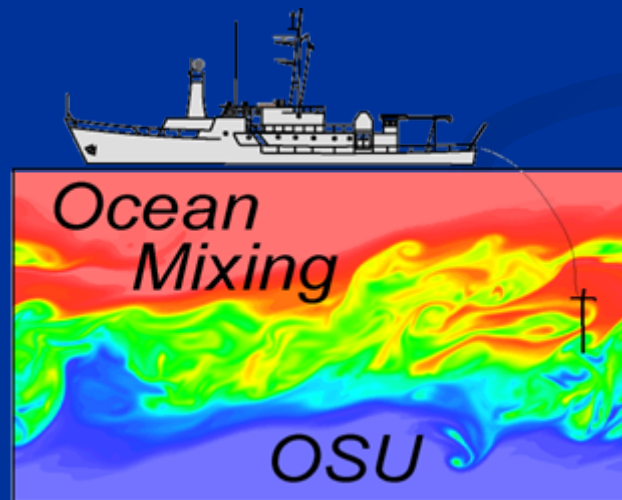




Mixing Measurements on an Equatorial Ocean Mooring

χ pod

Jim Moum
Jonathan Nash



Thanks to:

Alexander Perlin
Mike McPhaden
PMEL buoy group
TAO Project Office

xpod

signal sample rate

compass 1 Hz

P 10

T₁ 10

T₂ 10

dT₁/dt 120

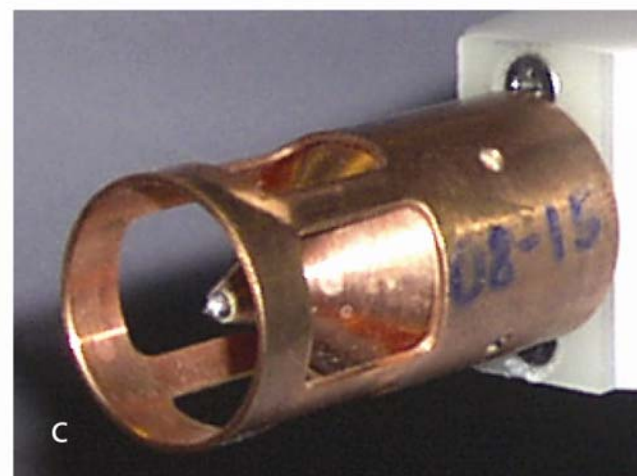
dT₂/dt 120

Accel_x 120

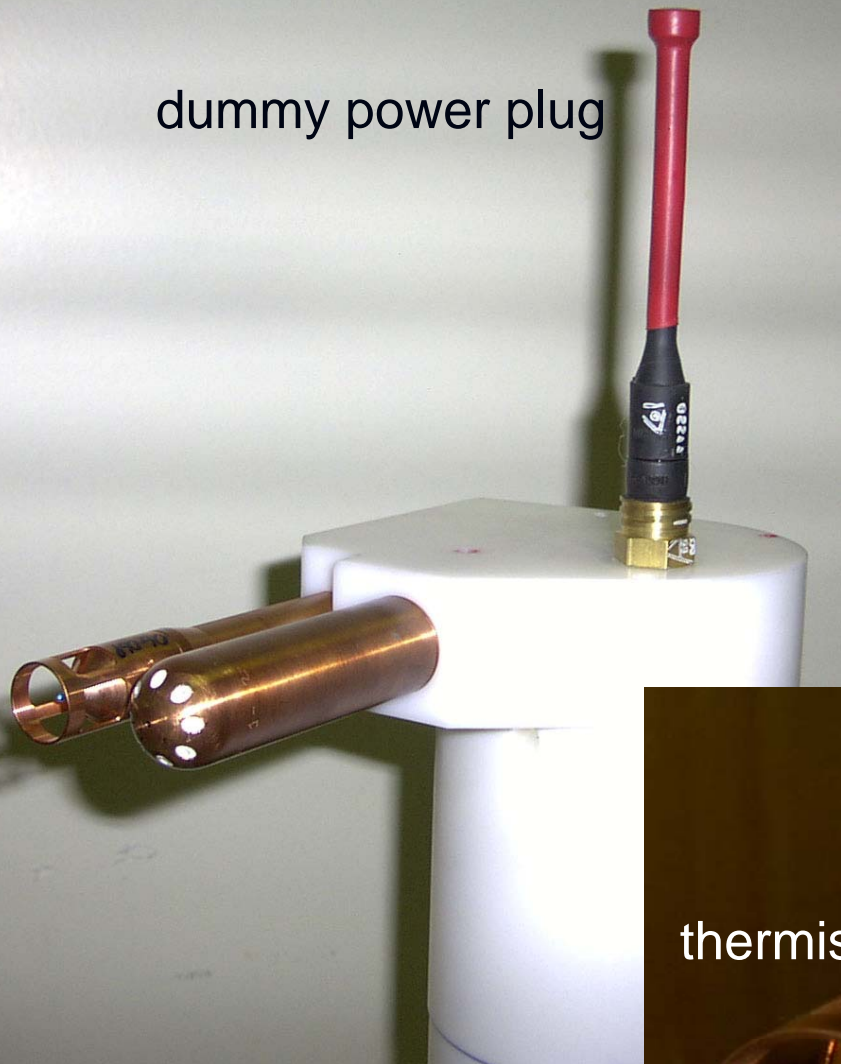
Accel_y 120

Accel_z 120

Total: 631 16-bit
words/s

