

**5. MIDDLE ATMOSPHERE OF THE SOUTHERN HEMISPHERE (MASH)  
GLOBAL METEOR OBSERVATIONS SYSTEM (GLOBMET)  
SOLAR SPECTRAL IRRADIANCE MEASUREMENTS (SSIM)  
GLOBAL OBSERVATIONS AND STUDIES OF STRATOSPHERIC AEROSOLS  
(GOSSA)**

**5.1 PROGRESS WITH THE MASH PROJECT**

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The aim of the MASH project is to study the dynamics of the middle atmosphere in the Southern Hemisphere, emphasizing inter-hemispheric differences. Both observational data and data from simulations with numerical models are being used. It is intended that MASH will be complemented by parallel studies on the transport and photochemistry of trace species in the Southern Hemisphere. Impetus for such studies has come from the unexpected finding of a springtime "ozone hole" over Antarctica.

A summary of recent progress with the MASH project is given. Data from polar-orbiting satellites are used to discuss the large-scale circulation found in the Southern Hemisphere at extratropical latitudes. Comparisons are made with that of the Northern Hemisphere. Particular attention is paid to the springtime final warming, the most spectacular large-scale phenomenon in the stratosphere of the Southern Hemisphere. The circulation before and after this event has to be taken into account in theories for the formation and subsequent disappearance of the ozone hole.

**Aim of MASH:** Concerted study of large-scale dynamics and transport processes, emphasizing inter-hemispheric differences and tropospheric coupling.

**Events:** Workshop in Williamsburg, 1986  
MASH/GRATMAP Workshop in Adelaide, 1987  
MASH Workshop in California, April 17-19, 1989

**Data Sources (for large-scale circulation):**

•Conventional	SCR (10-50 km)/PMR (40 - 80 km)	73 - 78
•Satellite	LIMS	End 78 - Mid 79
	SAMS	End 78 - Mid 83
	This paper ⇒ SSU	End 78
•'Base Levels' (usually 100 mb)	UKMO ECMWF      global NMC ANMRC      hemispheric	

**Outline of seasonal evolution of stratosphere in SH compared with NH**

- Data: SSU, 3-channel pmr
- Phenomena:
  - Early winter SH vs NH Canadian warmings
  - Midwinter SH vs NH major midwinter warming
  - Final warming SH often drastic vs NH sometimes quiescent
  - Interannual variability SH

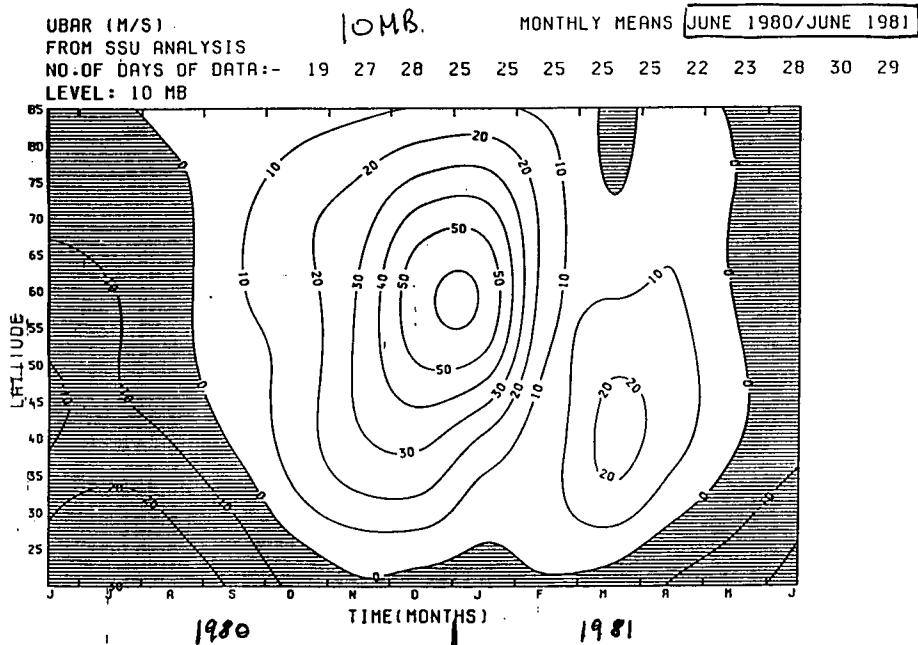


Figure 1.

