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Ciências Geodésicas

Universidade Federal do Paraná - UFPR
Setor de Ciências da Terra - SCT
Departamento de Geomática - DGEOM

Curso de Pós-Graduação em Ciências Geodésicas - CPGCG
Fax (55-41) 361-3161
http://www.geoc.ufpr.br , "curso de pós-grad..."
cpgcg @ ufpr.br
robtluz @ ufpr.br

Fund. Inst. Bras. Geografia e Estatística - IBGE
Diretoria de Geociências - DGC

Coordenação de Geodésia - CGED
Fax (55-21) 2142-4859
http://www.ibge.gov.br , "geociências" , "geodésia"
geodesia @ ibge.gov.br

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Rede SIRGAS no Brasil

- No Brasil existem 22 estações SIRGAS
- 21 delas têm altitude através do nivelamento e 10 têm gravimetria
- A rede de nivelamento do Brasil ainda não está consistente em sua totalidade. Há diferenças entre trabalhos antigos e mais novos que estão sendo analisadas. Consequentemente as altitudes das estações SIRGAS ainda não podem ser consideradas definivas.

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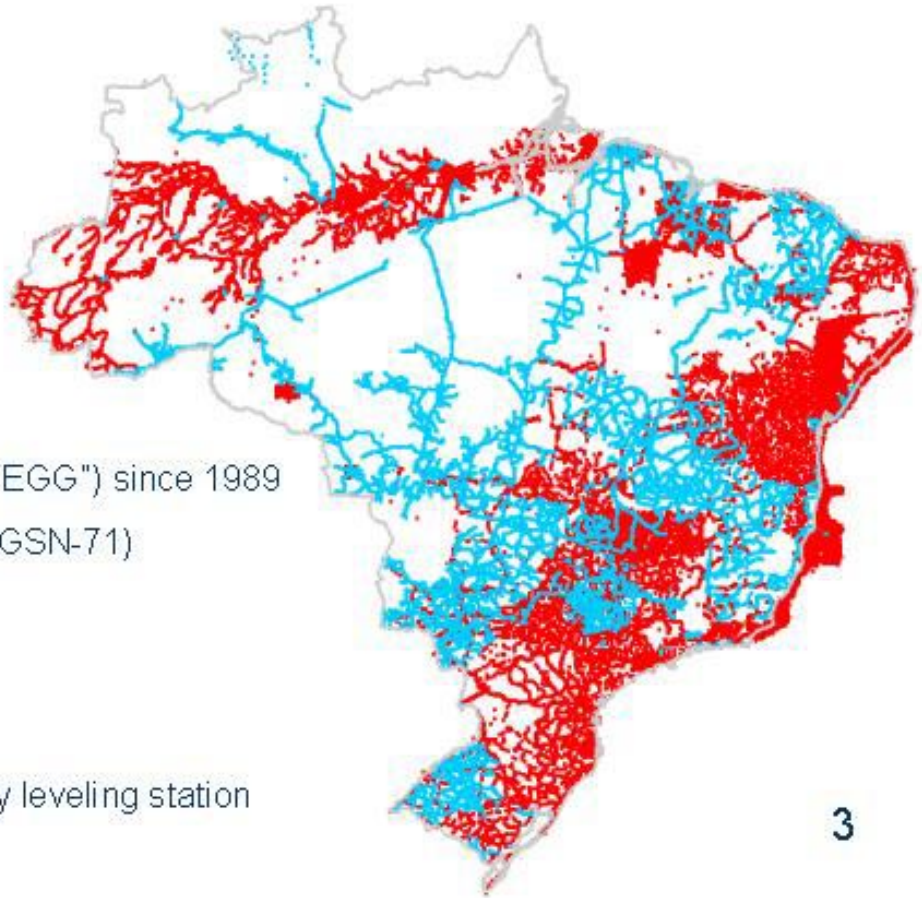
First Studies

Gravity Densification Stations (IBGE and others)



- ✓ several institutions
- ✓ IBGE : 17000 stations ("EEGG") since 1989
- ✓ gravity datum : "RGFB" (IGSN-71)
- ✓ entirely in digital media
- ✓ several file formats
- ✓ variable availability
- ✓ not necessarily over every leveling station

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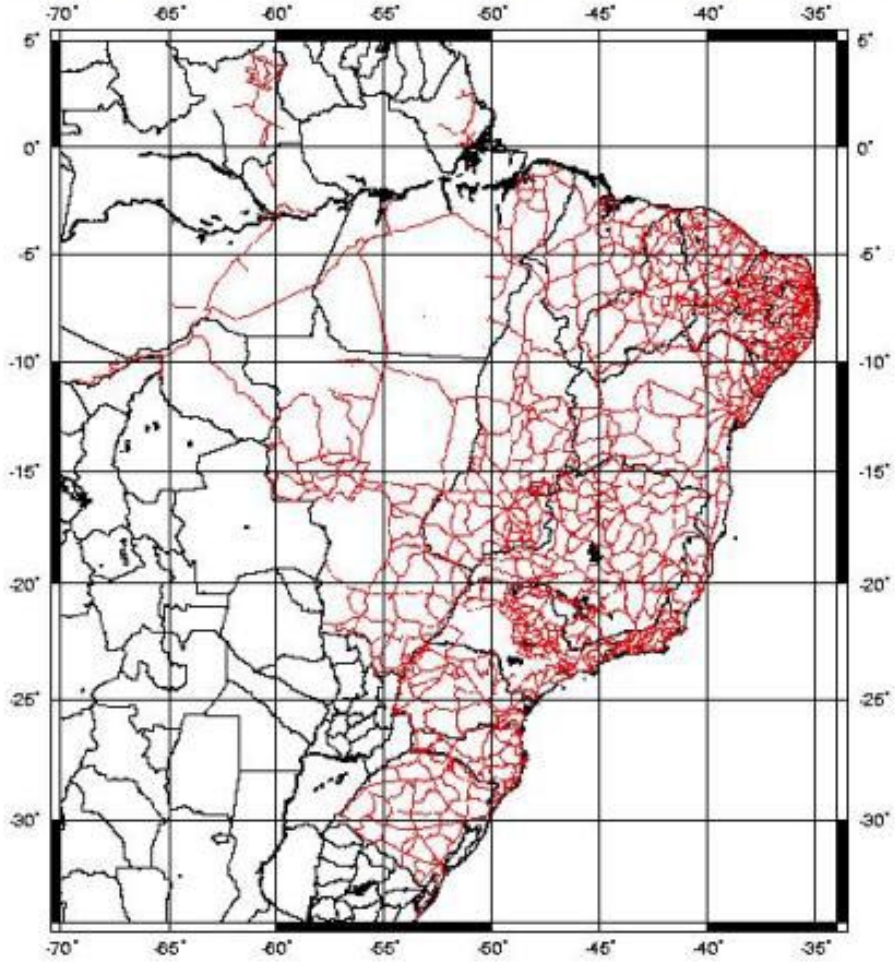
Leveling Network in Brazil

