



ITU WORKSHOP

Overview of activities of ITU-R Study Group 3
on radiowave propagation

**The Hague, The Netherlands
10 April 2014**

www.itu.int/go/rsg3-EuCAP14



ITU WORKSHOP
Overview of activities of ITU-R
Study Group 3 on radiowave propagation:
(The Hague, 10 April 2014)

SG3 Software, Databanks and Testing Procedures

Antonio Martellucci
Carlo Riva

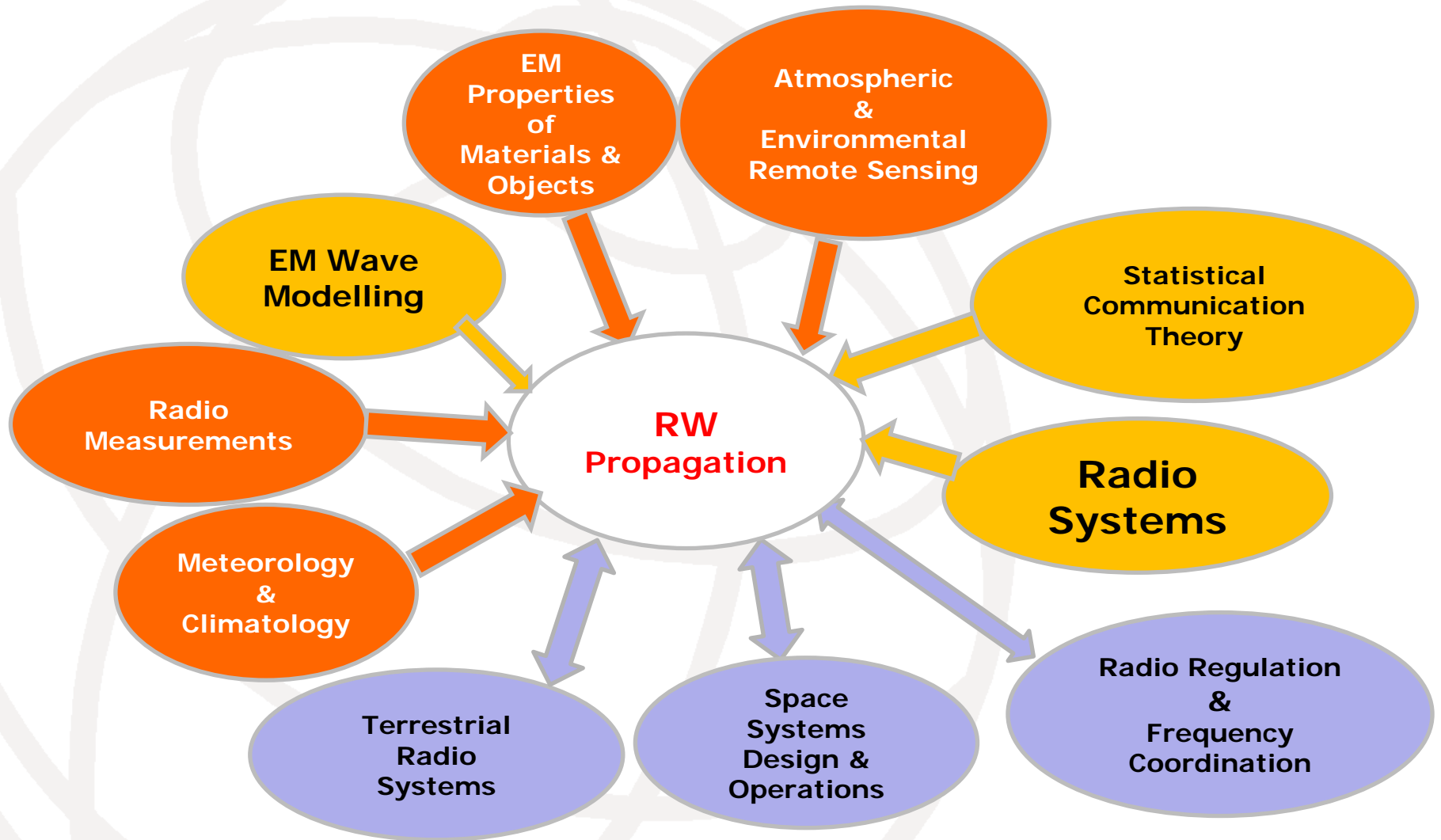
- Introduction and Background
- Terms of Reference, Work Method
- Experimental Data
- Testing of Models
- Conclusions, The way ahead

Introduction and Background



Where we are.