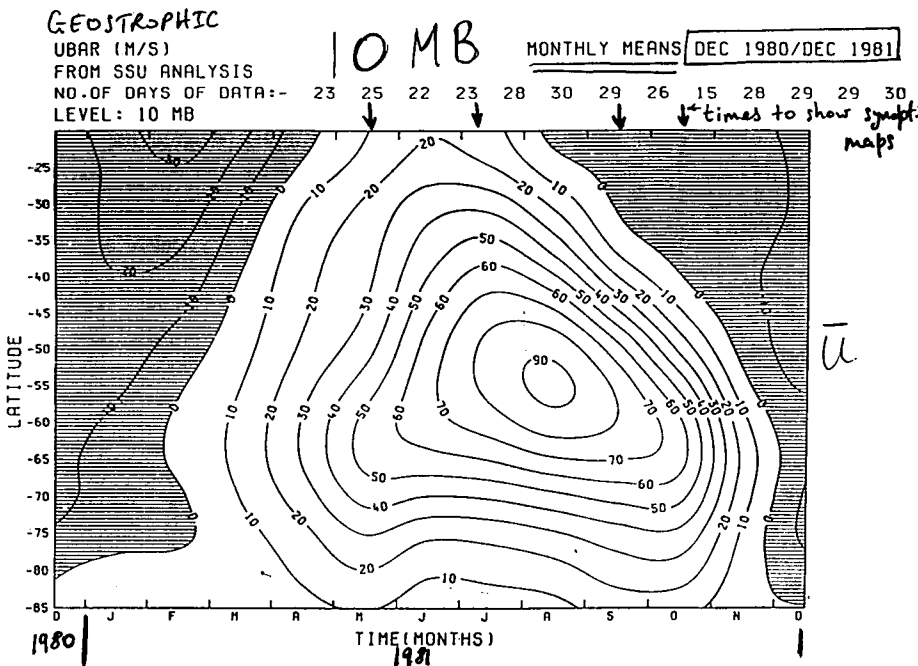


Figure 2.



