# JMR Side Lobe Correction

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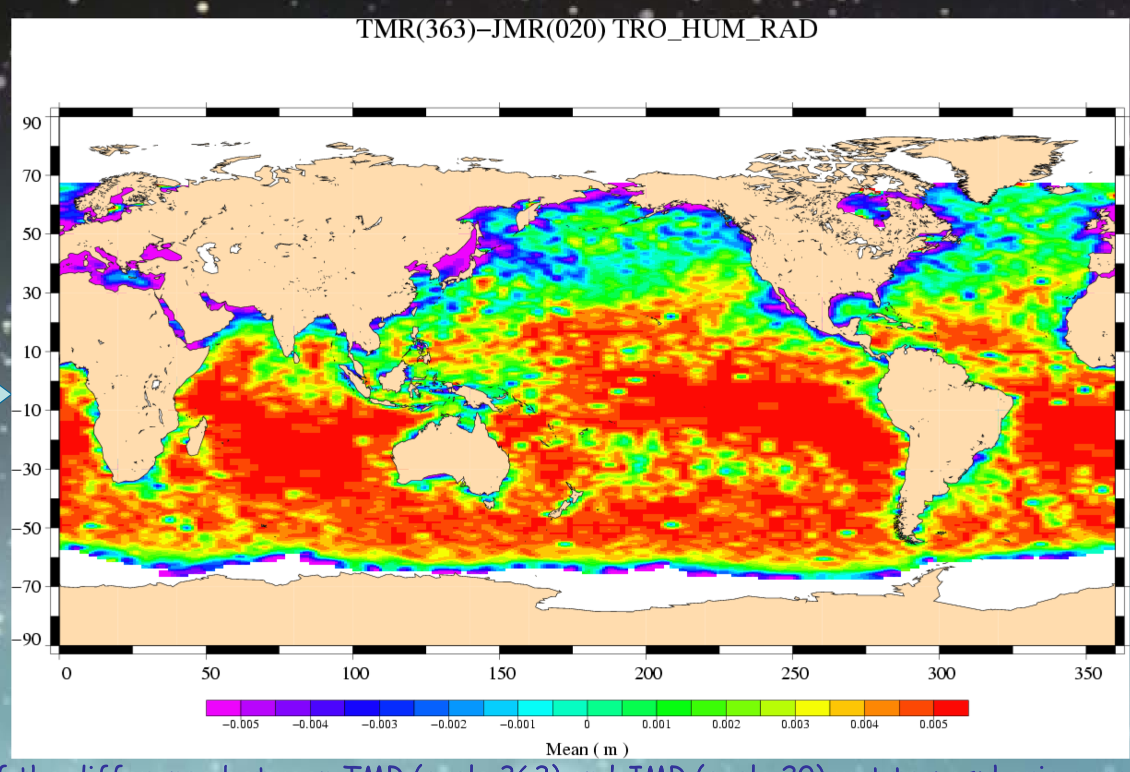
## OVERVIEW

The objective of this study is to explain the differences observed between the TMR and the JMR wet tropospheric corrections, near coasts, and particularly in the north hemisphere. This latitudinal dependence can be related to the side lobe correction since it is the only term in the radiometer brightness temperature formulation that presents an imposed dependence on latitude. In order to understand furthermore these differences observed between TMR and JMR wet tropospheric corrections, the side lobe corrections applied on the raw antenna temperature measurements for both instruments are analyzed in details and compared.

A more physical method to perform this correction, that is already use in the ENVISAT/MWR processing, is presented and the impact on the brightness temperatures and wet tropospheric correction are estimated.




Map of the difference between TMR (cycle 363) and JMR (cycle 20) wet tropospheric correction.

