

# 1240-1300 MHz

## 1. Band Introduction

The band 1240-1300 MHz is used by Federal agencies for operating various types of long-range radar systems that perform missions critical to safe and reliable air traffic control (ATC) in the national airspace, border surveillance, early warning missile detection, and drug interdiction. These radar systems ensure the safe transportation of people and goods, encourage the flow of commerce, and provide for national defense. Long-range radar systems are operated in this portion of the radio frequency spectrum because the effects of rain and fog on radar target detection are very low, the external background noise levels are low, and high-power transmitter tubes operate very efficiently. These factors are important to achieve the long-range detection of different size aircraft as well as other targets.

## 2. Allocations

### 2a. Allocation Table

The frequency allocation table shown below is extracted from the Manual of Regulations and Procedures for Federal Radio Frequency Management, Chapter 4 – Allocations, Allotments and Plans.

*Table of Frequency Allocations*

*United States Table*

| Federal Table   | Non-Federal Table  | FCC Rule Part(s) |
|---|--|------------------|
| 1240-1300<br>EARTH EXPLORATION-SATELLITE<br>(active)<br>RADIOLOCATION G56<br>SPACE RESEARCH (active)<br>AERONAUTICAL RADIONAVIGATION<br>5.332 5.335 | 1240-1300<br>AERONAUTICAL RADIONAVIGATION<br>Amateur<br>Earth exploration-satellite (active)<br>Space research (active)<br>5.282 | Amateur (97)     |

**2b. Additional Allocation Table Information**

**G56** Federal radiolocation in the bands 1215-1300, 2900-3100, 5350-5650 and 9300-9500 MHz is primarily for the military services; however, limited secondary use is permitted by other Federal agencies in support of experimentation and research programs. In addition, limited secondary use is permitted for survey operations in the band 2900-3100 MHz.

**5.282** In the bands 435-438 MHz, 1 260-1 270 MHz, 2 400-2 450 MHz, 3 400-3 410 MHz (in Regions 2 and 3 only) and 5650-5670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table (see No. 5.43). Administrations authorizing such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. 25.11. The use of the bands 1 260-1 270 MHz and 5 650-5 670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.

**5.332** In the band 1 215-1 260 MHz, active spaceborne sensors in the Earth exploration-satellite and space research services shall not cause harmful interference to, claim protection from, or otherwise impose constraints on operation or development of the radiolocation service, the radionavigation- satellite service and other services allocated on a primary basis. (WRC-2000)

**5.335** In Canada and the United States in the band 1 240-1 300 MHz, active spaceborne sensors in the earth exploration-satellite and space research services shall not cause interference to, claim protection from, or otherwise impose constraints on operation or development of the aeronautical radionavigation service.

### 3. Federal Agency Use

#### 3a. Federal Agency Frequency Assignments Table

The following table identifies the frequency band, types of allocations, types of applications, and the number of frequency assignments in the Government Master File (GMF) by agency.

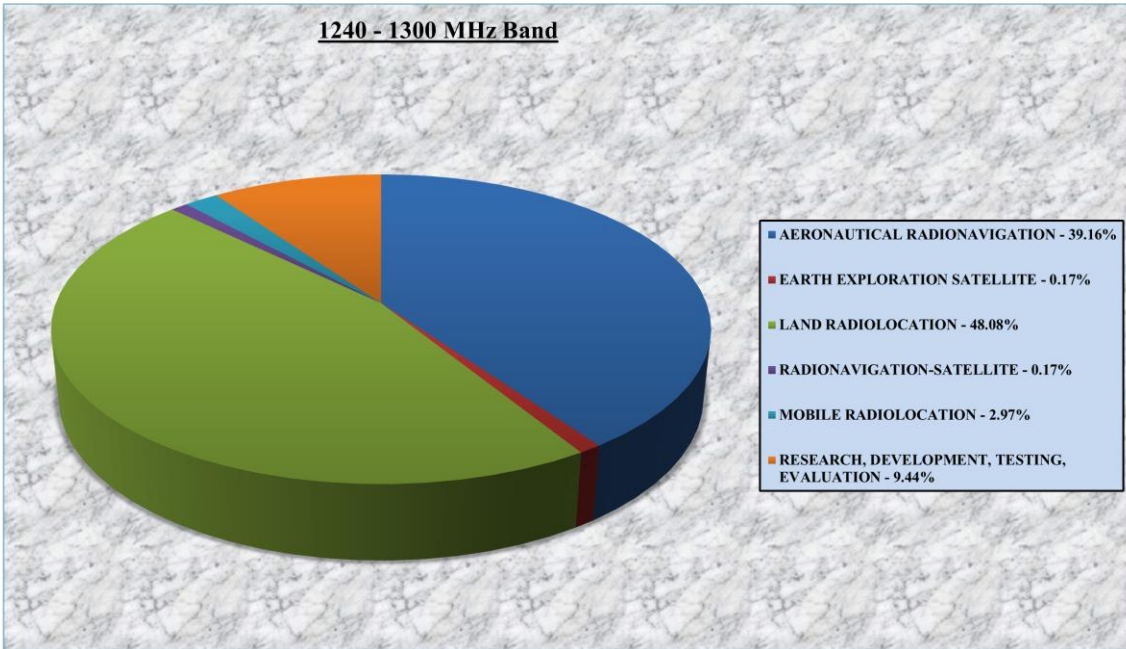
*Federal Frequency Assignment Table*

| 1240-1300 MHz Band |                                 |  |                               |                    |                         |  |            |
|--------------------|---------------------------------|--|-------------------------------|--------------------|-------------------------|--|------------|
| SHARED BAND        |                                 |  |                               |                    |                         |  |            |
| AGENCY             | TYPE OF APPLICATION             |  |                               |                    |                         |  |            |
|                    | AERONAUTICAL<br>RADIONAVIGATION | EARTH EXPLORATION<br>SATELLITE   | RADIONAVIGATION-<br>SATELLITE | LAND RADIOLOCATION | MOBILE<br>RADIOLOCATION | RESEARCH<br>DEVELOPMENT<br>TESTING<br>EVALUATION | TOTAL      |
|                    |                                 | AERONAUTICAL RADIONAVIGATION<br>AMATEUR<br>EARTH EXPLORATION-SATELLITE (active)<br>RADIOLOCATION<br>RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space)<br>SPACE RESEARCH (active) |                               |                    |                         |  |            |
| AF                 | 2                               |  |                               | 20                 |                         | 30   | 52         |
| AR                 |                                 |  |                               | 138                | 5                       | 2  | 145        |
| DHS                |                                 |  |                               | 6                  | 10                      |  | 16         |
| DOC                |                                 |  | 1                             |                    |                         |  | 1          |
| DOE                | 8                               |  |                               |                    |                         | 3  | 11         |
| FAA                | 208                             |  |                               |                    |                         |  | 208        |
| MC                 | 2                               |  |                               | 95                 |                         | 2  | 99         |
| N                  | 4                               |  |                               | 15                 | 1                       | 11   | 31         |
| NASA               |                                 | 1  |                               | 1                  | 1                       | 6  | 9          |
| <b>TOTAL</b>       | <b>224</b>                      | <b>1</b>   | <b>1</b>                      | <b>275</b>         | <b>17</b>               | <b>54</b>  | <b>572</b> |

The number of actual systems, or number of equipments, may exceed and sometimes far exceed, the number of frequency assignments in a band. Also, a frequency assignment may represent, a local, state, regional or nationwide authorization. Therefore, care must be taken in evaluating bands strictly on the basis of assignment counts or percentages of assignments.

### 3b. Percentage of Frequency Assignments Chart

The following chart displays the percentage of frequency assignments in the GMF for the systems operating in the frequency band 1240-1300 MHz.



## 4. Frequency Band Analysis By Application

### 4a. Aeronautical Radionavigation

The Federal Aviation Administration (FAA) and Department of Defense (DoD) operate long-range aeronautical radionavigation radar systems in the band 1240-1300 MHz. These radars are capable of operating throughout the 1215-1400 MHz frequency range. These radar systems are used to monitor aircraft and other targets within the national airspace, along the border areas, and around military bases and airfields. The Air Route Surveillance Radar (ARSR) systems that operate throughout this band measure range, bearing, and velocity of aircraft and other targets.<sup>1</sup> They are used in directing aircraft en-route across the United States within the National Airspace System.

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<sup>1</sup> The radar systems operating in this band transmit pulsed radio frequency signals that are reflected from the surface of aircraft or target. The time required for a reflected signal that is transmitted to return from an aircraft and the direction of the reflected signal are measured. From this information, the radar can determine the distance of the aircraft from the antenna, the direction of the aircraft relative to the antenna, and in some cases the altitude.

The aeronautical radionavigation radar systems operating in the band 1215-1240 MHz use a continually rotating antenna mounted on a tower. The antennas are mounted on a tower to provide an unobstructed view of the airspace they are monitoring. The antennas are directed slightly upwards to remove the effects of local obstructions (e.g., ground clutter), that would degrade the performance of the radar system. Each system installation is unique but the typical antenna height is approximately 45 feet for fixed radar systems, and approximately 20 feet for transportable radar systems. The typical antenna rotation rate for radar systems operating in this band is 5 to 6 revolutions per minute.

#### **4b. Radiolocation**

The military operates tactical radar systems in the band 1240-1300 MHz. Tactical radars are designed to be more easily tuned than air traffic control radars, since they may have to operate in a battlefield environment with many other systems and require the flexibility to change frequencies to reduce their exposure to hostile forces.

