

A platform approach to the organization of digital forest monitoring of the Baikal natural territory

Платформенный подход к организации цифрового экологического мониторинга лесных ресурсов Байкальской природной территории

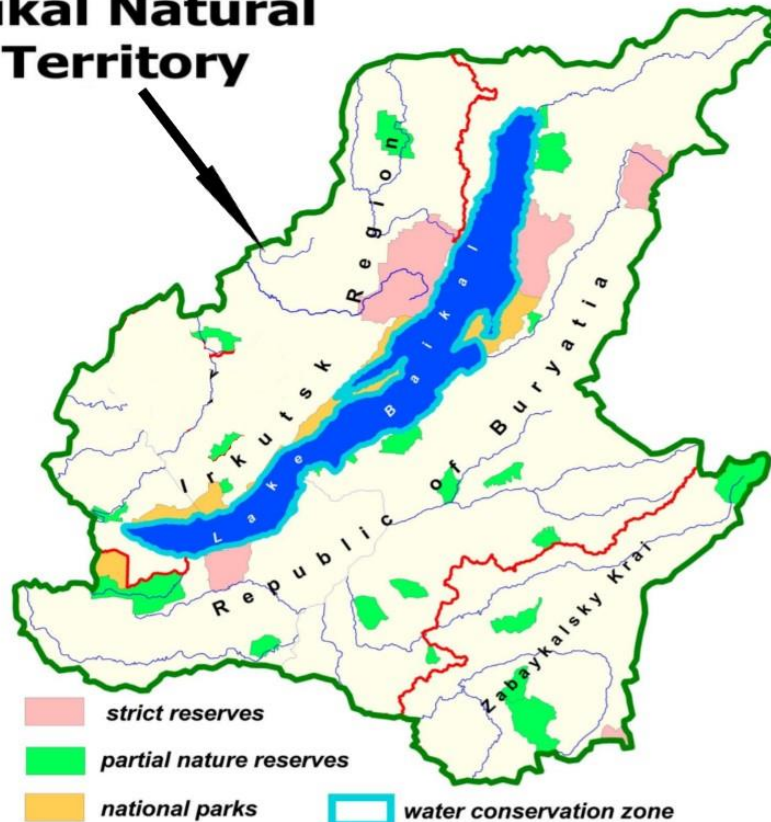
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Baikal natural territory



Baikal Natural Territory



The Baikal Natural Territory includes Lake Baikal, coastal water protection zone of the lake, its drainage basin within the territory of the Russian Federation, special protected areas adjacent to Baikal, and also a 200 km wide territory adjoining the lake in the west and north-west.

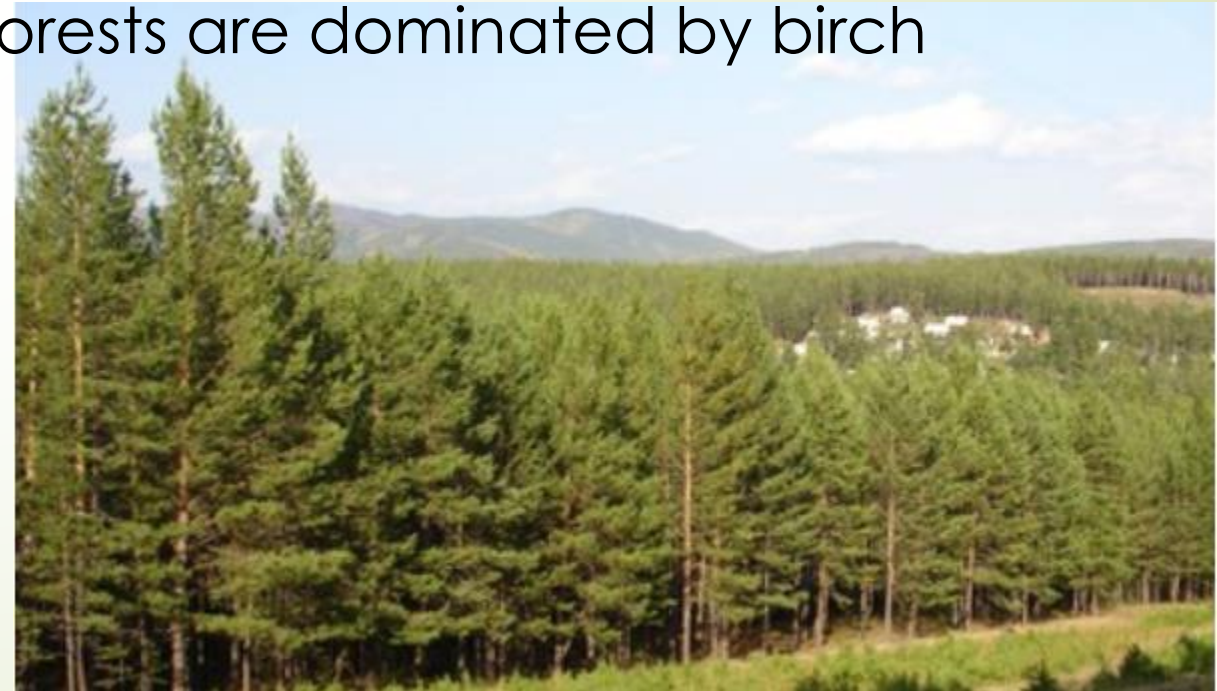
BNT is located in the areas of three constituent entities of the Russian Federation: 28.5% in the Irkutsk region, 57.1% in the Republic of Buryatia, 14.4% in the Trans-Baikal Territory. The area of the BNT is 386 thousand km².

