EGSIEM

European Gravity Service for Improved Emergency Management

Title: WP6 (Hydrological Service)

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Henryk Zwenzner, Sandro Martinis (DLR)

EGSIEM Annual Meeting

University of Luxembourg

January 18-19.2016

WP6: Hydrological Service

European Gravity Service for Improved Emergency Management

Task 6.1
Evaluation of historical flood events (M07-M30)

Task 6.2

Development and evaluation of gravity-based indicators for flood forecasting and drought monitoring (M01-M36)

Task 6.3

Rapid mapping concept (M07-M36)

European Gravity Service for Improved Emergency Management

Evaluation of GRACE daily and combined monthly solutions against river discharge and hydrological model simulations for selected river basins

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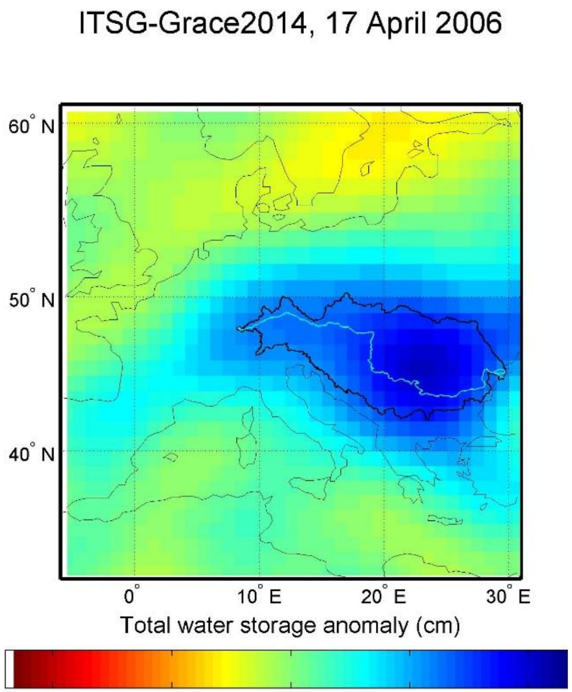
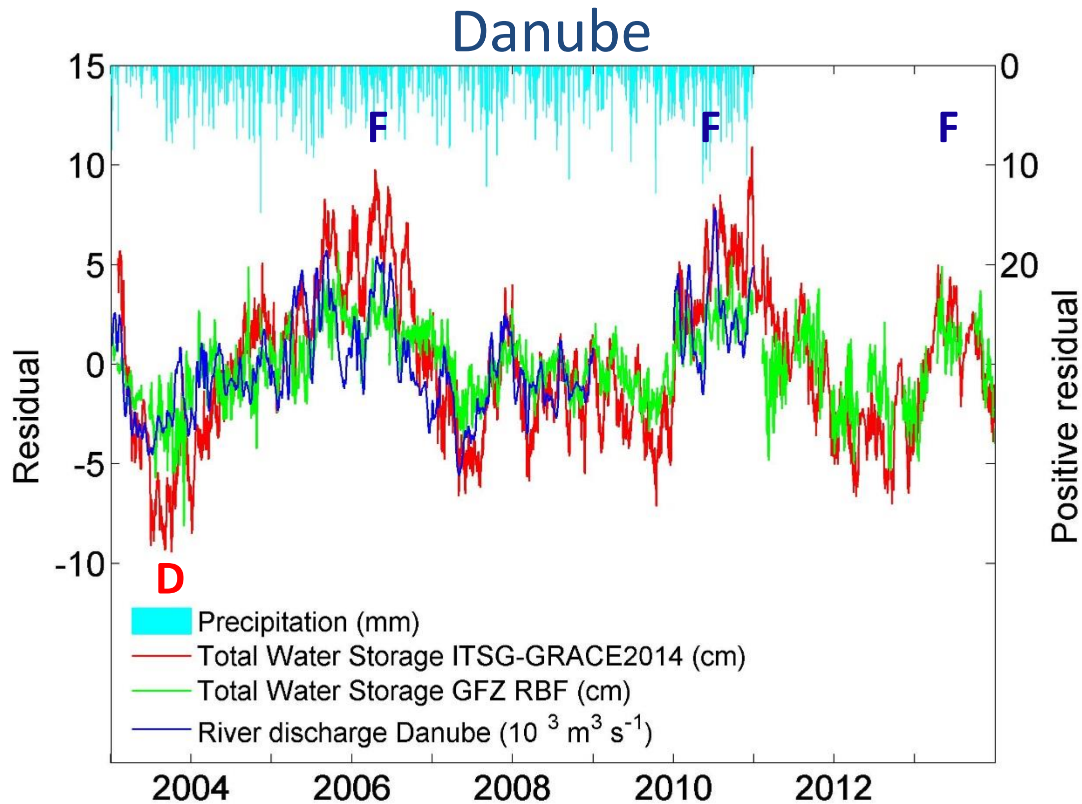
daily GRACE solutions vs. river discharge





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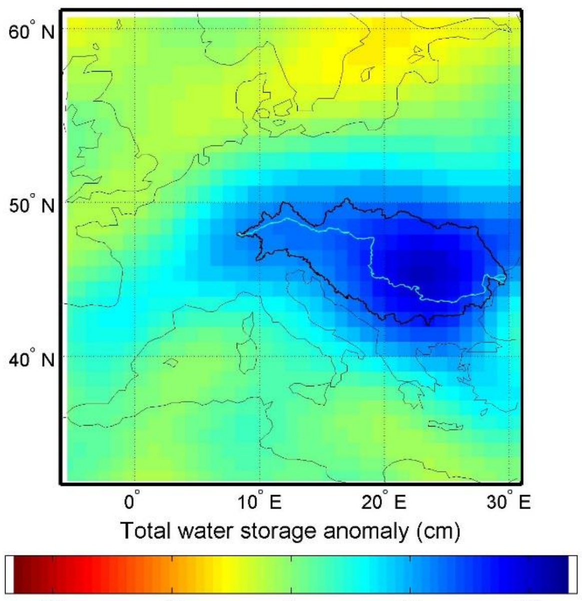
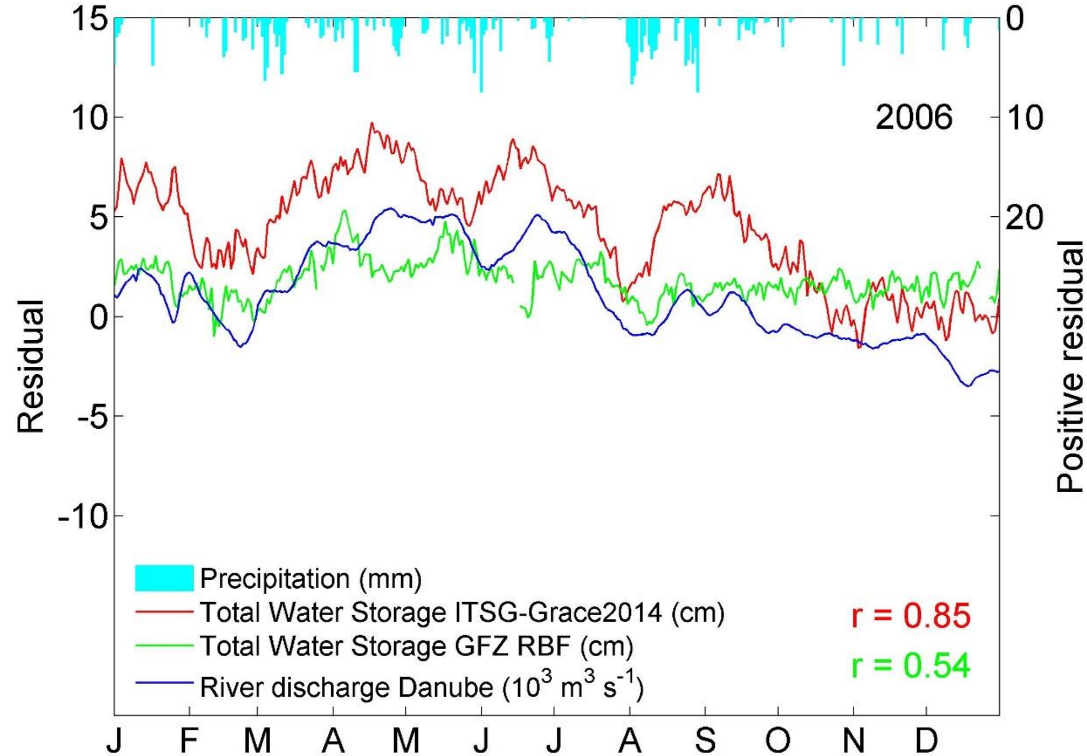
daily GRACE solutions vs. river discharge

ITSG-Grace2014, 17 April 2006



Danube



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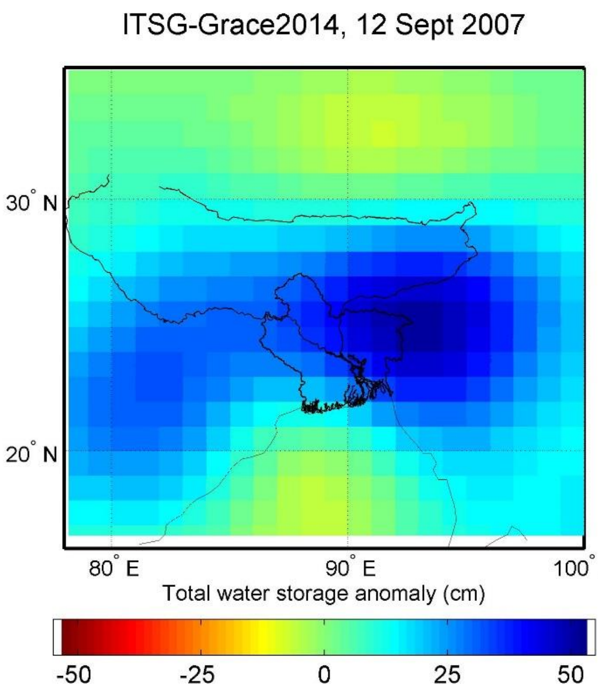
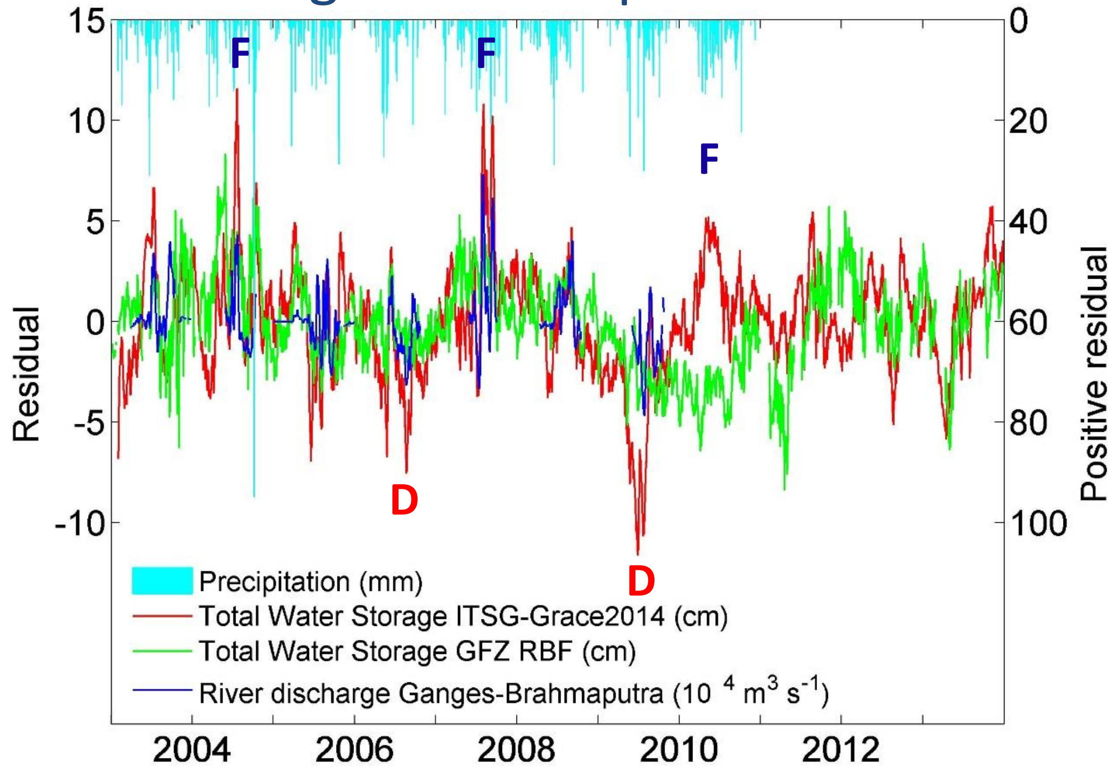
daily GRACE solutions vs. river discharge



