

A recent update on the circulation and water masses around the Filchner and Ronne Ice Shelves in the southern Weddell Sea



¹Markus A. Janout, ¹Hartmut H. Hellmer, ²Tore Hattermann, ³Oliver Huhn, ³Jürgen Sültenfuss, ^{4,5}Svein Østerhus, ¹Lukrecia Stulic, ⁶Svenja Ryan, ¹Michael Schröder, ¹Torsten Kanzow

¹Alfred-Wegener-Institute Helmholtz Center for Polar and Marine Research, Bremerhaven, Germany

²Norwegian Polar Institute, Tromsø, Norway

³Institute of Environmental Physics, University Bremen, Germany

⁴Norwegian Research Center, Bergen, Norway

⁵Bjerknes Centre for Climate Research, University of Bergen, Norway

⁶Woods Hole Oceanographic Institution, Woods Hole, USA



Photo: M. Janout

Questions or comments? Email: markus.janout@awi.de



Motivation and background



- Filchner Ronne Ice Shelf (FRIS) is the world's largest ice shelf (by volume) and still characterized by moderate basal melt rates
- *RV Polarstern*-expedition to the southern Weddell Sea in austral summer 2018 was able to survey the entire length of FRIS for the first time since 1995
- The 2018 survey provided a recent status update on FRIS hydrography and circulation and allows insights regarding the variability of the region

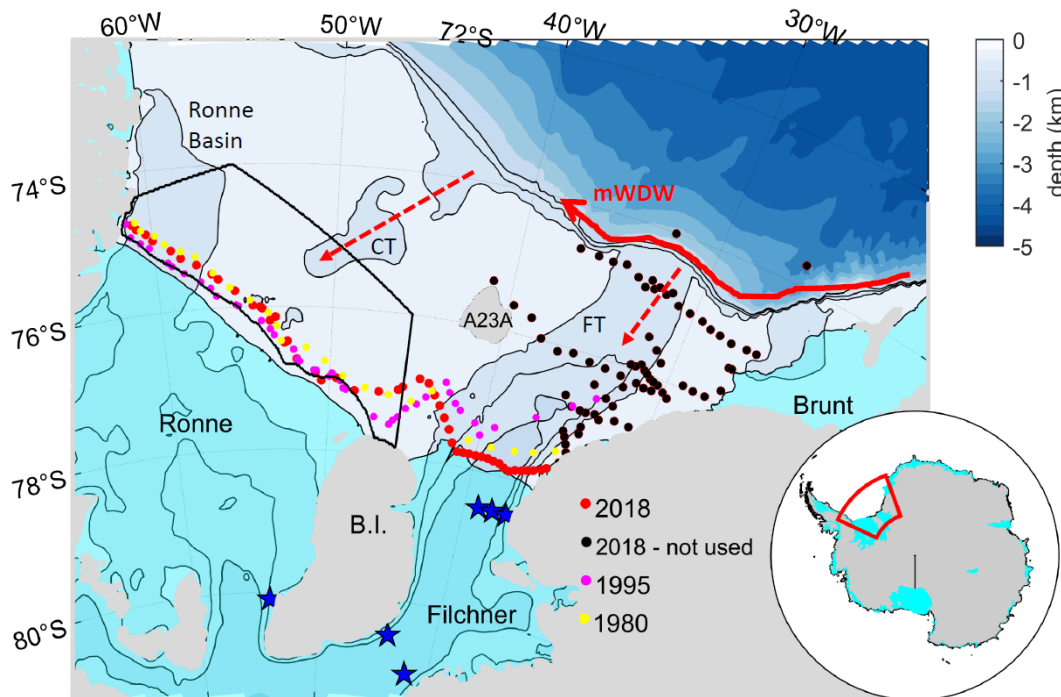


Fig.1: Map of the FRIS region. Red and black dots show 2018 station locations.



Note: All figs shown here from Janout et al. (under review)



