On the Collapse of the Surface Easterly Wind in the Eastern Equatorial Pacific in the 2015 El Niño

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Definitions: El Niño and La Niña

	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	
2000	-1.6	-1.4	-1.1	-0.9	-0.7	-0.7	-0.6	-0.5	-0.6	-0.7	-0.8	-0.8	La Niña 1
2001	-0.7	-0.6	-0.5	-0.3	-0.2	-0.1	0	-0.1	-0.1	-0.2	-0.3	-0.3	
2002	-0.2	-0.1	0.1	0.2	0.4	0.7	0.8	0.9	1.0	1.2	1.3	1.1	El Niño 1
2003	0.9	0.6	0.4	0	-0.2	-0.1	0.1	0.2	0.3	0.4	0.4	0.4	
2004	0.3	0.2	0.1	0.1	0.2	0.3	0.5	0.7	0.7	0.7	0.7	0.7	El Niño 2
2005	0.6	0.6	0.5	0.5	0.4	0.2	0.1	0	0	-0.1	-0.4	-0.7	
2006	-0.7	-0.6	-0.4	-0.2	0.0	0.1	0.2	0.3	0.5	0.8	0.9	1.0	El Niño 3
2007	0.7	0.3	0	-0.1	-0.2	-0.2	-0.3	-0.6	-0.8	-1.1	-1.2	-1.3	La Niña 2
2008	-1.4	-1.3	-1.1	-0.9	-0.7	-0.5	-0.3	-0.2	-0.2	-0.3	-0.5	-0.7	
2009	-0.8	-0.7	-0.4	-0.1	0.2	0.4	0.5	0.6	0.7	1.0	1.2	1.3	El Niño 4
2010	1.3	1.1	0.8	0.5	0	-0.4	-0.8	-1.1	-1.3	-1.4	-1.3	-1.4	La Niña 3
2011	-1.3	-1.1	-0.8	-0.6	-0.3	-0.2	-0.3	-0.5	-0.7	-0.9	-0.9	-0.8	La Niña 4
2012	-0.7	-0.6	-0.5	-0.4	-0.3	-0.1	0.1	0.3	0.4	0.4	0.2	-0.2	
2013	-0.4	-0.5	-0.3	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	
2014	-0.5	-0.6	-0.4	-0.2	0	0	0	0	0.2	0.4	0.6	0.6	
2015	0.5	0.4	0.5	0.7	0.9	1.0	1.2	1.5	1.8	2.1	2.2	2.3	El Niño 5

