

# Satellite telemetry and remote sensing techniques in ecological and zoological education

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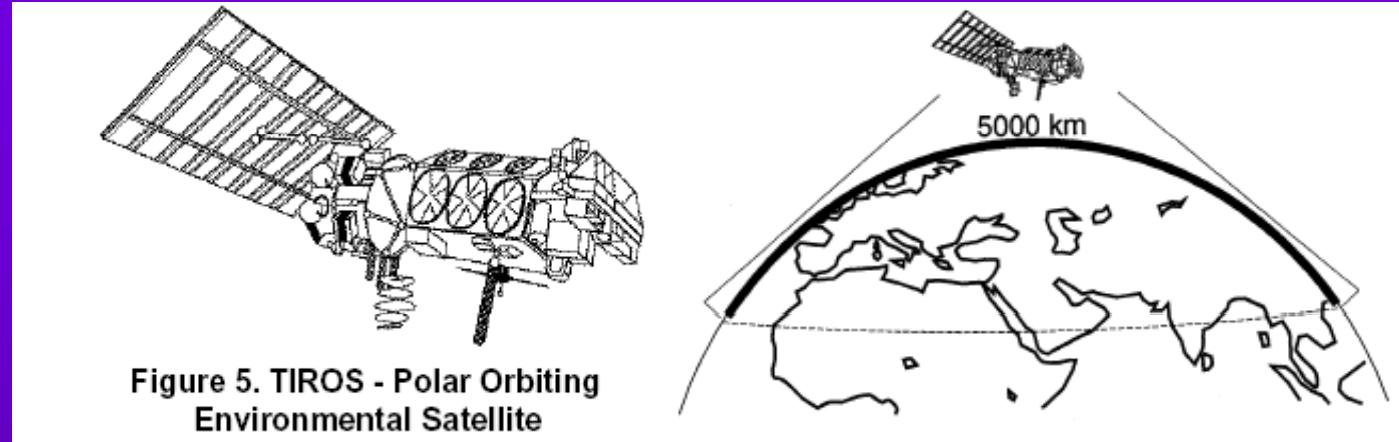
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## Argos

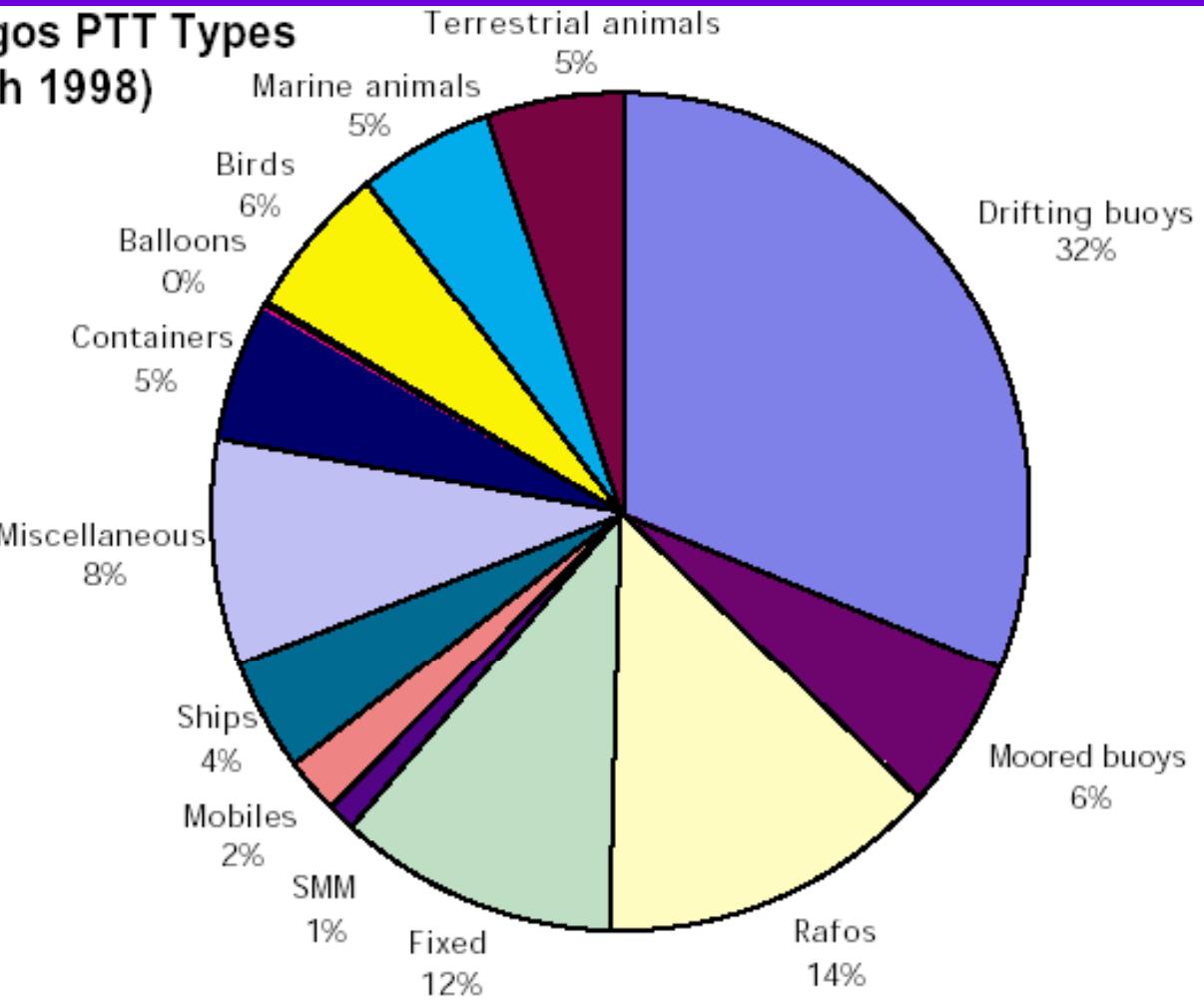


US NOAA (National Oceanic and Atmospheric Administration) and French Space Agency (Centre National d'Etudes Spatiales, CNES).

4 satellites operate  
850 km near-polar orbits  
ultra high frequency  $401.650 \text{ MHz} \pm 4\text{kHz}$

nearly 8000 transmitters on live and artificial objects

**Figure 1. Argos PTT Types  
(March 1998)**

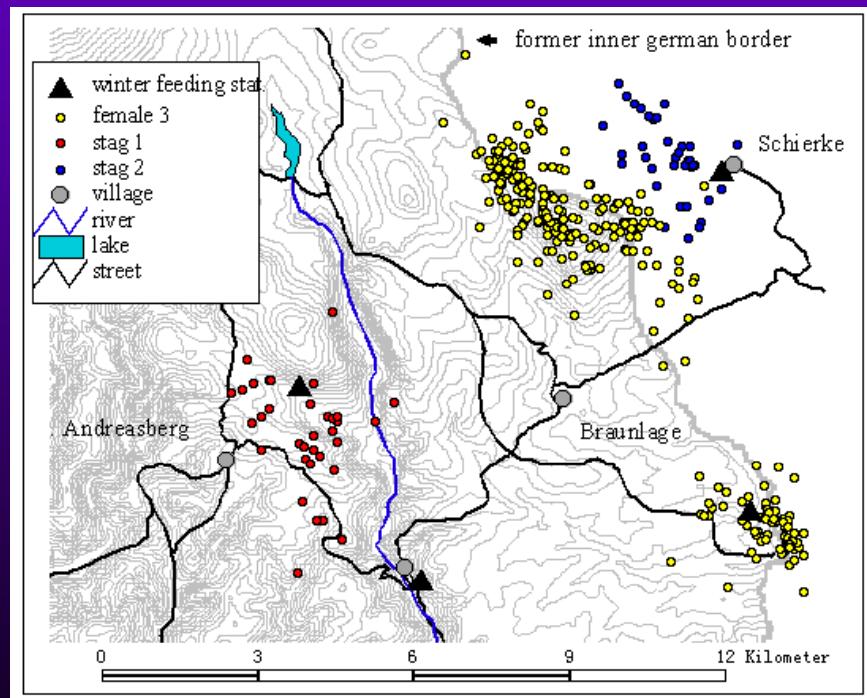


Fields of application of platform transmitter terminals (PTTs)

**TUBSAT-A**  
(Technical University Berlin  
Satellite)  
financed by German Agency  
for Space Flight (DARA)

Features:  
143,075 MHz  
38 x 38 x 38 cm  
35 kg  
contacts 2 times a day

Tracking red deer (*Cervus elaphus*) movements with GPS-collars (February - August)

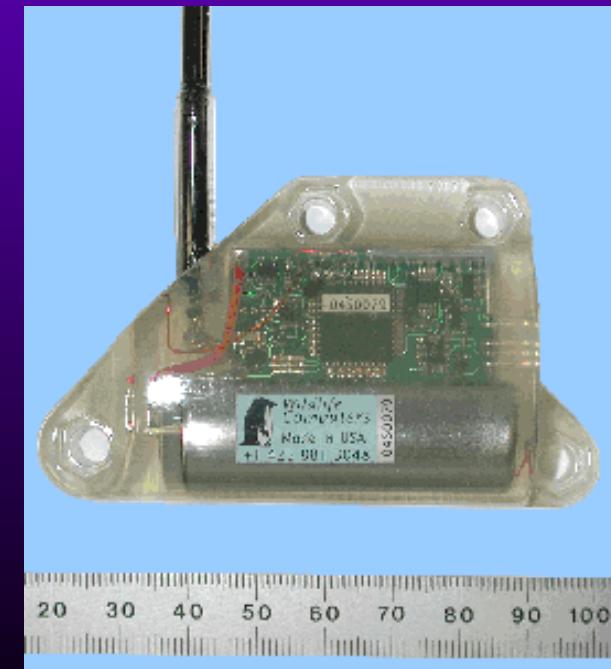




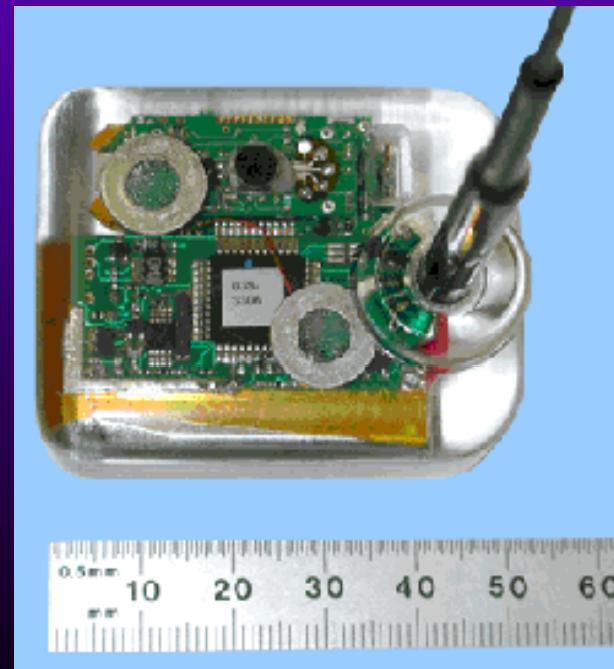
**Wildlife Computers**  
Innovative Tags for Innovative Research

## PTTs - Platform Transmitter Terminals

- SPOT or *Smart Position and Temperature Transmitting tag* (30 g)



- SPLASH - *measures depth, temperature, light level, and wet/dry periods* (14Mb, 65 g)



- PAT or *Pop-Up Archival Transmitting tag* (16Mb, 75 g)



