

Surface Fluxes: Challenges for High Latitudes

Joint Workshop for SeaFlux and
the US CLIVAR Working Group on High Latitude Surface Fluxes
March 17-19, 2010, Boulder, Colorado

Introduction, Logistics,
Summary of Objectives

Thanks to sponsors: US CLIVAR and NASA Physical Oceanography

Photo: Peter Guest, SHEBA, 1998,
http://www.weather.nps.navy.mil/~psguest/sheba/pictures/maui_rescue.html

Logistics



Photo: GasEx3

- Schedule: morning plenary; afternoon breakouts
- Talks should be loaded on meeting machine during break prior to talk (or earlier).
- Speakers: Turn off phones or leave at seat. Even in silent or vibrate mode they cause feedback.
- Posters can be put up immediately and left up throughout the workshop.
- Poster reception this evening. Open beer and wine bar with appetizers.

Logistics (2)

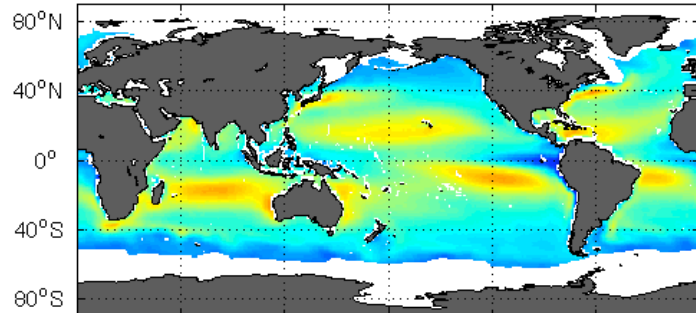


- Lunch: Included with registration. In cafeteria. Mention SeaFlux to avoid being charged.
- Wifi login sheets available from Jill. She can help trouble shoot as well.
- Restrooms in North/East corner of lobby.
- See Jill if you need transport to or from hotel at times other than scheduled shuttle times.
- Not registered? Please sign in to help us track participation.

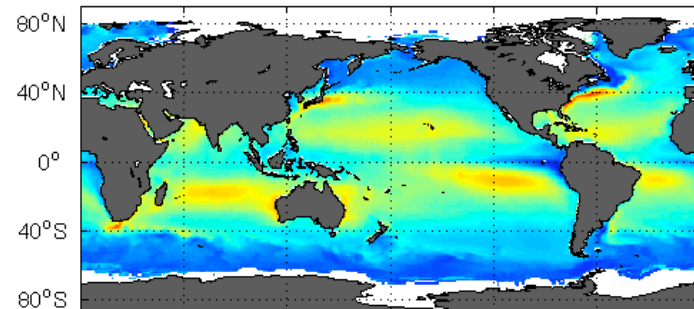
Photo from L. M. Gould, Feb. 2004, Drake Passage

