Research and pre-operational application of near real time services for maritime situational awareness

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TerraSAR-X / TanDEM-X Science Team Meeting
17-20 October 2016

Maritime Project EMSec - Echtzeitdienste für die Maritime Sicherheit –Security

Executive Summary

EMSec

Echtzeitdienste für die Maritime Sicherheit – Security

founded by the Federal Ministry of Education and Research (FKZ: 13N12740)

The availability of different meteo-marine parameters within Maritime Situation Awareness Systems, derived from SAR images

- Development of value added image processing frame work to derive
  - Ship detection information
  - Wind speed add direction
  - Wave height,
  - Detection of hazardous
- Development of Experimental System to derive meteo-marine parameters in near real time (< 15 minutes)

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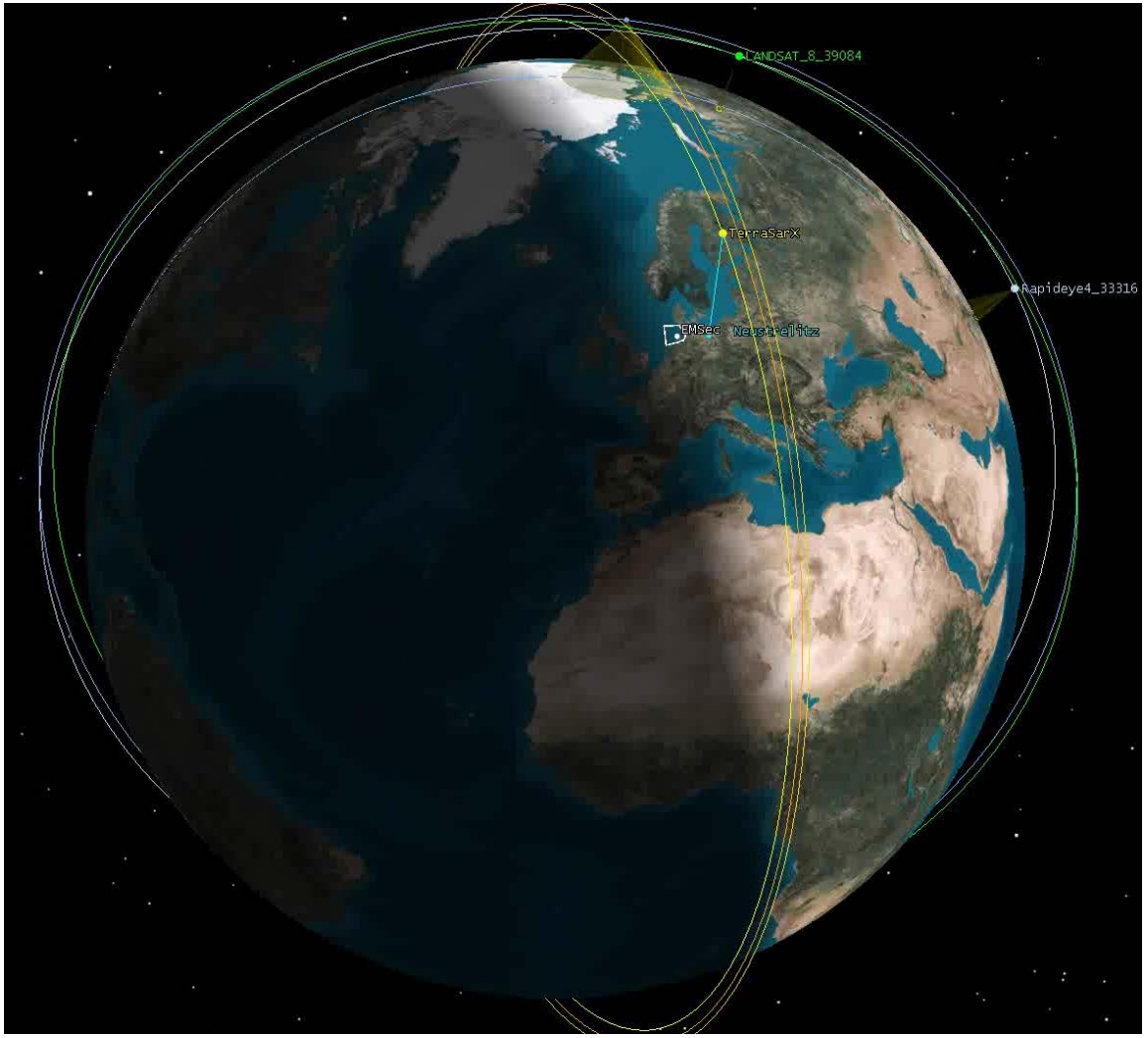
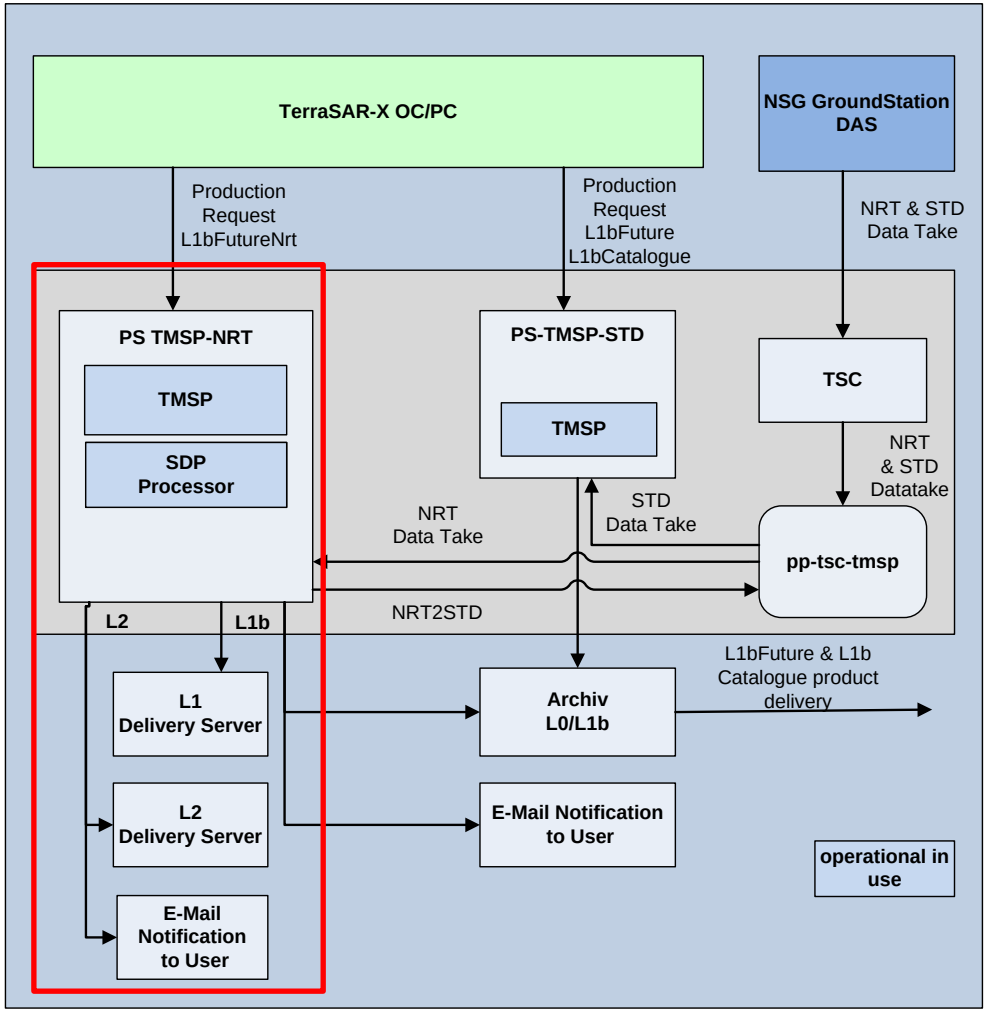
Maritime Project EMSec - Echtzeitdienste für die Maritime Sicherheit –Security