The Tethered Aerostat Radar (TAR) system also operates in this band. The TAR consists of balloon mounted radars that are used for monitoring the southern borders and Caribbean airspace for drug interdiction. The balloon is tethered to a ground station and the radar monitors the airspace, sending data down to the ground control station and the information is relayed to appropriate authorities.

The technical characteristics of systems operating in this band can be found in ITU-R M 1463-2 titled “*Characteristics of and protection criteria for radars operating in the radiodetermination service in the frequency band 1 215-1 400 MHz*”. The systems in the band 1240-1300 MHz operated by the federal government and DoD are similar to the ones described in the following tables.

TABLE 1  
1 215-1 400 MHz radiodetermination system characteristics

| Parameter  | Units | System 1                         | System 2                      | System 3                                     | System 4  | System 5                                  | System 6                                      | System 7  | System 8                |
|--|-------|----------------------------------|-------------------------------|--|---|---|---|---|-------------------------|
| Peak power into antenna                                  | dBm   | 97                               | 80                            | 76.5   | 80  | 73.9                                      | 96  | 93  | 78.8                    |
| Frequency range  | MHz   |                                  |                               |  |   | 1 215-1 400                               | 1 280-1 350                                   | 1 215-1 350                                     | 1 240-1 350             |
| Pulse duration   | μs    | 2                                | 88.8; 58.8<br>(Note 1)        | 0.4; 102.4; 409.6<br>(Note 2)                | 39 single frequency<br>26 and 13 dual frequency<br>(Note 3) | 2 each of 51.2<br>2 each of 409.6         | 2   | 6   | 115.5; 17.5<br>(Note 4) |
| Pulse repetition rate                                    | pps   | 310-380 staggered                | 291.5 or 312.5 average        | 200-272 long-range<br>400-554 short-range    | 774 average   | 240-748                                   | 279.88 to 370.2                               | 279.88 to 370.2                                 | 319 average             |
| Chirp bandwidth for frequency modulated (chirped) pulses |       | Not applicable                   | 770 kHz for both pulse widths | 2.5 MHz for 102.4 μs<br>625 kHz for 409.6 μs | Not applicable  | 1.25 MHz                                  | Not applicable                                | Not applicable                                  | 1.2 MHz                 |
| Phase-coded sub-pulse width                              | μs    | Not applicable                   | Not applicable                | Not applicable                               | 1   | Not applicable                            | Not applicable                                | Not applicable                                  | Not applicable          |
| Compression ratio  |       | Not applicable                   | 68.3:1 and 45.2:1             | 256:1 for both pulses                        |   | 64:1 and 256:1                            | Not applicable                                | Not applicable                                  | 150:1 and 23:1          |
| RF emission bandwidth (3 dB)                             | MHz   | 0.5                              | 1.09                          | 2.2; 2.3; 0.58                               | 1   | 0.625 or 1.25                             | 1.2   | 1.3   | 1.2                     |
| Output device  |       | Klystron                         | Transistor                    | Transistor                                   | Cross-field amplifier                                       | Transistor                                | Magnetron/Amplitron                           | Klystron  | Transistor              |
| Antenna type   |       | Horn-fed reflector               | Stack beam reflector          | Rotating phased array                        | Parabolic cylinder  | Planar array with elevation beam steering | 47' × 23'<br>(14.3 × 7 m)<br>cosecant squared | 45' × 19'<br>(13.7 × 5.8 m)<br>cosecant squared | Horn-fed reflector      |
| Antenna polarization                                     |       | Horizontal, vertical, LHCP, RHCP | Vertical, circular            | Horizontal                                   | Vertical  | Horizontal                                | CP/LP   | Linear orthogonal and CP                        | Vertical; RHCP          |

TABLE 1 (continued)

| Parameter                               | Units   | System 1                        | System 2  | System 3  | System 4                                 | System 5     | System 6                                    | System 7   | System 8                               |
|---|---------|---------------------------------|---|---|--|--------------|---|--|--|
| Antenna maximum gain                    | dBi     | 34.5, transmit<br>33.5, receive | 32.4-34.2,<br>transmit<br>31.7-38.9,<br>receive | 38.9, transmit<br>38.2, receive   | 32.5                                     | 38.5         | 34  | 35   | 34.5                                   |
| Antenna elevation beamwidth             | degrees | 3.6 shaped to<br>44             | 3.63-5.61,<br>transmit<br>2.02-8.79,<br>receive | 1.3   | 4.5 shaped to 40                         | 2            | 3.75 (cosecant<br>squared)                  | 3.75 (cosecant<br>squared)   | 3.7 shaped to 44<br>(cosecant squared) |
| Antenna azimuthal beamwidth             | degrees | 1.2                             | 1.4   | 3.2   | 3.0                                      | 2.2          | 1.2   | 1.3  | 1.2                                    |
| Antenna horizontal scan characteristics | rpm     | 360°<br>mechanical at<br>5 rpm  | 360°<br>mechanical at<br>5 rpm                  | 360° mechanical at<br>6 rpm for long range<br>and 12 rpm for short<br>range | 360° mechanical<br>at<br>6, 12 or 15 rpm | 5            | 6   | 5  | 360° mechanical at<br>5 rpm            |
| Antenna vertical scan characteristics   | degrees | Not<br>applicable               | -7 to +30<br>in 12.8 or<br>13.7 ms              | -1 to +19<br>in 73.5 ms   | Not applicable                           | -6 to +20    | -4 to +20                                   | -4 to +20  | Not applicable                         |
| Receiver IF bandwidth                   | kHz     | 780                             | 690   | 4 400 to 6 400  | 1 200                                    | 1 250<br>625 | 720 to 880 (log)<br>1 080 to 1 320<br>(MTI) | 270 to 330<br>(20 series log)<br>360 to 480<br>(20 series<br>MTI)<br>540 to 660<br>(60 series log)<br>720 to 880<br>(60 series<br>MTI) | 1 200                                  |
| Receiver noise figure                   | dB      | 2                               | 2   | 4.7   | 3.5                                      | 2.6          | 4.25  | 9  | 3.2                                    |

**TABLE 1 (end)**

| <b>Parameter</b>     | <b>Units</b> | <b>System 1</b> | <b>System 2</b> | <b>System 3</b> | <b>System 4</b> | <b>System 5</b>   | <b>System 6</b>   | <b>System 7</b>   | <b>System 8</b> |
|----------------------|--------------|-----------------|-----------------|-----------------|-----------------|-------------------|-------------------|-------------------|-----------------|
| Platform type        |              | Fixed           | Fixed           | Transportable   | Transportable   | Fixed terrestrial | Fixed terrestrial | Fixed terrestrial | Fixed           |
| Time system operates | %            | 100             | 100             | 100             | 100             | 100               | 100               | 100               | 100             |

LHCP: left-hand circularly polarized

RHCP: right-hand circularly polarized

NOTE 1 – The radar has 44 RF channel pairs with one of 44 RF channel pairs selected in normal mode. The transmitted waveform consists of a 88.8 μs pulse at frequency  $f_1$  followed by a 58.8 μs pulse at frequency  $f_2$ . Separation of  $f_1$  and  $f_2$  is 82.854 MHz.

NOTE 2 – The radar has 20 RF channels in 8.96 MHz increments. The transmitted waveform group consists of one 0.4 μs P0 pulse (optional) which is followed by one 102.4 μs linear frequency modulated pulse (if 0.4 μs P0 is not transmitted) of 2.5 MHz chirp which may be followed by one to four long-range 409.6 μs linear frequency modulated pulses each chirped 625 kHz and transmitted on different carriers separated by 3.75 MHz. Normal mode of operation employs frequency agility whereby the individual frequencies of each waveform group are selected in a pseudo-random manner from one of the possible 20 RF channels within the frequency band 1 215-1 400 MHz.

NOTE 3 – The radar has the capability of operating single frequency or dual frequency. Dual RF channels are separated by 60 MHz. The single channel mode uses the 39 μs pulse width. In the dual channel mode, the 26 μs pulse is transmitted at frequency  $f$ , followed by the 13 μs pulse transmitted at  $f+ 60$  MHz.

NOTE 4 – This radar utilizes two fundamental carriers, F1 and F2, with two sub-pulses each, one for medium range detection and one for long range detection. The carriers are tunable in 0.1 MHz increments with a minimum separation of 26 MHz between F1 (below 1 300 MHz) and F2 (above 1 300 MHz). The carrier sub-pulses are separated by a fixed value of 5.18 MHz. The pulse sequence is as follows: 115.5 μs pulse at  $F1 + 2.59$  MHz, then a 115.5 μs pulse at  $F2 + 2.59$  MHz, then a 17.5 μs pulse at  $F2 - 2.59$  MHz, then a 17.5 μs pulse at  $F1 - 2.59$  MHz. All four pulses are transmitted within a single pulse repetition interval.



#### **4c. Space Research (Active) Service**

There are no Federal systems operating in the space research (active) service.

#### **4e. Earth Exploration-Satellite (Active) Service**

There is an assignment for the NASA Aquarius non-geostationary satellite that operates in the EESS (active) service at 1260 MHz. It is a remote sensing instrument that is used to measure the salinity of the ocean as a joint venture with Argentina. The transmitter has a power of 200 Watts and 4.6 MHz bandwidth.

