On the Modified Warm Deep Water Flow toward the Filchner Ronne Ice Shelf: Observations and Model Results

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Why the Filchner Ronne Ice Shelf?

FRIS plays key role in bottom water formation. By volume, the largest ice shelf in Antarctica.

No warm water enters cavity.
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The Filchner Ronne Ice Shelf

- Filchner Sill
- A23-A
- Weddell Sea
- Ronne Trough
- Berckner Bank
- Berckner Island

**Observed inflow**

**Modelled inflow**

**Summary/Outlook**
The Filchner Ronne Ice Shelf

Introduction

Observed inflow

FESOM

Modelled inflow

Summary/Outlook

The Filchner Ronne Ice Shelf

Ryan et al., 2017

Arthun et al., 2012

Hellmer et al., 2012

Three two year-long time series at 76°S (2014-2016)

MWDW Inflow Filchner

Ocean Sciences Meeting, 15.01.2018

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The Filchner Ronne Ice Shelf

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Ryan et al., 2017
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Hellmer et al., 2012
Seasonal Hydrography Filchner Trough

- thick ISW layer filling the trough
- MWDW enters over the eastern shelf
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Seasonal Hydrography Filchner Trough

- thick ISW layer filling the trough
- MWDW enters over the eastern shelf
- persistant inflow of MWDW in summer
- strong seasonal shift in circulation
Seasonal Hydrography Filchner Trough

- seasonal intrusion of MWDW

MWDW Inflow Filchner

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Seasonal Hydrography Filchner Trough

- Seasonal intrusion of MWDW

![Graph showing temperature and salinity changes over time with depth and location markers.](image-url)

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**Seasonal Hydrography Filchner Trough**

- Seasonal intrusion of MWDW

**Graphical Representation**

- Temperature, Salinity
- Velocity

**Temperature Profile**

- Observed inflow
- FESOM
- Modelled inflow
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Seasonal Hydrography Filchner Trough

- Seasonal intrusion of MWDW
- Shelf convection in winter
Seasonal Hydrography Filchner Trough

- seasonal intrusion of MWDW
- shelf convection in winter
- connection to slope front position

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Seasonal Hydrography Filchner Trough

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Finite Element Sea Ice-Ocean Model (FESOM)

- unstructured mesh
- primitive-equation, hydrostatic global ocean model
- dynamic-thermodynamic sea-ice and ice-shelf component
- hybrid vertical coordinate with 22 sigma-layers and 36 z-layers, transition at 2500 m
- forced with NCEP-CFSR reanalysis (1979-2010)
- initialised with World Ocean Data Atlas 2013
New high resolution configuration

New high resolution configuration


Configuration leads to significantly improved:

- general Weddell Gyre circulation
- slope front properties
Introduction

Sensitivity test: Slope front restoring

- Implement data into World Ocean Data Atlas (2013)
- restore model upstream of the study area (3 hourly)

Hattermann, in prep.
Sensitivity test: Slope front restoring

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- restore model upstream of the study area (3 hourly)

Hattermann, in prep.
• Hydrographic shelf break properties cannot be reproduced in high resolution run

• Restoring upstream leads to a realistic representation
Modelled inflow eastern shelf

Model reproduces seasonal southward flow of MWDW and deep convection in winter over eastern shelf.
Modelled inflow eastern shelf

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Does MWDW reach and enter the cavity?

• significant modification of MWDW on the shelf
Does MWDW reach and enter the cavity?

- significant modification of MWDW on the shelf
- traces of warm water reach the ice front every year...
Does MWDW reach and enter the cavity?

- significant modification of MWDW on the shelf
- traces of warm water reach the ice front every year...
- ... and can enter the cavity
Summary

- Strong seasonal cycle over shelf east of the Filchner Trough driven by winter convection and seasonal uplift of Antarctic Slope Front
- Deep convection in winter erodes MWDW on shelf, limiting a year long southward heat transport
- The correct representation of the shelf break hydrography in the model is crucial to achieve a realistic hydrography and inflow on the continental shelf
Summary

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Improved Slope Front Current

Only oceanic heat supply for Weddell Gyre via the eastern inflow of Circumpolar Deep Water → has to be captured by model

→ New configuration leads to realistic gyre structure and transports
Erosion of dense layer by MWDW