- Supported SAR Satellite Missions
  - TerraSAR-X
  - Sentinel-1
  - Radarsat-2



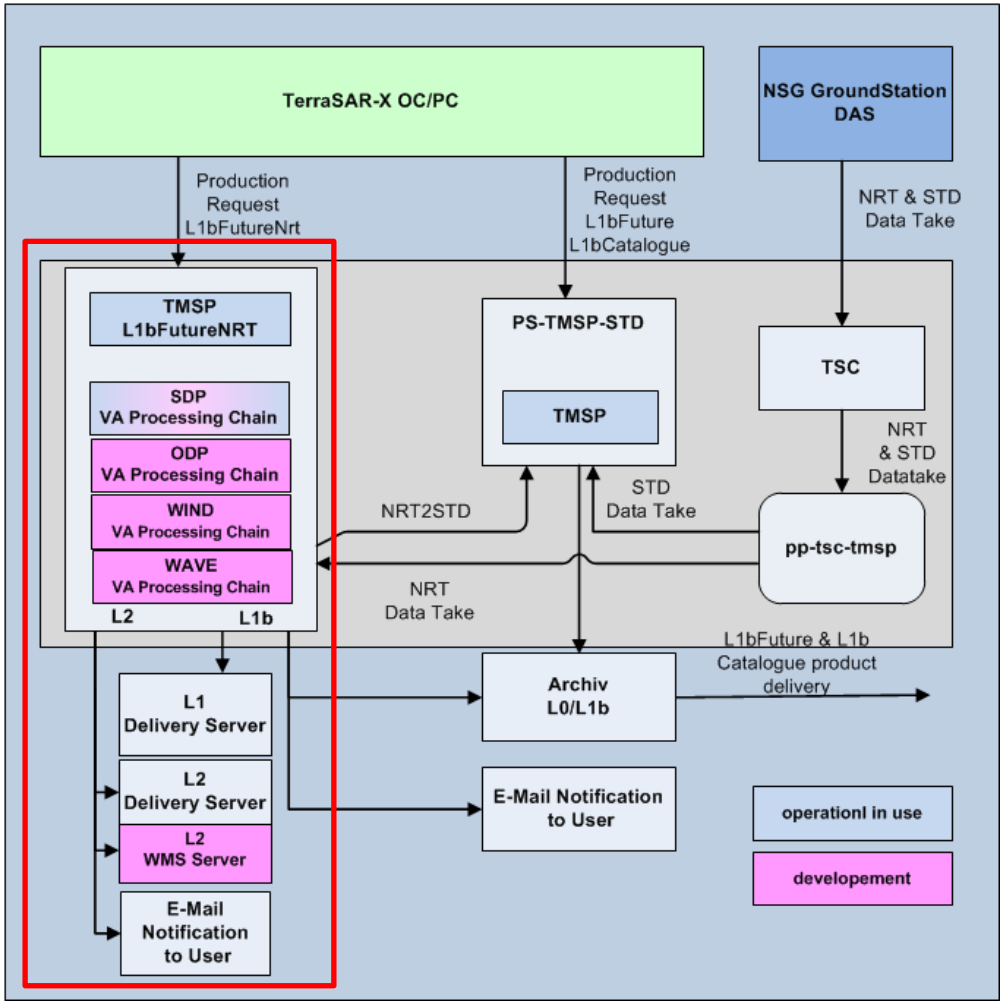
TerraSAR-X Processing Workflow - Current Situation

- Separation of processing work flow
  - single TMSP instance for
    - Lo,
    - L1bFuture and
    - L1b Catalogue
  - single TMSP instance for
    - L1bFutureNRT incl. SAR/AIS Ship detection (SM,SC)



Processing Framework Requirements

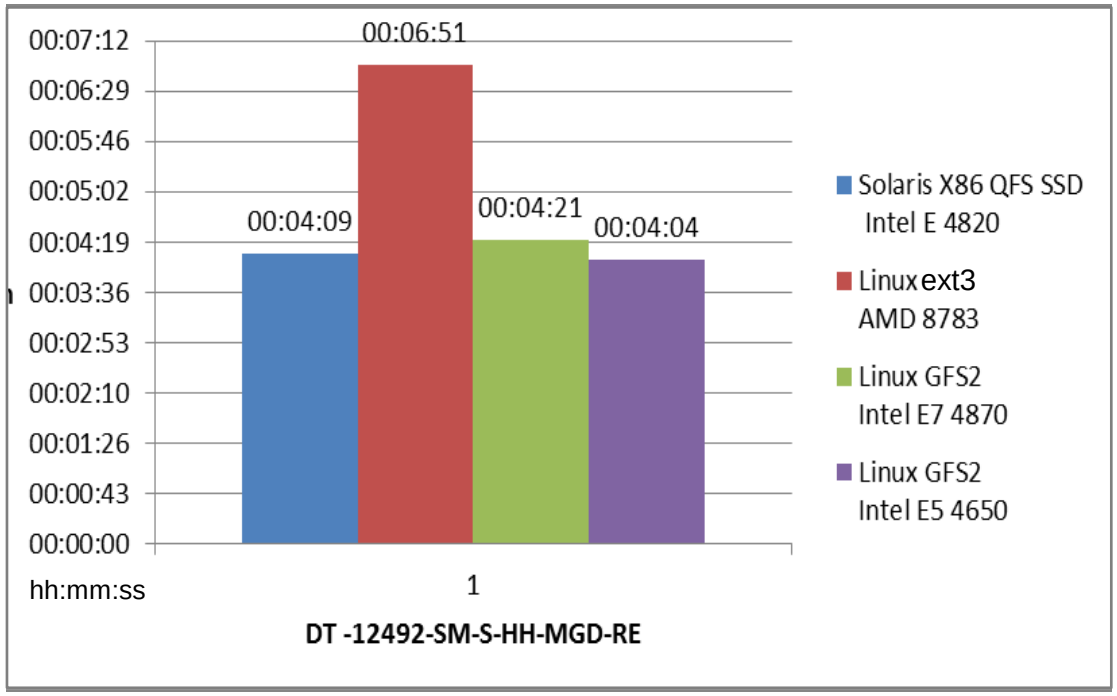
- Extension of request parameter to enable value adding product generation for wind and wave in addition to the ship detection product.
- Extension of processing framework in the way that additional processing rules can called and executed in parallel if requested
  - Support both, single and parallel value add processing
  - Support product slicing and parallel scene processing
  - Support wind WRF model function
  - Support scene based AIS (Automated Identification System) data fusion in real time (AIS Fetcher)
  - Share of hardware resources to support multiple mission and archive near real time performance.



Experimental Environment Project EMSec

Objective: Share the hardware resources to support multiple mission and archive near real time performance.

- Test configuration
  - Solaris vs. Linux
  - Native vs. VMware (Linux)
  - Processor E7 vs. E5
  - File system tests
    - QFS (Solaris, x86, 64 CPU's, 2000GHz)
    - ext3 (Linux, x86)
    - GFS2, ext3 (Linux, x86)
      - E7 4870
      - E5 4650



X4470, Intel(R) Xeon(R) CPU E7- 4820 32 Cores/ 64 Threads @ 2.00GHz

R920, Intel(R) Xeon(R) CPU E7-4870 v2 60 Cores @ 2.30GHz

R820, Intel(R) Xeon(R) CPU E5-4650 v2 32 Cores /32 Threads@ 2.70GHz

(R820, Intel(R) Xeon(R) CPU E5-4627 v2 32 Cores /32 Threads@ 3-30GHz)

