Loharinang Pala hydropower plant, Uttarakhand – en.Wikipedia.org

Science and Hydropower:

Can freshwater science help India realise its hydropower potential?

Dr. Gwyn Rees
Science Lead - Water Resources
Centre for Ecology & Hydrology

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Future Ganga: Science Needs for Water Security, New Delhi, 2-4 December 2015

Context: India's electricity demand

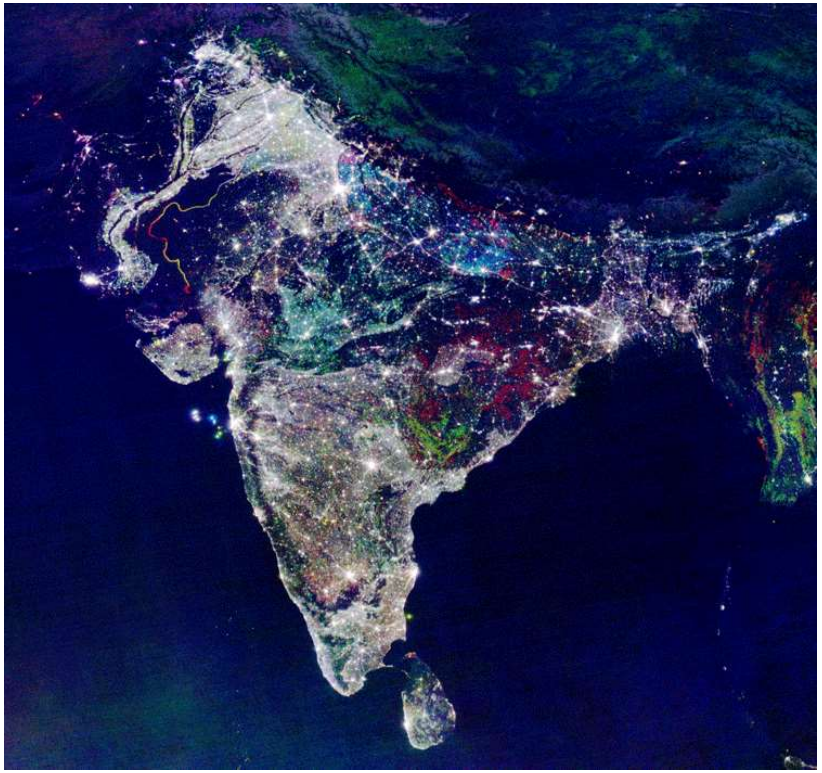
To sustain economic growth, India requires c.7% annual growth in electricity supply over the next few years[1]

Demand for electricity already outstrips supply: 4.2% deficit in 2013/14[1]

Over half of India's 1.2Billion people have no access to electricity[2]

India is under pressure to reduce carbon emissions…

GoI COP21 commitment: at least 40% of India's total power capacity will come from renewable sources by 2030[3]



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Sources;
(1) Hydropower in India – Key enablers for a better tomorrow, FICCI/PwC India, July 2014
(2) Over half of all Indians without electricity, BBC, 18 August 2013
(3) India's Energy Mix…, Business Standard, by Nithin Sethi, 22/09/2015

Why hydropower?

India has huge hydro potential – ranked 5th in the world - est. 148GW useable hydro potential

Only 33% of this potential has been tapped

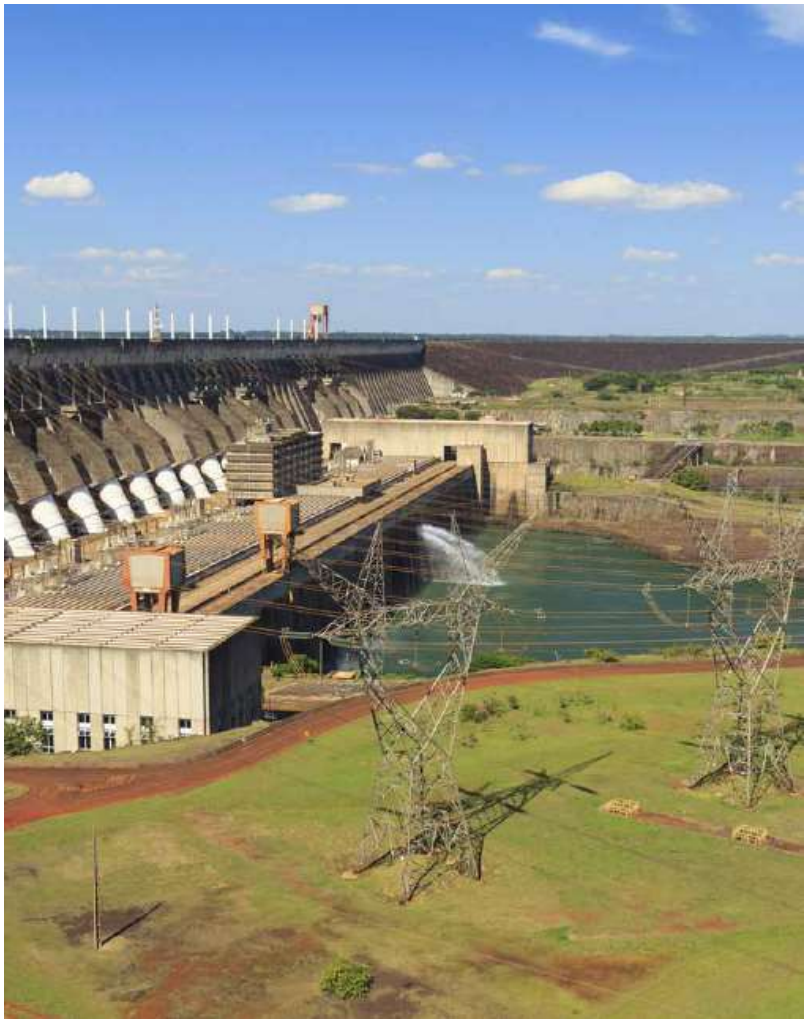
Important source to meet India's future needs!

Hydropower is a "clean" energy, with no GHG emissions

Reliable supply, meets peak demand and demand fluctuations

Long economic life, low maintenance costs, cost of generation reduces over time

Contributes to irrigation and flood control



Sources;

Hydropower in India – Key enablers for a better tomorrow, FICCI/PwC India, July 2014

Hydropower: Down to a trickle, The Indian Express, by Anil Sasi, 10/6/2015

The problems with hydropower…

Despite Government policies, targets & incentives… hydro's share of India's energy mix has declined since 1966

Barriers to hydro':

Inter-state disputes

Land acquisition/ land valuation problems

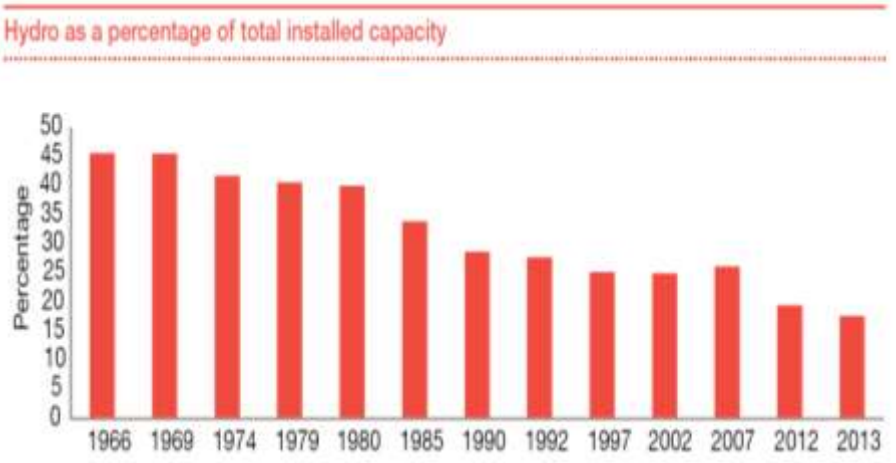
Resettlement & rehabilitation issues

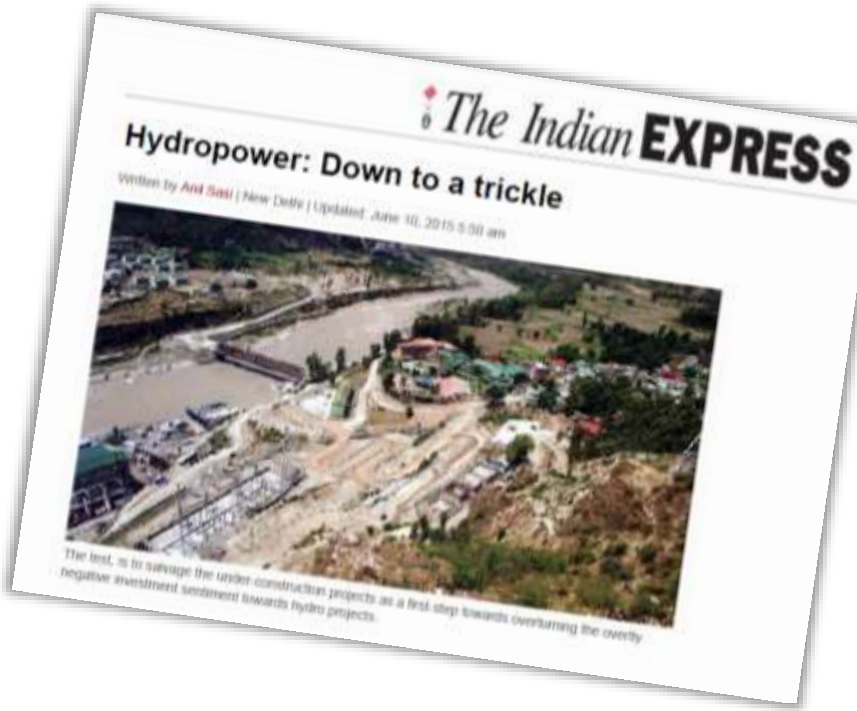
Long approval process

Lack of private investment & return

Spiritual concerns… *"The water (of the Ganges) is not ordinary water to a Hindu. It is a matter of life and death of Hindu faith"* *Prof. G.D Agrawal, formerly IIT-Kanpur, January 2009*

