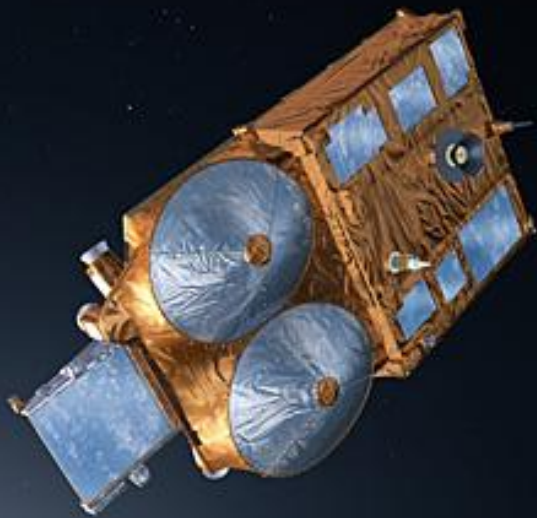


IDS Analysis Working Group Meeting

# First Results on the GDR-E Reprocessing Based on CryoSat-2



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**May 29, 2015**

IDS AWG  
Toulouse, France

# Outline

- **GDR-E POD STANDARDS**
- **IMPLEMENTATION STATUS**
- **RESULTS OF THE CRYOSAT-2 REPROCESSING**
- **CONCLUSION**

# GDR-E POD STANDARDS

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## Main changes

- Geophysical models:
  - ◆ Updated geopotential model accounting for interannual variability
  - ◆ Orbits better referenced to the center-of-mass of the total Earth system
- Orbit parameterization:
  - ◆ Calibrated semi-empirical Solar Radiation Pressure (SRP) models
  - ◆ Improved stochastic (reduced-dynamic) parameterization
  - ◆ DORIS-only and GPS+DORIS orbits
  - ◆ SLR used as a reference to independently evaluate orbit precision and stability

# GDR-E POD STANDARDS

## Updated measurement models

- **Displacement of reference points:**

- ◆ FES2012 ocean loading (FES2004)
- ◆ S1-S2 atmospheric pressure loading, implementation of Ray & Ponte (2003) by van Dam
- ◆ Ocean pole tides (Desai, 2002)
- ◆ Reference GPS constellation: JPL solution at IGS -> JPL solution in “native” format (orbits and clocks), referenced to the CoM of the solid Earth/Ocean system

- **Geocenter variations:**

- ◆ Tidal: ocean loading and S1-S2 atmospheric pressure loading
- ◆ Non-tidal: seasonal SLR-only model from J. Ries

- **Propagation delays:**

- ◆ DORIS beacons phase center correction

# GDR-E POD STANDARDS

## Updated **dynamic** models

### ● **Geopotential:**

- ◆ EIGEN-GRGS/RL03-v2.MEAN-FIELD (based on 28 years of LAGEOS data, 12 years of GRACE data and 3 years of GOCE data) now accounts for interannual variability
- ◆ Non-tidal TVG: one annual, semi-annual, bias and drift term for each year up to degree/order 80;  $C_{21}/S_{21}$  modeled according to IERS2010 conventions;  $C_{31}/S_{31}$  estimation by arc if necessary
- ◆ FES2012 ocean tides (FES2004)
- ◆ Atmospheric gravity: 6hr NCEP pressure fields (20x20 -> 70x70) + tides from Biancale-Bode model

### ● **Surface forces:**

- ◆ Calibrated semi-empirical solar radiation pressure models
- ◆ Drag from DTM-2013 atmospheric density model for Jason satellites and HY-2A

# GDR-E POD STANDARDS

## Improved parameterization

- **Estimated dynamic parameters:**
  - ◆ Improved stochastic (reduced-dynamic) solutions
- **Jason-1 DORIS data corrections:**
  - ◆ Updated South Atlantic Anomaly model (J.-M. Lemoine et al.)
- **Jason-1 DORIS weight:**
  - ◆ SAA DORIS beacons weight is divided by 10 before DORIS instrument change
- **SLR weight:**
  - ◆ Data saved for orbit validation (DORIS-only and GPS+DORIS orbits)
    - » SLR stations can monitor regional errors (at orbit level) ⇔ tide gauges (at sea level)
    - » Now the reference used to independently evaluate orbit precision and stability (solicit ILRS to stress this new need with F. Lemoine in June)