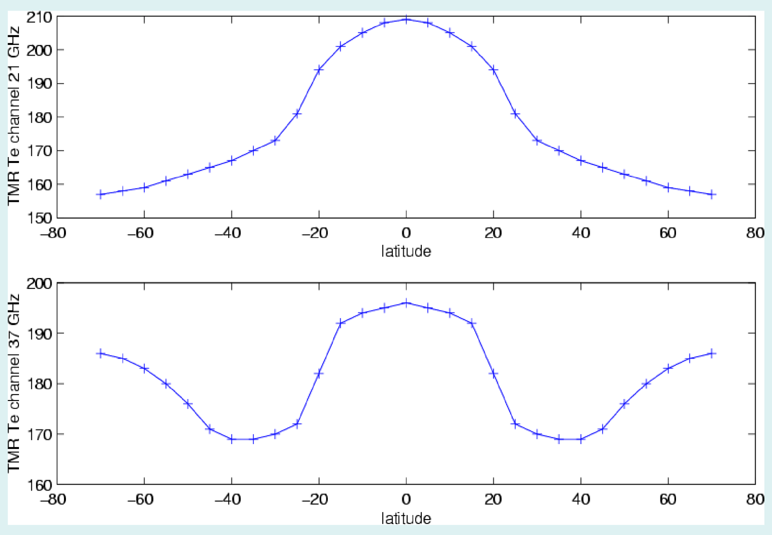
| | Channel (GHz) | b | c | Tc (K) | e | f |
|---|---|---|---|---|---|---|
| TMR | 18 | 0.0278 | 0.0049 | ?2.7 | - | - |
| JMR | 18.7 | 0.0385 | 0.043 | 2.758 | 2.1267 | -2.914e-03 |
| TMR | 21 | 0.0316 | 0.0030 | ?2.7 | - | - |
| JMR | 23.8 | 0.0259 | 0.0308 | 2.773 | 2.1267 | -2.844e-03 |
| TMR | 37 | 0.0215 | 0.0037 | ?2.7 | - | - |
| JMR | 34 | 0.0422 | 0.051 | 2.812 | 2.2258 | -3.125e-03 |

The antenna temperature measured by a radiometer comes mainly from the main beam but also from the secondary lobes. If we neglect the weak contribution from both the sun and the platform, the signal in the secondary lobes is due to the earth and to the cosmic background. The brightness temperature in the main lobe, used to retrieve the wet tropospheric correction, is therefore obtained by correcting the antenna temperature for the different contamination contributions:

$$Tmb_i = (Ta_i - b_i\, Te_i - c_i\, Tc_i)/(1-b_i-c_i)$$

## TMR Correction

The Tei brightness temperatures are estimated from a radiative transfer model on a data base of radiosonde measurements (5 sites between 8° and 52° in latitude). These values were then interpolated/extrapolated to obtain a correction table tabulated by step of 5° in latitude.



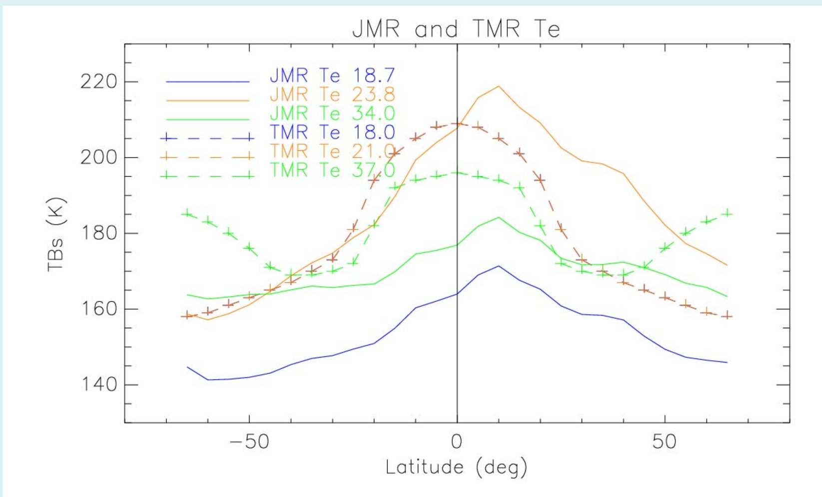

Tabulated values of Te for the 21 and 37 GHz channel, as provided in RD 1.