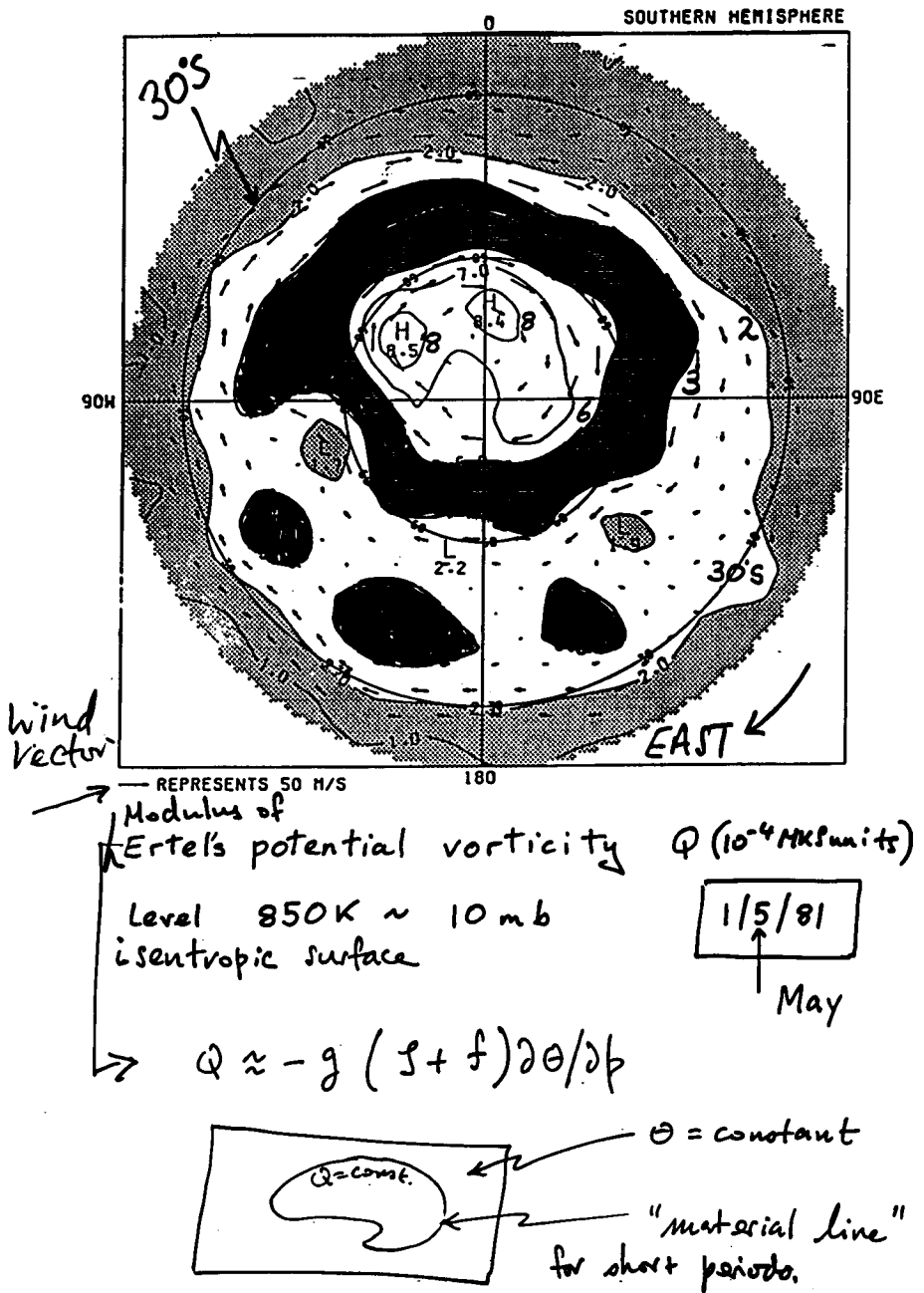


Figure 4.

Q

850 K

1/2/81

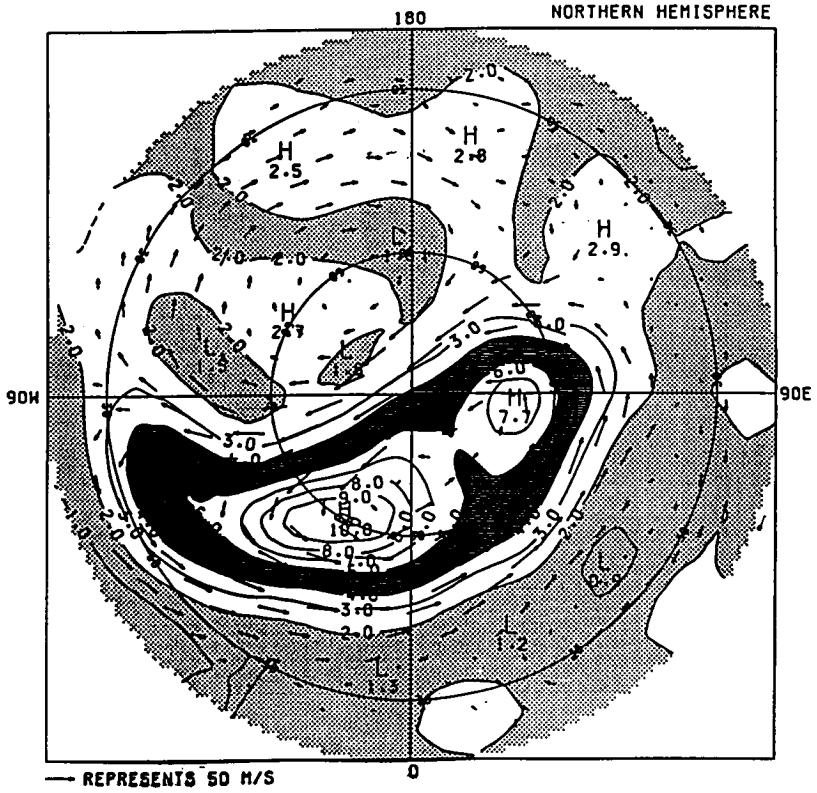


Figure 5.