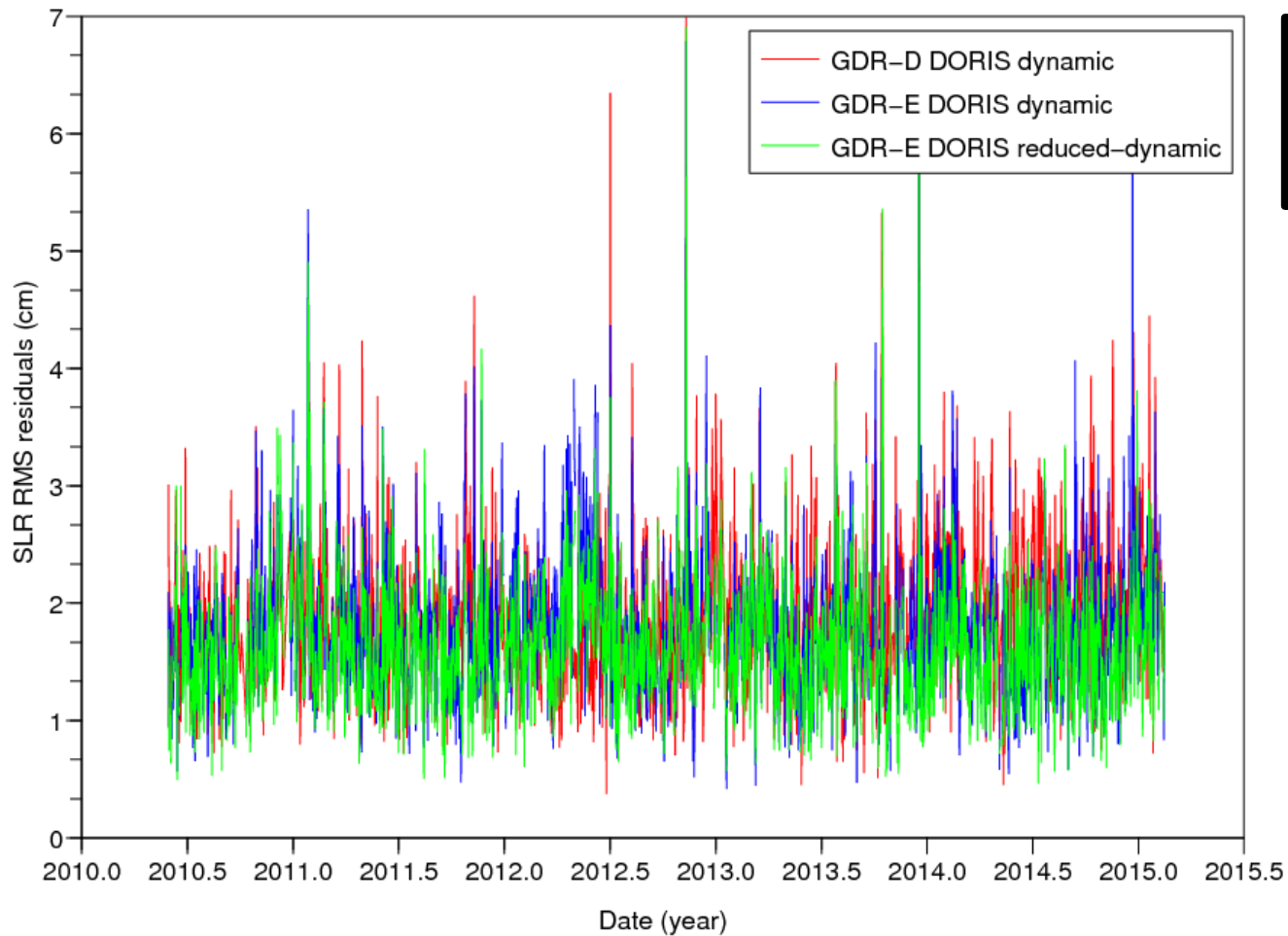
# IMPLEMENTATION STATUS

- **CryoSat-2:** POEs from arc 260 (April 2015) are in GDR-E; previous arcs have been reprocessed and delivered to ESA and IDS
  - » See [DORISMail] No 0969 from April 29, 2015
- **Jason-1:** POE will be available by mid-June 2015
- **Jason-2:** switch to new POE standards will be effective from cycle 254 (end of May 2015)
- **Saral:** switch to new POE standards will be effective from cycle 25 (July 2015)
- **Jason-3, Sentinel-3A:** first POE will start in GDR-E standards - July 2015 for Jason-3 and late 2015 for Sentinel-3A
- **HY-2A, Envisat:** POEs will switch to the GDR-E standards at a later stage

## Results of the CryoSat-2 reprocessing



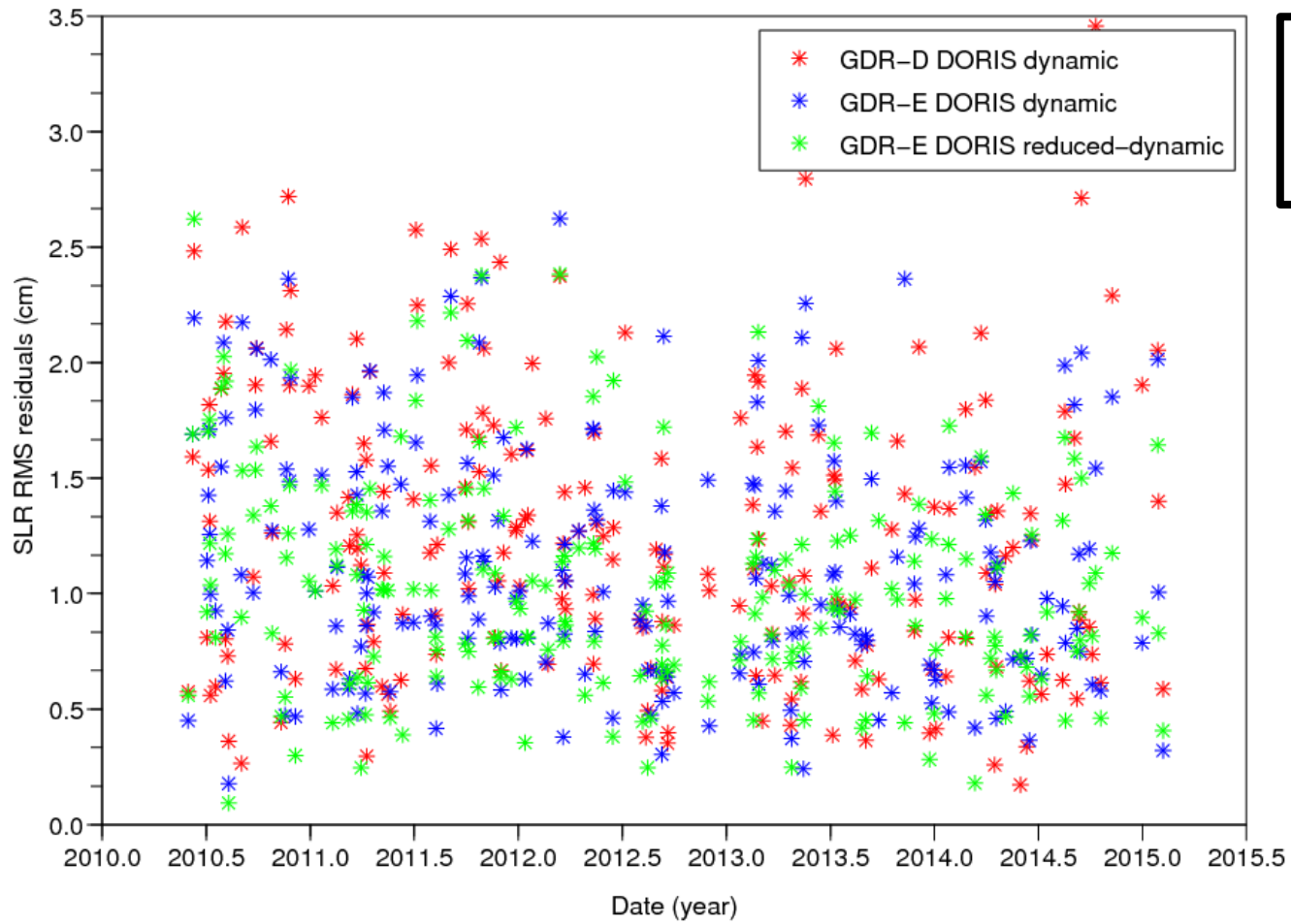
# INDEPENDENT SLR VALIDATION



**1.9 cm RMS**  
**1.8 cm RMS**  
**1.6 cm RMS**

6-station core-network: Yarr7090, Greb7105, Zimm7810, Graz7839, Hers7840, Mate7941