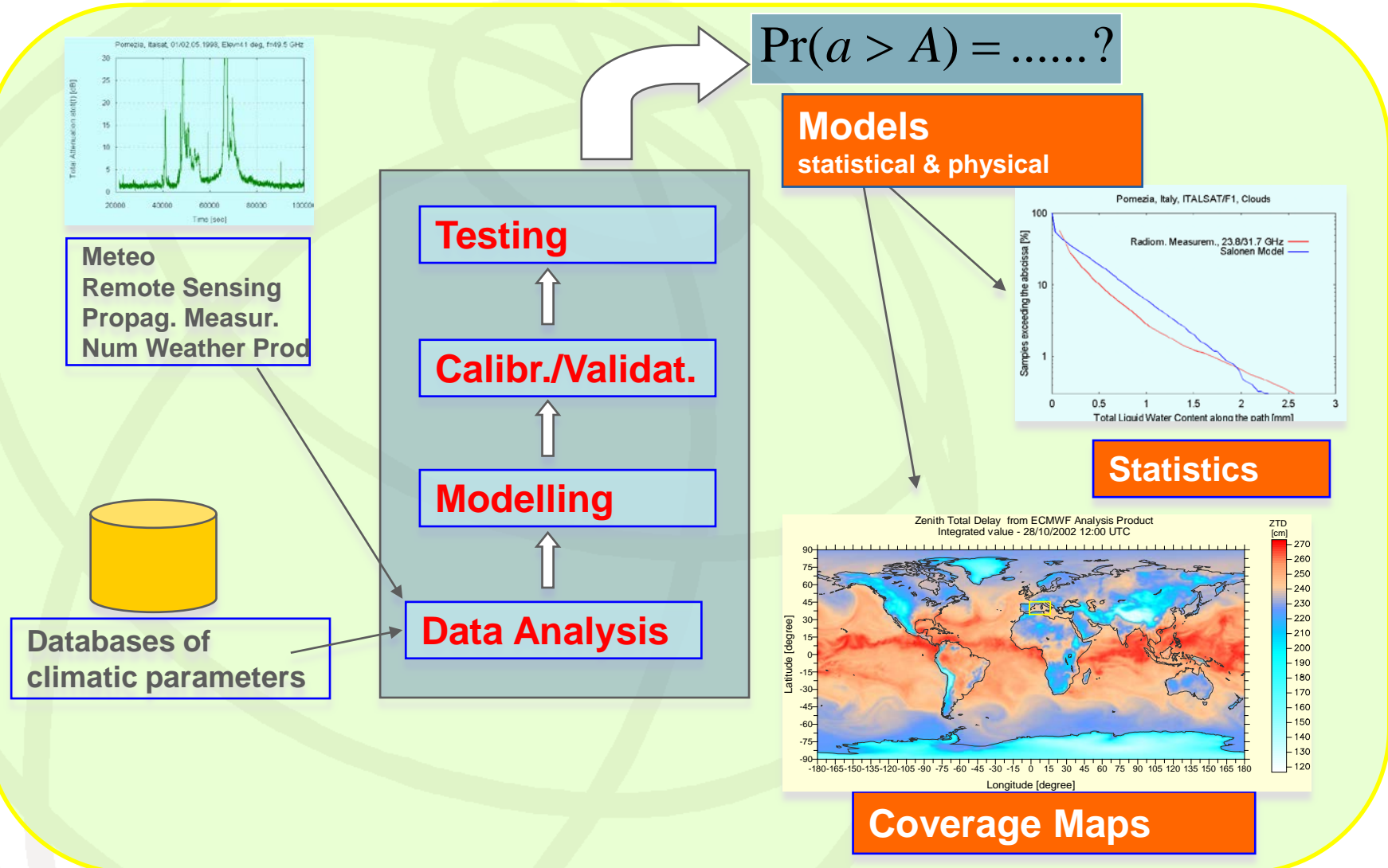
3M4



Introduction and Background

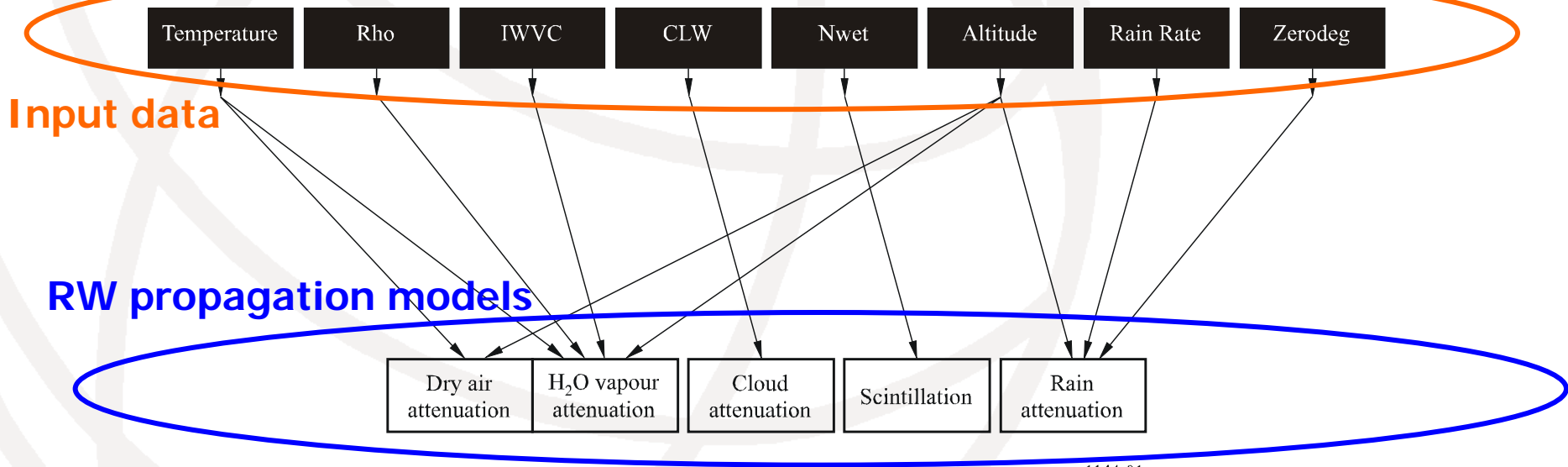


Example: workflow for tropospheric propagation



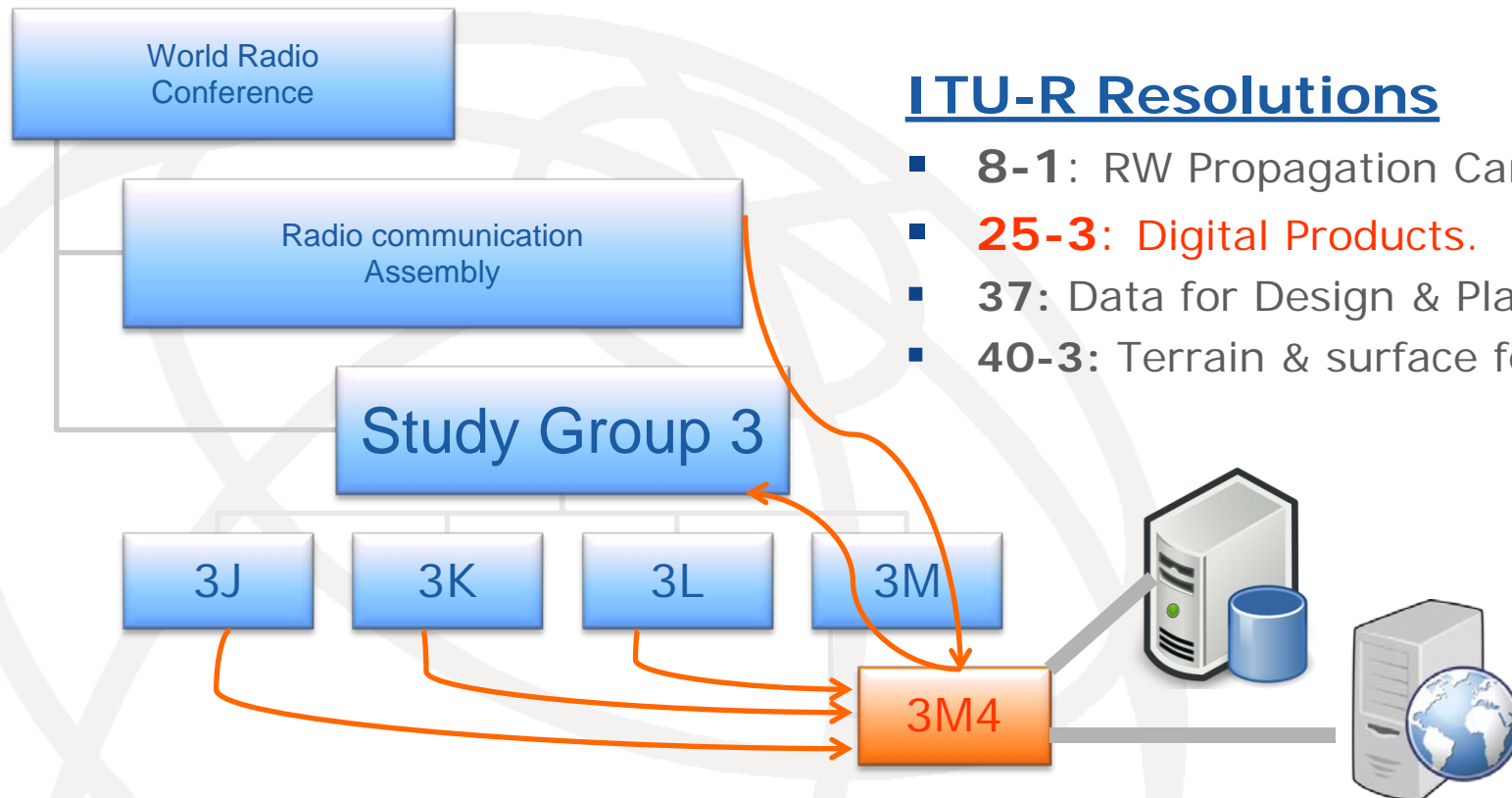
- ITU-R P Recommendations
- Option between:
 - User provided data
 - global maps/standard parameters
- **Some recs. require the use of other recs. (nested recs.)**

