

Upper Stratospheric Analysis:

- Rocketsonde Validation
- Stratospheric Research Topics
- The SPARC Perspective

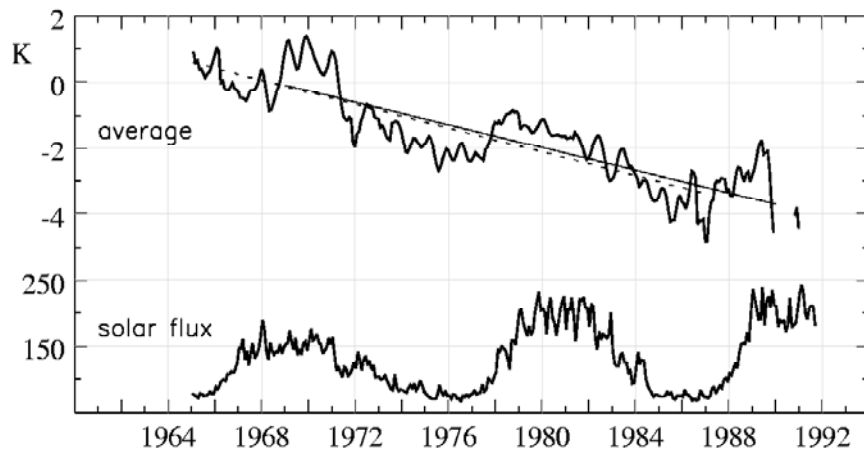
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ECMWF Workshop on Re-Analysis
7 November 2001

Rocketsonde Data

- Data record begins ~1960 and ends ~1992
- ~35 stations, mostly Northern Hemisphere
- We have processed all available data into a compact netCDF format
- The data can be obtained from the SPARC data center (<http://www.sparc.sunysb.edu/>)
- Some Russian and Japanese data have not been made public yet.



Average of 5 low-latitude rocketsonde stations.

SPARC

Stratospheric Reference Climatology Project

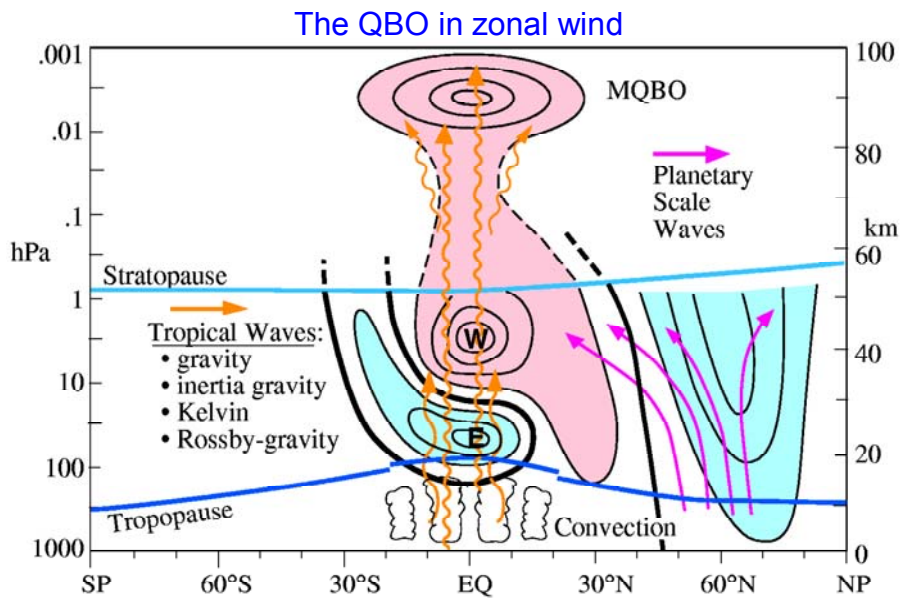
The group met on 1 November 2001 in
Boulder, CO USA:

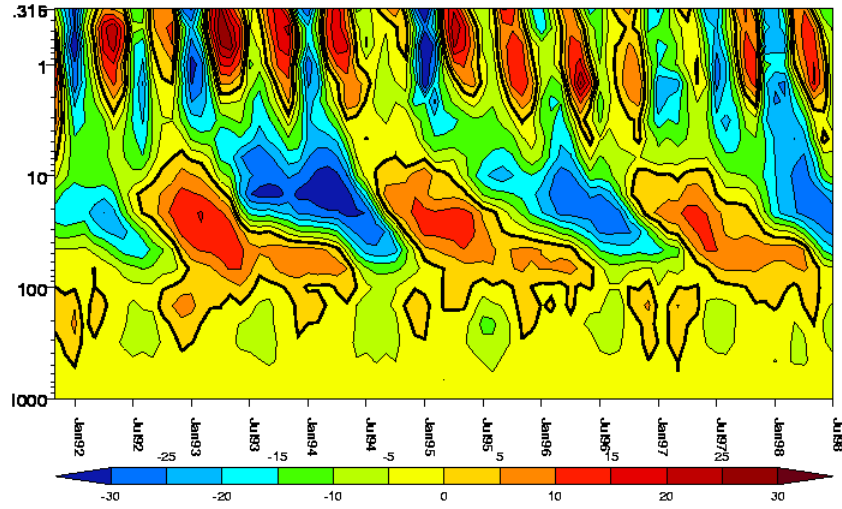
- Enthusiastic Support for the ERA-40 project
- Enthusiastic Support for the rocketsonde/ERA-40 comparison
- Inclusion of 1992-1997 ERA-40 in SPARC Report?
- Concern: Access to the ERA-40 data
- Concern: Availability of netCDF format ERA-40 data



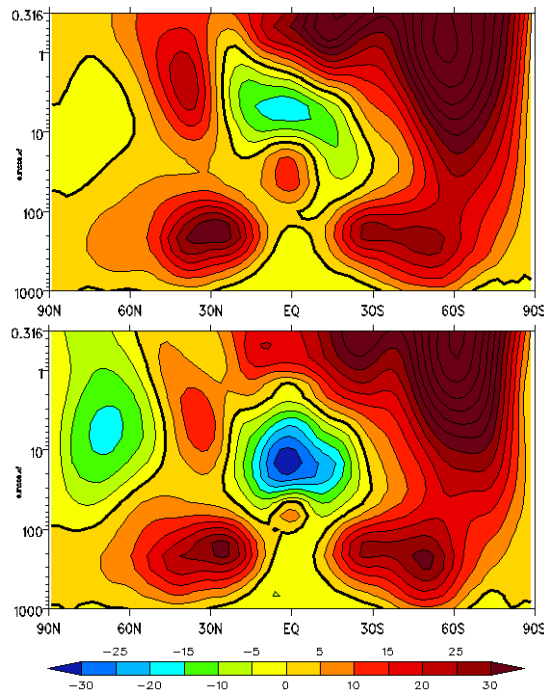
The Quasi-Biennial Oscillation (QBO)

The eruption of the Krakatau volcano (6° S 105° E) on 27 August 1883 led people to believe that the stratospheric winds above the equator were easterly. Dust from the eruption took 13 days (35 m/s) to circle the equator and this upper air wind became known as the “Krakatau easterlies.”





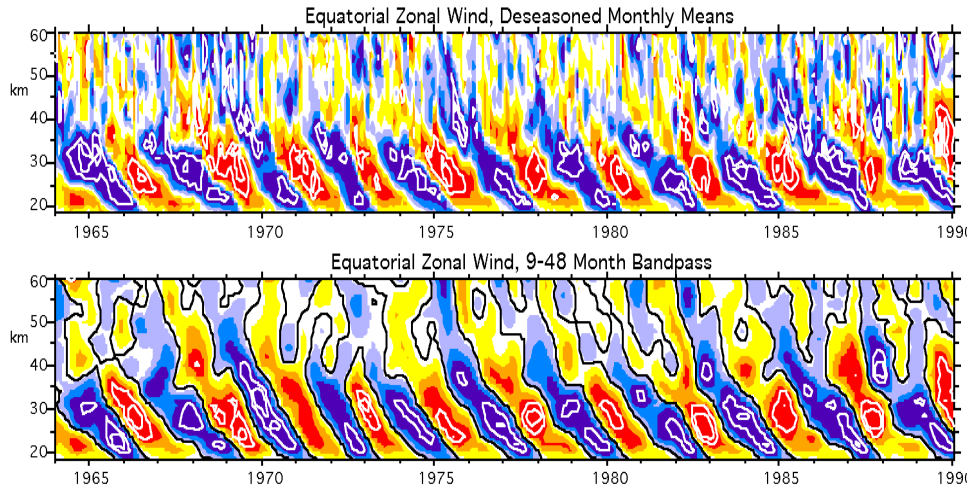
Monthly longitudinally-averaged wind in m/s near the equator. Easterlies are blue and westerlies are red. The contour interval is 5 m/s.



