

# Sea ice introduction

- Movement on sea ice
- Equipment briefing
- Rescue exercise
- Practical training



# Movement on sea ice

- Hazards
- Planning
- How to travel on sea ice
- Rescue work on sea ice



# Sea ice hazards – Ice thickness



UNIS

The major concern for everyone who travel on sea ice is the fact that the ice sheet can be thin in certain areas, because of;

- strong currents
- active or newly formed cracks
- land formations like long, low-angle ridges or peninsulas that descend into the sea
- type of weather when the ice is formed (calm vs. rough conditions)



# Sea ice hazards – Ice thickness

- With a salinity at app 3% saltwater freezes at minus 1,8 degrees
- When conditions are good sea ice grows 3 – 5 cm the first 24 hrs, after that growth speed is reduced as a function of increased insulation.
- First year ice has its maximum at about 130 cm .
- Second year ice has its maximum at about 250 cm

## Capacity of sea ice to support a load

- The recommended thickness for a person on foot is not less than 12 cm
- For a 3 tonn vehicle the recommended thickness is 28 cm at minus 15 and 50 cm at minus 2.
- For a 30 tonn vehicle the recommended thickness is 110 cm at minus 15 and 180 cm at minus 2
- For UNIS parties travelling with snowmobiles there should be a minimum of 30 cm

# Sea ice hazards – the color of the ice

## Young ice (first year)

- Dark nilas less than 5 cm
- Light nilas 5 – 10 cm
- grey ice 10 – 15 cm thick
- greywhite ice 15 – 30 cm thick
- white ice 30 – 70 cm thick



# Sea ice hazards – newly formed ice



# Sea ice hazards

## Weather

- Low visibility can disorient you
- Poor weather can obscure surface definitions – hard to detect cracks etc



## Cracks

- Produced by the stresses of wind, wave, tidal action, and thermal forces
- Typically cracks will form around; coastline, islands, grounded icebergs or glacier jutting into the sea

# Sea ice hazards – crack in Tempelfjorden

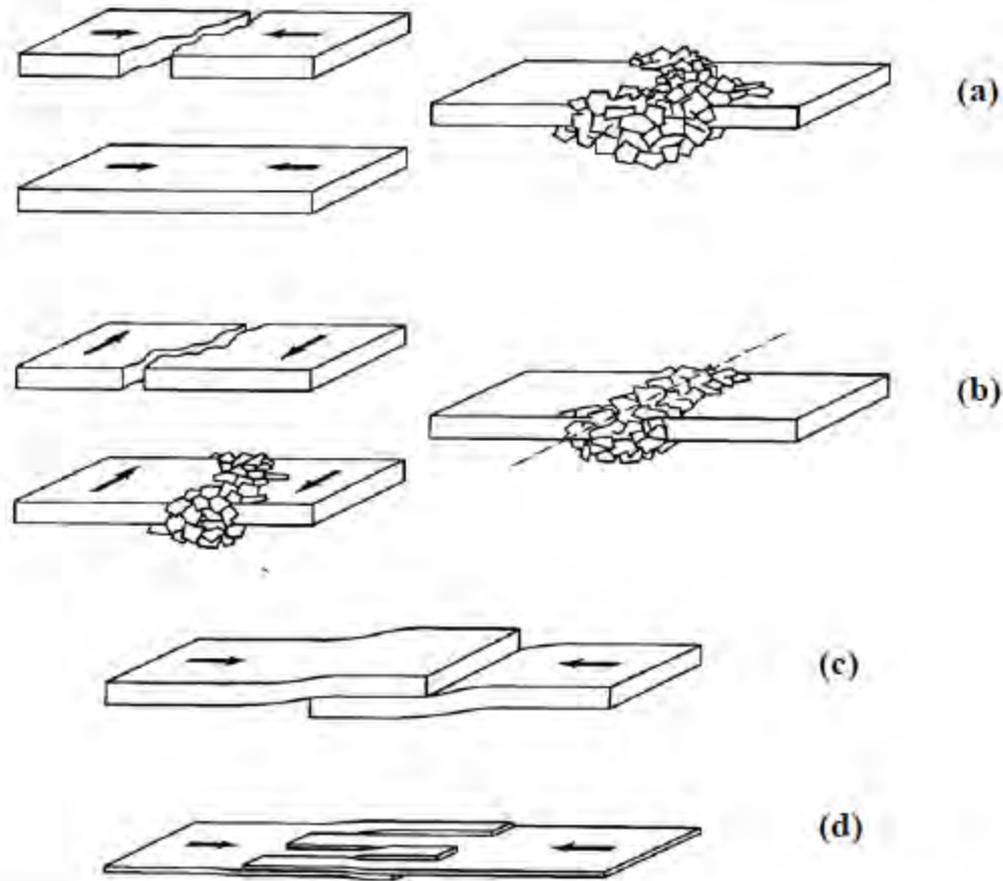


# Sea ice hazards – pressure ridges

- Forms when ice is broken by pressure and thrusts up into a chaotic pile



# Sea ice hazards – pressure ridges



Figur 11 Pressure ridge (a), shear ridge (b), rafted ice (c) and finger rafts (Sanderson 1988).

# Sea ice hazards

## Melt pools

- Area on the sea ice that have subsurface melting – usually occurs late in the season

## Seal holes

- Can be a possible trap, usually easy to spot – but snow could hide the hole
- If you see a seal lying far from the ice edge – most likely a seal hole or a crack nearby



# Sea ice hazards

## Surface water

Water pressing through the ice as a result of heavy snowfall, can be hard to spot when covered by snow.

