

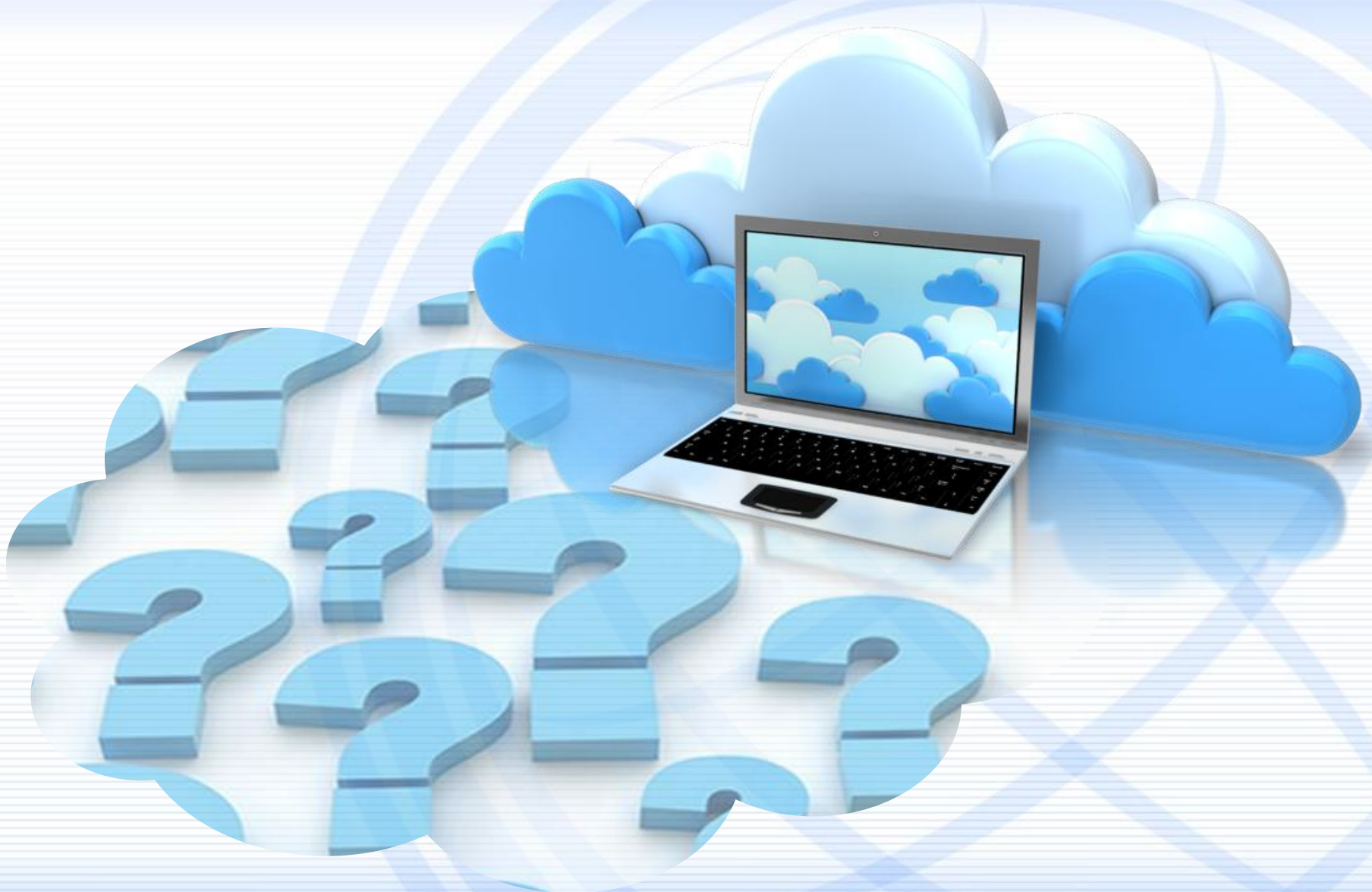
PHOTOGRAMMETRY and Cloud Technologies

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Scientific Director, Racurs, Russia

