

MODIS-Processing at DLR/DFD

MODIS Workhop, Nov. 26-29, Leeuwin Centre

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MODIS on Terra/Aqua

Orbit:	705 km, 10:30 a.m. descending node or 1:30 p.m. ascending node, sun-synchronous, near-polar, circular
Scan Rate:	20.3 rpm, cross track
Swath Dimensions:	2330 km (across track) by 10 km (along track at nadir)
Telescope:	17.78 cm diam. off-axis, afocal (collimated), with intermediate field stop
Size:	1.0 x 1.6 x 1.0 m
Weight:	250 kg
Power:	225 W (orbital average)
Data Rate:	11 Mbps (peak daytime)
Quantization:	12 bits
Spatial Resolution:	250 m (bands 1-2)
(at nadir):	500 m (bands 3-7)
	1000 m (bands 8-36)
Design Life:	5 years



MODIS Technical Specifications (1)

Primary Use	Band	Bandwidth	Spectral Radiance	Required SNR
Land/Cloud Boundaries	1	620- 670	21.8	128
	2	841- 876	24.7	201
Land/Cloud Properties	3	459- 479	35.3	243
	4	545- 565	29.0	228
	5	1230- 1250	5.4	74
	6	1628- 1652	7.3	275
	7	2105- 2155	1.0	110
Ocean Color/ Phytoplankton/ Biogeochemistry	8	405- 420	44.9	880
	9	438- 448	41.9	838
	10	483- 493	32.1	802
	11	526- 536	27.9	754
	12	546- 556	21.0	750
	13	662- 672	9.5	910
	14	673- 683	8.7	1087
	15	743- 753	10.2	586
	16	862- 877	6.2	516
Atmospheric Water Vapor	17	890- 920	10.0	167
	18	931- 941	3.6	57
	19	915- 965	15.0	250

MODIS Technical Specifications (2)

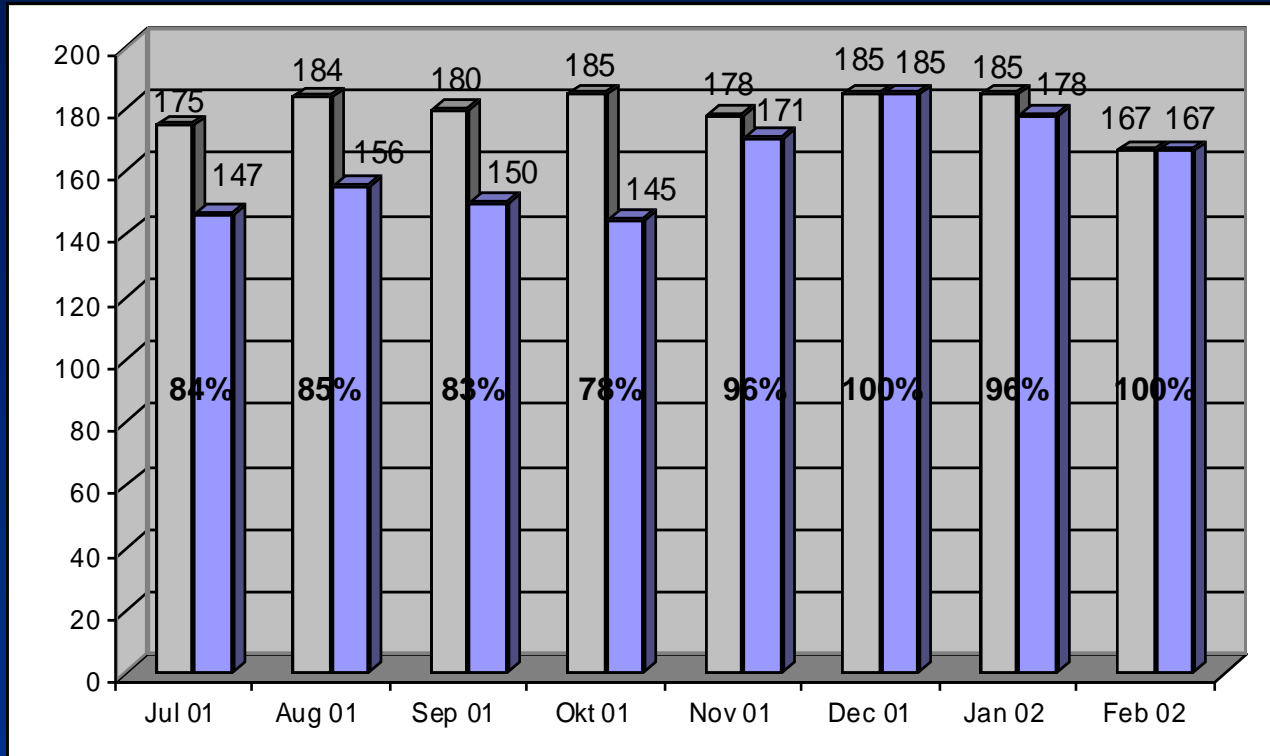
Primary Use	Band	Bandwidth	Spectral Radiance	Required NE Δ T(K)
Surface/Cloud Temperature	20	3.660- 3.840	0.45	0.05
	21	3.929- 3.989	2.38	2.00
	22	3.929- 3.989	0.67	0.07
	23	4.020- 4.080	0.79	0.07
Atmospheric Temperature	24	4.433- 4.498	0.17	0.25
	25	4.482- 4.549	0.59	0.25
Cirrus Clouds	26	1.360- 1.390	6.00	150
Water Vapor	27	6.535- 6.895	1.16	0.25
	28	7.175- 7.475	2.18	0.25
	29	8.400- 8.700	9.58	0.05
Ozone	30	9.580- 9.880	3.69	0.25
Surface/Cloud Temperature	31	10.780- 11.280	9.55	0.05
	32	11.770- 12.270	8.94	0.05
Cloud Top Altitude	33	13.185- 13.485	4.52	0.25
	34	13.485- 13.785	3.76	0.25
	35	13.785- 14.085	3.11	0.25
	36	14.085- 14.385	2.08	0.35

Status X-Band Receiving Station DFD OP



- December 2000
station delivery and set up
- January 2001
first acquisition of Terra (MODIS)
- February 2001
start of preoperational phase
- May 2001
start Level 1b processing
- October 2001
replacement of receiver
- November 2001
first acquisition of Oceansat-1 (OCM)
- November 2001
start of operational phase

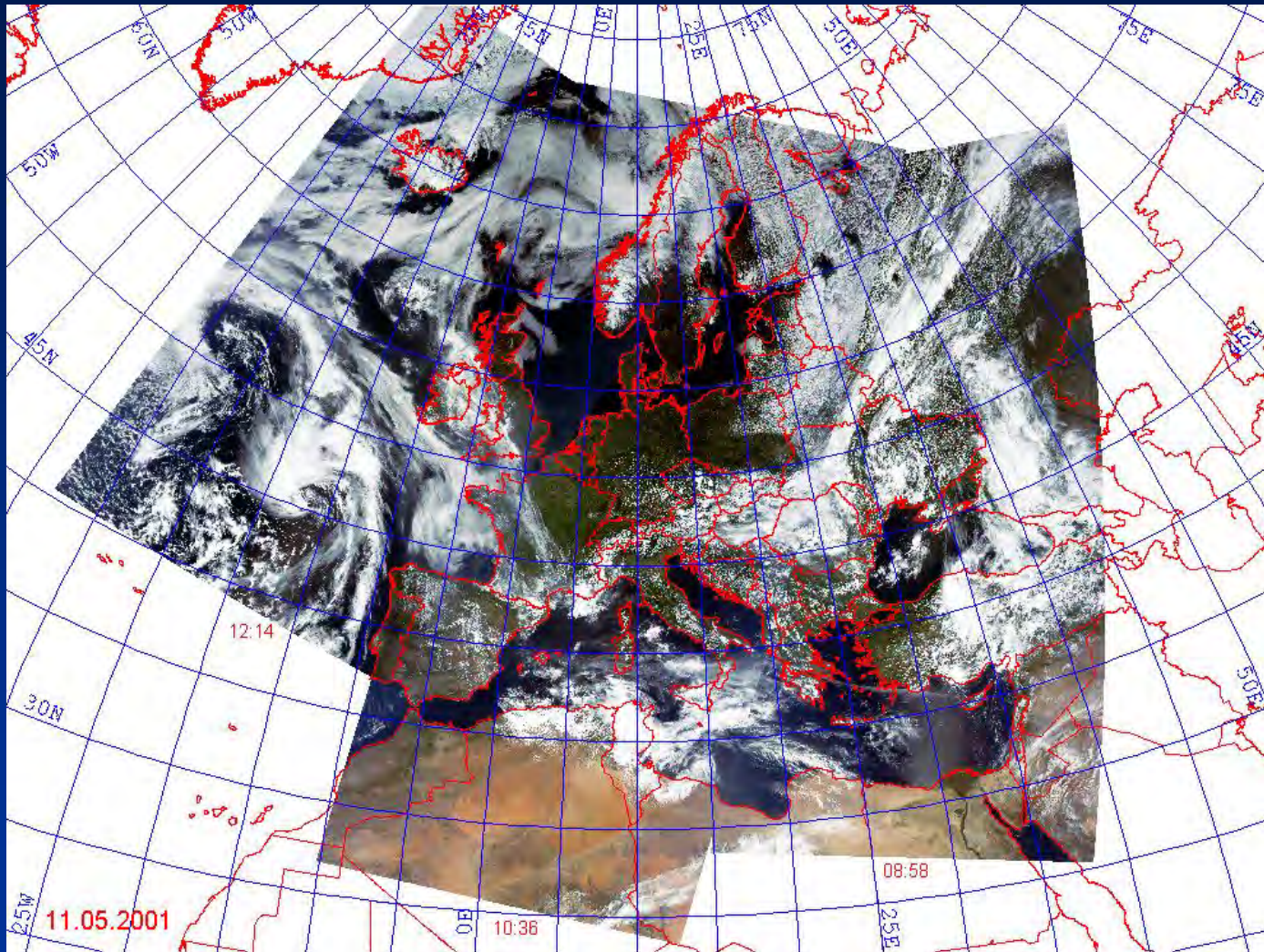
MODIS Station Efficiency (July 2001 - Feb. 2002)



in total: 1439 data sets in RAW format
(0,67 TByte ~ 480 Mbyte / dataset)

24.01.2001 - 31.06.2001 ~ 750 datasets recorded

Coverage of DFD Receiving Station



DFD Operating as ESA PAF for MODIS Data

- From the MODIS mission flying on Terra and later on Aqua satellites, the DFD as ESA D-PAF shall
 - ▶ receive, archive and process MODIS data
 - ▶ receive MODIS data from the ESA MODIS network (Kiruna, Matera and Maspalomas stations) and shall convert the data to the international archive format
 - ▶ keep the MODIS historical archive located at Oberpfaffenhofen
 - ▶ generate on request the Level 1b products on CD-ROM for delivery to users (2.5min data granules)

MODIS „Station Network“ (ESA and DFD National)