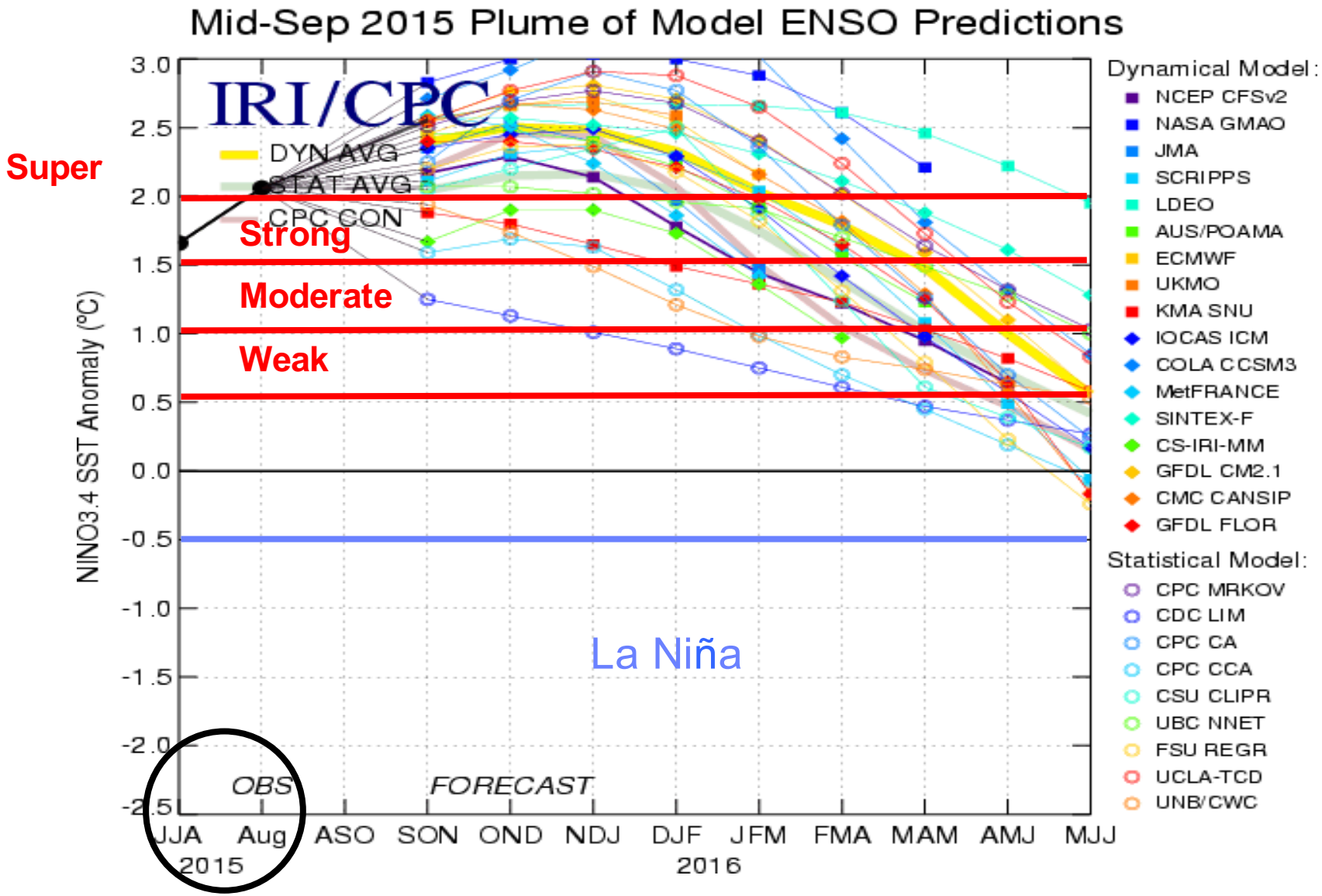
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml

An El Niño event occurs when the SST anomaly in each of five consecutive 3-month average ≥ 0.5 ˚C.

A La Niña event occurs when the SST anomaly in each of five consecutive 3-month average ≤ - 0.5 ˚C.