## JMR Correction

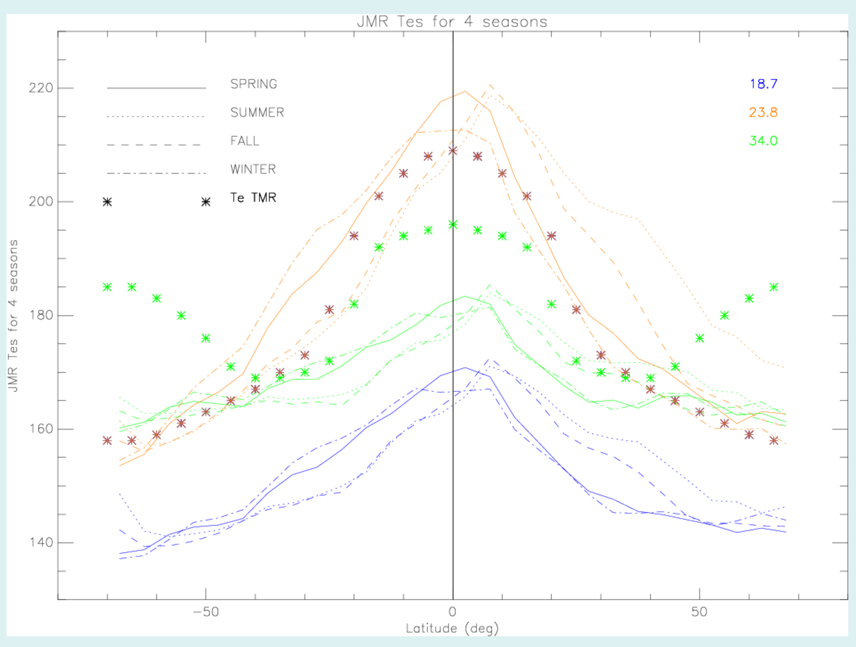
The JMR sidelobe correction development closely follows that of the TMR. Although a big difference is that these Tei corrections are calculated for each pixel as a quadratic function of the antenna temperature :

$$Te_i = d_i\,(lat) + e_i\, Ta_i + f_i\, Ta_i^2$$

The ei and fi coefficients have a constant value for a given channel and di is a latitude dependent coefficient.




Variation of JMR and TMR values of Te as a function of the latitude.




Variation of JMR values of Te as a function of the latitude for 4 different seasons.

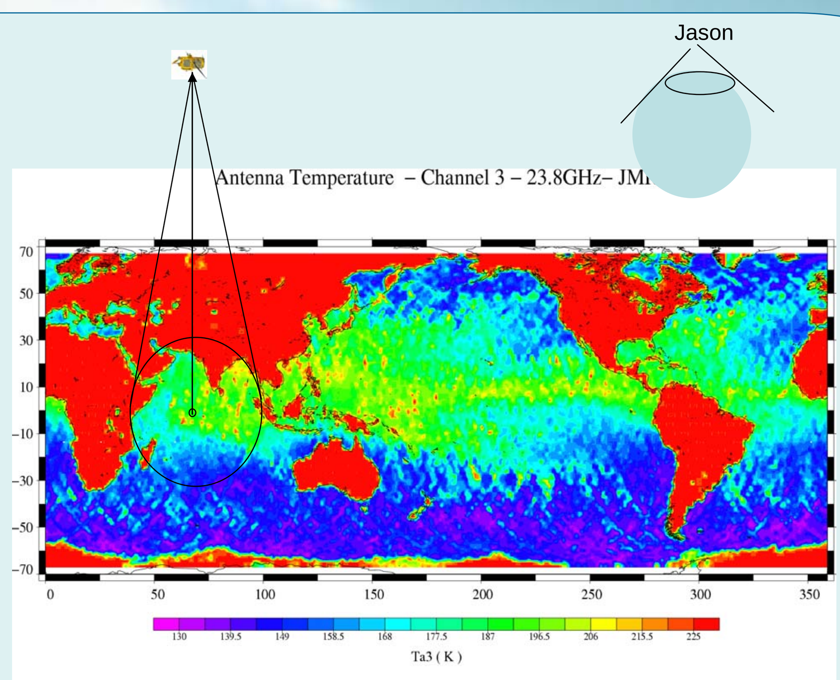
## A new method to correct the side lobe contamination