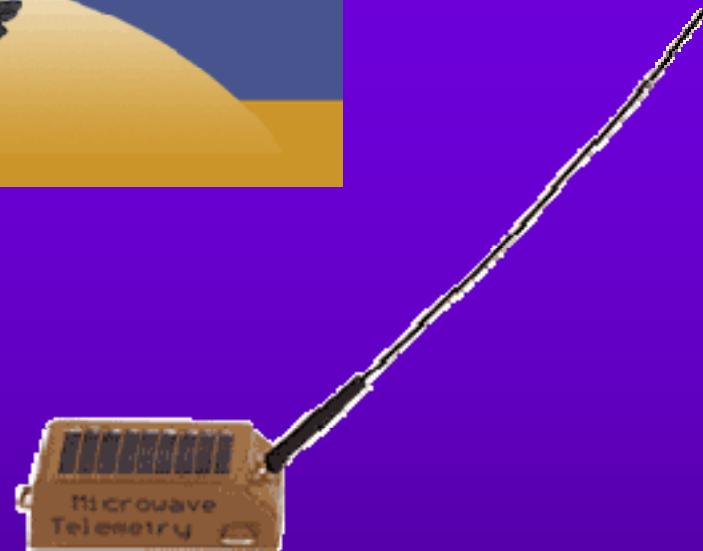
**Microwave  
Telemetry, Inc.**



## **PTT-100 9.5 gram Solar PTT**

**Dimensions:**

**L 38 x W 17 x H 12 mm**



### **General Electrical Specifications:**

**Operating frequency:** 401.650 MHz  $\pm$  36 kHz

**Power output:** 200mW output is standard \*\*\*

**Output impedance:** 50 ohms

**Modulation Tri Phase PSK:**  $\pm$  1.1 Rad  $\pm$  0.1 Rad

**Quiescent current:** <3 $\mu$ A

**Spurious emissions:** -45 dB

**Transmission interval:** 45 to 120 sec\*\*

**Supply voltage:** 3.6 - 4 volts

**Operating temperature range:** -15 to 45 Deg C

# Vectronic Aerospace

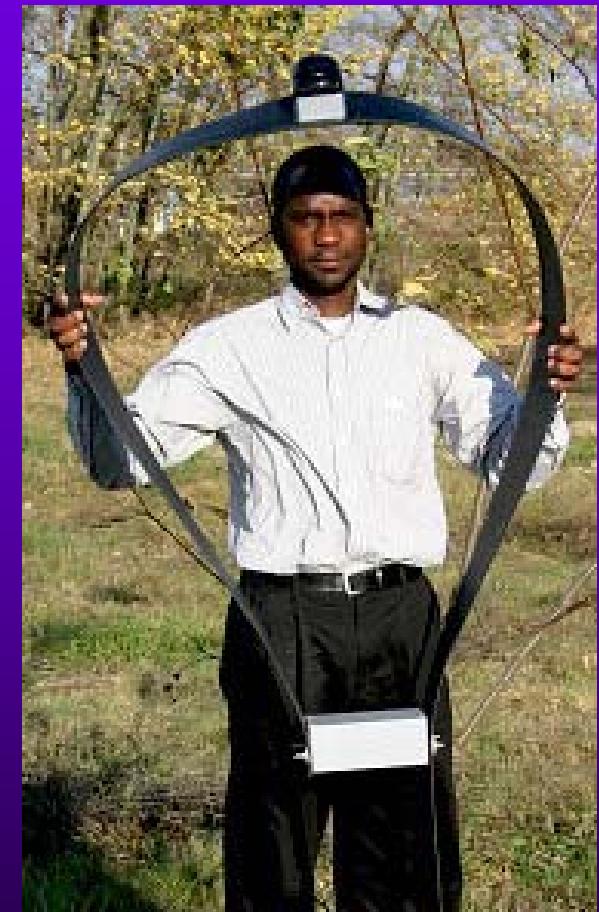
GPS-GSM Collar (GSM modem)



for ungulates  
500 г



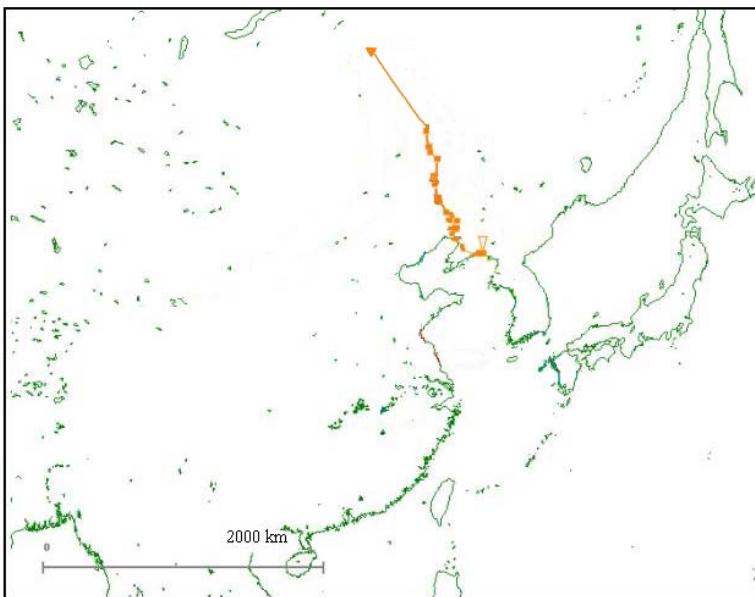
for lynx  
420 г

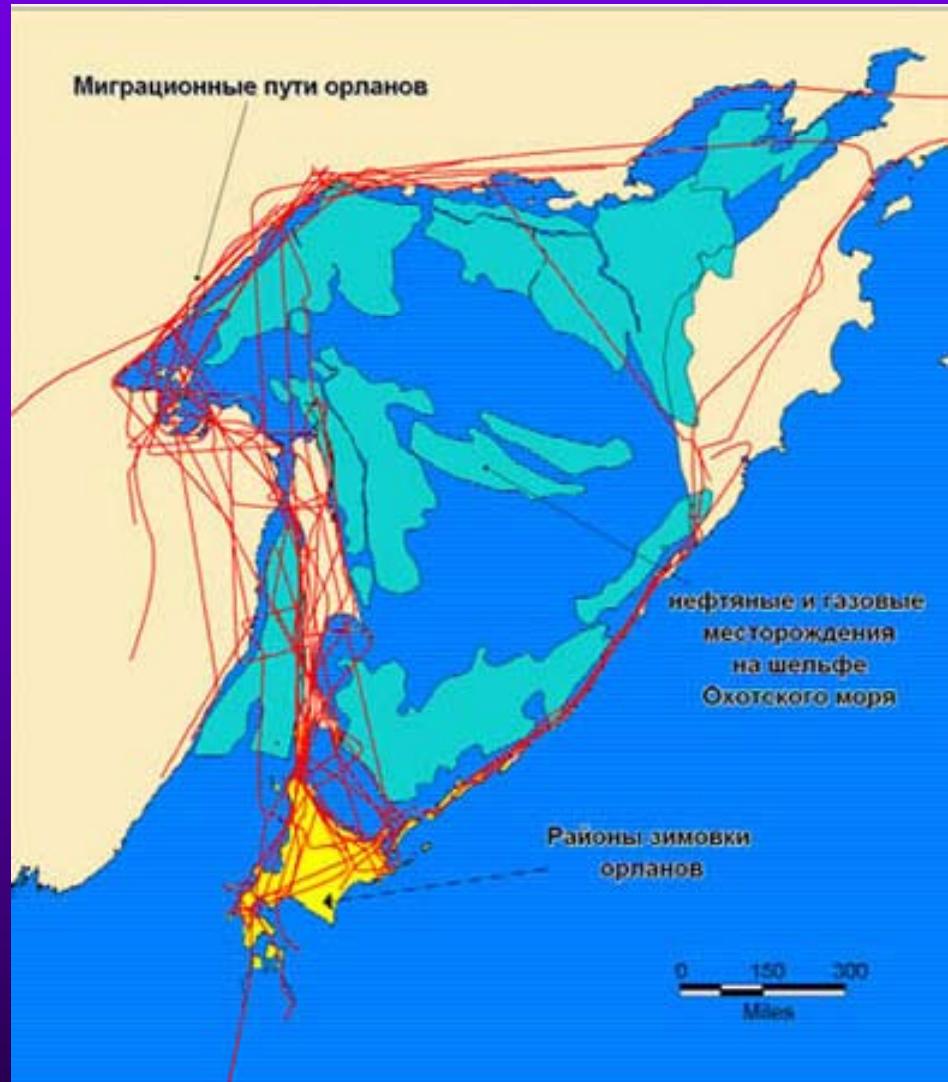


for elephant



## Investigating migration routes of swan goose (*Cygnopsis cygnoides*) from Amur region to China





Tracking migrations of Steller's sea eagles (*Haliaeetus pelagicus*) from Sakhalin and Kamchatka to Japan

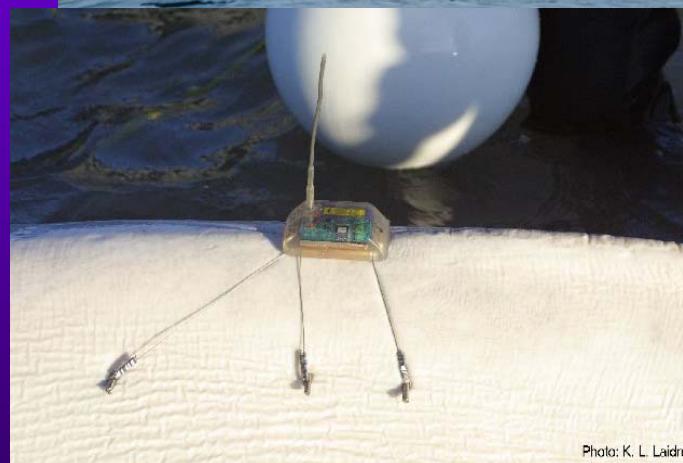
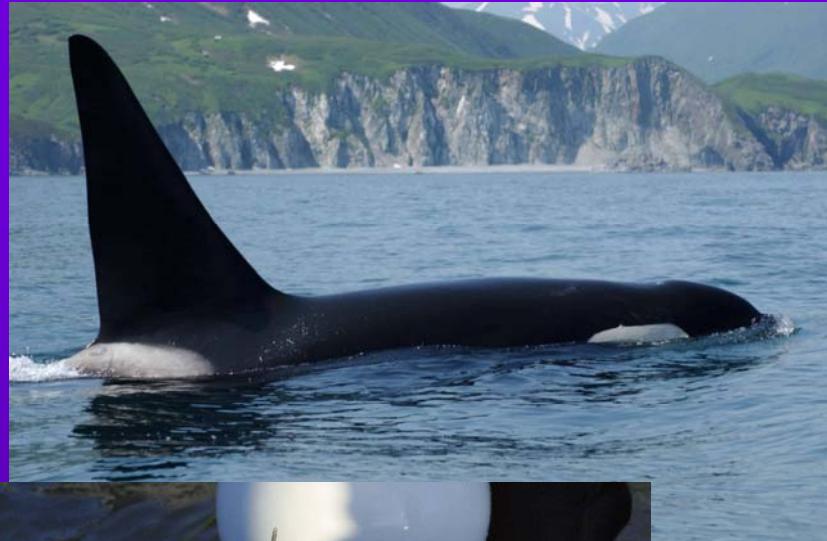
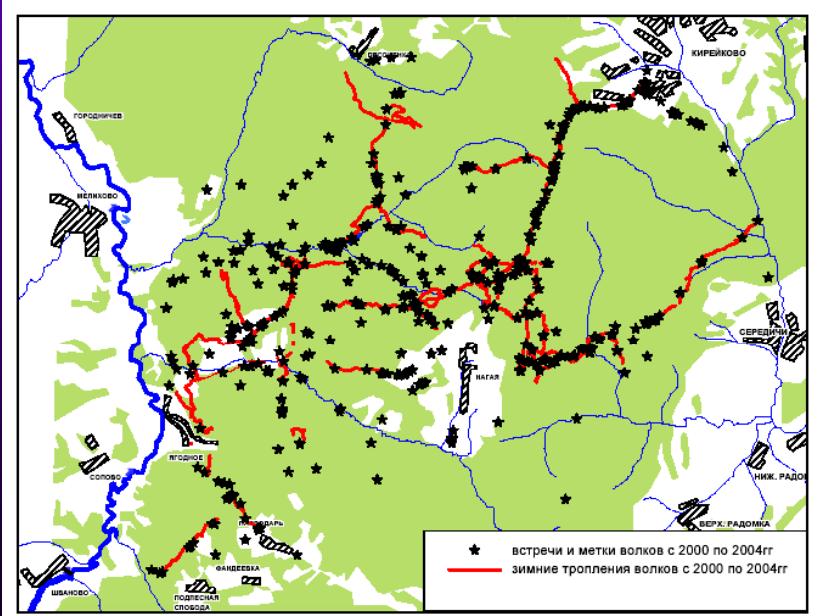
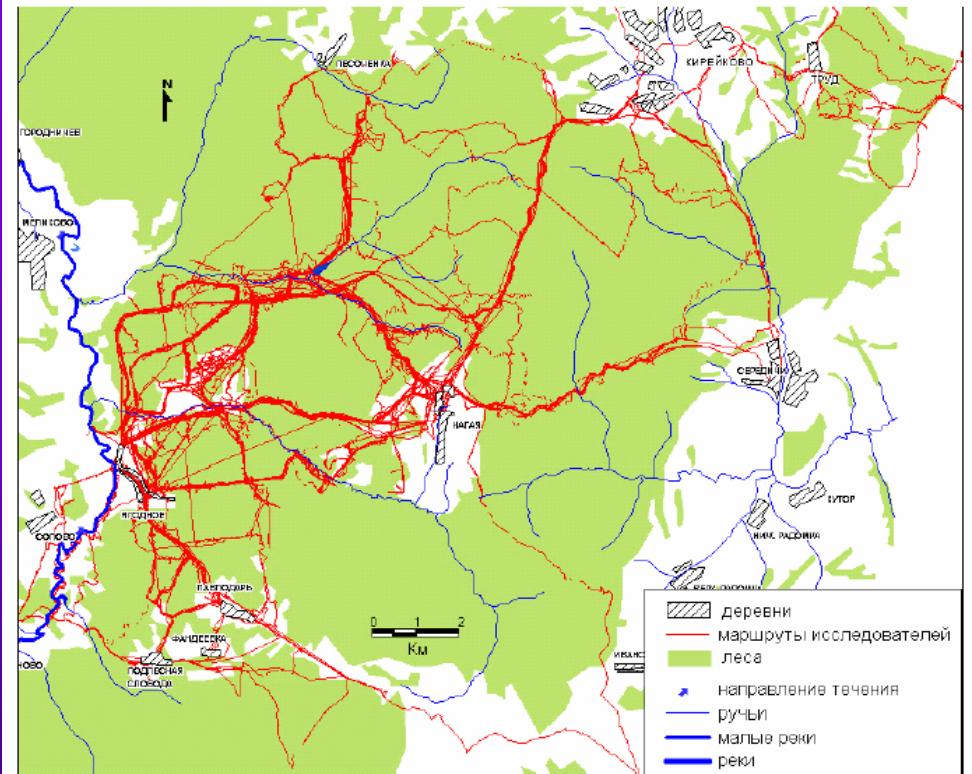