#### **4c. Research Testing and Development**

In addition to the operational radars in the band 1240 -1300 MHz, there are frequency assignments for research and development purposes to examine hardware and software improvements for existing systems. The research and development includes examining new waveforms and testing new signal processing techniques. The operation of radar systems used for research and development are carefully coordinated to ensure that they do not cause harmful interference to operational aeronautical radionavigation radar systems.

#### **4d. Frequency Coordination and Sharing**

In the band 1240-1300 MHz hundreds of high-power long-range radar systems operate across the country. In some cases near large population centers with airports, multiple radars must operate in the same geographic area. Compatible operation between different types of radar systems is accomplished through careful design of the radar receivers, frequency selection, and NTIA spectrum standards. The radar receivers use various types of circuitry and signal processing to reduce or eliminate the effects of pulsed interference from other radars.<sup>2</sup> The careful assignment of frequencies for radars operating in this band is crucial to prevent interference to and from other radar systems. The FAA and DoD carefully choose and coordinate the frequencies of each of their systems that operate in this band. Radar systems that operate in the band 1240-1300 MHz with power levels above 1 kilowatt are expected to comply with the NTIA Radar Spectrum Engineering

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<sup>2</sup> These techniques are not effective in mitigating the effects of interference from continuous signals such as those generated by communication systems as discussed in NTIA Report TR-06-444, *Effects of RF Interference on Radar Receivers* (September 2006) available at [www.its.bldrdoc.gov/publications](http://www.its.bldrdoc.gov/publications).

## ***1240–1300 MHz***

Criteria (RSEC) Category C.<sup>3</sup> The RSEC regulates how much bandwidth radars are permitted to use, based on the parameters of the transmitted pulses and the amount of unwanted or spurious emissions they emit.

The radars in the band 1240-1300 MHz may experience interference from the RNSS systems of other administrations as they launch satellites and become operational. This will place additional limitations on the spectrum available for the radar systems operating in this band.

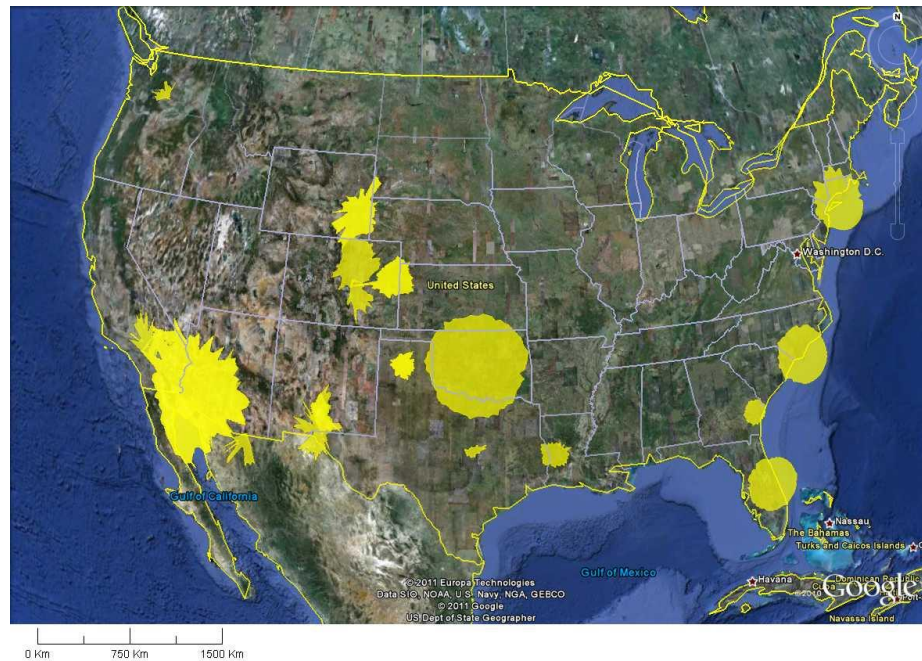
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<sup>3</sup> The RSEC standards are available in Chapter 5 National Telecommunications and Information Administration, Manual of Regulations and Procedures for Federal Radio Frequency Management.

#### 4e. Spectrum Contours

The spectrum contours for the radars operating in the aeronautical radionavigation, and radiolocation, services have been computed for a generic ground-based communication receiver. The spectrum contours represent the locations where the power of the radar signal causes the thermal noise power of the generic receiver to increase by 1 dB.<sup>4</sup> These contours do not represent the coverage area of the radar; rather they represent the locations where the signal level of the radar system causes a generic receiver to exceed the interference threshold. Any receiver inside the contour would experience interference from the radar.

The spectrum contour plots for the radar systems operating in 5-MHz segments of the band 1240-1300 MHz are shown in Figure 1 through Figure 27.



**Figure 1. 1240 – 1245 MHz Band Segment**

<sup>4</sup> A 1 dB increase in receiver noise is equivalent to an interference-to-noise (I/N) ratio of -6 dB, which is a commonly used value for a first level interference threshold used in electromagnetic compatibility analyses.