Results - Hydrography

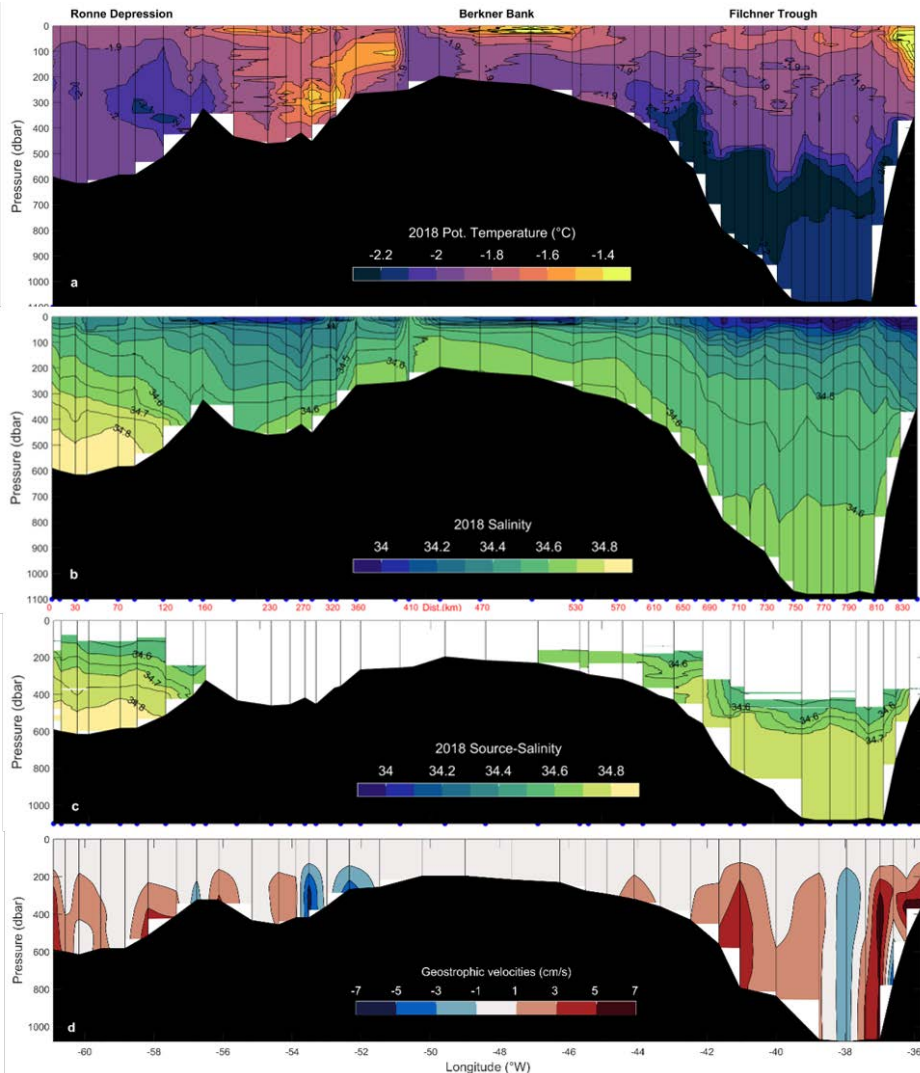


Fig.2: a) Pot. Temperature, b) practical salinity, c) ISW source salinity based on the Gade line, d) geostrophic velocities referenced to 200m along FRIS

- **Ronne** dominated by High Salinity Shelf Water (HSSW) and Ice Shelf Water (ISW)
- **Filchner** showed ISW in the entire Trough below 300m.
- 2018 found some of the coldest conditions seen in any survey in Filchner Trough
- Source water analysis indicates that the ISW in Filchner Trough was derived from Ronne-HSSW, which points to vigorous sub-ice shelf circulation in recent years



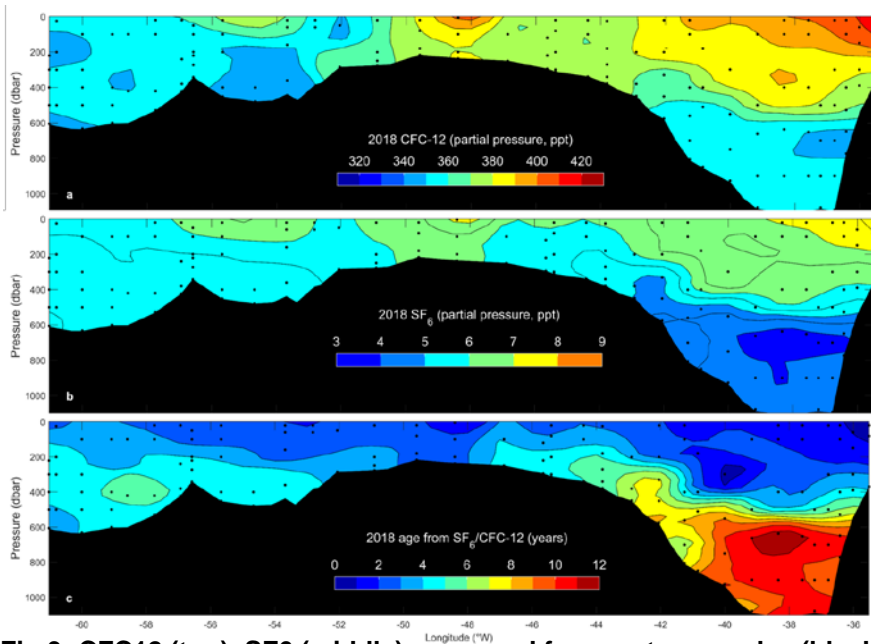


Fig.3: CFC12 (top), SF6 (middle) measured from water samples (black dots), and the estimated water mass age based on the SF6/CFC-ratio (bottom).

