CGMS-XXXI RUS-WP-07
Prepared by Russia
Agenda Item: II/4

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 Roshydromet/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: no action required.

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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 at different locations: European (Moscow, SRC PLANETA), Western-Siberian (Novosibirsk) and Far-Eastern (Khabarovsk). The ground segment also includes the network of APT, HRPT and WEFAX receiving stations. Roshydromet's main satellite Center SRC PLANETA (Moscow) performs a scientific and methodological management and coordinates the activities of the above-mentioned acquisition Centers and stations. The radiovisibility circles of these Centers cover the whole territory of Russia as well as Baltic States and major part of Europe.

Present SRC PLANETA receiving facilities provide on a regular basis the data acquisition from geostationary (METEOSAT-7 and METEOSAT-5, GOES-E, GOES-W, GMS via METEOSAT-7) and polar-orbiting (Meteor-3M N 1, NOAA series, EOS/Terra/Aqua) satellites. On the base of acquired raw data SRC PLANETA produces every day above 50 types of products (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 60 users.

Current activities within Roshydromet and SRC Planeta are concentrated on providing all operational functions and services (satellite data acquisition, processing, generation and dissemination of products) as well as on the preparation to the forthcoming satellites data handling and fulfillment of their mission objectives.

The architecture of future METEOR and GOMS-Electro ground segments (hardware, software, communication links) is envisaged to be based on the physical facilities of Roshydromet ground segment major components. Now the technical design and development of next METEOR and GOMS-Electro N 2 ground segments have been commenced. Some elements of future METEOR ground segment have been tested in the framework of METEOR-3M N 1 commissioning phase.

Below the progress in satellite products generation is briefly outlined with sharing them for various applications. The software for products generation was created by SRC Planeta.

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, for example, is a randomly chosen mosaic of infrared images over Eurasia constructed from data provided by Meteosat 7, Meteosat 5 and GMS. Similar mosaics are generated daily on the basis of various compositions of imageries provided by 5 geostationary satellites (see Fig.2). Along with these some "quantitative" cloud products are derived daily from satellite data, including estimates of cloud cover fraction and cloud top temperature and height (CTTH). Now the validation of

CTTH is being continued. Clouds nephanalysis maps are produced every day on the base of NOAA AVHRR data (see Fig.3).

Sea surface temperature maps.

World Ocean surface temperature maps are derived on a regular base (ten days period) from the data provided by 5 geostationary satellites. The example of such map is presented at Fig.4. Water surface temperature maps for "inner" and "external" seas of Russia are generated from NOAA AVHRR data one time in 2-3 days (see Fig. 5).

Snow cover and ice concentration maps

The measurements of microwave scanning radiometers like imager SSM/I (DMSP) or 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 refined methodology ensures the discriminations of melting snow and coastal ice. The example AMSU (NOAA-16) – based snow and ice cover map for Europe is given at fig 6. Such maps are provided regularly (on experimental basis) using AMSU NOAA-HRPT data during all seasons. As follows from validation tests, the above maps are in a good correspondence with conventional data and satellite coastal ice images.

Another non-sounding product is the identification of precipitation zones and instantaneous rain rate estimation (both over land and sea). Fig 7 is an example of such product, generated from AMSU-A (NOOA-16) data. Comparison with conventional data confirms the reliability of rain rate estimates, but further trials and verifications are required.

Forest fires detection

Meteorological satellites (NOAA and EOS series) are capable to monitor large-scale smoke plums and forest fires. More detailed monitoring of forest fires is provided via the analysis of high spatial resolution satellite images. Fig 8 and Fig.9 demonstrates examples of dangerous fire detection in Moscow region (summer 2002), using MSU-E Meteor 3M N 1 imagery with spatial resolution of 38 m as well as forest fires and smokes in Irkutsk region defined from MODIS/Terra imagery (spatial resolution is 250 m).

Ice cover operational mapping

In order to detect ocean and sea ice and to characterize its features (that is of significant importance for many applications) it is necessary to combine high and low resolution information from various satellite-based active and passive sensors, namely from SLR, SAR as well as MW and optical imagers. SRC Planeta has many years experience in the interpretation of radar imageries (SLR's on board "Okean" satellites) and operational generation of ice maps. At present, because of absence this source of information, the operational sea ice monitoring is carried out using visible and thermal imageries provided by NOAA, Meteor-3M N 1 and EOS/Terra/Aqua satellites. Fig 10, for example, is a randomly chosen ice map for the "inner" Azov sea constructed from AVHRR/NOAA, MODIS/Terra and Meteor-3M N 1 data. This product of relatively low resolution is generated not automatically, but with human analyst intervention. More detailed information on ice cover can be derived using high resolution images provided by MSU-E imager from Meteor 3M N1, see Fig 11. Here is presented the ice cover for Volgograd reservoir. 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 and snow cover pollution

The multispectral high-resolution images from Meteor 3M N 1 can be utilized for regular detection of pollution areas on snow cover around big industrial centers as well as for investigation of pollution propagation within sea coastal zones. The example of snow cover pollution in Southern Ural region and the imagery of pollution propagation in Eastern coastal zone of Black Sea are given at Fig.12, 13 respectively.

Climatological studies of sea ice cover in Arctic

Since the moment of the first Okean series satellite launch in 1983 ("Космос-1500") SRC Planeta carries out satellite monitoring of ice conditions in Arctic Region using side looking radar (RLSBO) 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 and first year ice distribution in the winter periods of 1983-2000 for Western sector of Arctic Region (east part of Barents sea and Kara sea) were generated (Fig. 14). At present the re-processing of long-term archive of OKEAN satellite radar data is being performed for Northern Sea Route region. Radar data mosaics, ice cover condition charts as well as multiyear and first year ice maps are generated in the framework of archive data re-processing (see Fig. 15). Examples of multiyear and first year ice maps for three winter periods are presented at Fig. 16.