ERA40 Daily Surface Data for the Mackenzie, Mississippi, La Plata and Amazon River Basins

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ERA40BasinDoc.pdf
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Abbreviations:
MA: MacKenzie River Basin
MI: Mississippi River Basin
AM: Amazon River/La Plata Basins
FLUX: flux variables [includes data groups (ECMWF designation) 1ld, flx, and mlf].
VARS: Near-surface atmospheric, snow and soil variables [includes data groups 1lv, mlv and var].

1. Data Set General Information

During the analysis cycle, the ECMWF reanalysis model (ERA-40, Simmons and Gibson, 2000, which covers 44+ years, 1958-Aug. 2002) archived hourly time-series of fields and accumulated fluxes, averaged over a prescribed set of river basins (see Betts et al. 2003a, 2003b for examples). This document describes the daily datasets for four major western hemispheric river basins, the MacKenzie (MA), Mississippi (MI), and the La Plata and Amazon (AM). The datasets described in this document contain the daily averages (water fluxes are summed), from January 1958 to Aug. 2002.

1.1 Basin Locations

These are shown in Figure 1. The basins were approximated by quadrilaterals, with the corner coordinates given in the Appendix. [Basin 48 and 49 are not included in this dataset. The blue point locations are where there is an hourly gridpoint dataset.]

MacKenzie River Basin, 7 sub-basins (33 through 39).
Mississippi River Basin, 5 sub-basins (28 through 32).

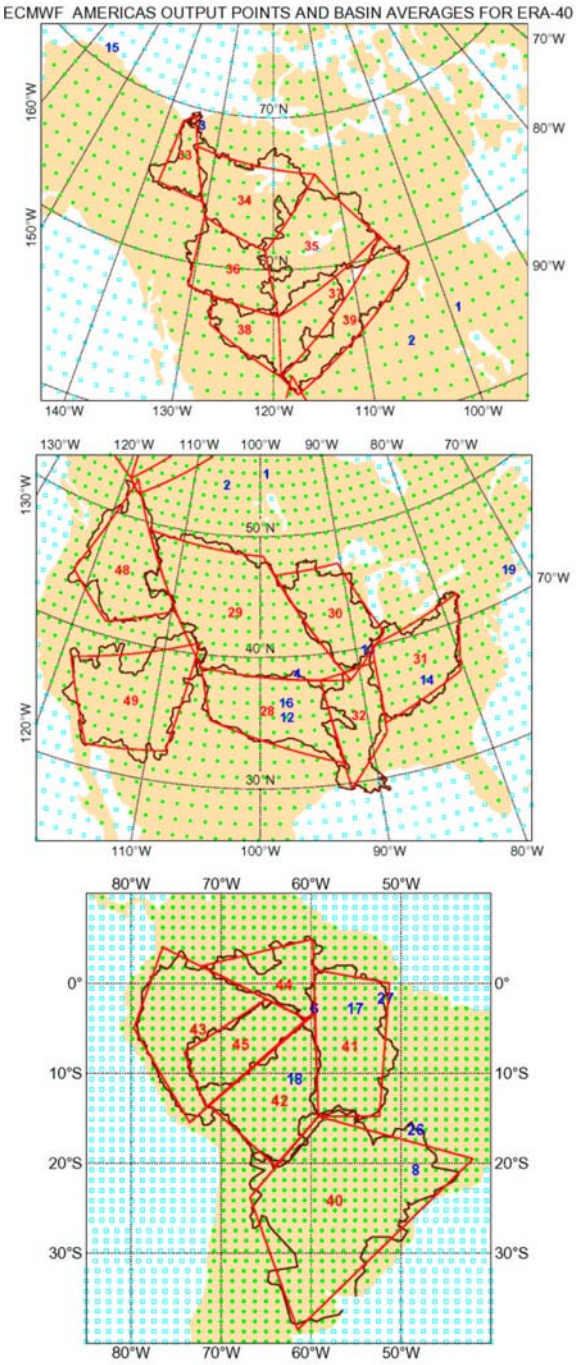

Figure 1. ERA-40 river basins (red).

La Plata and Amazon River Valley Basin, 6 sub-basins (40 through 45).

1.2. Datasets

The data is subdivided into 7-year periods: 1958-1964, 1965-1971, 1972-1978, 1975-1985, 1986-1992, 1993-1999, and the final period 2000- August, 2002. The 7-year period of each dataset is designated by the prefix of the 7-year range (e.g. 58_64_).

