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ECDIS S-411 for Antarctica

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Member of the JCOMM Expert team on sea ice**

May 2016



"S-411 Ice Information Product Specification" summary



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INTERNATIONAL HYDROGRAPHIC ORGANIZATION
JCOMM



Ice Information Product Specification

Edition 1.1.0, June 2014

Special Publication JCOMM S-411

Published by the
International Hydrographic Bureau
4, Quai Antoine 1er
B.P. 447 - MC 98011 MONACO Cedex
Téléfax: (377) 93 10 81 40
E-mail: info@iho.int
Web: www.iho.int

12.2.1.1 IceNavigationalDisplayMode (Traffic Light Principle, depends on Ice Class)

Object Class	Acronym								
Sea Ice	seaiice								
Lake Ice	laciice								
Iceberg Area	icebrg								

12.2.1.2 IceScientificIceAreaDisplayMode

Iceent	Description	rgb	color
1	Ice Free	000 100 255	
2	Open Water (< 5/10 ice)	150 200 255	
3	Bergy Water	150 200 255	
10	1/10 ice	140 255 140	
12	1/10 to 2/10 ice	140 255 140	
13	1/10 to 3/10 ice	140 255 140	
20	2/10 ice	140 255 140	
21	2/10 to 3/10 ice	140 255 140	
24	2/10 to 4/10 ice	140 255 140	
30	3/10 ice	140 255 140	
34	3/10 to 4/10 ice	140 255 140	
35	3/10 to 5/10 ice	255 255 000	
40	4/10 ice	255 255 000	
45	4/10 to 5/10 ice	255 255 000	
46	4/10 to 6/10 ice	255 255 000	
50	5/10 ice	255 255 000	
56	5/10 to 6/10 ice	255 255 000	
57	5/10 to 7/10 ice	255 255 000	
60	6/10 ice	255 255 000	
67	6/10 to 7/10 ice	255 255 000	
68	6/10 to 8/10 ice	255 125 007	
70	7/10 ice	255 125 007	
78	7/10 to 8/10 ice	255 125 007	
79	7/10 to 9/10 ice	255 125 007	
80	8/10 ice	255 125 007	
81	8/10 to 9/10 ice	255 000 000	
89	9/10 to 10/10 ice	255 125 007	
90	9/10 ice	255 000 000	
91	9/10 to 10/10 or 0/10 ice	255 000 000	
92	10/10 ice	140 000 000	
99	Undetermined/Unknown	Symbol#	

- Development was led by the BSH as a part of JCOMM/ETSI. It was adopted as version 1.0 by JCOMM ETSI-5, March 2014 with the latest version 1.1.0 (June 2014)
- The S-411 is fully based on the IHO S-100 framework specification, Geography Markup Language (GML), Encoding Standard and the ISO 19100 series of standards.
- It is a vector product specification that is primarily intended for encoding the extent and nature of Sea Ice for navigational purpose.
- The application schema of ice information product contains 28 feature types with their attributes, enumerations, is based on the Ice Objects Catalogue (Version 5.1) and can be found in the ICE domain of the IHO Registry. The full schema as XML Schema File included in Annex B – Data Product format (encoding).
- Ice information datasets use S-100 Level 3a geometry which supports 0-, 1-, and 2-dimensional objects (points, line strings, polygons)
- The portrayal specification is based on Styled Layer Descriptors (SLD), follows OGC standards and supports 3 polygon portrayals, one according to the vessels ice capabilities, the second and third one being the WMO ice concentration/stages of development colour codes. Portrayals for line and point objects follow the WMO symbology and are implemented using SVG-graphics.
- Besides future ECDIS SDKs, the S-411 data could actually be read and presented using open source GIS software (e.g. QGIS) with python scripts from the national ice services available to convert shapefiles, specially SIGRID-3 files, into the S-411 format.

S-411



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Charts in S-411 format are available in the JCOMM Ice Logistics Portal <http://www.bsis-ice.de/IcePortal/>.

there are also available over ftp at
<ftp://ftp.bsh.de/outgoing/Eisbericht/S411/>



Ice Logistics Portal

World regions: [Southern](#) | [Northern 90W](#) | [Northern 90E](#) | [MetAreas](#) | [Position](#) | [Home](#) | [Contact Us](#)

Background Information

- » [Sea Ice Service of the World](#)
- » [Manual of Standard Procedures for Observing and Reporting Ice Conditions](#)
- » [SIGRID-3: A Vector Archive Format for Sea Ice Charts](#)
- » [Ice Chart Colour Code Standard](#)

Links

- » [JCOMM-ETSI](#)
- » [GMDSS-MetArea](#)

The Ice Logistics Portal was created as a joint initiative of the International Ice Charting Working Group, the JCOMM Expert Team on Sea Ice and Polar View for the International Polar Year. It is now maintained by the German Bundesamt für Seeschifffahrt und Hydrographie. It is intended to create a convenient point of access to operational sea ice information produced by the world's ice services. Access to products is provided via a series of pre-defined regions for both the Arctic and the Antarctic. Since the primary focus of the Ice Logistics Portal is on operational sea ice data (i.e. ice charts), only the most recent information is displayed for any given region.

Enter High Connection Speed Site
- For broadband connection

Enter Low Connection Speed Site
- Text only for dial-up connection

As a new feature it is now possible to choose charts according to a given geographic position. Up till now the position can be input only as full degrees .

INTERNATIONAL HYDROGRAPHIC ORGANIZATION
JCOMM



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Published by the
International Hydrographic Bureau
4, Quai Antoine 1er
B.P. 445 - MC 98011 MONACO Cedex
Principauté de Monaco
Téléfax: (377) 93 10 81 40
E-mail: info@ihb.mc
Web: www.ihb.int

S-411 Production 1: setup



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```
#
# This the main program part to for the Antarctic data
import struct
import shutil
import glob
import tarfile
import zipfile
from ftplib import FTP
import os
import datetime, time
from xml.etree import ElementTree as ET
import arcpy
import geometry
import s411
import s411metadata
import s411objects
from sigrid3 import sigrid3ToS411Objects
from s411 import createS411DataSet
from s411 import createS411ExchangeSet
from s411 import s411ObjectsToGml
from s411 import zipdir

# path for input files and S411 output files
PRODUKT='Ant'
ekPath = u'X:\\S411_Specification\\production\\'+PRODUKT+'Input'
OutPath= u'X:\\S411_Specification\\production\\'+PRODUKT+'S411'
InName= u'*_ant*.pl'
```

S-411 Production 2: getting data