1240–1300 MHz

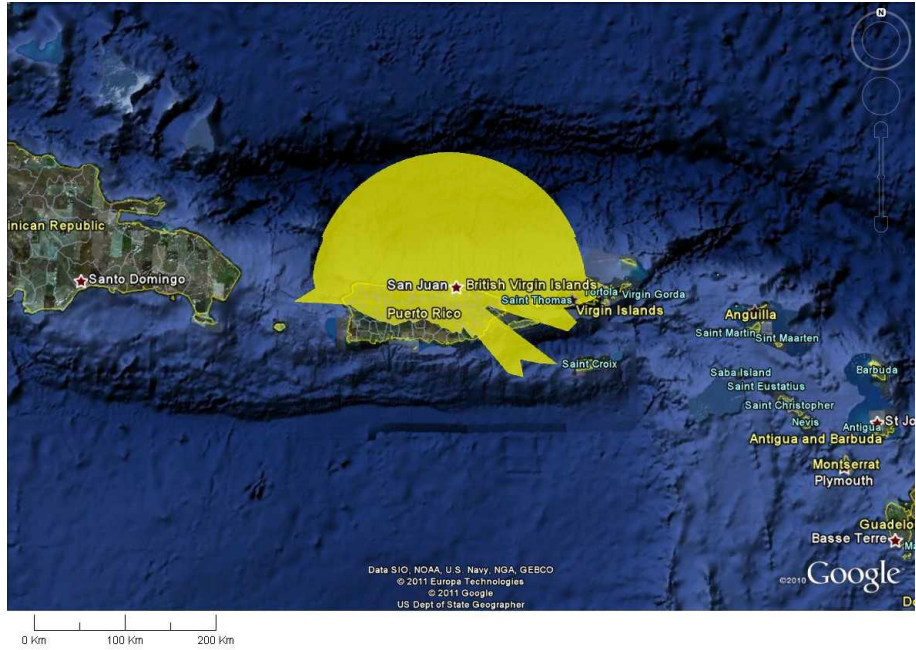


Figure 2. 1240-1245 MHz Band Segment

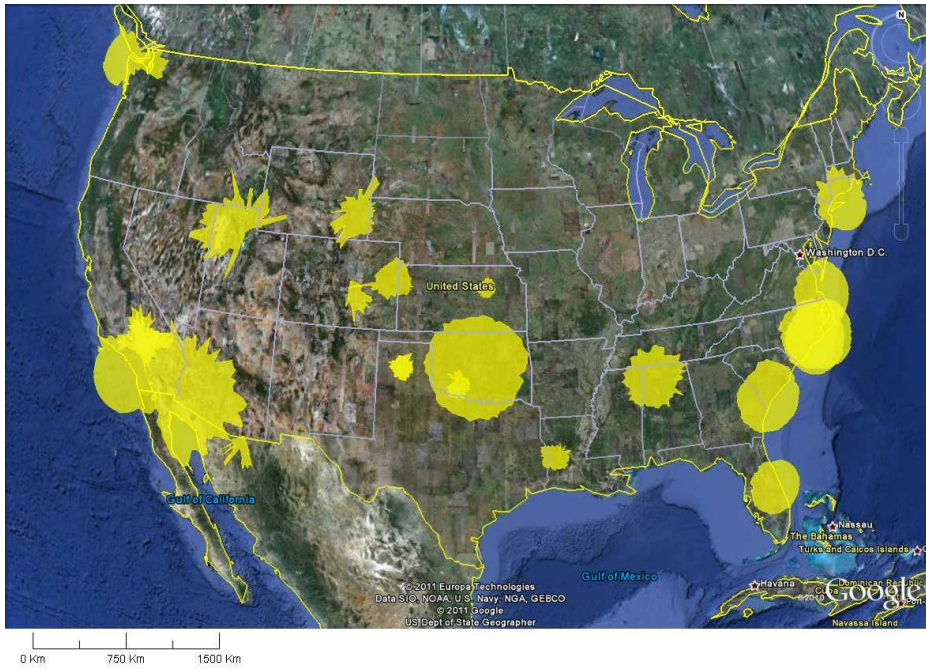


Figure 3. 1245-1250 MHz Band Segment



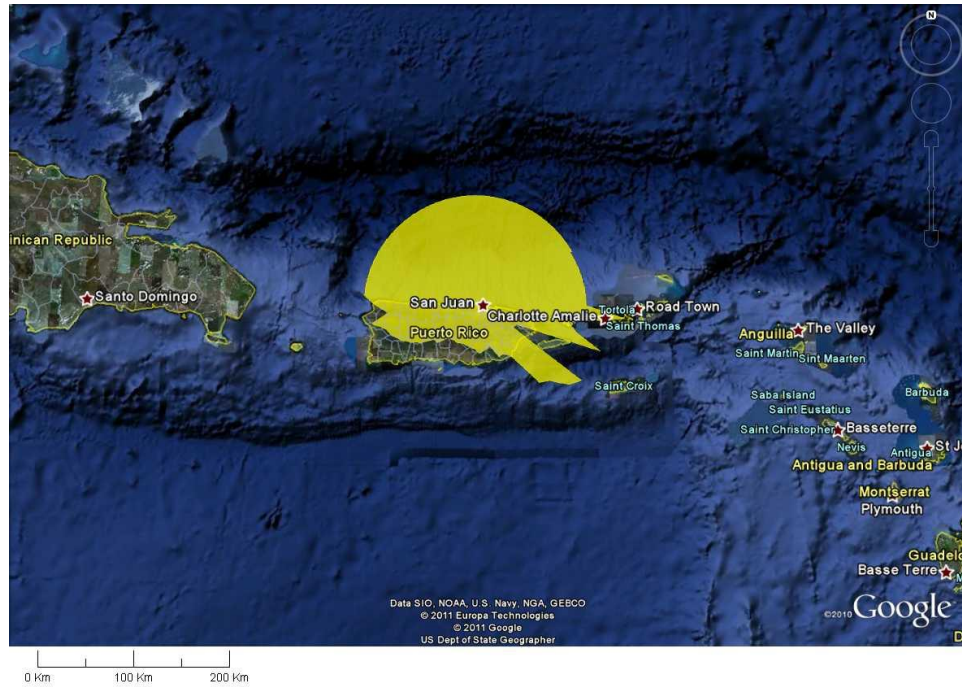


Figure 4. 1245-1250 MHz Band Segment

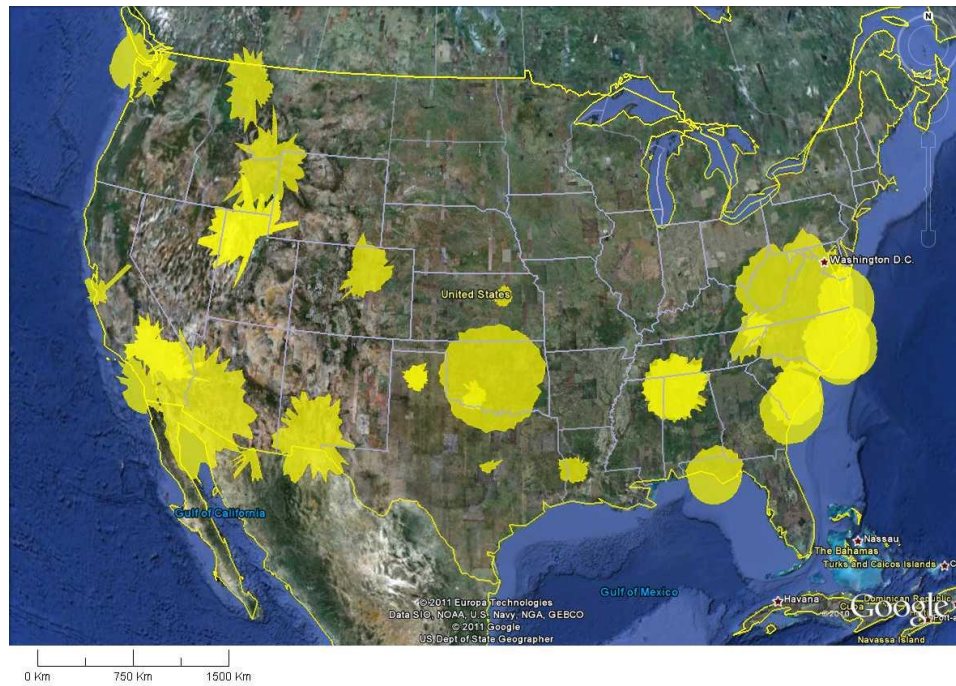
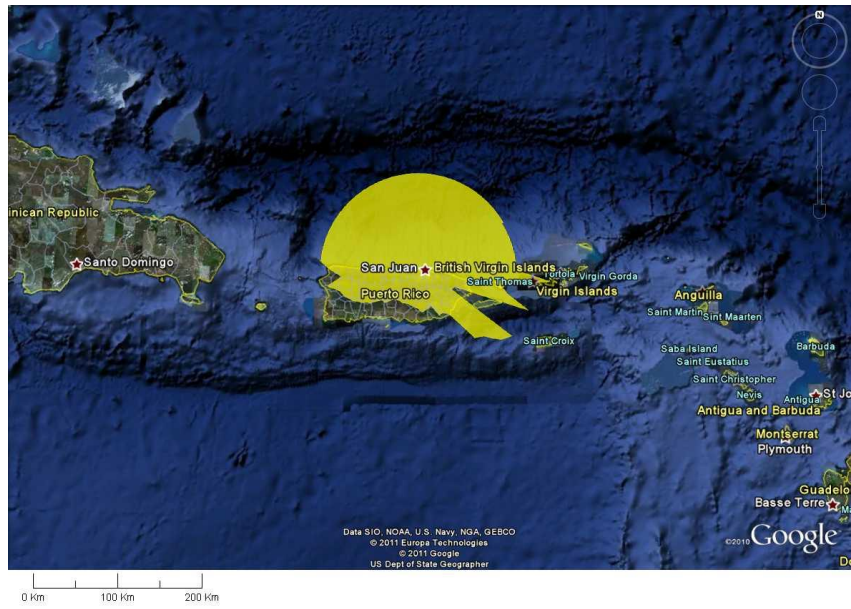
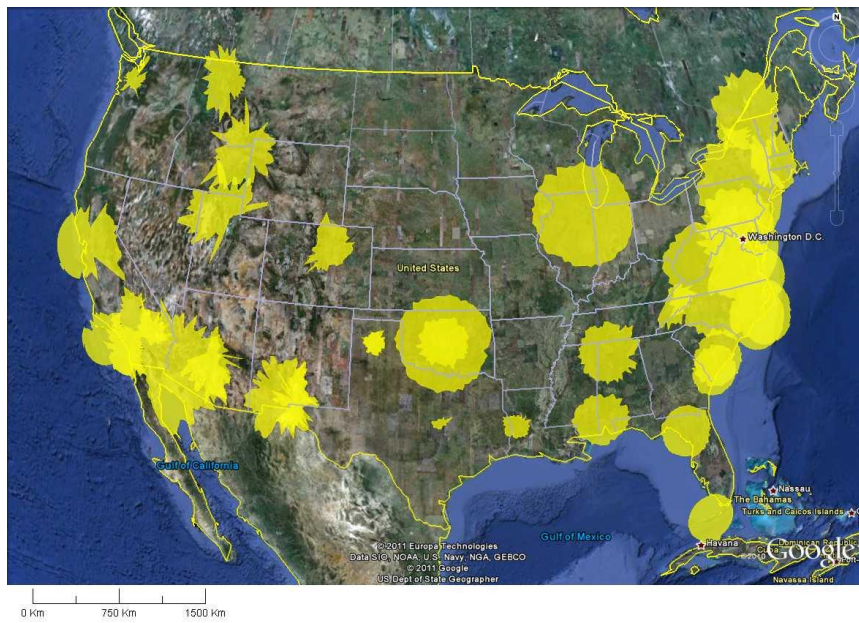


