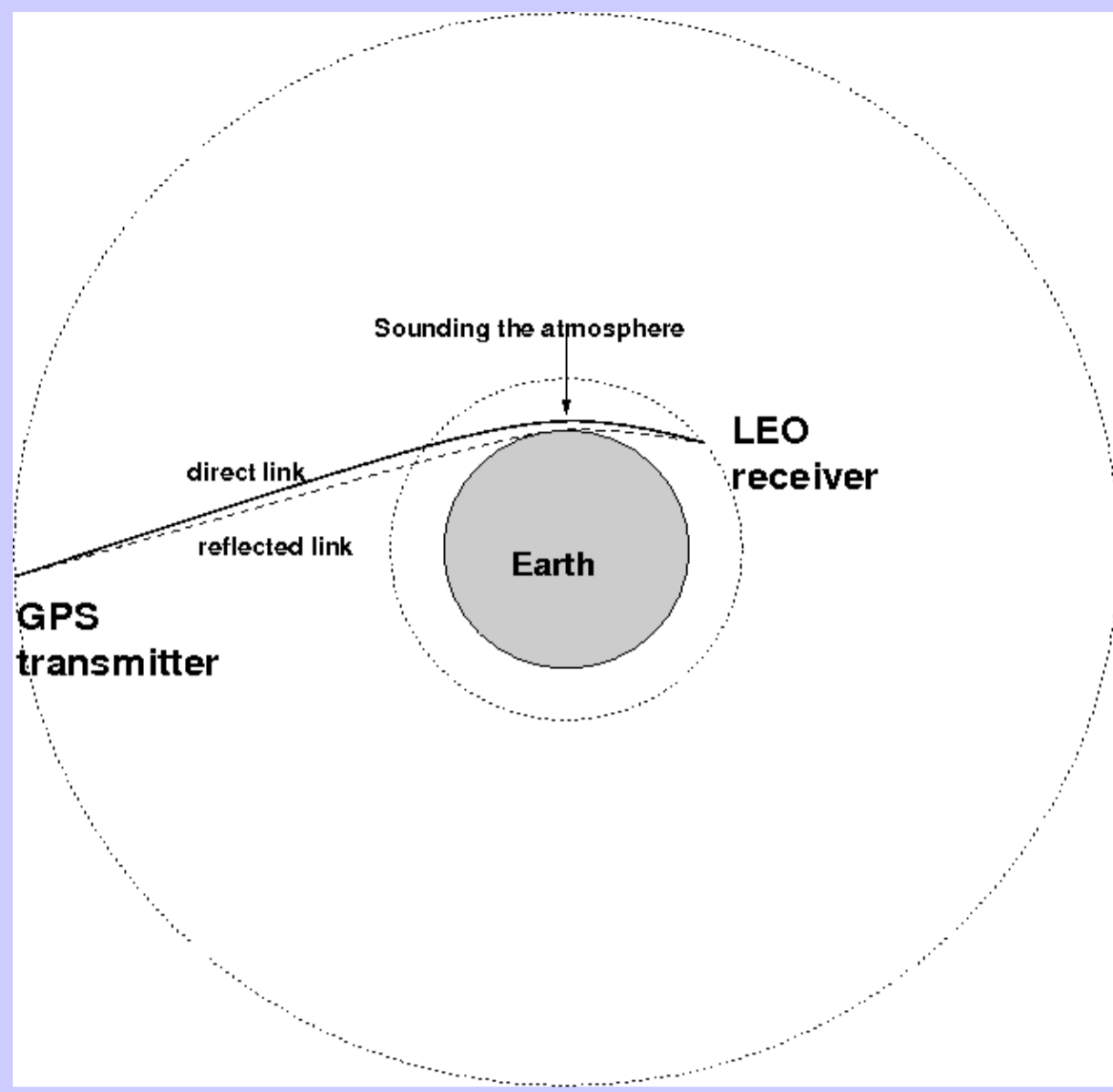