```
#
# Getting the newest zip files from ftp
INPUT_ftp= FTP('ice.aari.aq','USER','PASSWORD')
RemoteDir=['/latest/aari','/latest/nic','/latest/nis/']
for R_dir in RemoteDir:
    INPUT_ftp.cwd(R_dir)
    F_dir=INPUT_ftp.nlst()
    for F_tar in F_dir:
        fileName, fileExtension = os.path.splitext(F_tar)
        if fileExtension != '.zip' : continue
        if os.path.isfile(os.path.join(ekPath,F_tar)): continue
        # we could also check if the S411 file is already present, so we could
        T_file=open(os.path.join(ekPath,F_tar),'wb')
        INPUT_ftp.retrbinary('RETR '+F_tar,T_file.write)
        T_file.close()
# the S411 files will be put back in the subdirectory S411
INPUT_ftp.cwd('/S411')

^
```

delete tarfiles and shapefiles

S-411 Production 3: unzip the data



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```
# Search for Zip files and decompress files starting with InName
# as long as S411-Zipfile is not present
Alltar=glob.glob(os.path.join(ekPath,InName+'.zip'))
for Datei in Alltar:
    filename = os.path.basename(Datei)
    ICEshape = filename.split(".")[0]
    N_411='S411_'+ICEshape
    if glob.glob(os.path.join(OutPath,N_411+'.zip')): continue
    zfile = zipfile.ZipFile(Datei)
    for name in zfile.namelist():
        (dirname, zfilename) = os.path.split(name)
        zfile.extract(name, ekPath)
```

S-411 Production 4: start translating

```
# Search for Shape files starting with Inputname
# and start S411 production
# as long as S411-Zipfile is not present
Allshape=glob.glob(os.path.join(ekPath,InName+'*.shp'))
for Datei in Allshape:
    filename = os.path.basename(Datei)
    ICEshape = filename.split(".")[0]
    N_411='S411_'+ICEshape
    if glob.glob(os.path.join(OutPath,N_411+'.zip')): continue
    print 'Starting S411 chart production:'+N_411

    dummy=ICEshape.find('_20')
    JDATUM=ICEshape[dummy+1:dummy+9]
    datum = datetime.datetime.strptime(JDATUM,"%Y%m%d")
    dateStamp0=datum.strftime("%Y%m%d")
    dateStampS=datum.strftime("%Y%m%d")
    dateStampE=(datum + datetime.timedelta(days=5)).strftime("%Y%m%d")
    extent = [0,0,0,0]
```

S-411 Production 5: spatial reference



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```
# For exchange of ice data WGS84 (EPSG: 4326) must be used.
# set the workspace environment
arcpy.env.workspace = ekPath
# create a spatial reference object to be used as output coordinate system
out_sr = arcpy.CreateSpatialReference_management(4326)
# use the output of CreateSpatialReference as input to Project tool
# to reproject the shapefile
spatialRef = arcpy.Describe(os.path.join(ekPath, ICEshape+'.shp')).spatialReference
if ICEshape.find('aari')>=0:
    # special test for AARI Antarctic
    out_sr2 = arcpy.CreateSpatialReference_management(3031)
    # use the output of CreateSpatialReference as input to Project tool
    arcpy.Project_management(os.path.join(ekPath, ICEshape+'.shp'), os.path.join(ekPath, 'DUMMY'+ICEshape), out_sr2)
    ICEshape='DUMMY'+ICEshape
    spatialRef = arcpy.Describe(os.path.join(ekPath, ICEshape+'.shp')).spatialReference
if spatialRef.factoryCode != 4326 :
    arcpy.Project_management(os.path.join(ekPath, ICEshape+'.shp'), os.path.join(ekPath, 'WGS'+ICEshape), out_sr)
    ICEshape='WGS'+ICEshape
```


S-411 Production 6: main conversion

```
fileList = []
fileList.append(os.path.join(ekPath, ICEshape+'.shp'))
extent = geometry.getExtent(fileList)

s411FeatureList = sigrid3ToS411Objects(os.path.join(ekPath, ICEshape+'.shp'))
s411FeatureElementsList = s411ObjectsToGml(s411FeatureList)
datasetTree = createS411DataSet(s411FeatureElementsList)
metadataTree = s411metadata.getS411MetadataFromTemplate("mdTemplate"+PRODUKT+".xml", N_411, dateStamp0,
    extent, dateStampS, dateStampE)
# the S411 directory structure is written to the subdirectory with the icearea
createS411ExchangeSet(OutPath, N_411, datasetTree, metadataTree)
exchangeCatalogueTree = s411metadata.getS411ExchangeCatalogueFromTemplate("ecTemplate"+PRODUKT+".xml",
    metadataTree, N_411, N_411 + ".gml", extent, OutPath + os.path.sep + N_411 + os.path.sep + "data" +
    os.path.sep + N_411 + ".gml")
exchangeCatalogueTree.write(OutPath + os.path.sep + N_411 + os.path.sep + "catalogue.xml", encoding='utf-8',
    xml_declaration=True)
```

S-411 Production 7: zip, write ftp, clean



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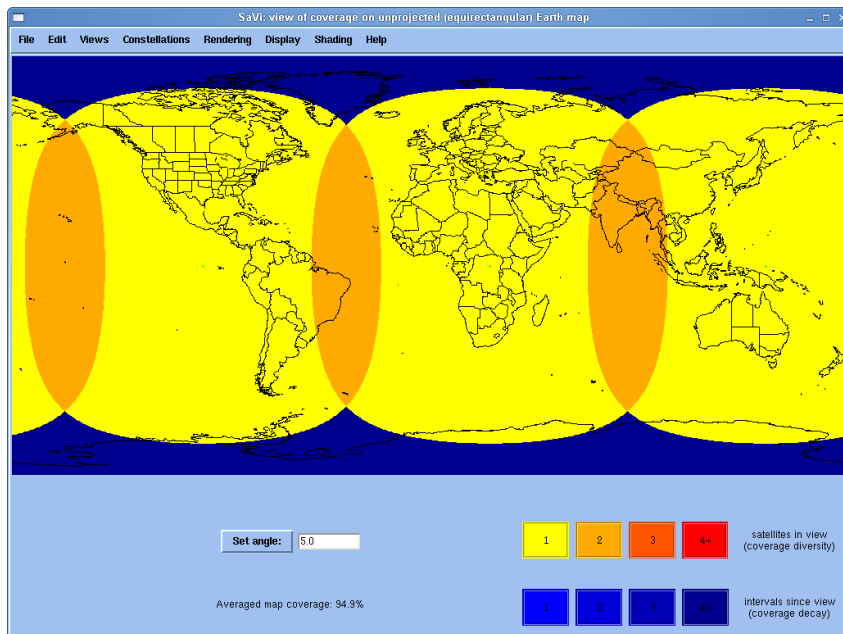
```
# a S411-zipfile is written to the chartdirectory =dirPath
dummy=os.path.join(OutPath, N_411)
zf = zipfile.ZipFile(dummy+'.zip', mode='w')
zipdir(dummy,zf)
zf.close()
INPUT_ftp.storbinary('STOR '+N_411+'.zip',open(dummy+'.zip','rb'))

