**APPLICATIONS OF METEOROLOGICAL SATELLITE DATA FOR
ENVIRONMENT MONITORING AND CLIMATE RESEARCH IN ROSHYDROMET**

Summary and purpose of the WP

The document presents an overview of Ros hydromet/SRC Planeta ground segment developed for the acquisition, processing and distribution of satellite data and products. The objective of operational and research activity in Roshydromet is to use satellite data and derived products in various application areas, including operational meteorology, NWP, hydrology, agrometeorology, hazards (fires, floods) and pollutions monitoring, climate researches. Examples of some derived by SRC Planeta products are presented.

Action proposed: none

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Roshydromet core ground segment capabilities

The major components of the Roshydromet's ground segment are three Main Regional satellite data receiving and processing Centers of SRC Planeta: European (Moscow-Obninsk-Dolgoprudny), Siberian (Novosibirsk) and Far-Eastern (Khabarovsk). These Centers together cover the whole territory of Russia. The ground segment also includes the network of APT, LRPT, HRPT, LRIT and HRIT receiving stations.

Since 2009 Roshydromet/SRC Planeta joined the EUMETSAT Advanced Retransmission Service (EARS program). The HRPT reception stations MEOS Polar were procured from Kongsberg Spacetec AS and installed in Moscow, Novosibirsk and Khabarovsk. NOAA and MetOp data acquired in Moscow is being processed and transferred to the main EUMETSAT facilities in Darmstadt for retransmission in real-time.

The SRC Planeta receiving facilities provide the data acquisition from geostationary (Electro-L №1, Meteosat-9, -7, GOES-E. –W, MTSAT 2) and polar-orbiting (Meteor-M №1, NOAA series, MetOp, EOS/Terra/Aqua) satellites. SRC PLANETA produces above 200 types of products daily (namely clouds cover, sea surface temperatures, vegetation, ice and snow covers condition, floods, forest fires, pollutions of water and snow covers, etc.) and provides satellite informational products for more than 400 users.

The Meteor-M and Electro-L ground segments have been developed by Roshydromet and Roskosmos.

The progress in satellite products generation (based in particular on Meteor-M №1 and Electro-L №1 data) and their sharing for various applications is briefly outlined below.

Cloud imagery and cloud analysis

Cloud imageries and cloud cover parameters continue to be one of the key output products of both polar orbiting and geostationary meteorological satellites. Fig.1, 2 shows the examples of full Earth disk images acquired by the MSU-GS/Electro-L instrument in VIS (1 km spatial resolution) and IR (10.5-11.2 m, 4 km spatial resolution). The MSU-GS data are used for global image mosaics production (Meteosat9 & Electro-L & MTSAT2 & GOES-E & GOES-W), see Fig.3. Products with similar coverage are generated with MSU-MR/Meteor-M instrument data. Some examples are presented at Fig.4-6 – a

mosaic of IR images over Eurasia, Arctic and Antarctic region and global coverage imagery.

The tropical cyclone monitoring is being performed using all available geostationary satellite' data, see Fig.7, 8.

Snow cover and ice concentration maps

The measurements of microwave scanning radiometers like sounder-imager MTVZA/Meteor-M and sounder AMSU (NOAA) can be utilized for generation of so called non-sounding products. In particular, it's possible to identify and discriminate snow and ice cover over the full range of snow conditions (excluding melting snow and coastal ice). The example AMSU− based snow and ice cover map for Arctic region is given at Fig 9. Such maps are provided using AMSU data received through EARS.

Forest fires detection

Meteorological satellites (Meteor-M, EOS and NOAA series) are capable to monitor large-scale smoke plums and forest fires. Example of the information given by the forest fires detection system is presented at Fig.10. Regional coverage forest fires' maps combined with satellite imagery are shown at Fig.11. Fig 12 demonstrates examples of dangerous fire detection, using KMSS/Meteor-M №1 instrument with spatial resolution of 100 m.

Ice cover operational mapping

In order to detect ocean and sea ice and to characterize its features it is necessary to combine high and low resolution information from various satellite-based active and passive sensors. Fig 13, for example, is an ice cover map for the Northern Sea Route. Mosaic radar image for Antarctic region from Severjanin/Meteor-M instrument is presented at Fig 14. Ice cover maps for various seas derived from a number of different instruments (Meteor-M/MSU-MR & KMSS, Terra & Aqua/MODIS, ENVISAT/ASAR, NOAA/AVHRR, MetOp/ASCAT) are given at Fig 15-17.

These examples illustrate how data from different satellite systems really appear to be a valuable tool for monitoring of ice cover.

Monitoring of sea water pollution

Coastal water pollution monitoring for the Black Sea area is performed using various visible, IR and microwave satellite data. An example of oil spill detected with help of Meteor-M/KMSS, ENVISAT/ASAR and Aqua/MODIS is shown at Fig 18. Next image on Fig. 19 presents a combined oil spills detection statistics for the period of 7 months 2010.

Climatological studies of sea ice and snow cover

Since the moment of the first Okean series satellite launch in 1983 SRC Planeta carries out satellite monitoring of ice conditions in Arctic Region using side looking radar (SLR) data. Long-term archive of OKEAN satellite radar data allows to perform a number of research and application tasks that require long-term sets of observation data, in particular, for climate change researches. The thematic maps of multiyear ice distribution in the winter periods of 1983-2010 for Western sector of Arctic Region (east part of Barents sea and Kara sea) were generated (Fig. 20) using Okean/SLR, QuikSCAT/Sea Wind NRT, ENVISAT/ASAR, AQUA/AMSR-E, MetOp/ASCAT data. Similar charts are presented at Fig.21-22 for Russian part of Arctic and Antarctic region and period of 2002-2010.

Another application of satellite data for climate studies is illustrated at Fig.23. Here a snow coverage statistics based on NOAA/AVHRR, NOAA/AMSU-A data is presented for the European part of Russia for winter seasons 2005-2010.