

climate change initiative

→ HIGH RESOLUTION LAND COVER

# ESA CCI High Resolution Land Cover: Methodology and EO Data Processing Chain

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- (4) Dept. of Electrical, Electronics and Telecommunication Engineering and Naval Architecture, University of Genoa, Genoa, Italy.



high resolution  
land cover  
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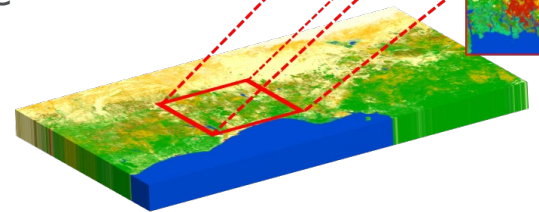
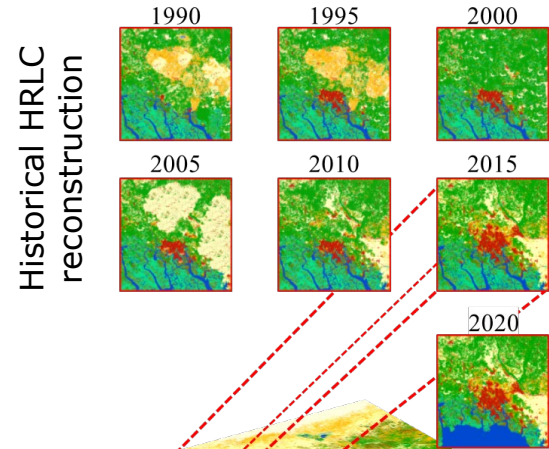
- ✓ CCI+ HRLC aims at improving the understanding of the interaction between climate and land cover **increasing the spatial resolution of 1 order of magnitude (from 300m to 10-30m).**
- ✓ The primary objectives are:
  - Generating **reliable products at high resolution** at regional level;
  - Examining the **role of the spatial resolution** to support climate research;
  - Studying LCC in key regions exposed to **extreme climate conditions** or characterized by **significant climate changes** over the last decades;
  - Understanding **classification variability across spatio-temporal scales.**
- ✓ Many **challenges** have been addressed that concerns mainly EO science, engineering and climate modelling.



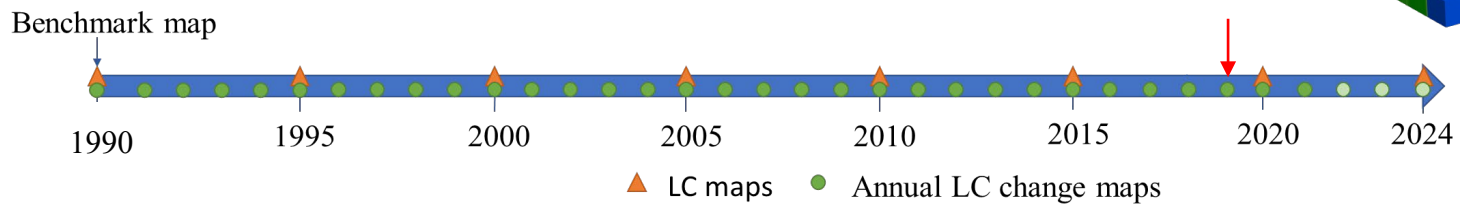
# Main Products



- ✓ A **HRLC map** at subcontinental scale for 2019 at **10m** as reference **static** input to the climate models.
- ✓ A **long-term time series of regional HRLC maps** at **30m** in sub-regions of the static input for historical reconstruction of LC every 5 years.
- ✓ The **change** information at **30m** on a **yearly scale** (when feasible from data availability) coherent with the updates of the HRLC maps.