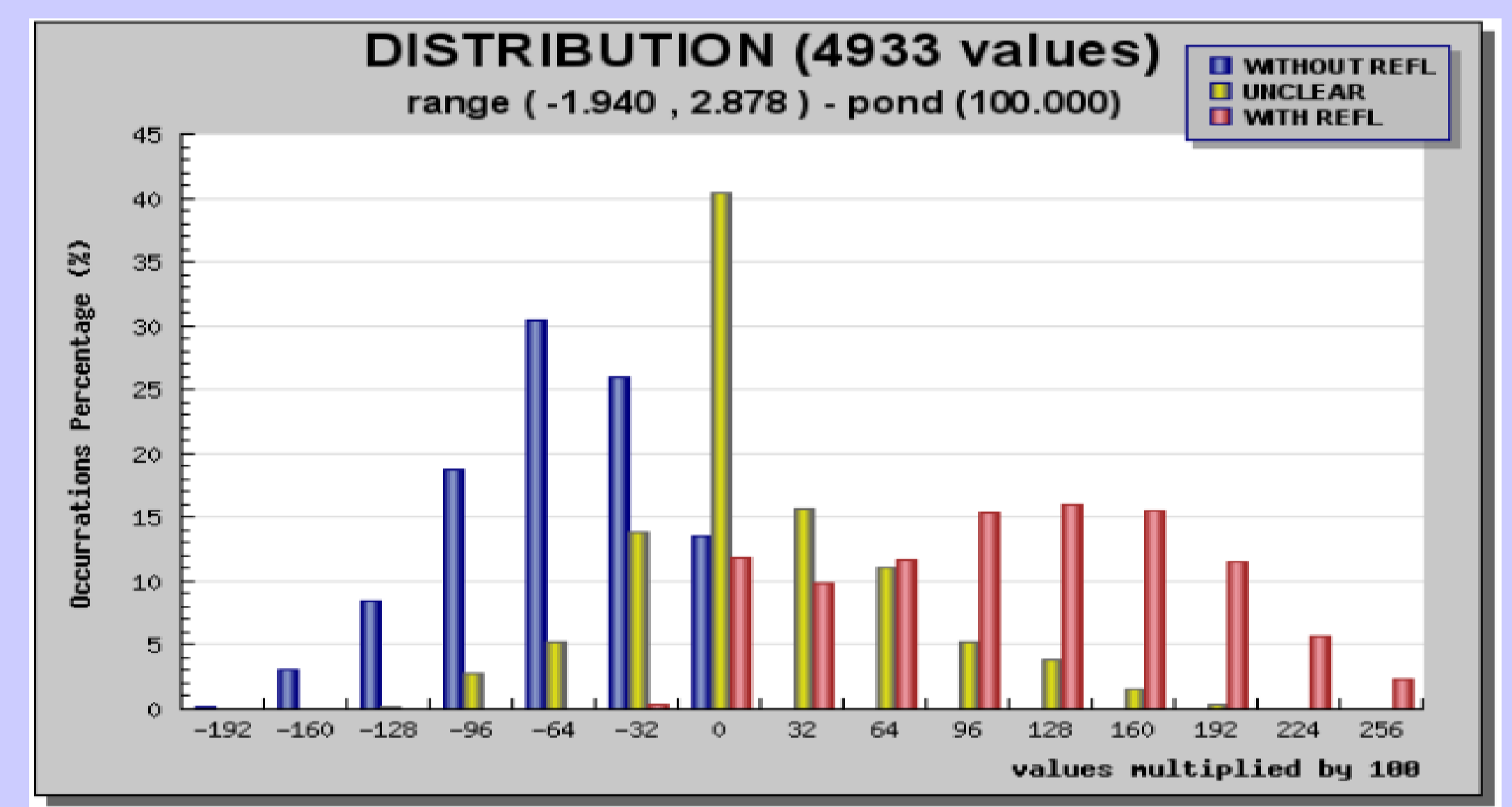
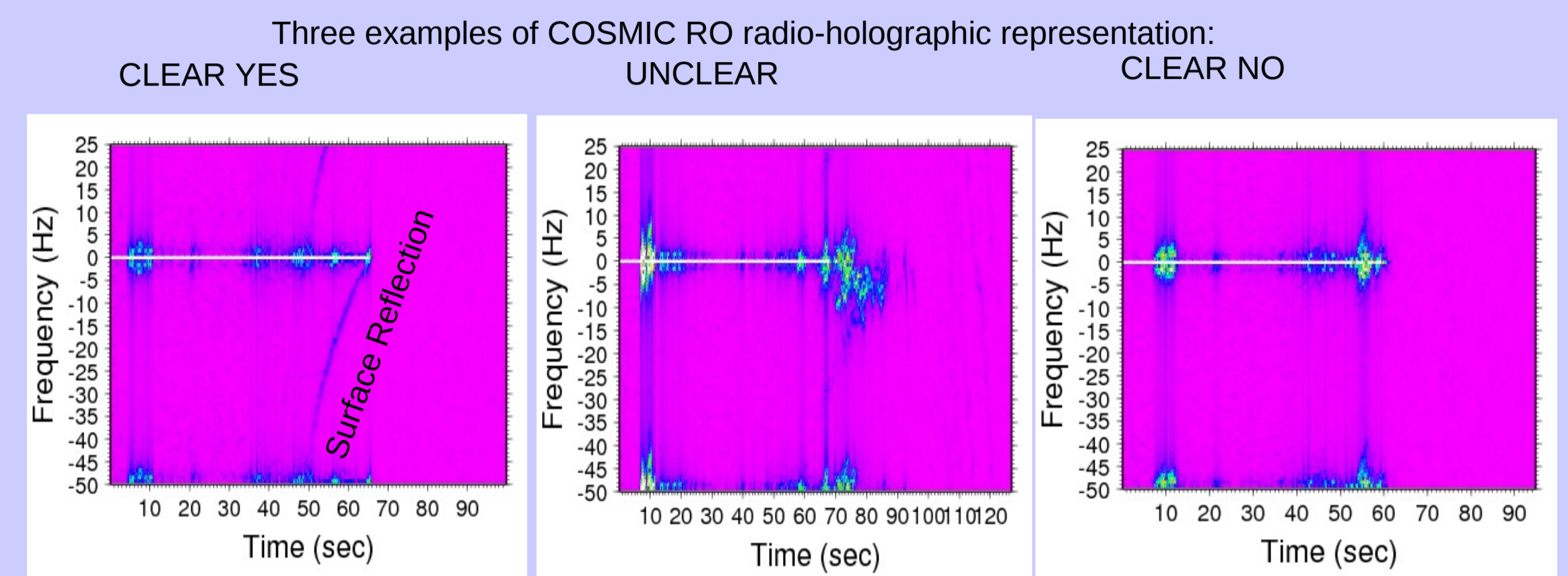
1- REFLECTED GNSS RO SIGNALS



