Global Runoff Data Centre

# The Global Terrestrial Network for River Discharge (GTN-R) – A contribution of the GRDC to GCOS and GEOSS

Nationale Informationsveranstaltung zum Thema
Global Earth Observation System of Systems (GEOSS) – Stand und Perspektiven
2.-3. November 2006, BMVBS, Bonn

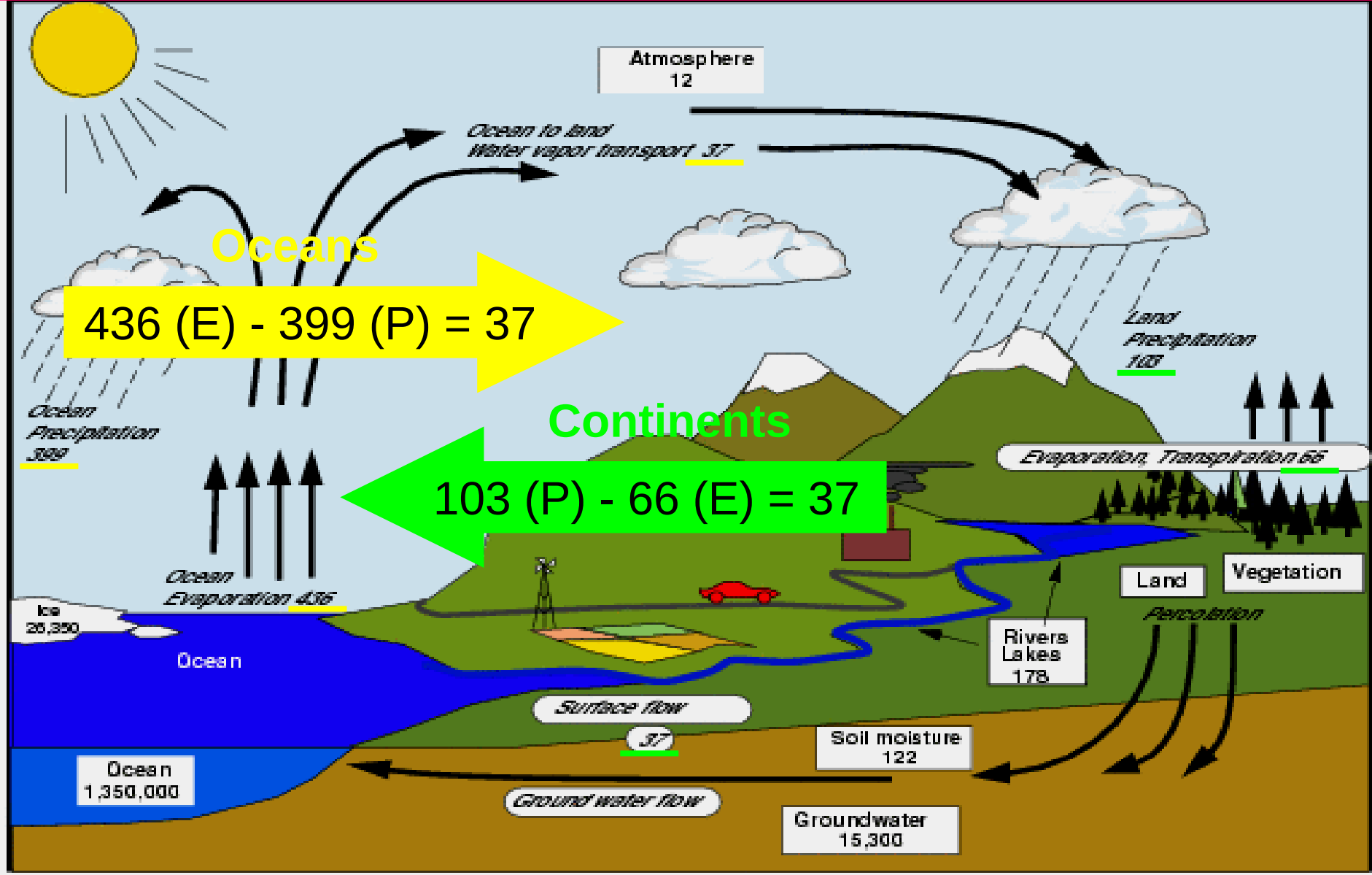
Thomas.Maurer@bafg.de
Referat M4: Geoinformation und Fernerkundungsverfahren

Bundesanstalt für Gewässerkunde
Koblenz

# Bundesanstalt für Gewässerkunde (BfG)

BfG is the scientific institution of the German Government for research, assessment and consulting in the fields of hydrology, water-resources management, ecology, and water protection.

BfG hosts the Global Runoff Data Centre (GRDC), which operates under the auspices of the World Meteorological Organization (WMO) to facilitate hydrological data exchange between providers and users in support of Global Change research.




# Hydrological cycle.

## Units are thousand cubic km for storage and thousand cubic km/year for exchanges

# Is the global hydrological cycle accelerating ?

There is yet no evidence for a significant global trend over the last 20 years, but regional anomalies seem to occur.

- How are regional trends distributed ?
  (water resources availability and use)
- Will intensity and/or frequency of extremes increase ?
  (floods and droughts)
- What is the human influence, what is natural?

# Need to understand the global context

Questions cannot always be answered satisfactorily on local or regional scales alone.

=> In order to arrive at improved predictions at local or regional scales the phenomena have to be examined in their (complex) global context

=> input of local data into global models.

=> results of improved global models to assist local management decisions

# Status, deficiencies, and needs

...of in-situ observation networks of hydrological variables

Two fundamental aspects:

- Availability: Are observations made, processed and stored in sufficient quality and resolution?
- Accessibility: How and to whom information on the observations and the gathered data itself is transmitted and disseminated?

Answer is dependent on the position of the one to judge!

# Status, deficiencies, and needs - different from local and global perspective!

- The perception of an insider (at the local scale) may be that there are sufficiently well developed and managed networks, readily accessible for (local) purposes.
- From an outsider (= larger scale) perspective this often does appear quite different.
  - » Authority over data and information often is scattered regionally and sectorally
    - > countries, federal states, departments, other sub-region definitions,...
    - > water resources, navigation, energy, groundwater, environment, climate, geomatics, agriculture...
  - » Results in highly fragmented and heterogeneous approaches to data management
  - » Limitations in availability and accessibility often connected to problems of scientific, technological, political, organisational and financial nature.