Example: ITU-R P. 618



1144-01

- RW Propagation Models :
 - Input parameters:
 - Tables
 - Digital Maps
 - Site specific data (e.g. raingauge VS rain maps)
 - Provided as:
 - Text in Annex (a kind of cooking recipe)
 - SW Code (Source AND/OR Executable)
 - Needs experimental data for:
 - Verification of accuracy of current models
 - SG3 Decision for adoption of a new model



ITU-R Resolutions

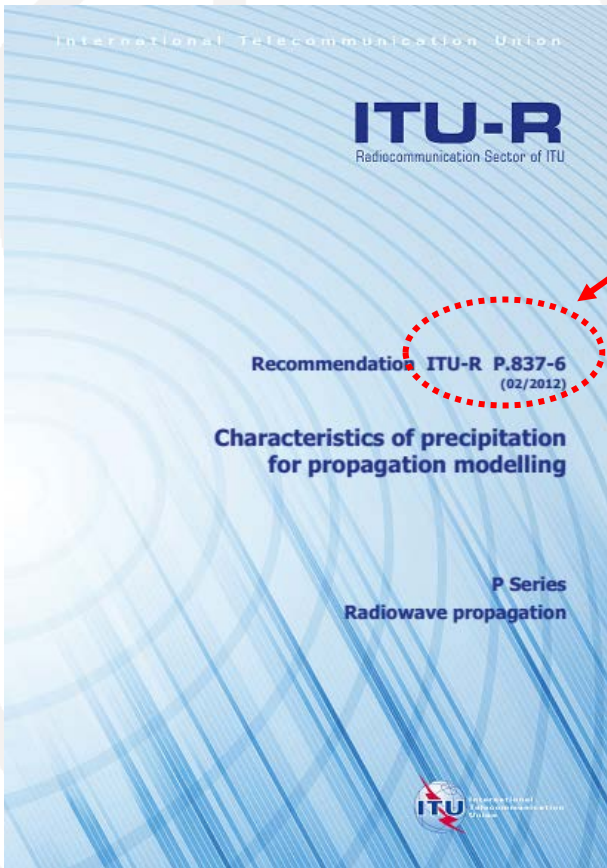
- **8-1:** RW Propagation Campaigns
- **25-3:** Digital Products.
- **37:** Data for Design & Planning
- **40-3:** Terrain & surface features

ITU-R P Recommendations and SG3 docs

- [P 311: Acquisition, presentation and analysis of data in studies of tropospheric propagation](#)
- [Format of Tables for experimental data submission](#)
- [3M Fascicles](#) (background and reference information on P-311)

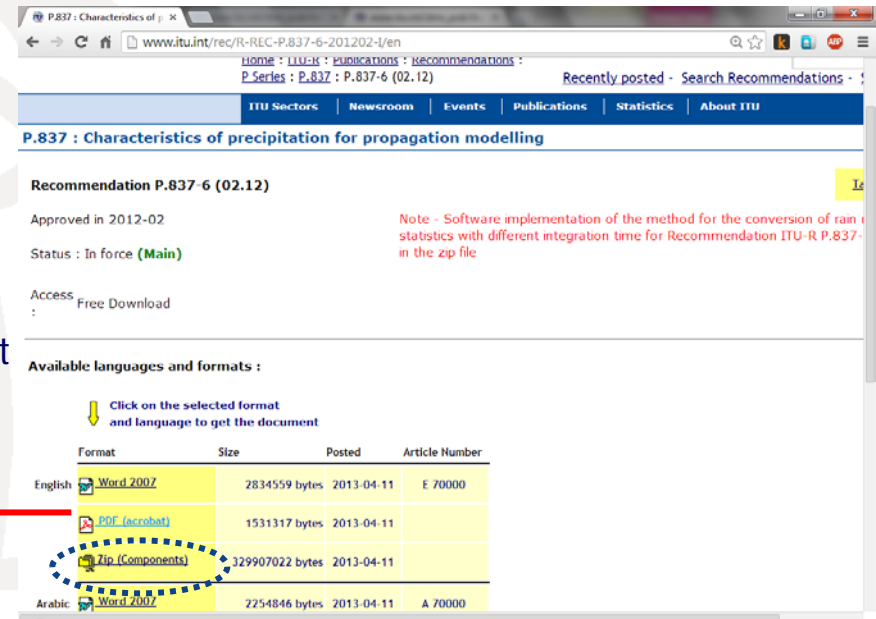
- Digital Products needed for Models
 - Computer Programs
 - Digital Maps
 - Reference Numerical Parameters
 - Measurement Databanks
- Digital products and P-Recs
 - Integral part = required to apply the recommendation
 - Supplemental = SW implementing the procedure in an Annex

SW Integral part of a Recommendation



P NNN-V
(mm/yyyy)
V = vers. #
mm = month
yyyy = year

USE always last
version



www.itu.int/rec/R-REC-P.837-6-201202-1/en

Home : ITU-R : Publications : Recommendations : P Series : P.837 : P.837-6 (02.12)

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P.837 : Characteristics of precipitation for propagation modelling

Recommendation P.837-6 (02.12)

Approved in 2012-02

Status : In force (**Main**)

Access : Free Download

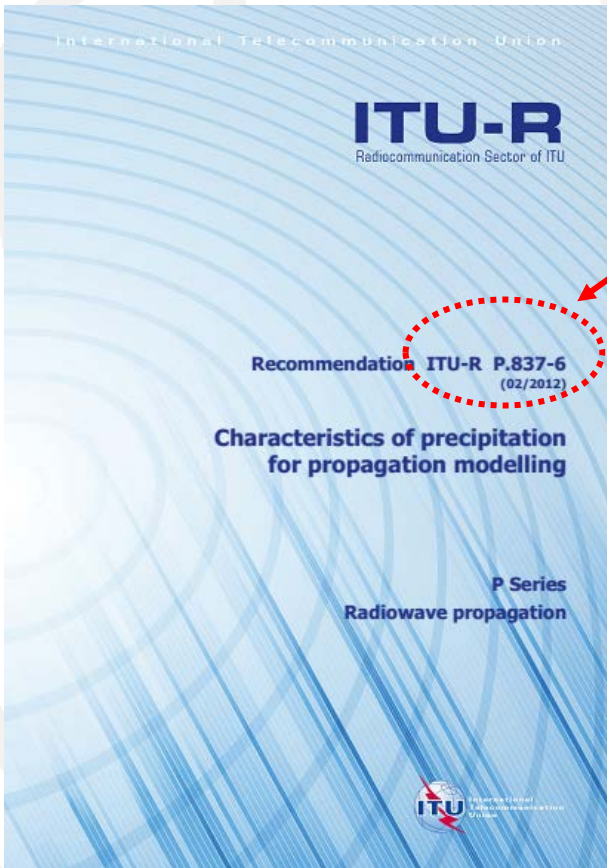
Note - Software implementation of the method for the conversion of rain statistics with different integration time for Recommendation ITU-R P.837-6 in the zip file

Available languages and formats :

