Status of DORIS stations in Antarctica for precise geodesy

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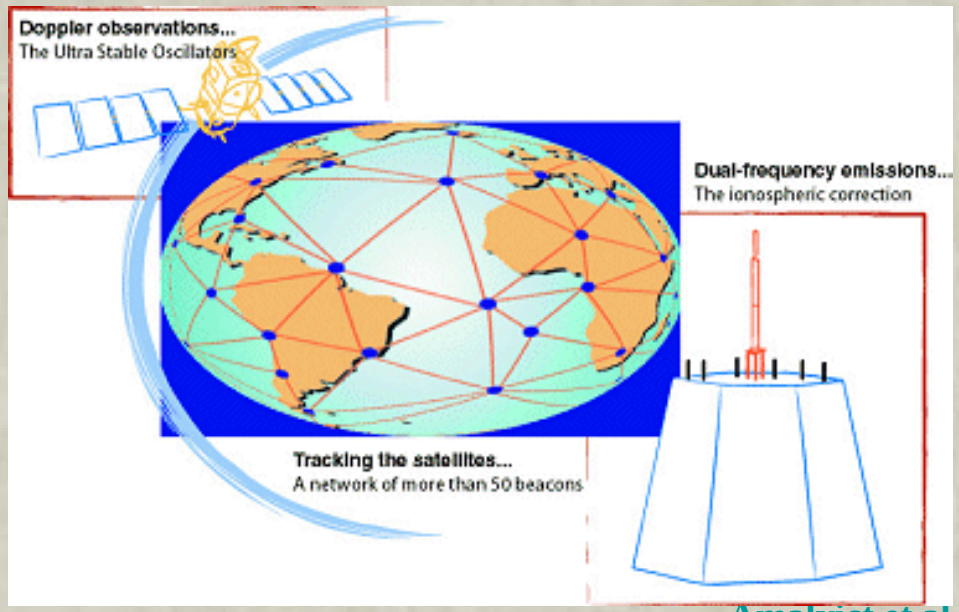
3 IGN, Saint-Mandé – France
4 JPL, Caltech, Pasadena – USA

DORIS general features

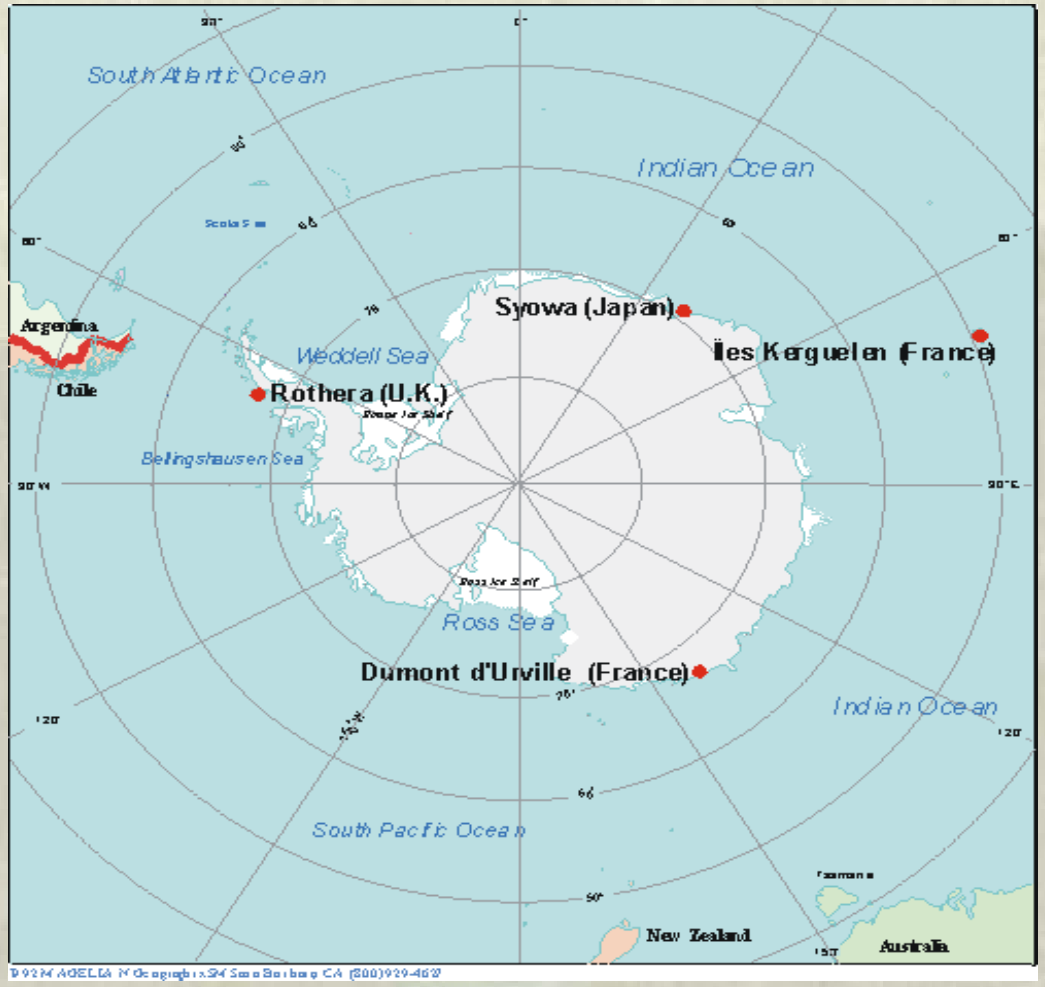
- initiated in 1990 (SPOT2 satellite)
- Around 55 stations well distributed all around the world
- Measuring Doppler effect