61.466 Bench Marks(BM)



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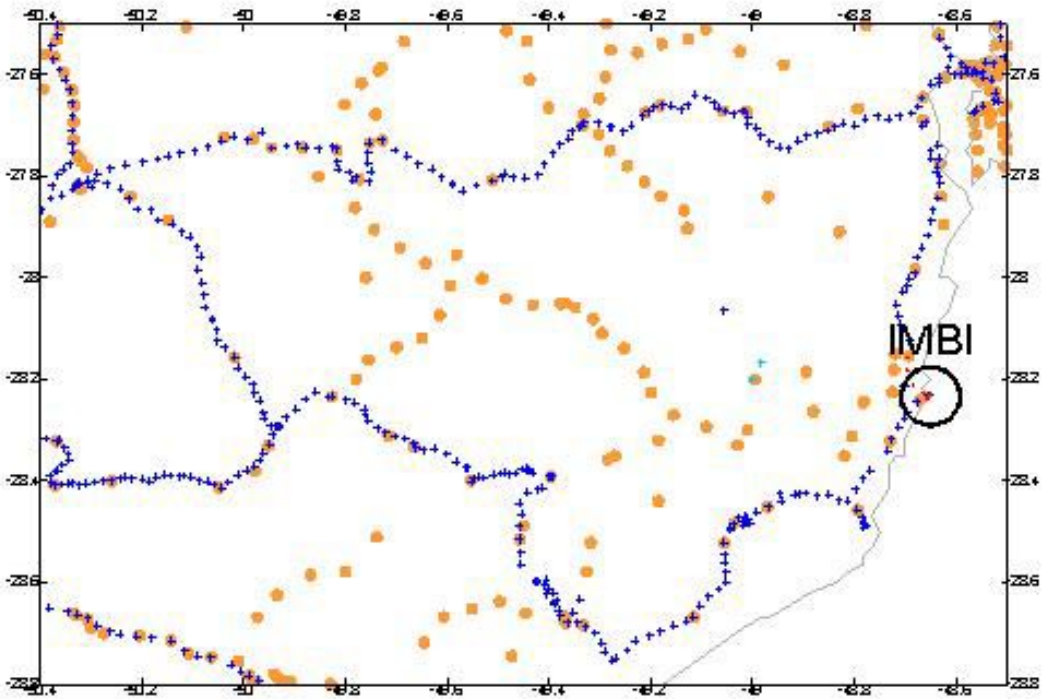
First Studies (cont.)

Gravity (orange) and leveling (blue) lines near IMBITUBA



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Gravity on leveling

- Since 1982, during many years, IBGE in a cooperation with the University of São Paulo (IAG, EPUSP) carried out gravity observations on BMs in south and center-west of Brasil. In the begining the coordinates were derived from topographic maps. More recently GPS is being used.

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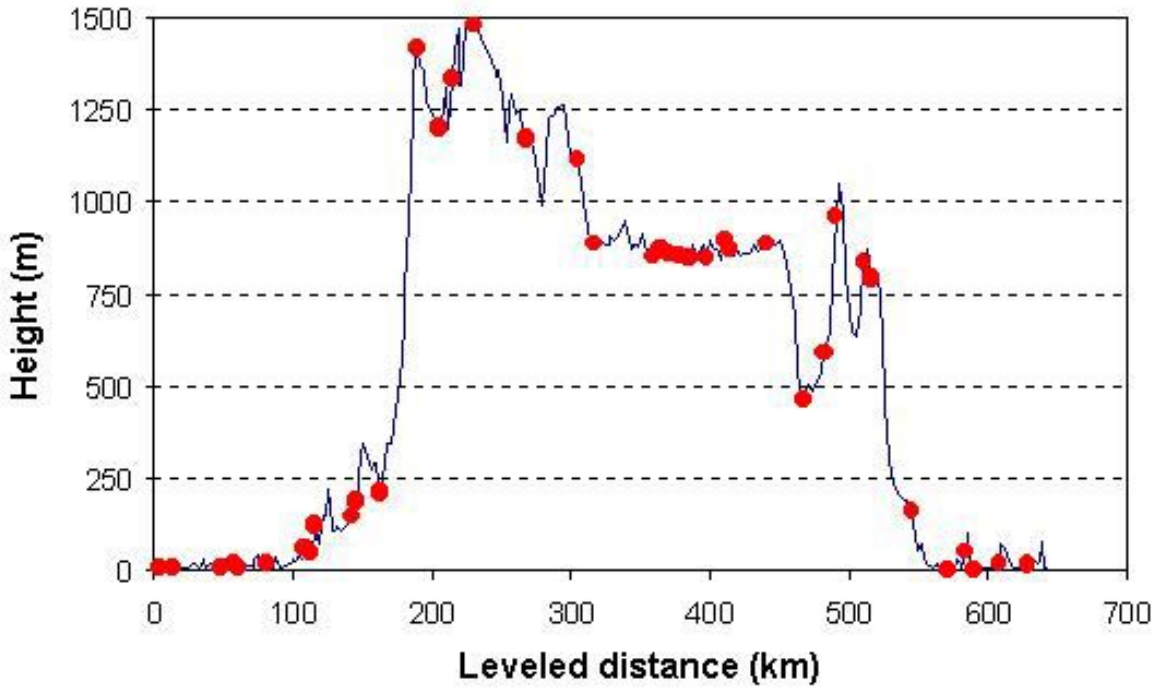
First Studies (cont.)