## The ice edge

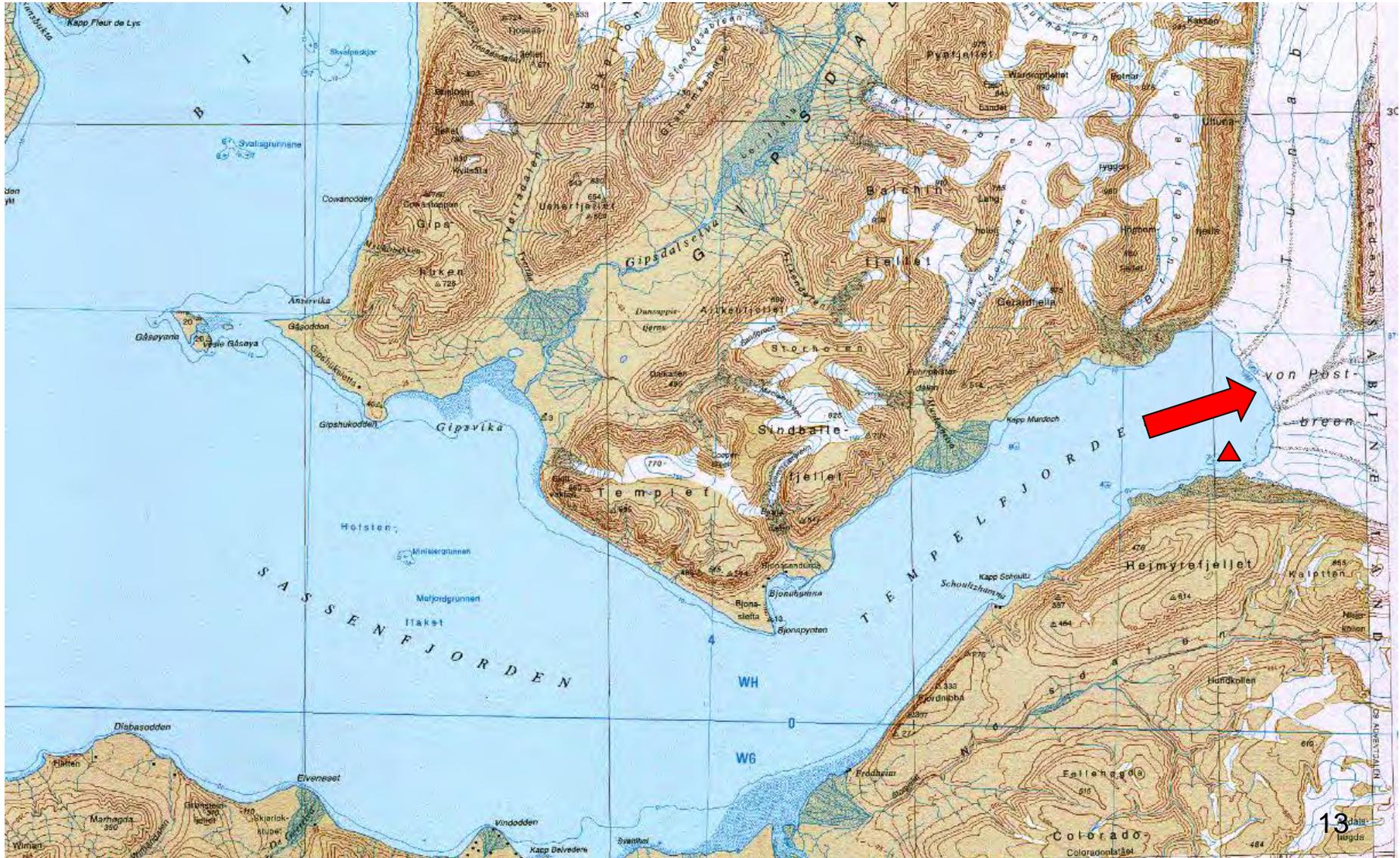
Possibility of breakouts

Keep your distance to the ice edge in rough conditions



# Sea ice hazards

## Moving in front of glaciers



# Sea ice hazards

- Moving in front of glaciers



# Sea ice hazards

- Moving in front of glaciers



# Sea ice hazards

- Moving in front of glaciers



# Sea ice hazards

- Moving in front of glaciers



# Sea ice hazards

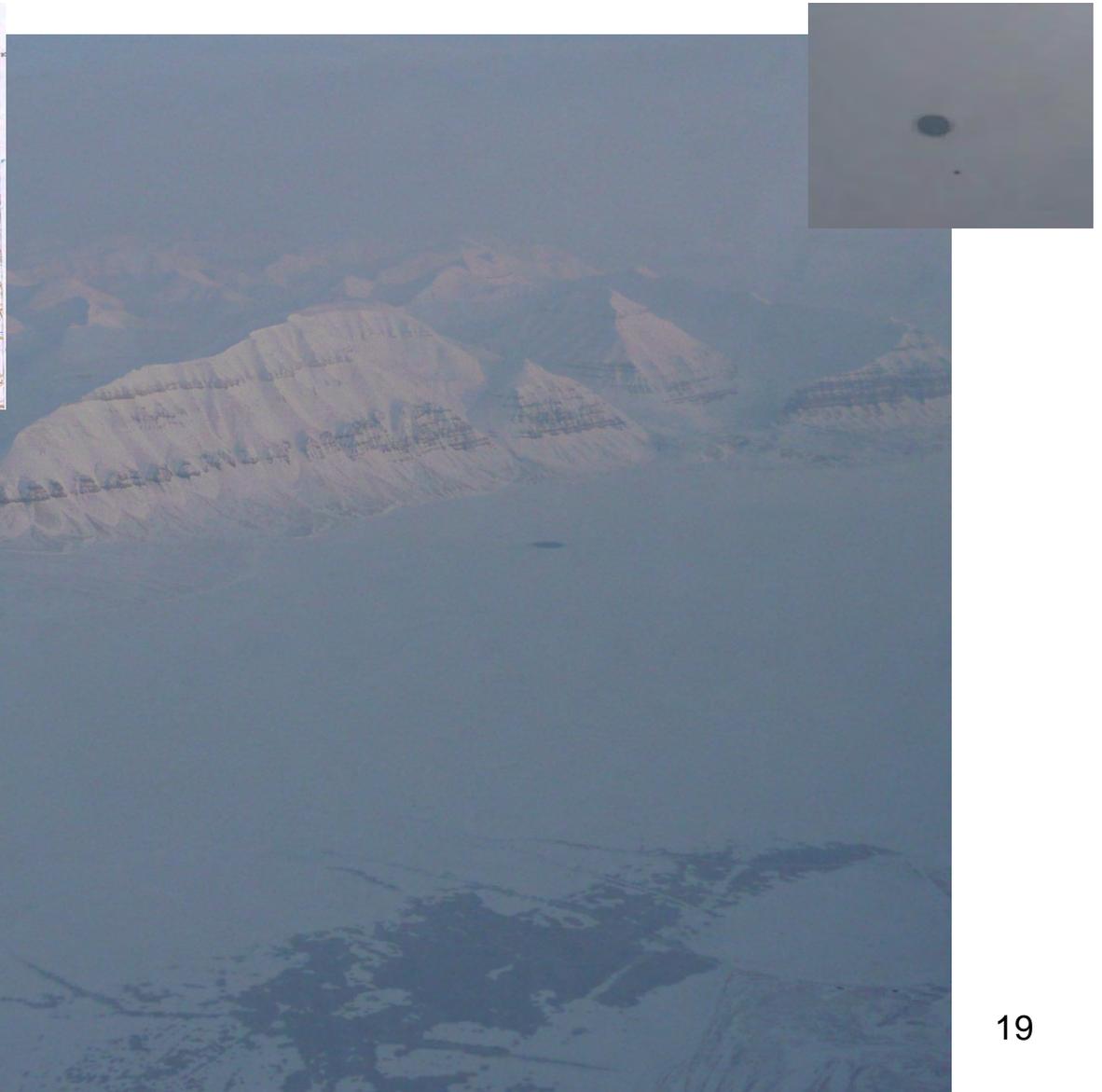
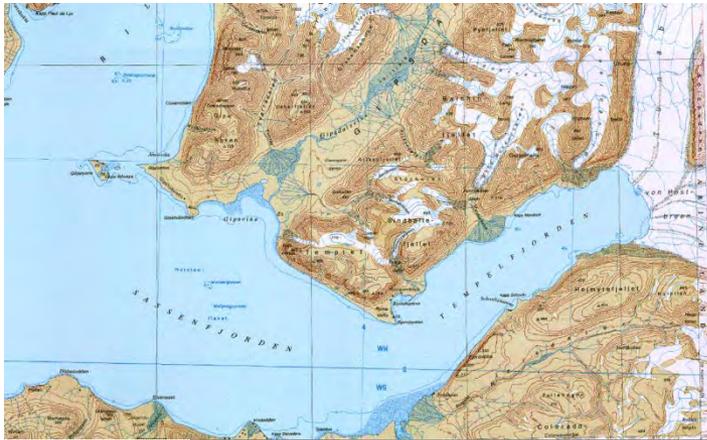
## When traveling on sea ice:

*Watch for telltale signs in the ice topography. It's a good habit to pay close attention to the color of the ice as you traverse it. – tells you that something about the ice sheet has changed and need to be investigated!*





# Opening in the ice - Murdoch



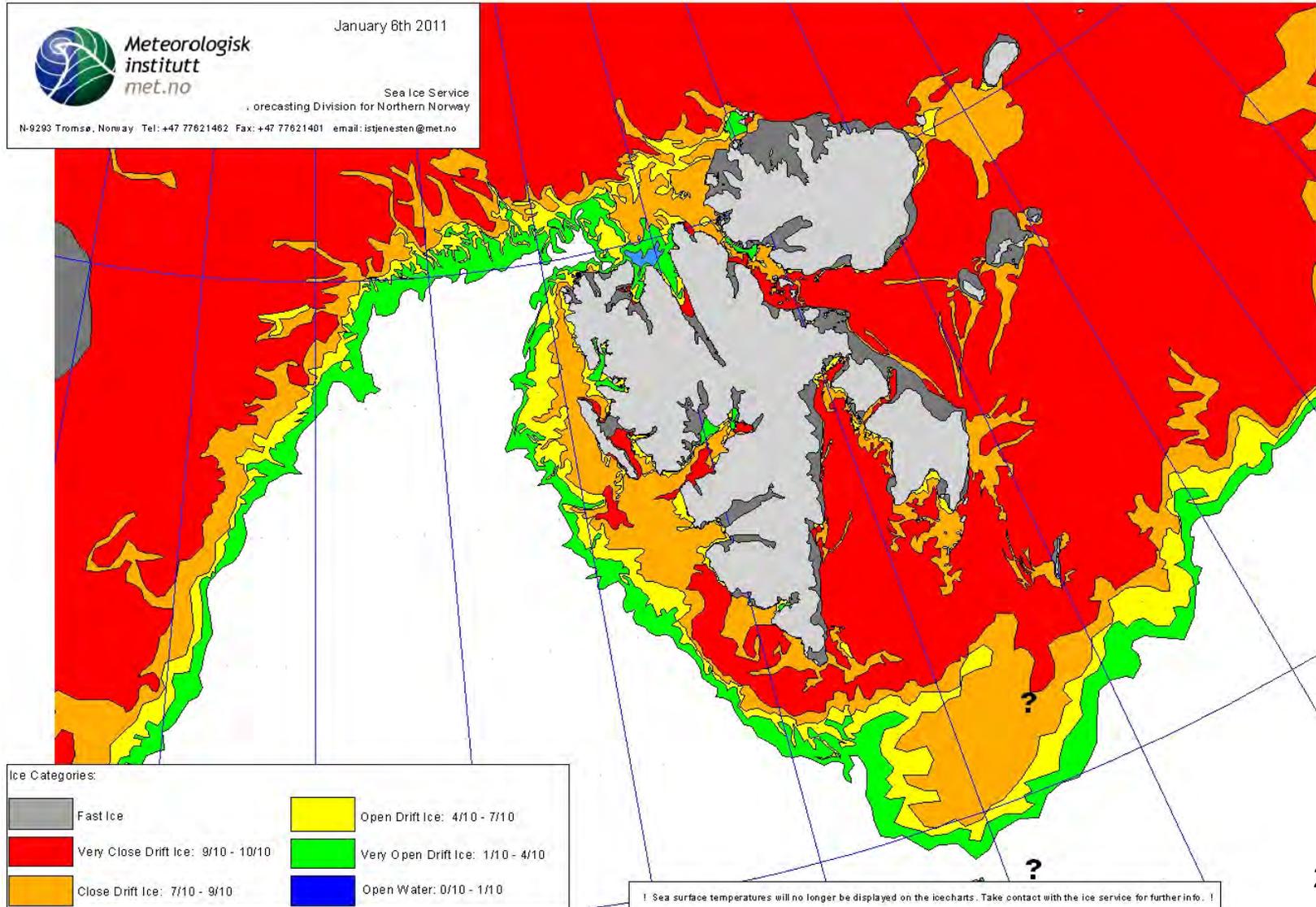
# Ice foot



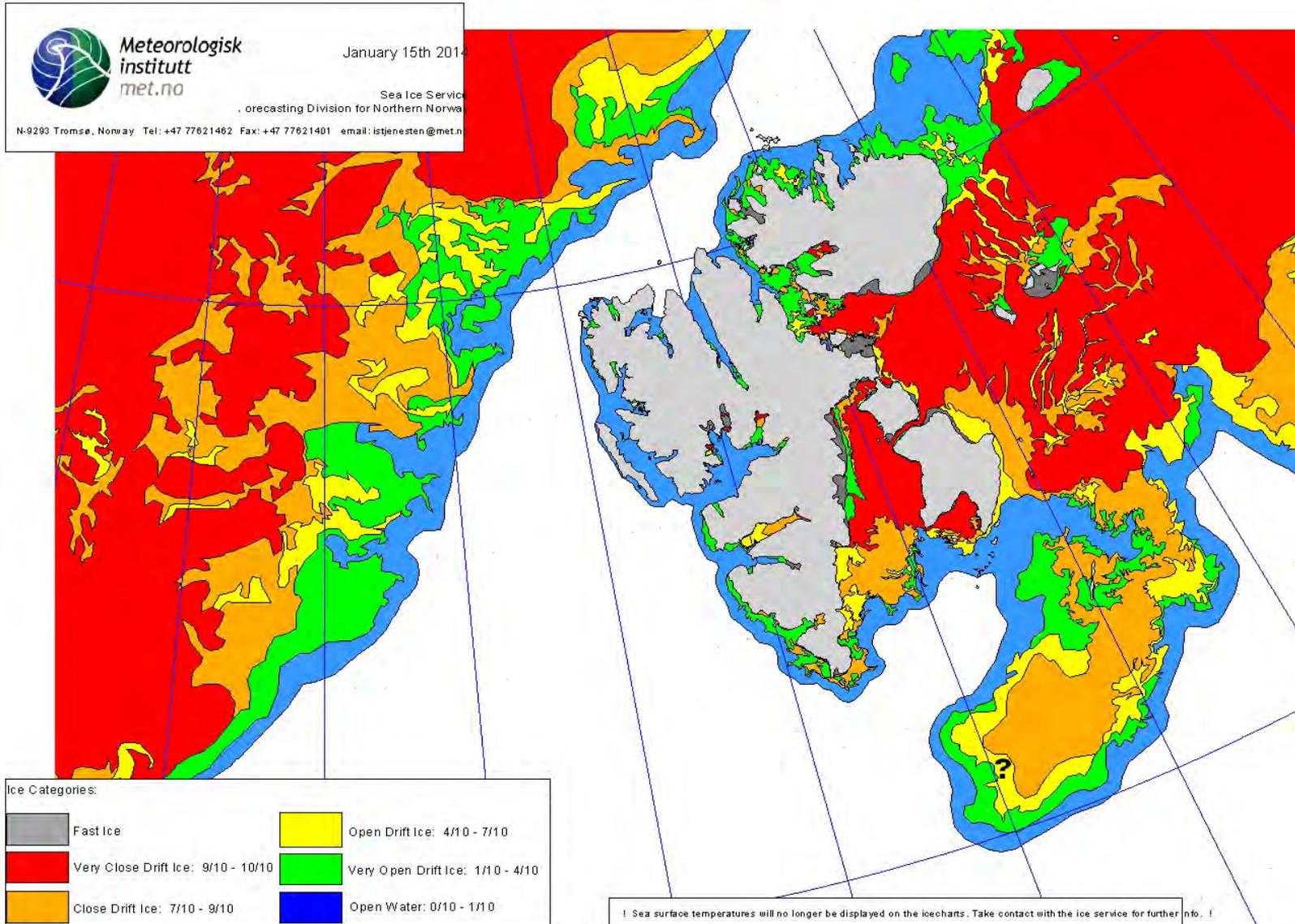
# Satellite picture



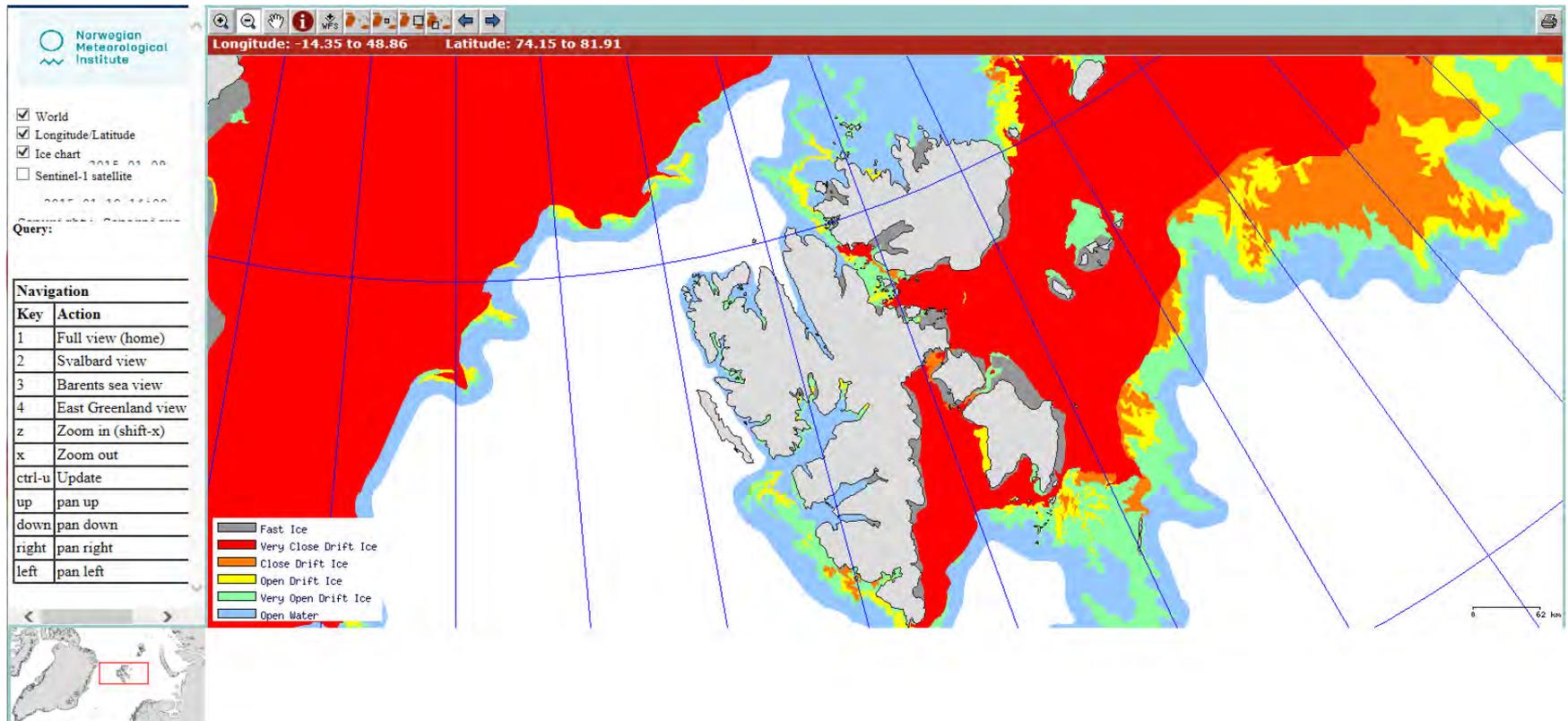
# Ice chart january 2011



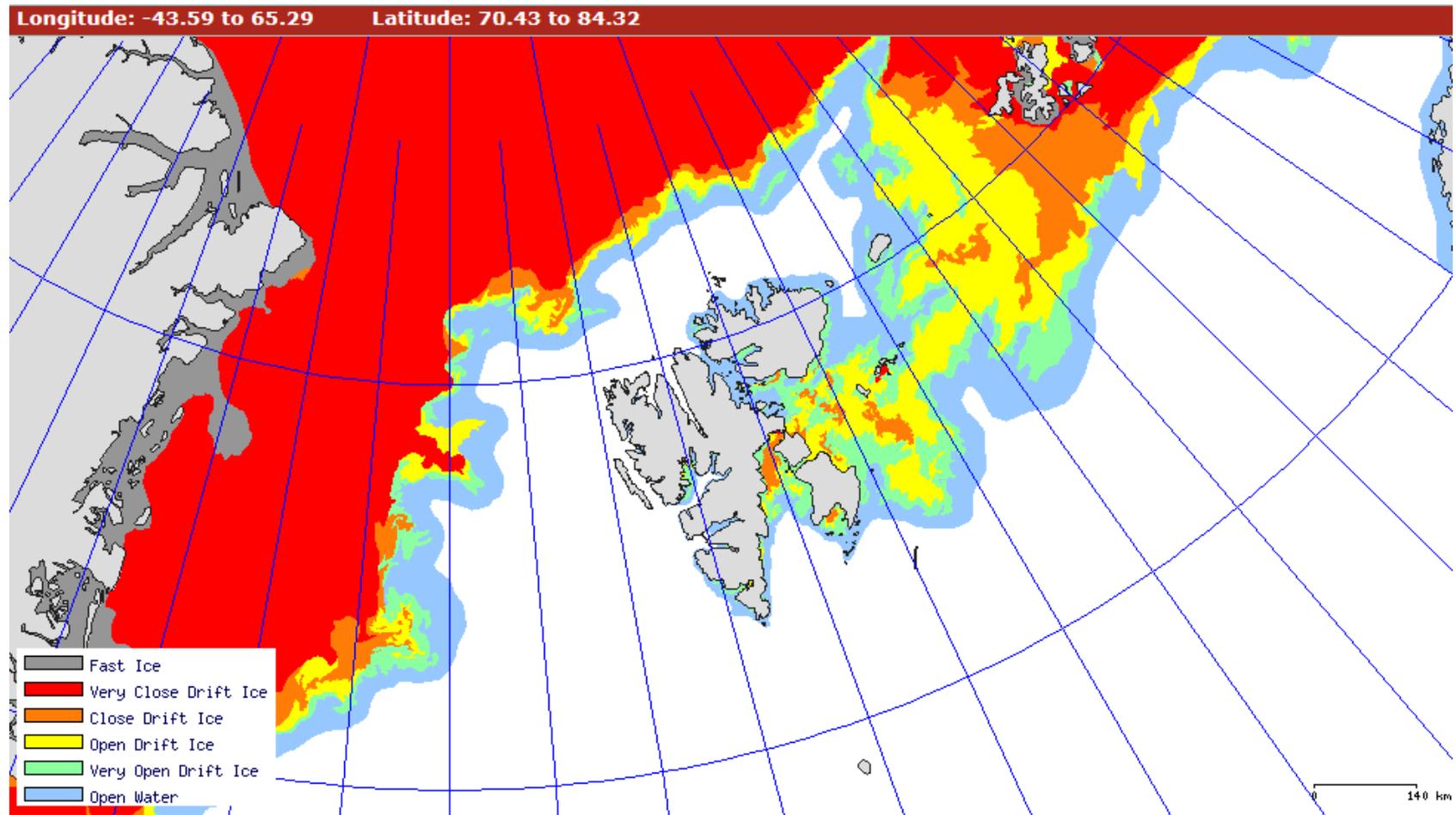
# Ice chart january 2014



# Ice chart january 2015



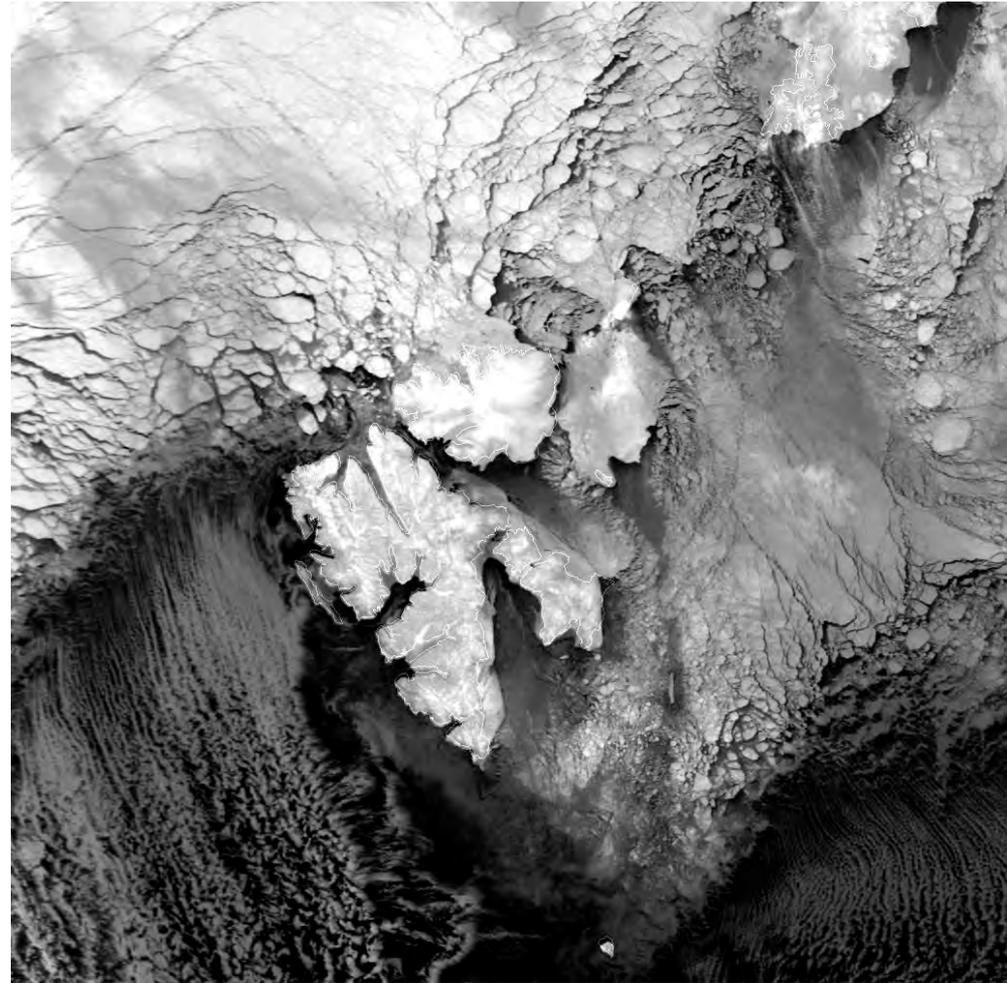
# Ice chart january 2016



# Planning your excursion

## Gather information from:

- People with experience who has been in the area recently
- Historical data
- Sea chart
- Satellite images