– Doris antenna at Dumont d'Urville

Stand-alone equipement (no data recorded on site)

DORIS Antarctic stations



- 4 Antarctic stations
  - Terre Adélie since Feb 1987
  - Rothera since Nov 1991
  - Syowa since Feb 1993
  - Belgrano since Jan 2004

@SCAR map

Example of information at the IDS website

Rothera station

Site name ROTHERA
Host agency BRITISH ANTARCTIC SURVEY
Geographical coordinates (ITRF) Latitude –67° 34' 10" N
Longitude –68° 7' 28" E

DORIS antenna and reference point information

ROTA
Antenna model Alcatel
Date installed 03 February 1993
Date removed

ITRF coordinates and velocities of the current DORIS ref. point (SYPB)
Solution : ITRF2000 Epoch : 1997.0
X = 909378.192 ± 0.004 m ; Y = -2264934.545 ± 0.004 m ; Z = -5872956.909 ± 0.005 m

VX = 0.0154 ± 0.0009 m/y ; VY = -0.0025 ± = 0.0012 m/y ; VZ = 0.0020 ± 0.0019 m/y

From http://ids.cls.fr/html/doris/stations/ROTA.shtml

Different DORIS solutions

- 1 - the parameters defining a solution are:
  - Observation period (start, end, continuity)
  - Antenna change handling
  - Sampling rate (weekly, monthly, …)
  - Reference frame (ITRF2000)
  - DORIS data analysis (Analysis group, software, Gravity model)
- 2 –STCD time series (at CDDIS)
- 3 – SINEX time series (at CDDIS)
- 4 - plots (at CDDIS)

DORIS results in **STCD** format
STation **C**oordinates **D**ifferences expressed in ITRF

Name	Contact	Type	Period
ign03wd01*	P. Willis	Week	Jan 1993 - Apr 2005
lca05md01	L. Soudarin	Month	Jan 1993 - Jan 2005
ssa05wd	J.J. Valette	Week	Dec 2000- Jan 2005

* = updated every week

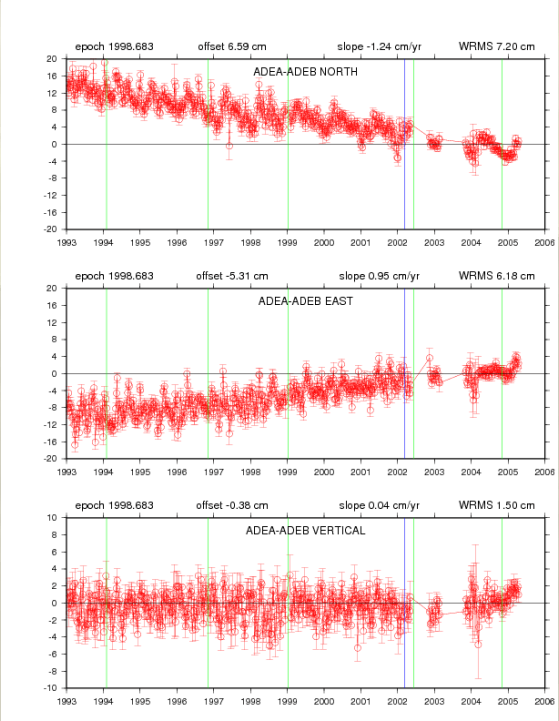
DORIS STCD results available at CDDIS
(ftp://cddis.gsfc.nasa.gov/pub/doris/products/stcd)
Status as June 1, 2005