■ Oberpfaffenhofen

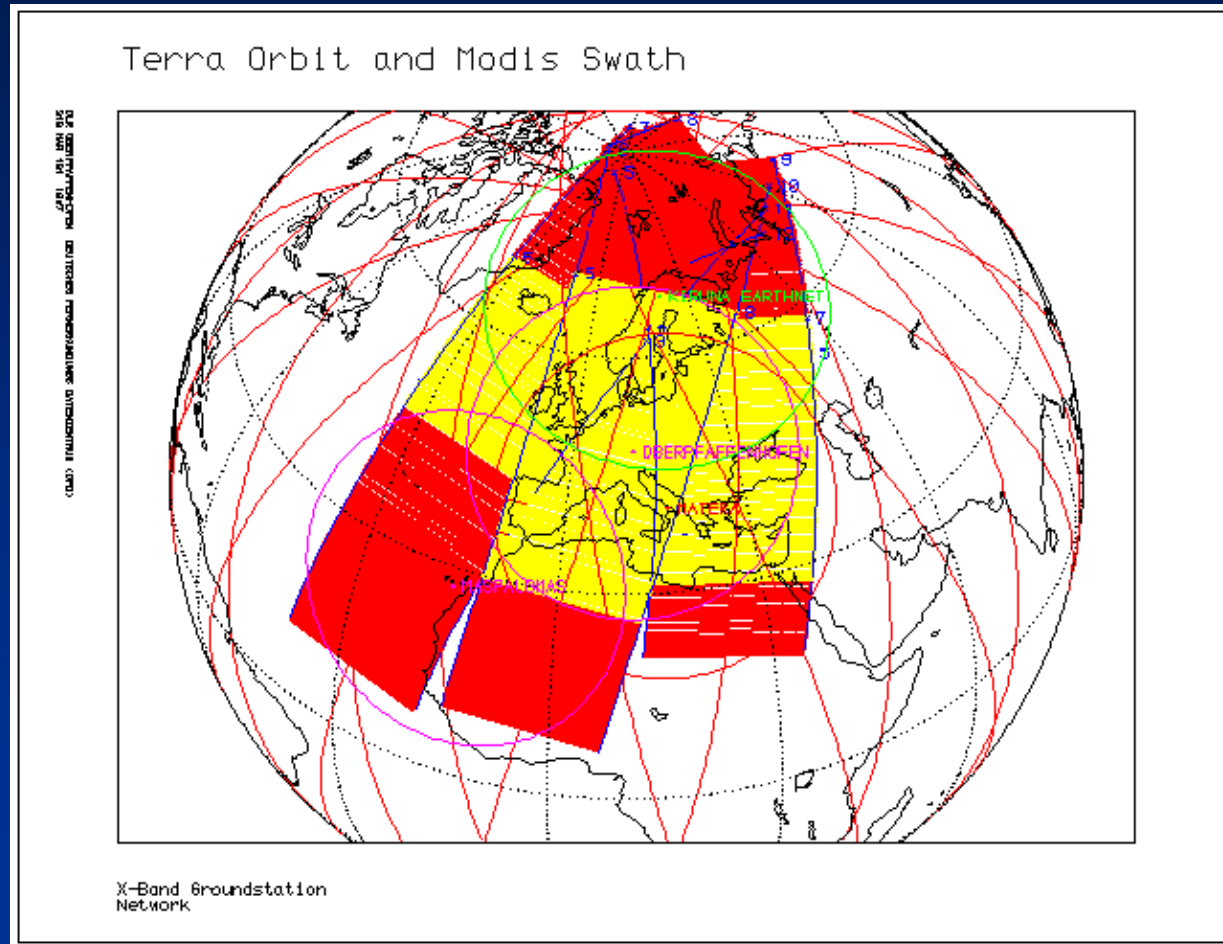
■ Kiruna

■ Matera

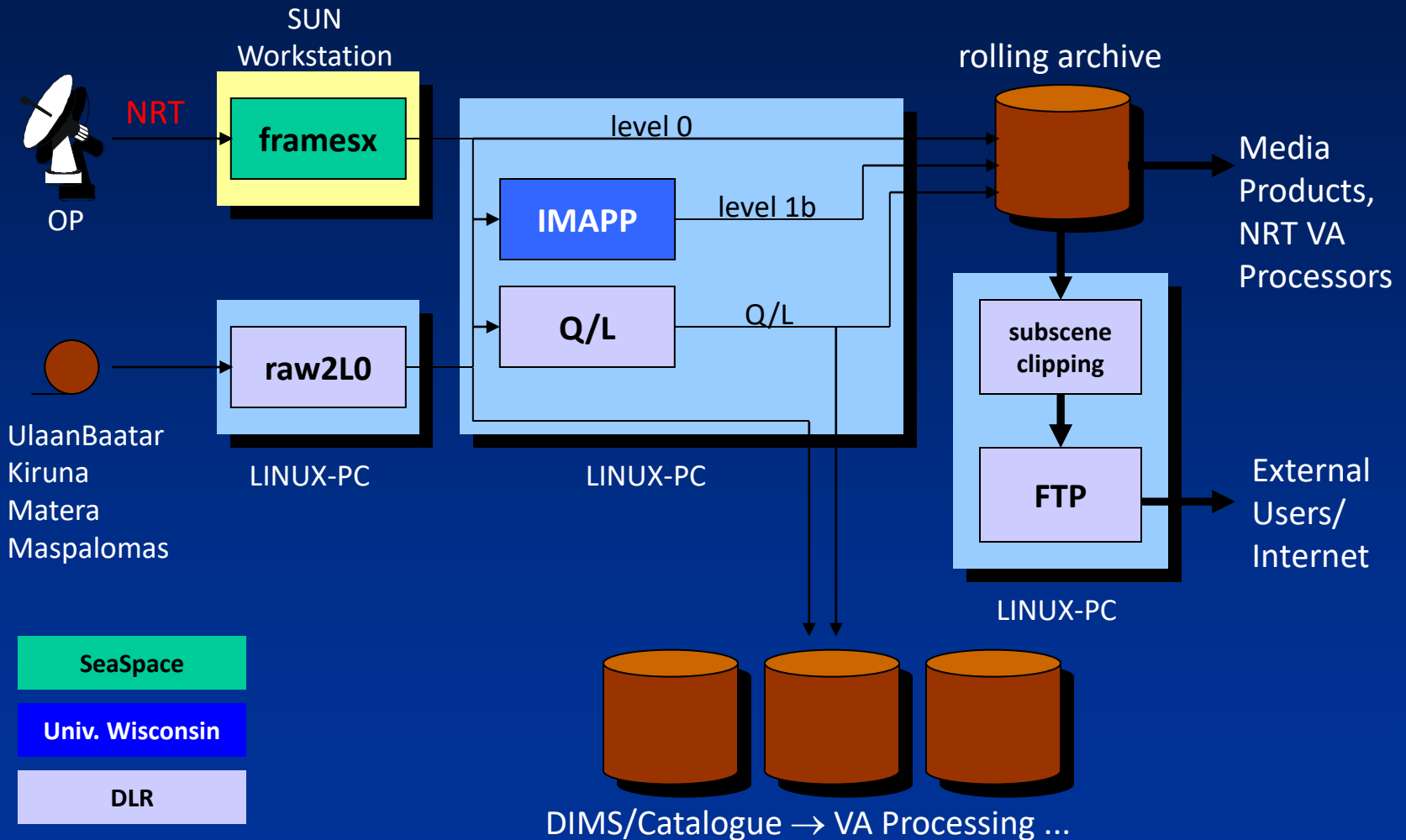
■ UlaanBaatar

■ Maspalomas

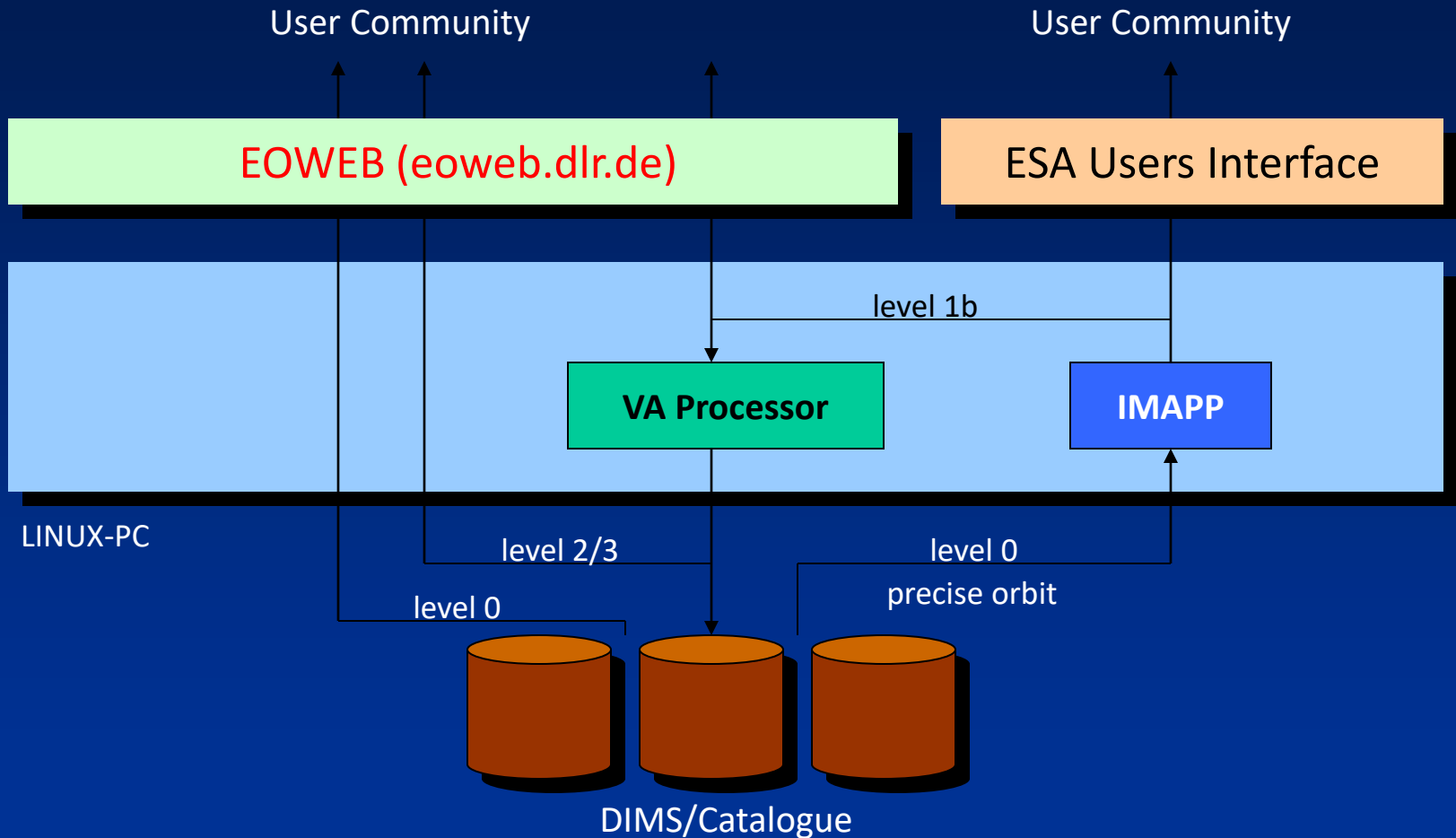
Orbital Stitching to Combine Data from Multiple Stations



NRT-Processing/Distribution and L0-Archiving



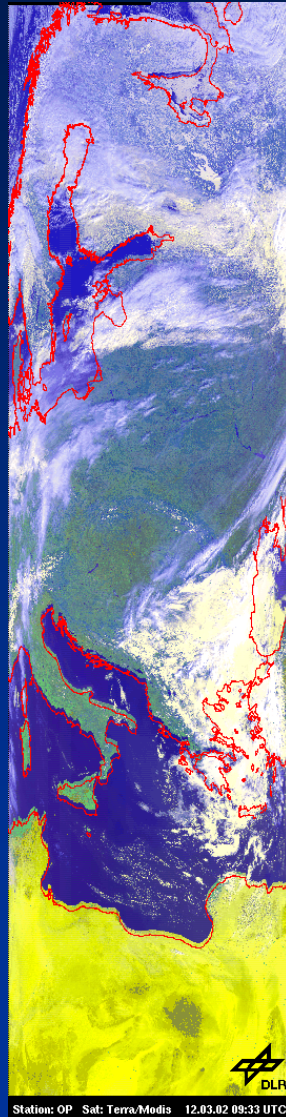
VA Processing, Archiving and Distribution



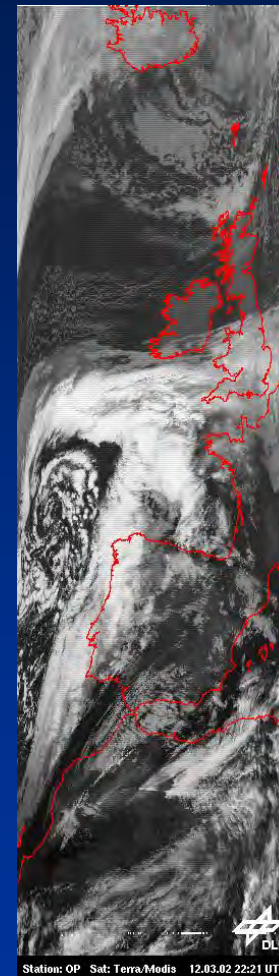
no archiving of Level 1b data!