# The main objective of the GRDC...

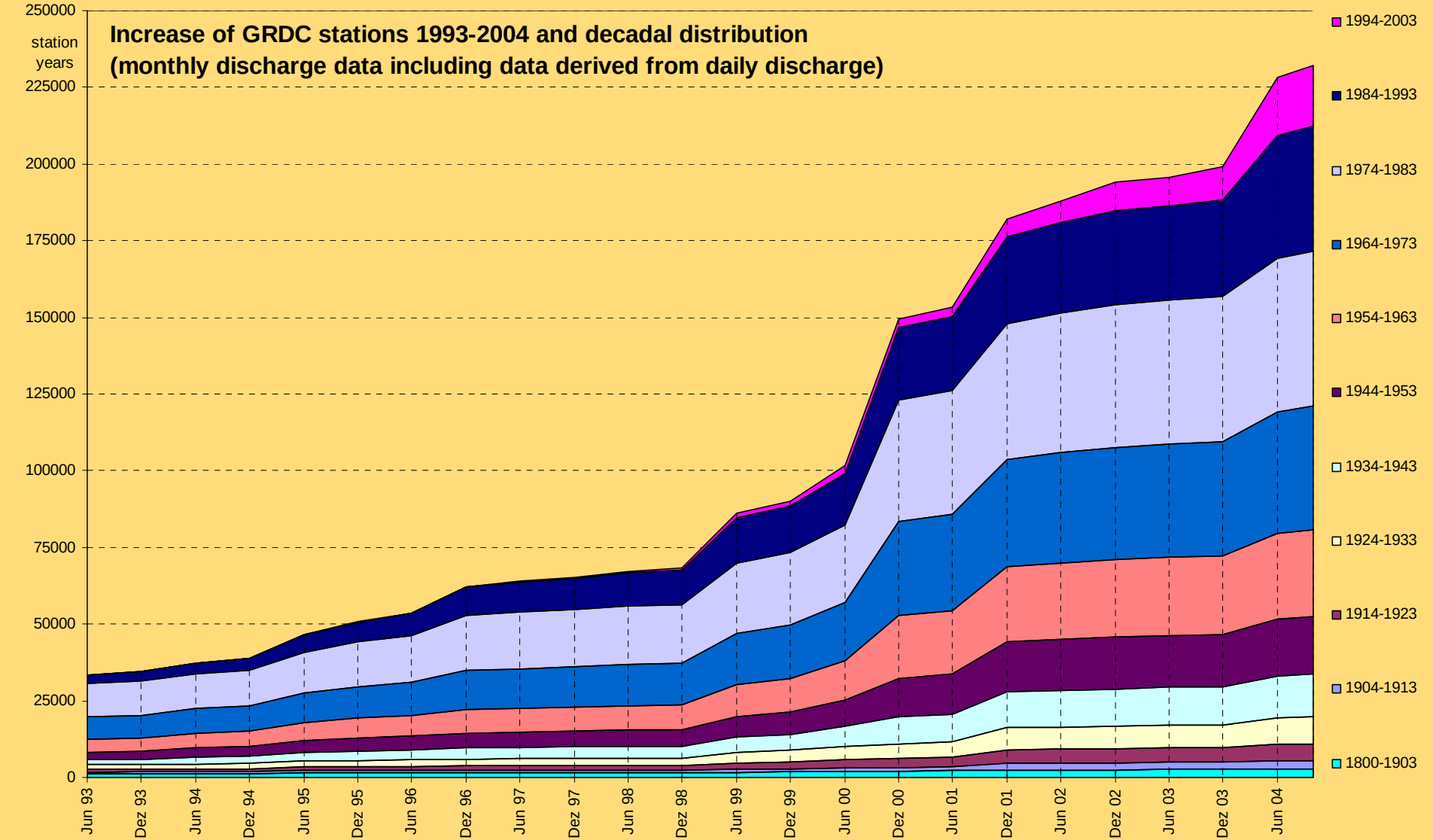

**Acceleration of data and information flow**

# "Data by pump"

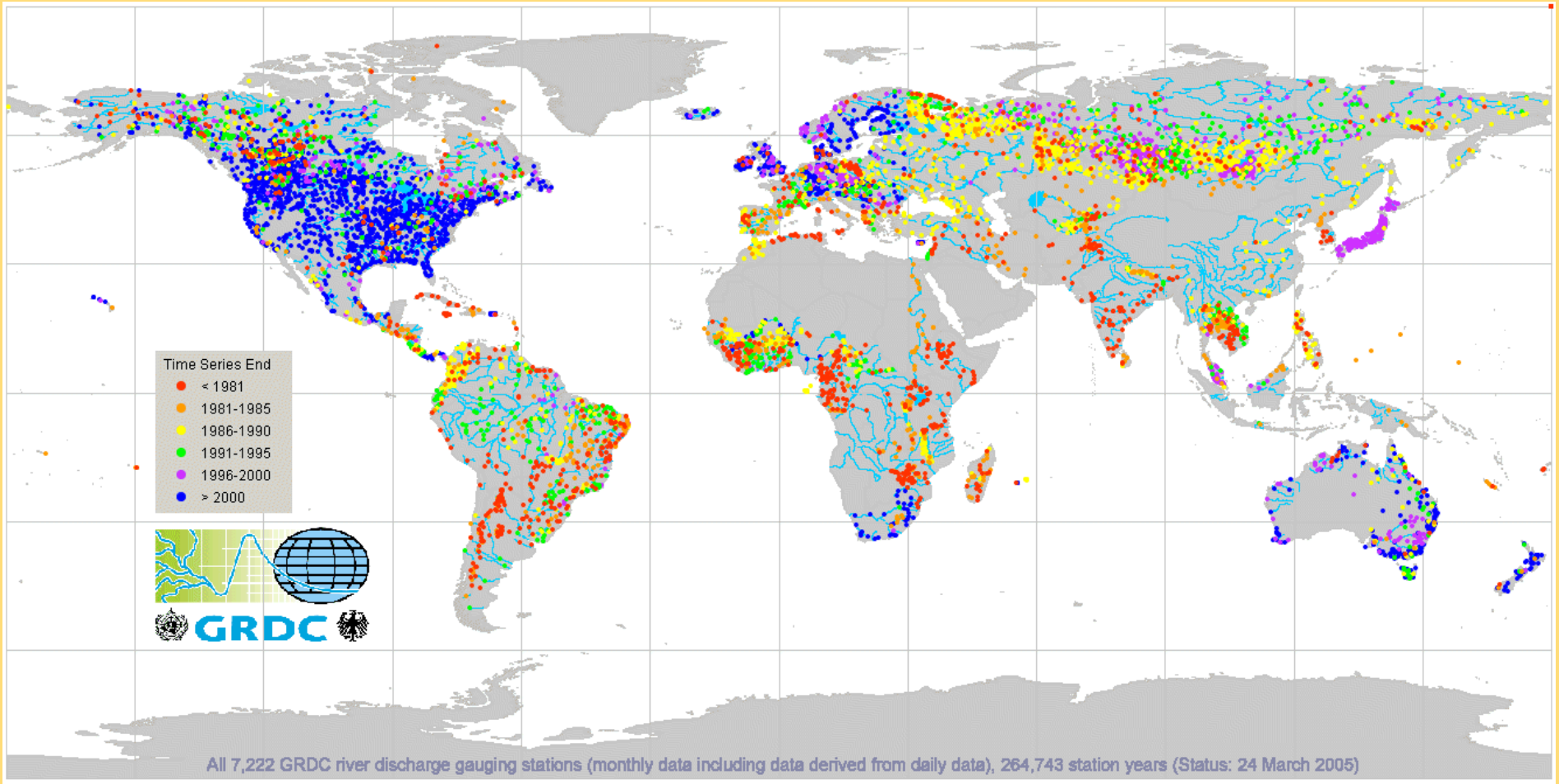
**collection and dissemination of discharge data**

supported by
WMO Resolutions
21 (Cg XII, 1995)
25 (Cg XIII, 1999)

# Increase of GRDC Data (Station-Years)



# 7222 GRDC Discharge Data Stations



# Research Cooperations (finalised)

Assessment of global annual runoff using Total Runoff Integrating Pathways (TRIP) (cooperation with Institute of Industrial Science, University of Tokyo)


**Oki, T., Musiake, K., Matsuyama, H. and Masuda, K.** (1995): Global Atmospheric Water Balance and Runoff from Large River Basins. *Hydrological Processes*, 9: 655-678.

