New versions of long-term models

(version 9.6)

Overview current research projects

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SINTEF Energi

Brukermøte produksjonsplanlegging

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Versjon policy

- New main releases 7, 8 , 9 etc , may include changes in file formats
  - Not always possible to run new version directly on existing catalogue
  - New main releases every second or third year.

- New development releases 9.4, 9.5 etc because of functionality ordered by one or more customers.
  - Can be run on existing catalogue

- Status:
  - 9.3 First official 9 version
  - 9.6 Current official version
  - Official versions include release notes with description of new functionality and main error corrections

General improvements

- **New hydrological archive ArchLtm**
- **English version of programs and documentation (ProdRisk not included yet)**
- **64 bit version of software (except Cplex versions)**
- Ukedetskr – presentation of inflow
- PcKurvetegn –default percentiles
- Use of national characters (æ, ø, å, ä ö, Æ, Ø, Å, Ä, Ö) in time series names (inflow and temperature).
- Possibility to use weekly values for Effektfaktorer
- Effektfaktors used as scaling factor or profiles
- Documentation of the DETD file included in the file

- Error corrections (also described in 9.6 release notes)

ArchLtm – New time series archive for hydrological data

- ArchLtm both the archive name and the name of an application
- Archive that can (will) replace to old archive Hydark
  - Hydark limitations: Norwegian water course names, 16 bits representation (integer*2)
  - Easier to use
    - E.g. to update existing series or to put in new time series
  - and maintain
  - English version
- Easy to make the archive from existing Hydark
- Based on the file system that is used for coupling to external data bases (i.e. Powels SmG database)

General improvements (licenced)

- Time resolution – can be hourly
- Economical based deviation from guidance curves
- Tilpro/HBV forecasts with daily time resolution
- PcKurvetegn – Accumulation of results to independent chosen time resolution

New functionality in Samkjøringsmodellen

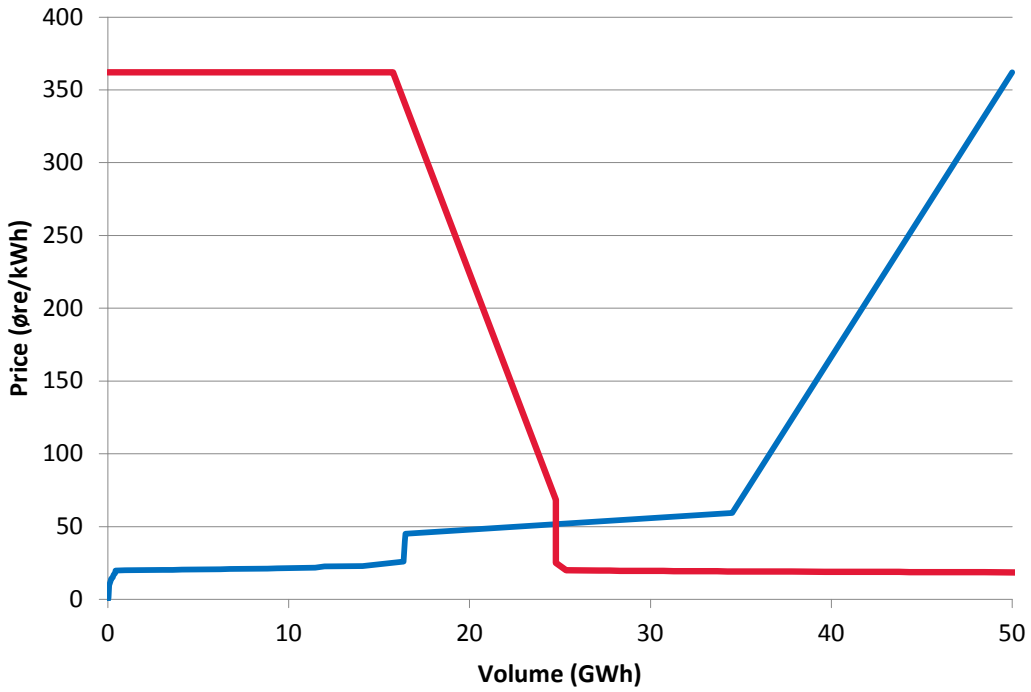
- Automatic time shift between days if sequential time resolution
- Temperature correction of load for individual load periods (licenced)
- Transmission capacity with hourly time resolution (licensed)
- Investment functionality (licensed)
- Result program ET adapted to Samkjøringsmodellen
- **Presentation of supply and demand curves**
- Detailed hydro simulation results stored at HDF5 format
- Accumulated time resolution for water value calculation (licensed)
- Increased number of curves and help curves in Avregn
- Parallel version of Kopl

Presentation of supply and demand (example *SDRes.sdv*)

Supply and demand information													
IVERK	IPENM	YEAR	WEEK	TYPE		UReg Hydr	VARMEKR/	VARMEKR/	VARMEKR/	IMPORT 3	IMPORT 4	VARMEKR/	IMPORT 5
1	1	10	2	S Volume	0	0	0.017376	0.036681	0.063342	0.159861	0.182844	0.198843	0.272379
1	1	10	2	S Price	0	0	0	1	9.6	13	14	14.3	15
IVERK	IPENM	YEAR	WEEK	TYPE		Firm dema	Exchange	KJELKRAFT	Pa. Salg DE	Pa. Salg DE	Pa. Salg DE	Pa. Salg DE	Pa. Salg DE
1	1	10	2	D Volume	0	15.76157	24.76157	24.76164	25.33249	27.16638	27.73723	28.30809	30.14198
1	1	10	2	D Price	362	362	68.31843	25	19.91414	19.85984	19.76274	19.63236	19.60851

