Seascape Structure and Benthic Habitat Heterogeneity of Santos Basin Slope, SW Atlantic

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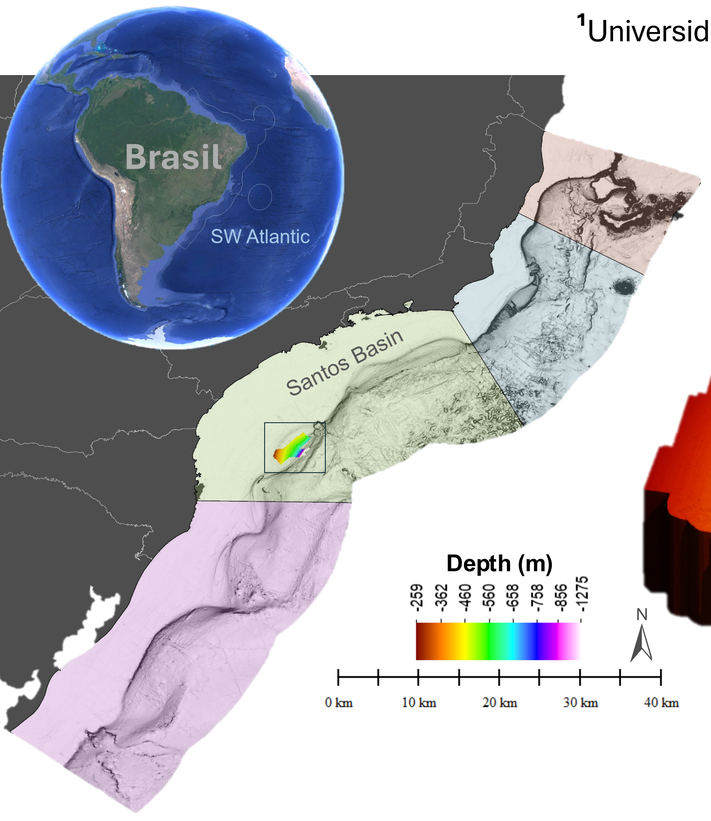