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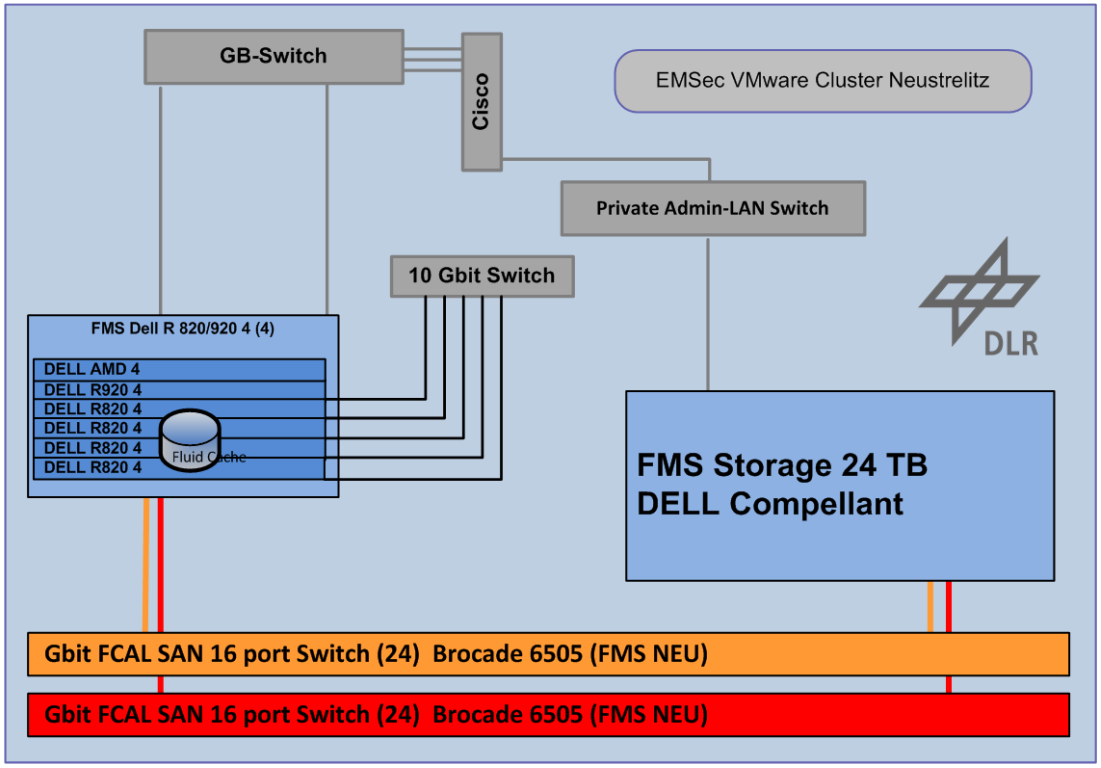

1 x R820, Intel(R) Xeon(R) CPU E5-4650 v2 32 Cores @ 2.70GHz
3 x R820, Intel(R) Xeon(R) CPU E5-4627 v2 32 Cores @ 3-30GHz
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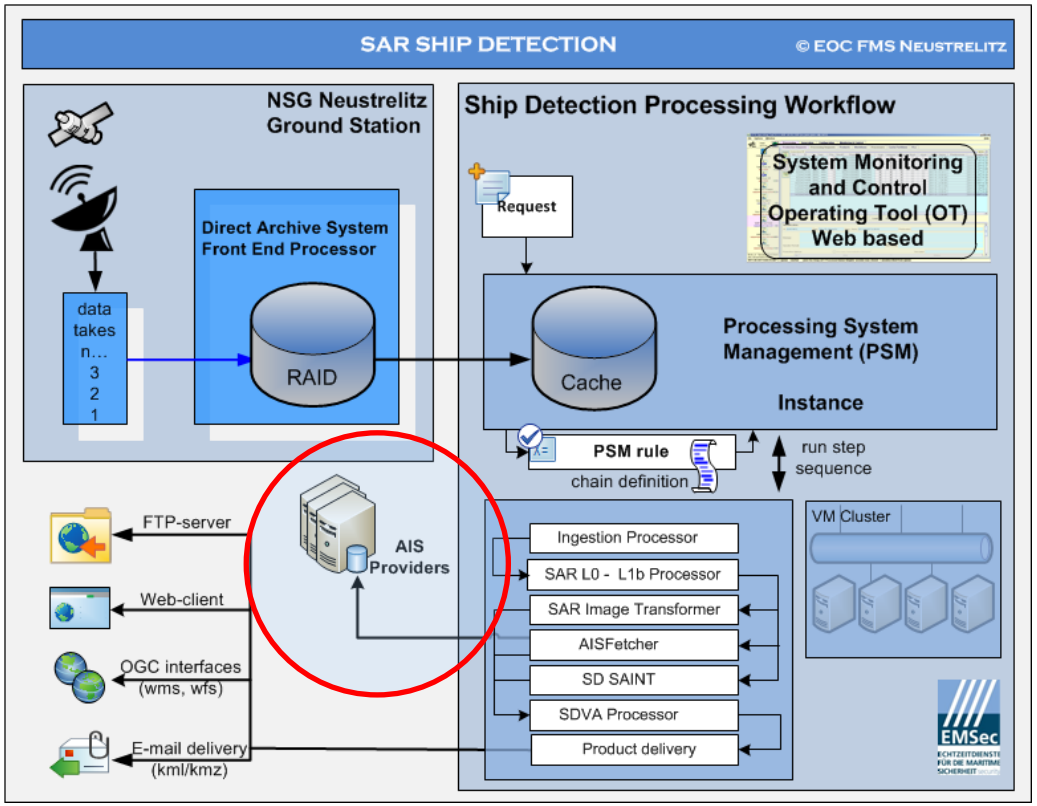
Processing Framework Extension (Example Ship Detection)

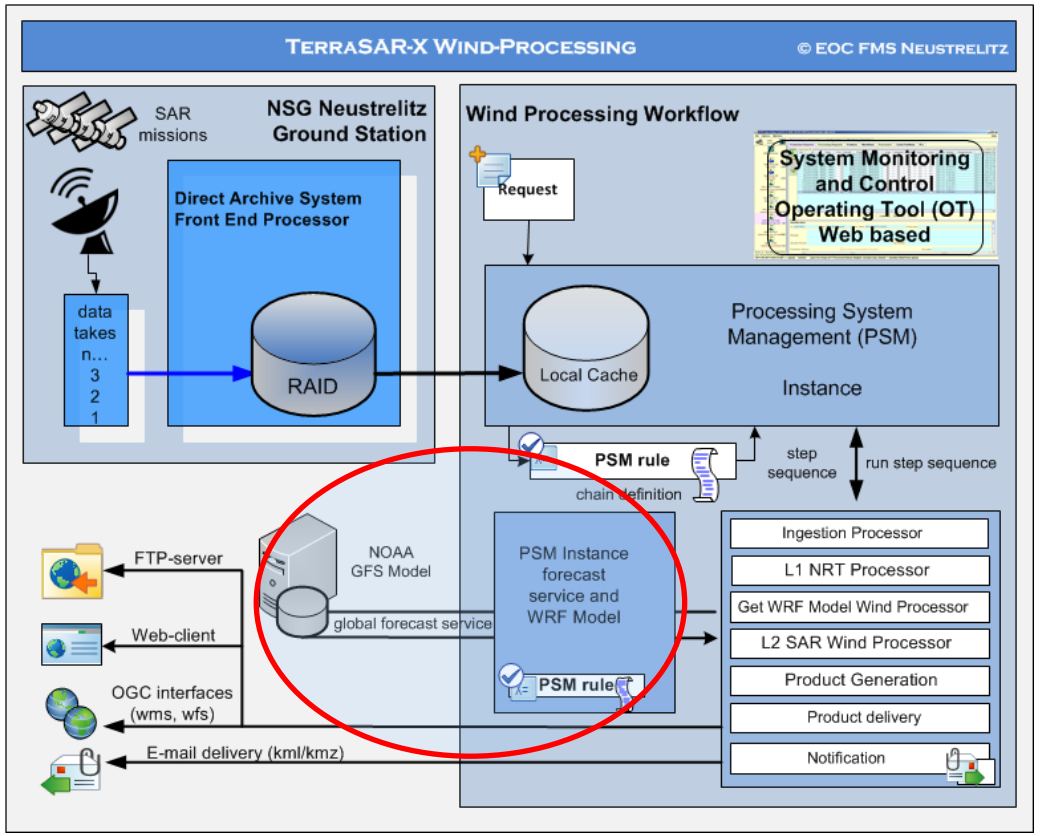
- Extension of processing framework in the way that additional processing rules can called and executed in parallel if requested
  - Support both, single and parallel value add processing
  - Support product slicing and parallel scene processing
  - **Support scene based AIS (Automated Identification System) data fusion in real time (AIS Fetcher)**



Example: Ship Detection frame work, part of the whole processing chain

Processing Framework Extension (Example Wind Detection)

- Extension of processing framework in the way that additional processing rules can called and executed in parallel if requested
  - Support both, single and parallel value add processing
  - Support product slicing and parallel scene processing
  - **Support Weather Research and Forecasting (WRF) Modelfunction to retrive wind direction**



Example: Wind Detection frame work, part of the whole processing chain

Processing Framework Requirements

- Extension of request parameter to enable value adding product generation for wind and wave in addition to the ship detection product.

