**WORLD METEOROLOGICAL ORGANIZATION**

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM)
EXPERT TEAM ON SEA ICE – FOURTH SESSION

STEERING GROUP FOR THE PROJECT GLOBAL DIGITAL SEA ICE DATA BANK (GDSIDB) – TWELFTH SESSION

ST PETERSBURG, RUSSIAN FEDERATION
1 TO 5 MARCH 2010

**INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)**

ETSI-IV GDSIDB-XI/Doc. 3.4.3
(25.II.2010)

ITEM 3.4.3

Original: ENGLISH

# PROPOSAL FOR A NEW FORMAT FOR SEA ICE GRIDDED DATA EXCHANGE

*(Submitted by Frode Dinessen, met.no)*

Summary and Purpose of Document

This document contains a status on the progress in extending and using the netCDF format within the MyOcean project.

## ACTION PROPOSED

The Expert Team on Sea Ice (ETSI) is invited to:

(a) Note and comment on the information in this document;

(b) Provide advice on future directions and recommend mechanisms for formalization of the netCDF format as one of a prototype format for sea ice gridded data exchange

Appendix 1 - SIWTAC netCDF common data product file structure (v3)

# DISCUSSION

## Introduction

1. Current practices of data exchange between the services and centers (at least CIS, AARI, met.no) show the need for a new generation format to support sea-ice gridded information in addition to raster SIGRID (WMO, 1989), SIGRID-2 (WMO, 1994) and vector SIGRID-3 (WMO, 2004). The main idea is that such format (SIGRID-4 or so) should be a) open format(s), b) compatible with the WMO Sea Ice Nomenclature including coding tables, c) supported by mainstream software, d) friendly to data providers at ice services and climatic centers. It is also desirable for such future format to be capable to support both vector and raster data.

2. The SIW TAC (Sea Ice and Wind Tematic Assembly Centre) in the MyOcean project deliver all sea ice data in the netCDF format. Met.no cooperated with the SIW TAC and had come up with a draft description of the sea-ice content in the netCDF file. This draft may be estimated as one of the possible prototype for sea ice gridded data exchange.

# SIWTAC netCDF common data product file structure (v3)

Products delivered from the SIW TAC to the MyOcean project shall follow the Climate and Forecasting (CF) netCDF convention. The netCDF data format is extremely flexible and regulates only major issues. This document gives some recommendations of the format of attributes and variables that should be included in products delivered form the SIW TAC. Not all variables and attributes are needed in each product but this will be up to the producer. The recommendation is based on the CF-1.4 version.

The following reference gives a general overview of the netCDF CF-1.4 standard.
http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.4

### SIWTAC netCDF global attributes

| Tag name | Format | Mandatory/ Recommended | Description |
|---|---|---|---|
| title | String | M | A descriptive title for the data set |
| Conventions | String | M | The SIWTAC products shall follow the CF-1.4 convention. |
| product_id | String | R | A unique product identification. If possible use the official product id from MyOcean product catalogue. http://catalogue.myocean.eu.org ie. SEAICE_ARC_SEAICE_L4_NRT_OBSERVATIONS_011_002 |
| product_name | String | M | Name of product |
| product_status | String | R | Recommended values operational/preoperational |
| abstract | String | M | Description of product |
| topiccategory | String | R | A blank separated list of topic keywords describing the dataset. http://gcmd.nasa.gov/User/difguide/iso_topic_category.html |
| keywords | String | R | A comma separated list of WMO keywords describing the dataset. http://www.wmo.ch/pages/prog/www/metadata/WMO-keywords.html |
| gcmd_keywords | String | R | This will be used to categorize the datasets according to the "Topics and variables". http://gcmd.gsfc.nasa.gov/Resources/valids/archives/keyword_list.html |
| activity_type | String | R | Comma separated list of activity types. In practice for SIW TAC: “Space borne instrument”. |
| area | String | M | Northern Hemisphere |
| start_date | String | M | Start date and time of the dataset in the form "2007-06-12 12:30:00 UTC" or “2009-10-01T14:01:05Z” |
| stop_date | String | M | Stop date and time of the dataset in the form described above. |
| project_name | String | R | EUMETSAT OSI SAF |
| PI_name | String | M | Name of the person responsible for the data set. |

