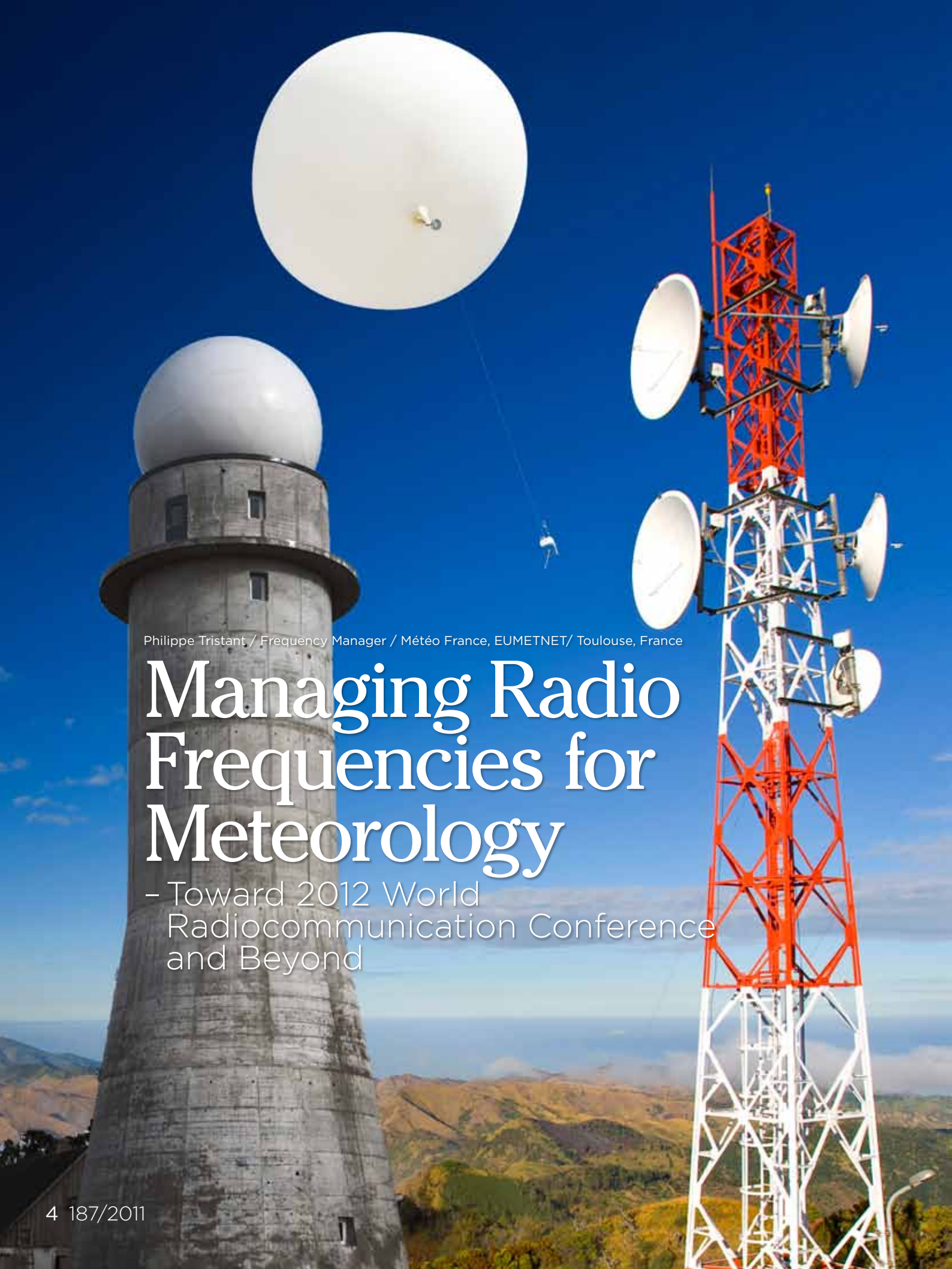


Philippe Tristant / Frequency Manager / Météo France, EUMETNET/ Toulouse, France

Managing Radio Frequencies for Meteorology

– Toward 2012 World Radiocommunication Conference and Beyond

Radio frequencies represent scarce and key resources for National Meteorological and Hydrological Services. They are used to measure and collect the observation data upon which analyses, predictions, and warnings are based or processed, and to disseminate this information to governments, policy makers, disaster management organisations, commercial interests and the general public.

