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INTRODUCTION

The Compact High Resolution Imaging System (CHRIS) on the Project for On-Board Autonomy platform (PROBA-1) is an **experimental hyperspectral satellite** sensor which provides 13kmx13km images with **62 spectral bands** from 415nm to 1050nm at a spatial resolution of 36m since 2001. To **prepare the exploitation of hyperspectral data from future ocean colour missions**, CHRIS images taken over inland and coastal waters were processed to retrieve water reflectance and water constituents.

The processing chain (Figure 3) includes the **correction of disturbance patterns** characterized by a strong spatial and spectral coherence (Gomez-Chova et al., 2008) and **atmospheric correction**. Atmospheric correction is adapted from Vanhellemont and Ruddick (2018). It assumes an homogeneous aerosol type and optical thickness over the scene and the presence of at least 1% of surface NIR dark pixels. Water leaving reflectance products have been **validated with Sentinel 2 match-ups** (Figures 4-7). Examples of suspended particulate matter and chlorophyll-a concentration products derived from CHRIS/PROBA are presented in Figures 1 and 2.

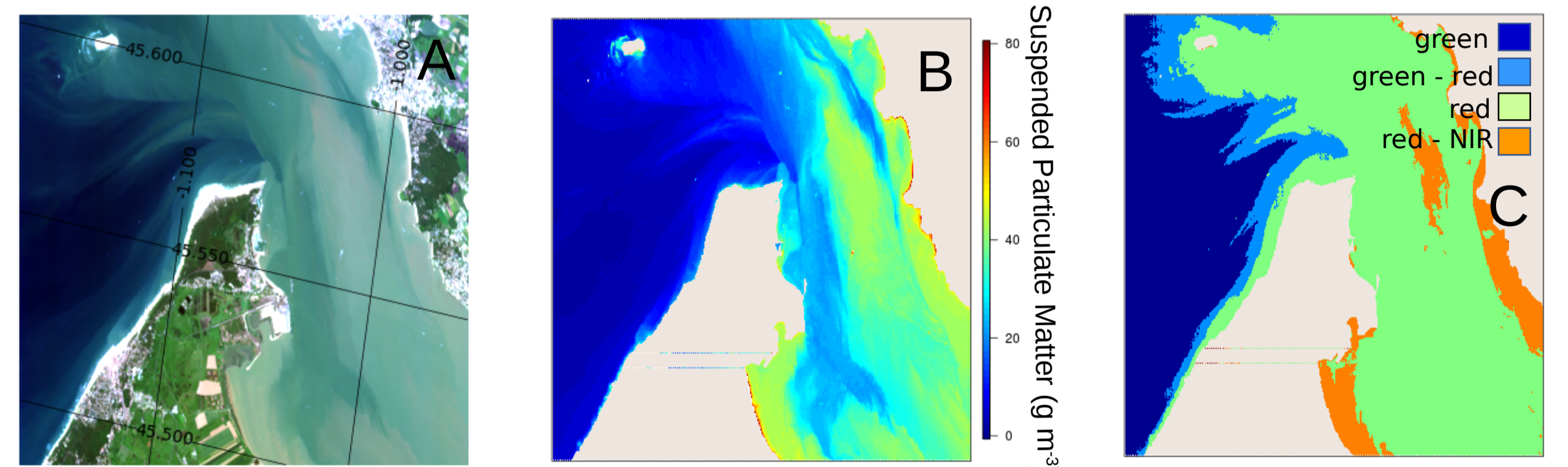


Figure 1: Application on CHRIS/PROBA image of the regional band shift algorithm developed by Novoa et al. (2017) to retrieve SPM in the Gironde estuary. CHRIS image was taken on 2018/05/27 with a fly-by-zenith angle of 36°. Panel B shows SPM distribution. Panel C indicates which spectral bands have been used for SPM retrieval.

