

# Weather Forecasting in Polar Regions

- An Experience Report from the MOSAiC Expedition -

EUMeTrain SNOW Event Week 08.-12. February 2021

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German Meteorological Service

maritime weather agency  
„Seewetteramt“ Hamburg



our department:  
„Seeschiffahrtsberatung“  
Marine Meteorological Office

## Our daily work:



- operational weather forecast
- meteorological expert opinions
- forecast products for customers:  
creation,  
initiation and supervision of supply
- monitoring and support of wave models (Oliver)
- pannel work at EUMETSAT (Oliver)
- occasionally weather forecast on board German research vessels





# start of the MOSAiC expedition

Deutscher Wetterdienst



20<sup>th</sup> September 2019, Tromsø (Norway)



20 September 2019, photo by Jens Kieser - MOSAiC - POLARSTERN





- **facts about the expedition**
- **snowy and icy impressions**
- **the work of the weather forecaster on POLARSTERN**
- **weather, forecast, and the role of satellite images**

# MOSAiC

spearheaded by the Alfred Wegener Institute,  
Helmholtz Centre for Polar and Marine Research (AWI)

Deutscher Wetterdienst



## MOSAiC

Multidisciplinary drifting Observatory  
for the Study of Arctic Climate

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## Expedition partners



Austria



Belgium



Canada



China



Denmark



Finland



France



Germany



Great Britain



Italy



Japan



Korea



Netherlands



Norway



Poland



Russia



Spain



Sweden



Switzerland



USA

source: Alfred Wegener Institute



# MOSAiC research focussed on:



- atmosphere
- ocean
- snow
- ice
- ecosystem
- biogeochemistry

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# MOSAiC further categories:

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- logistics
- bear guards
- media
- helicopter crews
- weather forecasters and technicians
- ship's crew

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Russian icebreaker accompanied the expedition during the first month



MOSAiC early October 2019

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# first steps on the ice floe



MOSAIC late September 2019  
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# set up phase

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MOSaIC early October 2019 , photo by Jens Kieser



# set up phase

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# set up phase

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# set up phase



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# set up phase



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# beginning polar night

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MOSAiC October 2019, photo by Jens Kieser





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# Ocean City

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# ROV City

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# Balloon Town

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# fascinating and hazardous



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# fascinating and hazardous



MOSAiC 2019, photo by Jens Kieser - MOSAiC - POLARSTERN



# Meteorological Office on board POLARSTERN



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**staffed by a meteorologist and a weather technician**



- **daily weather forecast**

**regular and spontaneous briefings,  
weather reports,  
flight weather reports,  
updates on request,  
presentations**

**for ship master, officers,  
scientists,  
helicopter pilots**



- **weather observations**
- **launching weather balloons**
- **collecting and preparing meteorological data  
e.g. observational, satellite,  
NWP**
- **maintaining of instruments  
and technical infrastructure**
- **technical support**



## weather forecast based on:

- on board measurements
- on board visual observations
- data from radio soundings
- a limited selection of model forecasts received by e-mail
- satellite data directly received and processed on board
- personal experiences



## weather forecast based on:

- on board measurements

wind & temperature (30 m)