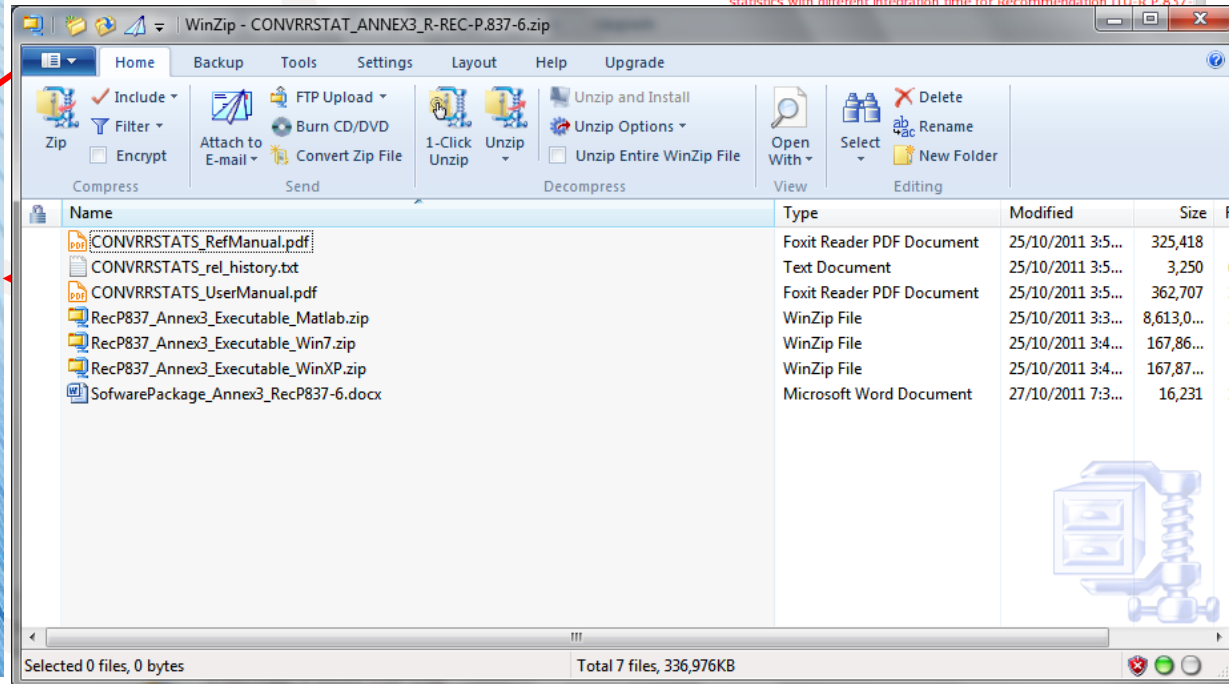
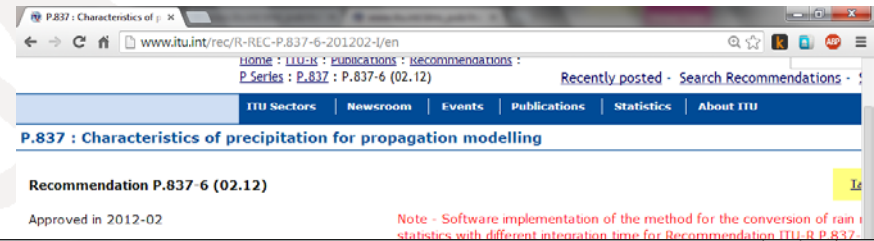
Click on the selected format and language to get the document

Format	Size	Posted	Article Number
English Word 2007	2834559 bytes	2013-04-11	E 70000
PDF (acrobat)	1531317 bytes	2013-04-11	
Zip (Components)	329907022 bytes	2013-04-11	
Arabic Word 2007	2254846 bytes	2013-04-11	A 70000

