

# Georeferencing information in SAFNWC/MSG raster products

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# Why this topic ?

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- The use of geographic information systems (GIS) to hold, associate and analyse data from various disciplines is increasing. This is also true for nowcasting applications where higher spatial resolution is required.
- But today users can't find any portable georeferencing information inside or beside SAFNWC/MSG product raster files. It makes products difficult to handle outside dedicated proprietary visualisation systems.
- We suggest that SAFNWC consortium consider an update of the HDF5 model used in the current SAFNWC/MSG to fill this lack, in a way that will increase the usability of SAFNWC/MSG products in agreement with interoperability standards.
- As an example I present how I handle today georeferencing information when I need quick conversion of MSG products to other geo-referenced data

# Georeferencing a raster file ?

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- Attribute spatial coordinates to pixels, i.e. establish a relationship between the pixels in the raster image and their location in the world.
- $(X_{\text{raster}}, Y_{\text{raster}}) \longleftrightarrow (X_{\text{geo}}, Y_{\text{geo}}) \longleftrightarrow (\text{Lat}, \text{Lon})$
- Requires a precise description of the shape of the earth and origin, orientation, units of the reference coordinate system used to map the earth (projection)
- Requires a precise description of the coordinates; size, origin, orientation, gridding convention (Pixel-is-Area or Pixel-is-Point)

# Open Source Georeferencing tools

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Two well known libraries of the Open Source community are mature and widely used

PROJ.4 (Cartographic Projections library)

GDAL/OGR (translator library for raster geospatial data formats released under [Open Source](#) license by the [Open Source Geospatial Foundation](#)).

# MSG 1.5 data projection definition with proj.4

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- The PROJ.4 Cartographic Projections library <http://trac.osgeo.org/proj/> allows the definition of the geostationary satellite view projection ( alias GEOS)
- For MSG with unit in metre, it is exactly defined by the following string:

`"+proj=geos +a=6378169.0 +b=6356583.8 +lon_0=0.0 +h=35785831.0"`

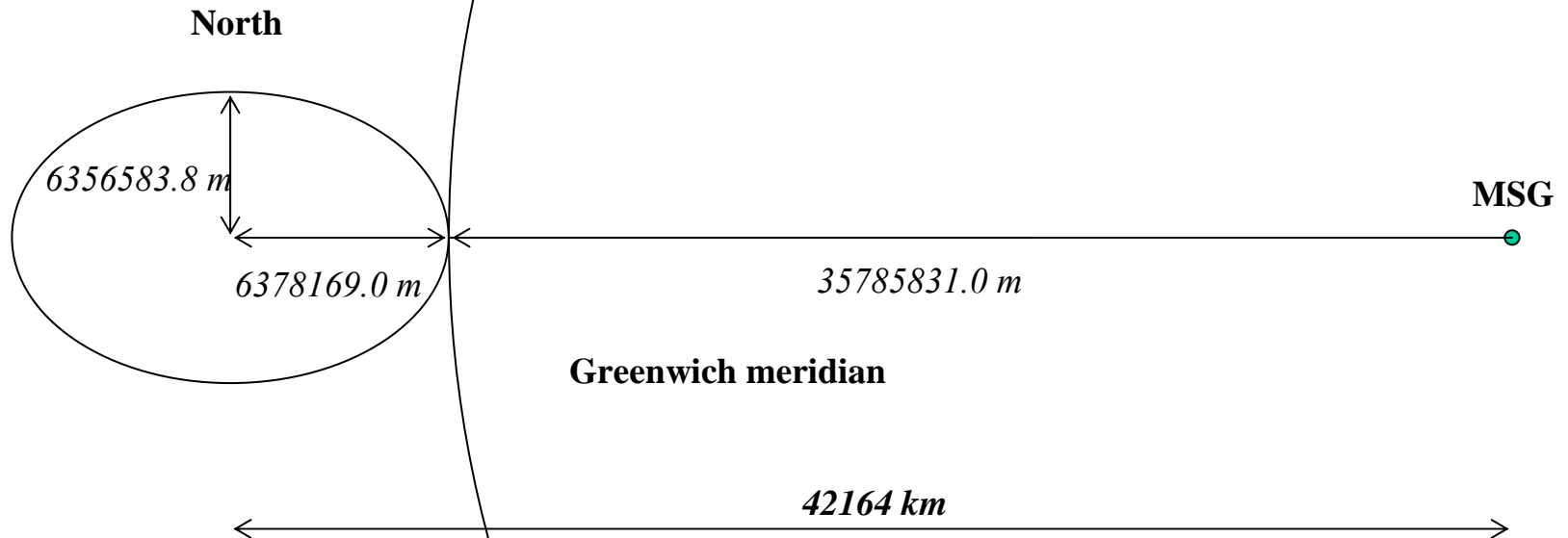
(derived from CGMS LRIT/HRIT Global specification

[http://www.eumetsat.int/groups/cps/documents/document/pdf\\_cgms\\_03.pdf](http://www.eumetsat.int/groups/cps/documents/document/pdf_cgms_03.pdf))