Photo: K. L. Laidre

Observing movements of killer whales and seals in Sakhalin and Kamchatka using theodolites



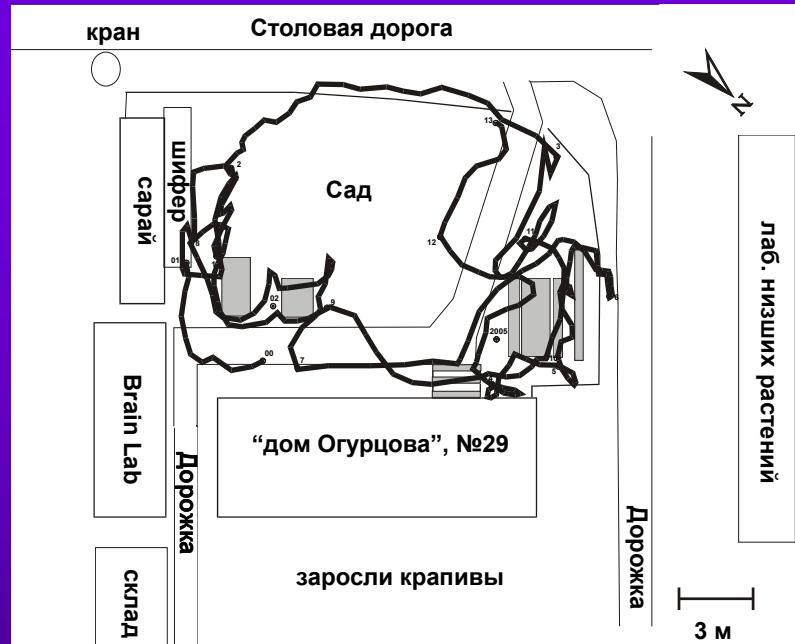


Following wolf tracks with  
GPS «Garmin eTrex»  
(2000-2004 гг.)



Tracking common toad  
(*Bufo bufo*) with a  
mechanical tracking device

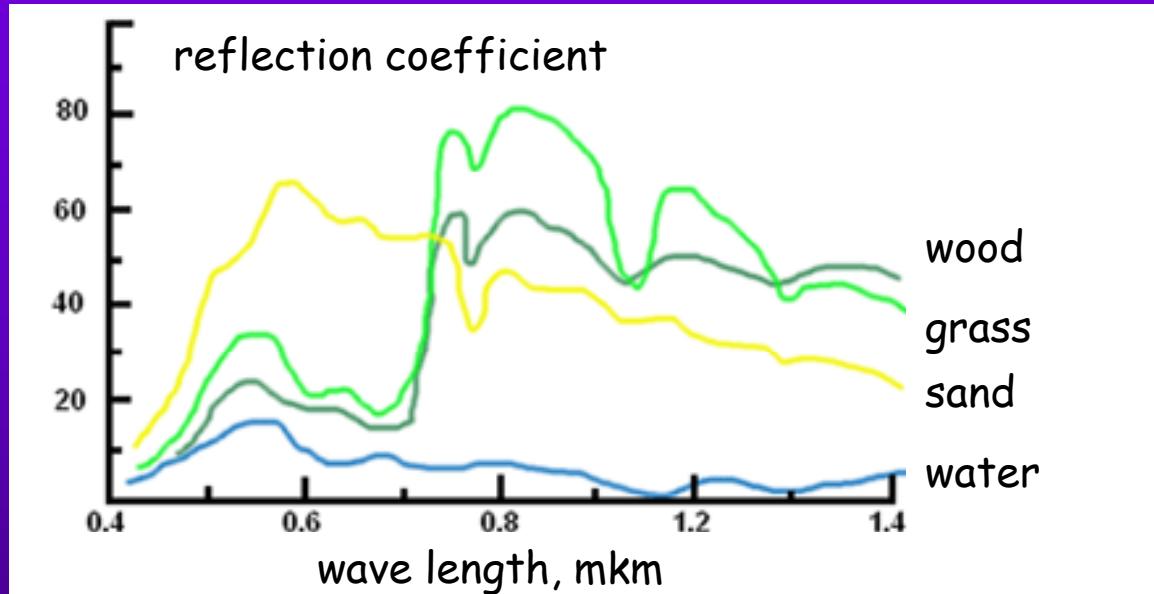
2004

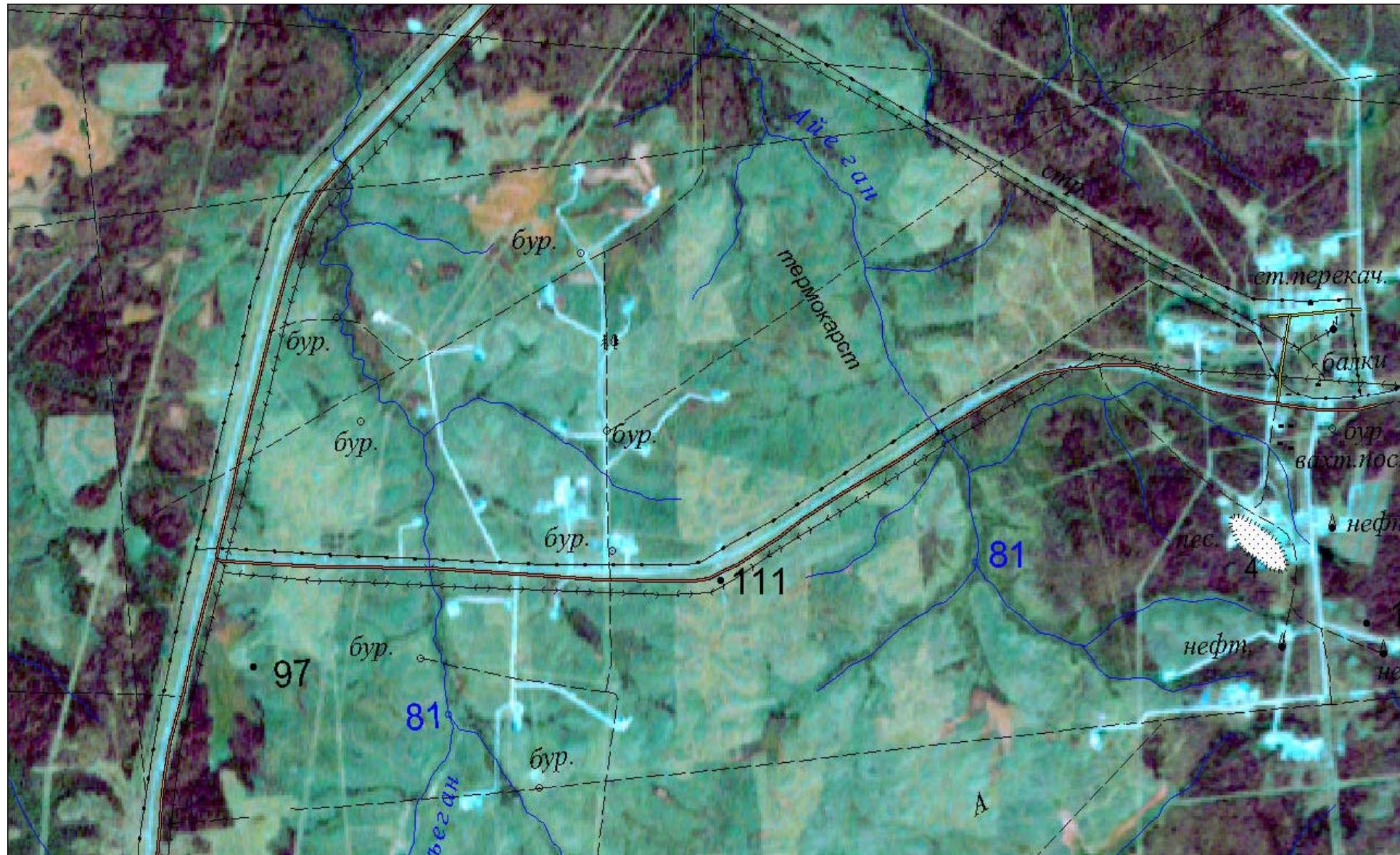


2005



# Remote sensing





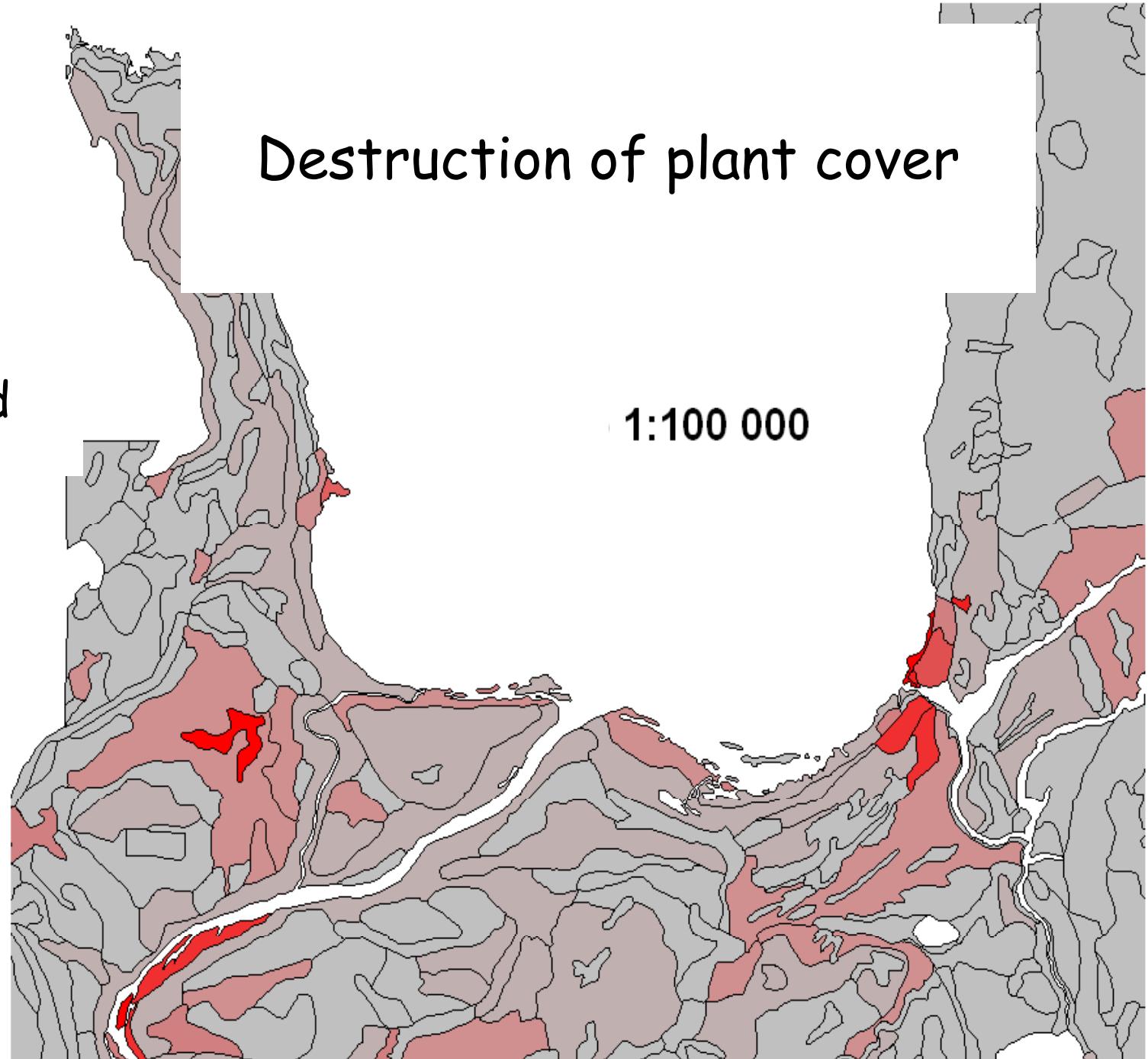
Map corrections for places with extensive petroleum production