- <ProcessingParameter key="**proc.shipDetection**">**true**</ProcessingParameter> was replaced by parameter
  <ProcessingParameter key="**proc.valueAdding**">**ship,wind,wave,ql**</ProcessingParameter> to support independent rule based value add processing

- extend ProductionRule "Ship"

- add ProductionRule "**Wind**"
  - <ProductionRequest type="TSX_WIND_FORECAST_PROCESSING"

- add ProductionRule "**Wave**"

<ProductionRequest type="TSX_WIND_FORECAST_PROCESSING"
priority="10"
initiationIsReleased="true"
preparationIsReleased="true"
productionIsReleased="true"
finishingIsReleased="false"
<ProcessingParameter key="origin">PdR 368923783
eschwarz_OCE1434_TC1_Mittelplatte_20130531</ProcessingParameter>
<ProcessingParameter key="origin.PdRId">368923783</ProcessingParameter>
<ProcessingParameter key="acq.customerOrderId">eschwarz_OCE1434_2013-05-08-07:58:04,860</ProcessingParameter>
<ProcessingParameter key="acq.customerOrderItemId">0001</ProcessingParameter>
<ProcessingParameter key="acq.customerGroup">SCI</ProcessingParameter>
<ProcessingParameter key="acq.timeStart">872717.8257060171</ProcessingParameter>
<ProcessingParameter key="acq.timeStop">872717.8257060171</ProcessingParameter>
<ProcessingParameter key="acq.sensorMode">SL</ProcessingParameter>
<ProcessingParameter key="acq.receivingStation">NSG</ProcessingParameter>
<ProcessingParameter key="acq.regionOfInterest">geoRing[(8.745,54.038)]</ProcessingParameter>
<ProcessingParameter key="acq.timeWindowStart">2013-05-31T05:41:56.558</ProcessingParameter>
<ProcessingParameter key="acq.timeWindowStop">2013-05-31T05:42:02.558</ProcessingParameter>
<ProcessingParameter key="acq.polarizationChannels">HH</ProcessingParameter>
<ProcessingParameter key="acq.polarizationMode">S</ProcessingParameter>
<ProcessingParameter key="proc.resolution">RE</ProcessingParameter>
<ProcessingParameter key="proc.sceneSelection">geoRing[(8.745,54.038)]</ProcessingParameter>
<ProcessingParameter key="startTime">2013-05-31T05:42:26.430</ProcessingParameter>
<ProcessingParameter key="stopTime">2013-05-31T05:42:30.601</ProcessingParameter>
<ProcessingParameter key="orbitTimeout">2013-05-31T20:42:30</ProcessingParameter>
<ProcessingParameter key="ftp_externalProtocol">ftp</ProcessingParameter>
<ProcessingParameter key="ftp_protocol">ftp</ProcessingParameter>
<ProcessingParameter key="ftp_host">txbnrt1.nz.dlr.de</ProcessingParameter>
<ProcessingParameter key="ftp_path">/home/tsxnrttest</ProcessingParameter>
<ProcessingParameter key="ftp_user">tsxnrttest</ProcessingParameter>
<ProcessingParameter key="ftp_pwd">test</ProcessingParameter>
<ProcessingParameter key="ftp_userEmailAddress">detmar.krause@dlr.de</ProcessingParameter>
<ProcessingParameter key="proc.valueAdding">ship,wind,wave</ProcessingParameter>
<ProcessingParameter key="proc.valueAddingShip">false</ProcessingParameter>
<ProcessingParameter key="packageId">dims_op_oc_dfd2_371370015_371370016</ProcessingParameter>
<ProcessingParameter key="subscription-not-to-pl">false</ProcessingParameter>
<ProcessingParameter key="orderId">371370013</ProcessingParameter>

Processing Framework View Operating Tool

Processing | Generation | Configuration | Monitoring & Control

Production Requests | Processing Requests | Products | Workflows | Processors | Cache Partitions | PLs

QUERY | FILTER | MORE | BATCH

Subscribed 100/101

No.	ID	Type	Prio.	Seq #	Phase	State	DataTakeId	Value Adding	map	prepare	process	finish	close
19	503699202	TsxL1bFutureNrt	40	27	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
62	503699204	TSX_WIND_...PROCESSING	10	70	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
63	503699378	TSX_SD_PROCESSING	10	71	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
64	503699379	TSX_WIND_PROCESSING	10	72	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
65	503699380	TSX_WAVE_PROCESSING	10	73	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
66	503699415	TSX_SD_PROCESSING	10	74	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
67	503699416	TSX_WIND_PROCESSING	10	75	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
68	503699417	TSX_WAVE_PROCESSING	10	76	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
69	503699452	TSX_SD_PROCESSING	10	77	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
70	503699453	TSX_WIND_PROCESSING	10	78	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
71	503699454	TSX_WAVE_PROCESSING	10	79	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
72	503699489	TSX_SD_PROCESSING	10	80	PROCESSING	ACTIVE	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
73	503699490	TSX_WIND_PROCESSING	10	81	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
74	503699491	TSX_WAVE_PROCESSING	10	82	PROCESSED	WAITING	TSX1_NSG_12975_20160906T053411	ship,wind,wave	✔	✔	✔		
94	503699570	QADelivery	80	2	PROCESSING	WAITING	TSX1_NSG_12975_20160906T053411		✔	✔	✔		

Load | Clone | Edit

Identification

ID 503686345 Type TsxL1bFutureNrt Assoc. Name eschwarz_OCE2639_20160729T0541 Predecessor

Message: volumes=4 size=555537625 volume=sftp://tsxnrttest@txbnrt1.nz.dlr.de//home/tsxnrttest/dims_op_oc_dfd2_522266020_522266021_1.tar volume=sftp://tsxnrttest@txbnrt1.nz.dlr.de//home/tsxnrttest/dims_op_oc_dfd2_522266020_522266021_2.tar volume=sftp://tsxnrttest@txbnrt1.nz.dlr.de//home/tsxnr volume=sftp://tsxnrttest@txbnrt1.nz.dlr.de//home/tsxnrttest/dims_op_oc_dfd2_522266020_522266021_4.tar

Operator Remark | User Remark: TSX request for future product TSX-1.S

Production Options: Successor Automatisation Released | Successor

Parameters

Nr.	Key	
2	datatakeId	TSX1_NSG_12952_20160729T054243
3	acq downlinkPriority	2

Inputs

Nr.	id	productId	components
1	503686495	TSX-1.RAW:///mission:T...C:2016-07-29T05:42:43/	*
2	368914008	TSX-1.IOCS-AUX:///dims_...:005 minorVersion:005/	*

Outputs

Nr.	id	productId	components
1	503688249	TSX-1.SAR.L1B://dims_...16-07-29T05:42:46.511/	*
2	503688252	TSX-1.SAR.L1B://dims_...16-07-29T05:42:48.788/	*