**Oki, T., Kanae, S. and Musiake, K.** (1996): Water cycle in large river basins of the earth estimated by atmospheric water balance and atmospheric general circulation model,. In: *International Conference on Water Resources and Environmental Research: Towards the 21st Century, II*, pp. 547-554, Kyoto

**Oki, T., Nishimura T., and Dirmeyer, P.** (1999): Assessment of annual runoff from land surface models using Total Runoff Integrating Pathways (TRIP), J. Meteor. Soc. Japan, 77, 235-255


Contribution to the development of the Global Water Assessment and Prognosis model WaterGAP (cooperation with the Center for Environmental Systems Research, University of Kassel, Germany)


**Döll, P., Kaspar, F. and Lehner, B.** (2003): A global hydrological model for deriving water availability indicators: model tuning and validation. *Journal of Hydrology*, 270: 105-134. - http://www.elsevier.com/locate/jhydrol

**Döll, P., Alcamo, J., Henrichs, T., Kaspar, F., Lehner, B., Rösch, T. and Siebert, S.** (2003): The global integrated water model WaterGAP2.1. In: *EuroWasser*, *Kassel World Water Series*, 5, pp. 18. University of Kassel, Kassel. - http://www.usf.uni-kassel.de/usf/archiv/dokumente/kwws/5/ew_2_watergap_low.pdf


Development of Global Composite Gridded Runoff Fields (cooperation with University of New Hampshire, USA)


**Fekete, B.M., Vorosmarty, C.J. and Grabs, W.** (1999): *UNH-GRDC Global Composite Runoff Fields on Observed River Discharge and Simulated Water Balances*. GRDC resports, 22. Global Runoff Data Centre, Koblenz.

# UNH-GRDC

Welcome to

## UNH / GRDC
## Composite Runoff Fields V 1.0

ISEOS

GRDC

Balázs M. Fekete
Charles J. Vörösmarty
Wolfgang Grabs

BfG

- Report and Supporting Documentation
- Station Data Explorer
- Basin Data Explorer
- Runoff Data Explorer
- Data Download (Monitoring Stations, River Networks & Runoff Fields)

**Database Supporters**

WMO UNESCO IGBP

**Co-sponsors**

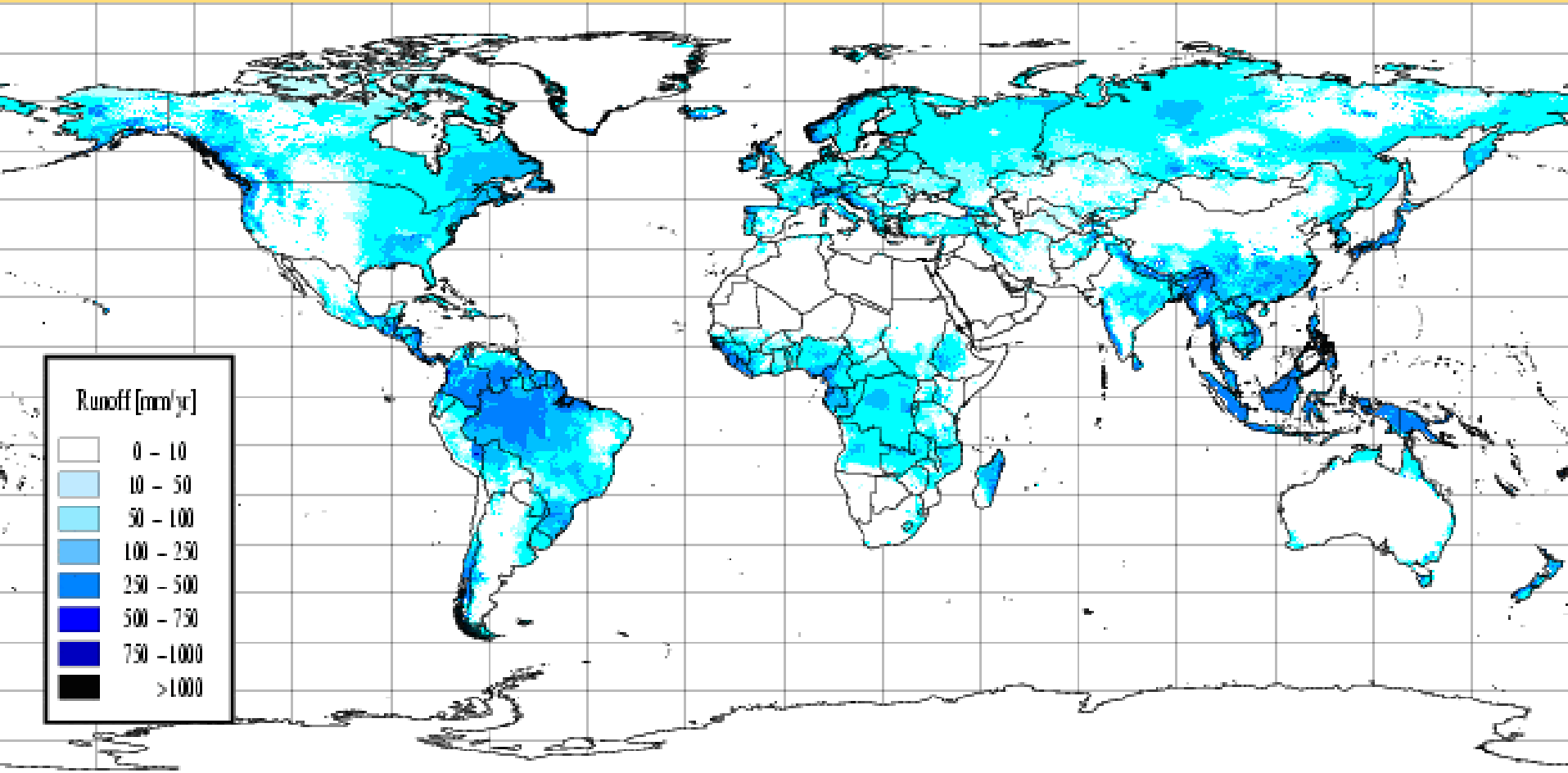
NASA NSF US COMMITTEE ON SCIENTIFIC HYDROLOGY

Return to Water Systems Research Group Home Page

watsys@unh.edu

http://www.grdc.sr.unh.edu

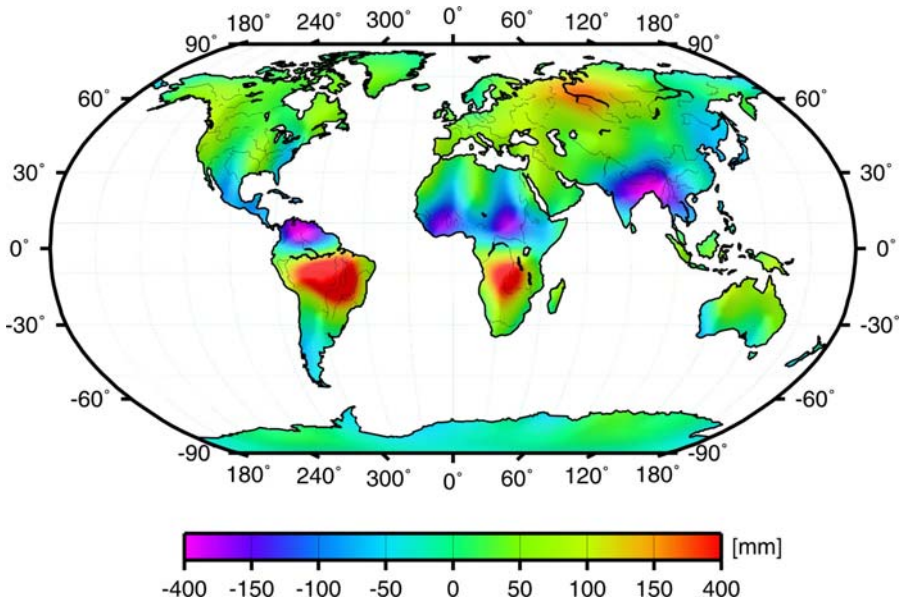
# Mean annual runoff [mm/a]