% of  
destructed  
cover in a  
contour

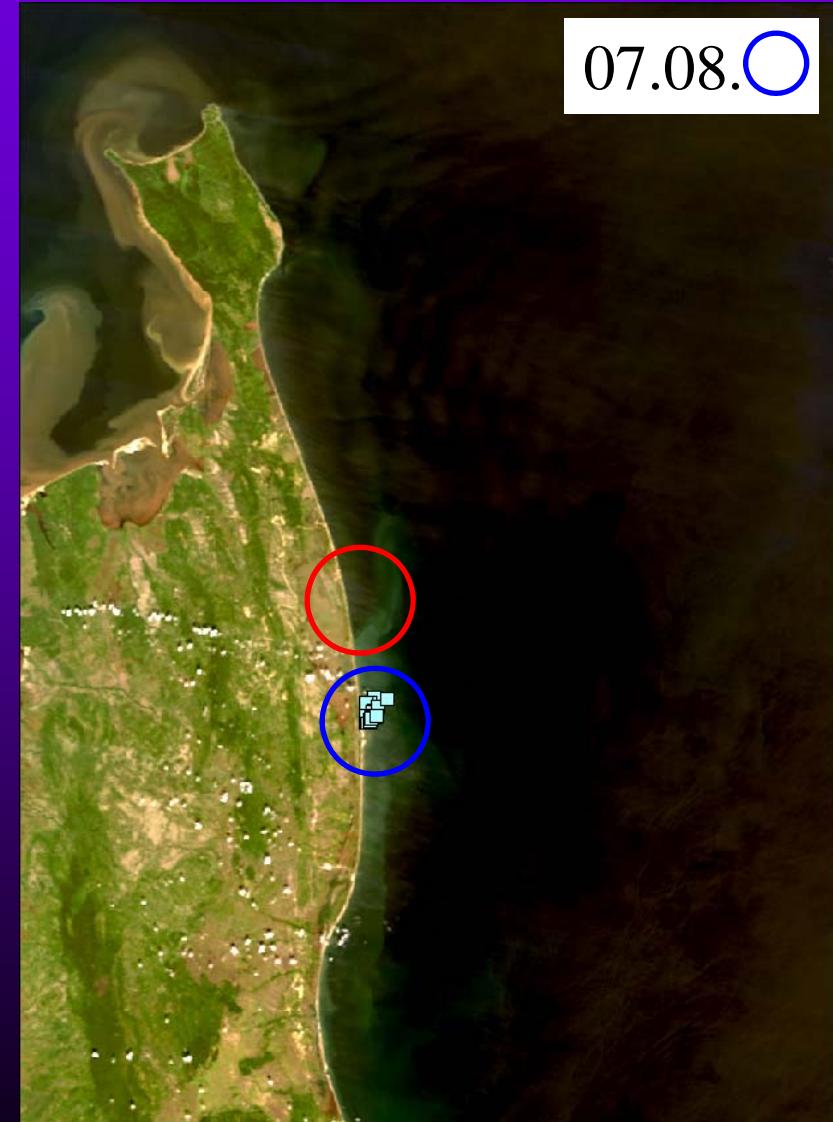
- 66.4 to 75
- 58.1 to 66.4
- 49.8 to 58.1
- 41.5 to 49.8
- 33.2 to 41.5
- 24.9 to 33.2
- 16.6 to 24.9
- 8.3 to 16.6
- 0 to 8.3

## Destruction of plant cover

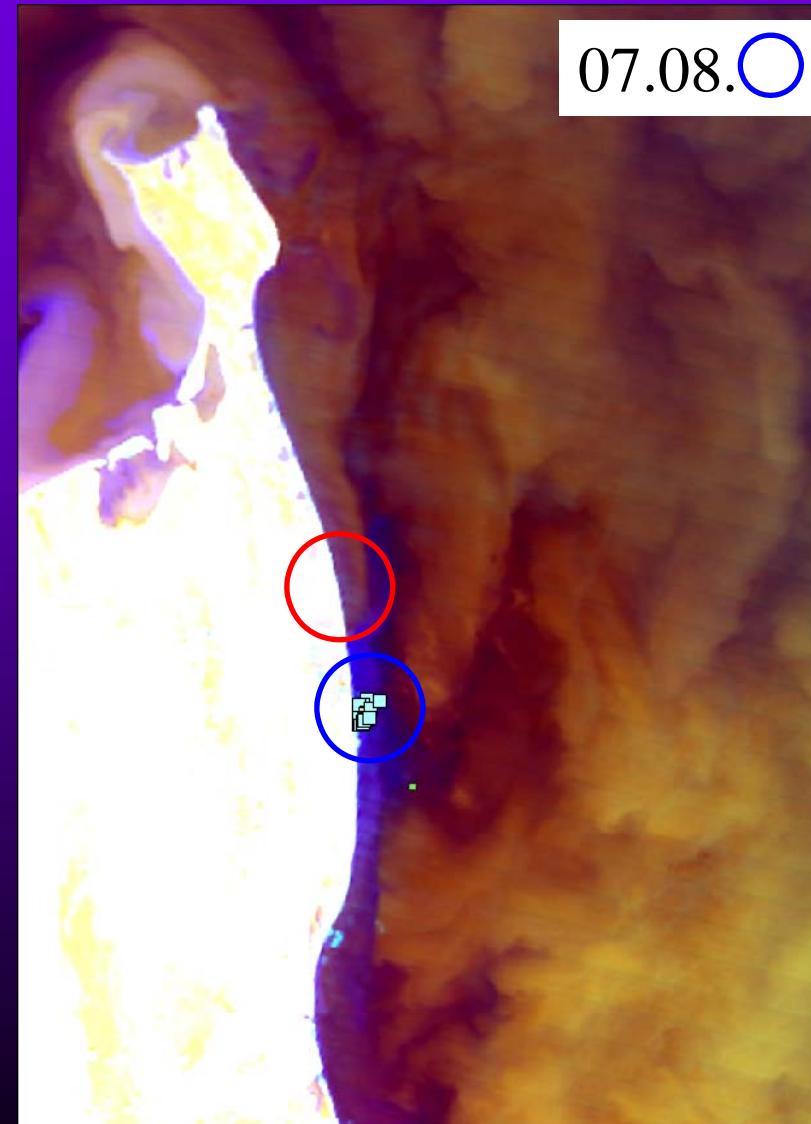
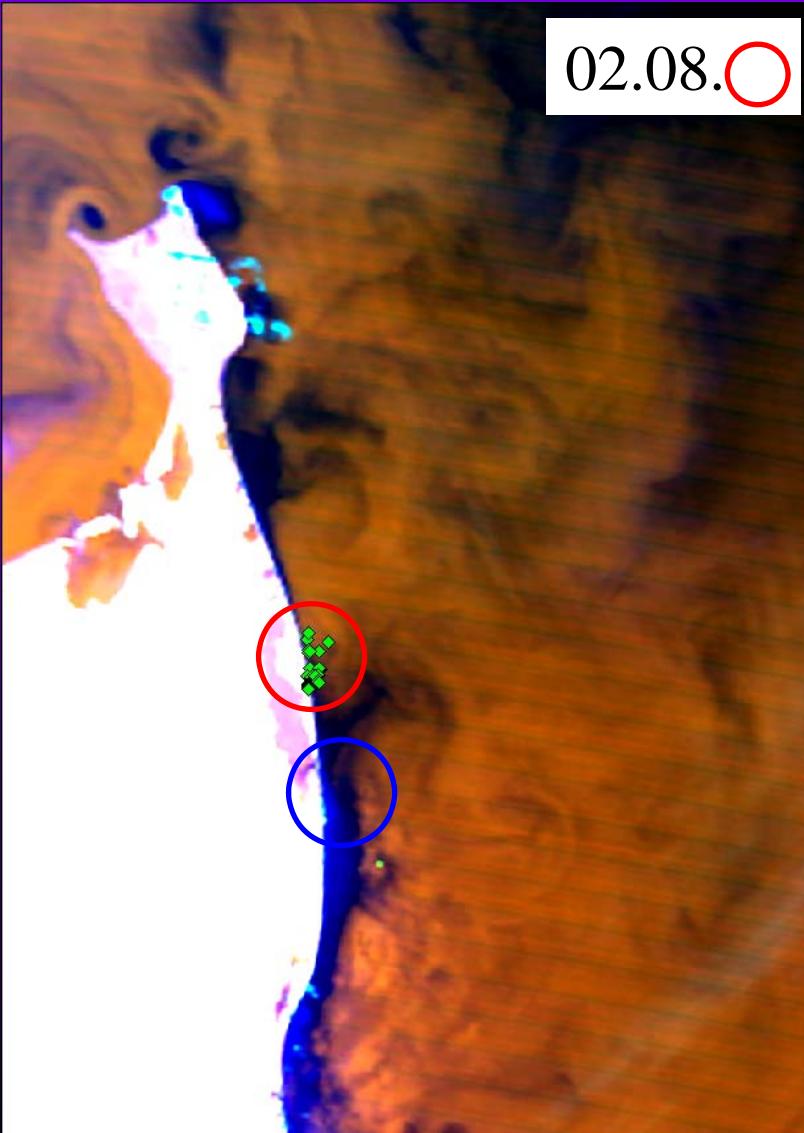
1:100 000