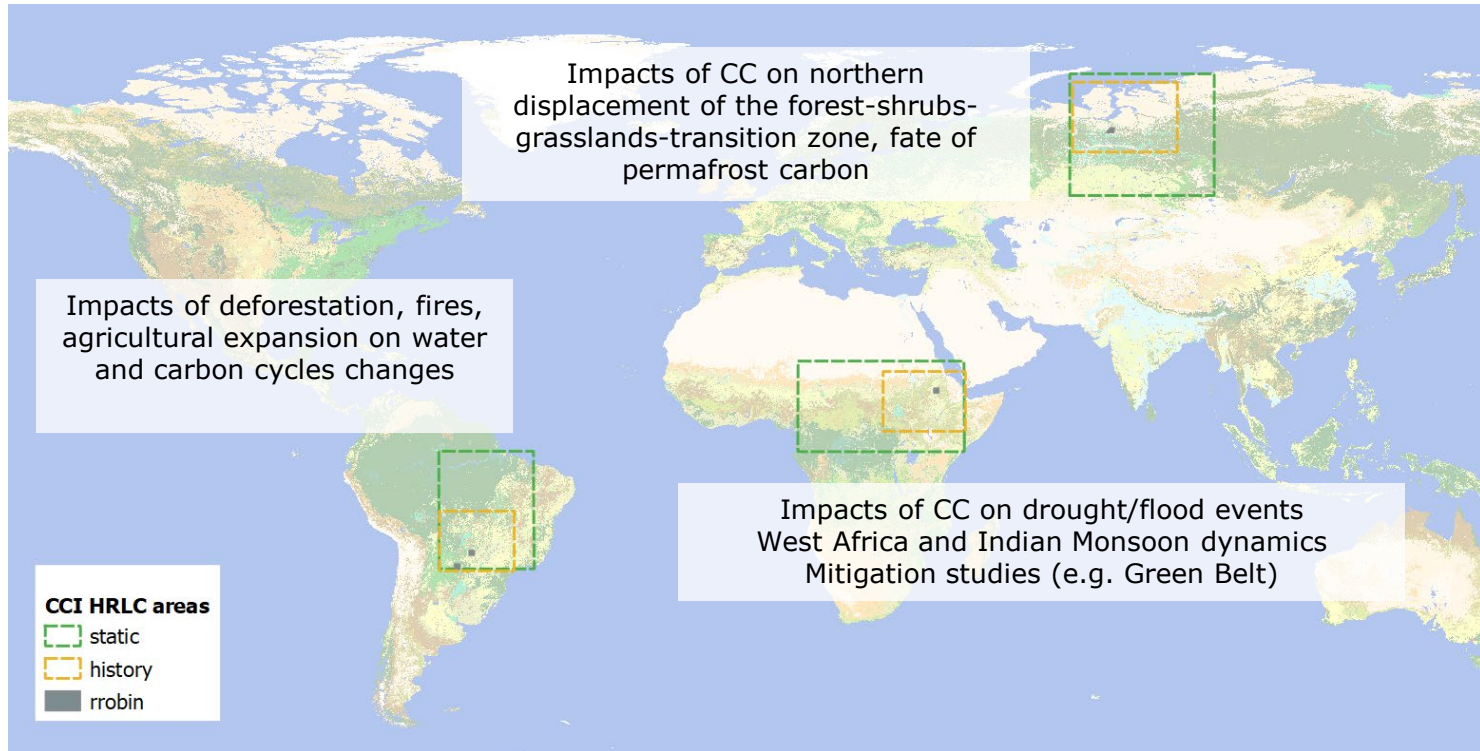


Static HRLC Map 2019





# Study Areas





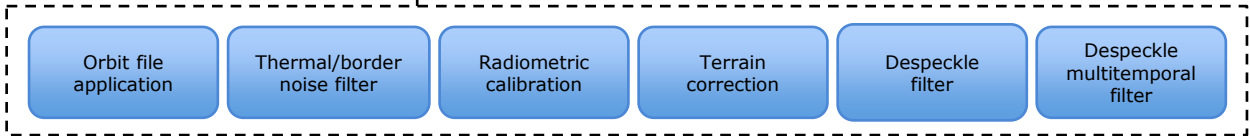
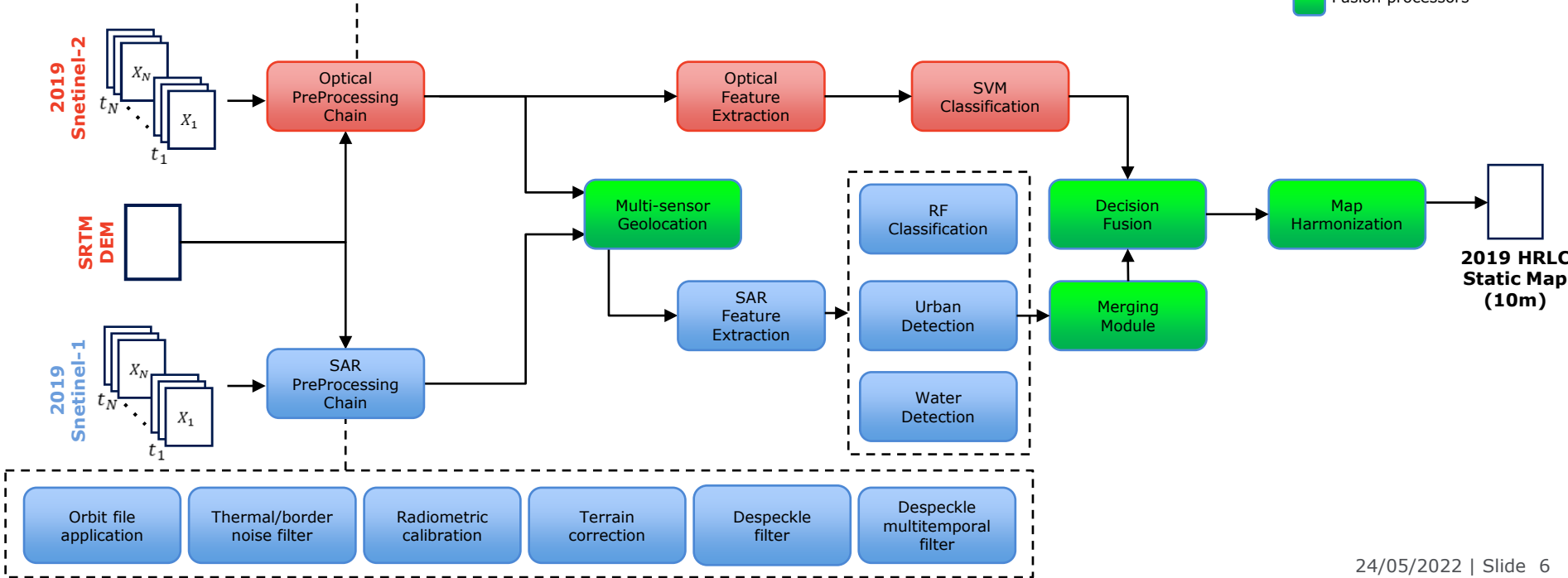
# Definition of Land-Cover Classes