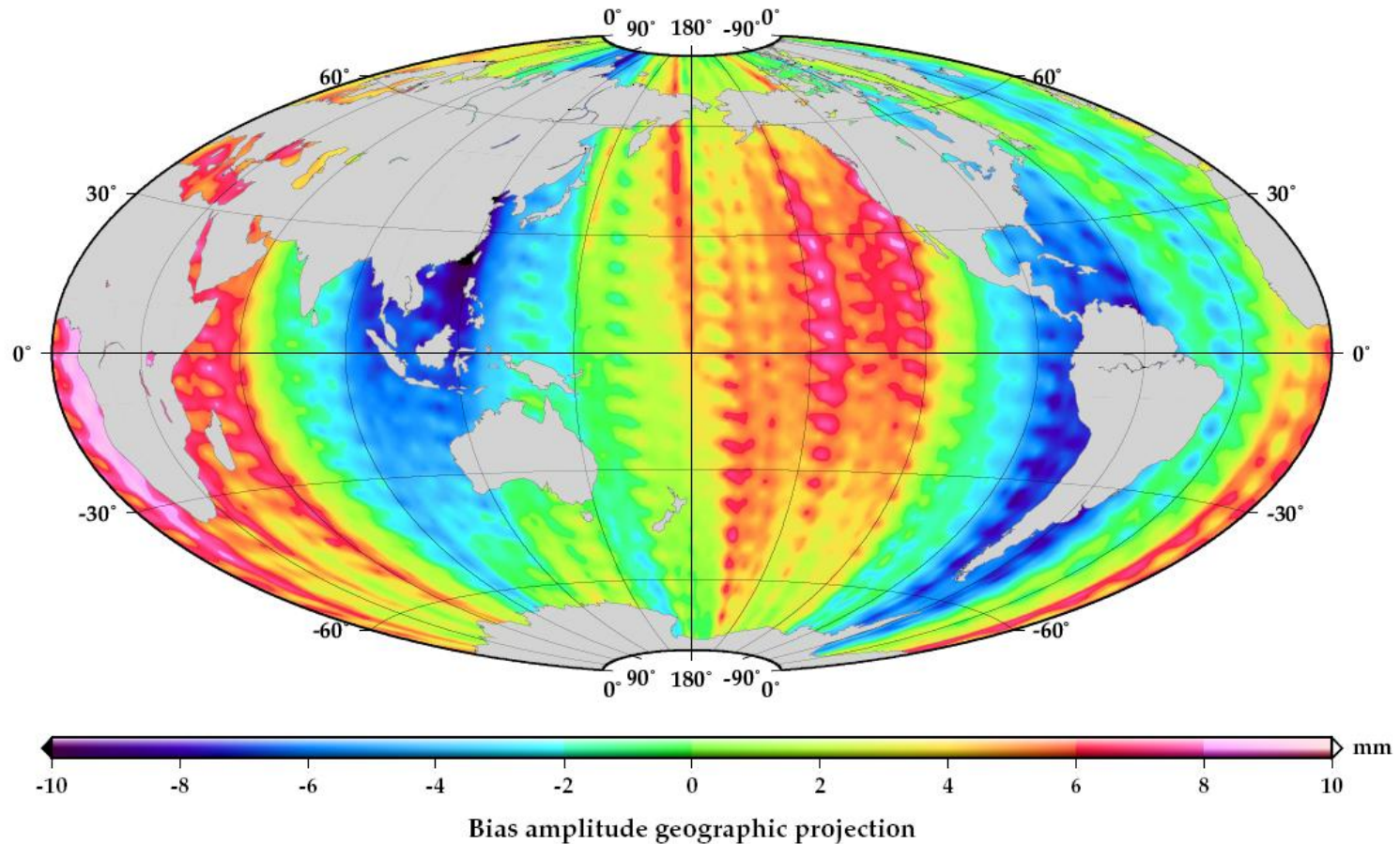
# HIGH-ELEVATION (> 70°) SLR RMS RESIDUALS



6-station core-network: Yarr7090, Greb7105, Zimm7810, Graz7839, Hers7840, Mate7941