Motivation for joint workshop

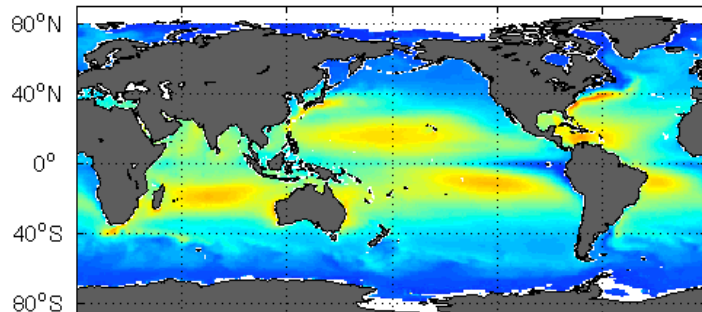
1992-2005 GSSTF2b Latent Heat Flux



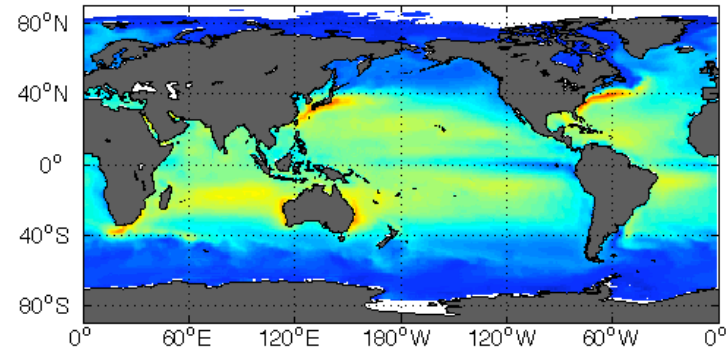
1992-2005 Jofuro2v2 Latent Heat Flux



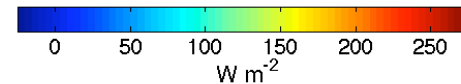
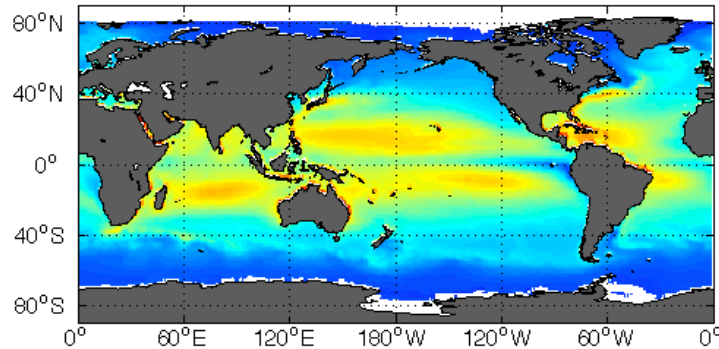
1992-2005 HOAPS Latent Heat Flux



1992-2005 OAFflux Latent Heat Flux



1992-2005 IFREMER Latent Heat Flux

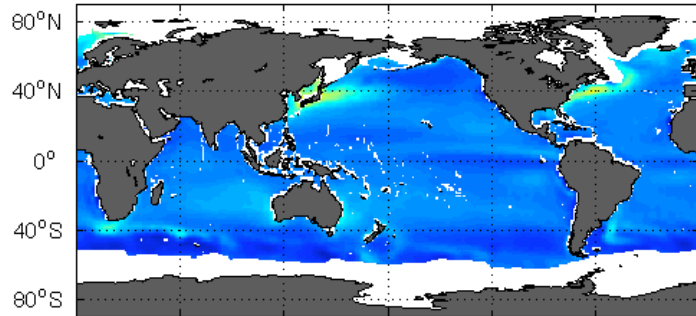


Means of High Latitudes:

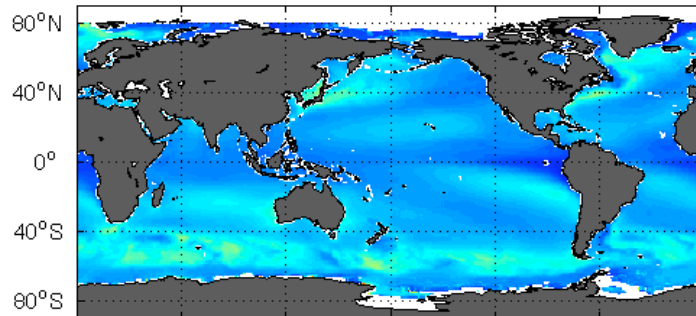
GSSTF2b	74.0 W m ⁻²
HOAPS3	47.4 W m ⁻²
IFREMER	49.9 W m ⁻²
JOFURO	55.8 W m ⁻²
OAFflux	34.3 W m ⁻²