10	Tree cover broadleaf	11	Tree cover broadleaf evergreen
		12	Tree cover broadleaf deciduous
20	Tree cover needleleaf	21	Tree cover needleleaf evergreen
		22	Tree cover needleleaf deciduous
30	Shrub cover	31	Shrub cover evergreen
		32	Shrub cover deciduous
40	Grasslands		
50	Croplands		
60	Woody vegetation aquatic or regularly flooded		
70	Herbaceous vegetation aquatic or regularly flooded		
80	Lichen and mosses		
90	Bare areas		
100	Built-up		
110	Snow and/or ice		
120	Open water	121	Open water permanent
		122	Open water seasonal

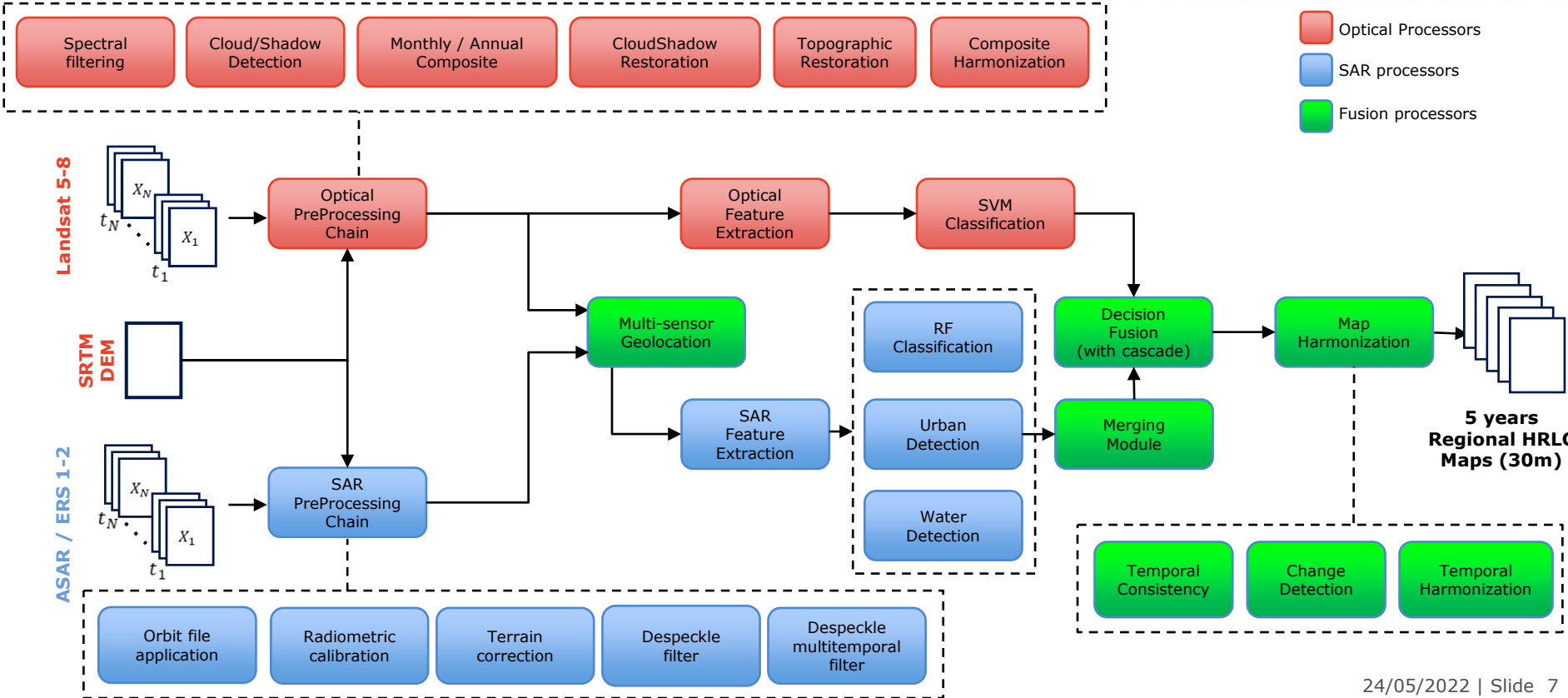


# Methodology: HRLC Static Maps at 10m



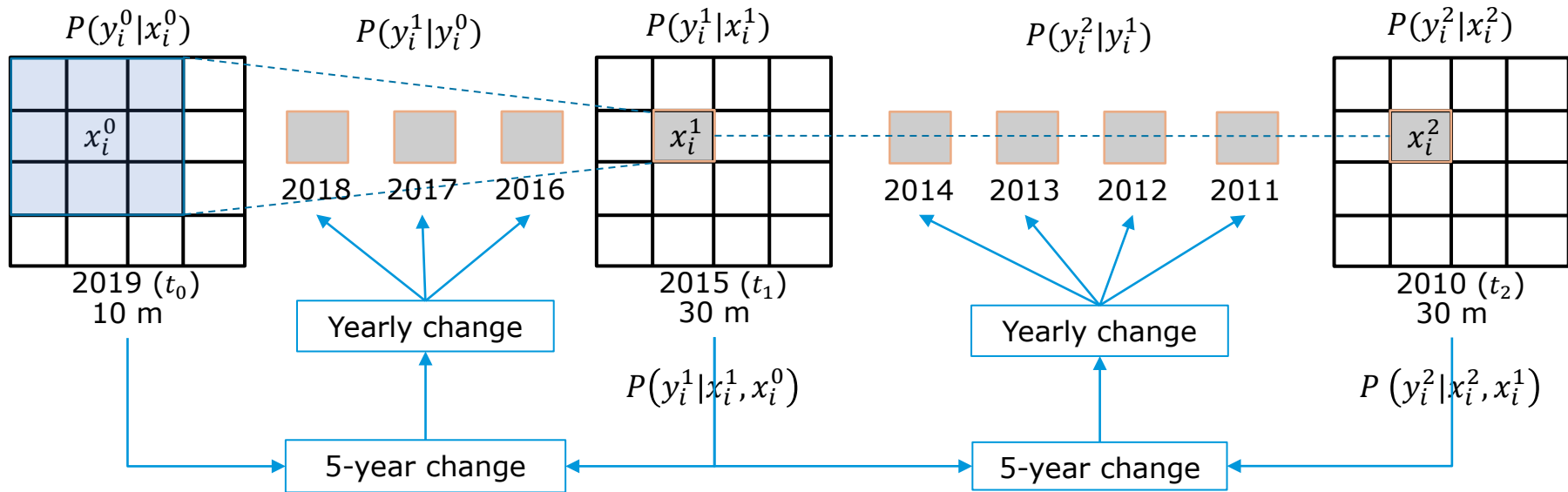


# Methodology: HRLC Historical Maps at 30m





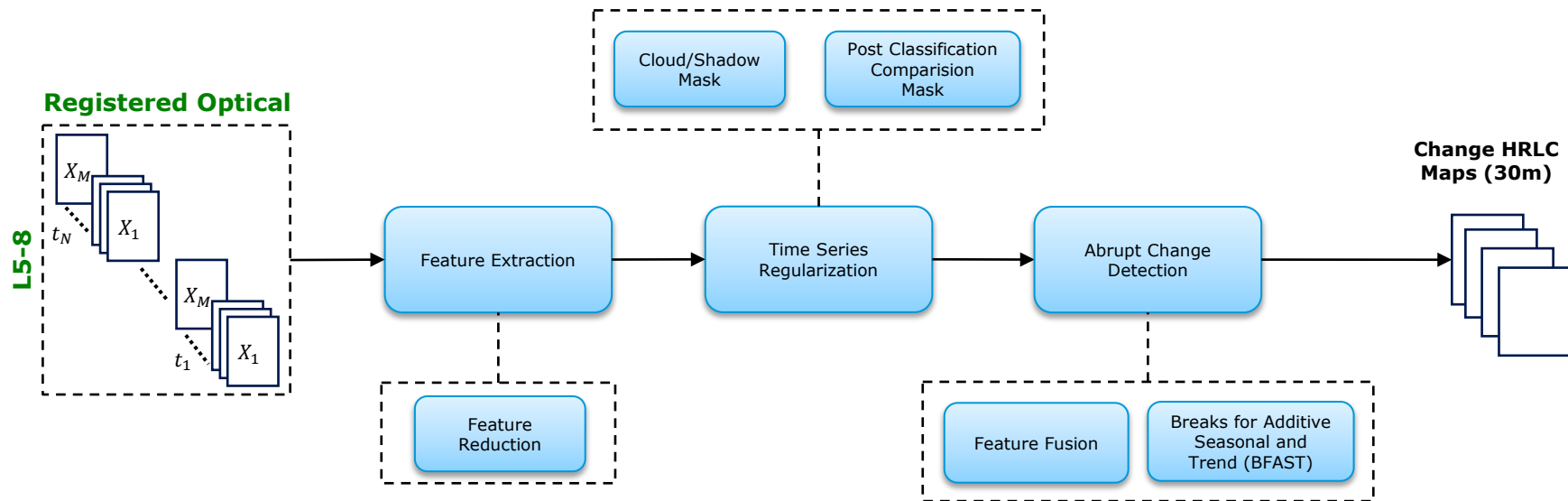
# Methodology: Cascade Classification Paradigm