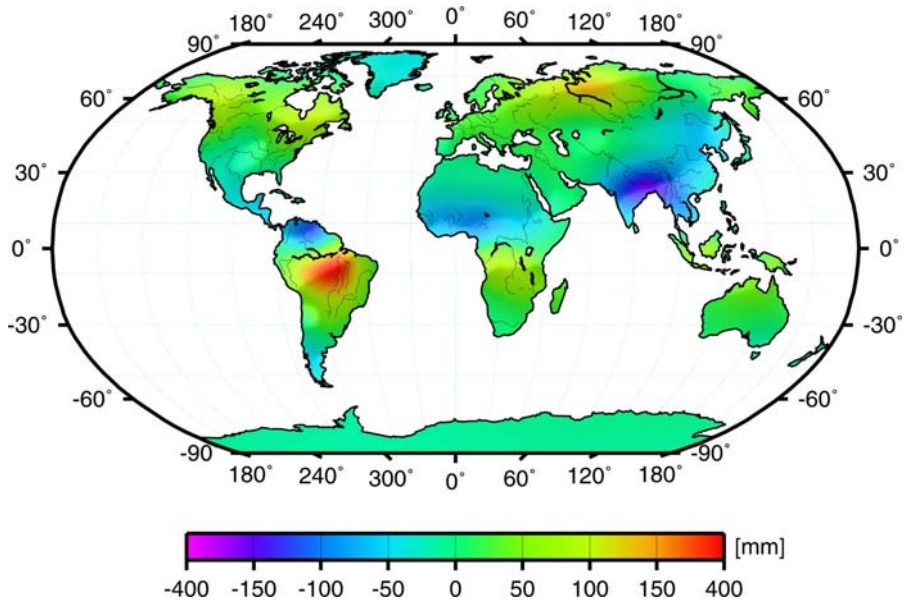


# Research Cooperations (ongoing)

Large scale variation of the continental water storage – modeling and remote sensing (under consideration of GRACE gravity field data, with GeoForschungsZentrum, Potsdam, Germany)

# GFZ Potsdam: Large-scale variations of the terrestrial water storage - Comparing global hydrological models and remote sensing data from GRACE




(April/May 2003 minus Aug. 2003)

**GRACE** **WGHM**

Seasonal changes (between the months of maximum and minimum storage) of the total terrestrial water storage, simulated on a 0.5° global grid with the model WGHM (all data spatially averaged with Gaussian filter of 750km averaging radius)

(See also http://www.gfz-potsdam.de/pb5/pb54/Html/projects/GRACE_hydrology.html)

# GRDC Data Product

**Long Term Mean Annual Freshwater Surface Water Fluxes into the World Oceans (Version 3):**

- Discharge from catchment through each 1/2° coastline grid cell (11.853 cells)
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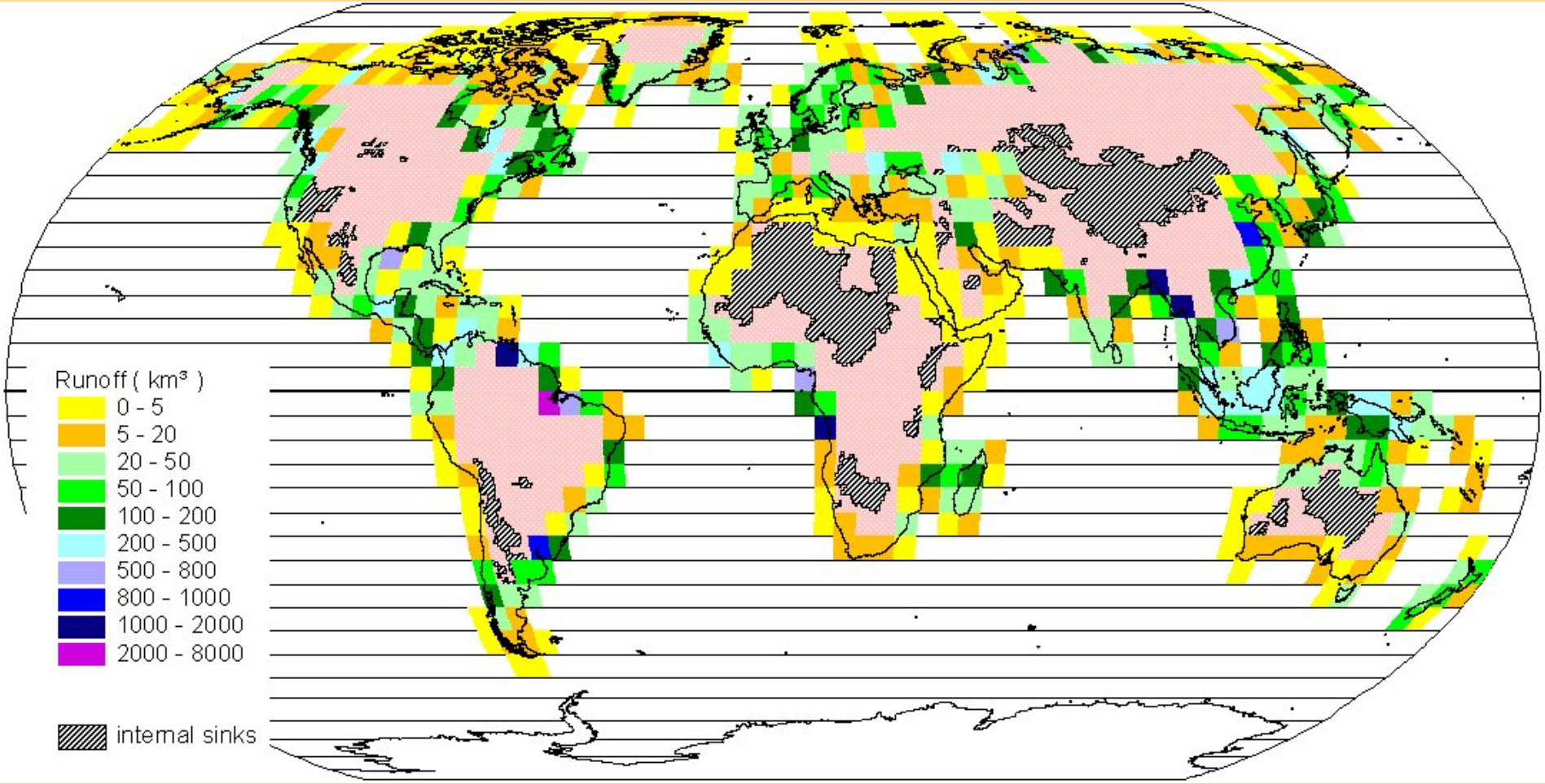