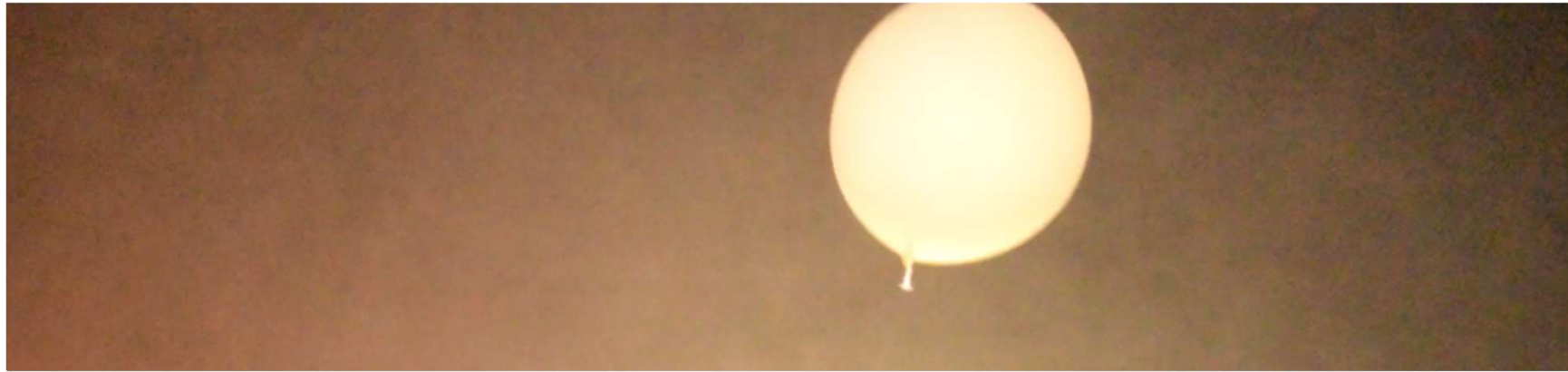
humidity

visibility

air pressure

water temperature

cloud base height

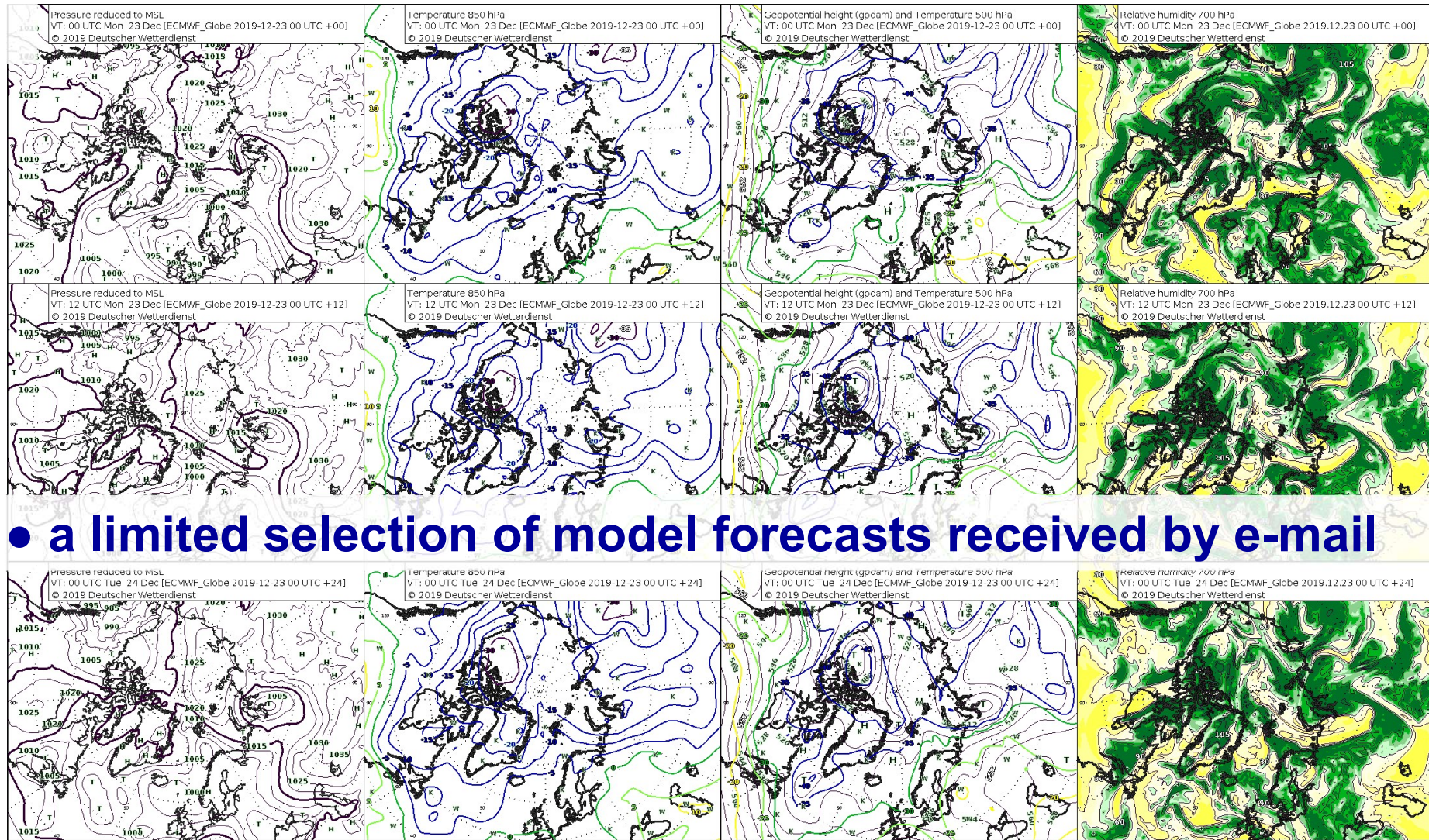


- data from radio soundings



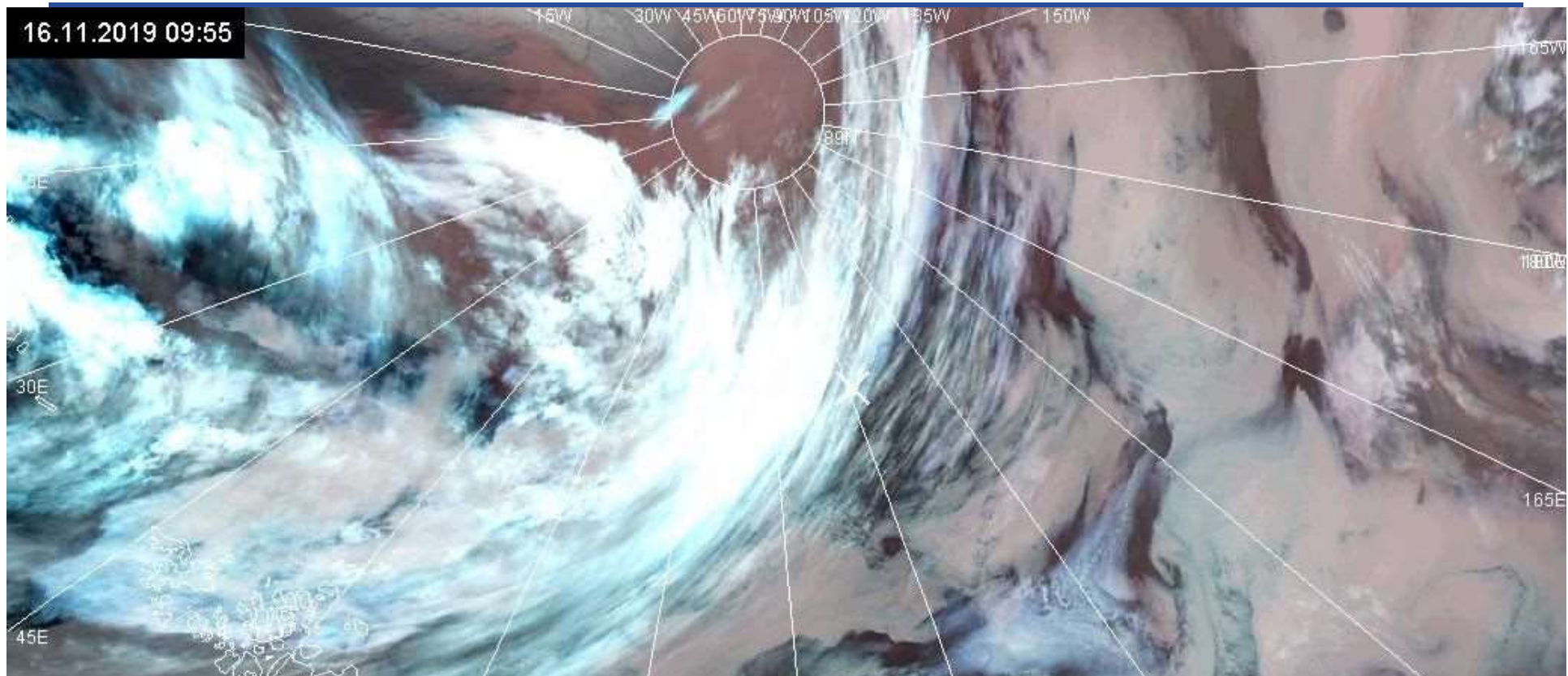
MOSAiC 2019, picture by Sandro Dahlke - MOSAiC - POLARSTERN







# Meteorological Office on board POLARSTERN



- satellite data directly received and processed on board





# satellite antenna and receiver on board POLARSTERN



# using satellite data on board POLARSTERN

- polar orbiting satellites MetOp B and NOAA 15,18,19
- satellite data individually processed and visualized on board
- in the vicinity of the North Pole frequently passing satellites
- limiting factors:
  - frequently low satellite elevations
  - disturbances by ship's funnel and mast