# Methodology: Land Cover Change Maps at 30m





# Example: CCI HRLC vs CCI MRLC (Africa)



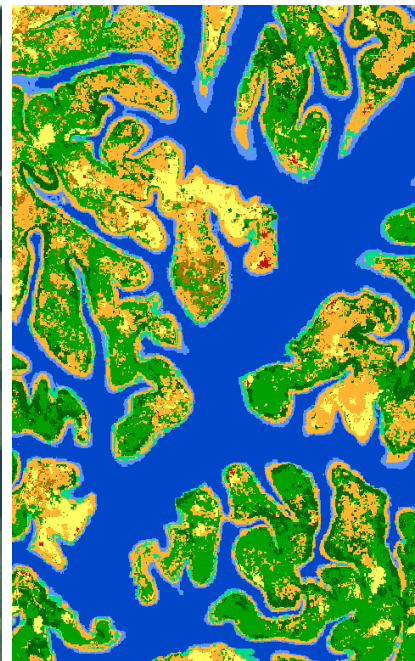
-  Evergreen broadleaf closed to open (>15%)
-  Deciduous broadleaf closed to open (>15%)
-  Deciduous broadleaf open (15-40%)
-  Tree and shrub (>50%) herbaceous (<50%)
-  Shrubland
-  Shrub or herbaceous cover flooded
-  Water bodies



CCI medium resolution



ESRI Image



CCI high resolution













-  Evergreen broadleaf
-  Deciduous broadleaf
-  Shrub evergreen
-  Shrub deciduous
-  Grassland
-  Cropland
-  Herbaceous Veg. aquatic
-  Bare areas
-  Built-up areas
-  Open water seasonal
-  Open water permanent

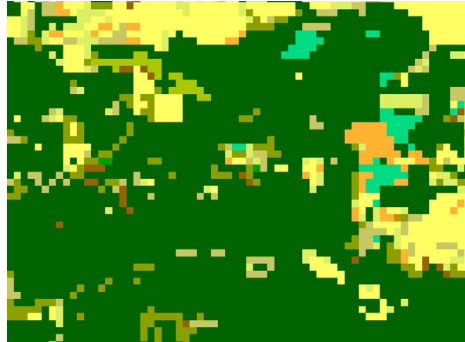




# CCI HRLC vs CCI MRLC and WorldCover 2020



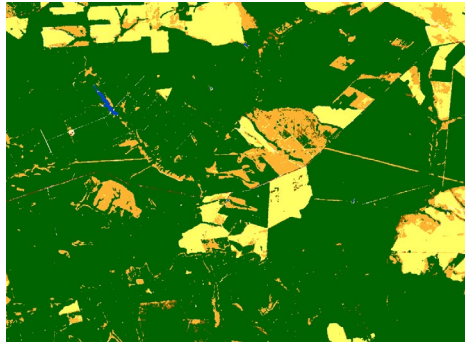
-  Evergreen broadleaf open (>15%)
-  Evergreen needleleaf
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-  Deciduous broadleaf open (15-40%)
-  Tree and shrub (>50%)  
Herbaceous (<50%)
-  Shrubland
-  Grassland
-  Cropland rainfed
-  Cropland (>50%)  
Natural veg. (<50%)
-  Natural veg. (>50%)  
Cropland (<50%)
-  Shrub or herbaceous cover flooded
-  Urban areas



CCI medium resolution  
2019



CCI high resolution  
2019



ESA WorldCover 2020



ESRI Image














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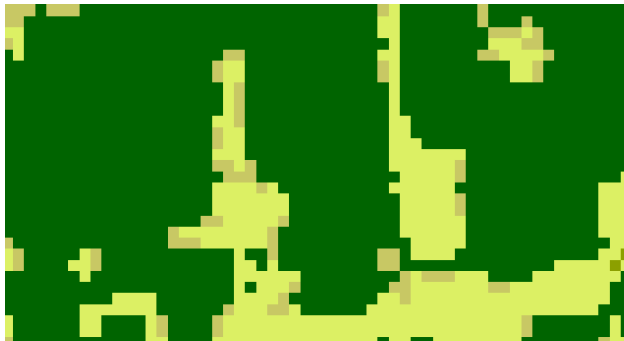




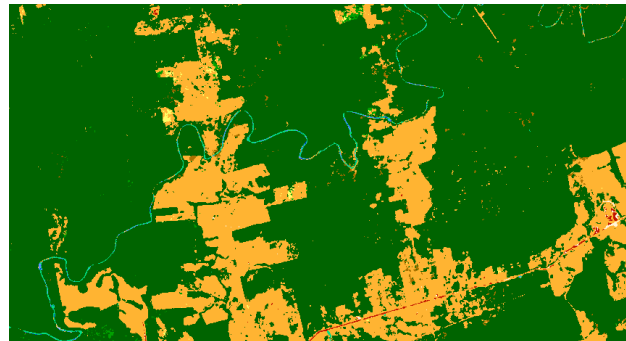
# HCCI RLC vs CCI MRLC and WorldCover 2020