Environmental issues & concerns




The Indian EXPRESS

Hydropower: Down to a trickle

Written by Anil Sasi | New Delhi | Updated: June 10, 2015 5:50 am

The test, is to salvage the under-construction projects as a first step towards overturning the overly negative investment sentiment towards hydro projects.

Source; Hydropower in India – Key enablers for a better tomorrow, FICCI/PwC India, July 2014

Environmental issues and concerns

Geological hazards – earthquakes, landslides, (GLOFs) …especially in the Himalayan region

Hydrological risk – flash- & extreme-floods, drought

Unreliable estimation of long-term water availability at ungauged sites

Uncertainty over climate change – monsoon, snow & ice, future river flows

Sediment accumulation & boulder flows

Environmental impact – on flora, fauna, deforestation

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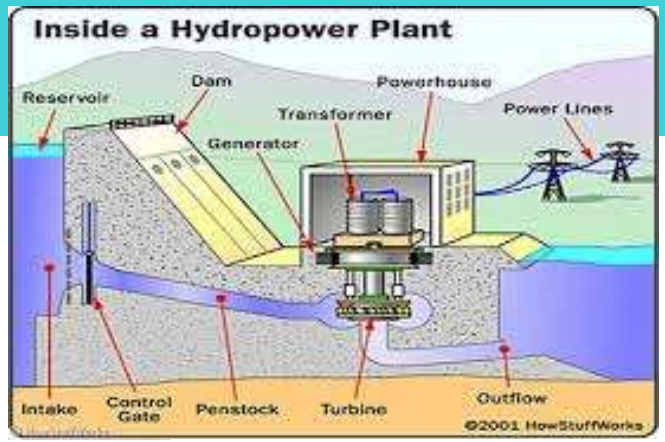
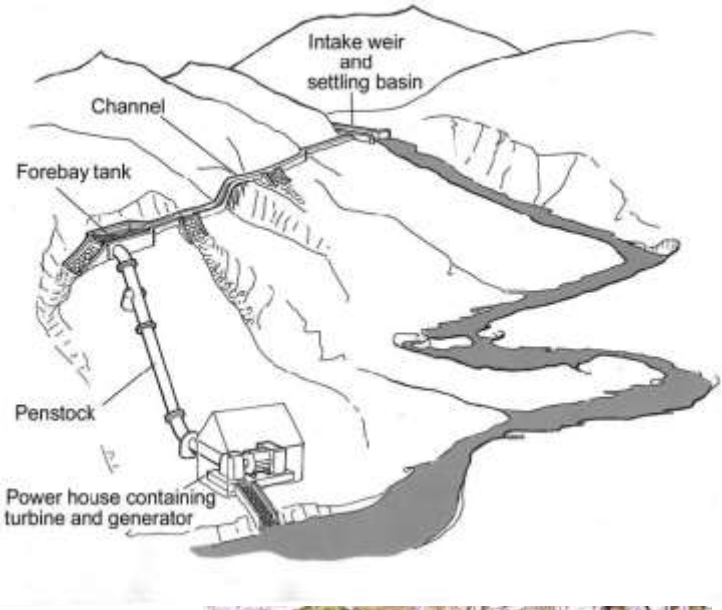
Types of hydropower

Type	Power output
Large	>25 MW
Small	2 – 25 MW
Mini	100kW – 2MW
Micro	< 100 kW

Source: GoI Ministry of New & Renewable Energy





MNRE Small Hydro Power (SHP) Programme:

"small hydropower projects can play a critical role in improving the overall energy scenario of the country and in particular for remote and inaccessible areas. The Ministry is encouraging development of small hydro projects both in the public as well as private sector"

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How can freshwater sciences help?

Develop the understanding, tools and guidance to…

- better inform policy makers of the extent and limit of HEP opportunities
- help developers identify suitable locations for new schemes
- appropriately design schemes & associated infrastructure (roads, transmission, etc)…
- minimise environmental impact
- minimise impact on local people
- minimise risk & maximise return to investors

What science is needed?

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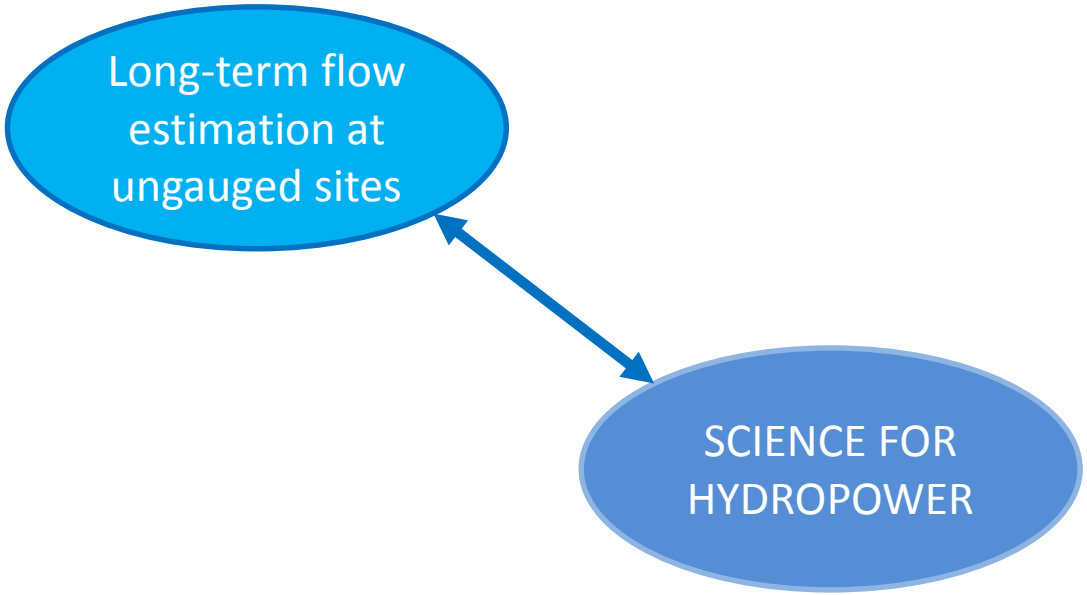
What science is needed?



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What science is needed?

