

Development of an Indicator to Monitor Mediterranean Wetlands

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Wetlands are sensitive ecosystems that are increasingly subjected to threats from anthropogenic factors. In the last decades, coastal Mediterranean wetlands have been suffering considerable pressures from land use change, intensification of urban growth, increasing tourism infrastructure and intensification of agricultural practices. Remote sensing (RS) and Geographic Information Systems (GIS) techniques are efficient tools that can support monitoring Mediterranean coastal wetlands on large scales and over long periods of time. The study aims at developing a wetland indicator to support monitoring Mediterranean coastal wetlands using these techniques. The indicator makes use of multi-temporal Landsat images, land use reference layers, a 50m numerical model of the territory (NMT) and Corine Land Cover (CLC) for the identification and mapping of wetlands. The approach combines supervised image classification techniques making use of vegetation indices and decision tree analysis to identify the surface covered by wetlands at a given date. A validation process is put in place to compare outcomes with existing local wetland inventories to check the results reliability. The indicator's results demonstrate an improvement in the level of precision of change detection methods achieved by traditional tools providing reliability up to 95% in main wetland areas. The results confirm that the use of RS techniques improves the precision of wetland detection compared to the use of CLC for wetland monitoring and stress the strong relation between the level of wetland detection and the nature of the wetland areas and the monitoring scale considered.



Figure 1. Camargue Natural Regional Park. Landsat 7 ETM+ satellite image.