Gravity (red points) and leveling (blue line) lines near IMBITUBA



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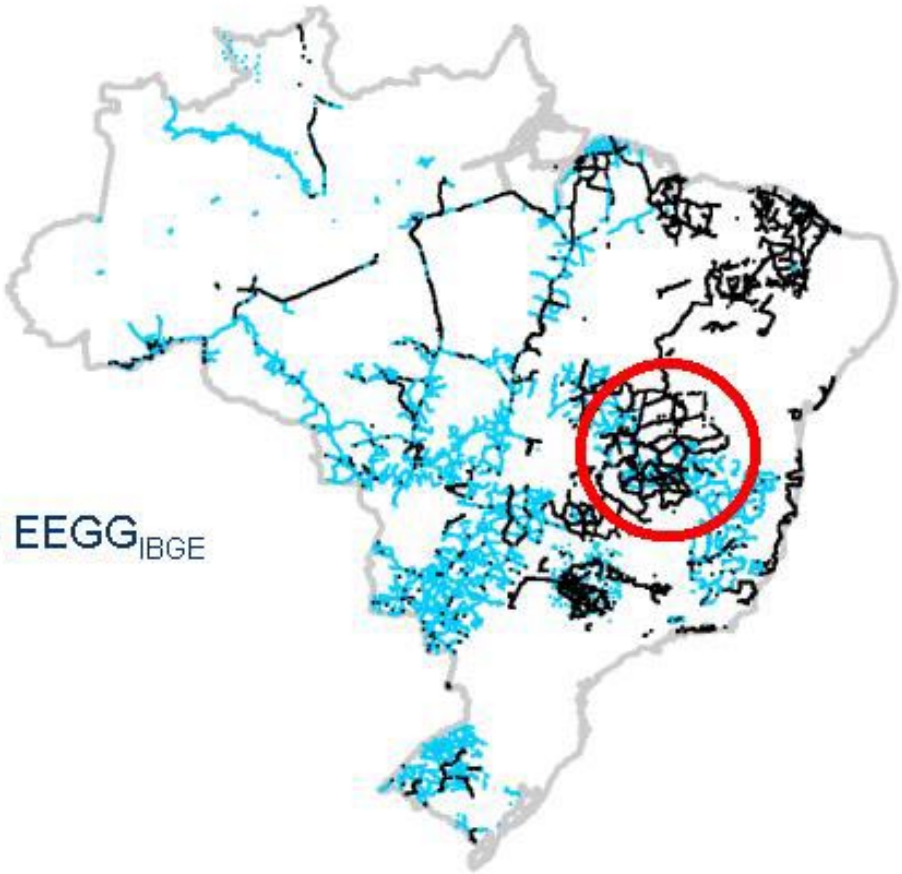
First Studies (cont.)



$RRNN_{IBGE} = EEGG_{IBGE}$

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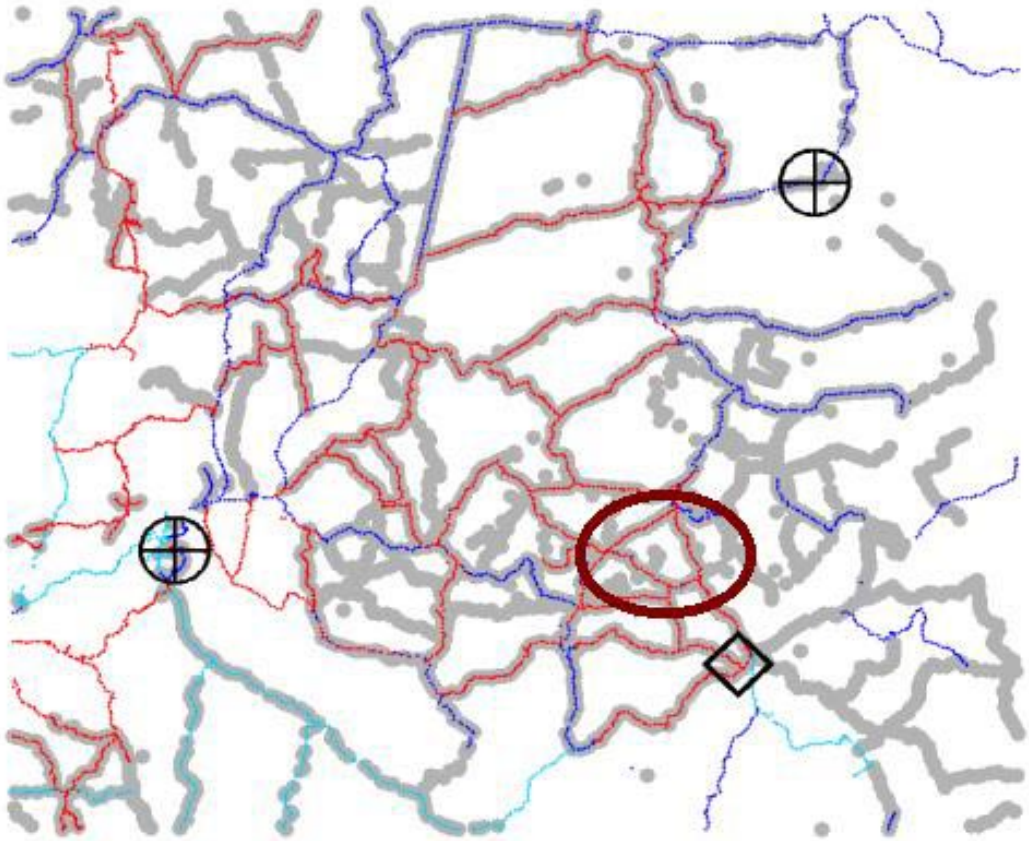
First Studies (cont.)



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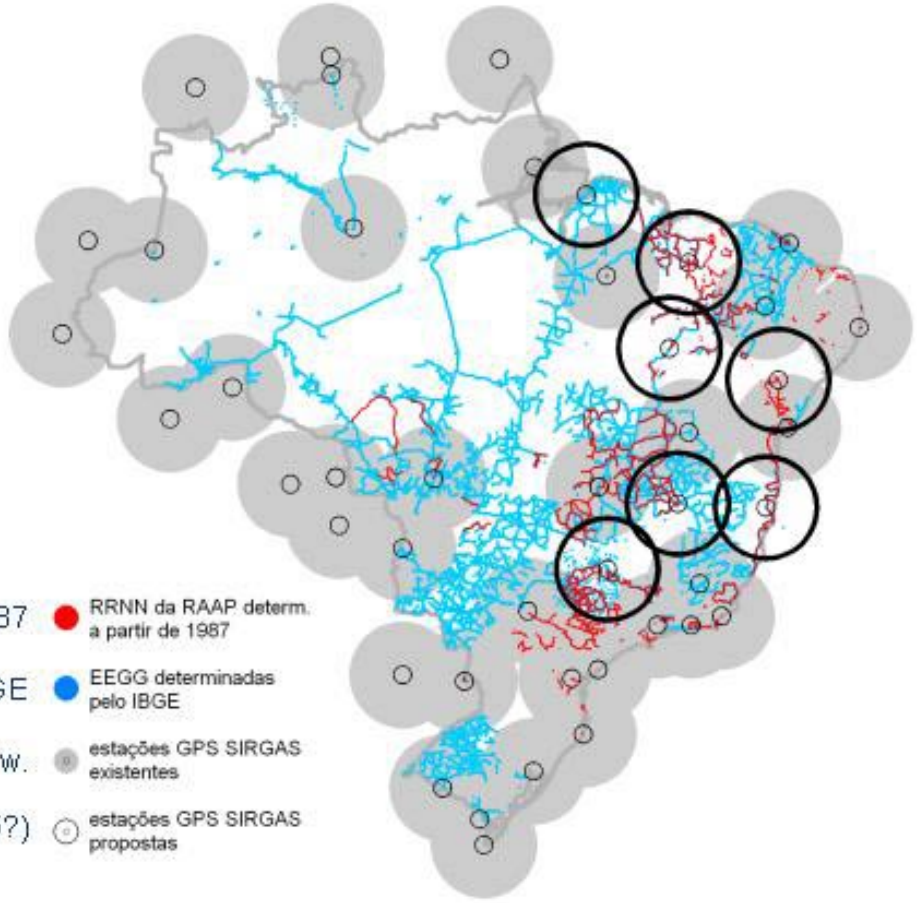
First Studies (cont.)