IVERK	IPENM	YEAR	WEEK	TYPE		UReg Hydr	Reg Hydro	GJENNKJ_S	GJENNKJ_S	GJENNKJ_S	GJENNKJ_S	Reg Hydro	Exchange	GJENNKJ_S	GJENNKJ_S
2	2	20	3	S Volume	0	0	5.085537	5.086787	5.613574	5.617503	5.628515	21.42045	31.42045	31.4217	31.42563
2	2	20	3	S Price	0	0	66.89899	68.75	68.75	68.75	68.75	68.8049	70.00863	76.25	76.25
IVERK	IPENM	YEAR	WEEK	TYPE		Firm dema	KJELKRAFT	KRAFT UTEN MARKED							
2	2	20	3	D Volume	0	18.09926	18.1783	518.1779							
2	2	20	3	D Price	445	445	24.6	0.01							

Supply and demand



Pre 9.3 Samkjøringsmodell functionality

- Thermals startup cost and reserve requirements|
- Dynamic end-user elasticity
- Wind power modelling
- Automatic calibration
- Time resolution
- System price
- Parallel processing
- Limits on change in hydro discharge between time periods
- Exogenous stochastic price
- Wind or load dependent transmission capacity

Current major research activities

- **Market simulation models and algorithms (the problem solved by Samkjøringsmodellen)**
  - **MAD (new IPN project) (next slides)**
  - **SOVN (IPN project)**
    - **Separate presentation (Geir Warland)**
  - **Internally financed I-SIP project**
    - **Separate presentation (Arild Lote Henden)**

- **Local production planning (ProdRisk/Vansimtap type problems)**
  - **IBM (Integrated Balancing Markets in HydroPower Scheduling Methods)**
    - **KPN project**
    - **Project period 2014-2017**
    - **How does new balancing markets (capacity and energy) effect long-term operation of reservoirs (i.e. water values)**

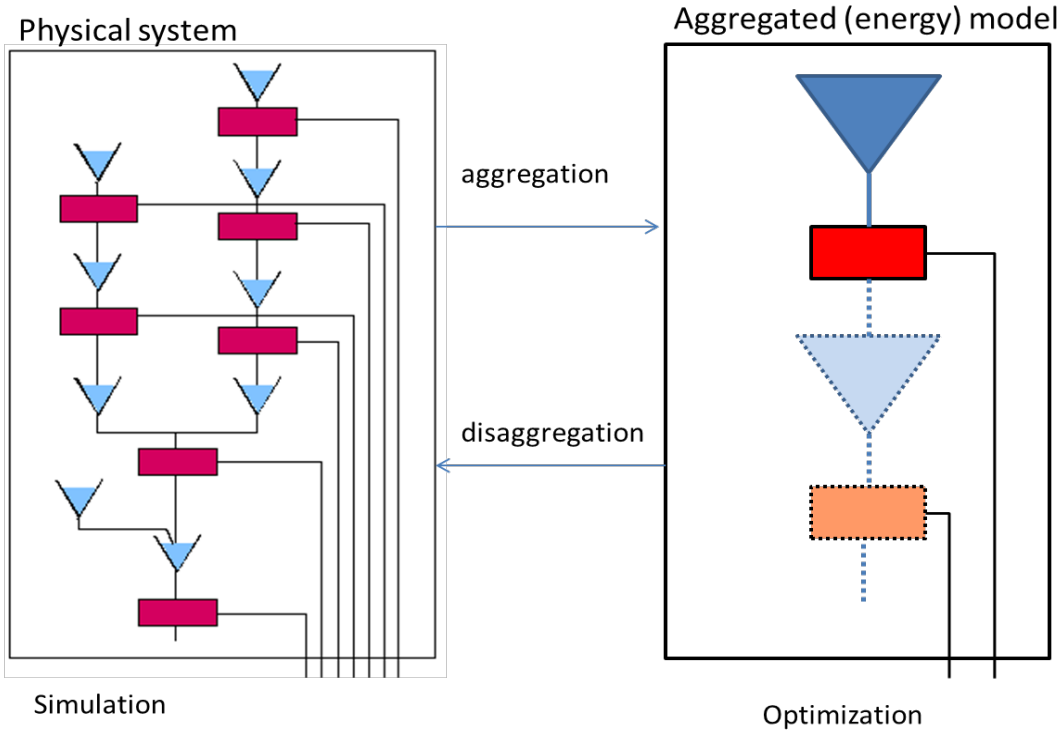
- KPN and IPN are abbreviations used by the Research Council of Norway
  - KPN typically 70 -80 % financing from the Research Council (Application deadline 2015: 9 September)
  - IPN Less than 50 % financing from the Research Council, applied by the industry (Application deadline 2015: 15 October)

MAD : Project background

- Aggregation and disaggregation of hydropower production
  - Used in the following SINTEF models Vansimtap, Samkjøringsmodellen, Samlast, Samnet

- Existing methods
  - Aggregated model consists of one reservoir, gives too high flexibility
    - New renewables, stronger coupling to Europe –system more often operated at its limits.
    - Aggregated model structure and disaggregation techniques not adapted to short-term pumping
  - Competence on existing disaggregation procedures is too low
    - Main procedures implemented a long time ago

Aggregation and disaggregation



Other project activities (financed directly by one or more users)

- Improved coupling between SHOP and ProdRisk (presentation by Hans Ole Riddervold, Hydro)

- Specification of API to Samkjøringsmodellen
  - Including calendar time
  - First phase
    - API for all results
    - API for time series input including load
    - Error messages, running the model, fixed hydro system data not included
  - Status: specification is done, implementation not decided