# remove the shapefiles with WGS datum
for dummy in glob.glob(os.path.join(ekPath,'WGS'+**)):
    os.remove(dummy)
if ICEshape.find('aari')>=0:
    for dummy in glob.glob(os.path.join(ekPath,'DUMY'+**)):
        os.remove(dummy)

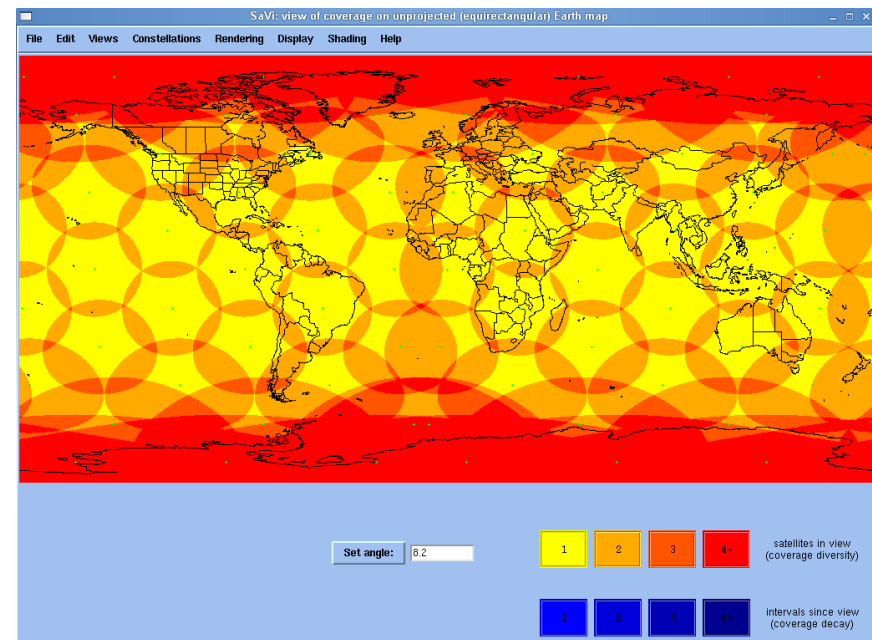
#end of S411 production
INPUT_ftp.quit()
```

Data transmission

Data transmission to ship far up north or south is not possible with Inmarsat. It is possible using Iridium, but transmission is slow and more expensive. Iridium claims 10 kbit/sec but actual rates for compressed files are more like 2300 to 2400 bit/sec.



Inmarsat coverage (Wikipedia)



Iridium coverage (Wikipedia)

Ice charts

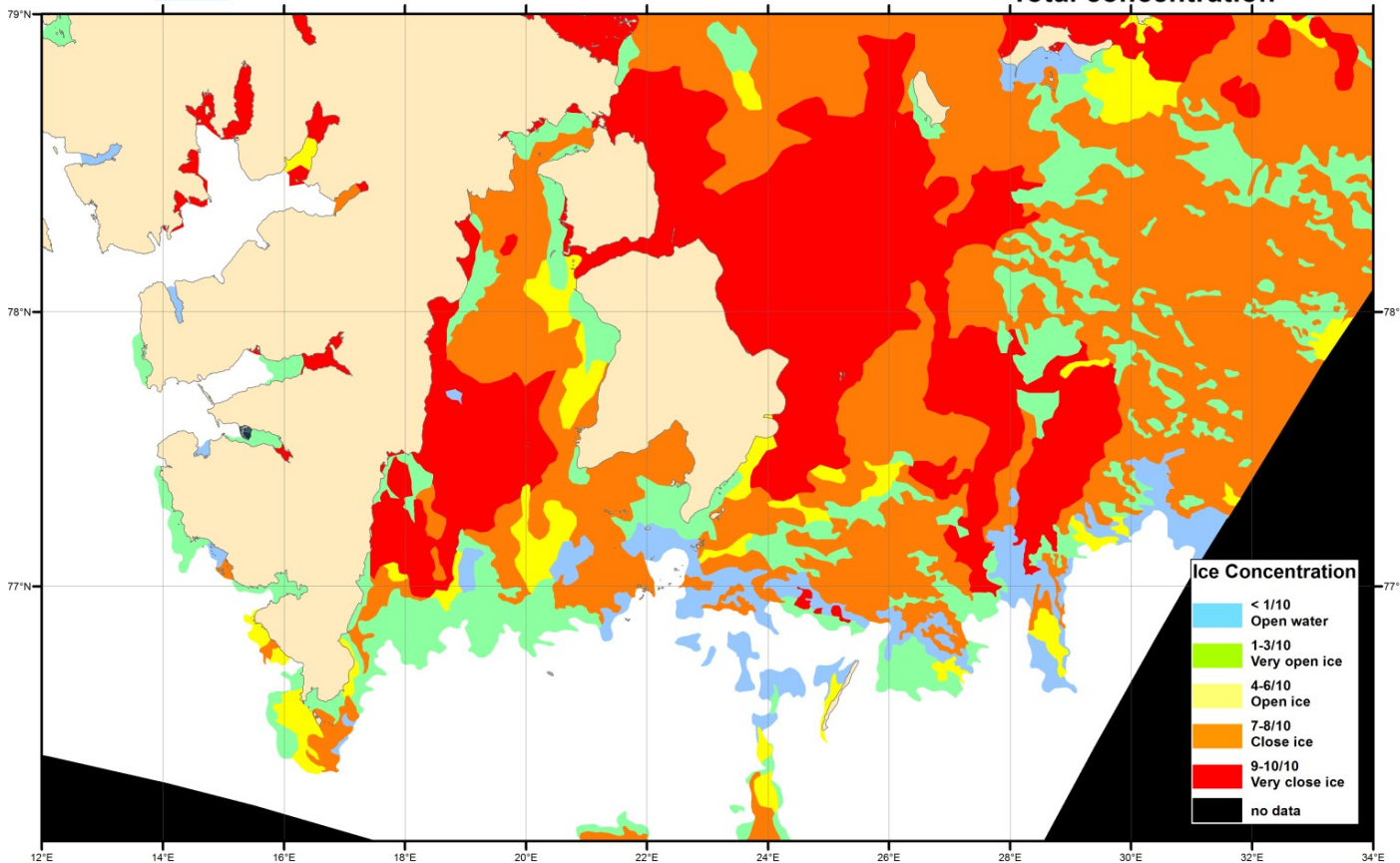


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Bundesamt für Seeschifffahrt
und Hydrographie

EISKARTE vom 19.03.2014
Spitzbergen / Barentssee
Total concentration



Size:
200 to 900 KB as
vector PDF

About 100 to
200kb as JPEG

S-411
starting at ~20kb,
typical ~60kb