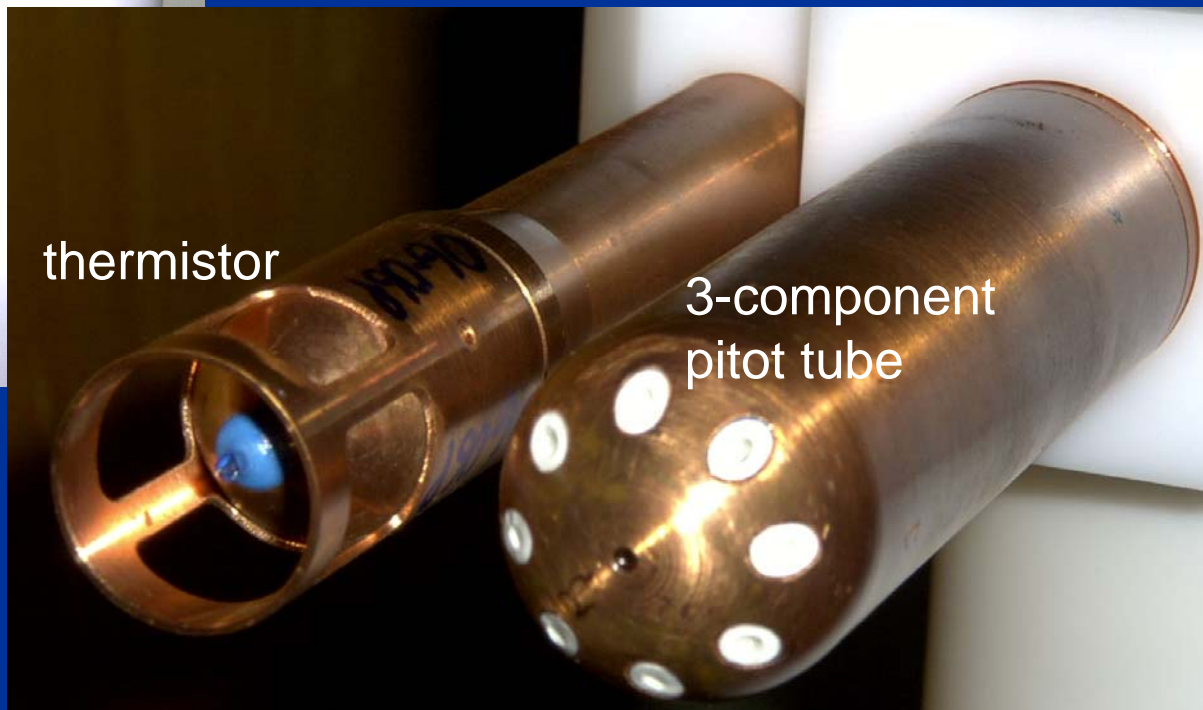


dummy power plug



χ pod v2.0

thermistor

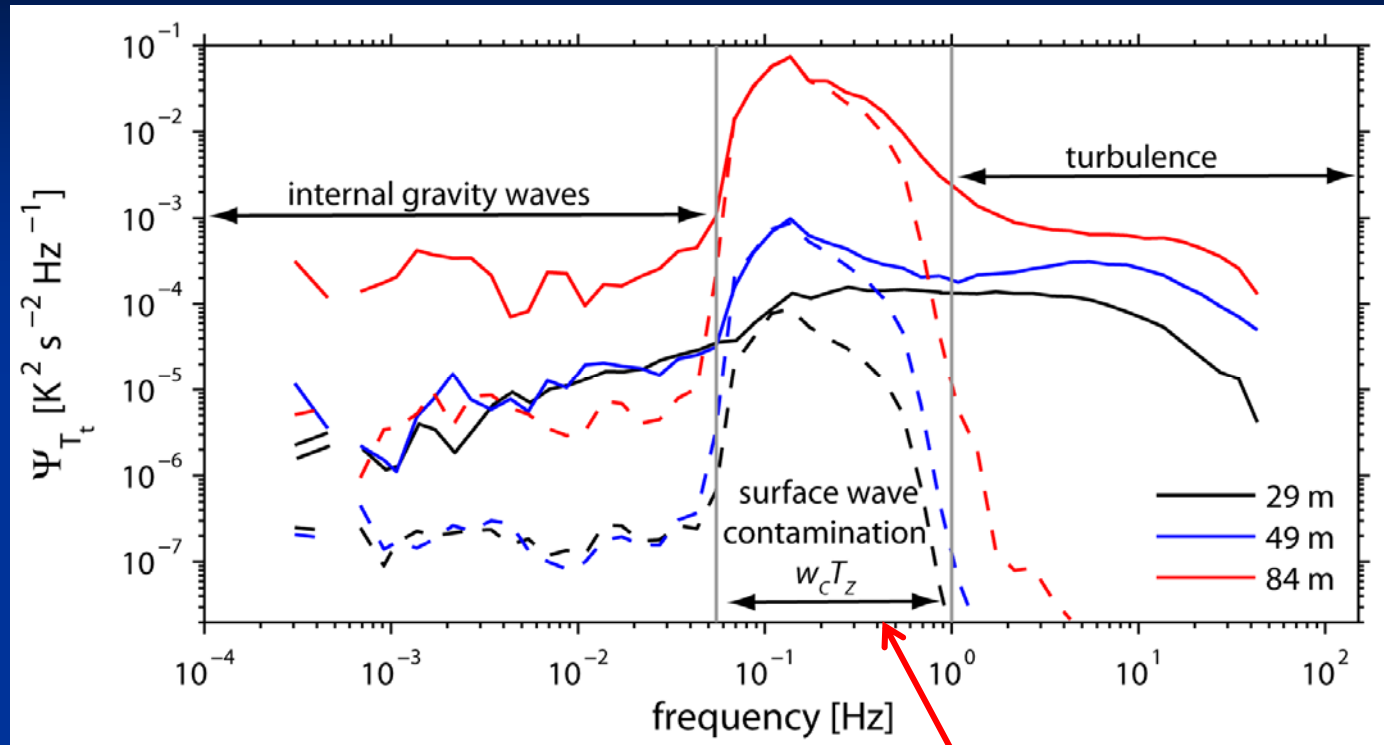


3-component
pitot tube



5 h spectrum of
temperature gradient
120 Hz data

we compute χ by
scaling 1 s spectra



surface wave pumping
vertical component of cable velocity
 $w_c = \pm 2 \text{ m s}^{-1}$

details on

- construction
- principle of operation
- how we make the computations
- use the measured cable motion