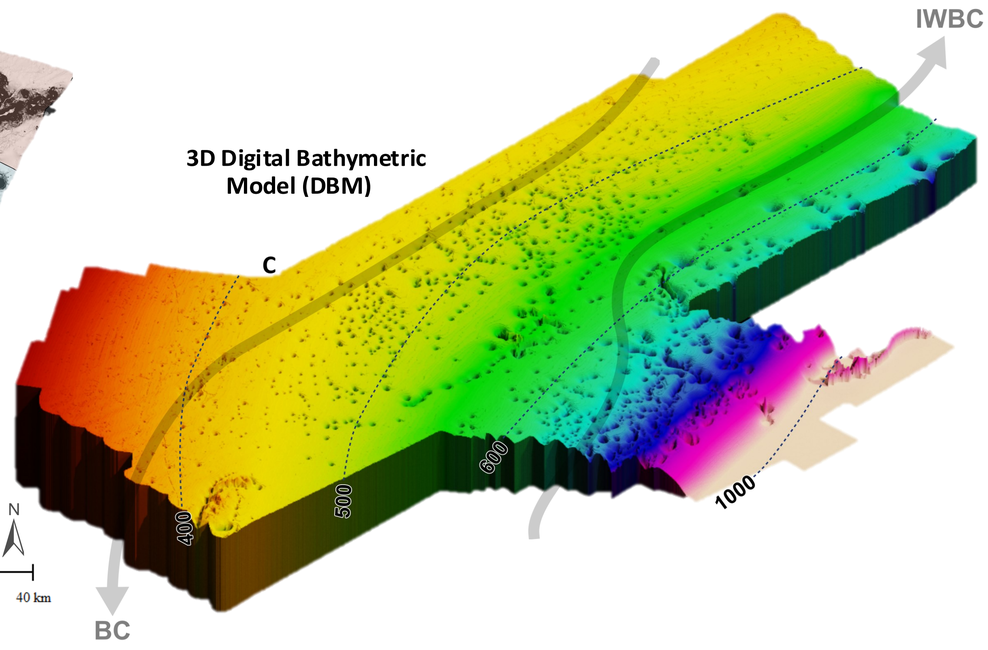
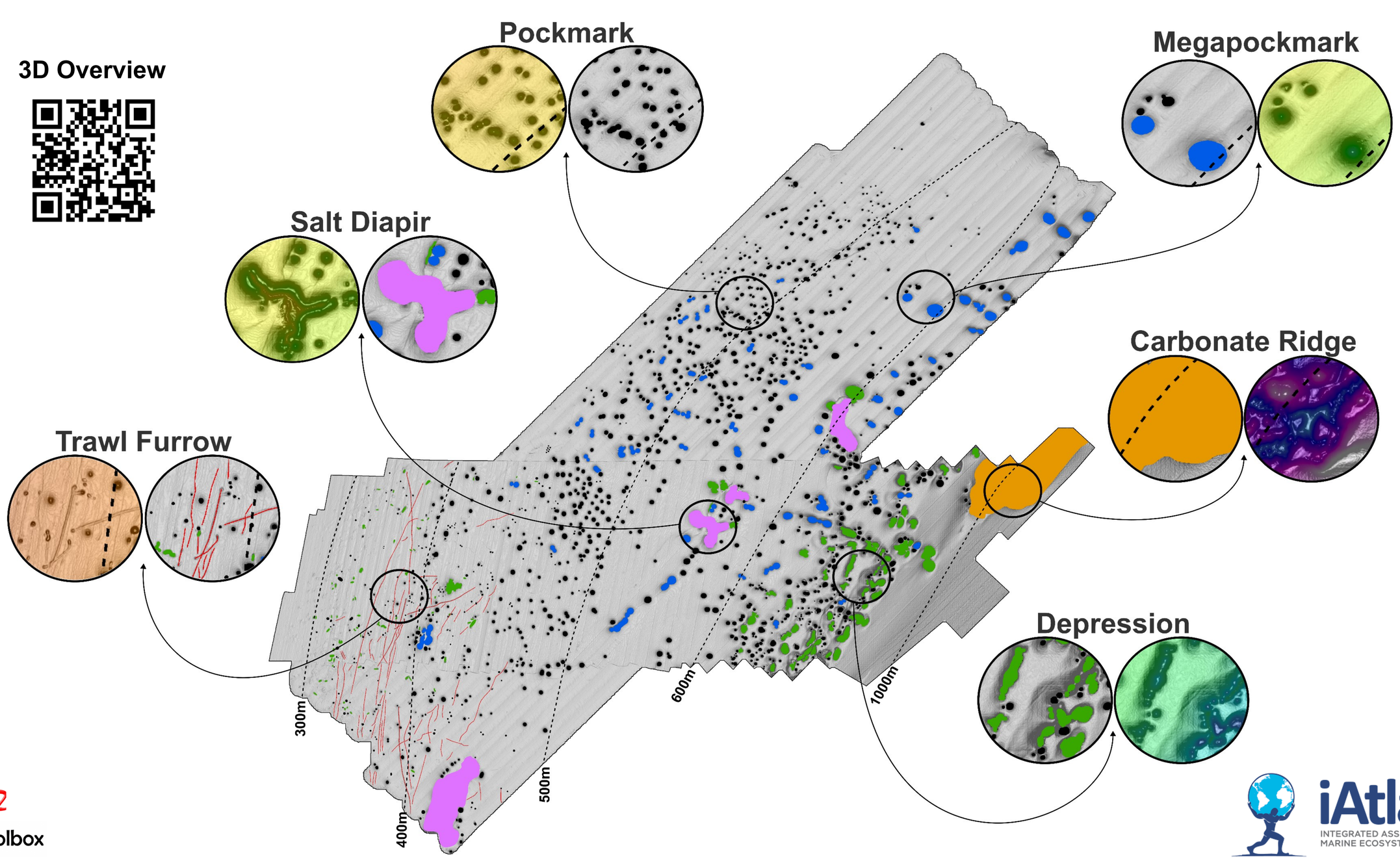
ONE OCEAN SCIENCE CONGRESS NICE FRANCE 4-6 June 2025