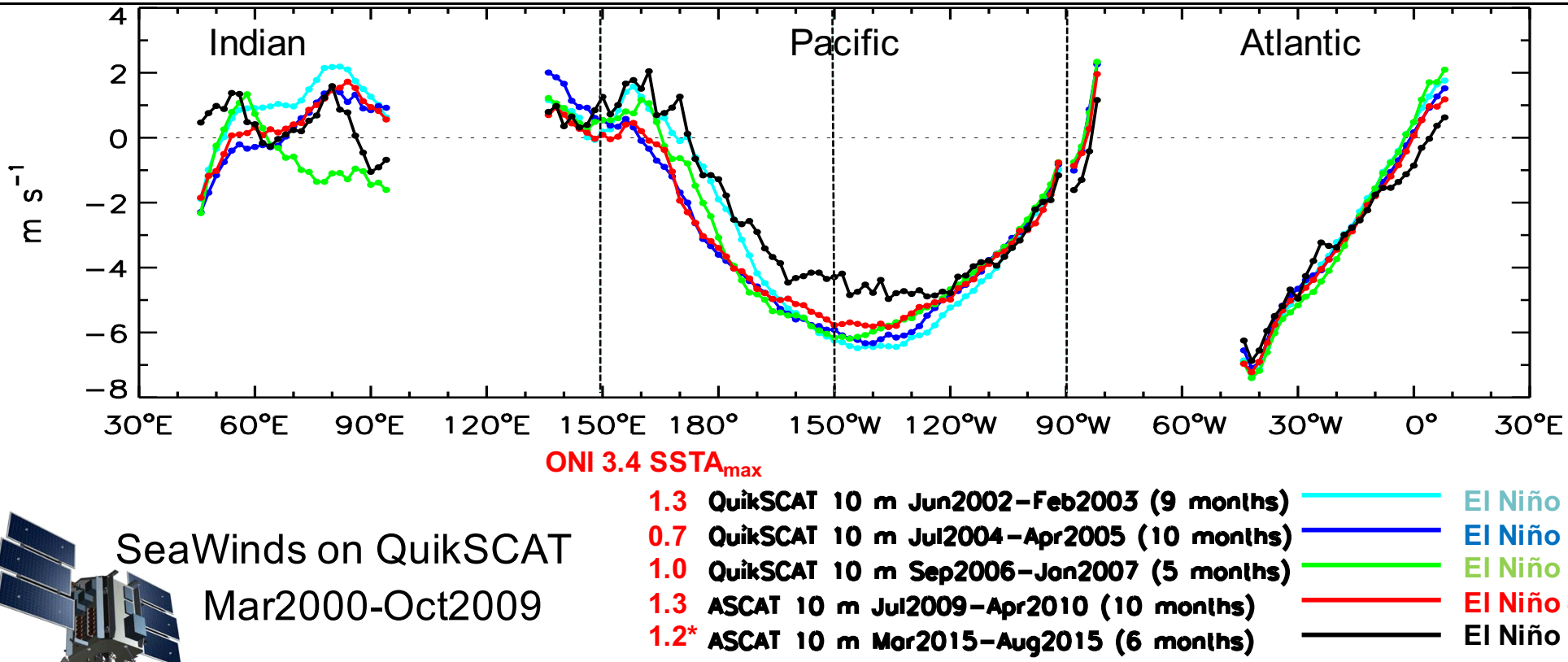
IRI Niño 3.4 SSTA Forecast in mid-Sep 2015

→ "Super El Niño is coming"



http://iri.columbia.edu/our-expertise/climate/forecasts/enso/2015-September-quick-look/?enso_tab=enso-sst_table

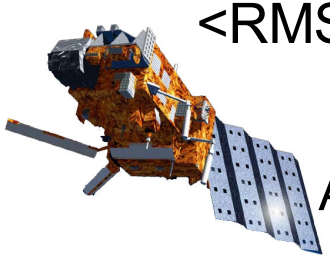
10-m (Surface) Zonal Wind Component



SeaWinds on QuikSCAT
Mar2000-Oct2009

La Niña 2 (11 mo)
El Niño 4 (4 mo)

