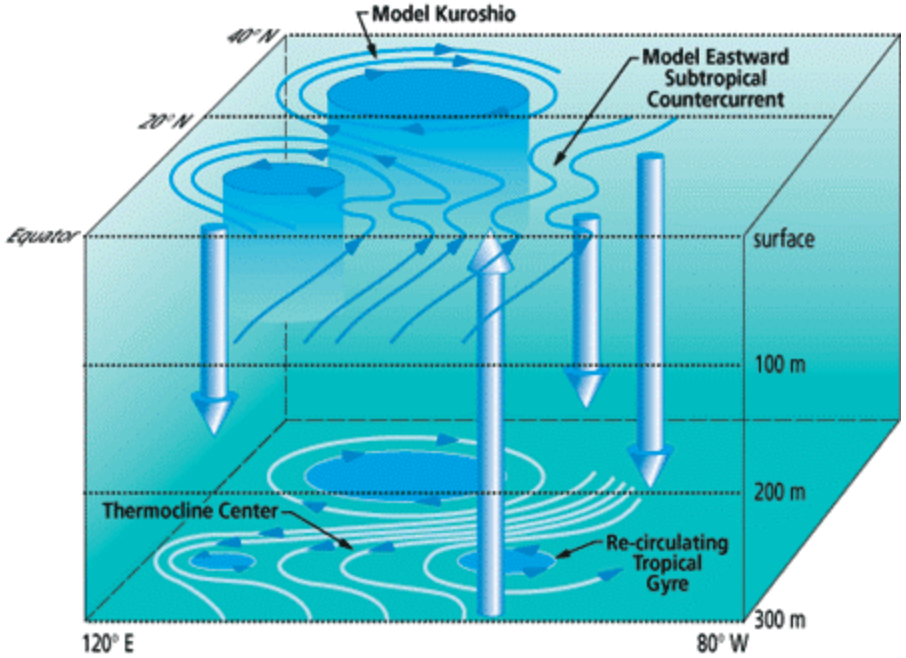
Subtropical - Tropical Pathways: *A personal view*

Meghan Cronin

NOAA Pacific Marine Environmental Laboratory

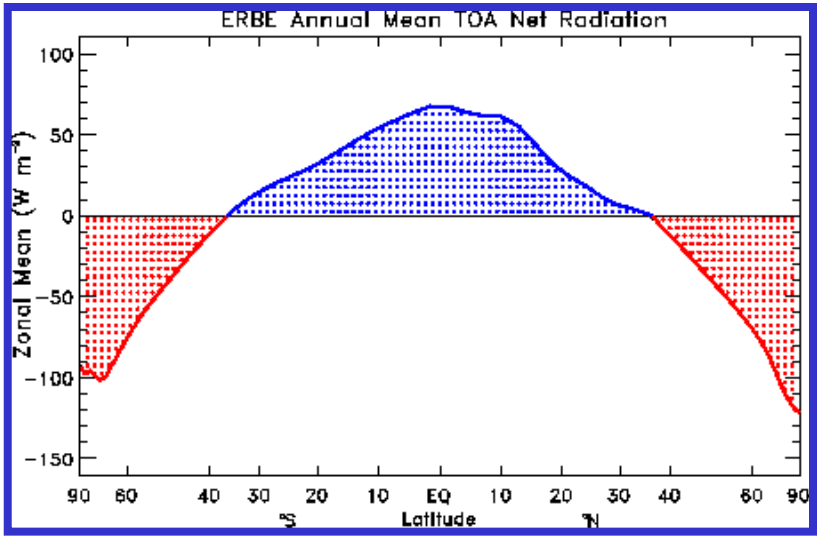
C&GC Fellow in 1993-95

(Host: Mike McPhaden at NOAA PMEL)



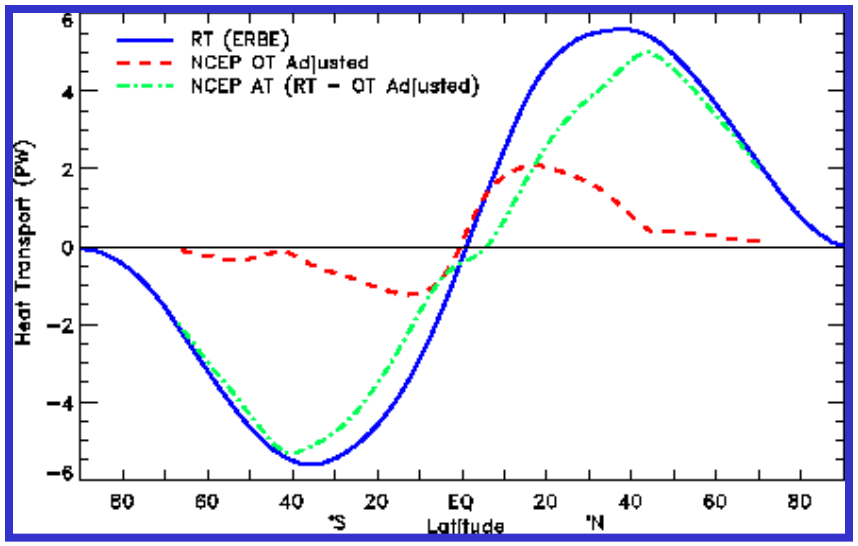
From: Rothstein and Chen (1996)

Net heat flux into top of atmosphere

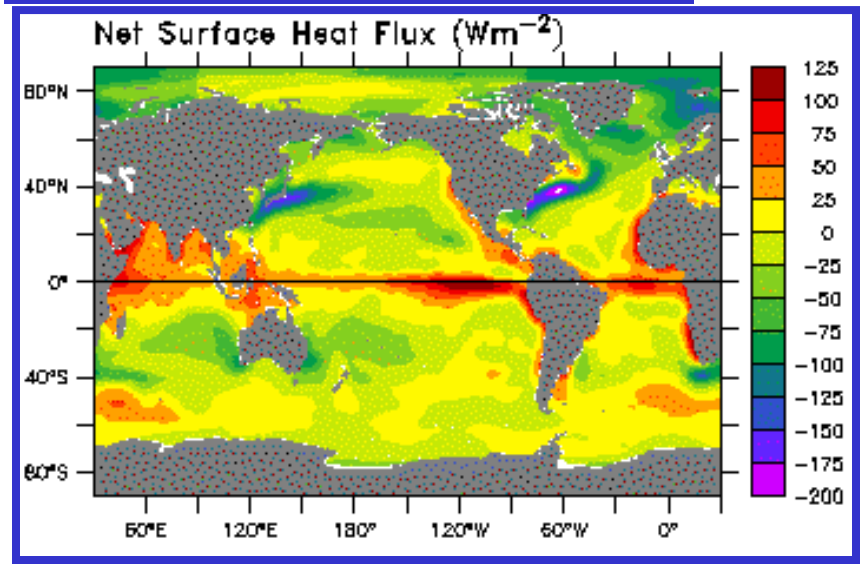


From: Trenberth and Caron (2001)

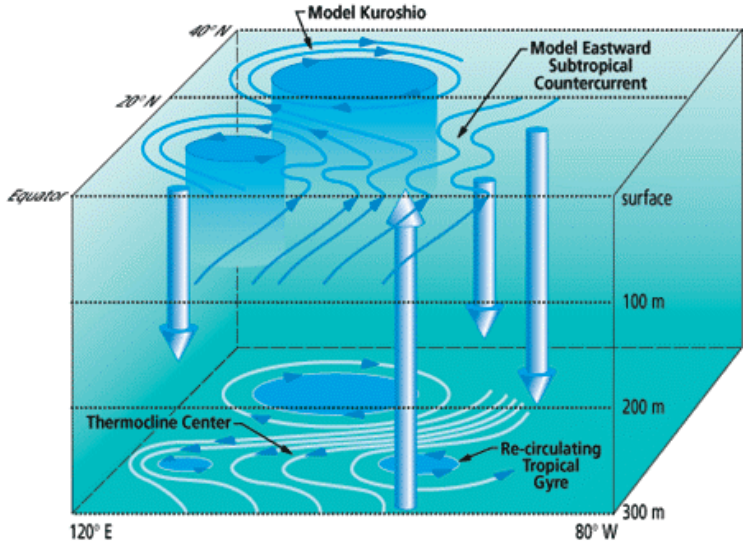
Latitudinal imbalance of heating at top of the ocean requires a net meridional transport of heat



Net heat flux into top of ocean



From: daSilva et al. (1994)