Motivation for joint workshop

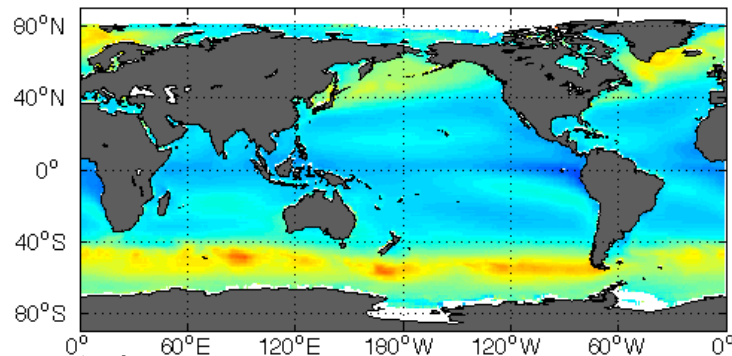
1992-2005 GSSTF2b Sensible Heat Flux



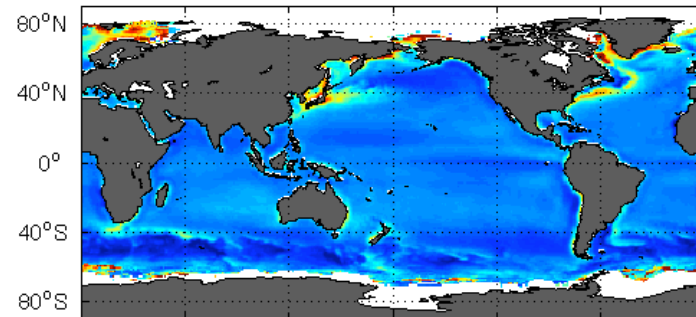
1992-2005 HOAPS Sensible Heat Flux



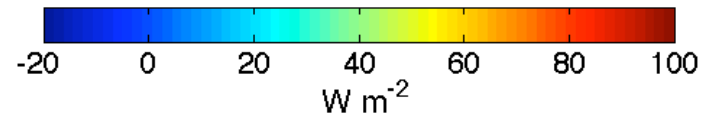
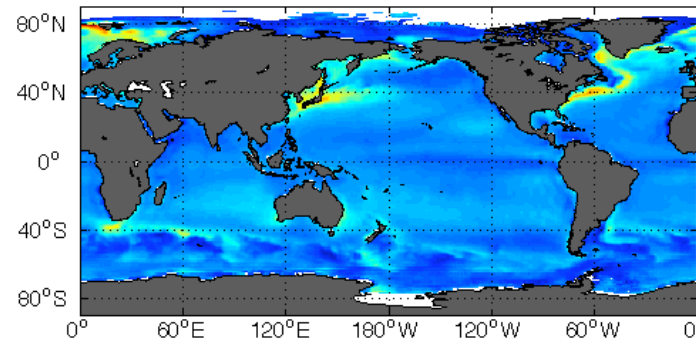
1992-2005 IFREMER Sensible Heat Flux



1992-2005 Jofuro2v2 Sensible Heat Flux



1992-2005 OAFlex Sensible Heat Flux



Means of High Latitudes:

GSSTF2b	3.3 $W m^{-2}$
HOAPS3	16.9 $W m^{-2}$
IFREMER	41.0 $W m^{-2}$
JOFURO	12.0 $W m^{-2}$
OAFlex	8.9 $W m^{-2}$

