Evidence for Globally Decreasing Subtropical Marine Stratocumulus since 1952

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Fall 2002 AGU

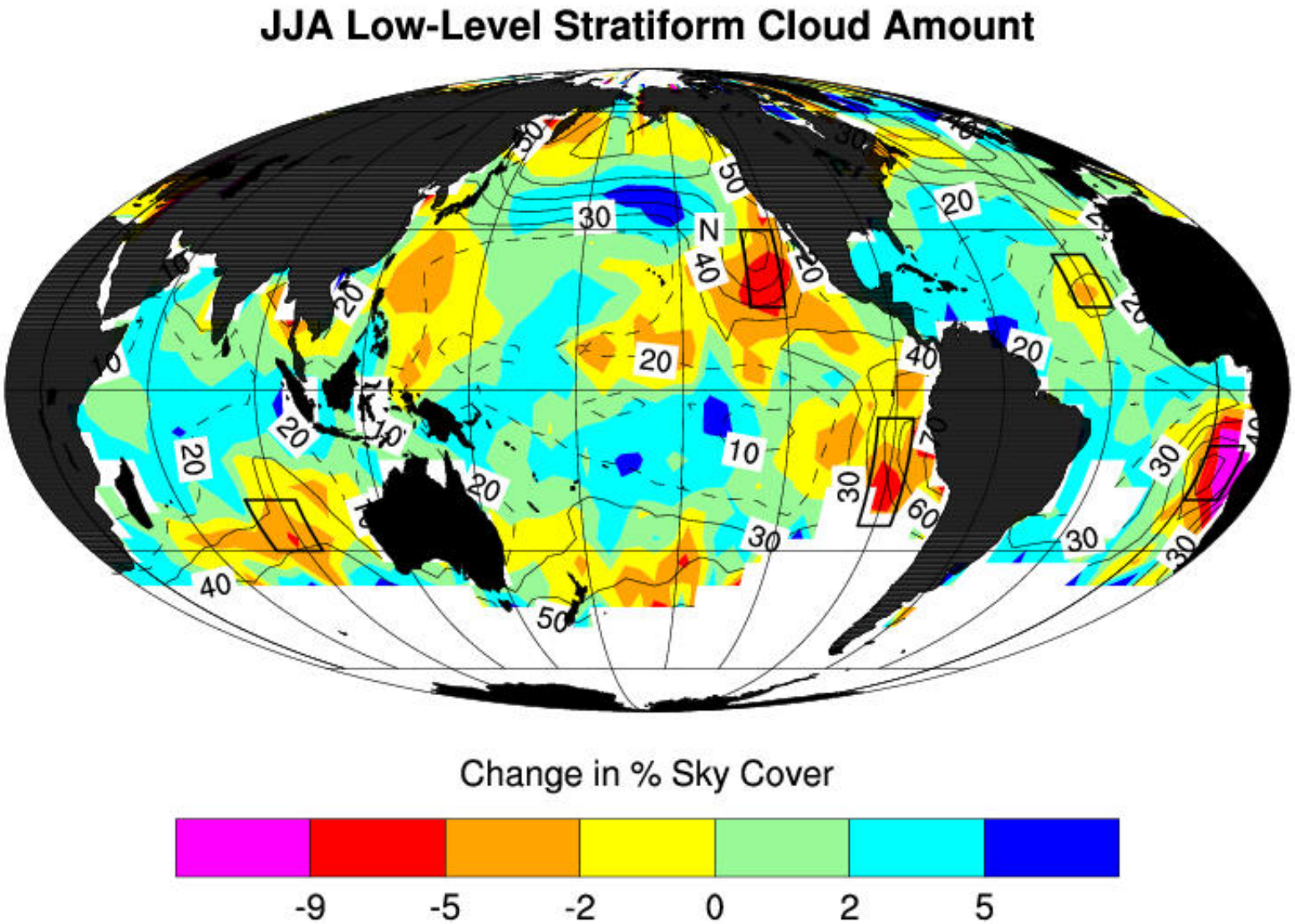
Cloud Data and Methods

- Stratus, stratocumulus and fog observed by ships of opportunity (archive compiled by Hahn and Warren)
- Averaging of individual synoptic cloud reports to season and spatial grid
- Special techniques handle highly non-uniform sampling
- Daytime only