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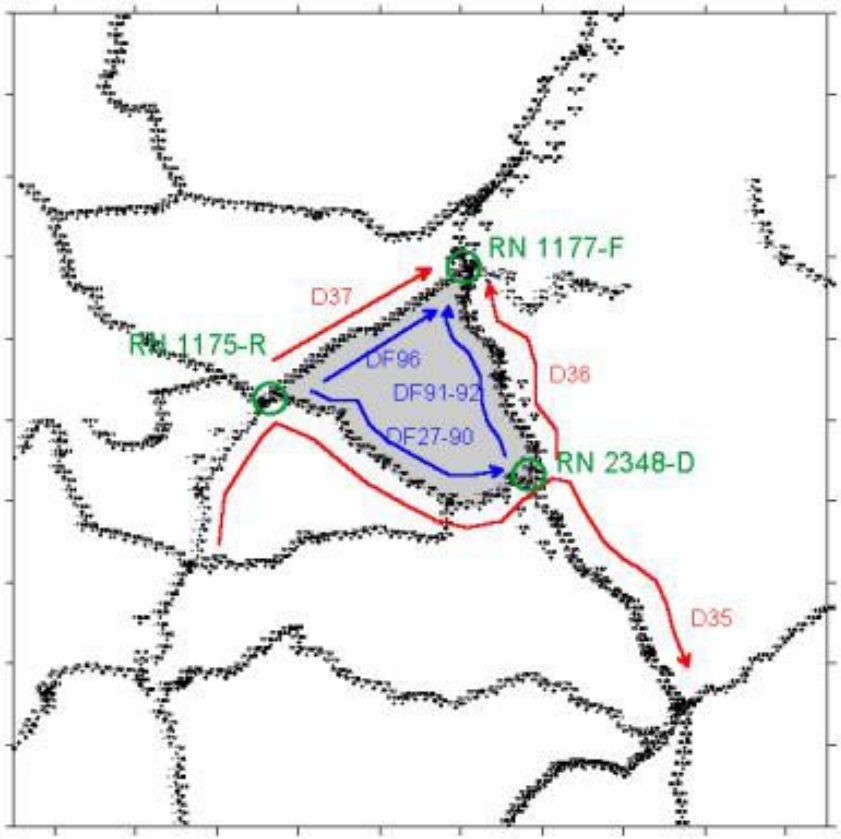
First Studies (cont.)



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First Studies (cont.)

```
14          S. ROMAO - SAO Fco.- BSB MINAS -MONTES CLAROS D       35
.....                                    .....          .....
       119030603   + 187671  089         1175R          1175S      N
       119030144   - 187666  089         1175R          1175S      C
.....                                    .....          .....
       029100404   - 520467  307         2348C          2348D      N
       029100312   + 520472  308         2348C          2348D      C
.....                                    .....          .....
      8
14          ENTRC. BSB DE MINAS - PEDRAS DE MARIA DA CRUZ D       36
       039101011   + 526405  265         2348D          2350A      N
       039101022   - 526408  265         2348D          2350A      C
.....                                    .....          .....
       049103230   -  26430  172         2351L          1177F      N
       049103240   +  26425  171         2351L          1177F      C
      8
14          SAO FRANCISCO - PEDRAS DE MARIA DA CRUZ       D       37
       049104025   - 165127  155         1175R          2352X      N
       049104031   + 165122  155         1175R          2352X      C
.....                                    .....          .....
       049103805   + 168675  133         2354E          1177F      N
       049103809   - 168669  134         2354E          1177F      C
      8
```

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First Studies (cont.)

```
  8070321  S. FCO. MONUMENTO  1175R  DF0027  -15 57  1.44  - 44 51 28.53   481.8100
                                                 978240.38   -32.83   -86.75

  8070459  DF0027-01          1175S  DF0027  -15 57 14.40  - 44 51  3.33   500.5000
                                                 978236.93   -30.68   -86.69
...
  8070321  S. FCO. MONUMENTO  1175R  DF0090  -15 57  1.44  - 44 51 28.53   481.8100
                                                 978240.37   -32.84   -86.76

  8071647  DF0090-01          2347T  DF0090  -15 57 41.76  - 44 49 29.01   520.9000
                                                 978235.00   -26.68   -84.97
...
  0191285  MIRABELA B                DF0091  -16 15 45.37  - 44  9 51.12   800.0000
                                                 978189.29     -.74   -90.26

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...
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                                                 978240.36   -32.85   -86.76

  8071726  DF0096-01          2352X  DF0096  -15 56 19.32  - 44 51  4.41   464.9900
                                                 978242.49   -35.36   -87.39
```

First Studies (cont.)

- ✓ prototyped with Excel
- ✓ loop perimeter : 230 km (small, for RAAP)
- ✓ loop closures (by height difference types)
  - leveled : 6,6 mm :: 0,4 mm$(d_{km})^{1/2}$
  - "dynamic" : 8,7 mmm :: 0,6 mm$(d_{km})^{1/2}$
- ✓ graphs of the differences between these two sets of heights show interesting behaviours