31 special protected areas, including 3 nature reserves, 2 national parks, 5 wildlife sanctuaries, 6 recreational sites and 128 natural monuments on the BNT.

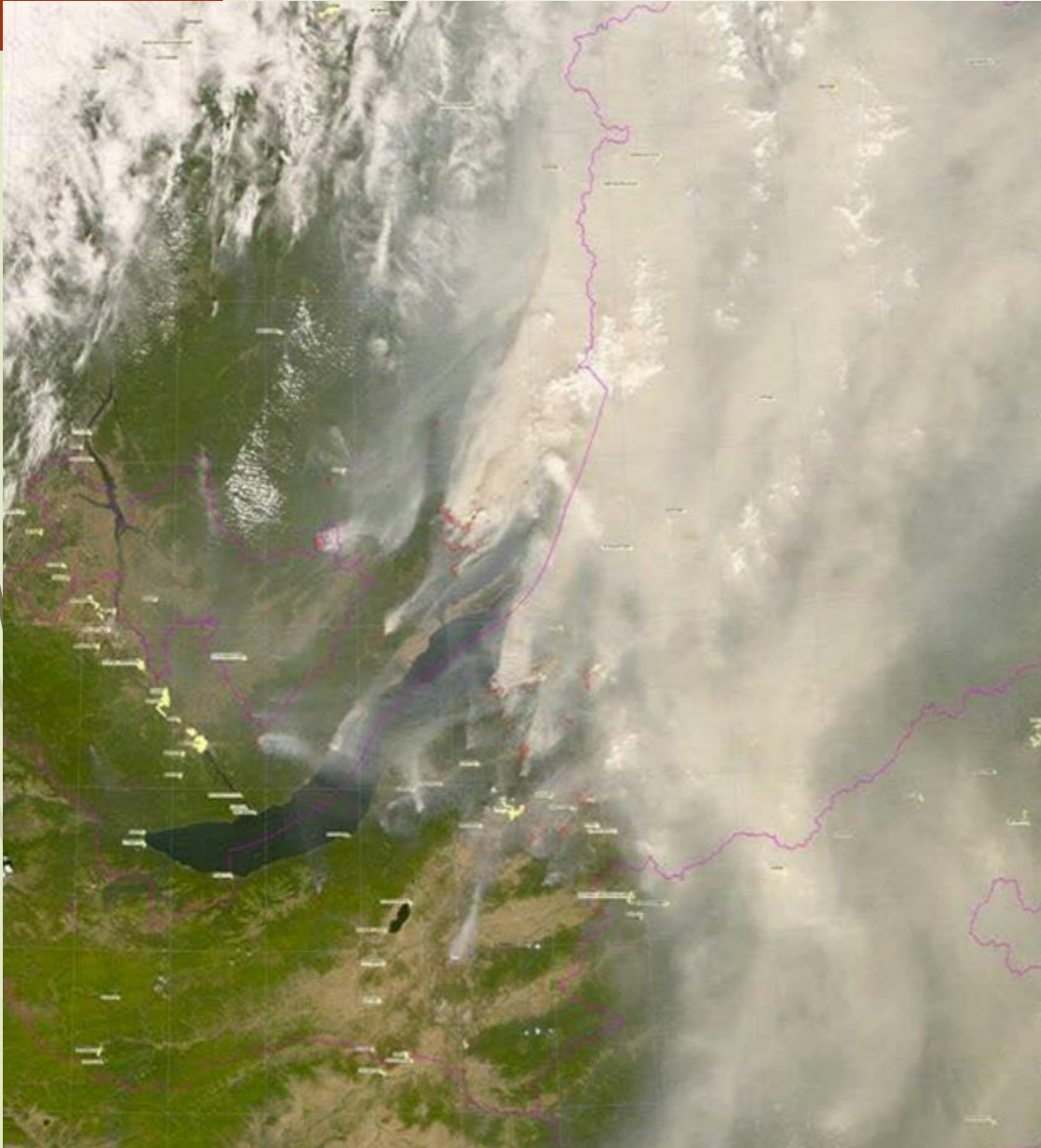
Forest resources

The area of forest covered land is near 8 517 thousand hectares, 95% of the area of these lands is covered with forests, and 5% - shrub thickets.

