New Objective FSU Winds and Fluxes

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The ‘New’ in ‘New FSU’

- Objective (i.e., fast)

- Surface turbulent fluxes (stress, latent heat, and sensible heat) and related fields (SST, air temperature, specific humidity) are also calculated.
  - Fluxes are internally consistent with the related fields
  - Currently using transfer coefficients from Smith (1980)
    - Will use the best from SEAFLUX evaluations
  - Similar approach can be used with satellite data

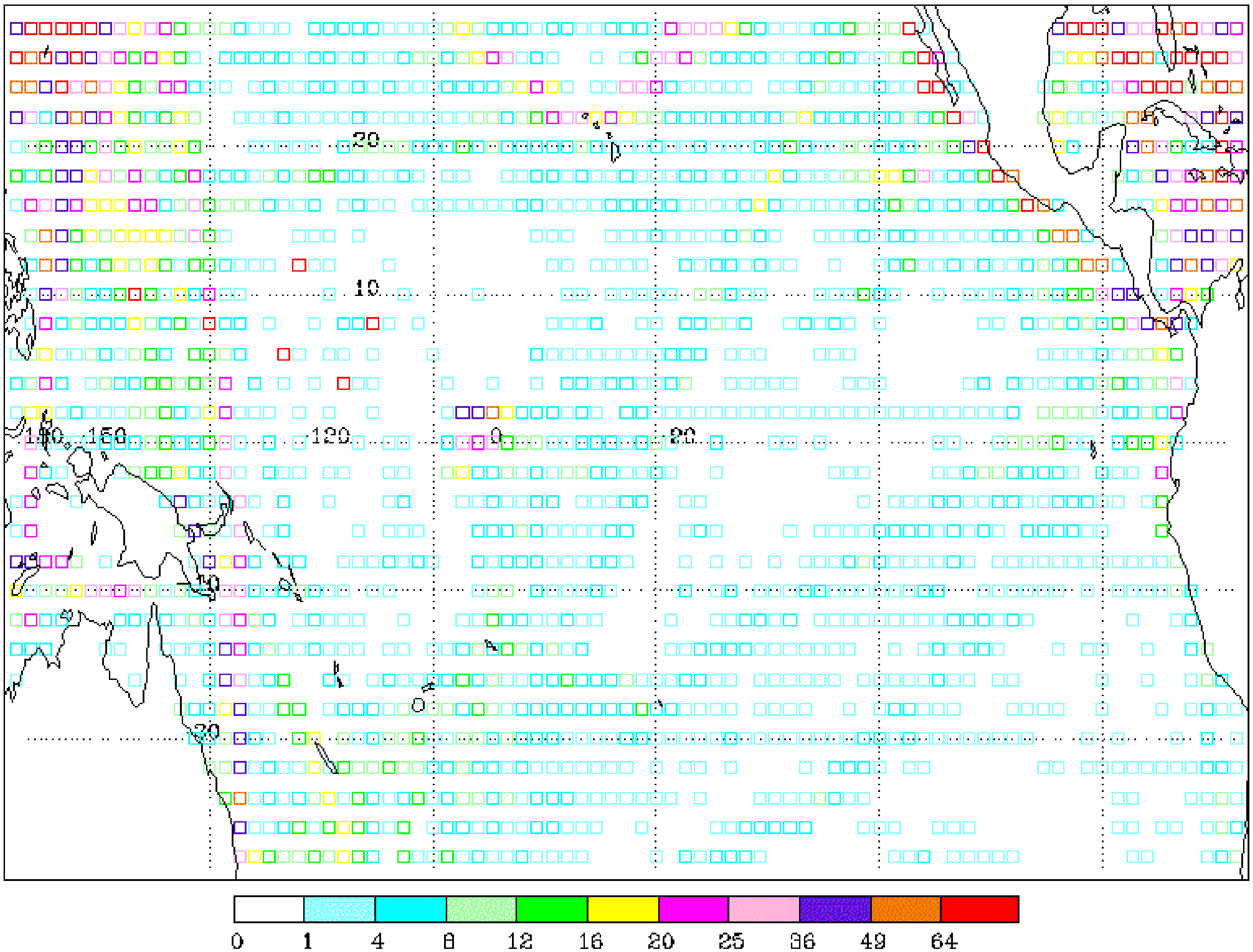
- Independently weights observations from different types of platforms
  - Platform classifications are currently either VOS or buoy
  - The weights for the platforms are determined objectively

Observational Coverage

- In-situ observations.
  - Buoys
    - Frequent in time (often hourly)
    - Very limited spatial coverage
  - Volunteer Observing Ships (VOS)
    - Sparse in time
    - Wider spatial coverage than buoys
    - Quality controlled observations date back to 1790s

- SeaWinds scatterometer has excellent coverage.
  - ~92% of the ice free oceans covered each day.
  - The daily number of SeaWinds observations is approximately equal to the annual number of ship and buoy observations that enter the GTS data stream.
  - Scatterometer (ERS-1) observations start in 1990s

Example VOS Observation Density (Aug. 1997)



Biases and Uncertainty

- Biases
  - Beaufort winds are adjusted with Lindau's correction.
  - Biases in VOS temperatures are removed following work of Liz Kent.

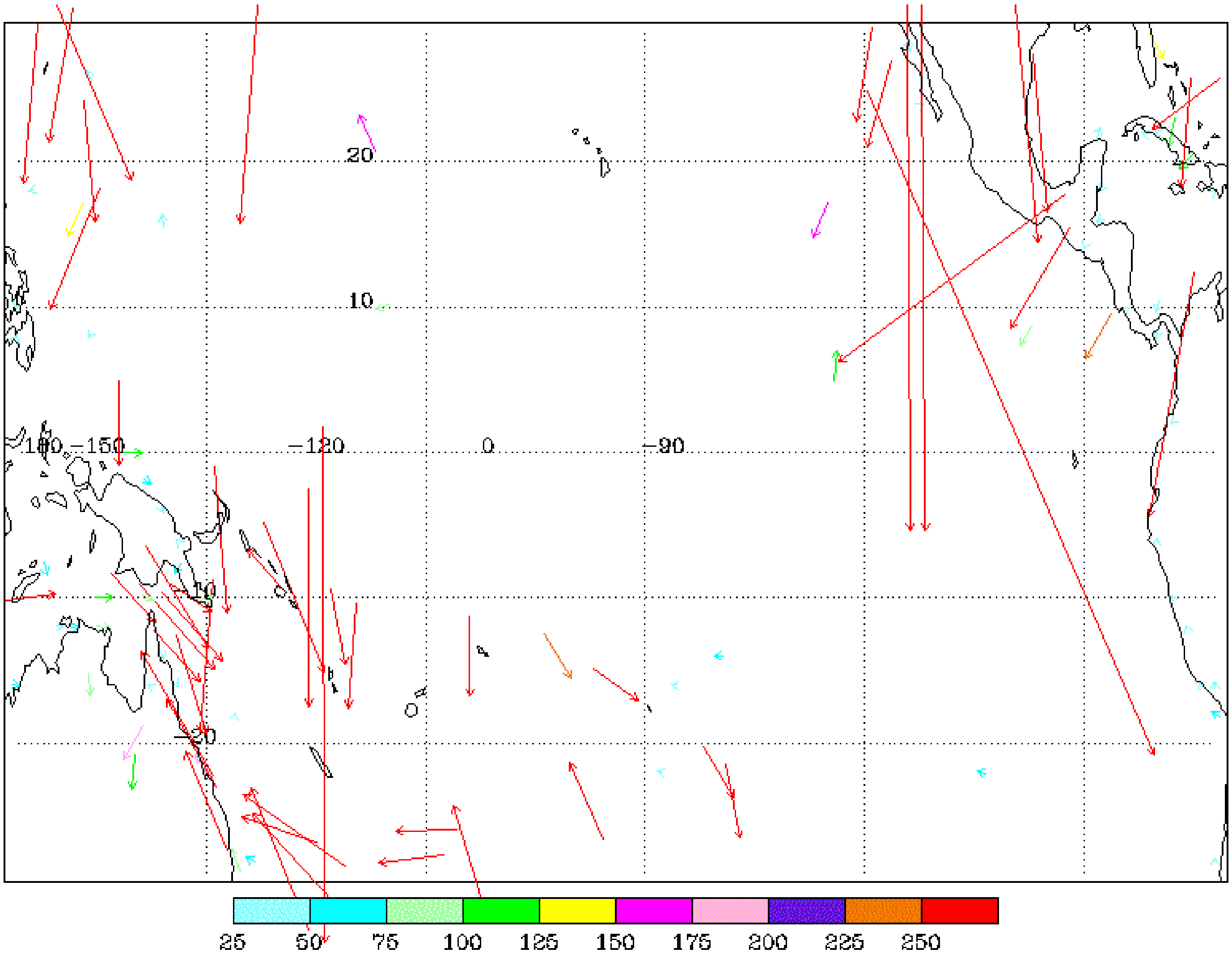
- Uncertainties in observational estimates (of monthly averages) include
  - Observational uncertainty (i.e., error in the observation)
  - Representiveness
    - Due to differences in location and time, and
    - Differences in sampling volume
  - Sampling error
    - How well are fluctuating fields sampled in time?