- Weather forecast
- Historical weather data through the season
- Low and high tide
- Felt logg (field log)



# Evaluation of the current ice conditions on site

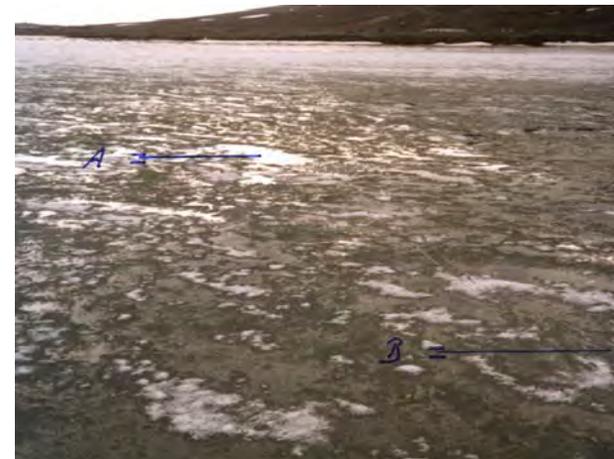
## Things to look for:

“Water sky” or “Iceblink” in the horizon.

Fog over open water (not only at sea but also in land)

The colour of the snow and ice.

The structure of snow and ice, and specially structural changes.



# Measuring the ice thickness and quality

- **Ice thickness**
  - Snow scooter > 30 cm / UNIS regulations
  - Ski > 10 cm
- **Ice quality**

## Important issues;

- The ice thickness and quality will change. Make new measurements when the structure changes.
- It is recommended to make several measurements when crossing over unknown ice conditions



