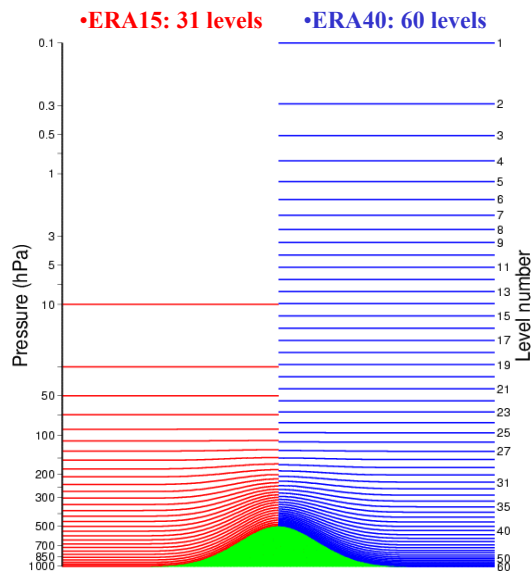


The stratosphere in ERA-40

Agathe Untch

ECMWF, Reading, U.K.

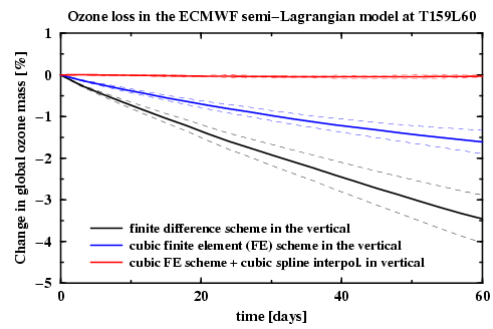
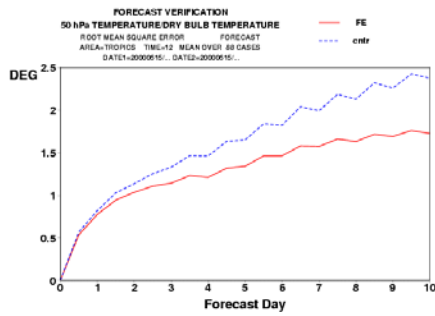
Vertical resolution in ERA15 and ERA40



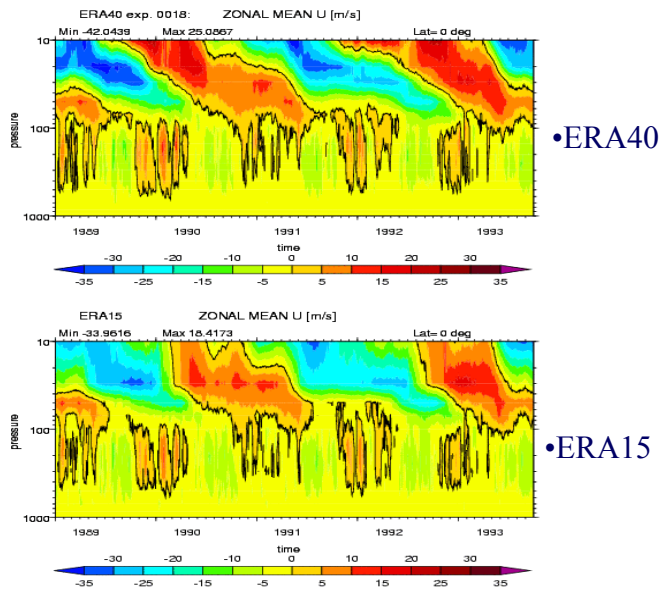
The ECMWF model for the stratosphere/mesosphere

- Radiation
- Gravity wave drag parametrization
 - orographic gravity wave drag
 - No parametrization of gravity wave drag from other sources (i.g. convection)
 - Rayleigh friction on zonal wind in upper stratosphere/mesosphere
- Methane oxidation
- Ozone model (advection + chemistry (MJ to France))
- Dynamics
 - semi-implicit semi-Lagrangian two-time level scheme
 - cubic finite elements in the vertical
 - increased horizontal diffusion in uppermost levels (simple sponge)

