

Shallow firn cores and stable isotopes - climate change during the past 50 years in Dronning Maud Land (DML)

Hans Oerter

Alfred Wegener Institute for Polar and Marine Research,
Bremerhaven, Germany

Introduction

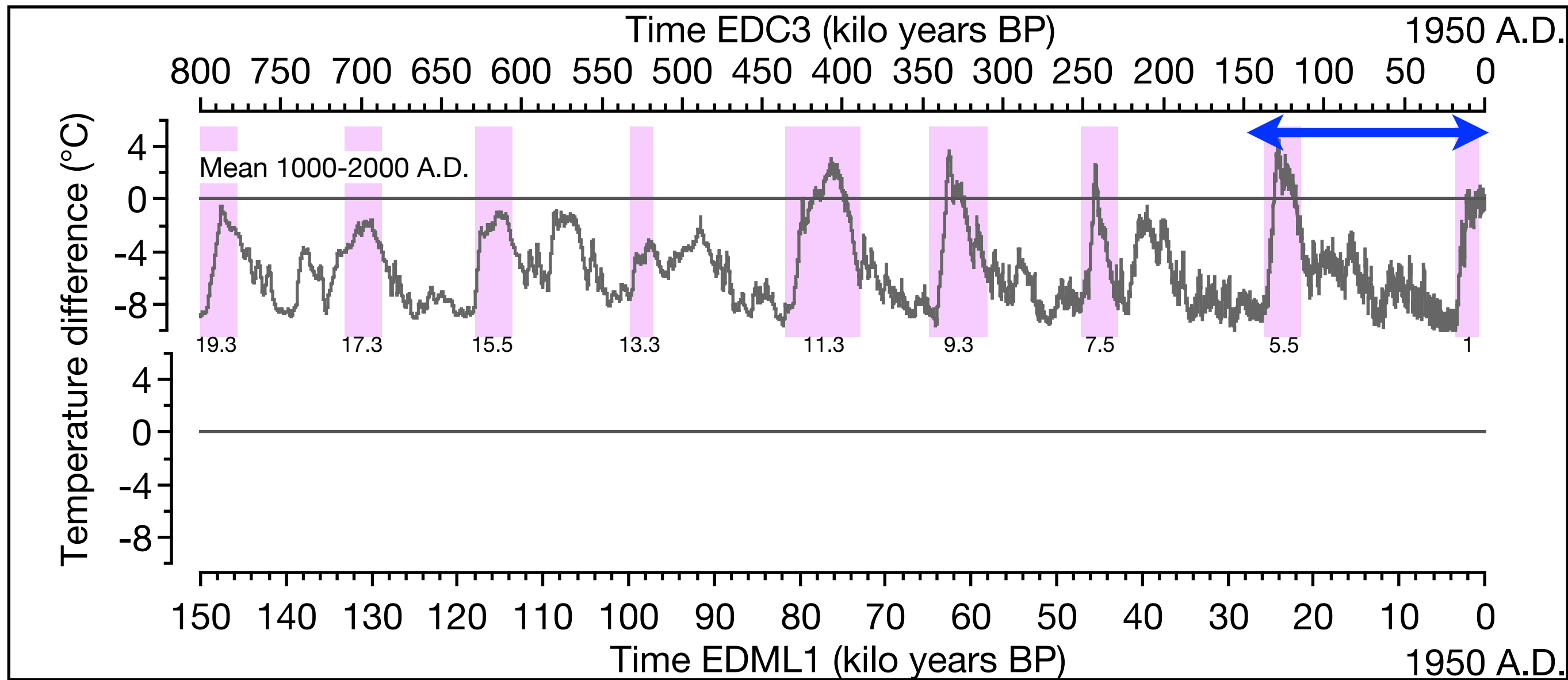
Stable isotopes, ^{18}O and Deuterium, are indicators for temperature change.

The annual cycle of stable isotopes in combination with electrical conductivity of the ice or the chemical composition can be used for dating firn/ice core cores.

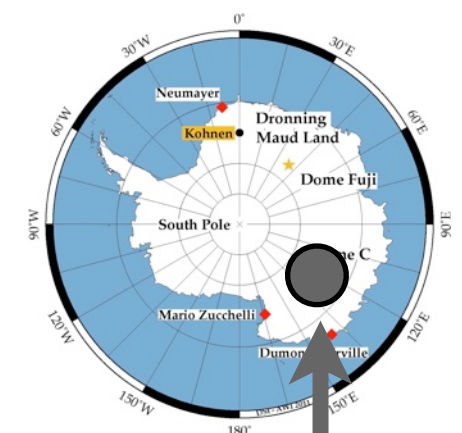
For dating absolute time markers/reference horizons are needed, e.g. volcanoes as Tambora in 1815 AD, Krakatau in 1883 AD, and Agung in 1963 AD.

Detection of Climate Change is a matter of time scale.