Long-term flow estimation at ungauged sites

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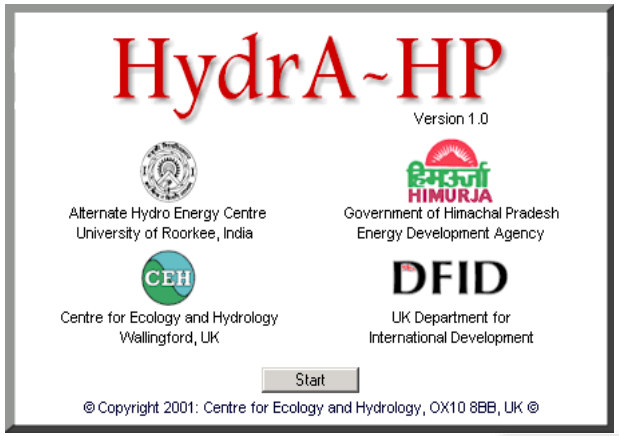
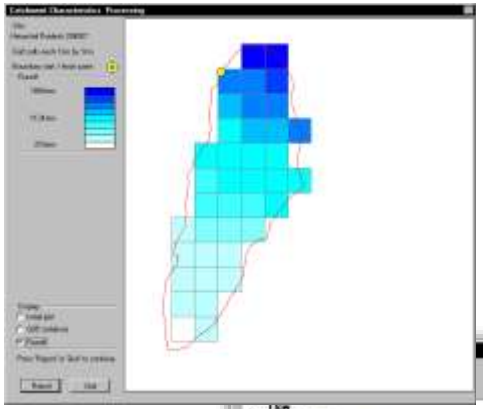
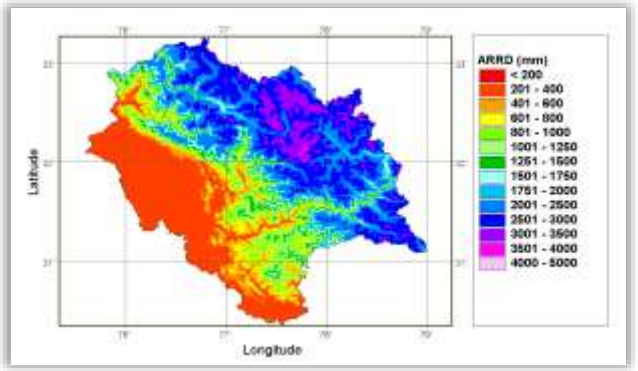
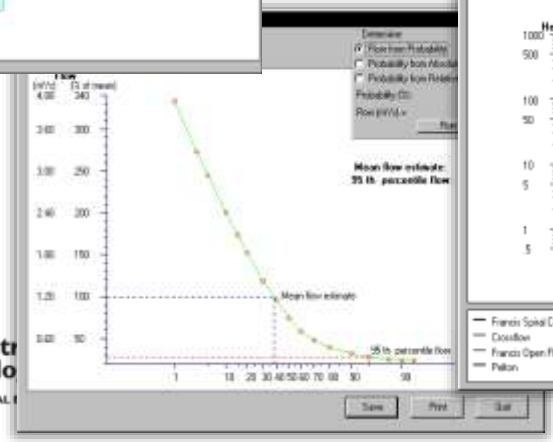
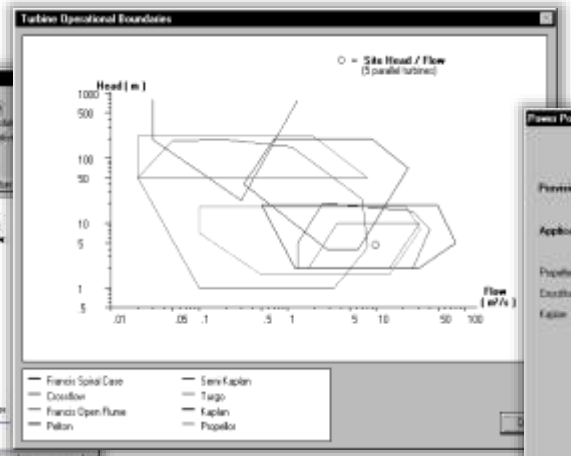
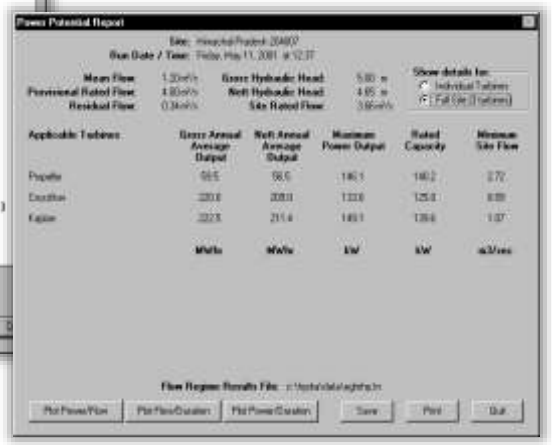






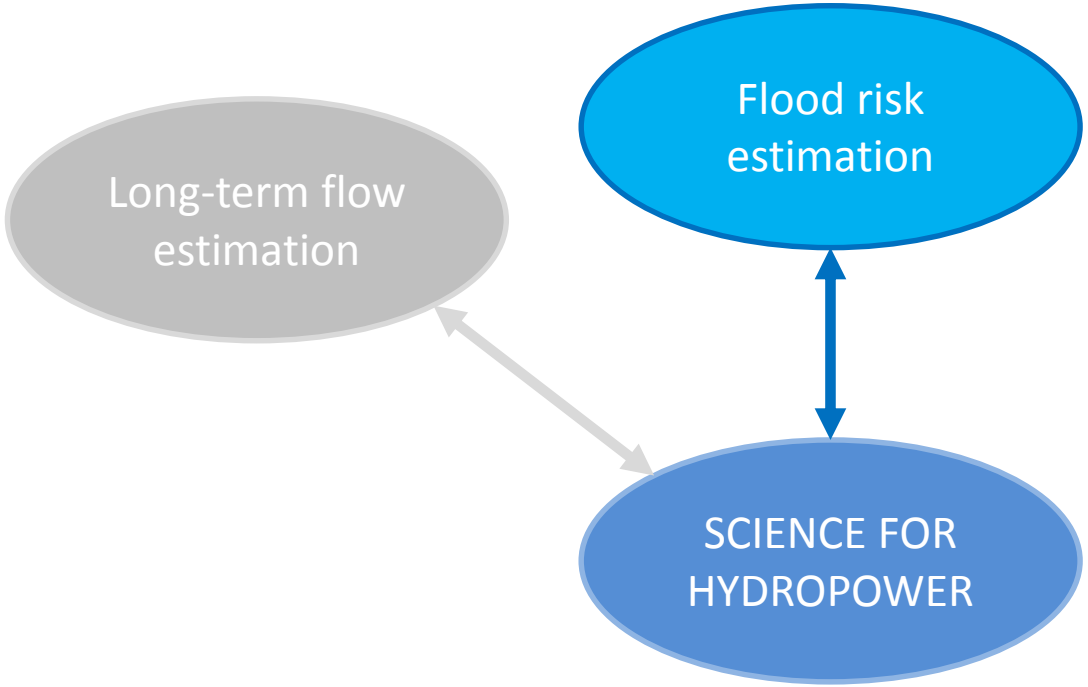






CEH

What science is needed?



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What science is needed?

Long-term flow estimation

Flood risk estimation

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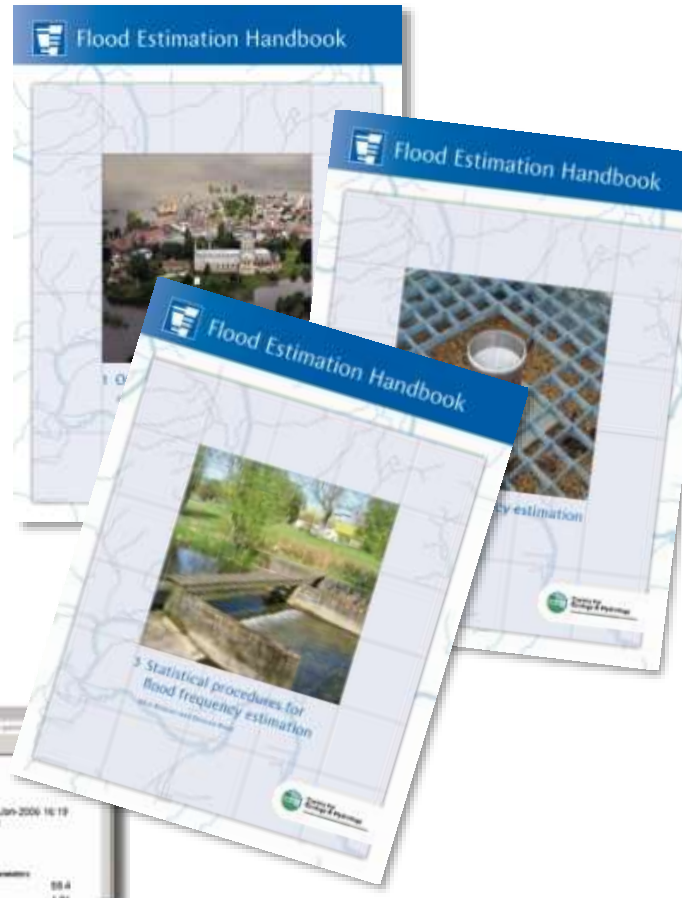

