

# Continuous Monitoring of Marine Mammals, Natural and Man-Made Sound In Georgia Strait and Saanich Inlet using the VENUS Observatory

Svein Vagle, Fisheries and Oceans Canada

&

Richard Dewey, UVIC/VENUS

Acknowledgements:

The VENUS team

Nick Hall-Patch, Scott Rose and Grace Kamitakahara (DFO/IOS)

Fisheries and Oceans Canada

# Outline:

- **Why are we interested in cabled hydrophones?**
- **The VENUS hydrophone systems**
  - Instrumentation
  - Preliminary data
- **Opportunities**
- **Impressions from the last 20 months**

# Ocean Sound

## ■ Natural:

- Wind, waves, precipitation (storms intermittent)
- Lightening (locally very intermittent)
- Earth quakes (rare)
- Ice
- Biological (some frequent, other rare)

## ■ Anthropogenic:

- Industrial (increasing, local problem)
- Shipping (increasing everywhere)
- Boating (increasing locally)
- Sonars (increasing power)
- Seismic (increasing)

**“The effect of man-made sounds on marine mammals has become a clear conservation issue. Overall, global ocean noise levels appear to be increasing as a result of human activity. (e.g., Off central California a 10 fold increase in low-frequency noise from 1960s to 1990s.)”  
(NOAA report)**

**Commercial fleet doubled in 38 years to 89,899 in 2003.**

**“To understand what impacts such noise might have on sound-dependent marine mammals and other sea life, repeated acoustic measurements at multiple sites are needed. (Scripps report 2006)“**

**Need to study the impact of anthropogenic noise on the ecosystem**

# Battery operated, self contained, Acoustic Recording Package (ARP)



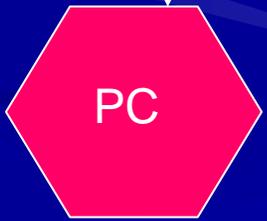
- Hybrid low freq/hi freq
- 1 hr on/1 hr off duty cycle 1kHz
- 18Gb + 6Gb
- Battery pack ~ 300D cells
- Deployed/recovered from ships
- Not real time
- No flexibility