Radiation Data and Methods

- ERBE WFOV monthly 10°x10° outgoing longwave radiation and all-sky albedo
- Interpolation in some cases to 5°x5°
- Averaging over season and spatial grid
- Aliasing of diurnal cycle is not a problem for this study
- Acknowledgement to Takmeng Wong

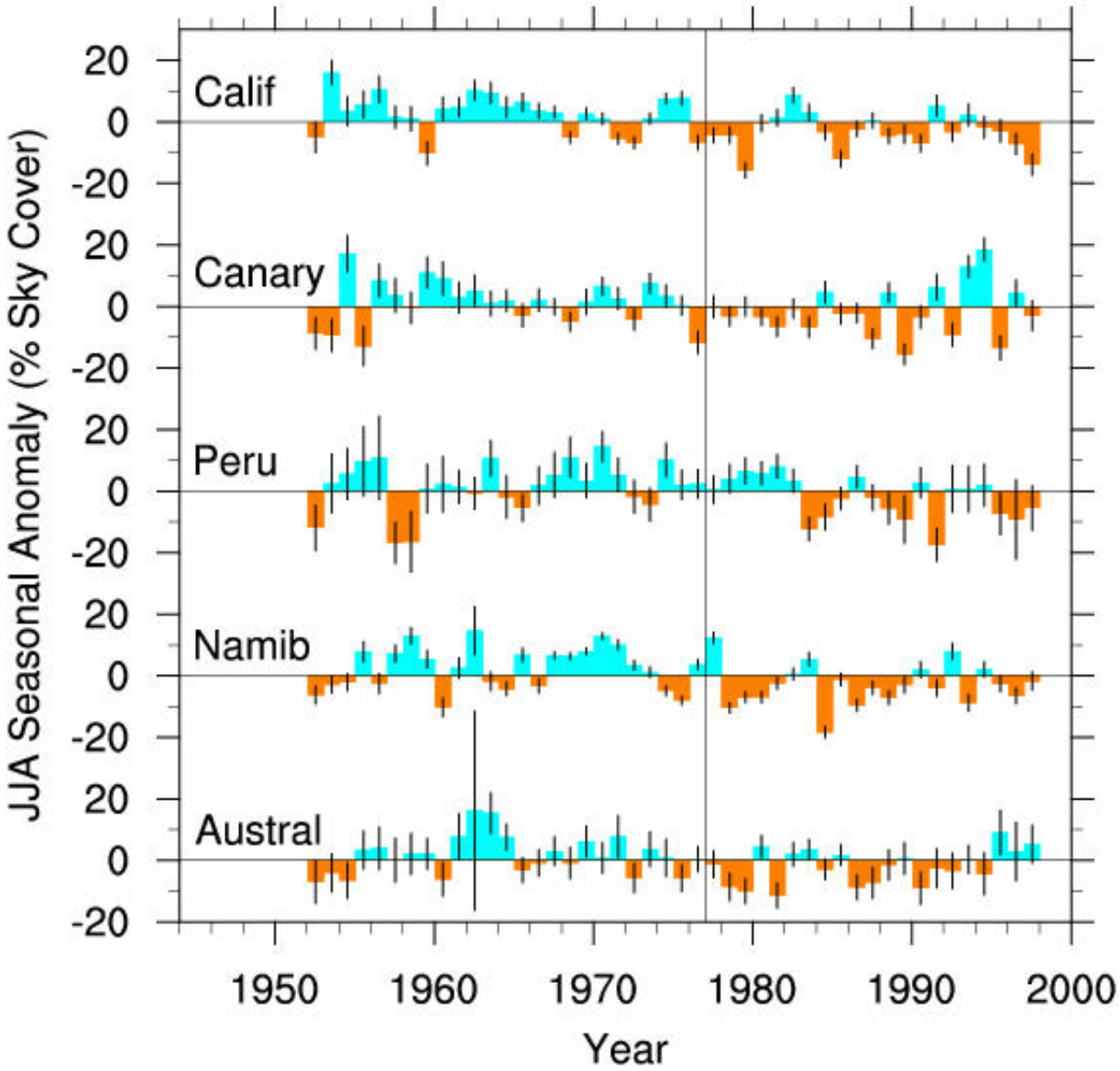
Decreasing cloud cover in every Sc region