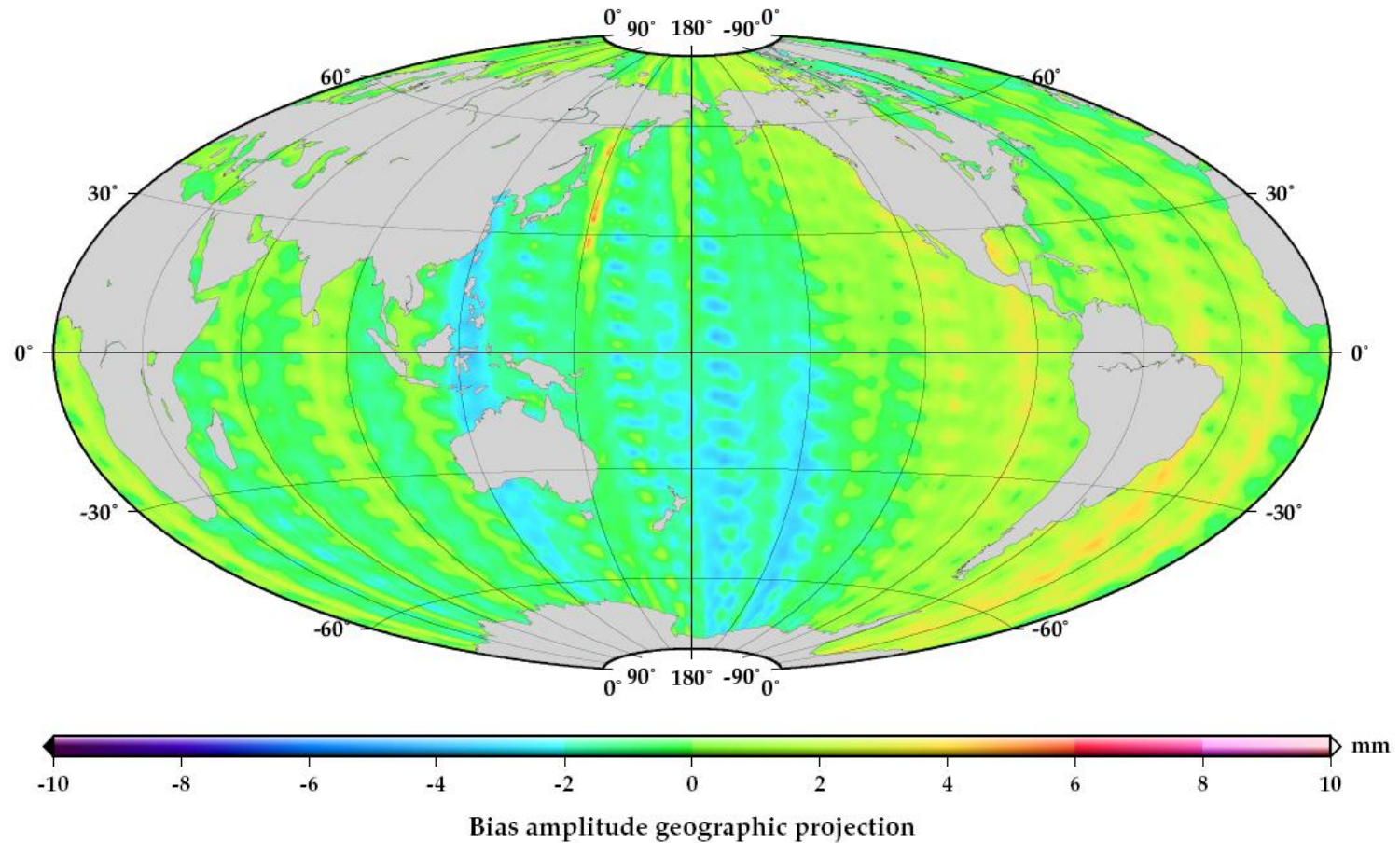
# BIAS GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-D DORIS dynamic (ascending)



# BIAS GEOGRAPHICALLY CORRELATED ORBIT ERRORS

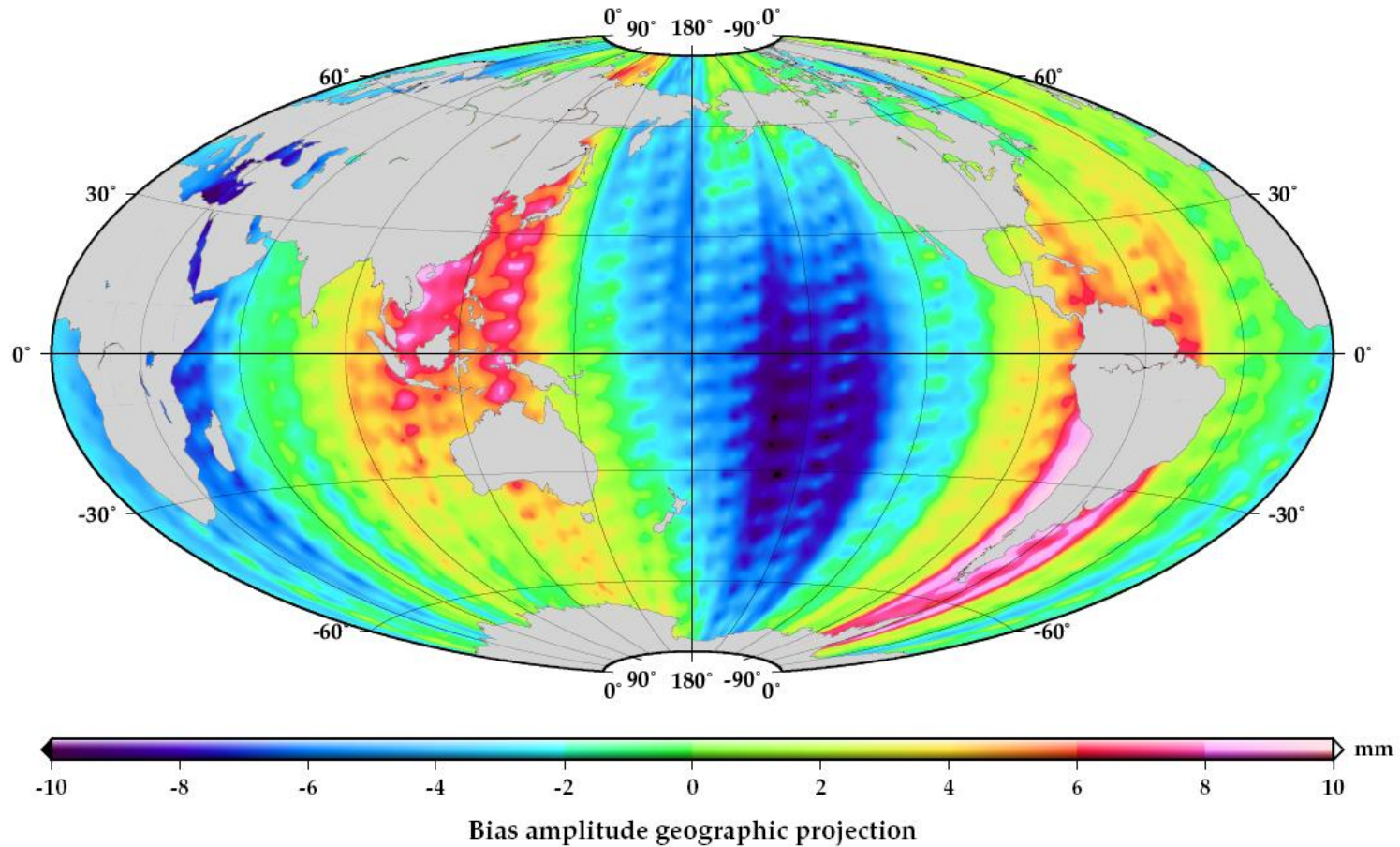
CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-E DORIS dynamic (ascending)