| | | | |
|---|---|---|---|
| distribution_statement | String | R | A distribution statement. (“Free”) |
| references | String | M | Document reference title or web link |
| history | String | M | Modification history of the dataset. Should be of the form describe in the start_date above. |
| netcdf_version_id | String | M | |
| valid_date | String | R | Date of valid product (UTC). Should be of the form describe in the start_date above. |
| product_version | String | R | Release number of the datafile |
| software_version | String | R | |
| comment | String | R | Miscellaneous information |
| satellite | String | R | Satellite identifier. If several satellites are used this must also be reflected in sensor list. |
| sensor | String | R | Sensor identifier. |
| spatial_resolution | String | R | Resolution of the product |
| southernmost_latitude | float | R | Southernmost latitude in degrees. |
| northernmost_latitude | float | R | Northernmost latitude in degrees. |
| westernmost_longitude | float | R | Westernmost longitude in degrees. |
| easternmost_longitude | float | R | Easternmost longitude in degrees. |
| production_frequency | String | R | Product frequency. eg. Daily, Workingdays, subdaily |
| institution | String | M | Name of production center. |
| institution_references | String | R | Reference to web page of production center |
| contact | String | M | e-mail address to production center |

**SIWTAC netCDF variable and attribute definitions**

This table describes the variables and attributes from products delivered from the SIWTAC. Examples values are taken from the ice concentration product and ice drift product produced at met.no.

| Variable name | Attribute name | Format | Description with some example values |
|---|---|---|---|
| time | | float | |
| | long_name | string | A descriptive name that indicates a variable"s content. This name is not standardized.<br>eg. “reference time of product file” |
| | standard_name | string | A standard name that references a description of a variable"s content in the standard name table.<br>eg. “time” |
| | units | string | Units of a variable"s content.<br>seconds since yyyy-mm-dd hh:MM:ss<br>eg. 1981-01-01 00:00:00 |
| | axis | string | Identifies latitude, longitude, vertical, or time axes. |

| | | | |
|---|---|---|---|
| | | | eg. “T” |
| | bounds | string | The value of bounds is the name of the variable that contains the vertices of the cell boundaries<br>eg. “time_bnds” |
| | comment | string | Miscellaneous information about the data or methods used to produce it. |
| yc | | float | |
| | axis | string | Y |
| | long_name | string | y-coordinate of projection |
| | units | string | eg. “m” or “km” |
| | standard_name | string | projection_y_coordinate |
| | grid_spacing | string | |
| xc | | float | |
| | axis | string | X |
| | long_name | string | x-coordinate of projection |
| | units | string | eg. “m” or “km” |
| | standard_name | string | projection_x_coordinate |
| | grid_spacing | string | |
| lat | | float | |
| | long_name | string | Latitude coordinate |
| | standard_name | string | latitude |
| | units | string | degrees_north |
| lon | | float | |
| | long_name | string | Longitude coordinate |
| | standard_name | string | longitude |
| | units | string | degrees_east |
| crs | | string | |
| | grid_mapping_name | string | polar_stereographic |
| | straight_vertical_longitude_from_pole | float | 0 |
| | latitude_of_projection_origin | float | 90 |
| | standard_parallel | float | 90 |
| | false_easting | float | 0 |
| | false_northing | float | 0 |
| | semi_major_axis | float | |
| | semi_minor_axis | float | |
| | proj4_string | string | proj=stere lon_0=0.0 lat_ts=90.0 lat _0=90.0 a=6371000.0 b=6371000.0 |
| ice_concentration | | short | |
| | long_name | string | sea ice concentration |
| | standard_name | string | sea_ice_area_fraction |

| | | | |
|---|---|---|---|
| | units | string | % |
| | coordinates | string | lon lat |
| | grid_mapping | string | crs |
| | _FillValue | short | A value used to represent missing or undefined data. |
| | scale_factor | float | 1 |
| | add_offset | float | 0 |

