The Simeiz Fundamental Geodynamics Area

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Abstract This report gives an overview about the astrophysical and geodetic activities at the the fundamental geodynamics area Simeiz-Katsively. It also summarizes the wavelet analysis of the ground and satellite measurements of local insolation on the "Nikita garden" of Crimea.

1 General Information

The Radio Astronomy Laboratory of the Crimean Astrophysical Observatory with its 22-m radio telescope is located near Simeiz, 25 km to the west of Yalta. The Simeiz geodynamics area consists of the radio telescope RT-22, two satellite laser ranging stations, a permanent GPS receiver, and a sea level gauge. All these components are located within 3 km (Figure 1).

RT-22, the 22-meter radio telescope, which began operations in 1966, is among the five most efficient telescopes in the world.

Various observations in the centimeter and millimeter wave ranges are being performed with this telescope now and will be performed in the near future. First VLBI observations were performed in 1969 on the Simeiz (RT-22) to Green Bank (RT-43, USA) intercontinental baseline. RT-22 is equipped with radiometers at the 92 cm, 18 cm, 13 cm, 6 cm, 3.5 cm, 2.8 cm, 2.3 cm, 2.0 cm, 13.5 mm, and 8 mm wavelengths.

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2 Activities during the Past Year and Current Status

During the past year, the Space Geodesy and Geodynamics stations regularly participated in the International Network programs — IVS, the International GPS Service (IGS), and the International Laser Ranging Service (ILRS).

During the period 2013 January 1 through 2013 December 31, the Simeiz VLBI station participated in 14 24-hour geodetic sessions. Simeiz regularly participated in the EUROPE and T2 series of geodetic sessions.

2.1 Multi-Frequency Molecular Line Observations

Study of the star-forming regions in molecular lines started in 1978. Two main types of observation are carried out at the radio telescope:
1) observations of maser sources (hydroxyl masers, water masers, and SiO masers) at the frequencies of 1.6 GHz, 4.8 GHz, 22 GHz, and 86 GHz.
2) observations of millimeter molecular emission at the frequency range from 85 GHz to 115 GHz.

The radio telescope is equipped with high-sensitive cryogenic receivers with the noise temperatures of: 1) 30 K at 22 GHz; 2) 39 K at 4.8 GHz; 3) 70 K at frequencies from 85 GHz to 115 GHz. At the 3 mm wavelength and with a beam width of 40 arcsecs, the effective aperture area of the antenna is 100 m^2. The spectrum analyzers for line observations are 1) a 128 channel filter

bank spectrum analyzer with frequency band 12 MHz; 2) a digital spectrum analyzer for maser observations with the frequency band of 4 MHz and the frequency resolution of 8 kHz; 3) a 64 channel filter bank spectrum analyzer with a frequency band of 64 MHz.

Using the RT-22, a comet was investigated in the OH line at the wavelength of 18 cm. Comets C/2009 R1 (McNaught) and 17P/Holmes were observed. For comet C/2009 R1 (McNaught), we determined the gas productivity of OH molecules as a function of heliocentric distance. The comet-gas productivity increases rapidly approaching perihelion [1].

2.2 The Testing of the Ground-Based Segment of the Radioastron Mission at Wavelengths of 1.35 cm.

In accordance with the scientific cooperation between Ukraine and Russia a series of studies for the preparation of the operation of the ground segment of the "RadioAstron" mission was held. Using the 22-m radio telescope RT-22 the scientific program of measurements, a substantial part of which is the study of the compact structures in the extragalactic sources, was prepared. For testing of the model of the ground segment of "Radioastron", RT-22 of Crimean Astrophysical Observatory in Simeiz and RT-70 (P-2500) in Evpatoria jointly conducted groundbased VLBI test experiments at 1.35 cm [2].

2.3 Wavelet Analysis of Ground and Satellite Measurements of Local Insolation

[3] presented the possibility of using wavelet analysis on the signals from long sequences of local terrestrial and NASA satellite observations of the insolation of the Center of HydroMeteorology (CHM) "Nikita Garden" (latitude 44.5, longitude 34.2 degrees). The choice of the method, the type of wavelets, and their parameters for analysis were found. Then the wavelet analysis was applied to the signals to determine and remove the noise and to establish the spectral composition of the signal data. The local terrestrial signal measurements and data from the signals of the satellite observations were presented in [3], along with the noise found from the statistical analysis of the observations.

3 Future Plans

Our plans for the coming year are the following: to put into operation the VLBI Data Acquisition System DBBC, to upgrade the laser of the SLR Simeiz-1873 station, and to set up a new GPS station near the Simeiz VLBI station.

References

1. Volvach L.N., Berezhnoi A.A., Volvach A.E. *Bulletin of the Crimean Astrophysical Observatory*, 109 (1), pp.71-75, 2012.
2. Volvach A.E., Kostenko V.I., Larionov M.G., Volvach L.N., et al. *Bulletin of the Crimean Astrophysical Observatory*, 108 (1), pp.158-162, 2012.
3. Kurbasova G.S., Volvach A.E. *Bulletin of the Crimean Astrophysical Observatory*, in press, 2014.