Quicklook Processing

daytime
color Q/L
bands 1, 2, 31



nighttime
B/W Q/L
band 31



L1b Processor

- IMAPP developed at University of Wisconsin-Madison
- radiometric and geometric calibration
- supported platforms:
 - ▶ SGI MIPS, IRIX 6.5
 - ▶ Sun Ultra, SunOS 5.7
 - ▶ IBM RS/6000, AIX 4.3
 - ▶ HP PA-RISC, HP-UX B.10.20
 - ▶ Intel Pentium, Linux 2.2.12-20 (with gcc)
 - ▶ Intel Pentium, Solarisx86 2.5.1 (with gcc)

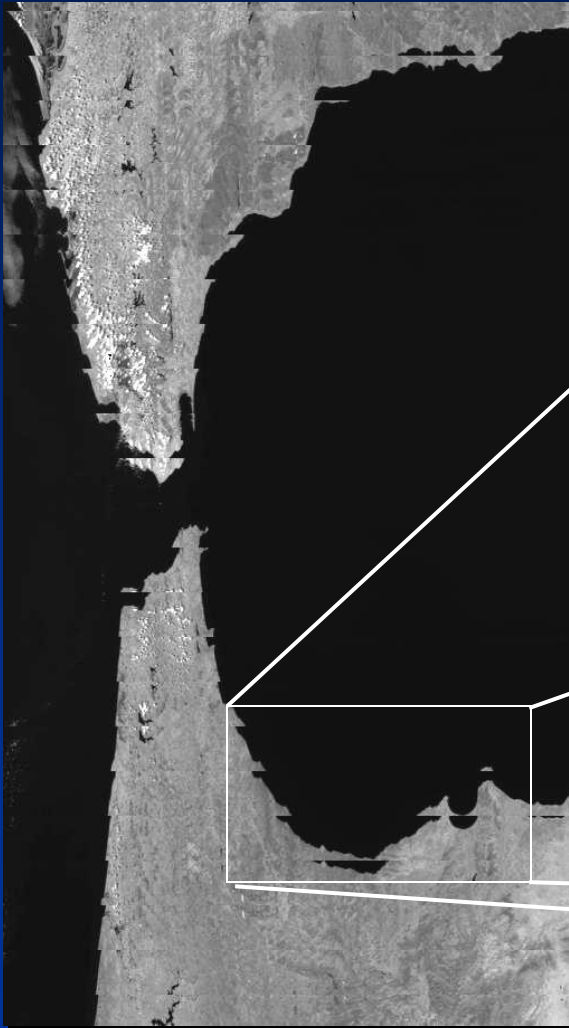
L1b Product (1)

- radiometrically and geometrically calibrated data
- sensor projection (→ georeferenced)
- HDF4 (not HDF-EOS!!!)
- access to rolling archive: [/home/modis_data](#)
- 4 files
 - ▶ 1000m.hdf
 - channels 1-36 (1km)
 - channels 1-19, 26 as radiances and reflectances
 - channels 20-25, 27-36 as radiances

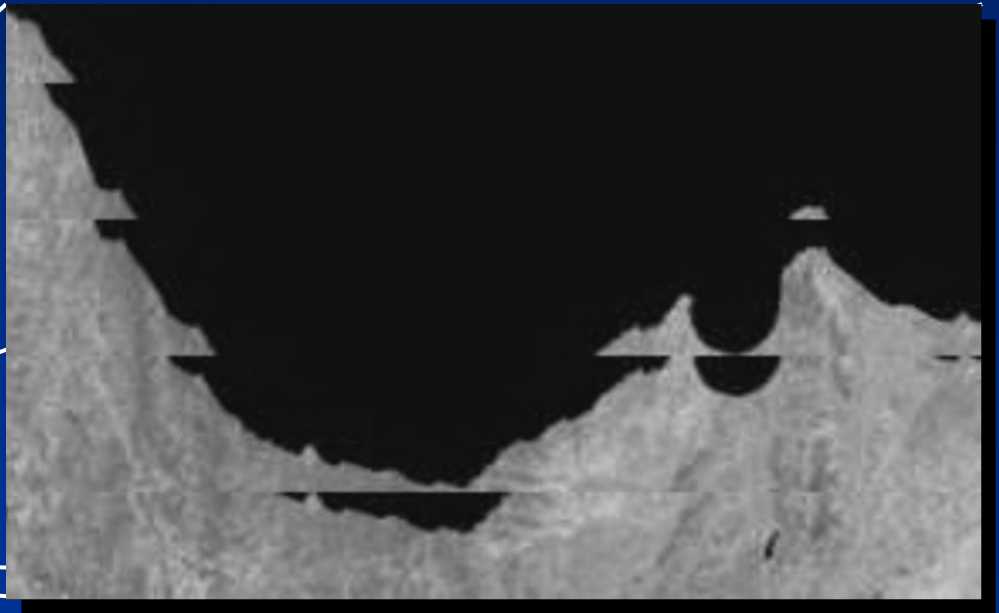
L1b Product (2)

- ▶ 500m.hdf
 - channels 1-7 (500m)
 - as radiances and reflectances
- ▶ 250m.hdf
 - channels 1+2 (250m)
 - as radiances and reflectances
- ▶ geo.hdf
 - latitude/longitude (1km)
 - height (1km)
 - sensor zenith/azimuth (1km)
 - sun zenith/azimuth (1km)
 - land/sea mask (1km)