Quality Control on In Situ Data

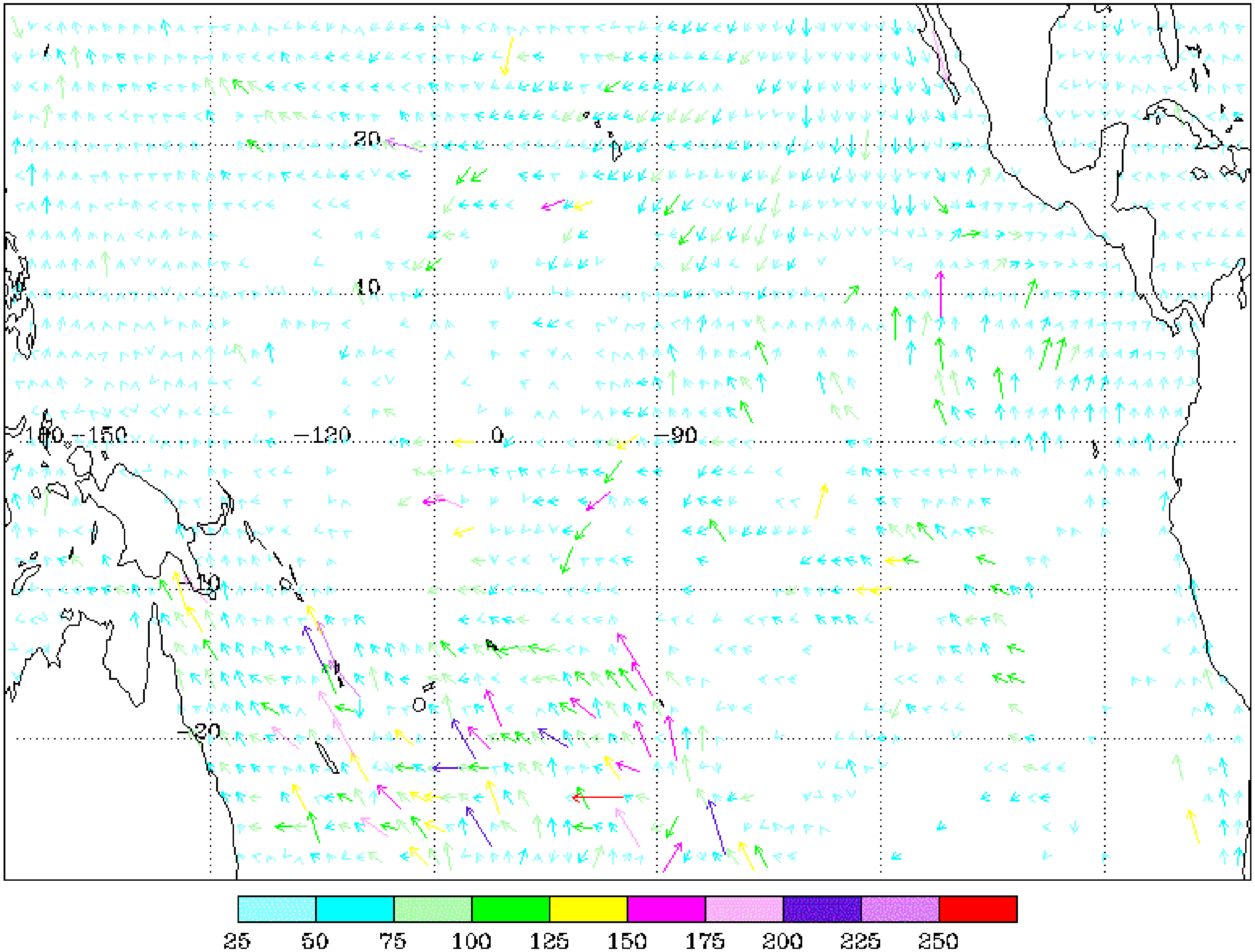
- In situ data, particularly VOS and drifting buoy data suffer from observational errors, incorrect geographical location, and errors in transmission

- Gross errors are removed in a two step process
  - Filtering in comparison to daSilva's monthly means and standard deviations in these means
    - A minimum standard deviation is defined for regions where poor sampling lead to little variability
    - Values >3.5 standard deviations from the mean are rejected
  - Deletion through a visual editor

Example Rejected VOS Data (Feb. 1999)



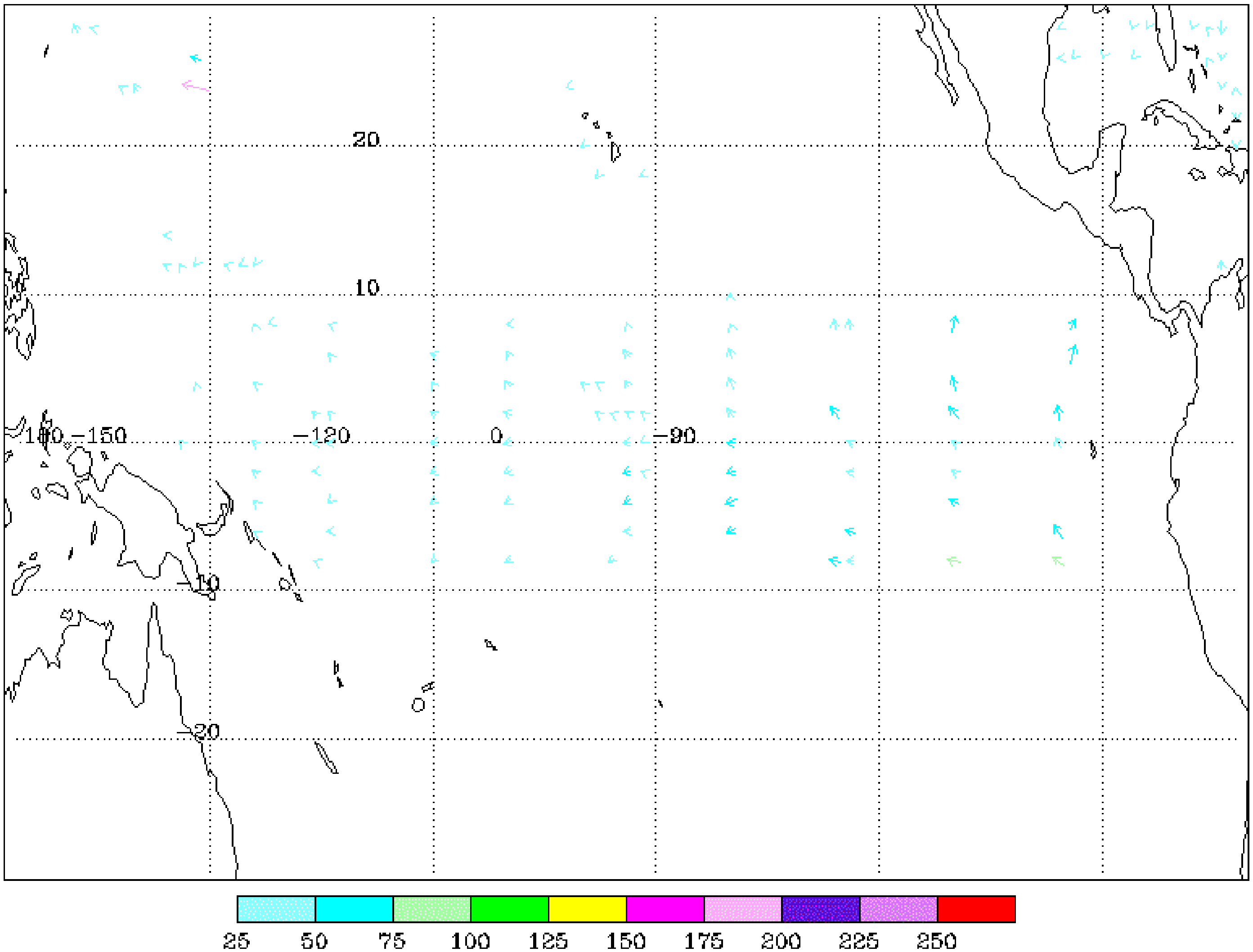
Example VOS Observations (Sept. 1999)



Considerations For Gridded Fields

- There are several problems that must be overcome
  - **Filling the gaps**
    - A good approximation
    - Must have realistic spatial trends
  - **Removing the edge effects** due to overlapping ship tracks (or buoy chains)
    - Poor techniques will introduce too much spurious divergence/curl
    - Ocean models are highly sensitive to divergence/curl
  - Avoid excessive **smoothing**

Example Buoy Observations (Aug. 1999)