- The Santos basin is a prominent offshore sedimentary feature of the SW Atlantic, extending 350,000 km² off the southeast Brazilian coast. The region is subject to fishing and oil and gas exploration.
- Seafloor is covered by sediments, interspersed by hard substrate patches associated with pockmarks, carbonate mounds and ridges, and salt diapirs. These features increase the diversity of benthic habitats that remain mostly unexplored, but are expected to host cold-water corals and cold-seep communities.
- We analyze benthic seascape structure and habitat heterogeneity in a 4,854 km2 section of Santos Basin slope region between 259 and 1,275 m depths. Seascape analysis was based on a high-resolution digital bathymetry model (14 m grain size) produced during deep-sea surveys conducted in 2011 and 2022.
- Seabed was segmented into seven classes, including: (a) the dominant and highly interconnected sediment "matrix", (b) the hard-substrate pockmarks, mega pockmarks, depressions, salt diapirs and carbonate ridges, and (c) human-made "trawl furrows".
- Seascape structure was quantified considering 1,430 mapped patches of all classes (patch types), except the sediment matrix. We analyzed 38 metrics that described: patch area, edge, aggregation, shape, core area and patch diversity.

3D Overview



ArcGIS · blender · Fragstats 4.2 · CoMMa Toolbox

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- **Pockmarks** included the most abundant and dense patches (2.7/km2), with their core covering 34.4% of the seascape area. They exhibited extensive edge sectors and were relatively small, disaggregated, regular-shaped and little interspersed among other classes. Pockmarks density was highest between 300 and 400 m depths and declined towards deeper slope sectors. Between 400 and 600 m their core area was smaller, but overall, they covered the highest proportions of the depth strata seascape (48.8 – 53.9%). Cold-water coral and cold-seeps communities tend to occur on the edges and core of pockmarks, respectively. They are more likely to occur at the 400 – 600 m depth stratum.
- In the 600 – 700 m stratum a more heterogeneous mix of hard bottom structures occur, some of large sizes (e.g.,carbonate ridge), potentially harboring more diverse benthic communities. The definition of **trawl furrows** as habitat patches, represents an important evidence of human activities modifying deep seascapes in Santos Basin. Whereas their core area was little significant, they tend to create extensive edge sectors amid the sediment matrix, potentially affecting soft bottom benthic communities.

1. Aggregation and Cohesion (AI,COHESION,CONTAG)

   Patches become more aggregated and connected in deeper áreas.

2. Fragmentation and Interspersion (Division,IJI,SIDI)

   More diverse and fragmented patches are seen in shallower areas (300–700 m)

3. Patch Density Size and Shape (LPI,LSI,NP,PD)

   Patches tended to become denser (3 – 5/ km2) and more irregular at depths greater than 500 m
   In deeper areas patches tend to become larger and more regular

4. Diversity and Heterogeneity (PR,PRD,RPR, SHEI, SHDI, SIEI)

   Between 500 and 800 m patches were more diverse and evenly distributed

5. Area and Edge (TCA,TE,TA)

   Area covered by patches a the edge area decrease with depth indicating reduced structural complexity. (except for a slight increase at 800–1000 m)