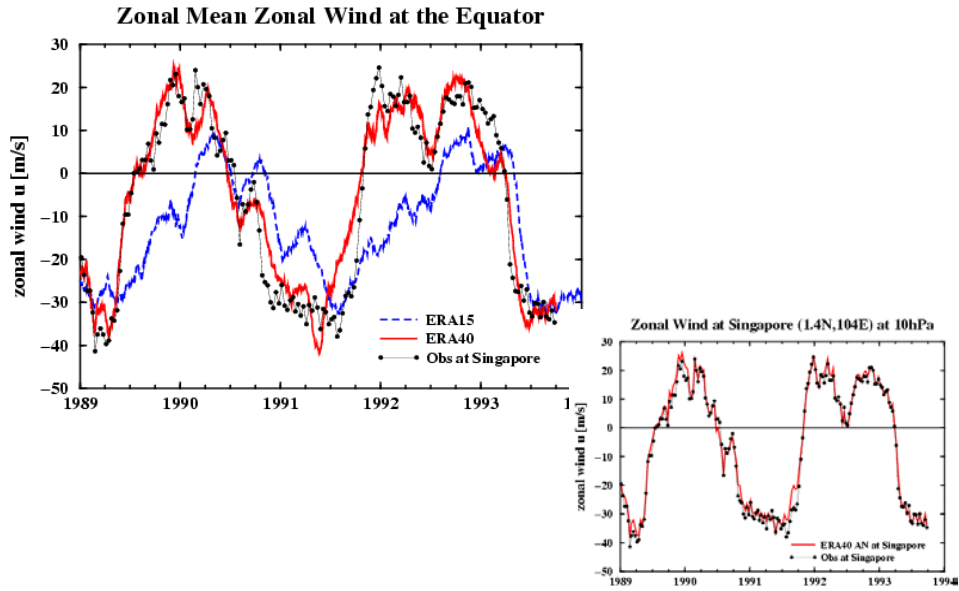
Cubic finite element scheme for the vertical



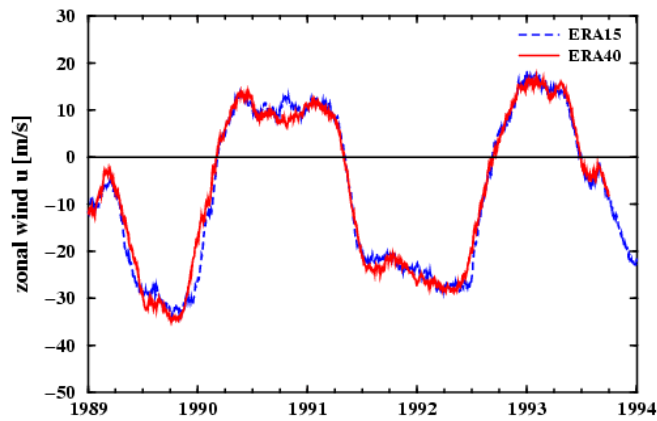
ERA40 vs ERA15 Quasi-biennial Oscillation (QBO)



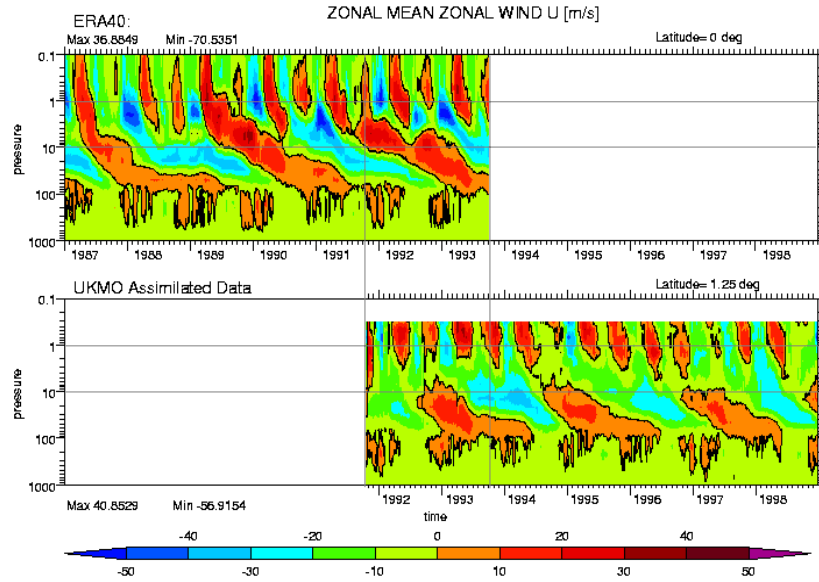
ERA40 vs ERA15: Zonal mean zonal wind at 10hPa



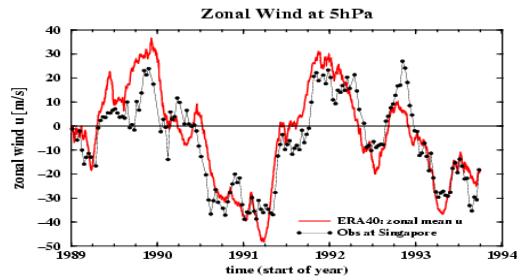
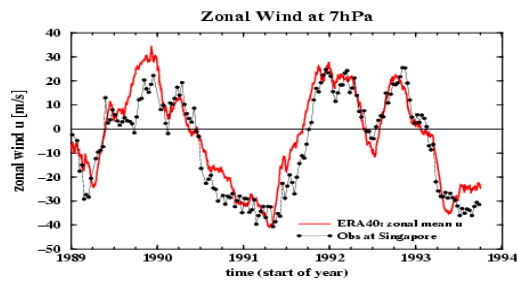
ERA40 vs ERA15: Zonal mean zonal wind at the equator at 30hPa



