INFO ON QA/QC Settings and Calibration

%%% QC info for all the period 01-Jun-2012 – 21-Jan-2020
OceanSITES quality flagging for GDOP threshold QC test. Threshold set to 2.83
OceanSITES quality flagging for Data density threshold QC test. Threshold set to 3 radials.
OceanSITES quality flagging for Velocity threshold QC test. Threshold set to 0.7 m/s.
OceanSITES quality flagging for variance threshold QC test. Test not applicable to Direction Finding systems. The Temporal Derivative test is applied. Threshold set to 1 m/s.

%%% Calibration info
GALF: 2015-08-18T00:00:00Z; FORM: 2017-01-26T00:00:00Z
GALF: 2018-11-14T00:00:00Z; FORM: 2018-11-15T00:00:00Z;

Inconsistencies between the information provided in the header of the radials and the dates of the last calibration performed. This problem is being analysed with the data provider

RESULTS OF HIST DATA INSPECTION

General comments:
We have noticed 3 periods to be controlled and/or reflagged, occurring in: 2013, 2015, 2018
(to be changed after control only if flag is not yet equal to 0 or 4)
High mean current values and standard deviation.

<table>
<thead>
<tr>
<th>year</th>
<th>General comment</th>
<th>Periods to be reflagged</th>
<th>Reason for new flagging</th>
<th>Sugg. Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td></td>
<td>01-Feb-2013 – 20-mar-2013</td>
<td>high std variability low data availability</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td></td>
<td>21-Jan-2018 – 22-Feb-2018</td>
<td>high std variability low data availability isolated data period</td>
<td>3</td>
</tr>
</tbody>
</table>

After exchanges with the provider the following periods where reflagged:

<table>
<thead>
<tr>
<th>Year</th>
<th>General comment</th>
<th>Periods to be reflagged</th>
<th>Reason</th>
<th>New Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td></td>
<td>01-Feb-2013 – 20-mar-2013</td>
<td>Observations &gt; Incidence in GALF (Ibiza Radial site) [22/01/2013-20/03/13]. Increase of reflected power from 1 to 6</td>
<td>3</td>
</tr>
</tbody>
</table>
W; change in loops phase; error related to the 13.5 MHz CODAR SeaSonde antenna design

Consequences > Radial vector count reduction

Actions required > Change to A4-AISI 316 Stainless Steel Dome Nut and Calibration of the station in April

2015


Observations > Incidence in FORM (Formentera Radial Site) [09/01/2015-21/02/2015]. Communication outage and hardware (macmini) outage.

Consequences > Radial data loss

Actions required > Reparation of WiMAX antenna and installation of a new macmini configured with SS Radial Suite R7

2018

21-Jan-2018 – 22-Feb-2018

Observations > Incidence in FORM related to the failure of the AWG module (PPS signal problems; spectrac acquisition restarted every 15 seconds); Incidence in GALF related to frequent AC power outage

Consequences > No generation of spectra, nor radials

Actions required > change the AWG module in FORM

From June 2012 to 2019, the spatial/temporal coverage of the system is quite stable, except in 2018 and 2019.

Mean surface currents:
- 2012: north-eastward and northward current along the 1ºE longitude
- 2013: anticyclonic gyre in the east of the region
- 2014: light anticyclonic gyre in the east of the region; cyclonic circulation between 0º35'E and 1º10'E.
- 2015: cyclonic gyre at the west of the zone; anticyclonic gyre at the east; northward current along 1ºE longitude
- 2016 & 2017: northward current
- 2018: northward current; anticyclonic gyre at the east of the zone
- 2019: north-eastward and northward current along the 1ºE longitude
- 2020: northward current between 0º45'E and 1º10'E

### Spatial Coverage vs. Temporal coverage: objective of USCG 80-80% data availability

<table>
<thead>
<tr>
<th>Period</th>
<th>General comments</th>
<th>Nb. analysed hours</th>
<th>80%-80% obj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (Jun-Dec)</td>
<td>75.77 % spatial availability 80% of time</td>
<td>4809</td>
<td>n</td>
</tr>
<tr>
<td>2013</td>
<td>59.18 % spatial availability 80% of time</td>
<td>6652</td>
<td>n</td>
</tr>
<tr>
<td>2014</td>
<td>70.71 % spatial availability 80% of time</td>
<td>8189</td>
<td>n</td>
</tr>
<tr>
<td>2015</td>
<td>76.52 % spatial availability 80% of time</td>
<td>8028</td>
<td>n</td>
</tr>
<tr>
<td>2016</td>
<td>79.8 % spatial availability 80% of time</td>
<td>8198</td>
<td>y</td>
</tr>
<tr>
<td>2017</td>
<td>89.14 % spatial availability 80% of time</td>
<td>4920</td>
<td>y</td>
</tr>
<tr>
<td>2018</td>
<td>65.15 % spatial availability 80% of time</td>
<td>7490</td>
<td>n</td>
</tr>
<tr>
<td>2019</td>
<td>76.01 % spatial availability 80% of time</td>
<td>8097</td>
<td>n</td>
</tr>
<tr>
<td>2020 (Jan-Jul)</td>
<td>55.78 % spatial availability 80% of time</td>
<td>4848</td>
<td>n</td>
</tr>
</tbody>
</table>
### Annex I Applied QA/QC tests

