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The WATCH Forcing Data and global hydrological modelling.

Graham Weedon EGU Vienna, 6th April 2011

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Global Hydrological modelling in WATCH:

- 1) Hydrological modelling for the full **20th Century** based on the WATCH Forcing Data.
- 2) Hydrological modelling for the full **21st Century** based on bias-corrected output from three General Circulation Models (ECHAM5, CNRM and IPSL). Each GCM provided data for two future scenarios (A2 and B1) plus control data.
- 3) **WaterMIP**: Land Surface Hydrology Model Global Hydrology Model Intercomparison. Used the maximum available hydrological models within and outside WATCH (inc. Japan and USA). Models run globally with the WATCH Forcing Data for 1985-1995.

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The three global hydrological efforts involved assessment of human impacts by modelling:

- 1) Naturalised conditions (i.e. no human influences).
- 2) Anthropogenic conditions:
i.e. human influences on hydrology of:
 - a) Land cover changes (esp. urbanization and crops).
 - b) Effects of dams and reservoir construction on river discharge.
 - c) Effects of irrigation of crops (including influence of abstraction from rivers).
 - d) Groundwater abstraction effects (water availability).

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WATCH Forcing Data (WFD):

- Three-hourly data, global in a half-degree regular latitude-longitude grid, stored in NetCDF format.
- Eight meteorological variables needed for running hydrological models derived from ERA-40 Reanalysis:
 - a) Temperature at 2 m.
 - b) Wind speed at 2 m.
 - c) Pressure at 10 m.
 - d) Specific humidity at 10 m.
 - e) Downwards longwave radiation flux.
 - f) Downwards shortwave radiation flux.
 - g) Rainfall rate.
 - h) Snowfall rate.
 (Some hydrological models do not need all 8 variables).
- 1958-2001 data derived directly from ERA-40.
- 1901-1957 data derived from randomly re-ordered ERA-40.

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Creation of the WATCH Forcing Data:

- 1) ERA-40 Reanalysis data bilinearly interpolated to half-degree global land grid (excluding Antarctica).
- 2) Elevation correction of near-surface temperature, surface pressure, specific humidity and downwards longwave radiation (due to elevation differences between one-degree grid and half-degree grid).
- 3) Monthly bias-correction of monthly average diurnal temperature range and monthly average temperature (CRU data).
- 4) Monthly bias-correction of monthly number of “wet” days (CRU) and precipitation totals (GPCCv4) plus precipitation gauge catch corrections.
- 5) Monthly bias correction of downwards shortwave radiation for the effects of both cloud cover (CRU) and aerosols (HadGEM2-A).

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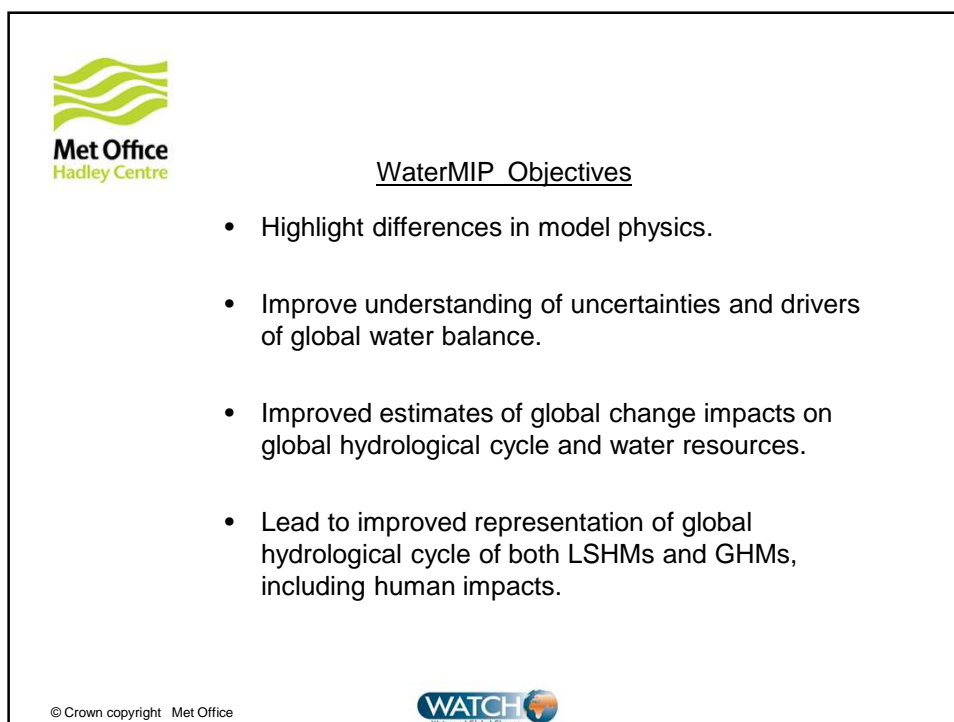
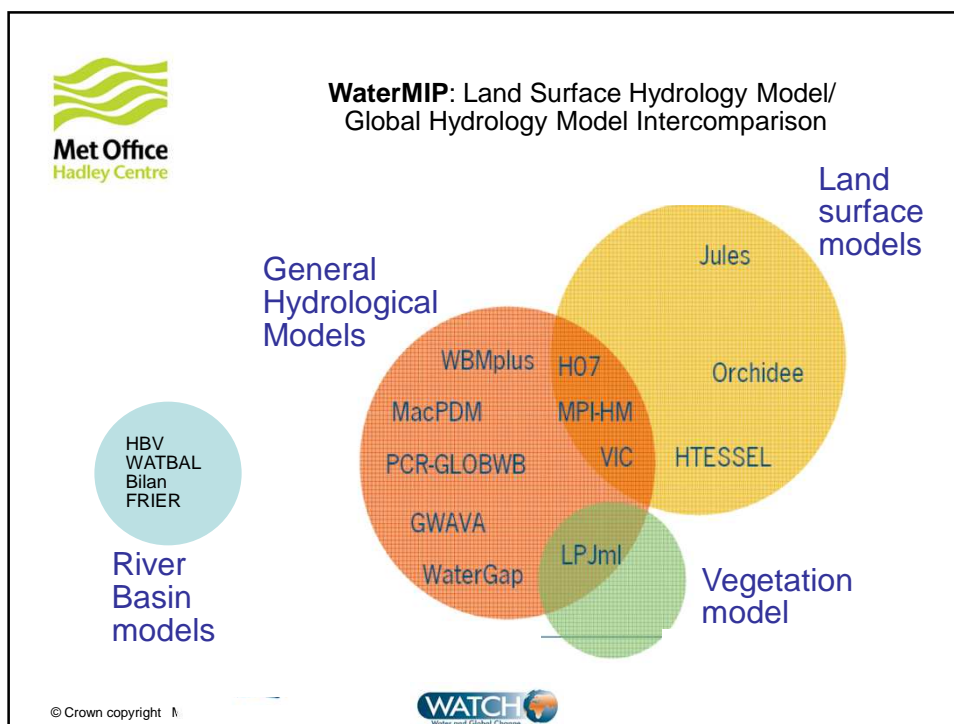