## Appendix

This appendix shows output from ncdump of an ice drift file and a ice concentration file on netCDF format

Ice drift:

```
netcdf ice_drift_nh_polstere-625_amsr-aqua_200911301200-200912021200 {
dimensions:
        time = 1 ;
        nv = 2 ;
        xc = 19 ;
        yc = 177 ;
variables:
        int Polar_Stereographic_Grid ;
                Polar_Stereographic_Grid:grid_mapping_name = "polar_stereographic" ;
                Polar_Stereographic_Grid:straight_vertical_longitude_from_pole = -45.f ;
                Polar_Stereographic_Grid:latitude_of_projection_origin = 90.f ;
                Polar_Stereographic_Grid:standard_parallel = 70.f ;
                Polar_Stereographic_Grid:false_easting = 0.f ;
                Polar_Stereographic_Grid:false_northing = 0.f ;
                Polar_Stereographic_Grid:semi_major_axis = 6378273.f ;
                Polar_Stereographic_Grid:semi_minor_axis = 6356890.f ;
                Polar_Stereographic_Grid:proj4_string = "+proj=stere +a=6378273 +b=6356889.44891
+lat_0=90 +lat_ts=70 +lon_0=-45" ;
        double time(time) ;
                time:long_name = "reference time of product" ;
                time:standard_name = "time" ;
                time:units = "seconds since 1978-01-01 00:00:00" ;
                time:axis = "T" ;
                time:bounds = "time_bnds" ;
                time:comment = "As of version 1.3 of the product, the \'time\' scalar dataset contains the _end_
date of motion (was begin date in previous versions)." ;
        double time_bnds(time, nv) ;
                time_bnds:units = "seconds since 1978-01-01 00:00:00" ;
        double xc(xc) ;
                xc:axis = "X" ;
                xc:units = "km" ;
                xc:long_name = "x coordinate of projection (eastings)" ;
                xc:standard_name = "projection_x_coordinate" ;
                xc:grid_spacing = "62.50 km" ;
        double yc(yc) ;
                yc:axis = "Y" ;
                yc:units = "km" ;
                yc:long_name = "y coordinate of projection (northings)" ;
                yc:standard_name = "projection_y_coordinate" ;
                yc:grid_spacing = "62.50 km" ;
        float lat(yc, xc) ;
                lat:long_name = "latitude coordinate" ;
                lat:standard_name = "latitude" ;
                lat:units = "degrees_north" ;
        float lon(yc, xc) ;
                lon:long_name = "longitude coordinate" ;
                lon:standard_name = "longitude" ;
                lon:units = "degrees_east" ;
        int dt0(time, yc, xc) ;
                dt0:long_name = "delta time for start of displacement" ;
                dt0:standard_name = "start_time_displacement" ;
                dt0:units = "seconds" ;
                dt0:_FillValue = -2147483648 ;
                dt0:valid_min = -43200 ;
                dt0:valid_max = 43200 ;
                dt0:grid_mapping = "Polar_Stereographic_Grid" ;
```

```
                dt0:coordinates = "lat lon" ;
        float lon1(time, yc, xc) ;
                lon1:long_name = "longitude at end of displacement" ;
                lon1:standard_name = "end_longitude_displacement" ;
                lon1:units = "degrees_east" ;
                lon1:_FillValue = -1.e+10f ;
                lon1:grid_mapping = "Polar_Stereographic_Grid" ;
                lon1:coordinates = "lat lon" ;
        float lat1(time, yc, xc) ;
                lat1:long_name = "latitude at end of displacement" ;
                lat1:standard_name = "end_latitude_displacement" ;
                lat1:units = "degrees_north" ;
                lat1:_FillValue = -1.e+10f ;
                lat1:grid_mapping = "Polar_Stereographic_Grid" ;
                lat1:coordinates = "lat lon" ;
        int dt1(time, yc, xc) ;
                dt1:long_name = "delta time for end of displacement" ;
                dt1:standard_name = "end_time_displacement" ;
                dt1:units = "seconds" ;
                dt1:_FillValue = -2147483648 ;
                dt1:valid_min = -43200 ;
                dt1:valid_max = 43200 ;
                dt1:grid_mapping = "Polar_Stereographic_Grid" ;
                dt1:coordinates = "lat lon" ;
        float dX(time, yc, xc) ;
                dX:long_name = "component of the displacement along the x axis of the grid" ;
                dX:standard_name = "sea_ice_x_displacement" ;
                dX:units = "km" ;
                dX:_FillValue = -1.e+10f ;
                dX:grid_mapping = "Polar_Stereographic_Grid" ;
                dX:coordinates = "lat lon" ;
        float dY(time, yc, xc) ;
                dY:long_name = "component of the displacement along the y axis of the grid" ;
                dY:standard_name = "sea_ice_y_displacement" ;
                dY:units = "km" ;
                dY:_FillValue = -1.e+10f ;
                dY:grid_mapping = "Polar_Stereographic_Grid" ;
                dY:coordinates = "lat lon" ;
        short status_flag(time, yc, xc) ;
                status_flag:long_name = "rejection and quality level flag" ;
                status_flag:standard_name = "ice_drift_x_displacement status_flag" ;
                status_flag:_FillValue = -1s ;
                status_flag:grid_mapping = "Polar_Stereographic_Grid" ;
                status_flag:coordinates = "lat lon" ;
                status_flag:valid_range = 0s, 30s ;
                status_flag:flag_values = 0s, 1s, 2s, 3s, 4s, 10s, 11s, 12s, 13s, 20s, 21s, 22s, 30s ;
                status_flag:flag_meanings = "missing_input_data over_land no_ice close_to_coast_or_edge
summer_period processing_failed too_low_correlation not_enough_neighbours filtered_by_neighbours
smaller_pattern corrected_by_neighbours interpolated nominal_quality" ;


// global attributes:
                :title = "OSI SAF Low Resolution Sea Ice Displacement" ;
                :product_id = "OSI-405" ;
                :product_name = "osi_saf_lr_ice_drift" ;
                :product_status = "preoperational" ;
                :abstract = "Gridded ice displacement fields obtained from  satellite  image\n",
                        "processing. It is a low resolution product (62.5km resolution).\n",
                        "The time span of  the  ice  displacement  is  approximately  48\n",
                        "hours. This dataset is intended both for  process  studies  and\n",
                        "data assimilation. Daily products  are  freely  available  from\n",
                        "the  OSI SAF distribution chain." ;
                :topiccategory = "Oceans ClimatologyMeteorologyAtmosphere" ;
                :keywords = "Sea Ice Motion,Sea Ice,Oceanography,Meteorology,Climate,Remote Sensing" ;
                :gcmd_keywords = "Cryosphere > Sea Ice > Sea Ice Motion\n",
                        "Ocean > Sea Ice > Sea Ice Motion\n",
                        "Geographic Region > Northern Hemipshere\n",
```

