Argo Status

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Japan Argo

#2 float deploying nation
1. Overview
Note on Performance Targets

Target for global/deep/bio are community requirements (*e.g.* OceanOBS’09), *i.e.* not yet fully supported by AST, and funding agencies.

<table>
<thead>
<tr>
<th>Targets</th>
<th>Initial</th>
<th>Global</th>
<th>Deep</th>
<th>Bio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMPLEMENTATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Nb of active units in the design targets = 3000, 4400, 1000, 900</td>
<td></td>
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</tr>
<tr>
<td>Operationality</td>
<td>Nb of operational units vs targets within the design</td>
<td></td>
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</tr>
<tr>
<td>Intensity</td>
<td>Nb of units deployed (t = 365) within the design targets = 750, 1100, 250, 225</td>
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<tr>
<td>Coverage (Yearly)</td>
<td>Nb of well sampled 3X3 grid element over last calendar year. See coverage maps</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Coverage (monthly)</td>
<td>Nb of well sampled 3X3 grid elements over last month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DATA FLOW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery</td>
<td>Nb of operational vs registered units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality (TEMP, PSAL)</td>
<td>Nb of profiles flag='A' vs total (last month)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM Processing</td>
<td>Ration DM/DM_eligible profiles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timeliness (FR, US)</td>
<td>Nb of profiles distributed within 24h (last month)</td>
<td></td>
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<tr>
<td><strong>INSTRUMENTATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reliability (75, 150)</td>
<td>Nb of platforms surviving 75 or 150 cycles vs total deployment date [t-750; t-1115] or [t-1500; t-1865]</td>
<td></td>
<td></td>
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</table>
# Performance Indicators (%)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Initial</th>
<th>Global</th>
<th>Deep</th>
<th>Bio</th>
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<td><strong>IMPLEMENTATION</strong></td>
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<tr>
<td>Activity</td>
<td>113</td>
<td>90</td>
<td>2</td>
<td>31</td>
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<tr>
<td>Operationality</td>
<td>112</td>
<td>88</td>
<td>2</td>
<td>30</td>
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<tr>
<td>Intensity</td>
<td>106</td>
<td>84</td>
<td>6</td>
<td>31</td>
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<tr>
<td>Coverage (Yearly)</td>
<td>70</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coverage (monthly)</td>
<td>54</td>
<td>43</td>
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<tr>
<td><strong>DATA FLOW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery</td>
<td></td>
<td>94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality (TEMP, PSAL)</td>
<td></td>
<td>93, 91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM Processing</td>
<td></td>
<td>69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timeliness (FR, US)</td>
<td></td>
<td>85, 84</td>
<td></td>
<td></td>
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<tr>
<td><strong>INSTRUMENTATION</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Reliability (75, 150)</td>
<td></td>
<td>75, 48</td>
<td></td>
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</tr>
</tbody>
</table>
Overview

3856 floats are fully operational amongst the 4100 registered.
Overview

Argo Equivalent (10%), Argo Bio (7%), Argo Deep (0.3%): + 650 floats
Overview

A year of Argo monthly observations (gaps in blue).
Overview

Same view on the initial design – 70% well sampled.
Overview

Hot Spots highlighted. Ideally, we should see here the expansions areas of the global design.

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Coverage vs Initial Design - 2015 - Hot Spot Analysis

For each float a spatial weight on age is calculated according to neighbours to identify spatial clusters of hot/cold spots. To be statistically significant, the hot/cold spot will have a high/low value and be surrounded by other features with high/low values. (Getis-Ord Method)

- Cold Spot - 99% Confidence
- Cold Spot - 90% Confidence
- Cold Spot - 95% Confidence
- Not Significant
- Hot Spot - 90% Confidence
- Hot Spot - 95% Confidence
- Hot Spot - 99% Confidence

Argo

February 2016

Generated by www.jocomops.org
Overview

Same view normalized on the global design targets. 55% well sampled.
Overview

Hot Spots highlighted.