SW Integral part of a Recommendation



P NNN-V
(mm/yyyy)
V = vers. #
mm = month

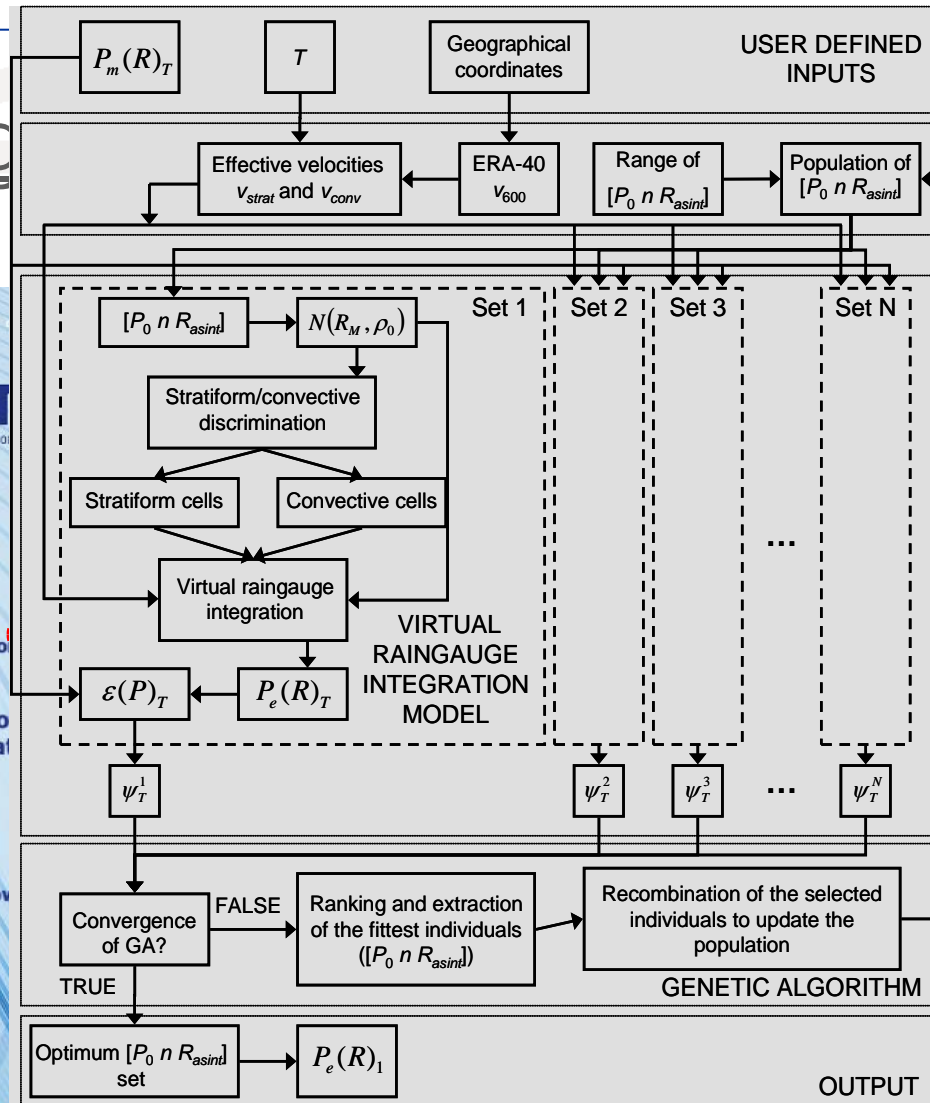


Terms of Reference/ Work Method

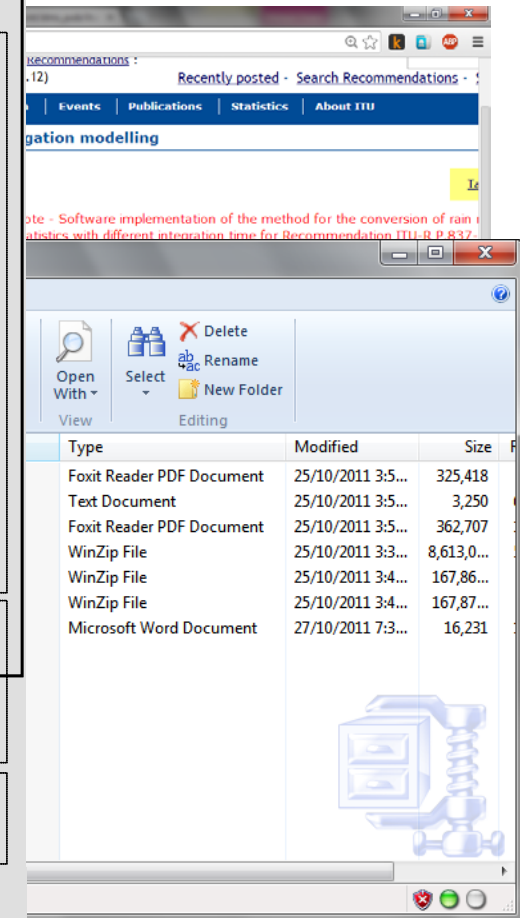


SW Integ

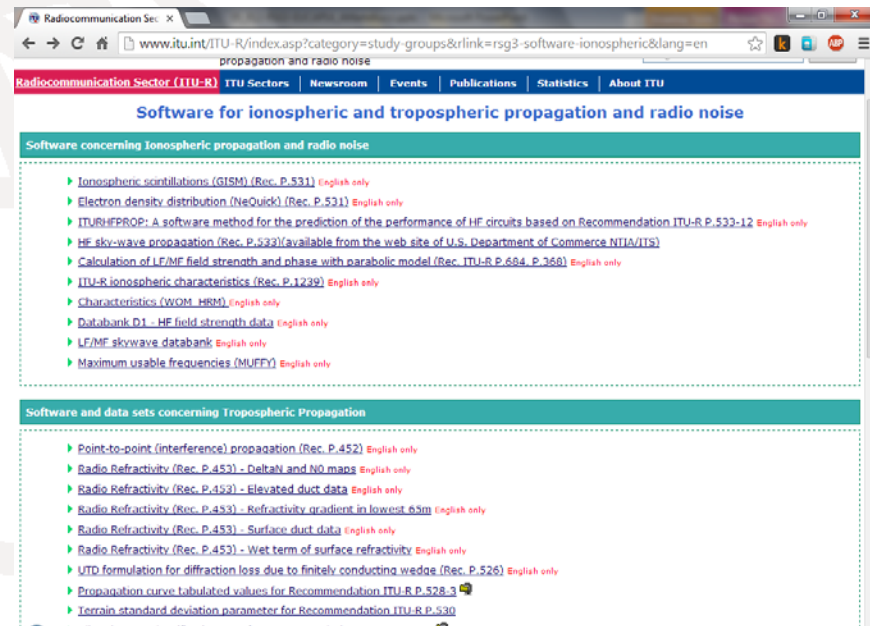
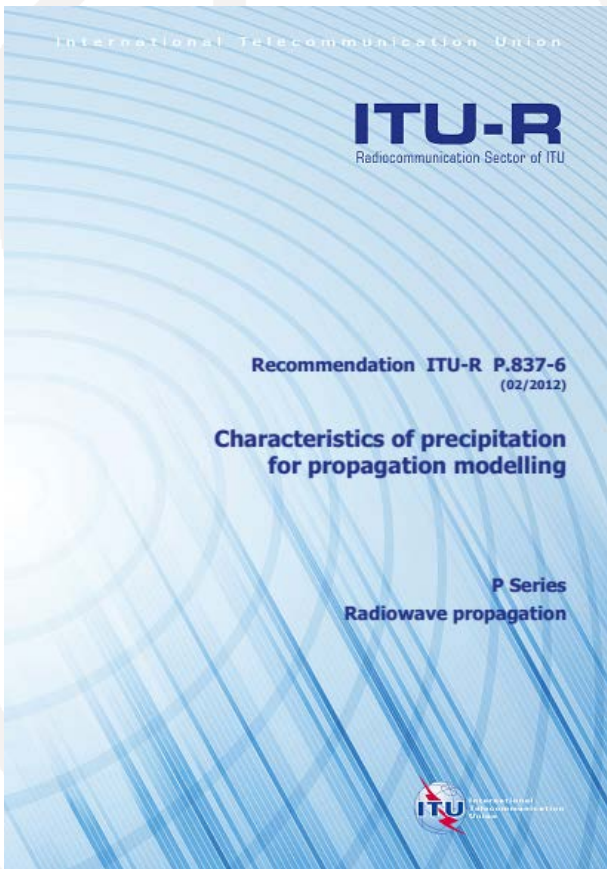
endation



Schematic of the rain gauge integration time conversion process



Digital Product supplemental to a Recommendation



www.itu.int/ITU-R/index.asp?category=study-groups&rlink=rsg3-software-ionospheric&lang=en

propagation and radio noise

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Software for ionospheric and tropospheric propagation and radio noise

