OTHER CONTRIBUTIONS

TEQC Summary

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UNAVCO

TEQC: UNAVCO's GPS/GLONASS Translate/Edit/Quality Check (TEQC) software has been available since April 1997 and recently had the last release specifically for the IGEX 98 on 22 October 1998. For translation, TEQC can read the following currently used raw formats:

* Ashtech B/E/S download fileset
* Ashtech RS-232 stream format
* Canadian Marconi binary format
* ConanBinary
* Leica 200/300 DS format
* Leica LB2 format
* Rockwell Zodiac binary format
* Trimble dat/eph/ion/mes download fileset
* Trimble RS-232 stream format
* Trimble TSIP format
* TurboBinary

plus the legacy formats:

* ARGO exchange format
* RINEX version 1
* TI-4100 BEPP/CORE format
* TI-4100 GESAR format
* TI-4100 ROM format

and convert to RINEX version 2 files (RINEX OBS, GPS RINEX NAV, GLONASS RINEX NAV, and/or RINEX MET). For metadata editing, TEQC can be used to edit RINEX header information, decimate data, and/or time window data during translation of a raw format to RINEX, or RINEX to RINEX. Data QC can be done on a raw format
or on RINEX, including mixed GPS/GLONASS data.

TEQC is currently available and supported on the following OS/platforms:

* Solaris Sparc 2.3 or later
* Solaris x86 2.6 or later
* SunOS 4.1.1 - 4.1.3
* HP-UX PA-RISC 10.20 or later
* DEC Digital-UXIX OSF1 4.0 or later
* Linux

* Microsoft Windows NT 4.0
* Microsoft Windows 95 or 98
* Microsoft Windows 3.1.1 or later
* Microsoft DOS 5.x or later

and in the past has been compiled and used via request on:

* MacIntosh OS
* HP-UX PA-RISC 9.03
* SGI Irix 5.3

Further plans for TEQC include:

* translators for other raw formats
* developing a single frequency (L1) QC
* tuning translators for the GPS Week 1024 rollover on 22 Aug 1999
* developing a Java GUI wrapper

TEQC is currently being used at/by:

* UNAVCO Facility
* CDDIS
* SCEC, UCSD
* SOPAC
* NASA Goddard Space Flight Center
* NASA Jet Propulsion Laboratory
* NGS/CORS
* USGS
* Massachusetts Institute of Technology
* Rensselaer Polytechnic Institute
* Stanford (BARD)
* Texas A&M
* University of Alaska
* University of California, Berkeley
* University of Colorado
* University of Florida
* University of Hawaii
* University of Illinois
* University of Maine
* University of Minnesota
* University of Texas
* University of Washington (PANGA)
* over 30 international users

* commercial users (e.g. Trimble, Ashtech, Leica)
* U.S. state surveyors

Full documentation for TEQC is available at

http://www.unavco.ucar.edu/software/teqc

including a tutorial, FAQs, a up-to-date bug report and status page, a development and release log, and example translations, editing, and qc situations. There is also an on-line email archive at

http://www.unavco.ucar.edu/html_mail/teqc

which logs emails to the subscribed email list of 100 users at teqc@unavco.ucar.edu

Proposed Changes of the RINEX Version 2 Format

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Introduction

During the last few years several proposals for changes in the RINEX format have been brought to my attention. This paper lists the changes that will be proposed to a broader public for discussion early 1999.

The proposed changes are so moderate that most certainly they do not justify the introduction of a RINEX Version 3. We propose therefore to introduce a new release 2.10 of Version 2, by simultaneously changing the RINEX version number field in the header from integer to a real value.

Proposed Changes

Fractional Version Number (All RINEX File Types)

Proposal*:*
The RINEX version number in the first header line should be a non-integer value for all RINEX file types, as already introduced for the GLONASS navigation message file.

Example:
```
     2.10           OBSERVATION DATA    M (MIXED)           RINEX VERSION / TYPE
```

Pad Two-digit Year Fields With a Zero (All Files)

Proposal:
Pad all 2-digit year fields for the years 2000-2009 with a zero for easier human readability.