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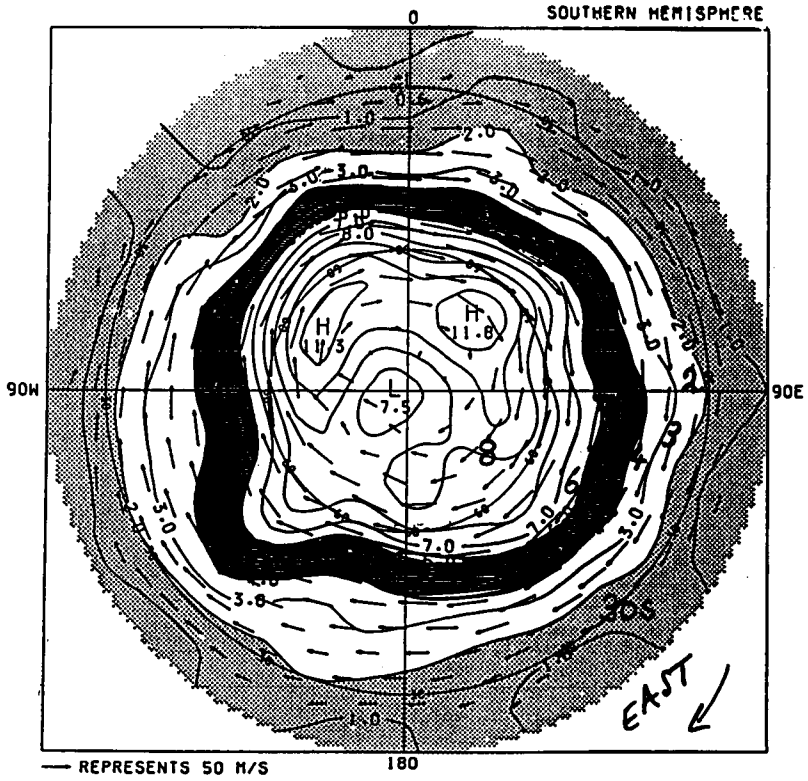


Figure 6.