For each float a spatial weight on age is calculated according to neighbours to identify spatial clusters of hot/cold spots. To be statistically significant, the hot/cold spot will have a high/low value and be surrounded by other features with high/low values. (Getis-Ord Method)

- Cold Spot - 99% Confidence (278)
- Cold Spot - 90% Confidence (145)
- Cold Spot - 95% Confidence (184)
- Not Significant (2639)
- Hot Spot - 90% Confidence (60)
- Hot Spot - 95% Confidence (92)
- Hot Spot - 99% Confidence (251)
Overview

Network evolution - keeps growing. Distinct floats distributing observations at GDACs (monthly).
Overview

- 3 Scenarios for network evolution based on yearly deployment rate, yearly failure rate, inflation index.
- A: 800, 20%, 0.03: peak to 3880 (2016-2018), drop below 3000 (2030)
- B: 900, 15%, 0.02: peak to 5000 in 2022, very slow decrease to 4500 (2030)
- C: 750, 28%, 0.03: See P. Durack paper.
Overview

P. Durack projected network status is rather conservative (excluding equivalent/bio contributions ie 15 %extras floats), using a 28% yearly failure rate. so I believe overall a little pessimistic. To be discussed … and tested on website.
« simulator » on website

Will be plugged to current sample, national commitments/inflation rate

<table>
<thead>
<tr>
<th>Metrics</th>
<th># Platforms</th>
<th># Deployments</th>
<th>Failure Rate</th>
<th>Inflation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Platform Count</td>
<td>3881</td>
<td>850</td>
<td>0.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Initial Annual Deployments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overview

Survival Rate by float generation. Reliability has not really been improving since 2004. But recent generations seem promising.

![Graph showing survival rate by float generation for different years from 2004 to 2012.](image)
Overview

% of float reaching 200, 150, 100 and 75, 10
Overview

Data flow: All observations : 20 Obs/Day.
Delayed-Mode QC Achieved/DMQC_ELIGIBLE ratio = 69%.
2. Implementation
Implementation

Distribution of operational floats by country –
USA (56%), AU (9%), FR (8%), JAP (5%), CH (4%), UK (3%), GER (3%), IN (2%), OTHERS (10%)
Implementation

Operational floats evolution, by national contribution.
Implementation

Operational floats evolution, by national contribution. Zoom (no USA).
Implementation

Yearly deployments
## Implementation

### Operationality/Intensity

<table>
<thead>
<tr>
<th>OCEAN BASINS</th>
<th>2015 STATUS NB</th>
<th>TARGETS NB</th>
<th>OPERATIONALITY %</th>
<th>INTENSITY %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OPERATIONAL</td>
<td>DEP 2015</td>
<td>INITIAL</td>
<td>GLOBAL</td>
</tr>
<tr>
<td>Arctic Ocean</td>
<td>53</td>
<td>21</td>
<td>0</td>
<td>141</td>
</tr>
<tr>
<td>Atlantic Ocean</td>
<td>792</td>
<td>234</td>
<td>791</td>
<td>1007.25</td>
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<tr>
<td>Baltic Sea</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Banda Sea</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Black Sea</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Caribbean Sea</td>
<td>12</td>
<td>8</td>
<td>0</td>
<td>38</td>
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<tr>
<td>Celebes Sea</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Flores Sea</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Gulf of Aden</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td>11</td>
<td>6</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Gulf of Oman</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Indian Ocean</td>
<td>689</td>
<td>136</td>
<td>695</td>
<td>833</td>
</tr>
<tr>
<td>Japan Sea</td>
<td>22</td>
<td>15</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>Makassar Strait</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
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<tr>
<td>Mediterranean Sea</td>
<td>60</td>
<td>46</td>
<td>0</td>
<td>56</td>
</tr>
<tr>
<td>Pacific Ocean</td>
<td>1837</td>
<td>394</td>
<td>1590</td>
<td>1895.75</td>
</tr>
<tr>
<td>Red Sea</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Sea of Okhotsk</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>South China Sea</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>22</td>
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<tr>
<td>Southern Ocean</td>
<td>139</td>
<td>89</td>
<td>0</td>
<td>326</td>
</tr>
<tr>
<td>Sulu Sea</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>3632</strong></td>
<td><strong>963</strong></td>
<td><strong>3076</strong></td>
<td><strong>4413</strong></td>
</tr>
</tbody>
</table>
Implementation

Coverage - initial design

[Graph showing coverage over time for different ocean regions]
Implementation

Simple density as of 01/03/2016, 6°x6°.
Implementation

Simple density as of 01/03/2016, 6°x6° normalized on initial design 3°x3°.
Implementation

Age = (Latest Observation date – Deployment date).