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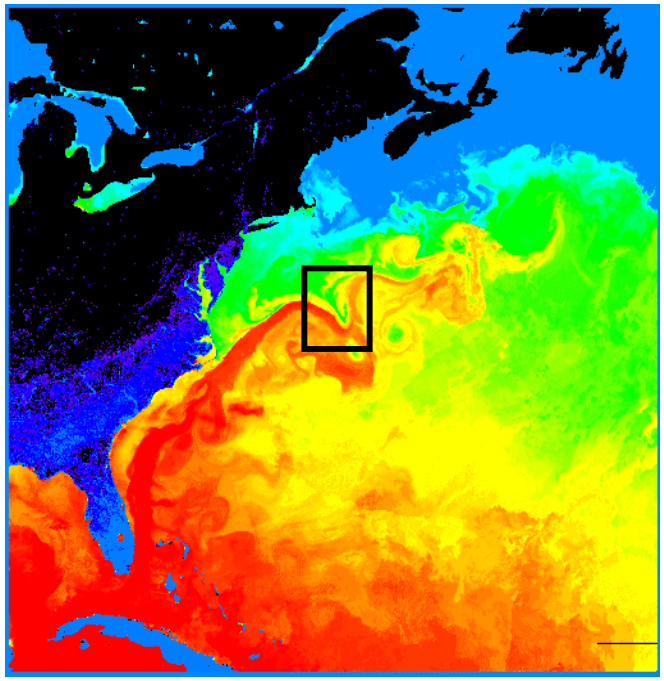
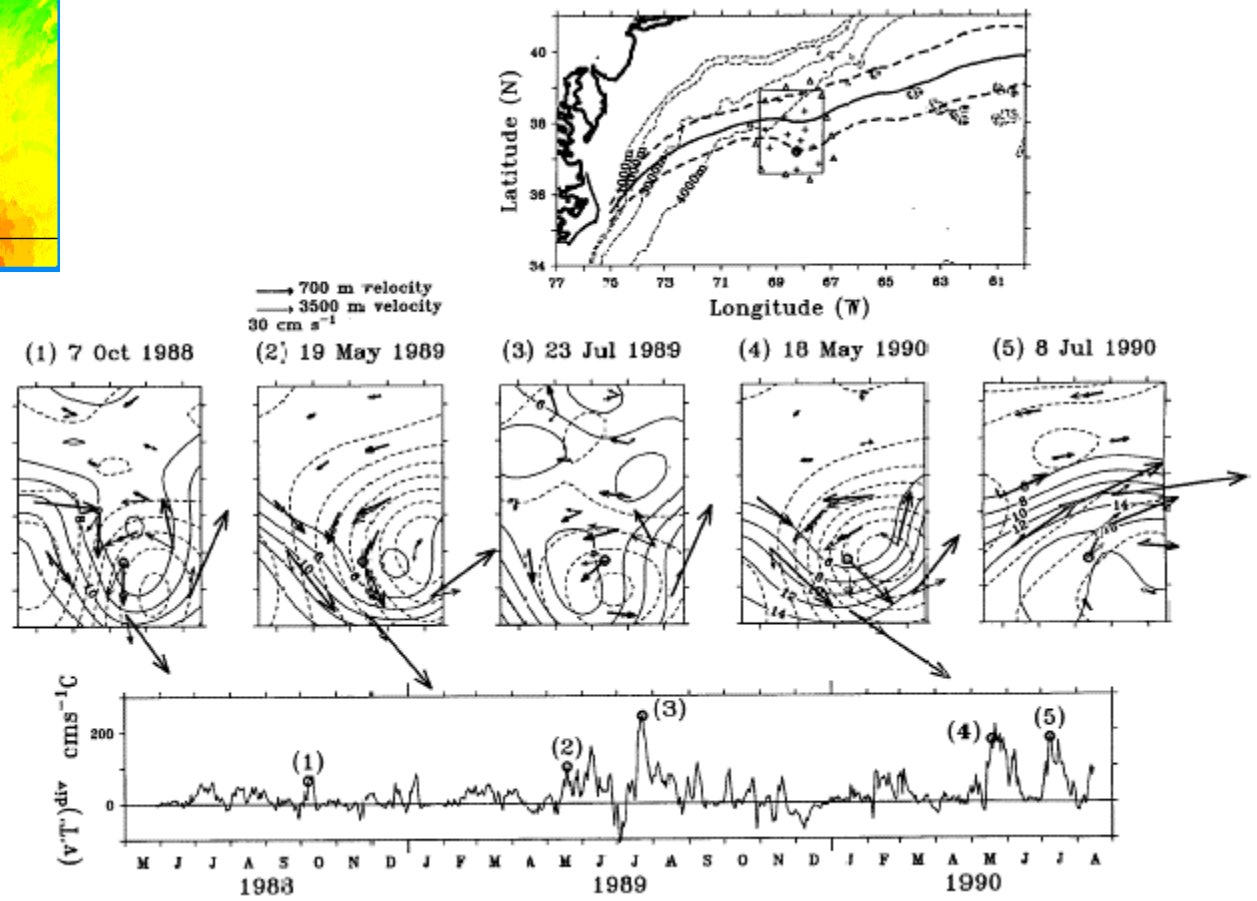


Pre-C&GC: Eddy-mean flow interaction in the Gulf Stream

How are eddies formed? How do the feedback onto steady-state?

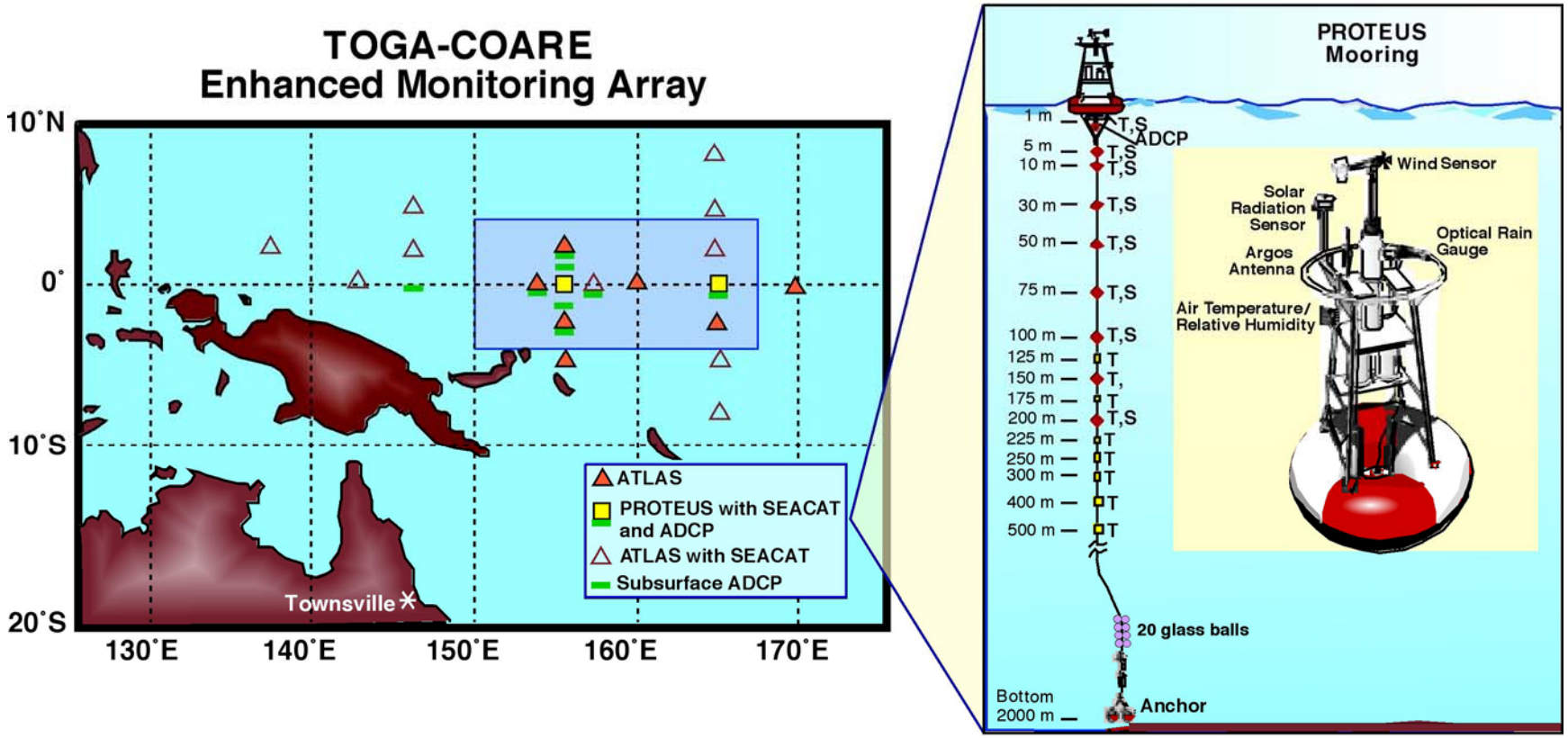
Meander life cycle similar to mid-latitude storms

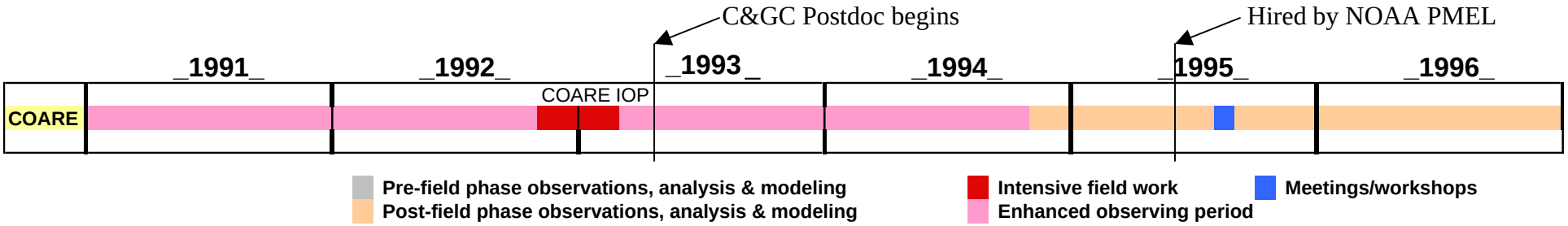
Heat is transported across front by eddies