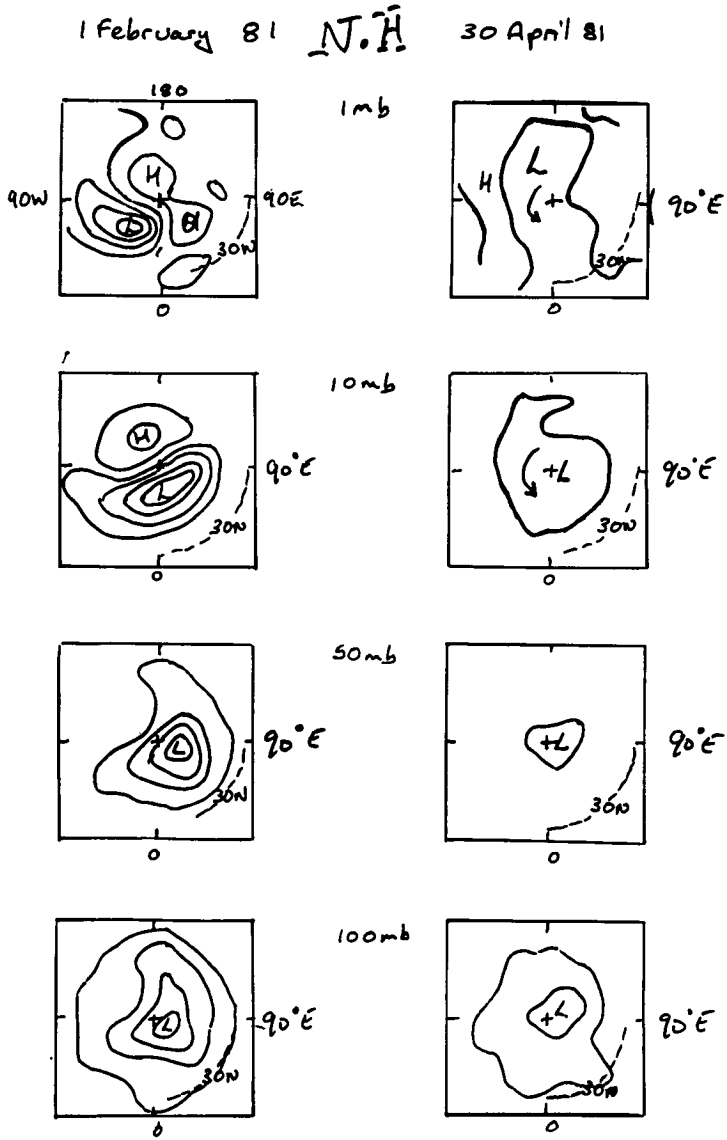


Figure 7.

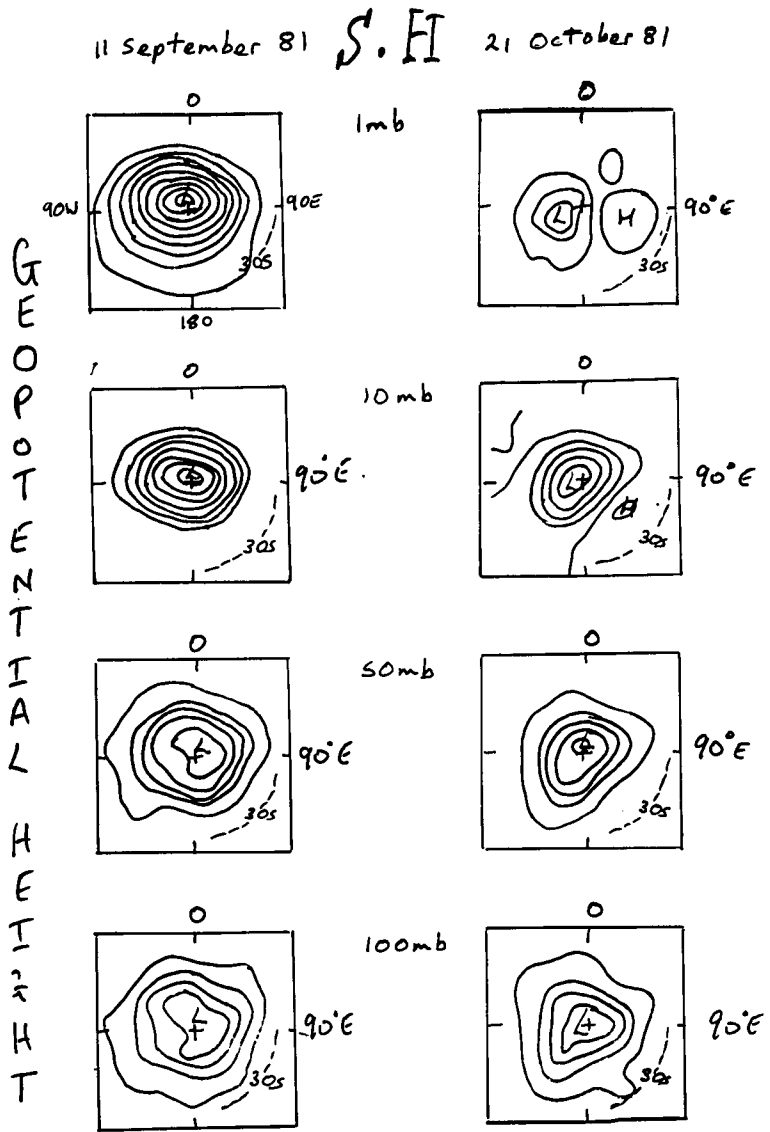


Figure 8.