Figure 5. 1250-1255 MHz Band Segment



**Figure 6. 1250-1255 MHz Band Segment**



**Figure 7. 1255-1260 MHz Band Segment**



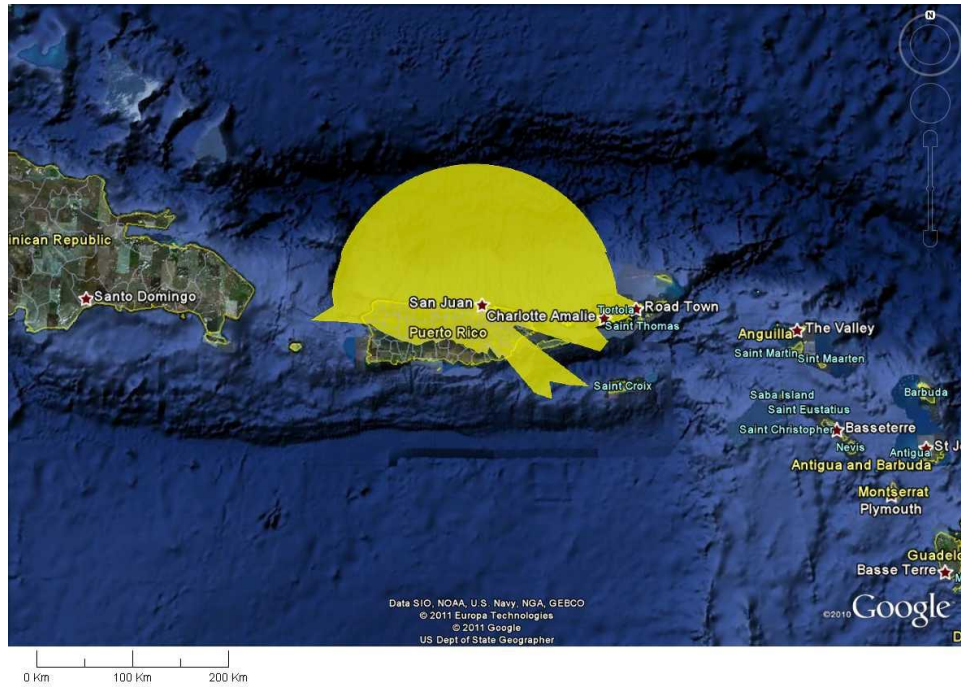


Figure 8. 1255-1260 MHz Band Segment

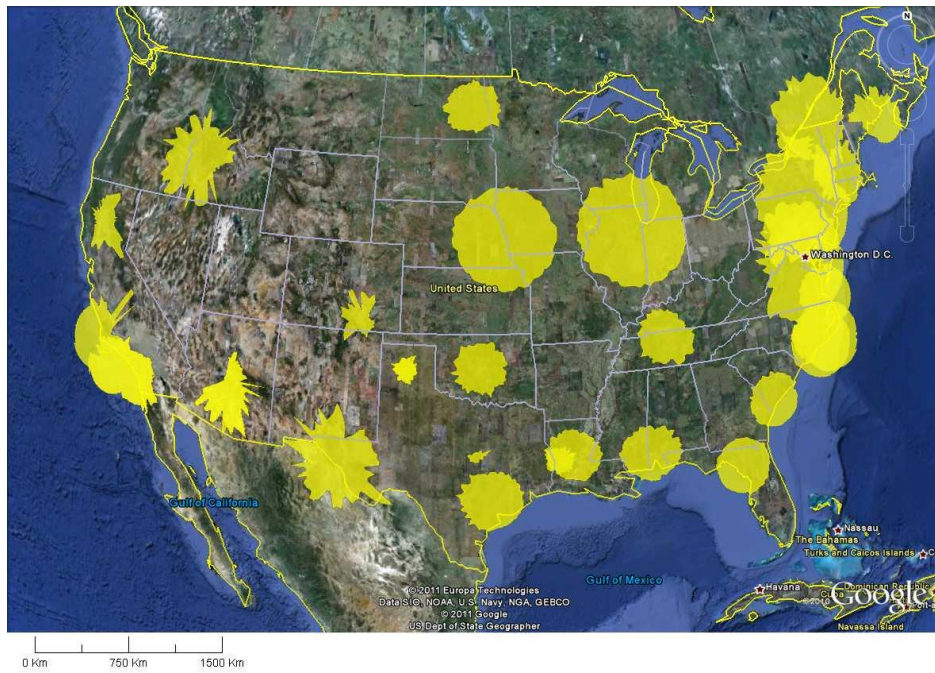


Figure 9. 1260-1265 MHz Band Segment

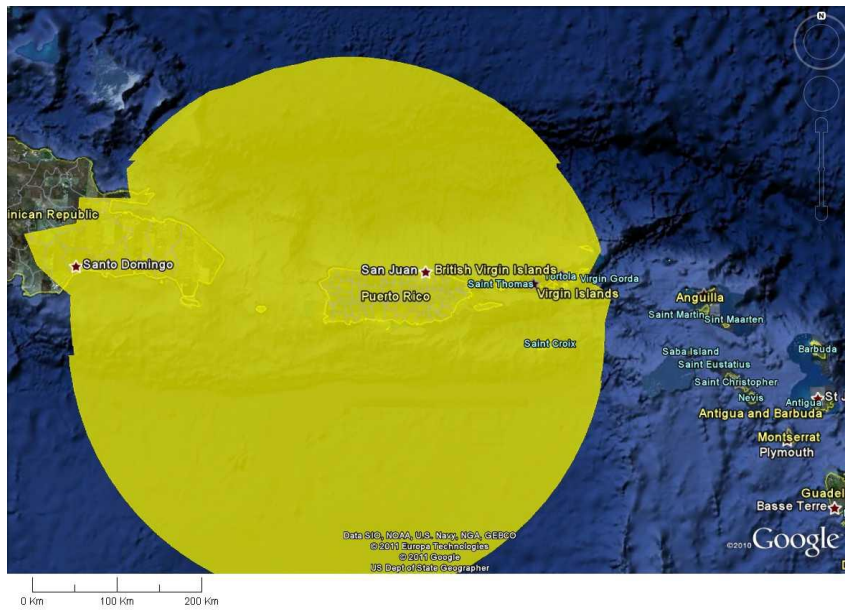