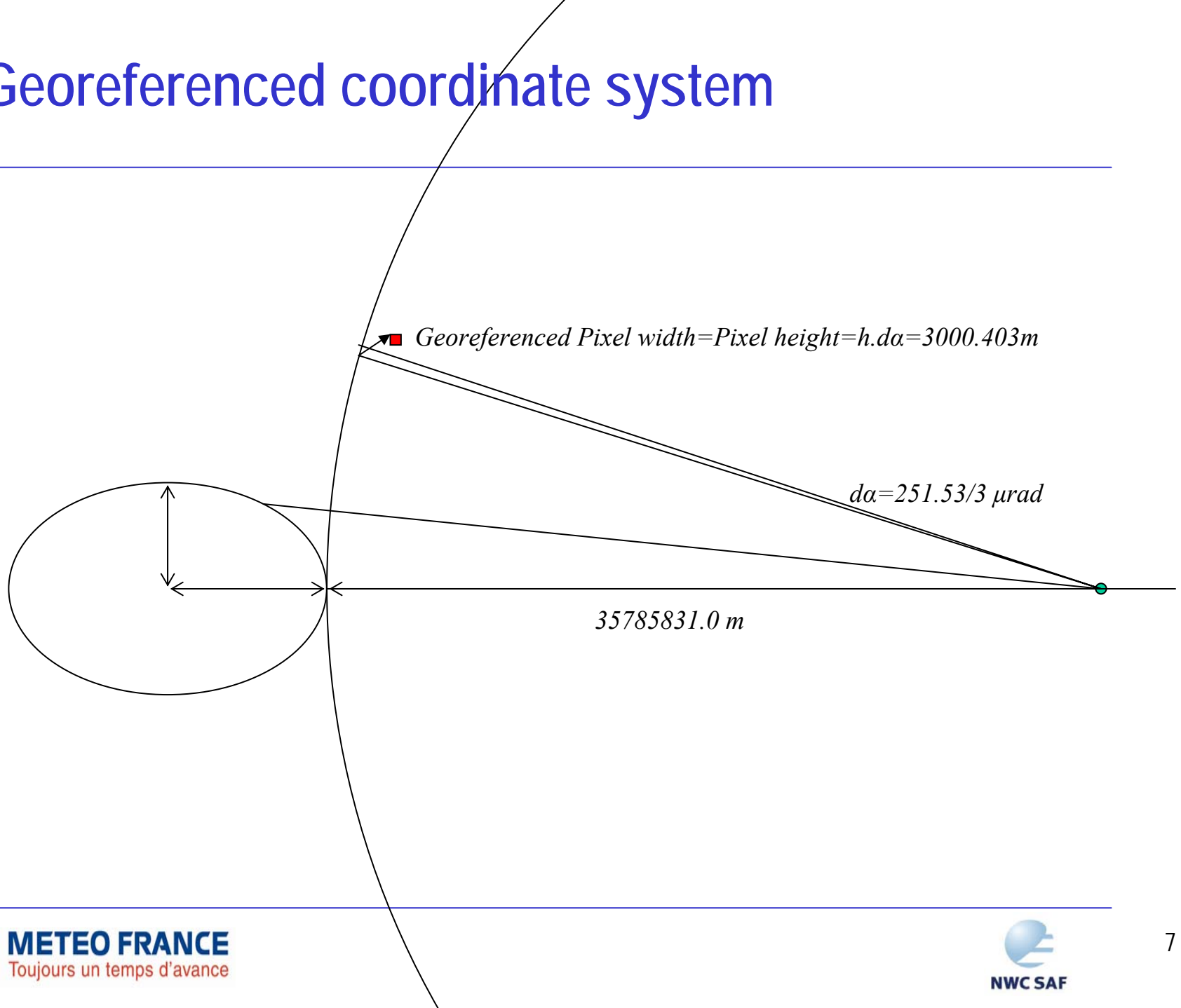
The presence of such information in the HDF model would fully define the reference system used by MSG raster images.