<table>
<thead>
<tr>
<th>QC Flag Variable name</th>
<th>Short name</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Syntax</td>
<td>Syntax check: this test will ensure the proper formatting and the existence of all the necessary fields within the total NetCDF file. This test is performed on the NetCDF files and it assesses the presence and correctness of all data and attribute fields and the correct syntax throughout the file. This test is performed by the European HFR Node before pushing data to the distribution platforms.</td>
</tr>
<tr>
<td>DDNS_QC</td>
<td>Data Density Threshold</td>
<td><strong>Data Density Threshold:</strong> this test labels total velocity vectors with a number of contributing radials bigger than the threshold with a “good data” flag and total velocity vectors with a number of contributing radials smaller than the threshold with a “bad data” flag.</td>
</tr>
<tr>
<td>CSPD_QC</td>
<td>Velocity Threshold</td>
<td><strong>Velocity Threshold:</strong> this test labels total velocity vectors whose module is bigger than a maximum velocity threshold with a “bad data” flag and total vectors whose module is smaller than the threshold with a “good data” flag.</td>
</tr>
<tr>
<td>VART_QC</td>
<td>Variance Threshold</td>
<td><strong>Variance Threshold:</strong> this test labels total vectors whose temporal variance is bigger than a maximum threshold with a “bad data” flag and total vectors whose temporal variance is smaller than the threshold with a “good data” flag. This test is applicable only to Beam Forming (BF) systems. Data files from Direction Finding (DF) systems will apply instead the “Temporal Derivative” test reporting the explanation “Test not applicable to Direction Finding systems. The Temporal Derivative test is applied.” in the comment attribute.</td>
</tr>
<tr>
<td>VART_QC</td>
<td>Temporal Derivative</td>
<td><strong>Temporal Derivative:</strong> for each total bin, the current hour velocity vector is compared with the previous and next hour ones. If the differences are bigger than a threshold (specific for each grid cell and evaluated on the basis of the analysis of one-year-long time series), the present vector is flagged as “bad data”, otherwise it is labelled with a “good data” flag. Since this method implies a one-hour delay in the data provision, the current hour file should have the related QC flag set to 0 (no QC performed) until it is updated to the proper values when the next hour file is generated.</td>
</tr>
<tr>
<td>GDOP_QC</td>
<td>GDOP Threshold</td>
<td><strong>GDOP Threshold:</strong> this test labels total velocity vectors whose GDOP (Geometrical Dilution Of Precision) is bigger than a maximum threshold with a “bad data” flag and the vectors whose GDOP is smaller than the threshold with a “good data” flag.</td>
</tr>
<tr>
<td>QCflag</td>
<td>Overall QC</td>
<td></td>
</tr>
</tbody>
</table>

### Annex II QC Flags

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No QC was performed</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>Good data</td>
<td>All real-time QC tests passed.</td>
</tr>
<tr>
<td>2</td>
<td>Probably good data</td>
<td>-*</td>
</tr>
<tr>
<td>3</td>
<td>Bad data that are potentially correctable</td>
<td>These data are not to be used without scientific correction.*</td>
</tr>
<tr>
<td>4</td>
<td>Bad data</td>
<td>Data have failed one or more of the tests.</td>
</tr>
<tr>
<td>5</td>
<td>Value changed</td>
<td>Data may be recovered after transmission error.</td>
</tr>
<tr>
<td>6</td>
<td>Not used</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Nominal value</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Interpolated value</td>
<td>Missing data may be interpolated from neighbouring data in space or time.</td>
</tr>
<tr>
<td>9</td>
<td>Missing value</td>
<td>-</td>
</tr>
</tbody>
</table>

*These two are to be used after examination of the hist data sets and exchanges with the data provider.*
Annex III Figures for the QA/QC tests

Fig A – Temporal series of the spatial average of the current velocity module (top panel), its standard deviation (middle panel) and the grid points of the total coverage (bottom panel). Black dots are the values obtained considering all the data in the domain, in green those considering only data with QC flag =1 (good data).