Figure 10. 1260-1265 MHz Band

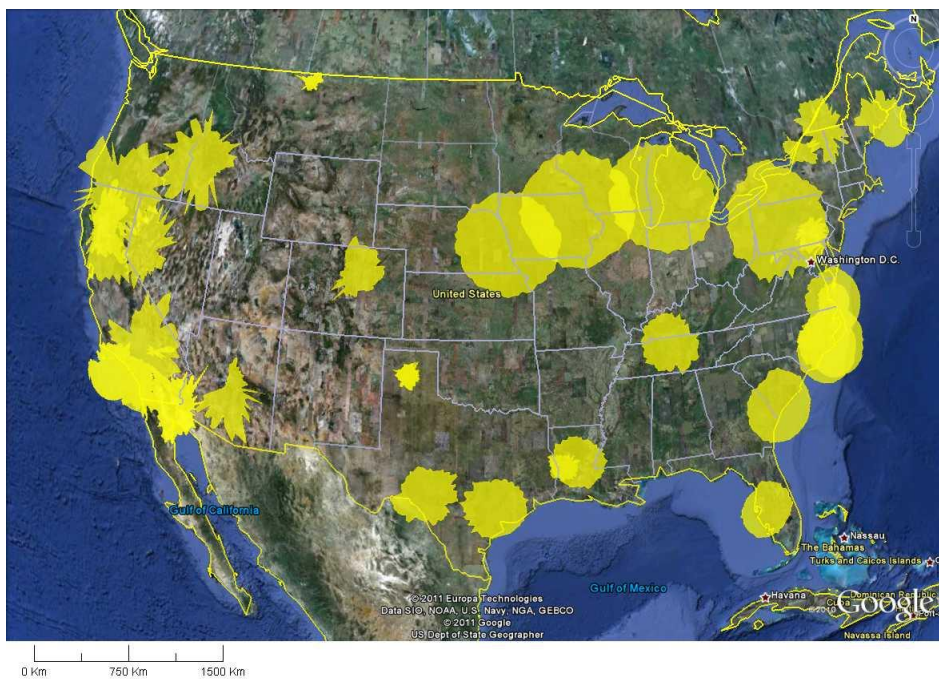


Figure 11. 1265-1270 MHz Band Segment



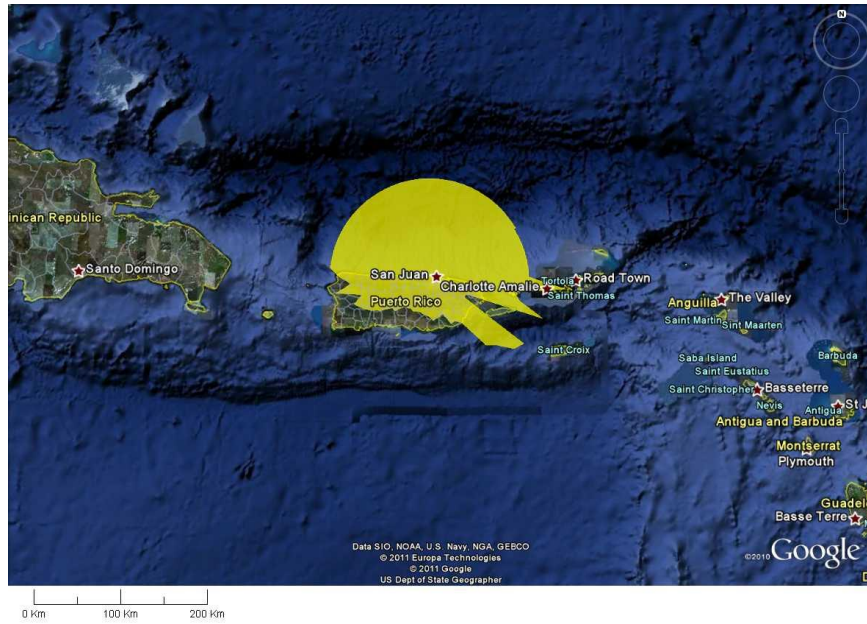


Figure 12. 1265-1270 MHz Band Segment

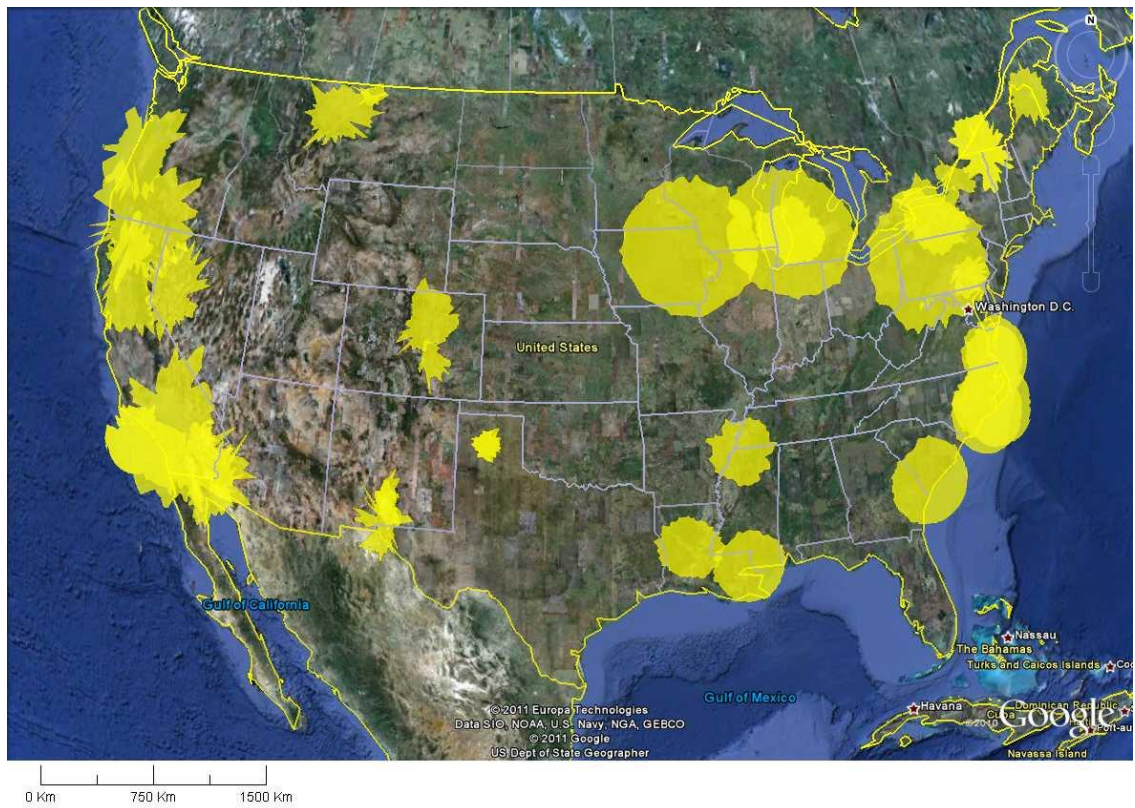


Figure 13. 1270-1275 MHz Band Segment

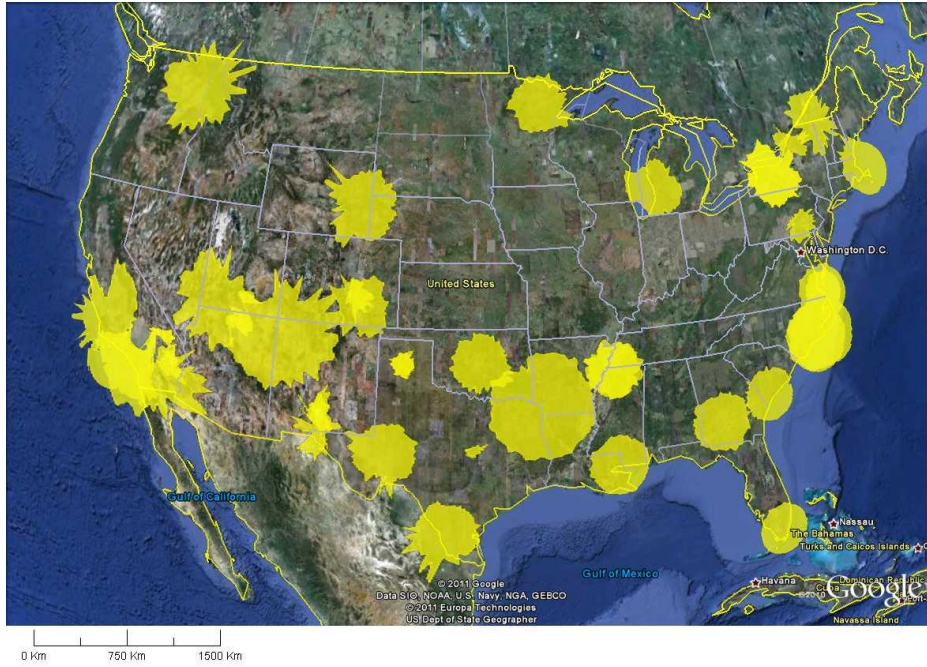