Hadera. Israel. October 2017



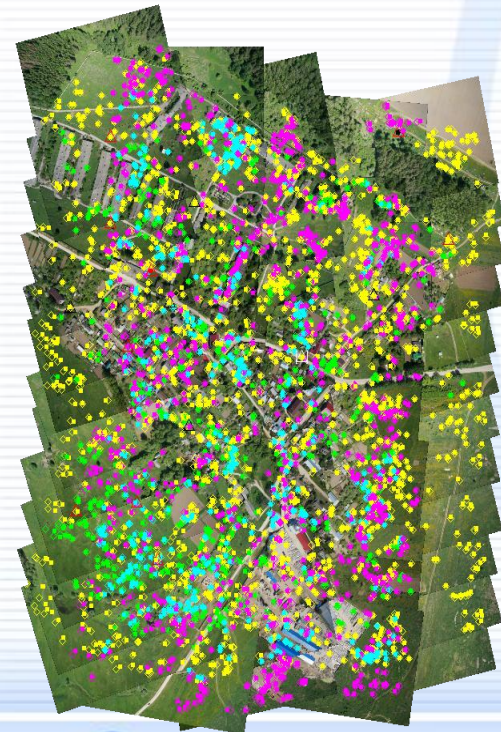
Cloud Technologies



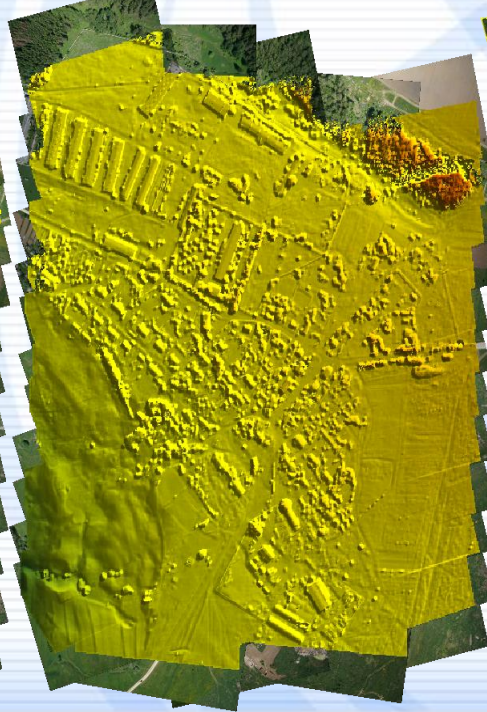
Photogrammetric tasks



aerial
triangulation



DEM building
and filtering



orthomosaic seam lines
and color balancing



stereo feature
extraction



Photogrammetric “blocks”

Blocks can be combined in automatic chains (sequences) of algorithms and data



Automatic sequences – PHOTOMOD Conveyor SA

Название проекта: Scanner project

Тип данных проекта: Космическая сканерная съемка

Входные данные

☐ Каталог со снимками

☒ Проект PHOTOMOD

/Ph55a2/Conveyor/RefProject/RefScannerProj

Параметры обработки

Размер пикселя ортофото: 10.0 м

ЦМР для ортотрансформирования: Внешняя матрица высот

Постоянная высота: 150.0 м

Внешняя матрица высот

/Ph55a2/Conveyor/DEMs/ReferenceDEM.x-dem

Система координат

СК-42, зона 7 (36° в.д.-42° в.д.)

Ориентация осей: левая тройка, геод. привязка: глобальная система координат

Корневой каталог для промежуточных данных

/Ph55a2/IMG2

Выходные форматы ортофото

☒ TIFF/BigTIFF

☐ BMP

☐ IMG/3GE

☐ MegaTIFF

☐ RSV

Формат геопривязки

Текстовый файл

☐ Net

☐ ArcWorld

☒ MapInfo TAB

☒ Внутренняя (GeoTIFF, IMG)

☐ Внутренние пирамиды overview

☐ Внешние пирамиды overview

Каталог для выходных ортофотопланов

\\RD-NEWGEN\Out

Этапы обработки

☒ Создать проекты и добавить изображения

☒ Выполнить поиск опорных точек

☒ Выполнить поиск связующих точек

☒ Уровнять проект

☒ Построить пикеты по данным проекта

☒ Построить цифровую модель рельефа

☒ Построить цифровую модель местности

☒ Ортотрансформировать и создать проект мозаики

☒ Построить выходную мозаику

Управление промежуточными данными

☐ Очистить каталог с проектами PHOTOMOD перед выполнением

☐ Очистить каталог ортотрансформированных растров и параметров сшивки

☐ Очистить каталог с выходными листами

☐ Очистить каталог с логами

Распределение задач... Очистить промежуточные данные

Нарезка на листы

☐ Простая километровая нарезка

☒ Стандартная

Параметры стандартной нарезки

Масштаб: 1:50 000

Номенклатура для четвертей: а, б, в, г

☐ Добавлять "(ю.л.)" к номенклатуре листа

☐ Дописывать нули к номеру 1:100 000

☐ Из ресурса

☒ Заполнять фоном области за пределами выходных листов

☐ Создавать прямоугольные рамки листов

☒ Учитывать цвет фона исходных растров при задании выходных листов

Начать обработку

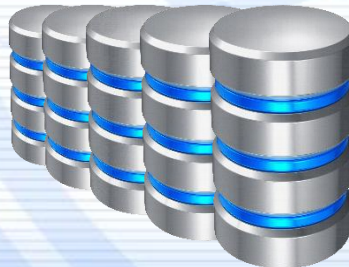
Data Volumes Increase

DMC/Ultracam - inflight data storage –
thousands of images, terabytes
of data

Current aerial block has thousands of
images

WorldView IV – 3.2 TB of storage on
board

Pleaiades 1A/1B - Daily constellation
capacity: 1,000,000 sq.km



New products: DSM, 3D point clouds, True Ortho (DSM based)



