Researches
Field work
Office work

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Software and dataware integration to polar bear studies

Experiences of the Permanent Expedition of Russian Academy of Sciences

VIth International Scientific and Practical Conference "Polar Bear Universe: Results of Researches 2012-2022, Plans for the Future", March 15-17, 2023
Anadyr, Chukotka
16 March 2023

«The Program For Polar Bear Researches In The Russian Arctic»

Performed by the Permanent Expedition of Russian Academy of Sciences

Comprehensive polar bear study:

- Estimating spatial-temporal distribution of polar bears
- Evaluating polar bear movement patterns and habitat use parameters in the different temporal resolutions using satellite biotelemetry
- Studying polar bear reproductive biology
- Investigating feeding, provision by food resources, the dynamics of primary preys of polar bear
- Detection natural and human-induced factors, which influence to polar bear reproduction and survival
- Genetic identification of polar bears
- Studying of intra-annual and inter-annual variability of sea ice and other habitat parameters

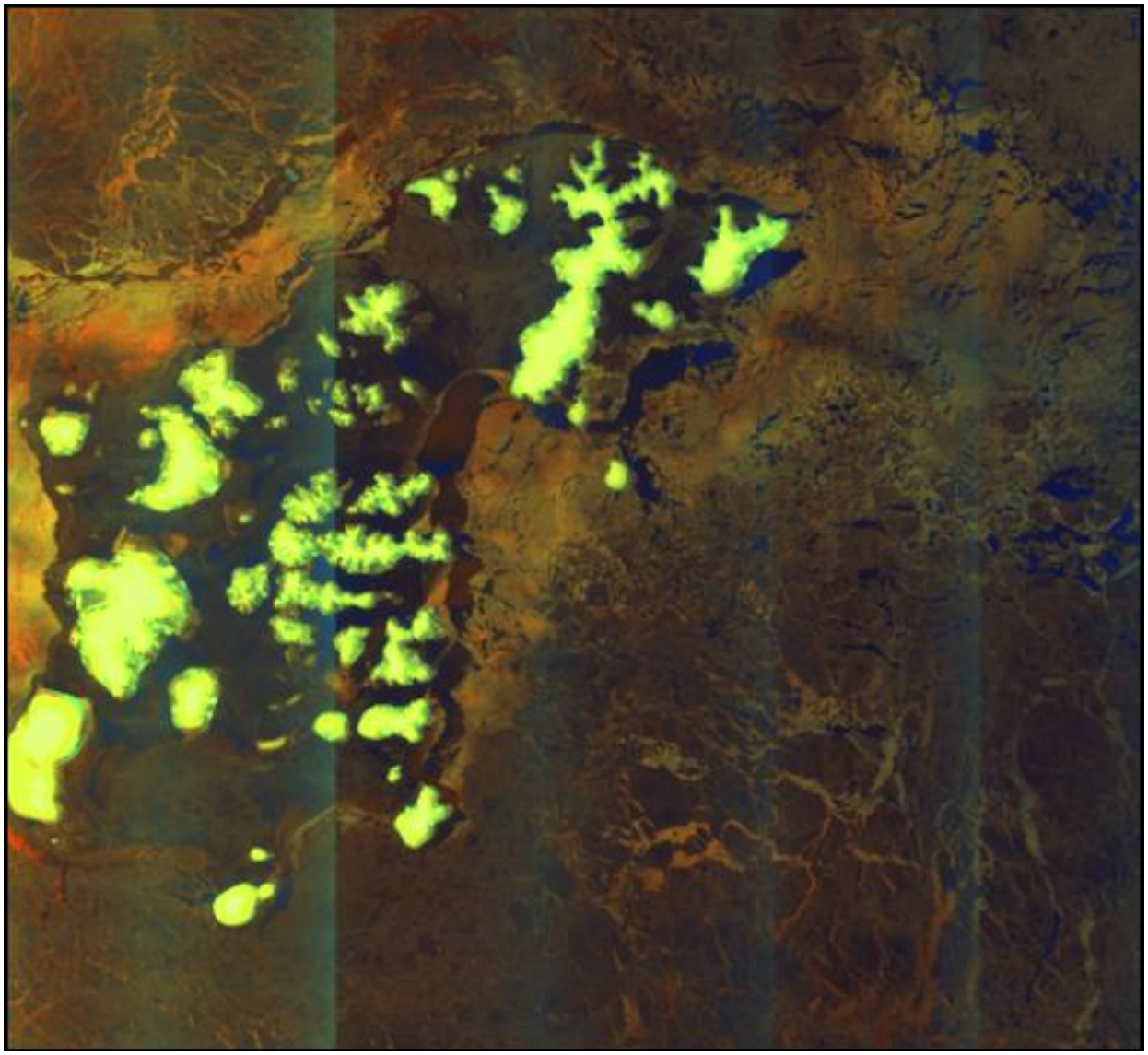
Issues:

- Data traffic is limited by volume and speed, with interrupted sessions
- Data are required to be near real-time.

Solutions:

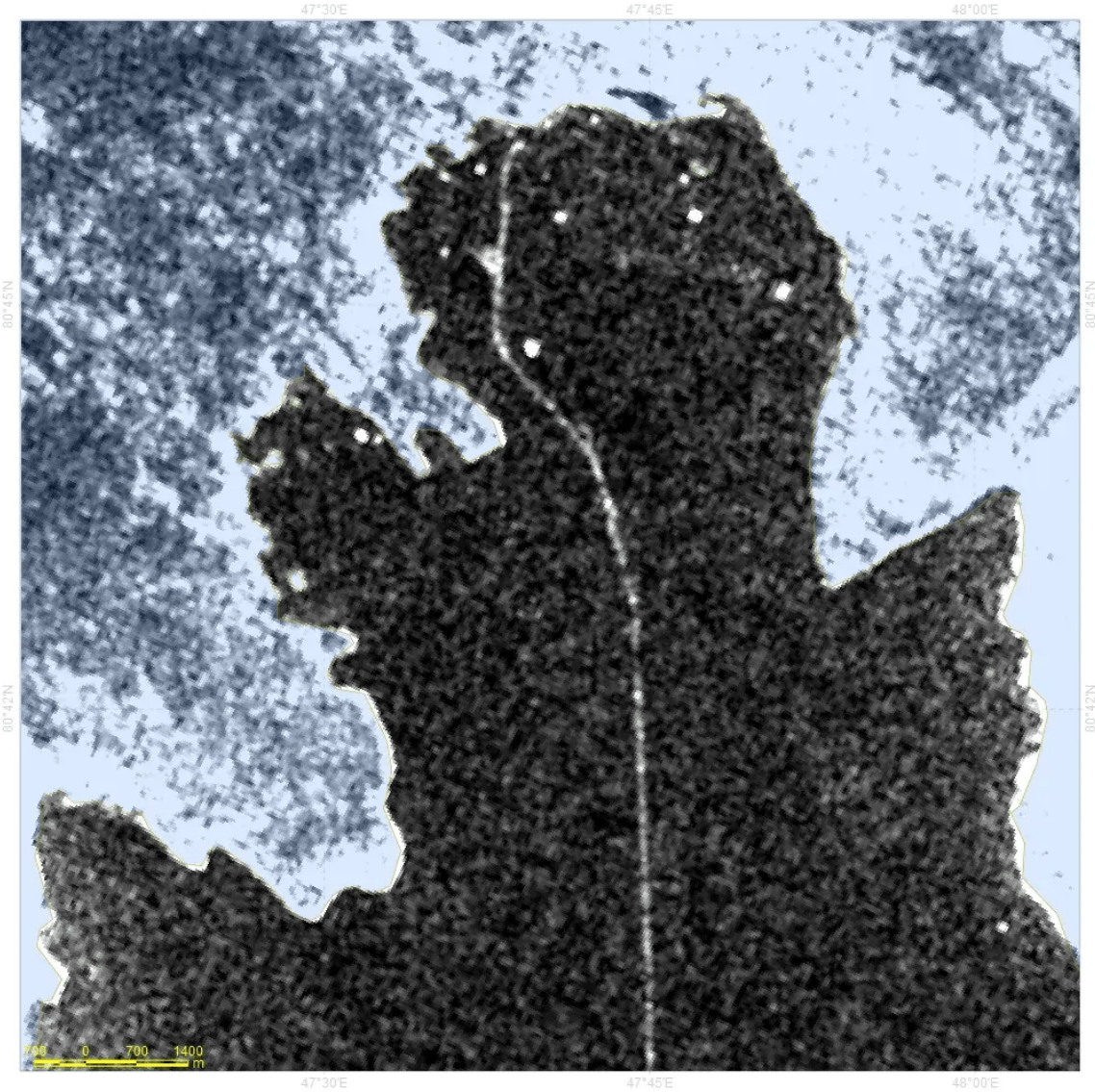
- Tasks by schedule or requests on server, located with favorable traffic conditions. Output is text summary or lightweight figures.
- Scripts for automatic data download during low traffic periods of sleeping or outdoor activity.
- API usage instead of interactive and multi-step browser requests.
  - Argos satellite biotelemetry data – SOAP requests, with additional profit in uniform date format.
  - Web map services (WMS) and tile map services (TMS) – data volume is defined by screen resolution
- Emergency assistance – voice or messages via Iridium satellite phones

