SEA LEVEL TRENDS IN THE SOUTHERN OCEAN OVER THE LAST CENTURY FROM HISTORICAL DATA

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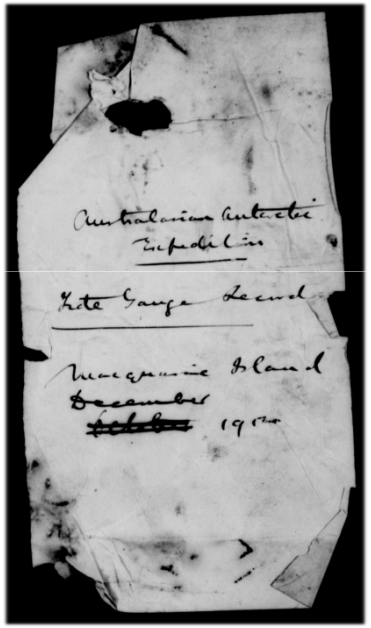
(1) LEGOS, Toulouse (France), (2) LIENSS, La Rochelle (France), (3) UTAS, Hobart (Australia), (4) EPSHOM, Brest (France) , (5) AAD, Hobart (Australia)



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Scientific Context

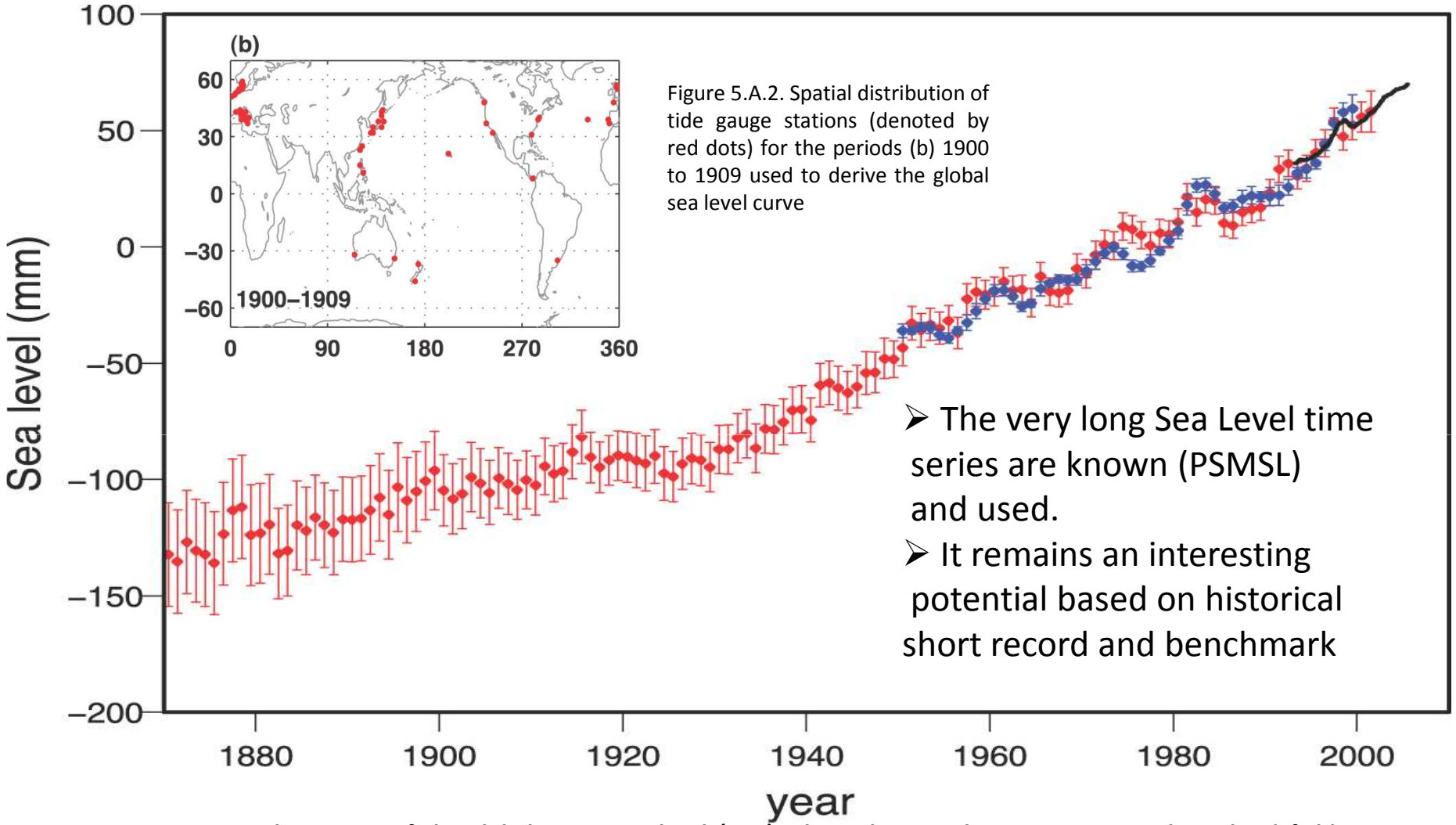
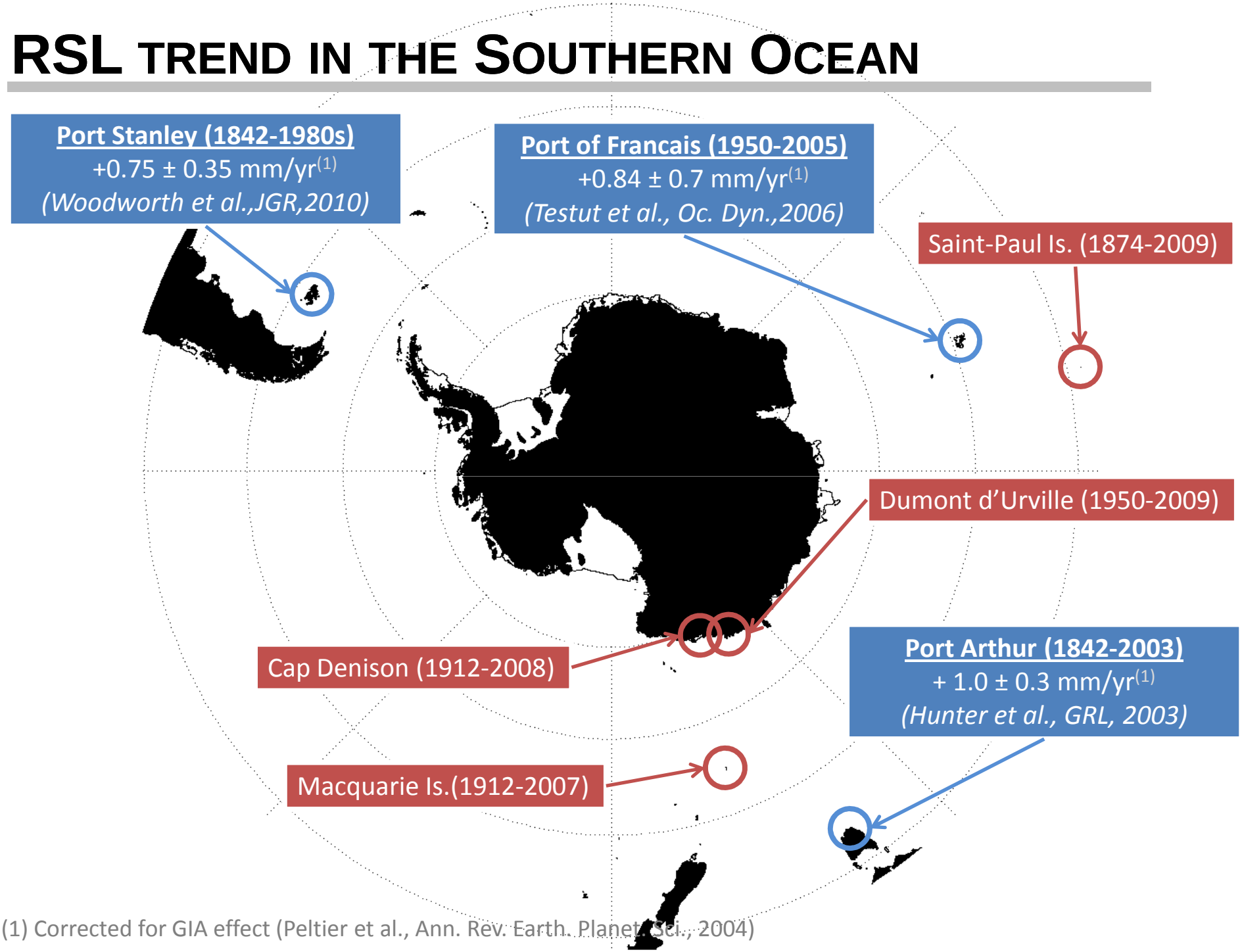