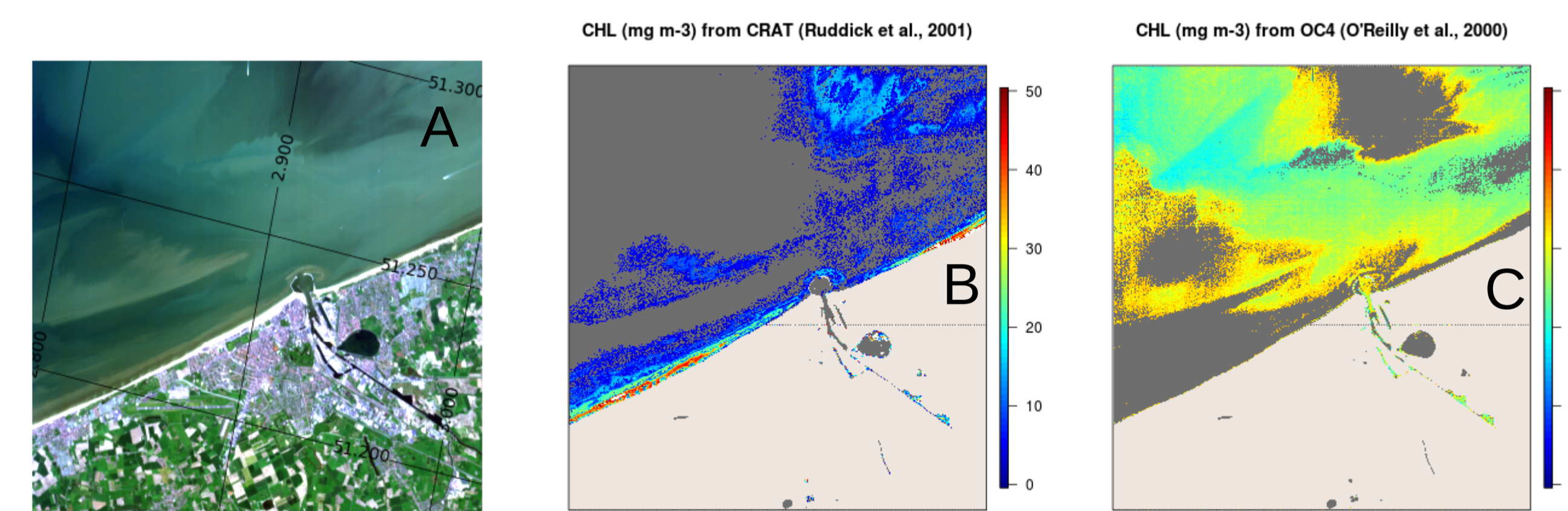


Figure 2: Chlorophyll-a concentration (CHL) in Belgian coastal waters. CHL is obtained in eutrophic and/or turbid waters with the red-edge hyperspectral CRAT algorithm (Ruddick et al., 2001, panel B) and with the blue-green OC4 algorithm in low CHL and low turbidity waters (CHL < 7 mg m⁻³, panel D). CHRIS image was taken on 2018/05/04 with a fly-by-zenith angle of 36°

DATABASE, PROCESSING AND VALIDATION WITH SENTINEL 2

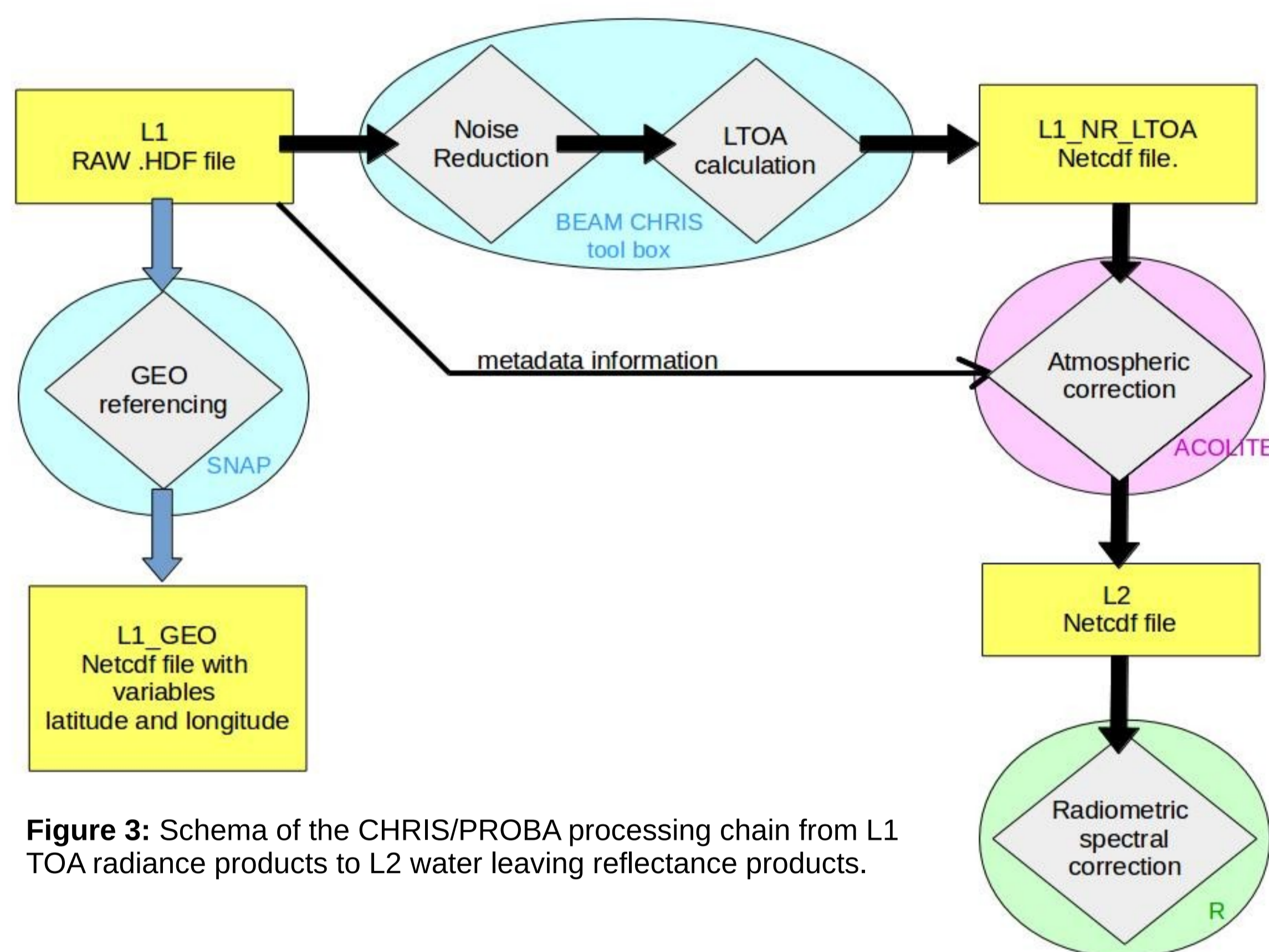


Figure 3: Schema of the CHRIS/PROBA processing chain from L1 TOA radiance products to L2 water leaving reflectance products.

