Doris ground antennas Radio Frequency characterization Latest analyses

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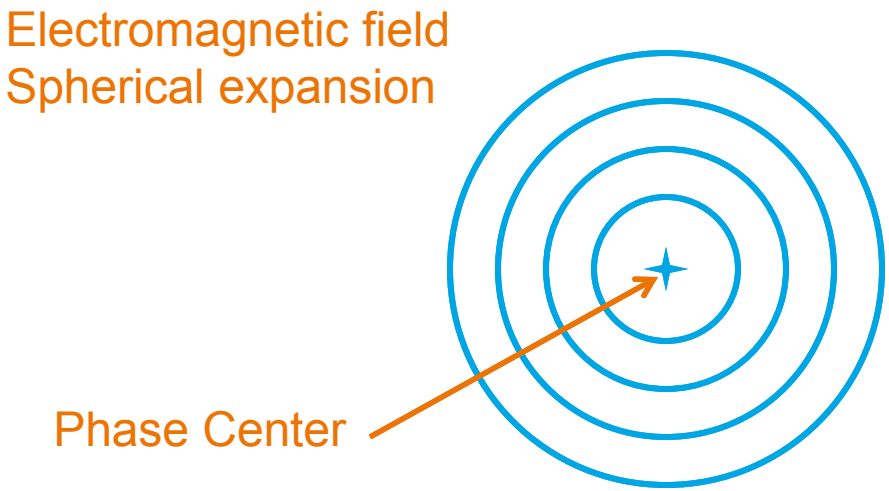
OUTLINE

- PHASE CENTER DEFINITION
- ANALYSIS HISTORY
- NEW APPROACH
- SYNTHESIS
- UPCOMING ACTIVITIES
- RECOMMENDATION FOR ITRF 2013

PHASE CENTER DEFINITION (1)

- The Antenna phase center is
  - a virtual point
  - theoretically defined as the center of the iso-phase sphere

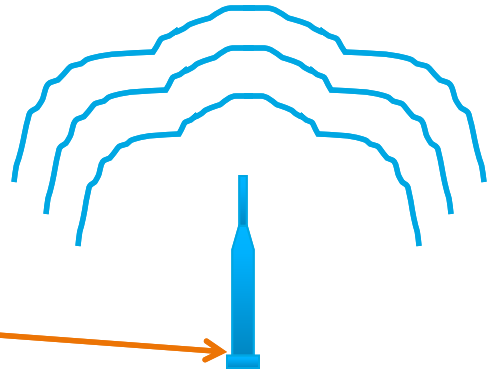


- But …

PHASE CENTER DEFINITION (2)

- The real iso-phase surface of the Antenna is
  - not a sphere
  - but a kind of potato

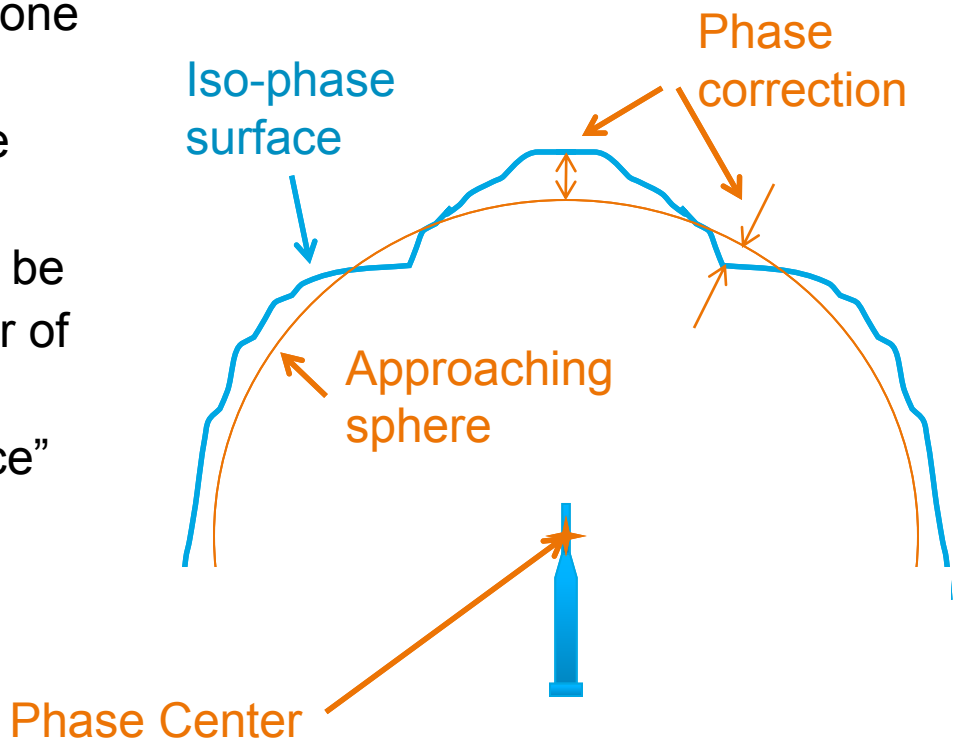
Electromagnetic field
Quasi Spherical expansion