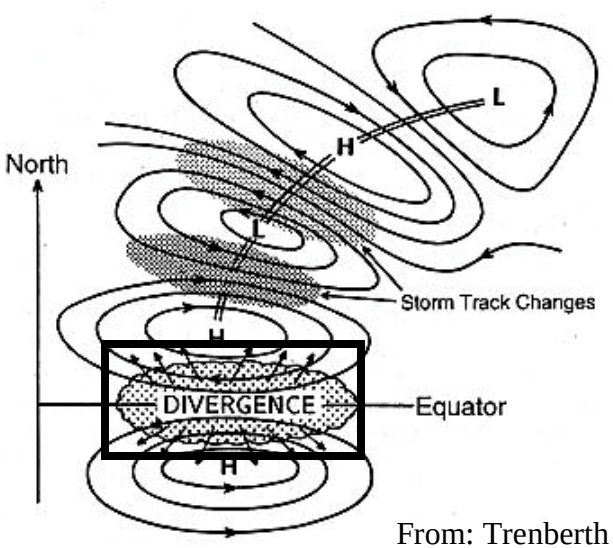
From: Cronin and Watts (1996)

C&GC Project: Coupled Ocean Atmosphere Response Experiment (host: M. McPhaden at NOAA PMEL)

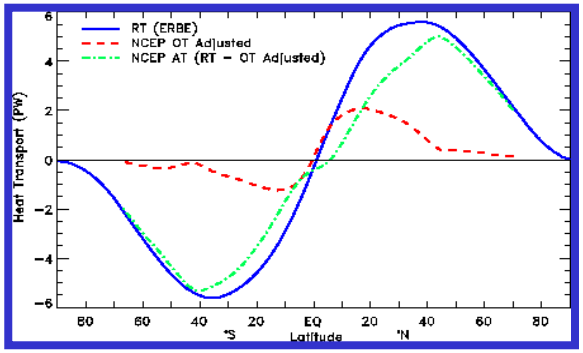




Surface heating at equator can generate wave train in atmosphere and teleconnections to mid-latidude

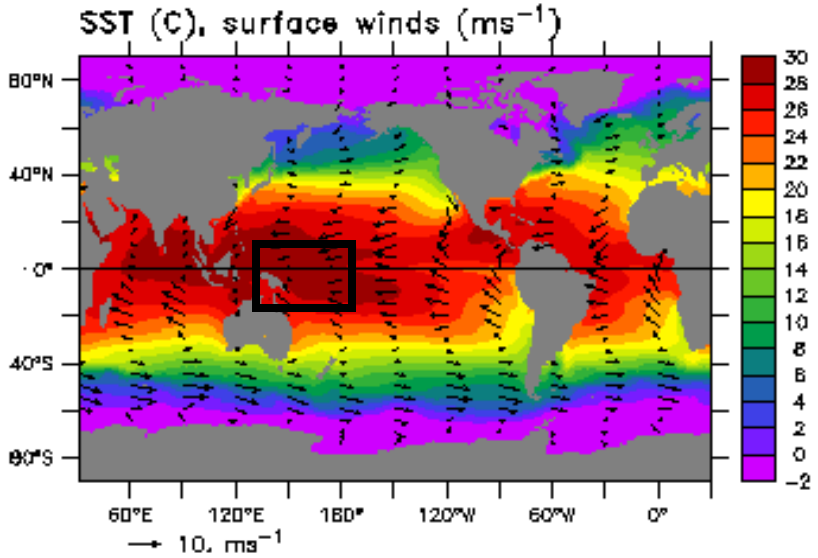


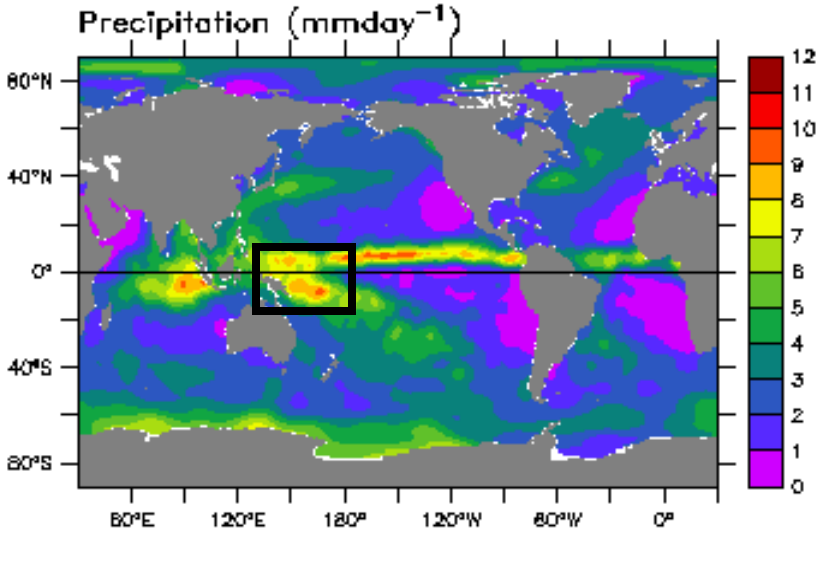
From: Trenberth et al. (1998)



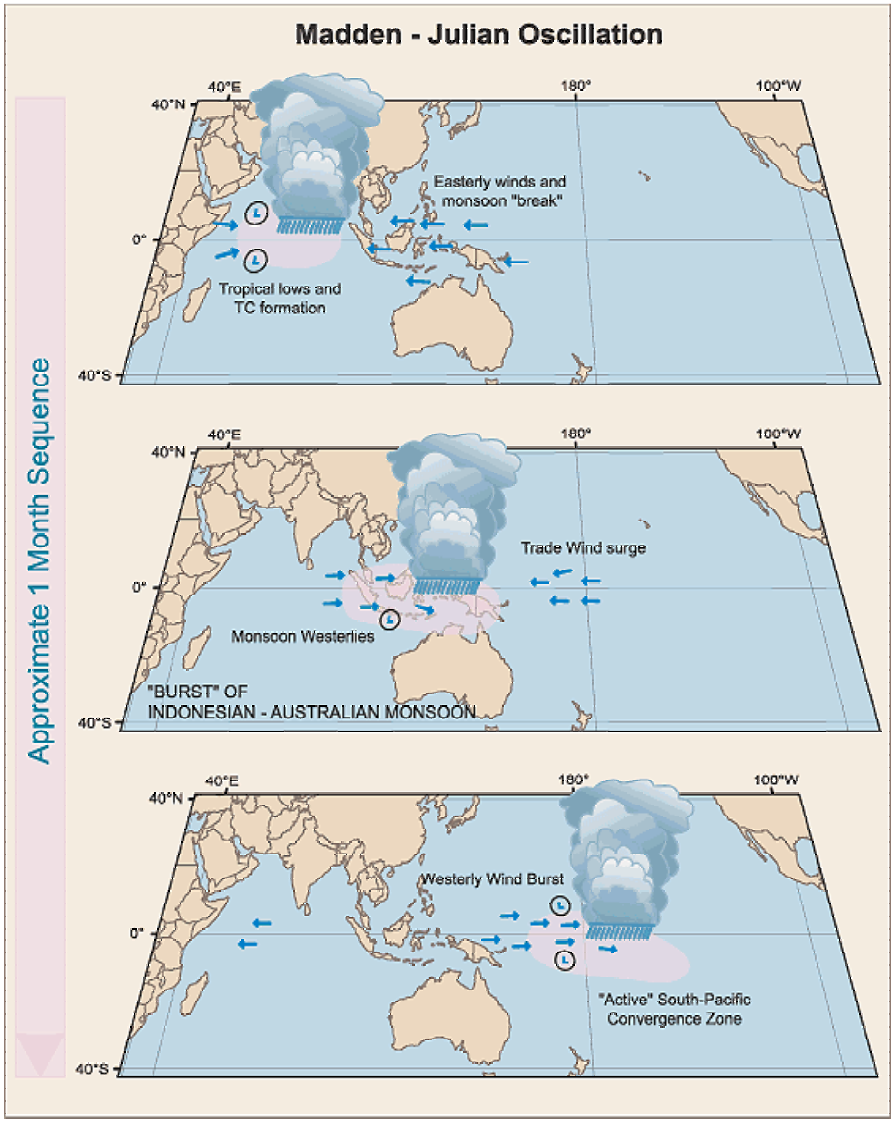
From: Trenberth and Caron (2001)

Predictability can be gained by understanding the coupling of the atmosphere and ocean in the tropics.