→ Moum & Nash, *J. Atmos. Ocean. Technol.*,
Feb2009

1 minute averages
from 1 s spectra

T

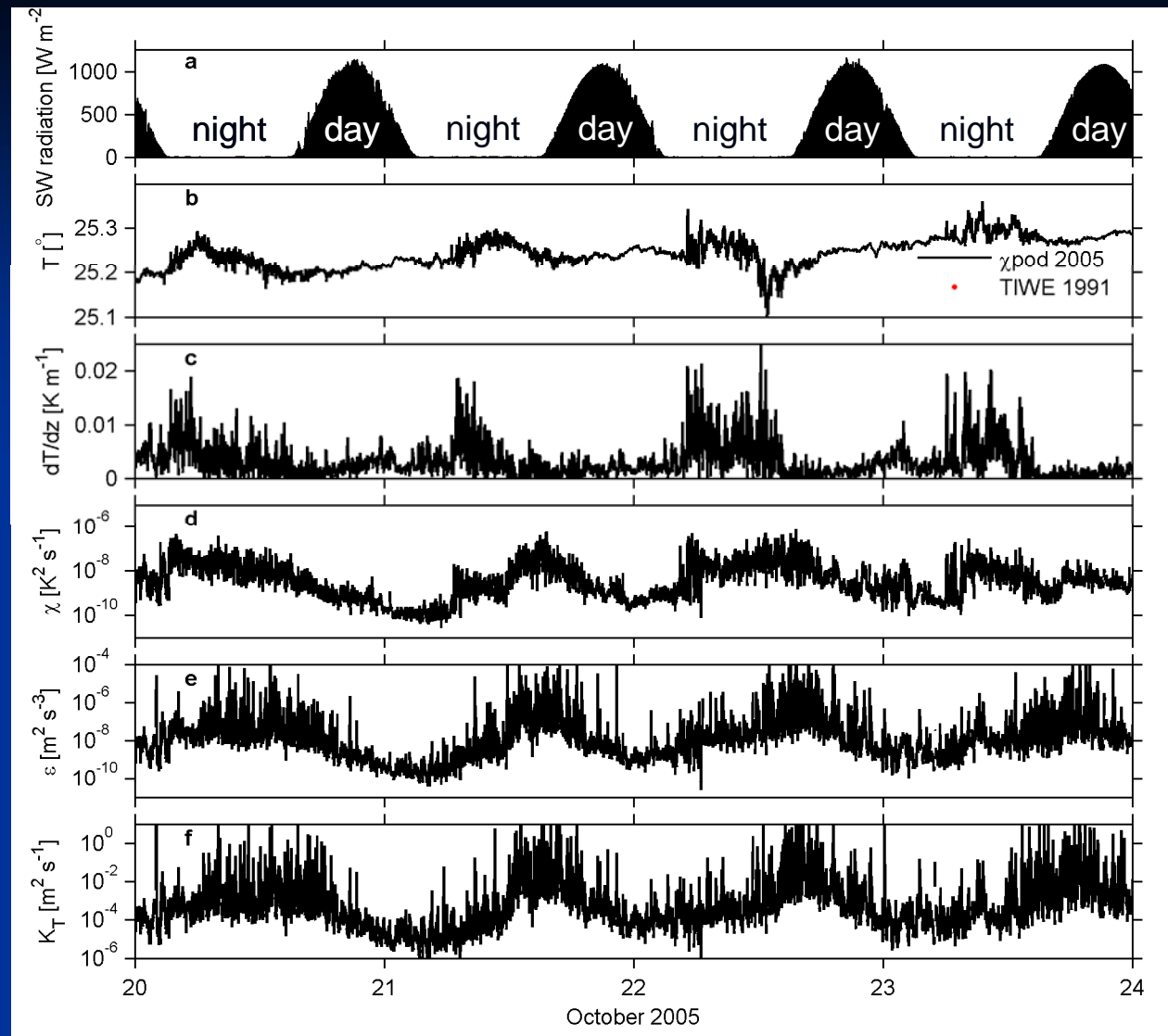
dT/dz

χ

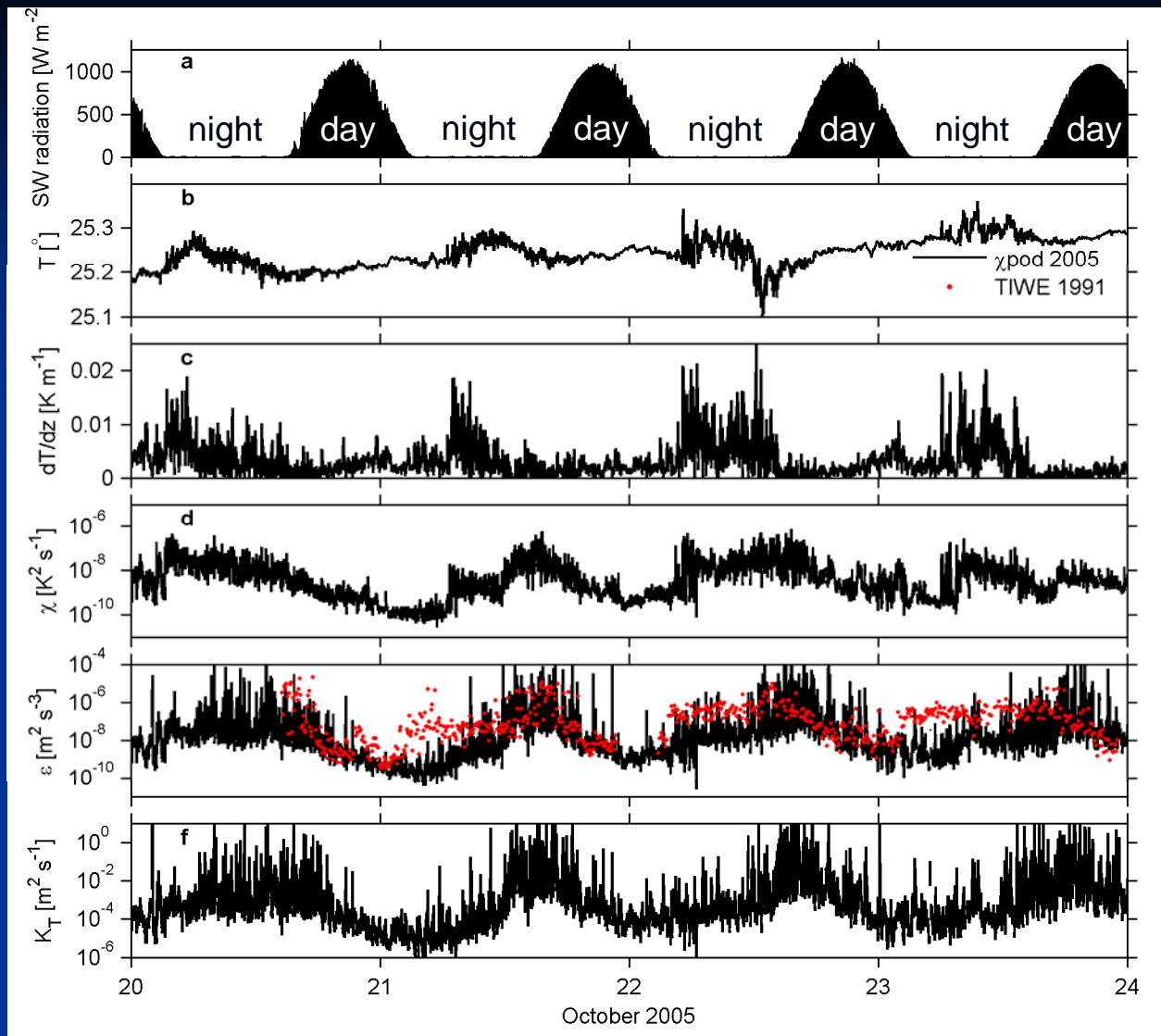
ε_χ

K_T