- Noble gas (bottom figure) and anthropogenic gas tracers (top) provide additional insights into basal melt rates and circulation time scales
- Oldest (5-8 yrs) waters were observed in central Filchner Trough
- A faster travel time (~3 yrs) from Ronne is indicated for waters on the western Filchner slope, which roughly agrees with earlier estimates (Nicholls & Osterhus, 2004)

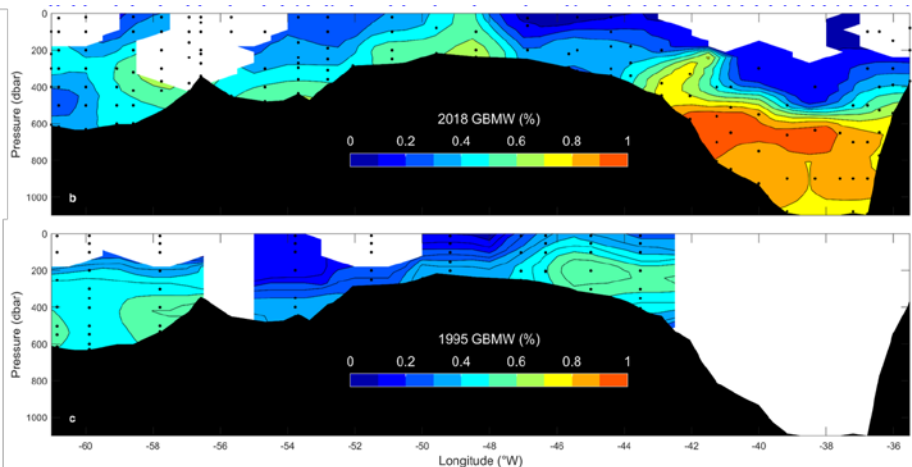


Fig.4: Glacial basal melt water fractions (calculated from Ne to exclude the addition from crustal He) in 2018 (top) and 1995 (bottom).

- Melt water fractions highest in ISW in Filchner Trough, and not apparently different from the 1995 survey (although 1995 had no measurements there)

Summary and conclusions

- Recent cold conditions on the southern Weddell Sea shelf likely supported by extensive ice formation off Ronne (see Fig.5)
- FRIS is still protected from large-scale inflow of mWDW through dense shelf waters
- Hydrography off Ronne likely stable over the last 4 decades
- More details regarding the 2018-survey are included in **Janout et al.** (under review at *JGR-Oceans*)
- Additional information on mWDW-inflow toward Filchner Ice Shelf by **Ryan et al.** „Strong and prolonged warm water flow toward the Filchner-Ronne Ice Shelf in 2017“ (under revision for *GRL*)

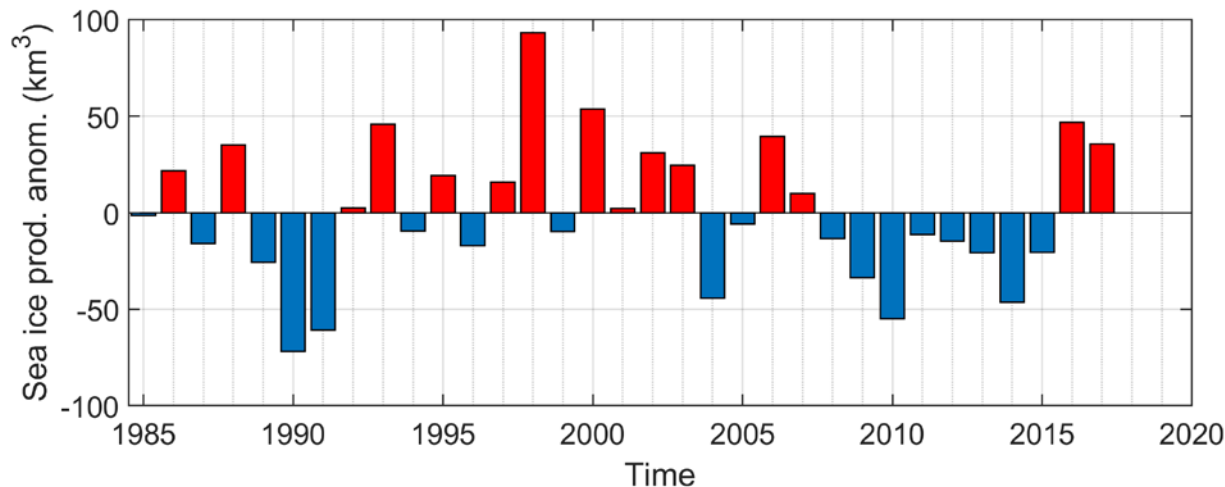


Fig.5: Sea ice production anomalies in the Ronne sector from 1985-2017 based on a simulation with the Finite Element Sea ice Ocean Model (FESOM; Timmermann et al., 2012) forced with data from the ERA-Interim reanalysis.