Forests are represented by two groups of forest-forming species: coniferous and deciduous. Among coniferous forests, pine (*Pinussilvestris*) and larch (*Larix*) forests are equally represented - 25% each. Siberian pine forests (*Pinussibirica*) are also widely represented - 17%. Deciduous forests are dominated by birch (*Betula*) - 16%



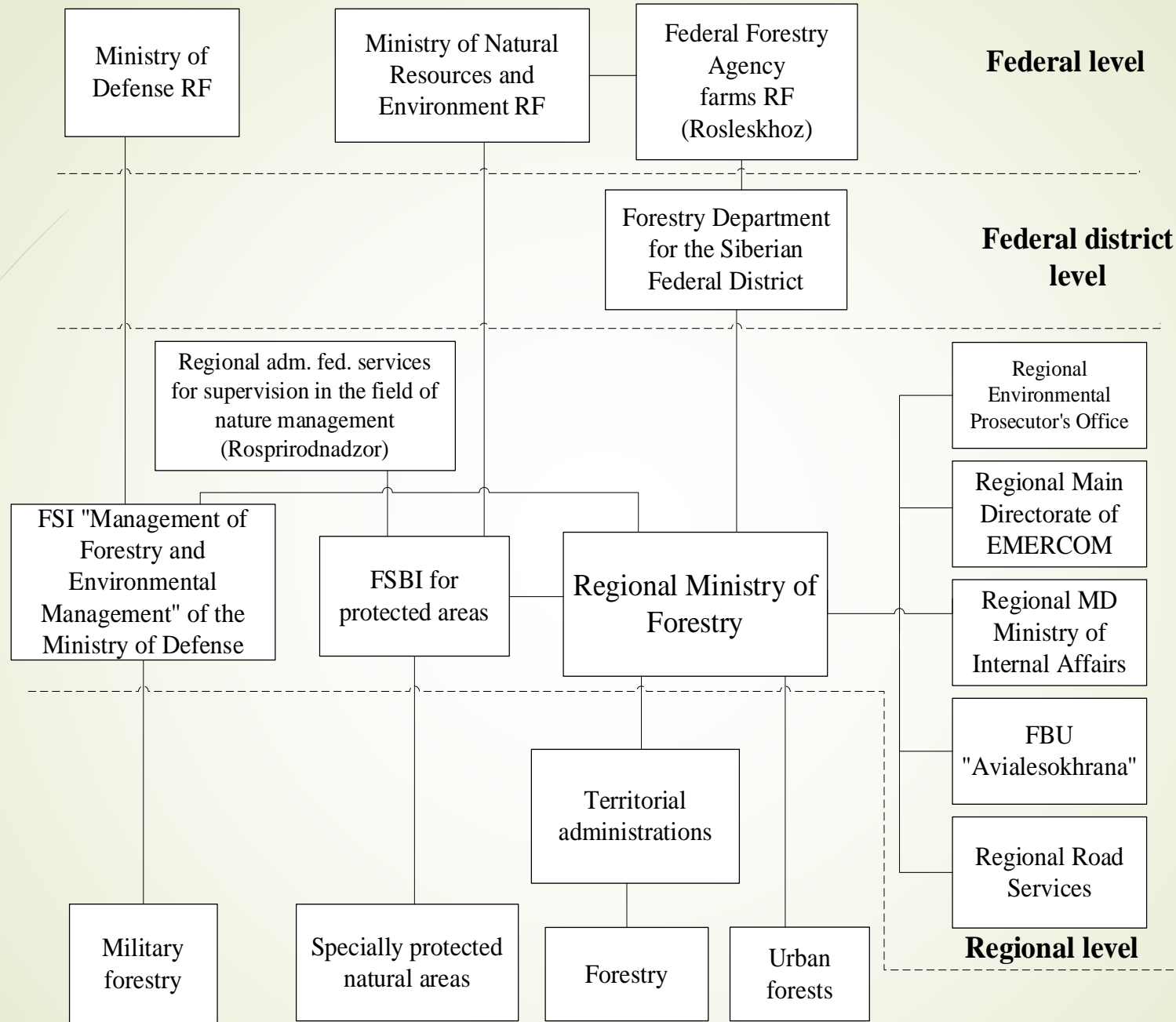
Problems of forest resources in BNT



- a decrease of the BNT forest resources due to forest pathologists, illegal logging and fires, which cause significant harm to the economy and the environment;
- growth of epidemiological damage to coniferous trees in taiga massifs;
- lack of a consistent system of reforestation and forest care, which leads to resource depletion and the development of new territories

Features of forest monitoring on the BPT

- the multiplicity of monitoring participants;
- the localization of departmental observation schemes;
- the territorial distribution of their software and hardware systems;
- formation of large volumes of spatio-temporal monitoring data, which are not coordinated with each other, in parametric, chronological and other aspects;
- various types of storage (in paper, digital) and different formats of monitoring data;
- lack of a system of integrated environmental monitoring in the mode (24/12/365) and storage of spatio-temporal data, assessment and analysis of the state of the ecology of Lake Baikal and BNT;
- low updating of official information on the state of the environment;
- poor efficiency and limited access to monitoring data, as well as support for interdisciplinary research.