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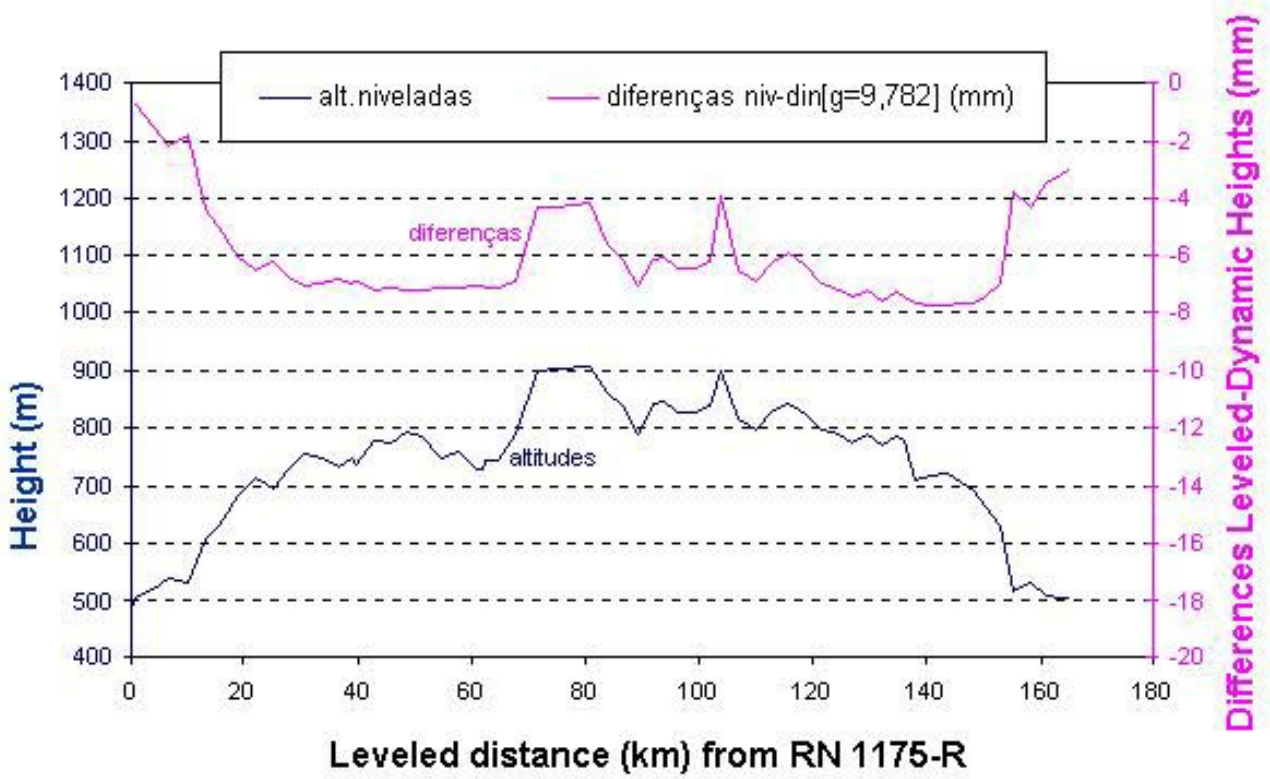
First Studies (cont.)



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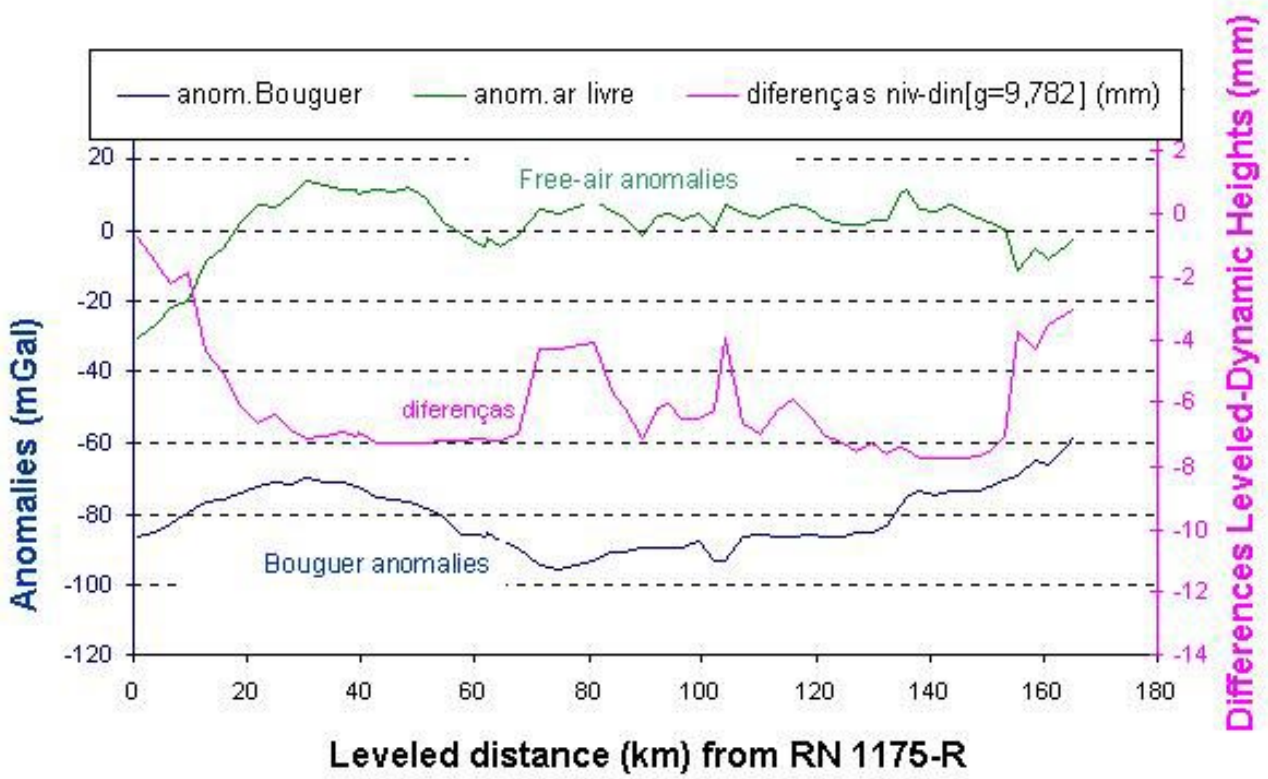
First Studies (cont.)



Next Activities

- ✓ computer program to integrate gravity in the height evaluation, including other types of heights (normal, normal-orthom. etc)
- ✓ apply same procedure to the other loops of the selected area, investigating the influence of arbitrary choose of "scale factor" for dynamic heights, and defining the strategy for gravity interpolation
- ✓ prepare the extension of the study to the whole RAAP (inclusion of lines connecting tide gauges etc)

Parallel Activities

- ✓ implementation of a GIS for the treatment of the network
- ✓ terrain correction (Bouguer anomaly) with SRTM DTM ?