Model Ice charts

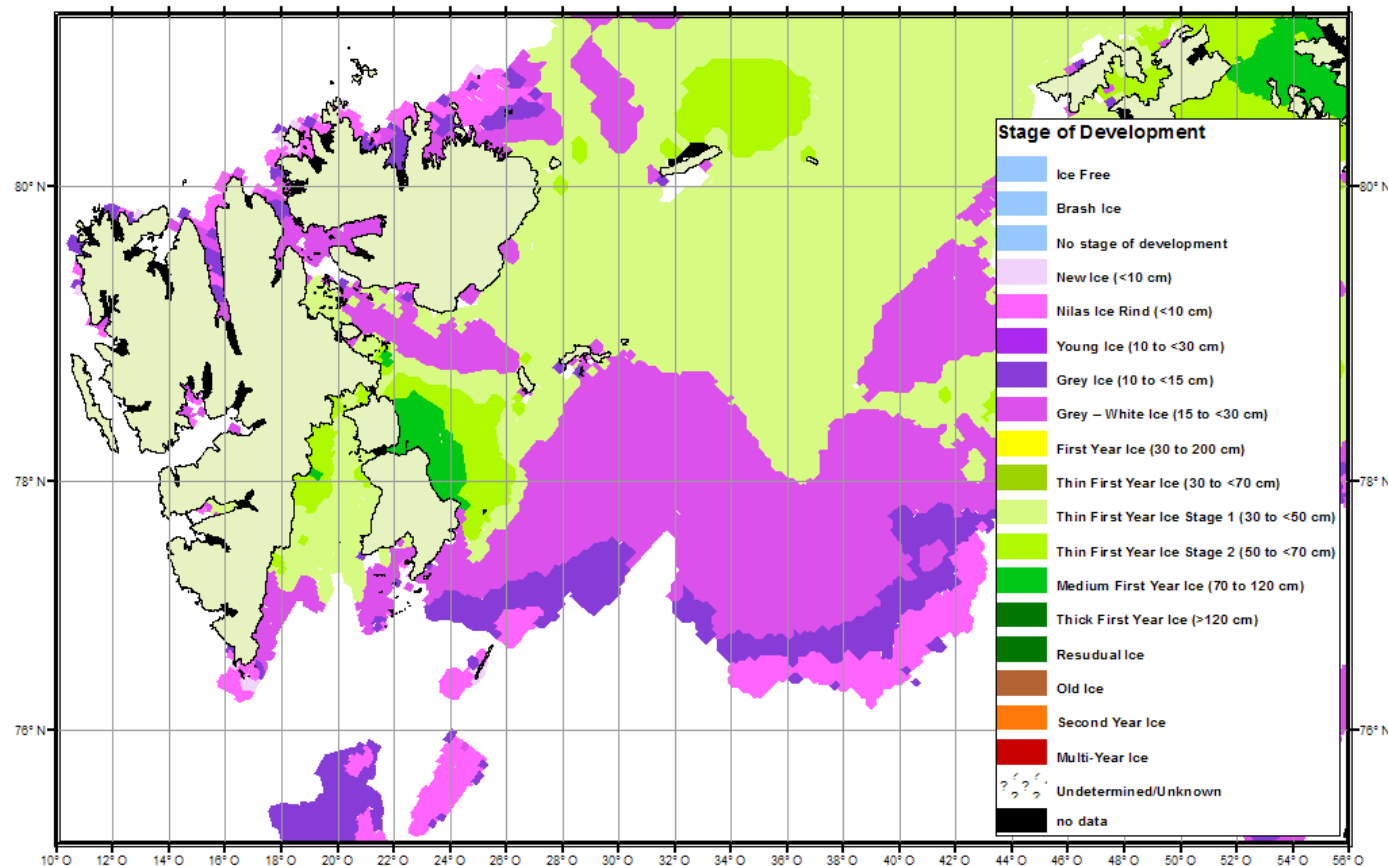


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Bundesamt für Seeschifffahrt
und Hydrographie

EISKARTE für den 19.03.2014, 12 Uhr
Hammermodel vom 18.03.2014 12Uhr
Spitzbergen / Barentssee



Size:
200 to 900 KB as
vector PDF

About 100 to
200kb as JPEG

S-411
starting at ~20kb,
typical ~60kb

A simple way to read and portray S-411.

A short, 4 page long document describes how to read and portray S-411 ice information in Quantum GIS (Version 2.0 or newer).

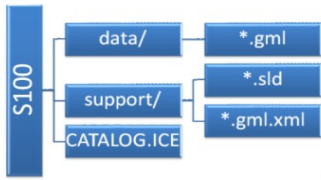
21.05.13

S100 - Ice Chart

Baltic sea ice chart issued by the Bundesamt für Seeschifffahrt und Hydrographie (BSH). This chart is issued weekly in during the ice season in the Baltic.

IHO S-100 Ice Charts

This chart is a test data, that was producing using [IHO S-100 Standard](#). The dataset and support files are combined in a Exchange Set. The Exchange Set structure for ice data is following:



- **S100** S100 is a root directory of Exchange Set
 - **data/** is subdirectory of S100 containing dataset
 - ***.gml** is dataset file in GML 3.2.1 format
 - **support/** is subdirectory of S100 containing support files
 - ***.sld** is a file containing display rules (at the moment WMO Color Code for ice concentration), for encoding was used [Symbology Encoding Y.1.1.9](#) from [OGC](#).
 - ***.gml.xml** contains the ISO 19139 Metadata
 - **CATALOG.ICE** Metadata file for whole Exchange Set (encoded in XML)

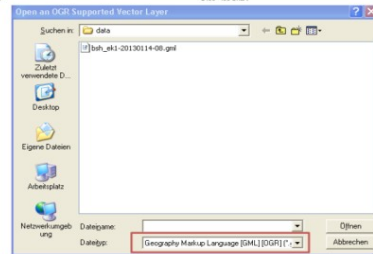
Display S-100 Ice Data

For displaying of S-100 ice data [QuantumGIS](#) can be used:

1. Install and start QuantumGIS
2. Layer-> Add Vector Layer ...-> Browse
3. Select as file type "Geography Markup Language [GML] ..."

21.05.13

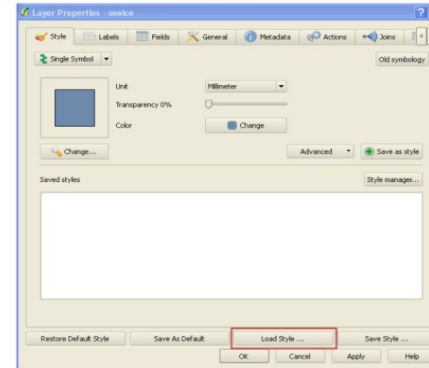
S100 - Ice Chart



4. Select *.gml file from Exchange Set ("data"- folder) -> Open
5. Select "Vector"- layer in the layer table -> Layer -> Properties ...-> Style
6. Load Style ...