DORIS results in **SINEX** format
Software **IN**dependent **EX**change format)

Name	Contact	Type	Period
gscwd	F. Lemoine	Week	Jan 2004 - Dec 2004
ignmd	P. Willis	Month	Jan 1993 - Oct 2002
ignwd	P. Willis	Week	Jan 1993 - Apr 2005
inamd	S. Kuzin	Month	May 1999 - May 2002
inawd	S. Kuzin	Week	Oct 1992 - Jun 2004
lcamd	L. Soudarin	Month	Jan 1993 - Aug 2002
lcawd	L. Soudarin	Week	Jan 1993 - Jan 2005
sodwd	J.P. Berthias	Week	June 2001 - June 2005
ssamd	J.J. Valette	Month	Jan 2001 - Apr 2002
ssawd	J.J. Valette	Week	Dec 2000 - Jan 2005

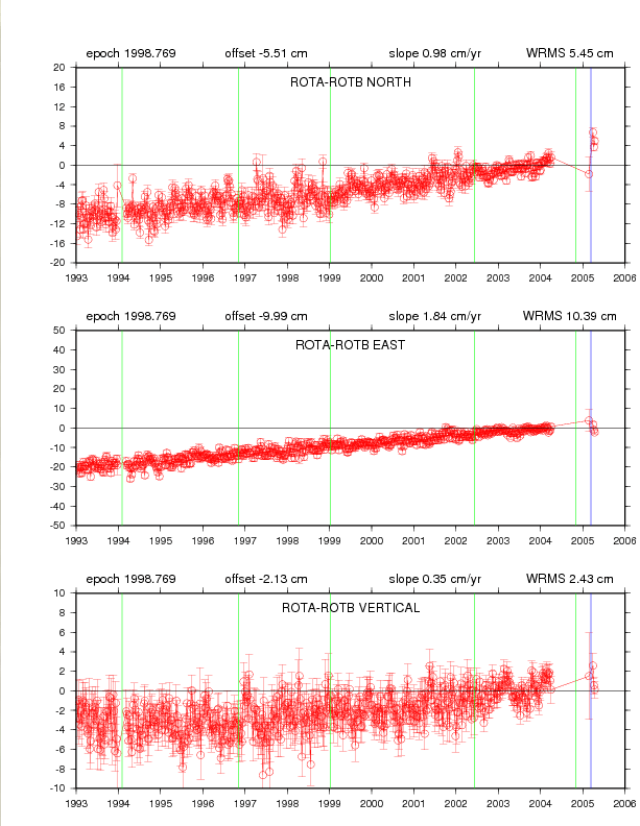
available at CDDIS (ftp cddis.gsfc.nasa.gov)
Status as June 1, 2005

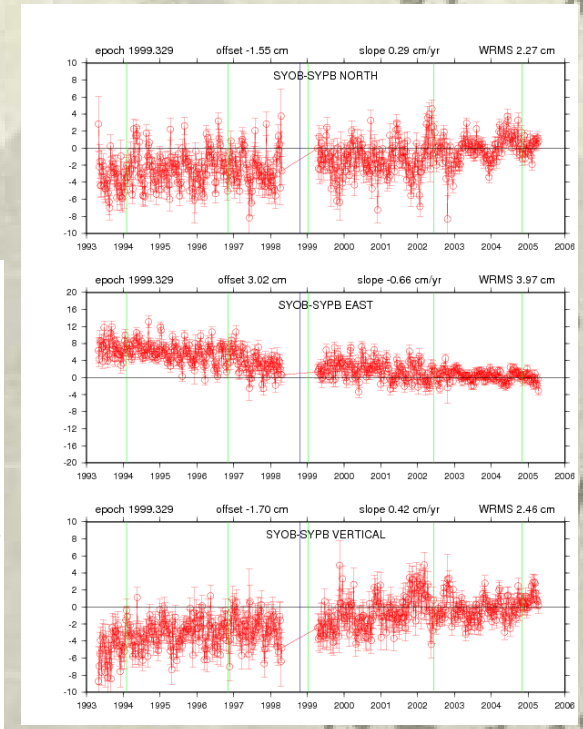
Plotting STCD files Examples



Dumont d'Urville

Rothera





Syowa

Blue line = change of antenna
Green line = change in DORIS satellite constellation

