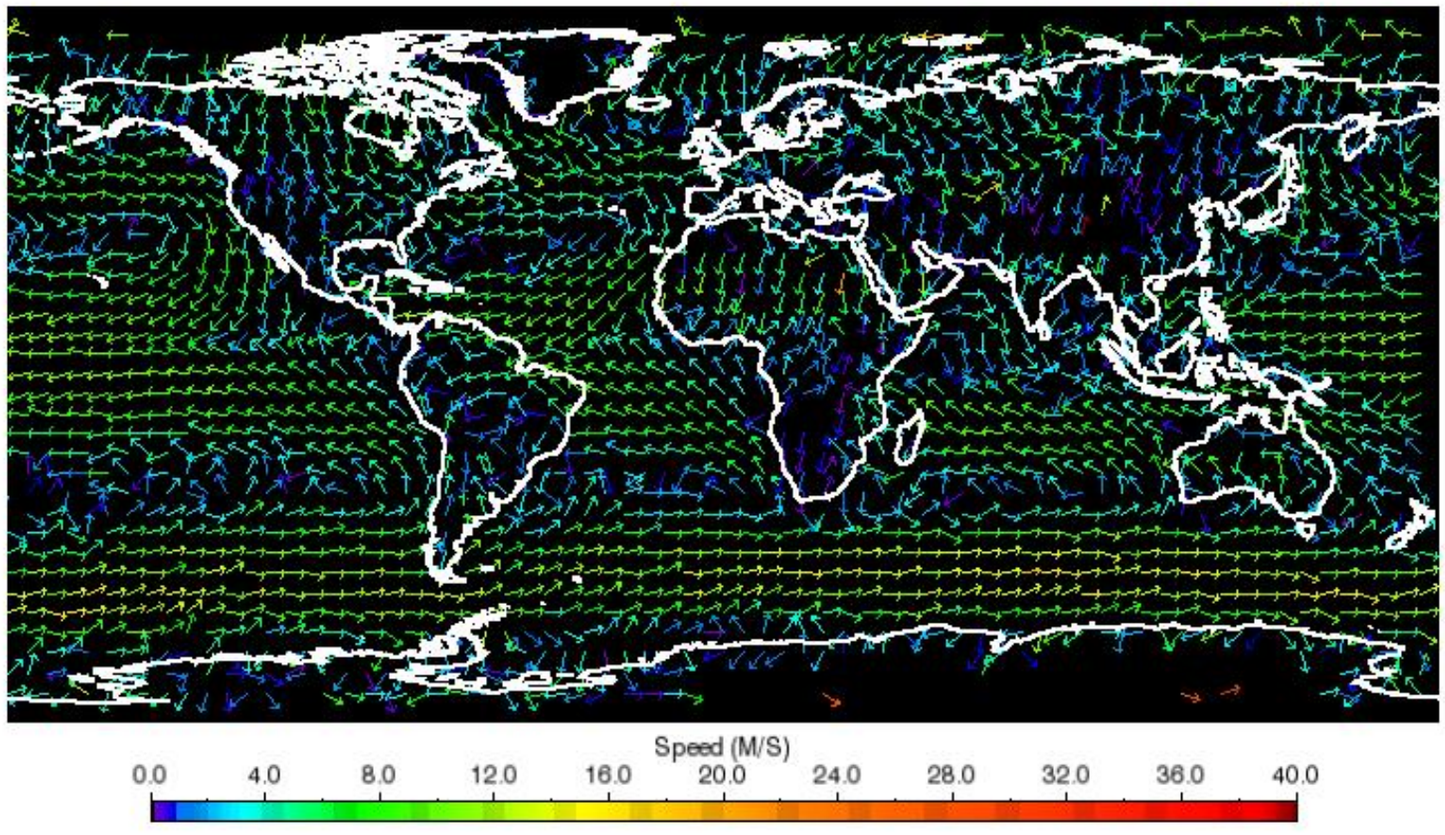
Globally Distributed Time Series of the enhanced Cloud Motion Vector Product

Roger Davies and Kevin Mueller

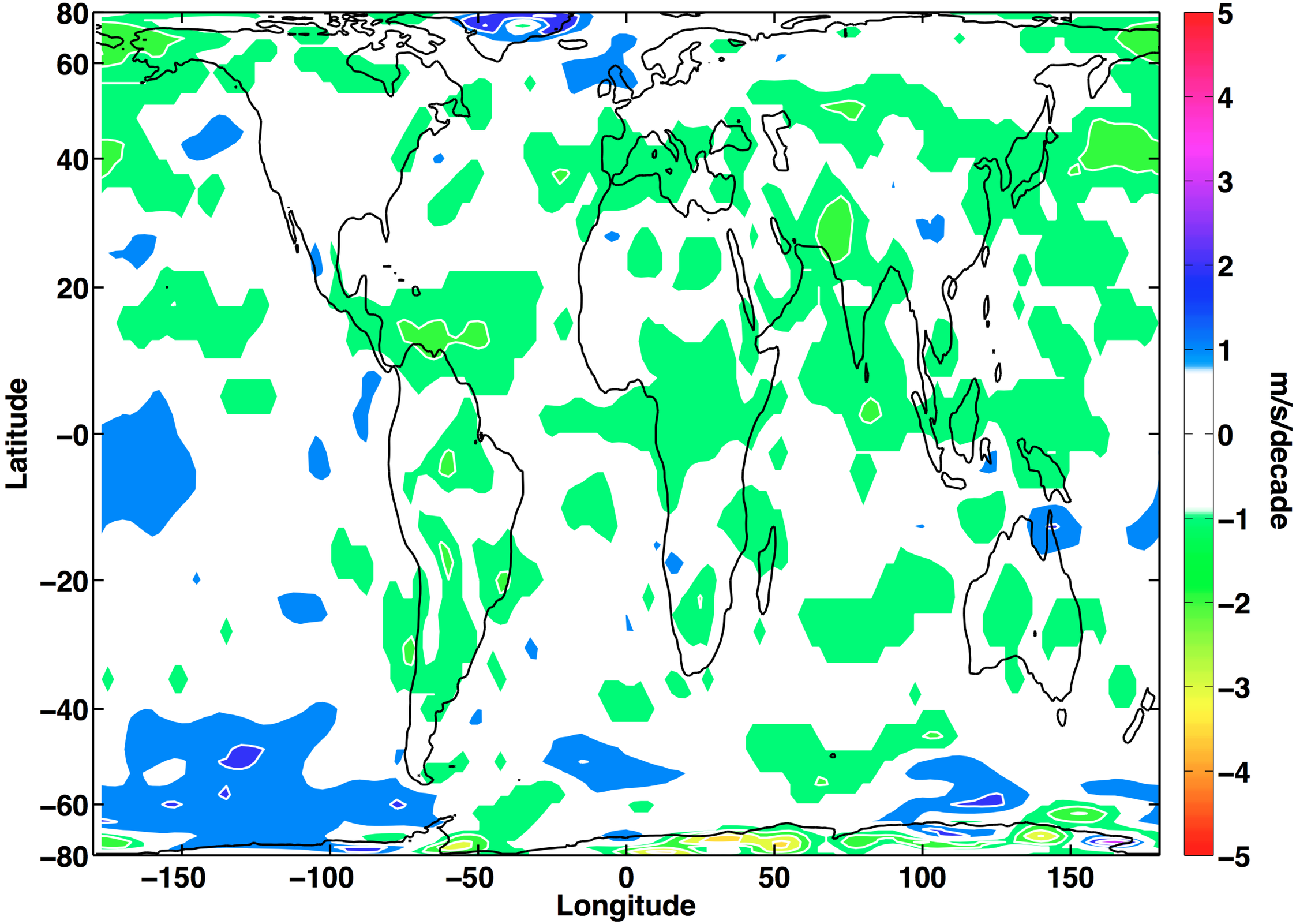
MISR low-level winds, annual 2008

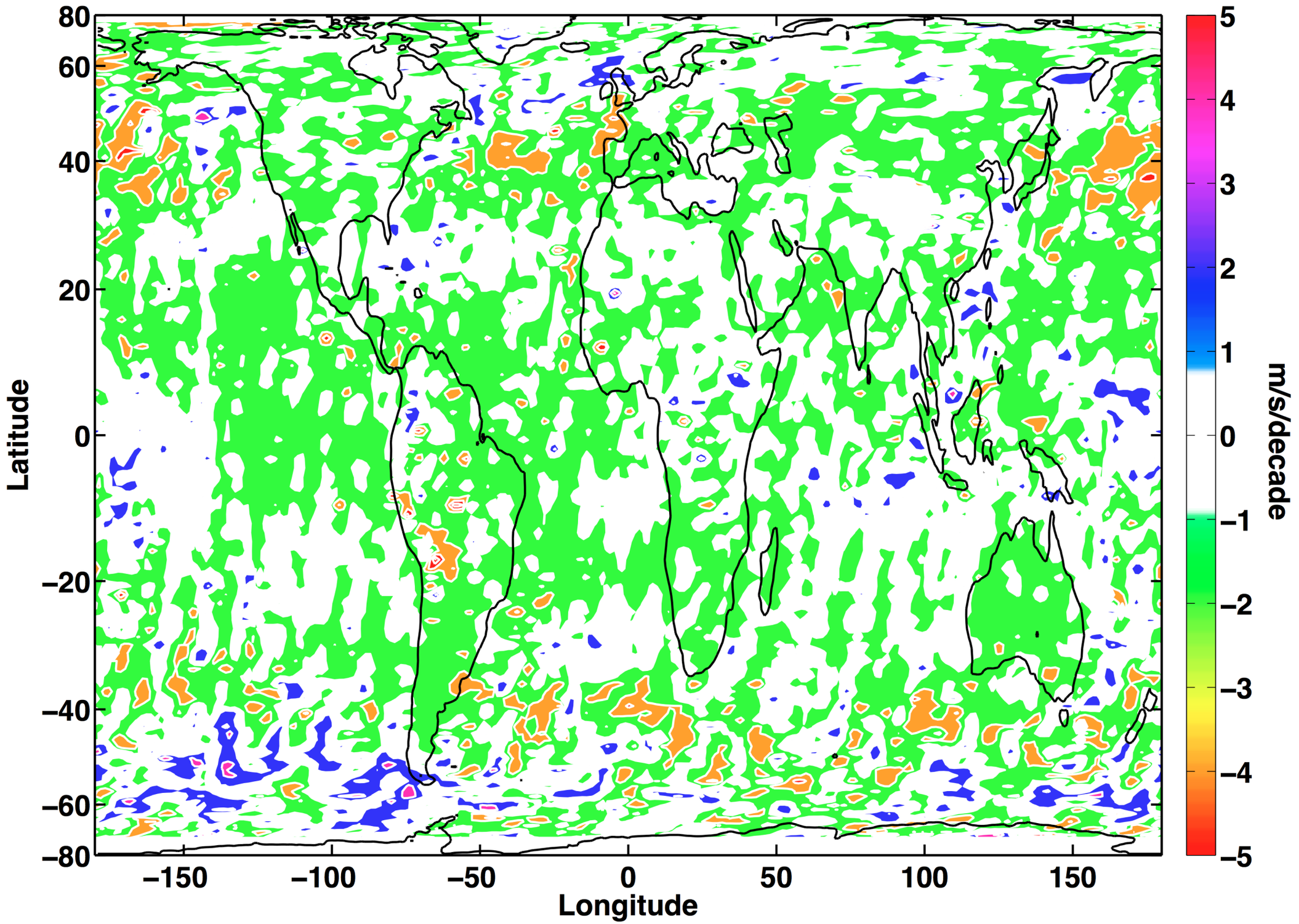


MISR winds: First Generation

- Previously (10th and 11th Workshops) showed general agreement between average MISR first generation winds and reanalysis winds over the ocean
  - better agreement over the Northern Hemisphere where the reanalysis had access to more data
  - differences in meridional wind component due to higher spatial resolution of MISR
  - differences in average low-level winds over the Southern Oceans due to lack of data in the reanalysis winds (they are too fast)
- Also showed similar 10-year trends in low level wind speed
  - increased wind speed over the Southern Oceans ≈1 m/s/decade
  - decreases elsewhere ≈0-1 m/s/decade
  - more spatial detail, and slightly larger values for MISR