# VENUS

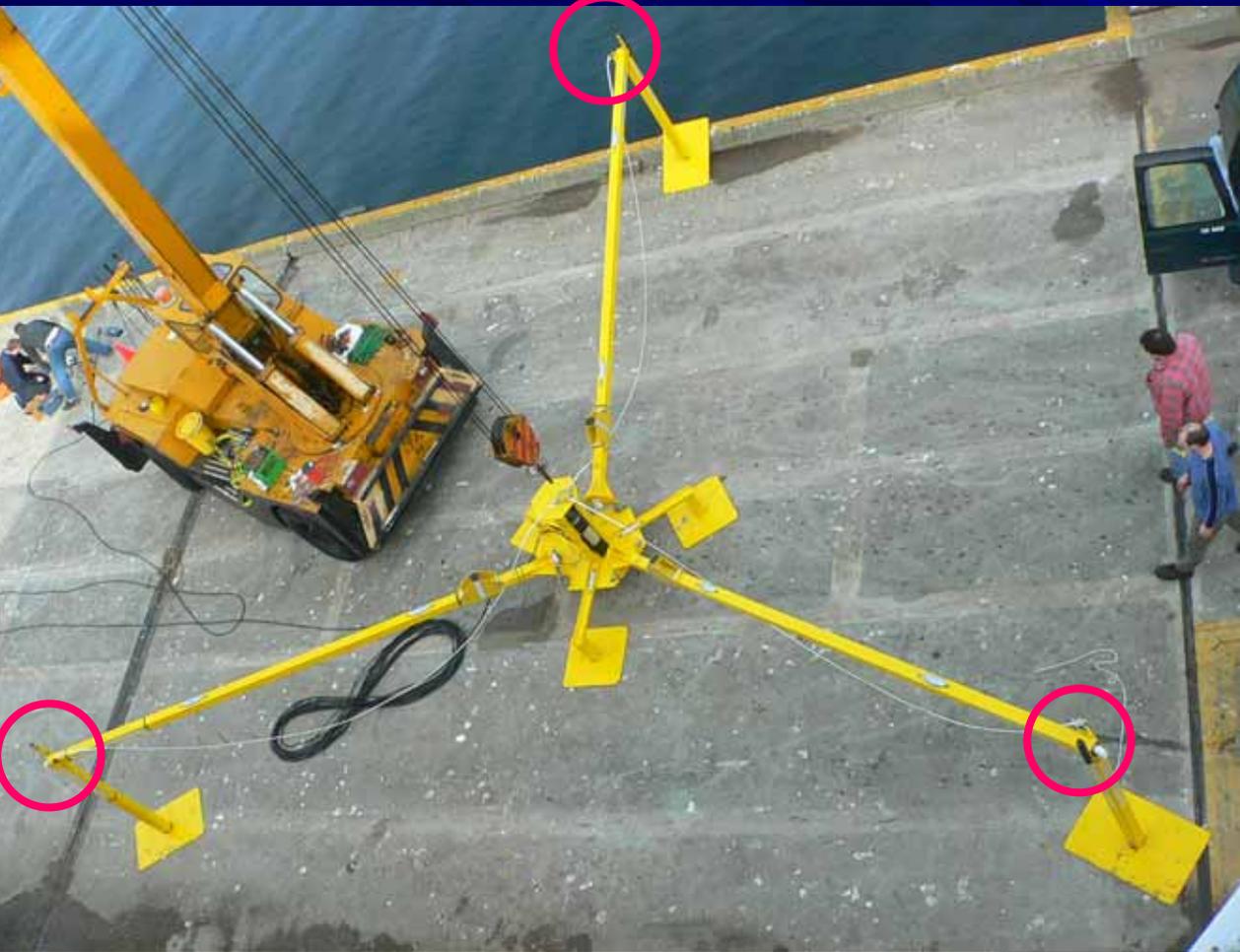
## Underwater

Broad-band hydrophones (10-100,000Hz)  
w/preamplifier



Power, bandwidth and 2-way communication, no problem

Shore