Figure 5.A.2. Spatial distribution of tide gauge stations (denoted by red dots) for the periods (b) 1900 to 1909 used to derive the global sea level curve

- The very long Sea Level time series are known (PSMSL) and used.
- It remains an interesting potential based on historical short record and benchmark

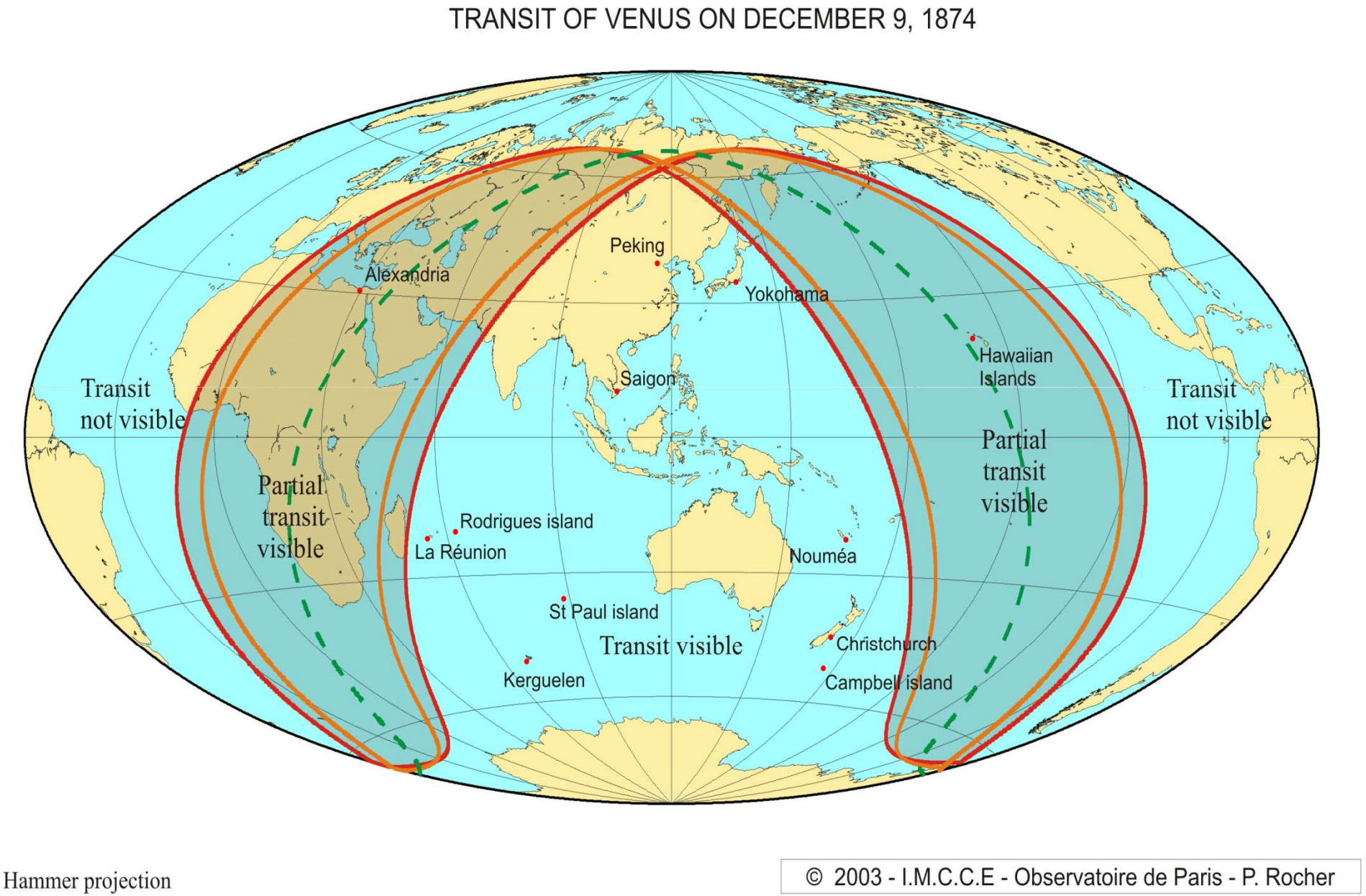
Figure 5.13. Annual averages of the global mean sea level (mm). The red curve shows reconstructed sea level fields since 1870 (updated from Church and White, 2006); the blue curve shows coastal tide gauge measurements since 1950 (from Holgate and Woodworth, 2004) and the black curve is based on satellite altimetry (Leuliette et al., 2004). The red and blue curves are deviations from their averages for 1961 to 1990, and the black curve is the deviation from the average of the red curve for the period 1993 to 2001. Error bars show 90% confidence intervals.