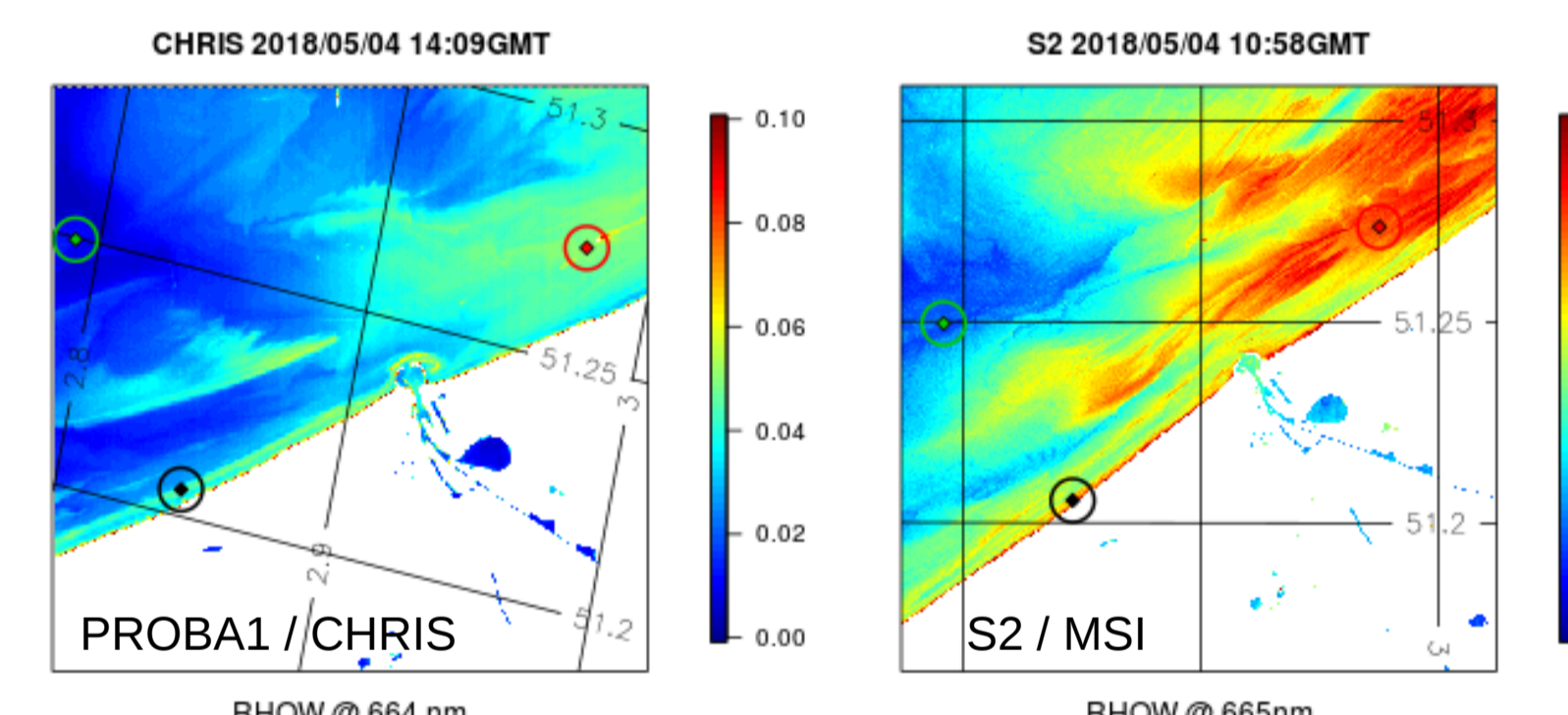
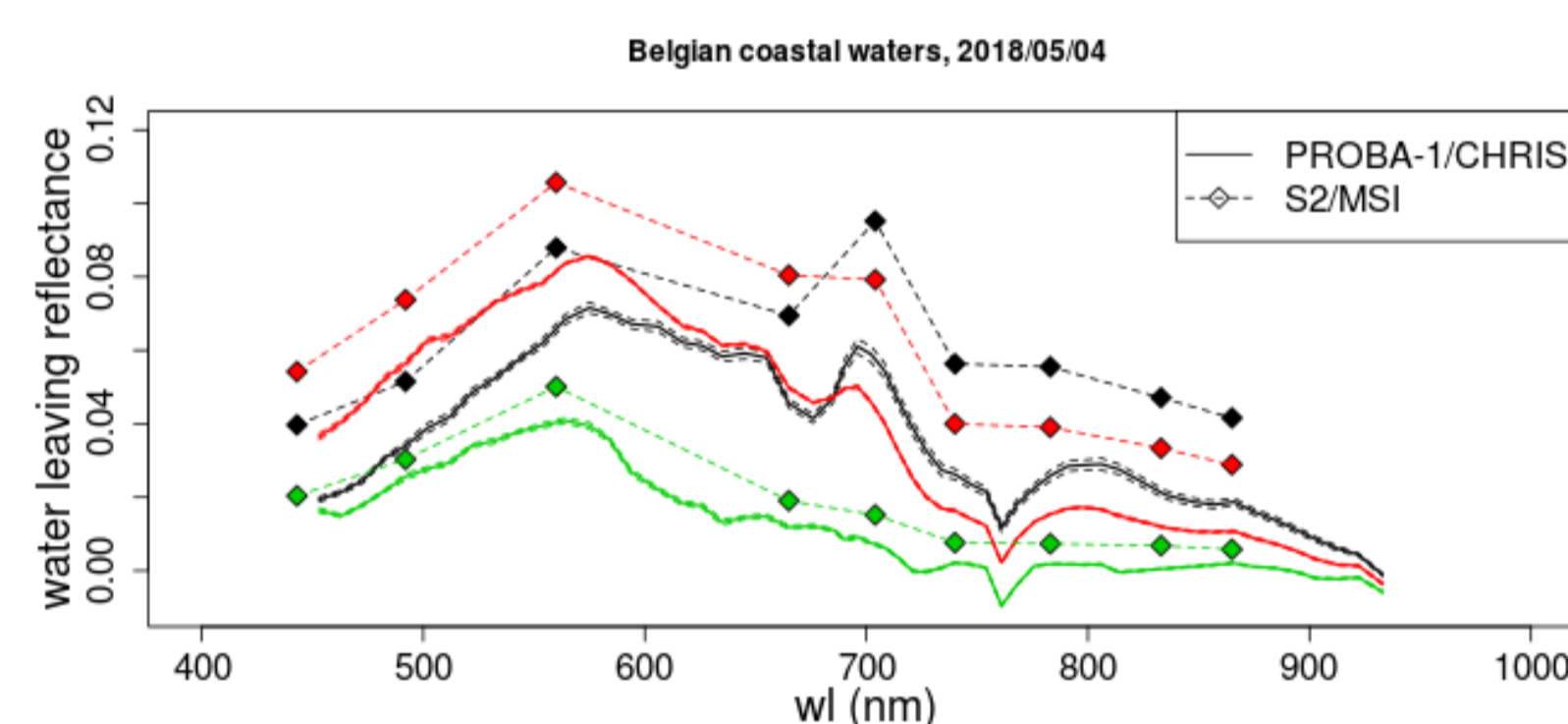