Figure 14. 1275-1280 MHz Band Segment

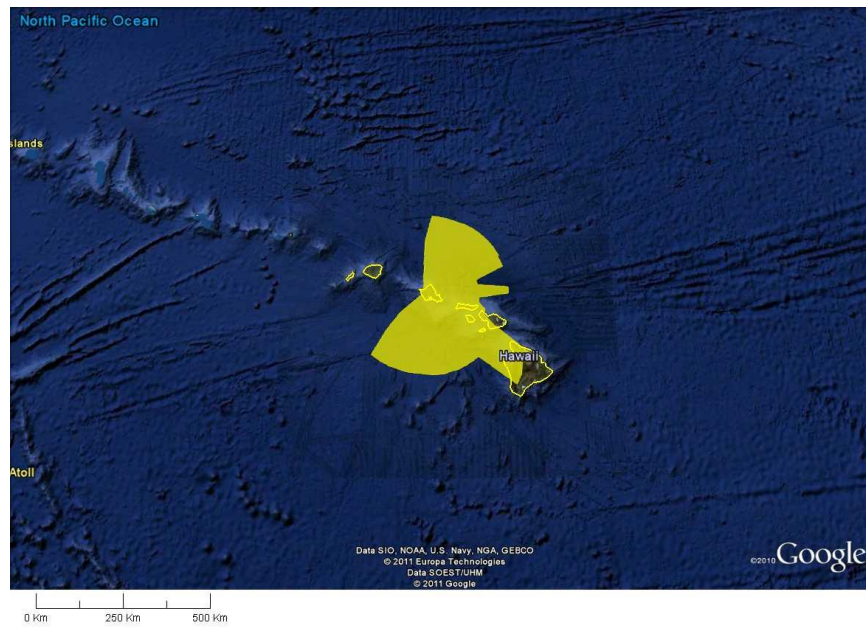


Figure 15. 1275-1280 MHz Band Segment



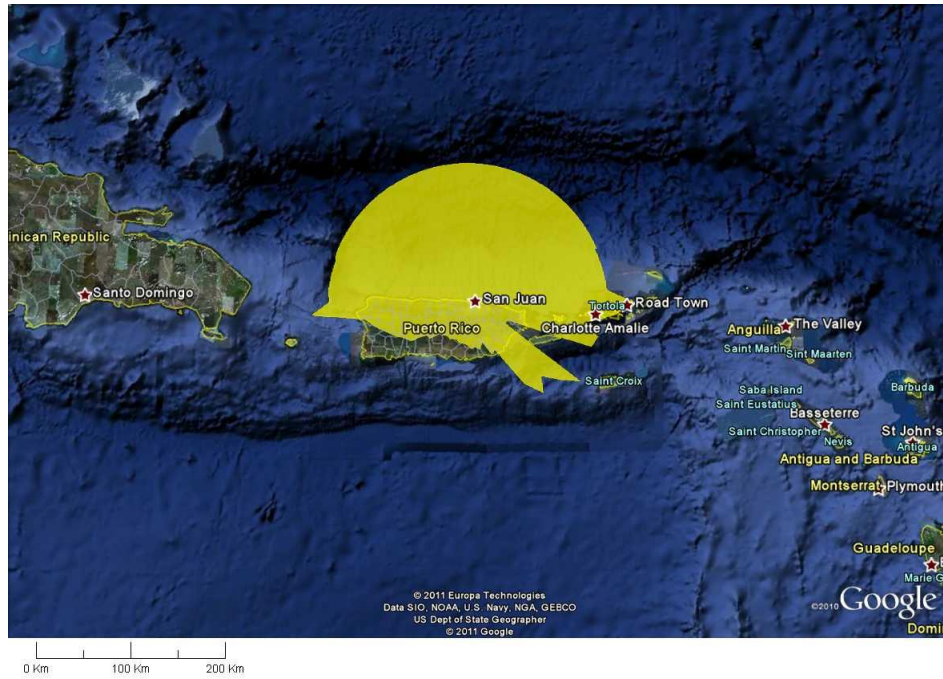


Figure 16. 1275-1280 MHz Band Segment

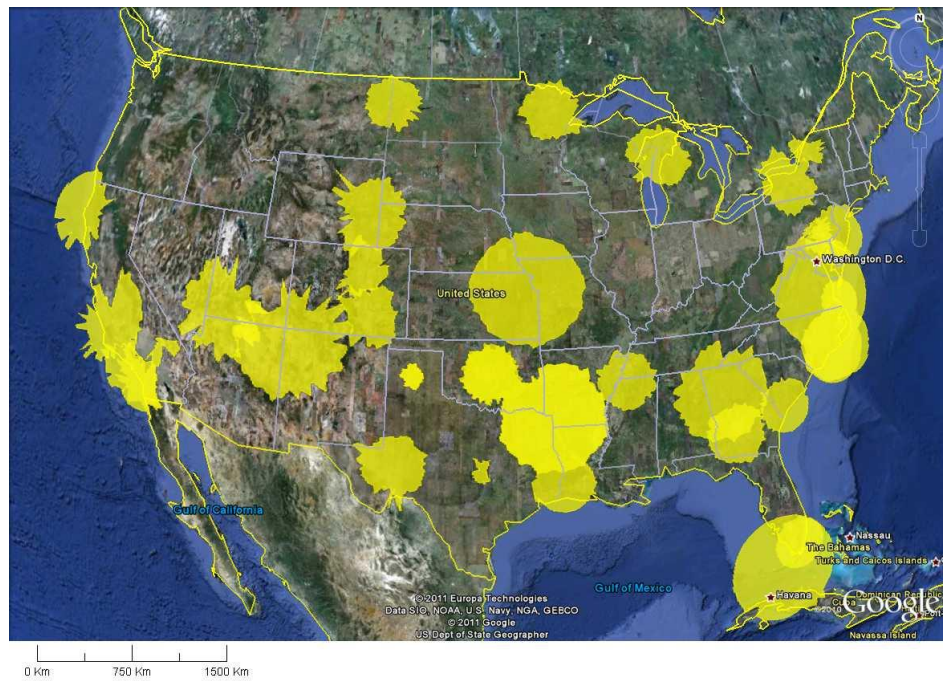
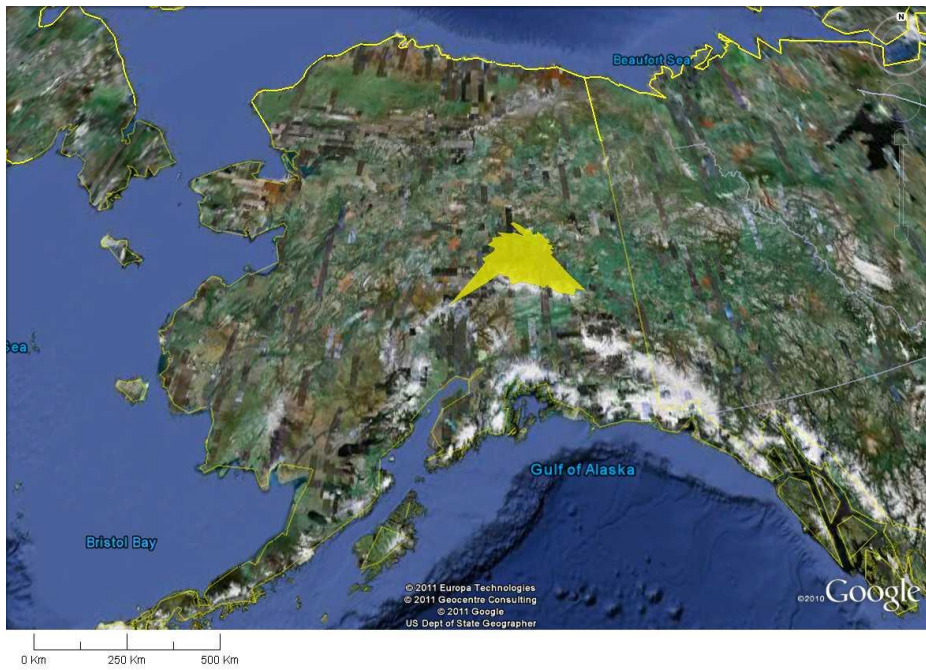
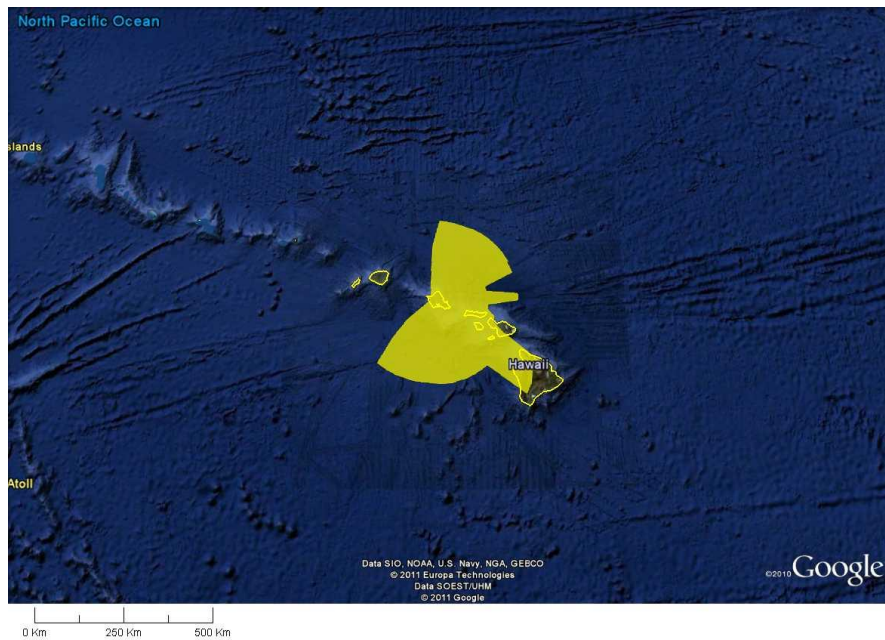