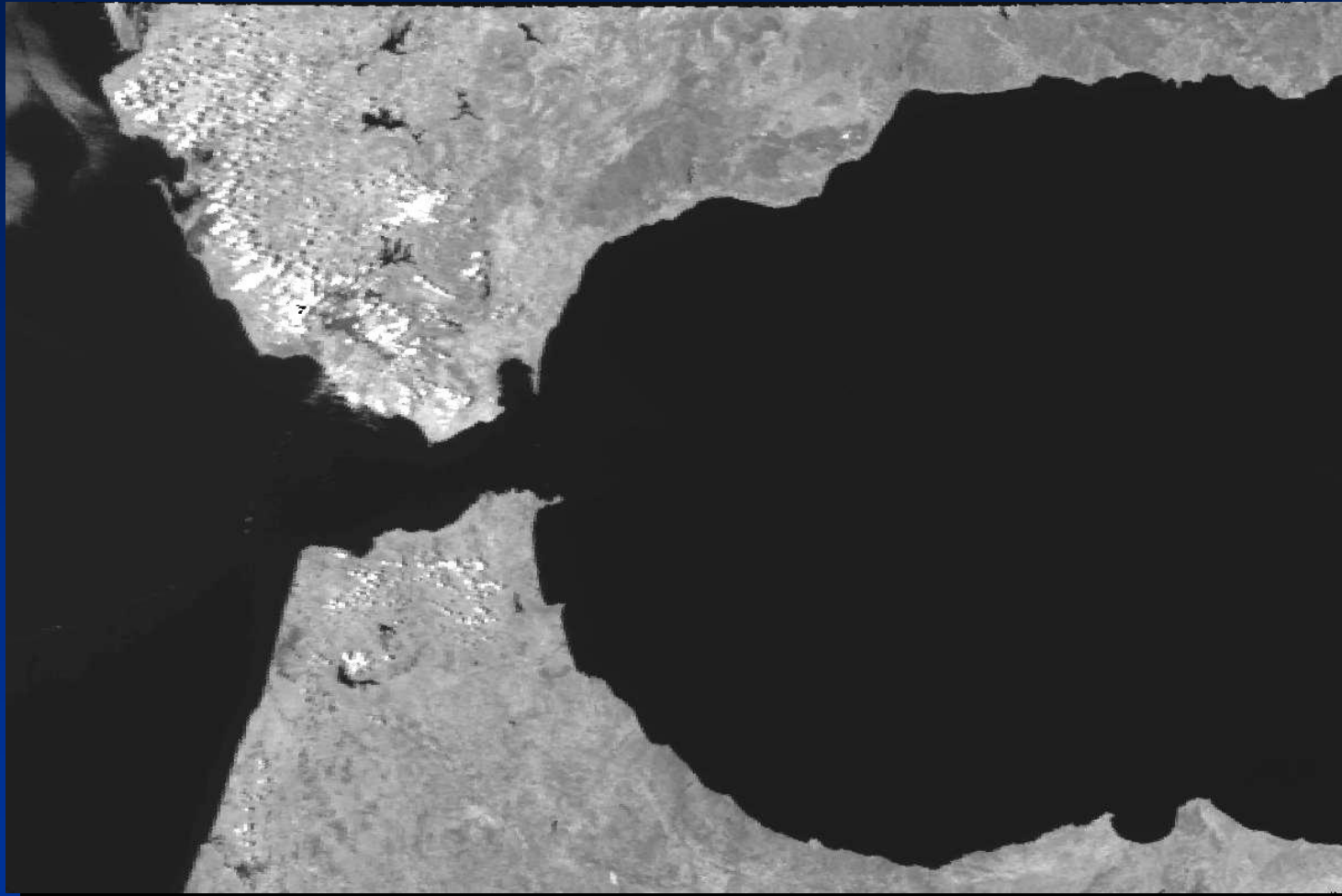
Sensor Projection: Strait of Gibraltar



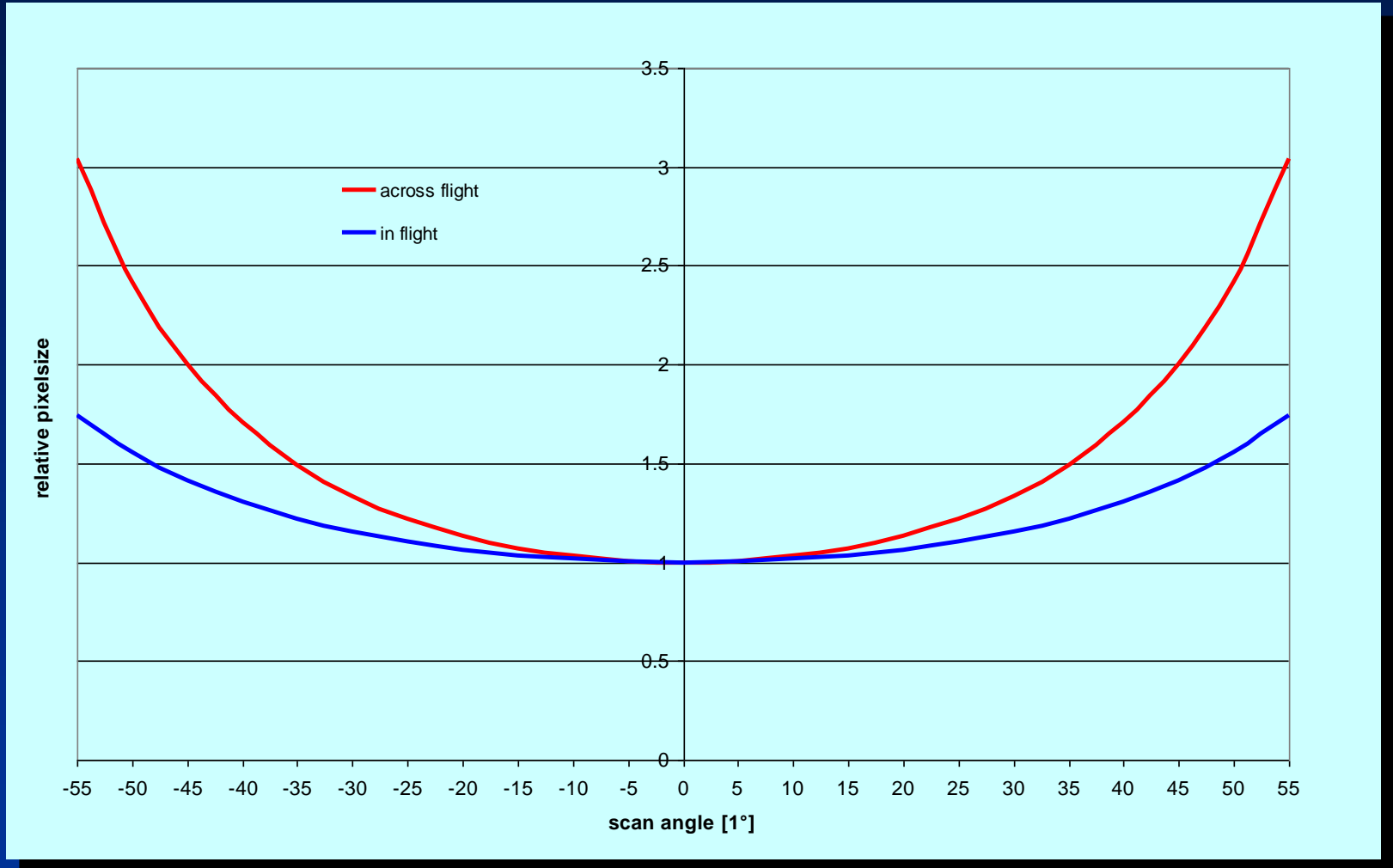
→ bow-tie effect



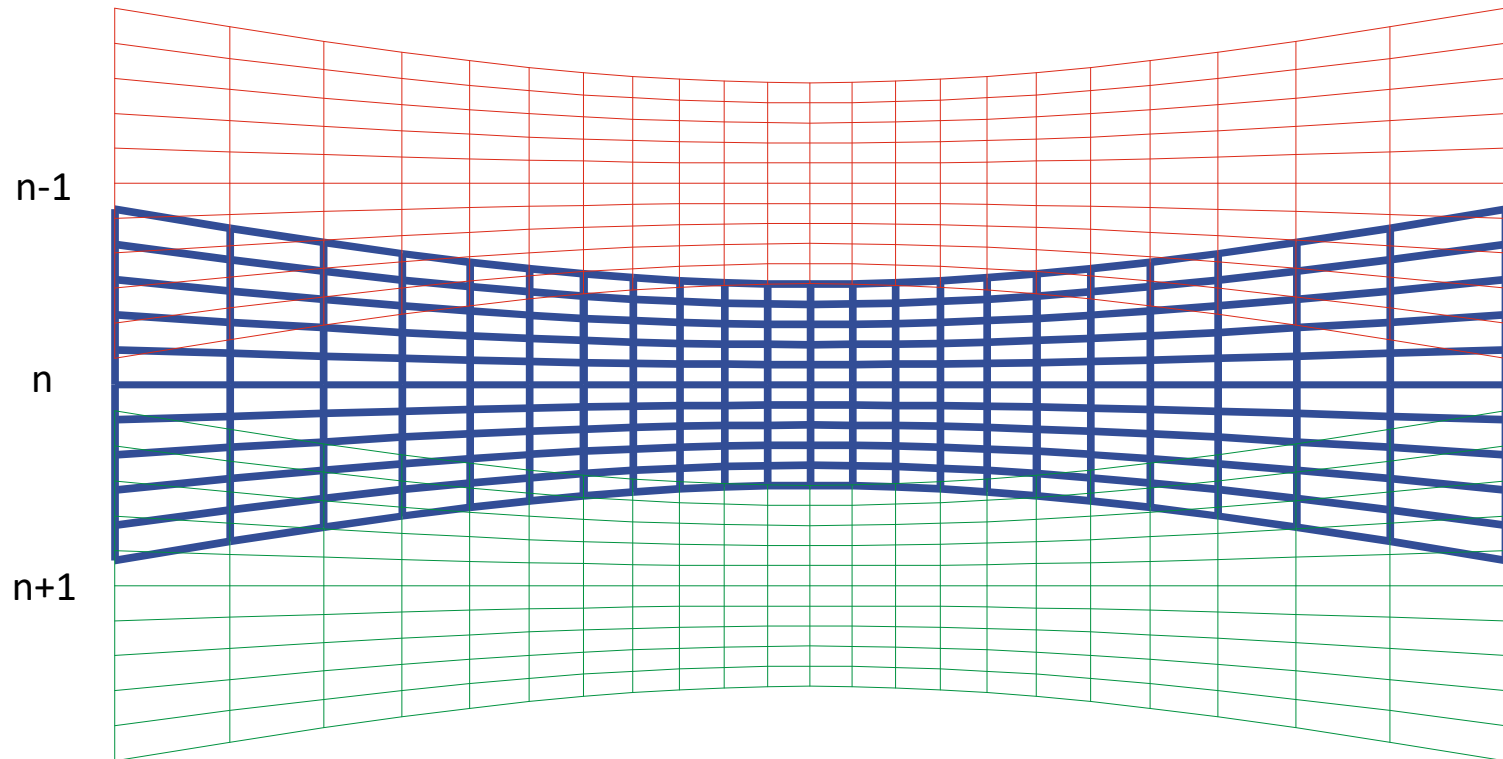
Map Projection: Strait of Gibraltar



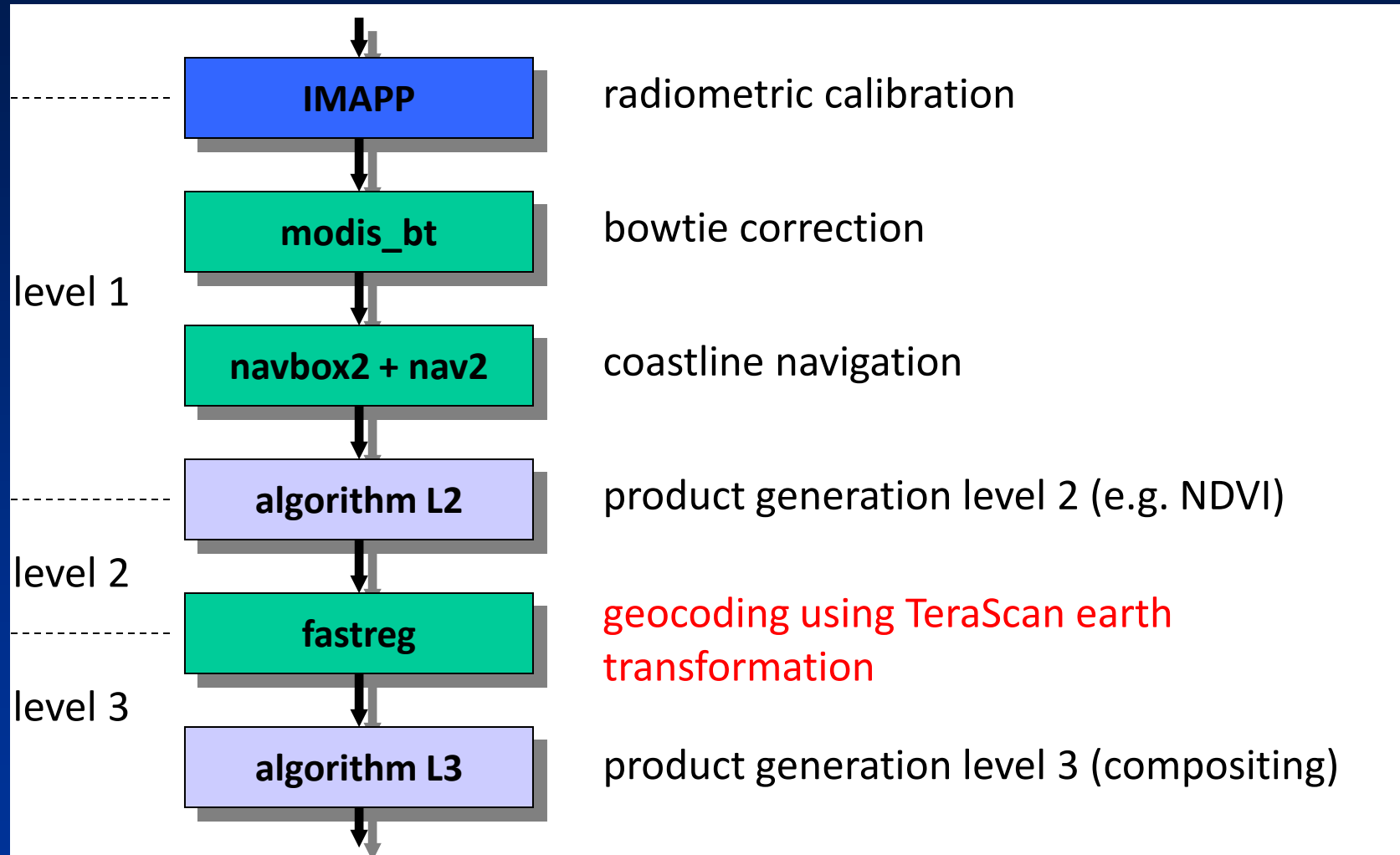
Pixel Size (neglecting earth curvature)



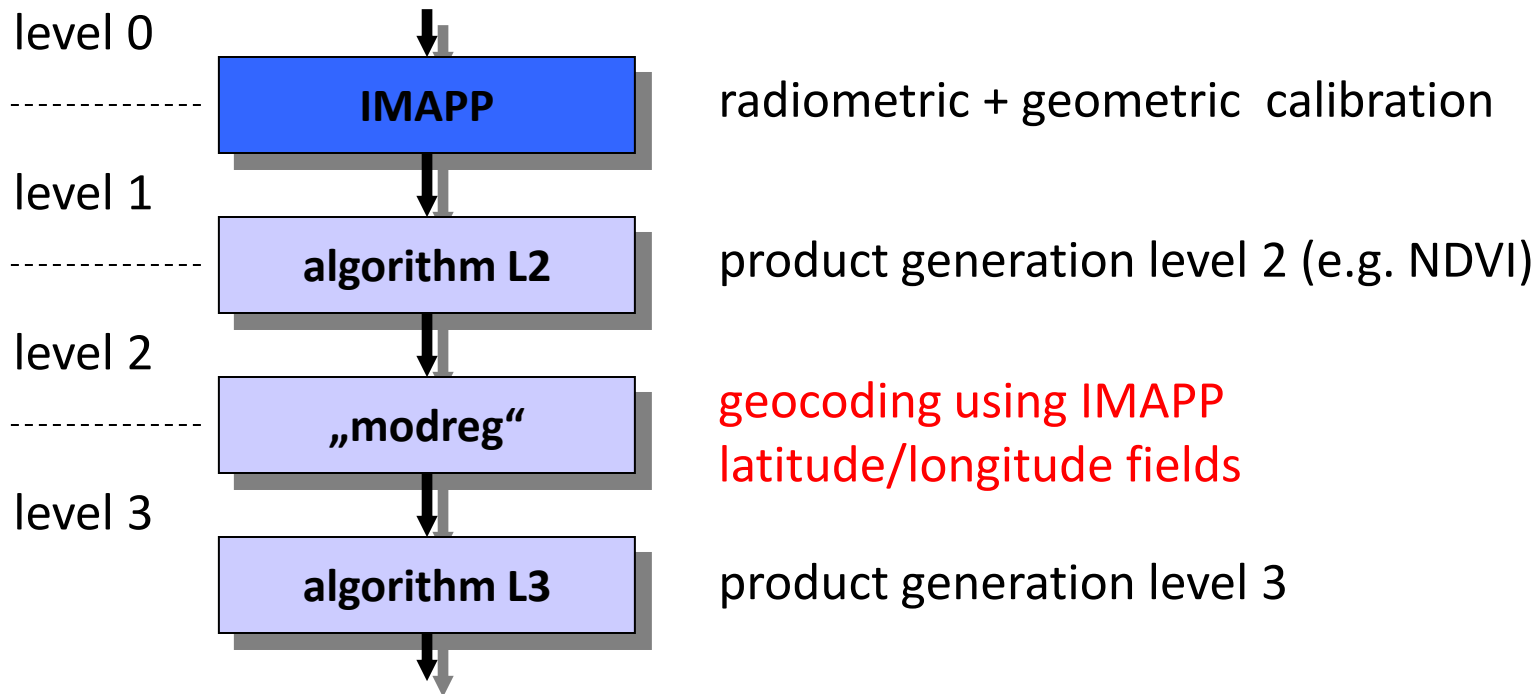
Bowtie Effect



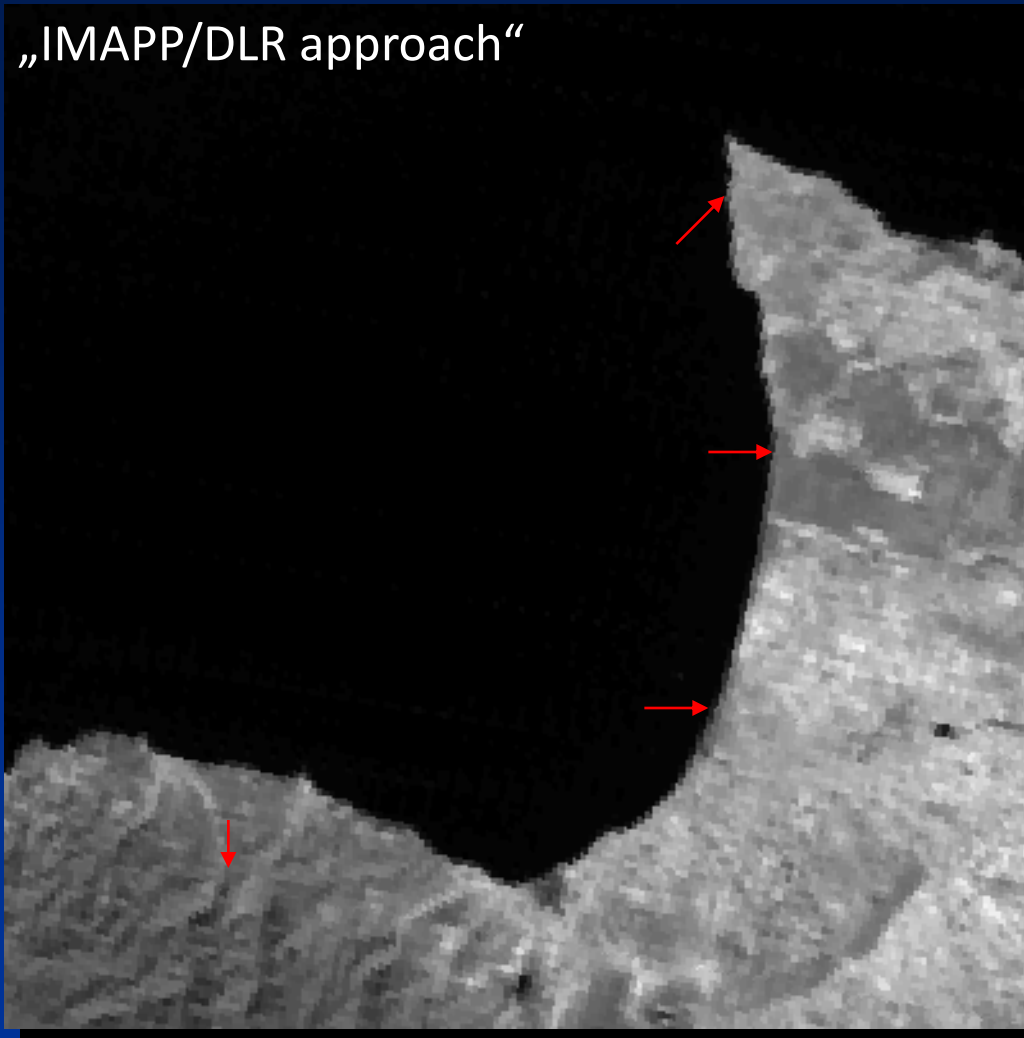
Processing Scheme I: TeraScan



Processing Scheme II: IMAPP/DLR



Geocoding of MODIS Data (Cyprus)