Amalvict et al., Cairns Aug. 2005

How to get DORIS velocities?

1) Select one of several Analysis Center

   GSFC, INASAN, IGN/JPL, LEGOS/CLS

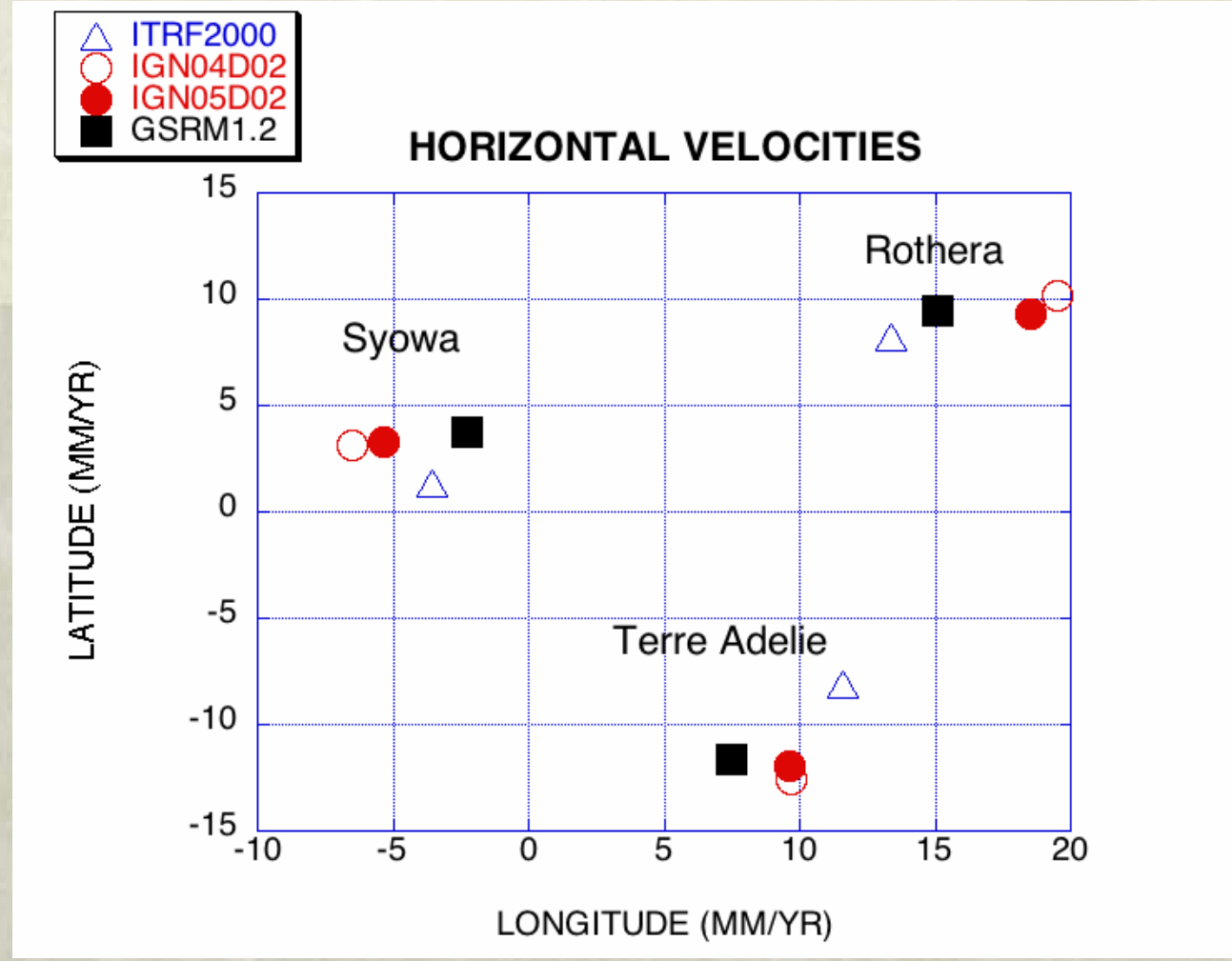
2) Select a type of product

   2.1) using a cumulative solution (position/velocity)