Figure 4: PROBA-1-CHRIS / S2-MSI comparison in Belgian coastal waters

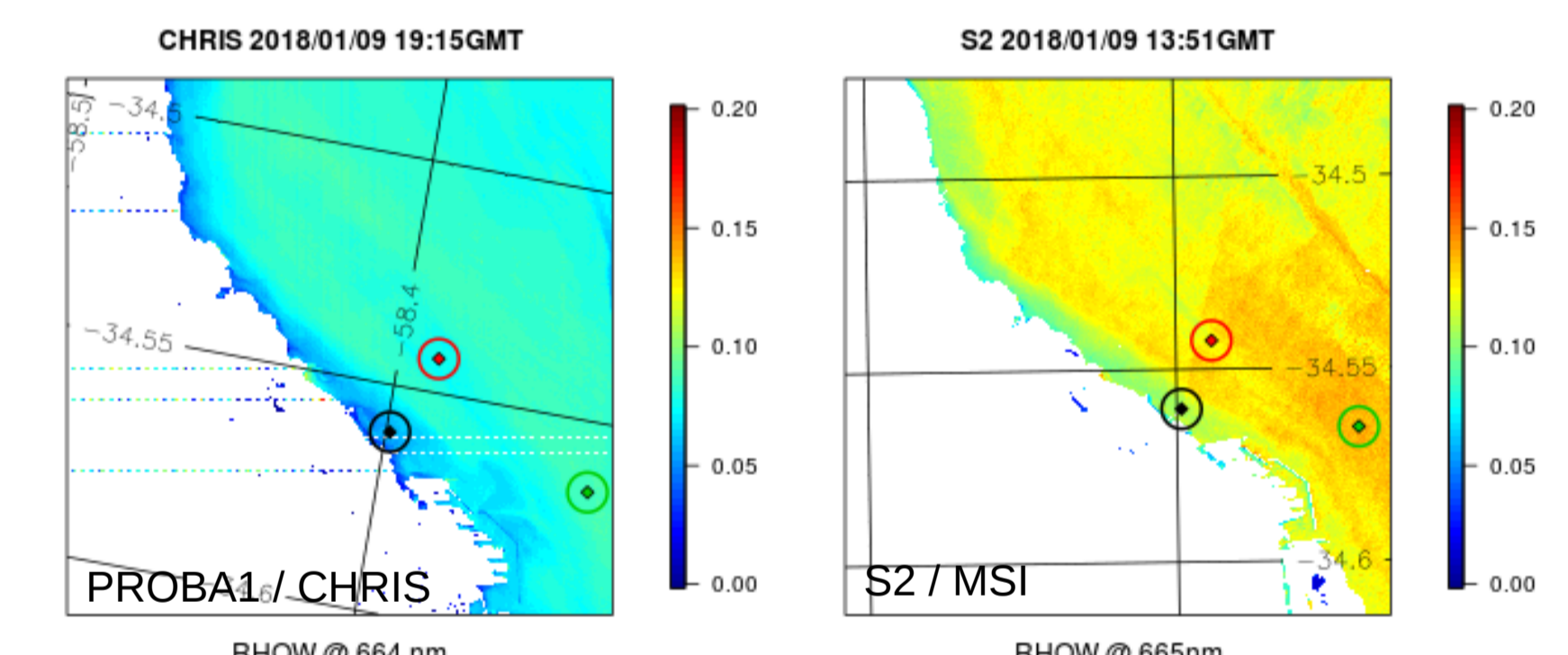
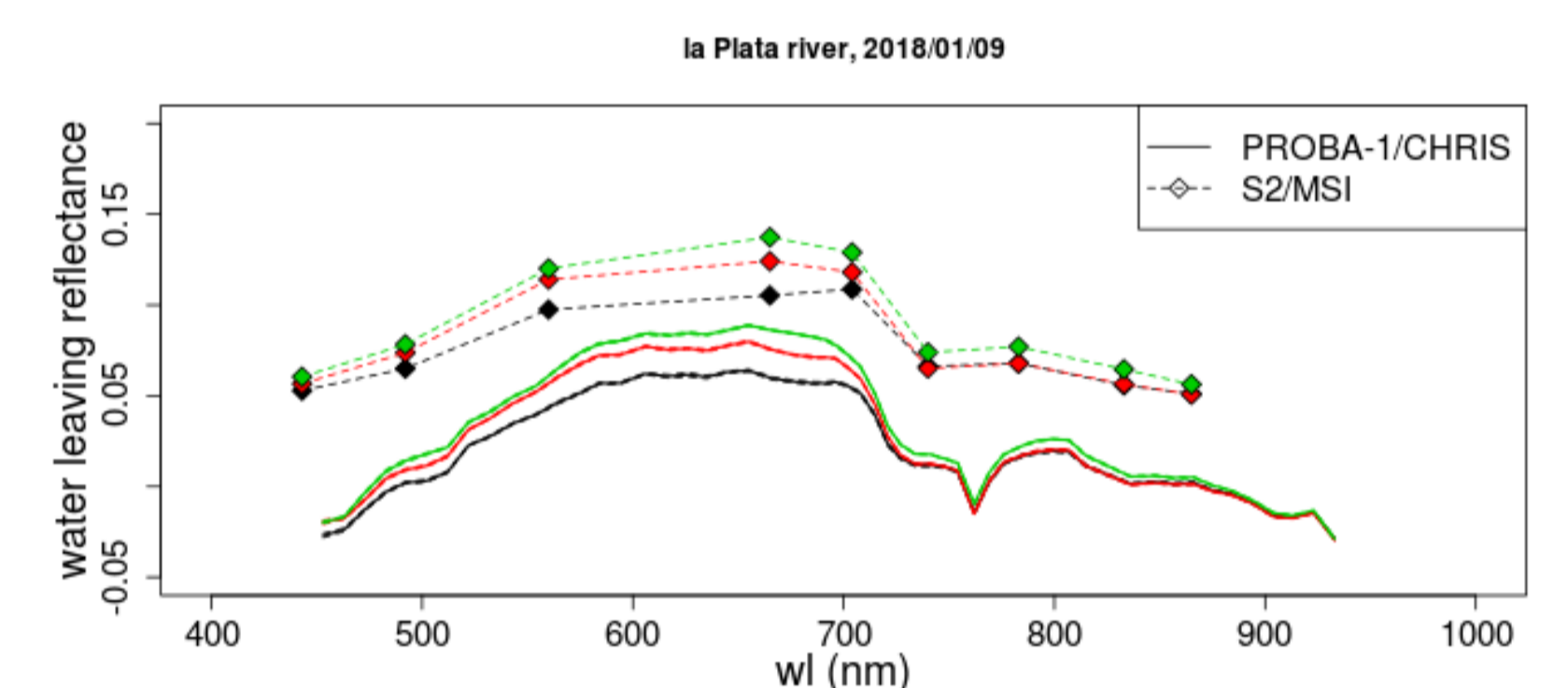


Figure 5: PROBA-1-CHRIS / S2-MSI comparison in the Plata river

Table 1: HYPERMAQ database of CHRIS/PROBA products for the period January-October 2018. Numbers after "x" indicate the number of available replicates (for each scene acquisition, CHRIS sensor takes 5 images with different view angles of the same target). Dates in red have a Sentinel 2 match-up on the same day.