"Vertical Location > Sea Surface\n",
"EUMETSAT/OSISAF > Satellite Application Facility on Ocean and Sea Ice, European Organisation for the Exploitation of Meteorological Satellites" ;
:northernmost_latitude = 90.f ;
:southernmost_latitude = 32.20287f ;
:easternmost_longitude = 180.f ;
:westernmost_longitude = -180.f ;
:activity_type = "Space borne instrument" ;
:area = "Northern Hemisphere" ;
:start_date = "2009-11-30 12:00:00" ;
:stop_date = "2009-12-02 12:00:00" ;
:project_name = "EUMETSAT OSI SAF" ;
:institution = "EUMETSAT OSI SAF" ;
:PI_name = "Thomas Lavergne" ;
:contact = "osisaf-manager@met.no" ;
:distribution_statement = "Free" ;
:references = "OSI SAF Low Resolution Sea Ice Drift Product Manual, Lavergne, T., Eastwood S., v1.3, November 2009, Validation and Monitoring of the OSI SAF Low Resolution Sea Ice Drift Product, Lavergne, T., v1.0, February 2009, http://saf.met.no, http://www.osi-saf.org" ;
:history = "2009-12-03 creation" ;
:product_version = "1.3" ;
:software_version = "4.0" ;
:netcdf_version = "3.6.3" ;
:Conventions = "CF-1.4" ;
}