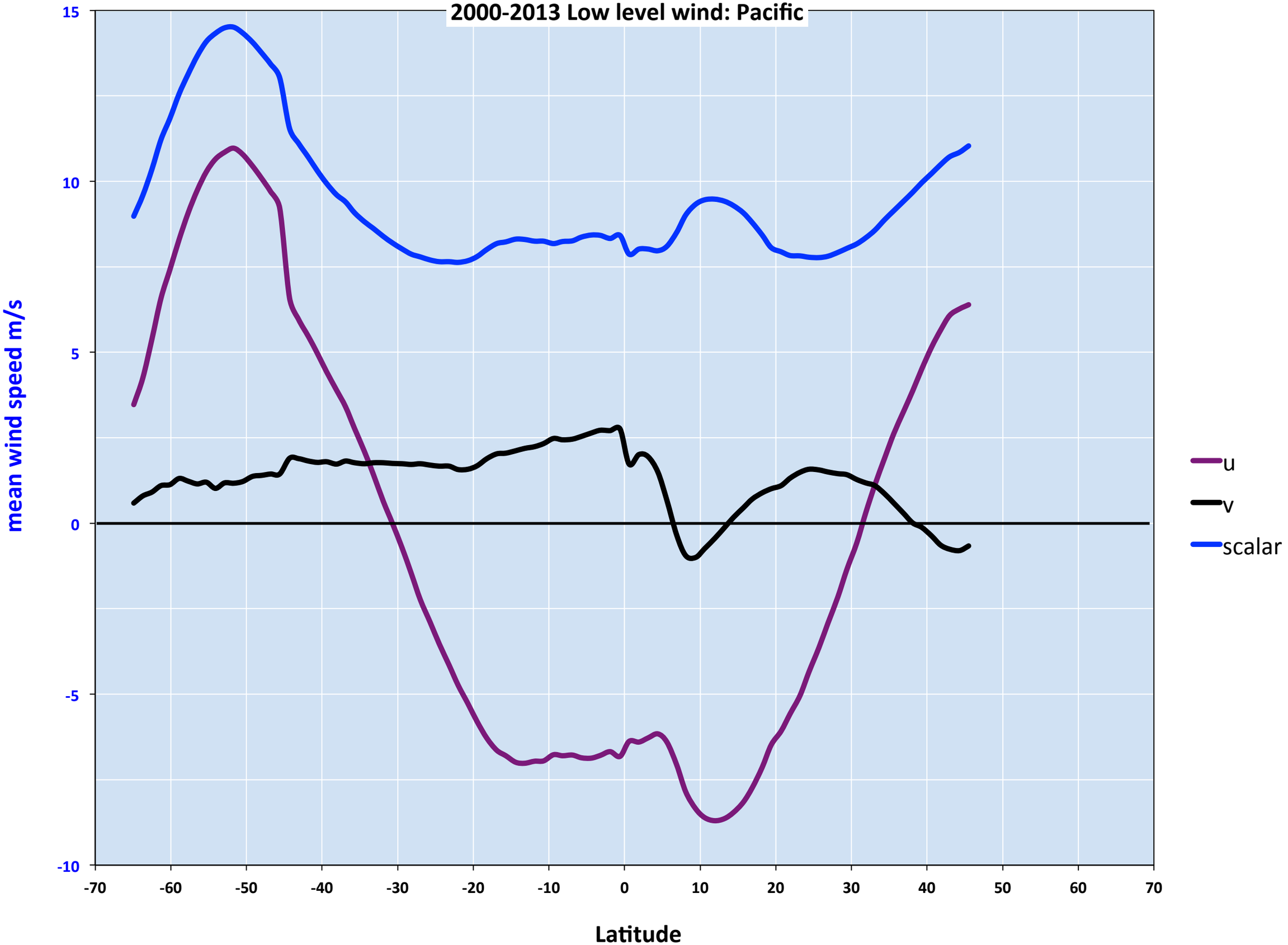
10–Year Trends in Scalar Wind from Reanalysis