# MSG 1.5 data projection definition with proj.4

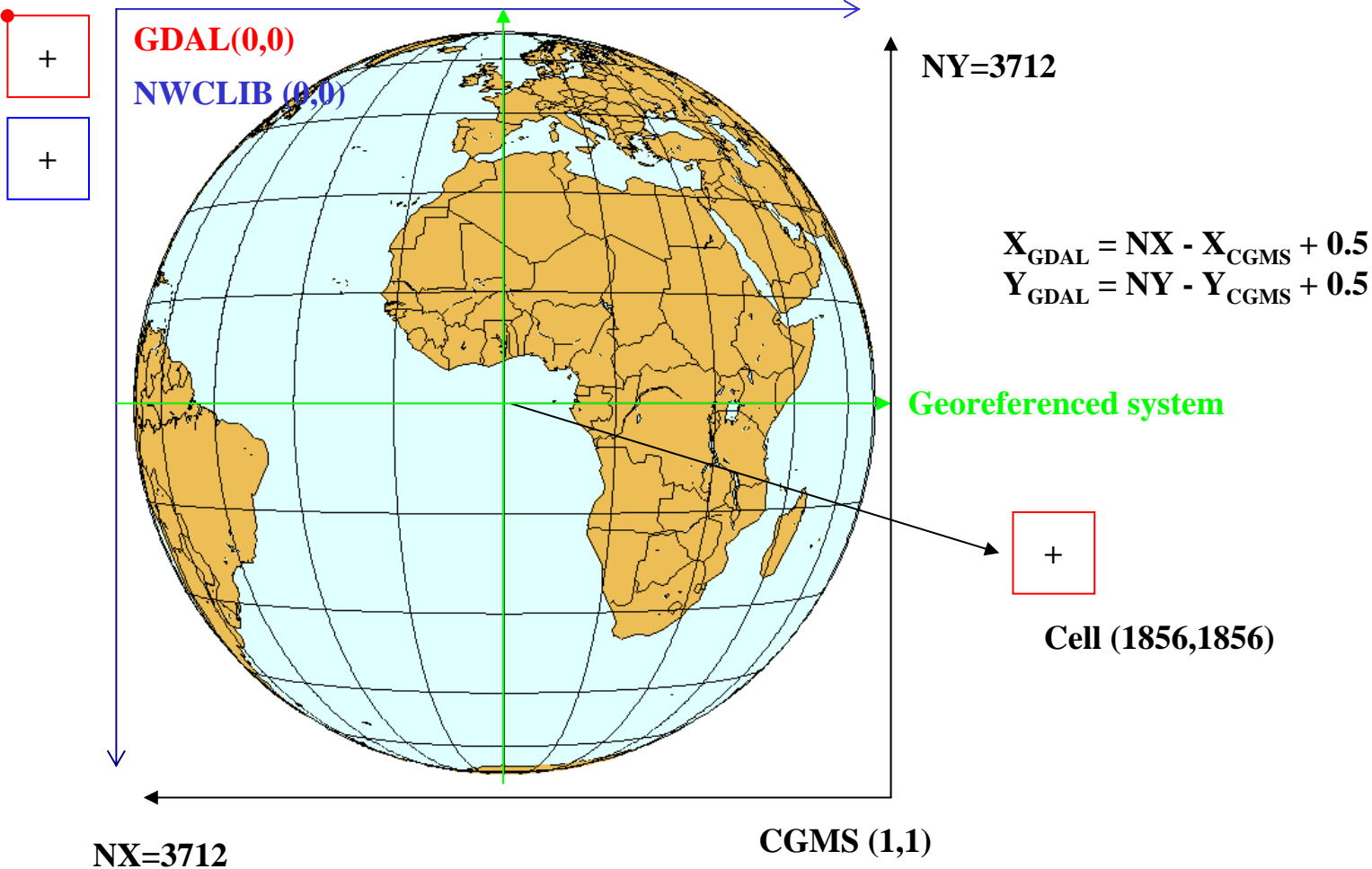
`+proj=geos +a=6378169.0 +b=6356583.8 +lon_0=0.0 +h=35785831.0`



# Georeferenced coordinate system



# Coordinate systems





# Georeferenced coordinate system

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- Raster coordinates  $x_{\text{pixel}}, y_{\text{line}}$ 
  - CGMS convention, GDAL convention, NWCLIB convention
- Conversion from raster coordinates to georeferenced coordinates (m)
  - GeoTransform arrays
    - $X_{\text{geo}} = \text{GT}(0) + X_{\text{pixel}} * \text{GT}(1) + Y_{\text{line}} * \text{GT}(2)$
    - $Y_{\text{geo}} = \text{GT}(3) + X_{\text{pixel}} * \text{GT}(4) + Y_{\text{line}} * \text{GT}(5)$

The  $(\text{GT}(0), \text{GT}(3))$  is the top left corner position of the top left pixel of the raster

In case of north up images, the  $\text{GT}(2)$  and  $\text{GT}(4)$  coefficients are zero

$\text{GT}(1)$  is pixel width, and  $\text{GT}(5)$  is pixel height (3000.403 m)

$\text{GT}(0) = -1856.5 * \text{GT}(1)$  and  $\text{GT}(3) = -1856.5 * \text{GT}(5)$

$\text{gt}[6] = \{ -5570248.832537, 3000.403357, 0, 5570248.832537, 0, -3000.403357 \}$

- GeoTransform array is GDAL representation of CFAC, LFAC, COFF, LOFF
- SAFNWC/MSG should provide a tool converting raster coordinates into georeferenced coordinates and vice versa (based on GT array)

# Numerical verification

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CGMS (x,y)	(45,1856)	(3667,1856)	(1856,51)	(1856,3661)
EUM(lat,lon)	(0.0000000000, 80.5488277779)	(0.0000000000, -80.5488277779)	(-80.6706777596, 0.0000000000 )	(80.6706777596, 0.0000000000)
SAFNWC(dx,dy)	(0.0000530508, 0.0000000888)	(0.0000532284, 0.0000000888)	(0.0000000888, 0.0000555096)	(0.0000000888, 0.0000334482)
GDAL(dx,dy)	(0.0000755498, 0.0000000888)	(0.0000757274, 0.0000000888)	(0.0000000888, 0.0000555096)	(0.0000000888, 0.0000556872)