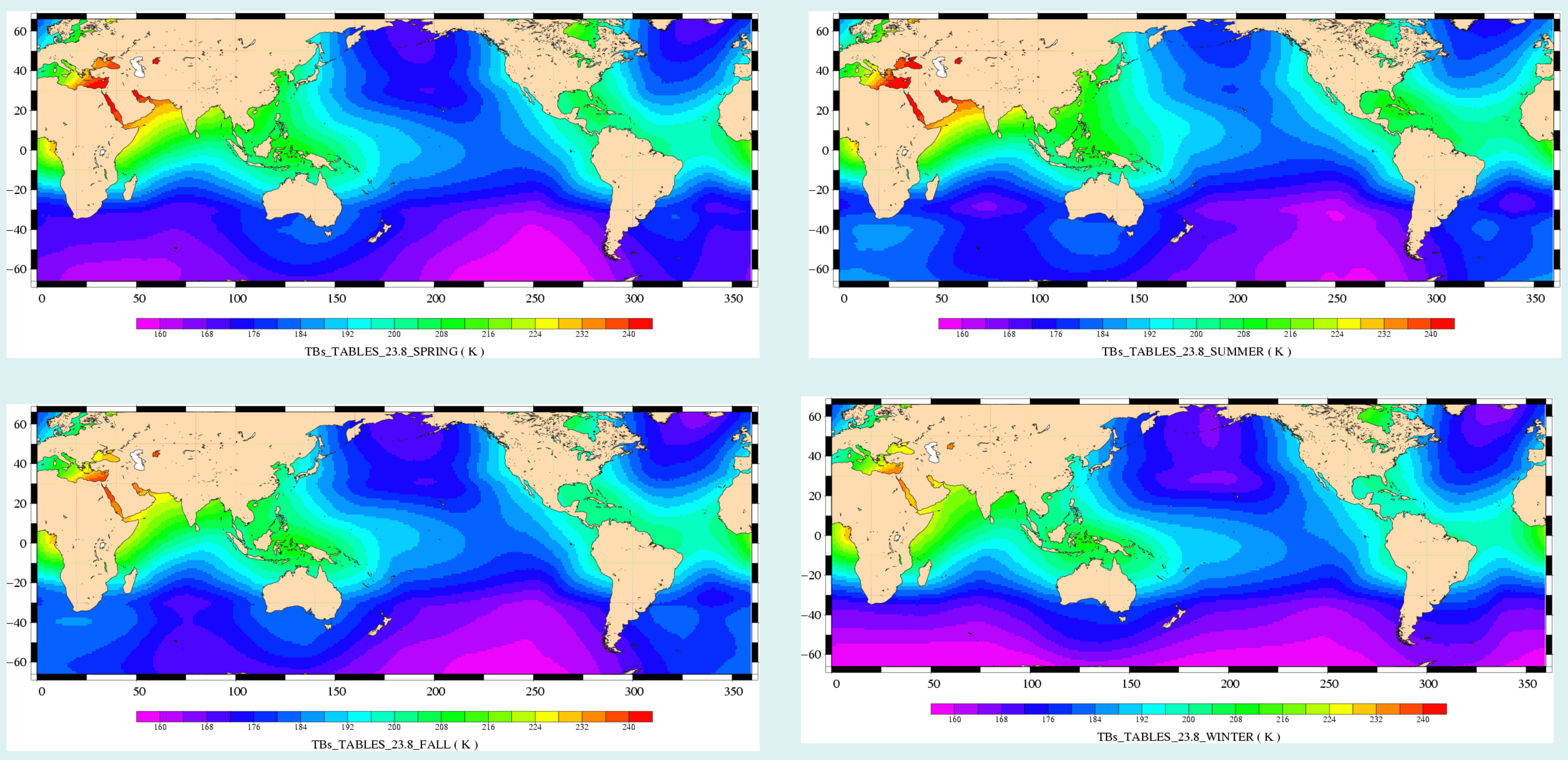
During the preparation phase of the ENVISAT mission, it was early identified that the side lobe contribution would be higher than for its predecessor (ERS2), mainly because of the specific position of the radiometer on the platform that implies a strong reflection of the earth by the satellite in the side lobe (efficiency around 4 %). In this context we propose an accurate correction and that is explained and adapted to the JMR processing

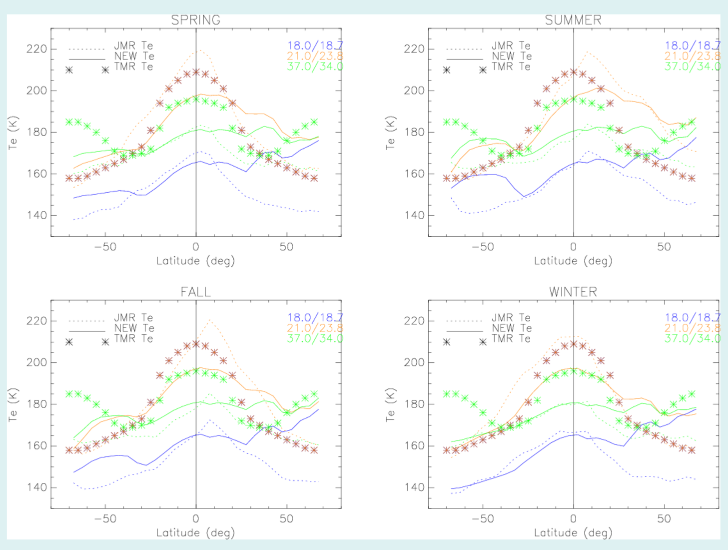
The method consists in the use of one year of measured brightness temperatures over land and sea, to compute the "real" mean brightness temperature in the far side lobe for each point over the globe. We first estimate the total surface of the earth seen by the side lobe of the radiometer when looking at a given point of the surface. For the JMR radiometer, flying at an altitude around 1500 km, the section of the earth seen is approximated with a circle centred on the pixel with a radius of 3600 km.

