Interannual comparison of water vapor in the north polar region of Mars

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Introduction

- Martian water cycle in one of 3 main annual cycles, CO2 and dust being the other two
- Very little evidence of water today, yet plenty of evidence for past water (e.g., outflow channels and gullies)
- There exists a hemispheric dichotomy in the amount of water observed today - north has more
- We can study the north polar cap water cycle through vapor and clouds to understand the current water cycle - the first step in understanding the historical water cycle on Mars

Background

- Viking Mars Atmospheric Water Detector (MAWD) showed water vapor increasing as northern summer season progressed - vapor appeared to be transported southward
- Amount of water cycling is uncertain - albedo changes between the Mariner 9 era and the Viking era. Thought to be different amounts of frost sublimed associated with dust storm activity
- Bass et al. (2000) showed that the north polar cap albedo changed seasonally, and modelling showed 14-35 pr microns of frost deposition onto northerly cold traps late in the season

Water Pulses Discussion

- In figures 1a and 1b, water pulses as a function of season are shown. The fact that the amount of water release is not uniform implies that it was not deposited uniformly. One possible explanation is that layers of clean water were deposited in the previous season due to cold-trapping, as theorized by Bass et al. (2000).

Figure 1a. TES averaged water vapor, ice, dust

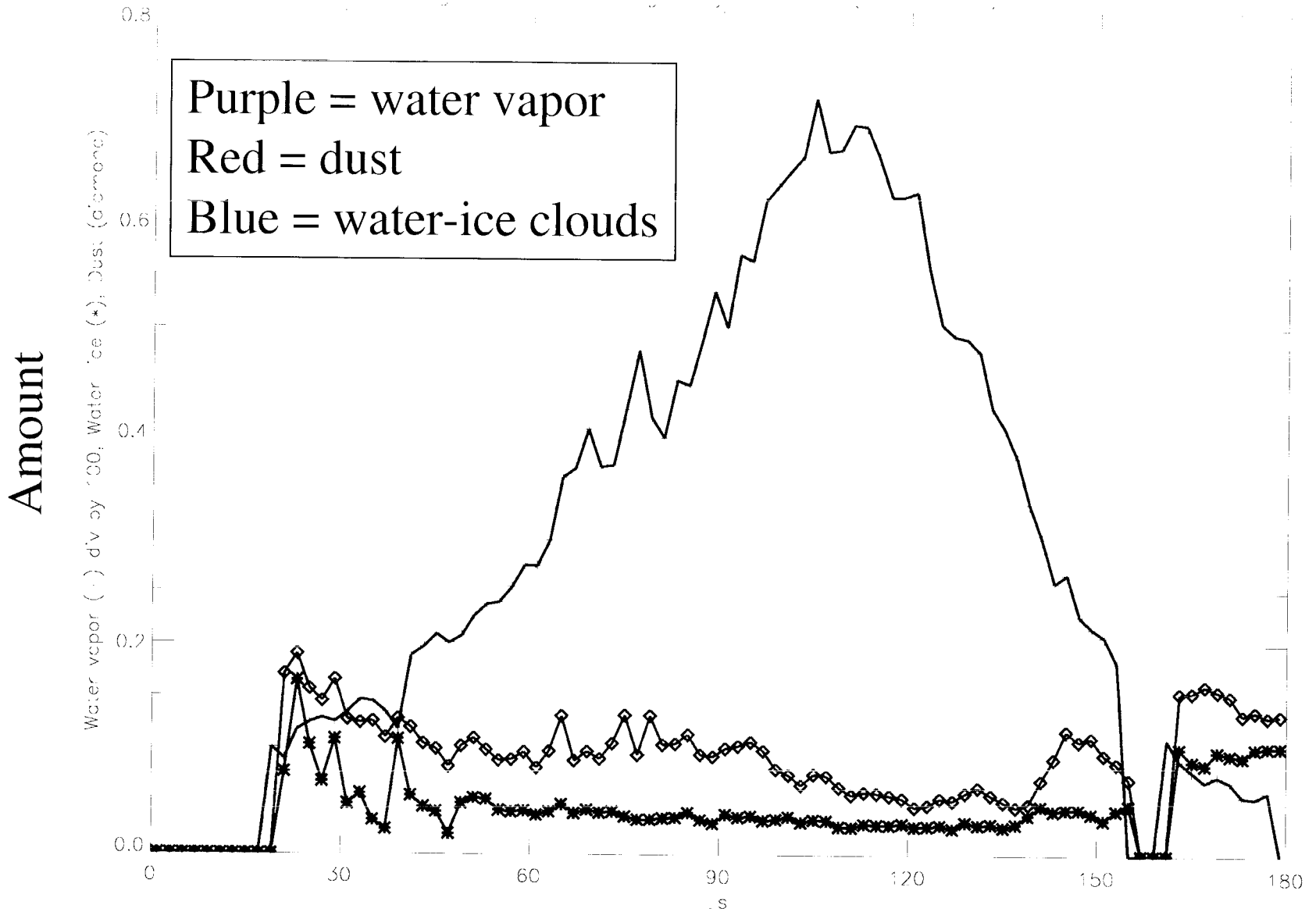
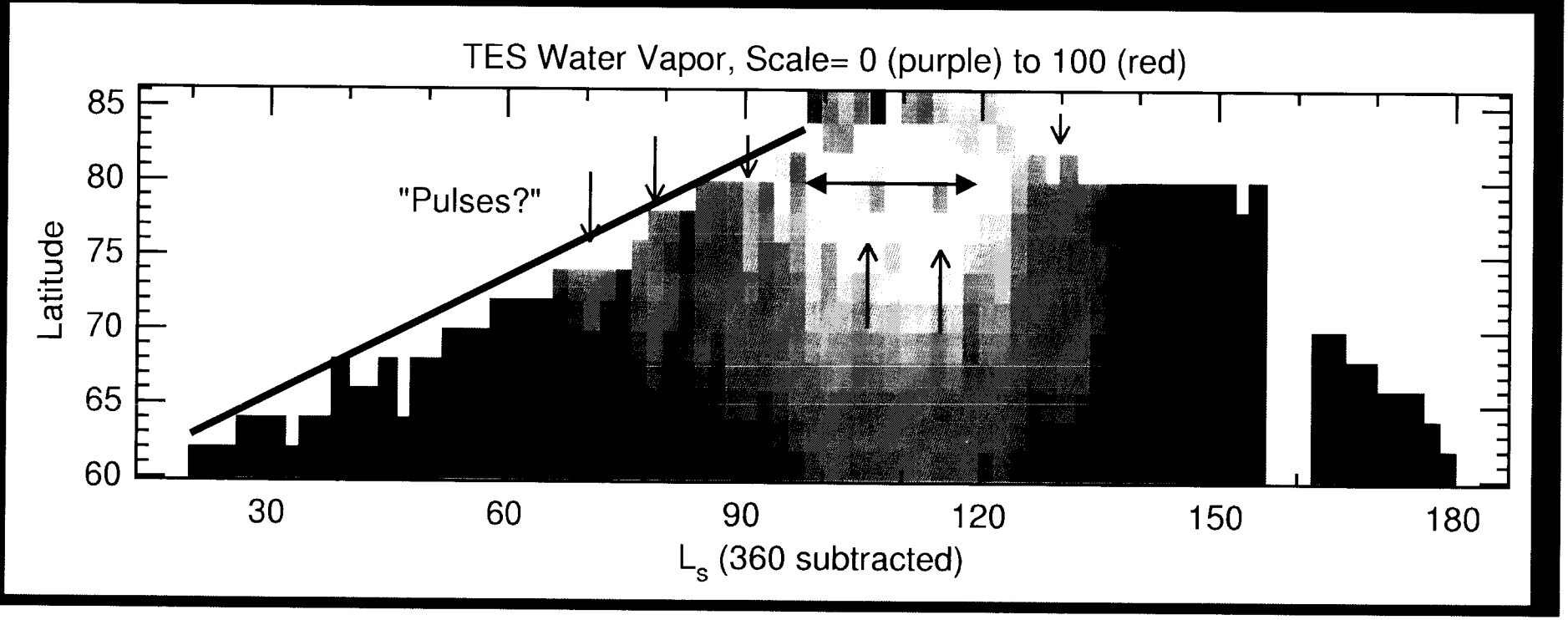


Figure 1b.
Water vapor

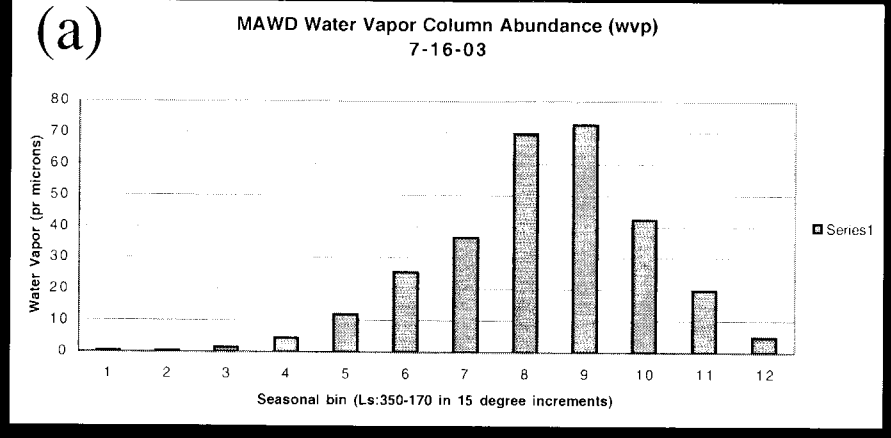
- Water pulses seen
- James and Cantor (2002)
  - –Polar cap edge fit: Lat=58.0+0.24L_s