**Saanich Inlet hydrophone system February 2006**



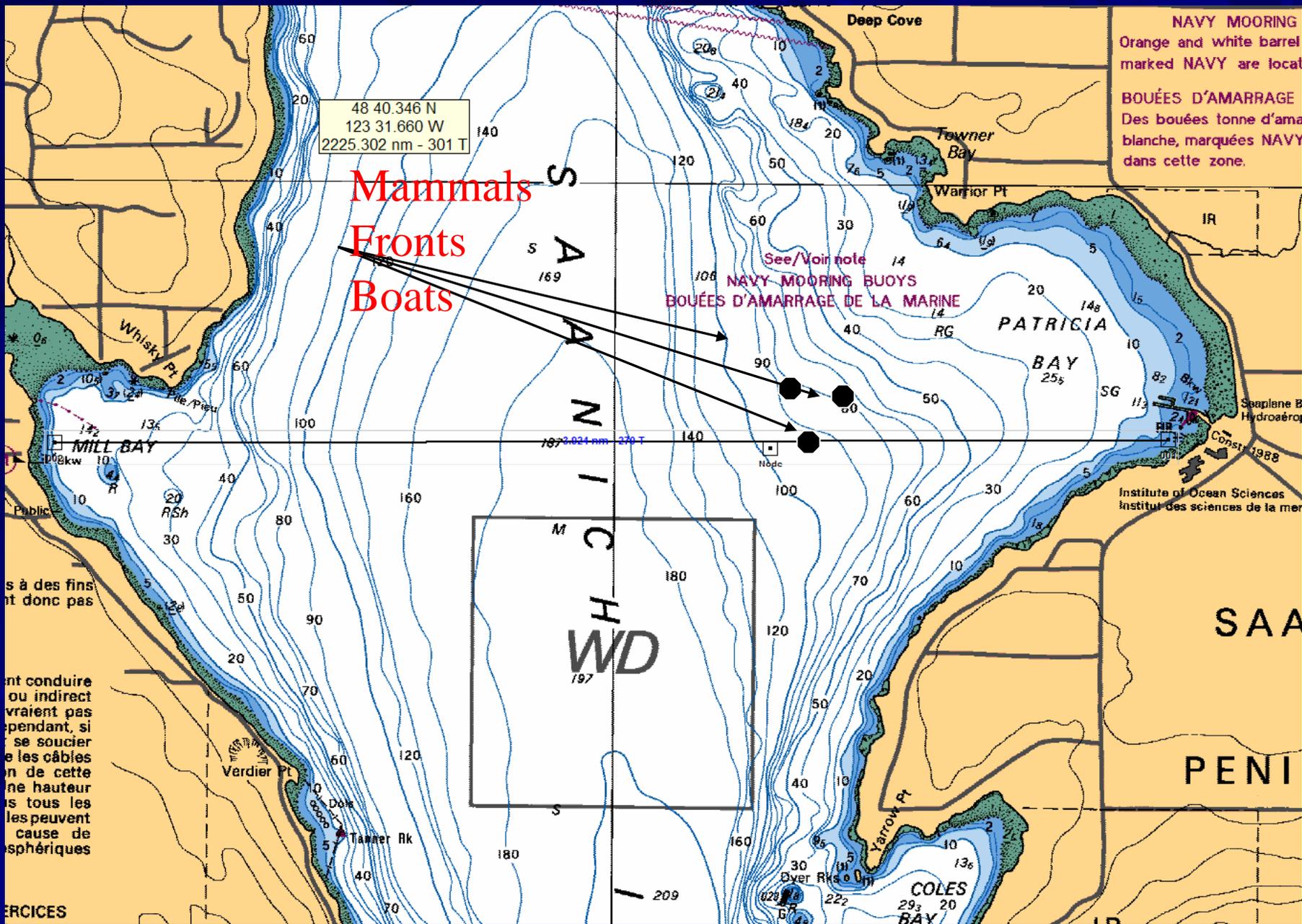
# ROPOS ROV



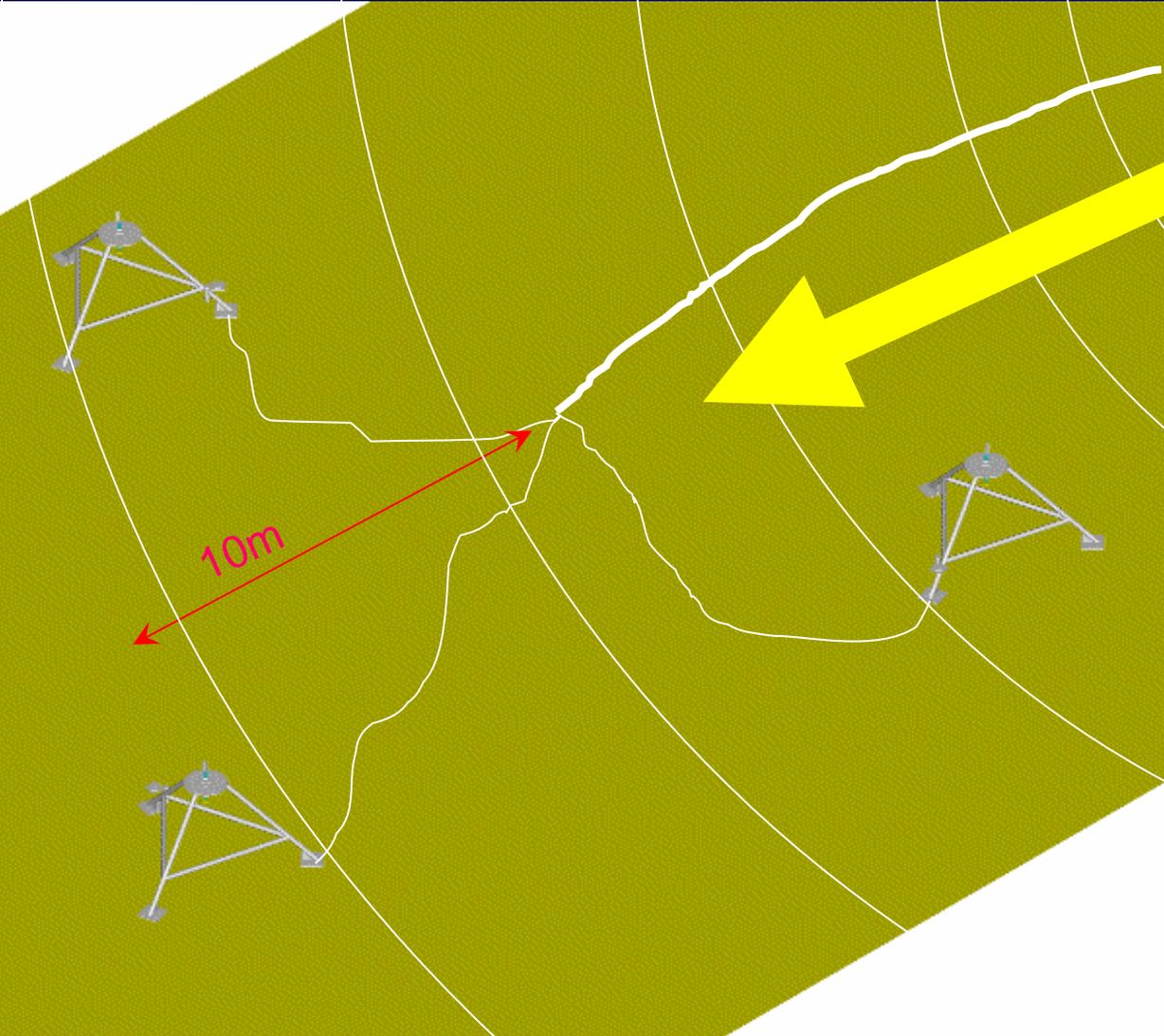
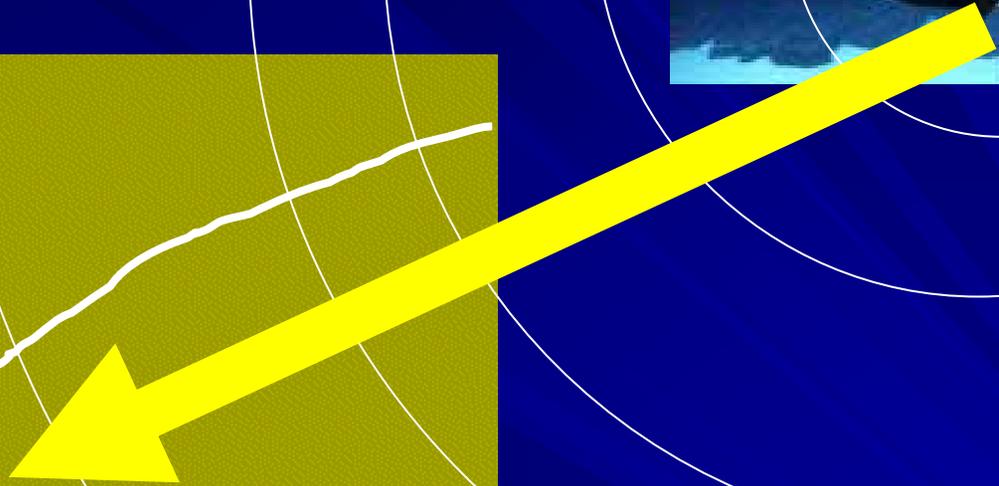