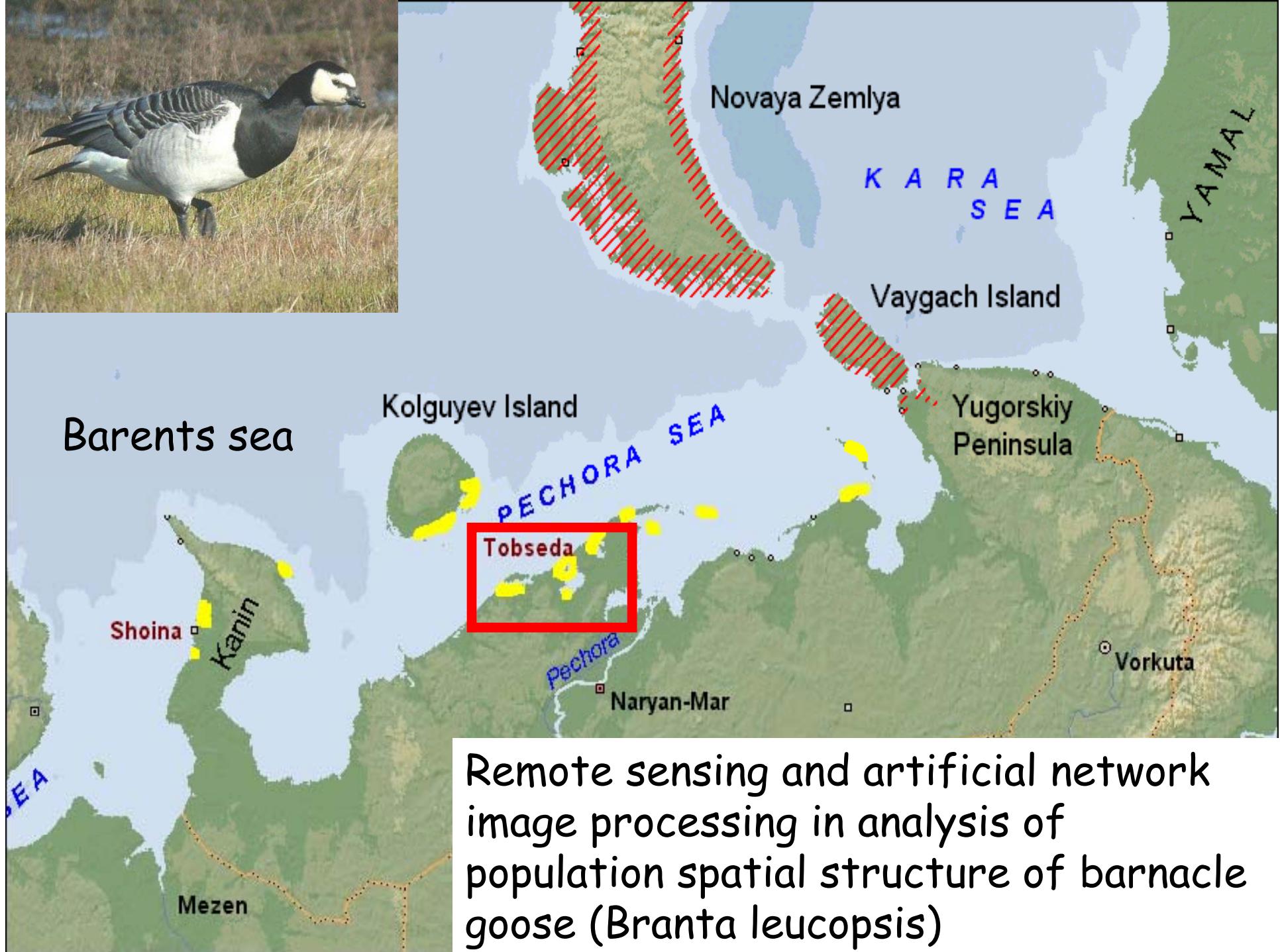


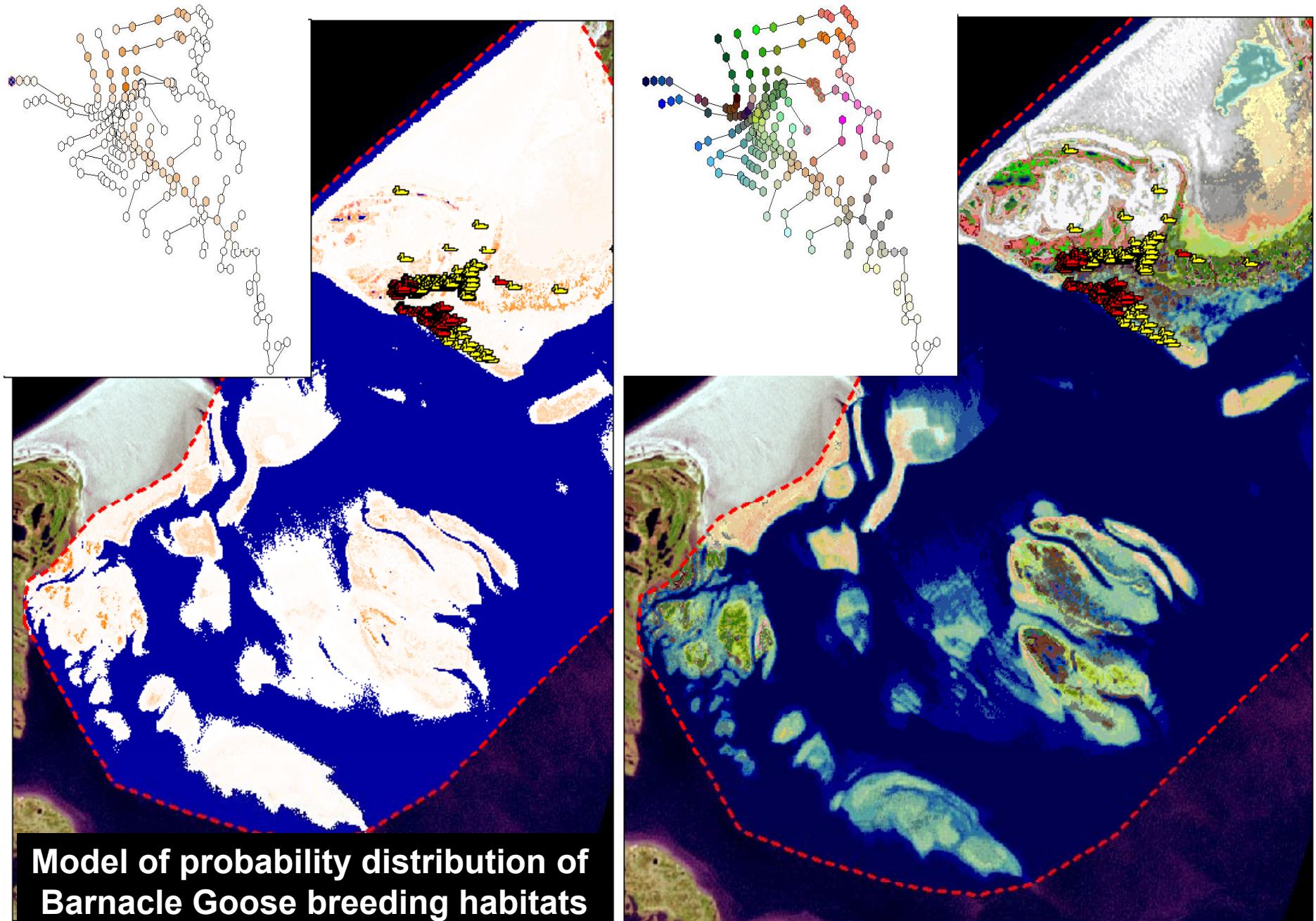
# Whales positions on MODIS images (Visible and Near IR)

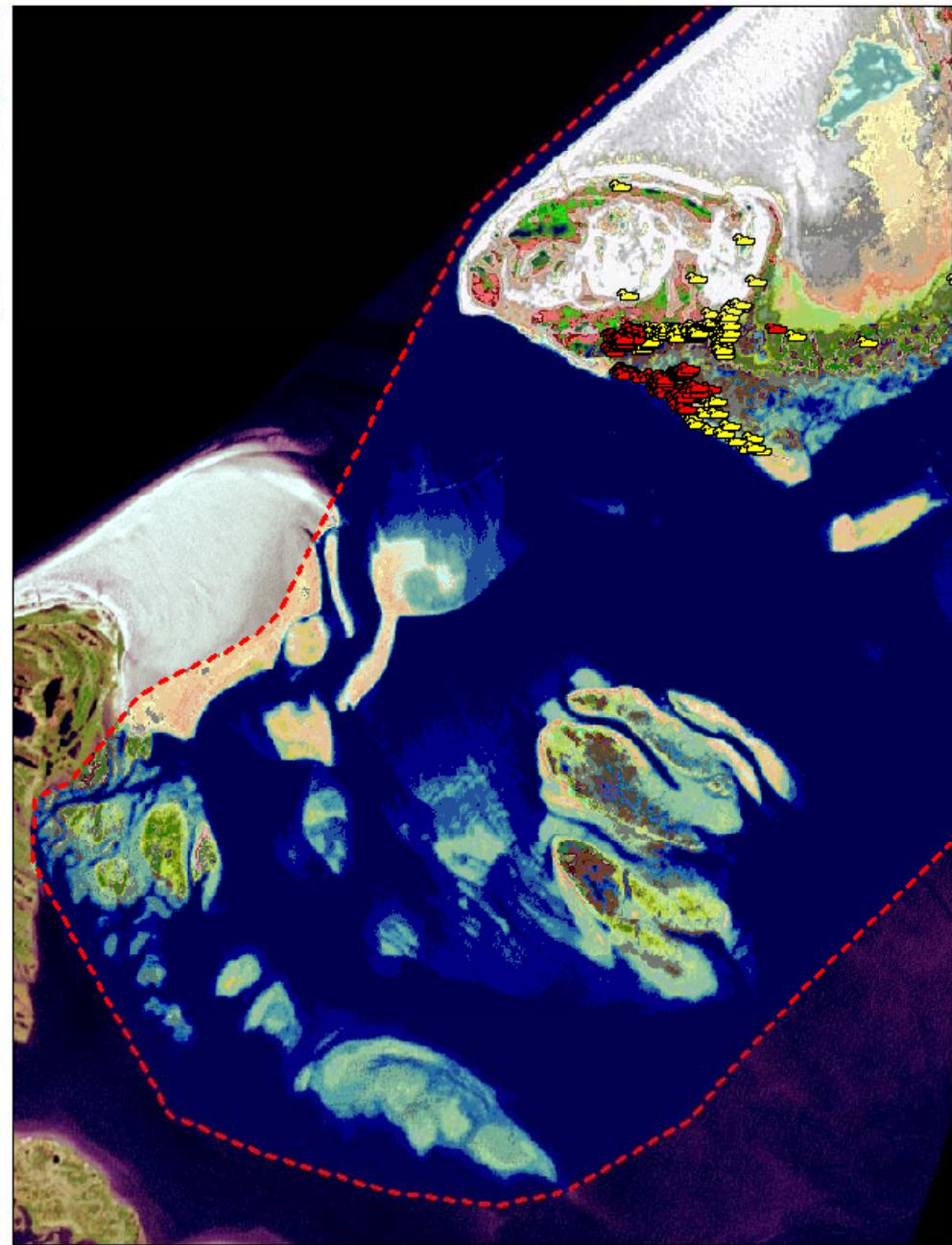
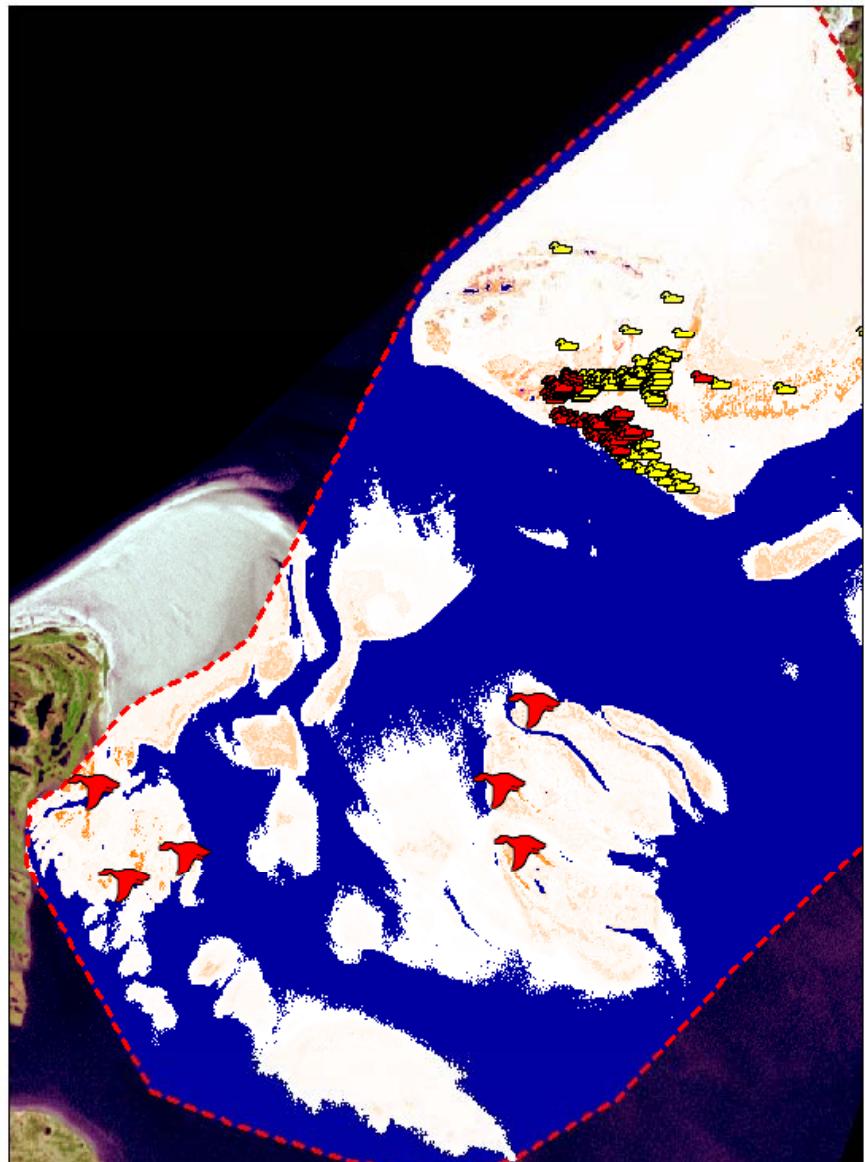