These applications are spread over the whole spectrum of frequencies from few kHz to several hundred GHz and make use of a large variety of radio technologies.

Apart from certain purely "passive bands" used for passive sensing of the atmosphere, the frequency bands allocated to meteorological related radio services are in general shared with other radiocommunication services under regulatory or technical conditions that are expected to allow all applications to operate on a nominal basis.

Radio Regulations

The provisions are given in the "Radio Regulations", an international treaty elaborated during the International Telecommunication Union's (ITU) World Radiocommunication Conferences (WRCs) that meet every 3 or 4 years.

Each WRC has a limited agenda in which items are dedicated to a specific issue that can request, for example, a new frequency allocation for a given type of service or to elaborate new regulatory regimes for certain applications.

The preparation of a WRC is a long process that extends over the time period between two conferences within the ITU Radiocommunication sector (ITU-R). The preparation takes place in a number of Working Parties (WP), some of which are specialised in Meteorological issues. These groups are attended by a number of National Radio Administrations, meteorological services and WMO representatives.

Meteorological Issues at WRCs

Meteorological issues have been on the agenda of the last five WRCs since 1995. Up until the last conference (WRC-2007), the preparation of the meteorological community has not been optimum for such important events and the results have hence been quite contrasted.

Among others, the following issues can be highlighted, stressing the level of threat and potential risk that can be faced by the meteorological community within the WRC process.

1. The possible introduction of Mobile Satellite applications in the 400.15-406 MHz frequency bands with obvious impact on radiosonde operations was initiated at WRC-1995. It was hopefully definitively disregarded at WRC-2003 after a considerable amount of technical and operational argumentation as well as political discussion during the four previous WRCs, thanks to the consistent involvement of the whole meteorological community (users and manufacturers). This issue started to convince meteorological community that the protection of the spectrum used for meteorology was essential and strategic.
2. The allocation of the 5 GHz range for RLAN systems (i.e. high data rate WIFI) at WRC-2003 was not at the time considered an important threat by most meteorological services. Unfortunately, although WRC-2003 imposed operational limitations to RLANs, in particular Dynamic Frequency Selection (DFS) to protect radars (including weather radars in the 5600-5650 MHz), the consequences since then have shown that the highest care should have been taken with this issue. Indeed, numerous interference cases have been experienced worldwide on C-Band weather radars, mainly due to mis-specification of DFS, and that could have led to disastrous consequences, even a total loss of the 5600-5650 MHz band for the meteorological community. The issue allowed to convince the whole meteorological community of the importance of the radio frequency management process and of the need to be present at all levels of preparation, and to consider all WRC agenda items with equal importance.
3. The consideration of the 2.7-2.9 GHz band, used by a number of S-Band weather radars worldwide, as a possible extension band for mobile phones (best known as 3G) was successfully opposed at WRC-2000. This issue was back on the agenda at WRC-2007, and was again successfully argued and opposed. It however shows that radio frequency management is a never-ending process and requires consistent survey and involvement.
4. The general case of the protection of "passive bands" used for satellite remote sensing also needs to be mentioned since it represents a very specific issue that is, in a way or another, on the agenda at all WRCs. These applications, essential for meteorology, involve the measurement of naturally-occurring radiations at very low power levels. The appropriate bands are uniquely determined by the physical properties (e.g. molecular resonance), which cannot be moved and are therefore an important natural resource. Low levels of interference (from in-band or out-of-band interferers) received at the input of the passive sensors may have a degrading impact especially since they are not able to discriminate between these natural radiations and man-made emissions or radiations. Compatibility with passive applications hence needs to be very carefully studied to avoid any risk of harmful interference that would