Belgian coast Oostende	(2018/05/04 14:09GMT) x5
Belgian coast Zeebrugge	(2018/05/20 14:00GMT) x5 (2018/08/31 13:46GMT) x5
Rio de la Plata (Argentina)	(2018/01/09 19:18GMT) x5 (2018/02/12 19:10GMT) x5 (2018/03/01 19:11GMT) x3 (2018/03/20 19:19GMT) x5
Chascomus Lake (Argentina)	(2018/01/08 19:09GMT) x4 (2018/02/14 19:20GMT) x5 (2018/03/04 19:24GMT) x4 (2018/03/19 19:11GMT) x5 (2018/05/27 19:07GMT) x5
Gironde Estuary (France)	(2018/05/27 14:37GMT) x5 (2018/08/19 14:15GMT) x4 (2018/09/07) x5 (2018/09/08) x5 (2018/09/24) x5
Rhone Estuary (France)	(2018/09/01 13:50GMT) x5
Var Estuary (France)	(2018/03/13 14:09GMT) x5 (2018/04/30 13:46GMT) x5 (2018/09/02 13:55GMT) x4

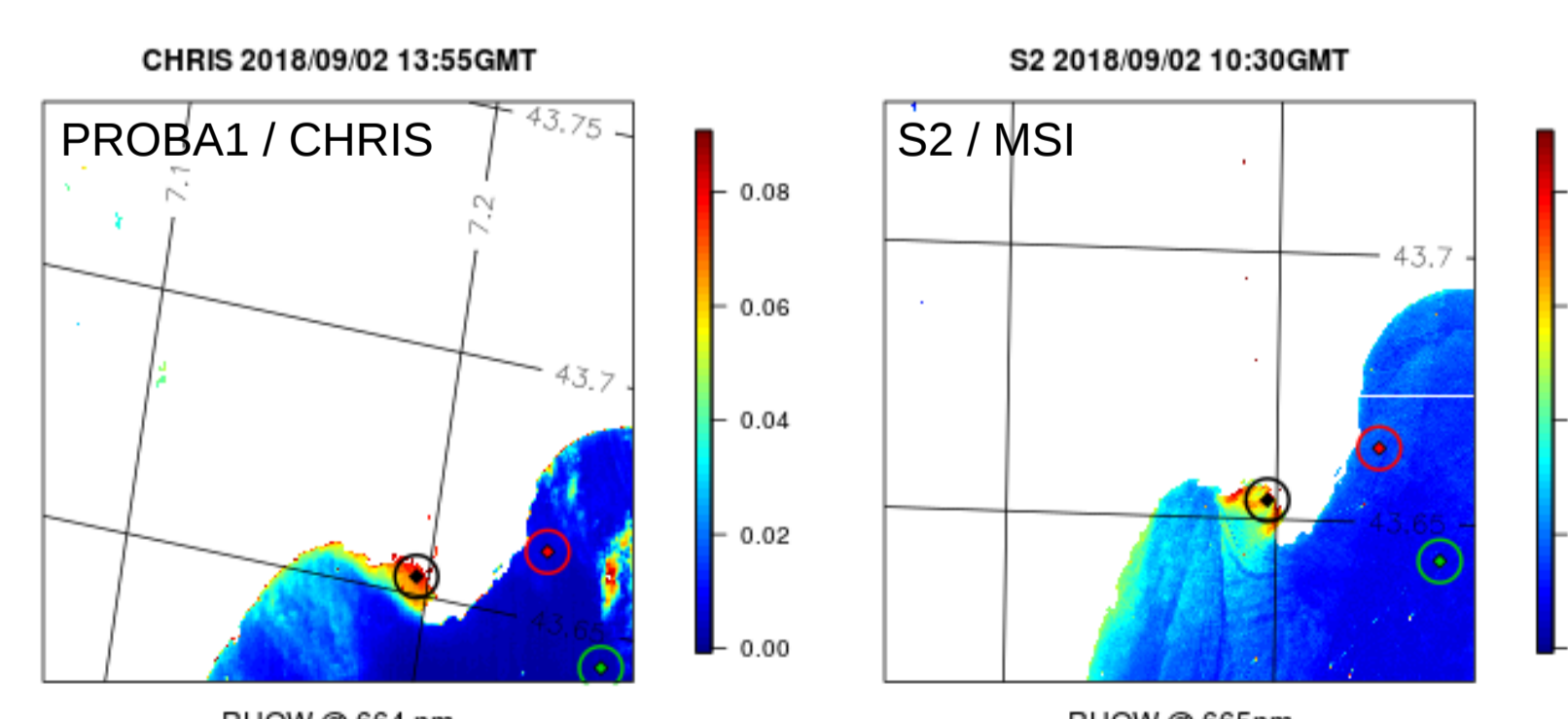
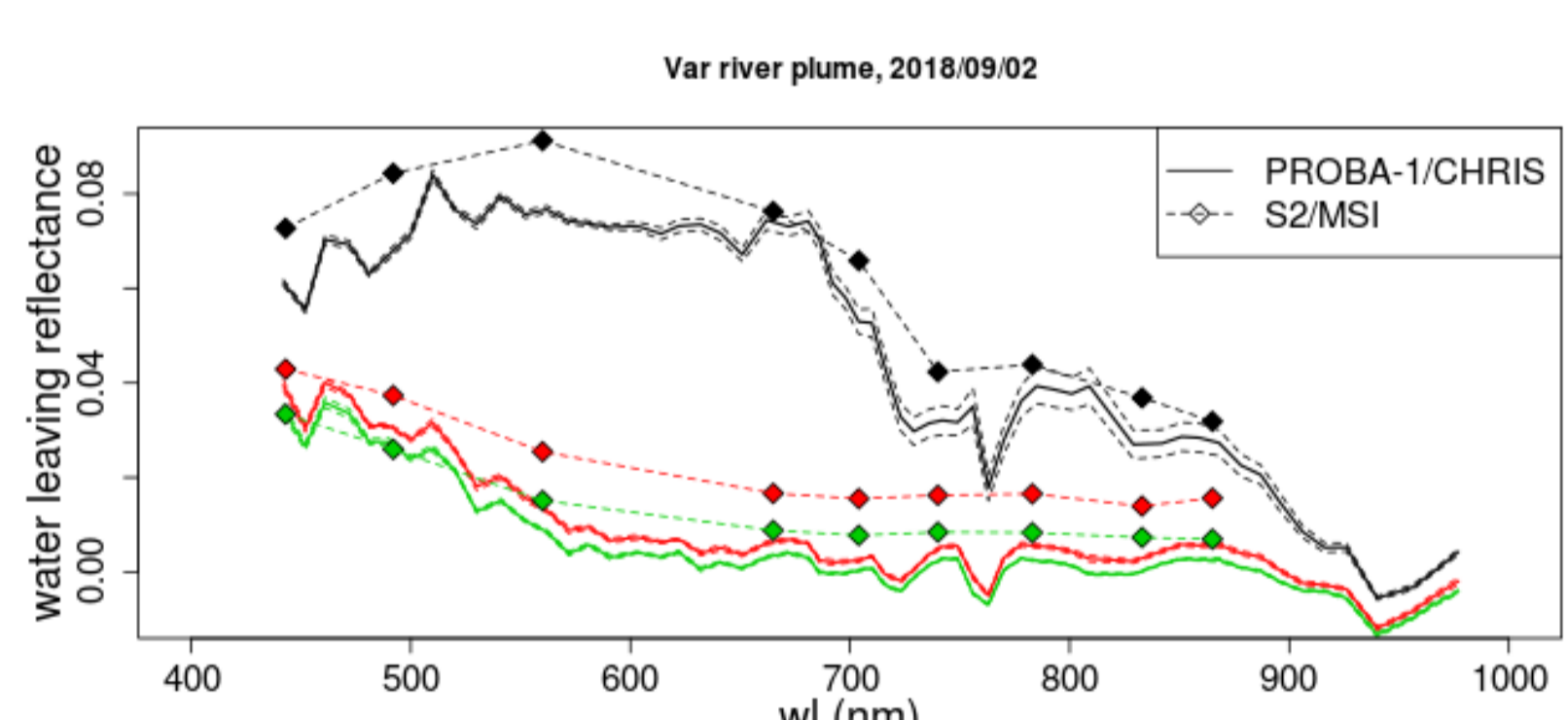