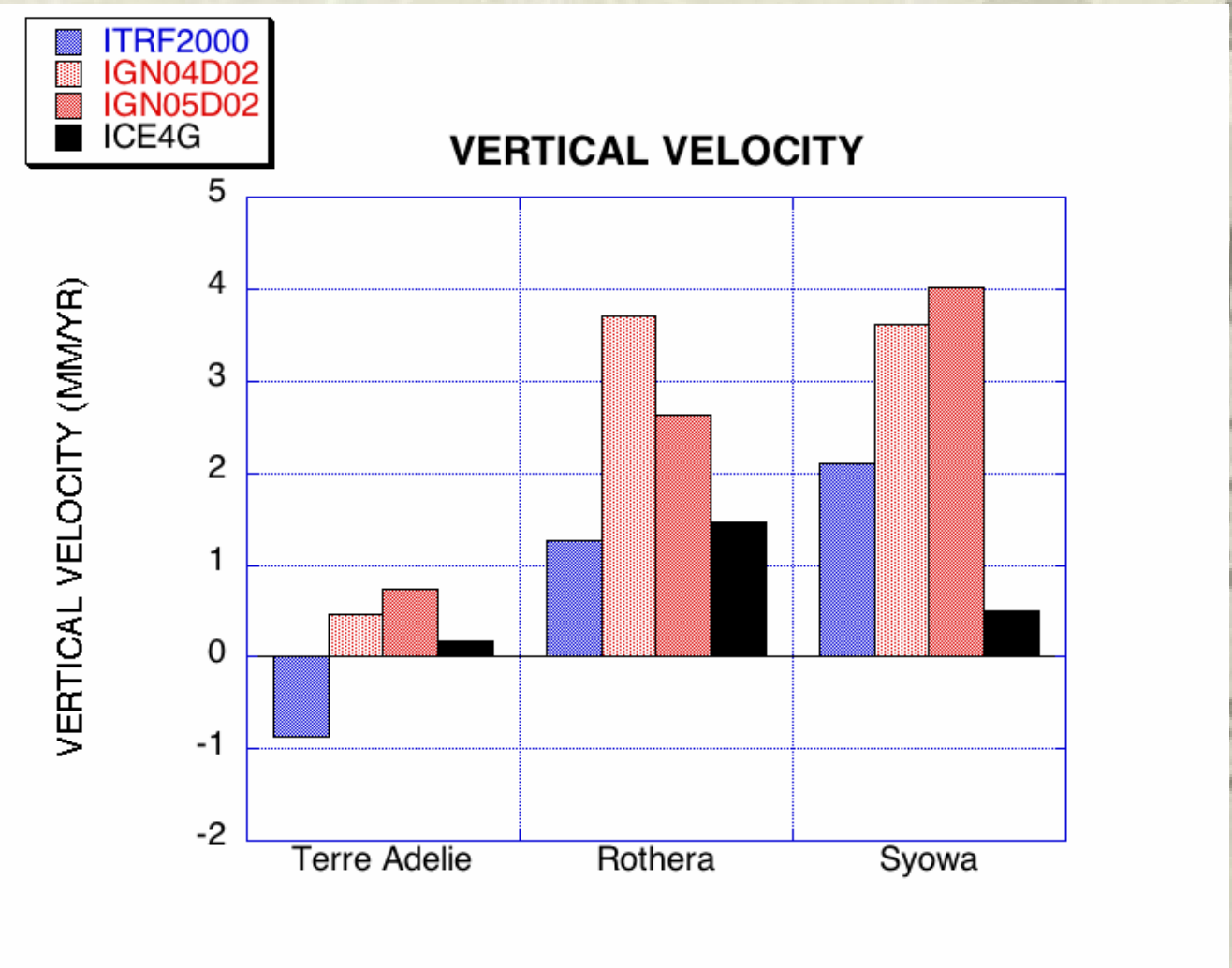
   2.2) Using time series of positions (week or month)

   - Directly expressed in ITRF2000 (STCD or SINEX)
   - Free-network solutions (more work needed there)

Horizontal velocities



Vertical velocities



Influence of sampling

- Monthly solutions

  more DORIS data --> more precise (6 mm / month)

  less data points --> integrity?

