

TIMELINE Background Information

The TIMELINE (TIME Series Processing of Medium Resolution Earth Observation Data assessing Long -Term Dynamics In our Natural Environment) project aims at the development of a operational processing and data management environment to reprocess 30 years of NOAA-AVHRR raw data into L1b, L2, and L3 products on the basis of 1.1 km HRPT (High Resolution Picture Transmission) and LAC (Local Area Coverage) data and provide them online to a wider community using a free and open data policy. The products shall enable the users to conduct change detection analyses as well as the identification of geo-scientific phenomena and trends. Highest level products (statistical information products) shall be deducted to enable global change related research in the European and Mediterranean context.

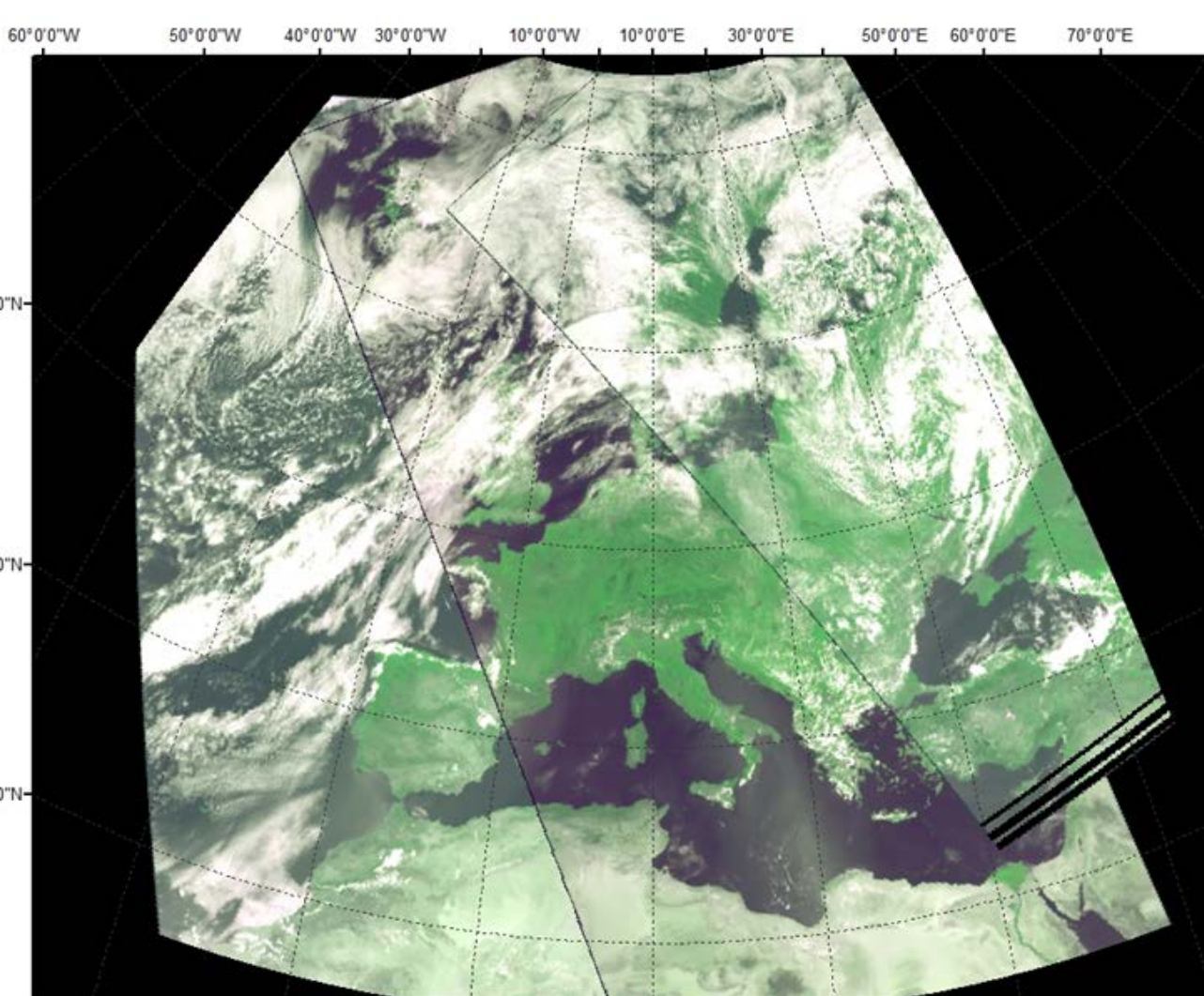


Fig. 1: Overview of the processing extent

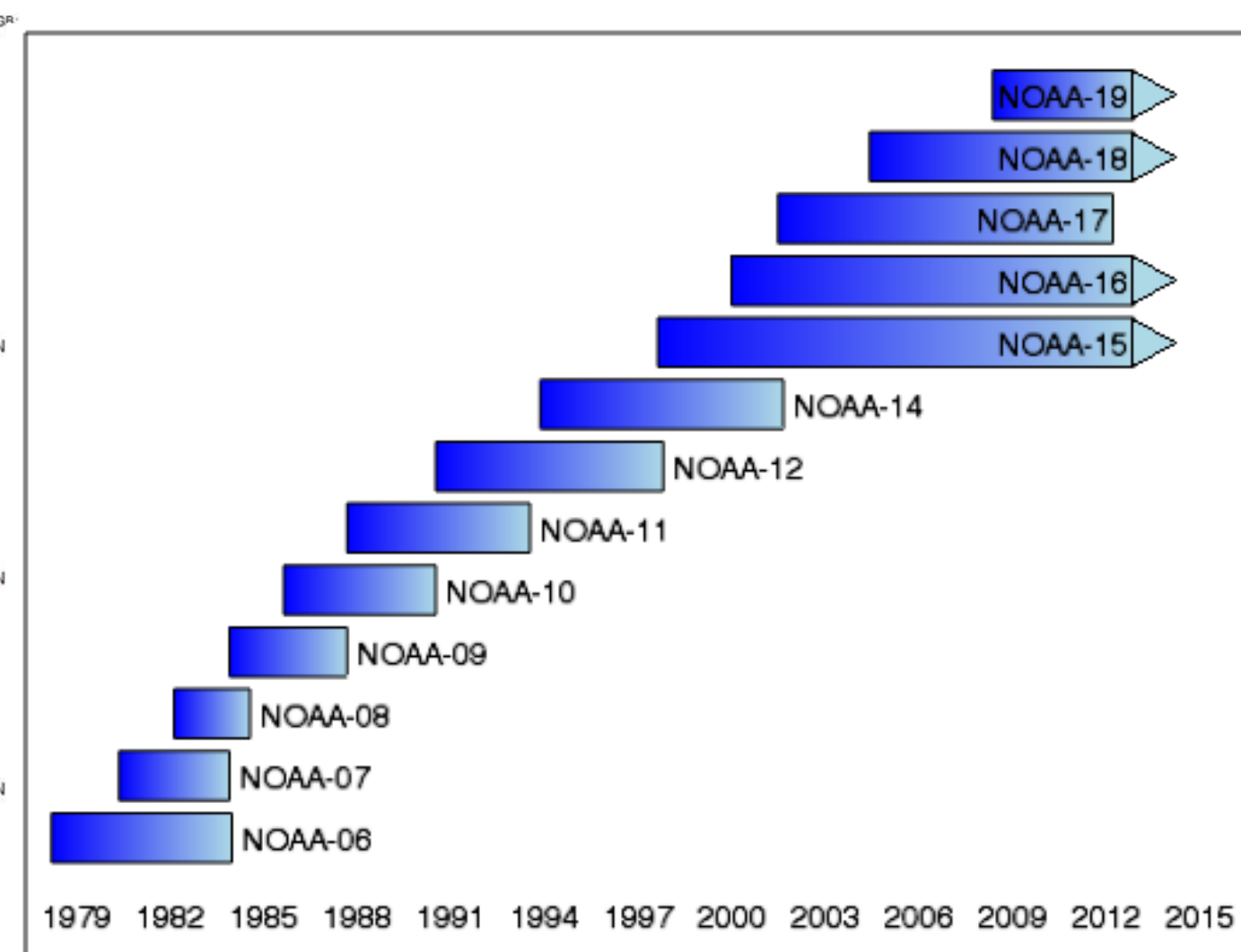


Fig. 2: Series of AVHRR Sensors

AVHRR Challenges

Deriving time series from the AVHRR sensors faces several challenges. AVHRR images contain geometric distortions not only due to the Earth curvature, but also because of rotation and satellite clock errors, imprecise orbital models and spacecraft attitude errors (Fig. 3). A two-step chip-matching procedure as well as an orthorectification shall ensure geometric correction on best efforts basis. The spectral responses of the different AVHRR sensors vary considerable, leading to relative differences in band 1 reflectances from -2% to 7%, in band 2 from -6% to 2%, and in NDVI from -20% to 15%. The high NDVI differences are due to unequal coverage of the red edge by the different sensors (Fig. 4). Further, each sensor has its own calibration drift. Both these effects ask for a homogenization of the time series, which will be done on the basis of the spectral characteristics, pixel wise land cover information, and pseudo-invariant calibration sites.