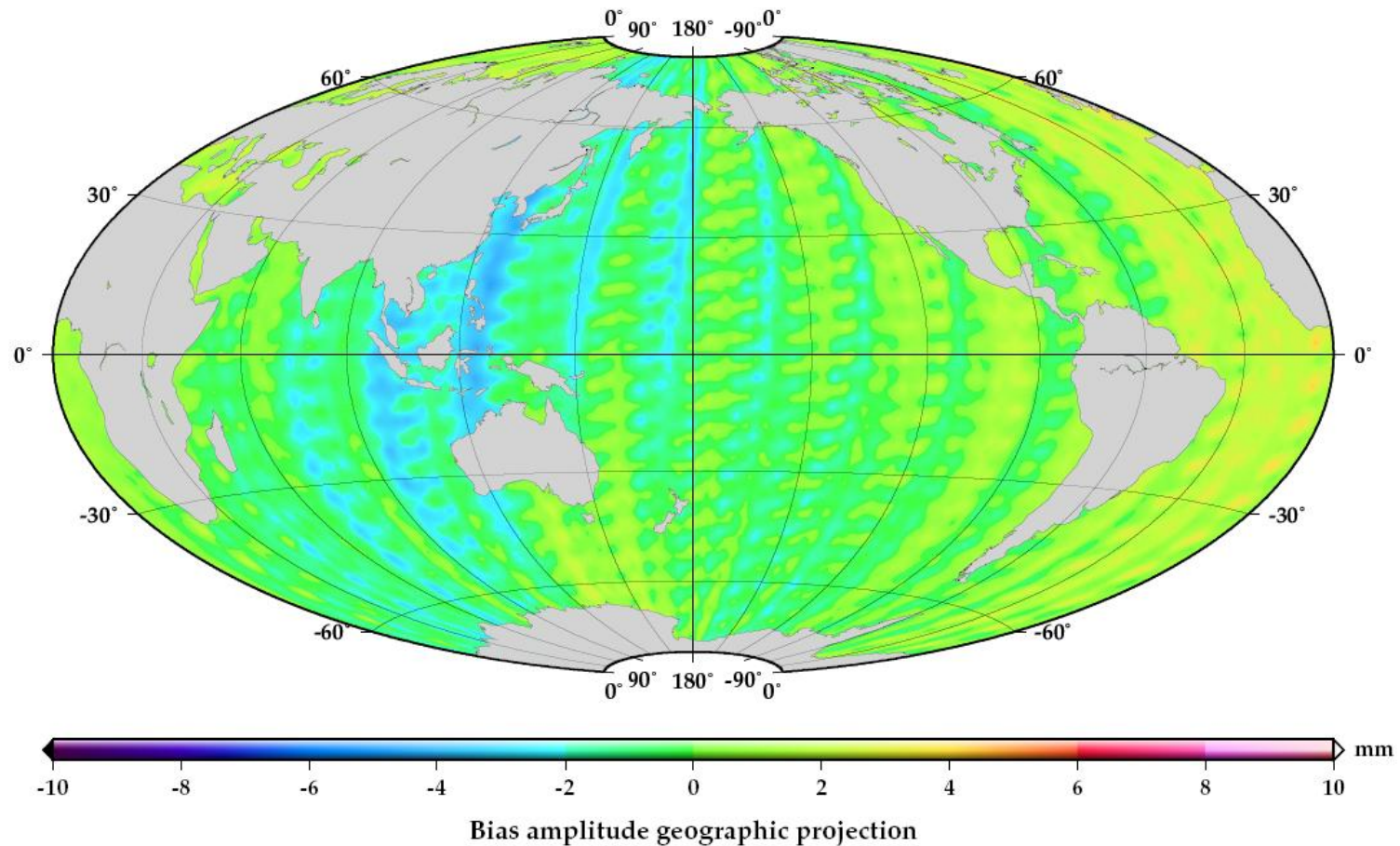
# BIAS GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-D DORIS dynamic (descending)



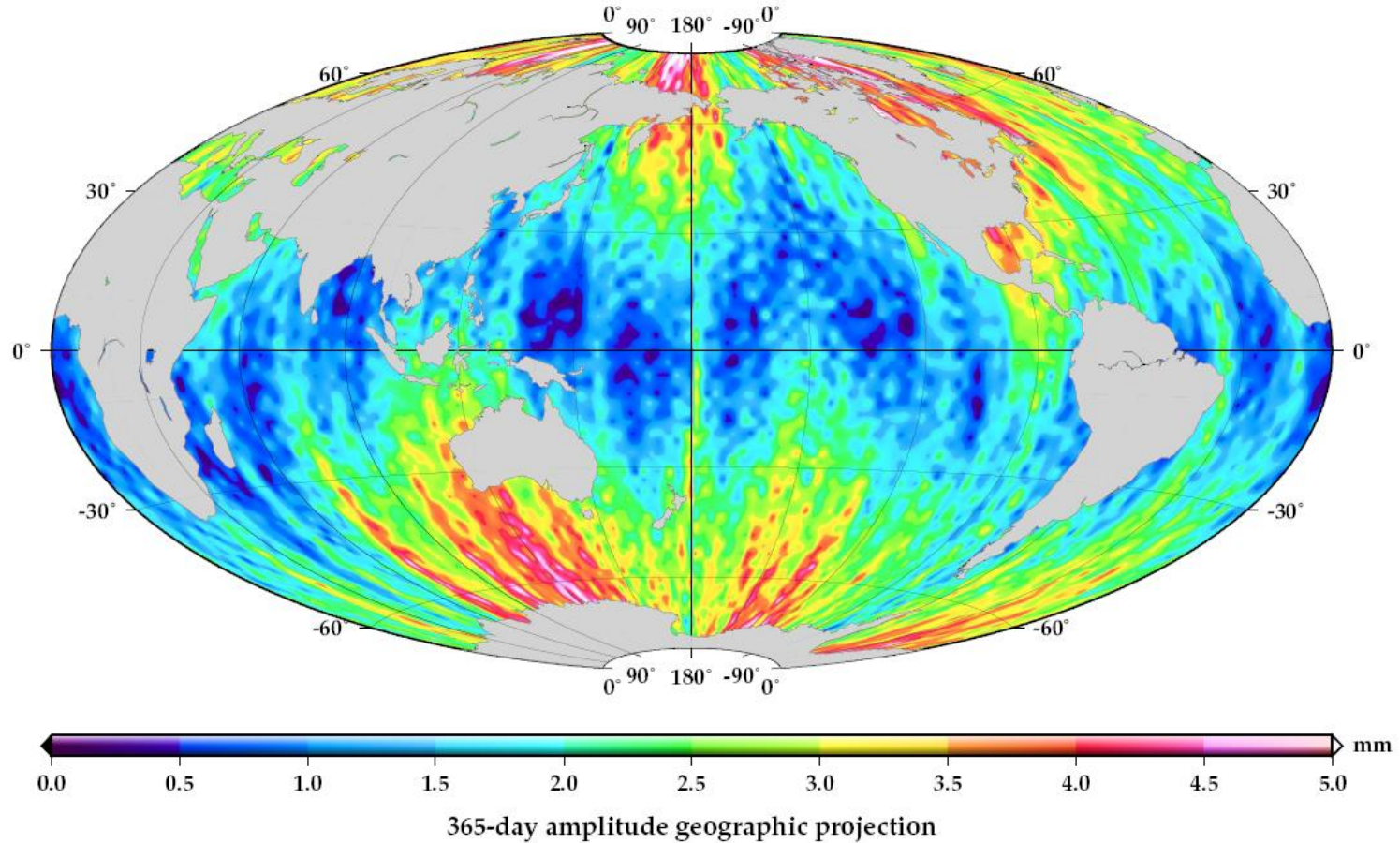
# BIAS GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-E DORIS dynamic (descending)