# using satellite data on board POLARSTERN

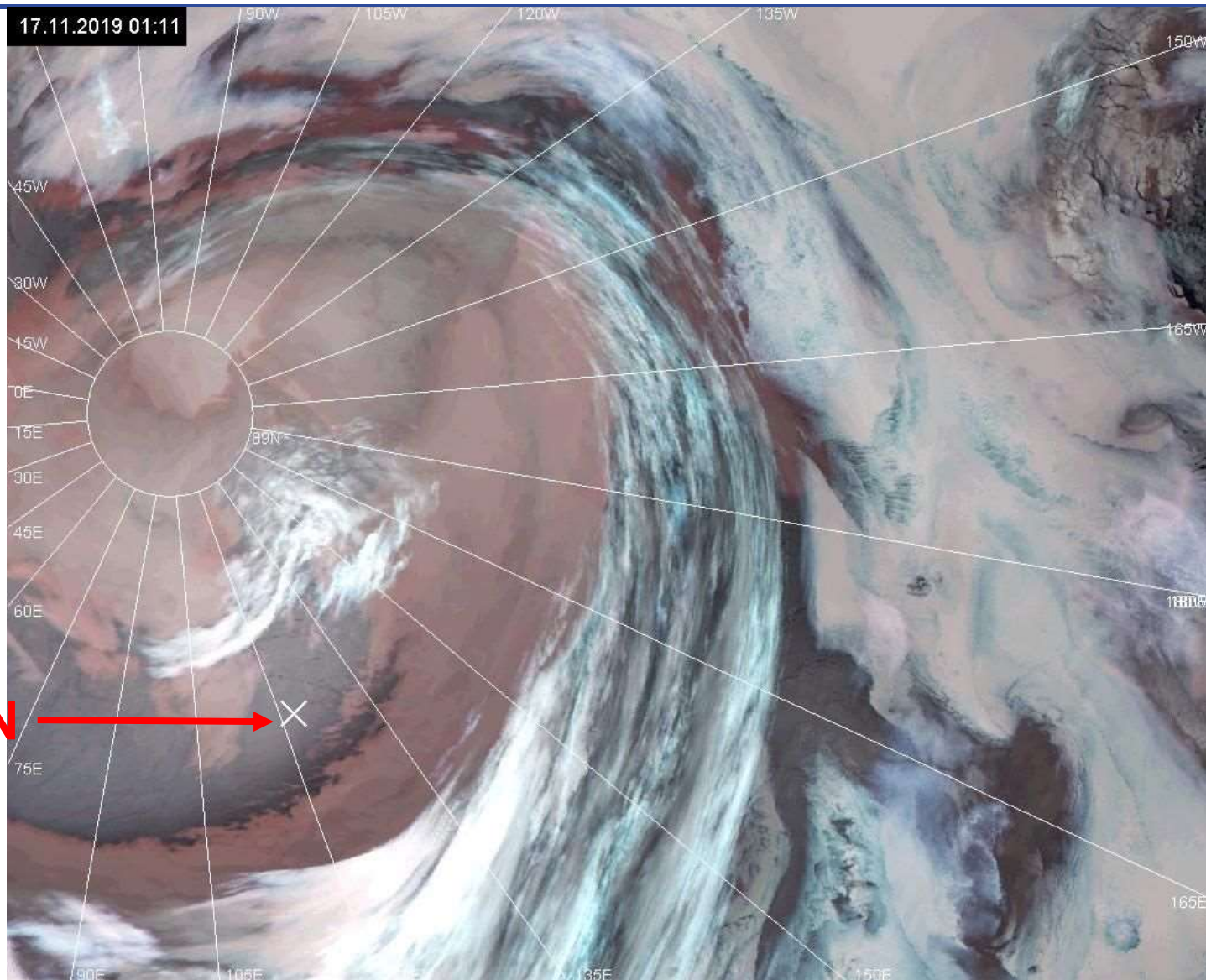
MetOp  
RGB  
composite  
IR channels:  
(3.9 $\mu\text{m}$ ,  
10.8 $\mu\text{m}$ ,  
12.0 $\mu\text{m}$ )