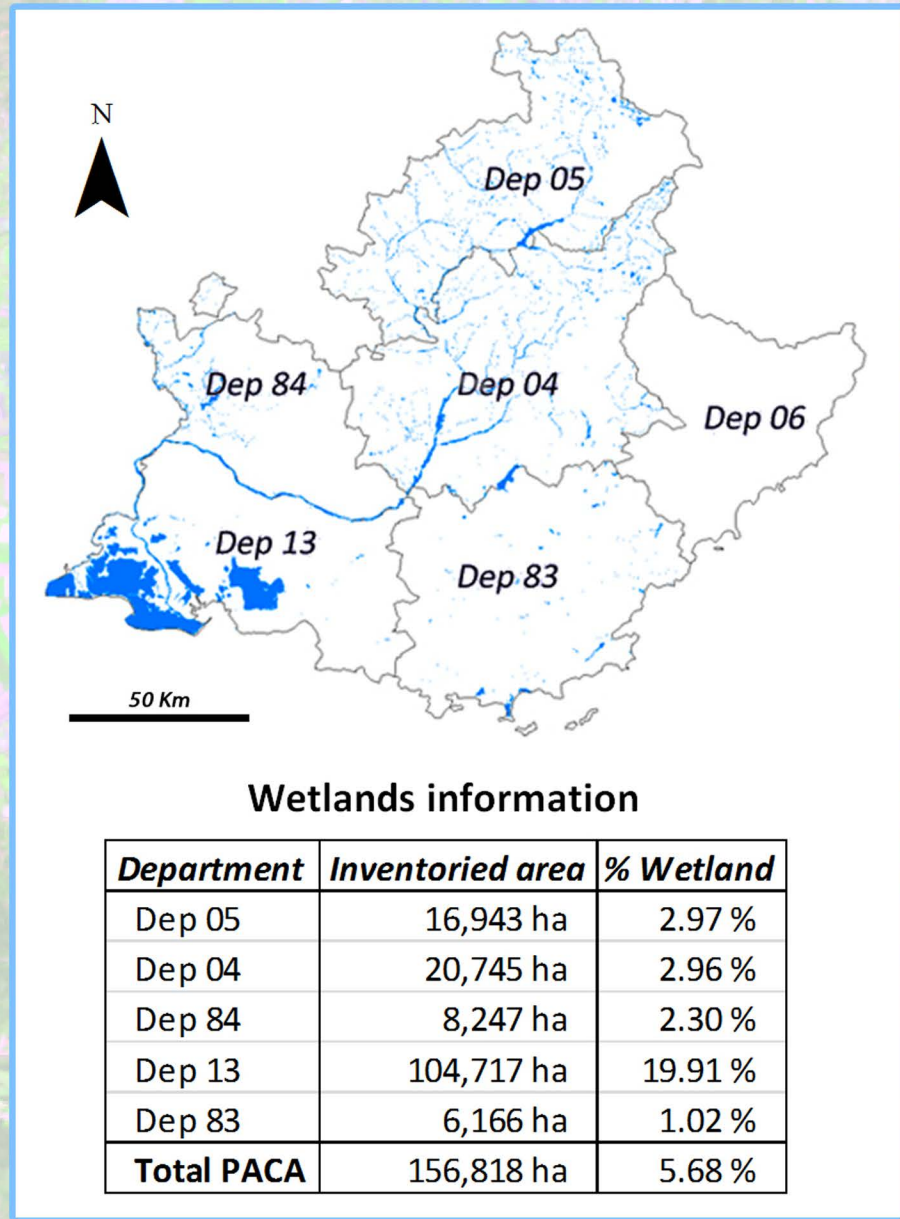


Figure 2. Study area: Departments of the PACA region, wetland surfaces, and % covered by wetland.