**Saanich Inlet  
hydrophone system 2007**

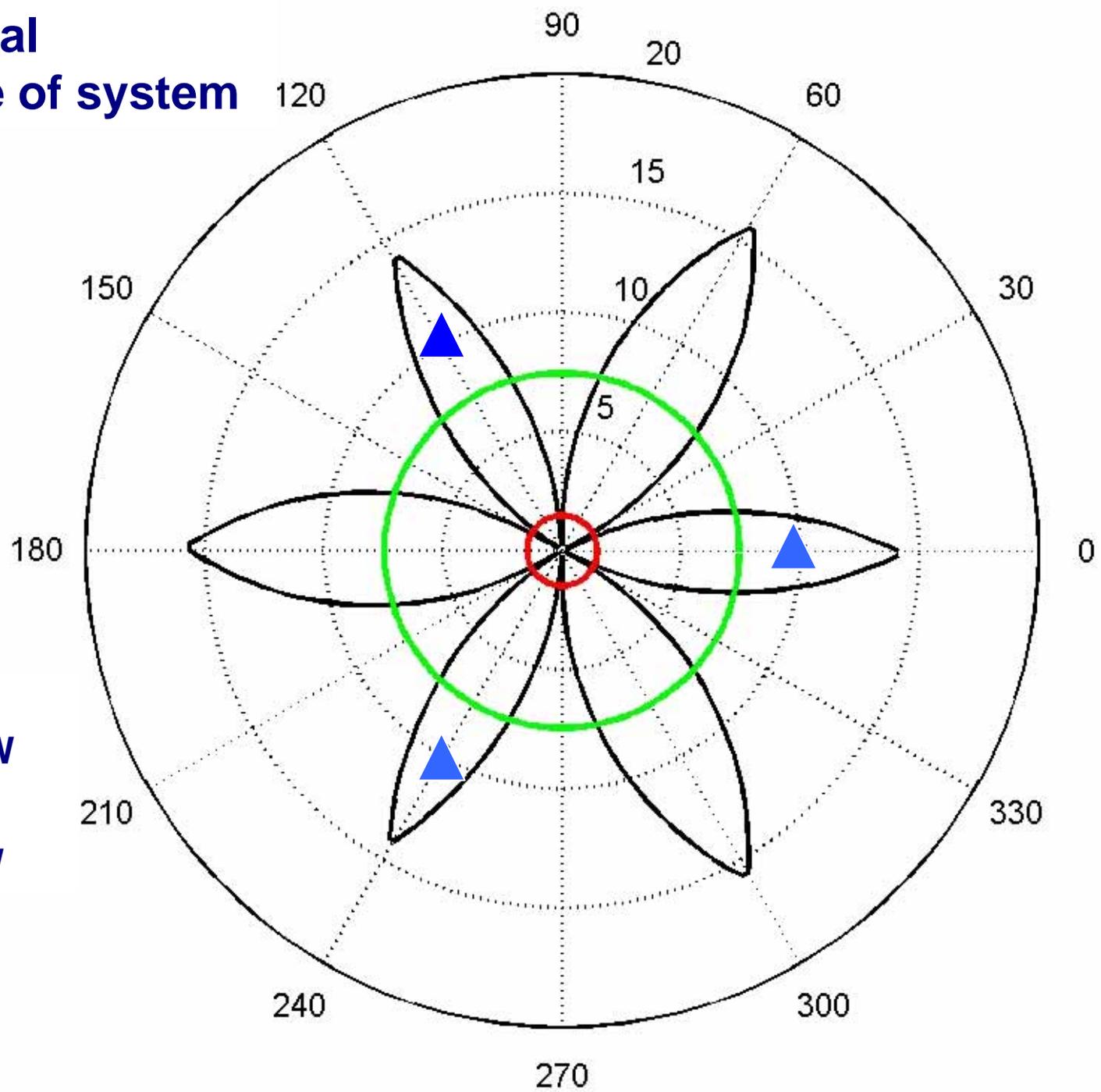
# VENUS Saanich Inlet 3-hydrophone system



# Location of sound source

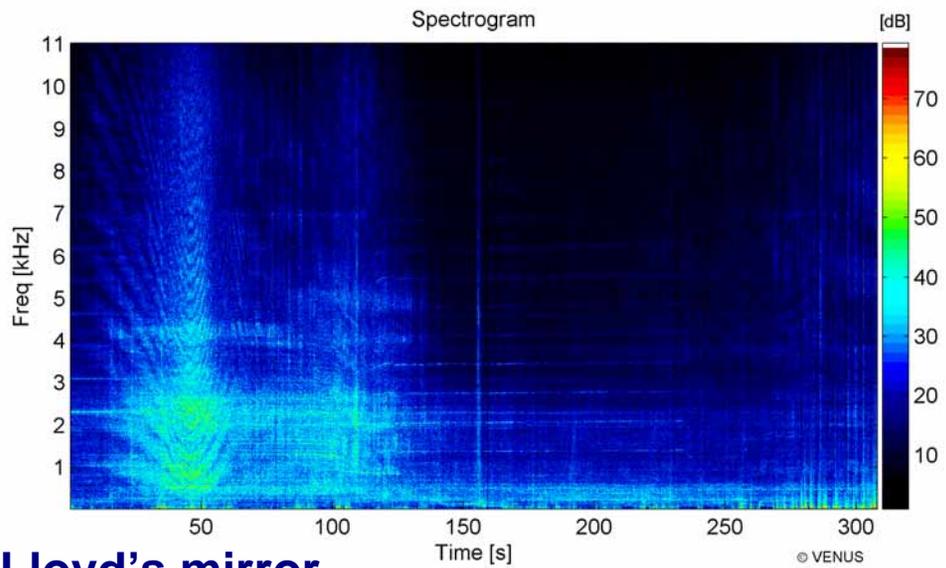
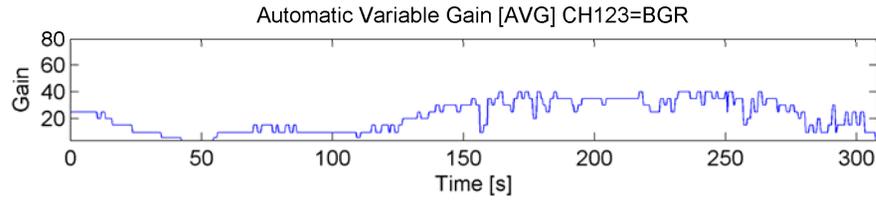
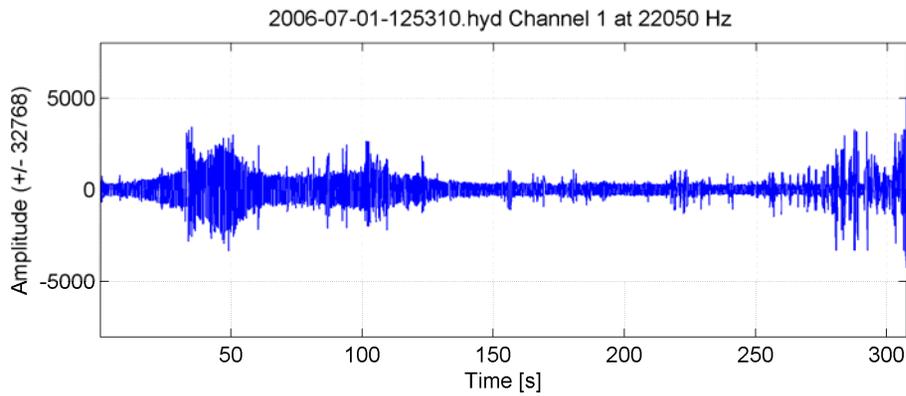