Motivation

Sensible heat flux in Northern Hemisphere

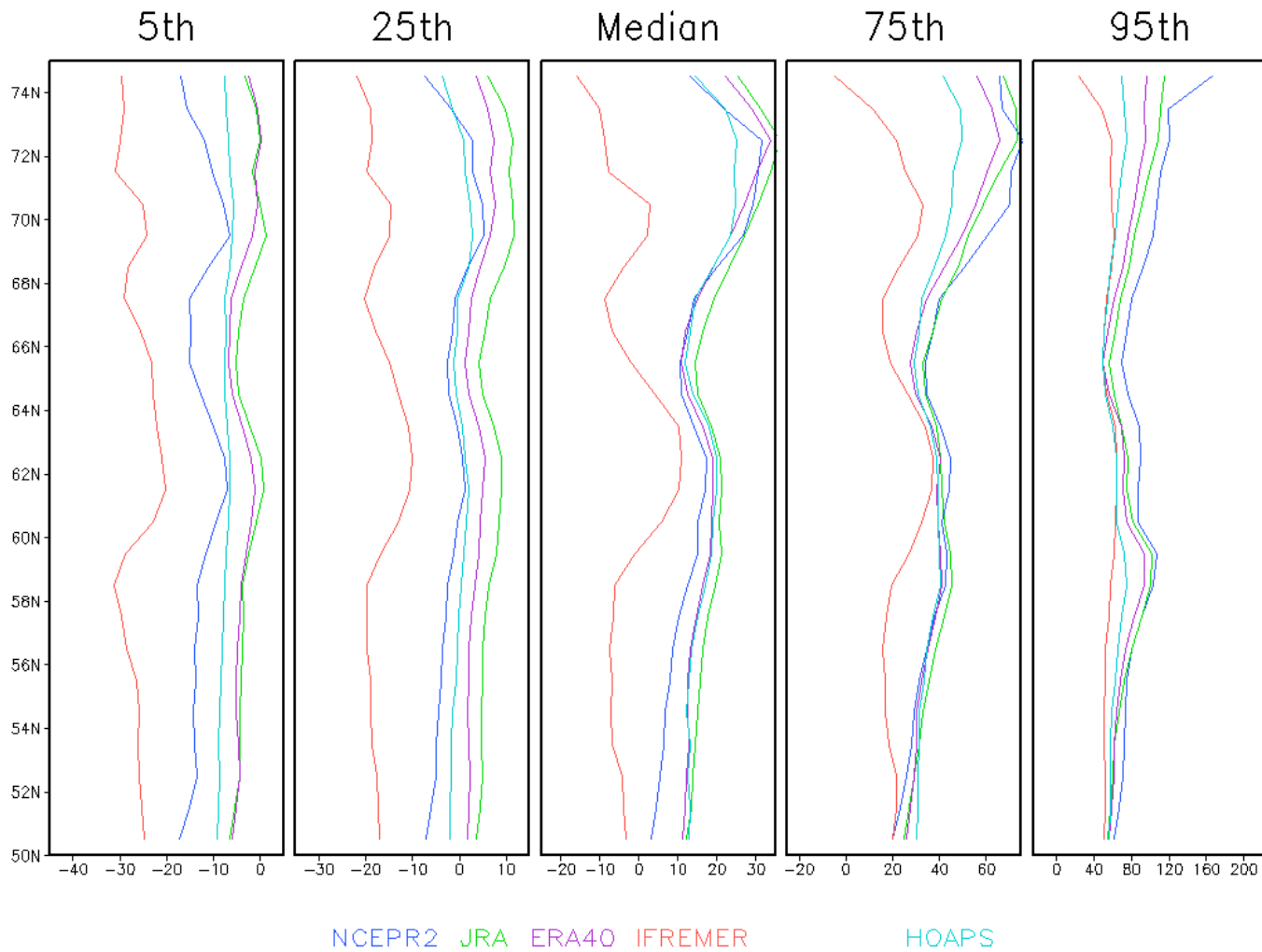
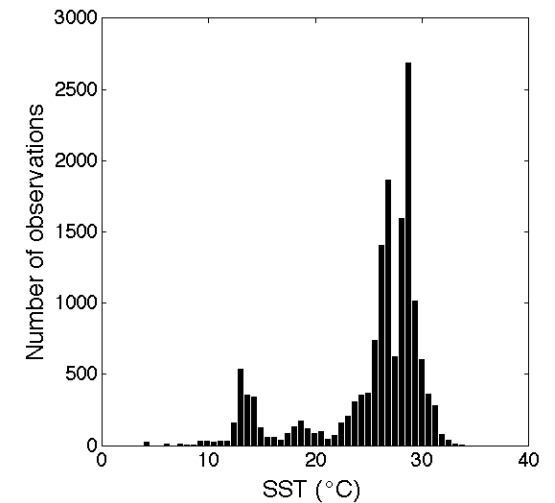