The globe is divided into 1° per 1° meshes and for each mesh, the mean brightness temperature in each circle centred on this mesh is estimated with one year of JMR measured brightness temperatures, classified in 4 seasons (from cycle 30 to 66). To take into account the brightness temperatures in the part of the far side lobe located at latitudes lower/higher than -/+66°, the brightness temperatures of these two parts of the globe are assumed constant and equal to the value measured at the lowest/highest latitude.

We obtained 12 tables, one for each channel and each season, containing for each mesh of the global grid, the mean JMR brightness temperatures seen in the far side lobe when the radiometer is measuring the antenna temperature at a pixel in this mesh. Brightness temperatures are between 160K in deep ocean (Pacific ocean) and reach 250K along the African and European coasts. Important annual variations appear around the Arabian Peninsula and for latitudes lower the -50° due the melting cycle of the Antarctic ice. The highest brightness temperatures appear during the summer in the North hemisphere and the coldest during the winter.

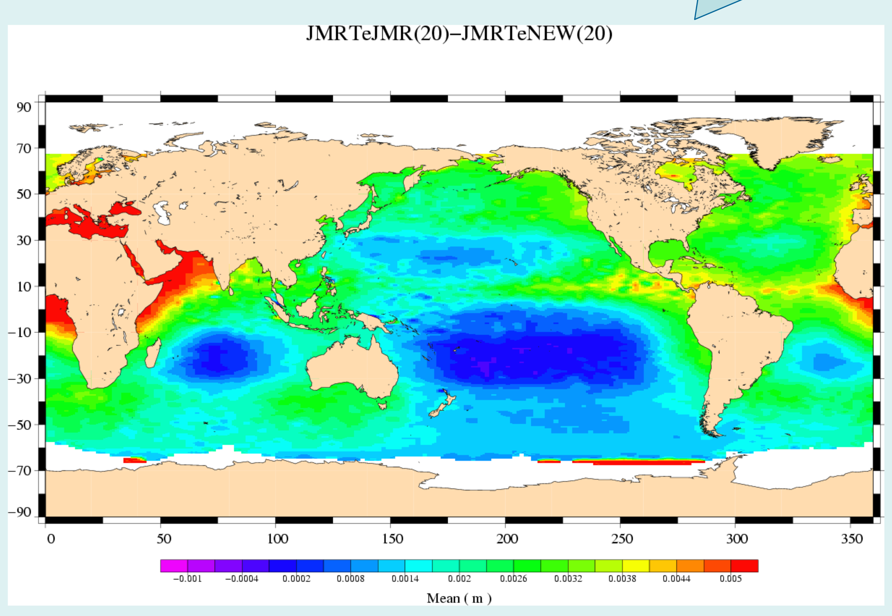



Variations of Te values as a function of the latitude for the four seasons. We indicated the TMR Te values, the JMR Te values and the NEW values obtained with the method described in 3.1.

Impact on the wet tropospheric correction




## CONCLUSIONS

In this study we analyzed the two different side lobe corrections used for the TMR and JMR processings. The first point is that these corrections are significantly different and that this difference explain for the most part the difference between TMR and JMR wet tropospheric corrections. The JMR correction is actually an improvement with respect to the TMR ones, but remains approximative (necessity of the quadratic function of the antenna temperature).

To prepare the Envisat/MWR processing, we developed a new method using the real surface of the earth contaminating the side lobe and the real mean brightness temperature in this surface. The correction is estimated for each geographical position over the globe (1° resolution) and for each season. With this new algorithm, the differences on the final main lobe brightness temperatures are between -2K and +0.5K, and the final impact on the wet tropospheric correction is between -1mm in deep ocean areas (South Pacific) and +5mm in areas surrounded by earth (Mediterannean Sea, Guinea Golf…)