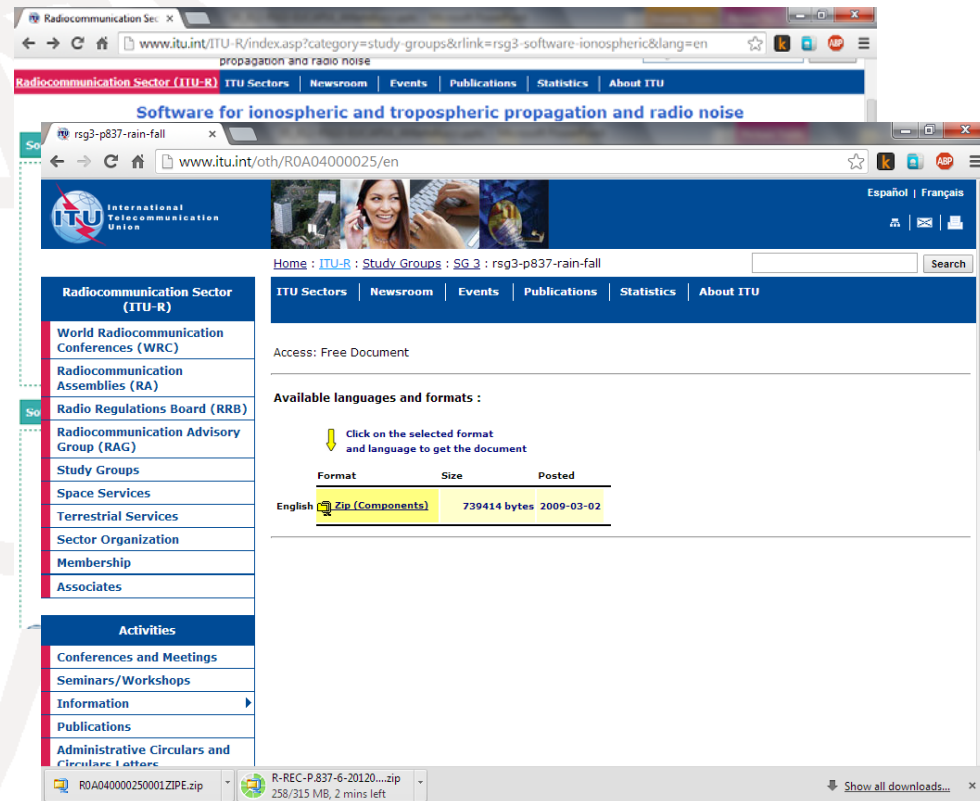
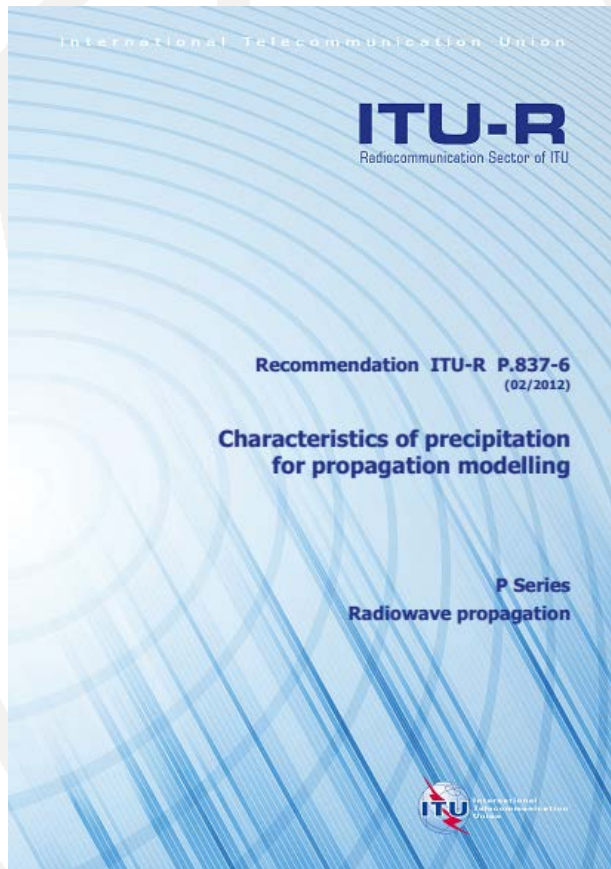
Software concerning Ionospheric propagation and radio noise

- ▶ Ionospheric scintillations (GISM) (Rec. P.531) English only
- ▶ Electron density distribution (NeQuick) (Rec. P.531) English only
- ▶ ITURHFPROP: A software method for the prediction of the performance of HF circuits based on Recommendation ITU-R P.533-12 English only
- ▶ HF sky-wave propagation (Rec. P.533) (available from the web site of U.S. Department of Commerce NTIA/ITS)
- ▶ Calculation of LF/MF field strength and phase with parabolic model (Rec. ITU-R P.684, P.768) English only
- ▶ ITU-R ionospheric characteristics (Rec. P.1239) English only
- ▶ Characteristics (WOM_HRM) English only
- ▶ Databank D1 - HF field strength data English only
- ▶ LF/MF skywave databank English only
- ▶ Maximum usable frequencies (MUFFY) English only

Software and data sets concerning Tropospheric Propagation

- ▶ Point-to-point (interference) propagation (Rec. P.452) English only
- ▶ Radio Refractivity (Rec. P.453) - DeltaN and NO maps English only
- ▶ Radio Refractivity (Rec. P.453) - Elevated duct data English only
- ▶ Radio Refractivity (Rec. P.453) - Refractivity gradient in lowest 65m English only
- ▶ Radio Refractivity (Rec. P.453) - Surface duct data English only
- ▶ Radio Refractivity (Rec. P.453) - Wet term of surface refractivity English only
- ▶ UTD formulation for diffraction loss due to finitely conducting wedges (Rec. P.526) English only
- ▶ Propagation curve tabulated values for Recommendation ITU-R P.528-3
- ▶ Terrain standard deviation parameter for Recommendation ITU-R P.530

Digital Product supplemental to a Recommendation



www.itu.int/ITU-R/index.asp?category=study-groups&link=rsg3-software-ionsospheric&lang=en

propagation and radio noise

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Software for ionospheric and tropospheric propagation and radio noise

www.itu.int/oth/ROA04000025/en

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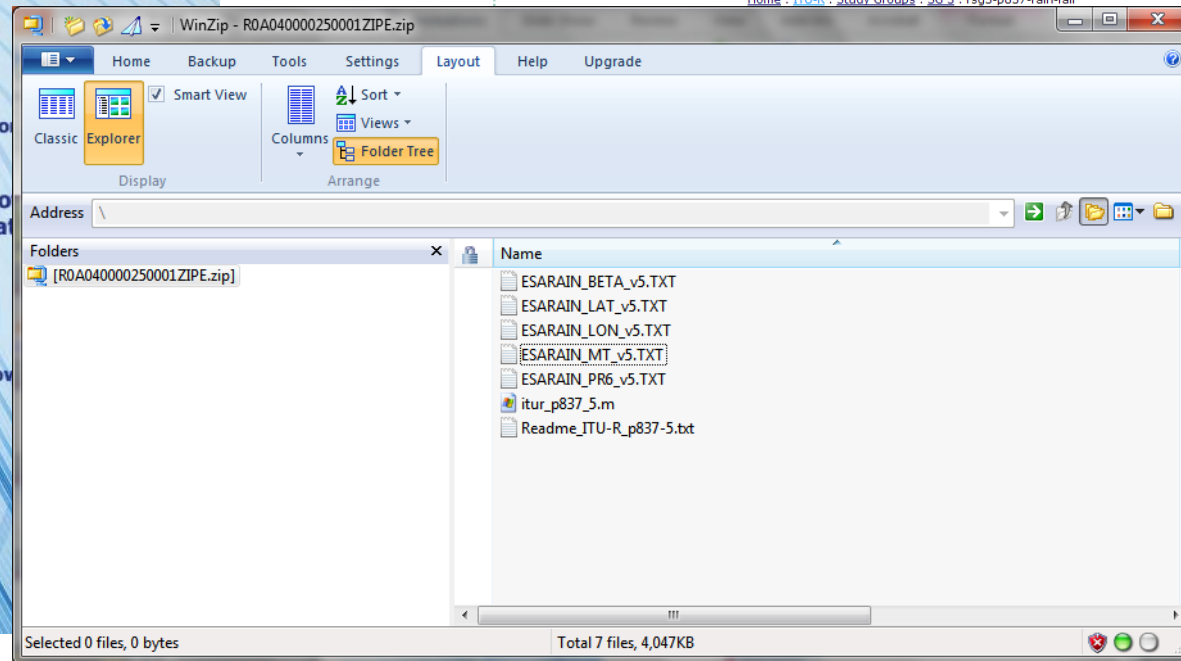
Click on the selected format and language to get the document