State forest management scheme at the BNT level

СИФИБР СО РАН, Иркутск

- сток углерода и продуктивность хвойных древостоев;
- структура растительности основных и сезонные ритмы дерева;
- дендроиндикация опасных природных процессов для создания надежной прогнозной базы их возникновения;
- выявление по ДЗЗ структурно-динамических особенностей растительных сообществ
- Отбор проб почвы и листьев на содержание элементов, оценка состояния дерева, методика ICP Forests.

ИМКЭС СО РАН, Томск

- изучение структуры разнообразия ЛР;
- выявление климатически обусловленных и эволюционных изменений;
- изучение процессов в лесных экосистемах с гидроморфным трендом развития;
- оценка депонирования углерода в заболоченных ландшафтах;
- разработка критериев и индикаторов оценки состояния лесов, методов лесопатологического мониторинга;
- разработка методологических аспектов экосистемного мониторинга, прогноза состояния лесных экосистем при различных сценариях изменчивости природных и антропогенных факторов;
- исследование гидрологического и температурного режима осушенных и естественных торфяников

Институт географии СО РАН, г. Иркутск

Картографирование лесных запасов, модели

ИВМ СО РАН, Красноярск

Оценка пожаров, влажности полого, карты.

Распознавание хвойных и лиственных по ДЗЗ нейронной сетью

ИСЗФ СО РАН, Иркутск

ДЗЗ пожары, температура земли, оценка изменения растительности, расчет количества эмиссии CO₂

ИВТ СО РАН, Новосибирск

Мат. модели, методы и алгоритмы для прогнозирования распространения пожаров, оценка повреждения древостоев по ДЗЗ, выделение дымовых шлейфов

БИП СО РАН, Улан-Удэ

Пожары, ДЗЗ

ИОА СО РАН, Новосибирск

ДЗЗ, коррекция

Институт почвоведения и агрохимии СО РАН, Новосибирск

Экологическое состояние болот лесостепной зоны, формирование торфяных отложений

Институт экологии человека ФИЦ УУХ СО РАН, Кемерово

Лесовозобновление на отвалах угольных разрезов Кузбасса, влияние экологических условий на количество семян древесных растений

Институт леса СО РАН, Красноярск

- биосферная роль и экологические функции лесных экосистем;
- биоразнообразие и рациональное использование ЛР;
- методы мониторинга по ДЗЗ в оптической и микроволновой частях спектра, лидарной и гравиметрической съемки;
- обнаружение, анализ и картографирование зон климатических, биотических и антропогенных воздействий на лес;
- анализ динамики продуктивности лесных экосистем и жизненного состояния древостоев в меняющемся климате;
- разработка инструментальных методов мониторинга лесных пожаров и состояния нарушенных территорий, оперативный анализ пожарной опасности, оценка пожарных эмиссий и прогноз горимости лесов.