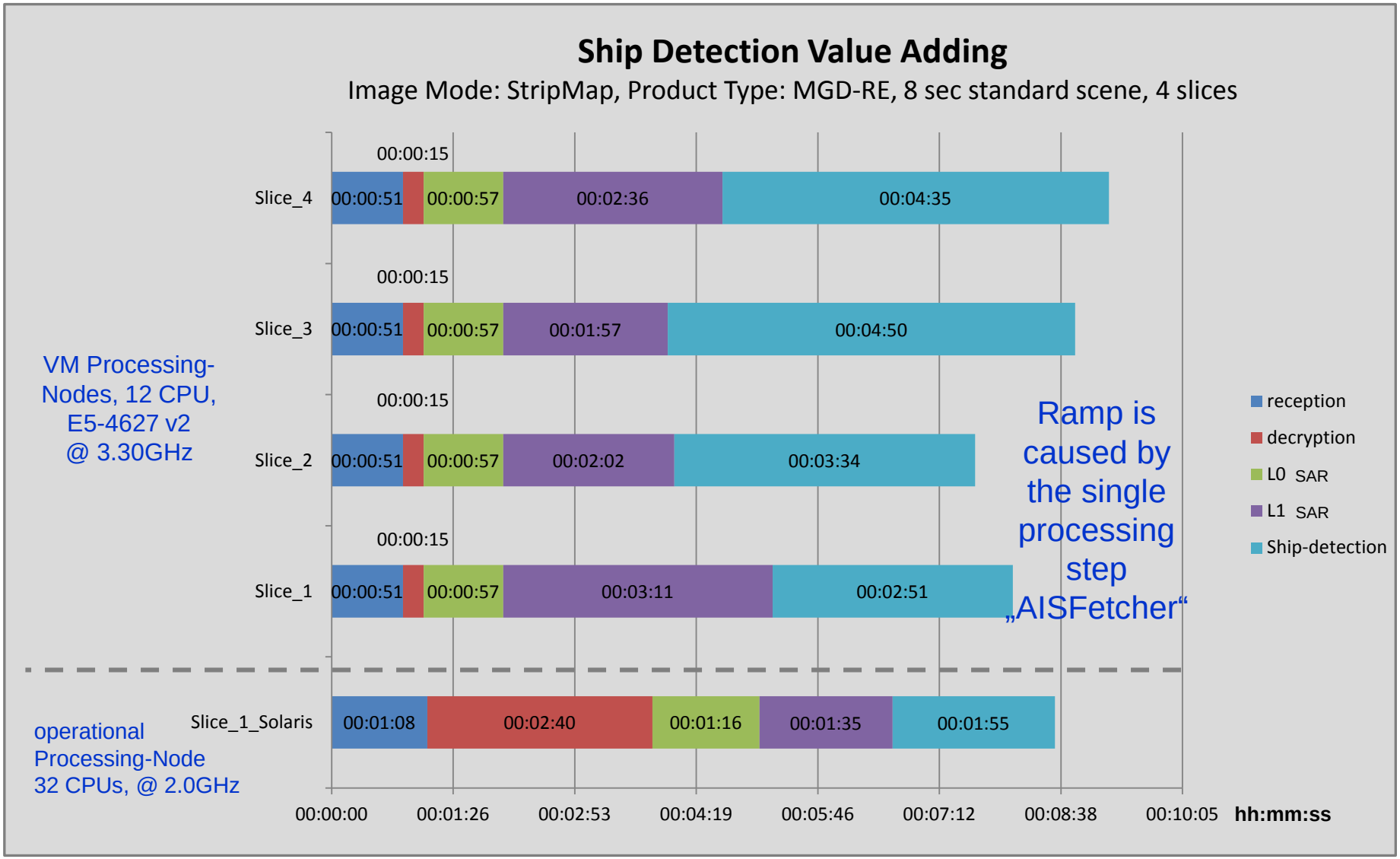
Release Flags

- ☑ initiation
- ☑ preparation
- ☑ processing
- ☐ finishing
- ☐ closing

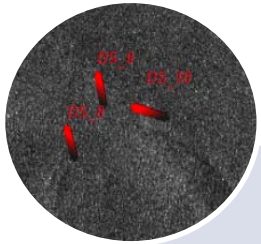
Administration Parameters

Phase	PROCESSED	Status	WAITING
Priority	40	Creation Date	2016-07-28 14:15:30.427
Sequence Number	26	Target Date	
Applied Rule	L1bFutureNrtRule	Expiration Date	
Scheduled Start	0	Scheduled End	0
Processing Start	2016-08-01 16:27:24.663	Processing Stop	2016-08-01 16:31:30.060

Processing Performance



Ship Detection Result



Near real time ship detection application based on SAR images

Core function is the CFAR algorithm and the SAINT Toolbox, developed by the Maritime Security Lab Bremen

Value added products

SAR/ AIS merged products (in case of available AIS Data)

ASCII ; KMZ, GML; DER (EMSA); ESRI shape; json; GeoTIFF (MRES_L1b; HRES_L1B)