Figure 6: PROBA-1-CHRIS / S2-MSI comparison in the Var river plume

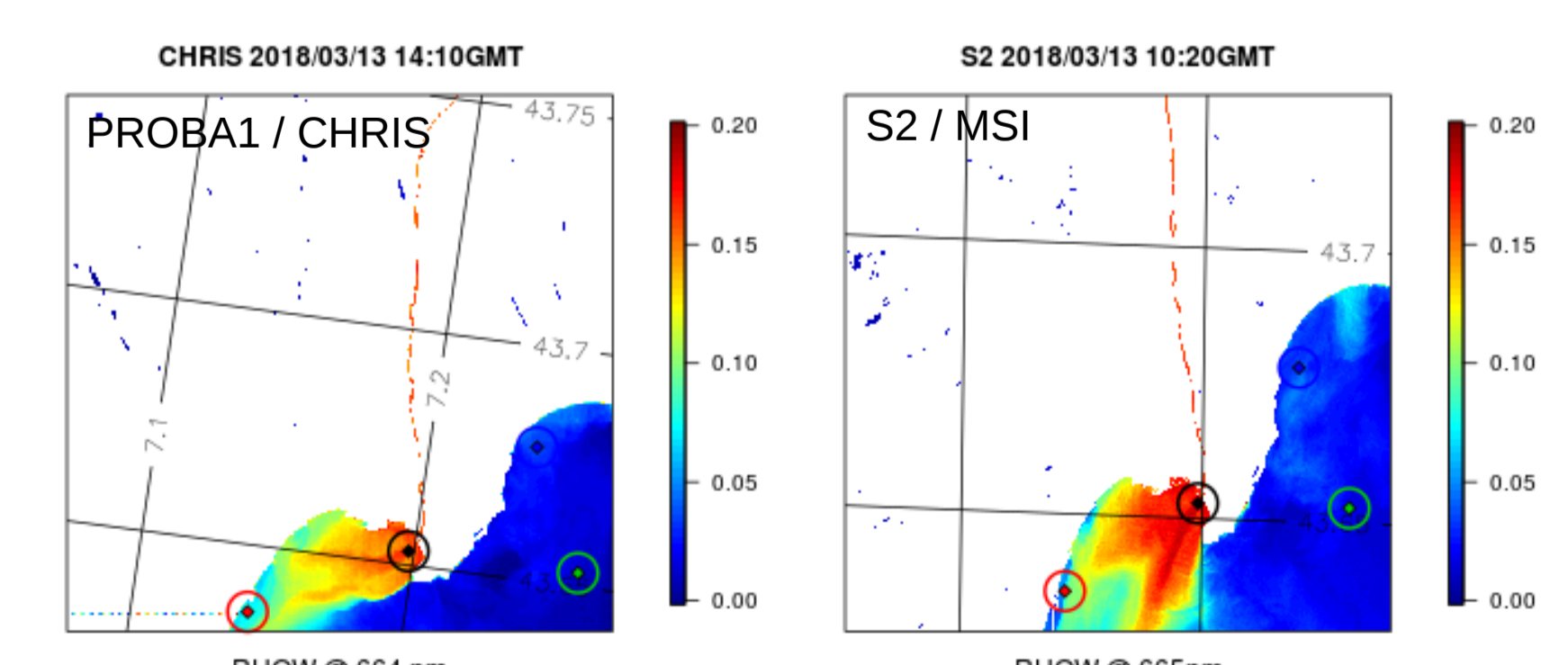
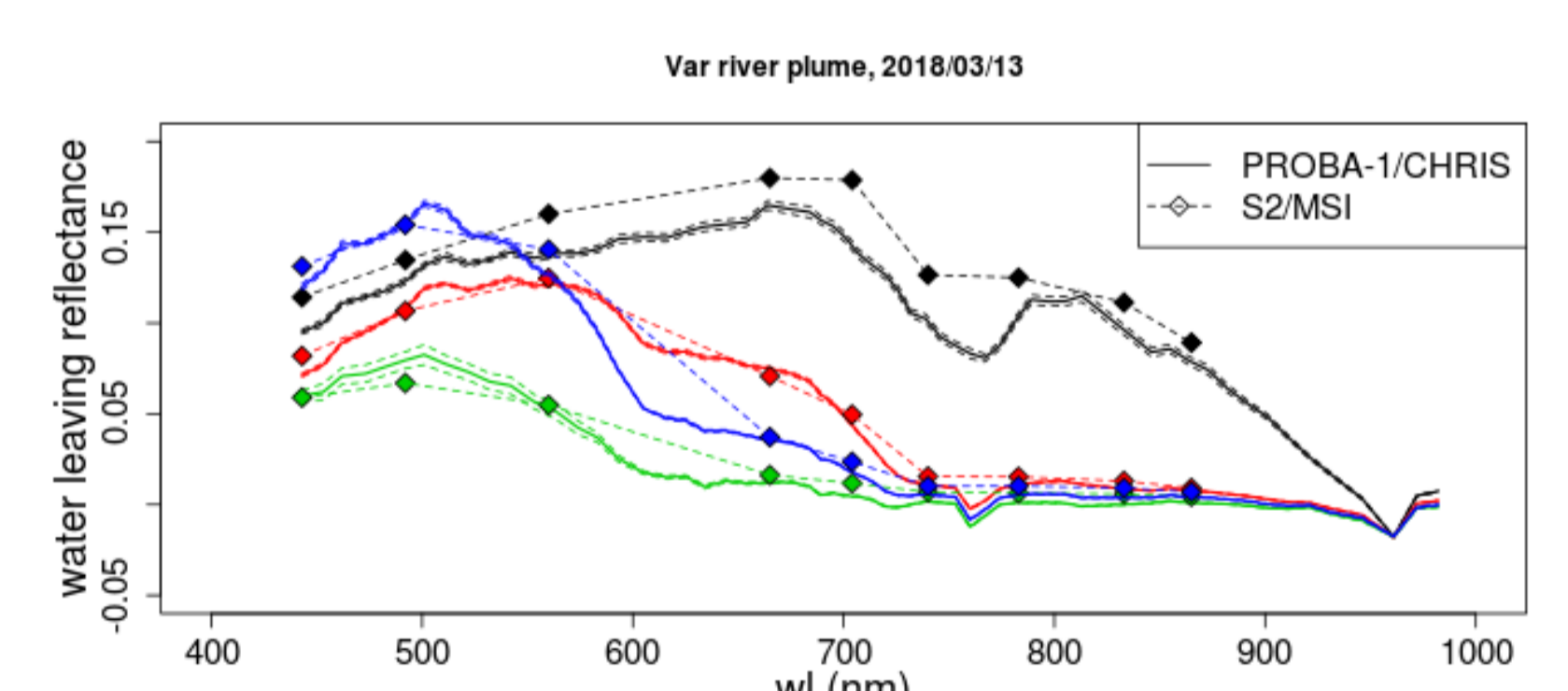


Figure 7: PROBA-1-CHRIS / S2-MSI comparison in the Var river plume

Figure 4 to 7: top panels: comparison of reflectance spectra between CHRIS/PROBA (solid lines) and Sentinel 2 (dotted lines). Bottom panels: CHRIS map (left) and Sentinel 2 map (right) of water leaving reflectance at 665nm. Colors of encircled dots refer to the colors of spectra in the upper panels. Dots indicate the location from where spectra have been extracted. All selected CHRIS images have a fly-by-zenith angle of 36°.

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