RSL TREND IN THE SOUTHERN OCEAN

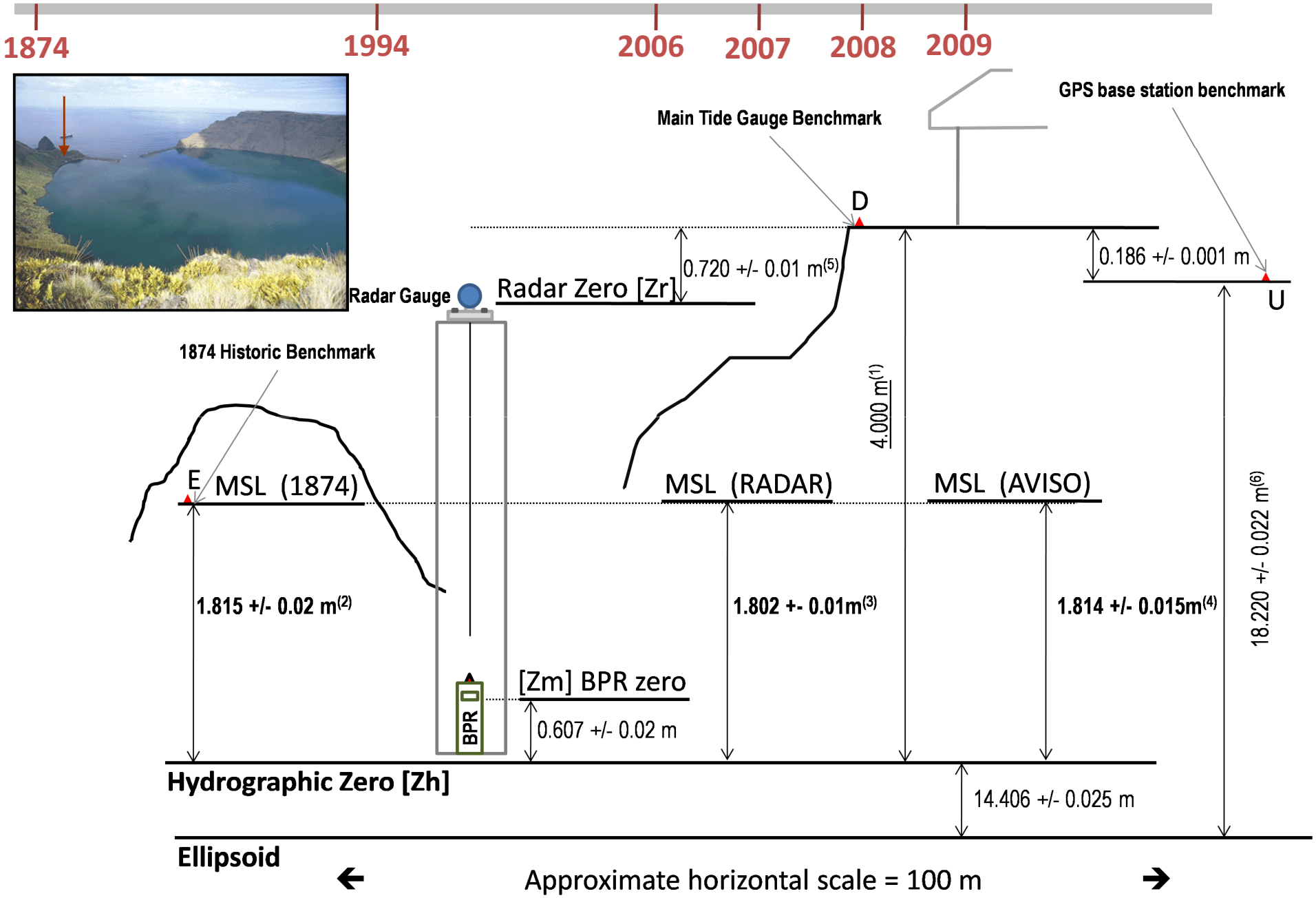


(1) Corrected for GIA effect (Peltier et al., Ann. Rev. Earth. Planet. Sci., 2004)

Ex. 1 : Saint-Paul Is. (1874-2009)