18.02.02

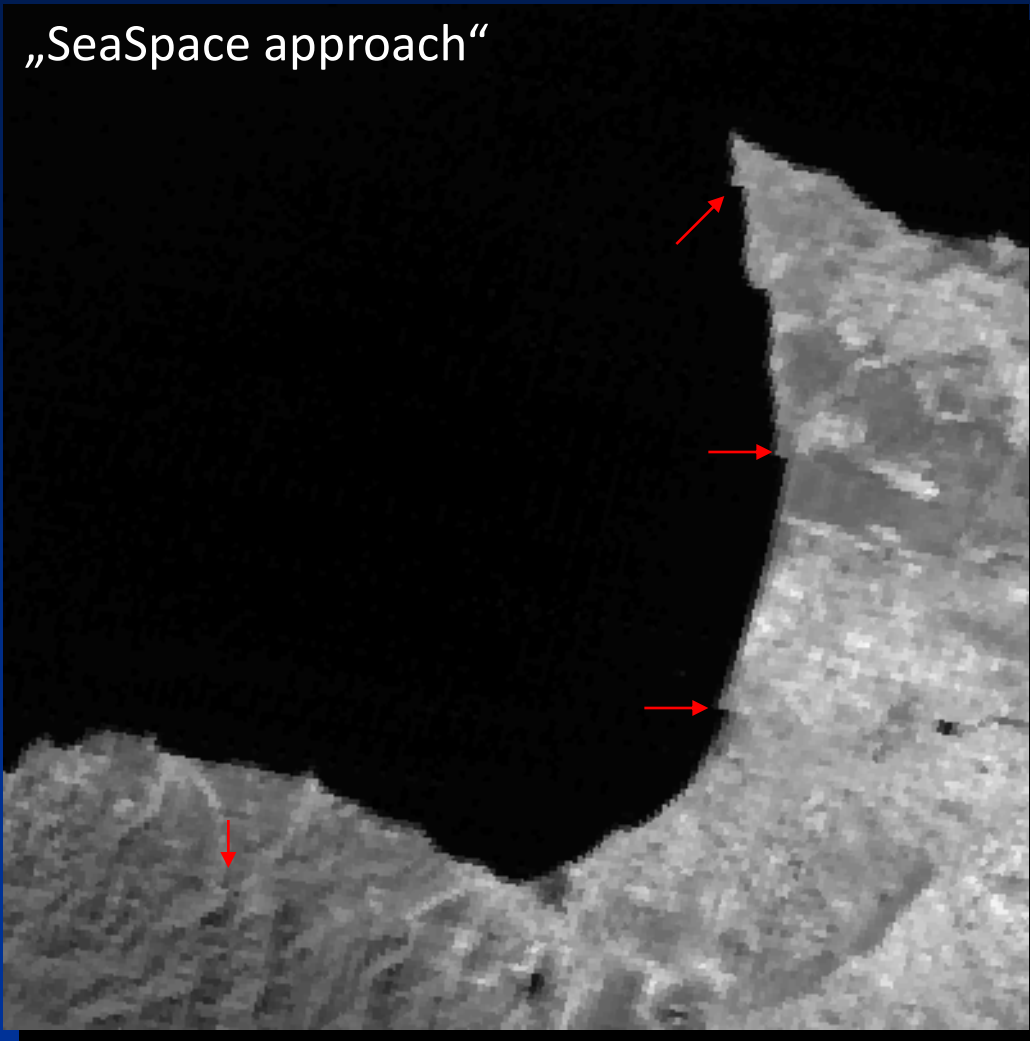
8:33UTC

band 2

view zenith 5°

view azimuth 104°

Geocoding of MODIS Data (Cyprus)



18.02.02

8:33UTC

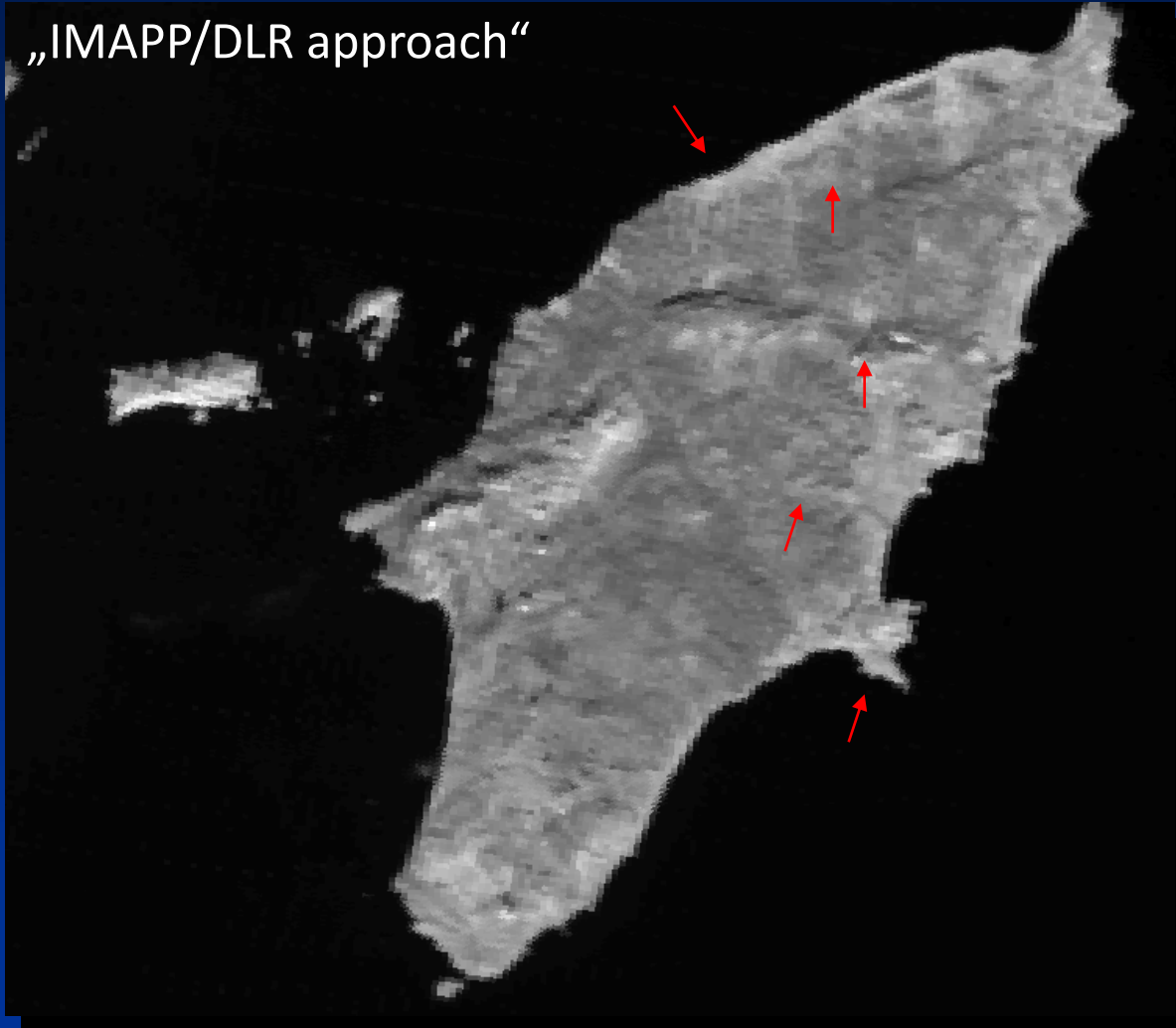
band 2

view zenith 5°

view azimuth 104°

Geocoding of MODIS Data (Rhodes)

„IMAPP/DLR approach“



18.02.02

8:33UTC

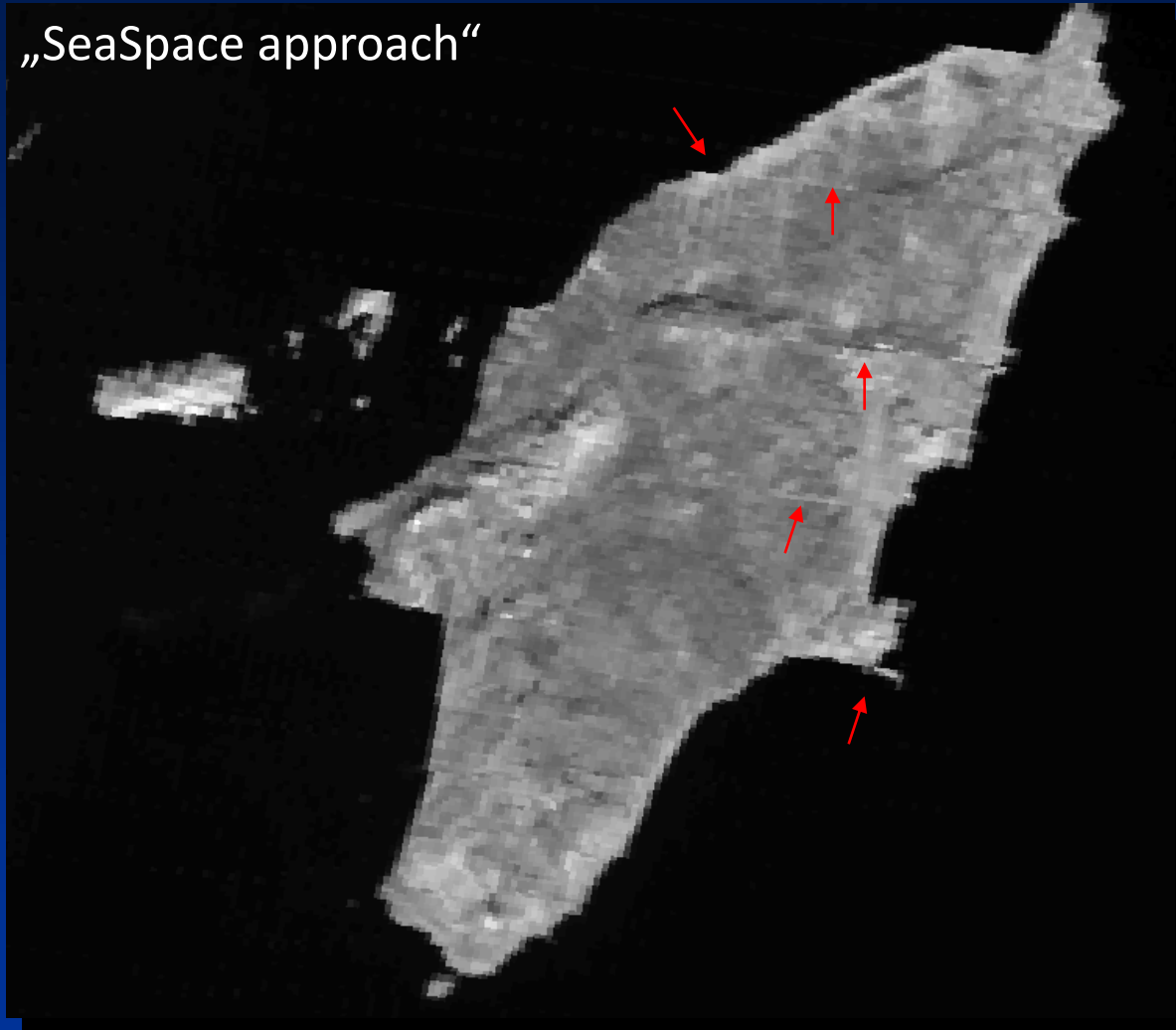
band 2

view zenith 39°

view azimuth 99°

Geocoding of MODIS Data (Rhodes)