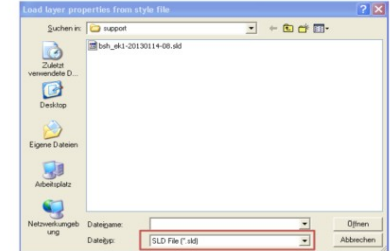
21.05.13

S100 - Ice Chart



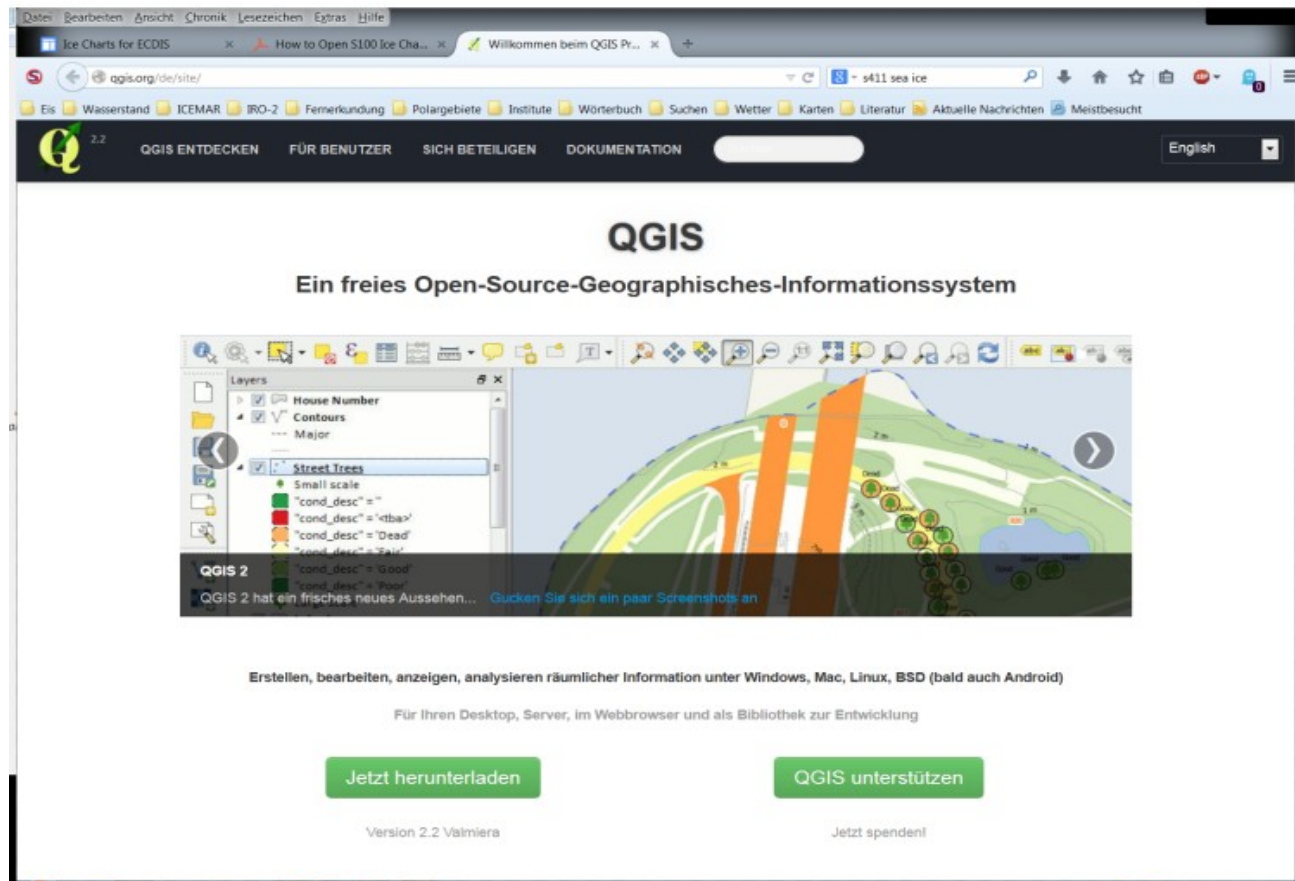
21.05.13

S100 - Ice Chart



Select *.sld file from support directory -> Open -> OK

QGIS is an Open-Source Geographic Information System available at no cost for Linux, Windows, Mac OsX, BSD and Android at <http://qgis.org/de/site/index.html>.

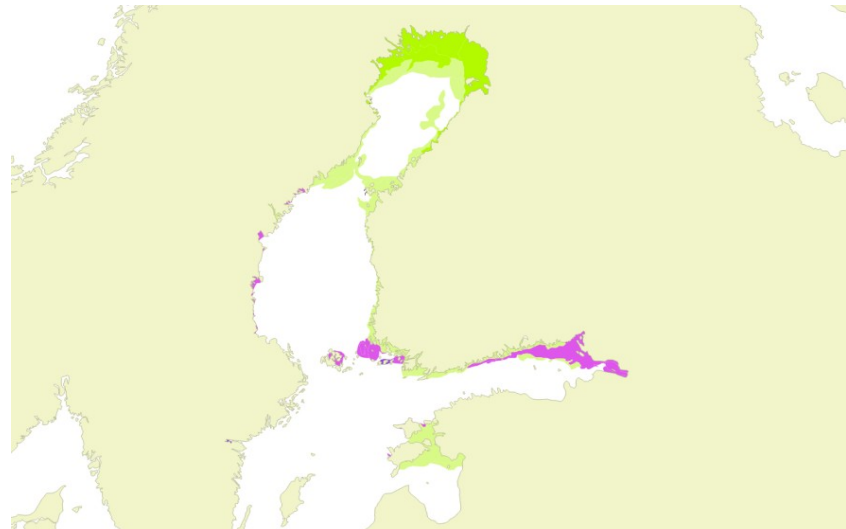
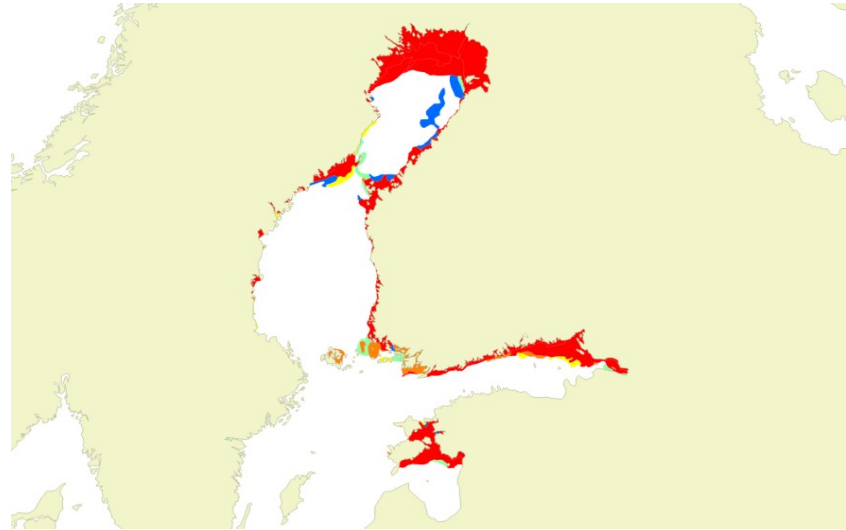
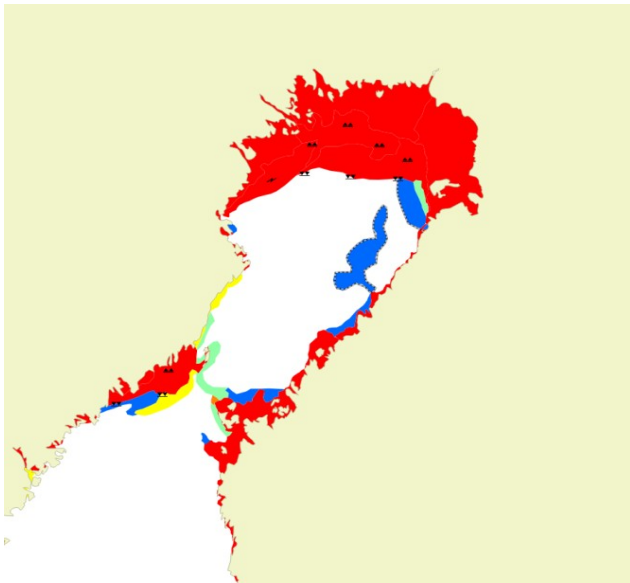


An example of S-411 data in Qgis

Example of an S-411 ice chart represented in Qgis using the respective S-411

In the upper right the total ice concentration, in the lower right the stage of development.

In the lower left is a concentration chart with additional symbols for pressure ridges, cracks, and rafted ice..



Different presentation of one S-411 dataset

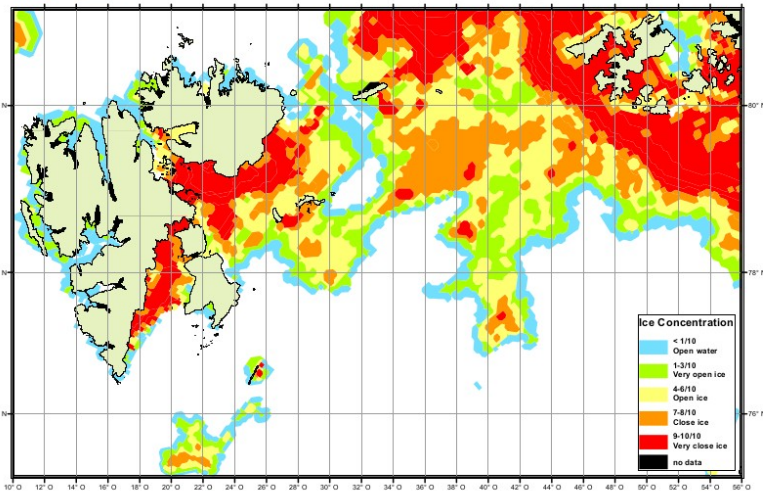


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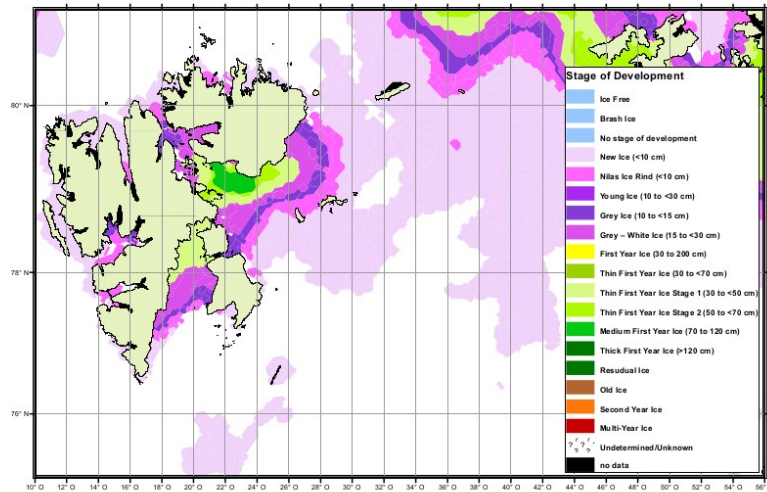