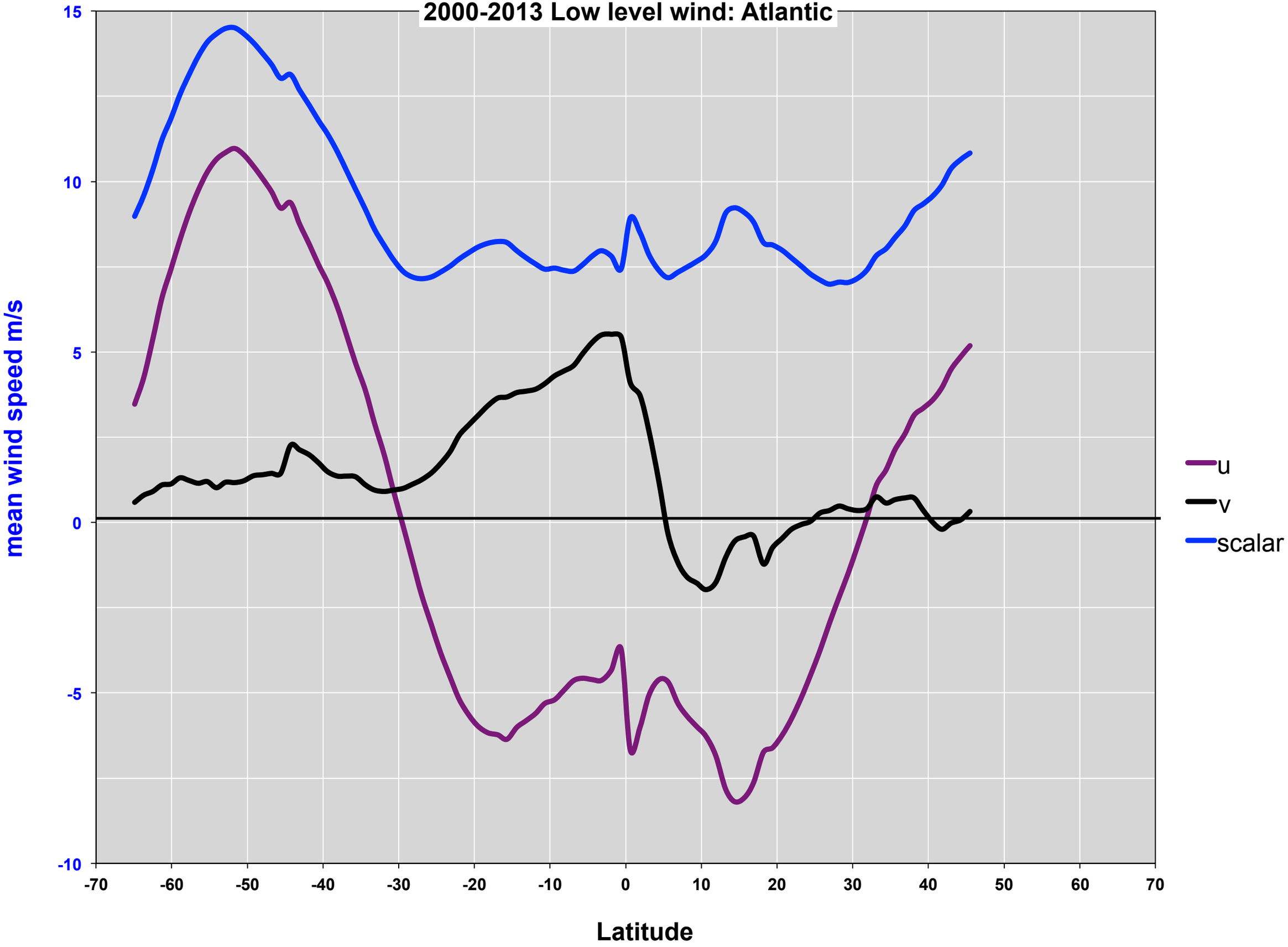


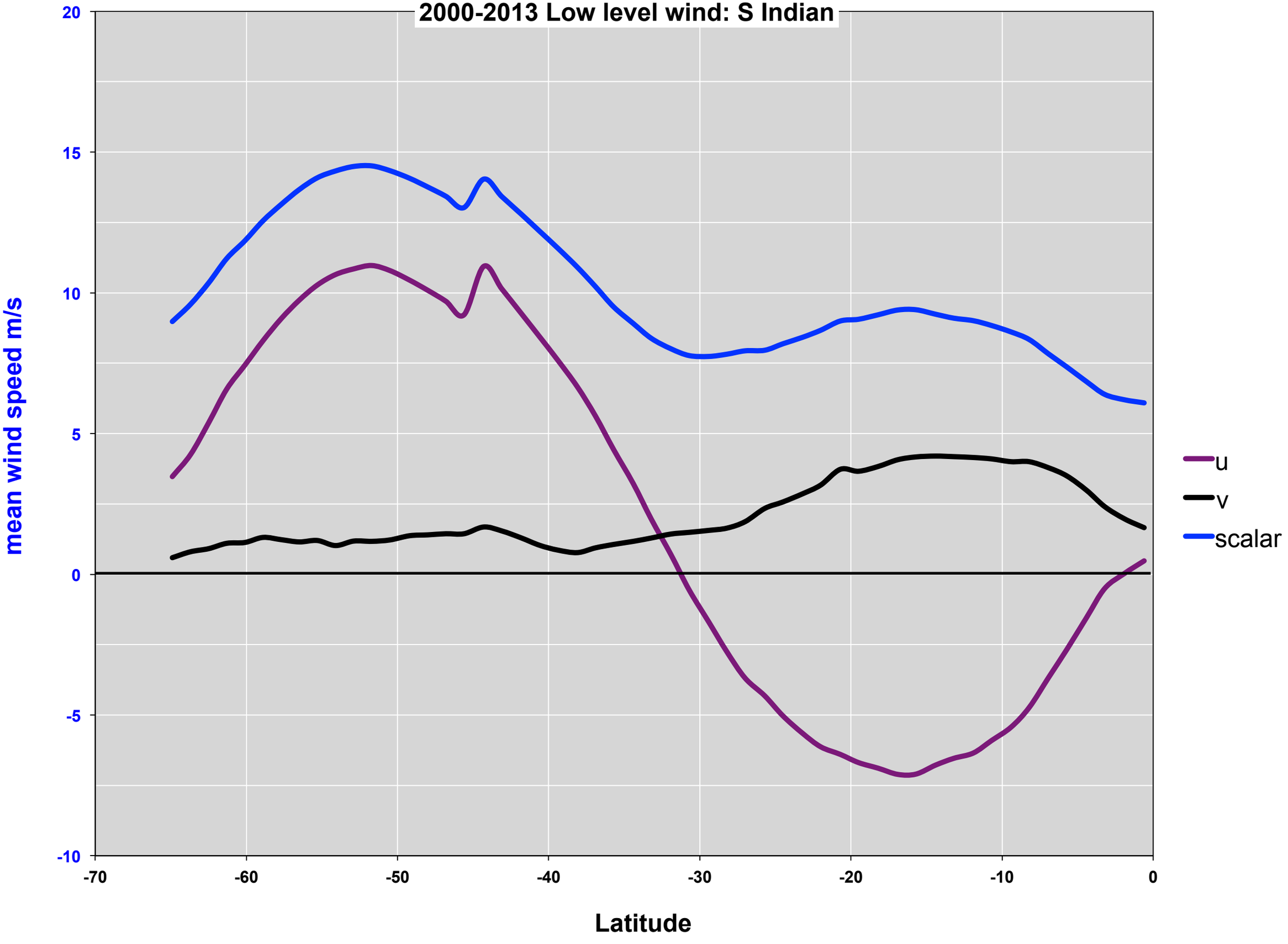

10–Year trends in Scalar Wind from MISR
Latitude
80
60
40
20
0
−20
−40
−60
−80
−150
−100
−50
0
50
100
150
Longitude
5
4
3
2
1
0
−1
−2
−3
−4
−5
m/s/decade

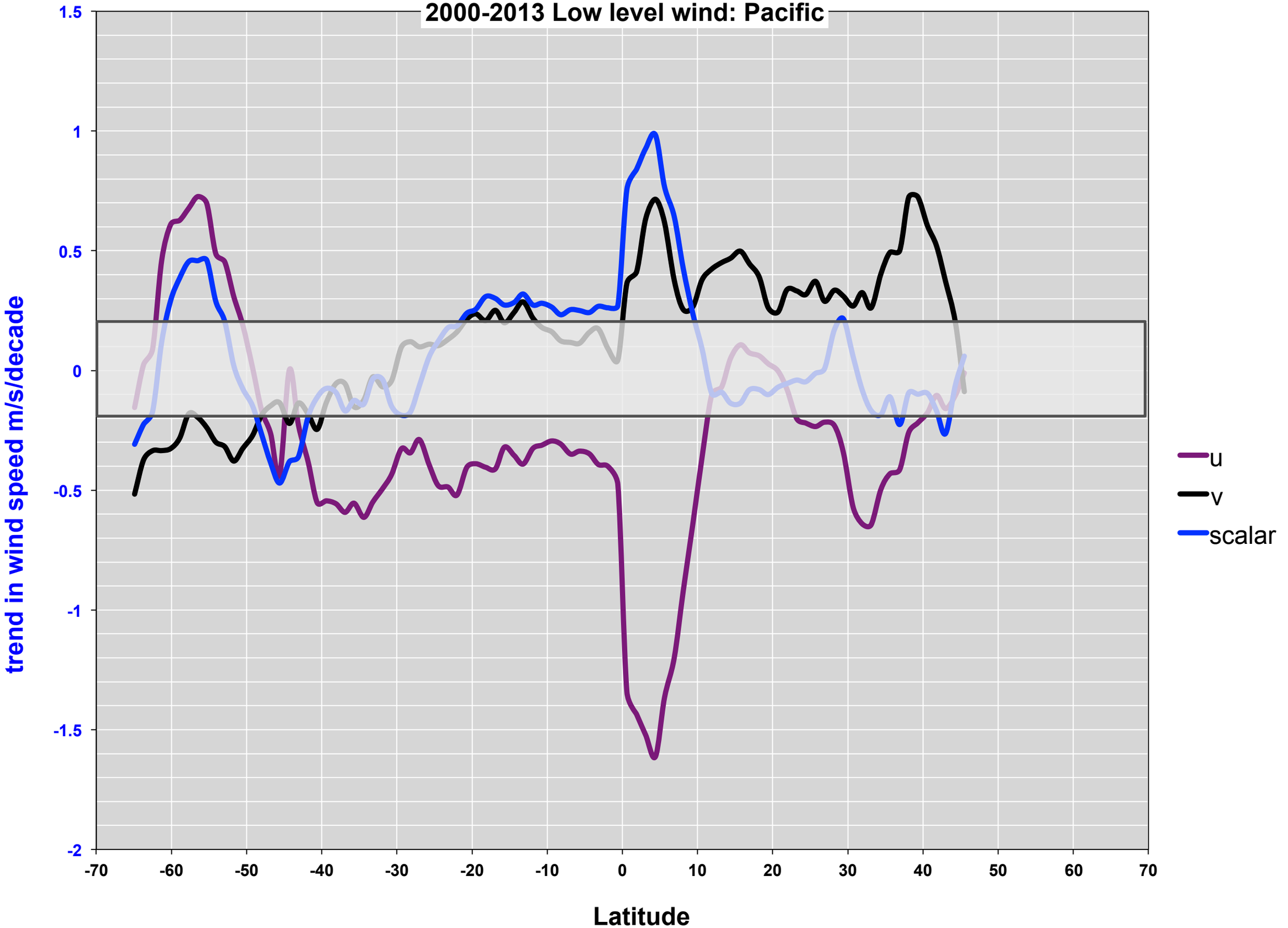
MISR winds: Second Generation

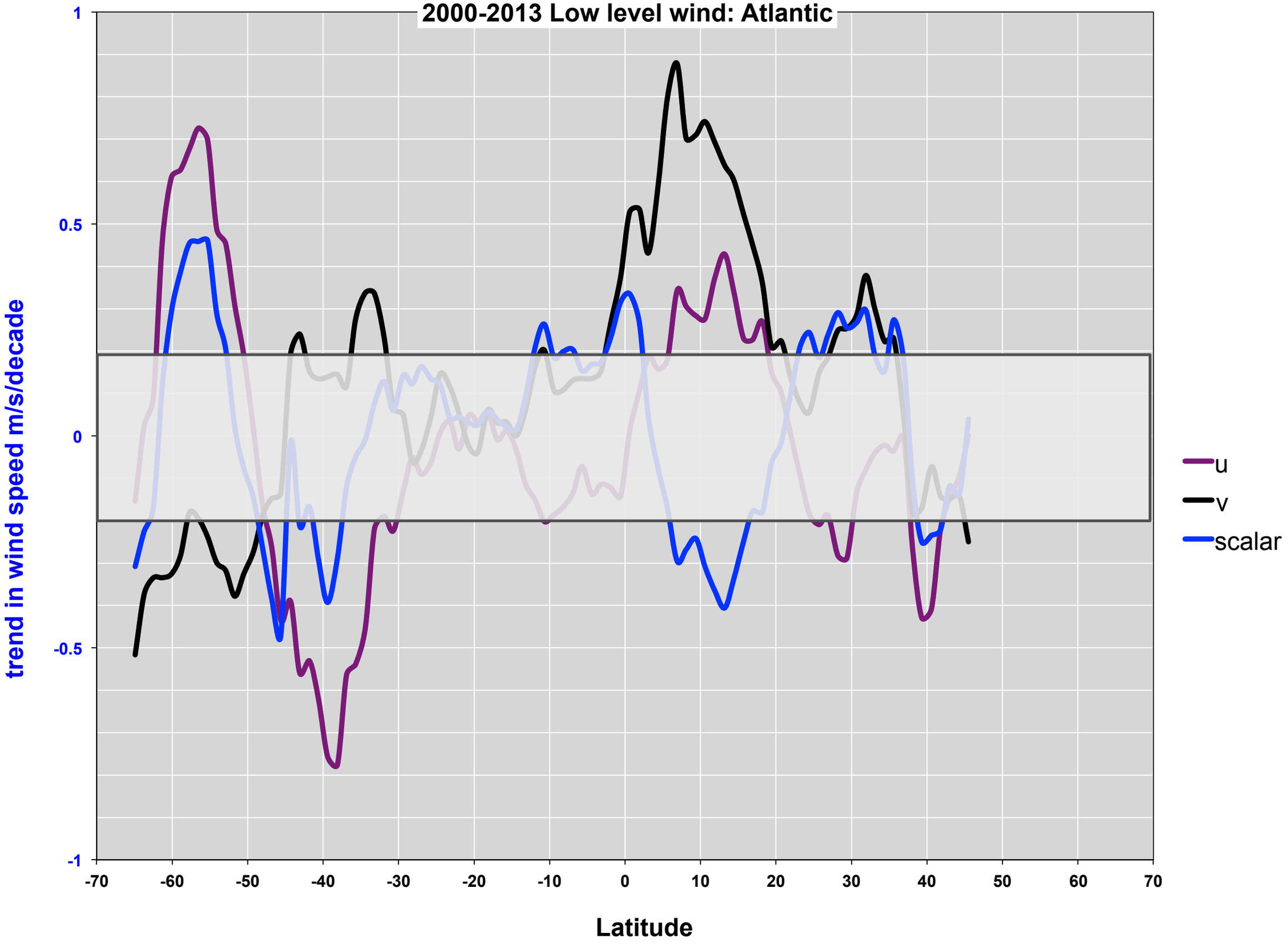
- Improved stereo algorithm for simultaneous wind and height retrieval
  - higher spatial resolution (17.6 km)
  - both fore and aft triplets to improve quality assurance
- Now have reprocessed the second generation winds for entire mission.
  - these give 14-years, pole-pole, geometrically height-resolved, cloud motion vectors
- Here are some preliminary results: 3/00–2/14
  - ocean only (land shows the expected slow bias that decreases with height, but simpler to exclude altogether)
  - average over ocean basin (Pacific, Atlantic, Indian, Southern Ocean–poleward of 45°S)
  - low level (<1.5 km) and high level (9–11 km)