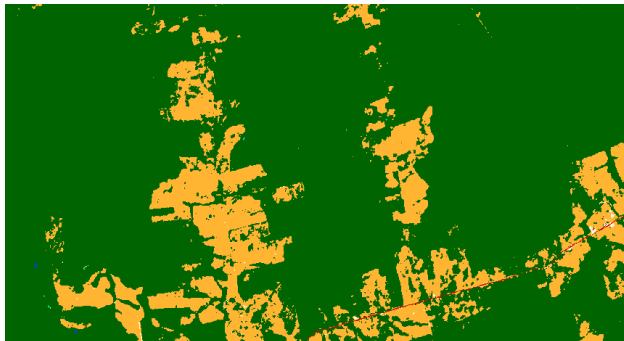
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-  Evergreen needleleaf
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-  Deciduous broadleaf open (15-40%)
-  Tree and shrub (>50%) herbaceous (<50%)
-  Shrub evergreen
-  Shrub deciduous
-  Grassland
-  Cropland rainfed
-  Cropland (>50%) natural veg. (<50%)
-  Natural veg. (>50%) cropland (<50%)
-  Shrub or herbaceous cover flooded
-  Urban areas



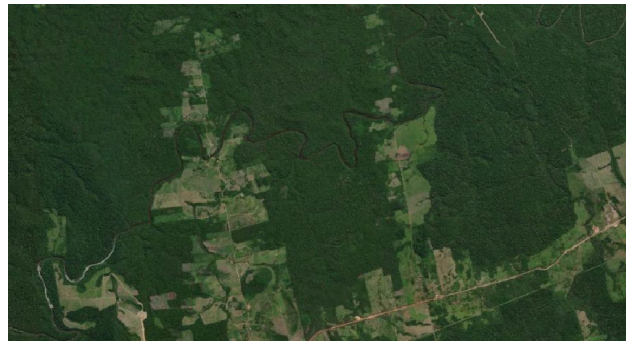
CCI medium resolution 2019



CCI high resolution 2019



ESA WorldCover 2020



Google Image













-  Evergreen broadleaf
-  Evergreen needleleaf
-  Deciduous broadleaf
-  Shrub evergreen
-  Shrub deciduous
-  Grassland
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-  Herbaceous Veg. aquatic
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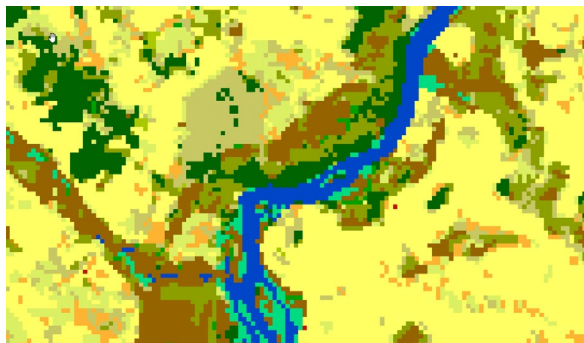




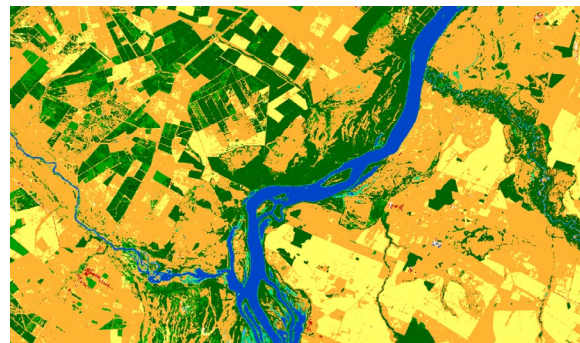
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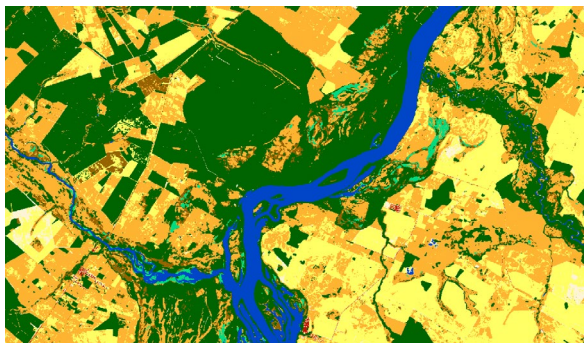
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CCI medium resolution  
2019