April 1993 monthly longitudinally-averaged E-W wind as a function of latitude and height.

April 1994.

QBO

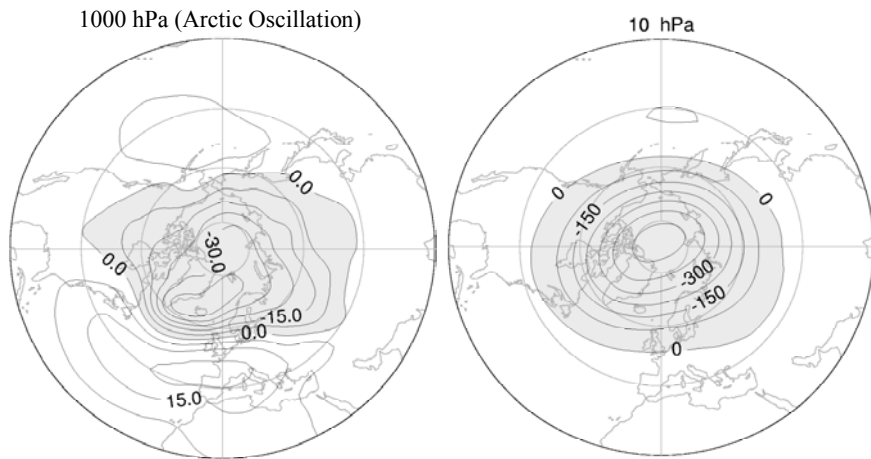


Rocketsondes above 31 km, and radiosondes below 31 km

Annular Modes

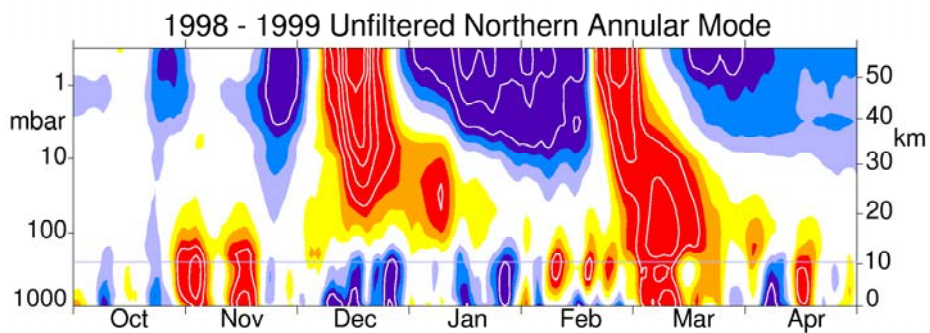
- Annular modes are the dominant recurrent spatial patterns of climate variability in the extratropics.
- The annular modes are similar in both hemispheres, from Earth's surface through the stratosphere.
- The patterns reflect movement of atmospheric mass between the polar cap and lower latitudes.
- The annular modes appear to be sensitive to the QBO, increasing greenhouse gases, and through radiative effects, large volcanic eruptions.

Northern Annular Mode (NAM)



Annular mode patterns are the leading EOF of low-frequency Z variability.