# GRDC (2004) estimated long term mean annual runoff volume from GRDC estimated hinterland catchment areas of coastal zones in km³/a

(1 km³/a = 31.688 m³/s = 0.0000316881 Sv)

| | EUR | ASI | AFR | AUS | NAM | SAM | ANT | LAND | NAM | SAM | ATL | EUR | ASI | AFR | NAM | EUR | ASI | NPO | ASI | AUS | PAC | NAM | SAM | NPO | ATL | IND | PAC | SEA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LATID | Sum Continents | | | | | | | | EaC | | WeC | EaC | WeC | | NoC | | | SoC | EaC | | WeC | WeC | WeC | Sum Coasts | | | | |
| N 90-85 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| 85-80 | 53 | 4 | | | 8 | | | 65 | 0 | | 0 | | | | 8 | 53 | 4 | 65 | | | | | | 65 | 0 | | | 65 |
| 80-75 | 36 | 34 | | | 18 | | | 88 | 0 | | 0 | 0 | 0 | | 18 | 36 | 34 | 88 | | | | | | 88 | 0 | | | 88 |
| 75-70 | 102 | 1552 | | | 84 | | | 1738 | 6 | | 6 | 0 | 0 | | 78 | 102 | 1552 | 1732 | | | | | | 1732 | 6 | | | 1738 |
| 70-65 | 641 | 761 | | | 510 | | | 1913 | 49 | | 49 | 322 | 322 | | 461 | 319 | 755 | 1535 | 7 | | 7 | 0 | 0 | 1535 | 371 | | 7 | 1913 |
| 65-60 | 538 | 163 | | | 607 | | | 1308 | 140 | | 140 | 382 | 382 | | 284 | 156 | 4 | 444 | 159 | | 159 | 184 | 184 | 444 | 522 | | 343 | 1308 |
| 90-60 | 1370 | 2515 | | | 1227 | | | 5112 | 195 | | 195 | 704 | 704 | | 849 | 666 | 2349 | 3863 | 166 | | 166 | 184 | 184 | 3863 | 899 | | 350 | 5112 |
| 60-55 | 422 | 150 | | | 814 | | | 1386 | 423 | | 423 | 422 | 422 | | | | | | 150 | | 150 | 391 | 391 | | 845 | | 541 | 1386 |
| 55-50 | 317 | 441 | | | 834 | | | 1591 | 551 | | 551 | 317 | 317 | | | | | | 441 | | 441 | 283 | 283 | | 868 | | 724 | 1591 |
| 50-45 | 457 | 42 | | | 1134 | | | 1633 | 677 | | 677 | 457 | 457 | 0 | ASI | AFR | IND | ASI | AUS | 42 | | 42 | 458 | 458 | | 1133 | | 500 | 1633 |
| 45-40 | 407 | 158 | | | 208 | | | 773 | 140 | | 140 | 407 | 407 | 0 | EaC | | WeC | EaC | WeC | 158 | | 158 | 68 | 68 | | 547 | | 226 | 773 |
| 40-35 | 110 | 425 | 17 | | 134 | | | 687 | 86 | | 86 | 132 | 110 | 5 | 17 | | | | | 421 | | 421 | 48 | 48 | | 218 | | 468 | 687 |
| 35-30 | | 1240 | 65 | | 188 | | | 1493 | 179 | | 179 | 66 | 0 | 1 | 65 | 2 | | 2 | | 1237 | | 1237 | 8 | 8 | | 246 | 2 | 1245 | 1493 |
| 60-30 | 1713 | 2456 | 82 | | 3311 | | | 7563 | 2055 | | 2055 | 1802 | 1713 | 6 | 82 | 2 | | 2 | | | 2448 | | 2448 | 1256 | 1256 | | 3857 | 2 | 3704 | 7563 |
| 30-25 | | 261 | 3 | | 660 | | | 924 | 644 | | 644 | 3 | | | 3 | 153 | 0 | 153 | | | 108 | | 108 | 17 | 17 | | 647 | 153 | 125 | 924 |
| 25-20 | | 2578 | 0 | | 193 | | | 2771 | 167 | | 167 | 0 | | | 0 | 0 | 0 | 0 | 1975 | 1975 | 602 | | 602 | 26 | 26 | | 167 | 1975 | 628 | 2771 |
| 20-15 | | 1534 | 34 | | 584 | | | 2152 | 521 | | 521 | 33 | | | 33 | 0 | 1 | 1 | 1306 | 1306 | 228 | | 228 | 63 | 63 | | 554 | 1307 | 292 | 2152 |
| 15-10 | | 497 | 60 | | 147 | 282 | | 985 | 97 | 282 | 379 | 59 | | | 59 | 0 | 2 | 2 | 101 | 101 | 396 | | 396 | 50 | 50 | 0 | 437 | 102 | 445 | 985 |
| 10-5 | | 941 | 401 | | 171 | 1702 | | 3215 | 81 | 1636 | 1717 | 400 | | | 400 | 0 | 1 | 1 | 129 | 129 | 812 | | 812 | 156 | 90 | 66 | 2117 | 131 | 967 | 3215 |
| 5-0 | | 1003 | 583 | | | 351 | | 1938 | | 162 | 162 | 581 | | | 581 | | 3 | 3 | 306 | 306 | 698 | | 698 | 189 | | 189 | 742 | 309 | 887 | 1938 |
| 30-0 | | 6813 | 1082 | | 1755 | 2334 | | 11985 | 1510 | 2079 | 3589 | 1075 | | | 1075 | 153 | 7 | 160 | 3817 | 3817 | 2844 | | 2844 | 500 | 245 | 255 | 4665 | 3977 | 3344 | 11985 |
| N 90-0 | 3083 | 11784 | 1165 | | 6294 | 2334 | | 24660 | 3761 | 2079 | 5840 | 3581 | 2417 | 6 | 1158 | 155 | 7 | 162 | 3817 | 3817 | 5458 | | 5458 | 1939 | 1685 | 255 | 3863 | 9421 | 3979 | 7397 | 24660 |
| S 0-5 | | 1673 | 264 | 339 | | 7735 | | 10011 | | 7673 | 7673 | 236 | | | 236 | | 28 | 28 | 107 | 107 | 0 | 1566 | 339 | 1905 | 61 | | 61 | | 7909 | 136 | 1967 | 10011 |
| 5-10 | | 388 | 1509 | 503 | | 34 | | 2434 | | 22 | 22 | 1473 | | | 1473 | | 36 | 36 | 92 | 92 | 0 | 296 | 503 | 799 | 13 | | 13 | | 1494 | 128 | 811 | 2434 |
| 10-15 | | 2 | 105 | 172 | | 115 | | 394 | | 112 | 112 | 16 | | | 16 | | 89 | 89 | 8 | 2 | 6 | | 166 | 166 | 4 | | 4 | | 128 | 97 | 169 | 394 |
| 15-20 | | | 454 | 182 | | 80 | | 716 | | 74 | 74 | 5 | | | 5 | | 448 | 448 | 35 | | 35 | | 148 | 148 | 6 | | 6 | | 79 | 483 | 154 | 716 |
| 20-25 | | | 103 | 41 | | 63 | | 208 | | 63 | 63 | 2 | | | 2 | | 101 | 101 | 4 | | 4 | | 37 | 37 | 0 | | 0 | | 66 | 105 | 37 | 208 |
| 25-30 | | | 60 | 26 | | 35 | | 121 | | 33 | 33 | 6 | | | 6 | | 54 | 54 | 1 | | 1 | | 25 | 25 | 2 | | 2 | | 39 | 55 | 27 | 121 |
| 0-30 | | 2064 | 2495 | 1264 | | 8063 | | 13885 | | 7977 | 7977 | 1739 | | | 1739 | | 757 | 757 | 248 | 202 | 46 | 1862 | 1217 | 3079 | 86 | | 86 | | 9716 | 1004 | 3165 | 13885 |
| 30-35 | | | 30 | 66 | | 1009 | | 1105 | | 990 | 990 | 10 | | | 10 | | 20 | 20 | 45 | | 45 | | 21 | 21 | 20 | | 20 | | 1000 | 66 | 40 | 1105 |
| 35-40 | | | | 130 | | 219 | | 348 | | 130 | 130 | | | | | | | | 3 | | 3 | | 127 | 127 | 89 | | 89 | | 130 | 3 | 216 | 348 |
| 40-45 | | | | 184 | | 171 | | 355 | | 67 | 67 | | | | | | | | 0 | | 0 | | 184 | 184 | 104 | | 104 | | 67 | 0 | 288 | 355 |
| 45-50 | | | 0 | 78 | | 64 | | 142 | | 15 | 15 | | | | | | 0 | 0 | | | | | 78 | 78 | 48 | | 48 | | 15 | 0 | 126 | 142 |
| 50-55 | | | | 0 | | 35 | | 35 | | 23 | 23 | | | | | | | | | | | | | | 12 | | 12 | | 23 | | 12 | 35 |
| 55-60 | | | | 0 | | 2 | | 2 | | 2 | 2 | | | | | | | | | | | | | | 0 | | 0 | | 2 | | 0 | 2 |
| 30-60 | | 0 | 30 | 458 | | 1500 | | 1988 | | 1227 | 1227 | 10 | | | 10 | | 20 | 20 | 48 | | 48 | | 410 | 410 | 273 | | 273 | | 1237 | 68 | 683 | 1988 |
| S 0-60 | | 2064 | 2525 | 1722 | | 9563 | | 15873 | | 9204 | 9204 | 1749 | | | 1749 | | 777 | 777 | 296 | 202 | 95 | 1862 | 1627 | 3489 | 359 | | 359 | | 10952 | 1073 | 3848 | 15873 |
| G 90-60 | 3083 | 13848 | 3690 | 1722 | 6294 | 11897 | | 40533 | 3761 | 11283 | 15044 | 5330 | 2417 | 6 | 2906 | 155 | 784 | 938 | 4113 | 4019 | 95 | 7320 | 1627 | 8947 | 2299 | 1685 | 614 | 3863 | 20373 | 5051 | 11245 | 40533 |