render the corresponding bands unusable and definitively lost for the meteorological community. All WRCs since 1995 have discussed the protection of these "passive bands" and the proposals to apply emissions power limits to "active" radio services. Although the situation is improving, unfortunately a lot of radio administrations are still not convinced about the necessity to impose such limits and these issues represent a major activity in the management of the meteorological spectrum.

"No spectrum, no global observations!"

– ITU Statement during the Cancun United Nations Climate Change Conference

Summary of Outcomes of WRC-2007

The latest World Radiocommunication Conference, WRC-2007, also considered a number of agenda items of interest to the meteorological community.

Unlike previous conferences, WRC-2007 saw the first global preparation from the meteorological community, in particular from the WMO. Thanks to Meteo France, WMO representation was ensured and it allowed meteorological interests to be duly taken into account.

As a result, WRC-2007 outcomes have been a real, clear and widely recognised success for the meteorological community with agreements on all WMO positions:

- Out-of-band limits on emissions from active radio services to ensure long-term protection of satellite remote passive sensing
- Extension by 100 MHz of the 18 GHz METSAT allocation
- No allocation for mobile telephones in the 2700-2900 MHz band
- Resolution 673 highlighting the importance of Earth Observation activities.

WRC-2012 Agenda

The next conference, WRC-2012, is scheduled to take place in January/February 2012 in Geneva. A number of agenda items representing either an interest or a possible threat to the meteorological community will be up for consideration, in particular:

- agenda item 1.6 dealing with the identification of relevant passive bands for satellite remote sensing between 275 and 3000 GHz.
- agenda item 1.8 dealing with fixed service between 71 and 238 GHz, with consideration of potential out-of-band emission limits to ensure protection of the passive bands.
- agenda item 1.15 dealing with the possible allocation of spectrum between 3 and 50 MHz for oceanographic radars.
- agenda item 1.16 dealing with the possible allocation of spectrum below 20 kHz for lightning detection applications.
- agenda item 1.19 dealing with the possible regulatory conditions to be applied to Software Defined Radio (SDR) and Cognitive Radio Systems (CRS), with possible threats to meteorological systems from CRS applications.
- agenda item 1.20 dealing with the possible identification of spectrum for High Altitude Platform Stations (HAPS) in the 5850-7075 MHz frequency range and potential impact on satellite passive sensing in the 6425-7075 MHz band.
- agenda item 1.22 dealing with the effects of emissions from Short Range Devices (SRDs) in order to ensure that radiocommunication services are adequately protected.
- agenda item 1.24 dealing with possible extension of the existing primary allocation to METSAT in the band 7750-7850 MHz to the band 7850–7900 MHz.
- agenda item 1.25 dealing with possible new allocations to the Mobile Satellite Service in the 4-16 GHz frequency range with potential threats to a number of meteorological applications.
- agenda item 8.1.1c following-up Resolution 673 adopted at WRC-2007 and requesting to study means of improving the recognition and increasing the knowledge and understanding of administrations regarding the use and benefits of Earth Observation applications.

Building upon the success of WRC-2007, the meteorological community has undertaken a similar global preparation for WRC-2012, either at the European level or within ITU-R, issuing several position documents and attending all relevant meetings.

Thanks to this preparation, considering the various positions taken by worldwide radio administrations, one can expect that this preparation will more than likely lead to a successful outcome on most agenda items. At this stage, only agenda items 1.8, 1.20 and 8.1.1c present situations for which different views are expressed and would hence require additional work and lobbying.

Future Issues and Necessary Actions

Within WRC-2012 agenda, item 8.2 aims at defining the agenda for the next WRC (probably in 2016). Although there is not yet a clear picture of the whole agenda, one can expect that the preparatory period will be difficult for the meteorological community as well as for other communities.