Институт природных ресурсов, экологии и криологии СО РАН, Чита

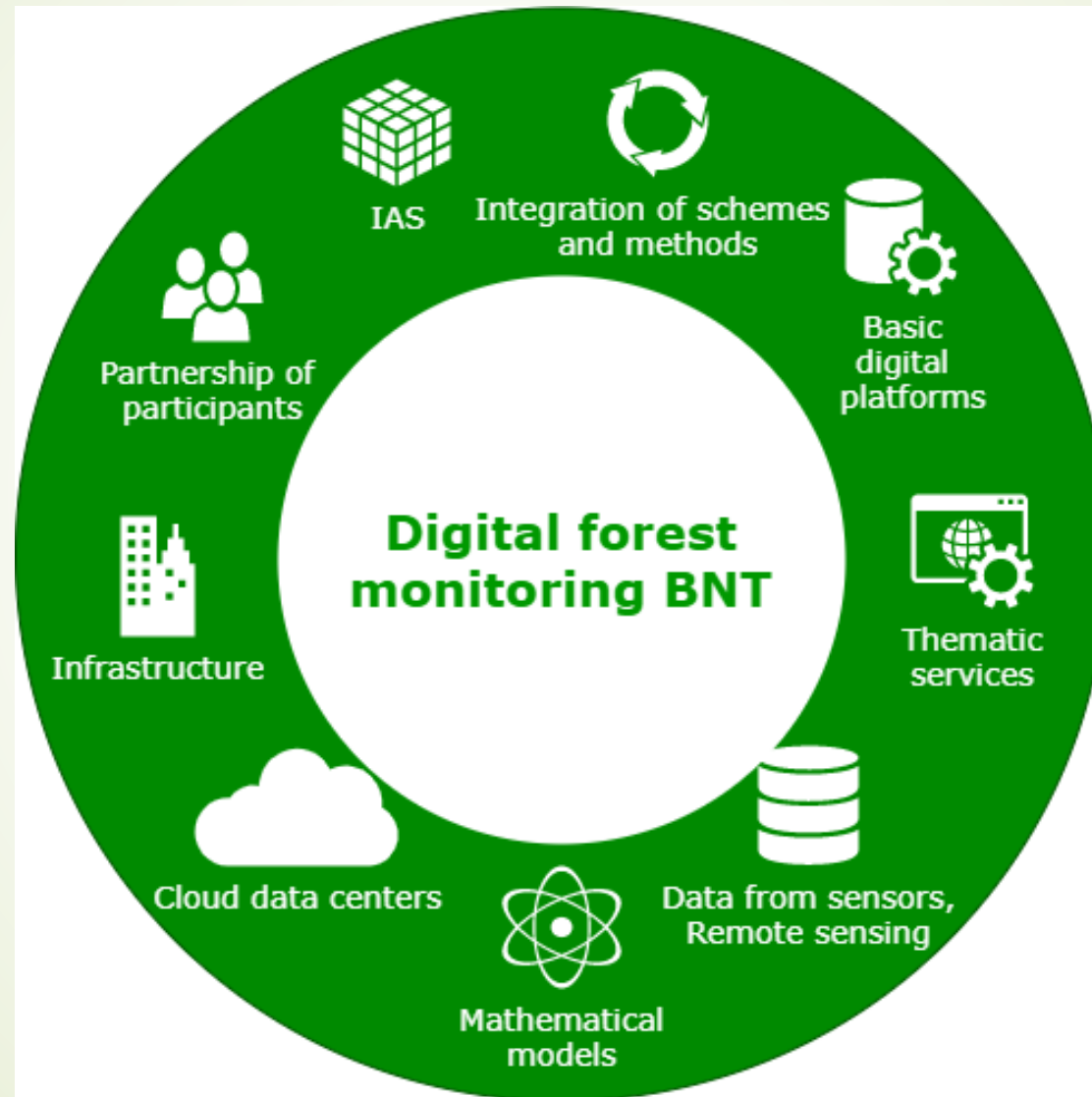
- многолетняя динамика растительного покрова Восточного Забайкалья в условиях изменения климата и антропогенной нагрузки;
- прогнозирование состояния ЛР;
- оценка биоразнообразия кедровых лесов;
- характеристика уязвимых лесных сообществ и масштаб их деградации в засушливый период;
- данные по изменчивости и полиморфизму лиственницы

Digital platform

By definition, a digital platform is an open system of algorithmic network interaction of independent participants of a certain type of activity, united by a single information environment, leading to a decrease in transaction costs and to an increase in the efficiency of services due to the use of a package of digital technologies for working with data (storage, processing, analysis, etc.) and changes in the division of labor.

The digital platform includes a set of digital data, algorithms, models (logic) and tools (methods, means), information-technologically united by a single information environment and telecommunications infrastructure for the interaction of participants.