# Special things to be aware of

- Ice foot
- Shallow areas
- Areas where we normally don't find ice (Murdoch)
- Around islands and peaks.
- Around ice bergs and pressure ridges.
- In front of glaciers
- Rivers coming out in the sea.
- Gas outlet under the ice
- Areas with a breach in the permafrost, causing local hot spots.
- Warm streams will “eat” the ice from underneath.
- The combination of wind and stream could make the ice brake up at shore and starting to drift out the fjord.
- What seems like solid sea ice could for the same reasons brake up and start to drift. This happens surprisingly fast !!
- Be specially aware at the end of the season, this is when most accidents happen.
- Close to settlements
  - **Ship traffic breaking the ice (Svea)**
  - **Outlet of warm water**



An aerial photograph of a vast, deep blue lagoon. The water is a rich, vibrant blue, and the surface is crisscrossed by a complex network of white, frothy foam. These foam patterns form irregular, interconnected shapes that resemble a map or a series of winding paths. The lighting is bright, highlighting the texture of the foam and the depth of the water.

**Take a walk ?**

# Before crossing

## 1. Stop and make an overview

- Look for signs of poor ice.
- Plan the route.

## 2. Make a plan and brief the group.

- Distance between scooters
- Signals
- Communications (VHF etc)
- Behaviour if stop
- What to do in an accident

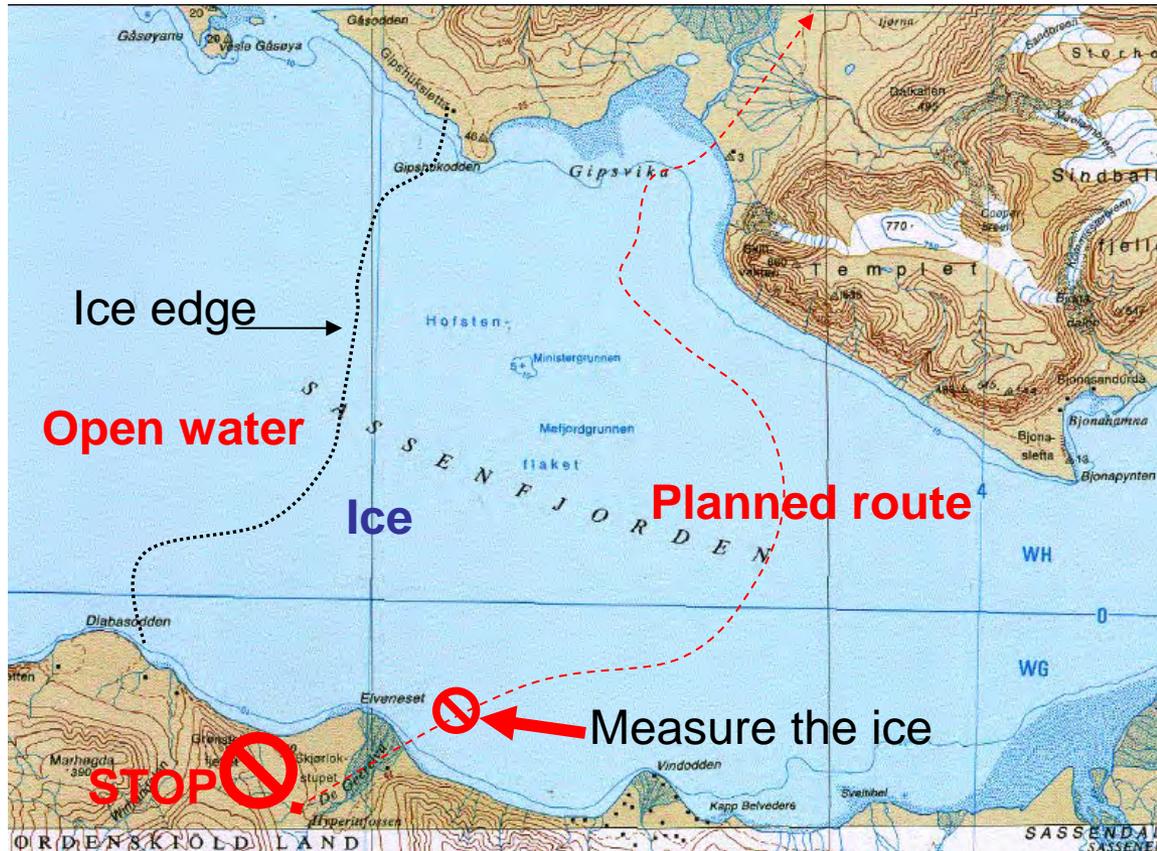
## 3. Make preparations

- Ice spikes ready
- Rescue equipment available (rescue rope, rope etc)

