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IGS Constellations

The Newsletter of the International GNSS Service

Issue 4 | June 2022

(Banner Image Source: NASA)

GNSS for Air Quality

by Mayra Oyola-Merced and Allison Craddock

Despite commitments to build resilience, tackle climate change and create sustainable development pathways; current societal, political and economic choices are sending us backwards. This jeopardizes not only the achievement of the Sendai Framework for Disaster Risk Reduction 2015–2030, but also hinders progress towards the Paris Agreement and the Sustainable Development Goals (SDGs).

SUSTAINABLE DEVELOPMENT GOALS

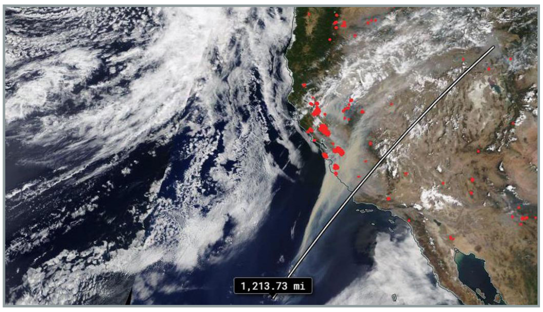
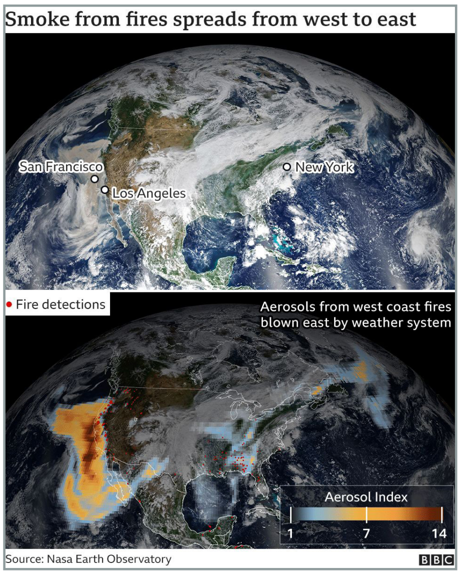


Figure 1: NASA's Terra satellite captured the smoke-engulfed state on Aug. 24, 2020. More than 650 wildfires were blazing in California after unprecedented lightning strikes, storms, and a heatwave that has set new records in the state. (Source: NASA)

Real-time monitoring of airborne pollutant composition and dispersion represents a unique transdisciplinary challenge to the scientific community as well as to global public health initiatives. Studies indicate that wildfire smoke is a risk to human health and increases the healthcare burden of smoke-impacted areas. Wildfire smoke composition is complex and dynamic, making characterization and forecasting even more difficult. Considering the perspectives of different highly specialized scientific disciplines in novel combinations will be increasingly critical to make best use of current technologies and drive future innovation. Earth observations of water vapor fields are made from numerous instruments measuring from the ultraviolet/visible, through the infrared bands, to as far as the microwave regions of the electromagnetic spectrum.

Atmospheric data collected from Earth observation satellites is increasingly used by decision makers in both public and private sectors to define, characterize, measure, and assess airborne pollutants. This data can be processed into information supporting improved air quality forecasting, modeling, and monitoring of long-term trends. Despite this broad potential benefit to global health and well-being, most atmospheric retrievals from satellites are neither designed nor optimized for air quality applications. Furthermore, spaceborne sampling and estimation of important features of the lower atmosphere, where most emissions and pollution plumes occur, is inherently difficult. Global Navigation Satellite Systems (GNSS) are well-known for providing geodetic data about positioning and movement of the Earth system, and thereby providing the geospatial reference frame for Earth observation satellites as well as ground-based measurements. In addition to these applications, novel uses of GNSS signals – and unexpected benefits to science and society – are being discovered through international collaboration and open data policies on a regular basis.