# Whales positions on MODIS images (Far IR )



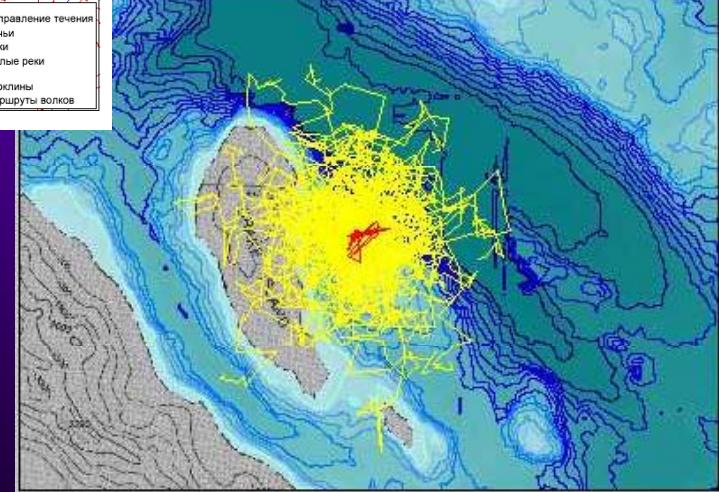
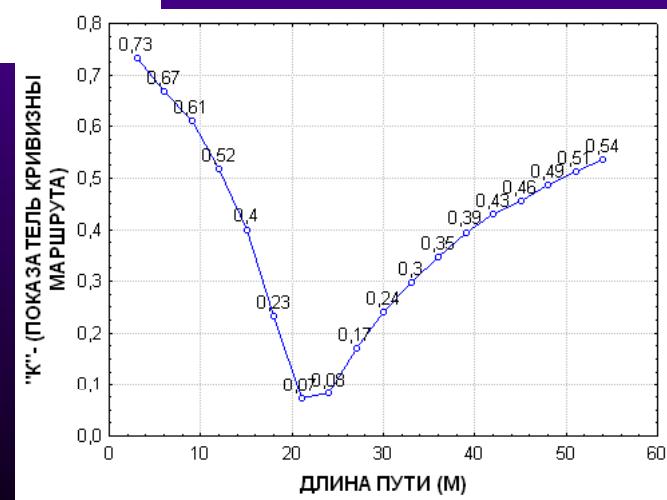
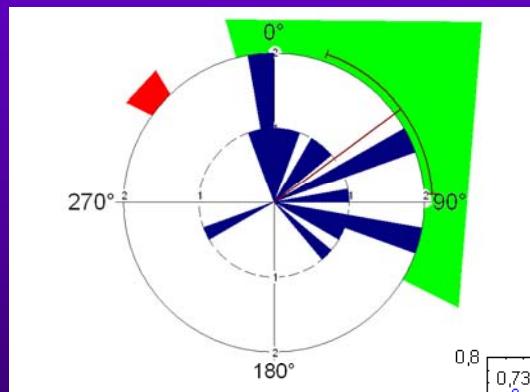
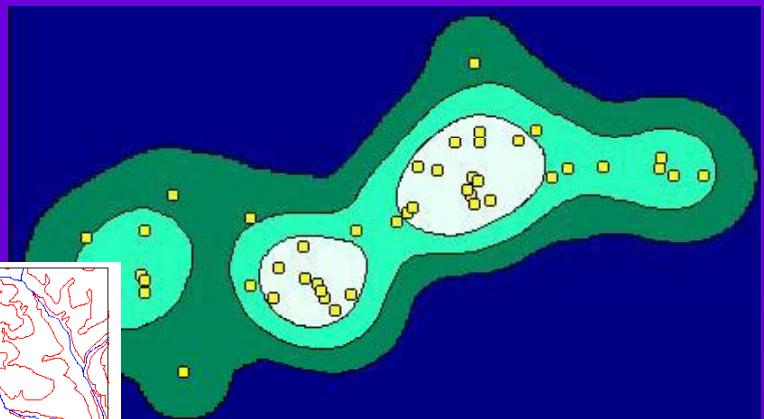
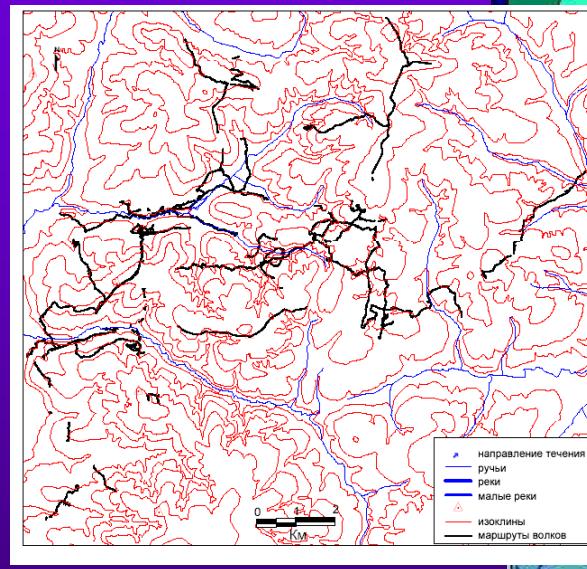
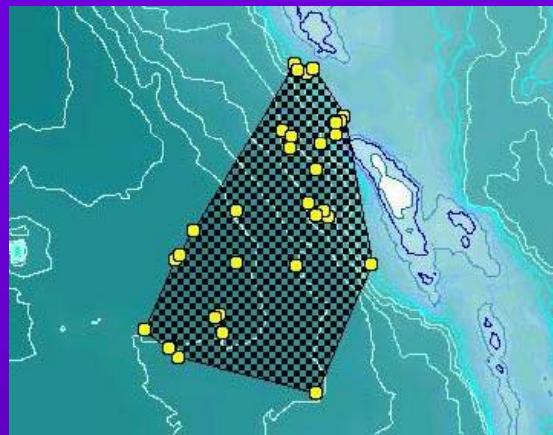






New points of Barnacle  
Goose nests observed by  
the expedition

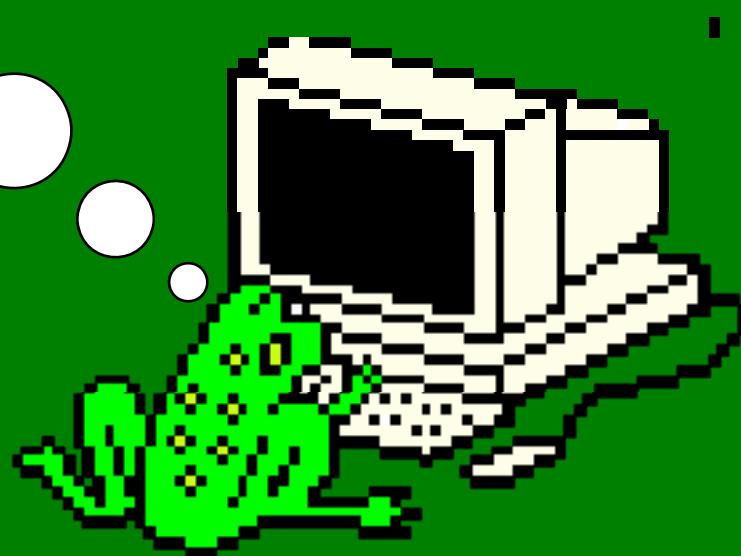
# Computer programs

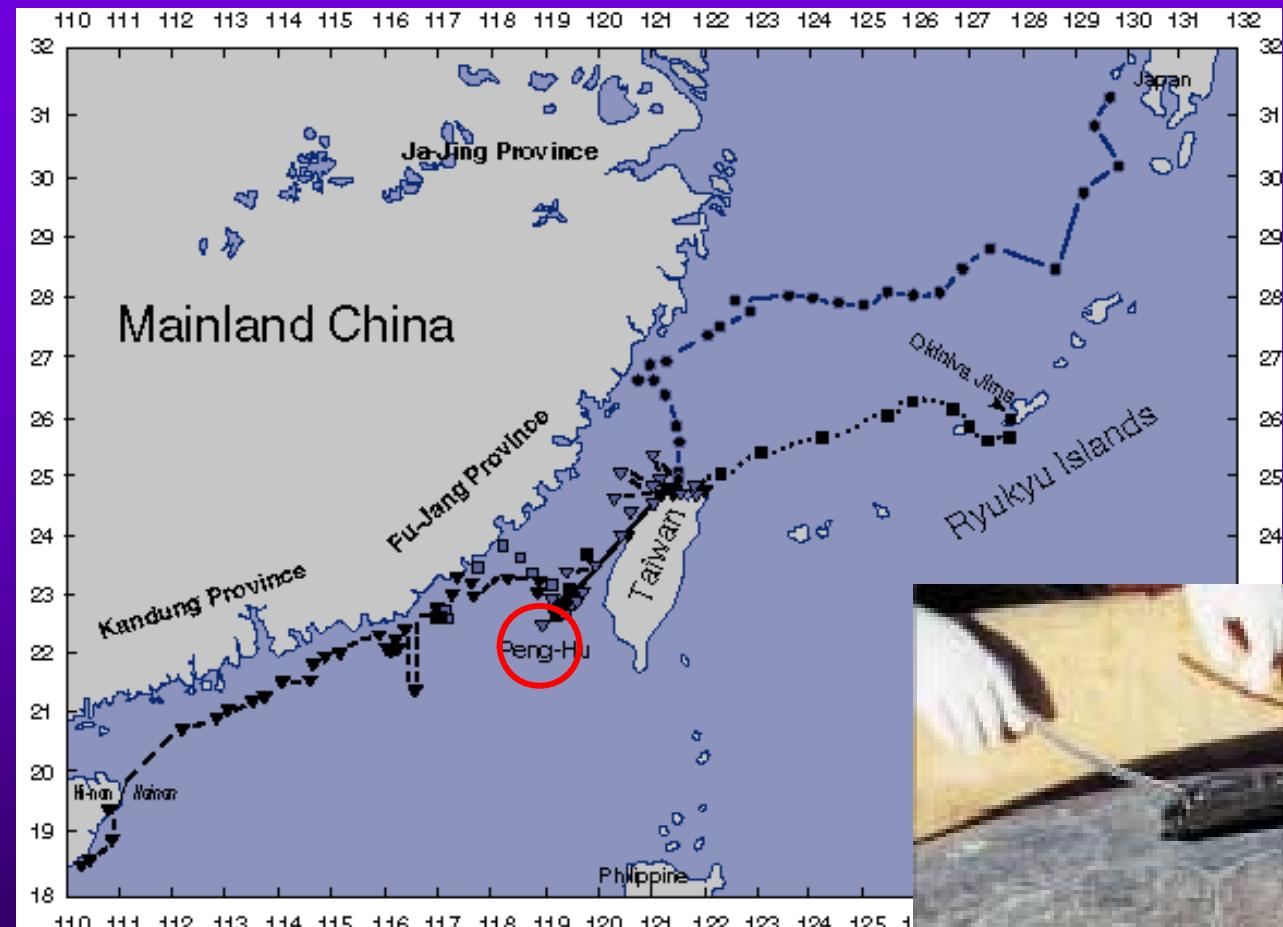


## Possible applications in education

- Student training course «Remote sensing techniques in studying the environment and soil cover»
- Computer training in electronic cartography and animal movement analysis
- Field summer and winter practice using GPS receivers
- Diploma study using GPS receivers and satellite telemetry