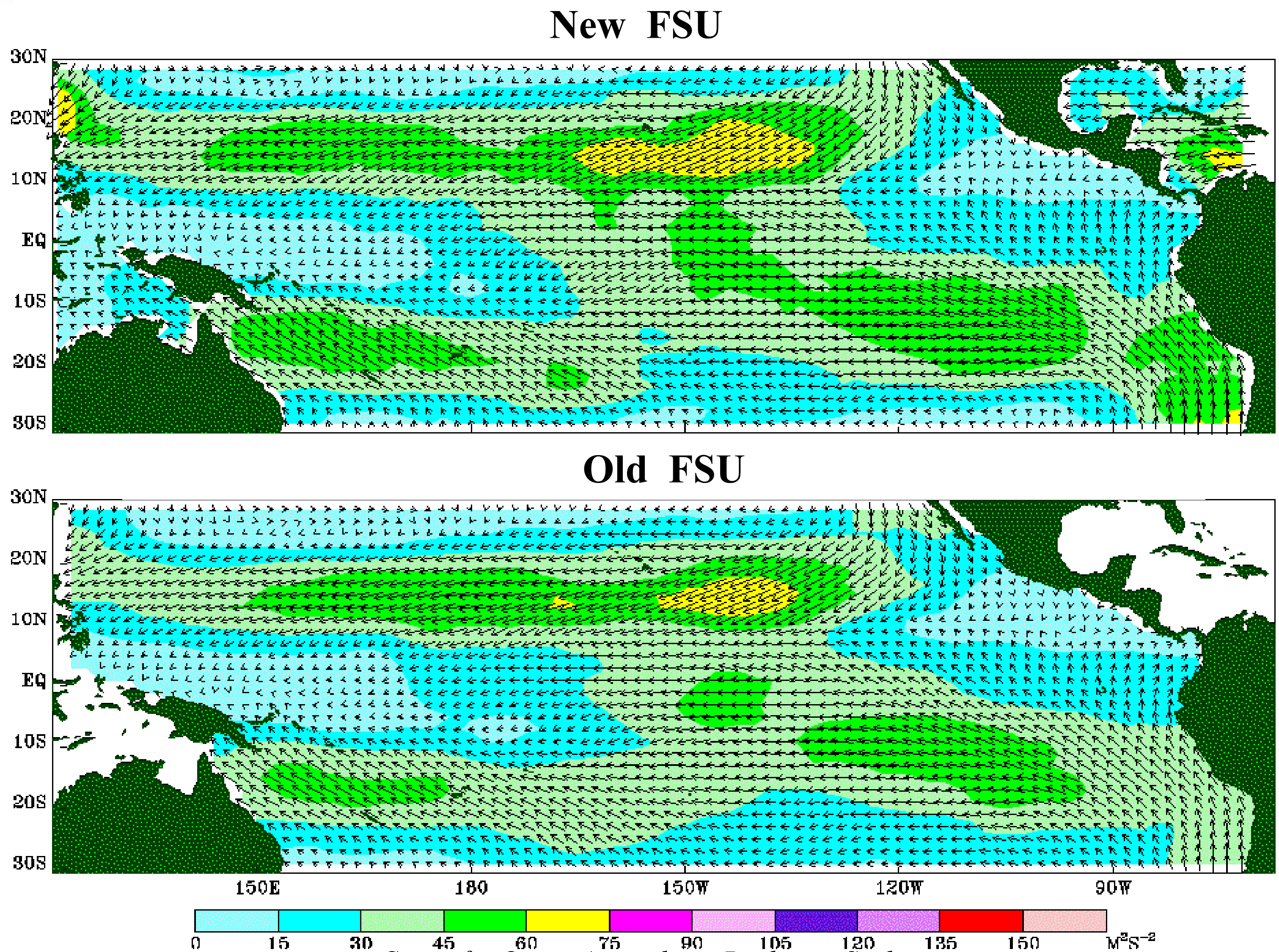


The Gridding Process

- The gridding technique is an improvement from our variational method (*Pegion et al*. 2000, *MWR*) applied to scatterometer winds.
  - Three types of constraints on the solution field (for vectors).
    - Misfits to observations, for each type of observational platform.
      - RMS sum of misfits to each pseudostress component.
    - Misfit to vorticity of background field.
    - A penalty function to smooth with respect to the background field.
  - The data to which these constraints are applied are scaled to be dimensionally consistent.
  - The background fields are based on the observational data.

- The weights for constraints are objectively estimated through cross validation

New and Old Mean Pseudostress (1997-1999)



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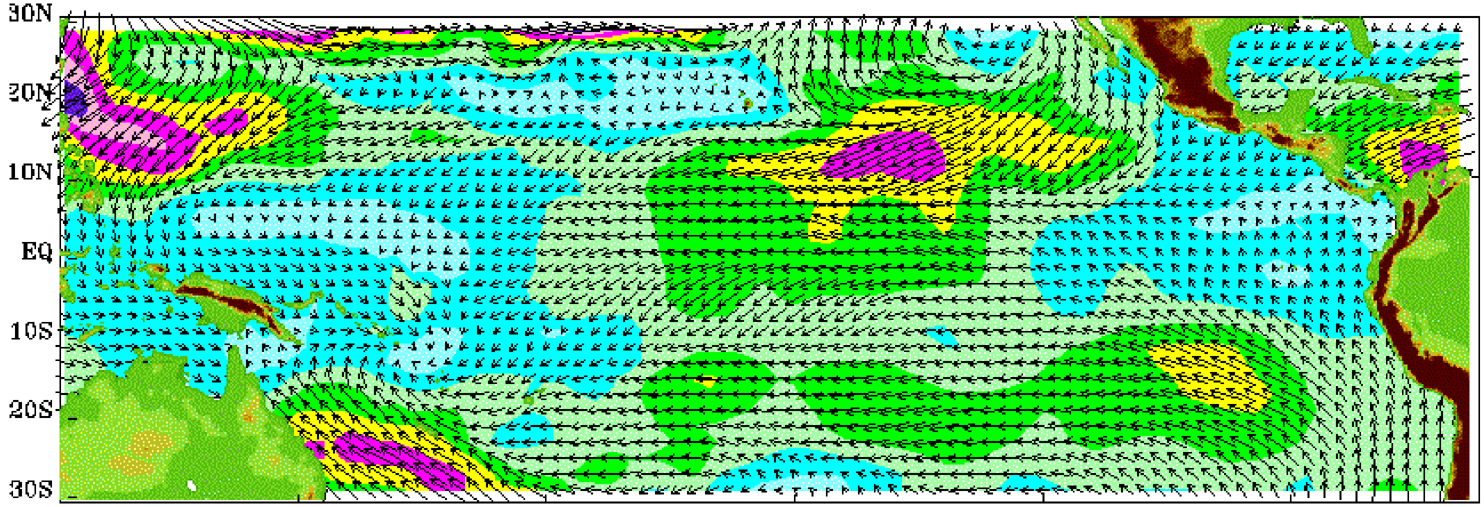
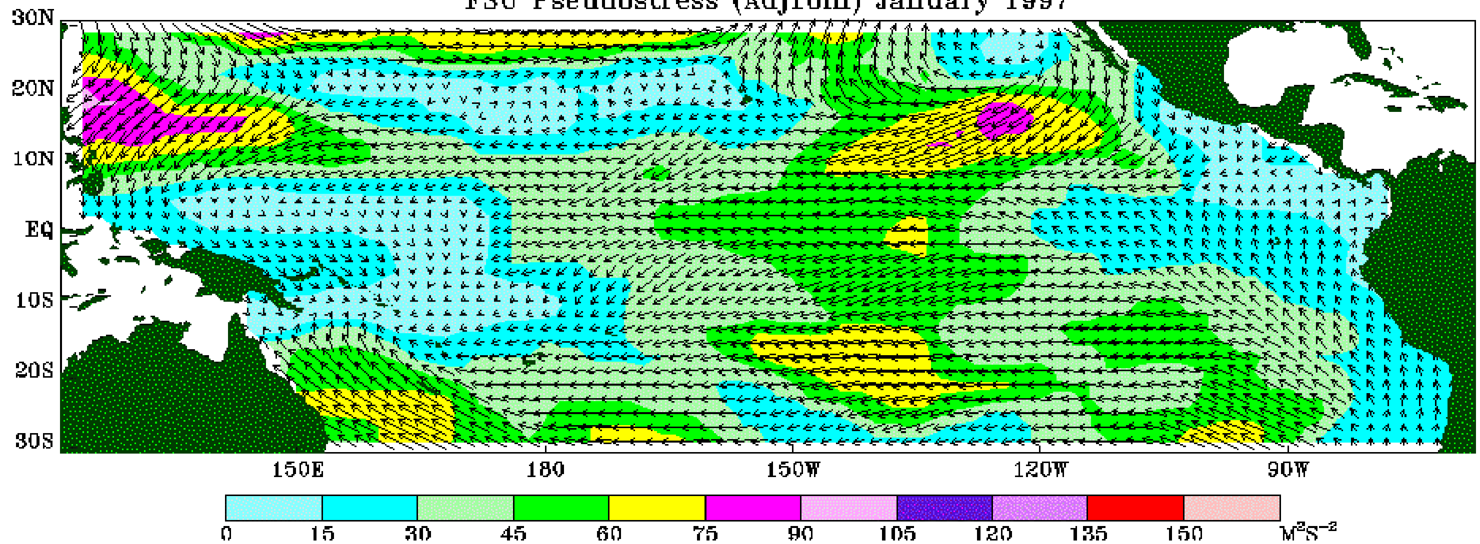
New and Old Pseudostress (Jan. 1997)