Bundesamt für Seeschifffahrt
und Hydrographie

EISKARTE für den 23.02.2014 12 Uhr
Hammermodel vom 23.02.2014 00 Uhr
Spitzbergen / Barentssee



Bundesamt für Seeschifffahrt
und Hydrographie

EISKARTE für den 23.02.2014 12 Uhr
Hammermodel vom 23.02.2014 00 Uhr
Spitzbergen / Barentssee



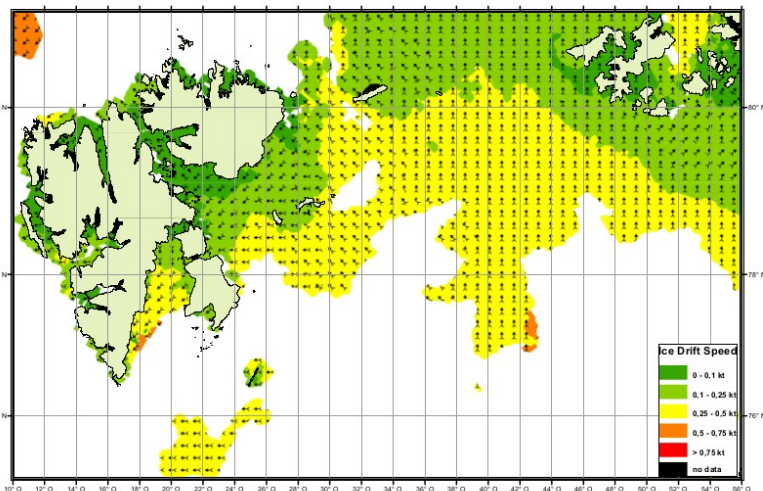
WMO/IHO standard
color scheme:

- * Concentration
- * Stage of development
- * (Ship capability)



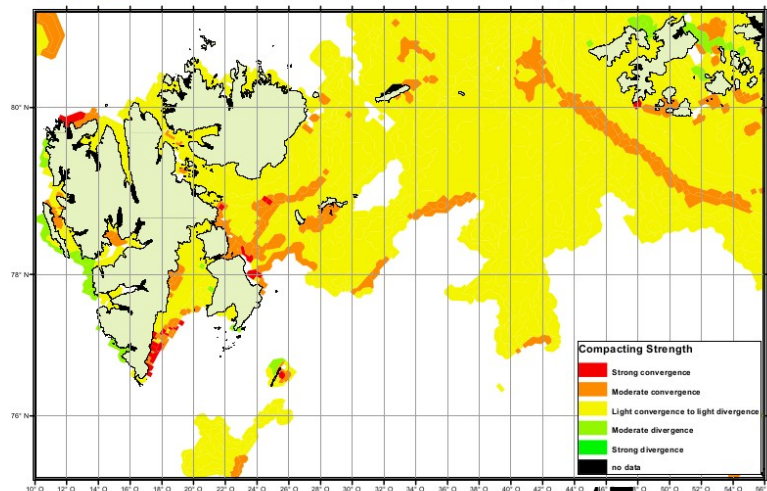
Bundesamt für Seeschifffahrt
und Hydrographie

EISKARTE für den 23.02.2014 12 Uhr
Hammermodel vom 23.02.2014 00 Uhr
Spitzbergen / Barentssee



Bundesamt für Seeschifffahrt
und Hydrographie

EISKARTE für den 23.02.2014 12 Uhr
Hammermodel vom 23.02.2014 00 Uhr
Spitzbergen / Barentssee

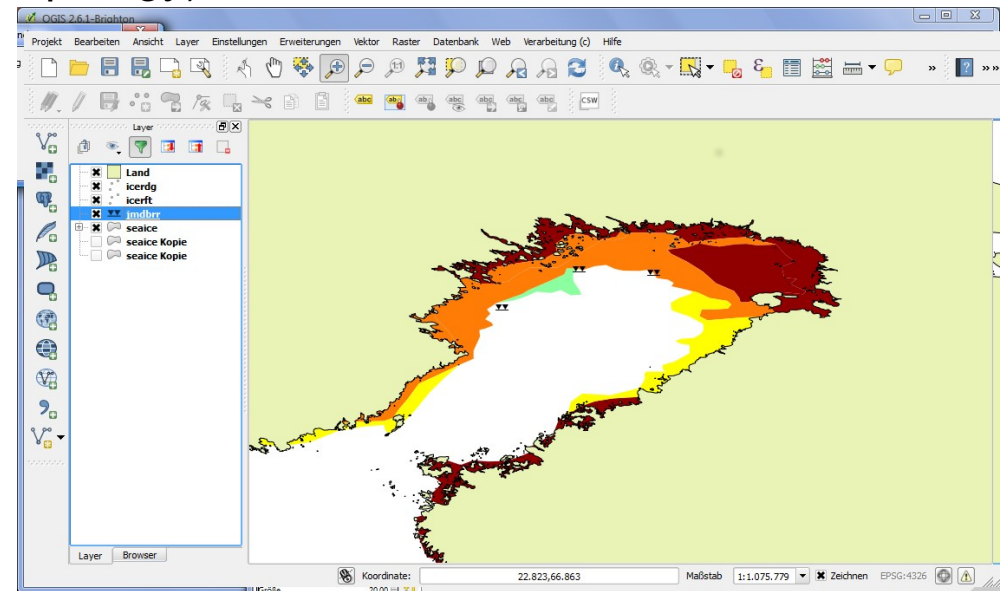
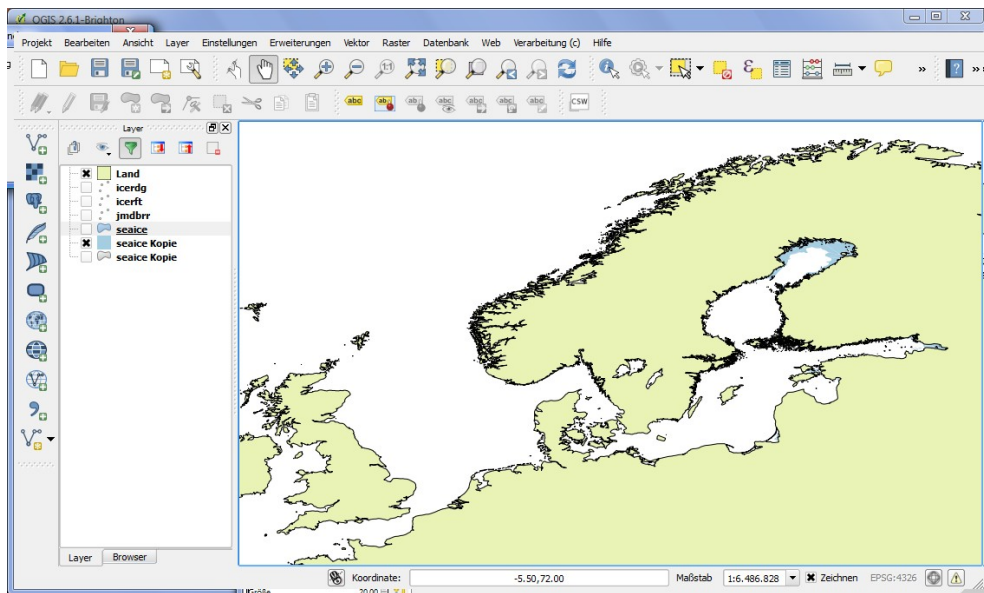


User defined color
scheme:

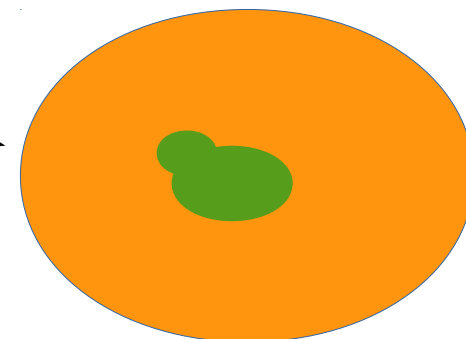
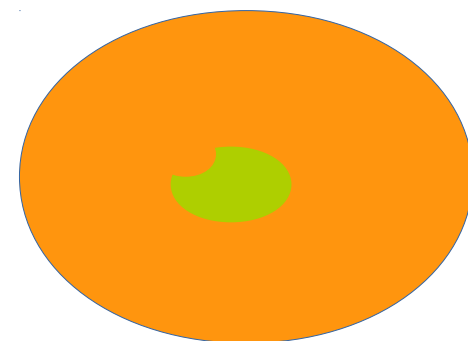
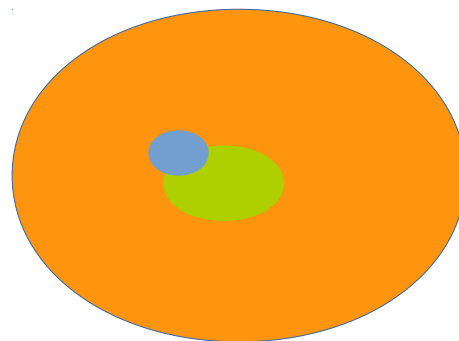