„SeaSpace approach“



18.02.02

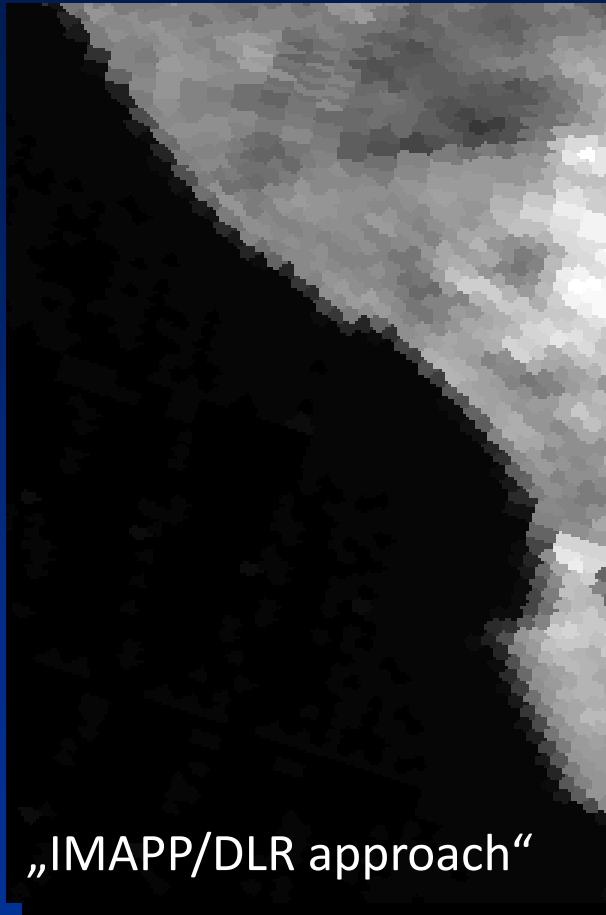
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band 2

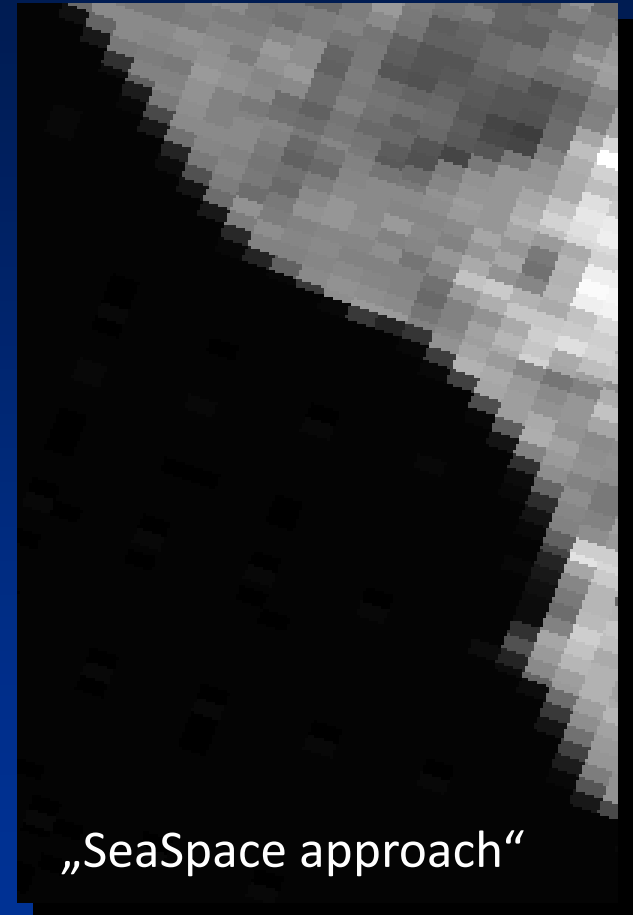
view zenith 39°

view azimuth 99°

Geocoding of MODIS Data (Greece)



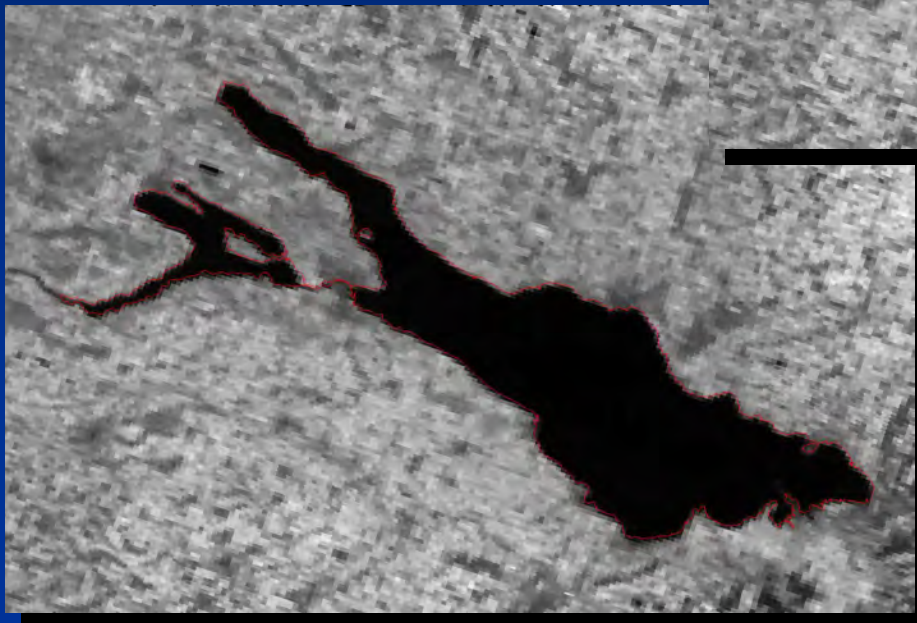
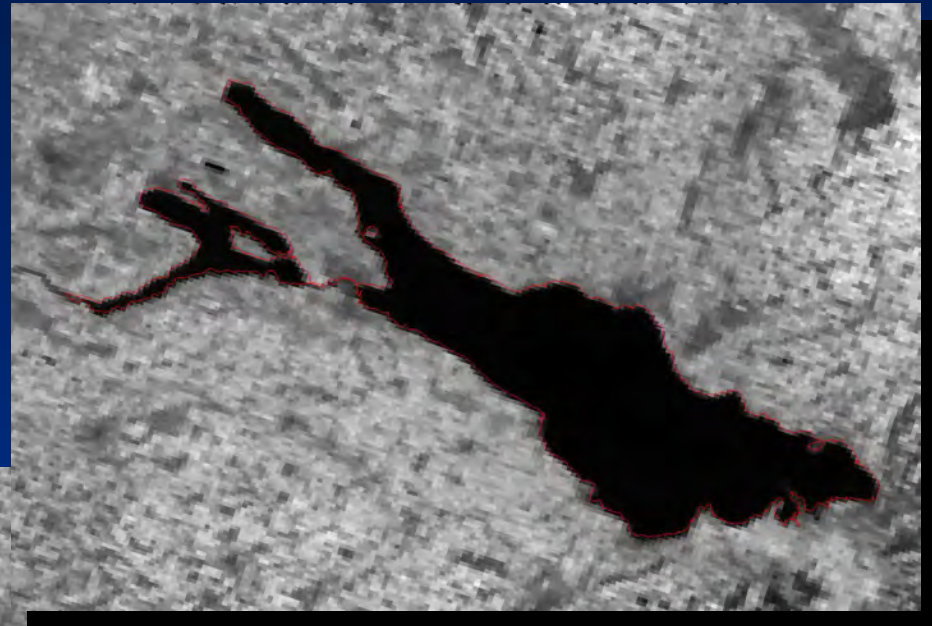
25.02.02
10:16UTC
band 2
view zenith 60°
view azimuth -72°



On-Line Versus Off-Line Geolocation (1)

on-line (accuracy better 250m)

27.08.2001

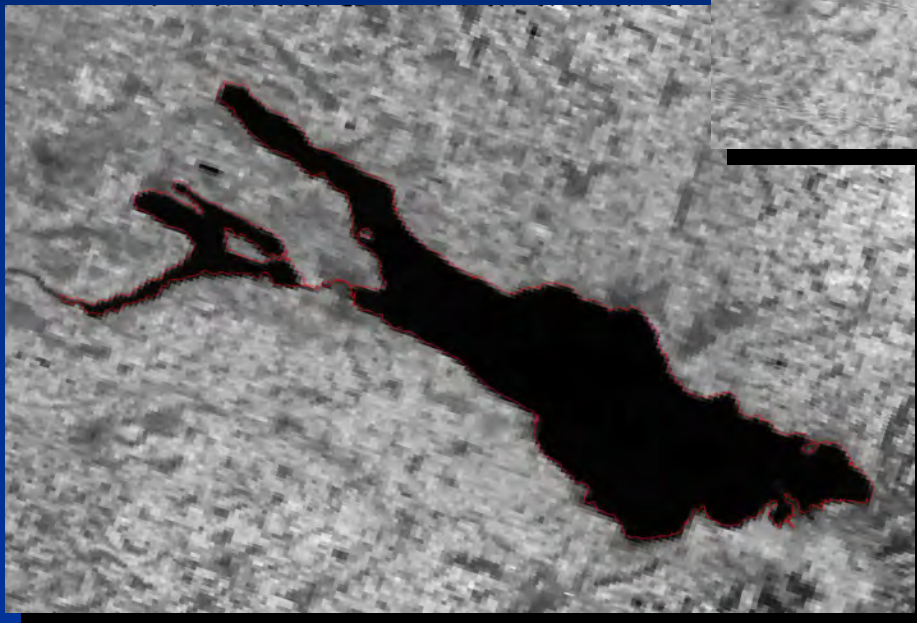
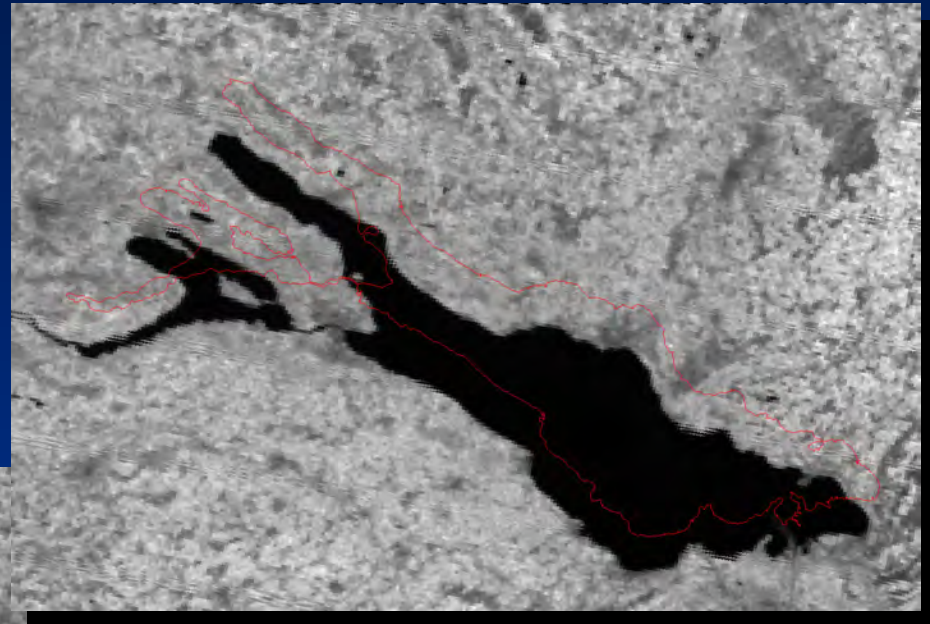


off-line (accuracy better 200m)

On-Line Versus Off-Line Geolocation (2)

