Field bases in the Russian Arctic.

Dr Vasily Smolyanitsky
Arctic and Antarctic Research Institute, St. Petersburg, Russia

The First Asia CryoNet Workshop (Beijing, China, 3 to 5 Dec 2013)
Network of polar observations

[Map of polar observation sites with labels such as Barrow, Alaska, Tiksi, Russia, Ny-Alesund, Svalbard, and others.]
Tiksi hydrometeorological observatory

• NOAA Thematic Lead: John Calder, NOAA/OAR/CPO
• Roshydromet Thematic Lead: Alexander Danilov, Roshydromet/AARI and Yury Tsaturov, Roshydromet
• Coordinators of project: Alexander Makshtas (AARI) and Taneil Uttal NOAA/OAR/PSD
• Other partners: Simon Stephenson, NSF, Alexander Reshetnikov, MGO Aleksey Konoplev, “Typhoon”, Irina Repina, IFA RAS, Tuomas Laurila, FMI
Infrastructure of HMO Tiksi

Main building HMO Tiksi

Clean air facility

Flux tower
Study of surface aerosol and WRF application

"Clean air" in Tiksi area under strong inversion

Aethalometer in CAF and results of aerosol measurements March 6, 2012

Surface meteorology from large scale forecast model

WRF forecast with spatial resolution 2 km

Application of WRF allows to discriminate the wrong data of measurements
Radiation measurements in framework of BSRN (Baseline solar radiation network). Comparison with standard Russian sensors

Installation of BSRN sensors on the roof of the Main building

Installation of standard Russian sensors on the distance 120 m from the Main building

Results of comparison show good agreement between data of the modern sensors of BSRN and standard Russian sensors for measurements characteristics of solar radiation
Study of soil temperature regime in wet and dry tundra

Spatial – temporal distribution of soil temperature in wet tundra in summer 2010 – autumn 2011 on 0.2 -3.6 m (left) and 0.05 – 0.2 m (right) depths.

Soil temperature in upper layer of dry tundra in spring – autumn 2011

Drilling holes for installation of temperature sensors on the depths 0.2 - 3.6 meters

Installation for temperature measurements in deep layers

Installation for temperature measurements in upper soil layers
Methane and carbon dioxide studies in HMO Tiksi

CH4, CO2 emission

CO2 and CH4 concentrations in summer 2010

Direct measurements of CH4 emission in summer 2011

Direct measurements of CO2 emission in wet tundra in June and August 2011
Field investigations on the drifting stations “North Pole 33 - 40”
Period of operations:
Domain of operations:
Estimation of reliability of NCEP/NCAR reanalysis data on air temperatures and total cloudiness

Why we are operating NPs?:

1) [the only site of] year-round comprehensive/complex measurements in the Arctic Basin
2) More flexible and “friendly” for measurements in comparison with shipborne sites
3) Source of various data for validation of numerical modelled / reanalysis parameters
4) Complements network of drifting buoys
5) etc

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Overview of observations: NP-39,40 and further:

- Unmanned plane
- Radiosound
- ADCP WHS 300
- Long ranger ADCP WH LP 757
- 2 SBE 37SM MicroCat
- 3 SBE 19 profilers
- Current meter RCM
- Grid Juday
- Submersible vehicle
- MAWS-420
- Lidar
- Radiation
- Precipitation gauge
- Carbon dioxide flux measurements
- Inlets of ozone, carbon dioxide, methane and radioactivity analyzers
- Polygon 80x100 m for mass balance and dynamic studies
- Ice thickness measurements
- Ice thickness
- Snow height
- Spectrometer “Ramses”
- Ice thickness
- Ice thickness

GPS and GLONAS systems for ice drift calculations
Meteorological observations (2012-2013...):

**Aerology**
- **Radiosonde RS-92** (Vaisala, Finland)

**Ozone sounding**
- **ECC-6A** (Science-Pump corp, USA)

**Aerostat sounding** — Profile measurements of air temperature, humidity and wind components - Sounder SmartTether (Anasphere, USA)