- Weekly solutions

  less DORIS data --> less precise (1 cm / week)

  more data points --> possible data screening (outliers, discontinuity handling)

DORIS Campaigns

- Dôme C
  - 2 campaigns:
    - Nov-Dec 1993
    - Dec 1999-Jan 2000
  - results:
    - No significant absolute horizontal displacement

@Vincent et al., 2000

- Sordsal and Lambert glaciers
  - 3 campaigns
    - Sordall Dec 2001-Jan 2002
    - Lambert Dec 2002
    - Sordall Nov-Dec 2003 Jan 2004

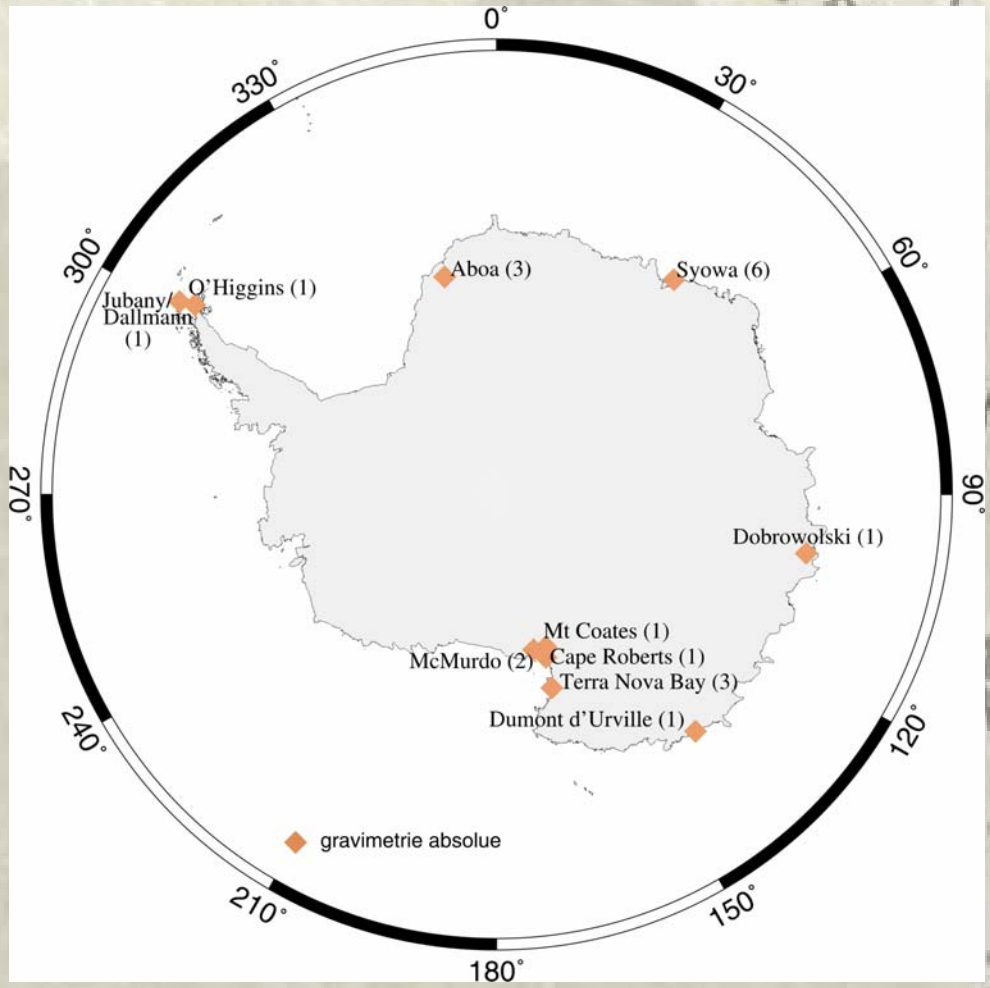
@Govind and Valette, 2004

Other positioning techniques in Antarctica

- GPS
  - Belgrano
  - Rothera (IGS)
  - Syowa (IGS) since 1999
  - Terre Adélie since 1998
- VLBI
  - Syowa since 1999