Sentinel-1 active microwave data



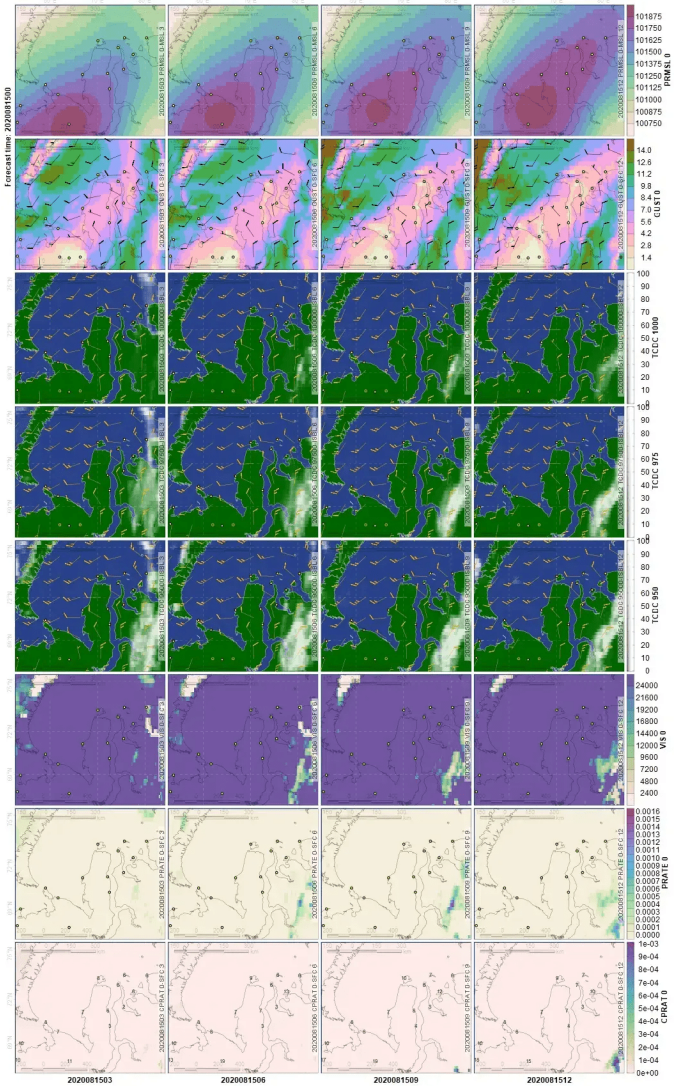
Scene S1B_EW_GRDM_1SDH_20210419T042651_20210…[1] (~200 MB)

Visual control for landfast ice continuity



Required figure/image size is 100-200 KB

Raw GFS atmosphere data in GRIB format: sea level pressure, cloud fraction and wind on geopotential height levels (aerial survey), horizontal visibility, precipitation rates, *etc.*