Examples:
```
Obs:      00  2  6 12 13 10.0000000  0 12G23G07G02G05G26G09G21R20R19R12R02R11
Nav:       3 00  2  6 12 15  0.0 0.163525342941D-03 0.363797880709D-11 0.108000000000D+05
Met:      00  2  6 12 15  0  987.1   10.6   89.5
```

Alternative proposal:
Padd all two-digit date and time fields with zeroes if necessary.

Examples:

```
Obs:   00 02 06 12 13 10.0000000   0 12G23G07G02G05G26G09G21R20R19R12R02R11

Nav:    3 00 02 06 12 15 00.0 0.163525342941D-03 0.363797880709D-11 0.108000000000D+05

Met:   00 02 06 12 15 00  987.1   10.6   89.5
```

Increase Field Length of TIME OF FIRST and LAST OBS (Observation Files)

Proposal:

In order to have the same granularity of the seconds field in the TIME OF FIRST OBS and TIME OF LAST OBS header record as the one in the OBS RECORDS we propose to increase the field length for the seconds from F12.6,6X to F13.7,5X.

Example:

```
1999     1     5    12    33   30.0490000     GPS         TIME OF FIRST OBS
```

Non-Integer Sampling Rates (Observation Files)

Proposal:

Introduction of a more general sampling interval, namely allowing for fractional parts of seconds (e.g. 0.5 second sampling)

Proposal 1:

```
 +--------------------+-----------------------------------------+------------+
*|INTERVAL            | Observation interval in seconds         | 14X,F14.4  |*
 |                    | (Old format for integer values only: I6) |            |
 +--------------------+-----------------------------------------+------------+
```

Example:

```
                  1.5000                              INTERVAL
    ^
    |
    +---- blank!
```

Such a record will still conform to RINEX version 1 and 2, since the original field (I6) will be blank and therefore be interpreted as "Interval unknown".

Proposal 2:

```
 +--------------------+-----------------------------------------+------------+
*|INTERVAL            | Observation interval in seconds         | F10.3      |*
 |                    | (Old format for integer values only: I6) |            |
 +--------------------+-----------------------------------------+------------+
```

Example:

```
       0.100                                          INTERVAL
```

Such a record will still conform to RINEX version 1 and 2 for
- integer intervals
- fractional intervals smaller than one second (read as zero = undefined)

Non-integer intervals larger than one second would be read as INT(interval).

Header Records After Event Flags (Obs Files)

Event flags 2 and 5 don't have header records assigned. That's why the RINEX2 document requested the number of (header) records to follow to be zero.

Proposal:
Remove this restriction so that COMMENT lines can directly follow such event flags.

Example:
```
99  1 24 13 13  1.2345678  5  2
     *** AN EVENT FLAG WITH SIGNIFICANT EPOCH ***           COMMENT
    *** DIRECTLY FOLLOWED BY TWO COMMENT LINES  ***         COMMENT
```

Default Wavelength Factor Header Line (Obs Files)

Proposal:
Make default wavelength factor RINEX header line a required line.

Additional Observation Type: S1, S2 (Obs Files)

Several individuals came up with the request to increase the number of significant digits for the signal strength. In the current RINEX definition the signal strength is a number between 1 and 9 to get a coarse receiver-independent indication about the actual signal strength. In order to account for the request we propose to define two new observation types S1 and S2 being the original signal strength values given by the receiver for L1 and L2 tracking.

Application of Receiver Clock Offsets to the Data and Time Tag (Obs Files)

RINEX Version 2 defines a field in the epoch/satellite records for the real-time determined clock offsets but asks that the observables code, phase and time tag have to be corrected by these offsets.

This might lead to some confusion. Some users would also like to report these offsets without having to modify the original data.