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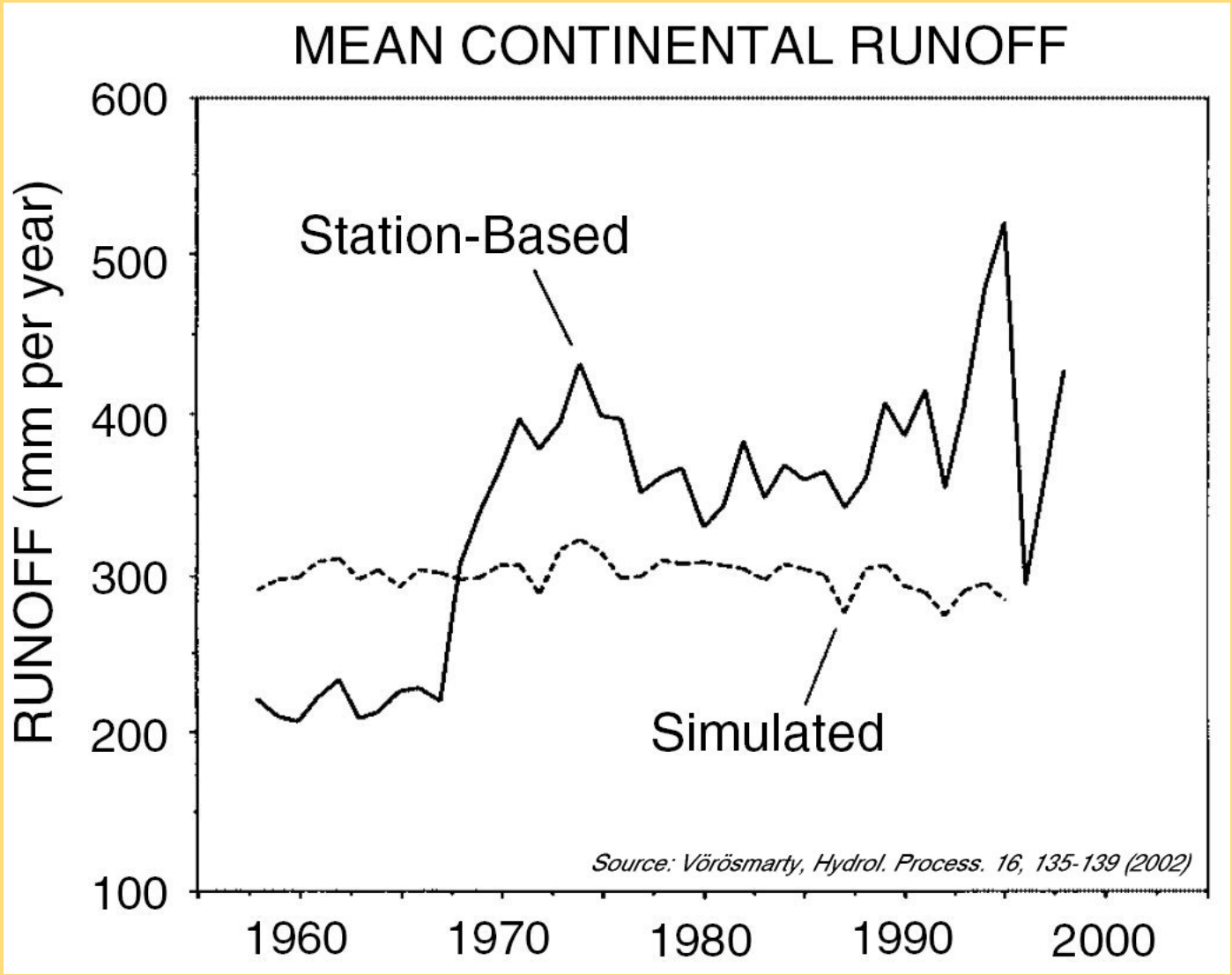
**Desired by research community: higher temporal resolution:**

- Long term monthly mean
- Time series of annual means
- Time series of monthly means
- Near real time estimates