1.2.1 FLUX Datasets [ASCII text, comma delimited]

Dataset Name	Description	Location
FDAv-AM.txt	Daily Averages	La Plata/Amazon basins
FDAv-MA.txt	Daily Averages	MacKenzie basin
FDAv-MI.txt	Daily Averages	Mississippi basin

1.2.2 VARS Datasets [ASCII text, comma delimited]

1.2.2a Daily Averages

Dataset Name	Description	Location
VDAv-AM.txt	Daily Averages	La Plata/Amazon basins
VDAv-MA.txt	Daily Averages	MacKenzie basin
VDAv-MI.txt	Daily Averages	Mississippi basin

1.2.2b Daily Analysis Cycle Averages

Dataset Name	Description	Location
AIDAv-AM.txt	Analysis Cycle avg	La Plata/Amazon basins
AIDAv-MA.txt	Analysis Cycle avg	MacKenzie basin
AIDAv-MI.txt	Analysis Cycle avg	Mississippi basin

1.3 Time Period: January 1, 1958 through August 31, 2002
$19580101 \leq YYYYMMDD \leq 20020506$

1.3.1 Analysis and Forecast cycles

There are four daily analyses [00, 06, 12, 18UTC] with 0-36h forecasts [FX] from the 00 and 12UTC analyses. There are in addition 0-6 h FX from the 06 and 18 UTC analyses. However these are missing from the basin archive for the early part of ERA40 [which was started in three parallel streams]: namely, the years, 1968, 1973, 1989-94. Consequently these seven years are missing from the dataset 1.2.2b.

1.4 Related datasets.

As well as these daily datasets, we have generated monthly mean/summed set and a monthly mean diurnal cycle set with very similar file structure, except for the 'time accounting' fields. These have similar filenames, with Dav replaced by Mav or Mdi.

In addition, there is a related global 1x1 degree set of surface fields, produced from ERA-40 for the ISLSCP-II project for the decade 1985-1995, documented in Betts and Beljaars (2003).

2. Investigators

2.1 Investigators Names and Contact Information

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2.2 Title of Investigation

ERA40 Daily Surface Data for the Mackenzie, Mississippi, La Plata and Amazon River Basins

2.3 Requested Form of Acknowledgment

We gratefully acknowledge the use of the ERA-40 river basin dataset (Betts et al., 2003a, 2003b)

3. Datasets

Each dataset starts with six housekeeping fields for basin, year, month and Julian Day. For each verifying day there are 3 or four values, identified by the counter FxKK which tracks the FX period from which the daily average or sum was calculated..

"FxKK" =1 from sum/mean derived from two 0-12h FX
"FxKK" =2 from sum/mean derived from two 12-24h FX
"FxKK" =3 from sum/mean derived from two 24-36h FX
"FxKK" =6 from sum/mean derived from four 0-6h FX
[FxKK=6 are missing for 1968, 1973, 1989-94: see 1.3.1]

From the archive there were 55 variables; 33 flux (FLUX) variables and 22 predicted state (VARS) variables. Six additional precipitation/evaporation fields were calculated for the FLUX

files, and seven for the VARS Analysis Cycle files, primarily related to the soil water and snow water anslysis increments in the analysis cycle.

Note: The “V” in the Date/Time headers signify the ‘Validation time’ of the forecasts. Date/time field headers for (FLUX’s) include an “F”.

We give the fluxes summed from the different FX periods, so the model spinup of the hydrological cycle can be seen. In the tropics the spinup is small and the 0-12h FX [FxKK=1] can be used, but in winter in the mid-latitudes, the large-scale spinup lasts 24-36 hours (see Betts et al., 2003a, b).

3.1 FLUX Variables

The following descriptors identify the ECMWF source files under the “File” column in Table 1.

1ld	Surface fluxes and near-surface met/ model cloud cover
flx	stresses
mlf	runoff fluxes

Table 1. Field Description: FLUX variables

No.	Name	Description	Units	File	Remarks
1.	Basin	sub-basin ID number			see sec.1.1; Fig.1
2.	VFYear	(YYYY)			
3.	VFYrJd	VFYear+(VFJulDay-0.5)/366,3)			
4.	VFMonth	(MM)			
5.	VFJulDay	Julian Day (DDD)			
6.	FxKK	The variable "FxKK" tracks the FX period: see above. "FxKK" =1 from sum/mean of 0-12h fx use this in tropics .. no spinup "FxKK" =2 from sum/mean of 12-24h fx "FxKK" =3 from sum/mean of 24-36h fx "FxKK" =6 from sum/mean of 0-6h fx [not always there]			
7.	SWDO	SW downward radiation	W/m2	1ld	
8.	K-Av-SWDO	No. of values in average.			
9.	LWDO	LW downward radiation	W/m2	1ld	
10.	SW	SW net radiation	W/m2	1ld	
11.	LW	LW net radiation	W/m2	1ld	
12.	SLHF	Latent heat flux	W/m2	1ld	
13.	SSHF	Sensible heat flux	W/m2	1ld	
14.	LCC	Low cloud cover	(0-1)	1ld	
15.	MCC	Mid cloud cover	(0-1)	1ld	
16.	HCC	High cloud cover	(0-1)	1ld	
17.	TCC	Total cloud cover	(0-1)	1ld	
18.	BLH	Boundary layer height	m	1ld	