Climate Change - a matter of time scale

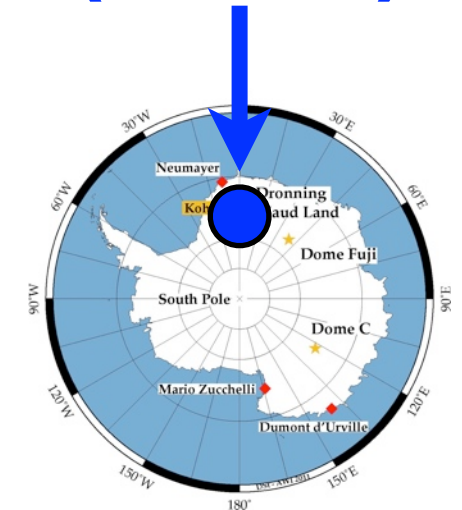


 Interglacial



**EPICA
Dome C
(EDC)**

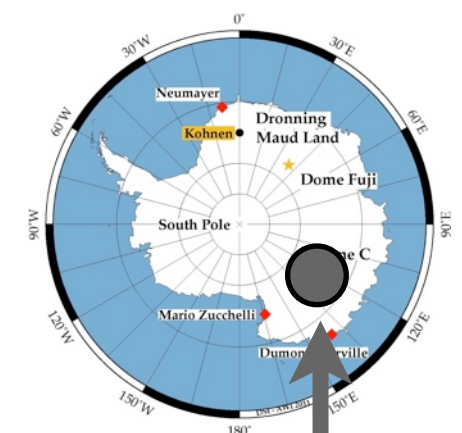
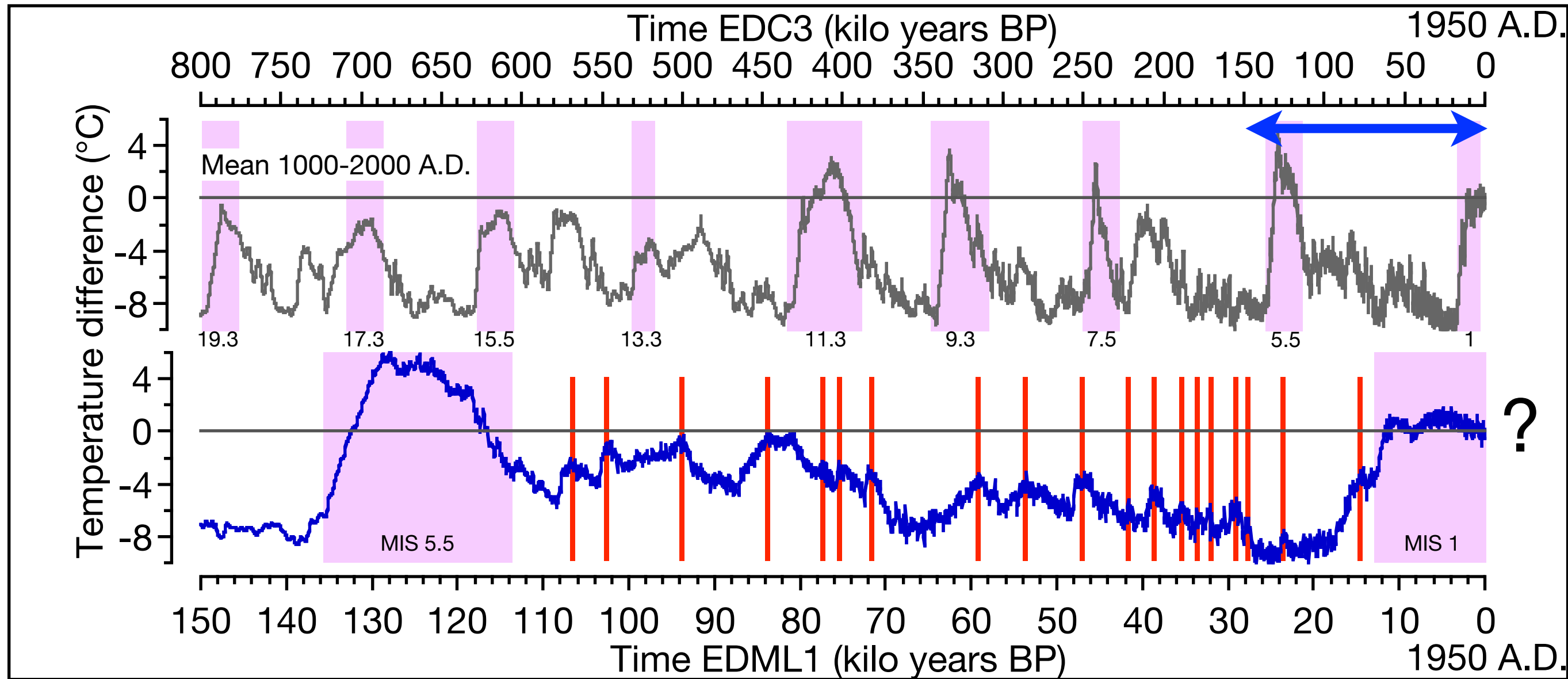
**EPICA
DML
(EDML)**



Jouzel et al., Orbital and Millennial Antarctic Climate Variability over the Past 100,000 Years. *Science* 317, 793-796 (2007)

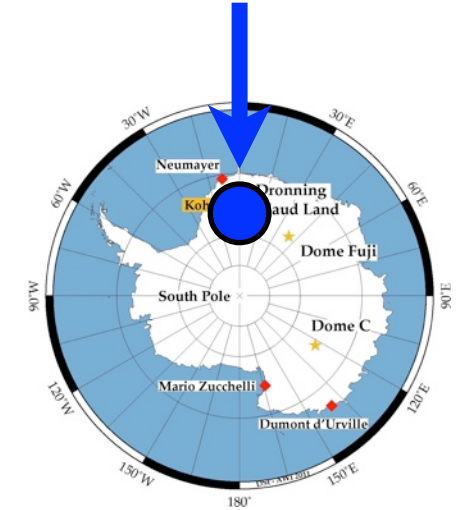
EPICA community members, One-to-one coupling of glacial climate variability in Greenland and Antarctica. *Nature* 444, 195-198 (2006)