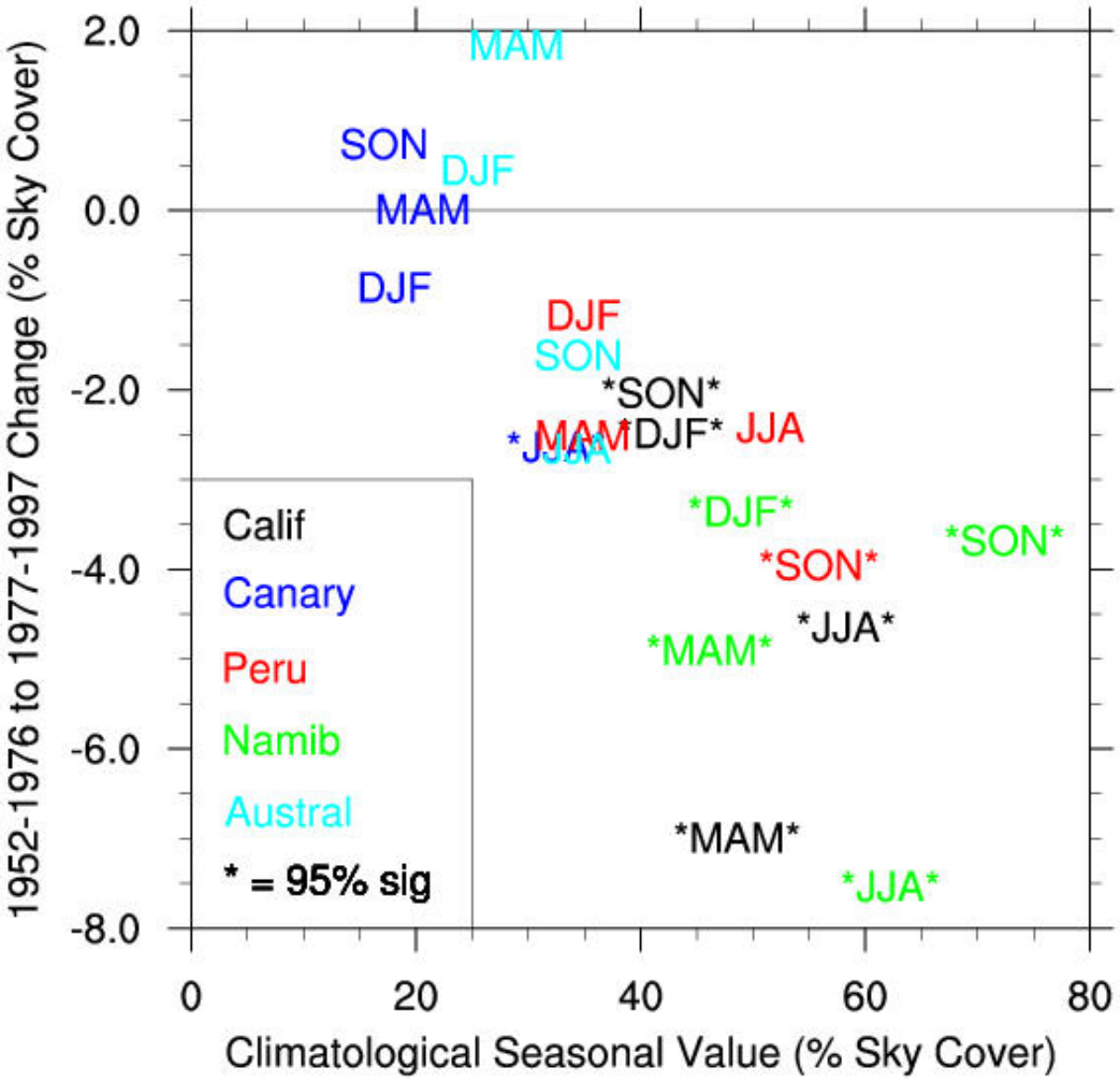
line = climatology

color = change from 1952-76 to 1977-97