Ganges-Brahmaputra Delta



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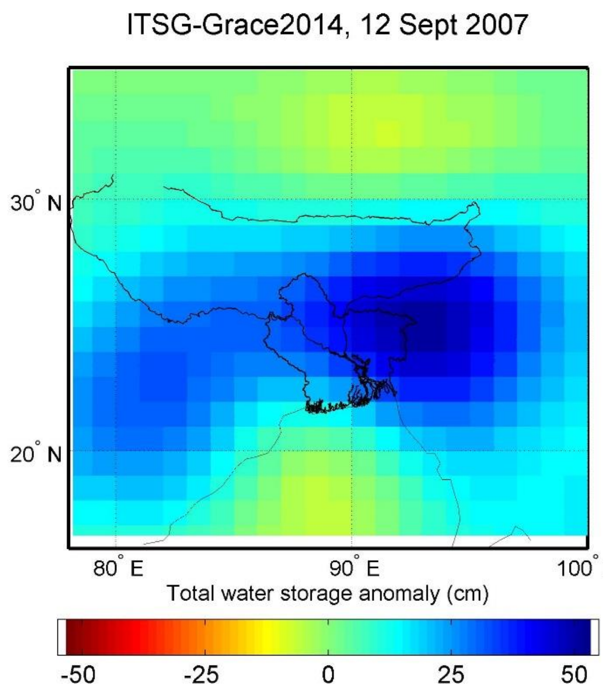
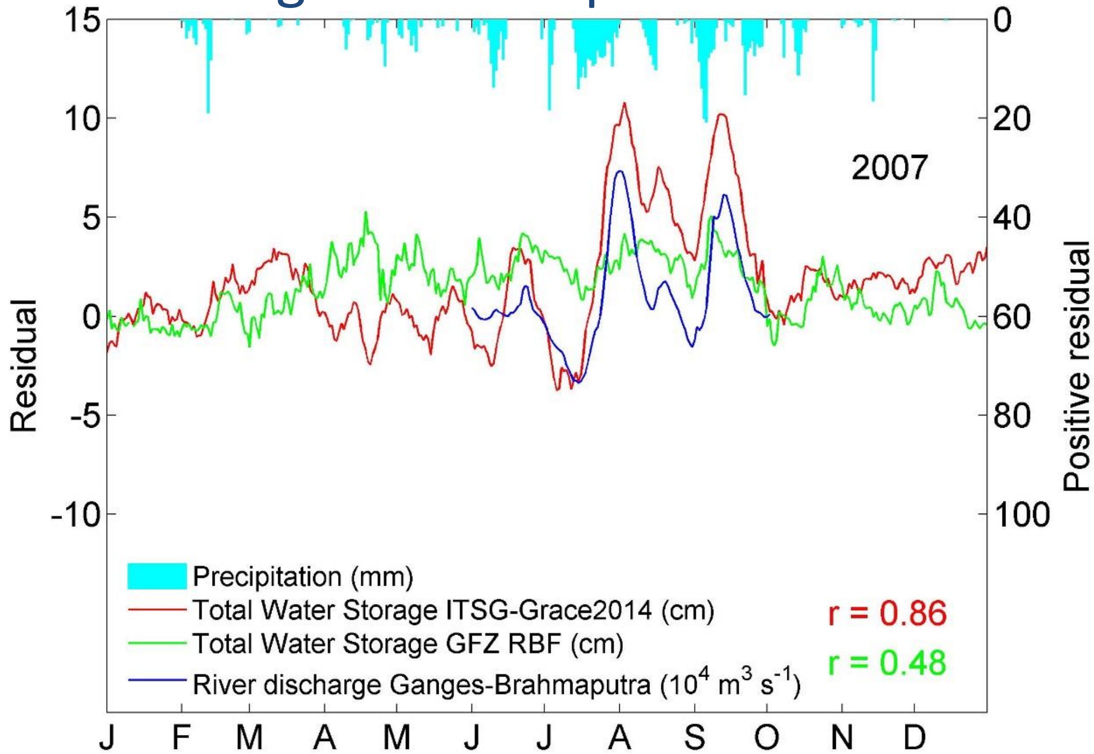
daily GRACE solutions vs. river discharge time series

Ganges-Brahmaputra Delta





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Evaluation of GRACE daily and combined monthly solutions against river discharge and hydrological model simulations for selected river basins

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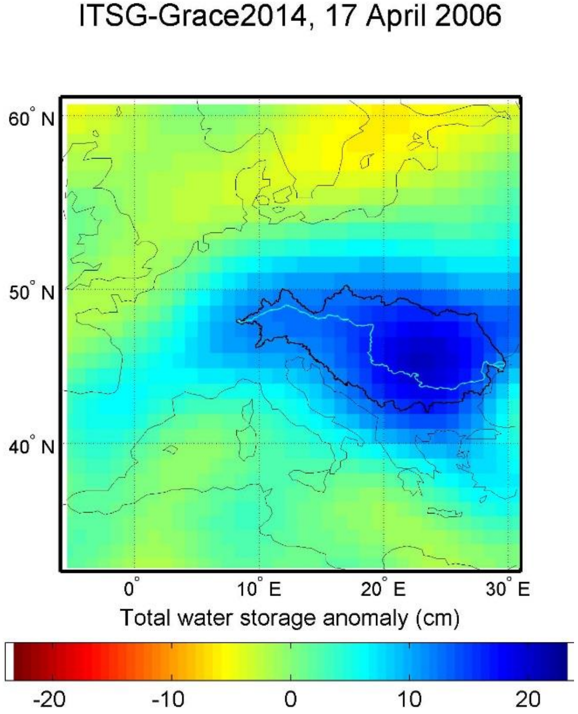
daily GRACE solutions vs. hydrological model simulations



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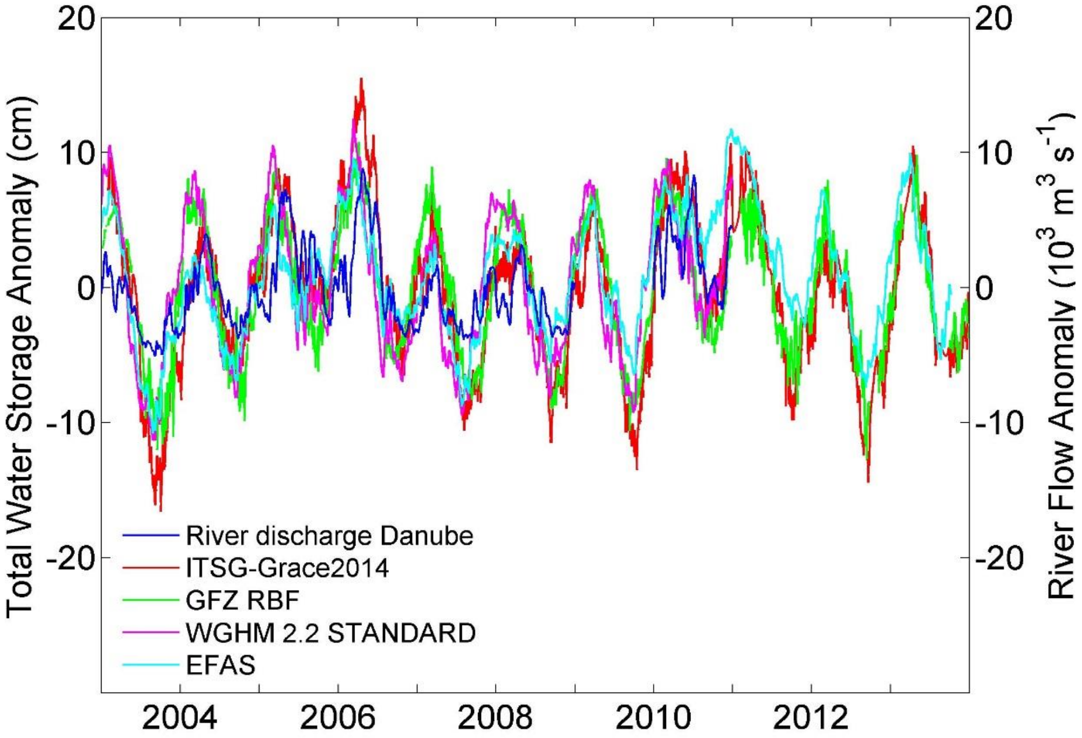

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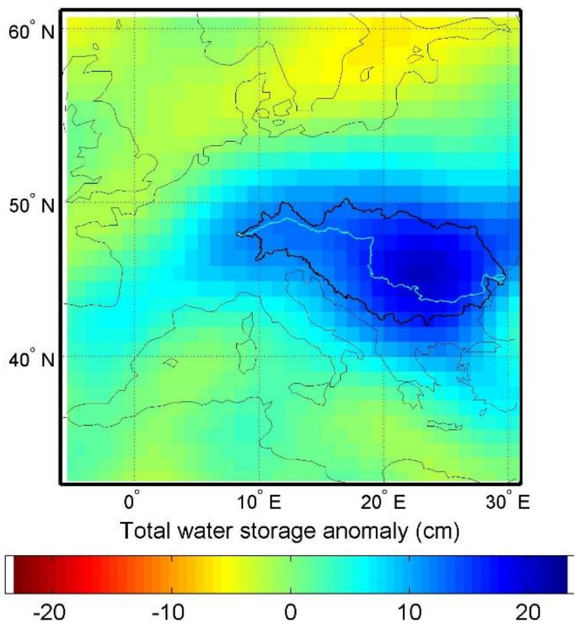
daily GRACE solutions vs. hydrological model simulations



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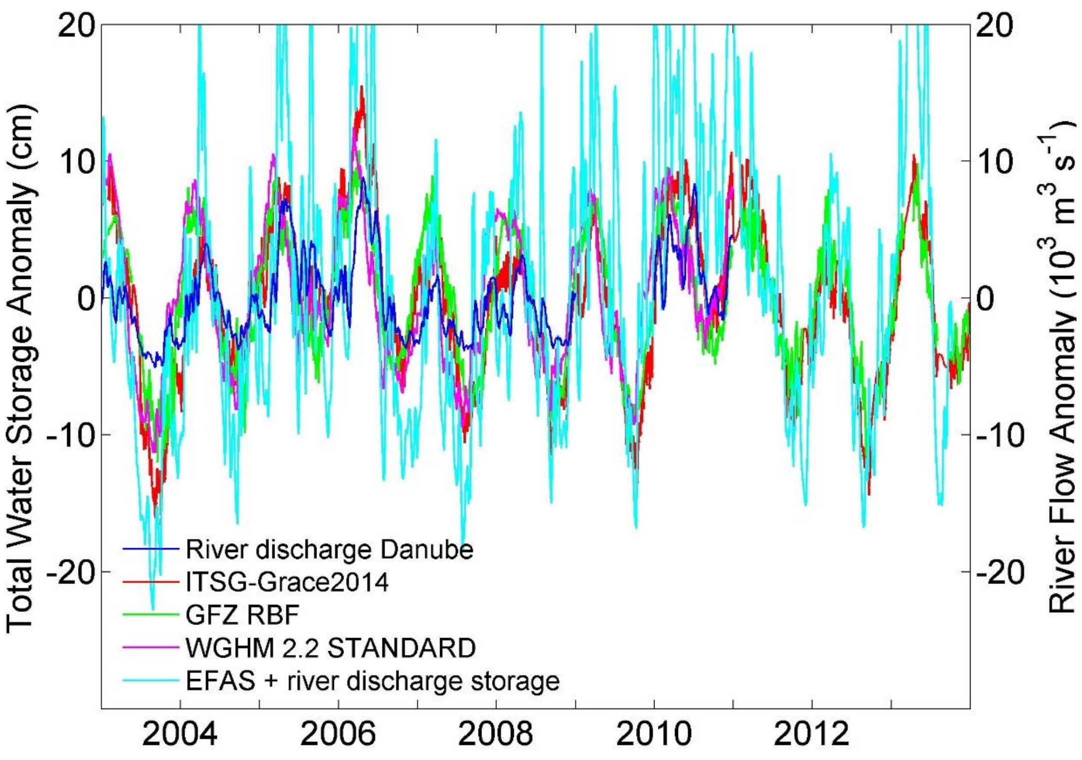