- The figure on the left sketches a reflection event during a GNSS Radio Occultation (RO).
- ~50 % of Ocean occultations present traces of reflected signals.
- Reflected signals cross the atmosphere in a different geometry than direct radio-link. We wonder whether it could be a useful source of complementary atmospheric information.
- Reflected signals might depend on properties of reflecting surface. We wonder whether it could be a source of surface information (altimetry, sea/ice properties...?).
- EUMETSAT GRAS-SAF: work package devoted to investigate potential use of reflected-link to help operational weather (data assimilation) and climate GRAS applications.

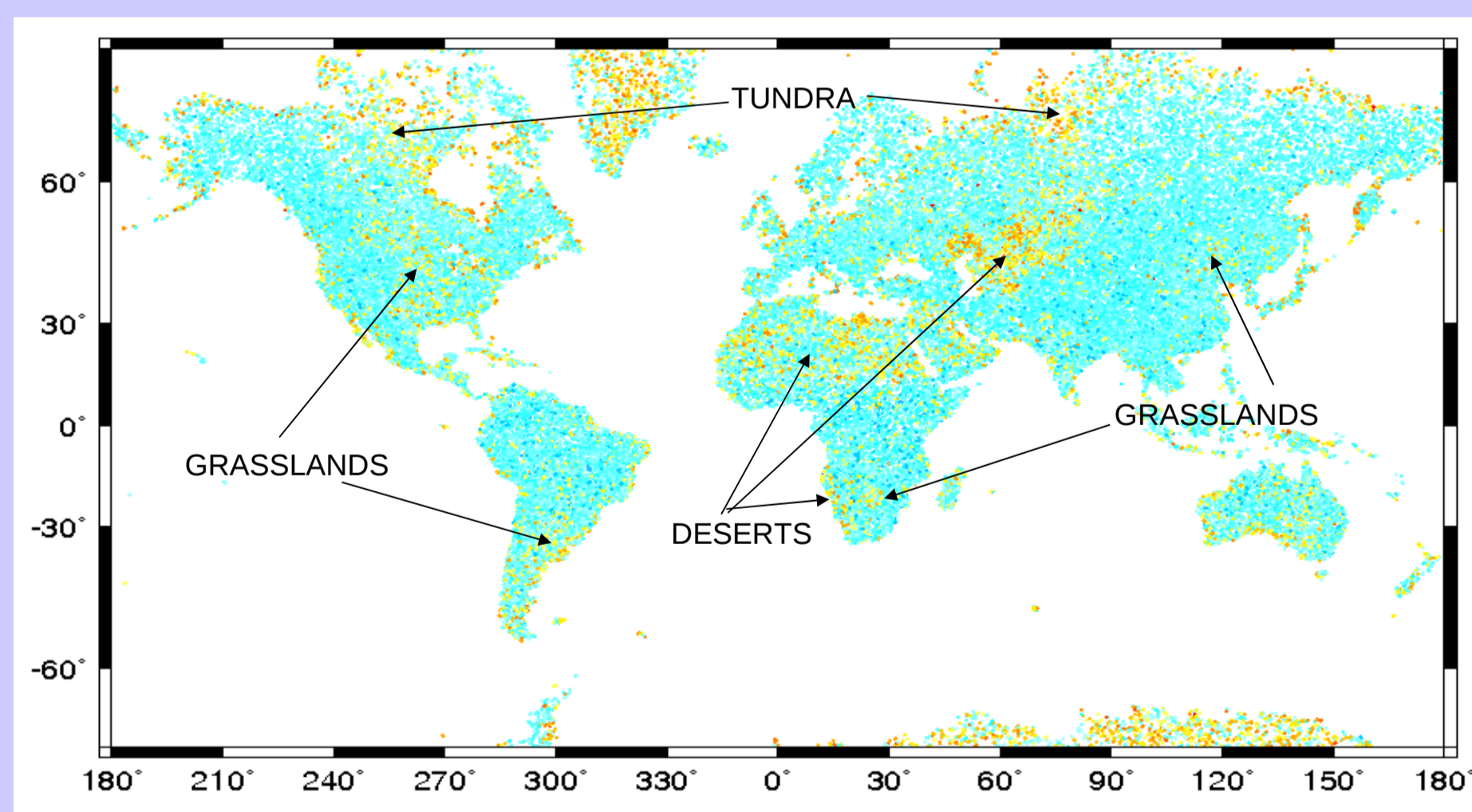
2- DETECTION OF GNSS RO SIGNALS

- An automatic tool for detection of reflected signals has been implemented using a Support Vector Machine (SVM) algorithm. The algorithm has been trained with visually inspected radio-holographic images of COSMIC RO. After tagging them in three categories (shown on the right), only clear reflection and clear non-reflection events are used for the training.
- The SVM provides a flag, positive for estimated clear reflection, negative for estimated non-reflection, and between -1 to 1 for non-confident identification. The more positive [negative] the flag value is, the more confident the algorithm is about the presence [lack] of reflected signals.
- The validation against an independent set of visually inspected and tagged images results in a success ratio better than **98%**. The figure on the right shows the validation (SVM values x 100).