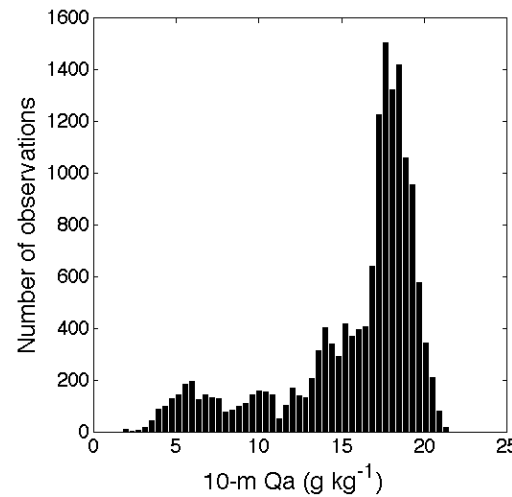
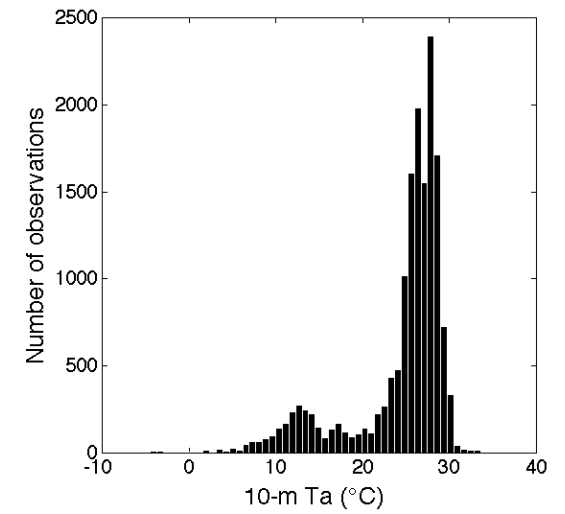
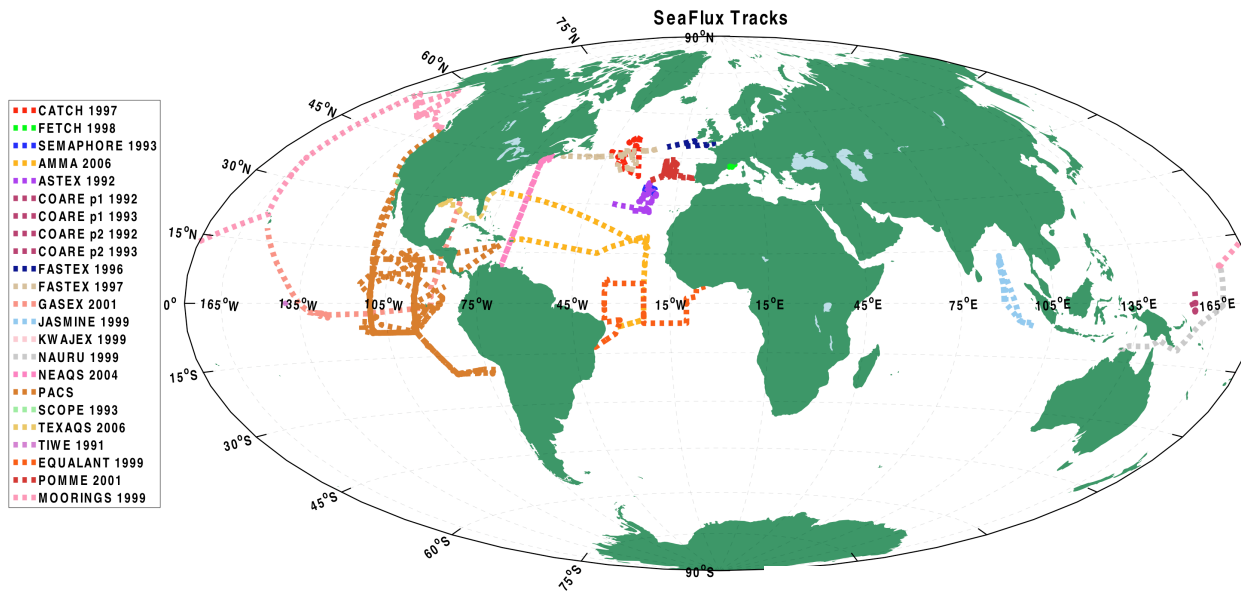