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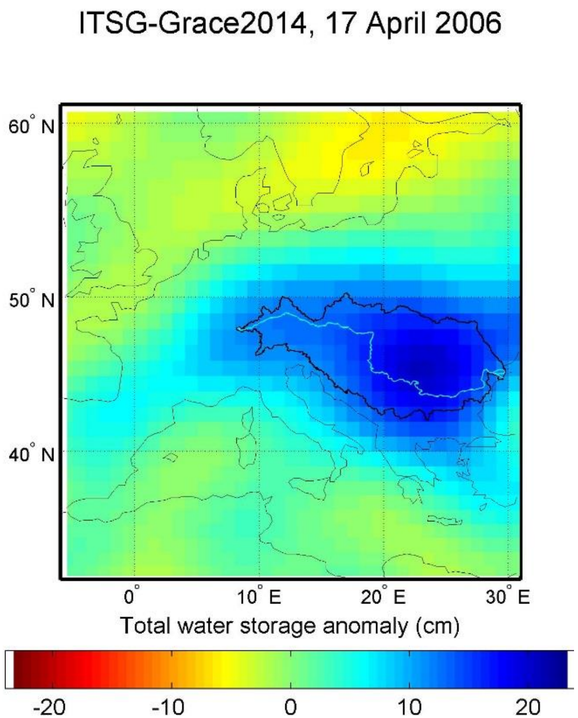
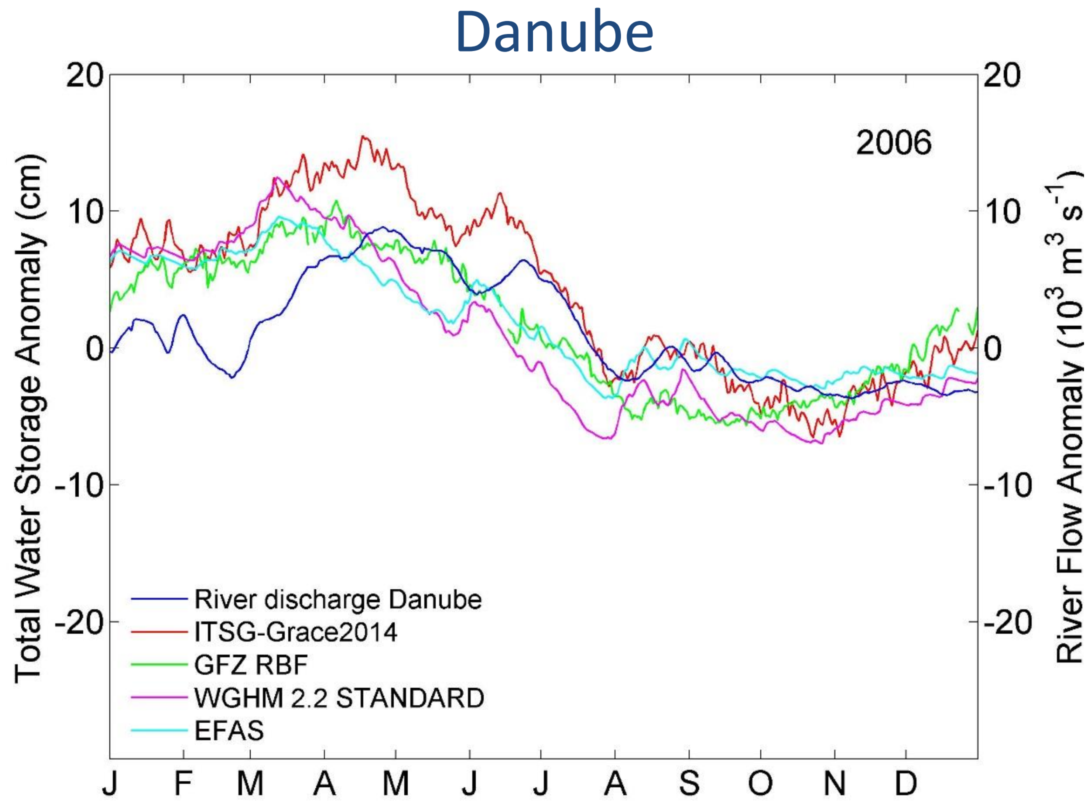
daily GRACE solutions vs. hydrological model simulations





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daily GRACE solutions vs. hydrological model simulations

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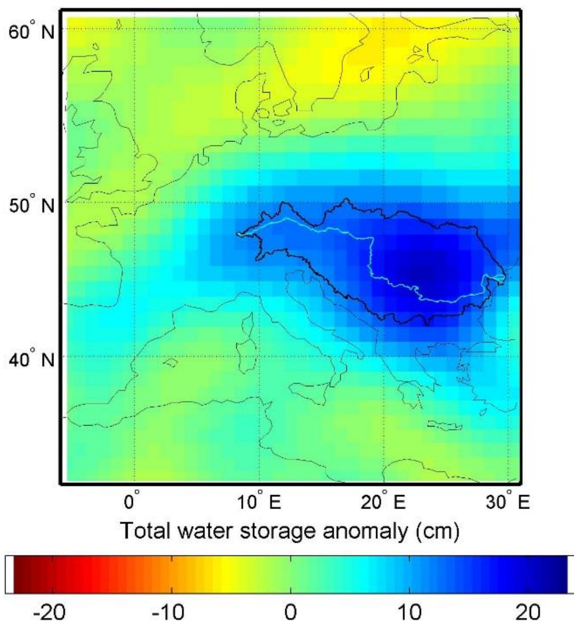

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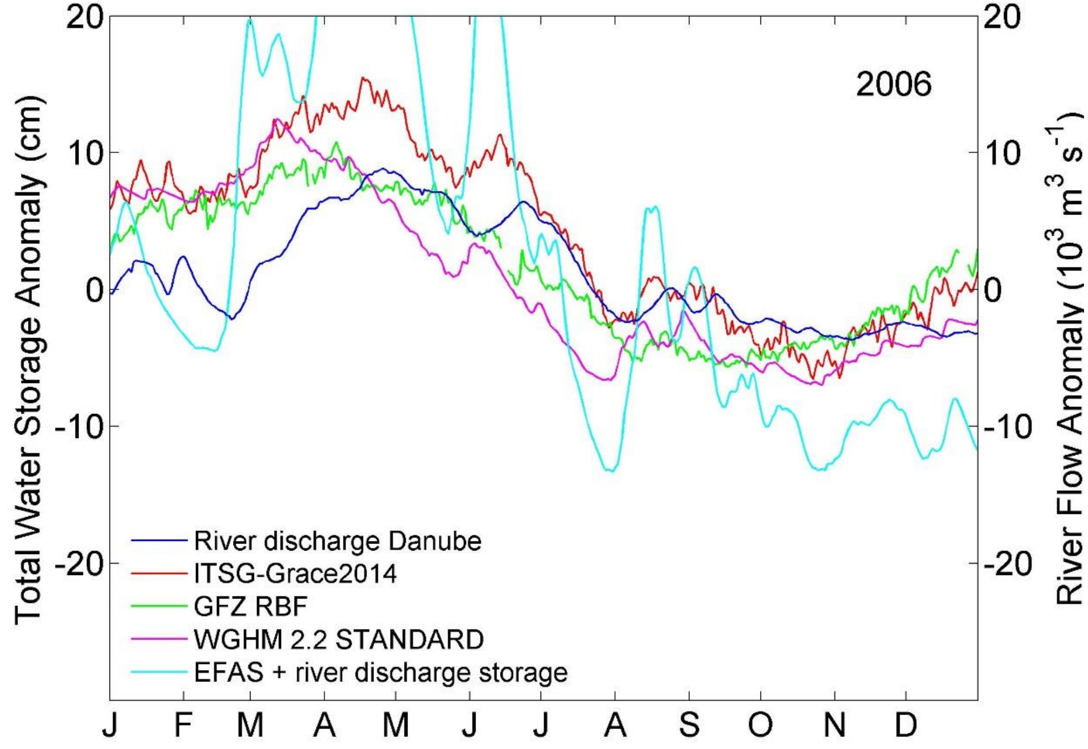

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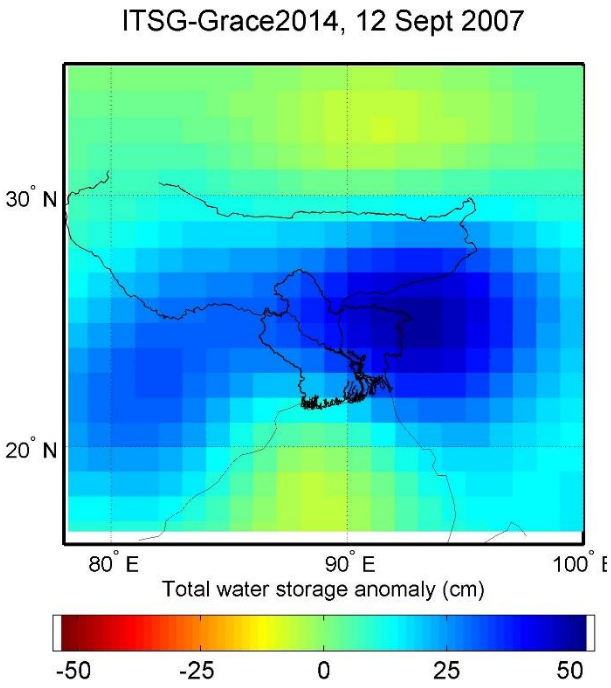
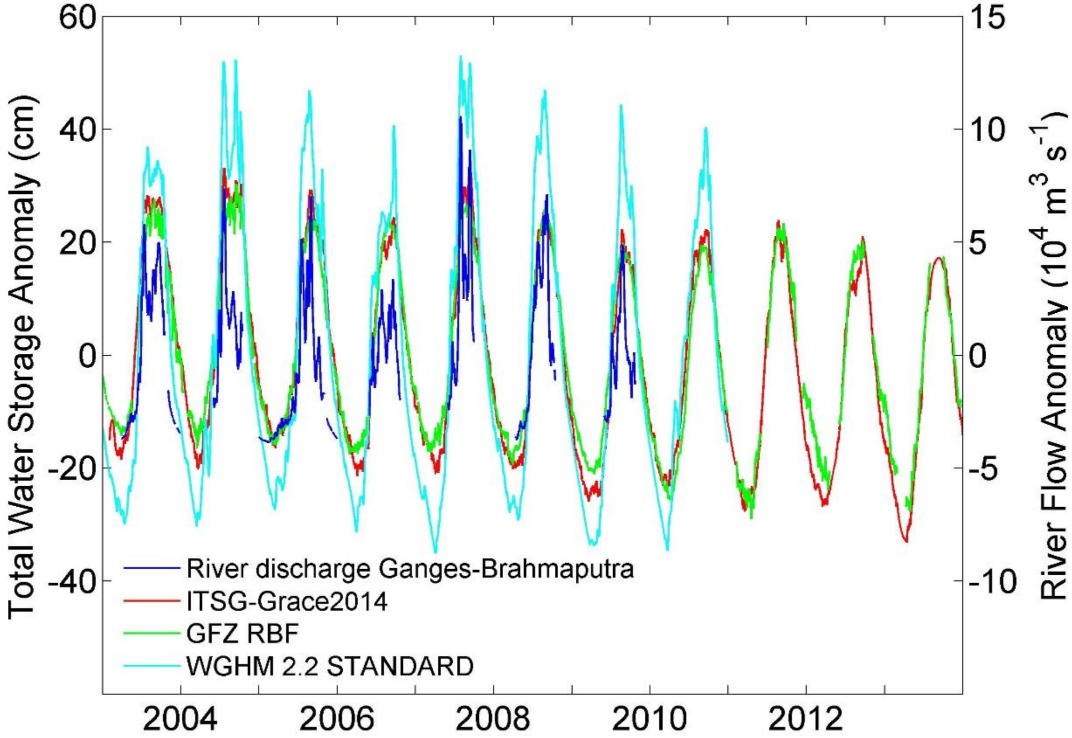
daily GRACE solutions vs. hydrological model simulations