- But …

PHASE CENTER DEFINITION (3)

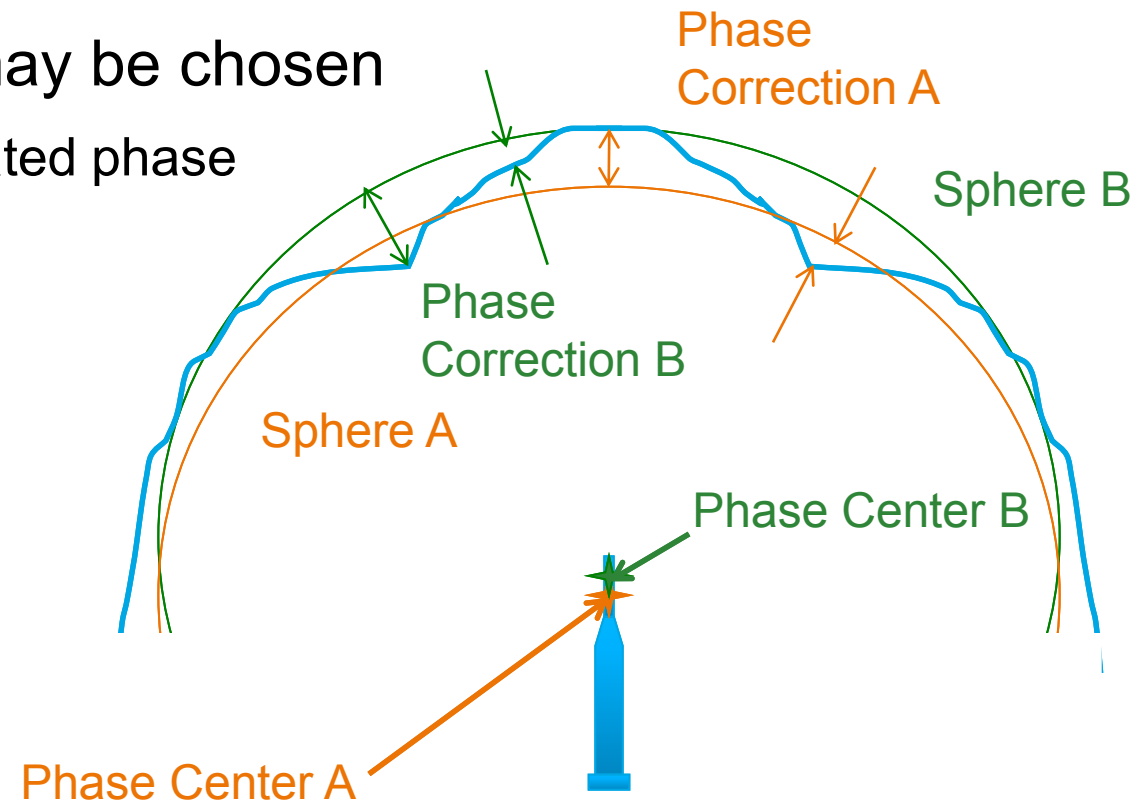
- The potato surface may be approached by a sphere
  - which is generally the closest one of the potato surface
  - at least in a defined part of the useful coverage
  - The center of this sphere may be considered as the phase center of the antenna
  - for each direction, the “distance” between the potato and the sphere defines the “phase correction” associated to the phase center



