PUMP workshop. May 19-21, 2003

Preamble. The task at hand:

The premise of the experiment is that:
1) we have arrived at a moment when models are ready to exploit realistic mixing, and a qualitative jump in climate modeling realism is now possible through improving the simulation of equatorial mixing;
2) observations to date have only sketched the situation and have not yet provided adequate guidance. In particular, previous observational programs have measured aspects of the cold tongue system in relative isolation, which has made interpretation difficult and left uncertainty about the applicability of these measurements to models.

PUMP intends to deliver a fuller, in-context and regime-dependent picture of diapycnal transport in the cold tongue that will be believable enough to serve as a modeling challenge. It will also provide data and interpretation sufficient to enable the measurements to be useful to modelers. A related goal is to learn to use sustained sparse observations assimilated into models to infer and diagnose equatorial mixing and its effects, based on the ongoing ENSO observing system.

The purpose of the workshop is to ventilate and resolve the issues that will enable us to write a defensible scientific plan. This plan will likely encompass a significant observational effort involving several phenomena, using a variety of technologies at a mix of scales, integrated with models of different types. Thus the workshop will consist first of short educational talks to inform participants of our capabilities and limitations in these diverse areas. Then the bulk of the time will be discussion of the many issues necessary to shape the program.

Agenda (8:30AM to 5PM Monday and Tuesday. 8:30AM to noon, Wednesday)

1. Pose the problem, the opportunity, and the task
Historical background/motivation, how PUMP fits with US CLIVAR's strategy (Kessler)
CPT concept, overview of models (readiness to incorporate "real" mixing) (Schopf)

2. The tools we have to work with (*short* (15 minutes max) educational talks)
a. Measuring issues and capabilities
Frontal processes (Rudnick)
Deep-cycle turbulence (Lien)
Tropical instability waves: Sampling and physics (Johnson)
Turbulence from ships (Moum)
Turbulence from floats (D'Asaro)
Possibilities using moored current measurements (Cronin)
Possibilities using surface drifters (Bonjean)
Possibilities using large-scale and historical data (Meinen)
Satellite observations of air-sea interaction over SST fronts (Chelton)
Atmospheric BL modification (shipboard measurements) (Wijsekara or Paulson)

b. Modeling challenges
Using small-scale models to improve climate models (Large)
Using internal wave models to interpret GCM mixing (Gregg)
Horizontal mixing/interleaving (Richards)
KPP formulation uses and limitations (Large)
LES models (Wang)
Incorporating biology into physical models (Strutton)
What is the thickness of the "Ekman layer" near the equator? (Niiler)

3. Issues to be resolved for planning the experiment (open discussion)

How do models help plan/direct/interpret/assimilate the observations?

What quantities are to be measured?
    Mixing
        Diapycnal, Isopycnal/Lateral (frontal and TIW), Interleaving
        Property fluxes. Momentum penetration. Diurnal cycle
        Shear instabilities due to EUC
    Horizontal divergence, velocity time series
        Is upwelling small-scale and filamentary or broadscale Ekman?
        Where to sample divergence? (Off-equatorial?). How densely?
        How to sample the very-near-surface velocities?
        Tropical cells
        TIW velocity and shear
    Heat/salt/momentum budgets
        In situ and remote sensing. What accuracy do we need/can we expect?
        PBL measurements/modeling? (Paying attention to feedbacks)
    Biology
        Use of satellite ocean color?
        Radiation profiles in the mixed layer

Where to make measurements?
    110°W or 140°W?
        Which is more crucial for models?
        Which is easier to diagnose from measurements?
    What latitude range is needed?
    What vertical sampling is needed?
    How to measure lateral mixing? (SST front and TIW)
    Is it necessary to sample/study mixing below the EUC core?
    What sampling patterns are most useful to verify/challenge OGCMs?

When to make measurements?
    Entire annual cycle needed?
    Just the cooling or warming time of year?
      Is the warm season like the west Pacific? (COARE)
    What happens if we get an El Nino?

How to sample the meso- and large-scale context?
    Remote sensing (winds, SSH, TMI)?
    Augmentation of TAO?
    Surface drifters
    Subsurface floats
    Reinterpreting/integrating previous mixing data sets

Onward: writing a scientific plan
    Appointing a steering committee?

Attendee list:

Mike Alexander	CDC
Dave Behringer	NCEP
Fabrice Bonjean	ESR
Antonietta Capotondi	CDC
Luca Centurioni	Scripps
Dudley Chelton	OSU
Meghan Cronin	PMEL
Eric D'Asaro	UW
Russ Davis	Scripps
Clara Deser	NCAR
Eric Firing	UH
Peter Gent	NCAR
Mike Gregg	UW
WeiChing Han	UColorado
Bob Helber	USF
Ming Ji	OGP
Eric Johnson	ESR
Sean Kennan	NovaU
Billy Kessler	PMEL
George Kiladis	Aeronomy
Bill Large	NCAR
Ren-Chieh Lien	UW
Mike McPhaden	PMEL
Chris Meinen	RSMAS
Art Miller	Scripps
Ralph Milliff	CoRA
Jim Moum	OSU
Ragu Murtugudde	UMD
Peter Niiler	Scripps
Clayton Paulson	OSU
Kelvin Richards	UH
Paul Robbins	Scripps
Tony Rosati	GFDL
Dan Rudnick	Scripps
Paul Schopf	COLA
Pete Strutton	SUNY/Stonybrook
Max Suarez	GSFC
LuAnne Thompson	UW
Dailin Wang	UH
Bob Weller	WHOI
Hemantha Wijsekara	OSU