Ganges-Brahmaputra Delta





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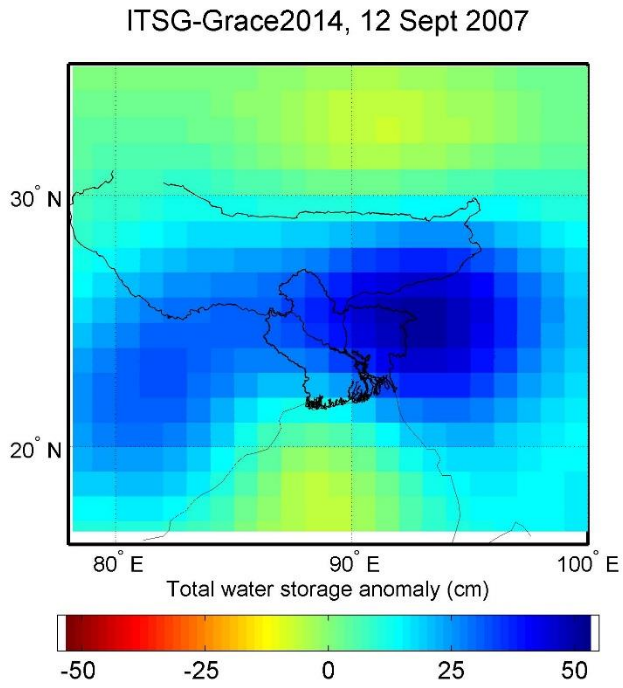

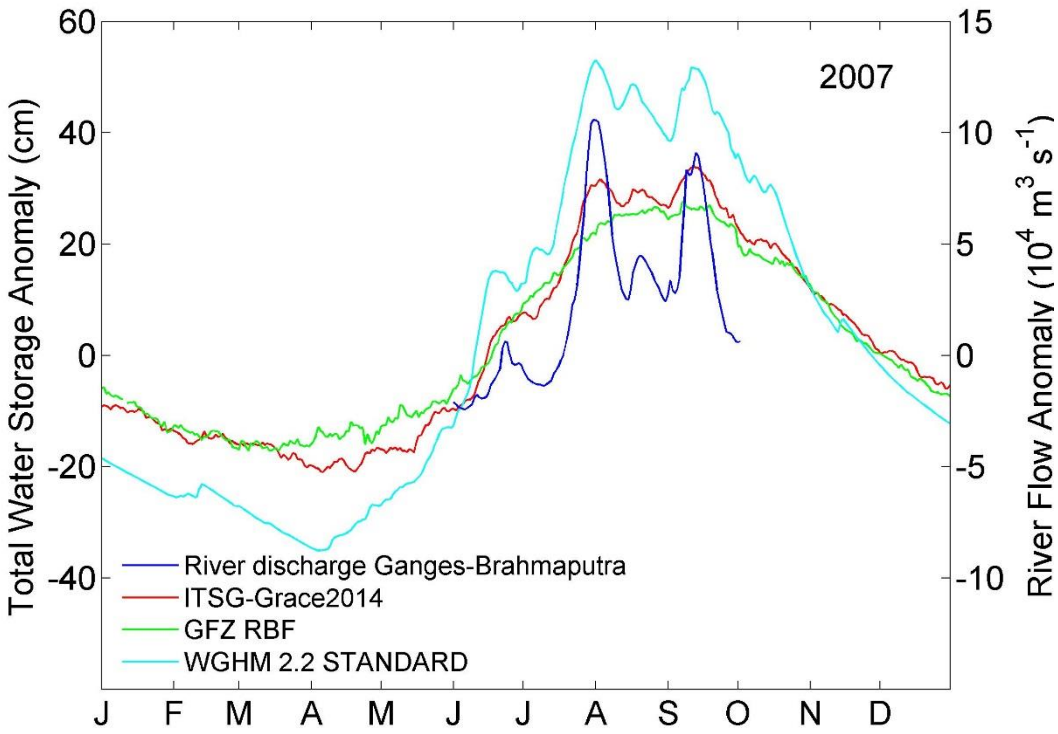

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Evaluation of GRACE daily and combined monthly solutions against river discharge and hydrological model simulations for selected river basins

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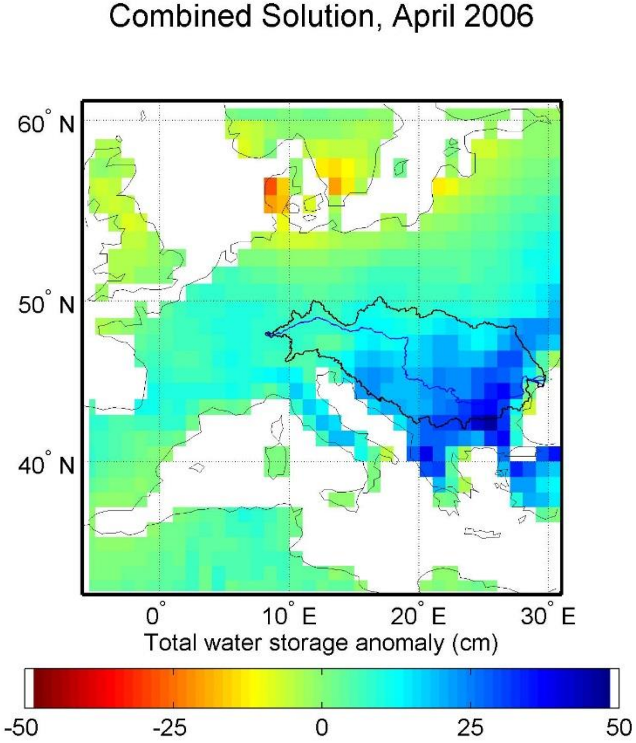
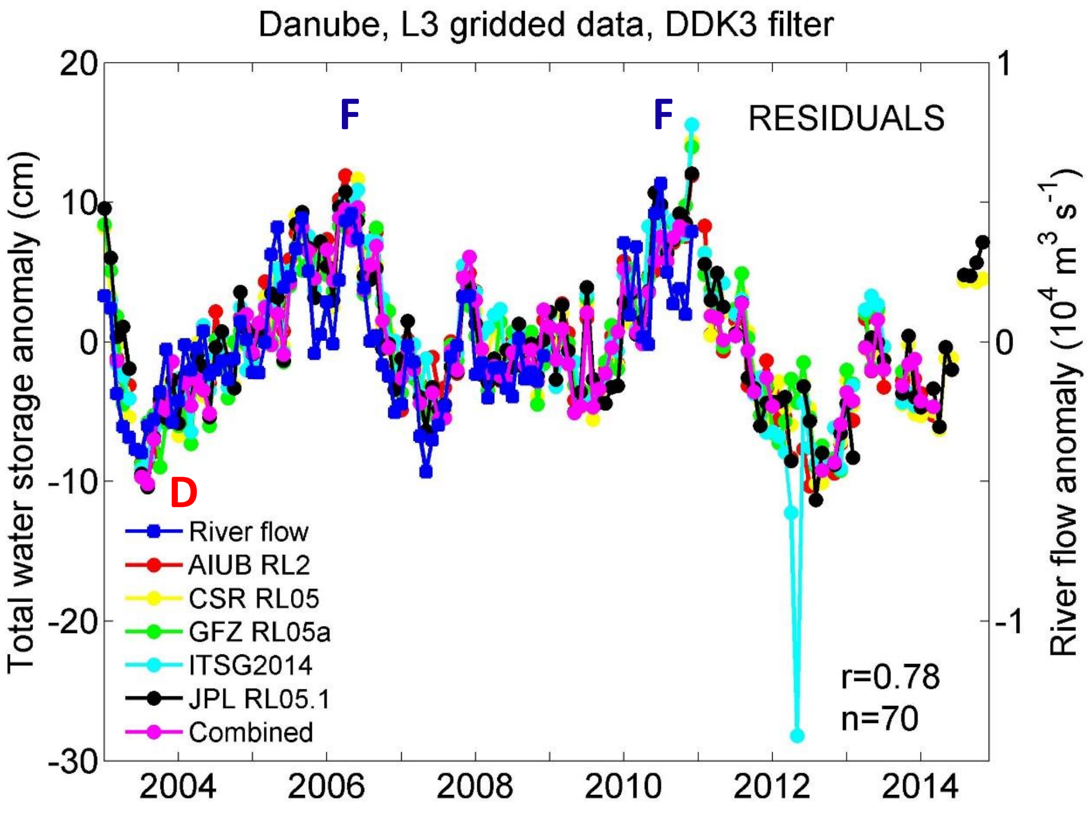
Combined monthly GRACE solution vs. river discharge