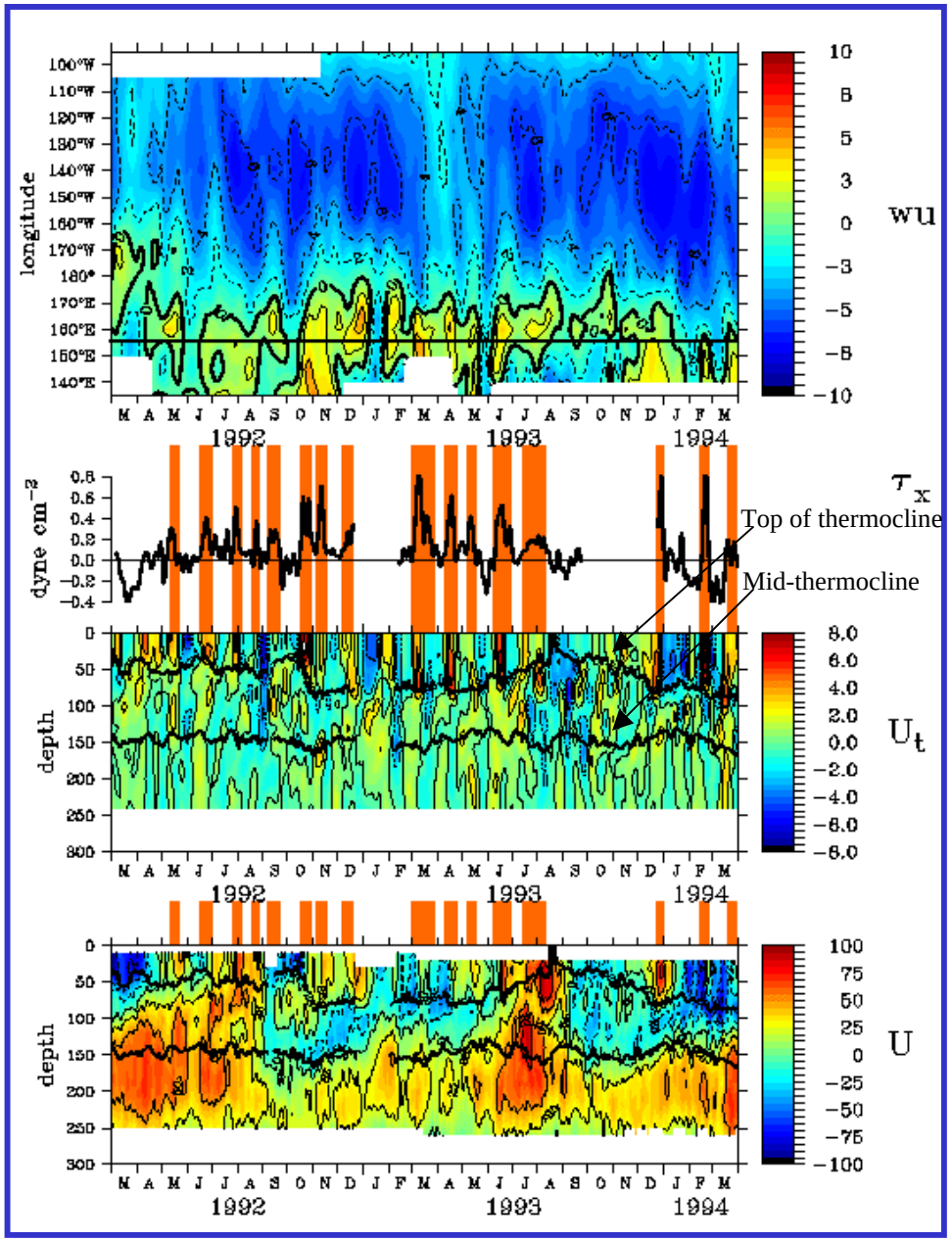




Ocean responds to Westerly Wind Bursts by accelerating eastward …



Courtesy: Wheeler



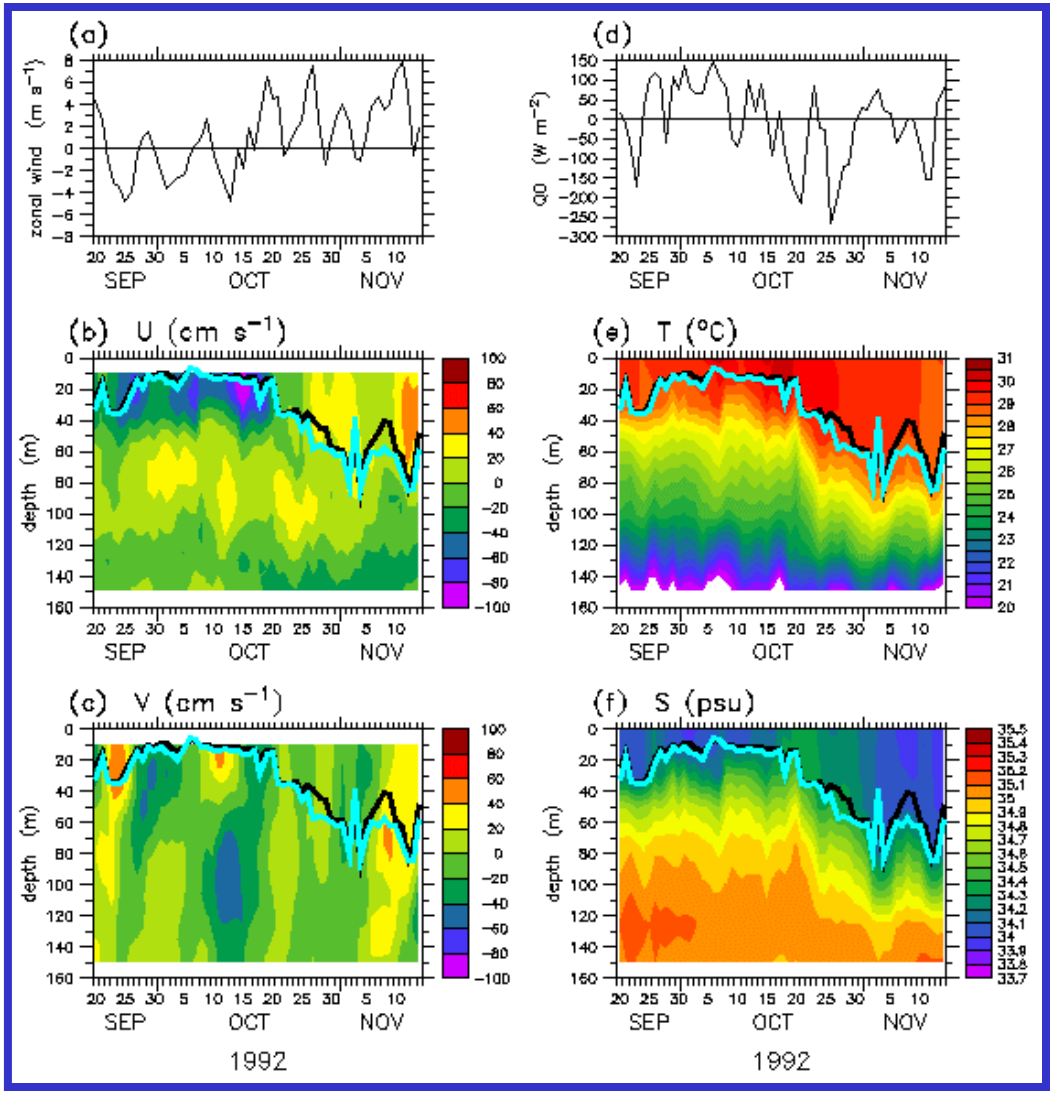
After: Cronin et al. (2000)

Ocean response to WWB:

* Eastward wind jet
* Subsurface counter jet “reversing jet” balanced by pressure gradient
* Kelvin Wave, Rossby Wave,…
* Net surface heat loss & rainfall
* SST cooling & SSS freshening
* Meridional convergence onto equator
* Mixed layer deepening
* (Salinity stratified barrier layer)

Excess heat in Warm Pool is carried away by eddy advection associated with WWB u’T’

