

GNSS for Global Earth Observation: The European coordination action Gfg²

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Introduction

The Gfgsquared (GfG²) project is an international research related project with focus to the use of GNSS (Global Navigation Satellite Systems) for Earth Observation in a more general sense. Within the project novel GNSS applications with outstanding social importance are identified. These applications can be classified by the nine Social Benefit Areas (SBA), which address the current crucial problems of mankind: disasters, health, energy, climate, water, weather, ecosystems, agriculture, biodiversity (see www.earthobservation.org). We give examples for GNSS applications in the different SBA. For several of these applications, GNSS radio occultation is a key observation technique with several applications in that context.

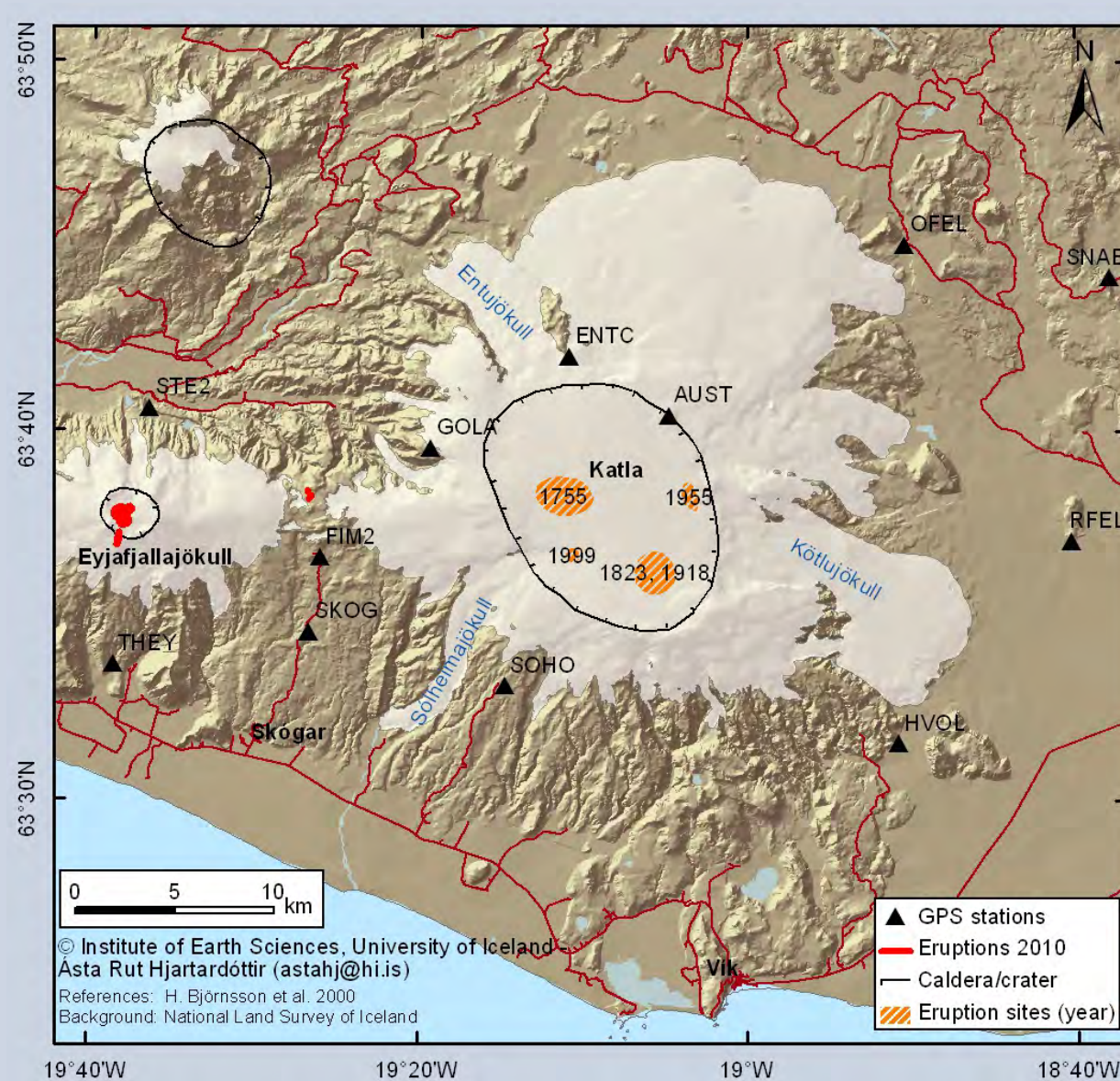
Potsdam Workshop

The 2nd GfG² consultation workshop was held on April 20, 2012 at the German Research Centre for Geosciences GFZ at Potsdam. The workshop was addressed to GNSS experts and reported on their GNSS exploitation methods. Main objectives of the workshop were: 1) Introduce novel GNSS applications from all societal benefit areas to the community 2) Evaluate GNSS need identified in the 1st Gfg2 consultation workshop and 3) Force networking between the core team and GNSS experts, scientists and industry.



Disasters

Fields of GNSS applications for all phases of the risk management cycle associated with hazards (mitigation and preparedness, early warning, response, and recovery) are: critical infrastructure, earthquakes, volcanos, landslides/avalanches and floods. Ground-based GNSS networks may provide useful information relevant to more than one type of disaster listed above. Examples for such networks are: COCONET for earthquakes and hurricanes in the Caribbean, Sumatran GPS Array (SuGAR) for tectonics, earthquakes, and tsunamis and GEONET for monitoring crustal deformation in Japan.