19. T2M	Two-metre temperature	K	1ld	
20. Q2M	Two-metre (sp) humidity	kg/kg	1ld	
21. 10U	U-comp ten-metre wind	m/s	1ld	
22. 10V	V-comp ten-metre wind	m/s	1ld	
23. TSK	Skin temperature	K	1ld	
24. STSG	Snow basal heat flux	W/m2	1ld	land weighted
25. STSMLT	Snowmelt	W/m2	1ld	land weighted
26. UFVDF	U-component stress	Pa	flx	
27. VFVDF	V-component stress	Pa	flx	
28. LSR	Large-scale rainfall	kg/m2	1ld	
29. CR	Convective rainfall	kg/m2	1ld	
30. LSF	Large-scale snowfall	kg/m2	1ld	
31. CF	Convective snowfall	kg/m2	1ld	
32. E	Evaporation	kg/m2	1ld	
33. RO	Total runoff	kg/m2	1ld	
34. ES	Snow evaporation	kg/m2	1ld	
35. SMLT	Snowmelt	kg/m2	1ld	
36. SSSE	Snow evaporation	kg/m2	1ld	land weighted
37. SSSMLT	Snowmelt	kg/m2	1ld	land weighted
38. SIIE	Intercepted water evap	kg/m2	1ld	land weighted
39. SWLR01	1 Surface runoff, s1	kg/m2	mlf	land weighted
40. SWLR04	4 Drainage, s4	kg/m2	mlf	land weighted
41. Rain	LSR+CR	kg/m2		calculated
42. SnowFall	LSF+CF	kg/m2		calculated
43. Precip	Rain+SnowFall	kg/m2		calculated
44. EvapLiq	E-ES	kg/m2		calculated
45. LSP_precip	LSR+LSF	kg/m2		calculated
46. CP	CR+CF	kg/m2		calculated

3.2 VARS Variables

The following descriptors identify the entries under the "File" column in Table 2 and 3.

mlv	soil variables (soilwater analysis increments come from this file.)
1lv	snow and interception (snow analysis increments come from this file**.)**
var	Atmosphere, lowest level of L60, about z=10m

Table 2. Field Description: VARS variables

No.	Name	Description	Units	File	Remarks

1. Basin	sub-basin ID number				see sec.1.1; Fig.1
2. VYear	(YYYY)				
3. VYrJd	VYear+(VJulDay-0.5)/366,3)				
4. VMonth	(MM)				
5. VJulDay	Julian Day (DDD)				
6. FxKK	The variable "FxKK" tracks this				
	"FxKK" =1 from sum/mean of 0-12h fx use this in tropics .. no spinup				
	"FxKK" =2 from sum/mean of 12-24h fx				
	"FxKK" =3 from sum/mean of 24-36h fx				
	"FxKK" =6 from sum/mean of 0-6h fx [not always there]				
7. Lev	Atmospheric level				
8. STTT01	1	Soil temperature, s1	K	mlv	land weighted
9. SWLL01	1	Soil water, s1	kgm-2	mlv	land weighted
10. SWLI01	1	Soil ice water, s1	kgm-2	mlv	land weighted
11. STTT02	2	Soil temperature, s2	K	mlv	land weighted
12. SWLL02	2	Soil water, s2	kgm-2	mlv	land weighted
13. SWLI02	2	Soil ice water, s2	kgm-2	mlv	land weighted
14. STTT03	3	Soil temperature, s3	K	mlv	land weighted
15. SWLL03	3	Soil water, s3	kgm-2	mlv	land weighted
16. SWLI03	3	Soil ice water, s3	kgm-2	mlv	land weighted
17. STTT04	4	Soil temperature, s4	K	mlv	land weighted
18. SWLL04	4	Soil water, s4	kgm-2	mlv	land weighted
19. SWLI04	4	Soil ice water, s4	kgm-2	mlv	land weighted
20. STST0	Snow temperature		K	1lv	land weighted
21. K-Av-STST0	No. of values in average.				
22. STSCT0	Snow thermal energy		Jm-2	1lv	land weighted
23. SSSS0	Snow mass		kgm-2	1lv	land weighted
24. SIII0	Interception water cont		kgm-2	1lv	land weighted
25. Lev-Var	Atmospheric level of var variables				
26. P	Pressure		Pa	var	
27. U	U-component wind		m/s	var	
28. V	V-component wind		m/s	var	
29. T	Temperature		K	var	
30. Q	Specific humidity		kg/kg	var	
31. R	Relative humidity		(0-1)	var	