Digital forest monitoring platform

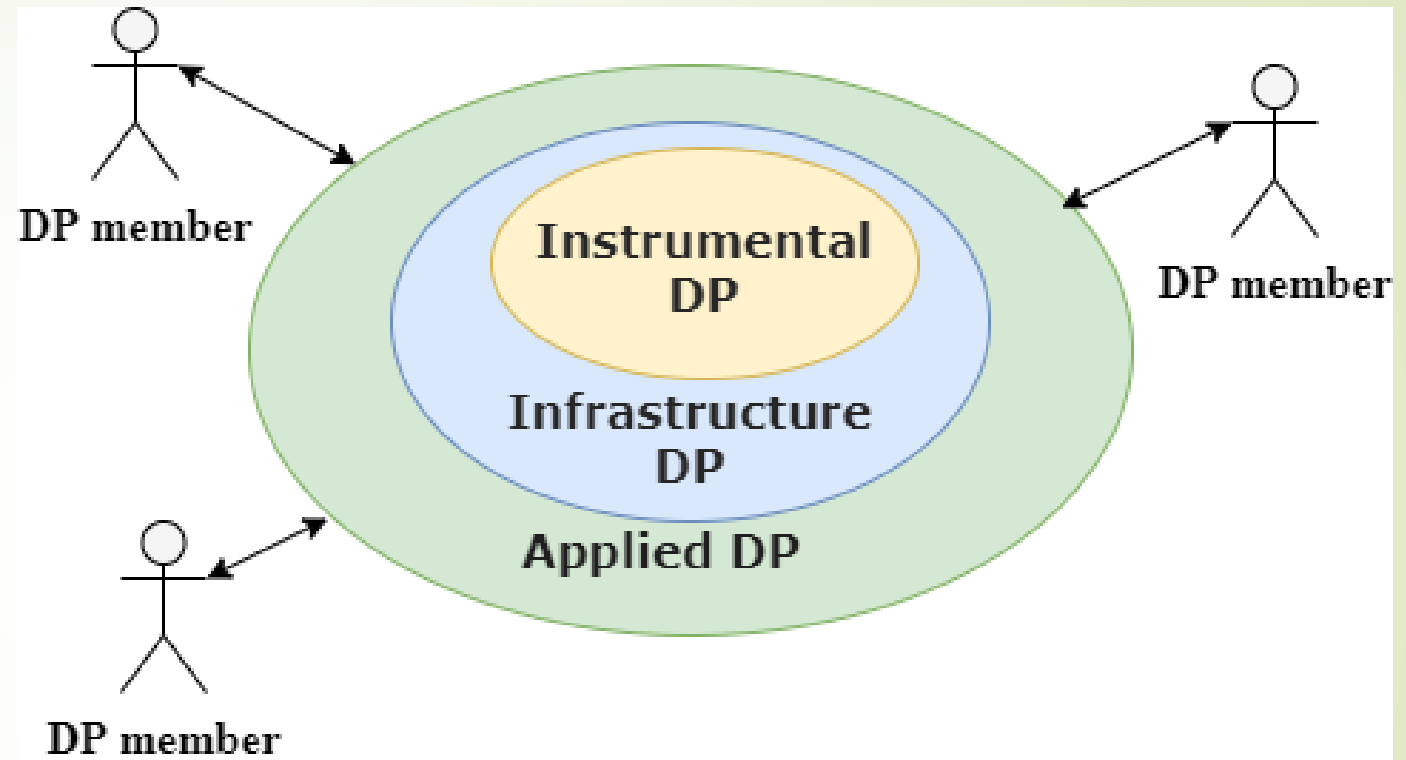


Digital forest monitoring of the BNT

- Creation of basic types of digital platforms for distributed ecological monitoring of the BNT forest, allowing in a quasi-continuous mode (24/12/365) to automate the recording of forest data and transfer them to the centers for processing spatial and temporal data
- Interdisciplinary integration of schemes and methods of forest monitoring participants
- Creation of a cloud-based data center network for BNT forests
- Increasing the reliability of forest monitoring data due to their multiplicity and complexity of receiving sensors, measuring instruments, remote sensing data
- Formation of an information and analytical system for assessing, analyzing and predicting the problems of forest resources in the BNT, using information and mathematical methods, modern distributed service-oriented information technologies for processing large spatial and temporal data on the environmental parameters of BNT forests
- Creation of thematic services for identifying and assessing the dynamics of forest resources based on series of remote sensing data under the influence of destructive factors (including fires, felling, outbreaks of insect outbreaks, technogenic pollution, abnormal meteorological phenomena)
- Extrapolation of the obtained results of a comprehensive analysis of the ecological characteristics of BNT forests in Siberia with similar landscape conditions
- Information availability of scientific research results for forest resources management of the BNT.