**dx and dy are differences in pixel fraction when converting lat,lon to x,y**

**EUM is obtained using MSG\_navigation.c from EUMESAT site**

**SAFNWC is obtained using NWCLIB**

**GDAL is obtained using the previously defined string and array.**

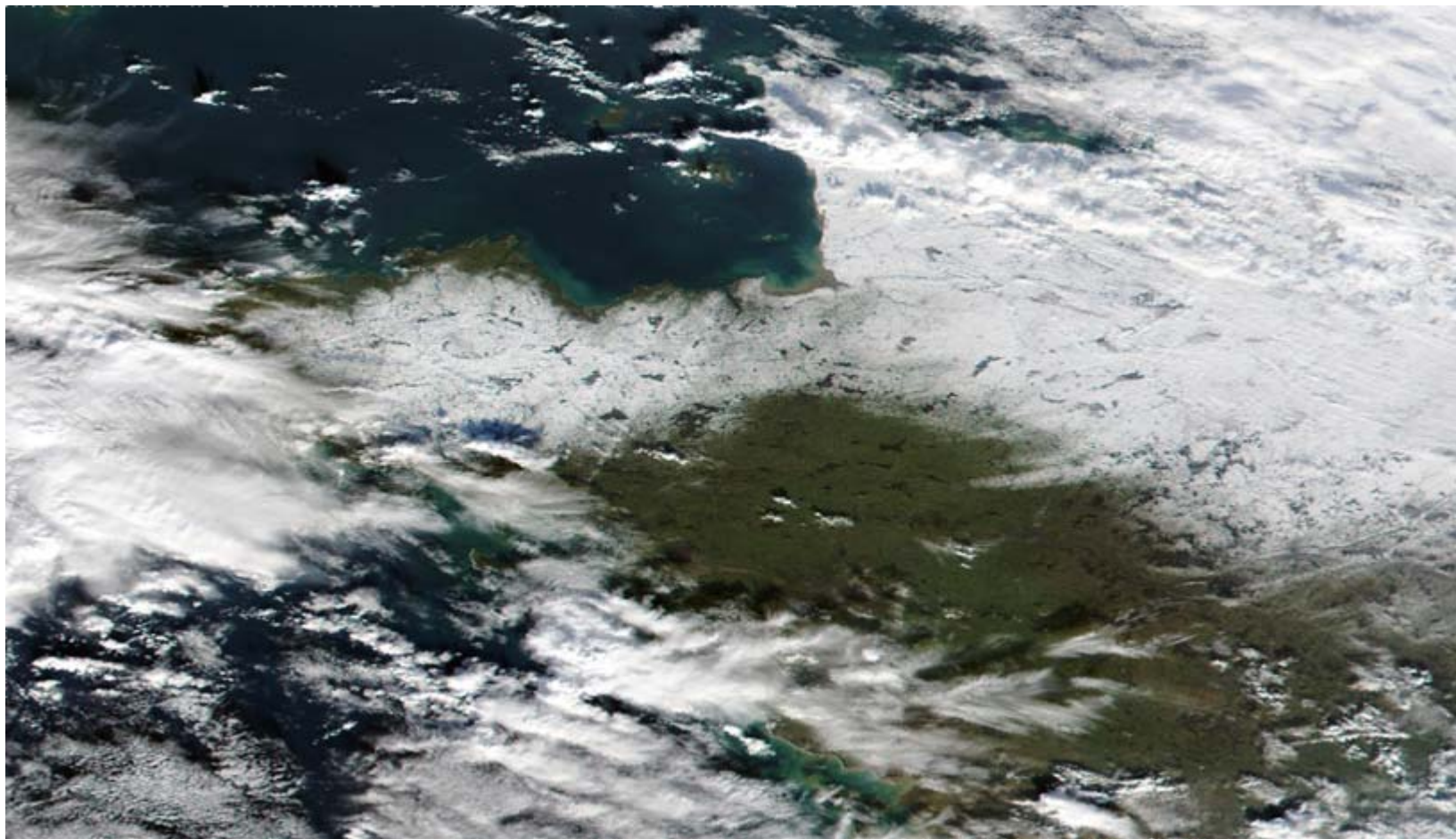
# Example for remapping raster product using GDAL utilities