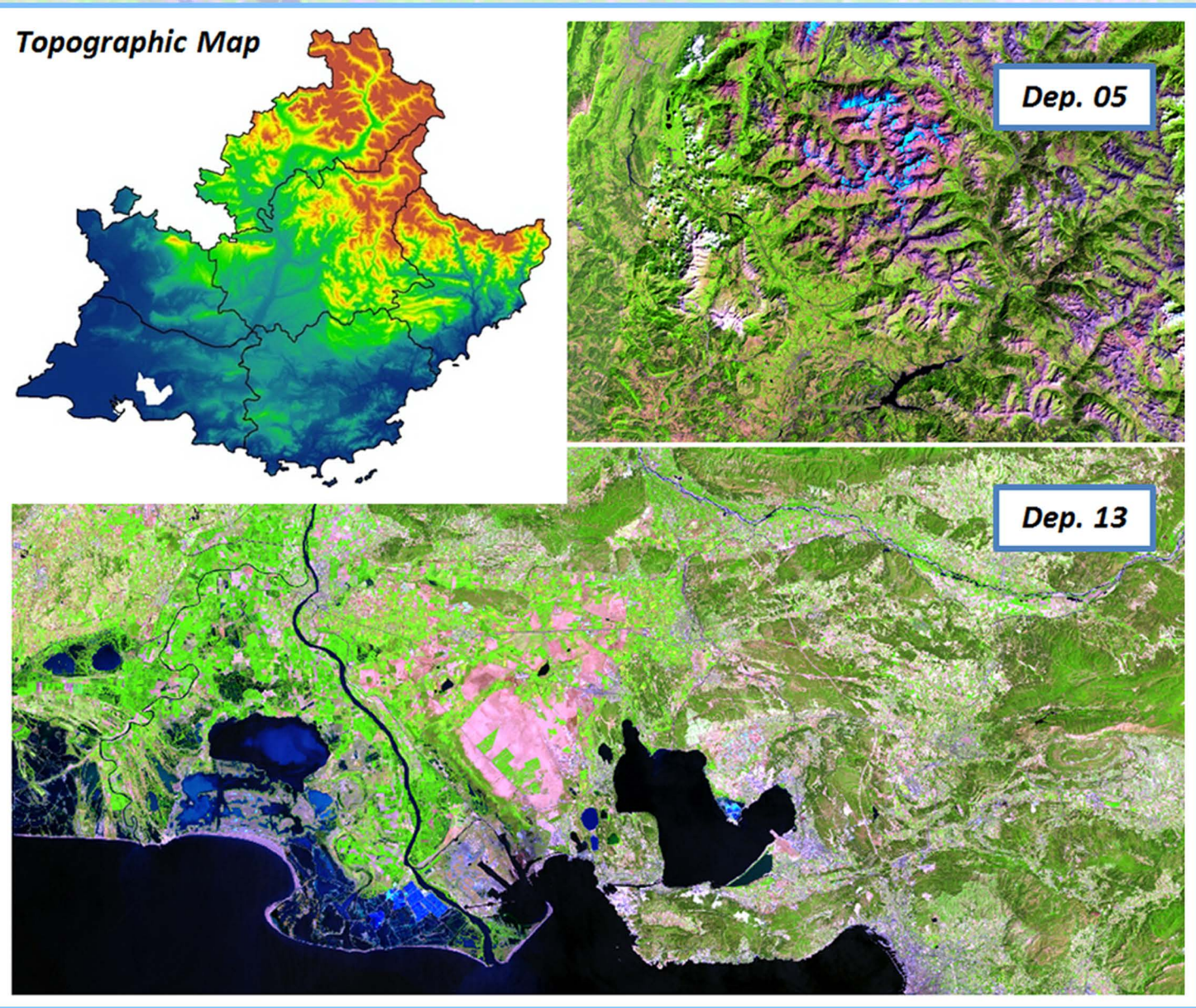


Figure 3. Topographic map of the PACA region and samples of satellite images (false color) of Dep. 13 (littoral) and Dep. 05 (mountainous).