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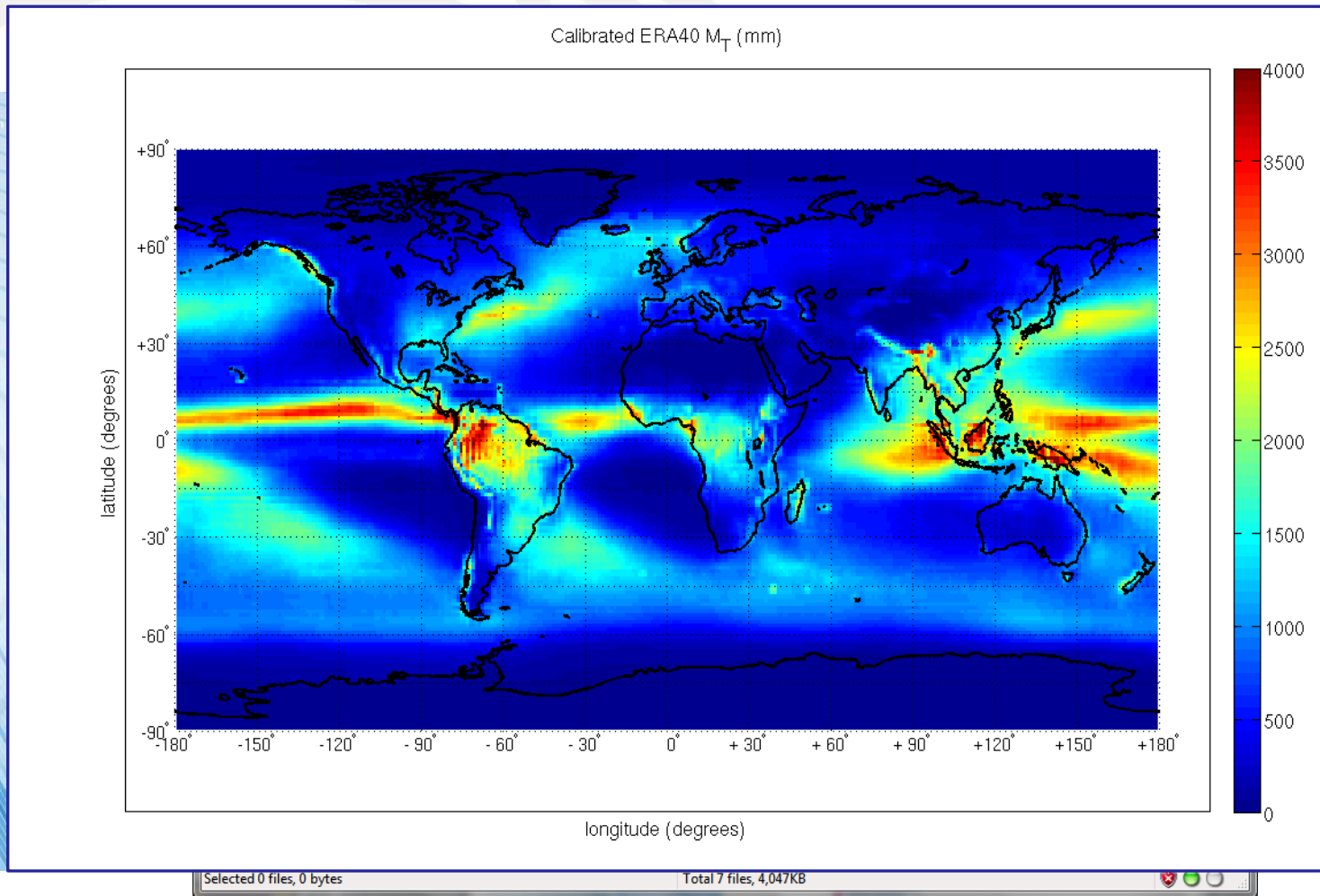
R0A040000250001ZIPE.zip R-REC-P.837-6-20120...zip
258/315 MB, 2 mins left

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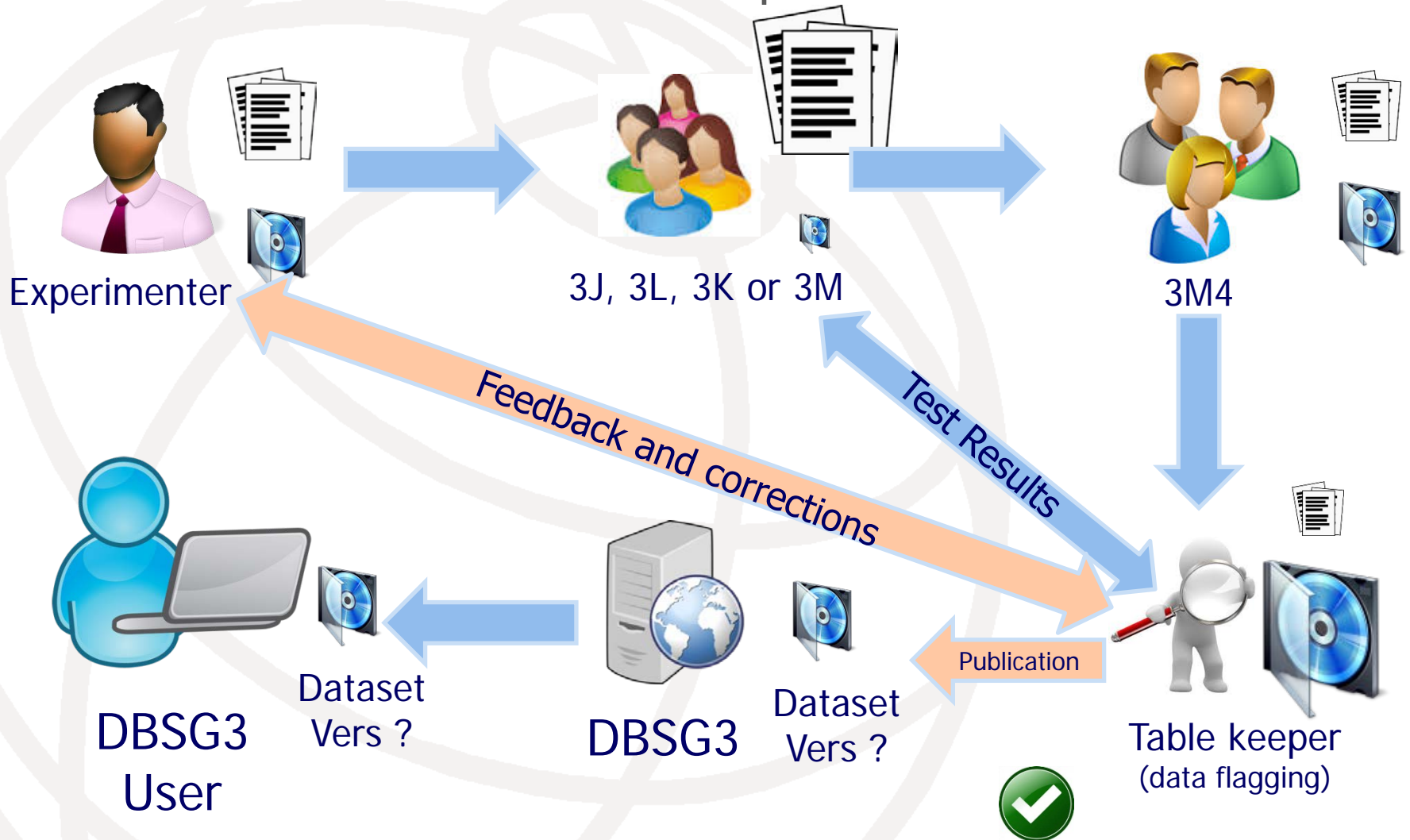
Digital Product supplemental to a Recommendation



Terms of Reference/ Work Method



Review and distribution of experimental data



Terms of Reference/ Work Method



Review and distribution of experimental data

Ex

DBSG3 - Tables - Mozilla Firefox

Main menu

Browse tables

Data Sets for **Earth-space path** :

- Annual rain att. stat. (C2_1)
- W.M. rain att. stat. (C2_2)
- Fade duration stat. (C2_3)
- Site diversity stat. (C2_4)
- Annual XPD stat. (C2_5A)
- Annual XPD cond. to CPA (C2_5B)
- Ampl. scintillation stat. (C2_6)
- Std dev of scintillation (C2_7)
- Slant path fade slope stat. (C2_8)

Done

DBSG3 - Search data set - Mozilla Firefox

Main menu Log out

Search in data set C2_1

Please select your search criteria.