EX. 1 : CONNECT MSL TO THE SAME DATUM



EX. 1 : ESTIMATE UNCERTAINTIES

Quality of data : σ_Q

Historical & Modern

✓Analysis of tidal constituents

✓Regr. Pa

✓Calibration / validation

Quality of connection : σ_L

-Leveling error

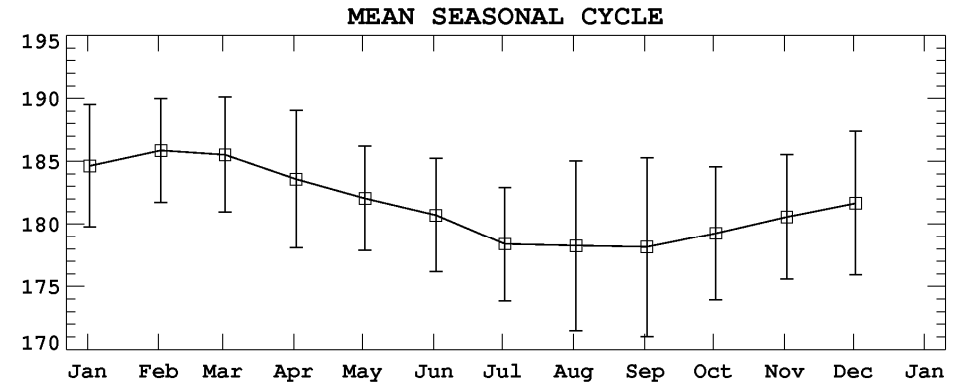
-Shape of the Benchmark

- …

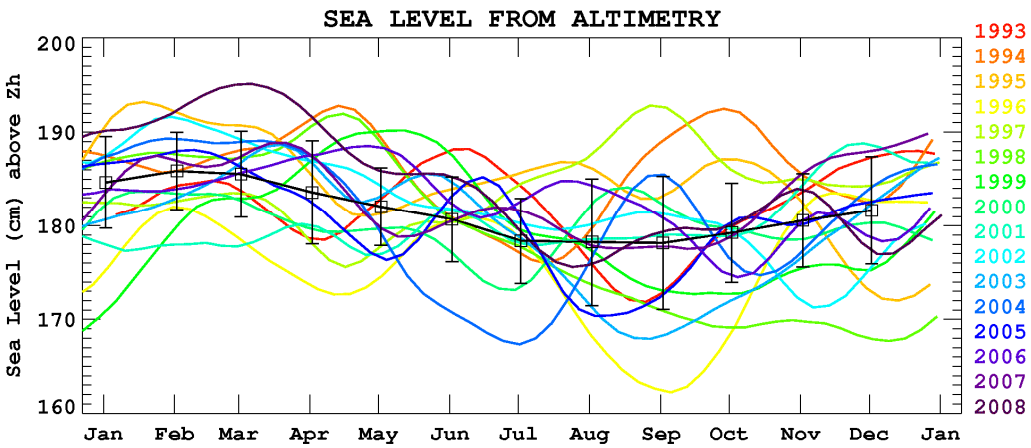
How MSL is representative : σ_S

Period	Instrument	MSL	σ_Q	σ_L	σ_S	σ_T
1874	Staff readings	**181.5**	**2**	**2**	**5.1**	**5.8**
2008-2009	Radar tide gauge	**180.2**	**1**	**1**	**4.1**	**4.3**
1993-2009	Altimetry	**181.4**	**2**	**1.5**	**~0**	**2.5**