**Thanks for  
listening!**



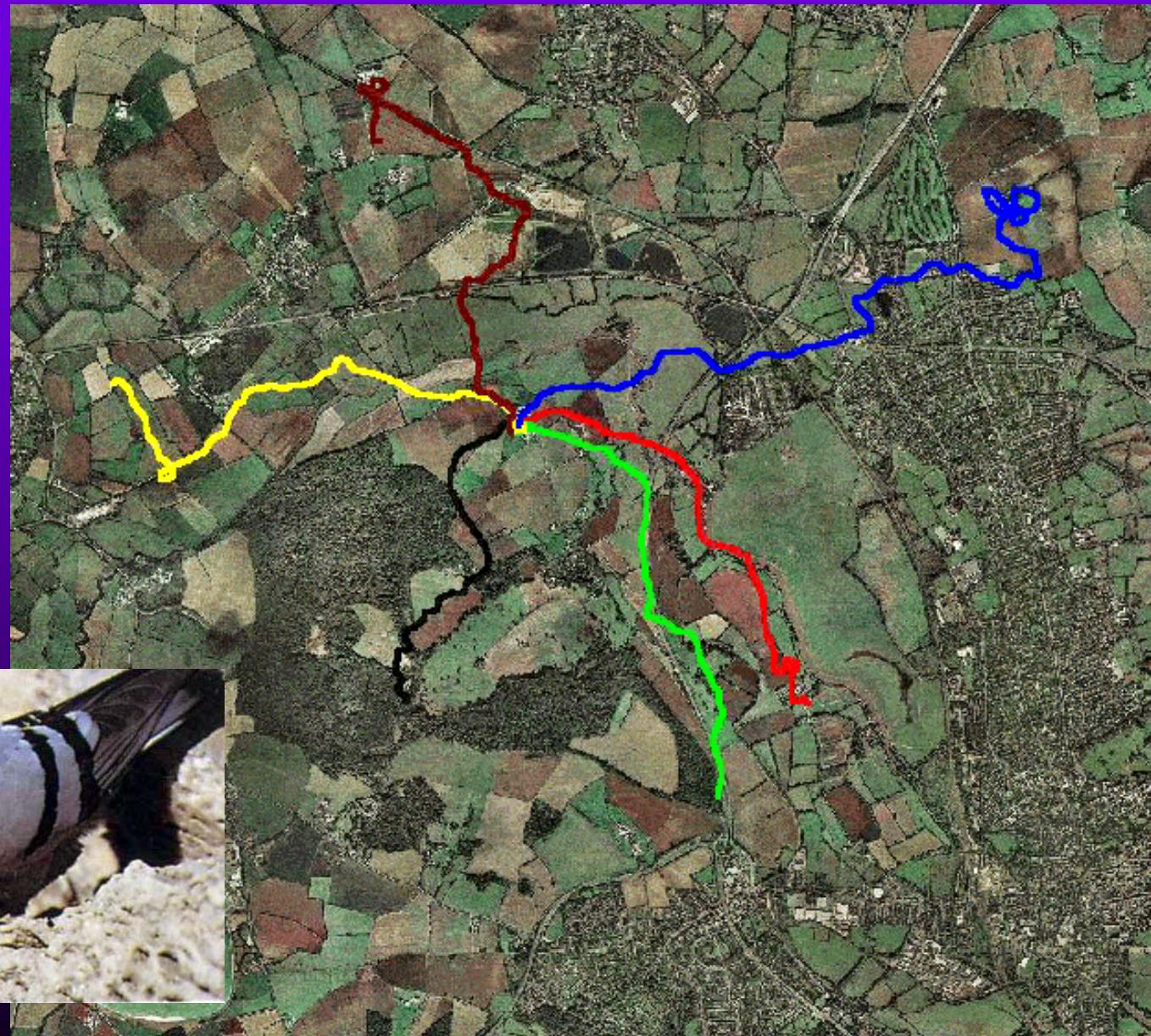


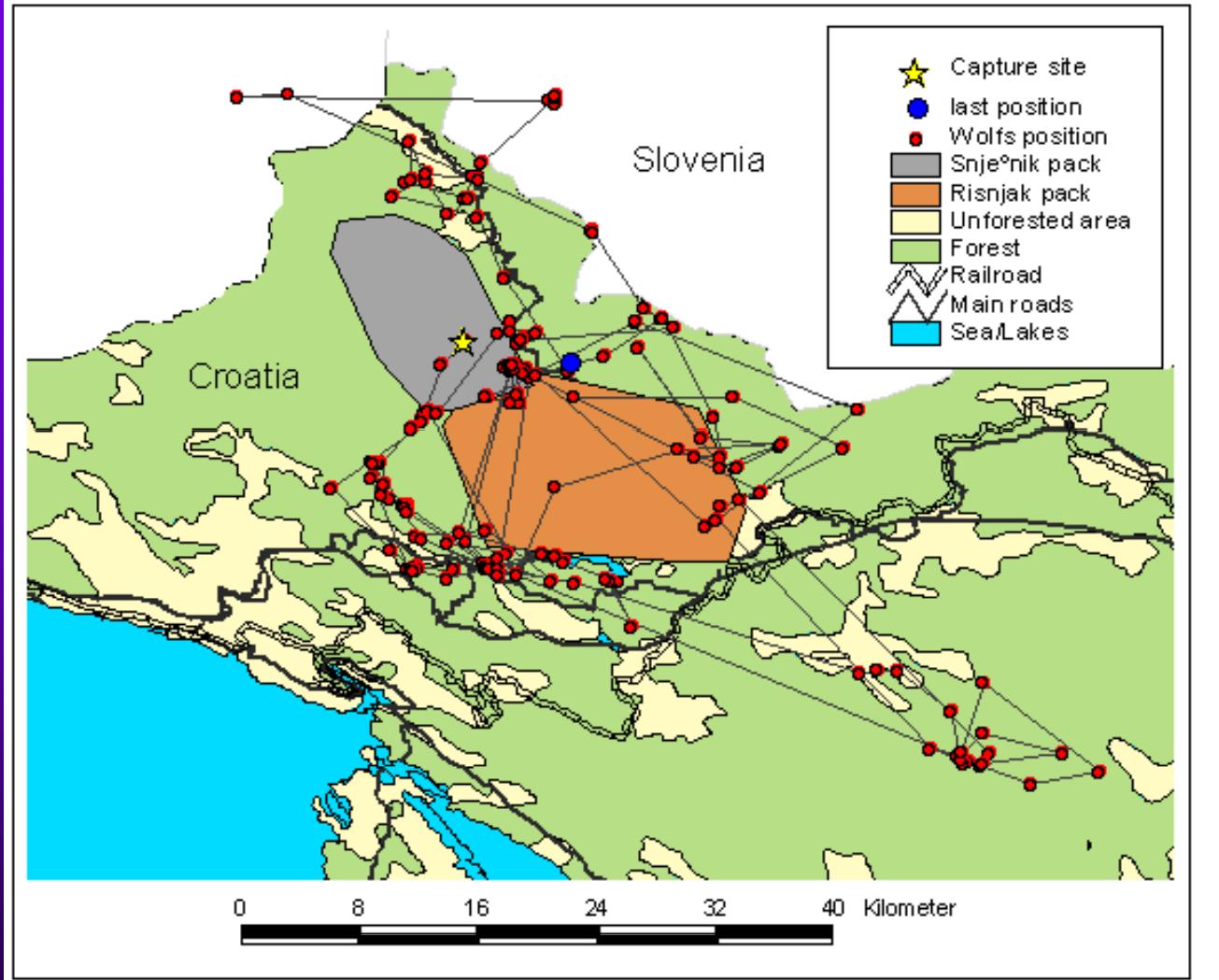
Tracking green sea turtles (*Chelonia mydas*)  
moving from a breeding site (red circle)



Migrating routes of  
peregrine falcon (*Falco*  
*peregrinus*)

Pigeons  
tracked by  
GPS  
transmitters  
while returning  
to their home  
loft

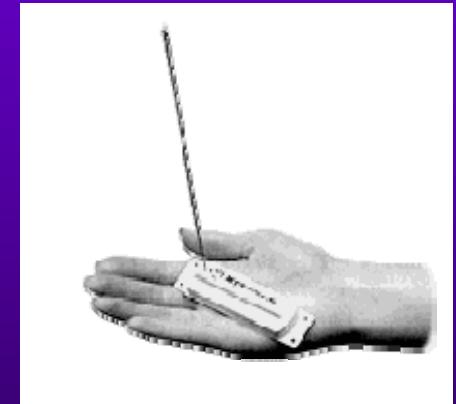




Movements of 3-year-old female wolf (*Canis lupus*)  
tracked with GPS-GSM collar (September-December)

## Satellite trasmitters

- weight from 9,5-65 g (PTT) to 300-1000 g (GPS)
- accuracy from 100-3000 m (PTT) to 5-15 m (GPS)
- battery for 3-12 months
- price per transmitter 900-3000 \$
- service 90-260 \$/month/transmitter

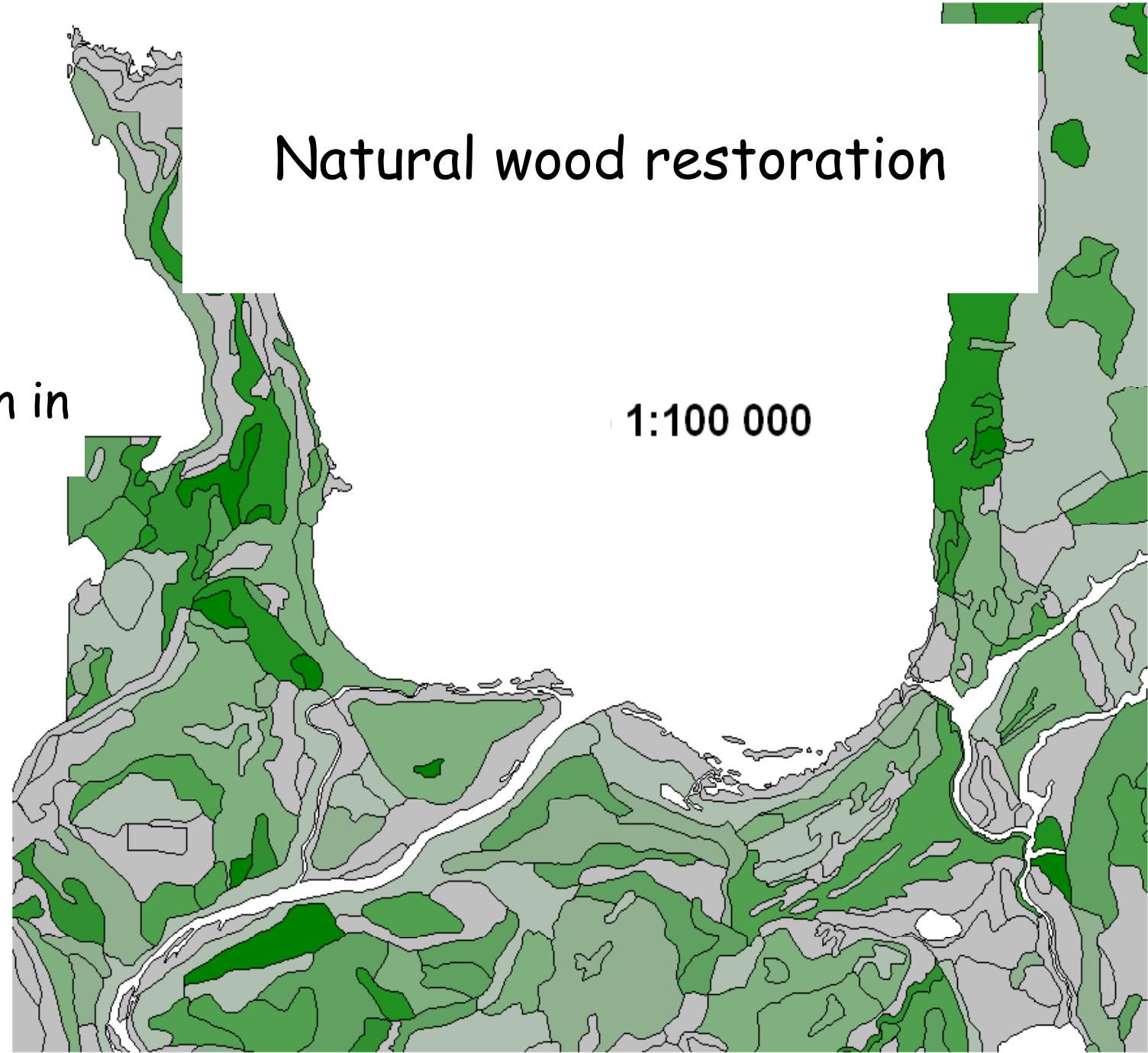


### Additional modules:

- depth / hight
- temperature (body / environment)
- salinity
- humidity
- light level

% of wood  
restoration in  
a contour

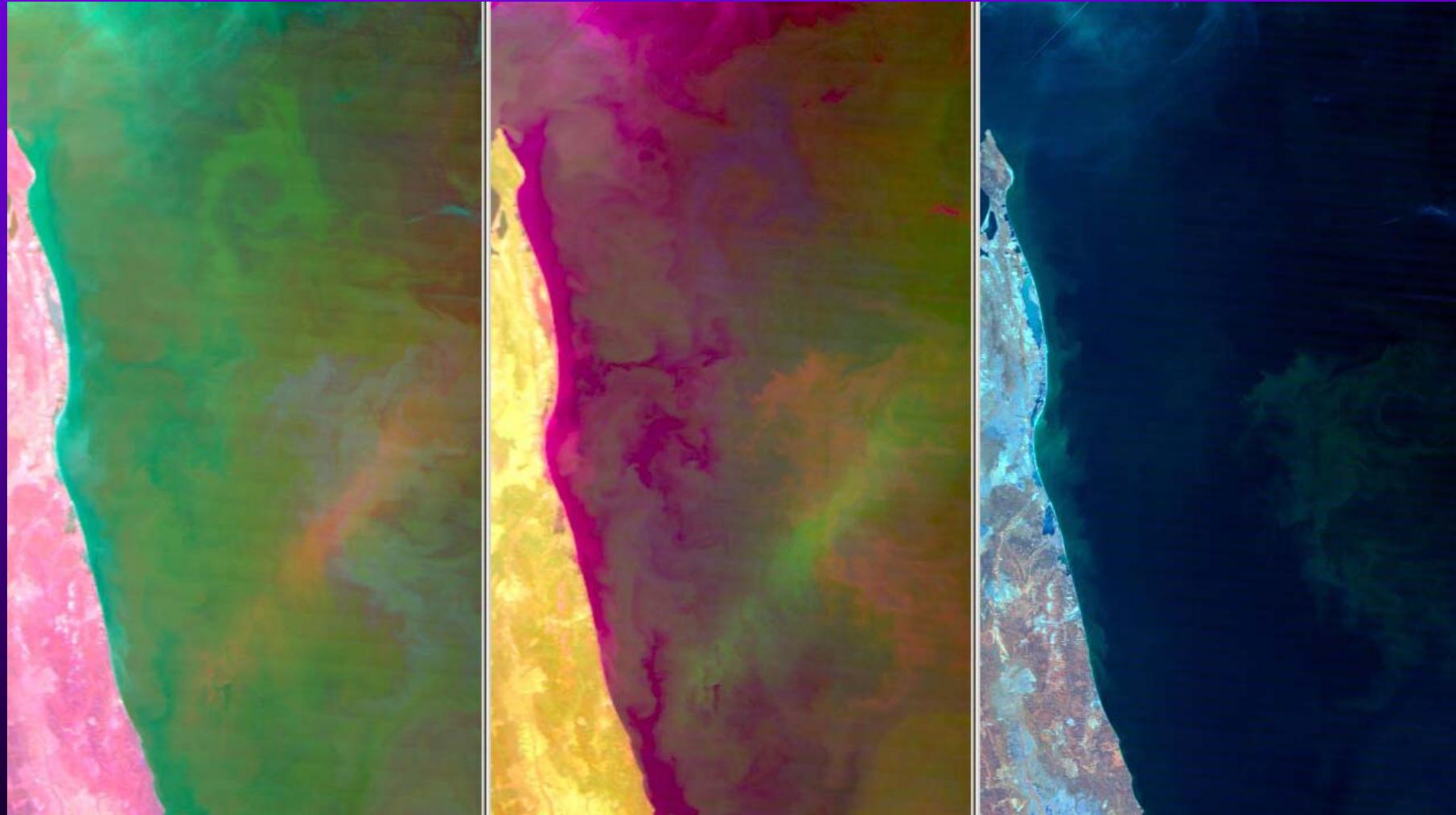
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10