3.2 VARS Analysis Cycle Variables

Table 3. Field Description: VARS variables

No.	Name	Description	Units	File	Remarks
1.	Basin	sub-basin ID number			see sec.1.1; Fig 1.
2.	VYear	(YYYY)			
3.	VMonth	(MM)			
4.	VJulDay	Julian Day (DDD)			
5.	Lev	Atmospheric level			
6.	STTT01	1 Soil temperature, s1	K	mlv	land weighted
7.	SWLL01	1 Soil water, s1	kgm-2	mlv	land weighted
8.	SWLI01	1 Soil ice water, s1	kgm-2	mlv	land weighted
9.	STTT02	2 Soil temperature, s2	K	mlv	land weighted
10.	SWLL02	2 Soil water, s2	kgm-2	mlv	land weighted
11.	SWLI02	2 Soil ice water, s2	kgm-2	mlv	land weighted
12.	STTT03	3 Soil temperature, s3	K	mlv	land weighted
13.	SWLL03	3 Soil water, s3	kgm-2	mlv	land weighted
14.	SWLI03	3 Soil ice water, s3	kgm-2	mlv	land weighted
15.	STTT04	4 Soil temperature, s4	K	mlv	land weighted
16.	SWLL04	4 Soil water, s4	kgm-2	mlv	land weighted
17.	SWLI04	4 Soil ice water, s4	kgm-2	mlv	land weighted
18.	STST0	Snow temperature	K	1lv	land weighted
19.	K-Av-STST0	No. of values in average.			
20.	STSCT0	Snow thermal energy	Jm-2	1lv	land weighted
21.	SSSS0	Snow mass	kgm-2	1lv	land weighted
22.	SIII0	Interception water cont	kgm-2	1lv	land weighted
23.	CSM	SWLL01+SWLL02+SWLL03+SWLL04			calculated
24.	CSM3	SWLL01+SWLL02+SWLL03			calculated
25.	Del-ST1	Analysis increment: STTT01			calculated
26.	Del-CSM	Analysis increment: CSM			calculated
27.	Del-CSM3	Analysis increment: CSM3			calculated
28.	Del-SWE	Analysis increment: SSSS0			calculated
29.	Del-SnowTherm	Analysis increment: STSCT0			calculated

References:

Betts, A. K., J. H. Ball, M, Bosilovich, P. Viterbo, Y.-C. Zhang, and W. B. Rossow, 2003: Intercomparison of Water and Energy Budgets for five Mississippi Sub-basins between ECMWF Reanalysis (ERA-40) and NASA-DAO fvGCM for 1990-1999. *J. Geophys. Res.*, **108** (D16), 8618, doi:10.1029/2002JD003127, GCIP-3 issue.
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temperature for the Mackenzie River basin. *J. Hydrometeorology*, **4**, 1194-1211.
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ERA-40 Project report series No. 8 from ECMWF, Reading RG2 9AX, UK.
http://www.ecmwf.int/publications/library/ecpublications/_pdf/ERA40_PRS_8.pdf

Simmons, A.J. and Gibson, J.K., 2000: The ERA-40 Project Plan. ERA-40 Project Report Series No. 1.