CCI high resolution  
2019



ESA WorldCover 2020



ESRI Image

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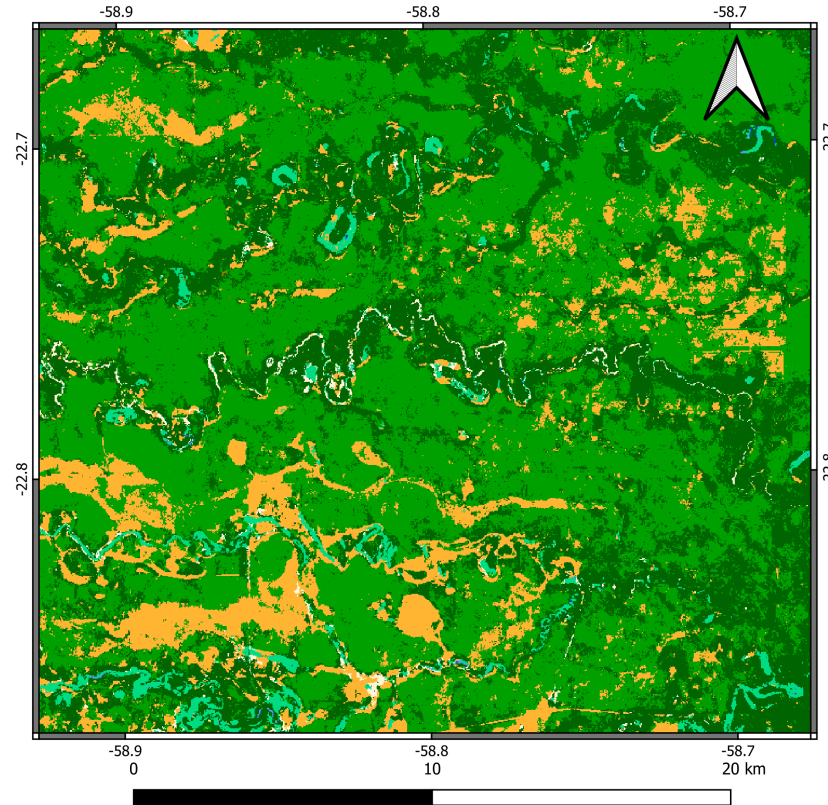




# Example: Historical LC Maps (Amazon)



- ✓ Example of deforestation through the years (1990, 1995, 2000, 2005, 2010, 2015, 2019) as seen by the HRLC land cover maps.



- Tree cover Evergreen broadleaf
- Tree cover Evergreen needleleaf
- Tree cover Deciduous broadleaf
- Shrub evergreen
- Shrub deciduous
- Grassland
- Cropland
- Herbaceous Veg. aquatic or regularly flooded
- Bare areas
- Built-up areas
- Open water seasonal
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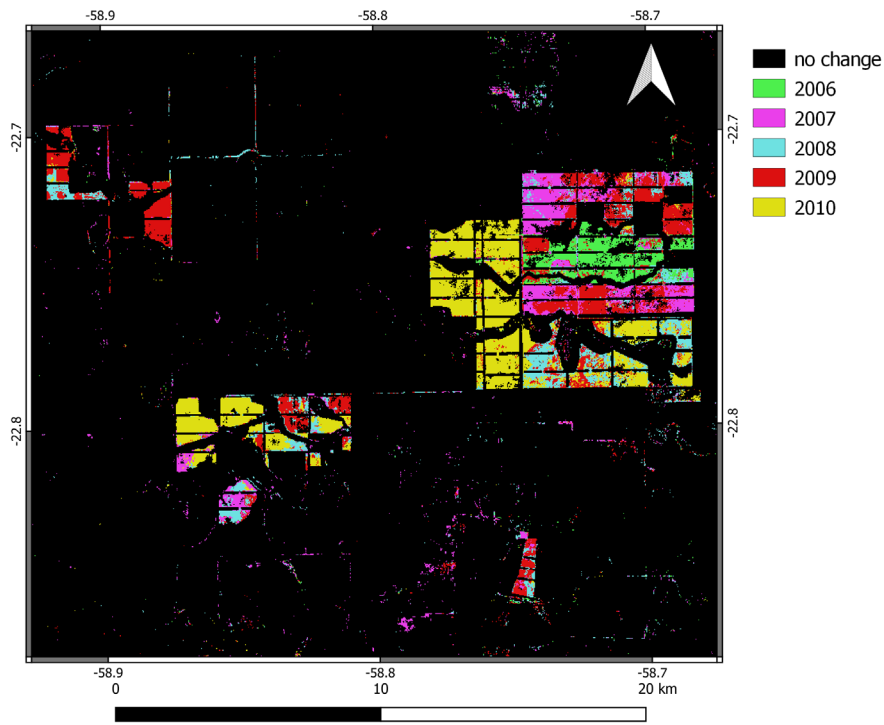