# using satellite data on board POLARSTERN

**MetOp  
RGB  
composite  
IR channels:  
3.9 $\mu$ m,  
10.8 $\mu$ m,  
12.0 $\mu$ m)**

**POLARSTERN**

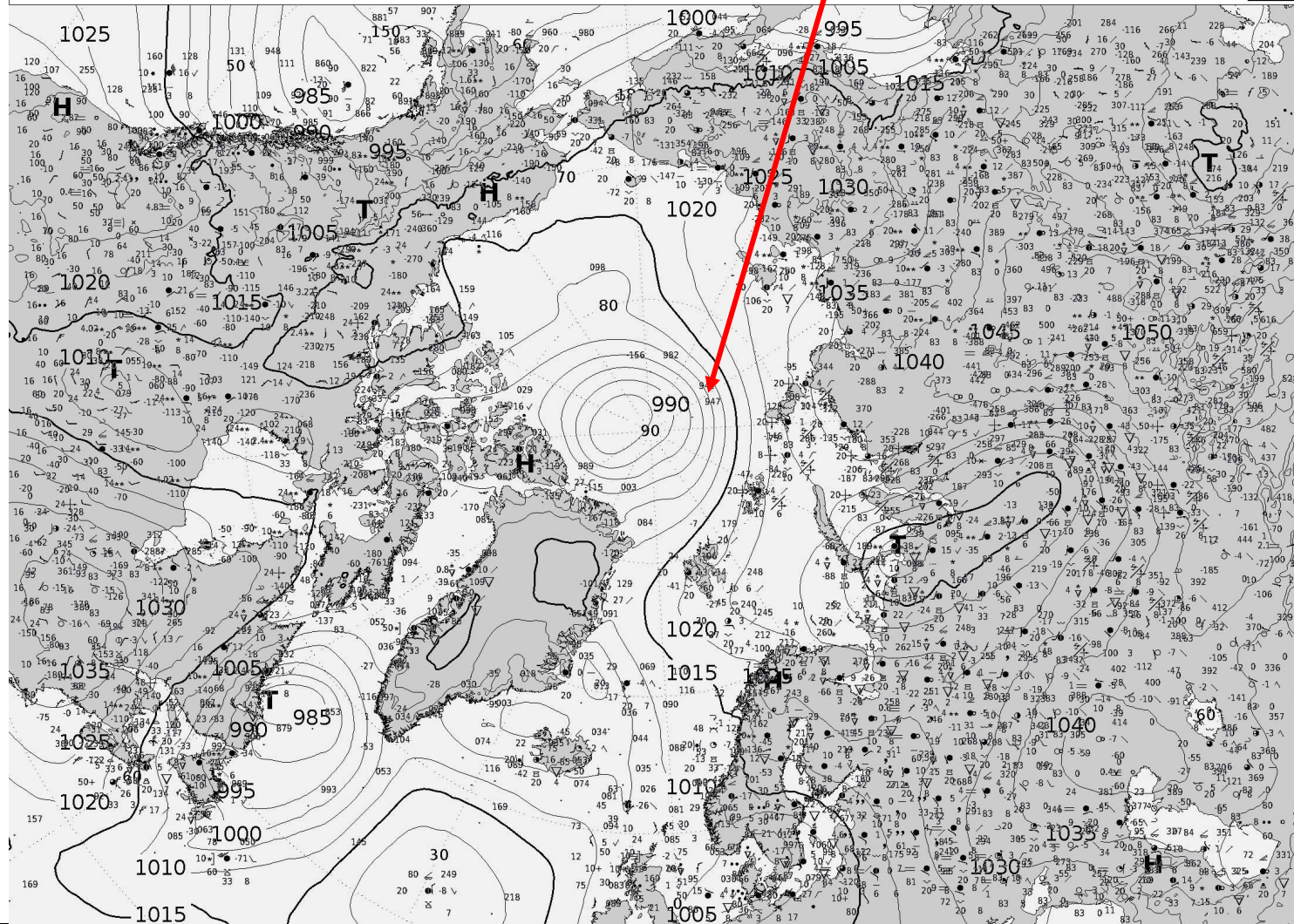




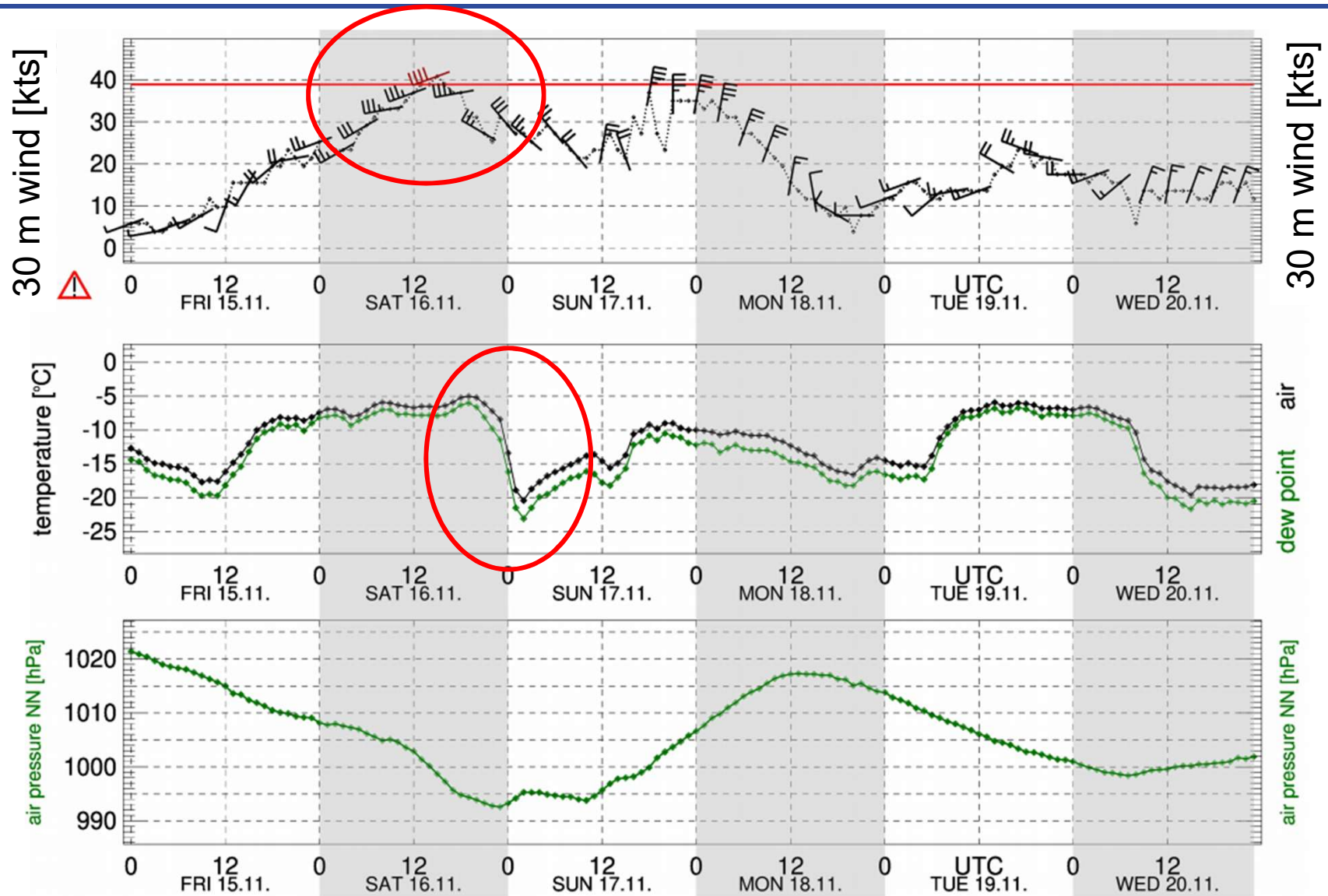
# analysis chart from 16 Nov. 2019 18 UTC

Pressure reduced to MSL (ICON13) + surface observations  
VT: 18 UTC Sat 16 Nov  
© 2019 Deutscher Wetterdienst

**POLARSTERN**



# observational data from POLARSTERN





## weather forecast based on:

- on board measurements
- on board visual observations
- data from radio soundings
- a limited selection of model forecasts received by e-mail
- satellite data directly received and processed on board
- personal experiences



## special features of the daily work:

- **direct contact to the customer**  
spontaneous requests  
ad hoc briefings  
direct response
- **direct contact to the present weather**  
direct verification of the forecast