## 4. Measure the ice thickness and quality.

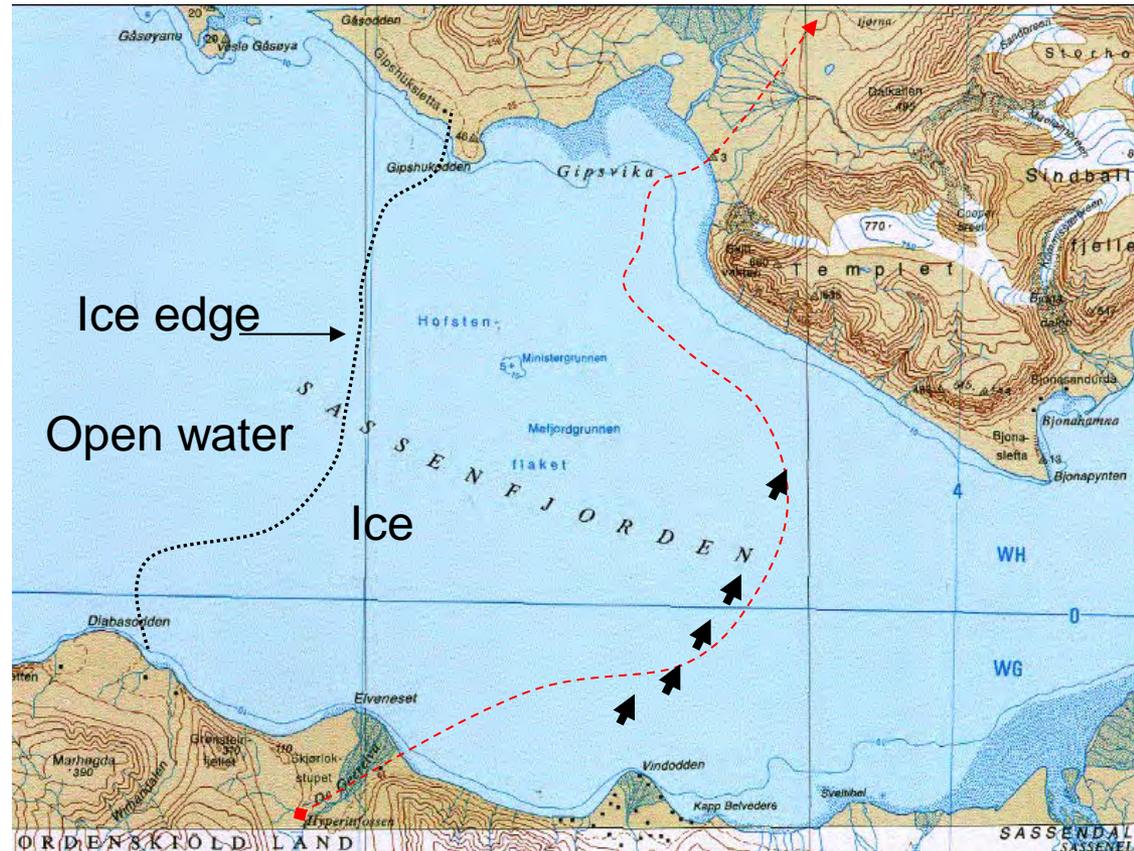
- Min 30 cm. UNIS regulations

## 5. Make a decision - whether to go or not.



# When you start driving

1. **Single scooter** (no sledge) at the front with good distance to the rest, or recon the route with a pair of scooters first.
2. **Keep the speed up**  
do not stop if you don't have to.
3. **Observe the track**  
look for water or slush.
4. **Observe** what is happening behind you.
  - Is everyone following?
  - Water behind the sledge?



# If something should happen

## If something like this happens:

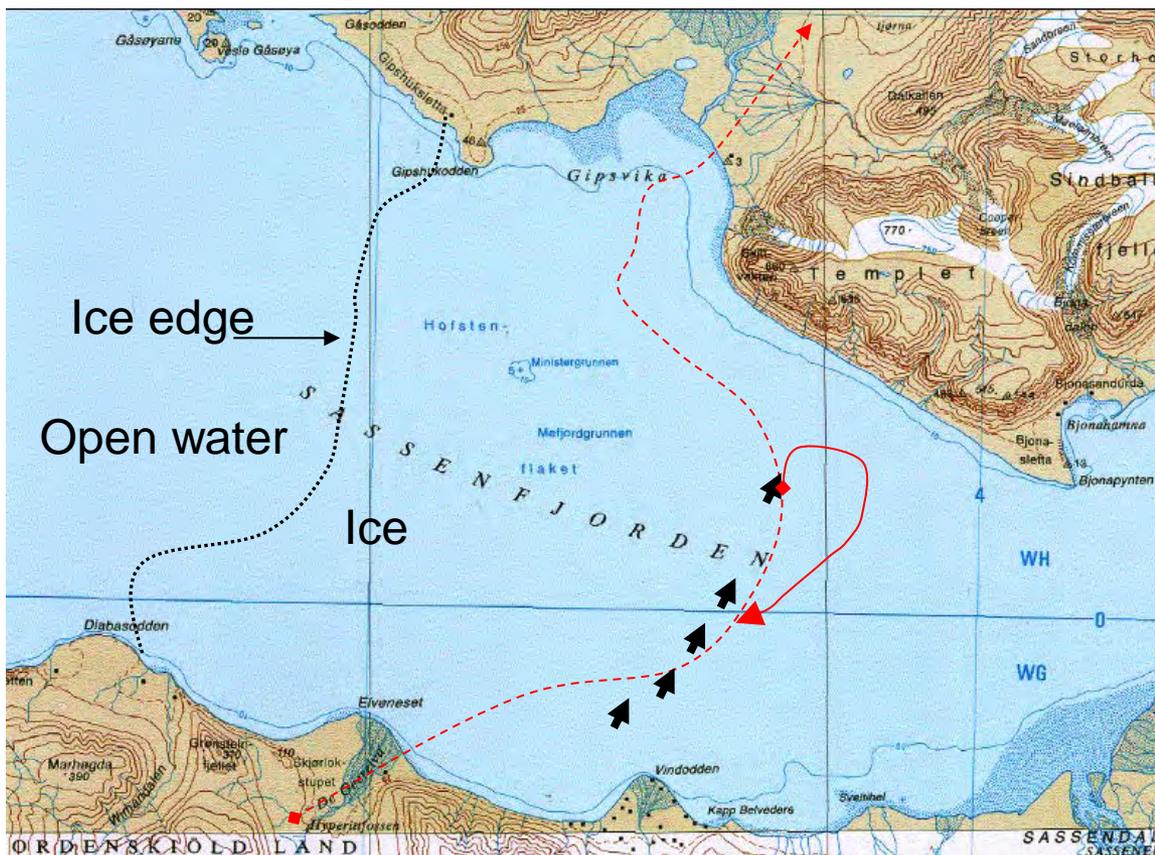
- The scooter seems to hold back (slush)
- You observe water in front of you or behind you
- You observe that the ice quality or consistence is changing considerably .
- Some of your colleges get in trouble.