Figure 17. 1280-1285 MHz Band Segment



**Figure 18. 1280-1285 MHz Band Segment**



**Figure 19. 1280-1285 MHz Band Segment**



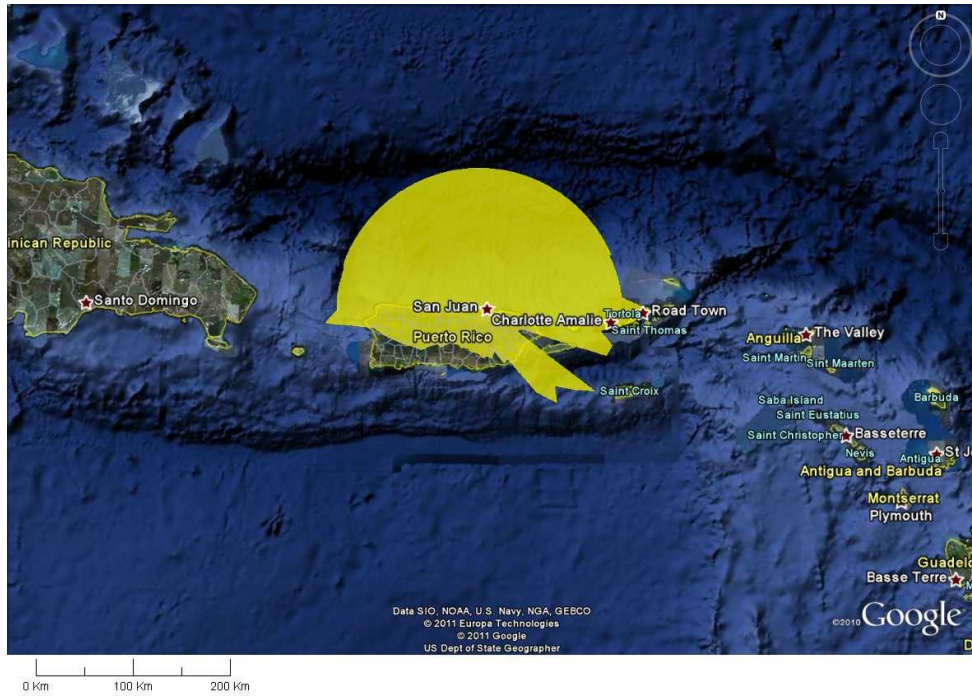


Figure 20. 1280-1285 MHz Band Segment

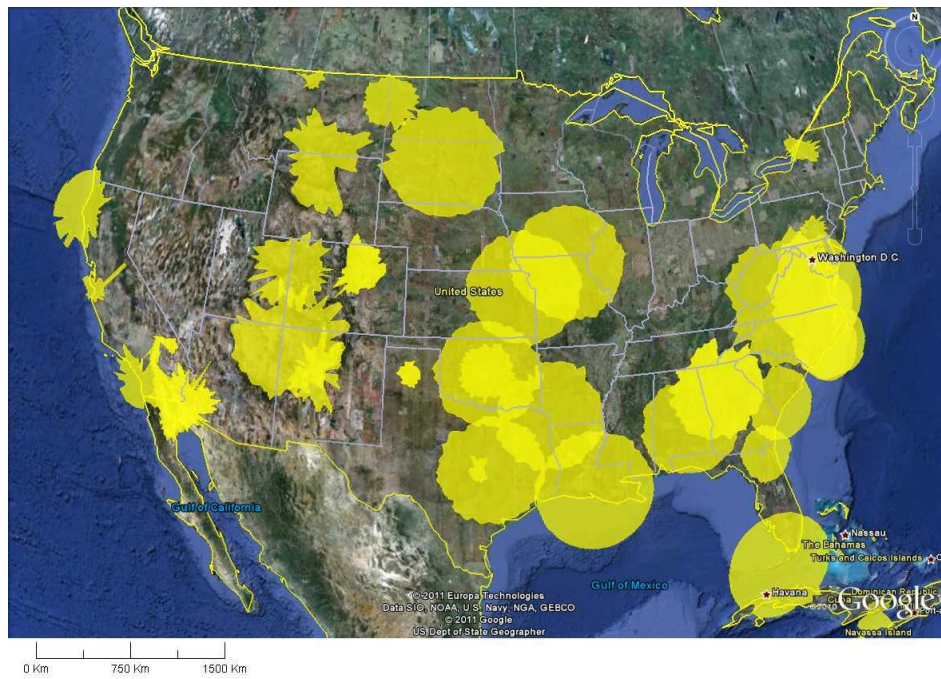


Figure 21. 1285-1290 MHz Band Segment



Figure 22. 1285-1290 MHz Band Segment

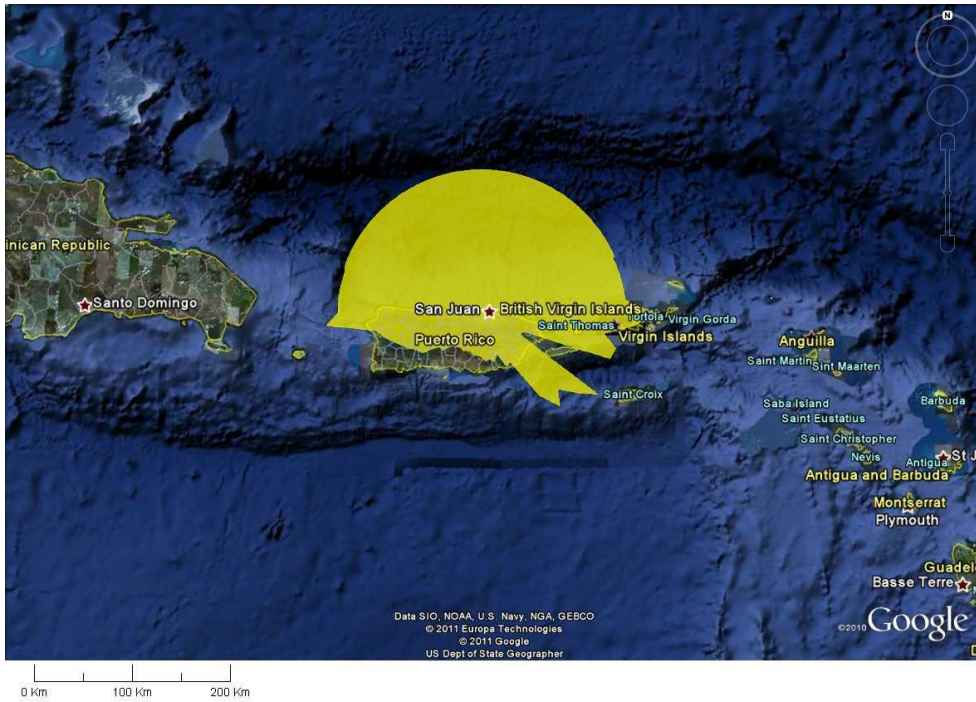


Figure 23. 1285-1290 MHz Band Segment



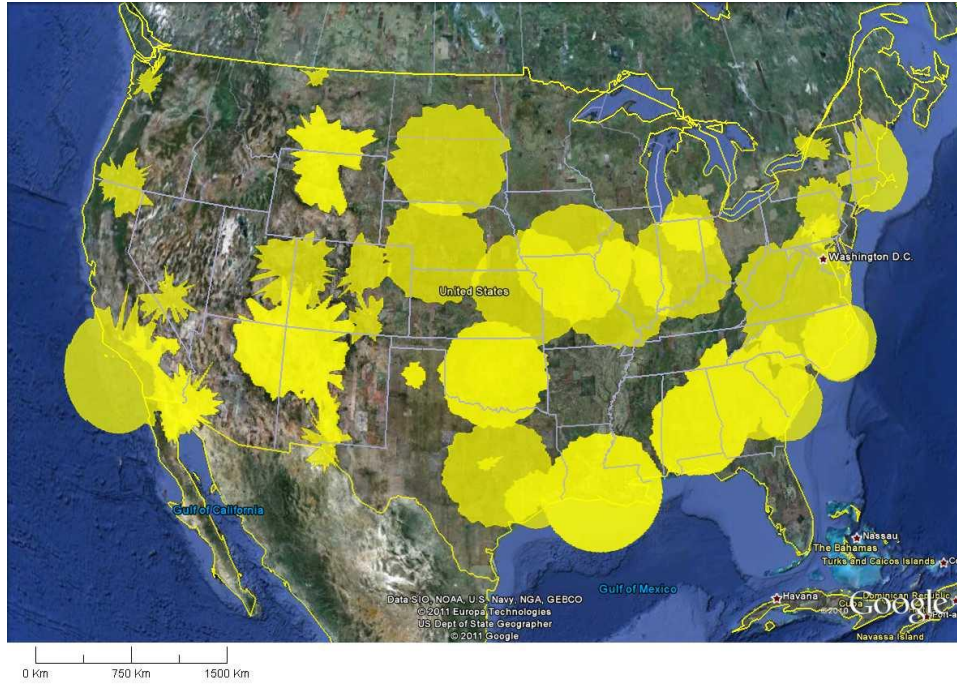


Figure 24. 1290-1295 MHz Band Segment



Figure 25. 1290-1295 MHz Band Segment

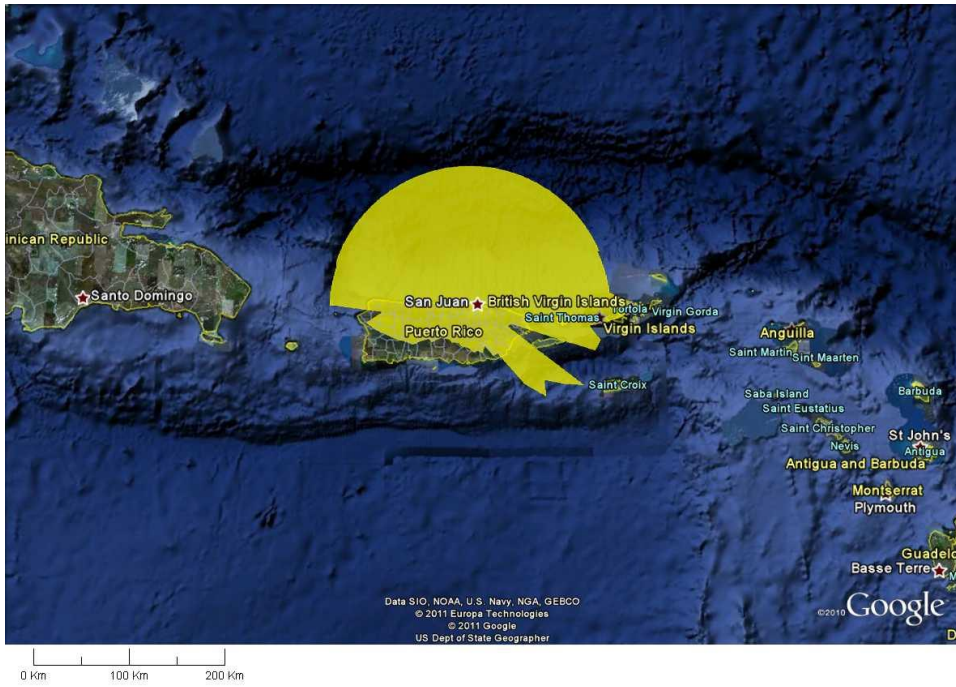


Figure 26. 1290-1295 MHz Band Segment

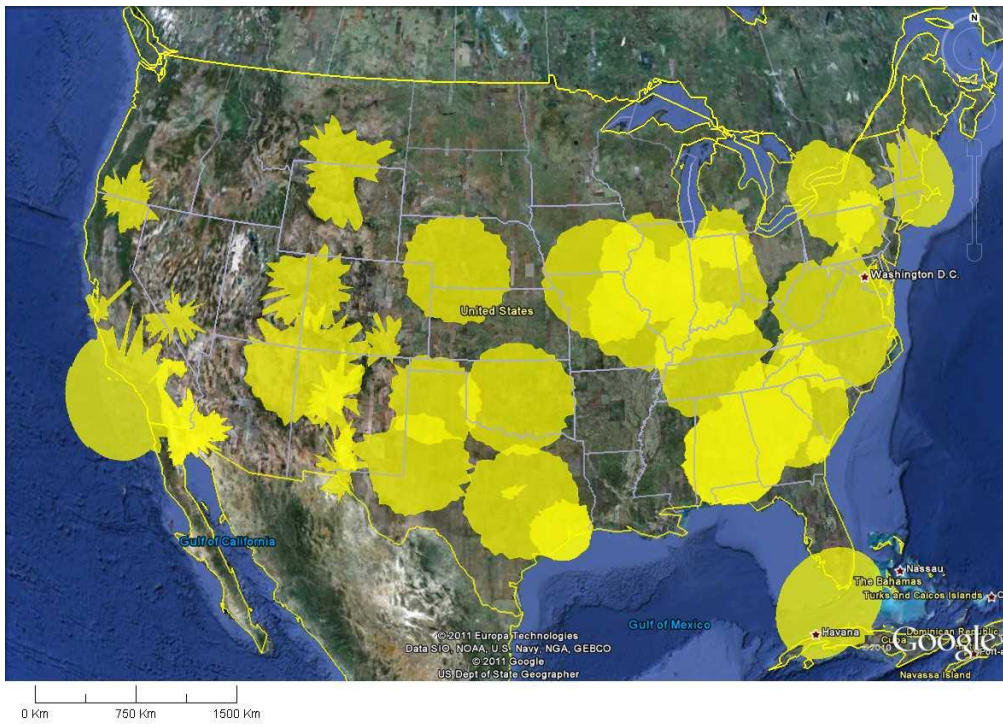


Figure 27. 1295-1300 MHz Band Segment



## **5. Planned Use**

The Federal use of the band 1240-1300 MHz for the long-range radar systems will remain the same for the foreseeable future.

The federal agencies will continue to operate ATC and tactical long-range radar systems in the band 1240-1300 MHz for the foreseeable future.

At this time there are no new installations planned, however new radar sites could be added if the need arises to monitor additional airspace or other vital assets.