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# convert CT product into gif file (hdf5 tools) using internal color palette
h52gif SAFNWC_MSG2_CT___201001131100_globe_____.h5 ct.gif -i "CT" -p "01-PALETTE"
# convert CT gif file into geotiff file (gdal utilities)
echo "+proj=geos +lon_0=0.0 +a=6378169.0 +b=6356583.8 +h=35785831" src_def.txt
#georeferenced coordinates of upper left and lower right SEVIRI globe
# obtained by GeoTransform arrays of upper left and lower right ( $X_{\text{raster}}, Y_{\text{raster}}$ )
ulx=-5568748.6308585005 ; uly=5568748.6308585005
lrx=5565748.2269684998; lry=-5565748.2269684998
gdal_translate -a_srs src_def.txt -a_ullr $ulx $uly $lrx $lry -ot Byte ct.gif ct_geo.gif
# remap CT to MODIS file projection implicitly using nearest neighbour (gdal utilities)
# MODIS file is geotiff format, its projection is described internally
cp modis_file.tif ct_tomodis.tif
gdalwarp -s_srs src_def.txt ct_geo.tif ct_tomodis.tif
.....
```

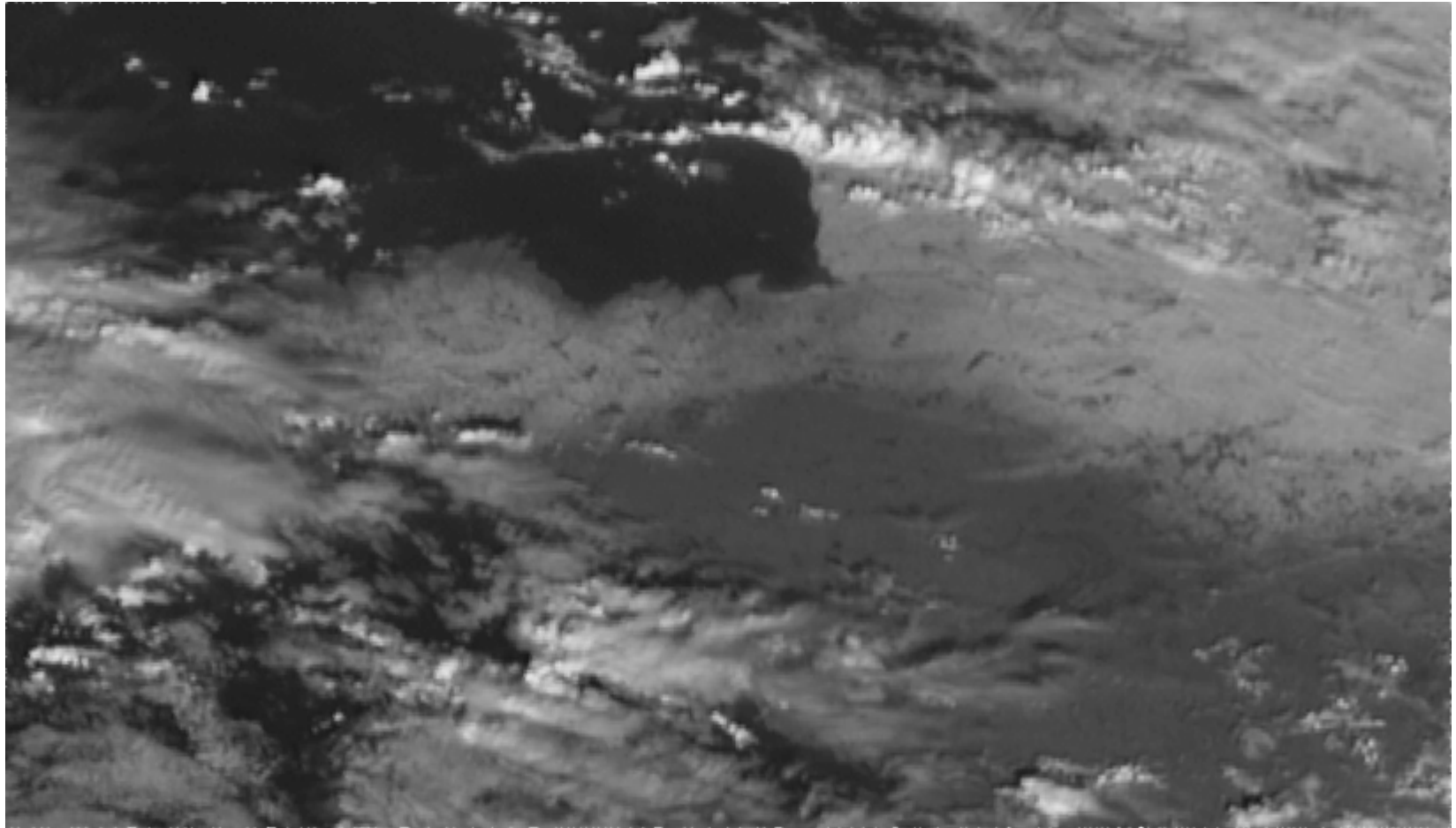
# Modis terra true color 13/01/2010 , 11h15 UTC

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# HRV 13/01/2010 11h00 UTC remapped to MODIS

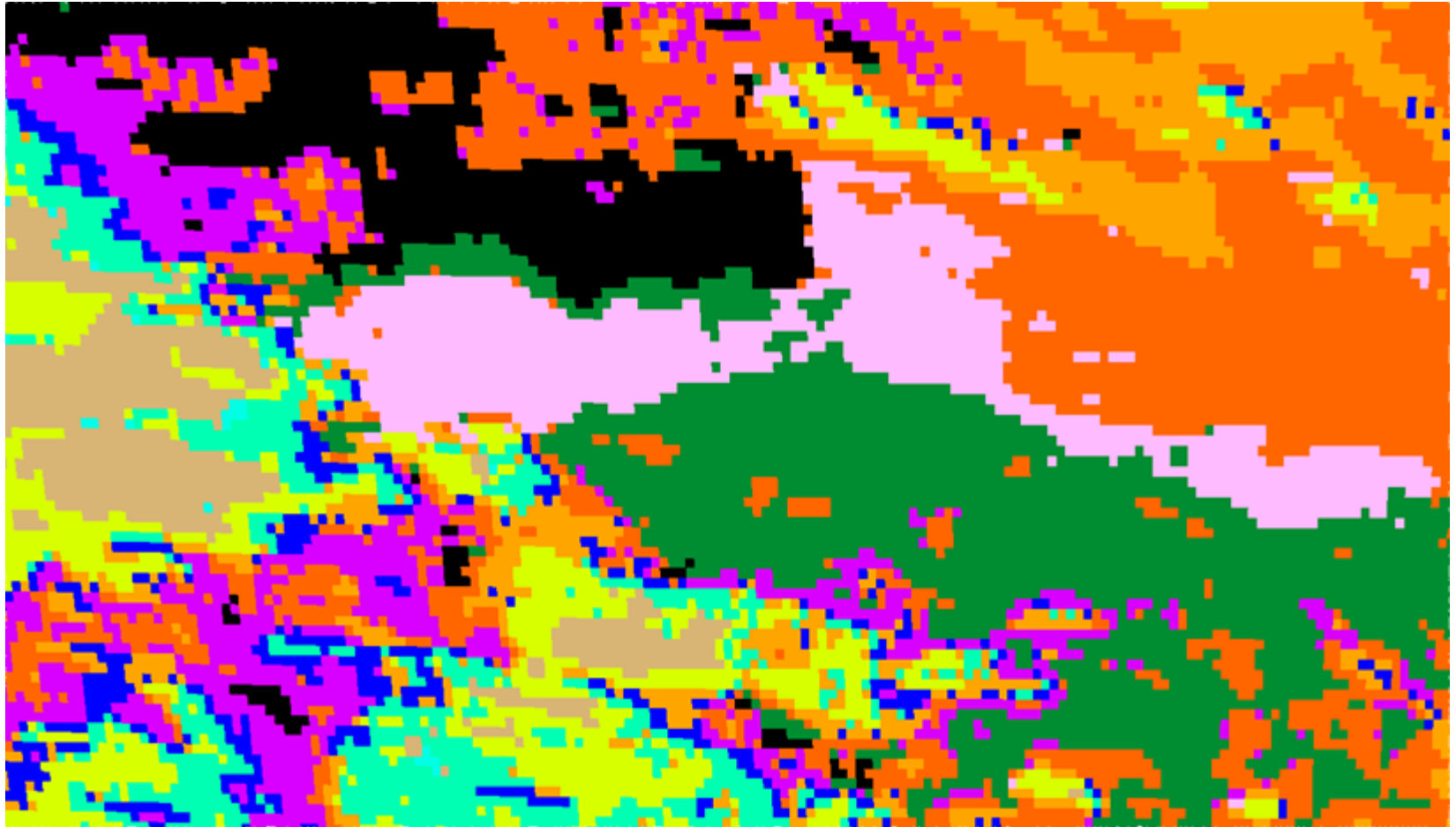