Ultracam Ospray



Orthophoto mosaic algorithm (parallelism)

1. Input the images (Compute pyramid levels and stored in tiles);
2. Orthotransform every image;
3. Compute seamlines;
4. Calculate image statistic for brightness adjustment;
5. Build mosaic divided into sheets (separate files);



Computer cluster Performance

Computing block:

Xeon E5-2680 2.40GHz – 10 CPU (140 cores, 280 hyper-threading),
RAM 1280GB, 10Gb/s Ethernet

Storage:

Xeon E5-2620 2.10GHz – 4 CPU, 20 TB Raid SSD (striping), RAM 512,
10Gb/s Ethernet

Performance

Aerial block (Ultracam): GSD 3-5 cm (mountain region), 103 sq. km
Mosaic production– 55 minutes

Pushbroom block Resurs-P: 17000 sq. km
Mosaic production – 43 minutes

Different photogrammetric algorithms have different CPU and storage requirements. 3D point cloud production is 4-10 times more time consuming.

Cloud Computing



A diagram illustrating the components of Cloud Computing. It features three white, cloud-shaped bubbles with black outlines, arranged in a triangular pattern. The top-left bubble contains the word 'Storage', the top-right bubble contains 'Computing', and the bottom-center bubble contains 'Big Data'. The background is a light blue gradient with a faint, stylized globe pattern.

Storage

Computing

Big Data

Cloud Storage



ОБЛАКО@mail.ru



Cloud Storage: Private Clouds



Problem of data security

Large companies can deploy there own private clouds on safe servers



Nextcloud



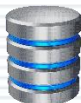
PUT YOUR DATA IN ORBIT

Cloud Storage: Capacity

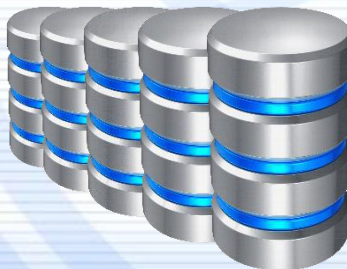
| Aerial images project | Space images project |
|---|--|
| 5 cm /10 cm x 4 band x 16 bit x 10 (overlap) | 30 cm /50cm x 4 band x 16 bit x 3 (overlap) |
| 1 sq.km | |
| 32 GB / 8 GB | 260 MB / 93 MB |
| Moscow, 870 sq.km | |
| 28 TB / 7 TB | 226 GB / 81 GB |
| Belgium, 30 528 sq.km | |
| 1 PB / 250 TB | 8 TB / 2.9 TB |

Data storage capacity

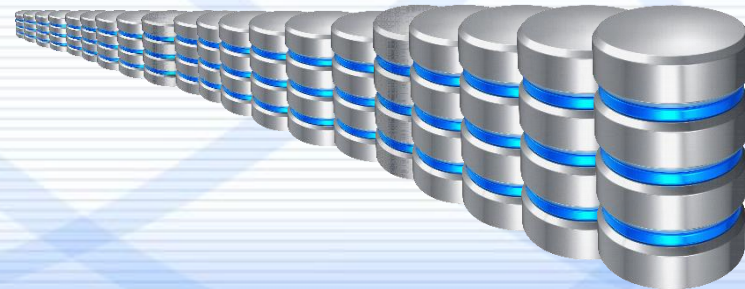
Racurs **0.5 PB**



Data center **100 PB**



Amazon **∞**



Cloud Storage: Time & Speed

4G up to 100 MB/c

Home Internet up to 100 MB/c

5G up to 10 GB/c

Data transfer services 1-10 GB/c

LAN: 1 – 10 GB/c

SSD – RAM: – 5-10 GB/c

Aerial images, 5 cm
1 km² – 32 GB

Aerial images, 5 cm
Moscow, 870 km² – 28 TB

Space images, 30 cm
Belgium, 30 528 km² – 8 TB



4G, Home Internet
10 - 100 Mb
10 – 1 hrs



Fiber
1 - 10 Gb
< 70 - 7 hrs



Fiber
1 - 10 Gb
< 20 - 2 hrs



Cloud Computing

Virtual computers from 5\$/month



CLOUDEO

Cloud Computing: Testing



Virtual Computer:

40 CPU cores
60GB RAM
HDD 250GB + 100GB

Upload Speed:

600KB/s
1.5TB – 1 month to upload,
Several hours to process



Virtual Computer:

Number of CPU cores – 168 (2.6 GHz),
656 GB of RAM
Disk space HDD 7000rpm - 12900GB
Disk space HDD 15000rpm - 8000GB
SSD disk space - 500GB.