$$K_T = K_\rho \rightarrow \varepsilon_\chi = \frac{N^2 \chi}{2\Gamma T_z^2}$$



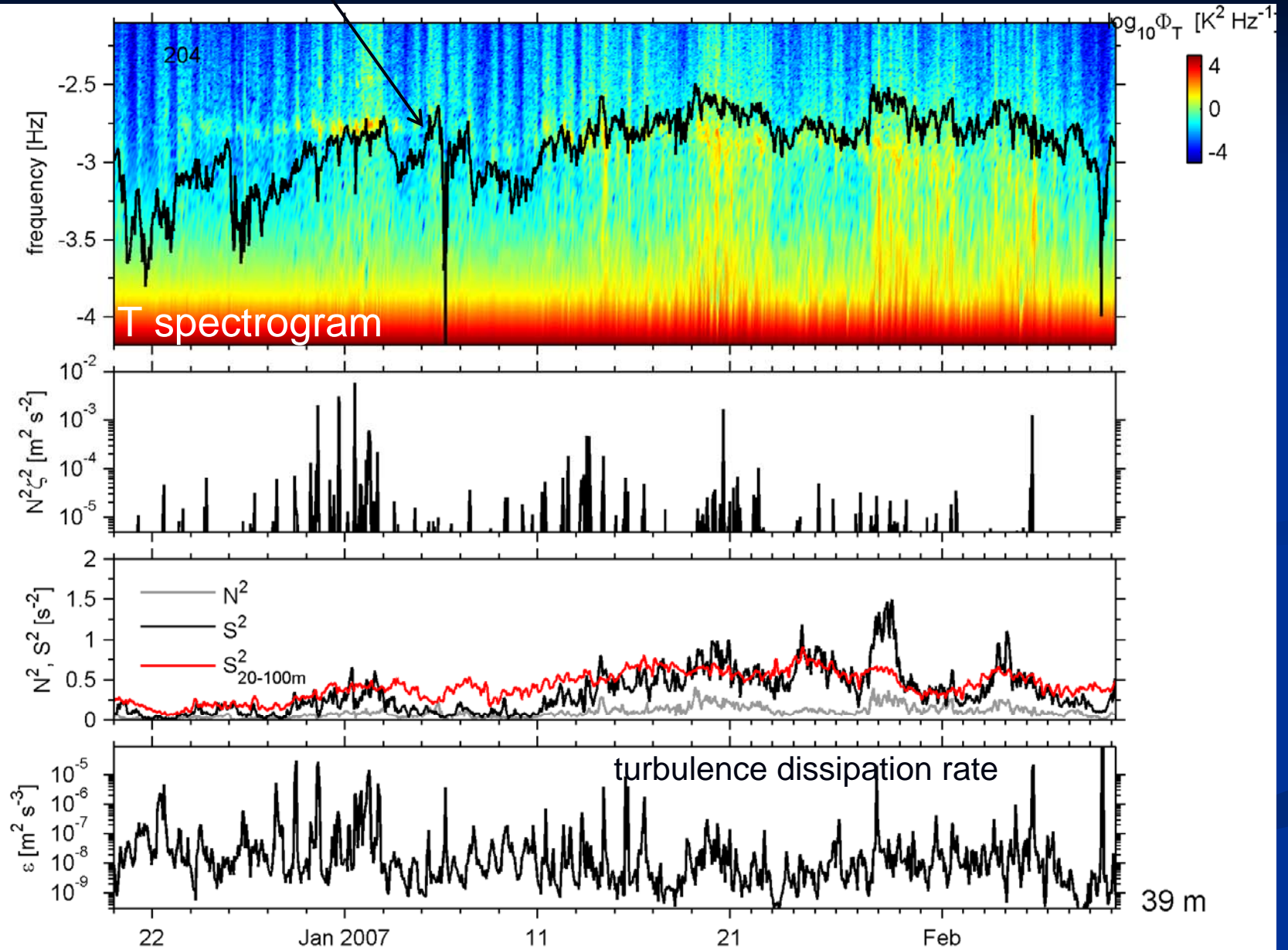
T
dT/dz
 χ
 ε_χ
 K_T

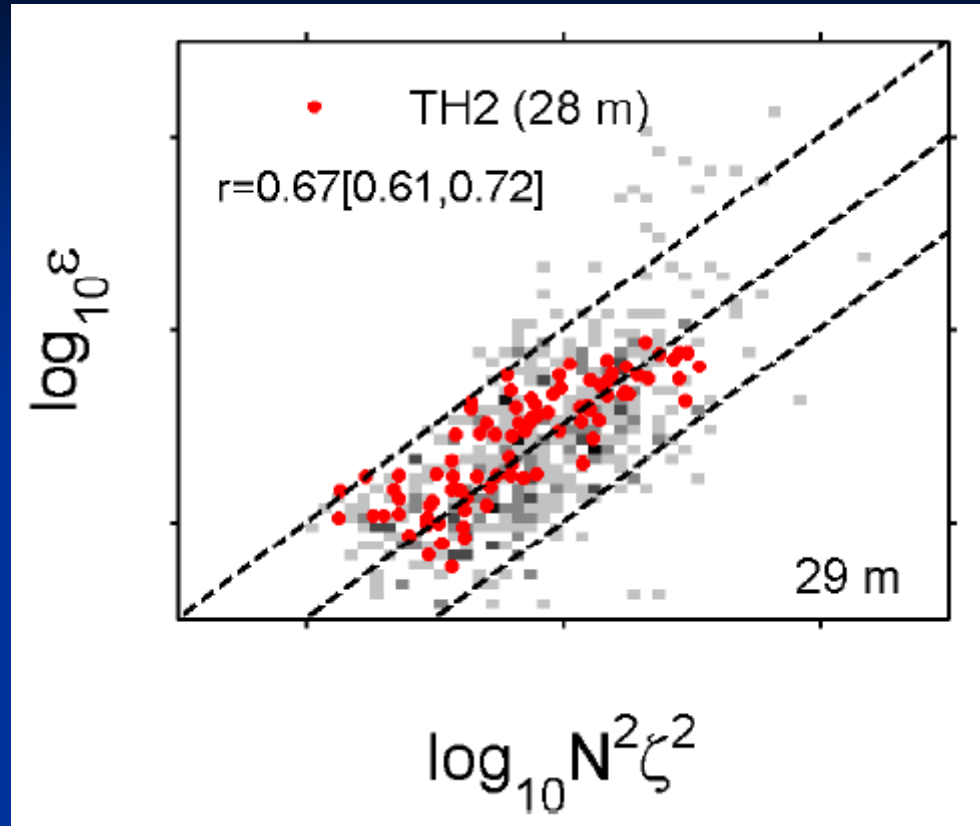