Proposal:
A new version of RINEX should allow for either way, i.e. define a header field to indicate if the data has been corrected by the reported clock offset or not.

```
 +--------------------+-----------------------------------------+------------+
*|RCV CLOCK OFFS APPL | Realtime-derived receiver clock offset  |     I6     |*
 |                    | applied to epoch/code/phase (1=yes, 0=no)|            |
 |                    | Default:  0=no                          |            |
 |                    | Record required if clock offsets are    |            |
 |                    | reported in the EPOCH/SAT records       |            |
 +--------------------+-----------------------------------------+------------+
```

Example:

```
       1                                                    RCV CLOCK OFFS APPL
```

INMARSAT GPS Payloads (Obs Files)

INMARSAT launched geostationary satellites called AOR-E and IOR having a navigation payload capable of GPS-like signal broadcasting (PRNs are choosen over 100 for those GEO satellites), in order to improve GPS performance.

Such satellites could be included into RINEX files using mixed files by using a satellite system identifier and identifying these payloads as "snn" where nn = PRN-100 and s a character to be discussed.

A special navigation message file (similar to the GLONASS navigation message file has to be defined.

Curve Fit Interval (Navigation Message File)

Bit 17 in word 10 of subframe 2 is a "fit interval" flag which indicates the curve-fit interval used by the CS in determining the ephemeris parameters, as follows (see ICD-GPS-200, 20.3.3.4.3.1):

0 = 4 hours
1 = greater than 4 hours.

Together with the IODC values and Table 20-XII the actual fit interval can be determined.

Proposal:
The second value in the last record of each message contains the fit interval in hours, determined using IODC, fit flag, and Table 20-XII, according to the Interface Document ICD-GPS-200.

SV Health (Navigation Message File)

Proposal:
Include also the health of the signal components (bits 18 to 22 of word three in subframe one) and not just the summary bit of the nav data health (bit 17).

A program reading RINEX files could easily decide if bit 17 only or all bits have been written:

RINEX Value: 0 Health OK
RINEX Value: 1 Health not OK (bits 18-22 not stored)
RINEX Value:>32 Health not OK (bits 18-22 stored)

Transmission Time of Message (Navigation Message File)

Clarification:
The transmission time of message can be shortly before midnight Saturday/Sunday, the TOE and TOC of the message already in the next week. As the reported week in the nav message (BROADCAST ORBIT - 5 record) goes with ToE, the transmission time of message should be reduced by 604800 (i.e., will become negative) to also refer to the same week.

Additional Observation Types (Met Data Files)

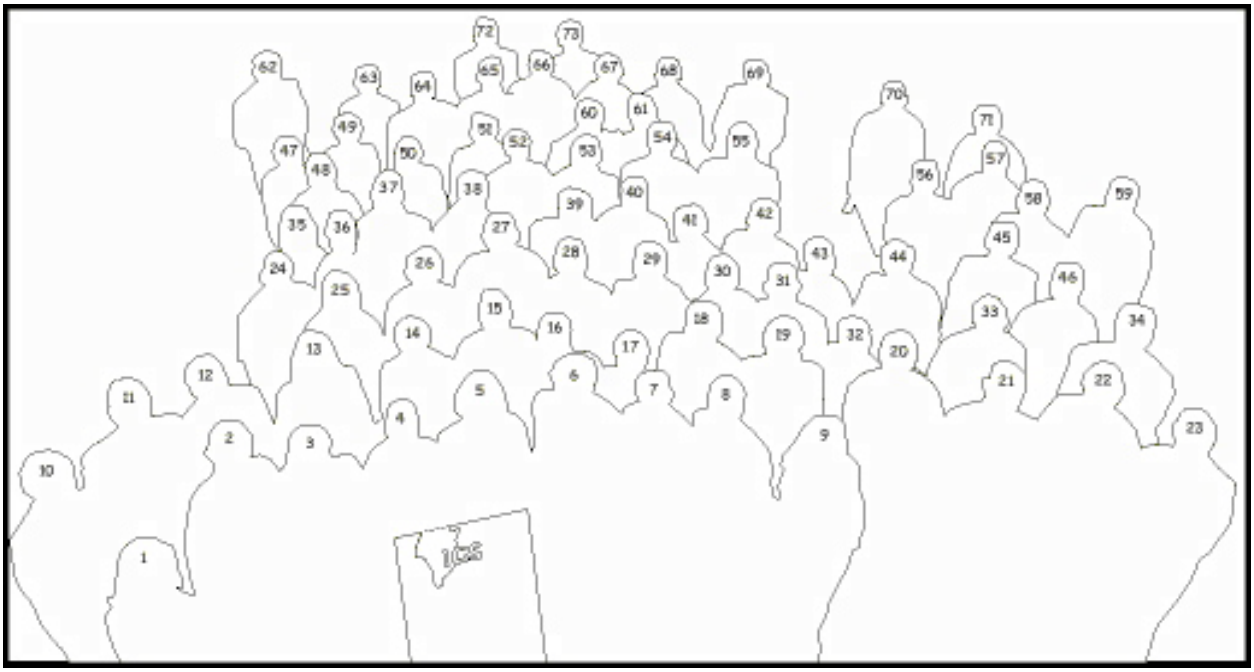
Proposal:
Define
ZD : Dry component of zenith path delay
ZT : Total zenith path delay