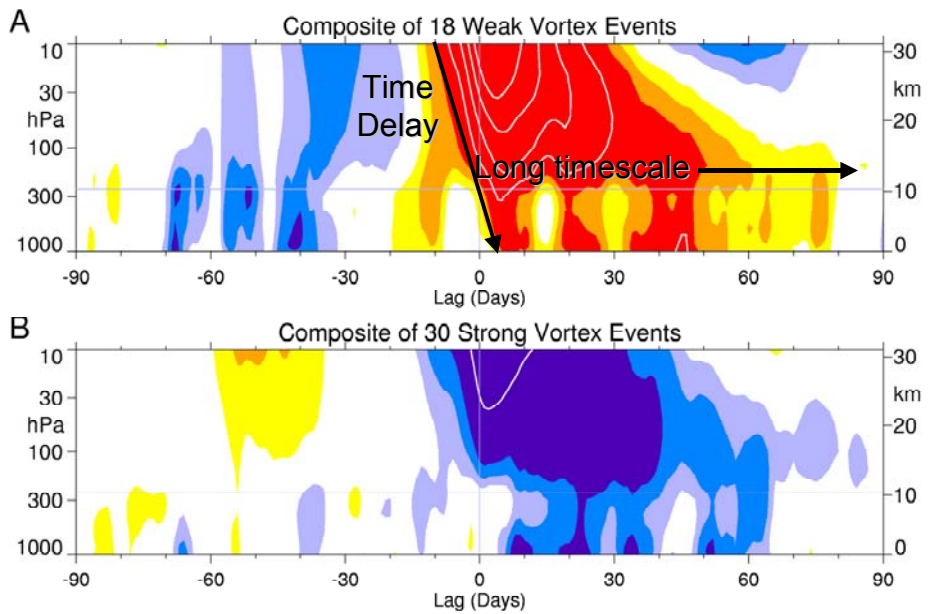
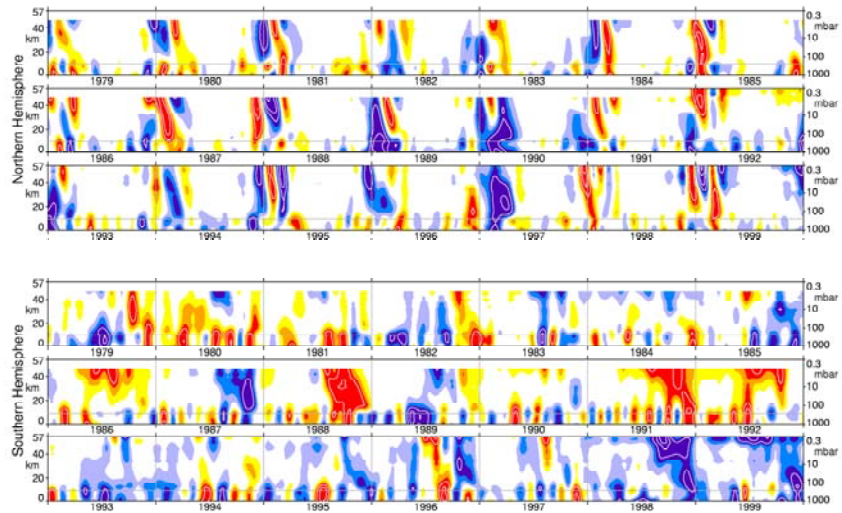
Annular mode patterns are similar from Earth's surface to 50+km.

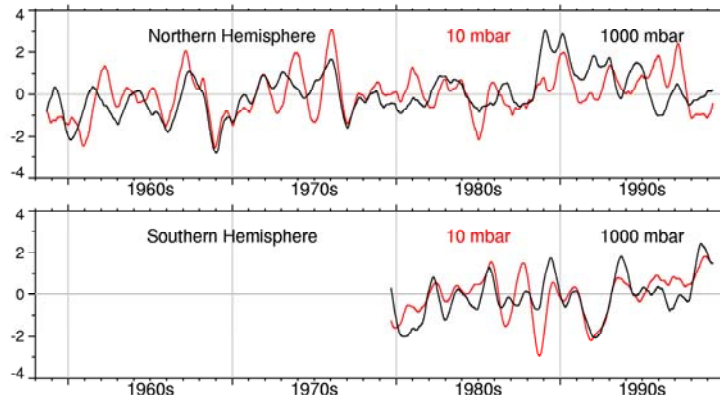


The timescale of the annular modes in the stratosphere is much longer than in the troposphere.

Annular mode signals often begin in the stratosphere (or mesosphere) and propagate downward.

Annular Mode Indices. 60-day LP Filter





Surface and stratospheric annular mode time series tend to be similar. Cause and effect is not clear.

Summary of Research

- The stratospheric circulation is driven mainly by waves from the troposphere.
- Observations show that anomalies in the stratospheric polar vortex frequently precede long-lived (up to ~two months) changes to the tropospheric circulation.
- Observations show similar trends in the stratosphere and at Earth's surface. GCM results suggest that the stratosphere plays an active role.
- Our understanding of the role of the stratosphere in tropospheric climate is poor.