Figure: Bourassa et al

Location and distributions of SeaFlux high-quality flux validation dataset



SeaFlux Overview

- Program initiated under the WCRP Global Energy and Water Experiment (GEWEX) Radiation Panel
- SeaFlux Project has the following elements:
 - Provide library of in-situ datasets from research ships, buoys, SOP
 - Provide library of available flux datasets, co-located with in situ datasets and also converted to equal area for comparisons
 - Evaluation/improvement of bulk turbulent flux models
 - Evaluation and improvement of methods for air temperature and specific humidity
 - Evaluation of global flux products in context of applications
 - Production of high-resolution skin SST including diurnal cycle
 - Production of open-ocean global high-resolution (0.25° , 3 hourly) turbulent flux dataset

US CLIVAR Working Group Objectives

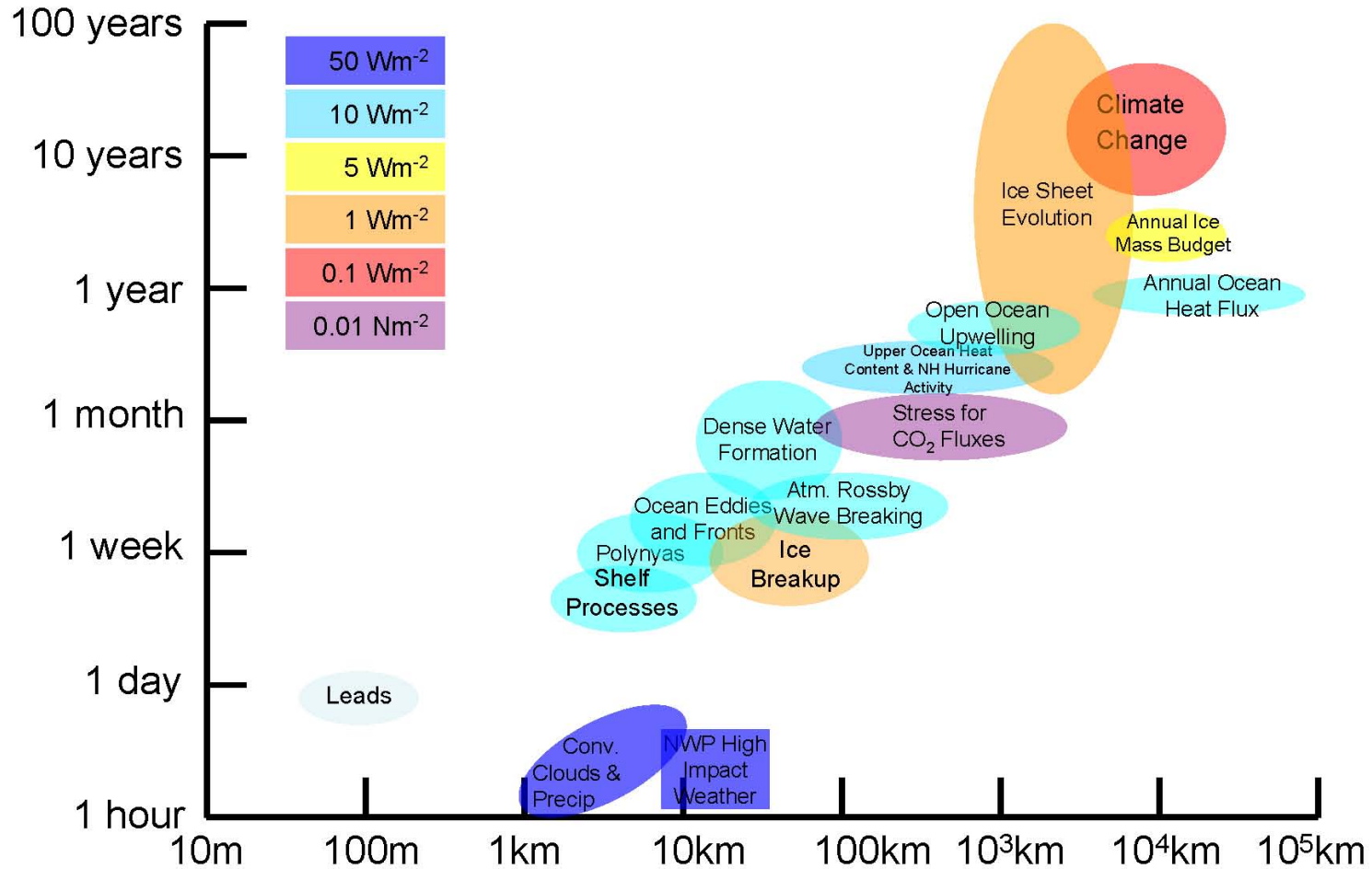
- Document present state of high-latitude fluxes, considering momentum, heat, freshwater, and CO₂. Focus primarily on ocean-atmosphere and ocean-ice-atmosphere fluxes. (BAMS manuscript in progress)
- Organize community workshop to coordinate efforts to improve flux estimates at high latitudes.