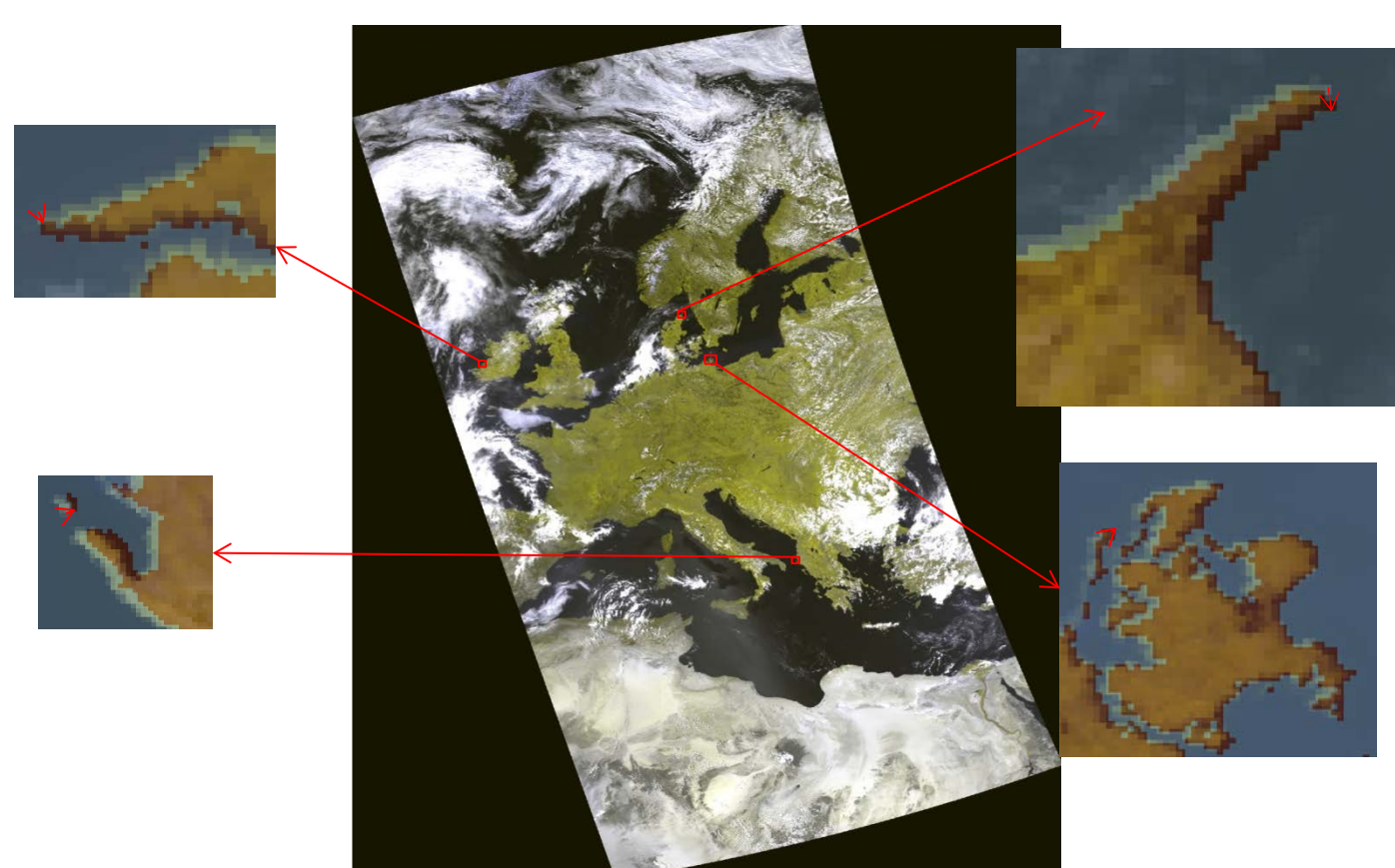


Fig. 3: Imprecise georeferencing

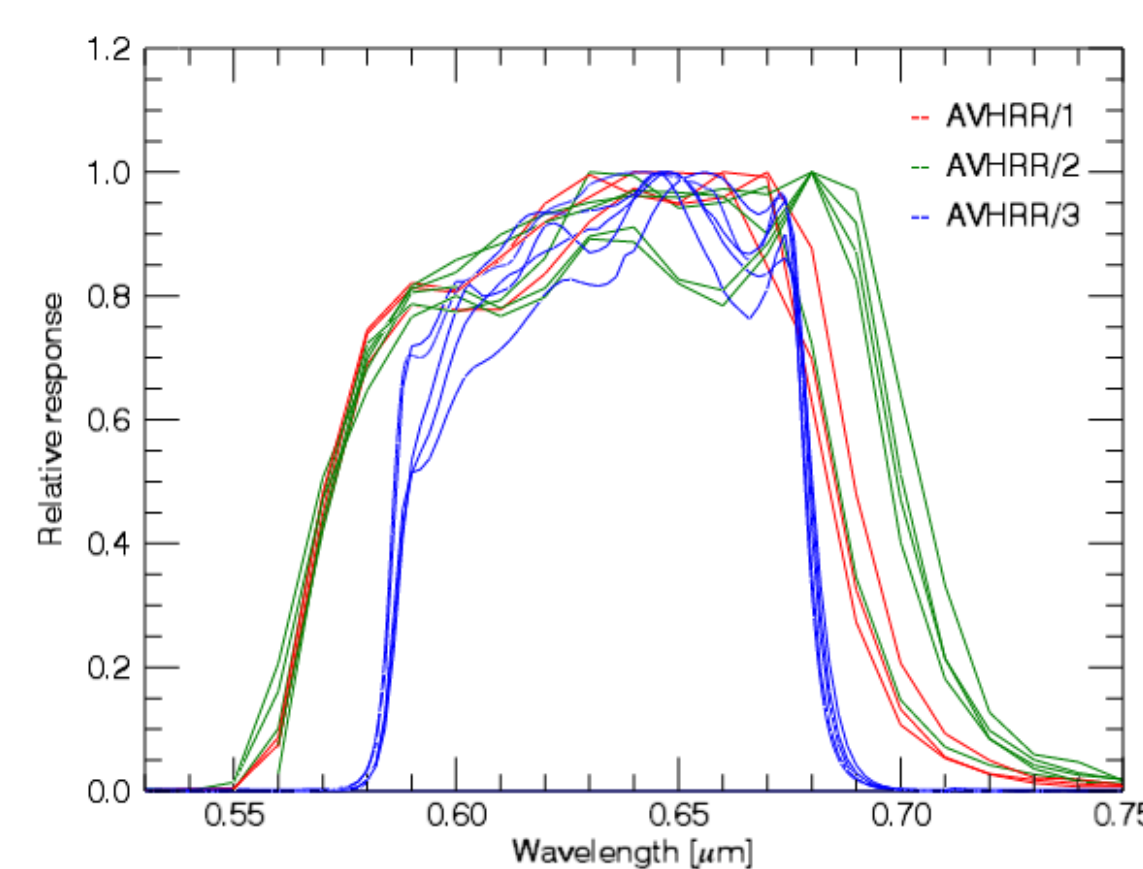


Fig. 4: Band 1 spectral response curves of the different sensors

Further issues are the satellite orbit drift, which leads to non-persistent solar zenith angles and acquisition times. While the first issue leads to strong BRDF effects, the latter imposes discontinuities in surface temperature and cloud products. Finally AVHRR does not feature a band for the aerosol correction, which makes the atmospheric correction difficult.

Products

The TIMELINE products will be available as L1b/L2 data in orbit-geometry, as well as projected and gridded L3 data in daily, 8-day and monthly temporal resolution. The products cover a large geo-scientific range; table 1 lists all foreseen variables.