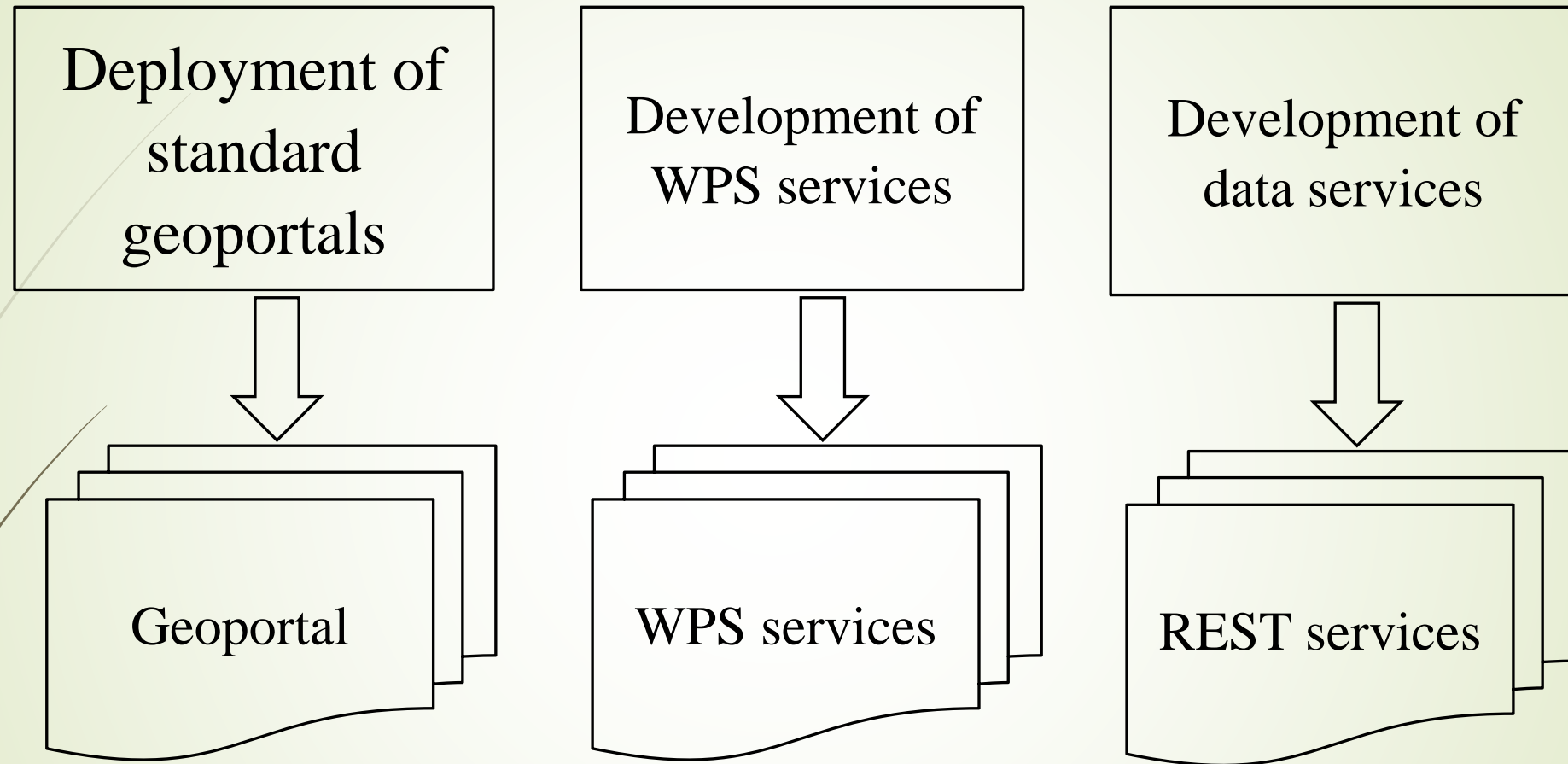
Types of digital platforms

Basic types of digital platforms are distinguished according to the level of information processing and provision of services : instrumental (IDP), infrastructure (InDP), applied (ADP).



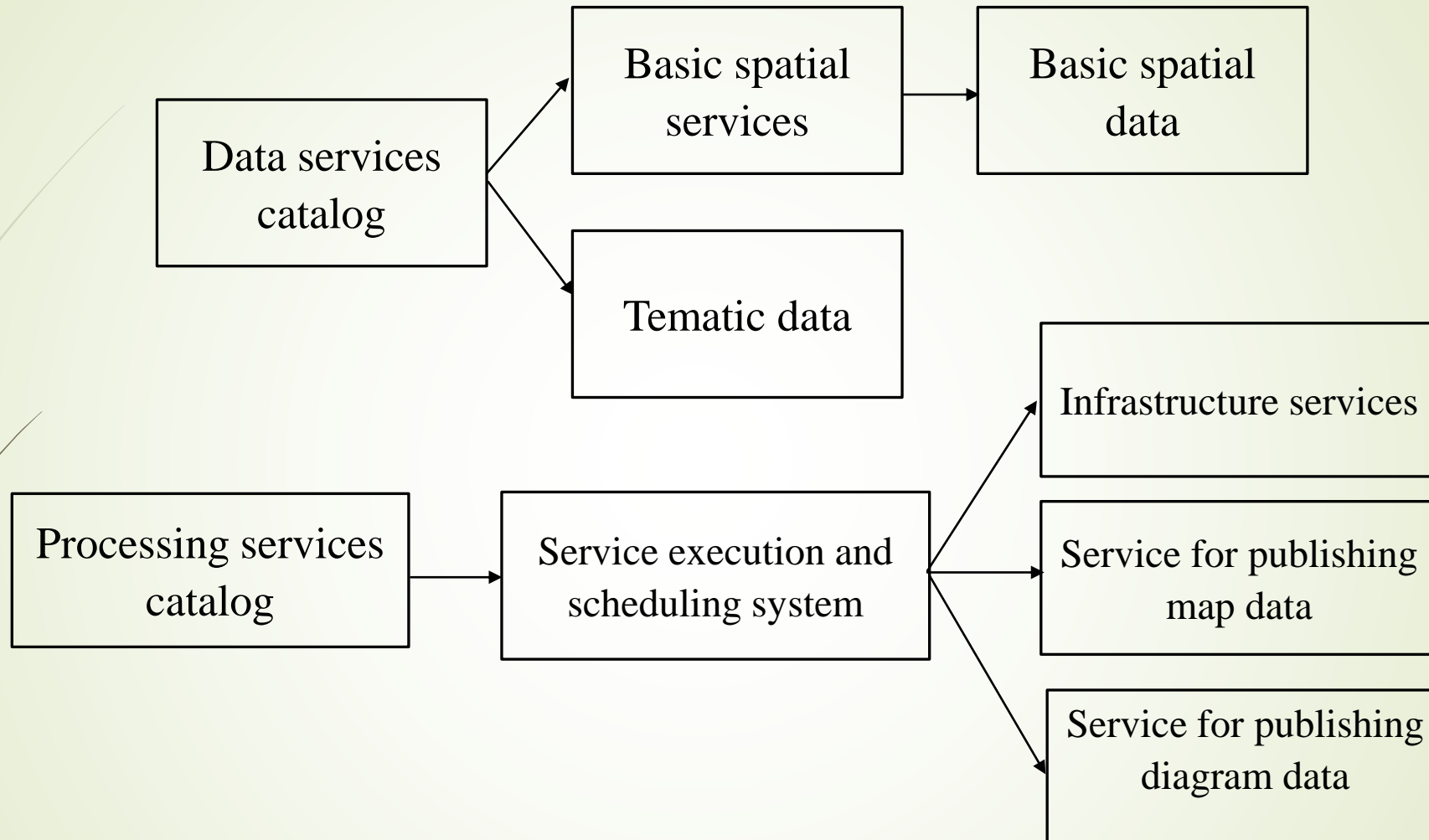
Digital platforms can form a hierarchy in which the instrumental DP are part of the infrastructure DP, and the infrastructure DP, in turn, provide the functioning of the application DP in various activities.