Photo: Sharon Escher, SIO

<http://antarcticsun.usap.gov/science/contentHandler.cfm?id=1608>

Flux Accuracies and Applications



Workshop Objectives

- Share results on applications that rely on fluxes, and look at flux requirements implied by applications.
- Share results on gridded flux products and regional observational (process) studies.
- Articulate a prioritized plan for improved fluxes.
- Disseminate findings:
 - *J. Climate* (AMS) special collection (submissions due October 1)
 - US CLIVAR Variations
 - EOS Workshop summary



Photo: Peter Guest, SHEBA

<http://www.weather.nps.navy.mil/~psgquest/sheba/pictures/artsy.html>

Interest in workshop outcomes ...



Photo: Peter Guest, SHEBA

<http://www.weather.nps.navy.mil/~psguest/sheba/pictures/>

- Surface Heat Budget of the Arctic (SHEBA) deployed instruments for 12 months from ice camp in 1997-98.
- Arguably best regional sampling of surface fluxes in high latitude environments.
- Could not repeat SHEBA in same location, because there is no longer year-round ice.
- WCRP/CLIC 2010 white paper (Rapid Sea Ice Loss in the Arctic) advocates repeat of a SHEBA-like campaign in part to validate remote sensing algorithms.

5 Strategies for Improving Fluxes

- Analyze existing data (mostly basic meteorological variables - temperature and humidity). Ensure data quality and make data more readily accessible.
- Expand field observations. Target direct flux observations and high-quality, high-temporal resolution data needed for satellite calibration/validation.
- Expand use of ships of opportunity and autonomous instruments.
- Make full use of satellite data, and expand the satellite observing system. Improve accuracy of flux related variables (e.g. air temperature, humidity, cloud properties.)
- Improve understanding of the physics underlying air-sea fluxes, and improve parameterizations.

Challenges about



Photo: Peter Guest, SHEBA
<http://www.weather.nps.navy.mil/~psguest/sheba/pictures/>

Stray slides follow.....