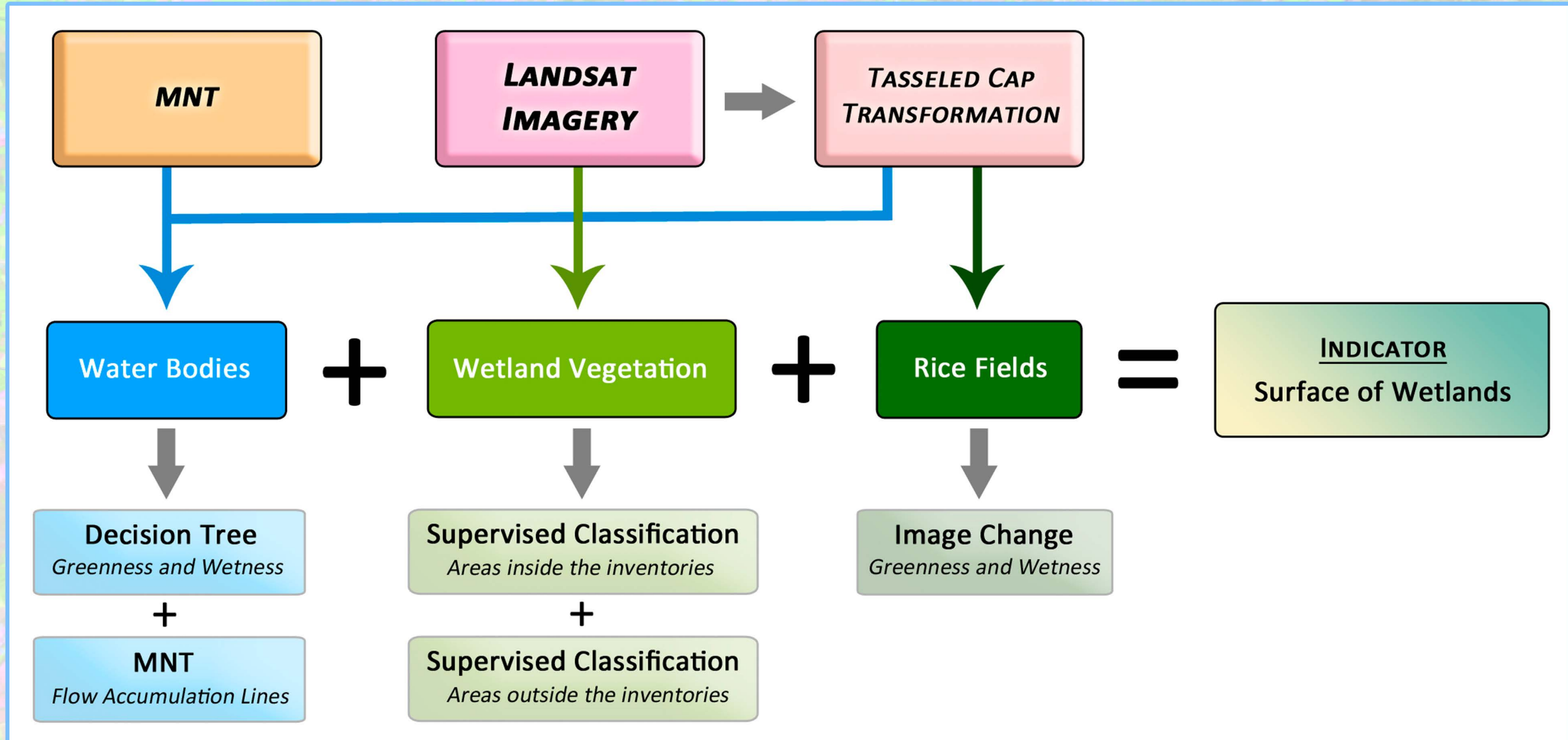


Figure 4. Diagram of the classification process developed for the wetland indicator.

- **Error A** is the percentage of land that is erroneously classified as wetland. This error is understood as the surface detected by the indicator that is outside the reference layers (not considered as wetland in the inventory). It would be the overestimation of wetlands compared with the inventories.

- **Error B** corresponds to the percentage of real wetlands (present in the inventories) that are not detected by the indicator. In other words, this would be the surface of the references that is not classified as wetland (omission).