- But …

PHASE CENTER DEFINITION (4)

- different spheres may be chosen
  - With different associated phase centers
  - and dedicated phase corrections



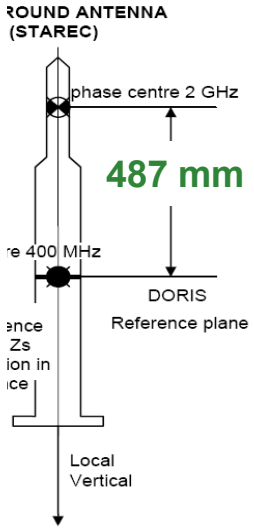
ANALYSIS HISTORY (2GHz Phase law)

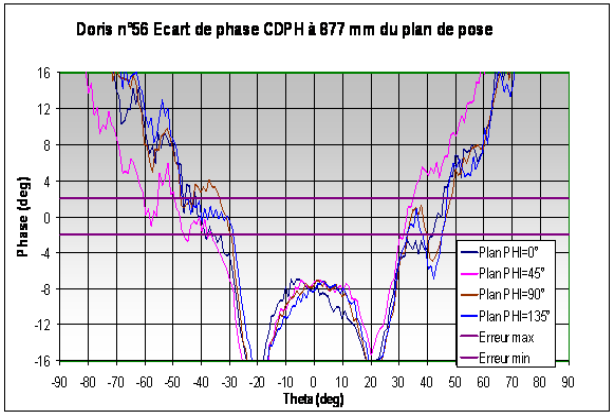
2011-2012 Analysis requested to CNES Antenna Department

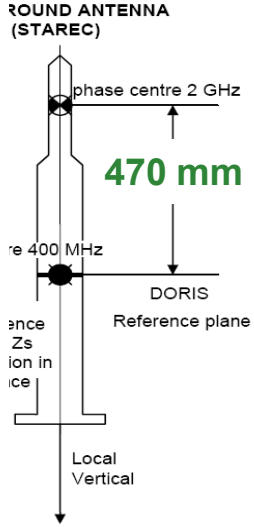
- Determine the phase center position that makes phase law fits with the specification

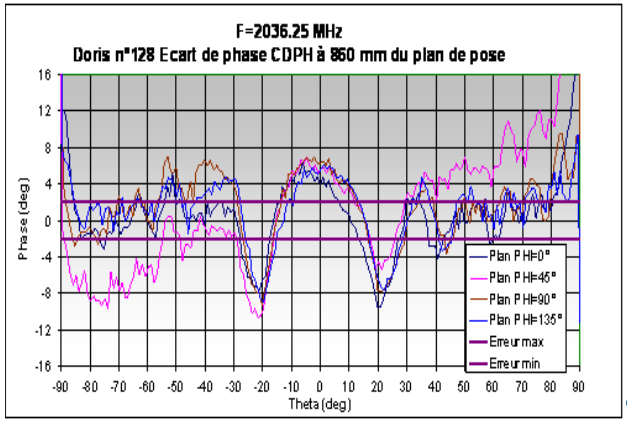
Results

- To have the best consistency between measured and specified phase law, a shift of 17mm of the phase center position is required
- A new phase law can be taken into account to improve this consistency





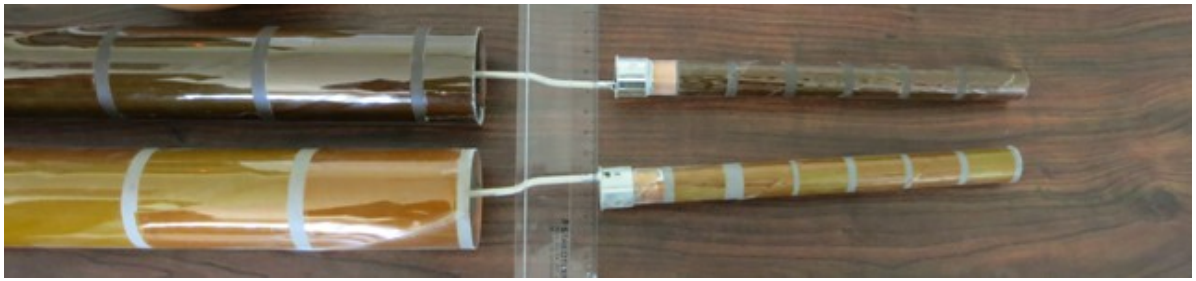




ANALYSIS HISTORY (2GHz Phase law)