# 365-DAY GEOGRAPHICALLY CORRELATED ORBIT ERRORS

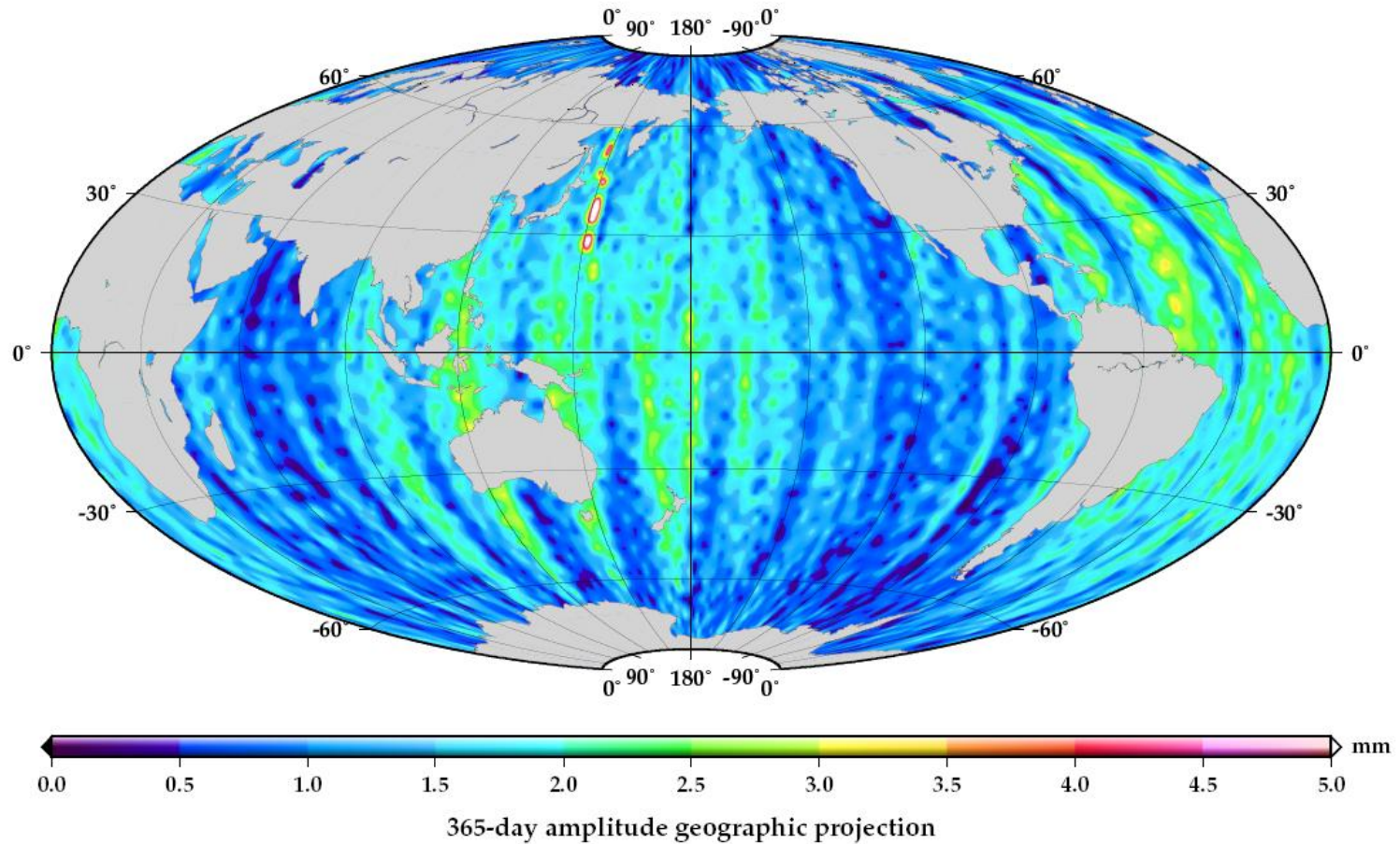
CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-D DORIS dynamic





