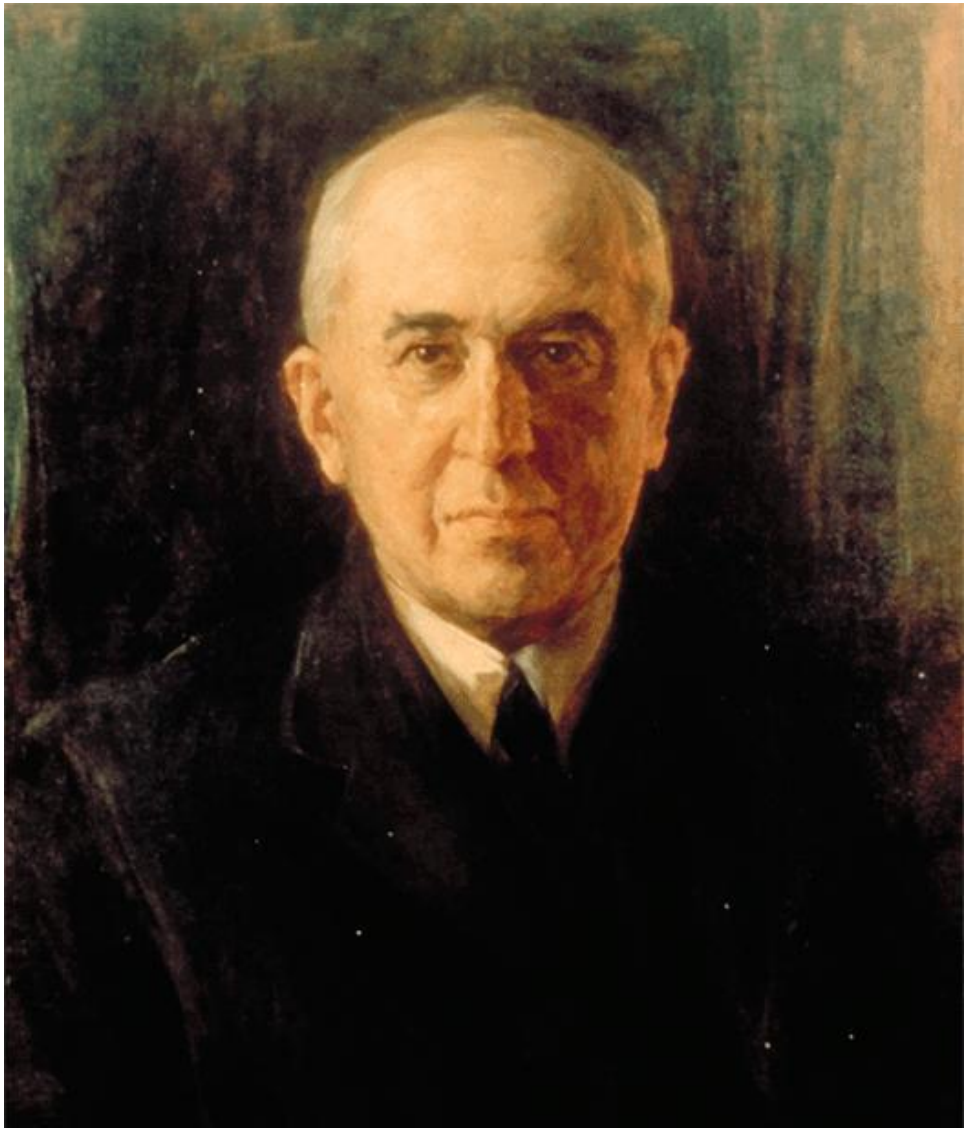
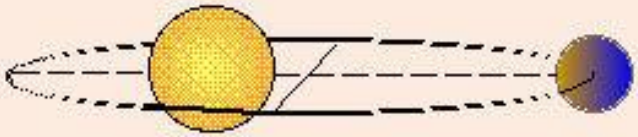
Milankovitch cycles and the control of the Pleistocene glaciations