ERA40 vs UKMO: QBO and Semiannual Oscillation (SAO)



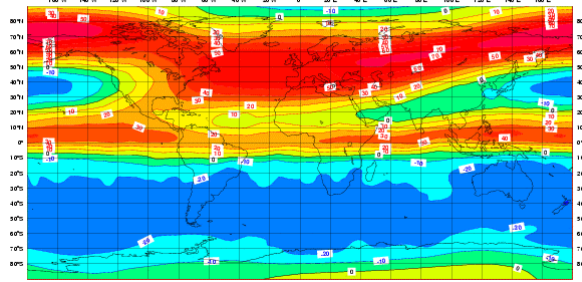
ERA40 compared to observations at Singapore Station



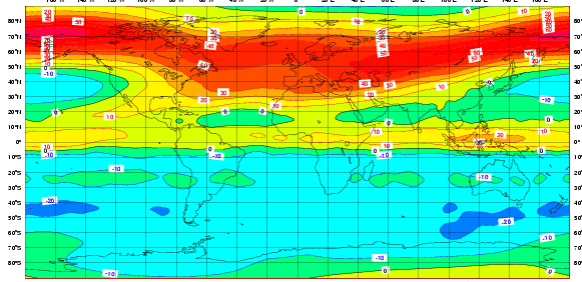
QBO in ERA40: horizontal structure

•5hPa

ERA40: Zonal wind u [m/s] at 5hPa (average for Dec. 1991)



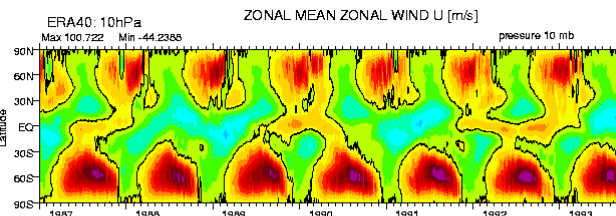
ERA40: Zonal wind u [m/s] at 10hPa (average for Dec. 1991)



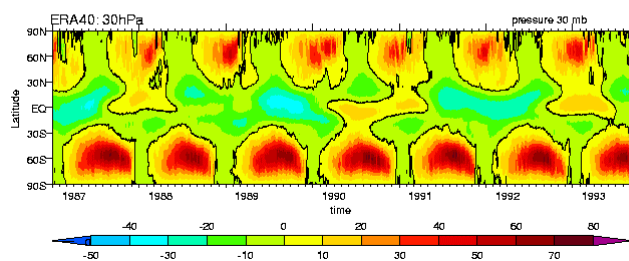
•10hPa

QBO in ERA40 time-latitude sections at 10 and 30 hPa

•10hPa



•30hPa



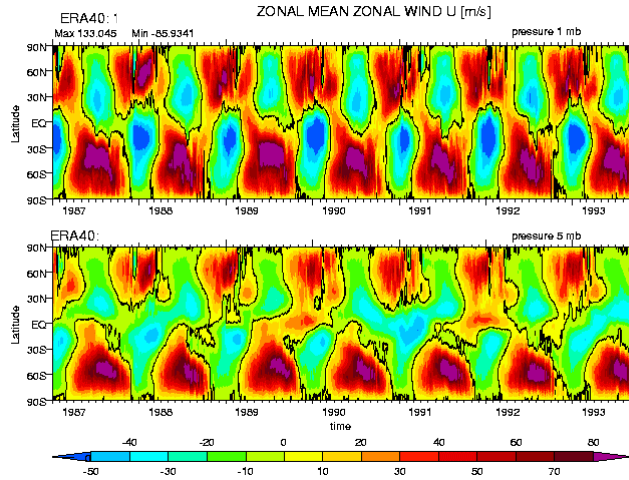
ERA40: time-latitude sections of SAO and QBO