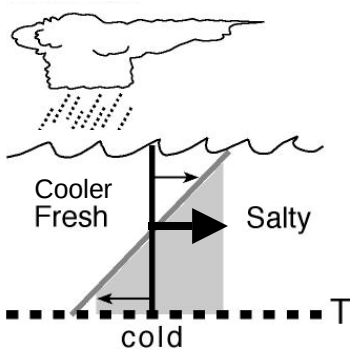
October 1992 WWB at 0 156E



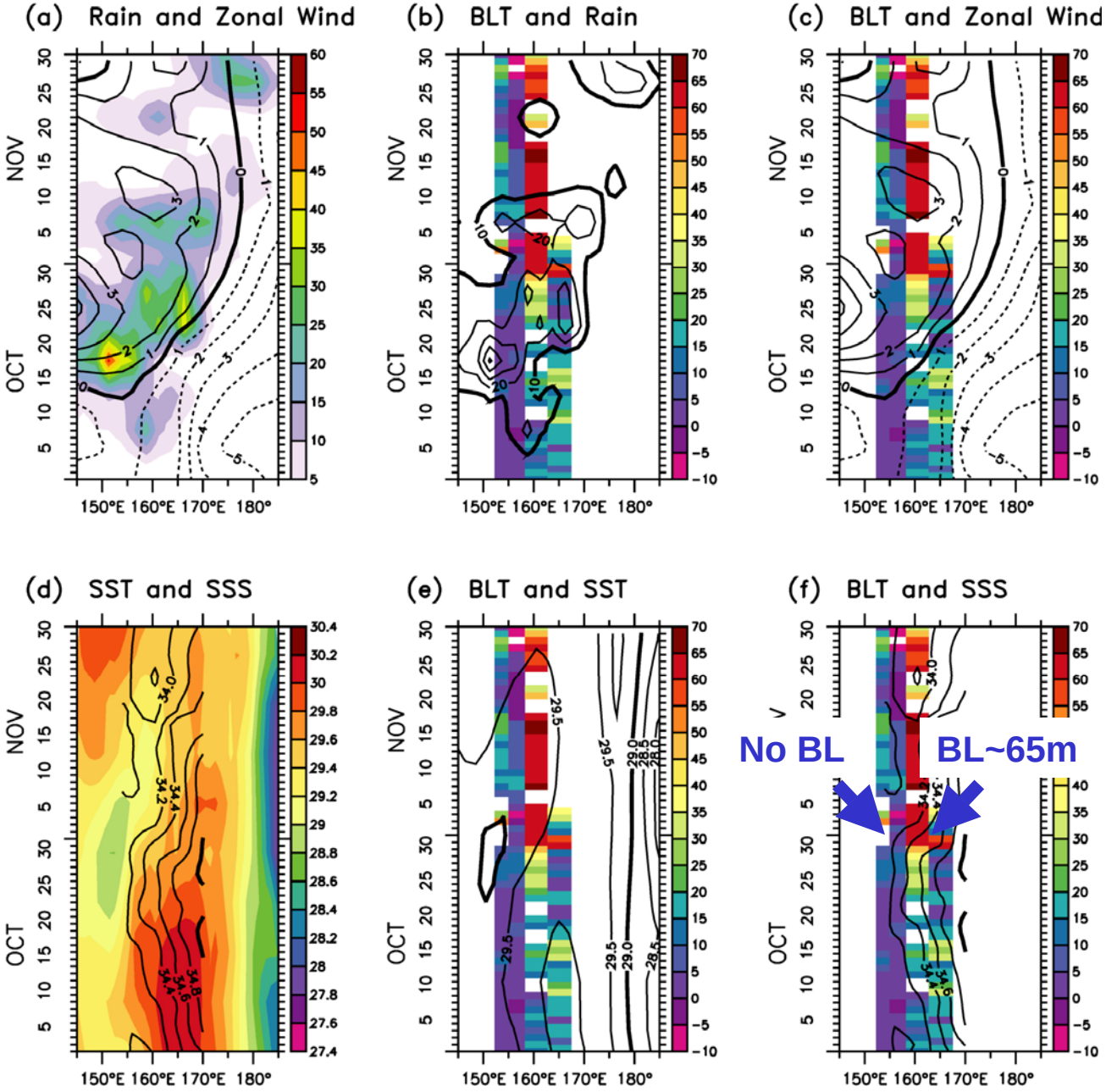
After: Cronin and McPhaden (2002)

Westerly Wind Bursts can lead to salinity stratified barrier layer through "tilting" of S_x into S_z

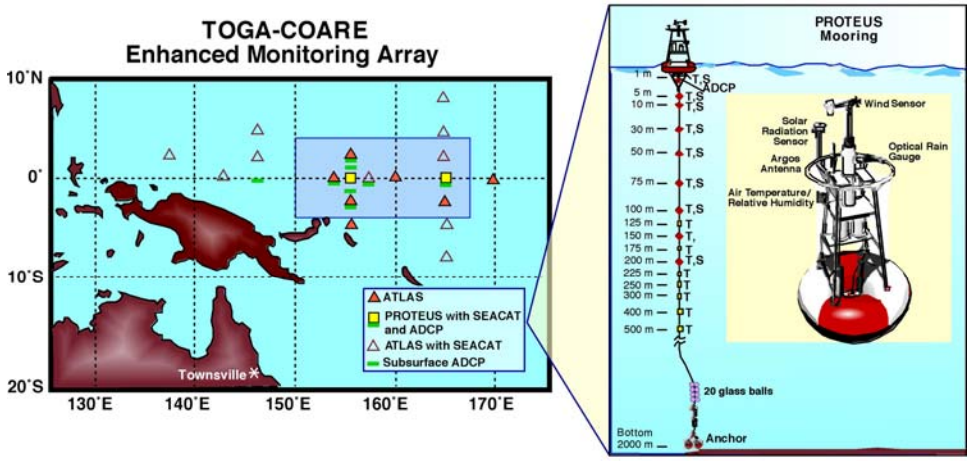
Need background S_x



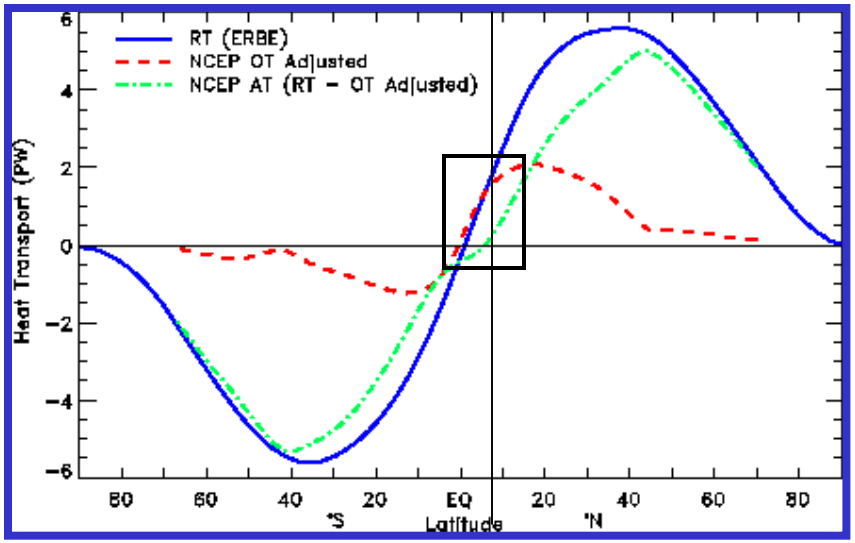
From: Cronin and McPhaden (2002)



Proven technology…

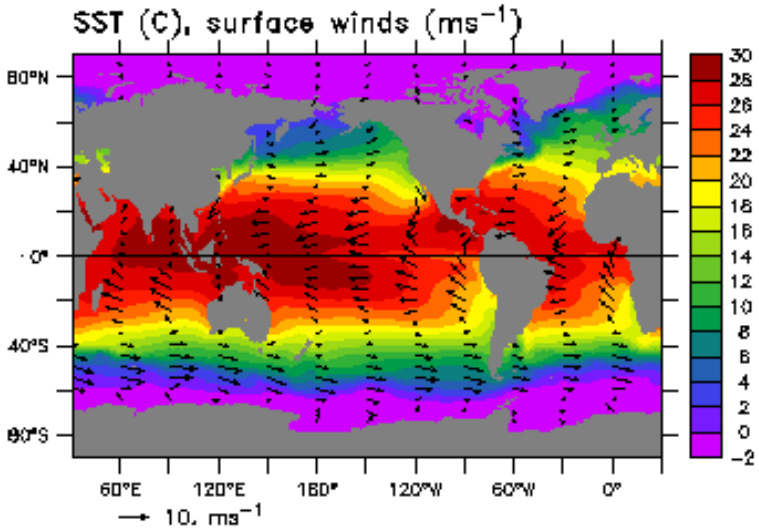


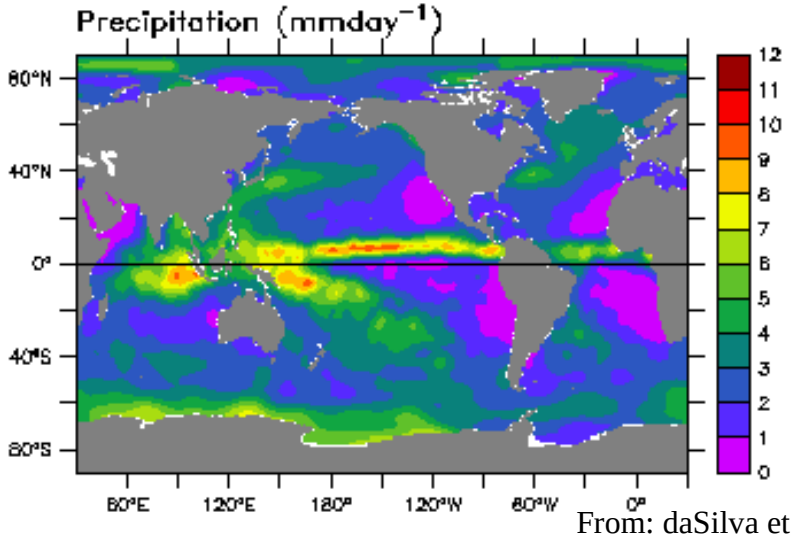
Atmospheric transport is 0 at ITCZ



From: Trenberth and Caron (2001)

Why is ITCZ and thermal equator north of equator?