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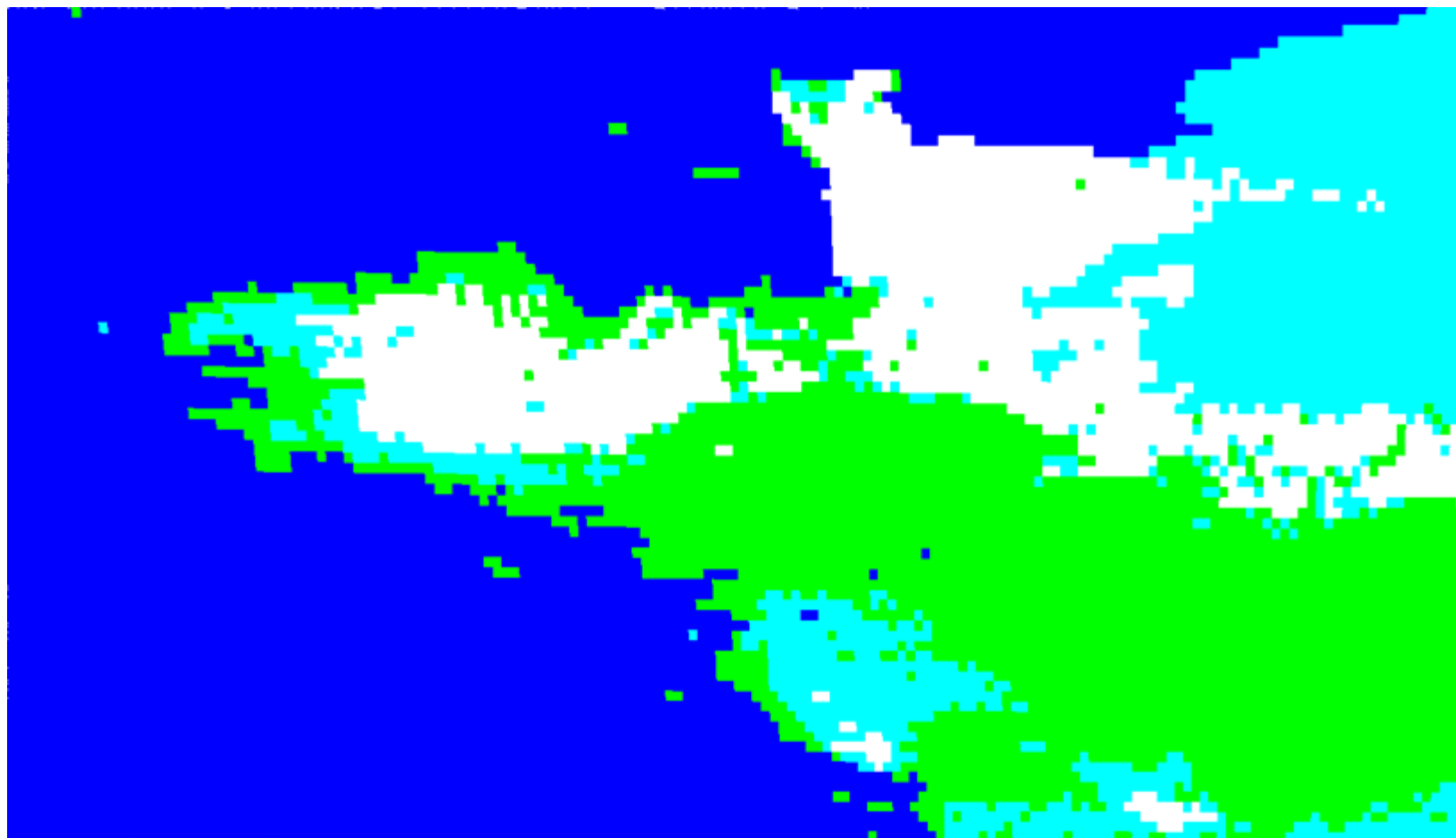
# CT remapped to MODIS projection

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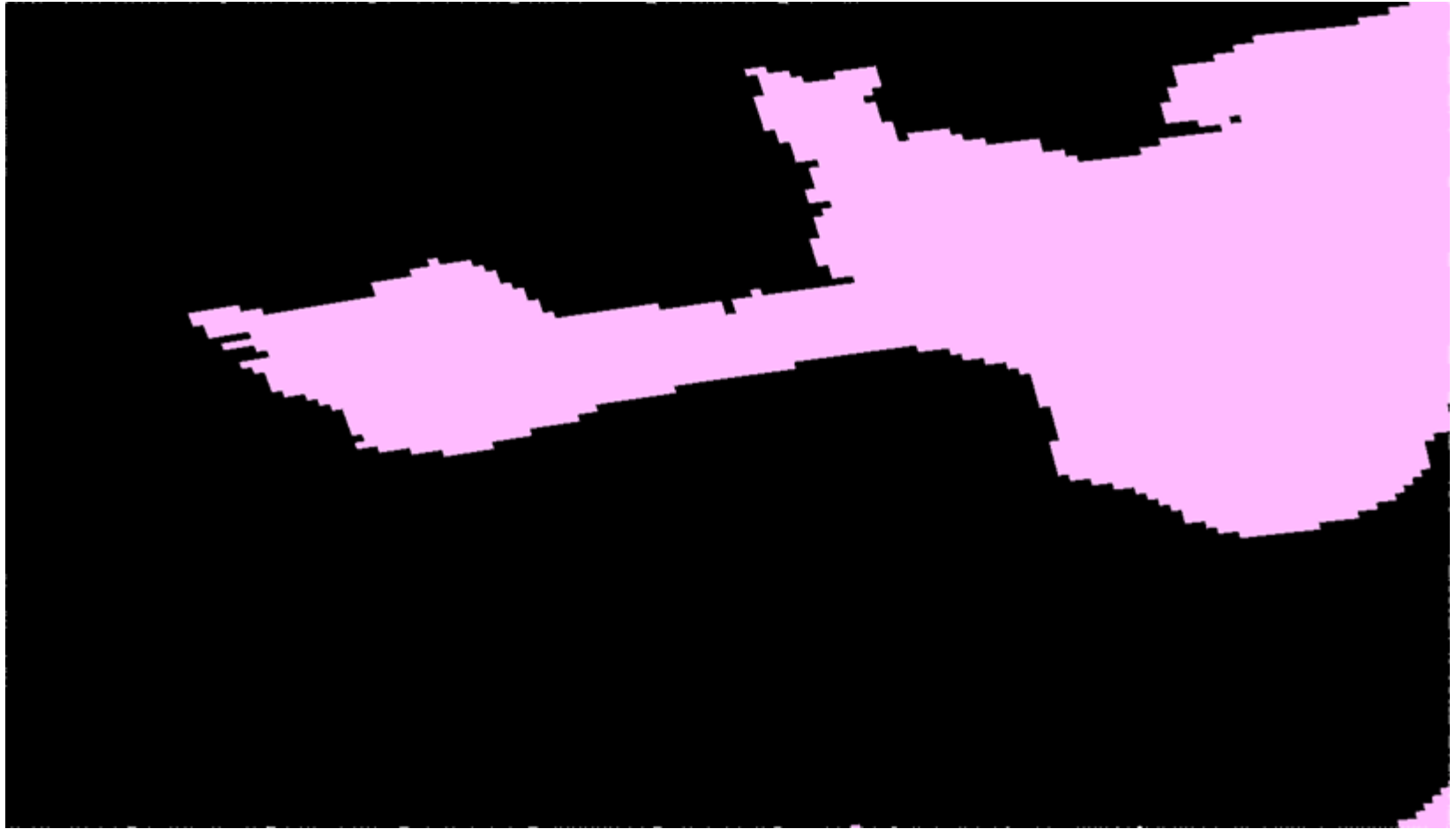
# H-SAF 13/01/2010 daily snow cover

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# Remapped daily snow mask from NOAA IMS product (geotiff, stereo-polar 4 km)

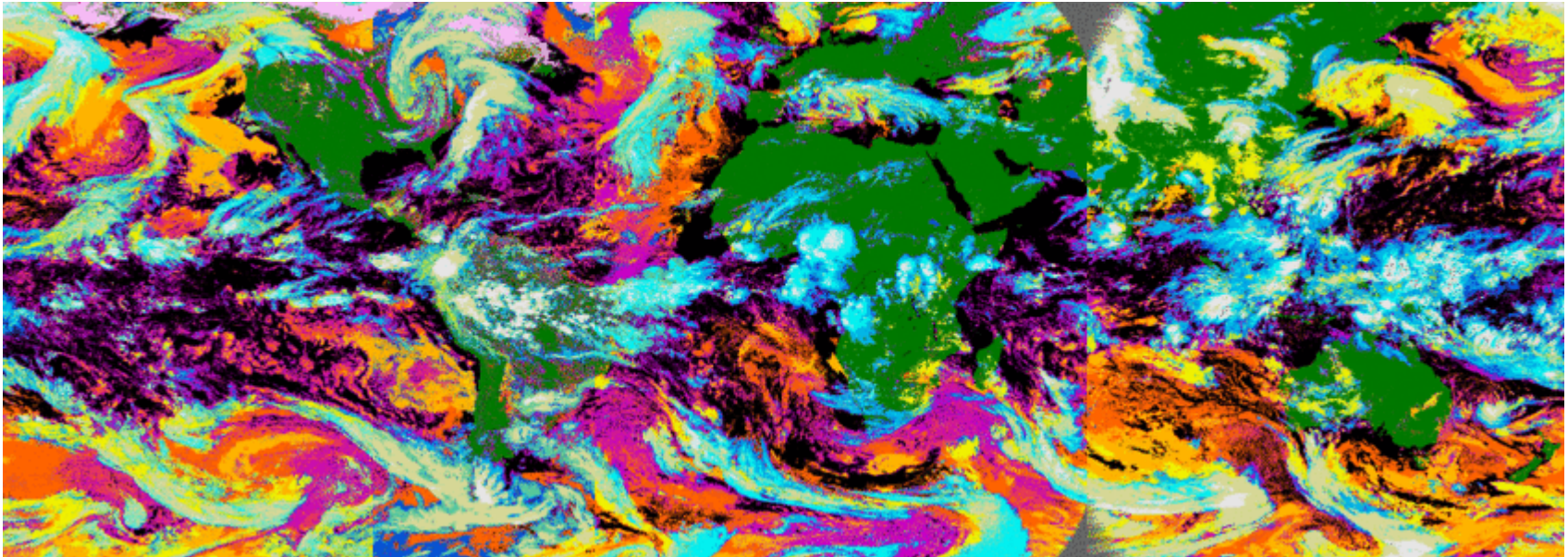
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# Or multi-satellite cloud products mapping (CT)

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GOES-W

GOES-E

MSG

MTSAT

**Satellite data processed at ICARE Thematic Centre by Bruno SIX, in collaboration with Geneviève SEZE for MEGHA-TROPIQUES project, using SAFNWC package scientifically adapted by METEO-FRANCE SAFNWC team**

# Conclusion

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- Lack of georeferencing information in SAFNWC/MSG raster products
- Proposal for an introduction of georeferencing information in SAFNWC/MSG hdf data model
- With tools to access the georeferencing data
- Open to interoperability standards
- Ideally in coordination with other SAFs