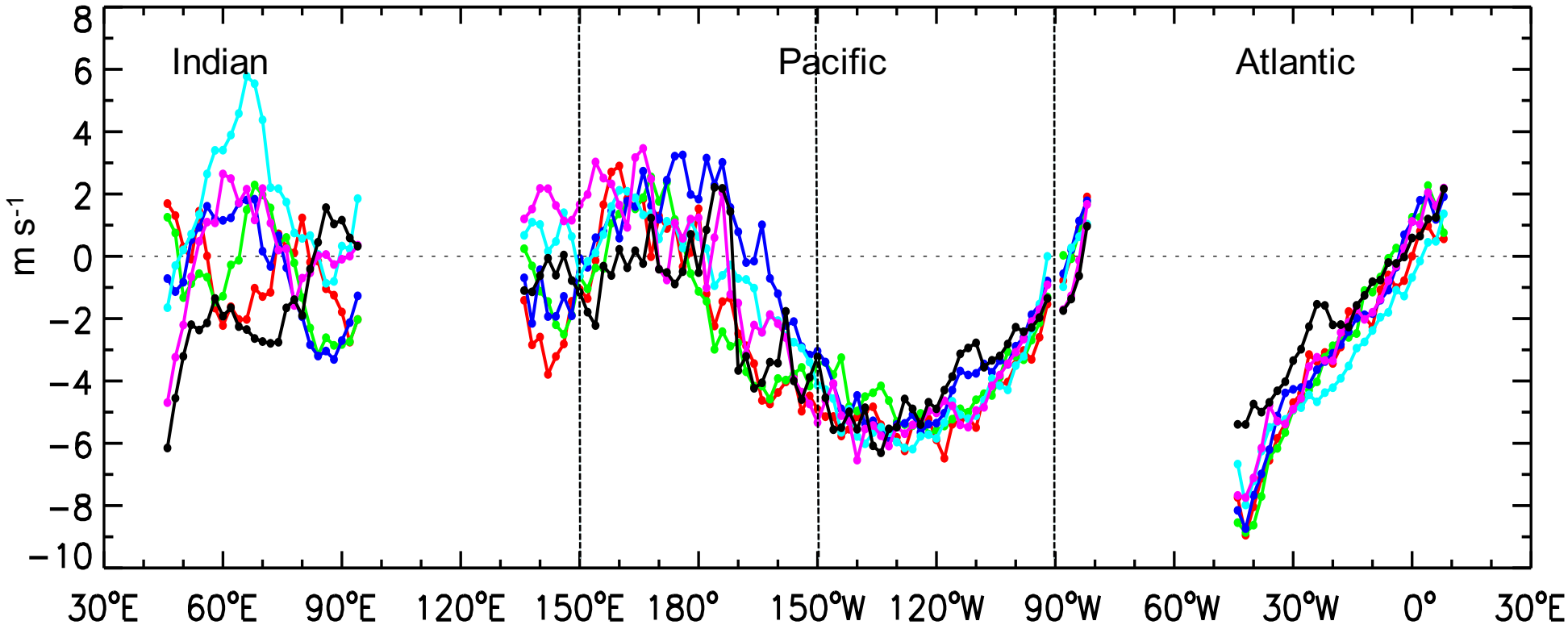
$\langle \triangle U_{A-Q} \rangle = -0.03$ m s^{-1}
$\langle RMSD \rangle = 0.38$ m s^{-1}



ASCAT-A on METOP-A
Jun2007-present

- On 21 Sep 2015, when the abstract was submitted, the Mar-Aug 2015 average easterly wind speed in the central Pacific was 1.0-1.5 m s^{-1} smaller than that in previous El Nino events.
- **OBJECTIVE**: Would the easterly wind collapse in the "predicted" super El Niño?