# 365-DAY GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-E DORIS dynamic





# CONCLUSION

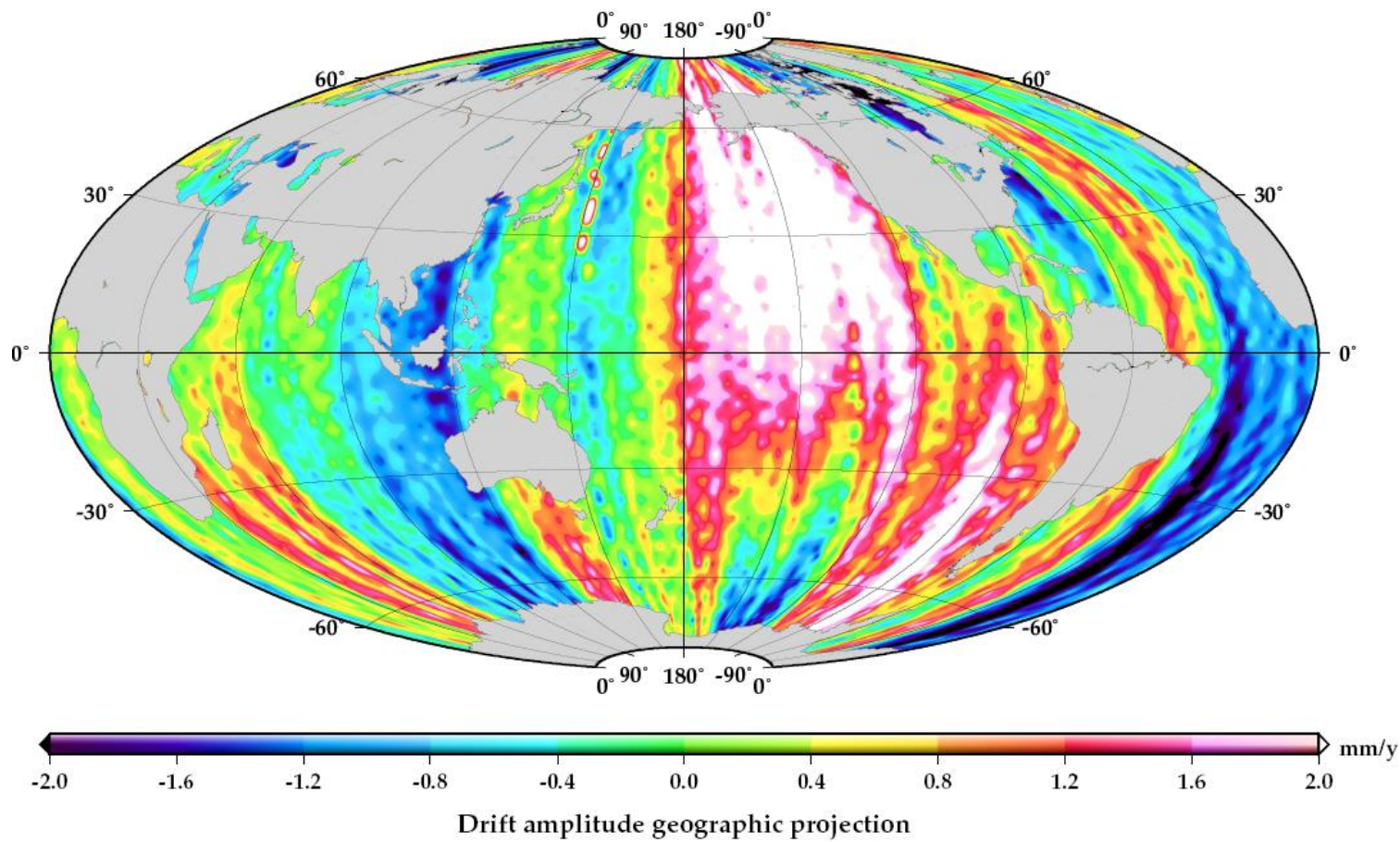
## First results of the GDR-E reprocessing

- **CryoSat-2 GDR-E POEs: 1-cm radial RMS orbit accuracy achieved at ~700 km with DORIS-only data**
  - ◆ *It augurs well for the quality of the future Jason-CS orbits (same platform)*
- **Jason-2 GDR-E MOEs already available:**
  - ◆ All-elevation SLR core-network RMS residuals:
    - » **GDR-D** DORIS “stochastic”: **2.6 cm RMS**
    - » **GDR-E** DORIS reduced-dynamic: **2.2 cm RMS**
  - ◆ High-elevation SLR core-network RMS residuals:
    - » **GDR-D** DORIS “stochastic”: **1.7 cm RMS**
    - » **GDR-E** DORIS reduced-dynamic: **1.3 cm RMS**