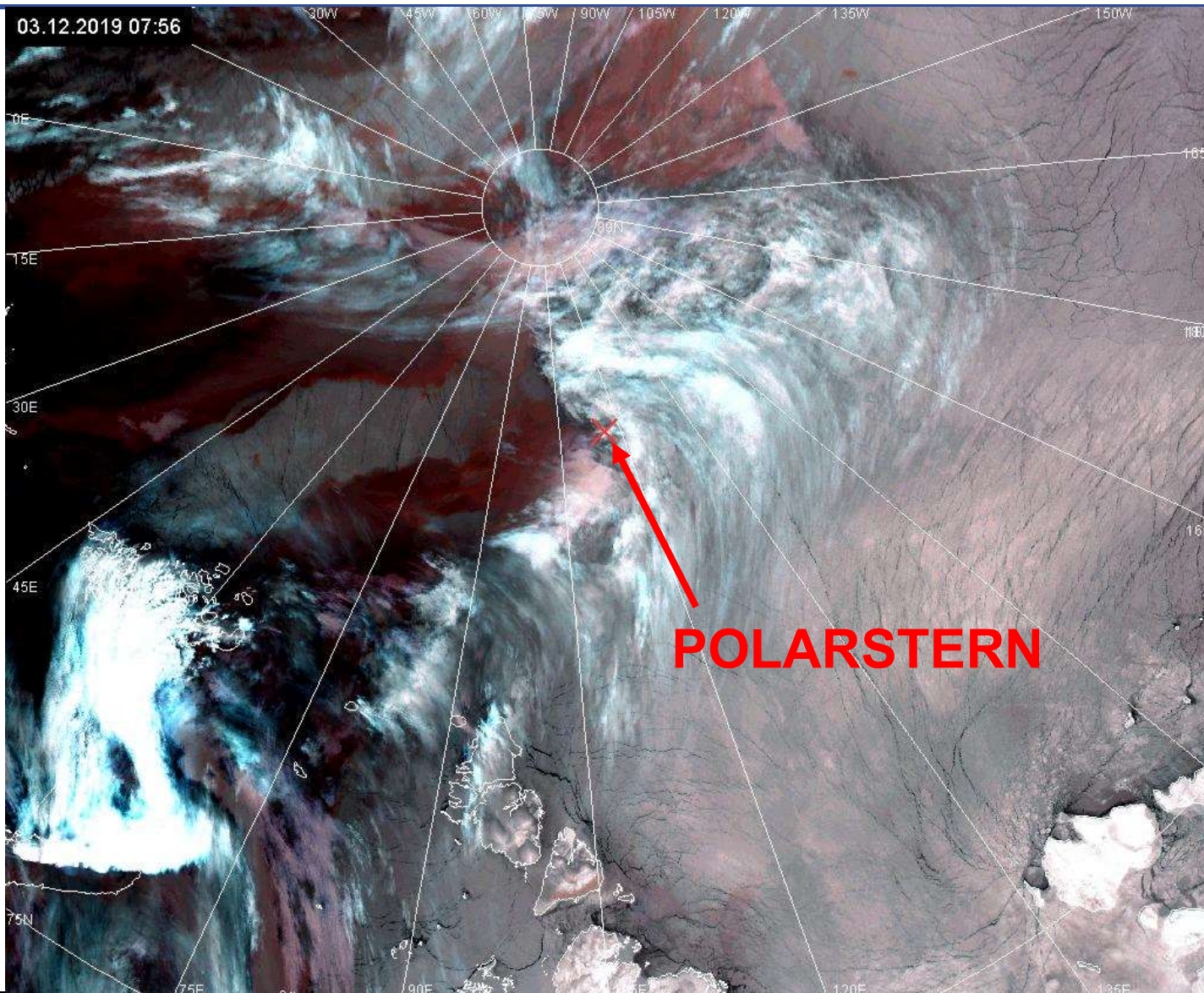


## challenges for weather technician and forecaster:

- **limited amount of observational and numerical forecast data**
- **no access to the www**
- **extreme environmental conditions**
  - polar night or polar day
  - very low temperatures
- **working 7 days per week**
  - sometimes for a couple of months
- **trapped in a “limited world“**