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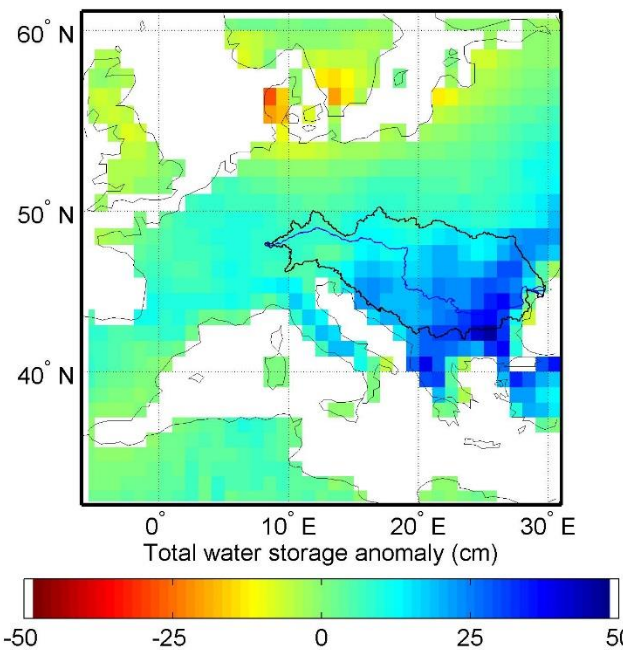
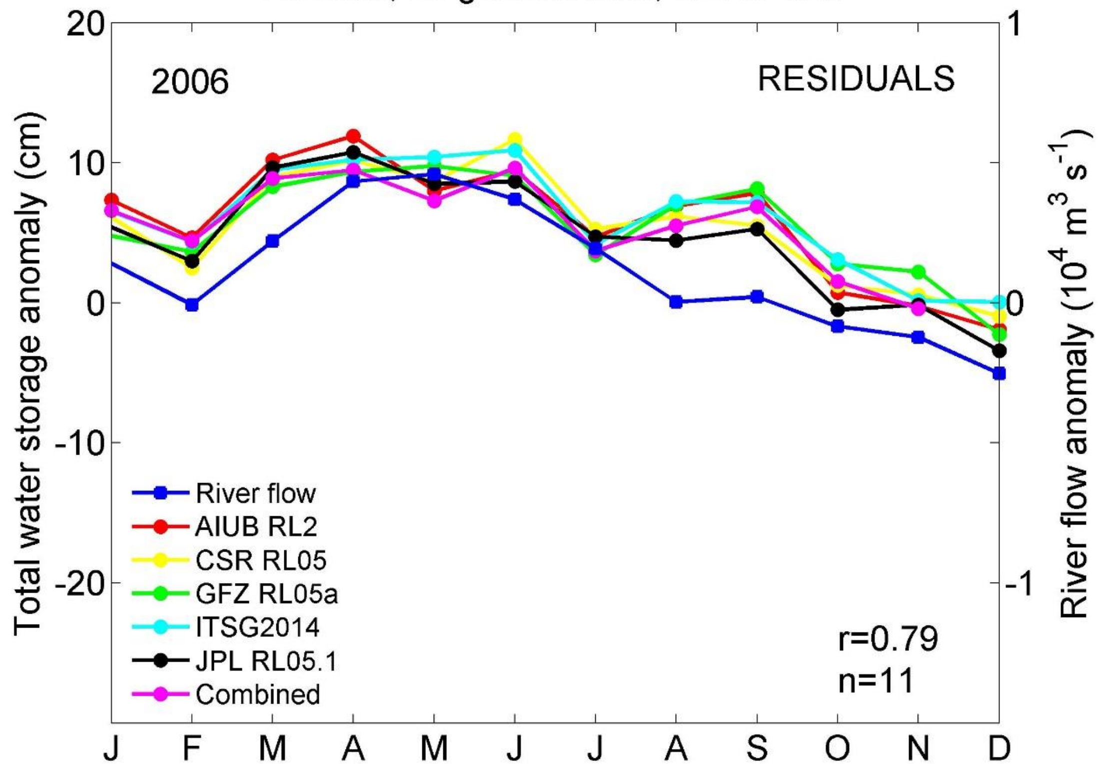
Combined monthly GRACE solution vs. river discharge

Combined Solution, April 2006



Danube, L3 gridded data, DDK3 filter



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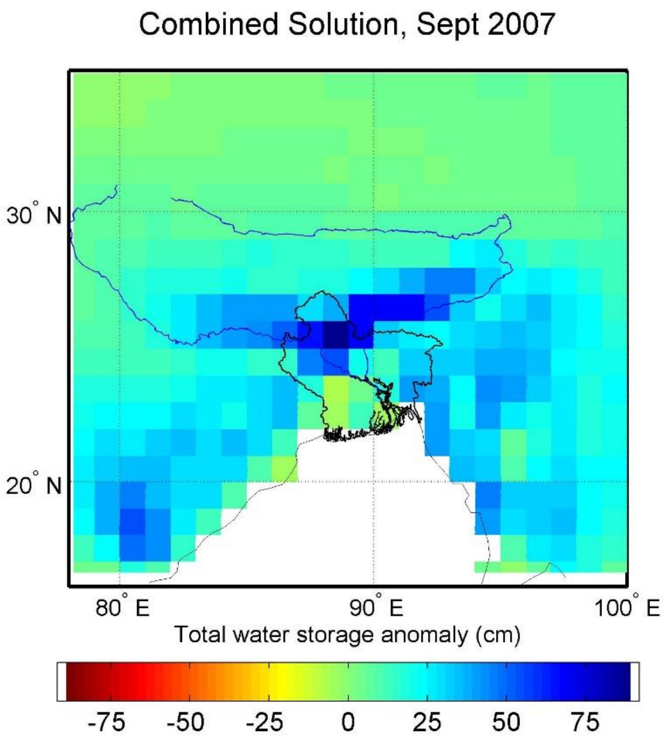
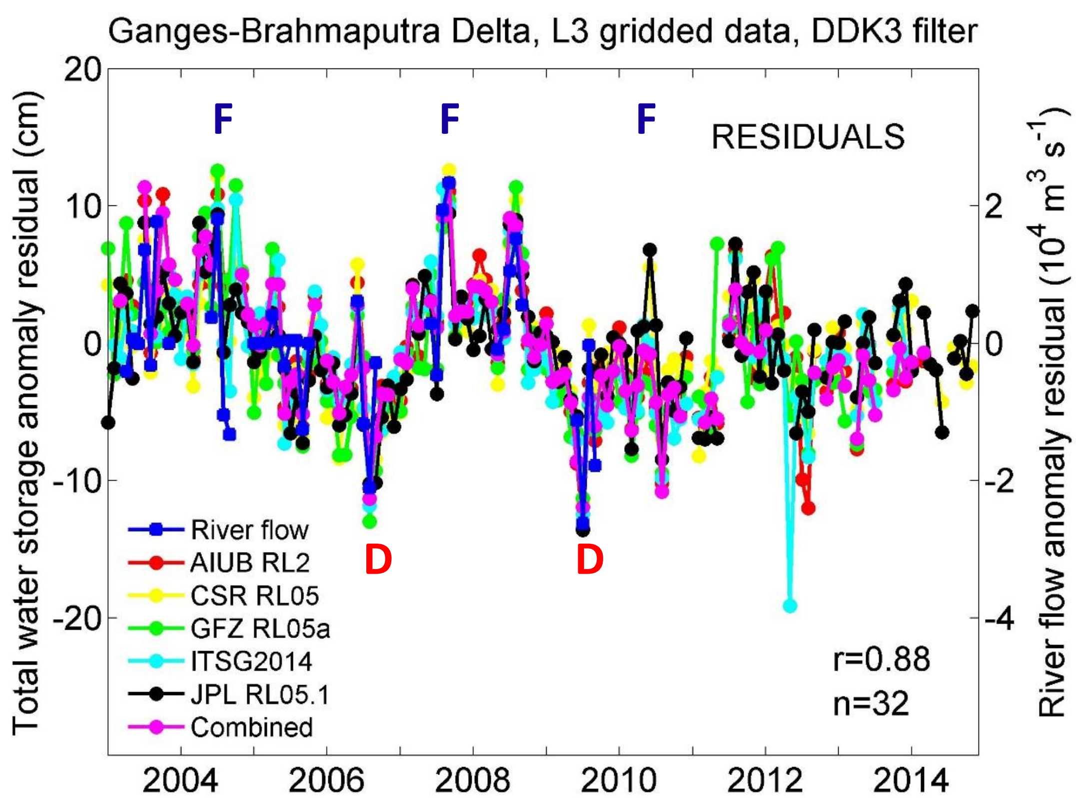
Combined monthly GRACE solution vs. river discharge





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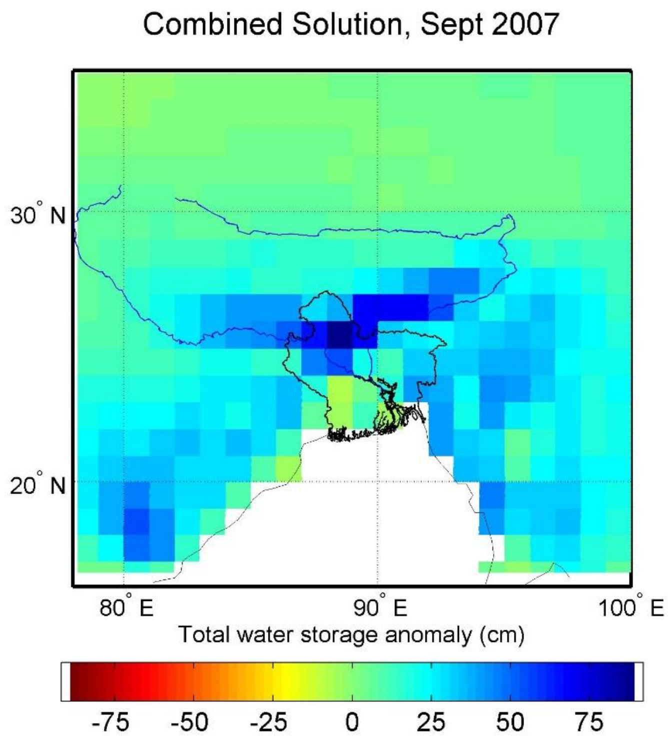
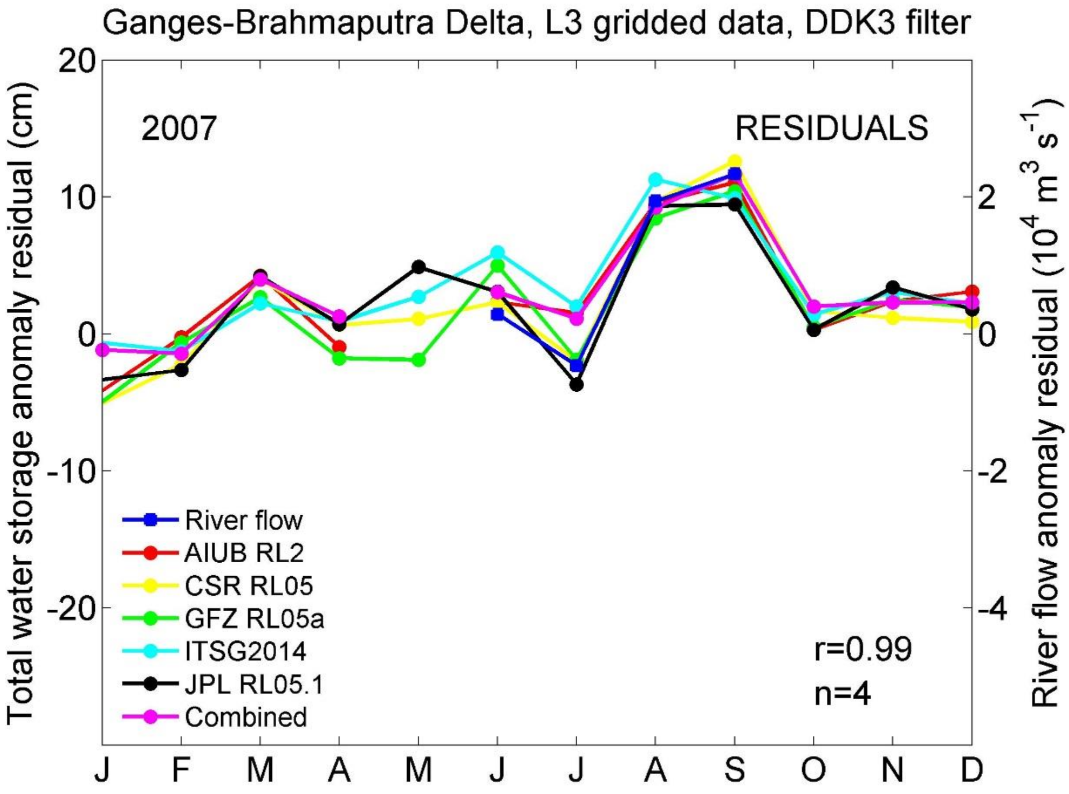
Combined monthly GRACE solution vs. river discharge