Novel features of the WATCH Forcing Data:

- a) The first **half-degree** global land surface sub-daily forcing data – spanning the **whole 20th century**.
- b) WFD wet-day corrections **preserve the spatial coherence of precipitation events**: allowing meaningful sub-daily hydrological modelling at the scale of large basins.
- c) First data set to use monthly GPCCv4 precipitation totals (instead of CRU precipitation totals).
- d) First data set seasonal and decadal “aerosol-corrections” for downward short-wave radiation fluxes.

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WATCH Hydrological modelling with “Natural conditions”.

Interval:	1901-1957	WaterMIP 1958-2001	1960-2100			1960-2100			1960-2100		
GCM:	N/A	N/A	ECHAM5	ECHAM5	ECHAM5	CNRM	CNRM	CNRM	IPSL	IPSL	IPSL
Data/Scenario:	WFD	WFD	A2	B1	Control	A2	B1	Control	A2	B1	Control
GWAVA	GWAVA										
Hessel	Htessel	Htessel	Htessel	Htessel	Htessel	Htessel	Htessel	Htessel	Htessel	Htessel	Htessel
JULES	JULES	JULES	JULES	JULES	JULES	JULES	JULES	JULES	JULES	JULES	JULES
LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI	LPJmI
	MacPDM	MacPDM	MacPDM	MacPDM	MacPDM				MacPDM	MacPDM	MacPDM
	MATSIRO										
MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM	MPI-HM
Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee	Orchidee
	VIC	VIC	VIC	VIC	VIC	VIC	VIC	VIC	VIC	VIC	VIC
WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP	WaterGAP
No. models:	7	11	8	6	8	7	5	7	7	6	8



The Forcing Data and Model outputs will be freely available in NetCDF format from ftp site after 1st August 2010. See www.eu-watch.org for details.

Journal of Hydrometeorology 2011:
Special Collection on Water and Global Change (WATCH).

Includes papers on the WATCH Forcing Data:

Weedon, G.P., Gomes, S., Viterbo, P., Shuttleworth, W.J., Blyth, E., Österle, H., Adam, J.C., Bellouin, O., and Best, M., in press. Creation of the WATCH Forcing Data and its use to assess global and regional reference crop evaporation over land during the twentieth century. *J. Hydrometeo.*

and the first WaterMIP results:

Haddeland, I., Best, M., Clark, D., Franssen, W., Ludwig, F., Voss, F., Bertrand, N., Folwell, S., Gerten, D., Gomes, S., Gosling, S., Hagemann, S., Hanaski, N., Harding, R., Heinke, J., Kabat, P., Koirala, S., Polcher, J., Stacke, T., and Weedon, G.P., in press. Multi-model estimate of the global water balance: setup and first results. *J. Hydrometeo.*