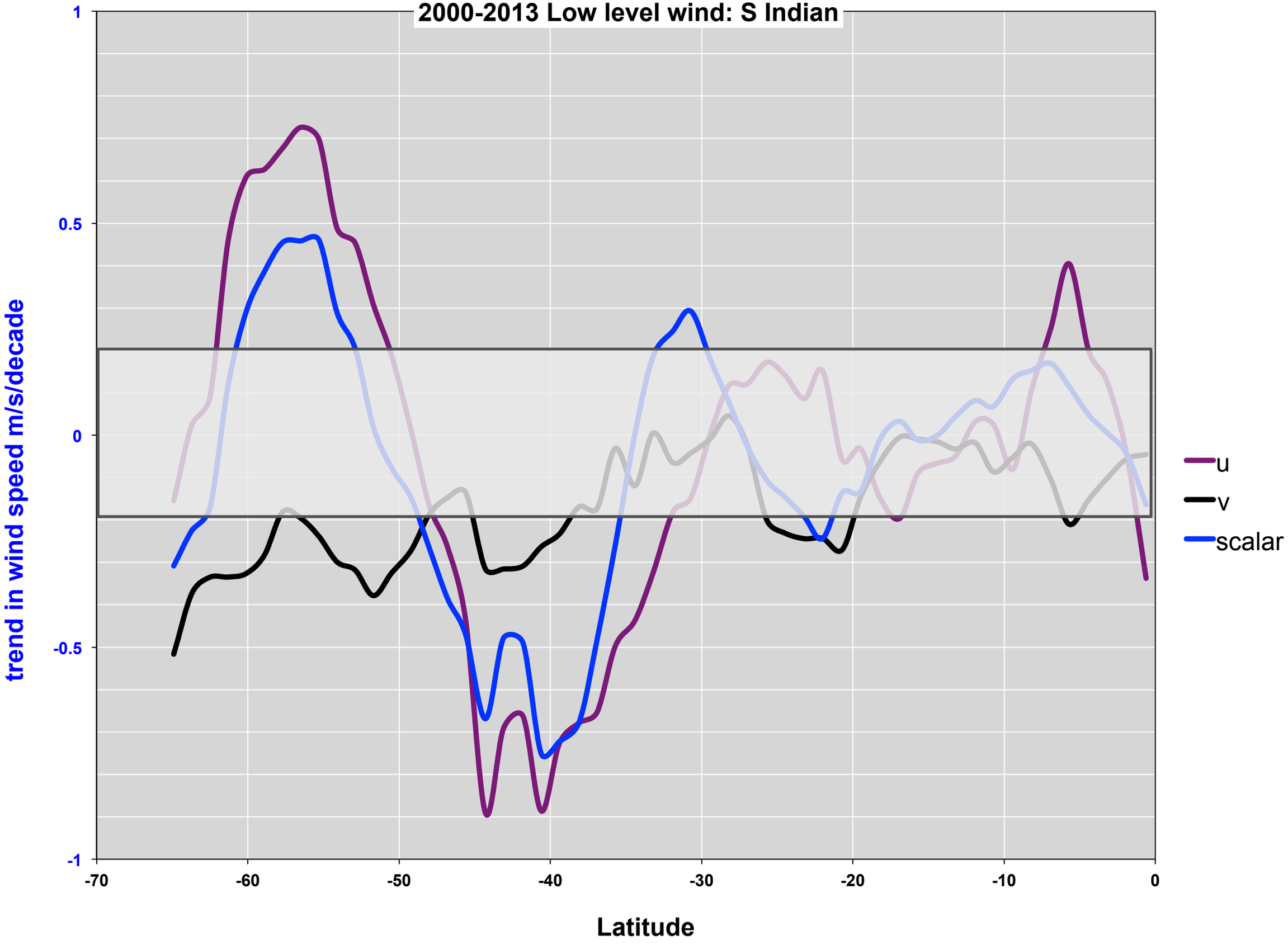

2000-2013 Low level wind: Pacific
mean wind speed m/s
15
10
5
0
-5
-10
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Latitude
u
v
scalar

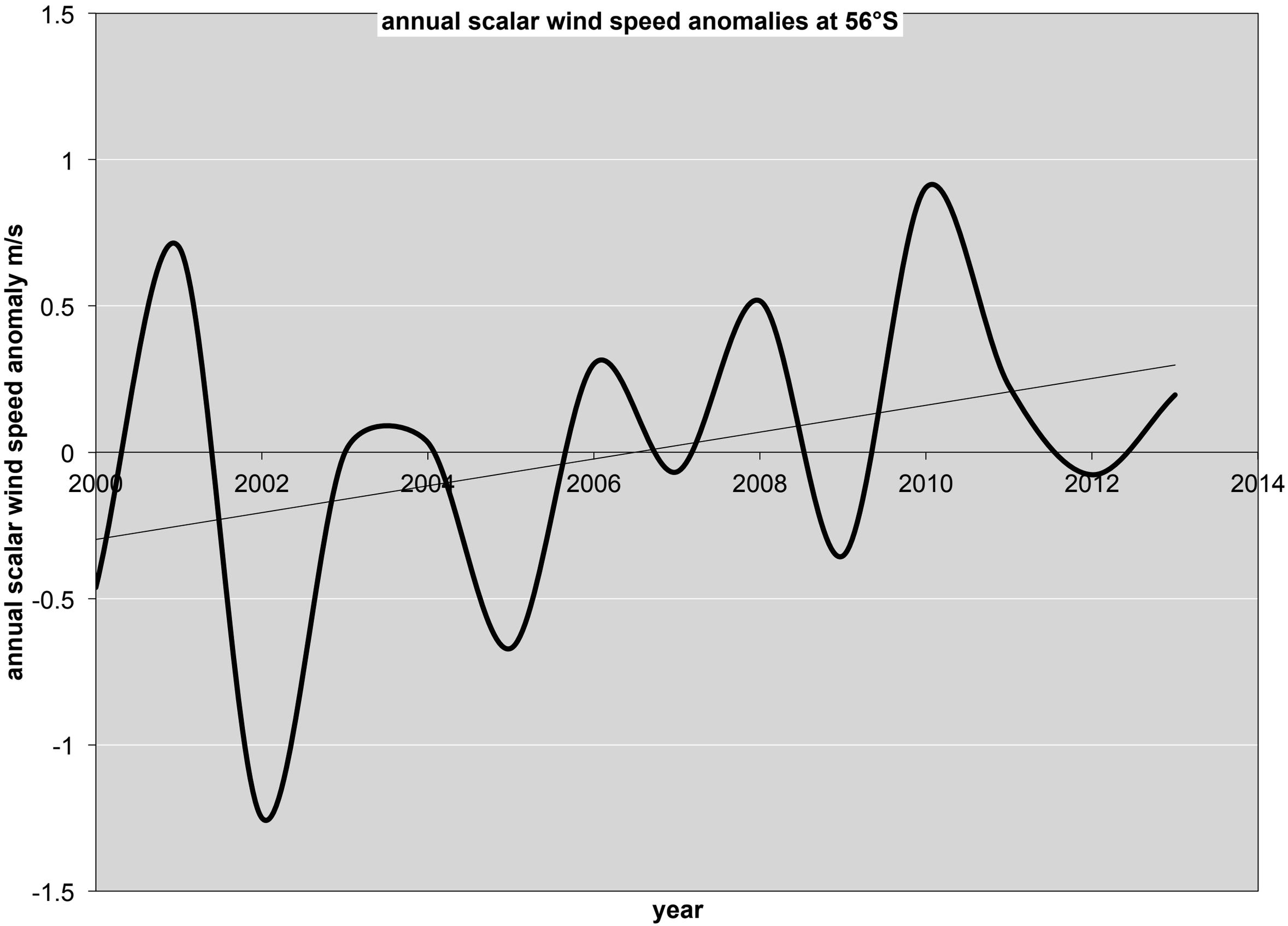

2000-2013 Low level wind: Atlantic
mean wind speed m/s
15
10
5
0
-5
-10
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Latitude
u
v
scalar

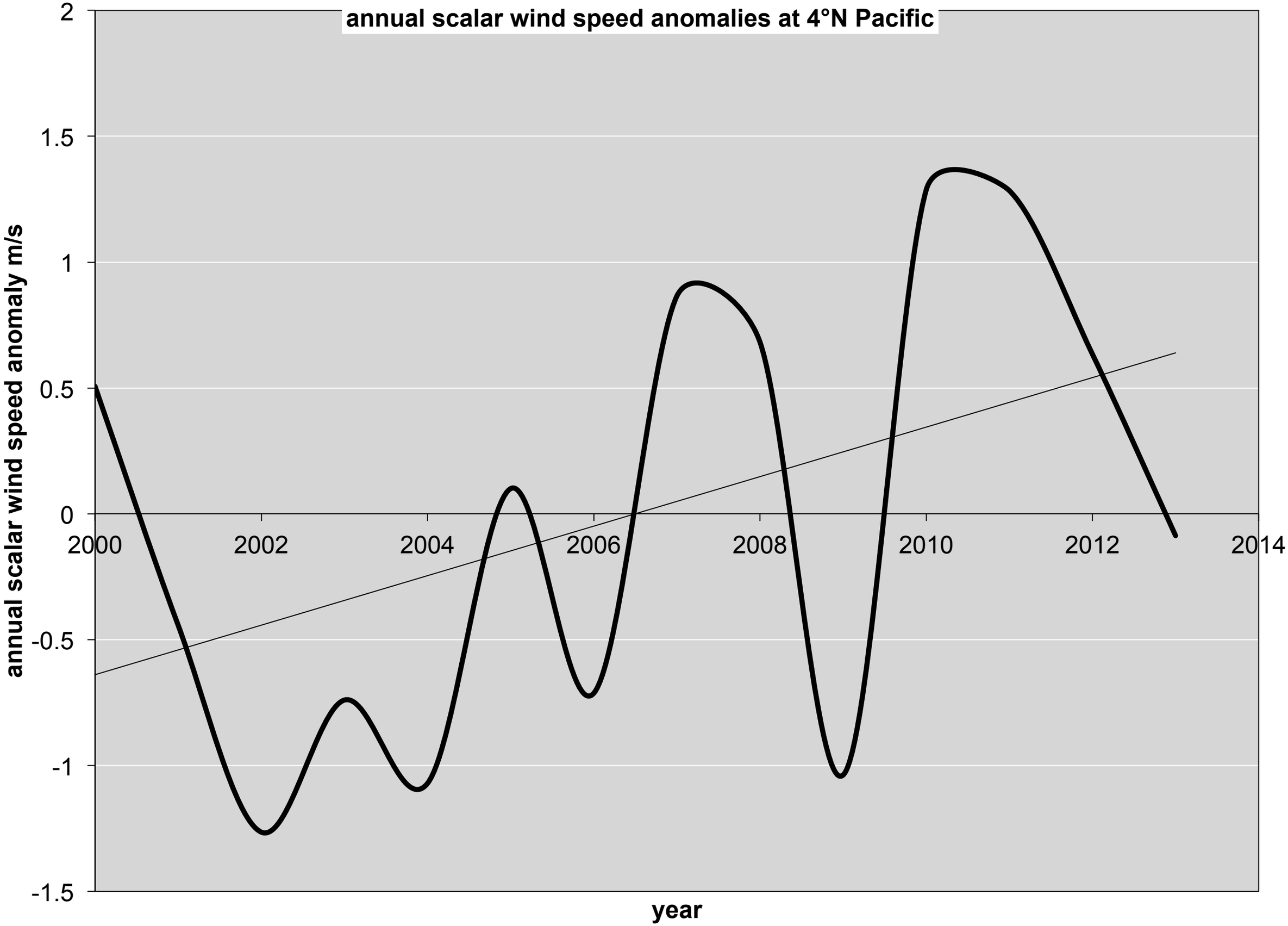

2000-2013 Low level wind: S Indian
mean wind speed m/s
20
15
10
5
0
-5
-10
-70
-60
-50
-40
-30
-20
-10
0
Latitude
u
v
scalar

