EGU22-1965
https://doi.org/10.5194/egusphere-egu22-1965
EGU General Assembly 2022

The long-term linear meridional shift of the jet structure of the Antarctic Circumpolar Current south of Africa

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A technique has been developed for assessing the linear long-term change in the structure of the gradient field of the Absolute Dynamic Topography (ADT) based on satellite altimetry data distributed on the website https://marine.copernicus.eu. This structure is understood as the alternation in the meridional direction of the zones of increased values of the absolute values of the ADT gradient (jets) and the zones of their reduced values (interjet spaces). The technique uses linear regression analyzes and makes it possible to calculate the meridional shift in the structure of the gradient field of the ADT and the change in the absolute values of the gradient of the ADT, as well as to estimate the calculation error.

Two 26-year series of dependences of the mean annual absolute values of the ADT gradient on latitude and on the ADT have been analyzed. Analysis of the dependence on latitude showed that in the ACC band (42°–57°S), there are three zones of increased gradients conventionally corresponding to the cores of the Subantarctic (SAC), South Polar (SPC) and South Antarctic (SthAC) currents. Analysis of the dependence on ADT showed that in the ACC band (-130–20 cm in ADT units) there are four such zones; an additional zone is observed in the SPC. In general, in the ACC band for 26 years of observations, a shift in the structure of the gradient field of the ADT in latitude by 0.05±0.10° to the north is noted. At the same time, in the zones of SAC, SPC, and SthAC the shifts on average are 0.16°±0.15 ° to the south, 0.30°±0.14° to the north and 0.03°±0.26° to the north, respectively. The extreme values of the shift in the SAC and SPC zones reach 0.4° to the south and 1.4° to the north, respectively. In the ACC band relative to the ADT, a positive shift in the structure of the gradient field of the ADT is observed amounting to 8.3±1.0 cm. This shift is mainly due to the corresponding increase in the ocean level at geographic points. However, for separate zones within the ACC, the shift can differ significantly from the mentioned value due to the meridional shift of the structure of the ADT gradient in geographic coordinates. In particular, in the boundary zone between SAC and SPC it reaches 17 cm. In the ACC band, an increase in the absolute value of the ADT gradient is also observed, $1.9\pm2.7\times10^{-3}$ cm/km, which is equivalent to an increase in the ADT difference across the ACC by about 3 cm, which corresponds to the difference in the increase in ADT at geographical points on the southern and northern periphery of the current. At the same time, in the SAC zone, a decrease in the absolute value of the ADT gradient by $8.0\pm4.2\times10^{\square3}$ cm/km is observed, and in the SPC and SthAC, on the contrary, an increase by $10.6\pm4.3\times10^{-3}$ cm/km and $8.2\pm5.4\times10^{-3}$ cm/km, respectively.