ZT could be used to distribute the zenith path delays estimated for permanently operated GPS sites using their GPS observables.

TIME OF FIRST OBS Record (Met Data Files)

Proposal***:***
In order to remove ambiguities in the 2-digit year of the data records we propose to include into the RINEX header a TIME OF FIRST OBS and, optionally, a TIME OF LAST OBS record.


IGS



1 Kelly Wetzel
2 Werner Gurtner
3 Gerhard Beutler
4 Carey Noll
5 Ruth Neilan
6 Jan Kouba
7 Pino Colucci
8 Robert Snow
9 Angelyn Moore
10 Hans Van der Marel
11 Rob Liu
12 Edward Manzanares
13 Barb Perin
14 Arthur Niell
15 Zinovy Malkin
16 Frank Webb
17 Meghan Miller
18 Yuki Hatanaka
19 Tom Stansell
20 Mike Jackson
21 B. Jalali
22 Boudewijn Ambrosius
23 John Bosworth
24 Steve Wilson
25 Michael Schmidt
26 Hans Kunze
27 Wayne Shiver
28 Yehuda Bock
29 Will Prescott
30 Gus Jones
31 Jim Zumberge
32 Seth Stein
33 Jim Ray
34 Bjorn Engen
35 Fran Boler
36 Myron McCallum
37 Mark Caissey
38 Loic Daniel
39 Finn Bo Madsen
40 Karim Owolabi
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44 Mikhail Kogan
45 Svein Rekkedal
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47 Nancy Doyle
48 Carlos Garcia-Martinez
49 Miranda Chin
50 Carine Bruyninx
51 Jim Davis
52 Ludwig Combrink
53 Grigory Steblov
54 James Stowell
55 Gerry Mader
56 Chuck Meertens
57 Oivind Ruud
58 Roger Wood
59 Richard Snay
60 Tom Clark
61 Herb Dragert
62 Juergen Neumeyer
63 Steve Hilla
64 Heinz Habrich
65 Jeff Behr
66 Simon McClusky
67 Chris Roelle
68 Jeff Dean
69 Dave Stowers
70 Jim Long
71 John Sheid
72 Hans-Peter Plag
73 Peter Pesec

Technical Workshop Committee

Top row L-R: Loic Daniel, Jeff Dean, Yehuda Bock, Jan Kouba, Chuck Meertens, Hans-Peter Plag
2nd row L-R: Werner Gurtner, Ivan Mueller, Jim Ray, Ludwig Combrinck
Front L-R: Ruth Neilan, Angelyn Moore, Carey Noll

(Organizing Committee: Ruth Neilan and Carey Noll)