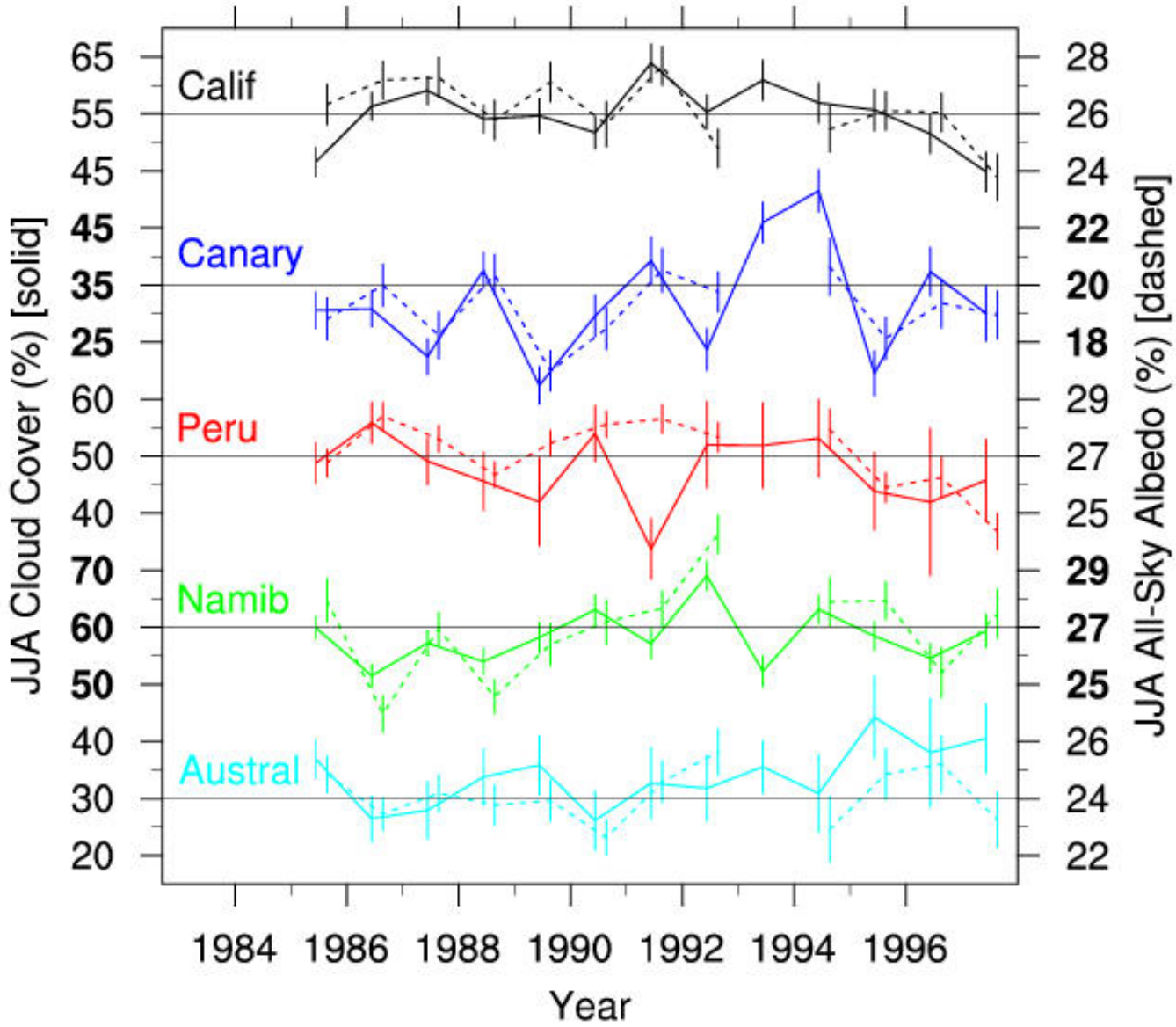
Decreasing cloud cover in every Sc region