Reproducible researces

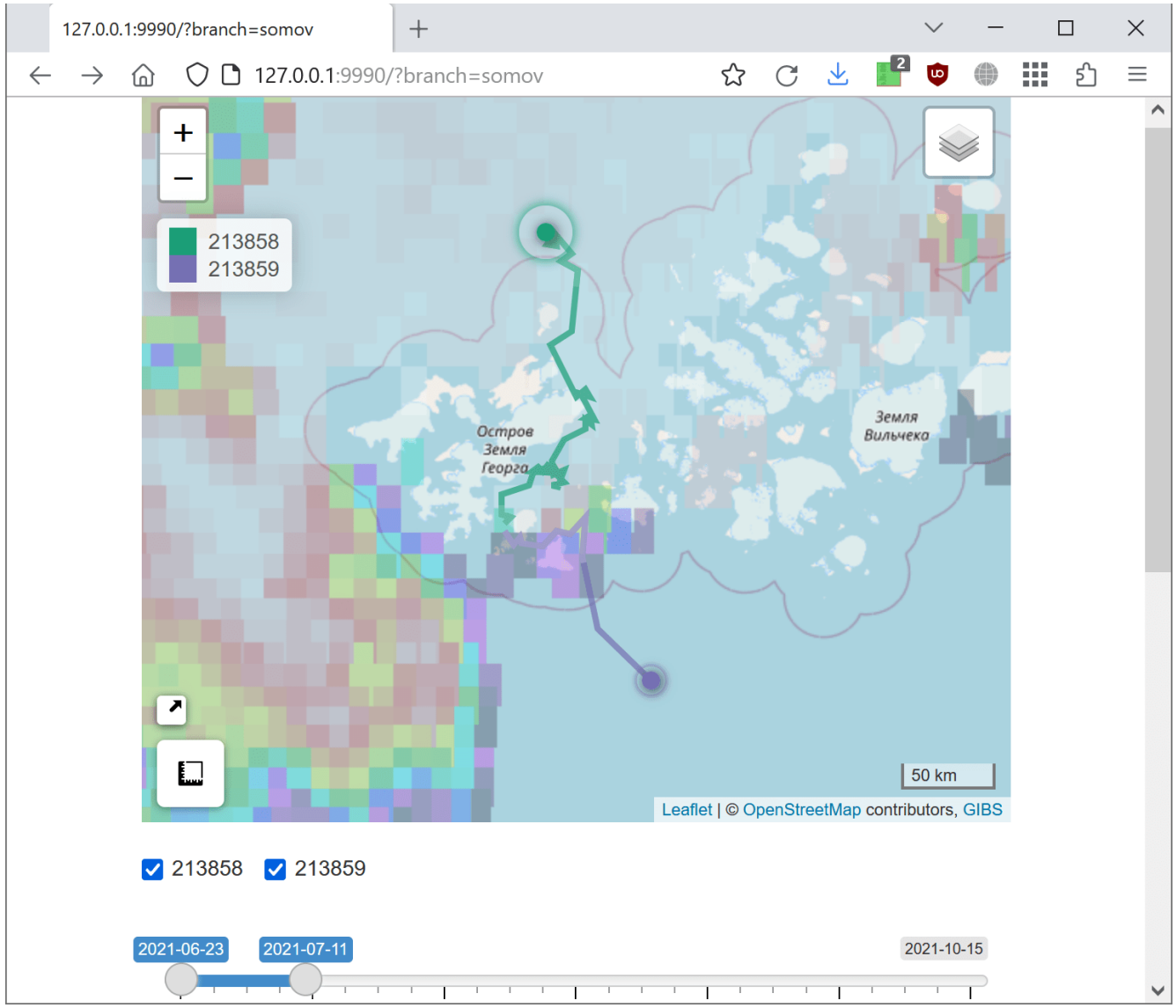
Code (program):

- converts raw data to processed data
- does data analysis
- implements literate programming
  - includes output (tables, figures, inline text)
- gets results for a new data set

Implementation: input R code, integrated to extended (Rmarkdown) markup language Markdown, is converted by Pandoc tool to formatted documents in various formats.