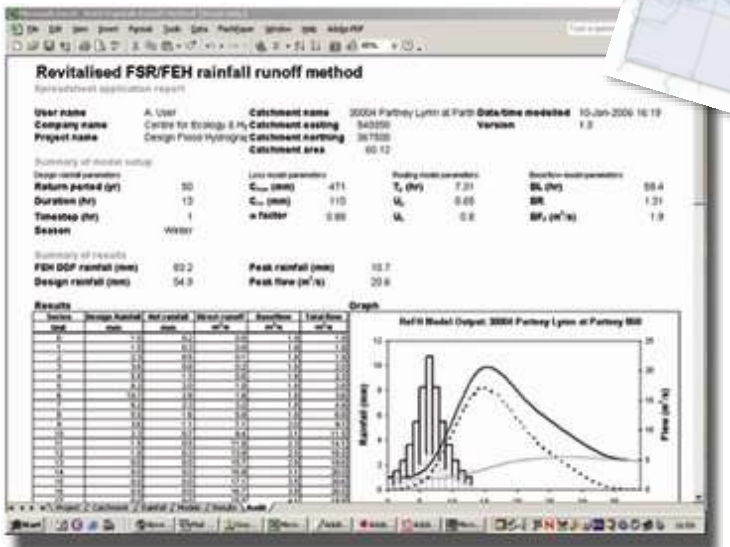

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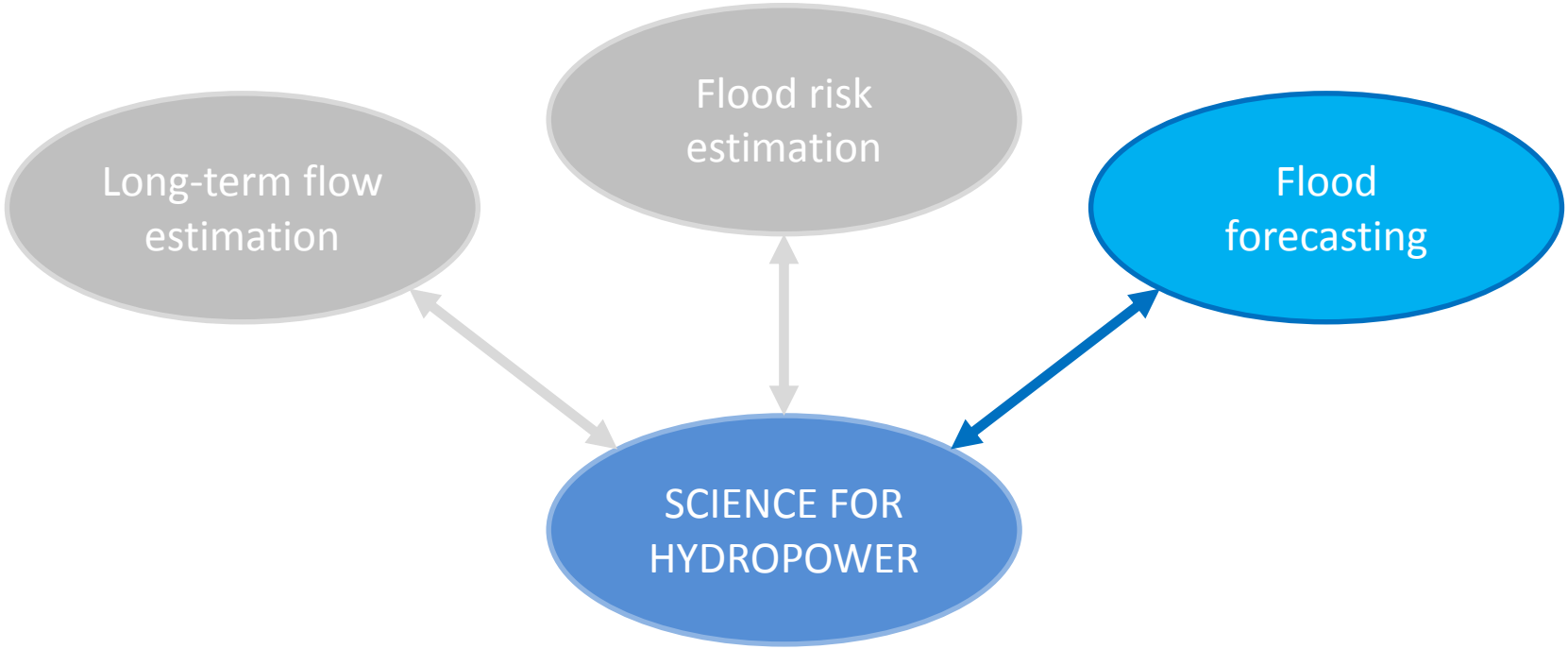

What science is needed?

Long-term flow estimation

Flood risk estimation

Flood forecasting

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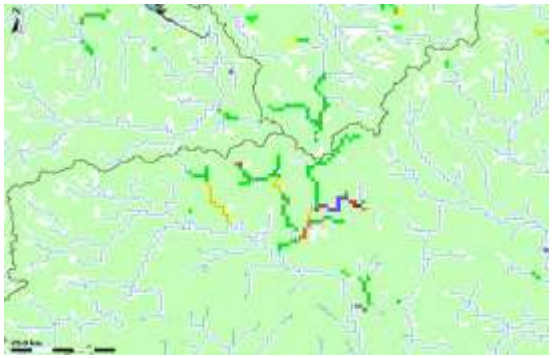
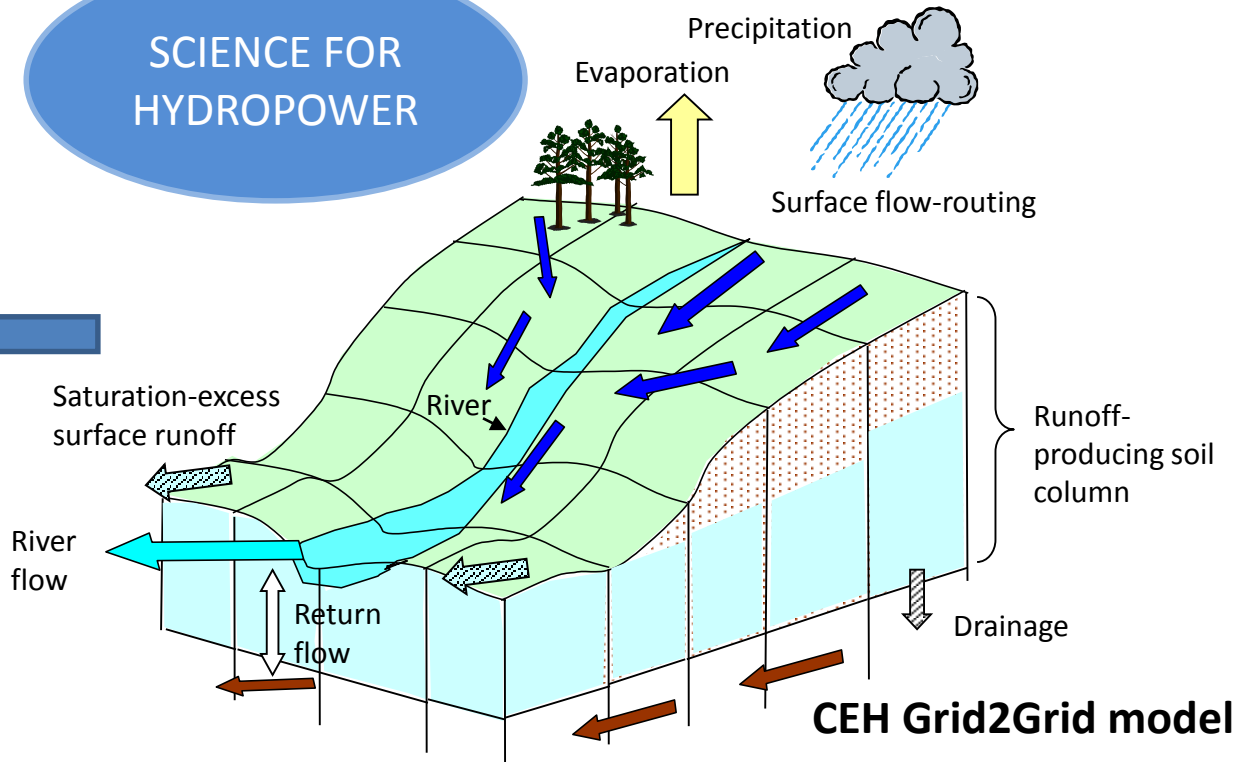


Real-time flood forecasts (used in UK by FFC & SFFS)