# Global change, the water cycle, and our search for a (hydrological) Mauna Loa



# Updated GRDC Data Product

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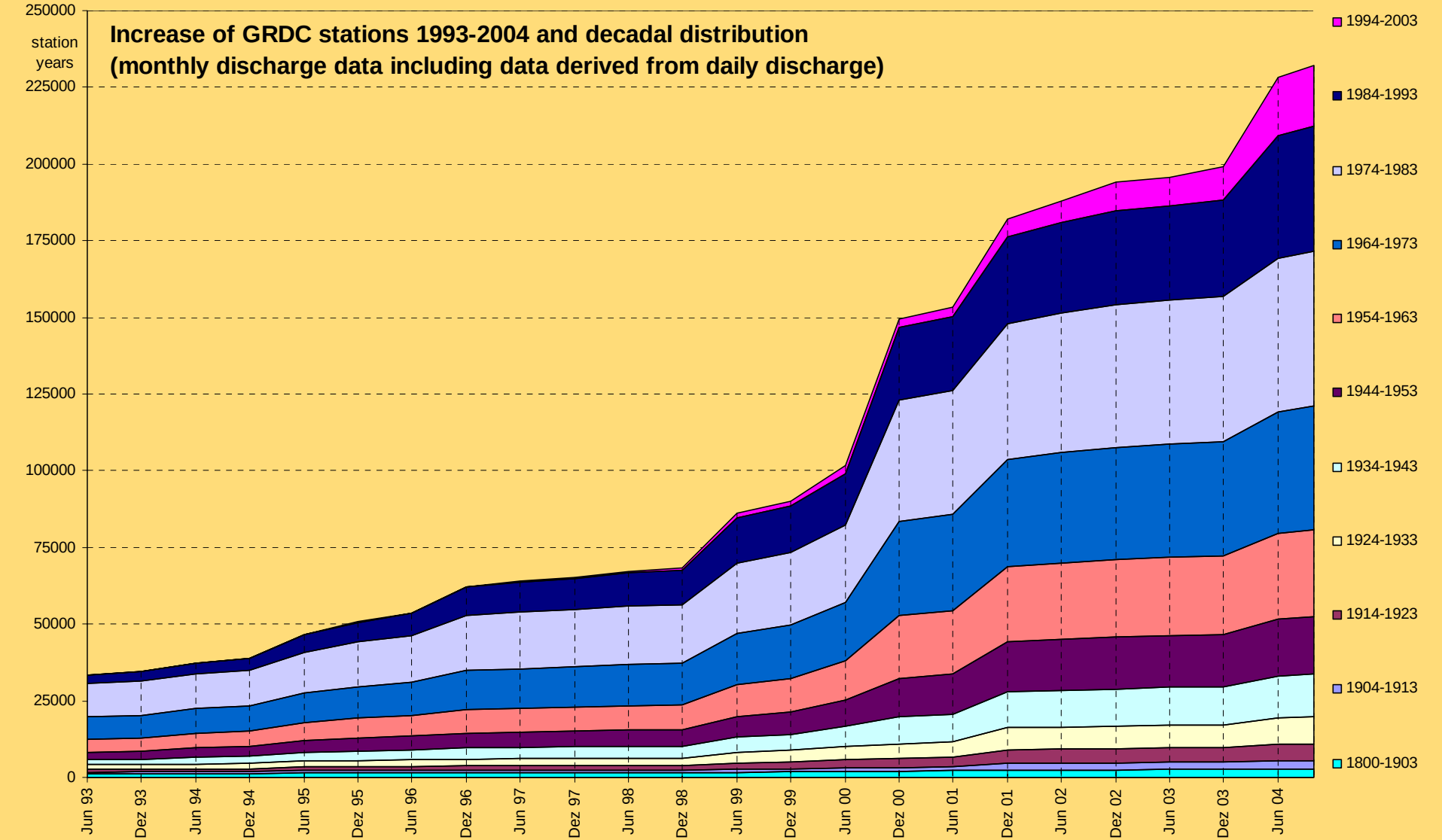
**Desired by research community: higher temporal resolution:**

- Long term monthly mean
- Time series of annual means
- Time series of monthly means
- Near real time estimates

