Monitoring boreal peatland microtopographic changes of Sarobetsu Wetland in Hokkaido, Japan using InSAR small baseline subset (SBAS) technique

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INTRODUCTION

Human-induced activities in Sarobetsu Wetland have led to a drop in the water table, triggered a drying out process that had impact on the surface vegetation, which in turn has affected the wetland's vegetative ecosystem1). In this study, InSAR small baseline subset (SBAS) technique was used to extract the temporal change of peatland surface. The technique used the data derived by Sentinel-1 satellite, the Hyp3 platform provided by ESA, and Mintpy tool to generate a surface displacement rate map and the effect of three influencing factors of displacement rate were analyzed.

Fig.1 The location of Sarobetsu Wetland

Fig.2 Remains of peat mining in the high peatlands of the Sarobetsu Wetland

METHODS

In this study, we used a total of 100 Sentinel-1A descent path (path number 46) images from January 2019 through December 2021 as the primary SAR data source, yielding a total of 218 pairs of paired scenes.

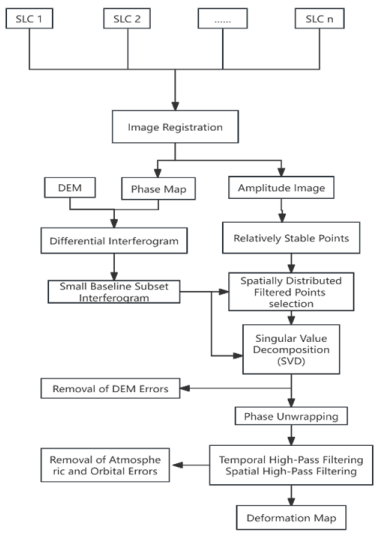
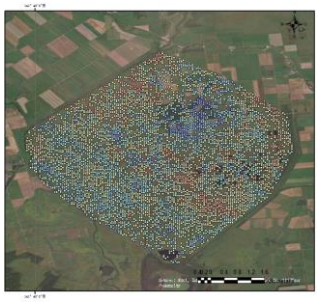


Fig.3 Data processing flow chart of the SBAS technique

RESULTS



Surface Displacement Changes Rate (mm/year)

- -98.784865 – -59.675878
- -59.675877 – -45.146502
- -45.146501 – -33.881001
- -33.881000 – -24.384778
- -24.384777 – -15.652353
- -15.652352 – -7.200149
- -7.200148 – 1.966136
- 1.966137 – 12.989593
- 12.989594 – 29.505902
- 29.505903 – 76.717398

Fig.4 Result of InSAR for the surface displacement

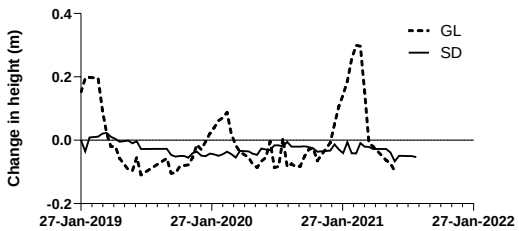


Fig.5 Temporal groundwater level (GL) and surface displacement (SD) changes

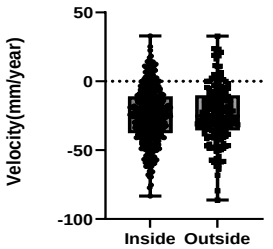


Fig.6 SD rate of inside and outside of the excavated relic

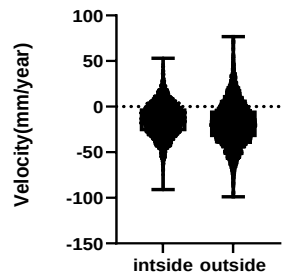


Fig.7 SD rate of inside and outside of sasa invasion area

- Fig.4 shows the land surface displacement rate map obtained from InSAR; the map reveals a pronounced heterogeneity in surface displacement rates across the landscape
- Fig.5 shows demonstrates the fluctuations in unison over the examined period, suggesting a potential linkage between them. although this potential connection is not transient, this potential connection suggests that groundwater loss due to drainage for pasture development has impacted the wetland.
- Fig.6 shows the result shows that surface displacement rates within peat excavation relics tend to be slightly lower than outside. This suggests that the growth of floating vegetation on the water in the excavation relic is slower than the surroundings.
- Fig.7 shows the result shows that surface displacement rates within sasa invasion area was slightly higher than outside. This difference is thought to be by the faster growth of sasa than peat moss, however, the ground surface change by organic matter accumulation in the bog is probably not parallel This issue is a current Limitation of monitoring bog surface change by InSAR technique.

CONCLUSION

For the present work we have used InSAR time-series based analysis technique. The comprehensive analysis of land deformation across various regions and factors presents a nuanced view of surface displacement patterns influenced by natural, anthropogenic, and environmental variables. Subsequent analyses revealing significant variability and a general downward trend in land deformation velocities over the years. This trend was particularly pronounced in later observations, hinting at an acceleration of land surface displacement potentially linked to long-term environmental or anthropogenic factors.

ACKNOWLEGEMENT

This work was supported by JST SPRING, Grant Number JPMJSP2138.
This work was partially supported by the Asahi Glass Foundation.