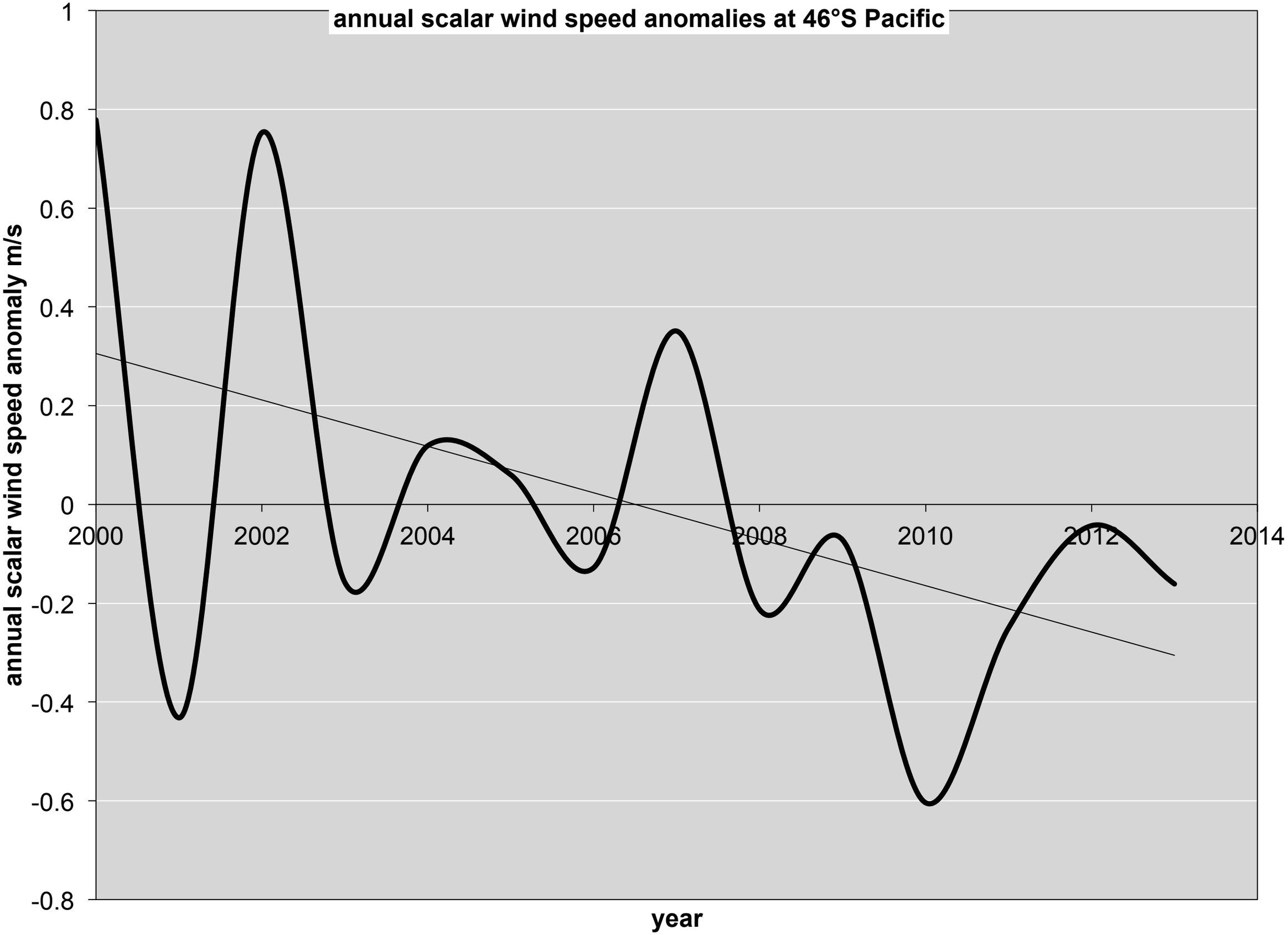

2000-2013 Low level wind: Pacific
trend in wind speed m/s/decade
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Latitude
u
v
scalar


2000-2013 Low level wind: Atlantic
trend in wind speed m/s/decade
1
0.5
0
-0.5
-1
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
Latitude
u
v
scalar


2000-2013 Low level wind: S Indian
trend in wind speed m/s/decade
1
0.5
0
-0.5
-1
-70
-60
-50
-40
-30
-20
-10
0
Latitude
u
v
scalar

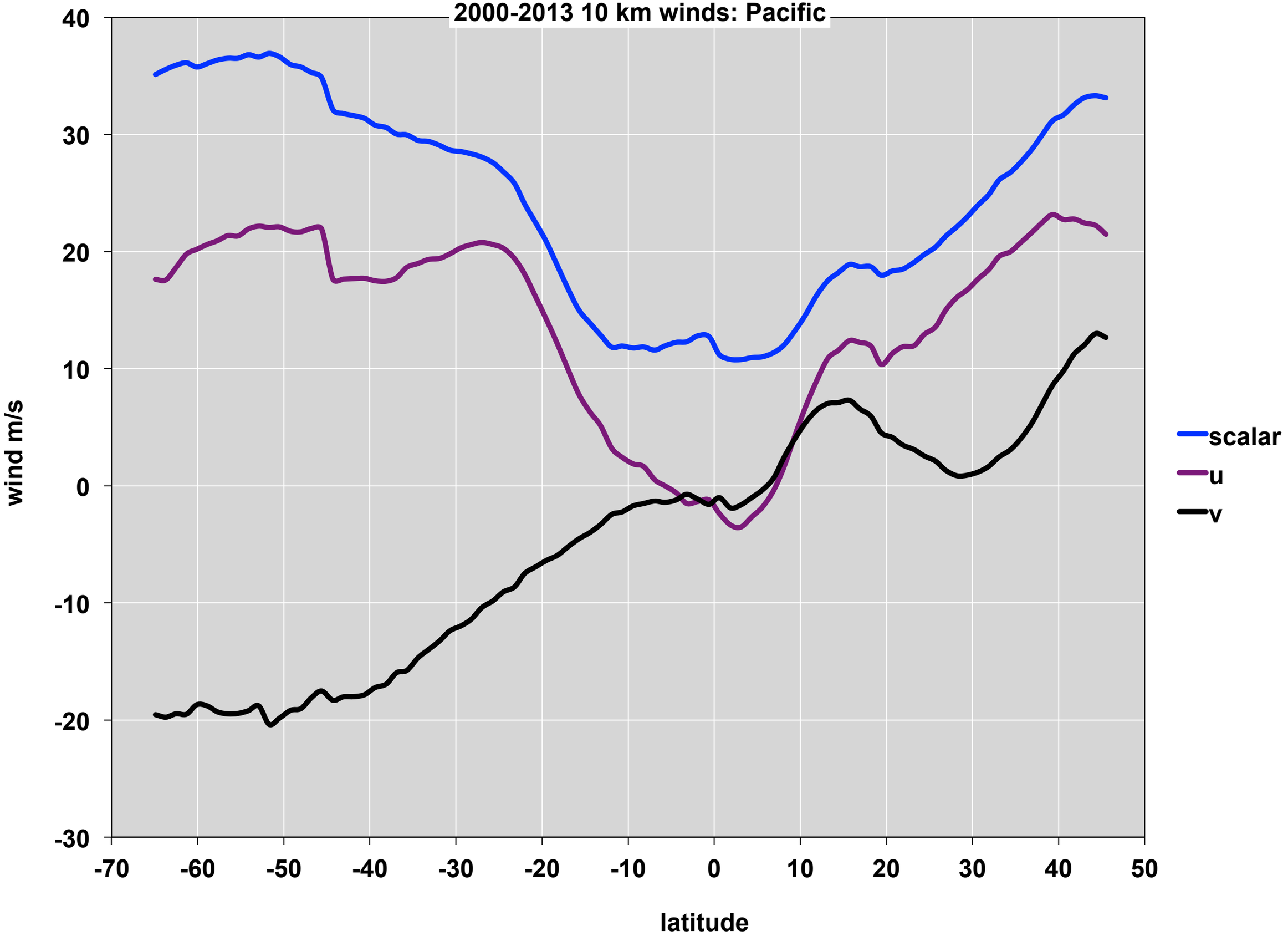

annual scalar wind speed anomalies at 56°S
annual scalar wind speed anomaly m/s
1.5
1
0.5
0
-0.5
-1
-1.5
2000
2002
2004
2006
2008
2010
2012
2014
year