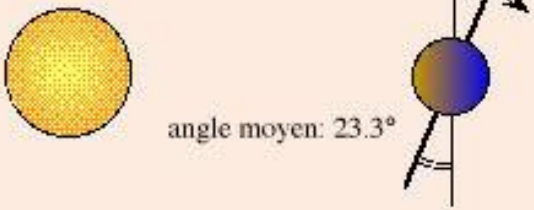
Milutin Milankovitch

Variations de l'EXCENTRICITE de l'orbite terrestre

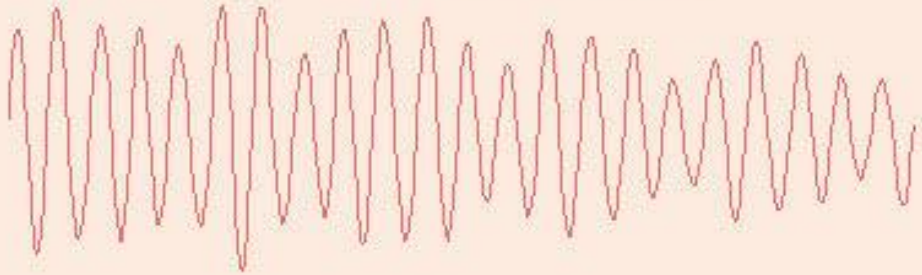


périodicités de 100 et 413 ka

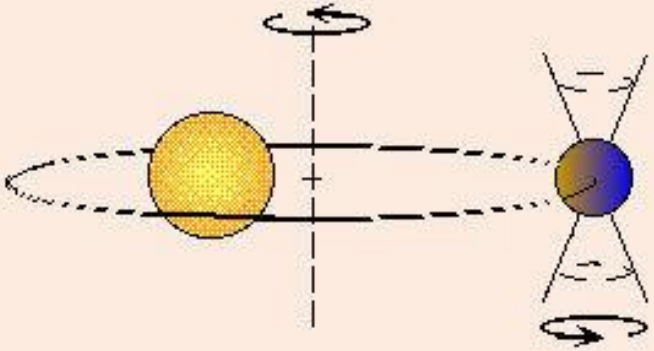
Variations de l'OBLIQUITE de l'axe de rotation