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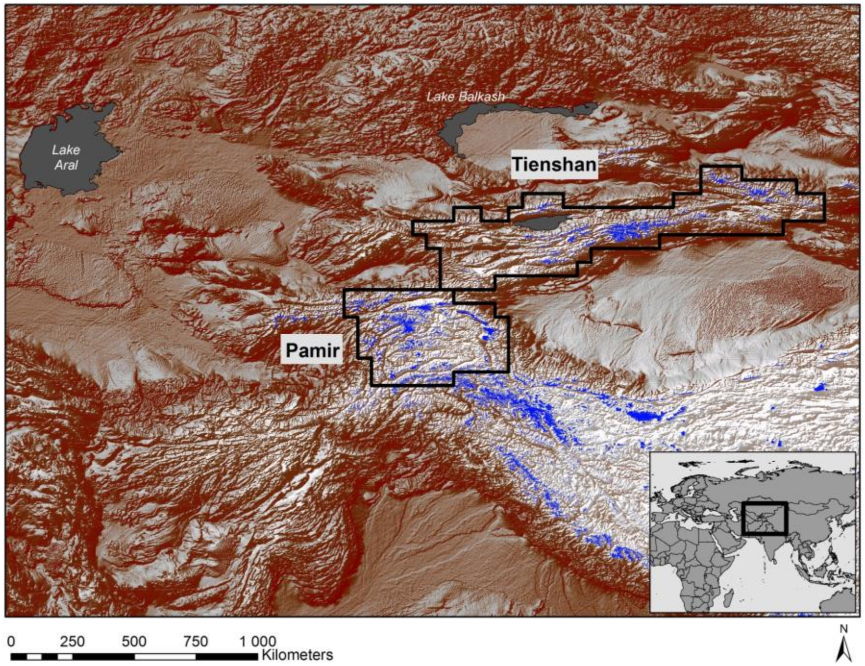
Other activities & outlook

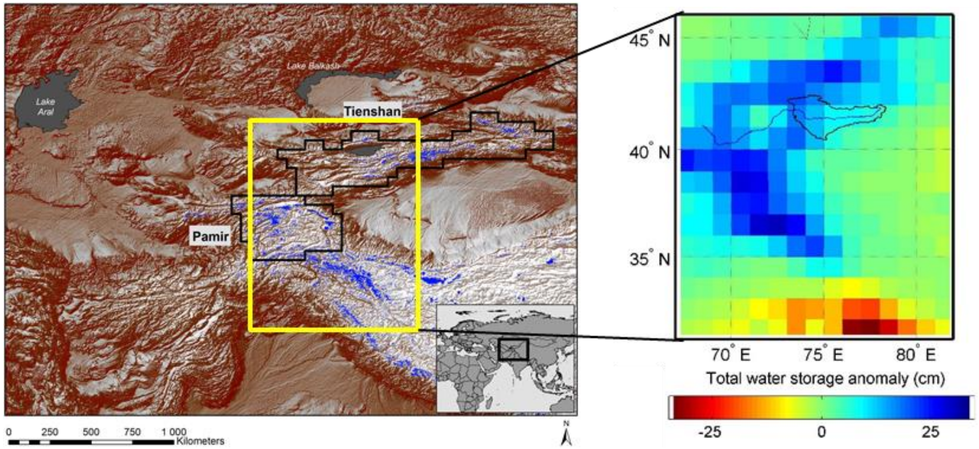
- Paper on evaluation of GRACE daily gravity solutions for hydrological extremes in selected river basins (Gouweleeuw et al., GRL, in prep.)
- Collection of complimentary hydrological data (groundwater level, surface water level, river discharge) for Ganges-Brahmaputra Delta.
- Planned research stay at IGG, Bonn to set up DA framework for assimilation of EGSIEM data products into WGHM for Ganges-Brahmaputra Basin.

Seasonal forecasting of summer streamflow in Central Asia



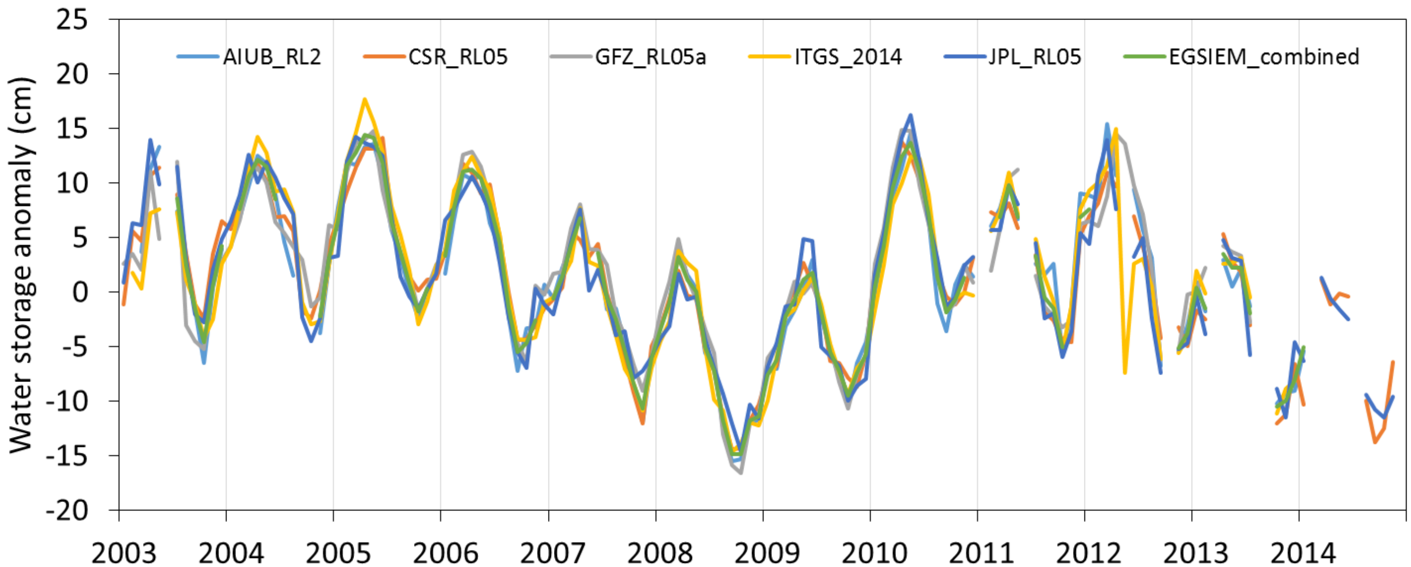
Water resources in Central Asia depend on snowmelt and glacier melt from mountain ranges such as Pamir and Tien Shan

Seasonal forecasting of summer streamflow in Central Asia

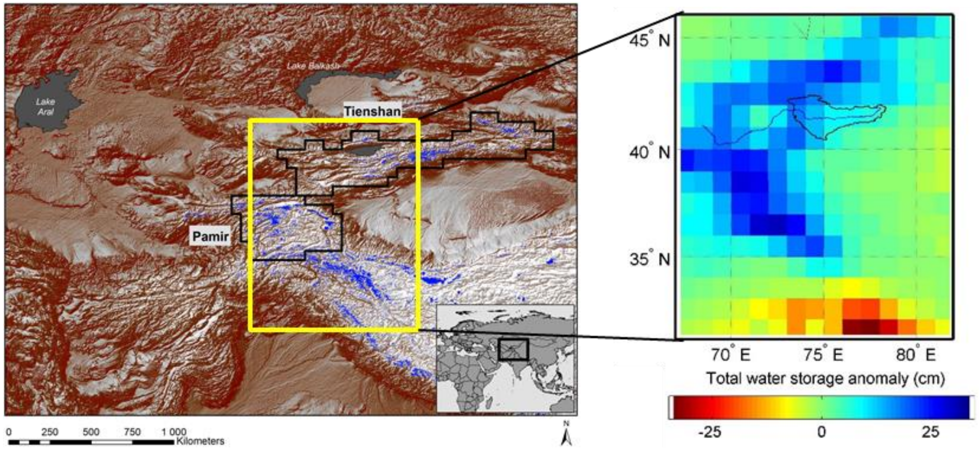


Naryn river basin
River gauging station Uchterek
Basin size ~50000km²

April 2010 total water storage (TWS) anomaly (CSR-RL05 with DDK2 and re-scaling)



Seasonal forecasting of summer streamflow in Central Asia



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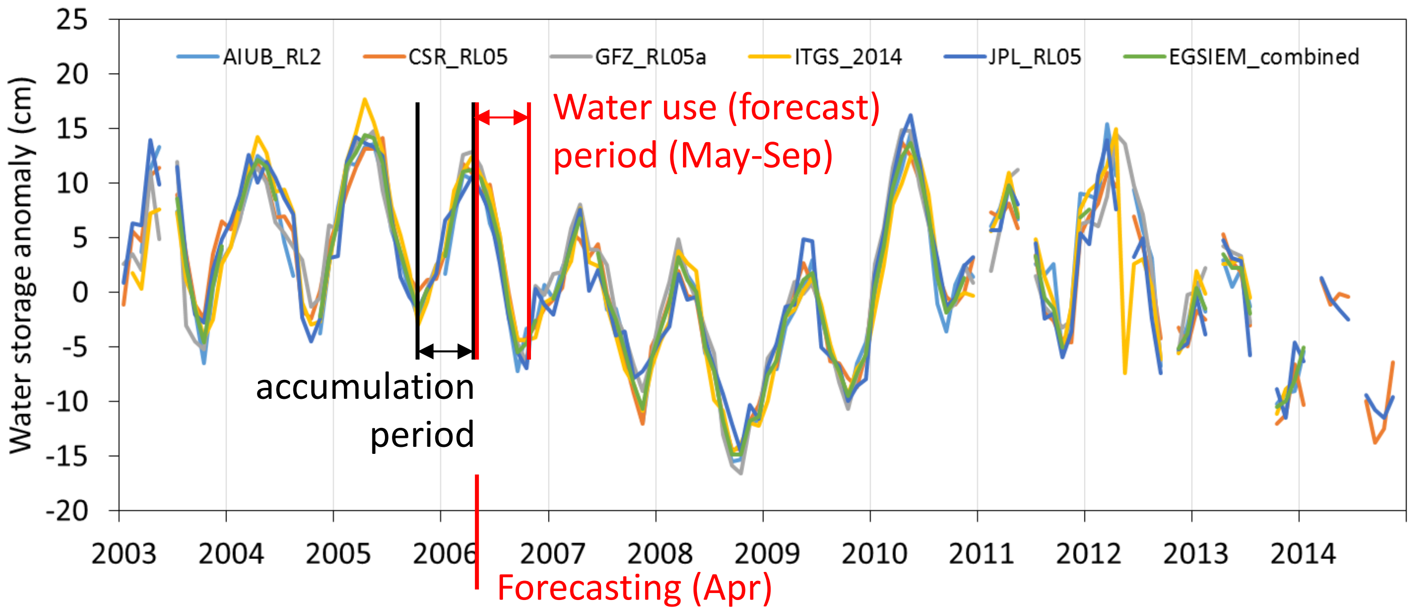
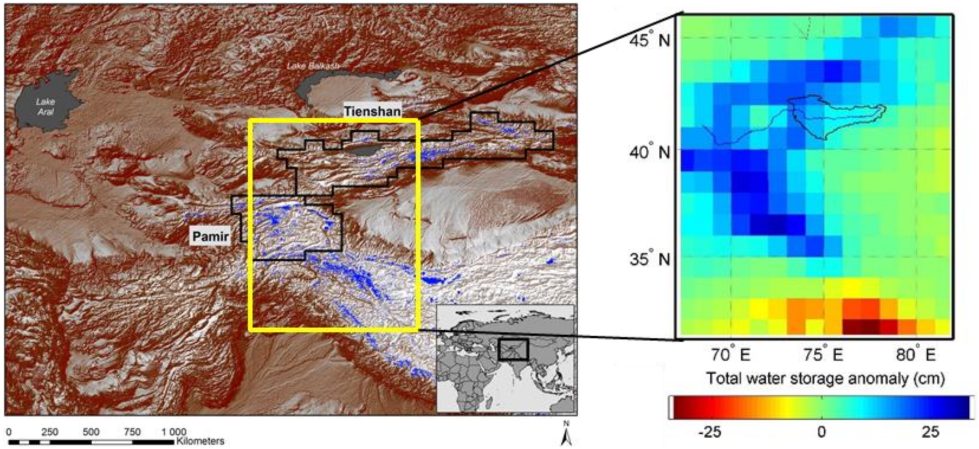