Health

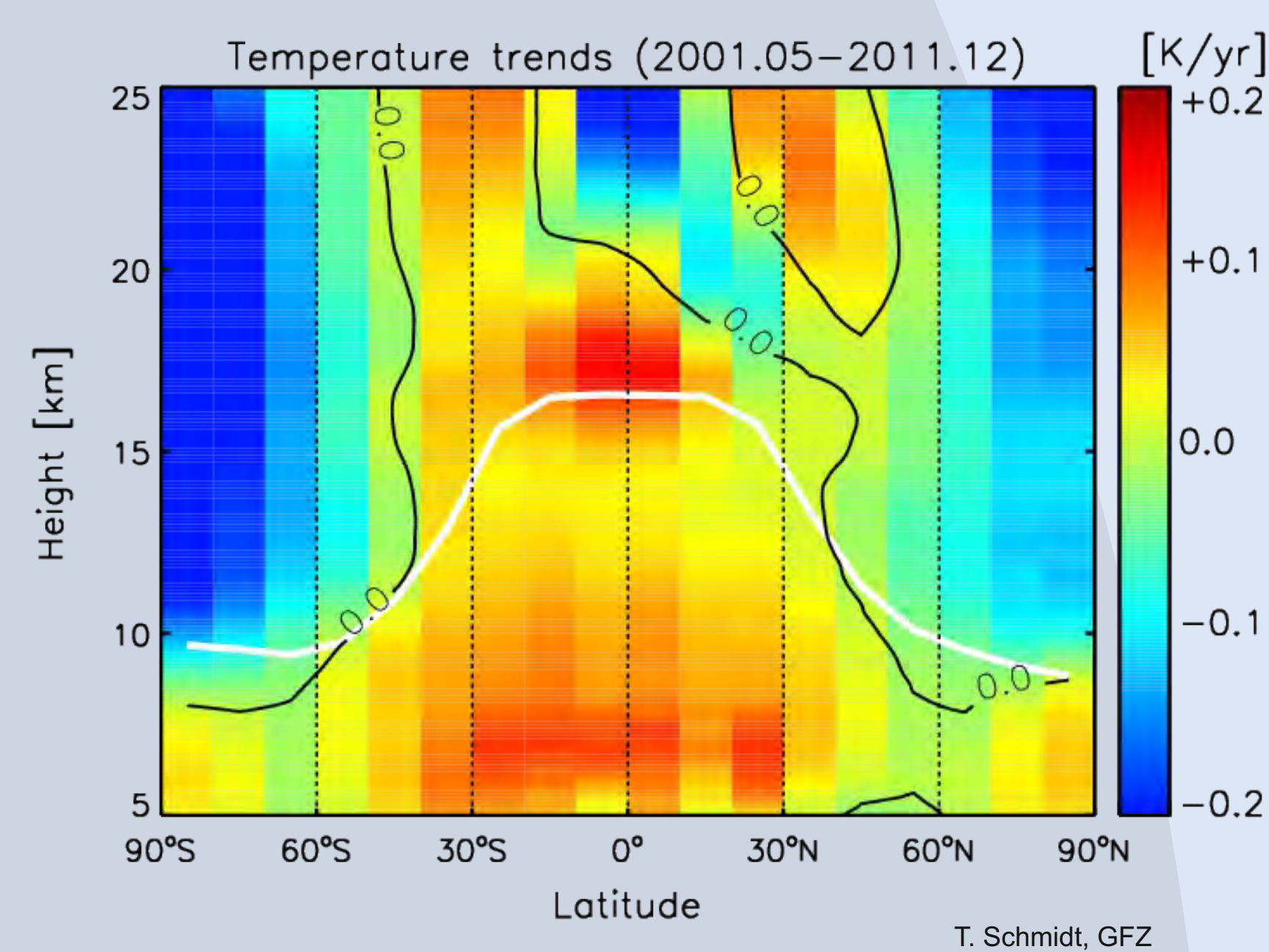


Health organisations are using GNSS positioning services to manage people and equipment, monitor disease propagation, and direct search and rescue operations.

Energy

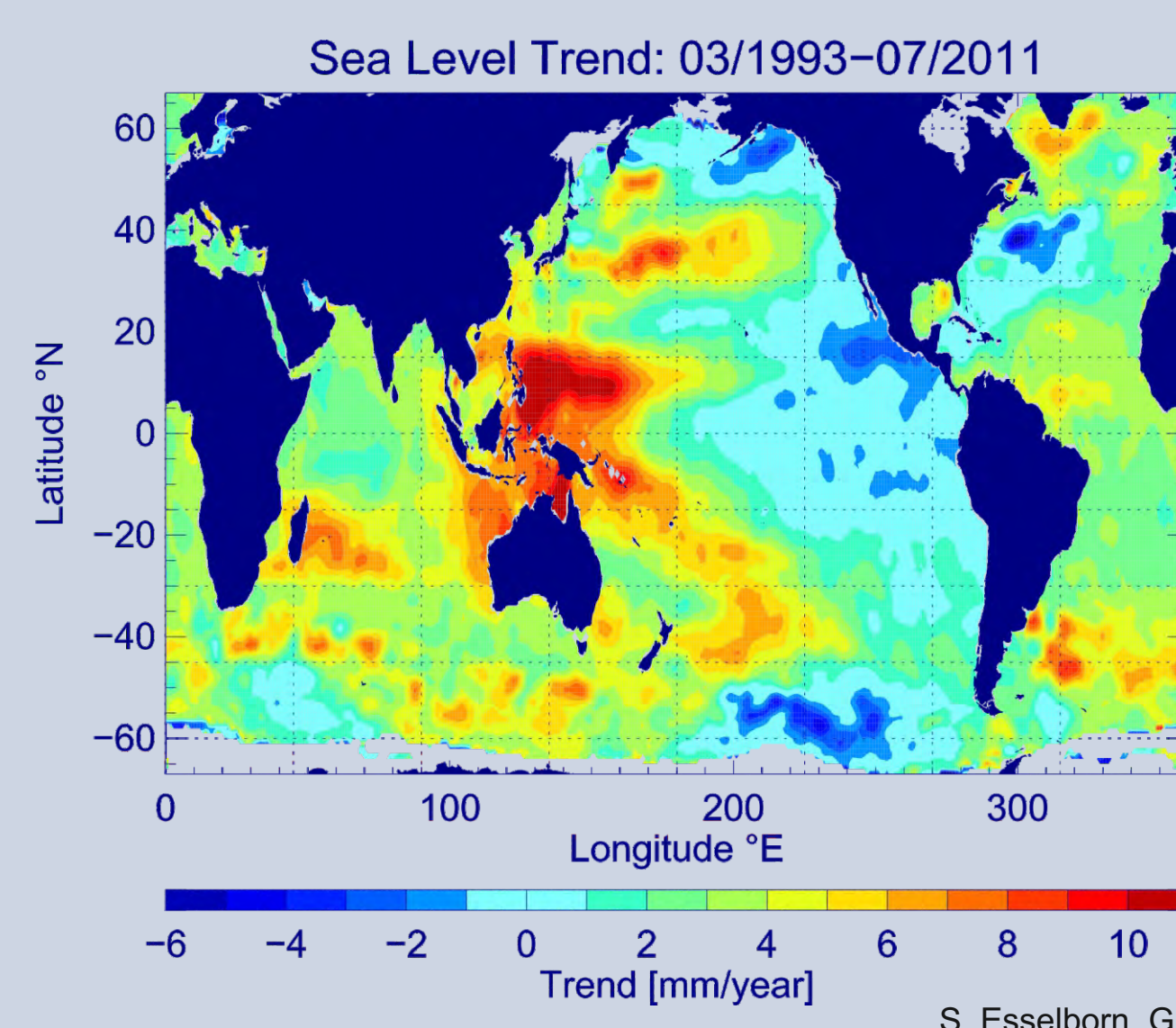
Several GNSS applications could beneficially contribute to this SBA: Tracking of goods related to energy, time synchronization in smart grids, subsidence in mining, wind scatterometry, lake level monitoring, geomagnetic induced currents.