2013 : analysis complement

- 17 mm is a strong shift
- Some concerns were raised internally with respect to this result
- To go further, antennas have been dismantled, and measurements have been performed on the 2Ghz hardware



- result :

  - **Antenna number 01 differs from all the others:**
  - **The base of the 2GHz part is about 1cm higher from the others.**

ANALYSIS HISTORY (2GHz Phase law)

Reminder :

- antenna number 01 is the prototype of the Starec antenna
  - » It has never been on the network
- all the other antennas analyzed are series antenna
  - » They were on the network

Note :

- There is a shift of about 1cm between the prototype and series antennas
- The phase law and the phase center position specified by the manufacturer have been determined on the prototype antenna

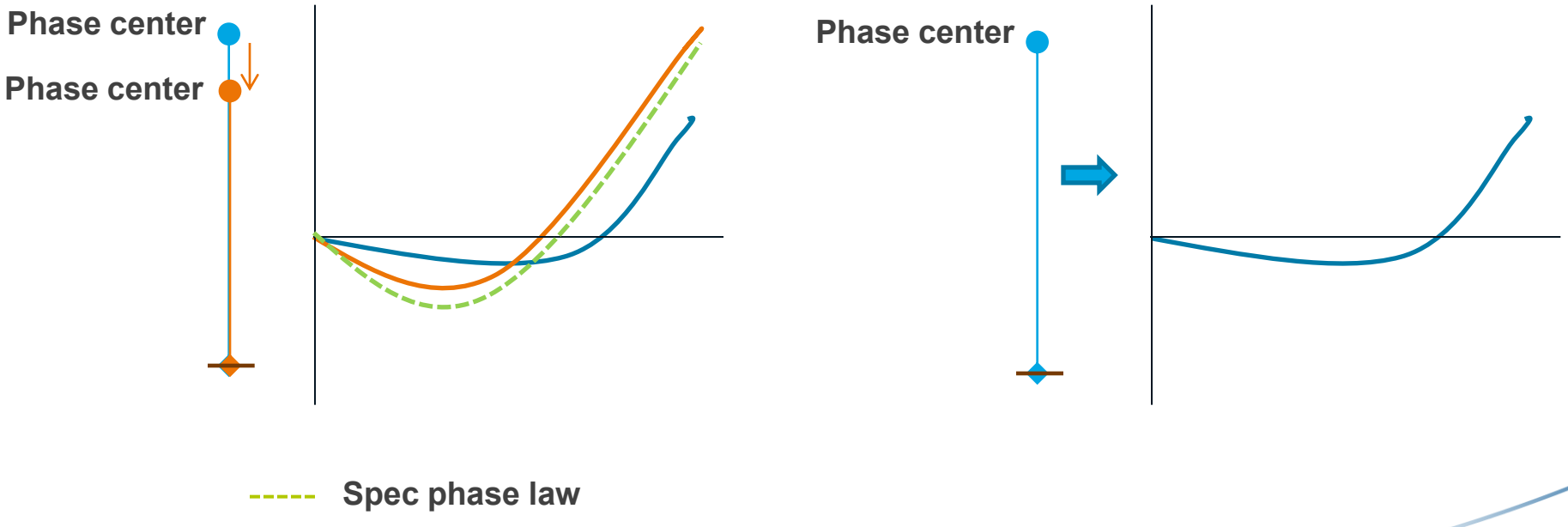
⇒ If we try to fit to the specified phase law, we will have a shift of the phase center position.

⇒ If we keep the specified phase center position, we will find a different phase law.