It is known for sure that WRC-2015/2016 will consider a specific item, new spectrum for 4G broadband mobile telecommunications, with expectation of several hundred of MHz, mainly targeting spectrum below 5 GHz. This issue has already

been discussed in the US in particular, with a goal to find up to 500 MHz of new spectrum allocations, already targeting the 1675-1710 MHz band widely used by meteorological satellites.

Similar process is on its way in Europe where the European Parliament recently issued the "Radio Spectrum Policy Program" (RSPP) asking for about 1200 MHz new spectrum for telecommunications applications.

The "mobile" community represents a huge economical weight, hence benefitting from heavy political support, and it will without any doubt roll into the discussions with unlimited means and large lobbying teams. The whole game will be played between the mobile community that will seek allocations in various bands and the incumbent users (civil aviation, broadcast, satellite, etc.) who will all argue to push the mobile applications in bands used by the others. The meteorological community will have relevant cards to play, provided that they'll join the table.

People all around the world are now expecting to have telecommunication facilities that are easy to handle, have no constraints and allow for high data rate wireless connections at home, at the office and from every remote area. To satisfy this demand, radio engineers are working with an inventiveness and skill that have almost no limit, helped by impressive technological breakthroughs.

Although the meteorological community also uses telecommunication facilities and will hence take advantage of these new spectrum allocations in one way or another, this trend represents a growing threat to the frequency bands used for meteorological purposes. It could have a tremendous impact on meteorological forecast and warning capability – with related financial and societal consequences.

In the frequency management process, cooperation between meteorological services, researchers and the industry is essential to safeguard current and future use of frequency bands and to give a reinforced visibility for the meteorological requirements in the international instances where frequency management now takes place.

It must however be recognised that such involvement is sometimes limited in that the decision-making process is mainly controlled by national radiocommunication authorities who also have to satisfy telecommunications needs.

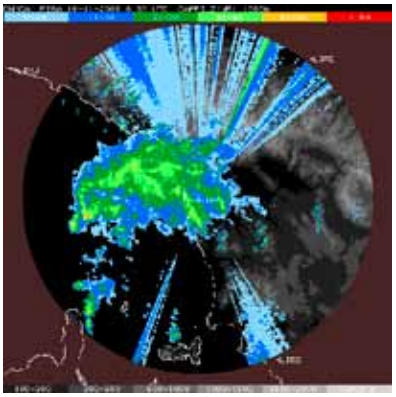
The meteorological community should hence be aware that action through international bodies would be significantly facilitated by consistent actions on a national basis of each meteorological service, research body and manufacturer. This would convince the world on the essential need of accurate meteorological forecast and warning capability for public safety as well as a large number of economical activities, and hence on the necessity to maintain the availability of the frequency bands used for meteorological purposes.

The meteorological community cannot afford to be absent from these debates, and need to be involved at all steps and during the whole WRC preparation process.

Meteorological Applications Relying on Radio Frequencies Include:

- radiosondes (mainly in the 400 and 1700 MHz bands)
- weather radars (mainly in the 2.8, 5.6 and 9.4 GHz bands)
- windprofilers (mainly in the 50, 400 and 900/1300 MHz bands)
- space-borne passive sensing performing measurements of natural radiation in frequency bands that depend on physical laws (e.g. 1.4 GHz, 24 GHz, and up to 400 GHz nowadays)
- space-borne active sensing (altimeters, cloud profiling and precipitation detection,…) (e.g. in the 5, 9.5, and 35 GHz bands)
- lightning detection (in bands from below 20 kHz up to 120 kHz)

All applications are described in detail in the handbook "Use of radio spectrum for meteorology: Weather, Water and Climate Monitoring" issued by the International Telecommunication Union and the World Meteorological Organisation (2009).



Example of interference on a meteorological radar (Pisa, Italy).