Type	Variable
Calibration	Radiance at sensor
Surface radiative variables	TOA and BOA Reflectance and Brightness Temperature
	Land surface albedo
	Land and sea surface temperature (LST/SST)
Land surface	Sea surface temperature (SST)
	Vegetation variables (NDVI, LAI, FAPAR, FVC)
	Burnt Area and Active Fire detection („Hot Spots“)
Cryosphere	Water masks
	Snow and Ice over land, Sea ice coverage
Atmosphere	Cloud masks
	Degree of cloud cover, Thermodynamic cloud phase, Cloud top temperature, cloud height, Cloud optical thickness, Precipitation potential

Table 1: Foreseen TIMELINE products

Product example 1: "LST"

LST is calculated using the generalized split window equation with AVHRR-adapted coefficients for different ranges of water vapour, surface air temperature, and view angle. The coefficients are derived from MODTRAN 5 runs using a subset of the SeaBor V5.0 profile database (Borbas et al. 2005). Emissivity will be land use depended and derived using the NDVI.

Product example 2: "Hot Spots"

Two different methods are being tested for hot spot detection:

1. Threshold-based, using band 3, band 4 and their difference.
2. Potential Fires are selected using a threshold of band 3. Fire confirmation follows by comparing statistical values of potential fires and background temperatures using a moving and growing window.

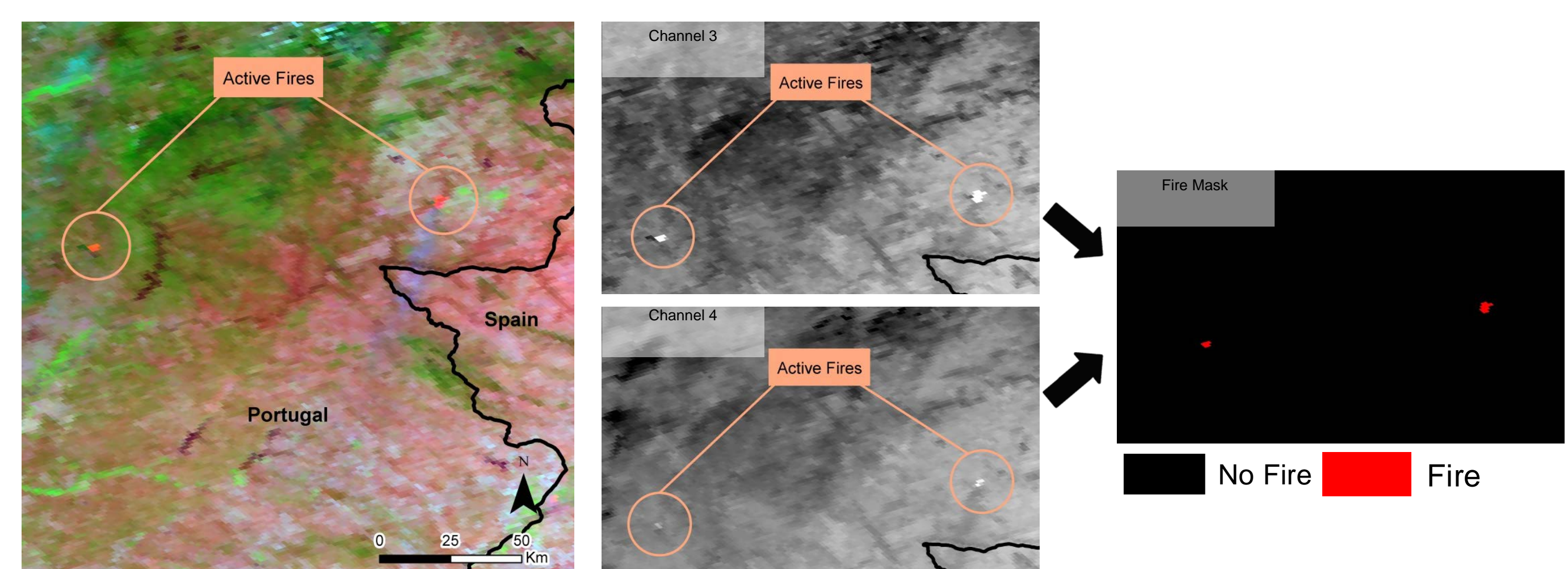


Fig. 5: Schematic workflow of the fire product

Data management and processing workflow

The DFD AVHRR archive is being consolidated with third-party data sources in order to include all AVHRR observations recorded since the early 1980s. This effort is part of the NOAA AVHRR Data Curation and Reprocessing initiative, which is a pilot project within ESA's long-term data preservation (LTDP) program. The TIMELINE processing workflow is integrated into the DIMS (Data and Information Management System) environment of DFD and uses its Processing System Management component PSM. DIMS features also an interactive web interface EOWEB for data access. The workflow is designed as generic as possible to enable fast extension to other AVHRR-heritage sensors.