périodicité de 41 ka



PRECESSION de l'axe de rotation et ROTATION de l'orbite terrestre

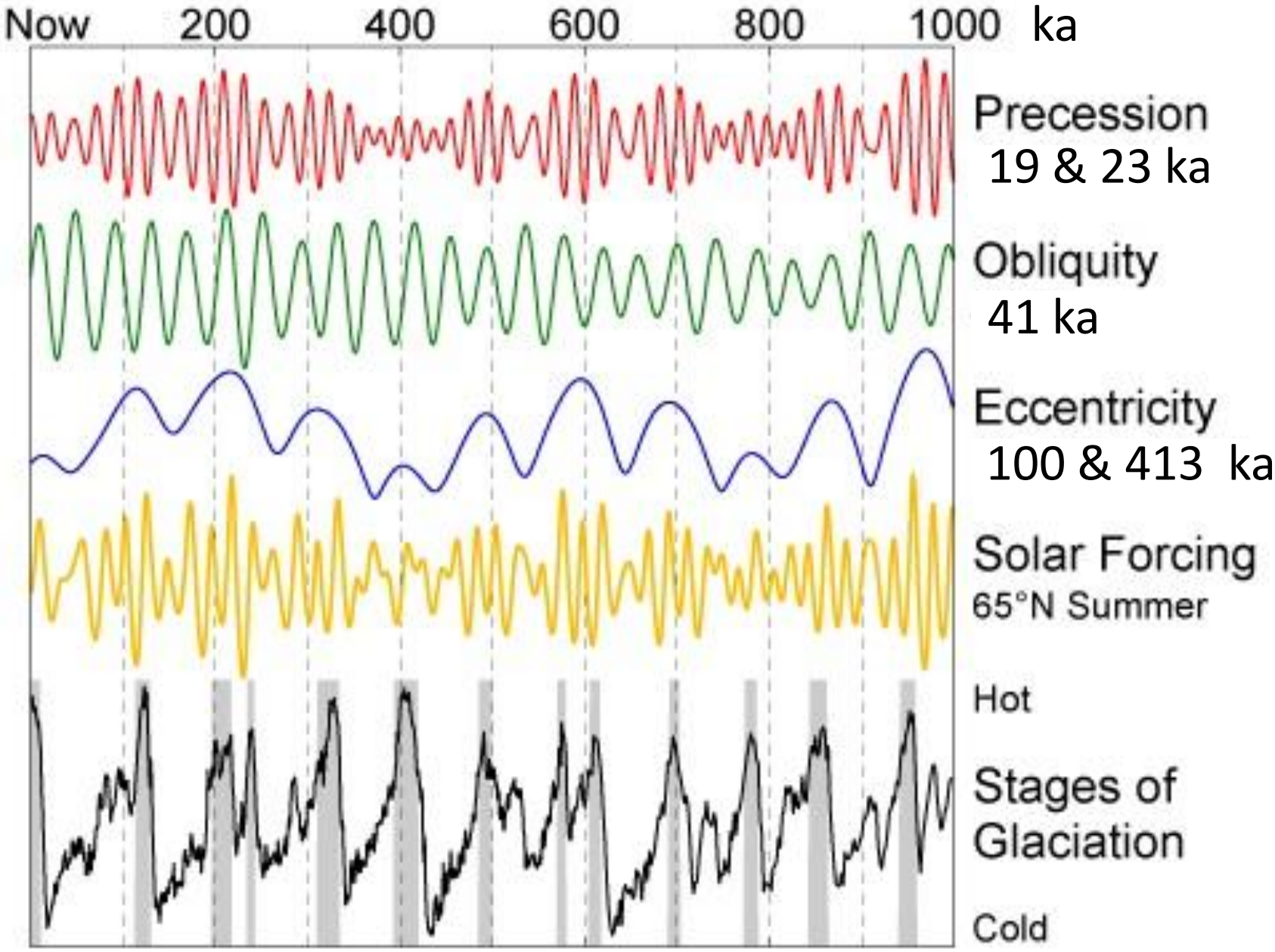


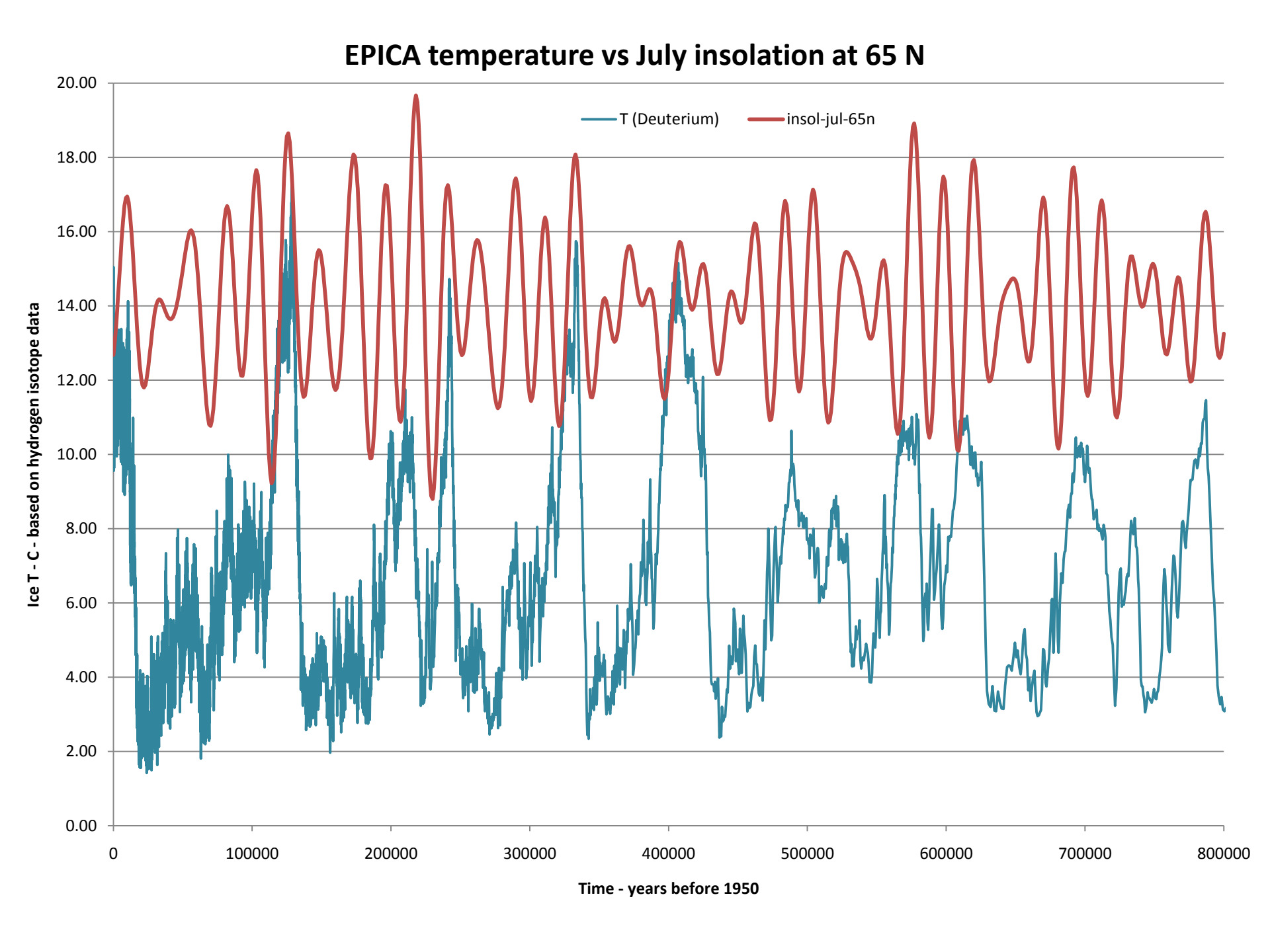
périodicités de 23 et 19 ka