CEH Grid2Grid model

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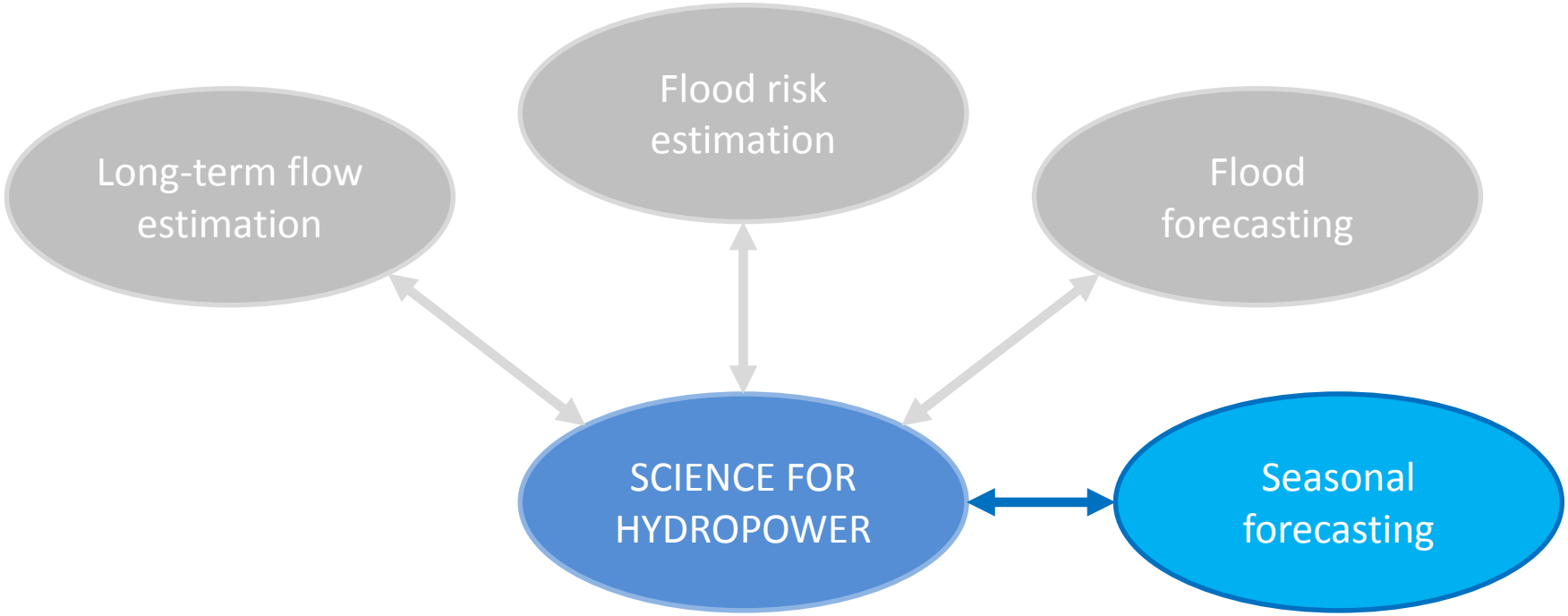
What science is needed?



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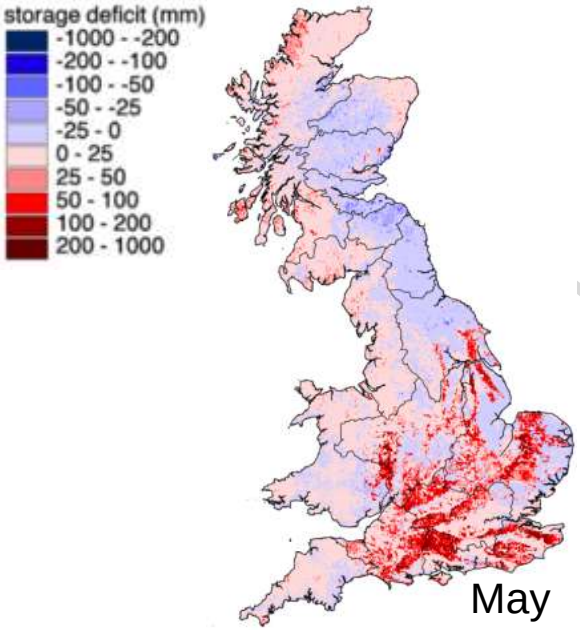

Tools for assessing the on-set & persistence of droughts

Flood risk estimation

1-3M UK-wide outlooks

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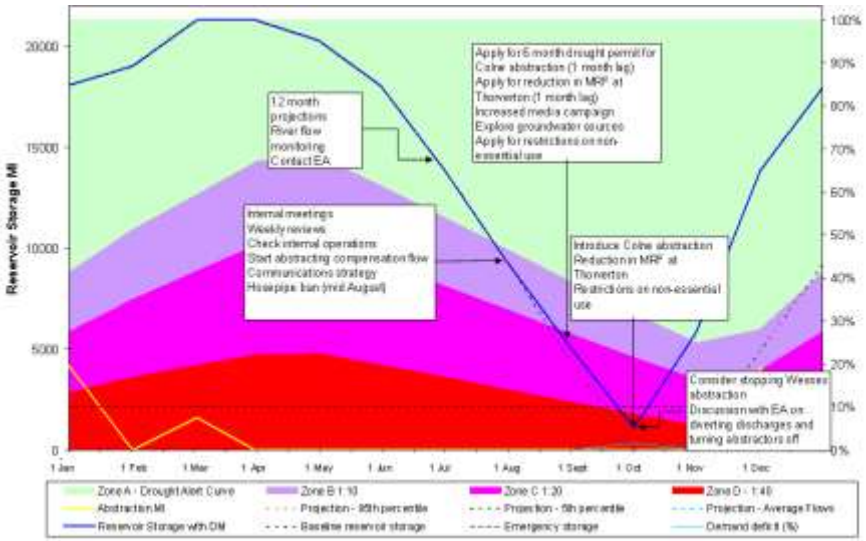
Seasonal forecasting



1-3M forecasts of reservoir level vs operating rules/thresholds

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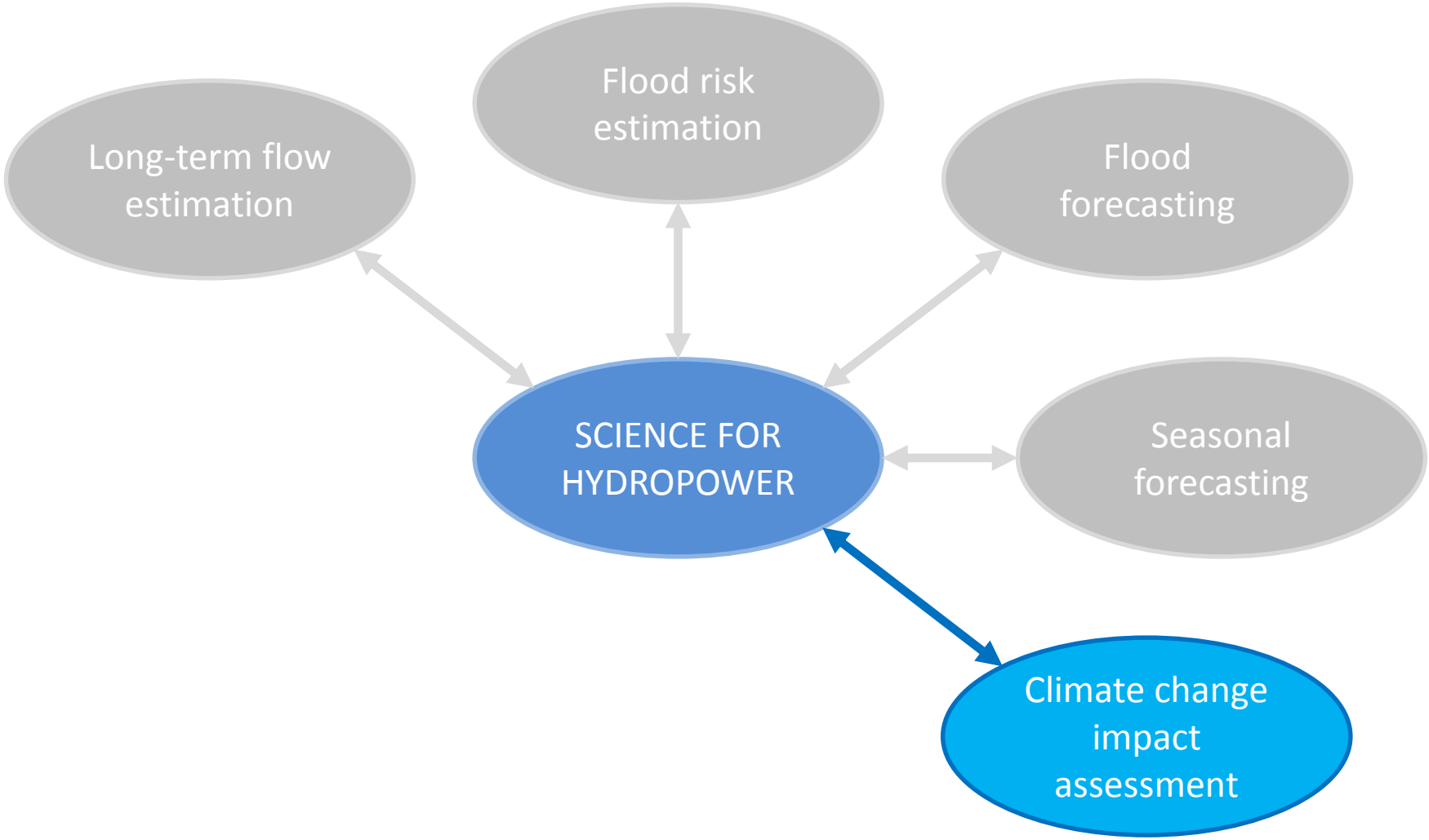