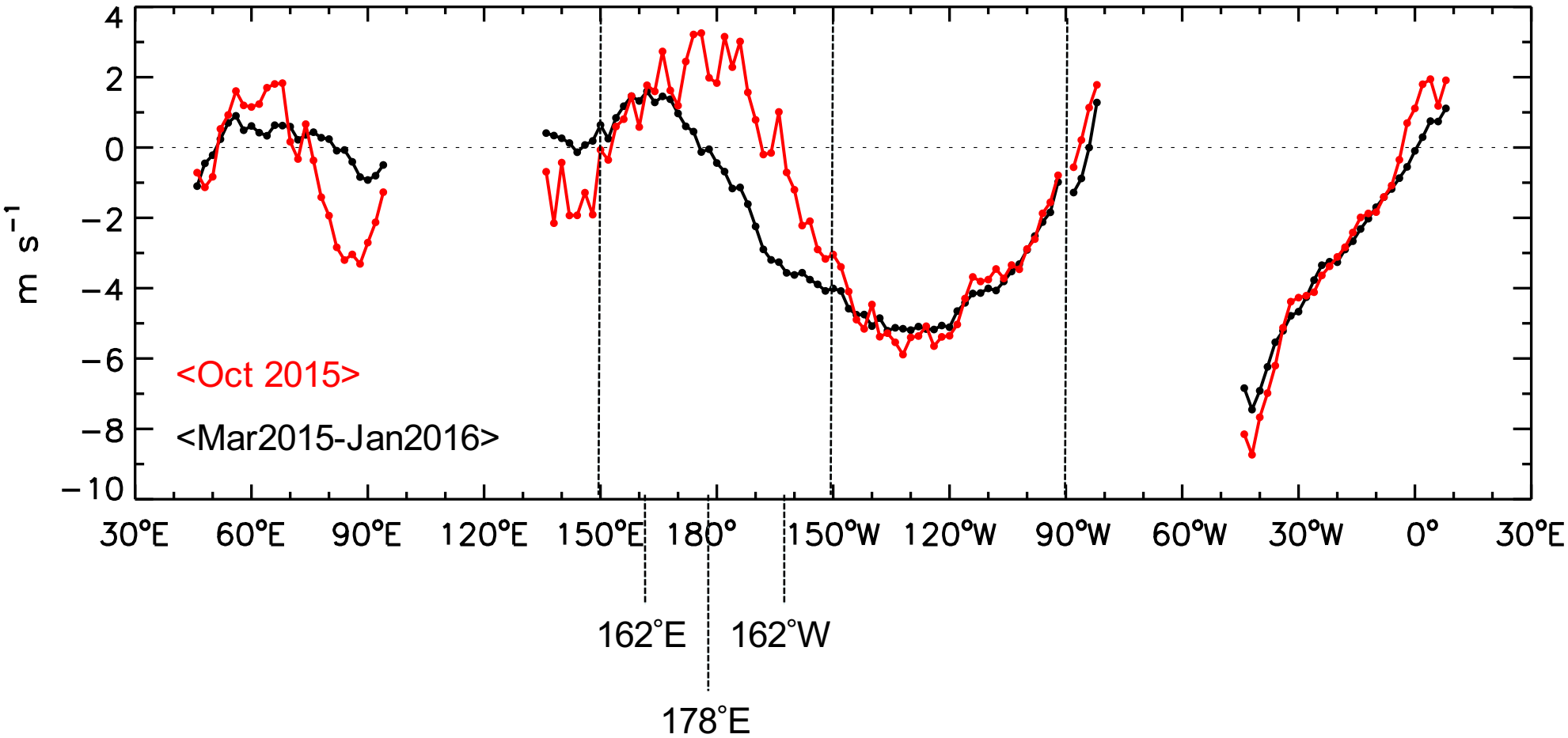
Monthly Surface Zonal Wind Along Equator
Aug 2015 – Jan 2016