New FSU

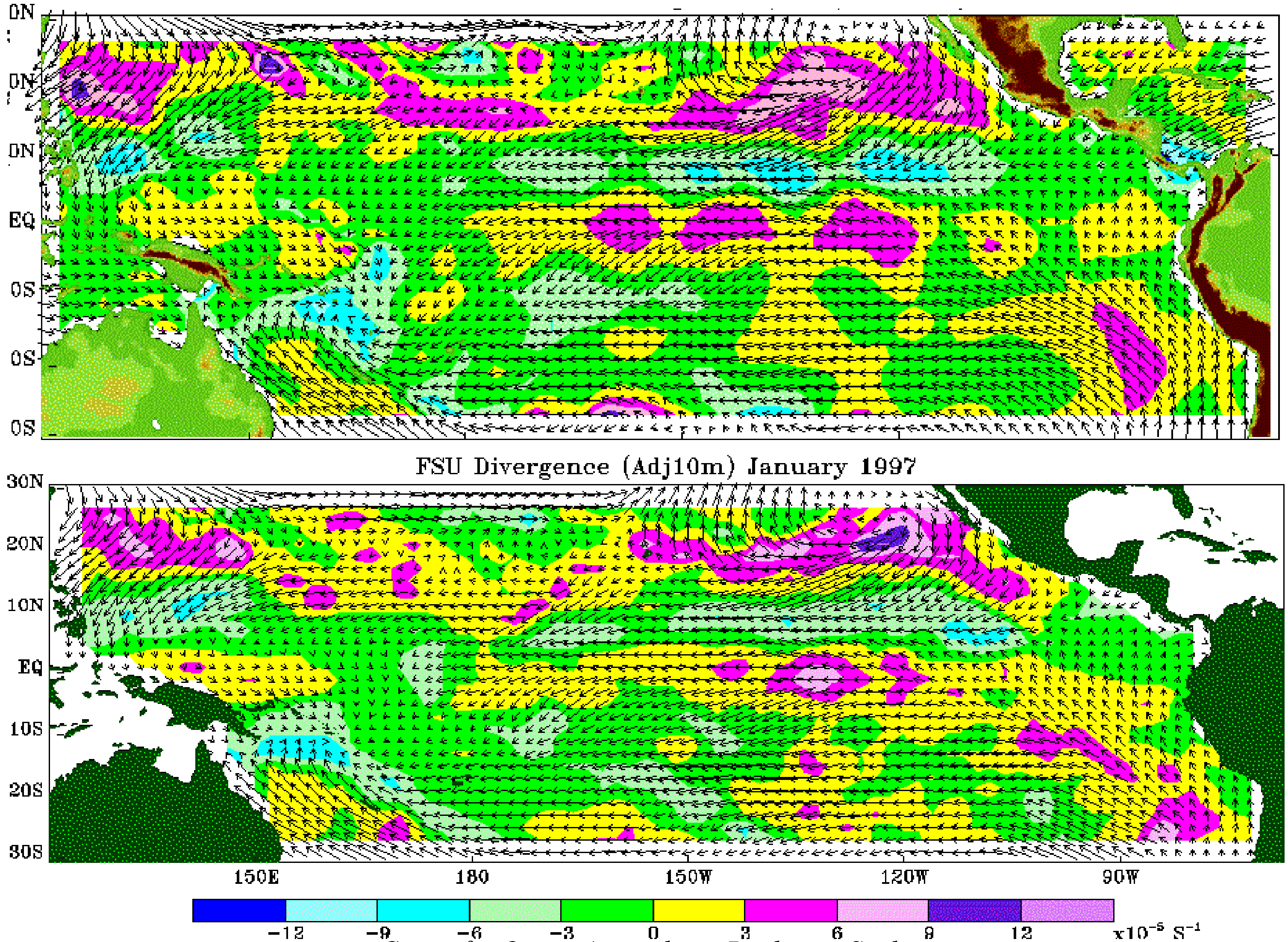


FSU Pseudostress (Adj10m) January 1997



New and Old Divergence (Jan. 1997)

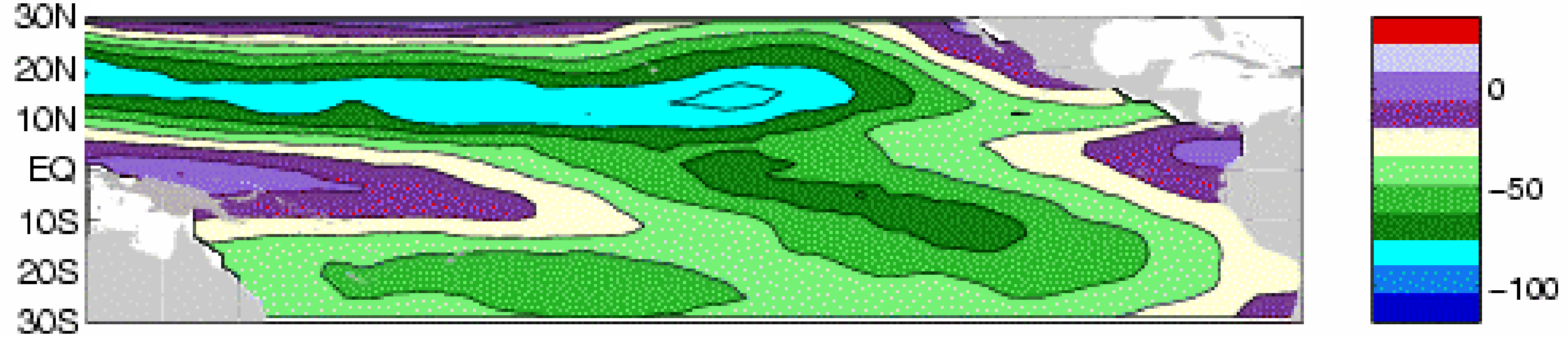
New FSU



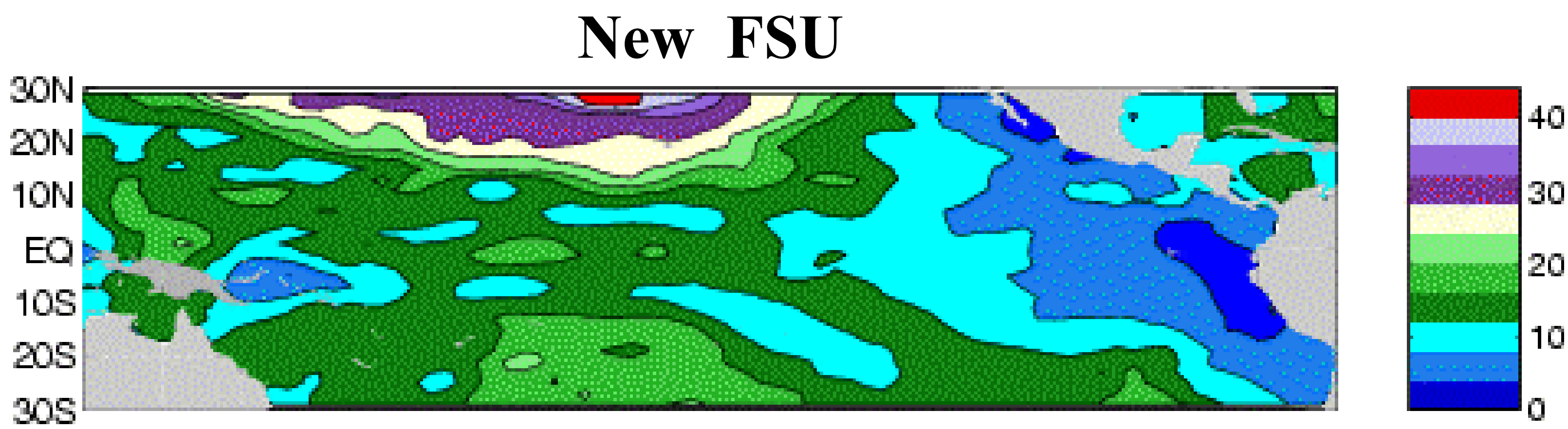
Composites of New and Old FSU Winds: Mean December (1978-1999)

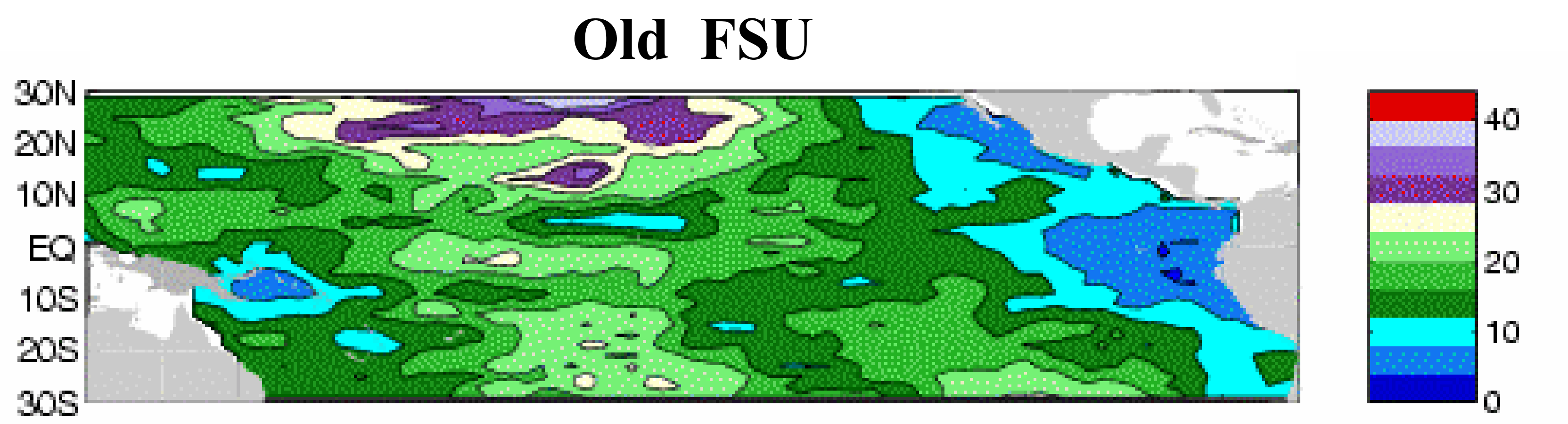
New FSU

Old FSU



Composites of New and Old FSU Winds: Standard Deviations (Dec. 1978-1999)





