Hybrid Arctic Float System HAFOS
Floats in Polar Oceans: Strategy

- Development of a system for bipolar use in the Antarctic because of easier conditions: 80% of ice melts in summer
- 1. priority: measurements of water mass properties by profiling floats
- Floats are part of a comprehensive system of observations which can be realised stepwise. On each level useful data can be obtained
- A higher horizontal resolution (more floats) has priority to sophisticated sensors
- Prototype system will be available during IPY 2007/2008
Causes for float destruction:

- Floats are likely to be damaged when surfacing within partially ice-covered region (during the onset of winter).

It is not sufficient to detect ice on top of float when surfacing:

- Local statement – neglects ice drift during time at surface (ARGOS transmissions)
- Energy budget and costs limit potential sensors for ice detection
Temperature algorithm

Temperature [°C]

Median \( (T| p=(50,45,40,35,30,25,20 \text{ dbar}) \leq -1.79 \text{ °C}) \):

\[ \rightarrow \text{abort surface attempt} \]
Float summary

- float bloom
- float die off

austral winter

○: float die off
○: float bloom
Conclusion: Successful and future steps towards HAFOS

- Determination of the range of the SOFAR under ice
  MARE: Maude Rise Pilot Experiment studies
  Ranges of 600 – 700 km were found in the Weddell Sea.

- Floats detect and avoid ice
  APEX & NEMO: ARGO type profiling floats modified to estimate likeliness of sea ice and to abort surfacing.
  80% of floats survived the first winter.

- Combine systems of floats, ice drifters and moorings.
- Transmit data by acoustics.
Components of HAFOS

- **75 profiling floats (15 deployments per year)**
  - Depth range: 25 m to 1000 m
  - Acoustically tracked and transmission of reduced data set: 10 inflection points
  - In open water full data transmission by satellite link

- **5 to 10 sea ice drifters (2 redeployments per year)** with bi-directional acoustic and satellite communication
  - shallow CT sensors

- **5 to 10 moored bases (5 redeployments every second year)** with bi-directional acoustic and satellite communication
  - deep profiling CTD
  - shallow profiling CTD
## Ice sensing algorithm (ISA)

- Checks temperature in upper 50m, ascent aborted if near freezing
- Tested successfully in 2002/3 with 3 and 2003/4 with 13 APEX floats, about 80% survival rate.
- Now standard for all AWI float orders (APEX and NEMO)

## RAFOS

- Provides subsurface profile position when surfacing impossible
- Tested in 2003/4 with 5 RAFOS floats: tracking range at least 600 km throughout season. 5 APEX currently on deployment
- To be ordered for 2004/5 season: 15 (ger. ARGO) & 5 (MERSEA) APEX.

## Interim storage

- Provides delayed mode profile when surfacing impossible
- - no tests yet -
- Ordered for 8 NEMO
Further progress

**Extent algorithm**
- Evaluate Arctic conditions
- Consider coupled abort conditions: $T, S, t, \text{position}$

**Float technology**
- Build NEMO (Navigating European Marine Observer)
- Add GPS receiver and use “missing downlink condition” to abort surfacing attempts
- Save all profiles for delayed download
- Increase data transmission speed
- Use acoustic navigation

**Install acoustic data transmission**
The HAFOS concept

How to extend ARGO into predominantly ice covered oceans?

- Use SOFAR floats in the Arctic Ocean,
- tracked by autonomous listening stations (ALS),

- Add T/S profiling capability to floats,
- which transmit profiles’ EOF parameters acoustically,
- using time delay method.

- Sporadic high resolution direct data dump (DDD) when surfacing is possible.
Float AWI 040
Float AWI 047

Time (header mon/day/year) [yr]

Temperature [°C]

Salinity [psu]

Depth [m]

Salinity [psu]

Depth [m]