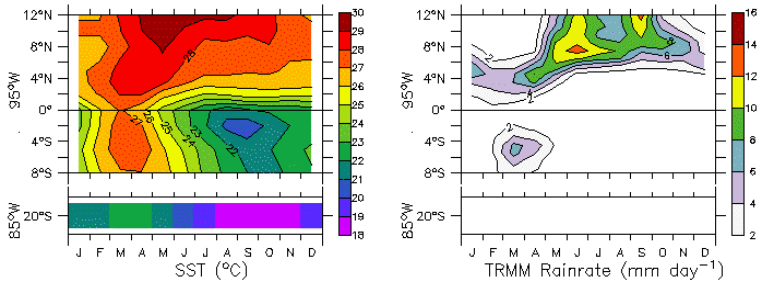


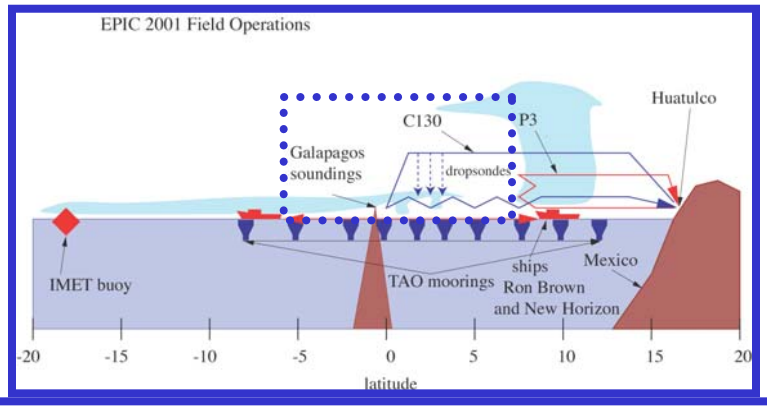
From: daSilva et al. (1994)

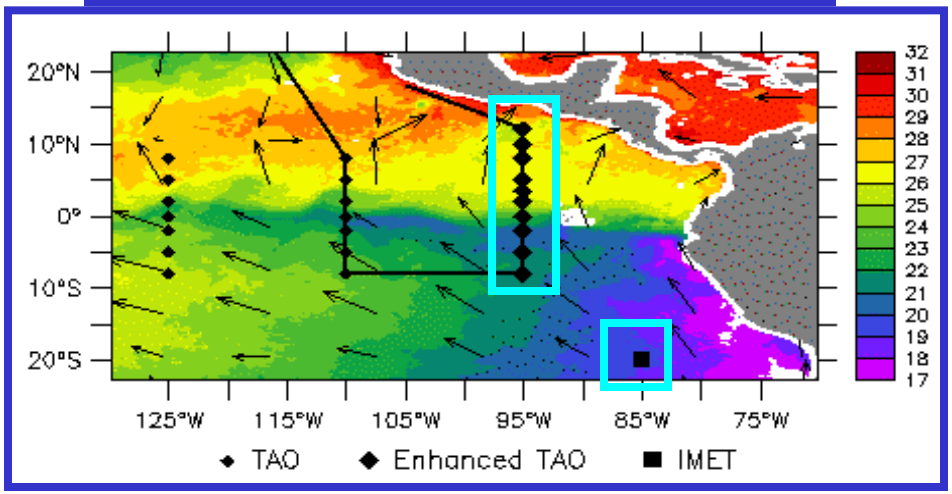
ITCZ

cold tongue

stratus deck

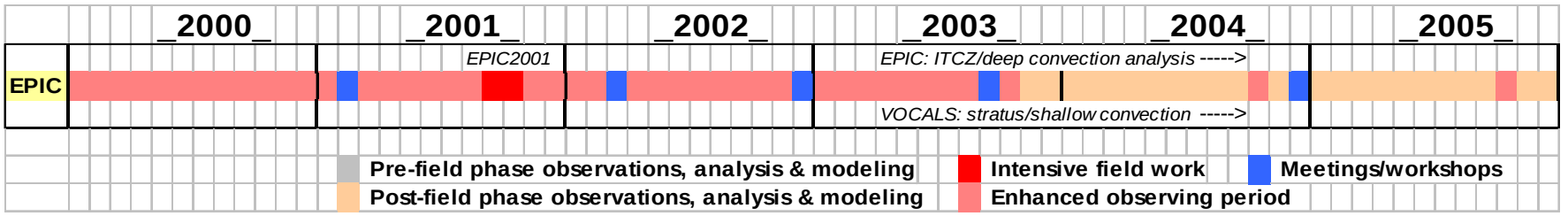






Eastern Pacific Investigation of Climate (EPIC) experiment

10 EPIC enhanced TAO buoys along 95W (PI: Cronin & co-PI: McPhaden)

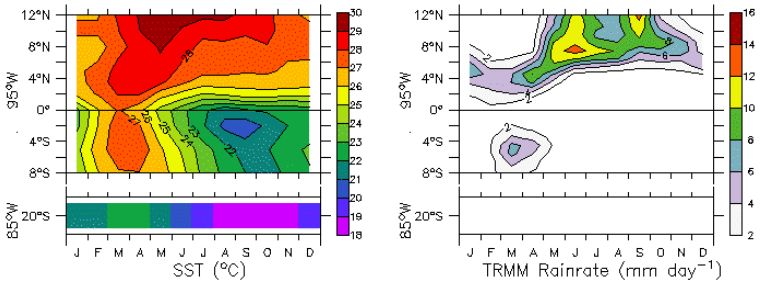


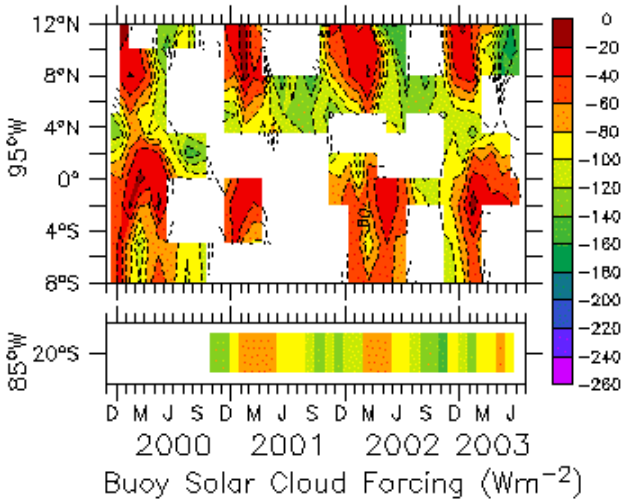
How much sunlight is blocked by clouds? *(How large is solar cloud forcing?)*

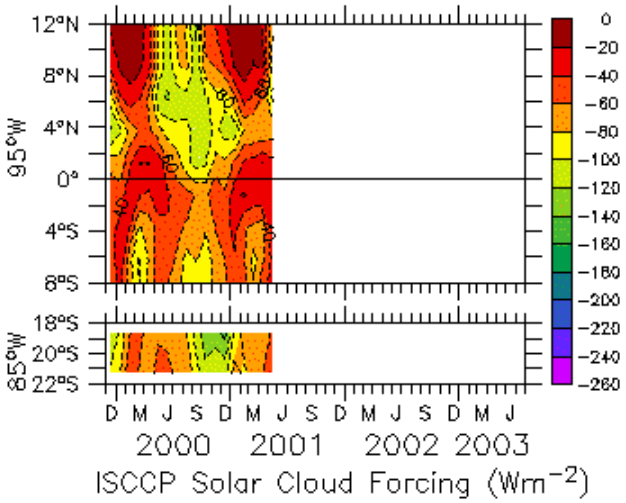
ITCZ

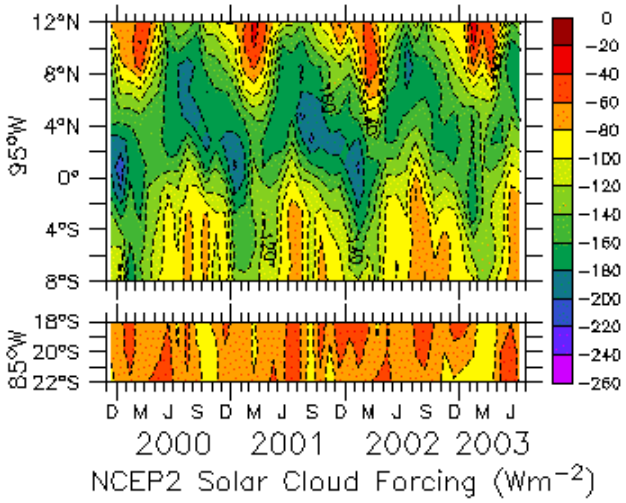
cold tongue

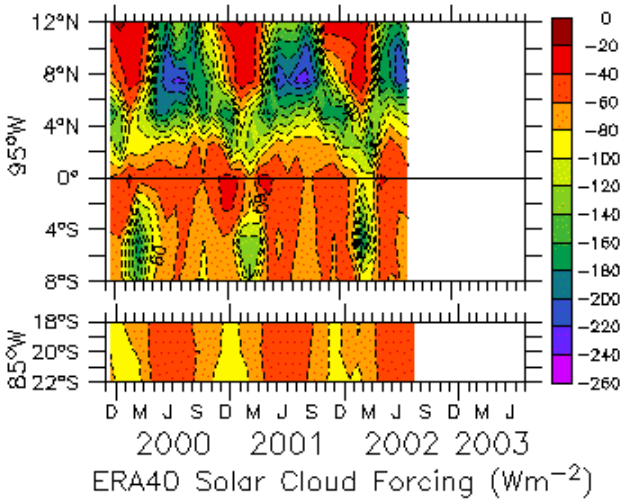
stratus deck











- **Buoys suffered losses due to fishing related vandalism.**
- **Are these all supposed to be the same? Yes!**