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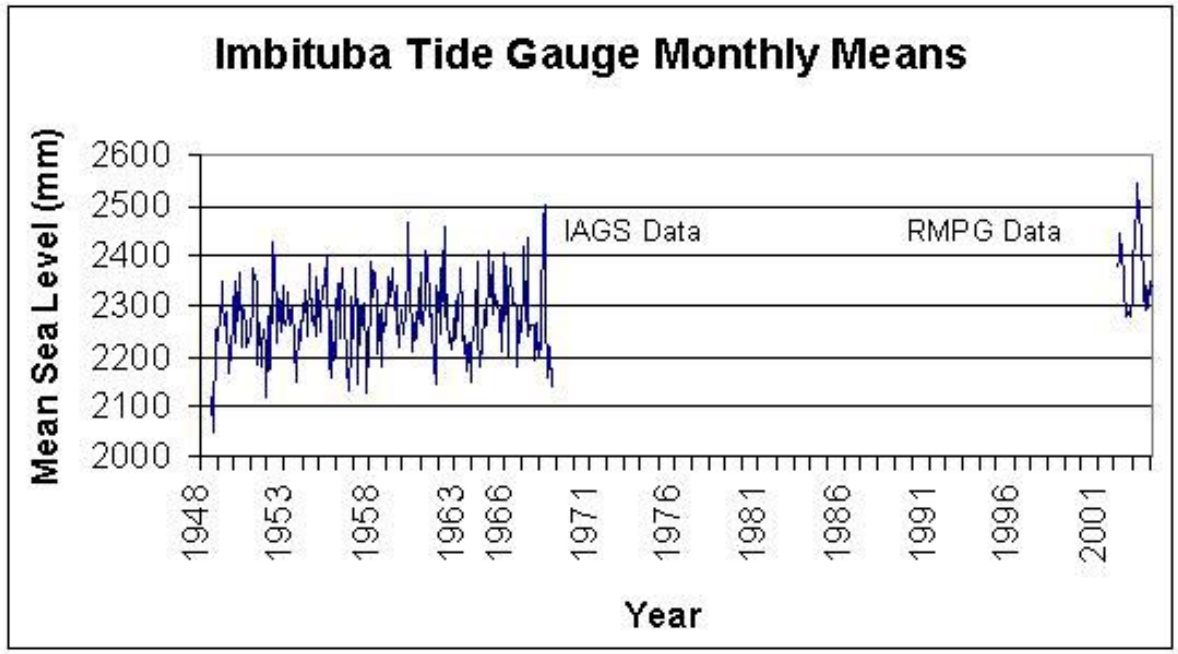
Parallel Activities (cont.)



- ✓ local effects at Imbituba ; recovering sea level series and integration with altimetry data

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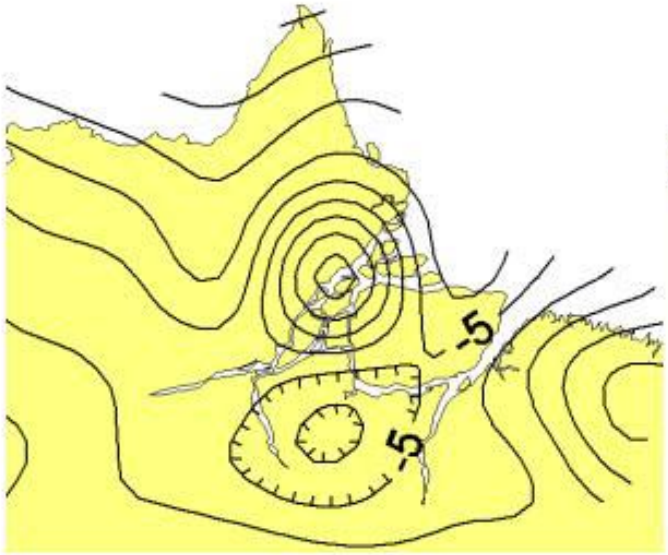
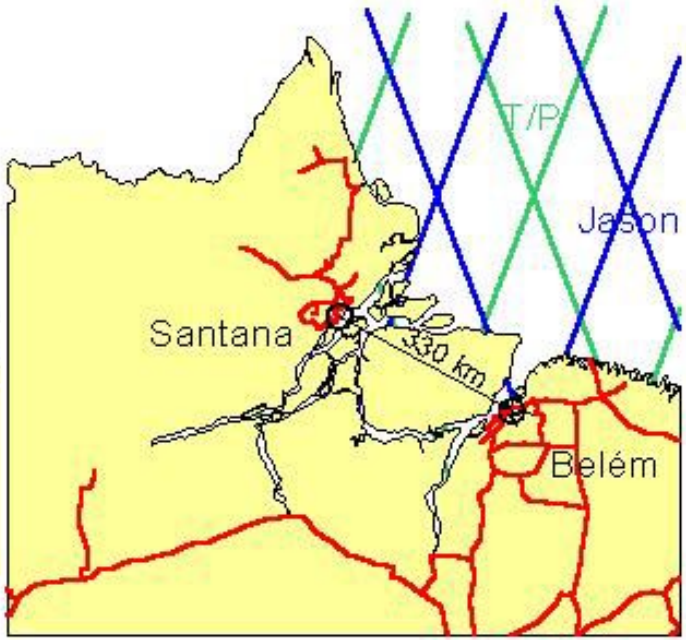
Next Activities (cont.)





- ✓ connection Santana - Imbituba ? Integration of an existent high resolution hydrodynamic model for the estuary area to the geodetic tools

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Next Activities (cont.)

- ✓ Investigation on the definition of a vertical reference system – questions about W_0, tide systems etc
- ✓ Investigation on the effects of blocking strategies of past adjustments ; same for temporal inhomogeneities
- ✓

Thank You !

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Escola Politécnica da USP

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IBGE-CGED

Reunion de Trabajo del Proyecto SIRGAS
Aquascalientes Diciembre 2004

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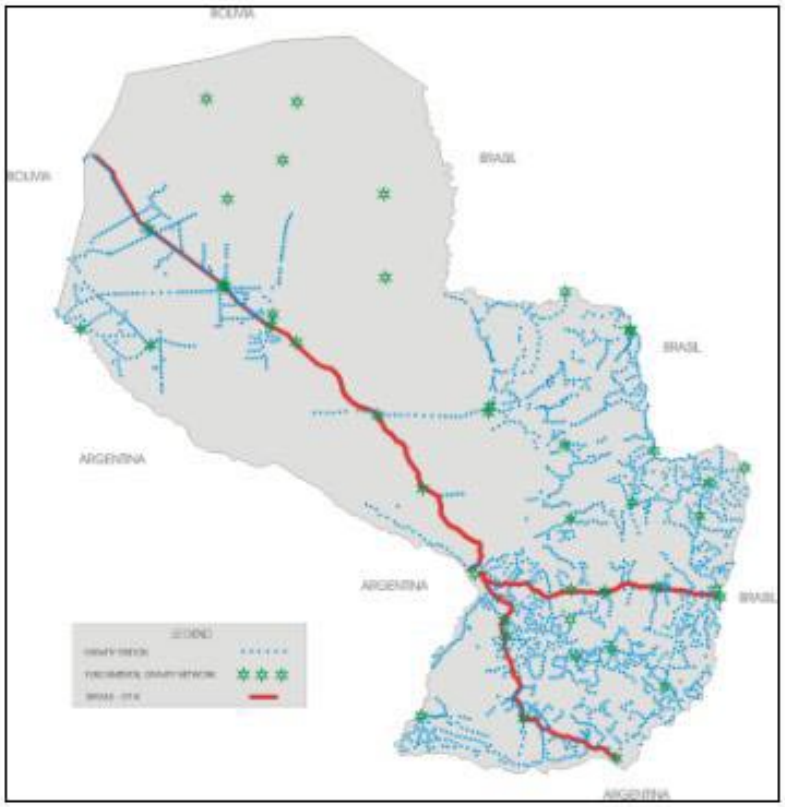
Levantamento no Paraguai