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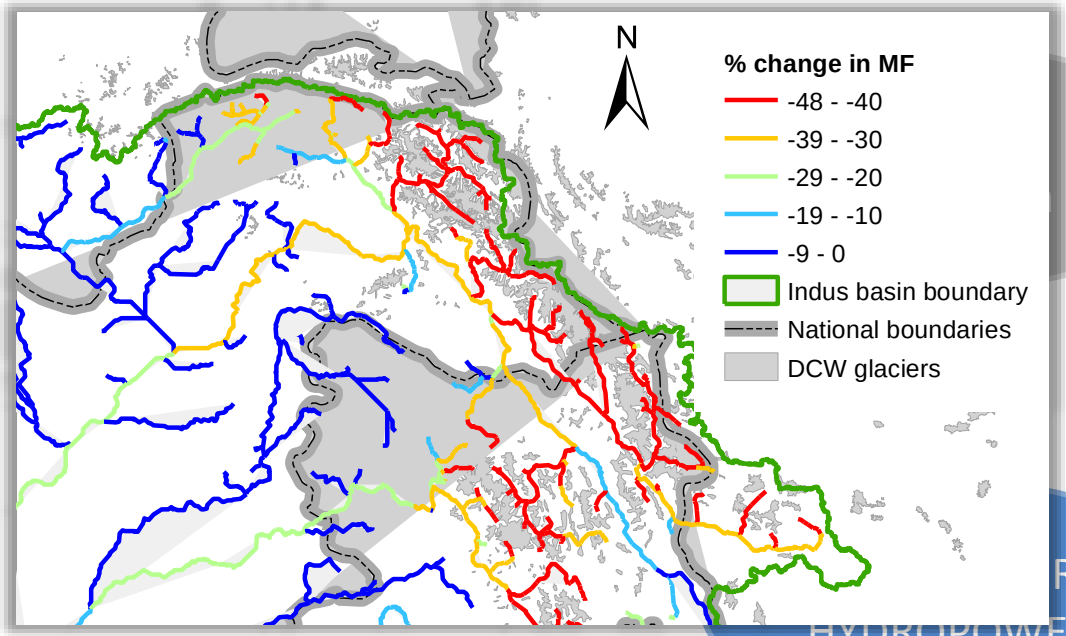
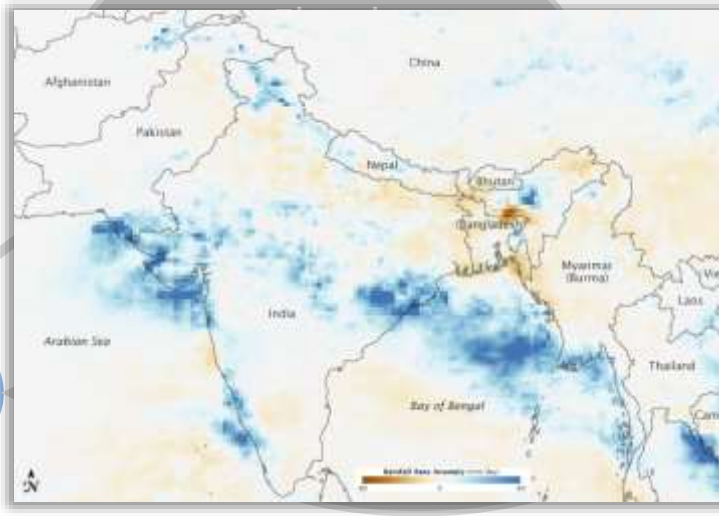
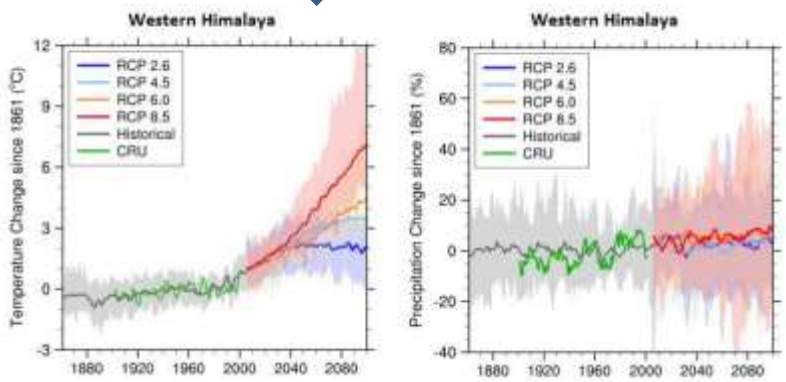


Impact of climatic warming on glacier-fed river flows

HYDROPOWER



NERC-MoES INCOMPASS: studying the dynamics of the Indian Monsoon



CMIP5 predictions of P & T anomalies to 2099 cf. 1961-1990 (Chaturvedi, et al. 2014)

Climate change impact assessment

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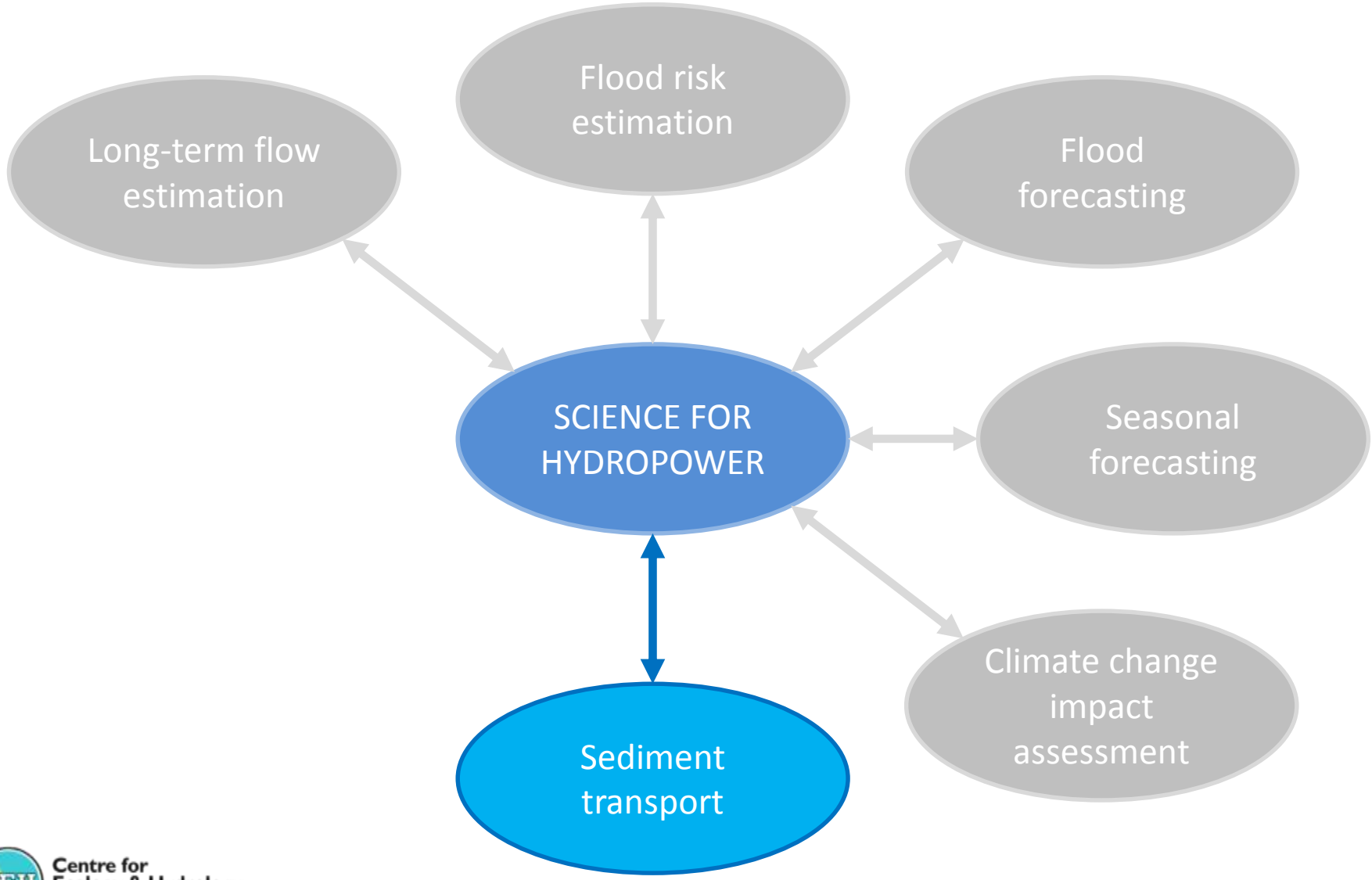
What science is needed?



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What science is needed?