# Directional response of system



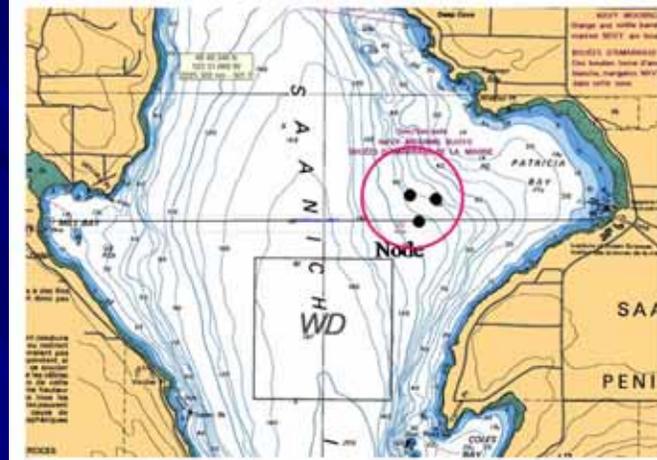
1.5cm @  
50kHz BW

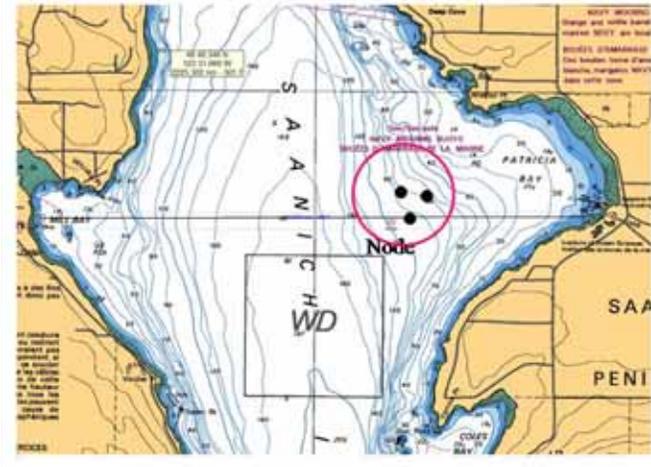
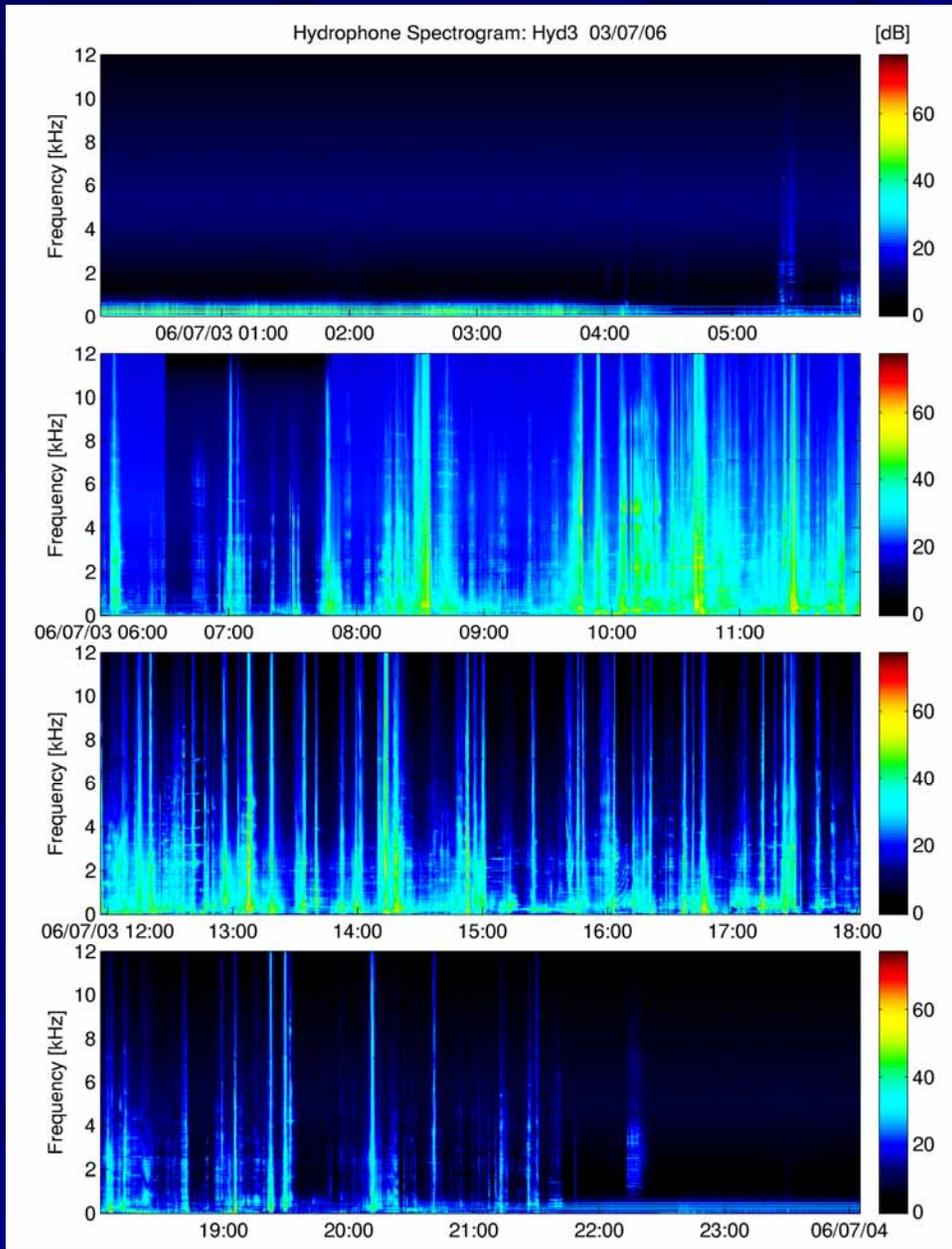
7.5cm @  
10kHzBW