consistency with historical data

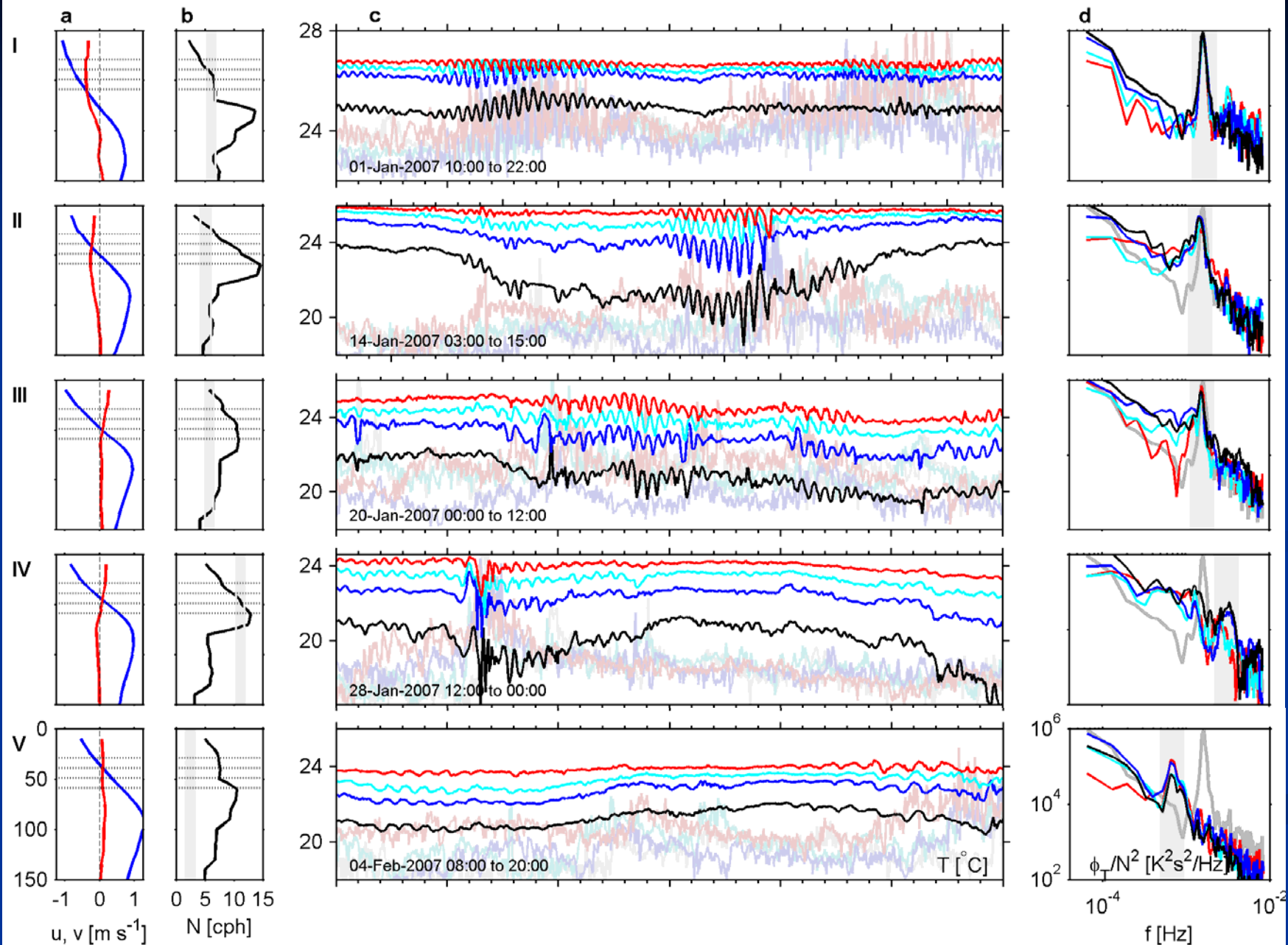
● TIWE – Chameleon ε profiles
using shear probes
(Moum *et.al.*, 1995)

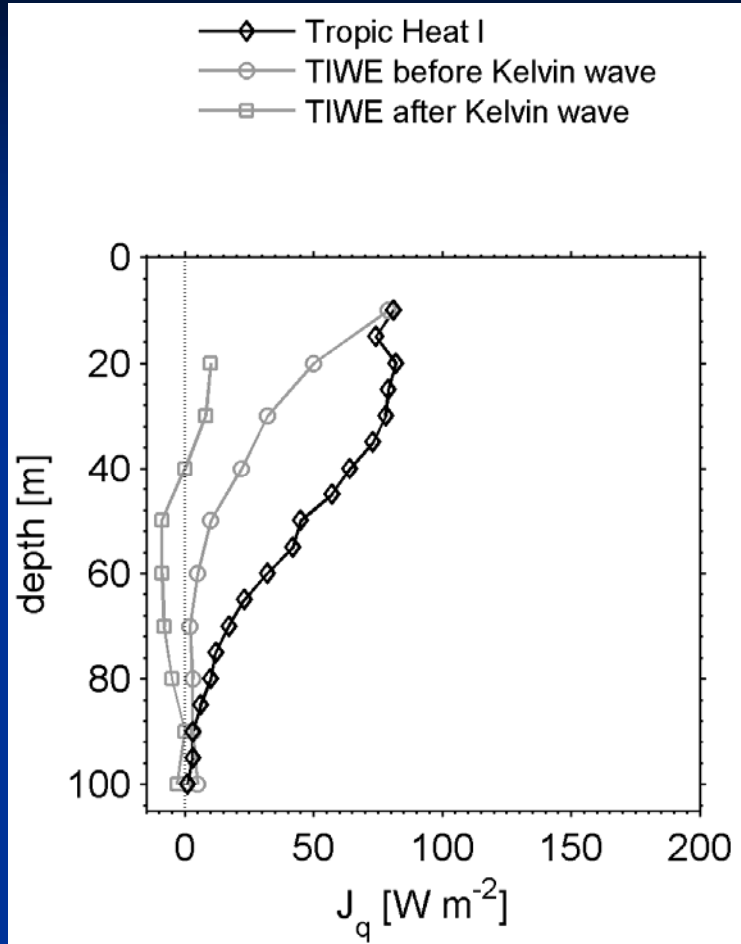
black line is N [Hz]