Sediment accumulation: reduces storage capacity & life of HEP schemes

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Sediment transport

Degradation of downstream geomorphology & ecosystem

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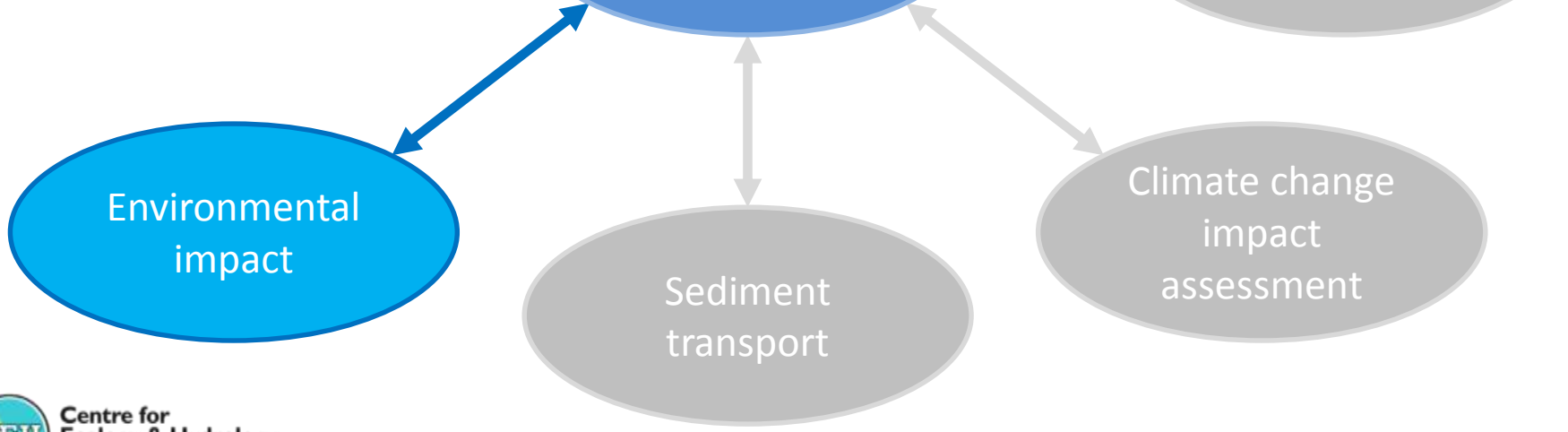
What science is needed?

Objective methods for setting d/s environmental flows - supporting appropriate allocation of water resources, to meet needs of people and the environment



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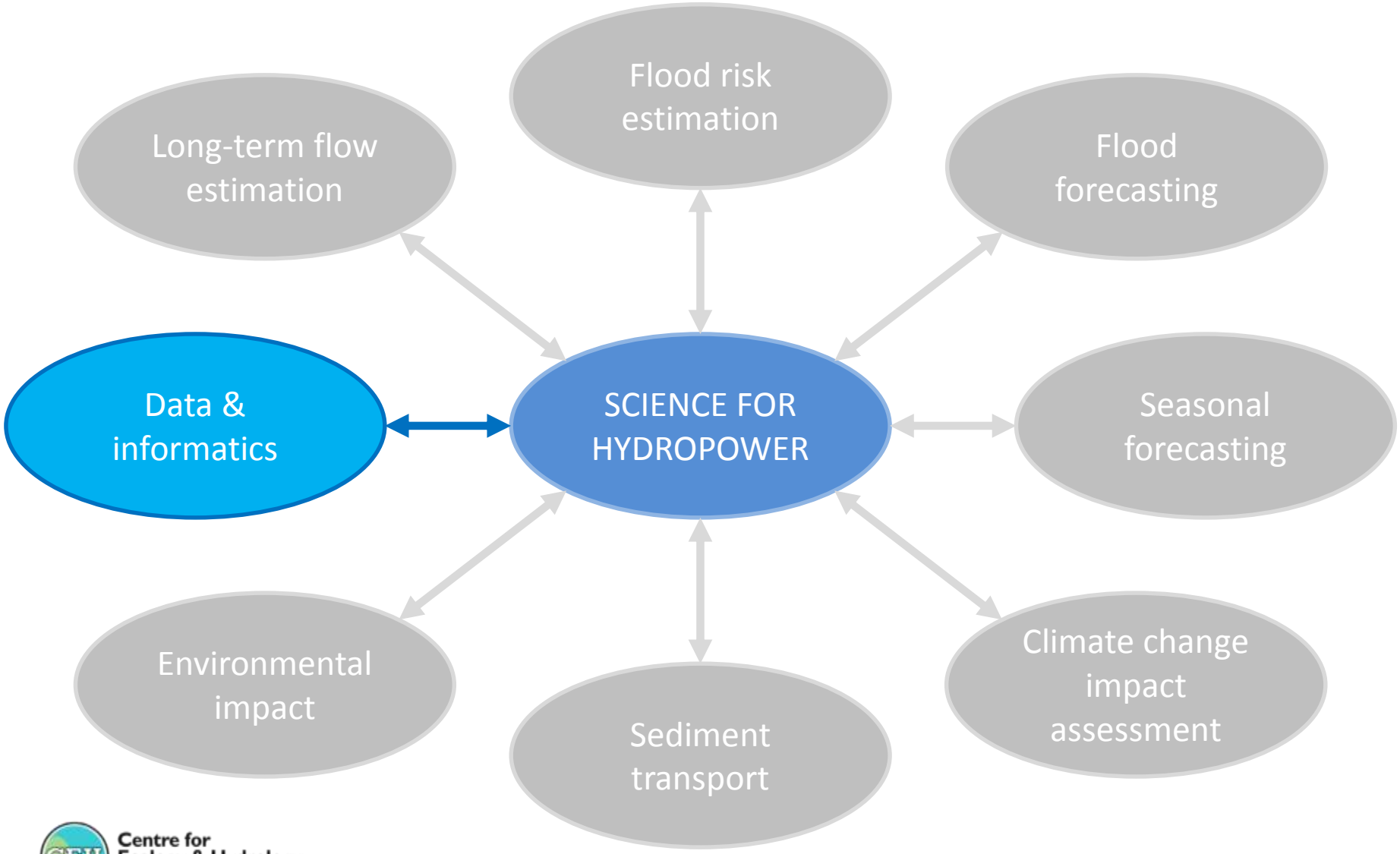

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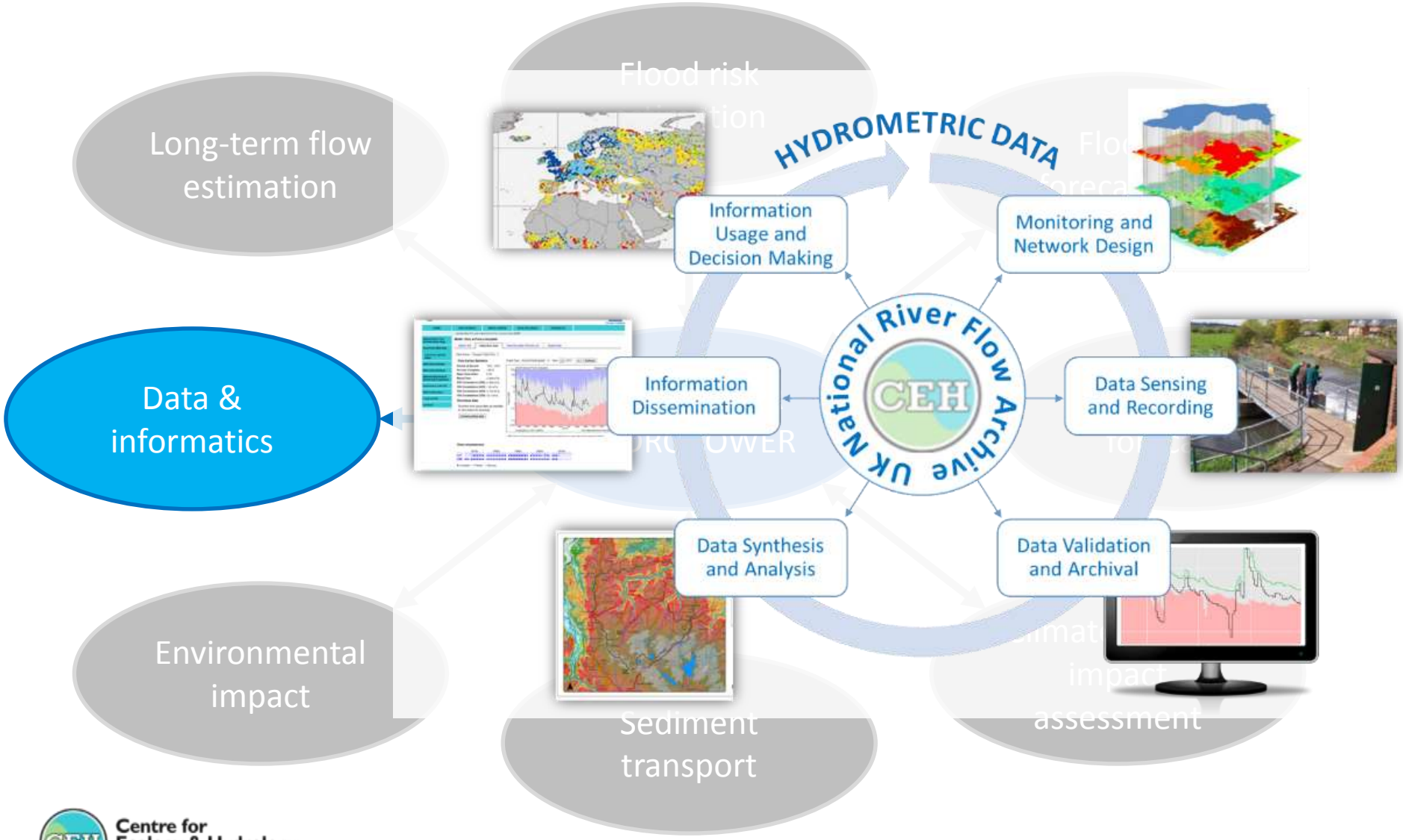