Source: NASA

In this case, the lower atmosphere or planetary boundary layer (PBL) is crucial in understanding weather phenomena and climate models, and is directly influenced by the land surface processes. The PBL plays a vital role in exchange of heat, momentum, moisture, and determines pollutant dispersibility. Thus, it is important to obtain estimates of both aerosols and PBL height for air pollution monitoring and assessment. Where PBL height measurements from traditional satellite platforms are limited or highly biased, transdisciplinary Global Navigation Satellite System (GNSS) radio occultation (RO) techniques provide a new approach as well as increased geographic distribution. GNSS-RO yields datasets with the accuracy, stability, and precision required for global assessments and other research applications, as well as potential enhancement or supplement to human health and safety alert systems. Fortunately, the availability of these observations has and will continue to increase as government and commercial missions continue to be launched thanks to the rapid emergence of low cost smallsats that will be able to provide dense coverages over the entire planet.

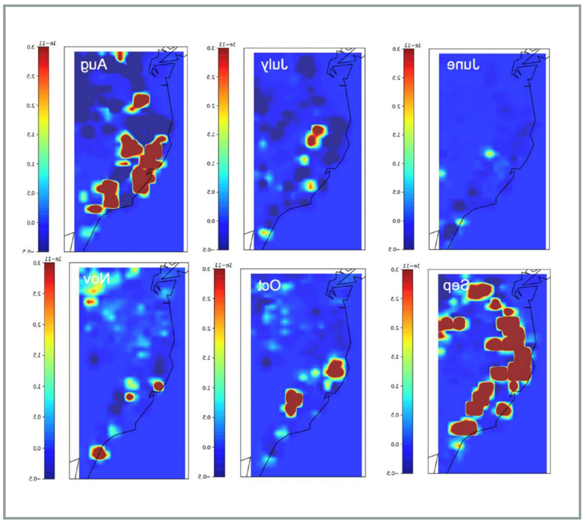


Figure 2: 2020 Fire Season black carbon concentration anomalies in ug/m3 , during the last wildfire season, calculated using 20-years of NASA's MERRA-2. Black carbon is a product of wildfires and major threat to public health (Source: Oyola-Merced et al. 2022)

IGS Central Bureau members Mayra Oyola-Merced and Allison Craddock, together with NASA JPL colleagues Chi Ao and Olga Verkhoglyadova, assessed the use of GNSS radio occultations to infer temperature and improve modeling for wildfire risk. This case study, which is a contributing paper to the 2022 UN Global Assessment Report (GAR) on Disaster Risk Reduction*, explores combining existing and emerging GNSS observational capabilities to support the measurement of fire-derived atmospheric indicators of systemic risk. The study is based on observations obtained during 2020, when the State of California experienced the largest wildfire season ever recorded in the state's modern history, with nearly 10,000 fires burning 4% of the state's 100 million acres and resulting in the state's worse air quality on record. The findings discussed here show that this geodesy-based analysis technique, coupled with existing and emerging aerosol concentration information from Earth observation satellites, weather models, and air quality indices, can potentially bring to the development of tools to study environmental triggers to air quality deterioration at both regional and global scale. As climate change and human behavior contribute to unprecedented occurrences of severe wildfires, constituting significant threat to life, it will be important to understand how previously unused or underutilized technologies (such as those derived from GNSS-RO analysis) may be applicable in the transdisciplinary understanding of disaster risk.

To download and read the full article, visit Transdisciplinary application of Global Navigation Satellite System Radio Occultation (GNSS-RO) to characterize atmospheric hazards and model systemic risk. To download and read the full 2022 GAR, visit 2022 UN Global Assessment Report on Disaster Risk Reduction.

*The UN Global Assessment Report (GAR) on Disaster Risk Reduction is the flagship report of the United Nations on worldwide efforts to reduce disaster risk. The GAR is published biennially by the UN Office for Disaster Risk Reduction (UNDRR), and is the product of the contributions of nations, public and private disaster risk-related science and research, amongst others. The UN Global Assessment Report (GAR) on Disaster Risk Reduction is the flagship report of the United Nations on worldwide efforts to reduce disaster risk. The GAR is published biennially by the UN Office for Disaster Risk Reduction (UNDRR), and is the product of the contributions of nations, public and private disaster risk-related science and research, amongst others.