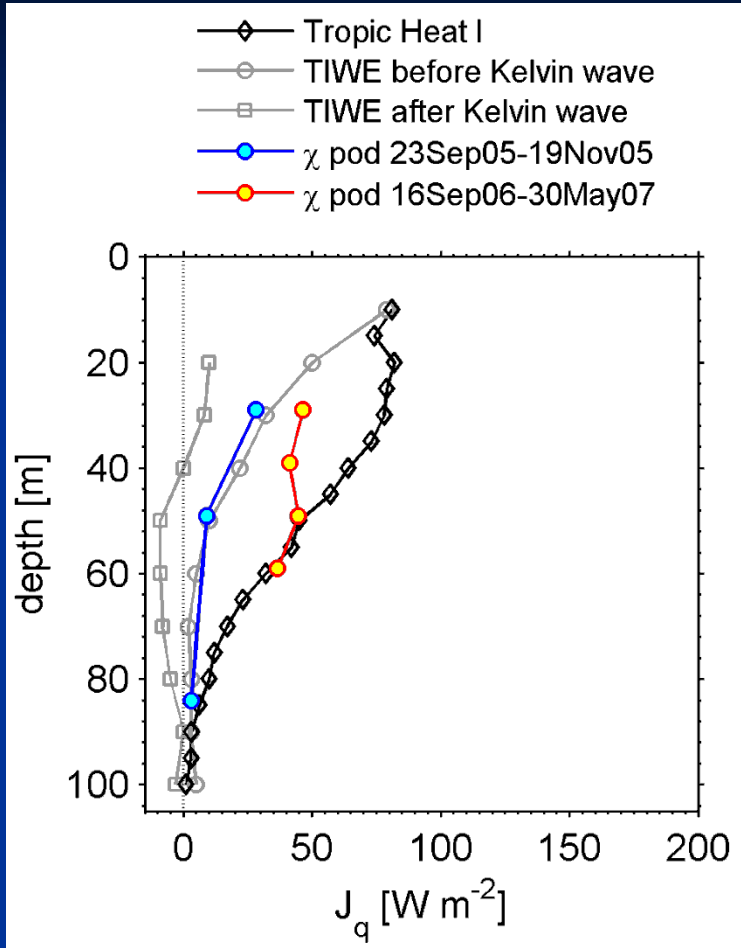


consistency with historical data

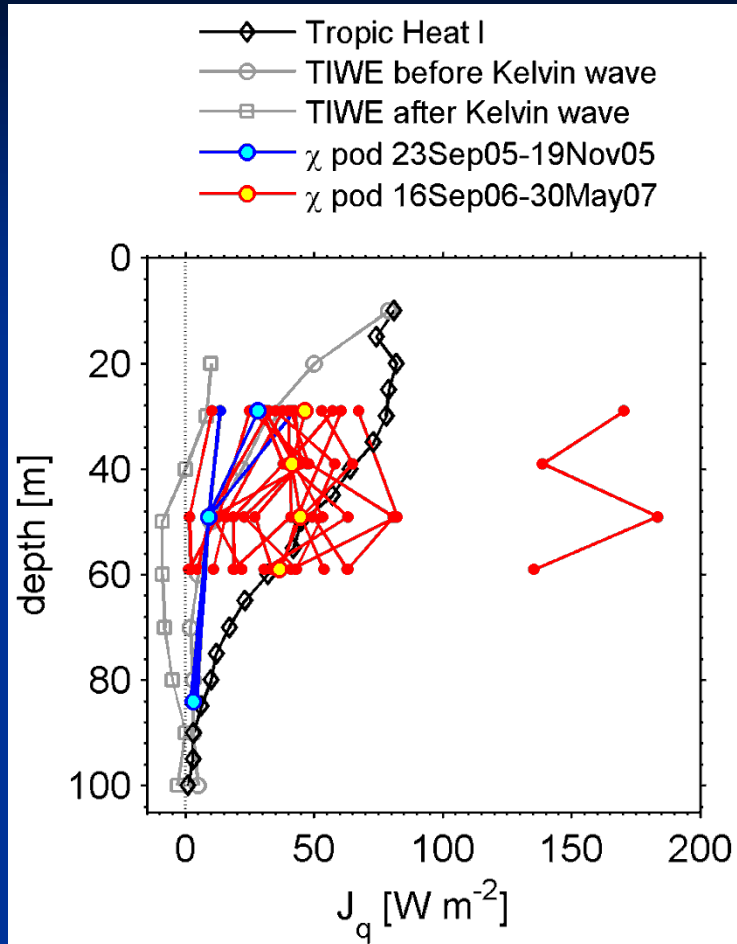




how do the χ_{pod} flux estimates compare to turbulence profiling experiments?