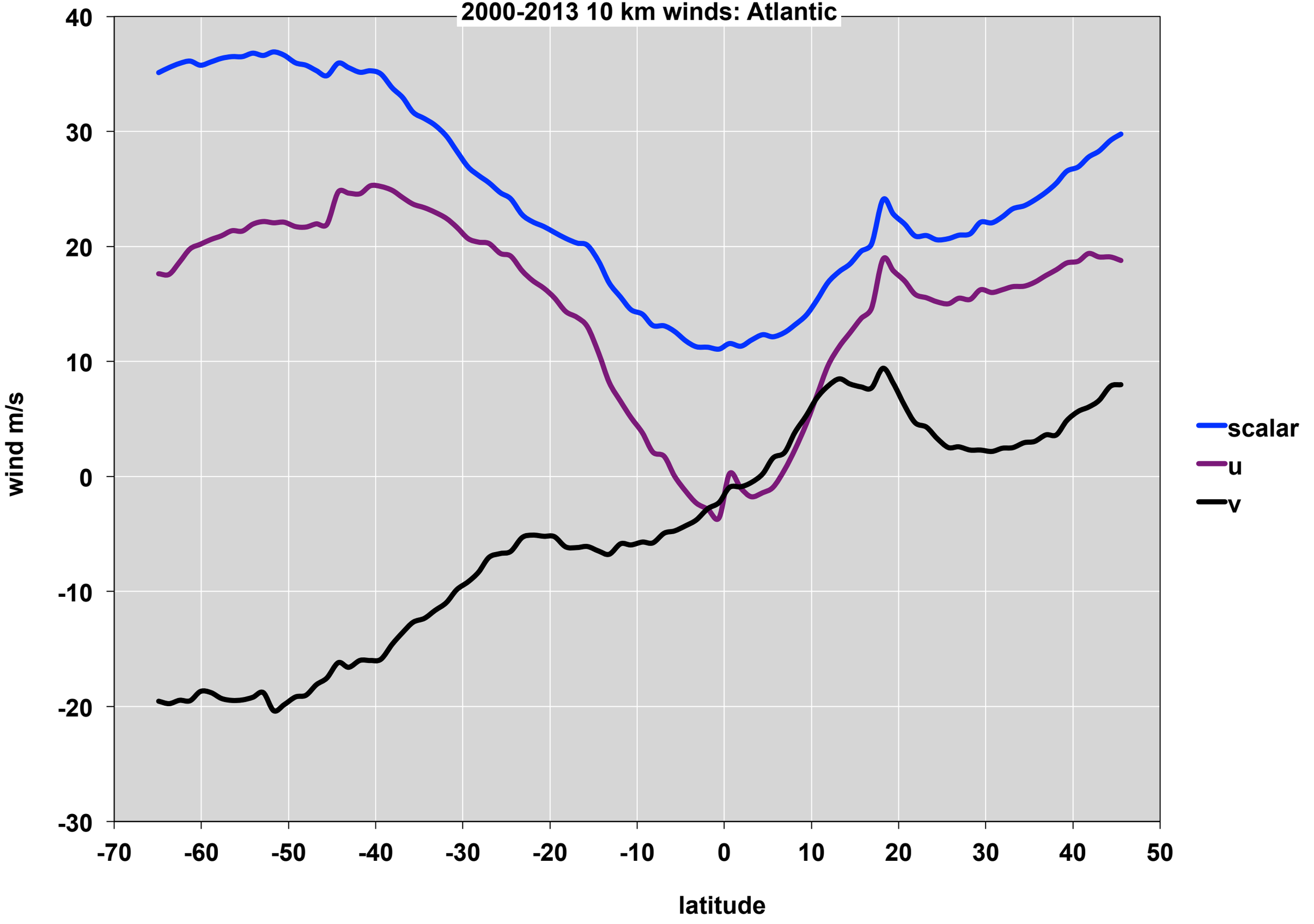

annual scalar wind speed anomalies at 4°N Pacific
annual scalar wind speed anomaly m/s
2
1.5
1
0.5
0
-0.5
-1
-1.5
2000
2002
2004
2006
2008
2010
2012
2014
year

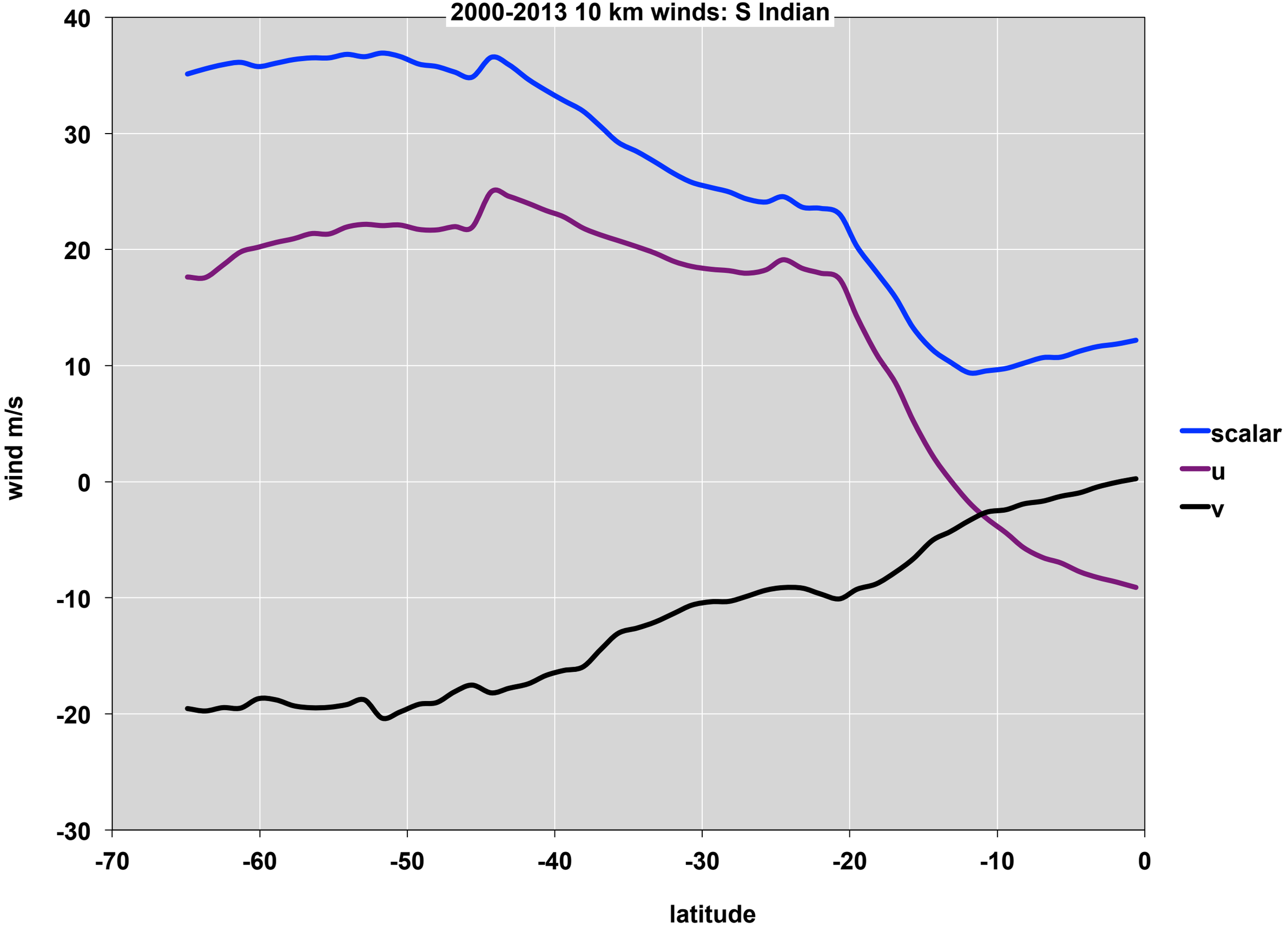

annual scalar wind speed anomalies at 46°S Pacific
annual scalar wind speed anomaly m/s
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
2000
2002
2004
2006
2008
2010
2012
2014
year