Ocean Modeling With New and Old FSU Winds

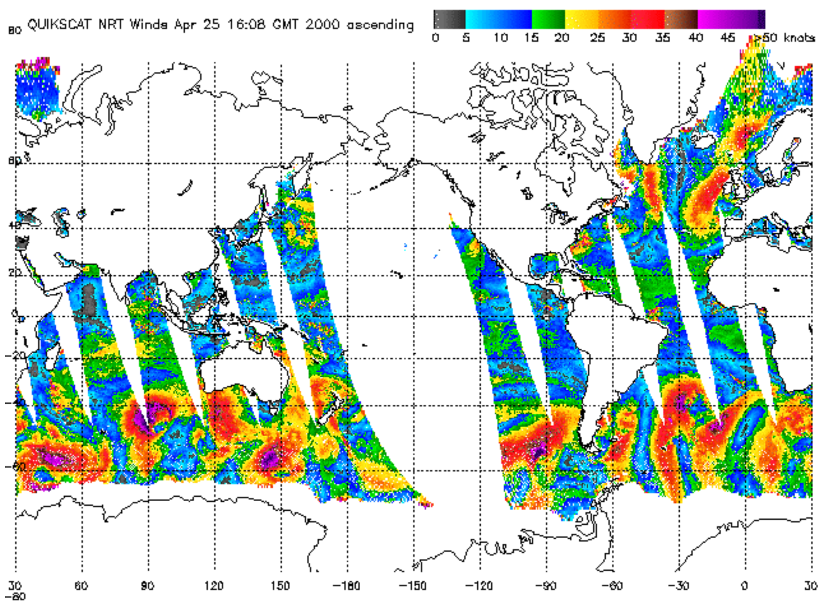
- The new and traditional FSU winds were used by Zuojun Yu at the IPRC to force a Tropical Pacific ocean model.

- Three year test period with a beta-release of the new FSU winds
  - 1997 – 1999
    - Includes strong El Niño and La Niña

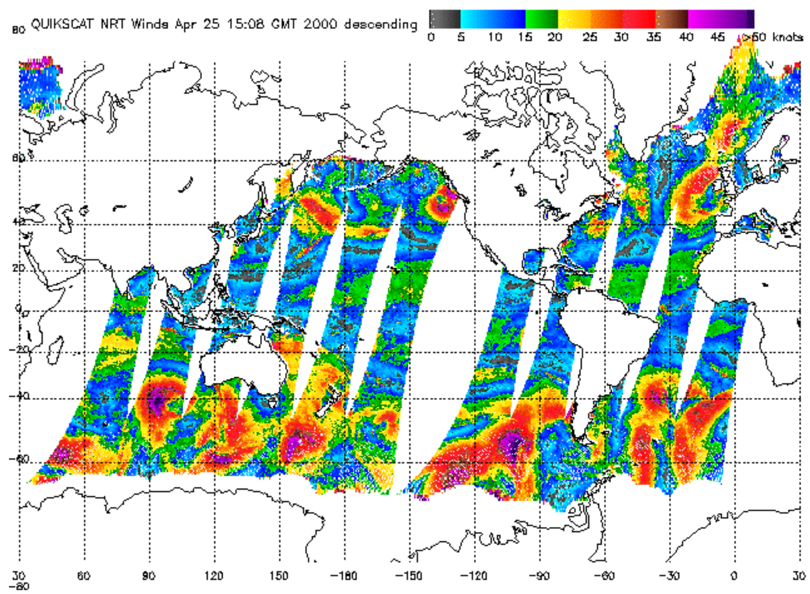
- The new FSU product produced a much more realistic NECC
  - The NECC in the traditional product was too weak