Candid Photos

The Future Requirements Panel are joined by speakers from the morning session. First row (seated, left to right): Carlos Garcia, Mike Watkins, Seth Stein, Mike Whitehead, Frank Webb, Jim Slater. Second row (standing, left to right): Jan Kouba, Mike Bevis, Jim Zumberge, Werner Gurtner, Clark Wilson, Jim Ray, Gerhard Beutler, and Hans-Peter Plag. *(photo courtesy of UNAVCO)*

Gerhard listens intently during the data center presentation. Also in the audience are Miranda Chin and Ludwig Combrink. *(photo courtesy of UNAVCO)*

Jan Kouba seems to find the data center discussions amusing! Werner Gurtner, however, seems very intense. *(photo courtesy of UNAVCO)*

Gerry Mader seems pleased with the certificate presented by Gerhard Beutler acknowledging Gerry's service on the IGS Governing Board. Jim Long (ATSC), Mike Bevis, Yehuda Bock, Gerhard, and Jim Zumberge look on. *(photo courtesy of UNAVCO)*

Candid Photos (continued)

James Stowell gives a demo of Leica hardware and software to Svein Rekkedal and Rune Hanssen. *(photo courtesy of Leica)*

An authentically-attired early American tour guide gives a group (Grigory Steblov, Heinz Habrich, Finn Bo Madsen, Rob Liu, Werner Gurtner, and Mark Caissey) a candlelight tour of Annapolis. *(photo courtesy of UNAVCO)*

Heinz Habrich is entertained during dinner by one of the Annapolis tour guides. *(photo courtesy of UNAVCO)*

Jeff Dean, Chris Roelle, and Simon McClusky are serenaded by colonial musicians during the banquet dinner. *(photo courtesy of UNAVCO)*

Acronyms and Abbreviations

AAC	(IGS) Associate Analysis Center
AAM	Atmospheric angular momentum
AC	(IGS) Analysis Center
ACC	(IGS) Analysis Center Coordinator
AGRS.NL	Active GPS Reference System for the Netherlands
AGU	American Geophysical Union
AIUB	Astronomical Institute of Berne, Switzerland
AOA	Allen Osborne Associates
APSG	Asia-Pacific Space Geodynamics Project
ARNS	A remote network server
AS	Anti-spoofing
ASI	Italian Space Agency
ATM	Asynchronous transfer mode
ATSC	AlliedSignal Technical Services Corporation, U.S.
AUSLIG	Bay Area Regional Deformation, U.S.
BIPM	Bureau International des Poids et Mesures, France
BKG	Bundesamt für Kartographie und Geodäsie
CB	(IGS) Central Bureau
CBIS	(IGS) Central Bureau Information System
CDDIS	Crustal Dynamics Data Information System, U.S.
CEOS	Committee on Earth Observation Satellites
CGRS	Continuous geodetic remote station
CGS	Centro di Geodesia Spaziale, Italy
CHAMP	Challenging Mini-Satellite Payload
CIGNET	Cooperative International GPS Network
CIR	Committed information rate
CNES	Centre National d'Etudes Spatiales, France
CODE	Center for Orbit Determination in Europe
CORE	Continuous Observation of the Rotation of the Earth
CORS	Continuously Operating Reference Station
COSMIC	Constellation Observing System for Meteorology, Ionosphere and Climate
CSTG	International Coordination of Space Techniques for Geodesy and Geodynamics
CWU	Central Washington University, U.S.
DC	(IGS) Data Center
DCB	Differential GPS
DLR	Deutsche Forschungsanstalt für Luft- und Raumfahrt. Germany
DMCR	Dorne Margolin choke ring
DoD	(U.S.) Department of Defense
DOMES	Directory of MERIT Sites
DORIS	Determination of Orbit Radiopositioning Integrated by Satellite
DOY	Day of year
DSN	Deep Space Network, U.S.
DUT	Delft University of Technology, the Netherlands
EGADS	Extendable GPS Array Data Software
EGNOS	European Geostationary Navigation Overlay System
EMP	Electro-magnetic pulse
ERP	Earth rotation parameter
ESA	European Space Agency
ESOC	ESA Space Operations Center