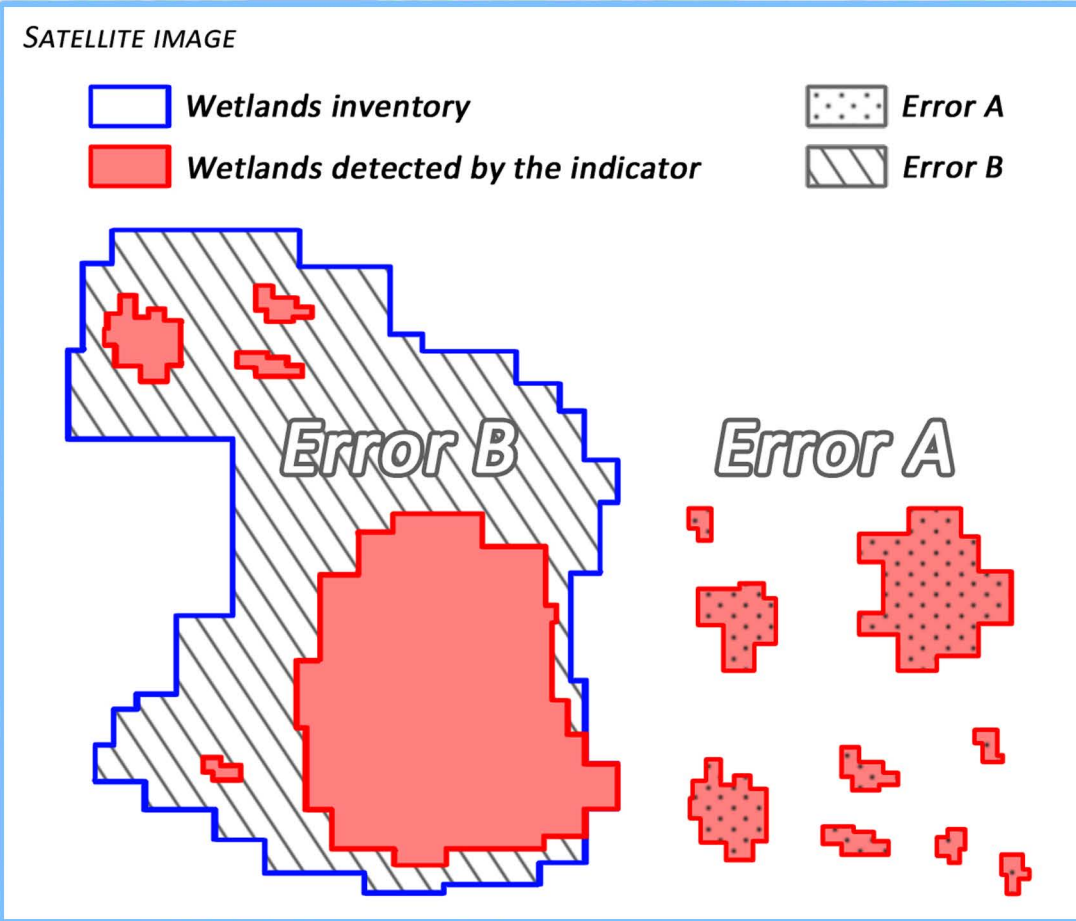


Figure 5. Illustrative example of error A and error B calculated from the layers of the indicator and the inventories of wetlands.