Seasonal forecasting of summer streamflow in Central Asia



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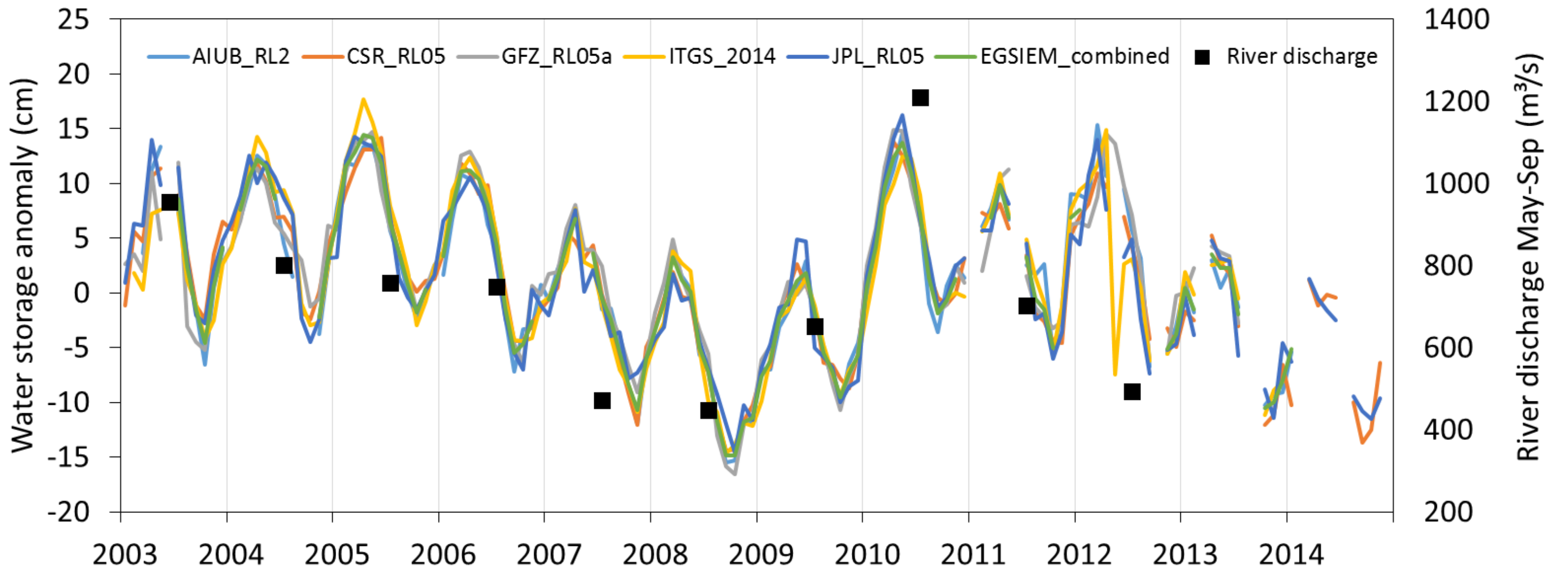


Seasonal forecasting of summer streamflow in Central Asia

Linear forecast models

Forecast variable:

- Summer streamflow (May-Sep)

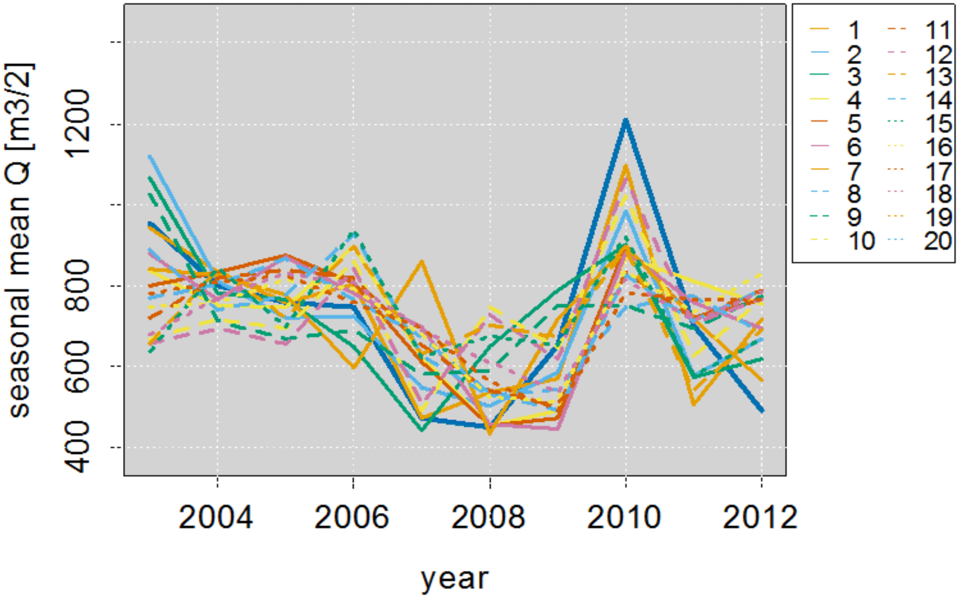
Predictors:

- Precipitation
- Standardized Precipitation Index (SPI)
- Air temperature
- River discharge
- Snow cover
- GRACE TWS anomaly

Seasonal forecasting of summer streamflow in Central Asia

Linear forecast model (1 predictor) (2003-2012)

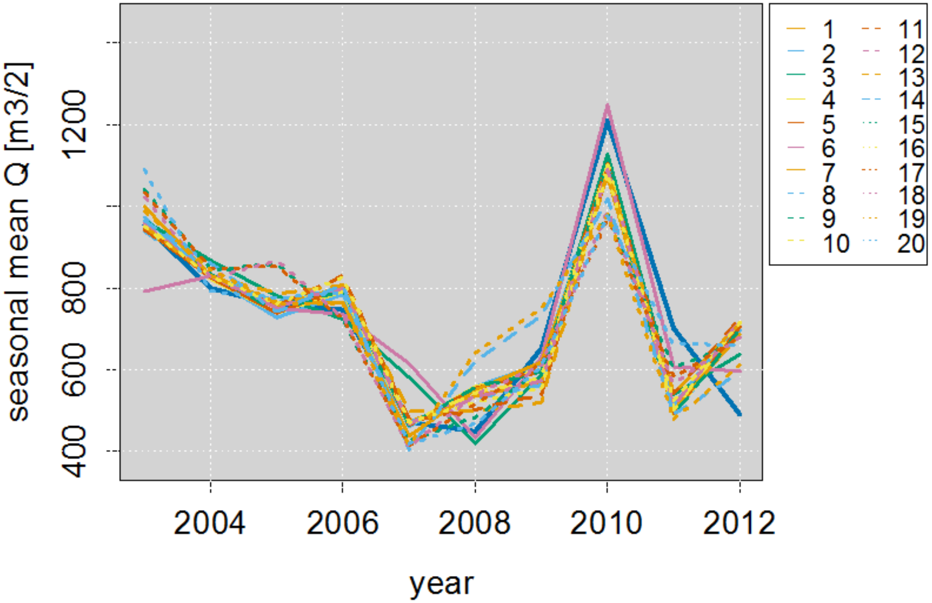
	Predictor	R2
1	SPI_JanApr	0.726
2	Precip_JanApr	0.424
3	SnowCover	0.355
4	Runoff_MarApr	0.141
5	CSR_RL05_DDK2s_TWS_Apr	0.128
6	JPL_RL05_1_DDK2s_TWS_Apr	0.084
7	Temp_Jan	0.040
8	Runoff_JanApr	0.030
9	Temp_MarApr	-0.091
10	SPI_JanFeb	-0.107
11	CSR_RL05_DDK2s_TWS_MarApr	-0.127
12	Precip_JanFeb	-0.128
13	SPI_Jan	-0.141
14	JPL_RL05_1_DDK2s_TWS_MarApr	-0.147
15	Precip_Jan	-0.186
16	GFZ_RL05a_DDK2s_TWS_Apr	-0.188
17	AIUB_RL2_DDK2s_TWS_Apr	-0.277
18	GFZ_RL05a_DDK2s_TWS_MarApr	-0.284



Seasonal forecasting of summer streamflow in Central Asia

Linear forecast model (2 predictors) (2003-2012)

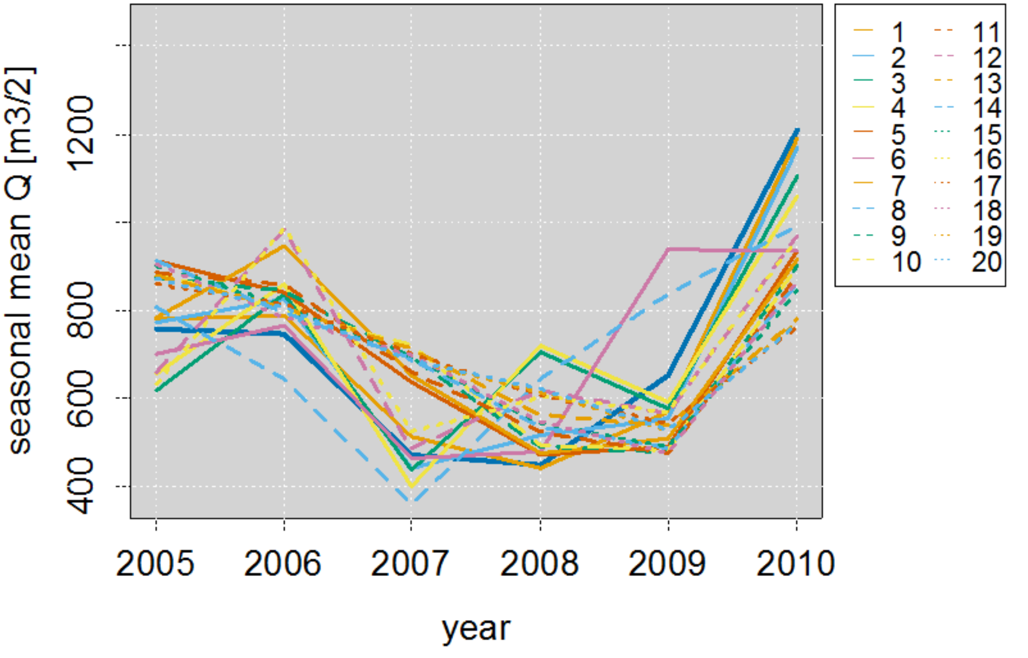
	Predictor	R2
1	SPI_JanApr	0.726
2	SPI_JanApr + GFZ_RL05a_DDK2s_TWS_MarApr	0.720
3	Temp_Jan + SPI_JanApr	0.714
4	SPI_JanApr + CSR_RL05_DDK2s_TWS_MarApr	0.696
5	SPI_JanApr + JPL_RL05_1_DDK2s_TWS_MarApr	0.681
6	Temp_Jan + SPI_JanFeb	0.670
7	SnowCover + SPI_JanApr	0.657
8	SPI_JanApr + CSR_RL05_DDK2s_TWS_Apr	0.650
9	SPI_JanApr + GFZ_RL05a_DDK2s_TWS_Apr	0.646
10	SPI_JanApr + AIUB_RL2_DDK2s_TWS_Apr	0.643
11	Runoff_MarApr + SPI_JanApr	0.637
12	Temp_MarApr + SPI_JanApr	0.628
13	SPI_JanApr + JPL_RL05_1_DDK2s_TWS_Apr	0.608
14	SnowCover + Precip_Jan	0.595
15	SnowCover + CSR_RL05_DDK2s_TWS_Apr	0.558
16	Runoff_JanApr + SPI_JanApr	0.552
17	SnowCover + CSR_RL05_DDK2s_TWS_MarApr	0.531
18	SnowCover + GFZ_RL05a_DDK2s_TWS_MarApr	0.530
19	SnowCover + SPI_Jan	0.529
20	SnowCover + Runoff_MarApr	0.525



Seasonal forecasting of summer streamflow in Central Asia

Linear forecast model (1 predictor) (2005-2010)