**Lloyd's mirror**

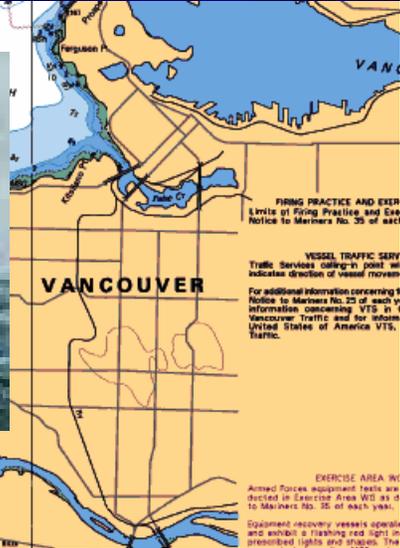
© VENUS





**Variability in  
man-made noise**

# VENUS Georgia Strait. A Golden Opportunity



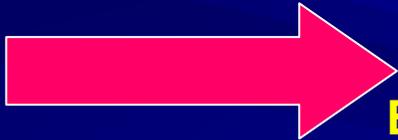
280m

170m

# Practical Issues:

## ■ Data, data and more data.

- 9 hydrophones sampled at 200kHz at 16 bits=3.6Mbytes/sec=13Gbytes/hour=312Gbytes/day=113Tbytes/year.



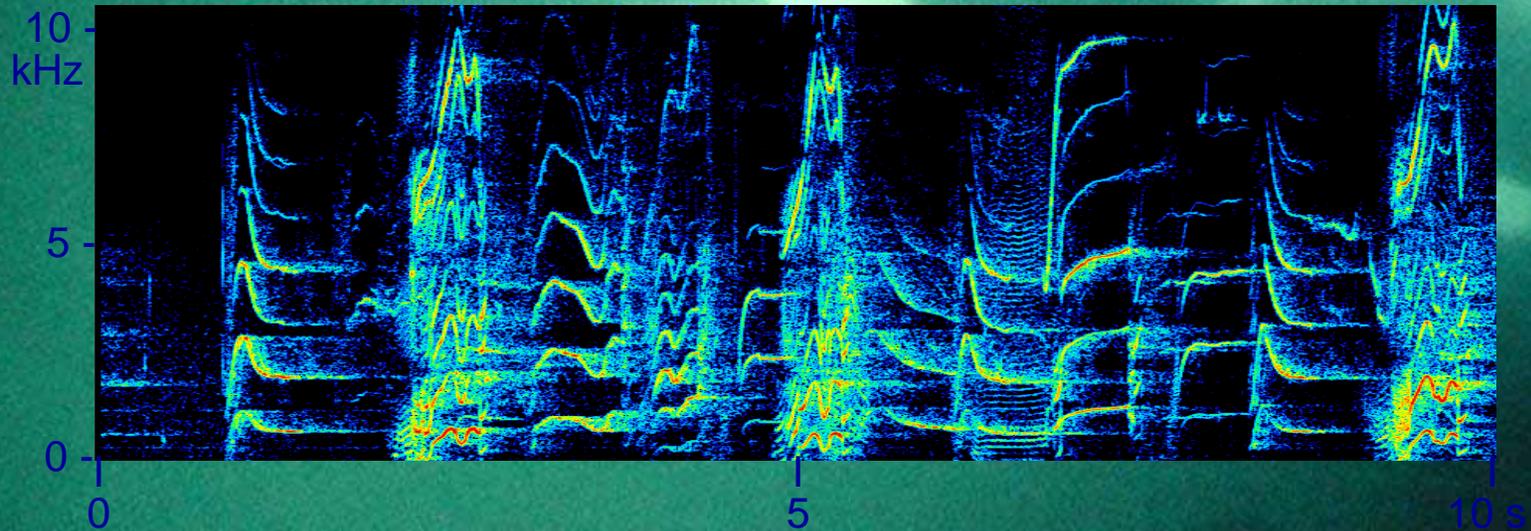
Event triggering (Changing system parameters).