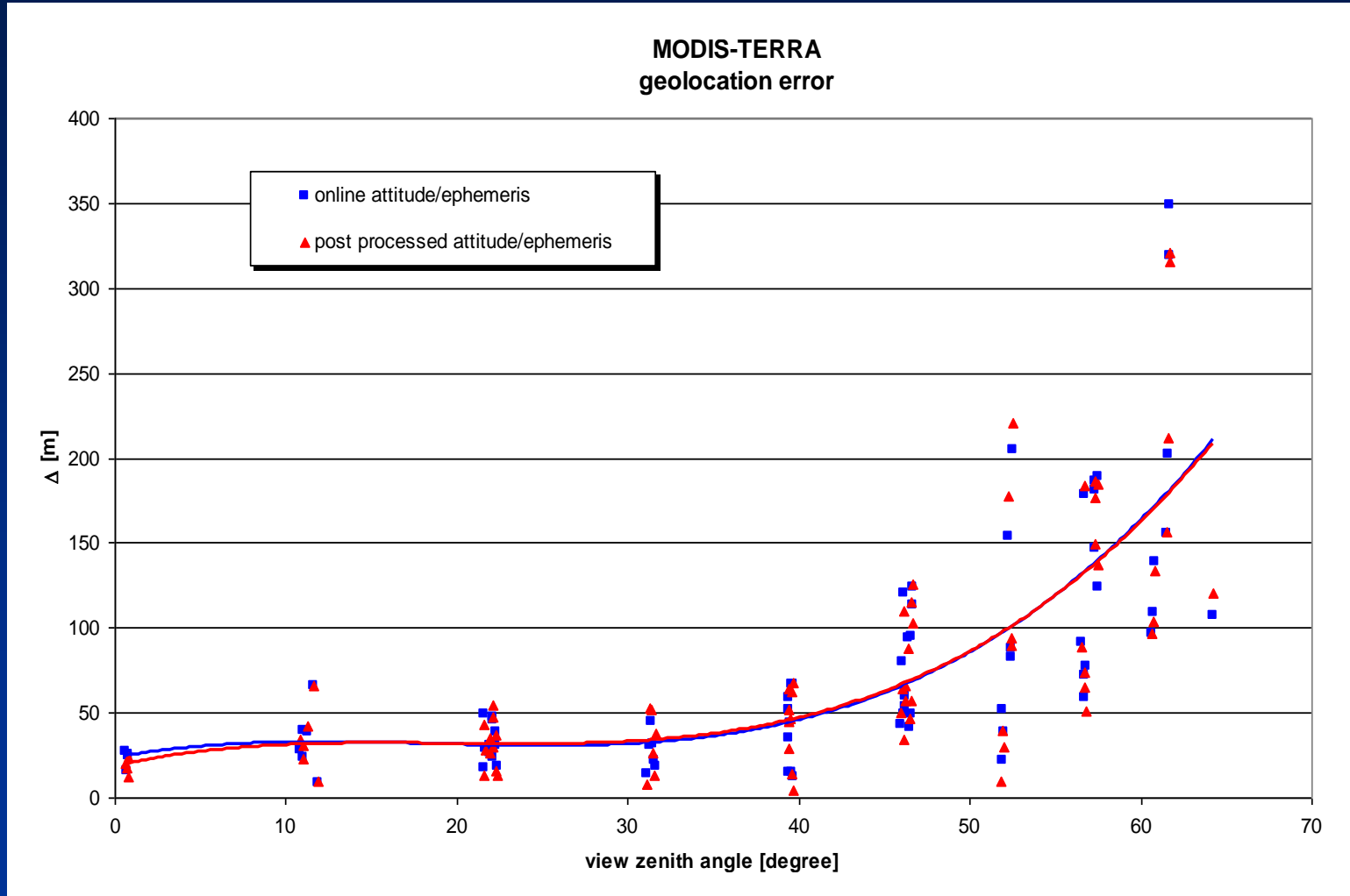
on-line

26.08.2001

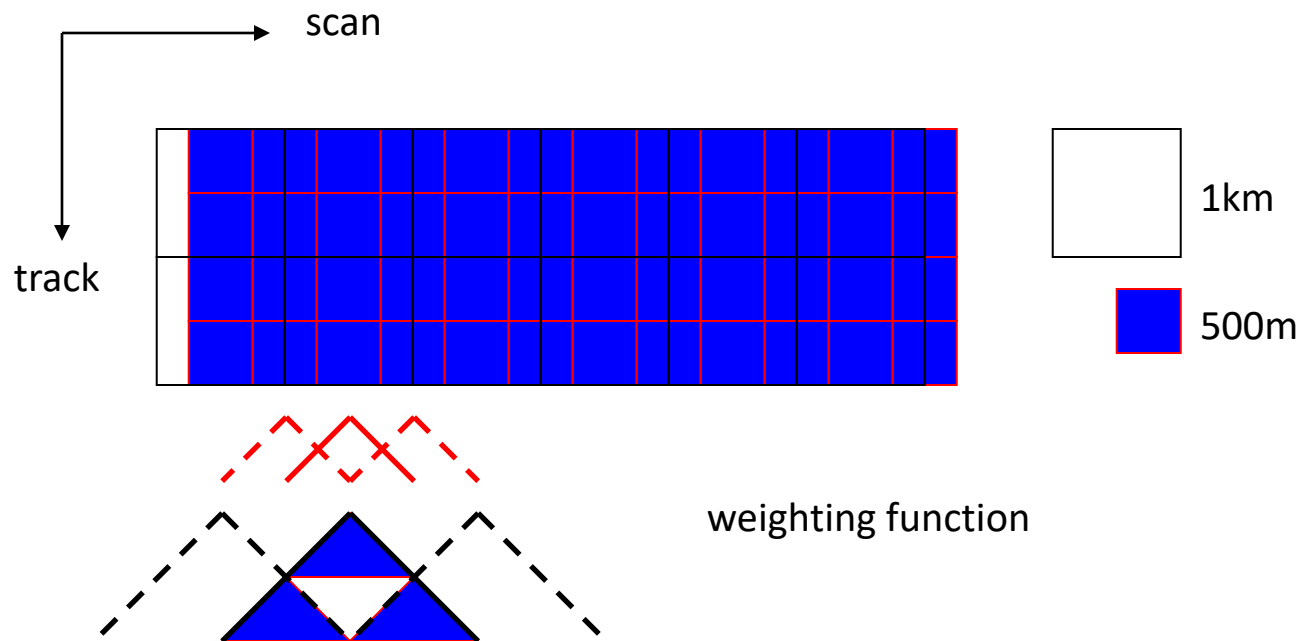


off-line (accuracy better 200m)

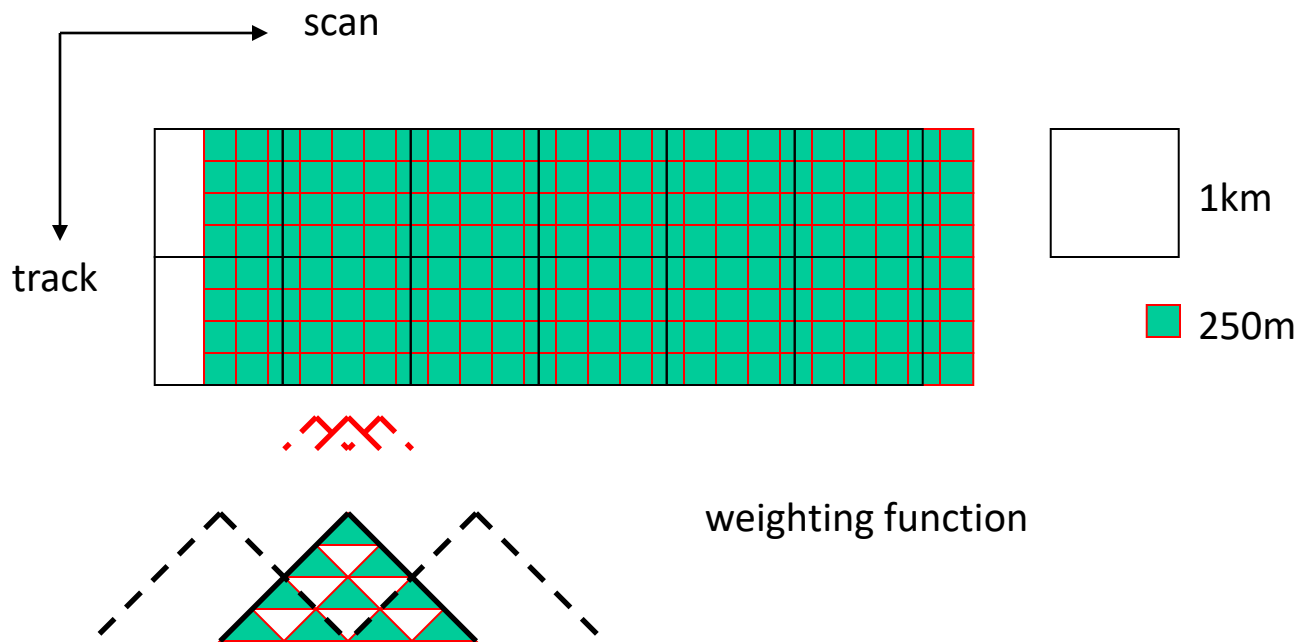
On-Line Versus Off-Line Geolocation (3)



Coregistration between Channels (1)

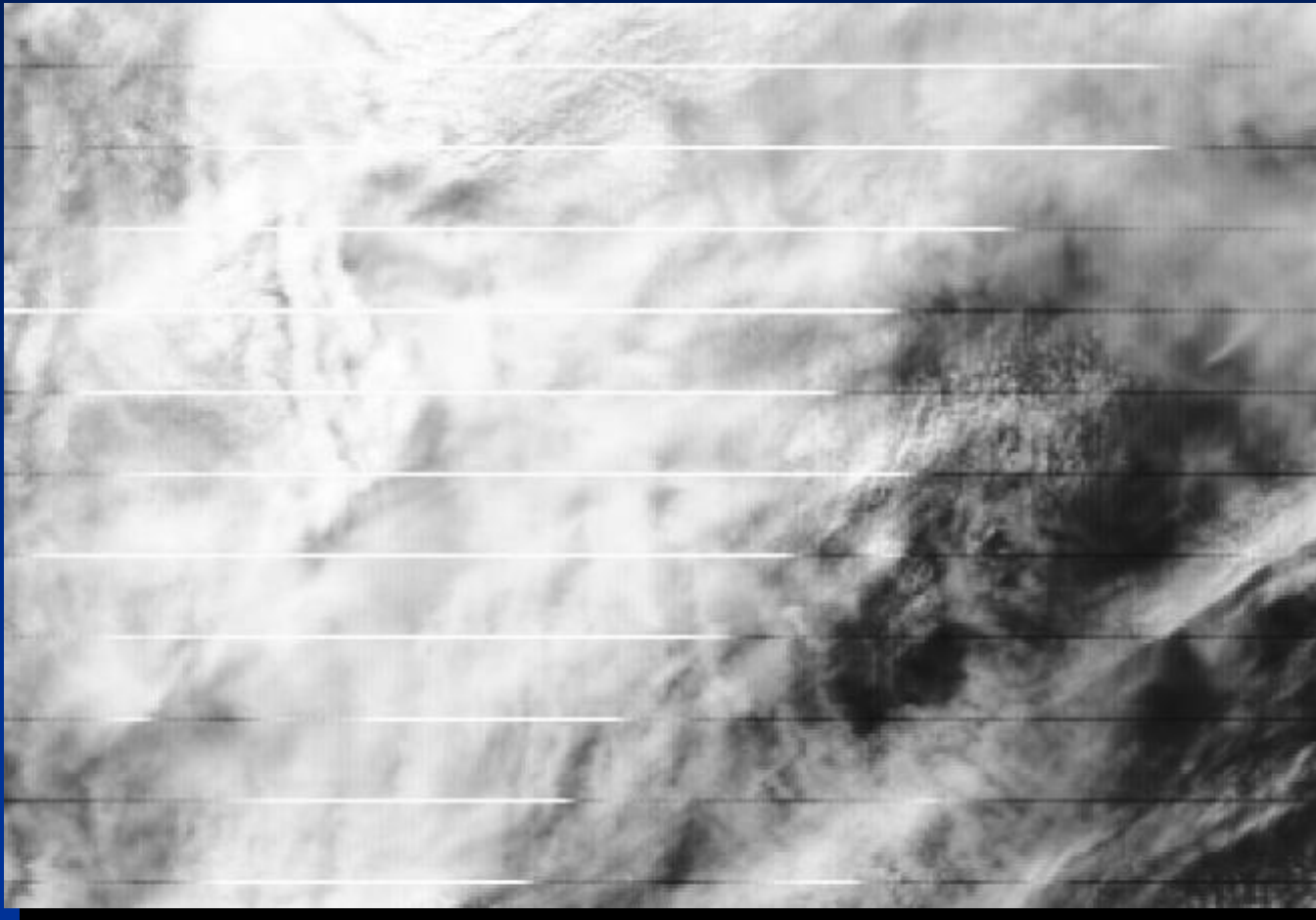


Coregistration between Channels (2)



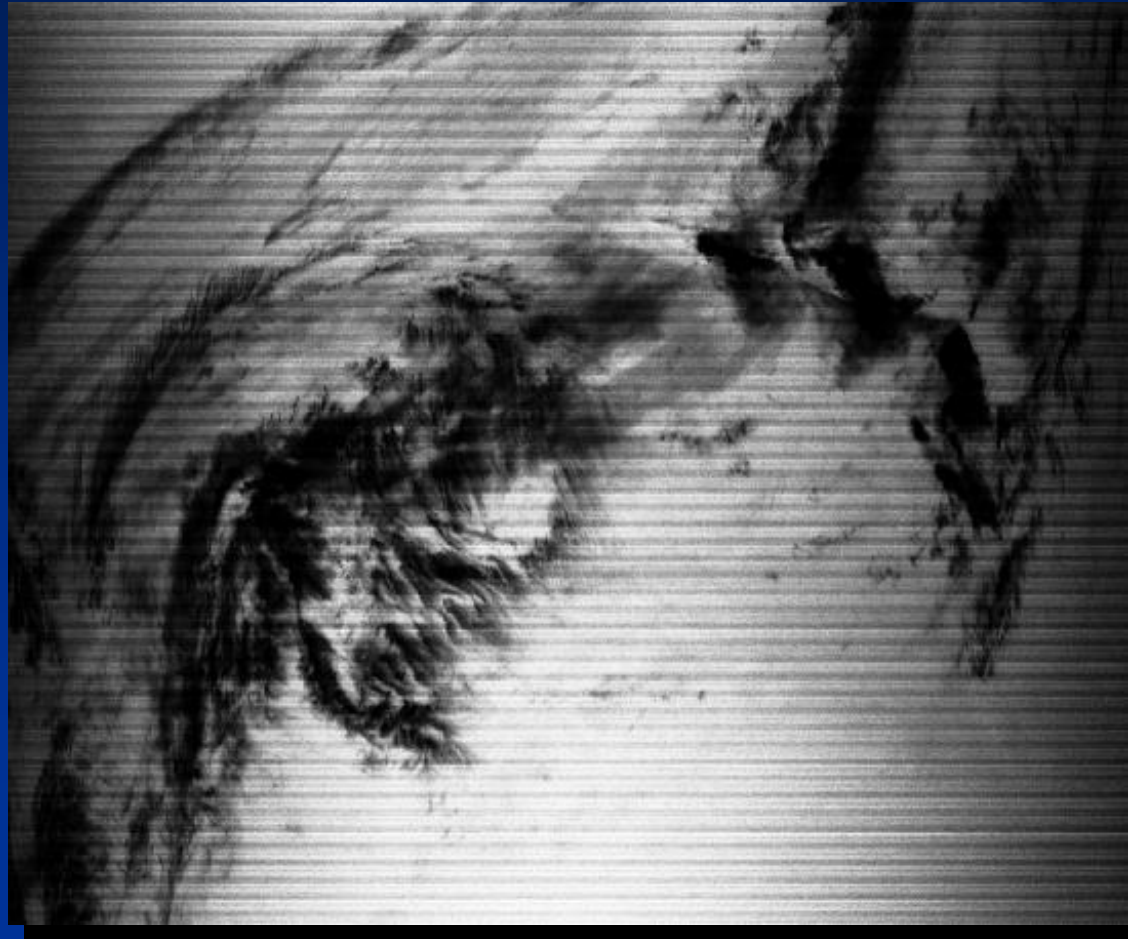
Problems with MODIS Data (1)

apparently one bad detector in bands: 5, 21, 24, 26, 28



Problems with MODIS Data (2)