Instrumental digital platform



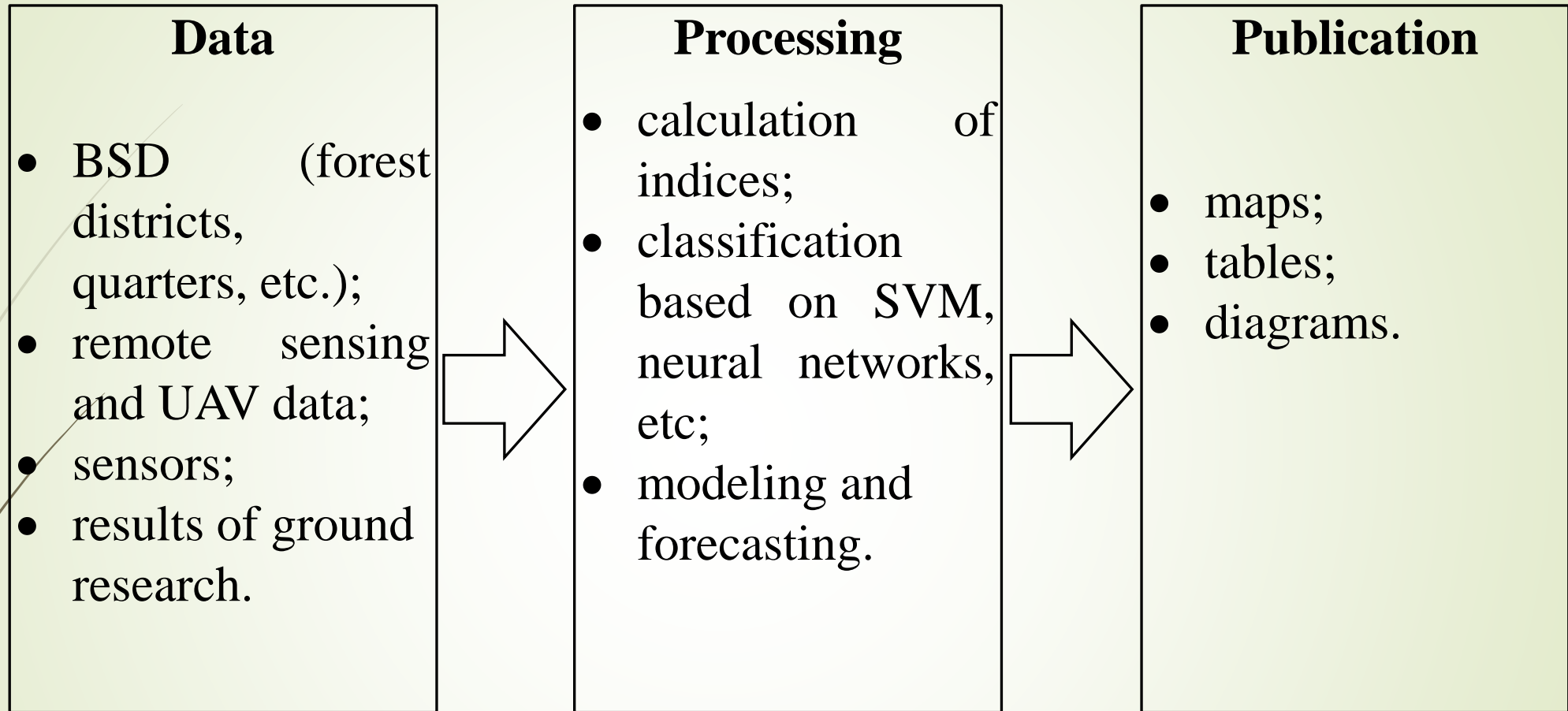
IDP contains instrumental software to support participants' access to the development and debugging of applied information and software and hardware monitoring by providing standard functions, instrumental (universal) services and their data processing interfaces.

Infrastructure digital platform



Infrastructure DP contains recourses for technological data processing, data sources, which allows to build application services for the automation of monitoring participants activities using cutting-edge digital technologies for decision-making

Applied digital platform



The applied DP operates with the processed data at the level of a separate group or monitoring type as a whole.

ADP supports the algorithmic exchange of services between participants using a single information environment and information technology infrastructure.



Thank you for
attention!