SeaWinds Daily (22 hour) Coverage

Ascending Node

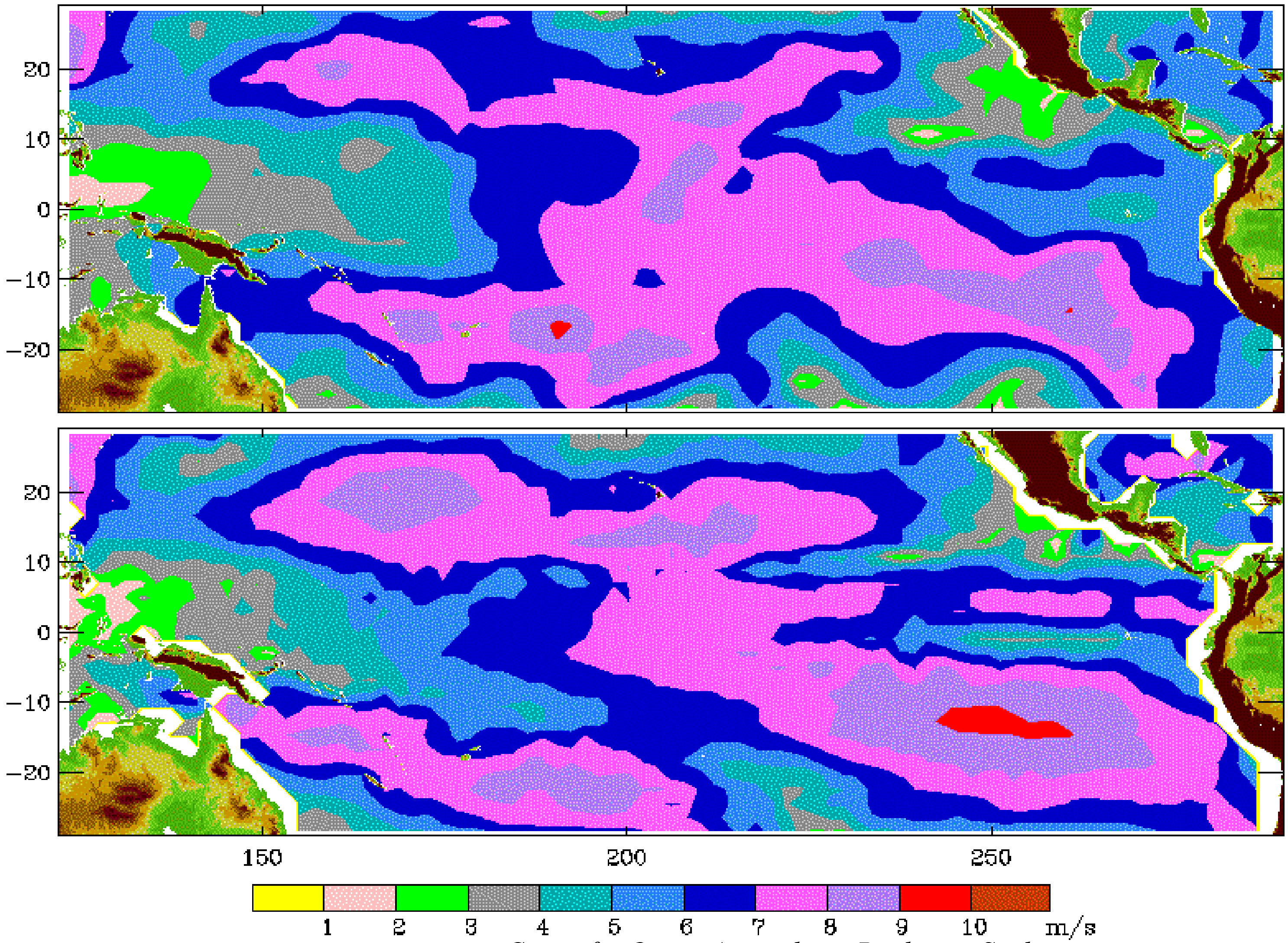


Descending Node



From Paul Chang (NOAA/NESDIS): http://manati.wwb.noaa.gov/quikscat/

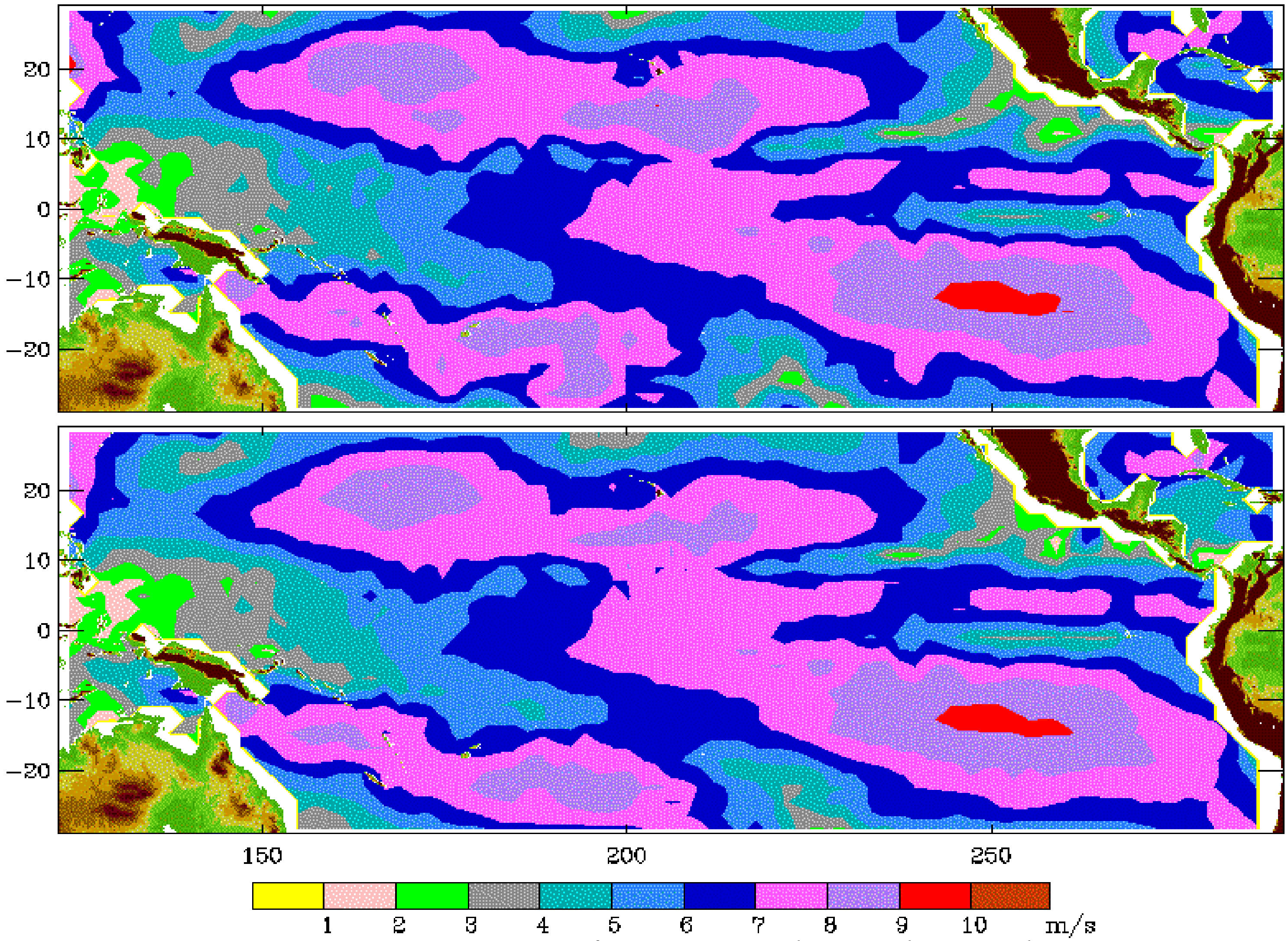
In Situ vs. Scatterometer Vector Wind Speed (October 1999)



Objective In Situ

SeaWinds Scatterom.

In Situ & SeaWinds (comb.) vs. SeaWinds Wind Speed (Oct. 1999)



Objective Combined

SeaWinds Scatterom.

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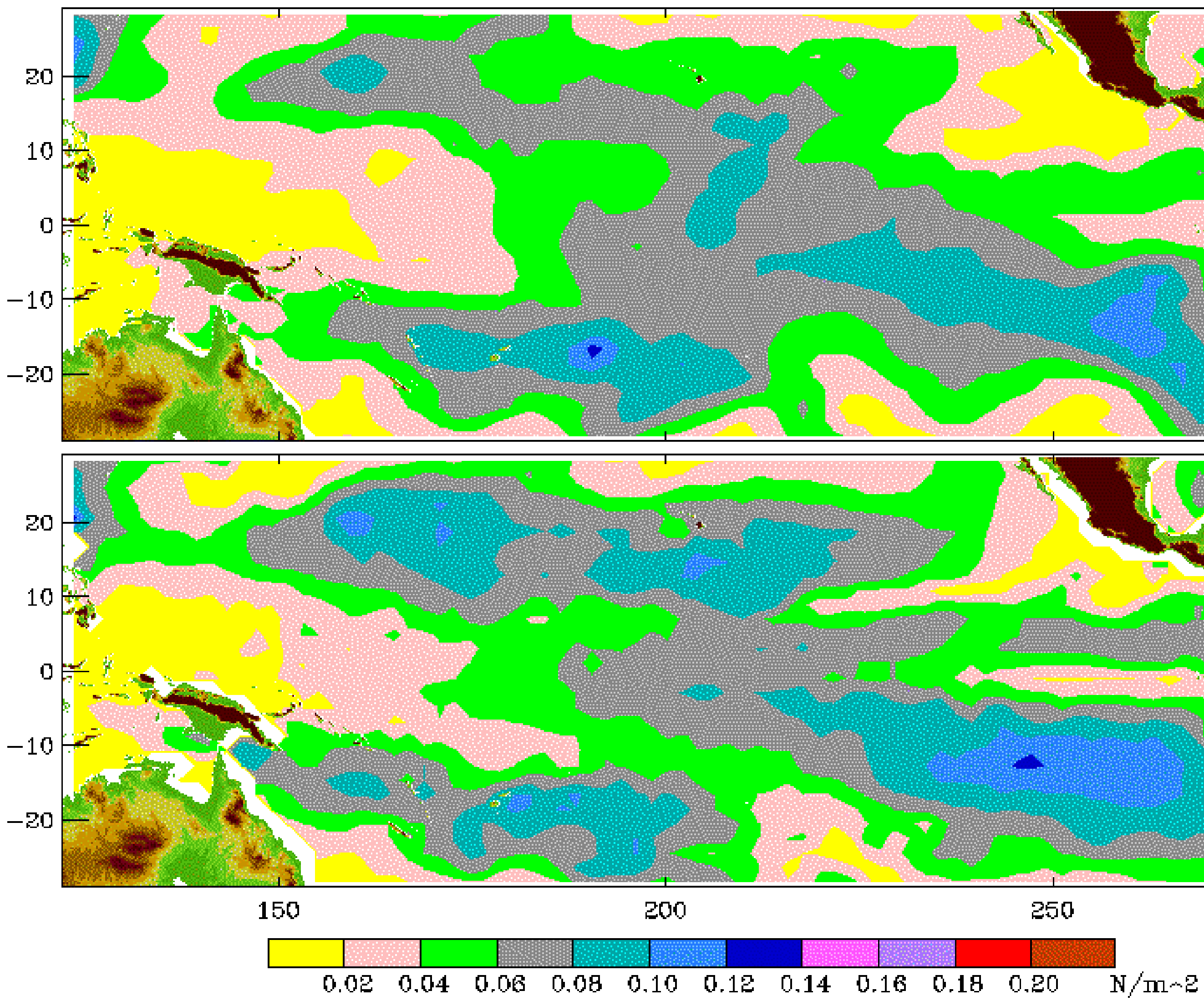
In Situ vs. Combined Stress Magnitude



Objective
In Situ

Combined

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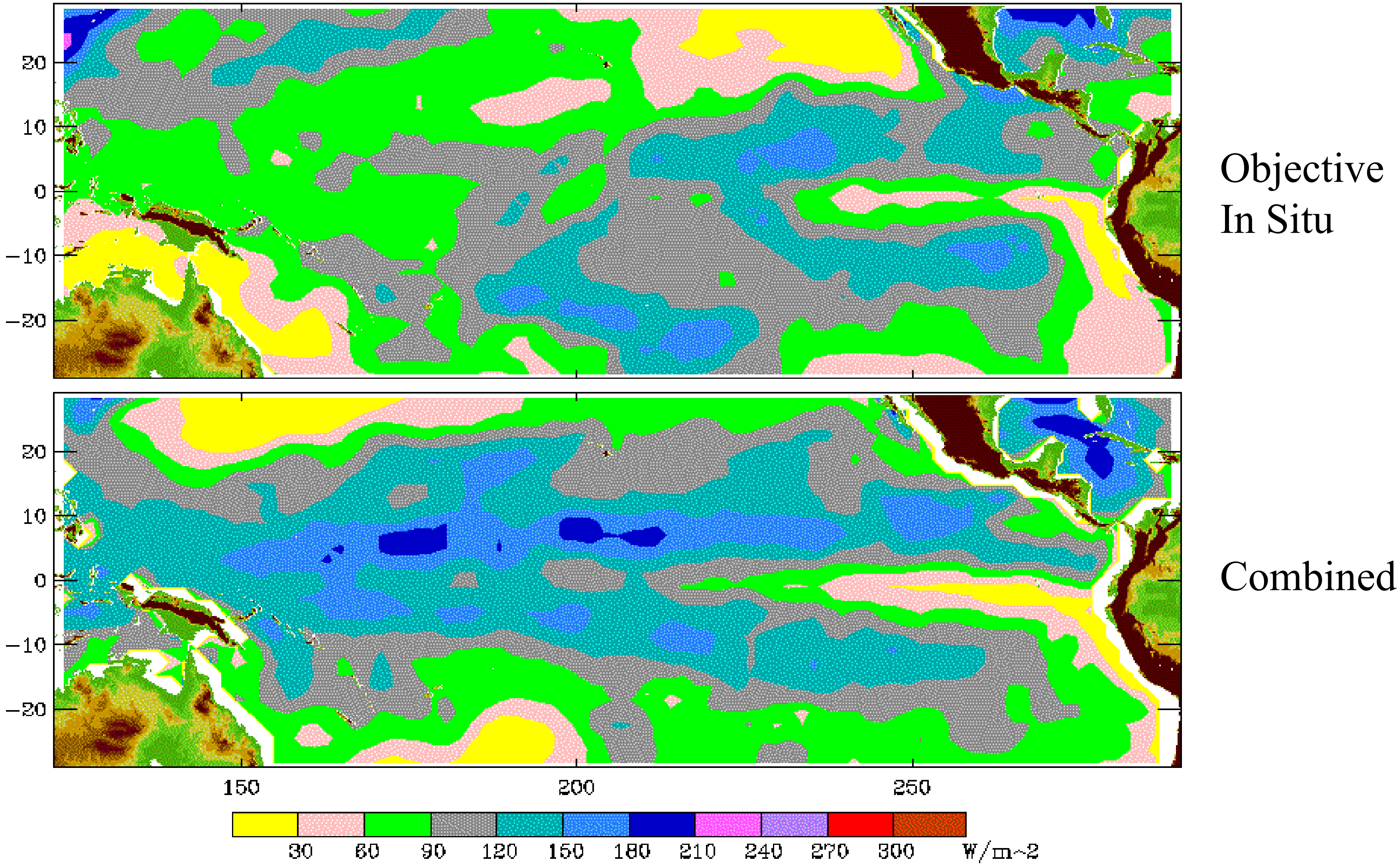
In Situ vs. Combined (In Situ + SeaWinds) Latent Heat Flux (Oct. 1999)