Acronyms and Abbreviations (cont'd)

EUREF	European Reference Frame
FAGS	Federation of Astronomical and Geophysical Data Analysis Services
FGI	Finnish Geodetic Institute
FLINN	Fiducial Laboratories for an International Natural Science Network
FTP	File transfer protocol
G3)S	Three Global Observing Systems
GB	(IGS) Governing Board
GBSS	Geodetic base station software
GDC	(IGS) Global Data Center
GEWEX	Global Energy and Water Cycle Experiment
GFZ	GeoForschungsZentrum, Germany
GGAO	Goddard Geophysical and Astronomical Observatory, U.S.
GGN	Global GPS network
GIS	Geographic information system
GLONASS	Global Navigation Satellite System
GNAAC	(IGS) Global Network Associate Analysis Center
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GSAC	GPS Seamless Archive Center
GSC	Geological Survey of Canada
GSFC	Goddard Space Flight Center, U.S.
GSI	Geographical Survey Institute, Japan
GTOS	Global Terrestrial Observing System
HQ	(NASA) Headquarters
HO	Haystack Observatory, U.S.
HRAO	Hartebeesthoek Radio Astronomy Observatory
IAA	Institute of Applied Astronomy, Russia
IAAC	(IGS) Ionosphere Associate Analysis Center
IAG	International Association of Geodesy
IAU	International Astronomical Union
IC	(IGS) Infrastructure Committee
IEEE	Institute of Electrical and Electronics Engineers
IERS	International Earth Rotation Service
IGBP	International Geosphere-Bisosphere Program
IGEB	Interagency GPS Executive Board
IGEX	International GLONASS Experiment
IGFA	International Group of Funding Agencies for Global Change Research
IGN	Institut Géographique National, France
IGOS	Integrated Global Observing Strategy
IGP	IGS predicted orbit
IGR	IGS rapid orbit
IGS	International GPS Service
ILRS	International Laser Ranging Service
INASAN	Institute of Astronomy of the Russian Academy of Sciences
IODC	Issue of data, clock
ION	Institute of Navigation, U.S.
IONEX	Ionosphere map exchange
IPCC	Intergovernmental Panel on Climate Change
IPv6	Internet protocol version 6
IRFC	IGS Reference Frame Coordinator
IRIS	Incorporated Research Institutions for Seismology, U.S.

Acronyms and Abbreviations (cont'd)

ISDN	Integrated services digital network
ISR	Institute for Space Research, Austria
ITRF	IERS Terrestrial Reference Frame (often referred to as International Terrestrial Reference Frame)
IUGG	International Union of Geodesy and Geophysics
IVS	International VLBI Service
IVTAN	Institute for High Temperature of the Russian Academy of Sciences
JPL	Jet Propulsion Laboratory, U.S.
JPS	Javad Positioning Systems
KAO	Korean Astronomical Observatory
KMS	National Survey and Cadastre, Denmark
LAAS	Local area augmentation system
LAN	Local area network
LDC	(IGS) Local Data Center
LDGO	Lamont-Doherty Geological Observatory, U.S.
LEO	Low Earth orbiter
LNA	Low noise amplifier
LOD	Length of day
MCS	Multipath calibration system
MEO	Medium Earth orbiter
MHz	Megahertz
MIT	Massachusetts Institute of Technology, U.S.
NASA	National Aeronautic and Space Administration, U.S.
NAVSTAR	Navigation Satellite Timing and Ranging
NCEDC	Northern California Earthquake Data Center
NCL	University of Newcastle upon Tyne, U.K.
NCSA	National Center for Supercomputing Applications, U.S.
NDGPS	Nationwide differential GPS
NEDA	Northern Eurasia Deformation Array
NERC	Natural Environment Research Council U.K.
NGI	Next generation Internet
NGS	National Geodetic Survey, U.S.
NIMA	National Imagery and Mapping Agency, U.S.
NLS	National Land Survey, Sweden
NMA	Norwegian Mapping Authority
NOAA	National Oceanic and Atmospheric Administration, U.S.
NPL	National Physical Laboratory, India
NRCan	Natural Resources, Canada
NRT	Near real time
ns	Nanosecond
NSF	National Science Foundation, U.S.
NUVEL	Northwestern University velocity model
ODC	(IGS) Operational Data Center
OLG	Observatory Lustbuehel Graz, Austria
OSO	Onsala Space Observatory
OSU	Ohio State University, U.S.
PANGA	Pacific Northwest Geodetic Array
PCV	Phase center variation
PFO	Pinyon Flat Geophysical Observatory, U.S.
PGC	Pacific Geoscience Center, Canada
PM	Polar motion

