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Moscow State University of Geodesy and Cartography (MIIGAiK) MIIGAiK Extraterrestrial Laboratory (MExLab)

# GIS-STUDY AND NEW GEOMORPHOLOGIC MAPPING OF PHOBOS

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EGU General Assembly 2016. April, 20th



#### Landforms on raw "Mars Express" images



Crater Gulliver on the image H5870\_0000.nd2 (left), systems of grooves on the image H2813\_0005.sr2.06 (right)





#### **External morphology of craters**





Elliptical craters (image H8974\_0000.nd22)

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Polygonal craters: Drunlo (left, H2780\_0000.nd2); Hall (right, H9574\_0000.nd2)



#### **Polygonal craters**







Unnamed crater, 800 m in diameter (H3843\_0000.nd2)

Crater Wendell 1.6 km in diameter (left: H4307\_0000.s22, right:H4847\_0000.nd2)



#### Internal morphology of craters

Craters with simple internal morphology
bowl-shaped funnel,
depth to diameter ratio:
d/D = 0.2-0.3,





## Internal morphology of craters

Complex internal morphology



Flat-bottomed crater (image 8974\_0000.nd2)

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Two craters with central peak (image H0756\_0000.nd2) Concentric crater Reldresal (image H0756\_0000.nd2)







#### **Grooves on Phobos**



The fragments of GIS-based map of the grooves with underlying photomosaic of the Phobos; differently oriented groove sets are shown by colors





### Morphological types of grooves





#### gutters chains of the overlaying funnels chains of separated funnels







Nothern polar area (image H3310\_0000.nd2)

![](_page_9_Picture_4.jpeg)

![](_page_9_Picture_5.jpeg)

![](_page_9_Picture_6.jpeg)

![](_page_9_Picture_7.jpeg)

![](_page_10_Picture_0.jpeg)

![](_page_10_Picture_2.jpeg)

Middle latitude belt (image H7478\_0000.s22)

![](_page_10_Picture_4.jpeg)

![](_page_10_Picture_5.jpeg)

![](_page_10_Picture_6.jpeg)

![](_page_11_Picture_0.jpeg)

![](_page_11_Figure_2.jpeg)

Southern polar area (image h4307\_0000.nd2)

![](_page_11_Picture_4.jpeg)

![](_page_11_Picture_5.jpeg)

![](_page_11_Picture_6.jpeg)

![](_page_12_Picture_0.jpeg)

1) Regions with prevail one or two systems of grooves in sub parallel orientation;

2) Regions with crossing two systems of grooves, which have global distribution;

- 3) Regions with large impact craters;
- 4) Regions with low density of grooves;
- 5) Regions with three or more grooves systems crossing.

![](_page_12_Picture_7.jpeg)

#### **Geomorphological map of craters**

Avalanche features

avalanche body

out of scale symbols

avalanche body

crater ejecta deposits

grooves

inner slopes with debris liners

inner slopes with debris liners

combination of the features

Other morphological features

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![](_page_13_Figure_2.jpeg)

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#### **Geomorphological map of grooves**

![](_page_14_Figure_2.jpeg)

#### ГЕОМОРФОЛОГИЧЕСКАЯ КАРТА БОРОЗД ФОБОСА

![](_page_15_Figure_1.jpeg)

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#### Борозды / Grooves

Chains of contiguous funnels-Цаточна соправление все все оче Chains of noncontiguous fumpts Жалоба

Разоряжных длязных воронов

#### Районы / Regions Границы и номеря морфологических районов

- Borders and numbers of mophological areas
- Guter

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Условные обозначения

Legend

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![](_page_16_Picture_0.jpeg)

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#### **Atlas of Phobos**

![](_page_16_Picture_2.jpeg)

![](_page_16_Figure_3.jpeg)

![](_page_16_Picture_4.jpeg)

Южная полярная область

Вилимая сторона

Ведомая сторона

#### **Acknowledgments**

This work was carried out in MIIGAiK and supported by Russian Science Foundation, Project "Study of fundamental geodetic parameters and relief of planets and satellites" #14-22-00197

#### References

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![](_page_17_Picture_4.jpeg)

# Thank you for attention

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