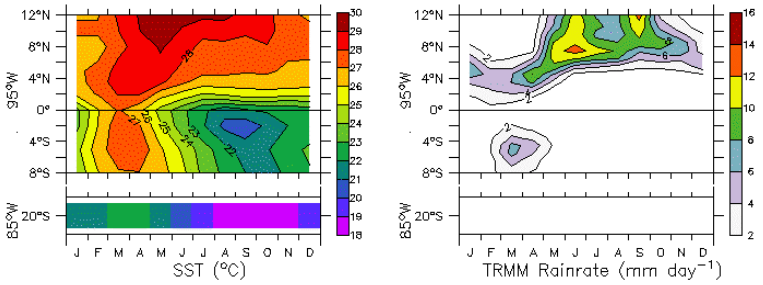
From: Cronin et al. (2005)

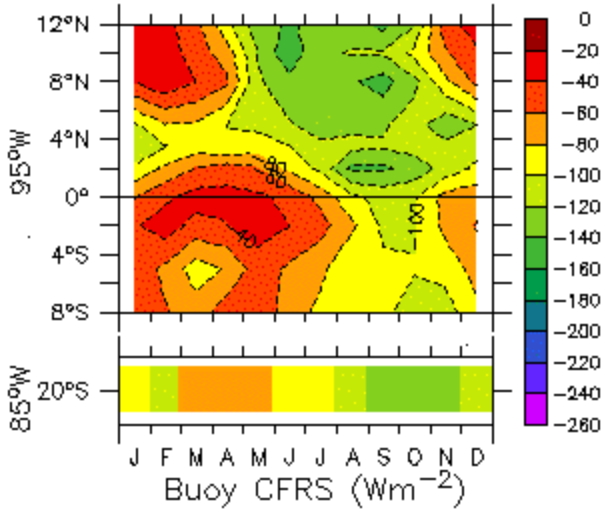
Solar Cloud Forcing is reduction in surface radiation caused by clouds

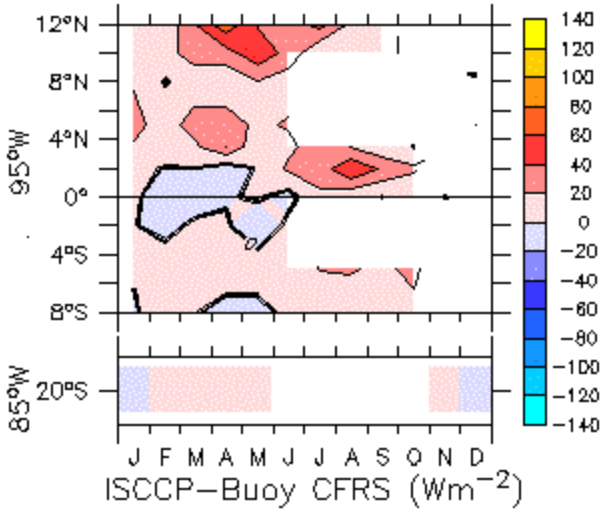
ITCZ

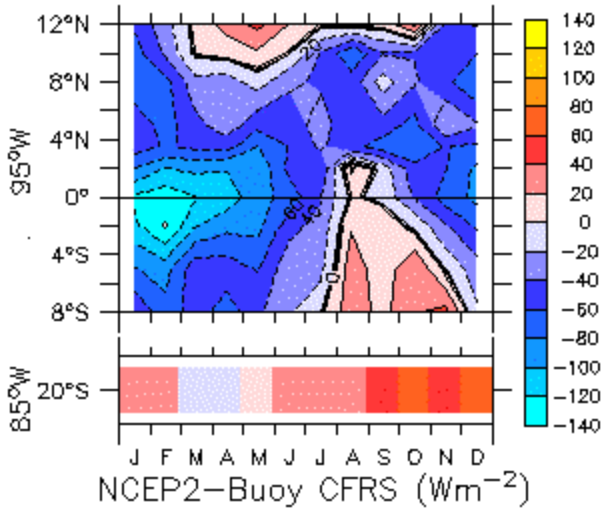
cold tongue

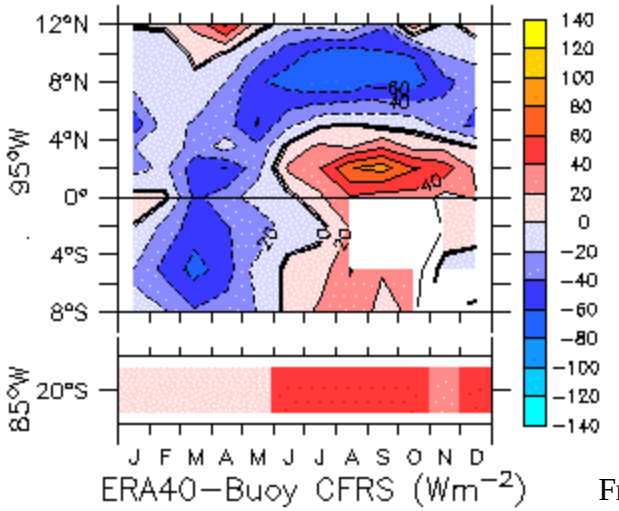
stratus deck







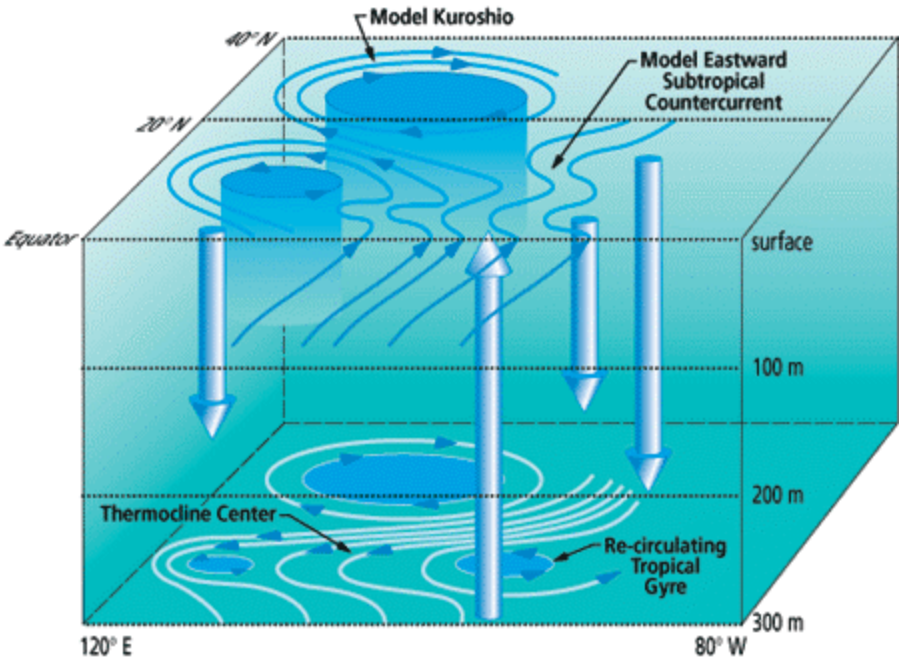


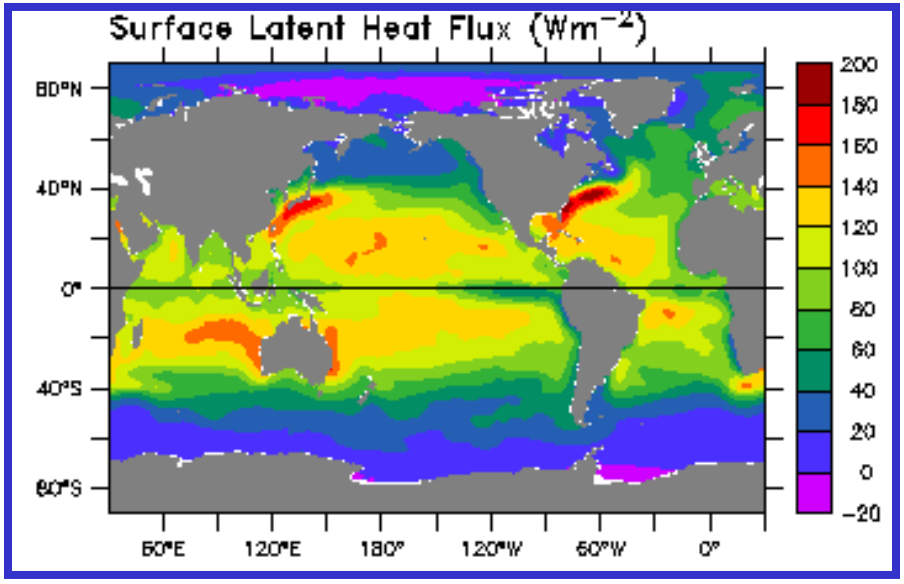


- **East Pacific clouds have an annual cycle.**
- **NCEP2 clouds block too much SWR over the cold tongue. This would produce a cold SST bias.**
- **Both NCEP2 and ERA40 have too little reduction in SWR in the stratus region. This would produce a warm SST bias.**

From: Cronin et al. (2005)