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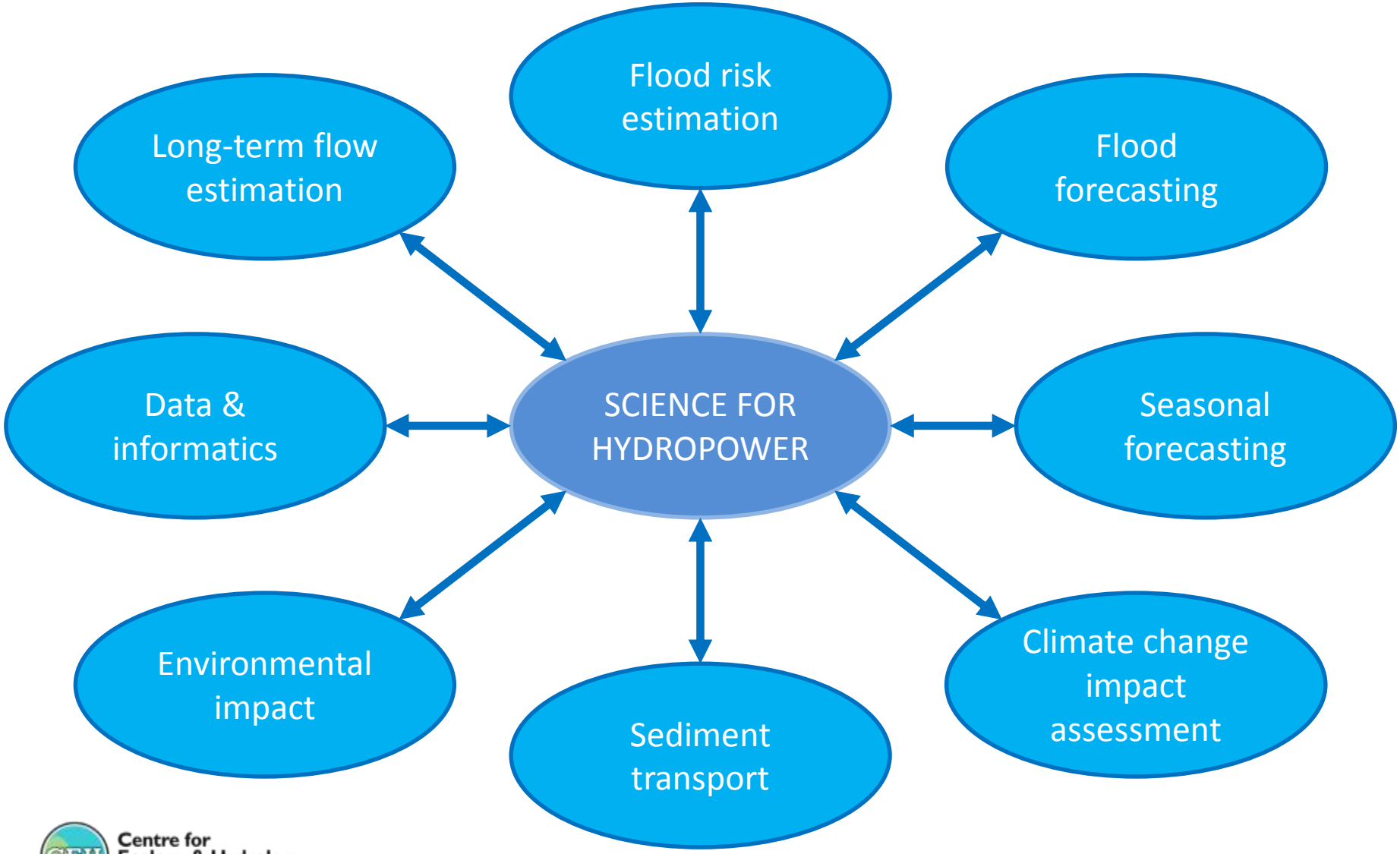
Can freshwater science help?



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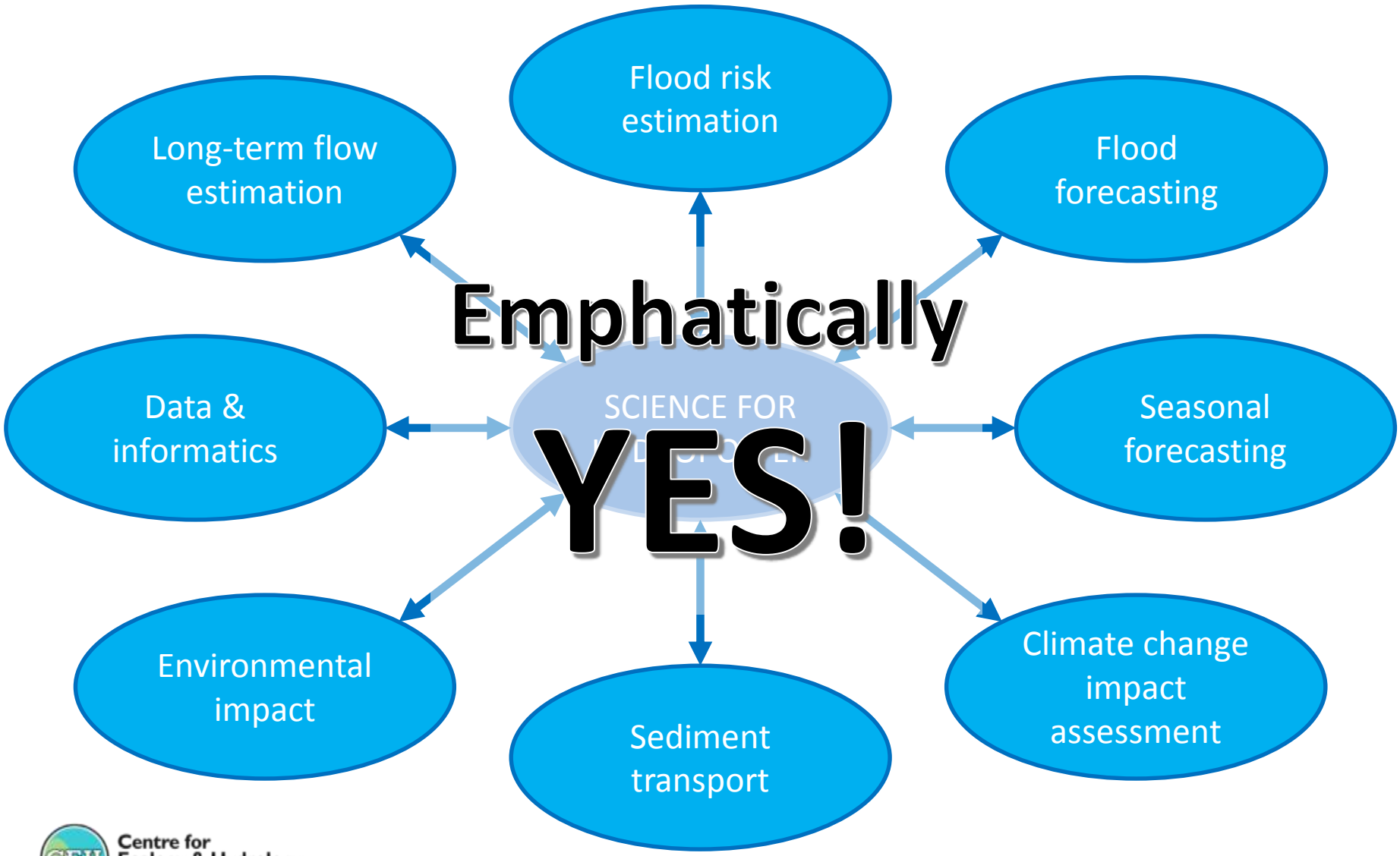

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Thank you: Dhanyavaad!

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