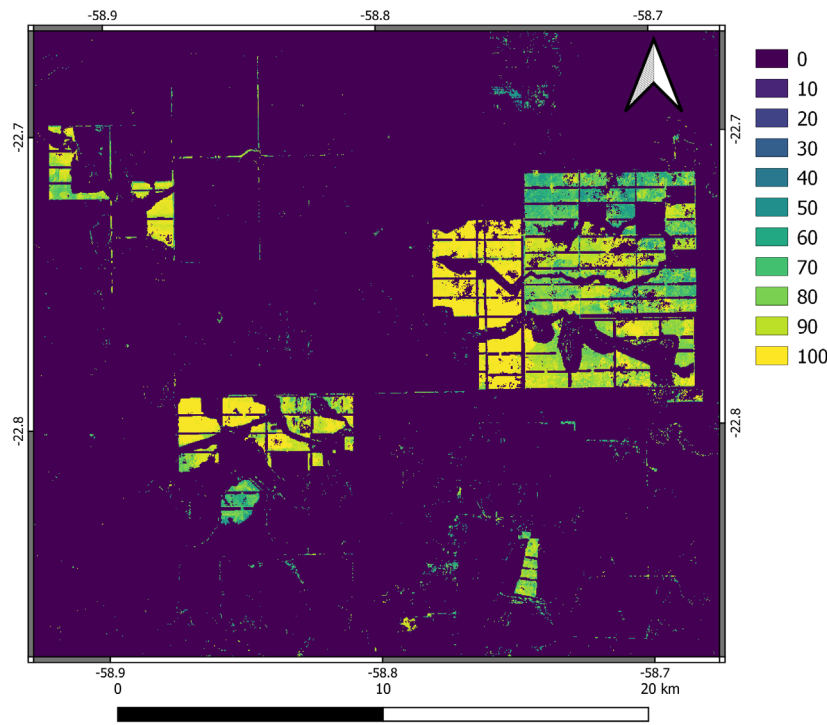
# Example: Land Cover Change Products



## Land Cover Change Map (2005 – 2010)

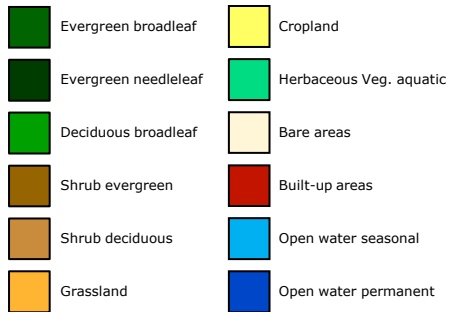
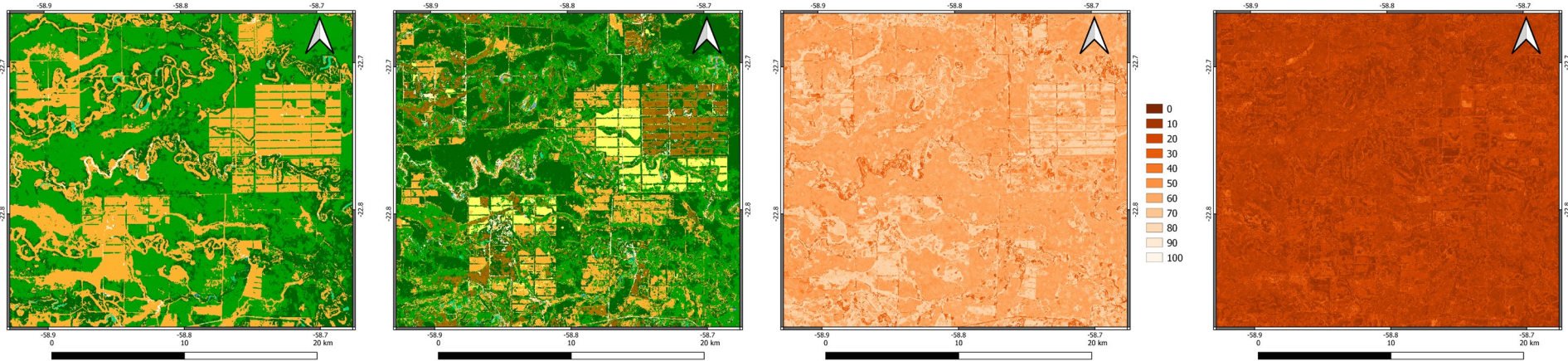


## Probability of Change





# Example: Historical LC Product (Amazon 2010)



From left to right: first class, second class, posterior probability (%) of the first class and posterior probability of the second class.







- ✓ Three processing chains have been developed for the **production of HRLC maps (at 10m and 30m)** and for the **change detection (at 30m)**. The adopted core methodology is based on **cascade classification paradigm** for modeling the temporal correlation in the mapping of the land-cover classes.
- ✓ The investigated areas are challenging in terms of data availability. In some tiles in many years there are very few (or no) cloud free data. In some regions there are not SAR images. Thus, the products should be analyzed considering always the attached **uncertainty information**.
- ✓ HRLC allows to capture **high relevance regional/local patterns** that cannot be recognized with MRLC and to **improve modeling capabilities** also towards a better use of MRLC products.
- ✓ For details on **quantitative validation**: [see Thursday – 26.05.2022 Poster Session: 05:33 pm ESA CCI High Resolution Land Cover Products](#)



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