

RECOMMENDATION ITU-R SA.1028-2*

Performance criteria for satellite passive remote sensing

(1994-1997-2003)

The ITU Radiocommunication Assembly,

considering

- a) that certain frequency bands, including some absorption bands of atmospheric gases (e.g. O₂ (oxygen) and H₂O (water vapour)), have been allocated for spaceborne passive microwave remote sensing;
- b) that some of these bands are also allocated to other radio services;
- c) that performance criteria are a necessary prerequisite to the establishment of interference and sharing criteria;
- d) that surface brightness temperature, the atmospheric temperature at points along a path, and absorption coefficients can be determined from measurements of the sensor antenna temperature, T_A ;
- e) that the surface brightness temperature and the absorption coefficients, in turn, depend upon the physical properties of the surface or atmosphere that are to be sensed;
- f) that studies have established measurement sensitivity requirements;
- g) that studies have established that measurements in absorption bands are extremely vulnerable to interference because, in general, there is no possibility to detect and to reject data that are contaminated by interference, and because propagation of undetected contaminated data into numerical weather prediction (NWP) models may have a destructive impact on the reliability/quality of weather forecasting;
- h) that passive microwave remote sensing is performed in absorption bands to obtain important three-dimensional atmospheric data that are used in particular to initialize NWP models;
- j) that performance requirements for passive sensors can be stated in terms of measurement sensitivity, ΔT_e , and availability, measured at the satellite, assuming that degradation from other elements in the system will be small;
- k) that three-dimensional measurements of atmospheric temperature or gas concentration are performed in the absorption bands including those in the range 52.6-59.3 GHz, 115.25-122.25 GHz, 174.8-191.8 GHz, as well as the auxiliary window channels at 23.6-24 GHz, 31.3-31.8 GHz, 50.2-50.4 GHz and 86-92 GHz,

* This Recommendation, particularly footnote⁽⁴⁾ to Table 1, should be brought to the attention of Radiocommunication Study Groups 1, 4, 6, 8 and 9.

recommends

1 that the measurement sensitivities suitable for passive remote sensing of the Earth's land, oceans and atmosphere are as indicated in Table 1;

2 that in bands used for passive remote sensing, the required minimum availability of passive sensor data for each band shall be as specified in column 4 (Data availability) of Table 1.

TABLE 1

Performance criteria for passive remote sensing of environmental data

Frequency band(s) ⁽¹⁾ (GHz)	Total BW required (MHz)	Required ΔT_e (K)	Data availability ⁽²⁾ (%)	Scan mode (N, L) ⁽³⁾
1.37-1.4s, 1.4-1.427P	100	0.05	99.9	N
2.64-2.655s, 2.655-2.69s, 2.69-2.7P	45	0.1	99.9	N
4.2-4.4s, 4.95-4.99s	200	0.3/0.05 ⁽⁴⁾	99.9	N
6.425-7.25	200	0.3/0.05 ⁽⁴⁾	99.9	N
10.6-10.68p, 10.68-10.7P	100	1.0/0.1 ⁽⁴⁾	99.9	N
15.2-15.35s, 15.35-15.4P	200	0.1	99.9	N
18.6-18.8p	200	1.0/0.1 ⁽⁴⁾	95/99.9 ⁽⁴⁾	N
21.2-21.4p	200	0.2/0.05 ⁽⁴⁾	99/99.9 ⁽⁴⁾	N
22.21-22.5p	300	0.4/0.05 ⁽⁴⁾	99/99.9 ⁽⁴⁾	N
23.6-24P	400	0.05	99.99	N
31.3-31.5P, 31.5-31.8p	500	0.2/0.05 ⁽⁴⁾	99.99	N
36-37p	1 000	1.0/0.1 ⁽⁴⁾	99.9	N
50.2-50.4P	200	0.05	99.99	N
52.6-54.25P, 54.25-59.3p	6 700 ⁽⁵⁾	0.3/0.05 ⁽⁴⁾	99.99	N
86-92P	6 000	0.05	99.99	N
100-102P	2 000	0.005	99	L
109.5-111.8P	2 000	0.005	99	L
114.25-116.P	1 750	0.005	99	L

TABLE 1 (continued)

Frequency band(s) ⁽¹⁾ (GHz)	Total BW required (MHz)	Required ΔT_e (K)	Data availability ⁽²⁾ (%)	Scan mode (N, L) ⁽³⁾
115.25-116P, 116.0-122.25p	7 000 ⁽⁵⁾	0.05/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
148.5-151.5P	3 000	0.1/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
155.5-158.5 ⁽⁷⁾ p	3 000	0.1	99.99	N
164-167P	3 000 ⁽⁵⁾	0.1/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
174.8-182p, 182-185P, 185-190p, 190-191.8P	17 000 ⁽⁵⁾	0.1/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
200-209P	9 000 ⁽⁵⁾	0.005	99	L
226-231.5P	5 500	0.2/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
235-238p	3 000	0.005	99	L
250-252P	2 000	0.005	99	L
275-277	2 000 ⁽⁵⁾	0.005	99	L
294-306	12 000 ⁽⁵⁾	0.2/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
316-334	18 000 ⁽⁵⁾	0.3/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
342-349	7 000 ⁽⁵⁾	0.3/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
363-365	2 000	0.005	99	L
371-389	18 000 ⁽⁵⁾	0.3	99.99	N
416-434	18 000 ⁽⁵⁾	0.4	99.99	N
442-444	2 000 ⁽⁵⁾	0.4/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
496-506	10 000 ⁽⁵⁾	0.5/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
546-568	22 000 ⁽⁵⁾	0.5/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
624-629	5 000 ⁽⁵⁾	0.005	99	L
634-654	20 000 ⁽⁵⁾	0.5/0.005 ⁽⁶⁾	99.99/99 ⁽⁶⁾	N, L
659-661	2 000	0.005	99	L
684-692	8 000 ⁽⁵⁾	0.005	99	L

TABLE 1 (*end*)

Frequency band(s) ⁽¹⁾ (GHz)	Total BW required (MHz)	Required ΔT_e (K)	Data availability ⁽²⁾ (%)	Scan mode (N, L) ⁽³⁾
730-732	2 000 ⁽⁵⁾	0.005	99	L
851-853	2 000	0.005	99	L
951-956	5 000 ⁽⁵⁾	0.005	99	L

- (1) P: Primary allocation, shared only with passive services (No. 5.340 of the Radio Regulations); p: primary allocation, shared with active services; s: secondary allocation.
- (2) Data availability is the percentage of area or time for which accurate data is available for a specified sensor measurement area or sensor measurement time. For a 99.99% data availability, the measurement area is a square on the Earth of 2 000 000 km², unless otherwise justified; for a 99.9% data availability, the measurement area is a square on the Earth of 10 000 000 km² unless otherwise justified; for a 99% data availability the measurement time is 24 h, unless otherwise justified.
- (3) N: Nadir, Nadir scan modes concentrate on sounding or viewing the Earth's surface at angles of nearly perpendicular incidence. The scan terminates at the surface or at various levels in the atmosphere according to the weighting functions. L: Limb, Limb scan modes view the atmosphere "on edge" and terminate in space rather than at the surface, and accordingly are weighted zero at the surface and maximum at the tangent point height.
- (4) First number for sharing conditions circa 2003; second number for scientific requirements that are technically achievable by sensors in the next 5-10 years.
- (5) This bandwidth is occupied by multiple channels.
- (6) Second number for microwave limb sounding applications.
- (7) This band is needed until 2018 to accommodate existing and planned sensors.
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