Largest decreases when and where Sc is prevalent



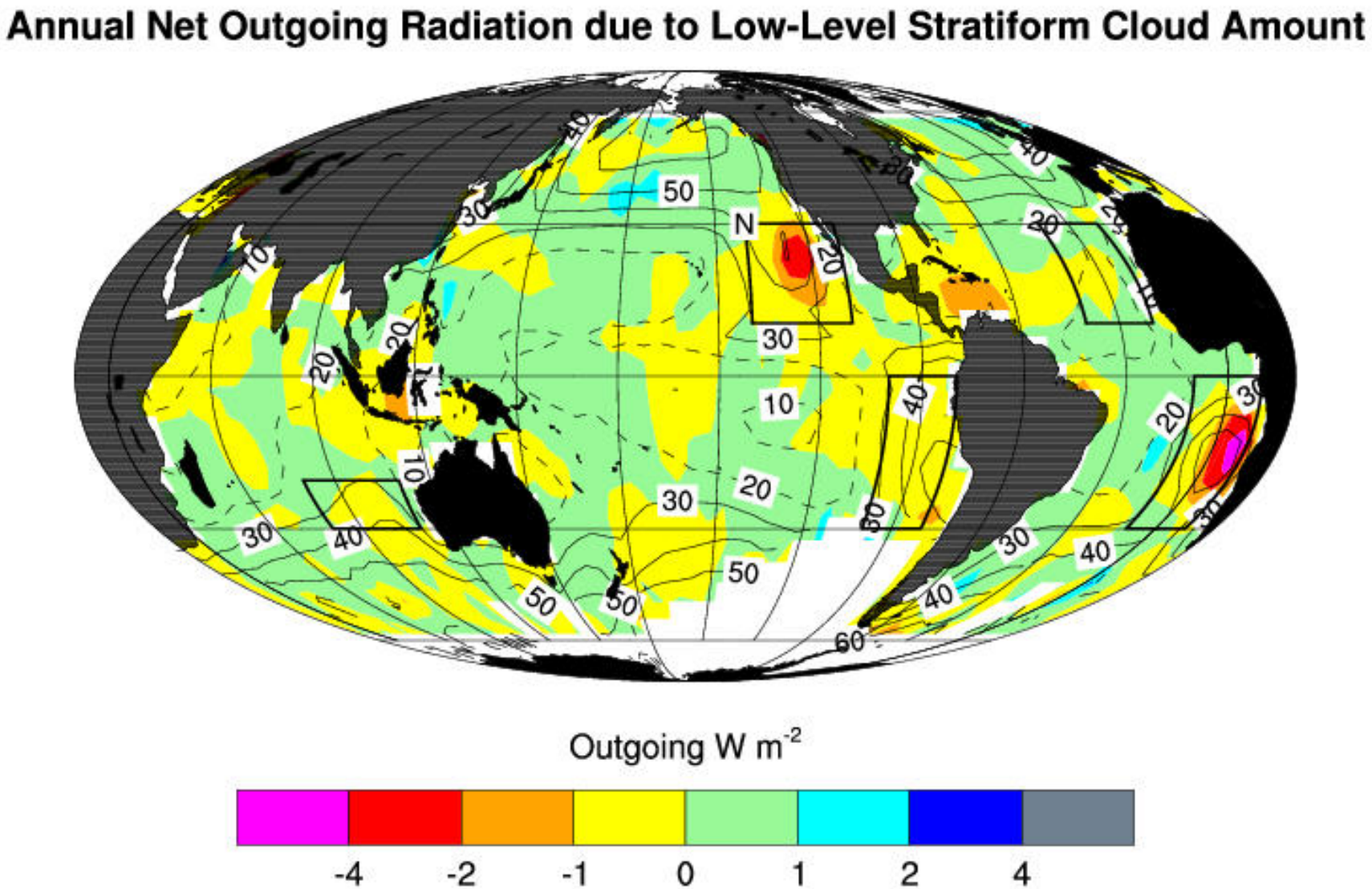
Corresponding variations in cloud and all-sky albedo



Estimation of Radiation Flux

- Regression of seasonal 10°x10° LW and albedo onto cloud amount
- Robust method avoids outlier problems
- Calculate radiation variability due to cloud variability using regressions
- Estimate net outgoing radiation change due to stratocumulus decrease