Table : Error budget in cm

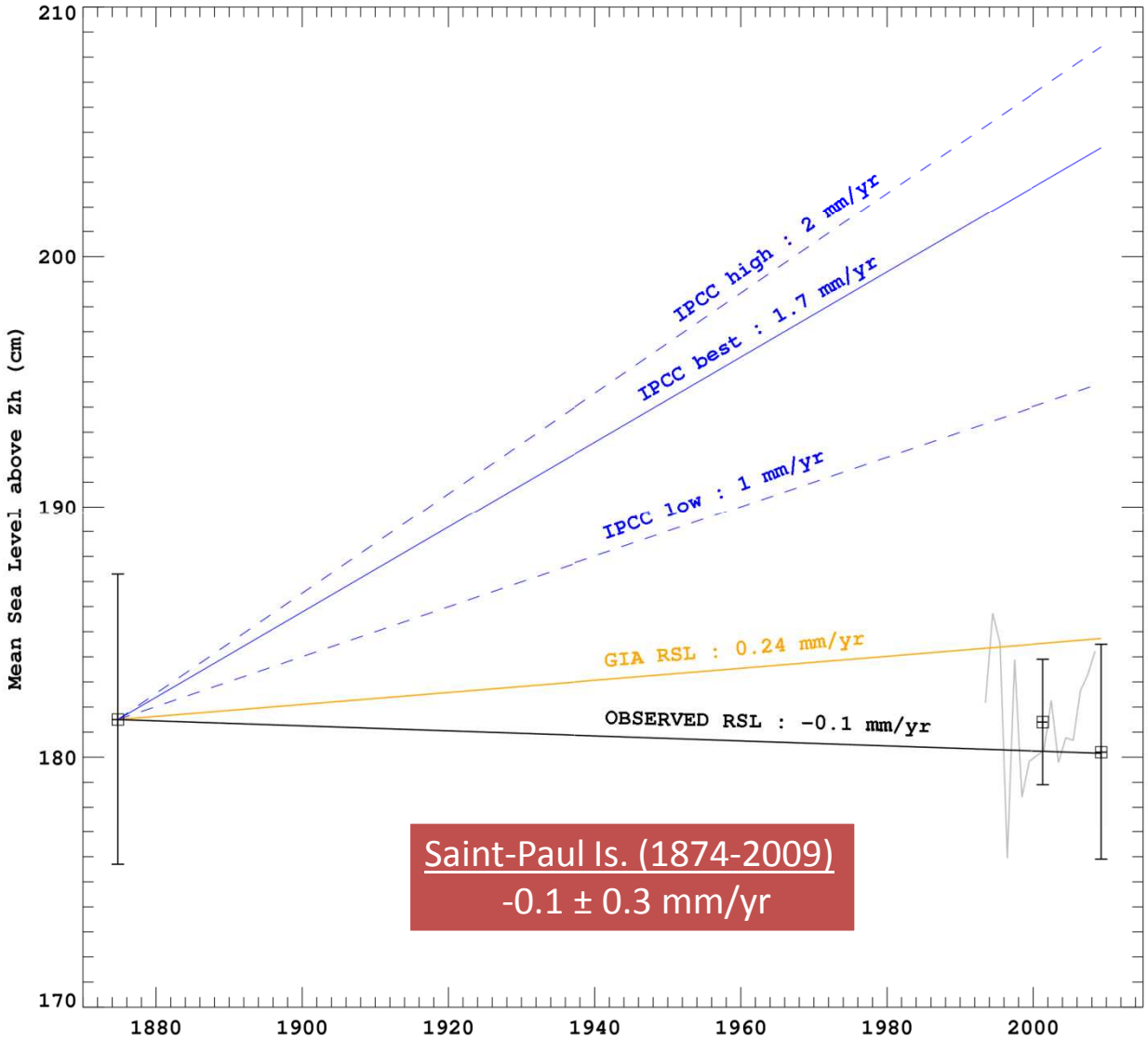


SEASONAL CYCLE AMPLITUDE = 7.7 / MIN= 178.2 in Sep / MAX= 185.9 in Feb



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean	184.6	185.9	185.5	183.6	182.0	180.7	178.4	178.3	178.2	179.3	180.6	181.7=	181.5
RMS	4.9	4.1	4.6	5.5	4.2	4.5	4.6	6.8	7.1	5.3	5.0	5.7=	5.9

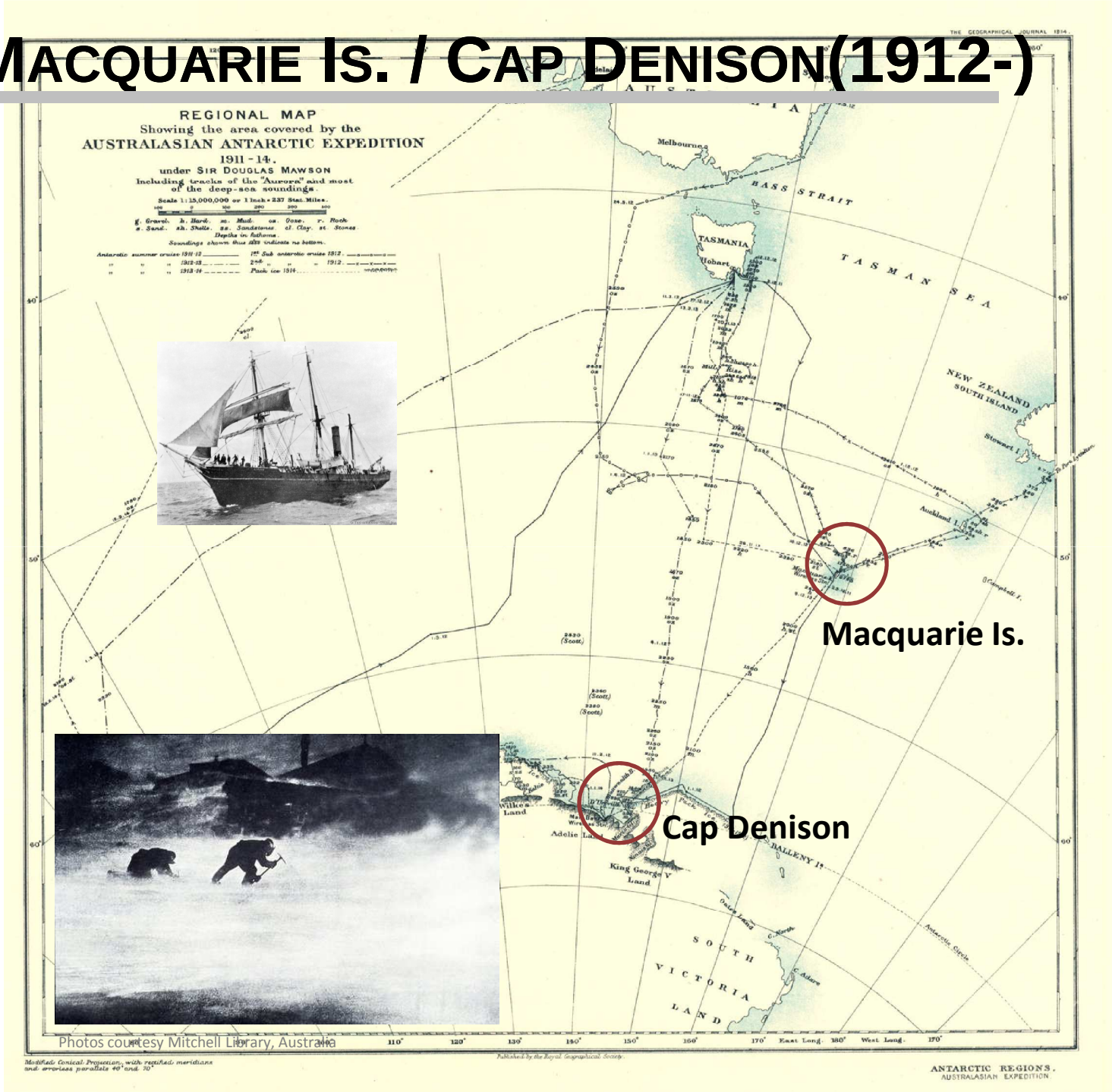
EX. 1 : RSL TREND ESTIMATE



Saint-Paul Is. (1874-2009)
-0.1 ± 0.3 mm/yr

Ex. 2&3 : Macquarie Is. / Cap Denison(1912-)

Australasian Antarctic Expedition
Sir Douglas Mawson
(1911-1914)