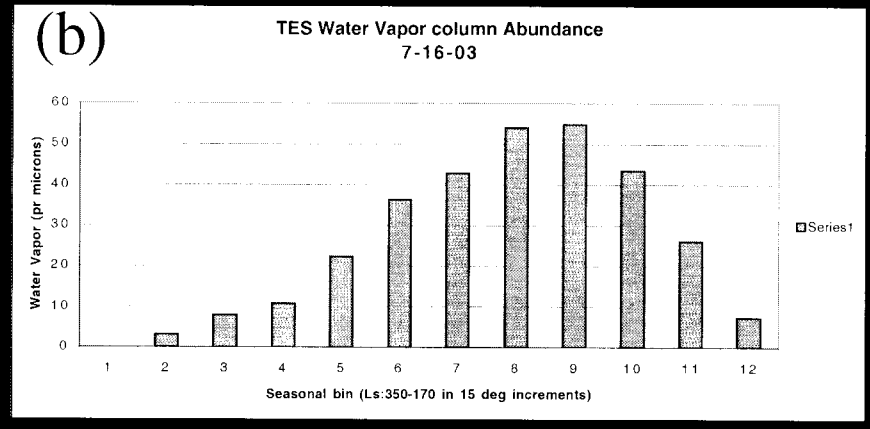


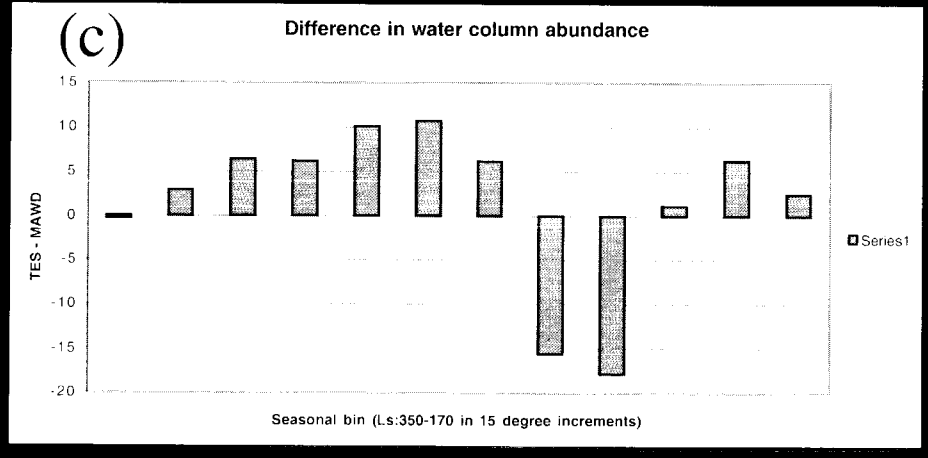
Interannual differences in water vapor

- Figure 2 (a,b,c) shows water vapor data over the north polar region for the Viking era (a), the second TES mapping year (b), and the difference between them (c). It is clear that in the Viking year there wasn't as much water earlier in the season and the amount at the peak is about 15 pr microns greater.

Figure 2.


(a)
MAWD Water Vapor Column Abundance (wvp)
7-16-03
Water Vapor (pr microns)
0
10
20
30
40
50
60
70
80
1
2
3
4
5
6
7
8
9
10
11
12
Seasonal bin (Ls:350-170 in 15 degree increments)
Series1


(b)
TES Water Vapor column Abundance
7-16-03
Water Vapor (pr microns)
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9
10
11
12
Seasonal bin (Ls:350-170 in 15 deg increments)
Series1


(c)
Difference in water column abundance
TES - MAWD
15
10
5
0
-5
-10
-15
-20
Seasonal bin (Ls:350-170 in 15 degree increments)
Series1

Conclusions

- There is significant interannual variability in water sublimation in the north polar region, during the northern spring and summer.

Future Work

- Continue examining other TES years to characterize water vapor amounts as a function of season
- Catalog the water-ice clouds in this same season through TES and imaging data sets, to understand if some water were sequestered as clouds during the season
- Compare surface temperatures and albedos during the various seasons to understand what affect these properties have on sublimation