Table 1 The antenna parameters of the Simeiz station.

Diameter D, m	22
Surface tolerance, mm (root mean square)	0.25
Wavelength limit, mm	2
Feed System	Cassegrain system or primary focus
Focal length F, m	9.525
Focal ratio F/D	0.43
Effective focal length for Cassegrain system, m	134.5
Mounting	Azimuth-Elevation
Pointing accuracy, arc sec.	10
Maximum rotation rate, degree/sec	1.5
Maximum tracking rate, arcsec/sec	150
Working range in Azimuth, degrees (0 to South)	-270 $\pm$ 270
Degrees in Elevation	0 - 85

Fig. 1 The Simeiz geodynamics area.

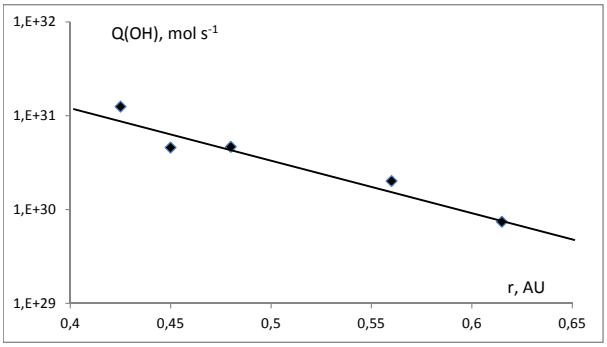

Fig. 2 The relationship between the gas productivity of comet C/2009 R1 (McNaught) and the heliocentric distance.

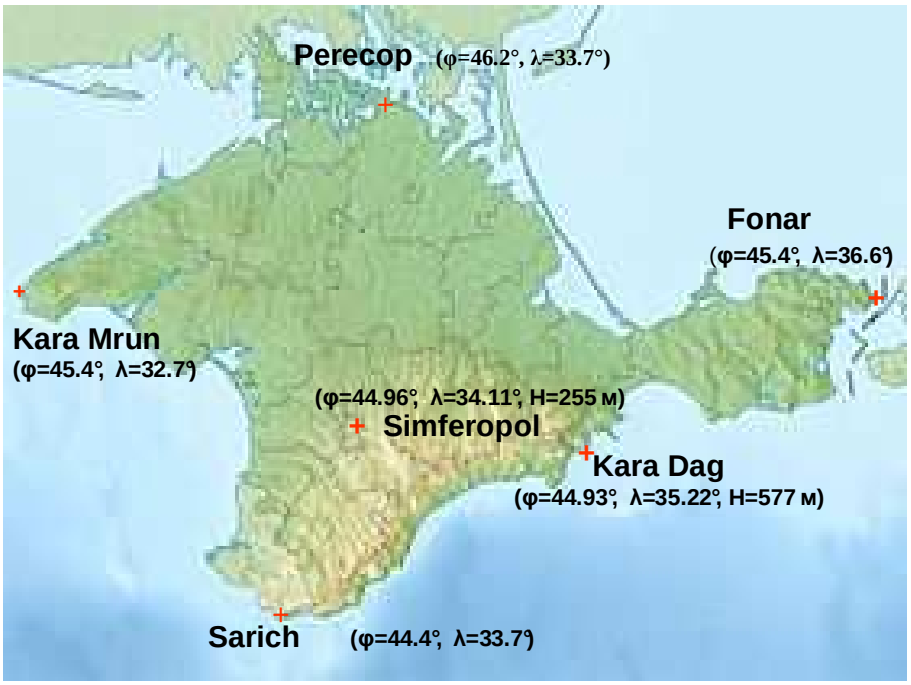

Fig. 3 Crimean area.

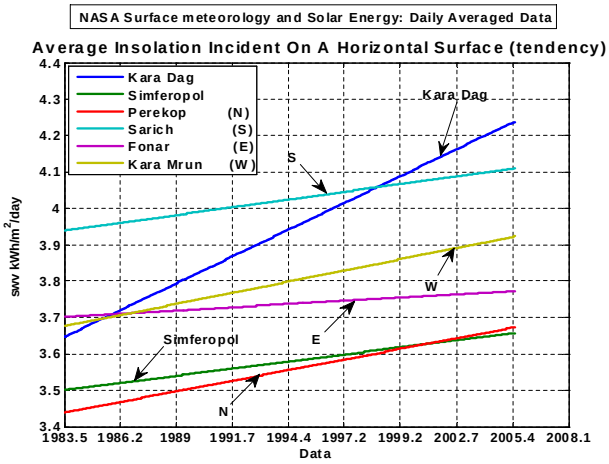

Fig. 4 The insolation for the Crimean area.