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Recommendation ITU-R RS.2042-2

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RS Series: Remote sensing systems

Typical technical and operating characteristics for spaceborne radar sounder systems using the 40-50 MHz band

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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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Series of ITU-R Recommendations

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Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	**Remote sensing systems**
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R RS.2042-2

Typical technical and operating characteristics for spaceborne radar sounder systems using the 40-50 MHz band

(2014-2018-2023)

Scope

This Recommendation provides the technical and operating characteristics of spaceborne radar sounder that would operate in the 40-50 MHz range. This information is to be used for compatibility studies.

Keywords

Earth exploration-satellite service (active), spaceborne active sensor, radar sounder, glacial bed surface, subsurface scattering layers, earth fossil aquifers in desertic environments, Shallow Radar Sounder (SHARAD)

Related ITU-R Recommendations and Reports

Report ITU-R M.2234 – The feasibility of sharing sub-bands between oceanographic radars operating in the radiolocation service and fixed and mobile services within the frequency band 3-50 MHz

Report ITU-R RS.2536 – Sharing and compatibility studies related to spaceborne radar sounders in the 40-50 MHz frequency band

The ITU Radiocommunication Assembly,

considering

a) that spaceborne radar sounders can provide radar maps of subsurface scattering layers to locate water/ice deposits using active spaceborne sensing;

b) that the mission scientific objectives are 1) to understand the global thickness, inner structure, and the thermal stability of the Earth's ice sheets (e.g. in Greenland and Antarctica) as an observable parameter of earth climate evolution, and 2) to understand the occurrence, distribution and dynamics of the earth fossil aquifers in desertic environments (e.g. in northern Africa and the Arabian peninsula) as key elements in understanding recent paleoclimatic changes;

c) that the measurement of reflectivity from subsurface scattering layers as deep as 10 m to 100 m for shallow aquifers and groundwater conduits, and on the order of 5 km for basal interface topography and ice-sheet thickness, is necessary;

d) that the penetration depth from subsurface scattering layers at microwave wavelengths increases approximately inversely with the frequency;

e) that worldwide, periodic measurements of subsurface water/ice deposits require the use of spaceborne active sensors;

f) that the 40-50 MHz frequency range is preferable to satisfy all requirements for spaceborne radar sounders;

g) that the 40-50 MHz band is allocated to the fixed, mobile and broadcasting services on a primary basis;

h) that the uses of the 40.98-41.015 MHz frequency band by the space research service are on a secondary basis;

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i) that country footnotes in the Table of Frequency Allocations for the 40-50 MHz frequency range provide primary or secondary allocations for the broadcasting, fixed and mobile, aeronautical radionavigation and radiolocation services in certain parts of the world;

j) that the Table of Frequency Allocations for the bands adjacent to the 40-50 MHz frequency range provides primary and secondary allocations for the amateur service;

k) that operations of spaceborne radar sounder outside of EESS (active) allocations would be under RR No. **4.4**;

l) that a bandwidth of 10 MHz is sufficient for use by spaceborne radar sounders;

m) that operational limitations have been identified as described in Annex 1,

recommends

that the characteristics given in Table 1 of the Annex should be used for sharing and compatibility studies related to spaceborne radar sounders in the 40-50 MHz frequency range.

Annex

Typical technical and operating characteristics for spaceborne radar sounder systems using the 40-50 MHz band

1 Introduction

There is an interest among climate researchers in remote sensing in the vicinity of 40-50 MHz for remote measurements of the Earth's subsurface providing radar maps of subsurface scattering layers with the intent of locating water/ice/deposits and examining sub-ice glacial bed surfaces using active spaceborne sensors. This Annex provides the preferred frequency band selection rationale, and typical technical and operating characteristics.

The technical and operating characteristics of active spaceborne sensors operating at 40-50 MHz are described.

2 Frequency band selection rationale

The reason for an allocation between 40 MHz and 50 MHz for a spaceborne sounding radar is based upon the following selection criteria: surface penetration, length scale of observation, region of electromagnetic scattering model, and previous work.

2.1 Surface penetration

Penetration of an incident radar wave is normally many tens of wavelengths. Under the proper conditions of wavelength and composition of the scattering medium, radio waves can readily penetrate the dielectric materials comprising the Earth's surface and cover. A quantitative estimate of this depth δ_p is as follows:

$$\delta_p = \frac{\lambda_0 \sqrt{e'}}{2\pi e''} \quad (1)$$

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