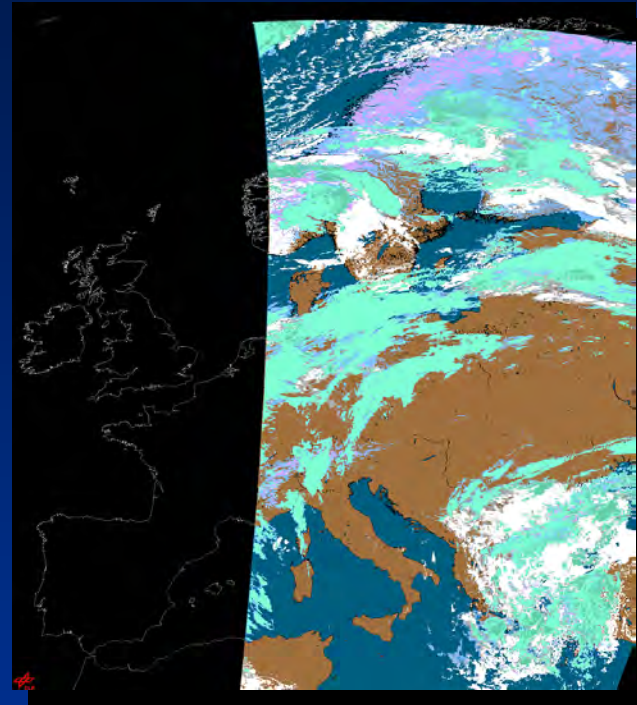
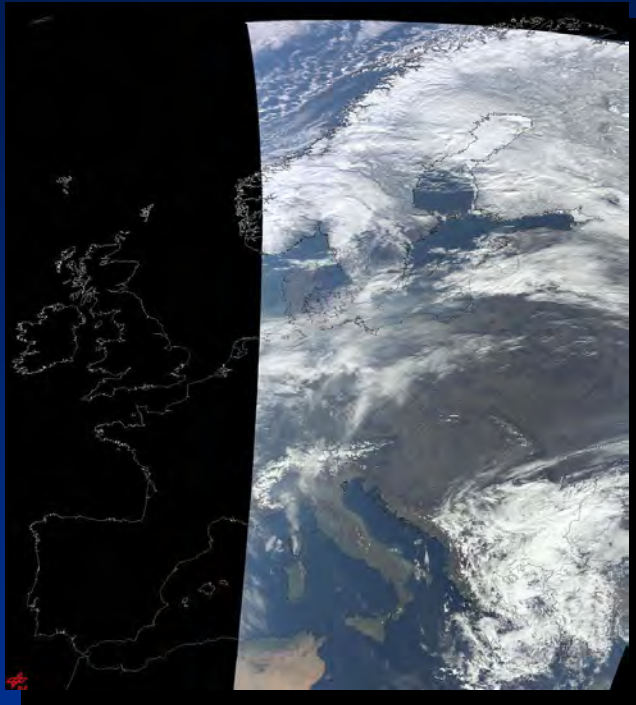
stripes in bands: 27, 30, (34), (35), 36



Planned Operational Value Added Products at DLR

- APOLLO Cloud Classification / Masking
- Normalized Difference Vegetation Index
- Atmosphere Correction
- Land Surface Temperature
- Leaf Area Index
- Fraction of Absorbed Photosynthetic Active Radiation
- APOLLO Cloud Parameters
- Net Primary Production

NRT Cloud Classification Using Adapted APOLLO



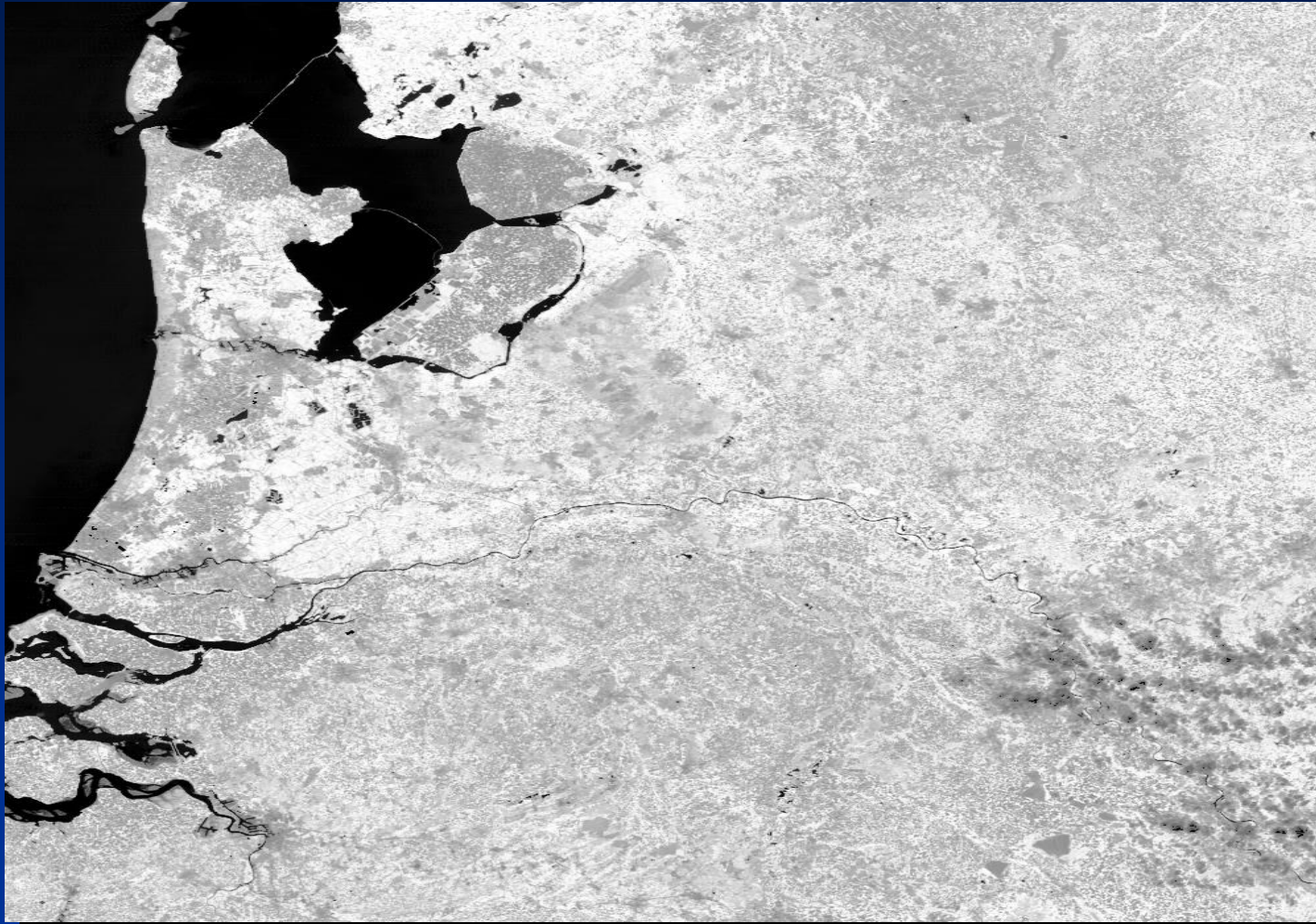
12.03.02
09:32UTC

- cloud free land
- cloud free sea
- thick water clouds
- thin clouds
- cirrus-level clouds
- snow/ice clouds
- snow

product available 2 hours after acquisition!!!

<http://auc.dfd.dlr.de/modisnrt>

Automatic Atmosphere Correction (DLR Patent) (1)



MODIS
NDVI

uncor-
rected

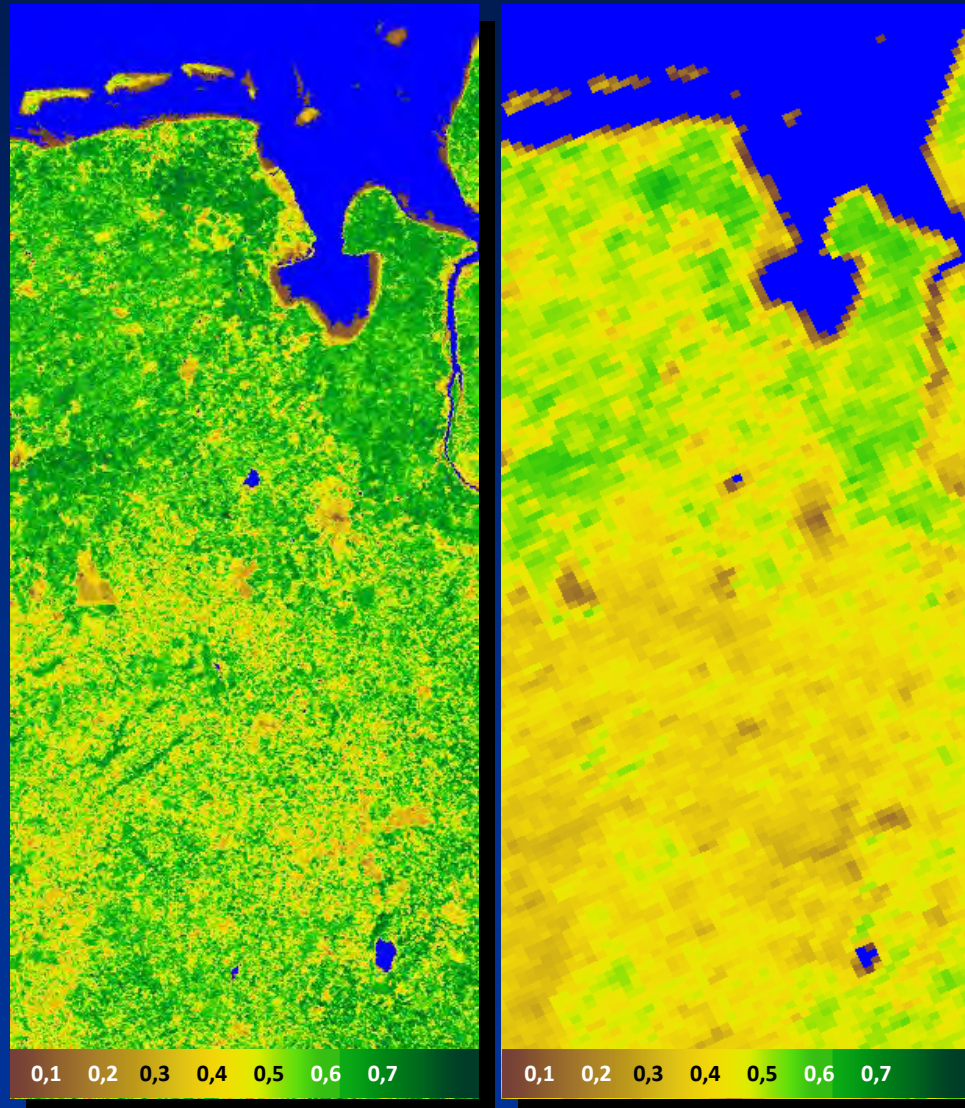
Automatic Atmosphere Correction (DLR Patent) (1)



MODIS
NDVI

cor-
rected

NDVI: Comparison MODIS - AVHRR



Etna Eruption (July 2001)



Cypres (27 February 2002)