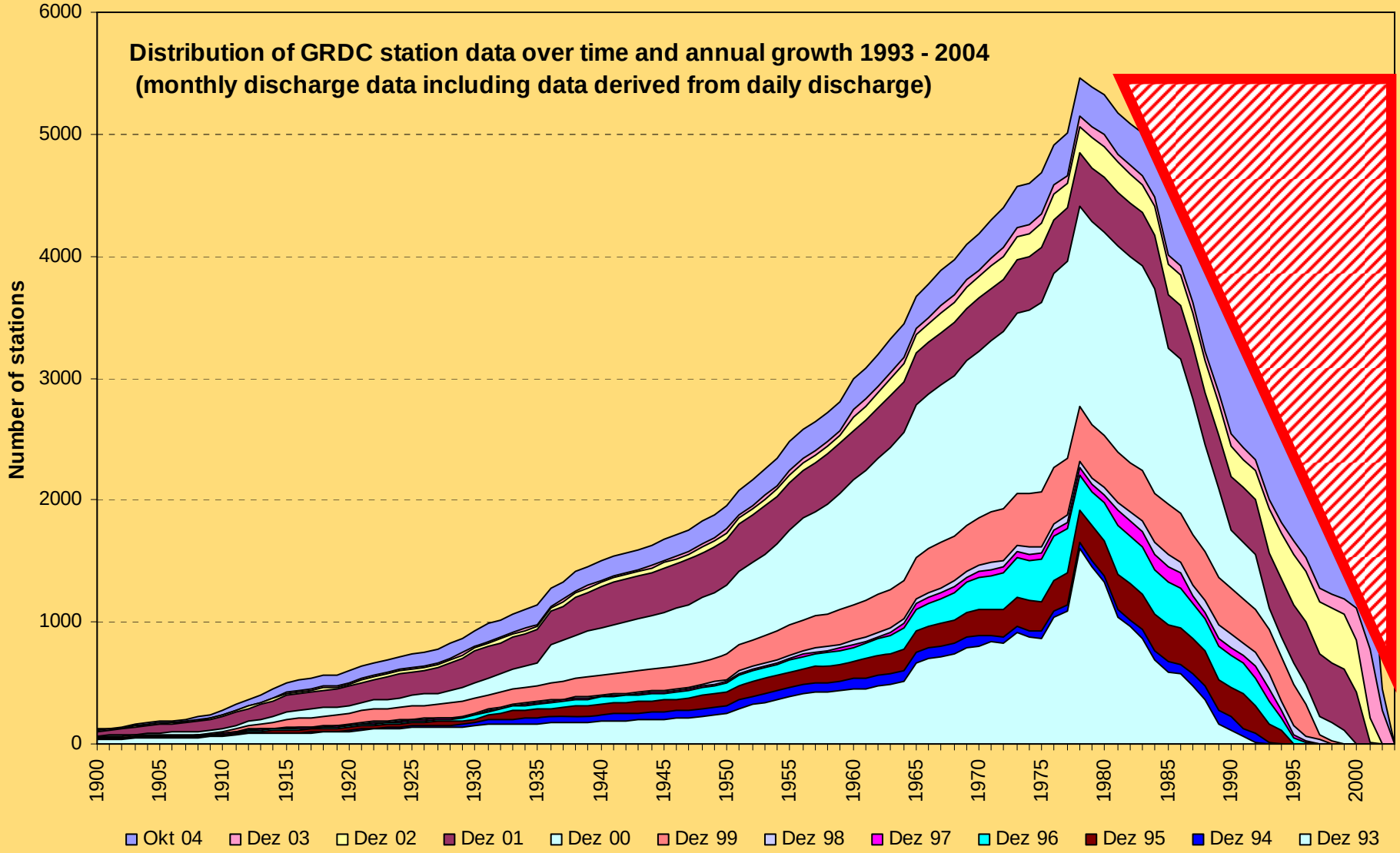
**This inevitably requires:**

- better global coverage with discharge stations
- more up-to-date data

# Increase of GRDC Data (Station-Years)

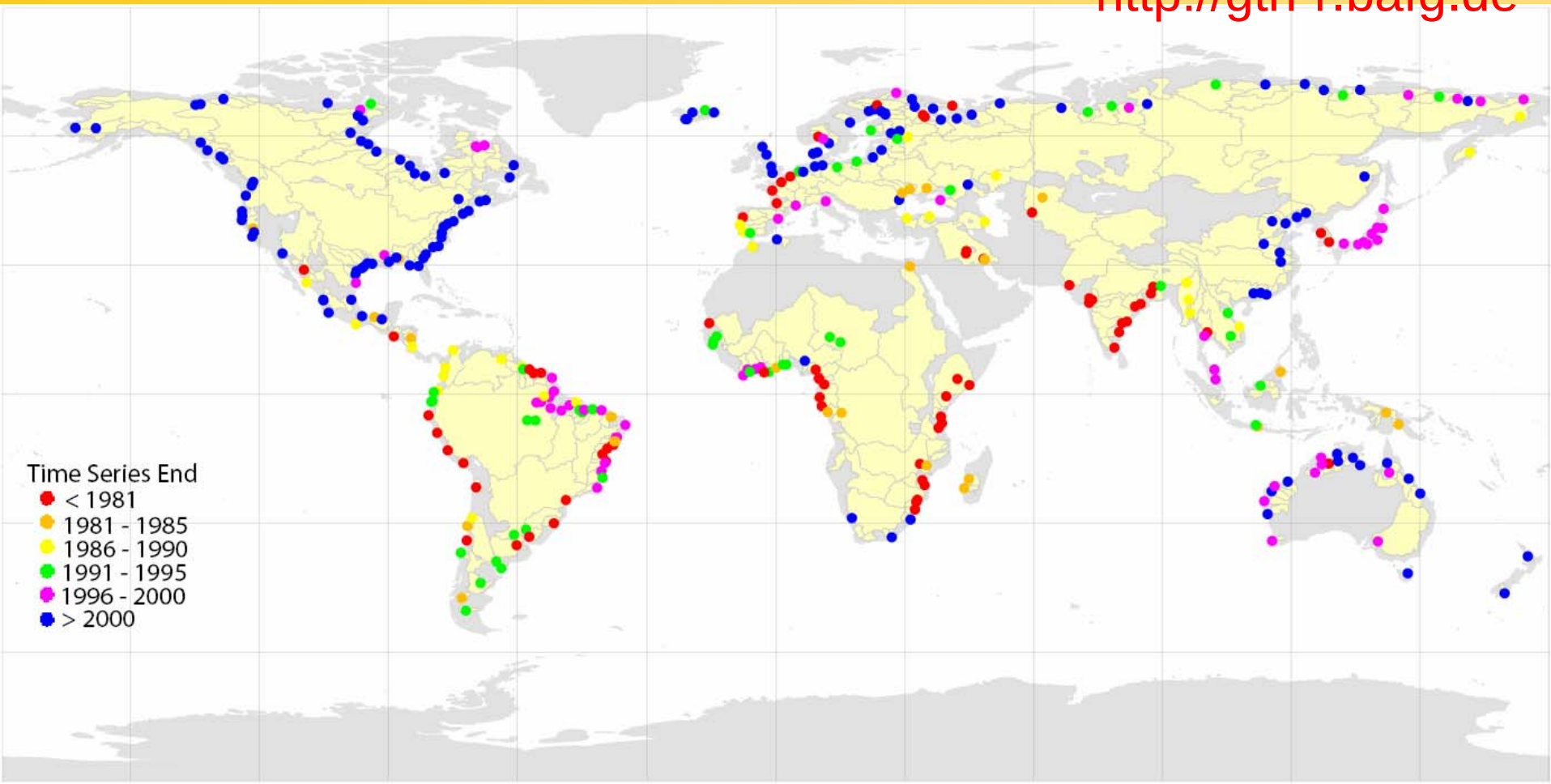


# Distribution of GRDC stations data over time



# Global Terrestrial Network for River Discharge (GTN-R)

http://gtn-r.bafg.de




The 380 river discharge stations along the continental coastlines lie in 355 of the 391 basins depicted here (status Nov 2006). The colour code indicates the latest data available in the GRDC database. (It well may be that many of the stations listed feature more up-to-date data which, however, are currently only available at the National Hydrological Service (NHS) maintaining the station, but not (yet) in the GRDC database.)

# Global Terrestrial Network for River Discharge (GTN-R)

http://gtn-r.bafg.de

River discharge contribution to the GTN-H project sponsored by GCOS and HWRP of WMO

GCOS baseline river discharge network, supported by the Implementation Plan for the Global Observing Systems for Climate in Support of the UNFCCC

Basis for GRDC co-operation with the UN GEMS/Water Programme Office of UNEP/DEWA in Burlington/Ontario for biogeochemical flux computations

Basis for future versions of the GRDC product "Long Term Mean Annual Freshwater Surface Water Fluxes into the World Oceans“

Contribution to the real time river discharge data collection and dissemination system for the European Flood Alert System EFAS (see http://efas.jrc.it)

# Multifold problems on availability and access to hydrological data remain

## Organisation and authority

Authority over data and information often is scattered regionally and sectorally, especially in the hydrological domain.

## Efficiency of hierarchies and official reporting lines

Dilemma, that the person able to technically provide the required information is not authorised to forward it, while the person in charge may not respond to a request for reasons of

- little time and assigning low priority to the request in view of his excessive duties
- limited understanding of the necessity
- general reservation against sharing of information
- agrandising character

## Transient organisation structures

Responsibilities, people and technologies change over time. Given the spatial scale of the contract, this is likely to happen also during the two year period of the project.

## Scale of interest

Data owners, especially in the field of hydrology, often show little understanding and willingness of providing their information for supra-regional purposes not directly serving their original and immediate interests. This is especially true when serving a project that is regarded either

- as constituting a potential thread (if successful) or
- as being minor in quality to comparable national efforts (and assistance is thus regarded as wasted time)

## Data policy

Data may be regarded as classified information to protect national interests (e.g. security, autonomy, economy). Partly no willingness to even share metadata.

# Multifold problems on availability and access to hydrological data remain

## Finances and capacity

Little capacity may be a prime reason for little interest in cooperation.

- equipment
- manpower

## Culture and work ethic

Work ethic may differ. Commitment may cease at any time, even if a window of opportunity had already been opened.

## Language barriers

May hinder effective communication

## Data processing technology

Fragmented and heterogeneous approaches to data management, required data will be described in varying depth and provided in various formats

## Scientific rigour applied

Data/network may be in bad shape and the potential provider may feel ashamed to uncover this circumstance.

## Education and sensitivity for data needs and documentation (i.e. metadata)

Partly low sensitivity towards the need and benefit of a state-of-the-art metadata inventory and international data exchange.

# Thank you for your attention

=> Please visit http://grdc.bafg.de

and http://gtn-r.bafg.de


*~1000 pages reporting on most aspects of GRDC*