consistency with historical data

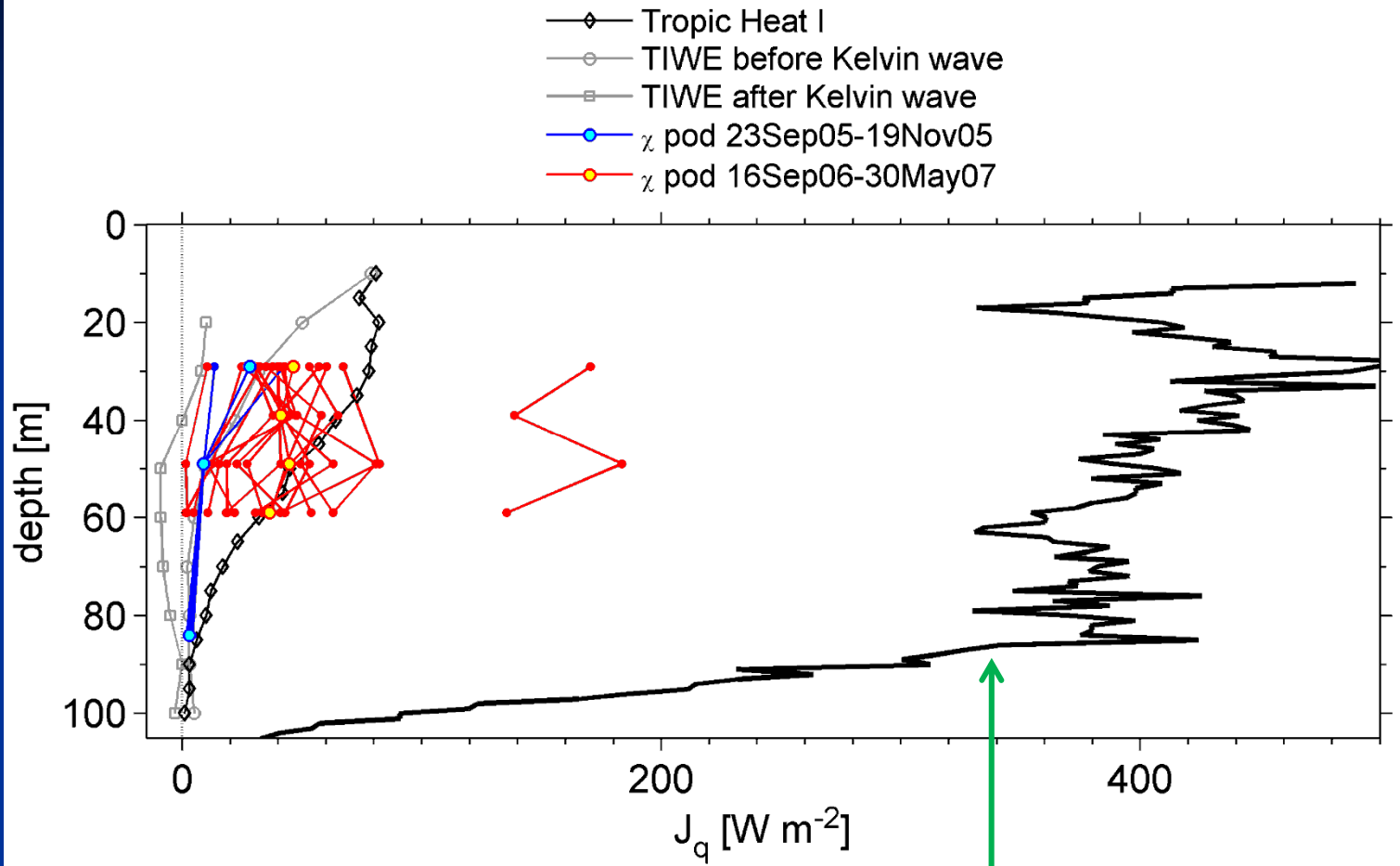


— 2 week averaged subsamples from longer records

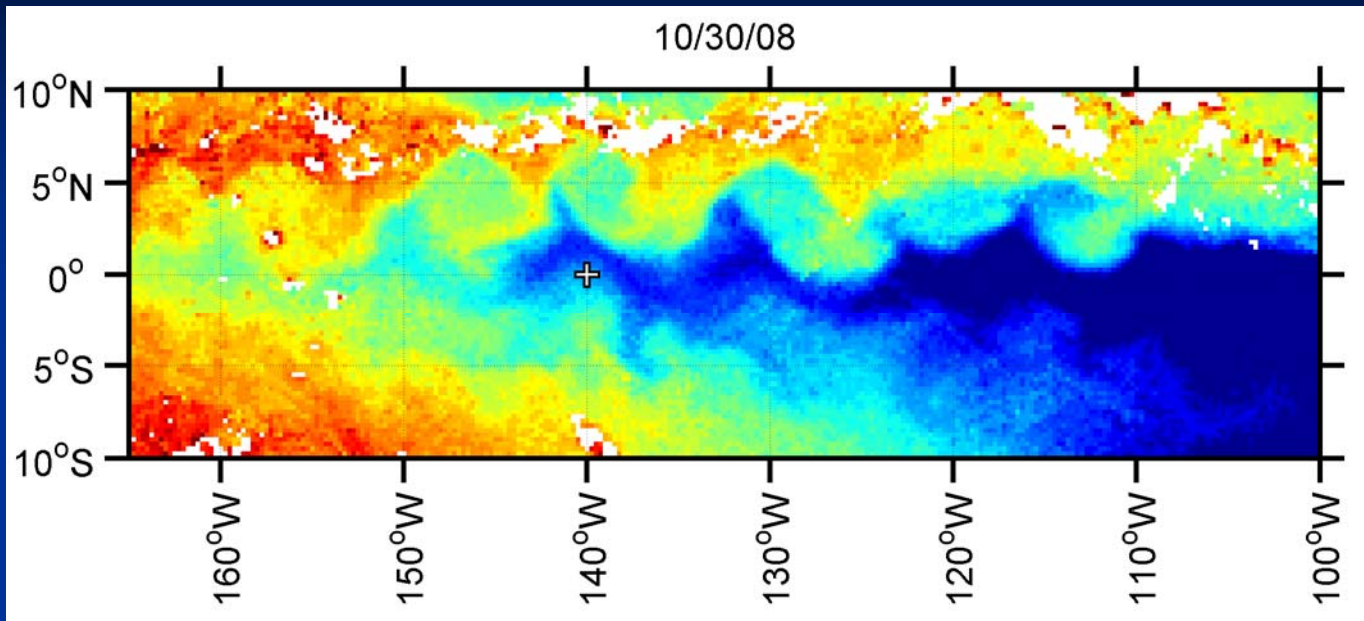
hints of *short time-scale, high-energy* events

or, not?

this is what we've been looking for !