Argo
Profiling floats age distribution (in years)

- <1 year (674)
- 1-2 (843)
- 2-3 (636)
- 3-4 (457)
- 4-5 (447)
- 5-6 (284)
- 6-7 (280)
- 7-8 (300)
- 8-9 (67)
- 9-10 (61)
- >10 years (73)
Implementation

Old/young spatial clusters.

For each float a spatial weight on age is calculated according to neighbours to identify spatial clusters of hot/cold spots. To be statistically significant, the hot/cold spot will have a high/low value and be surrounded by other features with high/low values. (Getis-Ord Method)
Implementation
density/age as of 01/03/2016, 6°x6° normalized on initial design 3°x3°.
Implementation

Please update your deployment plans for 2016!
Implementation

Density/age and deployment plans.
Implementation

Density including deployment plans.
3. Data Flow
Data Flow

Confirm float status (e.g. deployment failure) or enable data distribution.
Data Flow

Confirm float status (e.g. deployment failure) or enable data distribution.
Data Flow

Delays (February) are rather good, except for a few DAC.
Data Flow

US GDAC has slightly better delays.
Data Flow

GDACs Delays, by DAC.
Data Flow

Timeliness, by DAC.

[Bar chart showing data flow timeliness for different organizations and the two categories IFREMER % <24h and NRL-MRY % <24h]
Data Flow

A try to identify spatial trends in lower quality profiles.
As of 01/03/2016, %DM achieved still on decrease.
4. Instrumentation
Instrumentation
Instrumentation

Distribution

- APEX: 1853
- ARVOR: 365
- SOLO_II: 247
- NAVIS_A: 290
- S2A: 438
- SOLO: 152
- PROVOR: 365
- SOLO_W: 1853
- NOVA: 365
- PROVOR_III: 247
- ARVOR_D: 290
- NINJA_D: 1853
- DOVA: 365
- PROVOR_II: 438
- NEMO: 152
- HM2000: 365
Instrumentation

Models evolution. APEX fleet decreasing.
Instrumentation

Models evolution - Zoom (no APEX)
Clear increasing trend for ARVOR, NAVIS_A, SOLO_II and S2A.
Instrumentation

Models - yearly deployments – APEX < Clear increasing trend for ARVOR, NAVIS_A, SOLO_II and S2A.

[Diagram showing yearly deployments of various models from 2001 to 2016]
Instrumentation

Survival chart by float model

![Survival chart by float model graph](chart.png)
Instrumentation

Survival chart by country
Instrumentation

Survival chart, by model, for float deployed from 01/01/2013 (1st year of deployment for new float models excluded), Good trend.
Instrumentation

55% Argos, 45% Iridium.
Instrumentation

Telecommunication Types Evolution.
Some programmes switched to Iridium (US, AU) some other didn’t (FR, JP, CH, UK, IN)
5. Operations
Operations

Ships database (all/2015) – unique id exists and should be used in metadata flow
6. Conclusion
Conclusion

• Argo is in good shape and close to reach a maximum of 4000 units and staying on it for a while.

• Initial design is achieved, rather well sustained but we should take care of the Indian ocean.
• Large parts of the PO are also getting old.

• National contributions from Asia seem decreasing

• We can improve the coverage maybe up to 80%

• Global design is in sight (but not on all expansions - see dedicated agenda item)
Conclusion

• Technology shows no progress and impacts dramatically network status.

• Some hope with new float models

• The market is very competitive which should be good for Argo

• Data distribution has also some margin for improvements.

• Data distribution could be optimized in volume, delays and quality

• Iridium/and multidisciplinary activities are adding a new level of decentralization. Needs to be operational.
Conclusion

• New on-line toolbox operational
  – Improvements will come fast with community feedback
  – See dedicated agenda item

• UNCLOS and IOC Res. XX-6, XLI-4 guidelines to be respected (more and more demands from ships)

• Argo’s future depends on its capacity to sustain its initial design and partner with the multi-disciplinary demand – ineluctable – but providing more T/S data, larger user community, and ensuring its long run visibility.

• Of course the extra cost on the « Argo infrastructure » has to be properly covered.