# a further storm





# after the storm



MOSAiC November 2019, photo by Jens Kieser



# Welcome „Kapitan Dranitsyn“

Deutscher Wetterdienst



- 13<sup>th</sup> December 2019
- end of MOSAiC Leg1 / start of Leg2



MOSAIC December 2019  
photo by Jens Kieser





# Goodbye POLARSTERN

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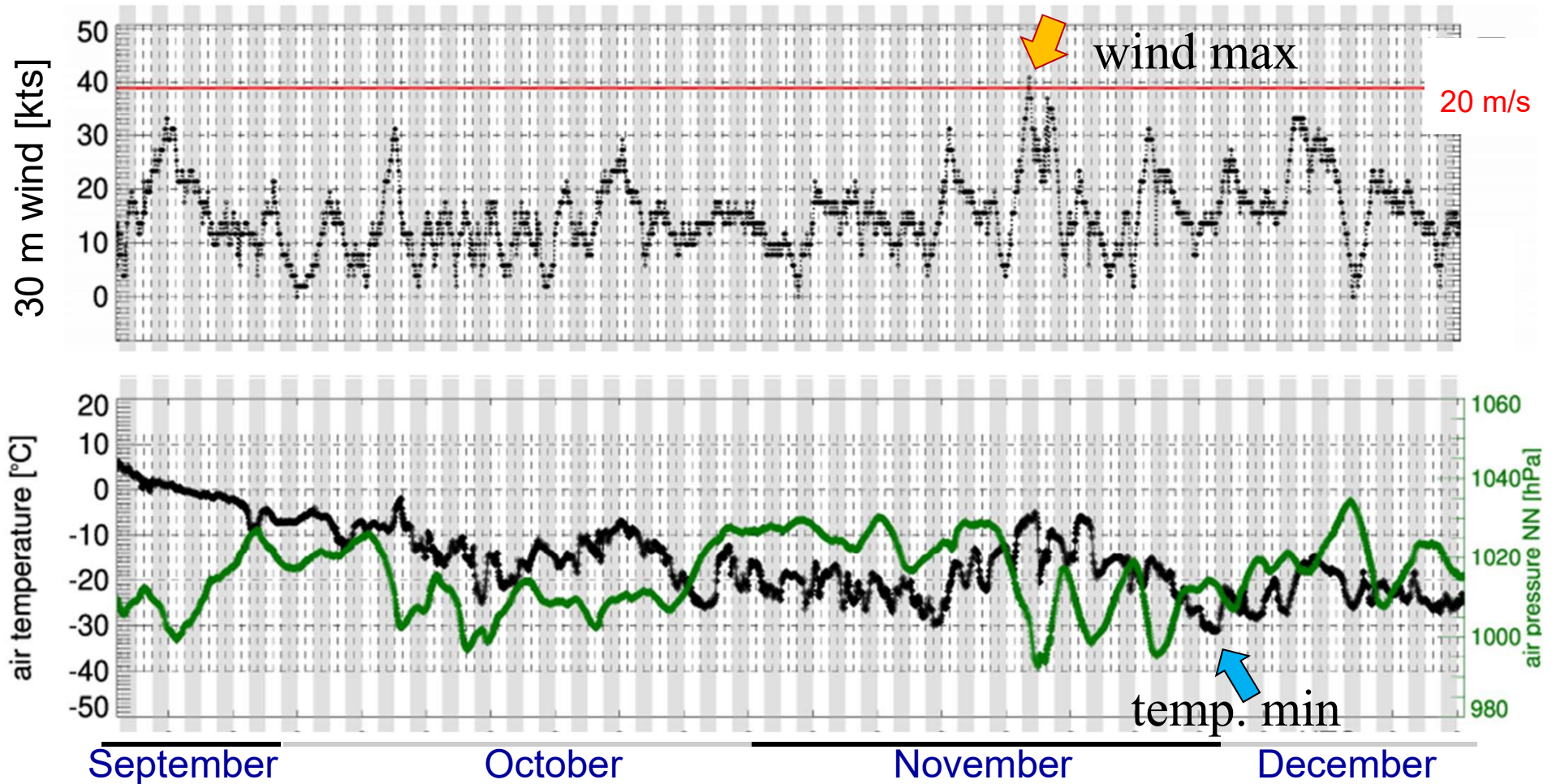


● 18<sup>th</sup> December 2019



# MOSAiC Leg1 weather

## 20<sup>th</sup> September – 13<sup>th</sup> December 2019







- **10<sup>th</sup> March 2020: -42.3°C lowest temperature**
- **May/June 2020: POLARSTERN suspended the drift for a few weeks**
- **30<sup>th</sup> July 2020 – northern Fram Strait: the MOSAiC ice floe broke into many pieces, after 300 days research on the floe**
- **22<sup>th</sup> August 2020: start on ice flow 2.0**
- **12<sup>th</sup> October 2020: POLARSTERN arrived at Bremerhaven, end of MOSAiC**

source: Alfred Wegener Institute ([www.awi.de](http://www.awi.de))



# MOSAiC summary:

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- duration 389 days
- more than 10 months frozen in ice
- 3400 km drift
- 442 participants
- 200 000 € per day  
(not including costs for instruments and researchers)

source: Alfred Wegener Institute ([www.awi.de](http://www.awi.de))

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**THANK YOU**  
**for your attention**

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- **Many thanks to our colleagues from the DWD for their comprehensive support during the expedition.**

**In this regard special thanks to our colleagues from the “Referat WV13“.**

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