Climate Change - a matter of time scale



**EPICA
Dome C
(EDC)**

**EPICA
DML
(EDML)**

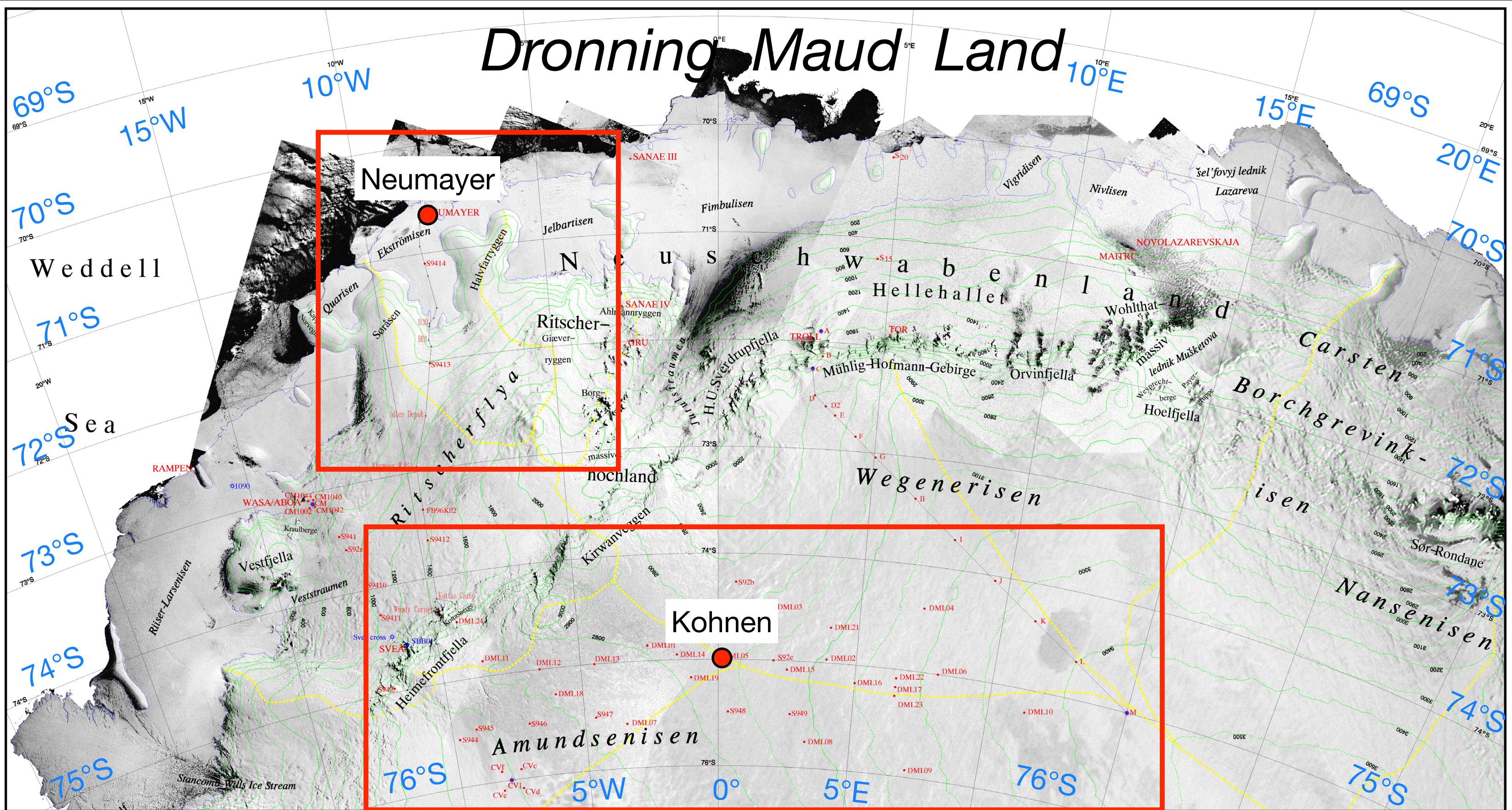


■ Interglacial | AIM corresp. D/O events

Jouzel et al., Orbital and Millennial Antarctic Climate Variability over the Past 100,000 Years. *Science* 317, 793-796 (2007)

EPICA community members, One-to-one coupling of glacial climate variability in Greenland and Antarctica. *Nature* 444, 195-198 (2006)

Dronning Maud Land



Satellite Image Map Dronning Maud Land 1:2000000, Draft Vers.4.2, BKG, Frankfurt am Main, Nov.1998 (detail)

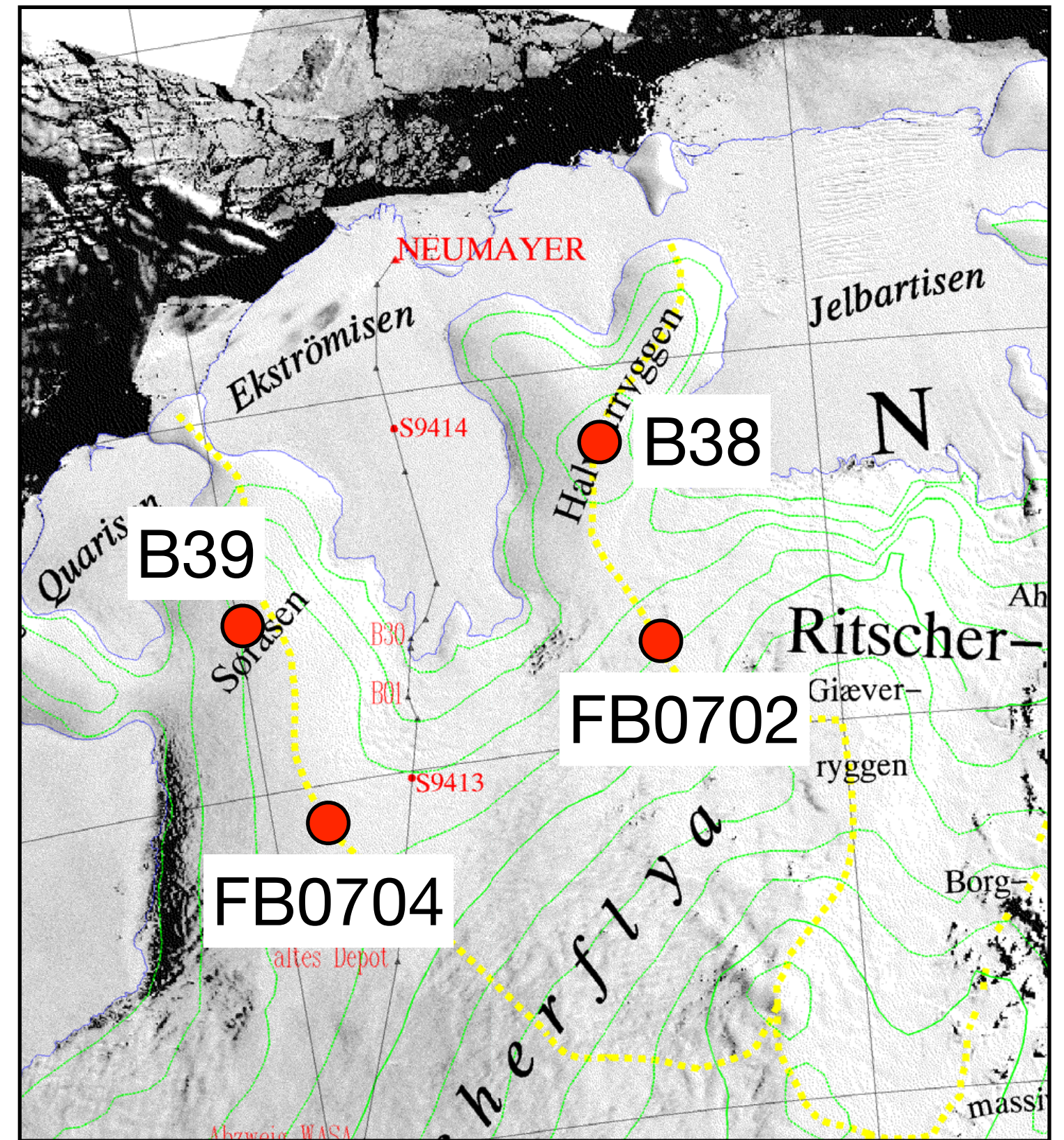
4 cores drilled in 2006/2007

core length: 84, 78.5, 43, and 36 m

snow accumulation:

B38:	$1257 \pm 347 \text{ kg m}^{-2}\text{a}^{-1}$
B39:	$818 \pm 238 \text{ kg m}^{-2}\text{a}^{-1}$
FB0702:	$547 \pm 168 \text{ kg m}^{-2}\text{a}^{-1}$
FB0704:	$489 \pm 128 \text{ kg m}^{-2}\text{a}^{-1}$

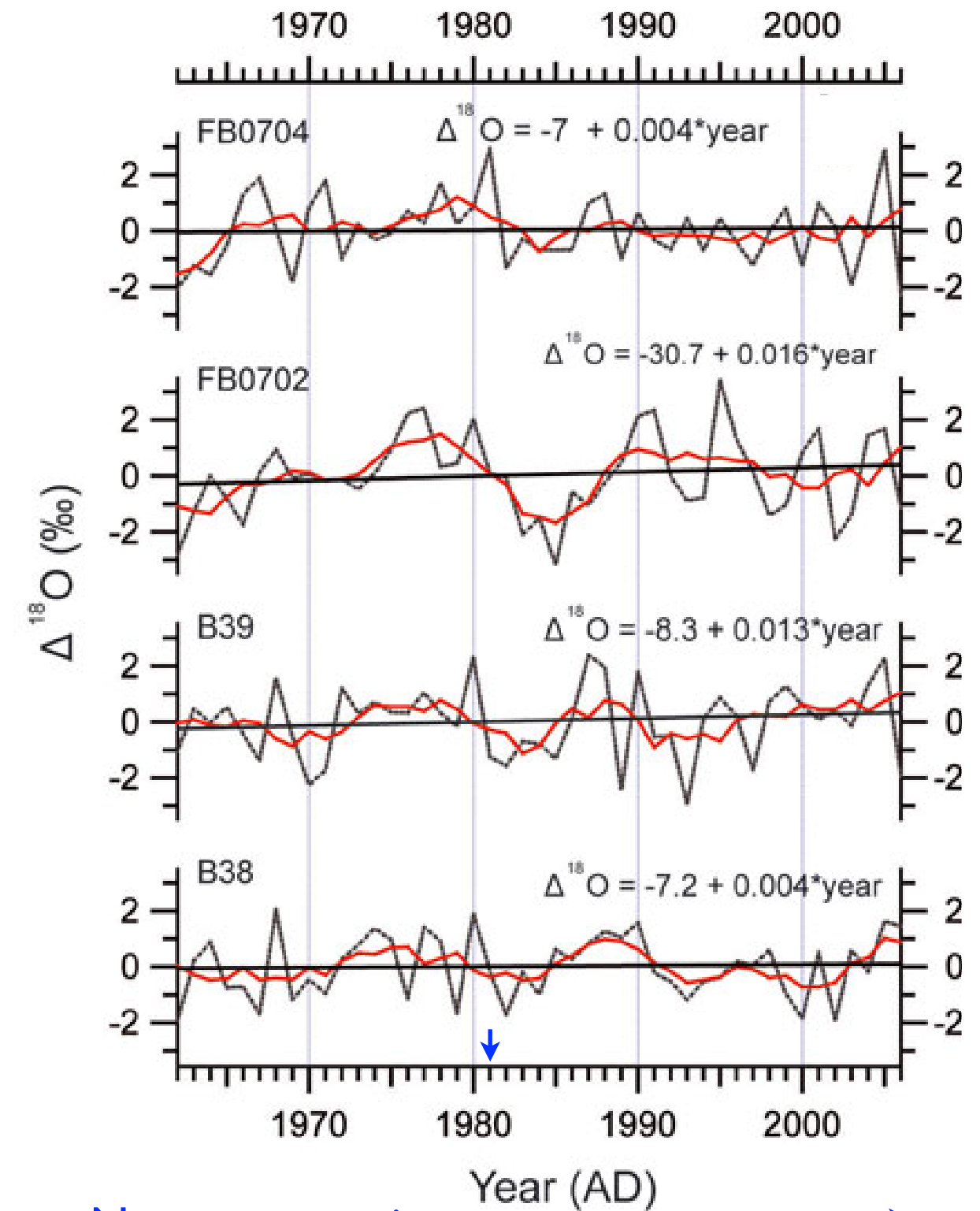
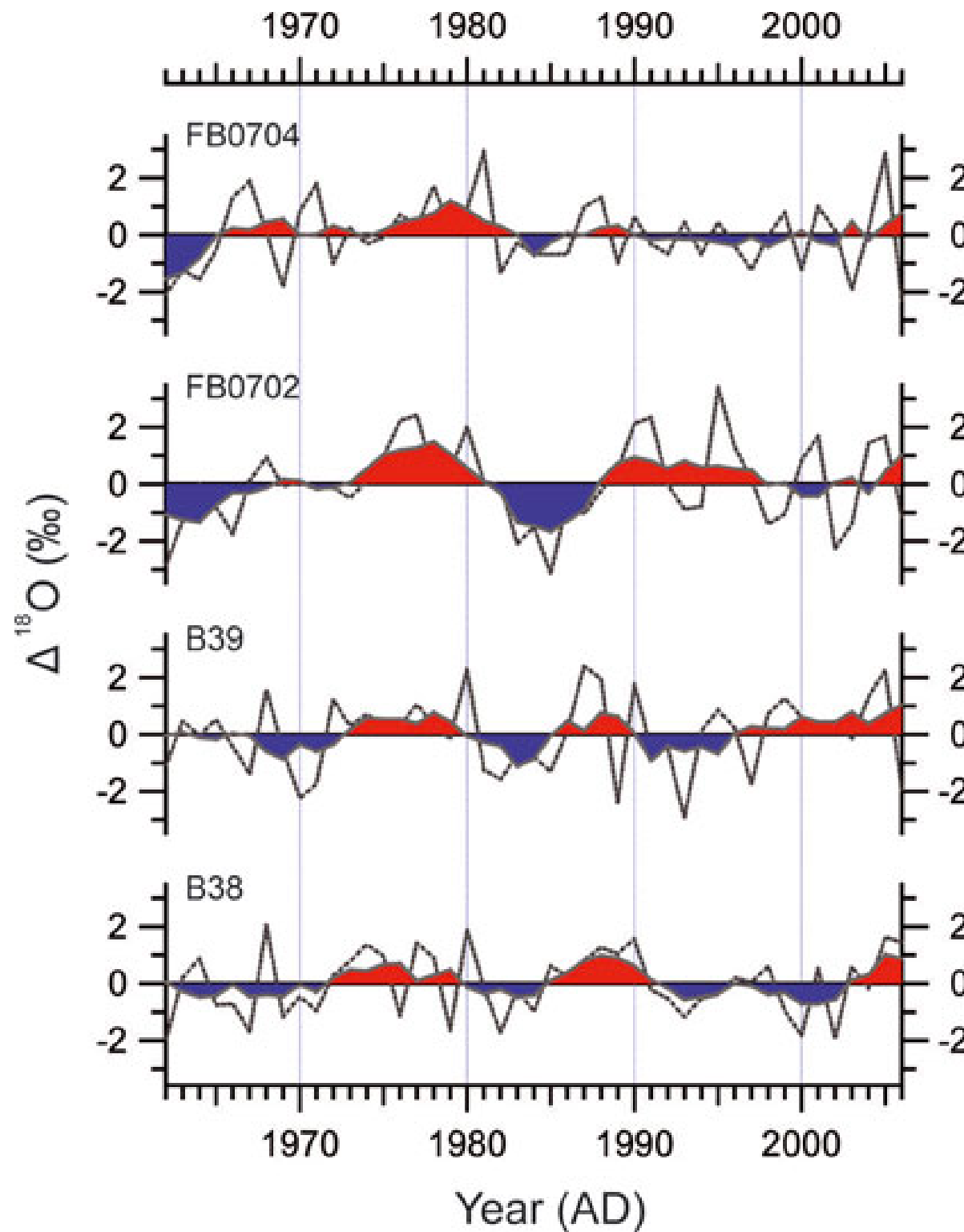
common time period: 1960 to 2007 AD