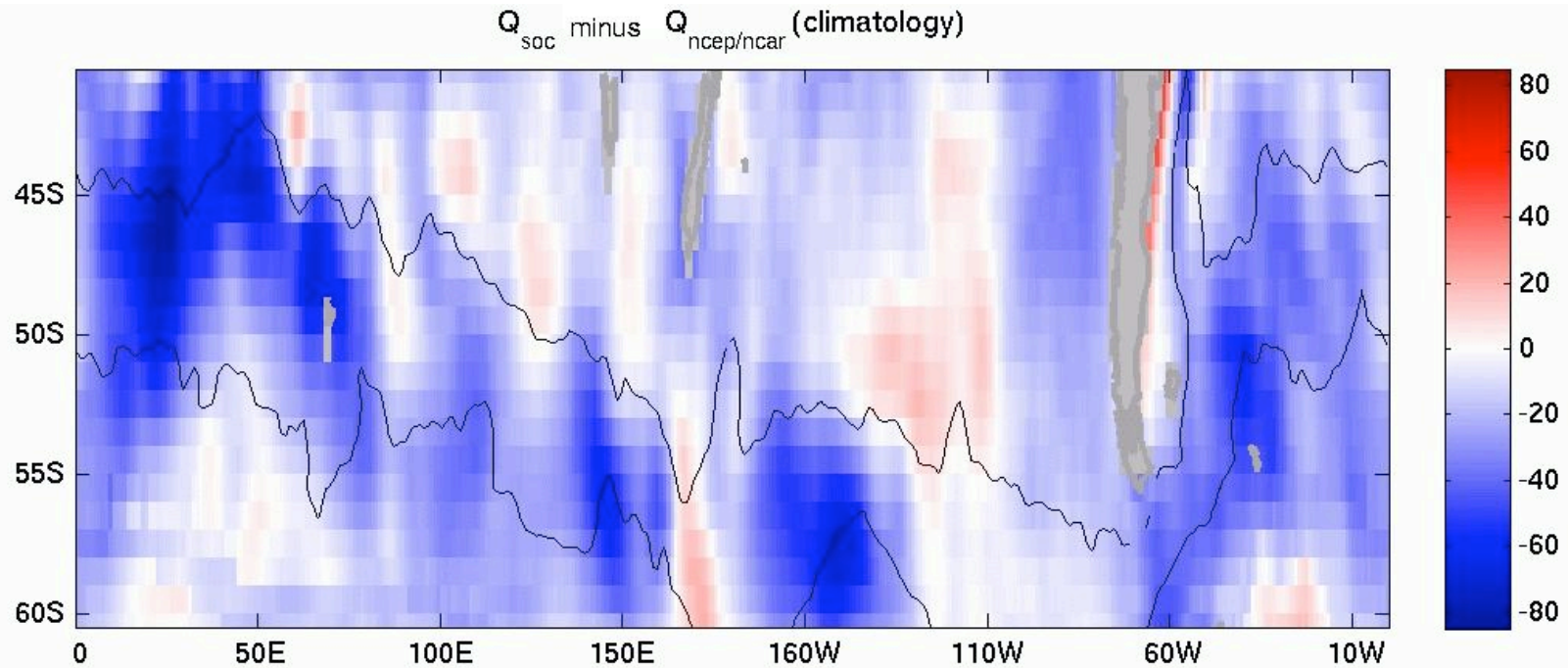
Other Findings

- Combination of large natural variability and poor in situ sampling makes it impossible (at present) to create regional flux fields from purely in situ products.
- Differences between NWP reanalyses and satellite products for surface turbulent fluxes exceeds 40 W m^{-2} in zonal averages.
 - Probability distributions of fluxes are very different
 - More complicated than a simple bias
 - Regional differences in radiative flux estimates have problems of a similar magnitude
- Analyses of many processes require accuracies of roughly 10 W m^{-2}
 - This accuracy requires improvements on the order of one order of magnitude in accuracy
 - As estimated by biases between modern products

Membership

- Ed Andreas (associate)
- Cecelia Bitz
- Mark Bourassa (co-chair)
- Dave Carlson
- Ivana Cerovecki (associate)
- Meghan Cronin (associate)
- Will Drennan
- Chris Fairall
- Sarah Gille (co-chair)
- Ross Hoffman
- Gudrun Magnusdottir
- Rachel Pinker (associate)
- Ian Renfrew (associate)
- Mark Serreze
- Kevin Speer
- Lynne Talley
- Gary Wick

Motivation 1: Heat Flux Differences in the Southern Hemisphere



Flux differences in W m^{-2}
Heat budget imbalance about 1 W m^{-2}
(Courtesy of Shenfu Dong).