Date Format is : **yyyy/MM/dd**
Decimal separator is : .

<input type="checkbox"/> R_CTRY	equal		
<input type="checkbox"/> R_LATITUDE	=		deg Range from -90.0 to 90.0
<input type="checkbox"/> R_LONGITUD	=		deg Range from 0.0 to 360.0
<input type="checkbox"/> R_ALTITUDE	equal		m
<input type="checkbox"/> SATEL_POS	=		deg Range from 0.0 to 360.0
<input type="checkbox"/> TYPE	equal		
<input type="checkbox"/> START_DATE	equal		and
<input type="checkbox"/> END_DATE	equal		and
<input checked="" type="checkbox"/> DURATION	=	365	days
<input checked="" type="checkbox"/> FREQUENCY	>	20	GHz
<input type="checkbox"/> POL_L_C	equal		
<input type="checkbox"/> POLAR	=		deg
<input type="checkbox"/> ELEVATION	=		deg Range from 0.0 to 90.0
<input type="checkbox"/> RAIN_CONC	equal		
<input type="checkbox"/> ATT_E_T	equal		

Done

DBSG3 Vers ?
User



(data flagging)

SG3 Classification of experimental Tables

Part I: Terrestrial line-of-sight path data

Part II: Earth-space path data

Part III: Terr. trans-horizon path & rain scatter data

Part IV: Radiometeorological data

Part V: Terrestrial land mobile data

Part VI: Terrestrial point-to-area data

Part VII: Data for mobile-satellite services

Part VIII: Vegetation and building data

Part IX: Noise

Part IV: Radiometeorological data

- Table IV-1: Statistics of rain intensity
- Table IV-2: Rain integration time conversion factor
- Table IV-3: Annual statistics of sky noise temperature
- Table IV-4: Statistics of mean surface refractivity
- Table IV-5: Statistics of rain event duration
- Table IV-6: Statistics of evaporation ducts
- Table IV-7: Statistics of cloud cover
- Table IV-8: Spatial statistics dependence of rain intensity
- Table IV-9: Total columnar water vapour content
- Table IV-10: Total columnar cloud liquid water content

Part II: Earth-space path data

Table II-1: Slant path annual rain atten. and rain rate statist.

Table II-2: Slant path worst-month rain attenuation statistics

Table II-3: Slant path fade duration statistics

Table II-4: Slant path site diversity statistics

Table II-5a: Slant path annual XPD statistics

Table II-5b: Slant path annual XPD statistics conditioned to CPA

Table II-6: Slant path statistics of amplitude scintillations

Table II-7: Slant path standard deviations of scintillations

Table II-8: Slant path fade slope statistics

Table II-9: Slant path time diversity statistics

Table II-10: Slant path instantaneous frequency scaling statistics

- Earth-space path (Table C2)

Table	Statistics	Total number of statistics	Number of statistics inserted since 2008
2-1	Slant path annual rain attenuation and rain rate statistics	612	16
2-2	Slant path worst month rain attenuation and rain rate statistics	77	6
2-3	Slant path fade duration statistics	86	17
2-4	Slant path site diversity statistics	59	0
2-5a	Slant path annual XPD statistics	41	0
2-5b	Slant path annual XPD statistics conditioned to CPA	43	0
2-6	Slant path statistics of amplitude scintillations	36	0
2-7	Slant path standard deviations of scintillations	52	0
2-8	Slant path fade slope statistics	0	0
2-9	Slant path time diversity statistics	0	0
2-10	Slant Path instantaneous frequency scaling statistics	0	0

- Slant path annual rain attenuation and rain rate statistics (Table 2-1):
Table Keeper Carlo Riva, Politecnico di Milano, Italy
 - 612 statistics, Single year or multiple years
 - Attenuation and rain rate exceeded for probability from 0.001 % to 50 % (20 points, 4 per decade: e.g. 1, 2, 3 and 5)
 - Beacon, Satellite link derived or radiometric derived attenuation
 - Latitude range: from 37.9 deg. S to 67.5 deg. N (60 statistics between +/-25 deg)
 - Observation periods in the interval 1968-2012
 - Frequency: 4-49.5 GHz (313 above 17 GHz)
 - Elevation angle: 3.3 - 90 deg
 - Statistics flagged and selected for testing by visual inspection :
 - 174 (excess/rain attenuation)
 - 97 (total attenuation)

- **Slant path annual rain attenuation and rain rate statistics (Table 2-1)**
Testing procedure:
 - Test variable as from of ITU-R Rec. P.311
 - Error calculated for each experiment and each probability in the validity range of the distribution (see flags)
 - Average, std and rms error for each probabilities averaged over all the selected experiments and weighted with their duration
 - Average, std and rms averaged over the probability range of interest and over all the experiments
 - Selection of the best model according to the rms (and the average) errors
- Test with input measured rain rate distributions or rain maps (ITU-R Rec. P.837)
- Test for excess and total attenuation
- Test in different probability/frequency/elevation/latitude ranges

Experimental Data



- Slant path annual rain attenuation and rain rate statistics (Table 2-1)

Test

AVERAGED ERRORS SUMMARY					
Method	AVERAGED	ERRORS	SUMMARY	WEIGHT	
	MEAN	RMS	STD.DEV.	YEARS	
ASSISEI	-9.7	33.2	31.8	63.1	
BRAZIL	-13.3	31.8	28.9	76.1	
BRYANT	-5.1	28.6	28.1	75.9	
CRANETC	-1.3	40.5	40.4	76.5	
DAHRAIN	-10.1	28.0	26.1	79.8	
EXCELL	-1.7	29.2	29.1	79.8	
FLAVIN	-7.9	27.7	26.6	76.1	
GARCIA	-21.8	35.9	28.5	76.1	
GLOBAL	8.3	33.9	32.9	75.3	
ITU-618	-9.1	31.6	30.3	79.8	
JAPAN	-12.7	32.7	30.2	70.2	
LEINA-S	-22.1	34.5	26.5	48.9	
MATRICC	3.5	32.5	32.3	78.5	
SAM	-9.1	35.1	33.9	76.1	
SVIATOG	-21.9	41.2	34.9	76.1	

all
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 ge)
 Rec.

Historical Example: from COST 255 FR

- **Method of work**
 - Demanding but consolidated for measurements
 - New role for SW, but method ?
- **Need for new propagation data**
 - New campaigns (climates, frequencies, systems)
 - Improvement of accuracy
 - New parameters
 - New/reviewed test variables
 - Data flagging and Test procedures