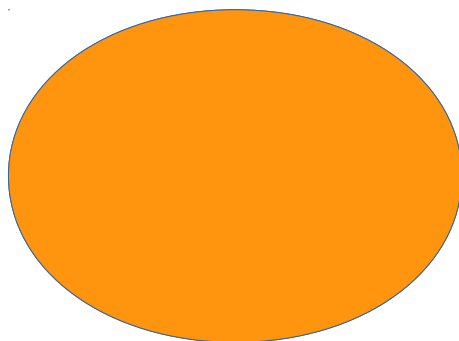
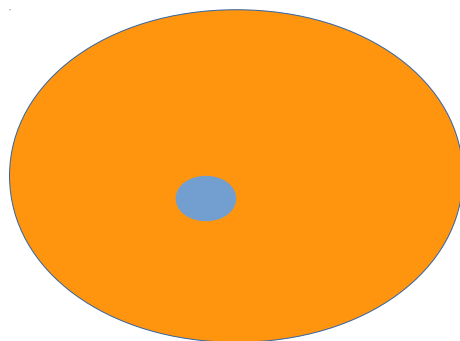
- * Drift velocity
- * Divergence and convergence
- * (any other)

Further development of S-411

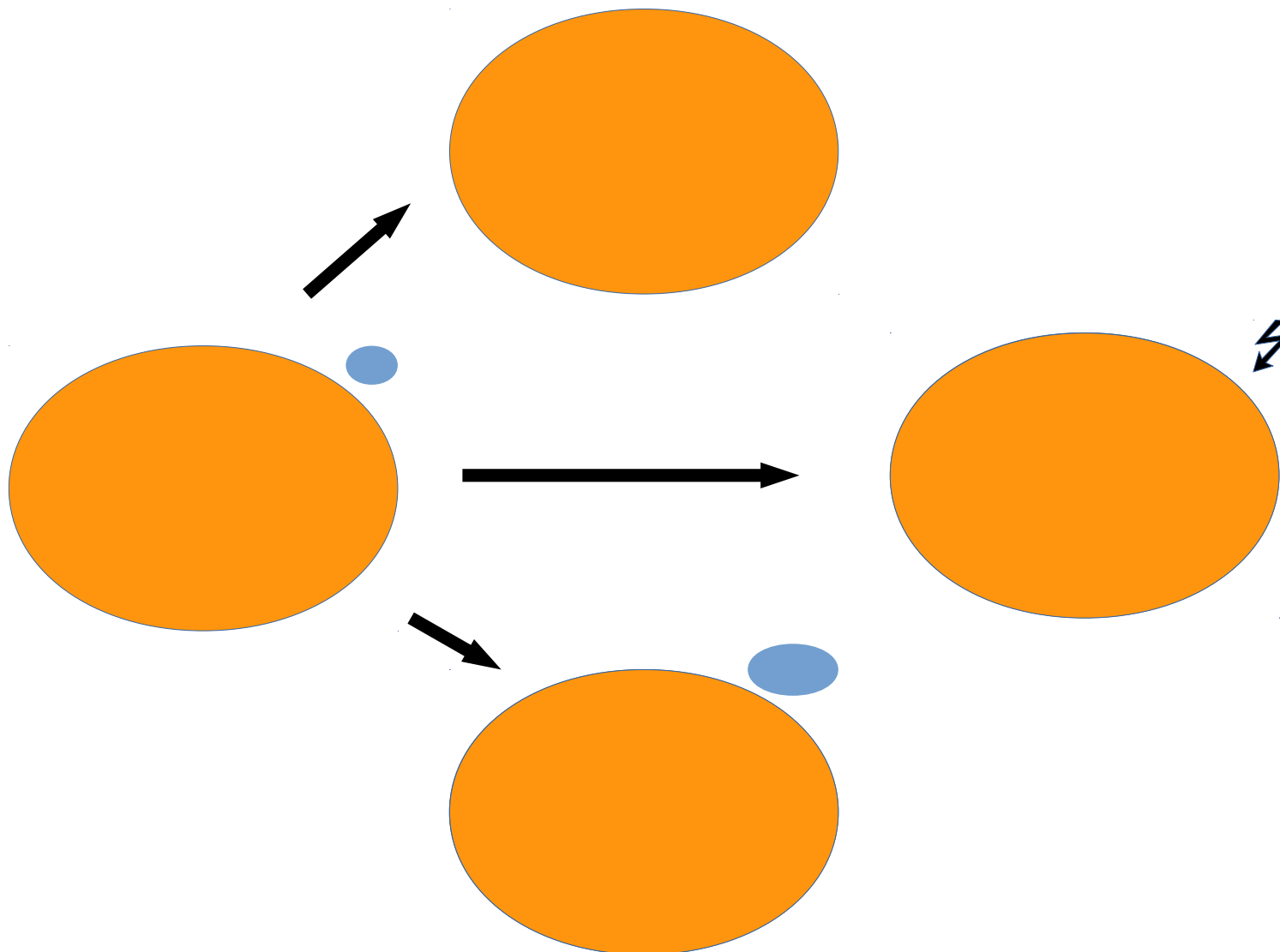
- A) better iceberg objects (points lines and polygones?; error area?)
- B) changing portrayal according to scale:
- join/dissolve/delete smaller polygons
 - change colors to white-grey at larger scales
 - group together same symbols if the overlap
 - join different overlapping symbols (e.G. rafted and ridged ice into a symbol denoting „heavy“ ice.
 - smooth features (polygon-coverage/topology)



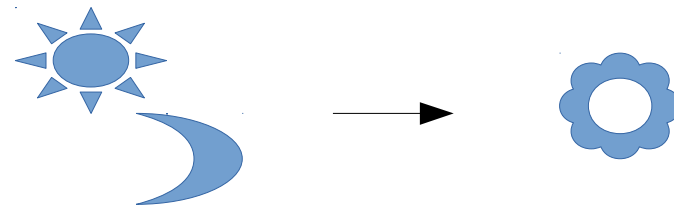
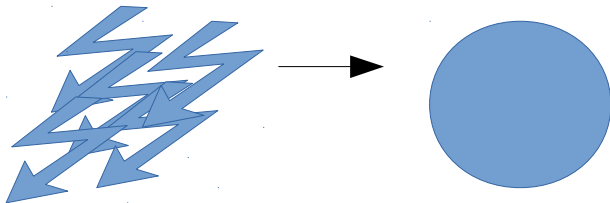
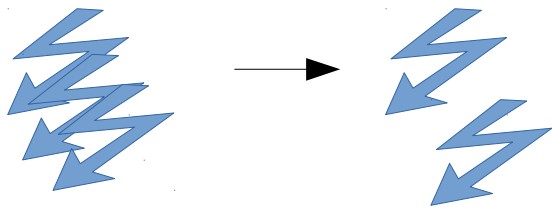
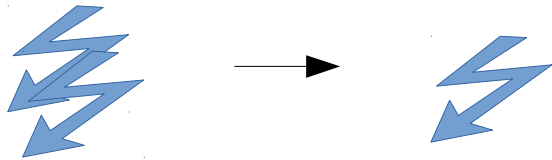
Simplification/generalization polygons



Simplification/generalization polygons



Simplification/generalization Symbols



Thanks for your attention



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