6. Composite Metrics (Splitting Index,PLADJ)

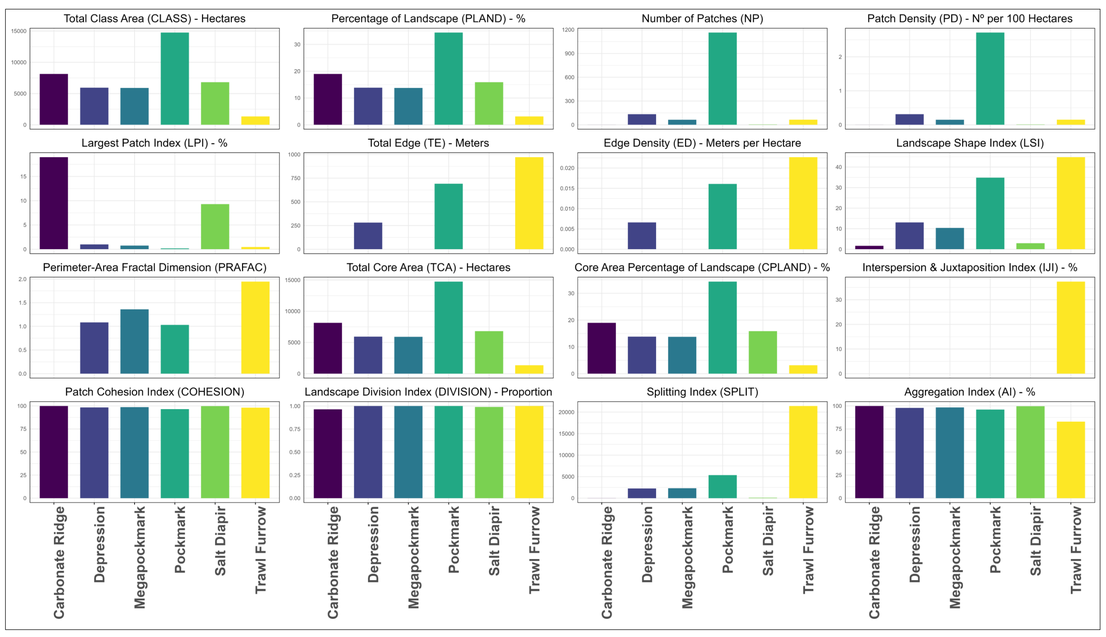
   Splitting decreases, showing less fragmentation in deeper areas.

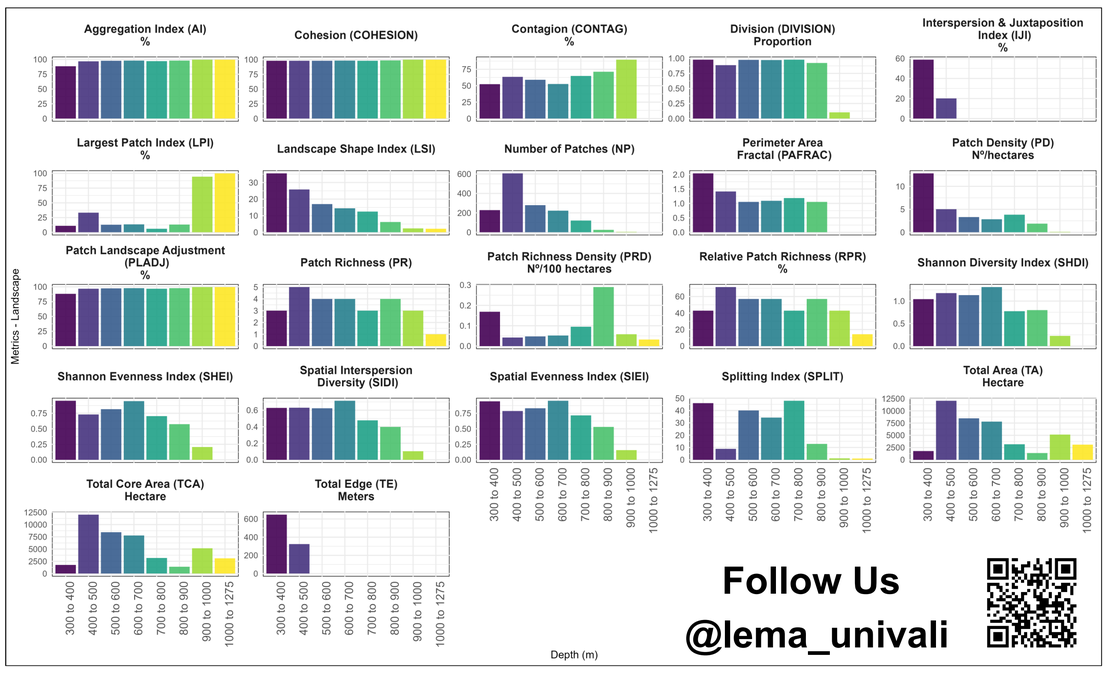
   PLADJ remains fairly constant, indicating little variation in landscape adjustment capacity.

Shallow regions (300–600 m): High diversity, fragmentation, and spatial complexity.

Intermediate regions (600–800 m): Greater richness of patch types, possibly indicating an ecological transition or ecotone zone.

Deep regions (800–1275 m): Higher connectivity, dominance of large patches, lower diversity: more homogeneous and continuous landscape.





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