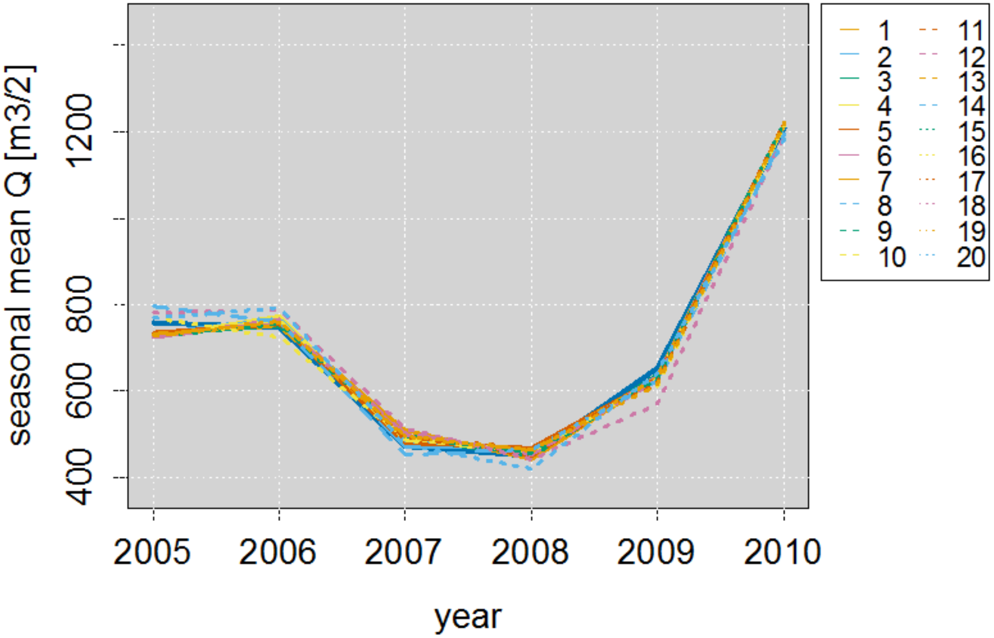
	Predictor	R2
1	Precip_JanApr	0.936
2	SPI_JanApr	0.831
3	Precip_JanFeb	0.209
4	SPI_JanFeb	0.106
5	CSR_RL05_DDK2s_TWS_Apr	-0.019
6	Temp_MarApr	-0.152
7	Runoff_MarApr	-0.155
8	SnowCover	-0.198
9	GFZ_RL05a_DDK2s_TWS_Apr	-0.202
10	JPL_RL05_1_DDK2s_TWS_Apr	-0.260
11	CSR_RL05_DDK2s_TWS_MarApr	-0.273
12	SPI_Jan	-0.285
13	EGSIEM_DDK1s_TWS_Apr	-0.380
14	JPL_RL05_1_DDK2s_TWS_MarApr	-0.390
15	EGSIEM_DDK2s_TWS_Apr	-0.392
16	Precip_Jan	-0.408
17	EGSIEM_DDK1s_TWS_MarApr	-0.441
18	EGSIEM_DDK3s_TWS_Apr	-0.481
19	EGSIEM_DDK3s_TWS_janApr	-0.496
20	EGSIEM_DDK2s_TWS_janApr	-0.515



Seasonal forecasting of summer streamflow in Central Asia

Linear forecast model (2 predictors) (2005-2010)

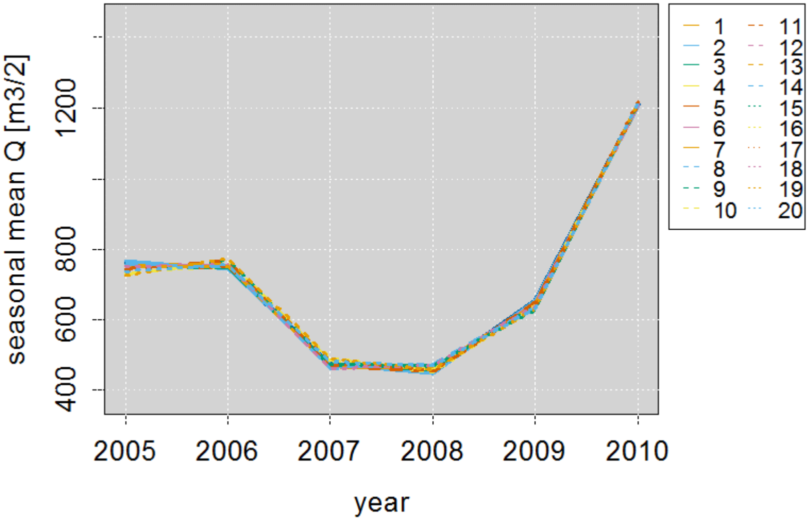
	Predictor	R2
1	Precip_JanApr + AIUB_RL2_DDK2s_TWS_Apr	0.980
2	Precip_JanApr + JPL_RL05_1_DDK2s_TWS_Apr	0.977
3	Precip_JanApr + GFZ_RL05a_DDK2s_TWS_MarApr	0.976
4	Precip_JanApr + EGSIEM_DDK3s_TWS_Apr	0.971
5	Precip_JanApr + GFZ_RL05a_DDK2s_TWS_Apr	0.971
6	Precip_JanApr + EGSIEM_DDK3s_TWS_MarApr	0.967
7	Precip_JanApr + EGSIEM_DDK3s_TWS_Mar	0.963
8	Precip_JanApr + JPL_RL05_1_DDK2s_TWS_MarApr	0.963
9	Precip_JanApr + EGSIEM_DDK2s_TWS_MarApr	0.963
10	Precip_JanApr + EGSIEM_DDK2s_TWS_Apr	0.962
11	Precip_JanApr + EGSIEM_DDK2s_TWS_janApr	0.956
12	Precip_JanApr + EGSIEM_DDK3s_TWS_janApr	0.952
13	Precip_JanApr + CSR_RL05_DDK2s_TWS_MarApr	0.951
14	SnowCover + Precip_JanApr	0.951
15	Precip_JanApr + EGSIEM_DDK1s_TWS_MarApr	0.947
16	Precip_JanApr + Runoff_MarApr	0.947
17	Precip_JanApr + EGSIEM_DDK1s_TWS_Apr	0.945
18	Precip_JanApr	0.936
19	Precip_JanApr + CSR_RL05_DDK2s_TWS_Apr	0.934
20	Temp_MarApr + Precip_JanApr	0.890



Seasonal forecasting of summer streamflow in Central Asia

Linear forecast model (3 predictors) (2005-2010)

	Predictor	R2
1	SnowCover + Precip_JanApr + EGSIEM_DDK3s_TWS_Mar	0.997
2	Temp_MarApr + Precip_JanApr + Runoff_MarApr	0.996
3	SnowCover + Precip_JanApr + GFZ_RL05a_DDK2s_TWS_MarApr	0.993
4	SnowCover + Precip_JanApr + EGSIEM_DDK2s_TWS_MarApr	0.991
5	SnowCover + Precip_JanApr + EGSIEM_DDK2s_TWS_janApr	0.990
6	SnowCover + Precip_JanApr + EGSIEM_DDK3s_TWS_MarApr	0.990
7	SnowCover + Precip_JanApr + EGSIEM_DDK3s_TWS_janApr	0.988
8	SnowCover + Precip_JanApr + EGSIEM_DDK1s_TWS_MarApr	0.983
9	SnowCover + Precip_JanApr + CSR_RL05_DDK2s_TWS_MarApr	0.981
10	Precip_JanApr + AIUB_RL2_DDK2s_TWS_Apr	0.980
11	Temp_MarApr + Precip_JanApr + GFZ_RL05a_DDK2s_TWS_Apr	0.980
12	SnowCover + Precip_JanApr + GFZ_RL05a_DDK2s_TWS_Apr	0.978
13	SnowCover + Precip_JanApr + EGSIEM_DDK1s_TWS_Apr	0.978
14	SnowCover + Precip_JanApr + CSR_RL05_DDK2s_TWS_Apr	0.977
15	Precip_JanApr + JPL_RL05_1_DDK2s_TWS_Apr	0.977
16	Precip_JanApr + GFZ_RL05a_DDK2s_TWS_MarApr	0.976
17	Temp_Jan + SPI_JanApr + AIUB_RL2_DDK2s_TWS_Apr	0.972
18	SnowCover + Precip_JanApr + EGSIEM_DDK2s_TWS_Apr	0.972
19	Precip_JanApr + EGSIEM_DDK3s_TWS_Apr	0.971
20	Precip_JanApr + GFZ_RL05a_DDK2s_TWS_Apr	0.971



Seasonal forecasting of summer streamflow in Central Asia

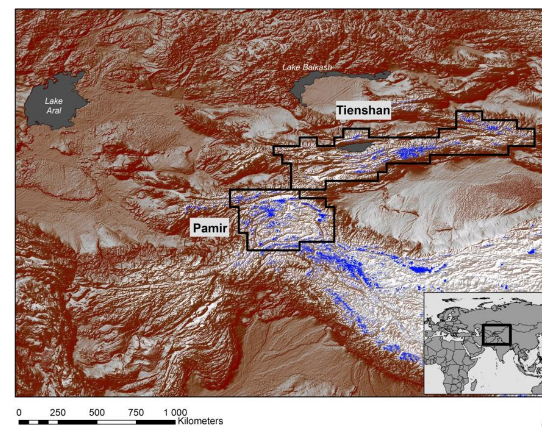
Summary

- GRACE TWS alone is not a good predictor for summer streamflow

- But forecasts can be improved by GRACE TWS as additional predictor (in addition to, e.g., precipitation, snow cover)

- EGSIEM combined monthly solution performs similar to individual solutions

- Short test period (2005-2010) due to missing months in EGSIEM combined solutions



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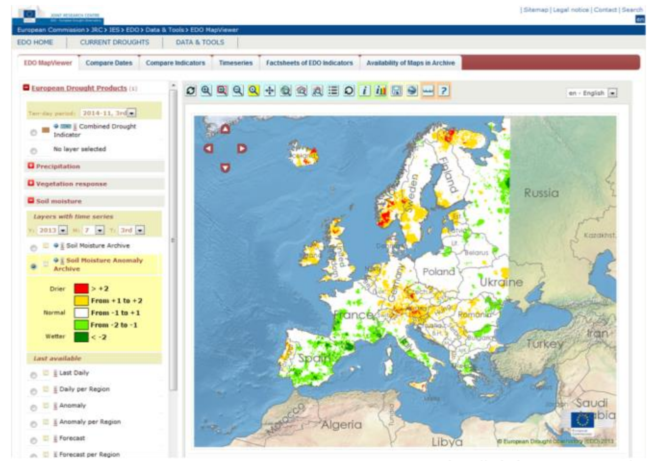
European Gravity Service for Improved Emergency Management

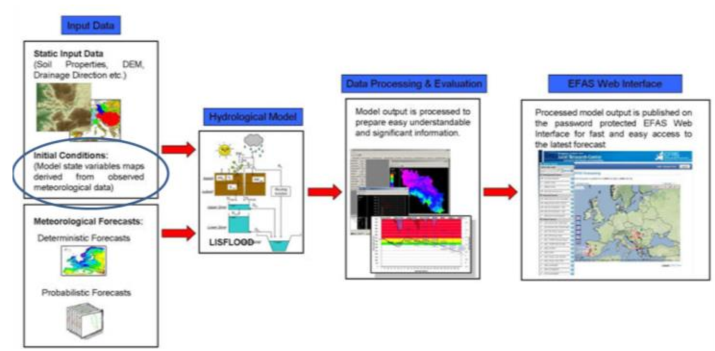
Cooperation JRC - Outlook 2016


http://edo.jrc.ec.europa.eu/

Define requirements of GRACE-based water storage anomalies as flood and drought indicators for

comparison, evaluation and possible future inclusion into

- EFAS (European Flood Awareness System)
- GloFAS (Global Flood Awareness System)
- EDO (European Drought Observatory)



HORIZON 2020