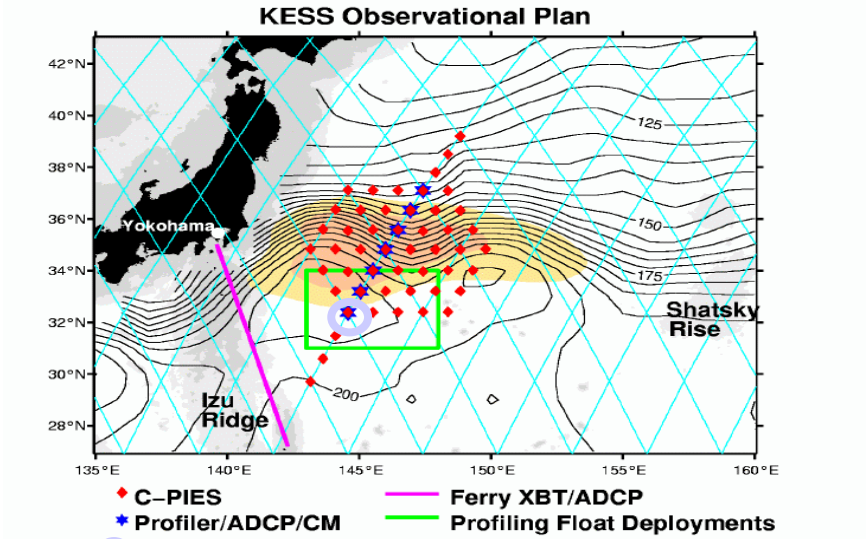
Have buoy…
can travel…



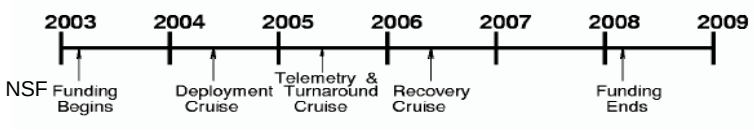


Can variations in the Kuroshio Extension affect overlying atmosphere? Winds? Storm development? Storm track?

How is the large net heat loss maintained by Kuroshio?

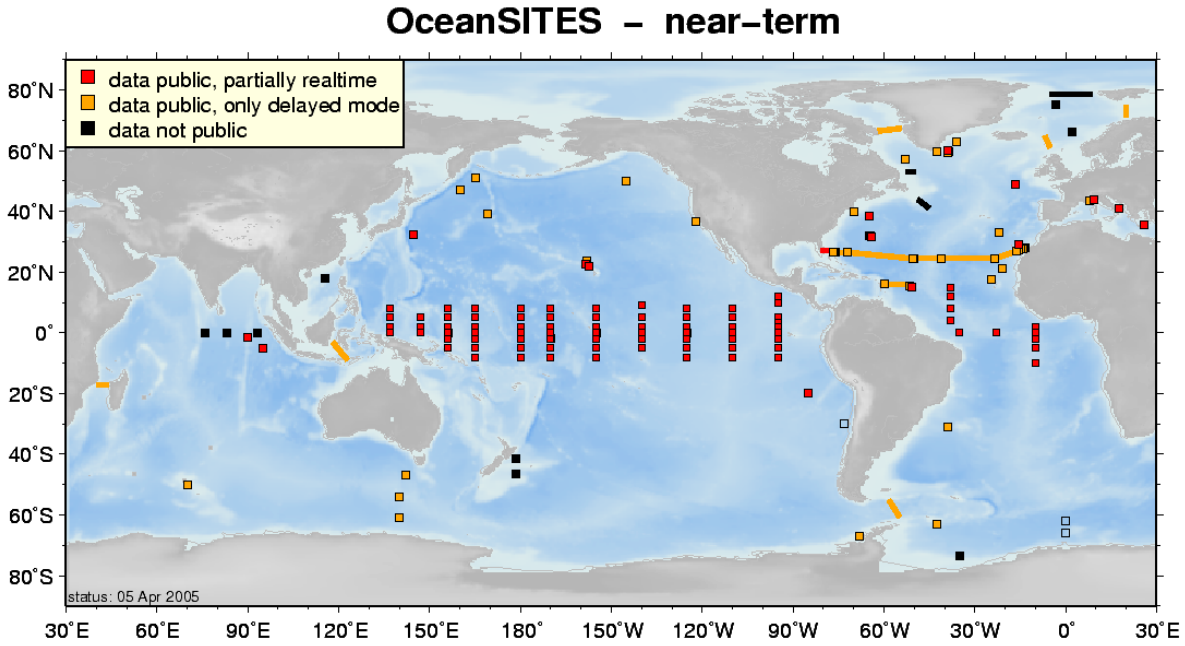


KESS Timeline



Kuroshio Extension System Study (KESS) is a 2-year process study funded by NSF (started June 2004)

Kuroshio Extension Observatory (KEO) is one of NOAA's most recent contributions to the global network of OceanSITES time series reference sites.



Kuroshio Extension Observatory (KEO) – Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://www.pmel.noaa.gov/keo/

Getting Started Latest Headlines

National Oceanic and Atmospheric Administration / Pacific Marine Environmental Laboratory

Kuroshio Extension Observatory (KEO)

a contribution to the global network of time series reference sites

As a contribution to the global network of OceanSITES time series reference sites, in June 2004, a surface buoy was deployed in the Kuroshio Extension recirculation gyre, at 144.5°E, 32.3°N. The buoy carries a suite of sensors to monitor heat, moisture and momentum fluxes, and upper ocean temperature and salinity. In June 2005, the buoy will carry air and sea surface pCO2 sensors to monitor the CO2 exchange between the atmosphere and ocean.

The KEO buoy

Lead: Dr. Meghan Cronin NOAA / PMEL
Lead Engineer: Mr. Christian Meinig NOAA / PMEL
Lead Carbon Scientist: Dr. Christopher Sabine NOAA / PMEL

The KEO time series reference site is sponsored by the National Oceanic and Atmospheric Administration (NOAA) Office of Climate Observations (OCO).

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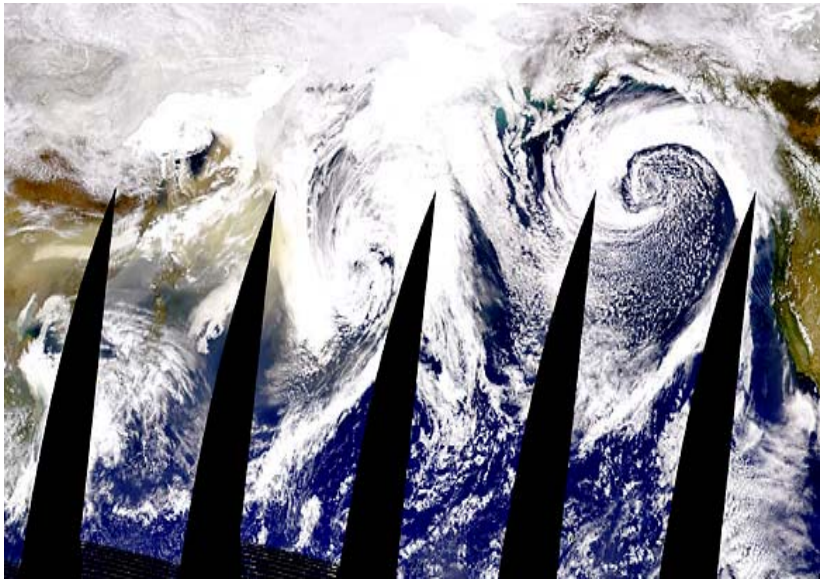
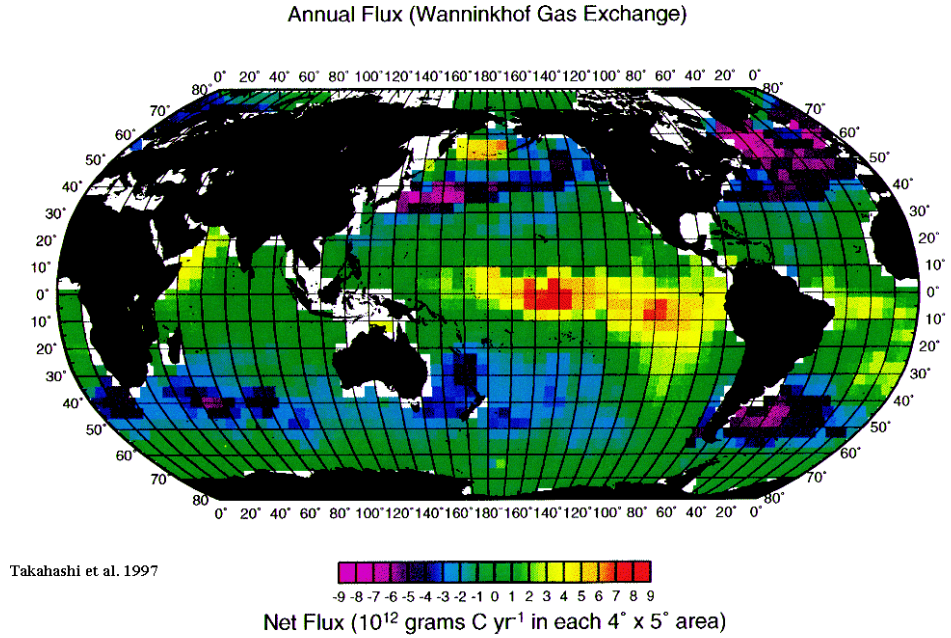
Asian dust storms are rich in iron and other micro-nutrients



How do dust clouds affect the ocean biological pump and carbon cycle?

The largest sink of carbon in the North Pacific is in the Kuroshio Extension



…and the largest source is in the equatorial cold tongue upwelling region. These source and sink regions are expressions of the subtropical meridional overturning cell.

Thanks
NOAA C&GC Postdoctoral Program
for setting me on this path !