Fig B - Temporal series of the QC flags for all the grid nodes with data.

Fig C - Maps of the mean velocity module and the mean value of QC flags for the target year (left column) and their standard deviations (right column) for the target year.

Fig D - Spatial (x-axis) vs. temporal (y-axis) coverage 80/80 annual metric. Allows to check if the system has reached the goal of providing surface currents over the 80% of the area during 80% of the time.

Fig E – Map of the % of availability of data in each grid point and contour showing the area of temporal availability >80%

Fig F- Mean surface current maps for the indicated systems and periods. The means are computed in the area of 80% temporal coverage for the target year.
Period: June-Dec 2012

A

Mean velocity module - 2012

Std velocity module - 2012

Number of good data - 2012

B

Overall QC Flag

Day QC Flag

Odds QC Flag

Calc QC Flag

Volt QC Flag
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/06/2012 to 31/12/2012

75.7653% data points available 80% of the time
Number of hours analyzed = 4809
(USCG 80-80 metric for data availability)
HFR-Ibiza: Percent Total Vector Coverage (contour showing >80%)
01/06/2012 to 31/12/2012

HFR-Ibiza: HFR Surface current average [m/s]
01/06/2012 to 31/12/2012

Only grid points with HFR percent coverage > 80 %
Period: 2013

A

B
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2013 to 31/12/2013

59.1837% data points available 80% of the time
Number of hours analyzed = 6552
(USCG 80-80 metric for data availability)
HFR-Ibiza: Percent Total Vector Coverage (contour showing >80%)
01/01/2013 to 31/12/2013

HFR-Ibiza: HFR Surface current average [m/s]
01/01/2013 to 31/12/2013

Only grid points with HFR percent coverage > 80%
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage

01/01/2014 to 31/12/2014

70.7071% data points available 80% of the time
Number of hours analyzed = 8189
(USCG 80-80 metric for data availability)
C

mean velocity module (m s\(^{-1}\))

std velocity module (m s\(^{-1}\))

mean gdop QC flag

std gdop QC flag

mean overall QC flag

std overall QC flag

D

HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2015 to 31/12/2015

76.5152\% data points available 80\% of the time
Number of hours analyzed = 8028
(USCG 80-80 metric for data availability)
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2016 to 31/12/2016

79.798% data points available 80% of the time
Number of hours analyzed = 8198
(USCG 80-80 metric for data availability)
HFR-Ibiza: Percent Total Vector Coverage (contour showing >80%)
01/01/2016 to 31/12/2016

HFR-Ibiza: HFR Surface current average [m/s]
01/01/2016 to 31/12/2016

Only grid points with HFR percent coverage > 80%
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2017 to 31/12/2017

89.1414% data points available 80% of the time
Number of hours analyzed = 4920
(USCG 80-80 metric for data availability)
HFR-Ibiza: Percent Total Vector Coverage (contour showing >80%)
01/01/2017 to 31/12/2017

HFR-Ibiza: HFR Surface current average [m/s]
01/01/2017 to 31/12/2017

Only grid points with HFR percent coverage > 80%
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2018 to 31/12/2018

65.1515% data points available 80% of the time
Number of hours analyzed = 7490
(USCG 80-80 metric for data availability)
C

mean velocity module (m s⁻¹)

std velocity module (m s⁻¹)

mean gdop QC flag

std gdop QC flag

mean overall QC flag

std overall QC flag

D

HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2019 to 31/12/2019

76.0101% data points available 80% of the time
Number of hours analyzed = 8097
(USCG 80-80 metric for data availability)
HFR-Ibiza: Percent Total Vector Coverage (contour showing >80%)
01/01/2019 to 31/12/2019

HFR-Ibiza: HFR Surface current average [m/s]
01/01/2019 to 31/12/2019

Only grid points with HFR percent coverage > 80 %
HFR-Ibiza: Spatial Coverage vs. Temporal Coverage
01/01/2020 to 21/07/2020

55.7895% data points available 80% of the time
Number of hours analyzed = 4848
(USCG 80-80 metric for data availability)

HFR-Ibiza: Percent Total Vector Coverage (contour showing >80%)
01/01/2020 to 21/07/2020
HFR-Ibiza: HFR Surface current average [m/s]
01/01/2020 to 21/07/2020

Only grid points with HFR percent coverage > 80 %