Collaboration: web applications *Shiny*

- Server avoids software (IDEs, GIS) installing
- Client (GUI) avoids coding



Researches

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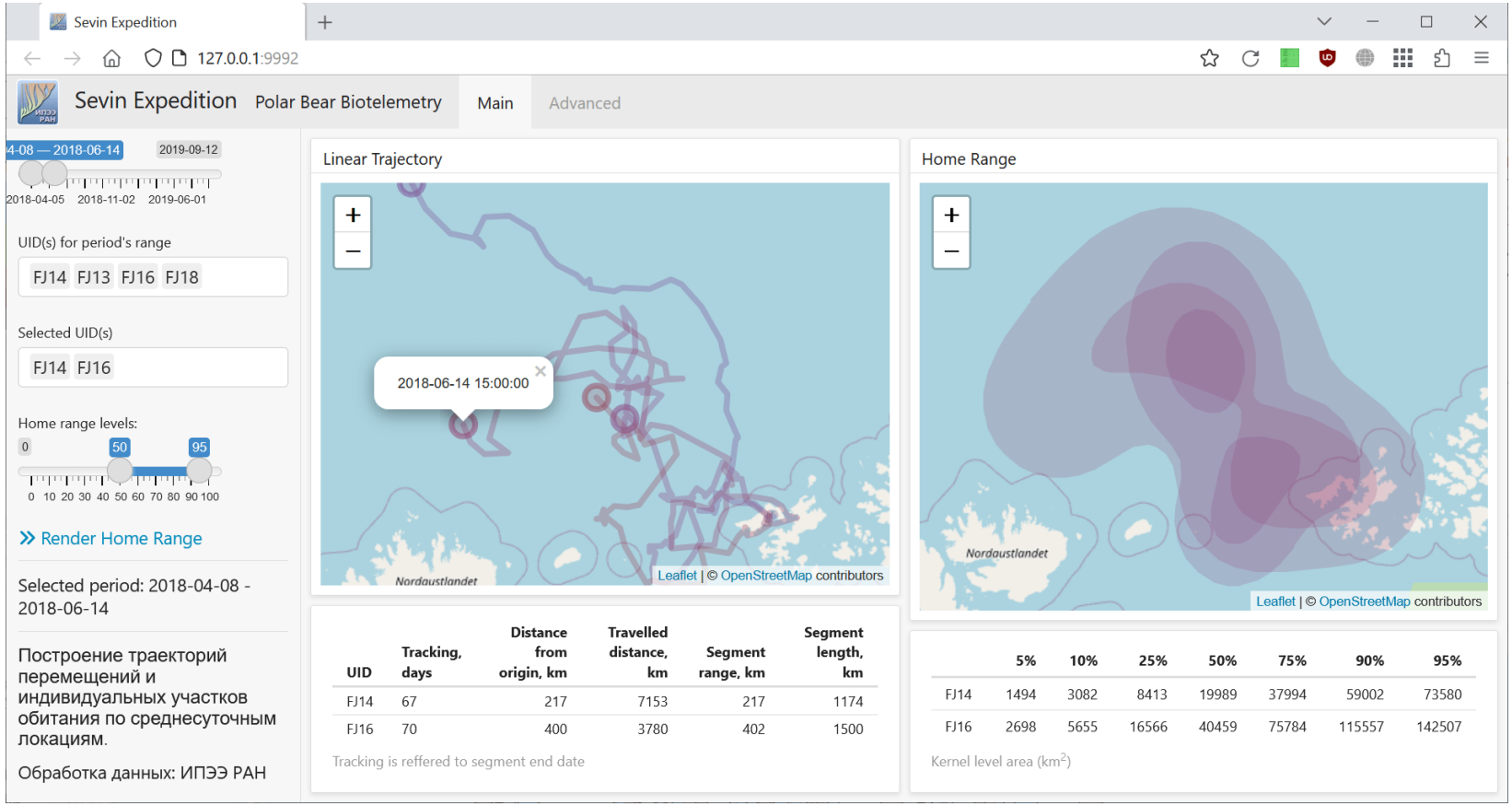
Polar bear tracking