# Backups

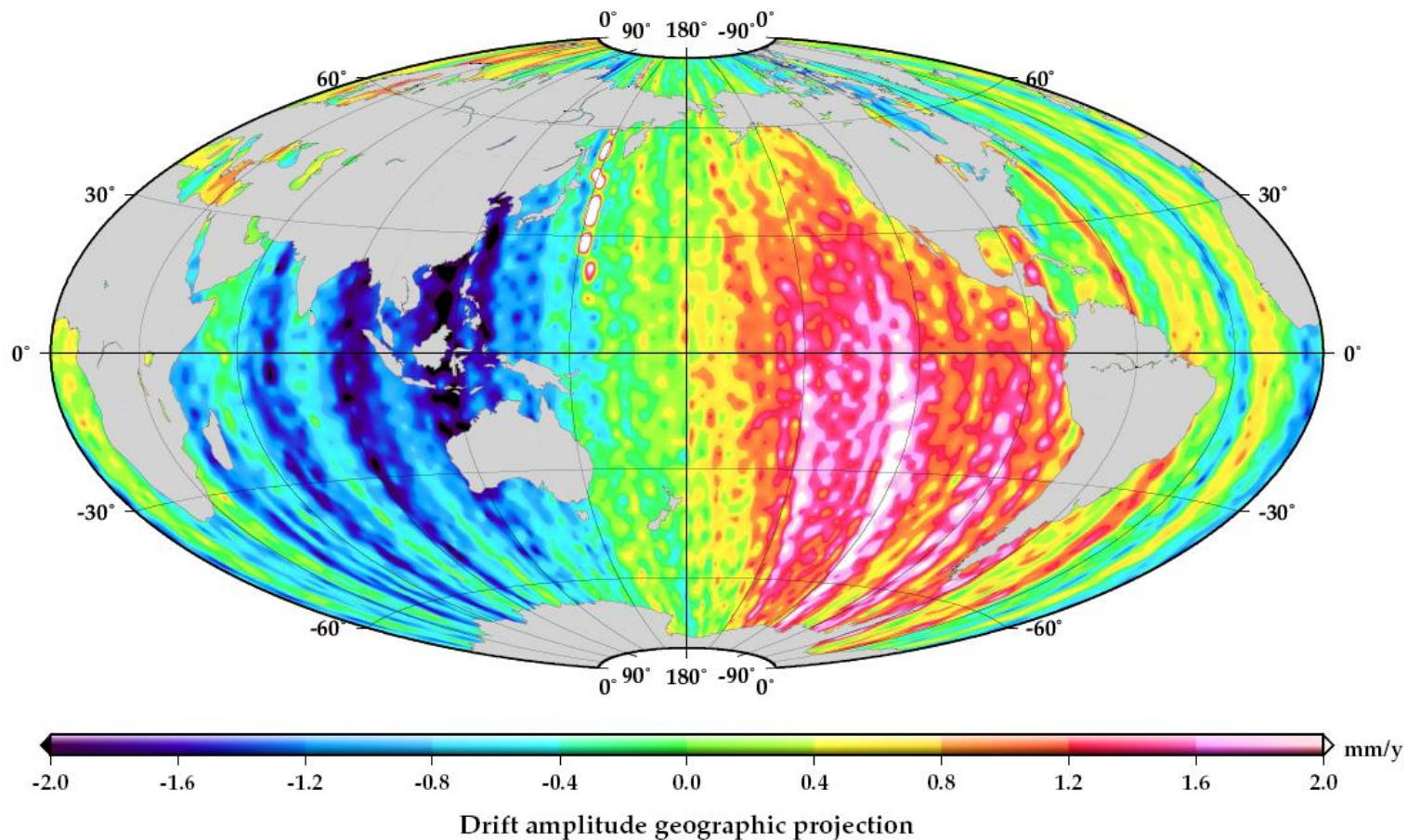
# DRIFT GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-D DORIS dynamic (ascending)



# DRIFT GEOGRAPHICALLY CORRELATED ORBIT ERRORS

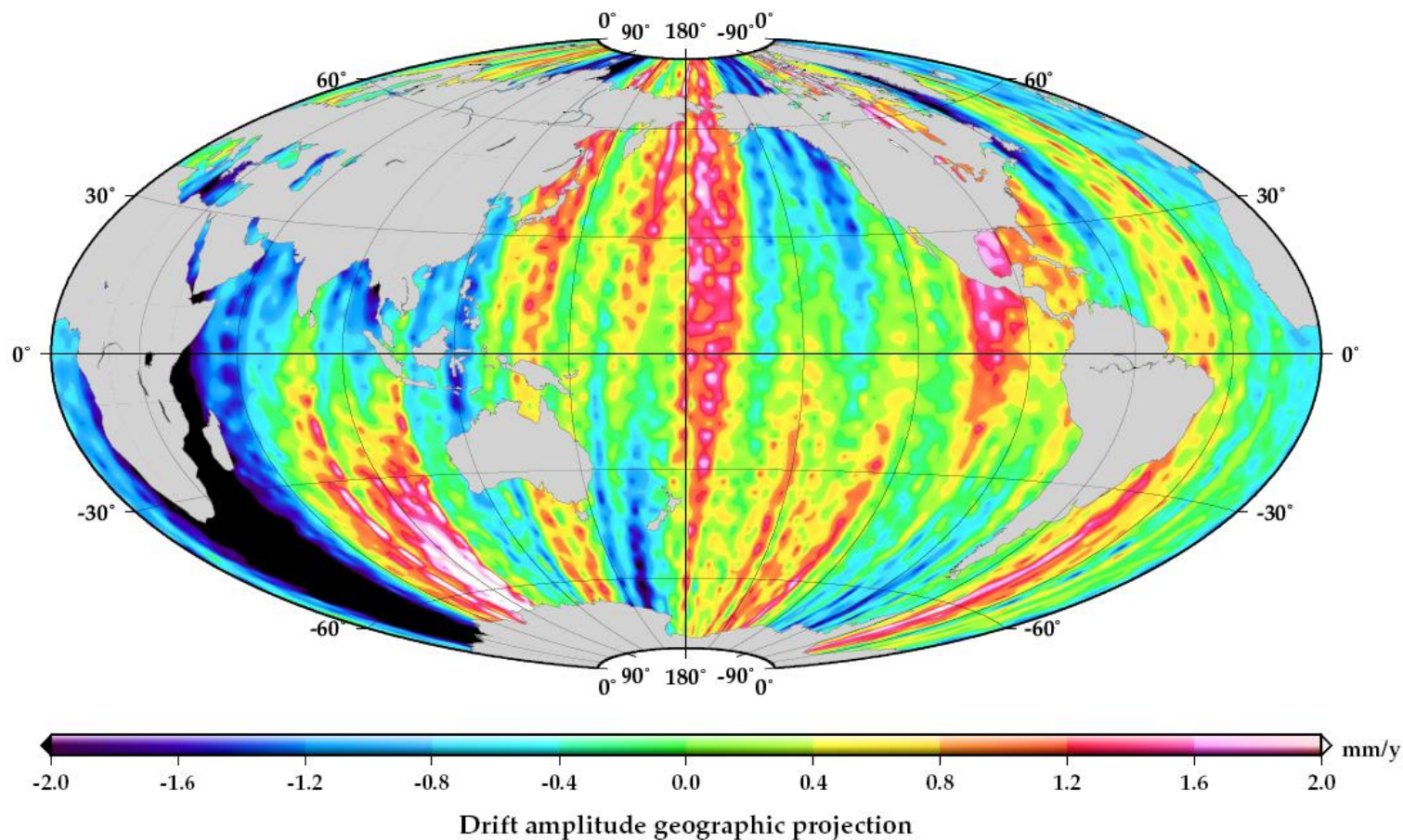
CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-E DORIS dynamic (ascending)





# DRIFT GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-D DORIS dynamic (descending)



# DRIFT GEOGRAPHICALLY CORRELATED ORBIT ERRORS

CryoSat-2 GDR-E DORIS reduced-dynamic - GDR-E DORIS dynamic (descending)