Climate



One example is the monitoring of climatological variations of the Earth's atmosphere using the GNSS occultation technique.

Water



One example is the research on global sea level rise, which is not possible without GNSS: Orbit determination of radar altimetry satellites, use for Geoid determination as reference surface and tide gauge calibration.

References

Wickert J., A. Egido, G. Elgered, S. Fuller, M. Gauss, R. Jongman, C. Martin-Puig, P. Monks, Novel GNSS applications for GEE0 and GEOSS, Public Report of the GfG2 project, European Union, FP7-ENV-2010 GA No. 265098, pp. 43, 2012.
Gauss, M., GNSS for Global Environmental Earth Observation (GEE0) and GEOSS, Public Report of the GfG2 project, European Union, FP7-ENV-2010 GA No. 265098, 22 p., 2011.

Weather

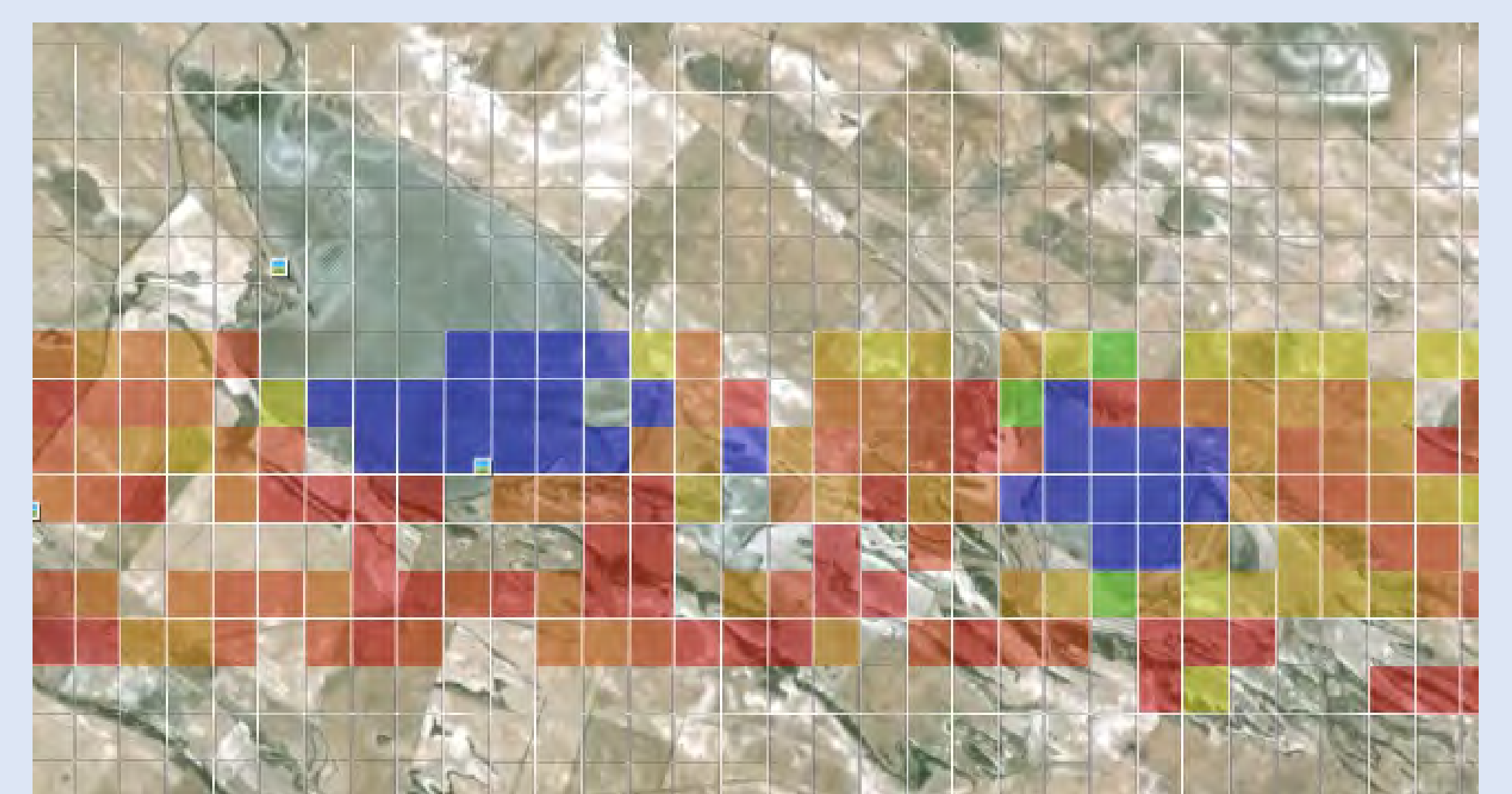
This SBA is mainly about improving weather information, forecasting and warnings. GNSS contributes by providing meteorological data, which are already operationally used by the leading weather centers of the world. Parameters, which can be derived are: Temperature, pressure, humidity measurements, precipitation, soil moisture, snow cover/depth, ice cover, and wind/turbulence.

Ecosystems and Biodiversity

GNSS is used for animal tracking and positioning and for satellite image analysis for habitat mapping (Spatial aspects, mapping, surveying and Digital Elevation Models).

Agriculture

GNSS techniques are widely used for agriculture. Related to positioning are machinery guidance, mapping and livestock monitoring. Reflected GNSS signals can be used for soil moisture estimation, land classification, crop development monitoring and biomass monitoring. One example is shown here: a soil moisture map, generated by using GNSS-Reflectometry measurements (red: dry; blue: wet).



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Outlook

The European coordinated action GfG² was briefly introduced. Numerous applications of GNSS for Earth Observation within the nine different SBA were summarized. Relevant references and weblinks are given in the GfG² reports, indicated below. GNSS based techniques are currently already widely used but also exhibit the potential for a significant extended spectrum of applications in Earth Observation during the next years. This process will mainly stimulated by the upcoming new Satellite Navigation Systems Galileo, BeiDou and QZSS in parallel with the modernization of the U.S. GPS and the Russian GLONASS system and the continuously increasing GNSS receiver infrastructure.