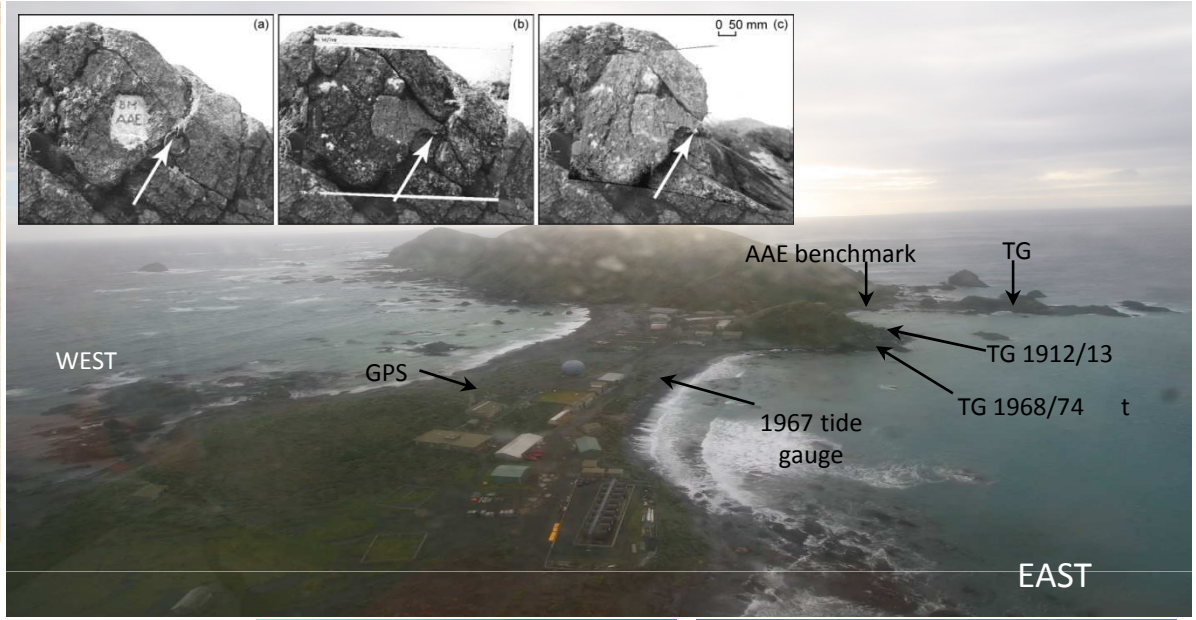


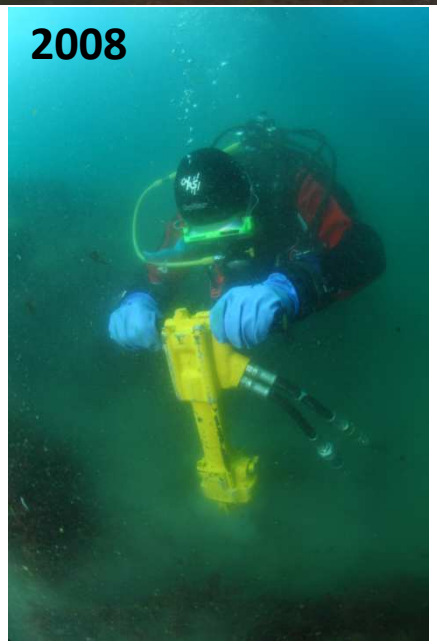
Photos courtesy Mitchell Library, Australia

Ex. 2&3 : The Tide Gauges and TGBMs

Fig. 2—The Tide Gauge at Garden Bay; Macquarie Island.

Photos courtesy Mitchell Library, Australia



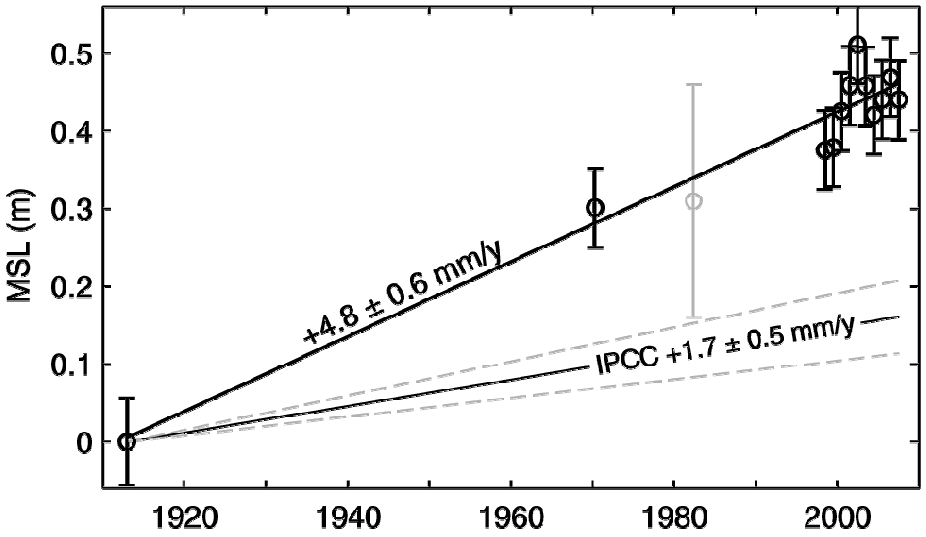


Photos courtesy E. Amice (CNRS)