Station **Highlight**

NIST00USA

Location:
Boulder, CO, USA
Established:
2002
Data Center:
JPL

Highlighted Quarterly **Publications**

To view these publications, click links in the titles below or visit igs.org/pub-alerts

GAR 2022 Our World at Risk: Transforming Governance for a Resilient Future

from United Nations Office for Disaster Risk Reduction

Spectral characteristics of ionospheric disturbances over the Southwestern Pacific from the January 15, 2022 Tonga eruption and tsunami

By Jessica N Ghent and Brendan W Crowell

Atmospheric waves and global seismoacoustic observations of the January 2022 Hunga eruption, Tonga

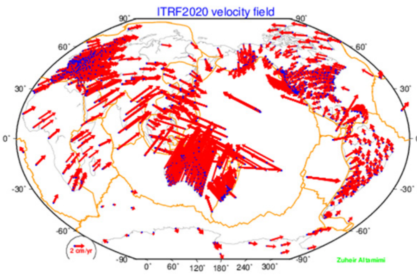
See full list of authors by clicking the link above

ITRF2020: A new release of the International Terrestrial Reference Frame

by Zuheir Altamimi

What is the current rate of sea level rise in different regions of the globe? How does our Earth deform under the effect of plate tectonics, seismic phenomena, or the melting of ice caps? How the Earth's center of mass is varying? How to determine the position of a point on the surface of a constantly deforming Earth and compare it to positions estimated decades apart? The answers to these fundamental questions for understanding the dynamics of our planet require the availability of a global, long-term stable terrestrial reference frame, but preferably a standard reference so to ensure interoperability and consistency of various measurements collected by sensors on the ground, or via artificial satellites.

The International Terrestrial Reference Frame (ITRF) is the standard reference recommended by a number of international scientific organizations, including the International Union of Geodesy and Geophysics (IUGG) and the International Association of Geodesy (IAG) for earth science, satellite navigation and operational geodesy applications.



The ITRF is an international effort that is built on the investments of space and mapping agencies, universities and research groups in operating geodetic observatories, archiving and analyzing the collected geodetic observations to derive not only the ITRF, but also critical geodetic products for science and society. The ITRF integrates and unifies technique-specific reference frames provided by the four IAG's international services of space geodetic technique (DORIS/IDS, GNSS/IGS, SLR/ILRS, VLBI/IVS). It is supplied to the users in the form of temporal coordinates of more than 1500 stations, Earth Orientation Parameters, as well as parametric functions describing nonlinear station motions: seasonal signals due to mainly loading effects and post-seismic deformations for sites subject to major earthquakes.

It is necessary to regularly update the ITRF (approximately every 5 years) in order to benefit from continuous observations so to improve its accuracy, considering station position temporal variations due to geophysical phenomena. The ITRF is maintained by a research group at IGN-France and IPGP (Institut de Physique de Globe de Paris), and whose new release called ITRF2020 was published on April 15 and accessible here: https://itrf.ign.fr/en/solutions/ITRF2020.

The ITRF2020 brings significant improvements compared to previous achievements: it confirms the estimate of the position of the center of mass of the Earth as it was determined in 2016, but also provides its seasonal variations; it improves the accuracy of the scale of the frame at the millimeter level, which represents a gain in precision of a factor of 8 on the measurement of the size of the Earth (compared to that determined in 2016); it provides a precise quantification of co- and post-seismic displacements caused by devastating earthquakes, such as that of Sumatra in 2004, Chile in 2010 and Japan in 2011.

The IAG Services rely on the ITRF to align their geodetic products to it, and therefore disseminate it widely among the various users. In particular, using the IGS products, such as the orbits, allows a universal access in space and time to the ITRF.

IGS Member Highlight

Ashley Santiago

IGS Governing Board Executive Secretary
IGS Central Bureau Member
United States

"I am honored to be the next IGS Governing Board Executive Secretary and would like to thank my team at the IGS Central Bureau and the Governing Board for helping me achieve this. Working with the IGS Central Bureau, I have learned so much about GNSS, geodesy, and science communications which has enabled me to use design and research as tools to improve IGS communications and systems. My goal is to continue bringing more awareness to the IGS and the amazing work being done within this community, as well as help move the IGS to achieve its 2021+ Strategic plan goals and objectives. I invite the community to contact me for any questions regarding your user experience with IGS systems or any design related questions." - Ashley