### Antarctic O<sub>3</sub> depletion

Two conditions required of all (current) chemical theories:

- (1) Liberation of ClO<sub>x</sub> radicals from their reservoirs (e.g., ClONO<sub>2</sub>)
- (2) Greatly reduced levels of NO<sub>x</sub>.

- (1) requires heterogeneous chemistry on solid (ice) surfaces. PSCs.
- (2) requires 'denitrification' -- gravitational settling of (H<sub>2</sub>O - HNO<sub>3</sub>) ice ⇒  
i.e.  $T \leq \text{frost point} \approx 193 \text{ K}$

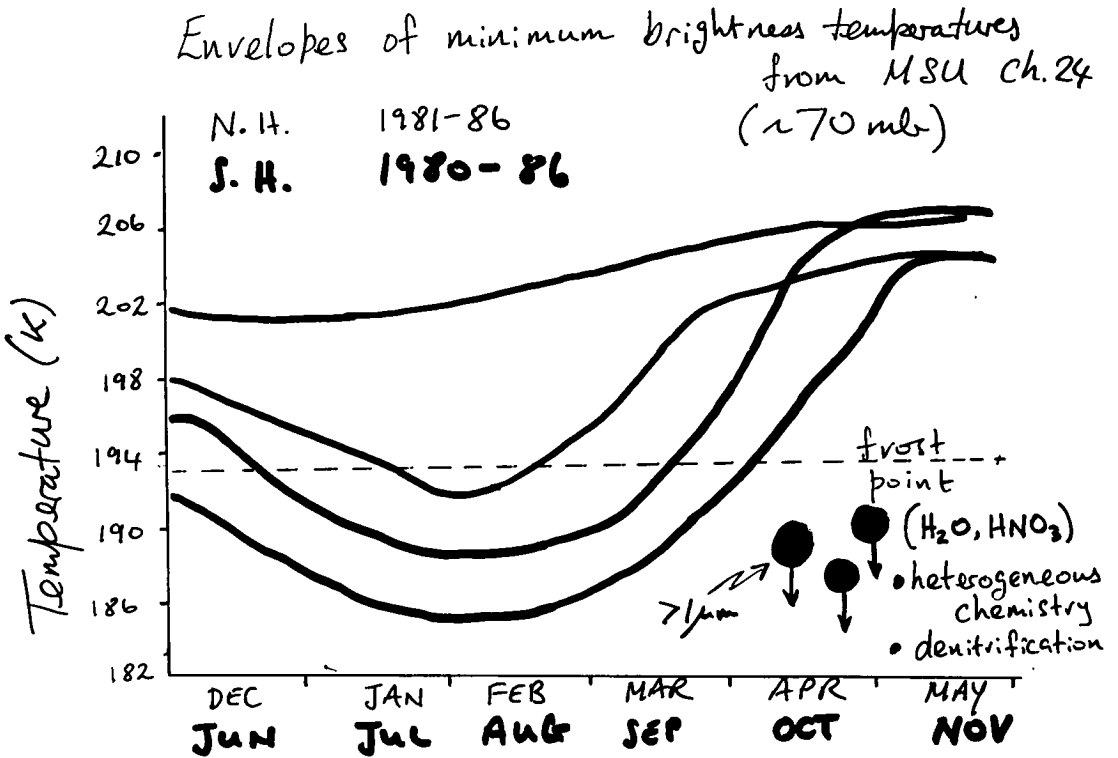


Figure 9.

### General strategy for future work

- Exploit inter-hemispheric differences (e.g. in troposphere/stratosphere coupling)
- Sometimes difficult to infer causal relationships diagnostically, so we use hierarchy of models.
- Make best use of measurements of meteorological and trace fields by assimilation into numerical mode. (UARS, EOS)