Ex. 2&3 : RSL TREND ESTIMATE

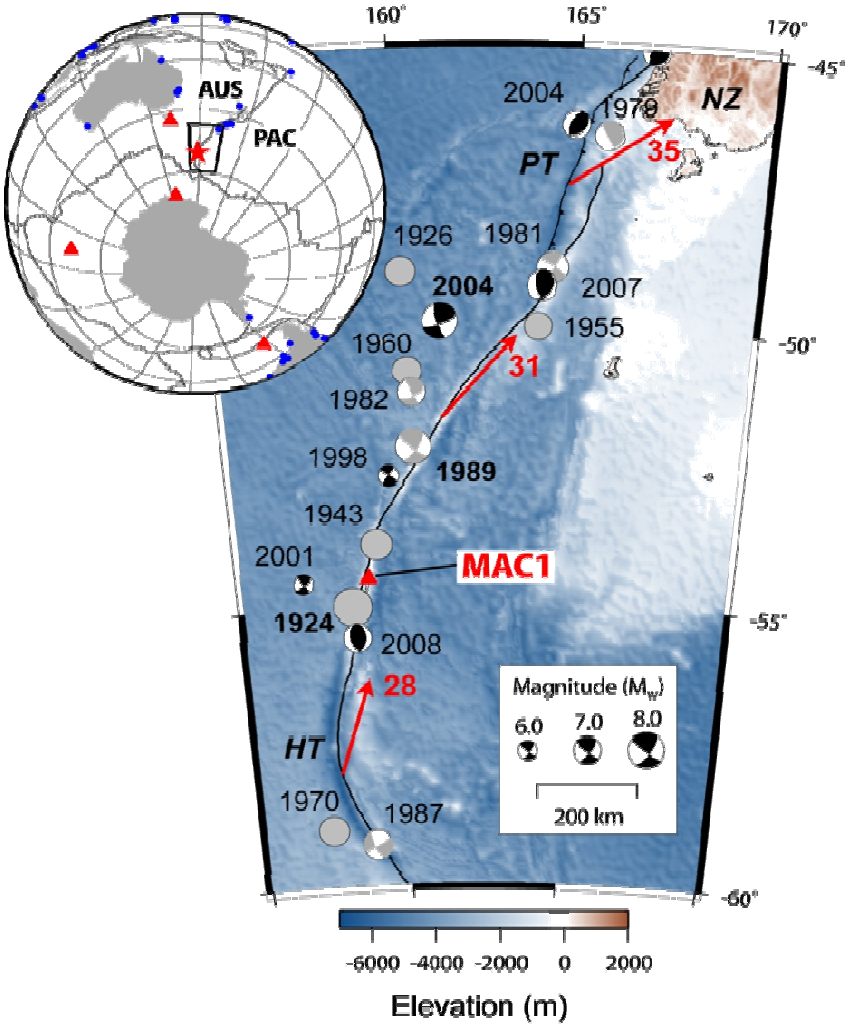
Relative Sea Level Rise, Macquarie Island

(Indicative of land subsidence)



Watson et al., (2010), *GJI*, Accepted

Preliminary estimation for Cap Denison
(1912-2008)
+2. ± 1.3 mm/yr



Watson et al., (2010), *GJI*, Accepted

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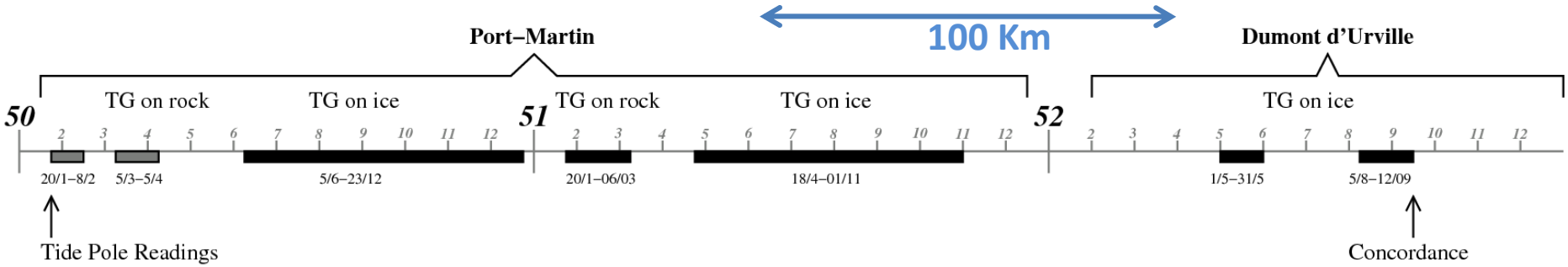
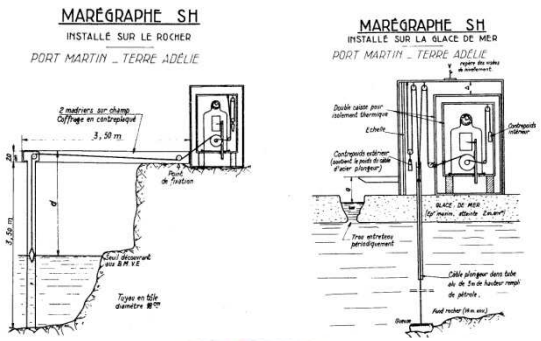
UTAS

EX. 4 : DUMONT D'URVILLE (1950-2010)





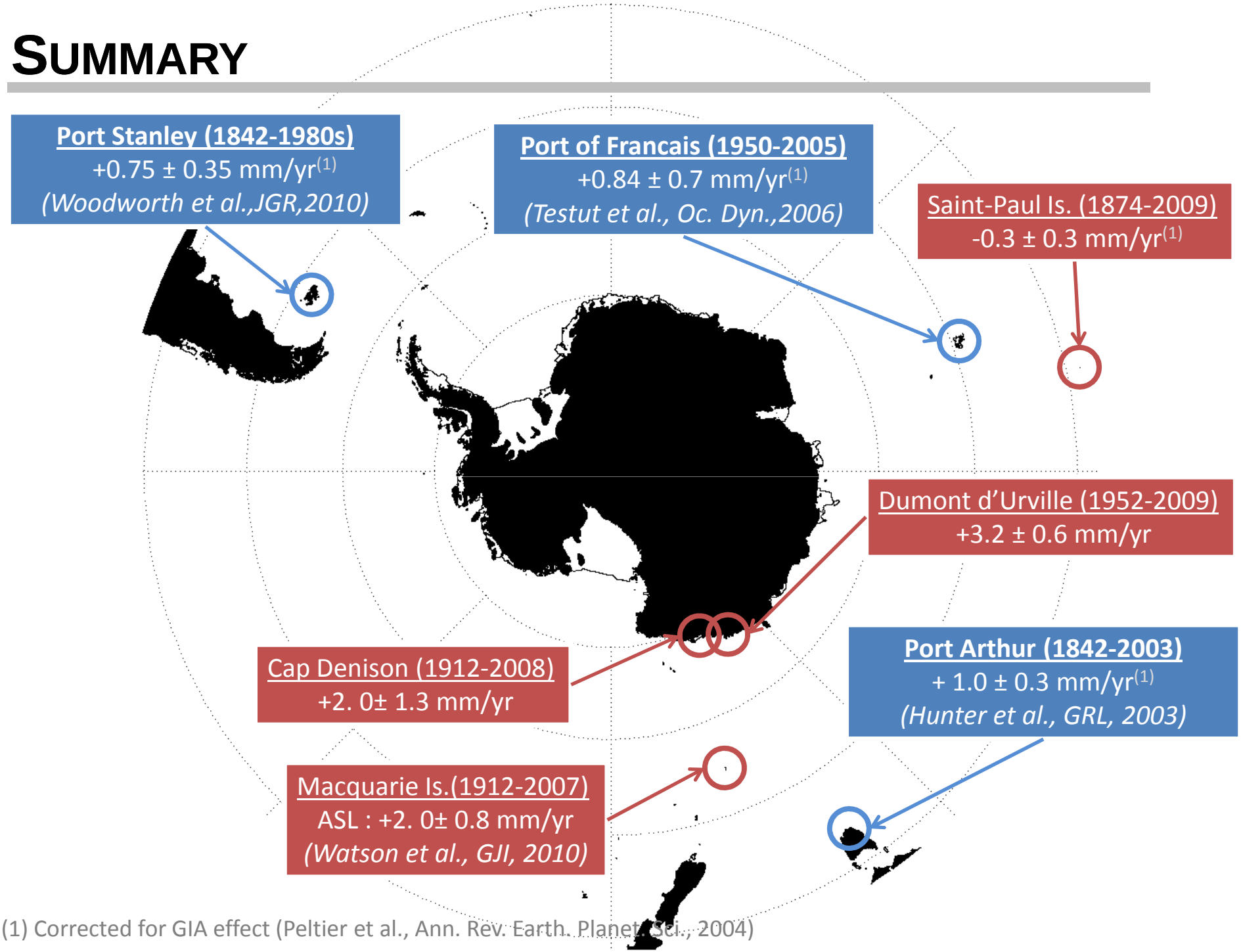
The Real Time GLOSS Tide Gauge (1997-2010)