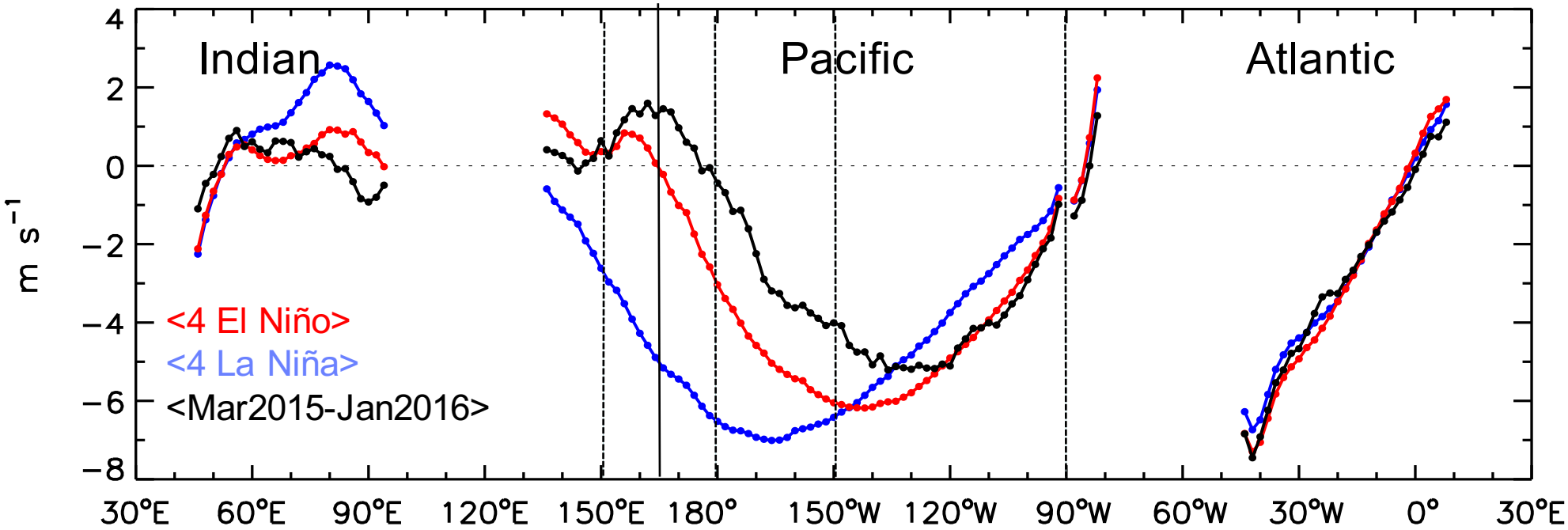
ASCATa 10 m Aug2015
ASCATa 10 m Sep2015
ASCATa 10 m Oct2015
ASCATa 10 m Nov2015
ASCATa 10 m Dec2015
ASCATa 10 m Jan2016