3- ANALYSIS OF GNSS RO SIGNALS (COSMIC constellation)

- Presence and lack of reflected signals follows geographic and seasonal patterns. The most significant being the land/ocean separation.
- OVER LAND:** only 7% of the RO contain reflected signals, mostly over smooth bare topography: deserts, grasslands, tundra (Figure below, showing land-reflected events, more confident for darker hues of yellow/orange).



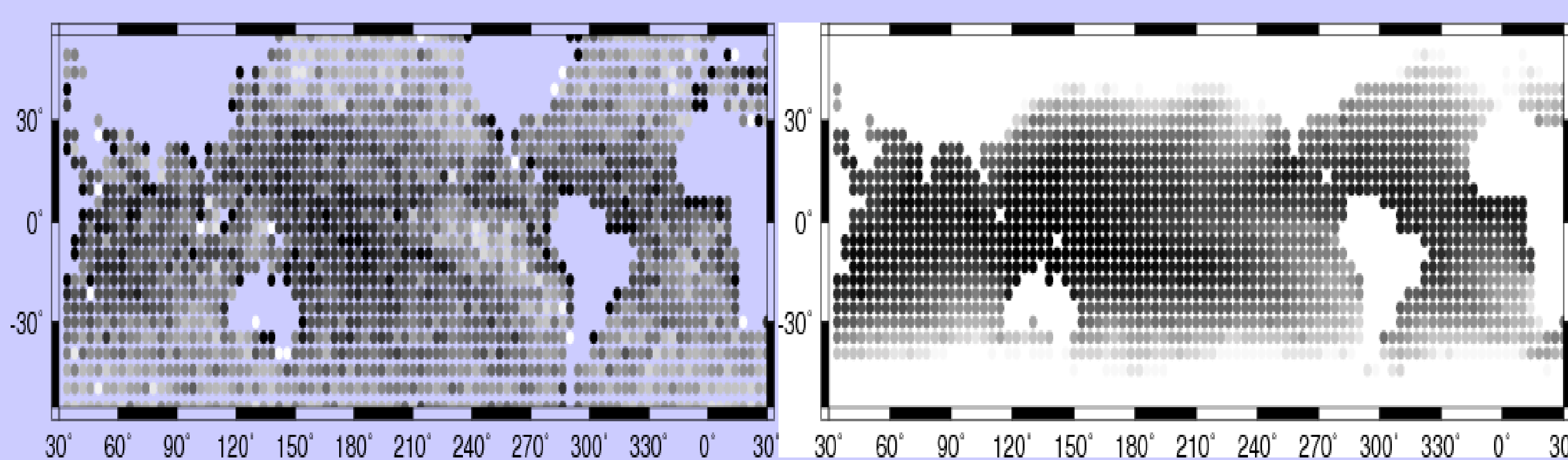
- OVER SEAS:** 40-70% of RO present reflected signals. **Seasonal effects**, more reflections observed during local winter times. **Anti-correlation with sea-surface temperature**, although the Fresnel reflectivity coefficients at grazing angles cannot explain it:

COSMIC Ocean RO -60 to 60 deg latitude, for December 2008

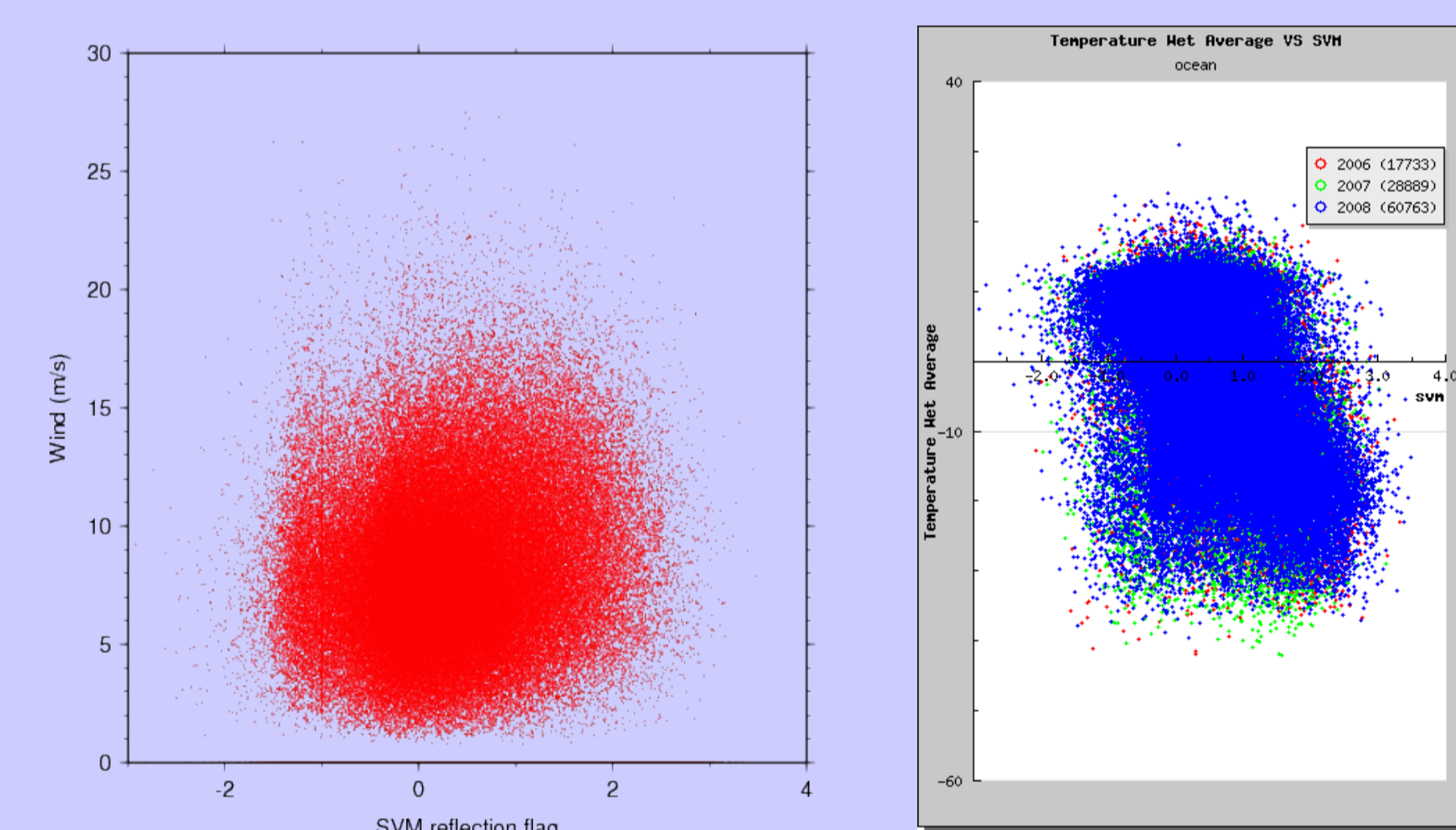
ODYSSEA SST -60 to 60 deg latitude, for December 2008