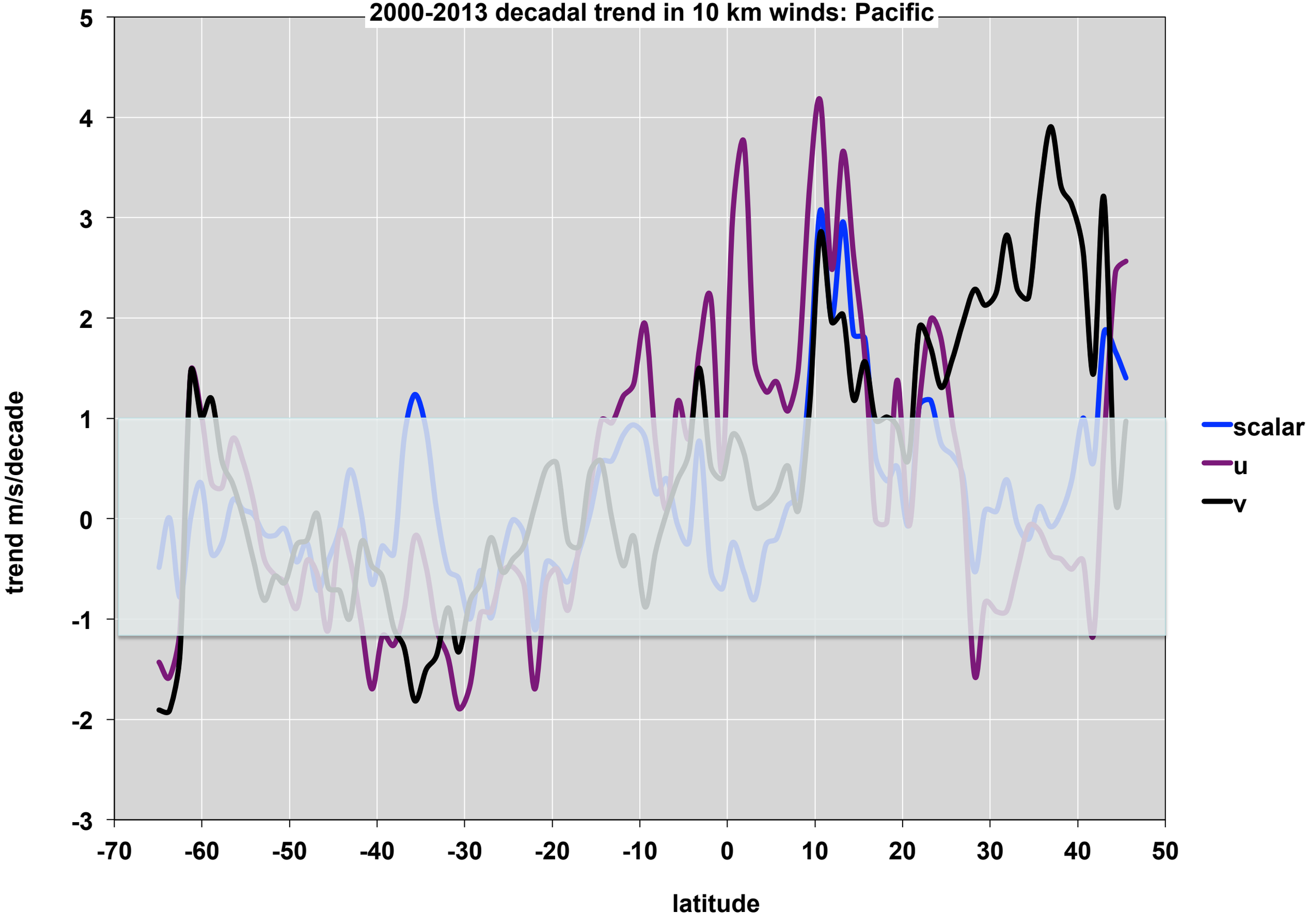
Summary of Low Level Winds

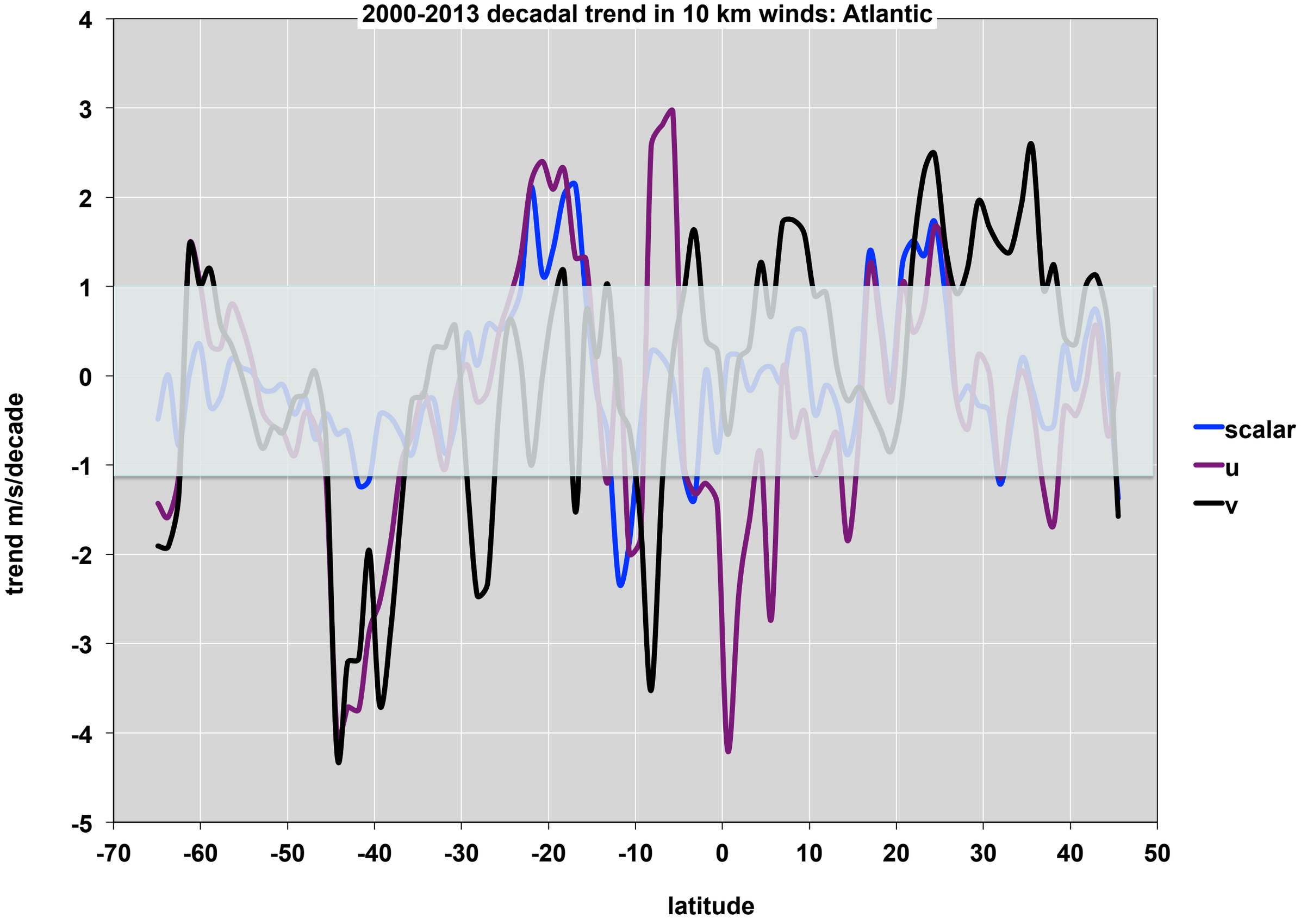
- Southern Ocean (max effect at 55°S)
  - increased wind speed ≈0.5 m/s/decade
  - due to increasing westerlies
- Southern Ocean (max effect at 45°S)
  - Narrow band of decreased westerlies reduces speed ≈0.6 m/s/decade at 45°S
- North Pacific
  - Narrow band of increased winds 1 m/s/decade at 4°N (probably a shift in the ITCZ), stronger easterlies by 1.5 m/s/decade
- North Atlantic
  - Slight decrease at 13°N of 0.4 m/s/decade, due to both ITCZ and decreasing easterlies

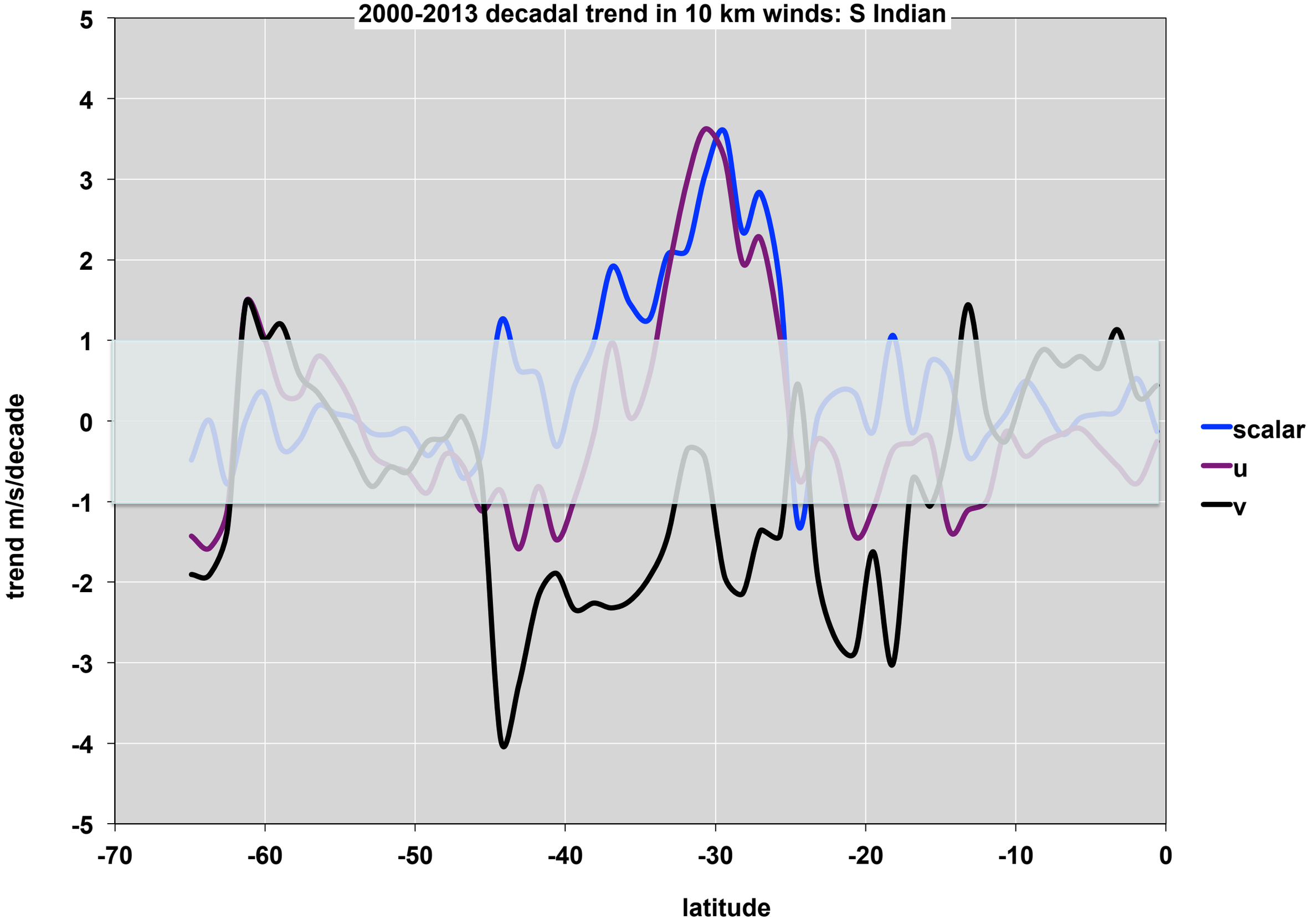

2000-2013 10 km winds: Pacific
wind m/s
40
30
20
10
0
-10
-20
-30
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
latitude
scalar
u
v

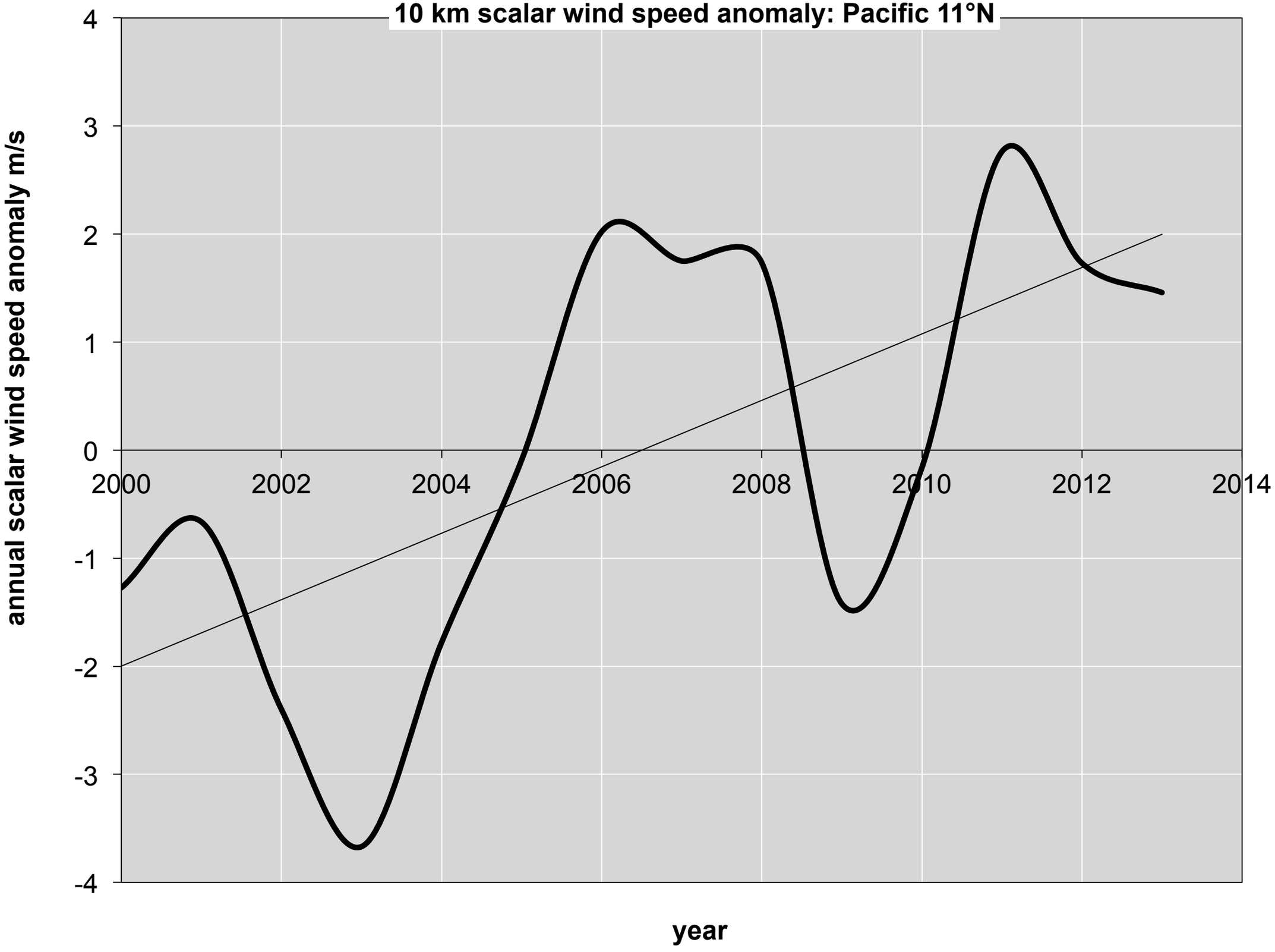

2000-2013 10 km winds: Atlantic
wind m/s
40
30
20
10
0
-10
-20
-30
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
latitude
scalar
u
v