Absolute gravity measurements in Antarctica

- 23 AG measurements
- 12 stations
- 4 stations of repeated AG measurements
- Syowa only AG/DORIS station

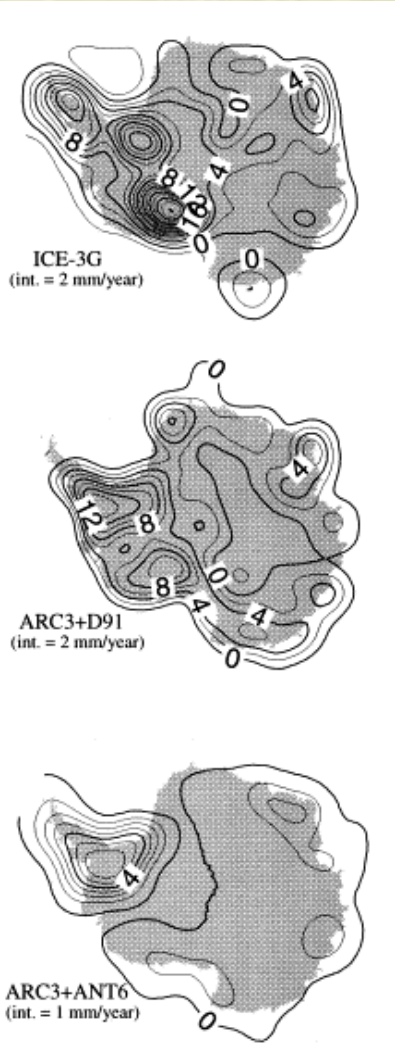


Causes of vertical motion in Antarctica

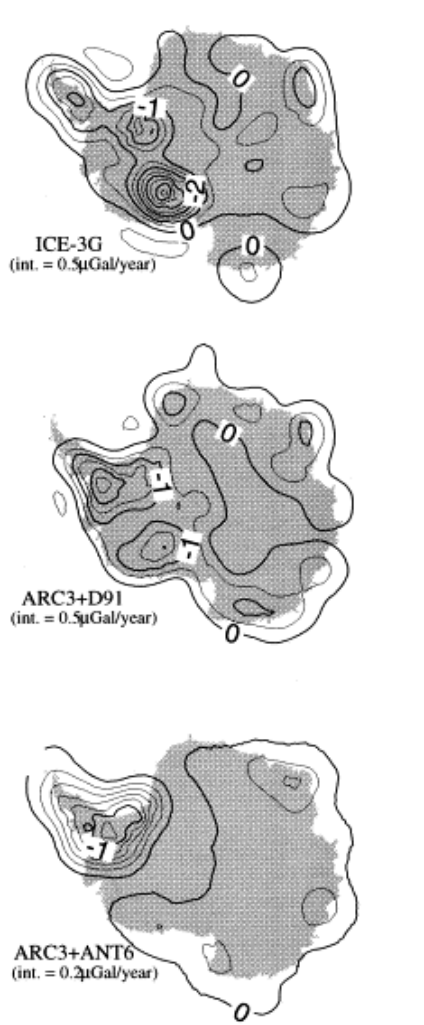
- Post-Glacial Rebound (PGR)
  - visco-elastic behaviour
- Present-day deglaciation
  - elastic behaviour

Predictions

- Several models
  - rheology
  - timing history of glaciation and deglaciation
  - ESL
- Peltier
- James & Ivins, 1998
- Nakada et al., 2000



Amalvict et al., Cairns Aug. 2005



Nakada et al., 2000

Observations from different positioning techniques techniques

	DORIS	GPS	VLBI
Rothera	2.65 +/- 0.37		NA
Syowa	3.6 +/- 0.2	1.75 +/- 0.32	4.6 +/- 2.2
Terre Adélie	0.73 +/- 0.15	-0.56/0.43	NA

Observations vs *predictions*

- Syowa
  - AG, GPS, VLBI, predictions
- Rothera
  - GPS, predictions

Conclusions

- Importance of knowing how the solution has been derived
- The longer the time series, the better
- Need for other DORIS stations
- Consistent results at Syowa (GPS, VLBI, DORIS)
- IPY