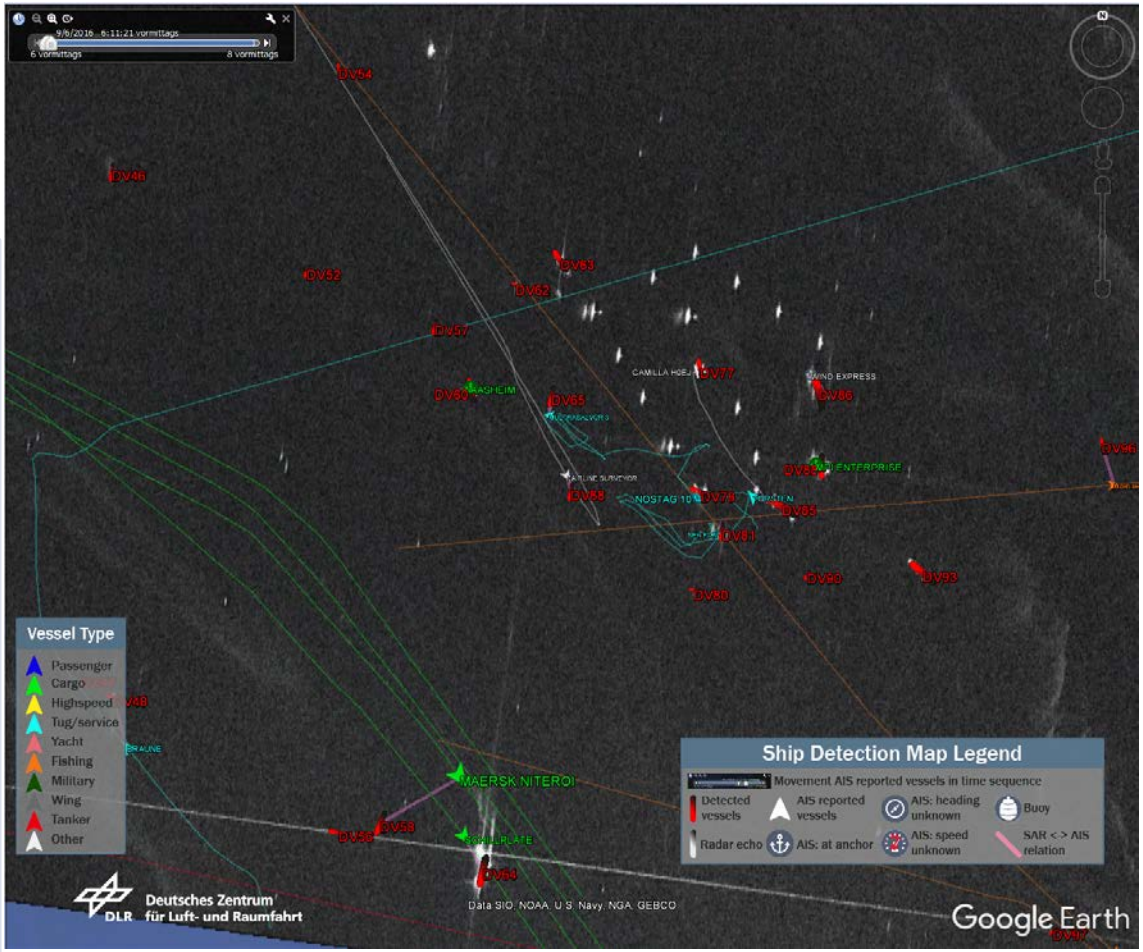
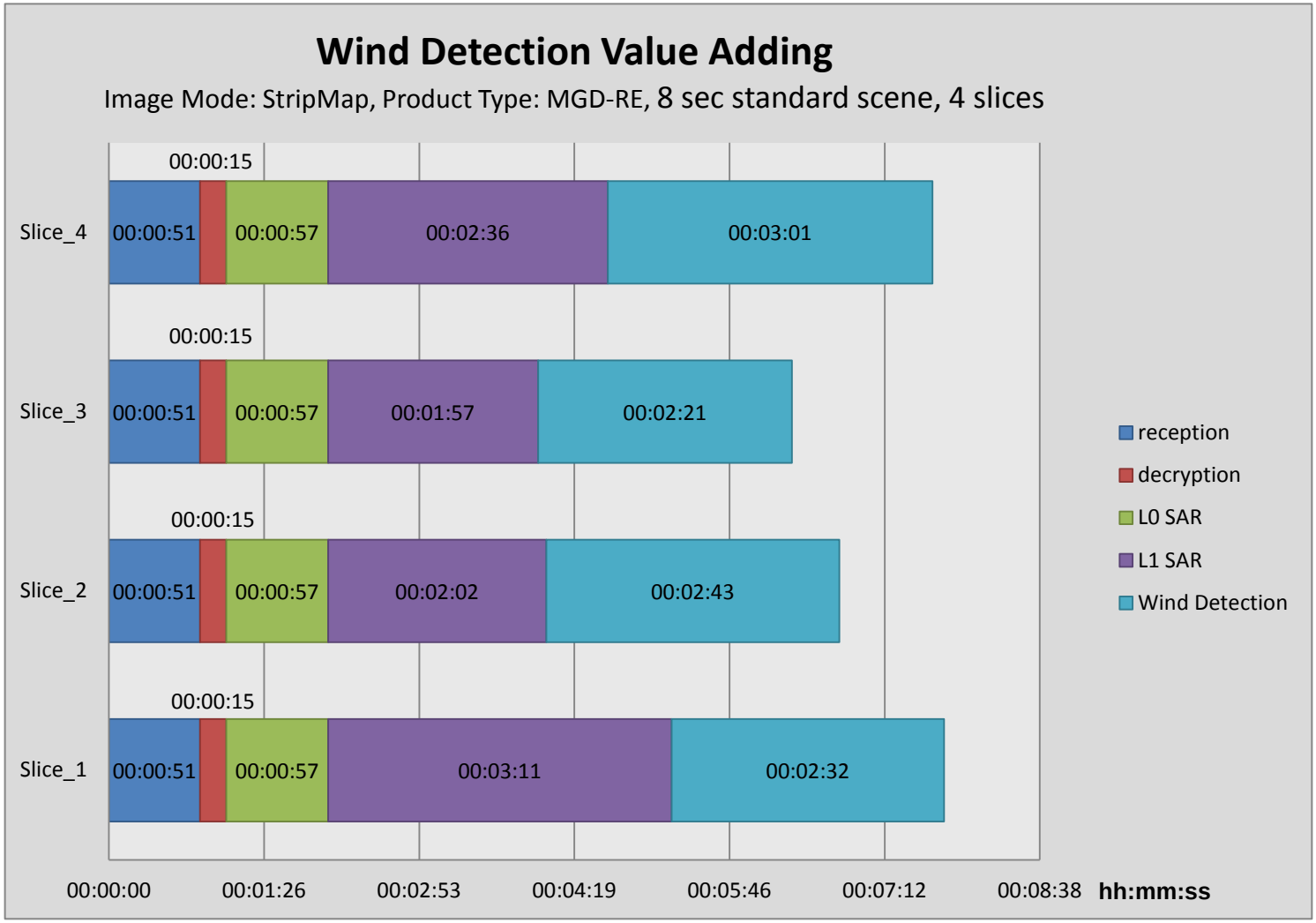


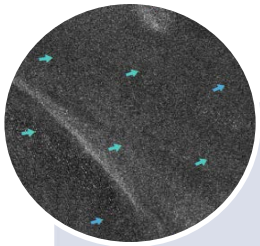
Image: TSX1_SAR__MGD_RE___SM_S_SRA_20160906T053413

DLR SAR/AIS Ship detection product (rectangles) derived from the TerraSAR-X StripMap image, L1 quicklook product as background.

Processing Performance



Wind Detection Result



Near real time wind detection application based on SAR images

Core function is the XMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction, (Jacobsen et al., 2016)

Forecast model is implemented to provide wind direction , the netCDF output is generated, containing the wind direction and intensity (WD10)

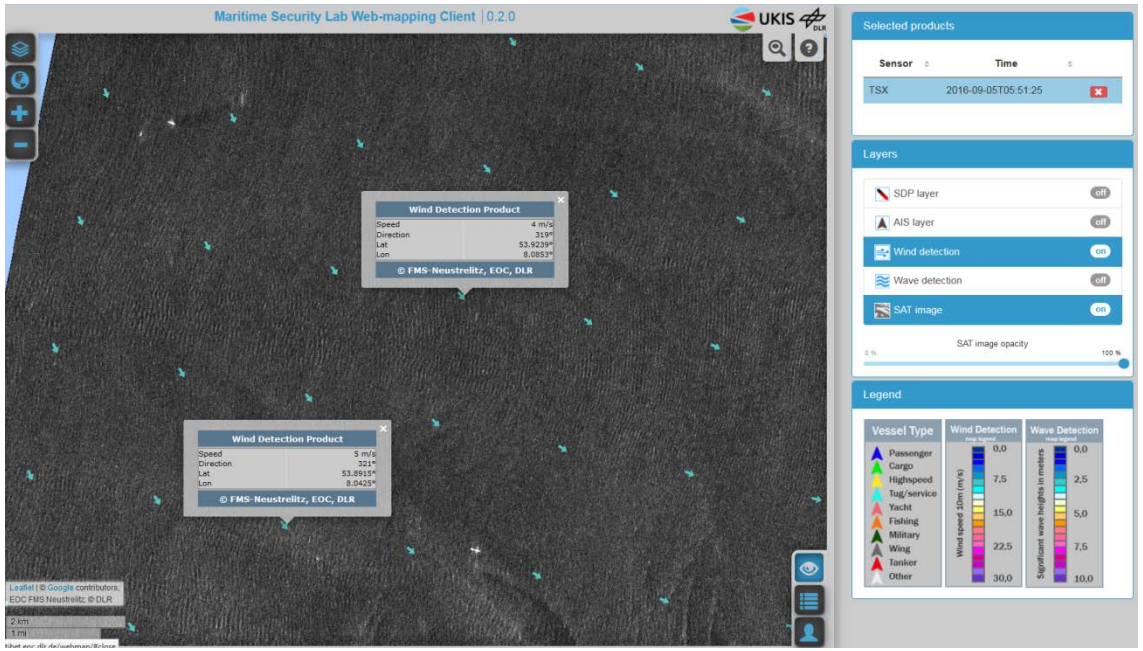
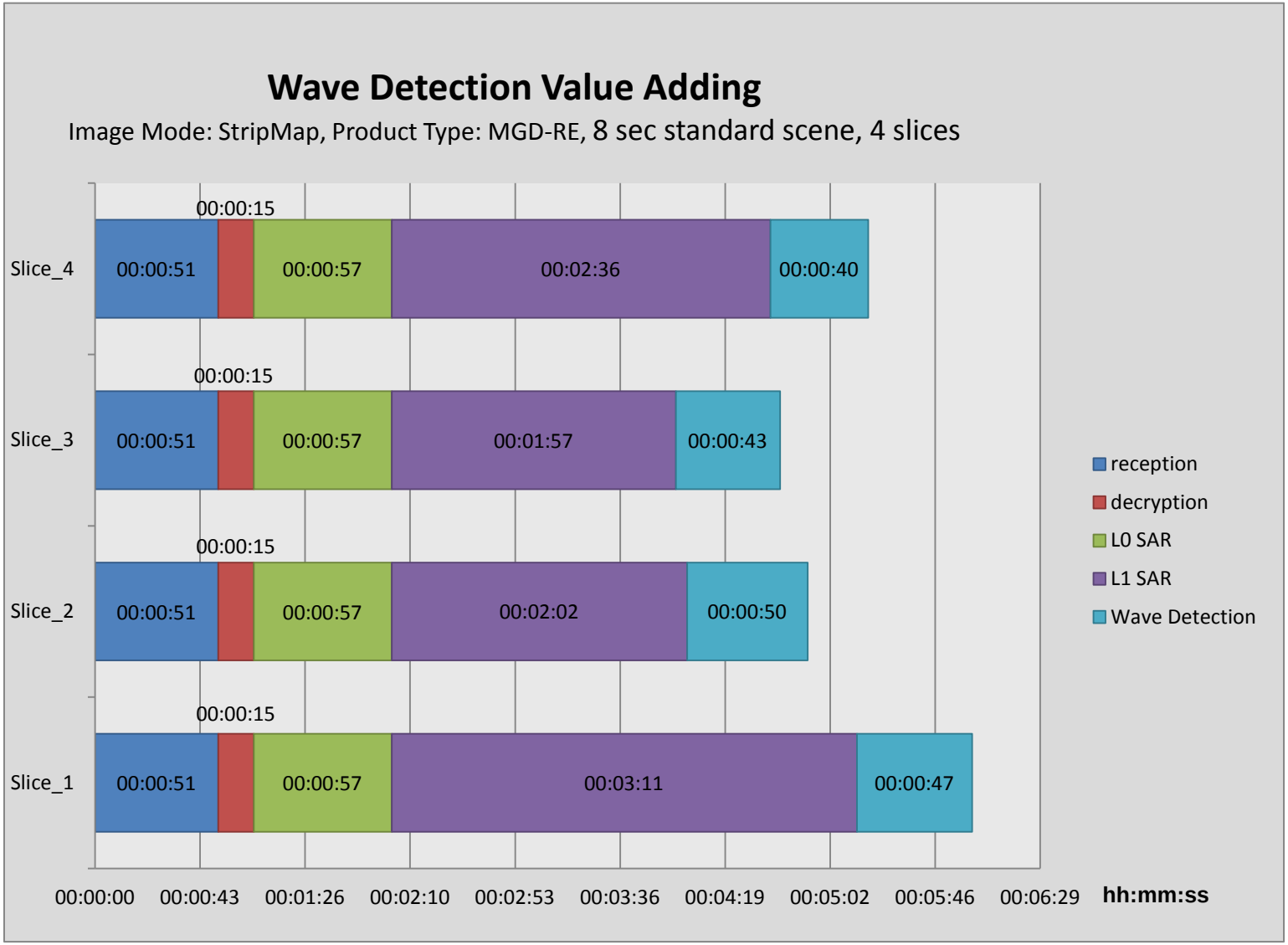