Recording of averaged spectra.

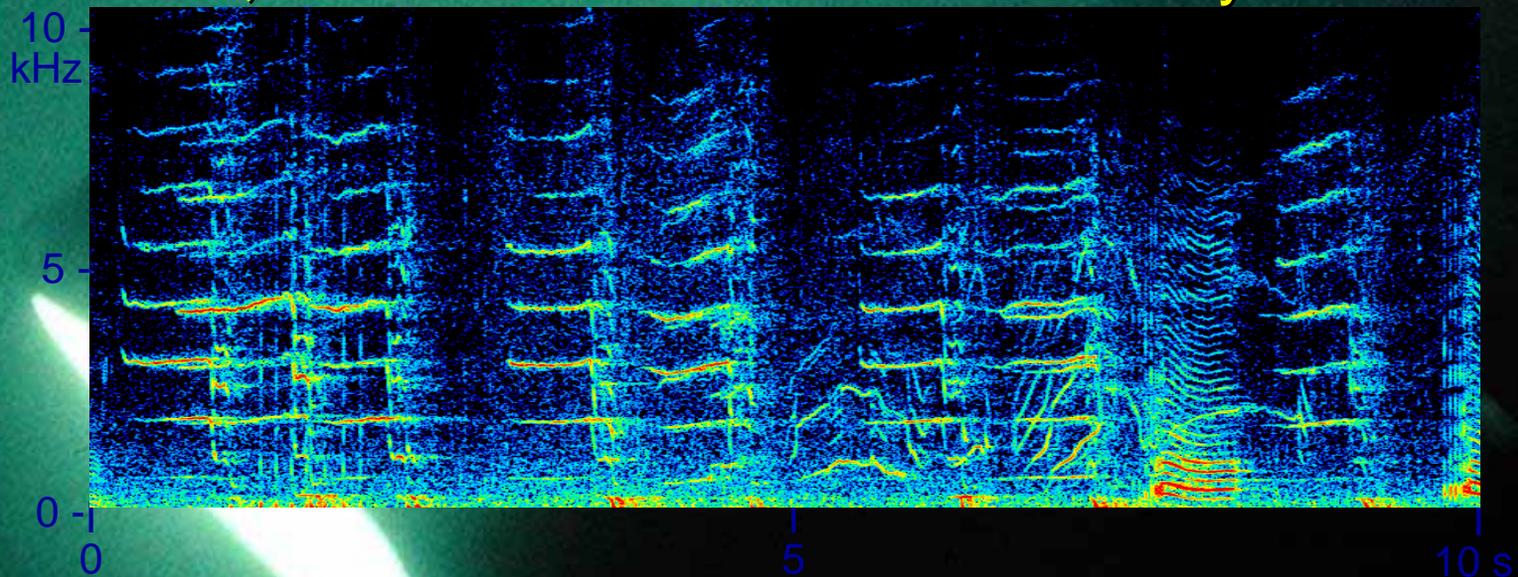
Real time or near real-time detection of signals of interest.