left:
 ^{18}O anomaly
 annual values
 and
 5yr running mean
 zero = mean

right:
 ^{18}O anomaly
 regression lines

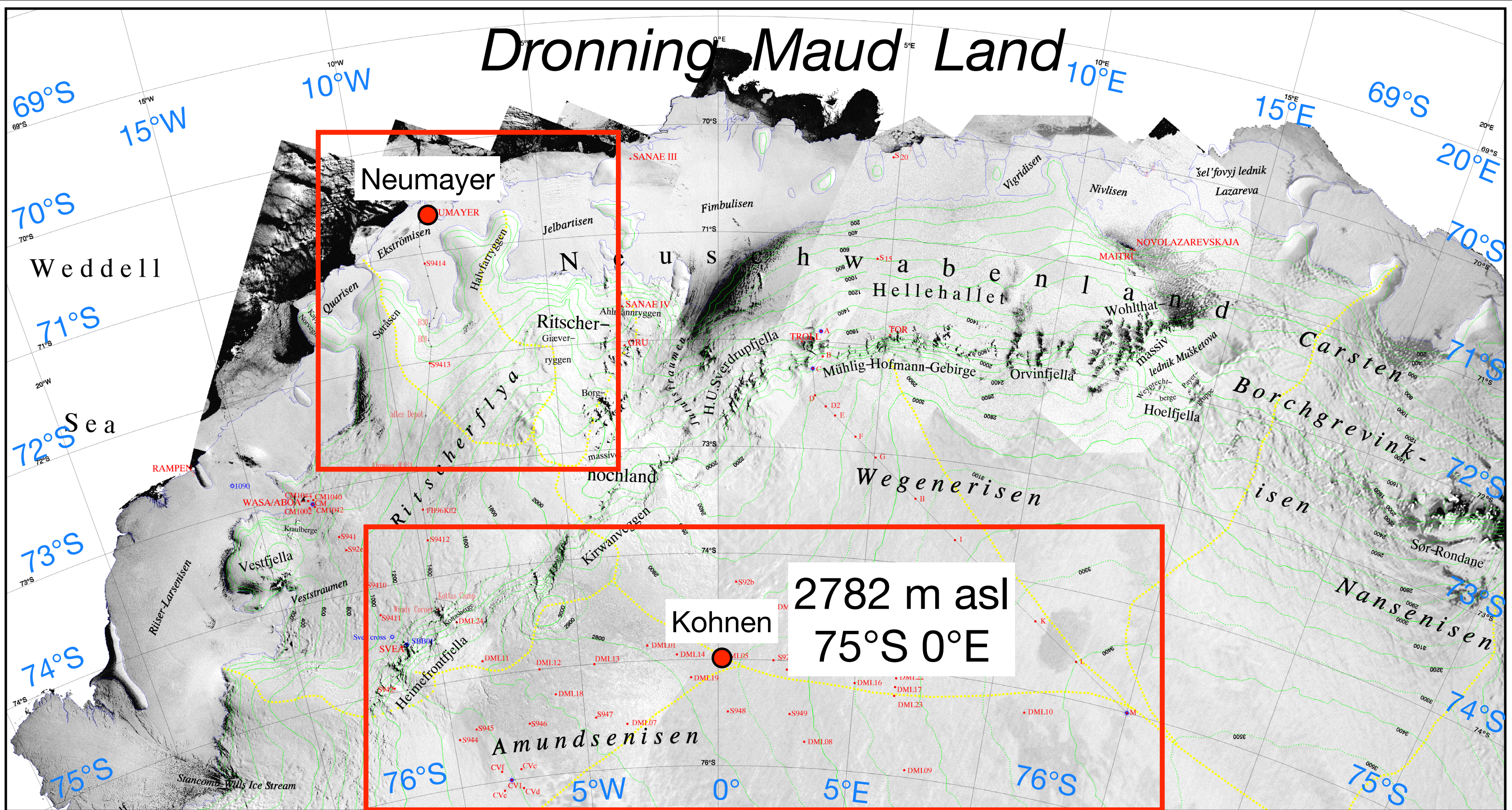
only B39 shows
 statistically
 significant trend
 0.013‰ /yr