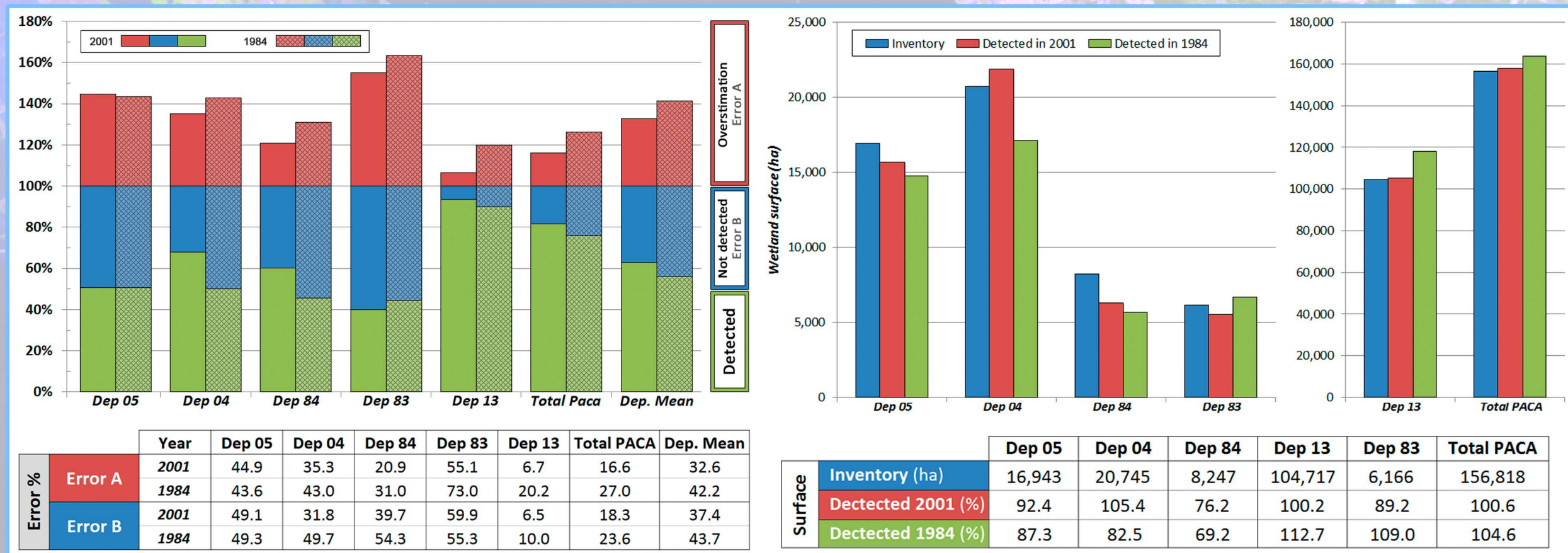
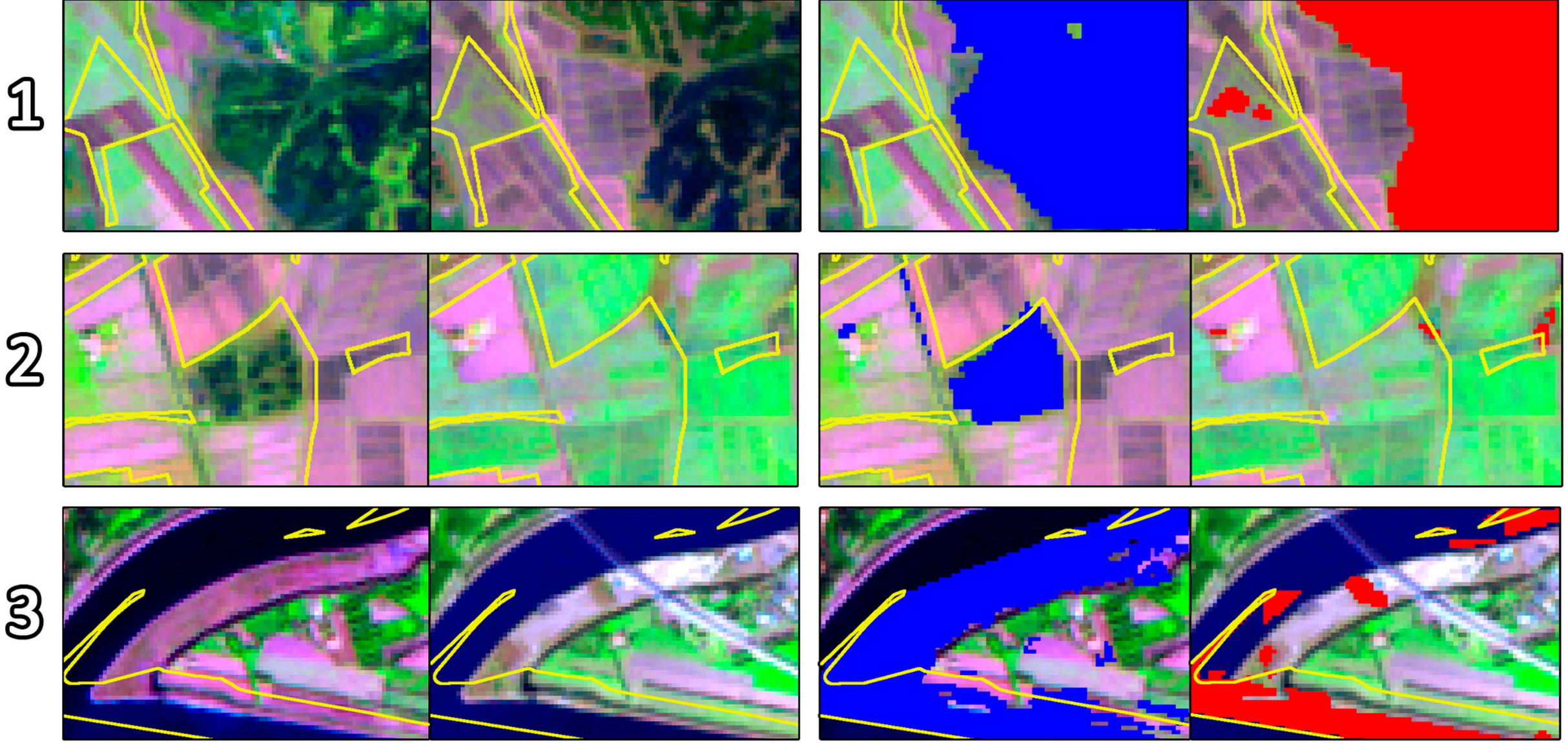