Appendix. Basin Identifiers, Locations and areas

```
28    MISSISSIPPI 1 Red-Arkansas
29    MISSISSIPPI 2 Missouri
30    MISSISSIPPI 3 Upper Mississippi
31    MISSISSIPPI 4 Ohio
32    MISSISSIPPI 5 Lower Mississ/Tennessee
NOTE: Between 2000 and 2001, the MISS basin labels were changed in archive
and rotated to 32,28,29,30,31. Corrected in this set on 6/15/2005
33    Mackenzie 1 Peel Riv Basin + Mackenzie Delta
34    Mackenzie 2 Great Bear Lake Sub-basin
35    Mackenzie 3 Great Slave Lake Sub-basin
36    Mackenzie 4 Liard Riv basin
37    Mackenzie 5 Peace Riv basin east
38    Mackenzie 6 Peace Riv basin west
39    Mackenzie 7 Athabasca Riv basin
40    Rio de la Plata
41    Amazon: Xingu+Tapajoz+Trombetas+Uatura
42    Amazon: Madeira River
43    Amazon: Solimoes
44    Amazon: Negro
45    Amazon: Purus+ others

BDEDDH(1,28)=2.,2.,254.  , 39.  ,266.  , 38.  ,267.4 , 31.5 ,255.3 , 35.  ,
BDEDDH(1,29)=2.,2.,245.3 , 49.4 ,260.4 , 48.3 ,269.  , 37.7 ,254.  , 39.  ,
BDEDDH(1,30)=2.,2.,261.8 , 46.7 ,269.6 , 47.2 ,273.3 , 40.9 ,269.  , 37.7 ,
BDEDDH(1,31)=2.,2.,271.7 , 40.  ,282.  , 42.1 ,279.6 , 36.3 ,271.6 , 34.  ,
BDEDDH(1,32)=2.,2.,266.  , 38.  ,271.7 , 38.8 ,271.5 , 33.3 ,267.7 , 29.6 ,
BDEDDH(1,33)=2.,2.,223.1 , 68.9 ,225.1 , 69.5 ,229.4 , 64.0 ,222.1 , 64.6 ,
BDEDDH(1,34)=2.,2.,226.7 , 67.5 ,246.7 , 66.1 ,238.9 , 61.2 ,230.  , 63.1 ,
BDEDDH(1,35)=2.,2.,246.7,  66.1 ,254.4 , 61.4 ,240.6 , 57.  ,238.9 , 61.2 ,
BDEDDH(1,36)=2.,2.,230.  , 63.1 ,238.9 , 61.2 ,240.6 , 57.  ,229.5 , 58.5 ,
BDEDDH(1,37)=2.,2.,254.4 , 61.4 ,254.5 , 61.3 ,240.8 , 53.2 ,240.6 , 57.  ,
BDEDDH(1,38)=2.,2.,232.7 , 58.1 ,240.6 , 57.  ,240.8 , 53.2 ,232.7 , 56.3 ,
BDEDDH(1,39)=2.,2.,254.5 , 61.3 ,257.2 , 59.1 ,242.5 , 52.1 ,240.8 , 53.2 ,
BDEDDH(1,40)=2.,2.,293.2 ,-23.8 ,300.8 ,-14.8 ,318.  ,-19.5 ,298.5 ,-38.5 ,
BDEDDH(1,41)=2.,2.,300.3 ,  1.5 ,308.7 ,  0.  ,307.6 ,-14.8 ,300.8 ,-14.8 ,
BDEDDH(1,42)=2.,2.,288.7 ,-13.6 ,300.4 , -3.4 ,300.8 ,-14.8 ,296.  ,-20.3 ,
BDEDDH(1,43)=2.,2.,283.5 ,  4.  ,299.5 , -4.  ,286.5 ,-15.5 ,280.3 , -5.  ,
BDEDDH(1,44)=2.,2.,287.8 ,  1.9 ,300.2 ,  4.9 ,300.4 , -3.4 ,299.5 , -4.  ,
BDEDDH(1,45)=2.,2.,285.9 , -7.7 ,295.  , -1.8 ,299.5 , -4.  ,288.3 ,-13.8 ,
```

For the Mississippi the basin areas in the ERA40 coordinates are

Index	Area (km^2)	# points
28	604051	43
29	1299225	94

30	512720	37
31	462518	34
32	382662	27

For the Mackenzie, the basin areas are in table 1 of Betts et al. 2003b.

Table 1. Mackenzie sub-basin drainage areas and their model representation.

Sub-Basin		Drainage Area (km^2)	ERA40 Area (km^2)	Model Elevation (m)			
				Mean	SD	max	min
1	Peel	117127	108187	686	384	1284	121
2	Great Bear Lake	421191	367573	478	361	1506	187
3	Great Slave Lake	378245	418757	348	99	565	196
4	Liard	273395	283920	991	315	1515	412
5	Peace	319110	344659				
	5A (E)		(206549)	573	198	1122	286
	5B (W)		(138110)	1147	213	1482	782
6	Athabasca	285111	260982	651	333	1611	358
	TOTAL	1791857	1784078				

For the Amazon, note that the actual area of basin 43 is quadrilateral 43 minus quadrilateral 45: that is the Amazon river includes the area weighted sum of (41), 42, 43, 44, and 45.
These are the areas of the Amazon basins in the ERA-40 coordinates.

Domain	Area (km^2)	z (m) orography	cvh (0-1) high_veg_cover	cvl (0-1) low_veg_cover
41	1375016	23	0.94	0.06
42	1292581	50	0.85	0.14
43-45	1520348	79	0.83	0.17
44	639117	21	0.93	0.06
45	881229	21	0.97	0.03