% Reflections:
 dark=low
 light=high

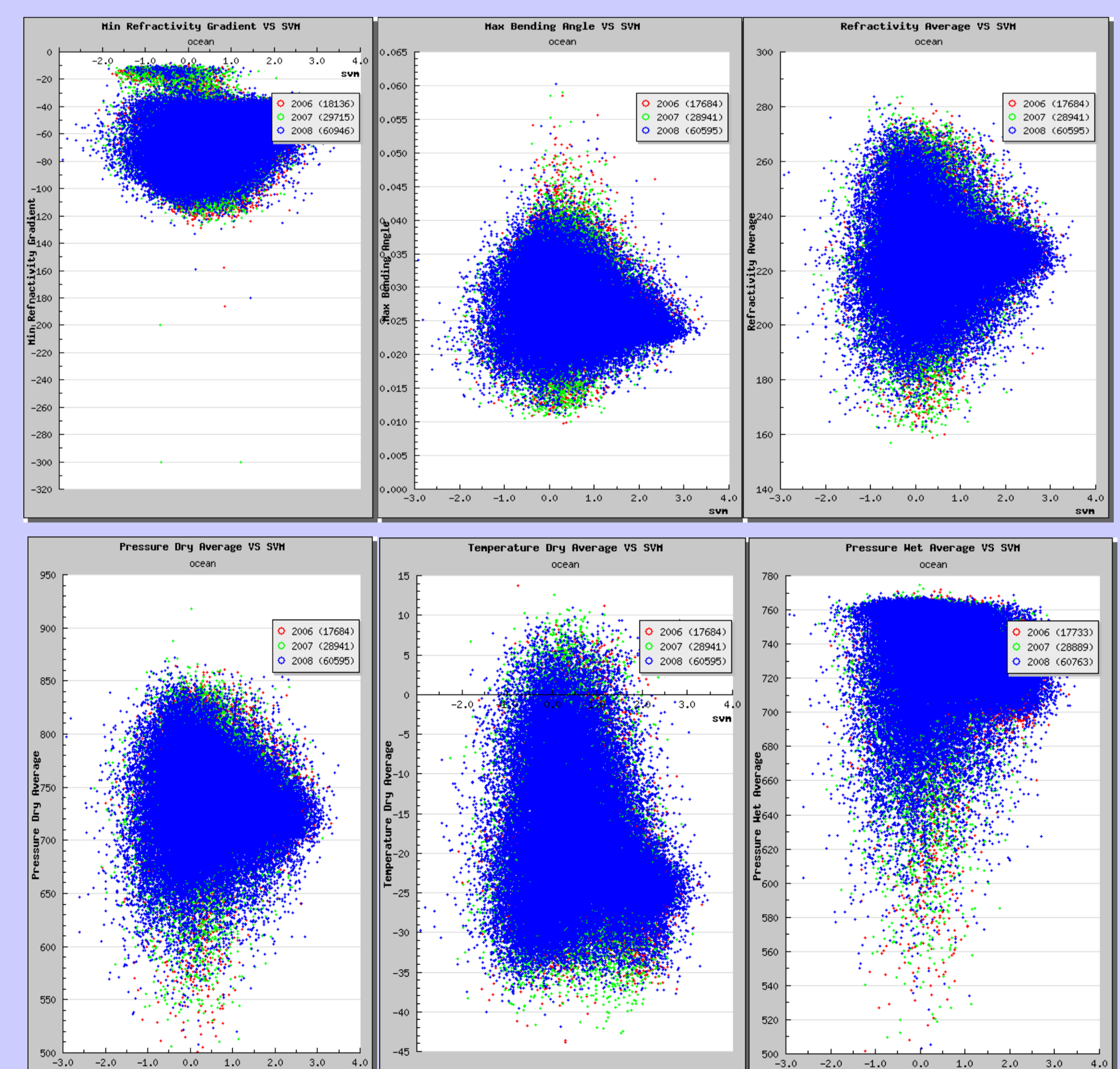
SST:
 dark=high
 light=low



- No correlation has been found between ocean reflection and sea surface roughness/wind, but with atmospheric wet temperature:



- Correlation with other parameters extracted from RO data (level 1 to 2) has not been found:



→ The lack of signals reflected off hot water masses seems to be driven by the wet temperature of the atmosphere.