New characterization protocol

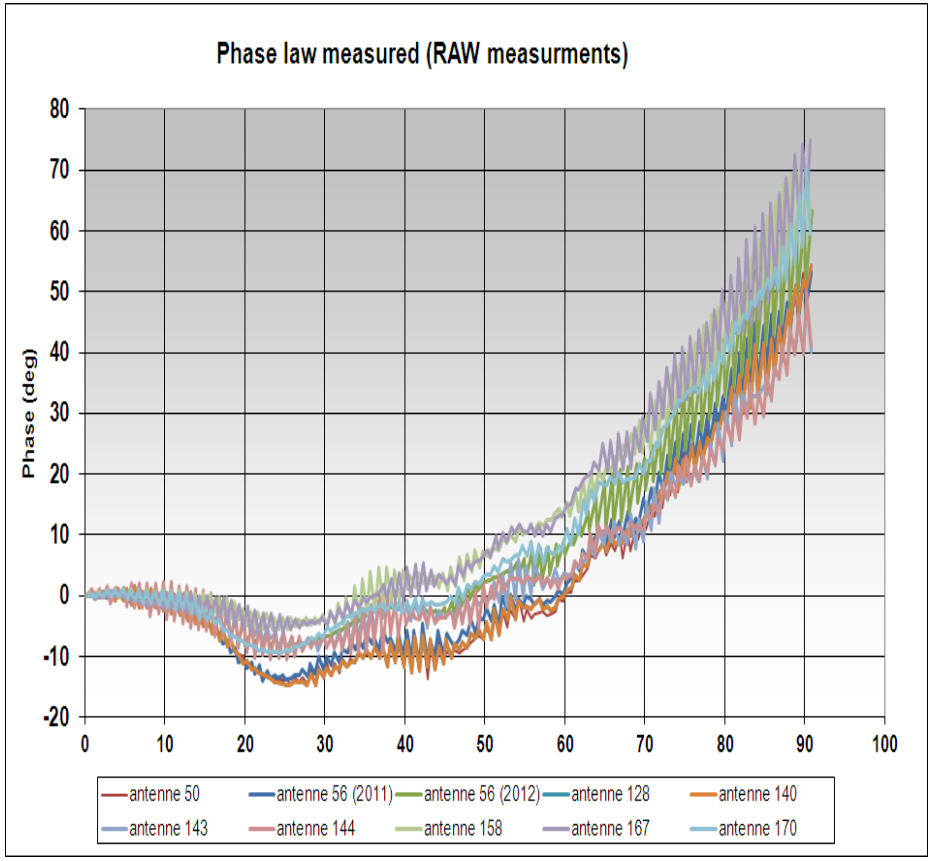
Goal :

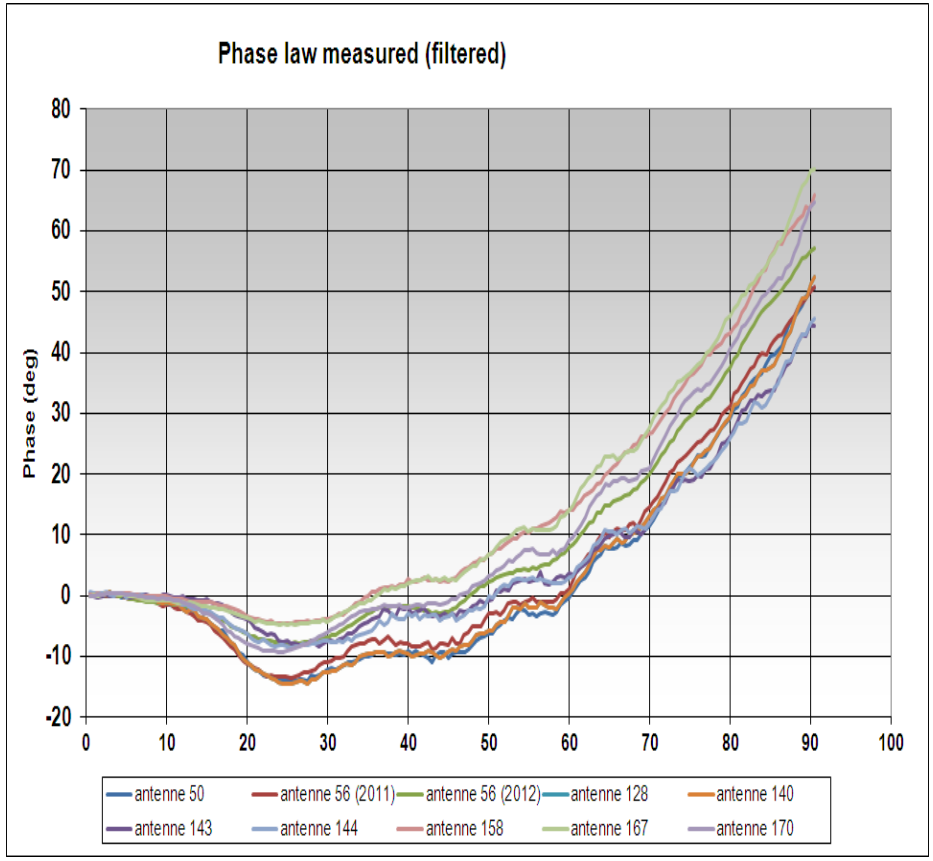
- The need is to characterize series antennas
- That means give a couple : Phase center position – phase law
- Instead of shifting the phase center position to fit a given phase law
- We keep the phase center position fixed (487mm) and we determine the phase law