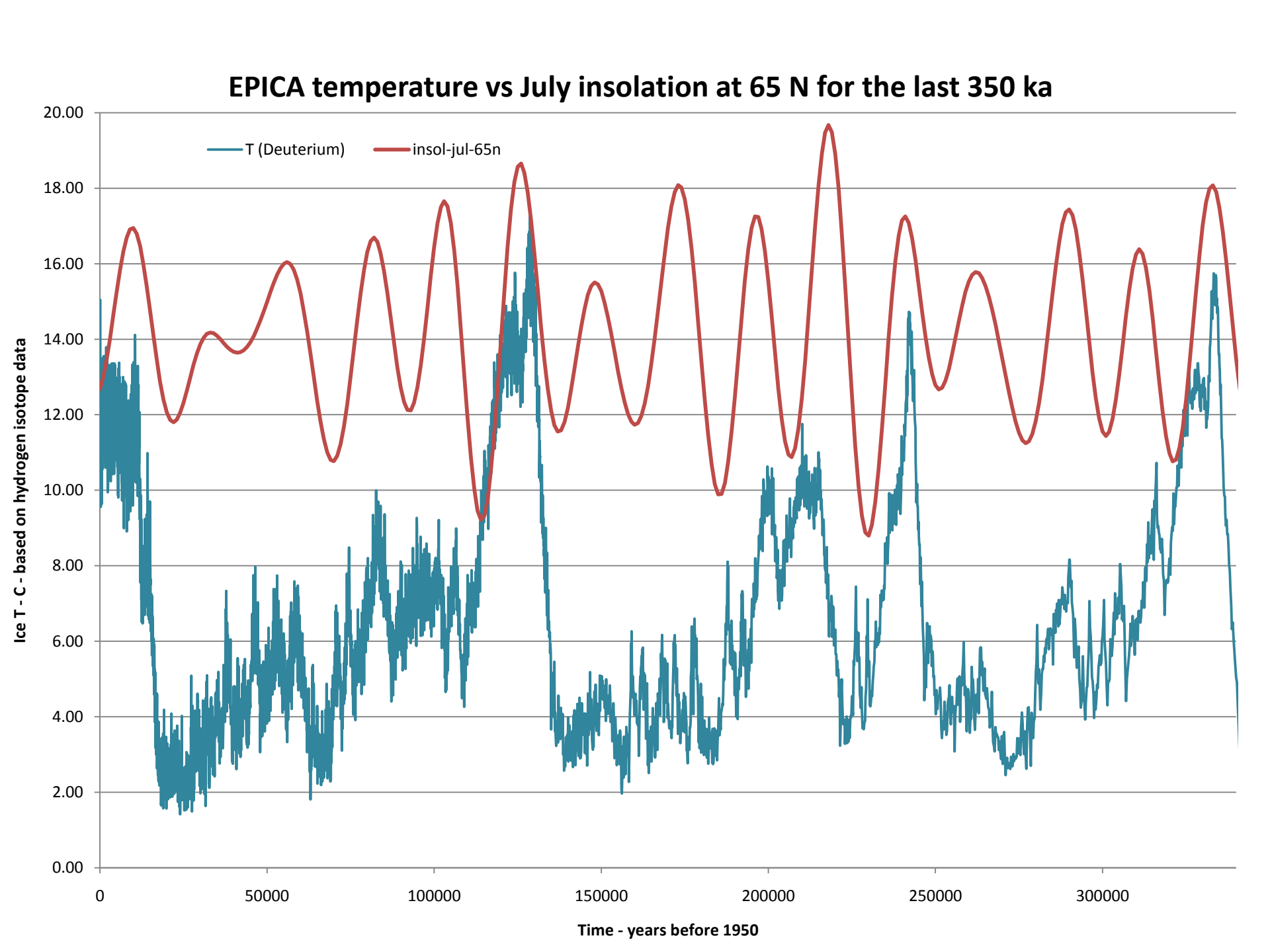
Milankovitch Cycles

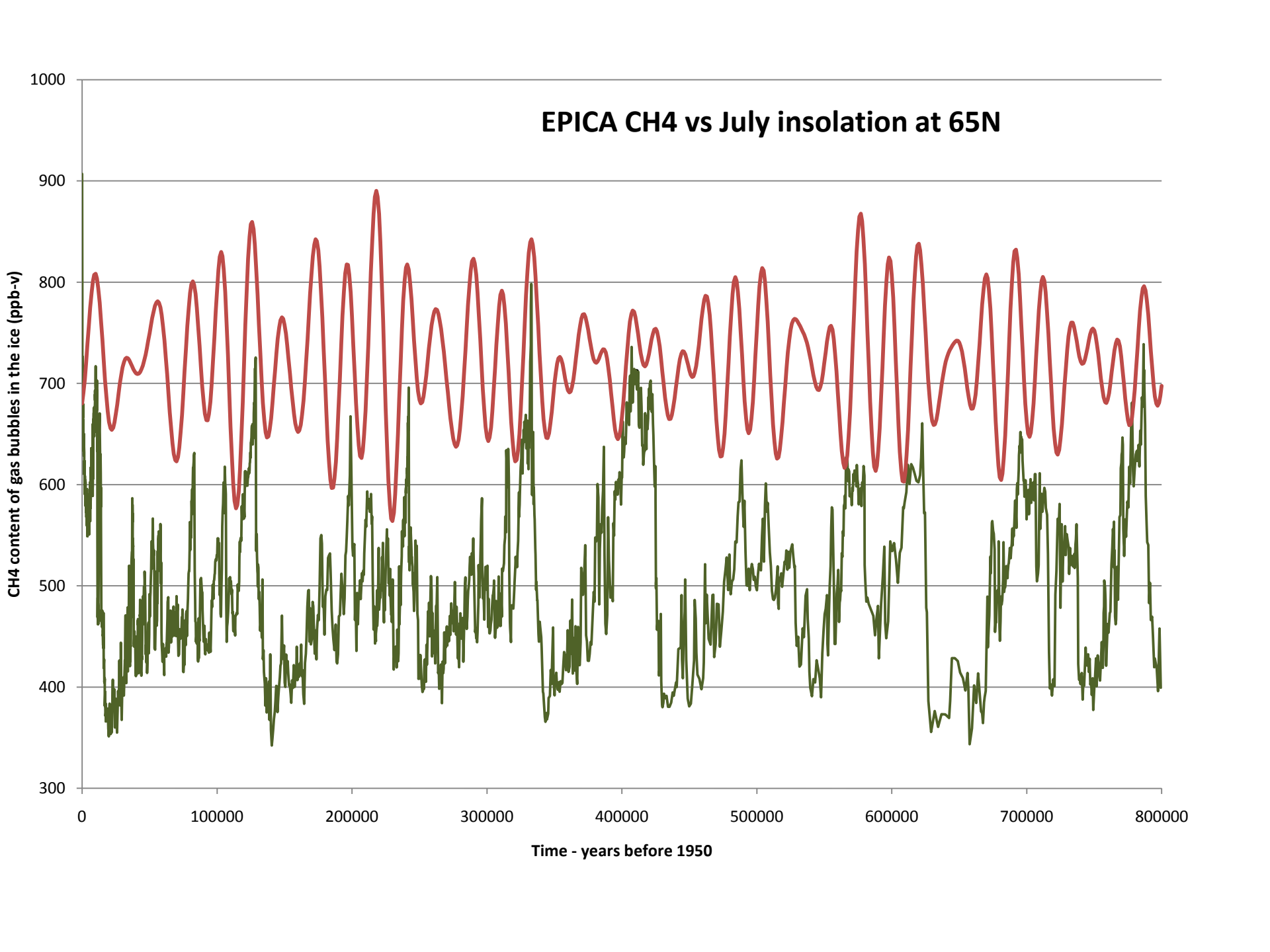
- Eccentricity: controls seasonality. Low eccentricity leads to low seasonality and hence promotes glaciation
- Obliquity (tilt): also controls seasonality. Low obliquity leads to low seasonality and hence promotes glaciation
- Precession (tilt direction): works in conjunction with eccentricity to control the level of insolation at 65° N. Glaciation is favoured when the direction of the tilt is such that N. hemisphere summers are at aphelion (largest earth-sun distance).