Trajectory analysis

Environmental conditions

Movement analysis, home range



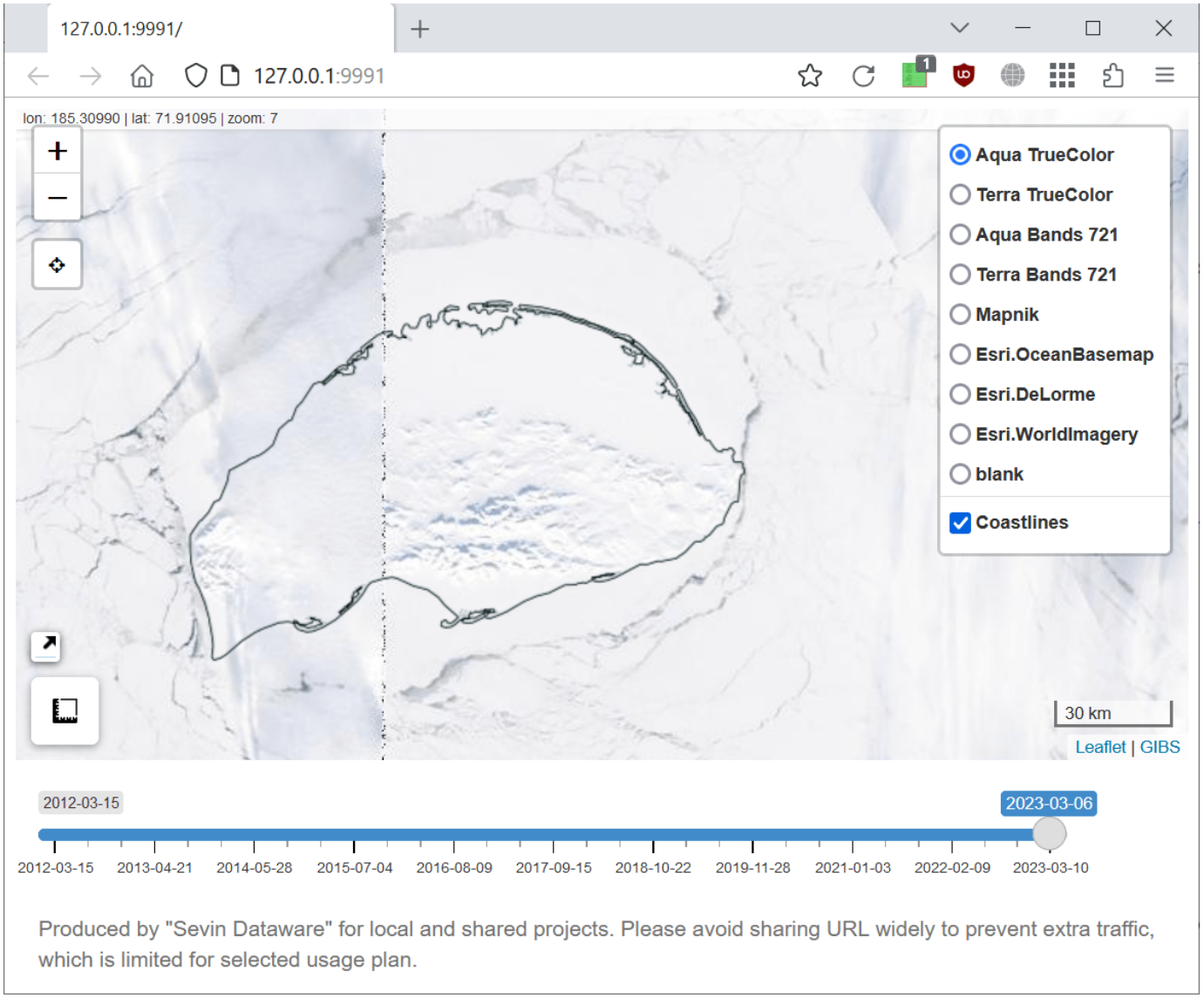
UID	Tracking, days	Distance from origin, km	Travelled distance, km	Segment range, km	Segment length, km
FJ14	67	217	7153	217	1174
FJ16	70	400	3780	402	1500

Tracking is reffered to segment end date

	5%	10%	25%	50%	75%	90%	95%
FJ14	1494	3082	8413	19989	37994	59002	73580
FJ16	2698	5655	16566	40459	75784	115557	142507

Kernel level area (km^2)

Sea ice, snow cover, vegetation growth using MODIS data



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  - National park «Lenskie Stolby», Institute of Biological Problems of the Cryoliptozone (Siberian branch of Russian Academy of Sciences)
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  - "Master of the Arctic-2021" project of the International Environmental Foundation "Clean Seas"
  - Chukotka Arctic Research Center
  - Alexey Yakovlev

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