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The Future FSU Flux Products

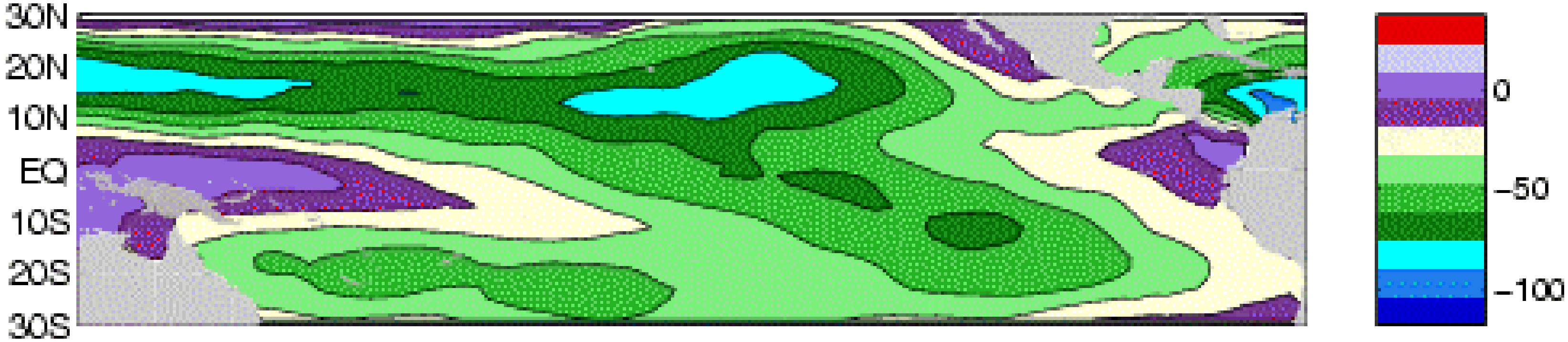
- The gridding technique can easily be extended to include data from additional platforms.
  - Scatterometer data will be included
  - Formulating plans to include data from additional platforms
  - Uncertainty fields will be included in the product
- Products
  - Objective FSU winds and and surface turbulent fluxes (Tropical Pacific; in-situ data only)
    - Working on 30 years (need for anomaly models)
    - Will examine how far back we can go with COADS data
  - Objective FSU winds including scatterometer observations
  - High spatial/temporal resolution global scatterometer winds

Conclusions

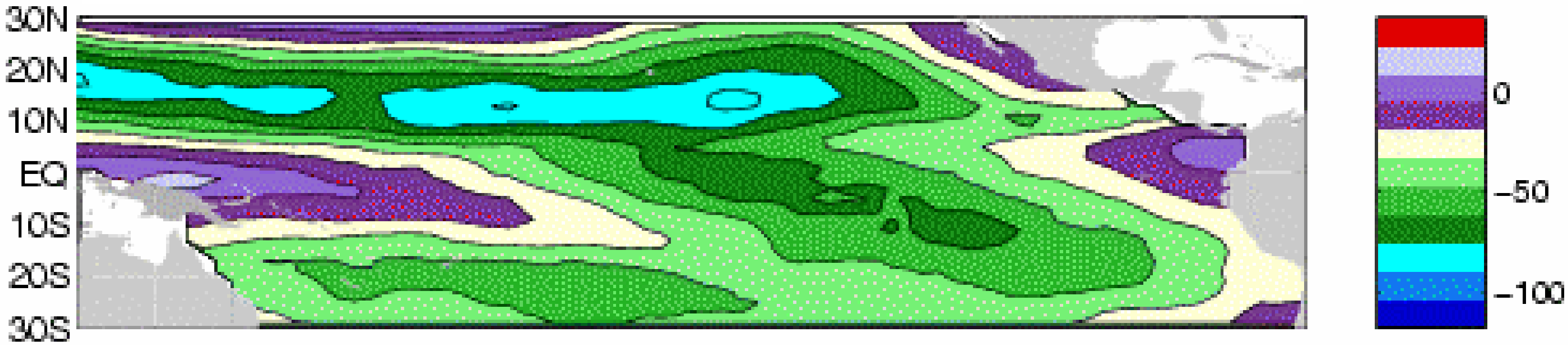
- The gridding technique produces internally consistent fields of winds, turbulent surface fluxes, and related variables.
- The gridding technique can easily be extended to include data from additional platforms.
- New and improved data sets are available.
  - Contact information:
    - Bourassa@coaps.fsu.edu
    - Smith@coaps.fsu.edu
    - http://coaps.fsu.edu/

Composites of New and Old FSU Winds: Neutral ENSO Years (Dec. 1978-1999)