**Contentious profiling measurement** of air temperature in layer 0-1000 m
- Thermal meteorological profiler
  - MTP5-PE (ATTEX, Russia)

**Standard routine meteorology**
- Gradient meteostation with 2 loggers and visibility sensor 20 km
  - Полуавтоматическая метеостанция MAWS420 (Vaisala, Finland)

**Actinometry**
- Solar tracking system 2AP
  - Sensors CNR4, CMP21, CGR-4 (Kipp&Zonen, Netherlands)

**Pulse measurements** - turbulence meter
- SATI-3K (Applied technologies USA)

**Spectral and morphometric**
- Investigations of snow-ice cover
- Multi-spectral radiometers Ramses-acc-vis, Ramses-arc-vis (TriOs Gmbh, Germany)

**Investigations of gas exchange processes** - Gase analyzer
- CO2, CH4, O3 Li-840, Li-8100
  - (Li-Cor, USA, Optogas 3.02ПА, 500.4С (Optek, Russia), APHA-370 (Horiba, Japan)}
Oceanographic observations (2012-2013....):

- **Monitoring of ice bottom layer**
  - Remotely controlled submersible Gnom

- **Acoustic Doppler Current Profiler velocity extended range**
  - WH LR 75
  - Workhorse Long Ranger ADCP

- **2 water temperature & conductivity recorders**
  - SBE 37SM MicroCat

- **SBE 19 plus SeaCat**

- **Depth measurement and acoustic Profiling of the ocean and bottom Sediment layer**
  - Echosounder Bathy-2010

- **Acoustic doppler velocity profiler**
  - ADCP WHS 300

- **Loging current meter**
  - Seaguard RCM

- **Grid Geddy**
Estimation of thickness and profile of hummocks

Thermal drilling (Russia)

Monitoring of ice conditions
Survey and meteorological observations using unmanned aerial vehicle UAV “ELERON” T-23 “Arctic” («ENIKS», Russia)

Measurements of geographic coordinates and ice floe drift vector
Spatially distributed GLONASS and GPS sensors

Morphometric and seismic measurements
Measurements of dynamic processes
Seismic meters CM3-KB, CH-1 (Russia)

Direct measurements of sea ice thickness, draft and snow height on ice polygon
(meter and drilling equipment Hitachi, Tanaka, Kovaks)

Indirect ice thickness measurements
Electro-magnetic thickness meter EM31-Ice (Geonics Co., Ltd., Canada)

Estimation of thickness and profile of hummocks
Thermal drilling (Russia)
Study of sea ice at the drifting station “North Pole 38” in 2010 – 2013 with UAV “Eleron T23 Arctic”
Research station “Cape Baranova”

Re-opened in June 2013
Under development
Area of the ice base is one of the least investigated regions of the Arctic Ocean. Pending the whole complex of meteorological be installed, the Ice Base “Cape Baranova” may pretend for a full partnership in the network of the International Polar Observatories, similar to Tiksi with a perspective to become a second regional station in the Russian Arctic and further as a global station in the WWW.
Planned meteorological observations

- Standard meteorological observations
- Standard actinometrical observations
- Upper atmosphere observations
- Monitoring of aerosols, greenhouse gases, pollutants (AMAP), ozone
- Spectral albedo measurements
- Thermo balance and soil thermal conditions
Planned sea ice cover measurements

- Investigations of evolution of morphometric parameters of icebergs, fast ice and drifting ice
- Observations of ice thickness using underwater TV cameras
- Mapping of sea ice parameters using UAV
Planned oceanographic measurements

- Oceanography measurements in Shokalskij strait
- Water level
- Hydrochemistry
- Hydrobiology (IO RAS)
Planned polar geographic measurements

- Complex land water balance investigations
- Glaciological observations
- Investigations and monitoring of glacial landscapes
- Medical – biological investigations
Thank you for attention!