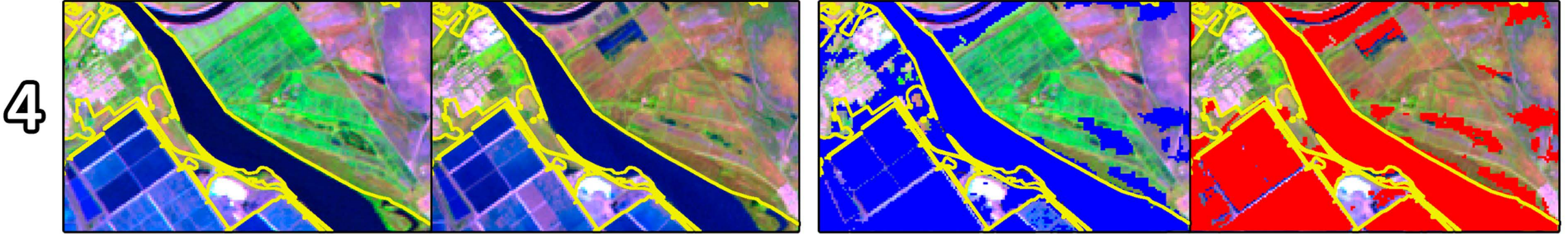
Figure 6. Indicator results in hectares and percentage.

Landsat Imagery 1984	Landsat Imagery 2001	Wetland Indicator 1984	Wetland Indicator 2001
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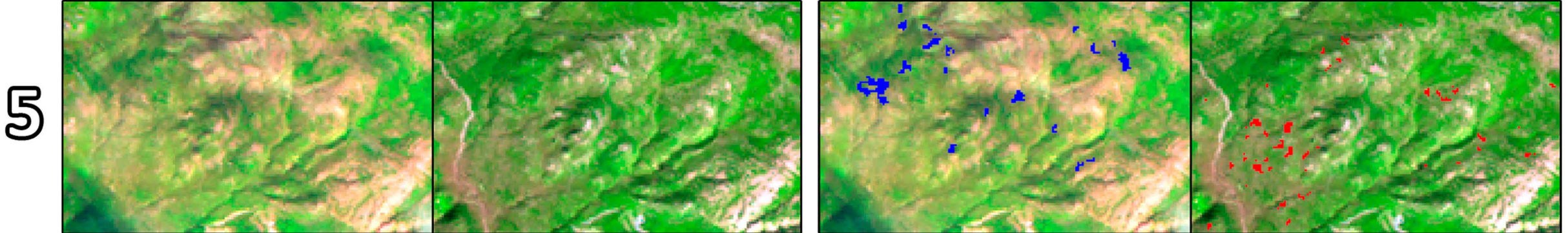
Apparent wetland loss