- Central Pacific, 170˚E – 150˚W
  - Weakest westward wind occurred in October

Surface Westward Wind in Oct 2015
Maximum Collapse Relative to 2015-2016 El Niño



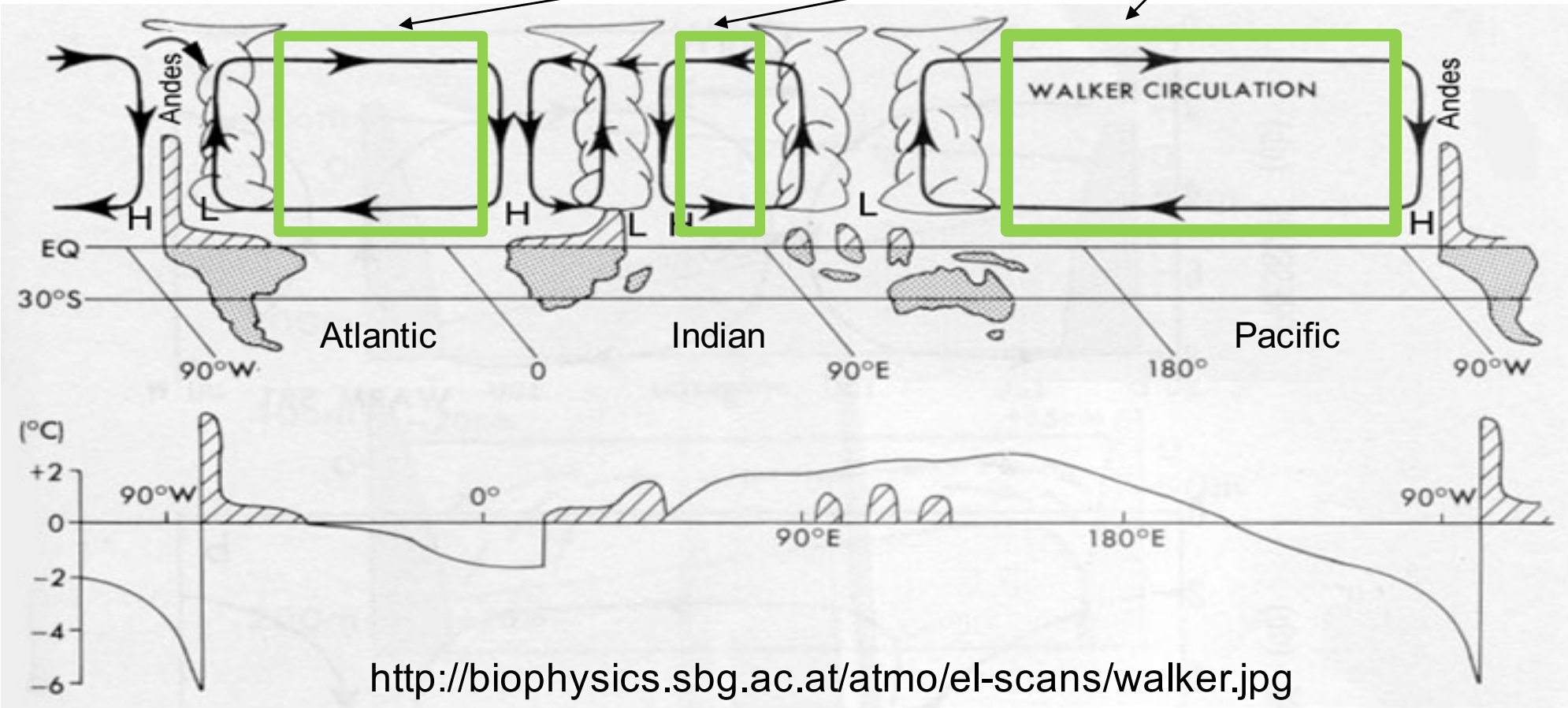
Collapse of Surface Westward Wind in El Niño



- Compared to <La Niña> conditions, the <El Niño> westward wind collapsed from 135°E (our "boundary") to 165°E (△L = 30°) and the <Mar2015-Jan2016 El Niño> westward wind collapsed and became eastward from 135°E to 180° (△L = 45°).
- Compared to <La Niña> conditions, the <Mar2015-Jan2016 El Niño> westward wind speeds were more than 3 m s^{-1} smaller than <La Niña> westward wind speeds from 150°E to 160°W, with a maximum decrease of 6 m s^{-1} at 165°E.
- Atlantic: No evidence of El Niño
- Easterly wind anomaly, compared to <La Niña> , occurred as far east as 140°W.
- East of 130°W, the <El Niño> and <Mar2015-Jan2016 El Niño > westward wind speeds were (i) equal and (ii) greater than <La Niña> by 1 m s^{-1}, contrary to conventional wisdom.