### 1. Make a big turn

- Keep as high speed as possible
- Get back in a safe track

### 2. Stop and evaluate

- Are you on safe ice?
- How could you solve the problem / help you colleges?





# Is it possible to drive your snow scooter over open water or over holes in the ice?

- Yes, a single snow scooter (without a sledge), at high speed, can cross over a limited number of meters of open water. This requires a experienced driver!
- Yes it is possible to cross over smaller holes in the ice, even with a sledge. This requires high speed and the opening must not be more then 1m in diameter.



**Crossing over open water, or holes in the ice, is hazardous, not only because of the risk of falling into the water, but also because you probably are going to damage your snow scooter or sledge.**

# What do we bring with us that could be used in a rescue operation?

## Personal protection:

- Ice spikes that should be hanging around your neck.
- The snow scooter suit will give you good positive buoyancy for a few minutes before it floods and soaks with water (and then it's to late).



# What do we bring with us that could be used in a rescue operation?

## Rescue equipment:

- Rescue rope 30 m, easy to throw
- Survival suit (passenger suit)
- Ropes in rope bags (100m and 50m) from the glacier rescue kit. The rope bag can be used as a weight and thrown towards the person in the water.
- Fuel cans can be used as weights to throw the rope (they will float even when full, but can also be emptied if you have time)
- Sledges can be used to spread the weight on the ice if you need to move in over thin ice.



# What do we bring with us that could be used in a rescue operation?

- **Nothing of this equipment will help you if it's not prepared and made ready for use!**
- **Keep the rescue ropes ready at hand!**
- **Keep the ice spikes around your neck.**
- **Have the survival suit easily available**



# What do we bring with us that could be used in a rescue operation?

**Taking care of wet and cold colleagues:**  
**- The content in the emergency camp kits**



# What do you do if you fall through the ice and into water?

**You have very little time!**

**After a few minutes the suit and boots will be full of water and it will be impossible to get up**



- **Do not waste time on trying to save the snow scooter or your equipment (rifle etc.)**
- **The snow scooter will float for a few seconds, use this time to jump on to the ice. Try to lie down on the ice to spread your weight. Wriggle back to safety, using your ice spikes to pull you forward.**
- **If you fall in the water, make one big push on to the ice, using your ice spikes to get a grip and pull you away from the ice edge.**

# How do we perform a rescue operation?

**If one person or more is in the water you have very little time, but your priorities should be:**

1. Make sure that you and the rest of the group is safe!
2. Try to assist / help the person in the water



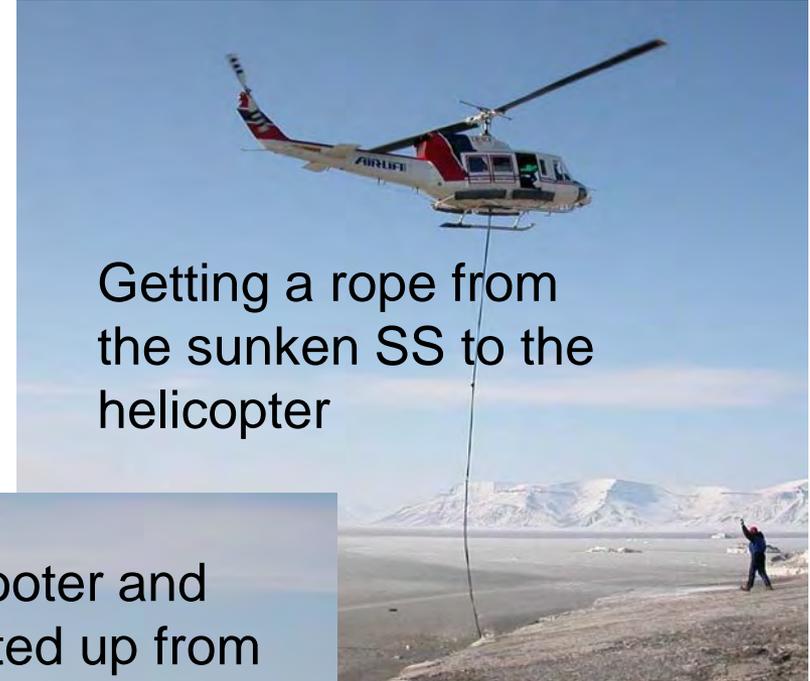
- **Assist the person in the water as best as you can using the equipment you have brought along. Make sure that everyone moving in over unsafe ice is secured with a rope!**
- **The person coming up from the water will need to warm up and might also need medical care. If you can, start immediate arrangements for:**
  - **Take of wet clothes and wrap the person into vapor barrier, insulation material and windproof barrier (Hiblers methode)**
  - **Raising a tent and firing up the stove.**
  - **Call for assistance / help.**

# WRAP – Hibler's method



vapor barrier – insulation – windproof barrier

# Results of movement on unsafe sea ice on the east coast of Svalbard



# Tempelfjorden



# Summary

- Hazards
- Planning
- How to travel
- Rescue work
  
- Meet in logistics area
- Bring extra clothes