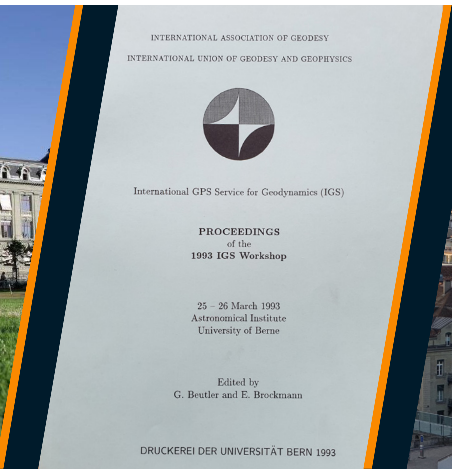
Welcome to the #IGSNetwork!

Welcome ANK200TUR in Ankara, Turkey and P77900USA in Rosman, North Carolina (NC), USA to the #IGSnetwork! We appreciate the Map General Directorate of Turkey for providing the ANK200TUR data and we appreciate UNAVCO for providing P77900USA data. For more information on ANK200TUR and P77900USA or other stations, visit the Network page on igs.org.

Station Name:
ANK200TUR
Location:
Ankara, Turkey

Station Name:
P77900USA
Location:
Rosman, NC, USA

Figure 1: University of Bern (Source: University of Bern)



INTERNATIONAL ASSOCIATION OF GEODESY
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

International GPS Service for Geodynamics (IGS)

PROCEEDINGS
of the
1993 IGS Workshop

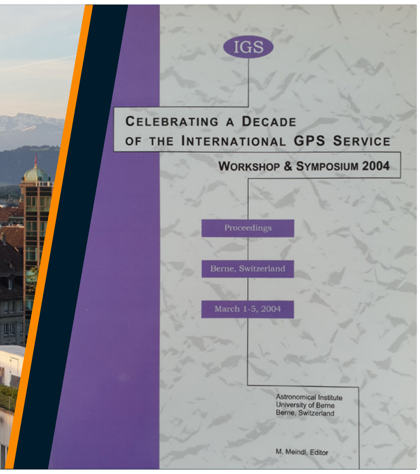
25 – 26 March 1993
Astronomical Institute
University of Berne

Edited by
G. Beutler and E. Brockmann

DRUCKEREI DER UNIVERSITÄT BERN 1993

Figure 2: Title page of the proceeding from the 1993 workshop in Bern (Source: Rolf Dach, AIUB)

Figure 3: View from the location of the University towards the city and the alps (Source: Rolf Dach, AIUB)



IGS

CELEBRATING A DECADE
OF THE INTERNATIONAL GPS SERVICE

WORKSHOP & SYMPOSIUM 2004

Proceedings

Berne, Switzerland

March 1-5, 2004

Astronomical Institute
University of Berne
Berne, Switzerland

M. Meindl, Editor

Figure 4: Title page of the proceeding from the 2004 workshops in Bern (Source: Rolf Dach, AIUB)

IGS Workshop 2024 Bern

by Rolf Dach

The IGS started its operational service on 1 January, 1994. During the course of preparing for this operational phase, the first IGS workshop was held at the premises of the University of Bern (see Figure 1) from 25 to 26 March, 1993 (see Figure 2) focusing on the analysis centers. The first decade of operational service was celebrated at an IGS workshop hosted again in Bern Switzerland (see Figure 3) by the University of Bern in March 2004 (see Figure 4).

In 2024 the IGS will celebrate 30 years of operational service. The University of Bern together with the partners from the CODE consortium (AIUB: Astronomical Institute of the University of Bern, Switzerland; swisstopo: Swiss Federal Office of Topography, Wabern, Switzerland; BKG: Federal Agency for Cartography and Geodesy, Frankfurt a. M., Germany; IAPG/TUM: Institute for Astronomical and Physical Geodesy, Technical University of Munich, Germany) invites the community to celebrate the third decade with a symposium together with an IGS workshop again in Bern, Switzerland (see Figure 4) at the premises of the University of Bern. The event is planned for the week from **1 to 5 July in 2024**.

Upcoming Events

TBD
Tour de l'IGS 4th Stop

11 December
IGS 62nd Governing Board Meeting

12 - 16 December
AGU Fall Meeting 2022

December 2022
IGS Associate Members Meeting

CREDITS
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