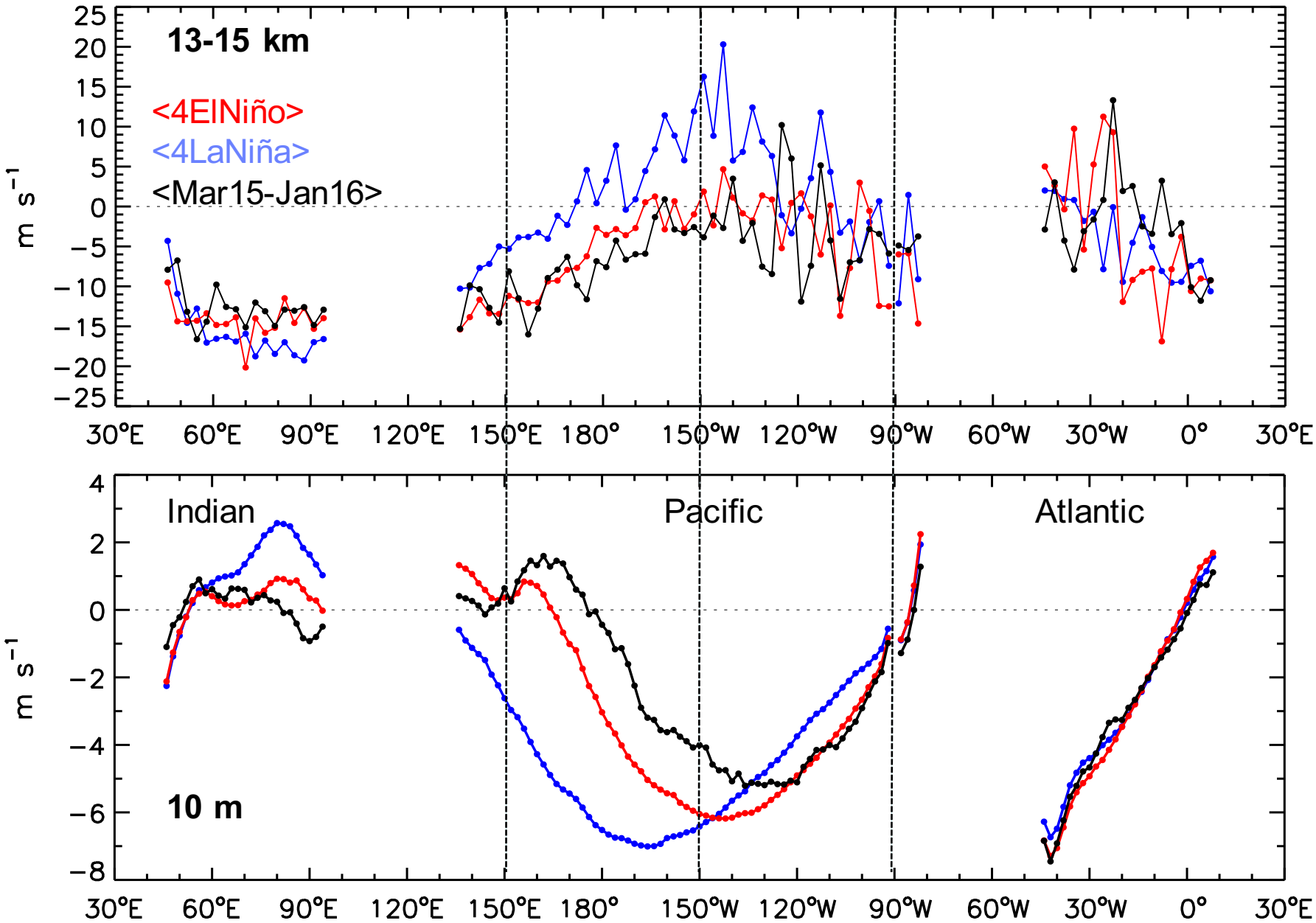
Walker Circulation, El Niño and La Niña

What happened to the intensity of the eastward (Atlantic, Pacific) or westward (Indian) wind in the upper troposphere in the 2015-2016 El Niño event?



http://biophysics.sbg.ac.at/atmo/el-scans/walker.jpg

Surface and Upper Troposphere Zonal Wind



Discussion / Surface Winds

- West and Central Pacific
  - Westward wind speeds in super El Niño were significantly smaller compared to typical El Niño
  - Collapse of westward wind speed was maximum in Oct 2015
  - Westward wind speeds in El Niño were smaller than those in La Niña [conventional wisdom]
- East Pacific
  - Westward wind speeds in super El Niño were equal to those in a typical El Niño
  - Westward wind speeds in El Niño were greater than those in La Niña [**not** conventional wisdom]
- Atlantic
  - No evidence that El Niño or La Niña existed [contrary to published reports, e.g., "Atlantic Nino" [(Wang, C. (2005) and (https://en.wikipedia.org/wiki/Atlantic_Equatorial_mode)]

➢ Future Work: (1) NWP data products. (2) ITCZ crossing equator.