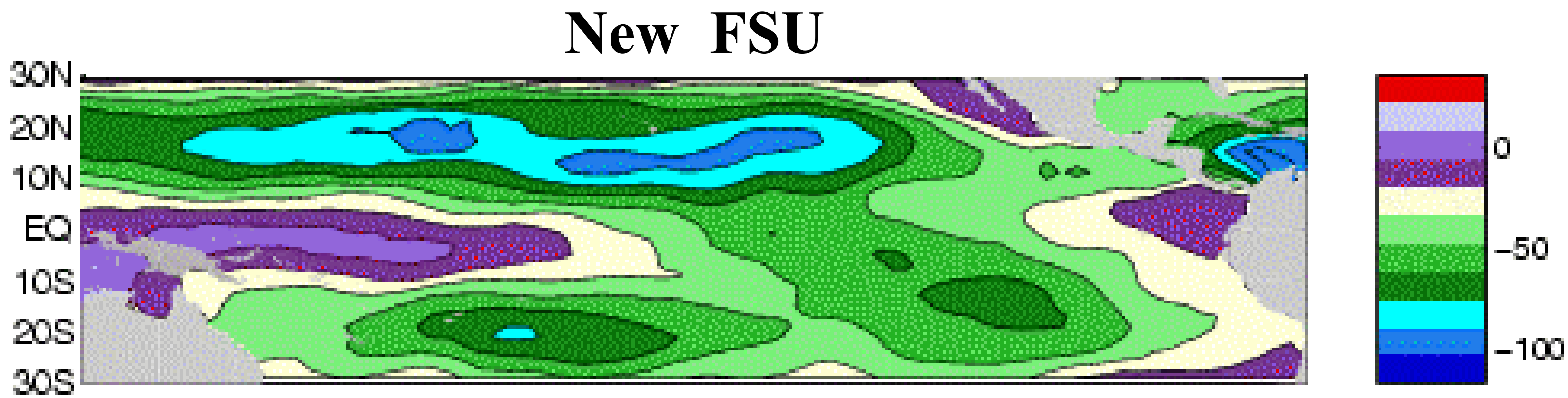
New FSU

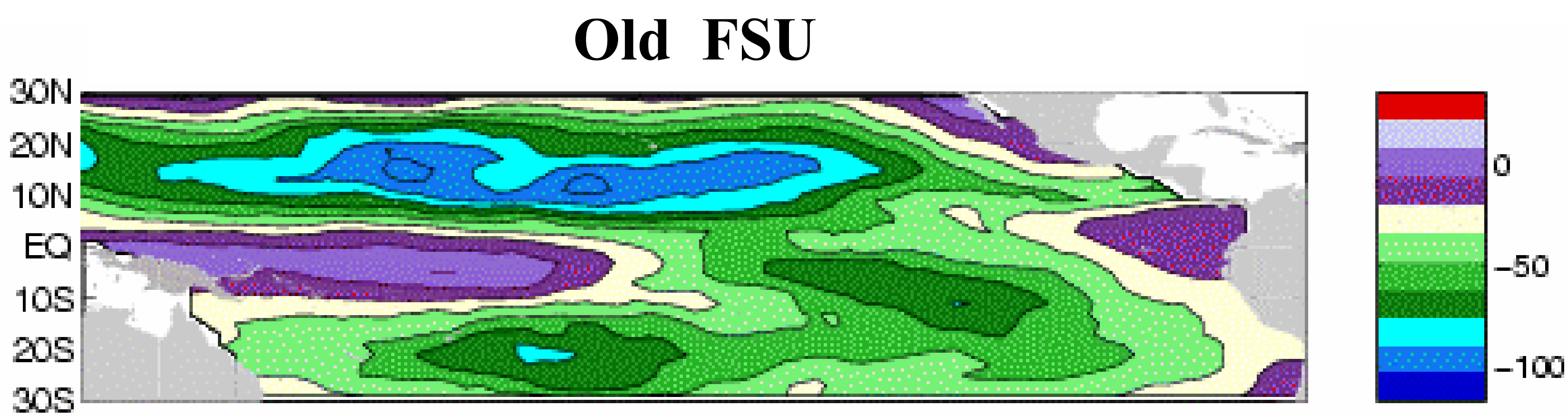


Old FSU

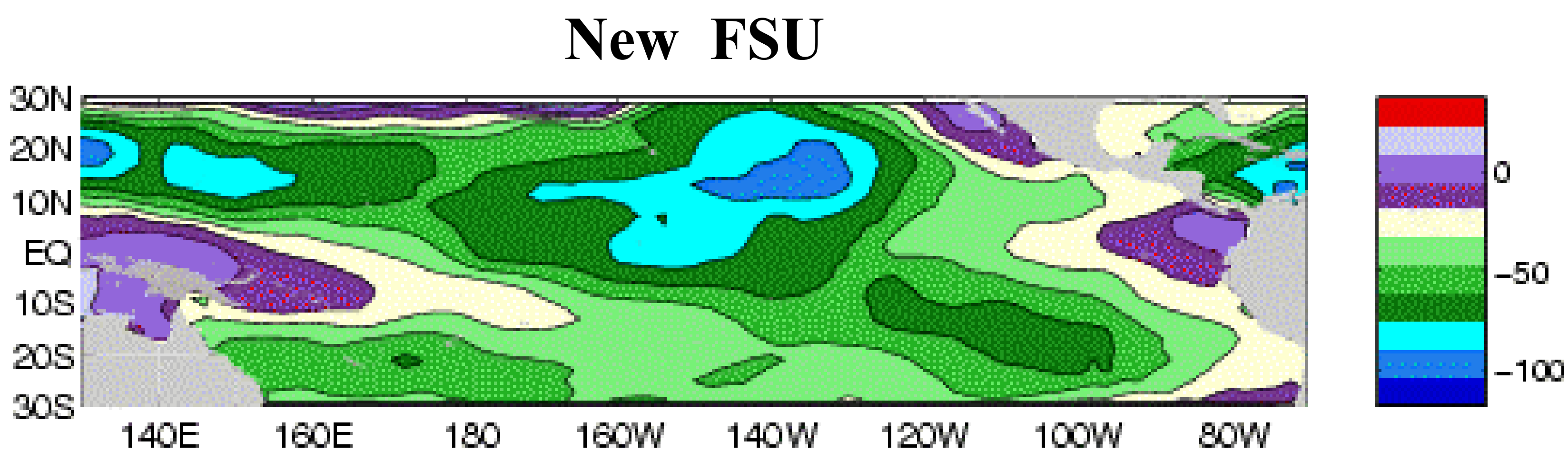


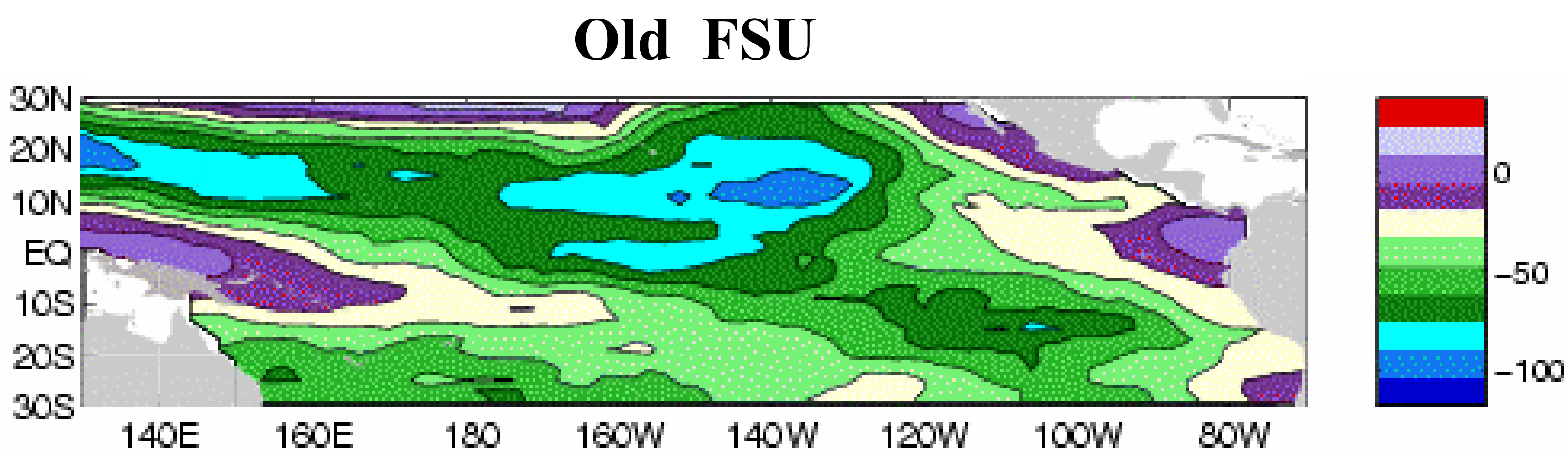
Composites of New and Old FSU Winds: El Niño Years (Dec. 1978-1999)



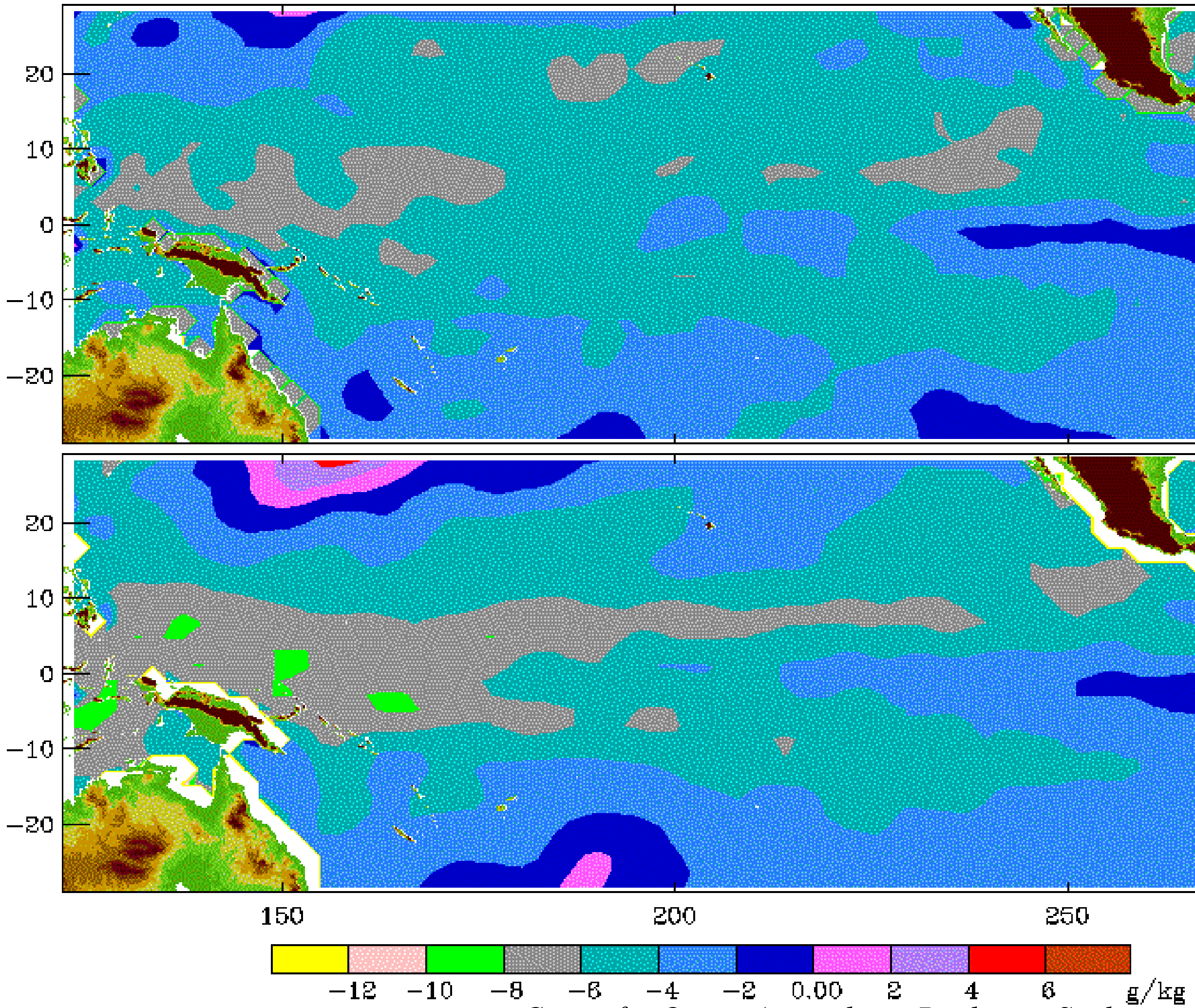


Composites of New and Old FSU Winds: La Niña Years (Dec. 1978-1999)





In Situ vs. Combined (In Situ & SeaWinds)
Surface – 10m Specific Humidity



Objective
In Situ

Combined