24 October – 09 November 2008



multiple high-res modern *ADCPs*

sampled rapidly

Hull 300 kHz

75 kHz

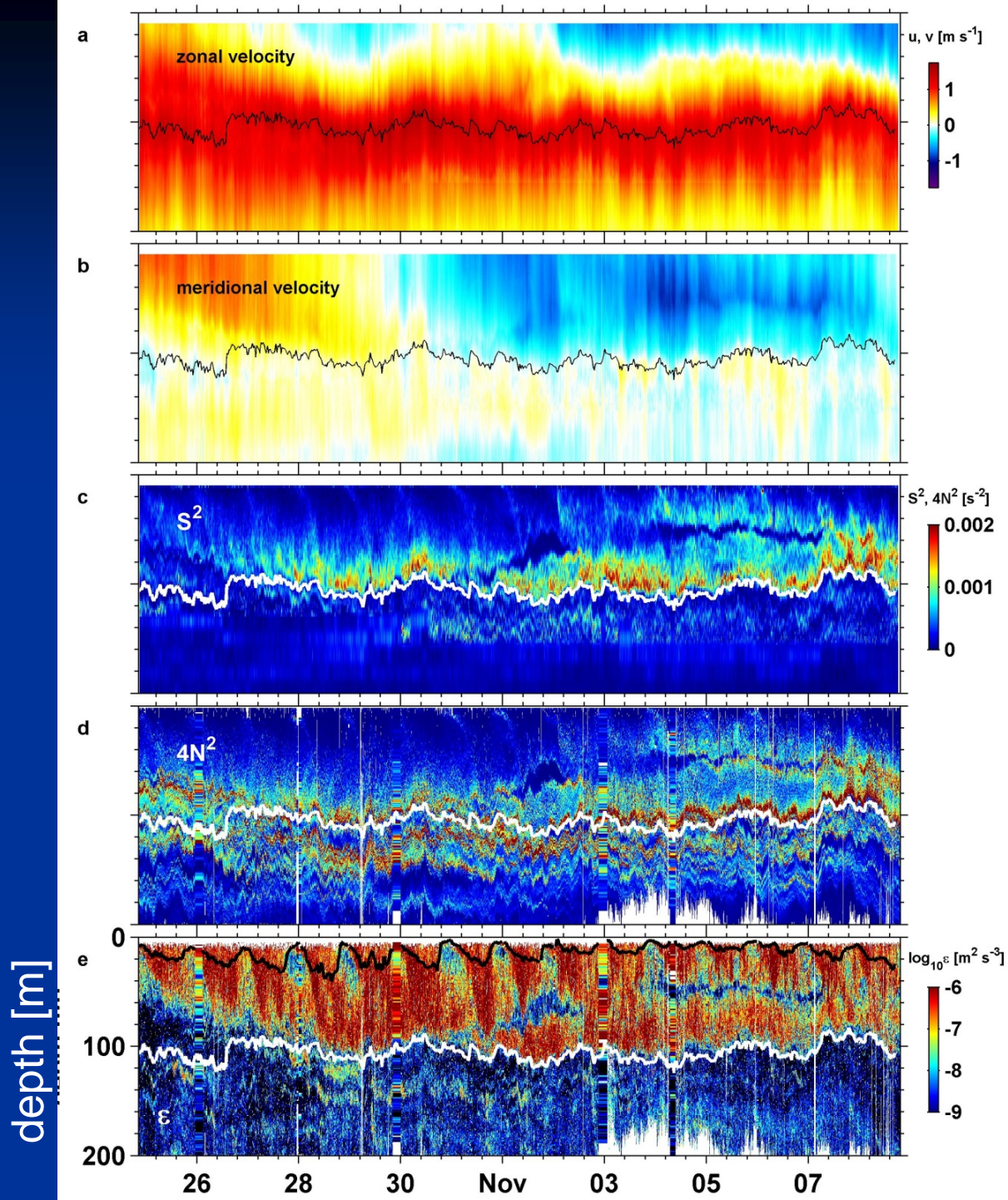
Over-the-side

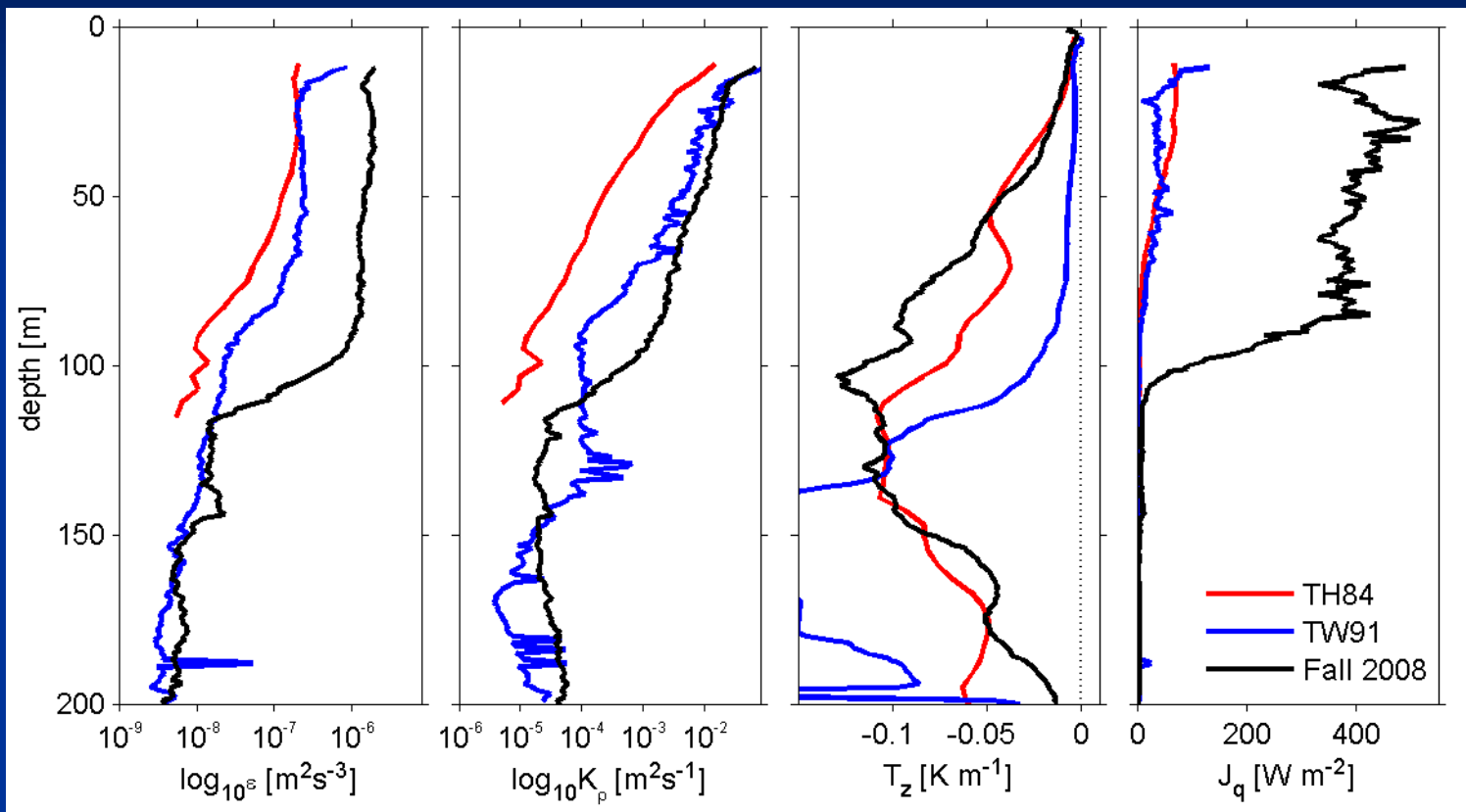
150 kHz

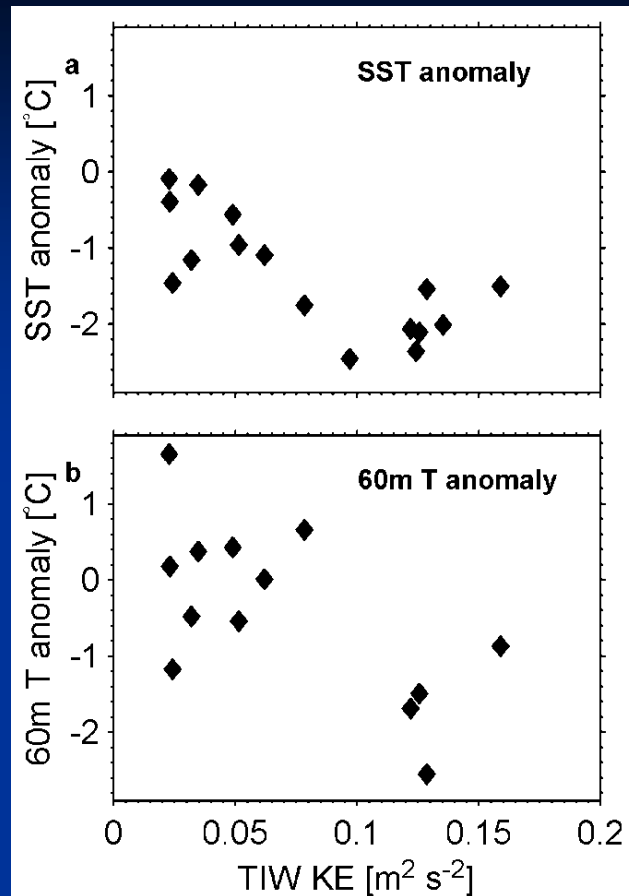


Chameleon turbulence profiler









Does TIW-induced mixing create the equatorial cold tongue?

Results

- *survivability*
 - mechanical damage a problem, not growth
 - redundancy / protection necessary
- *motion*
 - vane works
 - measurement necessary (3-axis linear accelerometers)
- *consistent with historical observations*
 - quantitatively
 - variability – daily IGW / turbulence cycle
- *unexpectedly large / short time scale mixing events*
must be reconciled in our long term accounting

Moored Mixing Measurements

χpod

scientific objectives

- quantify turbulence heating rates
- improved perception of IGW/turbulence interactions leading to mixing
- can parameterizations be improved?

to accomplish this

- maintain long-term presence (multiple *ENSO* cycles)
- extend to multiple locations along/across equator

Fall 2008

(0, 140W)

profiling experiment

high-res mooring (Lien/Gregg)

supplemented by 10 *χpod*s



Moored Mixing Measurements

to accomplish this

- supplement with ***intensive profiling experiments*** as we try to define the scope and importance of the large mixing events that may control the cold tongue