•SAO

•1hPa

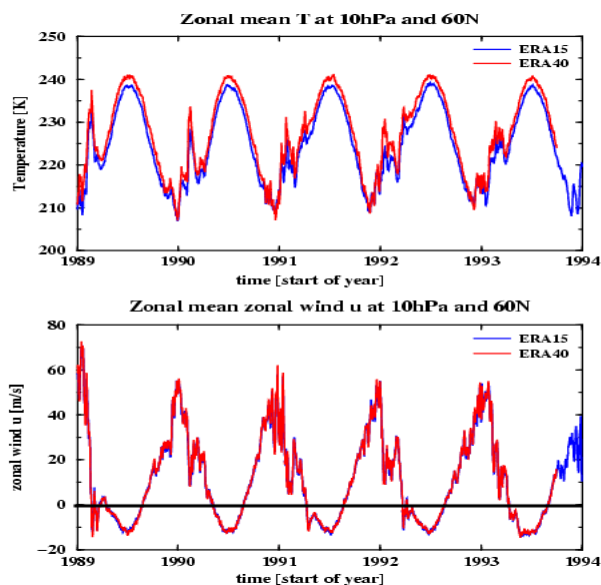
•QBO

•5hPa

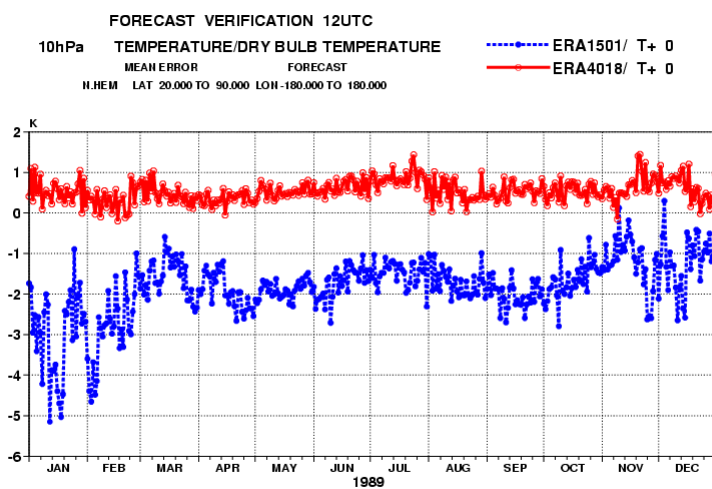


Sudden Stratospheric Warmings in ERA40 and ERA15

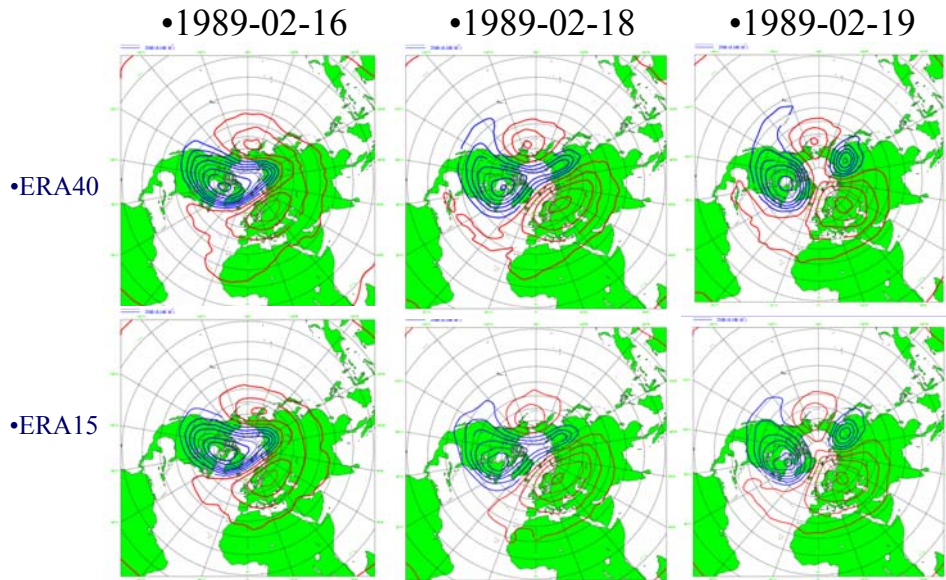
ERA40 vs ERA15: Sudden Stratospheric Warmings



ERA40 vs ERA15: Mean Error in 10hPa T verified against radiosondes in NH



Wavenumber 2 sudden stratospheric warming



Summary

- Tropical winds in the stratosphere:
 - The QBO in ERA40 is much more realistic at 10hPa than in ERA15.
 - At 30hPa and below it is very similar to ERA15.
 - Above 10hPa ERA40 has stronger westerlies than the UKMO analysis, but they agree remarkably well with the radiosonde observations at Singapore.
- Sudden stratospheric warmings are very similar in ERA40 and ERA15, even at 10hPa, the top of the ERA15 model.
- Much more validation is required in the stratosphere above 10hPa.
- Independent conventional observations like rocketsonde data are needed for this purpose.