Phase law measured on the set of series antennas

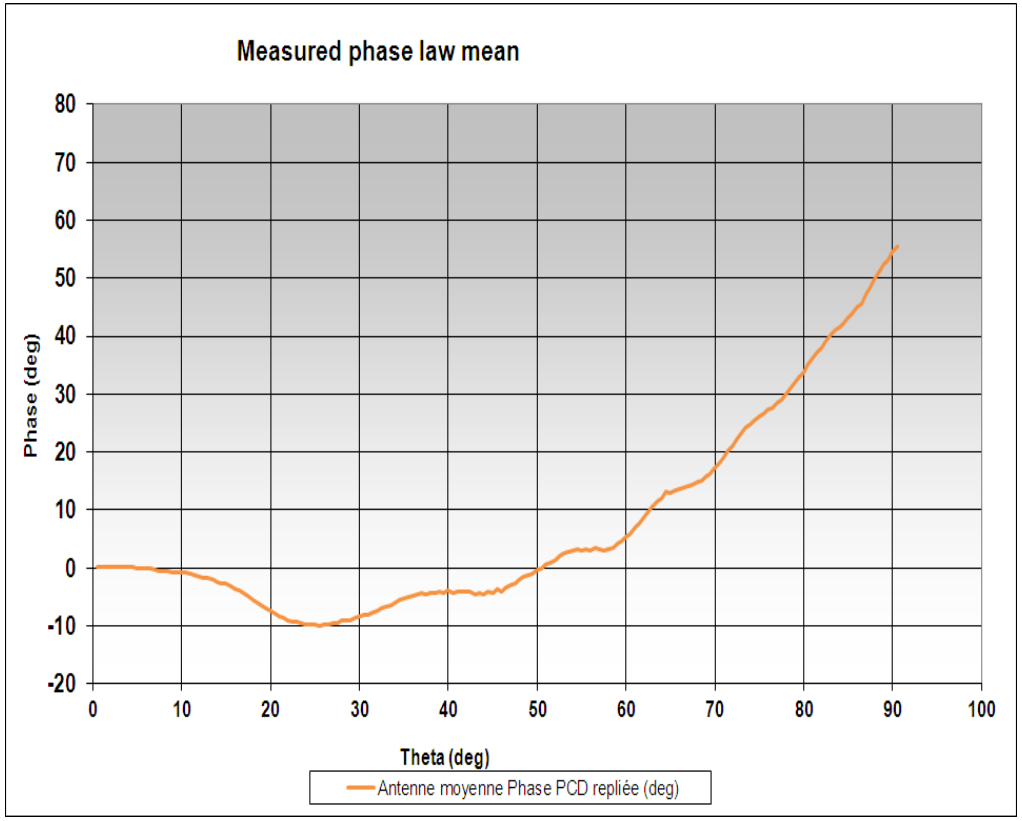
- Measurements performed on 9 series antennas





Mean phase law measured on the set of series antennas

- Meaning the measurements performed
- We obtain a phase law for a phase center at 487mm