- Levantamento gravimétrico em RNs no Paraguai realizado pelo IBGE, EPUSP e DISERGEMIL.

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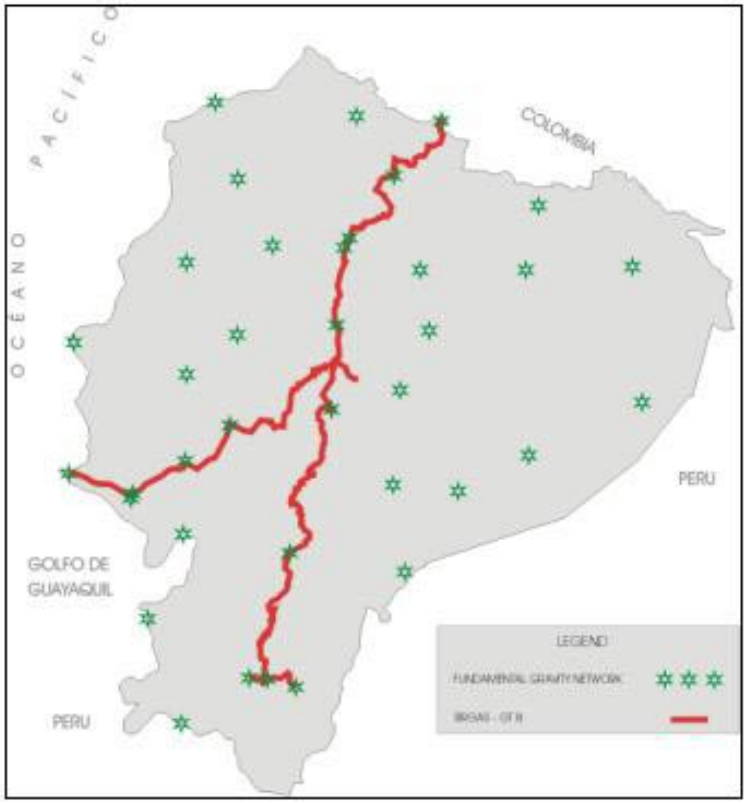
Gravimetria no Equador



- Levantamento gravimétrico em RNs do Equador realizado pelo IBGE, EPUSP, IGM, INOCAR.

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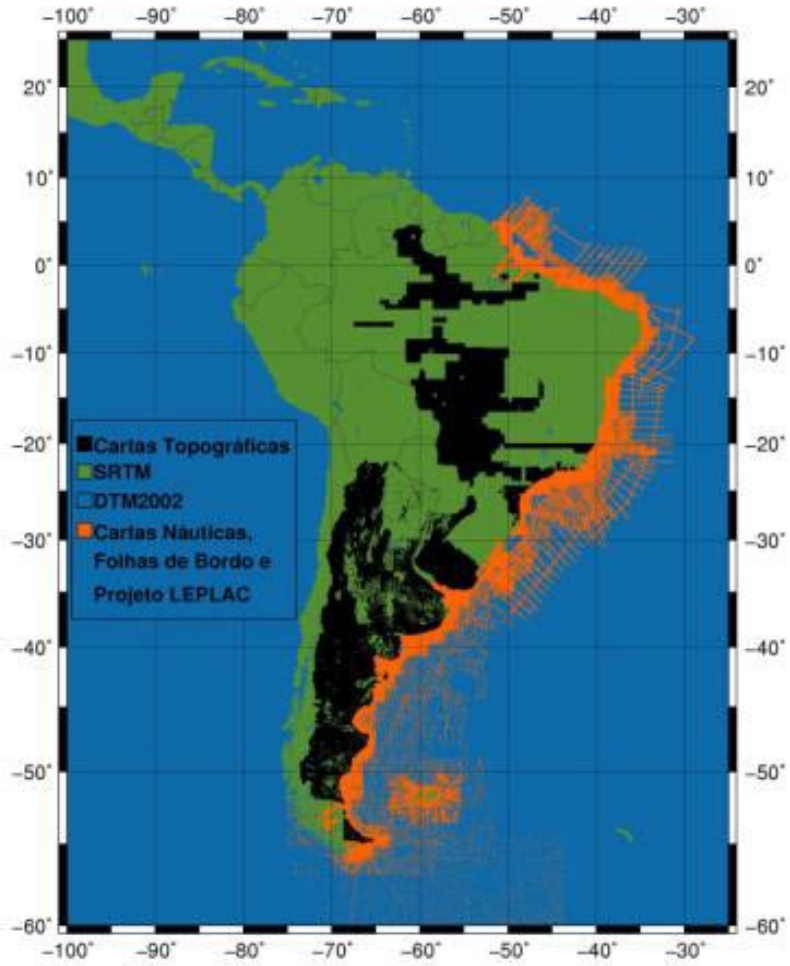
- Modelo Digital do Terreno SAM2004 em três versões: 30" (SRTM), 1'(SRTM), 1' (cartas topográf.)
  - Cartas Náuticas e Folhas de Bordo
  - Cartas topográficas
  - Modelo de 3" do SRTM
  - Modelo DTM2002