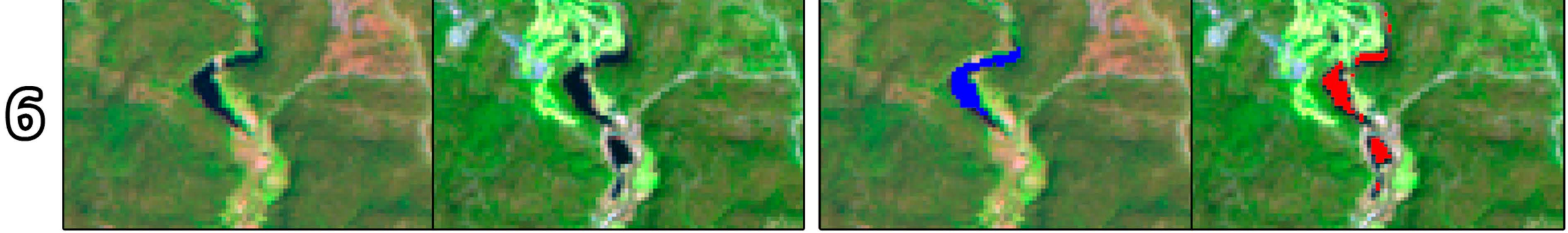
Stability



Classification errors



New and not inventoried wetlands



Wetland Inventory

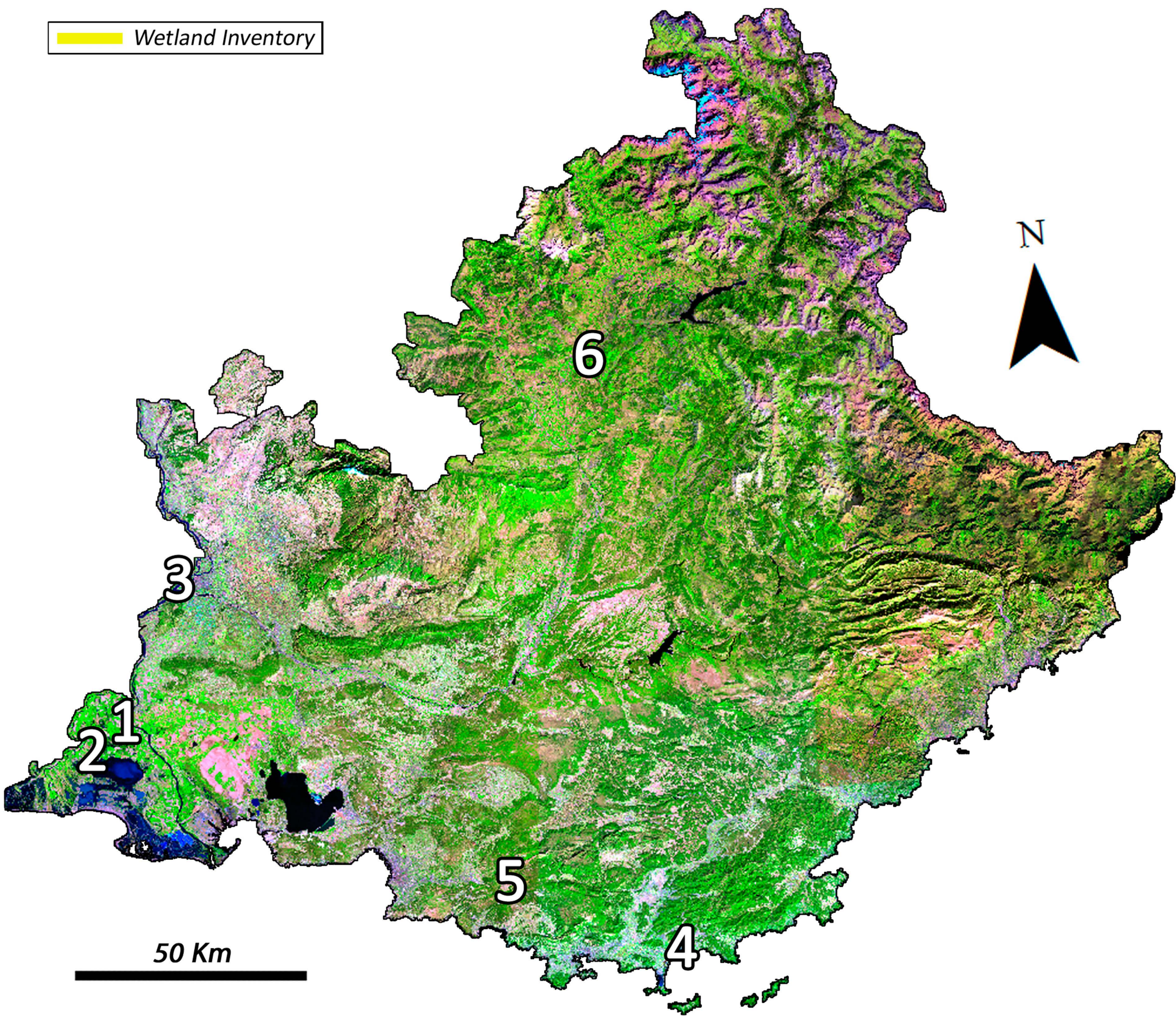


Figure 7. Cases of wetland classifications between 1984 and 2001.