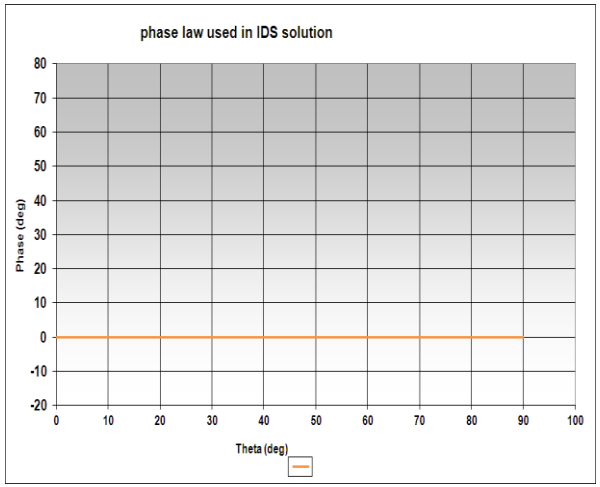
⇒**Results to be consolidated**

Synthesis (1/2)

- **3 characterizations are available/used**

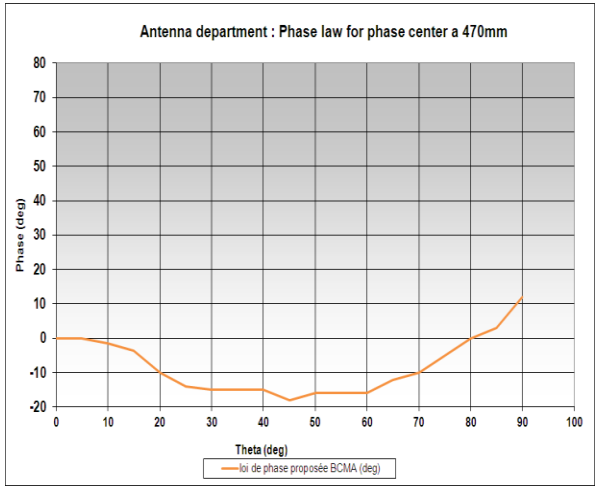
IDS characterization : C_IDS

- **Phase center position : 487 mm**
- **Phase law :**



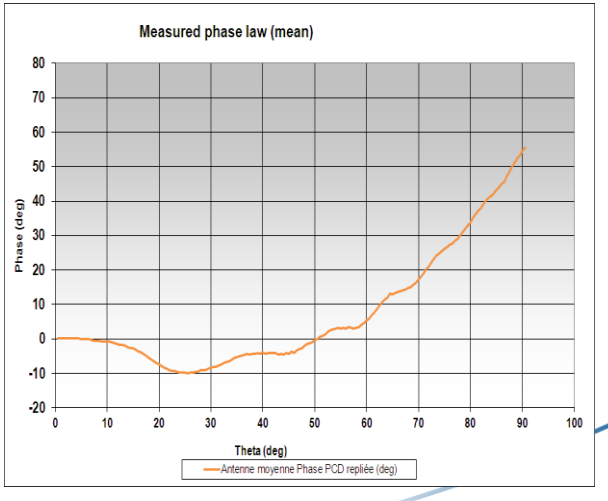
2011 antenna department characterization : C_ant_1:

- **Phase center position : 470 mm**
- **Phase law :**



Latest characterization TBC : C_ant_2:

- **Phase center position : 487 mm**
- **Phase law :**



Synthesis (2/2)

In terms of RF Characterization:

- The C_ant_1 and C_ant_2 are equivalent : we describe the same antenna.
- => C_ant_1 = C_ant_2

First investigations seems to show :

- For C_IDS, the two mistakes done:
  - on the position of the phase center (the one from the prototype)
  - Not taking into account the phase law
- Compensate each other and the impact is very low
- => C_IDS ≈ C_ant_dep1

Still to be consolidated

NEXT

- Perform accurate physical measurements on antenna hardware
  ⇒to consolidate the consistency of series antennas

- Perform a new measurement campaign on the same antennas
  ⇒to evaluate the precision and repeatability of measurements

- Consolidate the phase law for C_ant_2

- Try to explain why C_IDS seems to be ≈ C_ant_1.