Neumayer station

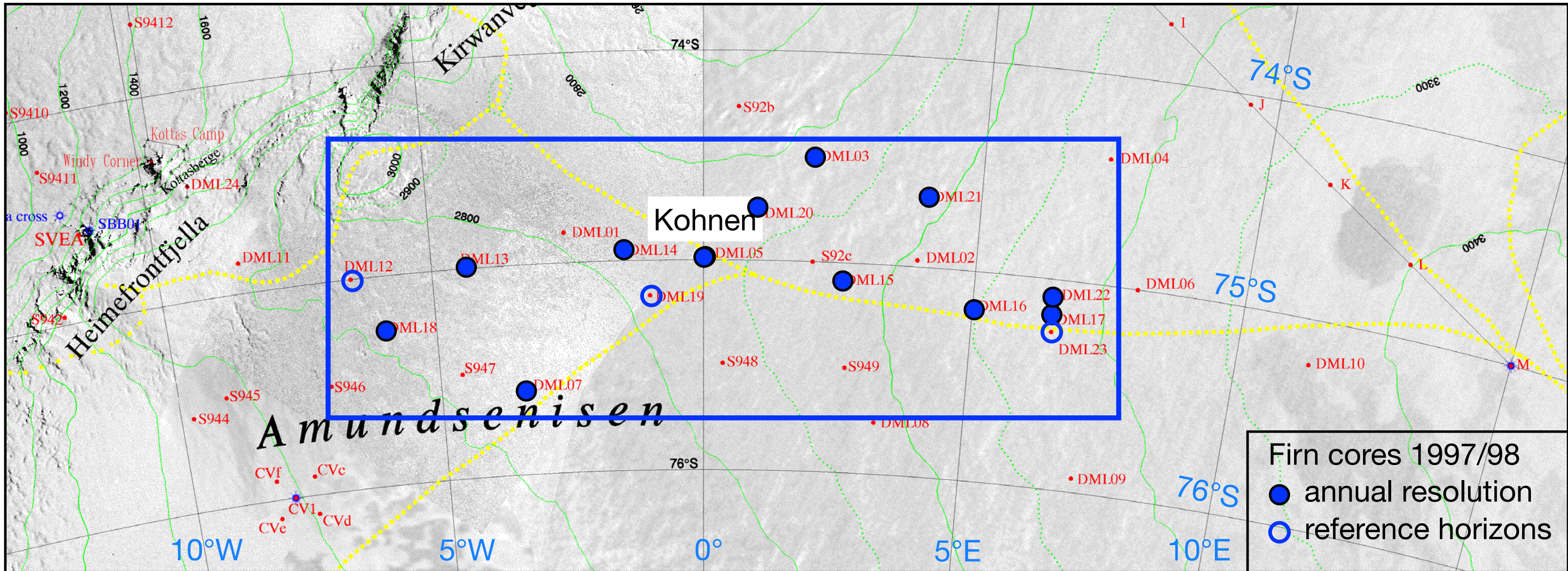
Fernandoy et al. (2010): Temporal and spatial variation of stable-isotope ratios and accumulation rates in the hinterland of Neumayer station, East Antarctica. *J. Glaciology* 56 (198), 673-687.

Dronning Maud Land



Satellite Image Map Dronning Maud Land 1:2000000, Draft Vers.4.2, BKG, Frankfurt am Main, Nov.1998 (detail)

EPICA Pre-site survey: 200-years firn cores



Satellite Image Map Dronning Maud Land 1:2000000, Draft Vers.4.2, BKG, Frankfurt am Main, Nov.1998

Climate Change - a matter of time scale

Stack of annual means
of 10 and 13 firn cores,
resp., from central DML

Deviation of stacked
annual means from
average over 1801-1997

1801-1905:

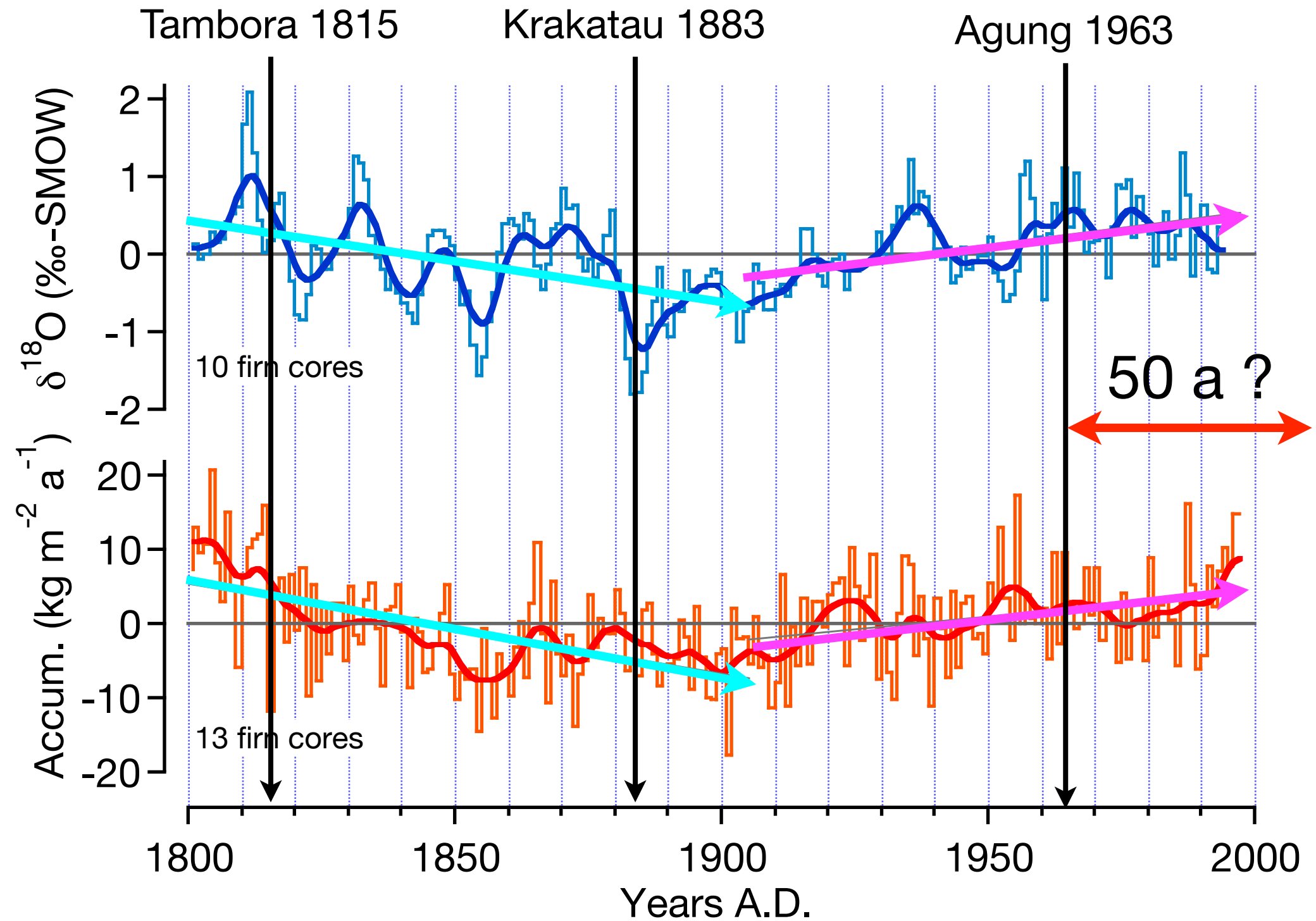
$\delta^{18}\text{O}$: -0.010 ‰/a

Acc.: $-0.120 \text{ kg m}^{-2}\text{a}^{-1}/\text{a}$

1905-1997:

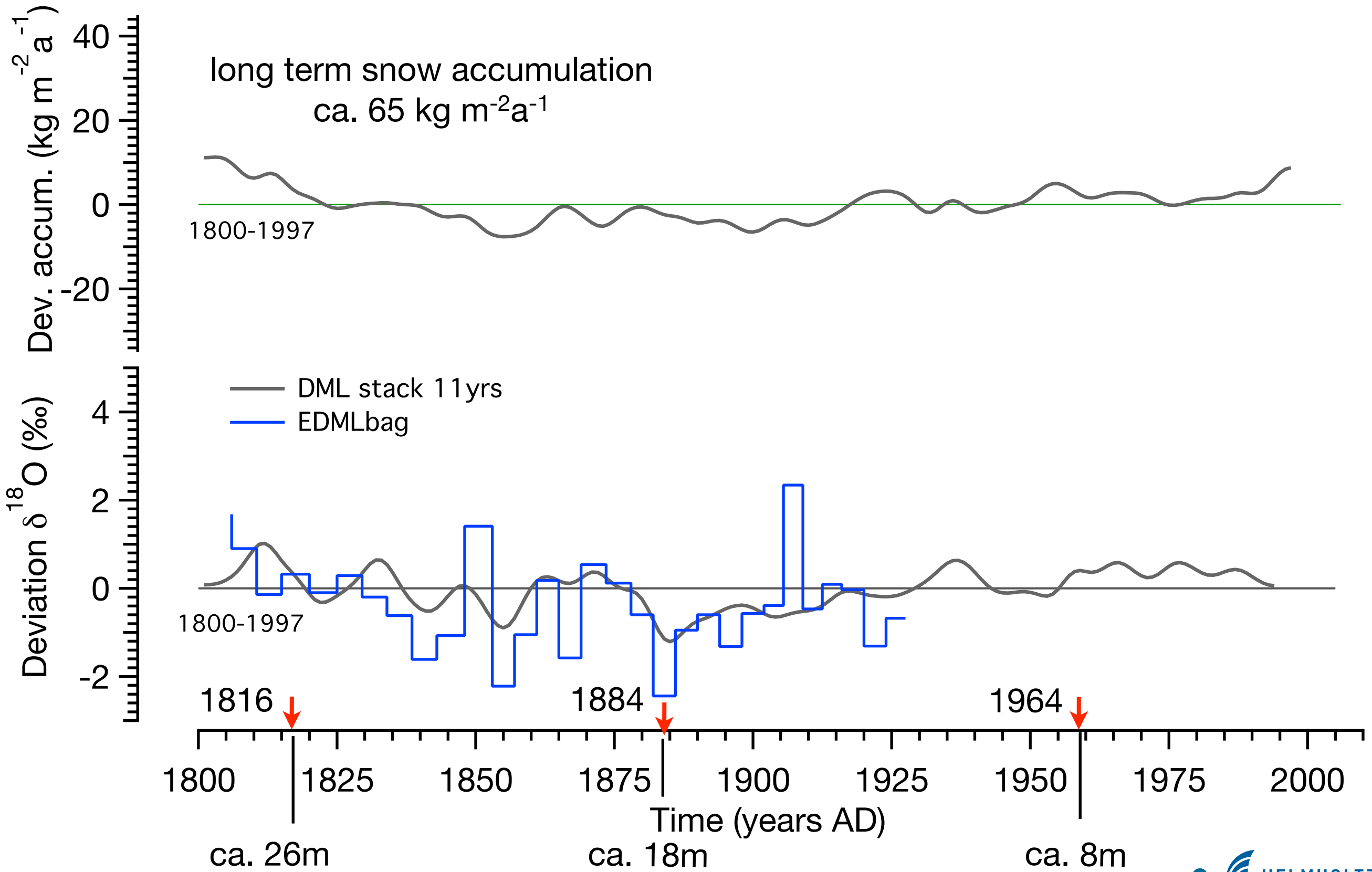
$\delta^{18}\text{O}$: $+0.009 \text{ ‰/a}$