Image: TDX1_SAR__MGD_RE___SC_S_SRA_20150912T151305

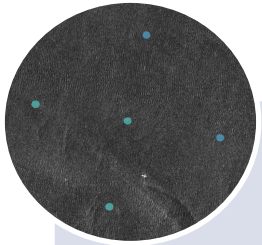
TerraSAR-X Level 1 image product in the background is overlaid by the DLR SAR WIND product (rectangle) derived from the TerraSAR-X image.

Level 2 product formats: ASCII, netCDF, ESRI Shape Layer Files (shape), Google (KMZ) , png, wld, png.aux.xml

Processing Performance



Wave Detection Result



Near real time wind detection application based on SAR images

Core function is theXWAVE-2 algorithm developed by the Maritime Security Lab Bremen to derive wave height and wave length (Pleskachevsky et al., 2016)

Level 2 product formats: ASCII, netCDF, ESRI Shape Layer Files (shape), Google (KMZ) , png, wld, png.aux.xml

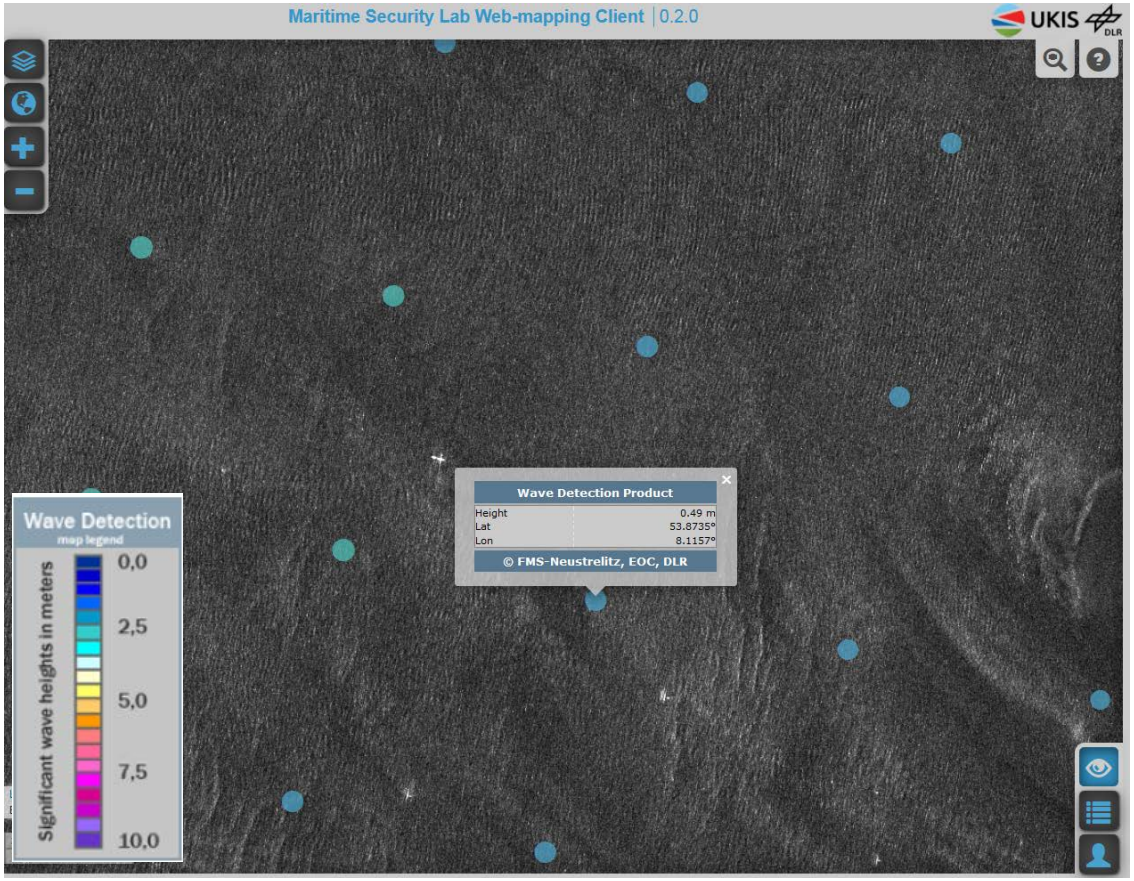
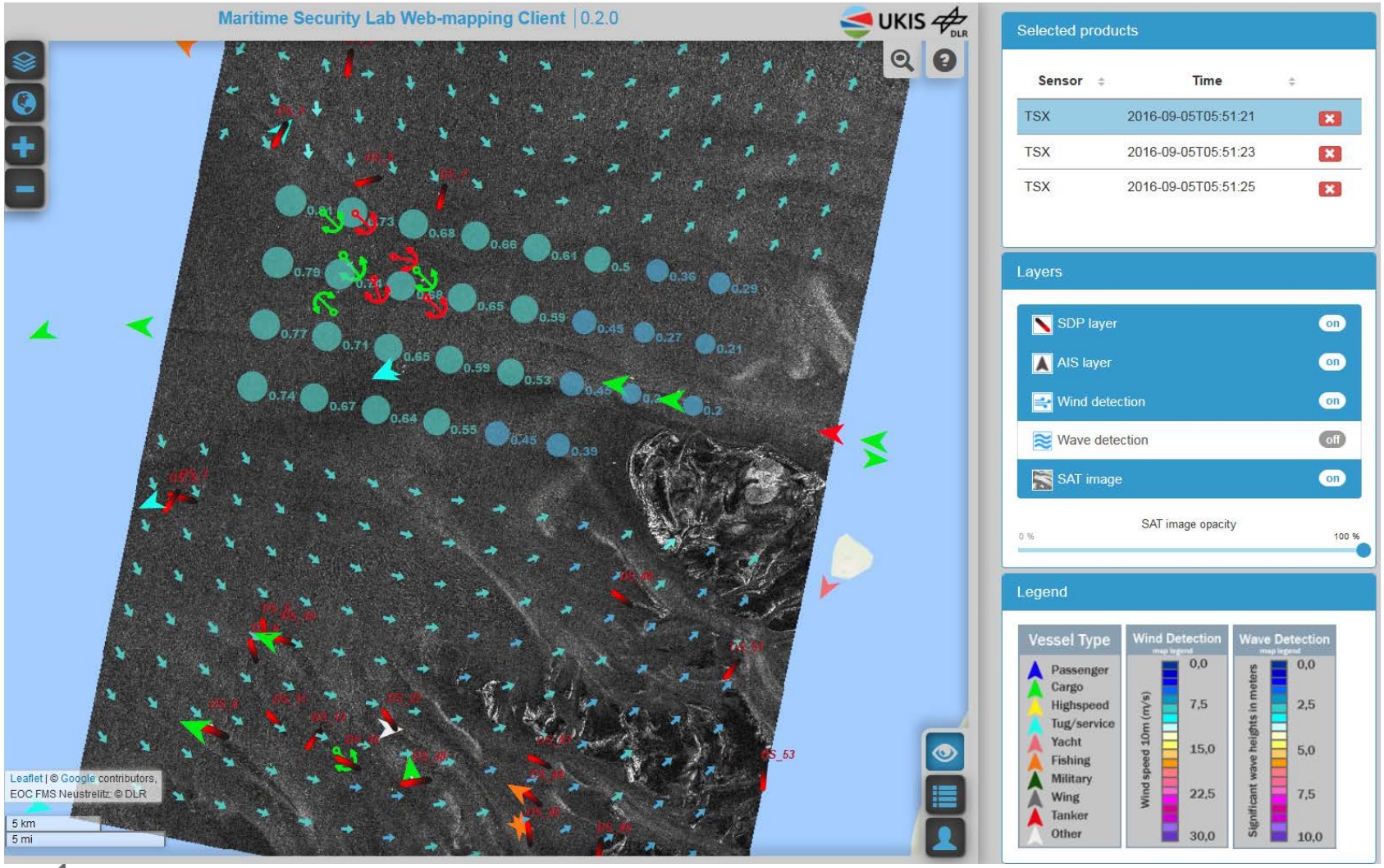