Natural wood restoration

1:100 000

## Water conditions in different spectral sets



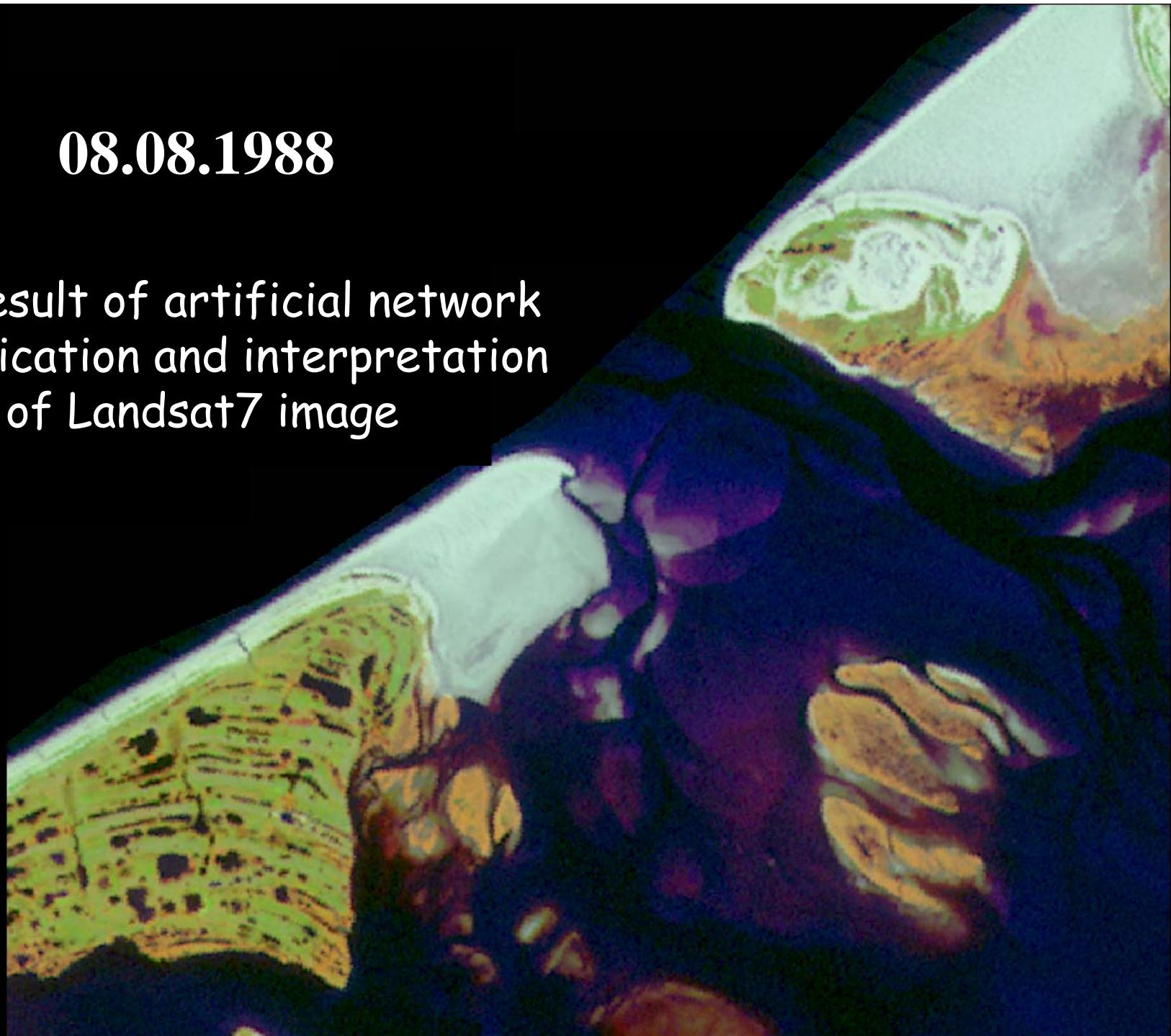
Far IR set

Near IR + Far IR +  
Visible set

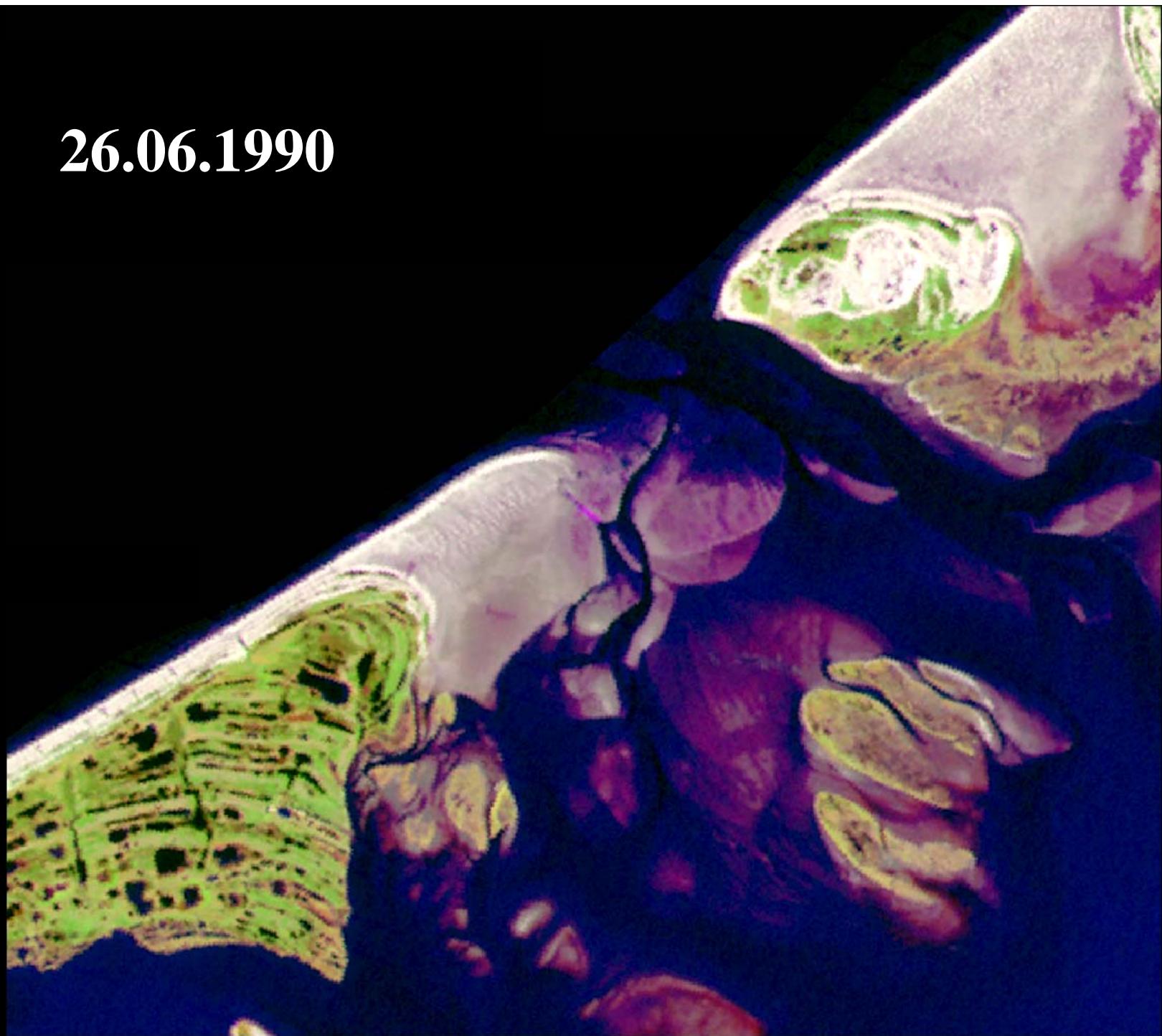
Visible + Near IR set

**08.08.1988**

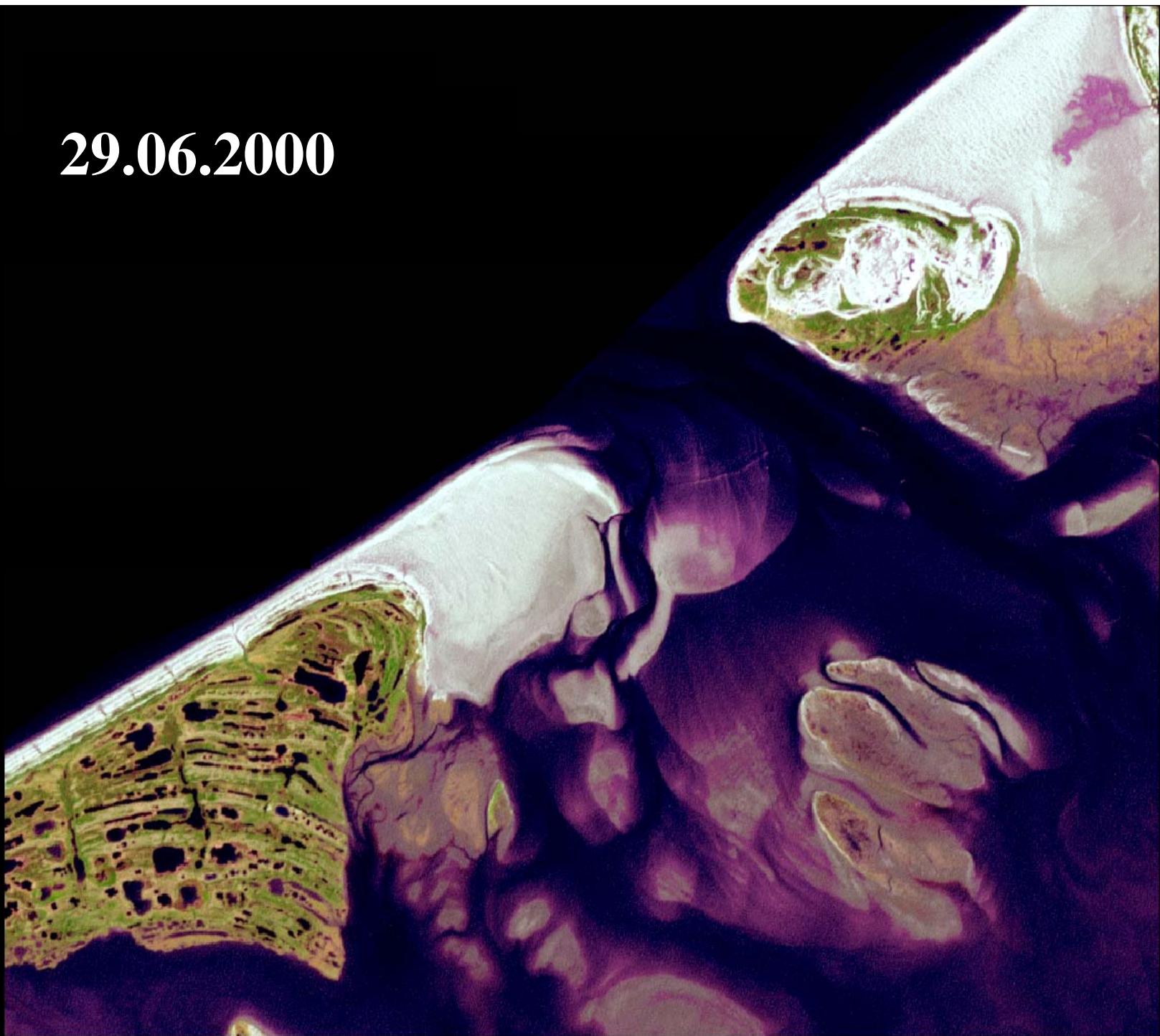
The result of artificial network  
classification and interpretation  
of Landsat7 image



**26.06.1990**



**29.06.2000**



The coastal dinamics of Kolokolkova Bay  
during the period  
08.08.88 - 26.06.90. - 29.06.00

**stable**

**positive**

**negative**