Acronyms and Abbreviations (cont'd)

POD	Precision orbit determination
PTTI	Precise Time and Time Interval
PW	Precipitable water
PWV	Precipitable water vapor
QC	Quality check
RAS	Russian Academy of Science
RDAAC	Russian Data Archive and Analysis Center
RDBMS	Relational data base management system
RDC	(IGS) Regional Data Center
RF	Radio frequency
RFI	Radio frequency interference
RGO	Royal Greenwich Observatory, U.K.
RINEX	Receiver Independent Exchange
RMS	Root mean square
RNAAC	(IGS) Regional Network Associate Analysis Center
RNSS	Radionavigation Satellite Services
ROB	Royal Observatory of Belgium
RSA	Russian Space Agency
RTCM	Radio Technical Commission for Maritime Services, U.S.
RTK	Real time kinematic
RUSEG	Russia/U.S. Experiment on Geodynamics by TPS technology
SA	Selective availability
SAO	Smithsonian Astrophysical Observatory
SCEC	Southern California Earthquake Center
SCIGN	Southern California Integrated GPS Network
SINEX	Software Independent Exchange
SIO	Scripps Institution of Oceanography
SLR	Satellite laser ranging
SNR	Signal to noise ratio
SOPAC	Scripps Orbit and Permanent Array Center
SP	Sveriges Provnings, Sweden
STAR TAP	Science, Technology, and Research Transit Access Point
SV	Space vehicle
SWEPOS	Swedish Permanent GPS Network
TAC	Totally accurate clock
TAI	International Atomic Time
TCP/IP	Transmission Control Protocol/Internat Protocol
TDMA	Time division multiple access
TEC	Total electron content
TEQC	Translate/edit/quality check
TOC	Time of clock
TOE	Time of ephemeris
TS	(IGS) tracking station
TSA	3S Navigation temperature stabilized antenna system
TZD	Tropospheric zenith delay
UARC	Upper Atmosphere Research Collaboratory
UCAR	University Corporation for Atmospheric Research
UCSD	University of California, San Diego, U.S.
UMBC	University of Maryland Baltimore Campus, U.S.
UNAVCO	University NAVSTAR Consortium, U.S.
UNCED	U.N. Conference on Environment and Development

Acronyms and Abbreviations (cont'd)

UNEP	U.N. Environmental Program
UNFCCC	U.N. Framework Convention on Climate Change
UPC	Polytechnical University of Catalonia, Spain
URL	Uniform resource locator
USGS	United States Geological Survey
USNO	United States Naval Observatory
UTC	Universal time coordinated
vBNS	Very high performance Backbone Network Service
VLBI	Very long baseline interferometry
VPN	Virtual private network
VSAT	Very small aperture satellite
VSL	NMi Van Swinden Laboratorium, The Netherlands
WAAS	Wide area augmentation system
WADGPS	Wide area differential GPS
WG	(IGS) working group
WGS	World geodetic system
WRCP	World Climate Research Program
WVR	Water vapor radiometer
WWW	World wide web
ZND	Zenith neutral delay