# Group-specific dialects:

'A' clan, northern resident Orca community

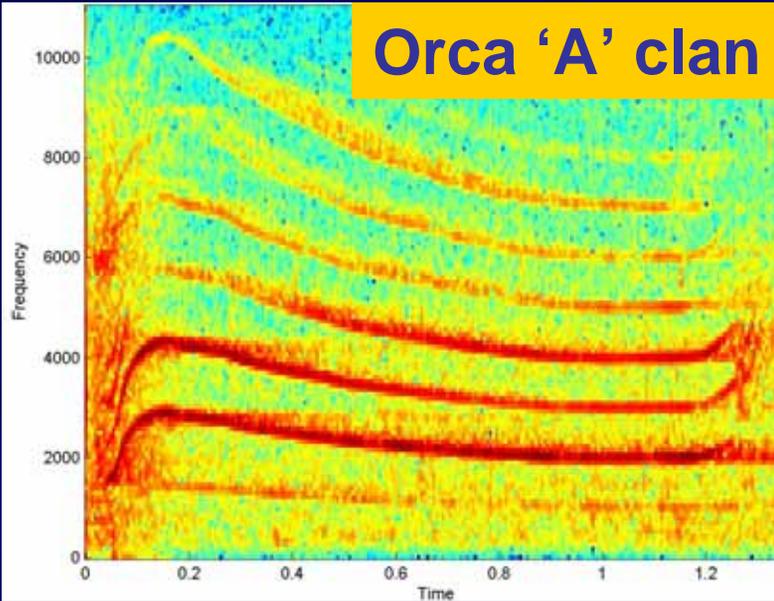


'J' clan, southern resident Orca community

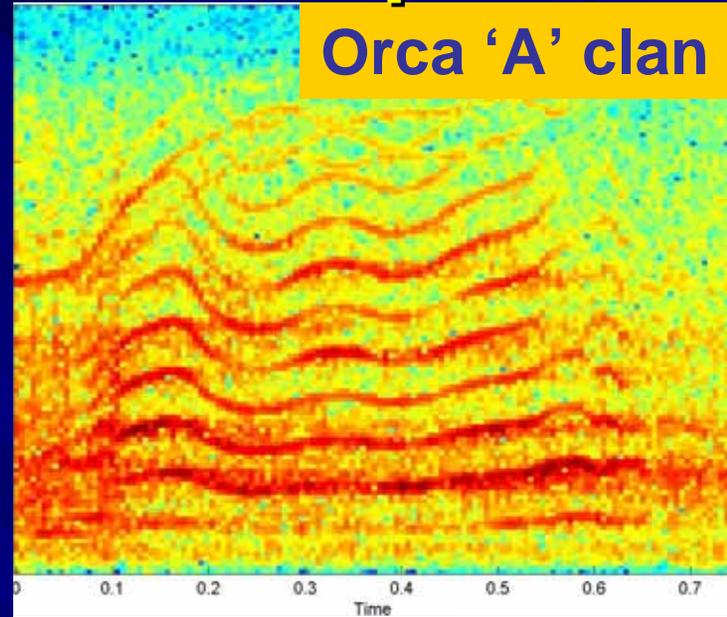


# Sometimes Difficult to separate

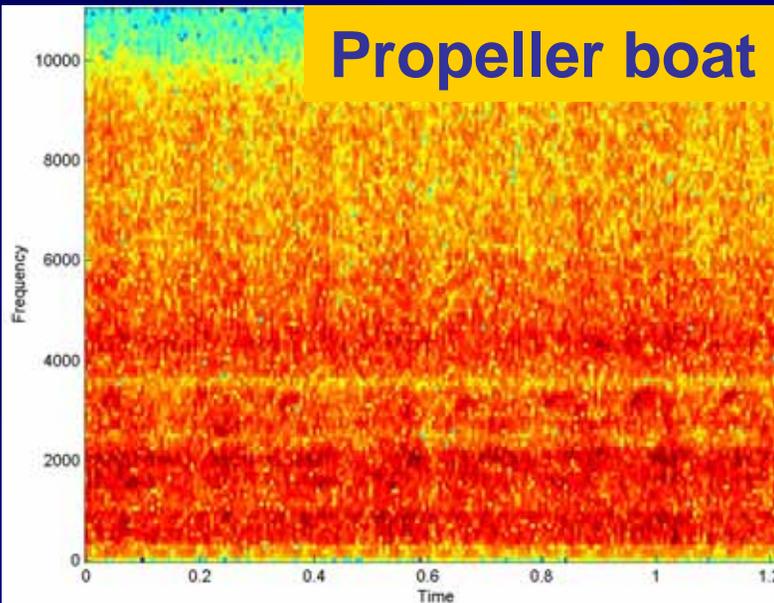
Orca 'A' clan



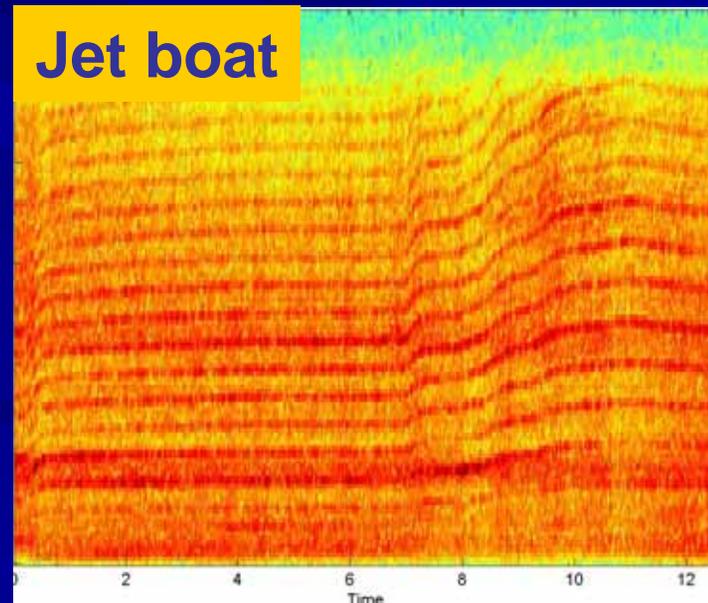
Orca 'A' clan



Propeller boat



Jet boat



# More Practical Issues:

## ■ Navy and National Security issues

- Remote control over systems. On/Off data bypass.
- No harddisk space near hydrophones.

Therefore, operating system in non-writeable flash memory and small writeable section for hydrophone code.



# Some gained experiences:

## ■ Hardware reliability

- Off the shelf components not holding up.
- How long is the warranty period? Will anybody know the workings of an instrument in 5 years?
- Corrosion issues.



# Even More Practical Issues:

- **Software reliability**
  - Bugs can be fixed.
  - Changeability.
  - Software might be obvious for one person or team that developed an instrument but this is supposed to last a long time and a number of people will be involved in the lifetime of the instrument/software.
- **Flexibility & Controllable by simple scripts or configuration files.**



A pixelated image of a white dog, possibly a Bull Terrier, with a black patch on its face. The dog is wearing a blue and white striped shirt. The background is a dark blue gradient. The text "THANK YOU" is overlaid in white, bold, sans-serif font at the bottom center.

**THANK YOU**