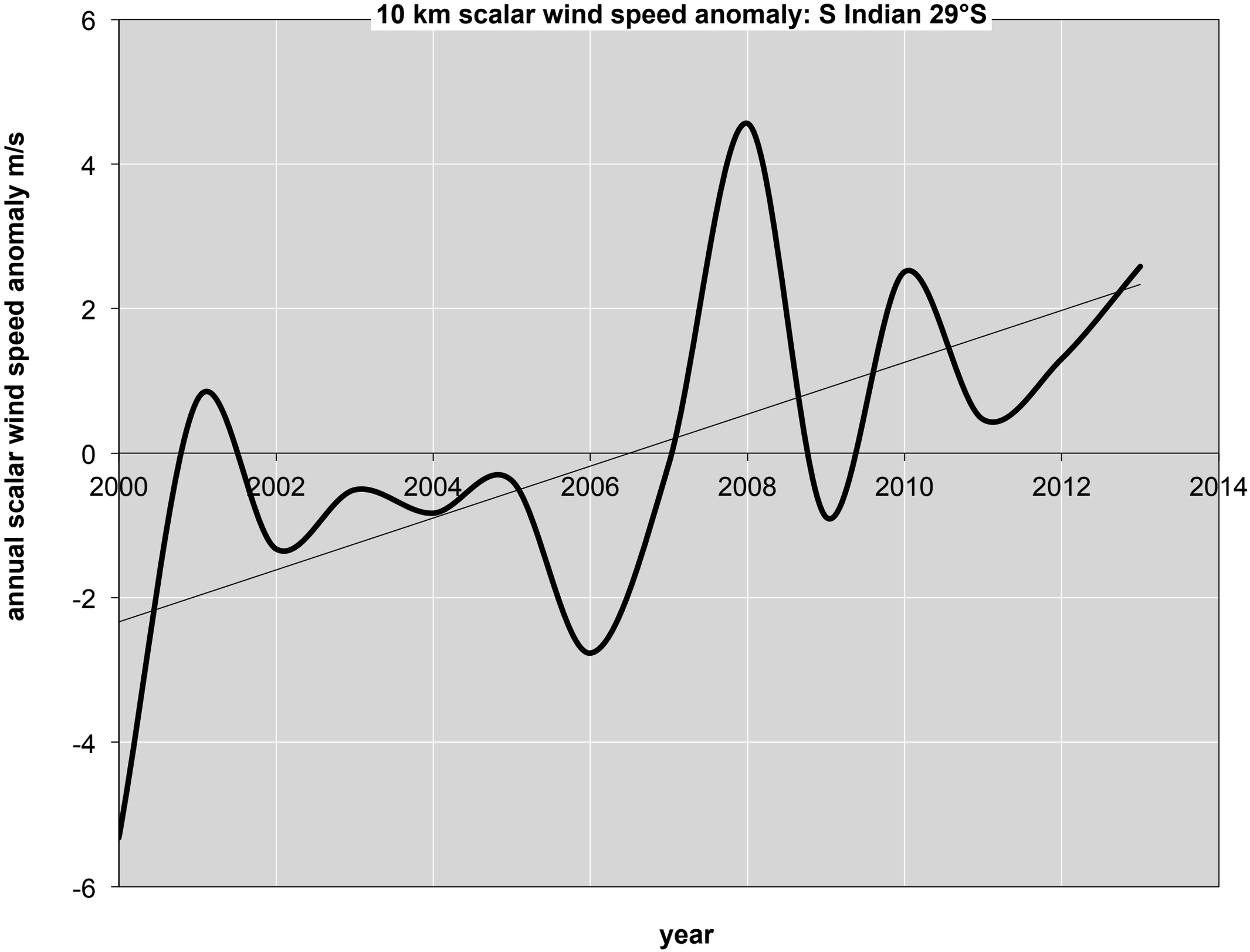

2000-2013 10 km winds: S Indian
wind m/s
40
30
20
10
0
-10
-20
-30
-70
-60
-50
-40
-30
-20
-10
0
latitude
scalar
u
v


2000-2013 decadal trend in 10 km winds: Pacific
trend m/s/decade
5
4
3
2
1
0
-1
-2
-3
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
latitude
scalar
u
v


2000-2013 decadal trend in 10 km winds: Atlantic
trend m/s/decade
4
3
2
1
0
-1
-2
-3
-4
-5
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
latitude
scalar
u
v


2000-2013 decadal trend in 10 km winds: S Indian
trend m/s/decade
5
4
3
2
1
0
-1
-2
-3
-4
-5
-70
-60
-50
-40
-30
-20
-10
0
latitude
scalar
u
v


10 km scalar wind speed anomaly: Pacific 11°N
annual scalar wind speed anomaly m/s
4
3
2
1
0
-1
-2
-3
-4
2000
2002
2004
2006
2008
2010
2012
2014
year

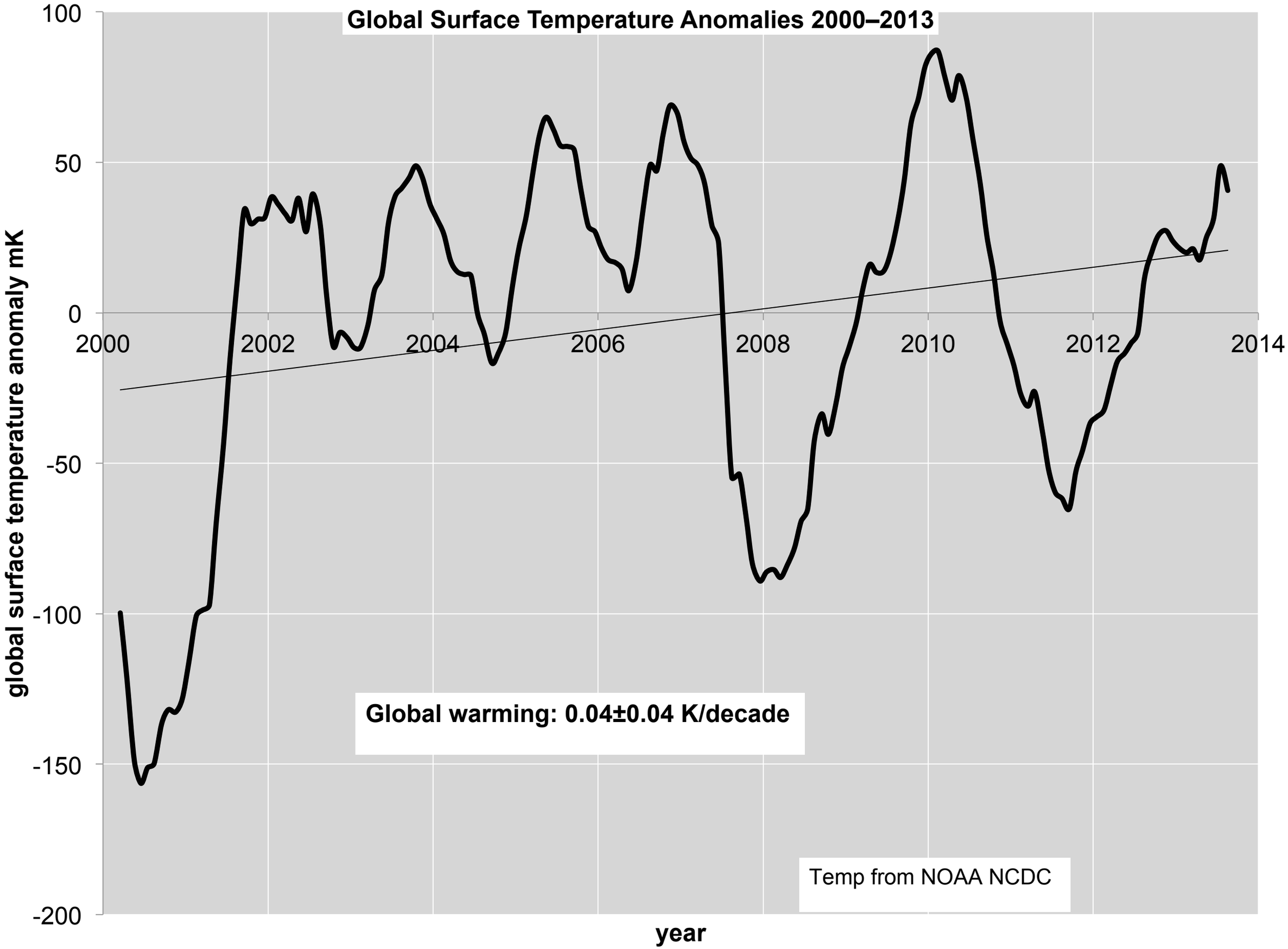

10 km scalar wind speed anomaly: S Indian 29°S
annual scalar wind speed anomaly m/s
6
4
2
0
-2
-4
-6
2000
2002
2004
2006
2008
2010
2012
2014
year

Upper level winds

- Climatology looks reasonable
  - stronger meridional components than for reanalysis, especially over S. Oceans
- Trends over last 14 years are fairly weak in general
  - increases of ≈3 m/s/decade in a few places

Work in Progress

- need to compare regions in more detail against reanalysis
- error analysis is still incomplete
- are there implications for circulation changes affecting high clouds?
- what is going on around the ITCZ?
- last 14 years has not been representative of climate change


Global Surface Temperature Anomalies 2000–2013
global surface temperature anomaly mK
100
50
0
-50
-100
-150
-200
2000
2002
2004
2006
2008
2010
2012
2014
Global warming: 0.04±0.04 K/decade
Temp from NOAA NCDC
year