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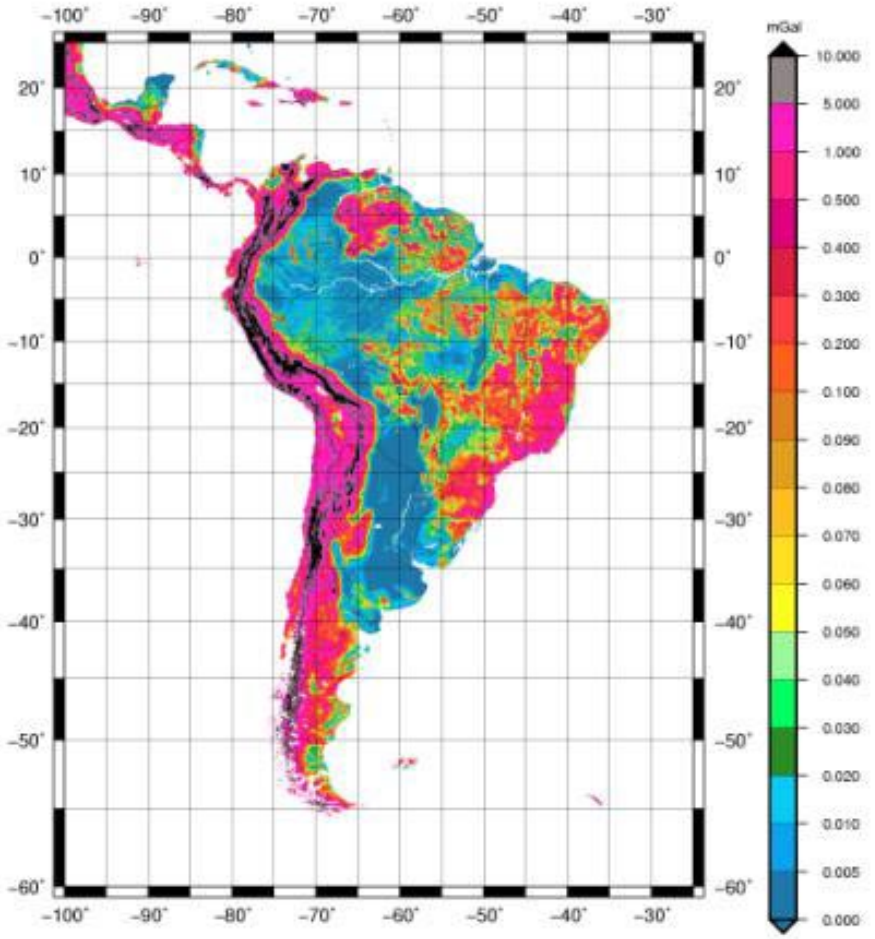
Correção de Terreno a partir do SAM2004



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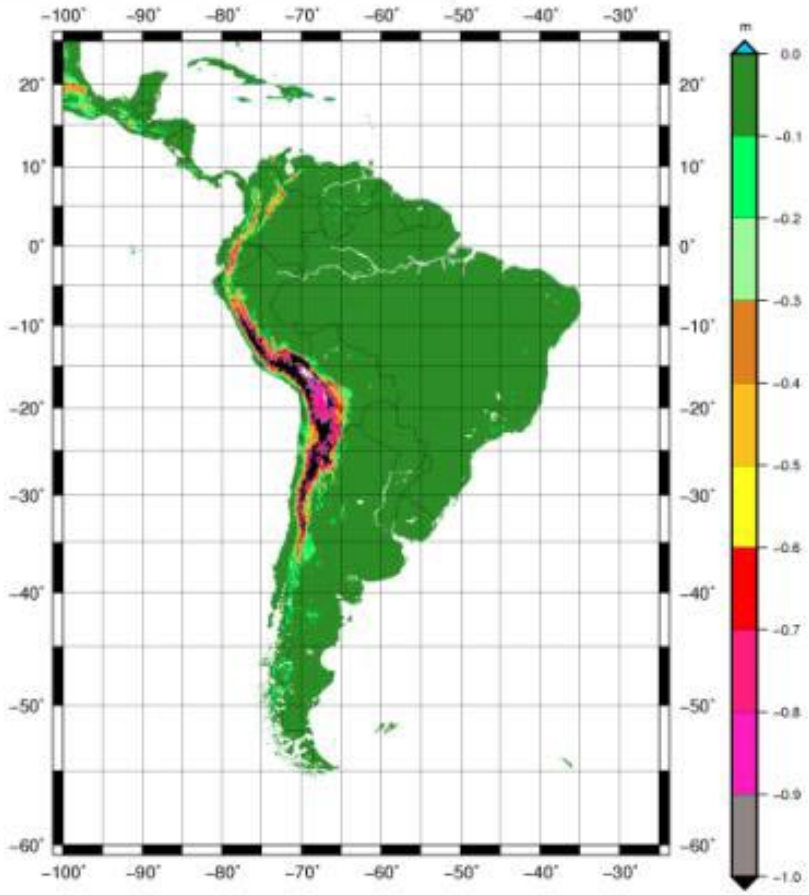
Efeito Indireto SAM2004

N_{ind} max = 0,300 m
(-20,466667,-28,850000)

N_{ind} min = -1,891 m
(-27,150000,-68,550000)

Média = -0,067 m



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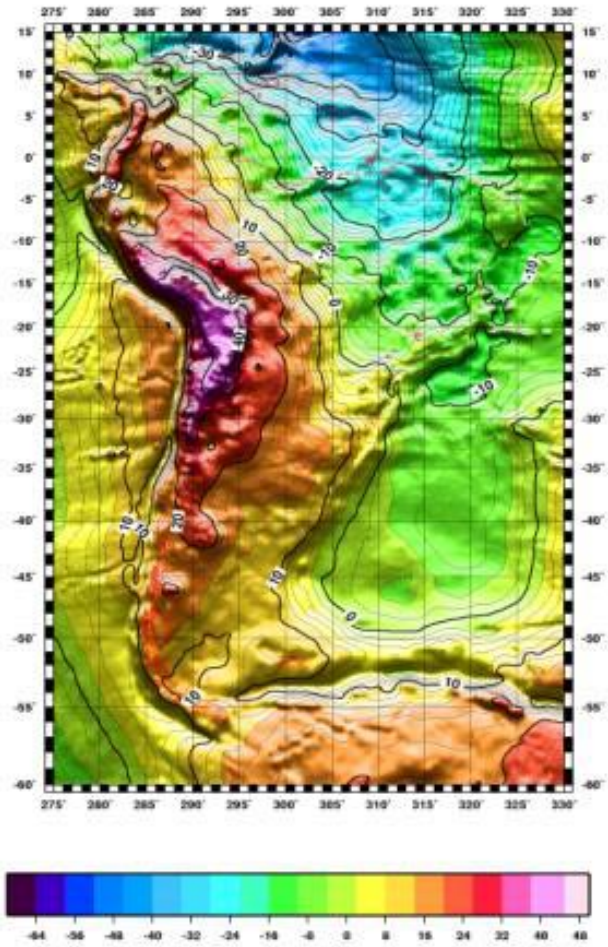
Modelo Geoidal 2004



- Modelo geoidal com resolução de 10'.
- Anomalias de Helmert.
- Referência SIRGAS.