and deep convection during TRMM KWAJEX. *Mon. Wea. Rev.*, **132**, 422-444.

Yuter, S. E., and R. A. Houze, Jr., 2002: Comment on "Partitioning tropical oceanic convective and stratiform rains by draft strength". *J. Geophys. Res.*, **107**, ACL-4.

Yuter, S. E., R. A. Houze, Jr., E. A. Smith, T. T. Wilheit, and E. Zipser, 2004: Physical characterization of tropical oceanic convection observed in KWAJEX. *J. Appl. Meteor.*, accepted.

Yuter, S. E., D. Kingsmill, L. B. Nance, and M. Löffler-Mang, 2004: Observations of precipitation characteristics near and within the melting layer. Submitted to *J. Atmos. Sci.*

Yuter, S. E., and W. S. Parker, 2001: Rain measurement on ship revisited: the 1997 PACS TEPPS cruise. *J. Appl. Meteor.*, **40**, 1003-1018.

Publications—reports

Adkins, W., and S. E. Yuter, 2001: Report on Potential Tropical Open Ocean Precipitation Validation Sites, NASA Global Precipitation Mission Reports. Accessible at: http://gpmscience.gsfc.nasa.gov, 77 pages.

Yuter, S., R. Houze, V. Chandrasekar, E. Foufoula-Georgiou, M. Hagen, R. Johnson, D. Kingsmill, R. Lawrence, F. Marks, S. Rutledge, and J. Weinman, 2002: GPM Draft Science Implementation Plan Ground Validation Chapter. Accessible at www.arxiv.org, arXiv:physics/0211095, 22 pp.

Publications—conference proceedings

Bidwell, S. W., W. J. Adams, I. K. Bibyk, D. F. Everett, E. A. Smith, and S. E. Yuter, 2003: Validation and error characterization for the Global Precipitation Measurement. *Preprints, 2003 International Geoscience and Remote Sensing Symposium,* Toulouse, France.

Bidwell, S. W., S. E. Yuter, W. J. Adams, D. F. Everett, G. M. Flaming, and E. A. Smith, 2002: Plans for Global Precipitation Measurement Ground Validation. *Preprints, 2002 International Geoscience and Remote Sensing Symposium and 24th Canadian Symposium on Remote Sensing*, June 2002, Toronto, Canada, **III**, 1370-1373.

Yuter, S. E., 2001: Sources of uncertainties in rainfall mapping with precipitation radar. *Abstracts, Pacific Northwest Weather Conf.*, March 2001, Seattle, WA.

Yuter, S. E., 2001: Characteristics of oceanic-influenced precipitation in midlatitudes and the tropics. *Abstracts, Seventh International Conference on Precipitation.* 30 June–3 July 2001. Rockport, ME.

Yuter, S. E., and R. Wood, 2003: Evaluating uncertainties in GPM oceanic precipitation retrievals. *Preprints, 31st Conference on Radar Meteorology*, Seattle, WA, 6-12 August, American Meteorological Society.