Acc.: $+0.068 \text{ kg m}^{-2}\text{a}^{-1}/\text{a}$

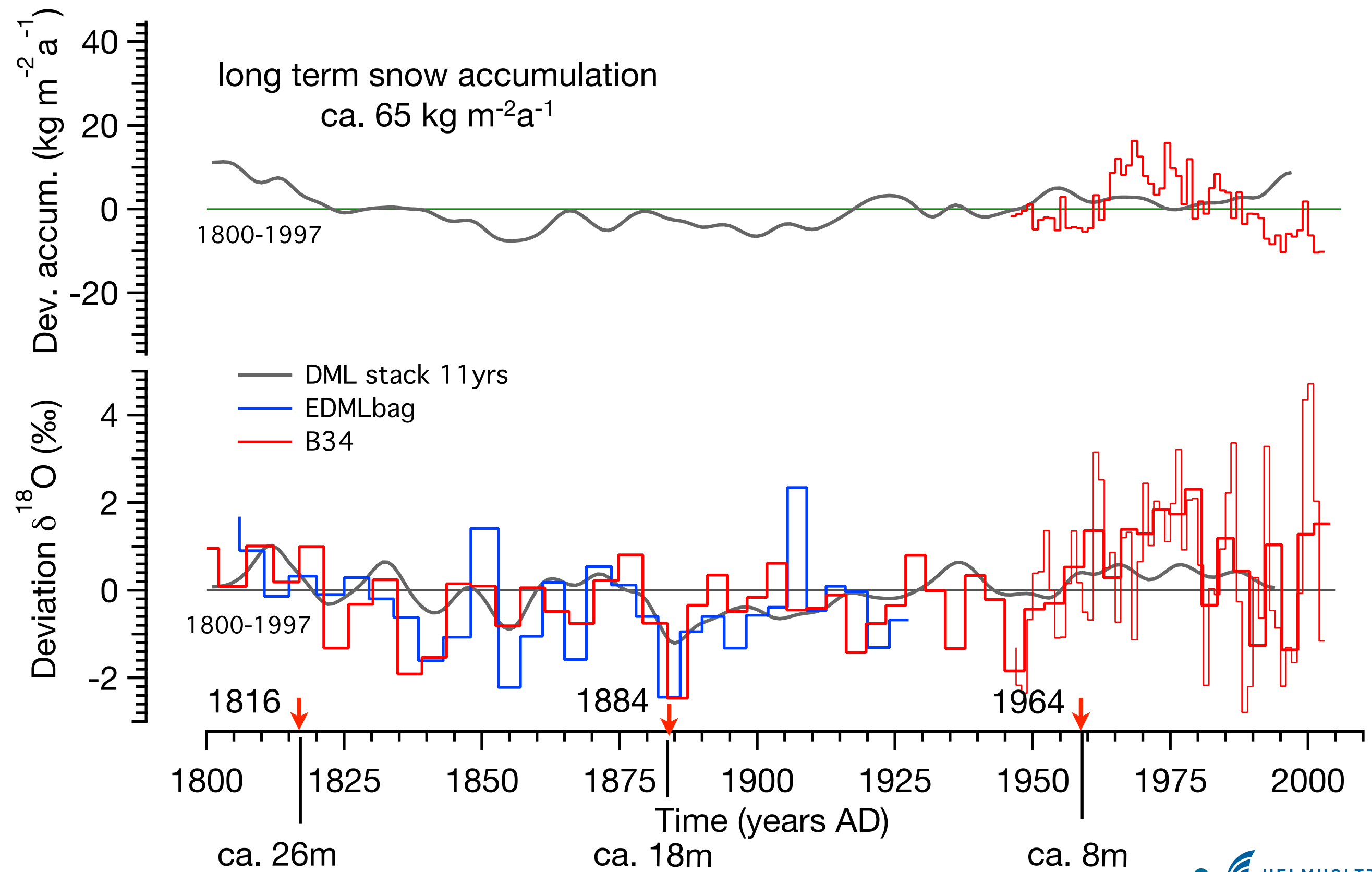


Oerter et al.: Accumulation rates in Dronning Maud Land, Antarctica, as revealed by dielectric-profiling measurements
of shallow firn cores. *Annals of Glaciology* **30**, 27-34 (2000)

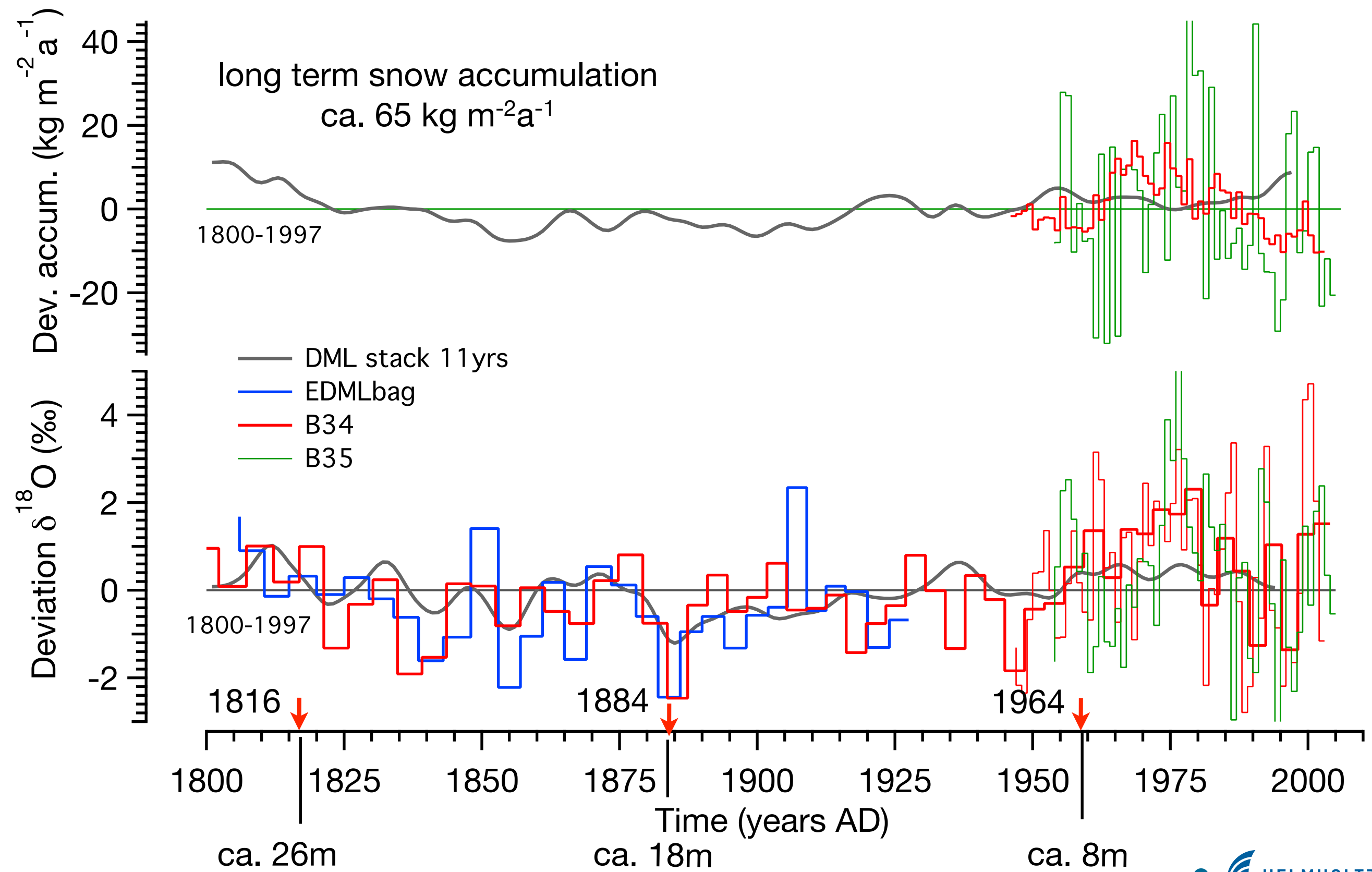
DML stack
+
EDML core



DML stack
 +
 EDML core
 +
 B34 core



DML stack
 +
 EDML core
 +
 B34 core
 +
 B35 core



Conclusions

During the past fifty no clear trend of increasing isotope or temperature values, respectively, nor accumulation rates are recognizable in western DML.

However, an increase of $\delta^{18}\text{O}$ cannot be excluded for the past decade.

There is still a major uncertainty in Antarctic ice mass balance calculations !

Thank you for your attention !