Recom for ITRF 2013

Doris team recommends to test the characterization C_ant_2

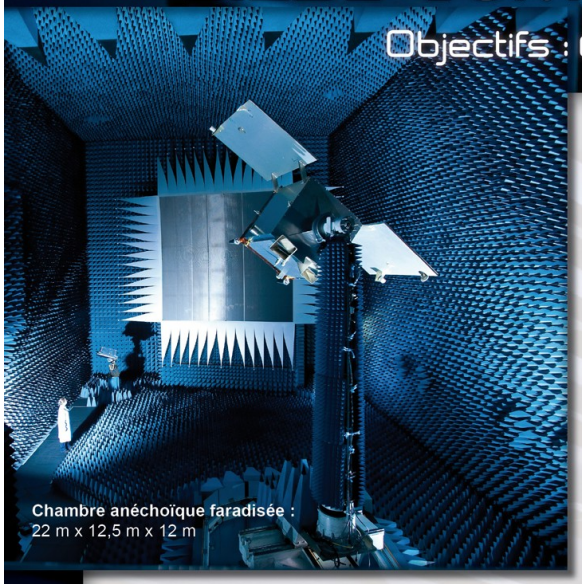
- In case of better results, use this characterization.
- Otherwise, continue to use the C_IDS

THANK YOU

Backup slides

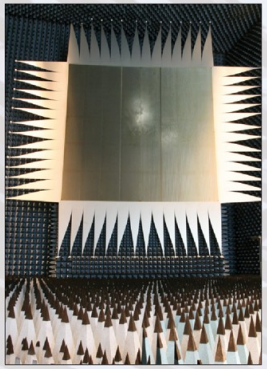
BASE COMPACTE DE MESURES D'ANTENNES

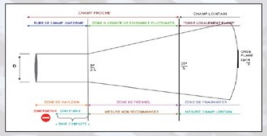
Objectifs : Connaître et maîtriser le rayonnement des antennes seules et sur structures



Chambre anéchoïque faradisée :
22 m x 12,5 m x 12 m

Simuler la distance satellite sol

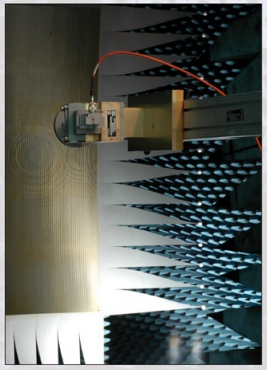




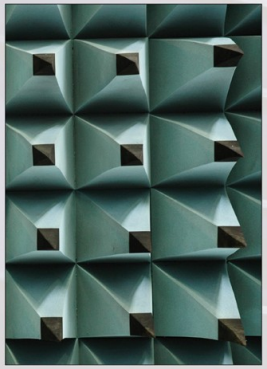
◄ **Réflecteur parabolique :**
5,3 m x 5,6 m, 48 tonnes.
- Focale : 13 m.
- Etat de surface : 25 µm RMS,
- Zone tranquille maximale de 4 m x 4 m x 4 m.

15 sources primaires ►
de 0,4 à 200 GHz.

Simuler la liaison bord sol



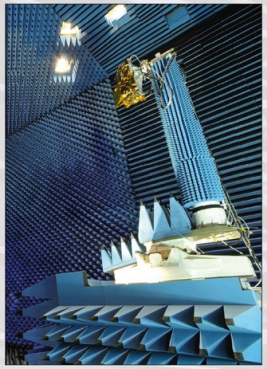
Isoler l'antenne dans l'espace



◄ **Absorbants :** -70 dB de réflectivité typique à 8 GHz.

Positionneur : 7 degrés de liberté en rotation et translation. Capacité : 350 Kg maximum. ►

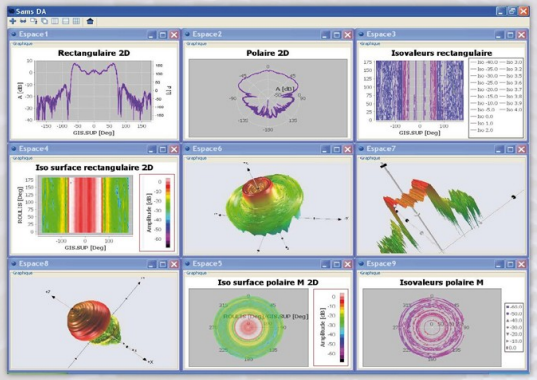
Positionner l'antenne dans l'espace



◄ Diagramme de rayonnement, directivité, gain, localisation centre de phase, temps de propagation de groupe. Performances système, surface équivalente radar.

Instrumentation : analyseurs de réseau Agilent et ABmillimètre, logiciels CNES/ SILICOM d'acquisition et post-traitement. ►

Réaliser les mesures avec précision



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