Preliminary estimation
(1952-2009)
+3.2 ± 0.6 mm/yr

The space geodetic monitoring at Dumond d'Urville station suggest that the site is vertically stable at least over the last 2 decades (+0.3 +/- 0.1 mm/yr)

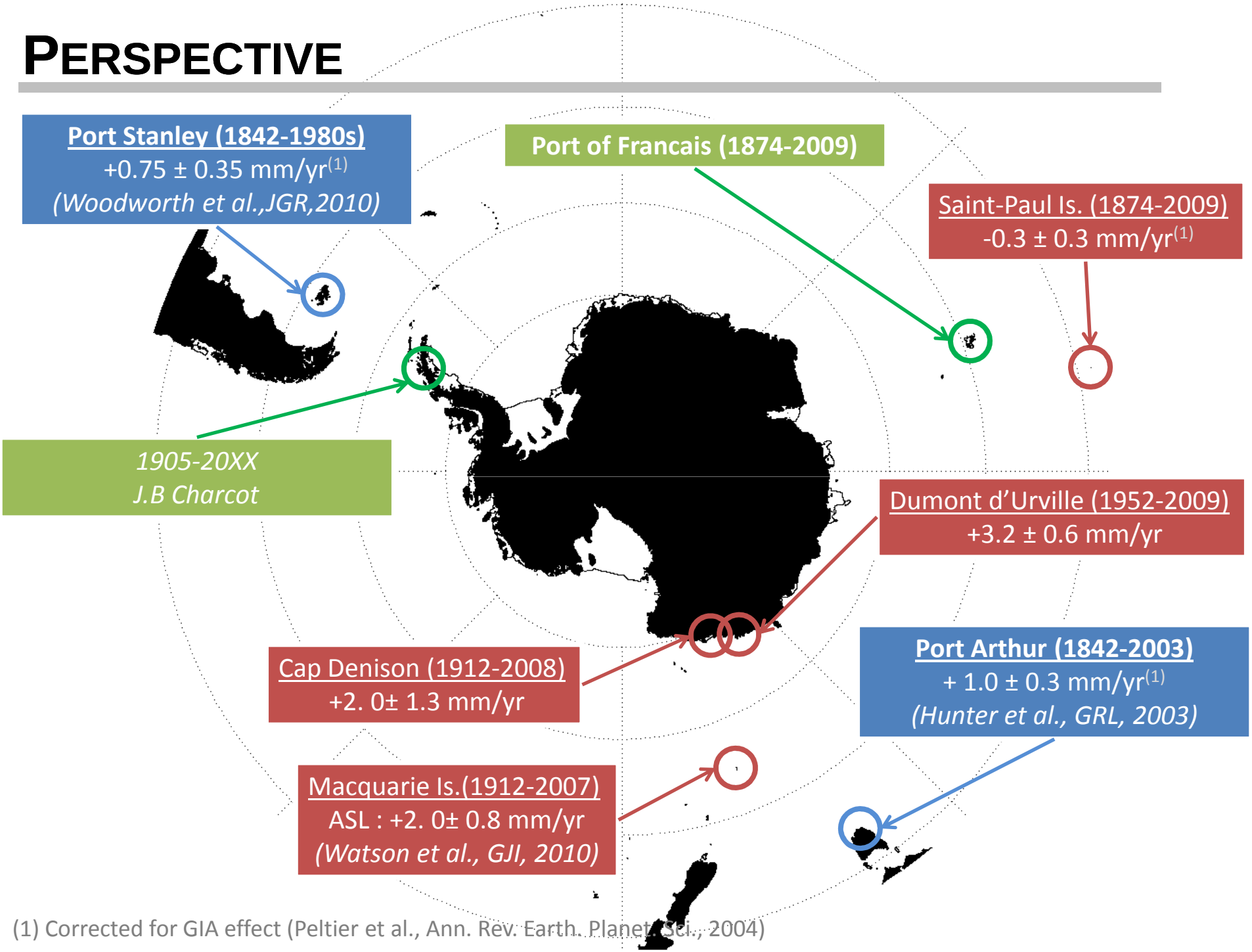
Amalvict et al., Polar Res., 2009

SUMMARY



(1) Corrected for GIA effect (Peltier et al., Ann. Rev. Earth. Planet. Sci., 2004)

PERSPECTIVE



(1) Corrected for GIA effect (Peltier et al., Ann. Rev. Earth. Planet. Sci., 2004)