## Ice concentration:

```
netcdf ice_conc_svalbard_200906171500 {
dimensions:
   time = 1 ;
   xc = 3812 ;
   yc = 2980 ;
variables:
   int time(time) ;
      time:long_name = "reference time of sea ice file" ;
      time:units = "seconds since 1981-01-01 00:00:00" ;
   float yc(yc) ;
      yc:axis = "Y" ;
      yc:long_name = "y-coordinate in Cartesian system" ;
      yc:units = "m" ;
   float xc(xc) ;
      xc:axis = "X" ;
      xc:long_name = "x-coordinate in Cartesian system" ;
      xc:units = "m" ;
   float lat(yc, xc) ;
      lat:long_name = "latitude" ;
      lat:units = "degrees_north" ;
   float lon(yc, xc) ;
      lon:long_name = "longitude" ;
      lon:units = "degrees_east" ;
   char crs ;
      crs:grid_mapping_name = "polar_stereographic" ;
      crs:straight_vertical_longitude_from_pole = 0.f ;
      crs:latitude_of_projection_origin = 90.f ;
      crs:standard_parallel = 90.f ;
      crs:false_easting = 0.f ;
      crs:false_northing = 0.f ;
      crs:proj4_string = "proj=stere lon_0=0.0 lat_ts=90.0 lat_0=90.0 a=6371000.0 b=6371000.0" ;
   short ice_concentration(time, yc, xc) ;
      ice_concentration:long_name = "sea ice concentration" ;
      ice_concentration:standard_name = "sea_ice_area_fraction" ;
      ice_concentration:units = "%" ;
      ice_concentration:coordinates = "lon lat" ;
      ice_concentration:grid_mapping = "crs" ;
      ice_concentration:source = "met.no" ;
```

```
        ice_concentration:_FillValue = -99s ;
        ice_concentration:scale_factor = 1.f ;
        ice_concentration:add_offset = 0.f ;
    short concentration_range(time, yc, xc) ;
        concentration_range:long_name = "concentration range" ;
        concentration_range:units = "%" ;
        concentration_range:coordinates = "lon lat" ;
        concentration_range:grid_mapping = "crs" ;
        concentration_range:_FillValue = -99s ;
        concentration_range:comments = "Range of the analyized ice consentration value" ;

// global attributes:
        :title = "Total Sea Ice Concentration from national ice services." ;
        :Conventions = "CF-1.4" ;
        :netcdf_version_id = "3.6.3" ;
        :creation_date = "2009-06-17T14:01:10Z" ;
        :produced_date = "2009-06-17T14:00:00Z" ;
        :valid_date = "2009-06-17T14:00:00Z" ;
        :product_version = "1.0" ;
        :software_version = "1.0" ;
        :comment = "The ice concentration is based on a manual interpretation of different satellite data. For more
information about the the product contact the national ice service" ;
        :satellite = "Radarsat" ;
        :sensor = "ASAR" ;
        :spatial_resolution_latitude = 1000.f ;
        :spatial_resolution_longitude = 1000.f ;
        :southernmost_latitude = 54.36565f ;
        :northernmost_latitude = 88.10237f ;
        :westernmost_longitude = -80.36474f ;
        :easternmost_longitude = 85.30225f ;
        :field_type = "daily" ;
        :institution = "met.no" ;
        :institution_references = "http://www.retro.met.no" ;
        :contact = "iceservice@met.no" ;
        :operational_status = "operational" ;
data:
 .......
```