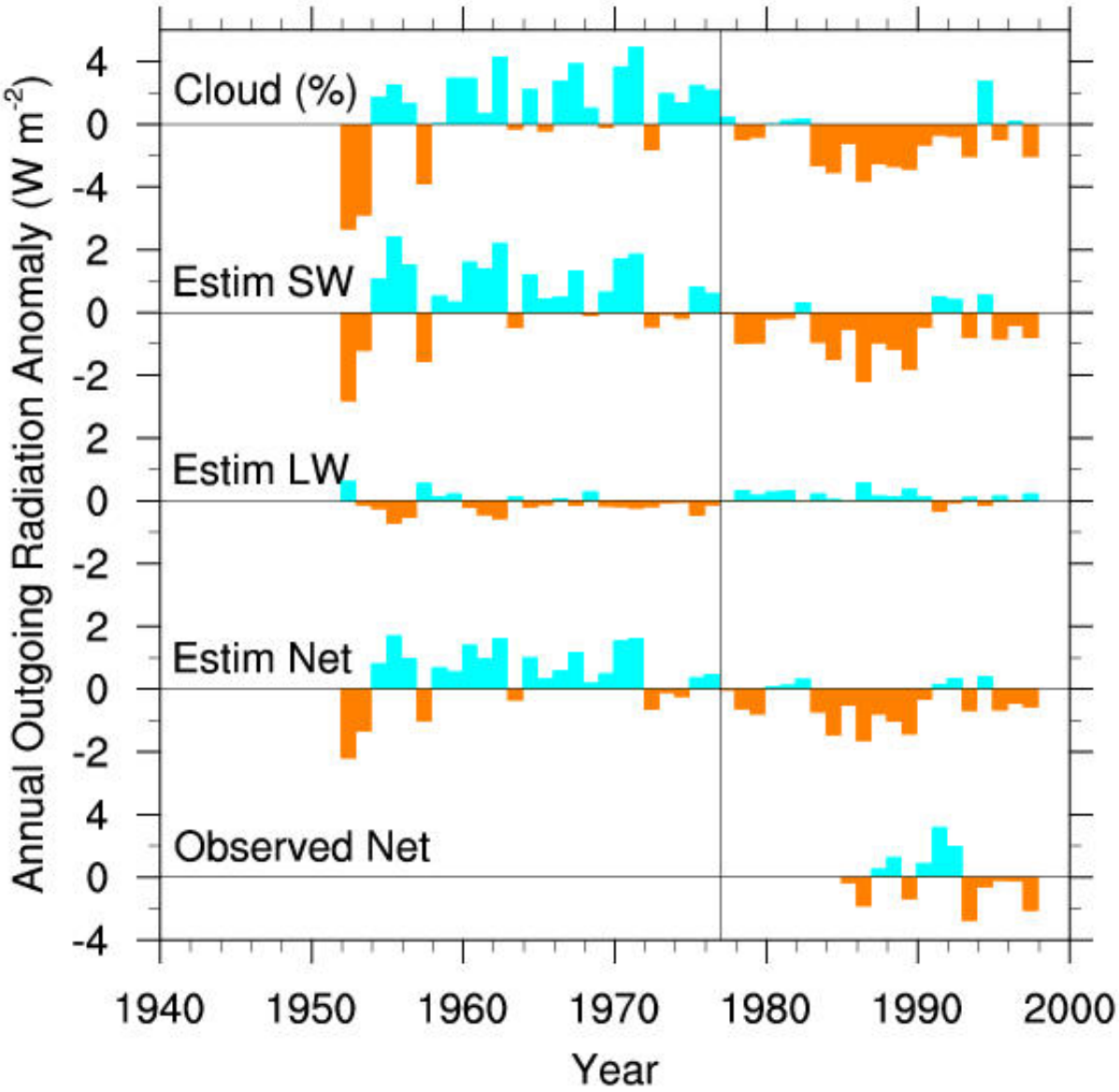
Less reflected radiation in every Sc region



line = cloud climatology

color = radiation change from 1952-76 to 1977-97

Less reflected radiation in every Sc region



Weathership N

- Cloud and radiosonde observations at 30°N, 220°E during 1954-1972
- Seasons with less stratocumulus cover are most strongly associated with a higher trade inversion (r = -0.83)
- Less cloud cover occurs with warmer SST (r = -0.30)
- Less cloud cover occurs with weaker trade winds (r = 0.54)

Summary

- From 1952-76 to 1977-97 subtropical stratocumulus cloud cover has decreased by 1.9% sky-cover
- Inferred net outgoing radiation has decreased by 0.8 Wm^{-2} in Sc regions (0.045 Wm^{-2} globally)
- The cloud decrease may be due to a higher trade inversion, warmer SST, and/or weaker trade winds