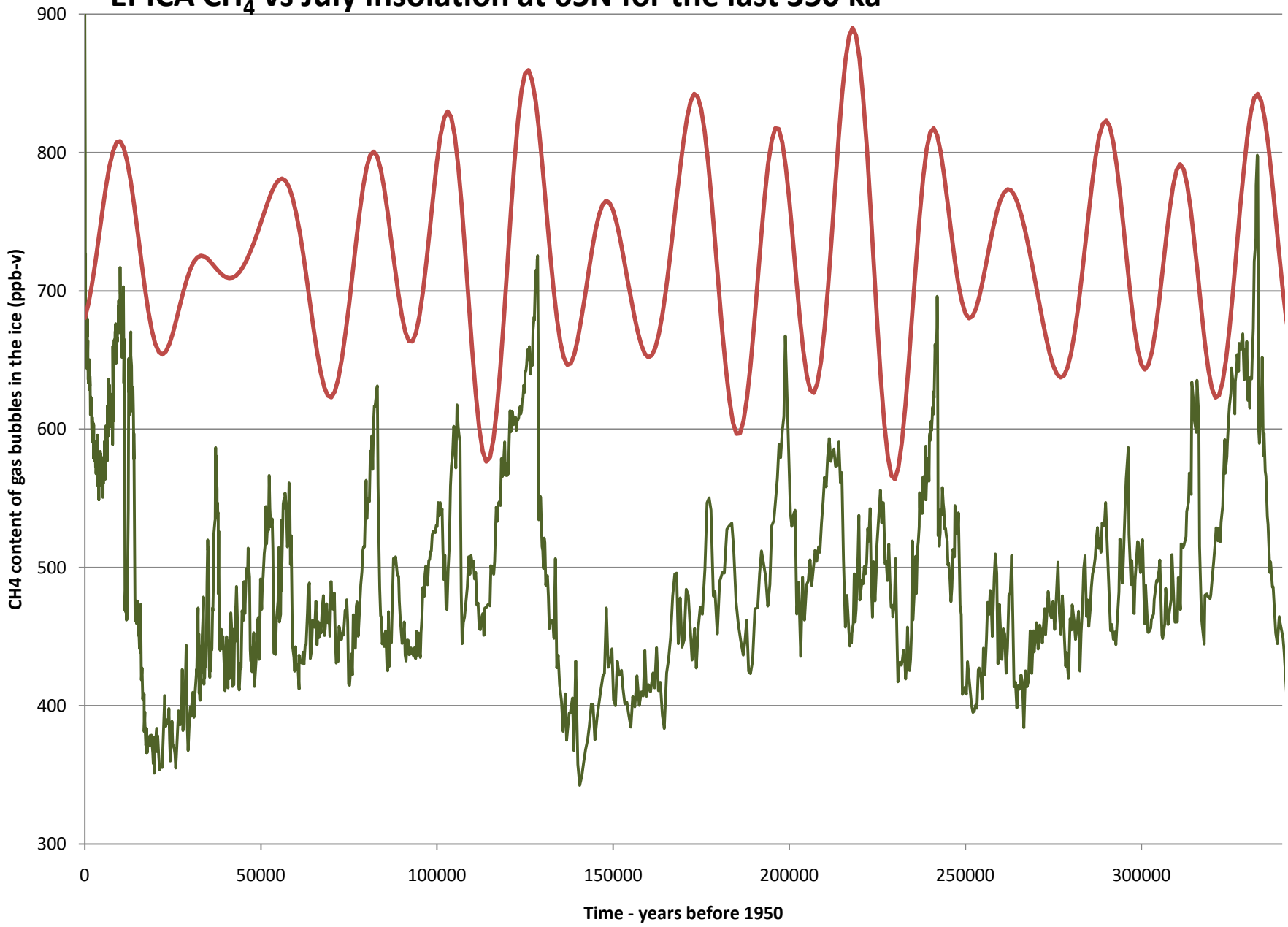
- 65° N insolation (a.k.a. “solar forcing”): a mathematical combination of the three cycles that expresses the variations in insolation at 65° N.


Now
200
400
600
800
1000
ka
Precession
19 & 23 ka
Obliquity
41 ka
Eccentricity
100 & 413 ka
Solar Forcing
65°N Summer
Hot
Stages of
Glaciation
Cold


EPICA temperature vs July insolation at 65 N
T (Deuterium)
insol-jul-65n
Ice T - C - based on hydrogen isotope data
Time - years before 1950
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
100000
200000
300000
400000
500000
600000
700000
800000


EPICA temperature vs July insolation at 65 N for the last 350 ka
T (Deuterium)
insol-jul-65n
Ice T - C - based on hydrogen isotope data
Time - years before 1950
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
50000
100000
150000
200000
250000
300000


EPICA CH4 vs July insolation at 65N
CH4 content of gas bubbles in the ice (ppb-v)
1000
900
800
700
600
500
400
300
0
100000
200000
300000
400000
500000
600000
700000
800000
Time - years before 1950


EPICA CH4 vs July insolation at 65N for the last 350 ka
900
800
700
600
500
400
300
CH4 content of gas bubbles in the ice (ppb-v)
0
50000
100000
150000
200000
250000
300000
Time - years before 1950