Upload Speed:

6MB/s
1.5TB – 7.5 hours to upload,
Several hours to process

No problems with PHOTOMOD

Photomod in Clouds



CLOUD EO

Космическая съемка.
Работает



Космическая и аэро съемка.
Скоро запуск



Innopolis
UNIVERSITY

Космическая и аэро съемка.
Прототип 2018. Запуск 2019



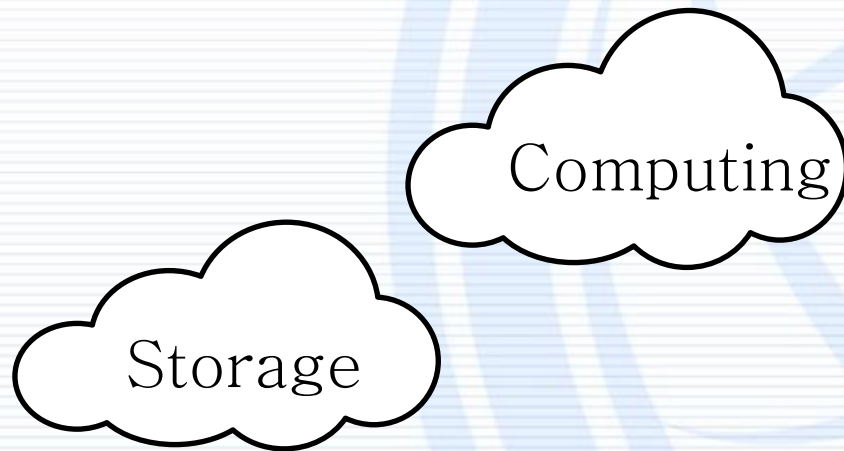
Аэро съемка, БПЛА
Тестирование.

Cloud Usage: Problems to be Solved



Stereo control/measurements

Client-Server architecture



Special adaptation for Storage
& Computing depends on
cloud architecture

Cloud Computing: Facts, Trends & Statistics (2017)

Security no longer the top concern (32%(2016)->24%(2017))

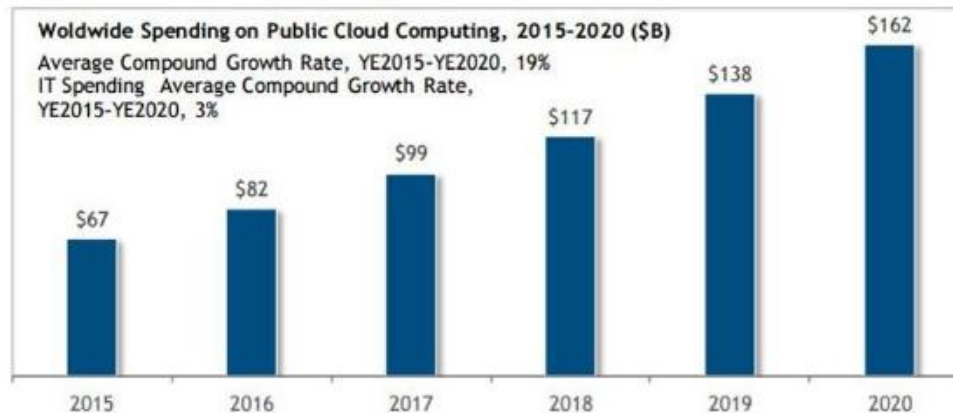
30% of Microsoft revenue to come from Cloud

41% of businesses are planning to increase their investment in Cloud technologies

File storage most popular use of Cloud computing (70% of enterprises use it)

Cloud deployment to become default by 2020 (Cloud deployment of software gradually becoming the default)

The Rapid Growth of Cloud Computing, 2015-2020



<http://www.salesforce.com/assets/pdf/misc/IDC-salesforce-economy-study-2016.pdf>

Rapid Growth of Cloud Computing, 2015-2020

Conclusions

Cloud technologies can be successfully used for photogrammetric processing

PHOTOMOD can be effectively used in clouds

The financial benefits of using cloud technologies in photogrammetry can be based on:

- absence of requirements to have expensive hardware in the user site but depend on the cloud storage and cloud computing price;
- different price of input images when the user does not download them to his computer and processes them in the cloud of the data owner (e.g. Digital Globe proposal)

Further development of cloud technologies and services will lead to a different business model when DPW is offered as a SaaS (Software as a Service) or IaaS (Infrastructure as a Service)

Thank you for attention