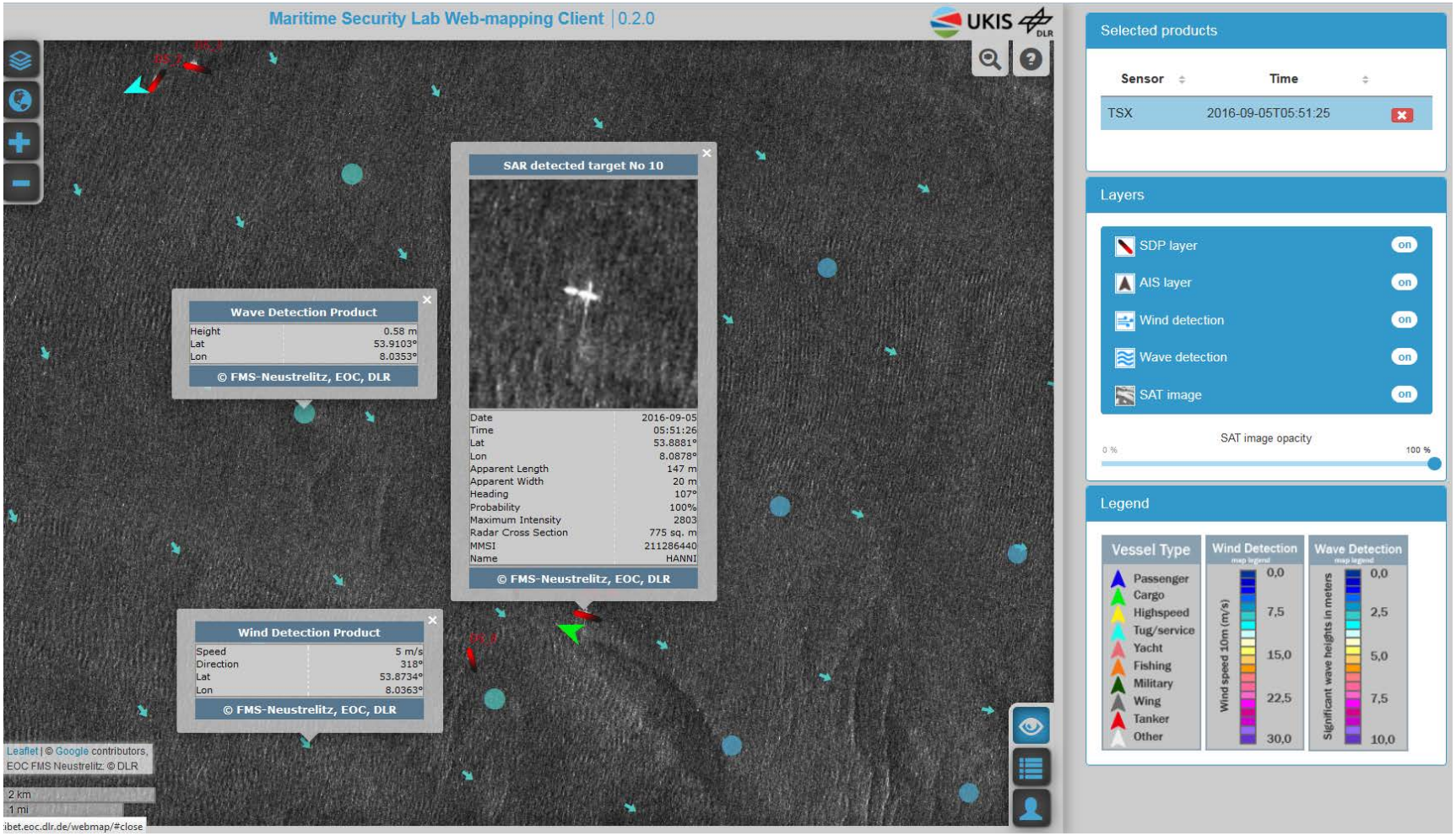
Image: TSX1_SAR__MGD_RE___SM_S_SRA_20160905T055125

TerraSAR-X Level 1 quicklook product in the background is overlaid by the DLR SAR Wave product (rectangle) derived from the TerraSAR-X image.

Example of Product delivery on GeoServer and connected via Web-mapping Client



Example of Product delivery on GeoServer and connected via Web-mapping Client



Egbert Schwarz

DLR
German Remote Sensing Data Center (DFD)
National Ground Segment (NBS)

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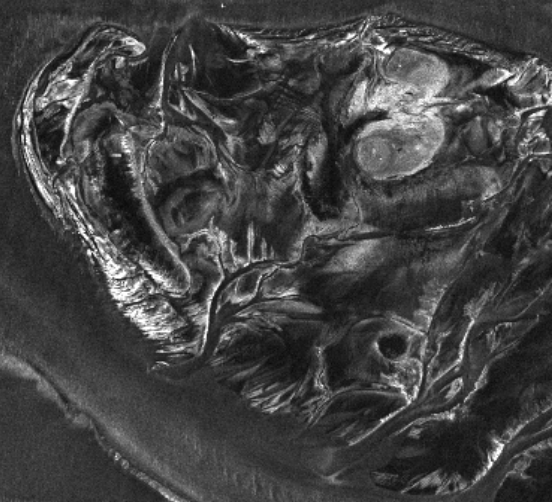
17235 Neustrelitz

Phone: 03981/480-149
Fax: 03981/480-299
E-mail: egbert.schwarz@dlr.de

Thank you for your attention !



TerraSAR-X 20160905T055125